ADF-T-12B/C Automatic Direction Finder System

Maintenance Manual

Bendix Avionics Division

Maintenance Manual

ADF-T-12B/C Automatic Direction Finder System Includes 551RL Servo Amplifier Supplement

I.B. 2012A

WARNING

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RECORD OF REVISIONS

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SERVICE BULLETINS

The following list of service bulletins apply to the equipment covered in this manual. Copies of these bulletins are available upon request to:

The Bendix Corporation
Avionics Division, Service Dept.
Post Office Box 9414
Fort Lauderdale, Florida 33310

SYSTEM BULLETIN NUMBER	EQUIPMENT BULLETIN NUMBER	DATE OF ISSUE	PURPOSE OF BULLETIN
	201-01	Apr/64	201A/201B Receiver. Incorrect part numbers (L2 through L11).
	201-02	Aug/64	201A-1/201B-1 Receiver. Component change.
	201-03	Aug/64	201A-1/201B-1 Receiver. Installation of static discharge resistor for sense antenna.
	201-04	Mar/66	201A/201A-1/201B Receiver. Replacing front panels with front panels used on 201C/201D Receiver.
	2321-005	Feb/66	2321E Fixed Loop Antenna. Antenna location. Supercedes 2321-003 and 2321-004.
	2321-006	Dec/66	2321E Fixed Loop Antenna. Antenna location on Piper PA-28 and PA-32.
T12-69-01		Jan/69	201( ) Receiver. Switched A+.
T12-002		Nov/69	2321E Fixed Loop Antenna. Replacement of mating connector assembly.
T12-003		Oct/69	2321E Fixed Loop Antenna. Change in mounting dimensions.
T12-004		Dec/69	551A/551E Servo-Amplifier Indicator. Gain increase.
T12-005		Apr/70	201C/201D Receiver. Sensitivity optimization.
T12-008-1	551( )-01-1	Jan/72	551A/551E/551RL Servo-Amplifier Indicator. New drive motor and switching circuit, mod 1.
T12-010	201C,D-07	Jun/73	201C/201D Receiver. Reduction of low level audio distortion.
T12-012	201C,D-08	Oct/73	201C/201D Receiver. Improvement of bearing indication.
T12-015	551( )-02	Oct/74	551A/551E/551RL Servo-Amplifier Indicator. Increased indicator sensitivity, mod 3.

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SYSTEM BULLETIN NUMBER	EQUIPMENT BULLETIN NUMBER	DATE OF ISSUE	PURPOSE OF BULLETIN
T12-016	551( )-03	Oct/74	551A/551E/551RL Servo-Amplifier Indicator. Improved high ambient temperature operation, mod 4.

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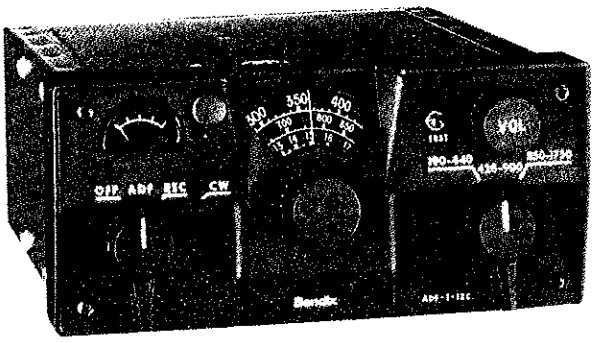

MODEL 201C/D
ADF RECEIVER

MODEL 551A/551E
SERVO AMPLIFIER-INDICATOR

MODEL 551C
DUAL SYNCHRO INDICATOR

MODEL 551RL
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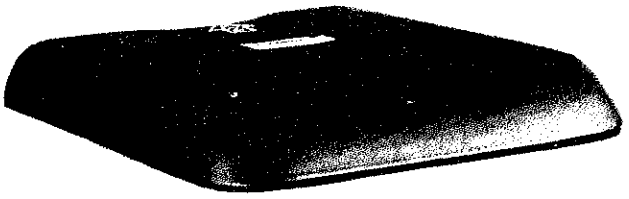


MODEL 2321E
FIXED LOOP ANTENNA

Figure 1
ADF-T-12( ) System

(Revised January 1973)

DESCRIPTION AND OPERATION

1. GENERAL

A. This manual contains maintenance, and overhaul instructions for the ADF-T-12B,C Automatic Direction Finder System. The manual contains five sections; Description and Operation, Maintenance Practices, Illustrated Parts Breakdown, Schematics and Addenda.

B. The ADF-T-12B,C System functions as an airborne automatic direction finder or as a range and broadcast band receiver. Three tuning bands provide continuous frequency coverage from 190 to 1750 kilocycles. During ADF mode of operation, the system may be used to either home on a station or to obtain a position fix. Directional information is displayed on a panel-mounted indicator.

C. The system comprises three principal components (See Figure1). They are as follows:

(1) Model 201( ) Receiver

(2) Model 551A Servo Amplifier-Indicator, Model 551B Remove Gonio Synchro, Model 551C Dual Synchro Indicator, Model 551E Servo Amplifier-Indicator, or Model 551RL Servo Amplifier-Indicator.

(3) Model 2321E Fixed Loop Antenna.

D. MODEL 201 RECEIVERS

(1) The differences between the various Model 201 Receivers consists of:

Model 201A	Receiver less CW oscillator
Model 201B	Receiver with CW oscillator
Model 201A-1	Narrow Band Receiver less CW oscillator
Model 201B-1	Narrow Band Receiver with CW oscillator
Model 201C	Narrow Band Receiver with built-in tuning meter less CW oscillator
Model 201D	Narrow Band Receiver with built-in tuning meter with CW oscillator

(2) The 1000 cps CW oscillator is used for each tuning-in of distant or weak stations. A fourth position (CW) on the function selector switch is available on the applicable models which have the 1000 CW oscillator.

(3) The tuning meter, included on Models 201C, D Receivers, is used to indicate peak signal strength for individual stations.

E. A speaker amplifier is available as optional equipment. The amplifier (Model 102A, B) is mounted separately at a convenient location in the aircraft.

F. A terminal at the ADF receiver connector is provided for connecting dry-cell batteries for emergency operation.

2. DESCRIPTION OF COMPONENTS (See Figure 1)

A. FIXED LOOP ANTENNA

(1) The Model 2321E Fixed Loop Antenna consists of two insulated coils, wound at right angles to each other on a flat ferrite core and terminated at a 7-pin socket connector. The loop is rectangular in shape and mounts externally on the aircraft. The assembly is sealed in potting compound making it impervious to extreme environmental conditions. The unit is sprayed with antistatic paint.

(2) The wavefront of the station-transmitted radio wave intersects the lateral and longitudinal coils of the fixed loop antenna and induces voltages in each of them. In relation to the aircraft, these voltages are proportional in amplitude to the angle of arrival of the radio wave with respect to the position of the aircraft.

(3) The loop antenna functions during ADF operation only.

B. RECEIVER

(1) The receiver contains all the circuitry for radio reception and provides an output to the servo amplifier-indicator unit which provides servo motor control of the resolver rotor coil. The unit is completely transistorized. Essentially, the chassis is divided into two sections; the r-f stages in form of removable modules are mounted in one section. The i-f, audio, 2nd. detector and age stages, together with the 4-section variable tuning capacitor are mounted in the other section.

(2) The receiver dust cover mounts in the aircraft instrument panel. The connector mounting bracket at the rear left-hand side of the dust cover supports a 16-pin connector receptacle for the main cable assembly and a coaxial connector for the sense antenna. The complete receiver assembly slides into the dust cover. The 16-pin connector at the rear of the receiver mates with the 16-pin receptacle in the dust cover. The receiver secures to the dust cover by means of a retaining cam. By rotating the retaining screw on the front of the panel, the cam attains an upright position and extends through the slot at the top of the cover. All operating controls for the system are located on the front panel of the receiver with the exception of the 14/28v selector switch, which is located at the rear of the receiver chassis.

(3) The receiver has three operating modes; REC, ADF and CW (Models 201B/B-1/D only). In the REC mode of operation, the unit functions as a conventional superheterodyne receiver and provides audio output to headphones. In the ADF mode of operation, two additional stages in the receiver become operative. The unit then functions, in the conjunction with the Model 551( ) Servo Amplifier-Indicator, as an automatic direction finder. During ADF mode of operation, the receiver receives the tuned-in signal from the selected transmitting station at two distinct points; one, at the bi-directional fixed loop antenna and the other at the omni-directional sense antenna. The receiver combines these two signals and after low-frequency modulation of the loop r-f signal from the output of the power oscillator in the servo amplifier-indicator, produces a low-frequency motor control output voltage. This voltage, after amplification and phase comparison in the servo amplifier, is applied to the control windings of the d-c servo motor in the Servo Amplifier-Indicator. The servo motor (mechanically linked to the r-f resolver) drives the rotor of the resolver until the indicator pointer, also mechanically linked to the r-f resolver assumes a position such, that results in zero voltage at the resolver output. This rotor position corresponds to the direction of arrival of the transmitted radio wave.

C. SERVO AMPLIFIER-INDICATOR

(1) The Model 551A Servo Amplifier-Indicator is a compact 6-stage transistorized amplifier-power oscillator unit which houses the d-c servo motor, r-f resolver and the ADF bearing indicator. The principal function of the unit is to amplify the low-frequency motor control voltage output from the receiver and phase compare this signal with the power oscillator reference signal and apply the resultant signal to the control windings of the d-c servo motor. The d-c servo motor, mechanically linked to the r-f resolver rotates until the r-f voltage output of the resolver becomes zero. The r-f resolver, mechanically linked to the ADF bearing indicator pointer will at this time, cease to rotate. The indicator pointer will indicate the relative bearing of the aircraft to the selected station.

(2) Model 551B Remote Gonio-Synchro is a remote mounting unit, similar to the Model 551A Servo Amplifier Indicator except it has no self-contained indicator. The 551B contains a transmitter synchro to drive a panel mounted indicator.

(3) Model 551C Dual Synchro Indicator incorporates dual pointers to permit the simultaneous presentation of two separate inputs.

(4) Model 551E provides all of the functions of the Model 551A but has an additional synchro transmitter output for operating a remotely located indicator.

(5) Model 551RL is similar to and interchangeable with the Model 551A. The primary difference is that the 551RL contains a rotatable azimuth card and internal blue-white lighting.

(6) The servo amplifier-indicator includes a low-frequency power oscillator and a filter circuit. The power oscillator provides reference voltage excitation for the balanced modulator stage in the receiver and the d-c servo motor phase comparison circuit. The filter functions to by-pass undesirable frequency components from the output of the receiver while passing the fundamental motor control frequency (47 cps ADF signal).

(7) The r-f resolver consists of two distributed stator windings wound inside a cylindrical form, with the two coils at right angles to each other. A secondary winding is wound on a cylindrical rotor that is free to rotate through 360 degrees in relation to the two stators.

(8) The r-f resolver is electrically connected to the Model 2321E fixed loop antenna. The r-f resolver stator coils convert the fixed loop voltages to a resultant magnetic field. This magnetic field is induced into the r-f resolver rotor coil. The angular position of the resultant field defines the direction of arrival of the transmitted radio wave. This action produces an output voltage that is a measure of the angular displacement between the rotor position and the resultant field. This "error" voltage is applied to the loop r-f stage in the receiver.

D. AUDIO AMPLIFIER

(1) The Models 102A and 102B Audio Amplifiers (optional to all ADF-T-12B, C units) are single stage push pull common emitter power amplifiers that operate from the headset output in the receiver. With a 3 ohm load, the Model 102A amplifier is designed for 3.5 watts output compared to 10 watts output of the Model 102B.

(2) The amplifiers are so constructed as to separately mount at any convenient location in the aircraft. It connects to the main interconnect cable by means of a 8-pin Amphenol plug.

(3) Power requirements for Models 102A and 102B Audio Amplifier are 14 and 28 volts respectively.

3. OUTLINE DIMENSIONS AND WEIGHT

A. Outline dimensions of the ADF-T-12B, C system may be found on the applicable outline drawings in installation Manual I.B. 2012.

B. WEIGHTS OF THE ADF-T-12B, C SYSTEM ARE AS FOLLOWS:

(1)	Model 201( ) Receivers	3.5 lbs.
(2)	Model 551A Servo Amplifier-Indicator	1.7 lbs.
	Model 551B Remote Gonio-Synchro	2.0 lbs.
	Model 551C Dual Synchro Indicator	1.2 lbs.
	Model 551E Servo Amplifier-Indicator	2.5 lbs.
	Model 551RL Servo Amplifier-Indicator	2.5 lbs.
(3)	Model 2321E Fixed Loop Antenna	1.3 lbs.

4. TRANSISTOR COMPLEMENT

A. RECEIVER

Schematic Symbol	Type	Function
Q1	2N1637 or MPS 6516	Loop R-F Amplifier
Q2	2N1637 or MPS 6516	Balanced Modulator Isolation Amplifier
Q3	2N1637 or MPS 6516	Sense R-F Amplifier
Q4	2N1637 or MPS 6516	Mixer
Q5	2N1637 or 2N2654	Local Oscillator
Q6	2N1638 or MPS 6516	1st. I-F Amplifier
Q7	2N1638 or MPS 6516	2nd. I-F Amplifier
Q8	2N1638 or MPS 6516	3rd. I-F Amplifier
Q9	2N1304	AGC Amplifier
Q10	2N1193	1st. Audio Amplifier
Q11	SA-279	2nd. Audio Amplifier
Q12, Q13	SA-279	3rd. Audio Amplifier
Q14	2N1193	CW Oscillator

B. SERVO AMPLIFIER-INDICATOR

Schematic Symbol	Type	Function
Q1	2N1304	Low Voltage Amplifier
Q2	2N1193	1st. Audio Amplifier
Q3	2N1193	2nd. Audio Amplifier
Q4	2N1193	3rd. Audio Amplifier
Q5, Q6 (matched pair)	SA319	Motor Control Amplifier
Q7, Q8	2N1191	47 cps Power Oscillator

5. TECHNICAL CHARACTERISTICS

Type of Reception:	AM (Amplitude Modulation) Voice CW (Models 201B/D-1/D only)
Modes of Operation:	REC (Broadcast Receiver) ADF (Automatic Direction Finder)
Frequency Range:	Band 1: 190 through 440 KC Band 2: 420 through 900 KC Band 3: 850 through 1750 KC
Threshold Sensitivity (ADF):	With 100μv/m input, a bearing within ±3.0 degrees will be produced with a S+N/N ratio of 6 db.
Sensitivity (REC):	70μv/m input will produce a S+N/N ratio of 6 db.
ADF bearing accuracy:	Within plus or minus 3 degrees with r-f inputs of 70 μv/m or more.
Selectivity:	4 kc maximum at -6 db points 12 kc maximum at -60 db points
Audio Output:	50 mw minimum with 70 μv/m input at 200 KC and VOL control set for maximum output level.
Audio Frequency Response:	Within 9 db from 350 to 1400 cps.
Output Impedance:	500 ohm headset
Primary Power Requirements:	13.75 vdc at 750 ma max. 27.5 vdc at 520 ma max.
Vibration:	10 to 55 cps ±0.03 inch total excursion.

6. OPERATING CONTROLS AND THEIR FUNCTION

A. All operating controls for the ADF-T12B/C System (with the exception of the 14/28V selector switch on the 201( ) and the azimuth control knob on the 551RL) are located on the front panel of the receiver (see figure 1). The function of each control is as follows:

B. FUNCTION SWITCH

(1) The four-position rotary function switch controls the operating mode of the system. The switch designations and their functions are as follows:

(a) OFF. Disconnects the primary d-c source voltage from the system.

(b) ADF. Establishes the necessary circuit connections for automatic direction finder operation.

(c) REC. Establishes the necessary circuit connections for broadcast superheterodyne receiver operation.

(d) CW (Models 201B/B-1/D only). Connects the 1000 cps CW oscillator into the circuit for assistance in tuning-in weak or distant stations.

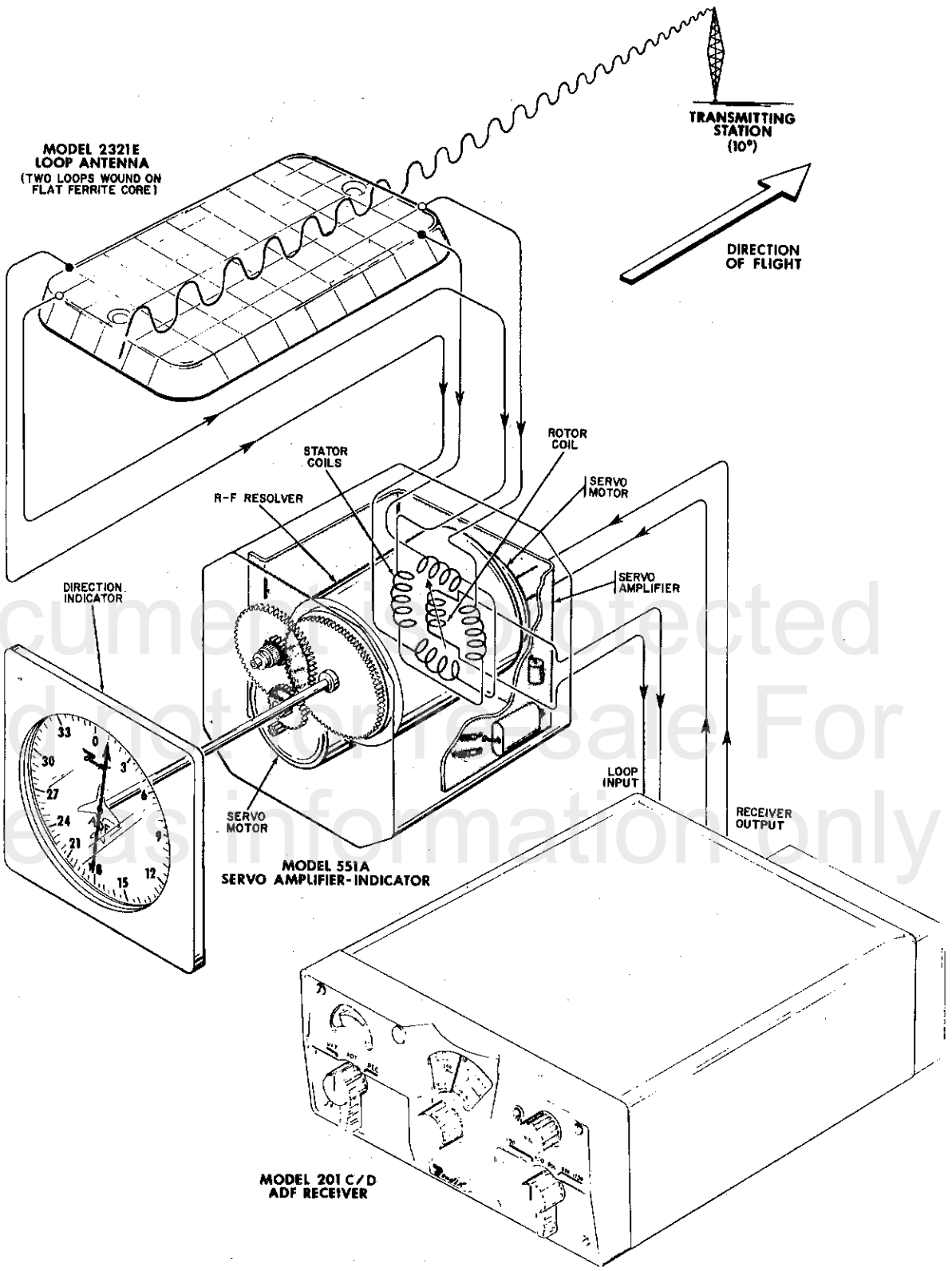
C. BAND SWITCH

(1) The three-position rotary band selector switch selects the tuned circuits for the three frequency bands. The switch designations and frequency coverage are as follows:

(a) 190-440. Selects the range of 190 to 440 kilocycles.

(b) 420-900. Selects the range of 420 to 900 kilocycles.

(c) 850-1750. Selects the range of 850 to 1750 kilocycles.



ADF Operation, Simplified Pictorial Diagram
Figure 2

D. TUNING CONTROL

(1) The tuning control tunes the receiver to a specific frequency within the selected frequency band. Tuning is accomplished by rotating the tuning knob until the desired frequency designation on the tuning dial aligns with the lubber line on the dial window or until the maximum indication on the tuning meter is obtained.

(2) The low and medium frequency bands are calibrated in kilocycles. The 850 - 1750 kc band is calibrated in hundreds of kilocycles.

E. VOL (Volume) Control

(1) This knob is mechanically linked to the wiper-arm of a potentiometer. The position of the wiper-arm determines the audio gain of the receiver.

F. TEST BUTTON

(1) The spring-loaded TEST button provides a quick operational check of the ADF-T-12B, C System. When the receiver (in the ADF mode) is tuned to a station, pressing the TEST button will cause the indicator pointer to rotate away from the indicated bearing. If the system is functioning properly, the indicator pointer will return to the station bearing upon release of the TEST button.

7. PRINCIPLES OF OPERATION (See Figure 2 and 3)

A. As indicated in figure 2 the cross-wound coils of the fixed loop antenna are connected to the cross-wound coils of the r-f resolver located in the Servo Amplifier-Indicator. The voltages induced across the coils of the fixed loop antenna by the received signal cause proportional currents to flow through the stator coils of the r-f resolver. The currents, in turn, produce proportional magnetic fields that combine algebraically to produce a resultant magnetic field. The resultant magnetic field assumes the same conditions as the induced signal voltage at the fixed loop antenna.

B. The magnetic field surrounding the stator coils of the r-f resolver induces a voltage in the resolver rotor coil. The amplitude and phase of this induced voltage is determined by the axis of the rotor coil with respect to the axis of the magnetic field created by the stator coils. When the two axes are displaced by zero or 180 degrees, that is, parallel to each other, the induced rotor voltage is at a maximum. Similarly, there are two positions of the rotor coil that produce zero voltage. This occurs when the two axes are displaced at right angles to each other, that is, 90 and 270 degrees.

C. The induced voltage developed across the r-f resolver rotor coil is the "error" input signal to the "servo loop" formed by the resolver rotor, the receiver, servo amplifier and the servo motor. The receiver converts the r-f rotor "error" voltage into a low-frequency motor control voltage, which is amplified and phase compared in the servo amplifier-indicator. The resultant signal is applied to the control windings of the d-c servo motor. The servo motor rotates and causes the resolver rotor coil to rotate to a position corresponding to zero output voltage. At this point, there is no input voltage applied to the receiver from the resolver rotor coil and therefore there is no low-frequency signal applied to the servo system. As a result, the servo motor stops rotating. A pointer, attached to the resolver rotor coil indicates the relative bearing of the aircraft from the "tuned-in" transmitting station as read against the dial.

D. The direction from which the transmitted radio wave is received, that is, from the left or right of the transmitting station, is therefore determined by the zero voltage or "null" position of the resolver rotor coil with respect to the induced magaetic field surrounding the stator coils. There are two positions of "null" (refer to paragraph B) and they occur 180° apart. The "null" position that causes the indicator pointer to point to the true direction of the transmitting station is called the "true" null. The other "null", displaced 180 degrees from the "true" null is called the "false" null. A means of discerning between the "true" and "false" null indications is incorporated in the system such, as to cause the pointer to indicate "true" null at all times. The manner in which this is accomplished is as follows:

E. Due to the design characteristics of the cross-wound coils of the fixed loop antenna, the incoming loop r-f signal will either lead or lag the incoming sense r-f signal by 90 degrees. Whether the loop r-f signal leads or lags the sense r-f signal, is dependent upon the position of the loop antenna and resolver rotor coil with respect to the transmitting station.

F. In order for the ADF indicator pointer to rotate in the proper direction and stop rotating at the correct aircraft to station relative bearing, a phase comparison or sampling between the loop r-f and sense r-f signals must be performed. The result, or phase of this "sampling" will determine the direction of rotation of the servo motor. This, in turn will cause the ADF indicator pointer to rotate in the proper direction. This "sampling" method is accomplished as follows:

G. The loop r-f signal is phase-shifted an additional 90 degrees through means of capacitor C10, C11 or C12 (depending upon the position of the band selector switch). Depending upon whether the loop r-f signal originally leads or lags the sense r-f signal by 90 degrees, the additional phase shift will cause the loop r-f signal to be either in-phase or 180 degrees out-of-phase with the sense r-f signal.

H. The 47 cps low frequency switching action of the balanced modulator circuit, modulates or switches the incoming r-f signal at the loop antenna in such a manner as to alternately switch the loop r-f signal in-phase and 180 degrees out-of-phase with the constant-phase sense r-f signal during each complete cycle of 47 cps switching voltage. The modulated loop r-f signal is amplified by isolation amplifier Q2 and the output combined with the incoming sense r-f signal. The low frequency modulated loop r-f signal alternately adds to and subtracts from the sense r-f signal and as a result, during one half-cycle of switching voltage (47 cps) either an addition or subtraction takes place with the sense r-f signal. Whether the loop signal, during 1st half-cycle of switching voltage, adds to or subtracts from the sense, is dependent upon the relative position of the r-f resolver rotor coil with respect to the field induced by the resolver stator windings. This in turn, is dependent upon the position of the loop antenna with respect to the transmitting station. The following example will facilitate the explanation given above:

I. With the tuned-in transmitting station at a relative bearing to the aircraft of 90 degrees to the right, the loop antenna will receive the incoming r-f signal at a maximum level in one of the internally cross-wound coils and at a minimum level in the other. Assume the two loop coils as A and B. Coil A being the coil that receives the signal at a maximum level. It will further be assumed that reception at coil A causes a 90 degree lead with respect to the constant-phase signal received at the sense antenna. Cross-wound coil A, directly connected to one pair of stator coils of the r-f resolver creates a maximum magnetic field in that pair of stator coils. Cross-wound coil B connected to the other pair of stator coils creates a minimum or virtually zero magnetic field. Depending upon the position of resolver rotor coil with respect to the induced magnetic field, the loop r-f signal will either lead or lag the incoming constant-phase sense r-f signal at the sense antenna by 90 degrees. In the example cited, the rotor coil is in a position such, that causes the loop r-f signal to lead the sense r-f signal by 90 degrees. A further 90 degree phase shift causes the loop r-f signal to become in-phase with the sense r-f signal.

J. The first half-cycle of balanced modulator switching voltage, reverses the loop signal 180 degrees or causes it to become 180 degrees out-of-phase with the sense r-f signal. Upon mixing, the two signals cancel each other and as a result, zero r-f voltage exists at the output of the r-f amplifier. (Assuming equal sense and loop signals). During the next half-cycle of balanced modulator switching voltage, the loop r-f signal is reversed or "switched" back to its previous state, that is, to an in-phase condition with the sense r-f signal. Upon mixing, the two signals aid each other and as a result, maximum r-f voltage exists at the output of the r-f amplifier.

K. Therefore, for a complete cycle of balanced modulator switching voltage, the loop r-f signal alternately subtracts from and adds to the constant-phase sense r-f signal. During amplification and demodulation, the resultant ADF signal maintains the same phase with respect to the power oscillator switching voltage in the servo amplifier unit.

L. The ADF signal, in this case, is at a higher amplitude than the oscillator switching voltage due to the 90 degree relationship in the position of the resolver rotor coil with respect to the stators.

M. The power oscillator signal, as applied to windings 7 and 9 of phase comparison transformer T1 (motor control amplifier) results in the ADF signal either being in-phase with the switching signal at winding 7 and out-of-phase with the switching signal at winding 9 or vice versa. From our example, we will assume that the former condition exists. Consequently, at winding 7 of transformer T1, both the ADF and switching signals aid each other and therefore add in amplitude while at winding 9 both signals cancel each other and therefore subtract in amplitude.

N. The resultant signals as observed at the bases of transistors Q5 and Q6 are such, that during the positive "swing" of the resultant signals, both transistors are "shut-off" or non-conducting. Hence, the servo motor "sees" zero voltage. Consequently, the motor does not rotate.

O. During the negative "swing" of the resultant signals, both transistors are "turned on" or conducting. Due to the higher amplitude of the signal at Q5, heavier collector current flows at the outpur of Q5 than that of Q6. The voltages developed at the respective transistor outputs are filtered and applied to both windings of the servo motor as d-c voltages of different amplitudes and polarity.

P. If the positive voltage developed across the motor from the output of Q5 causes clockwise rotation of the servo motor, the positive voltage developed from the output of Q6 will cause counterclockwise rotation of the motor.

Q. The motor responds only to the differential between the two transistor outputs. In this case, the motor will rotate clockwise due to the higher amplitude signal current derived from the output of Q5.

R. The r-f resolver rotor coil, mechanically coupled to the armature of the servo motor begins to rotate clockwise as does the ADF indicator pointer, which is linked to the r-f resolver rotor coil.

S. The motor continues to turn until the developed magnetic field surrounding the rotor coil and the magnetic field surrounding the stators result in zero voltage at the output of the resolver.

T. At this point, the loop r-f signal is absent in the receiver. Since phase comparison cannot be made with both the sense r-f and oscillator switching signals, the motor stops rotating and the indicated bearing as observed on the ADF will read 90 degrees.

U. If cross-wound coil B receives the maximum signal and A the minimum, the opposite effect occurs. That is, the incoming loop r-f signal will lag the sense r-f signal by 90 degrees.

V. The additional 90 degree phase shift, results in the loop r-f signal becoming 180 degrees out-of-phase with the sense r-f signal.

W. Consequently, due to the switching action of the balanced modulator, the demodulated ADF signal as compared to the power oscillator switching signal across transformer T1 in the servo amplifier unit is opposite to that explained previously. As a result, the motor rotatates in a counterclockwise manner and the indicator pointer will stop at 270 degrees on the dial.

X. Due to the inertia of the motor together with noise modulation, in some cases, the ADF pointer will "overshoot" the "true" null position by approximately 5 degrees. The pointer will then reverse its rotation and stop at the true null position.

Y. Once the rotor coil passes through the "true" null position (overshoots), a reversal in phase of the loop r-f signal appears at the resolver output. This is due to the fact that the rotor coil has passed through the magnetic field created in the stator coils by a factor of 180 degrees with relation to the position of the transmitting station. As a result, the rotor begins cutting the magnetic field of the stator coils with reversed polarities to that previously encountered. Hence, the variable ADF signal in the servo amplifier is reversed by 180 degrees. When compared with the reference 47 cps voltage, the resultant signal causes the servo motor to reverse its rotation, which in turn, brings the pointer back to the "true" null position.

Z. The 47 cps modulated loop r-f output of the balanced modulator is amplified by modulator isolation amplifier Q2 and applied to the input of sense r-f amplifier Q3 where it is further amplified and alternately added to the sense r-f signal. The resultant output of the sense r-f amplifier is applied to the input of the mixer stage, where, together with the output of the local oscillator, it is converted to an I-F frequency of 142.5kc. The signal is further amplified through the three stages of I-F and the output applied to the 2nd. detector where the audio, together with the 47 cps modulation component is recovered from the r-f signal.

AA. The output of the 3rd I-F amplifier is also applied to an automatic gain control (AGC) detector. The d-c component of the demodulated output of the AGC detector is amplified by the AGC amplifier and applied to the r-f amplifier stage, and both the 1st and 2nd I-F amplifier stages. The AGC voltage lowers the gain of the system upon reception of an r-f signal above a pre-determined amplitude. A 1000 cps CW oscillator is included in the Model 201B, B-1, D Receiver to enable the tuning in of weak o: distant stations. The output of the oscillator modulates the output of the 2nd I-F amplifier.

BB. The 47 cps modulated audio signal is applied to the 1st audio amplifier (in the receiver) where it is amplified and applied to the input of 1st audio amplifier Q1 in the servo amplifier-indicator. The audio signal is also applied to two more stages of amplification in the ADF receiver where it is finally reproduced in the headset output.

CC. The optional speaker amplifier is connected to the output of push-pull audio amplifier Q12 and Q13. The output of the push-pull amplifier circuit in the optional speaker amplifier is reproduced in the speaker.

DD. The output of the 1st audio amplifier in the servo amplifier-indicator is applied to three additional stages of audio amplification where the signal is brought to the necessary amplitude required to drive the servo motor.

EE. The output of the 4th audio amplifier is also applied to the input of the filter. The filter is designed and adjusted to reject the 47 cps component while feeding back the higher frequency audio components. Consequently, the original 47 cps signal applied to the input of the balanced modulator from the output of the power oscillator is recovered at the output of the 4th audio amplifier in the servo amplifier-indicator and applied to the control windings of the servo motor through motor control amplifier stage Q5 and Q6.

FF. The low-frequency power oscillator produces a nominal 47 cps signal. This signal, besides being applied to the balanced modulator stage in the ADF receiver. is also applied to the motor control amplifier as a reference voltage. The recovered 47 cps at the 4th audio amplifier output is compared in phase and amplitude with the 47 cps reference voltage. The resultant signal serves to drive the servo motor in the proper direction.

8. PHASE RELATIONSHIPS

A. The phase relationships that exist between the loop r-f, sense r-f and the low frequency (47 cps) modulating signals during ADF mode of operation are indicated in Figure 4.

B. Normally, the modulated voltage waveforms shown in the illustration, if observed on a "scope", would appear as square waves. The sine waves depicted are shown for clarity and ease of understanding. The numbers in parentheses listed below correspond to the numbers to the left of each waveform in the illustration. The explanation follows the corresponding number for each of the waveforms illustrated.

(1) The output of the sense antenna is of constant phase.

(2) The output of the resolver rotor coil (loop antenna input signal) is 90-degrees out-of-phase with the sense antenna r-f input signal and either leads or lags the sense r-f (by 90 degrees) depending on whether the resolver rotor coil is to the right or left of the "true" null position.

(3) The resolver rotor signal is shifted in phase an additional 90 degrees. This results in the output of the loop r-f amplifier being in phase or 180 degrees out-of-phase with the incoming sense antenna signal.

(4) The resolver rotor coil output signal is applied to the input of the balanced modulator.

(5) and (6) The low-frequency output (47 cps) of the power oscillator is also applied to the input of the balanced modulator. The modulation voltage (47 cps) causes the four diodes of the balanced modulator circuit to be switched (as pairs) on and off in phase opposition during each half-cycle of the modulating voltage.

(7) and (8) The balanced modulator produces a 47 cps modulated loop r-f output signal in which the phase of the r-f component undergoes a 180 degree phase reversal during each half-cycle of the modulating signal (47 cps). The phase of the loop r-f output of each pair of diodes in the balanced modulator with respect to the resolver rotor input voltage is a function of the position of the rotor coil with respect to the "true" null position.

(9) The sense antenna signal (1) is illustrated again, below the output of the balanced modulator (7 and 8) for clarification.

(10) When the resolver rotor coil is to the left of "true" null, the sense and loop r-f signals combine in the sense antenna transformer and reinforce the output of one pair of diodes in the balanced modulator circuit and reduces that of the other pair. When the rotor coil is to the right of "true" null, the same effect occurs but in opposite sequence.

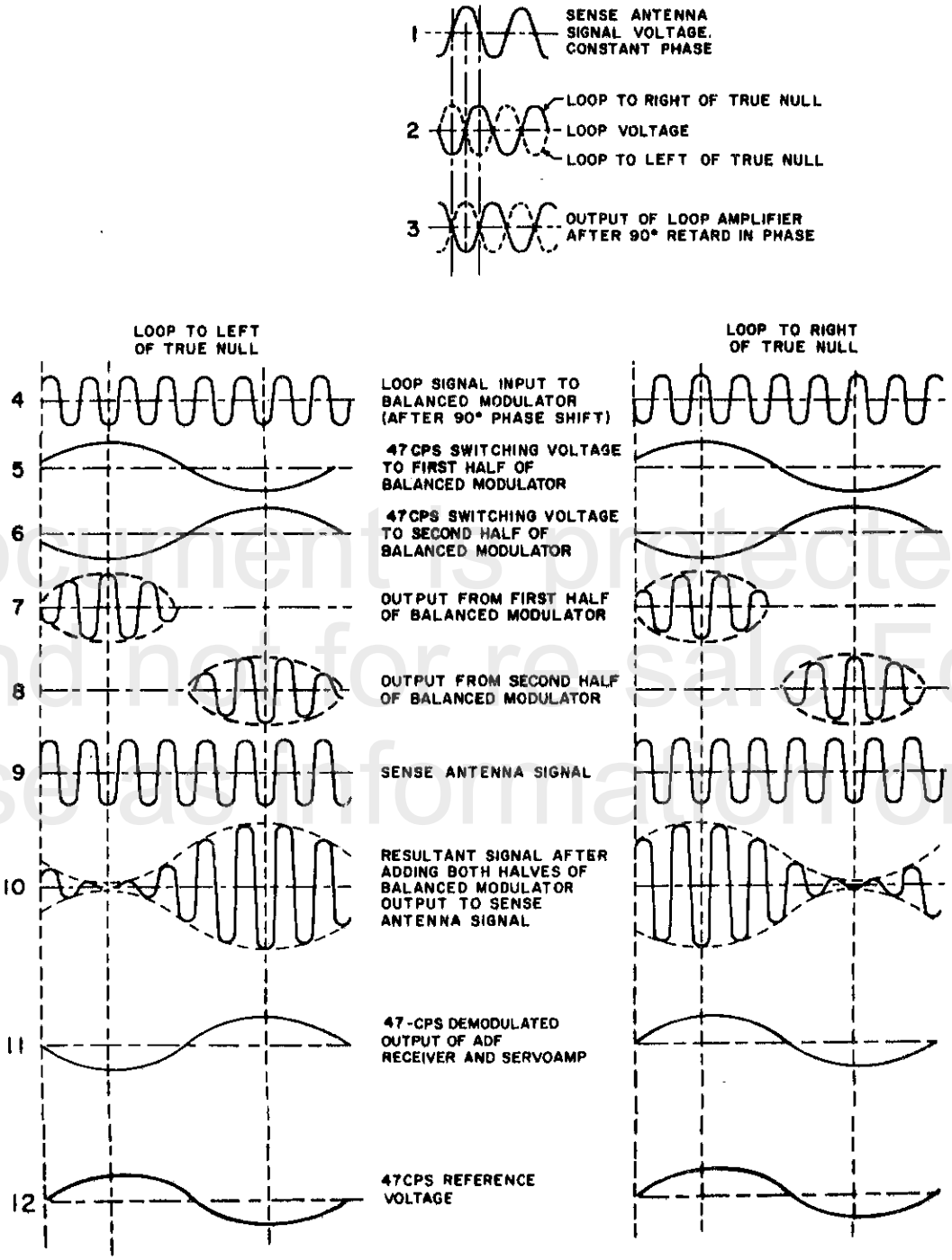


Figure 4
Phase Relationships

(11) The modulated r-f output of the balanced modulator is amplified and demodulated by the conventional superheterodyne circuits of the ADF receiver. The output of the receiver consists of a 47 cps voltage that is either in-phase or 180 degrees out-of-phase with the output of the 47 cps low-frequency power oscillator located in the servo amplifier-indicator.

(12) The power oscillator output voltage is applied to both the balanced modulator and the phase comparison circuits.

9. RECEIVER (REC) OPERATION

A. When the ADF Receiver function switch is in the REC position, the ADF-T-12B, C System operates as a conventional superheterodyne receiver, with the input signal supplied from the sense antenna only. The output consists of an audio signal that produces aural reproduction in a 500 ohm headset and into a 3.2 ohm speaker when the optional Model 102A, B Audio Amplifier is used.

B. When operating the system in the REC position the following ADF circuits and components become inoperative:

1. Model 2321E Fixed Loop Antenna
2. Loop r-f amplifier circuit
3. Balanced modulator circuit
4. Isolation amplifier circuit
5. Model 551( ) Servo Amplifier-Indicator
6. CW Oscillator (Models 201B, B-1, D only)

C. Operating in the CW position is the same as operating in the REC position except the 1000 cps CW oscillator is available for assistance in tuning in stations.

D. Figure 5 illustrates the A+ power distribution as witnessed through the action of the function selector switch (S7) on the front panel of the receiver. For ease of understanding, the wafer switch is shown as a four-pole four-position switch. The switch terminal numbers correspond to the wafer terminal numbers located in the schematic diagram (Figure 401).

10. DETAILED CIRCUIT DESCRIPTION: BALANCED MODULATOR

A. The balanced modulator stage consists of r-f transformers T-1 and T-2 together with a ring modulator bridge comprised of diodes CR1 through CR4. The circuit is re-drawn for ease of explanation in Figures 6 and 7 .

B. The purpose of the balanced modulator stage is to modulate or switch the incoming loop r-f signal 180 degrees at a rate of 47 cps and mix this signal with the incoming sense r-f carrier. The phase of the resultant signal is such, as to drive the servo motor in the proper direction. The degree of rotation being dependent upon the amplitude of the received r-f signals at the loop and sense antennas.

C. The output of the 47 cps power oscillator located in the servo amplifier-indicator is applied to the input of the balanced modulator through the center-tapped windings or r-f transformers T-1 and T-2.

D. It will be assumed the first half-cycle of the applied 47 cps voltage causes the center-tap of transformer T1 to become negative and the center-tap of T2, positive.

E. Therefore, during the first half-cycle of the incoming switching voltage, diodes CR2 and CR3 are conducting in the direction shown in Figure 6, and diodes CR1 and CR4 are considered "open" or non-conducting. This action is realized due to the existing distributed polarities across the individual diodes. In this case, diodes CR2 and CR3 are forward biased to conduction because of the assumed phase of the incoming half-cycle. That is, the cathodes of both CR2 and CR3 are more negative with respect to their anodes which is the primary requirement of conduction through the two diodes. On the other hand, diodes CR1 and CR4 develop polarities of the opposite direction and therefore cannot conduct during the first half-cycle of applied switching voltage.

F. During the first-half cycle of applied switching voltage, the incoming loop r-f signal is switch 180 degrees by the half-cycle of switching voltage conducted through diodes CR2 and CR3.

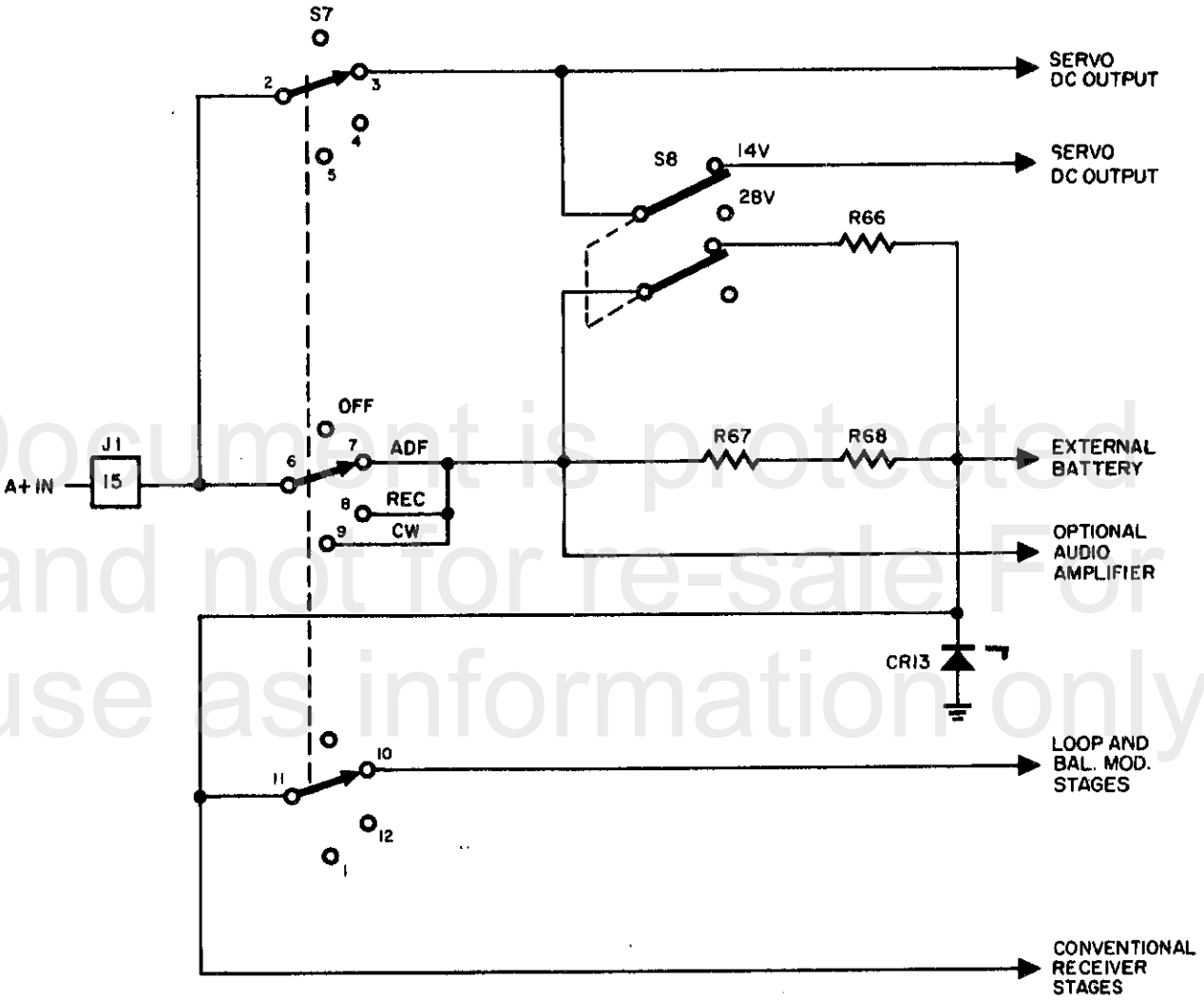
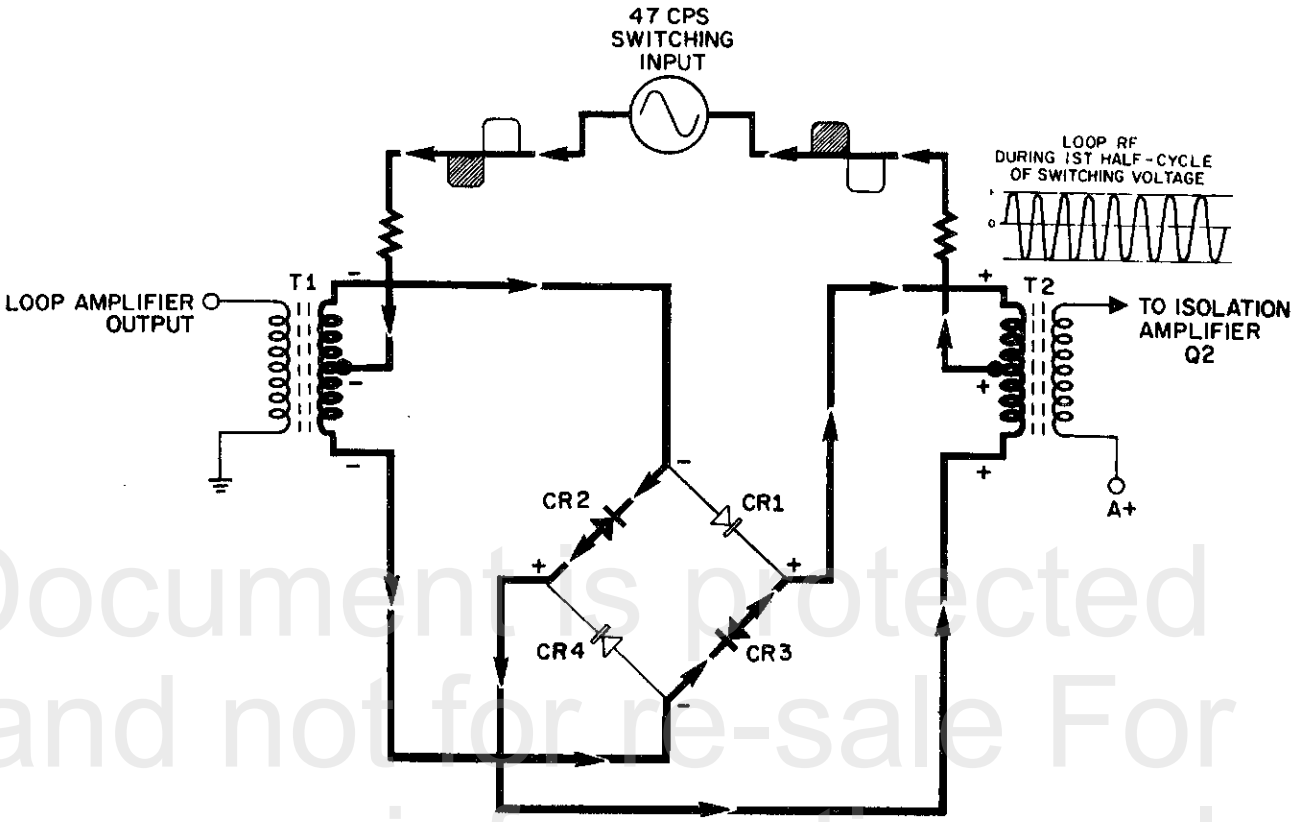
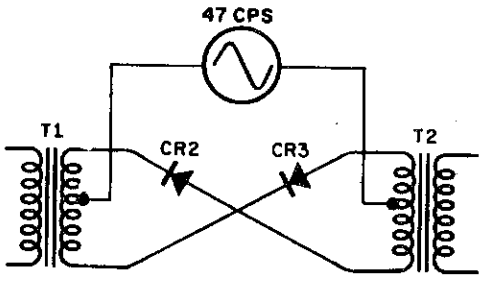


Figure 5
A+ Power Distribution
(Revised October 1969)





SIMPLIFIED EQUIVALENT CIRCUIT

Figure 6
Balanced Modulator (Condition No. 1). Simplified Schematic Diagram

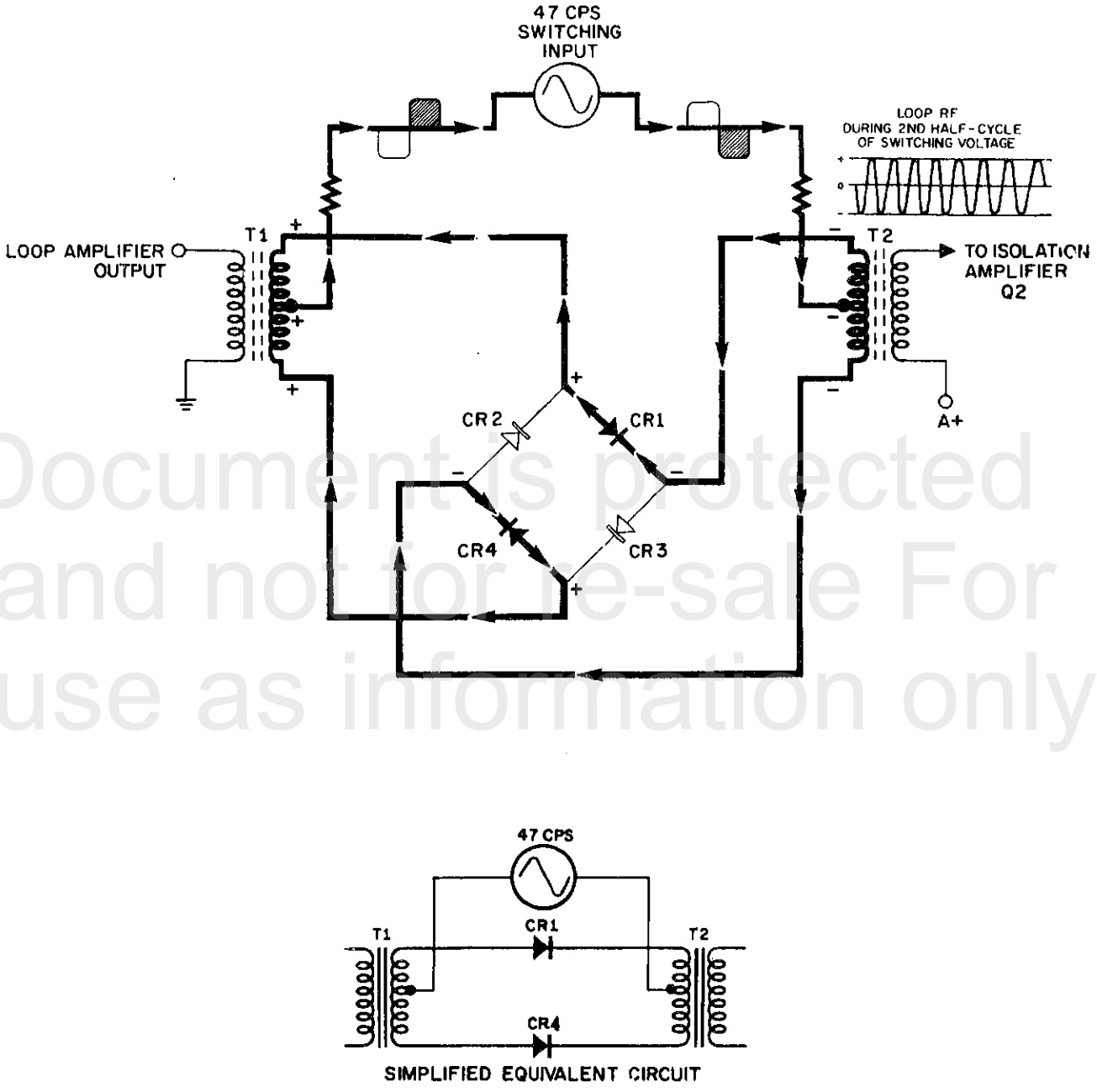


Figure 7
Balanced Modulator (Condition No. 2), Simplified Schematic Diagram

G. During the next half-cycle of the incoming switching voltage, diodes CR2 and CR3 are "shut-off" or non-conducting while diodes CR1 and CR4 are conducting in the direction shown in figure 7. The polarities of the four diodes therefore reverse themselves from that of the first-half cycle of switching voltage. In this case, the conducting path through the circuit is now 180 degrees out-of-phase with the conducting path of the first half-cycle as can be seen by comparing the simplified equivalent circuits below each figure in the illustration.

11. DETAILED CIRCUIT DESCRIPTION: MOTOR CONTROL AMPLIFIER

A. The motor control amplifier stage consists essentially of transistors Q5 and Q6, the secondary winding of transformer T-1, a low-pass filter network and the d-c servo motor.

B. The purpose of the motor control amplifier is to amplify and compare the relative phase and amplitudes of both the 47 cps power oscillator reference voltage and the incoming 47 cps variable ADF voltage. This is necessary in order to arrive at a resultant voltage that will control the direction of rotation of the servo motor. Consequently, this will enable the r-f resolver rotor coil to stop rotating upon reaching the "true" null position.

C. The output of the 47 cps power oscillator is applied to the input of the motor control amplifier through the secondary winding of transformer T-1 (See Figure 403). As a result, a square-wave voltage exists at the bases of transistors Q5 and Q6 that are 180 degrees out-of-phase due to the center-tapped secondary winding of transformer T1. The two signals are of equal amplitude.

D. The recovered ADF signal is coupled through capacitor C8 to the center tap secondary of T1 and applied in-phase to the bases of transistors Q5 and Q6. Therefore, upon receipt of a loop r-f signal, two signals, algebraically added will exist at the bases of transistors Q5 and Q6. One signal being the recovered 47 cps variable ADF signal from the output of the ADF receiver and the other signal being the 47 cps reference output signal from the power oscillator. The ADF variable signal is the same phase at both transistor bases. The power oscillator reference signal is 180 degrees out-of-phase at both transistor bases.

E. Figure 8 illustrates the operation of the circuit when the relative bearing of the aircraft from the station is 45 degrees (right). Figure 9 illustrates the operation of the circuit when the relative bearing of aircraft from the station is 225 degrees (left). Figure 10 illustrates the operation of the circuit when the relative bearing of the aircraft from the station is zero degrees; that is, the aircraft pointing directly to the transmitting station.

F. Referring to Figure 8 it is indicated by the position of the aircraft in relation to the transmitting station that the ADF indicator pointer should rotate in a clockwise manner and stop at the 45 degree mark on the calibrated dial.

G. It will be assumed that the output at the collector of transistor Q5 causes clockwise rotation of the servo motor armature while the output at the collector of transistor Q6 causes counterclockwise rotation of the motor armature.

H. It will further be assumed, for the sake of clarity, that the amplitude of the 47 cps oscillator output signal is 5 vac and the amplitude of the ADF signal at the bases of Q5 and Q6 is 10 vac. The incoming ADF signal will either add to the 47 cps oscillator signal at the base of Q5 and subtract from the 47 cps oscillator signal at the base of Q6 or vice versa.

I. Due to the action of the mixed loop r-f and sense r-f signals at the output of the balanced modulator isolation amplifier, the ADF signal (in this case) adds (or aids) the oscillator signal at the base of Q5 and subtracts (or opposes) the oscillator signal at the base of Q6. This is indicated in (a) and (c) of Figure 8. The resultant signal derived from the algebraic summation of the two signals is indicated in (b) and (d) of the figure.

J. Consequently, during the first half-cycle of the resultant signals ((b) and (d)), the bases of transistors Q5 and Q6 are positive enough with respect to their emitters to cause a state of reverse-bias in both transistors. In other words, neither transistor is conducting during this first half-cycle of resultant voltage. As a result, there is no output at the collectors of both transistors. Hence, the servo motor armature does not rotate.

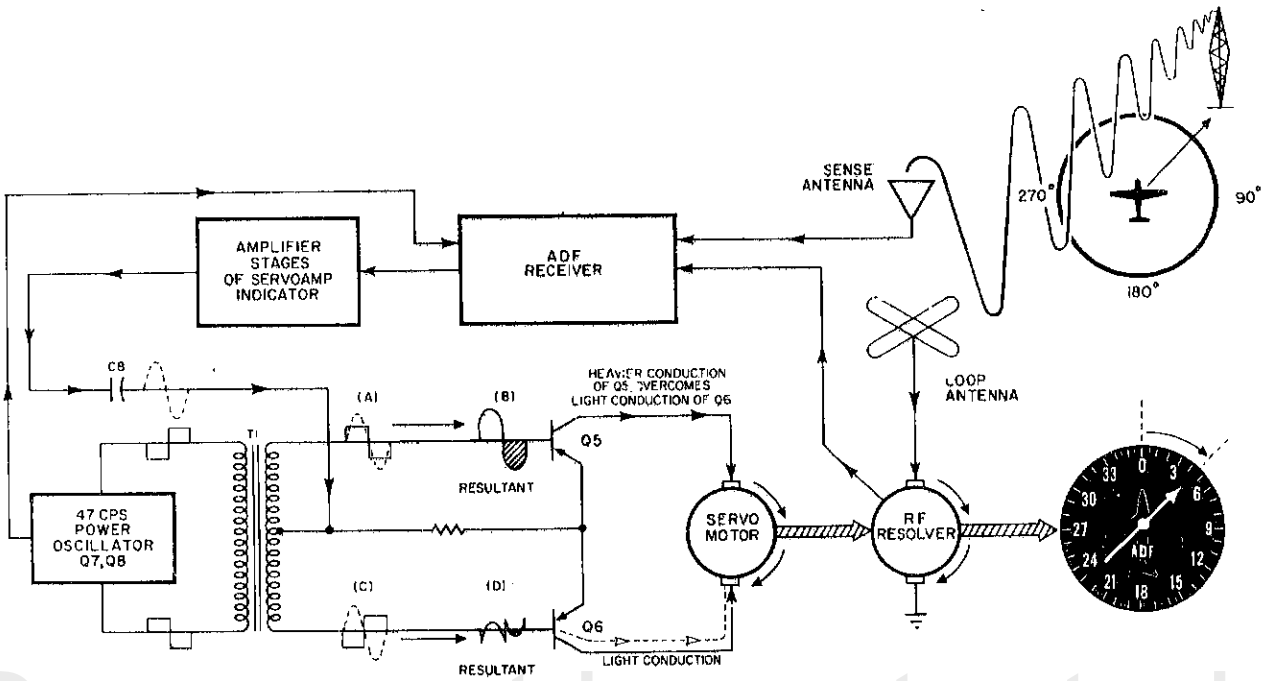


Figure 8
Motor Control Amplifier Operation (45° Bearing), Simplified Schematic Diagram

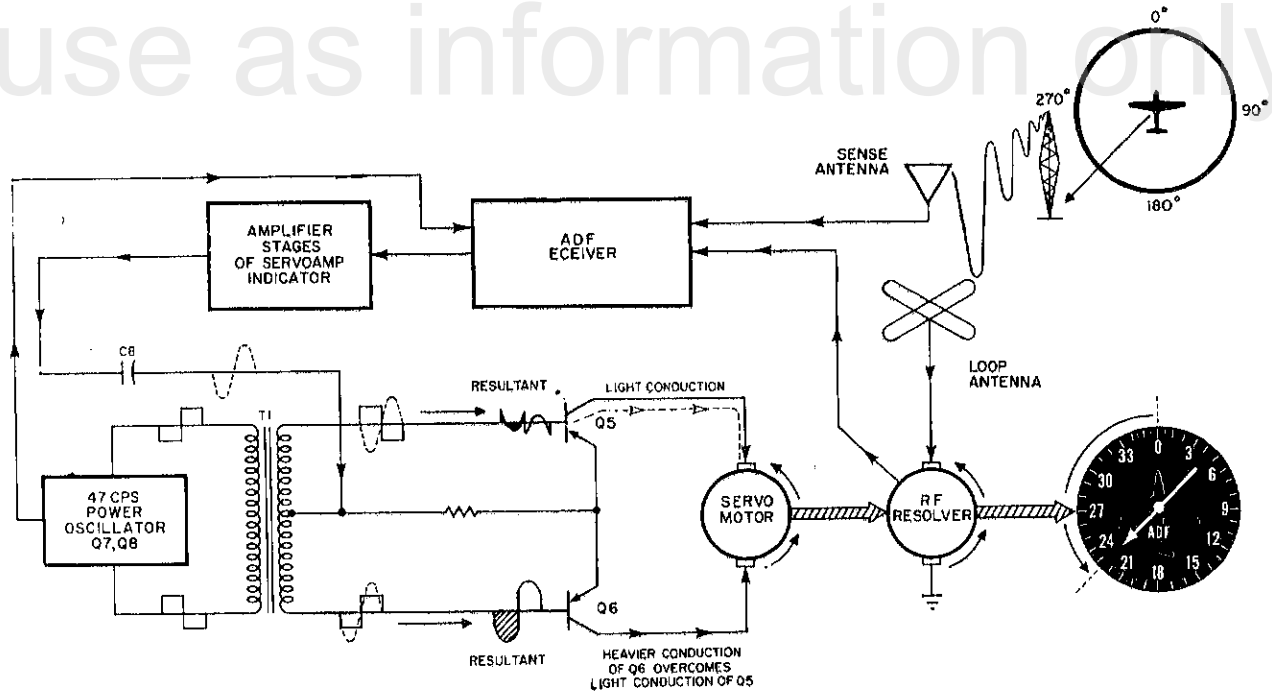


Figure 9
Motor Control Amplifier Operation (225° Bearing), Simplified Schematic Diagram

K. During the next half-cycle of resultant voltage (shaded areas), the bases of transistors Q5 and Q6 become negative enough with respect to their emitters so as to cause a state of forward bias in both transistors. In other words, both transistors are conducting during this second half-cycle of resultant voltage.

L. It will be noted at this time that the base of transistor Q5 is more forward-biased than that of the base of Q6. With our representative values taken into consideration, this means there is a -15 vac signal at the base of Q5 and only a -5 vac signal at the base of Q6. Transistor Q5, being more forward-biased than that of Q6 results in heavier collector current flowing through the clockwise rotation control winding of the motor than that of the counterclockwise control winding applied from the collector output of transistor Q6.

NOTE

In some cases, the 47 cps oscillator reference voltage will be at a higher amplitude than the ADF signal. This is dependent upon the relative position of the loop antenna "pickup" with respect to the angle and distance of the transmitting station. Whether the ADF signal is at a higher or lower amplitude than the reference voltage, the motor control amplifier essentially operates the same. The only difference being that when the ADF signal is lower in amplitude than the reference voltage, transistors Q5 and Q6 alternately conduct during each half cycle of resultant voltage. The servo motor responds only to the output developed from the heavier conducting transistor.

M. Hence, the motor "sees" only the difference between both collector output currents. Since more current is flowing from the collector output of Q5, the motor responds to this output only and momentarily rotates in a clockwise direction.

N. As explained previously, the servo motor, mechanically linked to the r-f resolver rotor, causes the resolver rotor coil to also rotate in a clockwise manner. This in turn, decreases the mutual inductance between the rotor coil magnetic field and the field surrounding the stator coils, until a point of zero voltage at the resolver output is attained, at which time the system is at "null".

O. Consequently, the variable 47 cps ADF signal is absent at the bases of transistors Q5 and Q6. Hence, the motor stops rotating and the resolver rotor coil stops rotating at a position that is 45 degrees relative to the stator coils. The ADF pointer, mechanically coupled to the r-f resolver rotor shaft also stops rotating at the 45 degree indication on the calibrated dial.

P. In effect, the ADF pointer is representative of the r-f resolver rotor coil and the calibrated dial is representative of the stator coils. The effected result as observed on the indicator is the angular relationship of the resolver rotor coil with respect to the stator coils. This in turn, is representative of the aircraft's relative bearing from the transmitting station.

Q. Figure 9 illustrates the aircraft in a position of 225 degrees bearing relative to the transmitting station. In this case, it is required that the servo motor armature must rotate counterclockwise enabling the r-f resolver rotor coil to stop at the 225 degree angle ("true" null).

R. The circuit operates identically to that shown in Figure 8, except that the ADF variable signal is reversed in phase. Consequently, transistor Q6 conducts heavier during the negative half-cycles of resultant voltage. Hence, the servo motor armature rotates in a counterclockwise direction.

S. Figure 10 illustrates the aircraft pointing to the station or with a relative bearing of zero degrees. When the condition exists, only the 47 cps oscillator reference voltage appears at the bases of transistors Q5 and Q6. This is due to the absence of the loop r-f "error" signal to the input of the receiver. In other words, the ADF System is "nulled" out.

T. During the first half-cycle of oscillator "switching" voltage, the base of transistor Q5 becomes more positive with respect to the emitter while the base of Q6 becomes more negative. As a result, transistor Q5 is "shut-off" (or non-conducting) while transistor Q6 is forward biased into a state of conduction. The output from the collector of Q6 (during the first half-cycle) causes the servo motor armature to rotate counterclockwise until the next half-cycle appears at the bases of both transistors. During this next half-cycle of oscillator switching voltage, a reverse action is initiated. That is, transistor Q5 becomes forward biased while transistor Q6 is "shut off". The collector output of Q5 tends to drive the motor armature in a clockwise direction.

U. Consequently, for a complete cycle of oscillator voltage (with the absence of an ADF loop r-f signal), the servo motor armature effectively "swings" back and forth as if vibrating. The repetition rate is so fast that if observed by the naked eye, the armature would appear to be standing still or not rotating at all. As a result, the indicator pointer is observed as simply a zero or "on course" indication against the fixed calibrated dial.

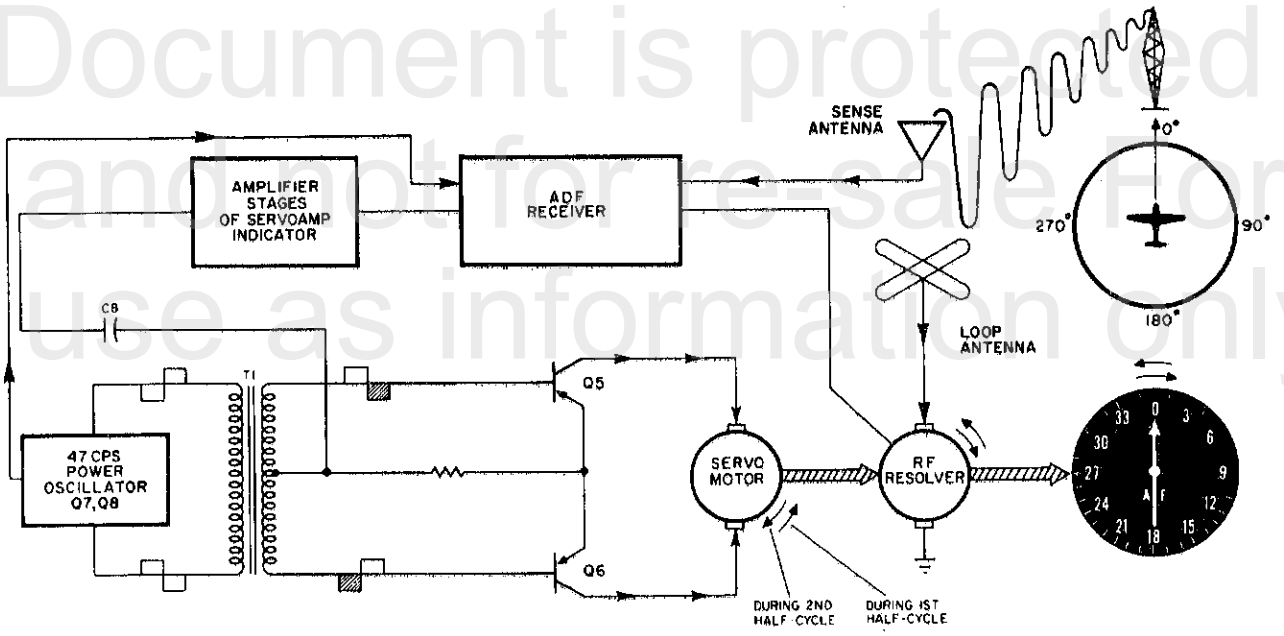


Figure 10
Motor Control Amplifier Operation (Zero Degrees Bearing), Simplified Schematic Diagram

1. GENERAL

A. This section of the manual contains information and procedures for performing tests and adjustments together with corrective and preventative maintenance of the ADF-T-12B, C System.

2. ADJUSTMENT/TESTS

A. JOB/USE

(1) The alignment procedures detailed in this section of the manual are performed to adjust the system for optimum performance. The performance tests detailed in the following paragraphs will determine whether the system meets its minimum performance requirements.

NOTE

Perform all alignment procedures in the order listed.

B. TEST EQUIPMENT REQUIRED

(1) The test equipment (or equivalent) required to perform the procedures detailed in the following paragraphs are listed in Table 101. The basic system test set-up required to perform these procedures is illustrated in **Figure 102. Instructions for connecting additional equipment are included in the specific procedures as required.**

TABLE 101

TEST EQUIPMENT

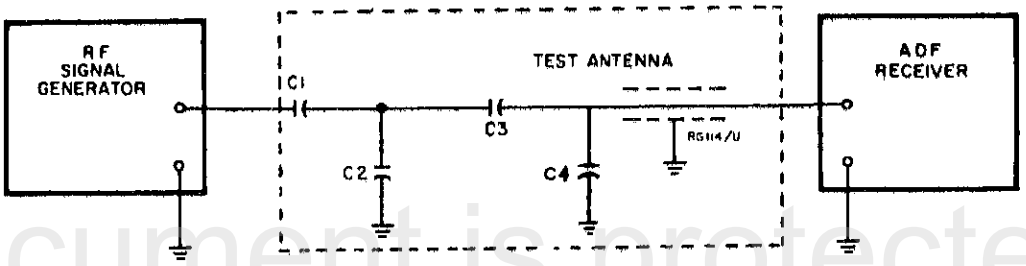
REPRESENTATIVE TYPE	NAME OF EQUIPMENT	PURPOSE OF EQUIPMENT
General Radio 805C	R-F Signal Generator	To simulate loop and sense r-f signals for application to receiver input for alignment purposes.
Hewlett Packard, Model 200B	A-F Signal Generator	Used to modulate R-F signal generator and for checking power oscillator.
Dumont, Model 304H Hewlett Packard 130	Oscilloscope	Used to visually check voltage waveforms during specific tests and adjustments.
Triplett Model 630	Multimeter	Used to check voltage and resistance of circuits where required.
Hewlett Packard, Model 400C	AC VTVM	Used to measure R-F and A-F voltages.
General Radio, Model 583A	Output Power Meter	Used to measure audio output power.
Perkin, Model MR532 - 15A	Power Supply	Provide primary d-c power to system. 14 vdc at 1 amp 28 vdc at 1 amp
Bendix, part no. 2V005 and 2V009	System interconnect cable and loop line.	Used to interconnect all components of system for bench test purposes.
------	Standard test sense antenna.	Simulate sense antenna during tests. See Figure 101.
Ace Mfg. Co., Philadelphia, Pennsylvania	Screen Room (FAA Approved)	Shielded room necessary to adequately test and adjust system in ADF mode of operation (See 2. C.)

C. SCREEN ROOM

(1) All tests performed on the system in the ADF mode of operation must be performed in a screen or shielded room so as to accurately simulate the conditions under which the loop antenna and associated circuits would operate in a free-space, radiated signal field. If a screen room is not available, the Transdyne Model G-1 ADF test unit or equivalent must be utilized for testing the system.

D. STANDARD TEST ANTENNA

(1) A standard test sense antenna must be constructed as follows:



Standard Sense Test Antenna Connection
Figure 101

C1 = 1100 uuf

C2 = 10000 *uuf*

C3 = 39 *uuf*

C4 = 82 *uuf* (Total capacitance of both C4 and Cable RG114/U)

RG/114U = 7 ft.

NOTE

The above figures simulate a one-half meter sense antenna in an average size screen room with an attenuation factor of approximately 5:1. For a screen room with a 10:1 factor, change capacitor C1 to 560 uuf.

Generator output levels in test and alignment procedures are for screen rooms with attenuation factors of 5:1. Adjust generator output level if any other screen room factor is used.

E. RECEIVER ALIGNMENT

(1) I-F Alignment

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Assemble the ADF-T-12B,C System as indicated in Figure 102.	Inject signal at mixer coil L7 pin 4.

NOTE

Make certain the 14/28 vdc selector switch located at rear of receiver corresponds to the selected input voltage from the power supply.

(b) Apply power to all equipment and allow 15 minutes for test equipment to warm-up.	
(c) Verify with multimeter that the d-c voltage between pins 15 and 9 of connector J1 is 13.75 ±5% vdc (for 14 v operation) or 27.5 ±5% vdc (for 28 v operation).	
(d) Adjust the r-f signal generator to 142.5 kHz ±50 Hz, modulated 30% at 400 Hz.	Signal generator frequency should be accurate within 1%.
(e) Set the receiver function switch to the REC position.	
(f) Set the receiver band selector switch to the 190-440 position.	
(g) Adjust the receiver tuning knob for a frequency of 400 kc.	
(h) Adjust the output of the R-F signal generator until a mid-scale deflection is obtained on the tuning meter.	Tuning meter (accessory for all but Models 201C/D) S20001-01, 0-1 ma.

NOTE

Steps (i) and (j) must be performed with extreme care so that the selectivity requirements of paragraph I.(3).(i) can be obtained.

(i) Adjust the tuning cores of the i-f transformers for maximum indication on the tuning meter. Adjust in the following order: T5, T4, T3. Primaries, top-side; secondaries, bottom.	Adjust the primaries of each transformer first; secondaries, second. Reduce the generator output as found necessary to maintain mid-scale indication of tuning meter.
(j) Tune T6 for maximum audio output on the output power meter.	Volume control to be set full clockwise. Steps (i) and (j) must be performed carefully if selectivity specifications in paragraph I.(3) (i) (page 116) are to be met.

(2) R-F Alignment

(a) Connect the R-F signal generator, through the "dummy" test antenna to terminal 1 of connector J1.	See Figure 102.
(b) With the receiver function selector switch still in the REC position, adjust the signal generator to 200 kc, unmodulated.	
(c) Adjust the receiver tuning knob for a frequency of 200 kc.	
(d) Adjust the output of the signal generator until the tuning meter reads about mid-scale.	

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(e) Adjust the tuning cores of local oscillator coil L10, mixer coil L7 and r-f coil L4 (in this order), for maximum indication on tuning meter.	Adjust output of signal generator as found necessary to maintain mid-scale reading on tuning meter.
(f) Adjust the signal generator to 400 kc. unmodulated.	
(g) Adjust the receiver tuning knob for a frequency of 400 kc.	
(h) Adjust trimmer capacitors C39, C24 and C22 (in this order), for maximum indication on the tuning meter.	Maintain tuning meter at mid-scale indication during adjustments, and repeat steps (b) through (h) until no further improvement can be obtain obtained.
(i) Repeat steps (b) through (h) as follows on bands 2 and 3: Band 2: 500 kc - Adjust L11, L8 and L5 800 kc - Adjust C41, C26 and C17 Band 3: 1000 kc - Adjust L12, L9 and L6 1600 kc - Adjust C43, C28 and C19	In each case, always make the last adjustment with the trimmer capacitor.

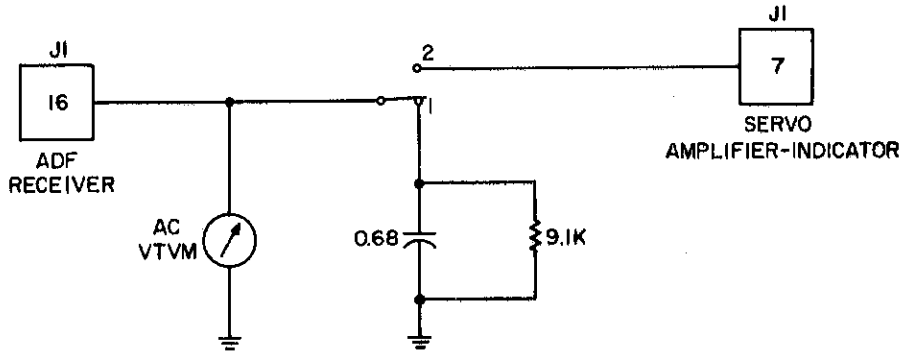
(3) Loop Stage Alignment

(a) Set the receiver function switch to the ADF position.

(b) Set the receiver band selector switch to the 190-440 position.

NOTE

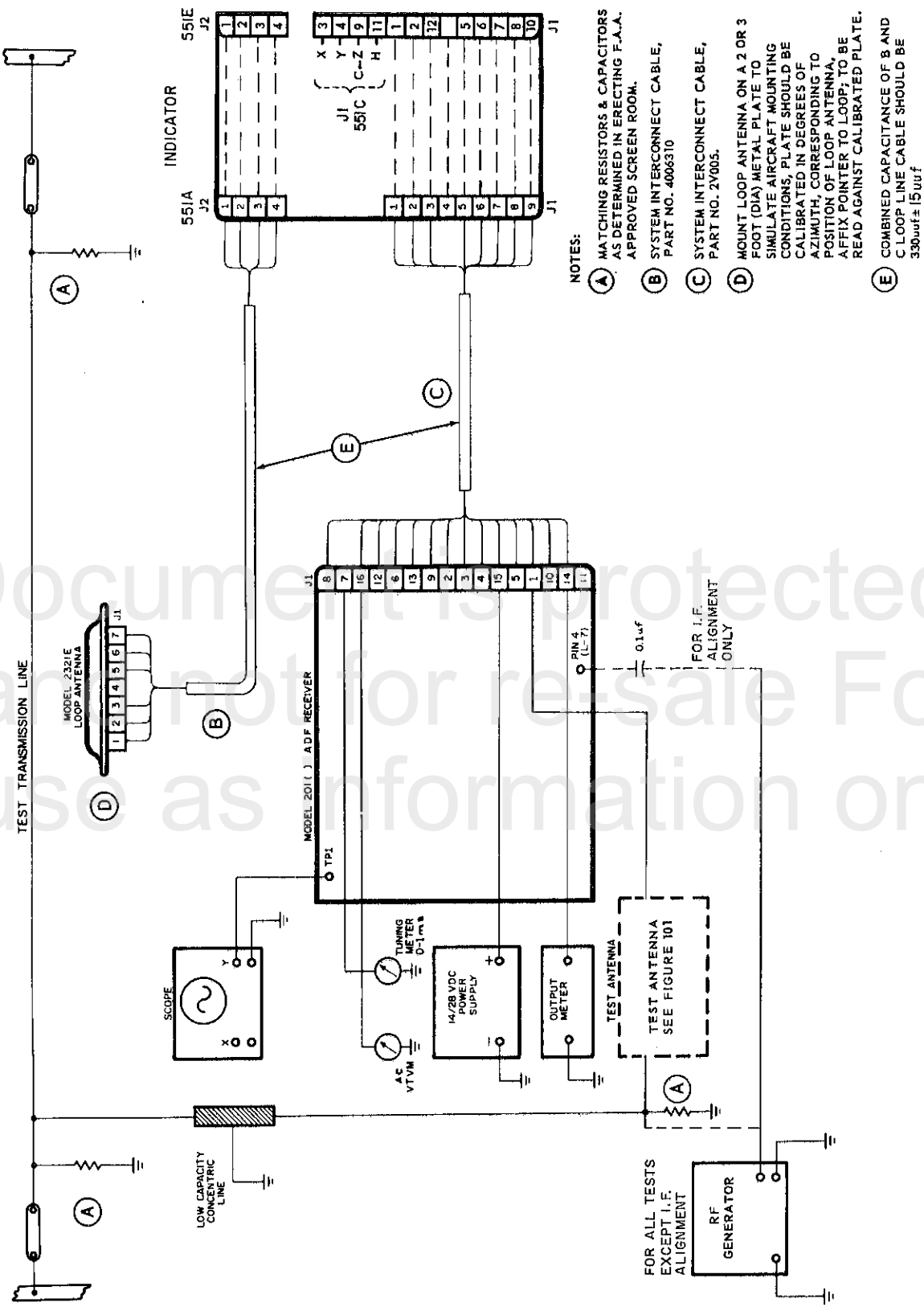
Servo motor must not rotate while aligning loop stages.
Do not attempt to retard motor by holding or clamping.
The recommended method of stopping motor is as follows:



(During loop alignment, switch must be in position 1)

(c) Adjust the signal generator to 200 kc, unmodulated and for a field strength of 1000 microvolts.	Manually rotate fixed loop through 90 degrees.

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(d) Adjust the receiver tuning knob for a frequency of 200 kc.	
(e) Adjust the tuning core of coil L1 for maximum indication on VTVM connected to J1 pin 16.	
(f) Adjust the signal generator and the receiver to 400 kc.	
(g) Adjust trimmer capacitor C3 for maximum indication on VTVM.	
(h) Repeat steps (c) through (g) until no further improvement can be obtained.	In each case, always make the last adjustment with the trimmer capacitor.
(i) Repeat steps (b) through (h) for band 2 and 3 as follows: Band 2: 500 kc - Adjust L2 800 kc - Adjust C4 Band 3: 1000 kc - Adjust L3 1600 kc - Adjust C6	
(j) With a scope connected to TP1 (see Figure 102 and Figure 308), a 47 cps modulated square-wave is to be expected as shown in Figure 104. The best modulation percentage is obtained when the loop stage is properly tuned. Modulation between 30% to 100% is typical of the low end of each band and 20% to 100% at the high end of each band.	



Bench Test Set-Up, ADF Receiver
Figure 102

(4) AGC Adjustment

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Set the receiver function switch to REC position.	
(b) Adjust the signal generator and the receiver to 200 Hz.	
(c) Modulate the generator 30% at 400 Hz and adjust for an output level of 150 uv.	Position IMPEDANCE switch of output meter to 500 ohm load.
(d) Adjust R43 fully clockwise. Note the audio output voltage at the receiver as indicated on the VTVM.	
(e) Adjust AGC control R43 counterclockwise until the ADF output voltage at the receiver decreases 4db as indicated on the VTVM.	

(5) Audio Level Adjustment

(a) Re-adjust signal generator for 150 uv output, with frequency and function as in step (4).	
(b) With VOL control adjusted for maximum output (fully clockwise), set audio trimmer potentiometer R51 for an output of 27- to 37- mw as indicated on the output meter.	Audio level shown is for average installation. Other levels may be used to satisfy particular system require requirements.
(c) Turn the Function Selector switch to OFF and note that the output meter indicates zero.	

(6) AGC Performance Check

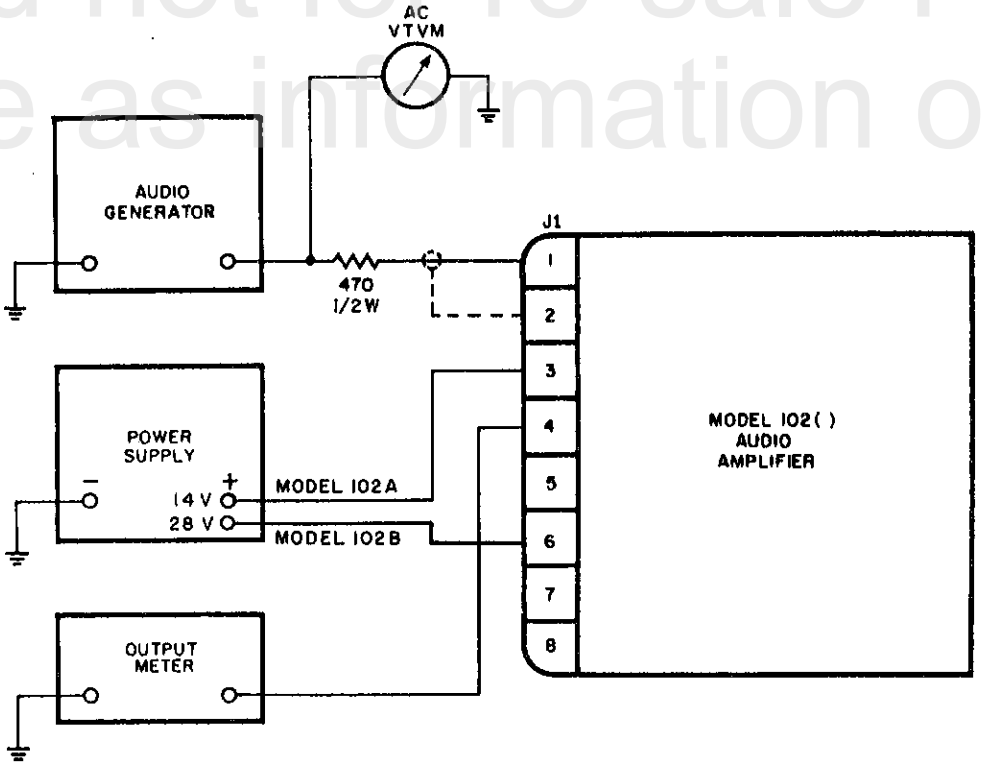
(a) Set the receiver and signal generator to 200 kHz. Modulate the signal generator 30% at 400 Hz.	
(b) Set signal generator output to 150 μ volts.	
(c) Set the volume control for 2.0 volts audio output on the VTVM.	
(d) Vary the signal generator output from 150 μ volts to 1.5 volts and note that the audio output does not increase more than 10db nor decrease more than 6db.	

F. AUDIO AMPLIFIER TEST

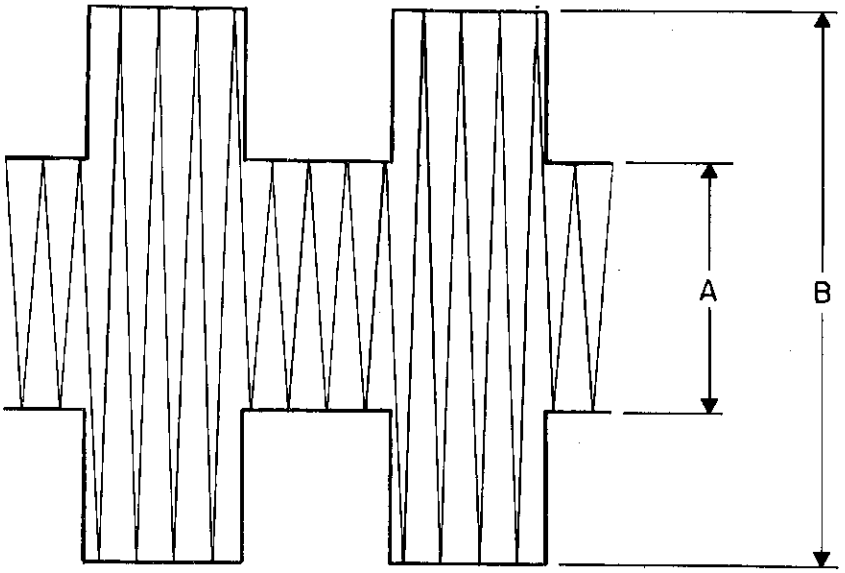
(1) Audio Gain

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Connect the test equipment to the audio amplifier as illustrated in Figure 103.	Connect plus terminal of power supply to pin 3 of Model 102A or to pin 6 of Model 102B.

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(b) Turn on test equipment and allow 15 minutes warm-up time.	
(c) Position IMPEDANCE switch on the output meter to 3 ohms.	
(d) Adjust the audio generator to 1000 Hz and an audio amplifier output of 1 watt.	The audio input shall not exceed 10 volts rms.
(2) Maximum Power Output	
(a) Adjust the audio generator to 1000 Hz and an audio amplifier output of 3.5 watts (102A) or 10 watts (102B).	The voltage input indicated on the vtvm should be less than 17.5 volts rms.
(3) Frequency Response	
(a) Adjust the audio generator to 1000 cps and an audio amplifier output of 1 watt.	
(b) Adjust the audio generator to 350 Hz 750 Hz, 1500 Hz, 2000 Hz and 2500 Hz (in that order).	The output level indicated on the output meter should be no greater than +1 db or -4 db from the 1000 Hertz reference for the five frequency positions tested.



Bench Test Set-Up, Audio Amplifier
Figure 103



$$\text{MODULATION } \% = \frac{B-A}{B+A} \times 100$$

Figure 104
Typical Modulation Percentages

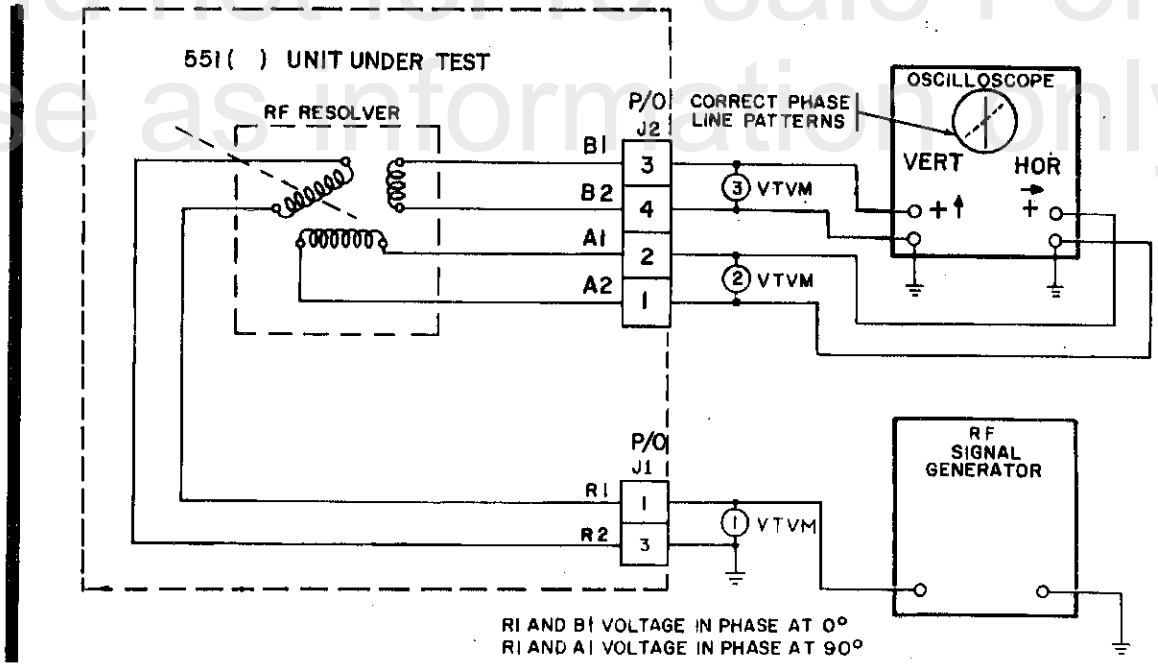


Figure 105
Resolver Alignment Set-Up

(Revised October 1973)

G. R-F RESOLVER ALIGNMENT

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(1) Remove the dust cover from servo amplifier indicator unit.	See Figure 303.
(2) Connect the equipment as shown in Figure 105.	
(3) Adjust the signal generator to 200 KHz with an output of 0.5 volts as idicated on VTVM no. 1.	
(4) Rotate the gear train until the pointer reads zero.	Use a gear close to the servo motor to rotate the gear train.
(5) Loosen the two screws that hold the resolver to mounting plate.	
(6) Rotate resolver until the oscilloscope trace is vertical and the voltage indicated on vtvm No. 2 is a minimum.	See that the resolver output gear does not rotate.
(7) Disconnect the wire from plug J2 pin 2. Connect a wire from plug J2 pin 1 to the + horizontal input of the oscilloscope.	Oscilloscope pattern must show in-phase condition for correct zero position of resolver rotor. The in-phase condition exists when the oscilloscope trace is inclined approximately 45 degrees to the right as shown in figure 105. If the trace is not inclined 45 degrees, rotate the resolver 180 degrees.
(8) Re-connect the wire from plug J2 pin 2 to the scope and disconnect the wire from pin 1 to the scope.	
(9) Tighten screws and rotate gear train through 360 degrees.	If the scope trace does not follow the direction and angle of the pointer, one pair of wires (A1-A2, B1-B2, or R1-R2) is reversed. Check the color coding of the resolver with the appropriate schematic in this manual.
(10) Check null points at zero and 180 degrees on VTVM No. 2.	
(11) Check null points at 90 and 270 degrees on VTVM No. 3	

H. SERVO AMPLIFIER-INDICATOR ALIGNMENT

(1) Amplifier Gain Test

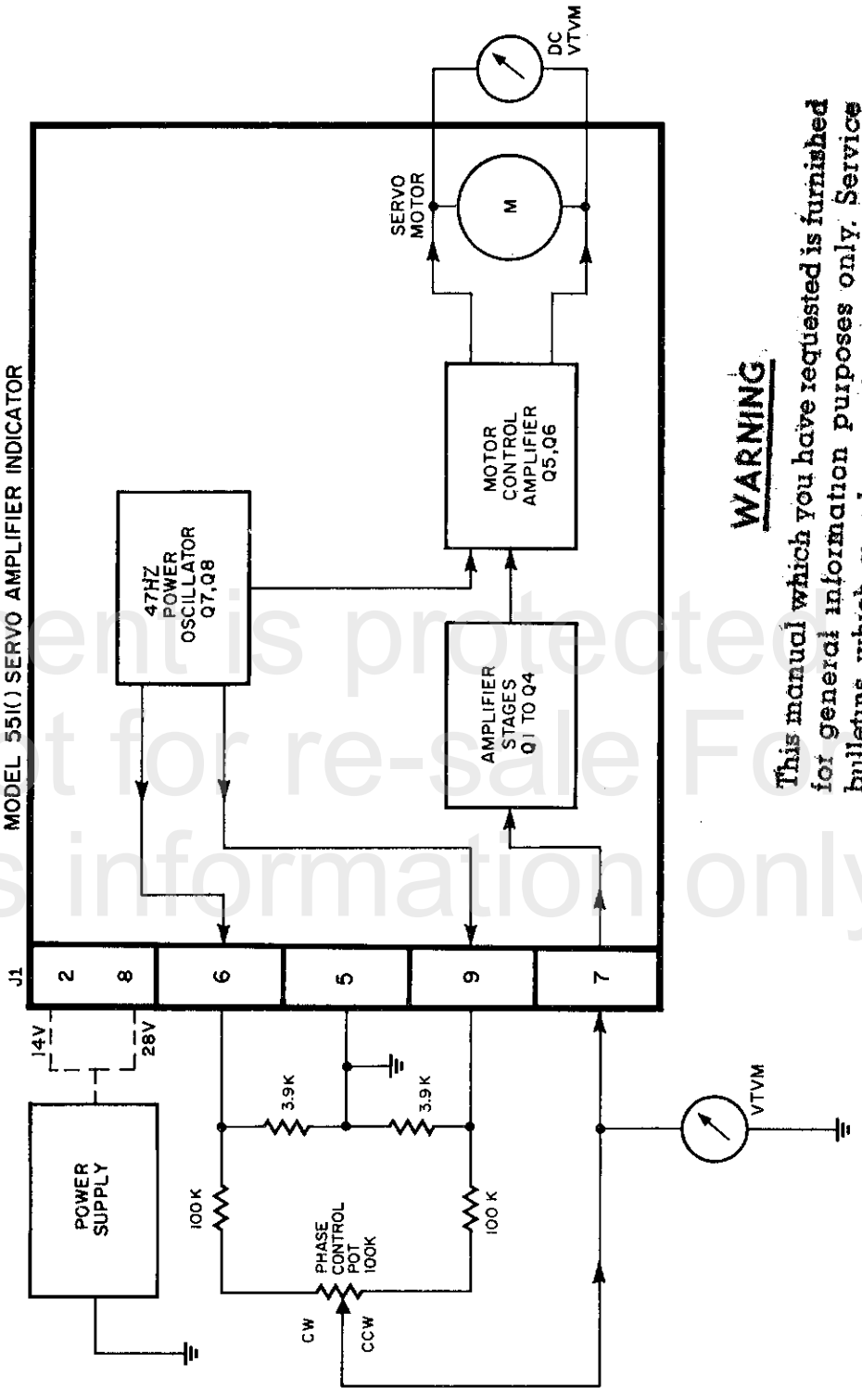
DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Connect the test equipment as illustrated in figure 106.	
(b) On units with old type motor, adjust the phase control potentiometer of the test rig for 0.5 millivolts above residual voltage. Adjust the servo sensitivity control (R 25) fully CCW. Adjust amplifier frequency control (R 15) for maximum indication on the d-c vtvm connected across the motor.	Refer to schematic summary of changes page for S/N effectivity of motor change. Residual voltage is the a-c voltage, usually 0.4- to 2.5-mv, indicated on the vtvm connected to pin 7 when the d-c voltage present across the motor is zero volts. R 25 may be readjusted, after installation of unit in aircraft, to increase or decrease pointer sensitivity as desired by customer.
(c) On units with new type motor, rotate the phase adjust potentiometer of the test rig CCW until the d-c voltage on the vtvm across the motor is 2.5- to 3.0- volts. Adjust frequency control (R 15) for a d-c voltage peak across the motor while maintaining the peak at 2.5- to 3.0- volts by use of the phase control.	See KEY ITEMS in step (b).

DETAIL STEPS/WORK ITEMS	KEY ITEMS
Rotate the phase adjust potentiometer until the d-c voltage across the motor is zero volts. Note the residual voltage [see KEY ITEMS in step (b)]. Adjust servo sensitivity control (R25) until pointer is just rotating CW as the phase control potentiometer is adjusted for 0.4 mv above the residual voltage.	
(d) Adjust the phase control potentiometer for 2 mv (above residual voltage), and observe vtvm across motor.	VTVM should indicate 2.5 vdc minimum
(e) Adjust the phase control potentiometer for 10 mv (above residual voltage), and observe VTVM across motor.	VTVM should indicate 5 vdc minimum. for old motor units or 3 vdc minimum for new motor units.
(2) Indicator Rotation Speed	
(a) Adjust phase control potentiometer for 10 mv (above residual voltage) and observe the time it takes for the indicator pointer to rotate 360 degrees.	Pointer should take not more than 9 seconds to rotate 360 degrees.
(3) Switching Voltage Test	
(a) Measure the oscillator switching voltage from pin 6 to ground and pin 9 to ground, with an average reading instrument, calibrated rms.	Voltage should indicate a minimum of 7.5v rms at each point.

I. RECEIVER OPERATIONAL TESTS

(1) Tuning Dial Calibration

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Connect the equipment as indicated in Figure 102.	
(b) Set the receiver function selector switch to REC position.	
(c) Set the band selector switch to the 190-440 position.	
(d) Adjust signal generator to 200 kc, unmodulated.	Signal generator output frequency should be accurate within 0.1% frequency tolerance.
(e) Adjust receiver tuning dial to 200 kc.	
(f) Adjust the tuning dial control for maximum indication on the tuning meter and compare the frequency indicated on the tuning dial with that of the generator output frequency.	The indicated frequency on the tuning dial should be within 1% of the signal generator output frequency.
(g) Repeat steps (d), (e) and (f) at frequencies of 400 kc, 500 kc, 850 kc, 1000 kc and 1600 kc positioning the band selector switch accordingly.	



Bench Test Set-Up, Servo Amplifier-Indicator
Figure 106

WARNING

This manual which you have requested is furnished for general information purposes only. Service bulletins which supplement this manual are only furnished to Bendix authorized FAA approved repair stations. DO NOT USE THIS MANUAL FOR EFFECTUATING REPAIRS OF THE EQUIPMENT.

DETAIL STEPS/WORK ITEMS | KEY ITEMS

(h) If the indicated frequencies on the tuning dial are not within 1% tolerance of the signal generator output frequencies, perform the following adjustments:

(i) With the signal generator and the receiver tuning dial adjusted to 200 kc, adjust local oscillator tuning coil L10 until the signal generator frequency can be monitored on the tuning meter at the maximum indicated level.

(j) Re-adjust the signal generator and receiver tuning dial to 400 kc.

(k) Adjust local oscillator trimmer capacitor C39 until maximum indication is observed on the tuning meter.

(l) Repeat steps (i), (j), and (k) until it is apparent that the signal generator output frequencies of 200 and 400 kc are received at a maximum indicated level on the tuning meter when the receiver tuning dial is adjusted to these frequencies, respectively.

(m) Re-tune signal generator to 200 kc and adjust mixer and R-F coils L7 and L4 (in this order) for maximum indication on the tuning meter.

(n) Re-tune signal generator to 400 kc and adjust trimmer capacitors C24 and C21 (in this order) for maximum indication on the tuning meter.

(o) Repeat the foregoing steps at other calibration points and adjustments as follows:

Band 2: 500 kc: Adjust L11, L8, L5
850 kc: Adjust C41, C28, C17

Band 3: 1000 kc: Adjust L12, L19, L6
1600 kc: Adjust C43, C28, C19

(p) Align loop stage. See paragraph 2.E (3) for loop stage alignment procedures.

(2) Receiver Sensitivity (MCW)

(a) Connect the equipment as illustrated in figure 102. | Allow 15 minutes for test equipment warm-up.

(b) Set output meter for 500 ohm load.

(c) Set receiver function selector switch to REC position.

NOTE

R-F and I-F alignment procedures must have been performed before continuing with this procedure.

(d) Adjust signal generator to 200 kHz, modulated 30% at 400 Hz; adjust for 120 uv output.

(e) Tune receiver to 200 kc.

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(f) Adjust receiver VOL control until output meter indicates 20 milliwatts output power.	
(g) Remove the 400 cps modulation signal.	Audio output should drop 6 db.
(h) Adjust signal generator for 100 mV output. Repeat steps (d) through (g) at the following frequencies: 400 kc, 450 kc, 800 kc, 1000 kc and 1600 kc. Adjust band selector switch accordingly.	
(3) Receiver Selectivity Test	
(a) Connect the equipment as illustrated in Figure 102.	
(b) Set output meter for 500 ohm load.	
(c) Set receiver function selector switch to REC position.	
(d) Adjust signal generator to 300 kc, modulated 30% at 400 cps.	
(e) Tune receiver to 300 kc.	
(f) Adjust signal generator output level to 80 uv and note reading on audio output meter.	
(g) Increase output of signal generator to 160 uv and detune the signal generator on either side of the center frequency until audio output meter indicates the same reading as was found in step (f); repeat on other side of center frequency.	Total bandwidth should be a maximum of 4 kc.
(h) Increase output of signal generator to 80,000 uv and detune the signal generator until audio output meter indicates the reading as was found in step (f); repeat on other side of center frequency.	Total bandwidth should be a maximum of 12 kc.
(4) ADF Threshold Sensitivity	
(a) Connect the equipment as illustrated in Figure 102.	
(b) Apply power to all equipment and allow 15 minutes for warm-up of test equipment.	
(c) Set the output meter for 500 ohm load.	
(d) Set the receiver function selector switch to ADF position.	

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(e) Set receiver and signal generator to 200 kHz.	
(f) Adjust signal generator output to 350 uv modulated 30% at 400 Hz.	
(g) Rotate the indicator needle 175° away from indicated bearing by using the Test Button.	
(h) Release the Test Button and note the time required for the needle to return to within 2° of indicated bearing.	Time should not exceed 7 seconds.
(i) Vary the signal level from 350 uv to 0.1 volts and note that the bearing remains within ±3° of indicated bearing.	
(j) Repeat steps (f) through (i) at frequencies of 650 kHz and 1300 kHz.	

3. TROUBLESHOOTING

A. GENERAL

The tabulated procedures detailed in this section are designed to isolate malfunctions in the ADF-T-12B, C System to the level where operational tests, signal tracing, or voltage and resistance measurements can profitably be made.

B. TRANSISTOR TESTING METHODS

Many conventional methods of troubleshooting electronic equipment can be destructive where applied to transistorized equipment. Although transistors can withstand much greater physical abuse than vacuum tubes, they are particularly sensitive to heat and excessive voltage. Before attempting to service the ADF-T-12B, C System, maintenance personnel should be come familar with the information contained herein.

(1) Signal Tracing

Stage-by-stage signal tracing is the most effective method for locating trouble in the system. This procedure is accomplished by connecting an output meter or oscilloscope across the output of a stage and injecting a known signal into the input of that stage. A comparison of the injected signal with the resultant output signal indicates the operating condition of that stage. Typical waveforms and RMS voltages existing at various stages of a representative receiver and servo amplifier-indicator are shown in Tables 104 and 105. During signal tracing or when making measurements, care must be exercised to prevent the test equipment from adversely influencing the circuits under test. Proper methods of coupling the test equipment during measurement procedures are illustrated in Figures 102, 103, 105 and 106.

(2) D-C Voltage Measurements

The voltages encountered in this equipment are less than 28 vdc. Meters with a sensitivity of 20,000 ohms per volt are satisfactory for these voltage measurements. Due to the inherent voltage variation characteristics of zener diode CR13 (ADF Receiver) and CR1 (Servo Amplifier Indicator),

the typical voltages to be found on the A+ line of the receiver and indicator circuits would be in the area of 7.5 to 10 volts d-c.

(3) The voltages across the leads of typical ohmmeters, are in many cases equal to the operating potentials of transistors. Therefore, connecting an ohmmeter across a transistorized circuit might cause the transistor to conduct, or become forward-biased from a previously reverse-biased state. This will result in erroneous indications of the ohmmeter. In some cases, the meter potentials may be sufficiently high to damage the transistor. Transistors should always be removed from the circuit before taking resistance measurements. In cases where the transistors are soldered into the circuit board and cannot be easily removed, resistance measurements should not be performed.

(4) Transistor Checking

Transistor failure is seldom encountered under normal operating conditions. The few cases of failure are due to excessive voltage or heat. Once a transistor has been damaged it will generally be completely inoperative. In some cases, damage will be evidenced by increases noise. The best way to check a transistor is to replace it with one known to be good. A transistor checker may also be used where marginal performance is suspected.

(5) Troubleshooting Table 102

The troubleshooting table is designed to assist the technician in recognizing some of the more probable symptoms (and what to do about them) that might be encountered during operation of the system. No special equipment is needed to perform the procedural steps outlined in the table.

TABLE 102

SYSTEM TROUBLESHOOTING CHART

SYMPTOM	PROCEDURE	RESULT	PROBABLE CAUSE OR CORRECTIVE ACTION
1. No audio in headset; no tuning meter indication. Function switch in REC position.	1. Set function switch to ADF.	A. Sound in headset. Tuning meter deflects. Pointer moves.	1. Sense antenna grounded or disconnected.
		B. Symptom unchanged.	1. No d-c reaching terminal 15 of receiver. Check primary d-c fuse external cable and CR13.
2. Tuning meter normal. No audio. Function switch in REC position.	1. Set function switch to ADF.	A. Indicator pointer rotates or nulls.	1. Audio amplifier Q11, Q12, Q13 defective. 2. Audio gain control R51 or R52 open.
		B. Pointer stationary.	1. Audio amplifier Q10 defective.
3. No tuning meter indication. Audio O.K.	1. Measure resistance between pins 7 and 9 of receiver connector J-1.	A. Meter reads zero.	1. Short across resistor R46.
		B. Meter reads infinite.	1. Open resistor R46.

TABLE 102 (Cont)

SYSTEM TROUBLESHOOTING CHART

SYMPTOM	PROCEDURE	RESULT	PROBABLE CAUSE OR CORRECTIVE ACTION
4. Hash on one or two bands. Other operative.	1. Check band switch for continuity and positive operation.	A. Bandswitch O.K.	1. Defective interstage transformers.
5. System O.K. in REC but inoperative in ADF except tuning meter responds.	1. Tune in station in REC Switch to ADF and press TEST switch.	A. Pointer rotates.	1. Defective loop amp. Q1 or balanced modulator CR1 through CR4.
		B. Pointer stationary.	1. Defective servo amp-indicator. 2. Defective power oscillator.
6. Equipment takes definite bearing 180 degrees reversed.	1. Check loop antenna connections to r-f resolver.	A. Connections O.K.	1. Connections between resolver and receiver reversed.
		B. Connections reversed.	1. Change connections.
7. Equipment takes definite bearings with a consistent error. 8. Equipment takes correct bearings near 0 and 180 degrees, but readings become increasingly inaccurate as 90 and 270 degrees are approached.			1. Loop antenna centerline not aligned with centerline of aircraft. 1. Quadrantal error. Relocate fixed loop. See INSTALLATION MANUAL
9. Indicator pointer hunts excessively on all bearings.	1. Re-adjust sensitivity control R25 (where applicable) in servo amplifier-indicator until "hunting" of indicator pointer is reduced. See Figure 309 location of control (R25).	A. Indicator pointer still hunts excessively.	1. Poor installation. See Table 103. 2. Check output transistors Q5 and Q6 and diode CR3 and CR4 in servo amp-indicator. 3. Defective filter capacitor C9, C10, C11, C12 or C14.
10. Excessive audio distortion on strong signals.	1. Readjust AGC.	A. Distortion unchanged.	1. Defective AGC circuit. Check AGC Amp Q9. 2. Check diodes CR5, CR7, CR9 and CR10.
11. Servo amp-indicator transistors fail periodically.			1. Check surge protector CR1 in servo amplifier indicator for open circuit. 2. Check motor for "shorts",

(6) Troubleshooting Marginal Performance

In most cases the troubleshooting chart, Table 102, will localize a failure to the point where simple voltage and resistance measurements will enable the technician to locate the specific malfunctioning component. In some cases, however, failure of the equipment will be evidenced by marginal performance. For instance, it will take bearings, but slowly. The indicator pointer may hunt excessively, or the sensitivity or selectivity of the equipment may be inadequate. In cases such as these proceed as follows:

(a) Check the Installation

A poor installation is frequently the cause of marginal performance. Use Table 103 to check the installation.

TABLE 103

INSTALLATION CHECK

WHAT TO CHECK	HOW TO CHECK	REMARKS
1. Sense Antenna	1. Gently vibrate sense antenna while observing connections to fuselage.	Mountings must not be loose. Check for corrosion and broken sense antenna wire.
	2. Check to see that stand-off insulators are clean and in good condition.	
	3. Examine sense antenna connections to receiver.	There must be no looseness in fasteners; the ground connections to cabling must be secure and not corroded.
2. Fixed Loop	1. Examine antenna housing and check that loop is fastened tight against aircraft skin.	Check for missing bolts and dented or torn housing. Check that housing is free of paint.
	2. Examine loop connections to receiver.	Check for loop connector pin corrosion.
	3. Check that loop lead-in is of the recommended type and length.	
3. ADF Receiver, and servo amp-indicator.	1. Be sure all cable connector locking rings are tight.	Loose connections can cause intermittent operation.
	2. Check that all components are properly bonded to the airframe.	
4. Tuning control	1. Rotate in both directions.	Must turn freely and not bind.
5. Band switch	1. Change bands.	Listen for positive switching action.
6. VOL control	1. Rotate both directions.	Binding or too loose operation can result in excessive noise.
7. Function switch	1. Set to REC.	Panel lamp should light, and equipment operate as a communications receiver.

(b) Waveforms and RMS Voltage Tables 104 and 105

Marginal trouble due to misalignment of the equipment or sub-standard performance of the components can be localized to a single stage by the signal tracing method. Table 104 and 105 show the signal voltage level and waveshape at selected stages of the equipment. When the observed voltage readings and waveforms differ widely from those indicated in the tables, the malfunctioning stage has been localized.

TABLE 104

ADF RECEIVER

CONDITIONS:

Frequency: 200 KC
Vol Control: Adjust for 50 mw into 500 ohms
Function: ADF

Input: 100 μv, modulated 30% at 400 cps
All voltages measured to ground, ±10%

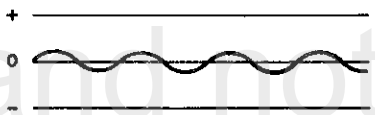
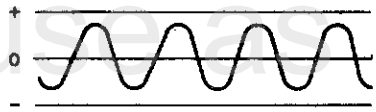
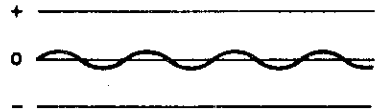
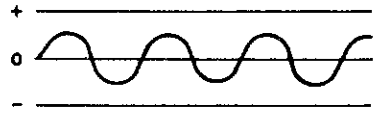
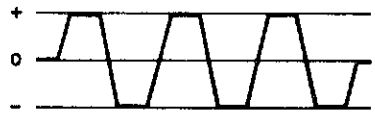
WAVEFORM	FREQUENCY	TEST POINT	RMS VOLTAGE
	142.5 kc	TP1	2.0 v
	400 cps	Pin 4 (T6)	170 mv
	400 cps	Coll. (Q10)	400 mv
	400 cps	C.T. (R51)	30 mv
	400 cps	Coll. (Q12)	3.3 v
	47 cps	Pin 8 (J1)	8.5 v

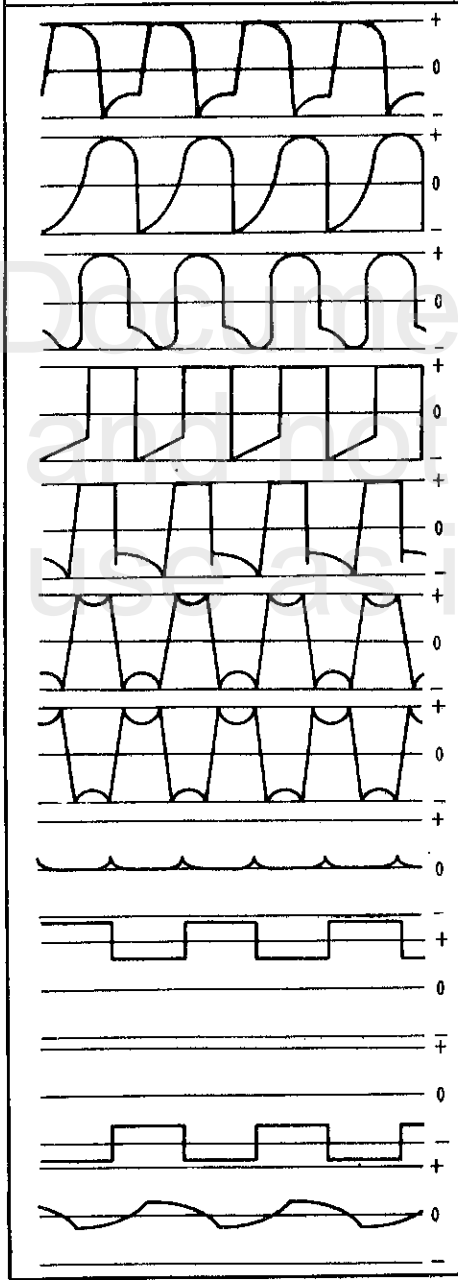
TABLE 105

SERVO AMPLIFIER-INDICATOR UNITS WITH OLD TYPE MOTOR
(REFER TO SCHEMATIC SUMMARY OF CHANGES PAGE FOR EFFECTIVITY)

CONDITIONS:

Frequency: 200 KC
Loop rotated 90° from null (Motor (17) gear must be disengaged from gear train prior to rotating loop.)
Input: 100 μv per-meter, unmodulated

Function: ADF
All voltages measured to ground ±10%

WAVEFORM	FREQUENCY	TEST POINT	RMS VOLTAGE
	47 cps	Pin 7 (J1)	.15v
	47 cps	Coll. (Q1)	1.3v
	47 cps	Base (Q2)	.15v
	47 cps	Coll. (Q3)	.6v
	47 cps	Coll. (Q4)	1.5v
	47 cps	Base (Q5)*	.9v
	47 cps	Base (Q6)*	1.8v
	47 cps	Emitt. (Q5)	.18v
	47 cps	Coll. (Q5)*	2.6v
	47 cps	Coll. (Q6)*	-2.6v
	47 cps	Base (Q7)	.28v

* or vice versa, depending upon phase of ADF signal at these test points.

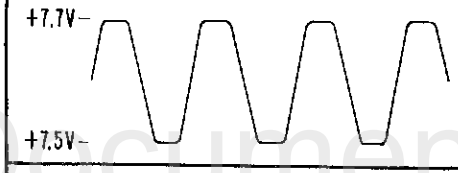
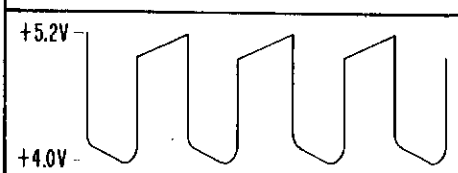
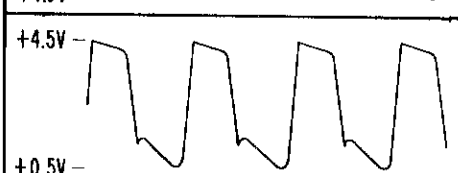
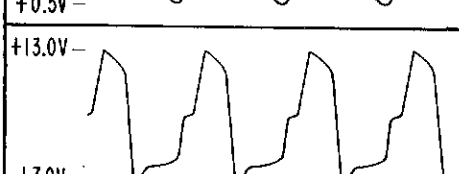
TABLE 105A

SERVO AMPLIFIER-INDICATOR UNITS WITH NEW TYPE MOTOR
(REFER TO SCHEMATIC SUMMARY OF CHANGES PAGE FOR EFFECTIVITY)

CONDITIONS:

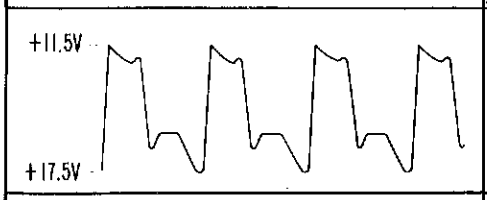
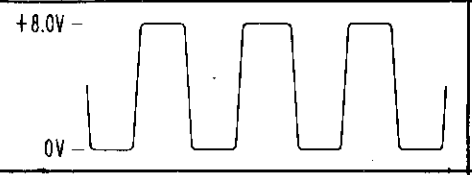
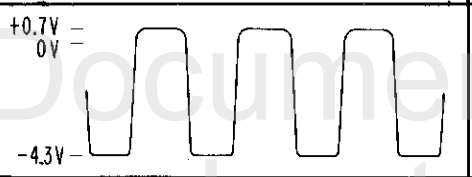
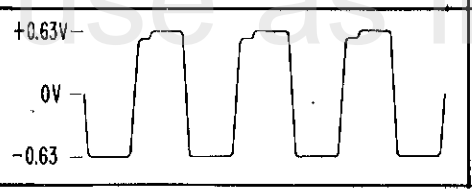
Frequency: 200 kHz.
Input: 1000 μV, unmodulated.
Remove motor (8) from indicator (do not disconnect wiring.) Use a clip lead from chassis ground to motor frame. With loop at 0° (null), manually rotate indicator pointer to 90° (off null).

Function : ADF
All voltages measured to ground ±20%.
Scope triggered from collector of Q7.

WAVEFORMS	FREQUENCY	TEST POINT	P-P VOLTAGE
	47 Hz	Pin 7 (J1)	0.2
	47 Hz	Coll. (Q1)	2.0
	47 Hz	Coll. (Q2)	1.0
	47 Hz	Coll. (Q3)	1.2
	47 Hz	Coll. (Q4)	4.0
	47 Hz	Base (Q5)*	6.0

* Q5 and Q6 waveforms may be reversed depending on phase of ADF signal [pin 7 (J1)].

TABLE 105A (Continued)

WAVEFORMS	FREQUENCY	TEST POINT	P-P VOLTAGE
	47 Hz	Base (Q6)*	4.0
	47 Hz	Coll. (Q5)*	8.0
	47 Hz	Coll. (Q6)*	5.0
	47 Hz	Coll. (Q7)	18.0
	47 Hz	Base (Q10)	1.35

* Q5 and Q6 waveforms may be reversed depending on phase of ADF signal [pin 7 (J1)].

4. LUBRICATION

A. SERVO AMPLIFIER-INDICATOR

(1) Lubrication of the servo amplifier-indicator gear train assembly is required at least every 1000 hours. Lubrication of the r-f resolver may be required whenever the resolver is overhauled.

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Remove the dust cover from the unit.	
(b) Apply one drop of Pioneer No. 11 oil to each felt washer of the gear train assembly while slowly rotating the gears.	Avoid excess oil on gears.
(c) Remove the r-f resolver (if necessary) for lubrication.	
(d) Apply a light film of grease to r-f resolver shaft.	
(e) Spin the resolver shaft to distribute grease evenly.	Remove excess grease.
(f) Re-assemble and test the resolver.	

5. DISASSEMBLY

A. JOB/USE

(1) Disassembly of the system components is required to perform those procedures concerned with inspection, cleaning, adjustment, troubleshooting and repair.

NOTE

The following disassembly procedures apply only to the Receiver models 201A, A-1, B, B-1 and Servo Amplifier Indicator model 551A.

B. DISASSEMBLY PROCEDURE: RECEIVER (See Figure 301)

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(1) Remove Receiver Assembly From Dust Cover (2)	
(a) Rotate retaining cam (4) by turning retaining screw (3) until cam is horizontal and clear of dust cover.	
(b) Carefully withdraw receiver assembly from dust cover.	While withdrawing assembly from the dust cover, slightly "rock" chassis from side to side to release male connector (58) from female connector (64).
(2) Remove front panel assembly (21).	
(a) Loosen setscrews (6), (10), (14) and (18).	
(b) Remove four knobs (5), (9), (13) and (17) from front panel.	
(c) Remove all knob shims (7), (11), (15), (19) and washers (8), (12), (16) and (20) from panel.	
(d) Remove four screws (22) that secure front panel (21) to chassis (71).	

(e) Withdraw front panel from chassis.

(3) Remove tuning dial (24)

(a) Loosen two setscrews (25) that fasten dial (24) to shaft of tuning capacitor (52).

(b) Withdraw tuning dial from shaft.

(4) Remove band switch detent (42).

(a) Remove two screws (43) that fasten detent to chassis.

(b) Withdraw detent from chassis.

Withdraw detent shaft carefully through module assemblies to prevent possible damage to wafer switches.

(5) Remove module assemblies (44) through (47).

(a) Remove two screws (39) that fasten RF shield (38) to module strap (40).

(b) Remove the one screw (41) that fasten module retaining strap (40) to chassis (71).

(c) Withdraw strap from its mounting position.

(d) Unsolder attaching wires on module assemblies.

(e) Withdraw module assemblies from chassis.

(6) Remove printed circuit board assembly (48).

(a) Remove six screws (49) that secure printed circuit board assembly to chassis.

(b) Withdraw printed circuit board assembly through bottom of chassis.

(7) Remove CW oscillator module (50).

(a) Remove two screws (51) that fasten CW oscillator module to chassis.

(b) Withdraw CW oscillator module.

(8) Remove tuning capacitor (52).

(a) Remove four screws (52c) that secure tuning capacitor (52) to chassis (71).

(b) Unsolder attaching wires on tuning capacitor.

(c) Withdraw tuning capacitor from chassis.

5.

C. DISASSEMBLY PROCEDURE: 551A SERVO AMP-INDICATOR (See figure 306).

(1) Remove dust cover (1)

(a) Remove two screws that hold dust cover to chassis assembly (23).

(b) Remove dust cover from servo amp-indicator assembly.

(2) Remove front indicator bezel assembly (2) from mounting plate (17).

(a) Remove three screws and three washers, that secure indicator bezel assembly (2) to mounting plate (17).

(b) Pull indicator bezel assembly (2) away from mounting plate (17). Chassis assembly (23) will be freed from its mounting place.

(3) Remove r-f resolver (19).

(a) Remove two screws, two washers, and two mounting clamps (20 that fasten resolver to mounting plate (17).

(b) Remove resolver (19) by first loosening the two set screws in gear (18).

(4) Remove motor (8).

(a) Remove two screws securing motor to mounting plate (17).

(b) Withdraw motor.

(5) Remove glass assembly (3).

Release retaining ring (4) and carefully withdraw glass (3) and frame gasket (5) from bezel (2).

(6) Remove pointer (7).

Remove pointer from gear shaft (19) by means of gear extracting tool. Pointer (7) is press fitted on shaft of resolver (19)and may be removed by using a suitable gear extracting tool.

(7) Remove dial (6).

(a) Remove two screws that secure dial to mounting plate (17).

(b) Withdraw dial.

(8) Remove gears (13) and (9).

(a) Withdraw spur reduction gear (13) by removing washer (16), washer (15) and retaining ring (14).

(b) Carefully withdraw reduction gear (13) from mounting plate (17).

(c) Withdraw spur reduction gear (9) from mounting plate (17) by removing washer (12) spacer (11) and retaining ring (10).

D. DISASSEMBLY PROCEDURE: 551B REMOTE GONIO-SYNCHRO (See figure 307).

(1) Remove dust cover (1).

(a) Remove two screws that hold dust cover to chassis assembly (26).

(b) Remove dust cover from gonio-synchro assembly.

(2) Remove r-f resolver (20).

(a) Remove three screws that secure chassis assembly (26) to mounting plate (19).

(b) Pull chassis assembly away from mounting plate and remove two screws, two washers, and two mounting clamps (21) that fasten resolver to mounting plate (19).

(c) Remove resolver (20) by first loosening the two set screws (each) in gears (22) and (23).

(3) Remove motor (10).

(a) Remove two screws securing motor to mounting plate (19).

(b) Withdraw motor.

(4) Remove synchro transmitter (7).

NOTE: Neither r-f resolver (20) nor motor (10) need be removed in order to remove sychro (7).

(a) Remove two screws that hold dust cover (4) to the posts attached to mounting plate (19).

(b) Pull dust cover (4) away from bezel (2) and remove two screws, two washers, and two mounting clamps (8) that fasten synchro to mounting plate (6).

(c) Remove synchro by first loosening the two setscrews in gear (9).

(5) Remove gears (15) and (11).

(a) Remove two posts securing mounting plate (6) to mounting plate (19) and withdraw mounting plate (6).

(b) Withdraw spur reduction gear (15) by removing washer (18), washer (17) and retaining ring (16).

(c) Withdraw spur reduction gear (11) from mounting plate (19) by removing washer (14) spacer (13) and retaining ring (12).

E. DISASSEMBLY PROCEDURE: 551C DUAL SYNCHRO INDICATOR (See figure 308).

(1) Remove dust cover (1).

(a) Remove two screws that hold dust cover to frame (15).

(b) Remove dust cover from synchro indicator assembly.

(2) Remove synchro (14).

(a) Remove three screws that secure frame (15) and synchro (14) to housing (11).

(b) Loosen setscrew in coupling (13).

(c) Withdraw frame (15) and synchro (14) from housing (11).

(d) Remove three screws securing synchro (14) to frame (15).

(e) Withdraw synchro (14).

NOTE: Indicator bezel assembly (2), glass (3), gasket (4), pointers (5) and (6), dial (7) spacer (8), filler (9) and synchro (10) need not be removed unless one of these parts is to be replaced.

(3) Remove front indicator bezel assembly (2) from housing (11).

(a) Remove eight screws that secure indicator bezel assembly (2) to housing (11).

(b) Pull indicator bezel assembly (2) away from housing (11). Glass (3) and gasket (4) will be freed.

(4) Remove pointers (5) and (6).

Remove pointers from shafts by means of gear extracting tool. Pointers are press fitted on shafts and may be removed by using a suitable gear extracting tool.

(5) Remove dial (7), spacer (8) and filler (9).

(a) Remove two screws that secure dial to filler plate (9).

(b) Withdraw dial and spacer.

(c) Remove four screws that secure filler plate to housing (11).

(d) Withdraw filler plate.

(6) Remove synchro (10).

(a) Remove all assemblies in paragraphs (1) through (5) above.

(b) Remove shaft (12) and coupling (13) from synchro (10).

(c) Remove three screws securing synchro (10) to housing (11).

(d) Withdraw synchro (10).

F. DISASSEMBLY PROCEDURE: 551E SERVO AMP-INDICATOR (See Figure 309).

(1) Remove dust cover (1).

(a) Remove two screws that hold dust cover to chassis assembly (24).

(b) Remove dust cover from servo amp-indicator assembly.

(2) Remove synchro transmitter (25).

(a) Remove three screws and three washers that secure chassis assembly (24) to posts behind gear plate (27).

(b) Loosen setscrew in coupler (21).

(c) Remove two synchro mounting clamps (26).

(d) Withdraw synchro (25).

(3) Remove r-f resolver (19).

(a) Remove two screws, two washers, and two mounting clamps (20) that fasten resolver to mounting plate (17).

(b) Remove resolver (19) by first loosening the two set screws in gear (18).

(4) Remove motor (8).

(a) Remove two screws securing motor to mounting plate (17).

(b) Withdraw motor.

(5) Remove front indicator bezel assembly (2) from mounting plate (17).

(a) Remove three posts that secure indicator bezel assembly (2) to mounting plate (17).

(b) Pull indicator bezel assembly (2) away from mounting plate (17).

(6) Remove glass assembly (3).

Release retaining ring (4) and carefully withdraw glass (3) and frame gasket (5) from bezel (2).

(7) Remove pointer (7).

Remove pointer from gear shaft (19) by means of gear extracting tool. Pointer (7) is press fitted on shaft of motor (19) and may be removed by using may suitable gear extracting tool.

(8) Remove dial (6).

(a) Remove two screws that secure dial to mounting plate (17).

(b) Withdraw dial.

(9) Remove gears (13) and (9).

(a) Withdraw spur reduction gear (13) by removing washer (16), washer (15) and retaining ring (14).

(b) Carefully withdraw reduction gear (13) from mounting plate (17).

(c) Withdraw spur reduction gear (9) from mounting plate (17) by removing washer (12) spacer (11) and retaining ring (10).

G. DISASSEMBLY PROCEDURE: 551RL SERVO AMPLIFIER-INDICATOR (See figure 310).

(1) The procedure for the 551RL is similiar to the procedure for the 551A, however for lens or lamp replacement proceed as follows:

(a) Remove azimuth control knob.

(b) Remove three screws on face of instrument and lift off the retaining mask assembly.

(c) Remove four small screws holding the indice plate on the rear of the retaining mask assembly.

(d) Lift off the indice plate and contact ring assembly.

(e) The indicator lamps are mounted on the contact ring assembly.

CAUTION

LEAD LENGTHS MUST ALLOW LAMPS TO LOCATE IN THE LENS RECESS.

(2) To remove azimuth dial and gear plate assembly:

(a) Remove azimuth control knob.

(b) Remove two screws holding dust cover, and withdraw unit from dust cover.

(c) Remove three holding screws from rear of front bezel assembly.

(d) Hold the azimuth control shaft and lift off the entire front bezel assembly.

CAUTION

THE AZIMUTH CONTROL SHAFT IS NOT CAPTIVE IN THE FRONT BEZEL ASSEMBLY: AND WILL DROP OUT IF NOT HELD.

(e) Remove pointer assembly.

(f) Remove two screws holding the azimuth dial.

(g) Remove two screws holding the gear plate assembly to posts on the motor and gear train assembly.

6. REASSEMBLY

A. JOB/USE

Reassembly of the ADF Receiver is required after completion of those procedures concerned with inspection cleaning, adjustment, troubleshooting and repair.

B. REASSEMBLY PROCEDURE: RECEIVER (See Figure 301)

Reassembly procedures are the reverse of the disassembly procedures with the exceptions of the following special instructions.

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Tuning dial (24)	
1 Before mounting tuning dial onto shaft of tuning capacitor (52) unmesh tuning capacitor plates fully to minimum capacitance.	
2 Mount tuning dial on shaft of tuning capacitor, but do not tighten setscrews (25).	
3 Rotate tuning dial until the 850 kc mark, lines up with "lubber line" on glass of front panel (23).	
4 Tighten setscrews (25).	
(b) R-F shield (38)	
Make certain all R-F shield alignment holes line up properly over the tuning "slugs" of module assemblies.	
(c) Module assemblies (44) through (47)	
1 Make certain module assemblies are replaced in their proper order.	
2 Positions from left to right (facing R-F shield) are: loop module, rf module (balance modulator assembly attached), oscillator module and mixer module.	

C. REASSEMBLY PROCEDURE: SERVO AMPLIFIER-INDICATOR

Reassembly procedures are the reverse of disassembly procedures with the exception of the following special instructions.

DETAIL STEPS/WORK ITEMS	KEY ITEMS
(a) Mounting screws.	
Apply glyptal (G. E. type 1276 or equivalent) to all threaded fasteners where there are no other locking devices.	
(b) Gasket (4)	
Secure gasket in place with pliobond adhesive if necessary.	
(c) Gears	
1 If found necessary, apply a few drops of light instrument oil to felt washers between gears.	
2 Make certain gears engage smoothly upon replacement.	

DETAIL STEPS/WORK ITEMS KEY ITEMS

(d) Pointer

Tap pointer lightly until adequate fit is attained on shaft of rf resolver.

D. INSTALLATION OF CW OSCILLATOR KIT OPTION (part no. 2V017-01)

(1) Position the cw oscillator assembly (item 54, figure 302) at rear of the tuner chassis (item 78) next to connector J1 (item 65) and secure in position using two sheet metal screws (item 55).

(2) Solder the black wire from the assembly (item 54) to pin 9 of J1 (item 65).

(3) Solder the red wire from the assembly (item 54) to terminal 1 of function switch (item 39); terminal 1 is physically located at the six o' clock position on the switch wafer.

(4) Solder the green wire from the assembly (item 54) to the junction of R30, R31, C47, and on the printed circuit board shown in figure 305.

(5) Turn the mode switch on the front panel fully clockwise (one step beyond the REC position).

(6) Attach the CW label to the front panel in line with the index mark on the mode switch knob.

(7) On the rear panel, near the nameplate, stencil or otherwise indelibly and legibly print the following:

KIT 2V017-01 ADDED. EQUIVALENT AND INTERCHANGEABLE WITH 201D ADF RECEIVER

INTRODUCTION

This Illustrated Parts List contains a complete list of parts for each of the separate units comprising the ADF-T-12B/C.

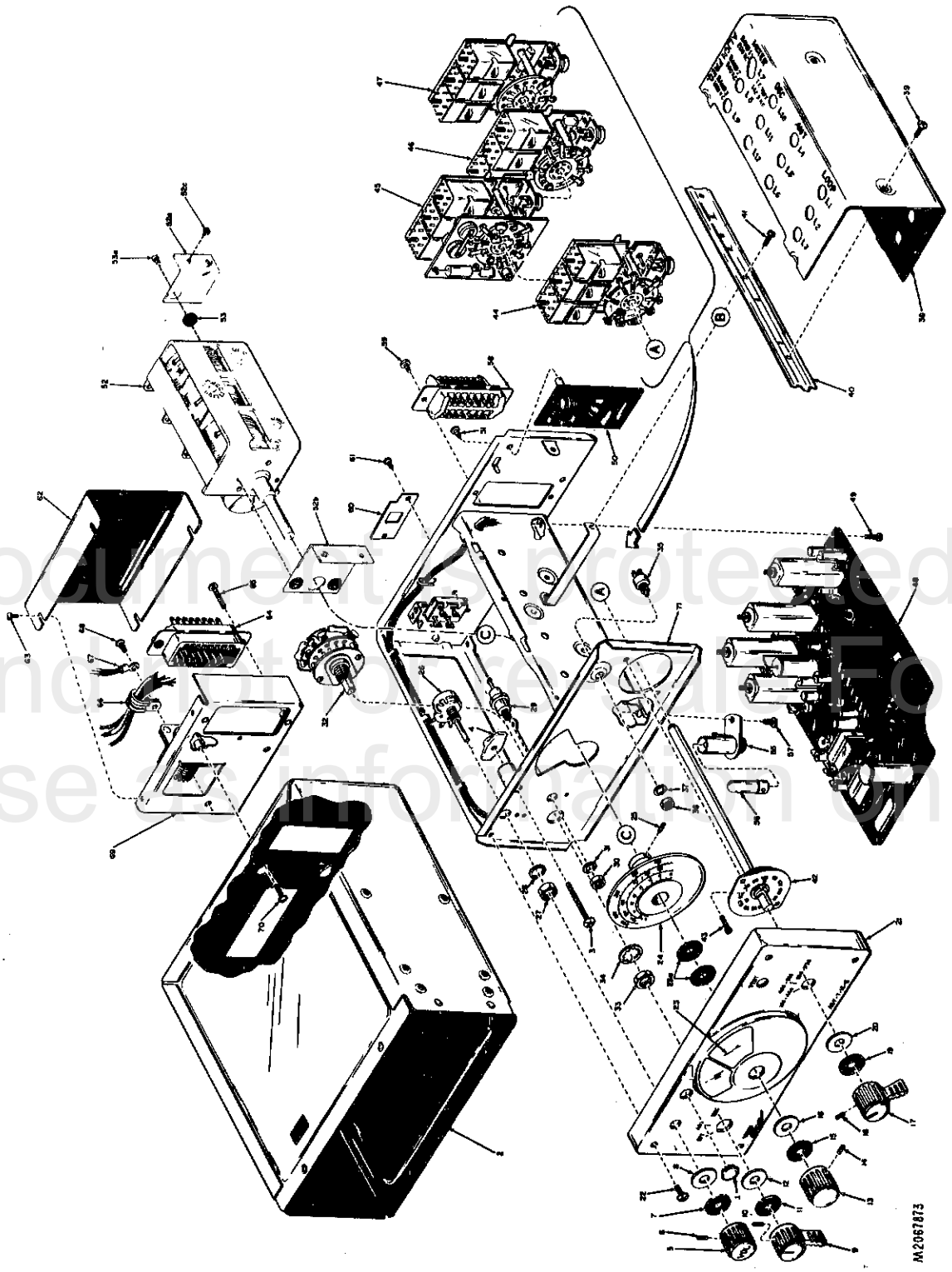
The Mechanical Parts List consists of a breakdown of the complete unit into subassemblies and detailed parts. Each assembly is listed in its order of disassembly. Immediately following each assembly are the listings of the component parts of the assembly.

Electrical components of subassemblies listed in the Mechanical Parts List are identified in the Electrical Parts List.

A "Used On" code identifies subassembly and component differences between the various configurations of ADF receivers. The code is as follows:

A, used on 201A
B, used on 201B
C, used on 201C
D, used on 201D
E, used on 201A-1
F, used on 201B-1

LIST OF FIGURES



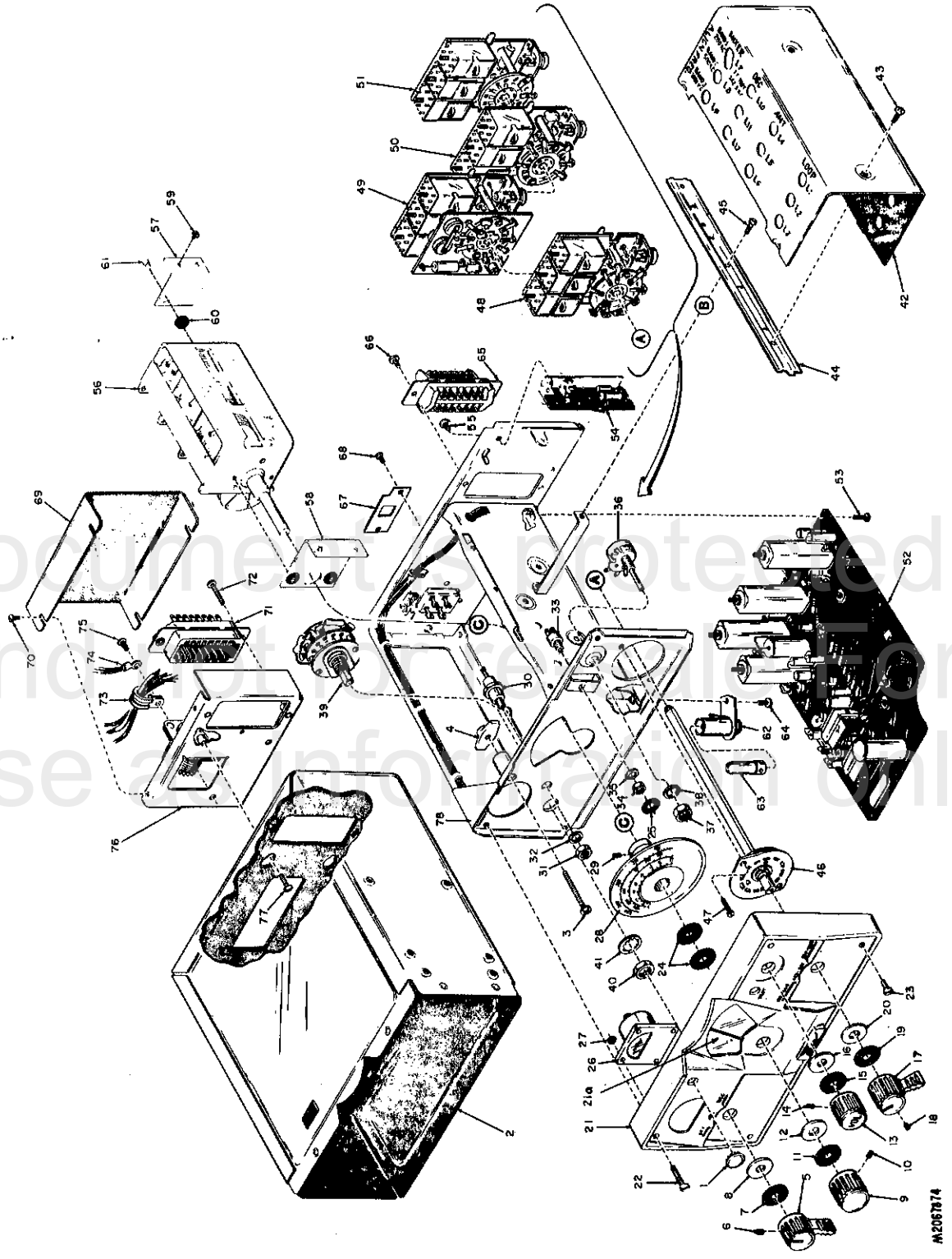
201A/201A-1/201B/201B-1 ADF Receiver,
Exploded View
Figure 301

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	301	RECEIVER,MODEL 201A		A	1U022-01
		RECEIVER,MODEL 201B		B	1U022-02
		RECEIVER,MODEL 201A-1		E	1U022-03
		RECEIVER,MODEL 201B-1		F	1U022-04
	1	BUTTON PLUG	1		59A009-01
	2	COVER,TUNER	1		60D-15-01
	3	SCREW,MACHINE,PH PAN HEAD	1		S46030-08-20B
	4	CAM,RETAINING	1		S39005-01
	5	KNOB,VOLUME	1		75C005-04
	6	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	7	WASHER,FELT 1/8ID	1		S36016-03
	8	SHIM,1/8ID X 5/8OD	1		S36005-21
	9	KNOB,LEVER	1		75B006-01
	10	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	11	WASHER,FELT 1/4ID	1		S36016-01
	12	SHIM 1/4ID X 5/8OD	1		S36005-22
	13	KNOB,TUNING	1		75B002-01
	14	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	15	WASHER,FELT 1/4ID	1		S36016-01
	16	SHIM,1/4ID X 5/8OD	1		S36005-22
	17	KNOB,LEVER	1		75B006-01
	18	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	19	WASHER,FELT 1/4ID	1		S36016-01
	20	SHIM,1/4ID X 5/8OD	1		S36005-22
	21	PANEL,FRONT	1		63C028-01
	22	SCREW,MACHINE,PH PAN HEAD	4		S46030-04-06B
	23	WINDOW,DIAL	1		78B002-01
	23A	WASHER,FELT 1/4ID	2		S36016-C1
	24	DIAL	1		78D003-01
	25	SETSCREW NO.6-32 X 1/8	2		S46006-62
	26	RESISTOR,VARIABLE VOL. CONTROL 50K	1		S11026-29
	27	NUT P/O CONTROL	1		
	28	WASHER P/O CONTROL	1		
CR13	29	DIODE,ZENER 10M9,1Z10	1		S12002-100
	30	NUT,HEX NO. 10-32	1		2089386-2304
	31	WASHER,INTERNAL TOOTH LOCK	1		AN936-A-10
	32	SWITCH,FUNCTION	1		S22014-001
	33	NUT P/O SWITCH	1		
	34	WASHER,INT.TOOTH LOCK P/O SWITCH	1		
	35	SWITCH,PUSHBUTTON	1		S22020-03
	36	NUT P/O SWITCH	1		
	37	WASHER P/O SWITCH	1		
	38	SHIELD,RF MODULE	1		60C014-01
	39	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	40	STRAP,MODULE RETAINING	1		62B025-01
	41	SCREW,PH PAN HEAD NO.4 X 1/4	3		S46042-04-04
	42	DETENT ASSEMBLY	1		91B002-01
	43	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	44	MODULE,LOOP ASSEMBLY	1		1V022-99-1
	45	MODULE,RF ASSY	1	EF	1V022-98-1
	45	MODULE,RF ASSY	1	AB	1V022-98-2
	46	MODULE,OSC ASSY	1	EF	1V022-97-1
	46	MODULE,OSC ASSY	1	AB	1V022-97-2
	47	MODULE,MIXER ASSEMBLY	1	EF	1V022-96-1
	47	MODULE,MIXER ASSEMBLY	1	AB	1V022-96-2
	48	ASSY,PRINTED CIRCUIT BOARD	1		1V022-94-1
	49	SCREW,PH PAN HEAD NO.4 X 1/4	6		S46042-04-04
	50	ASSEMBLY,CW OSCILLATOR	1		1V022-87-1

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	51	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	52	CAPACITOR,VAR. AIR DIELECTRIC (TUNING)	1	AB	S10096-01
	52	CAPACITOR,VAR. AIR DIELECTRIC (TUNING)	1	EF	S10118-01
	52A	BRACKET,CAPACITOR MOUNTING (REAR)	1		62B239-01
	52B	BRACKET,CAPACITOR MOUNTING (FRONT)	1		62B239-02
	52C	SCREW,PH PAN HEAD NO.4 X 3/16	4		S46030-04-03B
	53	MOUNT,NEOPRENE	3		S40004-03
	53A	STUD,MOUNTING	3		66A017-01
	54	NOT USED			
	55	SOCKET,PILOT LIGHT	1		S21009-03
	56	BULB,28V	1		S21014-02
		BULB,14V	1		S21014-04
	57	SCREW,PH PAN HEAD NO.4 X 1/4	1		S46042-04-04
	58	CONNECTOR,16 PIN	1		S24045-16P
	59	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	60	KEY,VOLTAGE SWITCH	1		63A038-01
	61	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	62	COVER,CONNECTOR	1		60B002-01
	63	SCREW,PH PAN HEAD NO.4 X 1/4	4		S46042-04-04
	64	CONNECTOR	1		S24045-16S
	65	SCREW,PH PAN HEAD NO.4 X 5/6	2		S46062-04-05
	66	CLAMP	1		S33016-N7
	67	LUG,SOLDER	1		51777
	68	SCREW,PH PAN HEAD NO.6 X 1/4	1		S46042-06-04
	69	BRACKET,CONNECTOR MOUNTING	1		62C032-01
	70	SCREW,PH PAN HEAD NO.6 X 1/4	2		S46042-06-04
	71	CHASSIS,TUNER	1		61R022-01



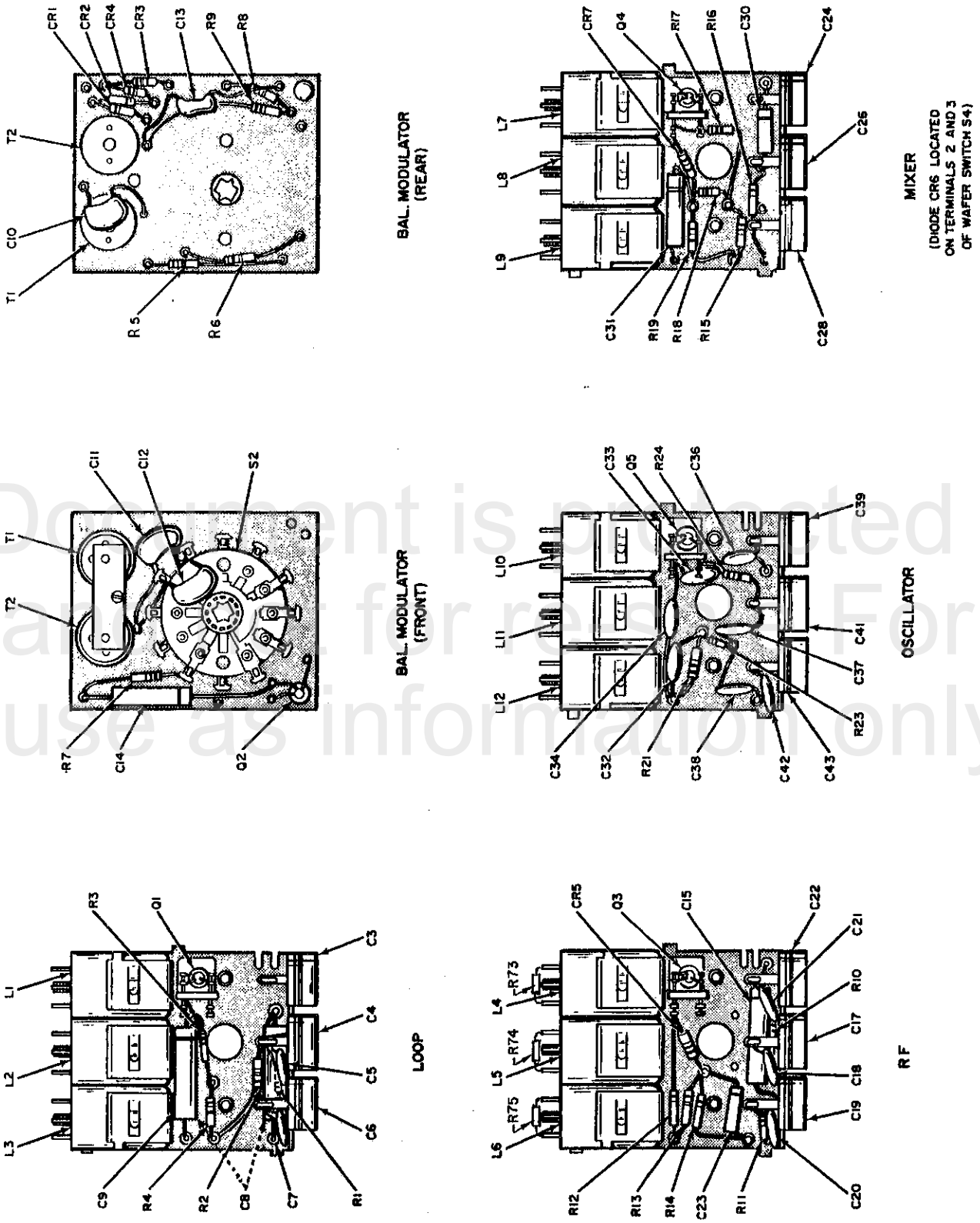
201C/201D ADF Receiver, Exploded View
Figure 302

MECHANICAL PARTS LIST

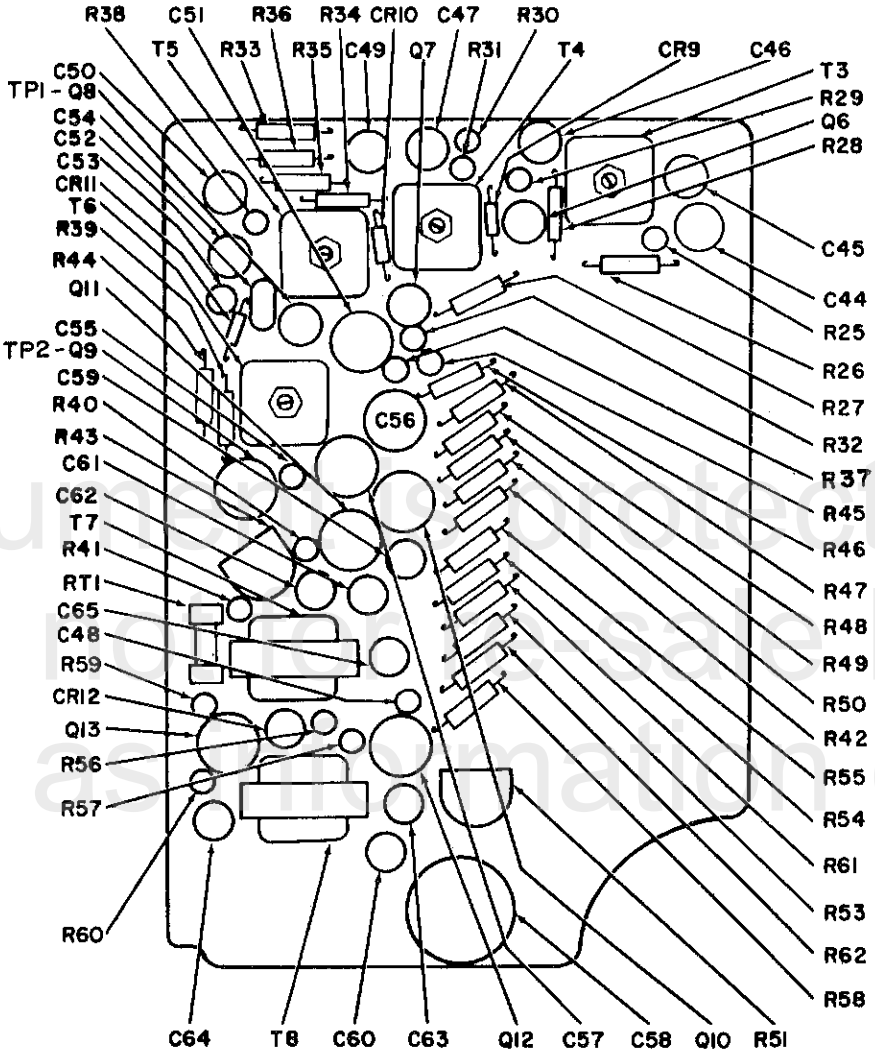
REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	302	RECEIVER,MODEL 201C	1	C	1U022-05
		RECEIVER,MODEL 201D	1	D	1U022-06
	1	PLUG,BUTTON	1		S41003-09-B
	2	COVER,TUNER	1		60D-15-01
	3	SCREW,PH PAN HEAD NO.8-32 X 1-1/4	1		S46030-08-20B
	4	CAM,RETAINING	1		S39005-01
	5	KNOB,LEVER	1		75B006-01
	6	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	7	WASHER,FELT 1/4ID	1		S36016-01
	8	SHIM,1/4ID X 5/8OD	1		S36005-22
	9	KNOB,TUNING	1		75B002-01
	10	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	11	WASHER,FELT 1/4ID	1		S36016-01
	12	SHIM,1/4ID X 5/8OD	1		S36005-22
	13	KNOB,VOLUME	1		75C005-04
	14	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	15	WASHER,FELT 1/8ID	1		S36016-03
	16	SHIM,1/8ID X 5/8OD	1		S36005-21
	17	KNOB,LEVER	1		75B006-01
	18	SETSCREW NO.4-40 X 3/16	2		S46006-4C-3F
	19	WASHER,FELT 1/4ID	1		S36016-01
	20	SHIM,1/4ID X 5/8OD	1		S36005-22
	21	PANEL,FRONT		C	63E161-01
		PANEL,FRONT		D	63E161-02
	22	SCREW,PH PAN HEAD NO.4-40 X 5/8	2		S46030-04-10B
	23	SCREW,PH PAN HEAD NO.4-40 X 1/2	2		S46030-04-8B
	24	WASHER,FELT 1/4ID	2		S36016-01
	24A	WINDOW,FREQUENCY	1		78B007-01
	25	WASHER,NEOPRENE	1		S36017-17
	26	METER	1		2068097-0002
	27	PUSHNUT	2		S45030-02
	28	DIAL	1		78D003-01
	29	SETSCREW NO.6-32 X 1/8	2		46006-6C2P
CR13	30	DIODE,ZENER 10M9,1Z10	1		S12002-100
	31	NUT,HEX NO.10-32	1		2089386-2304
	32	LOCKWASHER,INTERNAL TOOTH	1		AN936-A10
	33	SWITCH,PUSHBUTTON	1		S22020-03
	34	NUT,HEX (NOT AVAILABLE SEPARATELY P/O ITEM 33)	1		
	35	WASHER (NOT AVAILABLE SEPARATELY P/O ITEM 33)	1		
	36	RESISTOR,VARIABLE,VOL. CONTROL 50K	1		S11026-30
	37	NUT,HEX (NOT AVAILABLE SEPARATELY P/O ITEM 36)	1		
	38	WASHER (NOT AVAILABLE SEPARATELY P/O ITEM 36)	1		
	39	SWITCH,FUNCTION	1		S22014-001
	40	NUT,HEX (NOT AVAILABLE SEPARATELY P/O ITEM 39)	1		
	41	LOCKWASHER,INTERNAL TOOTH (NOT AVAILABLE SEPARATELY P/O ITEM 39)	1		
	42	SHIELD,RF MODULE	1		60C014-01
	43	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	44	STRAP,MODULE RETAINING	1		62B025-01
	45	SCREW,PH PAN HEAD NO.4 X 1/4	3		S46042-04-04
	46	DETENT ASSEMBLY	1		91B002-01
	47	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	48	MODULE,LOOP ASSEMBLY	1		1V022-99-1
	49	MODULE,RF ASSEMBLY	1		1V022-98-1
	50	MODULE,OSCILLATOR ASSEMBLY	1		1V022-97-1
	51	MODULE,MIXER ASSEMBLY	1		1V022-96-1
	52	PRINTED CIRCUIT BOARD ASSEMBLY	1		1V022-94-1
	53	SCREW,PH PAN HEAD NO.4 X 1/4	6		S46042-04-04
	54	CW OSCILLATOR ASSEMBLY P/O CW OSC KIT P/N2V017-01	1		1V022-87-1
	55	SCREW NO.4 X 1/4 P/O CW OSC KIT P/N2V017-01	2		S46042-04-04
	56	CAPACITOR,VAR. AIR DIELECTRIC (TUNING)	1		10118-01
	57	BRACKET,CAPACITOR MOUNTING (REAR)	1		628239-01
	58	BRACKET,CAPACITOR MOUNTING (FRONT)	1		628239-02
	59	SCREW,PH PAN HEAD NO.4 X 3/16	4		S46042-04-03
	60	MOUNT,NEOPRENE	3		S40004-03
	61	STUD,MOUNTING	3		66A017-01
	62	SOCKET,PILOT LIGHT	1		S21009-03
	63	BULB,28V	1		S21014-02
		BULB,14V	1		S21014-04
	64	SCREW,PH PAN HEAD NO.4 X 1/4	1		S46042-04-04
	65	CONNECTOR,16 PIN	1		S24045-16P
	66	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	67	KEY,VOLTAGE SWITCH	1		4003265-0001
	68	SCREW,PH PAN HEAD NO.4 X 1/4	2		S46042-04-04
	69	COVER,CONNECTOR	1		608002-01
	70	SCREW,PH PAN HEAD NO.4 X 1/4	4		S46042-04-04
	71	CONNECTOR	1		S24045-16S
	72	SCREW,PH PAN HEAD NO.4 X 5/16	2		S46042-04-05
	73	CLAMP	1		S33016-N7
	74	LUG,SOLDER	1		51777
	75	SCREW,PH PAN HEAD NO.6 X 1/4	1		S46042-06-04
	76	BRACKET,CONNECTOR MOUNTING	1		62C032-01
	77	SCREW,PH PAN HEAD NO.6 X 1/4	2		S46042-06-04
	78	CHASSIS,TUNER	1		61R025-01



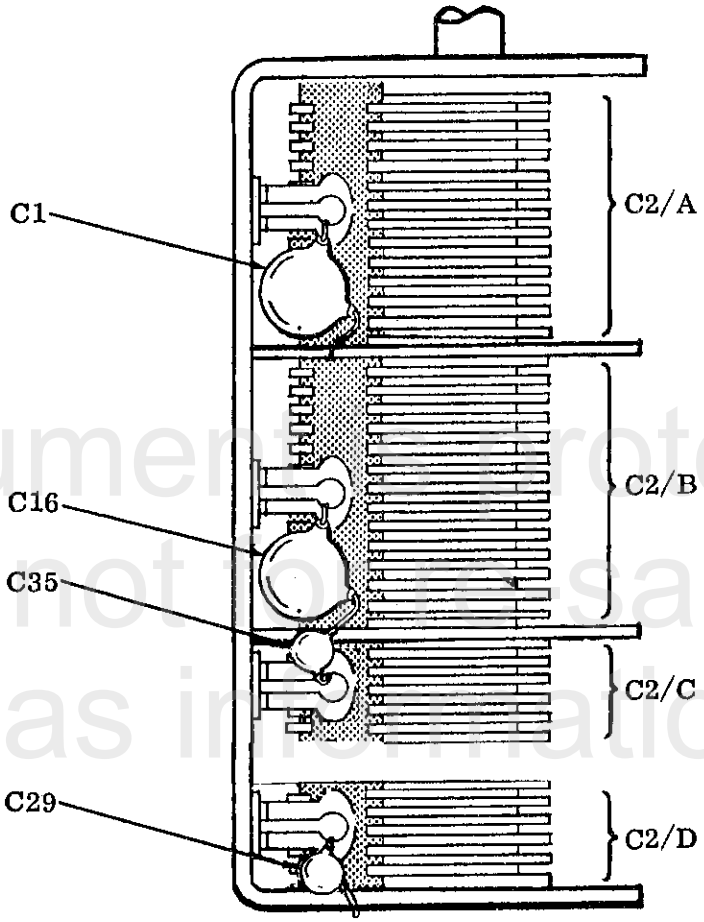
R. F. Modules, Layout Diagram
Figure 303



WARNING

This manual which you have requested is furnished for general information purposes only. Service bulletins which supplement this manual are only furnished to Bendix authorized FAA approved repair stations. DO NOT USE THIS MANUAL FOR EFFECTUATING REPAIRS OF THE EQUIPMENT.

ADF Receiver Tuning Capacitor,
Layout Diagram
Figure 304



ADF Receiver Printed Circuit Board,
Layout Diagram
Figure 305

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	CAPACITORS		
C1	36UF P/M10% 500 WVDC TYPE N220 CERAMIC		S10041-RB-36K
C2A/B/C/D	12.6-452UUF VARIABLE AIR TRIMMER	AB	S10096-01
C2A/B/C/D	12.6-452UUF VARIABLE AIR TRIMMER	CDEF	S10118-01
C3	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C4	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C5	22UUF P/M10% 500 WVDC CERAMIC		S10041-CB-22K
C6	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C7	27UUF P/M2% 500 WVDC SILVER MICA		S10041-CB-27K
C8	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C9	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C10	570UUF P/M5% 500 WVDC SILVER MICA		S10087-C-571J3
C11	160UUF P/M5% 500 WVDC SILVER MICA		S10087-C-161J3
C12	100UUF P/M5% 500 WVDC SILVER MICA		S10087-C-101J3
C13	240UUF P/M5% 500 WVDC SILVER MICA		S10087-C-241J3
C14	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C15	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C16	12UUF P/M10% 500 WVDC TYPE N750 CERAMIC		S10041-UA-12K
C17	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C18	12UUF P/M10% 500 WVDC CERAMIC		S10041-CA-12K
C19	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C20	22UUF P/M10% 500 WVDC CERAMIC		S10041-CB-22K
C21	43UUF P/M10% 500 WVDC SILVER MICA		S10087-C-430G3
C22	8-50UUF P/M.015 VARIABLE CERAMIC TRIMMER		S10115-06
C23	.01UF P/M10% 100 WVDC MYLAR		S10171-10
C24	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C25	22UUF P/M10% 500 WVDC CERAMIC	AB	S10041-CB-22K
C26	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C27	22UUF P/M10% 500 WVDC CERAMIC	AB	S10041-CB-22K
C28	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C29	5UUF P/M10% 500 WVDC TYPE N750 CERAMIC	CDEF	S10041-UA-5K
C29	43UUF P/M10% 500 WVDC CERAMIC	AB	S10041-RD-43K
C30	.015UF P/M10% 100 WVDC MYLAR		S10171-03
C31	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C32	200UUF P/M10% 500 WVDC SILVER MICA	AB	S10087-C-201K3
C32	.022UF P/M10% 500 WVDC SILVER MICA	CDEF	2088942-0002
C33	140UUF P/M2% 500 WVDC SILVER MICA	CDEF	S10087-C-141J3
C33	43UUF P/M10% 500 WVDC SILVER MICA	AB	S10087-C-430K3
C34	300UUF P/M10% 500 WVDC SILVER MICA	AB	S10087-C-301G3
C35	5UUF P/M10% 500 WVDC TYPE N750 CERAMIC	CDEF	S10041-UA-5K
C35	8.2UUF P/M2% 500 WVDC CERAMIC	AB	S10041-UH-SR2C
C36	390UUF P/M2% 500 WVDC SILVER MICA	CDEF	S10087-C-391G3
C36	680UUF P/M2% 30 WVDC SILVER MICA	AB	S10087-C-681G3
C37	910UUF P/M2% 500 WVDC SILVER MICA	CDEF	S10087-C-911G1
C37	1700UUF P/M2% 500 WVDC SILVER MICA	AB	S10088-C-172G3
C38	1800UUF P/M2% 500 WVDC SILVER MICA	CDEF	S10088-C-182G3
C38	3600UUF P/M2% 300 WVDC SILVER MICA	AB	S10088-C-362G3
C39	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C40	22UUF 500 WVDC CERAMIC	AB	S10041-CB-22K
C41	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C42	33UUF P/M2% 500 WVDC SILVER MICA	AB	S10087-C-330G3
C43	5-30UUF VARIABLE CERAMIC TRIMMER		S10115-05
C44	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C45	10UF 10 WVDC ELECTROLYTIC		S10183-10R15
C46	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C47	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C48	39UF P/M20% 10 WVDC TANTALUM		S10183-39R15
C49	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C50	0.1UF P/M10% 100 WVDC MYLAR		S10171-02

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
C51	.47UF P/M10% 100 WVDC MYLAR		S10171-04
C52	750UUF P/M10% 500 WVDC SILVER MICA		S10087-C-751K3
C53	1.0UF P/M20% 20 WVDC TANTALUM		2088201-0003
C54	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C55	39UF P/M20% 10 WVDC TANTALUM		S10183-39R15
C56	0.1UF P/M10% 100 WVDC MYLAR		S10171-02
C57	10UF 10 WVDC ELECTROLYTIC		S10183-10R15
C58	1000UF M10% P100% TANTALUM		10049-0002
C59	.022UF P/M20% 100 WVDC MYLAR		S10171-05
C60	2.2UF P/M10% 10 WVDC TANTALUM		S10183-2R210
C61	6.8UF M10% P150% 25 WVDC		51083-6R815
C62	.047UF P/M10% 100 WVDC MYLAR		S10171-06
C63	.047UF P/M10% 100 WVDC MYLAR		S10171-06
C64	.047UF P/M10% 100 WVDC MYLAR		S10171-06
C65	10UF 10 WVDC ELECTROLYTIC		S10183-10R15
C66	.0068UF P/M10% 100 WVDC MYLAR	BDF	S10083-13
C67	.033UF P/M20% 100 WVDC MYLAR	BDF	S10083-01
C68	2UF 25 WVDC ELECTROLYTIC	BF	S10002-2-25S
C68	3UF 25 WVDC ELECTROLYTIC	D	S10002-3-25S
	DIODES		
CR1	GERMANIUM		S12004-01
CR1	1N914 EFF. S/N30500 201C, S/N28900 201D	CD	12040-0003
CR2	GERMANIUM		S12004-01
CR2	1N914 EFF. S/N30500 201C, S/N28900 201D	CD	12040-0003
CR3	GERMANIUM		S12004-01
CR3	1N914 EFF. S/N30500 201C, S/N28900 201D	CD	12040-0003
CR4	GERMANIUM		S12004-01
CR4	1N914 EFF. S/N30500 201C, S/N28900 201D	CD	12040-0003
CR5	GERMANIUM		S12004-01
CR5	1N117 EFF. S/N30500 201C, S/N28900 201D	CD	12041-0037
CR6	SILICON HD4418	AB	S12002-098
CR7	GERMANIUM		S12004-01
CR7	1N117 EFF. S/N30500 201C, S/N28900 201D	CD	12041-0037
CR8	NOT USED		
CR9	GERMANIUM		S12004-01
CR9	1N117 EFF. S/N30500 201C, S/N28900 201D	CD	12041-0037
CR10	GERMANIUM		S12004-01
CR10	1N117 EFF. S/N30500 201C, S/N28900 201D	CD	12041-0037
CR11	GERMANIUM		S12004-01
CR11	1N117 EFF. S/N30500 201C, S/N28900 201D	CD	12041-0037
CR12	1N2326		S12002-063
CR13	10M9,1Z10,ZENER		S12002-100
	LAMPS		
DS1	AIRCRAFT 14V		S21014-04
DS1	AIRCRAFT 28V		S21014-02

201( ) ADF RECEIVER

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	CONNECTORS		
K1	16 PIN RIBBON CONNECTOR		S24045-16P
	INDUCTORS		
L1	RF ASSEMBLY		90D029-01
L2	RF ASSEMBLY		90D029-05
L3	RF ASSEMBLY		90D029-09
L4	RF ASSEMBLY		90D029-02
L5	RF ASSEMBLY		90D029-06
L6	RF ASSEMBLY		90D029-10
L7	RF ASSEMBLY	CDEF	90D029-13
L7	RF ASSEMBLY	AB	90D029-03
L8	RF ASSEMBLY	CDEF	90D029-15
L8	RF ASSEMBLY	AB	90D029-07
L9	RF ASSEMBLY	CDEF	90D029-17
L9	RF ASSEMBLY	AB	90D029-11
L10	RF ASSEMBLY	CDEF	90D029-14
L10	RF ASSEMBLY	AB	90D029-04
L11	RF ASSEMBLY	CDEF	90D029-16
L11	RF ASSEMBLY	AB	90D029-08
L12	RF ASSEMBLY	CDEF	90D029-18
L12	RF ASSEMBLY	AB	90D029-12
	TRANSISTORS		
Q1	2N1637		S12001-055
Q1	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q2	2N1637		S12001-055
Q2	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q3	2N1637		S12001-055
Q3	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q4	2N1637		S12001-055
Q4	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q5	2N2654	CDEF	S12001-083
Q5	2N1639	AB	S12001-057
Q6	2N1638		S12001-056
Q6	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q7	2N1638		S12001-056
Q7	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q8	2N1638		S12001-056
Q8	MPS6516 EFF. S/N30500 201C, S/N28900 201D	CD	12048-0015
Q9	2N1304		S12001-053
Q10	2N1193		S12001-064
Q11	SA-279		S12001-072
Q12	SA-279		S12001-072
Q13	SA-279		S12001-072
Q14	2N1193		S12001-064

ELECTRICAL PARTS LIST

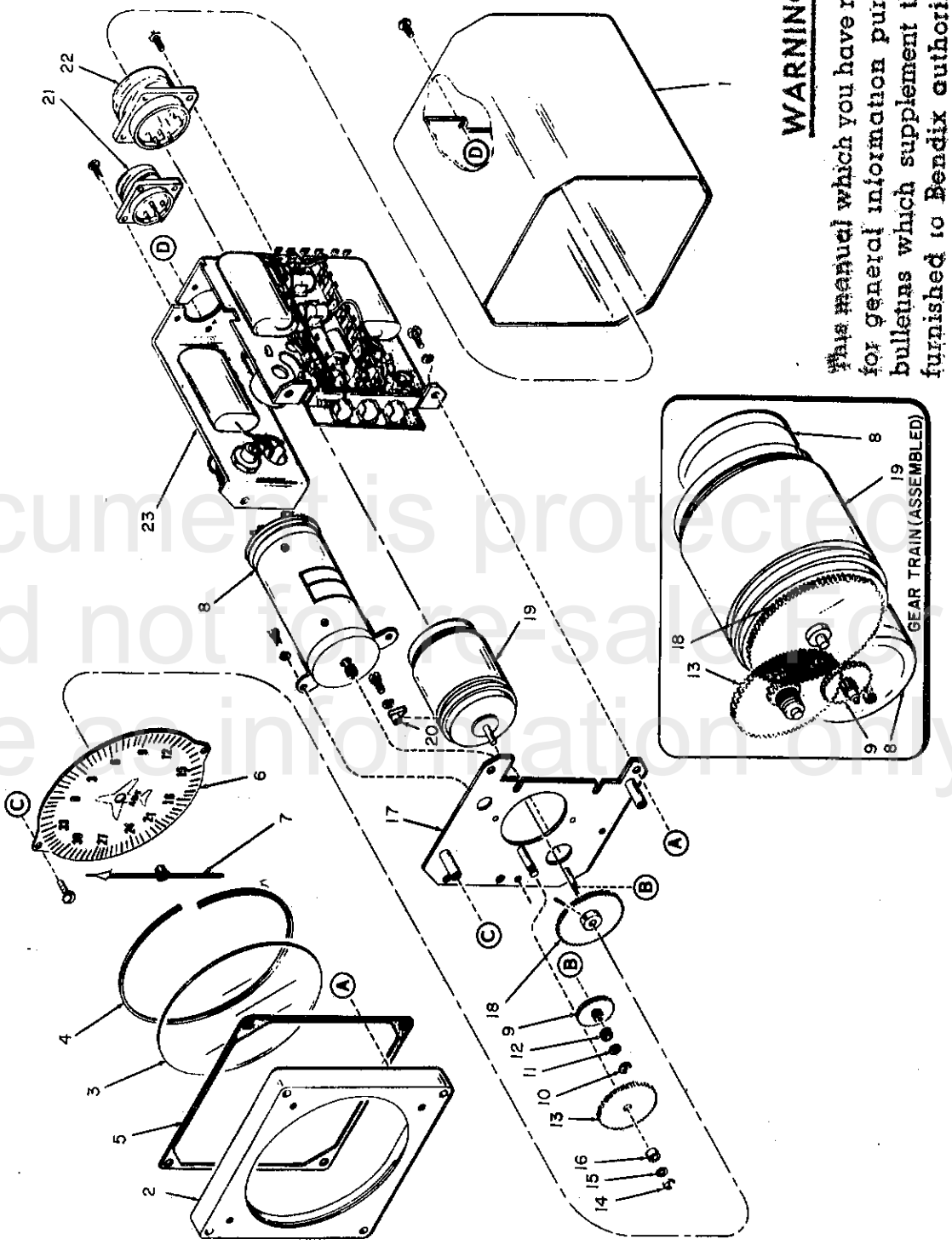
REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	RESISTORS		
R1	3.3K OHMS P/M10% 1/4W COMPOSITION		S11011-332K
R2	3.3K OHMS P/M10% 1/4W COMPOSITION		S11011-332K
R3	82 OHMS P/M10% 1/4W COMPOSITION		S11011-820K
R4	4.7K OHMS P/M10% 1/4W COMPOSITION		S11011-472K
R4	3.0K OHMS P/M5% 1/4W COMPOSITION EFF. S/N30500 201C, S/N28900 201D	CD	RC07GF302J
R5	3.9K OHMS P/M10% 1/4W COMPOSITION		S11011-392K
R5	2.7K OHMS P/M5% 1/4W COMPOSITION EFF. S/N30500 201C, S/N28900 201D	CD	RC07GF272J
R6	3.9K OHMS P/M10% 1/4W COMPOSITION		S11011-392K
R6	2.7K OHMS P/M5% 1/4W COMPOSITION EFF. S/N30500 201C, S/N28900 201D	CD	RC07GF272J
R7	3.3K OHMS P/M10% 1/4W COMPOSITION		S11011-332K
R8	3.3K OHMS P/M10% 1/4W COMPOSITION		S11011-332K
R9	1K OHM P/M10% 1/4W COMPOSITION		S11011-102K
R10	47K OHMS P/M10% 1/4W COMPOSITION		S11011-473K
R11	2.2K OHMS P/M10% 1/4W COMPOSITION		S11011-222K
R12	10K OHMS P/M10% 1/4W COMPOSITION		S11011-103K
R13	10K OHMS P/M10% 1/4W COMPOSITION		S11011-103K
R14	27K OHMS P/M10% 1/4W COMPOSITION		S11011-273K
R15	68K OHMS P/M10% 1/4W COMPOSITION		S11011-683K
R16	27K OHMS P/M10% 1/4W COMPOSITION		S11011-273K
R17	15K OHMS P/M10% 1/4W COMPOSITION		S11011-153K
R18	10K OHMS P/M10% 1/4W COMPOSITION		S11011-103K
R19	120K OHMS P/M10% 1/4W COMPOSITION		S11011-124K
R20	33K OHMS P/M10% 1/4W COMPOSITION	CDEF	S11011-333K
R21	12K OHMS P/M10% 1/4W COMPOSITION	CDEF	S11011-123K
R21	22K OHMS P/M10% 1/4W COMPOSITION	AB	S11011-223K
R22	3.3 OHMS P/M5% 1/4W COMPOSITION EFF. S/N30500 201C, S/N28900 201D	CD	RC07GF3R3J
R23	1.5K OHMS P/M10% 1/4W COMPOSITION		S11011-152K
R24	180 OHMS P/M10% 1/4W COMPOSITION	CDEF	S11011-181K
R24	3.9K OHMS P/M10% 1/4W COMPOSITION	AB	S11011-392K
R25	47K OHMS P/M10% 1/2W COMPOSITION		S11012-473K
R26	2.2K OHMS P/M10% 1/2W COMPOSITION		S11012-222K
R27	10K OHMS P/M10% 1/2W COMPOSITION		S11012-103K
R28	10K OHMS P/M10% 1/2W COMPOSITION		S11012-103K
R29	22K OHMS P/M10% 1/2W COMPOSITION		S11012-223K
R30	47K OHMS P/M10% 1/2W COMPOSITION		S11012-473K
R31	2.2K OHMS P/M10% 1/2W COMPOSITION		S11012-222K
R32	10K OHMS P/M10% 1/2W COMPOSITION		S11012-103K
R33	10K OHMS P/M10% 1/2W COMPOSITION		S11012-103K
R34	56K OHMS P/M10% 1/2W COMPOSITION		S11012-563K
R35	6.8K OHMS P/M10% 1/2W COMPOSITION		S11012-682K
*R35	3.9K OHMS P/M10% 1/4W COMPOSITION EFF. S/N30500 201C, S/N28900 201D	CD	RC07GF392K
R36	1K OHMS P/M10% 1/2W COMPOSITION		S11012-102K
R37	330 OHMS P/M10% 1/2W COMPOSITION		S11012-331K
R38	6.8K OHMS P/M10% 1/2W COMPOSITION		S11012-682K
R39	15K OHMS P/M10% 1/2W COMPOSITION		S11012-153K
R40	1K OHMS P/M10% 1/2W COMPOSITION		S11012-102K
R41	4.7K OHMS P/M10% 1/2W COMPOSITION		S11012-472K
R42	8.2K OHMS P/M10% 1/2W COMPOSITION		S11012-822K
R43	25K OHMS P/M10% 1/2W VARIABLE		S11058-05
R44	150 OHMS P/M10% 1/2W COMPOSITION		S11012-151K
R45	2.2K OHMS P/M10% 1/2W COMPOSITION		S11012-222K
R46	1K OHMS P/M10% 1/2W COMPOSITION		S11012-102K
R46	150 OHMS P/M10% 1/2W COMPOSITION EFF. S/N30775 201C, S/N29002 201D	CD	11012-151K

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
R47	33K OHMS P/M10% 1/2W COMPOSITION		S11012-333K
R48	10K OHMS P/M10% 1/2W COMPOSITION		S11012-103K
R49	820 OHMS P/M10% 1/2W COMPOSITION	CDEF	S11012-821K
R49	1.8K OHMS P/M10% 1/2W COMPOSITION	AB	S11012-182K
R50	1K OHMS P/M10% 1/2W COMPOSITION		S11012-102K
R51	2K OHMS P/M10% 1/2W VARIABLE		S11058-02
R51	500 OHMS P/M10% 1/2W VARIABLE EFF. S/N31109 201C, S/N21194 201D	CD	S11058-01
R52	50K OHMS P/M10% 1/2W VARIABLE MINIATURE	ABEF	S11026-29
R52	50K OHMS P/M10% 1/2W VARIABLE MINIATURE	CD	S11026-30
R53	6.8K OHMS P/M10% 1/2W COMPOSITION		S11012-682K
R54	270 OHMS P/M10% 1/2W COMPOSITION		S11012-271K
R55	27 OHMS P/M10% 1/2W COMPOSITION		S11012-270K
R56	1.5K OHMS P/M10% 1/2W COMPOSITION		S11012-152K
R57	47K OHMS P/M10% 1/2W COMPOSITION		S11012-473K
R58	10 OHMS P/M10% 1/2W COMPOSITION		S11012-100K
R59	10 OHMS P/M10% 1/2W COMPOSITION		S11012-100K
R60	47K OHMS P/M10% 1/2W COMPOSITION		S11012-473K
R61	1.5K OHMS P/M10% 1/2W COMPOSITION		S11012-152K
R62	10K OHMS P/M10% 1/2W COMPOSITION		S11012-103K
R63	2.2K OHMS P/M10% 1/4W COMPOSITION		S11011-222K
R64	2.2K OHMS P/M10% 1/4W COMPOSITION		S11011-222K
R65	22K OHMS P/M10% 1/4W COMPOSITION		S11011-223K
R66	20 OHMS P/M10% 3W WW		S11040-200K
R67	50 OHMS P/M5% 3W WW		S11040-500J
R68	50 OHMS P/M5% 3W WW		S11040-500J
R69	NOT USED		
R70	NOT USED		
R71	470K OHMS P/M10% 1/4W COMPOSITION	CDEF	S11011-474K
R72	68K OHMS P/M10% 1/4W COMPOSITION EFF. S/N29506 201C, S/N27823 201D	CD	RC07GF683K
R73	470K OHMS P/M5% 1/4W COMPOSITION ADDED EFF. S/N31239 201C S/N29210 201D	CD	RC07GF474J
R74	270K OHMS P/M5% 1/4W COMPOSITION ADDED EFF. S/N31239 201C, S/N29210 201D	CD	RC07GF274J
R75	270K OHMS P/M5% 1/4W COMPOSITION ADDED EFF. S/N31239 201C, S/N29210 201D	CD	RC07GF274J
R90	270K OHMS P/M5% 1/4W COMPOSITION EFF. S/N30500 201C, S/N28900 201D	CD	RC07GF274J
	THERMISTORS		
RT1	2700 OHMS P/M10% 1/2W COMPOSITION		S11015-F272K07
	SWITCHES		
S1/A/B/C	SWITCH, WAFER		S22015-01
S2/B	SWITCH, WAFER		S22015-01
S3/A/B/C	SWITCH, WAFER		S22015-01
S4/A/B/C	SWITCH, WAFER		S22015-01
S5/A/B/C	SWITCH, WAFER		S22015-01
S6	SWITCH, PUSHBUTTON		S22020-01
S7	SWITCH, FUNCTION		S22014-001
S8	SWITCH, SLIDE, DPDT		S22013-03

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	TRANSFORMERS		
T1	RF		90D042-01
T2	RF		90D042-01
T3	IF INTERSTAGE		90D069-01
T4	IF INTERSTAGE		90D069-01
T5	IF INTERSTAGE		90D069-01
T6	IF OUTPUT		90D031-01
T7	AUDIO		90A027-01
T8	500 OHMS OUTPUT		90A026-01
T9	DO-T22		S17190-22



551A Servo Amplifier-Indicator, Exploded View
Figure 306

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	306	SERVO AMP INDICATOR,MODEL 551A			1U027-01
	1	COVER, INDICATOR			60B031-0001
		BEZEL ASSEMBLY			4006709-0501
	2	BEZEL, INDICATOR			70C019-0001
	3	GLASS, DISC			49002-0002
	4	RING, GLASS RETAINING			62B037-0002
	5	GASKET, FRAME			81C014-0001
		GEAR TRAIN AND DIAL ASSEMBLY			1V027-97-1
	6	DIAL, GONIOMETER			63C062-0001
	7	POINTER ASSEMBLY			63B064-0001
		MOTOR AND GEAR TRAIN ASSEMBLY			86C009-0001
		MOTOR AND GEAR TRAIN ASSEMBLY EFFECTIVE S/N28227 AND ABOVE			4007177-0501
B1	8	MOTOR			86C009-0501
		END CAP ASSEMBLY, FRONT -P/O ITEM 8-			86C009-0509
		END CAP ASSEMBLY, REAR -P/O ITEM 8-			86C009-0510
B1	8A	MOTOR ASSEMBLY			4004554-0501
		MOTOR EFF. S/N28127 AND ABOVE -P/O ITEM 8A-			4004554-0001
		END CAP ASSEMBLY,REAR -P/O MOTOR-			4004554-0002
		P.C. BOARD ASSEMBLY -P/O ITEM 8A-			4007098-0001
	9	GEAR, SPUR REDUCTION			86C009-0503
	9	GEAR, SPUR REDUCTION EFFECTIVE S/N28227 AND ABOVE			4004542-0001
	10	RING, RETAINING			36001-0003
	10	RING, RETAINING EFFECTIVE S/N28227 AND ABOVE			36001-003C
	11	WASHER, BRASS			86C009-0508
	11	WASHER, BRASS EFFECTIVE S/N28227 AND ABOVE			36017-0023
	12	WASHER, FELT			86C009-0506
	12	WASHER, FELT EFFECTIVE S/N28227 AND ABOVE			36016-0009
	13	GEAR, SPUR REDUCTION			86C009-0502
	13	GEAR, SPUR REDUCTION EFFECTIVE S/N28227 AND ABOVE			4004543-0001
	14	RING, RETAINING			36001-0006
	14	RING, RETAINING EFFECTIVE S/N28227 AND ABOVE			36001-006C
	15	WASHER, BRASS			86C009-0507
	15	WASHER, BRASS EFFECTIVE S/N28227 AND ABOVE			36017-0024
	16	WASHER, FELT			86C009-0505
	16	WASHER, FELT EFFECTIVE S/N28227 AND ABOVE			36016-0009
	17	PLATE, GEAR			86C009-0504
	17	PLATE, GEAR EFFECTIVE S/N28227 AND ABOVE			4006997-0501
	18	GEAR, RESOLVER			86C009-0500
	18	GEAR, RESOLVER EFFECTIVE S/N28227 AND ABOVE			4004545-0001
B2	19	RESOLVER, GONIOMETER			1V023-01

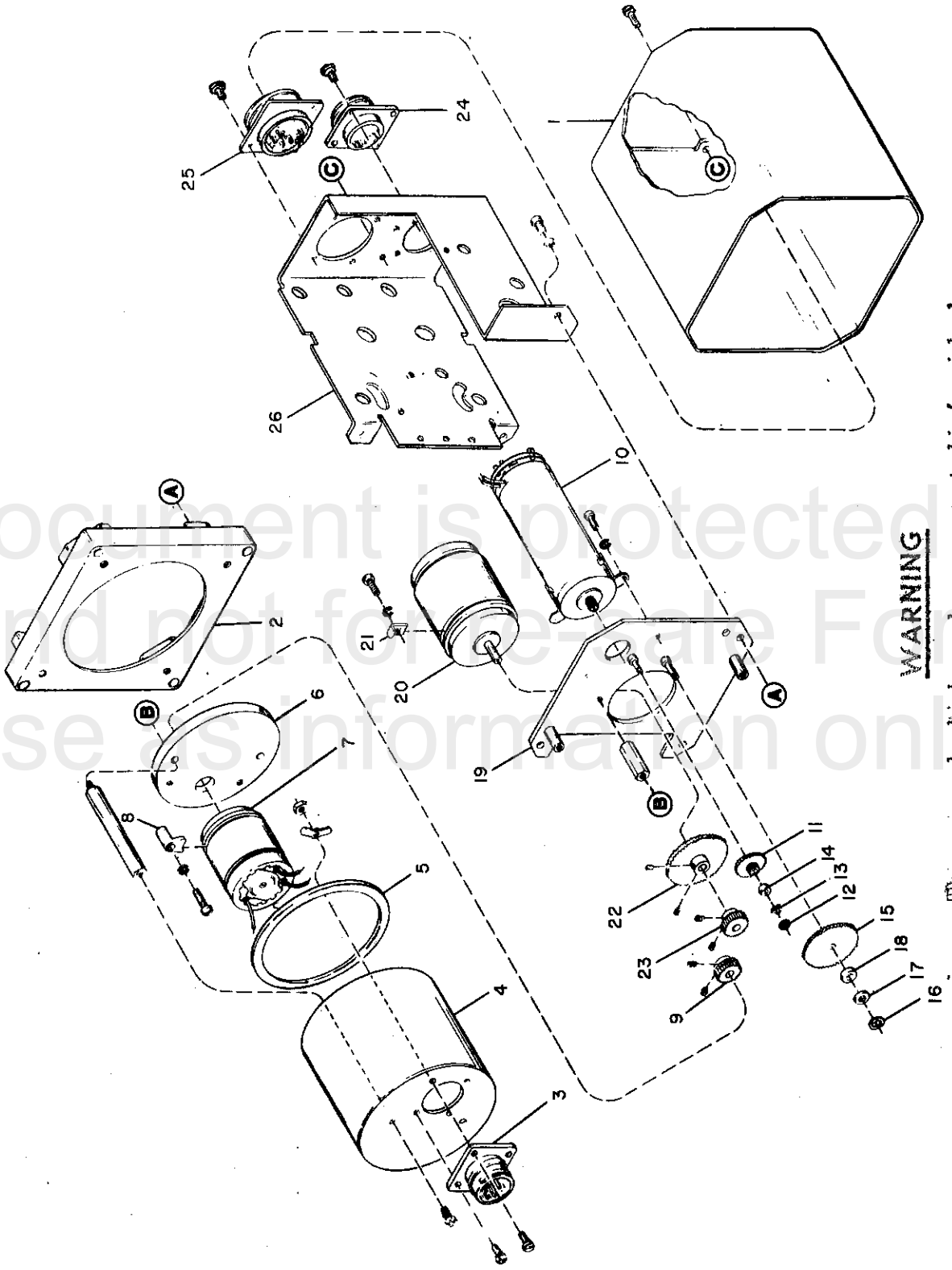
551A SERVO AMPLIFIER-INDICATOR

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	20	CLAMP, SYNCHRO MOUNTING	2		62C109-0004
J2	21	CONNECTOR WK-4-32S			24062-0010
J1	22	CONNECTOR GK-9-32S			24062-0001
	23	WIRED CHASSIS ASSEMBLY -INCLUDES COMPONENTS-			1V027-98-1
		GASKET, REAR -NOT ILLUSTRATED-			818021-0001
		SHIELD -NOT ILLUSTRATED-			63B164-0001

551B REMOTE GONIO-SYNCHRO

MECHANICAL PARTS LIST

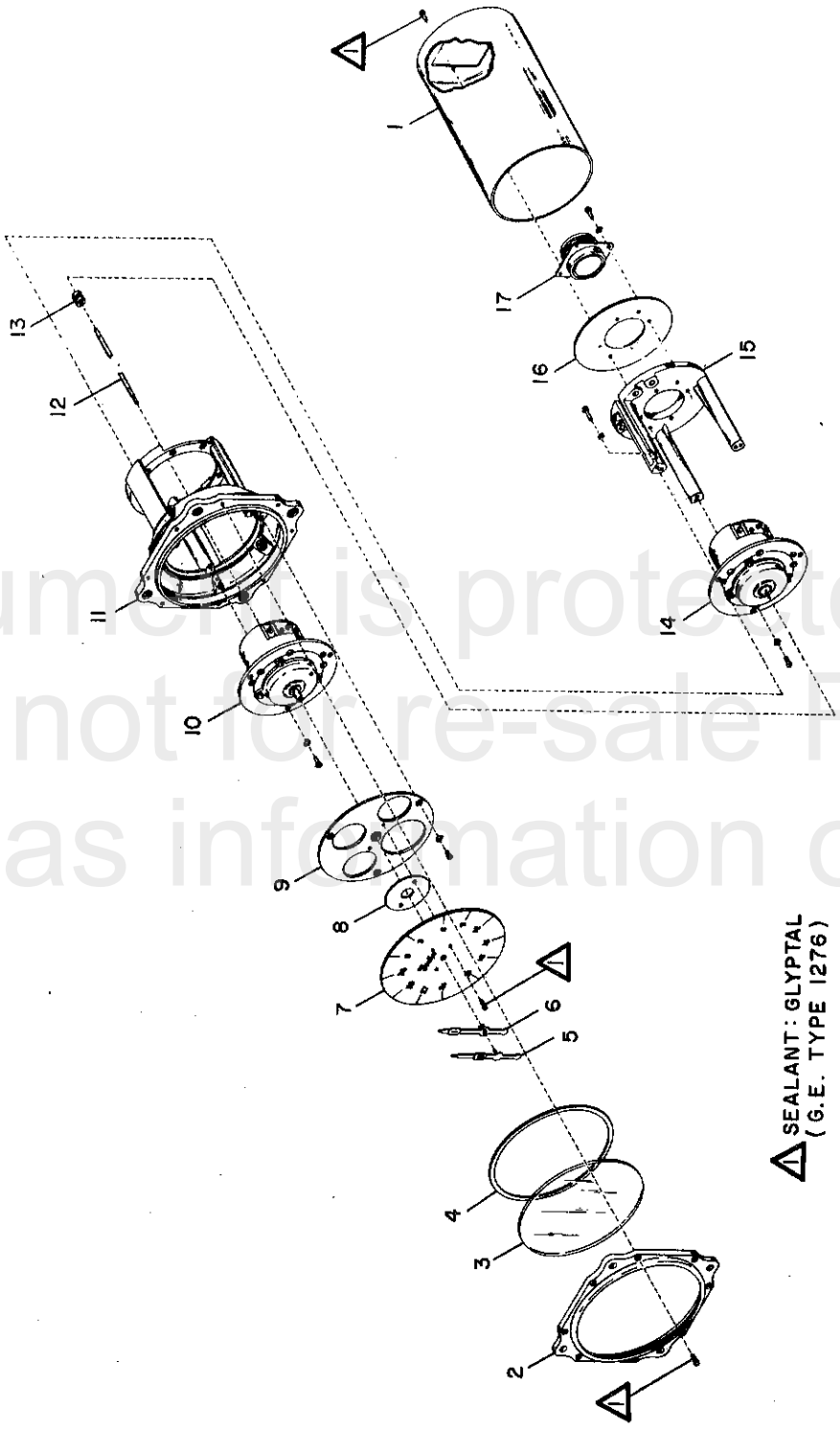


551B Remote Gonio-Synchro, Exploded View
Figure 307

551B REMOTE GONIO-SYNCHRO

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	307	REMOTE GONIO SYNCHRO,MODEL 551B			1U027-02
	1	COVER, INDICATOR			60B031-0001
	2	BEZEL			70C019-0001
J3	3	CONNECTOR			24062-0004
	4	COVER, SYNCHRO			60B049-0001
	5	GASKET, SYNCHRO COVER			81B055-0001
		SYNCHRO PLATE ASSEMBLY			4006715-0501
	6	PLATE, SYNCHRO MOUNTING	2		678033-0001
B3	7	SYNCHRO, TRANSMITTER			220908-0002
	8	CLAMP, SYNCHRO MOUNTING			33006-0005
	9	GEAR ASSEMBLY, ANTI-BACKLASH			1V027-95-1
		GEAR TRAIN AND GONIO ASSEMBLY			1V026-96-1
		MOTOR AND GEAR TRAIN ASSEMBLY			86C009-0001
B1	10	MOTOR			86C009-0501
		END CAP ASSEMBLY, FRONT -P/O ITEM 10			86C009-0509
		END CAP ASSEMBLY, REAR -P/O ITEM 10			86C009-0510
	10.	MOTOR EFFECTIVE S/N3791 AND ABOVE			4004554-0001
	11	GEAR, SPUR REDUCTION			86C009-0503
	12	RING, RETAINING			36001-0003
	13	WASHER, BRASS			86C009-0508
	14	WASHER, FELT			86C009-0506
	15	GEAR, SPUR REDUCTION			86C009-0502
	16	RING, RETAINING			36001-0006
	17	WASHER, BRASS			86C009-0507
	18	WASHER, FELT			86C009-0505
	19	PLATE, GEAR			86C009-0504
B2	20	RESOLVER, GONIOMETER			1V023-01
	21	CLAMP, SYNCHRO MOUNTING	2		62C109-0004
	22	GEAR, RESOLVER			86C009-0500
	23	GEAR, RESOLVER			68B055-0001
J2	24	CONNECTOR WK-4-32S			24062-0010
	25	CONNECTOR GK-9-32S			24062-0001
	26	WIRED CHASSIS ASSEMBLY			1V027-98-1
		-INCLUDES COMPONENTS-			
		GASKET, REAR -NOT ILLUSTRATED-			81B021-0001
		GASKET, FRAME -NOT ILLUSTRATED-			81C014-0001
		SHIELD -NOT ILLUSTRATED-			63B164-0001



551C Dual Synchro Indicator, Exploded View
Figure 308

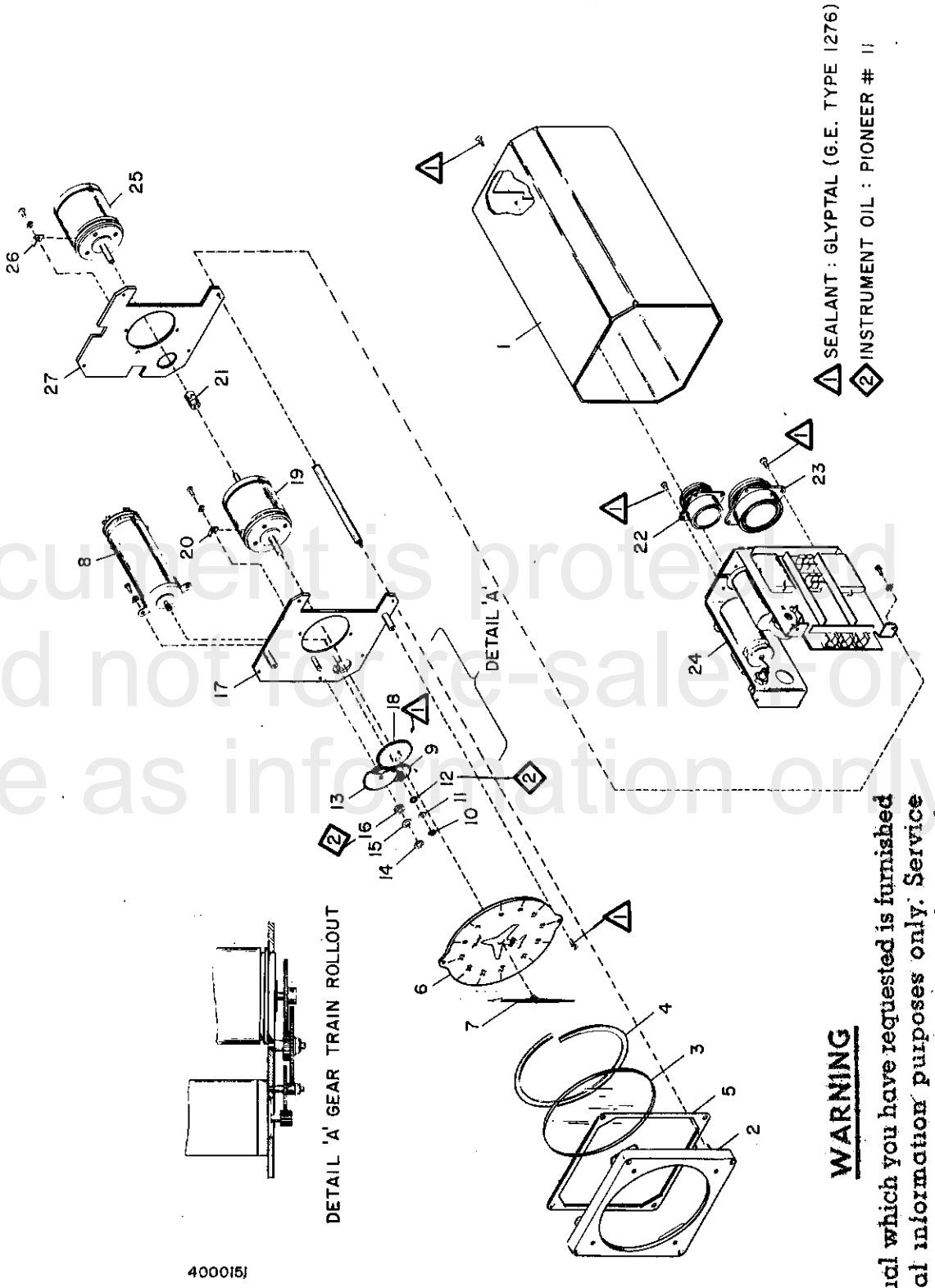
551C DUAL SYNCHRO INDICATOR

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	308	DUAL SYNCHRO INDICATOR,MODEL 551C			1U63938
	1	COVER			701056-0002
	2	BEZEL			716830-0001
	3	GLASS			716831-0001
	4	GASKET			716832-0001
	5	POINTER, NO.2 WHITE TIP			96919-0002
		POINTER, NO.2 GREEN TIP			96919-0004
	6	POINTER, NO.1 WHITE TIP			96919-0001
		POINTER, NO.1 GREEN TIP			96919-0003
	7	DIAL, WHITE MARKINGS			96729-0001
		DIAL, GREEN MARKINGS			96729-0002
	8	SPACER			716833-0001
	9	FILLER			716834-0001
	10	SYNCHRO ASSEMBLY			1V701057-02
	11	HOUSING			716835-0001
	12	SHAFT			716836-0001
	13	HUB, COUPLING			68A067-0001
	14	SYNCHRO ASSEMBLY			1V701057-02
	15	FRAME			716837-0001
	16	SEAL, FELT			716838-0001
	17	CONNECTOR			716839-0001

551E SERVO AMPLIFIER-INDICATOR

MECHANICAL PARTS LIST



551E Servo Amplifier-Indicator, Exploded View
Figure 309

WARNING

This manual which you have requested is furnished for general information purposes only. Service Bulletins which supplement this manual are only furnished to Bendix authorized FAA approved repair stations. DO NOT USE THIS MANUAL FOR EFFECTUATING REPAIRS OF THE EQUIPMENT.

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	309	SERVO AMP INDICATOR,MODEL 551E			4000062-0501
		WITH CABLE CONNECTOR 24061-0019			4000062-0502
	1	COVER, INDICATOR			60B031-0002
		BEZEL ASSEMBLY			4006709-0501
	2	BEZEL, INDICATOR			70C019-0001
	3	GLASS, DISC			49002-0002
	4	RING, GLASS RETAINING			62B037-0002
	5	GASKET, FRAME			81C014-0001
		GEAR TRAIN AND DIAL ASSEMBLY			1V027-97-3
	6	DIAL, GONIOMETER			63C062-0001
	7	POINTER ASSEMBLY			63B064-0001
		MOTOR AND GEAR TRAIN ASSEMBLY			86C009-0001
		MOTOR AND GEAR TRAIN ASSEMBLY			4007177-0501
		EFFECTIVE S/N3791 AND ABOVE			
B1	8	MOTOR			86C009-0501
		END CAP ASSEMBLY, FRONT			86C009-0509
		-P/O ITEM 8-			
		END CAP ASSEMBLY, REAR			86C009-0510
		-P/O ITEM 8-			
B1	8A	MOTOR ASSEMBLY			4004554-0501
		MOTOR			4004554-0001
		EFF. S/N3741 AND ABOVE			
		-P/O ITEM 8A-			
		END CAP ASSEMBLY,REAR			4004554-0002
		-P/O MOTOR-			
		P.C. BOARD ASSEMBLY			4007098-0001
		-P/O ITEM 8A-			
	9	GEAR, SPUR REDUCTION			86C009-0503
	9	GEAR, SPUR REDUCTION			4004542-0001
		EFFECTIVE S/N3791 AND ABOVE			
	10	RING, RETAINING			36001-0003
	10	RING, RETAINING			36001-003C
		EFFECTIVE S/N3791 AND ABOVE			
	11	WASHER, BRASS			86C009-0508
	11	WASHER, BRASS			36017-0023
		EFFECTIVE S/N3791 AND ABOVE			
	12	WASHER, FELT			86C009-0506
	12	WASHER, FELT			36016-0009
		EFFECTIVE S/N3791 AND ABOVE			
	13	GEAR, SPUR REDUCTION			86C009-0502
	13	GEAR, SPUR REDUCTION			4004543-0001
		EFFECTIVE S/N3791 AND ABOVE			
	14	RING, RETAINING			36001-0006
	14	RING, RETAINING			36001-006C
		EFFECTIVE S/N3791 AND ABOVE			
	15	WASHER, BRASS			86C009-0507
	15	WASHER, BRASS			36017-0024
		EFFECTIVE S/N3791 AND ABOVE			
	16	WASHER, FELT			86C009-0505
	16	WASHER, FELT			36016-0009
		EFFECTIVE S/N3791 AND ABOVE			
	17	PLATE, GEAR			86C009-0504
	17	PLATE, GEAR			4006997-0501
		EFFECTIVE S/N3791 AND ABOVE			
	18	GEAR, RESOLVER			86C009-0500
	18	GEAR, RESOLVER			4004545-0001
		EFFECTIVE S/N3791 AND ABOVE			

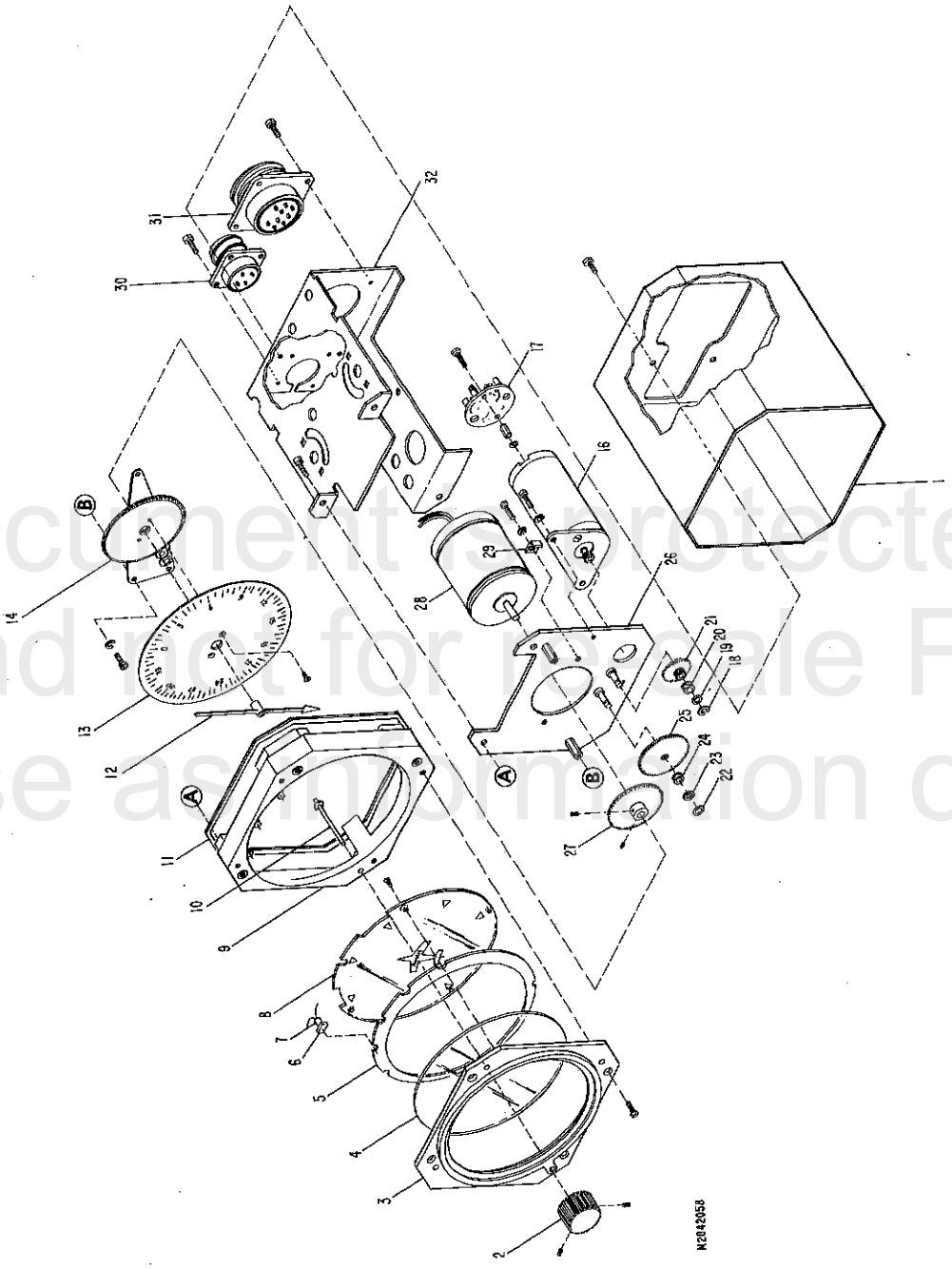
551E SERVO AMPLIFIER-INDICATOR

MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
B2	19	RESOLVER, GONIOMETER			1V023-03
	20	CLAMP, SYNCHRO MOUNTING	2		620109-0004
	21	COUPLING, FLEXIBLE			38001-0005
J2	22	CONNECTOR WK-4-32S			24062-0001
J1	23	CONNECTOR GK-12-32S			24062-0012
	24	WIRED CHASSIS ASSEMBLY -INCLUDES COMPONENTS-			1V027-98-2
		SYNCHRO PLATE ASSEMBLY			4006712-0501
	25	SYNCHRO, TRANSMITTER			220908-2
	26	CLAMP, SYNCHRO MOUNTING	2		620109-0004
	27	PLATE, GEAR			4002418-0001
		GASKET, REAR -NOT ILLUSTRATED-			818021-0001

551RL SERVO AMPLIFIER-INDICATOR

MECHANICAL PARTS LIST



551RL Servo Amplifier-Indicator, Exploded View
Figure 310

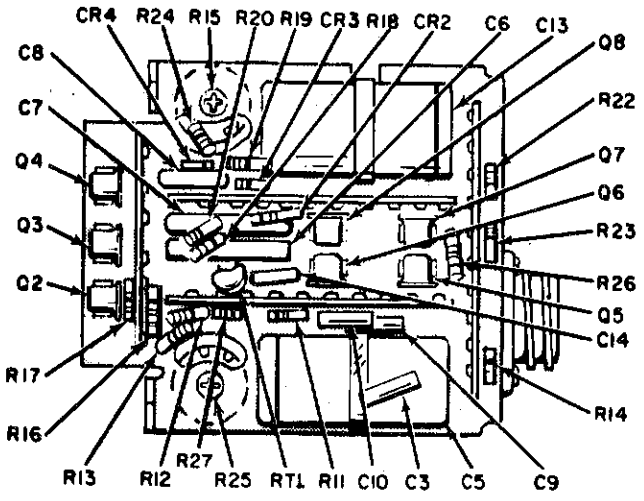
MECHANICAL PARTS LIST

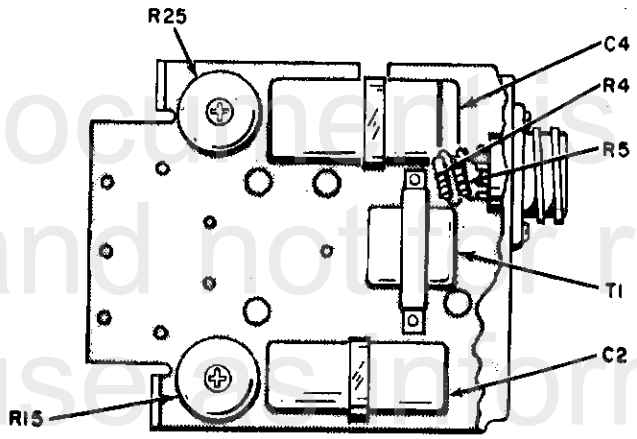
REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	3?0	SERVO AMP INDICATOR,MODEL 551RL			4000240-5101
	1	COVER,INDICATOR			608031-0001
	2	KNOB			4002419-0503
	3	MASK,BEZEL			4003284-0001
	4	LENS			4003285-0001
	5	RING,CONTACT			4003282-0001
	6	FILTER,LAMP	2		21024-0008
DS1-DS2	7	LAMP,INDICATOR	2		21023-0701
	8	PLATE,INDICE			4006654-0502
	9	BEZEL,INDICATOR -MOLDED ASSEMBLY-			4003279-0501
		RETAINING MASK ASSEMBLY			4006653-0501
	10	GEAR,PINION AND KNOB SHAFT			68B062-0001
	11	GASKET,FRAME			4003276-0001
		GEAR TRAIN AND DIAL ASSEMBLY			1V027-97-2
	12	POINTER ASSEMBLY			63B064-0002
	13	DIAL,ROTATABLE			4003278-0001
	14	PLATE,GEAR ASSEMBLY			87C006-0501
		MOTOR AND GEAR TRAIN ASSEMBLY			86C009-0002
		MOTOR AND GEAR TRAIN ASSEMBLY			4007177-0501
		EFFECTIVE S/N2724 AND ABOVE			
B1	15	MOTOR			86C009-0501
		END CAP ASSEMBLY,FRONT -P/O ITEM 15			86C009-0509
		END CAP ASSEMBLY,REAR -P/O ITEM 15			86C009-0510
	15A	MOTOR ASSEMBLY			4004554-0501
		EFFECTIVE S/N2674 AND ABOVE			
	16	MOTOR -P/O ITEM 15A-			4004554-0001
		EFFECTIVE S/N2674 AND ABOVE			
		END CAP ASSEMBLY,REAR -P/O ITEM 15A-			4004554-0002
	17	BOARD ASSEMBLY -P/O ITEM 15A-			4007098-0501
		EFFECTIVE S/N2674 AND ABOVE			
	18	RING,RETAINING			36001-0003
	18	RING,RETAINING			36001-003C
		EFFECTIVE S/N2724 AND ABOVE			
	19	WASHER,BRASS			86C009-0508
	19	WASHER,BRASS			36017-0023
		EFFECTIVE S/N2724 AND ABOVE			
	20	WASHER,FELT			86C009-0506
	20	WASHER,FELT			36016-0009
		EFFECTIVE S/N2724 AND ABOVE			
	21	GEAR,SPUR REDUCTION			86C009-0503
	21	GEAR,SPUR REDUCTION			4004542-0001
		EFFECTIVE S/N2724 AND ABOVE			
	22	RING,RETAINING			36001-0006
	22	RING,RETAINING			36001-006C
		EFFECTIVE S/N2724 AND ABOVE			
	23	WASHER,BRASS			86C009-0507
	23	WASHER,BRASS			36017-0024
		EFFECTIVE S/N2724 AND ABOVE			
	24	WASHER,FELT			86C009-0505
	24	WASHER,FELT			36016-0019
		EFFECTIVE S/N2724 AND ABOVE			
	25	GEAR,SPUR REDUCTION			86C009-0502
	25	GEAR,SPUR REDUCTION			4004543-0001
		EFFECTIVE S/N2724 AND ABOVE			
	26	PLATE,GEAR			86C009-0504
	26	PLATE,GEAR			4006997-0501
		EFFECTIVE S/N2724 AND ABOVE			

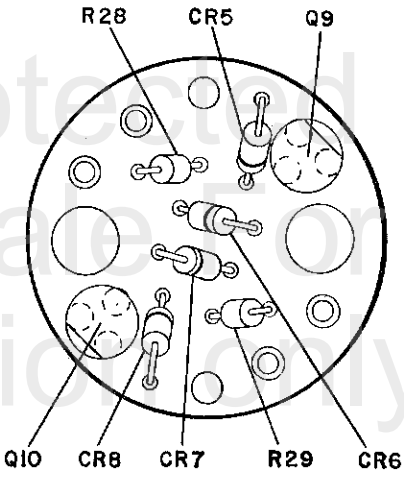
MECHANICAL PARTS LIST

REF DESIG	FIG ITEM	DESCRIPTION	UNITS PER ASSY	USED ON	BENDIX PART NUMBER
	27	GEAR,RESOLVER			86C009-0500
	27	GEAR,RESOLVER EFFECTIVE S/N2724 AND ABOVE			4004545-0001
R2	28	RESOLVER,GONIOMETER			1V023-01
	29	CLAMP, SYNCHRO MOUNTING			62C109-0004
J2	30	CONNECTOR WK-4-32S			24062-0010
J1	31	CONNECTOR GK-9-32S			24062-0001
	32	WIRED CHASSIS ASSEMBLY -INCLUDES COMPONENTS-			1V027-98-3
		GASKET, REAR			81B021-0001
		SHIELD			63B164-0001

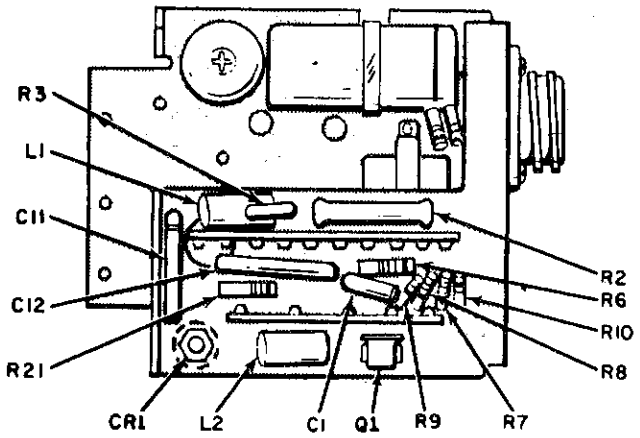
SERVO AMPLIFIER-INDICATOR
ELECTRICAL PARTS LIST







(PC BOARD P/N 4007098-0001
P/O MOTOR ASSEMBLY)



ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	311 MOTORS/ROTATING COMPONENTS		
B1	MOTOR (REF.)		
B2	GONIOMETER		1V023-01
B3	SYNCHRO TRANSMITTER (551B AND 551E ONLY)		220908-0002
	CAPACITORS		
C1	39UF P/M20% 10VDC TANTALUM		10098-0002
C2	1000UF P/M20% 10VDC ELECTROLYTIC		10049-0003
C3	39UF P/M20% 10VDC TANTALUM		10098-0002
C4	1.0UF P/M10% 200VDC MYLAR		10171-0007
C5	1.0UF P/M10% 200VDC MYLAR		10171-0007
C6	0.1UF P/M20% 200VDC MYLAR		10092-0004
C7	0.1UF P/M20% 200VDC MYLAR		10092-0004
C8	39UF P/M20% 10VDC TANTALUM		10098-0002
C9	39UF P/M20% 10VDC TANTALUM		10098-0002
C10	39UF P/M20% 10VDC TANTALUM		10098-0002
C11	0.068UF P/M20% 200VDC MYLAR		10171-0008
C12	0.068UF P/M20% 200VDC MYLAR		10171-0008
C13	1.5UF P/M20% 200VDC MYLAR		10171-0009
C14	39UF P/M20% 10VDC TANTALUM		10098-0002
C15	750UF P/M20% 10VDC ELECTROLYTIC		10101-0001
	DIODES		
CR1	1N2973A		12002-0100
CR2	1N645		2088156-0001
CR3	1N645		2088156-0001
CR4	1N645		2088156-0001
CR5	1N4003 ADDED EFF S/N28127 AND ABOVE (551A) ADDED EFF S/N3741 AND ABOVE (551E) ADDED EFF S/N2674 AND ABOVE (551RL)		12042-0031
CR6	1N4003 ADDED EFF S/N28127 AND ABOVE (551A) ADDED EFF S/N3741 AND ABOVE (551E) ADDED EFF S/N2674 AND ABOVE (551RL)		12042-0031
CR7	1N4003 ADDED EFF S/N28127 AND ABOVE (551A) ADDED EFF S/N3741 AND ABOVE (551E) ADDED EFF S/N2674 AND ABOVE (551RL)		12042-0031
CR8	1N4003 ADDED EFF S/N28127 AND ABOVE (551A) ADDED EFF S/N3741 AND ABOVE (551E) ADDED EFF S/N2674 AND ABOVE (551RL)		12042-0031
	CONNECTORS		
J1	GK-9-32S 9-PIN (EXCEPT 551E)		24062-0001
J1	GK-12-32S (551E ONLY)		24062-0012
J2	WK-4-32S 4-PIN		24062-0010
J3	WK-6-32S 6-PIN		24062-0004
	CHOKES		
L1	CHOKE		90A068-0001
L2	CHOKE		90A068-0001

SERVO AMPLIFIER-INDICATOR

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	TRANSISTORS		
Q1	2N1304		12046-0005
Q1	2N2222A		12051-0003
	EFFECTIVE MOD 4 S/N31778 (551A)		
	EFFECTIVE MOD 4 S/N3812 (551E)		
	EFFECTIVE MOD 4 S/N5445 (551RL)		
Q2	2N1193		12045-0025
Q3	2N1193		12045-0025
Q4	2N1193		12045-0025
Q5	SA319		12045-0083
Q5	2N1193		12045-0025
	ADDED EFFECTIVE S/N28127 AND ABOVE (551A)		
	ADDED EFFECTIVE S/N3741 AND ABOVE (551E)		
	ADDED EFFECTIVE S/N2674 AND ABOVE (551RL)		
Q6	SA319		12045-0083
Q6	2N1193		12045-0025
	ADDED EFFECTIVE S/N28127 AND ABOVE (551A)		
	ADDED EFFECTIVE S/N3741 AND ABOVE (551E)		
Q7	2N1191		12045-0027
	ADDED EFFECTIVE S/N2674 AND ABOVE (551RL)		
Q8	2N1191		12045-0027
Q9	2N3414		12047-0013
	ADDED EFFECTIVE S/N28127 AND ABOVE (551A)		
	ADDED EFFECTIVE S/N3741 AND ABOVE (551E)		
	ADDED EFFECTIVE S/N2674 AND ABOVE (551RL)		
Q10	2N3414		12047-0013
	ADDED EFFECTIVE S/N28127 AND ABOVE (551A)		
	ADDED EFFECTIVE S/N3741 AND ABOVE (551E)		
	ADDED EFFECTIVE S/N2674 AND ABOVE (551RL)		
	RESISTORS		
R1	NOT USED		
R2	75 OHMS P/M10% 7W WW		11047-750K
R3	25 OHMS P/M10% 3W WW		11040-250K
R4	4.7K OHMS P/M5% 1/4W COMPOSITION		11011-472J
R5	4.7K OHMS P/M5% 1/4W COMPOSITION		11011-472J
R6	150 OHMS P/M10% 1/2W COMPOSITION		11012-151K
R7	8.2K OHMS P/M10% 1/4W COMPOSITION		11011-822K
R8	470 OHMS P/M10% 1/4W COMPOSITION		11011-471K
R8	1K OHMS P/M5% 1/4W COMPOSITION		RC07GF102J
	EFFECTIVE MOD 4 S/N31778 (551A)		
	EFFECTIVE MOD 4 S/N3812 (551E)		
	EFFECTIVE MOD 4 S/N5445 (551RL)		
R9	100 OHMS P/M10% 1/4W COMPOSITION		11011-101K
R10	2.2K OHMS P/M10% 1/4W COMPOSITION		11011-222K
R11	2.7K OHMS P/M10% 1/4W COMPOSITION		11011-272K
R12	1.2K OHMS P/M10% 1/4W COMPOSITION		11011-122K
R13	180 OHMS P/M10% 1/4W COMPOSITION		11011-181K
R14	15K OHMS P/M10% 1/4W COMPOSITION		11011-153K
R15	2.2K OHMS P/M20% 2W VARIABLE		11063-0001
R16	10 OHMS P/M10% 1/2W COMPOSITION		11012-100K
R17	1K OHMS P/M10% 1/2W COMPOSITION		11012-102K
R18	2.2K OHMS P/M10% 1/4W COMPOSITION		11011-222K
R19	10 OHMS P/M10% 1/2W COMPOSITION		11011-100K
R20	2.2K OHMS P/M10% 1/4W COMPOSITION		11011-222K
R21	220 OHMS P/M10% 1/2W COMPOSITION		11012-221K

SERVO AMPLIFIER-INDICATOR

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
R22	2.2K OHMS P/M10% 1/4W COMPOSITION		11011-222K
R23	100 OHMS P/M10% 1/4W COMPOSITION		11011-101K
R24	330 OHMS P/M10% 1/4W COMPOSITION		11011-331K
R25	20 OHMS P/M20% 2W VARIABLE		11062-0001
R25	40 OHMS P/M20% 2W VARIABLE EFFECTIVE MOD 3 S/N31581 (551A) EFFECTIVE MOD 3 S/N3804 (551E) EFFECTIVE MOD 3 S/N5171 (551RL)		11062-0007
R26	20 OHMS P/M10% 1/2W COMPOSITION		11012-100K
R27	27KOHMS P/M10% 1/4W COMPOSITION		11011-273K
R28	4.7K OHMS P/M5% 1/4W COMPOSITION ADDED EFFECTIVE S/N28127 AND ABOVE (551A) ADDED EFFECTIVE S/N3741 AND ABOVE (551E) ADDED EFFECTIVE S/N2674 AND ABOVE (551RL)		RC07GF472J
R29	4.7K OHMS P/M5% 1/4W COMPOSITION ADDED EFFECTIVE S/N28127 AND ABOVE (551A) ADDED EFFECTIVE S/N3741 AND ABOVE (551E) ADDED EFFECTIVE S/N2674 AND ABOVE (551RL)		RC07GF472J
	THERMISTORS		
RT1	250 OHMS P/M10% DISC		11030-0001
	TRANSFORMERS		
T1	TRANSFORMER, OSCILLATOR		90A044-0001

102A/102B AUDIO AMPLIFIER

ELECTRICAL PARTS LIST

REF DESIG	DESCRIPTION	USED ON	BENDIX PART NUMBER
	AUDIO AMPLIFIER, MODEL 102A		10041-01
	AUDIO AMPLIFIER, MODEL 102B		10041-02
	CAPACITORS		
C1	500UF P/M10% 50VDC ELECTROLYTIC		10101-0004
C2	0.047UF P/M20% 100VDC MYLAR		10083-0030
	JACKS		
J1			24085-0003
	INDUCTORS		
L1	CHOKE, INPUT FILTER		90A067-01
	TRANSISTORS		
Q1	SP764 MODEL 102A ONLY		12001-0075
Q1	SP1141 MODEL 102B ONLY		12001-0082
Q2	SP764 MODEL 102A ONLY		12001-0075
Q2	SP1141 MODEL 102B ONLY		12001-0082
	RESISTORS		
R1	680 OHMS P/M10% 1/2W COMPOSITION		RC20GF681K
R2	680 OHMS P/M10% 1/2W COMPOSITION		RC20GF681K
R3	1.8 OHMS P/M10% 2W		11064-0005
R4	1.8 OHMS P/M10% 2W		11064-0005
	TRANSFORMERS		
T1	AUDIO DRIVER		93A066-01
T2	AUDIO DRIVER		90A065-01

GENERAL

This section contains schematic diagrams of Model 201( ) Receiver and its associated Model 551( ) Indicator and Model 2321E Fixed Loop Antenna.

NOTE

Refer to the schematic diagram issue letters contained in this section for the corresponding schematic issue letter stamped on the nameplate of the particular unit(s) of the ADF-T-12B, C System under test.

SUMMARY OF CHANGES TO

201A/201B/201A-1/201B-1 ADF RECEIVER, SCHEMATIC DIAGRAM
DRAWING NO. 3D042

SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
A	Changes made prior to release.		
B	Deleted CR8, R20, R22, and shield at J1 pin 2; changed value of C32 and R24.		
C	Changed value of C7 from 27 pf to 36 pf.		
D	Deleted "GROUND" at J1 pin 5 and added "A+".		
E	Changed value of Q5.		
F	Changed value of C12 from 100 pf to 33 pf.		
G	Added J1 pin 2		
H	Change values of the following parts: C35 from 12 pf to 8.2 pf C60 from .1 uf to 2.2 uf C61 from 2 uf to 6.8 uf R21 from 56 kilohms to 22 kilohms R53 from 8200 ohms to 6800 ohms R54 from 220 ohms to 270 ohms		
J	Changed connection at J1 pin 11.		
K	Changed value of C21 of C21 from 50 pf to 43 pf.		
L	Changed value of R16 from 2200 ohms to 27 kilohms; changed connection of R16 to junction of R17 and R18.		
M	Changed values of the following parts: C20 from 27 pf to 22 pf C66 from .01 uf to .0068 uf R63 from 1500 ohms to 2200 ohms		
N	Added R69 (100 ohms) and R70 (100 ohms).		
P	Changed Q11, Q12, and Q13 from 2N1192 to SA273.		

Part of Figure 401 and Figure 401a
201A/201B ADF Receiver Schematic Diagram
201A-1/201B-1 ADF Receiver Schematic Diagram

SUMMARY OF CHANGES TO

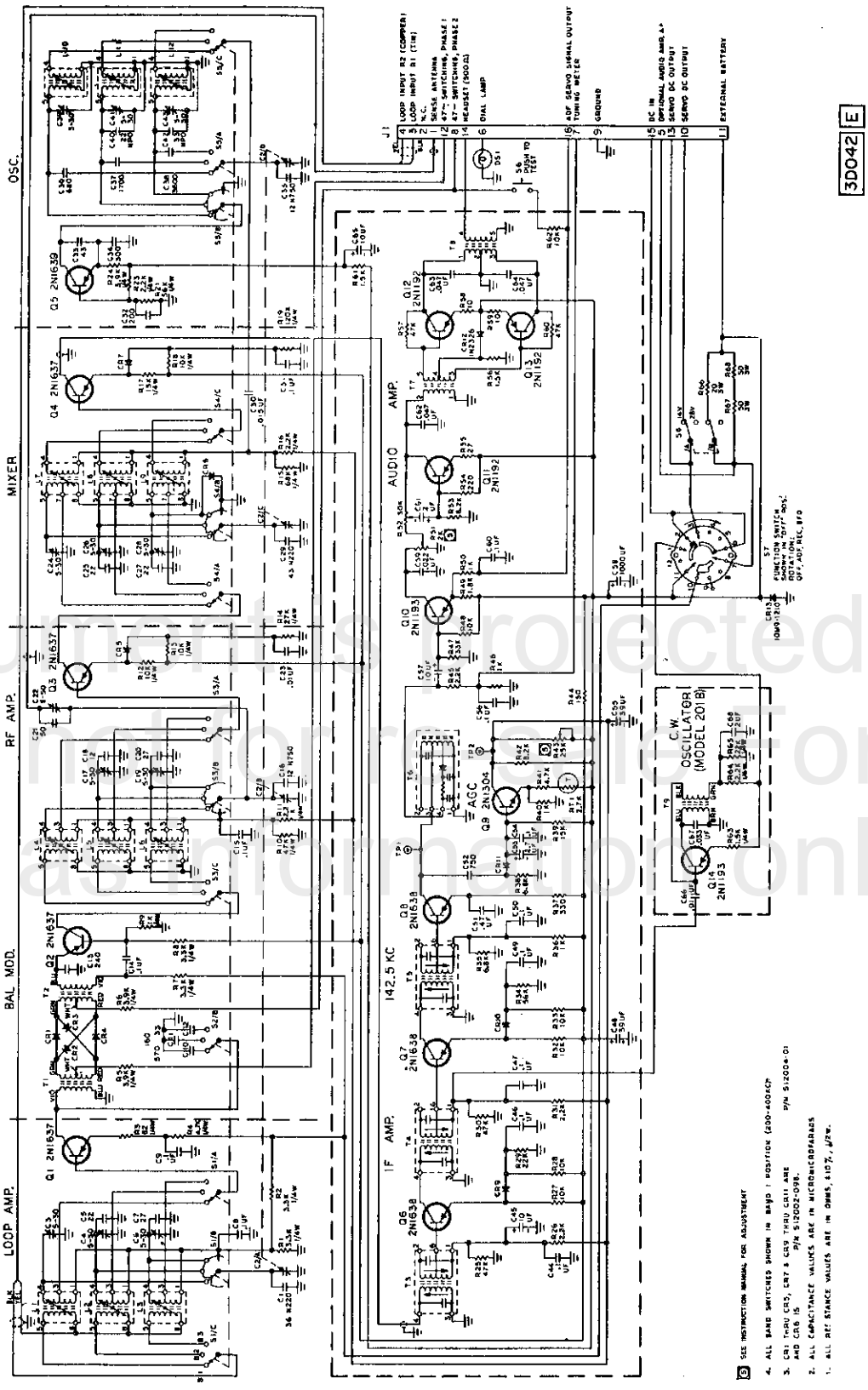
201A/201B/201A-1/201B-1 ADF RECEIVER SCHEMATIC DIAGRAM
DRAWING NO. 3D042

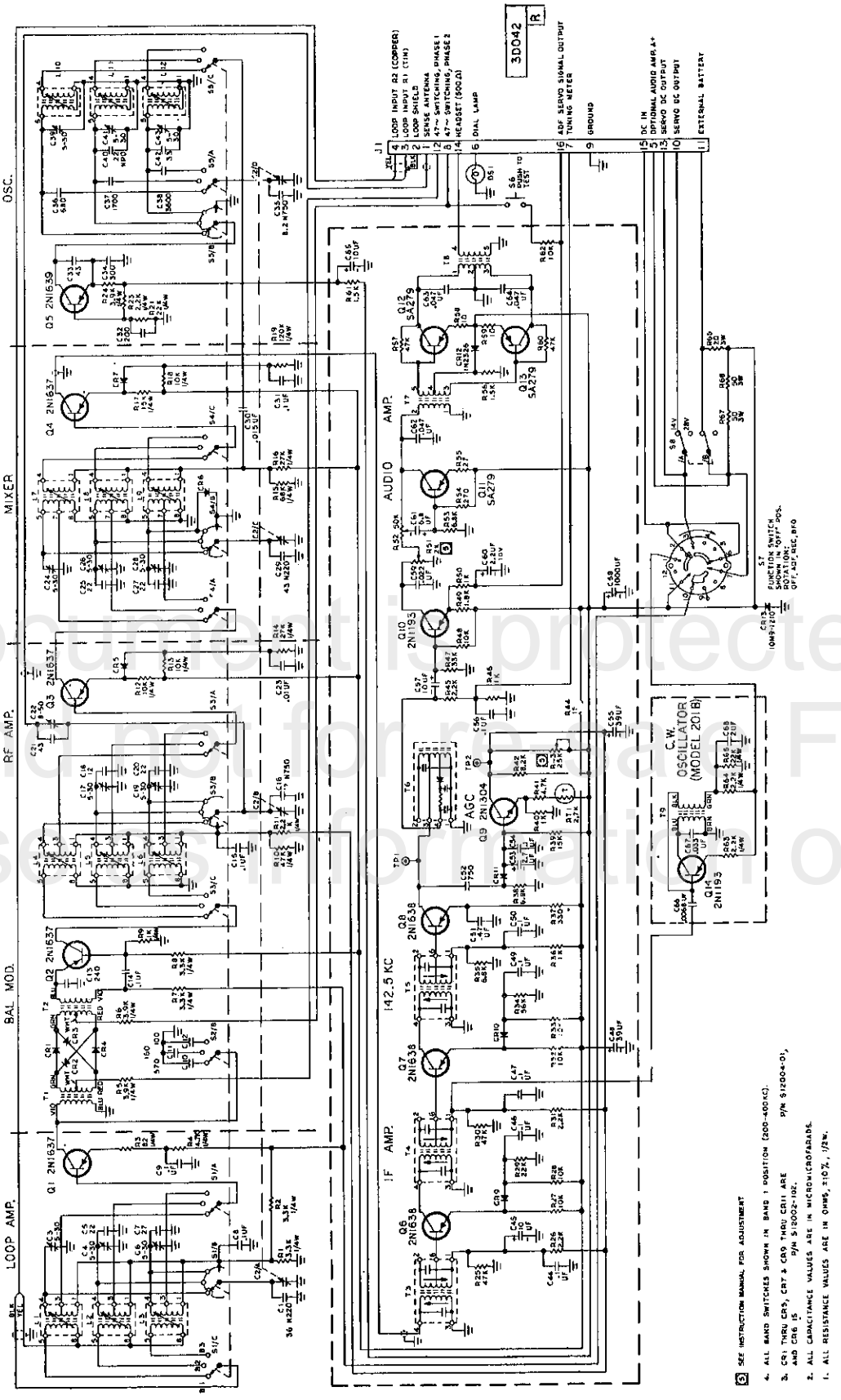
SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
R	Delete R69 and R70		
S	Deleted: C25 (22 pf variable) C27 (22 pf variable) C33 (43 pf) C34 (300 pf) C40 (22 pf) C42 (33 pf) CR6 Added R20 (33 kilohms) and C33 (100 pf). Changed values of: C29 from 43 pf to 10 pf C32 from 200 pf to .022 uf C35 from 8.2 pf to 10 pf C36 from 680 pf to 390 pf C37 from 1700 pf to 910 pf C38 from 3600 pf to 1800 pf R21 from 21 kilohms to 12 kilohms R23 from 2200 ohms to 1500 ohms R24 from 3900 ohms to 180 ohms Changed wiring and/or pin numbers of L7 through L12. Changes made to improve local oscillator stability.		
T	Changed C29 from 10 pf to 5 pf to allow tracking of C2. Changed C33 (100 pf) to 140 pf and R49 (1800 ohms) to 1200 ohms in order to increase drive to local oscillator and eliminate intermittent operation.		
U	Changed Q5 (2N1639) to 2N2654 and C3 (10 pf) to 5 pf to permit tracking of local oscillator.		
V	Add R71 (470 kilohms) for static discharge.		

SUMMARY OF CHANGES TO

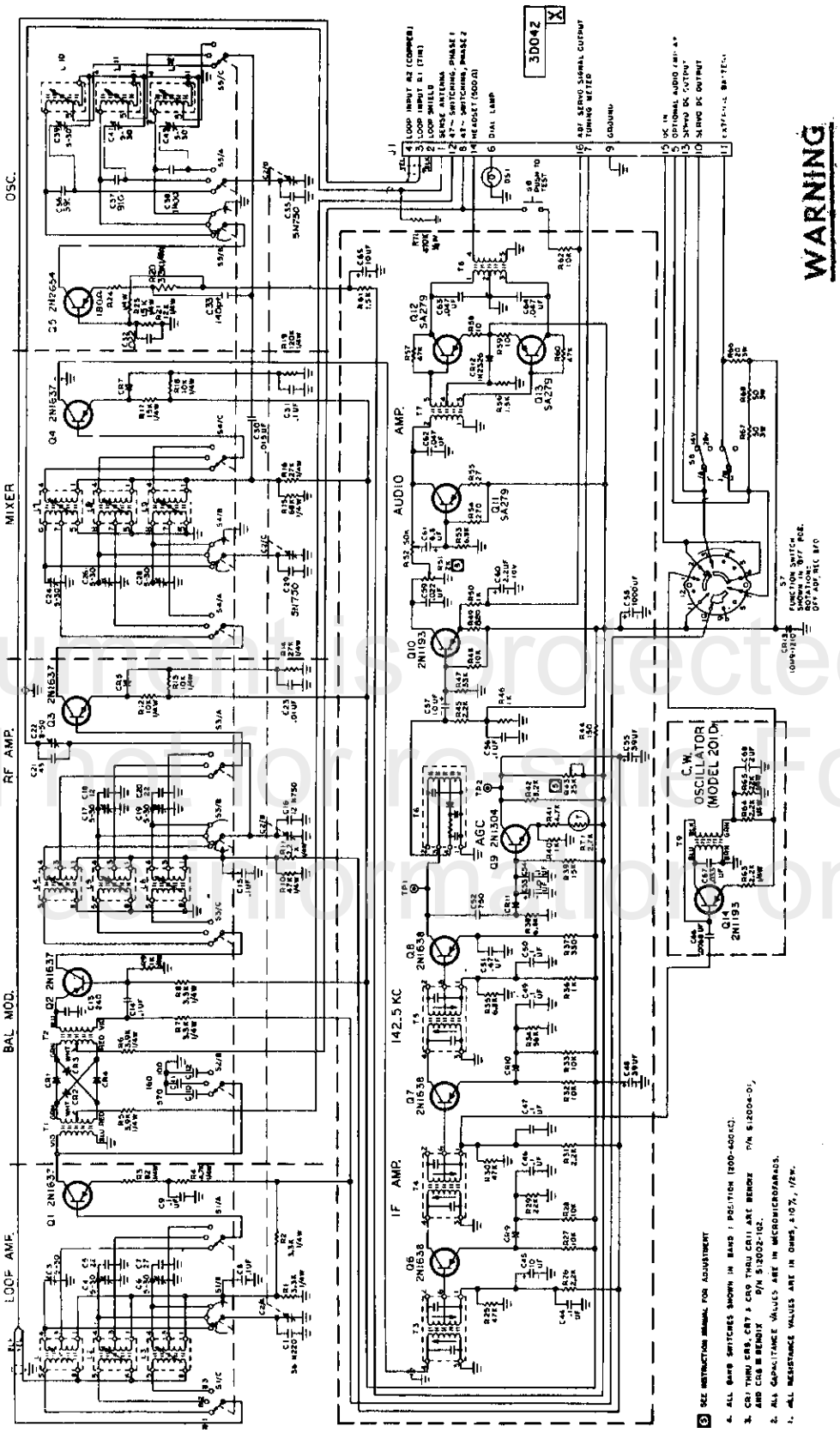
201A/201B/201A-1/201B-1 ADF RECEIVER SCHEMATIC DIAGRAM
DRAWING NO. 3D042

SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
W	Changed R49 from 1200 ohms to 820 ohms to increase audio output.		
X	Changed C53 from 2.7 uf to 1.0 uf to eliminate AGC oscillation.		





201A/201B ADF Receiver, Schematic Diagram
(Issues F through R)
Figure 401



WARNING

This manual which you have requested is furnished for general information purposes only. Service bulletins which supplement this manual are only furnished to Bendix authorized FAA approved repair stations. DO NOT USE THIS MANUAL FOR EFFECTUATING REPAIRS OF THE EQUIPMENT.

201A-1/201B-1 ADF Receiver, Schematic Diagram
(Issues S through X)
Figure 401a

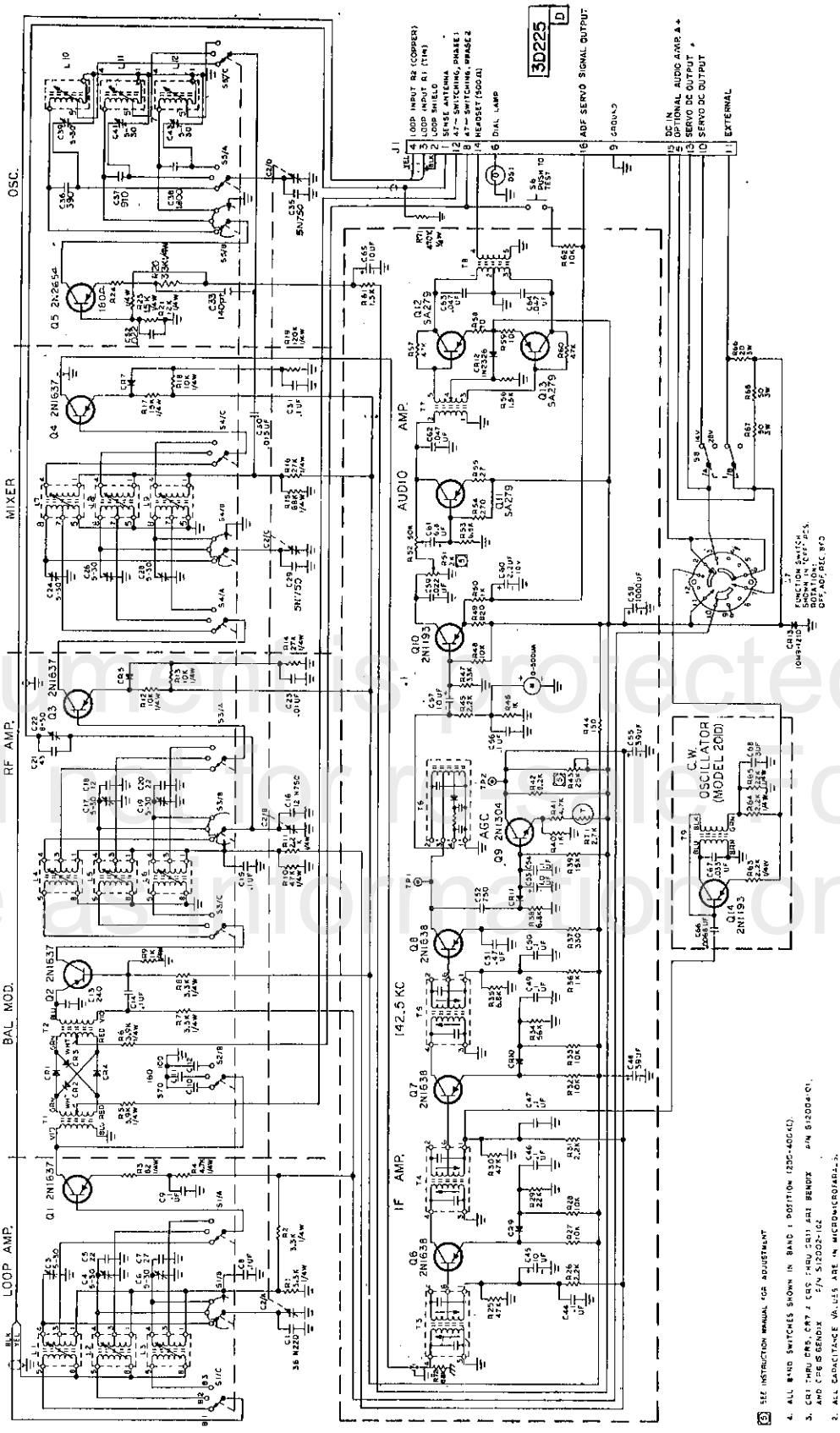
SUMMARY OF CHANGES TO

201C/201D ADF RECEIVER, SCHEMATIC DIAGRAM
DRAWING NO. 3D225

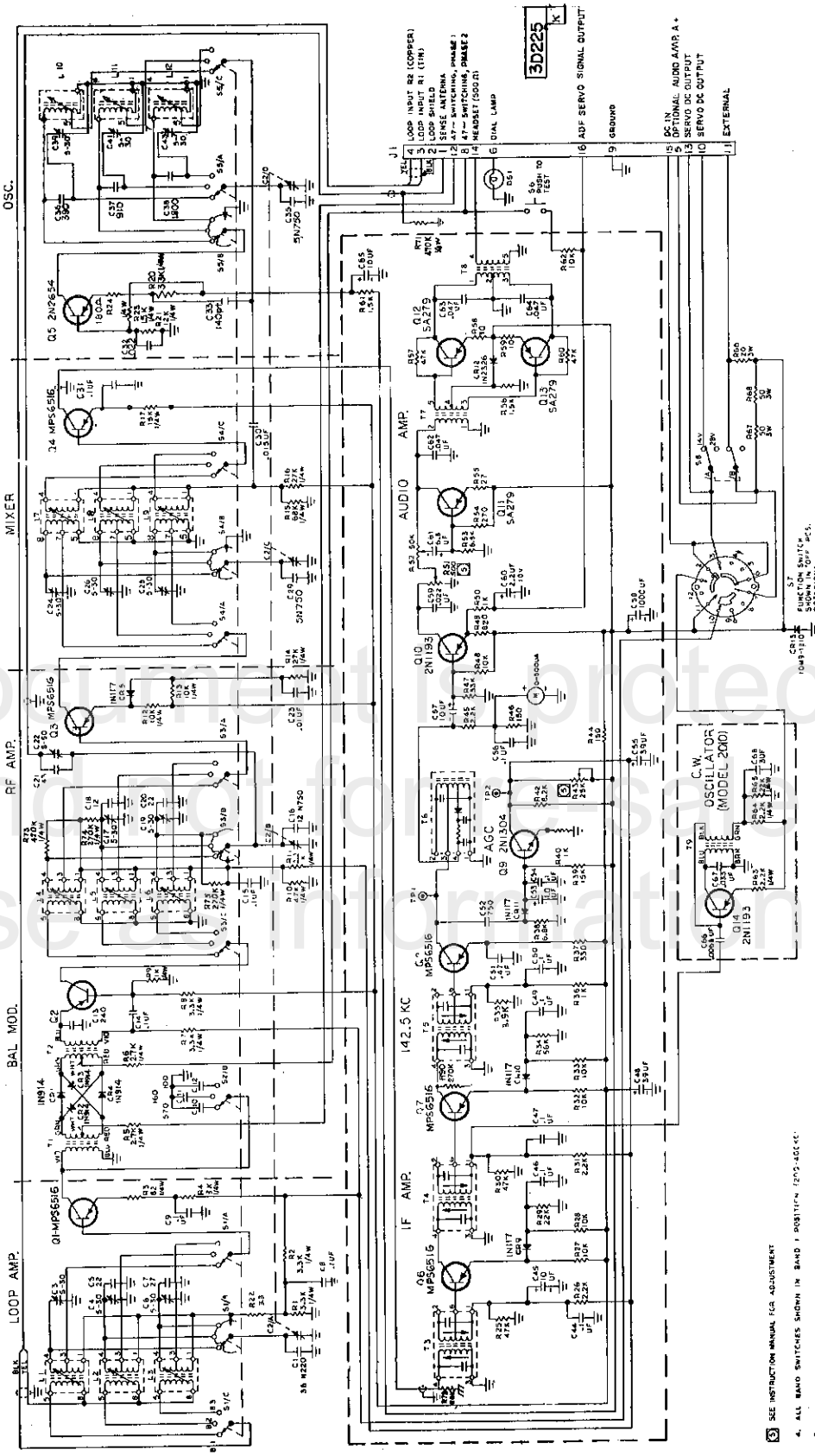
SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
A	Changed R49 from 1200 ohms to 820 ohms to increase audio output.		
B	Changed C53 from 2.7 uf to 1.0 uf to eliminate A.G.C. oscillation.		
C	Changed C68 from 2 uf to 3 uf because old part no longer available.		
D	Added R72 (68 kilohms) to improve mixer stability.		29506 (201C) 27823 (201D)
E	Changed the following parts to replace germanium components with silicon components: Q1, Q2, Q3, Q4 from 2N1637 to MPS6516 Q6, Q7, Q8 fron 2N1638 to MPS6516 CR1, CR2, CR3, CR4 to IN914 CR5, CR9, CR10, CR11 to IN117 R4 from 4700 ohms to 3000 ohms R5 from 3900 ohms to 2700 ohms R6 from 3900 ohms to 2700 ohms R35 from 6800 ohms to 3900 ohms Deleted CR7, R18 (10 kilohms), R19 (120 kilohms), and moved C31 (.1 uf) to connect to Q4 emitter and ground. Deleted R41 (4700ohms) and RT1 (2700 ohms). Added R22 (3.3 ohms) to junction of R1, R2, and C8.		30500 (201C) 28900 (201D)
F	Added R90 (270 kilohms) to collector of Q7 for increased i-f stability		30500 (201C) 28900 (201D)
G	Changed value of R46 from 1000 ohms to 150 ohms to provide optimum range for tuning meter.		30775 (201C) 29002 (201D)

SUMMARY OF CHANGES TO
201C/201D ADF RECEIVER, SCHEMATIC DIAGRAM
DRAWING NO. 3D225

SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
H	Changed value of R51 from 2000 ohms to 500 ohms.	T12-010	31109 (201C) 21194 (201D)
J	Added R73, R74, and R75 to improve bearing accuracy by reducing rf feedback and lowering Q of tuned circuit in the rf amplifier circuit.	T12-012	31239 (201C) 29210 (201D)
K	Corrected drawing error		



201C/201D ADF Receiver, Schematic Diagram
(Issue A through D)
Figure 402



201C/201D ADF Receiver, Schematic Diagram
(Issues E through K)
Figure 402

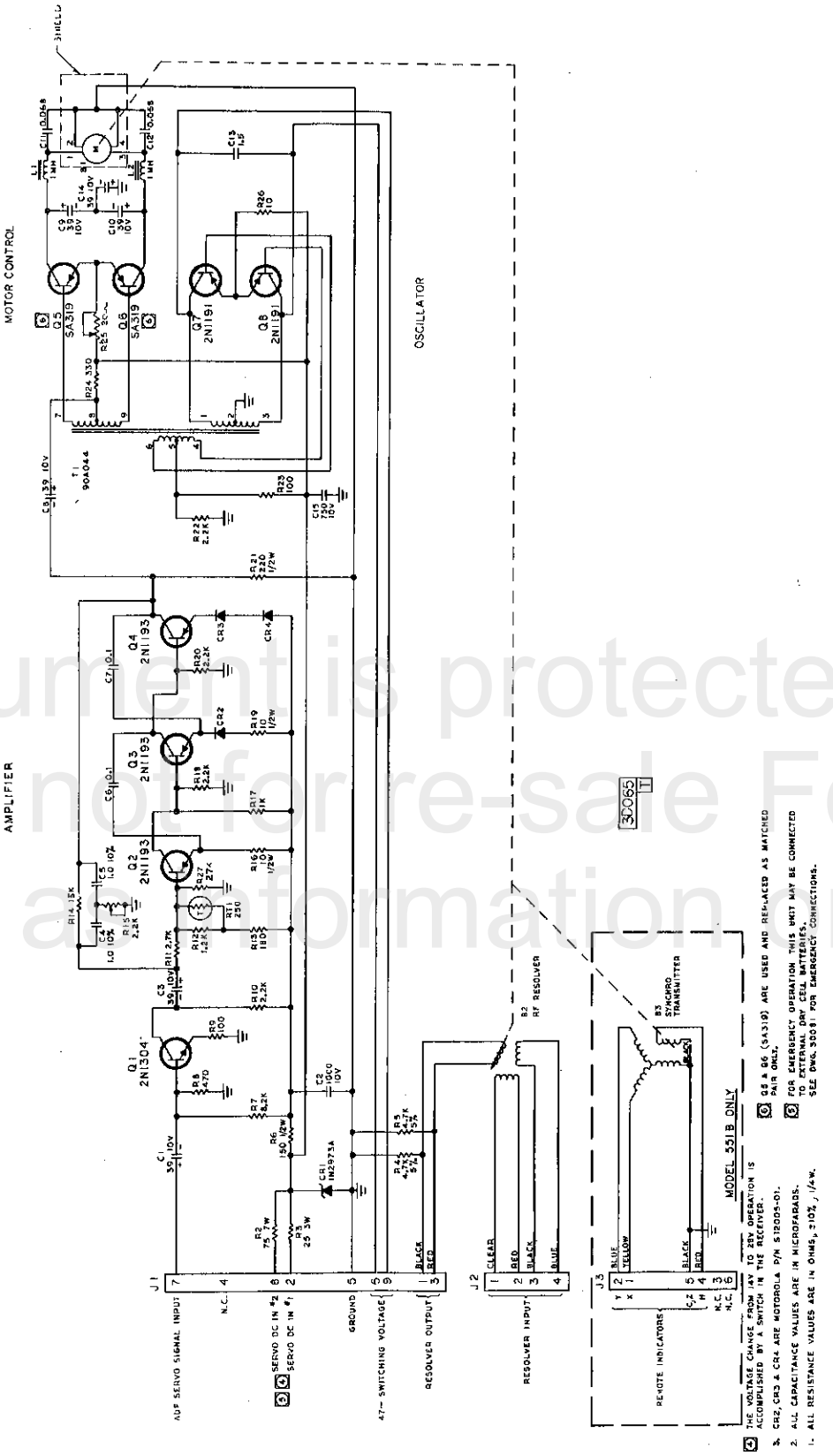
SUMMARY OF CHANGES TO

551A/551B SERVO AMPLIFIER-INDICATOR, SCHEMATIC DIAGRAM
DRAWING NO. 3D065

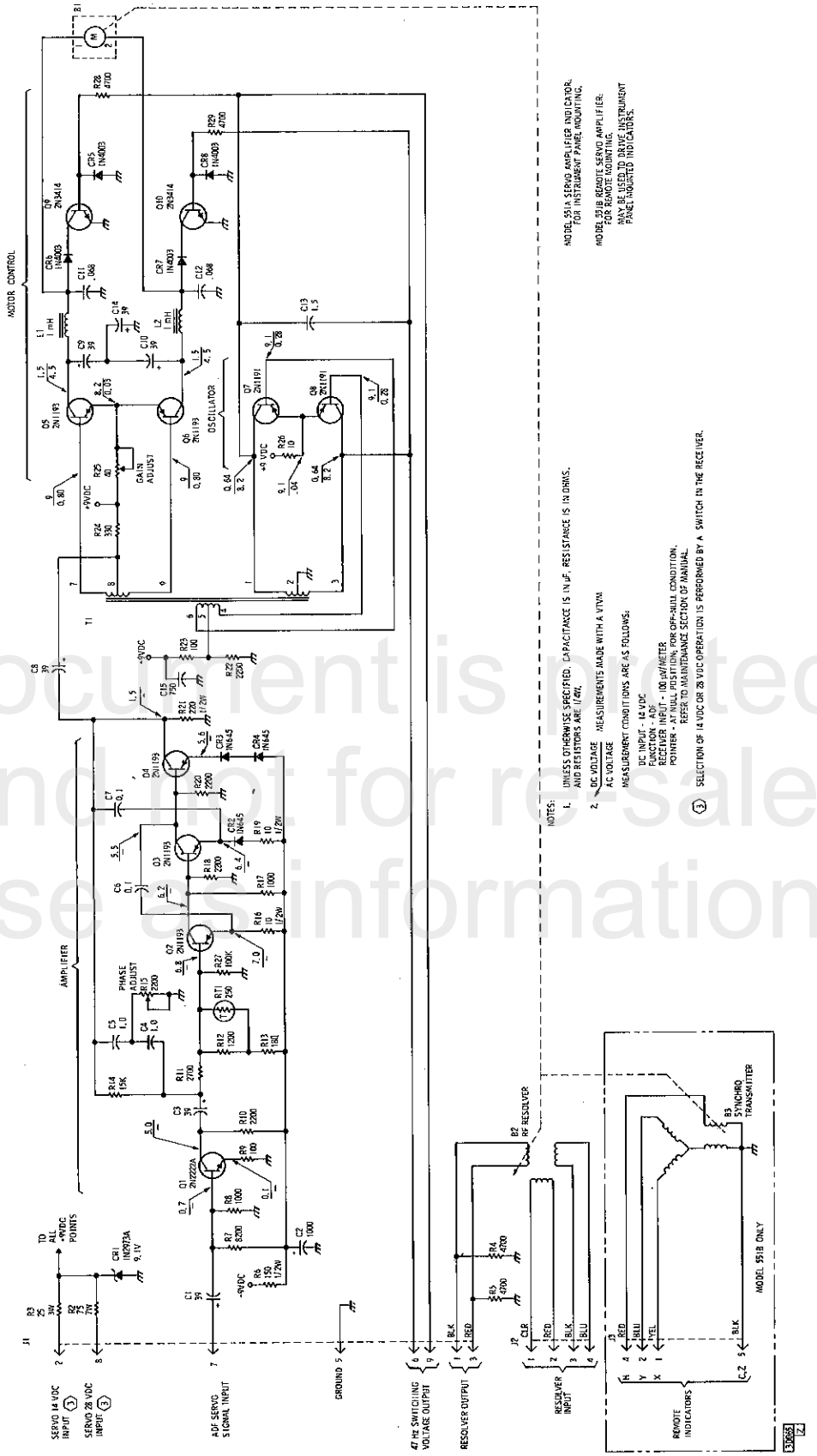
SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
A thru T	Changes made prior to release.		
U	Transistors Q9, Q10 and associated switching circuitry added for new type motor (B1).	T12-008-1	28127
V	Changed reference designator of 4700 ohm resistor from R27 to R29. Changed value of C2 from 1 K to 1000. Change to correct drawing errors only.		N/A
W	Changed Q5 and Q6 from SA319 to 2N1193. Matched pair (SA319) not needed with new type motor (B1).		28127
X	Changed value of R25 from 20 ohms to 40 ohms to increase adjustment range.	T12-015	31581
Y	Changed value of R8 from 470 ohms to 1000 ohms. Changed type number of Q1 from 2N1304 to 2N2222A. Changes made to improve high temperature operation.	T12-016	31778
Z	Illustration redrawn.	-	N/A

Part of Figure 403

551A Servo Amplifier-Indicator/551B Remote Gonio-Synchro Schematic Diagram



551A Servo Amplifier-Indicator/551B Remote Gonio-Synchro
Schematic Diagram
(Issues A through T)
Figure 403



551A Servo Amplifier-Indicator/551B Remote Gonio-Synchro
Schematic Diagram
(Issue Z)

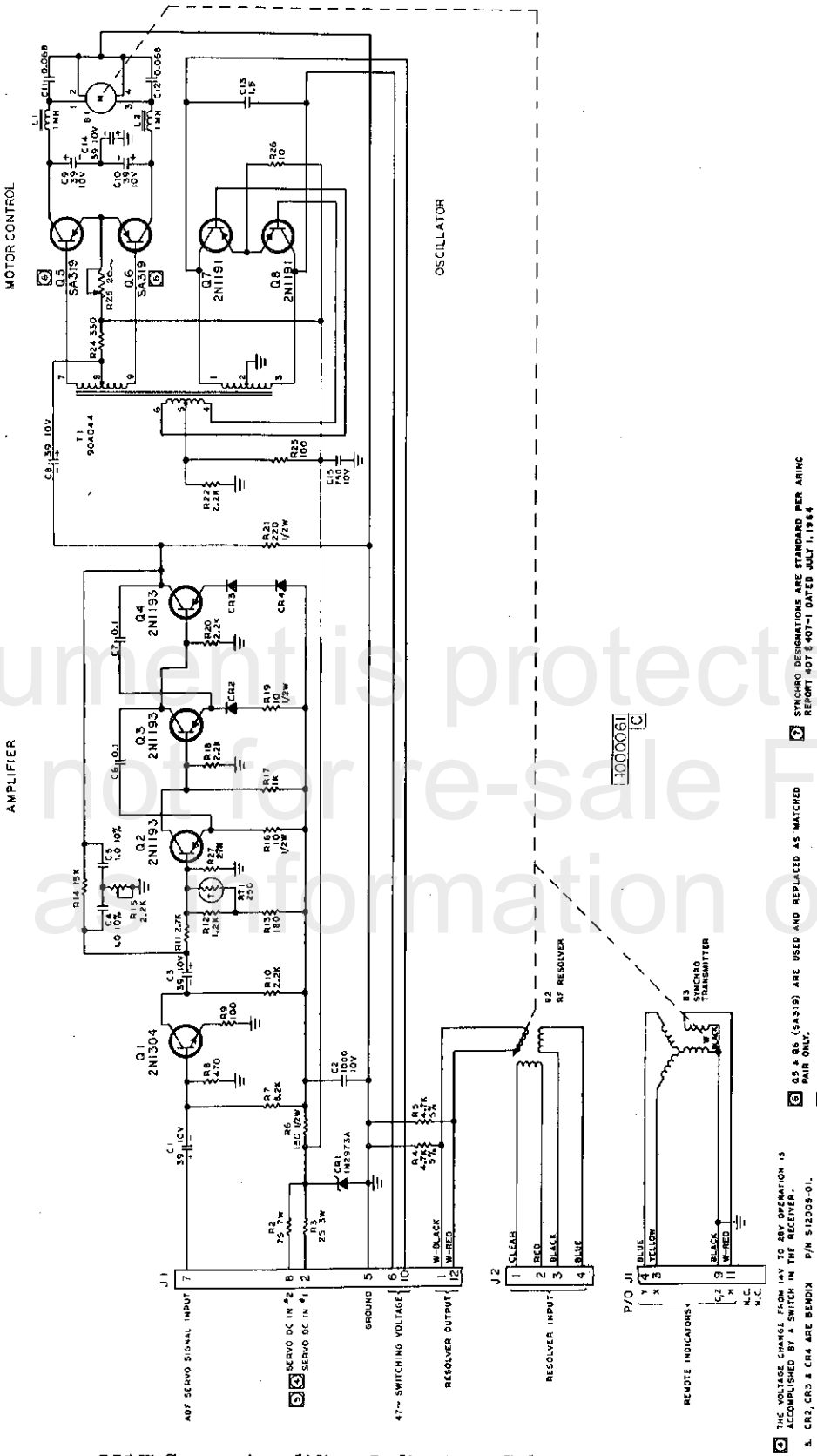
Figure 403

SUMMARY OF CHANGES TO

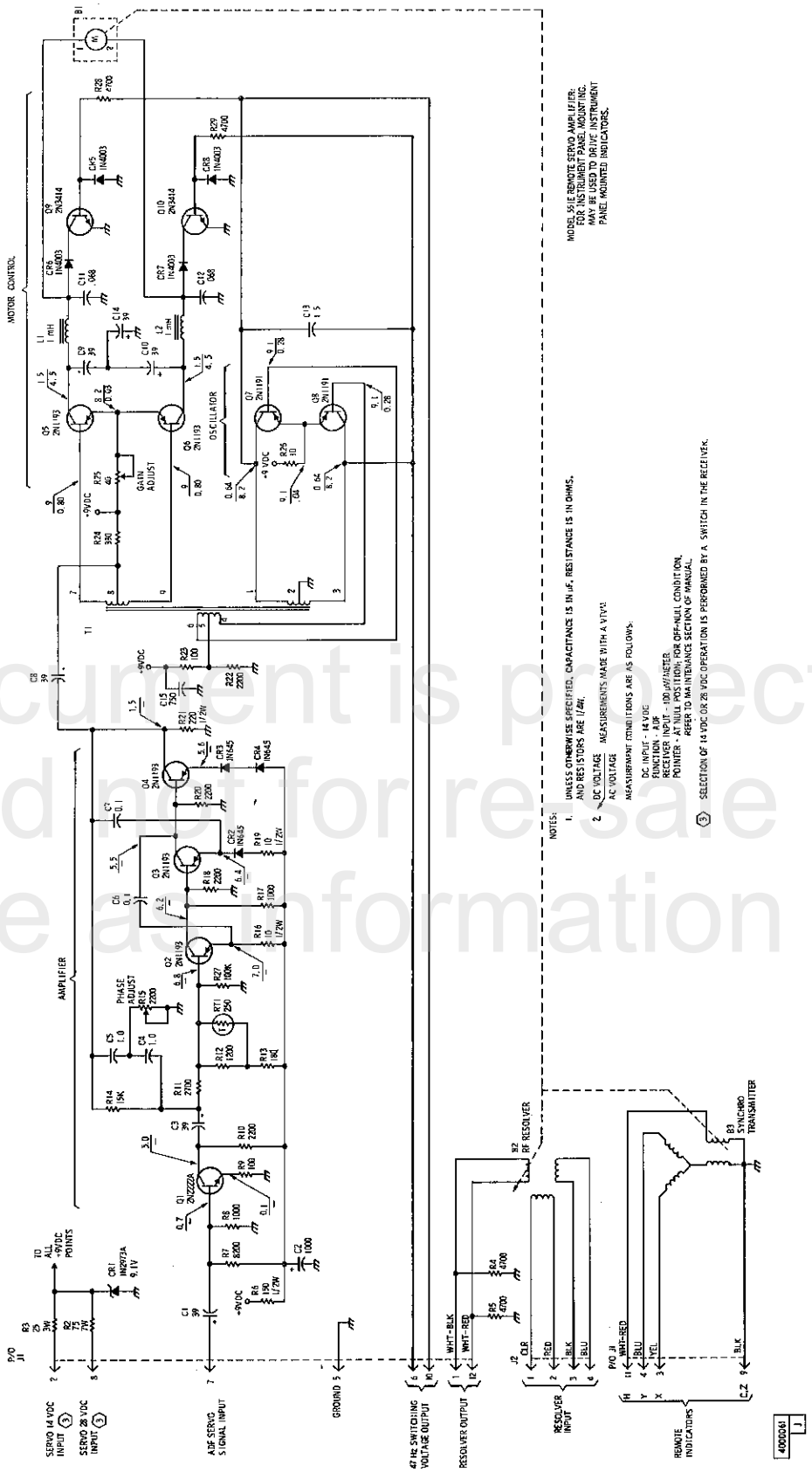
551E SERVO AMPLIFIER-INDICATOR, SCHEMATIC DIAGRAM
DRAWING NO. 4000061

SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
A thru C	Changes made prior to release.		
D	Transistors Q9, Q10 and associated switching circuitry added for new type motor (B1).	T12-008-1	3741
E	Changed reference designator of 4700 ohm resistor from R27 to R29. Changed value of C2 from 1 K to 1000. Change to correct drawing errors only.		N/A
F	Changed Q5 and Q6 from SA319 to 2N1193. Matched pair (SA319) not needed with new type motor (B1).		3714
G	Changed value of R25 from 20 ohms to 40 ohms to increase adjustment range.	T12-015	3804
H	Changed value of R8 from 470 ohms to 1000 ohms. Changed type number of Q1 from 2N1304 to 2N2222A. Changes made to improve high temperature operation.	T12-016	3812

Part of Figure 404



551E Servo Amplifier-Indicator, Schematic Diagram
(Issues A through C)
Figure 404



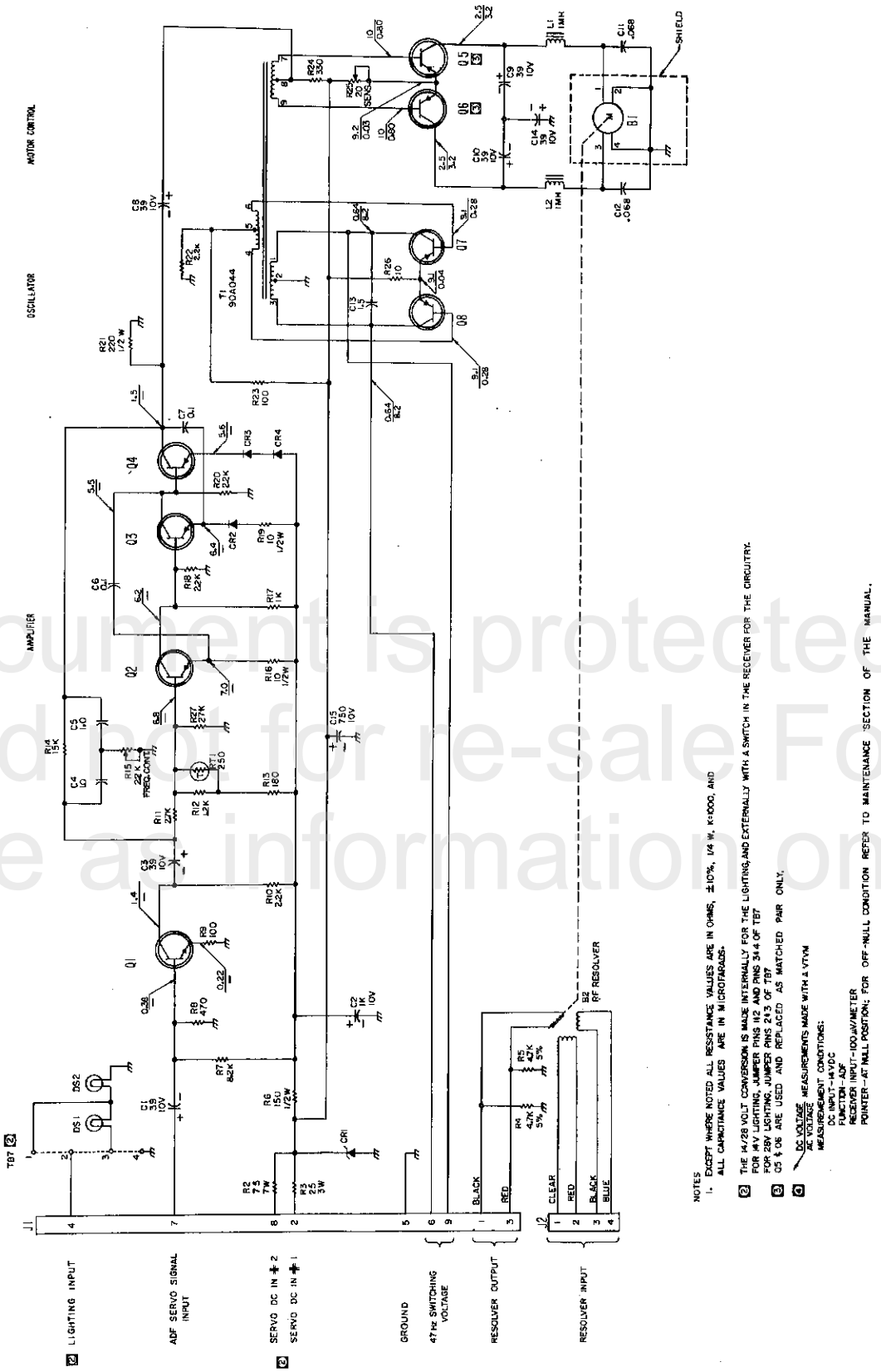
551E Servo Amplifier-Indicator, Schematic Diagram
(Issue J)
Figure 404

SUMMARY OF CHANGES TO

551RL SERVO AMPLIFIER-INDICATOR, SCHEMATIC DIAGRAM
DRAWING NO. 4000243

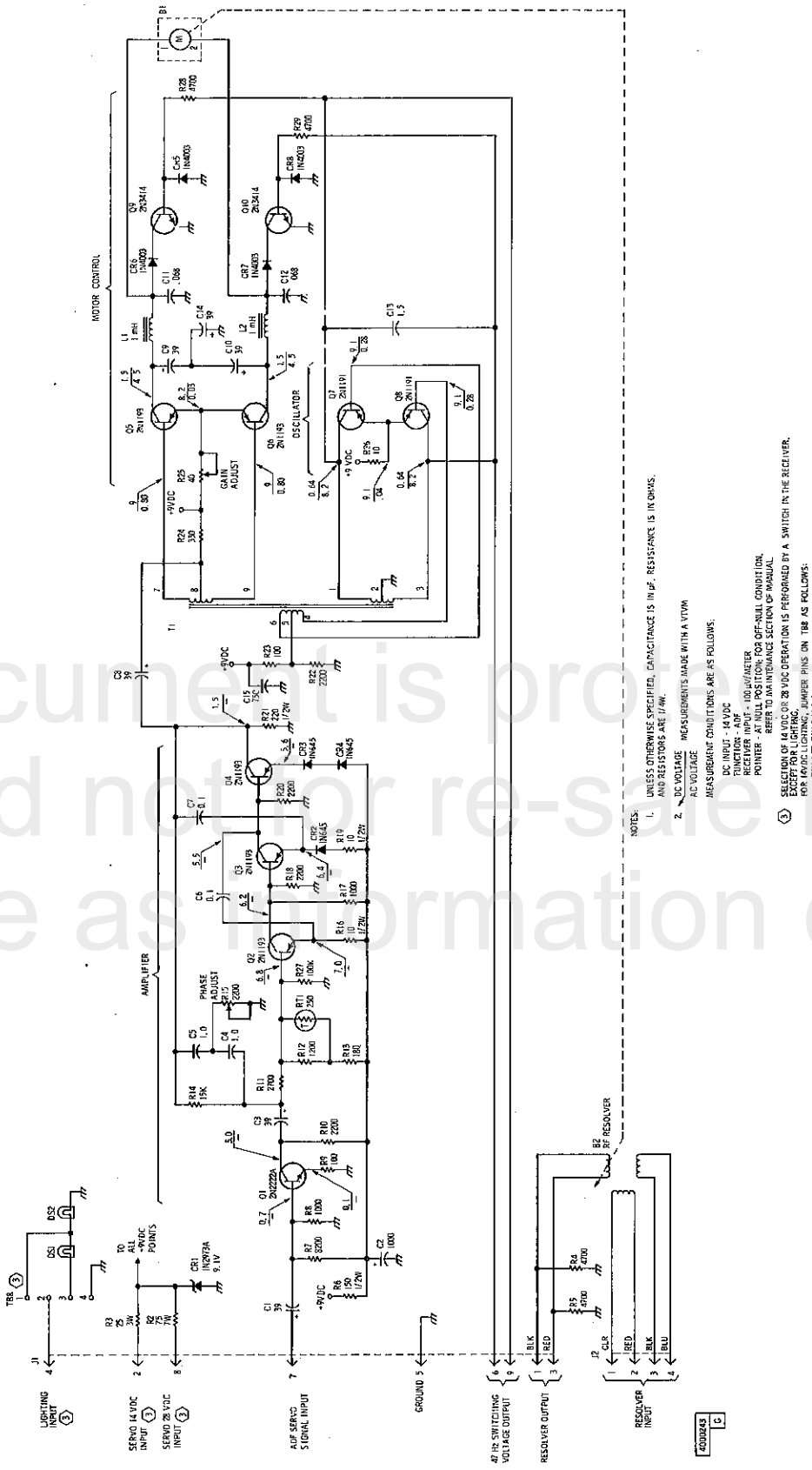
SCHEMATIC ISSUE	DESCRIPTION OF CHANGE	SERVICE BULLETIN NO.	EFFECTIVITY UNIT S/N
B	Transistors Q9, Q10 and associated switching circuitry added for new type motor (B1).	T12-008-1	2674
C	Changed reference designator of 4700 ohm resistor R27 to R29. Changed value of C2 from 1K to 1000. Changes made to correct drawing errors.	-	N/A
D	Changed Q5 and Q6 from SA319 to 2N1193. Matched pair not needed with new type motor (B1).		2674
E	Changed value of R25 from 20 ohms to 40 ohms to increase adjustment range.	T12-015	5171
F	Changed value of R8 from 470 ohms to 1000 ohms. Changed type number of Q1 from 2N1304 to 2N2222A. Changes made to improve high temperature operation.	T12-016	5445
G	Illustration redrawn.	-	N/A

Part of Figure 405
551RL Servo Amplifier-Indicator, Schematic Diagram

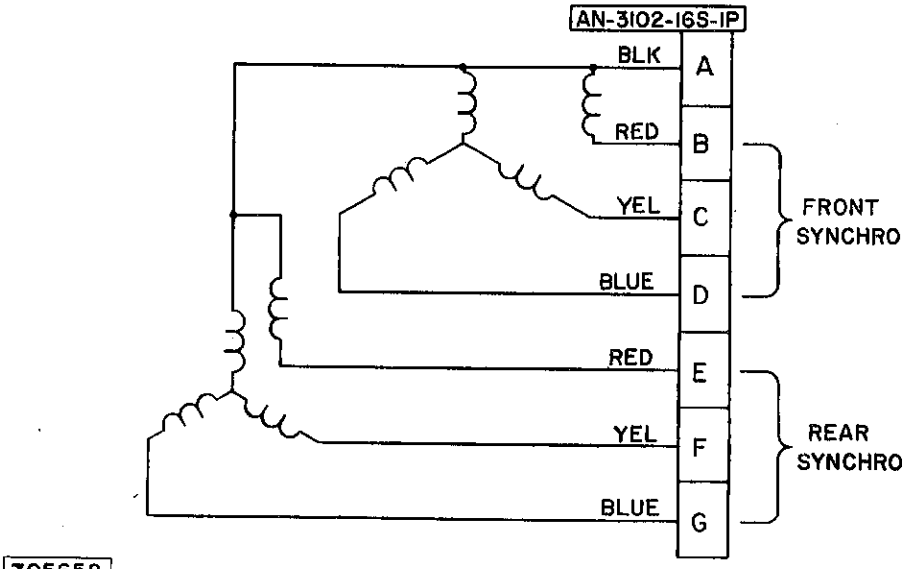


NOTES
1. EXCEPT WHERE NOTED ALL RESISTANCE VALUES ARE IN OHMS, ±10%, 1/4 W, K=1000, AND ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. THE 14/28 VOLT CONVERSION IS MADE INTERNALLY FOR THE LIGHTING, AND EXTERNALLY WITH A SWITCH IN THE RECEIVER FOR THE CIRCUITRY.
FOR 14V LIGHTING, JUMPER PINS 112 AND PINS 314 OF TB7
FOR 28V LIGHTING, JUMPER PINS 213 OF TB7
3. DS 1 & 106 ARE USED AND REPLACED AS MATCHED PAIR ONLY.
4. DC VOLTAGE
AC VOLTAGE MEASUREMENTS MADE WITH A VTVM
MEASUREMENT CONDITIONS:
DC INPUT-14VDC
FUNCTION-ADF
RECEIVER INPUT-100 μV/METER
POINTER-AT NULL POSITION; FOR OFF-NULL CONDITION REFER TO MAINTENANCE SECTION OF THE MANUAL.

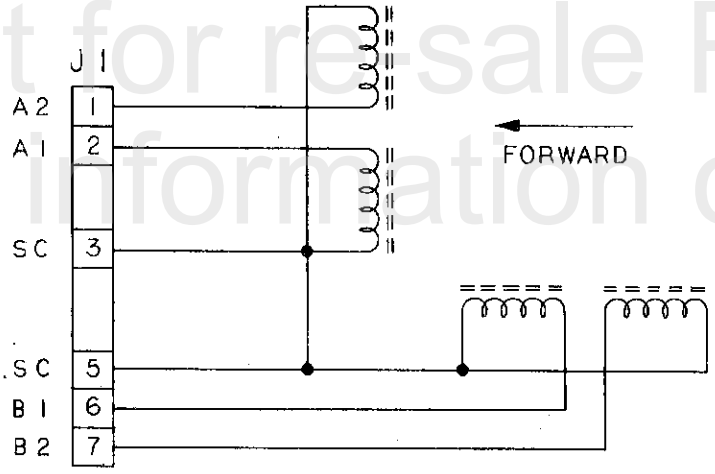
551RL Servo Amplifier-Indicator, Schematic Diagram
(Issue A)
Figure 405



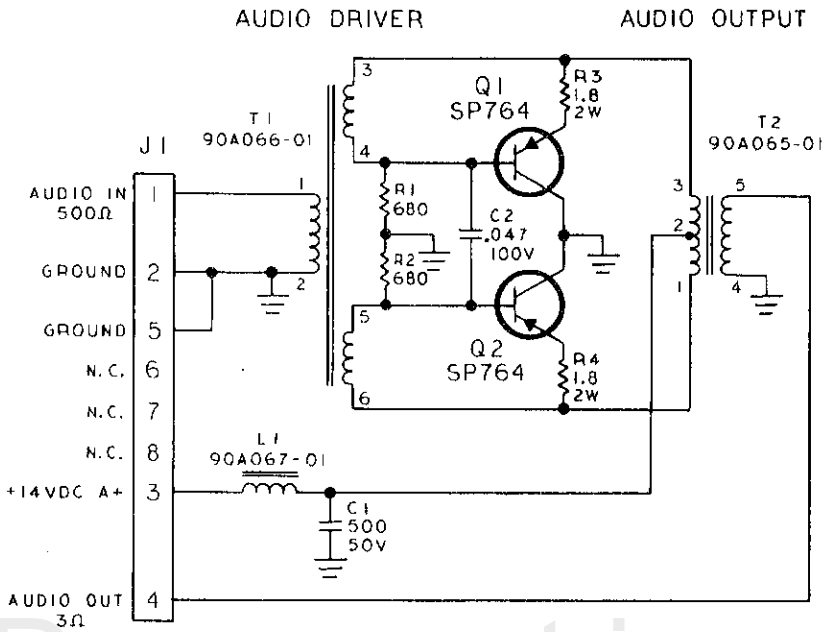
551RL Servo Amplifier-Indicator, Schematic Diagram
(Issue G)
Figure 405



551C Dual Synchro Indicator, Schematic Diagram
Figure 406



2321E Loop Antenna, Schematic Diagram
Figure 407

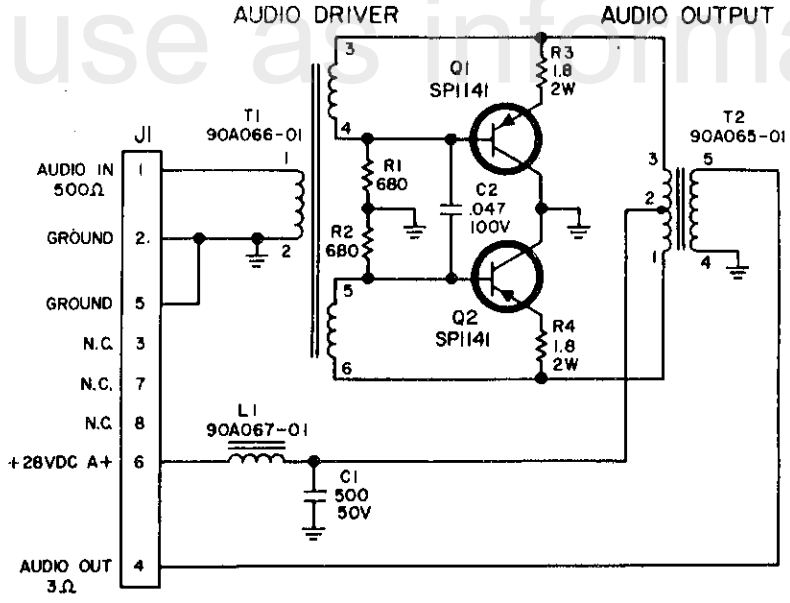


NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS, ±10%, 1/2W. UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.

3B092
A

102A Audio Amplifier, Schematic Diagram
Figure 408



NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS, ±10%, 1/2W. UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.

3B264

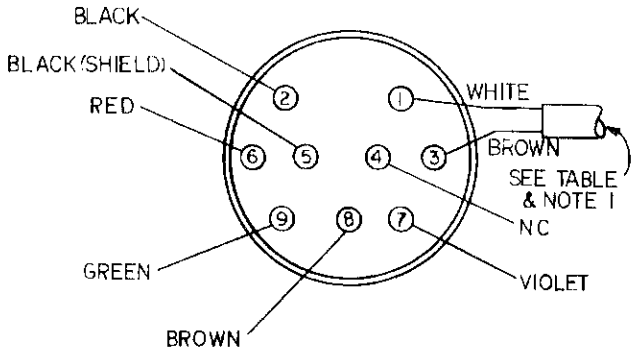
102B Audio Amplifier, Schematic Diagram
Figure 409

TABLE I

COAX COLOR CAN BE AS FOLLOWS

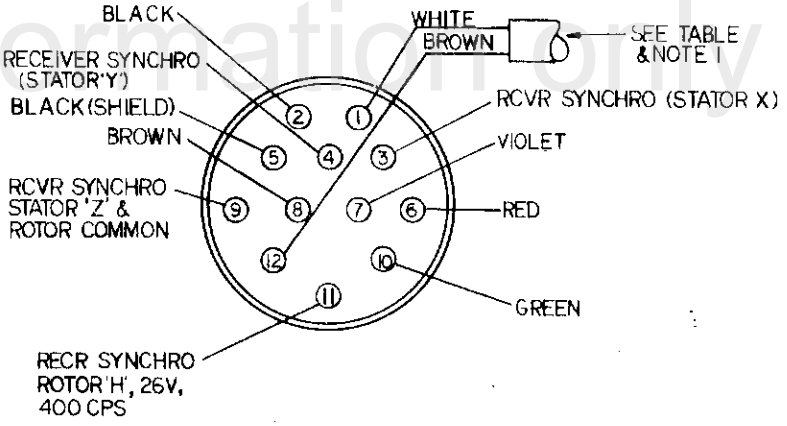
PIN 1	PIN 3	PIN 12
WHITE	BROWN	BROWN
GOLD	SILVER	SILVER
GREEN	YELLOW	YELLOW
WHITE	BLACK	BLACK

P2 (2V005 MAIN CABLE)



9 PIN
551A

P2 (2V005 MAIN CABLE)



12 PIN
551E

NOTES:

1. REVERSE CONNECTIONS FOR BOTTOM MOUNTED SENSE ANTENNA.

2071610 A

551( ) Indicator (Connector Field Modification), Wiring Diagram
Figure 410