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Table 38

LIST OF FUNCTIONAL SCHEMATICS

Figure	Descriptive Title
47	ΔcR, ΔYo and ΔXo group
48	Es and Rh loop
49	jB loop and B resolver
50	Coordinate inputs and mode-and-plot switch group
51	Plotter group
52	ORh and OB computing loop
53	Et and OR loop
54	OL' and OZh resolver group
55	L' and Zh computing loops
56	jOB'r' - jB'r' loop
57	jOB'r' loop
58	OB'r' differentials
59	Parallax group

Section 5.4—Trouble Shooting Electronic Units

PROCEDURE

This section contains general information and instructions for trouble shooting defective electronic units which have been located through the procedures given in previous sections of this chapter. These trouble-shooting tests are essentially the same as those used by the manufacturer. These tests will enable fire controlmen to test individual units in or out of the computer, locate the exact source of difficulty, and correct the defective unit.

When a malfunctioning electronic unit has been found, remove if from the instrument and immediately replace it with a spare that is in good condition. The main object is to return the computer to a satisfactory operative condition as quickly as possible.

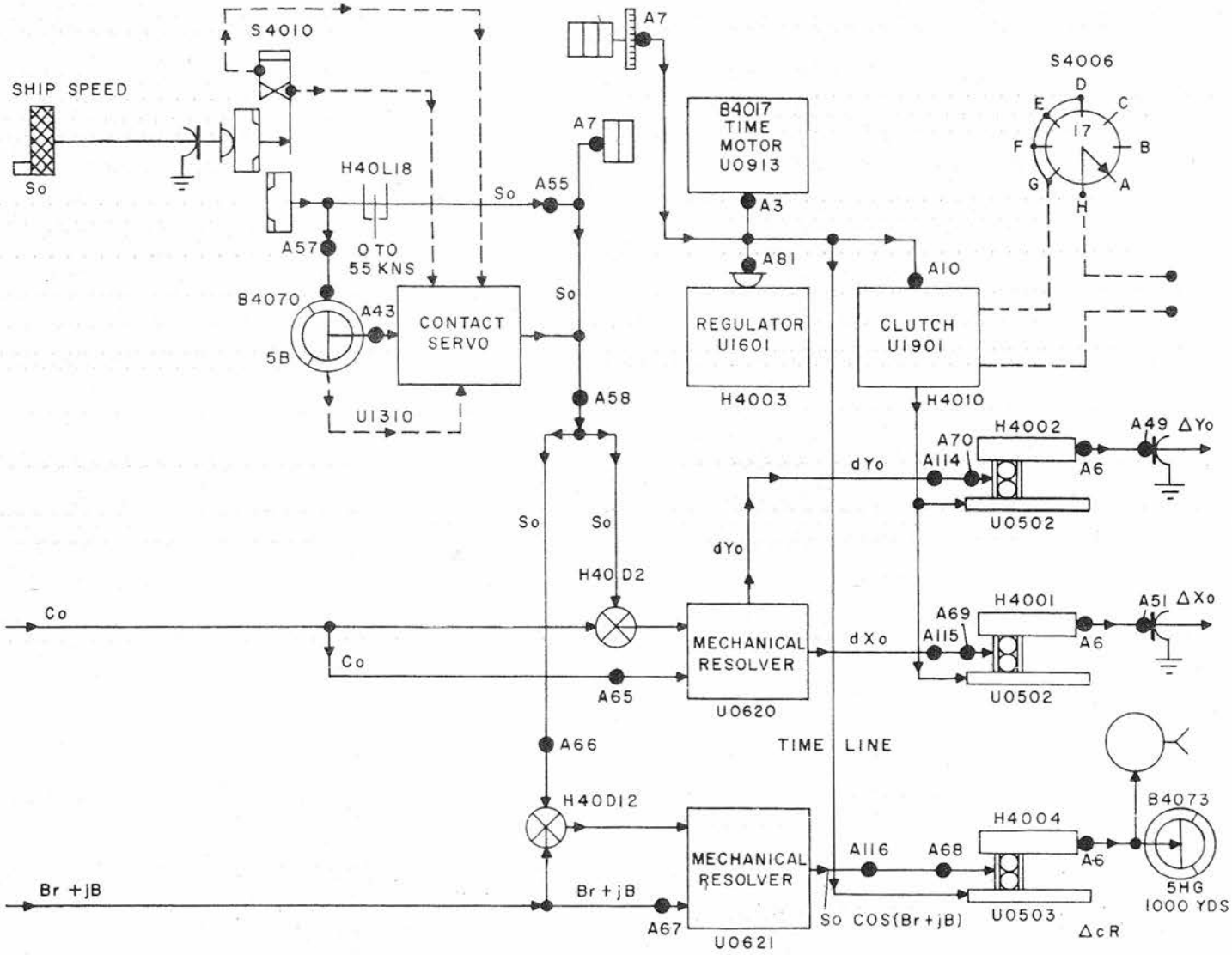

Figure 47. ΔcR, ΔYo, and ΔXo Group

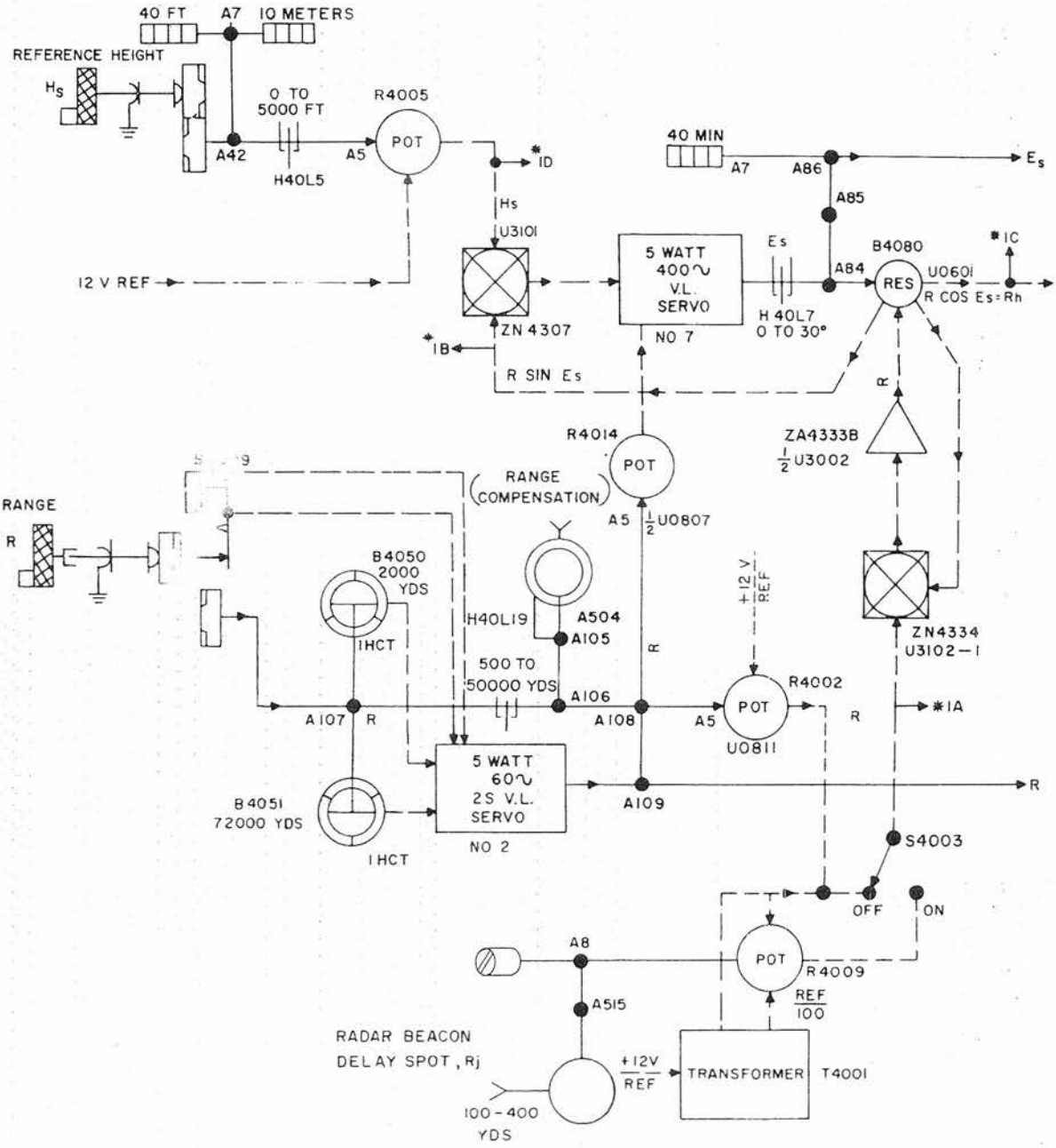

Figure 48. Es and Rh Loop

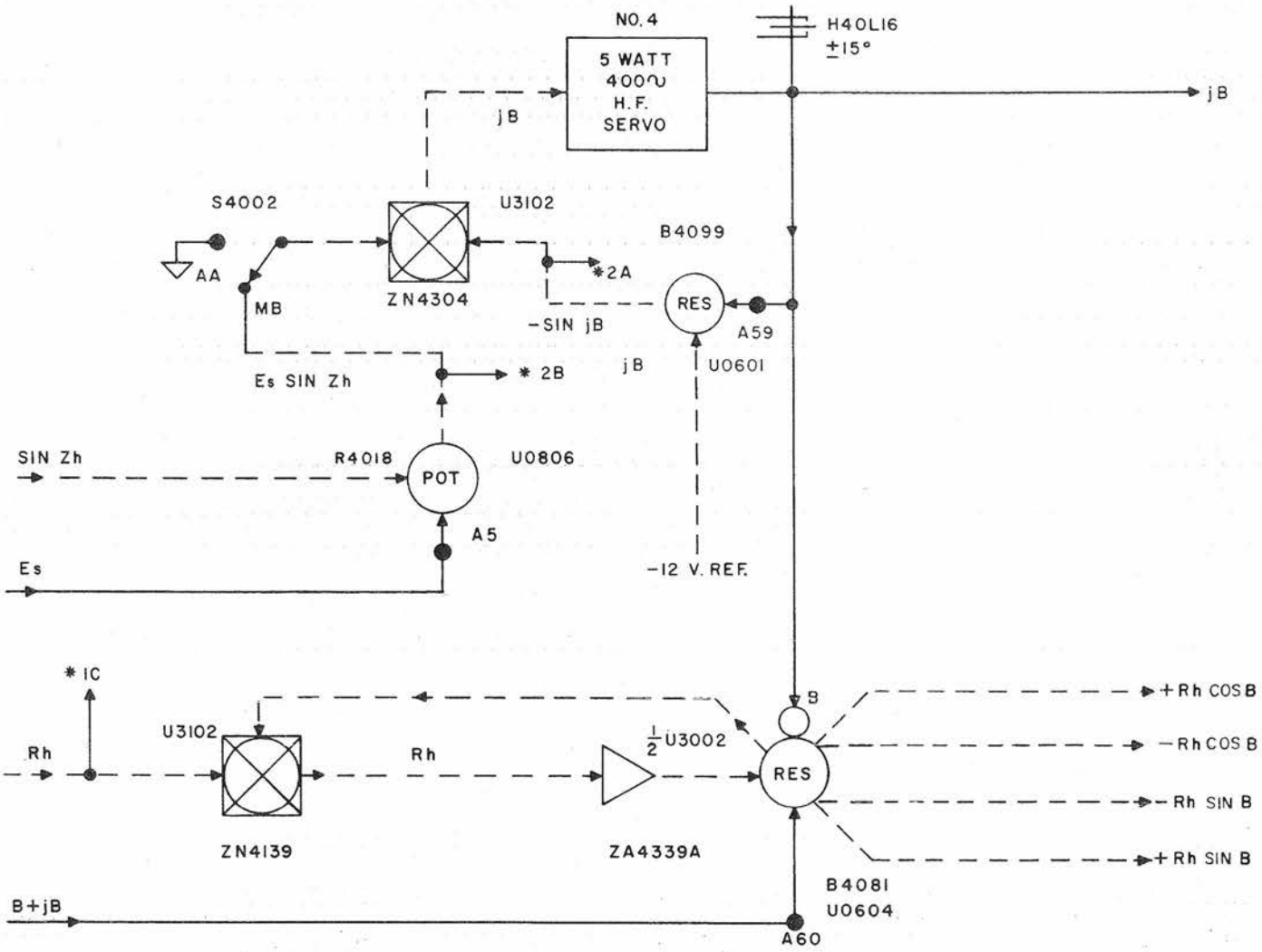

Figure 49. jB Loop and B Resolver

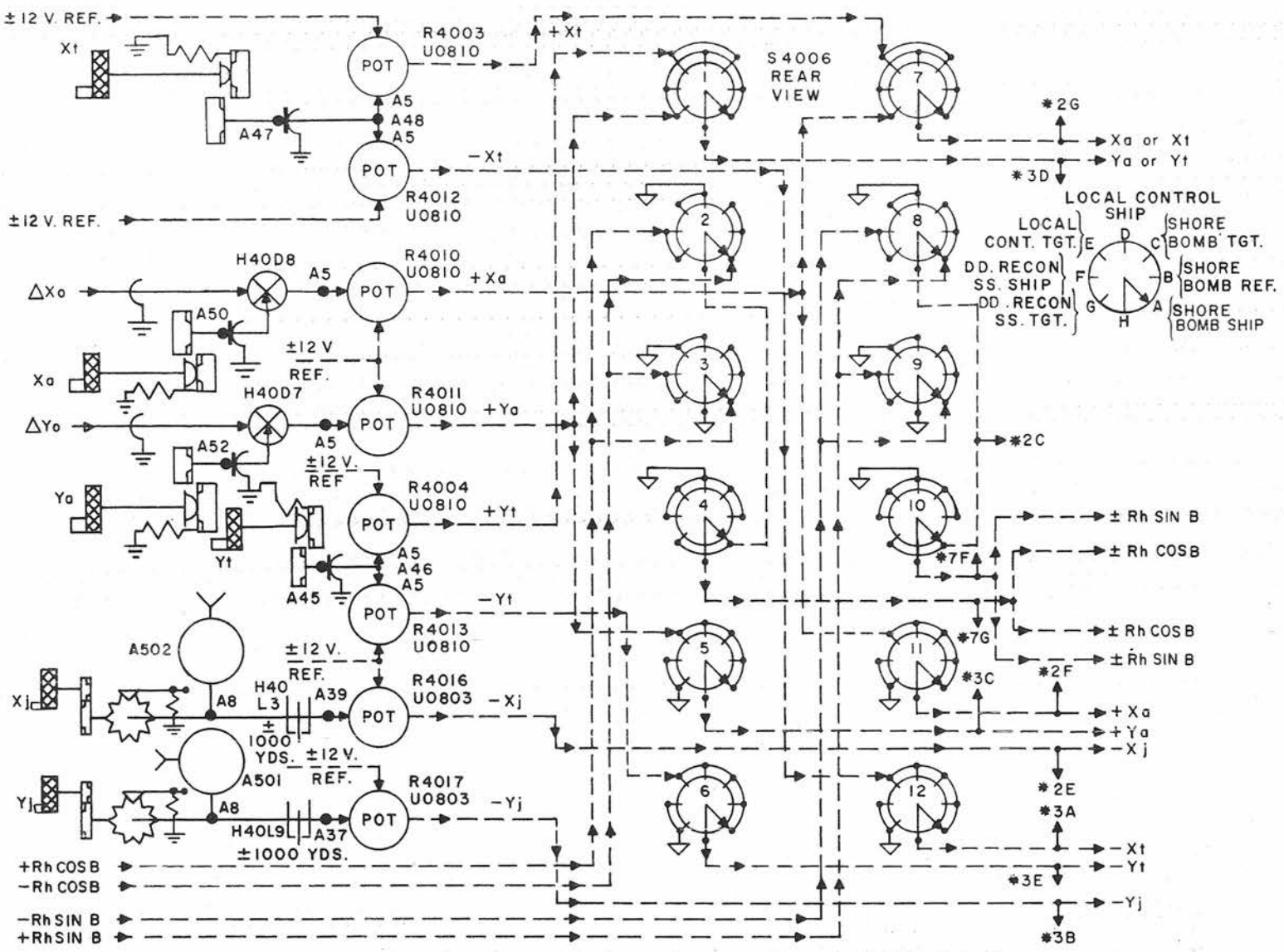

Figure 50. Coordinate Inputs and Mode-and-Plot Switch Group

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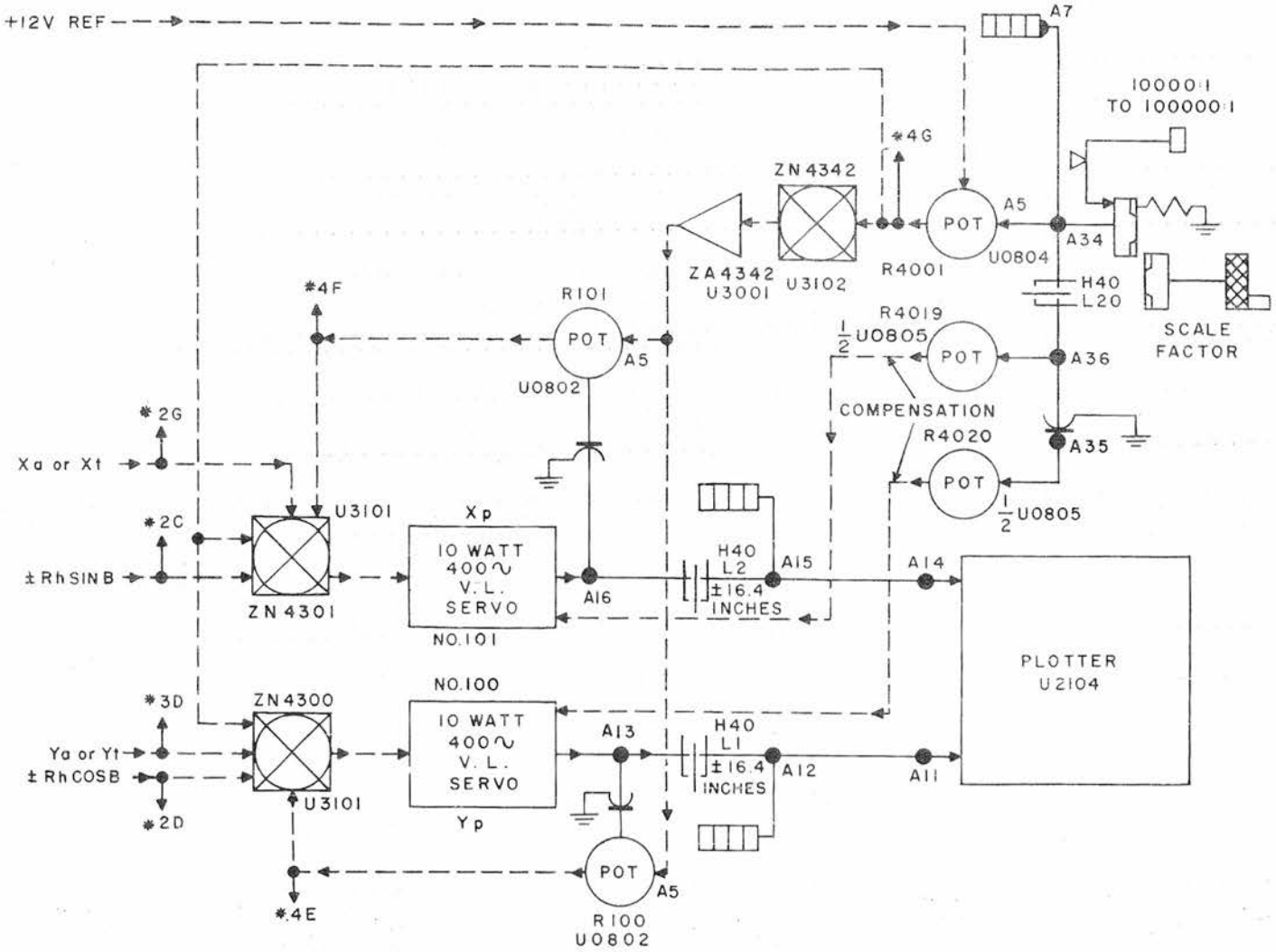

Figure 51. Plotter Group

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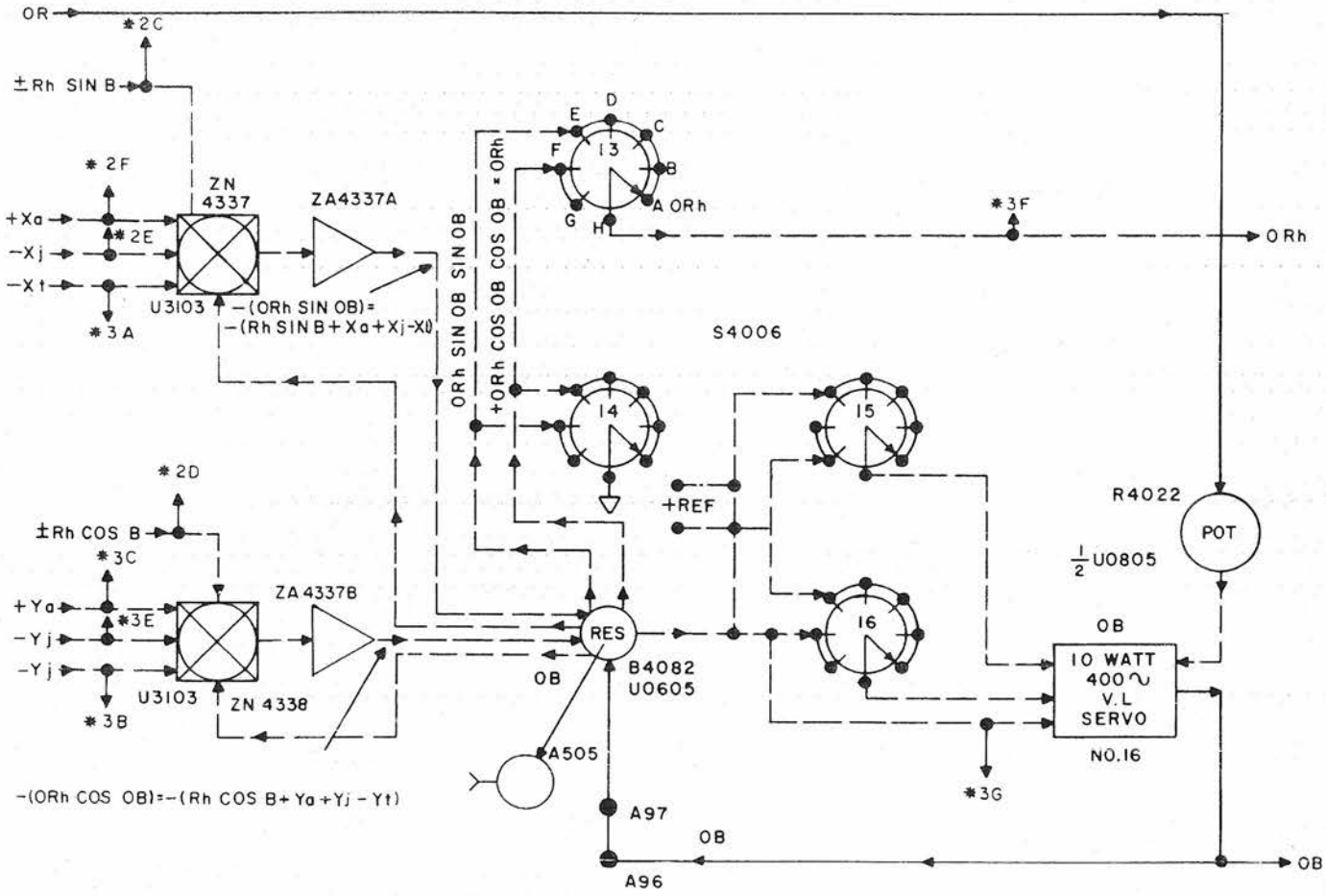

Figure 52. ORh and OB Computing Loop

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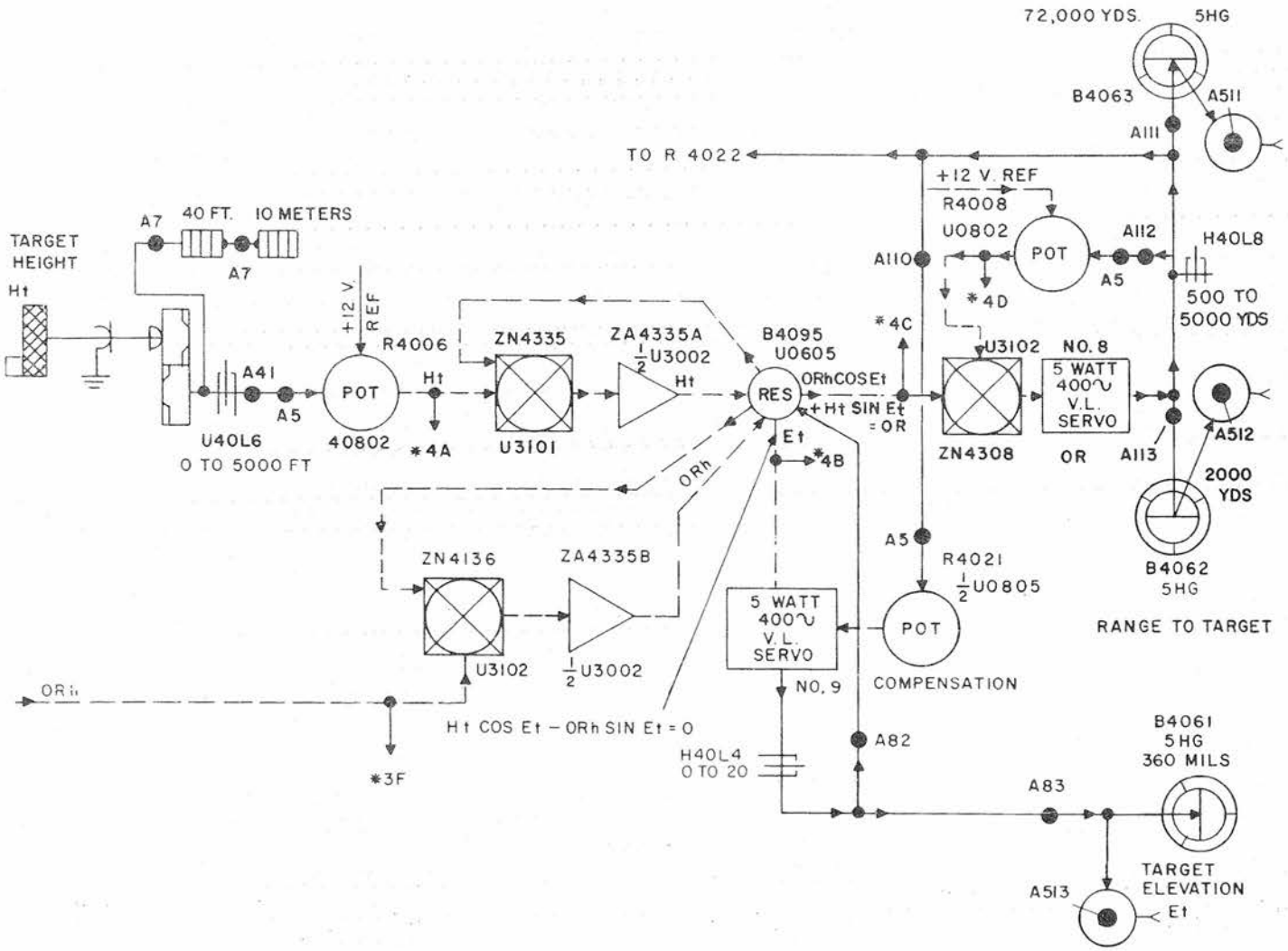

Figure 53. Et and OR Loop

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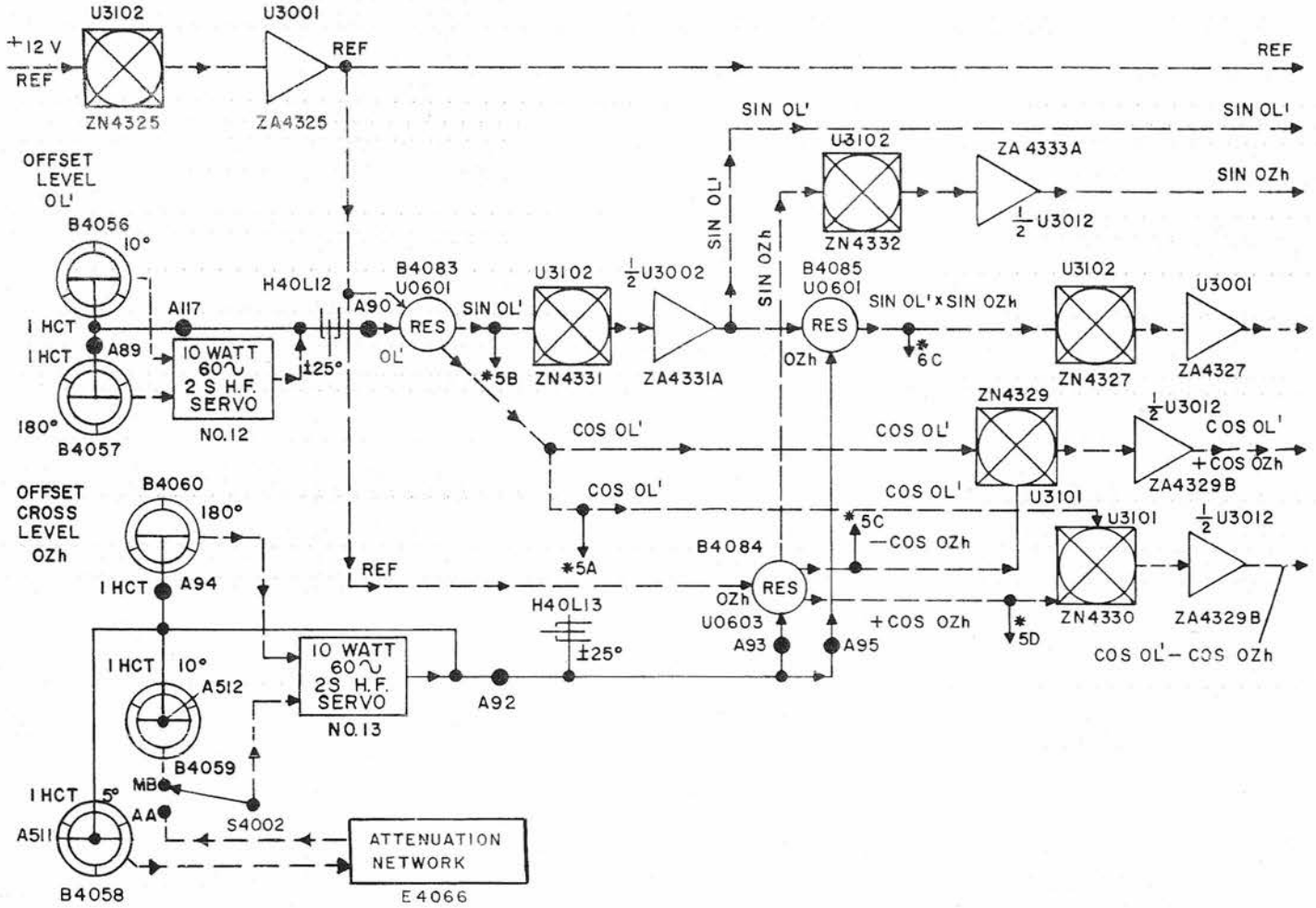

Figure 54. OL' and OZh Resolver Group

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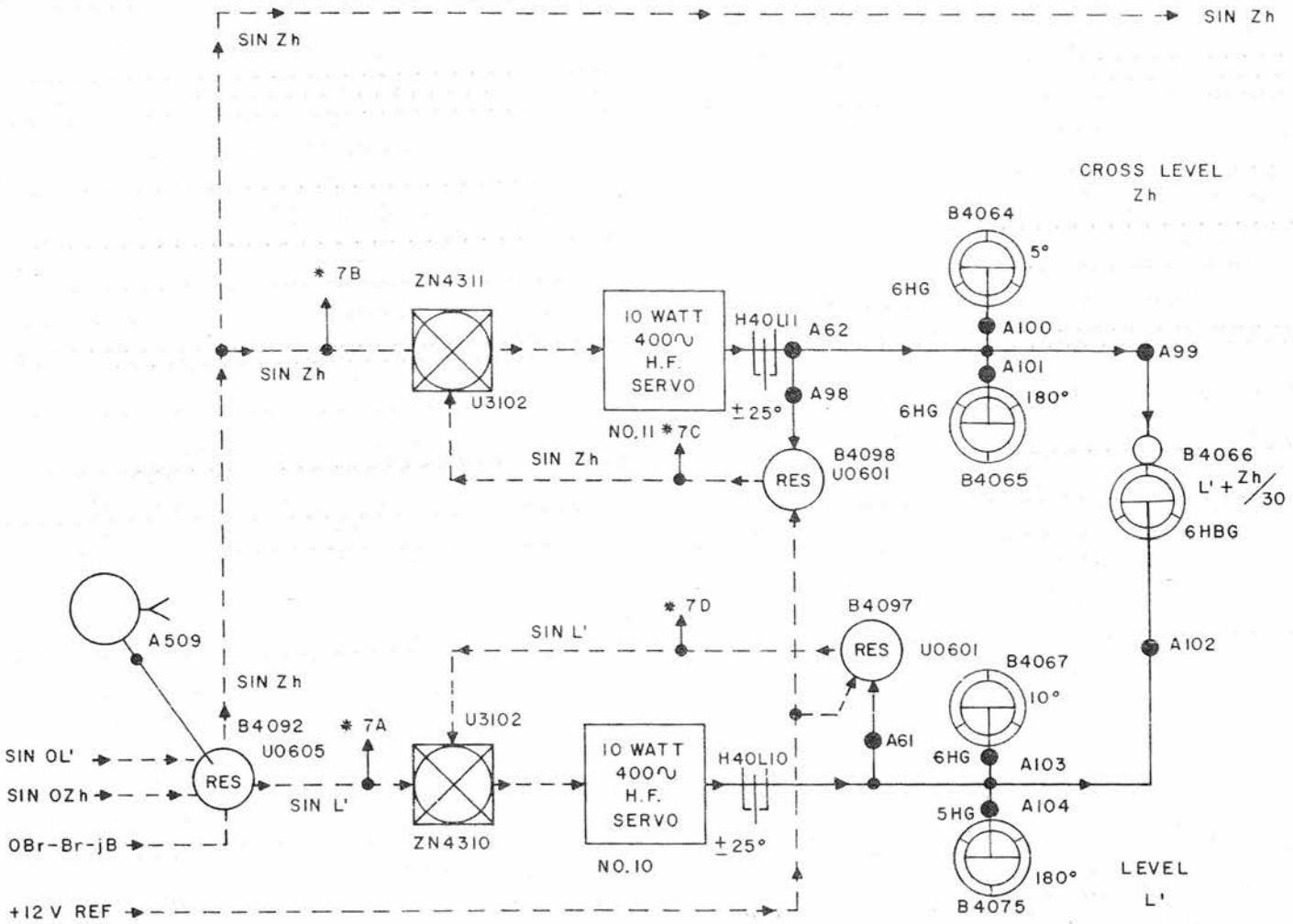

Figure 55. L' and Zh Computing Loops

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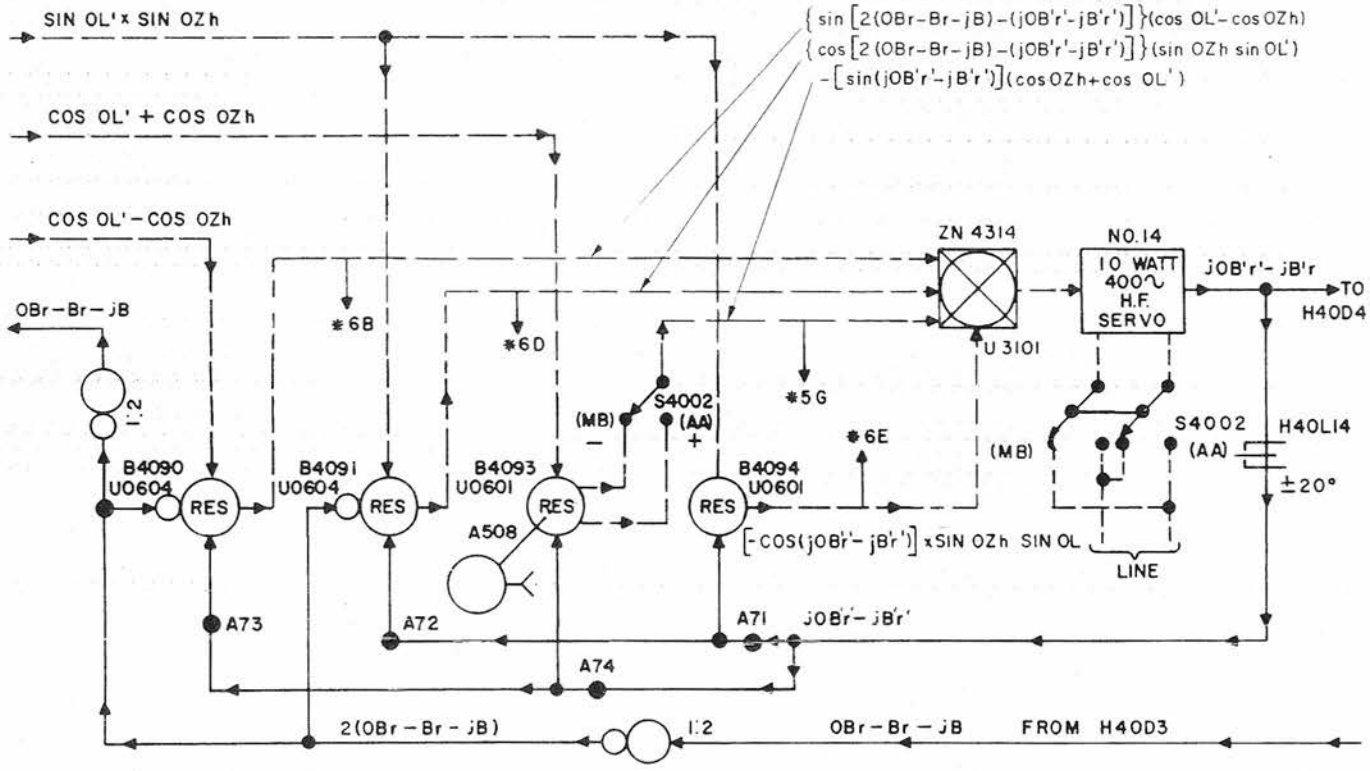

Figure 56. jOB'r' - jB'r' Loop

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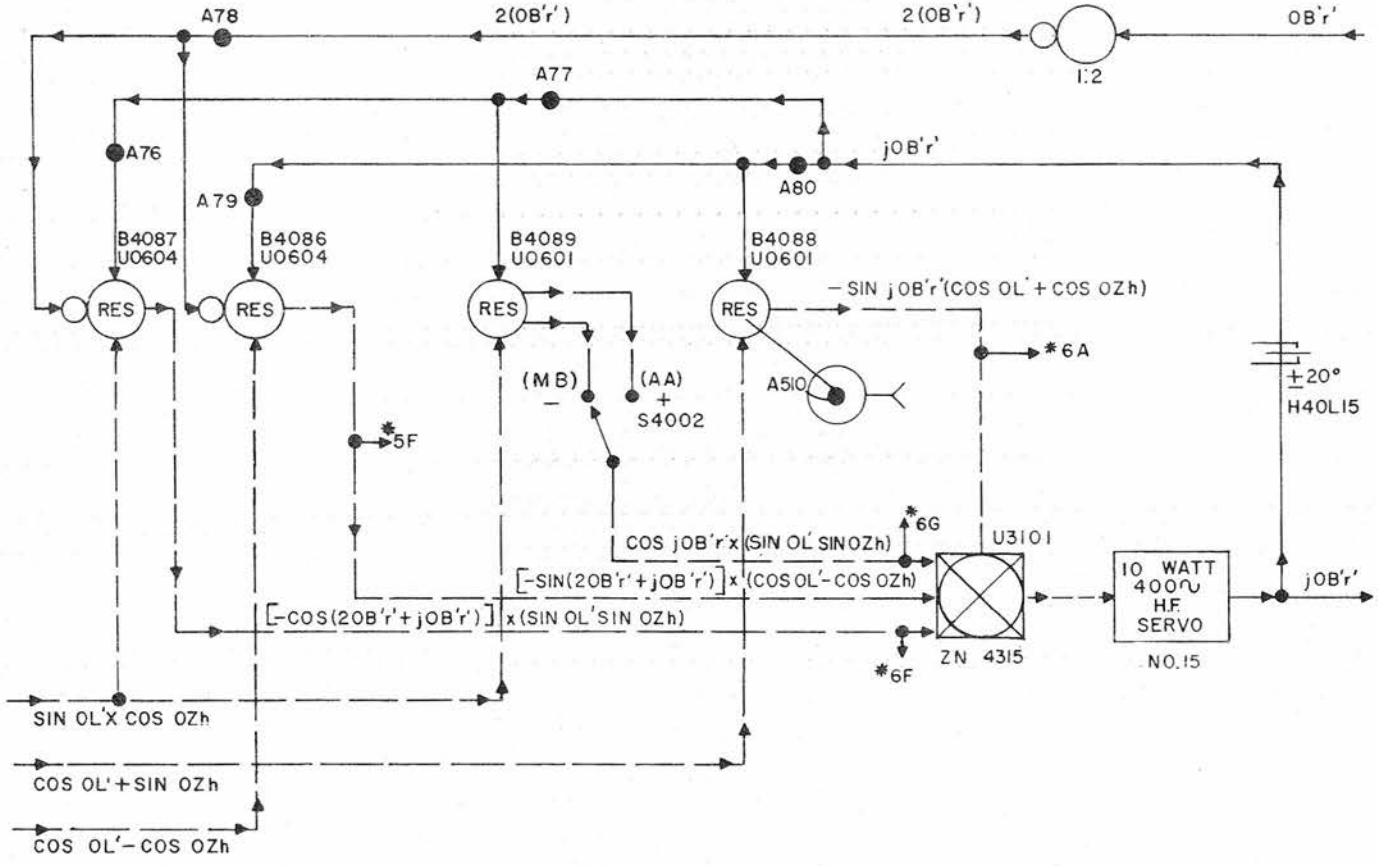

Figure 57. jOB'r' Loop

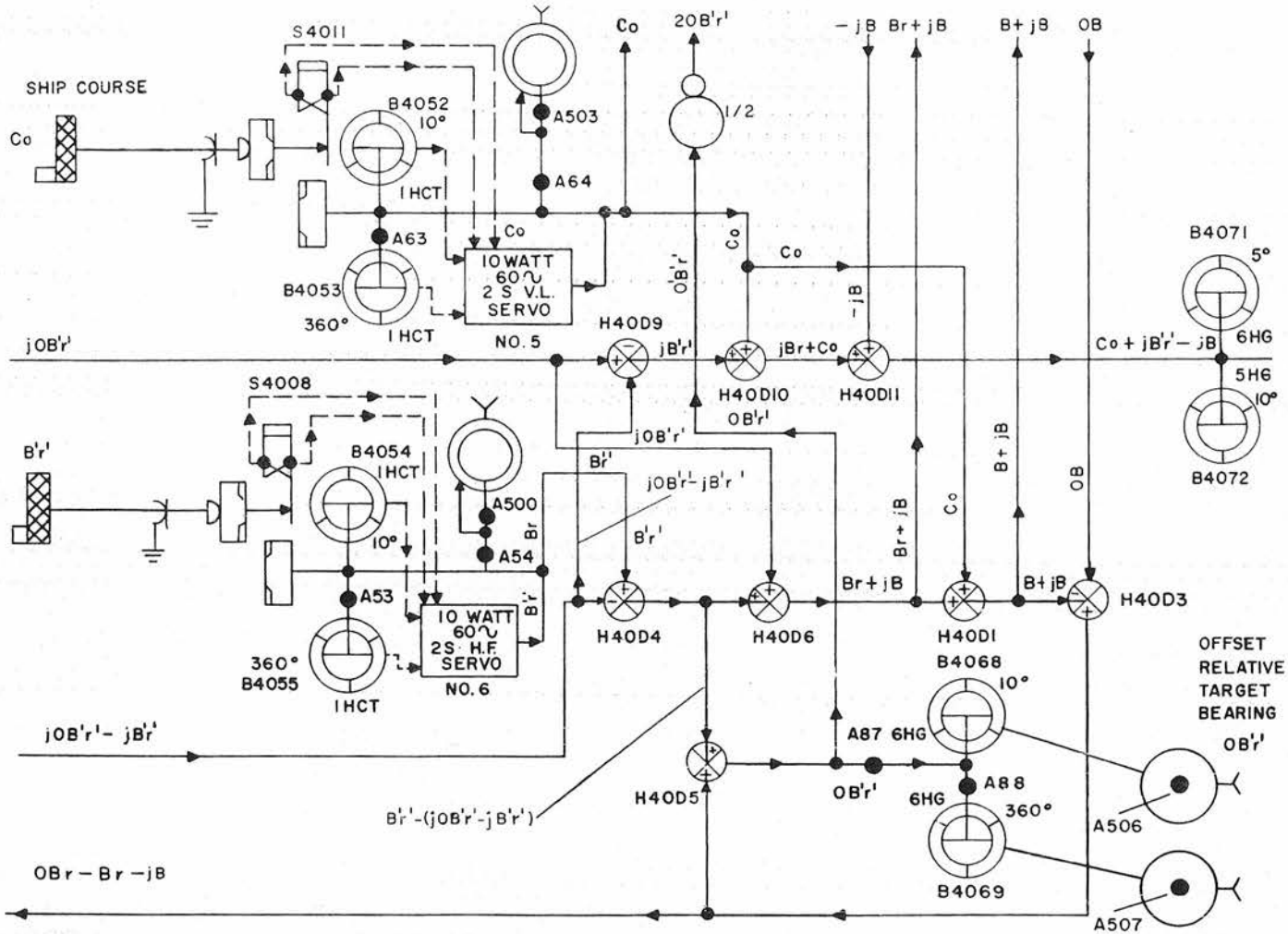

Figure 58. OB'r' Differentials

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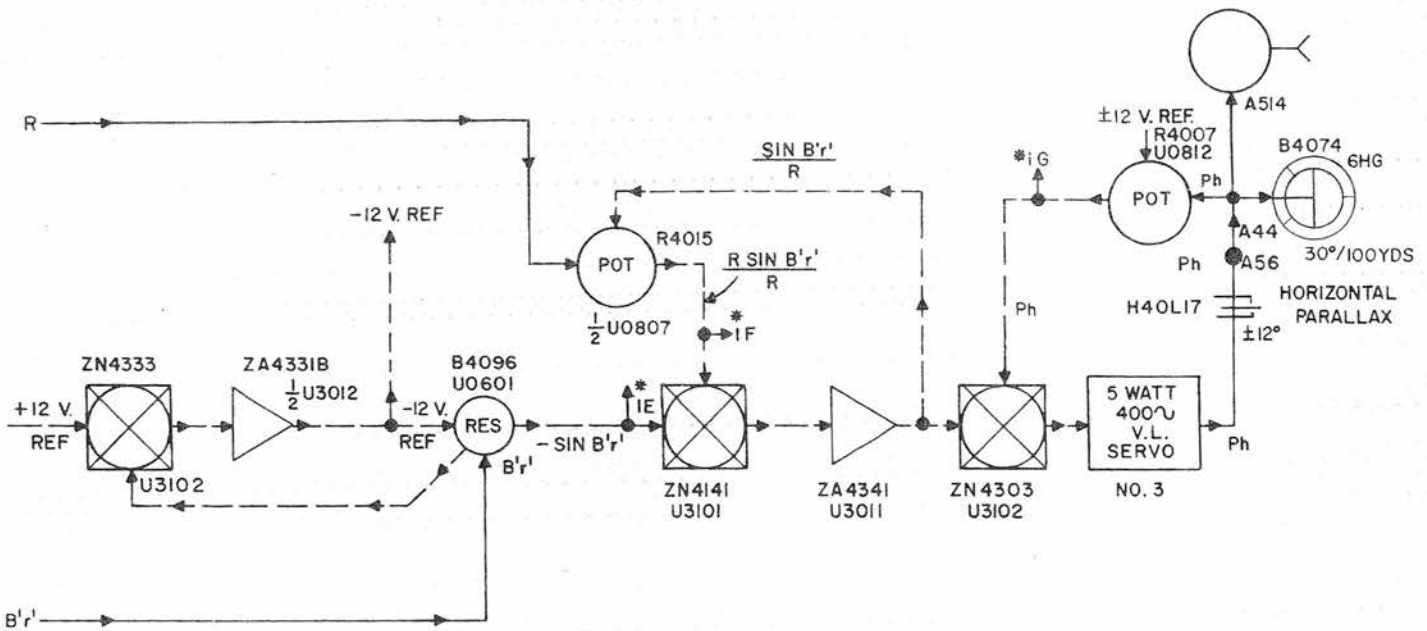

Figure 59. Parallax Group

Preliminary Check

In general, examine a defective unit for visible signs of trouble and for electron-tube failure. Check to see if all soldered connections are good, both mechanically and electrically. Look for charring on insulation and resistors and leaking of compound from potted components due to overheating. Check for an odor of burned insulation from transformers and resistors, as both usually indicate shorts in the circuit. Replace damaged components and conduct a complete point-to-point resistance and voltage test to locate other circuit faults which may have caused the obvious damage to the parts that were replaced. Check the electron tubes by substituting good ones, one at a time, each time operating the element in the circuit and using the neon monitoring system to determine whether the trouble has been cleared. All tubes not requiring replacement should be reinstalled in the element sockets from which they were taken. If the preliminary check of components does not reveal the cause of failure, then the troubleshooting tests should be used to locate the source of trouble and to correct it.

Trouble Shooting Tests

The trouble shooting tests for electronic elements consist of point-to-point measurements of circuit voltages and resistance. An element circuit schematic that shows the location of all test points is included with each test.

Test Points. Test point identification numbers are shown enclosed in circles on the schematic. These same numbers are found on the terminal boards in the element chassis adjacent to their respective terminals. Additional test points are the terminals of tubes, transformers, and panel connectors, any of which can be found correspondingly designated in the test-data tables, on the circuit schematic, or in the element proper.

Electrical Measurements. Voltage readings are taken with the element plugged into its normal position in the computer and with the tubes installed. If the trouble is not localized during the voltage tests, remove the element from the computer to eliminate any effects other circuits may have on the measurements, remove all tubes, and conduct the resistance tests. All voltage and resistance measurements are made between the prescribed test points and chassis ground, unless otherwise noted. The number of test points covered for each element is sufficient to enable localization of trouble to a relatively small portion of the circuit.

To further localize the defective part, refer to the circuit schematic where values for individual circuit components are shown. When measuring resistance across points not covered in the tables, determine beforehand the total value for the points concerned. Consider all resistances in series or in parallel between the two points. Also, consider that each capacitor has infinite resistance, unless defective. If an incorrect resistance reading is obtained between two circuit points, disconnect one side of each component and measure it separately. Compare the value measured with the value specified in the schematic. If the error indicated exceeds the stated tolerance, replace the component with a new one of correct value and power rating. Replace any capacitor which, when tested separately, indicates other than infinite resistance.

After replacing a defective part, the resistance check should be re-run to make sure that the circuit has been corrected, then make a complete recheck of the voltages with the element plugged into the instrument. Before assigning the element to active or spare use, test it functionally in the computer by performing appropriate routine computer tests.

Electronic Element Reference Table

Table 39 lists all of the electronic elements in the order of their element identification numbers, and contains pertinent maintenance information for each item. (Refer to Component Identification, section 5. 2) One purpose of this table is to show those elements that are interchangeable. All elements that have identical unit numbers, designation, and ordnance drawing numbers can be interchanged with one another. Also, the table serves as a guide in finding the physical location of an element in the electronic section of the computer. The key to element location listed in the fourth column of the table is explained in the following paragraph.

Location of Electronic Elements

To locate the position of an electronic element in the instrument, refer to table 39 and note the key letter in the location column opposite the designation symbol of the element. Then refer to figure 60, which is a left-side block diagram of the computer with the element racks drawn out and turned down (fully extended). The letters labeling the various sections correspond with those in the table and give the general location of an element. To find the exact position of an element in its section, figures 61 through 66 show elevation views of the sections and also are correspondingly labeled.

Access to Electronic Elements

Once the position of an element is determined, the appropriate panel can be removed by turning all fasteners one-quarter turn and lifting the panel off. Figures 43 and 67 show the front electronic section before and after panel removal. The front elements diagrammed in figure 61 (A in figure 60) thus are exposed, providing access to all test points and underchassis components. Access to the rear elements (figure 62 and B in figure 60) is gained by depressing the catch-release button, pulling the drawer out, and turning it down as shown in figures 68 and 69.

To gain access to the electron tubes, turn the fasteners to the release position and swing the top basket (of the two that make up the drawer) upward as shown in figure 70.

To remove an element from the basket, unscrew the retaining jack-screw (s), tilt the panel-connector end away from the basket, and withdraw the element from the two supporting dowel pins at the opposite end. Figure 71 shows the above-mentioned features of a typical electronic element withdrawn from the instrument.

Figures 72 through 85 are element circuit schematics that show the location of all test points. Test data for the point-to-point measurements, and all information too lengthy to include on the schematics, such as parts lists and notes, are given in tables 40 through 65.

Special Potentiometer Settings For Tests

Potentiometer adjustments are set by the manufacturer, and unless disturbed, ordinarily will not change in value. Most potentiometers are held in correct position by a detent action associated with its control shaft. Turning the control shaft of the potentiometer will correspondingly change the potentiometer value, but should not change the original detent position. When testing an electronic element the test procedure may require a potentiometer to be turned fully clockwise or counter-clockwise before a measurement is taken. To turn the potentiometer, first partially unscrew the outer locking screw from the control shaft, and then turn the shaft in the direction specified in the test procedure. Upon completing the test, return the potentiometer to its original position by rotating the control shaft back over the

Table 39

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZA4102	3201	R	A	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4103	3201	Ph	A	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4104	3201	jB	A	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4105	3201	Co	A	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4106	3201	B'r'	A	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4107	3201	Es	A	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4108	3201	OR	B	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4109	3201	Et	B	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4110	3201	L'	B	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4112	3201	OL'	B	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZA4145	3402	Ref v	C	Tuning-fork amplifier	1372170	1372171	285623
ZA4300	3201	Xp	E	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4301	3201	Yp	E	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4311	3201	Zh	F	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4313	3201	OZh	F	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276960
ZA4314	3201	jOB'r' - jB'r'	F	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276906
ZA4315	3201	jOB'r'	F	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276608
ZA4316	3201	OB	E	Servo amplifier 5- and 10-watt motor, 60-c	980405	980406	276608
ZA4325	3001	Ref v	E	Amplifier, single-channel, computing, 400-c	980431	980432	276958
ZA4327	3001	Sin OL' x sin OZh	E	Amplifier, single-channel, computing, 400-c	980431	980432	276958

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZA4329	3012	Cos OL' + cos OZh Cos OL' - cos OZh	E	Amplifier, dual-channel, resolver	1371930	1371931	285612
ZA4331	3012	Sin OL', ref v	E	Amplifier dual-channel, resolver	1371930	1371931	285612
ZA4333	3002	Sin OZh, R	E	Amplifier, dual-channel, resolver, 400-c	980156	980230	276632
ZA4335	3002	Ht, ORh	E	Amplifier, dual-channel, resolver, 400-c	980156	980230	276632
ZA4337	3002	ORh sin OB, ORh cos OB	E	Amplifier, dual-channel, resolver, 400-c	980156	980230	276632
ZA4339	3002	Rh, spare	E	Amplifier, dual-channel, resolver, 400-c	980156	980230	276632
ZA4341	3011	Ph	E	Amplifier, single-channel, 400-c, 500-ohm load	1371876	1371873	285607
ZA4342	3001	SF	E	Amplifier, single-channel, 400-c, 500-ohm load	980431	980432	276958

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZB4102	3304	R	A	Servo control, vel-lag, 60-c, double-speed	980419	980420	276965
ZB4103	3301	Ph	A	Servo control, vel-lag, 400- to 60-c	980602	980604	276627
ZB4104	3302	jB	A	Servo control, high-fidelity, 400- to 60-c	1371797	1371982	285614
ZB4105	3304	Co	A	Servo control, vel-lag, 60-c, double-speed	980419	980420	276965
ZB4106	3305	B'r'	A	Servo control, high-fidelity, double-speed, 60-c	980422	980423	276956
ZB4107	3301	Es	B	Servo control, vel-lag, 400- to 60-c	980602	980604	276627
ZB4108	3301	OR	B	Servo control, vel-lag, 400- to 60-c	980602	980604	276627
ZB4109	3301	Et	B	Servo control, vel-lag, 400- to 60-c	980602	980604	276627
ZB4110	3302	L'	B	Servo control, high-fidelity, 400- to 60-c	1371797	1371982	285614
ZB4112	3305	OL'	B	Servo control, high-fidelity, 400- to 60-c	980422	980423	276956

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZB4300	3301	Xp	E	Servo control, vel-lag, 400- to 60-c	980602	980604	276627
ZB4301	3301	Yp	E	Servo control, vel-lag, 400- to 60-c	980602	980604	276627
ZB4311	3302	Zh	F	Servo control, high-fidelity, 400- to 60-c	1371797	1371982	285614
ZB4313	3305	OZh	F	Servo control, high-fidelity, double-speed, 60-c	980422	980423	276956
ZB4314	3302	jOB'r' -jB'r'	F	Servo control, high-fidelity 400- to 60-c	1371797	1371982	285614
ZB4315	3302	jOB'r'	F	Servo control, high-fidelity 400- to 60-c	1371797	1371982	285614
ZB4316	3301	OB	F	Servo control, vel-lag 400- to 60-c	980602	980604	276627
ZC4101	3803	B+	C	+250 VDC series regulator	951989	951990	273343
ZC4102	3803	B+	C	+250 VDC series regulator	951989	951990	273343
ZC4103	3803	B+	C	+250 VDC series regulator	951989	951990	273343
ZC4104	3804	B-	C	-105 DC regulated power supply	979772	979827	276954

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZM4101	1903		C	Time delay control, 60-c	979577	596437	273365
ZN4136	3102	ORh	C	Resistance summing networks	952085-1	979458-1	285600
ZN4139	3102	Rh	C	Resistance summing networks	952085-1	979458-1	285600
ZN4141	3101	Sin B'r'	C	Resistance summing networks	951731-88	137907	285600
ZN4300	3101	Yp	D	Resistance summing networks	951731-89	137907	285600
ZN4301	3101	Xp	D	Resistance summing networks	951731-89	137907	285600
ZN4303	3102	Ph	D	Resistance summing networks	952085-1	979458-1	285600
ZN4304	3102	jB	D	Resistance summing networks	952085-39	1371900-1	285600
ZN4307	3101	Hs	D	Resistance summing networks	951731-85	1371903	285600
ZN4308	3102	OR	D	Resistance summing networks	952085-40	1371900-2	285600

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZN4310	3102	Sin L'	D	Resistance summing networks	952085-41	1371900-3	285600
ZN4311	3102	Sin ZH	D	Resistance summing networks	952085-41	1371900-3	285600
ZN4314	3101	jOB'r' -jB'r'	D	Resistance summing networks	951731-86	1371904	285600
ZN4315	3101	jOB'r'	D	Resistance summing networks	951731-86	1371904	285600
ZN4325	3102	Ref v	D	Resistance summing networks	952085-43	1371900-5	285600
ZN4327	3102	Sin OL' x Sin OZh	D	Resistance summing networks			
ZN4329	3101	Cos OL' + cos OZh	D	Resistance summing networks	951731-87	1371905	285611
ZN4330	3101	Cos OL' - cos OZh	D	Resistance summing networks	951731-90	1371908	285611
ZN4331	3102	Sin OL'	D	Resistance summing networks	952085-45	1371900-7	285611
ZN4332	3102	Sin OZh	D	Resistance summing networks	952085-41	1371900-3	285600

Table 39 (Cont'd)

ELECTRONIC ELEMENTS

Element	Unit	Function	Location on Figure 60	Designation	Assembly BuOrd Dwg	Schematic BuOrd Dwg	Test Spec BuOrd Sk
ZN4333	3102	Ref v	D	Resistance summing networks	952085-1	979458-1	285600
ZN4334	3102	R	D	Resistance summing networks	952085-1	979458-1	285600
ZN4335	3101	Ht	D	Resistance summing networks	951731-85	1371903	285600
ZN4337	3103	Orh sin OB	D	Resistance summing networks			
ZN4338	3103	Orh cos OB	D	Resistance summing networks	952088-27	1371902	285600
ZN4342	3102	SF	D	Resistance summing networks	952085-7	979458-7	285600
ZY4101	3401	Ref v	C	Tuning-fork oscillator	1372162	1372163	285702

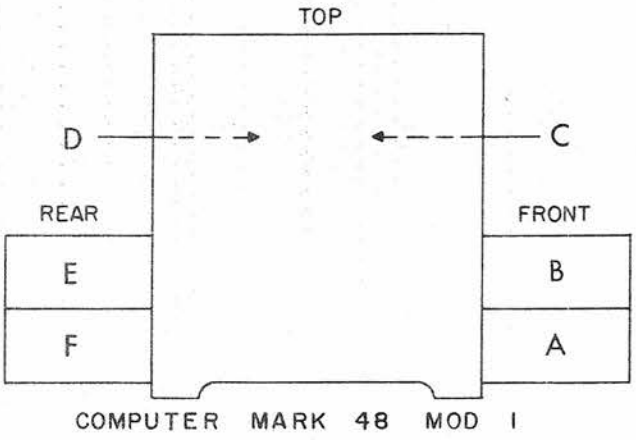

Figure 60. Key Diagram for Figures 61 through 66

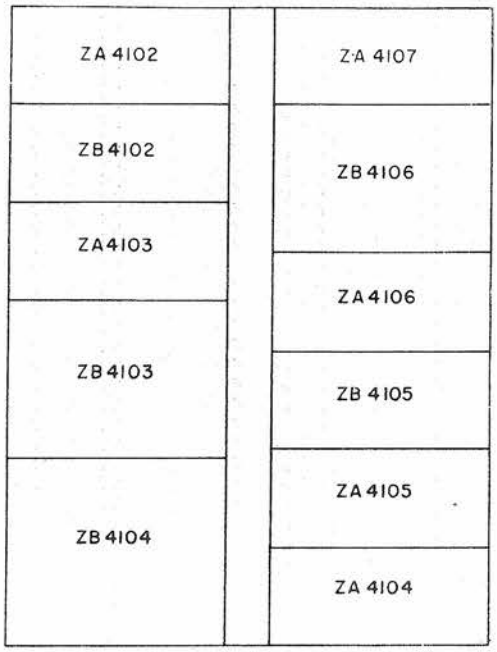

Figure 61. Electronic Section, Front Drawer - Front View (Section A, Figure 60)

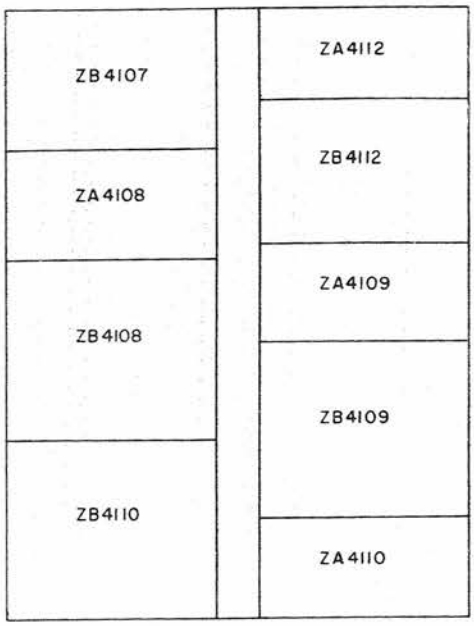

Figure 62. Electronic Section, Front Drawer - Rear View (Section B, Figure 60)

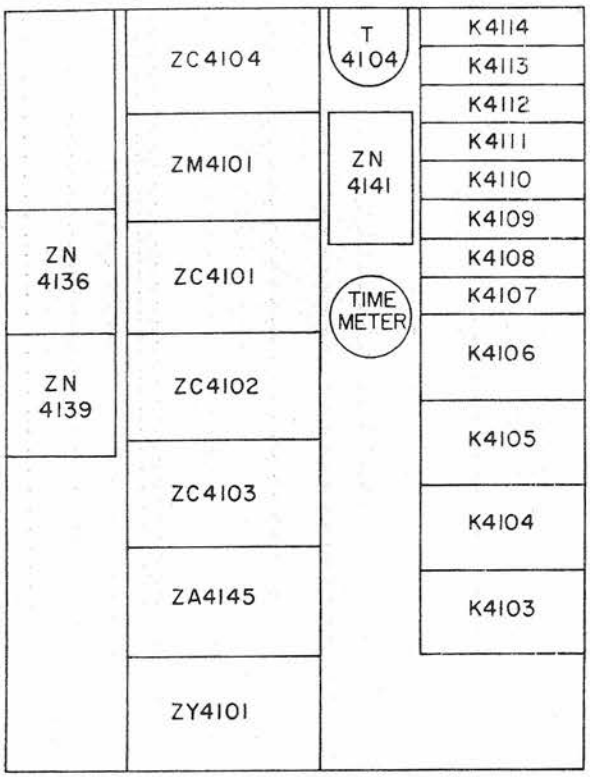

Figure 63. Electronic Section, Center Wall - Front View
(Section C, Figure 60)

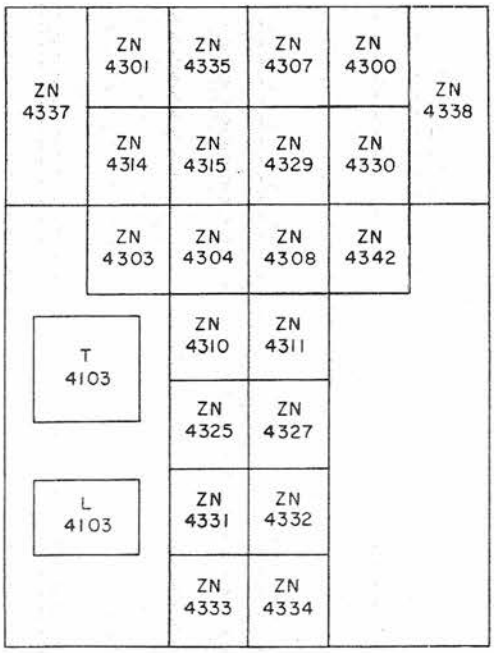

Figure 64. Electronic Section, Center Wall - Rear View (Section D, Figure 60)

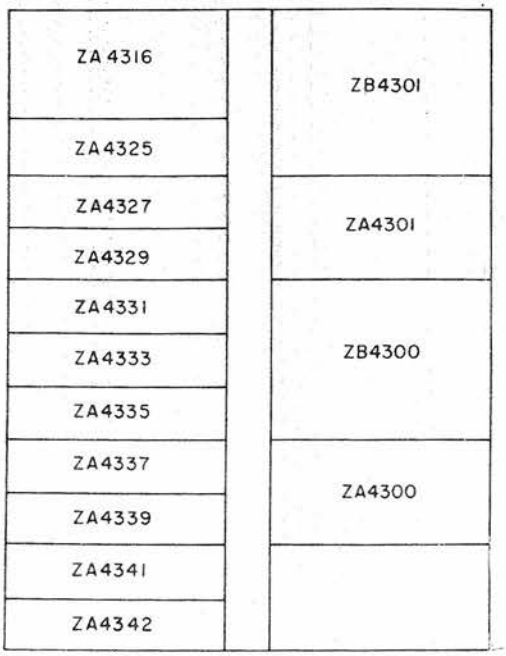

Figure 65. Electronic Section, Rear Drawer - Rear View (Section E, Figure 60)

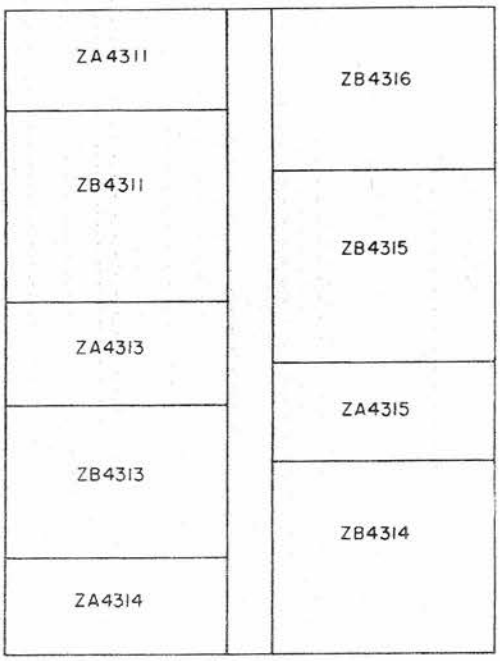

Figure 66. Electronic Section, Rear Drawer - Front View
(Section F, Figure 60)

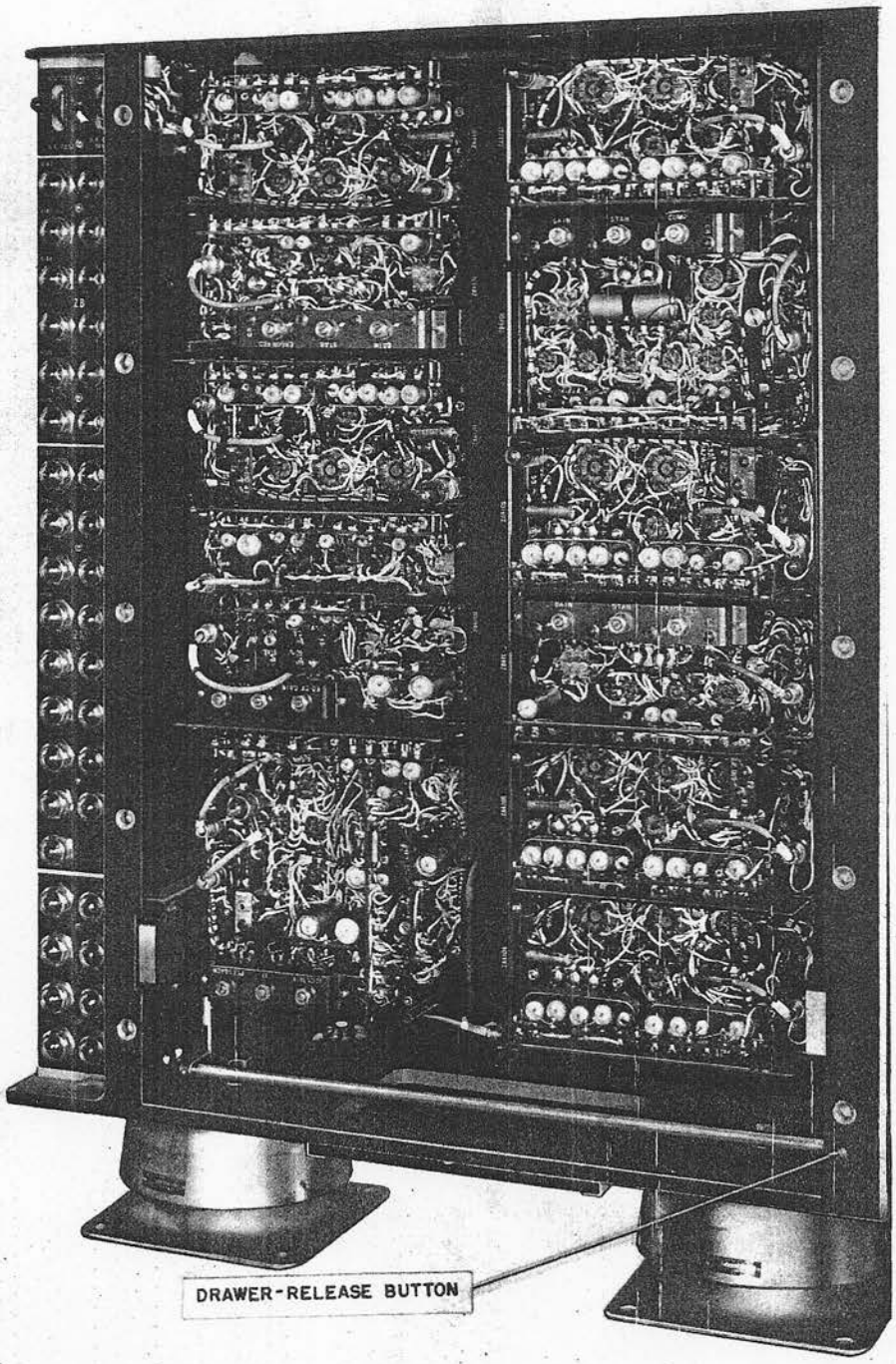

Figure 67. Front Electronic Section, Cover No. 4 Removed

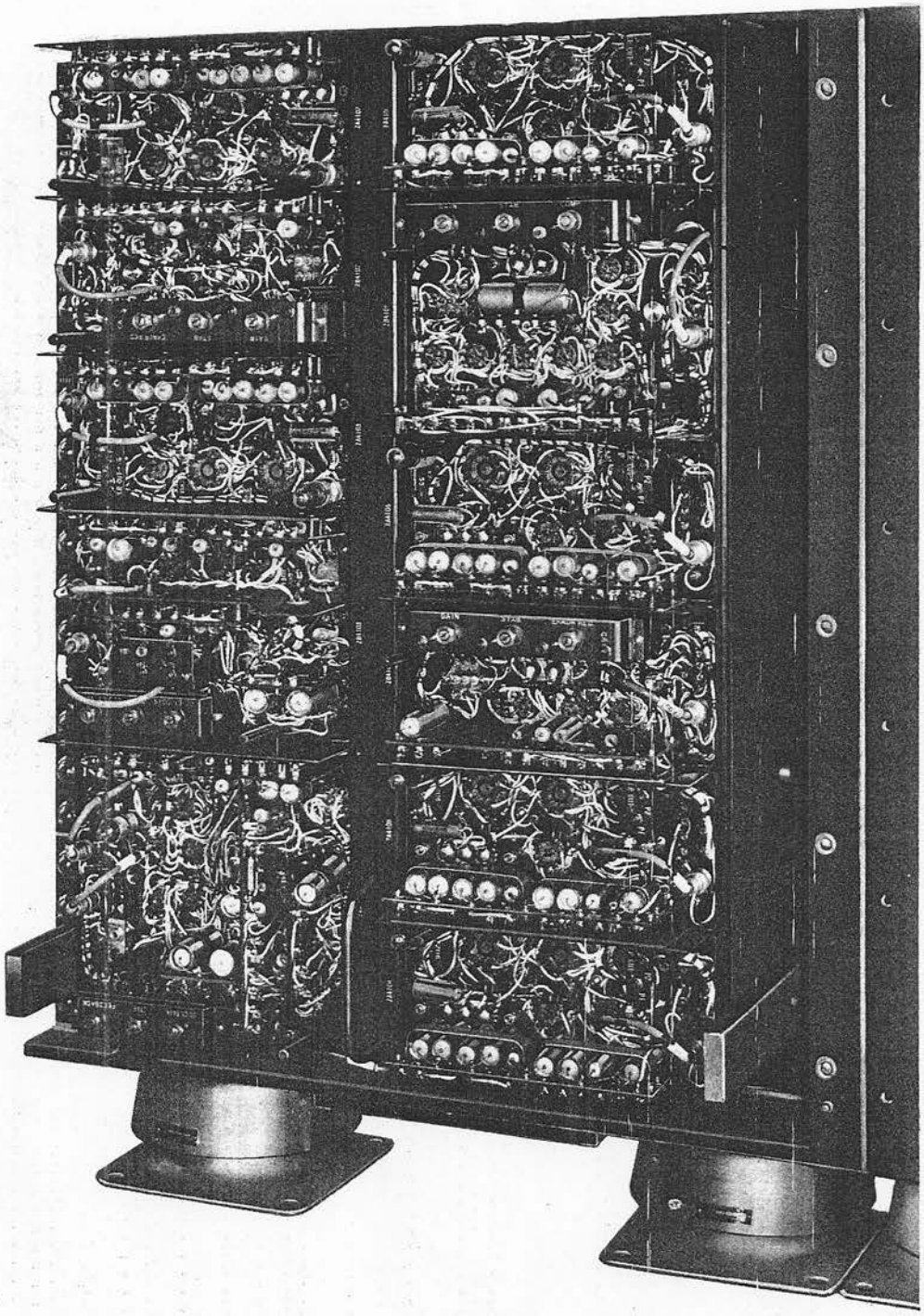

Figure 68. Front Drawer Pulled Out

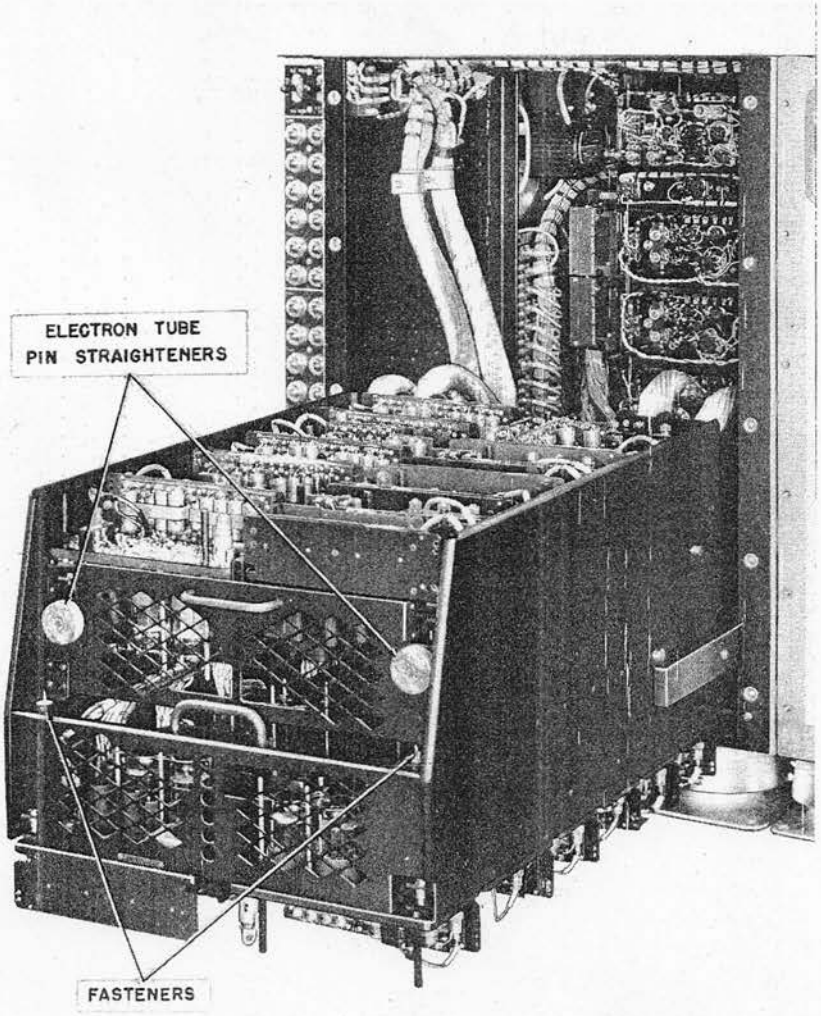

Figure 69. Front Drawer Out, Baskets Swung Down

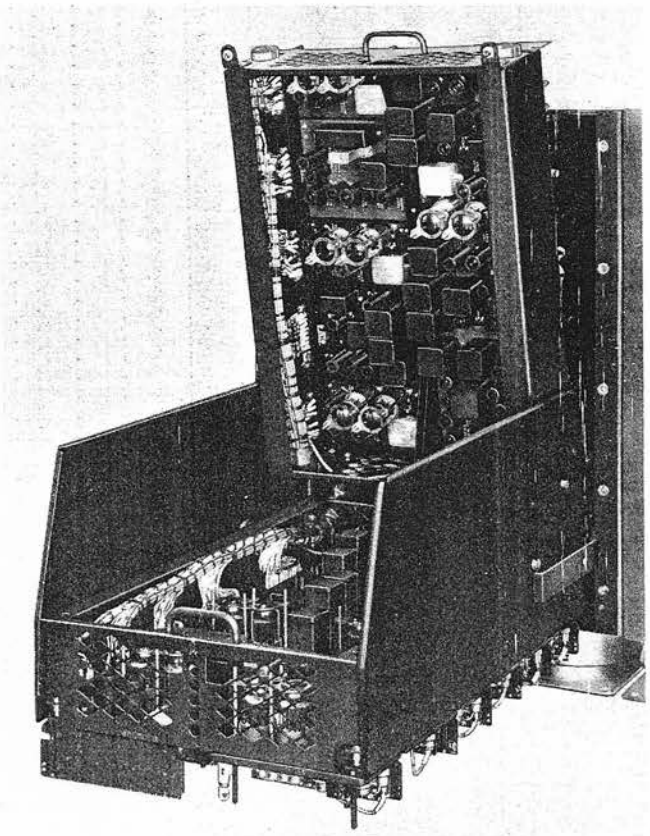

Figure 70 Front Drawer Out, Baskets Opened

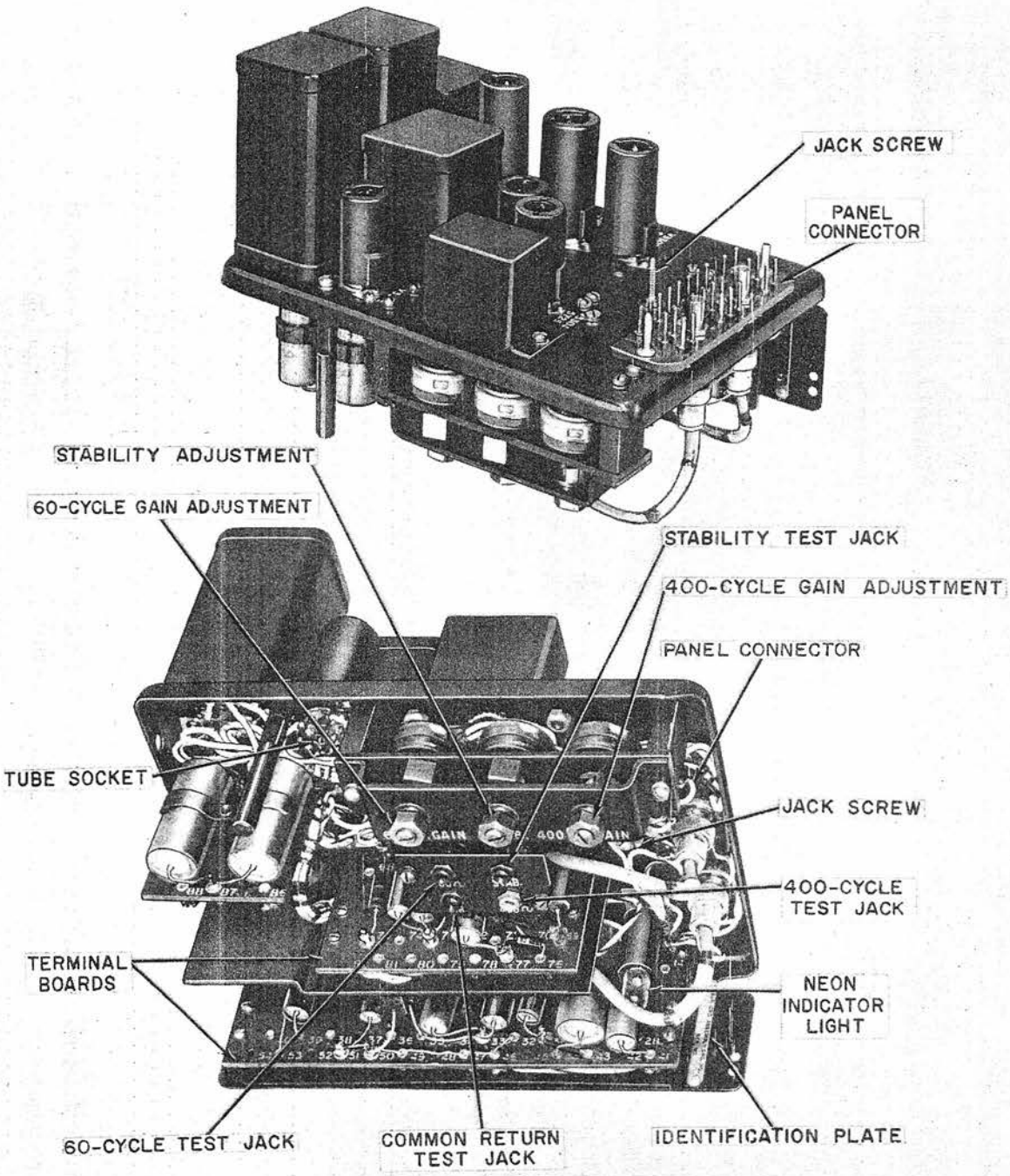

Figure 71. Typical Electronic Element of Computer Mk 48 Mod 1

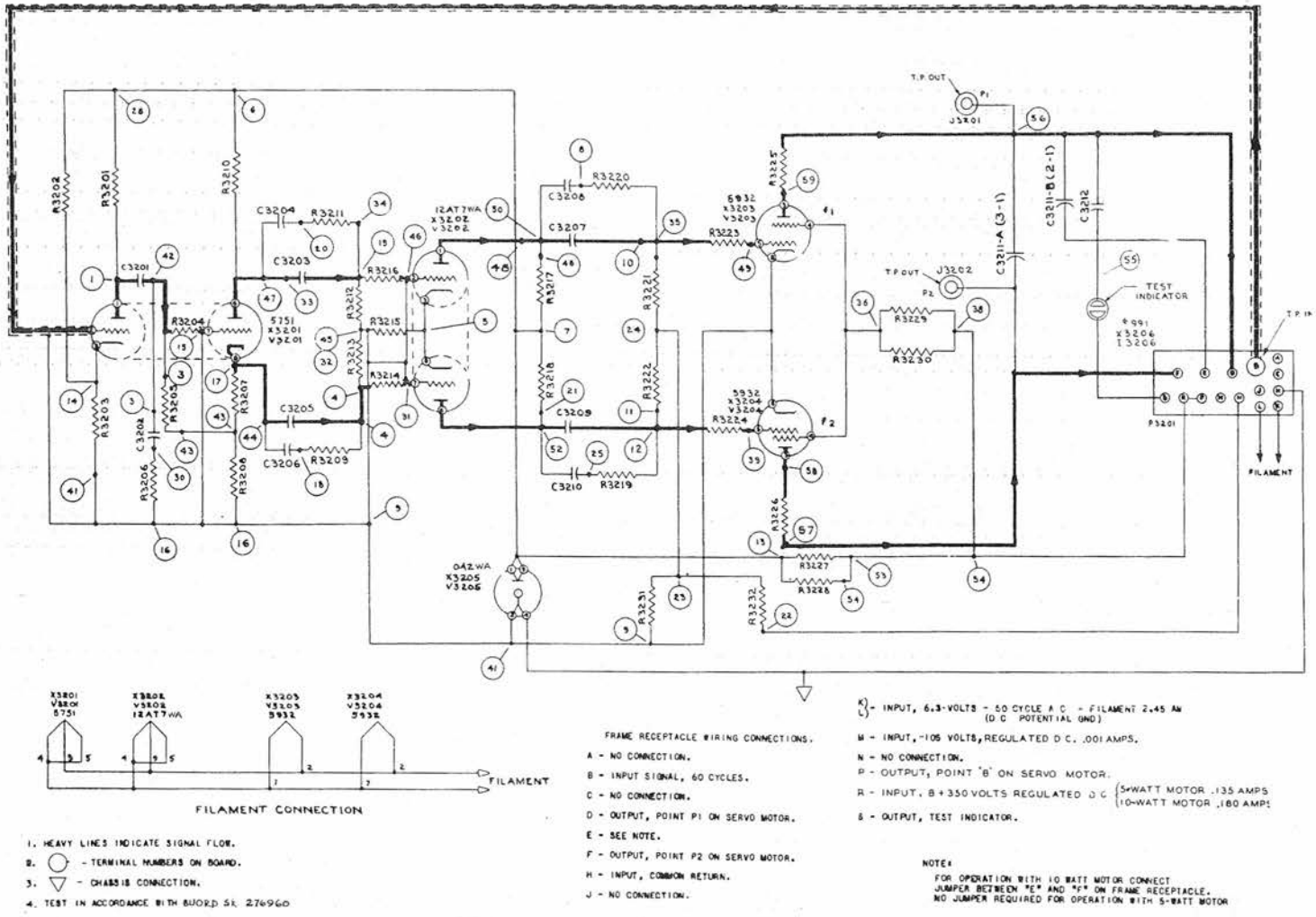

Figure 72. Servo Amplifier, 60-cycles, Schematic Diagram (Unit 3201)

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CONFIDENTIAL

Table 40

UNIT 3201 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980405

Resistance Tests

Terminals	Normal	Minimum	Maximum
1	530.6K	503K	556K
2	Infinite	---	---
3	1.02M	972K	1.08M
4	470K	423K	517K
5	390	370	410
6	100.5K	95K	105.5K
7	100.5K	95K	105.5K
8	551K	499K	602K
9	0	0	0
10	81K	76.9K	85.1K
11	81K	76.9K	85.1K
12	81K	76.9K	85.1K
13	100.5K	95K	105.5K
14	560	532	588
15	1.49M	1.39M	1.59M
16	0	0	0
17	28.3K	26.9K	29.5K
18	1.47M	1.32M	1.62M
19	470K	423K	417K
20	470K	666K	814K
21	122.5K	115K	128.7K
22	122K	106.4K	117.6K
23	30K	28.5K	31.5K
24	30K	28.5K	31.5K
25	551K	499K	602K
28	100.5K	95K	105.5K
29	Infinite	---	---
30	100K	90K	110K
31	940K	886K	1.03K
32	0	0	0
33	130.5K	123K	137K
34	470K	423K	517K
35	81K	76.9K	85.1K
36	121.2K	114.7K	127.3K
38	115.5K	109.3K	120.3K
39	81.1K	77K	85.2K
41	0	0	0
42	1.03M	972K	1.08M
43	24K	22.8K	25.2K
44	28.3K	26.9K	29.5K
45	0	0	0
46	940K	886K	1.03M
47	130.5K	123K	137K
48	122.5K	115.9K	128.6K
49	81.1K	77K	85.2K

Table 40 (Cont'd)

UNIT 3201 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980405

Resistance Tests

Terminals	Normal	Minimum	Maximum
50	122.5K	115.9K	128.6K
52	122.5K	115.9K	128.6K
53	115.5K	109.3K	120.3K
54	115.5K	109.3K	120.3K
55 to 56	56	50.4	61.6
57 to 58	56	50.4	61.6

DC Voltage Tests

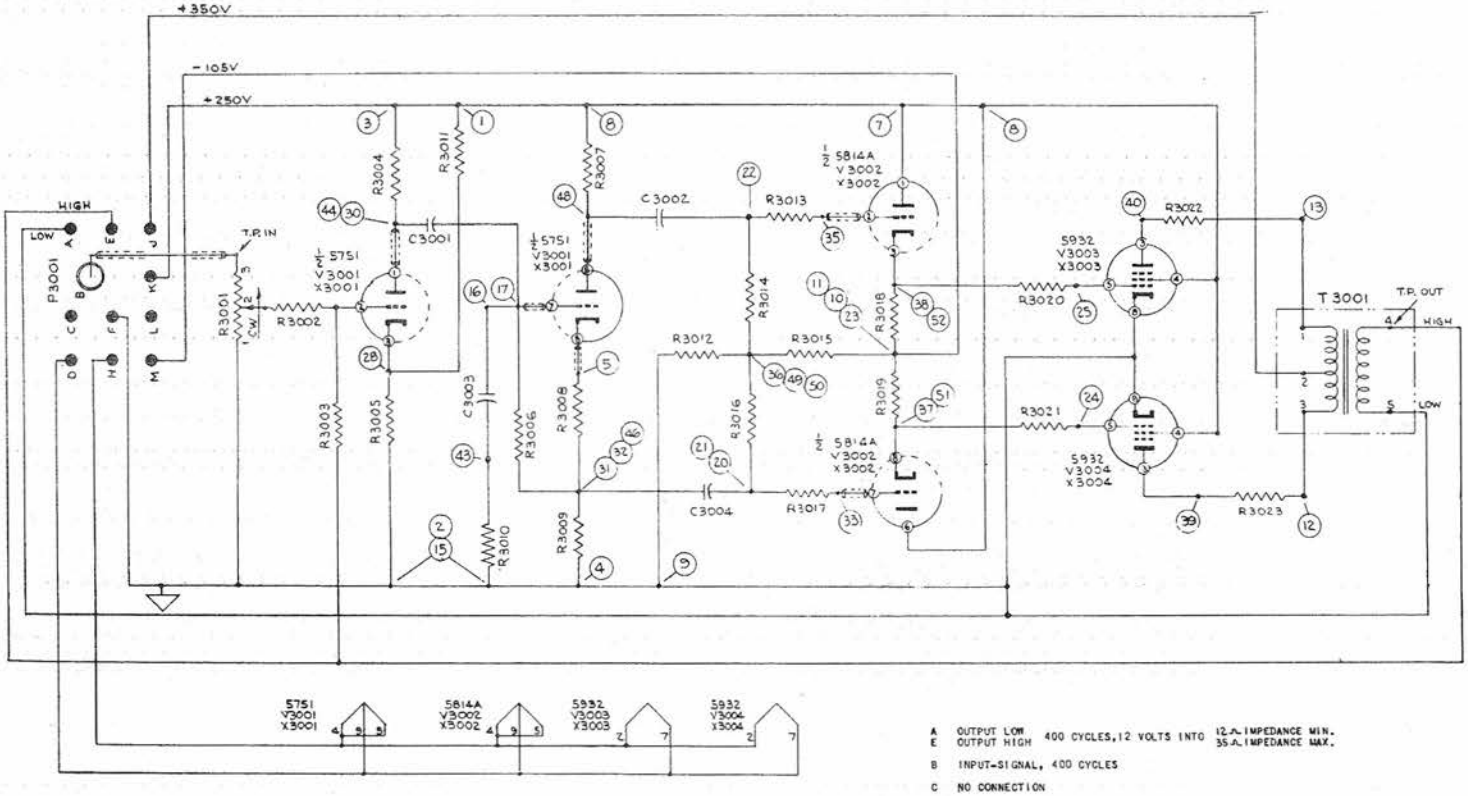
Terminal	Volts	Terminal	Volts
1	+75	31	0
2	+75	32	0
4	0	33	+137
5	0	34	0
6	+148	35	-27
7	+148	36	+275
8	-19.5	38	+350
9	0	39	-27.5
10	-27.5	41	0
11	-27.5	43	+7
13	+148	44	+9
14	+0.89	46	0
15	0	47	+137
16	0	49	-27.5
17	+9	50	+108.5
18	0	52	+105
19	0	53	+350
20	0	54	+350
21	+105	55	+320*
22	-105	55	+285**
23	-28	56	+315*
24	-28	56	+280**
25	-18.6	57	+320*
28	+148	57	+285**
29	+7	58	+315*
30	0	58	+280**

*For 10-watt servo motor.
**For 5-watt servo motor.
Voltage tolerance ±20 per cent. Measurements made with input grid grounded to chassis.

Table 41

UNIT 3201 - PARTS LIST

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
X3206	1000448		SOCKET				1
X3205	12-Z-7510	113	SOCKET,TUBE; 7 PIN JAN TYPE TS102P01				1
X3204 X3203	12-Z-7510	117	SOCKET,TUBE; 8 PIN JAN TYPE TS101P02				2
X3202 X3201	12-Z-7510	114	SOCKET,TUBE; 9 PIN JAN TYPE TS103P01				2
V3205	16-T-52001	3	TUBE,ELECTRON; 0A2WA				1
V3204 V3203	12-Z-13005	608	TUBE,ELECTRON; 5932				2
V3202	16-T-58240	14	TUBE,ELECTRON; 12AT7WA				1
V3201	12-Z-13005	574	TUBE,ELECTRON; 5751				1
I3206	16-T-69910		LAMP, NEON GLOW: TYPE JAN-991				1
P3201	12-Z-7113	6391	CONNECTOR,PLUG;14 LUG 1 COAX. CONTACT; MTG STUDS 2.688" C/C				1
J3202 J3201	12-Z-7113	3001	CONNECTOR,RECEPT; BR,SIL PL RD NYLON INSUL;WITH MTG NUT				2
R3232	12-Z-13111	296	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	82 K	1/2 WATT	±5%	1
R3231	12-Z-13111	255	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	30 K	1/2 WATT	±5%	1
R3230	12-Z-13111	708	RESISTOR,FIXED COMPOSITION .750 LG X .370 DIA.	12 K	2 WATT	±5%	1
R3229	12-Z-13111	707	RESISTOR,FIXED COMPOSITION .750 LG X .370 DIA.	11 K	2 WATT	±5%	1
R3228 R3227	12-Z-13111	717	RESISTOR,FIXED COMPOSITION .750 LG X .370 DIA.	30 K	2 WATT	±5%	2
R3226 R3225	12-Z-13111	428	RESISTOR,FIXED COMPOSITION .750 LG X .280 DIA.	56Ω	1 WATT	±10%	2
R3224 R3223	12-Z-13111	198	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	100Ω	1/2 WATT	±10%	2
R3222 R3221	12-Z-13111	261	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	51 K	1/2 WATT	±5%	2
R3220	12-Z-13111	358	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.47 M	1/2 WATT	±10%	1
R3219	12-Z-13111	358	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.47 M	1/2 WATT	±10%	1
R3218 R3217	12-Z-13111	252	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	22 K	1/2 WATT	±5%	2
R3216	12-Z-13111	358	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.47 M	1/2 WATT	±10%	1
R3215	12-Z-13111	210	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	390Ω	1/2 WATT	±5%	1
R3214 R3213	12-Z-13111	358	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.47 M	1/2 WATT	±10%	2
R3212	12-Z-13111	358	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.47 M	1/2 WATT	±10%	1
R3211	12-Z-13111	355	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.27 M	1/2 WATT	±10%	1
R3210	12-Z-13111	255	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	30 K	1/2 WATT	±5%	1
R3209	12-Z-13111	362	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	1.0 M	1/2 WATT	±10%	1
R3208	12-Z-13111	253	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	24 K	1/2 WATT	±5%	1
R3207	12-Z-13111	235	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	4.3 K	1/2 WATT	±5%	1
R3206	12-Z-13111	350	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.1 M	1/2 WATT	±10%	1
R3205	12-Z-13111	322	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	1.0 M	1/2 WATT	±5%	1
R3204	12-Z-13111	358	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.47 M	1/2 WATT	±10%	1
R3203	12-Z-13111	214	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	560Ω	1/2 WATT	±5%	1
R3202	12-Z-13111	298	RESISTOR,FIXED COMPOSITION .006 LG X .175 DIA.	0.1 M	1/2 WATT	±5%	1
R3201	12-Z-13111	313	RESISTOR,FIXED COMPOSITION .406 LG X .175 DIA.	0.43 M	1/2 WATT	±5%	1
C3211-A C3211-B	12-Z-13100	2177	CAPACITOR,FIXED PAPER JAN TYPE CP55H4FG254V	0.25 MFD 0.25 MFD	1000 WVDC	+20% -10%	1
C3212	12-Z-13100	9624	CAPACITOR,FIXED PAPER 1-1/8 LG X .400 DIA.	.033 MFD	600 WVDC	±20%	1
C3210 C3209 C3208 C3207 C3206	16-C-46201	1001	CAPACITOR,FIXED PAPER 1-3/8 LG X .562 DIA.	.22 MFD	300 WVDC	±20%	5
C3205	12-Z-13100	9539	CAPACITOR,FIXED PAPER 7/8 LG X .400 DIA.	.047 MFD	300 WVDC	±20%	1
C3204	16-C-46201	1001	CAPACITOR,FIXED PWPER 1-3/8 LG X .562 DIA.	.22 MFD	300 WVDC	±20%	1
C3203	12-Z-13100	9539	CAPACITOR,FIXED PAPER 7/8 LG X .400 DIA.	.047 MFD	300 WVDC	±20%	1
C3202	12-Z-13100	9503	CAPACITOR,FIXED PAPER 3/4 LG X .235 DIA.	.0022MFD	300 WVDC	±10%	1
C3201	16-C-46201	1001	CAPACITOR,FIXED PAPER 1-3/8 LG X .562 DIA.	.22 MFD	300 WVDC	±20%	1



NOTES:

1. ○ = TERMINAL POINTS ON TERMINAL.
2. ▽ = CHASSIS CONNECTION.
3. ⊂⊃ = SHIELDED WIRE.
4. TEST IN ACCORDANCE WITH BUORD SK 28562S
5. ALL SHIELDED WIRES GROUND AT ONE END.

A OUTPUT LOW
E OUTPUT HIGH — 400 CYCLES, 12 VOLTS INTO 12Ω IMPEDANCE MIN. 35Ω IMPEDANCE MAX.

B INPUT-SIGNAL, 400 CYCLES

C NO CONNECTION

D H INPUT - 6.3-VOLT FILAMENT, 60-CYCLES, 2.3 AMPS (D.C. POTENTIAL, GND)

F INPUT - COMMON RETURN

J INPUT - +350 VOLTS D C .115 AMPS.

K INPUT - +250 VOLTS REGULATED D C .024 AMPS

L NO CONNECTION

M INPUT - -150 VOLTS, .009 AMPS.

Figure 73. Tuning Fork Amplifier, 400-cycles, Schematic Diagram (Unit 3402)

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Table 42

UNIT 3402 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1372170

Resistance Tests

Remove all tubes from sockets.

Terminals	Normal	Minimum	Maximum
1, 3	120K	110K	130K
2, 4	0	0	0
5	106K	95K	117K
6	No connection		
7, 8	120K	110K	130K
9	0	0	0
10, 11	66K	65K	67K
12, 13	**Infinite**	**Infinite**	**Infinite**
14	No connection	---	---
15	0	0	0
16, 17	1.1M	1M	1.2M
18, 19	No connection	---	---
20, 21, 22	492K	440K	530K
23	66K	65K	67K
24, 25	88K	86K	90K
26, 27	No connection	---	---
28	510	484	536
29	**Infinite**	**Infinite**	**Infinite**
30	510K	480K	540K
31, 32	100K	90K	110K
33, 35	.962M	.86M	1.06M
34	No connection	---	---
36	22K	21.8K	22.2K
37, 38	88K	86K	90K
39, 40	**Infinite**	**Infinite**	**Infinite**
43	12K	11K	13K
44	510K	480K	540K
45, 47	No connection	---	---
46	100K	90K	110K
48	220K	210K	230K
49, 50	22K	21.8K	22.2K
51, 52	88K	86K	90K
TOP OF POT	500K	450K	550K

Table 42 (Cont'd)

UNIT 3402 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1372170

Resistance Tests

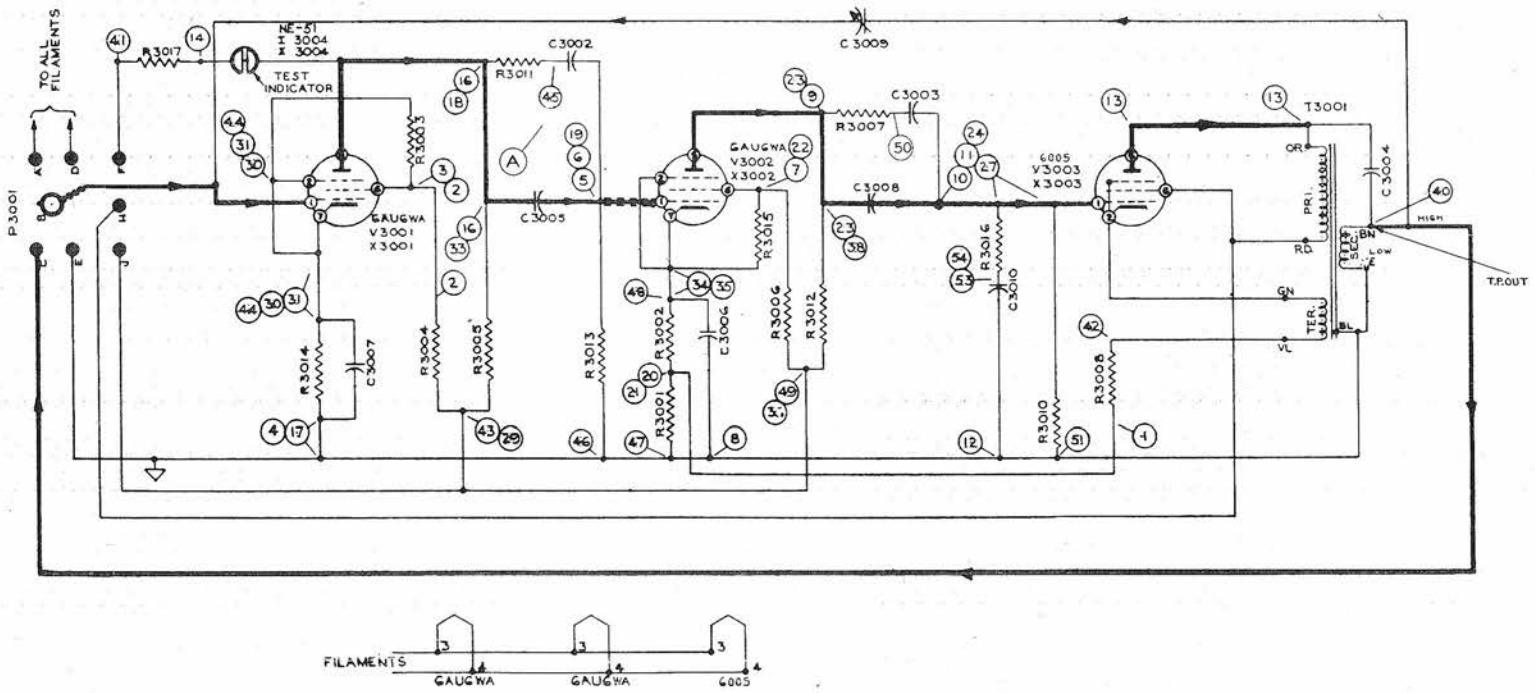
Turn all potentiometers counterclockwise.

Terminals	Volts ±20%	Terminal	Volts ±20%
5 to 46	2.3	38 to 49	15
10, 11, 23	-105	12, 13, 39, 40	350
24, 25	-22	1, 3, 7, 8	250
33, 35	-19		
37 to 49	15	37, 38	-22

Table 43

UNIT 3402 - PARTS LIST

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
X3004 X3003	12-Z-7510	117	SOCKET				2
X3002 X3001	12-Z-7510	114	SOCKET				2
V3004 V3003	12-Z-13005	608	TUBE, ELECTRON; 5932				2
V3002	12-Z-13005	652	TUBE, ELECTRON; 5814A, MINIATURE (RUGGED); 9 PIN				1
V3001	12-Z-13005	574	TUBE, ELECTRON; 5751 MINIATURE VOLTAGE AMPLIFIER; 9 PIN				1
T3001	ORD.SK.276518		TRANSFORMER (596439)				1
P3001	12-Z-7113	6306	CONNECTOR, PLUG; PNL.TY. 10 LUGS ONE COAX; 2 5/16 LG. x 1/8				1
R3023 R3022	12-Z-13111	419	RESISTOR, FIXED; COMPOSITION .750 LG. X .280 DIA.	10 OHMS	1 WATT	±10%	2
R3021 R3020	12-Z-13111	427	RESISTOR, FIXED; COMPOSITION .750 LG. X .280 DIA.	47 OHMS	1 WATT	±10%	2
R3019 R3018	12-Z-13111	482	RESISTOR, FIXED; COMPOSITION .750 LG. X .280 DIA.	22 K	1 WATT	±5%	2
R3017 R3016	12-Z-13111	358	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	470K	1/2 WATT	±10%	2
R3015	12-Z-13110	7392	RESISTOR, FIXED; COMPOSITION 5/8 LG. X .203 DIA.	44 K	1/2 WATT	±1%	1
R3014 R3013	12-Z-13111	358	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	470K	1/2 WATT	±10%	2
R3012	12-Z-13110	7382	RESISTOR, FIXED; COMPOSITION 5/8 LG. X .203 DIA.	22 K	1/2 WATT	±1%	1
R3011	12-Z-13111	531	RESISTOR, FIXED; COMPOSITION .750 LG. X .280 DIA.	120 K	1 WATT	±5%	1
R3010	12-Z-13111	222	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	12 K	1/2 WATT	±5%	1
R3009	12-Z-13111	350	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	100K	1/2 WATT	±10%	1
R3008	12-Z-13110	7371	RESISTOR, FIXED; COMPOSITION 5/8 X .203 DIA.	5.7K	1/2 WATT	±1%	1
R3007	12-Z-13111	298	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	100K	1/2 WATT	±5%	1
R3006	12-Z-13111	362	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	1 MEG	1/2 WATT	±10%	1
R3005	12-Z-13111	213	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	510 OHMS	1/2 WATT	±5%	1
R3004	12-Z-13111	312	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	390K	1/2 WATT	±5%	1
R3003	12-Z-13111	322	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	1 M	1/2 WATT	±5%	1
R3002	12-Z-13111	314	RESISTOR, FIXED; COMPOSITION .406 LG. X .175 DIA.	470K	1/2 WATT	±5%	1
R3001	16-R-88179	4680	RESISTOR, VARIABLE COMP. LIN. TAPER 1 1/16 DIA. x 9/16D. RD. SHAFT, SCR. DR. SLT. 1/4 DIA. x 5/8 LG. BUSHING 3/8-32 TH'D NEF-2	500K	2 WATT	±10%	1
C3004	12-Z-13100	9539	CAPACITOR, FIXED PAPER DIELEC. SUBMINIATURE 7/8 LG. x .400 DIA.	.047 MFD	300 WVDC	±20%	1
C3003	16-C-30663	3292	CAPACITOR, FIXED MICA DIELEC. MOLDED 51/64 x 51/64 x 9/32	.00075 MFD	500 WVDC	±5%	1
C3002 C3001	12-Z-13100	9539	CAPACITOR, FIXED PAPER DIELEC. SUBMINIATURE 7/8 LG. x .400 DIA.	.047 MFD	300 WVDC	±20%	2



FRAME RECEPTACLE WIRE CONNECTIONS.

A, B } INPUT 6.3 VOLT-FILAMENT, 60~ A C , 1.05 AMPS.(D C POTENTIAL-GND).

B INPUT SIGNAL 400 ~

C OUTPUT SIGNAL 12 VOLTS, 400 ~ INTO 500-OHM LOAD.

E INPUT, COMMON RETURN.

F OUTPUT, TEST INDICATOR.

H INPUT B+250 VOLTS REGULATED D C , .087 AMPS.

J INPUT B+250 VOLTS REGULATED D C , .007 AMPS.

NOTES:

1. ○ = TERMINAL POINTS ON TERMINAL BOARD.
2. ⏚ = CHASSIS CONNECTION.
3. SIGNAL FLOW INDICATED BY HEAVY LINES.
4. TEST IN ACCORDANCE WITH BUORD SK 276958

Figure 74. Single-Channel Amplifier, Schematic Diagram (Unit 3001)

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Table 44

UNIT 3001 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980431

Resistance Tests

Terminals	Normal	Minimum	Maximum
1	1.8	1.7	1.9
2, 3	20.3K	18.3K	22.3K
4	0	0	0
5, 6	1M	950K	1.05M
7	20.3K	18.3K	22.3K
8	0	0	0
9	211K	193K	229K
10, 11	560K	504K	616K
12	0	0	0
13, 14	Infinite	---	---
16	211K	193K	229K
17	0	0	0
18	211K	193K	229K
19	1M	950K	1.05M
20, 21	1.8	1.7	1.9
22	20.3K	18.3K	22.3K
23	211K	193K	229K
24	560K	504K	616K
27	560K	504K	616K

Table 44 (Cont'd)

UNIT 3001 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980431

Resistance Tests

Terminals	Normal	Minimum	Maximum
29	61.2K	55.1K	67.3K
30, 31	468	444	492
33	211K	193K	229K
34, 35	332	315	349
36	61.2K	55.1K	67.3K
38	211K	193K	229K
40	16	15	17
41	Infinite	---	---
42	622	587	653
43	61.2K	55.1K	67.3K
44	468	444	492
45	1.41M	1.33M	1.49M
46, 47	0	0	0
48	332	315	349
49	61.2K	55.1K	67.3K
50	2.41M	2.28M	2.54M
51	0	0	0
53	599K	541K	657K
54	599K	541K	657K

Table 44 (Cont'd)

UNIT 3001 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980431

Resistance Tests

Terminals	Normal	Minimum	Maximum
13 to P3001-H	255	242	268
42 to X3003-2	19	18	20
41 to 14	75K	71.2K	78.3K

DC Voltage Tests

Terminal	Volts	Terminal	Volts
1	+0.05	16	+180
2	+44	29	+250
4	0	31	+1.1
5	0	34	+0.85
7	+40	37	+120
9	+170	40	0
10	0	41	+87.5
13	+243	42	+16

Voltage tolerance ±20 per cent. Measurements made with input grid grounded to chassis.

Table 45

UNIT 3001 - PARTS LIST

SYMBOL	DRAWING NO	FC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
I3004	17-L-6806	130	LAMP, NEON GLOW TYPE MAZA CAT. NO. OR EQUAL NE51				1
X3004	12-Z-7499	17	SOCKET				1
X3003	12-Z-7510	112	SOCKET, ELECTRON TUBE, 7 PIN BE.CU.SI.PLATED HOT TIN DIPPED				1
X3002 X3001	12-Z-7510	113	SOCKET, ELECTRON TUBE, 7 PIN JAN TYPE TS102P01				2
V3003	12-Z-13005	620	TUBE, ELECTRON, JAN-6005/6AQ5W MINIATURE POWER AMPL. REC.				1
V3002 V3001	16-T-56203	53	TUBE, ELECTRON, JAN-6AU6WA, 7 PIN MINIATURE BUTTON BASE				2
T3001	SK 137317		TRANSFORMER (595596)				1
P3001	12-Z-7113	6331	CONNECTOR, PLUG 7 LUG, 1 COAX. CONTACT, MTG. STUDS, 1.562 C/C				1
R3017	12-Z-13111	295	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	75 K	1/2 WATT	± 5%	1
R3016	12-Z-13111	258	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	39K	1/2 WATT	± 5%	1
R3015	12-Z-13111	287	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	22 K	1/2 WATT	±10%	1
R3014	12-Z-13110	837	RESISTOR, FIXED WIRE WOUND 15/64 DIA. X 21/32 LONG	470 Ω	1/2 WATT	± 5%	1
R3013	12-Z-13111	322	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	1.0 M	1/2 WATT	± 5%	1
R3012	12-Z-13111	352	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	0.15 M	1/2 WATT	±10%	1
R3011	12-Z-13111	324	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	1.2 M	1/2 WATT	± 5%	1
R3010	12-Z-13111	359	RESISTOR, FIXED COMPOSITION .175 DIA. .406 LONG	0.56 M	1/2 WATT	±10%	1
R3008	12-Z-13110	904	RESISTOR, FIXED WIRE WOUND 15/64 DIA. X 19/32 LONG	620 Ω	1 WATT	± 5%	1
R3007	12-Z-13111	330	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	2.2 M	1/2 WATT	± 5%	1
R3006	12-Z-13111	585	RESISTOR, FIXED COMPOSITION .28 DIA. X .750 LONG	0.1 M	1 WATT	±10%	1
R3005	12-Z-13111	352	RESISTOR, FIXED COMPOSITION .175 DIA. X.406 LONG	0.15 M	1/2 WATT	±10%	1
R3004	12-Z-13111	585	RESISTOR, FIXED COMPOSITION .28 DIA.X.750 LONG	0.1 M	1 WATT	±10%	1
R3003	12-Z-13111	287	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	22 K	1/2 WATT	±10%	1
R3002	16-R-68373	1526	RESISTOR, FIXED, WIRE WOUND 15/64 DIA. X 21/32 LONG	330 Ω	1/2 WATT	± 5%	1
R3001	12-Z-13110	799	RESISTOR, FIXED, WIRE WOUND 15/64 DIA.X 21/32 LONG	1.8 Ω	1/2 WATT	± 5%	1
C3010	16-C-32720	7533	CAPACITOR, FIXED MICA, DIELEC. 53/64 X 53/64 X 11/32	5100 MMFD	500 WVDC	± 5%	1
C3009	16-C-63900	6761	CAPACITOR, VARIABLE, CERAMIC JAN TYPE CV11A070	1.5 TO 7 MMFD	500 WVDC	—	1
C3008	12-Z-13100	9547	CAPACITOR, FIXED PAPER DIELEC. .312 DIA. 7/8 LONG	.01 MFD	300 WVDC	±10%	1
C3007	16-C-32646	6813	CAPACITOR, FIXED MICA, DIELEC. 53/64 X 53/64 X 11/32	4700 MMFD	500 WVDC	±10%	1
C3006	16-C-31908	1569	CAPACITOR, FIXED MICA, DIELEC. 53/64 X 53/64 X 9/32	2200 MMFD	500 WVDC	±10%	1
C3005	12-Z-13100	9547	CAPACITOR, FIXED PAPER, DIELEC. .312 DIA. 7/8 LONG	.01 MFD	300 WVDC	±10%	1
C3004	12-Z-13100	9587	CAPACITOR, FIXED PAPER, DIELEC. .400 DIA. 7/8 LONG	.051 MFD	300 WVDC	± 5%	1
C3003 C3002	12-Z-13100	9559	CAPACITOR, FIXED PAPER, DIELEC. .400 DIA. 1 3/8 LONG	0.1 MFD	300 WVDC	±10%	2

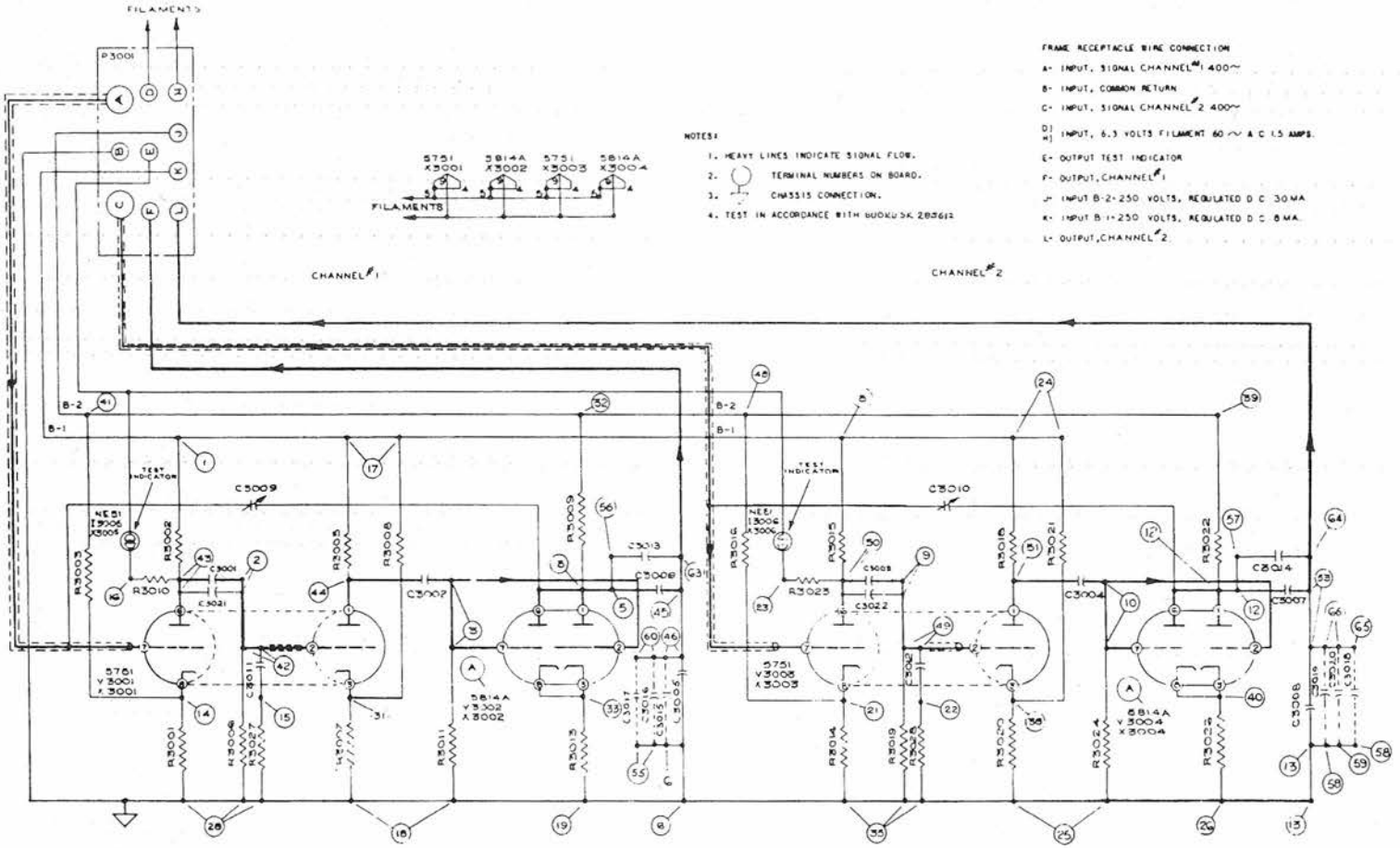

Figure 75. Computing Amplifier, Dual-Channel, Schematic Diagram (Unit 3012)

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Table 46

UNIT 3012 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371931

Resistance Tests

Terminals	Normal	Minimum	Maximum
2	2.4M	2.28M	2.52M
3	470K	423K	517K
6,13,18, 19,25,26, 28,35	0		
8	53K	50.3K	55.7K
9	2.4M	2.28M	2.52M
10	470K	423K	517K
14	470	446	494
15	56K	53.2K	58.8K
21	470	446	494
22	56K	53.2K	58.8K
31	470	446	494
32	55K	52.2K	57.75K
33	560	532	588
38	470	446	494
40	560	532	588
42	2.4M	2.28M	2.52M
49	2.4M	2.28M	2.52M
56,58,59	0		
8,17,24 to 1	0		
37,39,48 to 41	0		
43,44,50,51 to 1	470K	446K	494K
5,12 to 41	5.6K	5.32K	5.88K
43 to 16	75K	71.25K	78.75K
50 to 23	75K	71.25K	78.75K

DC Voltage Tests

Terminals	Voltage	Terminal	Voltage
14,21,31,38	1.2	43,44,50,51	85
33,40	4.5	55,57	180

Table 47

UNIT 3012 - PARTS LIST

SYMBOL	DESCRIPTION	VALUE	RATING	TOL	DRAWING NO	QUAN
X3006	SOCKET				1000447	2
X3005						
X3004	SOCKET				12-Z-7510-114	4
X3003						
X3002						
X3001						
I3005	LAMP NE-51				17-L-6806-130	2
I3006						
V3004	TUBE(5814A)				12-Z-13005-652	1
V3003	TUBE(5751)				12-Z-13005-574	1
V3002	TUBE(5814A)				12-Z-13005-652	1
V3001	TUBE(5751)				12-Z-13005-574	1
P3001	CONNECTOR				12-Z-7113-6389	1
R3028	RESISTOR	56 K	½ WATT	± 5%	12-Z-13111-292	1
R3027	RESISTOR	56 K	½ WATT	± 5%	12-Z-13111-292	1
R3026	RESISTOR	560Ω	½ WATT	± 5%	12-Z-13111-214	1
R3024	RESISTOR	470 K	½ WATT	± 10%	12-Z-13111-358	1
R3023	RESISTOR	75 K	½ WATT	± 5%	12-Z-13111-295	1
R3022	RESISTOR	5.6K	2 WATT	± 5%	12-Z-13111-700	1
R3021	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3020	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
R3019	RESISTOR	2.4 M	½ WATT	± 5%	12-Z-13111-331	1
R3018	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3016	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3015	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3014	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
R3013	RESISTOR	560Ω	½ WATT	± 5%	12-Z-13111-214	1
R3011	RESISTOR	470 K	½ WATT	± 10%	12-Z-13111-358	1
R3010	RESISTOR	75 K	½ WATT	± 5%	12-Z-13111-295	1
R3009	RESISTOR	5.6K	2 WATT	± 5%	12-Z-13111-700	1
R3008	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3007	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
R3006	RESISTOR	2.4M	½ WATT	± 5%	12-Z-13111-331	1
R3005	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3003	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3002	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3001	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
C3020			100WVDC			
C3019			100WVDC			
C3018			100WVDC			
C3017			100WVDC			
C3016			100WVDC			
C3015			100WVDC			
C3014	CAPACITOR	.068 MFD	300WVDC	±10%	12-Z-13100-9557	2
C3013						
C3012	CAPACITOR	.001 MFD	300 WVDC	±10%	12-Z-13100-9499	2
C3011						
C3010	CAPACITOR	9-16 MMF			51-128	2
C3009						
C3008	CAPACITOR		100 WVDC			
C3007	CAPACITOR	.1 MFD	300 WVDC	±10%	12-Z-13100-9559	2
C3006						
C3005	CAPACITOR		100 WVDC			
C3022						
C3021	CAPACITOR	.1 MFD	300 WVDC	±10%	12-Z-13100-9559	6
C3004						
C3003						
C3002						
C3001						

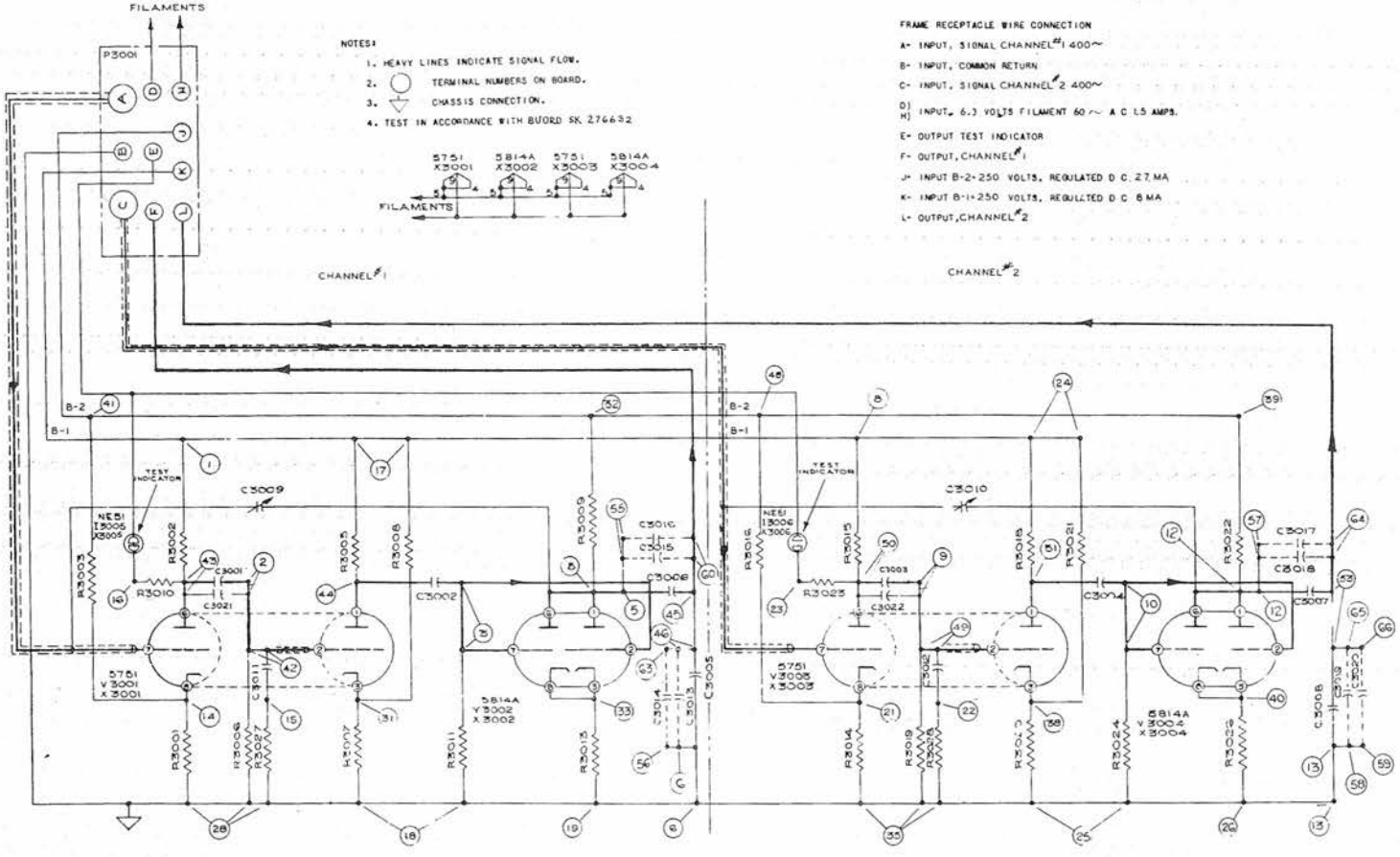

Figure 76. Dual-Channel Amplifier, Schematic Diagram (Unit 3002)

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Table 48

UNIT 3002 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980156

Resistance Tests

Terminal	Normal	Minimum	Maximum
2	2.4M	2.3M	2.5M
3	470K	423K	517K
6,13,18,19	0	0	0
25,26,28,35	0	0	0
8	53K	50.3K	55.7K
9	2.4M	2.3M	2.5M
10	470K	423K	517K
14	470	446	494
15	56K	53.2K	58.8K
21	470	446	494
22	56K	53.2K	58.8K
31	470	446	494
32	55K	52.25K	57.75K
33	560	532	588
38	470	446	494
40	560	532	588
42	1.5M	1.42M	1.58M
49	1.5M	1.42M	1.58M
56,53,59	0	0	0
8,17,24 to 1	0	0	0
32,39,48 to 41	0	0	0
43 to 1	470	446	494
44 to 1	470	446	494
50 to 1	470	446	494
51 to 1	470	446	494
5 to 41	12K	11.4K	12.6K
12 to 41	12K	11.4K	12.6K
43 to 16	75K	71.25K	78.75K
50 to 23	75K	71.25K	78.75K

DC Voltage Tests

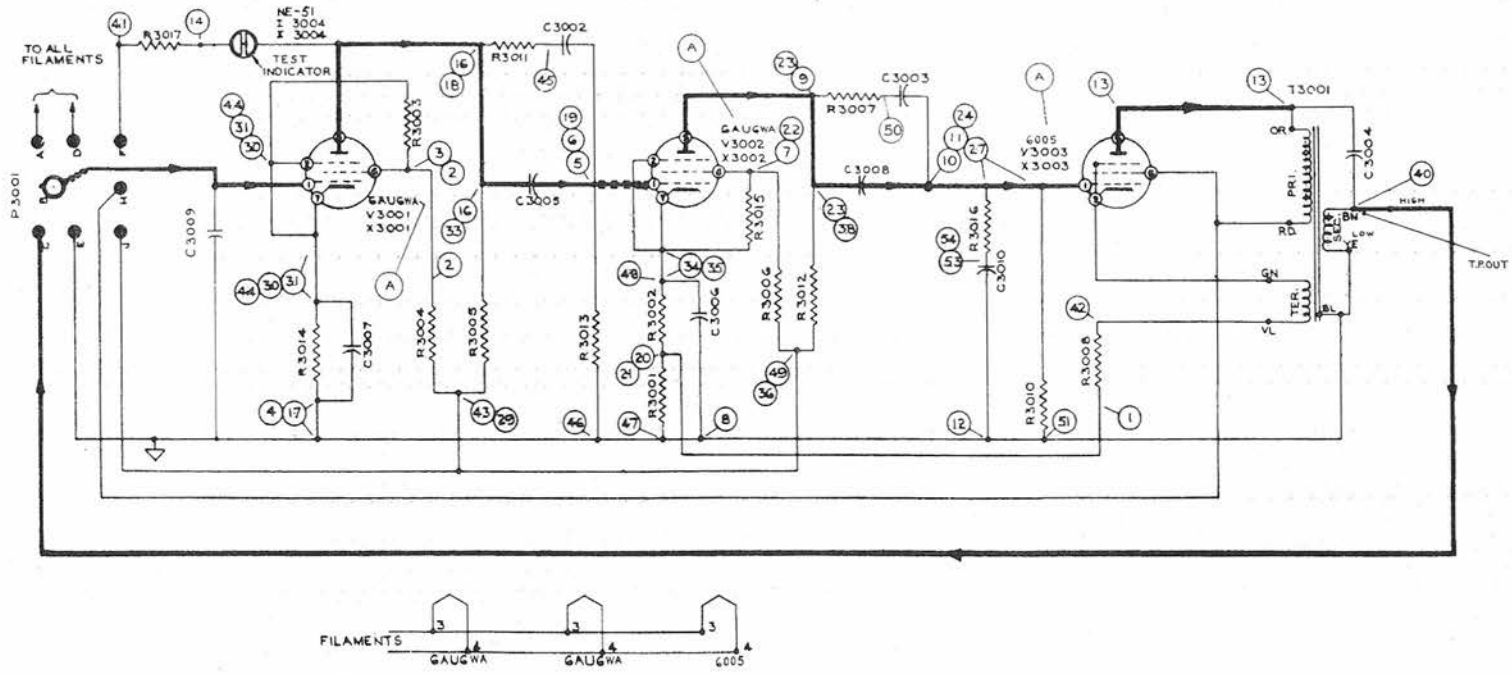
Terminal	Volts	Terminal	Volts
14,21,31,38	+1.2	43,44,50,51	+85
33,40	+4.5	55,57	+125

Voltage tolerance ±20 per cent. Measurements made with two input grids grounded to chassis.

Table 49

UNIT 3002 - PARTS LIST

SYMBOL	DESCRIPTION	VALUE	RATING	TOL	DRAWING NO	QUAN
X3006 X3005	SOCKET				1000447	2
X3004 X3003 X3002 X3001	SOCKET				12-Z-7510-114	4
I3005 I3008	LAMP NE-51				N17-L-6806-130	2
V3004	TUBE(5814A)					1
V3003	TUBE(5751)				12-Z-13005-574	1
V3002	TUBE(5814A)					1
V3001	TUBE(5751)				12-Z-13005-574	1
P3001	CONNECTOR				12-Z-7113-6389	1
R3028	RESISTOR	56 K	½ WATT	± 5%	12-Z-13111-292	1
R3027	RESISTOR	56 K	½ WATT	± 5%	12-Z-13111-292	1
R3026	RESISTOR	560 Ω	½ WATT	± 5%	12-Z-13111-214	1
R3024	RESISTOR	470 K	½ WATT	± 10%	12-Z-13111-358	1
R3023	RESISTOR	75 K	½ WATT	± 5%	12-Z-13111-295	1
R3022	RESISTOR	12K	2 WATT	± 5%	12-Z-13110-964	1
R3021	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3020	RESISTOR	470 Ω	½ WATT	± 5%	12-Z-13111-212	1
R3019	RESISTOR	2.4 M	½ WATT	± 5%	12-Z-13111-331	1
R3018	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3016	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3015	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3014	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
R3013	RESISTOR	560Ω	½ WATT	± 5%	12-Z-13111-214	1
R3011	RESISTOR	470 K	½ WATT	± 10%	12-Z-13111-358	1
R3010	RESISTOR	75 K	½ WATT	± 5%	12-Z-13111-295	1
R3009	RESISTOR	12K	WATT	± 5%	12-Z-13110-964	1
R3008	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3007	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
R3006	RESISTOR	2.4M	½ WATT	± 5%	12-Z-13111-331	1
R3005	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3003	RESISTOR	110 K	1 WATT	± 5%	12-Z-13111-530	1
R3002	RESISTOR	470 K	½ WATT	± 5%	12-Z-13111-314	1
R3001	RESISTOR	470Ω	½ WATT	± 5%	12-Z-13111-212	1
C3020			100WVDC			
C3019			100WVDC			
C3018			300WVDC			
C3017			300WVDC			
C3016			300WVDC			
C3015			300WVDC			
C3014			100WVDC			
C3013			100WVDC			
C3012 C3011	CAPACITOR	.001 MFD	300 WVDC	± 10%	12-Z-13100-9499	2
C3010 C3009	CAPACITOR	9-16 MMF			51-128	2
C3008	CAPACITOR	.068MFD	100 WVDC	± 10%	12-Z-13100-9269	1
C3007 C3006	CAPACITOR	.1 MFD	300 WVDC	± 10%	12-Z-13100-9559	2
C3005	CAPACITOR	.068MFD	100 WVDC	± 10%	12-Z-13100-9269	1
C3022 C3021 C3004 C3003 C3002 C3001	CAPACITOR	.1 MFD	300 WVDC	± 10%	12-Z-13100-9559	6



FRAME RECEPTACLE WIRE CONNECTIONS

A, D — INPUT 6.3-VOLT FILAMENT, 60~ A C , 1.05 AMPS.(D C POTENTIAL-GND).
B — INPUT SIGNAL 400 ~
C — OUTPUT SIGNAL 18 VOLTS, 400 ~ INTO 500 OHM LOAD.
E — INPUT, COMMON RETURN
F — OUTPUT, TEST INDICATOR.
H — INPUT B+250 VOLTS REGULATED D C , .087 AMPS.
J — INPUT B+250 VOLTS REGULATED D C , .007 AMPS.

NOTES:
1. ◯ = TERMINAL POINTS ON TERMINAL BOARD.
2. ⏚ = CHASSIS CONNECTION.
3. SIGNAL FLOW INDICATED BY HEAVY LINES.
4. TEST IN ACCORDANCE WITH BUORD SK NO 265607

Figure 77. Computing Amplifier, Variable-Feedback, Schematic Diagram (Unit 3011)

Table 50

UNIT 3011 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371876

Resistance Tests

Terminals	Normal	Minimum	Maximum
1	1.8	1.7	1.9
2,3	20.3K	18.3K	22.3K
4	0		
5,6	1M	950K	1.05M
7	20.3K	18.3K	22.3K
8	0		
9	211K	193K	229K
10,11	560K	504K	616K
12	0		
13,14	Infinite		
16	211K	193K	229K
17	0		
18	211K	193K	229K
19	1M	950K	1.05M
20,21	1.8	1.7	1.9
22	20.3	18.3K	22.3K
23	211K	193K	229K
24	560K	504K	616K
27	560K	504K	616K
29	61.2K	55.1K	67.3K
30,31	468	444	492
33	211K	193K	229K
34,35	332	315	349
36	61.2K	55.1K	67.3K
38	211K	193K	229K
40	16	15	17
41	Infinite		
42	622	587	653
43	61.2K	55.1K	67.3K
44	468	444	492
45	1.41M	1.33M	1.49M
46,47	0		
48	332	315	349
49	61.2K	55.1K	67.3K
50	5.31M	5.04M	5.59M
51	0		
53,54	599K	541K	657K

Table 50 (Cont'd)

UNIT 3011 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371876

Resistance Tests (Cont'd)

Terminals	Normal	Minimum	Maximum
13 to Pin H (P3001)	255	242	268
42 to Pin 2 (X3003)	19	18	20
41 to 14	75K	71.2K	78.8K

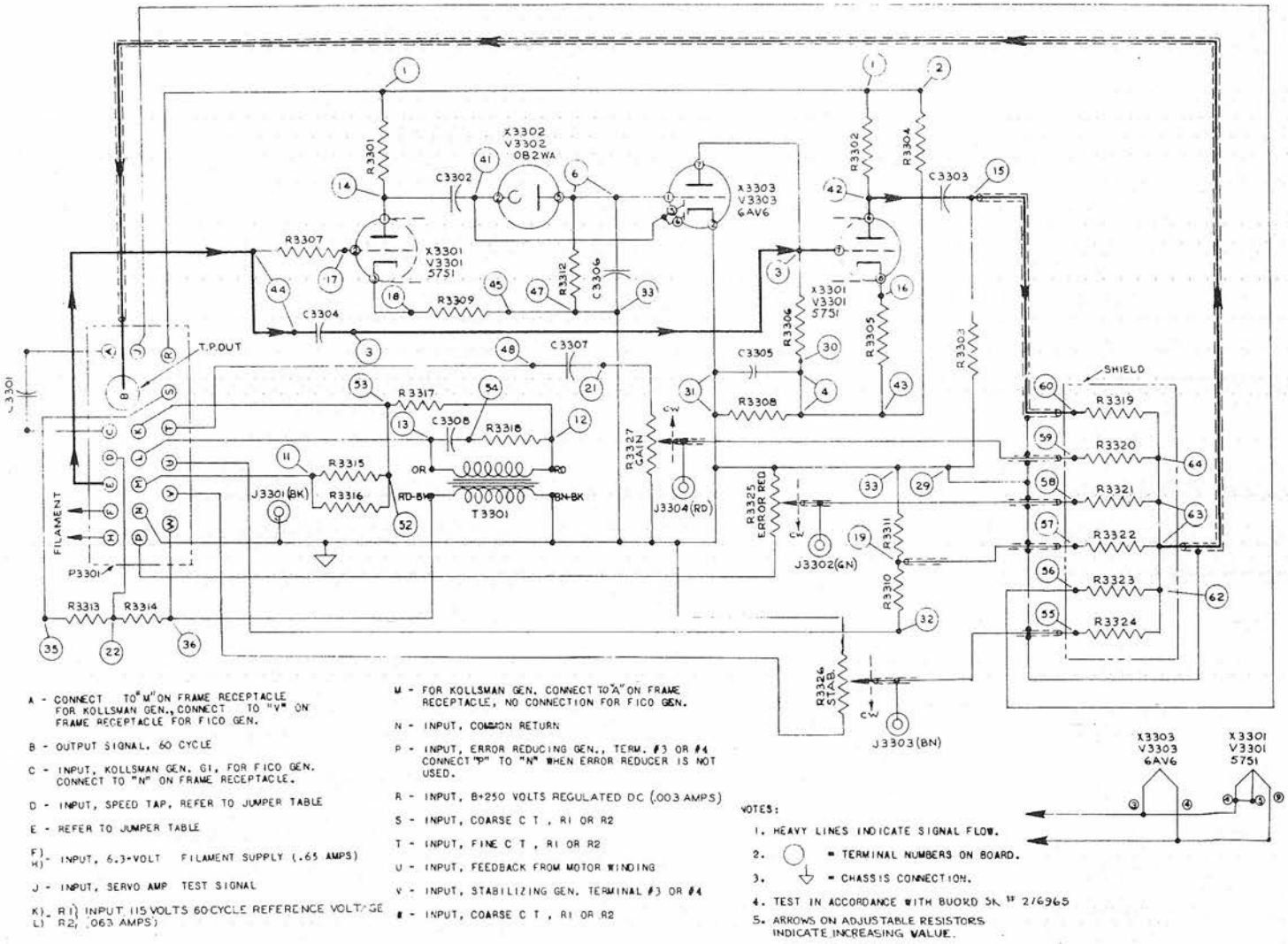
DC Voltage Tests

Terminals	Voltage ±20%	Terminal	Voltage ±20%
1	0.05	16	160
2	44	29	250
4,5	0	31	1.1
7	40	34	0.85
9	170	40	0
10	0	41	87.5
13	243	42	16

Table 51

UNIT 3011 - PARTS LIST

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
I3004	17-L-6806	130	LAMP, NEON GLOW TYPE MAZDA CAT. NO. OR EQUAL NE51				1
X3004	12-Z-7499	17	LAMPHOLDER				1
X3003	12-Z-7510	112	SOCKET, ELECTRON TUBE, 7 PIN BE.CU.SI.PLATED HOT TIN DIPPED				1
X3002 X3001	12-Z-7510	113	SOCKET, ELECTRON TUBE, 7 PIN JAN TYPE TS102P01				2
V3003	12-Z-13005	620	TUBE, ELECTRON, 6005/6AQ5W MINIATURE POWER AMPL., REC.				1
V3002 V3001	16-T-56203	53	TUBE, ELECTRON, 6AU6WA, 7 PIN MINIATURE BUTTON BASE				2
T3001	SK 137317		TRANSFORMER (595596)				1
P3001	12-Z-7113	6331	CONNECTOR, PLUG 7 LUG, 1 COAX. CONTACT, MTG. STUDS, 1.562 C/C				1
R3017	12-Z-13111	295	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	75 K	1/2 WATT	± 5%	1
R3016	12-Z-13111	248	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	15 K	1/2 WATT	± 5%	1
R3015	12-Z-13111	287	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	22 K	1/2 WATT	±10%	1
R3014	12-Z-13110	837	RESISTOR, FIXED WIRE WOUND 15/64 DIA. X 21/32 LONG	470 Ω	1/2 WATT	± 5%	1
R3013	12-Z-13111	322	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	1.0 M	1/2 WATT	± 5%	1
R3012	12-Z-13111	352	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	0.15 M	1/2 WATT	±10%	1
R3011	12-Z-13111	324	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	1.2 M	1/2 WATT	± 5%	1
R3010	12-Z-13111	359	RESISTOR, FIXED COMPOSITION .175 DIA. .406 LONG	0.56 M	1/2 WATT	±10%	1
R3008	12-Z-13110	904	RESISTOR, FIXED WIRE WOUND 15/64 DIA. X 1 3/32 LONG	620 Ω	1 WATT	± 5%	1
R3007	12-Z-13111	339	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	5.1 M	1/2 WATT	± 5%	1
R3006	12-Z-13111	585	RESISTOR, FIXED COMPOSITION .28 DIA. X .750 LONG	0.1 M	1/2 WATT	±10%	1
R3005	12-Z-13111	352	RESISTOR, FIXED COMPOSITION .175 DIA. X.406 LONG	0.15 M	1/2 WATT	±10%	1
R3004	12-Z-13111	585	RESISTOR, FIXED COMPOSITION .28 DIA.X.750 LONG	0.1 M	1 WATT	±10%	1
R3003	12-Z-13111	287	RESISTOR, FIXED COMPOSITION .175 DIA. X .406 LONG	22 K	1/2 WATT	±10%	1
R3002	16-R-68373	1526	RESISTOR, FIXED, WIRE WOUND 15/64 DIA. X 21/32 LONG	330 Ω	1/2 WATT	± 5%	1
R3001	12-Z-13110	799	RESISTOR, FIXED, WIRE WOUND 15/64 DIA.X 21/32 LONG	1.8 Ω	1/2 WATT	± 5%	1
C3010	16-C-32720	7533	CAPACITOR, FIXED MICA, DIELEC. 53/64 X 53/64 X 11/32	5100 MMFD	500 WVDC	± 5%	1
C3009	16-C-30188	5001	CAPACITOR, FIXED MICA, DIELEC. 51/64 X 15/32 X 7/32	510 MMFD	500 WVDC	± 5%	1
C3008	12-Z-13100	9547	CAPACITOR, FIXED PAPER DIELEC. .312 DIA. 7/8 LONG	.01 MFD	300 WVDC	±10%	1
C3007	16-C-32646	6813	CAPACITOR, FIXED MICA, DIELEC. 53/64 X 53/64 X 11/32	4700 MMFD	500 WVDC	±10%	1
C3006	16-C-31908	1569	CAPACITOR, FIXED MICA, DIELEC. 53/64 X 53/64 X 9/32	2200 MMFD	500 WVDC	±10%	1
C3005	12-Z-13100	9547	CAPACITOR, FIXED PAPER, DIELEC. .312 DIA. 7/8 LONG	.01 MFD	300 WVDC	±10%	1
C3004	12-Z-13100	9587	CAPACITOR, FIXED PAPER, DIELEC. .400 DIA. 7/8 LONG	.051 MFD	300 WVDC	± 5%	1
C3003 C3002	12-Z-13100	9559	CAPACITOR, FIXED PAPER, DIELEC. .400 DIA. 1 3/8 LONG	0.1 MFD	300 WVDC	±10%	2



A - CONNECT TO "U" ON FRAME RECEPTACLE FOR KOLLSMAN GEN., CONNECT TO "V" ON FRAME RECEPTACLE FOR FICO GEN.

B - OUTPUT SIGNAL, 60 CYCLE

C - INPUT, KOLLSMAN GEN. G1, FOR FICO GEN. CONNECT TO "N" ON FRAME RECEPTACLE.

D - INPUT, SPEED TAP, REFER TO JUMPER TABLE

E - REFER TO JUMPER TABLE

F) H) - INPUT, 6.3-VOLT FILAMENT SUPPLY (.65 AMPS)

J - INPUT, SERVO AMP TEST SIGNAL

K) L) - R1) INPUT 115 VOLTS 60-CYCLE REFERENCE VOLTAGE
R2) (.063 AMPS)

M - FOR KOLLSMAN GEN. CONNECT TO "A" ON FRAME RECEPTACLE, NO CONNECTION FOR FICO GEN.

N - INPUT, COMMON RETURN

P - INPUT, ERROR REDUCING GEN., TERM. #3 OR #4 CONNECT "P" TO "N" WHEN ERROR REDUCER IS NOT USED.

R - INPUT, B+250 VOLTS REGULATED DC (.003 AMPS)

S - INPUT, COARSE C T , R1 OR R2

T - INPUT, FINE C T , R1 OR R2

U - INPUT, FEEDBACK FROM MOTOR WINDING

V - INPUT, STABILIZING GEN. TERMINAL #3 OR #4

- INPUT, COARSE C T , R1 OR R2

NOTES:

1. HEAVY LINES INDICATE SIGNAL FLOW.
2. ○ = TERMINAL NUMBERS ON BOARD.
3. ⏚ = CHASSIS CONNECTION.
4. TEST IN ACCORDANCE WITH BUORD SK # 276965
5. ARROWS ON ADJUSTABLE RESISTORS INDICATE INCREASING VALUE.

Figure 78. Servo Control, Double-Speed, Velocity-Lag, Schematic Diagram (Unit 3304)

Table 52

UNIT 3304 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980419

Resistance Tests

Terminals	RESISTANCE*		
	Normal	Minimum	Maximum
1	124K	117K	131K
2	124K	117K	131K
3	705K	670K	740K
4	24K	22.8K	25.2K
6	1M	900K	1.1M
11	Infinite	---	---
12	Infinite	---	---
13	Infinite	---	---
14	344K	327K	361K
15	730K	660K	790K
16	28.3K	26.9K	29.7K
17	INFINITE	---	---
18	9.1K	8.6K	9.6K
19	1K	0.95K	1.05K
21	100K	90K	110K
22	47K	44.5K	49.5K
29	0	0	0
30	24K	22.8K	25.2K
31	0	0	0
32	52K	49K	55K
33	0	0	0
35	94K	89K	100K
36	60	54	66
41	Infinite	---	---
42	514K	463K	565K
43	24K	22.8K	25.2K
44	Infinite	---	---
45	0	0	0
47	0.	0	0
48	Infinite	---	---
55	100K	90K	110K
56	2.64M	2.5M	2.8M
57	1K	0.95K	1.05K
58	100K	90K	110K
59	100K	90K	110K
60	730K	700K	760K
62	770K	740K	1M
63	770K	740K	1M
64	770K	740K	1M
11 to 52	0.75K	0.71K	0.79K
12 to 13	190	170	210
12 to 53	39K	58K	66K
12 to 54	1.8K	1.7K	1.9K

*All controls completely turned clockwise.

Table 52 (Cont'd)

UNIT 3304 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980419

DC Voltage Test

Terminals	Volts	Terminals	Volts
17	0	42	+240
18	+2.8	16	+47
14	+165	2	+250
3	+19	1	+250
4	+48		

Voltage tolerance ±10 per cent. Measurements made with input grid grounded to chassis.

Table 53

UNIT 3304 - PARTS LIST

SYMBOL	DRAWING NO	PIECE NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
T3301	LD NO 137367 (DWG NO 595753		TRANSFORMER				1
X3303 X3302	12-Z-7510	113	SOCKET, ELECTRON TUBE, 7 PIN JAN TYPE TS102P01				2
X3301	12-Z-7510	114	SOCKET, ELECTRON TUBE, 9 PIN JAN TYPE TS103P01				1
V3303	16-T-56203	60	ELECTRON TUBE, 6AV6 RECEIVING MINIATURE DBL D. HI MU TRI				1
V3302			ELECTRON TUBE, 6BZ6A MINIATURE				1
V3301	12-Z-13005	574	ELECTRON TUBE, 5751 DBL. TRI. VOLTAGE AMPLIFIER 9 PIN				1
P3301	12-Z-7113	6340	CONNECTOR, PLUG, 18 LUG 1 COAX CONTACT MTG STUDS 2.688 "C/C				1
J3304	12-Z-7113	3001	CONNECTOR, RECPT. BR. NI PL RD NYLON INSUL. WITH MTG NUT				1
J3303	12-Z-7113	3003	CONNECTOR, RECPT. BR. NI PL BN NYLON INSUL. WITH MTG NUT				1
J3302	12-Z-7113	3004	CONNECTOR, RECPT. BR. NI PL GN NYLON INSUL. WITH MTG NUT				1
J3301	12-Z-7113	3002	CONNECTOR, RECPT. BR. NI PL BK NYLON INSUL. WITH MTG NUT				1
R3327 R3326 R3325	12-Z-13110	9273	RESISTOR (ADJ.)	100 K OHMS	2 WATT	±10%	3
R3324 R3323 R3322 R3321 R3320 R3319	625225	3	RESISTOR, 5/8 LG X 1/4 DIA.	2.2 MEGOHM	1/2 WATT	± 1%	6
R3318	12-Z-13111	226	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	1.8 K OHMS	1/2 WATT	± 5%	1
R3317	12-Z-13111	258	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	39 K OHMS	1/2 WATT	± 5%	1
R3316 R3315	12-Z-13111	741	RESISTOR, FIXED COMPOSITION, .750 LG X .370 DIA.	1.5 K OHMS	2 WATT	±10%	2
R3314 R3313	12-Z-13111	260	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	47 K OHMS	1/2 WATT	± 5%	2
R3312	12-Z-13111	362	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	1.0 MEGOHM	1/2 WATT	±10%	1
R3311	12-Z-13111	220	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	1.0 K OHMS	1/2 WATT	± 5%	1
R3310	12-Z-13111	261	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	51 K OHMS	1/2 WATT	± 5%	1
R3309	12-Z-13111	243	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	9.1K OHMS	1/2 WATT	± 5%	1
R3308	12-Z-13111	483	RESISTOR, FIXED COMPOSITION, .750 LG X .280 DIA.	24 K OHMS	1 WATT	± 5%	1
R3307	12-Z-13111	358	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	470 K OHMS	1/2 WATT	±10%	1
R3306	12-Z-13111	318	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	680 K OHMS	1/2 WATT	± 5%	1
R3305	12-Z-13111	235	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	4.3 K OHMS	1/2 WATT	± 5%	1
R3304	12-Z-13111	529	RESISTOR, FIXED COMPOSITION, .750 LG X .280 DIA.	100 K OHMS	1 WATT	± 5%	1
R3303	12-Z-13111	362	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	1.0 MEGOHM	1/2 WATT	±10%	1
R3302	12-Z-13111	357	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	390 K OHMS	1/2 WATT	±10%	1
R3301	12-Z-13111	306	RESISTOR, FIXED COMPOSITION, .406 LG X .175 DIA.	220 K OHMS	1/2 WATT	± 5%	1
C3308	12-Z-13100	9333	CAPACITOR, FIXED PAPER, 1 5/8 LG X .562 DIA.	.68 MFD	100 WVDC	±10%	1
C3307	12-Z-13100	9259	CAPACITOR, FIXED PAPER, 3/4 LG X .235 DIA.	.01 MFD	100 WVDC	±10%	1
C3306	12-Z-13100	9394	CAPACITOR, FIXED PAPER, 1 1/8 LG X .400 DIA.	0.1 MFD	200 WVDC	±20%	1
C3305	12-Z-13100	9449	CAPACITOR, FIXED PAPER, 7/8 LG X .400 DIA.	.051 MFD	200 WVDC	± 5%	1
C3304	16-C-31903	1089	CAPACITOR, FIXED MICA. 53/64 X 53/64 X 11/32	2200 MMFD	500 WVDC	± 5%	1
C3303	12-Z-13100	9551	CAPACITOR, FIXED PAPER 7/8 LG X .312 DIA.	.022 MFD	300 WVDC	±10%	1
C3302	16-C-32720	7533	CAPACITOR, FIXED MICA. 53/64 X 53/64 X 11/32	5100 MMFD	500 WVDC	± 5%	1
C3301	986504	5	CAPACITOR	1.0 MFD	400 WVDC	±10%	1

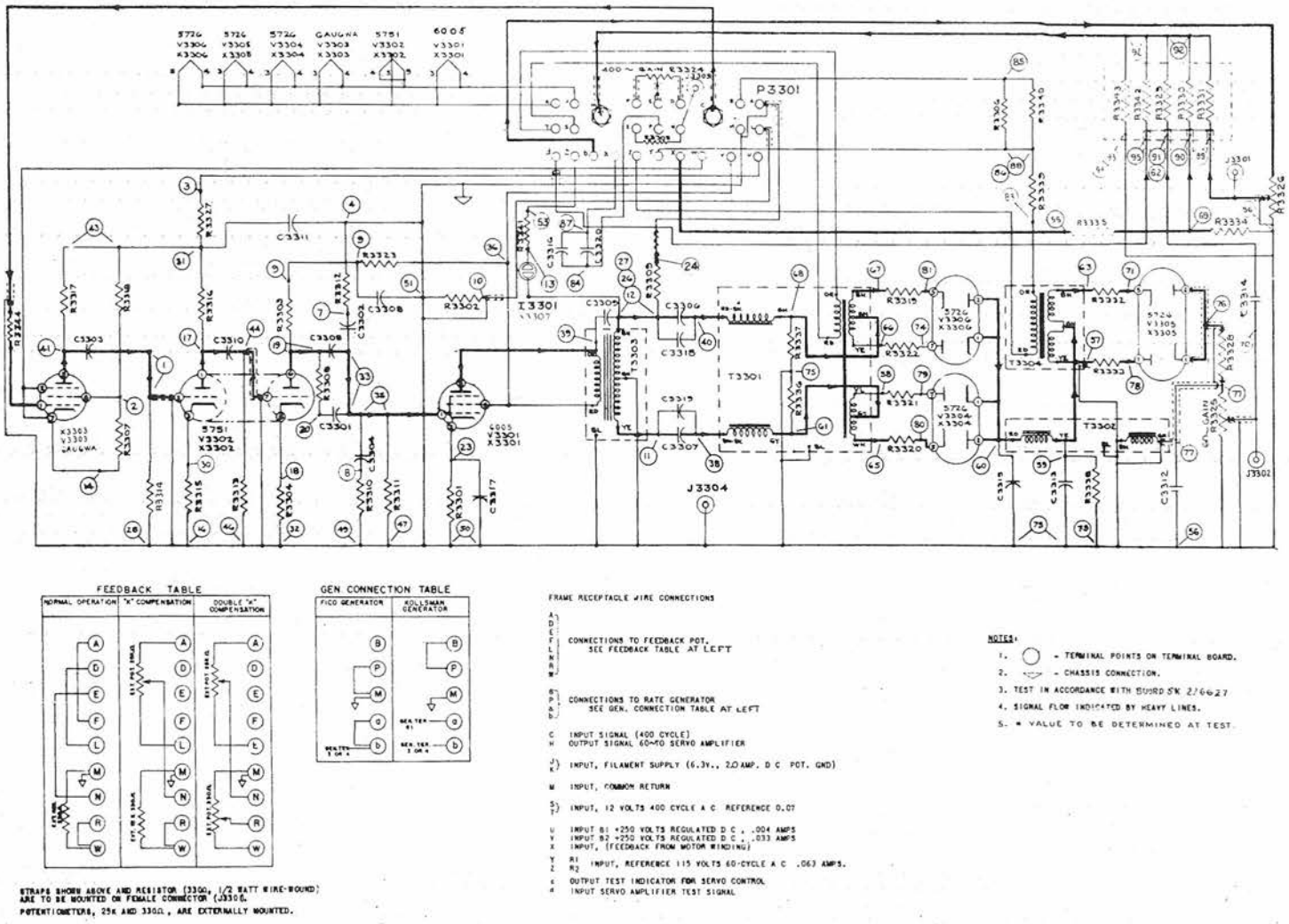


Figure 79. Servo Control, Velocity-Lag, 400-cycles, Schematic Diagram (Unit 3301)

Gene Slover's US Navy Pages

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Table 54

UNIT 3301 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980602

Resistance Tests

Terminal	Normal	Minimum	Maximum
M	0	0	0
1 to 4	100K	95K	105K
2 to 43	100K	90K	110K
3 to 43	10K	8K	12K
7	100K	90K	110K
8	5.6K	5.0K	6.2K
9	Infinite	---	---
9 to 19	100K	90K	110K
9 to 36	10K	8K	12K
10	200	180	220
11	85	76.5	93.5
12	85	76.5	93.5
14	Infinite	---	---
14 to 43	122	109.8K	132.2K
16	0	0	0
17 to 43	220K	198K	222K
18	510	485	535
19 to 20	5.6M	5.1M	6.1M
23	620	590	650
24	39K	38.5K	39.5K
26	85	76.5	93.5
27	85	76.5	93.5
28	0	0	0
30	510	485	535
33	820K	740K	900K
35	820K	740K	900K
36	Infinite	---	---
38	1.8K	1.7K	1.9K
40	1.8K	1.7K	1.9K
44	100K	95K	105K
46	0	0	0
47	0	0	0
49	0	0	0
50	0	0	0
51	0	0	0
55	52K	54.6K	49.4K
56	0	0	0
57	15.5K	14.7K	16.3K
58	1.6K	1.5K	1.7K
59	15K	14.3K	15.8K
60	15.8K	15K	16.6K
61	1.5K	1.43K	1.58K
63	15.5K	14.7K	16.3K
65	1.6K	1.5K	1.7K
66	1.6K	1.5K	1.7K

Table 54 (Cont'd)

UNIT 3301 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980602

Resistance Tests

Terminal	Normal	Minimum	Maximum
67	1.6K	1.5K	1.7K
68	1.5K	1.43K	1.58K
69	1K	0.95K	1.05K
71	33.5K	31.8K	35.2K
73	0	0	0
74	5.5K	5.2K	5.8K
75	0	0	0
76	19.1K	17.2K	21K
77	1.1K	900	1.3K
78	33.5K	31.8K	35.2K
79	5.5K	5.2K	5.8K
80	5.5K	5.2K	5.8K
81	5.5K	5.2K	5.8K
85 to 83	11.8K	11K	12.5K
85	Infinite	---	---
85 to 88	750	675	825
85 to 86	750	675	825
95 to 92	2.2M	---	---
91 to 92	2.2M	---	---
92	505K	---	---
83 to Z	200	160	240
F to D	25K	20K	30K
R to N	27K	25.6K	28.4K
C to I	100K	80K	120K

Stabilizer and 60-cycle gain control completely turned counterclockwise.

DC Voltage Tests

Terminal	Volts	Terminal	Volts
1	0	28	0
2	+36	30	+0.3
8	0	31	+210
9	+240	32	0
10	0	33	0
14	+0.8	35	0
16	0	41	+158
17	+91	43	+210
18	+0.6	44	0
19	+123	46	0
20	+55	47	0
23	+16	49	0
24	0	51	0
26	0		0

Voltage tolerance ±20 per cent. Measurements made with input grid grounded to chassis.

Table 55

UNIT 3301 - PARTS LIST

SYMBOL	DESCRIPTION	VALUE	RATING	TOL	DWG NO	PC NO	NO REQ
C3315	CAPACITOR	.047 MFD	100 WVDC	±10%	12-Z-13100	9267	1
C3314	CAPACITOR	.01 MFD	300 WVDC	±10%	625196	133	1
C3313	CAPACITOR	.047 MFD	100 WVDC	±10%	12-Z-13100	9267	1
C3312	CAPACITOR	0.1 MFD	300 WVDC	±20%	12-Z-13100	9541	1
C3311	CAPACITOR	.022 MFD	300 WVDC	±20%	12-Z-13100	9537	1
C3310	CAPACITOR	.47 MFD	300 WVDC	±20%	12-Z-13100	9545	1
C3309	CAPACITOR	.047 MFD	300 WVDC	±20%	12-Z-13100	9539	1
C3308	CAPACITOR	.022 MFD	300 WVDC	±20%	12-Z-13100	9537	1
C3307 C3306	CAPACITOR		100 WVDC		12-Z-13100	*	2
C3305	CAPACITOR	.022 MFD	300 WVDC	±20%	12-Z-13100	9537	1
C3304	CAPACITOR	.0068 MFD	300 WVDC	±10%	625196	129	1
C3303 C3302	CAPACITOR	0.1 MFD	300 WVDC	±20%	12-Z-13100	9541	2
C3301	CAPACITOR	.047 MFD	300 WVDC	±20%	12-Z-13100	9539	1
X3307	SOCKET				1000447		1
X3302	SOCKET				12-Z-7510	114	1
X3306 X3305 X3304 X3303 X3301	SOCKET				12-Z-7510	113	5
V3306 V3305 V3304	TUBE (7726)						3
V3303	TUBE (6AU6WA)						1
V3302	TUBE (5751)				12-Z-13005	574	1
V3301	TUBE (6005)						1
J3304	TIP JACK				12-Z-7113	3002	1
J3303	TIP JACK				12-Z-7113	3005	1
J3302	TIP JACK				12-Z-7113	3001	1
J3301	TIP JACK				12-Z-7113	3003	1
I3301	LAMP (NE 51)				N17-L-6806	130	1
T3304	TRANSFORMER(595753)				SK 137367		1
T3303	TRANSFORMER(595671)				SK 137345		1
T3302	TRANSFORMER(595669)				SK 137354		1
T3301	TRANSFORMER(595982)				SK 272904		1
P3301	CONNECTOR				12-Z-7113	6393	1
R3344	RESISTOR	0.1 MEG	1/2 WATT	±10%	12-Z-13111	350	1
R3343	RESISTOR	1.1 MEG	1/2 WATT	± 1%	625225	57	1
R3342	RESISTOR	2.2 MEG	1/2 WATT	± 1%	625225	3	1
R3341	RESISTOR	10 K	1/2 WATT	± 5%	12-Z-13111	244	1
R3340	RESISTOR	1.5 K	2 WATT	±10%	12-Z-13111	741	1
R3339	RESISTOR	11 K	2 WATT	± 5%	12-Z-13111	707	1

SYMBOL	DESCRIPTION	VALUE	RATING	TOL	DWG NO	PC NO	NO REQ
R3338	RESISTOR	15 K	1 WATT	± 5%	12-Z-13111	478	1
R3337 R3336	RESISTOR	1.5 K	1 WATT	± 5%	12-Z-13111	454	2
R3335	RESISTOR	51 K	1/2 WATT	± 5%	12-Z-13111	261	1
R3334	RESISTOR	1 K	1/2 WATT	± 5%	12-Z-13111	220	1
R3333	RESISTOR	18K	1/2 WATT	± 1%	625225		1
R3332	RESISTOR		1/2 WATT		12-Z-13111	*	1
R3331 R3330 R3329	RESISTOR	2.2 MEG	1/2 WATT	± 1%	625225	3	3
R3328	RESISTOR	18 K	1/2 WATT	±10%	12-Z-13111	286	1
R3327	RESISTOR	10 K	1 WATT	±10%	12-Z-13111	517	1
R3326 R3325	ADJ. RESISTOR	0.1 MEG	2 WATT	±20%	626052	68	2
R3324	ADJ. RESISTOR	25 K	2 WATT	±20%	626052	176	1
R3323	RESISTOR	10 K	1 WATT	±10%	12-Z-13111	517	1
R3322 R3321 R3320 R3319	RESISTOR	3.9 K	1/2 WATT	± 1%	625225	8	4
R3318	RESISTOR	100 K	1 WATT	±10%	12-Z-13111	585	1
R3317	RESISTOR	0.15 MEG	1/2 WATT	± 5%	12-Z-13111	302	1
R3316	RESISTOR	0.22 MEG	1/2 WATT	±10%	12-Z-13111	354	1
R3315	RESISTOR	510 Ω	1/2 WATT	± 5%	12-Z-13111	213	1
R3314 R3313	RESISTOR	0.1 MEG	1/2 WATT	± 5%	12-Z-13111	298	2
R3312	RESISTOR	0.1 MEG	1/2 WATT	±10%	12-Z-13111	350	1
R3311	RESISTOR	0.82 MEG	1/2 WATT	±10%	12-Z-13111	361	1
R3310	RESISTOR	5.6 K	1/2 WATT	±10%	12-Z-13111	280	1
R3309	RESISTOR	39 K	1/2 WATT	± 1%	625225	19	1
R3308	RESISTOR	5.6 MEG	1/2 WATT	±10%	12-Z-13111	371	1
R3307	RESISTOR	22 K	1/2 WATT	±10%	12-Z-13111	287	1
R3306	RESISTOR	1.5 K	2 WATT	±10%	12-Z-13111	741	1
R3305	RESISTOR	27 K	1/2 WATT	± 5%	12-Z-13111	254	1
R3304	RESISTOR	510 Ω	1/2 WATT	± 5%	12-Z-13111	213	1
R3303	RESISTOR	0.1 MEG	1/2 WATT	±10%	12-Z-13111	350	1
R3302	RESISTOR	200 Ω	1/2 WATT	± 1%	625225	43	1
R3301	RESISTOR	620 Ω	1 WATT	± 5%	12-Z-13111	445	1
C3320	CAPACITOR	.47 MFD	300 WVDC	±10%	12-Z-13100	9567	1
C3319 C3318	CAPACITOR		100 WVDC		12-Z-13100	*	2
C3317	CAPACITOR	.0051 MFD	500 WVDC	± 2%	16-C-32715	6053	1
C3316	CAPACITOR	.47 MFD	300 WVDC	±10%	12-Z-13100	9567	1

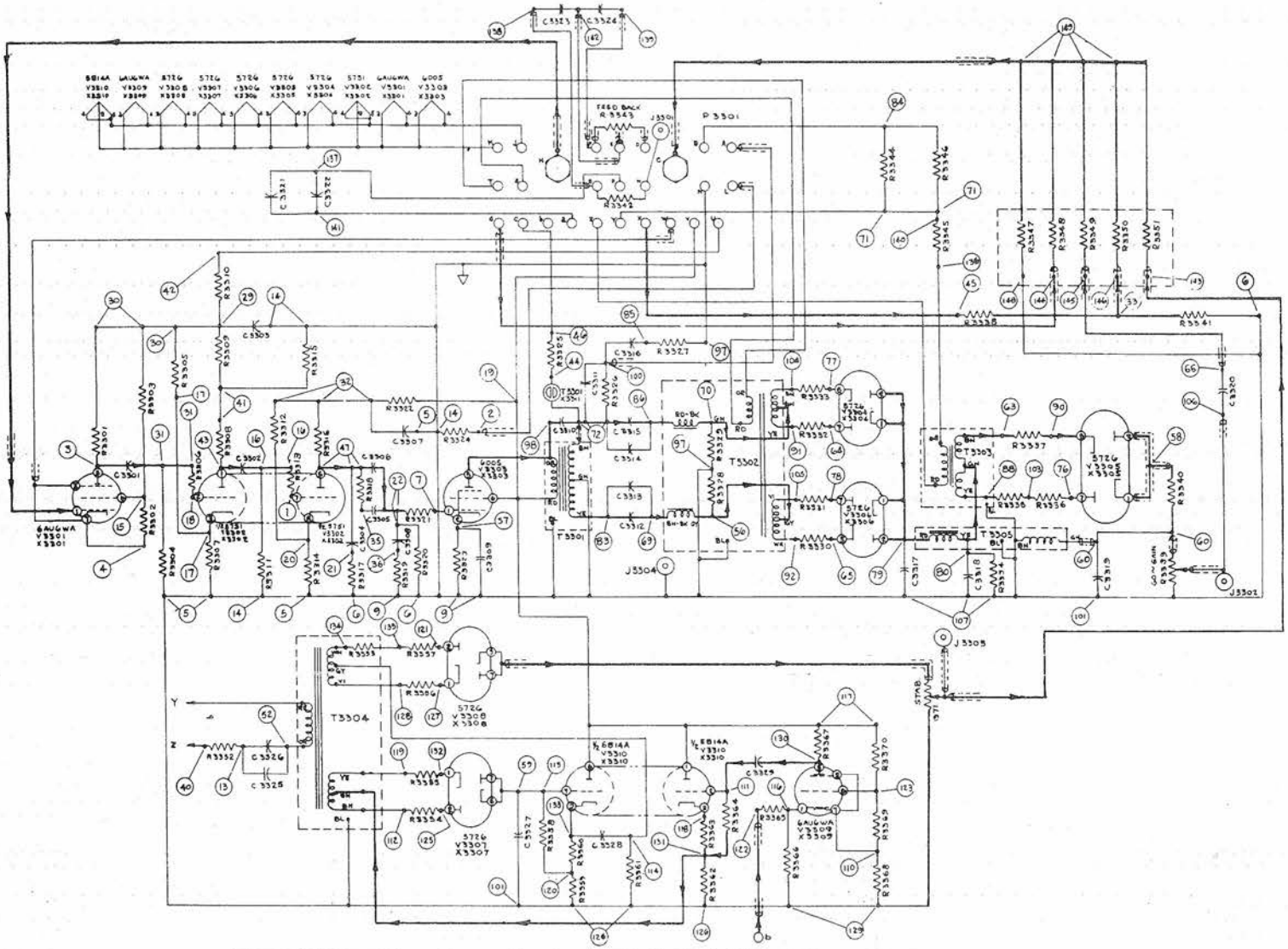

Figure 80. Servo Control, High-Fidelity, Schematic Diagram (Unit 3302)

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Table 56

UNIT 3302 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371797

Resistance Tests

Rotate all controls completely counterclockwise.

Terminals	Normal	Minimum	Maximum
1	690K	621K	759K
2	75	71	79
3	185K	167K	203K
4	207K	186K	228K
5,6	0	---	---
7	150K	135K	165K
8	No connection	---	---
9	0	---	---
10,11,12	No connection	---	---
13	Infinite	---	---
14	0	---	---
15	185K	167K	203K
16	470K	446K	494K
17	1.2K	1.1K	1.3K
18	690K	621K	759K
19	53.2K	50.2K	56.2K
20	510	485	535
21	3.9K	3.7K	4.1K
22	100K	95K	105K
23,24,25, 26,27	No connection	---	---
28	1.07M	.97M	1.17M
29,30	85.6K	77.6K	94.6K
31	470K	446K	494K
32	52.3K	47.3K	57.3K
33	1.0K	0.9K	1.1K
34	No connection	---	---
35	820K	740K	900K
36	No connection	---	---
37	1.2K	1.1K	1.3K
38,39	No connection	---	---
40	Infinite	---	---
41	71.5K	64.5K	78.5K
42	95.6K	85.6K	105.6K
43	401K	361K	441K
44	Infinite	---	---
45	52K	49K	55K
46	Infinite	---	---
47	180K	162K	198K
48,49,50,51	No connection	---	---

Table 56 (Cont'd)

UNIT 3302 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371797

Resistance Tests

Rotate all controls completely counterclockwise.

Terminals	Normal	Minimum	Maximum
52	Infinite	---	---
53	No connection	---	---
54,55	No connection	---	---
56	1.7K	1.6K	1.8K
57	No connection	---	---
58	20K	18K	22K
59	492K	467K	517K
60	1K	0.9K	1.1K
61,62	No connection	---	---
63	15K	14K	16K
64,65	5.4K	4.9K	5.9K
66	2.75M	2.70M	2.80M
67,68	No connection	---	---
69	1.8K	1.6K	2.0K
70	1.7K	1.6K	1.8K
71	Infinite	---	---
72	80	72	88
73,74,75	No connection	---	---
76	33K	31K	35K
77	5.4K	4.9K	5.9K
78	5.4K	4.9K	5.9K
79,80	15K	14K	16K
81,82	No connection	---	---
83	80	72	88
84	Infinite	---	---
85	5.1K	4.8K	5.4K
86	1.8K	1.6K	2.0K
87	No connection	---	---
88,89	15K	13.5K	16.5K
90	33K	31K	35K
91,92	1.7K	1.6K	1.8K
93,94,95, 96	No connection	---	---
97	0	---	---
98	53.1K	49.2K	57K
99	No connection	---	---
100	20K	19.8K	20.2K
101	0	---	---

Table 56 (Cont'd)

UNIT 3302 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371797

Resistance Tests

Terminals	Normal	Minimum	Maximum
102	No connection	---	---
103	15.4K	14.7K	16.2K
104,105	1.7K	1.6K	1.8K
106,107	0	---	---
108,109	No connection	---	---
110	750	712	788
111	492K	443K	541K
112	22K	21K	23K
113	492K	467K	517K
114,115	150K	142K	158K
116	22K	21K	23K
117	53.1K	49.2K	57K
118	24K	22K	26K
119	22K	21K	23K
120	22K	21K	23K
121	172K	163K	181K
122	242K	218K	266K
123	41K	37K	45K
124	No connection	---	---
125	44K	42K	46K
126	0	---	---
127	172K	163K	181K
128	150K	142K	158K
129	0	---	---
130	173K	156K	190
131	22K	21K	23K
132	44K	42K	46K
133	24K	23K	25K
134,135	150K	142K	158K
136,137,138, 139,140, 141,142	Infinite	---	---
143	0	---	---
144,145	2.75M	2.70M	2.80M
146	1.0K	0.90K	1.1K
147,148	0		
149	0.55M	0.54M	0.56M
N to R (Plug 3301)	27K	25.5K	28.5K
D to F (Plug 3301)	25K	22.5K	27.5K

Table 56 (Cont'd)

UNIT 3302 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 1371797

DC Voltage Tests

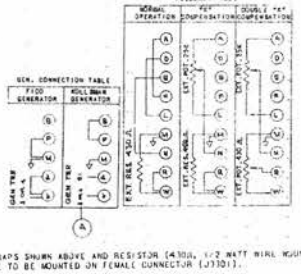
Terminals	Voltage ±10%	Terminal	Voltage ±10%
1,2	0	60	0
3	165	61,62	No connection
4	0.85	63,64,65,66	0
5,6,7	0	67,68	No connection
8	No connection	69,70,71,72	0
9	0	73,74,75	No connection
10,11,12	No connection	76,77,78 79,80	0
13,14	0	81,82	No connection
15	31.5	83,84,85,86	0
16	0	87	No connection
17	1.7	88,89,90 91,92	0
18	0	93,94,95,96	No connection
19	250	97	0
20	1.5	98	242
21,22	0	99	No connection
23,24,25, 26,27	No connection	100,101	0
28	70	102	No connection
29,30	215	103,104,105 106,107	0
31	0	108,109	No connection
32	225	110	2.6
33	0	111	5.8
34	No connection	112	73
35	122	113	72
36	No connection	114,115,116	0
37	20	117	250
38,39	No connection	118	80
40	0	119,120	73
41	103	121,122	0
42	250	123	127
43	80	124	No connection
44,45,46	0	125	73
47	138	126,127,128 129,130	0
48,49,50,51	No connection	131,132	73
52	0	133	82
53,54,55	No connection	134-149	0
56	0		
57	No connection		
58	0		
59	72		

Table 57

UNIT 3302 - PARTS LIST

SYMBOL	DRAWING NO.	PC. NO.	NOMENCLATURE	VALUE	RATING	TOL.	NO. REQ.
X3311	12-Z-7499	17	LAMPHOLDER				1
X3310	12-Z-7510	114	SOCKET				1
X3309							
X3308							
X3307							
X3306	12-Z-7510	113	SOCKET				7
X3305							
X3304							
X3303							
X3302	12-Z-7510	114	SOCKET				1
X3301	12-Z-7510	113	SOCKET				1
V3310	12-Z-13005	652	TUBE 5814A				1
V3309	16-T-56203	53	TUBE 6AU6WA				1
V3308							
V3307							
V3306	16-T-75726		TUBE 5726				5
V3305							
V3304							
V3303	12-Z-13005	620	TUBE 6005				1
V3302	12-Z-13005	574	TUBE 5751				1
V3301	16-T-56203	53	TUBE 6AU6WA				1
T3305	SK 137354		TRANSFORMER 595669				1
T3304	SK 137367		TRANSFORMER 595753				P
T3302	SK 272904		TRANSFORMER 595982				1
T3301	SK 137245		TRANSFORMER 525671				1
P3301	12-Z-7113	6393	CONNECTOR				1
J3304	12-Z-7113	3002	CONNECTOR				1
J3303	"	3003	CONNECTOR				1
J3302	"	3001	CONNECTOR				1
J3301	"	3005	CONNECTOR				1
I3301	17-L-6806	830	LAMP				1
R3371	12-Z-13110	9273	RESISTOR ADJUSTABLE	.1 MEG	2 WATT	±10%	1
R3370	12-Z-13111	260	RESISTOR	47 K	1/2 WATT	±5%	1
R3369	12-Z-13111	252	RESISTOR	56K	1/2 WATT	±5%	1
R3368	12-Z-13111	217	RESISTOR	750 OHMS	1/2 WATT	±5%	1
R3367	12-Z-13111	351	RESISTOR	.17 MEG	1/2 WATT	±10%	1
R3366	12-Z-13111	252	RESISTOR	22K	1/2 WATT	±5%	1
R3365	12-Z-13111	354	RESISTOR	.22 MEG	1/2 WATT	±10%	1
R3364	12-Z-13111	351	RESISTOR	.470MEG	1/2 WATT	±10%	1
R3363	12-Z-13111	279	RESISTOR	2.2K	1/2 WATT	±10%	1
R3362	12-Z-13111	252	RESISTOR	22K	1/2 WATT	±5%	1
R3361	12-Z-13111	332	RESISTOR	.15 MEG	1/2 WATT	±5%	1
R3360	12-Z-13111	228	RESISTOR	2.2K	1/2 WATT	±5%	1
R3359	12-Z-13111	252	RESISTOR	22K	1/2 WATT	±5%	1
R3358	12-Z-13111	314	RESISTOR	.470MEG	1/2 WATT	±5%	1
R3357 R3356 R3355 R3354	12-Z-13110	7382	RESISTOR	22K	1/2 WATT	±1%	4
R3353	12-Z-13111	"	RESISTOR	0-510 OHMS	1/2 WATT	±5%	1
R3352 R3351	12-Z-13111	752	RESISTOR	12K	2 WATT	±10%	1
R3350 R3349 R3348	12-Z-13110	7420	RESISTOR	2.2 MEG	1/2 WATT	±1%	4
R3347	12-Z-13110	7417	RESISTOR	3.1 MEG	1/2 WATT	±1%	1
R3346	12-Z-13111	741	RESISTOR	1.5K	2 WATT	±10%	1
R3345	12-Z-13111	707	RESISTOR	11K	2 WATT	±5%	1
R3344	12-Z-13111	741	RESISTOR	1.5K	2 WATT	±10%	2
R3343	626052	176	RESISTOR ADJUSTABLE	25K	2 WATT	±10%	1

SYMBOL	DRAWING NO.	PC. NO.	NOMENCLATURE	VALUE	RATING	TOL.	NO. REQ.
R3342	12-Z-13111	254	RESISTOR	27K	1/2 WATT	±5%	1
R3341	12-Z-13111	220	RESISTOR	1K	1/2 WATT	±5%	1
R3340	12-Z-13111	286	RESISTOR	10K	1/2 WATT	±10%	1
R3339	12-Z-13110	9273	RESISTOR ADJUSTABLE	.1 MEG	2 WATT	±10%	1
R3338	12-Z-13111	261	RESISTOR	51K	1/2 WATT	±5%	1
R3337 R3336	12-Z-13110	7380	RESISTOR	18K	1/2 WATT	±1%	2
R3335	12-Z-13111	"	RESISTOR	0-510 OHMS	1/2 WATT	±5%	1
R3334	12-Z-13111	478	RESISTOR	15K	1 WATT	±5%	1
R3333 R3332 R3331 R3330	12-Z-13110	7365	RESISTOR	3.9K	1/2 WATT	±1%	4
R3329 R3328	12-Z-13111	454	RESISTOR	1.5K	1 WATT	±5%	1
R3327	12-Z-13111	237	RESISTOR	5.1K	1/2 WATT	±5%	1
R3326	12-Z-13110	7381	RESISTOR	20K	1/2 WATT	±1%	1
R3325	12-Z-13111	283	RESISTOR	10K	1/2 WATT	±10%	1
R3324	12-Z-13111	1176	RESISTOR	75 OHMS	1/2 WATT	±5%	1
R3323	12-Z-13111	452	RESISTOR	1.2 K	1 WATT	±5%	1
R3322	12-Z-13111	517	RESISTOR	10 K	1 WATT	±10%	1
R3321	12-Z-13111	354	RESISTOR	.22 MEG	1/2 WATT	±10%	1
R3320	12-Z-13111	361	RESISTOR	.82 MEG	1/2 WATT	±10%	1
R3319	12-Z-13111	309	RESISTOR	.30 MEG	1/2 WATT	±5%	1
R3318	12-Z-13111	364	RESISTOR	1.5 MEG	1/2 WATT	±10%	1
R3317	12-Z-13111	237	RESISTOR	5.1 K	1/2 WATT	±5%	1
R3316	12-Z-13111	351	RESISTOR	.12 MEG	1/2 WATT	±10%	1
R3315	12-Z-13111	350	RESISTOR	.1 MEG	1/2 WATT	±10%	1
R3314	12-Z-13111	213	RESISTOR	510 OHMS	1/2 WATT	±5%	1
R3313	12-Z-13111	354	RESISTOR	.22 MEG	1/2 WATT	±10%	1
R3312	12-Z-13111	350	RESISTOR	.1 MEG	1/2 WATT	±10%	1
R3311	12-Z-13111	314	RESISTOR	.47 MEG	1/2 WATT	±5%	1
R3310	12-Z-13111	203	RESISTOR	10 K	1/2 WATT	±10%	1
R3309	12-Z-13111	350	RESISTOR	.1 MEG	1/2 WATT	±10%	1
R3308	12-Z-13111	356	RESISTOR	.33 MEG	1/2 WATT	±10%	1
R3307	12-Z-13111	222	RESISTOR	1.2 K	1/2 WATT	±5%	1
R3306	12-Z-13111	354	RESISTOR	.22 MEG	1/2 WATT	±10%	1
R3305	12-Z-13111	302	RESISTOR	.15 MEG	1/2 WATT	±5%	1
R3304	12-Z-13111	314	RESISTOR	.47 MEG	1/2 WATT	±5%	1
R3303	12-Z-13111	585	RESISTOR	.10 MEG	1 WATT	±10%	1
R3302	12-Z-13111	287	RESISTOR	22 K	1/2 WATT	±10%	1
R3301	12-Z-13111	350	RESISTOR	.10 MEG	1/2 WATT	±10%	1
C3329	12-Z-13100	9541	CAPACITOR	.1 MFD	300 WVDC	±20%	1
C3328 C3327	12-Z-13100	9335	CAPACITOR	1.0 MFD	100 WVDC	±10%	2
C3326 C3325	12-Z-13100	9472	CAPACITOR	.47 MFD	200 WVDC	±10%	2
C3324	12-Z-13100	9501	CAPACITOR	.0015 MFD	300 WVDC	±10%	1
C3323	12-Z-13100	9499	CAPACITOR	.001 MFD	300 WVDC	±10%	1
C3322 C3321	12-Z-13100	9567	CAPACITOR	.47 MFD	300 WVDC	±10%	2
C3320	12-Z-13100	9547	CAPACITOR	.01 MFD	300 WVDC	±10%	1
C3319	12-Z-13100	9541	CAPACITOR	.1 MFD	300 WVDC	±20%	1
C3318 C3317	12-Z-13100	9267	CAPACITOR	.047 MFD	100 WVDC	±10%	2
C3316	12-Z-13100	9503	CAPACITOR	.0022 MFD	300 WVDC	±10%	1
C3315	12-Z-13100	"	CAPACITOR		100 WVDC	±10%	1
C3314	12-Z-13100	"	CAPACITOR		100 WVDC	±10%	1
C3313	12-Z-13100	"	CAPACITOR		100 WVDC	±10%	1
C3312	12-Z-13100	"	CAPACITOR		100 WVDC	±10%	1
C3311	12-Z-13100	9499	CAPACITOR	.001 MFD	300 WVDC	±10%	1
C3310 C3309	12-Z-13100	9571	CAPACITOR	.011 MFD	300 WVDC	±5%	1
C3308	12-Z-13100	9267	CAPACITOR	.047 MFD	100 WVDC	±10%	2
C3307	12-Z-13100	9539	CAPACITOR	.047 MFD	300 WVDC	±20%	1
C3306	12-Z-13100	9537	CAPACITOR	.022 MFD	300 WVDC	±20%	1
C3305	12-Z-13100	9539	CAPACITOR	.047 MFD	300 WVDC	±20%	1
C3304	12-Z-13100	9503	CAPACITOR	.0022	300 WVDC	±10%	1
C3303 C3302	12-Z-13100	9539	CAPACITOR	.047 MFD	300 WVDC	±20%	2
C3301	12-Z-13100	9541	CAPACITOR	.1 MFD	300 WVDC	±20%	1



STRAPS SHOWN ABOVE AND RESISTOR (4300, 1/2 WATT WIRE WOUND) ARE TO BE MOUNTED ON FEMALE CONNECTOR (J3301).
POTENTIOMETERS, 25K AND 4300, ARE EXTERNALLY MOUNTED.

FRAME RECEPTACLE WIRE CONNECTIONS

A, D, E, F, L, M, N, R — CONNECTIONS TO FEEDBACK POT. SEE FEEDBACK TABLE AT LEFT

B, P, A, S — CONNECTIONS TO RATE GENERATOR SEE GEN. CONNECTION TABLE AT LEFT

H — INPUT SIGNAL (400 CYCLE)
C — OUTPUT SIGNAL 60 ~ TO SERVO AMPLIFIER

J, K — INPUT, FILAMENT SUPPLY (6.3V., 60 ~, .28 AMP.)

W — INPUT, COMMON RETURN

S, T — INPUT, 12 VOLTS 400 CYCLE A.C. REFERENCE

U — INPUT B1 +250 VOLTS REGULATED D C , .004 AMPS
V — INPUT B2 +250 VOLTS REGULATED D C , .028 AMPS
X — INPUT, (FEEDBACK FROM MOTOR WINDING)

Y, Z — R1, R2 INPUT, REFERENCE 115 VOLTS 60 CYCLE A C .0 AMPS.

C, d — OUTPUT TEST INDICATOR FOR SERVO CONTROL INPUT SERVO AMPLIFIER TEST SIGNAL (CONNECT TO COMMON RETURN OR FRAME RECEPTICAL IF NOT USED)

NOTES:
1. ◯ = TERMINAL POINTS ON TERMINAL BOARD
2. ▽ = CHASSIS CONNECTION
3. TEST IN ACCORDANCE WITH BUORD SK 285614
4. @@@@@ = SHIELDED WIRE
5. ALL SHIELDED W RES GROUNDED AT ONE END UNLESS OTHERWISE SHOWN.
6. HEAVY LINE INDICATES SIGNAL FLOW.

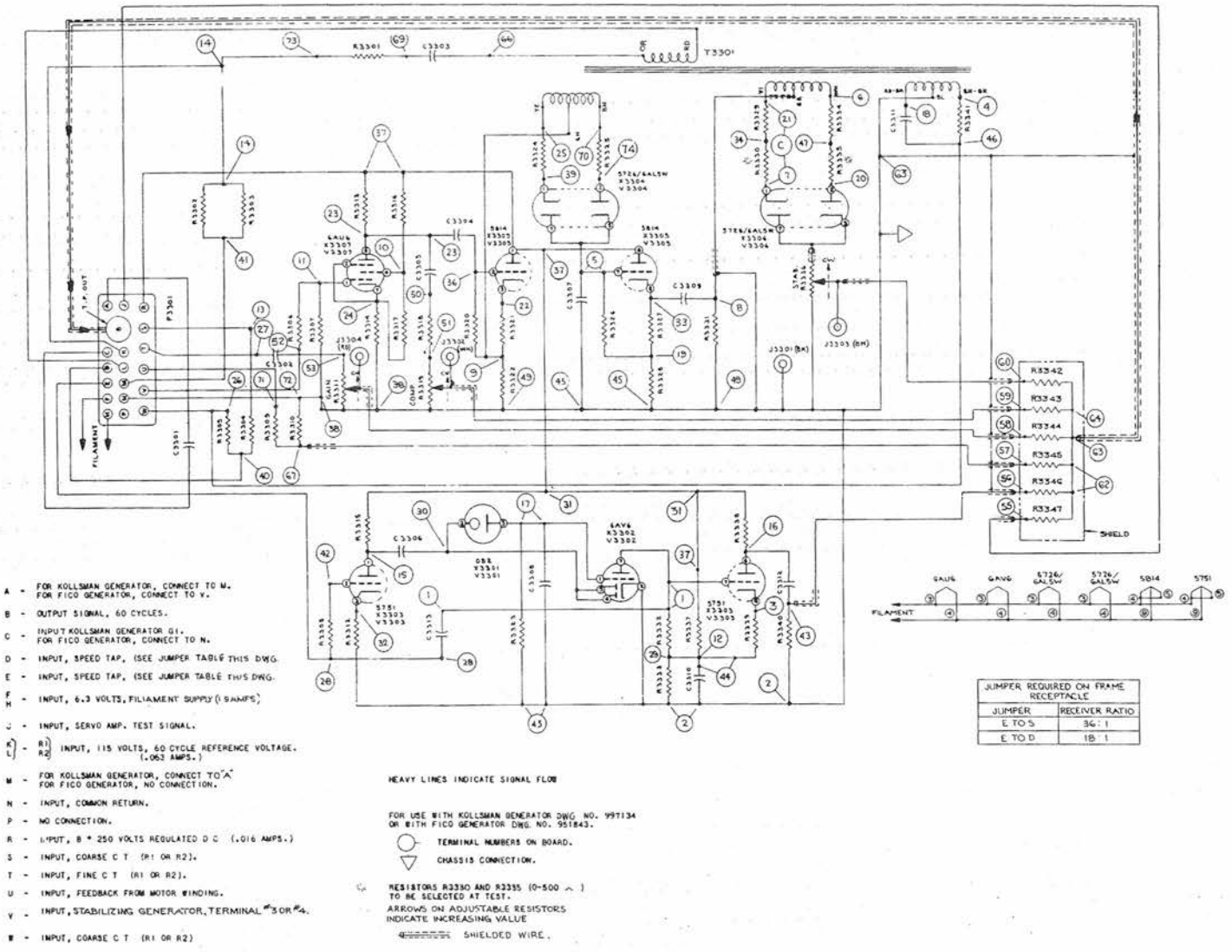


Figure 81. Servo Control, Double-Speed, Schematic Diagram (Unit 3305)

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Table 58

UNIT 3305 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980422

Resistance Tests

Terminals	Normal	Minimum	Maximum
1	704K	670K	738K
2	0	0	0
3	28.3K	26.9K	29.7K
4	30 ohms	27 ohms	33 ohms
5	492K	444K	540K
6	150K	145K	155K
7	172K	167K	177K
8	150K	145K	155K
9	22K	21K	23K
10	42K	41K	43K
11	22K	21K	23K
12	21K	20K	22K
13	141K	134K	148K
14	Infinite	---	---
15	276K	262K	290K
16	446K	401K	491K
17	1M	0.95M	1.05M
18	30 ohms	27 ohms	33 ohms
19	22K	21K	23K
20	172K	167K	177K
21	150K	145K	155K
22	24.2K	22.8K	25.2K
23	176K	161K	191K
24	750 ohms	713 ohms	787 ohms
25	22K	21K	23K
26	47K	44.6K	49.4K
27	Infinite	---	---
28	---	---	---
29	21K	20K	22K
30	Infinite	Infinite	Infinite
31	56K	53K	59K
32	9.1K	8.6K	9.6K
33	24.2K	22.8K	25.2K
34	172K	167K	177K
36	492K	444K	540K
37	56K	53K	59K
38	0	0	0
39	44K	41.8K	46.2K
40	94K	89.3K	98.7K
41	Infinite	---	---
42	Infinite	---	---
43	.74M	.67M	.81M
44	21K	20K	22K
45	0	0	0

Table 58 (Cont'd)

UNIT 3305 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 980422

Resistance Tests

Terminals	Normal	Minimum	Maximum
46	47K	44.6K	49.4K
47	172K	167K	177K
48	Infinite	Infinite	Infinite
49	0	0	0
50	2.5M	2.2M	2.8M
51	1M	0.8M	1.2M
52	242K	230K	254K
53	100K	90K	110K
55	2.66M	2.62M	2.70M
56	0.74M	0.67M	0.81M
57	1K	0.95K	1.05K
58	0	0	0
59	0	0	0
60	0	0	0
62	0.47M	0.45M	0.49M
63	0	0	0
64	0.47M	0.45M	0.49M
66	Infinite	---	---
67	1K	0.95K	1.05K
68	Infinite	---	---
69	Infinite	---	---
70	22K	21K	23K
71	52K	49K	55K
72	0	0	0
73	Infinite	---	---
74	44K	41.8K	46.2K

Turn all potentiometers fully counterclockwise.

DC Voltage Tests

Terminals	Volts	Terminals	Volts
1	+18	22	+82
3	+50	23	+105
5	+74	24	+3.1
6	0	25	+74
7	0	31	+235
9	+74	32	+2.6
10	+120	33	+82
11	0	36	+50
15	+180	43	0
16	+235	44	+50
17	0	51	+18
19	+74	70	+74

Turn all potentiometers fully counterclockwise. Readings may vary ±10 per cent about values given.

Table 59

UNIT 3305 - PARTS LIST

SYMBOL	DRAWING NO	FC HQ	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
T3301	2K137587 (595753)		TRANSFORMER				1
P3301	12-Z-7113	6340	CONNECTOR, PLUG				1
J3304	12-Z-7113	3001	CONNECTOR, RECEPTACLE				1
J3303	12-Z-7113	3003	CONNECTOR, RECEPTACLE				1
J3302	12-Z-7113	3000	CONNECTOR, RECEPTACLE				1
J3301	12-Z-7113	3002	CONNECTOR, RECEPTACLE				1
V3307	16-T-56203	50	ELECT. TUBE, 6AV6				1
V3306	16-T-75726		ELECT. TUBE, 5726/6AL5W				1
V3305	16-T-75814		ELECT. TUBE, 5814				1
V3304	16-T-75726		ELECT. TUBE, 5726/6AL5W				1
V3303	12-Z-13005	574	ELECT. TUBE, 5751 DBL. TRI.				1
V3302	16-T-56203	60	ELECT. TUBE, 6AV6				1
V3301	16-T-52091	5	ELECT. TUBE, 082				1
X3307	12-Z-7810	113	SOCKET, ELECT. TUBE, 7 PIN				1
X3306	12-Z-7510	113	SOCKET, ELECT. TUBE, 7 PIN				1
X3305	12-Z-7510	114	SOCKET, ELECT. TUBE, 9 PIN				1
X3304	12-Z-7510	113	SOCKET, ELECT. TUBE, 7 PIN				1
X3303	12-Z-7510	114	SOCKET, ELECT. TUBE, 9 PIN				1
X3302	12-Z-7510	113	SOCKET, ELECT. TUBE, 7 PIN				1
X3301	12-Z-7510	113	SOCKET, ELECT. TUBE, 7 PIN				1
R3347 R3346 R3345 R3344 R3343 R3342	625225	3	RESISTOR	2.2 M	½ WATT	±10%	6
R3341	12-Z-13111	260	RESISTOR, FIX. COMP.	47 K	½ WATT	± 5%	1
R3340	12-Z-13111	362	RESISTOR, FIX. COMP.	1 M	½ WATT	±10%	1
R3339	12-Z-13111	235	RESISTOR, FIX. COMP.	4.3 K	½ WATT	± 5%	1
R3338	12-Z-13111	357	RESISTOR, FIX. COMP.	390 K	½ WATT	±10%	1
R3337	12-Z-13111	529	RESISTOR, FIX. COMP.	100 K	1 WATT	± 5%	1
R3336	12-Z-13110	9274	RESISTOR, ADJ. W.W.	1 M	2 WATT	±20%	1
R3335	625463	*	RESISTOR, FIX. COMP.	0-500 Ω	½ WATT	± 5%	1
R3334	625225	10	RESISTOR,	22 K	½ WATT	± 1 %	1
R3333	12-Z-13111	483	RESISTOR, FIX. COMP.	24 K	1 WATT	± 5%	1
R3332	12-Z-13111	318	RESISTOR, FIX. COMP.	680 K	½ WATT	± 5%	1
R3331	12-Z-13111	302	RESISTOR, FIX. COMP.	150 K	WATT	± 5%	1
R3330	625463	*	RESISTOR, FIX. COMP.	0-500 Ω	WATT	± 5%	1
R3329	625225	10	RESISTOR,	22 K	WATT	± 1 %	1
R3328	12-Z-13111	252	RESISTOR, FIX. COMP.	22 K	WATT	± 5%	1
R3327	12-Z-13111	228	RESISTOR, FIX. COMP.	2.2 K	WATT	± 5%	1
R3326	12-Z-13111	358	RESISTOR, FIX. COMP.	470 K	WATT	±10%	1
R3325 R3324	625225	10	RESISTOR,	22 K	WATT	± 1 %	2
R3323	12-Z-13111	322	RESISTOR, FIX. COMP.	1 M	WATT	± 5%	1
R3322	12-Z-13111	252	RESISTOR, FIX. COMP.	22 K	WATT	± 5%	1
R3321	12-Z-13111	228	RESISTOR, FIX. COMP.	2.2 K	WATT	± 5%	1
R3320	12-Z-13111	358	RESISTOR, FIX. COMP.	470 K	WATT	±10%	1
R3319	12-Z-13110	9274	RESISTOR, ADJ. W.W.	1 M	2 WATT	±20%	1
R3318	12-Z-13111	326	RESISTOR, FIX. COMP.	1.5 M	½ WATT	± 5%	1
R3317	12-Z-13111	292	RESISTOR, FIX. COMP.	56 K	WATT	± 5%	1
R3316	12-Z-13111	260	RESISTOR, FIX. COMP.	47 K	WATT	± 5%	1
R3315	12-Z-13111	306	RESISTOR, FIX. COMP.	220 K	WATT	± 5%	1
R3314	12-Z-13111	217	RESISTOR, FIX. COMP.	750 Ω	WATT	± 5%	1
R3313	12-Z-13111	351	RESISTOR, FIX. COMP.	120 K	WATT	±10%	1
R3312	12-Z-13111	243	RESISTOR, FIX. COMP.	9.1 K	WATT	± 5%	1
R3311	12-Z-13110	9273	RESISTOR, ADJ. W.W.	100 K	2 WATT	±10%	1
R3310	12-Z-13111	220	RESISTOR, FIX. COMP.	1 K	½ WATT	± 5%	1
R3309	12-Z-13111	261	RESISTOR, FIX. COMP.	51 K	WATT	± 5%	1
R3308	12-Z-13111	358	RESISTOR, FIX. COMP.	470 K	WATT	±10%	1
R3307	12-Z-13111	252	RESISTOR, FIX. COMP.	22 K	WATT	± 5%	1
R3306	12-Z-13111	306	RESISTOR, FIX. COMP.	220 K	WATT	± 5%	1
R3305 R3304	12-Z-13111	260	RESISTOR, FIX. COMP.	47 K	WATT	± 5%	2
R3303 R3302	12-Z-13111	741	RESISTOR, FIX. COMP.	1.5 K	2 WATT	±10%	2
R3301	12-Z-13111	752	RESISTOR, FIX. COMP.	12 K	2 WATT	±10%	1
C3313	16-C-31903	1089	CAPACITOR, FIXED MICA	2200MMFD	500WVDC	± 5%	1
C3312	12-Z-13100	9551	CAPACITOR, FIXED PAPER	.022MFD	300WVDC	±10%	1
C3311	12-Z-13100	9267	CAPACITOR, FIXED PAPER	.047MFD	100WVDC	±10%	1
C3310	12-Z-13100	9449	CAPACITOR, FIXED PAPER	.051MFD	200WVDC	± 5%	1
C3309	12-Z-13100	9329	CAPACITOR, FIXED PAPER	.33 MFD	100WVDC	±10%	1
C3308	12-Z-13100	9394	CAPACITOR, FIXED PAPER	.1MFD	200WVDC	±20%	1
C3307	12-Z-13100	9329	CAPACITOR, FIXED PAPER	.33 MFD	100WVDC	±10%	1
C3306	16-C-32720	7533	CAPACITOR, FIXED MICA	5100MMFD	500WVDC	± 5%	1
C3305	12-Z-13100	9539	CAPACITOR, FIXED PAPER	.047MFD	300WVDC	±20%	1
C3304	12-Z-13100	9559	CAPACITOR, FIXED PAPER	.1MFD	300WVDC	±10%	1
C3303	12-Z-13100	9476	CAPACITOR, FIXED PAPER	1MFD	200WVDC	±10%	1
C3302	12-Z-13100	9259	CAPACITOR, FIXED PAPER	.01MFD	100WVDC	±10%	1
C3301	12-Z-13101	307	CAPACITOR, FIXED PAPER	1MFD	400WVDC	±10%	1

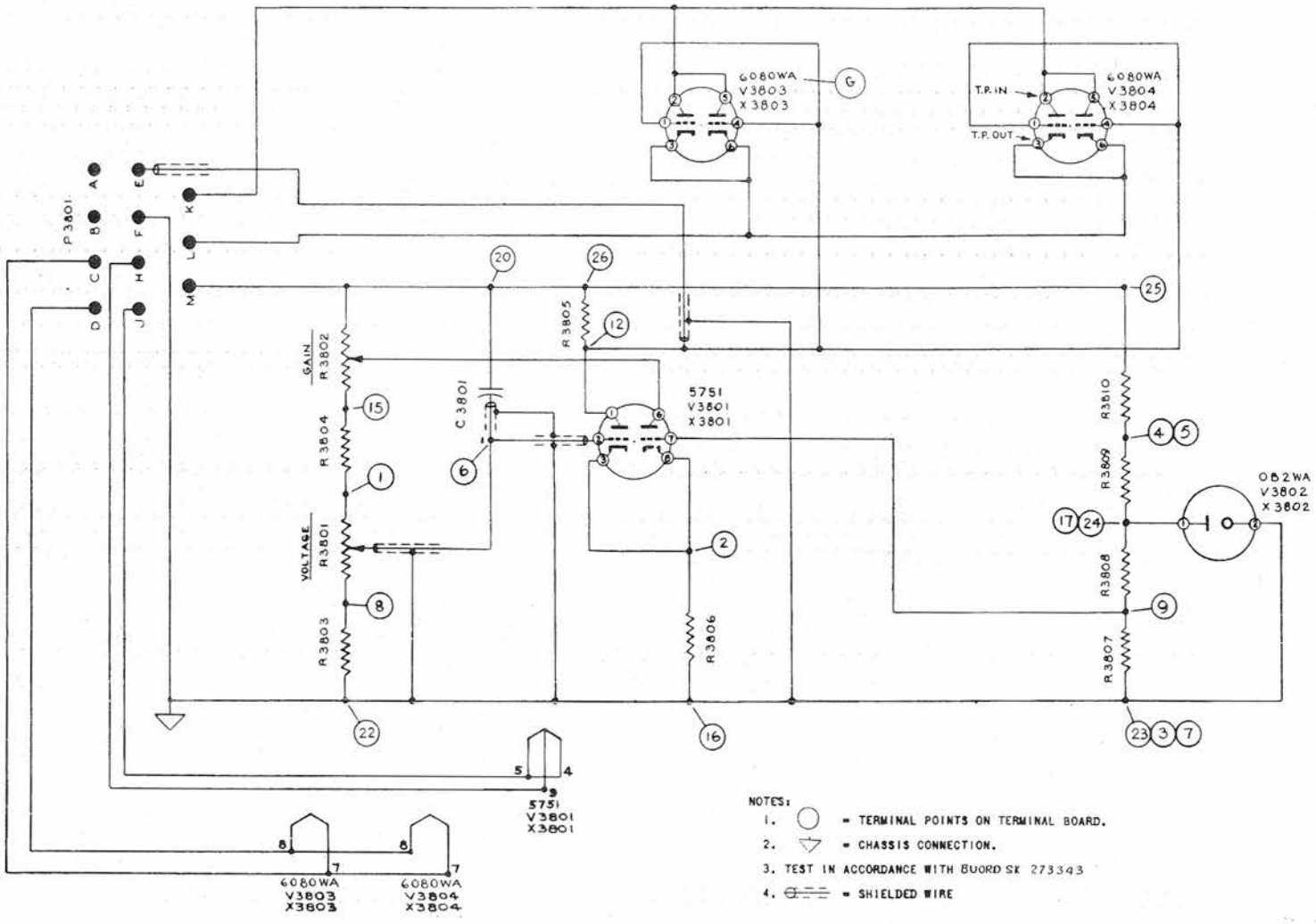

Figure 82. +250-v DC Power Supply, Schematic Diagram (Unit 3803)

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CONFIDENTIAL

Table 60

UNIT 3803 - RESISTANCE VOLTAGE TESTS

BuOrd Dwg 951989
Resistance Tests

Terminals	Normal	Minimum	Maximum
1	9.4K	8.89K	9.83K
2	51K	48.45K	53.55K
3	0	0	0
4	34.8K	32.37K	36.95K
5	34.8K	32.37K	36.95K
7	0	0	0
8	7.14K	6.78K	7.5K
9	32.89K	31.13K	34.65K
12	132.07K	119.82K	144.30K
15	17.45K	16.55K	18.34K
16	0	0	0
17	36.67K	34.34K	38.99K
20	32.07K	29.82K	34.30K
22	0	0	0
23	0	0	0
24	36.67K	34.34K	38.99K
25	32.07K	29.82K	34.30K
26	32.07K	29.82K	34.30K

DC Voltage Tests

Terminals	Volts	Terminals	Volts
1	+57	9	+52
2	+53	12	+232
4	+183	15	+113
6	+52	17	+110
8	+40		

Voltage tolerance 5 per cent.

Table 61

UNIT 3803 - PARTS LIST

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
X3804 X3803	12-Z-7510	117	SOCKET; ELECTRON TUBE, 8 PIN, JAN TS101P02				2
X3802	12-Z-7510	113	SOCKET; ELECTRON TUBE, 7 PIN, JAN TYPE TS102P01				1
X3801	12-Z-7510	114	SOCKET; ELECTRON TUBE, 9 PIN, JAN TYPE TS103P01				1
V3804 V3803	16-T-76080	85	TUBE; ELECTRON; 6080WA TWIN TRIODE 8 PIN				2
V3802	16-T-52001	8	TUBE; ELECTRON; 0B2WA MINIATURE, 7 PIN				1
V3801	12-Z-13005	574	TUBE; ELECTRON; 5751 MINIATURE TRIODE, 9 PIN				1
P3801	12-Z-7113	6301	CONNECTOR; PLUG, 11 LUG, PNL TYPE, MTG. STUDS 1.562 C/C				1
R3810 R3809	12-Z-13111	702	RESISTOR; FIXED COMPOSITION .405 DIA. X 1.41 LG.	6.8 K	2 WATT	±5%	2
R3808	12-Z-13111	261	RESISTOR; FIXED COMPOSITION .175 DIA. X .406 LG.	51 K	1/2 WATT	±5%	1
R3807	12-Z-13111	260	RESISTOR; FIXED COMPOSITION .175 DIA. X .406 LG.	47 K	1/2 WATT	±5%	1
R3806	12-Z-13111	261	RESISTOR; FIXED COMPOSITION .175 DIA. X .406 LG.	51 K	1/2 WATT	±5%	1
R3805	12-Z-13111	298	RESISTOR; FIXED COMPOSITION .175 DIA. X .406 LG.	100 K	1/2 WATT	±5%	1
R3804	12-Z-13111	244	RESISTOR; FIXED COMPOSITION .175 DIA. X .406 LG.	10 K	1/2 WATT	±5%	1
R3803	12-Z-13111	241	RESISTOR; FIXED COMPOSITION .175 DIA. X .406 LG.	7.5 K	1/2 WATT	±5%	1
R3802	16-R-87749	4560	RESISTOR; VARIABLE COMPOSITION 1-1/16 DIA. X 9/16 D.	25 K	2 WATT	±10%	1
R3801	12-Z-13110	9031	RESISTOR; VARIABLE COMPOSITION 1-1/16 DIA. X 9/16 D.	2.5 K	2 WATT	±10%	1
C3801	16-C-32720	7533	CAPACITOR; FIXED MICA, DIELEC. 53/64 X 53/64 X 11/32	5100 MMFD	500 WVDC	±5%	1

FRAME RECEPTACLE WIRING CONNECTIONS

A. NO CONNECTION

B. NO CONNECTION

C, D } 6.3-VOLT FILAMENT, 60-CYCLE AC { AT 2.5 AMPS INPUT FOR DWG. 951989-1 / AT 5.0 AMPS INPUT FOR DWG. 951989-2 } (DC POTENTIAL + 250V.)

E. GRID CONTROL (FOR USE WITH EXTERNAL CURRENT BOOSTER, IS 6AS7G TUBES MAX.)

F. COMMON RETURN

H, J } 6.3-VOLT FILAMENT, 60-CYCLE AC , AT 0.35 AMPS INPUT (DC POTENTIAL - GND)

K. +350-VOLT REGULATED DC INPUT, { .25 AMPS MAX. FOR DWG. 951989-1 / .50 AMPS MAX. FOR DWG. 951989-2 }

* L. +250-VOLT DC OUTPUT { AT 0.225 AMPS MAX. FOR DWG. 951989-1 / AT 0.475 AMPS MAX. FOR DWG. 951989-2 }

* M. +250-VOLT REGULATOR * L AND M TIED TOGETHER AT DISTRIBUTION BUSS

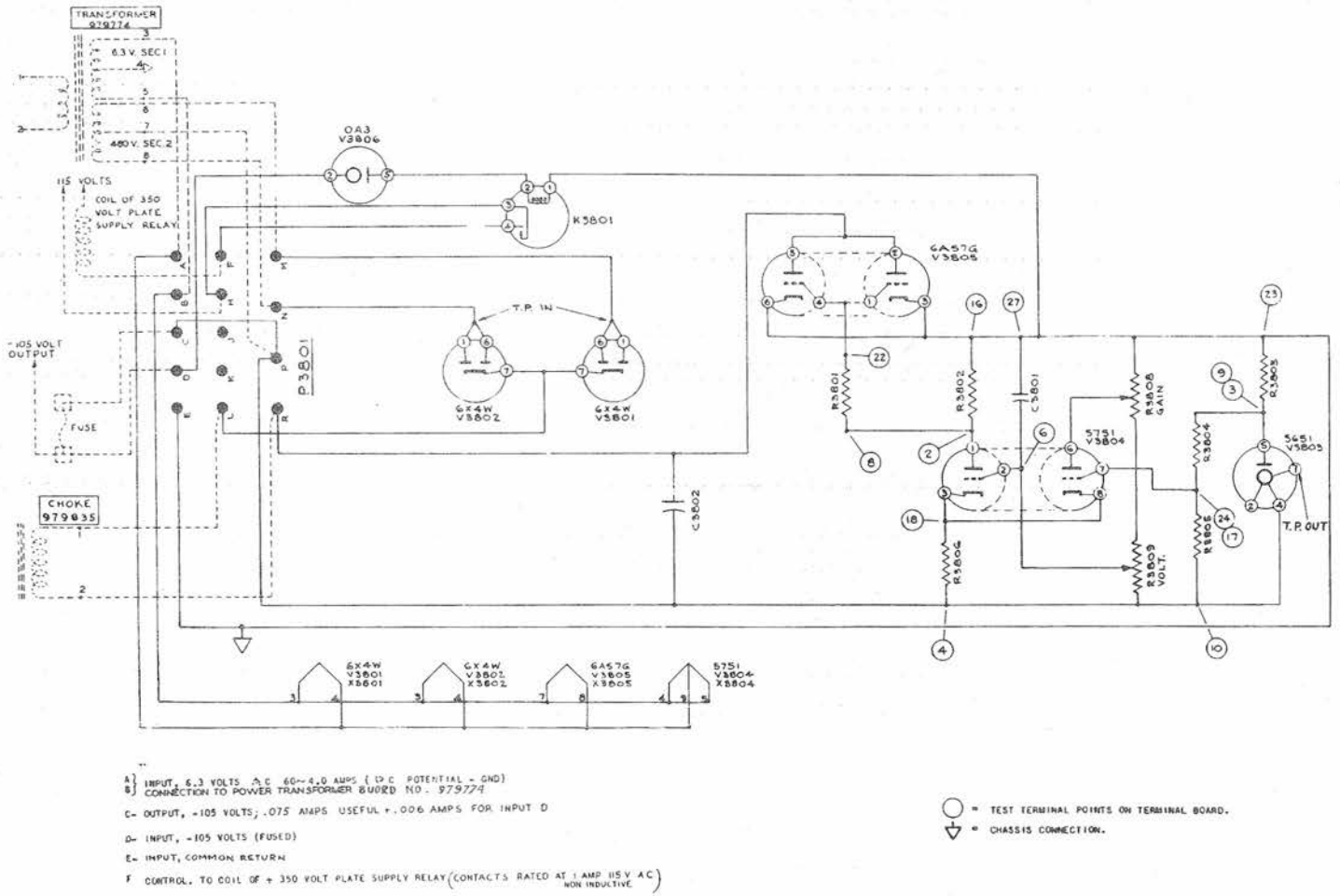

Figure 83. -105-v DC Power Supply, Schematic Diagram (Unit 3804)

Gene Slover's US Navy Pages

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Table 62

UNIT 3804 - RESISTANCE AND VOLTAGE TESTS

BuOrd Dwg 979772

Resistance Tests

Turn voltage potentiometer fully counterclockwise.

Terminals	Normal	Minimum	Maximum
2	100K	95K	105K
3	4.12K	3.92K	4.32K
4,6	25.6K	23.3K	27.5K
8	100K	95K	105K
9	4.12K	3.92K	4.32K
10	25.6K	23.3K	27.5K
16	0		
17	23.7K	21.5K	25.9K
18	76.6K	71.7K	81.1K
22	151K	143K	159K
23	0		
24	23.7K	21.5K	25.9K
27	0		
A,B,M,N	Infinite	---	---
P	25.6K	23.3K	27.5K
1 to 2 on Relay K3801	3600	3500	3700
H to F on P3801	Infinite	---	---

DC Voltage Tests

Measure voltages with VTVM

Terminals	Voltage ±20%	Terminals	Voltage ±20%
2	-16	16	0
3	-18.5	17,18	-75
4	-105 (± 1 volt)	22	-16
6	-75	23	0
8	-16	24	-75
9	-18.5	27	0
10	-105 (± 1 volt)	L	67
		R	55

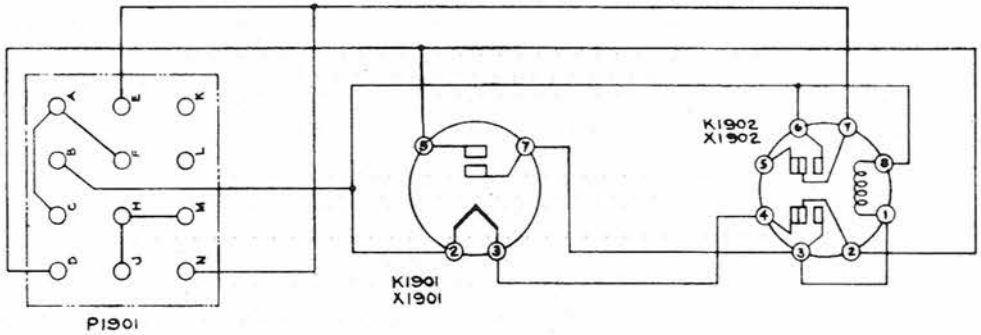
With the supply operating under normal conditions, a resistance check between pins H and F must read zero, indicating that the relay contacts are closed.

If the line voltage is decreased until the supply output falls to -90 volts, a resistance check between pins H and F will show infinite resistance, indicating that the relay contacts are open.

Table 63

UNIT 3804 - PARTS LIST

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
X3806	12-Z-7510	117	SOCKET, ELECTRON TUBE, 8 PIN JAN TYPE TS101P02				1
X3805	12-Z-7510	117	SOCKET, ELECTRON TUBE, 8 PIN JAN TYPE TS101P02				1
X3804	12-Z-7510	114	SOCKET, ELECTRON TUBE, 9 PIN JAN TYPE TS103P01				1
X3803	12-Z-7510	113	SOCKET, ELECTRON TUBE, 7 PIN JAN TYPE TS102P01				1
X3802	12-Z-7510	113	SOCKET, ELECTRON TUBE, 7 PIN JAN TYPE TS102P01				1
X3801	12-Z-7510	113	SOCKET, ELECTRON TUBE, 7 PIN JAN TYPE TS102P01				1
V3806	16-T-53030		ELECTRON TUBE, 0A3 DIODE VOLTAGE REGULATOR 6 PIN				1
V3805	16-T-56202		ELECTRON TUBE, 6080WA RECEIV. TWIN TRIODE VOLTAGE REG., 8 PIN				1
V3804	12-Z-13005	574	ELECTRON TUBE, 5751 DBL-TRI VOLTAGE AMPLIFIER, 9 PIN				1
V3803	16-T-75651		ELECTRON TUBE, 5651WA VOLTAGE REGULATOR (MINIA. VR-75) 7 PIN				1
V3802	16-T-56840	50	ELECTRON TUBE, 6X4W MINIA. TYPE DUO DI VAC. RECTIFIER 7 PIN				1
V3801	16-T-56840	50	ELECTRON TUBE, 6X4W MINIA. TYPE DUO DI VAC. RECTIFIER 7 PIN				1
P3801	12-Z-7113	6307	CONNECTOR, PLUG, 14 LUG CONTACT MOUNTING STUDS 1.938" C/C				1
K3801	1149374		RELAY, ARMATURE; SPST, NO; 3600 OHM COIL; HS. STEEL CASE	9 MA	30 R.C.V.	± 10%	1
R3809 R3808	16-R 87749	4560	RESISTOR, VARIABLE, COMP., 25000 OHMS, ± 10%, 2W, LIN. TAPER.	25 K	2 WATT	± 10%	2
R3806	12-Z-13111	261	RESISTOR, FIXED COMPOSITION .406 LG X .175 DIA.	51 K	½ WATT	± 5%	1
R3805	12-Z-13111	248	RESISTOR, FIXED COMPOSITION .406 LG X .175 DIA.	15 K	½ WATT	± 5%	1
R3804	12-Z-13111	289	RESISTOR, FIXED COMPOSITION .406 LG X .175 DIA.	33 K	½ WATT	±10%	1
R3803	12-Z-13111	235	RESISTOR, FIXED COMPOSITION .406 LG X .175 DIA.	4.3 K	½ WATT	± 5%	1
R3802	12-Z-13111	298	RESISTOR, FIXED COMPOSITION .406 LG X .175 DIA.	100 K	½ WATT	± 5%	1
R3801	12-Z-13111	261	RESISTOR, FIXED COMPOSITION .406 LG X .175 DIA.	51 K	½ WATT	± 5%	1
C3802	16-C-49981	9967	CAPACITOR, FIXED, PAPER, DIELEC. JAN TYPE CP70E1FF 405 V	4 MFD.	600 WVDC	+ 20% - 10%	1
C3801	16-C-31085	3689	CAPACITOR, FIXED MICA DIELECT. 53/64 x 53/64 x 9/32	.001 MFD	500WVDC	± 5%	1



DRAWING NUMBERS IN TABLE ARE FOR REFERENCE ONLY

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	NO REQ
X1902 X1901	12-Z-7510	117	SOCKET, ELECTRON TUBE: JAN TYPE TS1Q1P02				2
P1901	12-Z-7113	6303	CONNECTOR PLUG: PML. TYPE; 12 LUGS NOCOAX; 1 5/16"L.,Q.,x 1 1/8"ID.				1
K1902	12-Z-13001	9277	RELAY	15 AMP	115 VOLTS		1
K1901	12-Z-13001	9109	RELAY, THERMAL 6AMP, 117V HEATER V.-30+5 SEC. OPERATING	6 AMP	250 VOLTS		1

A) INPUT
B) 115-VOLT-60 CYCLE SUPPLY.

C) INTERLOCK *
D) -105 VOLT POWER SUPPLY RELAY.

E OUTPUT TO PRI. LEAD OF PLATE TRANSFORMER FOR +350 VOLT POWER SUPPLY (SEE NOTE.)

F) STAND BY SWITCH.*
H)

J SAFETY INTERLOCK (FROM +350-VOLT POWER SUPPLY.)

K) NO CONNECTION.
L)

M) SINGLE PHASING RELAY (COIL CONNECTION.)
N)

*WHEN NOT USED, CONNECT JUMPER ACROSS TERMINALS.

NOTE: RELAY CONTACT RATING IS 15-AMP. MAX., NON-INDUCTIVE

TEST IN ACCORDANCE WITH BUORD SK 273365

Figure 84. Time Delay Control, Schematic Diagram (Unit 1903)

Table 64

UNIT 1903 (TIME DELAY CONTROL)

BuOrd Dwg 979577

Resistance Tests

Remove the two relays from their sockets.

Between Terminals	Resistance
A and E	INF
A and B	INF
B and E	INF

Replace relay K1902 only, and continue tests on socket X1901.

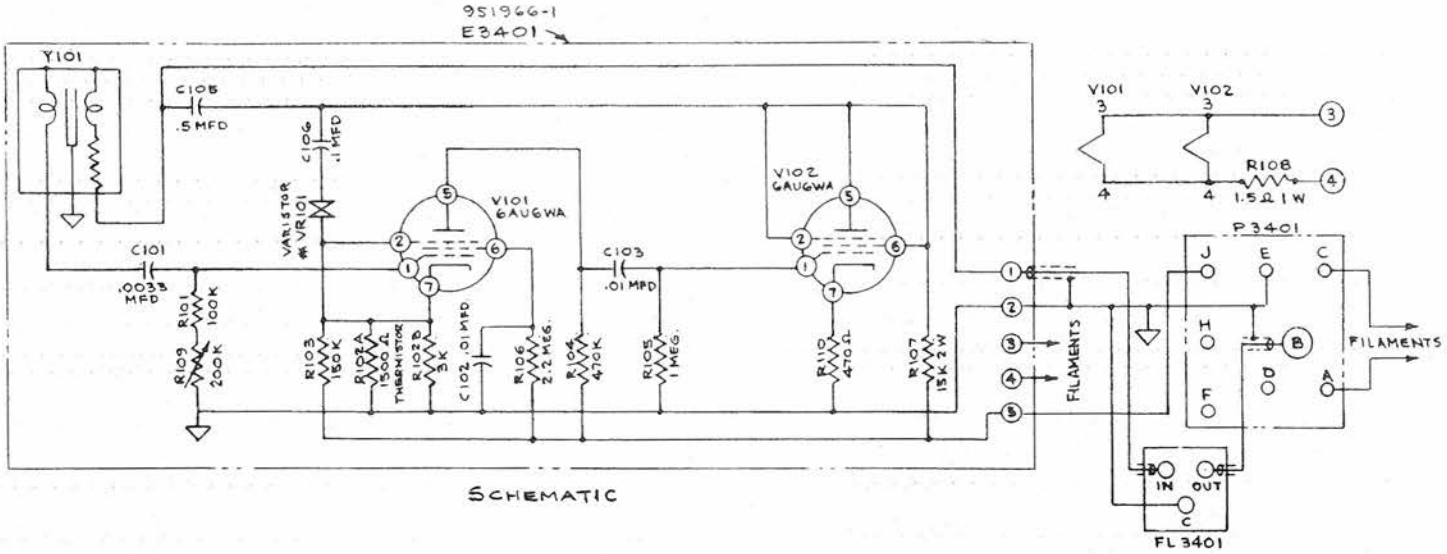
1 and 8	400 ±10%
3 and 4	INF
5 and 6	INF

Observe the physical condition of the relay mechanism housed in K1901. The contacts of the relay should be separated and its finished surfaces clean.

TIME DELAY TEST

Reinsert the two relays. With a test jumper, short together terminals C and D, and with another jumper, terminals H and F. Obtain a 115-volt 60-cycle power source, and connect it across terminals A and B. Connect the clip leads of an analyzer across terminals C and N on the plug connector. Energize the unit, simultaneously noting the exact time the power is applied. After 30 seconds, the measured voltage on the analyzer should read 115 volts.

De-energize the unit. Remove the clip leads from A and E, and connect them across terminals C and N. Energize the unit again, and complete the test as directed for terminals A and E above.



DRAWING NUMBERS IN THIS TABLE ARE FOR REFERENCE ONLY

SYMBOL	DRAWING NO	PC NO	NOMENCLATURE	VALUE	RATING	TOL	QUAN
P3401	12 7 7113	6300	PLUG CONNECTOR				1
FL3401	52-876		FILTER				1
E3401	951966		FREQUENCY STANDARD				1

RECEPTICAL WIRING CONNECTIONS

A } INPUT-HEATER FILAMENT 6.3 VOLTS
C } 60 CYCLES 0.6 AMPS

B - OUTPUT

D - NO CONNECTION

E - INPUT COMMON RETURN

F - NO CONNECTION

H - NO CONNECTION

J - INPUT B+ 250 VOLTS, REGULATED D C , .010 AMPS

NOTES:

1. ◯ TERMINAL LETTERS ON BOARD AND SOCKET
2. ▽ COMMON RETURN
3. TEST IN ACCORDANCE WITH BUORD SK 285702

Figure 85. Tuning Fork Oscillator, 400-cycles, Schematic Diagram (Unit 3401)

Table 65

UNIT 3401 (400-CYCLE TUNING FORK OSCILLATOR)

BuOrd Dwg 1372162

Resistance Tests

Terminal	Normal	Minimum	Maximum
5 to V101-5	470K	423K	517K
5 to V101-6	2. 2M	2. 0M	2. 4M
V102-1	1M	0. 9M	1. 1M
5 to V102-6	15K	13. 5K	16. 5K
V102-7	470	423	517
Across R101	100K	90K	110K

DC Voltage Tests

Terminal	Volts ±10%	Terminal	Volts ±10%
V102-2	250	V101-5	225
V102-5	250	V101-6	175
V102-6	250		

detent position. A positive detent action at the correct position automatically will align the potentiometer shaft to its original setting. Then, retighten the locking screw on the control shaft.

Test Equipment

Accurate test equipment and technical ability are equally important in trouble shooting electronic equipment. In the trouble-shooting tests that follow, two basic test instruments are used: the analyzer volt-ohm meter and the AC VTVM (vacuum-tube voltmeter). Refer to the operation manual for each instrument to be certain that its operation is understood thoroughly.

Analyzer. The Weston Analyzer, Model #779, was used for establishing all volt-ohm meter data given in the tables of point-to-point voltages and resistances. However, any reliable volt-ohm meter of 20,000 ohms per volt sensitivity, capable of measuring AC and DC to 1000 volts, will be satisfactory.

AC VTVM. The Hewlett Packard VTVM, Model #400-C, was used for establishing all tabulated test data requiring the use of an AC vacuum-tube voltmeter. Any reliable VTVM capable of measuring AC voltages from 0.001 to 300 volts rms will be acceptable.

WARNING: The maximum voltage that exists in Computer Mk 48 Mod 1 is +455 volts DC. Contact with voltages of such magnitude can be fatal. Maintenance personnel, therefore, are urged to be always alert when checking energized equipment and to adhere strictly to the rules and regulations pertinent to work on high voltage electrical equipment.

Unit 3804—Relay Operation Check

This power supply contains a single-pole single-throw relay housed in a steel case. With an analyzer connected between terminals 1 and 2, measure the DC resistance of the armature coil. Its resistance should be about 3600 ohms.

With power off, a resistance check between pins H and F must show infinite resistance, indicating that the relay contacts are open.

With the supply operating under normal conditions, a similar resistance check between pins H and F must read zero, indicating that the relay contacts are closed.

If the line voltage is decreased until the supply output falls to -90 volts, a resistance check between pins H and F will show infinite resistance, indicating that the relay contacts are open.

TRANSFORMERS AND CHOKES

A list of the transformers and chokes used in this computer are arranged in table 66 according to their BuOrd drawing numbers. Positive identification of a transformer or choke can be made only by referring to its BuOrd number. Units that may be readily interchanged will have identical BuOrd numbers.

The resistance tests of table 67 and the voltage tests of table 68 are used in testing the transformers and chokes. When conducting these tests, use a 20,000 ohms per volt analyzer for both resistance and voltage measurements. For critical measurements, however, use an AC VTVM.

When testing a transformer, conduct the voltage tests while the transformer is working under typical load conditions. Take each measurement in the step-by-step manner shown in the tests. If the transformer is defective, the resistance tests

Table 66

TRANSFORMERS AND CHOKES REFERENCE INDEX

BuOrd Dwg	Transformer Unit No	Transformer Designation	Located in Element	BuOrd Test Sketch	Function
595596	1001	T3301	3001, 3011	137433	Step-down
595669	1009	T3305	3301, 3302	137441	Filter
595671	1006	T3303	3301, 3302	137438	400-c control
595753	1008	T3304	3301, 3302, 3304, 3305	137440	60-c sensing
595982	1007	T3301	3301, 3302	137486	400-c sensing
596426	1056	T3401	3401	276623	Filter
596439	1019	T3001	3402	276601	400-c output
979774	1002	T4103	3804 and section 4100	276951	Plate, fil
979835	1003		3804	276952	Filter
980516	1017	T4304	Section 4300	276983	60-c ref
997471	1018	T4303	Section 4300	276985	400-c ref
1225461	1004	T4104	Section 4100	2856009	400-c ref
1225521	1057	T4001	Section 4000	285620	Step-down
1371778	1051	T4101, 4102 4301, 4302	Sections 4100, 4300	285605	Fil

Table 67

TRANSFORMERS AND CHOKES RESISTANCE MEASUREMENTS

Unit	Winding	Terminals	Resistance ±10%
1001	Pri	O and RED	273
	Sec	BRN and YEL	17.5
	Tertiary	GRN and VIOLET	20.2
1002	Pri	1 and 2	10
	Sec (1)	3 and 5	0.03
	Sec (2)	6 and 8	200
1003	-	1 and 2	140
1004	Pri	1 and 2	0.04
	Sec	3 and 4	0.04
1006	Pri	O and RED	625
	Sec	BRN and YEL	176
1007	Pri	O and RED	11
	Sec (1)	WH and VIOLET	270
	Sec (2)	YEL and BRN	270
1008	Pri	O and RED	190
	Sec (1)	RED, BLK dot and BRN, BLK dot	60
	Sec (2)	BRN and YEL	810
	Sec (3)	VIOLET and WH	155
1009	-	RED and YEL	800
	-	BRN and GRN	1100

Table 67 (Cont'd)

TRANSFORMERS AND CHOKES RESISTANCE MEASUREMENTS

Unit	Winding	Terminals	Resistance ±10%
1017	Pri	1 and 2	35
	Sec (1)	3 and 4	22
	Sec (2)	4 and 5	210
	Sec (3)	5 and 6	0.55
	Sec	3 and 6	232
1018	Pri	1 and 2	0.215
	Sec (1)	3 and 4	10.5
	Sec (2)	4 and 5	0.5
	Sec	3 and 5	11
1019	Pri	1 and 3	152
	Sec	4 and 5	0.15
	Sec c-tap	1 and 2	76
1051	Pri	1 and 2	0.8
	Sec (1)	3 and 5	0.005
	Sec (2)	6 and 8	0.005
1056	-	RED and 0	1100

Table 68

TRANSFORMERS AND CHOKES VOLTAGE MEASUREMENTS

Unit	Winding	Terminals	Voltage	Tolerance
1001	Pri	0 and RED	60	±10%
	Sec	BRN and YEL	12	±10%
	Tertiary	GRN and VIOLET	5	±10%
1002	Pri	1 and 2	115	
	Sec (1)	3 and 5	6.5	± 0.2 v
	Sec (2)	6 and 8	460	± 10 v
1004	Pri	1 and 2	12	
	Sec	3 and 4	12	± 0.1 v
1006	Pri	0 and RED	120	
	Sec	BRN and YEL	60	± 10%
1007	Pri	0 and RED	12	
	Sec (1)	WH and VIOLET	60	± 10%
	Sec (2)	YEL and BRN	60	± 10%
1008	Pri	0 and RED	30	
	Sec (1)	RED, BLK dot and BRN, BLK dot	5	± 10%
	Sec (2)	BRN and YEL	60	± 10%
	Sec (3)	WH and VIOLET	10	± 10%
1017	Pri	1 and 2	115	
	Sec (1)	3 and 4	25	± 2 v
	Sec (2)	4 and 5	224.5	± 5 v
	Sec (3)	5 and 6	5	± 0.05 v

Table 68 (Cont'd)

TRANSFORMERS AND CHOKES VOLTAGE MEASUREMENTS

Unit	Winding	Terminals	Voltage	Tolerance
1018	Pri	1 and 2	12	
	Sec (1)	3 and 4	92.5	± 1 v
	Sec (2)	4 and 5	2.5	± .05 v
1019	Pri	1 and 3	380	± 10%
	Sec	4 and 5	12	± 10%
1051	Pri	1 and 2	115	± 10%
	Sec (1)	3 and 5	6.65	± 10%
	Sec (2)	6 and 8	6.65	± 10%
1057	Pri	1 and 2	12	- - -
	Sec	3 and 4	0.12	- - -

can be used to locate the faulty winding. Replace a defective transformer with a good one of identical drawing number. After the new transformer has been installed, test it for satisfactory operation.

> WARNING: High voltages are used in these transformers. Death or injury can result if personnel fail to observe the safety precautions pertinent to work on high voltage equipment.

SERVO CONTROL POTENTIOMETER SETTINGS

Table 69 lists the optimum potentiometer settings for the various servo controls. The settings are made with the servo control removed from the computer. Some settings are made by turning the potentiometer shaft to the end of its clockwise or counterclockwise travel. Other settings are made by turning the potentiometer shaft to an intermediate resistance point, the value of which is expressed as a percentage of the total potentiometer-resistance available. With percentage settings, an ohmmeter is used to measure the total resistance of the potentiometer. Then, by calculation, the specified percentage value is converted into an equivalent resistance value, and the potentiometer shaft locked in at that setting. The potentiometer setting procedure can be summarized as follows:

1. Remove the servo control from the computer.

2. Turn each servo control potentiometer in the direction specified in the table.

3. For percentage setting, measure the resistance between the pertinent test jack and the common-return jack.

4. Set the potentiometer according to the percentage values shown in the columns. For some potentiometers, rotation of their shafts from maximum counterclockwise to maximum clockwise causes the resistance reading to rise from zero to a maximum reading. Therefore, the correct setting is simply the specified percentage of this maximum value. For other potentiometers, however, rotation of their shafts from minimum to maximum travel will cause the readings to rise from zero to a maximum value (near the midpoint of travel) and then back to a zero reading. With these potentiometers, the correct percentage setting is indicated by a percentage of the maximum reading from the low end of the potentiometer.

For a setting that requires a potentiometer to be set at a maximum reading, the setting is listed as "MAX RES."

For a servo control designated "K COMP," no potentiometer setting is required. This is because the feedback is controlled automatically by an external potentiometer, the internal potentiometer not being used. All other feedback potentiometer settings are at maximum clockwise. All compensation potentiometer settings are at maximum counterclockwise.

RESOLVER TRIMMING PROCEDURE

When a resolver is being installed as a replacement, the trim components used for the old resolver usually will not be correct for the new one, and must therefore be checked and replaced as necessary. The purpose of the trimming procedures that follow is to duplicate the trim-circuitry requirements needed for optimum accuracy of the computer. Six different procedures are required to cover all of the resolvers in the instrument. The trimming procedures fall into two main sections: four procedures for trimming resolvers paralleled in groups of two, and two procedures for those paralleled in groups of four. The resolvers treated in each procedure are listed in the main title for the procedure.

Table 69

SERVO CONTROL POTENTIOMETER SETTINGS

Servo Control			Potentiometer Test Jack Settings (Percent)				
Type	Function	Element No ZB	Feedback (Orange)	Gain (Red)	Stab (Brown)	Err Red (Green)	Comp (White)
Computing Velocity-Lag Unit 3301	Ph	4103	MAX CW	MAX RES	60%	--	--
	Es	4107	K COMP	MAX RES	15%	--	--
	OR	4108	K COMP	MAX RES	30%	--	--
	Et	4109	K COMP	MAX RES	20%	--	--
	Xp	4300	K COMP	MAX RES	32%	--	--
	Yp	4301	K COMP	MAX RES	32%	--	--
	OB	4316	K COMP	35% LOW	68%	--	--
	jB	4104	MAX CW	77% LOW	6.2%	--	--
Computing High-Fidelity Unit 3302	L'	4110	MAX CW	46% LOW	17%	--	--
	Zh	4311	MAX CW	65% LOW	33%	--	--
	(jOB'r' -jB'r')	4314	MAX CW	66% LOW	57%	--	--
	jOB'r'	4315	MAX CW	65% LOW	54%	--	--
Double-Speed Velocity Lag Unit 3304	R	4102	--	17%	55%	Not Used	--
	Co	4105	--	21%	50%	Not Used	--
Double-Speed High-Fidelity Unit 3305	B'r'	4106	--	35%	48%	--	MAX CCW
	OL'	4112	--	5.6%	20%	--	MAX CCW
	OZh	4313	--	6.5%	23%	--	MAX CCW

Determine first which resolver numbers are concerned and then select the correct trim procedure.

Trimming Procedures for Resolvers Paralleled in Groups of Two

The diagram of figure 86 shows the method of paralleling two resolvers on the output of one amplifier (BuOrd Dwg 1371930, Unit 3012). Notice that one resolver provides the feedback to the summing network. This resolver is called the feedback resolver. The second resolver, which is connected in parallel with the feedback resolver, is called the shunt resolver.

The general procedure for trimming resolvers paralleled in groups of two is the same for all loops, and may be summarized as follows: Remove the network boxes loading down the resolver outputs (except for ZN4304). Connect a 1:1 network box (BuOrd Dwg 952085-1) between the feedback resolver output and the signal source, as shown in figure 86. Disconnect the original trim and connect the two decade boxes to the terminal block as shown in figures 87 and 88. The resolver being trimmed is made to put out a -1-volt signal by placing the special test probe of the test unit on the remaining resolver winding and then by turning the resolver rotor until the test unit reads exactly zero. As the resolver is being turned, the null from the 1:1 network box as read on the VTVM should decrease. If the reading increases, the resolver is being turned in the wrong direction, that is, toward plus 90 degrees. Follow the procedure just given with the shunt resolver. If the angle of rotation of the resolver is limited, open the gear mesh.

As shown in figure 86, several different sets of trims are used with each pair of resolvers. Capacitors that are marked "C" in figure 86 are placed on the outputs of both resolvers and on the feedback windings. These capacitors are for trimming the lead capacitance only and should not be disturbed. The other trim components are marked Cs, Rs, Cf, and Rt. These last four components always must be rechecked or reset whenever a resolver of a pair is changed.

The decade boxes needed for trimming these resolvers, as well as their electrical connections, are shown in figures 87 and 88. Notice that the 100-ohm resistor shown in figure 87 is a special temperature compensated resistor. If decade resistance boxes of the required ranges are not available, use potentiometers connected between the same terminals instead. If no decade capacitance box is available, use fixed capacitors one by one until the correct trim is obtained.

Use the following initial settings for trimming:

Rf equals 2000 ohms	Rs equals 40 ohms
Cf equals 0.002 mfd	Cs equals 0.4 mfd

Trim Rf and Cf first by observing the null from the network box connected to the output of the feedback resolver. Vary the decades Rf and Cf until a minimum value is read on the VTVM. Now connect the 1:1 box between the output of the shunt resolver and the signal source. Without changing Rf or Cf, vary Rs and Cs until the best null is obtained. Connect the 1:1 box to the output of the feedback resolver again. If the null has changed, readjust Rf and Cf until the best null is obtained again. Proceed back and forth between the resolvers until it is found that a null has not changed. Usually two or three cycles will be sufficient to obtain optimum nulls.

Finally, substitute fixed components for the decades, and recheck the nulls. If the null changes by more than 300 microvolts, select other components that will bring the reading in closer. There is sufficient space on each terminal board for two series resistors and two parallel capacitors.

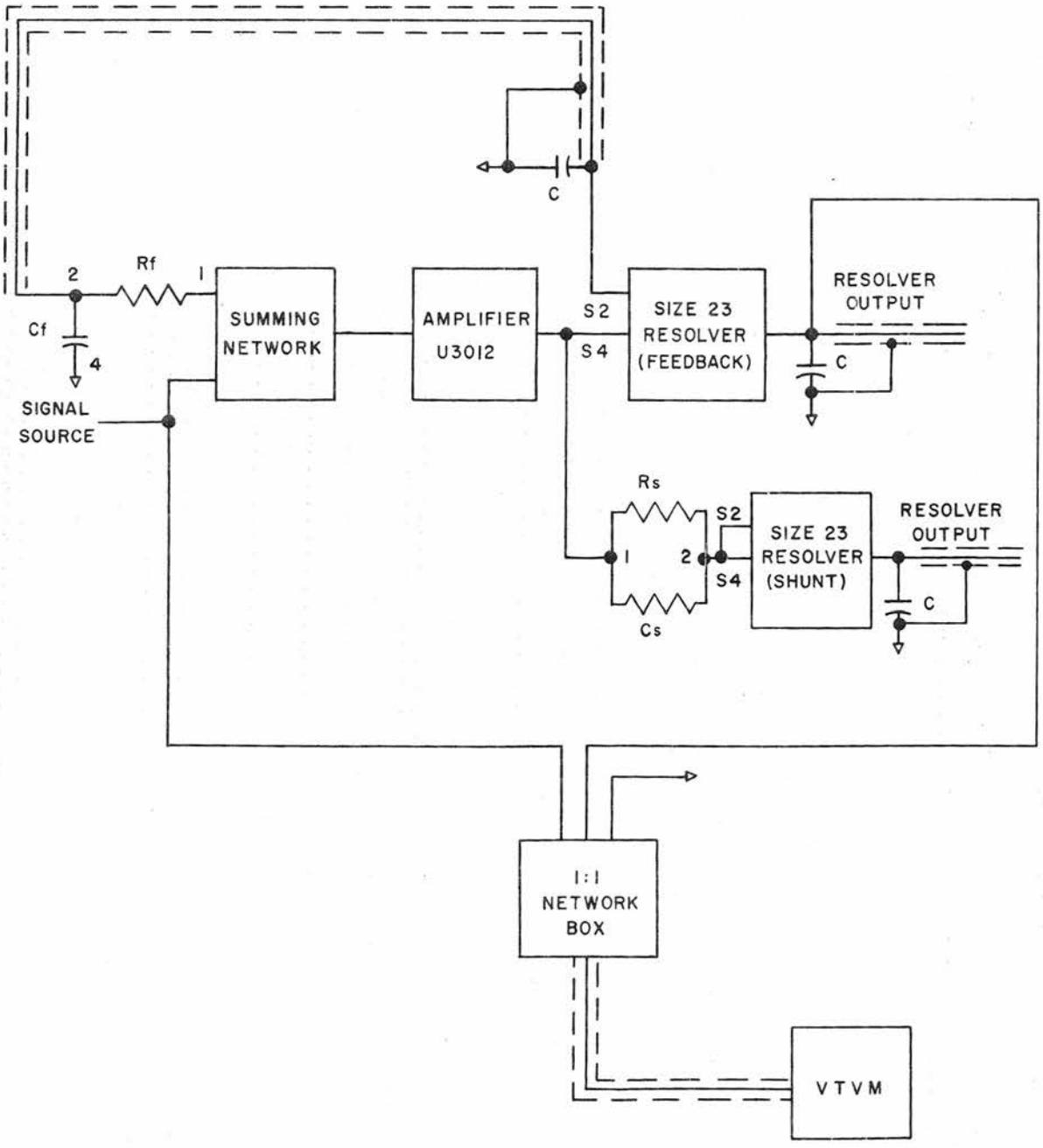


Figure 86. Schematic of Null Measuring System for Resolver Trimming

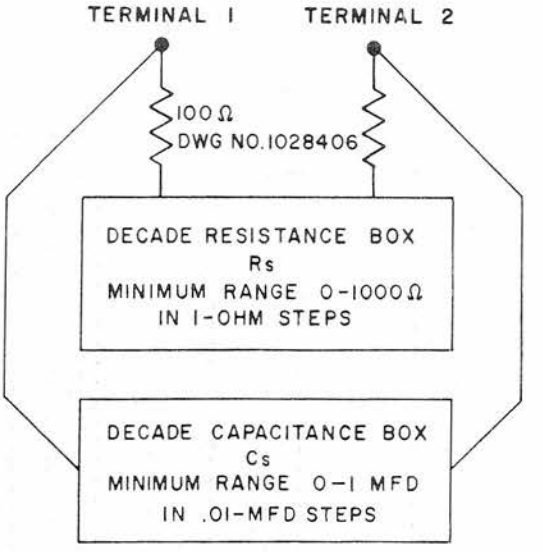


Figure 87. Method of Connecting Rs and Cs

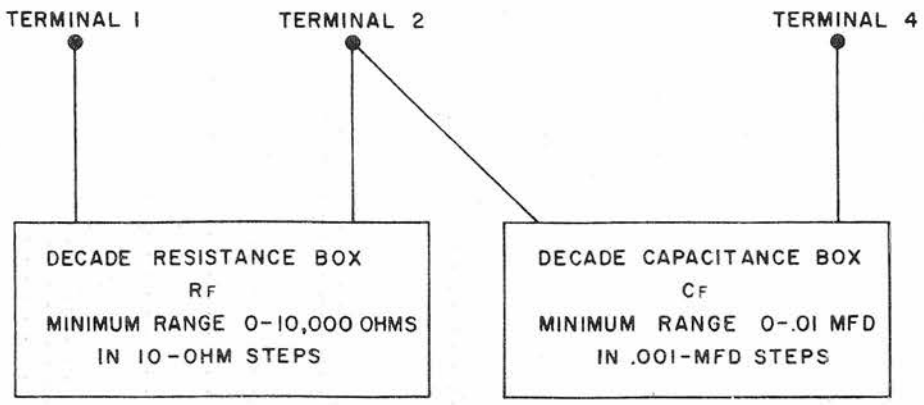


Figure 88. Method of Connecting Rf and Cf

Specific Trim Procedures

A. Trim of Resolvers on Output of Amplifier ZA4331 B (Resolvers B4096 and B4099)

1. Feedback resolver is B4096. Shunt resolver is B4099.

2. Remove network box ZN4141. Do not remove network box ZN4304.

3. Connect Rf and Cf to terminal block E4336. Connect Rs and Cs to terminal block E4065.

4. Connect the 1:1 box between terminals E4022-11 and B4096-R4. Connect the special test probe on R1 of resolver B4096. Set test switch at 7E and turn the resolver to +90 degrees.

5. Vary Rf and Cf until a best null is obtained on the VTVM.

6. Disconnect the 1:1 box from B4096-R4 and connect it to E4031-3. Connect the special test probe to R1 on B4099. Turn the rotor of B4099 to +90 degrees.

7. Vary Rs and Cs until the best null is read.

8. Reconnect the 1:1 box to B4096-R4. If necessary, readjust Rf and Cf. Continue this way until both nulls are optimum.

9. Connect a 1/2 watt, 5 per cent carbon resistor, of the nearest value below Rf between terminals E4336-1 and E4336-3, and connect the Rf decade between E4336-3 and E4336-2. Connect a fixed value mica capacitor of the nearest value below Cf between E4336-2 and E4336-4. Leave the Cf decade connected between these two terminals. In one of the spaces available on E4065, place a 1 per cent wirewound 100-ohm temperature compensated resistor (Dwg 1028406) in series with a regular 1 per cent wirewound resistor. The value of the latter resistor will be the difference between the Rs decade reading and 100 ohms. Next, connect the Rs decade in series with the two resistors first mentioned. Place a tubular paper capacitor, 100-watt VDC of the nearest value below Cs (maximum value 0.47 mfd), between terminals E4065-1 and E4065-2. Reset the decades so that the original nulls are again obtained. The decade settings show the amount of additional resistance and capacitance required for each trim. Insert the additional fixed trims, and check the nulls. For these resolvers, a change in null of 500 microvolts is acceptable.

B. Trim of Resolver on Output of amplifier ZA4331 A (Resolvers B4085 and B4092)

1. Feedback resolver is B4085. Shunt resolver is B4092.

2. Remove network boxes ZN4327 and ZN4310.

3. Remove amplifier ZA 4333 and jump the following terminals on B4092 to ground: S1 and S3

4. Remove network box ZN4331, and replace with network box ZN4333 (BuOrd dwg 952085-44).

5. Hand servo B4083 to the limit stop.

6. Connect Rf and Cf to terminal board E4335. Connect Rs and Cs to terminal board E4064.

7. Connect the 1:1 box between B4083-R2 and E4051-6. Set the special test probe on R1 of B4085 and computer test selector switch at 7E and proceed as in steps A4 and A5.

8. Disconnect the 1:1 box from terminal board E4051-6 and connect it to E4033-5. Set the computer test selector switch on 7B and proceed as in steps A6 and A7.

9. Complete trimmings as described in steps A8 and A9.

C. Trim of Resolvers on Output of Amplifier ZA4329A (Resolvers B4093 and B4088).

1. Feedback resolver is B4093. Shunt resolver is B4088.

2. Remove network boxes ZN4314 and ZN4315.

3. Put MODE SELECTOR switch in MB position.

4. Disconnect terminal B4083-R1 and jump it to ground.

5. Set TEST SELECTOR switch on 5C. Hand servo B4084 until the test unit reads approximately +6 volts.

6. Connect Rf to Cf to terminal board E4333 and Rs and Cs to E4062.

7. Connect the special test probe to R1 or B4093. Set the test selector switch at 7E. Connect the 1:1 box between terminal boards E4306-11 and E4033-12, and proceed as in steps A4 and A5.

8. Disconnect the 1:1 box from terminal board E4033-12, and connect to terminal E4034-2. Connect special test probe to terminal R1 or B4088. Proceed as in steps A6 and A7.

9. Complete trimming as described in steps A8 and A9.

D. Trim of Resolvers on Output of Amplifier ZA4329-B (Resolvers B4086 and B4090)

1. Feedback resolver is B4086. Shunt resolver is B4090.

2. Remove network boxes ZN4314 and ZN4315.

3. Remove network box ZN4330 and replace by network box ZN4329 (BuOrd dwg 951731-87).

4. Disconnect terminal B4083-R1 and jump it to ground.

5. Set the TEST SELECTOR switch on 5D. Hand servo B4084 until the test unit reads -6 volts.

6. Connect Rf and Cf to E4334 and Rs and Cs to E4063.

7. Connect 1:1 box between E4306-4 and E4034-3. Connect the special test probe to R3 of B4086. Set TEST SELECTOR switch to 7E position. Proceed as in steps A4 and A5.

8. Disconnect the 1:1 box from terminal E4034-3, and connect to terminal E4033-8. Connect the special test probe to R3 or B4090. Proceed as in steps A6 and A7.

9. Complete trimming as described in steps A8 and A9.

Trimming Procedures for Resolvers Paralleled in Groups of Four

Resolvers paralleled in groups of four must be trimmed to keep the capacitance-to-ground effects for certain cables at a specific value. The procedures that follow

are used to duplicate the original specified capacitance-to-ground values and differ from those used in trimming resolvers paralleled in groups of two in that most of the steps consist of only resistance and capacitance measurements. Take the measurements in the step-by-step method listed for the particular resolver and select fixed components to duplicate the required trim. The resolvers that are covered in each of the two procedures are given in the main title of the procedure.

Specific Trim Procedures:

E. Trim of Resolvers on Output of Amplifier ZA4325 (Resolvers B4098, B4097, B4083, and B4084).

1. Measure the capacitance to ground of the following cables. In each measurement, the cable must be disconnected at both ends.

   a. From terminal E of network box ZN4325.

   b. From terminal S2 of resolver B4083.

   c. From terminal S4 of resolver B4098.

   d. From terminal R4 of resolver B4097.

   e. From terminal R1 and from terminal "R2" of resolver B4083.

   f. From terminal R1 and from terminal "R3" of resolver B4084.

   g. From terminal R2 of resolver B4084.

2. For the cable measured in step E.a., add capacitance such that the sum of the measured and added capacitance is 1000 mmf ±2.5 per cent.

3. For each cable measured in steps E.b., E.c., E.d., E.e. and E.g., add capacitance so that the sum of the measured and added capacitance is 2000 mmf ±5 per cent.

4. For each cable measured in step E.f., add capacitance such that the sum of the measured and added capacitance is 4000 mmf ±5 per cent.

5. Insert 2000 mmf to ground at each of the following points:

   a. R1 of resolver B4098.

   b. R1 of resolver B4097.

F. Trim of Resolvers on Output of Amplifier ZA4327 (Resolver B4087, B4091, B4089, and B4094).

1. Measure the capacitance to ground of the following cables. In each measurement, the cable must be disconnected at both ends.

   a. From terminal E of network box ZN4327.

   b. From terminal S2 of resolver B4091.

   c. From terminal R3 of resolver B4087.

   d. From terminal R1 and from terminal R3 of resolver B4089.

   e. From terminal R3 of resolver B4094.

   f. From terminal R1 of resolver B4091.

2. For the cable measured in step F.a., add capacitance such that the

sum of the measured and added capacitance is 1000 mmf ±2.5 per cent.

3. For each cable measured in steps F.b., F.c., F.e. and F.f., add capacitance such that the sum of the measured and added capacitance is 2000 mmf ±5 per cent.

4. For each cable measured in step E.d., add capacitance such that the sum of the measured and added capacitance is 4000 mmf ±5 per cent

5. Insert 2000 mmf to ground at each of the following points:

   a. R4 of resolver B4087.

   b. R2 of resolver B4091.

   c. R2 of resolver B4089.

   d. R2 of resolver B4094.

Section 5.5—Adjustment, Assembly, and Disassembly

This section consists of the complete adjustment procedure with illustrations that show the location of adjustment points, and reference information on assembly and disassembly. Diagrams showing the mechanisms and adjustments schematically (figure 47 through 59) are included in section 5.3. For adjustment of servo control potentiometers, refer to section 5.4.

ADJUSTMENT PROCEDURE

The complete adjustment procedure is given in table 70. The adjustments are tabulated in groups according to function and in logical order. This order should be followed whenever the entire instrument or any portion of it is being adjusted. The "A" numbers in the first column of the table serve to identify the adjustment and do not necessarily indicate its order in the procedure. In cases where the adjustment takes the form of a clamp securing a gear or coupling to a shaft, the identifying "A" number appears on the clamp. However, in the case of certain dials, synchros, and resolvers, the adjustments, which are made by loosening the securing screws or nuts, have no identification indicated in the instrument. Adjustment points for which the procedure consists of the word "tighten" are included to facilitate assembly of the instrument and thus are classified as assembly clamps.

Where the procedure is used for readjustment of a single adjustment point or a small number of points, study the pertinent functional schematic to determine all other points that could be affected by the readjustment. Then, check these points in accordance with the corresponding procedures in table 70.

Checking an Adjustment

The procedure given in the last column of table 70 serves as an individual performance test for any adjustment. If the results of trouble analysis, as described in section 5.3, indicate that an adjustment may be inaccurate, perform the procedure for that adjustment before actually disturbing it to prove whether readjustment should be attempted. During any readjustment procedure, inability to fulfill the adjustment performance requirements given in the table and any other abnormal indications should be investigated. Refer to Common Mechanical and Electrical Faults, section 5.3.

Adjustment Practice

A critical adjustment of a clamp can be accomplished more easily if the clamp is slip-tightened or partially tightened so that the adjustment can be slipped with light pressure, yet will remain sufficiently tight to prevent unwanted movement of the part during a check. Then, after the clamp adjustment is found to be correct, a slight additional turn of the clamp screw will lock the clamp without disturbing the adjustment.

Frequently, gearing which is not directly accessible to the hand must be repositioned to perform an adjustment. This may be done by gently pushing the line with a soft metal gear-pusher. Never use a screwdriver. With certain adjustments the gearing must be wedged tightly to complete the adjustment. Wedges made from linen bakelite are recommended. Wooden wedges are not recommended because fallen chips of wood could interfere with the proper operation of a mechanism. All wedges used in these adjustments should be inserted by hand between a side of a gear and a fixed hanger or plate. They should never be hammered into place. Never wedge counters or differentials because these two mechanisms are both susceptible to damage from this type of treatment.

ASSEMBLY AND DISASSEMBLY

The pictures used to illustrate component and adjustment locations, figures 89 through 96, can be used as a general guide in maintenance operations involving assembly and disassembly of Computer Mk 48 Mod 1. If the operation to be performed requires more complete information, than a complete set of assembly drawings should be available before proceeding. Appendix A lists the BuOrd numbers of these drawings.

Table 70

ADJUSTMENT PROCEDURE

The test unit, unit 4400, BuOrd dwg 1371829, is used to check and adjust Computer Mk 48 Mod 1, and must be adjusted prior to any adjusting of the computer proper. The test unit is energized from the computer through power cable 888783.

With Computer Mk 48 Mod 1 energized, and the test-unit TEST SELECTOR switch at OFF, proceed as follows:

Adj No	Function	Connection	Procedure
A1		Assembly	Tighten
A2		Assembly	Tighten
None		Coarse to fine dial	Set zero of coarse and fine dials together at index.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Function	Connection	Procedure
A4	Test	Dials to stop H44L1	See limit at ±12.05 on dials.
None		Lost motion take-up spring	Wind up spring to remove backlash in gearing.
A3		Dials to pot R4401	With dials at zero, set pot to mid-point of mechanical travel. Then, with the test-unit TEST SELECTOR switch at OFF and test unit energized, refine setting so that dials read 0.000. With switch at +12 position, dial should read +12.00. With switch at -12 position, dial should read -12.00.

The following assembly clamps must be tightened before proceeding with adjustments of Computer Mk 48 Mod 1.

Assembly Clamp	Fig No	Location
A1	93	Pinions on servo motor shafts B100, B101, B4002, B4003, B4004, B4005, B4006, B4007, B4008, B4009, B4010, B4011, B4012, B4013, B4014, B4015, and B4016.
A2	93	Pinions on induction generator shafts G100, G101, G4002, G4003, G4004, G4005, G4006, G4007, G4008, G4009, G4010, G4011, G4012, G4013, G4014, G4015, and G4016.
A3	89	Spur gears or 1/50 hp motor B4017.

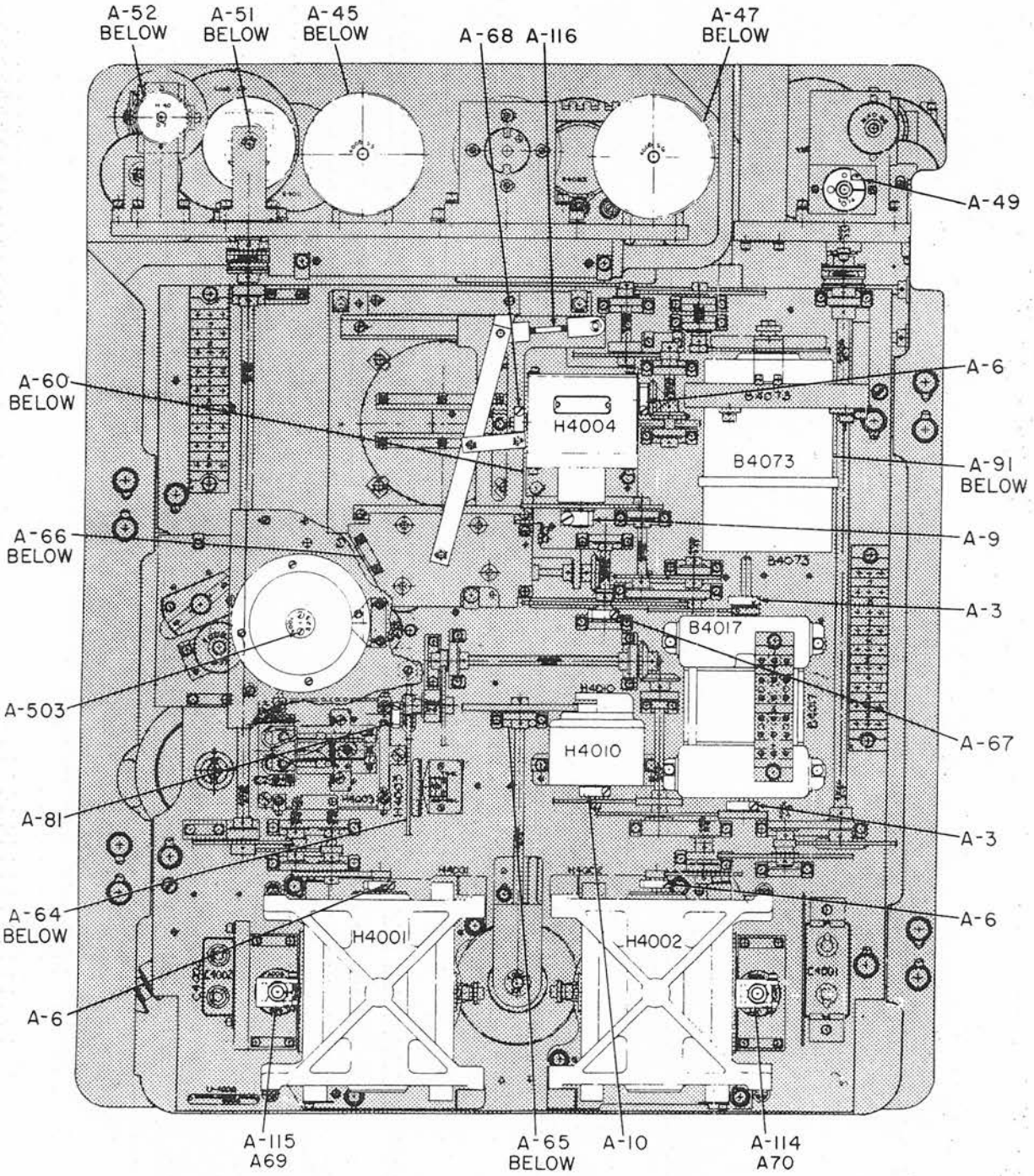


Figure 89. Front Mechanical Section Under Cover No. 5

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Assembly Clamp	Fig No	Location
A5	93	Spur gears on pot shafts R100, R101, R4001, R4002, R4003, R4004, R4005, R4006, R4007, R4008, R4010, R4011, R4014, R4018, R4020, and R4022.
A6	89	Bevel or spur gears on integrator roller shafts H4001, H4002, and H4004.
A7	95	Bevel gears on counter shafts So, Es, Hs, and Ht. Spur gears on counter shafts SF, Hs, Ht, and Time.
A9	89	Spur gear on integrator disk shaft H4004.
A10	89	Spur gear on clutch shaft H4010.

Adj No	Fig No	Function	Connection	Procedure
None	--	Co	1HCT B4052 to shafts 1302S2 and 1302S3	Remove synchro from mesh with shafts 1302S2 and 1302S3. Wind take-up spring sufficiently to remove lost motion. Replace synchro.
A63	91	Co	Fine 1HCT B4052 to coarse 1HCT B4053	Set fine and coarse synchros together on electrical zero.
A64	89	Co	Co dials to 1HCTs B4052 and B4053	With Co receivers on electrical zero, set fine and coarse dials on zero.
*A503	89	Co	Fine and coarse dials	
A65	89	Co	Receiver to component solver U0620	With Co receiver on electrical zero, set vector gear to produce no movement of dXo rack.
A55	95	So	So counter to stop H40L18	Set stop to read zero and 55 knots on counter.

* Number not indicated in instrument.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A57	94	So	So receiver (B4070) to counter	With So receiver at electrical zero, set So counter to read zero.
A58	90	So	So receiver (B4070) to component solver U0620	With So receiver and counter on zero, set speed cam to produce no movement of dXo and dYo racks for 360° rotation of vector gear.
A81	89	Time	Regulator H4003 to time motor B4017	Adjust friction to drive regulator mechanism in normal direction. Check that friction slips if time line is turned backwards.
A69 A115	89	dYo	Integrator carriage H4001 to component solver U0620	With time motor running and So on zero, set integrator carriage to produce no movement of roller, Yo.
A70 A114	89	dXo	Integrator carriage H4002 to component solver U0620.	With time motor running and So on zero, set integrator carriage to produce no movement of roller, Xo.
A49 A50	89 95	Xo Xa	Holding friction	Set friction to hold Xo and Xa inputs to H40D8. With Xa handle disengaged, Xo signal should not back out through A50. With Xa handle engaged, Xa signal should not back out A49.
A47	95	Xt	Holding friction	Set friction to hold Xt setting.

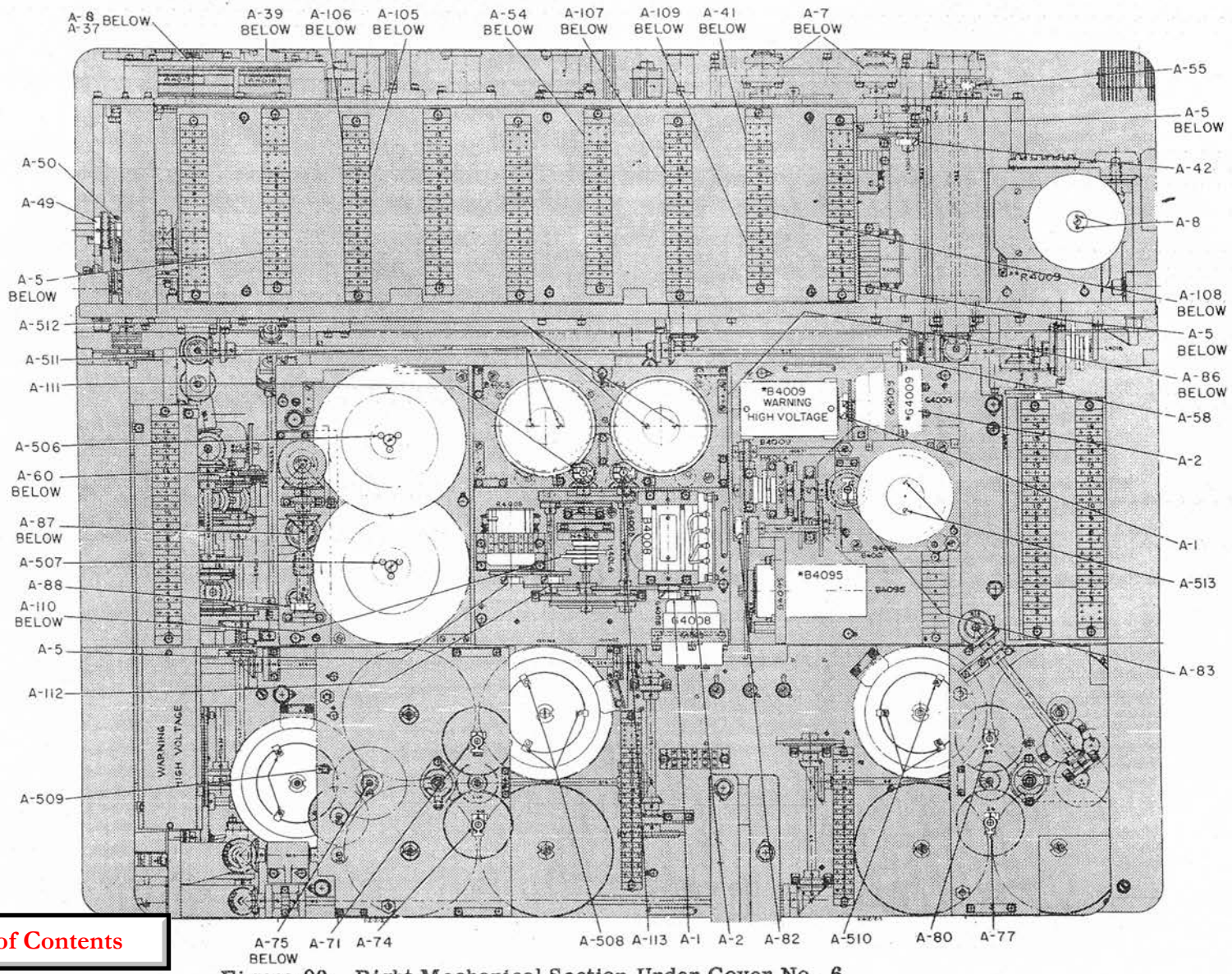


Figure 90. Right Mechanical Section Under Cover No. 6

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Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A51 A52	89 95	Yo Ya	Holding friction	Set friction to hold Yo and Ya inputs to H40D7. With Ya handle disengaged, Yo signals should not back out A52. With Ya handle engaged, Ya signal should not back out A51.
A45	95	Yt	Holding friction	Set friction to hold Yt setting.
A46	95	Yt	R4004 to R4013	With both R4004 and R4013 sliptight, rotate Yt handle clockwise until both pots hit their stops. Tighten clamps. Check with mode-and-plot switch (S4006) at SHORE BOMB TGT and TSS(SIGNAL TEST SELECTOR switches) at 3D for R4004, and 3E for R4013, so that R4013 reads 0 when R4004 reads 0.
A48	95	Xt	R4003 to R4012	With both R4003 and R4012 sliptight, rotate Xt handle clockwise until both pots hit their stops. Tighten clamps. Check with mode-and-plot switch (S4006) at SHORE BOMB TGT and TSS at 2G for R4003, and 3A for R4012, so that R4012 reads 0 when R4003 reads 0.
None	--	Xa	Pot R4010 and Xa handcrank	With mode-and-plot switch (S4006) at SHORE BOMB SHIP and TSS at either 2F or 2G, extreme CW rotation of Xa handle will produce reading of +12 v CCW rotation, reading = -12 v.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
None	--	Ya	Pot R4011 and Ya handcrank	With mode-and-pot switch (S4006) at SHORE BOMB SHIP and TSS at either 3D or 3C, extreme CW rotation of Ya handle will produce reading of +12 v. CCW rotation, reading = -12 v.
*A501	95	Yj	Yj dial to limit stop H40L9	See limit stop to act a ±1017.5 on dials. At same time set the detent to operate at 25-yd intervals on dial.
A8	90	Yj	Yj dial to detent on shaft 4004S29	
A37	90	Yj	Pot R4017 to Yj dial	With ±12 v across pot, pot outputs to read as follows: Dial Reading / TSS at 3B +1000 yds / -10.97 volts -1000 yds / +10.97 volts
*A502	95	Xj	Xj dial to limit stop H40L3	Set limit stop to act at ±1017.5 on dials. At the same time, set the detent to operate at 25-yd intervals on dial.
A8	90	Xj	Xj dial to detent on shaft 4004S32	
A39	90	Xj	Pot R4016 to Xj dial	With ±12 v across pot, pot outputs to read as follows: Dial Reading / TSS at 2E +1000 yds / -10.97 volts -1000 yds / +10.97 volts
A7	90	Ht	Ht(feet) counter stop H40L6	Set stop limits to 0 and 5000 feet on counter.
A7	90	Ht	Ht(feet) counter to Ht(meter) counter	Ht(meter) counter to read 0 meters for 0 feet on Ht(feet) counter, and 1524 meters at 5000 feet.

* Number not indicated in instrument

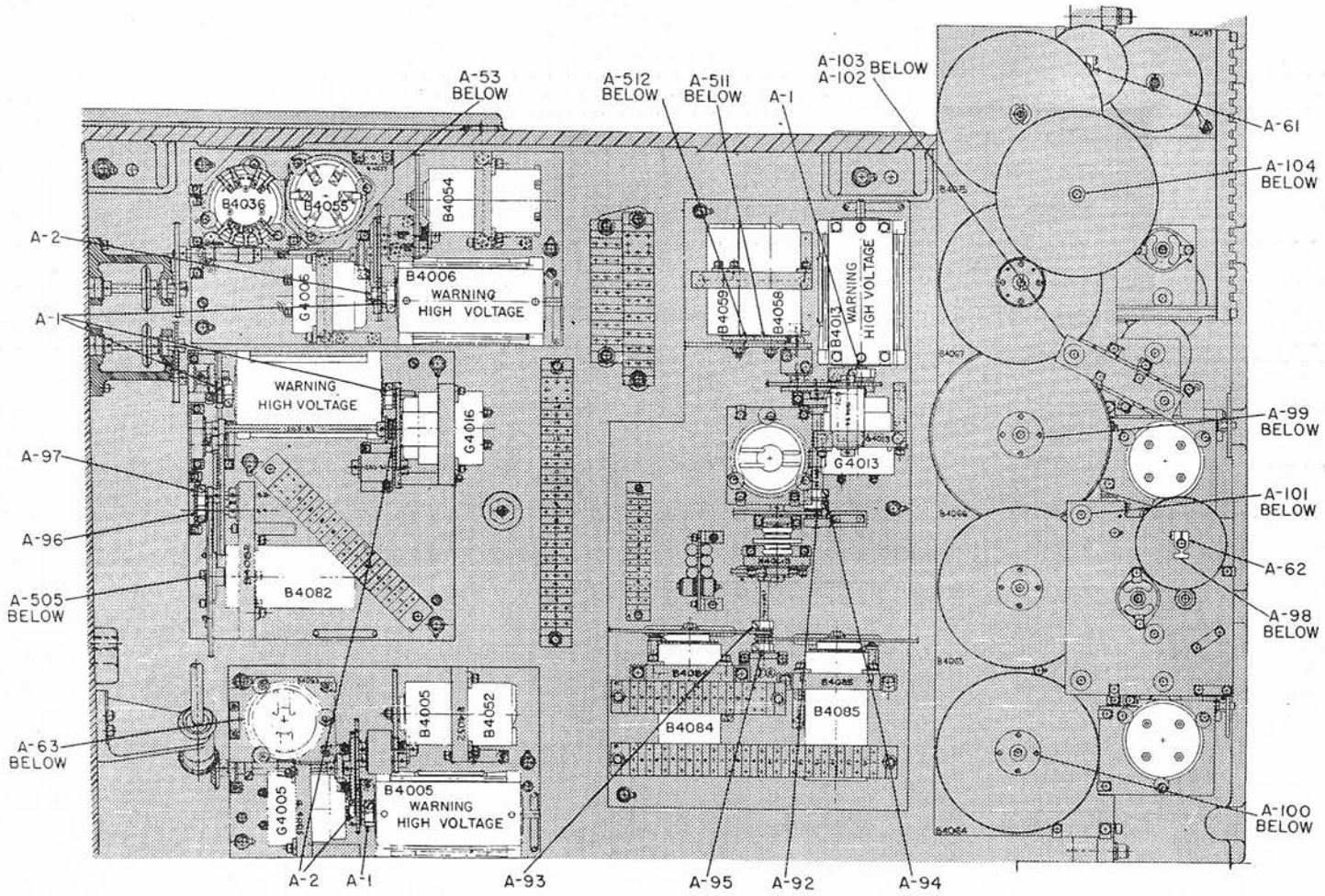

Figure 91. Mechanical Section Left Wall as Viewed from Right Side

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A41	90	Ht	R4006 to stop and counter	With +12 v across pot and TSS at 4A, dials at 0, and stop at lower limit (extreme CCW rotation of Ht handle), test reading = 0. Turn Ht handle CW to dial reading of 3000 feet. Test reading 7.074 v.
A7	95	Hs	Hs(feet) counter to stop H40L5	Set stop limits to 0 and 5000 feet on counter.
A7	95	Hs	Hs(feet) counter to Hs(meter) counter	Hs(meter) counter to read 0 for 0 feet on Hs(feet) counter, and 1524 meters at 5000 feet.
A42	90	Hs	R4005 to stop and counter	With +12 v across pot and TSS at 1D, dials at 0 and stop at lower limit (extreme CCW rotation of Hs handle), test reading = 0. Turn Hs handle CW to dial reading of 3000 feet. Test reading = 7.074 v.
A35	95	SF	Holding friction	Set friction to hold scale factor setting.
A7	90	SF	Stop H40L20 to counter	With clamp A7 loose, depress SF push button and rotate SF handcrank CW to upper limit of stop. Set counter to read 100,000:1, and tighten A7. Rotate SF CCW to lower limit of stop, check reading of 10,000:1 on counter.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A34	95	SF	Pot R4001 to stop H40L20 and counter	With +12 v across pot, TSS at 4G, and counter at 100,000:1, set pot to test reading of 12,000 v: rotate SF handcrank CCW to counter reading of 10,000:1. Check test reading of 1.200 v.
A36	94	SF	Pots R4019 and R4020 to counter	With SF counter at 100,000:1, resistance between slider and terminal 2 of pots should be at a minimum. Check to see that resistance increases as SF decreases.
A12	93	Xp (E-W)	Counter to stop	Set stop to act from 32.8 (lower) to 0 (upper limit) on counter.
A15	93	Xp (N-S)	Counter to stop H40L2	Set stop to read from 0 to 32.8 on counter.
A11	93	Xp (E-W)	Plotter to Xp counter and stop H40L1	Run plotter light to end of screws at lower right-hand corner. Back off one turn on each screw. Counter should be at zero. H40L2 at lower limit; H40L1 at upper limit. Check that at upper left-hand corner stops act at 32.8, and before end of each lead screw.
A14	93	Xp (E-W)	Plotter to Xp counter and stop H40L2	
A13	93	Xp	Pot R100 to counter	With SF counter at 100,000:1, TSS at 4E for R100 and for R101, set as follows:
A16	93	Xp	Pot R101 to counter	Yp Xp 4E 4F 0 32.8 .30 30 32.8 0 11.39 v 11.39 v

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
None		R	1HCT B4050 to shafts 4004S4 and 4004S5	Remove synchro from mesh with shafts 4004S4 and 4004S5. Wind take-up spring sufficiently to remove lost motion. Replace synchro.
A107	90	R	Fine 1HCT B4050 to coarse 1HCT B4051	Set fine and coarse synchros together on electrical zero.
A105	90	R	R dials to 1HCTs B4050 and B4051	With R receivers on electrical zero, set range dials to read 10,000 yds.
*A504	95	R	Fine and coarse dials	
A106	90	R	Receiver to stop H40L19	Set stop to act at 500 yds, and 50,000 yds on dial.
A108	90	R	Pot R4002 to receiver, stop, and dial	With TSS at 1A and receiver at 10,000 yds, set pot to test reading of +2.350, increasing. Check test reading: R = 50,000, Reading = +11.750 R = 1000, Reading = +0.235
A109	90	R	Pot R4014 to R dials	With R = 50,000 yds, resistance between slider and terminal 1 of pot should be at a minimum. Check to see that resistance increases as R decreases.
A86	92	Es	Counter to stop H40L7	Set stop to act at 2000 min and 3800 min.

* Number not indicated in instrument.

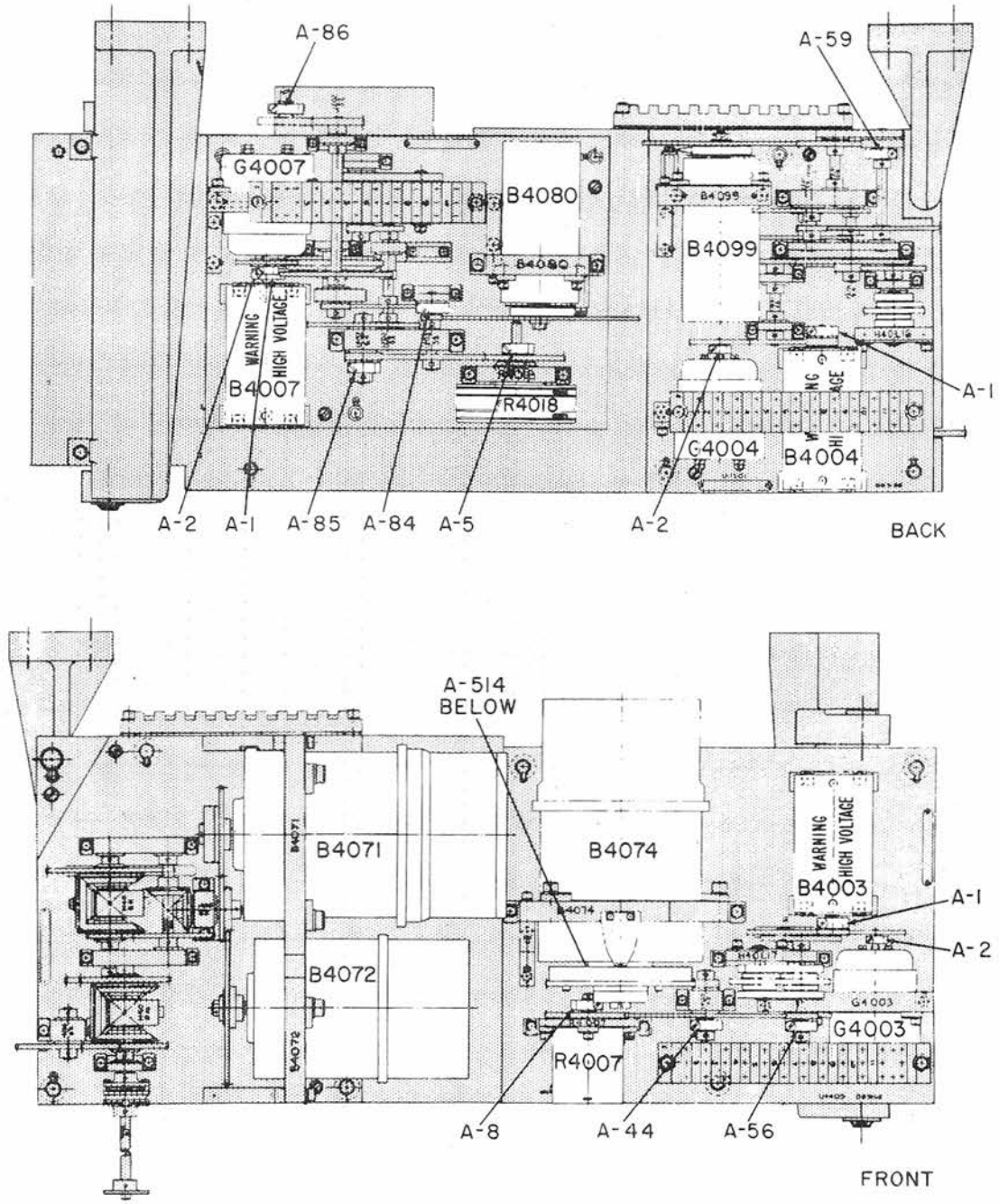

Figure 92. Front and Back Sides of Hinged Plate

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A84	92	Es	Resolver B4080 to stop H40L7	With A84 loose and A85 tight, turn shaft 1202S5 CW (viewed from A84 end) until limit stop hits. Turn gear on resolver shaft until take-up spring is wound solid. Back off 1/2 turn and tighten clamp A84.
**A85	92	Es	Resolver B4080 to counter	With Es on 2000 min, TSS at 1B position, turn resolver shaft CW (viewed from gear end) to give a test reading of zero for output, decreasing from plus to minus, with TSS at 1C. Es = 2000 min, R = 50,000 yds. Test reading = +11.750. With R = 30,000 yds, Es = 3800 min. Test readings at 1B = -3.525, 1C = 6.105. Check that take-up spring is active throughout resolver travel. Refine with A84 if necessary.
None	--	Rj	Pot R4009 to Rj dial	With Rj switch on; Hs, Ht, OL', OZh, Xa, Ya, Xt and Yt = 0; R = 20,000 yds; set Rj pot R4009 such that OR dial = 19,900 when Rj dial = 100.
None	--	B'r'	1HCT B4054 to shafts 1305S2 and 1305S3	Remove synchro from mesh with shafts 1305S2 and 1305S3. Wind take-up spring sufficiently to remove lost motion. Replace synchro.

** Set A5, page 284 at this point.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A90	96	OL'	Resolver B4083 to stop H40L12	Turn shaft 1301S5 CCW (viewed from clamp end) until stop hits. Turn gear on resolver shaft CCW (viewed from gear end) until take-up spring is wound solid. Back off 1/2 turn and tighten A90.
None	--	OL'	Resolver B4083 to OL' receivers	With OL' receivers on electrical zero, TSS at 5B position, rotate resolver rotor CW to a test reading of zero, increasing. With TSS at 5A, check test reading of +12.000 v. Check that take-up spring is active throughout resolver travel. Refine setting with A90, if necessary.
*A512	91	OZh	Fine 1HCT B4059 to shaft 1304S2	Remove 1HCT from mesh with shaft 1304S2. Wind take-up spring sufficiently to remove lost motion. Replace synchro.
A94	91	OZh	Fine 1HCT B4059 to coarse 1HCT B4060	Set fine and coarse synchros together on electrical zero.
*A511	91	OZh	Fine 1HCT B4058 to coarse 1HCT B4060	With switch S4002 on AA position, B4060 on electrical zero as in A94, set B4058 on electrical zero. Turn switch to MB position, and check that B4059 is on electrical zero.

*Number not indicated in instrument.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
None	91	B'r'	Fine 1HCT B4054 to coarse 1HCT B4055	Set fine and coarse synchros together at electrical zero.
A53	91	B'r'	Resolver B4096 to shaft 1305S4	With B'r' at 0°, TSS at 1E position, rotate resolver shaft CW to a test reading of zero, decreasing.
*A500	95	B'r'	Fine and coarse dials	Set fine and coarse dials together on zero.
A54	90	B'r'	Receivers to fine and coarse dials	With B'r' receivers on electrical zero, set dials on zero.
None	--	OL'	1HCT B4056 to shafts 1301S2 and 1301S3	Remove 1HCT from mesh with shafts 1301S2 and 1301S3. Wind take-up spring sufficiently to remove lost motion. Replace synchro.
A89	96	OL'	Fine 1HCT B4056 to coarse 1HCT B4057	Set fine and coarse synchros together on electrical zero.
A117	96	OL'	Receiver to stop H40L12	With receiver at electrical zero, set stop at midpoint of travel. When stop is set correctly, shafts 1301S2 and 1301S3 will turn exactly 10 turns in each direction from position where synchros are at electrical zero.

* Number not indicated in instrument.

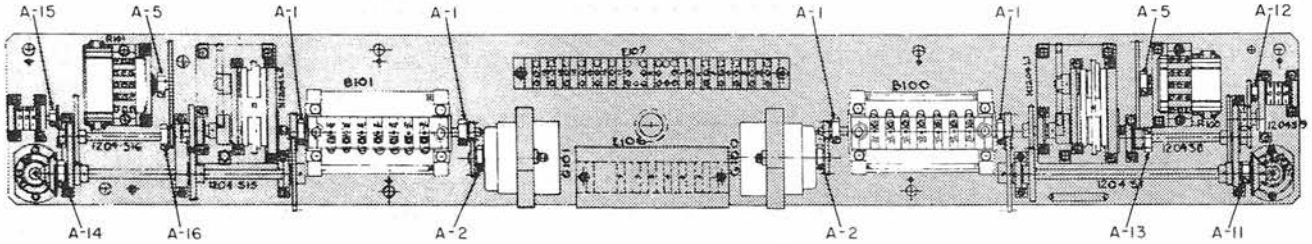

Figure 93. Plotter Mechanical Section Under Cover No. 1

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Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A92	91	OZh	Receivers to stop H40L13	With receivers on electrical zero, set stop H40L13 at mid-point of its travel. When stop is set correctly, shafts 1304S2 and S3 will turn exactly 10 turns in each direction from position where synchros are at electrical zero.
A93	91	OZh	Resolver B4084 to stop H40L13	Turn shaft 1304S6 CW (viewed from clamp end) until limit stop hits. Rotate gear on each resolver CW (viewed from gear end) until take-up spring is wound solid. Back off 1/2 turn, and tighten clamps.
A95	91	OZh	Resolver B4085 to stop H40L13	
None	--	OZh	Resolver B4084 to receivers	With OZh on electrical zero, TSS at 5E position, rotate resolver CW to a test reading of zero, increasing. Tighten nut, and check at following TSS points: 5C reading = +6.000v 5D reading = -6.000v Check that take-up spring is active throughout resolver travel. Refine settings with A93, if necessary.
None	--	OZh	Resolver B4085 to receiver	With OL' on +20°, OZh on electrical zero, TSS at 6C position, rotate resolver rotor CW to a test reading of zero, increasing. With OZh and OL' on +20°, TSS at 6C, check reading of +2.807. Check that take-up spring is active throughout resolver travel. Refine settings with A95, if necessary.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A77	96	jOB'r'	Resolver B4089 to limit stop H40L15	With clamps A76, A77, A79, and A80 tight, rotate shaft 4005S6 CCW (viewed from A77 end) until stop H40L15 hits. Wedge stop. Loosen these 4 clamps and rotate resolvers B4086, B4087, B4088, and B4089 rotor gears CCW until springs are wound up solid. Back off 1/2 turn on each spring and tighten 4 clamps. Remove wedge from stop H40L15.
A80	96	jOB'r'	Resolver B4088 to limit stop H40L15	
A76	96	jOB'r'	Resolver B4087 to limit stop	
A79	96	jOB'r'	Resolver B4086 to limit stop H40L15	
A510	96	jOB'r'	Dial to limit stop H40L15	With step H40L15 at its upper limit, rotate shaft 4005S6 CCW (viewed from A77 end) until stop hits, set dial at 20°, tighten screws. Check that stop acts at 340°.
A71	90	jOB'r' -jB'r'	Resolver B4094 to limit stop H40L14	With clamps A71, A72, A73, and A74 tight, rotate shaft 4005S19 CCW (viewed from A71 end) until stop H40L14 hits. Wedge stop. Loosen these 4 clamps, and rotate resolvers B4090, B4091, B4093, and B4094 rotor gears CCW until springs are wound up solid. Back off 1/2 turn on each spring, and tighten 4 clamps. Remove wedge from stop H40L14.
A74	90	jOB'r' -jB'r'	Resolver B4093 to limit stop H40L14	
A72	96	jOB'r' -jB'r'	Resolver B4091 to limit stop H40L14	
A73	96	jOB'r' -jB'r'	Resolver B4090 to limit stop H40L14	

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A508	90	jOB'r' -jB'r'	Dial to limit stop H40L14	With stop H40L14 at its upper limit, rotate shaft 4005S19 CCW (viewed from A71 end) until stop hits, set dial at 20°, tighten screws. Check that stop acts at 340°.
A91	89	B'r'	jOB'r' and (jOB'r' -jB'r') dials to B'r' receivers B4054 and B4055	Set jOB'r' dial on zero, and wedge line. With B'r' dials on zero, (jOB'r - jB'r'), dial should read zero.
A59	92	jB	Resolver B4099 to stop H40L16	Turn shaft 1201S1 CCW (viewed from clamp end) until limit stop hits. Turn resolver gear CCW until spring is wound up solid. Back off 1/2 turn, and tighten A59.
None	--	jB	Resolver B4099 to stop H40L16	With stop H40L16 at midpoint of travel, switch S4002 to AA. With TSS at 2A, rotate resolver rotor CW to a reading of zero, decreasing. Refine with A59, if necessary.
None	--	B	Resolver B4081 to stop H40L16	Check that lost motion spring is active throughout limits of stop H40L16. If necessary to adjust, break mesh between 1201S1 and B4081 stator gear, wind up spring, and remesh.

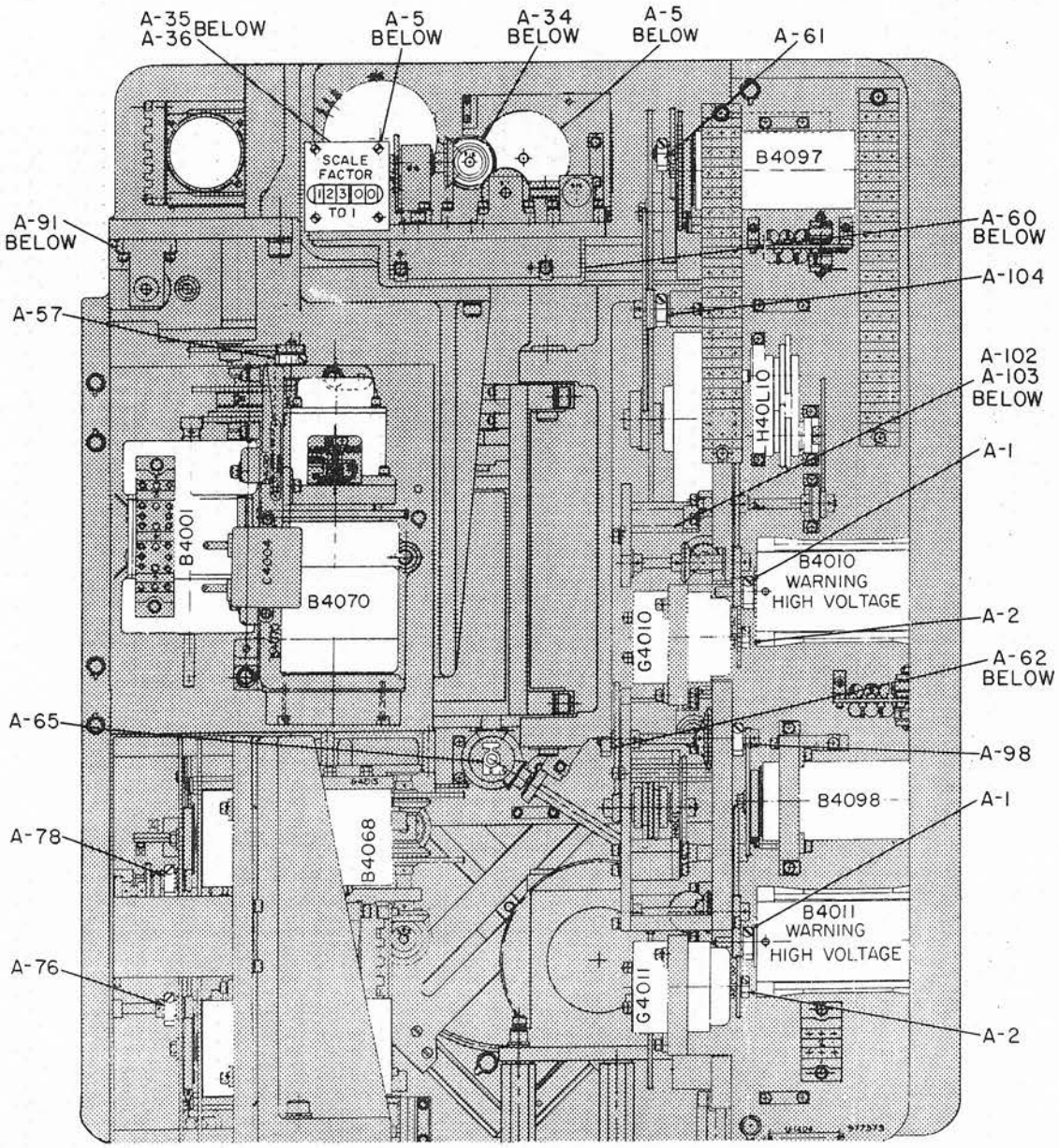

Figure 94. Rear Mechanical Section Under Cover No. 7

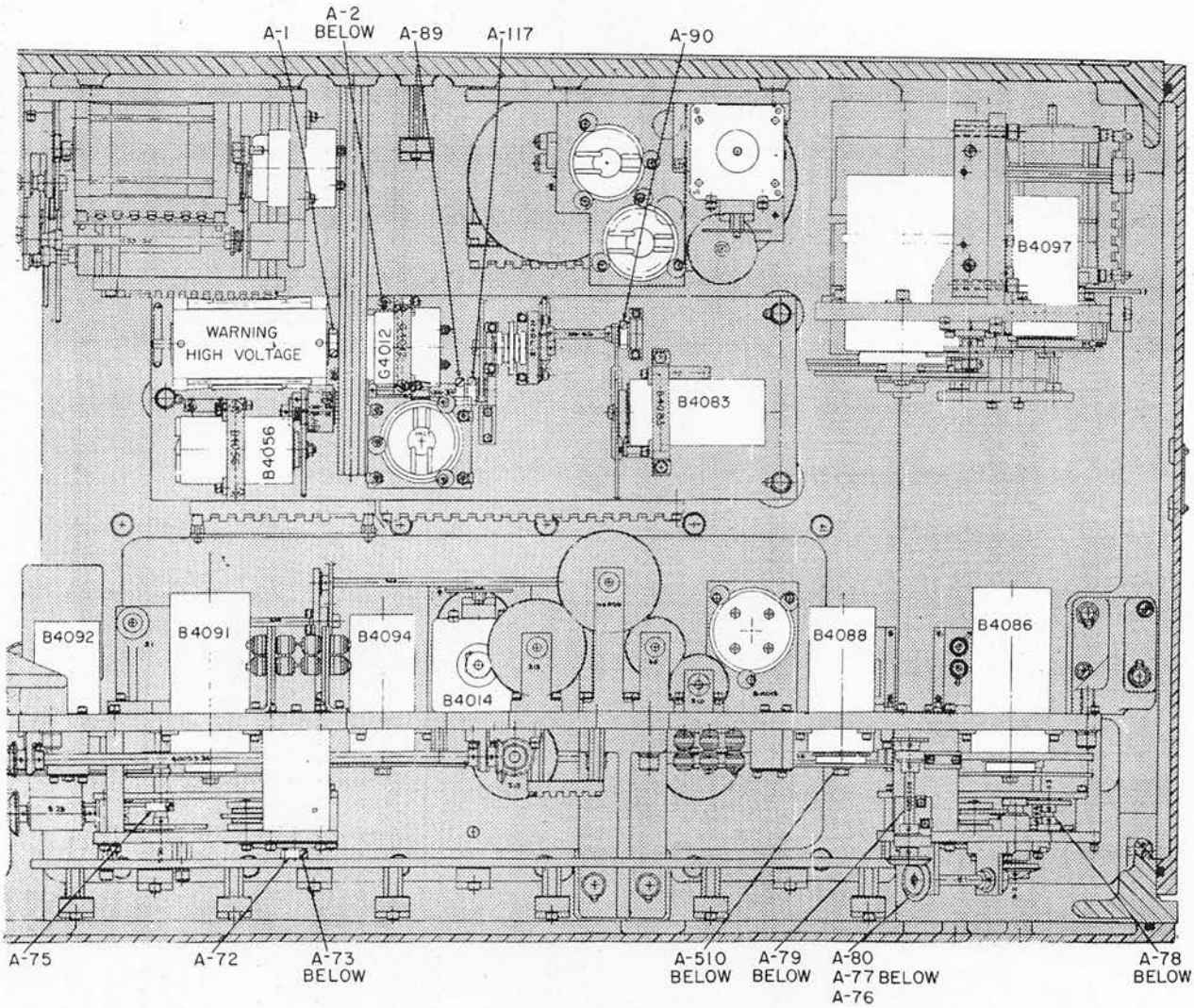

Figure 96. Lower Mechanical Section (Floor Plan)

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A5	90	Es	Pot R4018 to Es counter and stop H40L7	With pot at lower limit (rotate gear on pot full CW to attain this), set for a minimum resistance between slider (S) and ground (2). With Es = 2900 min, Zh = +25°, switch S4002 on MB position, TSS at 2B, check reading of +2.302.
None	--	jB	Resolver B4099 to servo motor B4004	With stops H40L16, H40L7, and H40L11 at midpoints of their travel, TSS at 2A, switch S4002 at MB, check test reading of zero. With Zh = +25°, Es = 3200 min, S4002 at MB, check reading at 2A = -2.307. Check that shaft 1201S4 will rotate 10 turns in each direction from midpoint of stop H40L16.
A67	89	Br + jB	Component solver U0621 to Br + jB line	With stops H40L14, H40L15, and H40L16 at midpoints of travel, and B'r' = 90°, set vector gear to produce no movement of output rack.
A66	89	So	So receiver to component solver U0621	With So on zero, set speed cam to produce no movement of output rack for 360° rotation of vector gear.
A68	89	△cR	Carriage of integrator H4004 to component solver U0621	With time motor running and U0621 set to zero output (as A66), set integrator to produce no movement of output roller. Check that component solver arm will travel 1.5 inches in either direction without hitting stops.
A116	89	△cR		

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Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
None	--	△cR	Transmitter B4073 to dial and H4004	With integrator H4004 set at zero output (see A68), set transmitter on electrical zero and dial at zero.
*A514	92	Ph	Dial to transmitter B4074	With transmitter on electrical zero, set dial on zero.
A44	92	Ph	Pot R4007 to dial	With transmitter and dial at zero, TSS at 1G, set pot R4007 to reading of zero.
A56	92	Ph	Stop H40L17 to dial	Set stop at ±12 degrees on dial.
None		R	Pot R4015 to range receiver	With B'r' = zero, R = 10,000 yds, TSS at 1F, check that pot is at zero. With B'r' = 90°, R = 10,000 yds, check that reading at 1F is +0.105. If necessary to refine, use phasing clamp on pot R4015. See A109 for pot R4014.

* Number not indicated in instrument.

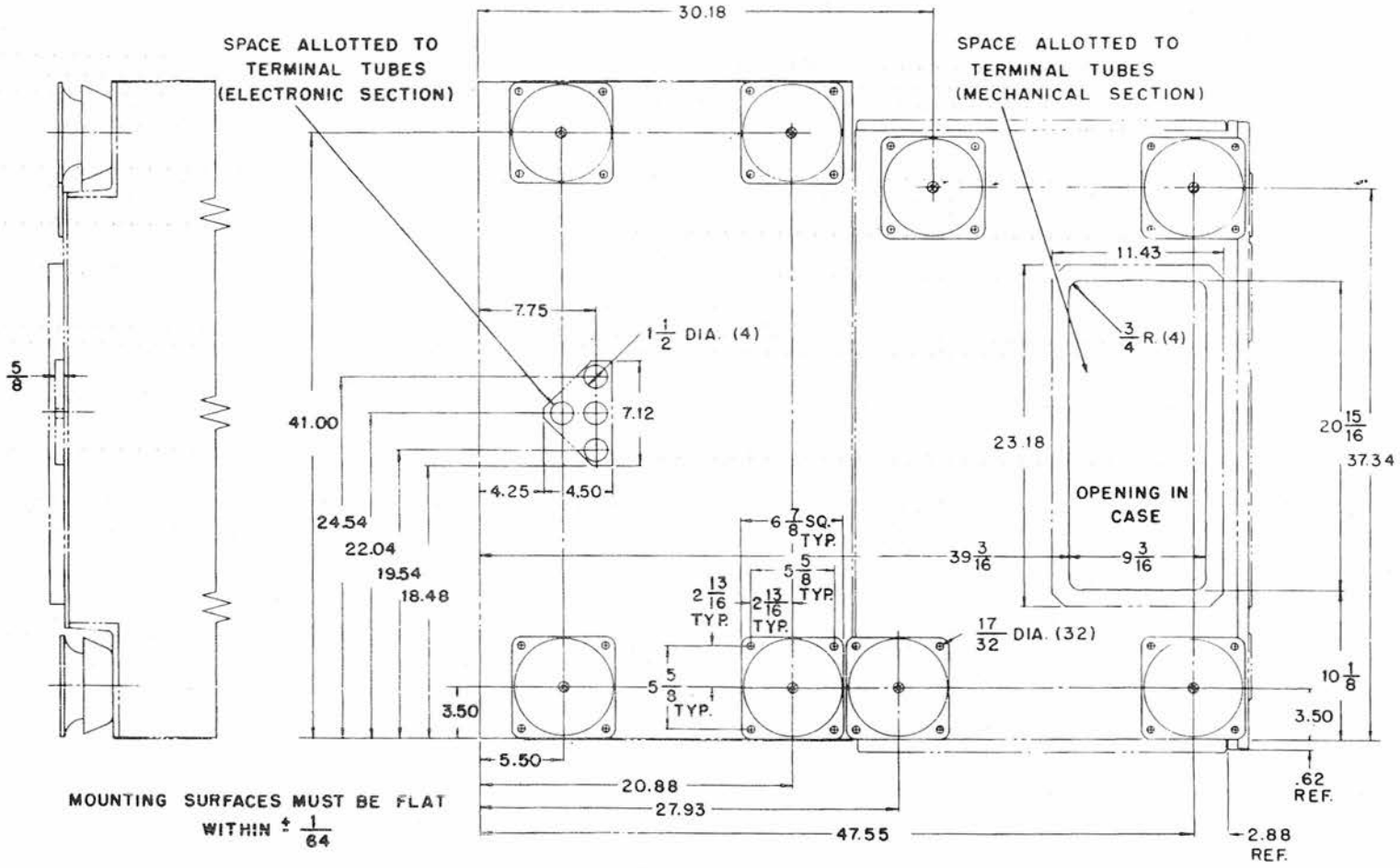

Figure 97. Computer Mk 48 Mod 1, Mounting Diagram

Gene Slover's US Navy Pages

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Chapter 6

INSTALLATION

Figure 97 is a plan and side view of the bottom surface and shock mounts of the computer. As noted there, the surface on which the computer rests must be flat within ±1/64 inch. Also shown are the terminal tube openings for the electronic and mechanical sections. Figures 98 and 99 show the interconnections between this computer and other elements of the fire control system.

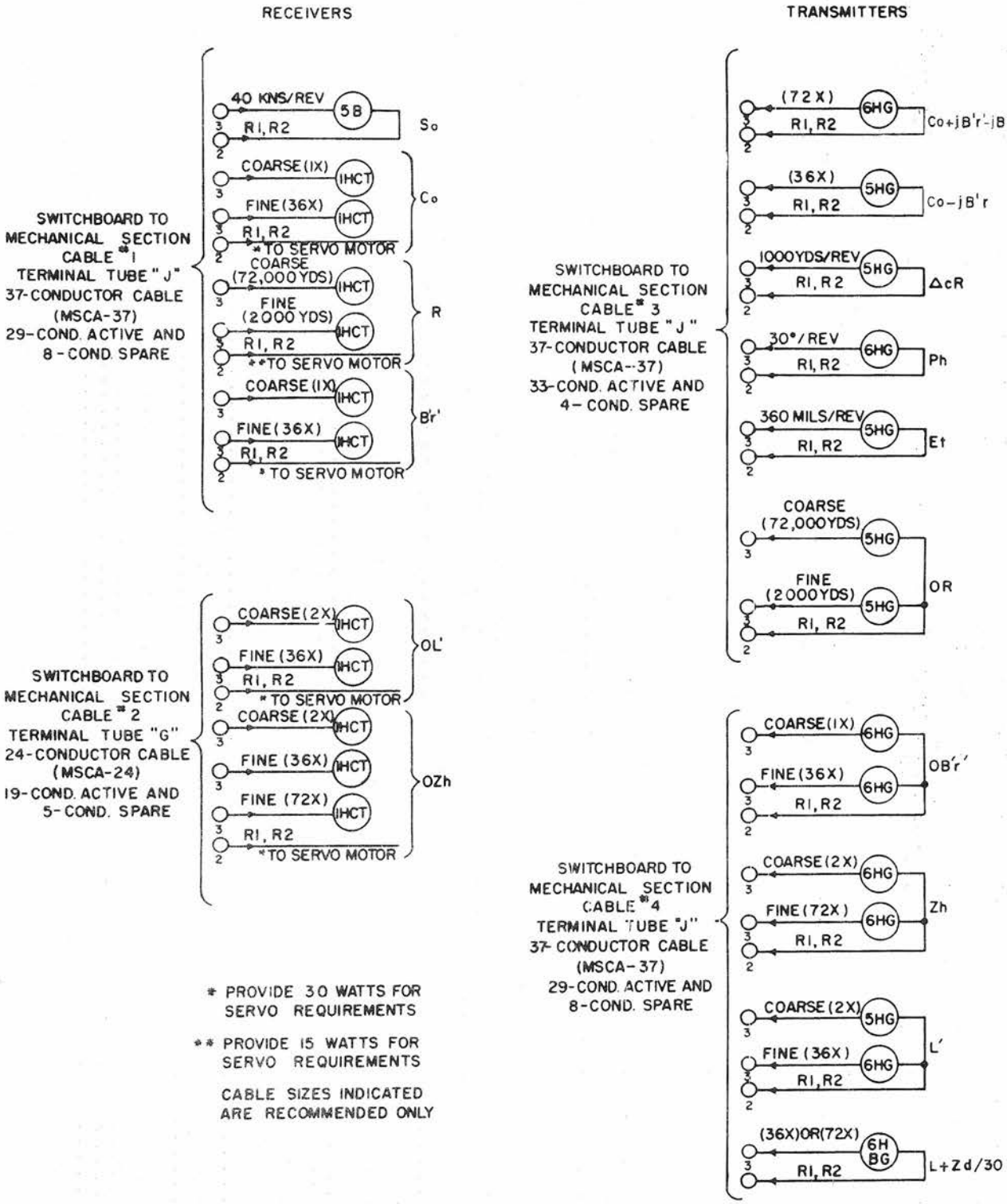
Figure 100 shows the left side of the computer with both electronics drawers open for servicing. The blower removes hot air from the computer interior.

Table 71 lists operating voltages. The motor-generator set requires 3.5 kva (5.9 kva max) from the ship's 440-volt, 60-cycle, 3-phase supply.

Table 71

OPERATING VOLTAGES

Voltage	Source	Where Used
6.3 volts, 60 cycles	T4101, T4102, T4103, T4301, and T4302	Filaments
Reference voltage ±12 volts, 400 cycles	ZY4101	Potentiometers and networks
+250-volts DC	ZC4101, ZC4102, and ZC4103	Servo controls, computing amplifiers, and tuning fork amplifier
+350-volts DC	Motor-Generator Set	Tuning fork amplifier, servo amplifiers, and series regulators (250v)
-105-volts DC	ZC4104	Servo amplifiers, tuning fork amplifier



* PROVIDE 30 WATTS FOR SERVO REQUIREMENTS

** PROVIDE 15 WATTS FOR SERVO REQUIREMENTS

CABLE SIZES INDICATED ARE RECOMMENDED ONLY

Figure 98. External Synchro Cable Connections

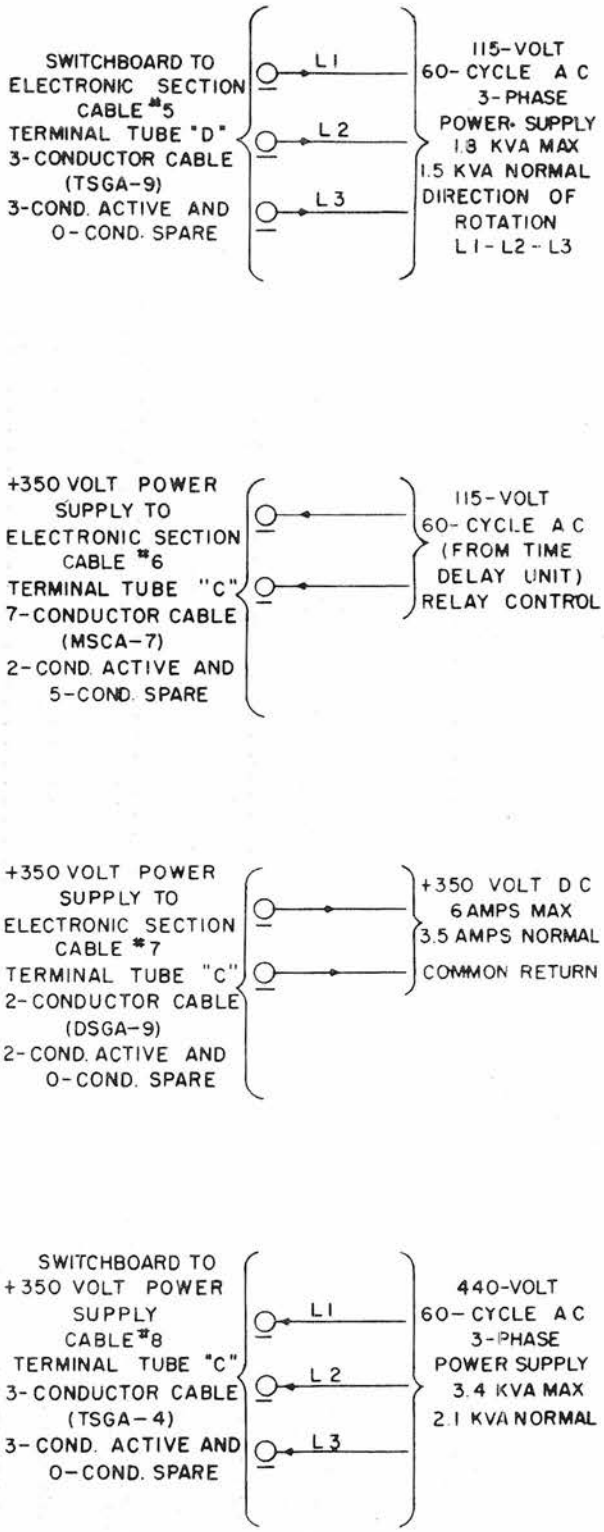


Figure 99. External Power Cable Connections

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A60	90	B	Resolver B4081 to line	With switch S4002 on AA, Co, B'r', jOB'r', jOB'r' - jB'r' = 0, Es = 2000 min, R = 40,000 yds. With mode switch S4006 on SHORE BOMB SHIP, TSS at 2C position, rotate resolver rotor CCW to a test reading of zero, decreasing. Turn TSS to 2D position, and check test reading of -9.400 v. With same set-up, but with S4006 on DEAD REK'NG-TGT, check that reading of TSS 2C = zero, increasing, and TSS 2D = +9.400.
A96	91	OB	Resolver B4082 to line	With switch S4006 on DEAD REK'NG-SHIP, Xj and Yj = 0, R = 50,000 yds, Es = 2000 min; 2D position on TSS, reading maximum plus voltage, put TSS on 3G position and rotate resolver gear CCW to a test reading of zero, increasing. Check that at TSS 3F, a positive signal, exists. Wind up spring sufficiently to remove lost motion in gearing.
A97	91	OB	Resolver B4082 to line	
*A505	91	OB	Dial to resolver B4082	With set-up A96 and A97 producing OB = zero, set coarse dial and vernier on 0°00'.
*A513	90	Et	Dial to synchro B4061	With transmitter B4061 on electrical zero, set dial to read 2000 minutes.
A83	90	Et	Dial to limit stop H40L4	Set stop to act between 2000 and 3200 minutes on dial.

* Number not indicated on instrument.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A82	90	Et	Resolver B4095 to stop H40L4	With stop at 3200 limit, turn resolver gear CCW until spring is wound tight. Back off 1/2 turn, and tighten clamp.
None	--	Et	Resolver B4095 to servo	With Et = 2000, Ht = zero, Et servo killed, max voltage indicated at TSS position 3F; rotate resolver rotor CCW to a reading of zero at TSS position 4B, and a negative reading at TSS position 4C.
*A511	90	OR	Dial to transmitter B4063	With synchros B4062 and B4063 on electrical zero, set OR dials to read 10,000 yds.
*A512	90	OR	Dial to transmitter B4062	
A111	90	OR	Transmitter B4063 to stop H40L8	Set stop to act between 500 yds and 50,000 yds on dials.
A113	90	OR	Transmitter B4062 to stop H40L8	Set stop to act between 500 yds and 50,000 yds on dials.
A112	90	OR	Pot R4008 to OR dials and stop H40L8	With TSS at 4D point, set pot to following: OR = 2000 yds, Reading = 0.470 Check at: OR = 5000 yds. Reading = 1.174. OR = 50,000 yds. Reading = 11.744.

* Number not indicated on instrument.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A110	90	OR	Pot R4021 and R4022 to stop H40L8	With OR at 50,000 yds, resistance between slider and terminal 1 of pots should be at minimum. Check to see that resistance increases as OR decreases.
A88	90	OB'r'	Synchro B4068 to B4069	Set transmitters together on electrical zero.
*A506	90	OB'r'	Dial to B4068	With synchros at electrical zero, set dials on zero.
*A507	90	OB'r'	Dial to B4069	
A87	90	OB'r'	OB'r' transmitter to line	With jOB'r', (jOB'r' - jB'r') dials on zero, Co, B'r', OB on zero, switch S4002 to AA position. Set OB'r' transmitter on zero.
A78	94	OB'r'	Resolvers B4086 and B4087 to OB'r' dials	With (jOB'r' - jB'r'), jOB'r', and OB'r' dials = 0, tighten clamp.
A75	--	OBr - Br - jB	Resolver B4092 to line	With B'r', Co, OB, jOB'r' - jB'r', jOB'r' dials = 0, H40L16 wedged at midpoint; OB, jOB'r' - jB'r', jOB'r' servos killed, OL' = 0, OZh = 25°. TSS at 7A, rotate resolver rotor CCW to a test reading of zero, decreasing 7B reads -10.143.
*A509	--	OBr - Br - jB	Dial to resolver B4092	With same set-up as for A75, set dial at zero.

* Number not indicated on instrument.

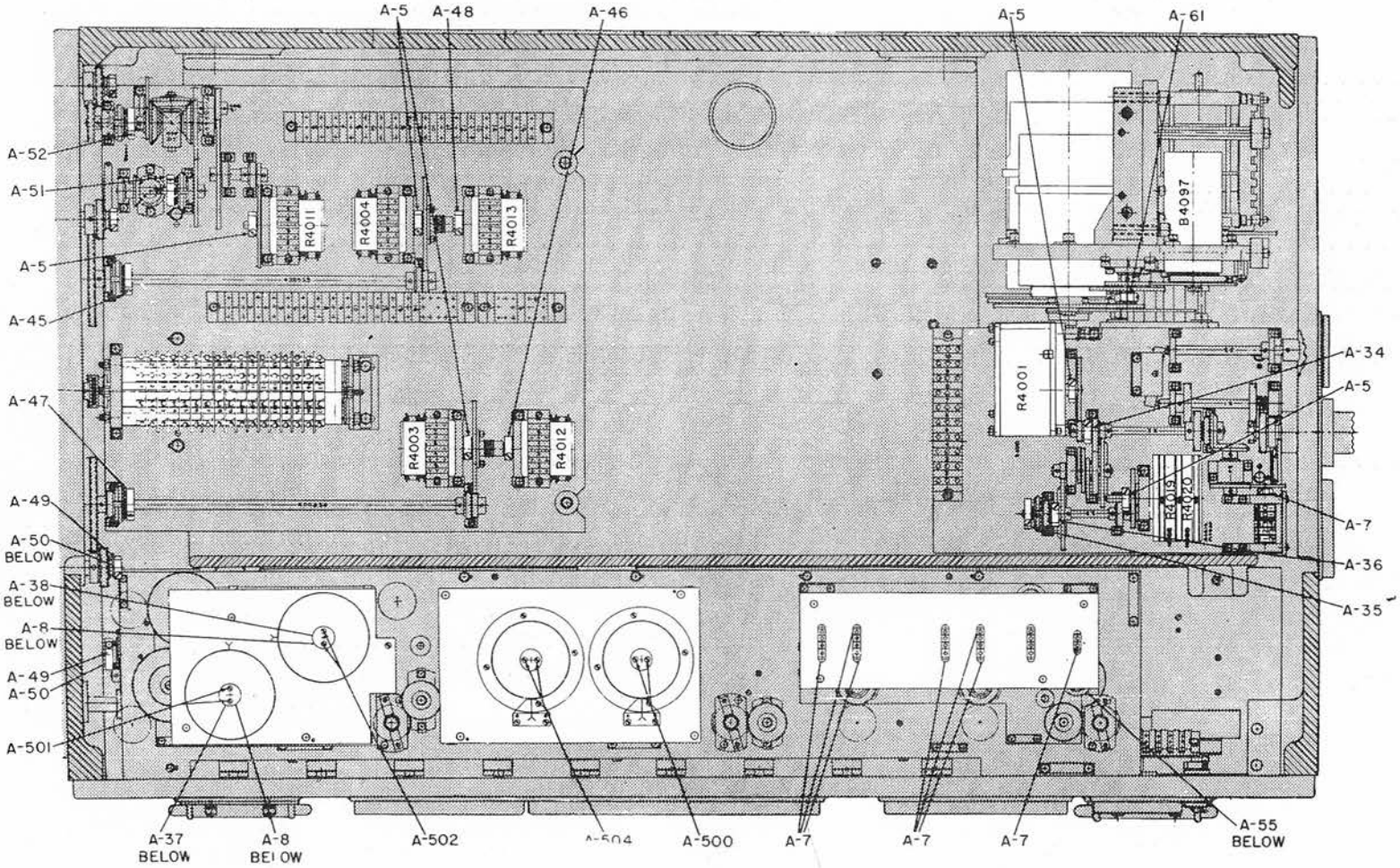


Figure 95. Top Mechanical Section Below Plotter and Cover No. 3

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Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
None	--	jOB'r'	Resolver B4088 to stop H40L15	With jOB'r', jOB'r' - jB'r', OB'r', OBr - Br - jB dials on zero; jOB'r' and jOB'r' - jB'r' servos killed; S4002 on AA, proceed as follows: OL, OZd = 0°; rotate resolver rotor CCW to a reading of zero, decreasing, at TSS position 6A.
None	--	jOB'r'	Resolver B4059 to stop H40L15	OL, OZd = 25°; rotate resolver rotor CCW to a reading of +8.573 at TSS position 6G. With special probe, check B4089, R2 = 0.
None	--	jOB'r' - jB'r'	Resolver B4094 to stop H40L14	OL, OZd = 25°; rotate resolver rotor CCW to a reading of -8.573 at TSS position 6E. With special probe, check B4094. R2 = 0.
None	--	jOB'r' -jB'r'	Resolver B4093 to stop H40L14	OL, OZd = 0; rotate resolver rotor CCW to a reading of zero, increasing, at TSS position 5G.
None	--	2(OBr - Br - jB) - (jOB'r' -jB'r')	Resolver B4091 to stop H40L14	OL, OZd = 25°; rotate resolver rotor CCW to a reading of +8.573 at TSS position 6D. With special probe, check B4091. R2 = 0.
None	--	2(OBr - Br - jB) -(jOB'r' - jB'r')	Resolver B4090 to stop H40L14	OL = 0°, OZd = 25°; rotate resolver rotor CCW to a reading of zero, decreasing, at TSS position 6B.
None	--	2OB'r' + jOB'r'	Resolver B4086 to stop H40L15	OL = 0°, OZd = 25°; rotate resolver rotor CCW to a reading of zero, decreasing, at TSS position 5F.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
None	--	20B'r' + jOB'r'	Resolver B4087 to stop H40L15	OL, OZd = 25°; rotate resolver rotor CCW to a reading of -8.573 at TSS position 6F. With special probe, check B4087. R4 = 0.
A62	91	Zh	Assembly	Tighten
A100	91	Zh	Fine 6HG B4064 to limit stop H40L11	With stop H40L11 at midpoint of travel, set B4064 on electrical zero. Check that 160/32 gear on 6HG makes 5 turns in either direction from electrical zero.
A101	91	Zh	Coarse 6HG B4065 to fine 6HG B4064	Set fine and coarse synchros together on electrical zero.
A98	91	Zh	Resolver B4098 to limit stop H40L11	Turn shaft 1404S5 CCW (viewed from A98 end) until stop hits. Turn resolver gear CCW until take-up spring is wound solid. Back off 1/2 turn, and tighten A98.
None	--	Zh	Resolver B4098 to Zh line	With TSS at 7C position, Zh transmitters at electrical zero, rotate resolver rotor CCW to a test reading of zero, increasing. With special probe, check reading of +12.000 at R1 of B4098. With TSS at 7C position, Zh at 20° check reading of +4.104. Refine setting, if necessary.

Table 70 (Cont'd)

ADJUSTMENT PROCEDURE

Adj No	Fig No	Function	Connection	Procedure
A103	91	L'	Fine 6HG B4067 to limit stop H40L10	With stop H40L10 at midpoint of travel, set B4067 at electrical zero. Check that 48/32 gear on 6HG makes 2.5 turns in either direction from electrical zero.
A104	91	L'	Coarse 5HG B4075 to fine 5HG B4067	Set fine and coarse synchros together on electrical zero.
A61	91	L'	Resolver B4097 to limit stop H40L10	Rotate shaft 1404S13 CW (viewed from A61 end) until stop H40L10 hits. Loosen clamp A61, and rotate shaft 1404S13 CW until take-up spring is wound solid. Back off 1/2 turn, and tighten A61.
None	--	L'	Resolver B4097 to L' line	With TSS at 7D position, L' transmitters on electrical zero, rotate resolver rotor CCW to a test reading of zero, increasing. With special probe, check reading of +12.000 at R1. With TSS at 7D position, L' at +20°, check reading of +4.104. Refine setting, if necessary.
A99	91	L' + Zd/30	6HBG B4066 stator to stop H40L11	With limit stops H40L10 and H40L11 at midpoints of their travel, set 6HBG (B4066) at electrical zero.
A102	94	L' + Zd/30	6HBG B4066 rotor to stop H40L10	

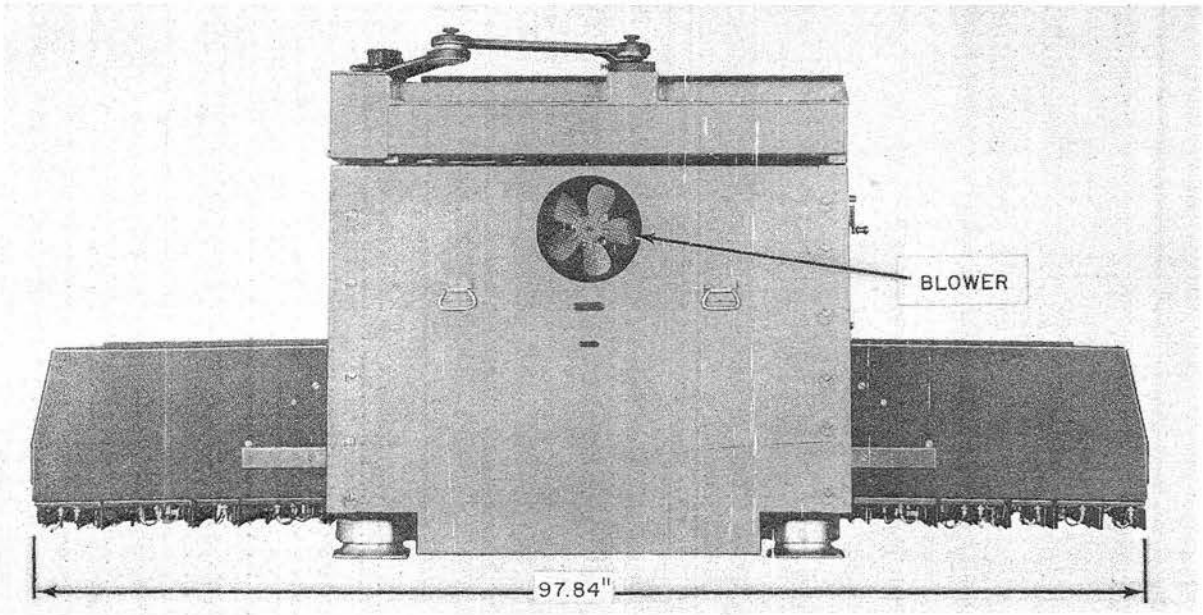

Figure 100. Left Side with Electronic Drawers Extended

As manufactured, the L + Zd/30 transmitter is designed for Mark 37 directors having the Amplidyne drive (36x, 10 degrees per revolution). Change gears for the Arma drive (72x, 5 degrees per revolution) and a change gear chart are attached inside the rear cover (cover No. 7) of the mechanical section. These gears can be mounted on shafts 1404S7, 1404S8, and the transmitter, B4066, as shown on the chart. The position of the entire unit in the computer is shown at the right side of figure 91.

Train control, Co + jB'r' - jB, is transmitted by a 36x (10 degrees per revolution) synchro transmitter and also by a 72x (5 degrees per revolution) synchro transmitter. The 36x transmitter is for Mark 37 directors with the Amplidyne drive. The 72x transmitter is for Mark 37 directors with the Arma drive and for other equipment with 72x train control receivers. When the computer is installed, each train control transmitter must be connected to the proper receiver. Specific transmission information for the various installations is given in table 72.

Table 72

TRANSMISSION INFORMATION FOR INSTALLATION

Function	Mk 34	Mk 38	Mk 54	Antenna Mt Mk 23	Mk 37
Level	36x	36x	36x	2 and 36x	
L + Zd/30					Arma 72x Drives 36x Amplidynes Ordalt 2815
Cross Level					2 and 72x
Train Control	72x	72x	72x	72x	Arma 72x Drives 36x Amplidynes
Increments of Range △cR	1000 yds/t	1000 yds/t	1000 yds/t	1000 yds/t	1000 yds/t
Unit Parallax (Ph)				12x	12x[1]

1. In the Mk 37 a fixed vertical parallax correction is made for a 10-yard base length.

Table 72 (Cont'd)

TRANSMISSION INFORMATION FOR INSTALLATION

Function	Mk 34	Mk 38	Mk 54	Antenna Mt Mk 23	Mk 37
Parallax Range	Manual[2] Sight Angle Dial Only	Manual Range Dial	Manual[3] Range Dial		
SHIPS	CL's CA's	BB's	CA's 134, 139, 148	CL 144, 145	DD's, CL's CA's, BB's

2. Also sets vertical parallax. A sight angle vs range conversion table is required.

3. Separate inputs for horizontal and vertical parallax. Parallax range, K/R, is received automatically in normal operation.

Appendix A

SUPPLEMENTARY DATA

DIAGRAMS

Title	BuOrd Dwg
Horizontal Section	1371751
Deck-Tilt Section	1371753
Computing Networks	1371765
Deck-Tilt Corrector Networks	1371764
Power Supply	1371754
Neon Test-Control Circuit	1371755
Gearing of Computing Mechanisms	1372018, 1372019
Control Circuit Diagram	1372106
External Cable Connections	1371758
Wiring of Mechanical Sections:	
Unit 4007	1436062
Unit 4007 (Terminal Blocks)	1436063
Unit 4004 and 4006	1436064
Unit 4004	1436065
Unit 4005	1436066
Unit 1401 to 1403	1436067
Unit 1201, 1202, 1405, 1406	1436068
Unit 1203, 1301, 1305	1436069
Unit 1302, 1304, 1404	1436070
Unit 4008, 4009, 1310	1436071

Appendix A (Cont'd)

Title	BuOrd Dwg
Wiring of Electronic Sections:	
Terminal Blocks Section 4100	1436073
Bottom and Right Side of Case and Jack Plate	1436074
Terminal Blocks Section 4300	1436075
Front Drawer, Front View	1436076
Front Drawer, Rear View	1436077
Networks and Power Supply	1436078
Rear Drawer, Rear View	1436079
Rear Drawer, Front View	1436080
Relay Bracket, Rear Right, Front, and Top Views	1436081
Relay Terminal Blocks Section 4300	1372099
Servo Unit Plotter Drive	1436072
Interconnecting (Computer Section to Electronic Section)	1436060, 1436061

ASSEMBLY DRAWINGS

Title	BuOrd Dwg	Unit No
Test Unit	1371830	--
Blower Assembly	981044	0905
Mechanical, Main Assembly	1371960 to 1371967	--
Horizontal Bearing Correction Assembly (jB)	1371693, 1371694	1201
Sight Elevation (Es)	980640, 980641	1202
True Target Bearing (OB)	980709, 980710	1203
Plotter Drive	980225	1204
Level Receiver (OL')	980660, 980661	1301

Appendix A (Cont'd)

Title	BuOrd Dwg	Unit No
Own Ship Course Receiver (Co)	1371624	1302
Cross-Level Receiver (OZh)	1371640, 1371641	1304
Director-Train Receiver (B'r')	1371637, 1371638	1305
Ship's Speed Receiver (So)	981171	1310
Relative Target Bearing Transmitter (OB'r')	981182	1401
Target Range Transmitter (OR)	1371708, 1371709	1402
Target Elevation Transmitter (Et)	981408, 981409	1403
Level and Cross-Level Transmitters (L), (Zh)	1371779-1371785	1404
Parallax Transmitter (Ph)	981040, 981041	1405
Bearing-Aided Tracking Transmitters (Co + jB'r' - jB)	1371748, 1371749	1406
Motor Regulator	195022	1601
Dial Gearing and Range Receiver	1371885	4004
Deck-Tilt Corrector	1371737 to 1371474	4005
Terminal Block Assembly	1371972	4007

Appendix A (Cont'd)

LIST OF ELECTRON TUBES

Tube Type	Quantity	Quantity per Electronic Unit
OA2WA	17	3201 (1)
OA3	1	3804 (1)
OB2WA	8	3304 (1), 3305 (1), 3803 (1)
5651WA	1	3804 (1)
5726/6AL5W	52	3301 (3), 3302 (5), 3305 (2)
5751	51	3002 (2), 3012 (2), 3201 (1), 3301 (1), 3302 (1), 3304 (1), 3305 (1), 3402 (1), 3803 (1), 3804 (1)
5814A	21	3002 (2), 3012 (2), 3302 (1), 3305 (1), 3402 (1)
5932	36	3201 (2), 3402 (2)
6005/6AQ5W	16	3001 (1), 3011 (1), 3301 (1), 3302 (1)
6080WA	7	3803 (2), 3804 (1)
6AU6WA	30	3001 (2), 3011 (2), 3301 (1), 3305 (1), 3302 (2), 3401 (2)
6AV6	5	3304 (1), 3305 (1)
6X4W	2	3804 (2)
12AT7WA	17	3201 (1)
	264 Total	

Appendix A (Cont'd)

MOTOR-GENERATOR SET DRAWINGS

Title	Bureau of Ships	Standard Navy Stock Number
Rheostat	S6307-3175735	S17-R-7456-1255
Controller	S6307-769124	S17-C-34264-204
Regulator	---	S17-R-57259-972
Motor-Generator	S6104-3244924	S17-M-69593-7415
On-board Repair Parts	S6104-1559380 S6104-1559381 S6104-1559382 S6104-1559383 S6104-1559384 S6104-1559385	S17-M-133502-4675

INSTALLATION DRAWINGS

Title	BuOrd Dwg
Navy lead designation assembly	1225505
Navy lead designation assembly	1225506
Navy lead designation assembly	1225507
General arrangement plan view	1371724
General arrangement front view	1371725
General arrangement left side view	1371726
General arrangement right side view	1371727
General arrangement rear view	1371729
General arrangement terminal tubes and mounting dimensions for computer	1371730
External cable connection diagram	1371758
Handle storage shelf assembly	13721001
Wiring diagram mechanical section (Unit 4007)	1436062

Appendix A (Cont'd)

Title	BuOrd Dwg
Wiring diagram mechanical section (Unit 4007) (terminal blocks)	1436063
Terminal blocks section 4100 wiring diagram	1436073
Master drawing motor generator set	S6104-H-3, 244, 924
Master drawing field rheostat, NOrd(z)14048, NOrd(z)14049	S6308-F-3, 175, 735
Master plan controller NOrd(z)14048, NOrd(z)14049	94104-S6307-769, 124
Master drawing voltage regulator, C/D NOrd(z)14048, NOrd(z)14049	S6104-3, 264, 661
Master plan pushbutton NOrd(z)14048, NOrd(z)14049	S6307-F-3, 000, 793

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L.D.294834	X						COMPUTER MK.48 MOD.1 GENERAL ARRANGEMENTS
L.D.290650		X					PLOTTER, MAIN ASSEMBLY
L.D.290651			X				PLOTTER LIGHT RAIL ASSEMBLY
L.D.290648			X				PLOTTER DRIVE SERVO
# ORD. SK.276506				X			10 WATT SERVO MOTOR 60 CYCLES
ORD. SK.276842				X			POTENTIOMETER (30 TURNS)
L.D.290649				X			GENEVA & LIMIT STOP
L.D.294893				X			COUNTER ASSEMBLY
L.D.294894				X			COUNTER ASSEMBLY
L.D.295104				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295052					X		CABLE NO.107
L.D.295053					X		CABLE NO.108
L.D.294837		X					MAIN ASSEMBLY, MECHANICAL
L.D.290640			X				SERVO & RESOLVER ASSEMBLY
# L.D.290566				X			SELF COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.295102				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295049					X		CABLE NO.104
L.D.295050					X		CABLE NO.105
L.D.290647			X				RESOLVER & GEARING ASSEMBLY
# ORD. SK.276506				X			10 WATT SERVO MOTOR 60 CYCLES
# L.D.290566				X			SELF COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.290567				X			VECTOR SOLVER RESOLVER SELF-COMPENSATING
# L.D.290587				X			SELF-COMPENSATING RESOLVER BEARING MOUNTED
# L.D.294930				X			RESOLVER (SPECIALLY TRIMMED)
# L.D.290566					X		SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.294932				X			RESOLVER (SPECIALLY TRIMMED)
# L.D.290587					X		SELF-COMPENSATING RESOLVER BEARING MOUNTED
L.D.294943				X			RESOLVER (SPECIALLY TRIMMED)
# L.D.290566					X		SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.295117				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295079					X		CABLE NO.134
L.D.295080					X		CABLE NO.135
L.D.295081					X		CABLE NO.136
L.D.295082					X		CABLE NO.137
L.D.295083					X		CABLE NO.138
L.D.295084					X		CABLE NO.139
L.D.295085					X		CABLE NO.140
L.D.295086					X		CABLE NO.141

L.D. NO. 294835
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L.D.295087					X		CABLE NO.142
L.D.290652			X				SERVO & TRANSMITTER ASSEMBLY
L.D.295114				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295071					X		CABLE NO.126
L.D.295072					X		CABLE NO.127
L.D.295073					X		CABLE NO.128
L.D.290653			X				SINGLE SPEED RESOLVER ASSEMBLY
ORD. SK.60882				X			1150 H.P. A.C. MOTOR
ORD. SK.63395				X			MAGNETIC DRAG
L.D.295109				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295061					X		CABLE NO.116
L.D.295062					X		CABLE NO.117
L.D.290655			X				DOUBLE SPEED RESOLVER ASSEMBLY
# ORD. SK.276506				X			10 WATT SERVO MOTOR
L.D.295055				X			MECHANICAL SECTION CABLE NO.110
L.D.290656			X				DOUBLE SPEED RESOLVER ASSEMBLY
# ORD. SK.276506				X			10 WATT SERVO MOTOR 60 CYCLES
# L.D.290566				X			SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.294931				X			RESOLVER (SPECIALLY TRIMMED)
L.D.290641					X		RESOLVER ASSEMBLY
L.D.295107				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295056					X		CABLE NO.111
L.D.295057					X		CABLE NO.112
L.D.295058					X		CABLE NO.113
L.D.290659			X				SERVO & RESOLVER ASSEMBLY
# L.D.290566				X			SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.295101				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295046					X		CABLE NO.101
L.D.295047					X		CABLE NO.102
L.D.295048					X		CABLE NO.103
L.D.290660			X				DOUBLE SPEED RESOLVER ASSEMBLY
# ORD. SK.276506				X			10 WATT SERVO MOTOR
# L.D.294930				X			RESOLVER (SPECIALLY TRIMMED)
# L.D.290566					X		SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.295105				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295051					X		CABLE NO.159
L.D.295054					X		CABLE NO.109
L.D.290661			X				DOUBLE SPEED RESOLVER ASSEMBLY

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# L.D.290566				X			SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.295108				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295059					X		CABLE NO.114
L.D.295060					X		CABLE NO.115
L.D.290673			X				TRANSMITTER & SERVO ASSEMBLY
# ORD. SK.276842				X			POTENTIOMETER (30 TURNS)
L.D.295111				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295064					X		CABLE NO.119
L.D.295065					X		CABLE NO.120
L.D.295066					X		CABLE NO.121
L.D.290674			X				TRANSMITTER & SERVO ASSEMBLY
L.D.290567				X			RESOLVER, VECTOR SOLVER
L.D.295112				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295067					X		CABLE NO.122
L.D.295068					X		CABLE NO.123
L.D.290675			X				SERVO & RESOLVER ASSEMBLY
# ORD. SK.276506				X			10 WATT SERVO MOTOR 60 CYCLES
# L.D.290567				X			VECTOR SOLVER RESOLVER SELF-COMPENSATING
L.D.295103				X			MECHANICAL SECTION CABLE NO.106
L.D.294841			X				TRANSMITTER ASSEMBLY
L.D.295063				X			ELECTRONIC SECTION CABLE NO.118
L.D.294844			X				TRANSMITTER ASSEMBLY
L.D.295074				X			MECHANICAL SECTION CABLE NO.129
L.D.294851			X				GEARING ASSEMBLY
# ORD. SK.276842				X			POTENTIOMETER ASSEMBLY
# ORD. SK.285395				X			ROTARY SWITCH ASSEMBLY
L.D.295091				X			MECHANICAL SECTION CABLE NO.146
L.D.294853			X				TRANSMITTER & SERVO ASSEMBLY
# ORD. SK.276506				X			10 WATT SERVO MOTOR 60 CYCLES
# L.D.294930				X			RESOLVER (SPECIALLY TRIMMED)
# L.D.290566					X		SELF-COMPENSATING RESOLVER ROTOR UNLIMITED
L.D.295113				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295069					X		CABLE NO.124
L.D.295070					X		CABLE NO.125
L.D.294856			X				SCALE FACTOR ASSEMBLY
ORD. SK.137396				X			POTENTIOMETER (30 TURNS)
L.D.294845				X			COUNTER ASSEMBLY

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L.D.295092					X		CABLE NO.147
L.D.295093					X		CABLE NO.148
L.D.294868			X				DIAL GEARING AND RECEIVER
ORD. SK.63393				X			PUSH SWITCH ASSEMBLY
# ORD. SK.276842				X			POTENTIOMETER (9.5 TURNS)
L.D.294890				X			COUNTER ASSEMBLY
L.D.294891				X			COUNTER ASSEMBLY
L.D.294920				X			COUNTER ASSEMBLY
L.D.294957				X			POTENTIOMETER (1 TURN)
L.D.294958				X			COUNTER ASSEMBLY
L.D.295116				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295075					X		CABLE NO.130
L.D.295076					X		CABLE NO.131
L.D.295077					X		CABLE NO.132
L.D.295078					X		CABLE NO.133
L.D.294887			X				COMPONENT SOLVER INTEGRATOR MOUNTING & GEARING ASSEMBLY
# L.D.290587				X			SELF-COMPENSATING RESOLVER BEARING MOUNTED
L.D.294857				X			1 1/2" COMPONENT SOLVER AND INTEGRATOR MOUNTING
L.D.294859				X			2 1/2" COMPONENT SOLVER
L.D.295118				X			MECHANICAL SECTION CABLE ASSEMBLIES & OUTLINE
L.D.295088					X		CABLE NO.143
L.D.295089					X		CABLE NO.144
L.D.295090					X		CABLE NO.145
L.D.294901			X				CASE & COVERS ASSEMBLY
L.D.294858				X			HANDLE ASSEMBLY
L.D.294874				X			HANDLE ASSEMBLY
L.D.294876				X			HANDLE ASSEMBLY
L.D.294877				X			HANDLE ASSEMBLY
L.D.294878				X			HANDLE ASSEMBLY
L.D.294879				X			HANDLE ASSEMBLY
L.D.294880				X			HANDLE ASSEMBLY
L.D.294881				X			HANDLE ASSEMBLY
L.D.294882				X			HANDLE ASSEMBLY
L.D.294883				X			HANDLE ASSEMBLY
L.D.294884				X			HANDLE ASSEMBLY
L.D.294885				X			HANDLE ASSEMBLY
L.D.295115				X			MECHANICAL SECTION CABLE ASSEMBLY & OUTLINE

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