830B-1B 250W FM TRANSMITTER

SPARE SEMICONDUCTOR AND TUBE LIST

310Z-1 EXCITER

9-1-69

Quantity Complete Set	Quantity Recommended Set	CPN	Description
2	1	352-0583-010	2N3055
1	1	352-0695-010	2N3740
4	2	352-0322-000	2N708
7	3	352-0743-010	2N4121
2	1	352-0713-030	2N3643
1	1	352-0116-000	2N491
4	2	352-0349-000	2N1613
1	1	352-0773-030	2N4250
1	1	352-0638-010	2N3565
1	1	352-0373-000	S4639
1	1	352-0848-020	2N4258
2	1	352-0756-010	2N4416
4	2	352-0630-010	2N3563
1	1	352-0671-010	2N3866
1	1	352-0611-010	2N3375
1	1	352-0747-010	2N5102
3	2	352-0629-030	2N3569
5	2	352-0695-040	2N4235
4	2	353-1721-000	1N1200
4	2	353-3593-010	FA2311U
10	4	353-2018-000	1N270
3	2	353-2857-000	1N626
3	2	353-3271-000	FA4000
1	1	353-2734-000	1N718
1	1	353-2710-000	1N751A

Quantity Complete Set	Quantity Recommended Set	CPN	Description
1	1	353-3304-000	SV3173
1	1	353-3123-000	1N3018B
1	1	353-3057-000	1N3027B
5	2	353-2607-000	1N645
3	2	353-2724-000	1N758A
2	1	353-2712-000	1N752A
2	1	353-3125-000	1N3020B
1	1	353-2718-000	1N755A

B830-1 AMPLIFIER

2	1	353-1794-000	4JA421EX55

___Transistors and diodes, 100% set including H.V. rectifiers $273.30

___Transistors and diodes, recommended set $169.20

TUBES

2	1	257-0001-000	OD3 Regulator
1	1	256-0138-000	4CX250B

Tube set, 100% $38.50

___Tube set, recommended $37.00

830D-1B 1KW FM TRANSMITTER

SPARE SEMICONDUCTOR AND TUBE LIST

310Z-1 EXCITER

9-1-69

Quantity Complete Set	Quantity Recommended Set	CPN	Description
2	1	352-0583-010	2N3055
1	1	352-0695-010	2N3740
4	2	352-0322-000	2N708
7	3	352-0743-010	2N4121
2	1	352-0713-030	2N3643
1	1	352-0116-000	2N491
4	2	352-0349-000	2N1613
1	1	352-0773-030	2N4250
1	1	352-0638-010	2N3565
1	1	352-0373-000	S4639
1	1	352-0848-020	2N4258
2	1	352-0756-010	2N4416
4	2	352-0630-010	2N3563
1	1	352-0671-010	2N3866
1	1	352-0611-010	2N3375
1	1	352-0747-010	2N5102
3	2	352-0629-030	2N3569
5	2	352-0695-040	2N4235
4	2	353-1721-000	1N1200
4	2	353-3593-010	FA2311U
10	4	353-2018-000	1N270
3	2	353-2857-000	1N626
3	2	353-3271-000	FA4000
1	1	353-2734-000	1N718
1	1	353-2710-000	1N751A

Quantity Complete Set	Quantity Recommended Set	CPN	Description
1	1	353-3304-000	SV3173
1	1	353-3123-000	1N3018B
1	1	353-3057-000	1N3027B
5	2	353-2607-000	1N645
3	2	353-2724-000	1N758A
2	1	353-2712-000	1N752A
2	1	353-3125-000	1N3020B
1	1	353-2718-000	1N755A

D830-1 AMPLIFIER

2	1	353-6015-000	50M140ZB5
8	2	549-2463-004	H.V. Rectifier Stack
2	1	353-1661-000	1N1492
1	1	353-1736-000	1N1566
1	1	353-3121-000	1N3016B
1	1	353-3220-000	1N963A
1	1	353-2016-000	1N270

Complete set of transistors and diodes $512.25

Recommended set of transistors and diodes $209.00

TUBES

1	1	256-0123-000	4CX1000A

Tube set, 100% $181.00

Tube set, recommended $181.00

830E-1B 5KW FM TRANSMITTER

SPARE SEMICONDUCTOR AND TUBE LIST

9-1-69

Quantity Complete Set	Quantity Recommended Set	CPN	Description
2	1	352-0583-010	2N3055
1	1	352-0695-010	2N3740
4	2	352-0322-000	2N708
7	3	352-0743-010	2N4121
2	1	352-0713-030	2N3643
1	1	352-0116-000	2N491
4	2	352-0349-000	2N1613
1	1	352-0773-030	2N4250
1	1	352-0638-010	2N3565
1	1	352-0373-000	S4639
1	1	352-0848-020	2N4258
2	1	352-0756-010	2N4416
4	2	352-0630-010	2N3563
1	1	352-0671-010	2N3866
1	1	352-0611-010	2N3375
1	1	352-0747-010	2N5102
3	2	352-0629-030	2N3569
5	2	352-0695-040	2N4235
4	2	353-1721-000	1N1200
4	2	353-3593-010	FA2311U
10	4	353-2018-000	1N270
3	2	353-2857-000	1N626
3	2	353-3271-000	FA4000
1	1	353-2734-000	1N718
1	1	353-2710-000	1N751A

Quantity Complete Set	Quantity Recommended Set	CPN	Description
1	1	353-3304-000	SV3173
1	1	353-3123-000	1N3018B
1	1	353-3057-000	1N3027B
5	2	353-2607-000	1N645
3	2	353-2724-000	1N758A
2	1	353-2712-000	1N752A
2	1	353-3125-000	1N3020B
1	1	353-2718-000	1N755A

B830 AMPLIFIER

2	1	353-1794-000	4JA421EX55

E830 AMPLIFIER

12	4	353-1546-000	1N540
1	0	353-6273-000	Z404 Screen Rectifie
0	2	353-6259-000	Rectifier (part of Z404)
0	2	353-6260-000	Rectifier (part of Z404)
1	0	549-2259-004	Z405 Bias rectifier
0	3	353-1546-000	1N540 (part of Z405)

Transistors and diodes, 100% set $422.00

Transistors and diodes, recommended set $267.00

TUBE SET

2	1	257-0001-000	0D3 Regulator
1	1	256-0138-000	4CX250B driver

Quantity Complete Set	Quantity Recommended Set	CPN	Description
1	1	256-0122-000	4CX5000A Final amplifier
6	3	256-0037-000	872A H.V. Rectifier

Tube set, 100% $598.00

Tube set, recommended $564.00

830F-1B 10KW FM TRANSMITTER

SPARE SEMICONDUCTOR AND TUBE LIST

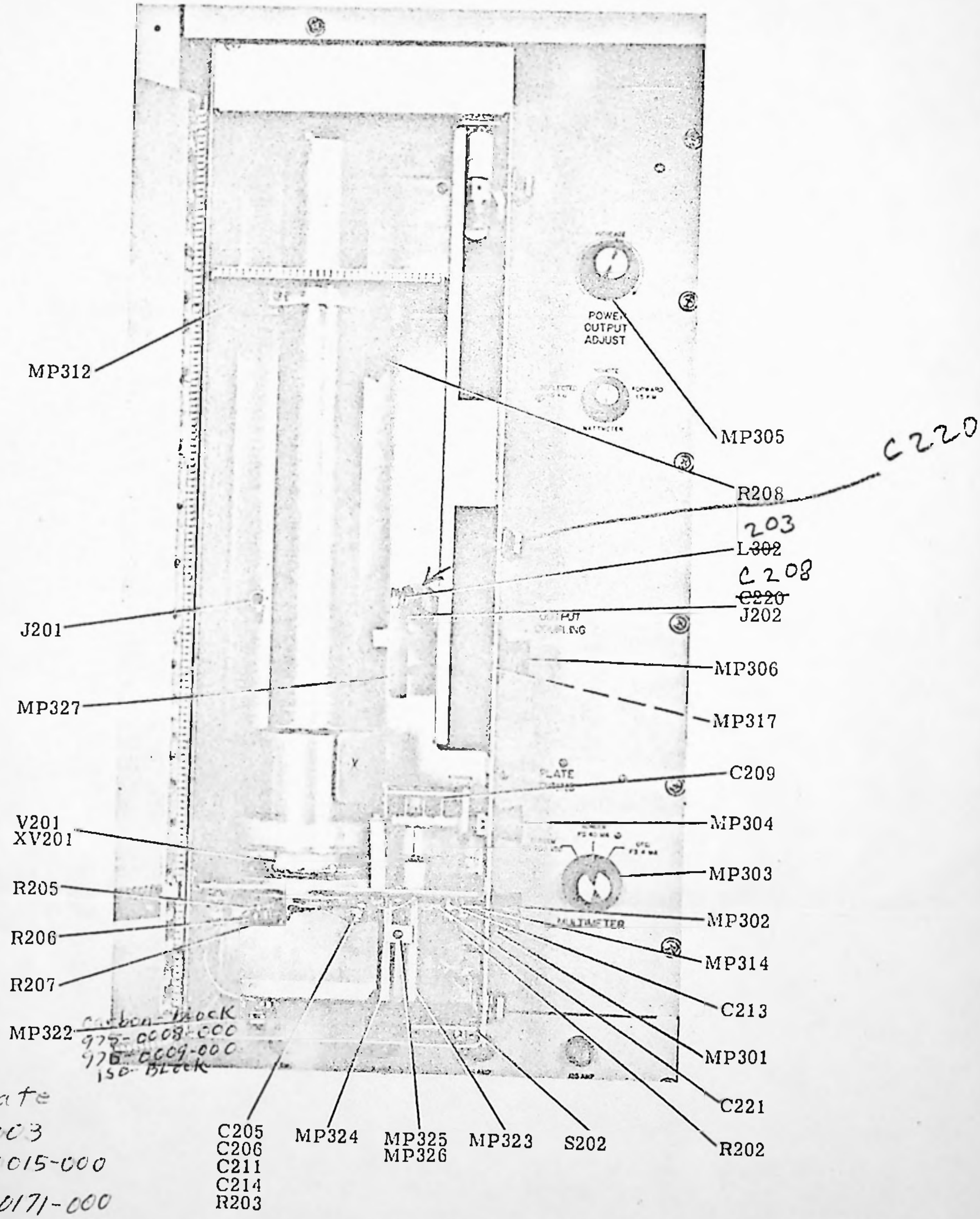
310Z-1 EXCITER

9-1-69

Quantity Complete Set	Quantity Recommended Set	CPN	Description
2	1	352-0583-010	2N3055
1	1	352-0695-010	2N3740
4	2	352-0322-000	2N708
7	3	352-0743-010	2N4121
2	1	352-0713-030	2N3643
1	1	352-0116-000	2N491
4	2	352-0349-000	2N1613
1	1	352-0773-030	2N4250
1	1	352-0638-010	2N3565
1	1	352-0373-000	S4639
1	1	352-0848-020	2N4258
2	1	352-0756-010	2N4416
4	2	352-0630-010	2N3563
1	1	352-0671-010	2N3866
1	1	352-0611-010	2N3375
1	1	352-0747-010	2N5102
3	2	352-0629-030	2N3569
5	2	352-0695-040	2N4235
4	2	353-1721-000	1N1200
4	2	353-3593-010	FA2311U
10	4	353-2018-000	1N270
3	2	353-2857-000	1N626
3	2	353-3271-000	FA4000
1	1	353-2734-000	1N718
1	1	353-2710-000	1N751A

Quantity Complete Set	Quantity Recommended Set	CPN	Description
1	1	353-3304-000	SV3173
1	1	353-3123-000	1N3018B
1	1	353-3057-000	1N3027B
5	2	353-2607-000	1N645
3	2	353-2724-000	1N758A
2	1	353-2712-000	1N752A
2	1	353-3125-000	1N3020B
1	1	353-2718-000	1N755A
B830 AMPLIFIER			
2	1	353-1794-000	4JA421EX55
F830 AMPLIFIER			
12	4	353-1546-000	1N540
1	0	353-6273-000	Z404 Screen rectifie
0	2	353-6259-000	Rectifier (part of Z404)
0	2	353-6260-000	Rectifier (part of Z404)
1	0	549-2259-004	Z405 Bias Rectifier
0	3	353-1546-000	1N540 (part of Z405)
1	0	353-6257-000	Z406 3Ø H.V.Rectifi
0	1	353-6258-000	One leg of Z406

Transistors and diodes, 100% set including 3Ø H.V. rectifier stack	$1,141.00
Transistors and diodes, 100% set including one leg only of 3Ø H.V. Rectifier Stack	$ 662.00
Transistors and diodes, 100% set less H.V. Rectifiers	$ 422.00
Transistors and diodes, recommended set including one leg of 3Ø H.V.Rectifier	$ 547.00
Transistors and diodes, recommended set less H. V. Rectifiers	$ 307.00



New Capacitor Plate
548-7995-003
2 standoff-190-0015-000
2 screws-347-0171-000
2 screws-343-0330-000
4 washers-302-0026-000
4 washers-310-0447-000

Figure 4-1. D830-1 FM Power Amplifier (Sheet 1 of 10)

Quantity Complete Set	Quantity Recommended Set	CPN	Description
2	1	257-0001-000	0D3 Regulator
1	1	256-0138-000	4CX250B
1	1	256-0122-000	4CX5000A

Set of tubes, 100% $534.00

Set of tubes, recommended $532.00

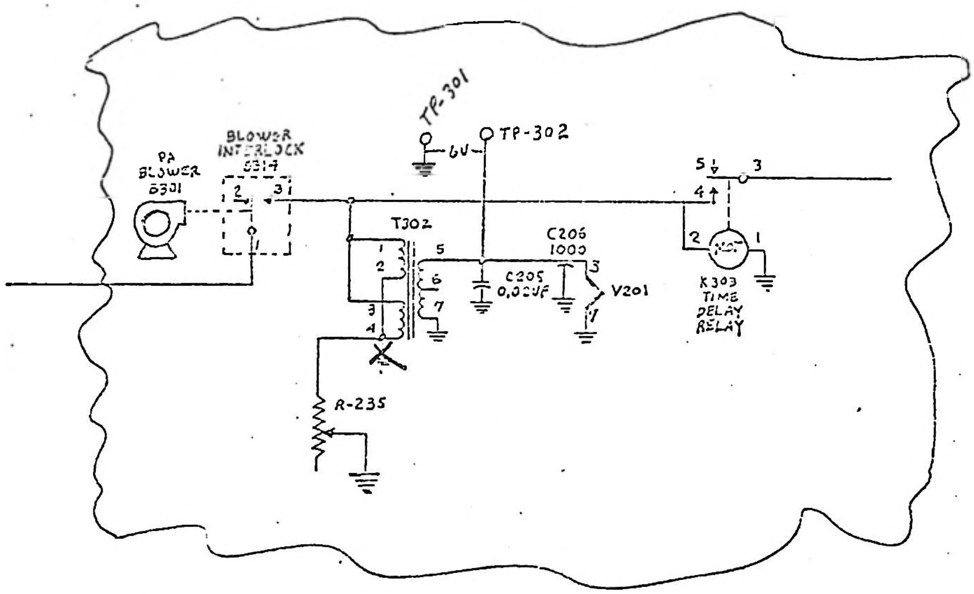
SET OF SPARE TRANSISTORS AND DIODES FOR 786M-1

9-1-69

Qty. 100% KIT	RECOMMENDED SPARE	PART NUMBER	DESCRIPTION
2	1	352-0349-000	2N1613
3	1	352-0243-000	2N1285
1	1	352-0322-000	2N708
2	1	352-0315-000	2N1175A
1	1	353-2041-000	1N270 quad

_____ 100% Spare transistor and diode kit $22.95

_____ Recommended spare transistor and diode kit $15.80



Ref: Fig 5-1 B830-1 250 Watt FM Power Amplifier, Schematic Diagram

Parts Required

R-235	CPN	749-4512-000	100 Ω	10%
TP-301	CPN	360-0156-000	Test Point	Black
TP-302	CPN	360-0155-000	Test Point	Yellow

8170
4CX5000A
RADIAL-BEAM POWER TETRODE

EITEL-McCULLOUGH, INC.
S A N C A R L O S , C A L I F O R N I A

The Eimac 8170/4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megacycles and is particularly suited for use as a linear single-sideband amplified, class-AB_1 audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of services and six kilowatts for class-AB operation.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid-Screen)		4.5		
▶ Direct Interelectrode Capacitances, Grounded Cathode:				
Input	108		122	uuf
Output	18		23	uuf
Feedback			1.0	uuf

▶ Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	48	58	uuf
Output	18	23	uuf
Feedback		0.16	uuf

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250° C
Maximum Anode-Core Temperature	250° C
Recommended Socket	Eimac SK-300A
Recommended Chimney	Eimac SK-306
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.13 inches
Diameter	4.94 inches
Cooling	Forced air
Net Weight	9.5 pounds
Shipping Weight (Approximate)	22 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megacycles)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	3 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	—350 volts
D-C Plate Current	2.8 amperes
D-C Screen Current	0.5 ampere
D-C Grid Current	0.25 ampere
Peak R-F Grid Voltage	590 volts
Driving Power	150 watts
Plate Dissipation	5000 watts
Plate Output Power	16,000 watts

▶ Indicates change from sheet dated 3-15-60

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR (From 30 to 110 megacycles)

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
30 to 60 megacycles	7000 MAX. VOLTS
60 to 110 megacycles	6500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT:	
30 to 60 megacycles	2.8 MAX. AMPERES
60 to 110 megacycles	2.6 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies between 88 and 108 megacycles)

D-C Plate Voltage	6500	volts
D-C Screen Voltage	750	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.3	amperes
D-C Screen Current	0.2	ampere
D-C Grid Current	0.05	ampere
Driving Power	25	watts
Useful Output Power	10,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPERES
PLATE DISSIPATION*	3500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megacycles)

D-C Plate Voltage	5000	volts
D-C Screen Voltage	500	volts
Peak A-F Screen Voltage (For 100-percent modulation)	450	volts
D-C Grid Voltage	—400	volts
D-C Plate Current	1.4	amperes
D-C Screen Current	0.26	ampere
D-C Grid Current	0.05	ampere
Peak R-F Grid Voltage	520	volts
Grid Driving Power	25	watts
Plate Dissipation	1100	watts
Plate Output Power	5.8	kilowatts

SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

(Carrier conditions except where noted)

MAXIMUM RATINGS, Class-C Telephony (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 megacycles, per tube)

D-C Plate Voltage	7500	7500	volts
D-C Screen Voltage	350	350	volts
Peak A-F Screen Voltage (For 100-percent modulation)	550	550	volts
D-C Grid Voltage	—300	—300	volts
D-C Plate Current	0.9	1.14	amperes
D-C Screen Current*	—0.01	—0.01	ampere
D-C Grid Current	0.015	0.03	ampere
Peak R-F Grid Voltage	350	375	volts
Grid Driving Power	7	11	watts
R-F Load Impedance	2000	1600	ohms
Plate Dissipation	4000	5000	watts
Useful Output Power	2750	3550	watts

*D-C Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, two tubes

D-C Plate Voltage	4000	5000	6000	7000	volts
D-C Screen Voltage	1250	1250	1250	1250	volts
D-C Grid Voltage	—270	—280	—310	—325	volts
Max.-Signal Plate Current	5.10	4.40	4.25	3.65	amperes
Zero-Signal Plate Current	1.25	1.00	0.83	0.70	amperes
Max-Signal Screen Current	0.35	0.33	0.30	0.24	ampere
Zero-Signal Screen Current	0	0	0	0	amperes
Peak A-F Driving Voltage	250	240	270	235	volts
Driving Power	0	0	0	0	watts
Load Resistance, Plate-to-Plate	1500	2370	2940	4100	ohms
Max.-Signal Plate Dissipation	4200	4200	4200	4200	watts
Max.-Signal Plate Output Power	11,500	13,500	17,000	17,500	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	1250	volts
D-C Grid Voltage*	—300	volts
Max.-Signal Plate Current	1.9	amperes
Zero-Signal Plate Current	0.50	ampere
Max.-Signal Screen Current	0.20	ampere
Peak R-F Grid Voltage	300	volts
Driving Power	0	watts
Plate Dissipation	4200	watts
Plate Output Power**	10,000	watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or r-f output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting—The 4CX5000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The Eimac SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

Cooling—The maximum temperature rating for the external surfaces of the 4CX5000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SK-300A Socket		SK-300 Socket	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

*Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Control Grid Operation— The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation—The power dissipated by the screen of the 4CX5000A must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

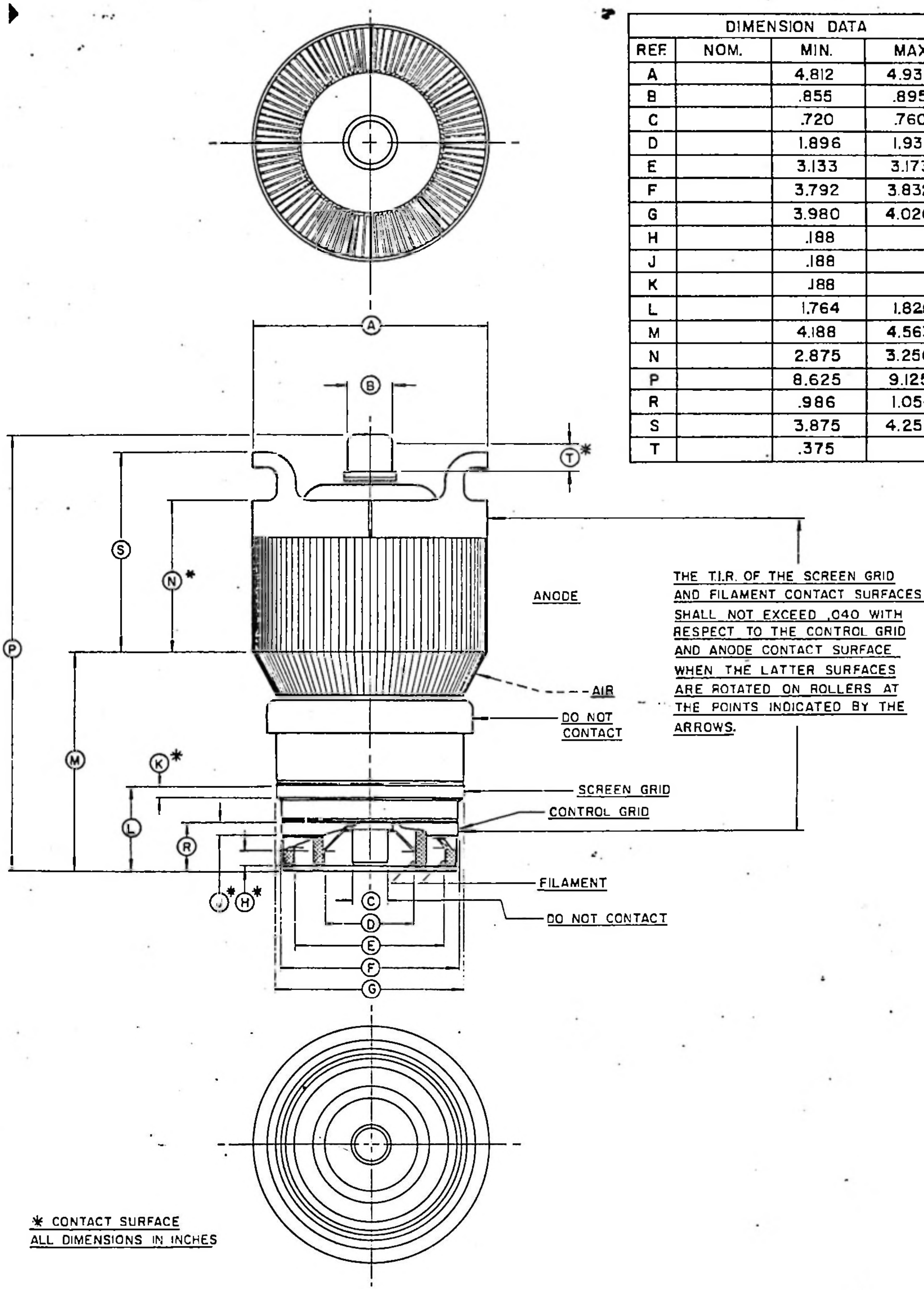
Plate Dissipation—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

When the 4CX5000A is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

Indicates change from sheet dated 3-15-60

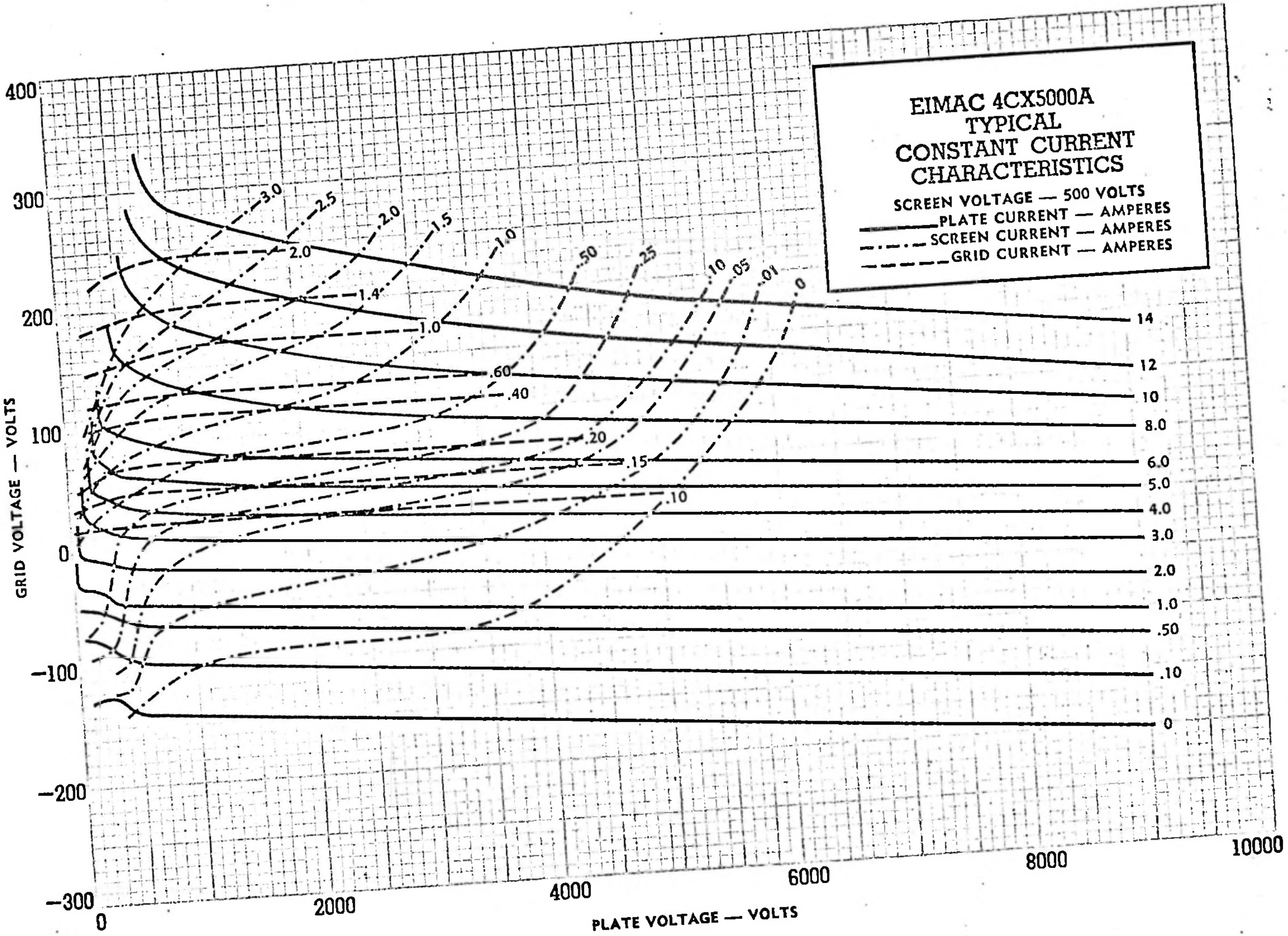
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		4.812	4.938
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		4.188	4.563
N		2.875	3.250
P		8.625	9.125
R		.986	1.050
S		3.875	4.250
T		.375	



THE T.I.R. OF THE SCREEN GRID AND FILAMENT CONTACT SURFACES SHALL NOT EXCEED .040 WITH RESPECT TO THE CONTROL GRID AND ANODE CONTACT SURFACE WHEN THE LATTER SURFACES ARE ROTATED ON ROLLERS AT THE POINTS INDICATED BY THE ARROWS.

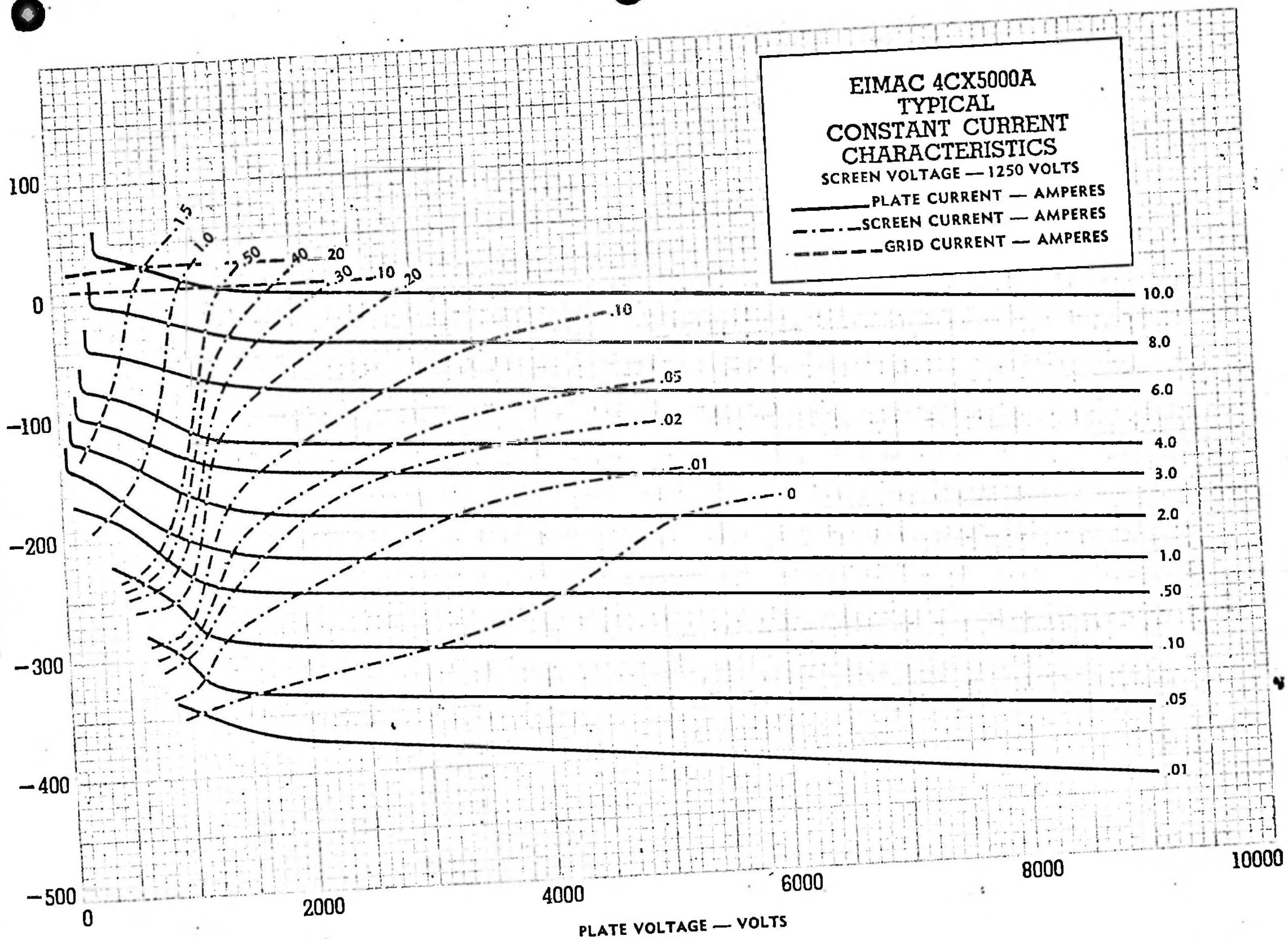
* CONTACT SURFACE
ALL DIMENSIONS IN INCHES

Indicates change from sheet dated 3-15-60



Eimac
4CX5000A

Eimac 4CX5000A



Printed in U.S.A. 5415

830E, F, H

REPORT 36652 FILE III PARTS LIST-TRANSCRIPT

ASSEMBLY	PIECE PART	QUANTITY	ADD	DEL	MC	ITM	X UMP	SER	ADD R	DEL R	PART NAME	DESCRIPTION	AL	P C	PAGE
762-8955-001	439-1355-000	9.000	733		00	003	02	7062	N61464		WIRE	RC95 (FT)			2
	762-8955-000		733		02	009	00	7062	N61464		CHART	FROM-TO			
	762-8955-001	1.000	733		05	000	07	7062	N61464		CABLE	RECT TUBE KIT			

*********************************** HIGHEST ITEM 9 ** DATE 9-421 ** RECORD COUNT 10 CO CODE 03 COGNIZ CD 00

ASSEMBLY	PIECE PART	QUANTITY	ADD	DEL	MC	ITM	X UMP	SER	ADD R	DEL R	PART NAME	DESCRIPTION	AL	P C	PAGE
762-8957-001	000-0000-001		733		02	000	00	7233	N61464		BRACKET	WIRED MTZ RHEO	0B		1
	015-3000-010	1.000	733		01	008	07	7062	N61464		COUPLER				
	150-1542-000	2.000	733		00	019	07	7062	N61464		CLAMP	LOOP			
	230-0517-000	1.000	733		01	005	07	7062	N61464		MOTOR	B403			
	302-0413-000	2.000	733		03	014	07	7062	N61464		WASHER	MICA			
	310-0046-000	1.000	733		03	013	07	7062	N61464		WASHER	NO. 6			
	310-0048-000	1.000	733		03	015	07	7062	N61464		WASHER	NO. 8			
	310-0282-000	8.000	733		03	004	07	7062	N61464		WASHER	NO. 6 LOCK			
	311-0371-000	1.000	733		03	007	07	7062	N61464		PIN				
	313-0002-000	6.000	733		03	003	07	7062	N61464		NUT	NO. 6			
	328-0267-000	2.000	733		03	009	07	7062	N61464		SETSCREW				
	342-0044-000	2.000	733		03	020	07	7062	N61464		SCREW	4-40 X 1/4 PFH			
	343-0167-000	5.000	733		03	012	07	7062	N61464		SCREW	6-32 X 1/4 PPH			
	343-0169-000	1.000	733		03	017	07	7062	N61464		SCREW	6-32 X 3/8 PPH			
	500-1143-001	1.000	733	803	01	016	07	7233	N61464	T66115	POST	RES MTG			
	500-1143-007	1.000	803		01	016	07	7233	T66115		POST	RES MTG			
	540-9474-003	2.000	733		01	010	07	7062	N61464		STANDOFF	HEX			
	553-7307-002	1.000	733		01	006	07	7062	N61464		REDUCER	SHAFT			
	553-7310-003	1.000	733		01	018	07	7062	N61464		BRACKET	MOTOR MTG			
	746-6131-000	1.000	737		01	011	07	7096	T32370		RES	27 OHM RA94			
	747-5533-000	1.000	733	737	01	011	07	7096	N61464	T82370	RESISTOR	27 OHM RA94			
	762-8957-000		733		02	021	00	7062	N61464		BRACKET	WIRED MTZ RHEO			
	762-8957-001	1.000	733		05	000	07	7062	N61464		BRACKET	WIRED MTZ RHEO			
	762-8958-001	1.000	733		09	022	07	7062	N61464		CABLE				
	762-8959-000		733		02	023	00	7062	N61464		SCHEMATI				
	970-2304-000	2.000	733		01	002	07	7062	N61464		RELAY	ARM K409 K410			

*********************************** HIGHEST ITEM 23 ** DATE 9-421 ** RECORD COUNT 26 CO CODE 03 COGNIZ CD 00

M E M O R A N D U M

28 March 1969

TO:	Carl Rollert	407-023
cc:	R. L. Uhrik	412-019
	L. E. Winter	412-013
	Paul Beyer	402-035
	Everett Gilbert	429-017
	George Doran	425-005
	J. L. Smith	401-021
FROM:	L. E. Keiser	412-019
SUBJECT:	Remote Control Relays on 830 Series FM Transmitters	

We have been notified by the vendor that after filling the present order for 970-1931-000 relays that he will not build any more. A search has been made for a direct substitute but none was found. It was decided, after consultation with Dick Uhrik, that a new panel be made and the new plug-in relay, which is widely used on other transmitters, used.

A new relay panel has been designed, P/N 793-9713-001, which will mount in the same holes as the old panel. Whenever an order for a replacement 970-1931-000 relay is received, this panel will have to be sent.

A number of these panels should be built up and placed in stock. An addendum to all instruction books should be issued.

L E Keiser

L. E. Keiser

LEK:mt

REMOTE CONTROL PANEL MODIFICATION

GENERAL:

This modification connects the Collins remote panel to the remote control relay circuits in the transmitter and adds a fail-safe circuit. The remote panel switch contacts will no longer parallel the control circuits of the transmitter. The filament-off circuit is connected in such a way that it will cause the transmitter to be turned off in the event of an open or short circuit in the remote equipment. This circuit over-rides all other control circuits. A relay is being added which prevents the power change motor from being operated if the motor control wires in the remote cable inadvertently make contact with the control voltage in the cable.

MODIFICATION PROCEDURE:

A. Remote panel changes:

1. Disconnect the wires on the PLATE-OFF switch S4, and reconnect to the normally open contacts of the same switch.

2. Disconnect the cable wires from TB1, terminals 1, 2, 3, 4, 5, 6, 7, and 8. Also disconnect the cable wire from TB3-1.

3. Jumper together terminals 1, 3, 5, and 7 on TB1.

4. Disconnect the wire from terminal 4 of S6 which connects to TB3-1.

5. Connect the "hot-side" of switch S2 to terminal 4 of S6.

6. Jumper S6-5 to S6-2 and 7.

7. Jumper S6-1 to 8.

8. Reconnect the RA7 wire, which was disconnected in 4 above, to S6-1.

B. B830-1 or D830-1 changes:

1. Move the wire connected to TB331-4 to TB331-6.

2. Remove the cable wires connecting to the remote unit at the following terminals:

   TB302-8
   TB302-9
   TB303-1 Connecting to S1 FIL-ON
   TB303-2 Connecting to S1 FIL-ON
   TB303-3
   TB303-4
   TB303-5
   TB303-7
   TB334-2 or TB410-2

3. Add a strap between TB302-9 and 10 if necessary. Add a strap between TB331-1 and 8.

4. Connect TB303-4 to TB332-2 if necessary.

   NOTE: If the above wires were already installed, look for some other wire disconnected between TB302 and TB331; and TB303 and TB332. See schematic.

5. If the power change motor is located in the B830-1 or D830-1 cabinet, continue with Step 6; otherwise continue with Section C.

6. Add the power change activate relay K311 and TB337 in the mounting holes above Z301 and Z302.

7. Remove the connections between TB334-4 and TB322-4; and TB334-5 and TB322-5.

8. Connect TB322-4 to TB337-2 (New).

9. Connect TB334-4 to TB337-6 (New).

10. Connect TB322-5 to TB337-1 (New).

11. Connect TB334-5 to TB337-5 (New).

12. Connect TB333-3 to TB337-8 (New).

C. E830-1 or F830-1 changes: (5 or 10 kw FM Transmitters only)

1. Add the power change activate relay K411 and TB337 in the mounting holes to the left of TB410, TB405, and TB403.

2. Remove the connections between TB411-4 and TB410-4; and TB411-5 and TB410-5. (Wires will be re-used below)

3. Connect TB411-4 to TB337-2 (New).

4. Connect TB410-4 to TB337-6 (New).

5. Connect TB411-5 to TB337-1 (New).

6. Connect TB410-5 to TB337-5 (New).

7. Connect TB337-8 (New) to TB410-1.

8. Connect TB410-2 to TB403-8 (TB410-2 may be connected to 115 vac at some other point but it should be connected to 115 vac at TB403-8.

9. Connect TB410-1 to TB410-3. (These points may already be connected).

D. Cable Connections: (Modification only)

From	To
TB337-7	TB3-1
TB331-7	TB1-2
TB331-10	TB1-4
TB332-7	TB1-6
TB332-10	TB1-8
TB302-10	TB1-7

E. Principles of operation:

The FIL-ON and PLATE-ON switches apply 115 VAC to relays, which close contacts to activate the desired circuit. The PLATE-OFF switch energizes a relay which opens the plate control circuit. The filament-off relay in the transmitter is held in the energized position continuously by 115 VAC supplied from the remote panel. The filament circuit is opened and the transmitter turned off by removing the 115 VAC from the filament relay. In the event of an open or short circuit in the cable, the filament relay would become de-energized automatically shutting off the transmitter. The filament-off control circuit will "over-ride" a malfunction in any of the other remote circuits. Relay K311 (or K411) disconnects the power control motor from the cable circuits except when the power is being changed by moving switch S6 on the remote panel. Unused contacts are connected by the above modification so that relay K311 (or K411) is energized, allowing power to be applied to the motor control circuits.

F. Circuit operation check:

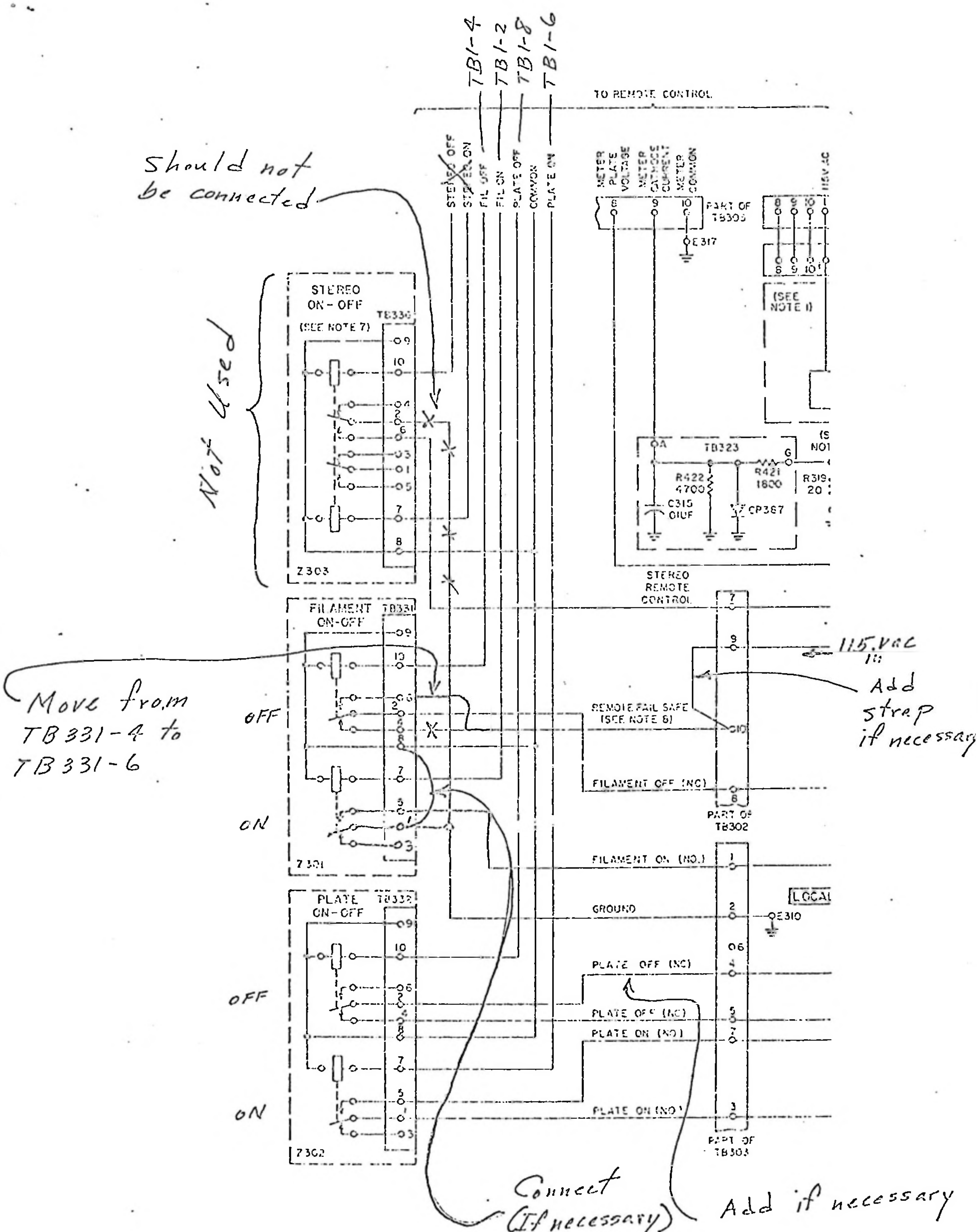
1. Operate the FIL-ON switch S1 on the remote panel. The transmitter filament circuits should turn on.

2. Operate the FIL-OFF switch S2. The filament circuits should turn off.

3. Operate the PLATE-ON switch S3. The plate and filament circuits should turn on.

4. Operate the PLATE-OFF switch S4. The plate circuits should be turned off.

5. Turn on the plate circuits again. Operate the power change switch S6. Relay K311 (or K411) should energize and the motor run in one direction or the other.



Modification 7 Mar 68
L E Kaiser

COLLINS RADIO COMPANY

Field Service Department *Cedar Rapids, Iowa*

COLLINS

SERVICE BULLETIN

EQUIPMENT SERIES: E830 BULLETIN NO. 1 DATE: 9-4-62

EQUIPMENT TYPE: E830-1 POWER AMPLIFIER

SYSTEM USE: 830E-1/1A 5-KW FM BROADCAST TRANSMITTERS

SUBJECT: IMPROVEMENT IN OPERATION AND RELIABILITY OF BEAD CHAIN DRIVES (PA TUNING MECHANISM) AND PA CAVITY AIR FLOW VANE

The modification in this bulletin is to improve the operation and reliability of the bead chain drives and to stabilize the air flow around the PA cavity air-flow interlock switch to improve its operation. The performance of the bead chain drive is improved by installing a new set of tested bead chain belts, improving the alignment of bead chain drive, and adding refinements to the chain driving mechanism. Operation of the air-flow interlock switch is improved by adding a bracket around the vane to reduce turbulence of air flow and stabilize vane operation.

These changes are recommended by the manufacturer to reduce the possibility of the chain drive failing and to improve the operation of the air interlock switch. These changes will be factory installed in E830-1 units with serial numbers above 15.

The estimated time required to perform this modification is 2 hours.

MODIFICATION PROCEDURE:

<u>Disassembly</u>

1. Remove lower front door by disconnecting the two retaining chains and lifting door up and out.

2. Disconnect fan plug on lower rear cover and remove the rear cover assembly by releasing two side latches and lifting cover up and out.

3. Locate two lead screws at the inside corner of the tuned cavity and remove the stop washers attached to the end of each lead screw. Discard washers.

4. Open cavity door at front of unit and remove the plate resonator center conductor, PA tube, and chimney.

5. Using the knobs, back out each capacitor plate until lead screws are clear of drive sprockets.

6. At rear of unit, locate and remove the sprocket channel which is bolted to the corner of the cavity with four screws.

7. Remove sprocket retainer from channel.

8. Give some slack to the bead chain and push out the two drive sprockets.

9. Remove knobs from front of cavity.

10. Back out the three flat head screws in the sprocket housing, and remove back plate from inside cavity wall.

11. Remove sprocket housing with sprockets and chains.

Reassembly

12. Reassemble sprocket channel with new bead chain belts (015-1888-00). Feed a loop of each belt through openings in one side of channel.

13. Thread the small sprockets through the loop into the sprocket bearings.

14. Center pads of the sprocket retainer over sprocket tapped holes and bolt in place.

15. Bolt the assembled sprocket channel to the cavity with the bead chains extending toward front of cabinet.

    NOTE: A misalignment problem may exist in this channel assembly. It may be corrected as follows:

    When replacing the channel, slip two 1/32-inch thick washers (310-0055-00) under the left flange at each screw point. This, in effect, rotates the channel in a counterclockwise direction looking down on the channel. Sighting through the sprocket at the rectangular holes in the capacitor shield will give a good indication as to correction of the misalignment.

16. With the channel properly attached and aligned, proceed by feeding the bead chains through the slot in the cavity flange to the knob positions.

17. From front of cabinet slip two new sprocket assemblies (549-2352-002) into the large holes in the cavity wall and slip on the respective bead chains.

18. Slip new sprocket housing (549-2353-003) onto sprocket shafts.

19. Temporarily attach knobs and start capacitor lead screws by rotating knobs forward while guiding screw until rectangular section is engaged in rectangular holes.

20. Screw capacitor plates in until approximately 1/8 inch of lead screw protrudes beyond sprocket bearing at rear of cavity.

21. Attach two hex posts (540-9053-003) to new knob backing plate (549-2180-003) and secure with screws (342-0045-00).

22. Without moving knobs from above position, turn outer stops on sprocket assembly inside cavity to extreme counterclockwise position.

23. Now turn knob so that long arms of the outer stop washers point toward each other. A further clockwise turn of 30 degrees (looking at the knobs) of the knobs gives exact positioning desired for attaching back plate.

24. Attach backing plate (549-2180-00) with three flat head screws through the sprocket housing and adjust the chain tensions by pulling out on the sprocket housing and back plate assembly until most of the slack is out of the bead chains. Tighten three screws to secure.

25. Loosen knobs and set the turn counting device for each knob to zero and retighten.

26. Attach new r-f shield (553-5690-003) to backing plate hex posts using two pan head screws (343-0286-00) with lock washers (310-0396-00).

27. Locate air flow switch (vane) at top of PA cavity air stack.

28. Center air baffle bracket (549-1992-003) around air vane and drill two 3/16-inch holes in cavity for mounting bracket. Mount bracket using two 6-32 machine screws (343-0169-00), two no. 6 lock washers (310-0071-00), and two 6-32 nuts (313-0002-00).

29. Check tuning mechanism to ensure that it works properly. Reinstall PA tube, chimney, and plate resonator center conductor in cavity.

30. Reassemble remainder of unit.

PARAMETERS REQUIRED: Price: $59.53

Modification kit 553-5769-00 which consists of the following items:

Qty	Description	Collins Part Number
1	Housing, sprocket-pressed	549-2353-003
1	Plate, backing-drive sprocket	549-2180-003
1	Shield, r-f	553-5690-003
2	Sprocket wheel, pinned assembly	549-2352-002
2	Belt, bead chain	015-1888-00
2	Post, hex	540-9053-003
2	Screw, machine, 4-40 x 5/16 flat head	342-0045-00
2	Screw, machine, 4-40 x 5/16 pan head	343-0286-00
2	Washer, lock no. 4	310-0396-00
2	Screw, machine 6-32 x 3/8	343-0169-00
2	Washer, lock no. 6	310-0071-00
2	Nut, 6-32 hex	313-0002-00
1	Bracket, air baffle	549-1992-003
4	Washer, no. 6 flat	310-0055-00

The above parts may be obtained from Collins Radio Company, Service Parts Department, Cedar Rapids, Iowa at no charge for six months after the date of this bulletin. All orders should specify modification kit 553-5769-00 and make reference to E830 Service Bulletin No. 1.

ENGINEERING ORDER

 E.O. NO. K-0019

See T-62337

PRODUCT LINE AFFECTED		CLASS I CHANGE	
Broadcast		☐ YES ☒ NO	
EQUIPMENT/SYSTEM AFFECTED		IF YES, REQUEST FOR CHANGE NO.	
830E-1A 522 2872 000			
NO. OF UNITS TO BE REWORKED	ENGINEER	EXT.	DATE
As required	Leo E Kuser	2232	11 Apr 67

Part Number Affected:

549 2273 000, Control Panel, Rev K

Reason for Change

Can no longer buy contactor. (K405, K406)

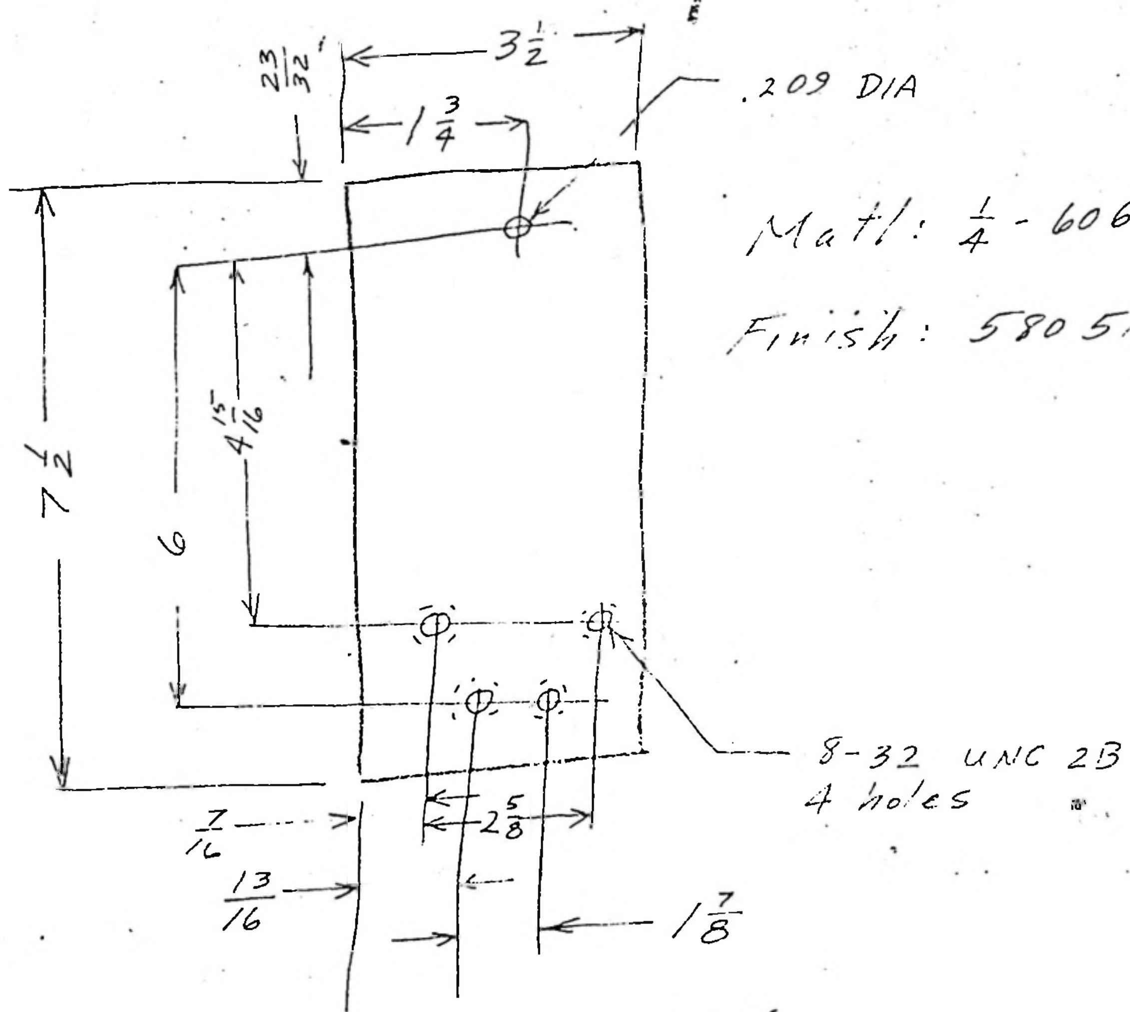
Effectivity:

Use all old contactors on hand.

List of Changes

1. Change 401 1170 000, Relay, K405, K406 (Qty 2) to 405 0674 030.

2. Rework existing units by using adapter plate when new contactor is used, (405 0674 030.)



Matl: 1/4 - 6061 T6 AL

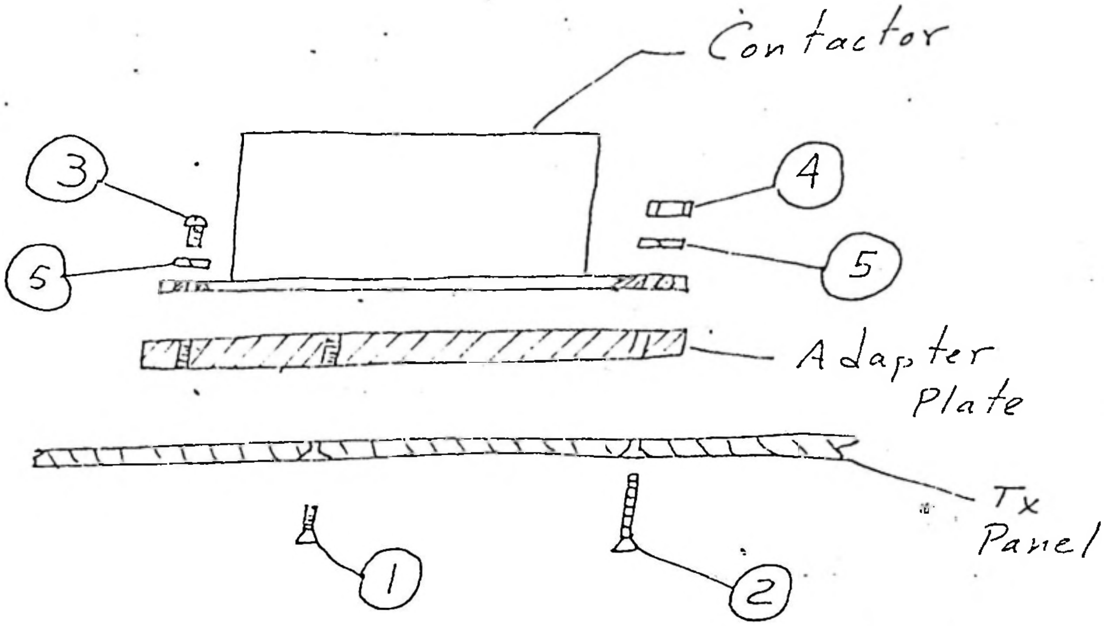
Finish: 580 5105 000

Adapter Plate

List of Materials:

Qty	Item	P/N	Discription
2	1	342 0182 000	Screw 8-32 x 1/4 PFH
1	2	342 0186 000	Screw 8-32 x 1/2 PFH
2	3	343 0185 000	Screw 8-32 x 1/4 PPH
1	4	313 0017 000	Nut 8-32
3	5	310 0072 000	Washer No 8 Lock

Assembly Details:



ENGINEERING ORDER

 E.O. NO. K-0029

PRODUCT LINE AFFECTED Broadcast	CLASS I CHANGE ☐ YES ☒ NO
EQUIPMENT/SYSTEM AFFECTED 830E-1A + 830F-1A 522 2872 000 522 3054 000	IF YES, REQUEST FOR CHANGE NO.

NO. OF UNITS TO BE REWORKED	ENGINEER	EXT.	DATE
35 (Sep - Dec)	Leo E Keiser	825-2232	25 Sep 67

Part Numbers Affected:

549 2273 00, Control Panel, Rev L
549 2269 005, Panel, Rev D

Reason for Change:

The metering resistor for the screen voltage is not close enough to the required value. Meters read out of tolerance.

Effectivity

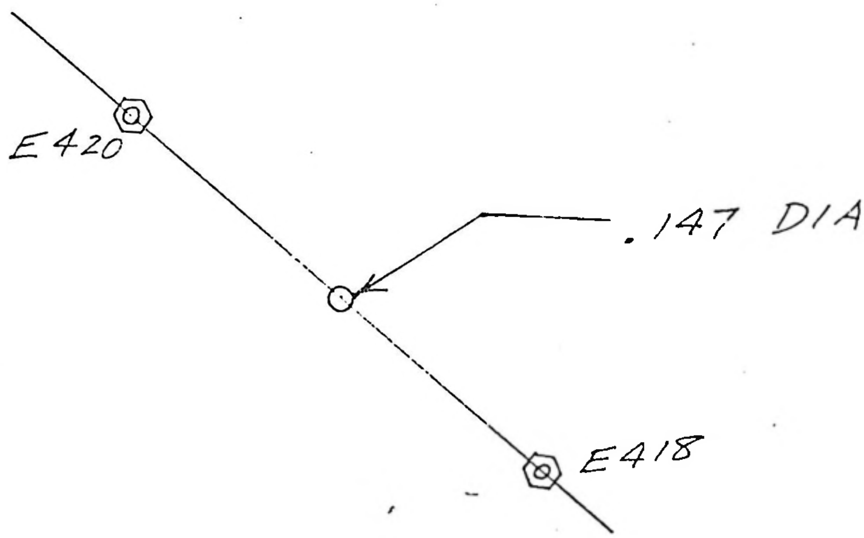
All units with meters reading out of tolerance.

List of Changes:

1. Add .147 dia hole mid way on a line between E420 and E418. Fig 1.
2. Install 306 0979 00 Terminal Qty 1, Using Screw 6-32 x 5/16, 343 0329 000, Qty 1, and Washer, No 6 Lock, Qty 1, 310 0077 000. Figs 1 + 2
3. Add Qty 2, Resistor, 402K, 1% 1 w, 705 3287 000, Mount in series between E420 and E418. Fig 2.

D-646 (11-63) IF MORE SPACE IS NEEDED, USE FORM NO. D-646A, ENGINEERING ORDER CONTINUATION SHEET.

Figure 1. Hole Location



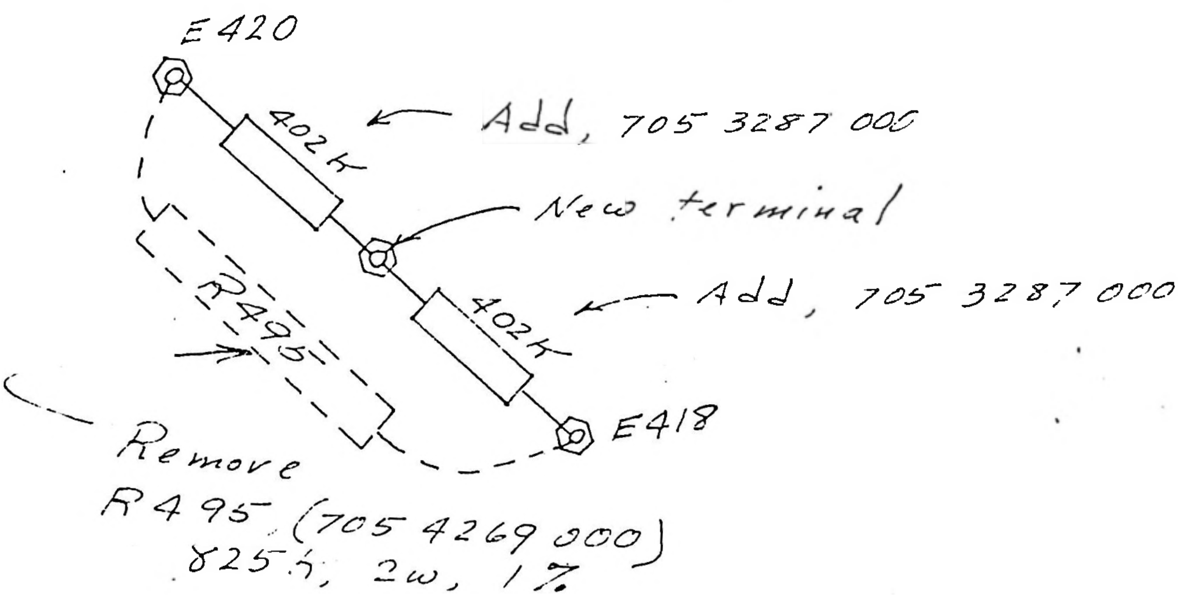


Figure 2. Parts Location

GC 9291 FOR TUNING FIL. CAP.

COLLINS

instruction book

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa

A. K. NOTT, COLLINS RADIO
DALLAS, TEX, MAIL STN 429-017

830F-1A
10-Kw FM Broadcast Transmitter

Guarantee

The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory, transportation prepaid, provided:

(a) Notice of the claimed defect is given Collins within one (1) year from date of delivery and goods are returned in accordance with Collins instructions.

(b) Equipment, accessories, tubes, and batteries not manufactured by Collins or from Collins designs are subject to only such adjustments as Collins may obtain from the supplier thereof.

(c) Failure of the equipment to operate in a normal and proper manner due to exposure to any environmental condition in excess of those published in the equipment specification shall not be deemed a defect within the meaning of this clause.

Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins or its authorized service center.

No other warranties, expressed or implied, shall be applicable to any equipment sold hereunder, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any other cause.

How to Return Material or Equipment

If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in the handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Product Support Division
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Type number, name and serial number of equipment
(B) Date of delivery of equipment
(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins number (and name) of unit subassemblies involved in trouble
(J) Remarks

How to Order Replacement Parts

When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

ADDRESS:

Collins Radio Company
Product Support Division
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Quantity required
(B) Collins part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
(D) Collins type number, name and serial number of principal equipment
(E) Unit subassembly number (where applicable)

15 March 1965

1 November 1967

SERVICE BULLETIN NO. 5

EQUIPMENT SERIES: 830

EQUIPMENT TYPE: 830B-1A through 830F-1A Broadcast Transmitters

SUBJECT: Installation of Striker Plate

This modification is recommended when a replacement door is installed.

1. MODIFICATION PROCEDURE

a. Locate and drill two 0.108-diameter holes (No. 36 drill) and tap for 6-32 screws in the cabinet as shown in figure 1.
b. Install magnetic striker plate on the cabinet as shown in figure 1. Use 6-32 X 1/4 PFH screw, 330-2295-000. Be sure the screw head is below the surface of the mounting plate.
c. Repeat steps a. and b. for the opposite side of the transmitter cabinet.

2. PARTS REQUIRED — Price: $2.04

Modification kit 962-9044-002 consists of the following parts:

QUANTITY	DESCRIPTION	COLLINS PART NUMBER
4	Screw, 6-32 X 1/4 PFH	330-2295-000
2	Plate, Striker	762-9041-002

The above parts may be secured from Service Parts Department, Collins Radio Company, Dallas, Texas 75207, at the indicated price. Orders should be for modification kit (762-9044-002), and the model of the transmitter should be included.

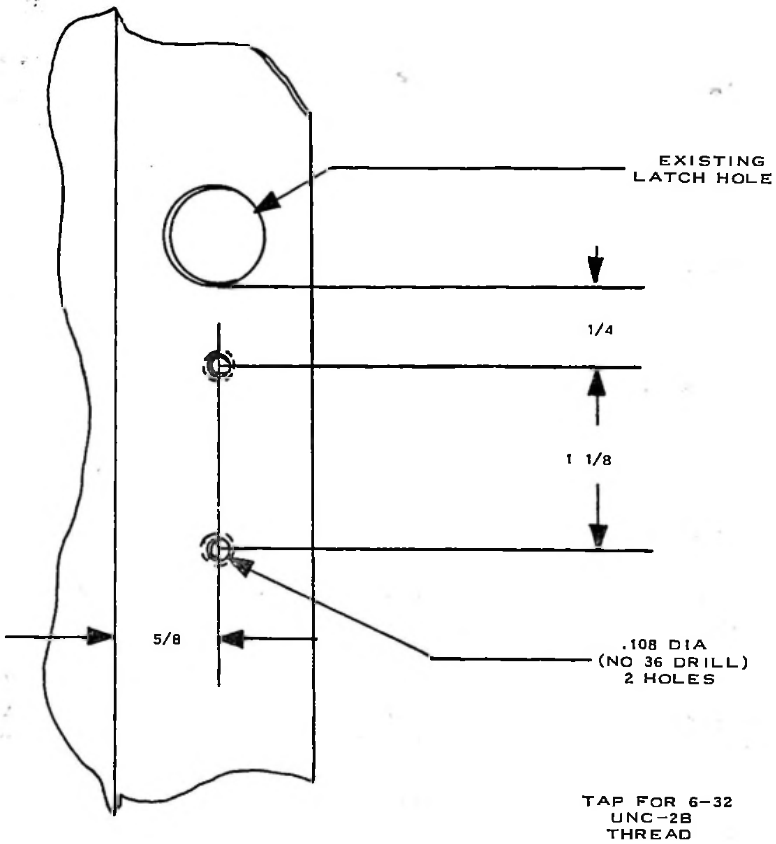


Figure 1. Installation of Striker Plate.

MEMORANDUM

COLLINS

TO: Gart Bowling LOCATION: 401-021

FROM: Harry Mims LOCATION: 401-021 483

DATE: January 31, 1967

SUBJECT: Modifications made in the A830-2

REFERENCE:

The following changes were made in the A830-2 Exciter to restore its frequency stability and improve operating conditions:

1. The bus wire lead from pin 1 of V427 to L429 was routed with excessive length. It now is routed from V427 pin 6 through the hole in terminal 3 of TB429 directly to terminal 1 of L429.

2. An additional ground terminal was added at GRD 432 to shorten lead length from V428-2 to ground and shorten lead length on bypass capacitor C439.

3. The 100K grid resistor (R441) in grid circuit of V428 was deleted. A 1K resistor (R441) and bypass capacitor (C492 - 4700 pf) was added to the meter end of R442 (10K) and ground,making R442 the grid resistor for V428.

4. V428 screen bypass capacitor (C443) and V428 cathode bypass capacitor (C441) leads were shortened to a maximum length of 1/8 inch.

5. R446 (100K) was deleted from grid circuit of V429 (5763). R446 (1K) and C493 (4700 pf) were added to the meter end of R447 and ground, making R447 the grid leak for V429.

6. V429 cathode resistor (R448) was changed from 270 ohms to 470 ohms. now back to 270

7. V429 cathode bypass capacitor (C447) was changed from 4700 pf to ~~470~~ pf. now to 1000 pf

8. V429 screen dropping resistor (R449) was changed from 10K ohms to 18K ohms. now to 27K

9. V429 screen bypass capacitor (C448) was changed from 4700 pf to ~~470 pf~~. It was found that the self-resonant frequency of 470 pf capacitor was approximately 94 MHz, making it more ideally suited for bypass use at these frequencies. now 1000 pf

10. C444 and C446 (4700 pf) were placed flat against the chassis and lead length reduced to 1/8 inch or less.

11. C 452 was changed from 33 pf to 39 pf and placed between L434-1 and GRD 434 according to the DO-FROM chart, CPN 549-1588-001.

12. C453 and C460 (4700 pf) were placed according to 549-1588-001.

13. C494 and C495 (4700 pf) were added to the metering leads from the grid and the cathode circuits of V430, (2E26) to keep any RF off these meter leads.

14. All six coils L429 through L434 had one turn removed and will now cover the tuning range with no additional capacitors.

15. The tube shields (4) were replaced with MS tube shields made by I.E.R.C. and already have good Collins part numbers

Harry Mims

HS;kht
cc: File
C. Dixon
S. Publicover

TD-536
523-0755303-101418
1 May 1962
1st Revision, 15 April 1964

COLLINS

unit instructions

STOLEN FROM
A.R. NOTT

A830-2
10W Wide-Band FM
Broadcast Exciter

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa
Printed in U.S.A.

TABLE OF CONTENTS

Section			Page
I	**GENERAL DESCRIPTION**		3
	1.1	General	3
	1.2	Purpose of Equipment	3
	1.3	Equipment Supplied	4
	1.4	Equipment Required but not Supplied	4
	1.5	Technical Summary	4
	1.6	Vacuum-Tube, Fuse, and Semiconductor Complement	5
II	**PRINCIPLES OF OPERATION**		8
	2.1	General	8
	2.2	Frequency Modulation Methods	8
	2.2.1	Phase Modulators	8
	2.2.2	Direct Frequency Modulation	9
	2.3	Block Diagram	9
	2.3.1	Modulator	9
	2.3.2	Automatic Frequency Control	9
	2.3.3	Power Amplifier	10
	2.3.4	Power Supply	10
III	**MAINTENANCE**		15
	3.1	General	15
	3.2	Test Equipment Required	15
	3.3	Alignment and Adjustment	15
	3.3.1	Preliminary Adjustments	15
	3.3.2	Modulator Limiter-Discriminator Alignment	15
	3.3.3	Modulator Output Amplifier Tuning	15
	3.3.4	AFC Buffer Tuning	15
	3.3.5	FM Oscillator Adjustment	16
	3.3.6	Modulation Discriminator	16
	3.3.7	Amplifier Bias Adjustment	16
	3.3.8	Modulator Gain Adjustment	16
	3.3.9	AFC Limiter-Discriminator Alignment	16
	3.3.10	Reference Level Adjustment	16
	3.3.11	Baseband Canceling Adjustment	16
	3.3.12	AFC Loop Check	17
	3.3.13	Power Amplifier Adjustment and Tuning	17
	3.4	Minimum Performance Standards	17
	3.4.1	Preliminary Adjustments	17
	3.4.2	Frequency Response	17
	3.4.3	Harmonic Distortion	17
	3.4.4	Residual FM Noise	17
	3.4.5	Carrier Frequency Shift	17
	3.4.6	AM Noise Measurement	17
IV	**PARTS LIST**		18
V	**ILLUSTRATIONS**		31

LIST OF ILLUSTRATIONS

Figure		Page
1-1	A830-2 10 W Wide-Band FM Broadcast Exciter, Over-all View (C859-15-P)	3
1-2	A830-2 10 W Wide-Band FM Broadcast Exciter, Rear View (C859-16-P)	7
2-1	Direct FM Modulation, Simplified Block Diagram (C859-14-3)	8
2-2	A830-2 10 W Wide-Band FM Broadcast Exciter, Block Diagram (C859-04-5)	11
2-3	Reference Switch, Simplified Schematic and Mechanical Analog Diagram (C859-12-3)	12
2-4	Baseband Cancel Switch, Simplified Schematic and Mechanical Analog Diagram (C859-11-3)	13
2-5	Synchronous Detector, Simplified Schematic and Mechanical Analog Diagram (C859-17-3)	14
3-1	Reference Level Adjustment, Oscilloscope Patterns (C859-18-2)	16
4-1	Modulator Compartment, Component (Except Resistors) Identification (C859-07-P)	24
4-2	Modulator Compartment, Resistor Identification (C859-08-P)	25
4-3	AFC Compartment, Component (Except Resistors) Identification (C859-09-P)	26
4-4	AFC Compartment, Resistor Identification (C859-10-P)	27
4-5	Power Amplifier Compartment, Component (Except Resistors) Identification (C859-05-P)	28
4-6	Power Amplifier Compartment, Resistor Identification (C859-06-P)	28
4-7	Power Supply, Component Identification (C859-03-P)	29
4-8	Chassis, Component Identification (C859-19-P)	30
5-1	A830-2 10 W Wide-Band FM Broadcast Exciter, Schematic Diagram (C859-01-6)	31

LIST OF TABLES

Table		Page
1-1	Vacuum-Tube, Fuse, and Semiconductor Complement	5
3-1	Test Equipment Required	15

SECTION I
GENERAL DESCRIPTION

1.1 GENERAL.

This instruction book contains information for operation and maintenance of A830-2 10 W Wide-Band FM Broadcast Exciter. See figure 1-1. The A830-2 is manufactured by Collins Radio Company, Cedar Rapids, Iowa.

1.2 PURPOSE OF EQUIPMENT.

The A830-2 10 W Wide-Band FM Broadcast Exciter is a direct FM exciter designed specifically to meet the stringent requirements of stereophonic FM broadcasting. The A830-2 may be used in monaural broadcasting, Storecasting (SCA), or with Collins 786M-1

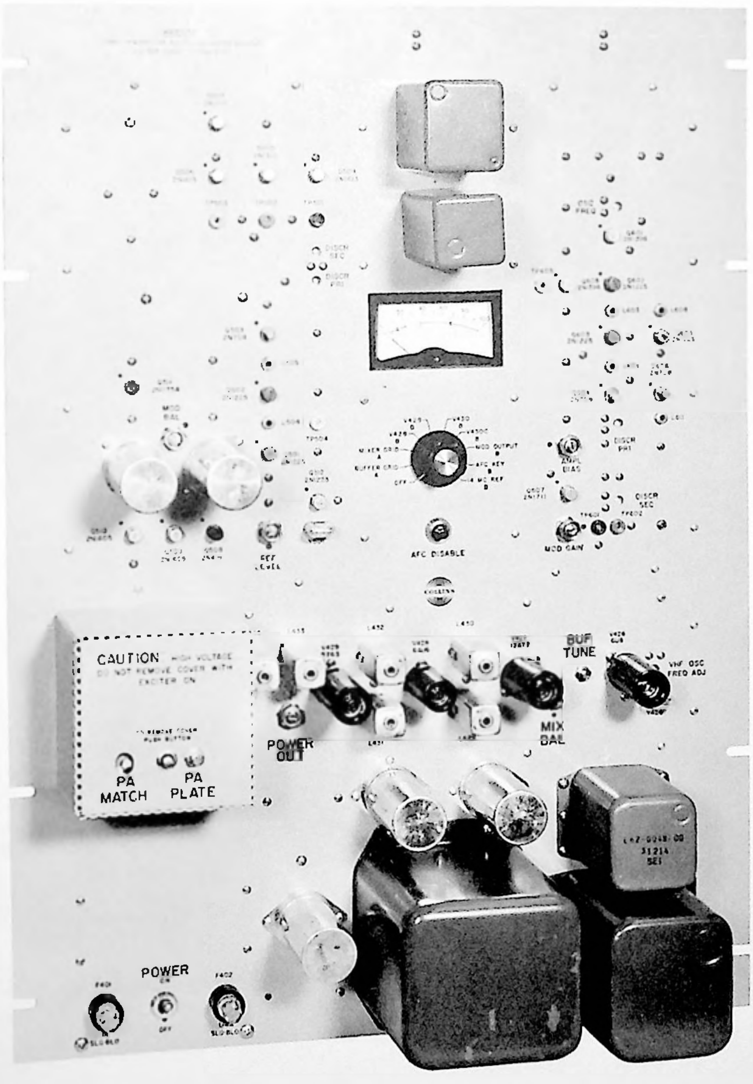


Figure 1-1. A830-2 10 W Wide-Band FM Broadcast Exciter, Over-all View

Stereo Generator (optional) for stereophonic broadcasting. The A830-2 is used to drive higher power amplifiers in the FM broadcast service.

1.3 EQUIPMENT SUPPLIED.

The A830-2 is normally supplied as a part of a Collins FM transmitter (830B-1A, 830D-1A, 830E-1A, etc.).

The A830-2 mounts in the same cabinet as the first stage of amplification (250 or 1000 watts) in the transmitter. A rear view of the A830-2 is shown in figure 1-2.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

The A830-2 is supplied with all required equipment.

1.5 TECHNICAL SUMMARY.

Ambient temperature range	+10°C(+50°F) to +55°C(+131°F).
Ambient humidity range	0 to 95 percent relative.
Altitude	7500 feet, maximum.
Shock and vibration	Normal handling and transportation.
Power source	117 volts ±5 percent, 50/60 cps, single phase.
R-f power output	Adjustable to 10 watts into a 50- to 70-ohm resistive load.
Frequency range	88 to 108 mc. Customer frequency is determined by one crystal in the heterodyning oscillator circuit.
Carrier frequency stability	Varies less than ±1000 cps with an ambient temperature range of +10°C(+50°F) to +55°C(+131°F), and a line-voltage range of ±5 percent.
Harmonic and spurious radiation	Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc, inclusive, is attenuated at least 30 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 240 kc up to and including 600 kc is attenuated at least 40 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 600 kc is attenuated at least 80 db below the level of the unmodulated carrier, with the exception of harmonics of the r-f carrier which complies with the requirements of the particular transmitter in which the A830-2 is installed.
Type of modulation	Frequency modulation. 100 percent modulation is defined as ±75-kc deviation of the main carrier.
Exciter inputs	Stereophonic channel: 600 ohms, unbalanced. Input of 0.1 volt (approximately) required for 100 percent modulation. Monophonic channel: 600 ohms, balanced. Input of 10 dbm ±2 db (approximately 2.45 volts) required for 100 percent modulation.

SCA channel: 600 ohms, balanced. Input of 0.35 volt (approximately) required for 10 percent modulation.

Frequency and phase response . . . . The frequency and phase response of the A830-2 is such that when used with a suitable stereophonic generator such as the 786M-1, stereophonic separation between left and right stereophonic channels shall be better than 35 db at audio modulating frequencies between 30 and 15,000 cps.

Distortion . . . . Does not exceed 0.5 percent in the 30- to 15,000-cps frequency range and 1.0 percent in the 15,000- to 75,000-cps frequency range.

Pre-emphasis . . . . Standard 75-microsecond pre-emphasis.

FM noise level . . . . 65 db below 100 percent modulation.

AM noise level . . . . 55 db below 100 percent AM level.

1.6 VACUUM-TUBE, FUSE, AND SEMICONDUCTOR COMPLEMENT.

Table 1-1 lists all of the vacuum tubes, fuses, and semiconductors used in the A830-2.

TABLE 1-1. VACUUM-TUBE, FUSE, AND SEMICONDUCTOR COMPLEMENT

SYMBOL	TYPE	FUNCTION
V426	6U8A	Oscillator and buffer
V427	12AT7	Balanced mixer
V428	6AU6	Limiter-amplifier
V429	5763	Driver
V430	2E26	Power amplifier
Q501	2N1225	First afc limiter
Q502	2N1225	Second afc limiter
Q503	2N708	Afc discriminator driver
Q504	2N1613	First error signal amplifier
Q505	2N1613	Second error signal amplifier
Q506	2N1613	Third error signal amplifier
Q507	2N1613	Fourth error signal amplifier
Q508	2N491	Keying generator
Q509	2N1605	Multivibrator
Q510	2N1605	Multivibrator
Q511	2N1175A	Baseband cancellation amplifier
Q601	2N1396	Frequency modulated oscillator
Q602	2N1225	First limiter
Q603	2N1225	Second limiter
Q604	2N708	Discriminator driver
Q605	2N1225	Afc buffer
Q606	2N708	Modulator output amplifier
Q607	2N1711	First baseband amplifier
Q608	2N1396	Second baseband amplifier
CR401	1N1492	B+ rectifier
CR402	1N1492	B+ rectifier
CR403	1N1492	B+ rectifier
CR404	1N1492	B+ rectifier
CR405	1N1492	B+ rectifier

TABLE 1-1. VACUUM-TUBE, FUSE, AND SEMICONDUCTOR COMPLEMENT (Cont)

SYMBOL	TYPE	FUNCTION
CR406	1N1492	B+ rectifier
CR407	1N1492	B+ rectifier
CR408	1N1492	B+ rectifier
CR409	1N538	+20-volt rectifier
CR410	1N538	+20-volt rectifier
CR411	10M10ZB1	+20-volt regulator
CR412	1Z10V01	+10-volt regulator
CR413	1N538	-10-volt rectifier
CR414	1N538	-10-volt rectifier
CR415	1Z10V01	-10-volt regulator
CR426	1N977A	Oscillator plate voltage regulator
CR501	1N270	Gate
CR502	1N270	Gate
CR503	1N270	Afc limiter
CR504	1N270	Afc limiter
CR505	1N270	Afc limiter
CR506	1N270	Afc limiter
CR507	1N198	Afc discriminator
CR508	1N198	Afc discriminator
CR509	FA-4000	Synchronous detector
CR510	FA-4000	Synchronous detector
CR511	FA-4000	Gate
CR512	1N198	Meter rectifier
CR513	1N198	Meter rectifier
CR514	1N718	Voltage regulator
CR601	1N626	Temperature compensation
CR602	SV3173	Voltage regulator
CR603	1N270	Limiter
CR604	1N270	Limiter
CR605	1N270	Limiter
CR606	1N270	Limiter
CR607	1N198	Modulation discriminator
CR608	1N198	Modulation discriminator
CR609	1N751A	Voltage regulator
CR610	1N198	Meter rectifier
F401	1 amp	Protect T401
F402	1/4 amp	Protect T402

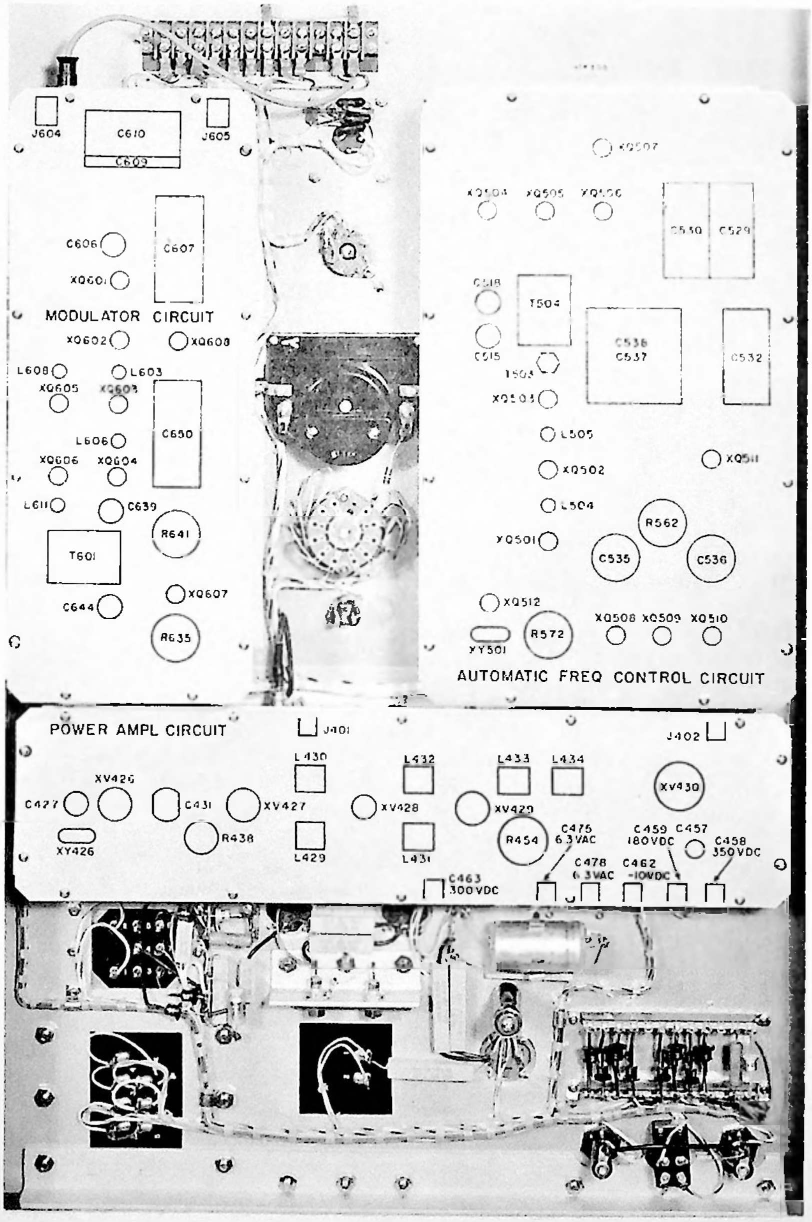


Figure 1-2. A830-2 10 W Wide-Band FM Broadcast Exciter, Rear View

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

This section describes the principles of operation of A830-2 10 W Wide-Band FM Broadcast Exciter. Figure 2-2 is a block diagram of the A830-2 and figure 5-1 is the schematic diagram of the A830-2. Refer to these figures for the following discussion.

2.2 FREQUENCY MODULATION METHODS.

There are two basic methods used to generate an FM signal, direct FM and phase modulation. There are variations of each of these two methods, but the end results are the same.

2.2.1 PHASE MODULATORS.

The phase modulation method consists of phase modulating a CW (continuous wave) signal with audio tones. The audio response is shaped to drop off 6 db per octave from the lowest to the highest frequency. The resultant signal is frequency modulated although produced by a phase modulator. The modulation index of an FM signal is defined as the ratio of the change in carrier frequency (deviation) to the modulating frequency, $\frac{\nabla f}{f_m}$. The modulation index of present phase modulators is so low that modulation is usually performed at a low frequency (approximately 100 kc) and then multiplied about 800 times to obtain the output frequency with the desired ±75-kc deviation. The outstanding advantage of this system is that the 100-kc oscillator may be crystal controlled and further frequency stabilization is not required. This system has been used widely in broadcast FM transmitters in the past.

The arrival of stereophonic FM broadcasting has caused problems in the phase modulator. A composite stereo plus SCA signal (referred to hereafter as the baseband audio signal) occupies a frequency band from 50 cps to 75 kc. The audio response shaping (6 db per octave) would require that 50-cps signals be 65.5 db above signals at 75 kc. When a signal-to-noise ratio of 65 db and a dynamic range of approximately 60 db is added to this, it is obvious that baseband amplifiers cannot be built to meet these requirements.

It is possible to split the phase modulation into two steps where one phase modulator accepts only the L + R (left and right audio signals) audio spectrum and a subsequent modulator adds the L - R double-sideband suppressed carrier signal. The audio bandwidth for each phase modulator is thereby reduced and the dynamic range of the baseband amplifiers is reduced to acceptable limits. The phase and amplitude relationships must be maintained between the two signals. These requirements are ±0.3-db gain variation and ±3-degree phase variation to meet the 30-db stereo separation requirement. These requirements would be difficult to obtain without frequent on-the-air adjustment to continually meet the stereo separation requirement.

There are other methods of splitting the signal and using more than one modulator, but all have the phase and gain stability problem.

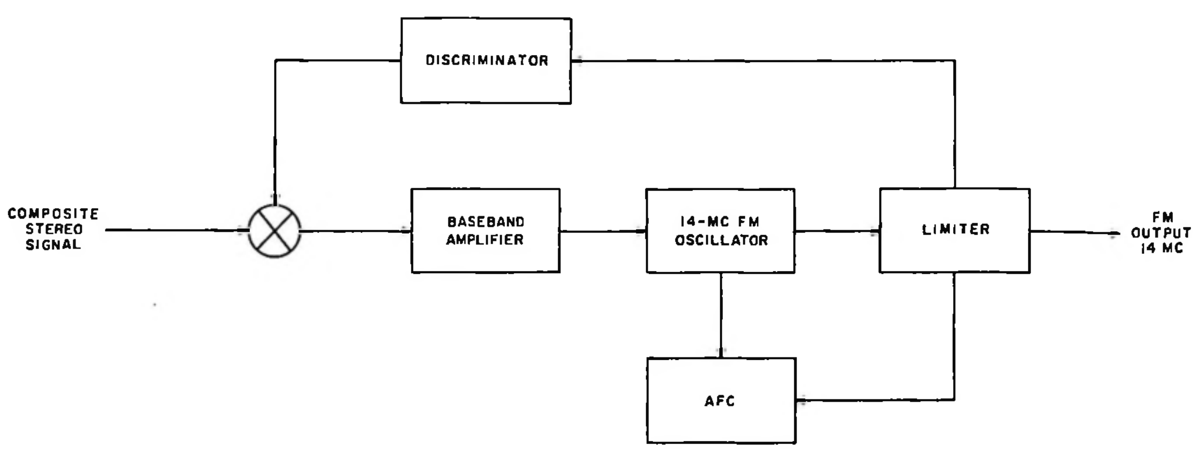


Figure 2-1. Direct FM Modulation, Simplified Block Diagram

2.2.2 DIRECT FREQUENCY MODULATION.

The direct method of generating a frequency modulated signal is shown in figure 2-1. The complete stereo signal (and SCA signal if used) is fed through a baseband amplifier to a frequency-modulated oscillator. The discriminator completes an audio feedback loop which suppresses FM oscillator distortion, incidental FM noise, transient carrier offset, and gain/phase variation in the baseband amplifier and modulator. The center frequency of the oscillator is not sufficiently stable so an automatic frequency control (afc) circuit is required to maintain frequency stability. The output of the modulator is a 14-mc FM signal with ±75-kc peak deviation. The output frequency is obtained by translating this signal with a stable vhf oscillator. The use of the direct FM system removes the requirement for double modulators, phase delay lines, and baseband amplifiers with a response which changes with frequency.

2.3 BLOCK DIAGRAM.

Refer to figure 2-2, a block diagram of the A830-2.

2.3.1 MODULATOR.

The A830-2 uses the direct FM method of generating an FM signal. The baseband input (and SCA input, if used) is connected to baseband amplifiers Q607 and Q608. The response of these amplifiers is flat.

The gain of the baseband amplifiers is adjustable with AMPL BIAS control R641. Refer to figure 5-1. The emitter voltage on Q608 is regulated to +15 volts by a silicon breakdown diode, CR609. The output of Q608 is coupled to frequency-modulated oscillator Q601. Q601 is an LC oscillator which has a center frequency of 14 mc. The tuned circuit in the base of Q601 contains a voltage-sensitive capacitor, C654. Refer to figure 5-1. The capacitance of C654 varies proportionately with the voltage across it. The change in capacity of C654 makes a corresponding change in the frequency of oscillations in Q601. Thus, the frequency deviation of the output of Q601 is directly proportional to the amplitude of the modulating signal and the peak deviation is ±75 kc.

The output of Q601 is coupled to two limiters, Q602 and Q603. The limiters remove any amplitude modulation from the FM signal. This amplitude modulation is caused by variation of the tuned circuit capacity by the baseband signal. The transistors do not do any limiting. The limiting takes place in the diodes connected to the collectors. This method provides symmetrical limiting (positive and negative) which avoids the phase modulation that occurs when unsymmetrical clipping followed by filtering is used. The limiters are set up so that as the input level is raised, the second limiter operates first; just before it becomes nonlinear, the first limiter starts limiting. The limiting range is approximately 31 db.

The output of the second limiter is coupled to discriminator driver Q604. One output of the discriminator driver is connected to modulator discriminator T601 and the other output goes to output amplifier Q606.

Modulator discriminator T601 converts the frequency-modulated 14-mc signal to an AM signal which is detected by diodes CR607 and CR608. The detected audio is mixed with the input baseband audio at the input to the baseband amplifiers. This feedback loop suppresses distortion from the FM oscillator, incidental FM noise, transient carrier offset, and gain/phase variation in the baseband amplifier and modulator.

Output amplifier Q606 provides a signal output of 1.0 volt rms for the balanced mixer in the power amplifier compartment. This output is matched to 50 ohms by an L-section impedance, L611 and C634. A low-pass filter, C632, C633, and L610, attenuates harmonics of the 14-mc signal. A portion of this output is rectified and connected to meter switch S101 for monitoring purposes.

The second output from Q606 is coupled to afc buffer amplifier Q605. This amplifier, as well as the limiters and amplifiers preceding it, reduces oscillator frequency change caused by variation of loading on the output. The output of Q605 is 0.1 volt rms across 50 ohms.

2.3.2 AUTOMATIC FREQUENCY CONTROL.

The A830-2 requires automatic frequency control to maintain the center frequency of the modulated oscillator at 14 mc. The error in frequency of this oscillator may be caused by temperature drift, carrier shift due to distortion in the modulator, etc. The afc circuits correct these errors to bring the stability of the output frequency to ±1000 cycles per second over a temperature range of +10°C(+50°F) to +55°C(+131°F) and a line voltage range of ±5 percent.

The afc correction voltage is obtained by comparing the modulator output signal with the output of a crystal-controlled reference oscillator, and deriving a d-c voltage which is proportional in magnitude and polarity to the magnitude and direction of the difference in frequency of these two signals.

The reference oscillator is a conventional crystal-controlled oscillator using a fundamental 14-mc series-resonant crystal. The temperature drift of this crystal contributes only ±70 cycles per second to the output frequency drift over temperature.

The signal from afc buffer Q605 and the output from the reference oscillator are connected to a diode switch, CR501 and CR502. The diode switch is simply two diodes which are alternately switched on and off by the 5-cps square wave. The diode switch is controlled by a signal from keying generator Q508. This signal, a square wave with a frequency of approximately 5 cps, alternately couples the reference signal, then the modulated carrier, to the input to first limiter Q501.

The two limiters, Q501 and Q502, and discriminator driver Q503 are identical to the limiters and driver (Q602, Q603, and Q604) used in the modulator. The limiters remove any amplitude difference which might exist between the two signals. The level of the reference signal is adjustable with REF LEVEL control R572. Q503 amplifies the limited signal to a level sufficient to drive the afc discriminator. Assume that there is no modulation applied. In this case, the output from the discriminator will be a 5-cps square wave with an amplitude proportional to the frequency error in the FM oscillator.

The 5-cps error signal is amplified and applied to the synchronous detector which develops the d-c correction voltage. This d-c voltage is coupled through a low-pass filter to the voltage-sensitive capacitor in the frequency-modulated oscillator to tune the FM oscillator back on frequency.

The operation of the afc circuitry is only slightly different when modulation is applied at ±75-kc deviation. Assume now that modulation is applied and an error of 100 cps exists in the FM oscillator. The output of the afc discriminator due to the 100-cps signal would be 100 K_d where K_d is the gain of the discriminator in volts per cps. The output of the discriminator due to the modulation on the carrier would be 150,000 K_d. This means that the undesired signal is 1500 times greater than the desired signal. The undesired signal is removed by the modulation canceling circuit consisting of baseband cancel amplifier Q511 and diode switch CR511. Whenever the modulated carrier is connected to the first limiter diode switch, CR501 and CR502, the baseband audio input is connected to the discriminator output by diode switch CR511. This baseband audio is 180 degrees out of phase with the discriminator output, and when MOD BAL control R652 is properly adjusted, the output of the afc discriminator due to modulation is completely canceled. The 5-cps error signal due to the frequency error in the FM oscillator is then amplified and detected as if modulation were not applied.

Note that the afc discriminator is used as a comparator rather than as a reference. The exact center frequency of the discriminator is not important since the output voltage need only be proportional to the difference in the two frequencies rather than to the absolute value of these frequencies. Therefore, the center frequency stability of the discriminator does not effect the operation of the afc system.

The last stage of the error signal amplifiers, Q507, is a phase splitter to provide a push-pull output to the synchronous detector. The synchronous detector is keyed by the 5-cps square-wave keying signal from the keying generator.

The synchronous detector recovers the information contained in the amplitude and phase of the 5-cps error signal. The circuit used in the A830-2 is actually two synchronous detectors operating from opposite half cycles of the 5-cps square-wave keying signal so that the 5-cps square-wave keying signal is balanced out in the output. This is analogous to a double-sideband balanced modulator in which neither input signal is present in the output.

Figures 2-3 through 2-5 illustrate the operation of the two diode switches and the synchronous detector. The electronic circuit and a mechanical analog for each of the circuits is shown. The resistances marked R_f represent the forward resistance of the diodes.

The output of the synchronous detector may be disabled for test and adjustment by depressing AFC DISABLE switch S102 on the front panel.

2.3.3 POWER AMPLIFIER.

The 14-mc FM signal from the modulator is coupled to a balanced mixer, V427. The other input to V427 is the amplified output of a vhf crystal oscillator, V426A. The crystal oscillator operates with a fifth-overtone series-resonant crystal in the 74- to 94-mc frequency range. The specific frequency of the crystal is 14 mc below the station's assigned output frequency. The exact frequency is adjustable over a small range by VHF OSC FREQ ADJ control C427. This adjustment is required to compensate for the finishing tolerance and aging in crystals Y426 and Y501. The output of V426A is amplified in V426B and coupled to V427. The two input signals are balanced out of the output of V427 and the sum of the two signals is the operating frequency. The MIX BAL control compensates for unbalance between the sections of V427.

The output of V427 is coupled to limiter amplifier V428. The limiter amplifier removes any amplitude modulation resulting from mixing and couples this signal to driver stage V429. The signal is amplified by V429 to a level sufficient to drive power amplifier stage V430. The power output is adjustable with POWER OUT control R454. The tuning and loading of the output stage is accomplished with C461 and C456.

2.3.4 POWER SUPPLY.

The power supply in the A830-2 provides all operating voltages for the A830-2 and 786M-1 Stereo Generator, if used. The primary power may be 115 or 230 volts, 60 cps. The power supply is of conventional design using a bridge rectifier and a voltage divider for the high voltages. The low voltages are obtained from full-wave rectifiers. Voltage breakdown diodes are used for regulating the +20-volt, +10-volt, and -10-volt outputs to ±5 percent.

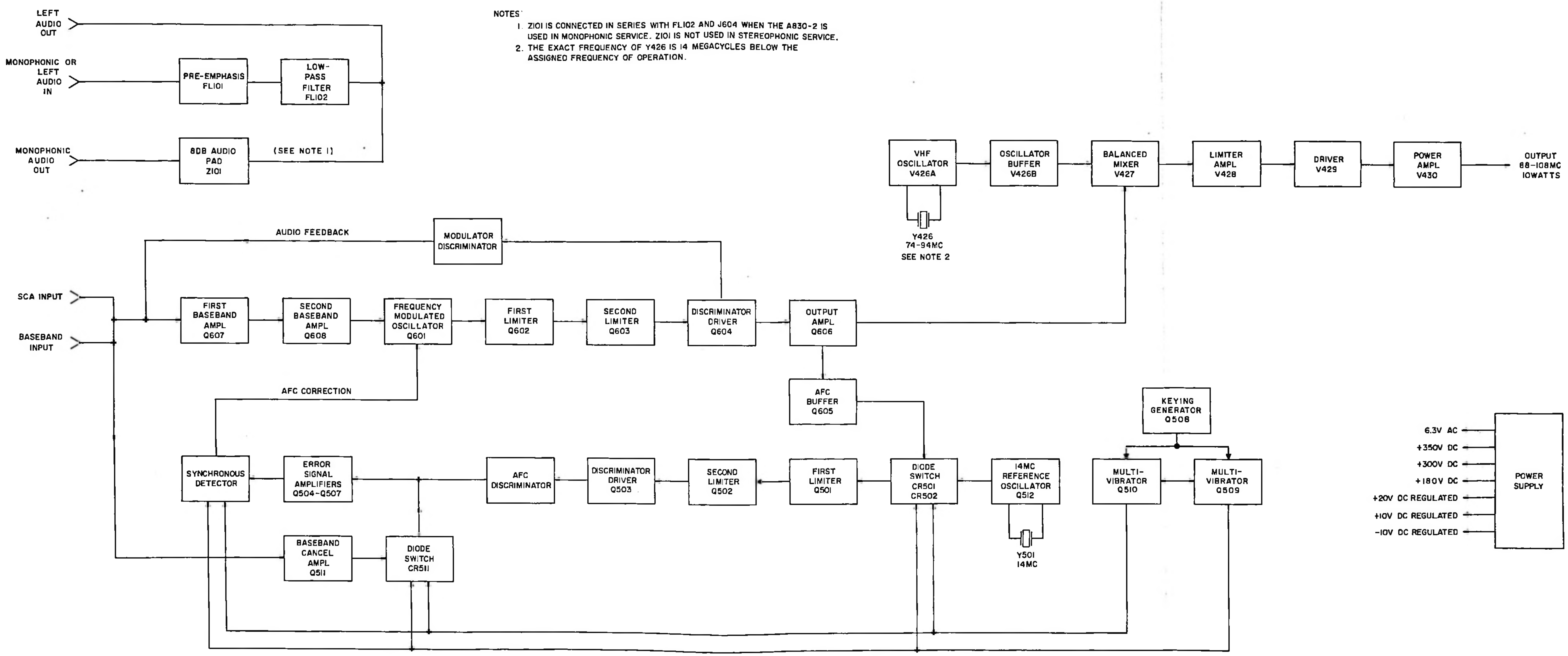


Figure 2-2. A830-2 10 W Wide-Band FM Broadcast Exciter, Block Diagram

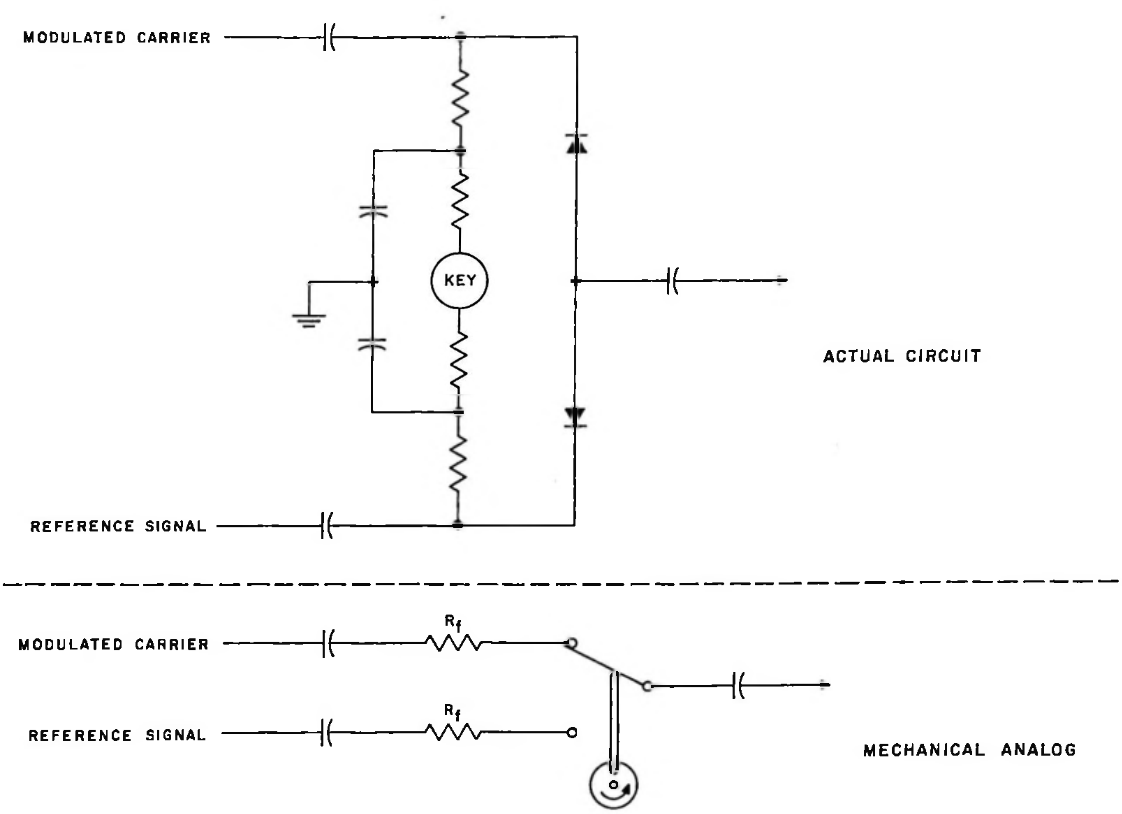


Figure 2-3. Reference Switch, Simplified Schematic and Mechanical Analog Diagram

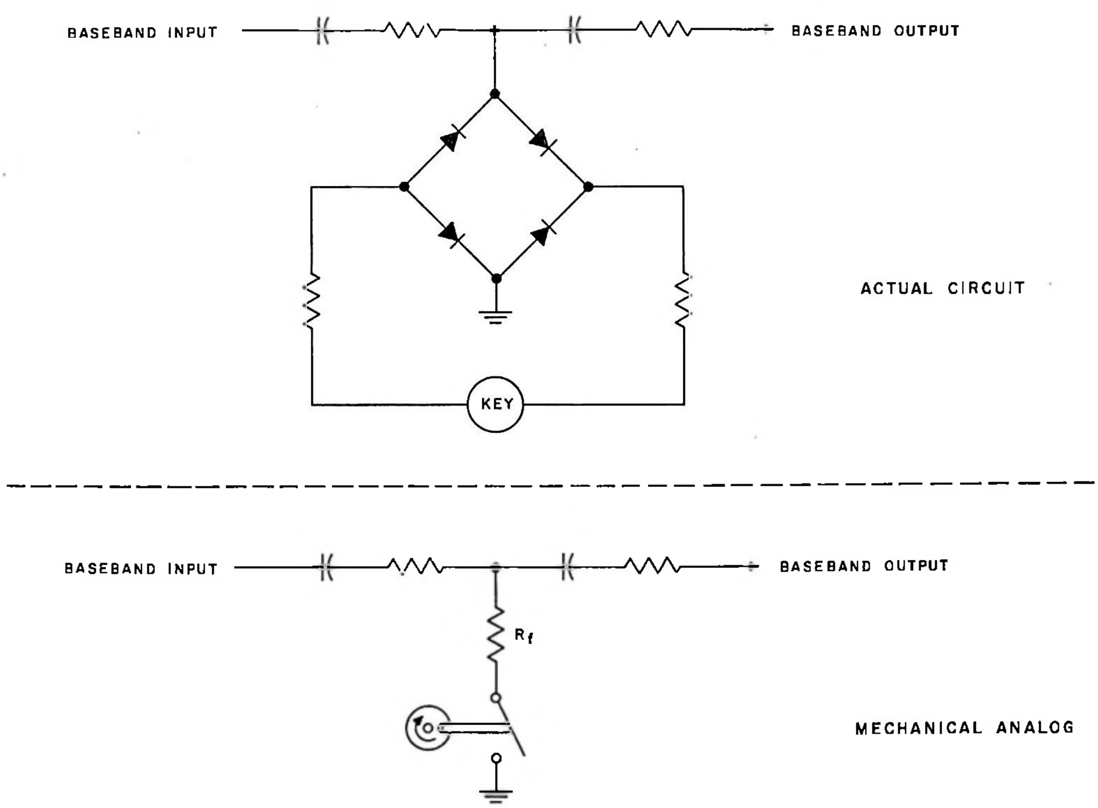


Figure 2-4. Baseband Cancel Switch, Simplified Schematic and Mechanical Analog Diagram

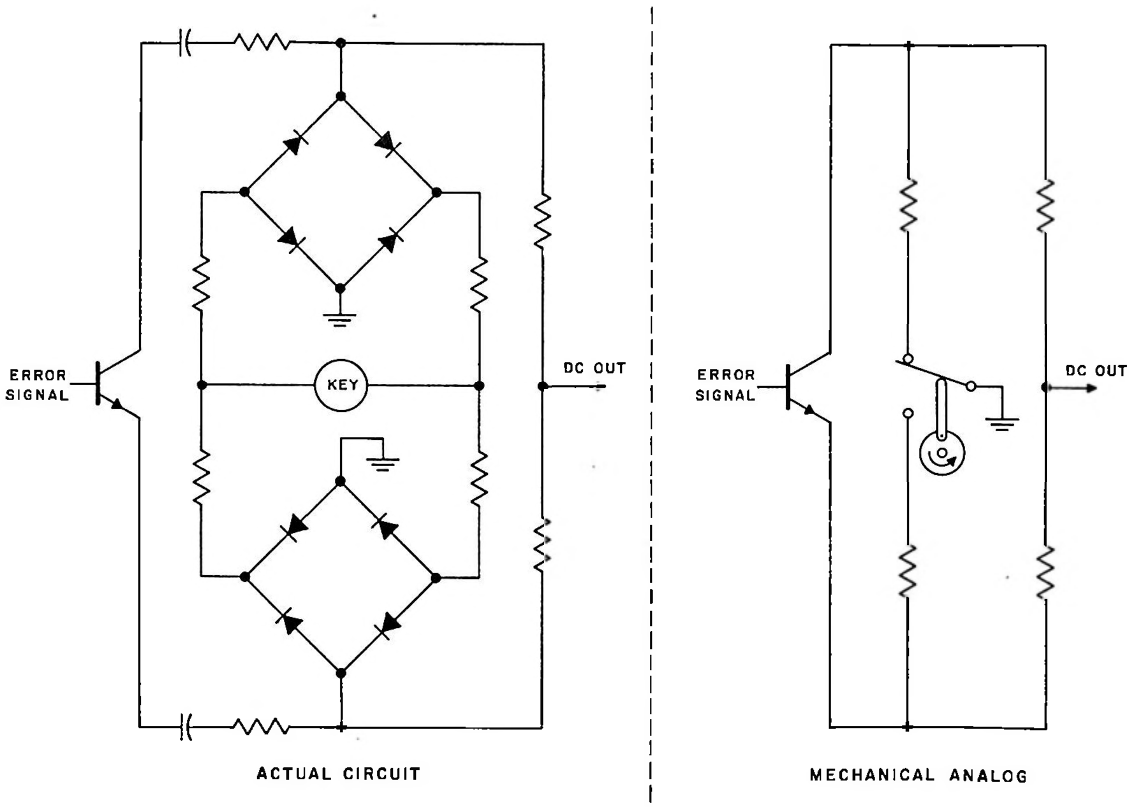


Figure 2-5. Synchronous Detector, Simplified Schematic and Mechanical Analog Diagram

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains alignment instructions, adjustment procedures, and minimum performance standards for the A830-2.

3.2 TEST EQUIPMENT REQUIRED.

The test equipment in table 3-1, or its equivalent, is required to perform the procedures given in this section.

TABLE 3-1
TEST EQUIPMENT REQUIRED

ITEM	MANUFACTURER'S DESIGNATION
Audio oscillator	Hewlett-Packard 200AB
Distortion and noise meter	Hewlett-Packard 330D
A-c vtvm	Hewlett-Packard 410B
R-f vtvm*	Bird 91C
Communications receiver	Capable of receiving 14 mc
10-db pad	Microlab AD-10N
Oscilloscope	
FM monitor	Hewlett-Packard 335B
50-ohm load	

*The 91C is not required if a Tektronix 541 oscilloscope is available. See paragraph 3.3.10.

3.3 ALIGNMENT AND ADJUSTMENT.

CAUTION

Do not make any adjustment in the modulator or automatic frequency control sections of the A830-2 unless trouble has definitely been traced to misadjustment.

3.3.1 PRELIMINARY ADJUSTMENTS.

Perform the following procedure prior to performing any of the alignment procedures.

a. Set the meter switch on the A830-2 to the OFF position.
b. Short AFC DISABLE switch S102 on the A830-2 with a clip lead.
c. Connect the 50-ohm load to RF OUTPUT jack J402.
d. Operate POWER switch S401 to the ON position. Allow 10 minutes for equipment warm up.

3.3.2 MODULATOR LIMITER-DISCRIMINATOR ALIGNMENT.

a. Remove Q601 from its socket.
b. Rotate REF LEVEL control R572 fully counterclockwise.
c. Connect a 0.01-uf capacitor and clip lead between the movable arm of REF LEVEL control R572 and the emitter pin on the socket for Q601. This supplies an accurate 14-mc signal for alignment of the A830-2.
d. Connect the HP-410B to TP602 and set it to the lowest d-c scale.
e. Rotate R572 clockwise until an indication is observed on the HP-410B.

NOTE

During this adjustment, maintain the 14-mc signal at a level below limiting. Limiting causes the tuning peaks to be very broad.

f. Adjust C639, L606, and L603 for maximum indication on the HP-410B.
g. Remove the 0.01-uf capacitor and clip lead from XQ601 and R572. Replace Q601 into XQ601.
h. Connect the 91C to TP504.

NOTE

Refer to note in paragraph 3.3.10.

i. Remove Q509 from its socket.
j. Adjust R572 for an indication of 30 millivolts.
k. Replace Q509.

3.3.3 MODULATOR OUTPUT AMPLIFIER TUNING.

a. Set the meter selector switch on the front panel of the A830-2 to the MOD OUTPUT B position.
b. Tune L611 for maximum indication on the front panel meter.

3.3.4 AFC BUFFER TUNING.

a. Connect the 91C (or Tektronix oscilloscope) to TP504.
b. Remove Q510 from its socket.
c. Tune L608 for maximum indication on the 91C (or oscilloscope).
d. Replace Q510 into its socket.

3.3.5 FM OSCILLATOR ADJUSTMENT.

a. Loosely couple the communications receiver to FM oscillator Q601 and to the 14-mc reference oscillator. If the receiver has a bfo, turn it off.
b. Adjust OSC FREQ control C606 for a zero beat on the communication receiver.
c. Remove the communications receiver.

3.3.6 MODULATION DISCRIMINATOR.

a. Connect the HP-410B to TP601.
b. Adjust DISCR SEC control C644 for a zero indication on the HP-410B.
c. Check adjustment of DISCR PRI control C639. It should be set for a maximum indication, and C644 set for a minimum indication.

3.3.7 AMPLIFIER BIAS ADJUSTMENT.

a. Connect the HP-410B to TP603.
b. Adjust R641 for an indication of +7.5 volts d-c.

3.3.8 MODULATOR GAIN ADJUSTMENT.

a. Remove the 50-ohms load and connect the HP-335B to the output of the A830-2 through the 10-db pad.
b. Connect the HP-200AB to baseband input jack J604.
c. Set the output level of the HP-200AB to 0.1 volt rms at 1000 cps.
d. Adjust MOD GAIN control R635 for an indication of 100 percent modulation (±75-kc deviation) on the HP-335B.

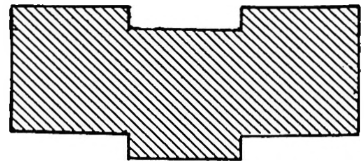
3.3.9 AFC LIMITER-DISCRIMINATOR ALIGNMENT.

a. Connect the HP-410B to TP501 and set to 10-volt scale.
b. Remove Q509 from its socket.
c. Adjust REF LEVEL control R572 fully counterclockwise.
d. Adjust L504, L505, and C515 (DISCR PRI control) for maximum indication on the HP-410B.
e. Connect the 91C to TP504.
f. Adjust R572 for an indication of 30 millivolts on the 91C.
g. Connect the HP-410B to TP502 and adjust DISCR SEC control C518 for a minimum indication on the HP-410B when set to its lowest range.
h. Replace Q509 in its socket.
i. Reset R572 as specified in paragraph 3.3.10.

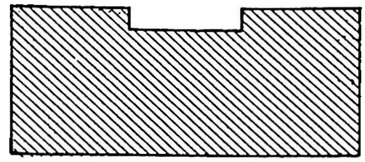
3.3.10 REFERENCE LEVEL ADJUSTMENT.

NOTE

The following procedure may be accomplished with the 91C or with a Tektronix 541 oscilloscope. Steps a through f describe the procedure for using the 91C and steps g and h describe the procedure for using the 541 oscilloscope.



IMPROPER ADJUSTMENT



PROPER ADJUSTMENT

Figure 3-1. Reference Level Adjustment, Oscilloscope Patterns

a. Connect the 91C to TP504.
b. Remove Q510 from its socket.
c. Tune L608 for maximum indication on the 91C. Record the reading on the 91C.
d. Replace Q510 and remove Q509 from its socket.
e. Adjust R572 for the same indication recorded in step c.
f. Replace Q509 in its socket.
g. Connect the Tektronix oscilloscope to TP504.
h. Adjust R572 for alignment of base lines of alternate signals. See figure 3-1.
i. Set meter switch S101 on the A830-2 front panel to the 14 MC REF B position. The meter should indicate in the B range.

3.3.11 BASEBAND CANCELING ADJUSTMENT.

a. Remove Q510 from its socket.
b. Make certain that AFC DISABLE switch S102 is still jumpered.
c. Rotate R562 to its maximum counterclockwise position.
d. Connect the oscilloscope to TP503.
e. Connect the HP-200AB to baseband input jack J604.
f. Set the HP-200AB to 50 cps.
g. Set the level of the HP-200AB to produce a 2-volt peak-to-peak waveform on the oscilloscope.
h. Adjust the oscilloscope to display the 50-cps waveform.
i. Slowly adjust R562 to cancel the signal on the oscilloscope. Gradually increase the input signal from the HP-200AB to 0.1 volt while maintaining the null by adjustment of R562. The waveform on the oscilloscope should be less than 1 volt peak-to-peak when the input signal is 0.1 volt.
j. Replace Q510.

3.3.12 AFC LOOP CHECK.

a. Remove the jumper from across AFC DISABLE SWITCH S102.
b. Observe the deviation meter on the HP-335B and depress the AFC DISABLE switch. The frequency should slowly drift off and come back quickly when the AFC DISABLE switch is released.

3.3.13 POWER AMPLIFIER ADJUSTMENT AND TUNING.

a. Set meter switch S101 on the A830-2 to the MIXER GRID A position.
b. Adjust C431 for maximum indication on front panel meter M101.
c. Adjust VHF OSC FREQ ADJ control C427 so that the HP-335B indicates on frequency.
d. Switch S101 to BUFFER GRID A and observe meter. It should indicate approximately 1 unit.
e. Switch S101 to V428 B.
f. Adjust L429, L430, and MIX BAL control R438 for maximum indication on the front panel meter.
g. Switch S101 to V429 B.
h. Adjust L431 and L432 for maximum indication on the front panel meter.
i. Remove all connections to J402 and connect the 50-ohm load to J402.
j. Connect the HP-410B across the 50-ohm load.
k. Switch S101 to V430C B.
l. Adjust PA PLATE control C461 for minimum indication on the front panel.
m. Adjust PA MATCH control C456 for a maximum indication on the HP-410B.
n. Adjust POWER OUT control R454 for an indication of 22.5 volts.

3.4 MINIMUM PERFORMANCE STANDARDS.

The A830-2 should be tested in accordance with the following procedures after alignment and adjustment. The following tests may be used to determine if the A830-2 is operating properly.

3.4.1 PRELIMINARY ADJUSTMENTS.

a. Connect the HP-200AB to J604 on the A830-2.
b. Connect the HP-335B through the 10-db pad to J402.
c. Connect the HP-330D to the modulation output of the HP-335B.

3.4.2 FREQUENCY RESPONSE.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-200AB for an output of 0.100 volt on a frequency of 400 cps.
c. Adjust the HP-330D for an indication of 0 db.
d. Set the HP-200AB to 50 cps and reset output level to 0.100 volt. The HP-330D indication should be 0 ±0.3 db.
e. Repeat step d for a frequency setting of 15,000 cps.

3.4.3 HARMONIC DISTORTION.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-200B frequency to 50 cps and the output level to 0.01 volt. Measure the harmonic distortion on the HP-330D. It should be 1.0 percent or less.
c. Repeat step b for frequencies of 400 and 15,000 cps.

3.4.4 RESIDUAL FM NOISE.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-200AB to 400 cps at an output level of 0.100 volt.
c. Measure the level across terminals 1 and 2 of the HP-335B with the HP-330D. Record the reading.
d. Turn off the HP-200AB and record the indication on the HP-330D. Record this reading.
e. Compute the s+n/n ratio using the readings recorded in steps c and d. The ratio should not be less than 60 db.

3.4.5 CARRIER FREQUENCY SHIFT.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Remove the audio input from J604.
c. Connect the output of the HP-200AB to terminals 3 and 4 of TB101.
d. Adjust the output of the HP-200AB to a frequency of 1000 cps and to a level sufficient to modulate the carrier 100 percent.
e. Remove the audio connections from terminals 3 and 4.
f. Adjust the HP-335B to indicate 0 frequency deviation.
g. Touch the audio connections from the HP-200AB to terminals 3 and 4 of TB101 and note the carrier deviation on the HP-335B. It should be less than 500 cps.

3.4.6 AM NOISE MEASUREMENT.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-335B function switch to CARRIER LEVEL and read the carrier output voltage on the modulation meter. An indication of 100 percent modulation equals 10 volts, 90 percent modulation equals 9 volts, etc.
c. Connect the 91C to J3 on the HP-335B and measure the noise output. Compute the carrier-to-AM noise ratio using the following formula:

$$\frac{\text{Carrier}}{\text{AM Noise}} = 20 \log_{10} \frac{\text{Carrier Voltage}}{\text{AM Noise Voltage}}$$

The ratio should not be less than 50 db.

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	A830-2 10 W WIDE-BAND FM BROADCAST EXCITER	~~349-1000-00~~ 522-2714-000
	PANEL	
FL101	ATTENUATOR, FIXED: pre-emphasis network for use in FM commercial broadcast equipment; 600 ohms balanced, w/ center tap; ±1 to ±1.5 db frequency response	379-0426-00
FL102	FILTER, HIGH PASS: metal encased, hermetically sealed, input 600 ohms, output 600 ohms, 4 solder type terminals, continuous duty cycle; A. D. C. part no. D10390	673-0869-00
M101	METER, ARBITRARY SCALE: permanent magnet moving coil d-c microammeter, 500 ua, 100 ohms resistance, 2 scales, A scale, 10-90 ua, B scale, 175-500 ua; Assembly Products, Inc. part no. 361	458-0650-00
R101	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R102	RESISTOR, FIXED, FILM: 562 ohms ±1%, 1/4 w	705-7084-00
R103	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7066-00
R104	RESISTOR, FIXED, FILM: same as R103	705-7068-00
S101	SWITCH, ROTARY: 2 circuit, 2 pole, 10 position, 2 section, 2 moving, 22 fixed contacts	259-1567-00
S102	SWITCH, PUSH: spst; momentary; 125 v a-c, 0.75 amp, 250 v a-c, 0.25 amp; Cutler-Hammer part no. 8411-K6	266-6160-00
TB101	TERMINAL BOARD: barrier type w/ double row front connection of 12 screw terminals; 13/32 in. by 7/8 in. by 5-11/64 in.; Howard B. Jones, Div. Cinch Mfg. Co. part no. 12-140-D	367-0518-00
TB102	TERMINAL BOARD: Bakelite, 4 terminals, 1 grounded, 3 insulated; 21/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1534-A	306-2240-00
XFL101	SOCKET, ELECTRON TUBE: 8 prong octal tube socket w/ steel mtg plate, Amphenol-Borg Electronics part no. 88-8TM	220-1005-00
	POWER AMPLIFIER AND POWER SUPPLY	
C401	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 500 vdcw	913-1186-00
C402 thru C408	CAPACITOR, FIXED, CERAMIC: same as C401	913-1186-00
C409 A & B	CAPACITOR, FIXED, ELECTROLYTIC: dual section, 40 uf ea section; -10% +50%, 450 vdcw; Sprague Electric part no. Y27674	183-1259-00
C410	CAPACITOR, FIXED, ELECTROLYTIC: 1000 uf -10% +100%, 50 vdcw	183-1403-00
C411	CAPACITOR, FIXED, ELECTROLYTIC: same as C410	183-1403-00
C412	CAPACITOR, FIXED, ELECTROLYTIC: 500 uf -10% +100%, 50 vdcw	183-1575-00
C413	CAPACITOR, FIXED, ELECTROLYTIC: 4 uf -10% +100%, 50 vdcw	183-1389-00
C414 thru C425	NOT USED	
C426	CAPACITOR, FIXED, MICA: 5 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C050J01	912-2750-00
C427	CAPACITOR, VARIABLE, CERAMIC: 3.0 uuf min to 12.0 uuf max, 350 vdcw	917-1072-00
C428	CAPACITOR, FIXED, MICA: 470 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F471J01	912-2864-00
C429	CAPACITOR, FIXED, CERAMIC: 1.5 uuf ±5%, 500 vdcw; Stackpole Carbon Co. part no. GA-1.5uufPORM5	913-2981-00
C430	CAPACITOR, FIXED, CERAMIC: 4700 uuf ±20%, 500 vdcw	913-1187-00
C431	CAPACITOR, VARIABLE, AIR: 3.0-9.8 uuf, 1250 vdcw; E. F. Johnson part no. 160-211	922-0046-00
C432	CAPACITOR, FIXED, CERAMIC: 7.5 uuf ±5%, 500 vdcw; Stackpole Carbon Co. part no. GA-7.5uufPORM5	913-2997-00
C433	CAPACITOR, FIXED, MICA: same as C426	912-2774-00
C434	CAPACITOR, FIXED, MICA: same as C426	912-2774-00
C435	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C436	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C100J01	912-2753-00
C437	CAPACITOR, FIXED, MICA: same as C436	912-2753-00
C438	CAPACITOR, FIXED, CERAMIC: same as C429	913-2981-00
C439 thru C444	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C445	CAPACITOR, FIXED, CERAMIC: same as C429	913-2981-00
C446 thru C449	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C450	CAPACITOR, FIXED, CERAMIC: 1000 uuf -20% +80%, 500 vdcw; Erie Resistor part no. 327-029X5T0102Z	913-1292-00
C451	CAPACITOR, FIXED, CERAMIC: same as C429	913-2981-00
C452	CAPACITOR, FIXED, MICA: 33 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E330J01	912-2780-00
C453	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C454	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C455	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C456	CAPACITOR, VARIABLE, CERAMIC: 4.5 uuf min to 25 uuf max, 500 vdcw	917-1026-00
C457	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C458	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C459	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C460	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C461	CAPACITOR, VARIABLE, AIR: 3.0 uuf min to 18.7 uuf max; 1250 v a-c; E. F. Johnson Co. part no. 160-110-3	922-0033-00
C462	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C463	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C464	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C465 thru C468	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C469	NOT USED	
C470	NOT USED	
C471 thru C474	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C475 thru C480	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C481	CAPACITOR, FIXED, CERAMIC: 1.0 uuf ±5%, 500 vdcw; Stackpole Carbon Co. part no. GA-1.0uufPORM5	913-2977-00
C482	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C483	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C484	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C485	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C486	CAPACITOR, FIXED, MICA: same as C426	912-2750-00
C487	CAPACITOR, FIXED, MICA: same as C426	912-2750-00
C488	CAPACITOR, FIXED, MICA: same as C426	912-2750-00
C489	CAPACITOR, FIXED, MICA: 150 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F151J01	912-2828-00
C490	CAPACITOR, FIXED, MICA: same as C489	912-2828-00
C491	CAPACITOR, FIXED, MICA: 20 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C200J01	912-2765-00
CR401	SEMICONDUCTOR DEVICE, DIODE: silicon; Motorola part no. 1N1492	353-1661-00
CR402 thru CR408	SEMICONDUCTOR DEVICE, DIODE: same as CR401	353-1661-00
CR409	SEMICONDUCTOR DEVICE, DIODE: silicon, single phase, half-wave; General Electric part no. 1N538	353-1526-00
CR410	SEMICONDUCTOR DEVICE, DIODE: same as CR409	353-1526-00
CR411 A & B	SEMICONDUCTOR DEVICE, SET: two hermetically sealed silicon voltage reference diodes; Motorola part no. 10M10ZB1	353-1238-00
CR412	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; International Rect. Corp part no. 1Z10V01	353-1208-00

THIS REPLACES 278-0730-00 COIL
278-1829-000

L433 ONLY IS
278-0326-010
#12 WIRE SILVER PL.

ITEM	DESCRIPTION	COLLINS PART NUMBER
CR413	SEMICONDUCTOR DEVICE, DIODE: same as CR409	353-1526-00
CR414	SEMICONDUCTOR DEVICE, DIODE: same as CR409	353-1526-00
CR415	SEMICONDUCTOR DEVICE, DIODE: same as CR412	353-1208-00
CR416 thru CR425	NOT USED	
CR426	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed, diffused-junction type; Motorola part no. 1N977A	353-3237-00
F401	FUSE, CARTRIDGE: 1.00 amp current rating, 250 v, glass body, ferrule terminals; Bussmann part no. MDL 1	264-4280-00
F402	FUSE, CARTRIDGE: 0.250 amp current rating, 250 v d-c, glass body, ferrule terminals	264-4240-00
J401	JACK, TELEPHONE: steel, miniature, panel mtg; Switchcraft, Inc. part no. 3501FP	360-0148-00
J402	CONNECTOR, RECEPTACLE, ELECTRICAL: single round female contact, right angle shape; Amphenol part no. 31-213	357-9258-00
L401	REACTOR: 7.2 henrys min, 0.300 amp d-c; 60 ohms; 4-37/64 in. by 5-5/16 in. overall; Stancor Elec. Inc. part no. RS-8300	668-0015-00
L402 thru L425	NOT USED	
L426	COIL, RADIO FREQUENCY: 0.68 uh ±3%, 250 mc, 0.12 ohm, 1750 ma; 3/16 in. dia by 7/16 in. lg; Delevon part no. 1840	240-1844-00
L427	COIL, RADIO FREQUENCY: 0.25 uh ±3%, 400 mc, 0.04 ohm, 2850 ma; 3/16 in. dia by 7/16 in. lg	240-1843-00
L428	COIL, RADIO FREQUENCY, NO. 1: single layer wound #14 wire, 1/2 in. ID of coil, 7/8 in. lg overall	549-1605-003
L429	COIL, RADIO FREQUENCY: variable; 88 to 108 mc, -15°C to +55°C temp range; 850 v d-c dielectric strength	278-0730-00
L430 thru L434	COIL, RADIO FREQUENCY: same as L429	278-0730-00
L435	COIL, RADIO FREQUENCY, NO. 2: single layer wound #16 wire; 3/4 in. ID of coil, 2-7/8 in. lg overall	549-1606-003
L436	COIL, RADIO FREQUENCY: single layer wound; 5.6 uh, 860 ma current, 0.95 ohm; Jeffers Electronics Div. of Speer Carbon Co. part no. 10402-34	240-0179-00
L437	COIL, RADIO FREQUENCY: same as L436	240-0179-00
L438	COIL, RADIO FREQUENCY: single layer wound, 0.47 uh nom inductance, 0.09 ohm max dc resistance, 1600 ma max current rating, Jeffers Electronics, Div. of Speer Carbon Co. part no. 10100-126	240-0060-00
L439	COIL, RADIO FREQUENCY, NO. 3: single layer wound #14 wire, 3/4 in. ID of coil, 1-3/8 in. h; approx 1-11/16 in. lg overall	549-1607-003
L440	COIL, RADIO FREQUENCY: 1.00 uh ±10%, 0.30 ohm d-c resistance; 850 ma d-c; Jeffers Electronics part no. 10100-128	240-0062-00
L441	COIL, RADIO FREQUENCY, NO. 4: single layer wound #18 wire, 3/16 in. ID of coil, 5/16 in. lg	553-5671-002
R401	RESISTOR, FIXED, WIREWOUND: 100 ohms ±10%, 10 w	710-9053-00
R402	RESISTOR, FIXED, WIREWOUND: 16,000 ohms ±5%, 25 w	710-0369-00
R403	NOT USED	
R404	RESISTOR, FIXED, WIREWOUND: 600 ohms ±10%, 10 w	710-9081-00
R405	RESISTOR, FIXED, WIREWOUND: 12,000 ohms ±10%, 10 w	710-9070-00
R406	RESISTOR, FIXED, WIREWOUND: 25,000 ohms ±10%, 10 w	710-9068-00
R407	RESISTOR, FIXED, WIREWOUND: 5.0 ohms ±10%, 5 w	710-9105-00
R408	RESISTOR, FIXED, WIREWOUND: 25 ohms ±10%, 7 w	710-9019-00
R409	RESISTOR, FIXED, WIREWOUND: same as R408	710-9019-00
R410	RESISTOR, FIXED, COMPOSITION: 160.0 ohms ±5%, 5 w	747-5444-00
R411	RESISTOR, FIXED, COMPOSITION: same as R407	710-9105-00
R412	RESISTOR, FIXED, COMPOSITION: same as R410	747-5444-00
R413	RESISTOR, FIXED, WIREWOUND: 100 ohms ±10%, 7 w	710-9005-00
R414 thru R425	NOT USED	

ITEM	DESCRIPTION	COLLINS PART NUMBER
R426	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R427	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R428	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%, 1/2 w	745-1324-00
R429	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%, 1/2 w	745-1370-00
R430	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
R431	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±10%, 1/2 w	745-1359-00
R432	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1/2 w	745-1419-00
R433	RESISTOR, FIXED, COMPOSITION: 2200 ohms ±10%, 1/2 w	745-1366-00
R434	RESISTOR, FIXED, COMPOSITION: 0.10 megohm ±10%, 1/2 w	745-1436-00
R435	RESISTOR, FIXED, COMPOSITION: same as R434	745-1436-00
R436	RESISTOR, FIXED, COMPOSITION: same as R431	745-1359-00
R437	RESISTOR, FIXED, COMPOSITION: same as R433	745-1366-00
R438	RESISTOR, VARIABLE: COMPOSITION; 500 ohms ±20%, 0.2 w	376-0202-00
R439	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 2 w	745-5673-00
R440	RESISTOR, FIXED, COMPOSITION: same as R439	745-5673-00
R441	RESISTOR, FIXED, COMPOSITION: same as R434	745-1436-00
R442	RESISTOR, FIXED, COMPOSITION: same as R426	745-1394-00
R443	RESISTOR, FIXED, COMPOSITION: 68 ohms ±10%, 1/2 w	745-1303-00
R444	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1 w	745-3419-00
R445	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1 w	745-3380-00
R446	RESISTOR, FIXED, COMPOSITION: same as R434	745-1436-00
R447	RESISTOR, FIXED, COMPOSITION: same as R426	745-1394-00
R448	RESISTOR, FIXED, COMPOSTION: 270 ohms ±10%, 1 w	745-3328-00
R449	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1 w	745-3394-00
R450	RESISTOR, FIXED, COMPOSITION: 820 ohms ±10%, 2 w	745-5649-00
R451	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 1/2 w	745-1268-00
R452	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 1/2 w	745-1373-00
R453	RESISTOR, FIXED, COMPOSITION: same as R432	745-1419-00
R454	RESISTOR, VARIABLE, WIREWOUND: 250 ohms ±10%, 2 w	377-0621-00
R455	RESISTOR, FIXED, COMPOSITION: 180 ohms ±10%, 2 w	745-5621-00
R456	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 1/2 w	745-1391-00
R457	RESISTOR, FIXED, COMPOSITION: 33 ohms ±10%, 1/2 w	745-1289-00
R458	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 1/2 w	745-1310-00
R459	RESISTOR, FIXED, COMPOSITION: same as R451	745-1268-00
R460	NOT USED	
R461	RESISTOR, FIXED, FILM: 51,000 ohms ±10%, 5 w	714-2973-00
R462	RESISTOR, FIXED, COMPOSITION: same as R443	745-1303-00
R463	RESISTOR, FIXED, COMPOSITION: 22,000 ohms ±10%, 1/2 w	745-1408-00
R464	RESISTOR, FIXED, COMPOSITION: same as R458	745-1310-00
R465	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R466	RESISTOR, FIXED, WIREWOUND: 20,000 ohms ±10%, 10 w	710-9067-00
R467	RESISTOR, FIXED, COMPOSITION: 22,000 ohms ±10%, 2 w	745-5708-00
S401	SWITCH, TOGGLE: dpst; 125 v a-c, 15 amp, 250 v a-c, 10 amp; Cutler-Hammer, Inc. part no. 7561K4	266-0099-00
T401	TRANSFORMER, POWER, STEP-UP, STEP-DOWN: pri 120 v; sec. #1, 438 v, sec. #2, 6.3 v, ct; 50/60 cps; continuous duty cycle; Stancor Electric part no. 31215	662-0046-00
T402	TRANSFORMER, POWER, STEP-DOWN: pri 120 v rms; sec. #1, 77 v, ct; sec. #2, 41.5 ct; 50/60 cps; continuous duty cycle; Stancor Electric part no. 31214	662-0048-00
T403 thru T425	NOT USED	

ITEM	DESCRIPTION	COLLINS PART NUMBER
T426	TRANSFORMER, RADIO FREQUENCY: pri 14 turns #26 wire, close wound; sec. 13 turns #26 wire, close wound	549-1590-00
TB401	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB402	TERMINAL BOARD: Baklite, 2 terminals; 21/32 in. by 3/4 in. lg; Cinch Mfg. Co. part no. 1513-A	306-2220-00
TB403	TERMINAL BOARD: laminated phenolic w/ 4 solder-lug terminals; 27/32 in. w by 1-1/2 in. lg overall; Cinch Mfg. Co. part no. 1909	306-0838-00
TB404	TERMINAL BOARD: same as TB401	306-9033-00
TB405	TERMINAL BOARD: phenolic; steel mounting base, brass lugs, 12 terminals, H. B. Jones part no. 2012	367-0905-00
TB406	TERMINAL BOARD: same as TB405	367-0905-00
TB407 thru TB425	NOT USED	
TB426	TERMINAL BOARD: phenolic, 4 brass solder-lug terminals; 1/16 in. by 3/8 in. by 1-1/2 in.; Cinch Mfg. Corp. part no. 1532-A	306-9032-00
TB427	TERMINAL BOARD: same as TB403	306-0838-00
TB428	TERMINAL BOARD: phenolic, 5 brass solder-lug terminals, 1/16 in. by 3/8 in. by 1-7/8 in.; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB429	TERMINAL BOARD: same as TB428	306-0951-00
TB430	TERMINAL BOARD: same as TB402	306-2220-00
TB431	TERMINAL BOARD: same as TB428	306-0951-00
V401 thru V425	NOT USED	
V426	ELECTRON TUBE: triode-pentode; Radio Corp. of America part no. 6U8A	255-0328-00
V427	ELECTRON TUBE: glass envelope; twin triode; Radio Corp. of America part no. 12AT7	255-0205-00
V428	ELECTRON TUBE: pentode, Radio Corp. of America part no. 6AU6	255-0202-00
V429	ELECTRON TUBE: glass envelope; vhf beam power; Radio Corp. of America part no. 5763	257-0059-00
V430	ELECTRON TUBE: glass envelope, Radio Corp. of America part no. 2E26	256-0084-00
XF401	FUSE HOLDER: extractor post type, for use w/ 3 AG fuses; 0-20 amp, 100-125 v; clear knob; neon lamp type	265-1072-00
XF402	FUSE HOLDER: same as XF401	265-1072-00
XV401 thru XV425	NOT USED	
XV426	SOCKET, ELECTRON TUBE: 9 contact miniature; copper nonmagnetic alloy contacts; phenolic insulation; Sylvania Electric Products, Inc. part no. 7490-0100	220-1244-00
XV427	SOCKET, ELECTRON TUBE: same as XV426	220-1244-00
XV428	SOCKET, ELECTRON TUBE: 7 contact miniature for uhf application; phenolic insulation; Sylvania Electric Products, Inc. part no. 7470-0125	220-1203-00
XV429	SOCKET, ELECTRON TUBE: same as XV426	220-1244-00
XV430	SOCKET, ELECTRON TUBE: 8 prong octal tube socket w/ steel mtg plate; Amphenol-Borg Electronics part no. 88-8TM	220-1005-00
	AUTOMATIC FREQUENCY CONTROL	
C501	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 500 vdcw	913-1186-00
C502	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C503	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C504	CAPACITOR, FIXED, CERAMIC: 0.01 uf -0% +100% temp range; 100 vdcw; Erie Resistor Corp. part no. 855-502-X550-103P	913-3680-00
C505	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C506	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C507	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C508	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C100J01	912-2753-00
C509	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C510	CAPACITOR, FIXED, MICA: 82 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E820J01	912-2810-00
C511	CAPACITOR, FIXED, CERAMIC: 0.1 uf -20% +80%, 50 vdcw; Sprague Electric part no. 33C41	913-3886-00
C512	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C513	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C514	CAPACITOR, FIXED, MICA: 100 uuf ±5% 500 wvdc	912-2816-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
C515	CAPACITOR, VARIABLE, CERAMIC: 5.0 uuf min to 37.5 uuf max, 350 vdcw; Erie Resistor part no. 557018C0P039R	917-1073-00
C516	CAPACITOR, FIXED, MICA: 220 uuf ±5%, 500 vdcw, Electro Motive part no. DM15F221J01	912-2840-00
C517	CAPACITOR, FIXED, MICA: 30 uuf ±2%, 500 vdcw; Electro Motive part no. DM15E300G01	912-2776-00
C518	CAPACITOR, VARIABLE, CERAMIC: 3.0 uuf min to 12.0 uuf max, 350 vdcw	917-1072-00
C519	CAPACITOR, FIXED, MICA: 470 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F471J01	912-2864-00
C520	CAPACITOR, FIXED, MICA: same as C519	912-2864-00
C521	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf -10% +100%, 10 vdcw; Sprague Electric part no. S13691	183-2151-00
C522	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf -10%, +100%, 25 vdcw; Sprague Electric part no. 30D188A1	183-1192-00
C523	CAPACITOR, FIXED, CERAMIC: 0.68 uf -20% +80%, 25 vdcw; Sprague Electric part no. 5C12A	913-3809-00
C524	CAPACITOR, FIXED, ELECTROLYTIC: same as C522	183-1192-00
C525	CAPACITOR, FIXED, CERAMIC: same as C523	913-3809-00
C526	CAPACITOR, FIXED, ELECTROLYTIC: same as C522	183-1192-00
C527	CAPACITOR, FIXED, CERAMIC: same as C523	913-3809-00
C528	CAPACITOR, FIXED, ELECTROLYTIC: same as C522	183-1192-00
C529	CAPACITOR, FIXED, PAPER: 5.0 uf ±20%, 150 vdcw; Sprague Electric part no. 121P50501R5S2	931-2585-00
C530	CAPACITOR, FIXED, PAPER: same as C529	931-2585-00
C531	CAPACITOR, FIXED, PAPER: 2.0 uf ±20%, 200 vdcw; Aerovox Corp. part no. P8292ZN14	951-0670-00
C532	CAPACITOR, FIXED, PAPER: 20 uf ±20%, 150 vdcw; Sprague Electric part no. 143P101M	951-2004-00
C533	CAPACITOR, FIXED, PAPER: same as C531	951-0670-00
C534	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 30 vdcw	183-1565-00
C535	CAPACITOR, FIXED, ELECTROLYTIC: 1000 uf -10% +100%, 50 vdcw	183-1403-00
C536	CAPACITOR, FIXED, ELECTROLYTIC: same as C535	183-1403-00
C537	CAPACITOR, FIXED, PAPER: 35 uf ±20%, 150 vdcw; Sprague Electric part no. 143P4M	951-2003-00
C538	CAPACITOR, FIXED, PAPER: same as C537	951-2003-00
C539	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 12 vdcw; Sprague Electric Co. part no. 30D157A1	183-1190-00
C540	CAPACITOR, FIXED, CERAMIC: same as C511	913-3886-00
C541	CAPACITOR, FIXED, MICA: 180 uuf ±5%, 500 vdcw, Electro Motive part no. DM15F181J01	912-2834-00
C542	CAPACITOR, FIXED, CERAMIC: same as C511	913-3886-00
C543	NOT USED	
C544	CAPACITOR, FIXED, MICA: 68 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E680J01	912-2804-00
C545	CAPACITOR, FIXED, MICA: 510 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F511J01	912-2867-00
C546	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C547	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C548	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C549	CAPACITOR, FIXED, CERAMIC: 3300 uuf ±20%, 500 vdcw	913-1193-00
C550	CAPACITOR, FIXED, MICA: 22 uuf ±5%, 500 vdcw, Electro Motive part no. DM15C220J01	912-2768-00
C551	CAPACITOR, FIXED, ELECTROLYTIC: same as C534	183-1565-00
C552	CAPACITOR, FIXED, CERAMIC: same as C549	913-1193-00
C553	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
CR501	SEMICONDUCTOR DEVICE, DIODE: germanium; Transitron part no. 1N270	353-2018-00
CR502 thru CR506	SEMICONDUCTOR DEVICE, DIODE: same as CR501	353-2018-00
CR507	SEMICONDUCTOR DEVICE, DIODE: germanium; Erie Resistor part no. 1N198	353-0160-00
CR508	SEMICONDUCTOR DEVICE, DIODE: same as CR507	353-0160-00
CR509	SEMICONDUCTOR DEVICE, SET: four matched silicon diodes; encapsulated; Fairchild Semiconductor Corp. part no. FA-4000	353-3271-00
CR510	SEMICONDUCTOR DEVICE, SET: same as CR509	353-3271-00
CR511	SEMICONDUCTOR DEVICE, SET: same as CR509	353-3271-00
CR512	NOT USED	
CR513	SEMICONDUCTOR DEVICE, DIODE: same as CR507	353-0160-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
CR514	SEMICONDUCTOR DEVICE, DIODE: hermetically sealed, silicon; Motorola, Inc. part no. 1N718	353-2734-00
CR515	SEMICONDUCTOR DEVICE, DIODE: quick recovery silicon junction diode; Hughes Aircraft part no. 1N626	353-2857-00
CR516	SEMICONDUCTOR DEVICE, DIODE: same as CR515	353-2857-00
J501	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; brown; E. F. Johnson Co. part no. 105-208-200	360-0152-00
J502	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; red; E. F. Johnson Co. part no. 105-202-200	360-0150-00
J503	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; orange; E. F. Johnson Co. part no. 105-206-200	360-0154-00
J504	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; yellow; E. F. Johnson Co. part no. 105-207-200	360-0156-00
L501	COIL, RADIO FREQUENCY: single layer wound, 100 uh nom inductance, 3.2 ohms d-c resistance, 530 ma current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10404-34	240-0193-00
L502	COIL, RADIO FREQUENCY: single layer wound, 3.30 uh nom inductance, 0.15 ohm d-c resistance, 1150 ma current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10102-110	240-0065-00
L503	COIL, RADIO FREQUENCY: single layer wound, 4.7 uh inductance; 0.22 ohm max d-c resistance, 950 ma current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10102-115	240-0145-00
L504	COIL, RADIO FREQUENCY: variable, +15°C to +55°C temp range; 100 v d-c dielectric strength	278-0733-00
L505	COIL, RADIO FREQUENCY: same as L504	278-0733-00
Q501	TRANSISTOR: germanium; RCA part no. 2N1225	352-0135-00
Q502	TRANSISTOR: same as Q501	352-0135-00
Q503	TRANSISTOR: hermetically sealed, NPN silicon; Fairchild Semi Conductor Co. part no. 2N708	352-0322-00
Q504	TRANSISTOR: hermetically sealed, NPN diffused silicon planar transistor; Fairchild Semiconductor Corp. part no. 2N1613	352-0349-00
Q505	TRANSISTOR: same as Q504	352-0349-00
Q506	TRANSISTOR: same as Q504	352-0349-00
Q507	TRANSISTOR: same as Q504	352-0349-00
Q508	TRANSISTOR: silicon; General Electric part no. 2N491	352-0116-00
Q509	TRANSISTOR: germanium; hermetically sealed; Sylvania Electric part no. 2N1605	352-0348-00
Q510	TRANSISTOR: same as Q509	352-0348-00
Q511	TRANSISTOR: hermetically sealed; PNP germanium; General Electric part no. 2N1175A	352-0315-00
Q512	TRANSISTOR: same as Q501	352-0135-00
R501	RESISTOR, FIXED, COMPOSITION: 68 ohms ±10%, 1/2 w	745-1303-00
R502	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%, 1/2 w	745-1370-00
R503	RESISTOR, FIXED, COMPOSITION: same as R502	745-1370-00
R504	RESISTOR, FIXED, COMPOSITION: 680 ohms ±10%, 1/2 w	745-1345-00
R505	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R506	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R507	RESISTOR, FIXED, COMPOSITION: same as R505	745-1380-00
R508	RESISTOR, FIXED, FILM: 42.2 ohms ±1%, 1/4 w	705-7030-00
R509	RESISTOR, FIXED, FILM: 51.1 ohms ±1%, 1/4 w	705-7034-00
R510	RESISTOR, FIXED, COMPOSITION: same as R506	745-1394-00
R511	RESISTOR, FIXED, COMPOSITION: same as R506	745-1394-00
R512	RESISTOR, FIXED, COMPOSITION: same as R505	745-1380-00
R513	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R514	RESISTOR, FIXED, COMPOSITION: 1800 ohms ±10%, 1/2 w	745-1363-00
R515	RESISTOR, FIXED, COMPOSITION: same as R514	745-1363-00
R516	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R517	RESISTOR, FIXED, FILM: 110 ohms ±1%, 1/4 w	705-7050-00
R518	RESISTOR, FIXED, FILM: 6810 ohms ±1%, 1/4 w	705-7136-00
R519	RESISTOR, FIXED, FILM: same as R518	705-7136-00
R520	RESISTOR, FIXED, FILM: same as R517	705-7050-00
R521	RESISTOR, FIXED, FILM: 34,800 ohms ±1%, 1/4 w	705-7170-00
R522	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1/4 w	705-7144-00
R523	RESISTOR, FIXED, FILM: 178,000 ohms ±1%, 1/4 w	705-7204-00
R524	RESISTOR, FIXED, FILM: 14,700 ohms ±1%, 1/4 w	705-7152-00
R525	RESISTOR, FIXED, FILM: 7500 ohms ±1%, 1/4 w	705-7138-00
R526	RESISTOR, FIXED, FILM: 422 ohms ±1%, 1/4 w	705-7078-00
R527	RESISTOR, FIXED, FILM: 196,000 ohms ±1%, 1/4 w	705-7206-00
R528	RESISTOR, FIXED, FILM: same as R524	705-7152-00
R529	RESISTOR, FIXED, FILM: same as R525	705-7138-00
R530	RESISTOR, FIXED, FILM: same as R526	705-7078-00
R531	RESISTOR, FIXED, FILM: same as R527	705-7206-00
R532	RESISTOR, FIXED, FILM: same as R524	705-7152-00
R533	RESISTOR, FIXED, FILM: same as R525	705-7138-00
R534	RESISTOR, FIXED, FILM: same as R526	705-7078-00
R535	RESISTOR, FIXED, FILM: 38,300 ohms ±1%, 1/4 w	705-7172-00
R536	RESISTOR, FIXED, FILM: 19,600 ohms ±1%, 1/4 w	705-7158-00
R537	RESISTOR, FIXED, FILM: 1470 ohms ±1%, 1/4 w	705-7104-00
R538	RESISTOR, FIXED, FILM: same as R537	705-7104-00
R539	RESISTOR, FIXED, FILM: 2870 ohms ±1%, 1/4 w	705-7118-00
R540	RESISTOR, FIXED, FILM: same as R539	705-7118-00
R541	RESISTOR, FIXED, FILM: 100,000 ohms ±1%, 1/4 w	705-7192-00
R542	RESISTOR, FIXED, FILM: same as R541	705-7192-00
R543	RESISTOR, FIXED, COMPOSITION: 0.12 megohm ±10%, 1/2 w	745-1440-00
R544	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R545	RESISTOR, FIXED, COMPOSITION: 0.18 megohm ±10%, 1/2 w	745-1447-00
R546	RESISTOR, FIXED, FILM: 5620 ohms ±1%, 1/4 w	705-7132-00
R547	RESISTOR, FIXED, FILM: 9090 ohms ±1%, 1/4 w	705-7142-00
R548	RESISTOR, FIXED, FILM: same as R547	705-7142-00
R549	RESISTOR, FIXED, FILM: 8250 ohms ±1%, 1/4 w	705-7140-00
R550	RESISTOR, FIXED, FILM: 1330 ohms ±1%, 1/4 w	705-7102-00
R551	RESISTOR, FIXED, COMPOSITION: 15,000 ohms ±10%, 1/2 w	745-1401-00
R552	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 1/2 w	745-1373-00
R553	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R554	RESISTOR, FIXED, COMPOSITION: same as R551	745-1401-00
R555	RESISTOR, FIXED, FILM: 75,000 ohms ±1%, 1/4 w	705-7186-00
R556	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 1/2 w	745-1268-00
R557	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%, 1/2 w	745-1324-00
R558	RESISTOR, FIXED, FILM: 56,200 ohms ±1%, 1/4 w	705-7180-00
R559	RESISTOR, FIXED, FILM: 2610 ohms ±1%, 1/4 w	705-7116-00
R560	RESISTOR, FIXED, FILM: 3160 ohms ±1%, 1/4 w	705-7120-00
R561	RESISTOR, FIXED, COMPOSITION: same as R553	745-1352-00
R562	RESISTOR, VARIABLE: COMPOSITION; 1000 ohms ±20%, 1/4 w	376-4727-00
R563	RESISTOR, FIXED, COMPOSITION: same as R506	745-1394-00
R564	RESISTOR, FIXED, FILM: 3480 ohms ±1%, 1/4 w	705-7122-00
R565	RESISTOR, FIXED, FILM: 4640 ohms ±1%, 1/4 w	705-7128-00
R566	RESISTOR, FIXED, FILM: same as R521	705-7170-00
R567	RESISTOR, FIXED, FILM: same as R521	705-7170-00
R568	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 1/2 w	745-1310-00
R569	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00
R570	RESISTOR, FIXED, COMPOSTION: 8200 ohms ±10%, 1/2 w	745-1391-00
R571	RESISTOR, FIXED, COMPOSITION: 18,000 ohms ±5%, 1/2 w	745-1404-00
R572	RESISTOR, VARIABLE: COMPOSITION; 500 ohms ±20%, 1/4 w	376-4726-00
R573	RESISTOR, FIXED, COMPOSITION: same as R502	745-1370-00
R574	RESISTOR, FIXED, COMPOSITION: same as R502	745-1370-00
R575	RESISTOR, FIXED, COMPOSITION: same as R505	745-1380-00
R576	RESISTOR, FIXED, COMPOSITION: 5600 ohms ±10%, 1/2 w	745-1384-00
R577	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1/2 w	745-1419-00
R578	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
R579	RESISTOR, FIXED, COMPOSITION: 2150 ohms ±1%, 1/4 w	705-7112-00
R580	RESISTOR, FIXED, COMPOSITION: 820 ohms ±10%, 1/2 w	745-1349-00
R581	RESISTOR, FIXED, COMPOSITION: same as R552	745-1373-00
T501	NOT USED	
T502	NOT USED	
T503	TRANSFORMER, RADIO FREQUENCY: 20 turns #30 AWG, close wound tapped at 10 turns; 43.5 uh inductance; ferrite core; 0.250 in. w by 0.500 in. dia	549-1589-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
T504	TRANSFORMER, RADIO FREQUENCY: 5 terminals, primary ct; 5/8 in. h by 1-1/8 in. w by 1-1/2 in. lg	549-1617-003
TB501	TERMINAL BOARD: phenolic, 1-7/8 in. lg by 3/8 in. w by 1/16 in. thk; 5 brass solder-lug terminals; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB502	TERMINAL BOARD: same as TB501	306-0951-00
TB503	TERMINAL BOARD: same as TB501	306-0951-00
TB504	TERMINAL BOARD: Bakelite, 4 terminals, 1 grounded, 3 insulated; 21/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1534-A	306-2240-00
TB505	TERMINAL BOARD: same as TB501	306-0951-00
TB506	TERMINAL BOARD: same as TB501	306-0951-00
TB507	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB508	TERMINAL BOARD: same as TB501	306-0951-00
TB509	TERMINAL BOARD: phenolic, 1/16 in. by 3/8 in. by 1-1/2 in.; 4 brass solder-lug terminals; Cinch Mfg. Corp. part no. 1532-A	306-9032-00
TB510	TERMINAL BOARD: same as TB507	306-9033-00
TB511	TERMINAL BOARD: same as TB501	306-0951-00
TB512	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals, 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1525-A	306-0001-00
TB513	TERMINAL BOARD: same as TB509	306-9032-00
TB514	TERMINAL BOARD: same as TB507	306-9033-00
TB515	TERMINAL BOARD: same as TB501	306-0951-00
TB516	TERMINAL BOARD: same as TB501	306-0951-00
TB517	TERMINAL BOARD: same as TB501	306-0951-00
TB518	TERMINAL BOARD: phenolic, 12 solder-lug terminals, Vector Mfg. Co. part no. 6H-12	306-0909-00
TB519	TERMINAL BOARD: same as TB501	306-0951-00
TB520	TERMINAL BOARD: phenolic w/ 4 solder lug terminals; 27/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1909	306-0838-00
TB521	TERMINAL BOARD: phenolic, 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg	306-0587-00
Y501	CRYSTAL UNIT, QUARTZ: 14.0 mc; type HC-27/U holder	289-2743-00
	MODULATOR	
C601	CAPACITOR, FIXED, CERAMIC: 20.0 uuf ±2%, 500 vdcw	916-0362-00
C602	CAPACITOR, FIXED, CERAMIC: same as C601	916-0362-00
C603	CAPACITOR, FIXED, CERAMIC: uninsulated, 10.0 uuf ±1/2 uuf, 500 vdcw	916-0412-00
C604	CAPACITOR, FIXED, MICA: 100 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F101J01	912-2816-00
C605	CAPACITOR, FIXED, CERAMIC: 0.01 uf -0% +100%, 100 vdcw; Erie Resistor Corp. part no. 855-502-X550-103P	913-3680-00
C606	CAPACITOR, VARIABLE, CERAMIC: 5.0 uuf min to 37.5 uuf max, 350 vdcw; Erie Resistor Corp. part no. 557018COP039R	917-1073-00
C607	CAPACITOR, FIXED, PAPER: 1.0 uf -10% +20%, 200 vdcw	931-0170-00
C608	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% -100%, 12 vdcw; Sprague Electric Co. part no. 30D157A1	183-1190-00
C609	CAPACITOR, FIXED, PAPER: 0.5 uf -10% +20%, 200 vdcw	931-0169-00
C610	CAPACITOR, FIXED, PAPER: 20 uf ±20%, 150 vdcw; Sprague Electric part no. 143P101M	951-2004-00
C611	CAPACITOR, FIXED, MICA: same as C604	912-2816-00
C612	CAPACITOR, FIXED, MICA: same as C604	912-2816-00
C613	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C614	CAPACITOR, FIXED, MICA: 330 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F331J01	912-2852-00
C615	CAPACITOR, FIXED, CERAMIC: 0.1 uf -20% +80%, 50 vdcw; Sprague Electric part no. 33C41	913-3886-00
C616	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C617	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C618	CAPACITOR, FIXED, CERAMIC: 100 uuf ±20%, 500 vdcw	913-1186-00
C619	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F100J01	912-2753-00
C620	CAPACITOR, FIXED, MICA: 82 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E820J01	912-2810-00
C621	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C622	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C623	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C624	NOT USED	
C625	CAPACITOR, FIXED, MICA: 22 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C220J01	912-2768-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
C626	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C627	CAPACITOR, FIXED, CERAMIC: same as C605	913-2680-00
C628	CAPACITOR, FIXED, CERAMIC: same as C605	913-2680-00
C629	CAPACITOR, FIXED, MICA: same as C625	912-2768-00
C630	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C631	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C632	CAPACITOR, FIXED, MICA: 150 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F151J01	912-2828-00
C633	CAPACITOR, FIXED, MICA: same as C632	912-2828-00
C634	CAPACITOR, FIXED, MICA: 39 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E390J01	912-2786-00
C635	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C636	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C637	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C638	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C639	CAPACITOR, VARIABLE, CERAMIC: same as C606	917-1073-00
C640	CAPACITOR, FIXED, CERAMIC: same as C618	913-1186-00
C641	CAPACITOR, FIXED, MICA: 68 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E680J01	912-2804-00
C642	CAPACITOR, FIXED, MICA: 220 uuf ±5%, 500 vdcw, Electro Motive part no. DM15F221J01	912-2840-00
C643	CAPACITOR, FIXED, CERAMIC: same as C601	916-0362-00
C644	CAPACITOR, VARIABLE, CERAMIC: 3.0 uuf min to 12.0 uuf max, 350 vdcw	917-1072-00
C645	CAPACITOR, FIXED, MICA: 33 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F330J01	912-2780-00
C646	CAPACITOR, FIXED, MICA: same as C645	912-2780-00
C647	CAPACITOR, FIXED, MICA: 560 uuf ±5%, 500 vdcw; Electro Motive part no. DM19F561J	912-2983-00
C648	CAPACITOR, FIXED, MICA: 1800 uuf ±5%, 500 vdcw; Electro Motive part no. DM20F182J	912-3333-00
C649	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf -15% +75%, 25 vdcw; Sprague Electric part no. 109D107C7025T2	184-7802-00
C650	CAPACITOR, FIXED, PAPER: same as C607	931-0170-00
C651	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C652	CAPACITOR, FIXED, CERAMIC: 10.0 uuf ±1/4 uuf, 500 vdcw	916-0203-00
C653	CAPACITOR, FIXED, MICA: 270 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F271J01	912-2846-00
C654	CAPACITOR, DIODE: 35 uuf ±20%, at -4 v d-c voltage, max 130 v d-c; total capacity range 6 to 88 uuf, 130 v d-c to 0.1 v d-c	922-6002-00
CR601	SEMICONDUCTOR DEVICE, DIODE: quick recovery silicon junction diode; Hughes Aircraft part no. 1N626	353-2857-00
CR602	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; Transitron Elect. Corp. part no. SV3173	353-3304-00
CR603	SEMICONDUCTOR DEVICE, DIODE: germanium, Transitron part no. 1N270	353-2018-00
CR604	SEMICONDUCTOR DEVICE, DIODE: same as CR603	353-2018-00
CR605	SEMICONDUCTOR DEVICE, DIODE: same as CR603	353-2018-00
CR606	SEMICONDUCTOR DEVICE, DIODE: same as CR603	353-2018-00
CR607	SEMICONDUCTOR DEVICE, DIODE: germanium; Erie Resistor part no. 1N198	353-0160-00
CR608	SEMICONDUCTOR DEVICE, DIODE: same as CR607	353-0160-00
CR609	SEMICONDUCTOR DEVICE, DIODE: silicon; Texas Instruments part no. 1N751A	353-2710-00
CR610	SEMICONDUCTOR DEVICE, DIODE: same as CR607	353-0160-00
J601	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; brown; E. F. Johnson Co. part no. 105-208-200	360-0152-00
J602	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; red; E. F. Johnson Co. part no. 105-202-200	360-0150-00
J603	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; orange; E. F. Johnson Co. part no. 105-206-200	360-0154-00
J604	JACK, TELEPHONE: steel, miniature; panel mtg; Switchcraft, Inc. part no. 3501FP	360-0148-00
J605	JACK, TELEPHONE: same as J604	360-0148-00
L601	COIL, RADIO FREQUENCY: 82 uh ±10%, 2.3 ohms max d-c resistance, 570 ma current rating; Jeffers Electronics part no. 10404-112	240-0192-00
L602	INDUCTOR, RADIO FREQUENCY: toroidal, single layer wound, approx 22 turns #28 double formvar; 2.4 uh ±2%, at 2.6 mc	240-1529-00
L603	COIL, RADIO FREQUENCY: variable; +15°C to +55°C temp range; 100 v d-c dielectric strength	278-0733-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
L604	COIL, RADIO FREQUENCY: universal wound, 3 pi; 72 turns ea section, #36 AWG wire; 220 uh inductance; 100 ma current; Delevan Electric part no. BS-217	240-0198-00
L605	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L606	COIL, RADIO FREQUENCY: same as L603	278-0733-00
L607	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L608	COIL, RADIO FREQUENCY: same as L603	278-0733-00
L609	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L610	COIL, RADIO FREQUENCY: 1.00 uh ±10%, 0.30 ohm d-c resistance; 850 ma dc; Jeffers Electronics part no. 10100-128	240-0062-00
L611	COIL, RADIO FREQUENCY: same as L603	278-0733-00
L612	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L613	NOT USED	
L614	COIL, RADIO FREQUENCY: single layer wound, 56 uh inductance, 750 ma current; 1.30 ohms d-c; Jeffers Electronics Div. of Speer Carbon Co. part no. 10404-30	240-0191-00
L615	COIL, RADIO FREQUENCY: same as L601	240-0192-00
L616	COIL, RADIO FREQUENCY: same as L604	240-0198-00
P601	PLUG, TELEPHONE: brass; phenolic insulation, w/ solder-lug terminal; Switchcraft part no. 3501MC	361-0062-00
P602, P603	NOT USED	
P604	PHONO, PLUG: w/ solder-lug terminals, phenolic insulation; Switchcraft, Inc. part no. 3501MC	361-0062-00
Q601	TRANSISTOR: germanium; hermetically sealed; Radio Corp. of America part no. 2N1396	352-0376-00
Q602	TRANSISTOR: germanium; Radio Corp. of America part no. 2N1225	352-0135-00
Q603	TRANSISTOR: same as Q602	352-0135-00
Q604	TRANSISTOR: hermetically sealed, NPN silicon; Fairchild Semiconductor Corp. part no. 2N708	352-0322-00
Q605	TRANSISTOR: same as Q602	352-0135-00
Q606	TRANSISTOR: same as Q604	352-0322-00
Q607	TRANSISTOR: silicon planar; hermetically sealed; Fairchild Semiconductor Corp. part no. S4639	352-0373-00
Q608	TRANSISTOR: same as Q601	352-0376-00
R601	RESISTOR, FIXED, FILM: 21,500 ohms ±1%, 1/4 w	705-7160-00
R602	RESISTOR, FIXED, FILM: 12,100 ohms ±1%, 1/4 w	705-7148-00
R603	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R604	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
*R605	RESISTOR, FIXED, FILM: 1470 ohms ±1%, 1/4 w	705-7104-00
*R605	RESISTOR, FIXED, FILM: 1960 ohms ±1%, 1/4 w	705-7110-00
*R605	RESISTOR, FIXED, FILM: 4220 ohms ±1%, 1/4 w	705-7126-00
*R605	RESISTOR, FIXED, FILM: 1000 ohms ±1%, 1/4 w	705-7096-00
R606	RESISTOR, FIXED, FILM: 19,600 ohms ±1%, 1/4 w	705-7158-00
R607	RESISTOR, FIXED, FILM: 2610 ohms ±1%, 1/4 w	705-7116-00
R608	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R609	RESISTOR, FIXED, COMPOSITION: 5600 ohms ±10%, 1/2 w	745-1384-00
R610	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R611	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±10%, 1/2 w	745-1359-00
R612	RESISTOR, FIXED, COMPOSITION: 1800 ohms ±10%, 1/2 w	745-1363-00
R613	RESISTOR, FIXED, FILM: 42.2 ohms ±1%, 1/4 w	705-7030-00
R614	RESISTOR, FIXED, FILM: 51.1 ohms ±1%, 1/4 w	705-7034-00
R615	RESISTOR, FIXED, COMPOSITION: same as R608	745-1394-00
R616	RESISTOR, FIXED, COMPOSITION: same as R608	745-1394-00
R617	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R618	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R619	RESISTOR, FIXED, COMPOSITION: same as R612	745-1363-00
R620	RESISTOR, FIXED, COMPOSITION: same as R612	745-1363-00
R621	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00

*Chosen per operational requirement.

ITEM	DESCRIPTION	COLLINS PART NUMBER
R622	RESISTOR, FIXED, COMPOSITION: same as R617	745-1380-00
R623	RESISTOR, FIXED, COMPOSITION: same as R621	745-1387-00
R624	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%, 1/2 w	745-1324-00
R625	RESISTOR, FIXED, COMPOSITION: same as R612	745-1363-00
R626	RESISTOR, FIXED, COMPOSITION: 2200 ohms ±10%, 1/2 w	745-1366-00
R627	RESISTOR, FIXED, COMPOSITION: 390 ohms ±10%, 1/2 w	745-1335-00
R628	RESISTOR, FIXED, FILM: 1960 ohms ±1%, 1/4 w	705-7110-00
R629	RESISTOR, FIXED, FILM: same as R628	705-7110-00
R630	RESISTOR, FIXED, FILM: 8250 ohms ±1%, 1/4 w	705-7140-00
R631	RESISTOR, FIXED, FILM: 1100 ohms ±1%, 1/4 w	705-7098-00
R632	RESISTOR, FIXED, FILM: same as R631	705-7098-00
*R633	RESISTOR, FIXED, FILM: 3480 ohms ±1%, 1/4 w	705-7122-00
*R633	RESISTOR, FIXED, FILM: 4220 ohms ±1%, 1/4 w	705-7126-00
*R633	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/4 w	705-7130-00
*R633	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1/4 w	705-7144-00
R634	RESISTOR, FIXED, FILM: 348 ohms ±1%, 1/4 w	705-7074-00
R635	RESISTOR, VARIABLE: COMPOSITION; 50,000 ohms ±30%, 1/4 w	376-4737-00
R636	RESISTOR, FIXED, FILM: 1000 ohms ±1%, 1/4 w	705-7096-00
R637	RESISTOR, FIXED, FILM: 7500 ohms ±1%, 1/4 w	705-7138-00
R638	RESISTOR, FIXED, FILM: 100,000 ohms ±1%, 1/4 w	705-7192-00
R639	RESISTOR, FIXED, FILM: 316 ohms ±1%, 1/4 w	705-7072-00
R640	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/4 w	705-7130-00
R641	RESISTOR, VARIABLE: COMPOSITION; 50,000 ohms ±30%, 1/4 w	376-4732-00
R642	RESISTOR, FIXED, FILM: 13,300 ohms ±1%, 1/4 w	705-7150-00
R643	RESISTOR, FIXED, FILM: 2870 ohms ±1%, 1/4 w	705-7118-00
R644	RESISTOR, FIXED, COMPOSITION: 0.10 megohm ±10%, 1/2 w	745-1436-00
R645	RESISTOR, FIXED, COMPOSITION: same as R644	745-1436-00
R646	RESISTOR, FIXED, COMPOSITION: same as R644	745-1436-00
R647	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R648	RESISTOR, FIXED, COMPOSITION: 680 ohms ±10%, 1/2 w	745-1345-00
R649	RESISTOR, FIXED, COMPOSITION: same as R608	745-1394-00
R650	RESISTOR, FIXED, COMPOSITION: same as R626	745-1366-00
R651	RESISTOR, FIXED, COMPOSITION: 22 ohms ±10%, 1/2 w	745-1282-00
T601	TRANSFORMER, RADIO FREQUENCY: 5 terminals primary, ct; 5/8 in. h by 1-1/8 in. w by 1-1/2 in. lg; Collins Radio Co.	549-1617-003
TB601	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB602	TERMINAL BOARD: phenolic, 1/16 in. by 3/8 in. by 1-1/2 in.; 4 brass solder lug terminals; Cinch Mfg. Corp. part no. 1532-A	306-9032-00
TB603	TERMINAL BOARD: same as TB602	306-9032-00
TB604	TERMINAL BOARD: same as TB601	306-9033-00
TB605	TERMINAL BOARD: same as TB601	306-9033-00
TB606	TERMINAL BOARD: same as TB601	306-9033-00
TB607	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1525-A	306-0001-00
TB608	TERMINAL BOARD: phenolic, 1-7/8 in. by 3/8 in. by 1/16 in.; 5 brass solder-lug terminals; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB609	TERMINAL BOARD: same as TB608	306-0951-00
TB610	TERMINAL BOARD: laminated phenolic w/ 4 solder lug terminals; 27/32 in. w by 1-1/12 in. lg overall, Cinch Mfg. Corp. part no. 1909	306-0838-00
TB611	TERMINAL BOARD: same as TB610	306-0838-00
TB612	TERMINAL BOARD: same as TB601	306-9033-00
TB613	TERMINAL BOARD: same as TB601	306-9033-00
TB614	TERMINAL BOARD: phenolic, 12 solder lug terminals; Vector Mfg. Co. part no. 6H-12	306-0909-00
TB615	TERMINAL BOARD: same as TB608	306-0951-00
TB616	TERMINAL BOARD: phenolic, 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg	306-0587-00

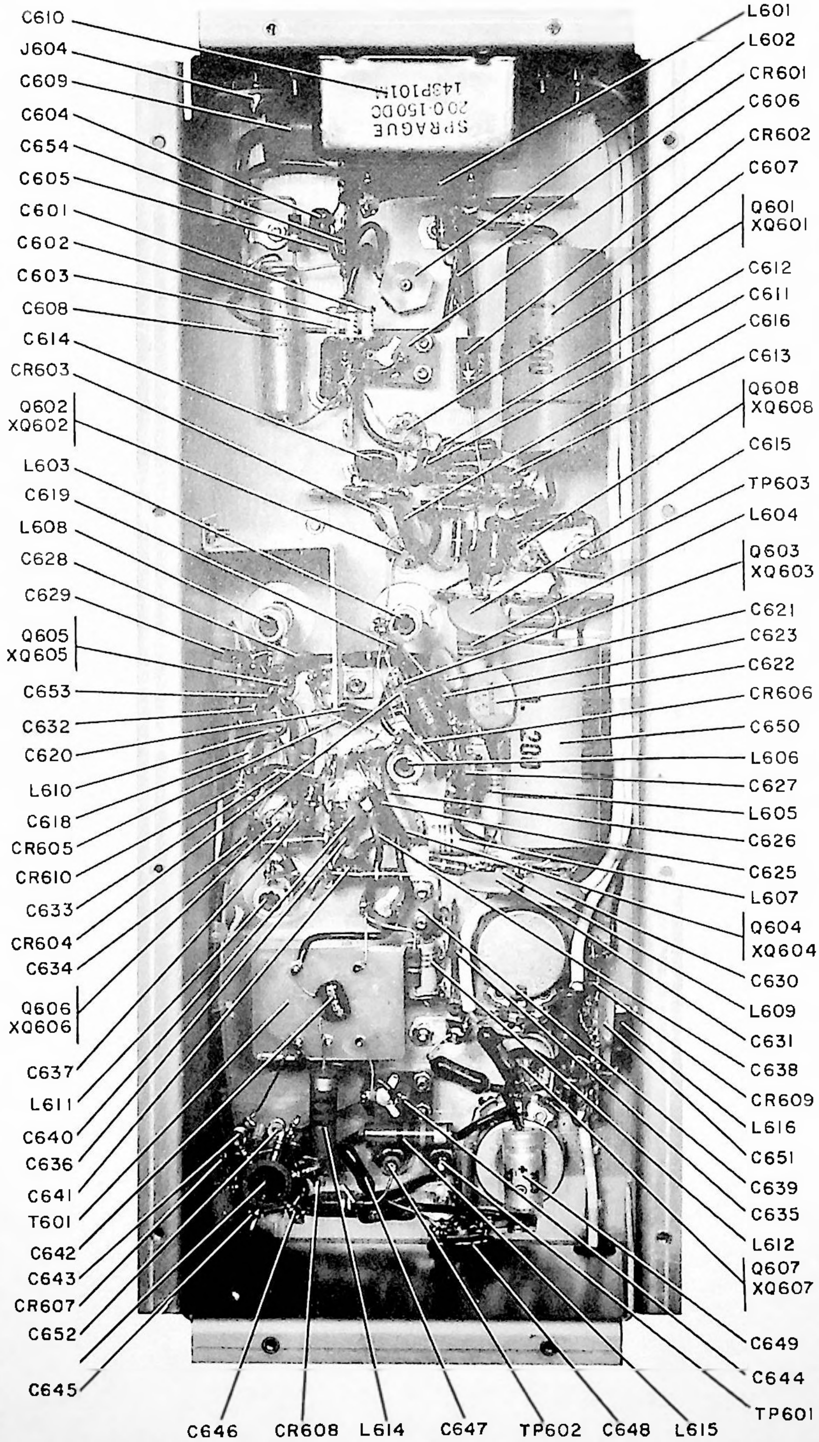


Figure 4-1. Modulator Compartment, Component (Except Resistors) Identification

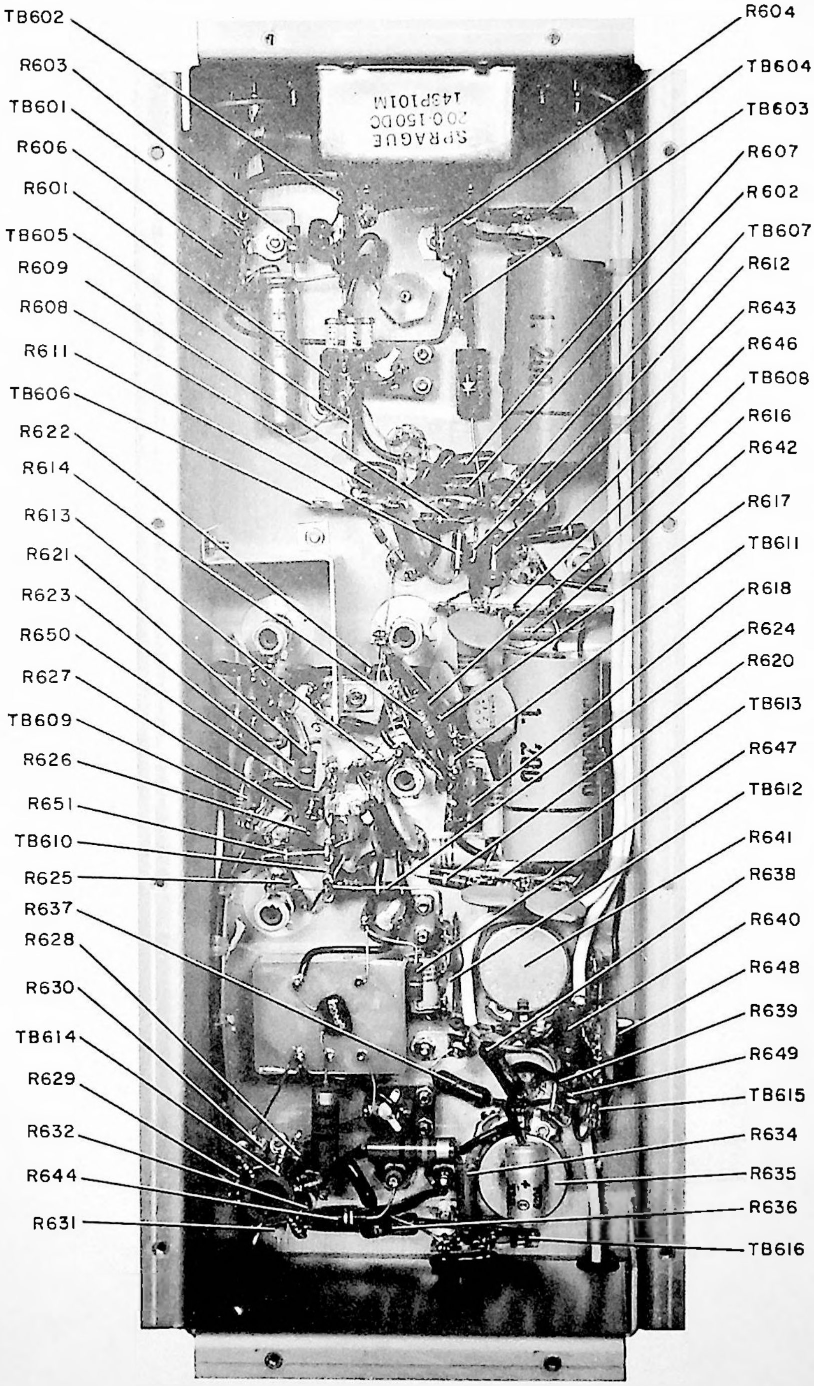


Figure 4-2. Modulator Compartment, Resistor Identification

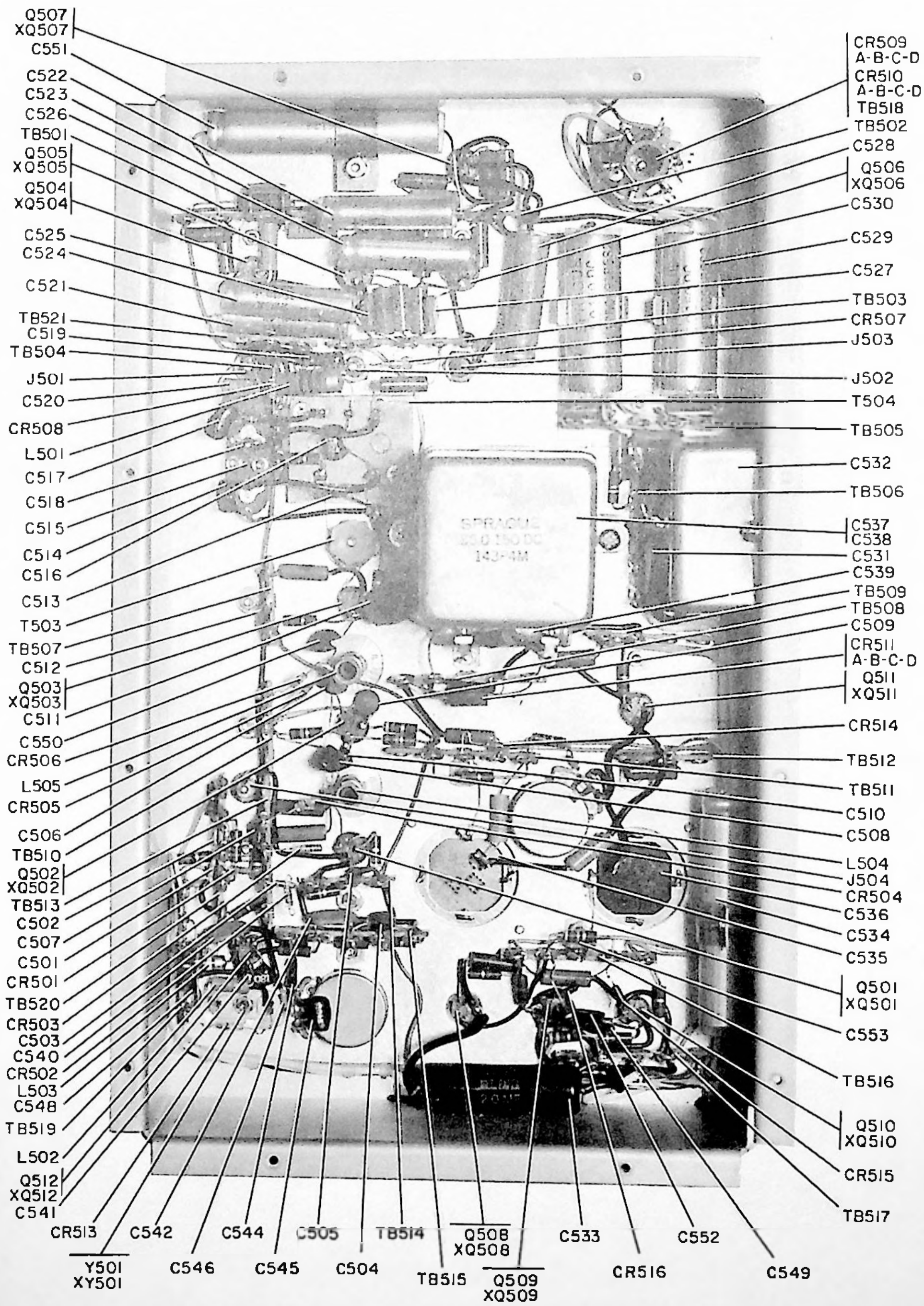


Figure 4-3. AFC Compartment, Component (Except Resistors) Identification

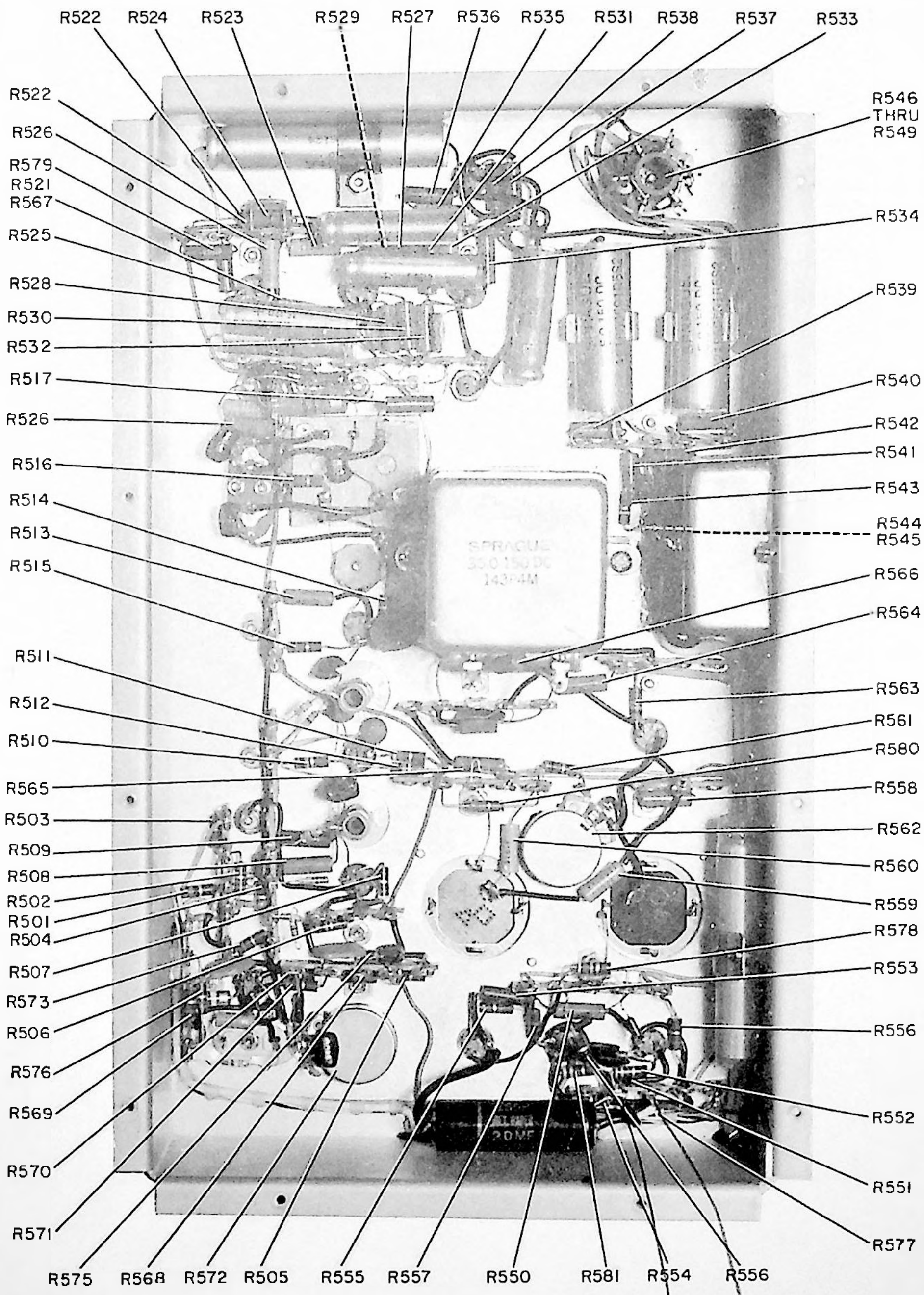


Figure 4-4. AFC Compartment, Resistor Identification

470 PF

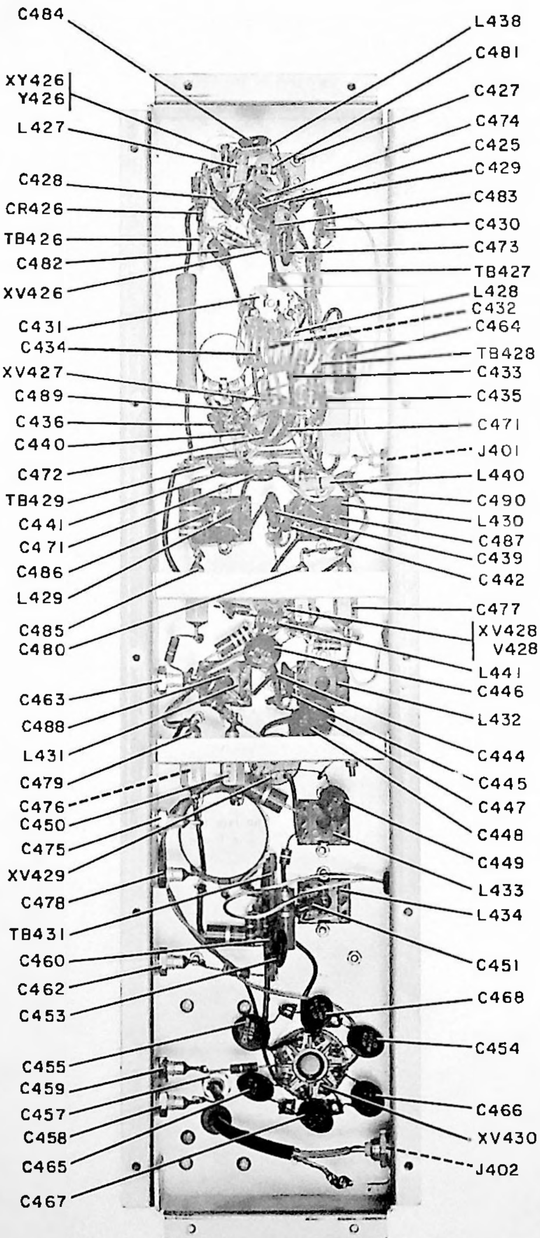


Figure 4-5. Power Amplifier Compartment, Component (Except Resistors) Identification

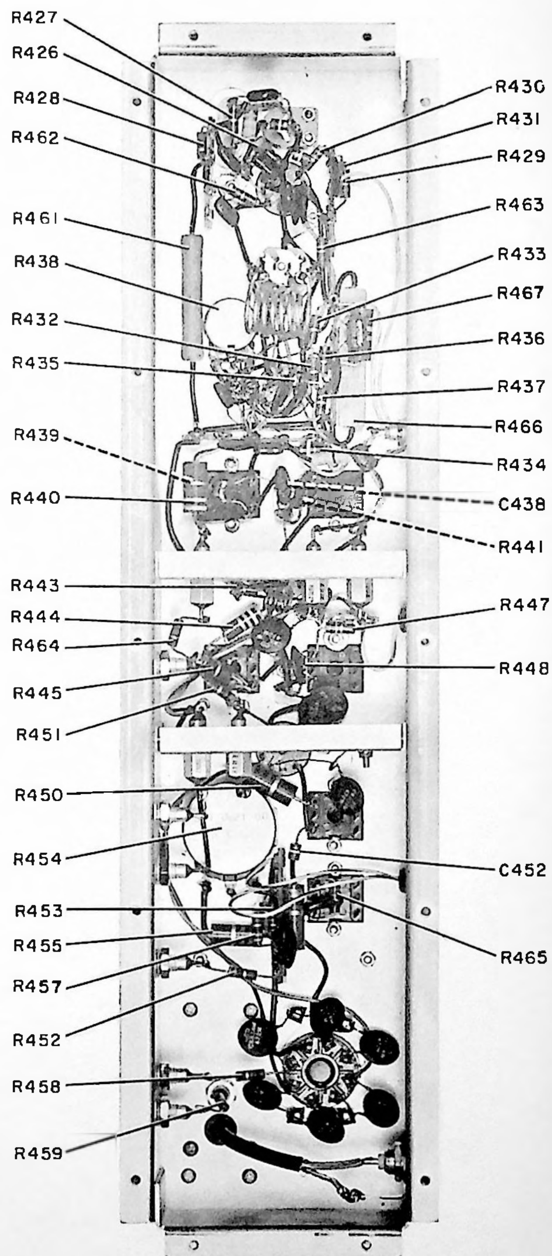


Figure 4-6. Power Amplifier Compartment, Resistor Identification

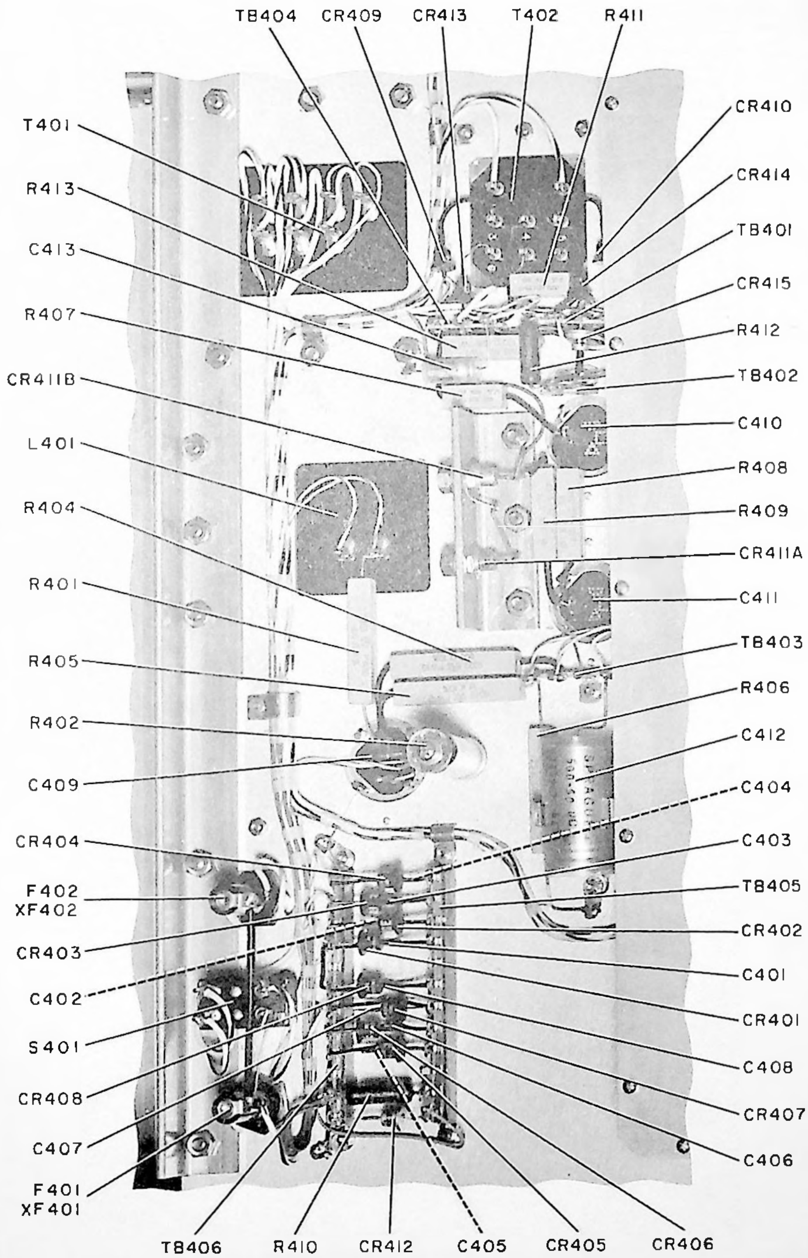


Figure 4-7. Power Supply, Component Identification

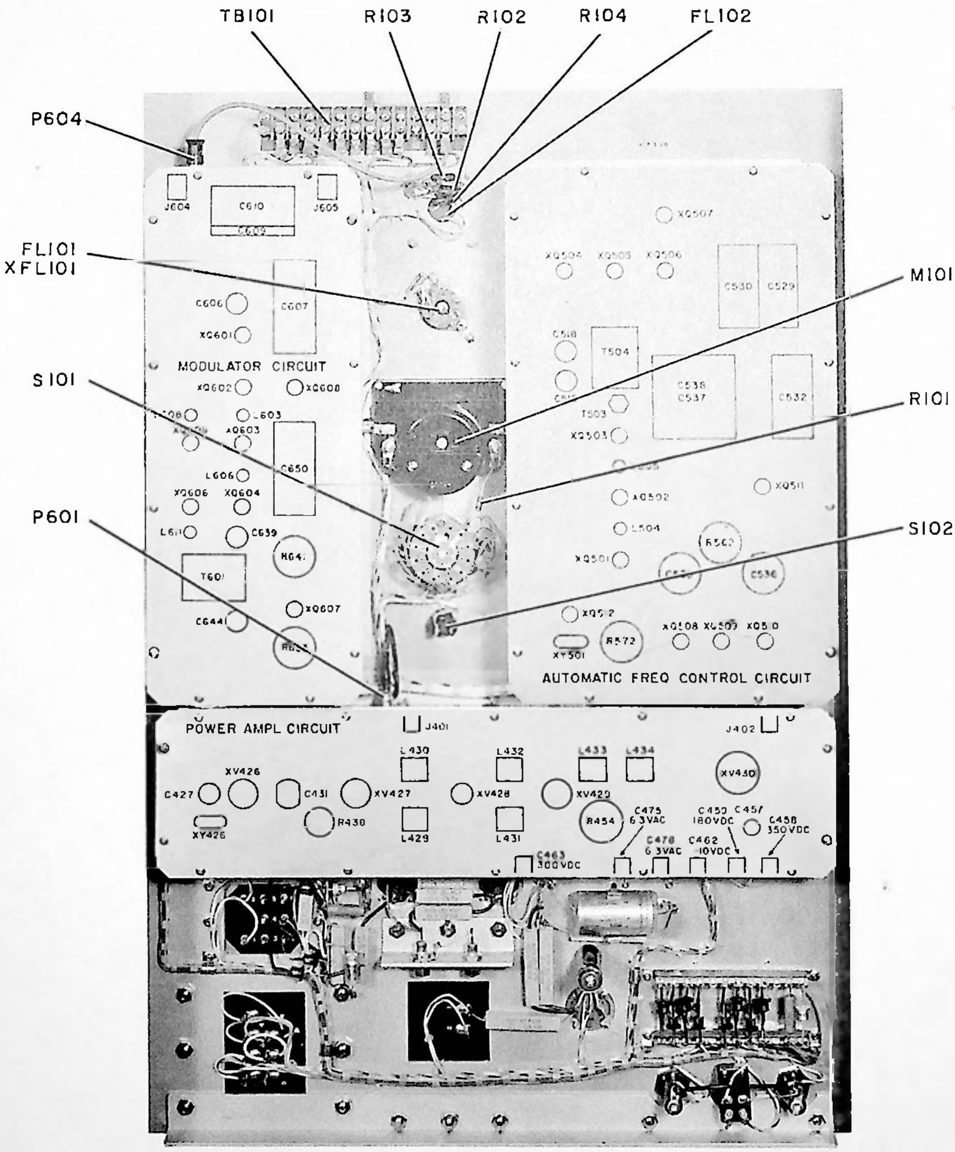


Figure 4-8. Chassis, Component Identification

SECTION V
ILLUSTRATIONS

Figure 5-1. A830-2 10 W Wide-Band FM Broadcast Exciter, Schematic Diagram

Sample Voltages Read on A830 Exciter
With Vacuum Tube Voltmeter

Transistor	Emitter	Base	Collector
Q501	+10.9	+10.8	+1.19
Q502	+12.2	+12.2	+1.18
Q503	+8.8	+9.3	+17.1
Q504	+0.51	+1.14	+9.0
Q505	+0.57	+1.17	+10.3
Q506	+0.53	+1.12	+11.0
Q507	+5.6	+6.4	~~+5.7~~ 14.4
Q508	-1.2 pulsing	B1 -10.5	B2 +9.8
Q509	-10.5	-10.2	-1 to 3 pulsing
Q510	-10.5	-10.3	-0.2 to 3 pulsing
Q511	+13.2	+13.2	+5.7
Q512	+5.25	+5.45	0
Q601	+5.3	+5.3	0
Q602	+5.6	+5.4	+1.24
Q603	+10.1	+9.7	+1.23
Q604	+9.3	+10.0	+16.2
Q605	+8.1	+7.8	0
Q606	+6.4	+7.0	+15.4
Q607	+0.52	+1.07	+15.3
Q608	+15.5	+15.2	+9.7

Tube Type	Pin Number to Ground	Voltage
6U8A	1	+48.0
	2	-1.25
	3	+78.0
	6	+99.0
	7	+0.37
	9	-0.8
12AT7	1	+260.0
	2	-3.2
	3	+1.5
	6	+260.0
	7	-3.1
	8	+1.5
6AU6	1	-5.2
	5	+295.0
	6	+208.0
	7	+0.67
5763	1	+298.0
	6	+260.0
	7	+11.0
	8-9	-2.35

Sample Voltages Read on A830 Exciter - Continued:

Tube Type	Output Minimum	
E26		
1,4,6	+26.0	
3	+188.0	
5	-15.1	
Plate at By-Pass Feedthru	+360.0	
TP501	-8.0 Volts	
TP502	+0.1 or -0.1 volt	(with AFC disabled, meter varies and goes toward zero)
TP503	+5.7 volts	(with AFC disabled, pulsing begins - release, meter goes toward zero, then goes to +8.0 volts and gradually returns to +5.7 volts)
TP504	+10.7 volts	

786M-1
Stereo Generator

COLLINS

unit instructions

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa

TD-537
523-0755304-002418
2nd Edition, 15 October 1963

TABLE OF CONTENTS

Section			Page
I	**GENERAL DESCRIPTION**		3
	1.1	Purpose of Instruction Book	3
	1.2	Purpose of the Equipment	3
	1.3	Description of Equipment	3
	1.3.1	Physical Description	3
	1.3.2	Electrical Description	3
	1.4	Equipment Supplied	4
	1.5	Equipment Required but not Supplied	4
	1.6	Accessory Equipment	4
	1.7	Equipment Specifications	4
	1.7.1	Mechanical	4
	1.7.2	Electrical	4
	1.8	Semiconductor Complement	5
II	**PRINCIPLES OF OPERATION**		6
	2.1	General	6
	2.2	Principles of FM Stereo	6
	2.2.1	Stereophonic Sound Systems	6
	2.2.2	Methods of Generating FCC Stereo	7
	2.3	Principles of Operation of 786M-1	8
	2.3.1	Detailed Description of 786M-1 Stereo Generator	8
	2.3.2	Control Functions	11
III	**MAINTENANCE**		12
	3.1	General	12
	3.2	Servicing Transistor Circuits	12
	3.2.1	Test Equipment	12
	3.2.2	Electric Soldering Irons	12
	3.2.3	Servicing Practices	12

Section			Page
	3.2.4	Trouble Shooting	13
	3.3	Trouble Shooting	13
	3.4	Adjustment and Tests	13
	3.4.1	38-Kc Oscillator Tuning	13
	3.4.2	38-Kc Amplitude Check	14
	3.4.3	Carrier Balance	14
	3.4.4	Pilot Carrier Phase	14
	3.4.5	Pilot Carrier Level	14
	3.4.6	Channel Separation Adjustment	16
	3.5	Minimum Performance Standards	16
	3.5.1	Over-all Gain	16
	3.5.2	Frequency Response	16
	3.5.3	Harmonic Distortion	16
IV		**PARTS LIST**	17
V		**ILLUSTRATIONS**	21

LIST OF ILLUSTRATIONS

Figure		Page
1-1	786M-1 Stereo Generator, Over-all View (C861-16-P)	3
2-1	Elementary Stereophonic System (C861-05-3)	6
2-2	Spectrum of Signals in Baseband Audio (C861-07-3)	7
2-3	An Elementary Time Division Multiplex System (C861-08-3)	8
2-4	786M-1 Stereo Generator, Block Diagram (C861-06-4)	9
2-5	Balanced Modulator Output When L+R=2, L-R=0 (C861-12-2)	10
2-6	Balanced Modulator Output When L+R=1 and L-R=1 (C861-10-3)	10
2-7	Balanced Modulator Output When L+R=0 and L-R=2 (C861-11-2)	10
2-8	786M-1 Control and Adjustment Locations (C861-17-P)	11
3-1	Transistor Base Configuration (C861-09-2)	14
3-2	Pilot Carrier Phase Test Setup (C861-13-3)	14
3-3	Pilot Carrier Phase Adjustment, Oscilloscope Pattern (C861-14-P)	15
3-4	Channel Separation Adjustment, Oscilloscope Pattern (C861-15-P)	16
4-1	786M-1 Stereo Generator, Rear View, Resistor Location (C861-19-P)	19
4-2	786M-1 Stereo Generator, Rear View, Capacitor Location (C861-20-P)	19
4-3	786M-1 Stereo Generator, Rear View, Miscellaneous Parts Location (C861-21-P)	20
4-4	786M-1 Stereo Generator, Front View Parts Location (C861-18-P)	20
5-1	786M-1 Stereo Generator, Schematic Diagram (C861-01-6)	21

LIST OF TABLES

Table		Page
1-1	Associated Equipment Instruction Books	4
1-2	Equipment Supplied	4
1-3	Equipment Required but not Supplied	4
1-4	Accessory Equipment	4
1-5	Semiconductor Complement	5
3-1	Test Equipment Required	13

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

Unit Instructions TD-537 provides information about 786M-1 Stereo Generator, Collins part number 522-2914-00. Information which is furnished includes a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

1.2 PURPOSE OF THE EQUIPMENT.

The 786M-1 Stereo Generator is used to convert stereophonic audio input signals into main and stereophonic subchannel signals and to generate a pilot subcarrier. The resultant signal is suitable for modulation of wide-band FM broadcast exciters.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The 786M-1 Stereo Generator, shown in figure 1-1, is constructed on a standard 19-inch rack-mounted panel. This panel is 19 inches wide, 10-1/2 inches high, 7 inches deep, and weighs approximately 14 pounds. All operating controls are located on the front panel with seldom-used adjustments located inside the back panel. A meter is placed conveniently on the lower left portion of the front panel for monitoring of input and output signals. All transistors and the 38-kc crystal are placed on the front panel for convenient access. Bulky components are grouped in the upper right-hand corner of the front panel leaving the remaining portion of the panel free of obstacles for ease of maintenance and adjustment. All components located in the rear of the unit are protected in a dust-resistant enclosure.

1.3.2 ELECTRICAL DESCRIPTION.

The 786M-1 Stereo Generator is an all transistorized unit consisting of the following circuits; a crystal controlled 38-kilocycle oscillator, a 19-kilocycle locked oscillator, a meter amplifier, two audio amplifiers, and a balanced modulator. All components for operation of the time division stereo generator are

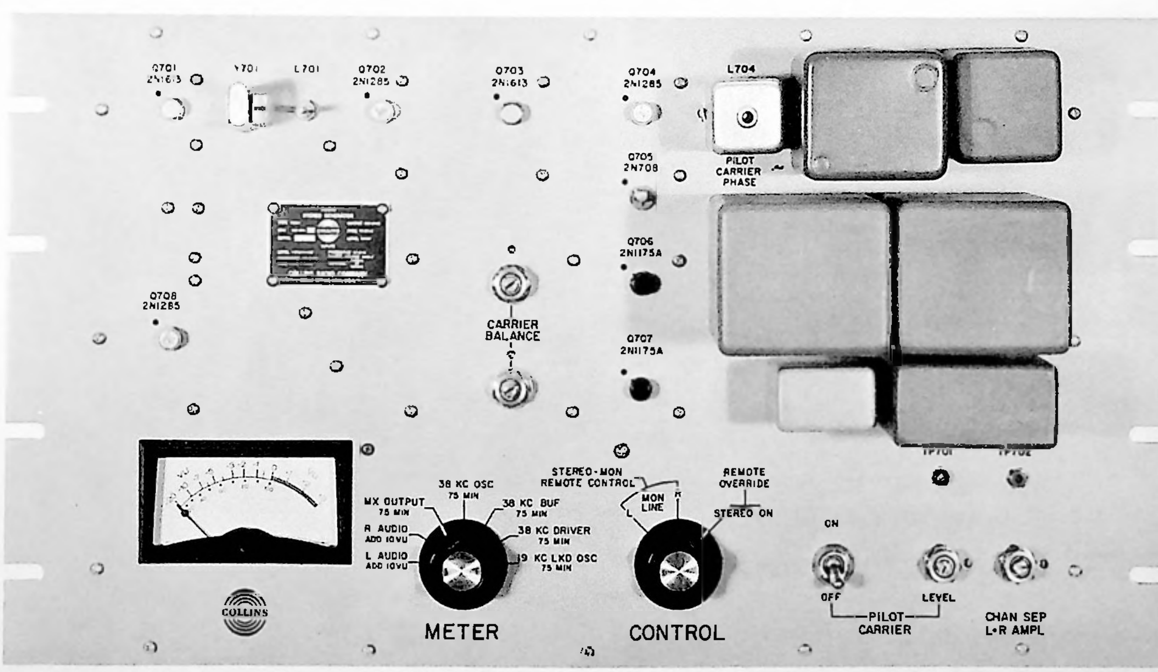


Figure 1-1. 786M-1 Stereo Generator, Over-all View

contained within the 19-inch rack-mounted panel with the exception of a left audio channel pre-emphasis network. This function must be supplied externally and is available in the Collins A830-2 10 W Wide-Band FM Broadcast Exciter.

Power input required is 20 ±0.1 volts d-c which is supplied by the A830-2. Remote control can be exercised over the stereophonic and monophonic modes. Power required for operation of remote control is 28 ±2.8 volts d-c. Instruction books covering the exciter and power amplifiers, used in conjunction with the 786M-1, are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
B830-1 250-Watt FM Power Amplifier	TD-538
D830-1 1000-Watt FM Power Amplifier	TD-567
E830-1 5-Kw FM Power Amplifier	TD-539

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of the 786M-1 Stereo Generator.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
786M-1 Stereo Generator	522-2914-00

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment that is required for operation of the 786M-1 Stereo Generator but not supplied as part of the 786M-1.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00

1.6 ACCESSORY EQUIPMENT.

Table 1-4 lists accessory equipment that is available for use with 786M-1 Stereo Generator.

TABLE 1-4
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
B830-1 250-Watt FM Power Amplifier	549-2008-00
D830-1 1000-Watt FM Power Amplifier	522-2948-00
E830-1 5-Kw FM Power Amplifier	549-2009-00
250-Watt/1-Kw Harmonic Filter	549-2010-00

1.7 EQUIPMENT SPECIFICATIONS.

1.7.1 MECHANICAL.

Weight . . . . 14 pounds approximately.

Size . . . . 19 inches wide, 10-1/2 inches high, 7 inches deep.

Ambient temperature range . . . . +15°C (59°F) to 45°C (113°F).

Ambient humidity range . . . . 0 to 95% relative humidity.

Altitude . . . . 0 to 7500 feet.

1.7.2 ELECTRICAL.

Power source . . . . . 20 ±0.1 volts d-c.

28 ±2.8 volts d-c (for remote operation).

Input . . . . Balanced 600 ohms, left and right channels.

Input level . . . . . . 10 ±2 dbm for 100% composite modulation.

Frequency range . . . 30 to 15,000 cps for each channel.

Output level . . . . . 280 ±50 mv peak to peak.

Pilot carrier frequency . . . . . . 19 kc ±2 cps.

Pilot carrier level . . Equivalent to 9% ±1% modulation of the main carrier.

Channel separation . . Greater than 30 db, 50 cps to 15,000 cps.

Crosstalk . . . . . . More than 40 db below single channel level.

Distortion . . . . . . Less than 0.5% over the frequency range of 30 to 15,000 cps.

38-kc subcarrier suppression . . . . . 40 db below output with 10-dbm input level.

Main channel and stereophonic subcarrier phase relationship. . . ±3 degrees for audio frequencies from 50 to 15,000 cps.

Audio-frequency response . . . . Complies with FCC standard 75-microsecond pre-emphasis curve (right channel only, left channel pre-emphasis is obtained from exciter).

1.8 SEMICONDUCTOR COMPLEMENT.

Table 1-5 lists the semiconductor complement supplied as part of 786M-1 Stereo Generator.

TABLE 1-5. SEMICONDUCTOR COMPLEMENT

SYMBOL	QUANTITY	TYPE	FUNCTION
Q701	1	2N1613	38-kc oscillator
Q702	1	2N1285	38-kc buffer
Q703	1	2N1613	38-kc driver
Q704	1	2N1285	38-kc isolation amplifier
Q705	1	2N708	19-kc locked oscillator
Q706	1	2N1175A	Left audio amplifier
Q707	1	2N1175A	Right audio amplifier
Q708	1	2N1285	Meter amplifier
CR702	4	1N270	Balanced modulator diode switches

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

The 786M-1 Stereo Generator provides facilities for the conversion of stereophonic input signals to an output which conforms to the standards approved by the FCC for the transmission of stereophonic signals. The following paragraphs discuss stereophonic principles and the operation of the 786M-1 Stereo Generator.

2.2 PRINCIPLES OF FM STEREO.

2.2.1 STEREOPHONIC SOUND SYSTEMS.

An elementary stereophonic sound system consists of two directional microphones placed to the right and left of a sound source. See figure 2-1. Each microphone in turn is connected to an amplifier and speaker system. When the listener is situated between the speakers, the left channel will be received by the left ear and the right channel will be received by the right ear. The effect upon the listener of such a system is to simulate placing the listener at a point midway between the two microphones and receiving a true representation of the originating sound source.

To provide a realistic stereo effect, the difference in time delay and signal amplitude from the sound source to each of the microphones must be maintained through the entire stereo system. If the time delay or amplitude difference is changed in one of the amplifier or speaker systems, the effect to the listener will be a change in direction of the sound source, when in reality no change has occurred. A change in time delay of the left or right channel is referred to as a phase relationship change. This phase relationship change between the channels must be held, in stereo transmitting equipment, to within ±3 degrees.

If the amplitude difference and time delay in each system is identical (as when the sound source is centered between the microphones), the sound source will

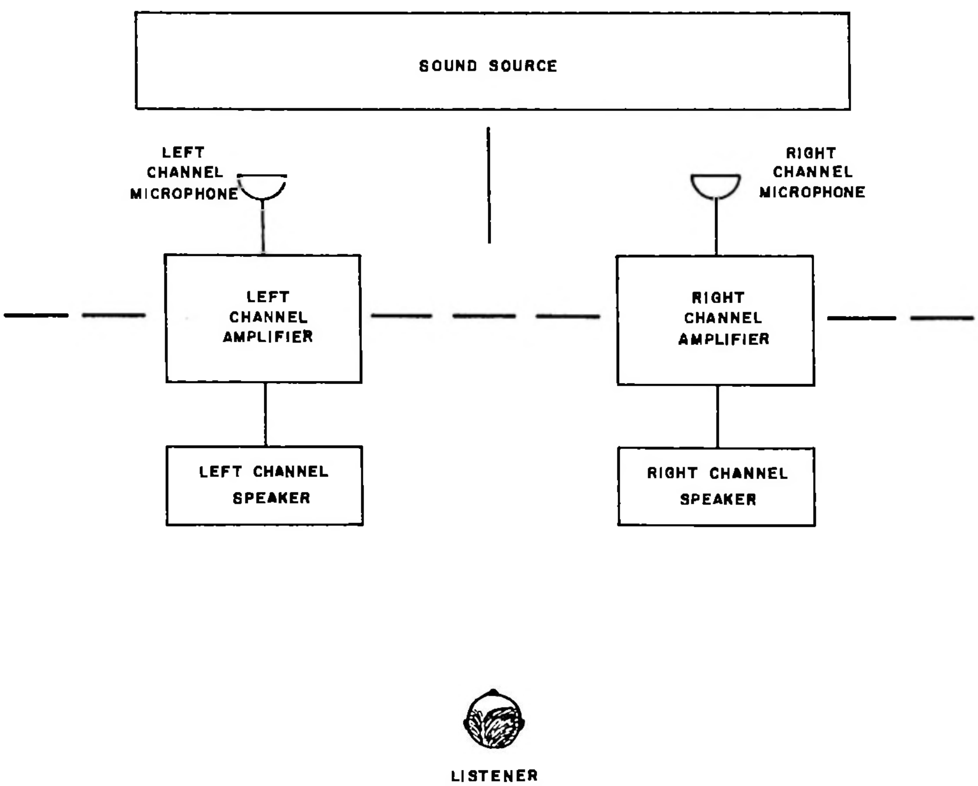


Figure 2-1. Elementary Stereophonic System

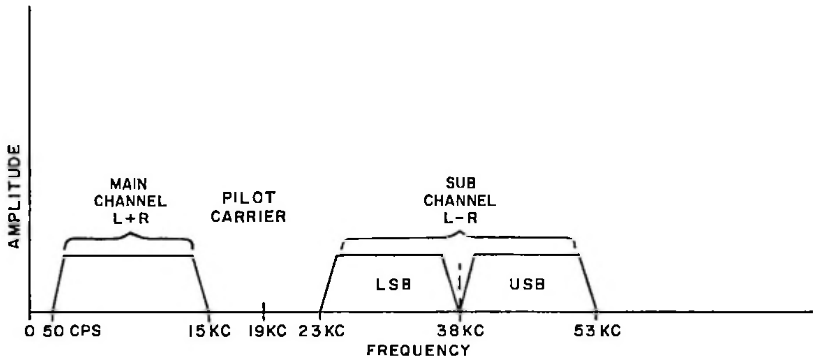


Figure 2-2. Spectrum of Signals in Baseband Audio

appear to the listener to be centered between the speakers. This is actually the true relationship of the microphones and the sound source.

To enhance the stereo effect to the listener, it is desirable for each microphone to be directional, as stated previously, so that sounds originating directly in front of the right microphone will be received by the right microphone, and as little as possible by the left microphone, and vice versa. If too much of the right sound source is picked up by the left microphone or vice versa, the effect to the listener will be to move the sound source to the center. This isolation between the two sound systems is known as channel separation and must be held greater than 29.7 db in stereo transmitting equipment.

If proper isolation of the amplifiers is not obtained, and there is an interchange of signals, the sound source will again appear to move toward the center. If the channel separation is reduced to zero, the effect would be to replace the two microphones with a single microphone feeding the same information to both amplifier and speaker systems. It is then understood that monophonic operation can be obtained by paralleling (adding) the left and right microphone outputs. This monophonic component is referred to as L+R.

An interchange of information between channels (main and subchannel) is referred to as crosstalk. Crosstalk will deteriorate the stereo signals by adding noise to the signal. In stereo transmitting systems, crosstalk must remain at least 40 db below a single channel level.

2.2.2 METHODS OF GENERATING FCC STEREO.

Signals which are prescribed by the FCC for the transmission of stereophonic intelligence is shown in figure 2-2. This band of frequencies must be generated and transmitted in order that both monaural and stereophonic receivers will be able to detect the FM signal. For monaural receivers, only the L+R (left plus right) channel is received, with the pilot carrier and L-R (left minus right) signals rejected by the pass band of the monaural receiver. Stereophonic FM receivers detect the complete band of frequencies in a discriminator and will process the signals into left and right stereophonic channels. The 19-kc pilot carrier is used in this process. The method of generating the signals shown in figure 2-2 depends upon the method chosen for modulating an FM signal.

The methods of modulating an FM signal may be broken down into two groups, a direct and an indirect method. These two general categories may be broken down further into various methods of obtaining the end result. Phase modulation is the most generally used method of generating an FM signal by the indirect method. If this system is used to modulate the composite stereo signal, various problems are encountered. The most serious problem is that of frequency response of the phase modulator. As the phase modulator audio response exhibits nonlinear modulation characteristics (rises 6 db per octave from the lowest to the highest frequency), predistortion is employed to compensate for this trait. In a stereo FM phase modulator this predistortion would amount to 65.5 db over the entire modulating frequency range of 50 cps to 75 kc (SCA added to stereo signal). When a 65-db signal to noise ratio and a 60-db dynamic range is added to this, it is apparent that baseband amplifiers cannot be built to give this characteristic.

It is possible to split the phase modulation into two steps and modulate one phase modulator with the L+R signal and the second phase modulator with the L-R and pilot carrier signals. This type of stereophonic phase modulation is not desirable because of the required phase linearity of ±3 degrees and the gain requirements of stereophonic transmission systems. These requirements are difficult, if not impossible, to maintain.

Another method of FM stereophonic modulation which could be employed is a combination of direct and indirect modulation. With this method the L+R signal directly FM modulates an oscillator, while the L-R signal phase modulates the signal produced in the oscillator, in a later stage. As in phase modulation of the stereophonic signal, it is difficult to maintain phase linearity and gain characteristics.

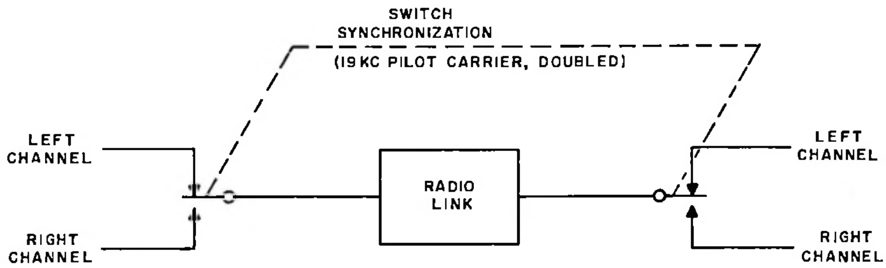


Figure 2-3. An Elementary Time Division Multiplex System

A third method of generating a stereophonic FM signal is by the use of direct modulation over the entire stereophonic generator frequency range. Phase relationship and gain characteristics are then easy to maintain because of the point input source. Until recently, it has been difficult to directly modulate an FM signal with a wide bandwidth of signals. With the advent of solid state components and specifically the production of the variable capacity diode, this wide-band type of modulation is possible. This is the type of modulation used in the Collins A830-2 10 W Wide-Band FM Broadcast Exciter. The development of the wide-band type of modulator made possible the development of 786M-1 Stereo Generator which is discussed in paragraph 2.3.

2.3 PRINCIPLES OF OPERATION OF 786M-1.

The 786M-1 Stereo Generator generates the spectrum of signals shown in figure 2-2 by the time division multiplex method. By this method, shown simplified in figure 2-3, the left and the right channels are switched alternately at a 38-kc rate. If the receiver switching rate is synchronized with the transmitter switching rate, the original left and right audio signals will be detected. In the receiver, the 19-kc pilot carrier is doubled to synchronize the receiver to the transmitter. It is important that the switching frequency in both the stereo generator and the receiver be of the same phase to retain the identity of the left and right audio signals.

The mathematical analysis of two audio signals being switched alternately by a square wave shows that the resultant signal is made up of two components of interest. One component is directly proportional to the sum of the two audio signals (L+R) and the other is a double-sideband (DSB) signal centered on a frequency equal to the switching frequency (38 kc). The modulation appearing on this DSB signal is directly proportional to the difference of the two audio channels (L-R). If L is defined as the audio signal in the left channel, R is defined as the audio signal in the right channel, and f_c is defined as the switching frequency, the composite signal is equal to:

$$\frac{L+R}{2} + \frac{2}{\pi}(L-R) \cos 2\pi f_c t - \frac{2}{3\pi}(L-R) \cos 6\pi f_c t$$

$$+ \frac{2}{5\pi}(L-R) \cos 10\pi f_c t \text{ etc.}$$

The first term of this expansion is the main channel component, the second term is the stereophonic subchannel component, and the remaining terms are higher frequency terms which are undesired.

The following is a block diagram explanation of the 786M-1 Stereo Generator which generates the signals just mentioned. Refer to figure 2-4. It is noted on the block diagram that the left audio channel is fed through the pre-emphasis network and high-pass filter of the A830-2 wide-band exciter and then to the 786M-1.

The right audio channel utilizes the pre-emphasis network and the high-pass filter located in the 786M-1. The outputs of the high-pass filters are fed through 15-kc low-pass filters where audio components above 15 kc are attenuated sharply. The 15-kc filter outputs are then fed to emitter follower amplifiers where isolation of the two channels from the balanced modulator is obtained. The two-channel audio output is then fed to a balanced modulator whose action resembles that of a switch. The balanced modulator utilizes the signal generated in the 38-kc oscillator to alternately switch on and off each audio channel. The balanced modulator consists of the composite spectrum which includes both desired and undesired components. The fundamental 38-kc modulating signal and all even order harmonics are balanced out.

The balanced modulator output is mixed with a small amount of direct L+R signal which equalizes the peak amplitude of the main and subchannel signals. The modulator output is then fed through a 50-cps to 53-kc low-pass linear phase filter where all odd harmonics above 53 kc are attenuated. The filter output is mixed with a 19-kc signal from the pilot carrier phase locked oscillator and is fed to the 786M-1 output. All FCC phasing, channel separation, crosstalk, and amplitude specifications are satisfied within the 786M-1 Stereo Generator.

2.3.1 DETAILED DESCRIPTION OF 786M-1 STEREO GENERATOR.

Refer to figure 5-1, a schematic diagram of the 786M-1. The right audio channel is identical to the left audio channel except that the pre-emphasis network and the 15-kc filter for the left channel are located within the A830-2 exciter. Only the right channel is discussed in the following paragraphs.

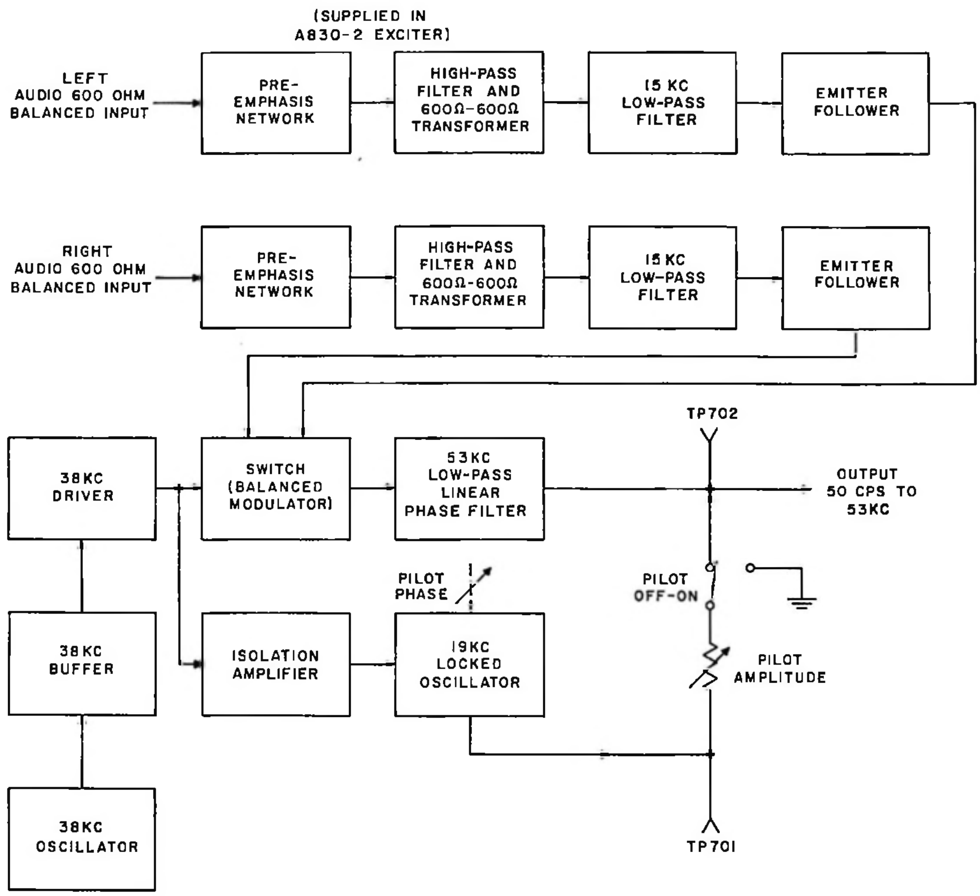


Figure 2-4. 786M-1 Stereo Generator, Block Diagram

The 600-ohm balanced right audio channel is fed into a pre-emphasis network, FL701. Due to the inherently low level of high-frequency audio components in program material, pre-emphasis is employed to overcome the effects of noise which is often found in home receivers. The 786M-1 follows the standard 75-microsecond pre-emphasis curve established by the FCC. The output of pre-emphasis filter FL701 is fed into a 30-cps high-pass filter, FL702, which sharply attenuates audio components below 30 cps. This is necessary to prevent 5-cps audio components from interfering with the 5-cps sampling circuits within the A830-2 exciter. Filter FL702 also transforms the 600-ohm balanced input into a 600-ohm single-ended output.

The output of FL702 is connected to relay K701 which remotely selects either the stereo mode for transmission, or the left or right audio channels for monaural operation. Relay K701 operates by applying 28 volts d-c across the solenoid. This 28-volt d-c source is supplied by the A830-2 exciter. Selection of either the left or right monaural channel is determined by the position of S701. At this point, if either the left or right channel is selected for monaural operation, the single 50-cps to 15-kc audio signal is fed through an 8-db loss pad to the output of the 786M-1 Stereo Generator. The 8-db loss pad is made up of R750, R751, and R752. The resulting audio input to the A830-2 is the same as that obtained without the stereo generator. Switch S701 will also override the remote relay if desired.

If the stereo mode is selected by S701, the audio component is fed to a 15-kc low-pass filter, FL704. FL704 attenuates all frequencies over 15 kc to prevent their interfering with adjacent channels. The output of FL704 is fed to the base of emitter follower Q707, which isolates the audio circuits from the balanced modulator.

The function of the balanced modulator is to generate the L+R and the L-R components shown in figure 2-2. The balanced modulator resembles a switch which samples the left audio channel and the right audio channel in turn. The 38-kc switching frequency and all even order harmonics are balanced out in the modulator output. The 38-kc switching frequency is obtained from the 38-kc driver and is impressed across transformer T701. If the primary switching voltage is negative, the secondary voltage will switch on diodes CR703 and CR704. Thus, right audio will appear at the secondary center tap. If the primary switching

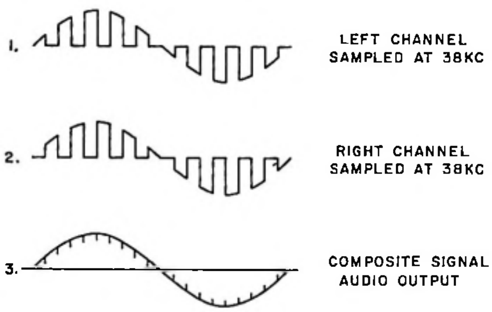


Figure 2-5. Balanced Modulator Output When L+R=2, L-R=0

voltage is positive, the secondary voltage will switch on diodes CR702 and CR705. The left audio channel will then appear on the secondary of T701. A representation of a sine wave input in each channel (L=R, L+R=2, L-R=0) switched in this manner is shown in figure 2-5. It is seen in this illustration that the composite signal at the output of the balanced modulator is a sine wave of an amplitude equal to the original signal level in each channel. The spikes shown on the composite sine wave result from imperfect switching and are filtered out in FL705.

Figure 2-6 shows the balanced modulator output when R=0, L+R=1, and L-R=1. The output of the balanced modulator is an audio component plus DSB components centered on the switching frequency and odd harmonics which form the square wave shape. When the odd harmonics are filtered out by the 53-kc harmonic filter, FL705, the third waveform results. Because the fundamental component of a square wave is $\frac{4}{\pi}$ times the square wave amplitude, the DSB component is larger than the audio. The audio component is then increased by $\frac{4}{\pi}$ and the fourth illustration results. The audio component is added by resistors R724 and R730 which leak a small portion of L+R directly around the balanced modulator. Potentiometer R755 adjusts the audio component so the $\frac{4}{\pi}$ loss in filtering is exactly compensated. Capacitors C736 through C739 are selected capacitor values which balance out the stray balanced modulator capacitance. This balanced condition reduces the suppressed 38-kc switching frequency level to well below the 40 db required by the FCC. On some units these capacitors are unnecessary.

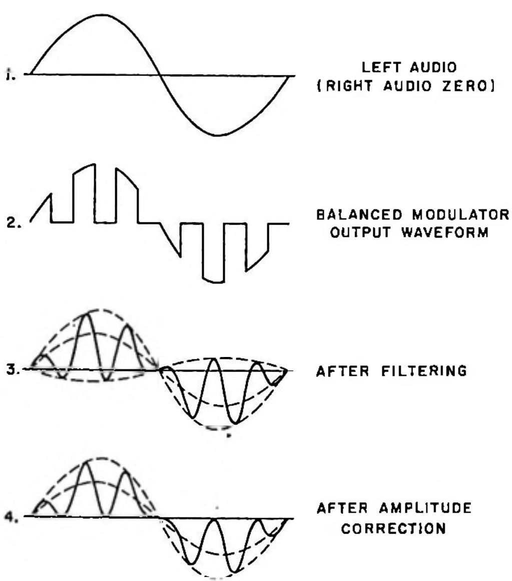


Figure 2-6. Balanced Modulator Output When L+R=1 and L-R=1

Figure 2-7 shows the time division signal when L=-R, or L+R=0, L-R=2. The composite waveform from the balanced modulator is shown in the third illustration. This waveform is composed of audio components and odd harmonics centered on the switching frequency. When the odd harmonics are removed by filtering in FL705, the waveshape in the fourth illustration results. This waveshape is a DSB signal which equals L-R as required by the matrix process.

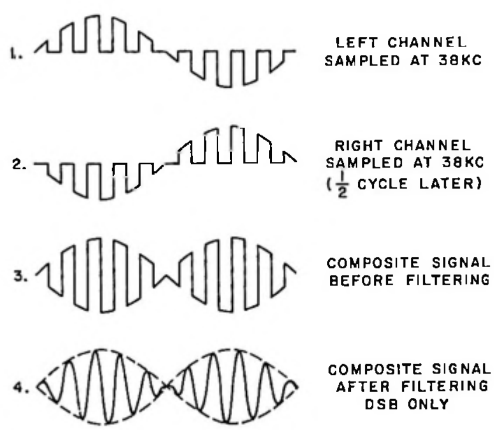


Figure 2-7. Balanced Modulator Output When L+R=0 and L-R=2

The output of the balanced modulator and L+R mixing is fed to a low-pass 53-kc filter, FL705. Filter FL705 removes all harmonics and noise above 53 kc to form the DSB waveshape as shown in figures 2-6 and 2-7. The output from FL705 is mixed with a 19-kc pilot carrier and fed to the stereo override switch, S701, and the remote relay, K701. Operation at this point is similar to audio switching which was discussed earlier. If relay K701 is energized and S701 is in the STEREO ON position, the composite stereo is fed to J701 for connection to the A830-2 10 W Wide-Band FM Exciter.

The balanced modulator switching frequency is obtained from crystal-controlled oscillator Q701. Oscillations are sustained by taking the output of L701

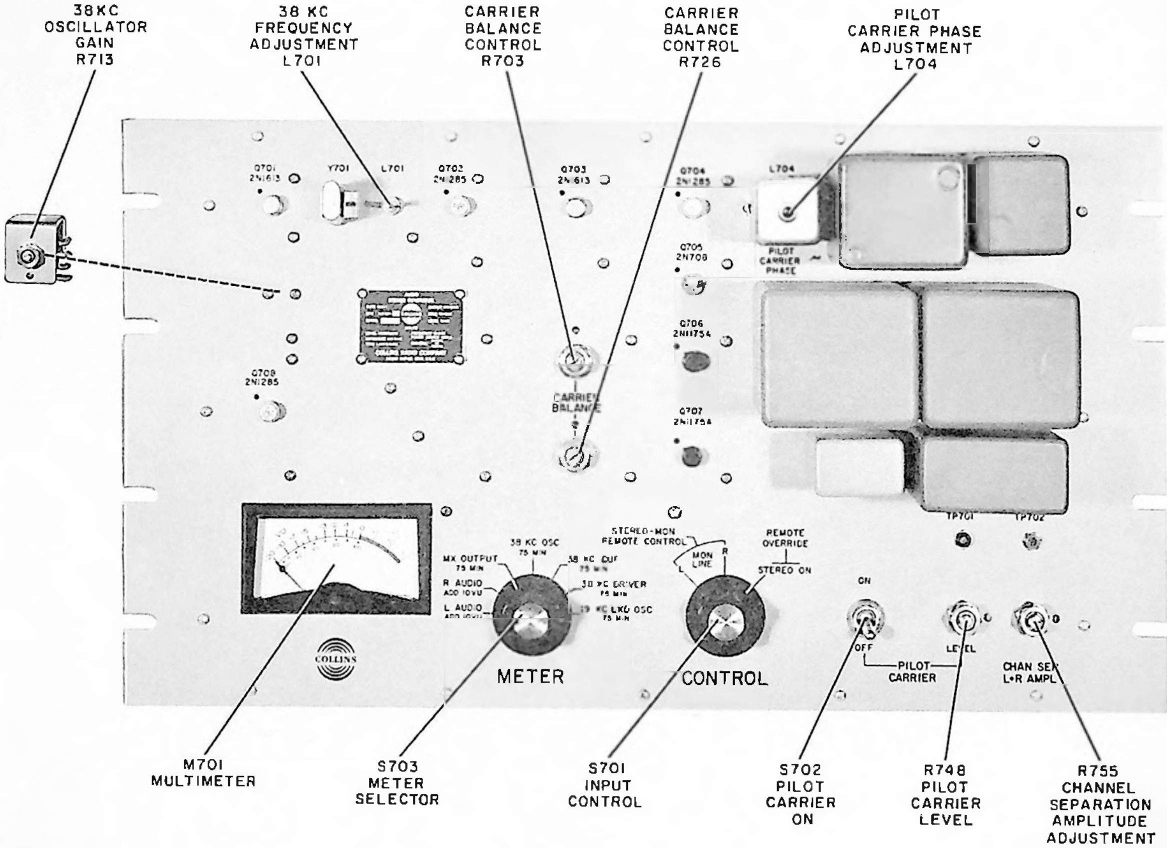


Figure 2-8. 786M-1 Control and Adjustment Locations

and feeding it into the base of Q701. The 38-kc output of L701 is also capacitively coupled into the 38-kc buffer amplifier, Q702. The output of Q702 is tuned to 38 kc by C714 and L702. The output of buffer amplifier Q702 is further amplified to approximately 4 volts peak to peak by driver amplifier Q703. The gains of Q701, Q702, and Q703 are stabilized by emitter degeneration to reduce gain variations between transistors. The output of Q703 is capacitively coupled to the primary of T701 (balanced modulator switching transformer) and to the 19-kc pilot carrier locked oscillator through an isolation stage, Q704.

The pilot carrier oscillator, Q705, is basically a grounded base oscillator which is synchronized by injecting a 38-kc signal into the base. The oscillator output is a 19-kc resonant tank placed across the base to emitter junction by means of a capacity voltage divider. The 19-kc output is taken from the emitter circuit and is injected into the output of FL705. The pilot carrier phase, which must be maintained in phase with the output of FL705, is adjusted by varying the inductance of L704. Pilot carrier level is adjusted with R748.

Metering circuits are provided within the 786M-1 to assist in trouble shooting. Meter amplifier Q705 provides isolation of the matrixing and oscillator circuits from the metering circuits. The right audio and left audio channels are fed directly from the 600-ohm balanced input through meter multiplying resistors R711 and R710 to meter M701.

2.3.2 CONTROL FUNCTIONS.

The following paragraphs describe the functions of all controls in the 786M-1 Stereo Generator. Refer to figure 2-8 for control locations.

Meter selector S703 connects meter M701 into various circuits for monitoring purposes. The metering positions are as follows; L AUDIO (left audio), R AUDIO (right audio), MX OUTPUT (multiplex output), R AUDIO OSC (38-kc oscillator), 38 KC BUF (38-kc buffer amplifier), 38 KC DRIVER, and 19 KC LKD OSC (19-kc locked oscillator output).

Audio input switch S701 selects one of three possible audio inputs; left audio, right audio, and stereo. If switch S701 is placed in the left audio or right audio positions, remote relay K701 is able to provide remote control over the monaural or stereo modes. When S701 is in the stereo mode, relay K701 is disabled and has no effect on stereo generator inputs.

CARRIER BALANCE controls R703 and R726 balance out the 38-kc carrier and 76-kc second harmonic in the secondary of T701. These controls are adjusted for zero indication at TP701 with no audio in either channel.

Channel separation L+R amplitude control (CHAN SEP L+R AMPL) R755 adjusts the amount of L+R fed around the balanced modulator to raise the L+R level by $\frac{4}{\pi}$.

Inductor L701 adjusts the frequency of the 38-kc oscillator. Resistor R713 adjusts the level of the 38-kc driver output into the balanced modulator. This level is set for 6 volts peak to peak at TP701 at the factory and should never need readjustment.

PILOT CARRIER PHASE control L704 adjusts the phase of the 19-kc pilot carrier. The control is set for an in-phase condition with relation to the output of FL705. PILOT CARRIER LEVEL control R748 adjusts the level of the 19-kc pilot carrier. This control is set for 0.009 volt rms at TP701. PILOT CARRIER switch S702 turns the 19-kc pilot carrier off and on for adjustment and testing purposes.

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains information concerning the maintenance of the 786M-1 Stereo Generator.

NOTE

As some transistor cases are electrically above ground, do not short transistor cases to ground or damage to the transistor may result. Always replace transistors with the transistor locating mark placed adjacent to the transistor socket.

3.2 SERVICING TRANSISTOR CIRCUITS.

Servicing procedures and test equipments that have been used in the past with other types of electronic equipment, for the most part, may be used with transistor circuits. Some special precautions which must be used are listed below.

3.2.1 TEST EQUIPMENT.

Damage to transistors by test equipment is usually the result of accidentally applying too much voltage to the transistor elements. Common causes of damage from test equipment are as follows:

a. Test equipment with a transformerless power supply is one source of such voltage. This type of test equipment can be used by employing an isolation transformer in the power line.

b. It is still possible to damage transistors from line voltage even though the test equipment has a power transformer in the power supply, if the test equipment is equipped with a line filter. This filter may act like a voltage divider and apply 55 volts a-c to the transistor. To eliminate trouble from this situation, connect a ground wire from the chassis of the test equipment to the chassis of the equipment under test before making any other connections.

c. Another cause of transistor damage is a multimeter that requires excessive current for adequate indications. Multimeters that have sensitivities of less than 5000 ohms per volt should not be used. A multimeter with lower sensitivity will draw too much current through many types of transistors and damage them. Use of 20,000-ohm-per-volt meters or vacuum-tube volt meters is recommended. Check the ohmmeter circuits (even those in vtvm's) on all scales with an external, low-resistance milliammeter in series with the ohmmeter leads. If the ohmmeter draws more than one milliampere on any range, this range cannot be used safely on small transistors.

3.2.2 ELECTRIC SOLDERING IRONS.

The following are possible causes of transistor damage from soldering irons:

a. Electric soldering irons may damage transistors through leakage current. To check a soldering iron for leakage current, connect an a-c volt meter between the tip of the iron and a ground connection, allow the iron to heat, then check for a-c voltage with the meter. Reverse the plug in the a-c receptacle and again check for voltage. If there is any indication on the meter, isolate the iron from the a-c line with a transformer. The iron may be used without the isolation transformer if the iron is plugged in and brought to temperature then unplugged for the soldering operation. It is also possible to use a ground wire between the tip of the iron and the chassis of the equipment being repaired to prevent damage from leakage current.

b. Light-duty soldering irons of 20 to 25 watts capacity are adequate for transistor work and should be used. If it is necessary to use a heavier duty iron, wrap a piece of number 10 copper wire around the tip of the iron and make it extend beyond the tip of the iron. Tin the end of the piece of copper wire and use it as the soldering tip.

3.2.3 SERVICING PRACTICES.

a. If a transistor is to be evaluated in an external test circuit, be sure that no more voltage is applied to the transistor than normally is used in the circuit from which it came.

b. Test prods should be clean and sharp. Because many of the resistors used in transistorized equipments have low values, any additional resistance produced by a dirty test prod will make a good resistor appear to be out of tolerance.

3.2.4 TROUBLE SHOOTING.

The usual trouble-shooting practices apply to transistors. Be sure the test equipment and tools meet the requirements outlined in the above paragraphs. It is recommended that transistor testers be used to evaluate the transistor.

If a transistor tester is not available, a good ohmmeter may be used for testing. Be sure the ohmmeter meets the requirements as set forth in the paragraph on test equipment, above. To check a PNP transistor, connect the positive lead of the ohmmeter to base and the negative lead to the emitter. (The red lead is not necessarily the positive lead on all ohmmeters.) Generally, a resistance reading of 50,000 ohms or more should be obtained. Connect the negative lead to the collector; again a reading of 50,000 ohms or more should be obtained. Reconnect the circuit with the negative lead of the ohmmeter to the base. With the positive lead connected to the emitter, a value of resistance in the order of 500 ohms or less should be obtained. Likewise, with the positive lead connected to the collector, a value of 500 ohms or less should be obtained.

Similar tests made on an NPN transistor produce results as follows: With the negative ohmmeter lead connected to the base, the value of resistance between the base and the emitter and between the base and the collector should be high. With the positive lead of the ohmmeter connected to the base, the value of resistance between the base and the emitter and between the base and collector should be low. If the readings do not check out as indicated, the transistor probably is defective and should be replaced.

CAUTION

If a defective transistor is found, make sure that the circuit is in good operating order before inserting the replacement transistor.

Make sure that the value of the bias resistors in series with the various transistor elements are as shown on the schematic diagram. The transistor is very sensitive to improper bias voltages; therefore, a short or open circuit in the bias resistors may damage the transistor. For this reason, do not trouble-shoot by shorting various points in the circuit to ground and listening for clicks.

3.3 TROUBLE SHOOTING.

Trouble shooting can best be accomplished by using standard trouble-shooting techniques. Suspected troubles should be isolated to individual stages before components are replaced. The pilot carrier can be turned off with switch S702 as an aid in trouble shooting and testing.

3.4 ADJUSTMENTS AND TESTS.

The 786M-1 is fitted with adjustments which adjust 38-kc oscillator tuning, carrier balance, pilot carrier level, and pilot carrier phase.

NOTE

Do not attempt the following adjustments without using the proper test equipment as serious deterioration of the 786M-1 output quality may result from the use of inferior test equipment.

The test equipments or their equivalents required to perform the specified tests are listed in table 3-1.

TABLE 3-1
TEST EQUIPMENT REQUIRED

EQUIPMENT	MANUFACTURER AND TYPE
Oscilloscope	Tektronix Model 545A with Type 53/54C plug-in unit and a Type D plug-in unit
Oscillator	Hewlett-Packard Model 200AB
Distortion and noise meter	Hewlett-Packard Model 330D
Vtvm	Hewlett-Packard Model 400H (or equivalent)

Figure 3-1 is a standard transistor base, viewed from the bottom, which provides a transistor element reference.

3.4.1 38-KC OSCILLATOR TUNING.

Turn on the A830-2 10 W Wide-Band FM Exciter. Connect an a-c vtvm to the collector of Q702. (See figure 3-1.) Turn R713 fully clockwise. Adjust L701 for a maximum indication on the vtvm. The oscillator output at the collector of Q702 should be approximately 1.5 volts.

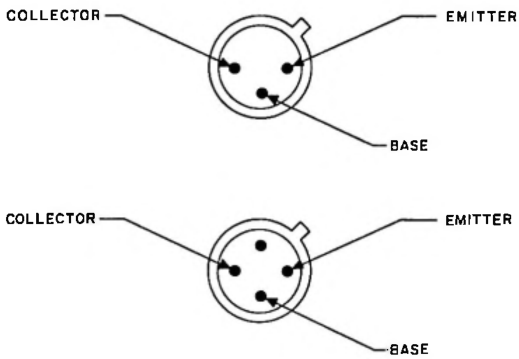


Figure 3-1. Transistor Base Configuration

3.4.2 38-KC AMPLITUDE CHECK.

Connect a calibrated Tektronix oscilloscope, provided with a Type D plug-in unit, across terminals 1 and 2 of T701. The voltage at this point should be 6 volts peak to peak as read on the oscilloscope. Adjust R713 if necessary to obtain 6 volts.

3.4.3 CARRIER BALANCE.

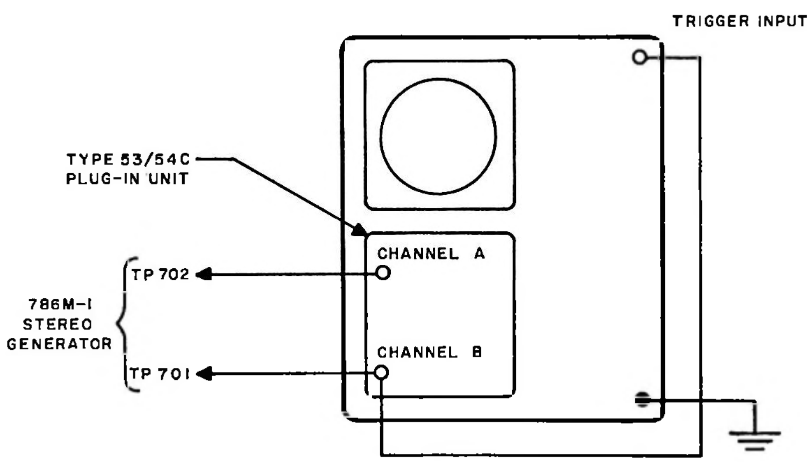
Turn the PILOT CARRIER switch to OFF. Remove any audio from the left and right audio channels. Connect the Tektronix oscilloscope with the Type D plug-in unit to TP702 and ground. Adjust in turn R703 and R726 in small steps for a minimum indication on the oscilloscope. The final indication on the oscilloscope must be more than 40 db below 100 millivolts (1.0 millivolts).

3.4.4 PILOT CARRIER PHASE.

Connect the Tektronix oscilloscope to the 786M-1 Stereo Generator as shown in figure 3-2. Connect the audio oscillator into the 786M-1 through 10-db pads to give an L= -R signal (right audio channel 180 degrees out of phase with the left audio channel) into the audio input terminals at a frequency of 1000 cps and a level of 7.8 volts rms. Set the PILOT CARRIER switch to OFF. Switch the CONTROL switch to STEREO ON. Adjust the PILOT CARRIER PHASE control until both traces on the oscilloscope are stationary and an exact coincidence of the zero crossings of the 19-kc pilot carrier and the L-R signal is obtained as shown in figure 3-3. Expand the sweep to 5X, and adjust the horizontal position knob to check the two points of coincident zero crossing.

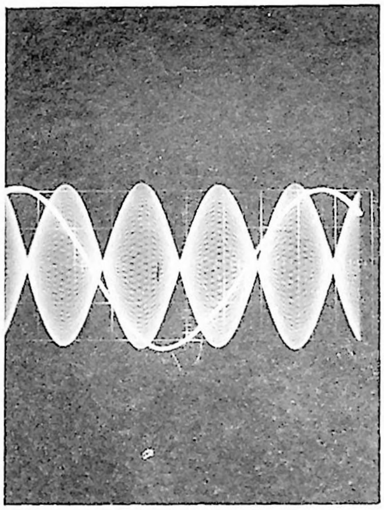
3.4.5 PILOT CARRIER LEVEL.

Remove any audio from the 786M-1 audio input channels and connect a vtvm to TP702. Set the PILOT CARRIER switch to ON, and adjust the PILOT CARRIER LEVEL control for a reading of 0.009 volt rms as read on the vtvm.

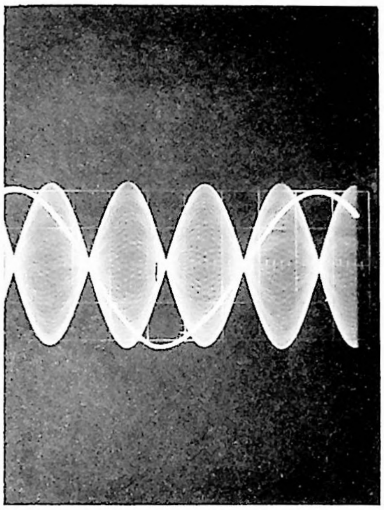


CONTROL SETTINGS	
1. CHANNEL A	0.05 V/CM, TP702
2. CHANNEL B	0.05 V/CM, TP701
3. MODE - ALTERNATE	
4. TRIGGERING MODE - AUTOMATIC TRIGGER SLOPE - + EXTERNAL	
5. SWEEP TIME/CM 5 USEC	
6. MAGNIFIER	X1, X5

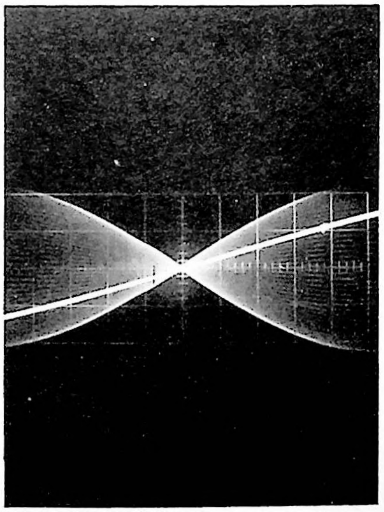
Figure 3-2. Pilot Carrier Phase Test Setup



MALADJUSTMENT OF PILOT CARRIER PHASE CONTROL.



PROPER ADJUSTMENT OF PILOT CARRIER PHASE CONTROL.



PROPER ADJUSTMENT OF PILOT CARRIER PHASE CONTROL, EXPANDED HORIZONTAL DEFLECTION.

Figure 3-3. Pilot Carrier Phase Adjustment, Oscilloscope Pattern

3.4.6 CHANNEL SEPARATION ADJUSTMENT.

Set the audio oscillator to 5000 cps, and connect it to the left audio input of the 786M-1. Connect the Tektronix oscilloscope with the type D plug-in unit to TP702 and ground, and adjust the audio oscillator for a 300-millivolt peak-to-peak indication on the oscilloscope. Adjust the CHAN SEP L+R AMPL control to produce a straight zero axis (within 4 millivolts) as shown in figure 3-4. Repeat with the audio input into the right audio channel. The final adjustment must bring the zero axis to within 4 millivolts of a straight zero axis.

3.5 MINIMUM PERFORMANCE STANDARDS.

3.5.1 OVER-ALL GAIN.

a. Connect the Tektronix oscilloscope to TP702 and ground.

b. Switch the PILOT CARRIER switch to OFF.

c. Connect the audio oscillator through 10-db pads to the 786M-1 in such a way to obtain an L=R signal (left channel equal in amplitude and phase with right channel).

d. Adjust the audio oscillator frequency to 1000 cps, and adjust the audio oscillator output to obtain 0 VU on the 786M-1 VU meter when the METER switch is set to L AUDIO or R AUDIO. The peak-to-peak indication on the oscilloscope shall be from 200 to 300 millivolts.

e. Connect the audio input so L= -R (right channel equal in amplitude but 180 degrees out of phase with the left channel). The peak-to-peak indication shall be from 200 to 300 millivolts.

3.5.2 FREQUENCY RESPONSE.

a. Connect the distortion analyzer between TP702 and ground.

b. Switch the PILOT CARRIER switch to OFF.

c. Connect the audio oscillator through 10-db pads to each channel in such a way to obtain an L=R signal (left channel equal in amplitude and in phase with right channel).

d. Adjust the audio oscillator frequency to 1000 cps, and adjust the audio oscillator output to obtain 0 VU on the 786M-1 VU meter when the METER switch is set to L AUDIO. Set the distortion analyzer to 0 db.

e. Set the audio oscillator to 50 cps, and adjust the audio level from the audio oscillator for 0 VU on the 786M-1 VU meter. The indication on the distortion analyzer shall be within ±0.5 db of the level at 1000 cps.

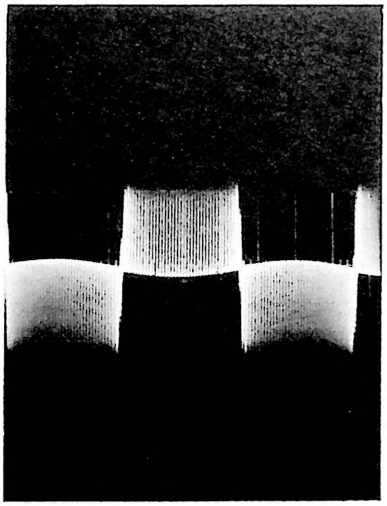
f. Repeat step e at 15,000 cps. The indication on the distortion analyzer shall be within ±1.5 db of the level at 1000 cps.

g. Repeat steps d, e, and f with the METER switch set at R AUDIO.

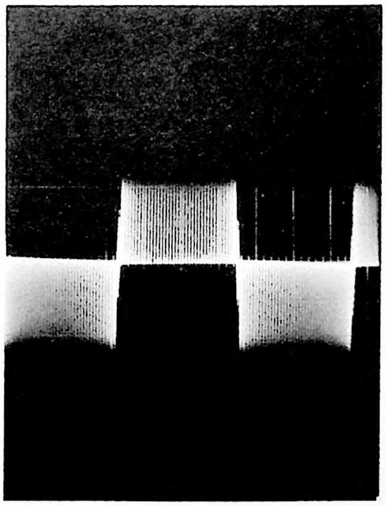
3.5.3 HARMONIC DISTORTION.

a. Connect the test setup as described in paragraph 3.5.2, steps a, b, and c.

b. The distortion at 50, 1000, and 15,000 cps should be not more than one percent.



MALADJUSTMENT OF CHANNEL SEPARATION L AND R AMPL CONTROL.



PROPER ADJUSTMENT OF CHANNEL SEPARATION L AND R AMPL CONTROL.

Figure 3-4. Channel Separation Adjustment, Oscilloscope Pattern

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	786M-1 STEREO GENERATOR	522-2914-00
C701	CAPACITOR, FIXED, ELECTROLYTIC: 30 uf -10% +100%, 10 v d-c	183-1377-00
C702	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf -10% +100%, 25 v d-c	183-1379-00
C703	CAPACITOR, FIXED, ELECTROLYTIC: same as C701	183-1377-00
C704	CAPACITOR, FIXED, ELECTROLYTIC: same as C702	183-1379-00
C705	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 12 v d-c; Sprague Electric part no. 30D157A1	183-1190-00
C706	CAPACITOR, FIXED, ELECTROLYTIC: same as C705	183-1190-00
C707	CAPACITOR, FIXED, ELECTROLYTIC: 15 uf -10% +100%, 25 v d-c; Sprague Electric part no. 40D180A1	183-1362-00
C708	CAPACITOR, FIXED, MICA: 6800 uuf ±10%, 300 v d-c	935-2110-00
C709	CAPACITOR, FIXED, PAPER: 0.047 uf ±10%, 400 v d-c; Sprague Electric part no. 160P47394	931-0295-00
C710	CAPACITOR, FIXED, PAPER: 0.1 uf ±10%, 400 v d-c; Sprague Electric part no. 160P10494	931-0299-00
C711	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf -10% +100%, 25 v d-c; Sprague Electric part no. 40D181A2	183-1365-00
C712	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C713	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C714	CAPACITOR, FIXED, MICA: 1800 uuf ±5%, 500 v d-c; Electro Motive part no. DM20F182J500WV	912-3333-00
C715	CAPACITOR, FIXED, PAPER: same as C710	931-0299-00
C716 thru C719	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C720	CAPACITOR, FIXED, MICA: 510 uuf ±5%, 500 v d-c; Electro Motive part no. DM19E511J	912-2980-00
C721	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C722	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C723	CAPACITOR, FIXED, FILM: same as C710	931-0299-00
C724	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C725	CAPACITOR, FIXED, MICA: 10,000 uuf ±2%, 500 v d-c; Electro Motive part no. DM30F103G	912-2734-00
C726	CAPACITOR, FIXED, PAPER: 0.0015 uf ±10%, 1000 v d-c; Sprague Electric Co. part no. 16(	931-0279-00
C727	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C728	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C729	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C730	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf -10% + 100%, 50 v d-c	183-1369-00
C731	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C732	CAPACITOR, FIXED, CERAMIC: 4700 uuf ±20%, 500 v d-c; MIL type CK62AW472M	913-1187-00
C733 thru C735	CAPACITOR, FIXED, CERAMIC: same as C732	913-1187-00
•C736	CAPACITOR, FIXED, CERAMIC: 5 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CH050D	916-0118-00
•C736	CAPACITOR, FIXED, CERAMIC: 10 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CH100D	916-0138-00
•C736	CAPACITOR, FIXED, CERAMIC: 15 uuf ±5%, 500 v d-c; MIL type CC20CH150J	916-0671-00
•C736	CAPACITOR, FIXED, CERAMIC: 20.0 uuf ±5%, 500 v d-c; MIL type CC20CH200J	916-0677-00

•Selected and added by test in the vicinity of TB714, TB718, and T701

ITEM	DESCRIPTION	COLLINS PART NUMBER
•C737	CAPACITOR, FIXED, CERAMIC: 5 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CH050D	916-0118-00
•C737	CAPACITOR, FIXED, CERAMIC: 10 uuf ±1/2 uuf, 500 v d-c, MIL type CC20CH100D	916-0138-00
•C738	CAPACITOR, FIXED, CERAMIC: 1.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CK010D	916-0071-00
•C738	CAPACITOR, FIXED, CERAMIC: 2.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CK020D	916-0076-00
•C738	CAPACITOR, FIXED, CERAMIC: 3.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CJ030D	916-0145-00
•C738	CAPACITOR, FIXED, CERAMIC: 4.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CH040D	916-0114-00
•C739	CAPACITOR, FIXED, CERAMIC: 1.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CK010D	916-0071-00
•C739	CAPACITOR, FIXED, CERAMIC: 2.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CK020D	916-0076-00
•C739	CAPACITOR, FIXED, CERAMIC: 3.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CJ030D	916-0145-00
•C739	CAPACITOR, FIXED, CERAMIC: 4.0 uuf ±1/2 uuf, 500 v d-c; MIL type CC20CH040D	916-0114-00
CR701	NOT USED	
CR702 A,B,C, &D	SEMICONDUCTOR DEVICE, SET: four hermetically sealed matched germanium diodes; Hughes Products part no. MQ4032	353-2041-00
FL701	ATTENUATOR, FIXED: pre-emphasis network for u/in FM commercial broadcast equipment; 75 microseconds, 600 ohms input and output	379-0426-00
FL702	FILTER, HIGH PASS: metal encased, hermetically sealed, input 600 ohms, output 600 ohms, 4 solder-type terminals, continuous duty cycle; A.D.C. part no. D10390	673-0869-00
FL703	FILTER, LOW PASS: continuous duty cycle, input 600 ohms ±20%, output 600 ohms ±20%, metal encased, hermetically sealed; C.A.C. part no. 90-1015-00	673-0871-00
FL704	FILTER, LOW PASS: same as FL703	673-0871-00
FL705	FILTER, LOW PASS: linear, continuous duty cycle, input 600 ohms ±20%, output 600 ohms ±20%, metal encased, hermetically sealed, solder-type terminals; C.A.C. part no. 90-1012-00	673-0870-00
J701	JACK, TIP: insulated for u/w 0.080 in. test probes; brown; E.F. Johnson part no. 105-208-200	360-0152-00
J702	JACK, TIP: insulated for u/w 0.080 in. test probes; red; E.F. Johnson part no. 105-202-200	360-0150-00
K701	RELAY, ARMATURE. 4 C contact arrangement: 0.25 amp, 300 v d-c, 1 inductive winding, 250 ohms resistance, 27.5 v d-c; 0.11 amp approx operating current; Aemco, Inc. part no. 94-3473	974-0127-00
L701	COIL, RADIO FREQUENCY: multilayer solenoid type winding; 2.3 ohms; -15°C to +55°C; 0.5 to 3.5 mh; Chicago Standard Transformer Corp. part no. WC-7	278-0734-00
L702	COIL, RADIO FREQUENCY: single layer wound, 10,000 uh, 66.5 ohms d-c, 75 ma current rating; Delevan part no. 2500-76	240-2564-00
L703	COIL, RADIO FREQUENCY: same as L702	240-2564-00
L704	COIL, RADIO FREQUENCY: 8 mh inductance; w/core; 1-5/32 in. by 1-5/32 in. by 2-1/2 in. excl terminals; Communications Coil part no. X-544-2	278-0780-00
M701	METER, AUDIO LEVEL: VU Meter for use in equipments exposed to environments; background color, white	456-0056-00
O701	KNOB: setscrew type; black phenolic body; 1.125 in. dia by 0.843 in. thk w/ skirt	546-1294-003
O702	KNOB: same as O701	546-1294-003
P701	PLUG, TELEPHONE: brass; phenolic insulation, w/solder-lug terminal; Switchcraft part no. 3501MC	361-0062-00
Q701	TRANSISTOR: hermetically sealed NPN diffused silicon planar transistor; Fairchild Semiconductor Corp. part no. 2N1613	352-0349-00
Q702	TRANSISTOR: germanium; RCA part no. 2N1285	352-0243-00
Q703	TRANSISTOR: same as Q701	352-0349-00
Q704	TRANSISTOR: same as Q702	352-0243-00
Q705	TRANSISTOR: hermetically sealed; NPN silicon; Fairchild Semiconductor Corp. part no. 2N708	352-0322-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
Q706	TRANSISTOR: hermetically sealed, PNP germanium; General Electric part no. 2N1175A	352-0315-00
Q707	TRANSISTOR: same as Q706	352-0315-00
Q708	TRANSISTOR: same as Q702	352-0243-00
R701	RESISTOR, FIXED, FILM: 750 ohms ±1%, 1/4 w	705-7090-00
R702	RESISTOR, FIXED, FILM: same as R701	705-7090-00
R703	RESISTOR, VARIABLE, WIREWOUND: 10 ohms ±10%, 2 w	377-0113-00
R704	RESISTOR, FIXED, COMPOSITION: 3900 ohms ±10%, 1/2 w	745-1377-00
R705	RESISTOR, FIXED, COMPOSITION: 15,000 ohms ±10%, 1/2 w	745-1401-00
R706	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 1/2 w	745-1373-00
R707	RESISTOR, FIXED, COMPOSITION: same as R704	745-1377-00
R708	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R709	RESISTOR, FIXED, COMPOSITION: same as R706	745-1373-00
R710	RESISTOR, FIXED, FILM: 1330 ohms ±1%, 1/4 w	705-7102-00
R711	RESISTOR, FIXED, FILM: same as R710	705-7102-00
R712	RESISTOR, FIXED, COMPOSITION: 33,000 ohms ±10%, 1/2 w	745-1415-00
R713	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms ±20%, 0.2 w	376-0205-00
R714	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R715	RESISTOR, FIXED, COMPOSITION: 120 ohms ±10%, 1/2 w	745-1314-00
R716	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R717	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R718	RESISTOR, FIXED, COMPOSITION: same as R712	745-1415-00
R719	RESISTOR, FIXED, COMPOSITION: 12,000 ohms ±10%, 1/2 w	745-1398-00
R720	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00
R721	RESISTOR, FIXED, COMPOSITION: 180 ohms ±10%, 1/2 w	745-1321-00
R722	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%, 1/2 w	745-1370-00
R723	RESISTOR, FIXED, COMPOSITION: 39 ohms ±10%, 1/2 w	745-1293-00
R724	RESISTOR, FIXED, FILM: 1960 ohms ±1%, 1/4 w	705-7110-00
R725	RESISTOR, FIXED, FILM: 464 ohms ±1%, 1/4 w	705-7080-00
R726	RESISTOR, VARIABLE, WIREWOUND: same as R703	377-0113-00
R727	RESISTOR, FIXED, FILM: same as R725	705-7080-00
R728	RESISTOR, FIXED, FILM: same as R725	705-7080-00
R729	RESISTOR, FIXED, FILM: same as R725	705-7080-00
R730	RESISTOR, FIXED, FILM: same as R724	705-7110-00
R731	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R732	RESISTOR, FIXED, COMPOSITION: same as R706	745-1373-00
R733	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R734	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R735	RESISTOR, FIXED, FILM: 13,300 ohms ±1%, 1/4 w	705-7150-00
R736	RESISTOR, FIXED, COMPOSITION: 560 ohms ±10%, 1/2 w	745-1342-00
R737	RESISTOR, FIXED, COMPOSITION: same as R719	745-1422-00
R738	RESISTOR, FIXED, COMPOSITION: same as R733	745-1317-00
R739	RESISTOR, FIXED, COMPOSITION: same as R719	745-1422-00
R740	RESISTOR, FIXED, COMPOSITION: same as R714	745-1394-00
R741	RESISTOR, FIXED, FILM: 287 ohms ±1%, 1/4 w	705-7070-00
R742	RESISTOR, FIXED, COMPOSITION: same as R720	745-1391-00
R743	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R744	RESISTOR, FIXED, COMPOSITION: same as R717	745-1352-00
R745	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R746	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R747	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R748	RESISTOR, VARIABLE: composition; 10,000 ohms ±30%, 1/4 w	376-4730-00
R749	RESISTOR, FIXED, COMPOSITION: same as R712	745-1415-00
R750	RESISTOR, FIXED, FILM: 562 ohms ±1%, 1/4 w	705-7084-00
R751	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R752	RESISTOR, FIXED, FILM: same as R751	705-7068-00
R753	RESISTOR, FIXED, COMPOSITION: same as R714	745-1394-00
R754	RESISTOR, FIXED, COMPOSITION: same as R714	745-1394-00
R755	RESISTOR, VARIABLE: composition; 250 ohms ±20%, 1/4 w	376-4725-00
R756	RESISTOR, FIXED, FILM: 619 ohms ±1%, 1/4 w	705-7086-00
R757	RESISTOR, FIXED, COMPOSITION: same as R736	745-1342-00
R758	RESISTOR, FIXED, COMPOSITION: same as R736	745-1342-00
R759	RESISTOR, FIXED, COMPOSITION: same as R723	745-1293-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
R760	RESISTOR, FIXED, COMPOSITION: same as R719	745-1398-00
R761	RESISTOR, FIXED, FILM: same as R724	705-7110-00
R762	RESISTOR, FIXED, COMPOSITION: same as R717	745-1352-00
R763	RESISTOR, FIXED, COMPOSITION: 390 ohms ±10%, 1/2 w	745-1335-00
R764	RESISTOR, FIXED, COMPOSITION: 0.12 megohm ±10%, 1/2 w	745-1440-00
R765	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/4 w	705-7130-00
R766	RESISTOR, FIXED, FILM: same as R765	705-7130-00
R767	RESISTOR, FIXED, FILM: same as R765	705-7130-00
R768	RESISTOR, FIXED, FILM: same as R765	705-7130-00
R769	RESISTOR, FIXED, COMPOSITION: same as R717	745-1352-00
R770	RESISTOR, FIXED, COMPOSITION: same as R719	745-1422-00
R771	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R772	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
S701	SWITCH SECTION, ROTARY: 6 circuit, 3 position; 3 section; 4 moving, 16 fixed contacts; Oak Mfg. Co. part no. 222274-AH3	259-1597-00
S702	SWITCH, TOGGLE: spdt; 40 amp continuous; 28 v d-c, 20 amp resistive, 15 amp inductance; 115 v, 400 cps, 10 amp resistance, 10 amp inductance; Hetherington, Inc. part no. T1003-AN	266-3099-00
S703	SWITCH SECTION, ROTARY: 4 circuit, 7 position, 4 section; 3 moving, 24 fixed contacts; Grigsby Allison Co., Inc. part no. A25242-4MLR-4	259-1596-00
T701	TRANSFORMER, RADIO FREQUENCY, BALANCED: c/o plastic fabric base phenolic board 1/16 in. by 1-3/16 in. by 1-3/16 in.; plus 3 coils, 75 turns ea; coil #1, wound ccw, coils #2 and #3, cw; plus plastic rod 0.159 in. w by 0.413 in. dia	549-1639-00
TB701	TERMINAL BOARD: phenolic, barrier type w/ lug for back connection, 12 terminals	367-0020-00
TB702	TERMINAL BOARD: bakelite, 4 terminals, 3/8 in. by 1/2 in. by 1-1/2 in.; Cinch Mfg. Corp. part no. 1534-A	306-2240-00
TB703	TERMINAL BOARD: same as TB702	306-2240-00
TB704	TERMINAL BOARD: 4 solder-lug terminals, brass; 3/8 in. by 1-1/2 in. overall	306-0698-00
TB705	TERMINAL BOARD: phenolic, 4 brass solder lug terminals; 1/16 in. by 3/8 in. by 1-1/2 in.; Cinch Mfg. Corp. part no. 1532A	306-0032-00
TB706	TERMINAL BOARD: phenolic, 3 solder-lug terminals; 11/16 in. by 1-1/8 in. lg	306-0587-00
TB707	TERMINAL BOARD: same as TB706	306-0587-00
TB708	TERMINAL BOARD: same as TB702	306-2240-00
TB709	TERMINAL BOARD: phenolic, 5 brass solder lug terminals; 1/16 in. by 3/8 in. by 1-7/8 in.; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB710	TERMINAL BOARD: same as TB702	306-2240-00
TB711	TERMINAL BOARD: laminated phenolic w/ 4 solder lug terminals, 27/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1909	306-0838-00
TB712	TERMINAL BOARD: same as TB702	306-2240-00
TB713	TERMINAL BOARD: same as TB706	306-0587-00
TB714	TERMINAL BOARD: same as TB711	306-0838-00
TB715	TERMINAL BOARD: same as TB711	306-0838-00
TB716	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB717	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1525A	306-0001-00
TB718	TERMINAL BOARD: same as TB704	306-0698-00
TB719	TERMINAL BOARD: same as TB702	306-2240-00
TB720	TERMINAL BOARD: same as TB717	306-0001-00
TB721	TERMINAL BOARD: same as TB704	306-0698-00
XFL701	SOCKET, ELECTRON TUBE: 8 prong octal tube socket w/ steel mtg plate; Amphenol-Borg Electronics part no. 88-8TM	220-1005-00
XQ701	SOCKET, TRANSISTOR: 3 contacts spaced on 0.200 in. dia circle; Elco Corp. part no. 3307X	352-9903-00
XQ702	SOCKET, TRANSISTOR: 4 contacts spaced on 0:200 in. dia circle; Elco Corp. part no. 3307	352-9902-00
XQ703	SOCKET, TRANSISTOR: same as XQ701	352-9903-00
XQ704	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XQ705	SOCKET, TRANSISTOR: same as XQ701	352-9903-00
XQ706	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XQ707	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XQ708	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XY701	SOCKET, CRYSTAL: 2 regularly spaced contact positions, 0.486 in. c to c ea contact, 0.243 in. from center; cadmium plated phosphor bronze or beryllium copper; Hugh H. Eby part no. 8879	292-0082-00
Y701	CRYSTAL UNIT, QUARTZ: 38.000 kc	289-5392-00

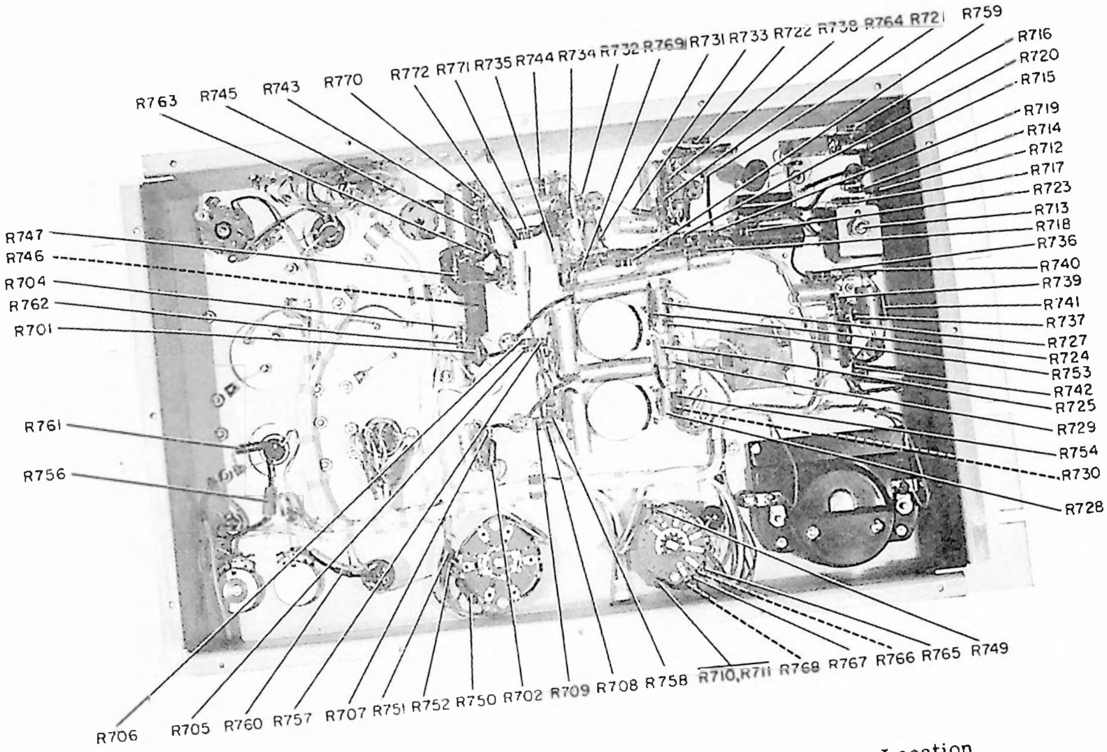


Figure 4-1. 786M-1 Stereo Generator, Rear View, Resistor Location

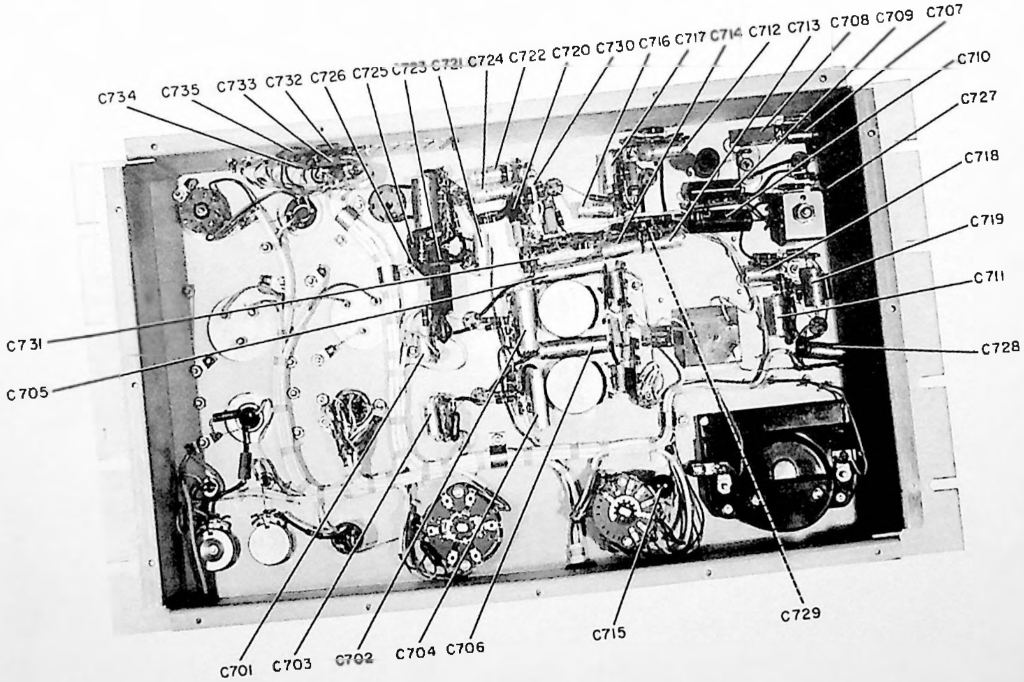


Figure 4-2. 786M-1 Stereo Generator, Rear View, Capacitor Location

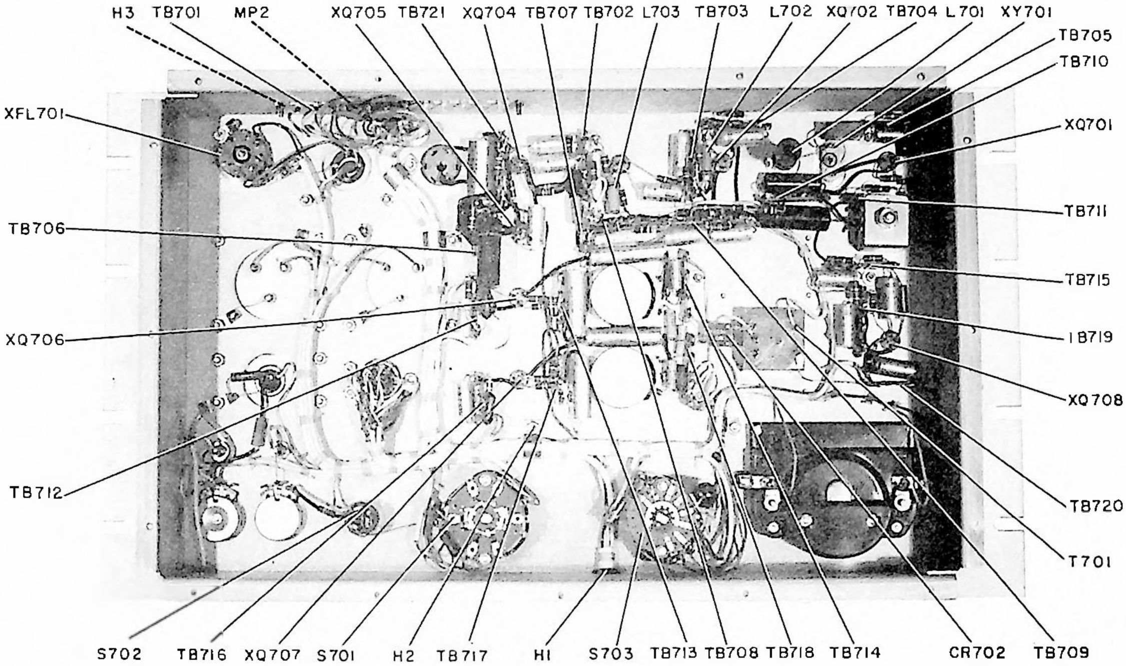


Figure 4-3. 786M-1 Stereo Generator, Rear View, Miscellaneous Parts Location

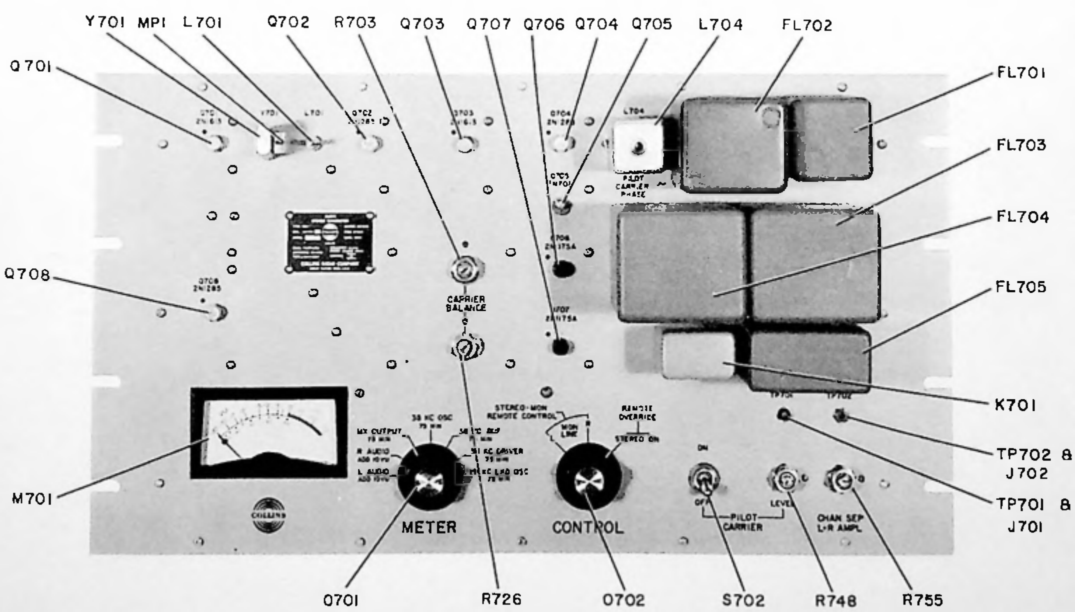


Figure 4-4. 786M-1 Stereo Generator, Front View, Parts Location

SECTION V
ILLUSTRATIONS

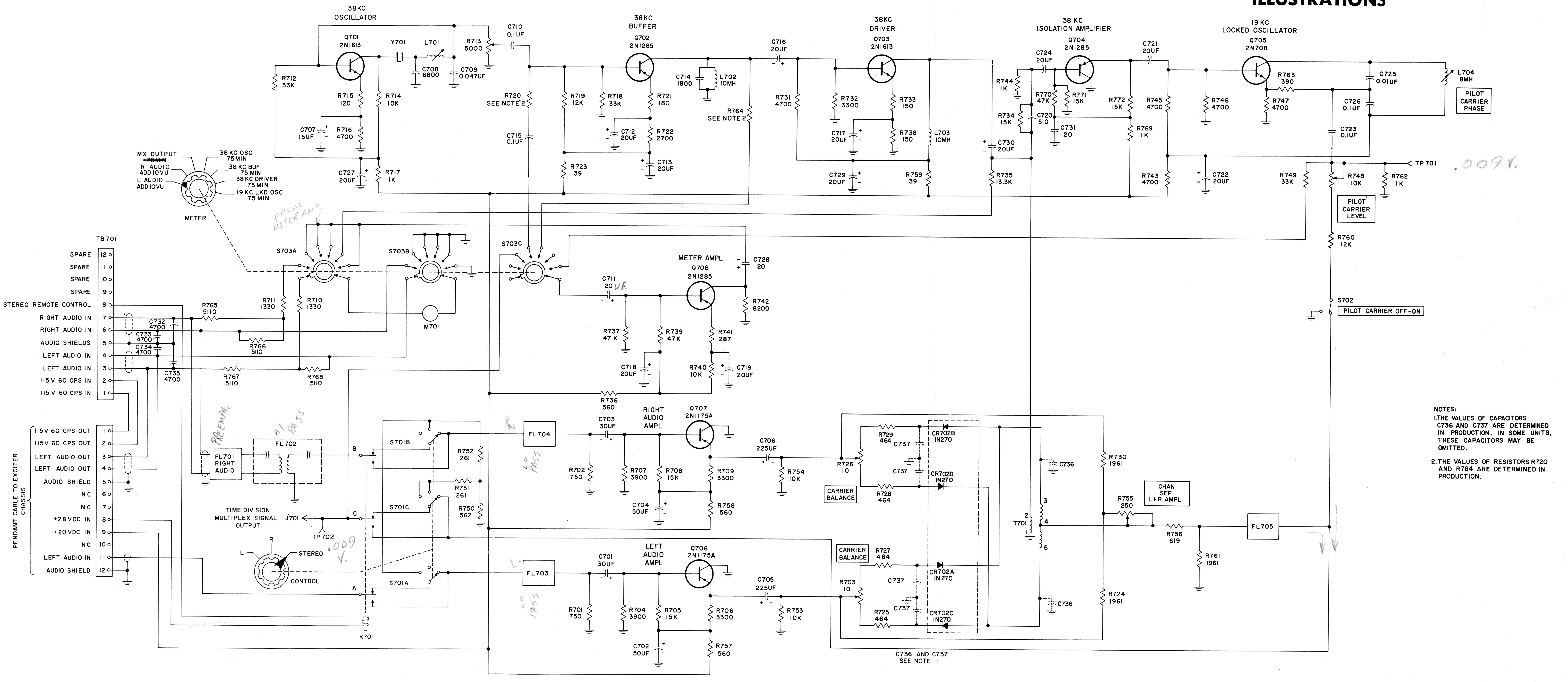


Figure 5-1. 786M-1 Stereo Generator, Schematic Diagram

Ron Nott

PRODUCTION TEST PROCEDURE

FOR

786M-1

STEREO GENERATOR

Prepared by: C. Thomas

Reviewed by: C. Dixon

Dated: October 4, 1962

Revised: August 22, 1964

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

TM 1859-5

REVISION RECORD

TM 1859-5 Revised August 22, 1964

7.5 Added for clarification.
8.2 Correction to data sheet.

1.0 SCOPE

This Production Test Procedure applies to the Collins Type 786M-1 Stereo Generator Part No. 522 2914 00.

2.0 REFERENCE INFORMATION

2.1 Specifications

Production Test Requirements, Part Number 569 2170 00
Equipment Specifications, Part Number 568 1702 00

2.2 Publications

Instruction Book, Part Number TD-537

2.3 Drawings

Schematic Diagram, Stereo Generator 786M-1, Part Number 553 8707 006
Test Jig for Stereo Generator 786M-1, Figure 1
Scope Setup for Phase Adjustment and Left Channel Check, Figure 2
Phase Relationship between Pilot Carrier and L = -R Signal, Figure 3
Scope Pattern for Amplitude Adjustment, Figure 4
Scope Pattern for Left Channel Check, Figure 5

3.0 TEST EQUIPMENT REQUIRED

The following equipments or their equivalents are required to perform the specified tests.

1. Oscilloscope, Tektronic Model 545A with Type CA plug-in unit.
2. Oscilloscope, Tektronic Model RM503.
3. Oscillator, Hewlett-Packard Model 200AB
4. Test Jig, Collins Radio, Special, No. 029 8047 00.
5. Power Supply, 28 volts.
6. Distortion and Noise Meter, Hewlett-Packard Model 330D.
7. Frequency Counter, Hewlett-Packard Model 524B/D.
8. VTVM, Hewlett-Packard Model 410B
9. AC VTVM, Hewlett-Packard Model 400D.
10. Resistive Pad to use in place of Pre-Emphasis Network, Figure 1.
11. Output Filter, Figure 1.

4.0 TEST CONDITIONS

Unless otherwise specified, all tests shall be performed under the following conditions:

4.1 Power Supply Voltage, Frequency and Phase

115 V, 60 cps, 1 Ø
28 V DC

4.2 Ambient Temperature, Humidity and Atmospheric Pressure

Normal factory ambient.

4.3 Shielding and Isolation Requirements: None

4.4 Operational Duty Cycle: Continuous

4.5 Warm-Up Period: None

5.0 PRELIMINARY TESTS

5.1 Equipment Corrections

Connect the 786M-1 Stereo Generator to the test jig shown in figure 1. Use resistive pad in place of Pre-Emphasis Network in test jig.

5.2 Transfer Relay Operation

Switch ON 28 volt power supply. S2 (Stereo) switch on test panel should operate K 701 relay in 786M-1.

5.3 Transistor Installation

Check to see that tabs on transistors are adjacent to locating black dots on the chassis.

6.0 INITIAL ADJUSTMENTS

6.1 38 KC Subcarrier Oscillator Tuning

Connect the RF probe of the VTVM to the collector of Q 702. Adjust R 713 fully clockwise and adjust L 701 for maximum output. Record level.

6.2 38 KC Amplitude Adjustment

Connect Tektronix RM 503 scope across terminals 1 and 2 of T 701. Adjust R 713 for 6 volts peak to peak amplitude.

6.3 Carrier Balance

Set pilot carrier to OFF. Set control switch to Stereo position. Set test jig switch S4 to the 0-15 KC position and S1 (Mode) to L = R. Adjust the audio oscillator frequency to 400 cps and the level to read 0 vμ on the 786M-1 vμ meter when the meter switch is placed in the MX output position. This sets up a reference level (90% modulation) at the output of the stereo generator to which the residual carriers will later be referred. Measure this voltage by connecting the AC VTVM to the output terminals of the test jig. The carrier level readings will later be recorded in db and will be referenced to this 0db level. Remove modulation by turning the test jig switch, S1, to the OFF position. Set test jig switch, S4, to the 23-53 KC position and observe the residual 38 KC carrier level as read on the audio VTVM. This reading must be at least 60 db below the preceeding reference level. It will not be this far down however until the balancing procedure which follows is completed. Turn the test jig switch, S4, to the 76 KC position and observe the residual 76 KC carrier level as read on the audio VTVM. It must be 70 db below the reference level. It, too, will be high until the following balancing procedure is completed.
Set test jig switch S4 to MX OUT. Adjust R 703 and R 726 for minimum indication on the AC VTVM. Recheck the 38 KC and 76 KC carrier levels as explained in the preceeding paragraphs. If these carrier levels are still too great, capacitors must be selected to balance them to a lower level. The 38 KC component can be reduced by step (a) and the 76 KC component can be reduced by step (b).

6.3 Carrier Balance (Continued)

Step (a)

Add a 0-50 pf trimmer from pin 5 of T 701 to ground. Adjust this trimmer, R 703, and R 726 for minimum output from the test jig when S4 is in the MX OUT position. If the trimmer goes to minimum capacitance, disconnect it from pin 5 and connect it to pin 3 of T 701. Repeat adjustment.

Step (b)

Switch S4 to 76 KC. Place your finger in turn on the junction between CR 702 B and R 729, CR 702 D and R 728, CR 702 A and R 727, and CR 702 C and R 725. Observe which junction causes a reduction in the 76 KC output. Connect a 0-50 pf capacitor from this point to ground. Switch S4 to MX OUT and tune the two trimmers, R703, and R726 for minimum carrier output as before.

The last step is to check the level of the 38 KC and 76 KC carriers individually as explained before and record these decibel readings. The 38 KC carrier must be at least 60 db below the reference level (90% modulation) and the 76 KC carrier must be at least 70 db below the reference level.

NOTE 1 Use a heat sink to install the trimmers because heat will effect the diodes and the balance of the circuit.

NOTE 2 Interference from near by transmitters may make it difficult to make this adjustment but will not effect the circuit when balanced.

6.4 Pilot Carrier Level and Frequency

Connect AC VTVM to TP 702. Set Pilot Carrier to ON and Control to STEREO ON. Adjust R748 for a reading of .009 V RMS. Connect frequency counter to TP 701 and record pilot carrier frequency. If frequency is off and crystal is changed repeat paragraph 6.3.

6.5 Locked Oscillator Phase

Connect the Tektronix 545A scope to the 786M-1 stereo generator and adjust as shown in figure 2. Set test jig to L = -R and the audio oscillator to 1000 cps and 7.8 VRMS. With PILOT CARRIER at OFF adjust L 704 until both traces are stationary and exact coincidence of the zero crossings of the 19 KC pilot carrier and the L-R signal is obtained as shown in Figure 3a. Expand the sweep to 5X and adjust the horizontal position knob to check two points of coincident zero crossing.

6.6 Channel Identification

Connect the Tektronix 545A scope to the 786M-1 stereo generator and adjust as shown in Figure 2. Set test jig to L. If wiring is correct the 38 KC subcarrier and stereo signal envelope will have the phase relation ship shown in figure 5b. If reversed the phase relationship will be as shown in 5a.

6.7 Amplitude Correction

Set the audio oscillator to 5000 cps. Switch Pilot Carrier OFF. Connect the Tektronix RM 503 oscilloscope to TP 702. Set the test jig to L and adjust the audio oscillator for a 250 mv P/P signal.

6.7 Amplitude Correction (Continued)

Adjust R 755 to product a straight zero axis (within 4 mv) as shown in Figure 4. Check over the frequency range 50 to 15000 cps with scope horizontal sensitivity set to 10 MV/CM. Repeat check over frequency range with the test jig set to R. Use appropriate settings of sweep time/cm as frequency is varied. Read and record the maximum excursion from a straight zero axis.

6.8 Meter Resistor Selection

Switch to the 38 KC Osc position. If the meter reading is less than 75 or greater than full scale, select R 720 to bring the reading within those limits. Switch the 786M meter switch to 38 KC BUF position and select R 764 for a meter reading between 75 and full scale.

6.9 Meter Levels

Set the METER switch to 38 KC OSC, 38 KC BUF, 38 KC DRIVER, 19 KC LKD OSC. Read and record level for each position.

7.0 TEST REQUIREMENTS

7.1 Preliminary Tests

Preliminary tests as outlined in section 5.

7.2 Initial Adjustments

Initial adjustments as outlined in section 6.

7.3 Gain

Replace resistive pads with pre-emphasis networks. Set test jig switch, S1, to L = R. Adjust audio oscillator frequency to 400 cps and amplitude to read 0 on the VU meter when the meter switch is set to L or R audio. Connect the Tektronix RM503 oscilloscope to TP702. With PILOT CARRIER OFF read and record the peak-to-peak amplitude as read on the oscilloscope. Set METER switch to MX OUTPUT. Read and record the output in VU. Set test jig switch, S1, to L = -R. Read and record peak-to-peak amplitude at TP 702.
Set CONTROL switch to L and test jig switch, S1, to L. Read and record peak-to-peak amplitude at TP702. Set CONTROL switch to R and test jig switch, S1, to R. Read and record, peak-to-peak amplitude at TP 702. Set the test jig switch, S2 (stereo), to the stereo position. The oscilloscope pattern should change from a sinusoid to the complex, right only, stereo presentation that was observed in the Amplitude Correction adjustment (par. 6.7). Remove pre-emphasis network and replace with resistive pads.

7.4 Frequency Response

Set the test jig to L = R. Adjust the oscillator output to read 0 VU on the VU meter when the METER switch is set to L or R audio. Read and record the output for oscillator frequencies of 50, 1000, and 15000 cps.

7.5 Cross Talk

Set test jig to L = R. Turn PILOT CARRIER to OFF. Connect the AC VTVM to OUTPUT of test jig. Set test jig switch to 0-15 KC. Adjust the audio oscillator to 400 cps and a level of 0 on the VU meter when the meter switch is set to L or R audio. Record output of test jig as the reference level. Switch to L = -R modulation. Measure and record sub-to-main cross talk. Set test jig switch to 23-53 KC. Switch to L = R modulation. Read and record main-to-sub cross talk. If one reading is good and the other out of spec interchange the resistive networks.

7.6 Harmonic Distortion

Connect the output of the stereo generator to the test jig LP FILTER IN terminals. Connect the distortion analyzer to the LP FILTER OUT terminals. Set test jig to L = R and adjust audio oscillator amplitude to read 0 on the VU meter when the meter switch is set to L or R audio. Measure harmonic distortion at 50, 1000, 5000 cps.

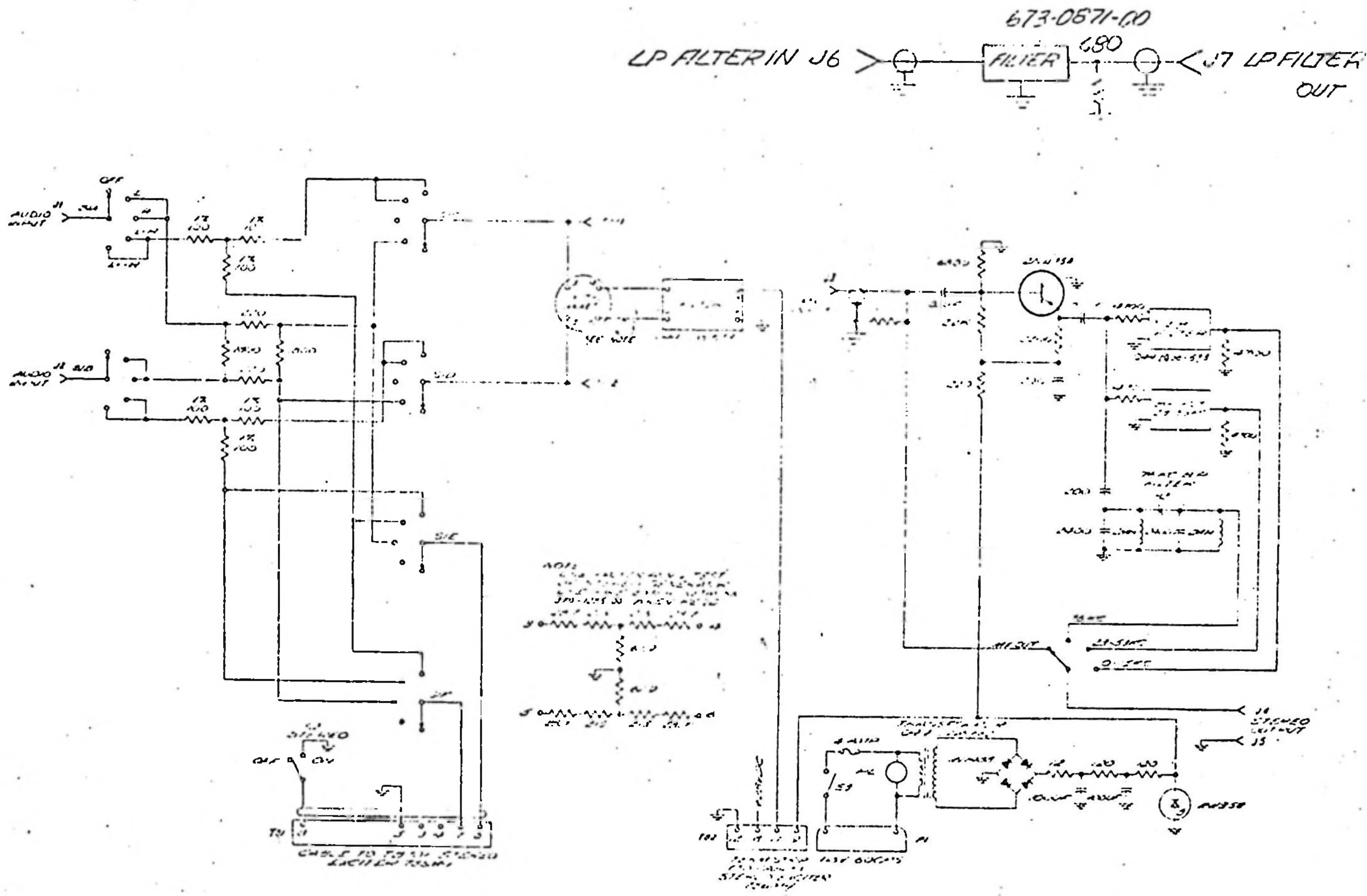


FIG. 1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1°

CODE IDENT NO. 13499

SIZE A

SCALE NONE

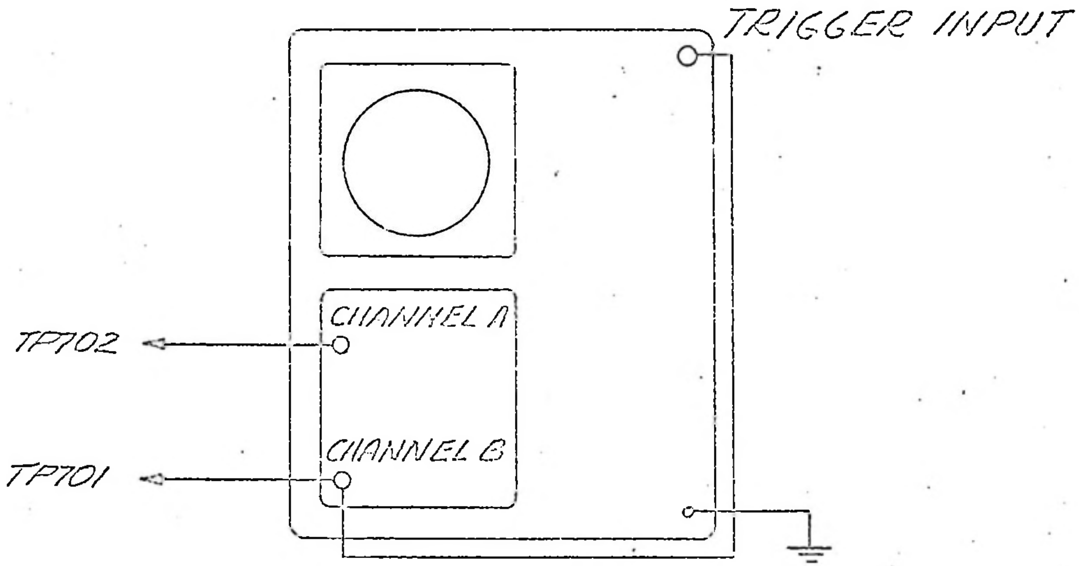
WT

569-2170-00

SHEET 7 OF 11

REV A

PD 446 05 (Rev 5 61) SPECIFICATION – CONTINUATION SHEET



CONTROL SETTINGS	PILOT CARRIER PHASE ADJ.	LEFT CHANNEL CHECK
1. CHANNEL A	.05V/CM, TP701	.05V/CM, TP 701
2. CHANNEL B	.05V/CM, TP702	.2V/CM, TP 702
3. MODE - ALTERNATE		
4. TRIGGERING MODE - AUTOMATIC TRIGGER SLOPE - + EXTERNAL		
5. SWEEP TIME / CM 5μ SEC		
6. MAGNIFIER	X1, X5	X1

SCOPE SET-UP FOR PHASE ADJUSTMENT AND LEFT CHANNEL CHECK

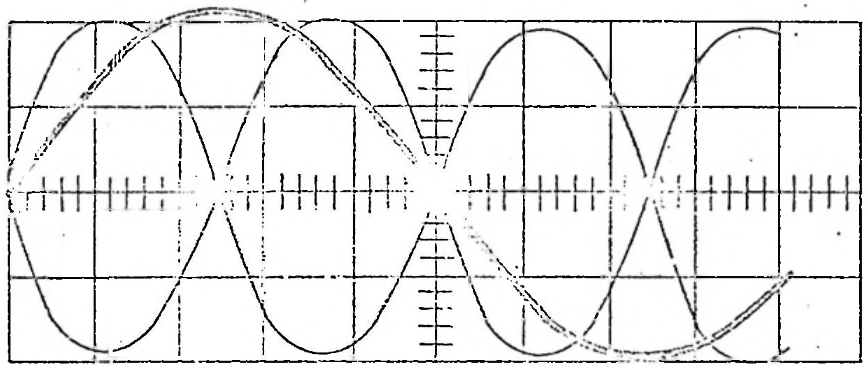
FIGURE 2

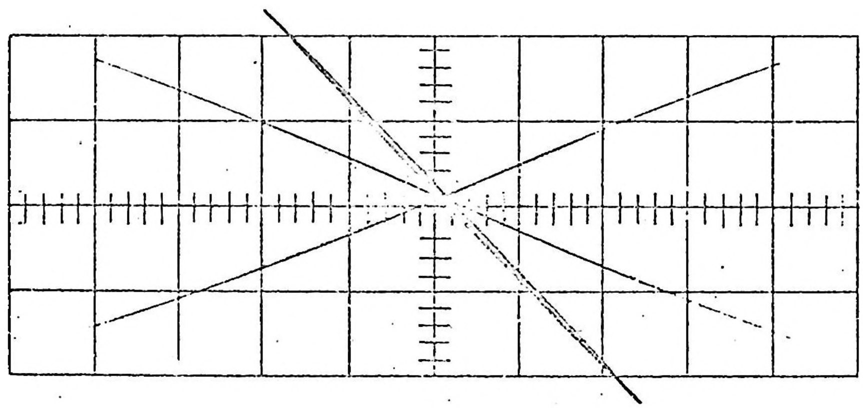
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1°

CODE IDENT NO 13499 | SIZE A | SCALE NONE | WT

569-2170-00

REV A

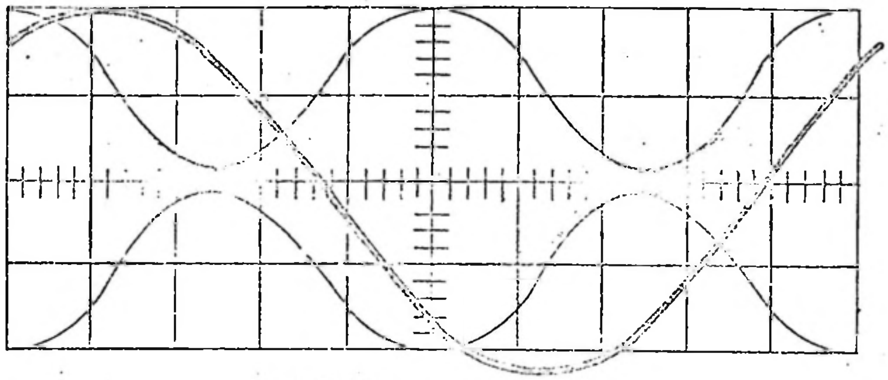




PHASE RELATIONSHIP BETWEEN PILOT CARRIER AND L = -R OUTPUT SIGNAL

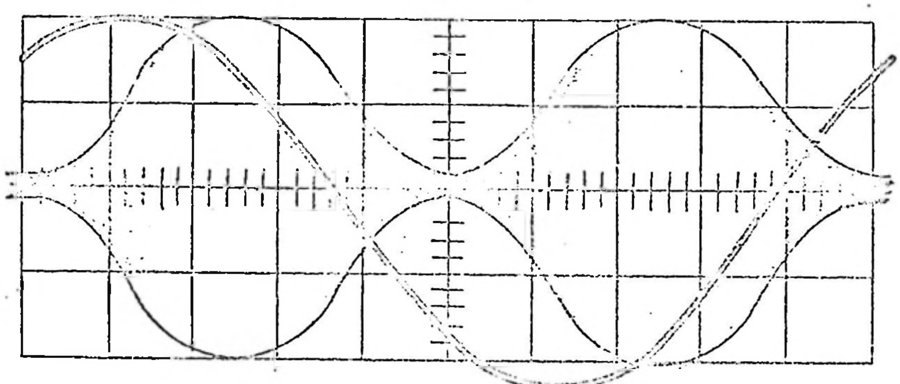
FIGURE 3

REV /T



LEFT

B



RIGHT

A

LEFT CHANNEL CHECK

FIGURE 5

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1°	CODE IDENT NO 13499	SIZE A	569-2170-00
	SCALE NONE	WT	SHEET 11 of 11

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

7203 / 4CX250B
7204 / 4CX250F
RADIAL-BEAM POWER TETRODE

The 7203/4CX250B and 7204/4CX250F are compact, forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 7203/4CX250B is designed to operate with a heater voltage of 6.0 volts, while the 7204/4CX250F is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.

Both tube types are of all-ceramic-and-metal construction and are recommended for use in equipments of new design.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60	---	seconds
Cathode-to-heater Potential			±150	volts
Heater: Voltage 4CX250B		6.0		volts
Current 4CX250B	2.30		2.90	amperes
Voltage 4CX250F		26.5		volts
Current 4CX250F	0.50		0.62	amperes
Amplification Factor (Grid-to-Screen)		5		
Direct Interelectrode Capacitances, Grounded Cathode: *				
Input	14.2	---	17.2	uuf
Output	4.0	---	5.0	uuf
Feedback	---	---	0.06	uuf
Direct Interelectrode Capacitances, Grounded Grid and Screen: *				
Input	---	13.0	---	uuf
Output	4.0	---	5.0	uuf
Feedback	---	0.01	---	uuf
Frequency for Maximum Ratings			500	Mc

MECHANICAL

Base	Special 9-pin, JEDEC-B8-236
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
Height	2.464 inches
Seated Height	1.910 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

	Frequencies up to 175Mc				500Mc	
D-C Plate Voltage	500	1000	1500	2000	2000	volts
D-C Screen Voltage	250	250	250	250	300	volts
D-C Grid Voltage	—90	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	250	ma
D-C Screen Current*	45	38	21	19	10**	ma
D-C Grid Current*	35	31	28	26	25**	ma
Peak R-F Grid Voltage*	114	114	112	112	—	volts
Driving Power*	4.0	3.5	3.2	2.9	—	watts
Plate Input Power	125	250	375	500	500	watts
Plate Output Power	70	190	280	390	225**	watts
Heater Voltage	6.0	6.0	6.0	6.0	5.5	volts

*Approximate values.
**Measured values for a typical cavity amplifier circuit.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

D-C Plate Voltage	500	1000	1500	volts
D-C Screen Voltage	250	250	250	volts
D-C Grid Voltage	—100	—100	—100	volts
D-C Plate Current	200	200	200	ma
D-C Screen Current*	31	22	20	ma
D-C Grid Current*	15	14	14	ma
Peak R-F Grid Input Voltage*	118	117	117	volts
Driving Power*	1.8	1.7	1.7	watts
Plate Input Power	100	200	300	watts
Plate Output Power	60	145	235	watts

*Approximate values.

4CX250B

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	volts
Zero-Signal D-C Plate Current	200	200	200	ma
Max-Signal D-C Plate Current	500	500	500	ma
Max-Signal D-C Screen Current	20	16	10	ma
Effective Load, Plate to Plate	3500	6200	9500	ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	240	430	600	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

D-C Plate Voltage	1000	1500	2000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	ma
D-C Plate Current	150	150	150	ma
D-C Screen Current*	—3	—4	—4	ma
Peak R-F Grid Voltage*	25	25	25	volts
Plate Output Power	30	50	65	watts

*Approximate values
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc, peak-envelope conditions except where noted)

D-C Plate Voltage	1000	1500	2000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	ma
Peak R-F Grid Voltage*	50	50	50	volts
D-C Plate Current	250	250	250	ma
D-C Screen Current*	10	8	5	ma
Plate Input Power	250	375	500	watts
Plate Output Power	120	215	300	watts
Two-Tone Average D-C Plate Current	190	190	190	ma
Two-Tone Average D-C Screen Current*	2	—1	—2	ma

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4CX250B and 4CX250F may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

Cooling—Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the Eimac SK-600 series and an Eimac SK-606 chimney are used with air flow in the base to anode direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1.20

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 Mc or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air-flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Vibration—These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration are expected to exceed approximately 5g units, it is suggested that the Eimac 4CX300A or 4CX250R be employed.

4CX250B

ELECTRICAL

Heater—The rated heater voltage for the 4CX250B and 4CX250F is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 megacycles, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency, Mc	4CX250B	4CX250F
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode Operation—The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum rated d-c input current is 200 milliamperes for plate-modulated operation and 250 milliamperes for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Control-Grid Operation—The maximum rated d-c grid bias voltage is –250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100-megacycle region, driving-power requirements for amplifiers increase noticeably. At 500 megacycles as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500-megacycle operation of the tubes in a stable "straight-through" amplifier is indicated by grid-current values below approximately 15 milliamperes.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the d-c screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the d-c screen voltage and the peak a-c or r-f signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation or plate-modulated r-f amplifiers using the 4CX250B or 4CX250F.

Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

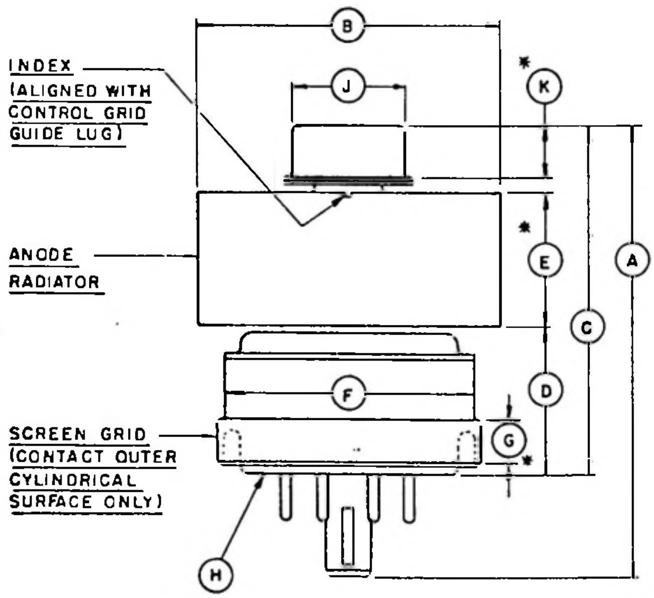
Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

UHF Operation—The 4CX250B and 4CX250F are suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

4CX250B

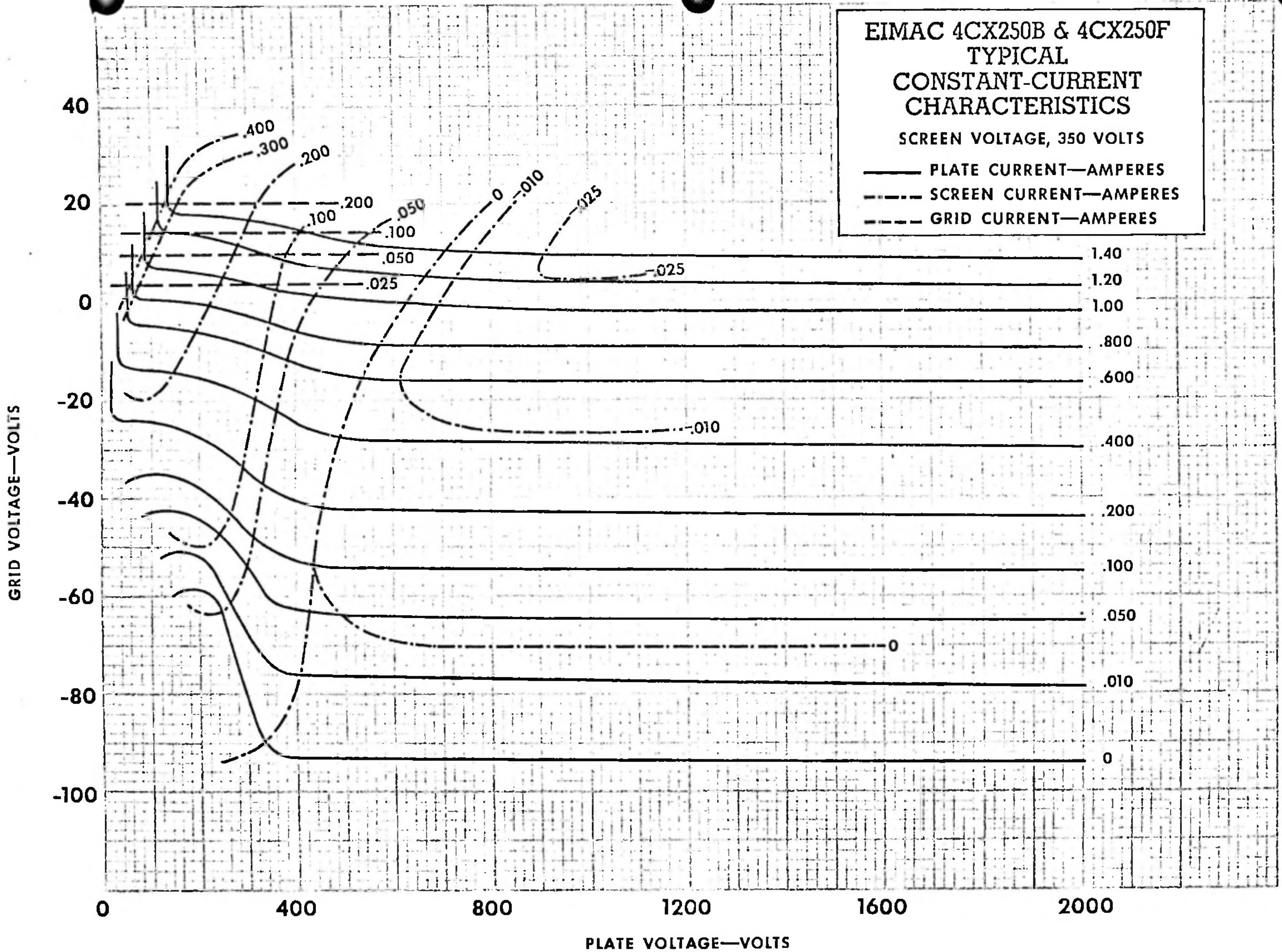


* CONTACT SURFACE

DIMENSIONAL DATA			
REF	MIN.	MAX.	NOM.
A	2.324	2.464	
B	1.610	1.640	
C	1.810	1.910	
D	.750	.810	
E	.710	.790	
F		1.406	
G	.187		
H	BASE: B8-236 (JEDEC DESIGNATION)		
J	.559	.573	
K	.240	.280	

DIMENSIONS IN INCHES

PIN NO. 1. SCREEN GRID
PIN NO. 2. CATHODE
PIN NO. 3. HEATER
PIN NO. 4. CATHODE
PIN NO. 5. I.C. DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6. CATHODE
PIN NO. 7. HEATER
PIN NO. 8. CATHODE
CENTER PIN—CONTROL GRID

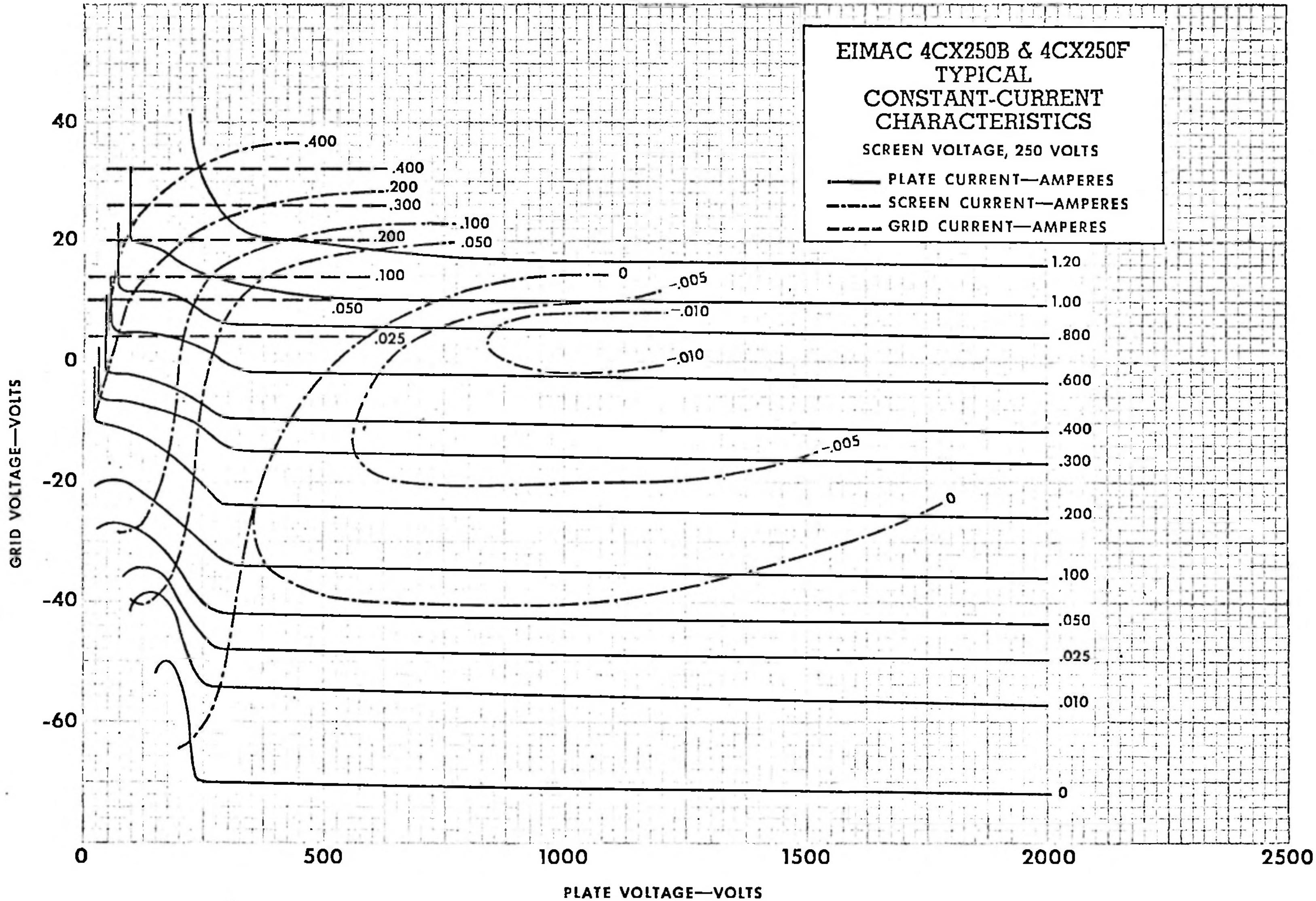


4CX250B/4CX250F

4CX250B

5

6


EIMAC 4CX250B & 4CX250F
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.400
.200
.300
.100
.050
.025
-.005
-.010

4CX250B

TD-538
523-0755596-001418
1 February 1962

COLLINS

unit instructions

B830-1
250-Watt FM
Power Amplifier

Second Printing February 1966

Cedar Rapids Region | Collins Radio Company, Cedar Rapids, Iowa
Printed in U.S.A.

table of contents

Section			Page
I	GENERAL DESCRIPTION		3
	1.1	Purpose of Instruction Book	3
	1.2	Purpose of Equipment	3
	1.3	Description of Equipment	3
	1.3.1	Physical Description	3
	1.3.2	Electrical Description	3
	1.4	Equipment Supplied	4
	1.5	Equipment Required but not Supplied	4
	1.6	Accessory Equipment	5
	1.7	Equipment Specifications	5
	1.7.1	Mechanical	5
	1.7.2	Electrical	5
	1.8	Tube and Semiconductor Complement	5
II	PRINCIPLES OF OPERATION		6
	2.1	General	6
	2.1.1	Control Circuits	6
	2.1.2	Power Amplifier Circuits	9
	2.2	Control Functions	10
III	MAINTENANCE		11
	3.1	General	11
	3.2	Preventive Maintenance	11
	3.2.1	Air Filter Cleaning	11
	3.2.2	PA Tube Cleaning	12
	3.2.2.1	PA Tube Removal	12
	3.2.3	Inspection	12
	3.2.4	Lubrication	12
	3.2.5	Tube Maintenance	12
	3.3	Trouble Shooting	12
	3.4	Cable Chart	13
IV	PARTS LIST		19
V	ILLUSTRATIONS		27

list of illustrations

Figure		Page
1-1	B830-1 250-Watt FM Power Amplifier, Over-all View (C848-07-P)	3
1-2	B830-1 250-Watt FM Power Amplifier, Rear View with Bottom Panel Removed (C848-06-P)	4
2-1	B830-1 250-Watt FM Power Amplifier, Block Diagram (C848-03-3)	6
2-2	B830-1 250-Watt FM Power Amplifier, Control Circuits, Simplified Schematic Diagram (C848-04-5)	7
2-3	B830-1 250-Watt FM Power Amplifier, Power Amplifier Circuits, Simplified Schematic Diagram (C848-05-5)	8
2-4	B830-1 250-Watt FM Power Amplifier, Control Locations (C848-08-P)	10
4-1	B830-1 250-Watt FM Power Amplifier Rear View, Parts Location (C848-13-P)	21
4-2	Meter Panel Subassembly, Parts Location (C848-16-P)	22
4-3	Plate Cavity Subassembly, Parts Location (C848-11-P)	23
4-4	Relay Panel Subassembly, Parts Location (C848-17-P)	24
4-5	Cabinet Blower Location (C848-14-P)	25
5-1	B830-1 250-Watt FM Power Amplifier, Schematic Diagram (C848-01-6)	27

list of tables

Table		Page
1-1	Associated Equipment Instruction Books	4
1-2	Equipment Supplied	4
1-3	Equipment Required but not Supplied	4
1-4	Accessory Equipment	5
1-5	Tube and Semiconductor Complement	5
3-1	Typical Meter Indications	13
3-2	From-To Information	13

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

Unit Instructions TD-538 provides information about B830-1 250-Watt FM Power Amplifier. Information which is furnished covers a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

1.2 PURPOSE OF EQUIPMENT.

The B830-1 250-Watt FM Power Amplifier can be used for continuous monaural or multiplex and SCA FM broadcast service on a single frequency in the range from 88 to 108 megacycles with an exciter input of 10 watts and an output power of 250 watts.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The B830-1 250-Watt FM Power Amplifier, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 596 pounds. All B830-1 operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The meters may be observed easily while operating the tuning controls. The B830-1 uses three tubes, all of which are accessible from the front of the transmitter. The bottom front of the B830-1 cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the B830-1 for servicing and maintenance. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks remove the B830-1 plate voltage and ground the high-voltage circuits when the doors are opened or the panel is removed. The power amplifier plate-tuning cavity is located in an interlocked compartment at the front of the B830-1.

Inside the B830-1, heavy iron-core components are at the bottom of the cabinet. A standard 19-inch rack is provided for mounting the 10-watt exciter within the confines of the B830-1. Room also is provided on the standard 19-inch rack for the mounting of SCA generators. An optional harmonic filter, which can be connected to the B830-1 output, is suspended from the top of the cabinet.

Cooling air for the B830-1 is drawn through a permanent air filter at the rear of the cabinet by a low-speed, high-volume fan and exhausted through a shielded opening in the top of the cabinet. A single pressure blower supplies cooling air directly to the power amplifier tube.

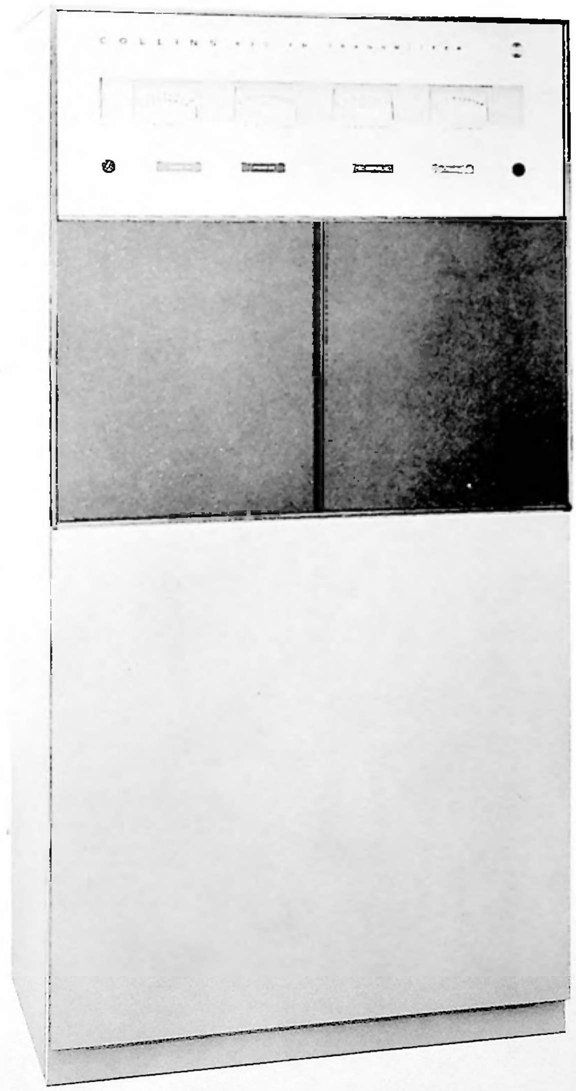


Figure 1-1. B830-1 250-Watt FM Power Amplifier, Over-all View

1.3.2 ELECTRICAL DESCRIPTION.

The B830-1 250-Watt FM Power Amplifier consists of a single, air-cooled, power amplifier tube capable of being driven to full power by a 10-watt exciter. All

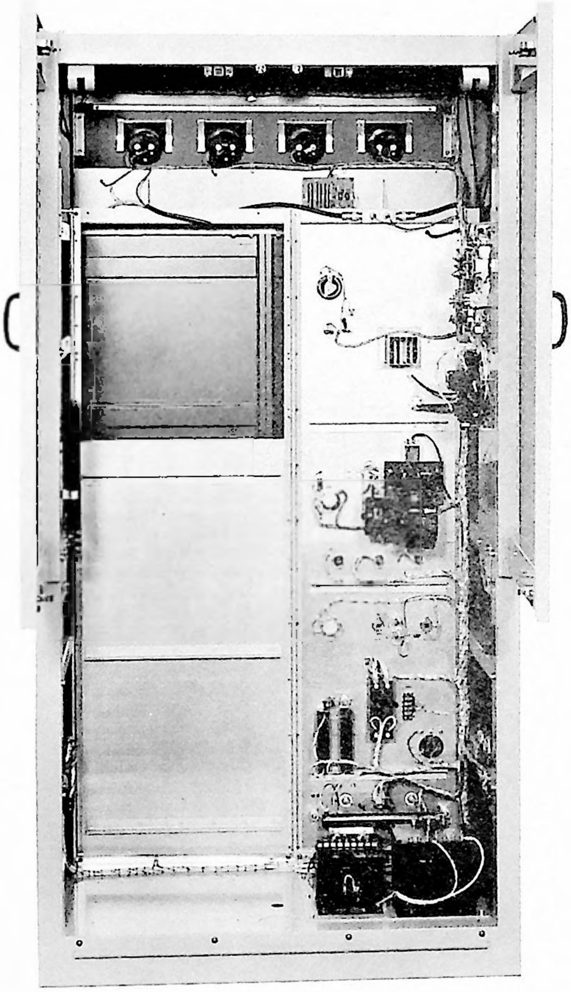


Figure 1-2. B830-1 250-Watt FM Power Amplifier, Rear View with Bottom Panel Removed

associated power supply and control circuitry is included for operation of the B830-1. The B830-1 r-f input impedance is 50 ohms nominal, unbalanced. The B830-1 output power is at least 250 watts over the frequency range of 88 to 108 megacycles into a 50-ohm load, with an swr not exceeding 2:1.

Line power input required is 50 or 60 cycles, single phase, with primary taps on all power transformers to compensate for line voltage variations from 200 to 250 volts. (For 50-cps operation, a special blower is available on request.) Circuit breakers in the input side of the line are provided for primary circuit protection. The control circuits and the final amplifier filament are fused. A time delay relay provides protection of the power amplifier tube during warmup. Remote control can be exercised over filament-on, filament-off, plate-on, and plate-off functions of the power amplifier. Instruction books covering the exciters and power amplifiers used in conjunction with B830-1 250-Watt FM Power Amplifier are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
786M-1 Stereo Generator	TD-537
E830-1 5-Kw FM Power Amplifier	TD-539

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of B830-1 250-Watt FM Power Amplifier.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
B830-1 250-Watt FM Power Amplifier	549-2008-00

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment that is required for operation of B830-1 250-Watt FM Power Amplifier but not supplied as part of the power amplifier.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
786M-1 Stereo Generator (for use with A830-2 only)	522-2914-00

1.6 ACCESSORY EQUIPMENT.

Table 1-4 lists accessory equipment that is available for use with B830-1 250-Watt FM Power Amplifier.

TABLE 1-4
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
250-Watt/1-Kw Harmonic Filter (used only if the B830-1 is fed directly to an antenna and not to a higher power amplifier)	549-2010-00

1.7 EQUIPMENT SPECIFICATIONS.

1.7.1 MECHANICAL.

Weight . . . . 596 pounds maximum.

Size . . . . 38 inches wide, 76 inches high, 27 inches deep.

Ventilation . . . . One ventilating fan, one blower.

Ambient temperature range . . . . +10°C (50°F) to +45°C (113°F).

Ambient humidity range . . . . 0 to 95 percent relative humidity.

Altitude . . . . 0 to 6000 feet. (Blower for higher altitude available on special request.)

1.7.2 ELECTRICAL.

Power source . . . . . . 200 to 250 volts, 50 or 60 cps, single phase (50-cps blower available on special request).

Maximum power requirements . . . . . 730 watts.

R-f input power . . . . . 10 watts nominal.

Input impedance . . . . . 50 ohms nominal, unbalanced.

Power output . . . . . . 250 watts nominal.

Output impedance . . . . 50 ohms, resistive, unbalanced. Maximum swr 2:1.

Frequency range . . . . 88 to 108 megacycles. Exact operating frequency determined by frequency exciter (80 to 100 mc available on special request).

1.8 TUBE AND SEMICONDUCTOR COMPLEMENT.

Table 1-5 lists the tube and semiconductor complement supplied as part of B830-1 250-Watt FM Power Amplifier.

TABLE 1-5
TUBE AND SEMICONDUCTOR COMPLEMENT

QUANTITY	TYPE	FUNCTION
1	4CX250B/7203	R-f power amplifier
2	OD3	Voltage regulation
2	4JA421EM20AB1	Plate and screen voltage rectifiers

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

The B830-1 250-Watt FM Power Amplifier consists of a power amplifier and associated control circuitry for the amplification of 10 watts of exciter drive to 250 watts of r-f power. The B830-1 output can drive a higher power amplifier or can be fed through a harmonic filter to an antenna.

Refer to figure 2-1. The 230 volts a-c is fed to a control circuit power transformer which reduces the input voltage to 115 volts a-c for use by the blower and control circuits. A second transformer located within the control circuitry reduces the 115 volts a-c to 6.3 volts for use by the power amplifier filament. The 230 volts a-c also is fed to a transformer which supplies the power amplifier plate and screen voltages. The primary power input to the plate power supply is controlled by the plate contactor.

The control circuits provide cabinet interlocks for protection of personnel from all high voltage, local or remote filament-on and filament-off controls, local or remote plate-on and plate-off controls, and time delay to prevent the application of high voltage before the power amplifier filament has heated sufficiently. Provisions also are available within the control circuitry for connection to the control circuitry of a higher power amplifier. The higher power amplifier will then control the B830-1 plate and filament power.

Exciter input power is applied directly to the power amplifier where it is raised to 250 watts of r-f power. The power amplifier consists of a forced-air-cooled ceramic tetrode, V201. The plate of V201 is connected to a tuned cavity ($\frac{\lambda}{4}$ coaxial line resonator). The output from the tuned cavity then can be fed to a higher power amplifier, or to a harmonic filter and antenna if higher power amplification is not necessary. A sample of the power amplifier output is taken from the plate-tuned cavity for monitoring purposes.

Metering circuits are provided for the power amplifier plate current and voltage, screen current and voltage, grid current, and output power.

2.1.1 CONTROL CIRCUITS.

Refer to figure 2-2. The primary purpose of the control circuitry is to provide filament and plate on and off control. The power amplifier filament is turned on in the following manner: When momentary FILAMENT ON switch S112 is pressed, a ground is placed on filament control relay K301. As 115 volts a-c is present on terminal 2 of relay K301 from 115-volt a-c supply transformer T301 the filament control relay will be energized. This closes contacts 3 and 4, holding the relay in the energized position after momentary FILAMENT ON switch S112 is released. The green filament indicator lamp, DS301, will light. When filament control relay K301 is energized, relay contacts 6 and 7 will

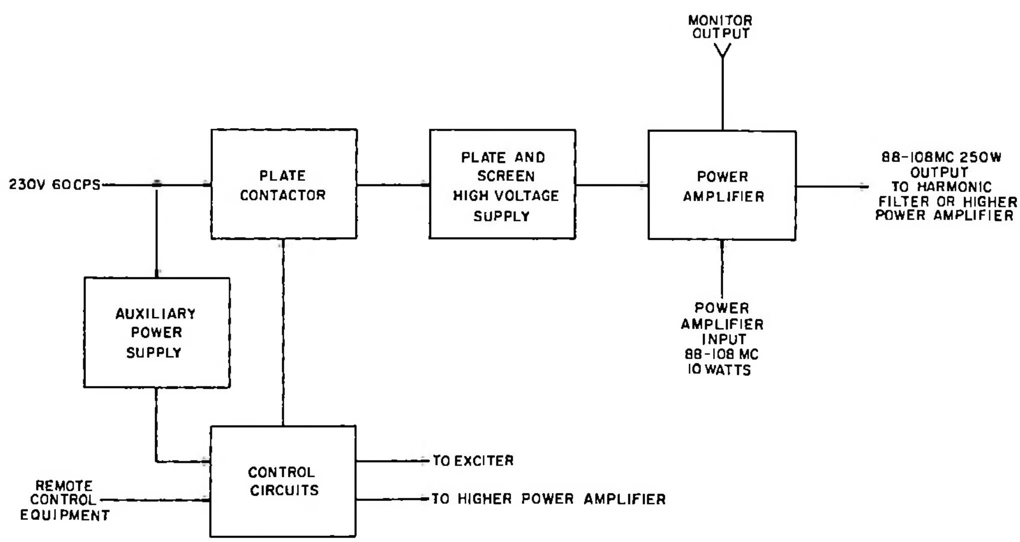


Figure 2-1. B830-1 250-Watt FM Power Amplifier, Block Diagram

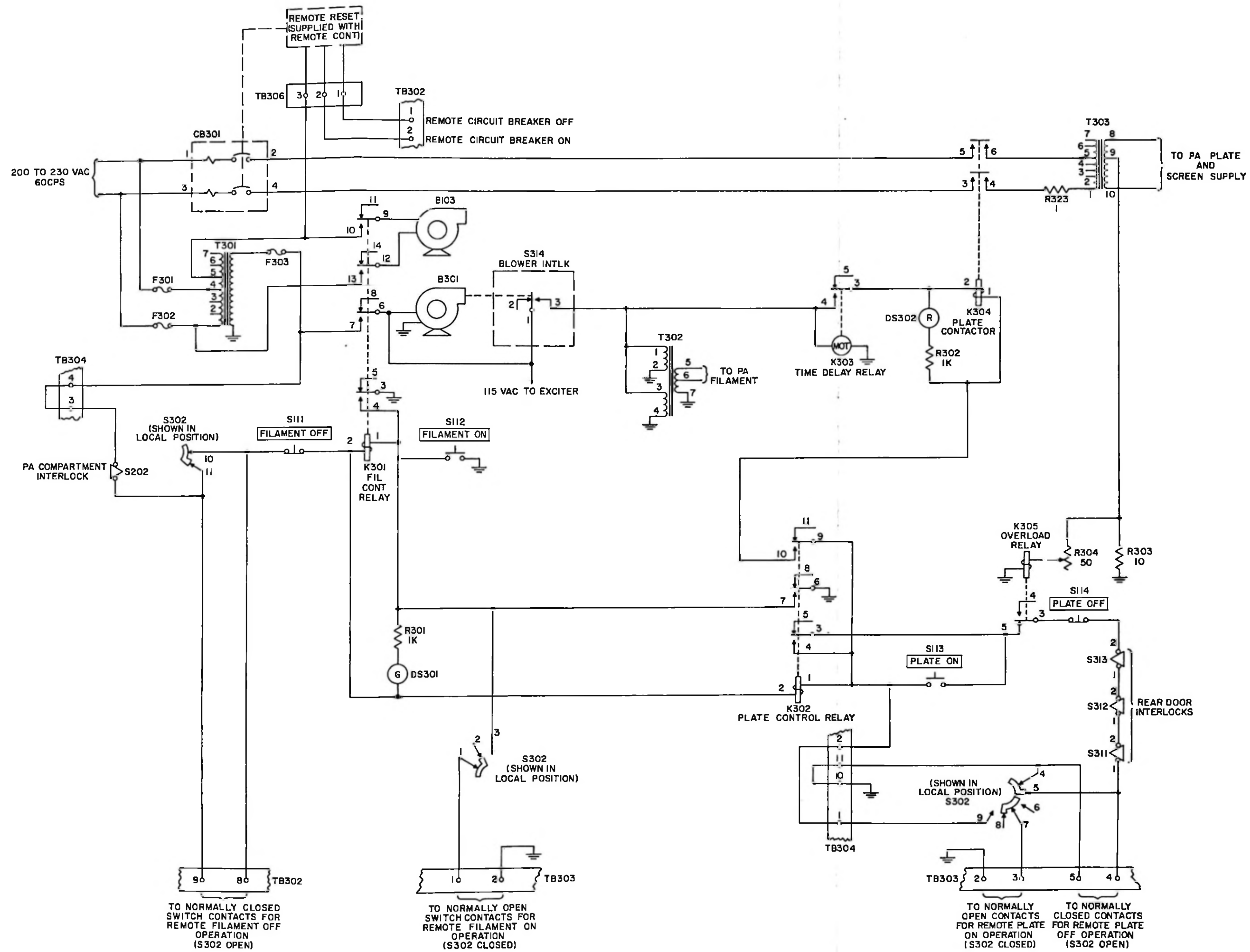


Figure 2-2. B830-1 250-Watt FM Power Amplifier, Control Circuits, Simplified Schematic Diagram

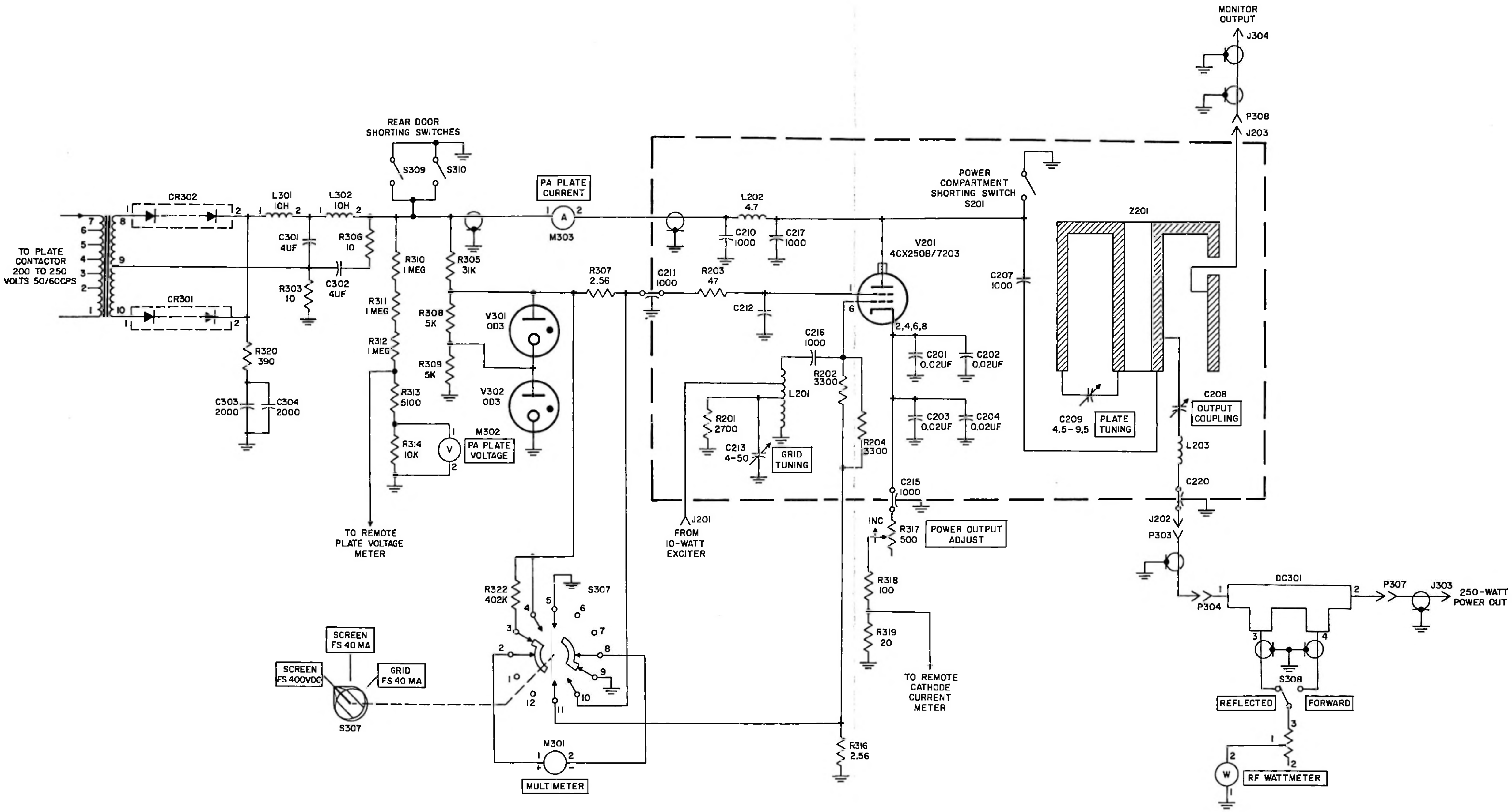


Figure 2-3. B830-1 250-Watt FM Power Amplifier, Power Amplifier Circuits, Simplified Schematic Diagram

close, starting the cabinet fan and power amplifier blower B301 and supplying 115 volts a-c to the 10-watt exciter. When blower B301 comes up to speed, air interlock switch S34 will close, applying 115 volts a-c to filament transformer T302 and time delay relay K303. After approximately 30 seconds (time for power amplifier filament V201 to warm up), time delay relay K303 will be energized, closing contacts 3 and 4, supplying 115 volts a-c to plate contactor relay K304.

The plate supply now can be turned on by pressing the momentary PLATE ON switch (providing all interlocks are closed). Pressing the momentary PLATE ON switch places a ground on plate control relay K302. Relay K302 then will energize, closing contacts 3 and 4, holding K302 in the energized position. Contacts 9 and 10 will also close energizing plate contactor K304 and lighting the red plate indicator lamp. When the plate contactor closes, the primary a-c supply will be applied to plate and screen supply transformer T303. The plate power supply then will furnish approximately 2000 volts d-c to power amplifier tube V201.

Momentary FILAMENT OFF switch S111 removes power from the control and power amplifier circuits. It accomplishes this by opening the 115-volt a-c lead to filament control relay K301, and plate control relay K302. This de-energizes plate contactor K304 and blower interlock S314, removing filament, plate, and screen voltages. The time delay relay will immediately reset for the next turn-on procedure.

Momentary PLATE OFF switch S114 removes only plate and screen voltage from power amplifier V201. This is accomplished by momentarily opening the ground lead of plate control relay K302, which de-energizes plate contactor K304, removing 230-volt a-c power from the plate supply.

Plate overload protection is provided by overload relay K305. As the plate current increases, the voltage across R303 will increase until overload relay K305 energizes, opening the ground lead of plate control relay K302, and removing plate voltage. Potentiometer R304 adjusts the point at which excess plate current will activate overload relay K305.

2.1.2 POWER AMPLIFIER CIRCUITS.

Refer to figure 2-3. The power amplifier consists of a forced-air-cooled tetrode amplifier, working into a tuned cavity over the standard frequency-modulated broadcast band of 88 to 108 megacycles.

The power amplifier plate and screen voltages are obtained from a full-wave, semiconductor-type, rectifier circuit. Transformer T303 increases the 200- to 250-volt, single-phase, 50- or 60-cps primary input to approximately 4000 volts rms across terminals 8 and 10 (T303 secondary winding, 2000 volts each side of center tap). The primary winding of transformer T303 has six adjustable taps to compensate for line voltages from 200 to 250 volts. The output voltage from the secondary winding of T303 is fed to a conventional full-wave rectifier consisting of diodes CR301 and CR302, inductors L301 and L302, and capacitors C301 and C302. Resistor R320 and capacitors C303 and C304 form a transient suppressor which eliminates the transient voltages formed when power is first applied to transformer T303, and when power is switched off. The 2000-volt d-c output from the power supply is fed through P.A. PLATE CURRENT meter M303 through an r-f filter consisting of C210, C217, and L202 to the plate of V201. Plate voltage and plate current are read directly from P.A. PLATE VOLTAGE meter M302 and P.A. PLATE CURRENT meter M303 respectively.

The screen voltage is obtained from the 2000-volt plate supply. The plate supply is fed to a combination bleeder resistor and voltage divider consisting of resistors R305, R308, and R309. Voltage regulator tubes V301 and V302 are placed in parallel with resistors R308 and R309 to form a regulated 300-volt supply which is supplied to the screen grid of V201. Capacitor C212 shunts any r-f energy present on the screen grid to ground

Power amplifier V201 is a cathode and grid leak biased, class C operated tetrode. The control grid circuit of V201 consists of a parallel-tuned resonant tank circuit (L201 and C213) with swamping resistor R201 placed in parallel to provide a low-impedance, broadband load to the control grid. Control grid tuning is accomplished by capacitor C213.

The cathode circuit of V201 contains an output power adjusting potentiometer which raises or lowers the cathode resistance. As V201 is cathode biased, adjusting POWER OUTPUT ADJUST potentiometer R317 changes the cathode bias, as well as the screen potential, which controls the power output of V201. Capacitors C201 through C204 form the cathode bypass.

The plate cavity is formed by a short section of coaxial transmission line resonating with the plate capacity of V201 and plate tuning capacitor C209. The coaxial transmission line is roughly tuned initially by adjusting a shorting plate which lengthens or shortens the coaxial transmission line. Final plate tuning is accomplished by C209. The output coupling network formed by C208 and L203 is connected to the plate transmission line adjacent to the plate of V201 for correct impedance matching. Inductance L203 and capacitor C209 act as an L-section, low-pass filter for frequencies above 130 megacycles to provide additional harmonic suppression. A monitor output is connected directly to the plate cavity for use by the station program monitor.

MULTIMETER M301 is located on the front panel of the power amplifier to enable the station operator to monitor screen voltage, screen current, and grid current. The multimeter functions are selected by the multimeter switch located within the power amplifier cabinet. Screen voltages are determined by connecting MULTIMETER M301 across the regulated screen

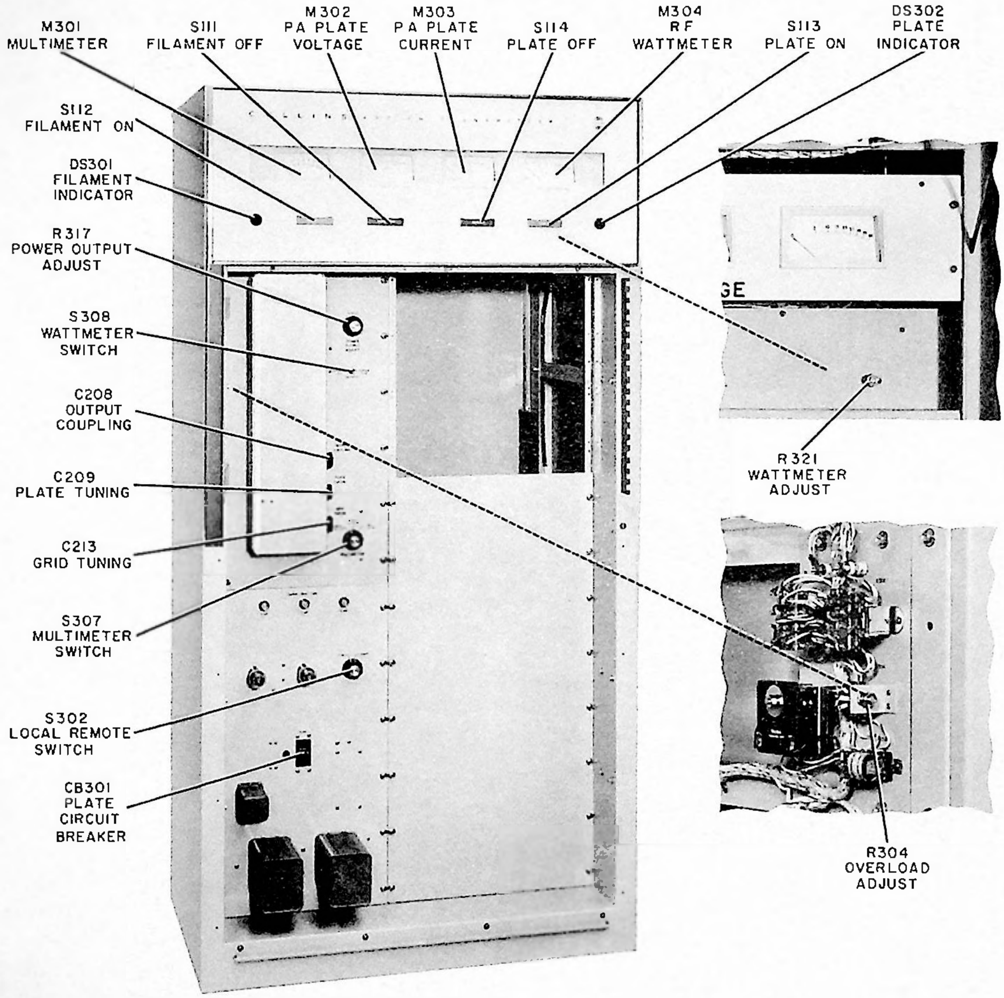


Figure 2-4. B830-1 250-Watt FM Power Amplifier, Control Locations

supply with switch S307. Meter multiplier resistor R322 limits the current through the multimeter for calibration purposes. Screen current is determined by the voltage differential across shunt R307. This voltage is fed to the multimeter when switch S307 is in the proper position. Grid current is determined by the voltage differential across shunt R316. This voltage is also available to the multimeter when S307 is in the proper position.

2.2 CONTROL FUNCTIONS.

The following paragraphs describe all the functions of controls in B830-1 250-Watt FM Power Amplifier. Refer to figure 2-4 for control locations.

The controls located directly on the front panel under the meters include the FILAMENT ON, FILAMENT OFF, PLATE OFF, and PLATE ON switches. The filament indicator and plate indicator lamps are placed in line with the above mentioned controls. The FILAMENT ON switch, S112, energizes the power amplifier filament, the power amplifier, and cabinet blowers, and supplies power to the 10-watt exciter. The FILAMENT OFF switch, S111, de-energizes all transmitter circuits. The PLATE ON switch, S113, energizes the plate power supply, starting the 250-watt power amplifier. The PLATE OFF switch, S114, removes plate and screen voltage. The green filament indicator lamp, DS301, comes on when the FILAMENT ON switch is pressed and indicates that voltage is available to the filament control relay and the PA blower. The PA blower will activate the PA blower air interlock which energizes the power amplifier filament. The red plate indicator lamp, DS302, indicates the plate voltage has been applied to the power amplifier.

The following controls are located directly under the left front door on the power amplifier panel. The POWER OUTPUT ADJUST potentiometer, R317, adjusts the power amplifier bias and screen potential, thus changing the output power. The WATTMETER switch, S308, connects the R.F. WATTMETER to either the reflected power or forward power section of the directional coupler. The WATTMETER switch normally is left in the FORWARD 400W position. The MULTIMETER switch, S307, selects either screen voltage, screen current, or grid current for MULTIMETER M301. Table 3-1 lists the MULTIMETER switch positions and typical indications for each of the three meter circuits.

The following controls are located directly behind the left front door on the power amplifier compartment. The OUTPUT COUPLING control, C208, adjusts the coupling of the load to the plate cavity. The PLATE TUNING control, C209, tunes the plate cavity to resonance and is set very near the minimum indication on P.A. PLATE CURRENT meter M303. At this point the power output should be at the peak as indicated on R. F. WATTMETER M304. The GRID TUNING control, C213, tunes the grid tank and is set for maximum indication on MULTIMETER M301 with the MULTIMETER switch, S307, set to GRID FS 40 MA.

The following controls are located on the power panel directly behind the bottom front panel of the power amplifier cabinet. The LOCAL-REMOTE switch, S302, allows the power amplifier to be operated from a remote position or from the power amplifier. With switch S302 in the REMOTE position, filament-on, filament-off, plate-on, and plate-off functions may be selected from either a remote position or at the power amplifier. With switch S302 in the LOCAL position, filament-on, filament-off, plate-on, and plate-off functions may be selected only at the power amplifier cabinet. The PLATE circuit breaker, CB301, is a protective device which monitors the plate supply transformer primary current. The circuit breaker will activate if the transformer primary current exceeds 5 amperes. The control circuits fuses protect the control circuits from overloads. The two 5-ampere fuses protect the control transformer primary, while the 4-ampere fuse protects the control transformer secondary.

The wattmeter adjusting potentiometer, R321, is located directly below the R.F. WATTMETER when the upper switch and meter panel is raised. The wattmeter adjusting potentiometer is set at the factory and normally does not require adjustment.

The overload adjusting potentiometer, R304, is located inside the right rear door on the relay panel. The overload adjusting potentiometer is set at the factory and normally does not require adjustment.

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains information concerning the maintenance of B830-1 250-Watt FM Power Amplifier.

WARNING

Voltages present in this equipment are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the B830-1 cabinet whenever high voltage is applied. Do not depend entirely on door interlocks. Always shut down the B830-1 before doing any work inside the B830-1 cabinet. Immediately upon opening the rear doors, short out all high-voltage points using the shorting stick located inside the left rear door.

3.2 PREVENTIVE MAINTENANCE.

Most service interruptions in equipment of this type are caused by dirt and corrosion. Corrosion is accelerated by the presence of moisture and dust. Dust should be removed periodically with a soft brush or a dry, oil-free air jet. Remove dust as often as a perceptible quantity accumulates at any point in the power amplifier.

When the B830-1 is operated near salt water or in other corrosive atmospheres, inspect and clean interlock switches, cable connectors, tube prongs, and other metal parts more frequently to keep the equipment in top operating condition.

3.2.1 AIR FILTER CLEANING.

At least once each month, or more often if needed, clean the air filter according to the following procedure:

a. Remove the air filter from the B830-1 cabinet by loosening the two thumb screws located above the air filter. Slide the air filter to the extreme right, and pull the left side of the air filter out as soon as the filter clears the panel. Slide the air filter to the left and remove.

b. Mark with an arrow the direction of airflow.

c. Wash by passing a fine spray of hot water through the filter in the direction opposite that of the airflow. Gently shake the water out of the filter.
d. Dip the filter in a water-soluble oil, such as Filter-kote "M" available from Collins Radio Company, Service Parts Department, Cedar Rapids, Iowa (Collins part number 005-0609-00).
e. Remove the filter from the oil; lay the filter face down until oil ceases to drip from the filter.
f. Replace the filter into the lower rear panel with the airflow arrow (marked when the filter was removed) pointing in the direction of the airflow. Tighten the two thumb screws.
g. Replacement filters are Collins part number 009-1069-00.

3.2.2 PA TUBE CLEANING.

The power amplifier tube depends upon a stream of air passing through the fins to cool the anode. When these fins become dirty, the airflow is reduced and the tube life is shortened. The radiator fins should be cleaned as follows:

a. Remove the r-f amplifier tube as described in paragraph 3.2.2.1.

CAUTION

Special care must be used in removing or installing the power amplifier tube.

b. Direct a low-pressure (50 psi) air stream through the fins in the direction opposite to the normal airflow until all dust is removed.
c. Replace the r-f amplifier tube as described in paragraph 3.2.2.1.

3.2.2.1 PA TUBE REMOVAL.

WARNING

Voltages present within the plate cavity are dangerous to life. Shut down the B830-1 before doing any work inside the cavity. Short the plate to ground immediately on opening the plate cavity door. Do not depend entirely on the door interlock.

The power tube may be removed as follows:

a. Open the power amplifier cavity, and loosen the anode clamp.
b. Grasp the anode with a tube puller for air-cooled tubes (or with the fingers) and lift. If the anode clamp has not been loosened enough, it will cause binding when the power amplifier tube is removed. Care should be taken not to distort the anode clamp.
c. Replacement is the reversal of the removal procedure.

3.2.3 INSPECTION.

Once each week check and clean the three interlock switches and the two shorting switches at the rear of the B830-1 cabinet to be sure they are in good working order.

Once each month check all connections in the B830-1. Tighten any nuts, bolts, or screws that may be loose. Check cable connections to see that they are clean and mechanically secure. Check moving parts such as tuning controls for excessive wear. Check the plate cavity slider for oxidation around ground springs.

3.2.4 LUBRICATION.

The PA blower is to be lubricated once every six months with two drops of SAE no. 20 oil in each bearing. The cabinet fan has bearings that are lubricated for the life of the equipment. No other lubrication of the B830-1 is required.

3.2.5 TUBE MAINTENANCE.

The power amplifier, V201, should be inspected (tube in place) once each week to ensure that an accumulation of dust does not build up on the radiator fins. If dust is present, clean as described in paragraph 3.2.2. When tuning the B830-1, care should be taken not to exceed the maximum plate current shown in table 3-1.

3.3 TROUBLE SHOOTING.

The most common cause of trouble will probably be traced to tube failure. If a tube is suspected of failure, replace it with a tube of known quality, and note any change in performance. A small loss in emission of V201 can be compensated for by a change in the setting of the POWER OUTPUT ADJUST potentiometer. Voltage regulator tubes V301 and V302 can be assumed to be operating properly if the screen voltage is held between 280 and 320 volts as read on MULTIMETER M301.

Four meters are located on the B830-1 front panel to assist in locating any trouble which may occur. Table 3-1 contains typical meter indications. These average indications are obtained from several production power amplifiers, the indications of some B830-1 may vary slightly outside the given limits without affecting the power amplifier performance. A list of panel meter indications for each individual power amplifier should be taken when the B830-1 is operating properly in its particular installation. Any abnormal deviation from these values will then be apparent during a check of meter indications.

TABLE 3-1. TYPICAL METER INDICATIONS

METER	METER SWITCH POSITION	INDICATION
MULTIMETER	SCREEN FS 400 VDC	280 to 320 volts
MULTIMETER	SCREEN FS 40 MA	5 to 20 ma
MULTIMETER	GRID FS 40 MA	5 to 20 ma
P. A. PLATE VOLTAGE		2000 to 2200 volts
P. A. PLATE CURRENT		Not more than 250 ma
R. F. WATTMETER	Forward	250 watts
R. F. WATTMETER	Reflected	Less than 40 watts

3.4 CABLE CHART.

Table 3-2 contains from-to information for cables installed in B830-1 250-Watt FM Power Amplifier. The table is useful in locating point-to-point wiring within the B830-1 cabinet. The from column is listed in alphabetical and numerical order. To find a particular wire, establish the point on the B830-1 from which wire tracing is to be initiated. Find this point in the from column of table 3-2, and the to column will give the location of the other end of that particular wire. The wire code column gives the type and color of wire used in each case. Refer to the back inside cover of this manual for the wire code explanation. When the wire code CBSJ is encountered, the letters SJ mean shield with jacket.

TABLE 3-2. FROM-TO INFORMATION

WIRE CODE	FROM	TO
RE91	C206-1	T302-5
LE9	C210	M303-2
RC4	C211	E303
RC93	C214	S307-11
RC905	C215	R317-3
RC95	C218	S302-11
RC95	C219	TB304-3
KE0	C301-1	L301-2
RC90	C301-2	R304-3
RC90	C301-2	T303-9
RC90	C301-2	C302-2
RC90	C302-2	C301-2
VG90	CB301-1	TB301-1
VG90	CB301-1	XF301-1
RE90	CB301-2	K304-5
VG9	CB301-3	XF302-1
VG9	CB301-3	TB301-2
RE95	CB301-4	K304-3
KE0	CR301-1	T303-10
KE0	CR302-1	T303-8
KE0	CR302-2	L301-1
CBSJ905	DC301-3	S308-2
Shield	DC301-3	E313
CBSJ903	DC301-4	S308-3
Shield	DC301-4	E313

TABLE 3-2. FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
KE0	E301	L302-2	RC9	E310	T301-9
KE0	E301	S309	RC9	E311	E310
KE0	E301	TB308-1	RC9	E312	E310
KE0	E301	R305-1	RC0	E312	K305-2
KE0	E301	M303-1	RC9	E312	K303-1
RC4	E303	C211	Shield	E313	DC301-3
RC1	E303	S307-10	Shield	E313	DC301-4
RC96	E304	R308	Shield	E313	E306
RC96	E304	S307-4	DA91	E314	T302-7
Shield	E306	M304-1	RC9	E317	TB309-2
Shield	E306	E313	RC905	E317	TB303-10
RC92	E307	TB309-1	RC9	E317	S307-9
RC91	E307	K301-6	RC9	E322	K302-6
RC91	E307	S314-1	RC9	E322	K301-3
RC91	E307	TB307-1	RC0	J305-1	K301-12
RC913	E308	S113-1	RC90	J305-2	K301-9
RC913	E308	K305-5	RC96	K301-1	S112-2
RC913	E308	K302-3	RC96	K301-1	S302-3
RC913	E308	TB304-7	RC902	K301-2	S111-2
VG9	E309	E310	RC902	K301-2	K302-2
RC9	E309	Power supply panel	RC9	K301-3	E322
VG9	E310	E309	RC916	K301-14	K302-7
VG9	E310	TB301-3	RC91	K301-6	E301
RC9	E310	E311	RC902	K301-7	XF303-2
RC9	E310	E312	RC90	K301-9	J305-2
RC9	E310	M302-2	RC93	K301-10	T301-5
RC9	E310	TB303-2	RC0	K301-12	J305-1
RC9	E310	TB304-10	RC92	K301-13	T301-1

TABLE 3-2. FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC916	K302-1	S113-2	KE0	L301-2	C301-1
RC916	K302-1	K302-4	KE0	L302-1	L301-2
RC91	K302-1	K302-9	KE0	L302-2	E301
RC902	K302-2	TB304-8	RC903	M301-1	S307-2
RC902	K302-2	K301-2	RC902	M301-2	S307-8
RC913	K302-3	E308	RC902	M302-1	TB308-5
RC916	K302-4	K302-1	RC9	M302-2	E310
RC9	K302-6	E22	RC9	M302-2	TB308-6
RC916	K302-7	K301-4	RC9	M302-2	M304-1
RC923	K302-9	TB304-2	KE0	M303-1	E301
RC91	K302-9	K302-1	LE9	M303-2	C210
RC916	K302-10	TB308-10	Shield	M304-1	E306
RC906	K302-10	K304-1	RC9	M304-1	M302-2
RC9	K303-1	E312	CBSJ906	M304-2	R321-1
RC925	K303-3	K304-2	RC915	R304-1	K305-1
RC92	K303-4	S314-3	RC90	R304-3	C301-2
RC906	K304-1	K302-10	KE0	R305-1	E301
RC925	K304-2	K303-3	RC5	R305-2	XV301-5
RC925	K304-2	TB304-5	RC96	R308	XV301-5
RC923	K304-2	XDS302-1	RC96	R308-2	S307-4
RE95	K304-3	CB301-4	RC903	R317-1	R318-1
RE92	K304-4	R323-1	RC905	R317-3	C215
RE90	K304-5	CB301-2	RC903	R318 - Bottom	TB303-9
RE91	K304-6	T303-5	RC903	R318-1	R317-1
RC915	K305-1	R304-1	CBSJ906	R321-1	M304-2
RC0	K305-2	E312	CBSJ902	R321-3	S308-1
RC916	K305-3	S306-2	RE92	R323-1	K304-4
RC913	K305-5	E308	RE93	R323-2	T303-1
KE0	L301-1	CR302-2			
KE0	L301-2	L302-1			

TABLE 3-2. FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC91	S302-1	TB303-1	RC93	S307-11	C214
RC96	S302-3	TB304-6	CBSJ902	S308-1	R321-3
RC96	S302-3	K301-1	CBSJ905	S308-2	DC301-3
RC912	S302-4	TB303-5	DBSJ903	S308-3	DC301-4
RC912	S302-4	TB304-11	VD902	S309	S310
RC90	S302-5	TB303-4	KE0	S309	E310
RC90	S302-5	S311-1	VD902	S310	S309
RC92	S302-7	TB303-3	RC90	S311-1	S302-5
RC915	S302-9	TB304-1	RC912	S311-2	S312-1
RC93	S302-10	TB302-8	RC912	S312-1	S311-2
RC95	S302-11	C218	RC913	S312-2	S313-1
RC95	S302-11	TB302-9	RC913	S313-1	S312-2
RC906	S111-1	TB302-8	RC915	S313-2	S114-1
RC902	S111-2	K301-2	RC91	S314-1	E307
RC902	S111-2	XDS301-1	RC92	S314-3	K303-4
RC9	S112-1	TB308-6	RC92	S314-3	T302-1
RC96	S112-2	TB308-8	RC92	T301-1	TB302-3
RC96	S112-2	K301-1	RE92	T301-1	XF302-2
RC913	S113-1	E308	RC92	T301-1	K301-13
RC916	S113-2	K302-1	RE91	T301-4	XF301-2
RC915	S114-1	S313-2	RC93	T301-4	TB306-3
RC916	S114-2	K305-3	RC93	T301-5	K301-10
RC903	S307-2	M301-1	RC96	T301-8	XF303-1
RC96	S307-4	E304	RC9	T301-9	E310
RC96	S307-4	R308-2	RC92	T302-1	S314-3
RC902	S307-8	M301-2	DA91	T302-5	C206-1
RC9	S307-9	E317	DA91	T302-7	E314
RC1	S307-10	E303	RE93	T303-1	R323-2

TABLE 3-2. FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RE91	T303-5	K304-6	RC925	TB304-5	K304-2
KE0	T303-8	CR302-1	RC96	TB304-6	S302-3
RC90	T303-9	C301-2	RC913	TB304-7	E308
KE0	T303-10	CR301-1	RC913	TB304-7	TB303-7
VG90	TB301-1	CB301-1	RC902	TB304-8	K302-2
VG9	TB301-2	CB301-3	RC9	TB304-10	E310
RC9	TB301-3	TB304-10	RC9	TB304-10	TB301-3
VG9	TB301-3	E310	RC91	TB302-2	TB306-2
RC90	TB302-1	TB306-1	RC92	TB302-3	TB301-1
RC91	TB302-2	TB306-2	RC96	TB302-7	TB307-8
RC92	TB302-3	T301-1	RC93	TB302-8	S302-10
RC96	TB302-7	TB307-9	RC906	TB302-8	S111-1
RC93	TB302-8	S302-10	RC95	TB302-9	S302-11
RC906	TB302-8	S111-1	RC91	TB303-1	S302-1
RC95	TB302-9	S302-11	RC9	TB303-2	E310
RC91	TB303-1	S302-1	RC92	TB303-3	S302-7
RC9	TB303-2	E310	RC90	TB303-4	S302-5
RC92	TB303-3	S302-7	RC912	TB303-5	S302-4
RC90	TB303-4	S302-5	RC913	TB303-7	TB304-7
RC912	TB303-5	S302-4	RC902	TB303-8	TB308-4
RC913	TB303-7	TB304-7	RC903	TB303-9	R318 - Bottom
RC902	TB303-8	TB308-4	RC905	TB303-10	E317
RC903	TB303-9	R318- Bottom	RC915	TB304-1	S302-9
RC905	TB303-10	E317	RC923	TB304-2	K302-9
RC915	TB304-1	S302-9	RC95	TB304-3	C219
RC923	TB304-2	K302-9	RC93	TB304-4	XF303-2
RC95	TB304-3	C219	RC925	TB304-5	K304-2
RC93	TB304-4	XF303-2	RC96	TB304-6	S302-3

TABLE 3-2. FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO
RC913	TB304-7	E308
RC913	TB304-7	TB303-7
RC902	TB304-8	K302-2
RC9	TB304-10	E310
RC9	TB304-10	TB301-3
RC912	TB304-11	S302-4
TAS9	TB305-1	TB307-3
TAS0	TB305-2	TB307-4
Shield	TB305-3	TB307-5
TAS9	TB305-4	TB307-6
TAS2	TB305-5	TB307-7
RC90	TB306-1	TB302-1
RC91	TB306-2	TB302-2
RC93	TB306-3	TB301-5
RC91	TB307-1	E307
RC9	TB307-2	TB308-6
TAS9	TB307-3	TB305-1
TAS0	TB307-4	TB305-2
Shield	TB307-5	TB305-3
RC96	TB307-8	TB302-7
TAS9	TB307-6	TB305-4
TAS2	TB307-7	TB305-5
KE0	TB308-1	E301
RC902	TB308-4	TB303-8
RC902	TB308-5	M302-1
RC9	TB308-6	S112-1
RC9	TB308-6	M302-2
RC9	TB308-6	TB307-2
RC903	TB308-7	XDS301-2
RC96	TB308-8	S112-2
RC925	TB308-9	XDS302-2
RC916	TB308-10	K302-10
RC92	TB309-1	E307
RC9	TB309-2	E317
RC902	XDS301-1	S111-2
RC903	XDS301-2	TB308-7
RC923	XDS302-1	K304-2
RC925	XDS302-2	TB308-9
VG90	XF301-1	CB301-1
RE91	XF301-2	T301-4
VG9	XF302-1	CB301-3
RE92	XF302-2	T301-1
RC96	XF303-1	T301-8
RC93	XF303-2	TB304-4
RC902	XF303-2	K301-7
RC92	XV301-2	XV302-5
RC5	XV301-5	R305-2
RC96	XV301-5	R308
RC92	XV302-5	XV301-2

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	B830-1 250-WATT FM POWER AMPLIFIER	549-2008-00
C201	CAPACITOR, FIXED, CERAMIC: 0.02 uf +100% -20%, 500 vdcw; Sprague Electric of Wisconsin part no. 33C2	913-2142-00
C202 thru C205	CAPACITOR, FIXED, CERAMIC: same as C201	913-2142-00
C206	CAPACITOR, FIXED, CERAMIC: 1000 uuf +80% -20%, 500 vdcw; Erie Resistor part no. DA722-002	913-1292-00
C207	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 5000 vdcw; Centralab part no. DA-858-003	913-0101-00
C208	PLATE, CAPACITOR, SOLDERED: c/o brass plate 2.500 in. dia by 0.125 in. thk; brass hub & copper electrical lead, irregular shape; Collins Radio Co.	549-2059-002
C209	CAPACITOR, VARIABLE, AIR: 4.5 uuf min to 9.5 uuf max, 7000 volts; E. F. Johnson type 9G70	922-0570-00
C210	CAPACITOR, FIXED, CERAMIC: same as C207	913-0101-00
C211	CAPACITOR, FIXED, CERAMIC: same as C206	913-1292-00
C212	Part of XV201	
C213	CAPACITOR, VARIABLE, AIR: 3.9 uuf min to 50 uuf max; single section; Hammerlund type APC-50B	922-0016-00
C214	CAPACITOR, FIXED, CERAMIC: same as C206	913-1292-00
C215	CAPACITOR, FIXED, CERAMIC: same as C206	913-1292-00
C216	CAPACITOR, FIXED, CERAMIC: same as C207	913-0101-00
C217	CAPACITOR, FIXED, CERAMIC: same as C207	913-0101-00
C218	CAPACITOR, FIXED, CERAMIC: same as C206	913-1292-00
C219	CAPACITOR, FIXED, CERAMIC: same as C206	913-1292-00
C220	CAPACITOR, FIXED, PLASTIC: c/o 2 external brass capacitor plates & 1 center plate, 8 Teflon washers, 4 eyelets; 1-9/32 in. dia by 0.225 in. lg overall; Collins Radio Company	549-2126-002
J201	CONNECTOR, RECEPTACLE, ELECTRICAL: type BNC panel mtg, 1 contact; R. F. Products Co. part no. 87075	357-9183-00
J202	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round female contact, straight shape; 1 in. by 1 in. by 1.106 in. overall	357-9003-00
J203	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J201	357-9183-00
L201	LEAD, ELECTRICAL: pitch copper, silver plated; 0.032 in. by 1-3/16 in. by 4-3/4 in.; Collins Radio Co.	549-2132-002
L202	COIL, RADIO FREQUENCY: 4.7 uh ±10%, 0.60 ohms dc resistance, 950 ma d-c, single layer wound; phenolic coil form; Jeffers Electronics part no. 10402-32	240-0178-00
L203	COIL, RADIO FREQUENCY: copper; 3/4 in. id by 2 in. lg; Collins Radio Co.	549-2133-00
R201	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%, 2 w	745-5670-00
R202	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10% 2 w	745-5673-00
R203	RESISTOR, FIXED, COMPOSITION: 47 ohms ±10%, 1 w	745-3296-00
R204	RESISTOR, FIXED, COMPOSITION: same as R202	745-5673-00
S201	LEAD, ELECTRICAL: beryllium copper, silver plated; 3/8 in. w by 2-15/16 in. lg approx; Collins Radio Co.	549-2060-00
S202	SWITCH, INTERLOCK: spdt; 10 amp at 250 volts a-c; screw-type terminals; Micro Switch part no. 3AC5	266-8013-00
V201	ELECTRON TUBE: tetrode; RCA type 7203/4CX250B	256-0138-00
XV201	SOCKET, ELECTRON TUBE: air system tube socket for u/w ungrounded cathodes & built-in capacitor, 1100 uuf ±20 uuf, 1000 volts d-c; E. F. Johnson part no. 124-115-2; includes C212	220-1294-00
Z201	PA CAVITY, RIVETED: c/o aluminum cavity, 6 in. w by 24-13/16 in. lg; aluminum cover 6-1/8 in. w by 23-13/16 in. lg and cavity hinge; Collins Radio Co.	549-2130-002
	ELECTRICAL CABINET	548-3659-005
B301	FAN, CENTRIFUGAL: 115 volts a-c, 60 cps, single phase, shaded pole, direct connected centrifugal fan; continuous duty cycle; Dayton Electrical Mfg. Co. part no. 2C610	009-1576-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
B302	MOTOR, ALTERNATING CURRENT: 230 volts, 50/60 cps, 1550 rpm, ccw rotation, totally enclosed; General Electric part no. 5KSP51CL17	230-0164-00
C301	CAPACITOR, FIXED, PAPER: 4 uf ±10%, 4000 vdcw; Sprague Electric part no. S4878	930-0705-00
C302	CAPACITOR, FIXED, PAPER: same as C301	930-0705-00
C303	CAPACITOR, FIXED, CERAMIC: 0.002 uf ±20%, 6000 vdcw; Centralab type DD60	913-3540-00
C304	CAPACITOR, FIXED, CERAMIC: same as C303	913-3540-00
C305	CAPACITOR, FIXED, CERAMIC: 25 uuf ±10%, 2500 volts rms at 2.0 mc, 1500 volts rms at 16.0 mc; Centralab part no. 850-001	913-4253-00
C306	CAPACITOR, FIXED, CERAMIC: same as C305	913-4253-00
C307	CAPACITOR, FIXED, CERAMIC: 33 uuf ±10%, 15,000 vdcw, Centralab type DA-857A	913-1425-00
C308	CAPACITOR, FIXED, CERAMIC: same as C305	913-4253-00
C309	CAPACITOR, FIXED, CERAMIC: same as C305	913-4253-00
CB301	CIRCUIT BREAKER: double pole, magnetic; back connected, 5.0 amp a-c contact rating, 230 volts a-c, 125 volts d-c; Heinemann Electric Co. part no. 2263S	260-0239-00
CR301	SEMICONDUCTOR DEVICE, DIODE: silicon; General Electric Co. part no. 4JA421EH20AB1	353-1794-00
CR302	SEMICONDUCTOR DEVICE, DIODE: same as CR301	353-1794-00
DC301	COUPLER UNIT: double coupler; 400 w incident, 40 w reflected; 50 ohms impedance; 1-1/4 in. w by 4-1/4 in. lg; M. C. Jones Electronics Co. part no. 576N(Mod)	277-0156-00
DS301	LAMP, INCANDESCENT: pilot light bulb w/ candelabra base and tapered bulb	262-3310-00
DS302	LAMP, INCANDESCENT: same as DS301	262-3310-00
E301	TERMINAL STUD: single ended insulated standoff terminal w/ metal case; 1/4 in. hex by 3/4 in. lg; Armel part no. RTMT16-6M	306-0979-00
E302	INSULATOR, STANDOFF: ceramic, white glaze on surfaces w/ heavy lines, other surfaces unglazed; 1.250 in. lg by 3/4 in. w	190-0025-00
E303 thru E309	NOT USED	
E310	INSULATOR, STANDOFF: same as E302	190-0025-00
F301	FUSE, CARTRIDGE: 250 volts, 5.0 amp, direct current; normal instantaneous	264-0361-00
F302	FUSE, CARTRIDGE: same as F301	264-0361-00
F303	FUSE, CARTRIDGE: 4 amp, 125 volts, glass enclosed, 4 spares furnished; Bussman Mfg. Co. part no. MDX-4	264-0217-00
J301	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round female contact, straight shape; 1 in. by 1 in. by 1.106 in. overall	357-9003-00
J302	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J301	357-9003-00
J303	CONNECTOR, RECEPTACLE, ELECTRICAL: female jack connector for u/w coaxial cable; 500 volts operating voltage, 50 ohms impedance; Teflon insulation, brass body, beryllium copper contact	357-9476-00
J304	CONNECTOR, RECEPTACLE, ELECTRICAL: for u/w RG-55/U, RG-58/U coaxial cables; Teflon insulation, copper contact, brass shell; 11/16 in. across hex, 1-5/32 in. lg; American Phenolic part no. 31-206	357-9248-00
J305	FAN, CONNECTOR: twist-lock, 3-wire midget, 10 amp, 250 volts; 15 amp, 125 volts	368-0014-00
K301	RELAY, ARMATURE: 4C contact arrangement; 115 volts a-c, 10 amp; 330 ohms resistance; Aemco Inc. part no. 83-3544	970-1933-00
K302	RELAY, ARMATURE: same as K301	970-1933-00
K303	RELAY, SWITCH: adjustable time delay, snap-action switch, 20 amp at 125 volts a-c or 250 volts a-c resistive load; 60 cps, 120 volts	402-0126-00
K304	RELAY: power contactor; 2 contacts corrosion and moisture resistant; 60 cps coil rating; 25 amp, non-inductive load 600 volts; 4 in. w by 5-7/8 in. lg	405-0124-00
K305	RELAY, ARMATURE: 1C contact arrangement; 28 volts d-c or 115 volts a-c; 300 ma; continuous duty cycle; Sigma Instruments Co. part no. 95062	408-1114-00
L301	CHOKE: 10 h at 10 volt rms, 60 cps w/ rated d-c current; 0.350 amp; 90 ohms max; 1000 volts rms ripple volt, 100/120 cps ripple frequency; Electro Engr. Works part no. E12321	668-0014-00
L302	CHOKE: same as L301	668-0014-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
M301	METER, ARBITRARY SCALE: permanent magnet moving coil type d-c milliammeter; 0-1 ma d-c meter range; 100 ohms meter resistance; double scale, 0-40, 0-80 in 40 scale divisions	458-0649-00
M302	VOLTMETER: permanent magnet moving coil type d-c milliammeter; 0-1 ma d-c meter range; 100 millivolts approx meter movement; 0-3000 vdc (60 scale divisions)	458-0640-00
M303	AMMETER: permanent magnet moving coil type d-c milliammeter; 0-1 ma d-c meter range; 0-300 ma scale markings	458-0639-00
M304	METER, ARBITRARY SCALE: permanent magnet moving coil type d-c microammeter; 0-200 ua meter range; 900 ohms resistance; 0-40 scale	458-0638-00
O301	KNOB: black phenolic w/ 6 flutes, aluminum insert w/ molded diamond knurl; 27/32 in. h by 1.500 in. dia; includes phenolic skirt; Collins Radio Co.	546-1293-003
O302 thru O305	KNOB: same as O301	546-1293-003
P301	CONNECTOR, PLUG, ELECTRICAL: type BNC cable mtg, 1 male contact, R. F. Products Div, part no. UG-88C/U	357-9292-00
P302	CONNECTOR, PLUG, ELECTRICAL: same as P301	357-9292-00
P303	CONNECTOR, PLUG, ELECTRICAL: brass body and contacts; Teflon insulation; 3/4 in. dia approx by 1-1/2 in. lg approx; Amphenol part no. UG-1185/U	357-9326-00
P304 thru P307	CONNECTOR, PLUG, ELECTRICAL: same as P303	357-9326-00
P308	CONNECTOR, PLUG, ELECTRICAL: same as P301	357-9292-00
P309	CONNECTOR, PLUG, ELECTRICAL: twist lock, 3-wire midget; 10 amp at 250 volts, 15 amp at 125 volts	368-0013-00
R301	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 2 w	745-5652-00
R302	RESISTOR, FIXED, COMPOSITION: same as R301	745-5652-00
R303	RESISTOR, FIXED WIREWOUND: 10 ohms ±5%, 5 w	747-5420-00
R304	RESISTOR, VARIABLE: wirewound; 50 ohms ±10%, 2 w	377-0619-00
R305	RESISTOR, FIXED, WIREWOUND: 31,000 ohms ±5%, 210 w	746-6727-00
R306	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 2 w	745-5568-00
R307	RESISTOR, FIXED, WIREWOUND: 2.56 ohms ±1%, 2.5 w; Dale Products part no. RSM2C/2R560F	746-9448-00
R308	RESISTOR, FIXED, WIREWOUND: 5000 ohms ±5%, 10w	710-2913-00
R309	RESISTOR, FIXED, WIREWOUND: same as R308	710-2913-00
R310	RESISTOR, FIXED, FILM: 1 megohm ±1%, 2 w	705-4254-00
R311	RESISTOR, FIXED, FILM: same as R310	705-4254-00
R312	RESISTOR, FIXED, FILM: same as R310	705-4254-00
R313	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/2 w	705-7630-00
R314	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1 w	745-3394-00
R315	NOT USED	
R316	RESISTOR, FIXED, WIREWOUND: same as R307	746-9448-00
R317	RESISTOR, VARIABLE: power type; 500 ohms ±10%, 50 w	736-0456-00
R318	RESISTOR, FIXED, WIREWOUND: 160 ohms ±5%, 10 w	710-2921-00
R319	RESISTOR, FIXED, WIREWOUND: 20 ohms ±5%, 5 w	710-3035-00
R320	RESISTOR, FIXED, COMPOSITION: 390 ohms ±10%, 2 w	745-5635-00
R321	RESISTOR, VARIABLE: composition; 5000 ohms ±30%, 1/4 w	376-4729-00
R322	RESISTOR, FIXED, FILM: 402,000 ohms ±1%, 1 w	705-3287-00
R323	RESISTOR, FIXED, WIREWOUND: 1.0 ohm ±5%, 26 w	747-1626-00
S301	NOT USED	
S302	SWITCH, ROTARY: 4-circuit, 4-pole, 2-position, 1-section; 4 moving, 12 fixed contacts	259-1564-00
S303	SWITCH, PUSH: normally open and closed; Bakelite; Arrow-Hart & Hegeman part no. B-2	260-2020-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
S304 thru S306	SWITCH, PUSH: same as S303	
S307	SWITCH, ROTARY: 2-circuit, 2-pole, 3-position, 1-section; 2 moving, 8 fixed contacts	259-1565-00
S308	SWITCH, TOGGLE: spdt; 125 volts or 250 volts d-c, 5 amp; Micro Switch, Div. Minneapolis-Honeywell part no. 6AT11-T	260-1509-00
S309	SPRING, INTERLOCK: beryllium copper, silver plated; 0.040 in. by 2-1/8 in. by 4-1/32 in. approx.	549-2315-003
S310	SPRING, INTERLOCK: same as S309	549-2315-003
S311	CONTACT ASSEMBLY, ELECTRICAL: 5/8 in. by 11/16 in. by 1-7/8 in. overall; Neptune Electronics part no. M-7460330G4	260-4040-00
S312	CONTACT ASSEMBLY, ELECTRICAL: same as S311	260-4040-00
S313	CONTACT ASSEMBLY, ELECTRICAL: same as S311	260-4040-00
S314	SWITCH, AIRFLOW INTERLOCK: spdt; 5 amp at 250 volts a-c, metal case	266-8307-00
T301	TRANSFORMER, POWER, STEP-DOWN: 200, 210, 220, 230, 240 & 250 volt input, 50/60 cps, 120 volts at 4.25 amp output; 5-1/8 in. by 5-1/8 in. by 5-3/8 in.; Electro Engineering Works part no. E12322	662-0043-00
T302	TRANSFORMER, POWER, STEP-DOWN: 115 volts, 230 volts, 50/60 cps input, 6.3-volt center tapped output; 2-17/32 in. by 3-1/32 in. by 3-3/32 in.; Chicago Std. Transformer part no. 12256	662-0162-00
T303	TRANSFORMER, POWER, STEP-UP: 200, 210, 220, 230, 240, & 250 volt input, 50/60 cps, 2100 volts center tapped at 250 ma output; 6-3/8 in. by 6-1/2 in. by 7-5/16 in.; Raytheon Mfg. Co. part no. 292-5783G1	662-0041-00
TB301	TERMINAL BOARD: barrier type; black phenolic connector strip; 4 terminals; 1-5/16 in. w by 3-7/32 in. lg; Howard B. Jones part no. 4-142	367-5040-00
TB302	TERMINAL BOARD: Bakelite; black finish; 10 terminal connector strips; 5-40 terminal screws; Howard B. Jones, Div. Cinch Mfg. Co. part no. 140-10	367-3100-00
TB303	TERMINAL BOARD: same as TB302	367-3100-00
TB304	TERMINAL BOARD: phenolic; 13/32 in. by 7/8 in. by 5-11/64 in.; includes 12 screw-type terminals; barrier type; Kulka Electric Corp. part no. 600-11-M	367-0518-00
TB305	TERMINAL BOARD: same as TB304	367-0518-00
TB306	TERMINAL BOARD: black Bakelite; 1/2 in. by 1-1/8 in. by 2-1/2 in.; 4 terminals included; Howard B. Jones, Div. Cinch Mfg. Co. part no. 4-141	367-4040-00
TB307	TERMINAL BOARD: barrier type, 14 terminals; 5/8 in. w by 8-3/8 in. lg; Howard B. Jones, Div. Cinch Mfg. Corp. part no. 14-162A-R	367-0300-00
TB308	RESISTOR ASSEMBLY: includes plastic terminal board, 1/16 in. by 3-1/2 in. by 4-9/16 in. & 7 fixed resistors	549-2102-002
TB309	TERMINAL BOARD: phenolic; 1/16 in. thk, 3/8 in. w by 1-1/8 in. lg overall excluding terminals; Cinch Mfg. Corp. part no. 18A18697	306-0168-00
V301	ELECTRON TUBE: RCA type OD3/VR150	257-0001-00
V302	ELECTRON TUBE: same as V301	257-0001-00
XDS301	LAMPHOLDER: panel mounting for u/w candelabra screw base lamp	262-0255-00
XDS302	LAMPHOLDER: same as XDS301	262-0255-00
XF301	FUSEHOLDER: extractor post type; transparent with 3 AG fuses; Bussman Mfg. Co. part no. HKL-JRZ	265-1040-00
XF302	FUSEHOLDER: same as XF301	265-1040-00
XF303	FUSEHOLDER: same as XF301	265-1040-00
XV301	SOCKET, ELECTRON TUBE: 8 prong octal tube socket; molded construction plastic; Amphenol part no. 88-8 TM	220-1005-00
XV302	SOCKET, ELECTRON TUBE: same as XV301	220-1005-00

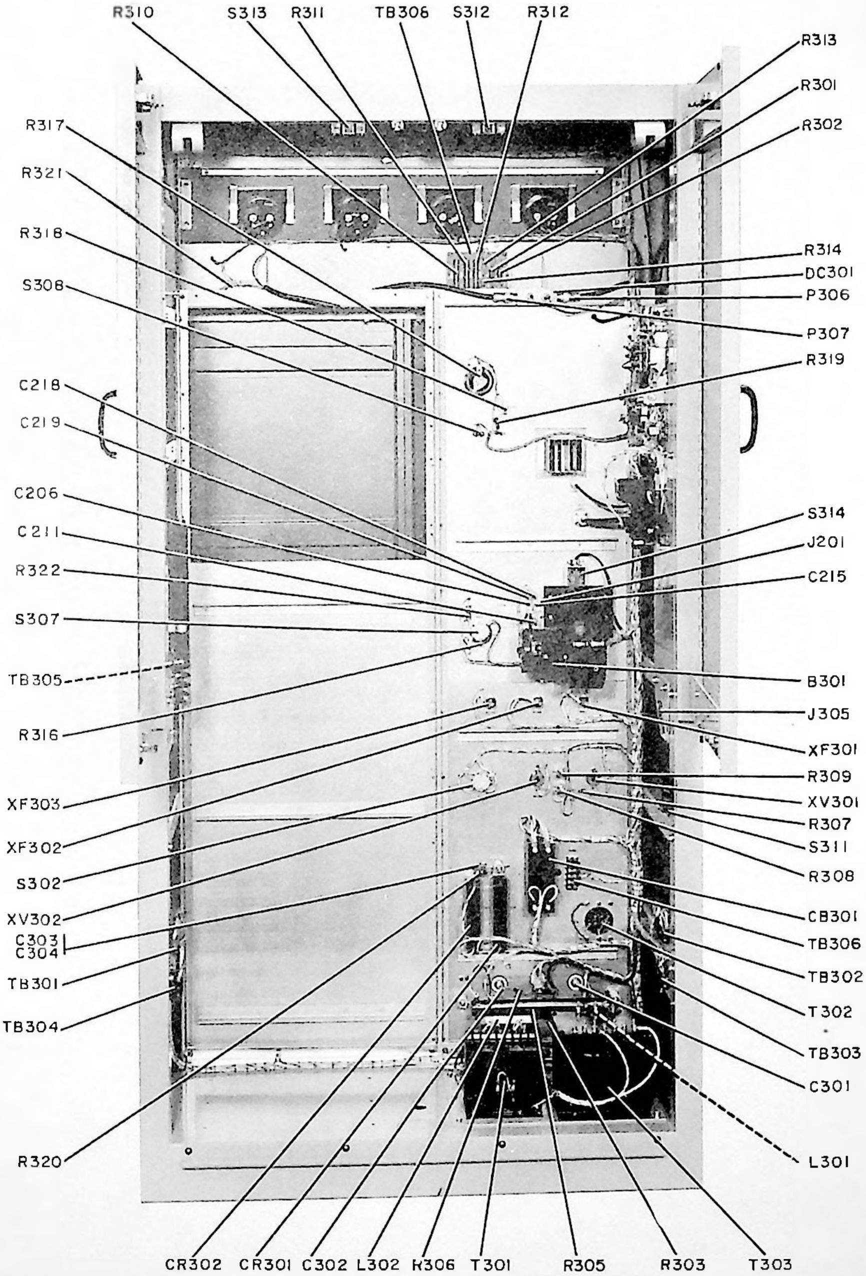


Figure 4-1. B830-1 250-Watt FM Power Amplifier, Rear View, Parts Location

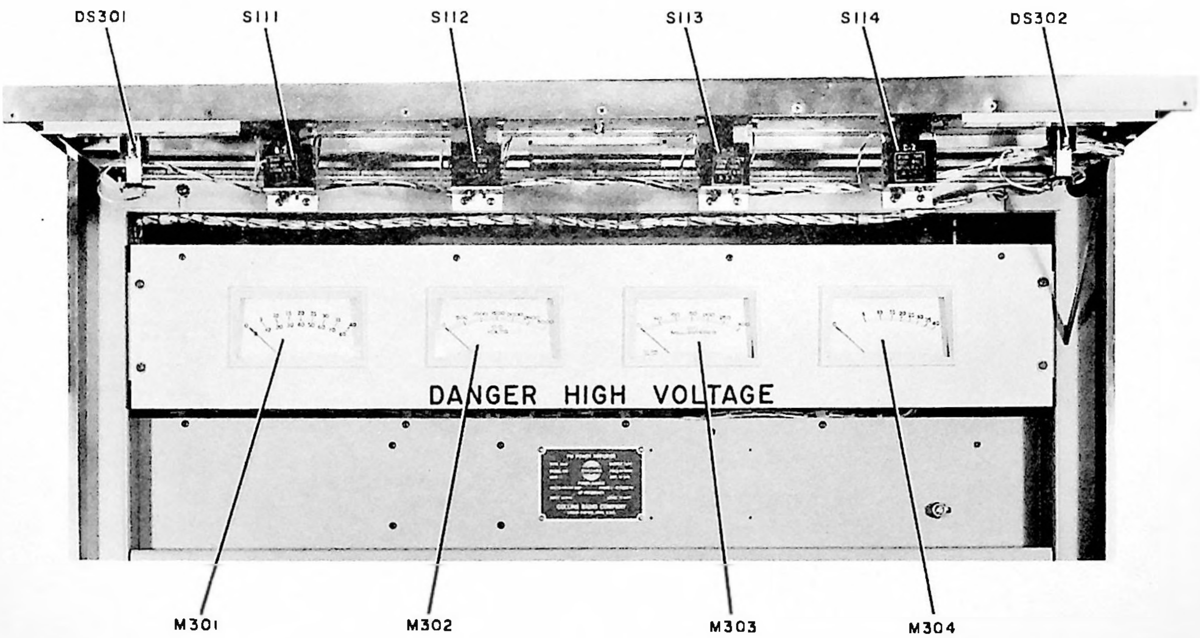


Figure 4-2. Meter Panel Subassembly, Parts Location

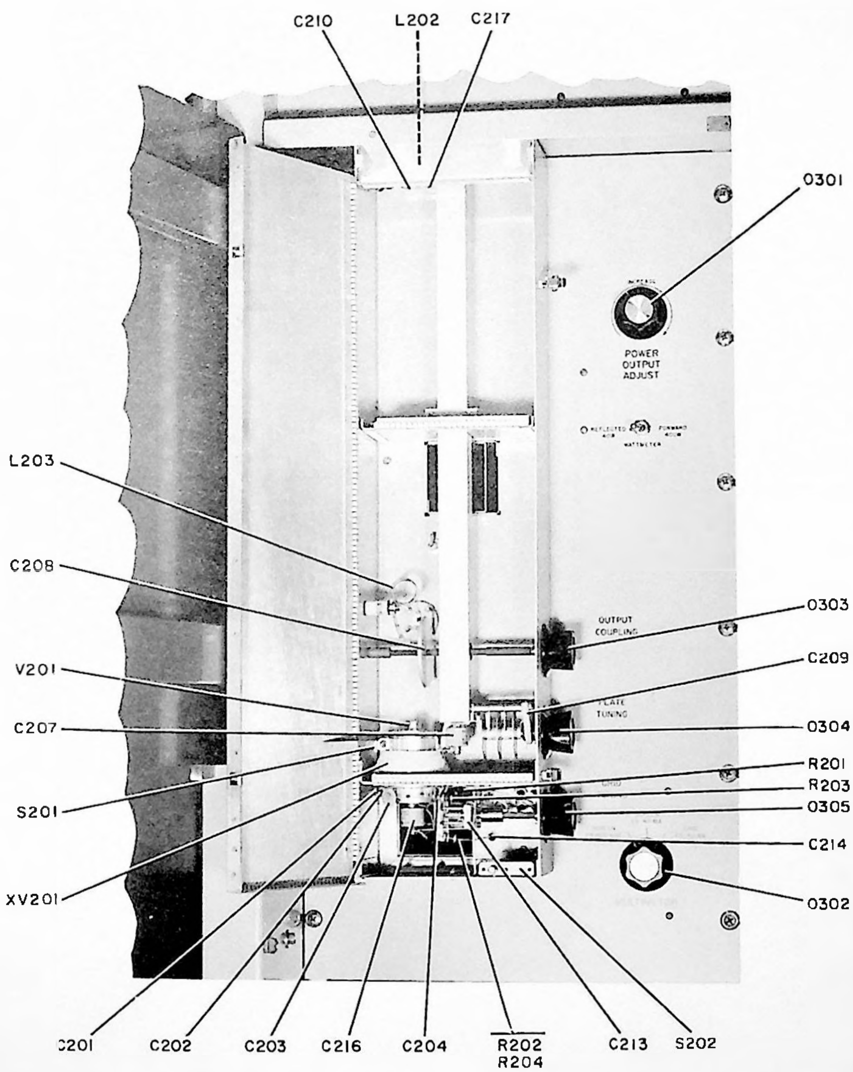


Figure 4-3. Plate Cavity Subassembly, Parts Location

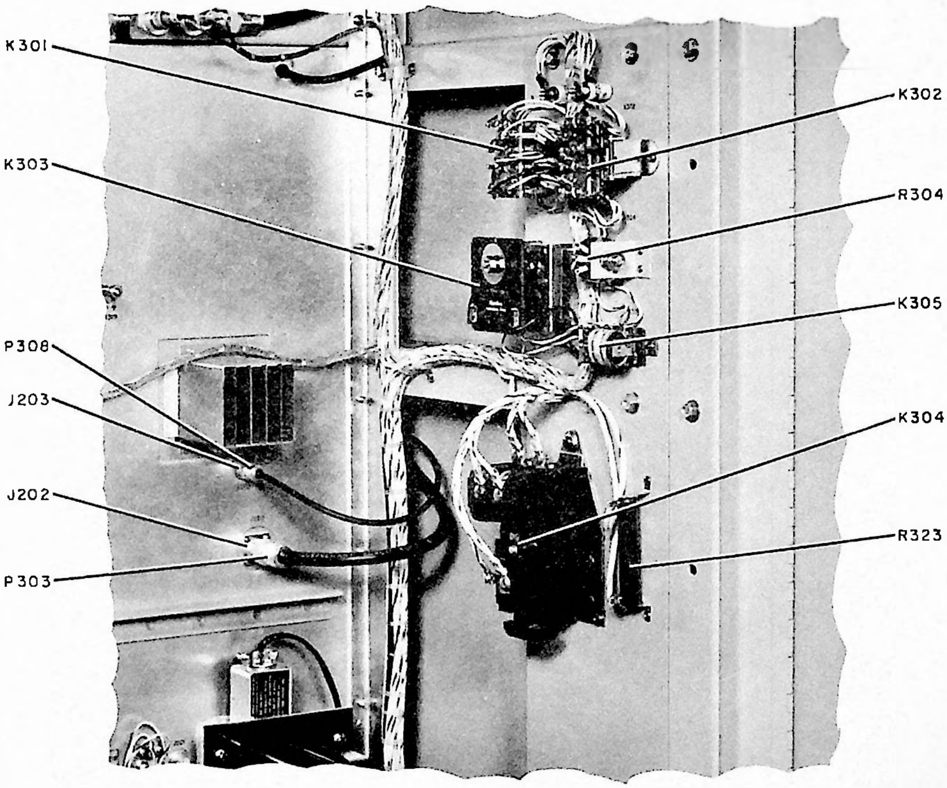


Figure 4-4. Relay Panel Subassembly, Parts Location

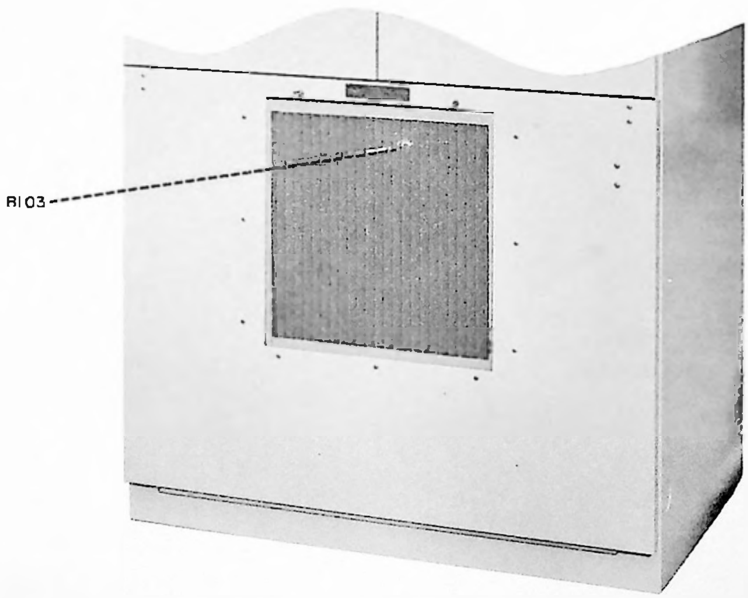


Figure 4-5. Cabinet Blower Location

Figure 5-1. B830-1 250-Watt FM Power Amplifier, Schematic Diagram

SP-190
523-0755446-002419
15 February 1962
2nd Edition, 15 July 1964

system instructions

830D-1A
1000 Watt FM Broadcast Transmitter

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa
Printed in U.S.A.

table of contents

Section			Page
1	GENERAL DESCRIPTION		1
	1.1	Purpose of Instruction Book	1
	1.2	Purposes of Equipment	1
	1.3	Description of Equipment	1
	1.3.1	Physical Description	1
	1.3.2	Electrical Description	1
	1.4	Equipment Supplied	1
	1.5	Accessory Equipment	3
	1.6	Equipment Specifications	3
	1.6.1	Mechanical	3
	1.6.2	Electrical	3
2	INSTALLATION		5
	2.1	Unpacking and Inspecting	5
	2.2	Transmitter Location	5
	2.3	External Connections	5
	2.4	Internal Connections	5
	2.5	Remote Control	7
	2.6	Frequency Change	7
	2.6.1	Neutralization Procedure	10
	2.7	Starting the Transmitter in a New Installation	11
3	OPERATION		13
	3.1	General	13
	3.2	Starting the Transmitter in Normal Operation	13
4	PRINCIPLES OF OPERATION		13
	4.1	General	13
	4.2	A830-2 10 Watt Wide-Band Exciter	13
	4.3	Control Circuits	14
	4.4	Plate Contactor and Plate Power Supply	14
	4.5	Control Grid Bias Supply	14
5	MAINTENANCE		16
	5.1	General	16
	5.2	Normal Tuning Procedures	16
	5.3	Modulator and AFC Discriminator Adjustment Procedures	16
	5.4	Distortion Testing Procedure	18
	5.5	Audio Frequency Response Measurements	19
	5.6	FM Noise Measurement	19
	5.7	AM Noise Measurement	19
	5.8	Trouble Shooting	19

list of illustrations

Figure		Page
1-1	830D-1A 1000 Watt FM Broadcast Transmitter, Over-All View (C850-14-P)	2
1-2	830D-1A 1000 Watt FM Broadcast Transmitter, Rear View with Lower Panel Removed (C850-13-P)	4
2-1	830D-1A 1000 Watt FM Broadcast Transmitter, Outline and Installation Drawing (C850-17-5)	6
2-2	Transformer Details (C850-02-2)	7
2-3	Plate Cavity Tuning Chart and Control Grid Inductor Spacing (C850-10-X)	9
2-4	Screen Neutralization Inductor Spacing (C850-09-X)	10
2-5	Efficiency Chart (C850-25-2)	12
4-1	830D-1A 1000 Watt FM Broadcast Transmitter, Block Diagram (C850-04-5)	15
5-1	Distortion Test Setup (C850-06-3)	18
5-2	Audio Frequency Response Test Setup (C850-08-3)	19
5-3	Audio Frequency Response Limits (C847-04-X)	20
5-4	FM Noise Test Setup (C850-05-3)	20
5-5	AM Noise Test Setup (C850-07-3)	22

list of tables

Table		Page
1-1	Subassembly Instruction Books	1
1-2	Equipment Supplied	1
1-3	Accessory Equipment	3
2-1	Remote Control Connections	7
2-2	Crystal Part Numbers	8
5-1	Abbreviated Tuning Procedures	17
5-2	Distortion Checks	18
5-3	Normal Transmitter Meter Indications	21

section 1

general description

1.1 Purpose of Instruction Book.

This instruction book is a guide for installing, adjusting, operating, and maintaining 830D-1A 1000 Watt FM Broadcast Transmitter.

1.2 Purposes of Equipment.

The 830D-1A 1000 Watt FM Broadcast Transmitter is used for continuous monophonic or optional stereophonic FM broadcast service on a single frequency in the range from 88 to 108 megacycles with an output power of 1000 watts.

1.3 Description of Equipment.

1.3.1 PHYSICAL DESCRIPTION.

The 830D-1A 1000 Watt FM Broadcast Transmitter, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 776 pounds. All transmitter operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The meters may be observed easily while operating the tuning controls. The transmitter uses 6 tubes and 20 transistors, all of which are accessible from the front of the transmitter. The bottom front of the transmitter cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the transmitter for servicing and maintenance. The lower rear half of the transmitter cabinet is covered by a removable panel that contains a ventilating fan and permanent type air filter. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks ground the transmitter high-voltage circuits when the doors are opened or the panel is removed. The power amplifier plate-tuning cavity is located in an interlocked compartment at the front of the transmitter.

Inside the transmitter, heavy iron-core components are at the bottom of the cabinet. The exciter portion of the transmitter is mounted on a 19-inch rack on one side of the cabinet. A harmonic filter that is connected to the transmitter output is suspended from the top of the cabinet.

Cooling air for the transmitter is drawn through a permanent type air filter at the rear of the cabinet by a low-speed, high-volume fan, and exhausted through a shielded opening in the top of the cabinet. An individual pressure blower supplies cooling air directly to the power amplifier tube.

1.3.2 ELECTRICAL DESCRIPTION.

The 830D-1A 1000 Watt FM Broadcast Transmitter is composed of two electrically connected subunits: (1) a wide band exciter that furnishes a 10-watt FM output to drive (2) a 1000-watt power amplifier. Instruction books covering the exciter and power amplifier used in the transmitter are listed in table 1-1. These two books are supplied following section 5 of this system instruction book. The subunit instruction books contain detailed descriptions of the two transmitter subunits.

TABLE 1-1
SUBASSEMBLY INSTRUCTION BOOKS

PUBLICATION	INSTRUCTION BOOK PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
D830-1 1000 Watt FM Power Amplifier	TD-567

1.4 Equipment Supplied.

Table 1-2 lists equipment that is supplied as part of 830D-1A 1000 Watt FM Broadcast Transmitter.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NO.
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
D830-1 1000 Watt FM Power Amplifier	522-2948-00
250 Watt/1 KW Harmonic Filter	549-2010-00

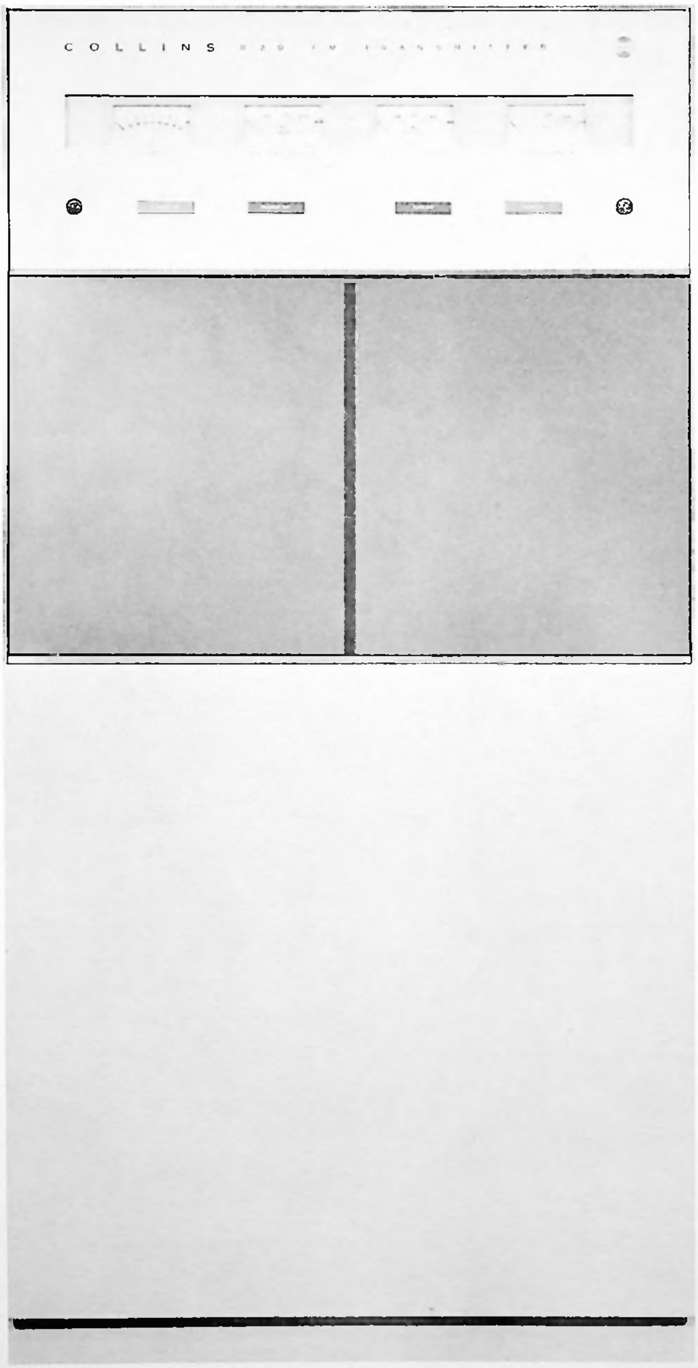


Figure 1-1. 830D-1A 1000 Watt FM Broadcast Transmitter, Over-all View

1.5 Accessory Equipment.

Table 1-3 lists accessory equipment that is available for use with 830D-1A 1000 Watt FM Broadcast Transmitter. Information on the 786M-1 Stereo Generator will be found in the applicable unit instructions.

TABLE 1-3
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NO.
786M-1 Stereo Generator	522-2914-00

1.6 Equipment Specifications.

1.6.1 MECHANICAL.

Weight	776 pounds. (approximate).
Size	38 inches wide, 76 inches high, 27 inches deep.
Ventilation	One ventilating fan, one blower.
Ambient temperature range	+10°C (50°F) to +55°C (131°F).
Ambient humidity range	0 to 95 percent relative humidity.
Altitude	0 to 6000 feet.
Shock and vibration	Normal handling and transportation.

1.6.2 ELECTRICAL.

Power source	200 to 250 volts, 60 cycle, single phase.
Maximum power requirements	2200 watts.
Power output	1000 watts.
Output impedance	50 ohms, unbalanced, Maximum swr 2:1.
Frequency range	88 to 108 megacycles. Exact operating frequency determined by frequency of crystal in heterodyning oscillator.
Excitation source	Crystal-controlled high-stability oscillator using plated, nontemperature-controlled crystal, controlling an LC modulation oscillator to provide automatic frequency control. The modulation oscillator is then heterodyned up to the station operating frequency by a second high-stability, crystal-controlled oscillator.
Carrier-frequency stability	Within ±1000 cps of specified carrier frequency over ambient temperature range from +10°C (50°F) to +55°C (131°F) and line-voltage variations of ±5 percent.
Harmonic and spurious radiation	Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc, inclusive, is at least 30 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 240 kc and up to and including 600 kc is at least 40 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 600 kc is at least 73 db below the level of the unmodulated carrier.
Modulation characteristics	Wide-band direct FM modulation. Standard audio pre-emphasis is incorporated in modulator.
Audio input impedance	600 ohms, balanced.
Audio input level	+10 dbm ±2 db.

Audio frequency response	Complies with standard FCC 75-microsecond pre-emphasis curve.
Audio frequency distortion	50-100 cps, 1.5 percent maximum. 100-7500 cps, 1.0 percent maximum. 7500-15,000 cps, 1.5 percent maximum.
FM noise level	Not less than 65 db below 100 percent modulation (±75 kc).
AM noise level (rms)	Not less than 55 db below equivalent 100 percent AM.

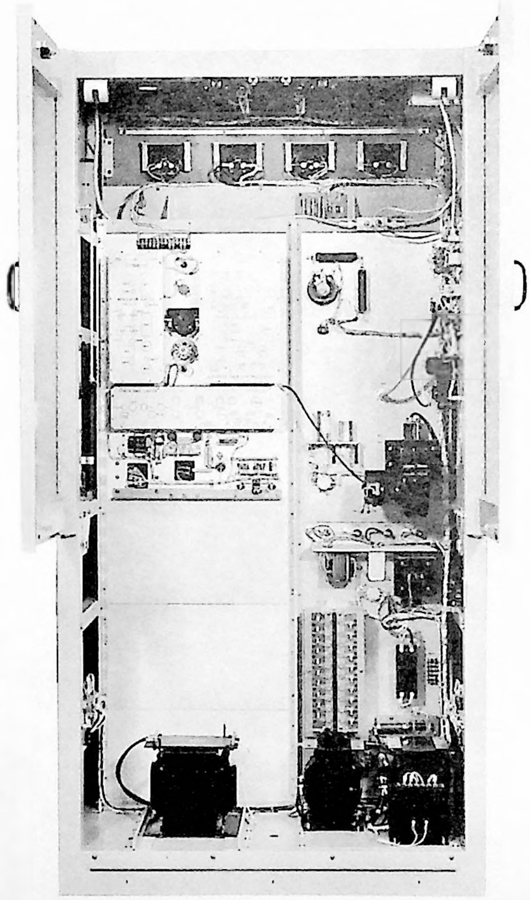


Figure 1-2. 830D-1A 1000 Watt FM Broadcast Transmitter, Rear View with Lower Panel Removed

section 2

installation

2.1 Unpacking and Inspecting.

Be careful when uncrating the transmitter and components to avoid damaging the equipment. Inspect the transmitter carefully for scratches, dents, or other physical damage. Check for loose screws and bolts. Inspect all controls, such as switches, for proper operation as far as can be determined without applying power to the transmitter. Examine cables and wiring, making sure that all connections are tight and clear of each other and the chassis. File any damage claims promptly with the transportation company. If such claims are to be filed, retain all packing material.

NOTE

> Before installation, check all transistors for proper placement. The transistor location tab must be pointing to the transistor socket locating mark placed adjacent to the transistor socket.

2.2 Transmitter Location.

Plan transmitter and wiring placement carefully before starting installation work. Refer to figure 2-1, the transmitter installation diagram. This diagram shows the location of all wiring openings in the transmitter cabinet. As will be noted, several alternate wiring arrangements can be used. Select the combination that most nearly meets the station requirements.

Allow adequate clearance both in front and back of the transmitter. There should be a minimum of clearance of 3-1/2 feet behind the transmitter to provide sufficient room for service work.

2.3 External Connections.

Refer to figure 2-1 for assistance in making the following external connections.

WARNING

> Disconnect the transmitter 230-volt ac power from the fused cutout box before making any connections to, or within, the transmitter.

a. Connect the audio input to the transmitter. Bring the audio signal through the bottom of the cabinet (or other optional input) on a shielded twisted pair. Connect the two audio leads to terminals 1 and 2 of TB305. If the optional stereophonic operation is employed, the left audio leads are connected to TB305-1 and 2 and the right audio leads to TB305-4 and 5. TB305 is located about half way up the cabinet on the left side as viewed from the rear of the cabinet. Connect the shield(s) to terminal 3 of TB305.

b. Connect the FM monitor to the monitor output on the top of the cabinet. Refer to figure 2-1. Use type RG-58U coaxial cable to make this connection.

c. Connect the antenna transmission line to the r-f output connector on top of the 830D-1A cabinet.

CAUTION

> Before making this antenna connection, be sure that the transmission line and antenna present a nominal impedance of 50 ohms and an swr of not more than 2:1 at the transmitter operating frequency. If the transmitter output is improperly matched, the transmitter will not operate properly and may be damaged. THIS IS IMPORTANT.

d. Connect the power input cable to the transmitter. This power cable should be brought from an external fused cutout box rated for 12 amperes. Use number 12 wire or larger to make this connection. Connect the power leads to terminals 1 and 2 of TB301, located at the lower left corner of the transmitter cabinet as viewed from the rear. Connect the neutral wire to terminal 3 of TB301. The power cable may be brought into the transmitter through holes in either the bottom or rear of the cabinet. Make sure that the PLATE circuit breaker on the front panel is set to OFF before making these power connections.

2.4 Internal Connections.

The 830D-1A 1000 Watt FM Broadcast Transmitter 830D plate and control circuit power transformers are fitted with adjustable taps to compensate for line voltage variations. These taps compensate for line variations from 200 to 250 volts in 10-volt steps. To adjust transformer T301 and T303 for line voltage variations, perform the following steps.

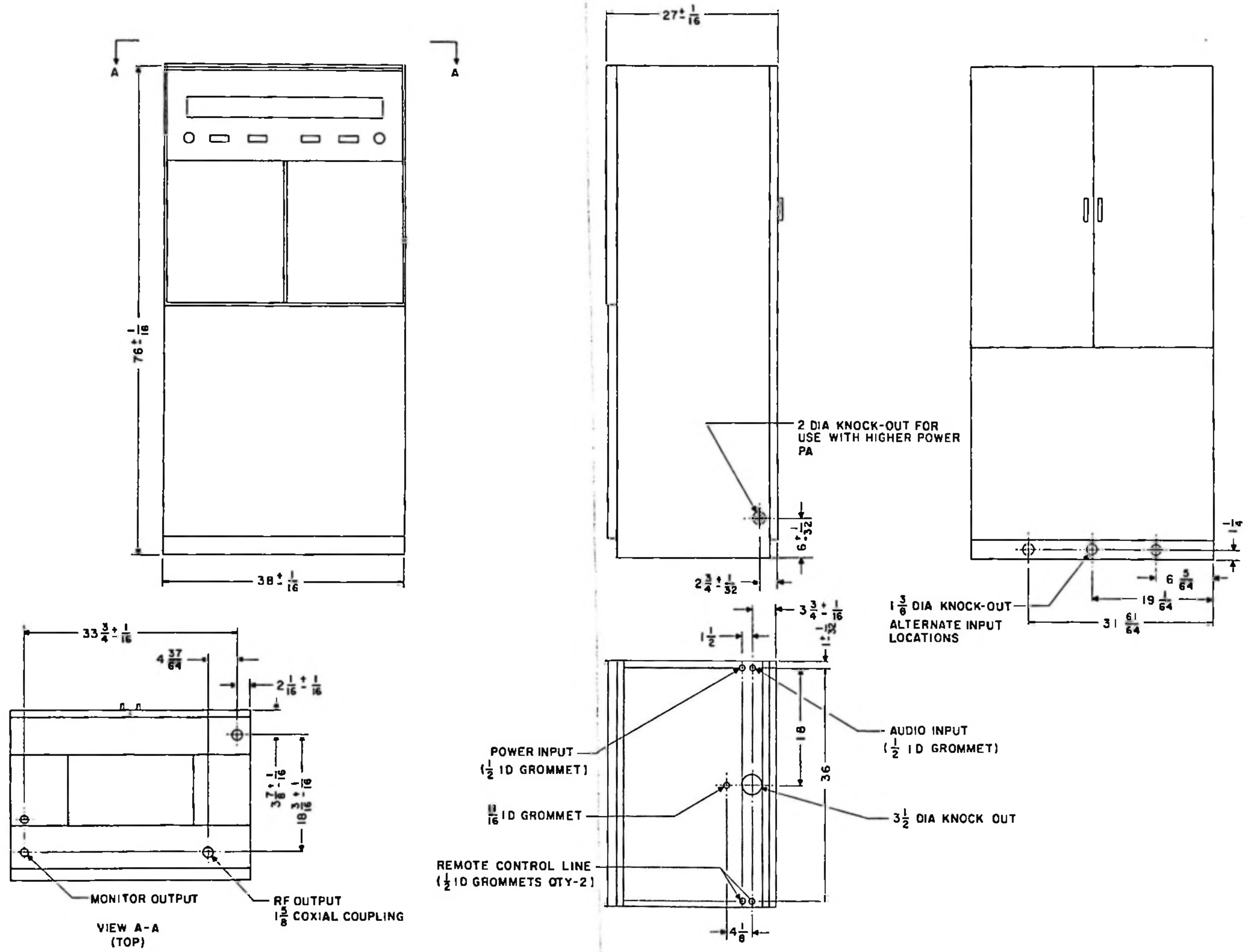


Figure 2-1. 830D-1A 1000 Watt FM Broadcast Transmitter, Outline and Installation Drawing

a. Measure the line voltage at the transmitter fused cutout box.

b. Remove the solder lug from T301, terminal 4, and move to the transformer terminal whose input voltage is nearest to the voltage measured in step a. Do not move the solder lug from transformer terminal 5, as this terminal supplies 230 volts to the cabinet fan for all line input connections. See figure 2-2 for transformer terminal numbers versus input voltage.

c. Remove the solder lug from T303, terminal 5, and move to the transformer terminal whose input voltage is nearest to the voltage measured in step a. See figure 2-2 for transformer terminal numbers versus input voltage.

d. Tighten all transformer terminal connections.

The following connections on TB304 should be checked to ensure that the plate-on and filament-off functions will operate: TB304-1 to TB304-2, TB304-3 to TB304-4, TB304-10 to TB304-11.

If the optional stereo generator is installed any time after the initial 830D-1A installation, the 18-db audio pad will have to be removed from the audio circuitry of the exciter.

2.5 Remote Control.

Remote control of 830D-1A 1000 Watt FM Broadcast Transmitter can easily be accomplished by connection to terminal boards TB302 and TB303. Table 2-1 lists the terminal board connections and the remote functions of each pair of terminals. Remote "on" switches should be the normally open momentary type. Remote "off" switches should be the normally closed momentary type. For remote operation, the LOCAL-REMOTE switch within the transmitter cabinet should be in the REMOTE position. When in the REMOTE position, it is still possible to control the transmitter from the transmitter panel switches.

For simplified operation, the FILAMENT ON and PLATE OFF switches could be eliminated. The PLATE ON switch starts a sequence of operations which turns the filaments on and the plate voltage on after the filament time delay is completed. The FILAMENT OFF switch shuts down all transmitter functions.

Equipment is available that will completely control and monitor transmitter operation from a remote location through standard telephone pairs. When such remote control equipment is used, necessary installation and connection information will be supplied with the remote equipment.

If an optional stereo generator is employed in the 830D-1A, remote control of the stereo mode may be accomplished by a ground on TB302-7. If the ground is present, the transmitter will be in the stereo mode. If the ground is removed, the transmitter will be in the monaural mode. Local control of the stereo mode is also available at the transmitter.

TABLE 2-1
REMOTE CONTROL CONNECTIONS

FUNCTION	TERMINALS	
	TB302	TB303
FILAMENT ON		1 and 2
FILAMENT OFF	8 and 9	
PLATE OFF		4 and 2
PLATE ON		3 and 2

2.6 Frequency Change.

If the transmitter operating frequency is changed, the following components will have to be changed or adjusted. These components are (1) exciter heterodyning oscillator crystal (2) plate cavity slider (3) grid tank inductance (4) the screen neutralization.

Table 2-2 lists the channel frequency versus crystal frequency and the Collins part number for each crystal. Figure 2-3 shows the distance the plate cavity slider

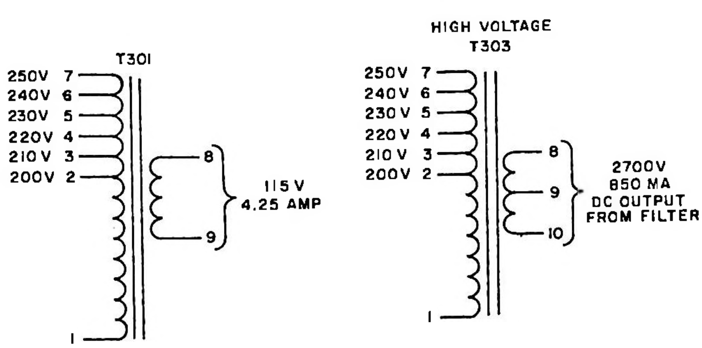


Figure 2-2. Transformer Details

TABLE 2-2. CRYSTAL PART NUMBERS

CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER	CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER
88.1	74.10000	289-2744-00	98.1	84.10000	289-2794-00
88.3	74.30000	289-2745-00	98.3	84.30000	289-2795-00
88.5	74.50000	289-2746-00	98.5	84.50000	289-2796-00
88.7	74.70000	289-2747-00	98.7	84.70000	289-2797-00
88.9	74.90000	289-2748-00	98.9	84.90000	289-2798-00
89.1	75.10000	289-2749-00	99.1	85.10000	289-2799-00
89.3	75.30000	289-2750-00	99.3	85.30000	289-2800-00
89.5	75.50000	289-2751-00	99.5	85.50000	289-2801-00
89.7	75.70000	289-2752-00	99.7	85.70000	289-2802-00
89.9	75.90000	289-2753-00	99.9	85.90000	289-2803-00
90.1	76.10000	289-2754-00	100.1	86.10000	289-2804-00
90.3	76.30000	289-2755-00	100.3	86.30000	289-2805-00
90.5	76.50000	289-2756-00	100.5	86.50000	289-2806-00
90.7	76.70000	289-2757-00	100.7	86.70000	289-2807-00
90.9	76.90000	289-2758-00	100.9	86.90000	289-2808-00
91.1	77.10000	289-2759-00	101.1	87.10000	289-2809-00
91.3	77.30000	289-2760-00	101.3	87.30000	289-2810-00
91.5	77.50000	289-2761-00	101.5	87.50000	289-2811-00
91.7	77.70000	289-2762-00	101.7	87.70000	289-2812-00
91.9	77.90000	289-2763-00	101.9	87.90000	289-2813-00
92.1	78.10000	289-2764-00	102.1	88.10000	289-2814-00
92.3	78.30000	289-2765-00	102.3	88.30000	289-2815-00
92.5	78.50000	289-2766-00	102.5	88.50000	289-2816-00
92.7	78.70000	289-2767-00	102.7	88.70000	289-2817-00
92.9	78.90000	289-2768-00	102.9	88.90000	289-2818-00
93.1	79.10000	289-2769-00	103.1	89.10000	289-2819-00
93.3	79.30000	289-2770-00	103.3	89.30000	289-2820-00
93.5	79.50000	289-2771-00	103.5	89.50000	289-2821-00
93.7	79.70000	289-2772-00	103.7	89.70000	289-2822-00
93.9	79.90000	289-2773-00	103.9	89.90000	289-2823-00
94.1	80.10000	289-2774-00	104.1	90.10000	289-2824-00
94.3	80.30000	289-2775-00	104.3	90.30000	289-2825-00
94.5	80.50000	289-2776-00	104.5	90.50000	289-2826-00
94.7	80.70000	289-2777-00	104.7	90.70000	289-2827-00
94.9	80.90000	289-2778-00	104.9	90.90000	289-2828-00
95.1	81.10000	289-2779-00	105.1	91.10000	289-2829-00
95.3	81.30000	289-2780-00	105.3	91.30000	289-2830-00
95.5	81.50000	289-2781-00	105.5	91.50000	289-2831-00
95.7	81.70000	289-2782-00	105.7	91.70000	289-2832-00
95.9	81.90000	289-2783-00	105.9	91.90000	289-2833-00
96.1	82.10000	289-2784-00	106.1	92.10000	289-2834-00
96.3	82.30000	289-2785-00	106.3	92.30000	289-2835-00
96.5	82.50000	289-2786-00	106.3	92.50000	289-2836-00
96.7	82.70000	289-2787-00	106.7	92.70000	289-2837-00
96.9	82.90000	289-2788-00	106.9	92.90000	289-2838-00
97.1	83.10000	289-2789-00	107.1	93.10000	289-2839-00
97.3	83.30000	289-2790-00	107.3	93.30000	289-2840-00
97.5	83.50000	289-2791-00	107.5	93.50000	289-2841-00
97.7	83.70000	289-2792-00	107.7	93.70000	289-2842-00
97.9	83.90000	289-2793-00	107.9	93.90000	289-2843-00

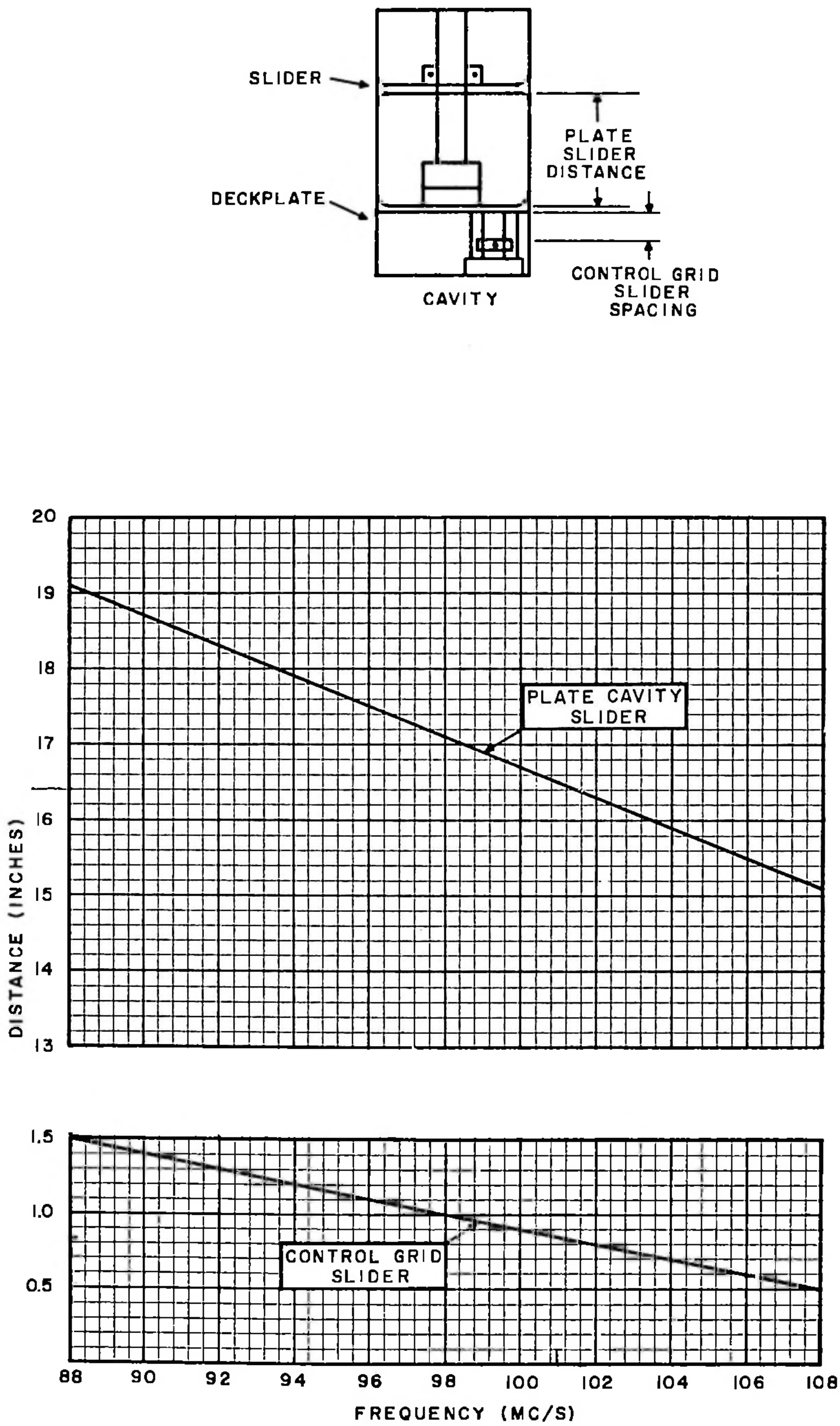


Figure 2-3. Plate Cavity Tuning Chart and Control Grid Inductor Spacing

should be positioned from the deck plate (tube socket mounting plate) for each frequency within the 88 to 108 megacycle range. Figure 2-3 also includes the grid inductance spacing for the same frequency range. Figure 2-4 gives the approximate positioning of the screen neutralizing inductor for the FM band. The plate cavity slider, the grid inductance, and the screen neutralizing inductor may have to be repositioned from positions shown to compensate for individual transmitter characteristics. Refer to the test procedures in paragraph 2.6.1 for tuning details.

2.6.1 NEUTRALIZATION PROCEDURE.

The 1000-watt power amplifier will have to be neutralized if the transmitter frequency is changed and may have to be neutralized if power amplifier tube V201 is replaced. If the frequency has changed, roughly adjust the neutralizing inductor to the spacing given in figure 2-4.

Neutralization is best accomplished by using the feedthrough method. As the sensitive voltmeter necessary for use with this method is normally not available at most stations, the following neutralization procedure should be substituted. Proper neutralization can be checked by tuning the plate through resonance and noting a minimum of change in control grid current.

a. Press the FILAMENT ON switch, and turn off the exciter. Allow the transmitter to warm up for at least 15 minutes. Place the WATTMETER switch in the FORWARD position.

b. Press the PLATE ON switch, and observe the R. F. WATTMETER. If there is an indication on the R. F. WATTMETER, the transmitter is not neutralized. If an indication is present, turn off the plate power, and open the plate cavity. Adjust the neutralizing inductor a SMALL AMOUNT by sliding both shorting blocks in opposite directions. This adjustment is critical. Do not move the shorting blocks a large distance.

c. Turn on the transmitter, and note the new indication on the R. F. WATTMETER. If the indication has increased, readjust the shorting blocks in the opposite direction.

d. If the indication has decreased upon applying plate voltage, repeat steps b and c until the R.F. WATTMETER indication is zero.

e. With the plate voltage on, remove the grid bias fuse, F304, and watch the R. F. WATTMETER for an indication. The PA plate current will start to rise immediately upon removing the grid bias fuse and will continue to rise until the overload relay trips or the plate current is shut off.

f. Repeat steps b and e until no further indication is shown on the R. F. WATTMETER.

g. Turn on the exciter, and retune the power amplifier according to the procedure given in paragraph 2.7.o.

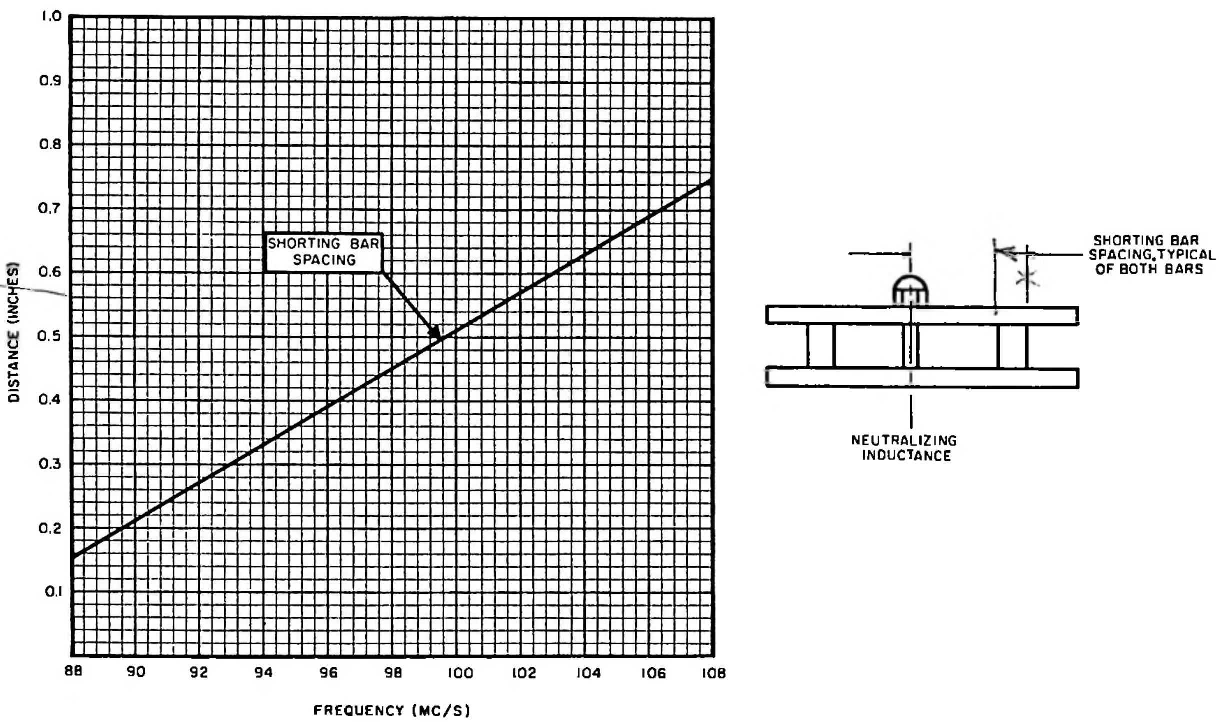


Figure 2-4. Screen Neutralization Inductor Spacing

2.7 Starting the Transmitter in a New Installation.

Before starting the transmitter for the first time, read section 2 of the subunit instruction books to become familiar with the location and function of the various transmitter controls. Then, perform the following procedure.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when making any transmitter adjustments. Do not reach inside the rear of the transmitter cabinet when high voltages are applied. Do not depend entirely on door interlocks. Always shut off transmitter power at the external cutout box, and ground all capacitors with the shorting stick in the transmitter cabinet before doing any work inside the rear of the cabinets. When working in the power amplifier cavity, remember that 115 volts a-c is present on one side of the cavity compartment interlock. Keep metal tools and the hands away from all transistor cases.

a. Complete the entire transmitter installation procedure as directed in this instruction book.

b. Close the doors at the rear of the cabinet. Open the doors at the front of the cabinet, and remove the lower front panel so that the entire inside panel is exposed. Check that the plate cavity slider, the grid inductor, and the screen neutralizing inductor conform approximately to the distance specified in figure 2-3 for the operating frequency. These adjustments have been set at the factory and will not normally require further adjustment. Close the cover on the plate cavity compartment.

c. Set the PLATE circuit breaker on the front panel to ON.

d. Press the FILAMENT ON switch. The green indicator lamp at the top left of the cabinet should light. This means that all transmitter tube filaments and cooling-air blowers are operating.

e. Place the proper crystals into the exciter sockets. The 14-megacycle crystal is placed into the Y501 socket. The heterodyning crystal is placed into the Y426 socket. Turn on the exciter, and allow it to warm up for at least 15 minutes.

f. Turn S101 to the 14 MC REF B position, and check M101 for an indication in the B meter range. Turn S101 to the AFC KEY B position, and check M101 for an indication in the B meter range.

NOTE

When S101 is in the AFC KEY position, the meter pointer will not hold steady but will pulse at the 5-cps keying generator rate. This pulsing is an indication of normal operation.

Turn S101 to the MOD OUTPUT B position, and check M101 for an indication in the B meter range. If all meter indications for the three S101 positions fall within the B meter range, proceed with the following power amplifier tuning procedures. If any of the meter indications fall outside of the B meter range, the modulator and afc discriminator is out of adjustment and will have to be adjusted according to the Modulator and AFC Discriminator Adjustment Procedures in the Maintenance section of this instruction book.

g. Switch S101 to the MIXER GRID A position. Set POWER OUT resistor R454 to its midposition. Using a nonmetallic screwdriver type tuning tool, adjust the BUF TUNE control for a peak indication on meter M101.

NOTE

The MIX BAL control, R438, should be placed in its midrange position. No further adjustment of this control is then necessary unless the transmitting frequency falls within the range of 97 to 100 megacycles. See step m if the transmitted frequency falls within this range.

h. Switch S101 to the V428B position. Adjust L429 and L430 for a maximum indication on M101.

i. Switch S101 to the V429B position. Adjust L431 and L432 for a maximum indication on M101.

j. Switch S101 to the V430B position. Adjust L433 and L434 for a maximum indication on M101.

k. Switch S101 to the V430C position. Adjust the PA PLATE control for a minimum indication on M101.

l. Set the MULTIMETER switch to GRID FS 4 MA. Remove the grid bias fuse F304. Adjust first the exciter PA MATCH control, then the power amplifier GRID TUNING control for a peak MULTIMETER indication. (The grid tuning capacitor should be near its center when the peak occurs. If not approximately in this position, move the grid inductance in the proper direction, and repeat the above step.) Replace the grid bias fuse and peak PA MATCH control and GRID TUNING control. Set GRID COUPLING control for 0.5 ma of grid current.

m. If the transmitter frequency falls between 97 and 100 megacycles, the following additional step will have to be completed. Place a grid dip meter tuned to 98 megacycles near the exciter output. Adjust the MIX BAL control for a minimum output as indicated on the grid dip meter.

n. Set the POWER OUTPUT ADJUST control fully counterclockwise.

o. Press the PLATE ON switch. The red indicator lamp at the top right of the cabinet should light, and the P. A. PLATE VOLTAGE meter should indicate 2700 ±100 volts.

p. Set the MULTIMETER switch to SCREEN FS 400 VDC. The MULTIMETER should indicate 240 ±30 volts.

q. Adjust the PLATE TUNING control for a dip in the P. A. PLATE CURRENT meter indication.

r. Set the WATTMETER switch to FORWARD. Adjust the OUTPUT COUPLING control for approximately 10 ma of screen current.

s. Turn the POWER OUTPUT ADJUST control approximately two-thirds of its maximum clockwise rotation.

t. Increase the transmitter coupling a small amount by turning the OUTPUT COUPLING control clockwise until the PA screen current is reduced to approximately 10 ma. Adjust the PLATE TUNING control for a dip in the P. A. PLATE CURRENT meter indication. (The plate tuning capacitor should be near its center position when the dip in power amplifier plate current occurs. If the capacitor is not in this position, move the plate slider in the appropriate direction and repeat step t.)

u. Rotate the POWER OUTPUT ADJUST control clockwise a small amount.

v. Repeat steps t and u until the P. A. PLATE CURRENT meter indicates the transmitter output is 1000 watts as measured by the indirect method. At this time, the PA screen current should be not less than 10 ma. or more than 35 ma. The indirect method of measuring power output is:

$$\text{Power Output} = I_p E_p K$$

when K is efficiency, E_p plate voltage, and I_p plate current.

NOTE

Determine efficiency by referring to the efficiency chart shown in figure 2-5.

w. Check to be sure that the FM monitor that is connected to the transmitter is properly calibrated. Then, if necessary, adjust the exciter VHF OSC FREQ ADJ control until the monitor indicates that the transmitter operating frequency is within specified operating limits.

x. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 dbm.

y. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation.

z. Replace the lower front panel on the transmitter cabinet, and close the front doors. The transmitter is now ready for standard broadcast use.

NOTE

At this point, it is suggested that a record be made of all meter readings for future maintenance and trouble shooting. These meter readings may be recorded in table 5-3.

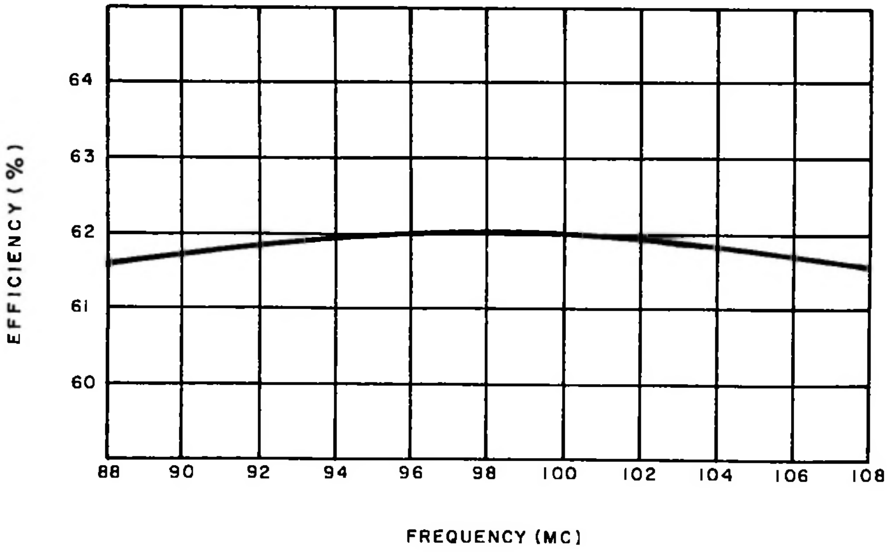
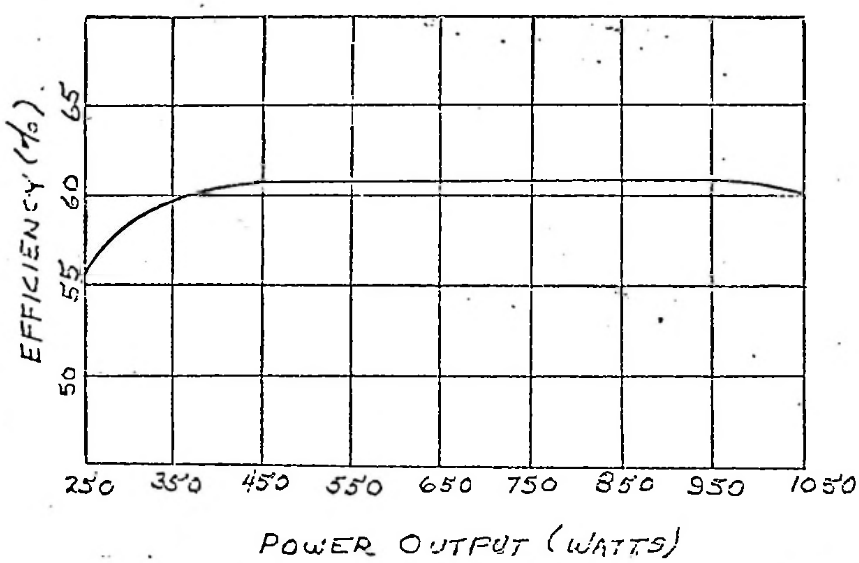


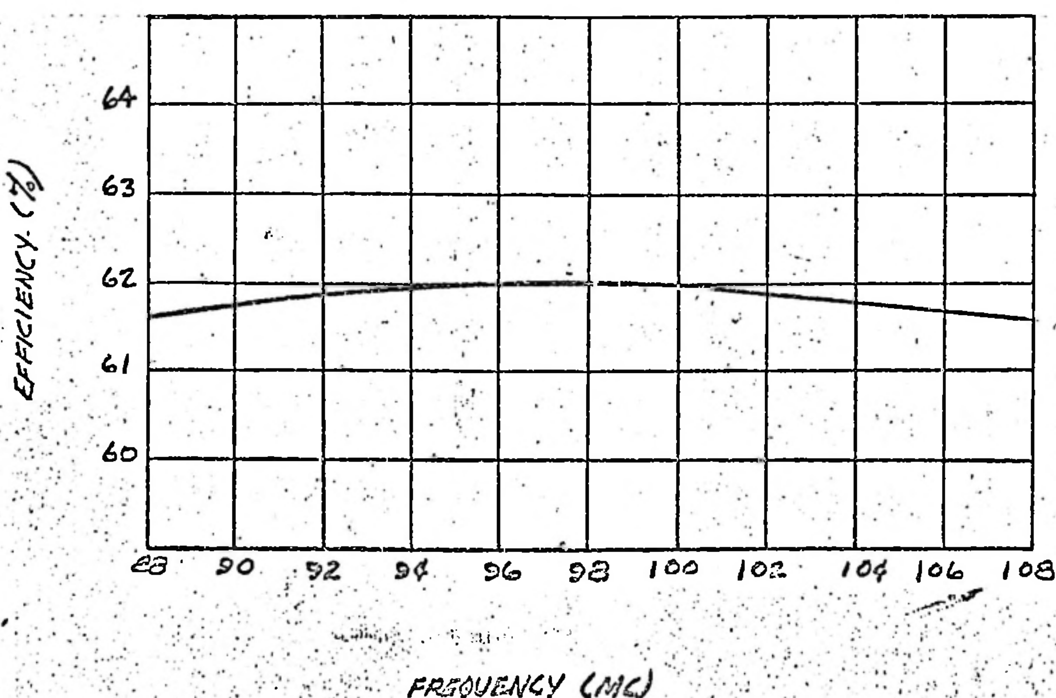
Figure 2-5. Efficiency Chart

ADDITION TO
APPLICATION FOR FCC TYPE ACCEPTANCE
COLLINS TYPE 830D-1 FM TRANSMITTER

1.0 POWER CAPABILITIES OF THE COLLINS TYPE 830D-1 FM TRANSMITTER

The power range of the Collins Type 830D-1 FM Transmitter is 250 to 1050 watts. The following graph demonstrates nominal efficiency over the power range.





section 3

operation

3.1 General.

Refer to the subunit instruction books to become familiar with the operation and function of controls on both the power amplifier and the exciter.

After the transmitter has been placed in operation, it will only be necessary to check meter indications from time to time to be sure the transmitter is operating properly and occasionally to "touch-up" the power amplifier loading and tuning.

3.2 Starting the Transmitter in Normal Operation.

The transmitter may be put into operation by two different methods, depending upon the circumstances. For normal operation, press the FILAMENT ON switch to start the power amplifier filament and to warm up the exciter (the exciter POWER switch should be left in the ON position at all times). Check the power amplifier grid current to be sure the exciter is presenting sufficient drive to the power amplifier before applying plate power. Approximately 3 to 4 minutes after filament power is applied, the PLATE ON switch may be pressed, starting the transmitter.

The alternate method of starting the transmitter consists of pressing the PLATE ON switch only. The power amplifier filament and the exciter will immediately start to warm up. As soon as the power amplifier time delay relay has completed its cycle, the power amplifier plate voltage will come on automatically, starting the transmitter.

To shut down the transmitter it is recommended, but not necessary, to press the PLATE OFF switch, wait a few seconds, and then shut off the filament and exciter power by pressing the FILAMENT OFF switch. It is also possible to press the FILAMENT OFF switch only, which removes plate, filament, and exciter power. Pressing the PLATE OFF switch first allows the plate power supply voltage to discharge through the power amplifier while the filament is at normal operating temperature and, in addition, cools the power amplifier components.

section 4

principles of operation

4.1 General.

Refer to figure 4-1, a block diagram of 830D-1A 1000 Watt FM Broadcast Transmitter. The transmitter can be broken down into three main subassemblies: an exciter, a power amplifier, and a harmonic filter. Refer to section 2 of the unit instruction books for a complete explanation of the exciter and the power amplifier.

4.2 A830-2 10 Watt Wide-Band FM Exciter.

The baseband audio is coupled to the A830-2 through a pre-emphasis network and through an 18-db pad to J101 and two baseband amplifiers. The baseband output is coupled to voltage-sensitive capacitor C654. C654 is a diode which varies in capacity in proportion to the voltage across it. The FM oscillator is tuned to 14 megacycles. The capacity of C654 varies in proportion to the baseband audio and, therefore, the output is a 14-mc signal frequency modulated by the baseband audio. The deviation of the 14-mc signal is ±75 kc for 100 percent modulation. The oscillator output is coupled through two limiters to remove any amplitude modulation. The limited 14-mc signal is then amplified and coupled to the rate correction frequency discriminator and to the output amplifier. The output of the frequency discriminator is simply the baseband audio detected from the modulated 14-mc signal. This detected audio is coupled back to the baseband input to correct for any nonlinearity in C654.

The output amplifier amplifies the modulated 14-mc signal to a level sufficient to mix with the 74- to 94-mc signal (per customer requirement) in the balanced mixer.

A portion of the limiter output is coupled to the afc buffer stage. The afc buffer output, the modulated

14-mc signal, is coupled to the reference oscillator and afc limiters through a diode switch. The output of the 14-mc reference oscillator, is also coupled to the reference oscillator and afc limiters through a diode switch. The diode switch is operated by a 5-cps keying generator. The 5-cps generator is a unijunction transistor operating as a relaxation oscillator keying a multivibrator.

The diode switch alternately connects the modulated 14-mc signal (afc buffer output) and the 14-mc reference signal. The limiter output is coupled to the afc discriminator. The afc discriminator detects the difference between the 14-mc reference signal and the modulated 14-mc signal. The modulated 14-mc signal will cause a baseband audio output at the discriminator. This is not an error in frequency, so a portion of the baseband audio input is amplified by the baseband canceling amplifier and fed into the output of the frequency discriminator through a diode switch. This diode switch is keyed by the same 5-cps signal which switched the reference oscillator and afc limiter input. When the modulated 14-mc signal is connected to the reference oscillator and afc limiter input, the baseband canceling signal is switched into the output of the frequency discriminator to cancel the baseband output from the discriminator.

The input signal to the four error signal amplifiers is a 5-cps square wave. The amplitude of this square wave is proportional to the frequency error in the FM oscillator. The error signal amplifier square wave output is converted to a d-c control signal in the synchronous detector. The synchronous detector is also keyed by the 5-cps keying signal. The d-c error signal is coupled to C654 to correct the frequency modulation oscillator.

The modulated 14-mc signal from the output amplifier is heterodyned up to the operating frequency in a balanced mixer. The injection frequency is generated in a crystal oscillator. The crystal frequency is 14 mc below the customer's operating frequency. The crystal oscillator output is coupled to a buffer stage and is mixed with the modulated 14-mc signal in the balanced mixer. The balanced mixer output is limited and amplified to the 10-watt r-f output level. The output impedance of the A830-2 is between 50 and 70 ohms.

The power supply for the A830-2 is of conventional design and supplies operating voltages for the vacuum tubes and transistors in the A830-2.

The final power amplifier consists of a single ceramic-type tetrode tube. The tube is operated as a class C amplifier with a tuned-cavity plate circuit. The output from the power amplifier is fed through a harmonic filter which reduces all output harmonics.

The harmonic filter consists of two series resonant "M-derived" low pass end sections and a "constant K" "T" center section. The harmonic filter starts to attenuate above 110 megacycles and reaches maximum attenuation at the carrier second harmonic. The attenuation pattern then tapers off slowly as the frequency rises. The over-all result of the harmonic filter is in keeping the harmonics attenuated at least 73 db below the carrier frequency.

4.3 Control Circuits.

The 230-volt a-c single phase power input is stepped down to 115 volts a-c by transformer T301. This lower voltage is used to activate relays in the transmitter control circuits and is also fed to the exciter as its primary power source. The control circuits allow power to be applied to the transmitter only in the proper sequency to prevent damage to the final amplifier. These circuits also contain protective devices to prevent damage to components from accidental overloads. All meter circuits are bypassed to eliminate damage from r-f energy.

4.4 Plate Contactor and Plate Power Supply.

The plate contactor consists of a heavy duty relay which controls the 230-volt a-c primary power to the plate power supply. The plate contactor is actuated by the PLATE ON switch through the control circuitry.

The plate power supply consists of a step-up transformer, a full wave bridge rectifier, and a filter. The power supply is capable of delivering 2,700 volts d-c at 850 ma to the power amplifier.

4.5 Control Grid Bias Supply.

The control grid bias supply is a conventional half-wave type with an adjustable output. The supply is fused for protection and, in addition, is an aid in neutralization of the power amplifier. The bias supply output is approximately a negative 48 volts.

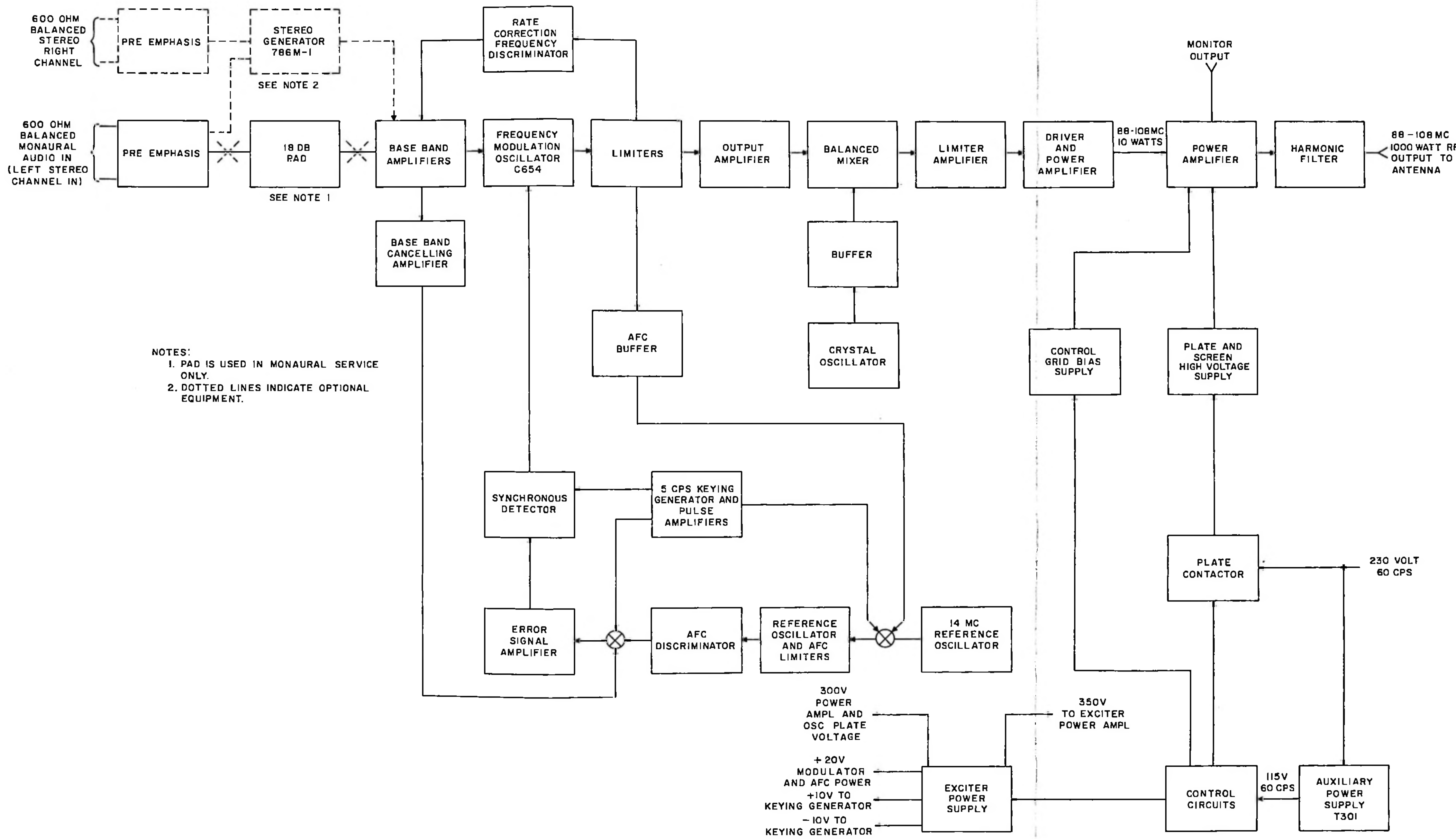


Figure 4-1. 830D-1A 1000 Watt FM Broadcast Transmitter, Block Diagram

TABLE 5-1. ABBREVIATED TUNING PROCEDURES

CONTROL	POSITION	ADJUSTMENT	INDICATING METER	INDICATION	NOTES Allow transmitter to warm up at least 15 minutes before tuning.
S101	MIXER GRID	BUF TUNE	M101	Maximum	
S101	V428 B	*L429, L430	M101	Maximum	
S101	V429 B	*L431, L432	M101	Maximum	
S101	V430 B	*L433, L434	M101	~~Minimum~~ MAX.	
S101	V430C B	PA (exciter) PLATE	M101	Minimum	
MULTIMETER	GRID FS 4 MA	PA MATCH GRID TUNING	MULTIMETER	Maximum	
MULTIMETER	GRID FS	GRID COUPLING	MULTIMETER	0.5 MA (approx)	
WATTMETER	FORWARD	PLATE TUNING	P. A. PLATE CURRENT	Near min.	Repeat the adjustment of PLATE TUNING, OUTPUT COUPLING, and POWER OUTPUT ADJUST controls until 1000 watts is achieved by the indirect power measuring method. $P = I_p E_p K$ **
		OUTPUT COUPLING	R. F. WATTMETER	Near 1000 watt indication	
		POWER OUTPUT ADJUST	R.F. WATTMETER	Near 1000 watt indication	

*Use slotted nonmetallic screwdriver on these adjustments.
**Check frequency and adjust if necessary with VHF OSC FREQ ADJ control.

adjusting tool. Keep all metallic tools and the hands or other parts of the body away from transistor cases. When disabling the afc, and the complete transmitter is in operation, check the station monitor to be sure the center frequency stays within the FCC requirements.

a. Remove transistor Q509, and place a vtvm from TP501 to ground. Tune L505 for a peak indication on the vtvm, tune L504 for a peak indication. Be sure to tune the inductances in the order given to minimize the limiting effect. Check that each stage is limiting when making these adjustments. Limiting will show up as a broad flat peak on the vtvm when tuning. Set the controls midway between the limiter fall-off points shown on the vtvm. Do not replace Q509.

b. Tune the afc discriminator by placing a vtvm from TP501 to ground, and tune the DISCR PRI control, C515, for a maximum indication. Place the vtvm from TP502 to ground, and adjust the DISCR SEC control, C518, for zero on the vtvm.

c. Disable the afc by pressing the AFC DISABLE switch, and adjust the OSC FREQ control until the station monitor indicates that the exciter is on frequency. Replace Q509.

d. Remove Q607. Place a vtvm between TP602 and ground. Tune L606 and L603 for a maximum indication on the vtvm. Tune the inductors in the order shown to minimize the effects of the limiter.

e. Remove afc by holding down the AFC DISABLE switch. With the vtvm from TP602 and ground, tune the DISCR PRI control, C639, for a maximum indication on the vtvm. Move the vtvm to TP601 and tune the DISCR SEC control, C644, for a zero indication when the modulation monitor indicates the exciter is approximately on frequency. Repeat the tuning of the DISCR PRI and DISCR SEC controls. Replace Q607.

f. Place a d-c vtvm between TP603 and ground. Set the AMP BIAS control for a 7.5-volt indication on the vtvm.

g. Place a vtvm between TP504 and ground. Remove Q510. Tune L611 and L608 for a maximum indication on the vtvm. Replace Q510.

h. With a vtvm on TP504, adjust the REF LEVEL control for an equal indication on the vtvm with first Q510 removed and then Q509 removed. (This equalizes the modulator oscillator voltage and the 14-megacycle reference voltage.) Replace the transistors.

i. Place an oscilloscope between TP503 and ground. Apply a 150-cps audio signal on J601. Adjust the MOD

TABLE 5-2. DISTORTION CHECKS

FREQUENCY	DISTORTION IN PERCENT		
	25% MODULATION	50% MODULATION	100% MODULATION
50			
100			
400			
1,000			
5,000			
7,500			
10,000			
15,000			

BALANCE control for a minimum 150-cps indication as shown on the oscilloscope.

NOTE

The MOD BAL control must be adjusted slowly to allow the error signal amplifiers to stabilize between adjustments.

5.4 Distortion Testing Procedure.

a. Refer to figure 5-1. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to the exciter audio input, terminals 1 and 2 of TB305. (Disconnect the station console audio input leads when making this connection.) Connect a distortion and noise meter, such as a Hewlett-Packard Model 330D, to the broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 ±2 dbm.

c. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation (±75 kilocycle deviation).

d. Measure the distortion at the frequencies and modulation levels given in table 5-2. The distortion shall be less than 1.5 percent for frequencies between 50 and 100 cps, less than 1.0 percent for frequencies between 100 and 7,500 cps, and less than 1.5 percent for frequencies between 7,500 and 15,000 cps.

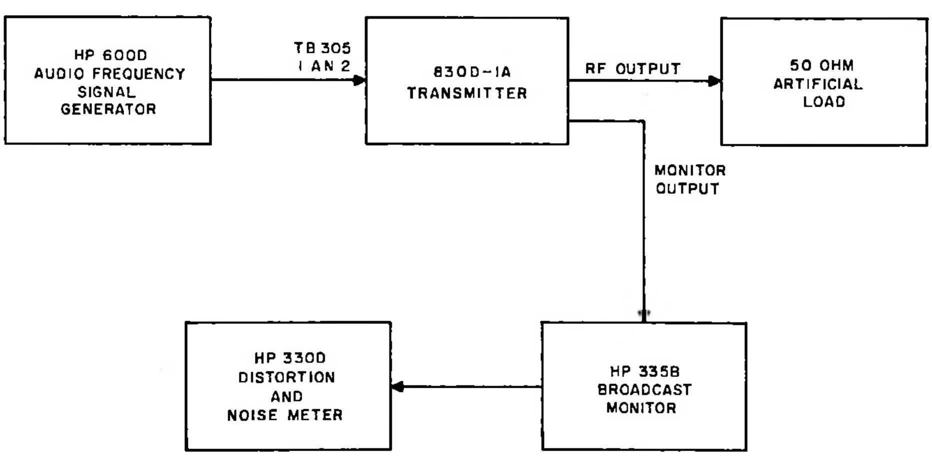


Figure 5-1. Distortion Test Setup

5.5 Audio Frequency Response Measurements.

a. Refer to figure 5-2. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making these measurements.) Connect a vacuum tube voltmeter, such as a Ballantine Model 310A, to the audio output terminals of the audio frequency generator. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Check the audio frequency response of the transmitter by modulating the transmitter at 50, 100, 400, 1,000, 5,000, 7,500, 10,000, and 15,000 cps for 25 percent, 50 percent, and 100 percent modulation. Audio frequency response is measured by keeping the percentage of modulation constant and measuring the magnitude of audio, at each frequency given, to give the desired percentage of modulation. The audio frequency response must fall within the limits given in figure 5-3.

NOTE

When taking audio frequency response measurements, a broadcast monitor, such as a Hewlett-Packard Model 335B, should be used. Do not use an instrument where audio de-emphasis might give a false indication of peak modulation.

5.6 FM Noise Measurement.

a. Refer to figure 5-4. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making this measurement.) Connect a vacuum tube voltmeter to the output terminals of the broadcast monitor. Connect an artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Modulate the transmitter 100 percent (±75 kilocycles deviation) with 400 cps of audio.

c. Remove the modulating 400 cps, and read the residual FM noise on the vacuum tube voltmeter. The residual FM noise shall be less than -65 db below 100 percent modulation.

5.7 AM Noise Measurements.

a. Refer to figure 5-5. Short out terminals 1 and 2 of terminal board TB305. Connect a vacuum tube voltmeter to connector J3 of the Hewlett-Packard Model 335B broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Switch the broadcast monitor to measure carrier level.

c. Measure the AM noise in db at J3 of the broadcast monitor in the following manner. Set modulation monitor to CARRIER LEVEL, and measure the d-c level on the modulation meter (100 percent on scale equals 10 volts). Connect the vacuum tube voltmeter to J3, and terminate J3 with a two-megohm resistor. Measure the a-c level on the vacuum tube voltmeter. (The input to the vacuum tube voltmeter should be a shielded cable having less than 100 uuf distributed capacitance.) The AM noise is the direct ratio of the d-c reading and the a-c level. The AM noise shall be not less than -55 db below voltage or d-c carrier level.

$$\text{AM Noise} = 20 \log \frac{\text{D-C reading}}{\text{A-C reading}}$$

5.8 Trouble Shooting.

Standard trouble-shooting procedures should be used in finding malfunctions in the transmitter. Meter indications for all functions should be

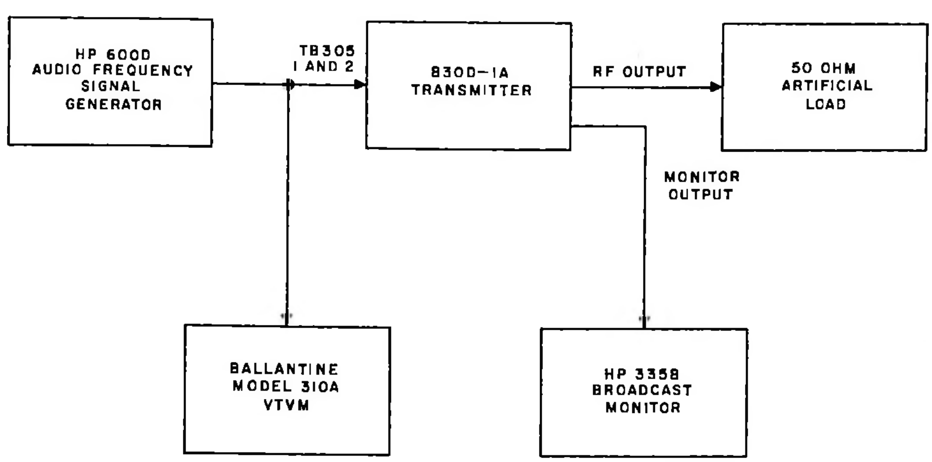


Figure 5-2. Audio Frequency Response Test Setup

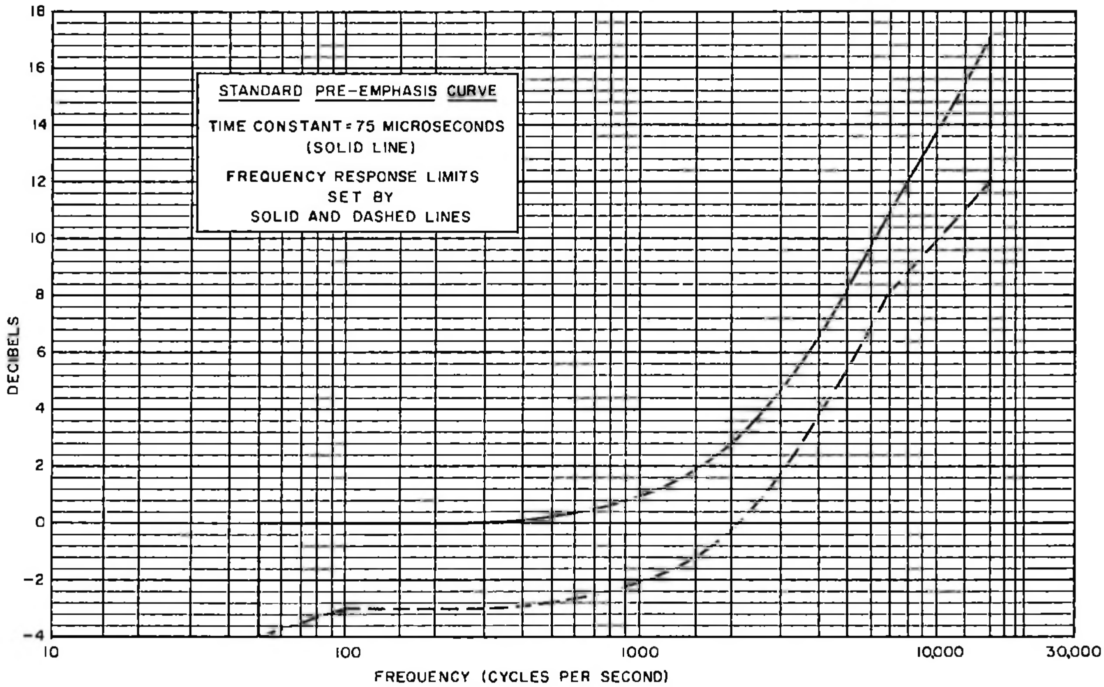


Figure 5-3. Audio Frequency Response Limits

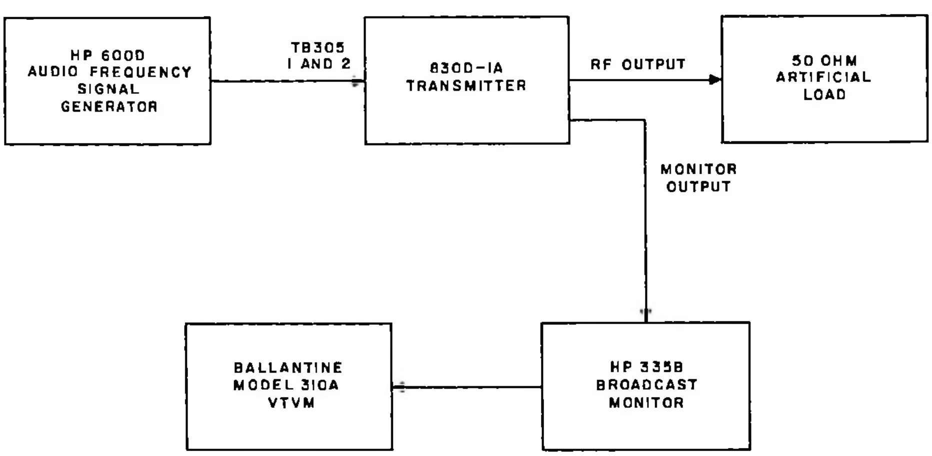


Figure 5-4. FM Noise Test Setup

recorded when the transmitter is installed and operating properly. Table 5-3 is supplied for recording these readings. If some malfunction should occur after the normal meter readings are recorded, it is a simple matter to compare the meter readings of the malfunctioning equipment with the normal meter readings. When trouble shooting and comparing the meter readings, it is advisable to start with the final stage and proceed backwards until normal readings are encountered. The malfunctioning stage will then be the one immediately ahead of the normal meter indications.

As most cases of trouble will be traced to tubes or transistors, it is advisable to first of all replace the tube (or transistor) in the stage in which the trouble is suspected. If the trouble does not clear with tube or transistor replacement, it will become necessary to take resistance or voltage measurements, within the suspected circuit, to determine which component has failed.

When tracing trouble within the power amplifier, it will be helpful to use the "from-to" information given in the D830-1 1000 Watt FM Power Amplifier Unit Instructions. The "from-to" information gives the actual location of the individual wires within the power amplifier cabinet. When used in conjunction with the schematic, the "from-to" information can be very helpful.

If the transmitter center frequency shifts excessively with modulation, the trouble may be isolated to either the afc circuitry or the modulator circuitry by disabling the afc and noting if the carrier shifts more than 1.8 kc with a change in modulation from zero to 100 percent. If the modulator oscillator shifts more than the 1.8 kc with the afc disabled, the trouble will be within the modulator oscillator circuits. The afc circuitry cannot shift the modulator oscillator frequency more than 1.8 kilocycles. If the carrier shift is under 1.8 kc the trouble will be in the afc circuitry.

If the power amplifier tube, V201, is replaced, the stage may no longer be neutralized. Check neutralization of the stage before going ahead with the neutralization procedure given in paragraph 2.6.1. It may not be necessary to change the neutralization adjustment.

TABLE 5-3. NORMAL TRANSMITTER METER INDICATIONS

CONTROL	POSITION	METER	INDICATION
S101	BUFFER GRID A	M101	
S101	MIXER GRID A	M101	
S101	V428 B	M101	
S101	V429 B	M101	
S101	V430 B	M101	
S101	V430C B	M101	
S101	MOD OUTPUT B	M101	
S101	AFC KEY B	M101	
S101	14 MC REF B	M101	
MULTIMETER	SCREEN FS 400 VDC	MULTIMETER	
MULTIMETER	SCREEN FS 40 MA	MULTIMETER	
MULTIMETER	GRID FS 4 MA	MULTIMETER	
		P.A. PLATE VOLTAGE	
		P.A. PLATE CURRENT	
WATTMETER	FORWARD 1.5KW	R.F. WATTMETER	
WATTMETER	REFLECTED 1.5KW	R.F. WATTMETER	

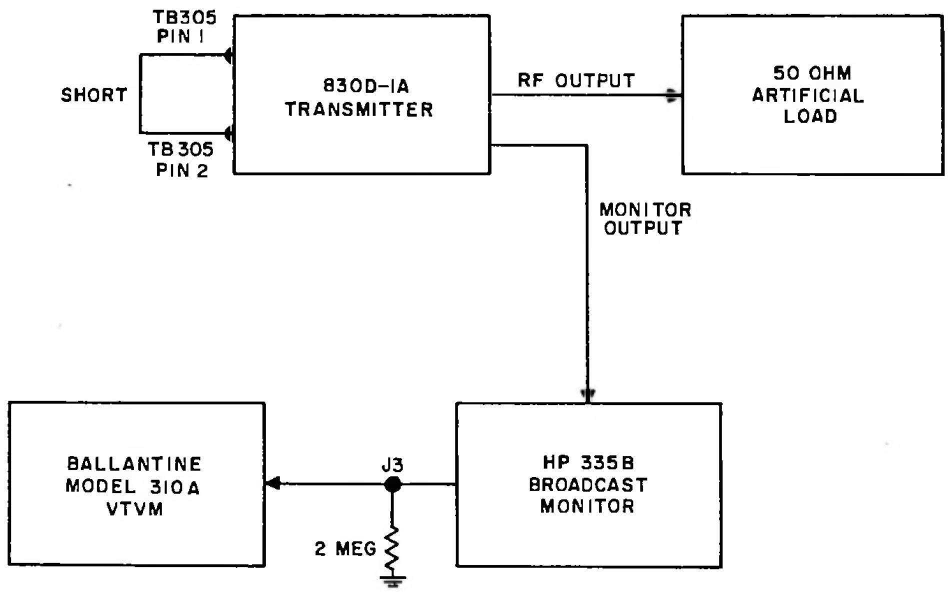


Figure 5-5. AM Noise Test Setup

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8168
4CX1000A

CERAMIC POWER TETRODE

The EIMAC 8168/4CX1000A is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1630 watts of peak-envelope output power. Two 8168/4CX1000As operating in Class-AB_1 will produce 3260 watts of audio power.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Oxide Coated, Unipotential	Min.	Nom.	Max.	
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	8.1		9.9	amperes
Transconductance (I_b=1.0 ampere)		37,000		μmhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	μμf
Output	11		13	μμf
Feedback			0.022	μμf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input	32.5		38.0	μμf
Output	11		13	μμf
Feedback			0.004	μμf
Frequency for Maximum Ratings			110	MHz

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	EIMAC SK-800 Series
Operating Position	Any
Maximum Over-all Dimensions:	
Height	4.8 inches
Diameter	3.37 inches
Net Weight	27 ounces
Shipping Weight (approximate)	3 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB or B

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	1.0 AMP
PLATE DISSIPATION	1000 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	0 WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	2000	2500	3000	volts
DC Screen Voltage	325	325	325	volts
DC Grid Voltage¹	−60	−60	−60	volts
Zero-Signal DC Plate Current	250	250	250	mA
Single-Tone DC Plate Current*	890	885	875	mA
Two-Tone Average DC Plate Current	645	650	635	mA
Zero-Signal DC Screen Current*	8	6	5	mA
Single-Tone DC Screen Current*	35	35	35	mA
Two-Tone Average DC Screen Current*	10	8	8	mA
Plate Output Power	930	1300	1630	watts

*Approximate values.
¹Adjust grid bias to obtain zero-signal plate current.

AUDIO AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE - - - -	3000 VOLTS
DC SCREEN VOLTAGE - - - -	400 VOLTS
DC PLATE CURRENT - - - - -	1.0 AMP
PLATE DISSIPATION - - - - -	1000 WATTS
SCREEN DISSIPATION - - - -	12 WATTS
GRID DISSIPATION - - - - -	0 WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless noted)

DC Plate Voltage - - - -	2000	2500	3000	volts
DC Screen Voltage - - - -	325	325	325	volts
DC Grid Voltage[1] - - - -	−60	−60	−60	volts
Zero-Signal DC Plate Current -	500	500	500	mA
Max.-Signal DC Plate Current -	1.78	1.77	1.75	amps
Zero-Signal DC Screen Current*	16	12	10	mA
Max-Signal DC Screen Current*	70	70	70	mA
Effective Load, Plate to Plate -	2040	2850	3680	ohms
Driving Power - - - - -	0	0	0	watts
Max-Signal Plate Output Power	1860	2600	3260	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling — Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Anode Core	250°C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes and at VHF increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

The 4CX1000A is tested for vibration (noise) from 10 Hz to 500 Hz. Vibration level is 10 G units peak 28 Hz to 500 Hz. Below 28 Hz vibration double amplitude is .25 inch.

The 4CX1000A is tested for shock, 50 G, 11 ms, three axes, after which the tube must be within specification for grid bias voltage and gas current.

ELECTRICAL

Heater — The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation — The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five-milliamperes as read on a five-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation — Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

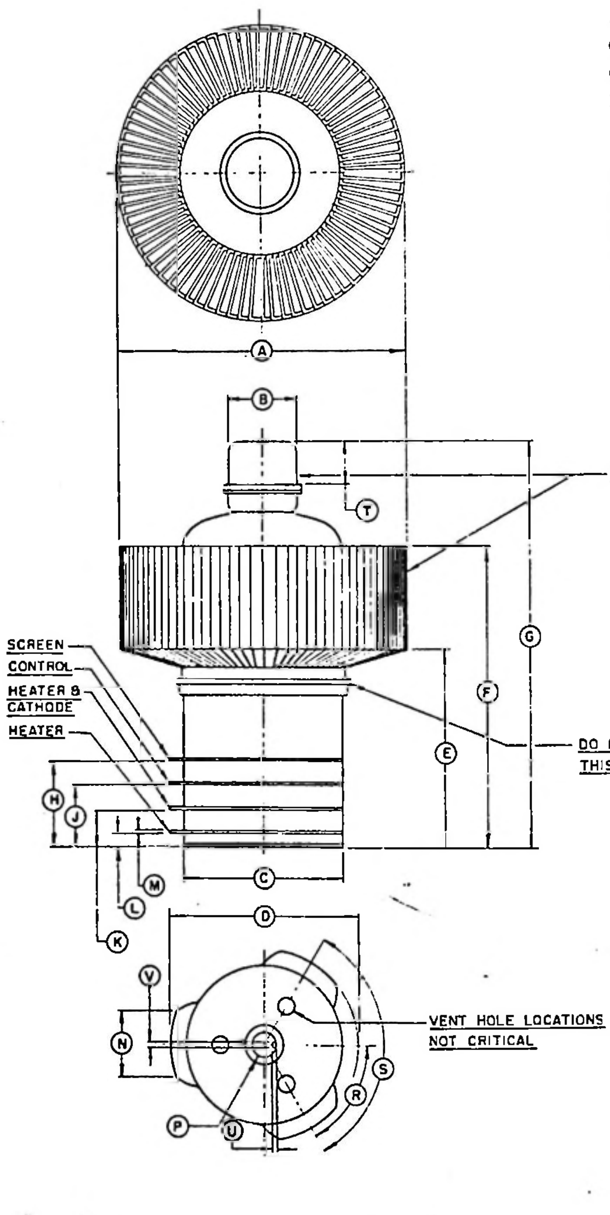
The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

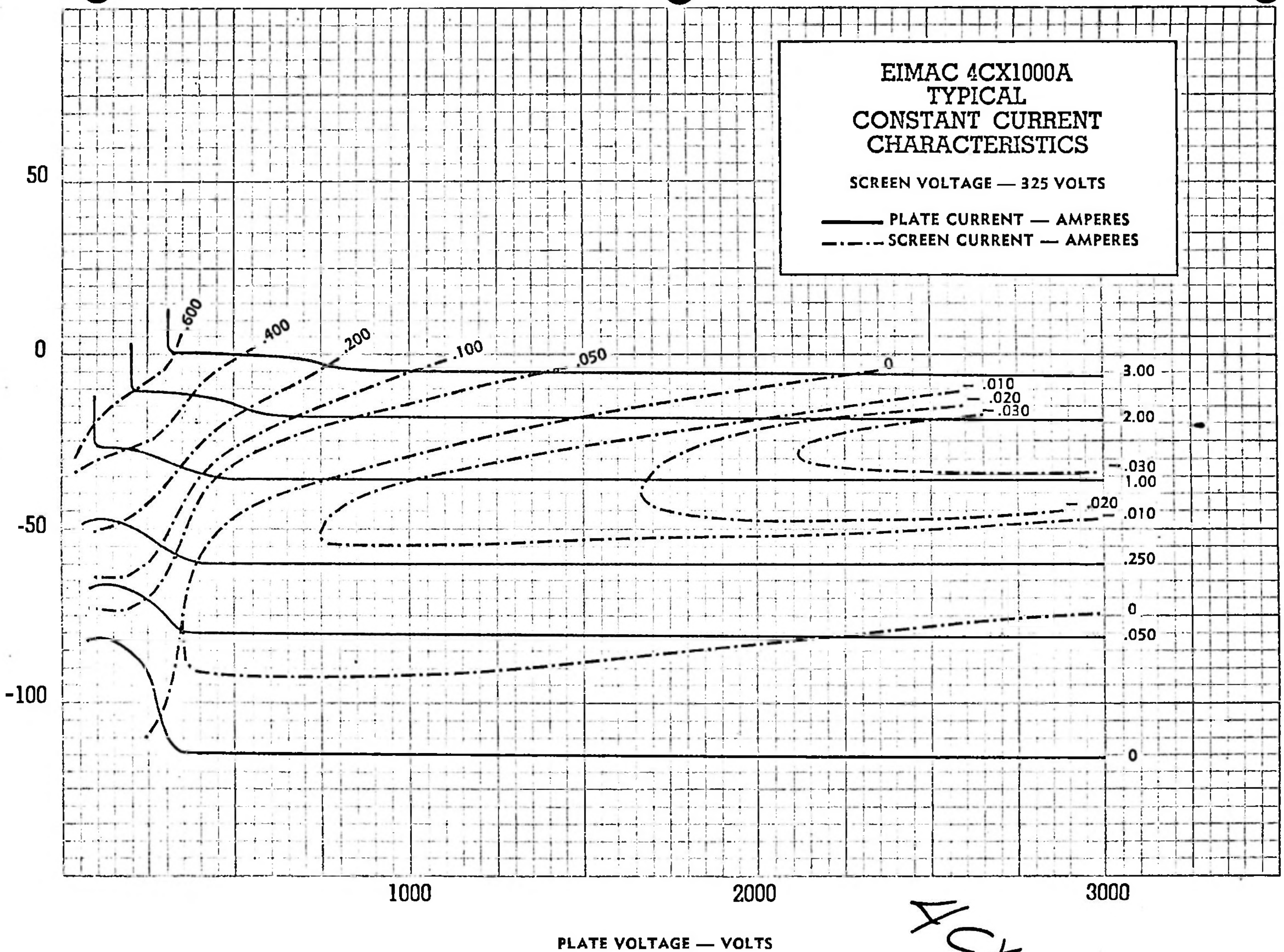
Plate Operation — The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, EIMAC Division of Varian, San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.

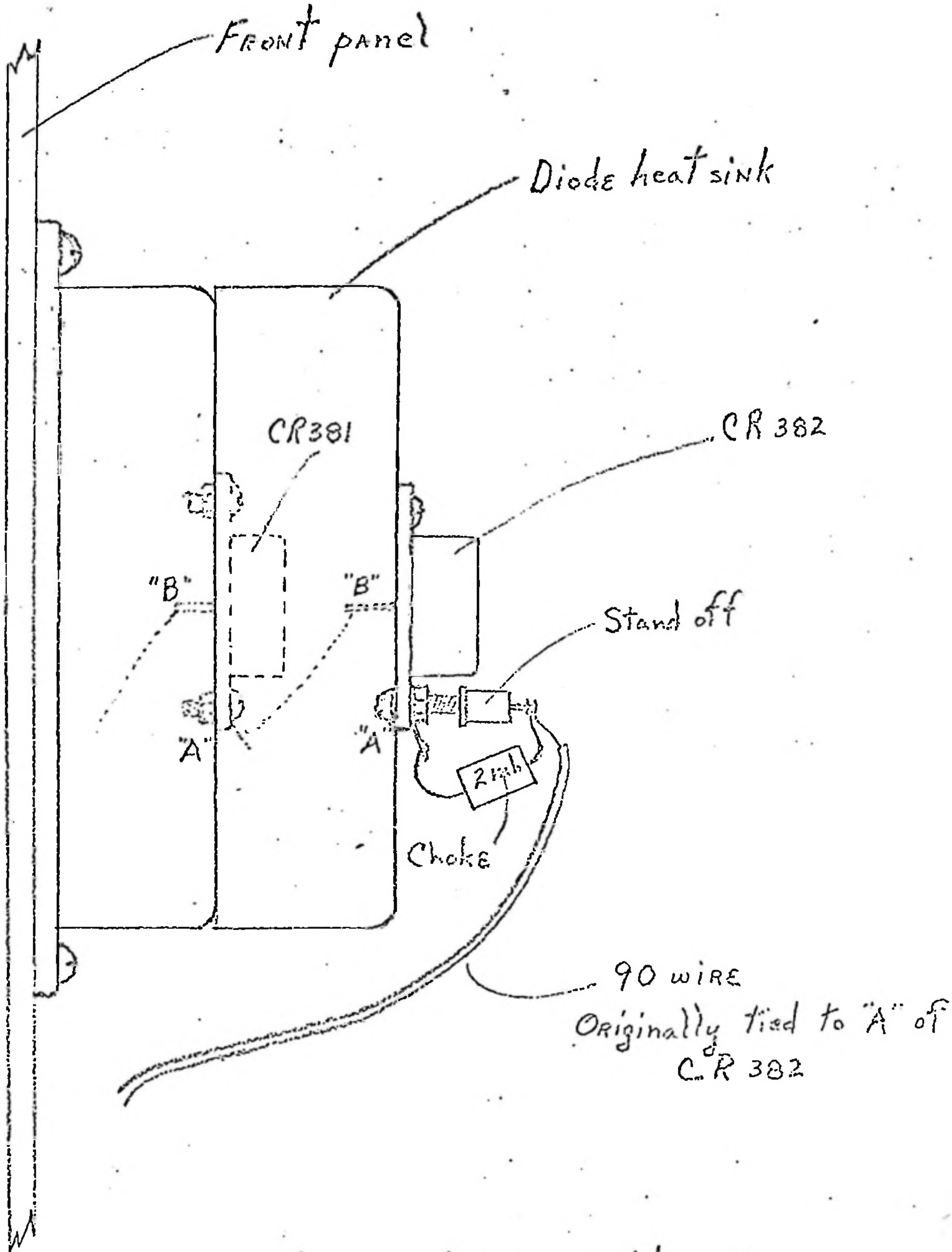


4CX1000A

4CX 1000

NEUTRALIZATION: Turn off the exciter; remove the bias fuse (F304) and observe that the plate current rises to full scale. The overload should cut the power off. Also observe that as the plate current rises that no power output is observed on the watt meter. If the OVERLOAD ~~breaker~~ does not cut off the power, immediately push the plate off button AT maximum current. If power is observed it means the PA has a tendency to oscillate; therefore, move the neutralization bars apart slightly. Repeat as above. If the PA is stable, but the grid drive drops off considerably as the plate voltage is applied, it indicates over neutralization and the bars should be moved slightly closer together. Repeat as necessary for optimum neutralization.

Screen Diode Protection Modification



0.47 μfd 600 Volt capacitor is tied across R 309 (15K Ω)

D830-1
1000-Watt
FM Power Amplifier

COLLINS

unit instructions

Collins Radio Company | Dallas, Texas

TD-567
523-0755334-101438
1 August 1966

TABLE OF CONTENTS

Section			Page
I	**GENERAL DESCRIPTION**		3
	1.1	Purpose of Instruction Book	3
	1.2	Purpose of Equipment	3
	1.3	Description of Equipment	3
	1.3.1	Physical Description	3
	1.3.2	Electrical Description	4
	1.4	Equipment Supplied	4
	1.5	Equipment Required but not Supplied	4
	1.6	Accessory Equipment	4
	1.7	Equipment Specifications	5
	1.7.1	Mechanical	5
	1.7.2	Electrical	5
	1.8	Tube and Semiconductor Complement	5
II	**PRINCIPLES OF OPERATION**		5
	2.1	General	5
	2.1.1	Control Circuits	6
	2.1.2	Power Amplifier Circuits	9
	2.2	Control Functions	9
III	**MAINTENANCE**		11
	3.1	General	11
	3.2	Preventive Maintenance	11
	3.2.1	Air Filter Cleaning	11

Section			Page
	3.2.2	PA Tube Cleaning	12
	3.2.2.1	PA Tube Removal	12
	3.2.3	Inspection	12
	3.2.4	Lubrication	12
	3.2.5	Tube Maintenance	12
	3.3	Trouble Shooting	12
	3.4	Cable Chart	13
IV	**PARTS LIST**		16
V	**ILLUSTRATIONS**		35/36

LIST OF ILLUSTRATIONS

Figure		Page
1-1	D830-1 1000-Watt FM Power Amplifier, Over-all View (C850-14-P)	3
1-2	D830-1 1000-Watt FM Power Amplifier, Rear View with Bottom Panel Removed (C850-23-P)	4
2-1	D830-1 1000-Watt FM Power Amplifier, Block Diagram (C850-01-3)	6
2-2	D830-1 1000-Watt FM Power Amplifier Control Circuits, Simplified Schematic Diagram (C850-12-6)	7
2-3	D830-1 1000-Watt FM Power Amplifier, Power Amplifier Circuits, Simplified Schematic Diagram (C850-11-6)	8
2-4	D830-1 1000-Watt FM Power Amplifier, Control Locations (B502-149-Pc)	10
4-1	D830-1 1000-Watt FM Power Amplifier (B502-150-Pb) (B502-153-Pb) (B502-151-Pb) (B502-152-Pb) (B502-154-Pb) (B502-156-Pb) (B502-155-Pb) (B502-157-Pb) (B502-158-Pb)	17
5-1	Schematic Diagram, D830-1 1000-Watt FM Power Amplifier (B502-136-6)	35/36

LIST OF TABLES

Table		Page
1-1	Associated Equipment Instruction Books	4
1-2	Equipment Supplied with D830-1 1000-Watt FM Power Amplifier	4
1-3	Equipment Required but not Supplied as Part of D830-1 1000-Watt FM Power Amplifier	4
1-4	Accessory Equipment	5
1-5	Tube and Semiconductor Complement	5
3-1	Typical Meter Indications	13
3-2	Cable From-To Information	13

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

Unit Instructions TD-567 provides information about D830-1 1000-Watt FM Power Amplifier. Information which is furnished covers a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

1.2 PURPOSE OF EQUIPMENT.

The D830-1 1000-Watt FM Power Amplifier can be used for continuous monaural or multiplex and SCA FM broadcast service on a single frequency, in the range from 88 to 108 megacycles with an exciter input of 10 watts and an output power of 1000 watts.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The D830-1 1000-Watt FM Power Amplifier, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 767 pounds. All D830-1 operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The meters may be observed easily while operating the tuning controls. The D830-1 uses one tube (the power amplifier), plus semiconductors for voltage rectification and regulating. The power amplifier tube is accessible from the front of the transmitter. The bottom front of the D830-1 cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the D830-1 for servicing and maintenance. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks remove the D830-1 plate voltage and ground the high voltage circuits when the doors are opened or the panel is removed. The power amplifier plate-tuning cavity is located in an interlocked compartment at the front of the D830-1.

Inside the D830-1, heavy iron-core components are at the bottom of the cabinet. A standard 19-inch rack is provided for mounting the 10-watt exciter within the confines of the D830-1. Room is also provided on the standard 19-inch rack, for the mounting of SCA generators. An optional harmonic filter which can be connected to the D830-1 output is suspended from the top of the cabinet.

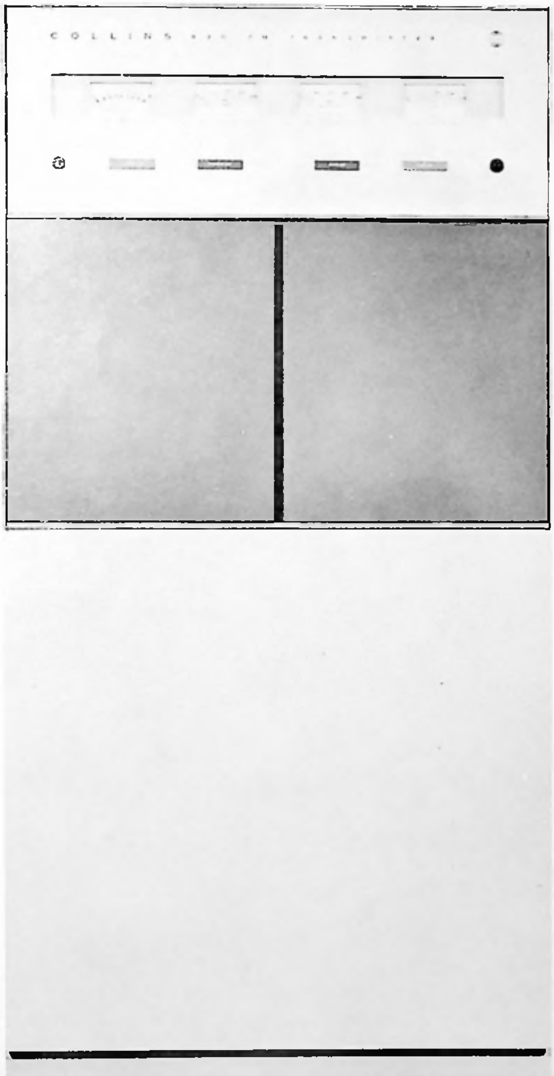


Figure 1-1. D830-1 1000-Watt FM Power Amplifier, Over-all View

Cooling air for the D830-1 is drawn through a permanent-type air filter at the rear of the cabinet by a low-speed, high-volume fan, and exhausted through a shielded opening in the top of the cabinet. A pressure blower supplies cooling air directly to the power amplifier tube.

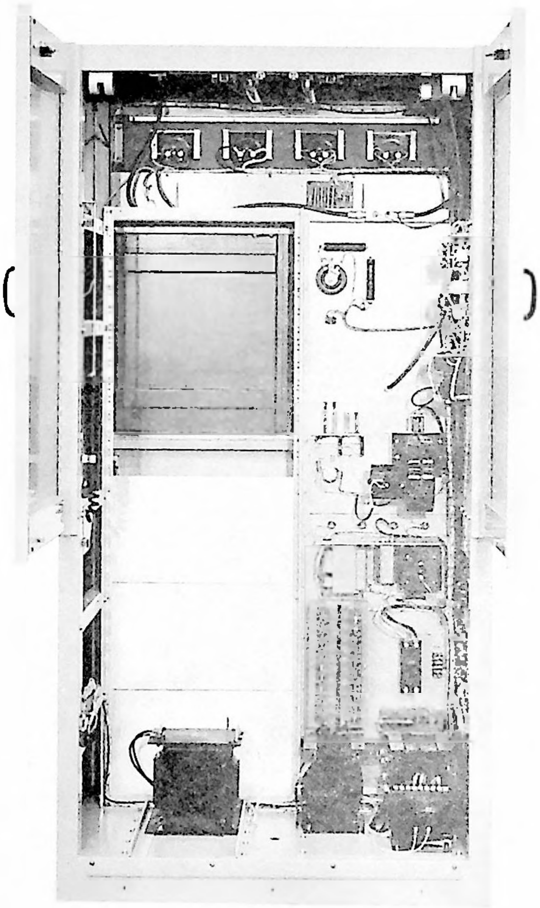


Figure 1-2. D830-1 1000-Watt FM Power Amplifier, Rear View with Bottom Panel Removed

1.3.2 ELECTRICAL DESCRIPTION.

The D830-1 1000-Watt FM Power Amplifier consists of a single air-cooled, power amplifier tube capable of being driven to full power by a 10-watt exciter. All associated power supply and control circuitry is included for operation of the D830-1. D830-1 r-f input impedance is 50 ohms nominal, unbalanced. D830-1 output power is at least 1000 watts over the frequency range of 88 to 108 mc into a 250-ohm load with an swr not exceeding 2:1.

Line power input required is 50/60-cycle, single-phase, with primary taps on all power transformers to compensate for line voltage variations from 200 to 250 volts. Circuit breakers in the input side of the line are provided for primary current overload protection. The control circuits, the final amplifier filament, and the central grid bias supply are fused. A time delay relay provides protection of the power amplifier tube during warmup. Remote control can be exercised over filament on, filament off, plate on, and plate off functions of the power amplifier. Instruction books covering the exciters used in conjunction with D830-1 1000-Watt FM Power Amplifier are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
786M-1 Stero Generator	TD-537

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of D830-1 1000-Watt FM Power Amplifier.

TABLE 1-2
EQUIPMENT SUPPLIED WITH D830-1
1000-WATT FM POWER AMPLIFIER

EQUIPMENT	COLLINS PART NUMBER
D830-1 1000-Watt FM Power Amplifier	522-2948-00

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment that is required for operation of D830-1 1000-Watt FM Power Amplifier but not supplied as part of the power amplifier.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED
AS PART OF D830-1 1000-WATT FM
POWER AMPLIFIER

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00

1.6 ACCESSORY EQUIPMENT.

Table 1-4 lists accessory equipment that is available for use with D830-1 1000-Watt FM Power Amplifier.

TABLE 1-4
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
250-Watt/1-Kw Harmonic Filter (used only if the D830-1 is fed directly to an antenna and not to a higher power amplifier).	549-2010-000

1.7 EQUIPMENT SPECIFICATIONS.

1.7.1 MECHANICAL.

Weight . . . . 767 pounds maximum.

Size . . . . 38 inches wide, 76 inches high, 27 inches deep.

Ventilation . . . . . . One ventilating fan, one blower.

Ambient temperature range . . . . +10°C (50°F) to +45°C (113°F).

Ambient humidity range . . . . 0 to 95 percent relative humidity.

Altitude . . . . 0 to 6000 feet.

1.7.2 ELECTRICAL.

Power source . . . . 200 to 250 volts, 50/60-cycle, single-phase. (When using the D830-1 as a driver, connect TB301-1 and TB301-2 across one phase of the three phase primary power source.)

Maximum power requirements . . . . . 3300 watts.

R-f input power . . . . 10 watts nominal.

Input impedance . . . 50 ohms nominal, unbalanced.

Power output . . . . . 1000 watts nominal.

Output impedance . . . 50 ohms, unbalanced. Maximum swr 2:1.

Frequency range . . . 88 to 108 mc. Exact operating frequency determined by frequency of exciter.

1.8 TUBE AND SEMICONDUCTOR COMPLEMENT.

Table 1-5 lists the tube and semiconductor complement supplied as part of the D830-1 1000-Watt FM Power Amplifier.

TABLE 1-5
TUBE AND SEMICONDUCTOR COMPLEMENT

QUANTITY	TYPE	FUNCTION
1	4CX1000A	R-f power amplifier
1	50M140ZB5	Voltage regulation
80	1N1566	H.V. rectifier diodes
1	1N1492	Bias rectifier
1	1N1492	Grid current diode
1	1N1566	Meter protection diode

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

The D830-1 1000-Watt FM Power Amplifier consists of a power amplifier and associated control circuitry, for the amplification of 10 watts of exciter drive to 1000 watts of r-f power. The D830-1 output can be used to drive a higher power amplifier or fed through a harmonic filter to an antenna.

Refer to figure 2-1, a block diagram of D830-1 1000-Watt FM Power Amplifier. The 230 volts a-c is fed to a control circuit power transformer which reduces the input voltage to 115 volts a-c for use by the power amplifier blower and control circuits. A second regulated transformer located within the control circuitry reduces the 230 volts a-c to 6.3 volts for use by the power amplifier filament. The 230 volts a-c is also fed to a transformer which supplies the power amplifier plate and screen voltages. The primary power to the plate power supply is controlled by the plate contactor. The control circuits provide cabinet interlocks for protection of personnel from all high voltage, local or remote filament on and filament off controls, local or remote plate on and plate off controls, and a time delay to prevent the application of high voltage before the power amplifier filament has heated sufficiently. Provisions are also available within the control circuitry for connection to the control circuitry of a higher power amplifier. The higher power amplifier could then control the D830-1 plate and filament power. Exciter input power is applied directly to the power amplifier where it is raised to 1000-watts of r-f power.

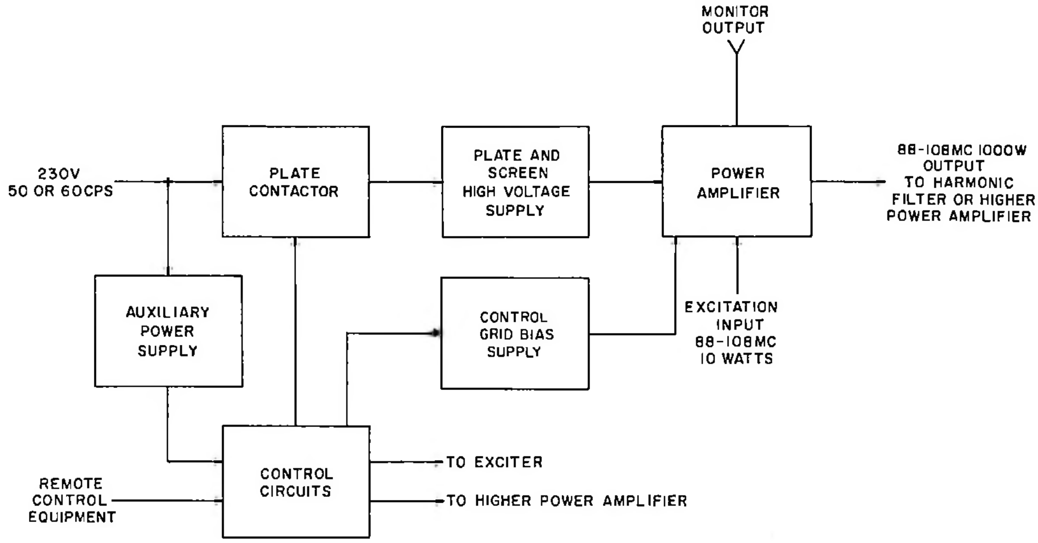


Figure 2-1. D830-1 1000-Watt FM Power Amplifier, Block Diagram

The power amplifier consists of a forced air cooled, ceramic tetrode, V201. The plate of V201 is connected to a tuned cavity (foreshortened $\frac{\lambda}{4}$ coaxial line resonator). The output from the tuned cavity can then be fed to a higher power amplifier or to a harmonic filter and antenna if high power amplification is not necessary. A sample of the power amplifier output is taken from the plate tuned cavity for monitoring purposes.

Metering circuits are provided for the power amplifier plate current and voltage, screen current and voltage, grid current, and output power.

2.1.1 CONTROL CIRCUITS.

Refer to figure 2-2, a simplified schematic diagram of the control circuits of D830-1 1000-Watt FM Power Amplifier. The primary purpose of the control circuitry is to provide filament and plate on and off control. The power amplifier filament is turned on in the following manner: When the momentary FILAMENT ON switch, S112, is pressed, a ground is placed on filament control relay K301. As 115 volts a-c is present on terminal 2 of relay K301 from 115-volt a-c supply transformer T301, the filament control relay will be energized. This closes contacts 3 and 4 holding the relay in the energized position after the momentary FILAMENT ON switch, S112, is released. The green filament indicator lamp, DS301, will light. The filament control relay, K301, when energized, will close relay contacts which will start cabinet fan B103, supply 230 volts to the regulated filament transformer, supply 115 volts a-c to the 10-watt exciter, and supply 115 volts a-c to the power amplifier bias supply. When blower B301 comes up to speed, the air interlock switch, S314, will close, applying 115 volts a-c to time delay K307. In 4 to 5 minutes (time for power amplifier filament V201 to warm up) time delay K307 will close, energizing auxiliary relay K306, which through contacts 3 and 5 supplies 115 volts a-c to plate contactor relay K304. The plate can now be turned on by pressing momentary PLATE ON switch S113 (providing all interlocks are closed). Pressing the momentary PLATE ON switch places a ground on plate control relay K302. Relay K302 will then energize, closing contacts 3 and 4 holding K302 in the energized position. Contacts 9 and 10 will also close providing a ground path energizing plate contactor K304, and lighting the red plate on indicator. When the plate contactor closes, the primary a-c supply will be applied to the plate and screen supply transformer T303. The plate power supply will then furnish approximately 2700 volts d-c to power amplifier tube V201.

The momentary FILAMENT OFF switch, S111, removes power from the control and power amplifier circuits. It accomplishes this by opening the 115-volt a-c lead to filament control relay K301 and plate control relay K302. This de-energizes plate contactor K304 and blower interlock S314, removing filament, plate, and screen voltage. The time delay relay will begin to recycle and will always cause the correct time delay necessary for proper filament heating.

The momentary PLATE OFF switch, S114, removes only plate and screen voltage from power amplifier V201. This is accomplished by momentarily opening the ground lead of plate control relay K302, which de-energizes plate contactor K304, removing 230-volt a-c power from the plate and screen supply.

Plate overload protection is provided by overload relay K305. As the plate current increases, the current through K305 will increase until overload relay K305 energizes, opening the ground lead of plate control relay K302, removing plate voltage. Potentiometer

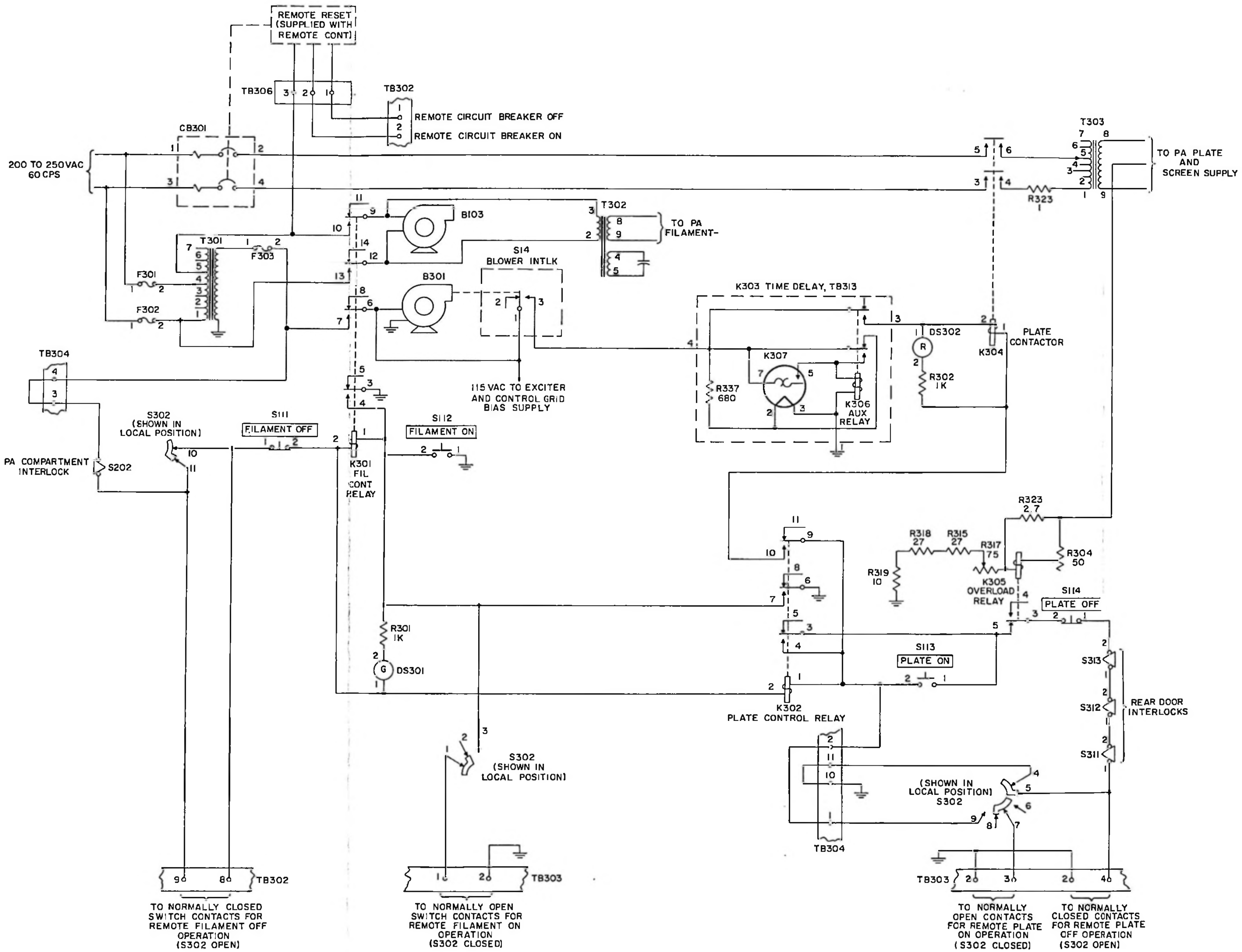


Figure 2-2. D830-1 1000-Watt FM Power Amplifier, Control Circuits, Simplified Schematic Diagram

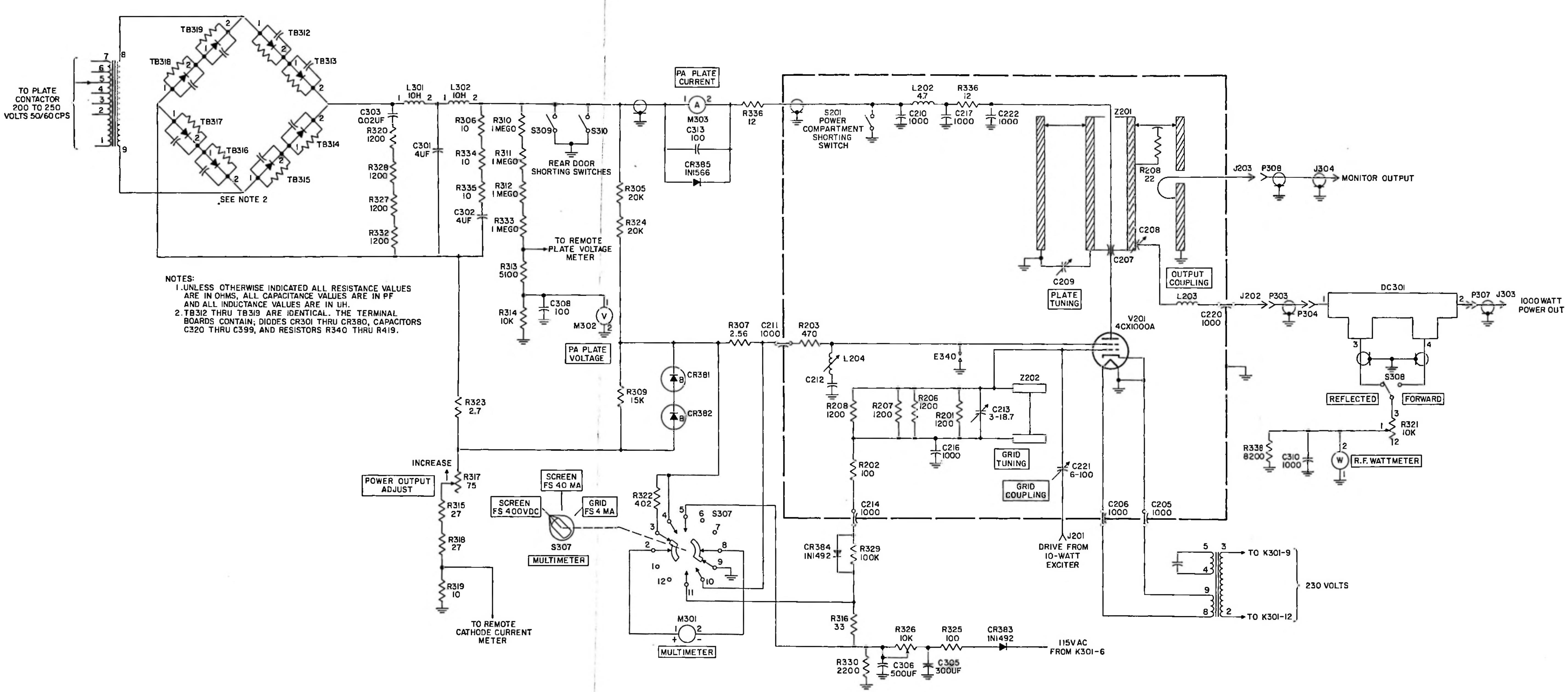


Figure 2-3. D830-1 1000-Watt FM Power Amplifier, Power Amplifier Circuits, Simplified Schematic Diagram

R304 adjusts the point at which excess plate current will activate overload relay K305.

2.1.2 POWER AMPLIFIER CIRCUITS.

Refer to figure 2-3, a simplified schematic of the power amplifier circuit of D830-1 1000-Watt FM Power Amplifier. The power amplifier consists of a forced air-cooled, tetrode amplifier, operating over the standard frequency modulated broadcast band of 88 to 108 mc.

The power amplifier plate and screen voltages are obtained from a full-wave bridge rectifier circuit. Transformer T303 increases the 230-volt single-phase 50/60-cps primary input to approximately 3000 volts rms across terminals 8 and 9 (T303 secondary) winding. The primary winding of transformer T303 has six adjustable taps to compensate for line voltages from 200 to 250 volts. The output voltage of the secondary winding of T303 is fed to a conventional full-wave bridge and filter circuit rectifier consisting of diodes CR301 through CR380, inductances L301 and L302, and capacitors C301 and C302. Resistors R340 through R419, and capacitors C320 through C399 are used to equalize the forward currents of all diodes. Resistor R320, R327, R328, R331, and R332, and capacitor C303 form a transient suppressor network which helps suppress transient voltages formed when power is first applied to transformer T303 and when power is switched off. The 2750-volt d-c output from the power supply is fed through P.A. PLATE CURRENT meter M303, through an r-f filter consisting of C210, C217, C222, L202 and R336 to the plate of V201. Plate voltage and plate current are read directly from P.A. PLATE VOLTAGE meter M302 and P.A. PLATE CURENT meter M303 respectively.

The screen voltage is obtained from the 2750-volt plate supply. The plate supply is fed to a combination bleeder resistor and voltage divider consisting of resistors R305, R324, R309, R315, R317, R318, and R319. Voltage regulation for the screen supply of V201 is accomplished by passing most of the bleeder current through two Zener diodes placed in parallel with R309. If the screen current should fluctuate, the screen voltage is held to 250 volts by the two Zener diodes, CR381 and CR382. Capacitor C212 is placed from the screen grid to ground to shunt any r-f energy present on the screen grid. Screen voltage, and thus the power output of V201, is made variable by POWER OUTPUT ADJUST control R317. A protective device consisting of two carbon blocks (which will arc over if the screen voltage exceeds 400 volts) is provided to protect the screen supply Zener diodes in the event of a screen-to-plate short.

Power amplifier V201 is a grounded cathode tetrode, using fixed and grid leak bias. The control grid circuit of V201 consists of a parallel-tuned resonant tank circuit, Z202 and C213. R201, R205, R206, and R207 placed in parallel with C213 present the proper load to the exciter and also provide a broad-band low-impedance input to the control grid. Z202 consists of two parallel rods, forming a shorted stub which is tuned by a shorting bar between the two rods. Control grid fine tuning is accomplished by capacitor C213. Negative fixed bias for the control grid is obtained from a half-wave power supply consisting of diode CR383, capacitors C383 and C384, and resistors R325, R326, and R330. The fixed bias is made adjustable by adjustable resistor R326. Power to operate the bias supply is obtained from T301 through the filament control relay, K301. Grid leak bias is obtained from the voltage drop across R329 due to grid current. Diode CR384 is placed across R329 to prevent the possibility of the grid going positive because of grid emission.

The plate cavity is formed by a short section of coaxial transmission line resonating with the plate capacity of V201 and plate tuning capacitor C209. The coaxial transmission line is roughly tuned initially by adjusting a shorting plate which lengthens or shortens the physical length of the coaxial transmission line. A resistor, R208, is attached to the tank slider to provide parasitic swamping. Fine plate tuning is accomplished by C209. The output coupling network, formed by C208 and L203, is coupled to the coaxial transmission line adjacent to the plate of V201 for correct impedance matching. Inductance L203 and capacitor C220 act as an L section low-pass filter for frequencies above 130 mc to provide a measure of harmonic suppression. A monitor output is provided in the plate cavity for use by the station program monitor.

Neutralization of V201 is accomplished by two small adjustable bars which are connected in series with the screen by-pass capacitor connected to the tube socket. These bars form two parallel inductances that adjust the over-all screen reactance, bringing the tube internal reactances into balance for neutralization.

A MULTIMETER is located on the front panel of the power amplifier to enable the station operator to monitor screen voltage, screen current, and grid current. The MULTIMETER functions are selected by the multimeter switch located within the power amplifier cabinet. Screen voltages are determined by connecting multimeter M301 and meter multiplier resistor R322 across the regulated screen supply with switch S307. Screen current is determined by placing M301 and shunt resistor R307 in series with the screen voltage line. Grid current is determined by placing M301 and shunt in series with the control grid bias input.

2.2 CONTROL FUNCTIONS.

The following paragraphs describe all the functions of controls in D830-1 1000-Watt FM Power Amplifier. Refer to figure 2-4 for control locations.

The controls located directly on the front panel under the meters include the FILAMENT ON, FILAMENT OFF, PLATE OFF, and PLATE ON controls. The filament on and plate on indicators are placed in line with the above mentioned controls. The FILAMENT ON switch, S112, energizes the power

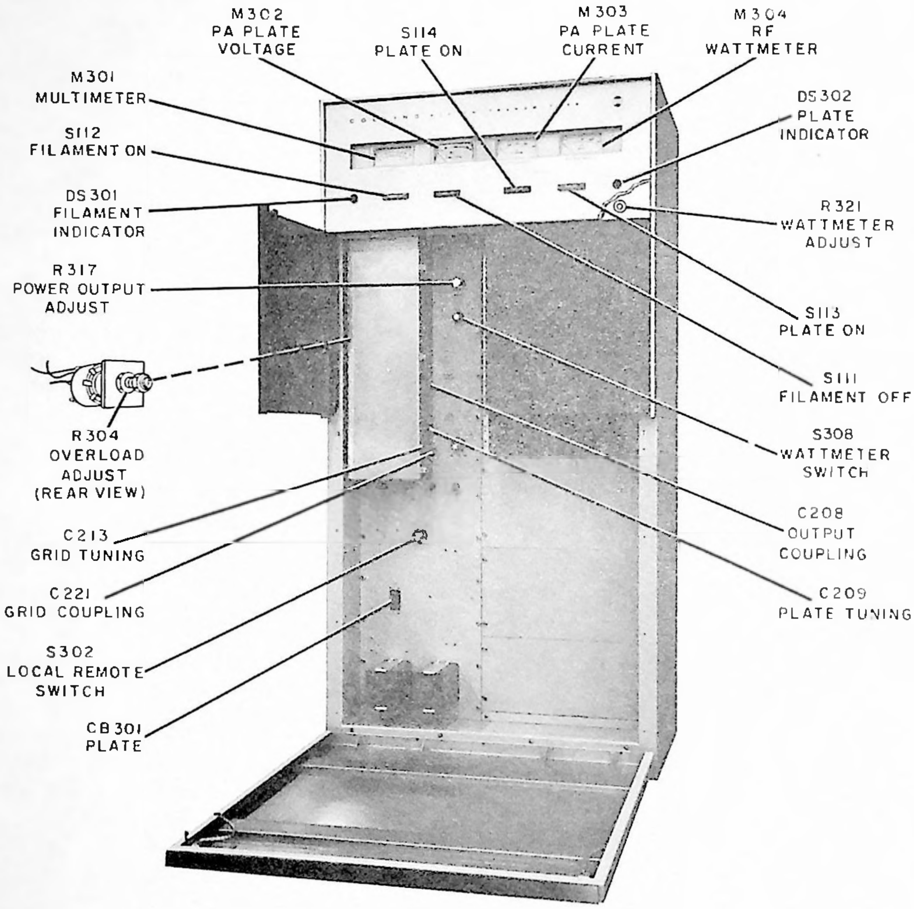


Figure 2-4. D830-1 1000-Watt FM Power Amplifier, Control Locations

amplifier filament, the power amplfier and cabinet blowers, and supplies power to the 10-watt exciter. The FILAMENT OFF switch, S111, de-energizes all transmitter circuits. The PLATE ON switch, S113, energizes the plate control relay, K302, which in turn could (if the FILAMENT ON switch has not been pressed) energize the filament control relay, K301, starting the power amplifier in sequence.

The PLATE OFF switch, S114, removes plate and screen voltage. The green filament indicator light, DS301, lights when the FILAMENT ON switch is pressed and indicates that voltage is available to the filament control relay. The filament control relay starts the PA blower which activates the PA blower interlock, energizing the power amplifier filament. The red plate on indicator light, DS302, indicates the plate contacter is receiving voltage.

The following controls are located directly under the left front door on the power amplifier panel. The POWER OUTPUT ADJUST potentiometer, R317, adjusts the power amplifier screen voltage thus changing the output power. The WATTMETER switch, S308, connects the R. F. WATTMETER to either the reflected power or forward power section of the directional coupler. The WATTMETER switch is normally left in the FORWARD position. The MULTIMETER switch, S307, selects either screen voltage, screen current or grid current for the MULTIMETER, M301. Table 3-1 lists the MULTIMETER switch positions and typical indications for each of the three meter circuits.

The following controls are located directly behind the left front door on the power amplifier compartment. The OUTPUT COUPLING control, C208, adjusts the coupling of the load to the plate cavity. The PLATE TUNING control, C209, tunes the plate cavity to resonance and is set very near the minimum indication on the P.A. PLATE CURRENT meter, M303. At this point the power output should be at the peak as indicated on the R.F. WATTMETER, M304. The GRID TUNING control, C213, tunes the grid tank and is set for maximum indication on the MULTIMETER, M301, with the MULTIMETER switch, S307, set to GRID FS 4 MA. The GRID COUPLING control, C221, adjusts the coupling of the grid tank to the exciter output and is normally set for 0.5 ma indication on the MULTIMETER. The following controls are located on the power supply panel directly behind the bottom front panel of the power amplifier cabinet. The LOCAL-REMOTE switch, S302, allows the power amplifier to be operated from a remote position or from the power amplifier. With S302 in the REMOTE position, filament on, filament off, plate on, and plate off functions may be selected from either a remote position or at the power amplifier. With S302 in the LOCAL position, filament on, filament off, plate on and plate off functions may be selected only at the power amplifier cabinet. The PLATE circuit breaker, CB301, is a protective device which monitors the plate supply transformer primary current. The circuit breaker will activate if the transformer primary current exceeds 12 amperes. The control circuit fuses protect the control circuits from overloads. The two 5-ampere fuses protect the control transformer primary while the 4-ampere fuse protects the control transformer secondary. A fourth fuse, 1/8-ampere, protects the control grid bias supply.

The wattmeter adjusting potentiometer, R321, is located directly below the R.F. WATTMETER when the upper switch and meter panel is raised. The wattmeter adjusting potentiometer is set at the factory and does not normally require adjustment.

The overload adjusting potentiometer, R304, is located inside the right rear door on the relay panel. The overload adjusting potentiometer is set at the factory and does not normally require adjustment. The bias adjust control, R326, is located on the rear of the power amplifier panel on the bias supply chassis. The bias adjusting control adjusts the fixed control grid bias. This control is set at the factory and does not normally require adjustment.

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains information concerning the maintenance of D830-1 1000-Watt FM Power Amplifier.

WARNING

> Voltages present in this equipment are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the D830-1 cabinet whenever high voltage is applied. Do not depend entirely on door interlocks. Always shut down the D830-1 before doing any work inside the D830-1 cabinet. Immediately upon opening the rear doors short out all high-voltage points using the shorting stick located inside the left rear door.

3.2 PREVENTIVE MAINTENANCE.

Most service interruptions in equipment of this type are caused by dirt and corrosion. Corrosion is accelerated by the presence of moisture and dust. Dust should be removed periodically with a soft brush or a dry, oil-free air jet. Remove dust as often as a perceptible quantity accumulates at any point in the power amplifier.

When the D830-1 is operated near salt water or in other corrosive atmospheres, inspect and clean interlock switches, cable connectors, tube prongs, and other metal parts more frequently to keep the equipment in good operating condition.

3.2.1 AIR FILTER CLEANING.

At least once each month, or more often if needed, clean the air filter according to the following procedure.

a. Remove the air filter from the D830-1 cabinet by loosening the two thumb screws located above the air filter. Slide the air filter to the extreme right and pull the left side of the air filter out as soon as the filter clears the panel. Slide the air filter to the left and remove.

b. Mark with an arrow the direction of air flow.

c. Wash by passing a fine spray of hot water through the filter in the direction opposite that of the air-flow. Gently shake the water out of the filter.

d. Dip the filter in a water-soluble oil, such as Filter-kote M available from Collins Radio Company, Service Parts Department, Cedar Rapids, Iowa (Collins part number 005-0609-00).

e. Remove the filter from the oil, lay the filter face down until oil ceases to drip from the filter.
f. Replace the filter into the lower rear panel with the air flow arrow (marked when the filter was removed) pointing in the direction of the air flow. Tighten the two thumb screws.
g. Replacement filters are Collins part number 009-1069-00.

3.2.2 PA TUBE CLEANING.

The power amplifier tube depends upon a stream of air passing through the fins to cool the anode. When these fins become dirty, the air-flow is reduced and the tube life is shortened. The radiator fins should be cleaned as follows:

a. Remove the r-f amplifier tube as described in paragraph 3.2.2.1.

CAUTION

Special care must be used in removing or installing the power amplifier tube to prevent damage to the tube.

b. Direct a low-pressure (50 psi) air stream through the fins in the direction opposite to the normal airflow until all dust is removed.
c. Replace the r-f amplifier tube as described in paragraph 3.2.2.1.

3.2.2.1 PA TUBE REMOVAL.

WARNING

Voltages present within the plate cavity are dangerous to life. Shut down the D830-1 doing any work inside the cavity. Short the plate to ground immediately on opening the plate cavity door. Do not depend entirely on the door interlock.

The power tube may be removed as follows:

a. Open the power amplifier cavity and loosen the clamp holding the coaxial transmission line and the power amplifier tube anode. Also loosen the plate slider clamp.
b. Grasp the center coaxial transmission line and lift until the center coaxial transmission line stops.
c. Turn the anode of V201 approximately 1/6 turn (counterclockwise) until the tube clears the tube socket.
d. Remove tube V201 from the socket.
e. Replacement is the reverse of the removal procedure.

NOTE

It may be necessary to move the OUTPUT COUPLING capacitor to the right so the center coaxial transmission line will clear the capacitor when the center transmission line is moved upwards.

3.2.3 INSPECTION.

Once each week check and clean the three interlock switches and the two shorting switches at the rear of the D830-1 cabinet to be sure they are in good working order.

Once each month check all connections in the D830-1. Tighten any nuts, bolts, or screws that may be loose. Check cable connections to see that they are clean and mechanically secure. Check moving parts such as tuning controls for excessive wear. Check the plate cavity for corrosion around the cavity contact strip. Check and clean (by lightly brushing) the screen grid voltage protector blocks located within the plate cavity.

3.2.4 LUBRICATION.

The PA blower is to lubricated once every six months with two drops of SAE no. 20 oil in each bearing. The cabinet fan has bearings that are lubricated for the life of the equipment. No other lubrication of the D830-1 is required.

3.2.5 TUBE MAINTENANCE.

The power amplifier, V201, should be inspected once each week to ensure that an accumulation of dust does not build up on the radiator fins. If dust is present, clean as described in paragraph 3.2.2. When tuning the D830-1, care should be taken not to exceed the maximum plate current shown in table 3-1.

3.3 TROUBLE SHOOTING.

The most common cause of trouble will probably be traced to tube failure. If the power amplifier tube is suspected of failure, replace it with a tube of known quality, retune, and note any change in performance. A small loss in emission of V201 can be compensated for by a change in the setting of the POWER OUTPUT ADJUST potentiometer. If no screen grid voltage is present, the trouble may lie in the screen grid protector blocks. These should then be cleaned or replaced.

Four meters are located on the D830-1 front panel to assist in locating any trouble which may occur. Table 3-1 contains typical meter indications. These average indications are obtained from several production power amplifiers, and the indications of some D830-1 may vary slightly outside the given limits without affecting the power amplifier performance. A list of panel meter indications for each

TABLE 3-1. TYPICAL METER INDICATIONS

METER	METER SWITCH POSITION	INDICATION
MULTIMETER	SCREEN FS 400 VDC	210 to 260
MULTIMETER	SCREEN FS 40 MA	25 ma
MULTIMETER	GRID FS 4 MA	0.5 ma
PA PLATE VOLTAGE		2650 to 2750
PA PLATE CURRENT		Approx 600 ma
RF WATTMETER	Forward	1000 watts
RF WATTMETER	Reflected	Less than 100 watts

individual power amplifier should be taken when the D830-1 is operating properly in its particular installation. Any abnormal deviation from these values will then be apparent during a check of meter indications.

3.4 CABLE CHART.

Table 3-2 contains from-to information for cables installed in D830-1 1000-Watt FM Power Amplifier. The table is useful in locating point to point wiring within the D830-1 cabinet. The FROM column is listed in alphabetical and numerical order. To find a particular wire, establish the point on the D830-1 from which wire tracing is to be initiated. Find this point in the FROM column of table 3-2 and the TO column will give the location of the other end of that particular wire. The WIRE CODE column gives the type and color of wire used in each case. Refer to the inside back cover of this manual for the wire code explanation. When the wire code CBSJ is encountered, the letters SJ mean shield with jacket.

TABLE 3-2. CABLE FROM-TO INFORMATION

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
C205	T302-7	TC91	E301	R3C5-1	KE0
C206	T302-5	TC91	E301	S309	KE0
C211	E216	RC4	E301	TB308-1	KE0
C217	M3C3-2	LE9	E304	R309-1	RC96
C218	S302-11	RC95	E304	S3C7-4	RC96
C219	TB3C4-3	RC95	E306	E313	SHIELD
C301-1	L301-2	KE0	E306	M304-1	SHIELD
C302-2	C3C1-2	RC90	E307	K301-6	RC91
C301-2	C302-2	RC90	E307	TB3C7-1	RC91
C301-2	R3C4-3	RC90	E307	TB3C9-1	RC92
C301-2	TB31C-3	RC90	E307	XF3C4-1	RC91
C307-1	T3C2-4	RC925	E308	K302-3	RC913
C303-1	TB316-1	KE0	E308	K3C5-5	RC913
C307-2	T302-5	RC926	E308	S113-1	RC913
CB301-1	TB3C1-1	VG90	E308	TB3C4-7	RC913
CB3C1-1	XF3C1-1	VG90	E310	E309	VG9
CB301-2	K304-5	RE90	E309	E31C	VG9
CB301-3	TB3C1-2	VG0	E310	E311	RC9
CB301-3	XF3C2-1	VG0	E310	E312	RC9
CB3C1-4	K3C4-3	RE95	E310	TB3C1-3	VG9
CR383-2	XF3C4-2	RC95	E31C	T3C1-8	RC9
DC301-3	E313	SHIELD	E310	TB3C3-2	RC9
DC301-3	S308B-4	CBSJ905	E310	TB3C8-7	RC9
DC3C1-4	E313	SHIELD	E311	E31C	RC9
DC301-4	S308A-11	CBSJ903	E312	E31C	RC9
E301	L302-2	KE0	E312	TB313-1	RC9
E301	M303-1	KE0	E313	DC3C1-3	SHIELD

TABLE 3-2. CABLE FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
E313	DC301-4	SHIELD	M302-2	TB303-8	RC902
E313	E306	SHIELD	M302-2	TB308-6	RC912
E313	TB333-3	SHIELD	M303-1	E301	KE0
E313	TB333-3	SHIELD	M303-2	C217	LE9
E314	S307-11	RC93	M304-1	E306	SHIELD
E316	C211	RC4	M304-1	TB308-7	RC9
E316	S307-10	RC1	M304-2	R321-1	CBSJ906
E317	TB303-10	RC905	R304-1	K305-1	RC915
E317	TB307-2	RC9	R304-3	C301-2	RC90
E317	TB309-2	RC9	R304-3	R323-1	RC90
E317	S112-1	RC9	R305-1	E301	KE0
E322	K301-3	RC9	R309-1	E304	RC96
E322	K302-6	RC9	R309-1	R324-1	RC6
J305-1	K301-12	RC0	R309-2	R317-3	RC90
J305-1	T302-1	RC0	R315-1	R317-1	RC903
J305-2	K301-9	RC90	R317-1	R315-1	RC903
J305-2	T302-2	RC90	R317-3	K305-2	RC90
K301-1	K301-4	RC916	R317-3	R309-2	RC90
K301-1	S302-3	RC96	R321-1	M304-2	CBSJ906
K301-1	S112-2	RC96	R321-3	S308B-2	CBSJ902
K301-2	K302-2	RC902	R323-1	R304-3	RC90
K301-2	S111-4	RC902	R323-2	K305-2	RC9
K301-2	S314-1	RC91	R324-1	R309-1	RC6
K301-3	E322	RC9	R330	S307-5	RC92
K301-4	K301-1	RC916	S111-3	TB302-8	RC906
K301-4	K302-7	RC916	S111-4	K301-2	RC902
K301-6	E307	RC91	S111-4	XDS301-1	RC902
K301-7	XF303-2	RC902	S112-1	E317	RC9
K301-9	J305-2	RC90	S112-2	K301-1	RC96
K301-10	T301-6	RC93	S112-2	TB308-9	RC96
K301-12	J305-1	RC0	S113-1	E308	RC913
K301-13	T301-1	RC92	S113-2	K302-1	RC916
K302-1	K302-4	RC916	S114-3	S313-2	RC915
K302-1	K302-9	RC 91	S114-4	K305-3	RC916
K302-1	S113-2	RC916	S302-1	TB303-1	RC91
K302-2	K301-2	RC902	S302-3	TB304-6	RC96
K302-2	TB304-8	RC902	S302-3	K301-1	RC96
K302-3	E308	RC913	S302-4	TB303-5	RC912
K302-4	K302-1	RC916	S302-4	TB304-11	RC912
K302-6	E322	RC9	S302-5	S311-1	RC90
K302-7	K301-4	RC916	S302-5	TB303-4	RC90
K302-9	K302-1	RC 91	S302-7	TB303-3	RC92
K302-9	TB304-2	RC923	S302-9	TB304-1	RC915
K302-10	K304-1	RC906	S302-10	TB302-8	RC93
K302-10	TB308-11	RC916	S302-11	C218	RC95
K304-1	K302-10	RC906	S302-11	TB302-9	RC95
K304-2	TB304-5	RC925	S307-2	M301-1	RC903
K304-2	TB313-3	RC925	S307-4	E304	RC96
K304-2	XDS302-1	RC923	S307-5	R330	RC92
K304-3	CB301-4	RE95	S307-8	M301-2	RC902
K304-4	T303-1	RE93	S307-10	E316	RC1
K304-5	CB301-2	RE90	S307-11	E314	RC93
K304-6	T303-5	RE91	S308A-6	TB333-5	RAS95
K305-1	R304-1	RC915	S308A-11	DC301-4	CBSJ903
K305-2	R317-3	RC90	S308B-2	R321-3	CBSJ902
K305-2	R323-2	RC9	S308B-4	DC301-3	CBSJ905
K305-3	S114-4	RC916	S308B-5	TB333-4	RAS90
K305-5	E30[illegible]	RC913	S309	E301	KE0
L301-1	TB315-1	KE0	S309	S310	KE0
L301-2	C301-1	KE0	S310	S309	KE0
L301-2	L302-1	KE0	S311-1	S302-5	RC90
L302-1	L301-2	KE0	S311-2	S312-1	RC912
L302-2	E301	KE0	S312-1	S311-2	RC912
M301-1	S307-2	RC903	S312-2	S313-1	RC913
M301-2	S307-8	RC902	S313-1	S312-2	RC913
M302-1	TB308-5	RC902	S313-2	S114-3	RC915

TABLE 3-2. CABLE FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
S314-1	K301-2	RC91	TB308-8	XDS301-2	RC903
S314-3	TB313-4	RC92	TB308-9	S112-2	RC96
TB301-1	CB301-1	VG90	TB308-10	XDS302-2	RC925
TB301-2	CB301-3	VG0	TB308-11	K302-10	RC916
TB301-3	E310	VG9	TB309-1	E307	RC92
TB301-3	TB304-10	RC9	TB309-2	E317	RC9
TB302-1	TB306-1	RC90	TB310-3	C301-2	RC90
TB302-2	TB306-2	RC91	TB310-3	TB320-2	RC90
TB302-3	T301-1	RC92	TB313-1	E312	RC9
TB302-7	TB307-8	RC96	TB313-3	K304-2	RC925
TB302-8	S111-3	RC906	TB313-4	S314-3	RC92
TB302-8	S302-10	RC93	TB313-4	T304-1	RC92
TB302-9	S302-11	RC95	TB314-2	T303-9	KE0
TB303-1	S302-1	RC91	TB315-1	L301-1	KE0
TB303-2	E310	RC9	TB316-1	C303-1	KE0
TB303-2	TB333-3	RC9	TB318-1	T303-8	KE0
TB303-3	S302-7	RC92	TB320-2	TB310-3	RC90
TB303-4	S302-5	RC90	TB323-A	TB303-9	RC903
TB303-5	S302-4	RC912	TB324-F	TB333-2	RA92
TB303-7	TB304-9	RC913	TB333-1	T304-7	RA90
TB303-8	M302-2	RC902	TB333-2	TB324-F	RA92
TB303-9	TB323-A	RC903	TB333-3	E313	SHIELD
TB303-10	E317	RC905	TB333-3	E313	SHIELD
TB304-1	S302-9	RC915	TB333-3	TB303-2	RC9
TB304-2	K302-9	RC923	TB333-4	S308B-5	RAS90
TB304-3	C219	RC95	TB333-5	S308A-6	RAS95
TB304-4	XF303-2	RC93	T301-1	K301-13	RC92
TB304-5	K304-2	RC925	T301-1	TB302-3	RC92
TB304-6	S302-3	RC96	T301-1	XF302-2	RE92
TB304-7	E308	RC913	T301-6	K301-10	RC93
TB304-8	K302-2	RC902	T301-6	TB306-3	RC93
TB304-9	TB303-7	RC913	T301-7	XF301-2	RE91
TB304-10	TB301-3	RC9	T301-8	E310	RC9
TB304-10	TB305-3	RC9	T301-9	XF303-1	RC96
TB304-11	S302-4	RC912	T302-1	J305-1	RC0
TB305-1	TB307-3	TAS9	T302-2	J305-2	RC90
TB305-2	TB307-4	TAS0	T302-4	C307-1	RC925
TB305-3	TB304-10	RC9	T302-5	C206	TC91
TB305-3	TB307-5	SHIELD	T302-5	C307-2	RC926
TB305-3	TB307-5	SHIELD	T302-7	C205	TC91
TB305-4	TB307-6	TAS9	T303-1	K304-4	RE93
TB305-5	TB307-7	TAS2	T303-5	K304-6	RE91
TB306-1	TB302-1	RC90	T303-8	TB318-1	KE0
TB306-2	TB302-2	RC91	T303-9	TB314-2	KE0
TB306-3	T301-6	RC93	T304-1	TB313-4	RC92
TB307-1	E307	RC91	T304-7	TB333-1	RA90
TB307-2	E317	RC9	XDS301-1	S111-4	RC902
TB307-3	TB305-1	TAS9	XDS301-2	TB308-8	RC903
TB307-4	TB305-2	TAS0	XDS302-1	K304-2	RC923
TB307-5	TB305-3	SHIELD	XDS302-2	TB308-10	RC925
TB307-5	TB305-3	SHIELD	XF301-1	CB301-1	VG90
TB307-6	TB305-4	TAS9	XF301-2	T301-7	RE91
TB307-7	TB305-5	TAS2	XF302-1	CB301-3	VG0
TB307-8	TB302-7	RC96	XF302-2	T301-1	RE92
TB308-1	E301	KE0	XF303-1	T301-9	RC96
TB308-5	M302-1	RC902	XF303-2	K301-7	RC902
TB308-6	M302-2	RC912	XF303-2	TB304-4	RC93
TB308-7	E310	RC9	XF304-1	E307	RC91
TB308-7	M304-1	RC9	XF304-2	CR303-2	RC95

SECTION IV
PARTS LIST

This section contains a list of all replaceable electrical, electronic, and critical mechanical parts for the D830-1 1000-Watt FM Power Amplifier 522-2948-000. The manufacturers' codes appearing in the MFR CODE column of the parts list are listed in numerical order at the end of the parts list. The code list provides manufacturers' names and addresses as shown in the Federal Supply Code for Manufacturers, Handbook H4-1. Manufacturers not listed in Handbook H4-1 are assigned a five-letter code and will appear first in the code list.

	Page
ILLUSTRATIONS	17
PARTS LIST	27

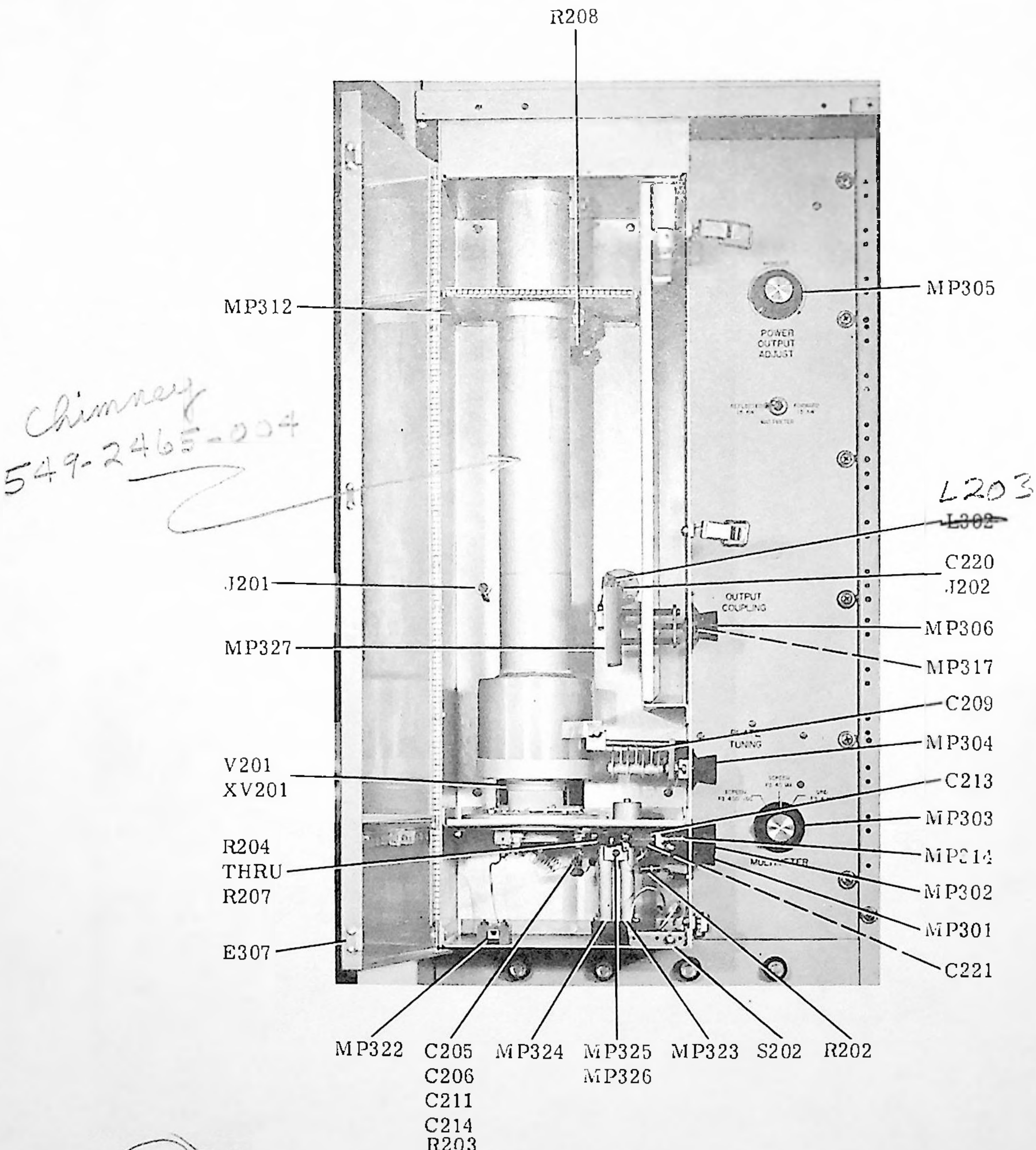
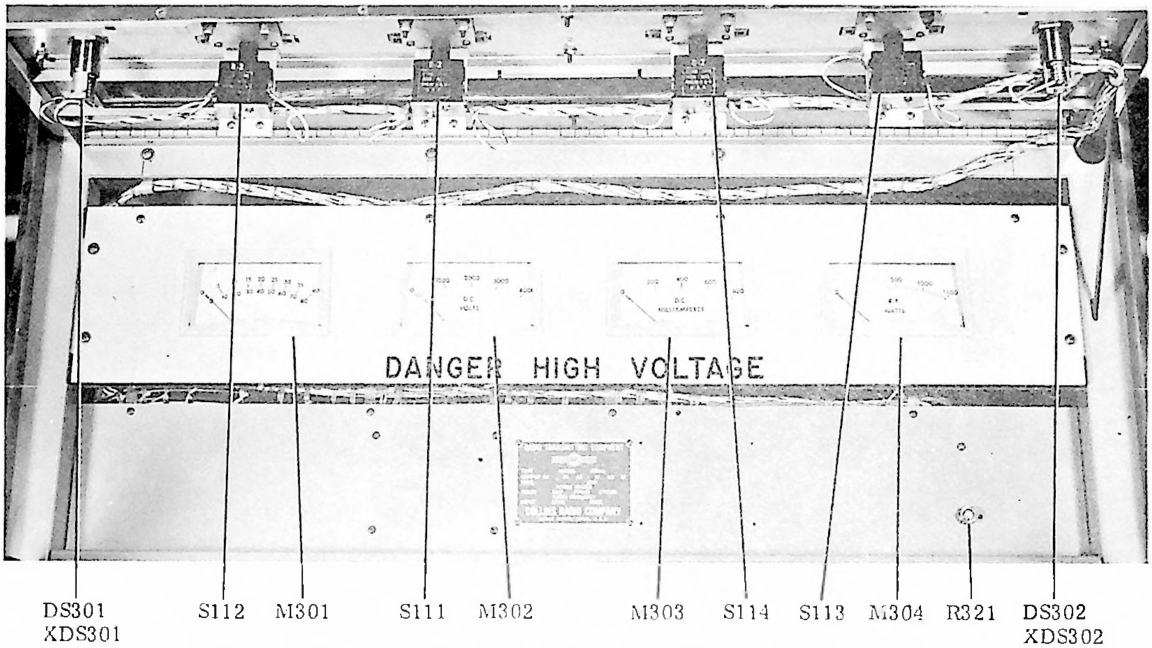


Figure 4-1. D830-1 FM Power Amplifier (Sheet 1 of 10)



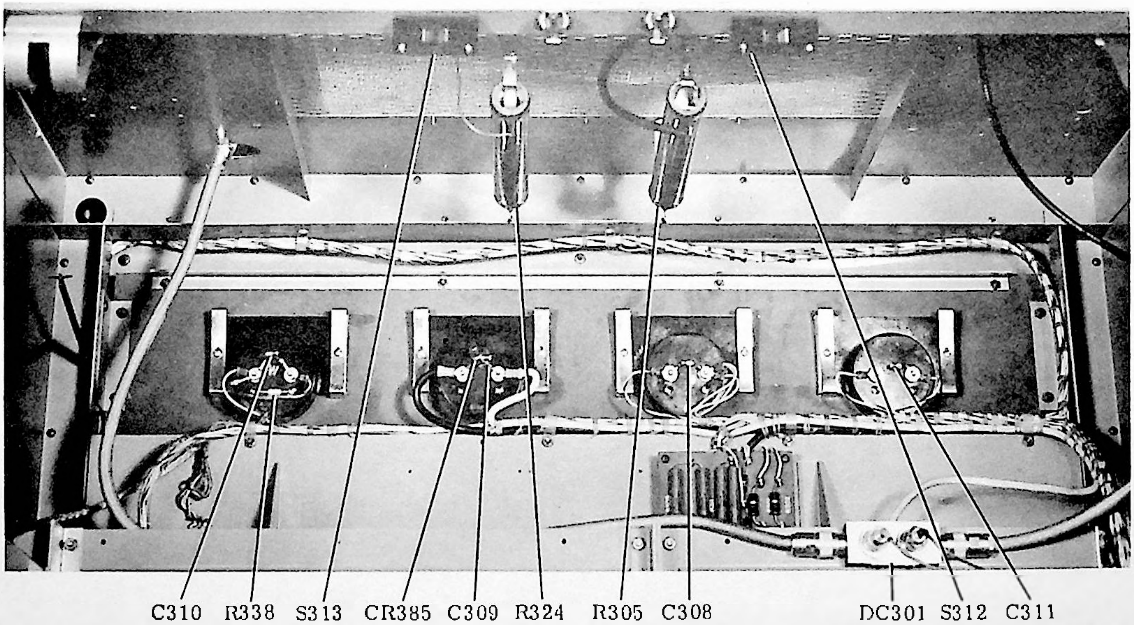


Figure 4-1. D830-1 FM Power Amplifier (Sheet 2 of 10)

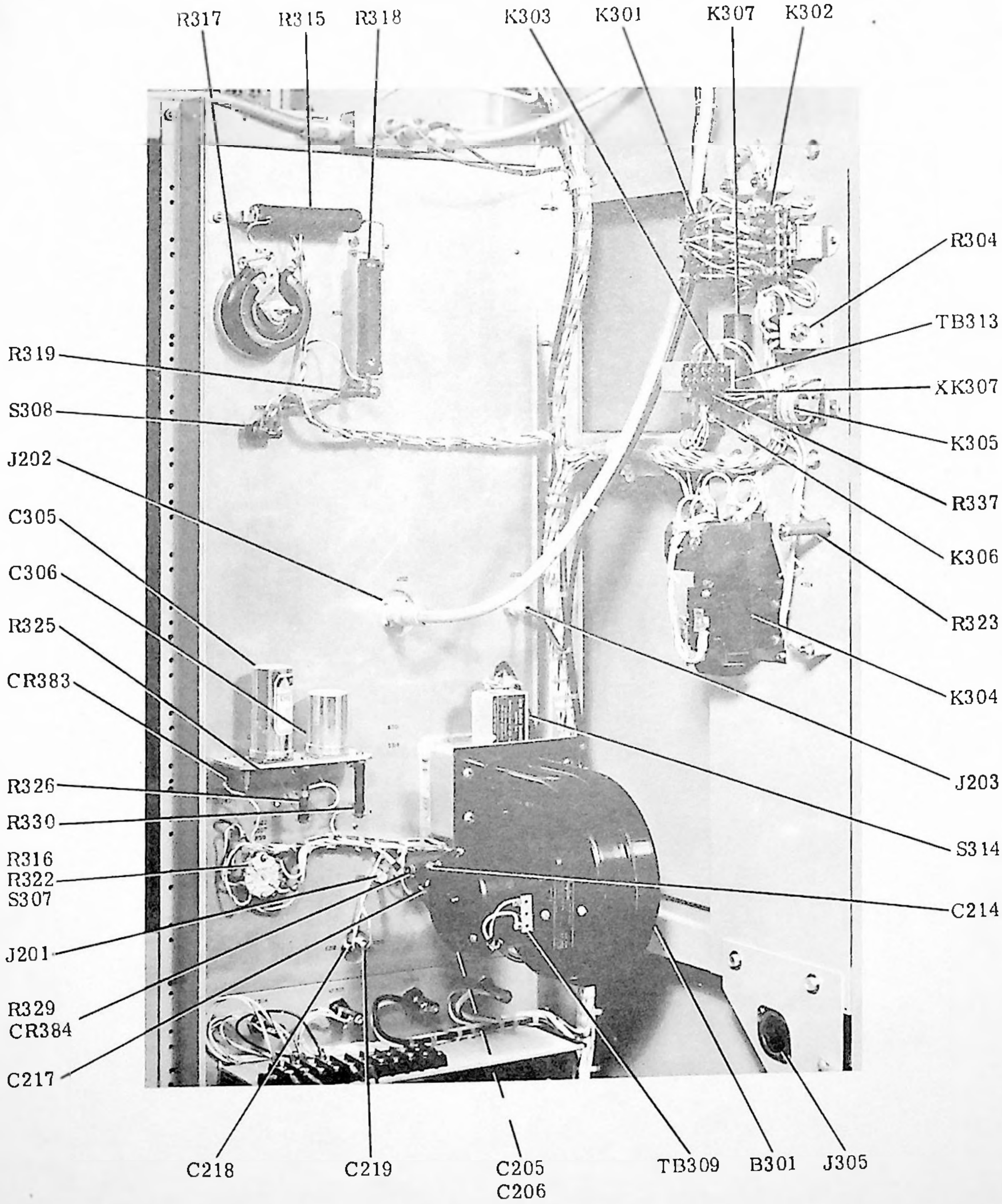


Figure 4-1. D830-1FM Power Amplifier (Sheet 3 of 10)

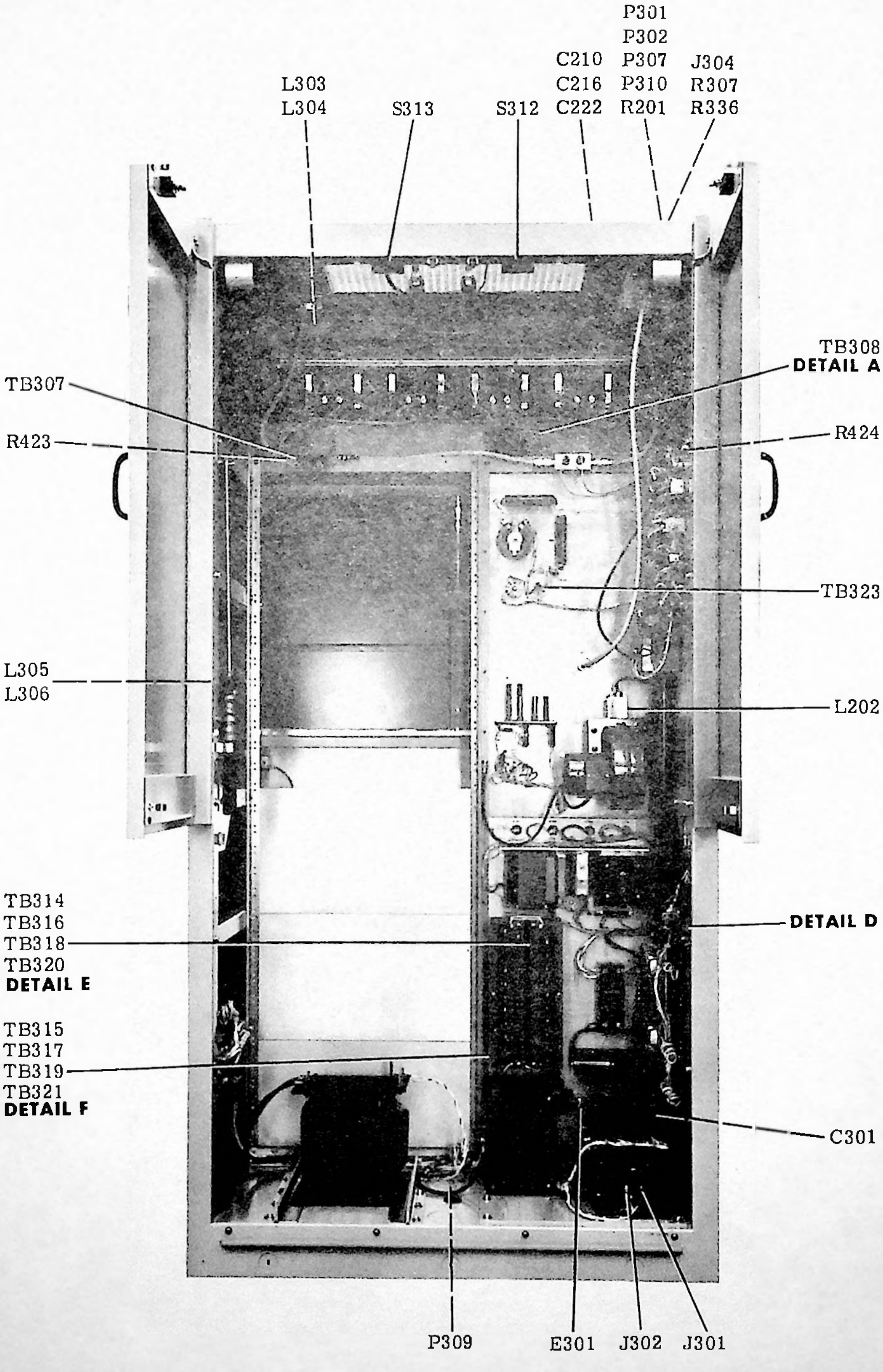


Figure 4-1. D830-1 FM Power Amplifier (Sheet 4 of 10)

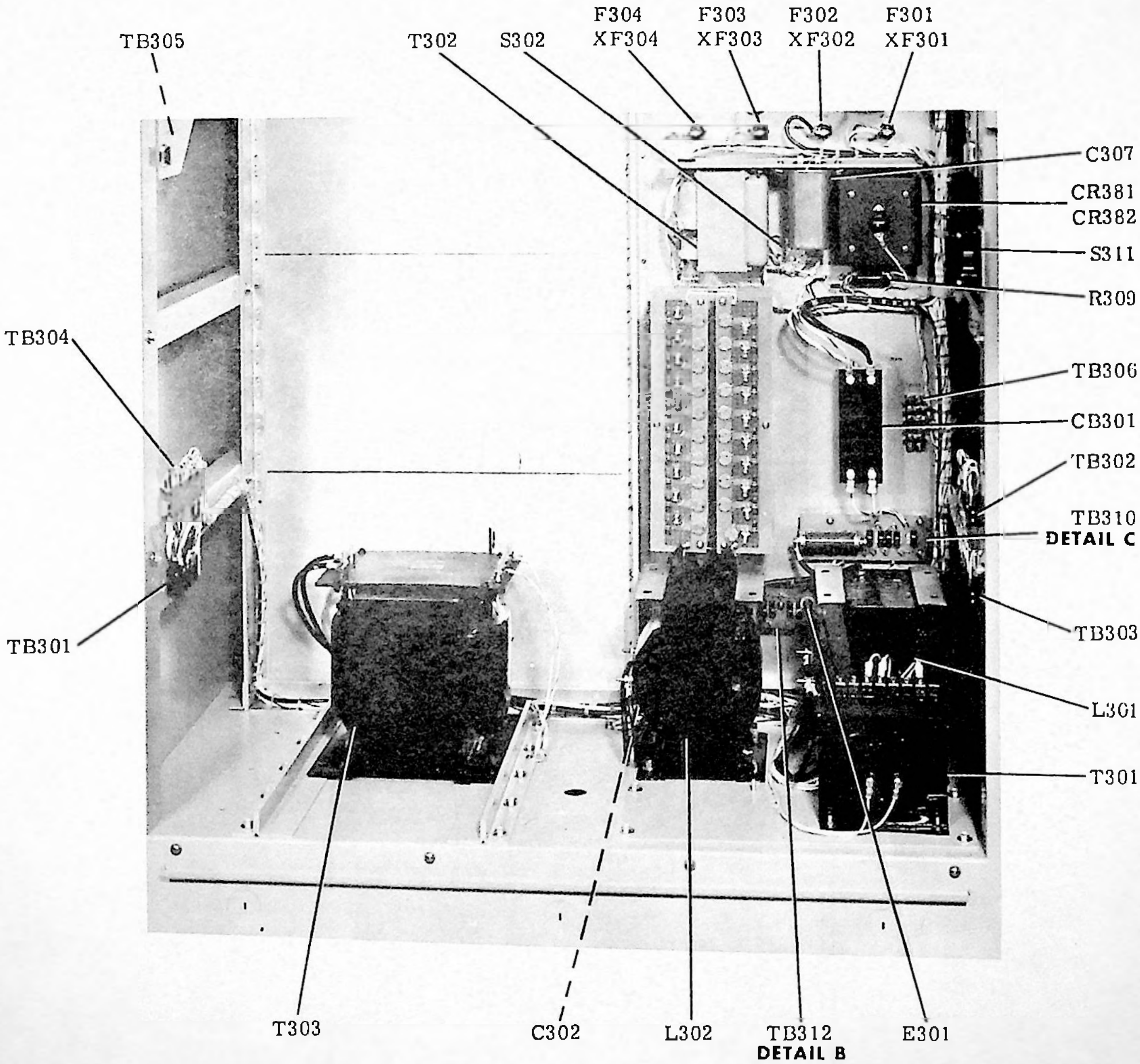
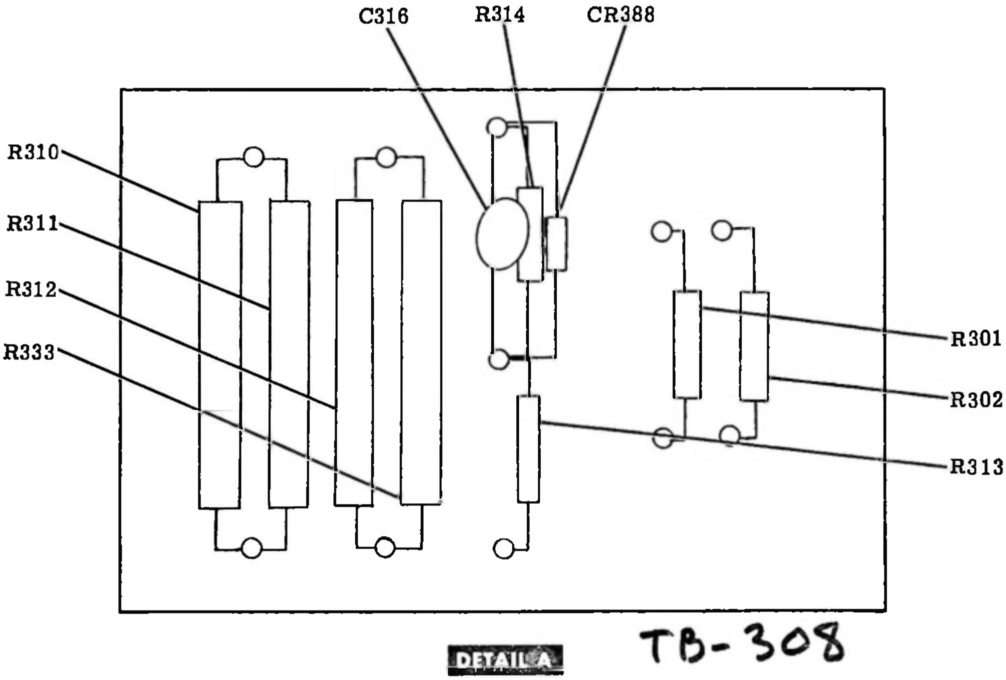


Figure 4-1. D830-1 FM Power Amplifier (Sheet 5 of 10)



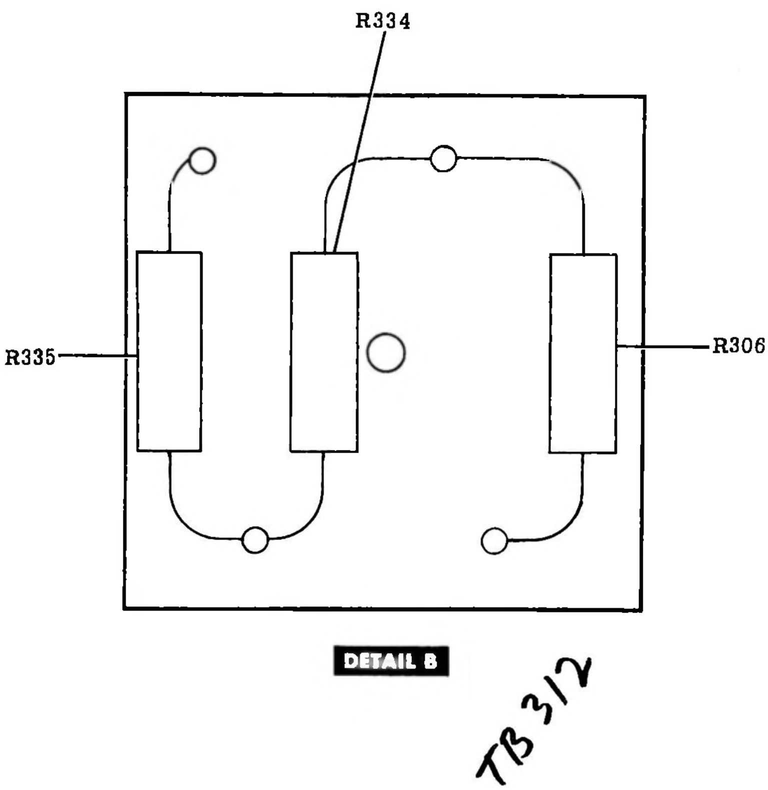


Figure 4-1. D830-1 FM Power Amplifier (Sheet 6 of 10)

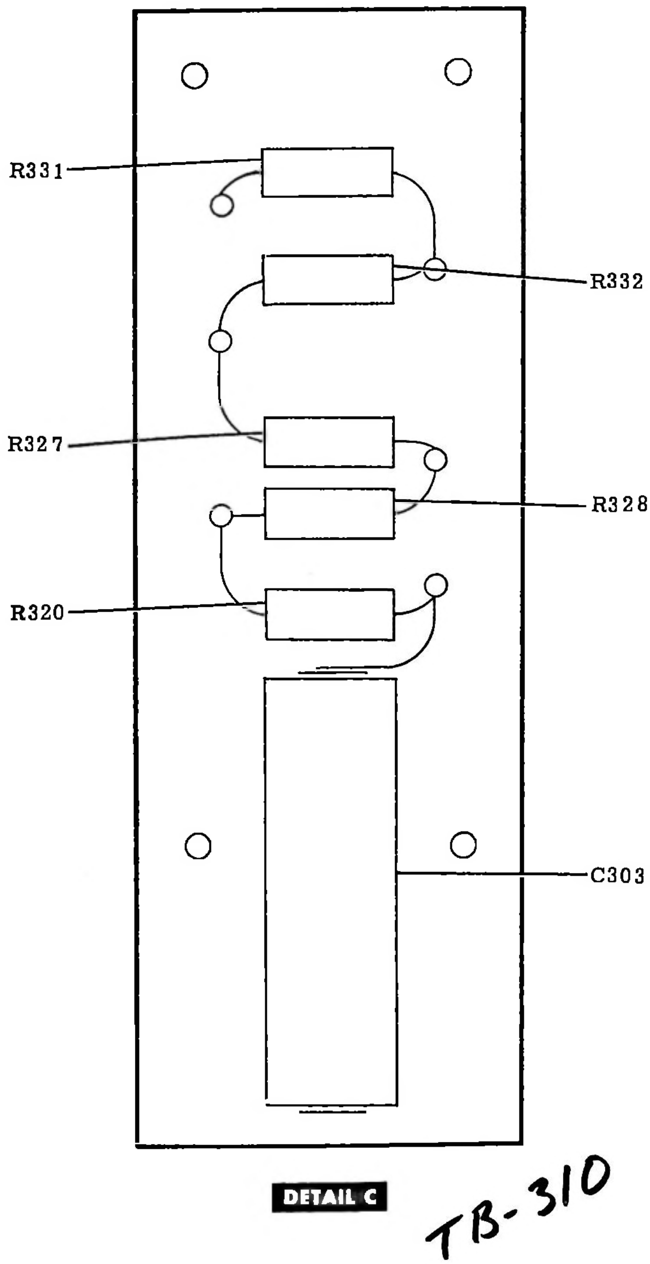


Figure 4-1. D830-1 FM Power Amplifier (Sheet 7 of 10)

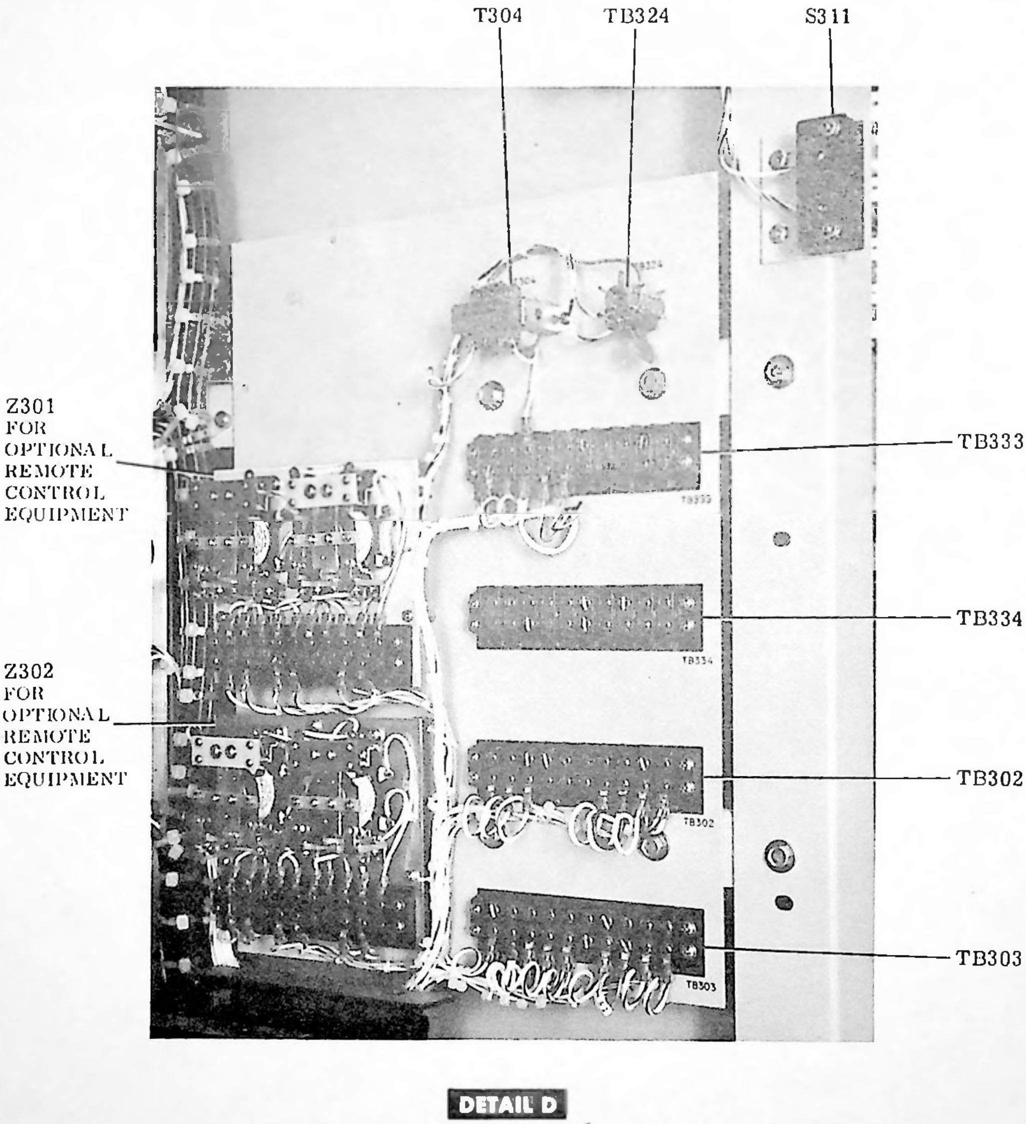
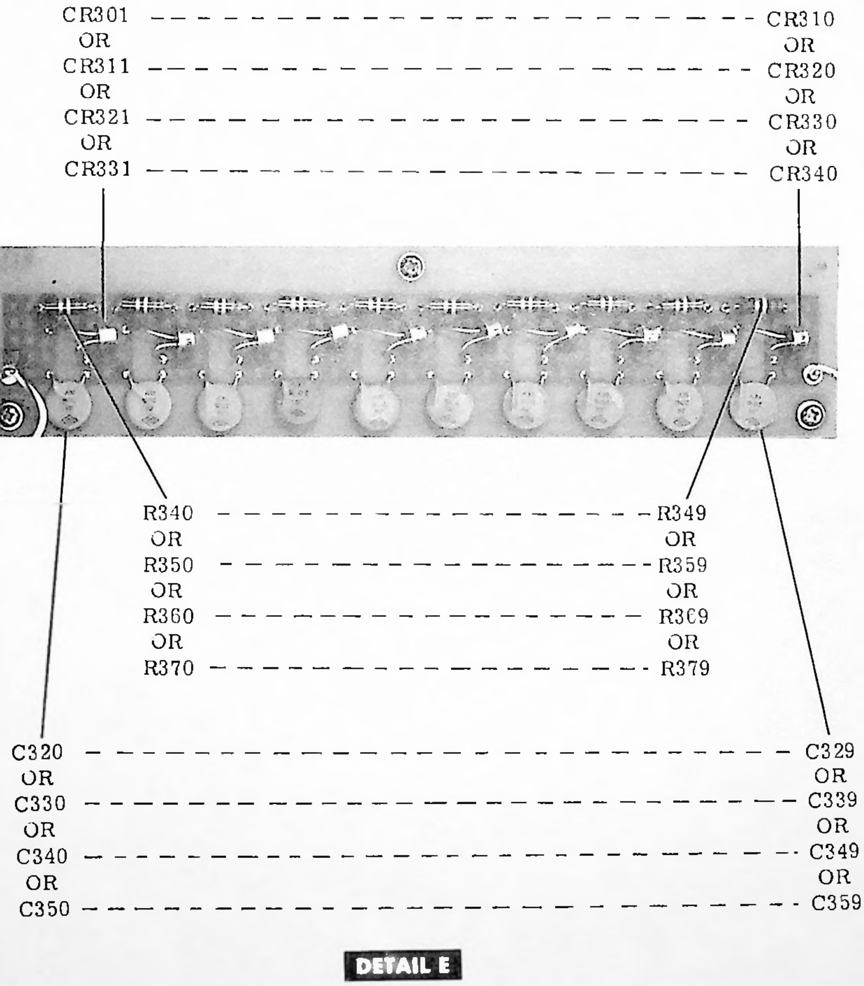
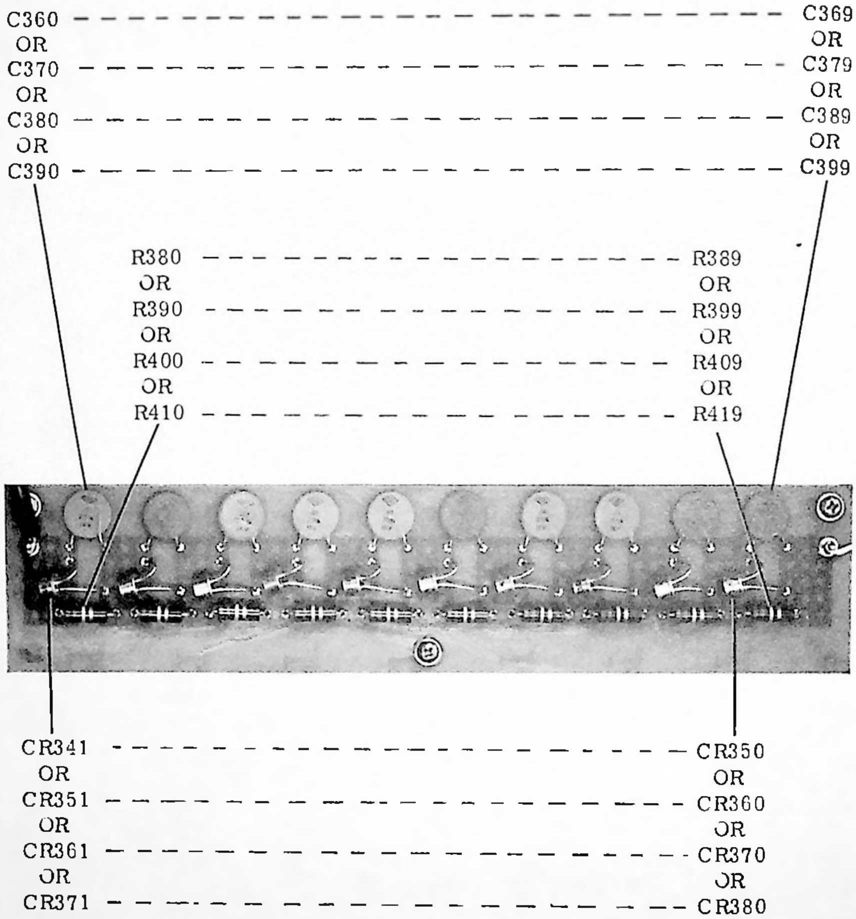


Figure 4-1. D830-1 FM Power Amplifier (Sheet 8 of 10)



TB314
316
318
320

Figure 4-1. D830-1 FM Power Amplifier (Sheet 9 of 10)



DETAIL F

TB315
317
319
321

Figure 4-1. D830-1 FM Power Amplifier (Sheet 10 of 10)

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	D830-1 1000-WATT FM POWER AMPLIFIER			522-2948-000
B101	NOT USED			
B102	NOT USED			
B103	MOTOR, ALTERNATING CURRENT 230 VOLTS, 50/60 CPS, 6, WATTS	5KSP51CL17	24446	230-0164-000
B301	FAN, CENTRIFUGAL 115 VAC, 60 CPS, SINGLE PHASE	2C6010	16327	009-1576-000
C201 THROUGH C204	NOT USED			
C205	CAPACITOR, FXD, CERAMIC 1000 UUF, PLUS 80% MINUS 20%, 500 VDC	327-029X5T0102Z	72982	913-1292-000
C206	SAME AS C205			
C207	~~NOT USED~~ CHIMNEY			549-2465-004
C208	PLATE, CAPACITOR ALUMINUM, 0.063 INCHES THICK, 2.625 INCHES BY 2.625 INCHES WIDE			549-2379-002
C209	CAPACITOR, VAR, AIR 7.6 UF TO 10.8 UF	PL2752	71313	922-0572-000
C210	CAPACITOR, FXD, CERAMIC 1000 UUF, 20% TOL, 5000 VDCW	DA858-003	71590	913-0101-000
C211	SAME AS C205			
C212	CAPACITOR PART OF XV201			
C213	CAPACITOR, VAR, AIR 3 UUF TO 18.7 UUF, 1250 VDC	160-110-3	74970	922-0033-000
C214	SAME AS C205			
C215	NOT USED			
C216	SAME AS C210			
C217	SAME AS C210			
C218	SAME AS C205			
C219	SAME AS C205			
C220	CAPACITOR, FXD, PLASTIC 35 UUF, 1000 VDC			549-2448-002
C221	CAPACITOR, VAR, AIR 6 UUF TO 100.5 UUF			922-0024-000
C222	SAME AS C210			
C301	CAPACITOR, FXD, PAPER 4 UF, PLUS 10% MINUS 10%, 4000 VDC	P47484	56289	930-0705-000
C302	SAME AS C301			
C303	CAPACITOR, FXD, PLASTIC 20,000 UUF, PLUS 10% MINUS 10%, 8000 VDC	0F80-203	99120	933-0038-000
C304	NOT USED			
C305	CAPACITOR, FXD, ELECTROLYTIC 300 MFD, MINUS 10% PLUS 100% TOL, 150 VOLTS	UP9A2371SPL	14655	183-1117-000
C306	CAPACITOR, FXD, ELECTROLYTIC 500 UF, MINUS 10% PLUS 100%, 50 VDC	D33642	56289	183-1402-000
C307	CAPACITOR, FXD, CERAMIC 33 UF, 10% TOL, 15,000 VDC	857-3ZZ	71590	913-1425-000
C308	CAPACITOR, FXD, CERAMIC 100 UUF, 5% TOL, 500 VDC	308611U2J0101J	72982	916-4059-000
C309 THROUGH C313	SAME AS C308			
C314	CAPACITOR, FXD, CERAMIC 10,000 UUF, 20% TOL, 500 VDC	CK63AW103M	81349	913-1188-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
C315	SAME AS C314			
C316	SAME AS C314			
C317	NOT USED			
C318	NOT USED			
C319	NOT USED			
C320	CAPACITOR, FXD, CERAMIC 10,000 UUF, PLUS 20% MINUS 20%, 1000 VDC	DA049-182CB	71590	913-3183-000
C321 THROUGH C399	SAME AS C320			
CB301	CIRCUIT BREAKER 50-AMP CURRENT RATING			260-0243-000
CR301	SEMICONDUCTOR DEVICE, DIODE	1N1576	07688	353-1736-000
CR302 THROUGH CR380	SAME AS CB301			
CR381	SEMICONDUCTOR DEVICE, SET	SOM140ZB5	04713	353-6015-000
CR382	SAME AS CR382			
CR383	SEMICONDUCTOR DEVICE, DIODE	1N1492	07688	353-1661-000
CR384	SAME AS CR383			
CR385	SAME AS CR301			
CR386	SEMICONDUCTOR DEVICE, DIODE	1N270	81349	353-2016-000
CR387	SEMICONDUCTOR DEVICE, DIODE	1N3016B	07688	353-3121-000
CR388	SEMICONDUCTOR DEVICE, DIODE	1N963A	07688	353-3220-000
DS301	LAMP, BULB 0.027 AMP, 125 VOLTS	356-5	24446	262-3310-000
DS302	SAME AS DS301			
E301	ARRESTOR, ELECTRICAL			549-2453-002
E302	LENS, INDICATOR GREEN	75A101GRN	72765	262-0258-000
E303	LENS, INDICATOR RED	75A101RED	72765	262-0259-000
E304	PUSHBUTTON			548-3590-003
E305	CONTACT, ELECTRICAL			549-2317-002
E306	CONTACT, SHORTING			542-1773-002
E307	SLIDER, CONTACT			549-2413-002
E308	SAME AS E307			
F301	FUSE, CARTRIDGE 5 AMPS, 250 VDC	F03A250V5AS	81349	264-0361-000
F302	SAME AS F301			
F303	FUSE, CARTRIDGE 4 AMPS, 125 VDC	MDX4	71400	264-0217-000
F304	FUSE, CARTRIDGE 1/8 AMP, 250 VOLTS	F02B250V1-8AS	81349	264-4230-000
J201	CONNECTOR, ELECTRICAL 1 CONTACT	UG1094U	80058	357-9183-000
J202	CONNECTOR, ELECTRICAL 1 CONTACT	UG58AU	80058	357-9003-000
J203	SAME AS J201			
J301	CONNECTOR, ELECTRICAL 1 CONTACT	UG58AU	80058	357-9003-000
J302	SAME AS J301			
J303	CONNECTOR	2261	84147	013-1215-000
J304	CONNECTOR, ELECTRICAL 1 CONTACT	100B3000C75	94375	357-9248-000
J305	CONNECTOR, ELECTRICAL 3 CONTACTS			368-0014-000
K301	RELAY, ARMATURE 4C CONTACT ARRANGEMENT	83-3544	04221	970-1933-000
K302	SAME AS K301			
K303	SEMICONDUCTOR DEVICE, RECTIFIER			549-2463-003
K304	RELAY, ARMATURE 2 CONTACTS	702L80092	01121	405-0674-010
K305	RELAY, ARMATURE 1C CONTACT ARRANGEMENT	95062	78277	408-1114-000
K306	RELAY, ARMATURE 2C CONTACT ARRANGEMENT	45-2446	04221	972-1347-000
K307	RELAY, THERMAL 1A CONTACT ARRANGEMENT	GT4574	93929	402-0388-000
L201	NOT USED			
L202	COIL, RADIO FREQUENCY	LT7K194	81349	240-0178-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	4.7 UH, 0.60 OHMS, 950 MA DC			
L203	COIL, RADIO FREQUENCY			549-2373-002
L301	CHOKE 10 H, 60 OHMS, 0.850 AMP	292-5822G1	49956	668-0022-000
L302	SAME AS L301			
L303	COIL			549-2042-002
L304	SAME AS L303			
L305	COIL			549-2043-002
L306	SAME AS L305			
M301	AMMETER 100 OHMS, PLUS 5% MINUS 10% METER RESISTANCE	56-0443-0000	80145	458-0649-000
M302	VOLTMETER 0 TO 1 MA METER RANGE, 50 OHMS	56-0273-0000	80145	458-0610-000
M303	AMMETER 0 TO 800 MA METER RANGE, 0.5 OHMS	56-9623-0000	80145	458-0611-000
M304	WATTMETER 900 OHMS, 2% ACCURACY	56-4752-0000	80145	458-0652-000
MP301	KNOB BLACK PHENOLIC			546-1293-002
MP302 THROUGH MP305	SAME AS MP301			
MP306	KNOB BLACK PHENOLIC			547-8792-003
MP307	CONTACT ASSEMBLY INTERLOCK SWITCH	N4050	85107	260-4050-000
MP308	SAME AS MP307			
MP309	LATCH, MAGNETIC ALUMINUM, STRIKER PLATE STEEL, FERRITE MAGNET	ADPL100DCST1	84792	015-0899-000
MP310	SAME AS MP309			
MP311	ROD ASSEMBLY, SHORTING BRASS, WITH PLASTIC HANDLE 24.938 INCHES LONG			549-2186-003
MP312	SLIDER, TUNING CAVITY ALUMINUM			549-2424-004
MP313	SHAFT, STRAIGHT, SHORT GLASS MELAMINE ROD			549-2436-002
MP314	SHAFT, STRAIGHT, LONG GLASS MELAMINE ROD			549-2437-002
MP315	SLIDER, CONTACT BRASS			549-2413-002
MP316	SAME AS MP315			
MP317	GEAR, SPUR ALUMINUM, 48 TEETH			542-7422-002
MP318	WINDOW, METER OBSERVATION GLASS, 3/16 INCHES THICK			548-3567-002
MP319	SPRING, SHORTING COPPER, 0.032 INCHES THICK			549-2374-002
MP320	COUPLING BRASS	2105	74887	015-0257-000
MP321	BEARING, SLEEVE	F346MILL6085A	70417	309-0086-000
MP322	NOT USED			
MP323	CONDUCTOR, ROD, LONG			549-2372-002
MP324	CONDUCTOR, ROD, SHORT			549-2371-002
MP325	CLAMP, HALF, ELECTRICAL, LOWER			549-2367-002
MP326	CLAMP, HALF, ELECTRICAL, UPPER			549-2366-002
MP327	PLATE, CAPACITOR			549-2379-003
P301	CONNECTOR, ELECTRICAL 1 CONTACT	MS35168-88E	96906	357-9292-000
P302	SAME AS P301			
P303	CONNECTOR, ELECTRICAL 1 CONTACT	UG1185AU	81349	357-9326-000
P304	SAME AS P303			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
P305	SAME AS P303			
P306	NOT USED			
P307	SAME AS P303			
P308	NOT USED			
P309	CONNECTOR, ELECTRICAL			368-0013-000
P310	SAME AS P303			
R201	RESISTOR, FXD, COMPOSITION 3300 OHMS, 10% TOL, 2 WATTS	RC42GF332K	81349	745-5673-000
R202	RESISTOR, FXD, COMPOSITION 100 OHMS, 10% TOL, 2 WATTS	RG42GF101K	81349	745-5610-000
R203	RESISTOR, FXD, WIRE WOUND 470 OHMS, 5% TOL, 6.5 WATTS	RW67V471	81349	747-5527-000
R204	NOT USED			
R205	SAME AS R201			
R206	SAME AS R201			
R207	SAME AS R201			
R208	RESISTOR, FXD, COMPOSITION 47 OHMS, 20% TOL, 15 WATTS	7705P6	10646	712-0014-000
R301	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 2 WATTS	RC42GF102K	81349	745-5652-000
R302	SAME AS R301			
R303	NOT USED			
R304	RESISTOR, VAR, WIRE WOUND 50 OHMS, 10% TOL, 2 WATTS		12697	377-0619-000
R305	RESISTOR, FXD, WIRE WOUND 20K OHMS, 5% TOL, 210 WATTS	RW47U203	81349	746-6723-000
R306	RESISTOR, FXD, COMPOSITION 10 OHMS, 10% TOL, 2 WATTS	RC42GF100K	81349	745-5568-000
R307	RESISTOR, FXD, WIRE WOUND 2.56 OHMS, 1% TOL, 2.5 WATTS	RS10-10001H	91637	746-9448-000
R308	NOT USED			
R309	RESISTOR, FXD, WIRE WOUND 15K OHMS, 5% TOL, 20 WATTS	0217	44655	710-4782-000
R310	RESISTOR, FXD, FILM 1000K OHMS, 1% TOL, 2 WATTS	RN80B1004F	81349	705-4254-000
R311	SAME AS R310			
R312	SAME AS R310			
R313	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL 1 WATT	RC32GF103K	81349	745-3394-000
R314	RESISTOR, FXD, FILM 7500 OHMS, 5% TOL, 1 WATT	RL32S752J	81349	745-3994-000
R315	RESISTOR, FXD, WIRE WOUND 27.0 OHMS, 5% TOL, 55 WATTS	RW35V270	81349	747-2815-000
R316	RESISTOR, FXD, COMPOSITION 33 OHMS, 10% TOL, 1 WATT	RC32GF330K	81349	745-3289-000
R317	RHEOSTAT, WIRE WOUND 75 OHMS, 10% TOL, 100 WATTS	R100-75REARSHAFT EXT	94310	735-4000-000
R318	SAME AS R315			
R319	RESISTOR, FXD, WIRE WOUND 10 OHMS, 5% TOL, 11 WATTS	RW29U100	81349	746-6040-000
R320	RESISTOR, FXD, COMPOSITION 1200 OHMS, 10% TOL, 2 WATTS	RC42GF122K	81349	745-5656-000
R321	RESISTOR, VAR, WIRE WOUND 10K OHMS, 20% TOL, 2 WATTS	RV4LAYSA103B	81349	380-2757-000
R322	RESISTOR, FXD, FILM 402K OHMS, 1% TOL, 1 WATT	RN75B4023F	81349	705-3287-000
R323	RESISTOR, FXD, WIRE WOUND 3.9 OHMS, 5% TOL, 11 WATTS	RW29V2R7	81349	746-6115-000
R324	SAME AS R305			
R325	RESISTOR, FXD, COMPOSITION 100 OHMS, 10% TOL, 2 WATTS	RC42GF101K	81349	745-5610-000
R326	RESISTOR, ADJUSTABLE			716-0013-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	10K OHMS, 10% TOL, 10 WATTS			
R327	SAME AS R320			
R328	SAME AS R320			
R329	RESISTOR, FXD, COMPOSITION 27K OHMS, 10% TOL, 2 WATTS	RC42GF273K	81349	745-5712-000
R330	RESISTOR, FXD, WIRE WOUND 310 OHMS, 5% TOL, 11 WATTS	RW29V222	81349	746-6087-000
R331	SAME AS R320			
R332	SAME AS R320			
R333	SAME AS R310			
R334	SAME AS R306			
R335	SAME AS R306			
R336	RESISTOR, FXD, WIRE WOUND 12 OHMS, 5% TOL, 14 WATTS	RW31V120	81349	747-0726-000
R337	RESISTOR, FXD, COMPOSITION 680 OHMS, 10% TOL, 2 WATTS	RC42GF681K	81349	745-5645-000
R338	RESISTOR, FXD, COMPOSITION 8200 OHMS, 10% TOL, 1 WATT	RC32GF822K	81349	745-3391-000
R339	NOT USED			
R340	RESISTOR, FXD, COMPOSITION 0.18 MEGOHMS, 10% TOL, 1 WATT	RC32GF184K	81349	745-3447-000
R341 THROUGH R419	SAME AS R340			
R420	NOT USED			
R421	RESISTOR, FXD, FILM 1800 OHMS, 5% TOL, 1 WATT	RL32S182J	81349	745-3956-000
R422	RESISTOR, FXD, FILM 4700 OHMS, 5% TOL, 1 WATT	RL32S472J	81349	745-3981-000
R423	RESISTOR, FXD, WIRE WOUND 100 OHMS, 5% TOL, 6.5 WATTS	RW67V101	81349	747-5440-000
R424	RESISTOR, FXD, WIRE WOUND 220 OHMS, 10% TOL, 6.5 WATTS	RW67V221	81349	747-5447-000
S101 THROUGH S110	NOT USED			
S111	SWITCH, PUSH DPST CONTACT ARRANGEMENT	B28L	04009	260-2020-000
S112	SAME AS S111			
S113	SAME AS S111			
S114	SAME AS S111			
S201	ARRESTOR, ELECTRICAL			549-2453-002
S202	SWITCH, INTERLOCK SPDT CONTACT ARRANGEMENT	3AC5	91929	266-8013-000
S301	NOT USED			
S302	SWITCH, ROTARY ROTARY WAFER SWITCH			259-1564-000
S303 THROUGH S306	NOT USED			
S307	SWITCH, ROTARY 8 CONTACTS			259-1565-000
S308	SWITCH, ROTARY ROTARY WAFER SWITCH	228556-F1E	76854	259-1808-000
S309	NOT USED			
S310	NOT USED			
S311A	CONTACT ASSEMBLY, ELECTRICAL 5 CONTACTS	N4050	85107	260-4050-000
S311B	CONTACT ASSEMBLY, ELECTRICAL 2 CONTACTS	N4040	85107	260-4040-000
S312A	SAME AS S311A			
S312B	SAME AS S311B			
S313A	SAME AS S311A			
S313B	SAME AS S311B			
S314	SWITCH, AIRFLOW SPDT CONTACT ARRANGEMENT	4000	82877	266-8307-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
T301	TRANSFORMER, POWER, STEP-DOWN 250 VOLTS, 50 TO 60 CPS	E12322	80008	662-0043-000
T302	TRANSFORMER, VOLTAGE REGULATING	W7539	49956	662-0053-000
T303	TRANSFORMER, POWER, STEP-UP	292-5828G1	49956	662-0054-000
T304	TRANSFORMER, POWER, STEP-DOWN	31178	97965	662-0045-000
TB301	TERMINAL, BOARD 4 TERMINALS	TB4	56365	306-0778-000
TB302	TERMINAL BOARD 10 TERMINALS	10-140	71785	367-3100-000
TB303	SAME AS TB302			
TB304	TERMINAL BOARD 12 TERMINALS	600-12M	71785	367-0518-000
TB305	SAME AS TB304			
TB306	TERMINAL BOARD 4 TERMINALS	18A18697	71785	367-4040-000
TB307	TERMINAL STRIP 12 TERMINALS	12-160AL	71785	367-1385-000
TB308	TERMINAL BOARD 11 TERMINALS			549-2102-003
TB309	TERMINAL BOARD 2 TERMINALS	18A18697	71785	306-0168-000
TB310	SUPPRESSOR TRANSIENT			549-2455-003
TB311	TERMINAL BOARD 10 TERMINALS	602-10	75382	367-5100-000
TB312	TERMINAL BOARD, ASSEMBLY			549-2450-002
TB313	TERMINAL BOARD 4 TERMINALS	18A18697	71785	367-0002-000
TB314 THROUGH TB321	TERMINAL BOARD, ASSEMBLY			549-2463-004
TB322	NOT USED			
TB323	TERMINAL BOARD 12 TERMINALS	6H12	00534	306-0909-000
TB324	SAME AS TB323			
V201	ELECTRON TUBE TETRODE	4CX10000A	EIMAC	256-0123-000
XDS301	LAMPHOLDER	75LESSLENS	72765	262-0255-000
XDS302	SAME AS XDS301			
XF301	FUSEHOLDER 20 AMP CURRENT RATING	HKLJRWZZ	71400	265-1040-000
XF302	SAME AS XF301			
XF303	SAME AS XF301			
XF304	SAME AS XF301			
XK301 THROUGH XK306	NOT USED			
XK307	SOCKET, ELECTRON TUBE	TS102P03	81349	220-1235-000
XV201	SOCKET, ELECTRON TUBE	SK890B	06980	220-1507-000

MANUFACTURERS CODES

CODE	MANUFACTURER
EIMAC	EIMAC
00534	VECTOR MFG. CO. 5616 LAWNDALE HOUSTON, TEXAS
01121	ALLEN-BRADLEY CO. 1201 SOUTH 2ND STREET MILWAUKEE, WIS.
04009	ARROW-HART AND HEGEMAN ELECTRIC CO. HARTFORD, CONN.
04221	TELEX-AEMCO MANKATO, MINN.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
04713	MOTOROLA INC. SEMICONDUCTOR PRODUCTS DIVISION 5005 E MC DOWELL RD. PHOENIX, ARIZONA			
06980	EITEL-MCCULOUGH INC. 301 INDUSTRIAL WAY SAN CARLOS, CALIF.			
07688	JOINT ELECTRON DEVICE ENGINEERING COUNCIL WASHINGTON, D.C.			
08594	EITEL-MCCULLOUGH 1678 PIONEER RD. SALT LAKE CITY, UTAH			
10646	CARBORUNDUM CO. BUFFALO AVE. NIAGARA FALLS, N.Y.			
12697	CLAROSTAT MFG. CO. INC. LOWER WASHINGTON ST. DOVER, N. H.			
14655	CORNELL-DUBILIER ELECTRIC CORP. 50 PARIS STREET NEWARK, N.J.			
16327	DAYTON ELECTRIC MFG. CO. 5959 WEST HOWARD ST. CHICAGO, ILL.			
24446	GENERAL ELECTRIC CO. SCHENECTADY, N.Y.			
44655	OHMITE MFG. CO. CHICAGO, ILL.			
49956	RAYTHEON CO. MICROWAVE AND POWER TUBE DIVISION ADMINISTRATION BLDG. WALTHAM, MASS.			
56289	SPRAGUE ELECTRIC CO. NORTH ADAMS MASS.			
56365	SQUARE D CO. DETROIT, MICH.			
70417	AMPLEX DIVISION OF CHRYSLER CORP. DETROIT, MICH.			
71313	CARDWELL CONDENSER CORP. PLAINVILLE, CONN.			
71400	BUSSMANN MFG. DIVISION OF MCGRAW-EDISON CO. 2538 WEST UNIVERSITY ST. ST. LOUIS, MO.			
71590	CENTRALAB DIVISION OF GLOBE- UNION INC. 932 EAST KEEFE AVE. MILWAUKEE, WIS.			
71785	CINCH MFG. CO. DIVISION OF UNITED-CARR FASTENER CORP. CHICAGO, ILL.			
72765	DRAKE MFG. CO. 4626 N OLCOTT AVE. CHICAGO, ILL			
72982	ERIE RESISTOR CORP. ERIE, PA.			
74887	INSULINE CORP. OF AMERICA MANCHESTER, N.H.			
74970	E.F. JOHNSON CO. 297 TENTH AVE. WASECA, MINN.			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
75382	KULKA ELECTRIC CORP. MT. VERNON, N.Y.			
76854	OAK MFG. CO., CHICAGO, ILL.			
78277	SIGMA INSTRUMENTS INC. 170 PEARL DRIVE SO BRAINTREE, MASS.			
80058	JOINT ELECTRONIC TYPE DESIGNATION SYSTEM			
80145	ASSEMBLY PRODUCTS INC. 7100 WILSON MILLS ROAD CHESTERLAND, OHIO			
81349	MILITARY SPECIFICATIONS PROMULGATED BY STANDARDIZATION DIVISION DIRECTORATE OF LOGISTIC SERVICES DSA			
82877	ROTRON MFG. CO. INC. 7-9 HASBROUCK LANE WOODSTOCK, N.Y.			
84147	ANDREW CORP. BOX 807 CHICAGO, ILL.			
84792	HEPPNER MFG. CO. P.O. BOX Q ROUND LAKE, ILL.			
85107	NEPTUNE ELECTRONICS CO. 30 WEST 15TH ST. NEW YORK, N.Y.			
91637	DALE ELECTRONICS INC. COLUMBUS, NEBR.			
91929	HONEYWELL INC. MICRO. SWITCH DIVISION FREEPORT ILL.			
93929	G-V CONTROLS INC. 81 OKNER PARKWAY LIVINGSTON, N.J.			
94310	TRU-OHM PRODUCTS MEMCOR COMPONENTS DIVISION P.O. BOX 890 HUNTINGTON, IND.			
94375	AUTOMATIC METAL PRODUCTS CO. 315 BERRY BROOKLYN, N.Y.			
96906	MILITARY STANDARDS PROMULGATED BY STANDARDIZATION DIVISION DIRECTORATE OF LOGISTIC SERVICES DSA			
97965	STANCOR ELECTRONICS INC. CHICAGO, ILL.			
99120	PLASTIC CAPACITORS INC. 2620 NORTH CLYBOURN AVE. CHICAGO, ILL.			

SECTION V
ILLUSTRATIONS

NOTES:

1. SUPPLIED WITH REMOTE CONTROL ONLY. R494 MAY CHANGE PER CUSTOMER REQUIREMENTS
2. SCA GENERATORS OPTIONAL FOR STEREO OR MULTIPLEX
3. ALL GROUNDS UNLESS OTHERWISE SPECIFIED ARE CONNECTED TO BASE PLATE OF CABINET CHASSIS
4. JUMPER WHEN USED AS 1000 WATT TRANSMITTER. TERMINAL 4 USED ON 1000 WATT TRANSMITTER ONLY
5. HARMONIC FILTER NOT PART OF D830-1, USED ONLY WHEN D830-1 IS CONNECTED TO ANTENNA. WHEN NOT USED, CONNECT J202 TO DC301-1
6. TB314 THRU TB321 CONTAIN THE FOLLOWING COMPONENTS:

   C320 THRU C399 — 10,000PF
   CR301 THRU CR380 — 1N1566
   R340 THRU R419 — 180K
7. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS
   ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS
   ALL INDUCTANCE VALUES ARE IN MICROHENRYS
8. LATCHING RELAY (Z303) SUPPLIED WITH REMOTE STEREO ONLY
9. FOR REMOTE CONTROL REMOVE JUMPER BETWEEN TERMINALS 9 AND 10 OF TB302
10. JUMPER R315 AND/OR R319 AS REQUIRED FOR PROPER POWER ADJUSTMENT RANGE OF R317

-45V. BIAS (A830-2)
± 5V.

-50V BIAS (3102-1)
± 5V.

Figure 5-1. Schematic Diagram, D830-1 1000-Watt FM Power Amplifier

830E-1A
5 KW FM Broadcast Transmitter

COLLINS

system instructions

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa

SP-184
523-0755440-001418
15 February 1962

TABLE OF CONTENTS

Section			Page
I	**GENERAL DESCRIPTION**		5
	1.1	Purpose of Instruction Book	5
	1.2	Purpose of Equipment	5
	1.3	Description of Equipment	5
	1.3.1	Physical Description	5
	1.3.2	Electrical Description	5
	1.4	Equipment Supplied	5
	1.5	Accessory Equipment	6
	1.6	Equipment Specifications	6
	1.6.1	Mechanical	6
	1.6.2	Electrical	6
II	**INSTALLATION**		7
	2.1	Unpacking and Inspecting	7
	2.2	Transmitter Location	7
	2.3	Intercabinet Connections	7
	2.4	Replacement of Components Removed for Shipping	8
	2.5	External Connections	8
	2.6	Internal Connections	8
	2.7	Remote Control	8
	2.8	Frequency Change	11
	2.8.1	Neutralization Procedure	12
	2.9	Final Installation Procedure	16
	2.10	Starting the Transmitter in a New Installation	16

Section			Page
III	**OPERATION**		19
	3.1	General	19
	3.2	Starting the Transmitter in Normal Operation	19
IV	**PRINCIPLES OF OPERATION**		19
	4.1	General	19
	4.2	A830-2 10 W Wide-Band FM Broadcast Exciter	19
	4.3	Control Circuits	20
	4.4	Plate Contactors and Power Supplies	20
V	**MAINTENANCE**		22
	5.1	General	22
	5.2	Normal Tuning Procedures	22
	5.3	Modulator and AFC Discriminator Adjustment Procedures	22
	5.4	Distortion Testing Procedure	25
	5.5	Audio Frequency Response Measurements	26
	5.6	FM Noise Measurement	26
	5.7	AM Noise Measurement	26
	5.8	Trouble Shooting	29

LIST OF ILLUSTRATIONS

Figure		Page
1-1	830E-1A 5-Kw FM Broadcast Transmitter, Over-all View (C849-15-P)	4
2-1	830E-1A 5-Kw FM Broadcast Transmitter, Outline and Installation Drawing (C849-03-5)	9
2-2	Transformer Details (C849-04-4)	10
2-3	Driver Plate Cavity Tuning Chart (C848-12-P)	13
2-4	Power Amplifier Plate and Grid Cavity Tuning Chart (C849-14-X)	14
2-5	Neutralization Tuning Chart (C849-13-X)	15
2-6	Neutralization Detector (C849-05-3)	16
4-1	830E-1A 5-Kw FM Broadcast Transmitter, Block Diagram (C849-12-5)	21
5-1	Distortion Test Setup (C849-09-3)	25
5-2	Audio Frequency Response, Test Setup (C849-06-3)	27
5-3	Audio Frequency Response Limits (C847-04-X)	27
5-4	FM Noise Test Setup (C849-07-3)	28
5-5	AM Noise Test Setup (C849-08-3)	28

LIST OF TABLES

Table		Page
1-1	Subassembly Instruction Books	5
1-2	Equipment Supplied	5
1-3	Accessory Equipment	6
2-1	Cabinet Interconnections	7
2-2	Remote Control Connections	11
2-3	Crystal Part Numbers	11
5-1	Abbreviated Tuning Procedures	23
5-2	Distortion Checks	26
5-3	Normal Transmitter Meter Indications	30

UNIT INSTRUCTIONS

TD No.	Title
536	A830-2 10 W Wide-Band FM Broadcast Exciter
538	B830-1 250-Watt FM Power Amplifier
539	5-Kw FM Power Amplifier

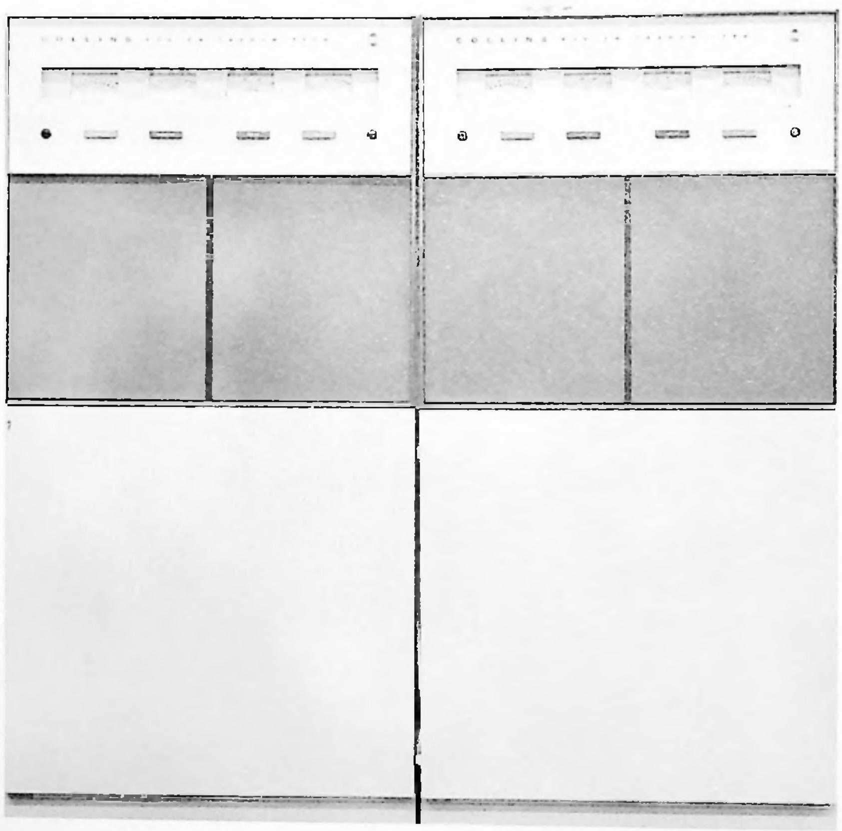


Figure 1-1. 830E-1A 5-Kw FM Broadcast Transmitter, Over-all View

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

This instruction book is a guide for installing, adjusting, operating, and maintaining 830E-1A 5-Kw FM Broadcast Transmitter.

1.2 PURPOSE OF EQUIPMENT.

The 830E-1A 5-Kw FM Broadcast Transmitter is used for continuous monophonic or optional stereophonic FM broadcast service on a single frequency in the range from 88 to 108 megacycles with an output power of 5000 watts.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The 830E-1A 5-Kw FM Broadcast Transmitter, shown in figure 1-1, is contained in two interconnected cabinets that, together, are 76 inches wide, 76 inches high, 27 inches deep, and weigh approximately 1800 pounds. All transmitter operating controls are located behind the doors on the front of the cabinets. The filament and plate on-off controls and eight monitoring meters are located at the top front of the cabinets. The meters may be observed easily while operating the tuning controls. A monitoring meter is also provided with the wide-band exciter. The transmitter uses 15 tubes and 20 transistors, most of which are accessible from the front of the transmitter. The bottom front of the transmitter cabinets are removable to allow access to components on the bottom of the inside panels.

Large doors at the upper rear of the cabinets allow access to the upper part of the transmitter for servicing and maintenance. The lower rear half of the transmitter cabinets are covered by removable panels that contain ventilating fans and permanent-type air filters. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panels. These interlocks ground the transmitter high-voltage circuits when the doors are opened or the panels are removed. The power amplifier plate-tuning cavity is located in an interlocked compartment at the front of the transmitter.

Inside the transmitter, heavy iron-core components are at the bottom of the cabinets. The exciter portion of the transmitter and the 250-watt driver are contained in one cabinet. The other cabinet contains a 5000-watt power amplifier and harmonic filter.

Cooling air for the transmitter is drawn through permanent air filters at the rear of the cabinets by low-speed, high-volume fans, and exhausted through shielded openings in the tops of the cabinets. Individual blowers supply cooling air directly to the driver and power amplifier tubes.

Room is provided in the 250-watt amplifier cabinet for mounting a stereo generator and SCA equipment if multiplex operation is desired.

1.3.2 ELECTRICAL DESCRIPTION.

The 830E-1A 5-Kw FM Broadcast Transmitter is composed of three electrically-connected subunits: (1) a wide-band exciter that furnishes a 10-watt FM output to drive (2) a 250-watt amplifier that, in turn, drives (3) a 5000-watt power amplifier. Instruction books covering the exciter and power amplifiers used in the transmitter are listed in table 1-1. These three books are supplied following section V of this system instruction book. The unit instruction books contain detailed descriptions of the three transmitter subunits.

TABLE 1-1
SUBASSEMBLY INSTRUCTION BOOKS

PUBLICATION	INSTRUCTION BOOK NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
B830-1 250-Watt FM Power Amplifier	TD-538
5-Kw FM Power Amplifier	TD-539

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of 830E-1A 5-Kw FM Broadcast Transmitter.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
B830-1 250-Watt FM Power Amplifier	522-2948-00
E830-1 5-Kw FM Power Amplifier	522-2656-00
5-Kw Harmonic Filter	549-2011-00

1.5 ACCESSORY EQUIPMENT.

Table 1-3 lists accessory equipment that is available for use with 830E-1A 5-Kw FM Broadcast Transmitter. Information on 786M-1 Stereo Generator will be found in Unit Instructions TD-537.

TABLE 1-3
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
786M-1 Stereo Generator	522-2914-00

1.6 EQUIPMENT SPECIFICATIONS.

1.6.1 MECHANICAL.

Weight . . . . 1800 pounds maximum.

Size . . . . 76 inches wide, 76 inches high, 27 inches deep.

Ventilation . . . . . Two ventilating-fans, two blowers.

Ambient temperature range . . . . +20°C (68°F) to +45°C (113°F).

Ambient humidity range . . . . 0 to 95 percent relative humidity.

Altitude . . . . . . 0 to 6000 feet.

Shock and vibration . Normal handling and transportation.

1.6.2 ELECTRICAL.

Power source. . . . 200 to 250 volts, 60-cycle, 3-phase.

Maximum power requirements . . . . 12.25 kilowatts.

Power output . . . . 5000 watts nominal.

Output impedance . . 50 ohms, unbalanced. Maximum swr 2:1.

Frequency range . . 88 to 108 mc. Exact operating frequency determined by frequency of exciter.

Excitation source . . Crystal - controlled high-stability oscillator using a plated, nontemperature-controlled crystal, controlling an LC modulation oscillator to provide automatic frequency control. Then the modulation oscillator is heterodyned up to the operating frequency of the station by a second high-stability crystal-controlled oscillator.

Carrier-frequency stability . . . . . . Within ±2000 cps of specified carrier frequency over ambient temperature range from +20°C(68°F) to +45°C (113°F) and line-voltage variations of ±5 percent.

Harmonic and spurious radiation . Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc, inclusive, is at least 30 db below the level of the unmodulated carrier.

Any emission appearing on a frequency removed from the carrier by more than 240 kc and up to and including 600 kc is at least 40 db below the level of the unmodulated carrier.

Any emission appearing on a frequency removed from the carrier by more than 600 kc is at least 80 db below the level of the unmodulated carrier.

Modulation characteristics . . . Direct - frequency modulation. Standard audio pre-emphasis is incorporated in modulator.

Audio input impedance . . . . . 600 ohms, balanced.

Audio input level . . +10 dbm ±2 db.

Audio frequency response . . . . . . Complies with standard FCC 75-microsecond pre-emphasis curve.

Audio frequency distortion . . . . . 50 to 100 cps, 1.5 percent maximum.
100 to 7500 cps, 1.0 percent maximum.
7500 to 15,000 cps, 1.5 percent maximum.

FM noise level . . . Not less than 65 db below 100 percent modulation (±75 kc).

AM noise level (rms) Not less than 55 db below equivalent 100 percent AM.

SECTION II
INSTALLATION

2.1 UNPACKING AND INSPECTING.

Be careful when uncrating the transmitter and components to avoid damaging the equipment. Inspect the transmitter carefully for scratches, dents, or other physical damage. Check for loose screws and bolts. Inspect all controls, such as switches, for proper operation as far as can be determined without applying power to the transmitter. Examine cables and wiring, making sure that all connections are tight and clear of each other and the chassis. File any damage claims promptly with the transportation company. If such claims are to be filed, retain all packing material.

2.2 TRANSMITTER LOCATION.

Plan transmitter and wiring placement carefully before starting installation work. Refer to figure 2-1, the transmitter installation diagram. This diagram shows the location of all wiring openings in the transmitter cabinets. As will be noted in figure 2-1, several alternate wiring arrangements can be used. Select the combination that most nearly suits the station requirements.

Allow adequate clearance both in front and back of the transmitter. There should be a minimum clearance of 3-1/2 feet behind the transmitter to provide sufficient room for service work.

If desired, an air duct may be placed over the exhaust-air opening in the top of the 5-kw amplifier cabinet to carry heat away from the transmitter.

2.3 INTERCABINET CONNECTIONS.

Place the two transmitter cabinets beside each other in their permanent location so that, when viewed from the front, the 250-watt driver cabinet is on the left and the 5-kw amplifier cabinet is on the right. Then connect the two cabinets with the appropriate cables. The intercabinet cables consist of (1) an r-f coaxial cable, and (2) a laced control and power cable. Both cables are furnished with the transmitter.

Connect the coaxial cable from the r-f output of the 250-watt driver to the r-f input of the 5-kw power amplifier. These connections are made on the tops of the cabinets. Run the control and power cable through the circular openings near the bottom rear of the cabinets on the sides where the cabinets adjoin. Table 2-1 shows the terminal locations of the laced control and power cable and the cable wire code. An explanation of the wire code is given inside the back cover of the instruction book. When the transmitter is received, one end of the laced control and power cable will be connected to the terminal boards of the 5-kw power amplifier. The other end must be connected to the 250-watt driver at the station site.

TABLE 2-1. CABINET INTERCONNECTIONS

WIRE CODE	5-KW POWER AMPLIFIER TERMINAL BOARD CONNECTIONS	250-WATT DRIVER TERMINAL BOARD CONNECTIONS
RE2	TB402-1	TB301-1
RE5	TB402-2	TB301-2
RE9	TB402-3	TB301-3
RC90	TB403-1	TB304-1
RC923	TB403-2	TB304-2
RC91	TB403-3	TB304-3
RC4	TB403-5	TB304-5
RC93	TB403-6	TB304-6
RC92	TB403-7	TB304-7
RC935	TB403-8	TB304-8
RC0	TB403-9	TB304-9
VE9	TB403-10	TB304-10
RC91	TB403-11	TB304-11

A.C.

SKIP 4

CONTROL

2.4 REPLACEMENT OF COMPONENTS REMOVED FOR SHIPPING.

Several of the transmitter components have been removed from the cabinets and packed separately for safety during shipping. These include the plate transformer and fragile units such as power amplifier tubes, mercury vapor tubes, and crystals. These units should not be replaced in the cabinets until the transmitter is in its permanent location. Wires and cables that were disconnected before shipping have been tagged to facilitate reconnection. Refer to the photographs in section VI of TD-538 and TD-539 for assistance in replacing these components in the transmitter.

2.5 EXTERNAL CONNECTIONS.

Refer to figure 2-1 for assistance in making the following external connections.

a. Connect the audio input to the transmitter. Bring the audio signal through the bottom (or any one of the optional cable input locations) of the 250-watt driver cabinet on a shielded twisted pair. Connect the two audio leads to terminals 1 and 2 of TB305 if monaural operation is specified. If optional stereophonic operation is employed, the left audio leads are connected to TB305-1 and 2 and the right audio leads to TB305-4 and 5. TB305 is located about half way up the cabinet on the left side as viewed from the rear of the cabinet. Connect the shield to terminal 3 of TB305.

b. Connect the FM monitor to the monitor output on the top of the 5-kw amplifier cabinet. Refer to figure 2-1. Use type RG-58U coaxial cable to make this connection.

c. Connect the antenna transmission line to the r-f output located on top of the 5-kw amplifier cabinet. The r-f connection is for a standard E1A 3-1/8-inch flange.

CAUTION

Before making this antenna connection, be sure that the transmission line and antenna present a nominal impedance of 50 ohms and an swr of not more than 2:1 at the transmitter operating frequency. If the transmitter output is improperly matched, the transmitter will not operate properly and may be damaged. THIS IS IMPORTANT.

d. Connect the power input cable to the transmitter. This power cable should be brought from an external fused cut-out box rated for 40 amperes. Use type R or T AWG #6 wire to make these connections. Connect the three wires to terminals 1, 2, and 3 of TB401, located at the bottom left side of the 5-kw amplifier cabinet. The power cable may be brought into the transmitter through holes in either the top or bottom of the 5-kw amplifier cabinet.

CAUTION

The 3-phase power input must be connected properly. To check for proper phasing of the 3-phase power input, turn off the plate circuit breaker and supply 3-phase power to the transmitter control circuits. Check the 5-kw PA blower for clockwise rotation. If the blower rotation is not clockwise, reverse any two of the incoming power leads. ALWAYS SHUT OFF THE TRANSMITTER 3-PHASE POWER AT THE EXTERNAL FUSED CUTOUT BOX BEFORE MAKING ANY ADJUSTMENTS TO THE TRANSMITTER. Recheck the PA blower for clockwise rotation.

2.6 INTERNAL CONNECTIONS.

The 830E-1A 5-Kw FM Broadcast Transmitter plate, screen, filament, and control circuit transformers are fitted with adjustable taps to compensate for line variations from 200 to 250 volts in 10-volt steps. To adjust transformers T301, T303, T401, T403, T404, and T405 perform the following steps.

a. Measure the line voltage at the transmitter fused cut-out box for each of the three phases. The three voltage readings should be nearly equal.

b. In turn remove the wire from the tapped portion of each of the transformers and move to the transformer tap whose voltage rating most closely corresponds to the voltage measured in step a. Refer to figure 2-2 for transformer terminal numbers and the input voltage which should be applied to each terminal. Do not move the solder lug from transformer terminal 5 of T301 or T401 as this terminal supplies 230 volts to the cabinet fans, the grid bias supply, and the high-voltage power supply filaments.

c. Tighten all transformer terminal connections.

Check that a jumper wire is installed from TB404-7 to TB404-8 to ensure that 115-volt power will be applied to the transmitter control circuitry.

If the optional stereo generator is installed any time after the initial 830E-1A installation, the 18-db audio pad will have to be removed from the audio circuitry of the exciter. Refer to Unit Instructions TD-536 for the location of the 18-db audio pad.

2.7 REMOTE CONTROL.

Remote control of 830E-1A 5-Kw FM Broadcast Transmitter, can easily be accomplished by connection to terminal boards TB-302 and TB303 located in the 250-watt power amplifier cabinet and by placing a jumper between TB404-4 and TB404-9. Terminal board TB404 is located within the 5-kw power amplifier cabinet. Table 2-2 lists the terminal board connections and the remote functions of each pair of terminals. Remote "on" switches should be the normally

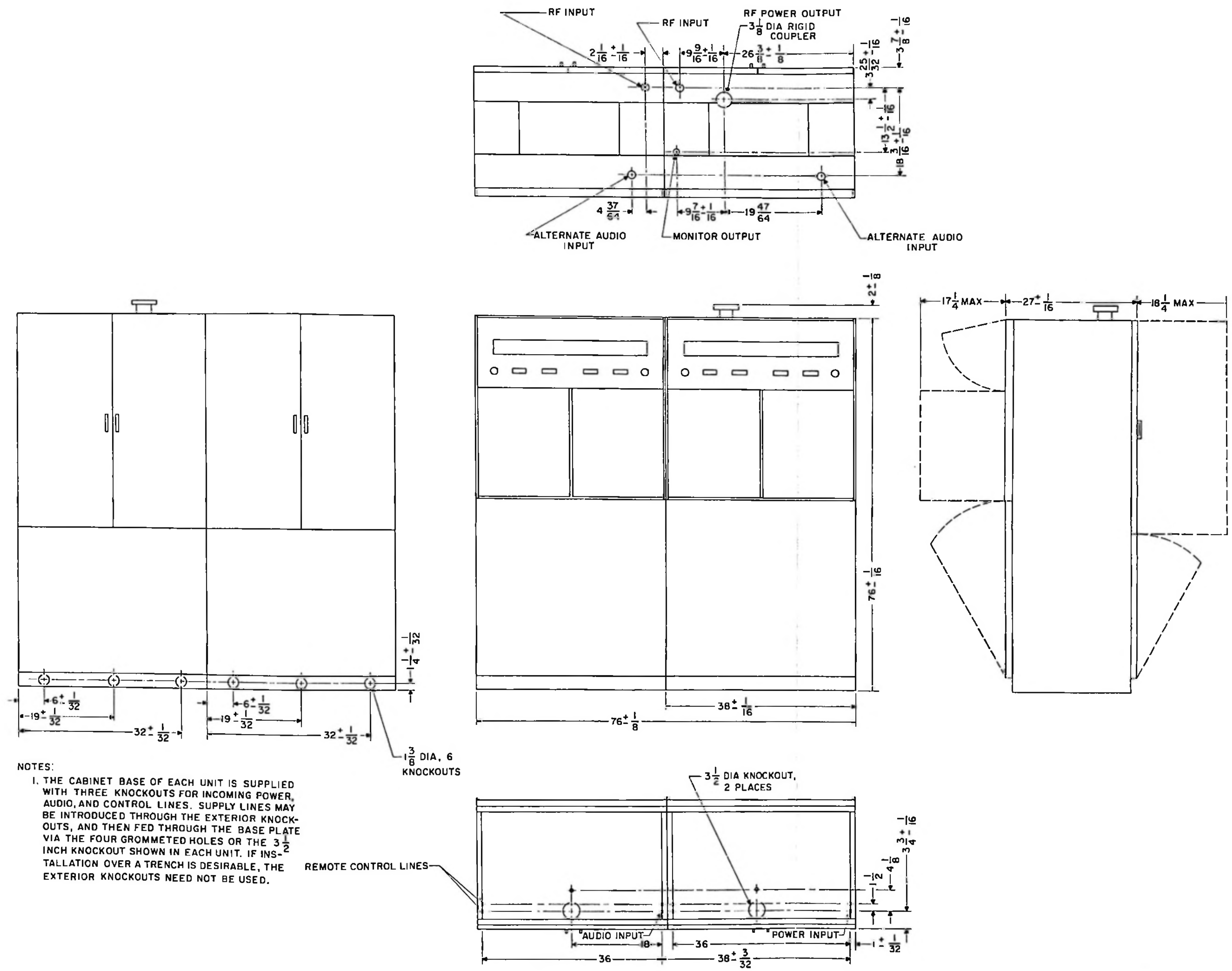


Figure 2-1. 830E-1A 5-Kw FM Broadcast Transmitter, Outline and Installation Drawing

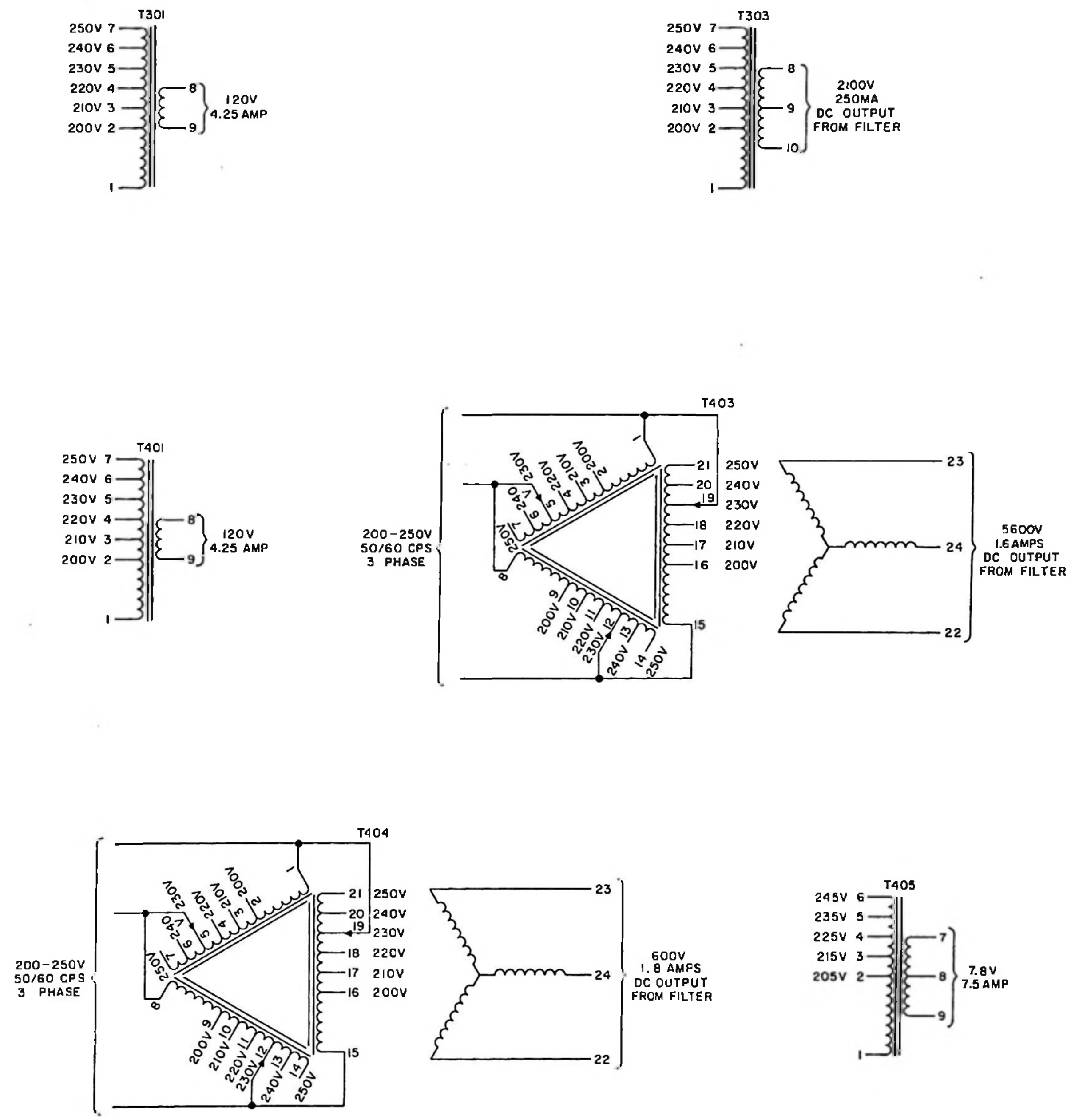


Figure 2-2. Transformer Details

open momentary type. Remote "off" switches should be the normally closed momentary type. For remote operation, the LOCAL-REMOTE switch within the 250-watt power amplifier cabinet, should be in the REMOTE position. When in the REMOTE position, it is possible to control the transmitter from the transmitter panel switches or from the remote point.

TABLE 2-2
REMOTE CONTROL CONNECTIONS

FUNCTION	TERMINALS	
	TB302	TB303
FILAMENT ON		1 and 2
FILAMENT OFF	8 and 9	
PLATE OFF		2 and 4
PLATE ON		2 and 3

For simplified operation the FILAMENT ON and PLATE OFF switches could be eliminated. The PLATE ON switch starts a sequence of operations which turns the filaments on and the plate voltage on after the filament time delay is completed. The FILAMENT OFF switch shuts down all transmitter functions.

Equipment is available that will completely control and monitor transmitter operation from a remote location through standard telephone pairs. When such remote control equipment is used, necessary installation and connection information will be supplied with the remote equipment.

If an optional stereo generator is employed in the 830E-1A, remote control of the stereo mode may be accomplished by a ground on TB302-7. If the ground is present the transmitter will be in the stereo mode. If the ground is removed the transmitter will switch to the monaural mode. Local control of the stereo mode is also available at the transmitter.

2.8 FREQUENCY CHANGE.

If the transmitter operating frequency is changed, the following components will have to be changed or adjusted. The components are (1) the hetrodyning crystal, Y426, (2) the driver plate cavity slider, (3) the power amplifier grid tank slider, (4) the power amplifier plate tank slider, and (5) the neutralizing bars of the power amplifier.

Table 2-3 lists the channel frequency versus crystal frequency and the Collins part number for each crystal. Figure 2-3 shows the distance the driver plate cavity slider should be positioned from the deck plate (tube socket mounting plate) for each operating frequency between 88 and 108 megacycles. Figure 2-4 shows the distance the power amplifier plate cavity and grid cavity sliders should be positioned from the deck plate for the operating frequencies.

TABLE 2-3. CRYSTAL PART NUMBERS

CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER	CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER
88.1	74.10000	289-2744-00	91.1	77.10000	289-2759-00
88.3	74.30000	289-2745-00	91.3	77.30000	289-2760-00
88.5	74.50000	289-2746-00	91.5	77.50000	289-2761-00
88.7	74.70000	289-2747-00	91.7	77.70000	289-2762-00
88.9	74.90000	289-2748-00	91.9	77.90000	289-2763-00
89.1	75.10000	289-2749-00	92.1	78.10000	289-2764-00
89.3	75.30000	289-2750-00	92.3	78.30000	289-2765-00
89.5	75.50000	289-2751-00	92.5	78.50000	289-2766-00
89.7	75.70000	289-2752-00	92.7	78.70000	289-2767-00
89.9	75.90000	289-2753-00	92.9	78.90000	289-2768-00
90.1	76.10000	289-2754-00	93.1	79.10000	289-2769-00
90.3	76.30000	289-2755-00	93.3	79.30000	289-2770-00
90.5	76.50000	289-2756-00	93.5	79.50000	289-2771-00
90.7	76.70000	289-2757-00	93.7	79.70000	289-2772-00
90.9	76.90000	289-2758-00	93.9	79.90000	289-2773-00

TABLE 2-3. CRYSTAL PART NUMBERS (Cont)

CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER	CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER
94.1	80.10000	289-2774-00	101.1	87.10000	289-2809-00
94.3	80.30000	289-2775-00	101.3	87.30000	289-2810-00
94.5	80.50000	289-2776-00	101.5	87.50000	289-2811-00
94.7	80.70000	289-2777-00	101.7	87.70000	289-2812-00
94.9	80.90000	289-2778-00	101.9	87.90000	289-2813-00
95.1	81.10000	289-2779-00	102.1	88.10000	289-2814-00
95.3	81.30000	289-2780-00	102.3	88.30000	289-2815-00
95.5	81.50000	289-2781-00	102.5	88.50000	289-2816-00
95.7	81.70000	289-2782-00	102.7	88.70000	289-2817-00
95.9	81.90000	289-2783-00	102.9	88.90000	289-2818-00
96.1	82.10000	289-2784-00	103.1	89.10000	289-2819-00
96.3	82.30000	289-2785-00	103.3	89.30000	289-2820-00
96.5	82.50000	289-2786-00	103.5	89.50000	289-2821-00
96.7	82.70000	289-2787-00	103.7	89.70000	289-2822-00
96.9	82.90000	289-2788-00	103.9	89.90000	289-2823-00
97.1	83.10000	289-2789-00	104.1	90.10000	289-2824-00
97.3	83.30000	289-2790-00	104.3	90.30000	289-2825-00
97.5	83.50000	289-2791-00	104.5	90.50000	289-2826-00
97.7	83.70000	289-2792-00	104.7	90.70000	289-2827-00
97.9	83.90000	289-2793-00	104.9	90.90000	289-2828-00
98.1	84.10000	289-2794-00	105.1	91.10000	289-2829-00
98.3	84.30000	289-2795-00	105.3	91.30000	289-2830-00
98.5	84.50000	289-2796-00	105.5	91.50000	289-2831-00
98.7	84.70000	289-2797-00	105.7	91.70000	289-2832-00
98.9	84.90000	289-2798-00	105.9	91.90000	289-2833-00
99.1	85.10000	289-2799-00	106.1	92.10000	289-2834-00
99.3	85.30000	289-2800-00	106.3	92.30000	289-2835-00
99.5	85.50000	289-2801-00	106.5	92.50000	289-2836-00
99.7	85.70000	289-2802-00	106.7	92.70000	289-2837-00
99.9	85.90000	289-2803-00	106.9	92.90000	289-2838-00
100.1	86.10000	289-2804-00	107.1	93.10000	289-2839-00
100.3	86.30000	289-2805-00	107.3	93.30000	289-2840-00
100.5	86.50000	289-2806-00	107.5	93.50000	289-2841-00
100.7	86.70000	289-2807-00	107.7	93.70000	289-2842-00
100.9	86.90000	289-2808-00	107.9	93.90000	289-2843-00

2.8.1 NEUTRALIZATION PROCEDURE.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when performing any inspection or work within the cabinet or plate cavity. Do not depend entirely on the interlocks. Always shut down the transmitter before doing any work inside the transmitter cabinet. Remember 115 volts is present on one side of the door interlocks.

Power amplifier neutralization must be completed after any change in frequency to provide the proper degree of amplifier stability. Neutralization of the power amplifier is accomplished as follows: Set the neutralization sliding contacts to the position corresponding to the station frequency as shown in figure 2-5. Construct a detector as shown in figure 2-6 (parts are available from Collins Radio Company, Cedar Rapids, Iowa) and connect to the station monitor output located on the top of the 5-kw power amplifier cabinet. Turn on the exciter and driver, and tune the exciter and driver according to the procedure given in paragraph 2.10. Tune the power amplifier grid tank. Adjust the power amplifier neutralization sliding contacts

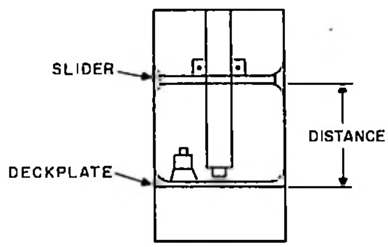


PLATE CAVITY

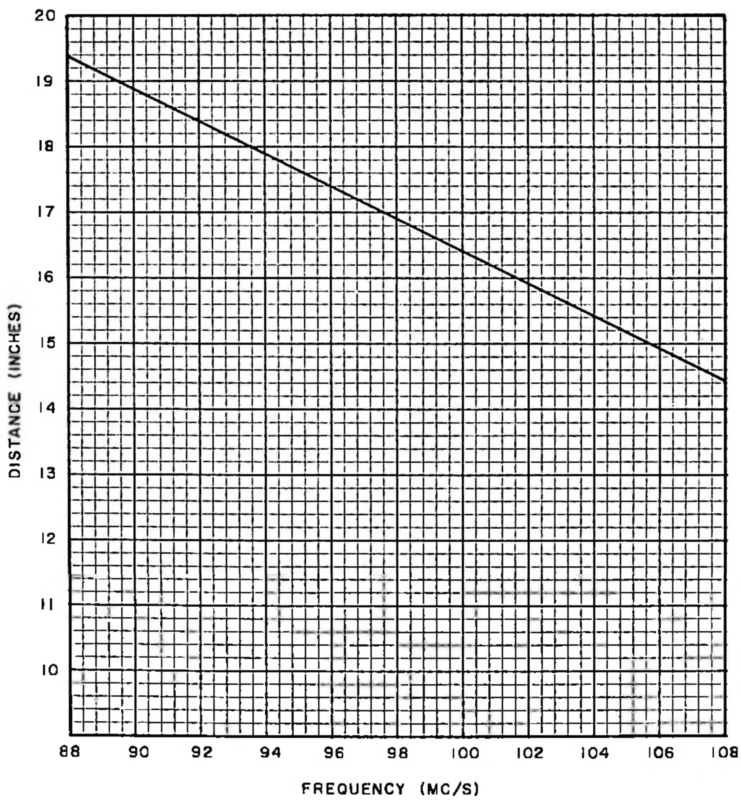


Figure 2-3. Driver Plate Cavity Tuning Chart

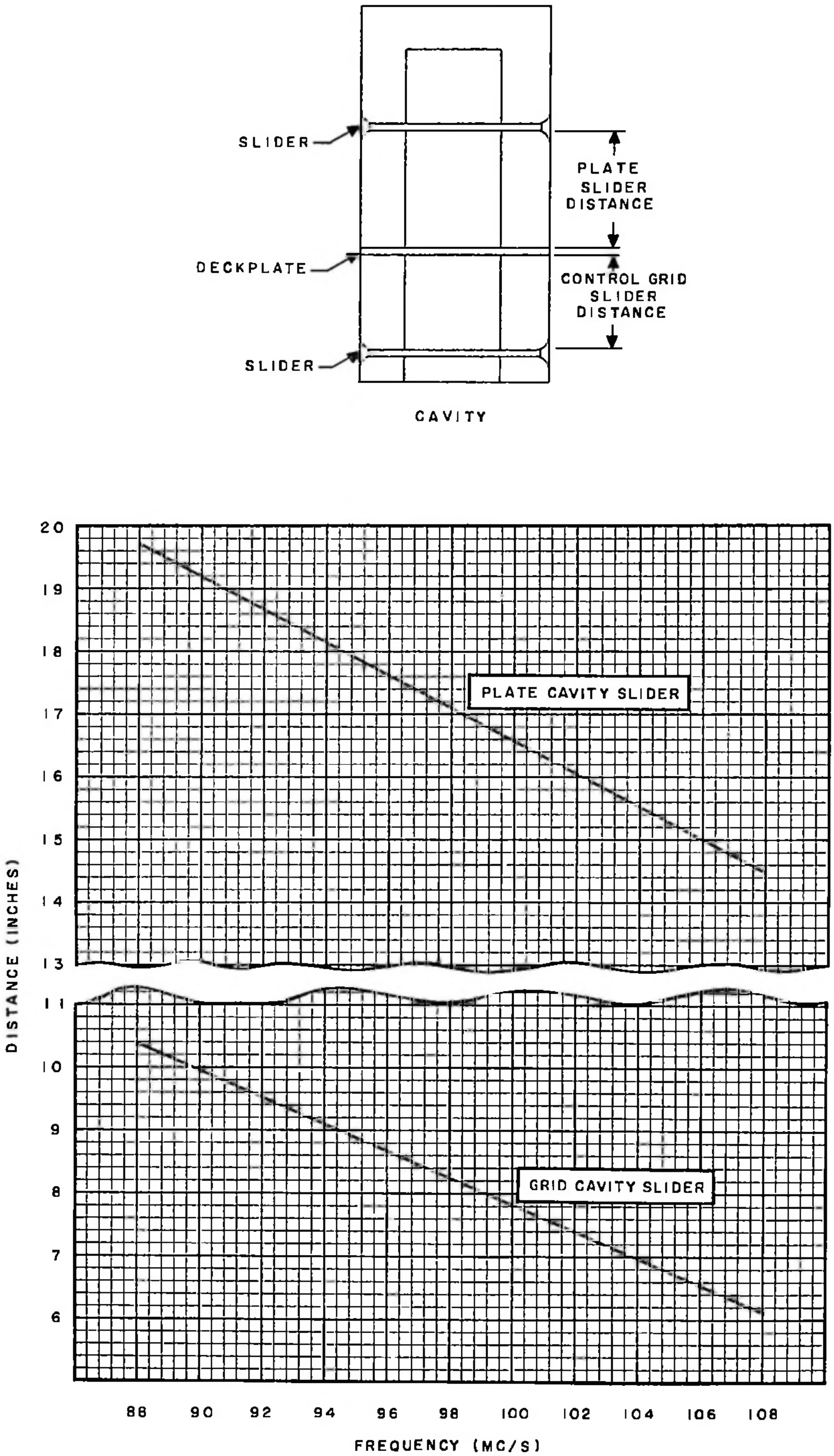


Figure 2-4. Power Amplifier Plate and Grid Cavity Tuning Chart

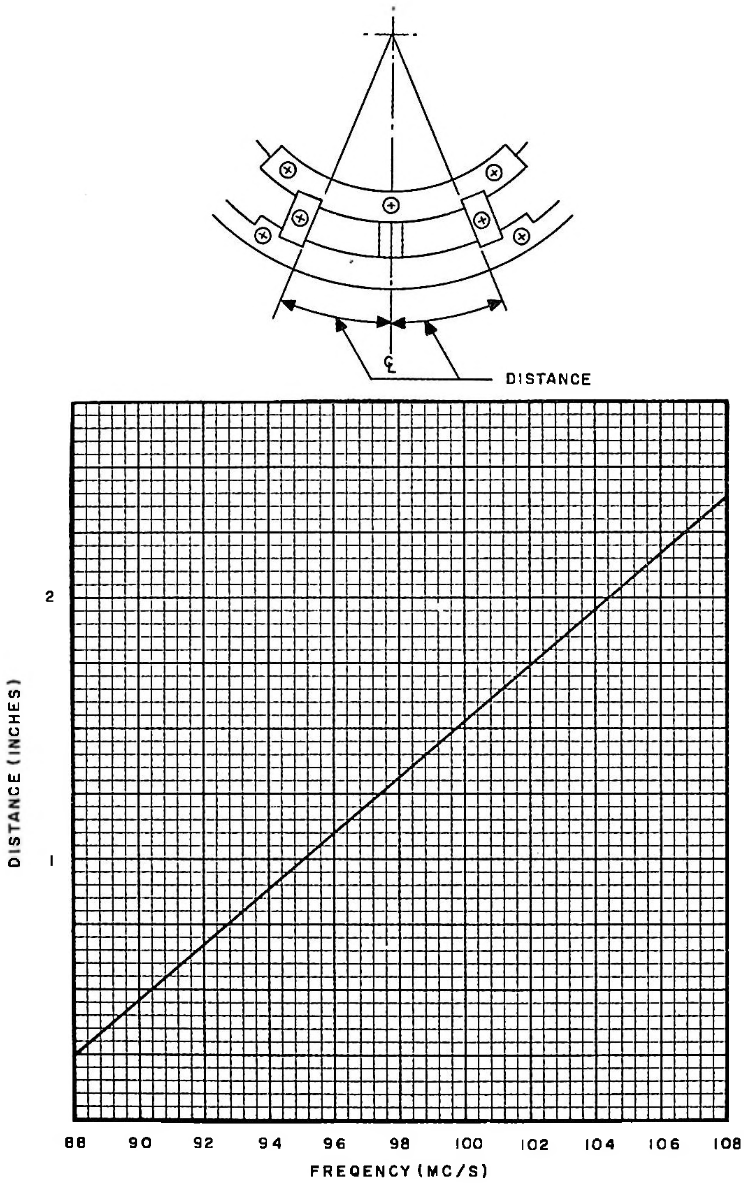
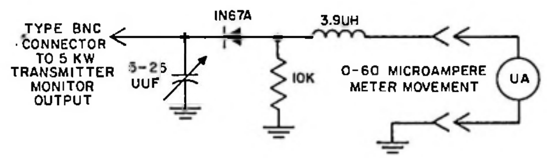


Figure 2-5. Neutralization Tuning Chart



PART	TYPE NO. OR VALUE	COLLINS PART NO.
CAPACITOR	5-25UUF	917-1073-00
DIODE	IN67A	353-0147-00
RESISTOR	10K	745-1394-00
INDUCTANCE	3.9UH	240-1575-00

Figure 2-6. Neutralization Detector

for a minimum indication on the detector meter. The neutralization can be checked by noting the grid reaction as the plate is tuned through resonance. Minimum grid current reaction indicates the neutralization is close. Neutralization of the 5-kw power amplifier is normally not critical and should be easily adjusted.

2.9 FINAL INSTALLATION PROCEDURE.

a. Check that all tubes, both in the exciter and power amplifiers are securely in place.

b. Check all exciter transistors for proper placement. The transistor location tab must be pointing to the transistor socket locating mark placed adjacent to the transistor socket.

c. Check fuses on both the exciter and power amplifiers.

d. Insert the crystals into the exciter crystal sockets. The 14-mc crystal should be placed into Y501 and the hetrodyning crystal into Y426.

e. Carefully inspect all rear door and panel interlocks to be certain that they are operating correctly. Do this by pressing the contact block, located on the doors and lower rear panels, until the spring is completely compressed, then releasing the block. If the block does not spring back to its original position adjust until it operates properly.

f. Recheck all cables and wiring in the transmitter to be sure that all connections are made securely and properly.

g. Check that the sliders in the tuning cavities of both the driver and the power amplifier are in proper position for the station frequency.

h. Check the final power amplifier tube for proper seating. This tube is pressed into place and may have jarred loose during installation.

i. Replace the lower rear panels on the transmitter cabinets. Insert the ventilating fan plugs into the sockets provided.

2.10 STARTING THE TRANSMITTER IN A NEW INSTALLATION.

Before starting the transmitter for the first time, read section III of the subunit instruction books to become familiar with the location and function of the various transmitter controls. Then, perform the following procedures.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when making any transmitter adjustments. Do not reach inside the rear of the transmitter cabinets whenever high voltages are applied. Do not depend entirely on door interlocks. Always shut off transmitter power at the external cutout box and ground all capacitors with the shorting stick in the transmitter cabinets before doing any work inside the rear of the cabinets. When working in the power amplifier cavities, remember that 115 volts a-c is present on one side of the cavity compartment interlocks. Keep metal tools and all parts of the body away from transistor cases.

a. Complete the entire transmitter installation procedure as directed in earlier paragraph of this instruction book.

b. Close the doors at the rear of the cabinets. Open the doors at the front of the cabinets and remove the lower front panels so that the entire inside panel is exposed. Check to be sure that the covers on the cavity compartments of both the driver and power amplifier are securely closed and latched.

c. Set the PLATE circuit breaker in the driver and the PLATE and FILAMENT breakers in the power amplifier to ON.

d. Press the FILAMENT ON switch on either cabinet. The green indicator lamps at the top left of both cabinets should light. This means that all transmitter tube filaments and cooling-air blowers are operating.

e. Set the right cabinet MULTIMETER switch to FIL V 8V FS. Adjust the FILAMENT VOLTAGE ADJUST control until the right cabinet MULTIMETER indicates 7.5 volts. If this meter indication cannot be reached, readjust the taps on the filament transformer, T403, to the next lower voltage tap.

NOTE

The mercury-vapor rectifier tubes in the 5-kw amplifier (right cabinet) should be run with only the filaments lighted for at least one-half hour before applying plate voltage to the amplifier. This is done to remove any mercury coating that may be on tube elements.

This operation is necessary only for new tubes or used tubes that have been inverted or agitated. While this aging process is being completed, the exciter and 250-watt amplifier may be tuned by performing the following steps.

f. Set the POWER switch on the exciter to ON. Allow the exciter oscillator to warm up for 15 minutes.
g. Turn S101 to the 14MC REF B position and check M101 for an indication in the B meter range. Turn S101 to the AFC KEY B position and check M101 for an indication in the B meter range.

NOTE

When S101 is in the AFC KEY B position the meter pointer will not hold steady but will pulse at approximately 5 cps, the keying generator rate. This pulse is an indication of normal operation.

Turn S101 to the MOD OUTPUT B position and check M101 for an indication in the B meter range. If all meter indications for the three S101 positions fall within the B meter range, proceed with the following tuning procedures. If any of the meter indications fall outside of the B meter range, the modulator and afc discriminator are out of adjustment and will have to be adjusted according to the Modulator and AFC Discriminator Adjustment Procedures in the Maintenance section of this instruction book.
h. Switch S101 to the MIXER GRID A position. Set POWER OUT resistor R454 to its midposition. Using a nonmetallic screwdriver type tuning tool adjust the BUF TUNE control for a peak indication on meter M101.

NOTE

The MIX BAL control, R438, should be placed in its midrange position. No further adjustment of this control is then necessary unless the transmitting frequency falls within the range of 97 to 100 mc. See step n if the transmitted frequency falls within this range.

i. Switch S101 to the V428B position. Adjust L429 and L430 for a maximum indication on M101.
j. Switch S101 to the V429B position. Adjust L431 and L432 for a maximum indication on M101.
k. Switch S101 to the V430B position. Adjust L433 and L434 for a maximum indication on M101.
l. Switch S101 to the V430C position. Adjust the PA PLATE control for a minimum indication on M101.
m. Set the driver MULTIMETER switch to GRID FS 40 MA. Adjust first the exciter PA MATCH control, then the power amplifier GRID TUNING control for a peak MULTIMETER indication.
n. If the transmitter frequency falls between 97 and 100 mc the following step will have to be completed. Place a grid dip meter tuned to 98 mc near the exciter output. Adjust the MIX BAL control for a minimum output as indicated on the grid dip meter.
o. Set the driver POWER OUTPUT ADJUST control fully counterclockwise. Connect a 50-ohm 250-watt dummy load to the rf output connector of the driver.
p. Press the driver PLATE ON switch. The red indicator lamp at the top right of the cabinet should light, and the P.A. PLATE VOLTAGE meter should indicate 2100 ±100 volts.
q. Set the driver MULTIMETER switch to SCREEN FS 400 VDC. The MULTIMETER should indicate 300 ±35 volts.
r. Adjust the driver PLATE TUNING control for a dip in the P.A. PLATE CURRENT meter indication.
s. Set the driver WATTMETER switch to FORWARD. Adjust the OUTPUT COUPLING control for approximately 5 ma of screen current.
t. Turn the driver POWER OUTPUT ADJUST control approximately 2/3 of its maximum clockwise rotation.
u. Increase the driver coupling a small amount by turning the OUTPUT COUPLING control clockwise until the PA screen current is reduced to approximately 10 ma. Adjust the PLATE TUNING control for a dip in the P.A. PLATE CURRENT meter indication. (The plate tuning capacitor should be near its center position when the dip in the driver plate current occurs. If the capacitor is not in this position move the plate slider in the appropriate direction and repeat step u.)
v. Rotate the POWER OUTPUT ADJUST control clockwise a small amount.
w. Repeat steps u and v until the P.A. PLATE CURRENT meter indicates a minimum indication and the WATTMETER indicates 250 watts. At this time the driver screen current should be not less than 5 ma nor more than 20 ma.
x. Turn off the driver plate power and disconnect the dummy load from the driver. Reconnect the coaxial cable from the driver to the power amplifier. Set the driver POWER OUTPUT ADJUST potentiometer fully counterclockwise.
y. Set the driver WATTMETER switch to REFLECTED. Adjust the power amplifier GRID TUNING control for minimum reflected power.

NOTE

If a low value of reflected power cannot be obtained, change the setting of the slider in the power amplifier (the right cabinet) grid cavity slightly, adjust the position of the input tap and repeat step y.

z. Turn the driver POWER OUTPUT ADJUST control until the proper PA grid current is flowing (approximately 20 ma).
aa. Set the power amplifier POWER OUTPUT ADJUST control in the maximum counter clockwise direction. Check the power amplifier filament voltage

and if necessary readjust the FILAMENT VOLTAGE ADJUST control for 7.5 volts as indicated on the power amplifier MULTIMETER. If the transmitter filaments have been energized for at least one-half hour, press the power amplifier PLATE ON switch. When this switch is pressed, the red indicator lamp at the top right of the power amplifier cabinet should light and the P.A. PLATE VOLTAGE should indicate 6400 ±200 volts.

ab. Adjust the power amplifier PLATE TUNING control for a dip in the P.A. PLATE CURRENT meter indication. (The power amplifier plate tuning capacitor should be near its center position when the dip in the power amplifier plate current occurs. If the capacitor is not in this position move the power amplifier plate slider in the appropriate direction and repeat step ab.)

CAUTION

The power amplifier P.A. PLATE CURRENT meter indication should never exceed 1.6 amperes (power supply rating).

ac. Set the power amplifier WATTMETER switch to REFLECTED. The swr must be less than 2:1 at all times. If the indication of reflected power is excessive, check the antenna and its associated r-f cable for possible troubles.

ad. Set the power amplifier WATTMETER switch to FORWARD. Adjust the OUTPUT COUPLING control for approximately 10 ma of screen current.

ae. Turn the power amplifier POWER OUTPUT ADJUST control to approximately its midpoint position. Recheck the driver power output for proper PA grid current.

NOTE

The values of screen current given in the steps are only approximate. The tube dissipation will allow for greater variations in screen current without adversely affecting tube operation.

af. Increase the power amplifier coupling a small amount by turning the OUTPUT COUPLING control clockwise until the PA screen current is reduced to approximately 15 ma. Adjust the PLATE TUNING control for a dip in the P.A. PLATE CURRENT meter indication.

ag. Rotate the power amplifier POWER OUTPUT ADJUST control clockwise a small amount.

ah. Repeat steps af and ag until the power amplifier P.A. PLATE CURRENT meter indicates the transmitter output is 5 kw as measured by the indirect method. At this time the PA screen current should be not less than 10 ma nor more than 30 ma. The indirect method of measuring power output is:

$$\text{Power output} = I_p E_p K$$

When K is efficiency, E_p is plate voltage, and I_p is plate current.

NOTE

K or efficiency for determining the transmitter power output is obtained from the production test data supplied with the transmitter.

If the final does not tune up properly the fault may lie in improper neutralization. If faulty neutralization is suspected, neutralize the final according to the procedure given in paragraph 2.8.1.

ai. Check to be sure that the FM monitor that is connected to the transmitter is properly calibrated. Then, if necessary, adjust the exciter VHF OSC FREQ ADJ control until the monitor indicates that the transmitter operating frequency is within specified operating limits.

aj. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 dbm.

ak. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation.

al. Replace the lower front panel on the transmitter cabinet and close the front doors. The transmitter is now ready for standard broadcast use.

NOTE

At this point it is suggested that a record be made of all meter readings for future maintenance and trouble shooting. These meter readings may be recorded in table 5-3.

SECTION III
OPERATION

3.1 GENERAL.

Refer to the unit instruction books to become familiar with the operation and function of controls on the power amplifier the driver, and the exciter.

After the transmitter has been placed in operation it will only be necessary from time to time to check meter indications to be sure the transmitter is operating properly and to occasionally touch-up the power amplifier loading and tuning.

3.2 STARTING THE TRANSMITTER IN NORMAL OPERATION.

The transmitter may be put into operation by two different methods, depending upon the circumstances. For normal operation, press either FILAMENT ON switch to start the driver and power amplifier filaments and to warmup the exciter (the exciter POWER switch should be left in the ON position at all times). Check the driver grid current to be sure the exciter is presenting sufficient drive to the driver before applying plate power. Approximately thirty seconds after filament power is applied, press the driver PLATE ON switch. Check the operation of the driver and, if operating properly, press the power amplifier PLATE ON switch, starting the transmitter.

The alternate method of starting the transmitter consists of pressing the power amplifier PLATE ON switch only. The power amplifier filament, the driver filament, and the exciter will immediately start to warm up. As soon as the driver time delay relay has completed its cycle, the driver and power amplifier plate voltages will come on automatically, starting the transmitter.

To shut down the transmitter it is recommended, but not necessary, to press the driver PLATE OFF switch, wait a few seconds, and then shut off the filament and exciter power by pressing either FILAMENT OFF switch. It is also possible to press either FILAMENT OFF switch which removes plate, filament, and exciter power. Pressing the driver PLATE OFF switch first allows the plate power supply voltages to discharge through the driver and power amplifier while the filament is at normal operating temperature and, in addition, cools the power amplifier components.

SECTION IV
PRINCIPLES OF OPERATION

4.1 GENERAL.

Refer to figure 4-1, a block diagram of 830E-1A 5-Kw FM Broadcast Transmitter. The transmitter can be broken down into four main subassemblies; an exciter, a driver, a power amplifier, and a harmonic filter. Refer to section II of the unit instruction books for a complete explanation of the exciter, the driver, and the power amplifier.

4.2 A830-2 10 W WIDE-BAND FM BROADCAST EXCITER.

Figure 4-1 is the block diagram of A830-2 10 W Wide-Band FM Exciter. The baseband audio is coupled to the A830-2 through a pre-emphasis network, and through an 18-db pad to J101 and two baseband amplifiers. The baseband output is coupled to a voltage-sensitive capacitor, C654. C654 is a diode which varies in capacity in proportion to the voltage across it. The FM oscillator is tuned to 14 mc. The capacity of C654 varies in proportion to the baseband audio and therefore the output is a 14-mc signal frequency modulated by the baseband audio. The deviation of the 14-mc signal is ±75 kc for 100 percent modulation. The oscillator output is coupled through two limiters to remove any amplitude modulation. The limited 14-mc signal is then amplified and coupled to the rate correction frequency discriminator and to the output amplifier. The output of the frequency discriminator is simply the baseband audio detected from the modulated 14-mc signal. This detected audio is coupled back to the baseband input to correct for any nonlinearity in C654.

The output amplifier amplifies the modulated 14-mc signal to a level sufficient to mix with the 74- to 94-mc signal (per customer requirement) in the balanced mixer. A portion of the limiter output is coupled to the afc buffer stage. The afc buffer output, the modulated 14-mc signal, is coupled to the reference oscillator and afc limiters through a diode switch. The output of the 14-mc reference oscillator, is also coupled to the reference oscillator and afc limiters through a diode switch. The diode switch is operated by a 5-cps keying generator. The 5-cps generator is a unijunction transistor operating as a relaxation oscillator keying a multivibrator.

The diode switch alternately connects the modulated 14-mc signal (afc buffer output) and the 14-mc reference signal. The limiter output is coupled to the afc discriminator. The afc discriminator detects the difference between the 14-mc reference signal and the modulated 14-mc signal. The modulated 14-mc signal will cause a baseband audio output at the discriminator. This is not an error in frequency, so a portion of the baseband audio input is amplified by the baseband canceling amplifier and fed into the output of the frequency discriminator through a diode switch. This diode switch is keyed by the same 5-cps signal which switched the reference oscillator and afc limiter input. When the modulated 14-mc signal is connected to the reference oscillator and afc limiter input, the baseband canceling signal is switched into the output of the frequency disciminator to cancel the baseband output from the discriminator.

The input signal to the four error signal amplifiers is a 5-cps square wave. The amplitude of this square is proportional to the frequency error in the FM oscillator. The error signal amplifier square wave output is converted to a d-c control signal in the synchronous detector. The synchronous detector is also keyed by the 5-cps keying signal. The d-c error signal is coupled to C654 to correct the frequency modulation oscillator.

The modulated 14-mc signal from the output amplifier is heterodyned up to the operating frequency in a balanced mixer. The injection frequency is generated in a crystal oscillator. The crystal frequency is 14 mc below the customer's operating frequency. The crystal oscillator output is coupled to a buffer stage and is mixed with the modulated 14-mc signal in the balanced mixer. The balanced mixer output is limited and amplified to the 10-watt r-f output level. The output impedance of the A830-2 is between 50 and 70 ohms.

The power supply for the A830-2 is of conventional design and supplies operating voltages for the vacuum tubes and transistors in the A830-2.

The driver consists of a single ceramic-type tetrode tube. The tube is operated as a class C amplifier with a tuned-cavity plate circuit. The output from the driver is fed to a 5-kw final amplifier.

The final power amplifier is also made up of a single ceramic-type tetrode tube. The tube is operated as a grounded screen, class C amplifier, using screen grid neutralization. The plate works into a tuned cavity with a tuned cavity control grid tank. The plate tuned cavity output is fed through a harmonic filter which reduces all output harmonics into the antenna.

The harmonic filter consists of two series resonant M-derived low-pass end sections and two constant K T center sections. The harmonic filter starts to attenuate above 110 mc and reaches maximum attenuation at the carrier second harmonic. The attenuation pattern then tapers off slowly as the frequency rises. The over-all result of the harmonic filter is in keeping the harmonics attenuated at least 80 db below the carrier frequency.

4.3 CONTROL CIRCUITS.

One phase of the 230-volt 3-phase power is stepped down to 115 volts a-c by transformers T301 and T401. This lower voltage is used to activate relays in the transmitter control circuits and is also fed to the exciter as its primary power source. The control circuits allow power to be applied to the transmitter only in the proper sequence to prevent damage to the driver and final amplifier. These circuits also contain protective devices to prevent damage to components from accidental overloads.

4.4 PLATE CONTACTORS AND POWER SUPPLIES.

4.4.1 The driver plate contactor consists of a heavy duty relay which controls the 230-volt a-c primary power to the plate power supply. The driver plate contactor is actuated by the driver PLATE ON switch through the control circuitry.

The driver plate power supply consists of a step-up transformer, a full-wave rectifier, and a filter. The power supply is capable of delivering 2100 volts of d-c at 250 ma to the driver.

4.4.2 The power amplifier plate contactors are heavy-duty relays similar to the type used in the driver. The plate contactors control the 3-phase power to the plate power supply and are activated by the power amplifier PLATE ON switch. The two plate contactors are energized in sequence to prevent transients from entering the power supply when power is first applied.

The power amplifier plate power supply is a conventional 3-phase full-wave mercury vapor power supply capable of providing 6400 volts at 1.6 amp. The screen power supply is a full-wave 3-phase silicon diode power supply capable of providing 600 volts at 1.8 amp. The control grid bias supply places the control grid at about cutoff and is set at the factory.

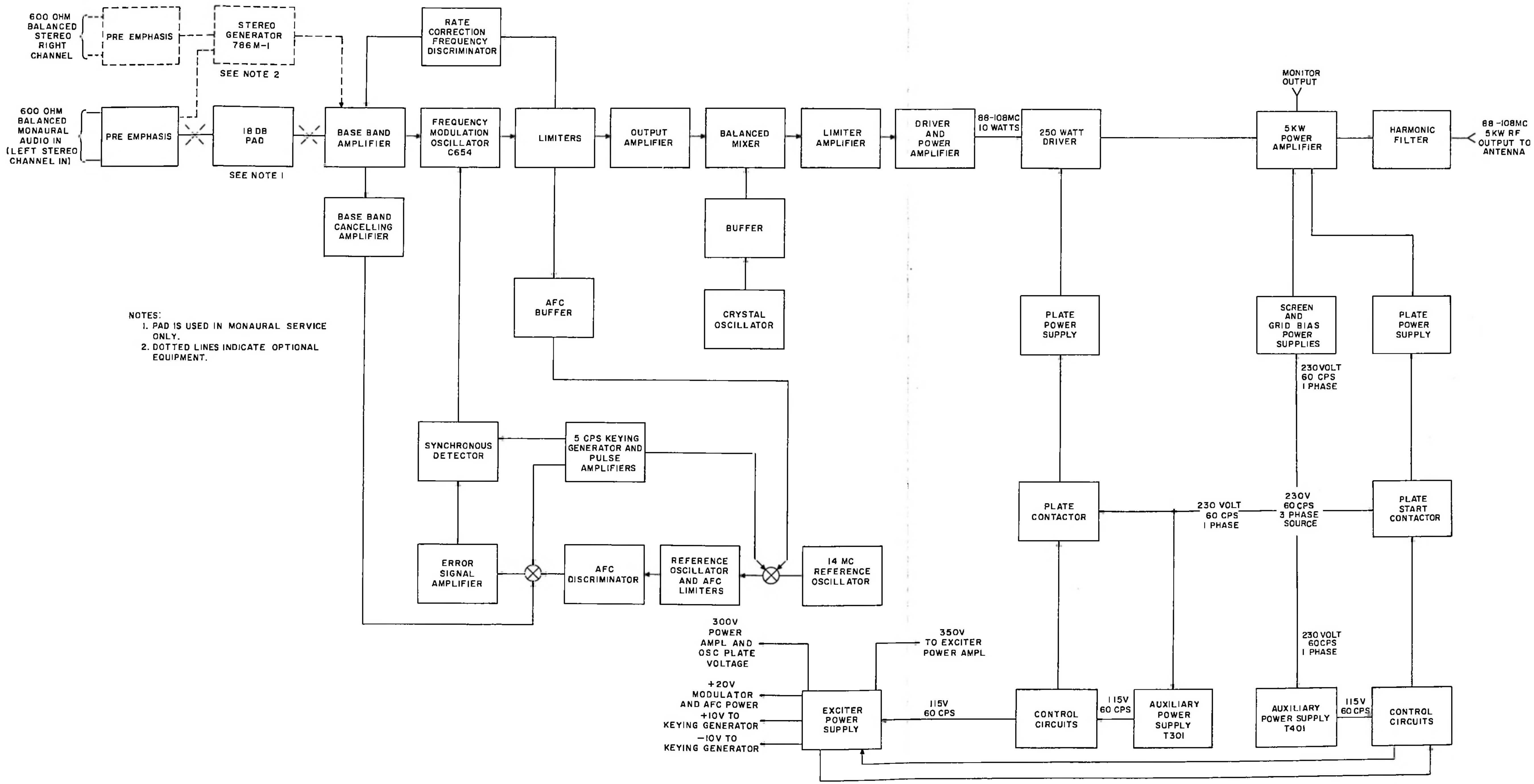


Figure 4-1. 830E-1A 5-Kw FM Broadcast Transmitter, Block Diagram

SECTION V
MAINTENANCE

5.1 GENERAL.

The following paragraphs contain information concerning maintenance of 830E-1A 5-Kw FM Broadcast Transmitter.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the transmitter cabinets whenever high voltage is applied. Do not depend on door interlocks. Always shut down the transmitter before doing any work inside the transmitter cabinets. Immediately upon opening the rear cabinet doors, short out the power supply capacitors with the shorting sticks provided with the transmitter.

Refer to the applicable unit instructions for specific maintenance procedures for each subassembly.

5.2 NORMAL TUNING PROCEDURES.

The following are tuning procedures which should be observed after the transmitter has been installed and tuned according to the installation procedures given in section II. Table 5-1 presents abbreviated tuning instructions to be used with the following procedures. Table 5-1 can be detached from this instruction book, placed within one of the cabinet doors or adjacent to the transmitter and used separately when the operator becomes familiar with the transmitter.

a. Open the doors at the front of the cabinets.
b. Press either FILAMENT ON switch and allow the exciter to warm up for at least 15 minutes.
c. Set S101 on the exciter to MIXER GRID A. Adjust BUF TUNE control for a peak on M101.
d. Set S101 to V428 B and adjust L429 and L430 for a peak on M101.
e. Set S101 to V429 B and adjust L431 and L432 for a peak on M101.
f. Set S101 to V430 B and adjust L433 and L434 for a peak on M101.
g. Set S101 to V430C B and adjust the PA PLATE control for a minimum indication on M101.

NOTE

Convenient marked ranges are available on the meter which correspond to switch positions. These ranges give an approximate requirement for min-max readings for each switch position.

h. Tune the exciter coupling by setting the MULTIMETER switch to GRID FS 40 MA and adjusting the exciter PA MATCH control for maximum coupling. Tune the driver GRID TUNING control for a peak MULTIMETER indication.
i. Set the driver WATTMETER to REFLECTED.
j. Press the driver PLATE ON switch. Adjust the power amplifier GRID TUNING for a dip in the R.F. WATTMETER indication. Set the driver WATTMETER to FORWARD. In turn, adjust the driver PLATE TUNING control for minimum indication and increase the OUTPUT COUPLING control and the POWER OUTPUT ADJUST control, by small amounts, until the proper value of PA grid current in flowing (approximately 20 ma). The driver screen current may be 0 but should not be more than 20 ma when the driver is properly tuned.
k. Press the power amplifier PLATE ON switch.
l. Adjust the FILAMENT VOLTAGE ADJUST control for 7.5 volts as shown on the MULTIMETER.
m. Adjust the power amplifier GRID TUNING control for a maximum indication on the MULTIMETER. (This should be near the minimum reflected power on the driver wattmeter.)
n. In turn, adjust the power amplifier PLATE TUNING control for minimum plate current indication and increase the OUTPUT COUPLING control and the POWER OUTPUT ADJUST control, by small amounts, until the transmitter output power is 5 kw as measured by the indirect method.

$$\text{Power output} = I_p E_p K$$

The power amplifier screen current should not be less than 10 ma or more than 30 ma when the power amplifier is properly tuned. Normal operation is achieved when the R.F. WATTMETER indication is maximum for near minimum power amplifier plate current.
o. Adjust the VHF OSC FREQ ADJ control until the FM monitor indicates the transmitter is operating within the specified operating limits.

5.3 MODULATOR AND AFC DISCRIMINATOR ADJUSTMENT PROCEDURES.

The broadband exciter is designed to be exceptionally stable and will require few adjustments over a long period of time. The following adjustment procedures should only be followed if the exciter is not operating within limits upon installation, or if any of the transistors (Q503, Q511, Q601, or Q604) are replaced.

TABLE 5-1. ABBREVIATED TUNING PROCEDURES

	CONTROL	POSITION	ADJUSTMENT	INDICATING METER	INDICATION	NOTES Allow transmitter to warm up at least 15 minutes before tuning.
EXCITER	S101	MIXER GRID A	BUF TUNE	M101	Maximum	
EXCITER	S101	V428 B	*L429, L430	M101	Maximum	
EXCITER	S101	V429 B	*L431, L432	M101	Maximum	
EXCITER	S101	V430B	*L433, L434	M101	Minimum	
EXCITER	S101	V430C B	PA (exciter) PLATE	M101	Minimum	
DRIVER	MULTIMETER	GRID FS 40 MA	PA MATCH GRID TUNING	MULTIMETER	Maximum	
DRIVER	WATTMETER	FORWARD	PLATE TUNING OUTPUT COUPLING POWER OUTPUT ADJUST	P.A. PLATE CURRENT R.F. WATTMETER R.F. WATTMETER	Minimum Maximum 250 watts or less depending on drive requirements	Repeat the adjustment of PLATE TUNING, OUTPUT COUPLING, and POWER OUTPUT ADJUST controls until proper power amplifier drive is obtained.
POWER AMPLIFIER	WATTMETER	FORWARD	PLATE TUNING OUTPUT COUPLING POWER OUTPUT ADJUST	 R.F. WATTMETER R.F. WATTMETER	Near minimum Near 5-kw indication Near 5-kc indication	Repeat the adjustment of PLATE TUNING, OUTPUT COUPLING, and POWER OUTPUT ADJUST controls until 5 kw is achieved by the indirect power measing method. $P = I_p E_p K$

*Use slotted nonmetallic screwdriver on these adjustments.

Replacement of other components should not normally require a change in the adjustments given in this section. The transmitter will have to be energized when performing steps c and e. Use an a-c vtvm such as a Ballantine Model 310A when making adjustments. A d-c vtvm such as a Heath type may be used in step f.

NOTE

When adjusting the modulator and afc section of the exciter, use a nonmetallic hex type adjusting tool. Keep all metallic tools and the hands or other parts of the body away from transistor cases. When disabling the afc, and the complete transmitter is in operation, check the station monitor to be sure the center frequency stays within the FCC requirements.

a. Remove transistor Q509 and place a vtvm from TP501 to ground. Tune L505 for a peak indication on the vtvm and tune L504 for a peak indication. Be sure to tune the inductances in the order given to minimize the limiting effect. Check that each stage is limiting when making these adjustments. Limiting will show up as a broad flat peak on the vtvm when tuning. Set the controls midway between the limiter fall off points shown on the vtvm. Do not replace Q509 at this time.

b. Tune the afc discriminator by placing a vtvm from TP501 to ground and tune the DISCR PRI control, C515, for a maximum indication. Place the vtvm from TP502 to ground and adjust the DISCR SEC control, C518, for 0 on the vtvm.

c. Disable the afc by pressing the AFC DISABLE switch and adjust the OSC FREQ control until the station monitor indicates that the exciter is on frequency. Replace Q509.

d. Remove Q607. Place a vtvm between TP602 and ground. Tune L606 and L603 for a maximum indication on the vtvm. Tune the inductors in the order shown to minimize the effects of the limiter.

e. Remove afc by holding down the AFC DISABLE switch. With the vtvm from TP602 and ground, tune the DISCR PRI control, C639, for a maximum indication on the vtvm. Move the vtvm to TP601 and tune the DISCR SEC control, C644, for a 0 indication when the modulation monitor indicates the exciter is approximately on frequency. Repeat the tuning of the DISCR PRI and DISCR SEC controls. Replace Q607.

f. Place a d-c vtvm between TP603 and ground. Set the AMP BIAS control for a 7.5-volt indication on the vtvm.

g. Place a vtvm between TP504 and ground. Remove Q510. Tune L611 and L608 for a maximum indication on the vtvm. Replace Q510.

h. With a vtvm on TP504 adjust the REF LEVEL control for an equal indication on the vtvm with first Q510 removed and then Q509 removed. (This equalizes the modulator oscillator voltage and the 14-mc reference voltage.) Replace the transistors.

i. Place an oscilloscope between TP503 and ground. Apply a 150-cps audio signal on J601. Adjust the MOD BAL control for a minimum 150-cps indication as shown on the oscilloscope.

NOTE

The MOD BAL control must be adjusted slowly to allow the error signal amplifiers to stablize between adjustments.

5.4 DISTORTION TESTING PROCEDURE.

a. Refer to figure 5-1. Connect an audio frequency signal generator, such as a Hewlett-Packard Model

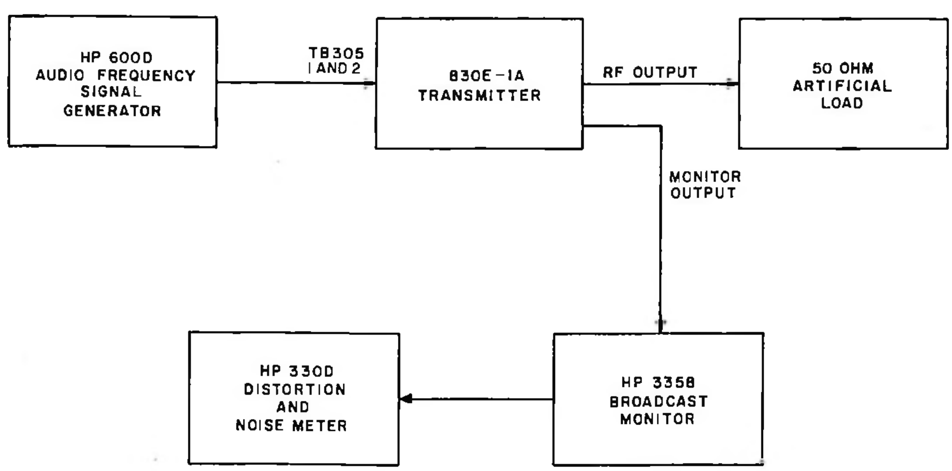


Figure 5-1. Distortion Test Setup

600D to the exciter audio input, terminals 1 and 2 of TB305. (Disconnect the station console audio input leads when making this connection.) Connect a distortion and noise meter, such as a Hewlett-Packard Model 330D, to the broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmiiter cabinet. Turn on the transmitter.

b. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 ±2 dbm.

c. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation (±75-kc deviation).

d. Measure the distortion at the frequencies and modulation levels given in table 5-2. The distortion shall be less than 1.5 percent for frequencies between 50 and 100 cps, less than 1.0 percent for frequencies between 100 and 7500 cps, and less than 1.5 percent for frequencies between 7500 and 15,000 cps.

TABLE 5-2. DISTORTION CHECKS

FREQUENCY	DISTORTION IN PERCENT		
	25% MODULATION	50% MODULATION	100% MODULATION
50			
100			
400			
1000			
5000			
7500			
10,000			
15,000			

5.5 AUDIO FREQUENCY RESPONSE MEASUREMENTS.

a. Refer to figure 5-2. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making these measurements.) Connect a vacuum-tube voltmeter, such as a Ballantine Model 310A, to the audio output terminals of the audio frequency generator. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Check the audio frequency response of the transmitter by modulating the transmitter at 50, 100, 400, 1000, 5000, 7500, 10,000, and 15,000 cps for 25 percent, 50 percent, and 100 percent modulation. Audio frequency response is measured by keeping the percentage of modulation constant and measuring the magnitude of audio, at each frequency given, to give the desired percentage of modulation. The audio frequency response must fall within the limits given in figure 5-3.

NOTE

When taking audio frequency response measurements a broadcast monitor, such as a Hewlett-Packard Model 335B, should be used. Do not use an instrument where audio de-emphasis might give a false indication of peak modulation.

5.6 FM NOISE MEASUREMENT.

a. Refer to figure 5-4. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to terminals 1 and 2 of terminal board TB-305. (Disconnect the station console audio input leads when making this measurement.) Connect a vacuum-tube voltmeter to the output terminals of the broadcast monitor. Connect an artificial load to the r-f output connector located on top of the power amplifier cabinet. Turn on the transmitter.

b. Modulate the transmitter 100 percent (±75-kc deviation) with 400 cps of audio.

c. Remove the modulating 400 cps and read the residual FM noise on the vacuum-tube voltmeter. The residual FM noise shall be less than -65 db below 100 percent modulation.

5.7 AM NOISE MEASUREMENTS.

a. Refer to figure 5-5. Short out terminals 1 and 2 of terminal board TB305. Connect a vacuum-tube

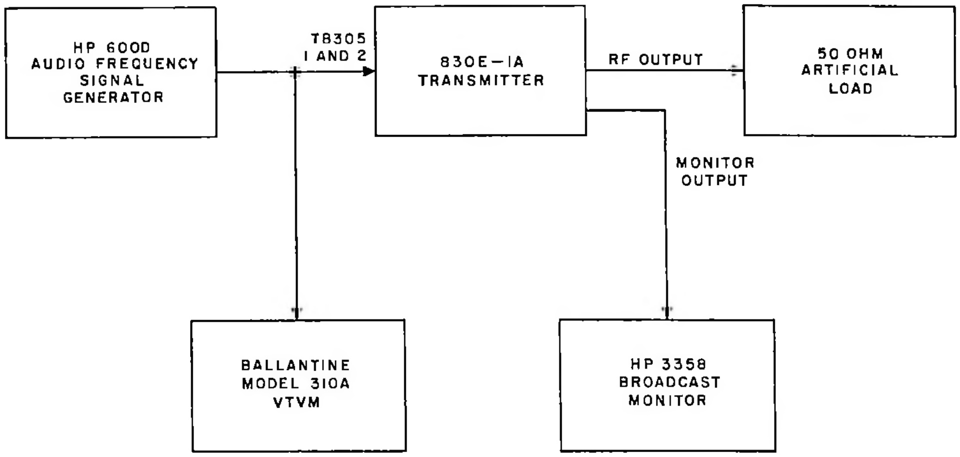


Figure 5-2. Audio Frequency Response, Test Setup

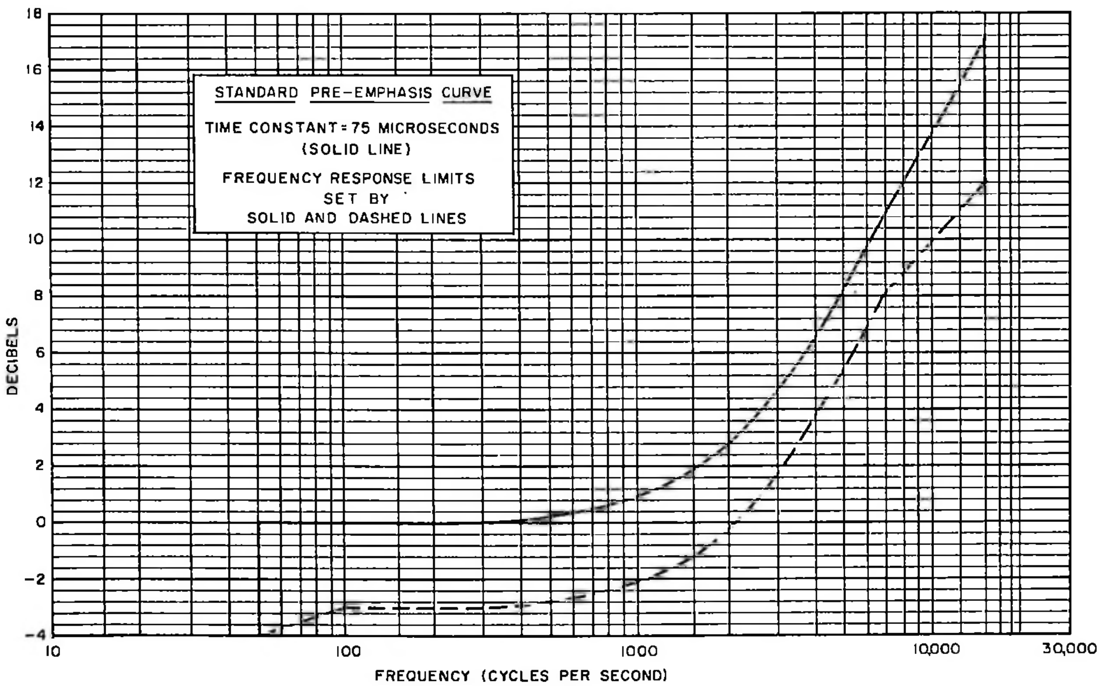


Figure 5-3. Audio Frequency Response Limits

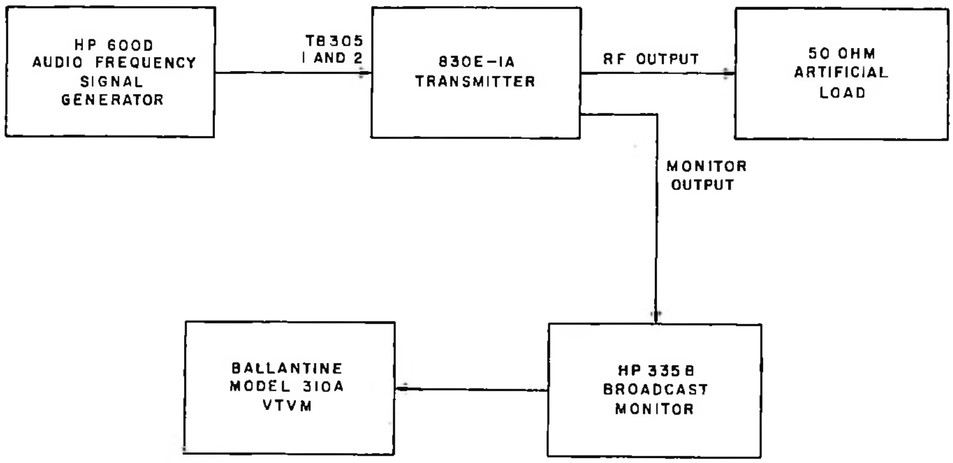


Figure 5-4. FM Noise Test Setup

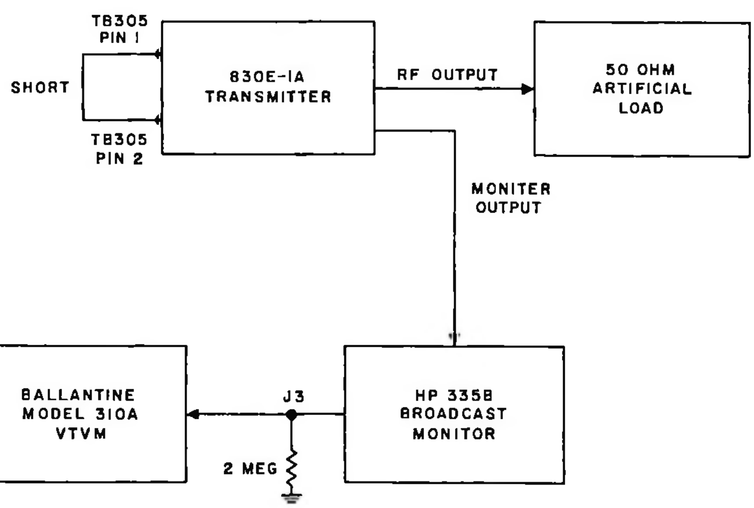


Figure 5-5. AM Noise Test Setup

voltmeter to connector J3 of the Hewlett-Packard Model 335B broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the power amplifier cabinet. Turn on the transmitter.

b. Switch the broadcast monitor to measure carrier level.

c. Measure the AM noise in db at J3 of the broadcast monitor in the following manner. Set modulation monitor to Carrier Level and measure the d-c level on the modulation meter (100 percent on scale equals 10 volts). Connect the vacuum-tube voltmeter to J3 and terminate J3 with a 2-megohm resistor. Measure the a-c level on the vacuum-tube voltmeter. (The input to the vacuum-tube voltmeter should be a shielded cable having less than 100 uuf distributed capacitance.) The AM noise is the direct ratio of the d-c reading and the a-c level. The AM noise shall be not less than -55 db below voltage or d-c carrier level.

$$\text{AM noise} = 20 \log \frac{\text{d-c reading}}{\text{a-c reading}}$$

5.8 TROUBLE SHOOTING.

Standard trouble-shooting procedures should be used in finding malfunctions in the transmitter. As is suggested in TD-536, TD-538, and TD-539, meter indications for all functions should be recorded when the transmitter is installed and operating properly. Table 5-3 is supplied for recording these readings. If some malfunction should occur after the normal meter readings are recorded, it is a simple matter to compare the meter readings of the malfunctioning equipment with the normal meter readings. When trouble-shooting and comparing the meter readings it is advisable to start with the final stage and proceed backwards until normal readings are encountered. The malfunctioning stage will then be the one immediately ahead of the normal meter indications.

As most cases of trouble will be traced to tubes or transistors, it is advisable to first of all replace the tube (or transistor) in the stage in which the trouble is suspected. If the trouble does not clear with tube or transistor replacement, it will become necessary to take resistance or voltage measurements, within the suspected circuit, to determine which component has failed.

When tracing trouble within the power amplifier it will be helpful to use the "from-to" information given in unit instructions, TD-528 and TD-539. The "from-to" information gives the actual location of the individual wires within the transmitter cabinets. When used in conjunction with the schematics, the "from-to" information can be very helpful.

If the transmitter center frequency shifts excessively with modulation, the trouble may be isolated to either the afc circuitry or the modulator circuitry of the exciter by disabling the afc and noting if the carrier shifts more than 1.8 kc with a change in modulation from 0 to 100 percent. If the modulator oscillator shifts more than 1.8-kc with the afc disabled, the trouble will be within the modulator oscillator circuits. The afc circuitry cannot shift the modulator oscillator frequency more than 1.8 kc. If the carrier shift is under 1.8 kc, the trouble will be in the afc circuitry.

TABLE 5-3. NORMAL TRANSMITTER METER INDICATIONS

	CONTROL	POSITION	METER	INDICATION
EXCITER	S101	BUFFER GRID A	M101	
	S101	MIXER GRID A	M101	
	S101	V428 B	M101	
	S101	V429 B	M101	
	S101	V430 B	M101	
	S101	V430C B	M101	
	S101	MOD OUTPUT B	M101	
	S101	AFC KEY B	M101	
	S101	14MC REF B	M101	
DRIVER	MULTIMETER	SCREEN FS 400 VDC	MULTIMETER	
	MULTIMETER	SCREEN FS 40 MA	MULTIMETER	
	MULTIMETER	GRID FS 40 MA	MULTIMETER	
			P.A. PLATE VOLTAGE	
			P.A. PLATE CURRENT	
	WATTMETER	FORWARD	R.F. WATTMETER	
	WATTMETER	REFLECTED	R.F. WATTMETER	
POWER AMPLIFIER	MULTIMETER	BIAS V400V FS	MULTIMETER	
	MULTIMETER	GRID I 40MA FS	MULTIMETER	
	MULTIMETER	SCREEN I 80MA FS	MULTIMETER	
	MULTIMETER	EXTERNAL NO 1	MULTIMETER	
	MULTIMETER	EXTERNAL NO 2	MULTIMETER	
			P.A. PLATE VOLTAGE	
			P.A. PLATE CURRENT	
	WATTMETER	FORWARD	R.F. WATTMETER	
	WATTMETER	REFLECTED	R.F. WATTMETER	

E830-1
5-KW FM Power Amplifier

unit instructions

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa

TD-539
523-0755306-001418
15 February 1962

TABLE OF CONTENTS

Section			Page
I	**GENERAL DESCRIPTION**		3
	1.1	Purpose of Instruction Book	3
	1.2	Purpose of Equipment	3
	1.3	Description of Equipment	3
	1.3.1	Physical Description	3
	1.3.2	Electrical Description	3
	1.4	Equipment Supplied	4
	1.5	Equipment Required but not Supplied	4
	1.6	Equipment Specifications	5
	1.6.1	Mechanical	5
	1.6.2	Electrical	5
	1.7	Tube and Semiconductor Complement	5
II	**PRINCIPLES OF OPERATION**		5
	2.1	General	5
	2.1.1	Control Circuits	5
	2.1.2	Power Amplifier Circuits	9
	2.2	Control Functions	10
III	**MAINTENANCE**		12
	3.1	General	12
	3.2	Preventive Maintenance	12
	3.2.1	Air Filter Cleaning	12
	3.2.2	PA Tube Cleaning	12

Section			Page
	3.2.2.1	PA Tube Removal	12
	3.2.3	Inspection	13
	3.2.4	Lubrication	13
	3.2.5	Tube Maintenance	13
	3.3	Trouble Shooting	13
	3.4	Cable Chart	14
IV	PARTS LIST		18
V	ILLUSTRATIONS		25

LIST OF ILLUSTRATIONS

Figure		Page
1-1	E830-1 5-Kw FM Power Amplifier, Over-all View (C849-16-P)	3
1-2	E830-1 Rear View with Doors Open and Lower Panel Removed (C849-17-P)	4
2-1	E830-1 5-Kw FM Power Amplifier, Block Diagram (C849-10-4)	6
2-2	E830-1 Control Circuits, Simplified Schematic (C849-11-6)	7
2-3	E830-1 Power Amplifier Circuits, Simplified Schematic (C849-18-6)	8
2-4	E830-1 Control and Adjustment Locations (C849-19-P)	11
4-1	Cavity, Parts Location (C849-25-P)	21
4-2	Indicator Panel, Parts Location (C849-23-P)	22
4-3	Plate Power Supply, Parts Location (C849-21-P)	22
4-4	Control Panel, Parts Location (C849-26-P)	23
4-5	Filament Supply, Parts Location (C849-20-P)	23
4-6	Power Panel, Small Parts Location (C849-24-P)	24
4-7	Power Panel, Parts Location (C849-22-P)	24
5-1	E830-1 5-Kw FM Power Amplifier Schematic Diagram (C849-02-6)	25

LIST OF TABLES

Table		Page
1-1	Associated Equipment Instruction Books	4
1-2	Equipment Supplied	4
1-3	Equipment Required but not Supplied	4
1-4	Tube and Semiconductor Complement	5
3-1	Typical Meter Indications	13
3-2	Cabinet From-To Information	14

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

Unit Instructions TD-539 provides information about E830-1 5-Kw FM Power Amplifier. Information which is furnished covers a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

1.2 PURPOSE OF EQUIPMENT.

The E830-1 5-Kw FM Power Amplifier is used for continuous monaural or stereophonic FM broadcast service on a single frequency, in the range from 88 to 108 megacycles with an output power of 5000 watts.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The E830-1 5-Kw FM Power Amplifier, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 1140 pounds. All power amplifier operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The meters may be observed easily while operating the tuning controls. The power amplifier uses 1 r-f amplifier tube and 6 rectifier tubes. The r-f amplifier tube is accessible from the front of the power amplifier. The bottom front of the power amplifier cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the power amplifier for servicing and maintenance. The lower rear half of the power amplifier cabinet is covered by a removable panel that contains a ventilating fan and a permanent type air filter. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks remove the plate voltage and ground the high-voltage circuits when the doors are opened or the panel is removed. The power amplifier plate tuning and grid tuning cavities are located in an interlocked compartment at the front of the transmitter.

Inside the E830-1, heavy iron-core components are at the bottom of the cabinet. An optional harmonic filter can be attached to the E830-1 within the confines of the rear cabinet compartment.

Cooling air for the power amplifier is drawn through a permanent type air filter at the rear of the cabinet by a low-speed, high-volume fan, and exhausted through a shielded opening in the top of the cabinet. A single high-volume blower supplies cooling air directly to the power amplifier tube.

1.3.2 ELECTRICAL DESCRIPTION.

The E830-1 5-Kw FM Power Amplifier consists of a single, air-cooled power amplifier tube capable of being driven to full power by a 250-watt driver. All

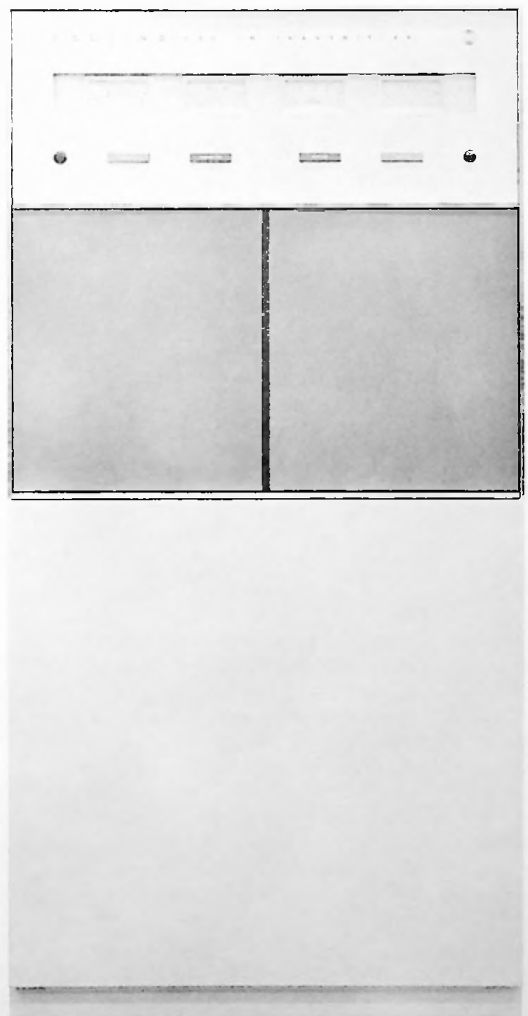


Figure 1-1. E830-1 5-Kw FM Power Amplifier, Over-all View

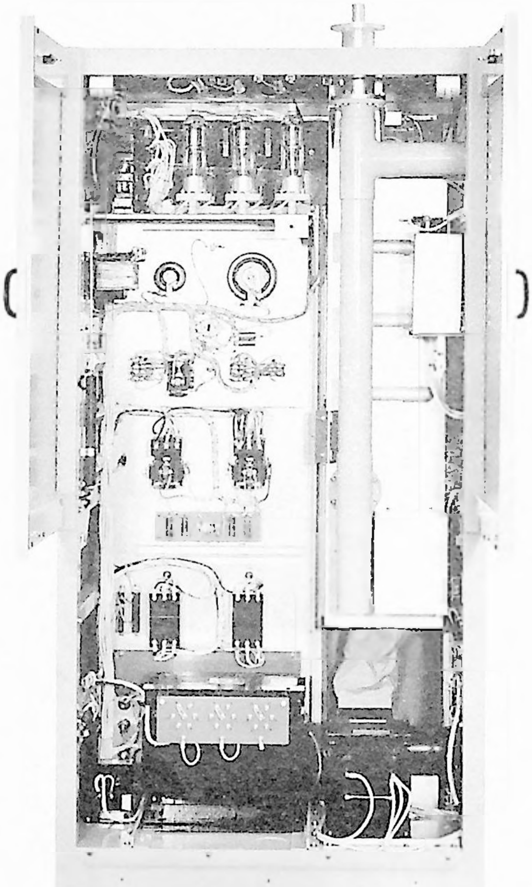


Figure 1-2. E830-1 Rear View with Doors Open and Lower Panel Removed

associated power supply and control circuitry is included for operation of the E830-1. The E830-1 input impedance is 50 ohms nominal, unbalanced. The E830-1 output power is at least 5000 watts over the frequency range of 88 to 108 megacycles into a 50-ohm load with an swr not exceeding 2:1.

Line power input required is 60 cycle, 3 phase with primary taps on all power transformers to compensate for line voltage variations from 200 to 250 volts. Circuit breakers in the input side of the plate and control circuits are provided for primary current overload protection. The control circuit auxiliary power supply transformer secondary and the control grid bias supply are fused. Time delay circuitry for protection of the high voltage rectifier tubes and the power amplifier tube during warmup is provided, with the actual time delay control received from the driver time delay relay. Circuits are provided for possible remote control tie-in with the driver remote control circuits, with the actual remote control available from one source for both units. Instruction books covering the exciter and driver used in conjunction with the E830-1 5-Kw FM Power Amplifier are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
786M-1 Stereo Generator	TD-537
B830-1 250-Watt FM Power Amplifier	TD-538

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of the E830-1 5-Kw FM Power Amplifier.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
E830-1 5-Kw FM Power Amplifier	549-2009-00
5-Kw Harmonic Filter	549-2011-00

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment that is required for operation of E830-1 5-Kw FM Power Amplifier, but is not supplied as part of the power amplifier.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
B830-1 250-Watt FM Power Amplifier	549-2008-00

1.6 EQUIPMENT SPECIFICATIONS.

1.6.1 MECHANICAL.

Weight	1140 pounds maximum.
Size	38 inches wide, 76 inches high, 27 inches deep.
Ventilation	One ventilating fan, one blower.
Ambient temperature range. . .	+20°C (68°F) to +45°C (113°F).
Ambient humidity range.	0 to 95% relative humidity.
Altitude.	0 to 6000 feet.

1.6.2 ELECTRICAL.

Power source. . .	200 to 250 volts, 60 cycle, 3 phase.
Maximum 60-cps power requirements	12 kilowatts.
R.F. Input Power. .	250 watts nominal
Power output . . .	5000 watts nominal.
Output impedance. .	50 ohms, nominal unbalanced.
Frequency range . .	88 to 108 megacycles. Exact operating frequency determined by frequency of exciter.

1.7 TUBE AND SEMICONDUCTOR COMPLEMENT.

Table 1-4 lists the tube and semiconductor complement supplied as part of the E830-1 5-Kw FM Power Amplifier.

TABLE 1-4
TUBE AND SEMICONDUCTOR COMPLEMENT

QUANTITY	TYPE	FUNCTION
6	872A/872	Plate voltage rectifiers
1	4CX5000A	Power amplifier
8	1N540	Control grid bias rectifiers
4	1N540	Multimeter rectifiers
24	MR326	Screen grid voltage rectifiers

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

The E830-1 5-Kw FM Power Amplifier contains a power amplifier and associated circuitry for the amplification of 250 watts of r-f drive to 5 kilowatts of r-f power. The E830-1 output can be fed through a harmonic filter, for the attenuation of spurious radiations, to an antenna or to a higher power amplifier.

Refer to figure 2-1, a block diagram of the E830-1 5-Kw FM Power Amplifier. The 230-volt, 60-cps, 3-phase line input is fed to the plate and screen step start contactors, where plate and screen voltage on-off functions are controlled by the control circuits. The 230-volt 3-phase line input is also fed to an auxiliary power supply, T401, where part of the 230-volt input is reduced to 115 volts single phase. The single phase output of T401 is then fed to the control circuits. The control circuits turn on and off the plate, screen, filament, and control grid bias supply. The control circuits also feed 230-volt, 60-cps, 1-phase power to the driver. Provisions are made within the control circuitry to connect to the filament on-off and plate on-off functions of a higher power amplifier if one is available. The higher power amplifier could then control the filament on-off and plate on-off functions.

The power amplifier consists of a single, ceramic type, forced air-cooled, grounded screen tube working into a resonant quarter wave-length cavity resonator. The control grid circuit consists of a resonant cavity with a swamping resistor in parallel to provide a low impedance broadband load to the control grid. Metering circuits are included to measure filament voltage, screen grid bias voltage, control grid current, and screen current.

2.1.1 CONTROL CIRCUITS.

Refer to figure 2-2, a simplified schematic diagram of the control circuits of E830-1 5-Kw FM Power Amplifier. The control circuits perform the function of applying or removing filament, plate, screen, and grid bias voltages, turn on and off the cabinet fan and power amplifier blowers, and also provide overload protection for all power amplifier circuits. These functions will be discussed in the following paragraphs.

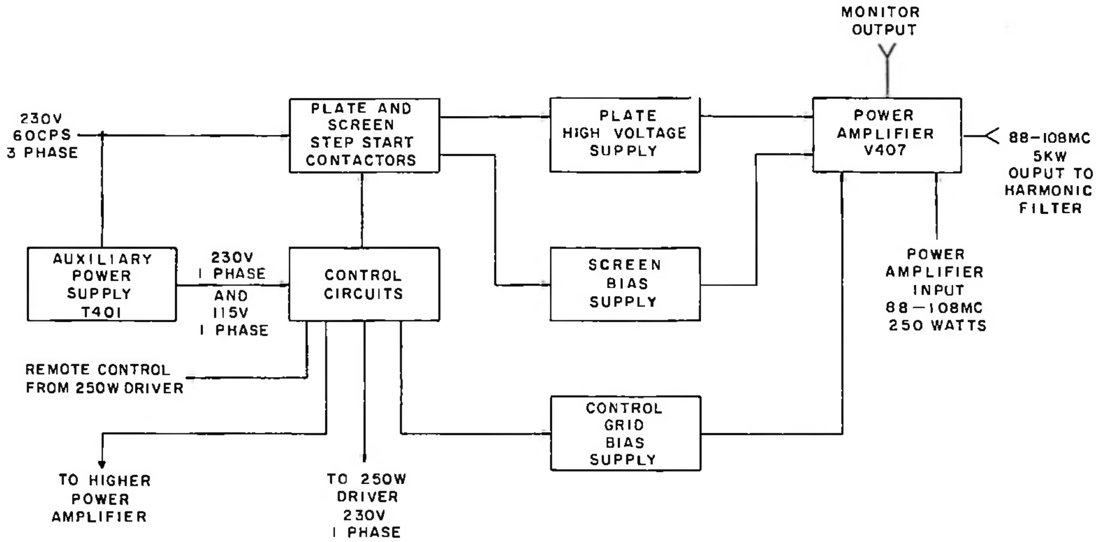


Figure 2-1. E830-1 5-Kw FM Power Amplifier, Block Diagram

The 230-volt 3-phase power enters the cabinet on TB401 and is fed to two circuit breakers, CB401 and CB402. The PLATE circuit breaker, CB402, protects only the plate and screen supplies, while the CONTROL circuit breaker, CB401, protects the remaining power amplifier circuitry. The 3-phase output from CB402 is fed to two contactors to provide a voltage stepping action when plate and screen power is applied. This stepping action reduces the transients generated in the plate and screen power supplies when the E830-1 is turned on or off. Switch S411 is placed in the screen supply 3-phase input to provide an aid when trouble shooting the transmitter. Screen voltage can be shut off, further isolating possible trouble.

The 3-phase output from the control circuit breaker, CB401, is split into single phase components and fed to the filament contactor, the blower relay, the auxiliary power supply T401, and to the 250-watt driver.

Power to operate the filament and blower relays is obtained from the 115-volt secondary of T401. A CONTROL indicator, DS403, is lighted when the 115-volt power is present at the secondary of T401. This power is fed through the FILAMENT OFF switch to the 250-watt driver control circuitry at TB403-3. The driver control circuitry can interrupt power at this point if filament off functions are to be controlled from the driver. Filament and blower control power is routed through the driver and re-enters the E830-1 at TB403-8. The power then is fed directly to the filament and blower control relays.

If the FILAMENT ON switch, S112, is pressed on either the driver or the E830-1, a ground is placed on the blower relay, K401, causing the relay to close. This action starts the power amplifier blower B401, and closes contacts K401-7 and K401-8. Closing of these contacts holds a ground on K401 when the momentary FILAMENT ON switch is released. When PA blower B401 comes up to speed, air pressure activated switch S407 closes, causing filament relay K402 to energize. The green filament-on light, DS401 will come on, the cabinet blower will start, and filament power will be fed to the tubes. The control grid bias supply will also be energized from the primary of transformer T401.

Power for operation of the plate circuits is obtained from the same source as the filament power transformer, T401. To start the plate-on sequence, PLATE ON switch S113 is pressed actuating the plate hold relay K403. This closes contacts 10 and 12 to hold K403 energized when the PLATE ON switch is released. The ground is obtained from the driver control circuitry to allow the driver to interrupt the ground for the plate-off function. Contacts 7 and 9 will also close, turning on the driver plate power if driver plate power has not been turned on previously. With K403 energized, contacts 1 and 3 will make, transferring the control voltage to the time delay transfer relay K404. K404 will actuate when the driver time delay relay has completed its cycle allowing the filaments to warm up to operating temperature. With K404 energized, 115 volts will be transferred to the plate-on contactor, K405. A fraction of a second later (as soon as K405-11 and 12 close) the step-start contactor will actuate applying 230 volts 3 phase to the plate and screen power supplies. The red plate-on indicator, DS402, will light indicating that plate and screen power is applied to the power amplifier.

If the PLATE OFF switch, S114, is pressed, plate and screen voltage will only be removed from the

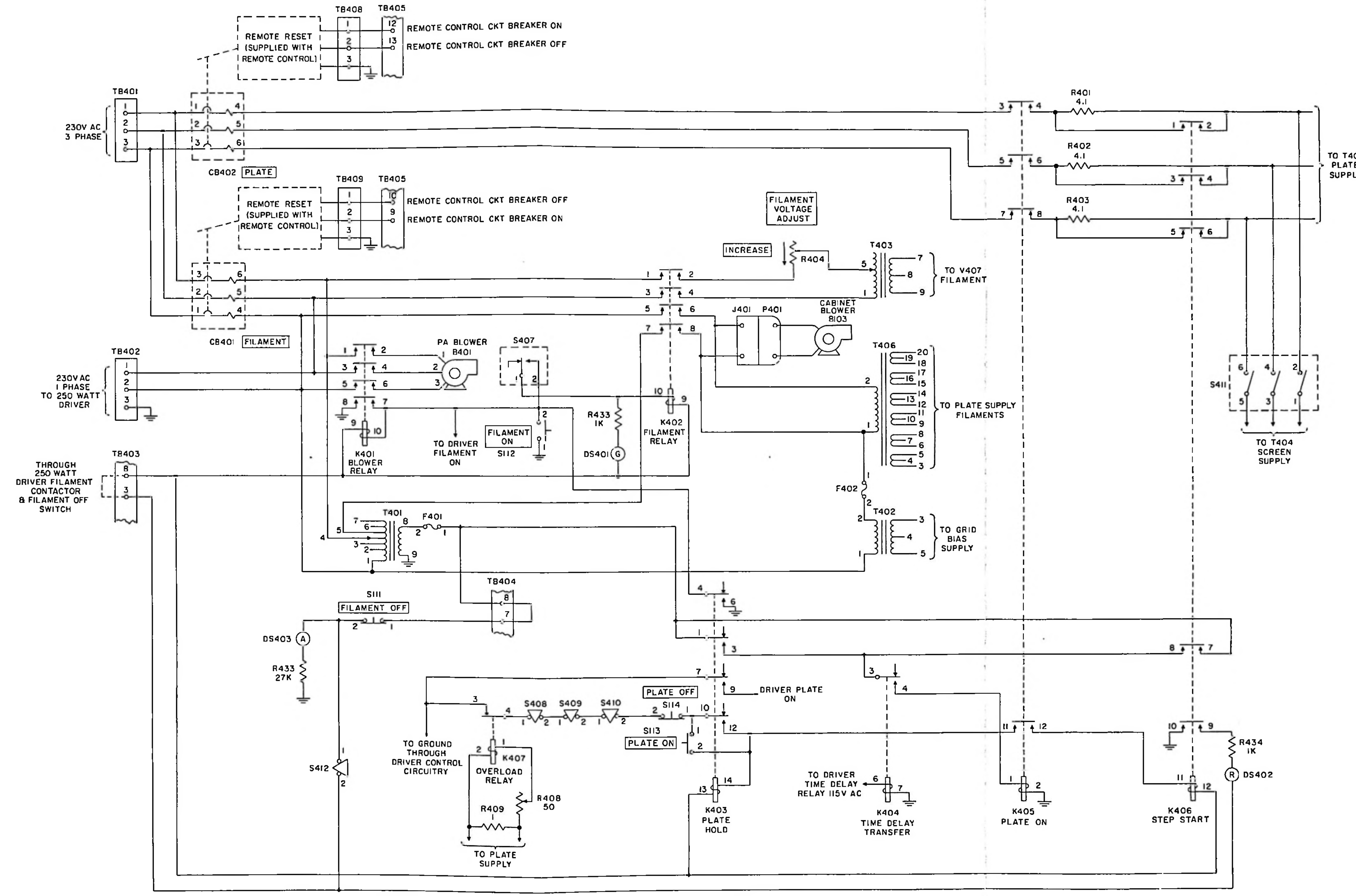


Figure 2-2. E830-1 Control Circuits, Simplified Schematic

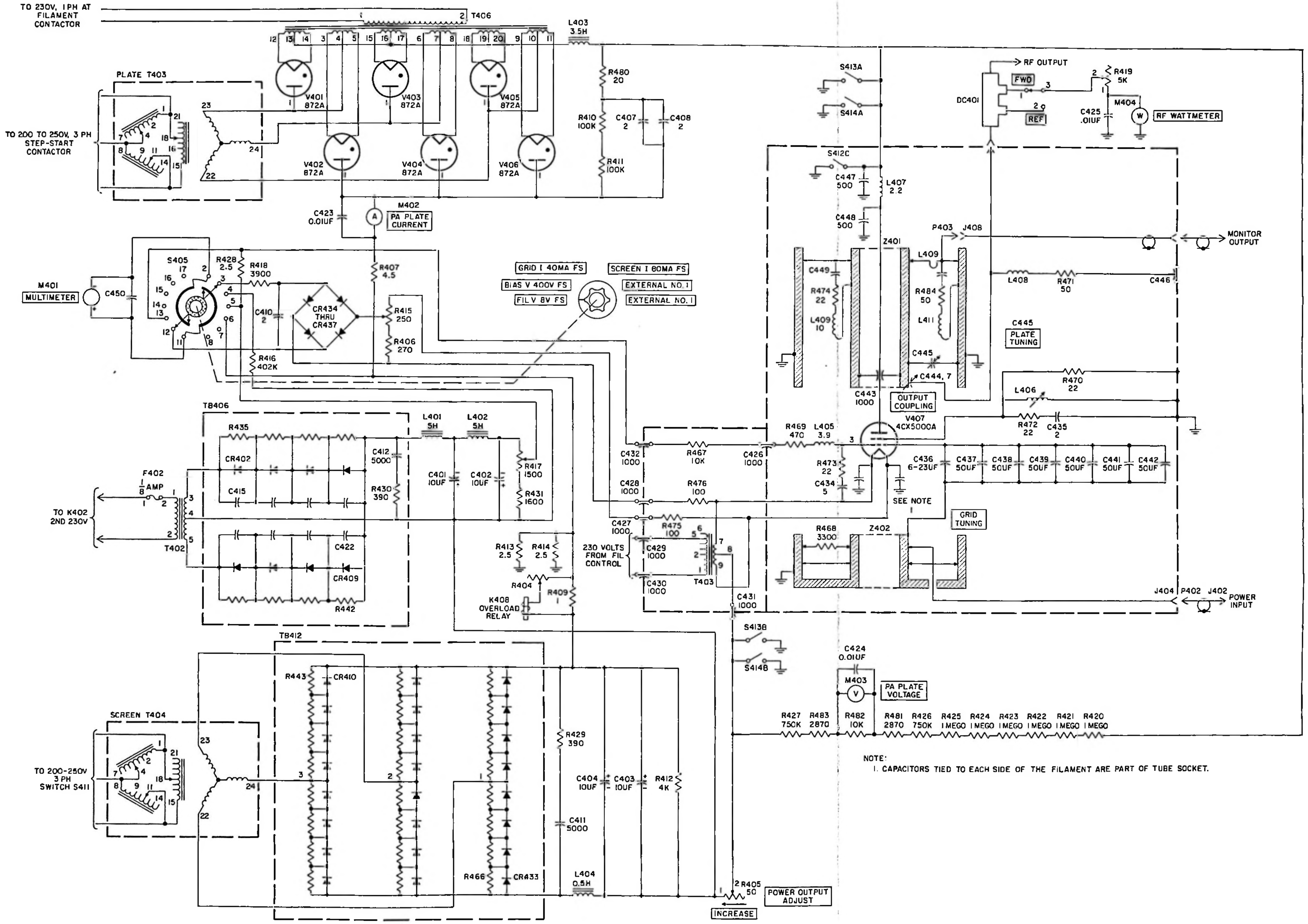


Figure 2-3. E830-1 Power Amplifier Circuits, Simplified Schematic

power amplifier and will not normally affect the driver. Pressing the PLATE OFF switch, S114, opens the ground to plate-hold relay K403, releasing K403. Step-start contactor, K406, will then release removing direct 3-phase power from plate and screen power supplies and momentarily throwing dropping resistors R401, R402, and R403 into the plate-screen circuits. Moments after step-start contactor K406 opens, plate-on contactor K405 will open, removing all power from the plate and screen power supplies. This stepping action limits transients that would normally be introduced into the power supply from the sudden shutting off of power.

If FILAMENT OFF switch S111 is pressed, power will momentarily be removed from all circuits within the driver and power amplifier causing the holding relays to drop out, shutting off the power amplifier and driver.

2.1.2 POWER AMPLIFIER CIRCUITS.

Refer to figure 2-3, a simplified schematic of the power amplifier circuitry of E830-1 5-Kw FM Power Amplifier. The power amplifier consists of a single ceramic type, forced air-cooled tube working into a tuned cavity over the standard frequency modulated broadcast band of 88 to 108 megacycles.

Power amplifier V207 is a fixed bias, class C, grounded screen tetrode. The input from the 250-watt driver is tied into a resonant tuned cavity (a foreshortened $\frac{\lambda}{4}$ resonator) and fed to the control grid. Resistor R468 swamps out much of the driver power which is fed into the tuned cavity and, in addition, presents a low impedance broadband load to the control grid. Initial tuning of the grid cavity is accomplished by a slider which physically lengthens or shortens the grid cavity. Grid cavity tuning is accomplished by adjusting variable capacitor C436. Fixed capacitors C437, C438, C439, C440, C441, and C442 in parallel with C436 couple the input tank to pa grid. As the power amplifier is a grounded screen amplifier necessitating the filament be below ground potential, the grid bias supply is floating and is connected in series with the screen grid power supply giving negative control grid bias with respect to the filament. Resistor R473 and capacitor C434 form a parasitic suppressor (parasitics around 200 megacycles) while L405 blocks r-f from the grid bias supply.

The plate works into a tuned cavity (foreshortened $\frac{\lambda}{4}$ resonator which is similar to the grid cavity. The plate cavity consists of a short piece of coaxial transmission line which resonates with the plate capacity of V407 and PLATE TUNING capacitor C445. Initial tuning is similar to the grid cavity, and is accomplished by a shorting slider on the transmission line which physically lengthens or shortens the transmission line. Parasitic suppressors located within the cavity (C449, L410, R484, and L411) suppress resonances around 200 and 400 megacycles. The parasitic suppressor capacity is formed by the distributed capacity of resistors, R474 and R484, and the cavity walls.

R-f output coupling is achieved by a movable plate within the cavity, forming a capacity between the coaxial transmission line and the movable metal plate. This capacitor is C444. R-f output from C444 is then fed to a directional coupler if a higher power amplifier is fed, or to a harmonic filter and through the directional coupler if an antenna is fed directly. Suppressor L408, R471, and C446 effectively damps the high order resonances of the plate tank circuit.

As stated previously, the power amplifier, V407, operates as a grounded screen amplifier. Actually the screen is slightly above r-f ground to provide screen neutralization of the tube. Neutralization is accomplished by balancing the capacitance bridge formed by the plate to control grid capacitance, the plate to screen grid capacitance, and the screen to control grid capacitance. This is accomplished by adding a small variable inductance, L406, to form an r-f voltage from the screen to control grid 180 degrees out of phase with the plate to control grid r-f. This additional impedance balances the bridge to neutralize the tube for a fixed operating frequency.

Plate voltage is obtained from a conventional 3-phase mercury vapor power supply, which, when connected in series with the screen power supply, forms the plate voltage. The power supply transformer is connected in a delta primary and a wye secondary configuration. Six mercury vapor rectifier tubes, V401 through V406, are arranged in a 3-phase full wave bridge rectifier circuit. A P.A. PLATE CURRENT meter, M402, is placed in the plate supply side of ground to indicate only plate current. As the screen supply is in series with the plate supply, the P.A. PLATE VOLTAGE meter, M403, is placed across both the screen and plate supplies to indicate the filament to plate voltage. The plate supply output is approximately 5700 volts d-c at 1.6 amp. When the plate supply voltage is added to the screen supply voltage, the total, 6350 volts, equals the total plate voltage.

Screen voltage is obtained from a conventional 3-phase semiconductor power supply. Resistors R443 through R466 are placed in parallel with the diodes to equalize the diode currents. A transient suppressor, R439 and C411, reduces transients formed when the power supply is turned on or off. The screen supply output is approximately 650 volts at 1.8 amp.

The control grid bias supply is a single phase, semiconductor power supply. A resistor and capacitor placed in parallel with each diode equalizes each diode. A transient suppressor, C412 and R430, reduces transients when power is turned on or off. The positive end of the grid bias supply is connected to the fixed side of POWER OUTPUT ADJUST potentiometer, R405. This permits R405 to control both the bias voltage and screen voltage when R405 is adjusted. The negative end of the bias supply is tied into the control grid through a meter shunt resistor and a filtering network. The control grid bias supply output is approximately 300 volts at 300 ma. Bias voltage is made adjustable by R417.

The filament of power amplifier V407 is below d-c ground because of the grounded screen configuration. The filament to ground potential will then be the screen voltage.

Metering circuits are provided to measure the filament voltage, control grid bias voltage, control grid current, and screen current. In addition, two external metering positions are available for connection to the multimeter. The customer may employ these extra meter positions for any use that he may desire.

The filament voltage metering circuit employs a full wave bridge rectifier to change the a-c filament voltage to d-c. The bridge output is filtered by R418 and C410, and the complete circuit is calibrated by R415. The grid bias voltage circuit is a voltage measuring device which measures the control grid bias voltage directly through the use of meter multiplier resistor R416. Grid current is metered by shunt resistor R428. Screen current is measured by placing the MULTIMETER across shunt resistors R413 and R414. As the screen is grounded, only screen current will flow through these resistors. External meter readings may be made by connecting to the proper terminals on TB405 (not shown on simplified schematic, see figure 5-1). The MULTIMETER is shunted with capacitor C450, to prevent any stray r-f from damaging the meter movement.

2.2 CONTROL FUNCTIONS.

The following paragraphs describe the functions of all controls in E830-1 5-Kw FM Power Amplifier. Refer to figure 2-4 for control locations.

The controls located on the front panel directly under the meters include the FILAMENT ON, FILAMENT OFF, PLATE OFF, and PLATE ON controls. The green "filament on" indicator and red "plate on" indicator are placed in line with the above mentioned controls. The FILAMENT ON switch, S112, energizes the filaments, the blowers, the bias supply, and will turn on the driver filament and the exciter if connected. The FILAMENT OFF switch, S111, de-energizes all transmitter circuits. The PLATE ON switch, S113, energizes the plate and screen power supplies and the driver plate supply. The PLATE OFF switch, S114, removes plate and screen voltage. The green filament indicator light, DS401, lights when the FILAMENT ON switch is pressed and the PA blower has activated the PA blower interlock. DS401 indicates that voltage is available to the filament control contactor. The filament control contactor starts the cabinet blower, the bias supply, and supplies the necessary voltage to the E830-1 filaments. The red "plate-on" indicator light, DS402, indicates plate voltage has been applied to the power amplifier.

The following controls are located directly under the right front door on the power amplifier panel. The POWER OUTPUT ADJUST potentiometer, R405, adjusts the power amplifier screen potential thus changing the output power. The FILAMENT VOLTAGE ADJUST potentiometer, R404, adjusts the filament transformer input voltage thus changing the filament voltage of V407. The WATTMETER switch, S406, connects the R.F. WATTMETER to either the reflected power or forward power section of the directional coupler. The WATTMETER switch is normally left in the FORWARD position. The MULTIMETER switch, S405, selects either filament voltage, bias voltage, control grid current, or screen current. In addition, two external positions are available for use by the customer. Table 3-1 lists the MULTIMETER switch positions and typical indications for each of the four meter positions.

The following controls are located directly behind the left front door on the power amplifier cavity. The PLATE TUNING control, C445, tunes the plate cavity to resonance and is set near the minimum indication on the P.A. PLATE CURRENT meter, M402. At this point, the power output should be at the peak as indicated on the R.F. WATTMETER, M404. The OUTPUT COUPLING control, C444, adjusts the coupling of the load to the plate cavity. The GRID TUNING control, C436, tunes the grid cavity.

The following controls are located on the power panel directly behind the bottom front panel of the power amplifier cabinet. The PLATE circuit breaker, CB402, is a protective device which monitors the plate and screen supply transformer primary currents. The circuit breaker will open when the current exceeds 30 amp. The CONTROL circuit breaker, CB401, monitors the total control circuit current. This current includes the power fed to the driver and exciter. The circuit breaker will open when the control circuit current exceeds 8 amp. The 5-amp CONTROL CIRCUIT fuse, F401, protects the control circuits from overloads. The 1/2 amp BIAS VOLTAGE fuse, F402, protects the bias supply from overloads.

The following adjustments are located directly below the P.A. PLATE CURRENT and R.F. WATTMETER indicators when the upper switch and meter panel is raised. The left potentiometer, located behind the panel, is the filament calibrating potentiometer, R415. This potentiometer is approximately 600 volts below ground potential and should only be adjusted with an insulated screwdriver. The filament metering circuit calibrating adjustment is also set at the factory and will not normally require adjustment. The center potentiometer is the overload adjusting potentiometer, R408. The overload adjustment is normally set for a plate current of 1.8 amp. The right potentiometer is the wattmeter adjusting resistor, R419. This potentiometer is normally set at the factory and should not require adjustment. The control grid bias adjustable resistor, R417, is located in the left bottom rear of the power amplifier cavity. The resistor is normally set for approximately 150 to 200 ma of plate current with no drive to the power amplifier.

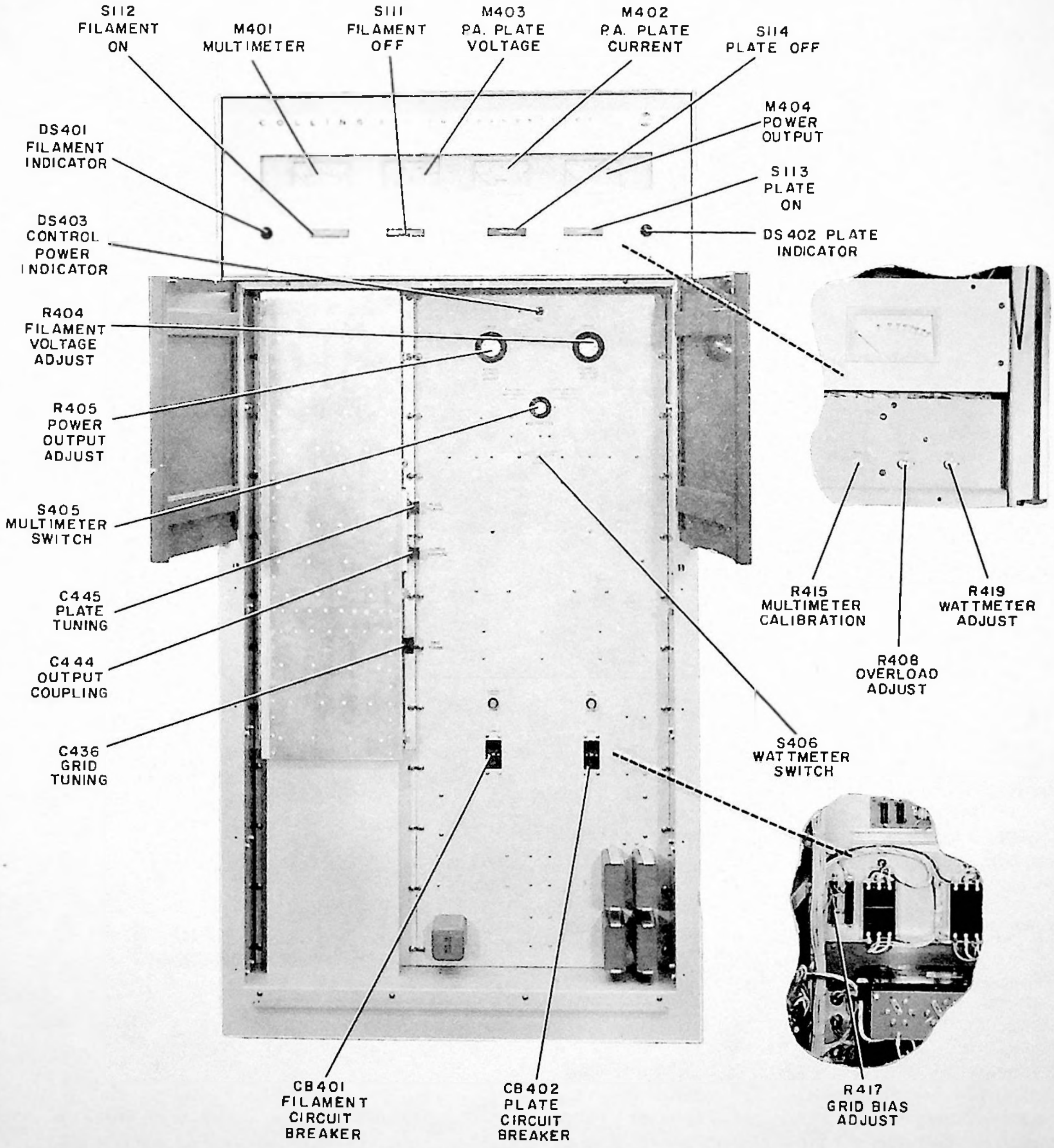


Figure 2-4. E830-1 Control and Adjustment Locations

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains information concerning the maintenance of E830-1 5-Kw FM Power Amplifier.

WARNING

Voltages present in this equipment are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the E830-1 cabinet when high voltage is applied. Do not depend entirely on door interlocks. Always shut down the E830-1 before doing any work inside the E830-1 cabinet. Immediately upon opening the rear doors, short out all high-voltage points using the shorting stick located inside the left rear door.

3.2 PREVENTIVE MAINTENANCE.

Most service interruptions in equipment of this type are caused by dirt and corrosion. Corrosion is accelerated by the presence of moisture and dust. Dust should be removed periodically with a soft brush or a dry, oil-free air jet. Remove dust as often as a perceptible quantity accumulates at any point in the power amplifier.

When the E830-1 is operated near salt water or in other corrosive atmospheres, inspect and clean interlock switches, cable connectors, tube prongs, and other metal parts more frequently to keep the equipment in top operating condition.

3.2.1 AIR FILTER CLEANING.

At least once each month, or more often if needed, clean the air filter according to the following procedure:

a. Remove the air filter from the E830-1 cabinet by loosening the two thumb screws located above the air filter. Slide the air filter to the extreme right, and pull the left side of the air filter out as soon as the filter clears the panel. Slide the air filter to the left and remove.

b. Mark with an arrow the direction of airflow.

c. Wash by passing a fine spray of hot water through the filter in the direction opposite that of the airflow. Gently shake the water out of the filter.

d. Dip the filter in a water-soluble oil, such as Filter-kote "M" available from Collins Radio Company Service Parts Department, Cedar Rapids, Iowa (Collins part number 005-0609-00).

e. Remove the filter from the oil; lay the filter face down until oil ceases to drip from the filter.

f. Replace the filter into the lower rear panel with the airflow arrow (marked when the filter was removed) pointing in the direction of the airflow. Tighten the two thumb screws.

g. Replacement filters are Collins part number 009-1069-00.

3.2.2 PA TUBE CLEANING.

The power amplifier tube depends upon a stream of air passing through the fins to cool the anode. When these fins become dirty, the airflow is reduced, and the tube life is shortened. The radiator fins should be cleaned as follows:

a. Remove the r-f amplifier tube as described in paragraph 3.2.2.1.

CAUTION

Special care must be used in removing or installing the power amplifier tube.

b. Direct a low-pressure (50 psi) air stream through the fins in the direction opposite to the normal airflow until all dust is removed.

c. Replace the r-f amplifier tube as described in paragraph 3.2.2.1.

3.2.2.1 PA TUBE REMOVAL

WARNING

Voltages present within the plate cavity are dangerous to life. Shut down the E830-1 before doing any work inside the cavity.

The power tube may be removed as follows:

a. Open the power amplifier cavity.

b. Grasp the center transmission line, and lift straight up until the transmission line clears the tube. (In some instances where the operating frequency is low, the slider clamp surrounding the center transmission line may have to be loosened. Before loosening the clamp, mark the plate slider position on the cavity sides for reference when replacing the slider.)

c. Grasp the handles located on the tube, and lift the tube from the tube socket. When the tube clears the tube socket chimney, the tube may be removed.

d. Tube replacement is the reverse of removal. After tube replacement, check the plate slider for proper distance from the deck plate for the station frequency. See System Instructions, Frequency Change for this approximate distance. Be sure the tube is seated firmly in the tube socket before replacing the center transmission line.

3.2.3 INSPECTION.

Once each week check and clean the three interlock switches at the rear of the E830-1 cabinet to be sure they are in good working order. Once each month check all connections in the E830-1. Tighten any nuts, bolts, or screws that may be loose. Check cable connections to see that they are clean and mechanically secure. Check moving parts, such as tuning controls, for excessive wear. Check the plate cavity slider for oxidation around ground springs.

3.2.4 LUBRICATION.

The cabinet fan and PA blower have bearings that are lubricated for the life of the equipment. No lubrication of the E830-1 is required.

3.2.5 TUBE MAINTENANCE.

The power amplifier, V201, should be inspected (tube in place) once each week to ensure that an accumulation of dust does not build up on the radiator fins. If dust is present, clean as described in paragraph 3.2.2. When tuning the E830-1, care should be taken not to exceed the maximum plate current shown in table 3-1.

3.3 TROUBLE SHOOTING.

The most common cause of trouble will probably be traced to tube failure. If a tube is suspected of failure, replace it with a tube of known quality, and note any change in performance. A small loss in emission of V201 can be compensated for by a change in the setting of the POWER OUTPUT ADJUST potentiometer.

Spare, preaged, mercury-vapor rectifier tubes should be available for immediate replacement. To ready these tubes for emergency use, place them in the power amplifier during off-the-air hours, and run them for approximately twenty minutes with only the filaments lighted. This will remove the mercury coating from the tube elements. Then carefully remove the tubes from the power amplifier, and store them in an upright position where they will not be inverted or agitated. When these preaged tubes are placed in the E830-1, handle them carefully to avoid the twenty-minute warmup period that will be required if mercury comes in contact with the tube elements. Never apply plate voltage to mercury-vapor rectifier tubes that have not been aged long enough to remove all mercury from the tube elements.

Four meters are located on the E830-1 front panel to assist in locating any trouble which may occur. Table 3-1 contains typical meter indications. These average indications are obtained from several production power amplifiers. The indications of some E830-1 may vary slightly outside the given limits without affecting power amplifier performance. A list of panel meter indications for each individual power amplifier should be taken when the E830-1 is operating properly in its particular installation. Any abnormal deviation from these values will be apparent during a check of meter indications.

TABLE 3-1. TYPICAL METER INDICATIONS

METER	METER SWITCH POSITION	INDICATION
MULTIMETER	Filament	~~7.5~~ volts 7.0 - 7.3
MULTIMETER	Bias V 400 V FS	~~140-180 volts~~ 200 V.
MULTIMETER	Grid I 40 MA FS	5-15 ma
MULTIMETER	Screen I 80 MA FS	5-40 ma 25-30
PA PLATE VOLTAGE		6100 to 6300 volts
PA PLATE CURRENT		Approx. 1.25 A
R.F. WATTMETER	Forward	5 Kw
R.F. WATTMETER	Reflected	Less than 500 watts

3.4 CABLE CHART.

Table 3-2 contains from-to information for cables installed in E830-1 5-Kw FM Power Amplifier. The table is useful in locating point-to-point wiring within the E830-1 cabinet. The from column is listed in alphabetical and numerical order. To find a particular wire, establish the point on the E830-1 from which wire tracing is to be initiated. Find this point in the from column of table 3-2, and the to column will give the location of the other end of that particular wire. The wire code column, located inside the rear cover of this instruction book, gives the type and color of wire used in each case.

TABLE 3-2. CABINET FROM-TO INFORMATION

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RD90	B401-1	K401-2	RC9	E401	K403-6
RD92	B401-2	K401-4	RC9	E401	K404-7
RD95	B401-3	K401-6	RC9	E401	K405-2
VC905	C401-1	L401-2	RC9	E401	K406-10
VC902	C401-2	TB406-12	RC925	E401	M404-2 (-)
RB91	C401-2	T402-4	VE905	E401	R413-1
VC92	C402-1	R417-1	RC9	E401	S112-1
VC906	C402-1	L402-2	VB9	E401	S405-15
VC91	C402-2	R431-2	RC9	E401	T401-9
VE92	C403-1	R405-1	RE9	E402	E401
VE902	C403-1	S413-B	RE9	E402	TB401-4
VE92	C403-1	R412-1	RE9	E402	TB403-10
VE92	C403-1	S412-B	VE93	E407	C408-2
RE92	C403-2	R412-2	VE92	E407	M402-1 (-)
VE92	C404-1	L404-2	LE9	E407	V404-1
VC95	C404-1	R431-2	LE9	E407	V406-1
LE9	C408-1	R410-1	LE9	E407	V402-1
VE93	C408-2	E407	VB90	E409	R417-3
VE92	C408-2	R411-2	VB90	E409	S405-5
RC93	C427	TB407-7	VC93	E410	R418
VB93	C428	TB407-2	VC92	E410	TB407-3
RC90	C429	R404-2	VB93	E411	TB407-1
RC92	C430	K402-4	VB92	E418	R431-2
VE2	C431	R405-2	RC95	J401-1	K402-6
VB91	C432	S405-13	RC90	J401-2	K402-8
LE9	C447-1	L403-2	RD93	K401-1	CB401-6
VG0	CB401-3	TB401-1	RD90	K401-2	B401-1
VG2	CB401-2	TB401-2	RD92	K401-3	CB401-5
VG95	CB401-1	TB401-3	RD92	K401-4	B401-2
RD95	CB401-4	K401-5	RD95	K401-5	CB401-4
RD95	CB401-4	T401-1	RD95	K401-6	B401-3
RC5	CB401-4	T402-2	RC93	K401-7	K403-4
RE5	CB401-4	TB402-2	RC9	K401-8	E401
RD92	CB401-5	K402-3	RC935	K401-9	TB403-8
RE2	CB401-5	TB402-1	RC935	K401-9	K402-9
RD92	CB401-5	K401-3	RC93	K401-10	S112-2
RD93	CB401-6	K4015	RC93	K401-10	TB403-6
VG0	CB402-1	TB401-1	RD93	K402-1	CB401-6
VG2	CB402-2	TB401-2	RC902	K402-2	C404-1
VG4	CB402-3	TB401-3	RD92	K402-3	CB401-5
VG0	CB402-4	K405-3	RC92	K402-4	C430
VG2	CB402-5	K405-5	RC923	K402-5	T401-1
VG4	CB402-6	K405-7	RC95	K402-6	J401-1
DAS0	DC401-1	S406-1	RC95	K402-6	T406-2
DAS9	DC401-2	S406-2	RD90	K402-7	T401-5
RC936	DS401-1	K402-9	RC90	K402-8	XF402-1
RE9	E401	E402	RC90	K402-8	T406-1
RC9	E401	K401-8	RC90	K402-8	J401-2

TABLE 3-2. CABINET FROM-TO INFORMATION (CONT)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC935	K402-9	K401-9	RC91	K406-12	XDS402-1
RC936	K402-9	DS401-1	RC91	K406-12	K403-13
RC91	K402-9	K403-13	VB95	K407-1	R408-2
RC935	K402-9	TB404-5	RC92	K407-3	TB403-7
RC936	K402-10	S407-1	RC923	K407-4	S408-1
RC902	K402-10	TB407-12	VC903	L401-1	TB406-5
RD96	K403-1	XF401-1	VC905	L401-2	C401-1
RC6	K403-1	K406-7	VC906	L402-2	C402-1
RC6	K403-3	K406-8	LE9	L403-1	T406-19
RC91	K403-3	S412-2	LE9	L403-2	C447-1
RC93	K403-4	K401-7	LE9	L403-2	TB407-11
RC93	K403-4	S407-2	LE9	L403-2	S413-A
RC9	K403-6	E401	LE9	L403-2	R480-1
RC923	K403-7	K407-3	VE93	L404-1	TB412-9
RC923	K403-9	TB403-2	VE92	L404-2	C404-1
RC925	K403-10	TB404-3	VB92	M401-1 (+)	S405-11
RC926	K403-12	K405-11	VB90	M401-2 (-)	S405-2
RC91	K403-13	K402-9	VE92	M402-1 (-)	E407
RC91	K403-13	K406-12	RE92	M402-2 (+)	R407-1
RC905	K403-14	S403-2	VC905	M403-1 (-)	TB407-15
RC926	K403-14	TB404-4	VC906	M403-2 (+)	TB407-7
RC7	K404-2	TB404-10	RC91	M404-1 (+)	R419-1
RC6	K404-3	K406-8	RC925	M404-2 (-)	E401
RC6	K404-4	K405-1	VG0	R401-1	K406-1
RC4	K404-6	TB403-5	VG0	R401-2	K406-2
RC9	K404-7	E401	VG2	R402-1	K406-3
RC6	K405-1	K404-4	VG2	R402-2	K406-4
RC9	K405-2	E401	VG4	R403-1	K406-5
VG0	K405-3	CB402-4	VF4	R403-2	K406-6
VG0	K405-4	K406-1	RC902	R404-1	K402-2
VG2	K405-5	K402-5	RC90	R404-2	C429
VG2	K405-6	K406-3	VE92	R405-1	C403-1
VG4	K405-7	CB402-6	VE2	R405-2	C431
VG4	K405-8	K406-5	VC92	R405-2	TB407-14
RC926	K405-11	K403-12	RE92	R407-1	M402-2 (+)
RC91	K405-12	K406-11	VC95	R407-1	TB405-4
VG0	K406-1	K405-4	VC93	R407-2	TB405-3
VG0	K406-1	R401-1	VB91	R407-2	S405-6
VG0	K406-2	R401-2	VB93	R408-1	R409-2
VG0	K406-2	T403-1	VB95	R408-2	K407-1
RE90	K406-2	S411-2	RE92	R409-1	TB412-4
VG2	K406-3	K405-6	VB93	R409-2	R408-1
VG2	K406-3	R402-1	LE9	R410-1	C408-1
VG2	K406-4	R402-2	VE92	R411-2	C408-2
VG2	K406-4	T403-8	VE92	R412-1	C403-1
RE2	K406-4	S411-4	RE92	R412-2	C403-2
VG4	K406-5	K405-8	VE905	R413-1	E401
VG4	K406-5	R403-1	VC92	R417-1	C402-1
VG4	K406-6	T403-15	VB90	R17-3	E409
VG4	K406-6	R403-2	VC93	R418	E410
RE5	K406-6	S411-6	RC91	R419-1	M404-1 (+)
RC6	K406-7	K403-1	DAS90	R419-2	S406-3
RC6	K406-8	K403-3	VC95	R431-2	C404-1
RC6	K406-8	K404-3	VC91	R431-2	C402-2
RC902	K406-9	TB407-5	VB92	R431-2	E418
RC9	K406-10	E401	LE9	R480-1	L403-2
RC91	K406-11	K405-12	RC1	S111-1	TB404-7

TABLE 3-2. CABINET FROM-TO INFORMATION (CONT)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC1	S111-2	XDS403-1	VG2	T403-8	K406-4
RC1	S111-2	S412-1	VG4	T403-15	K406-6
RC9	S112-1	E401	LE9	T403-22	T406-10
RC93	S112-2	K401-10	LE9	T403-23	T406-4
RC925	S113-1	TB404-3	LE9	T403-24	T406-7
RC925	S113-1	S114-1	RE90	T404-1	S411-1
RC925	S114-1	S113-1	RE2	T404-8	S411-3
RC923	S114-2	S410-2	RE5	T404-15	S411-5
RC925	S114-2	TB404-3	VD91	T404-22	TB412-1
RC905	S403-2	K403-14	VD95	T404-23	TB412-2
VB90	S405-2	M401-2 (-)	VD96	T404-24	TB412-3
VB91	S405-6	R407-2	RC90	T406-1	K402-8
VB95	S405-7	TB405-5	RC95	T406-2	K402-6
VB902	S405-8	TB405-7	LE9	T406-3	XV402-F1
VB90	S405-5	E409	LE9	T406-4	V401-1
VB92	S405-11	M401-1 (+)	LE9	T406-4	T403-23
VB91	S405-13	C432	LE9	T406-5	XV402-F2
VB9	S405-15	E401	LE9	T406-6	XV404-F1
VB903	S405-16	TB405-6	LE9	T406-7	V403-1
VB96	S405-17	TB405-8	LE9	T406-7	T403-24
DAS0	S406-1	DC401-1	LE9	T406-8	XV404-F2
DAS9	S406-2	DC401-2	LE9	T406-9	XV406-F1
DAS90	S406-3	R419-2	LE9	T406-10	V405-1
RC936	S407-1	K402-10	LE9	T406-10	T403-22
RC93	S407-2	K403-4	LE9	T406-11	XV406-F2
RC923	S408-1	K407-4	LE9	T406-12	XV401-F1
RC92	S408-2	S409-1	LE9	T406-14	XV401-F2
RC92	S409-1	S408-2	LE9	T406-15	XV403-F1
RC92	S409-2	S410-1	LE9	T406-17	XV403-F2
RC92	S410-1	S409-2	LE9	T406-18	XV405-F1
RC923	S410-2	S414-2	LE9	T406-19	L403-1
RE90	S411-1	T404-1	LE9	T406-20	XV405-F2
RE90	S411-2	K406-2	VG0	TB401-1	CB402-1
RE2	S411-3	T404-8	VG0	TB401-1	CB401-3
RE2	S411-4	K406-4	VG2	TB401-2	CB402-2
RE5	S411-5	T404-15	VG2	TB401-2	CB401-2
RE5	S411-6	K406-6	VG4	TB401-3	CB402-3
VE92	S412-B	C403-1	VG95	TB401-3	CB401-1
RC1	S412-1	S112-2	RE9	TB401-4	TB402-3
RC91	S412-2	TB403-3	RE9	TB401-4	E402
LE9	S413-A	L403-2	RE2	TB402-1	CB401-5
LE9	S413-A	S414A	RE5	TB402-2	CB401-4
VE903	S413-B	S414-B	RE9	TB402-3	TB401-4
VE903	S414-B	S413-B	RD90	TB403-1	TB404-9
LE9	S414-A	S413-A	RC923	TB403-2	K403-9
RC923	T401-1	K402-5	RC91	TB403-3	S412-2
RC95	T401-1	CB401-4	RC4	TB403-5	K404-6
RD93	T401-5	CB401-6	RC93	TB403-6	TB404-6
RD90	T401-5	K402-7	RC93	TB403-6	K401-10
RC6	T401-8	X401-2	RC92	TB403-7	K407-3
RC9	T401-9	E401	RC935	TB403-8	K401-9
RC90	T402-1	XF402-2	RE9	TB403-10	E402
RC5	T402-2	CB401-4	RC925	TB404-3	K403-10
RB90	T402-3	TB406-1	RC925	TB404-3	S113-1
RB91	T402-4	C401-2	RC926	TB404-4	K403-14
RB92	T402-5	TB406-7	RC935	TB404-5	K402-9
VG0	T403-1	K406-2	RC93	TB404-6	TB403-6

TABLE 3-2. CABINET FROM-TO INFORMATION (CONT)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC1	TB404-7	S111-1	VB96	TB408-1	TB405-12
VB95	TB404-8	TB405-11	VB93	TB408-2	TB405-13
RD96	TB404-8	XF401-1	VB92	TB409-1	TB405-10
RD90	TB404-9	TB403-1	VE91	TB409-2	TB405-9
RC7	TB404-10	K404-2	VD91	TB412-1	T404-22
VC92	TB405-1	TB407-16	VD95	TB412-2	T404-23
VC91	TB405-2	TB407-6	VD96	TB412-3	T404-24
VC93	TB405-3	R407-2	RE92	TB412-4	R409-1
VC95	TB405-4	R407-1	VE93	TB412-9	L404-1
VB95	TB405-5	S405-7	LE9	V401-1	T406-4
VB903	TB405-6	S405-16	LE9	V402-1	E407
VB902	TB405-7	S405-8	LE9	V403-1	T406-7
VB96	TB405-8	S405-17	LE9	V404-1	E407
VB91	TB405-9	TB409-2	LE9	V405-1	T406-10
VB92	TB405-10	TB409-1	LE9	V406-1	E407
VB95	TB405-11	TB404-8	RC902	XDS401-2	TB407-13
VB96	TB405-12	TB408-1	RC91	XDS402-1	K406-12
VB93	TB405-13	TB408-2	RC902	XDS402-2	TB407-4
RB90	TB406-1	T402-3	RC1	XDS403-1	S111-2
VC903	TB406-5	L401-1	RD96	XF401-1	TB404-8
RB92	TB406-7	T402-5	RD96	XF401-1	K403-1
VC902	TB406-12	C401-2	RC6	XF401-2	T401-8
VB93	TB407-1	E411	RC90	XF402-1	K402-8
VB93	TB407-2	C428	RC90	XF402-2	T402-1
VC92	TB407-3	E410	LE9	XV401-F2	T406-14
RC902	TB407-4	XDS402-2	LE9	XV401-F1	T406-12
RC902	TB407-5	K406-9	LE9	XV402-F2	T406-5
VC91	TB407-6	TB405-2	LE9	XV402-F1	T406-3
RC93	TB407-7	C427	LE9	XV403-F2	T406-17
VC906	TB407-7	M403-2 (+)	LE9	XV403-F1	T406-15
LE9	TB407-11	L403-2	LE9	XV404-F1	T406-6
RC902	TB407-12	K402-10	LE9	XV404-F2	T406-8
RC902	TB407-13	XDS401-2	LE9	XV405-F1	T406-18
VC92	TB407-14	R405-2	LE9	XV405-F2	T406-20
VC905	TB407-15	M403-1 (-)	LE9	XV406-F1	T406-9
VC92	TB407-16	TB405-1	LE9	XV406-F2	T406-11

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	E830-1 5-Kw FM Power Amplifier	549-2009-00
B401	FAN, CENTRIFUGAL: 230 v ac, 50/60 cps, three phase; continuous duty cycle; IMC Magnetics part no. BT3830B-13	009-1584-00
C401	CAPACITOR, FIXED, PAPER: 10 uf, ±10%, 1000 v dc	962-4360-00
C402 thru C404	CAPACITOR, FIXED, PAPER: same as C401	962-4360-00
C405	NOT USED	
C406	NOT USED	
C407	CAPACITOR, FIXED, PAPER: 2 uf, ±10%, 7500 v dc	930-0330-00
C408	CAPACITOR, FIXED, PAPER: same as C407	930-0330-00
C409	CAPACITOR, FIXED, PAPER: 1 uf, ±20%, 100 v dc	931-4500-00
C410	CAPACITOR, FIXED, PAPER: same as C409	931-4500-00
C411	CAPACITOR, FIXED, CERAMIC: 0.005 uf, ±20%, 3000 v dc	913-3512-00
C412	CAPACITOR, FIXED, CERAMIC: same as C411	913-3512-00
C413	NOT USED	
C414	NOT USED	
C415	CAPACITOR, FIXED, CERAMIC: 0.02 uf, +100% -20%, 500 v dc; Solar Electric Co. part no. CD20XD-203W	913-2142-00
C416 thru C422	CAPACITOR, FIXED, CERAMIC: same as C415	913-2142-00
C423	CAPACITOR, FIXED, CERAMIC: 10,000 uuf, ±20%, 500 v dc	913-1188-00
C424	CAPACITOR, FIXED, CERAMIC: same as C423	913-1188-00
C425	CAPACITOR, FIXED, CERAMIC: same as C423	913-1188-00
C426	CAPACITOR, FIXED, CERAMIC: 1000 uuf, -0% +100% at room temp; 1600 v dc	913-0154-00
C427 thru C432	CAPACITOR, FIXED, CERAMIC: same as C426	913-0154-00
C433	NOT USED	
C434	CAPACITOR, FIXED, CERAMIC: 5 uuf, ±0.5 uuf, 5000 v dc	913-0760-00
C435	CAPACITOR, FIXED, CERAMIC: 2 uuf, ±0.5 uuf, 5000 v dc	913-0757-00
C436	CAPACITOR	922-0571-00
C437	CAPACITOR, FIXED, CERAMIC: 50 uf, ±2%, 5000 v dc; Centralab part no. 850S-50Z	913-0828-00
C438 thru C440	CAPACITOR, FIXED, CERAMIC: same as C437	913-0828-00
C441	CAPACITOR, FIXED, CERAMIC: S/A C437	913-0828-00
C442	CAPACITOR, FIXED, CERAMIC: S/A C437	913-0828-00
C443	CAPACITOR, FIXED, PLASTIC: c/o insulator sheet; brass electrical contact assembly 16-7/8 in. lg by 5 in. w overall; copper electrical contact; brass capacitor ring 3-7/8 in. lg by 5-1/8 in. dia	549-2069-003
C444	NOT USED	
C445	NOT USED	
C446	NOT USED	
C447	CAPACITOR, FIXED, CERAMIC: 500 uuf +50 -20%, 20,000 v dc	913-1101-00
C448	CAPACITOR, FIXED, CERAMIC: same as C447	913-1101-00
C449	NOT USED	
CB401	CIRCUIT, BREAKER: three pole magnetic circuit breaker; 50 amps contact rating; 8 v ac amps	260-0406-00
CB402	CIRCUIT, BREAKER: 3 pole magnetic circuit breaker; 50 amps contact rating; 30.0 ac amps rating	260-0412-00
CR401	NOT USED	
CR402	SEMICONDUCTOR DEVICE, DIODE: silicon; General Electric type 1N540	353-1546-00
CR403 thru CR409	SEMICONDUCTOR DEVICE, DIODE: same as CR402	353-1546-00
CR410	SEMICONDUCTOR DEVICE, DIODE:	353-1452-00
CR411 thru CR421	SEMICONDUCTOR DEVICE, DIODE: same as CR410	353-1452-00
CR422	SEMICONDUCTOR DEVICE, DIODE:	353-1453-00
CR423 thru CR433	SEMICONDUCTOR DEVICE, DIODE: same as CR422	353-1453-00

Early 830E-1
830B 830D
Rear door fan
230-0164-000

ITEM	DESCRIPTION	COLLINS PART NUMBER
CR434 thru CR437	SEMICONDUCTOR DEVICE, DIODE: same as CR402	353-1546-00
DC401	COUPLER, DIRECTIONAL: double coupler, 5000 w, 88 to 108 megacycle frequency range; 50 ohms impedance; 5-3/16 in. dia by 7 in. lg	277-0157-00
DS401	LAMP, INCANDESCENT: pilot light bulb w/ candelabra base and tapered bulb	262-3310-00
DS402	LAMP, INCANDESCENT: same as DS401	262-3310-00
DS403	LAMP, GLOW: neon bulb; 1/25 w, 65 v ac, 1-3/16 in. h overall; General Electric Co. part no. NE-51	262-0021-00
F401	FUSE, CARTRIDGE: glass enclosed, 5.0 amps, 250 v ma, 0.03 ohms resistance; Bussmann Mfg. Co. part no. MTH5	264-4090-00
F402	FUSE CARTRIDGE: 0.125 amps, 250 v; glass body; Bussman Mfg. Co. part no. MDL 1/8	264-4230-00
H401	CLAMP, LOOP: molded nylon cable clamp; 0.27 in. od by 0.38 in.; Burndy Eng. Co., Inc. part no. HP-4N	150-1541-00
H402	SHOCK, MOUNTING: cylindrical; neoprene; 9/16 in. dia by 1-1/4 in. lg	200-0060-00
H403	GASKET, synthetic rubber; circular; 0.103 in. w by 0.373 in. id; Precision Rubber Prod. Co. part no. 902-14	200-0230-00
H404	BUMPER: rubber or synthetic rubber; 19/64 in. by 7/16 in.; Lavelle Rubber Co. part no. 15-A-3PB	200-0669-00
H405	SPRING, SHORTING SWITCH: steel, corrosion resistant; passivate finish; 5/16 in. coil dia; 0.031 in. wire size	540-5342-002
H406	PIN, STRAIGHT, HEADED: carbon steel; 5/8 in. dia undercut to 15/32 in. dia; 3/8 in. lg	549-2283-002
H407	SPRING, INTERLOCK, DUAL: beryllium copper; silver plate finish; 0.040 in. by 2 in. by 4-7/32 in. lg approx, irregular shape	549-2315-003
J401	CONNECTOR, PLUG, ELECTRICAL: 3 female contacts; straight; 10 amps, 250 v; 15 amps, 125 v	368-0014-00
J402	CONNECTOR, RECEPTACLE, ELECTRICAL: female jack connector for use w/ coaxial cable; 500 v operating voltage, 50 ohms impedance; teflon insulation, brass body, beryllium copper contact	357-9476-00
J403	CONNECTOR, RECEPTACLE, ELECTRICAL: for use w/ RG-55/U, RG-58/U coaxial cables; teflon insulation, copper contact, brass shell; 11/16 in. across hex, 1-5/32 in. lg; Communication Electronics part no. UG-909A/U	357-9248-00
J404	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 rd female contact, straight shape, 1 in. by 1 in. by 1.106 in. overall	357-9003-00
J405	CONNECTOR, RECEPTACLE, ELECTRICAL: UG-1094/U; type BNC; male, straight shape; panel mtg; Industrial Products, part no. 87075	357-9183-00
K401	RELAY, ARMATURE: 4C contact arrangement (4PDT) 50/60 cps nom coil voltage; 330 ohms ±10% coil resistance; 10 amps at 115 v ac, non-inductive contact rating; Aemco, Inc. part no. Type II R83-4PDT(mod)	970-1933-00
K402	RELAY, POWER: 50 cps coil; 10 amps, non-inductive load at 600 v ac; 110 v coil; 4 NO contacts; Allen-Bradley part no. Bul. 700	405-0428-00
K403	RELAY, ARMATURE: same as K401	970-1933-00
K404	RELAY, ARMATURE: 2C contact arrangement (DPDT); 10 amps at 115 v ac, non-inductive contact rating; 390 ohms ±10% coil resistance; Aemco, Inc. part no. Type II R 83-5 (mod)	970-1934-00
K405	RELAY, POWER: 110 v coil; 3 contacts; 60 cps frequency; 25 amps contact rating; non-inductive load 600 volts; Allen-Bradley part no. Size 1	401-1170-00
K406	RELAY, POWER: same as K405	~~401-1170-00~~
K407	RELAY, ARMATURE: 1C contact arrangement; 5 amps at 28 v dc or 115 v ac; 300 ma coil current; 10 ohms ±10% at +25°C coil resistance; continuous duty cycle; Sigma Instruments part no. 95062	~~408-1114-00~~ SUB
L401	REACTOR: 5.0 hys inductance; 100 ma dc; 280 ohms; continuous duty cycle; 1000 v rms; C.A.C. part no. 94-0422-00	678-0584-00
L402	REACTOR: same as L401	

ITEM	DESCRIPTION	COLLINS PART NUMBER
L403	REACTOR: 3.5 hy inductance, 2 amps dc; 25 ohms at +25°C, 15,000 v rms; Electro Engr. Works part no. E-10237	668-0274-00
L404	REACTOR: 0.5 hy inductance, 2 amps dc; 4 ohms at +25°C, 2500 v rms, Electro Engr. Works part no. E-10238	668-0269-00
L405	COIL, RADIO FREQUENCY: single layer wound; 3.9 uh, 1145 ma current, 0.50 ohms; Jeffers Electric part no. 10402-30	240-0177-00
L406	NOT USED	
L407	COIL, RADIO FREQUENCY: single layer wound; 2.2 uh, 1980 ma current; 0.20 ohms, Jeffers Electric part no. 10402-24	240-0174-00
L408	NOT USED	
L409	COIL, RADIO FREQUENCY: soldered; 1/2 in. id by 1-1/8 in. lg by 5/8 in.	547-2297-003
L410	NOT USED	
M401	METER, ELECTRICAL: permanent magnet moving coil type dc milliammeter; 0-1 ma dc meter range, 100 ohms ±5% meter resistance, ±2% accuracy	458-0649-00
M402	METER, ELECTRICAL: permanent magnet moving coil type dc milliammeter; 0-1 ma dc; ±2% accuracy	458-0645-00
M403	METER, ELECTRICAL: permanent magnet moving coil dc milliammeter; 0-1 ma dc; ±1% accuracy	458-0644-00
M404	METER, ELECTRICAL: permanent moving coil type dc microammeter; 0-200 ma meter range; 900 ohms approx meter resistance; ±2% accuracy	458-0647-00
MP401	COUPLING, RIGID: brass; nickel plated finish; 1/2 in. dia by 3/4 in. lg; two set screws; James Millen Mfg. Co. Inc. part no. 39003	015-0257-00
MP402	CHAIN ASSEMBLY, SINGLE LEG: 9 in. lg chain, terminated w/ hook	548-3592-002
MP403	CATCH: spring loaded w/ concealed springs; steel; cadmium or zinc plate; 13/32 in. by 1-1/8 in. by 2-29/32 in. lg; Nielsen Hardware Corp. part no. SC-B-83314-2	015-0803-00
MP404	BEARING, SLEEVE: flanged porous bronze: 9/16 in. dia; 3/8 in. lg; Oilite-Chrysler part no. F411-1	309-0093-00
MP405	BEARING, SLEEVE: same as MP404	309-0093-00
MP406	SHAFT, DOOR MOUNTING: aluminum; chromate dip; 1/2 in. dia by 32-15/32 in. lg	548-3574-002
MP407	SHAFT, DOOR MOUNTING: same as MP406	548-3574-002
MP408	CHAIN ASSEMBLY, SINGLE LEG: same as MP402	548-3592-002
MP409	ROD, SHORTING: free cutting brass; bright alloy finish; 1/2 in. dia by approx 16-1/2 in. lg	549-2154-002
MP410	BAR, ADJUSTING: aluminum bar, brass screw; 0.375 in. by 1 in. by 5.250 in. overall dim.	549-2294-003
MP411	BAR, ADJUSTING: fiber glass bar, brass screw; 0.375 in. by 1 in. by 5.250 in. overall dim.	549-2295-003
MP412	SPROCKET WHEEL: brass; tapped 10-24 id; 0.646 in. dia by 0.187 in. lg	549-2168-003
MP413	SHAFT, SHOULDER: melamine rod: 0.250 in. od by 8-1/8 in. lg	549-2223-002
MP414	SHAFT, STRAIGHT, SPROCKET: aluminum; chromate dip; 0.249 in. dia by 1-5/16 in. lg	549-2225-002
MP415	SHAFT, STRAIGHT, FLAT: CRES, type 303; passivate finish; 0.310 in. dia by 0.244 in. by 5-7/32 in. lg	549-2242-003
MP416	REDUCER, SHAFT: coml yellow brass; bright alloy finish, 5/8 in. dia undercut to 0.250 in. dia by 7/8 in. lg	549-2275-002
MP417	SHAFT, EXTENSION: CRES type 303; passivate finish; 0.250 in. dia by 1 in. lg	549-2284-002
MP418	SPROCKET WHEEL: brass, 60 sprockets; incl shaft	549-2352-002
MP419	SPROCKET WHEEL: same as MP418	549-2352-002
MP420	SPROCKET WHEEL: S/A MP412	549-2168-003
MP421	NOT USED	
MP422	FILTER, LOW PASS: 130 mc cut-off freq; 50 ohms input and output; 4 ft. lg o/a	549-2192-004
MP423	TRANSITION, AIR: plastic, 5.312 in. by 10.125 in. by 12 in.	549-2254-004
MP424	PARTITION, BOTTOM: brass, silver plated; 1.341 in. by 11.499 in. by 11.532 in.	549-2307-004
MP425	PARTITION, TOP: brass, silver plated; 1.314 in. by 11.499 in. by 11.532 in.	549-2189-004
MP426	LEAD SCREW: brass w/ aluminum bar; 10-24 thd. 2-3/4 in. lg, 5-1/2 in. lg o/a	549-2294-003
MP427	LEAD SCREW: brass w/ teflon bar; 10-24 thd. 2-3/4 in. lg; 5-1/2 in. lg o/a	549-2295-003
MP428	WASHER, CONTACT: aluminum; 2 in. dia by 0.063 in. thk	504-9553-001
MP429	ROD ASSEMBLY, SHORTING: brass rod w/ plastic handle; 24.938 in. lg o/a	549-2186-003
MP430	CLIP, ELECTRICAL: silver plated bronze; accommodates 1-1/16 in. dia component	549-2201-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
O401	KNOB: black phenolic w/ 6 flutes, aluminum insert w/ molded diamond knurl; 27/32 in. h by 1.500 in. dia, incls phenolic skirt	546-1293-003
O402 thru O404	KNOB: same as O401	546-1293-003
O405	KNOB: set screw type; black phenolic body; 1.009 in. dia by 0.750 in. thk; w/ skirt	547-8792-003
O406	KNOB: same as O405	547-8792-003
P401	CONNECTOR, PLUG, ELECTRICAL: 3 wire midget, twist-lock, 10 amps, 250 v; 15 amps, 125 v	368-0013-00
P402	CONNECTOR, PLUG, ELECTRICAL: brass body and contacts, teflon insulation; 3/4 in. dia approx by 1-1/2 in. lg approx; Amphenol part no. UG-1185/U	357-9326-00
P403	CONNECTOR, PLUG, ELECTRICAL: 1 male contact; Automatic Metal part no. 100B 1000A	357-9292-00
P404	CONNECTOR, PLUG, ELECTRICAL: same as P402	357-9326-00
P405	CONNECTOR, PLUG, ELECTRICAL: same as P402	357-9326-00
R401	RESISTOR, FIXED, WIREWOUND: 4.1 ohms, ±1%, 230 w	714-1613-00
R402	RESISTOR, FIXED, WIREWOUND: same as R401	714-1613-00
R403	RESISTOR, FIXED, WIREWOUND: same as R401	714-1613-00
R404	RESISTOR, FIXED, WIREWOUND: 7.5 ohms, ±10%, 100 w	738-0025-00
R405	RESISTOR, FIXED, WIREWOUND: 50 ohms, ±10%, 225 w	735-0362-00
R406	RESISTOR, FIXED, COMPOSITION: 270 ohms, ±10%, 2 w	745-5628-00
R407	RESISTOR, FIXED, WIREWOUND: 3.5 ohms, ±3%, 50 w; Dale Products part no. RH-50	747-8700-00
R408	RESISTOR, VARIABLE: wirewound; 50 ohms, ±10 ±10%, 2 w	377-0619-00
R409	RESISTOR, FIXED, WIREWOUND: 1 ohm, ±3%, 50 w; Dale Products part no. RH-50	747-8689-00
R410	RESISTOR, FIXED, WIREWOUND: 100,000 ohms, ±5%, 210 w	746-6737-00
R411	RESISTOR, FIXED, WIREWOUND: same as R410	746-6737-00
R412	RESISTOR, FIXED, WIREWOUND: 4000 ohms, ±5%, 210 w	746-6709-00
R413	RESISTOR, FIXED, WIREWOUND: 2.5 ohms, ±3%, 50 w Dale Products part no. RH-50	747-8697-00
R415	RESISTOR, VARIABLE: wirewound; 250 ohms, ±10%, 2 w	750-0519-00
R416	RESISTOR, FIXED, FILM: 402,000 ohms, ±1%, 1 w	705-3287-00
R417	RESISTOR, ADJUSTABLE: wirewound; 1500 ohms, ±10%, 50 w	716-0026-00
R418	RESISTOR, FIXED, COMPOSITION: 3900 ohms, ±10%, 1 w	745-3377-00
R419	RESISTOR, VARIABLE: composition; 5000 ohms, ±30%, 1/4 w	376-4729-00
R420	RESISTOR, FIXED, FILM: 1,000,000 ohms, ±1%, 2 w	705-4254-00
R421 thru R425	RESISTOR, FIXED, FILM: same as R420	705-4254-00
R426	RESISTOR, FIXED, FILM: 750,000 ohms, ±1%, 2 w	705-4251-00
R427	RESISTOR, FIXED, FILM: same as R426	705-4251-00
R428	RESISTOR, FIXED, WIREWOUND: 2.50 ohms, ±3%, 5 w	747-9748-00
R429	RESISTOR, FIXED, COMPOSITION: 390 ohms, ±10%, 1 w	745-3335-00
R430	RESISTOR, FIXED, COMPOSITION: same as R429	745-3335-00
R431	RESISTOR, FIXED, WIREWOUND: 1600 ohms, ±5%, 55 w	747-2751-00
R432	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±10%, 1 w	745-3412-00
R433	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±10%, 2 w	745-5652-00
R434	RESISTOR, FIXED, COMPOSITION: same as R433	745-5652-00
R435	RESISTOR, FIXED, COMPOSITION: 0.10 megohms, ±10%, 1 w	745-3436-00
R436 thru R442	RESISTOR, FIXED, COMPOSITION: same as R435	745-3436-00
R443	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, ±10%, 2 w	745-5715-00
R444 thru R466	RESISTOR, FIXED, COMPOSITION: same as R443	745-5715-00
R467	RESISTOR, FIXED, WIREWOUND: 1800 ohms, ±5%, 5 w; Dale Products part no. RSM-5	747-5465-00

549-2188-004
Shelf only

complete w/
finger stock

ITEM	DESCRIPTION	COLLINS PART NUMBER
R468	RESISTOR, FIXED, COMPOSITION: 3300 ohms, ±20%, 30 v dc	712-4224-00
R469	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%, 2 w	745-5638-00
R470	RESISTOR, FIXED: 22 ohms, ±20%, 18 w	712-0002-00
R471	RESISTOR, FIXED: 50 ohms, ±20%, 60 w	712-0070-00
R472 thru R474	RESISTOR, FIXED: same as R470	712-0002-00
R475	RESISTOR, FIXED, WIREWOUND: 100 ohms, ±5%, 5 w; Dale Products part no. RSM-5	747-5440-00
R476	RESISTOR, FIXED, WIREWOUND: same as R475	747-5440-00
R477 thru R479	NOT USED	
R480	RESISTOR, FIXED, WIREWOUND: 20 ohms, ±5%, 55 w	747-2713-00
R481	RESISTOR, FIXED, FILM: 2870 ohms, ±1%, 1 w	705-3272-00
R482	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%, 2 w	745-5694-00
R483	RESISTOR, FIXED, FILM: same as R481	705-3272-00
S401	SWITCH, PUSH: normally open and closed, bakelite; Arrow-Hart & Hegeman part no. B-2	260-2020-00
S402 thru S404	SWITCH, PUSH: same as S401	260-2020-00
S405	SWITCH, ROTARY: 6 positions, 2 moving, 12 fixed contacts, 115 v ac, 7-1/2 amps, 2 poles, 5 throw	259-0113-00
S406	SWITCH, TOGGLE: spdt; 125 v or 250 v dc or 250 v dc; 5 amps; Micro Switch part no. 6AT11-T	260-1509-00
S407	SWITCH, AIRFLOW INTERLOCK: spdt; 5 amps at 250 v ac; metal case	266-8307-00
S408A	CONTACT ASSEMBLY, ELECTRICAL: 5/8 in. by 11/16 in. by 1-7/8 in. overall	260-4040-00
S408B	CONTACT ASSEMBLY: door interlock switch, female; Neptune Electronics part no. F7460330G4	260-4050-00
S409A	CONTACT ASSEMBLY, ELECTRICAL: same as S408A	260-4040-00
S409B	CONTACT ASSEMBLY: same as S408B	260-4050-00
S410A	CONTACT ASSEMBLY, ELECTRICAL: same as S408A	260-4040-00
S410B	CONTACT ASSEMBLY: same as S408B	260-4050-00
S411	SWITCH TOGGLE: 3 pst; lug type terminals, 10 amps, 250 v ac; 15 amps at 125 v ac; Cutler-Hammer, Inc. Part no. 7611-K2	260-2274-00
S412	ELEMENT SECTION, ANTENNA NO. 1: chromate dip; 9 in. lg overall	549-2245-003
R412A	SWITCH, SENSITIVE: spdt; 6 amps 28.5 v dc; Micro Switch part no. Y3-1	260-0025-00
R412BC	P/o S412	
T401	TRANSFORMER, POWER, STEP-DOWN: 1 pri winding, 250 v, tapped at 200 v, 210 v, 220 v, 230 v at 100 va, 240 v, 50 to 60 cps; 120 v at 4.25 amp secondary, open frame; 5-1/8 in. by 5-1/8 in. by 5-3/8 in.; Electro Engr. Works part no. E12322	662-0043-00
T402	TRANSFORMER, POWER, STEP-UP: 230 v, 60 cps pri, 300 v dc at 100 ma, center tapped secondary; metal case; 2.750 in. by 2.937 in. by 3.812 in.; Chicago Std. Transformer part no. 31260	662-0049-00
T403	TRANSFORMER, POWER, STEP-UP: 230 v, 3 phase, 50 to 60 cps, tapped at 200, 210, 220, 240, 250 v inputs; 5800 v dc at 1.6 amps secondary; open frame; 10 in. by 13-1/4 in. by 16 in.; Electro Engr. Works part no. E12211	664-0007-00
T404	TRANSFORMER, POWER, STEP-UP: 230 v, 3 phase, 50 to 60 cps, tapped at 200, 210, 220, 240, 250 v inputs; 650 v at 1.8 amp secondary; open frame; 6-1/2 in. by 8-3/4 in. by 9 in., Electro Engineering Works part no. E12371	664-0004-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
T405	TRANSFORMER, POWER, STEP-DOWN: 1 primary winding 245 v, tapped at 235 v, 225 v, 215 v, 205 v, 50 to 60 cps; 7.8 v at 75 amp, center tapped, secondary; open frame; 5-1/2 in. by 6-1/4 in. by 6-5/8 in.; Electro Engr. Works part no. E9186-A	662-0213-00
T406	TRANSFORMER, POWER, STEP-DOWN: 1 primary winding, 230 v, 50 to 60 cps, 4 secondaries each w/ 5 v, center tapped, three at 7.5 amps, one at 22.5 amps; open frame; 4-3/4 in. by 8-5/8 in. by 9-1/8 in.; Electro Engr. Works part no. E10240	662-0273-00
TB401	TERMINAL BOARD: phenolic; 50 amps 600 v ac or dc; 3-1/4 in. lg by 1-5/16 in. h; Square D Co. part no. TB-4	306-0778-00
TB402	TERMINAL STRIP: barrier type; black phenolic connector strip; 4 terminals; 1-5/16 in. by 3-7/32 in. lg; Howard B. Jones part no. 4-142	367-5040-00
TB403	TERMINAL BOARD: phenolic; 13/32 in. by 7/8 in. by 5-11/64 in., incls 12 screw type terminals; barrier type	367-0518-00
TB404	TERMINAL BOARD: same as TB403	367-0518-002
TB405	TERMINAL BOARD, black phenolic; 1/2 in. by 1-1/8 in. by 7-3/4 in.; 16 terminals incl	367-4160-00
TB406	TERMINAL BOARD: type PBE-P plastic; 1/16 in. thk, 3-1/2 in. w by 6-5/8 in. lg	549-2234-003
TB407	TERMINAL BOARD: type GEE laminated glass cloth; 1/8 in. thk, 4-1/4 in. w by 12 in. lg	549-2264-003
TB408	TERMINAL BOARD: 4 terminals brass nickel plated screws and eyelets; 7/8 in. w by 2-5/32 in. lg	367-0002-00
TB409	TERMINAL BOARD: same as TB408	367-0002-00
TB410	NOT USED	
TB411	NOT USED	
TB412	RECTIFIER ASSEMBLY: 1-1/2 in. by 3-3/4 in. by 18-1/4 in.	549-2274-00
V401	ELECTRON TUBE: glass envelope, rectifier; General Electric 872A/872	256-0037-00
V402 thru V406	ELECTRON TUBE: same as V401	256-0037-00
V407	ELECTRON TUBE: tetrode; type 4CX5000A	256-0122-00
XDS 401A	LAMPHOLDER: panel mounting for use with candelabra screw base lamp	262-0255-00
XDS 401B	LENS, INDICATOR LIGHT: glass, green, translucent; frosted back; chrome holder	262-0258-00
XDS 402A	LAMPHOLDER: same as XDS401A	262-0255-00
XDS 402B	LENS, INDICATOR LIGHT: glass, red, translucent; frosted back; chrome holder	262-0259-00
XDS 403A	LAMPHOLDER: mounting bracket for miniature bayonet base pilot light bulbs	262-1260-00
XDS 403B	LENS: for use w/ miniature bayonet base type T-3-1/4 lamp; amber, frosted back; Dialight Corp. part no. 857B-213	262-0922-00
XF401	FUSEHOLDER: w/ transparent knob for use with 3 AG fuses; 0-20 amps, 100-250 v rating; Bussman Mfg. Co. part no. HKL-JRZ	265-1040-00
XF402	FUSEHOLDER: same as XF401	265-1040-00
XV401	SOCKET, ELECTRON TUBE: jumbo 4 pin bayonet base tube socket; 20 amps; E. F. Johnson Co. part no. 123-211-1	220-1460-00
XV402 thru XV406	SOCKET, ELECTRON TUBE: same as XV401	220-1460-00
XV407	SOCKET	220-1479-00

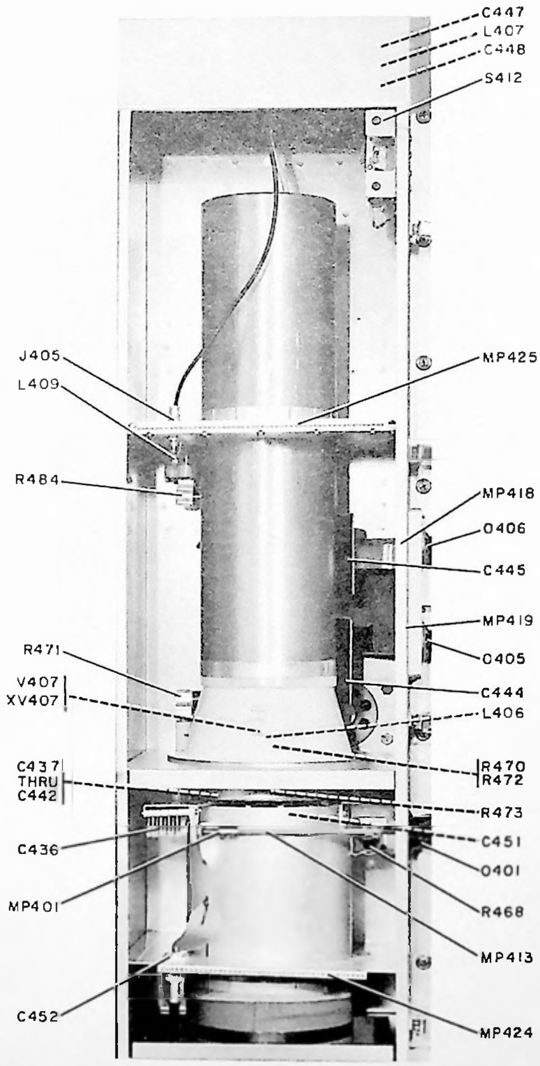


Figure 4-1. Cavity, Parts Location

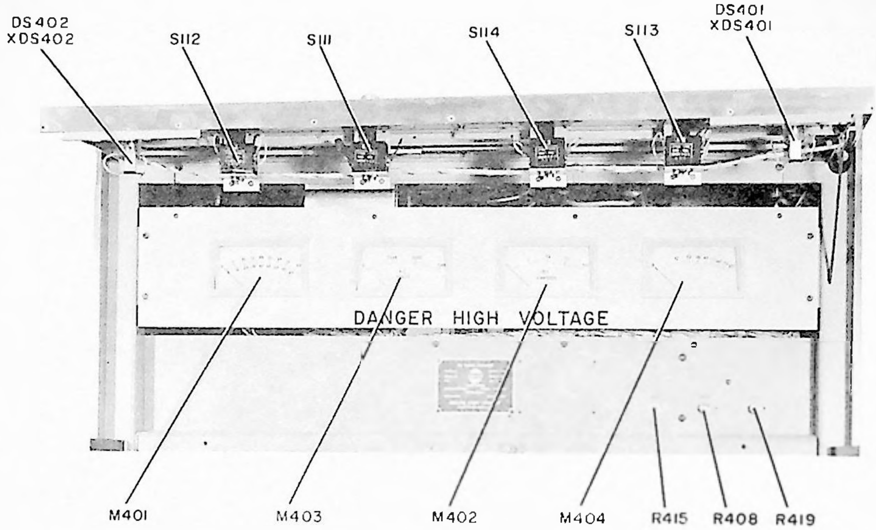


Figure 4-2. Indicator Panel, Parts Location

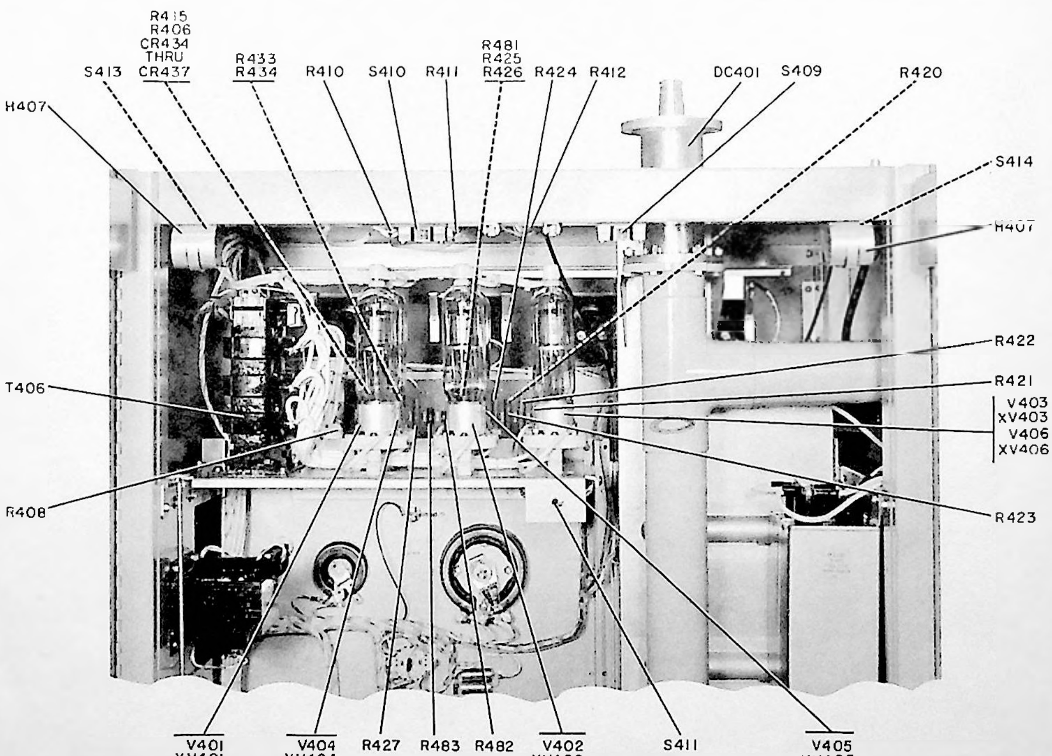


Figure 4-3. Plate Power Supply, Parts Location

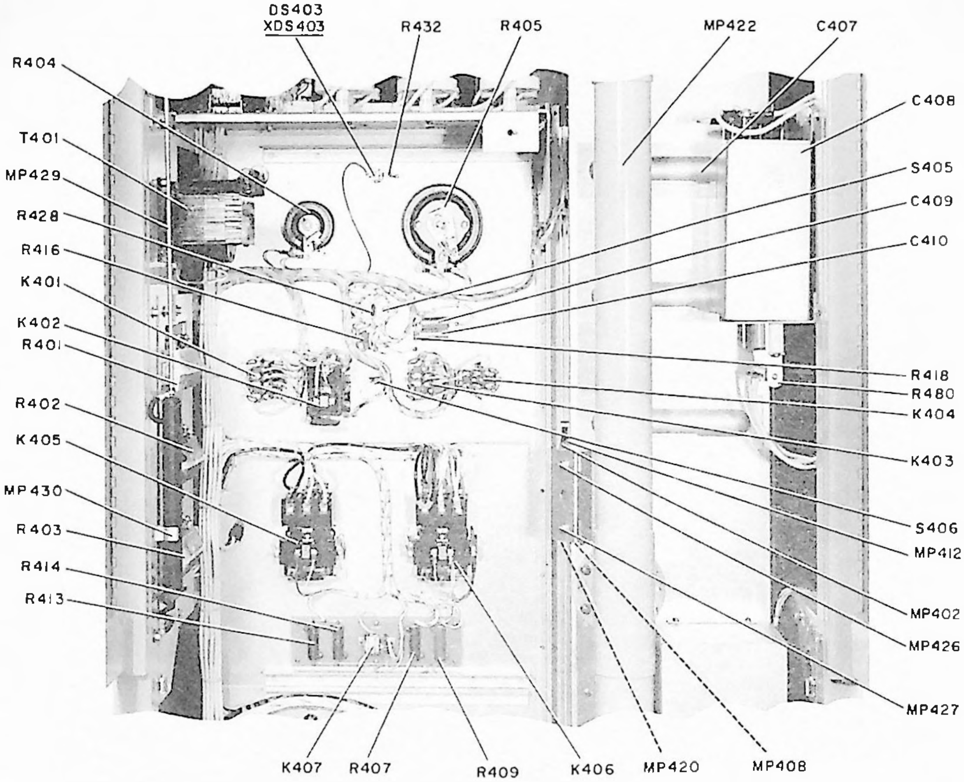


Figure 4-4. Control Panel, Parts Location

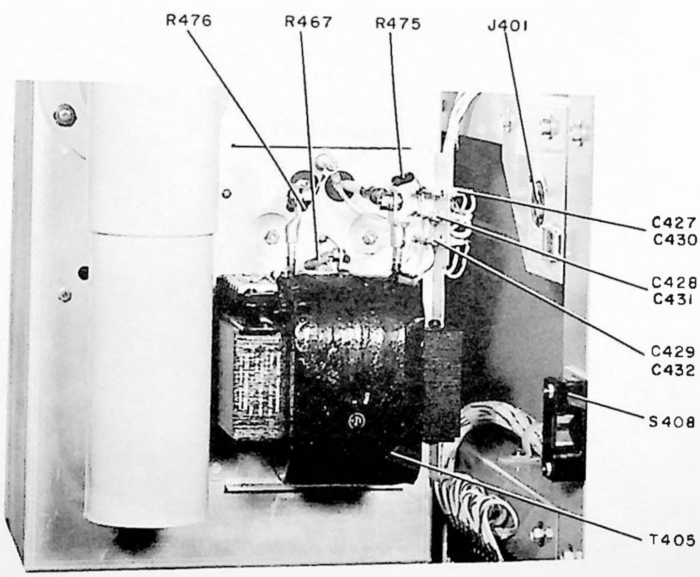


Figure 4-5. Filament Supply, Parts Location

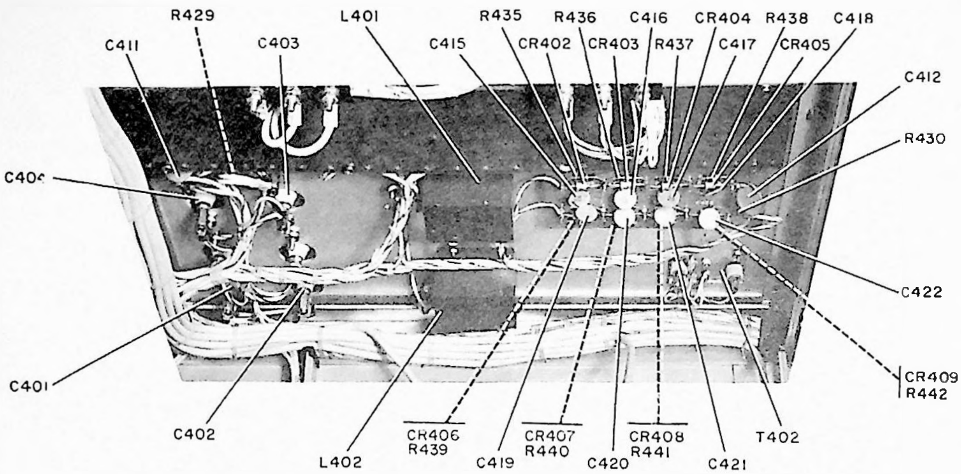


Figure 4-6. Power Panel, Small Parts Location

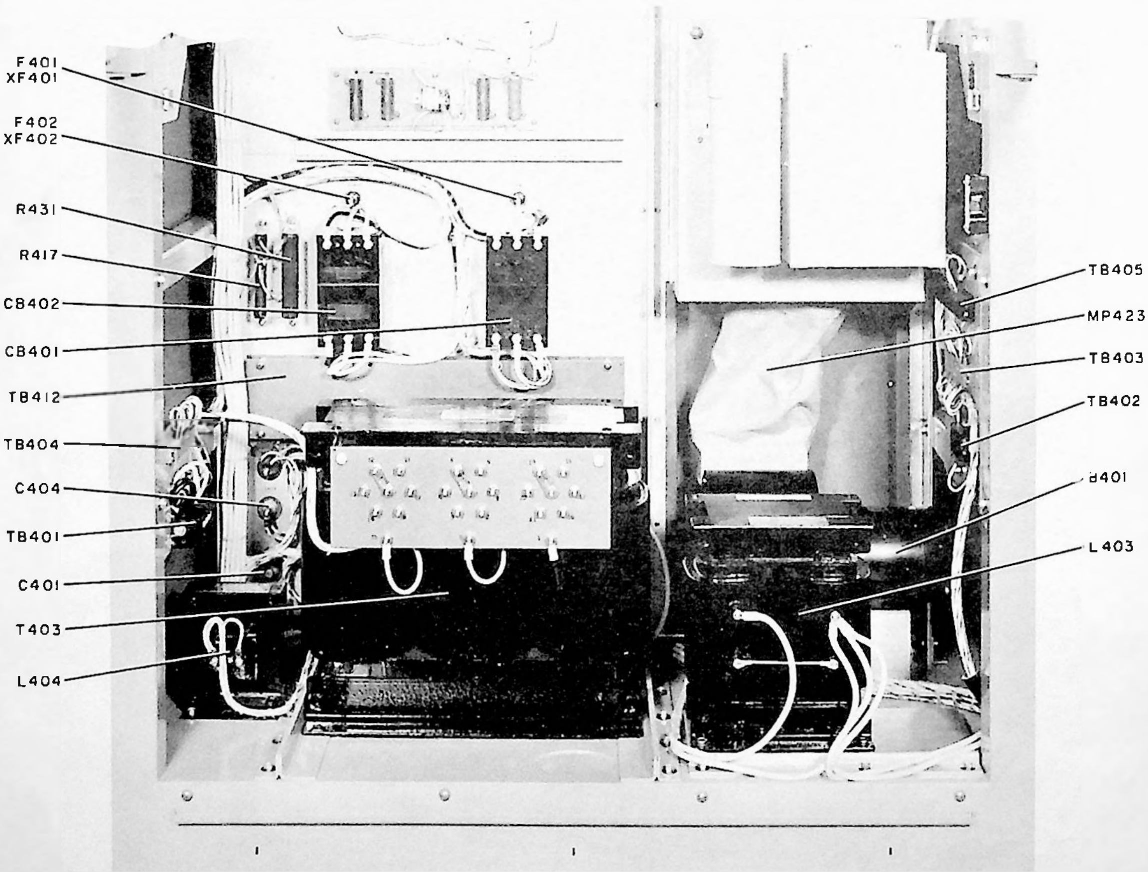


Figure 4-7. Power Panel, Parts Location

SECTION V
ILLUSTRATIONS

NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRYS.
2. TB412 CONTAINS THE FOLLOWING COMPONENTS: CR410 THROUGH CR433, MR326 R443 THROUGH R466, 33K.
3. TB406 CONTAINS THE FOLLOWING COMPONENTS: CR402 THROUGH CR409, 1N540 R435 THROUGH R442, 100K C415 THROUGH C422, 02UF.
4. MERCURY VAPOR TUBES V401 THROUGH V406 ARE TYPE 872A/872.

Figure 5-1. E830-1 5-Kw FM Power Amplifier, Schematic Diagram

523-0732000-00141A
15 August 1962

COLLINS

system instruction book

830F-1A
10-Kw FM Broadcast Transmitter

This manual includes

SP-195	*830F-1A 10-Kw FM Broadcast Transmitter*
TD-536	*A830-2 10 W Wide-Band FM Broadcast Exciter*
TD-537	*786M-1 Stereo Generator (optional)*
TD-538	*B830-1 250-Watt FM Power Amplifier*
TD-580	*F830-1 10-Kw FM Power Amplifier*

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa

Printed in U.S.A.

523-0755452-001419
15 August 1962

system instructions

830F-1A
10-Kw FM Broadcast Transmitter

Cedar Rapids Division | Collins Radio Company, Cedar Rapids, Iowa
Printed in U.S.A.

table of contents

Section			Page
1	GENERAL DESCRIPTION		1
	1.1	Purpose of Instruction Book	1
	1.2	Purpose of Equipment	1
	1.3	Description of Equipment	1
	1.3.1	Physical Description	1
	1.3.2	Electrical Description	2
	1.4	Equipment Supplied	2
	1.5	Accessory Equipment	2
	1.6	Equipment Specifications	2
	1.6.1	Mechanical	2
	1.6.2	Electrical	3
2	INSTALLATION		4
	2.1	Unpacking and Inspecting	4
	2.2	Transmitter Location	4
	2.3	Intercabinet Connections	4
	2.4	Replacement of Components Removed for Shipping	6
	2.5	External Connections	6
	2.6	Internal Connections	6
	2.7	Reduced Power Operation	9
	2.8	Remote Control	9
	2.9	Frequency Change	11
	2.9.1	Neutralization Procedure	11
	2.10	Final Installation Procedure	11
	2.11	Starting the Transmitter in a New Installation	15
3	OPERATION		19
	3.1	General	19
	3.2	Starting the Transmitter in Normal Operation	19
4	PRINCIPLES OF OPERATION		20
	4.1	General	20
	4.2	A830-2 10 W Wide-Band FM Broadcast Exciter	20
	4.3	Driver and Final	20
	4.3.1	Control Circuits	22
	4.3.2	Plate Contactors and Power Supplies	22
5	MAINTENANCE		23
	5.1	General	23
	5.2	Normal Tuning Procedures	23
	5.3	Modulator and AFC Discriminator Adjustment Procedures	24
	5.4	Distortion Testing Procedure	27
	5.5	Audio Frequency Response Measurements	27
	5.6	FM Noise Measurements	28
	5.7	AM Noise Measurements	28
	5.8	Trouble Shooting	29

list of illustrations

Figure		Page
1-1	830F-1A 10-Kw FM Broadcast Transmitter, Over-all View (C919-14-P)	1
2-1	830F-1A 10-Kw FM Broadcast Transmitter, Outline and Installation Drawing (C849-03-5)	5
2-2	Transformer Details (C919-10-4)	7
2-3	Recommended Screen Grid Current for Reduced Power Operation (C919-11-X)	10
2-4	Recommended Control Grid Current for Reduced Power Operation (C919-12-X)	10
2-5	Driver Plate Cavity Tuning Chart (C848-12-X)	13
2-6	Power Amplifier Plate and Grid Tuning Chart (C849-14-X)	14
2-7	Neutralization Tuning Chart (C849-13-X)	15
2-8	Directional Wattmeter SWR Determination Table (C919-21-X)	18
4-1	830F-1A 10-Kw FM Broadcast Transmitter, Block Diagram (C919-20-5)	21
5-1	Distortion Test Setup (C919-08-3)	24
5-2	Audio Frequency Response, Test Setup (C919-05-3)	27
5-3	Audio Frequency Response Limits (C847-04-X)	28
5-4	FM Noise Test Setup (C919-07-3)	29
5-5	AM Noise Test Setup (C919-06-3)	29

list of tables

Table		Page
1-1	Subassembly Instruction Books	2
1-2	Equipment Supplied	2
1-3	Accessory Equipment	2
2-1	Cabinet Interconnections	4
2-2	Plate Supply Transformer Connections for Reduced Power Operation	8
2-3	Screen Grid Supply Transformer Connections for Reduced Power Operation	9
2-4	Remote Control Connections	11
2-5	Crystal Part Numbers	12
5-1	Abbreviated Tuning Procedures	25
5-2	Distortion Checks	27
5-3	Normal Transmitter Meter Indications	31

unit instructions

TD No.	Title
536	A830-2 10 W Wide-Band FM Broadcast Exciter
538	B830-1 250-Watt FM Power Amplifier
580	F830-1 10-Kw Power Amplifier

section 1

general description

1.1 Purpose of Instruction Book.

This instruction book is a guide for installing, adjusting, operating, and maintaining 830F-1A 10-Kw FM Broadcast Transmitter.

1.2 Purpose of Equipment.

The 830F-1A 10-Kw FM Broadcast Transmitter is used for continuous monophonic or optional stereophonic FM broadcast service on a single frequency in the range from 88 to 108 megacycles with a maximum output power of 10,000 watts.

1.3 Description of Equipment.

1.3.1 PHYSICAL DESCRIPTION.

The 830F-1A 10-Kw FM Broadcast Transmitter, shown in figure 1-1, is contained in two interconnected cabinets that, together, are 76 inches wide, 76 inches high, 27 inches deep, and weigh approximately 1900 pounds. All transmitter operating controls are located behind the doors on the front of the cabinets. The filament and plate on-off controls and eight monitoring meters are located at the top front of the cabinets. The meters may be observed easily while operating the tuning controls. A monitoring meter is also provided with the

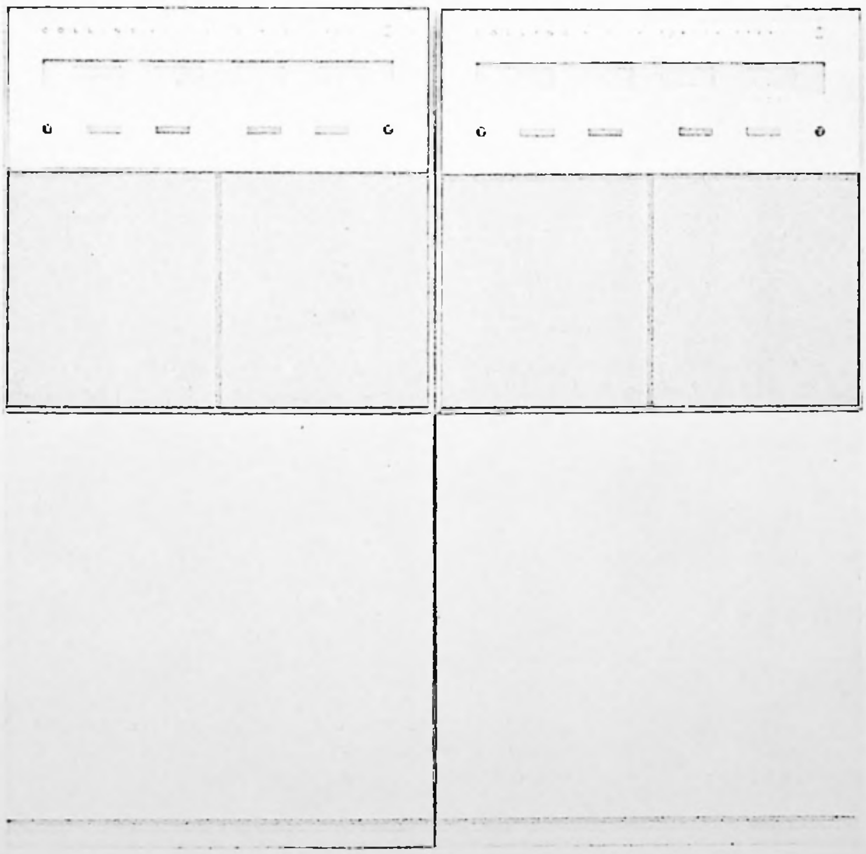


Figure 1-1. 830F-1A 10-Kw FM Broadcast Transmitter, Over-all View

wide-band exciter. The transmitter uses a maximum of 15 tubes (10-kw power amplifier may use optional silicon diode rectifiers in the plate supply instead of mercury-vapor tubes) and 20 transistors, most of which are accessible from the front of the transmitter. The bottom front of the transmitter cabinets are removable to allow access to components on the bottom of the inside panels.

The large doors at the upper rear of the cabinets allow access to the upper part of the transmitter for servicing and maintenance. The lower rear half of the transmitter cabinets are covered by removable panels that contain ventilating fans and permanent air filters. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panels. These interlocks ground the transmitter high-voltage circuits when the doors are opened or the panels are removed. The power amplifier plate-tuning resonator is located in an interlocked compartment at the front of the transmitter.

Inside the transmitter, heavy iron-core components are at the bottom of the cabinets. The exciter portion of the transmitter and the 250-watt driver are contained in one cabinet. The other cabinet contains a 10,000-watt power amplifier and harmonic filter.

Cooling air for the transmitter is drawn through permanent air filters at the rear of the cabinets by high-volume fans and exhausted through shielded openings in the tops of the cabinets. Individual blowers supply cooling air directly to the driver and power amplifier tubes.

Room is provided in the 250-watt amplifier cabinet for mounting a stereo generator and SCA equipment if multiplex operation is desired.

1.3.2 ELECTRICAL DESCRIPTION.

The 830F-1A 10-Kw FM Broadcast Transmitter is composed of three electrically-connected subunits: (1) a wide-band exciter that furnishes a 10-watt FM output to drive (2) a 250-watt amplifier that, in turn, drives (3) a 10,000-watt power amplifier. Instruction books covering the exciter and power amplifiers used in the transmitter are listed in table 1-1. These three books are supplied following section V of this system instruction book. The unit instruction books contain detailed descriptions of the three transmitter subunits.

TABLE 1-1
SUBASSEMBLY INSTRUCTION BOOKS

PUBLICATION	INSTRUCTION BOOK NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
B830-1 250-Watt FM Power Amplifier	TD-538
F830-1 10-Kw FM Power Amplifier	TD-580

1.4 Equipment Supplied.

Table 1-2 lists equipment that is supplied as part of 830F-1A 10-Kw FM Broadcast Transmitter.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
B830-1 250-Watt FM Power Amplifier	549-2008-00
F830-1 10-Kw FM Power Amplifier	522-2981-00
5/10-Kw Harmonic Filter	2172-004 549-~~2011~~-00

1.5 Accessory Equipment.

Table 1-3 lists accessory equipment that is available for use with 830F-1A 10-Kw FM Broadcast Transmitter. Information on 786M-1 Stereo Generator will be found in Unit Instructions, TD-537.

TABLE 1-3
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
786M-1 Stereo Generator	522-2914-00

1.6 Equipment Specifications.

1.6.1 MECHANICAL.

Weight . . . . 1900 pounds maximum.

Size . . . . 76 inches wide, 76 inches high, 27 inches deep.

Ventilation . . . . . . Two ventilating fans, two blowers.

Ambient temperature range	+20°C (68°F) to 45°C (113°F) with mercury vapor rectifiers or +10°C (50°F) to +45°C (113°F) with optional silicon diode rectifiers.
Ambient humidity range	0 to 95 percent relative humidity.
Altitude	0 to 6000 feet.
Shock and vibration	Normal handling and transportation.

1.6.2 ELECTRICAL.

Power source	200 to 250 volts, 60-cycle, 3-phase.
Maximum power requirments	20.25 kilowatts.
Power range	3 to 10 kilowatts.
Power output	10,000 watts nominal.
Output impedance	50 ohms, unbalanced. Maximum swr 2:1.
Frequency range	88 to 108 mc. Exact operating frequency determined by frequency of exciter.
Excitation source	Crystal-controlled high-stability oscillator using a plated, nontemperature-controlled crystal, controlling an LC modulation oscillator to provide automatic frequency control. Modulation oscillator output is then heterodyned up to operating frequency of station by a second high-stability crystal-controlled oscillator.
Carrier-frequency stability	Within ±2000 cps of specified carrier frequency over ambient temperature range from +10°C (50°F) to +45°C (113°F) and line-voltage variations of ±15 percent.
Harmonic and spurious radiation	Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc, inclusive, is at least 30 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 240 kc and up to and including 600 kc is at least 40 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 600 kc is at least 80 db below the level of the unmodulated carrier.
Modulation characteristics	Direct frequency modulation. Standard audio pre-emphasis is incorporated in modulator.
Audio input impedance	600 ohms balanced.
Audio input level	+10 dbm ±2 db.
Audio frequency distortion	50 to 15 kc, 1.0 percent maximum.
FM noise level	Not less than 65 db below 100 percent modulation (±75 kc).
AM noise level (rms)	Not less than 55 db below equivalent 100 percent AM.

section 2
installation

2.1 Unpacking and Inspection.

Be careful when uncrating the transmitter and components to avoid damaging the equipment. Inspect the transmitter carefully for scratches, dents, or other physical damage. Check for loose screws and bolts. Inspect all controls, such as switches, for proper operation as far as can be determined without applying power to the transmitter. Examine cables and wiring, making sure that all connections are tight and clear of each other and the chassis. File any damage claims promptly with the transportation company. If such claims are to be filed, retain all packing material.

2.2 Transmitter Location.

Plan transmitter and wiring placement carefully before starting installation work. Refer to figure 2-1. This diagram shows the location of all wiring openings in the transmitter cabinets. As will be noted in figure 2-1, several alternate wiring arrangements can be used. Select the combination that most nearly suits the station requirements.

Allow adequate clearance both in front and back of the transmitter. There should be a minimum clearance of 3-1/2 feet behind the transmitter to provide sufficient room for service work.

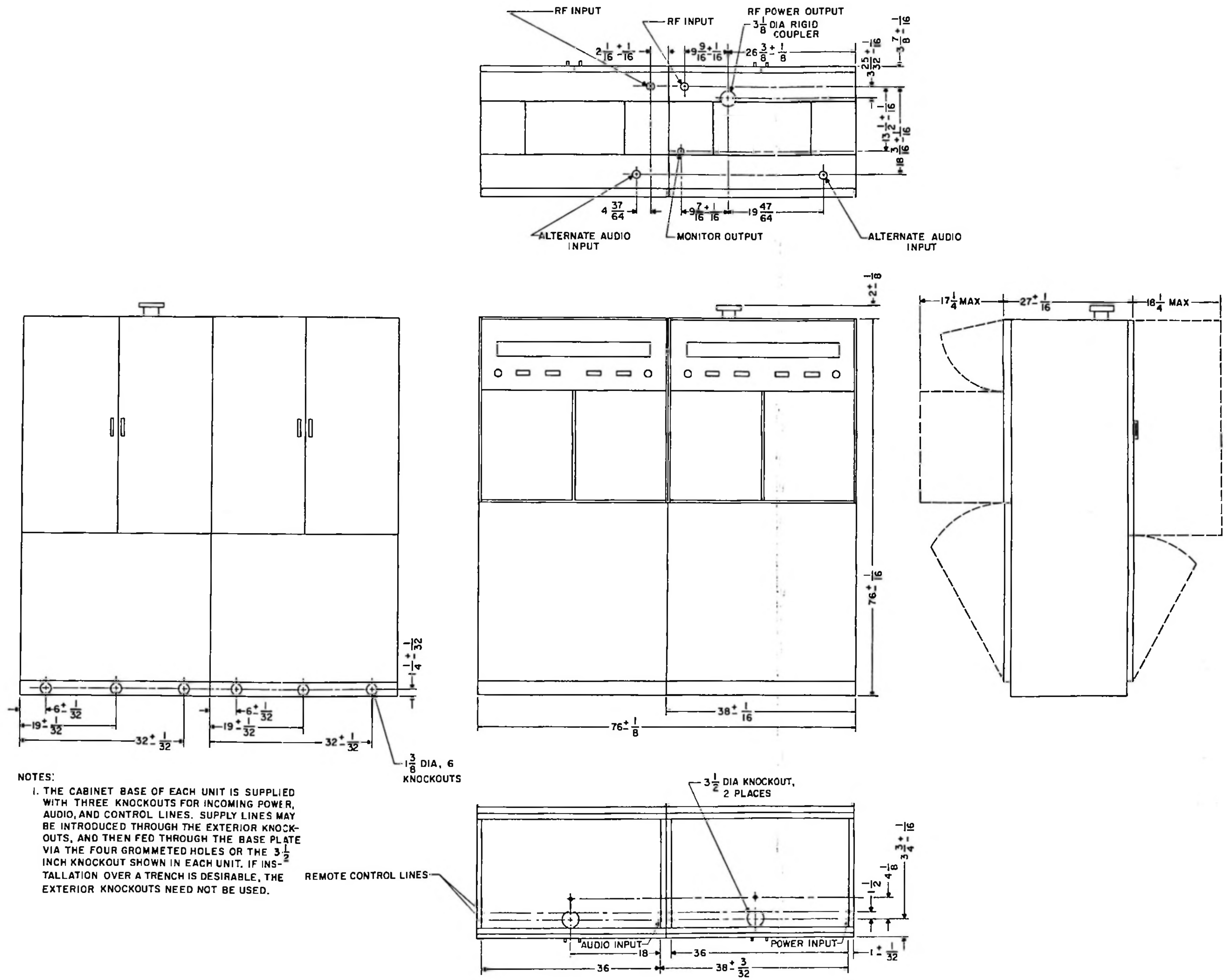
If desired, an air duct may be placed over the exhaust-air opening in the top of the 10-kw amplifier cabinet to carry heat away from the transmitter.

2.3 Intercabinet Connections.

Place the two transmitter cabinets beside each other in their permanent location so that, when viewed from

TABLE 2-1. CABINET INTERCONNECTIONS

WIRE CODE	10-KW POWER AMPLIFIER TERMINAL BOARD CONNECTIONS (from)	250-WATT DRIVER TERMINAL BOARD CONNECTIONS (to)
RE2	TB402-1	TB301-1
RE5	TB402-2	TB301-2
RE9	TB402-3	TB301-3
RC90	TB403-1	TB304-1
RC923	TB403-2	TB304-2
RC91	TB403-3	TB304-3
RC4	TB403-5	TB304-5
RC93	TB403-6	TB304-6
RC92	TB403-7	TB304-7
RC935	TB403-8	TB304-8
RC0	TB403-9	TB304-9
VE9	TB403-10	TB304-10
RC91	TB403-11	TB304-11



NOTES:

1. THE CABINET BASE OF EACH UNIT IS SUPPLIED WITH THREE KNOCKOUTS FOR INCOMING POWER, AUDIO, AND CONTROL LINES. SUPPLY LINES MAY BE INTRODUCED THROUGH THE EXTERIOR KNOCKOUTS, AND THEN FED THROUGH THE BASE PLATE VIA THE FOUR GROMMETED HOLES OR THE 3 1/2 INCH KNOCKOUT SHOWN IN EACH UNIT. IF INSTALLATION OVER A TRENCH IS DESIRABLE, THE EXTERIOR KNOCKOUTS NEED NOT BE USED.

Figure 2-1. 830F-1A 10-Kw FM Broadcast Transmitter, Outline and Installation Drawing the front, the 250-watt driver cabinet is on the left and the 10-kw amplifier cabinet is on the right. Then connect the two cabinets with the appropriate cables. The intercabinet cables consist of an r-f coaxial cable, and a laced control and power cable. Both cables are furnished with the transmitter.

Connect the coaxial cable from the r-f output of the 250-watt driver to the r-f input of the 10-kw power amplifier. These connections are made on the tops of the cabinets. Run the control and power cable through the circular openings near the bottom rear of the cabinets on the sides where the cabinets adjoin. Table 2-1 shows the terminal locations of the laced control and power cable and the cable wire code. An explanation of the wire code is given inside the back cover of the instruction book. When the transmitter is received, one end of the laced control and power cable will be connected to the terminal boards of the 10-kw power amplifier. The other end must be connected to the 250-watt driver at the station site.

2.4 Replacement of Components Removed for Shipping.

Several of the transmitter components have been removed from the cabinets and packed separately for safety during shipping. These include the plate and screen transformers, the coaxial line resonator center conductor, and fragile units such as power amplifier tubes, mercury-vapor tubes, and crystals. These units should not be replaced in the cabinets until the transmitter is in its permanent location. Wires and cables that were disconnected before shipping have been tagged to facilitate reconnection. Refer to the photographs in section 4 of TD-538 and TD-580 for assistance in replacing these components in the correct locations.

NOTE

When replacing the 10-kw screen transformer, make sure the transformer clears the cabinet blower blades and the components located on the rear of the power panel by at least 3/4 inch.

2.5 External Connections.

Refer to figure 2-1 for assistance in making the following external connections.

a. Connect the audio input to the transmitter. Bring the audio signal through the bottom (or any one of the optional cable input locations) of the 250-watt driver cabinet on a shielded twisted pair. Connect the two audio leads to terminals 1 and 2 of TB305 if monaural operation is specified. If optional stereophonic operation is employed, the left audio leads are connected to TB305-1 and 2 and the right audio leads to TB305-4 and 5. TB305 is located about half way up the cabinet on the left side as viewed from the rear of the cabinet. Connect the shield to terminal 3 of TB305.

b. Connect the FM monitor to the monitor output on the top of the 10-kw amplifier cabinet. Refer to figure 2-1. Use type RG-58/U coaxial cable to make this connection.

c. Connect the antenna transmission line to the r-f output located on top of the 10-kw amplifier cabinet. The r-f connection is for a standard EIA 3-1/8-inch flange.

CAUTION

Before making this antenna connection, be sure that the transmission line and antenna present a nominal impedance of 50 ohms and an swr of not more than 2:1 at the transmitter operating frequency. If the transmitter output is improperly matched, the transmitter will not operate properly and may be damaged. This is important. See figure 2-8 for a chart showing swr as a function of power out versus reflected power.

d. Connect the power input cable to the transmitter. This power cable should be brought from an external fused cutout box rated for 100 amperes. Use type R or T AWG #4 wire to make these connections. Connect the three wires to terminals 1, 2, and 3 of TB401, located at the bottom left side of the 10-kw amplifier cabinet. The power cable may be brought into the transmitter through holes in either the top or bottom of the 10-kw amplifier cabinet.

CAUTION

The 3-phase power input must be connected properly. To check for proper phasing of the 3-phase power input, turn off the plate circuit breaker and supply 3-phase power to the transmitter control circuits. Check the 10-kw PA blower for clockwise rotation. If the blower rotation is not clockwise, reverse any two of the incoming power leads. Always shut off the transmitter 3-phase power at the external fused cutout box before making any adjustments to the transmitter. Recheck the PA blower for clockwise rotation.

2.6 Internal Connections.

The 830F-1A 10-Kw FM Broadcast Transmitter plate, screen, filament, and control circuit transformers are fitted with adjustable taps to compensate for line variations from 200 to 250 volts in 10-volt steps. To adjust transformers T301, T303, T401; T403, T404, and T405, perform the following steps.

a. Measure the line voltage at the transmitter fused cutout box for each of the three phases. The three voltage readings should be nearly equal.

b. In turn remove the wire from the tapped portion of each transformer and move to the transformer tap

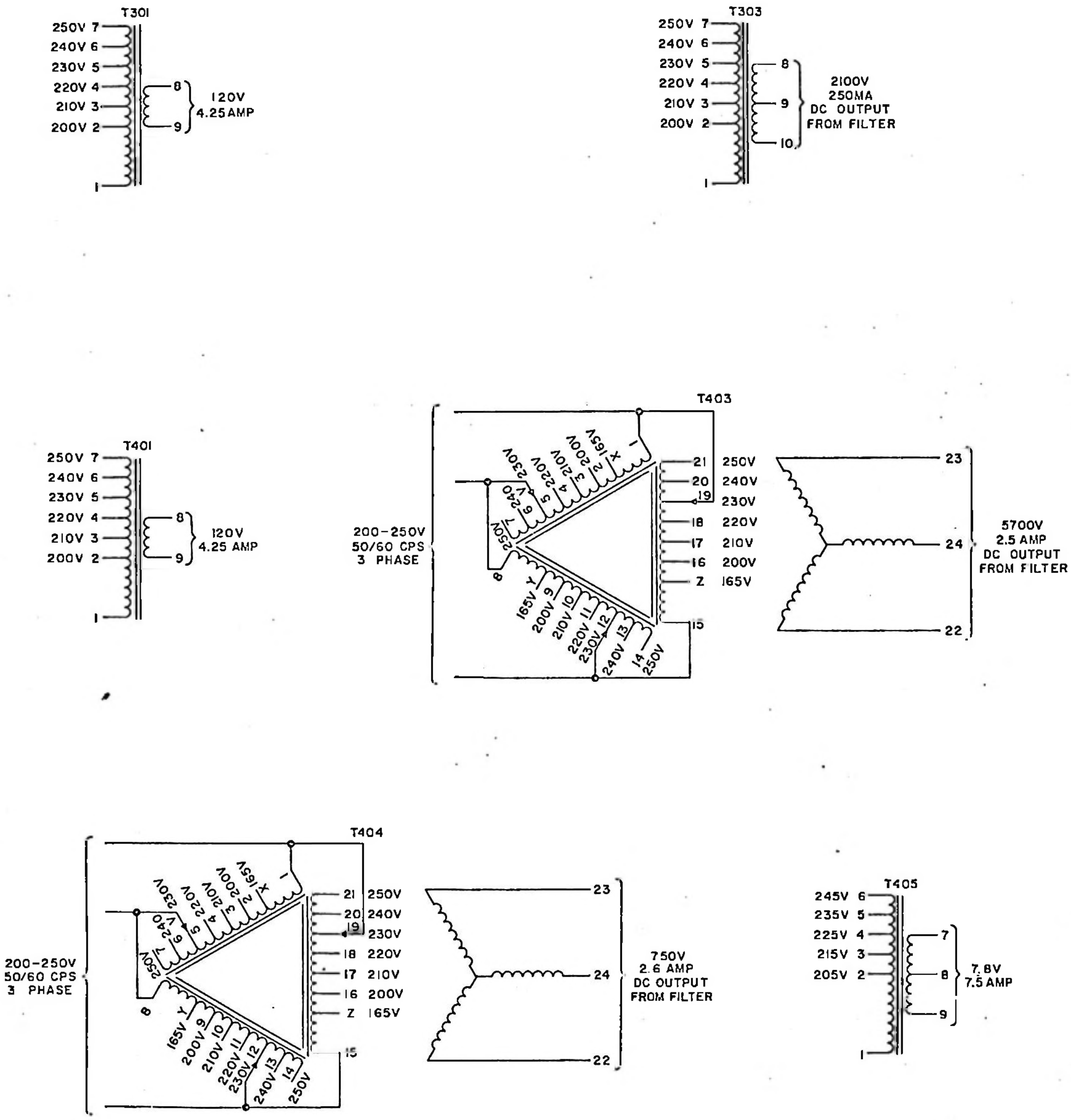


Figure 2-2. Transformer Details

whose voltage rating most closely corresponds to the voltage measured in step a. Refer to figure 2-2 for transformer terminal numbers and the input voltage which should be applied to each terminal. Do not move the solder lug from transformer terminal 5 of T301 or T401 as this terminal supplies 230 volts to the cabinet fans, the grid bias supply, and the high-voltage power supply filaments.

c. Tighten all transformer terminal connections.

NOTE

The first three units of the F830-1 have power amplifier plate and screen transformers with connections numbered differently than in figure 2-2.

TABLE 2-2. PLATE SUPPLY TRANSFORMER CONNECTIONS FOR REDUCED POWER OPERATION

LINE VOLTAGE	AUTHORIZED TRANSMITTER OUTPUT POWER								
	3-4 KILOWATTS			4-5 KILOWATTS			5-10 KILOWATTS		
	TYPE CONNECTION	CONNECT TO TRANSFORMER VOLTAGE TAP	PLATE VOLTS OUT	TYPE CONNECTION	CONNECT TO TRANSFORMER VOLTAGE TAP	PLATE VOLTS OUT	TYPE CONNECTION	CONNECT TO TRANSFORMER VOLTAGE TAP	PLATE VOLTS OUT
200	Delta	250	4500	Delta	240	4800	Delta	200	5700
210	Y	165	4500	Delta	250	4800	Delta	210	5700
220	Y	165	4400	Delta	250	5000	Delta	220	5700
230	Y	165	4600	Y	165	4600	Delta	230	5700
240	Y	200	4000	Y	165	4800	Delta	240	5700
250	Y	200	4100	Y	165	5000	Delta	250	5700

TABLE 2-3. SCREEN GRID SUPPLY TRANSFORMER CONNECTIONS FOR REDUCED POWER OPERATION

LINE VOLTAGE	AUTHORIZED TRANSMITTER OUTPUT POWER					
	3-7 KILOWATTS			7-10 KILOWATTS		
	TYPE CONNECTION	CONNECT TO TRANSFORMER VOLTAGE TAP	SCREEN VOLTS OUT	TYPE CONNECTION	CONNECT TO TRANSFORMER VOLTAGE TAP	SCREEN VOLTS OUT
200	Delta	240	625	Delta	200	750
210	Delta	250	630	Delta	210	750
220	Delta	250	660	Delta	220	750
230	Y	165	630	Delta	230	750
240	Y	165	650	Delta	240	750
250	Y	165	680	Delta	250	750

Check that a jumper wire is installed from TB404-7 to TB404-8 to ensure that 115-volt power will be applied to the transmitter control circuitry.

If the optional stereo generator is installed any time after the initial 830F-1A installation, the 18-db audio pad will have to be removed from the audio circuitry of the exciter. Refer to Unit Instructions TD-536 for the location of the 18-db audio pad.

2.7 Reduced Power Operation.

If the authorized transmitter power output is below 10 kilowatts, the plate and screen voltage and the power amplifier drive will have to be reduced accordingly. Refer to tables 2-2 and 2-3 for the plate and screen power supply transformer hookup for reduced output. The tables refer to the transformer primary windings in each case. Figures 2-3 and 2-4 show the recommended control grid and screen grid currents for output power ratings from 3 to 10 kilowatts of transmitter output power.

For example, if the authorized transmitter power is 4.5 kilowatts, and the measured line voltage is 230 volts, table 2-2 shows the plate supply transformer primary will be connected in a wye configuration. To obtain a wye connected primary, connect transformer terminals 1, 8, and 15 together and remove the adjustable jumpers. As the measured line voltage is 230 volts, connect the 3-phase line to the 165-volt terminals X, Y, and Z as shown in table 2-2. (The 165 terminology is only for reference. The actual winding voltage is less than 165 volts.) This will give a plate supply output voltage of approximately 4600 volts. The actual transformer tap number for the given tap voltage may be obtained by referring to figure 2-2. As the authorized power output is 4.5 kw and the line voltage 230 volts, the screen supply transformer will also be connected in a wye configuration. (Refer to table 2-3.) The screen supply transformer wye primary is obtained by connecting together transformer terminals 1, 8, and 15, and removing the adjustable jumpers. Connect the 3-phase line input to 165-volt terminals X, Y, and Z. This will give a screen voltage of approximately 630 volts.

With the plate and screen transformer now connected correctly for a 3-phase input of 230 volts and a 4.5-kw output, the transmitter may be tuned according to the tuning procedure given in paragraph 2.11. When tuning for reduced power operation, substitute drive and screen currents taken from figures 2-3 and 2-4 for those given in the tuning procedure.

NOTE

> If, when tuning the power amplifier, sufficient power output cannot be obtained by adjusting the POWER OUTPUT ADJUST potentiometer, connect the plate and screen transformers as shown in the next lower line voltage column of tables 2-2 and 2-3.

2.8 Remote Control.

Remote control of 830F-1A 10-Kw FM Broadcast Transmitter can easily be accomplished by connection to terminal boards TB302 and TB303, located in the 250-watt power amplifier cabinet, and by placing a jumper between TB404-4 and TB404-9. Terminal board TB404 is located within the 10-kw power amplifier cabinet. Table 2-4 lists the terminal board connections and the remote functions of each pair of

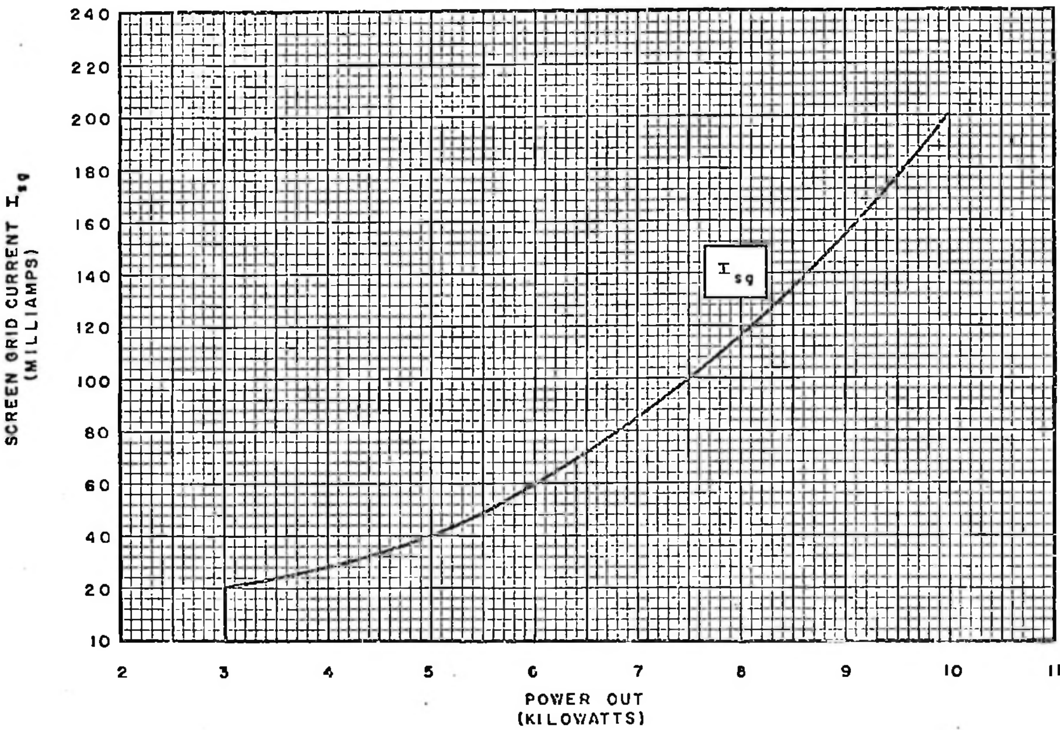


Figure 2-3. Recommended Screen Grid Current for Reduced Power Operation

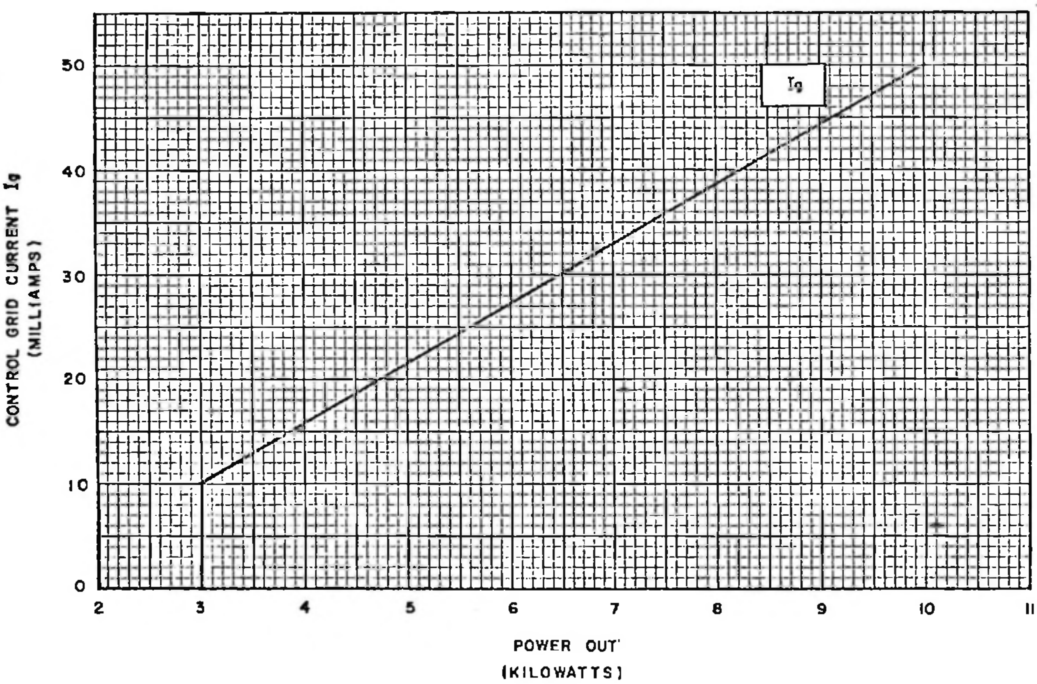


Figure 2-4. Recommended Control Grid Current for Reduced Power Operation

terminals. Remote "on" switches should be the normally open momentary type. Remote "off" switches should be the normally closed momentary type. For remote operation, the LOCAL-REMOTE switch within the 250-watt power amplifier cabinet should be in the REMOTE position. When in the REMOTE position, it is possible to control the transmitter from the transmitter panel switches or from the remote point.

TABLE 2-4
REMOTE CONTROL CONNECTIONS

FUNCTION	TERMINALS	
	TB302	TB303
FILAMENT ON		1 and 2
FILAMENT OFF	8 and 9	
PLATE OFF		2 and 4
PLATE ON		2 and 3

For simplified operation, the FILAMENT ON and PLATE OFF switches could be eliminated. The PLATE ON switch starts a sequence of operations which turns the filaments on and the plate voltage on after the filament time delay is accomplished. The FILAMENT OFF switch shuts down all transmitter functions.

Equipment is available that will completely control and monitor transmitter operation from a remote location through standard telephone pairs. When such remote control equipment is used, necessary installation and connection information will be supplied with the remote equipment.

If an optional stereo generator is employed in the 830F-1A, remote control of the stereo mode may be accomplished by a ground on TB302-7. If the ground is present, the transmitter will be in the stereo mode. If the ground is removed, the transmitter will switch to the monaural mode. Local control of the stereo mode is also available at the transmitter.

2.9 Frequency Change.

If the transmitter operating frequency is changed, five components will have to be changed or adjusted. The components are the exciter heterodyning crystal, Y426; the driver plate slider; the power amplifier grid tank slider; the power amplifier plate tank slider; and the neutralizing bars of the power amplifier.

Table 2-5 lists the channel frequency versus crystal frequency and the Collins part number for each crystal. Figure 2-5 shows the distance the driver plate tank slider should be positioned from the deck plate (tube socket mounting plate) for each operating frequency between 88 and 108 megacycles. Figure 2-6 shows the distance the power amplifier plate tank and grid tank sliders should be positioned from the deck plate for the operating frequencies.

2.9.1 NEUTRALIZATION PROCEDURE

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when performing any inspection or work within the cabinet or plate resonator. Do not depend entirely on the interlocks. Always shut down the transmitter before doing any work inside the transmitter cabinet. Remember that 115 volts is present on one side of the door interlocks.

Power amplifier neutralization must be completed after any change in frequency to provide the proper degree of amplifier stability. Neutralization of the power amplifier is accomplished as follows: Set the neutralization sliding contacts to the position corresponding to the assigned station frequency as shown in figure 2-7. Turn on the exciter and driver, and tune the exciter and driver according to the procedure given in paragraph 2.11. Tune the power amplifier grid and plate tank. Turn the POWER OUTPUT ADJUST control to its maximum counterclockwise position. Turn off the exciter. Turn off the driver plate circuit breaker. Turn on the power amplifier plate voltage and remove the power amplifier control grid bias fuse while observing the WATTMETER for an indication. The WATTMETER switch must be in the FORWARD position. If no indication is noted on the WATTMETER, the power amplifier is properly neutralized.

CAUTION

Do not allow the power amplifier plate current to exceed 2 amperes during the test. Do not run the test for more than 5 seconds without a 1-minute cooling off period between tests.

If a WATTMETER indication is noted with the removal of the control grid bias fuse, readjust the neutralizing sliding contacts and repeat the test.

The neutralization can be checked further by noting the grid reaction as the plate is tuned through resonance. Minimum or no grid current reaction indicates proper neutralization. Neutralization of the 10-kw power amplifier is normally not critical and should be easily adjusted.

2.10 Final Installation Procedure.

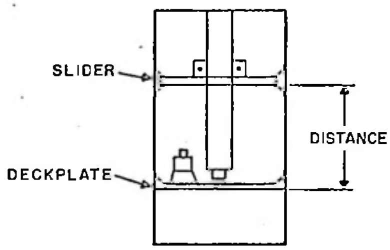
a. Check that all tubes, both in the exciter and power amplifiers, are securely in place.

b. Check all exciter transistors for proper placement. The transistor locating tab must be pointing to the transistor socket locating mark placed adjacent to the transistor socket.

c. Check fuses on both the exciter and power amplifiers.

TABLE 2-5. CRYSTAL PART NUMBERS

CHANNEL FREQ. (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER	CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER
88.1	74.10000	289-2744-00	98.1	84.10000	289-2794-00
88.3	74.30000	289-2745-00	98.3	84.30000	289-2795-00
88.5	74.50000	289-2746-00	98.5	84.50000	289-2796-00
88.7	74.70000	289-2747-00	98.7	84.70000	289-2797-00
88.9	74.90000	289-2748-00	98.9	84.90000	289-2798-00
89.1	75.10000	289-2749-00	99.1	85.10000	289-2799-00
89.3	75.30000	289-2750-00	99.3	85.30000	289-2800-00
89.5	75.50000	289-2751-00	99.5	85.50000	289-2801-00
89.7	75.70000	289-2752-00	99.7	85.70000	289-2802-00
89.9	75.90000	289-2753-00	99.9	85.90000	289-2803-00
90.1	76.10000	289-2754-00	100.1	86.10000	289-2804-00
90.3	76.30000	289-2755-00	100.3	86.30000	289-2805-00
90.5	76.50000	289-2756-00	100.5	86.50000	289-2806-00
90.7	76.70000	289-2757-00	100.7	86.70000	289-2807-00
90.9	76.90000	289-2758-00	100.9	86.90000	289-2808-00
91.1	77.10000	289-2759-00	101.1	87.10000	289-2809-00
91.3	77.30000	289-2760-00	101.3	87.30000	289-2810-00
91.5	77.50000	289-2761-00	101.5	87.50000	289-2811-00
91.7	77.70000	289-2762-00	101.7	87.70000	289-2812-00
91.9	77.90000	289-2763-00	101.9	87.90000	289-2813-00
92.1	78.10000	289-2764-00	102.1	88.10000	289-2814-00
92.3	78.30000	289-2765-00	102.3	88.30000	289-2815-00
92.5	78.50000	289-2766-00	102.5	88.50000	289-2816-00
92.7	78.70000	289-2767-00	102.7	88.70000	289-2817-00
92.9	78.90000	289-2768-00	102.9	88.90000	289-2818-00
93.1	79.10000	289-2769-00	103.1	89.10000	289-2819-00
93.3	79.30000	289-2770-00	103.3	89.30000	289-2820-00
93.5	79.50000	289-2771-00	103.5	89.50000	289-2821-00
93.7	79.70000	289-2772-00	103.7	89.70000	289-2822-00
93.9	79.90000	289-2773-00	103.9	89.90000	289-2823-00
94.1	80.10000	289-2774-00	104.1	90.10000	289-2824-00
94.3	80.30000	289-2775-00	104.3	90.30000	289-2825-00
94.5	80.50000	289-2776-00	104.5	90.50000	289-2826-00
94.7	80.70000	289-2777-00	104.7	90.70000	289-2827-00
94.9	80.90000	289-2778-00	104.9	90.90000	289-2828-00
95.1	81.10000	289-2779-00	105.1	91.10000	289-2829-00
95.3	81.30000	289-2780-00	105.3	91.30000	289-2830-00
95.5	81.50000	289-2781-00	105.5	91.50000	289-2831-00
95.7	81.70000	289-2782-00	105.7	91.70000	289-2832-00
95.9	81.90000	289-2783-00	105.9	91.90000	289-2833-00
96.1	82.10000	289-2784-00	106.1	92.10000	289-2834-00
96.3	82.30000	289-2785-00	106.3	92.30000	289-2835-00
96.5	82.50000	289-2786-00	106.5	92.50000	289-2836-00
96.7	82.70000	289-2787-00	106.7	92.70000	289-2837-00
96.9	82.90000	289-2788-00	106.9	92.90000	289-2838-00
97.1	83.10000	289-2789-00	107.1	93.10000	289-2839-00
97.3	83.30000	289-2790-00	107.3	93.30000	289-2840-00
97.5	83.50000	289-2791-00	107.5	93.50000	289-2841-00
97.7	83.70000	289-2792-00	107.7	93.70000	289-2842-00
97.9	83.90000	289-2793-00	107.9	93.90000	289-2843-00



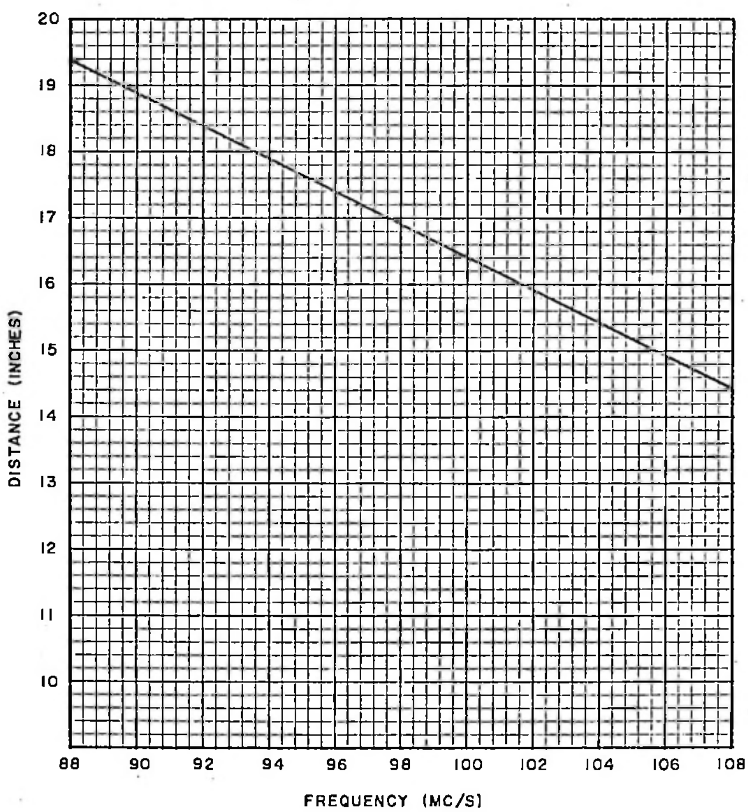
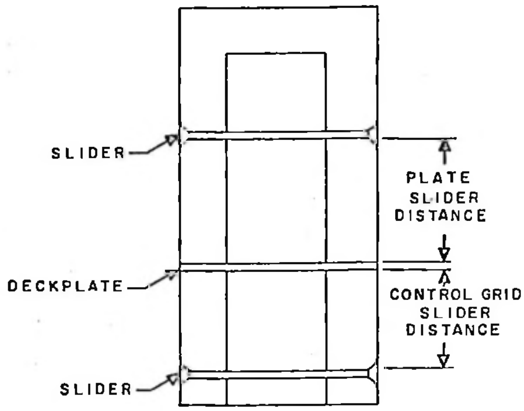


Figure 2-5. Driver Plate Cavity Tuning Chart



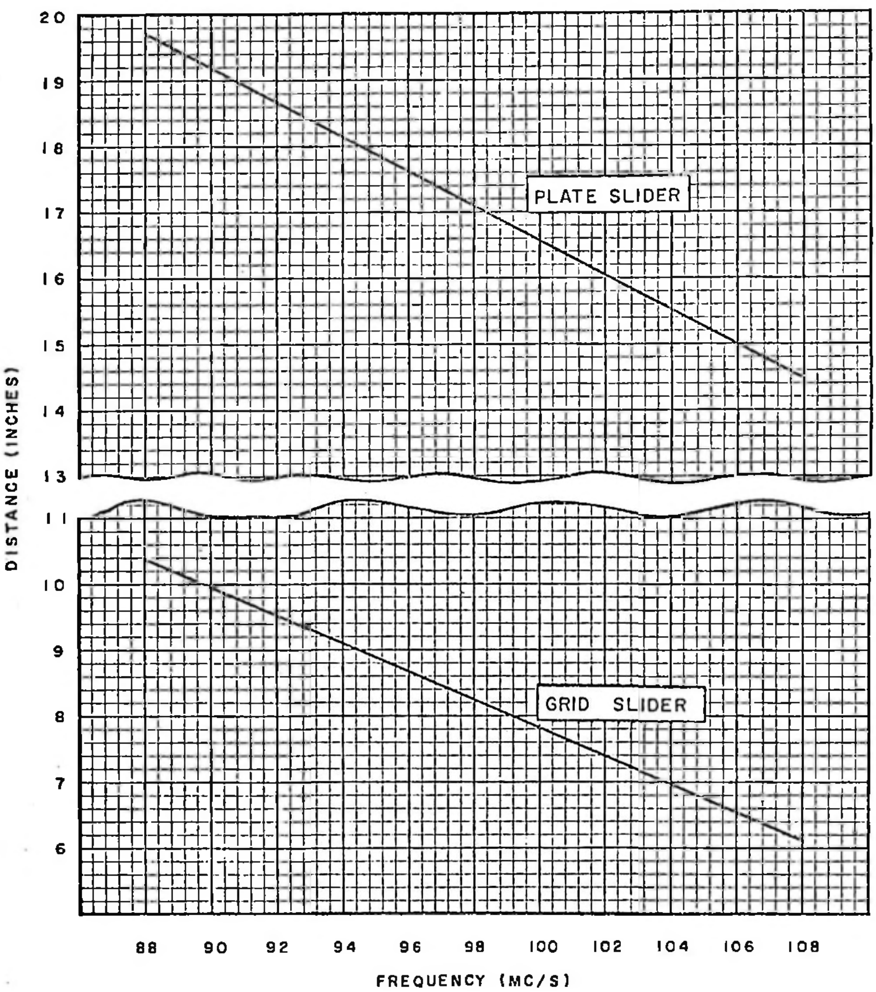


Figure 2-6. Power Amplifier Plate and Grid Tuning Chart

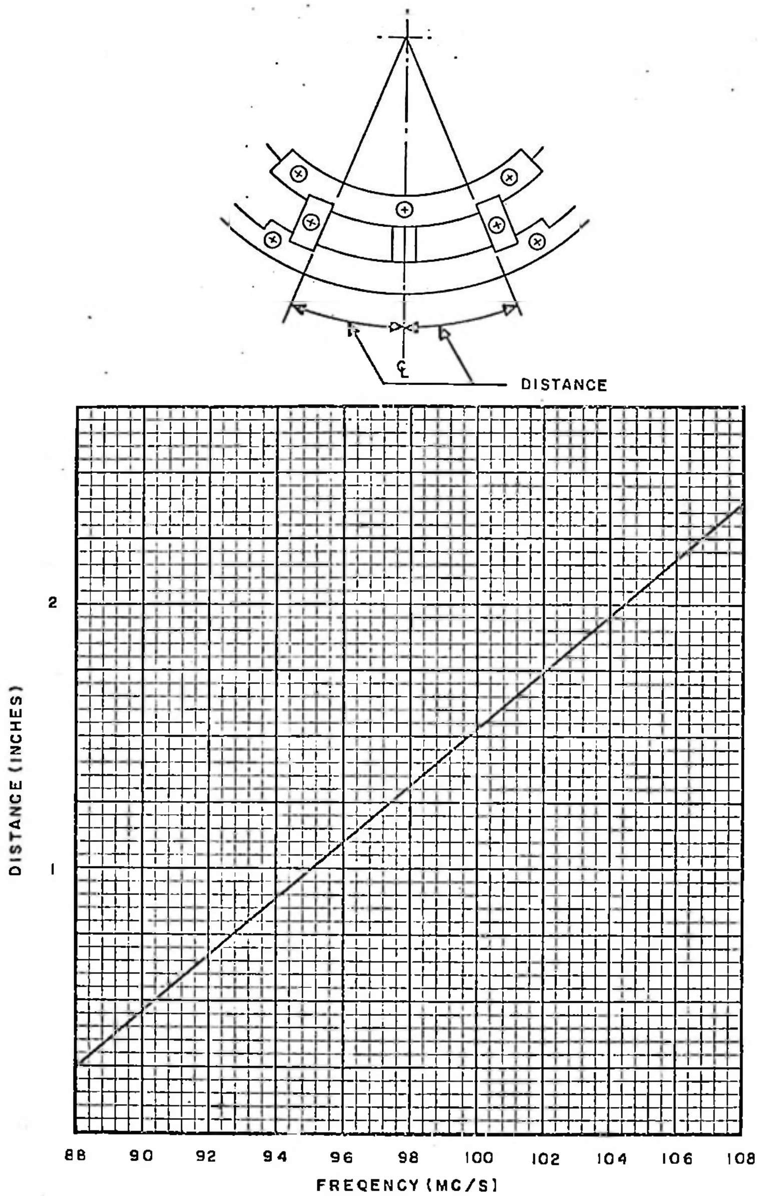


Figure 2-7. Neutralization Tuning Chart

d. Insert the crystals into the exciter crystal sockets. The 14-mc crystal should be placed into Y501 and the heterodyning crystal into Y426.

e. Carefully inspect all rear door and panel interlocks to be certain that they are operating correctly. Do this by pressing the contact block, located on the doors and the lower rear panels, until the spring is completely compressed, then releasing the block. If the block does not spring back to its original position, adjust until it operates properly.

f. Recheck all cables and wiring in the transmitter to be sure that all connections are made securely and properly.

g. Check that the sliders in the tuning resonators of both the driver and the power amplifier are in proper position for the assigned station frequency and that the sliders are tight against the outer resonator walls.

h. Check the final power amplifier tube for proper seating. This tube is pressed into place and may have jarred loose during installation.

i. Replace the lower rear panels on the transmitter cabinets. Insert the ventilating fan plugs into the sockets provided.

2.11 Starting the Transmitter in a New Installation.

Before starting the transmitter for the first time, read section 3 of the subunit instruction books to become familiar with the location and function of the various transmitter controls. Then, perform the following procedures.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when making any transmitter adjustments. Do not reach inside the rear of the transmitter cabinets whenever high voltages are applied. Do not depend entirely on door interlocks. Always shut off transmitter power at the external cutout box and ground all capacitors in the transmitter cabinets with the shorting stick before doing any work inside the rear of the cabinets. When working in the power amplifier resonators, remember that 115 volts a-c is present on one side of the resonator compartment interlocks. Keep metal tools and all parts of the body away from transistor cases.

a. Complete the entire transmitter installation procedure as directed in earlier paragraphs of this instruction book.

b. Close the doors at the rear of the cabinets. Open the doors at the front of the cabinets and remove the lower front panels so the entire inside panel is exposed. Check to be sure that the covers on the resonator compartments of both the driver and power amplifier are securely closed and latched.

c. Set the PLATE circuit breaker in the driver and the PLATE and FILAMENT breakers in the power amplifier to ON.

d. Press the FILAMENT ON switch on either cabinet. The green indicator lamps at the top left of both cabinets should light. This means that all transmitter tube filaments and cooling air blowers are operating.

e. Set the right cabinet MULTIMETER switch to FIL V 8V FS. Adjust the FILAMENT VOLTAGE ADJUST control until the right cabinet MULTIMETER indicates 7.5 volts. If this meter indication cannot be reached, readjust the taps on the filament transformer, T403, to the next lower voltage tap.

NOTE

If mercury-vapor rectifier tubes are used in the 10-kw amplifier (right cabinet), run the tubes with only the filaments lighted for at least 1/2 hour before applying plate voltage to the amplifier. This is done to remove any mercury coating that may be on tube elements. This operation is necessary only for new tubes or used tubes that have been inverted or agitated. While this aging process is being completed, the exciter and 250-watt amplifier may be tuned by performing the following steps.

f. Set the POWER switch on the exciter to ON. Allow the exciter oscillator to warm up for 15 minutes.

g. Turn S101 to the 14MC REF B position and check M101 for an indication in the B meter range. Turn S101 to the AFC KEY B position and check M101 for an indication in the B meter range.

NOTE

When S101 is in the AFC KEY B position, the meter pointer will not hold steady but will pulse at approximately 5 cps, the keying generator rate. This pulse is an indication of normal operation.

Turn S101 to the MOD OUTPUT B position and check M101 for an indication in the B meter range. If all meter indications for the three S101 positions fall within the B meter range, proceed with the following tuning procedures. If any of the meter indications fall outside of the B meter range, the modulator and afc discriminator are out of adjustment and will have to be adjusted according to the maintenance section of this instruction book.

h. Switch S101 to the MIXER GRID A position. Set POWER OUT resistor R454 to its midposition. Using a nonmetallic screwdriver type tuning tool, adjust the BUF TUNE control for a peak indication on meter M101.

NOTE

The MIX BAL control, R428, should be placed in its midrange position. No further adjustment of this control is necessary unless the transmitter frequency falls within the range of 97 to 100 mc. See step n if the transmitter frequency falls within this range.

i. Switch S101 to the V428B position. Adjust L429 and L430 for a maximum indication on M101.

j. Switch S101 to the V429B position. Adjust L431 and L432 for a maximum indication on M101.

k. Switch S101 to the V430B position. Adjust L433 and L434 for a maximum indication on M101.

l. Switch S101 to the V430C position. Adjust the PA PLATE control for a minimum indication on M101.

m. Set the driver MULTIMETER switch to GRID FS 40 MA. Adjust first the exciter PA MATCH control, then the power amplifier GRID TUNING control for a peak MULTIMETER indication.

n. If the transmitter frequency falls between 97 and 100 mc, the following additional step will have to be completed. Place a grid dip meter tuned to 98 mc near the exciter output. Adjust the MIX BAL control for a minimum output as indicated on the grid dip meter.

o. Set the driver POWER OUTPUT ADJUST control fully counterclockwise. Connect a 50-ohm, 250-watt dummy load to the r-f output connector of the driver.

p. Press the driver PLATE ON switch. The red indicator lamp at the top right of the cabinet should light, and the P. A. PLATE VOLTAGE meter should indicate 2100 ±100 volts.

q. Set the driver MULTIMETER switch to SCREEN FS 400 VDC. The MULTIMETER should indicate 300 ±35 volts.

r. Adjust the driver PLATE TUNING control for a dip in the P.A. PLATE CURRENT meter indication.

s. Set the driver WATTMETER switch to FORWARD. Adjust the OUTPUT COUPLING control for approximately 5 ma of screen current.

t. Turn the driver POWER OUTPUT ADJUST control approximately two-thirds of its maximum clockwise rotation.

u. Increase the driver coupling a small amount by turning the OUTPUT COUPLING control clockwise until the PA screen current is reduced to approximately 10 ma. Adjust the PLATE TUNING control for a dip in the P.A. PLATE CURRENT meter indication. (The plate tuning capacitor should be near its center position when the dip in the driver plate current occurs. If the capacitor is not in this position, move the plate slider in the appropriate direction and repeat step u.)

v. Rotate the POWER OUTPUT ADJUST control clockwise a small amount.

w. Repeat steps u and v until the P.A. PLATE CURRENT meter indicates a minimum indication and the WATTMETER indicates 250 watts. At this time the driver screen current should be not less than 5 ma nor more than 20 ma.

x. Turn off the driver plate power and disconnect the dummy load from the driver. Reconnect the coaxial cable from the driver to the power amplifier. Set the driver POWER OUTPUT ADJUST potentiometer fully counterclockwise.

y. Set the driver WATTMETER switch to REFLECTED. Adjust the power amplifier GRID TUNING control for minimum reflected power.

NOTE

If a low value of reflected power cannot be obtained, change the setting of the power amplifier (right cabinet) grid slider slightly. Adjust the position of the r-f input tap and repeat step y.

z. Turn the driver POWER OUTPUT ADJUST control until the proper PA grid current is flowing (proper value approximately 50 ma obtained from figure 2-4).

aa. Set the power amplifier POWER OUTPUT ADJUST control in the maximum counterclockwise direction. Check the power amplifier filament voltage and if necessary readjust the FILAMENT VOLTAGE ADJUST control for 7.5 volts as indicated on the power amplifier MULTIMETER. If the transmitter filaments have been energized for at least 1/2 hour (if mercury-vapor rectifiers are used), press the power amplifier PLATE ON switch. When this switch is pressed, the red indicator lamp at the top right of the power amplifier cabinet should light and the P.A. PLATE VOLTAGE should indicate 6450 ±200 volts.

ab. Set the WATTMETER switch to FORWARD. Adjust the power amplifier PLATE TUNING control for maximum WATTMETER indication. (The power amplifier plate tuning capacitor should be near its center position when the maximum WATTMETER indication occurs. If the capacitor is not in this position, move the power amplifier plate slider in the appropriate direction and repeat step ab.)

CAUTION

The power amplifier P.A. PLATE CURRENT meter indication should never exceed 2.5 amperes (power supply rating).

When tuning, be sure that the plate dissipation does not exceed 6 kw at any time. Plate dissipation is:

$$\text{Plate dissipation} = E_p I_p - \text{power out}$$

ac. Set the power amplifier WATTMETER switch to REFLECTED. The swr must be less than 2:1 at all times (see figure 2-8). If the indication of reflected power is excessive, check the antenna and its associated r-f cable for a possible mismatch.

ad. Set the power amplifier WATTMETER switch to FORWARD. Adjust the OUTPUT COUPLING control for approximately 100 ma of screen current.

ae. Turn the power amplifier POWER OUTPUT ADJUST control to approximately its midpoint position. Recheck the driver power output for proper PA grid current.

NOTE

The values of screen current given in the steps are only approximate. The tube dissipation will allow for greater variations in screen current without adversely affecting tube operation.

af. Increase the power amplifier coupling a small amount by turning the OUTPUT COUPLING control clockwise until the PA screen current is reduced to approximately 200 ma (or value obtained from figure 2.3). Adjust the PLATE TUNING control for maximum WATTMETER indication.

ag. Rotate the power amplifier POWER OUTPUT ADJUST control clockwise a small amount.

ah. Repeat steps af and ag until the power amplifier P. A. PLATE CURRENT meter indicates the transmitter output is 10 kw (or authorized power) as measured by the indirect method. At this time, the PA screen current should be approximately 200 ma (or reduced current for reduced power applications obtained from figure 2-3). The indirect method of measuring power output is:

$$\text{Power output} = I_p E_p K$$

K or efficiency for determining the transmitter power output is obtained from the production test data supplied with the transmitter. If the final does not tune up properly, the fault may lie in improper neutralization. If faulty neutralization is suspected, neutralize the final according to the procedure given in paragraph 2.9.1.

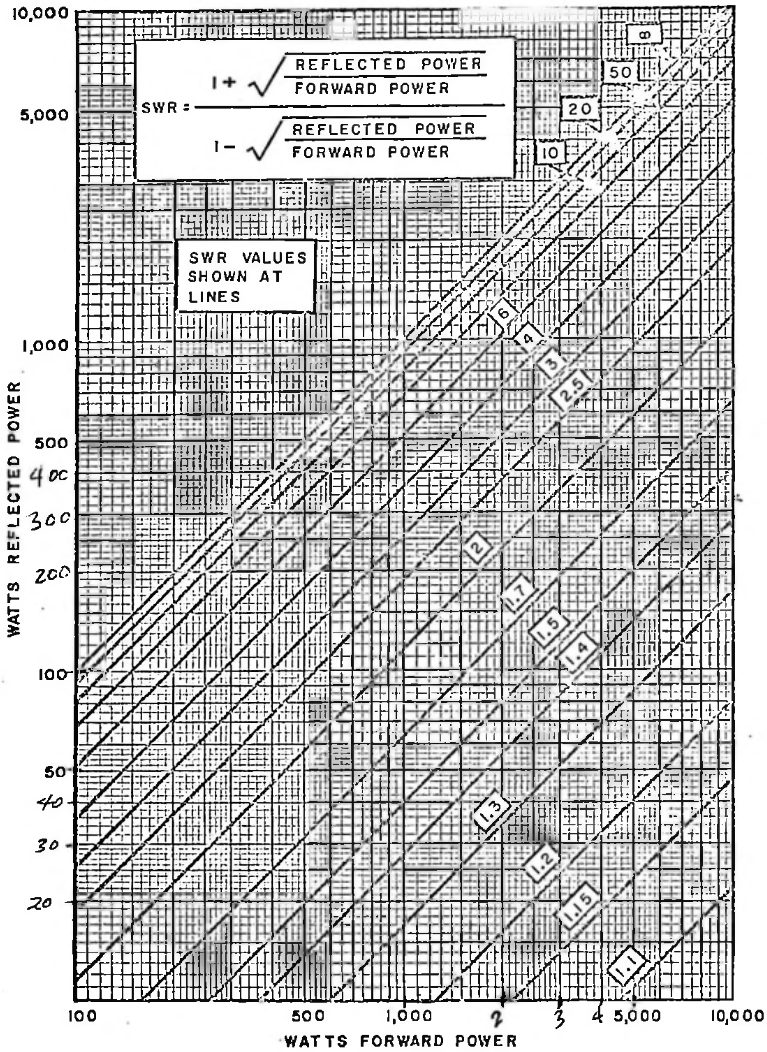


Figure 2-8. Directional Wattmeter SWR Determination Table

ai. Check to be sure that the FM monitor that is connected to the transmitter is properly calibrated. Then, if necessary, adjust the exciter VHFOSC FREQ ADJ control until the monitor indicates that the transmitter operating frequency is within specified operating limits.

aj. Apply 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 dbm.

ak. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation.

al. Replace the lower front panel on the transmitter cabinet and close the front doors. The transmitter is now ready for standard broadcast use.

NOTE

At this point it is suggested that a record be made of all meter readings for future maintenance and trouble shooting. These meter readings maybe recorded in table 5-3.

section 3
operation

3.1 General.

Refer to the unit instruction books to become familiar with the operation and function of controls on the power amplifier, the driver, and the exciter.

After the transmitter has been placed in operation it will be necessary to check meter indications from time to time to be sure the transmitter is operating properly and to occasionally touch-up the power amplifier loading and tuning.

3.2 Starting the Transmitter in Normal Operation.

The transmitter may be put into operation by two different methods, depending upon the circumstances. For normal operation, press either FILAMENT ON switch to start the driver and power amplifier filaments and to warm up the exciter (the exciter POWER switch should be left in the ON position at all times). Check the driver grid current to be sure the exciter is presenting sufficient drive to the driver before applying plate power. Approximately 30 seconds after filament power is applied, press the driver PLATE ON switch. Check the operation of the driver and, if it is operating properly, press the power amplifier PLATE ON switch, starting the transmitter.

The alternate method of starting the transmitter consists of pressing the power amplifier PLATE ON switch only. The power amplifier filament, the driver filament, and the exciter will immediately start to warm up. As soon as the driver time delay relay has completed its cycle, the driver and power amplifier plate voltages will come on automatically, starting the transmitter.

To shut down the transmitter it is recommended, but not necessary, to press the driver PLATE OFF switch, wait a few seconds, and then shut off the filament and exciter power by pressing either FILAMENT OFF switch. It is also possible to press either FILAMENT OFF switch which immediately removes plate, filament, and exciter power. Pressing the driver PLATE OFF switch first allows the plate power supply voltages to discharge through the driver and power amplifier while the filament is at normal operating temperature and, in addition, cools the power amplifier components.

section 4
principles of operation

4.1 General.

Refer to figure 4-1, a block diagram of 830F-1A 10-Kw FM Broadcast Transmitter. The transmitter can be broken down into four main subassemblies; an exciter, a driver, a power amplifier, and harmonic filter. Refer to section 2 of the unit instruction books for a complete explanation of the exciter, the driver, and the power amplifier.

4.2 A830-2 10 W Wide-Band FM Broadcast Exciter.

Refer to figure 4-1, a block diagram of the 830F-1A. The baseband audio is coupled to the A830-2 through a pre-emphasis network, and through an 18-db pad to J604 and two baseband amplifiers. The baseband output is coupled to a voltage-sensitive capacitor, C654. C654 is a diode which varies in capacity in proportion to the voltage across it. The FM oscillator is tuned to 14 mc. The capacity of C654 varies in proportion to the baseband audio and therefore the output is a 14-mc signal frequency modulated by the baseband audio. The deviation of the 14-mc signal is ±75 kc for 100 percent modulation. The osciallator output is coupled through two limiters to remove any amplitude modulation. The limited 14-mc signal is then amplified and a portion of the output coupled to the rate correction frequency discriminator and to the output amplifier. The output of the frequency discriminator is simply the baseband audio detected from the modulated 14-mc signal. This detected audio is coupled back to the baseband input to correct for any nonlinearity in C654.

A portion of the limiter output is also coupled to the afc buffer stage. The afc buffer output, the modulated 14-mc signal, is coupled to the reference oscillator and afc limiters through a diode switch. The output of the 14-mc reference oscillator is also coupled to the reference oscillator and afc limiters through a diode switch. The diode switch is operated by a 5-cps keying generator. The 5-cps generator is a unijunction transistor operating as a relaxation oscillator keying a multivibrator.

The diode switch alternately connects the modulated 14-mc signal (afc buffer output) and the 14-mc reference signal to the afc discriminator. The afc discriminator detects the difference between the 14-mc reference signal and the modulated 14-mc signal. The modulated 14-mc signal will cause a baseband audio output at the discriminator. This is not an error in frequency, so a portion of the baseband audio input is amplified by the baseband canceling amplifier and fed into the output of the frequency discriminator through a diode switch. This diode switch is keyed by the same 5-cps signal which switched the reference oscillator and afc limiter input. When the modulated 14-mc signal is connected to the reference oscillator and afc limiter input, the baseband canceling signal is switched into the output of the frequency discriminator to cancel the baseband output from the discriminator.

The input signal to the four error signal amplifiers is a 5-cps square wave. The amplitude of this square wave is proportional to the frequency error in the FM oscillator. The error signal amplifier square wave output is converted to a d-c control signal in the synchronous detector. The synchronous detector is also keyed by the 5-cps keying signal. The d-c error signal is coupled to C654 to correct the frequency modulation oscillator.

A portion of the limiter output is fed to the output amplifier. The modulated 14-mc signal from the output amplifier is then heterodyned up to the operating frequency in a balanced mixer. The crystal frequency is 14 mc below the customer's operating frequency. The crystal oscillator output is coupled to a buffer stage and is mixed with the modulated 14-mc signal in the balanced mixer. The balanced mixer output is limited and amplified to the 10-watt r-f output level. The output impedance of the A830-2 is between 50 and 70 ohms.

The power supply for the A830-2 is of conventional design and supplies operating voltages for the vacuum tubes and transistors in the A830-2.

4.3 Driver and Final.

The driver consists of a single ceramic-type tetrode tube. The tube is operated as a class C amplifier with a tuned coaxial line resonator plate circuit. The output from the driver is fed to a 10-kw final amplifier.

The final power amplifier is also made up of a single ceramic-type tetrode tube. The tube is operated as a grounded screen, class C amplifier, using screen grid neutralization. The plate works into a tuned coaxial line resonator with a similar tuned coaxial line resonator for the control grid tank. The plate output is fed through a harmonic filter which reduces all output harmonics into the antenna.

The harmonic filter consists of two series-resonant M-derived low-pass end sections and two constant-K,

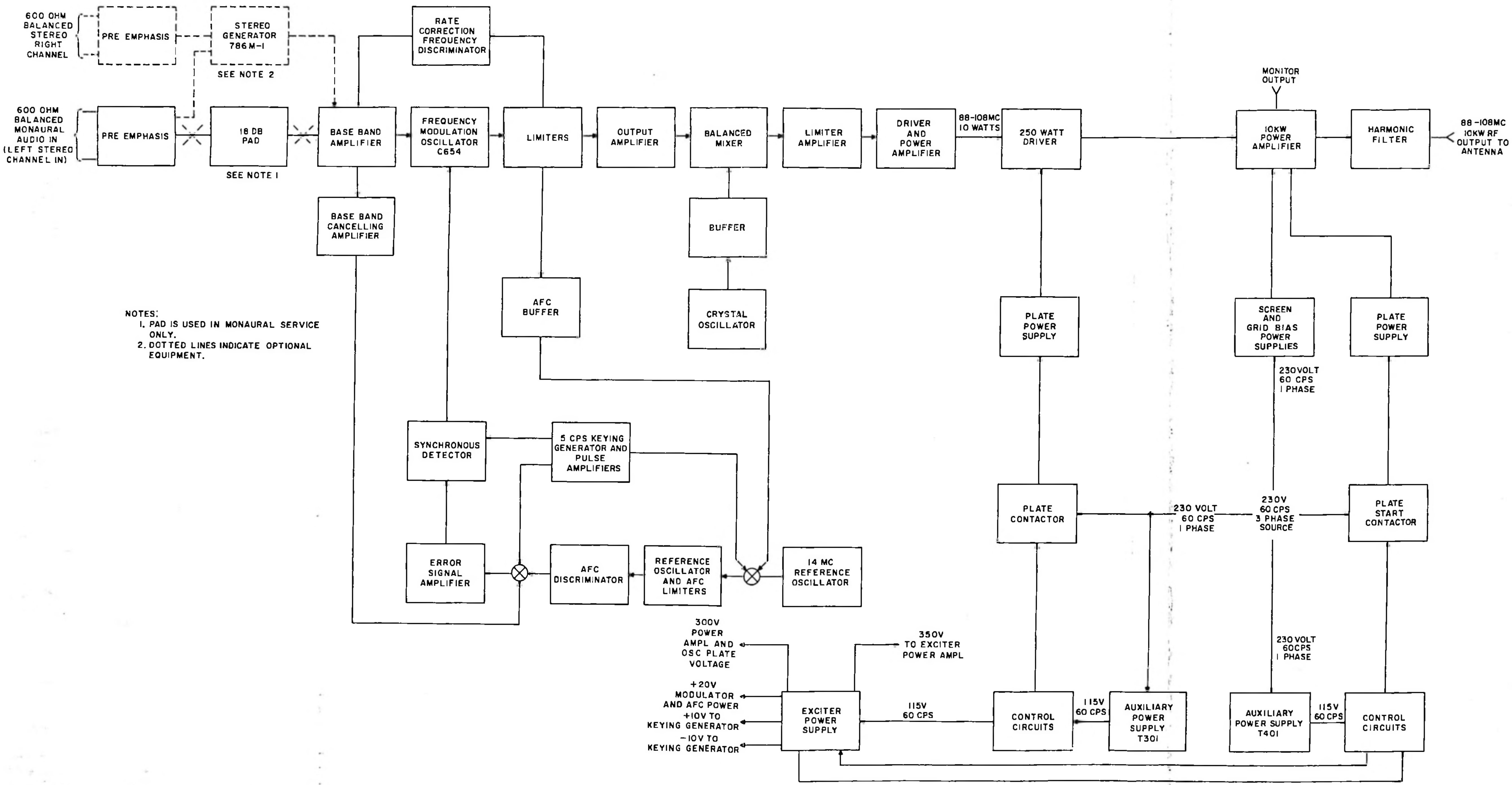


Figure 4-1. 830F-1A 10-Kw FM Broadcast Transmitter, Block Diagram

T center sections. The harmonic filter starts to attenuate above 110 mc and reaches maximum attenuation at the carrier second harmonic. The attenuation pattern then tapers off slowly as the frequency rises. The over-all result of the harmonic filter is in keeping the harmonics attenuated at least 80 db below the carrier frequency.

4.3.1 CONTROL CIRCUITS.

One phase of the 230-volt, 3-phase power is stepped down to 115 volts a-c by transformers T301 and T401. This lower voltage is used to activate relays in the transmitter control circuits and is also fed to the exciter as its primary power source. The control circuits allow power to be applied to the transmitter only in the proper sequence to prevent damage to the driver and final amplifier. These circuits also contain protective devices to prevent damage to components from accidental overloads.

4.3.2 PLATE CONTACTORS AND POWER SUPPLIES.

The driver plate contactor consists of a heavy-duty relay which controls the 230-volt a-c primary power to the plate power supply. The driver plate contactor is actuated by the driver PLATE ON switch through the control circuitry.

The driver plate power supply is a conventional full-wave power supply capable of delivering 2100 volts d-c at 250 ma to the driver.

The power amplifier plate contactors are heavy-duty relays which control the 3-phase power supply and are activated by the power amplifier PLATE ON switch. The two plate contactors are energized in a step-start sequence (switches resistances momentarily into the line) to reduce the generation of transients in the power supply when power is first applied.

The power amplifier plate power supply is a conventional 3-phase full-wave power supply capable of providing 5700 volts at 2.5 amperes. The screen power supply is a full-wave 3-phase silicon diode power supply capable of providing 750 volts at 2.6 amperes. The control grid bias supply places the control grid at about cutoff and is set at the factory.

section 5

maintenance

5.1 General.

The following paragraphs contain information concerning maintenance of 830F-1A 10-Kw FM Broadcast Transmitter.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the transmitter cabinets whenever high voltage is applied. Do not depend on door interlocks. Always shut down the transmitter before doing any work inside the transmitter cabinets. Immediately upon opening the rear cabinet doors, short out the power supply capacitors with the shorting sticks provided with the transmitter.

Refer to the applicable unit instructions for specific maintenance procedures for each subassembly.

5.2 Normal Tuning Procedures.

The following are tuning procedures which should be observed after the transmitter has been installed and tuned according to the installation procedures given in section 2. Table 5-1 presents abbreviated tuning instructions to be used with the following procedures. Table 5-1 can be detached from this instruction book, placed within one of the cabinet doors or adjacent to the transmitter, and used as a reference when the operator becomes familiar with the transmitter.

a. Open the doors at the front of the cabinets.
b. Press either FILAMENT ON switch and allow the exciter to warm up for at least 15 minutes.
c. Set S101 on the exciter to MIXER GRID A. Adjust BUF TUNE control for a peak on M101.
d. Set S101 to V428 B and adjust L429 and L430 for a peak on M101.
e. Set S101 on V429 B and adjust L431 and L432 for a peak on M101.
f. Set S101 to V430 B and adjust L433 and L434 for a peak on M101.
g. Set S101 to V430C B and adjust the PA PLATE control for a minimum indication on M101.

NOTE

Convenient marked ranges are available on the meter which correspond to switch positions. These ranges give an approximate requirement for min-max readings for each switch position.

h. Tune the exciter coupling by setting the MULTIMETER switch to GRID FS 40 MA and adjusting the exciter PA MATCH control for maximum coupling. Tune the driver GRID TUNING control for a peak MULTIMETER indication.
i. Set the driver WATTMETER to REFLECTED.
j. Press the driver PLATE ON switch. Adjust the power amplifier GRID TUNING for a dip in the R.F. WATTMETER indication. Set the driver to FORWARD. In turn, adjust the driver PLATE TUNING control for minimum indication on the driver P.A. PLATE CURRENT meter and increase the OUTPUT COUPLING control and the POWER OUTPUT ADJUST control, by small amounts, until the proper value of PA grid current is flowing (function of power level; see figure 2-4). The driver screen current may be 0 but should not be more than 20 ma when the driver is properly tuned.
k. Adjust the power amplifier FILAMENT VOLTAGE ADJUST control for 7.5 volts as shown on the MULTIMETER.
l. Press the power amplifier PLATE ON switch.
m. Adjust the power amplifier GRID TUNING control for a maximum indication on the MULTIMETER. (This should be near the minimum reflected power on the driver wattmeter.) Place the power amplifier WATTMETER switch in the FORWARD position.
n. In turn, adjust the power amplifier PLATE TUNING control for a maximum WATTMETER indication and increase the OUTPUT COUPLING control and the POWER OUTPUT ADJUST control, by small amounts, until the transmitter is producing authorized power as measured by the indirect method.

$$\text{Power output} = I_p E_p K$$

The power amplifier screen current should be at the value specified in figure 2-3 for the transmitter output power level when the power amplifier is properly tuned. Normal operation is achieved when the R.F. WATTMETER indication is maximum. Efficiency may be improved by detuning plate circuit slightly from maximum power to the high frequency side of resonance (less capacity).
o. Adjust the VHF OSC FREQ ADJ control until the FM monitor indicates the transmitter is operating within the specified operating limits.

5.3 Modulator and AFC Discriminator Adjustment Procedures.

The broadband exciter is designed to be exceptionally stable and will require few adjustments over a long period of time. The following adjustment procedures should only be followed if the exciter is not operating within limits upon installation, or if any of the transistors (Q503, Q511, Q601, and Q604) are replaced. Replacement of other components should not normally require a change in the adjustments given in this section. The transmitter will have to be energized when performing steps c and e. Use an a-c vtvm such as a Ballantine Model 310A when making adjustments. A d-c vtvm such as a Heath type may be used in step f.

NOTE

> When adjusting the modulator and afc section of the exciter, use a nonmetallic hex type adjusting tool. Keep all metallic tools, the hands, and other parts of the body away from transistor cases. When disabling the afc with the complete transmitter in operation, check the station monitor to be sure the center frequency stays within the FCC requirements.

a. Remove transistor Q509 and place a vtvm from TP501 to ground. Tune L505 and L504 for a peak indication on the vtvm. Be sure to tune the inductances in the order given to minimize the limiting effect. Check that each stage is limiting when making these adjustments. Limiting will show up as a broad flat peak on the vtvm when tuning. Set the controls midway between the limiter fall-off points shown on the vtvm. Do not replace Q509 at this time.

b. Tune the afc discriminator by placing a vtvm from TP501 to ground and tune the DISCR PRI control, C515, for maximum indication. Place the vtvm from TP502 to ground and adjust the DISCR SEC control, C518, for 0 on the vtvm.

c. Disable the afc by pressing the AFC DISABLE switch and adjust the OSC FREQ control until the station monitor indicates the exciter is on frequency. Replace Q509.

d. Remove Q607. Place a vtvm between TP602 and ground. Tune L606 and L603 for a maximum indication on the vtvm. Tune the inductors in the order shown to minimize the effects of the limiter.

e. Remove afc by holding down the AFC DISABLE switch. With the vtvm from TP602 and ground, tune the DISCR PRI control, C639, for a maximum indication on the vtvm. Move the vtvm to TP601 and tune the DISCR SEC control, C644, for a 0 indication when the modulation monitor indicates the exciter is approximately on frequency. Repeat the tuning of the DISCR PRI and DISCR SEC controls. Replace Q607.

f. Place a d-c vtvm between TP603 and ground. Set the AMP BIAS control for a 7.5-volt indication on the vtvm.

g. Place a vtvm between TP504 and ground. Remove Q510. Tune L611 and L608 for a maximum indication on the vtvm. Replace Q510.

h. With a vtvm on TP504, adjust the REF LEVEL control for an equal indication on the vtvm with first Q510 removed and then Q509 removed. (This equalizes the modulator oscillator voltage and the 14-mc reference voltage.) Replace the transistors.

i. Place an oscilloscope between TP504 and ground. Apply a 150-cps audio signal on J601. Adjust the MOD BAL control for a minimum 150-cps indication as shown on the oscilloscope.

NOTE

> The MOD BAL control must be adjusted slowly to allow the error signal amplifiers to stabilize between adjustments.

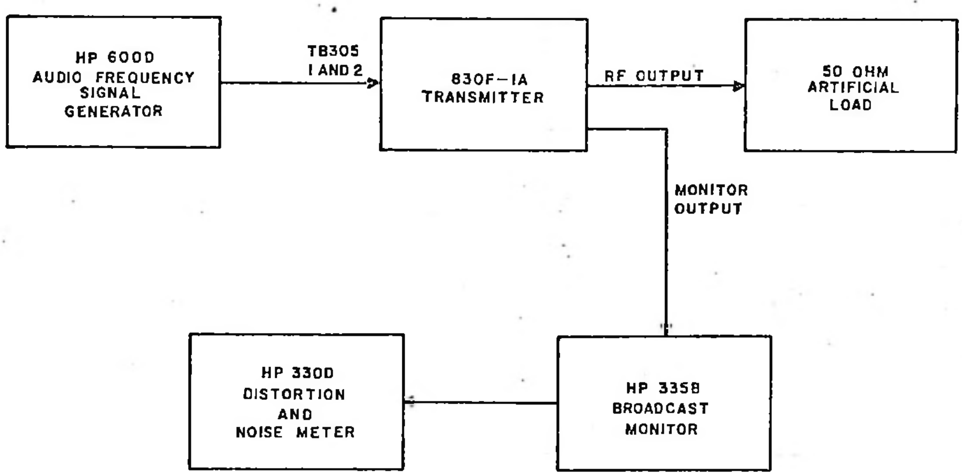


Figure 5-1. Distortion Test Setup

TABLE 5-1. ABBREVIATED TUNING PROCEDURES

	CONTROL	POSITION	ADJUSTMENT	INDICATING METER	INDICATION	NOTES Allow transmitter to warm up at least 15 minutes before tuning.
EXCITER	S101	MIXER GRID A	BUF TUNE	M101	Maximum	
	S101	V428 B	*L429, L430	M101	Maximum	
	S101	V429 B	*L431, L432	M101	Maximum	
	S101	V430B	*L433, L434	M101	Minimum	
	S101	V430C B	PA (exciter) PLATE	M101	Minimum	
DRIVER	MULTIMETER	GRID FS 40 MA	PA MATCH GRID TUNING	MULTIMETER	Maximum	
	WATTMETER	FORWARD	PLATE TUNING OUTPUT COUPLING POWER OUTPUT ADJUST	P.A. PLATE CURRENT R.F. WATTMETER R.F. WATTMETER	Minimum Maximum 250 watts or less depending on drive requirements	Repeat the adjustment of PLATE TUNING, OUTPUT COUPLING, and POWER OUTPUT ADJUST controls until proper power amplifier drive is obtained.
POWER AMPLIFIER	WATTMETER	FORWARD	PLATE TUNING OUTPUT COUPLING POWER OUTPUT ADJUST	R.F. WATTMETER R.F. WATTMETER R.F. WATTMETER	Maximum Authorized power indication Authorized power indication	Repeat the adjustment of PLATE TUNING, OUTPUT COUPLING, and POWER OUTPUT ADJUST controls until authorized power is achieved by the indirect power measuring method. $P = I_pE_pK$

*Use slotted nonmetallic screwdriver on these adjustments.

TABLE 5-2. DISTORTION CHECKS

FREQUENCY	DISTORTION IN PERCENT		
	25% MODULATION	50% MODULATION	100% MODULATION
50			
100			
400			
1000			
5000			
7500			
10,000			
15,000			

For a complete exciter alignment procedure, refer to the maintenance section in TD-536.

5.4 Distortion Testing Procedure.

a. Refer to figure 5-1. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D to the exciter audio input, terminals 1 and 2 of TB305. (Disconnect the station console audio input leads when making this connection.) Connect a distortion and noise meter, such as a Hewlett-Packard Model 330D, to the broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 ±2dbm.

c. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation (±75-kc deviation).

d. Measure the distortion at the frequencies and modulation levels given in table 5-2. The distortion shall be less than 1.0 percent for frequencies between 50 cps and 15 kc.

5.5 Audio Frequency Response Measurements.

a. Refer to figure 5-2. Connect an audio frequency signal generator, such as a Hewlett-Packard Model

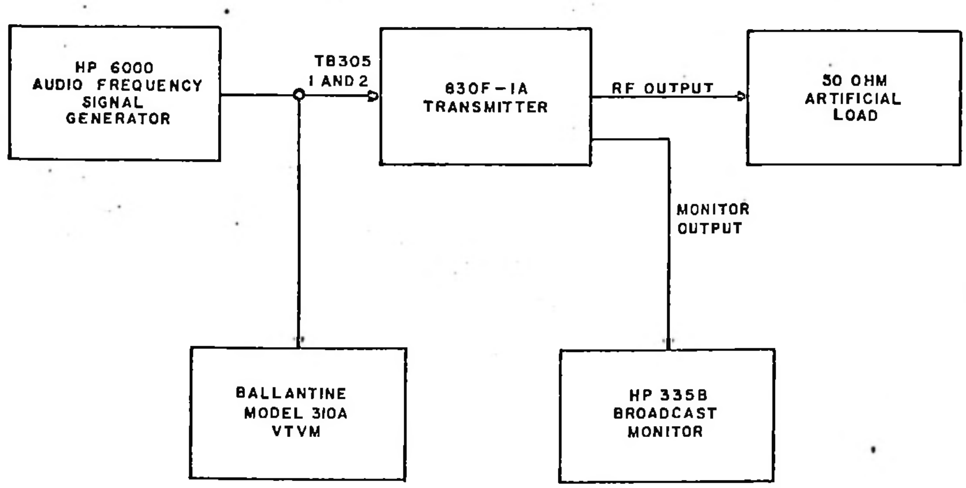


Figure 5-2. Audio Frequency Response, Test Setup

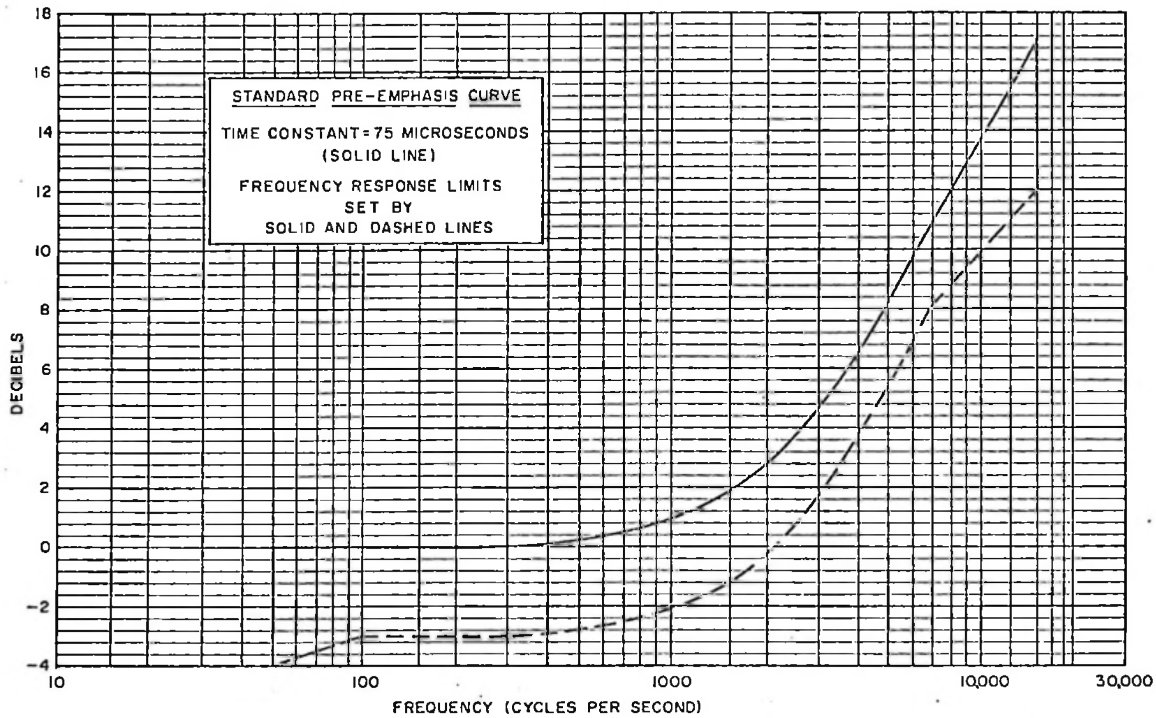


Figure 5-3. Audio Frequency Response Limits

600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making these measurements.) Connect a vacuum-tube voltmeter, such as a Ballantine Model 310A, to the audio output terminals of the audio frequency generator. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Check the audio frequency response of the transmitter by modulating the transmitter at 50, 100, 400, 1000, 5000, 7500, 10,000, and 15,000 cps for 25 percent, 50 percent, and 100 percent modulation. Audio frequency response is measured by keeping the percentage of modulation constant and measuring the magnitude of audio, at each frequency given, to give the desired percentage of modulation. The audio frequency response must fall within the limits given in figure 5-3.

NOTE

When taking audio frequency response measurements, a broadcast monitor, such as Hewlett-Packard Model 335B, should be used. Do not use an instrument where audio de-emphasis might give a false indication of peak modulation.

5.6 FM Noise Measurements.

a. Refer to figure 5-4. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making this measurement.) Connect a vacuum-tube voltmeter to the output terminals of the broadcast monitor. Connect an artificial load to the r-f output connector located on top of the power amplifier cabinet. Turn on the transmitter.

b. Modulate the transmitter 100 percent (±75-kc deviation) with 400 cps of audio.

c. Remove the modulating 400 cps and read the residual FM noise on the vacuum-tube voltmeter. The residual FM noise shall be less than -65 db below 100 percent modulation.

5.7 AM Noise Measurements.

a. Refer to figure 5-5. Short out terminals 1 and 2 of terminal board TB305. Connect a vacuum-tube voltmeter to connector J3 of the Hewlett-Packard Model 335B broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the power amplifier cabinet. Turn on the transmitter.

b. Switch the broadcast monitor to measure carrier level.

c. Measure the AM noise in db at J3 of the broadcast monitor in the following manner. Set modulation monitor to carrier level and measure the d-c level on the modulation meter (100 percent on scale equals 10 volts). Connect the vacuum-tube voltmeter to J3 and terminate J3 with a 2-megohm resistor. Measure the a-c level on the vacuum-tube voltmeter. (The

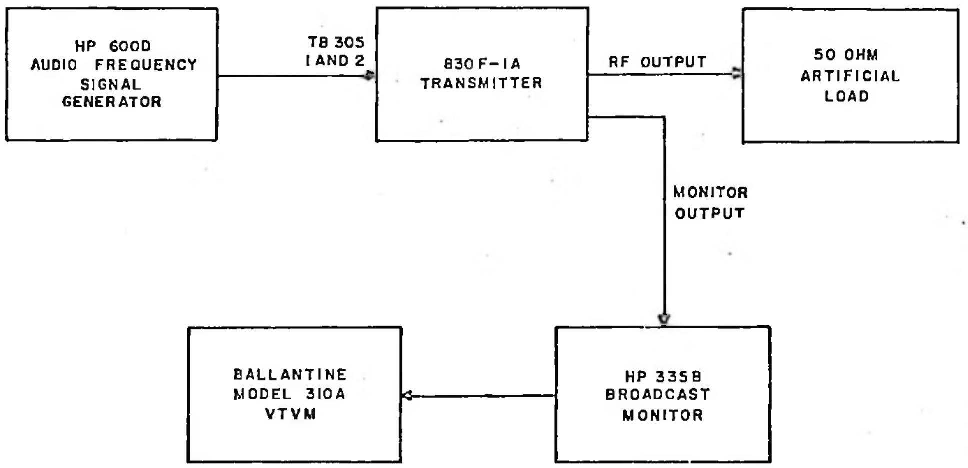


Figure 5-4. FM Noise Test Setup

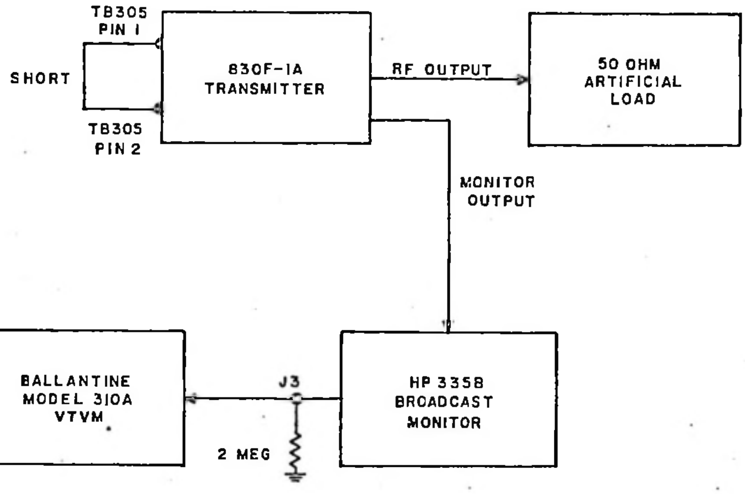


Figure 5-5. AM Noise Test Setup

input to the vacuum-tube voltmeter should be a shielded cable having less than 100 uuf distributed capacitance.) The AM noise is related to the ratio of the d-c reading and the a-c level. The AM noise shall be not less than -55 db below voltage or d-c carrier level.

$$\text{AM noise in db} = 20 \log \frac{\text{d-c reading}}{\text{a-c reading}}$$

5.8 Trouble Shooting.

Standard trouble-shooting procedures should be used in finding malfunctions in the transmitter. As suggested in TD-536, TD-538, and TD-580, meter indications for all functions should be recorded when the transmitter is installed and operating properly. Table 5-3 is supplied for recording these readings. If some malfunction should occur after the normal meter readings are recorded, it is a simple matter to compare the meter readings of the malfunctioning equipment with the normal meter readings. When trouble-shooting and comparing the meter readings it is advisable to start with the final stage and proceed backwards until normal readings are encountered. The malfunctioning stage will then be the one immediately ahead of normal meter indications.

As most cases of trouble will be traced to tubes or transistors, it is advisable to first of all replace the tube (or transistor) in the stage in which the trouble is suspected. If the trouble does not clear with tube or transistor replacement, it will become necessary to take resistance or voltage measurements within the suspected circuit to determine which component has failed.

When tracing trouble within the power amplifier it will be helpful to use the "from-to" information given in unit instructions TD-538 and TD-580. The "from-to" information gives the actual location of individual wires within the transmitter cabinets. When used in conjunction with the schematics, the "from-to" information can be very helpful.

If the transmitter center frequency shifts excessively with modulation, the trouble may be isolated to either afc circuitry or the modulator circuitry of the exciter by disabling the afc and noting if the carrier shifts more than 1.8 kc with a change in modulation from 0 to 100 percent. If the modulator oscillator shifts more than 1.8 kc with the afc disabled, the trouble will be within the modulator oscillator circuits. The afc circuitry cannot shift the modulator oscillator frequency more than 1.8 kc. If the carrier shift is under 1.8 kc, the trouble will be in the afc circuitry.

TABLE 5-3. NORMAL TRANSMITTER METER INDICATIONS

	CONTROL	POSITION	METER	INDICATION
EXCITER	S101	BUFFER GRID A	M101	
	S101	MIXER GRID A	M101	
	S101	V428 B	M101	
	S101	V429 B	M101	
	S101	V430 B	M101	
	S101	V430C B	M101	
	S101	MOD OUTPUT B	M101	
	S101	AFC KEY B	M101	
	S101	14MC REF B	M101	
DRIVER	MULTIMETER	SCREEN FS 400 VDC	MULTIMETER	
	MULTIMETER	SCREEN FS 40 MA	MULTIMETER	
	MULTIMETER	GRID FS 40 MA	MULTIMETER	
			P.A. PLATE VOLTAGE	
			P.A. PLATE CURRENT	
	WATTMETER	FORWARD	R.F. WATTMETER	
	WATTMETER	REFLECTED	R.F. WATTMETER	
POWER AMPLIFIER	MULTIMETER	BIAS V400V FS	MULTIMETER	
	MULTIMETER	GRID 80 MA FS	MULTIMETER	
	MULTIMETER	SCREEN 400 MA FS	MULTIMETER	
	MULTIMETER	SCREEN V 800 V FS	MULTIMETER	
	MULTIMETER	EXTERNAL	MULTIMETER	
			P.A. PLATE VOLTAGE	
			P.A. PLATE CURRENT	
	WATTMETER	FORWARD 15 KW	R.F. WATTMETER	
	WATTMETER	REFLECTED 5 KW	R.F. WATTMETER	

TD-580
523-0755345-003418
3rd Edition, 1 September 1966

COLLINS

unit instructions

F830-1
10-Kw FM Power Amplifier

Collins Radio Company | Dallas, Texas
Printed in U. S. A.

table of contents

Section			Page
1	GENERAL DESCRIPTION		1
	1.1	Purpose of Instruction Book	1
	1.2	Purpose of Equipment	1
	1.3	Description of Equipment	1
	1.3.1	Physical Description	1
	1.3.2	Electrical Description	1
	1.4	Equipment Supplied	3
	1.5	Equipment Required but not Supplied	3
	1.6	Equipment Specifications	3
	1.6.1	Mechanical	3
	1.6.2	Electrical	3
	1.7	Tube and Semiconductor Complement	3
2	PRINCIPLES OF OPERATION		4
	2.1	General	4
	2.1.1	Control Circuits	4
	2.1.2	Power Amplifier Circuits	7
	2.2	Control Functions	8
3	MAINTENANCE		11
	3.1	General	11
	3.2	Preventive Maintenance	11
	3.2.1	Air Filter Cleaning	11
	3.2.2	PA Tube Cleaning	11
	3.2.2.1	PA Tube Removal	11
	3.2.3	Inspection	12
	3.2.4	Lubrication	12
	3.2.5	Tube Maintenance	12
	3.3	Trouble Shooting	12
	3.4	Cable Chart	13
4	PARTS LIST		18
5	ILLUSTRATIONS		29

list of illustrations

Figure		Page
1-1	F830-1 10-Kw FM Power Amplifier, Over-all View (C919-01-P)	1
1-2	F830-1 Rear View with Doors Open and Lower Panel Removed (C919-04-P)	2
2-1	F830-1 10-Kw FM Power Amplifier, Block Diagram (C849-10-4)	4
2-2	F830-1 Control Circuits, Simplified Schematic Diagram (B502-133-5)	5
2-3	F830-1 Power Amplifier Circuits, Simplified Schematic Diagram (B502-134-5)	6
2-4	F830-1 Control and Adjustment Locations (B502-171-Pb)	9
4-1	F830-1 10-Kw FM Power Amplifier (B502-164-Pb) (B502-162-Pb) (B502-165-Pb) (B502-142-Pb) (B502-144-Pb) (B502-146-Pb) (B502-145-Pb) (B502-143-Pb) (B502-163-Pb) (B502-147-Pb) (B502-148-Pb) (B502-161-Pb) (B502-166-Pb) (B502-160-Pb) (B502-167-Pb) (B502-168-Pb)	20
4-2	Semiconductor Device, Rectifier (B502-169-Pb) (B502-170-Pb)	46
5-1	F830-1 10-Kw FM Power Amplifier, Schematic Diagram (B502-132-6)	49/50

list of tables

Table		Page
1-1	Associated Equipment Instruction Books	2
1-2	Equipment Supplied	3
1-3	Equipment Required but not Supplied	3
1-4	Tube and Semiconductor Complement	3
3-1	Typical Meter Indications	12
3-2	Cabinet From-To Information	13

section 1

general description

1.1 Purpose of Instruction Book.

This unit instructions provides information about F830-1 10-Kw FM Power Amplifier. Information which is furnished covers a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

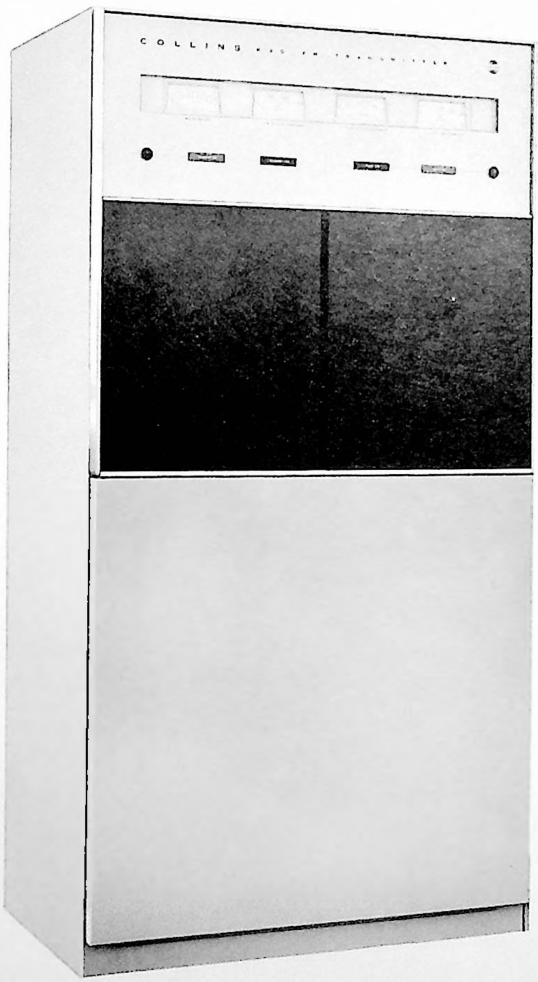


Figure 1-1. F830-1 10-Kw FM Power Amplifier, Over-all View

1.2 Purpose of Equipment.

The F830-1 10-Kw FM Power Amplifier is used for continuous monaural or stereophonic FM broadcast service on a single frequency in the range from 88 to 108 megacycles with an output power of 10,000 watts.

1.3 Description of Equipment.

1.3.1 PHYSICAL DESCRIPTION.

The F830-1 10-Kw FM Power Amplifier, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 1240 pounds. All power amplifier operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The screen circuit breaker is located inside the rear of the cabinet. The monitoring meters may be observed easily while operating the tuning controls. The power amplifier uses one r-f amplifier tube and six rectifier tubes. Silicon diode rectifiers are an optional item used in place of the six rectifier tubes. The r-f amplifier tube is accessible from the front of the power amplifier. The bottom front of the power amplifier cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the power amplifier for servicing and maintenance. The lower rear half of the power amplifier cabinet is covered by a removable panel containing a ventilating fan and a permanent air filter. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks remove the plate voltage and ground the high-voltage circuits when the doors are opened or disable the high voltage when the panel is removed. The power amplifier plate tuning and grid tuning resonators are located in an interlocked compartment at the front of the transmitter.

Inside the F830-1, heavy iron-core components are at the bottom of the cabinet. A harmonic filter, attached to F830-1, is located in the rear cabinet compartment.

Cooling air for the power amplifier is drawn through a permanent air filter at rear of cabinet by a high-volume fan and exhausted through a shielded opening at top of cabinet. A single high-volume blower supplies cooling air directly to the power amplifier tube.

1.3.2 ELECTRICAL DESCRIPTION.

The F830-1 10-Kw FM Power Amplifier consists of a single, air-cooled power amplifier tube and all

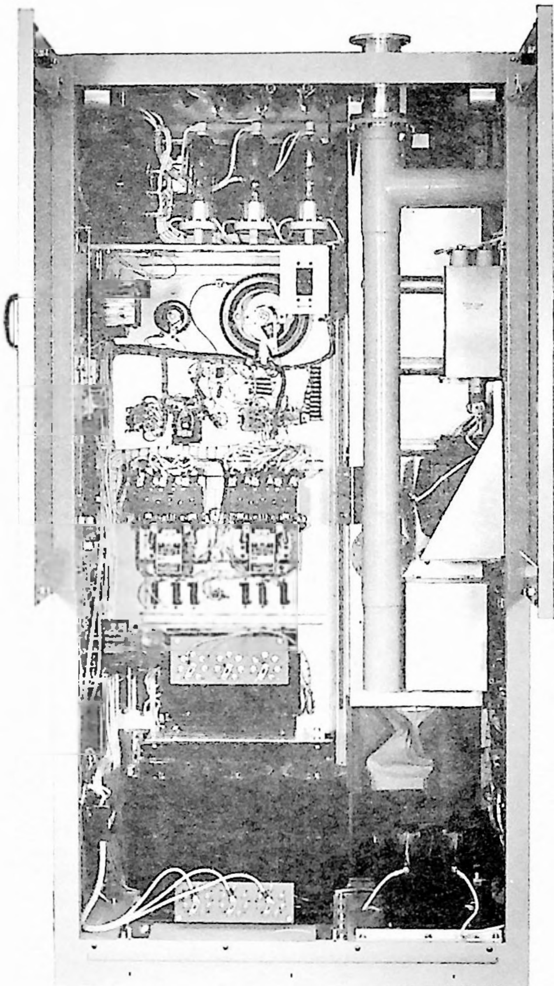


Figure 1-2. F830-1 Rear View with Doors Open and Lower Panel Removed

associated power supply and control circuitry. The F830-1 input impedance is 50 ohms nominal, unbalanced. The F830-1 output power is at least 10,000 watts over the frequency range of 88 to 108 megacycles into a 50-ohm load with an swr not exceeding 2:1.

Line power input required is 60 cycle, 3 phase with primary taps on all power transformers to compensate for local line voltage variations from 200 to 250 volts. Other taps are available for reduced power operation. Circuit breakers in the input side of the plate, screen, and control circuits are provided for primary current overload protection. The control circuit auxiliary power supply and the control grid bias supply are fused. Time delay circuitry for protection of the power amplifier during warmup is provided, with the actual time delay control received from the driver time delay relay. Circuits are provided for remote control tie-in with the driver remote control circuits, with the actual remote control available from one source. Instruction books covering the exciter and driver used in conjunction with the F830-1 10-Kw FM Power Amplifier are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK PART NO.
A830-2 10 W Wide-Band FM Broadcast Exciter	523-0755303
786M-1 Stereo Generator	523-0755304
B830-1 250-Watt FM Power Amplifier	523-0755596
D830-1 1000-Watt FM Power Amplifier	523-0755334

1.4 Equipment Supplied.

Table 1-2 lists equipment supplied as part of the F830-1 10-Kw FM Power Amplifier.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
F830-1 10-Kw FM Power Amplifier	522-2981-00
5/10-Kw Harmonic Filter	549-2192-004

1.5 Equipment Required but not Supplied.

Table 1-3 lists equipment required for operation of F830-1 10-Kw FM Power Amplifier but not supplied as part of the power amplifier. The 250-watt power amplifier is used in place of the 1000-watt power amplifier for reduced power applications.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
B830-1 250-Watt FM Power Amplifier	549-2008-00
or	
D830-1 1000-Watt FM Power Amplifier	522-2948-00

1.6 Equipment Specifications.

1.6.1 MECHANICAL.

Weight . . . . 1240 pounds maximum.

Size . . . . 38 inches wide, 76 inches high, 27 inches deep.

Ventilation . . . . . . One ventilating fan, one blower.

Ambient temperature range . . . . +20°C (68°F) to +45°C (113°F) with mercury vapor rectifiers or +0°C (32°F) to +45°C (113°F) with silicon diode rectifiers.

Ambient humidity range . . . . 0 to 95 percent relative humidity.

Altitude . . . . 0 to 6000 feet.

1.6.2 ELECTRICAL.

Power source. . . . . 200 to 250 volts, 60 cycle, 3 phase.

Maximum 60-cps power requirements . . 20 kilowatts.

R-f input power . . . . 250 watts nominal.

Power output . . . . . 10,000 watts nominal or at optional reduced power.

Output impedance . . . 50 ohms, nominal unbalanced.

Frequency range . . . 88 to 108 megacycles. Exact operating frequency determined by frequency of exciter.

1.7 Tube and Semiconductor Complement.

Table 1-4 lists the tube and semiconductor complement supplied as part of the F830-1 10-Kw FM Power Amplifier.

TABLE 1-4. TUBE AND SEMICONDUCTOR COMPLEMENT

QUANTITY	TYPE	FUNCTION
6	872A/872	Plate voltage rectifiers or
72	66-6726	Plate voltage silicon rectifiers
1	4CX5000A	Power amplifier
8	1N540	Control grid bias rectifiers
4	1N540	Multimeter rectifiers
12	66-6726	Screen grid voltage rectifiers
4	1N3044A	Zener remote control line protection
2	1N3016B	Zener remote control line protection

section 2

principles of operation

2.1 General.

The F830-1 10-Kw FM Power Amplifier contains a power amplifier and associated circuitry for the amplification of approximately 250 watts of r-f drive up to 10 kilowatts of r-f power. The F830-1 operates in the frequency range of 88 to 108 megacycles. The F830-1 output can be fed through a harmonic filter, for the attenuation of spurious radiations, to an antenna or to a higher power amplifier.

Refer to figure 2-1, a block diagram of the F830-1 10-Kw FM Power Amplifier. The 230-volt, 60-cps, 3-phase line input is fed to the plate and screen step-start contactors where plate and screen voltage on-off functions are controlled by the control circuits. The 230-volt, 3-phase line input is also fed to an auxiliary power supply, T401, where part of the 230-volt input is reduced to 115 volts single phase. The single phase output of T401 is then fed to the control circuits. The control circuits turn the plate, screen, filament, and control grid bias supply on and off. The control circuits also feed 230-volt, 60-cps, single phase power to the driver. Provisions are made within the control circuitry to connect to the filament on-off and plate on-off functions of a higher power amplifier, if one is used. The higher power amplifier could then control the filament on-off and plate on-off functions.

The power amplifier consists of a single, ceramic type, forced air-cooled, grounded screen tube working into a resonant, quarter wavelength, coaxial line. The control grid circuit consists of a coaxial line resonator with a swamping resistor in parallel to provide a low impedance broadband load to the control grid. Metering circuits are included to measure filament voltage, control grid bias voltage, screen grid voltage, control grid current, and screen current.

The output power of the F830-1 may be reduced by lowering the plate, screen, and control grid voltages.

2.1.1 CONTROL CIRCUITS.

Refer to figure 2-2, a simplified schematic diagram of the control circuits of F830-1 10-Kw FM Power Amplifier. The control circuits apply or remove filament, plate, screen, and grid bias voltages, turn the cabinet fan and power amplifier blower on and off, and provide

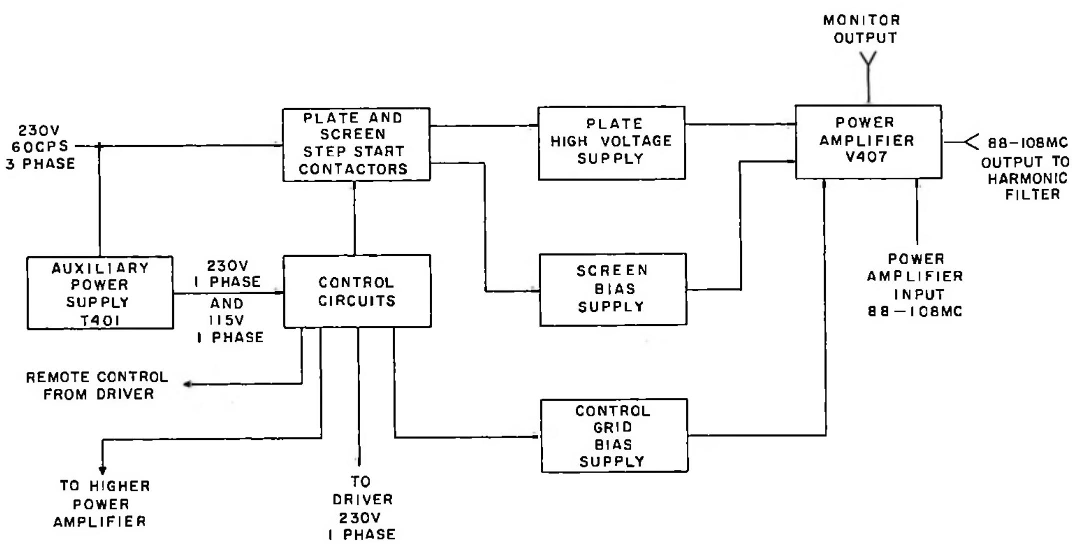


Figure 2-1. F830-1 10-Kw FM Power Amplifier, Block Diagram

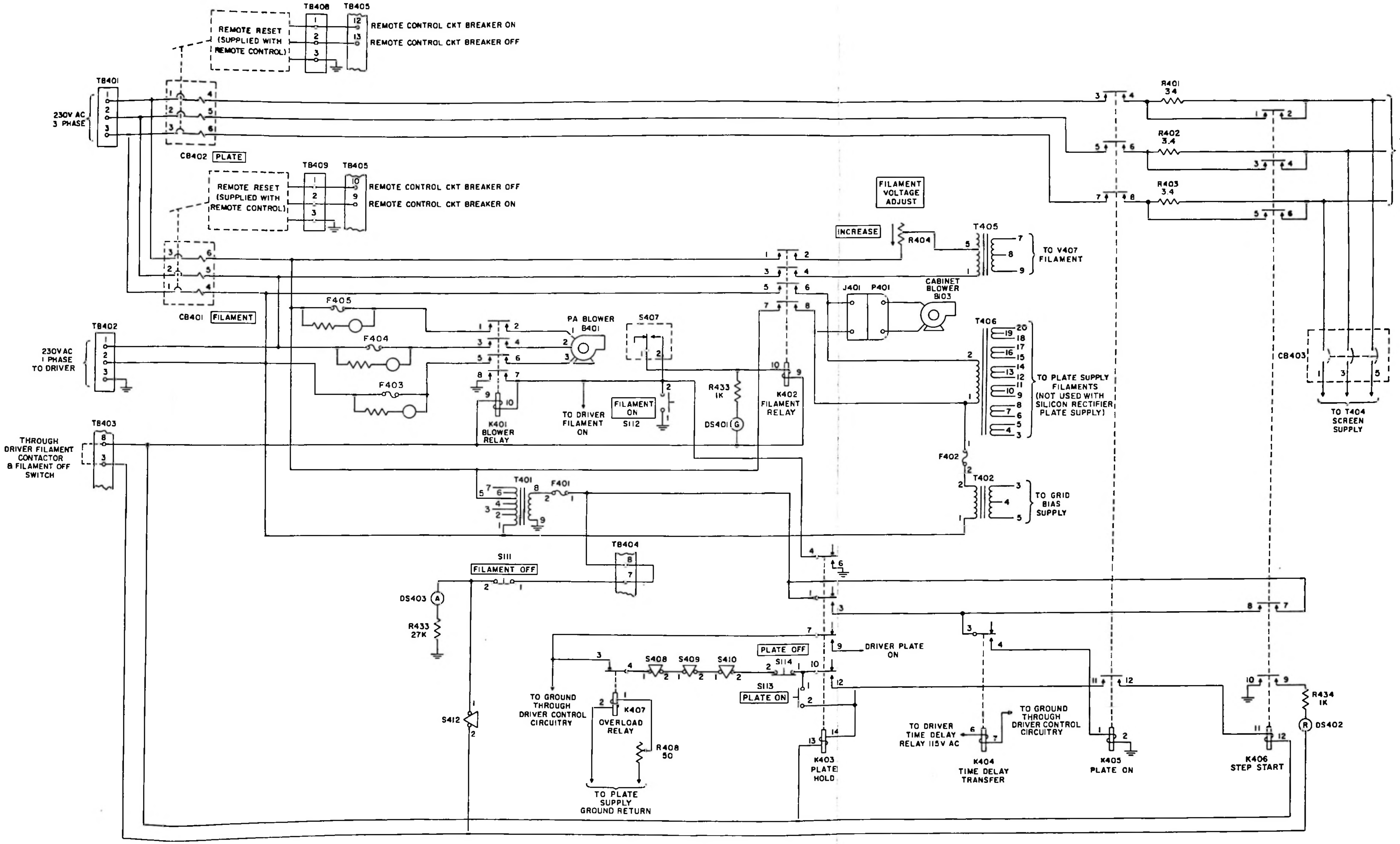
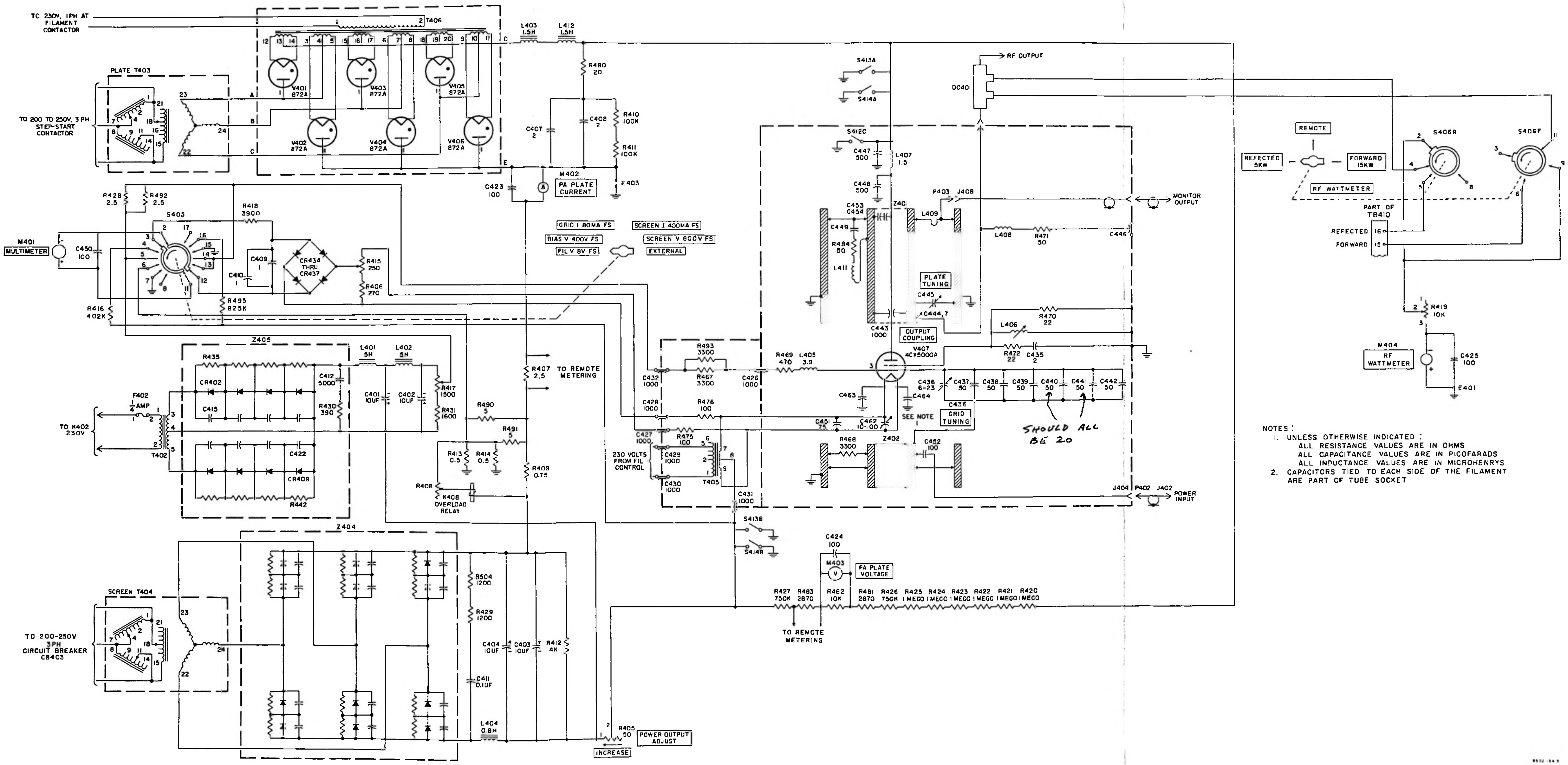


Figure 2-2. F830-1 Control Circuits, Simplified Schematic Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED:
   ALL RESISTANCE VALUES ARE IN OHMS
   ALL CAPACITANCE VALUES ARE IN PICOFARADS
   ALL INDUCTANCE VALUES ARE IN MICROHENRYS
2. CAPACITORS TIED TO EACH SIDE OF THE FILAMENT ARE PART OF TUBE SOCKET

Figure 2-3. F830-1 Power Amplifier Circuits. Simplified Schematic Diagram overload protection for all power amplifier circuits. These functions are discussed in the following paragraphs.

The 230-volt 3-phase power enters the cabinet on TB401 and is fed to two circuit breakers, CB401 and CB402. The PLATE circuit breaker, CB402, protects only the plate and screen supplies, while the filament circuit breaker, CB401, protects the remaining power amplifier circuitry. The 3-phase output from CB402 is fed to two contactors to provide a voltage stepping action when plate and screen power is applied. This stepping action reduces the transients generated in the plate and screen power supplies when the F830-1 is turned on or off. Circuit breaker CB403 is placed in the screen supply 3-phase input to protect the screen power supply and to provide an aid when trouble shooting the transmitter.

The 3-phase output from filament circuit breaker CB401 is split into single phase components and fed to the filament contactor, the blower relay, the auxiliary power supply T401, and the driver.

Power to operate the filament and blower relays is obtained from the 115-volt secondary of T401. A CONTROL indicator, DS403, is lighted when the 115-volt power is present at the secondary of T401. This power is fed through the FILAMENT OFF switch to the 250-watt driver control circuitry at TB403-3. The driver control circuitry can interrupt power at this point if filament-off functions are to be controlled from the driver. Filament and blower control power is routed through the driver and re-enters the F830-1 at TB403-8. The power then is fed directly to the filament and blower control relays.

If FILAMENT ON switch S112 is pressed on either the driver or the F830-1, a ground is placed on blower relay K401 causing the relay to close. This action starts the power amplifier blower, B401, and closes contact K401-7 and K401-8. Closing of these contacts holds a ground on K401 when the momentary FILAMENT ON switch is released. When PA blower B401 comes up to speed, air pressure activated switch S407 closes, causing filament relay K402 to energize. The green filament-on light, DS401, will come on; the cabinet blower will start; and filament power will be fed to the tubes. The control grid bias supply will also be energized from the primary of transformer T401.

Power for operation of the plate circuits is obtained from the same source as the filament power transformer, T401. To start the plate-on sequence, PLATE ON switch S113 is pressed actuating plate hold relay K403. This closes contacts 10 and 12 to hold K403 energized when the PLATE ON switch is released. The ground is obtained from the driver control circuitry to allow the driver to interrupt the ground for the plate-off function. Contacts 7 and 9 will also close, turning on the driver plate power if driver plate power has not been turned on previously. With K403 energized, contacts 1 and 3 will make, transferring the control voltage to time delay transfer relay K404. K404 will actuate when the driver time delay relay has completed the cycle allowing the filaments to warm up to operating temperature. With K404 energized, 115 volts will be transferred to the plate-on contactor, K405, causing K405 to close and apply power to the plate and screen power supplies. A fraction of a second later (as soon as K405-11 and 12 close), the step-start contactor will actuate and apply 230 volts 3 phase to the plate and screen power supplies. The red plate-on indicator, DS402, will light, indicating that plate and screen power is applied to the power amplifier. This stepping action limits transients that may be introduced into the power supply by the initial application of power.

If the PLATE OFF switch, S114, is pressed, plate and screen voltage will be removed from the power amplifier only and will not normally affect the driver. Pressing the PLATE OFF switch, S114, opens the ground to plate-hold relay K403, releasing K403. Step-start contactor K406 will then release removing direct 3-phase power from the plate and screen power supplies and momentarily throwing dropping resistors R401, R402, and R403 into the plate-screen circuits. Moments after step-start contactor K406 opens, plate-on contactor K405 will open, removing all power from the plate and screen power supplies. This stepping action limits transients that would normally be introduced into the power supply by the sudden removal of power.

If FILAMENT OFF switch S111 is pressed, power will be removed momentarily from all circuits within the driver and power amplifier, causing the holding relays to drop out and shut off the power amplifier and driver.

2.1.2 POWER AMPLIFIER CIRCUITS.

Refer to figure 2-3, a simplified schematic of the power amplifier circuitry of F830-1 10-Kw FM Power Amplifier. The power amplifier consists of a single ceramic type, forced air-cooled tube working into a tuned coaxial line resonator over the standard frequency modulated broadcast band of 88 to 108 megacycles.

Power amplifier V407 is a fixed bias, class C, grounded screen tetrode. The input from the driver is fed through blocking capacitor C452 into a tuned coaxial line resonator (a foreshortened $\frac{\lambda}{4}$ transmission line) and fed to the control grid. Resistor R468 in the grid circuit swamps out much of the driver power which is fed into the tuned coaxial line resonator and, in addition, presents a low impedance broadband load to the control grid. Initial tuning of the grid coaxial line resonator is accomplished by a slider which physically lengthens or shortens the grid coaxial line resonator. Fine grid tuning is accomplished by adjusting variable capacitor C436. Fixed capacitors C437, C438, C439, C440, C441, and C442 in parallel with C436 couple the input tuned circuit to the grid. As the power amplifier is a grounded screen amplifier, the filament must be below ground potential. The grid bias supply is floating and is connected in series with the screen grid power supply giving negative control grid bias with respect to the filament. L405 blocks r-f from the grid bias supply.

The plate works into a tuned coaxial line resonator (foreshortened $\frac{\lambda}{4}$ transmission line) similar to the grid resonator. The plate resonator consists of a short piece of coaxial transmission line which resonates with the plate capacity of V407 and PLATE TUNING capacitor C445. Initial tuning is similar to the grid resonator, and is accomplished by a shorting slider on the transmission line which physically lengthens or shortens the transmission line. Parasitic suppressors located within the resonator (C449, R474, L410, R484, and L411) suppress resonances around 200 and 400 megacycles. The parasitic suppressor capacity is formed by the distributed capacity of resistors R747 and R484 and the resonator walls.

R-f output coupling is achieved by a movable plate within the resonator forming a capacitor between the center conductor of the coaxial transmission line and the movable metal plate. This capacitor is C444. R-f output from C444 is then fed to a directional coupler if a higher power amplifier is driven, or to a harmonic filter and through the directional coupler if an antenna is fed directly. Suppressor L408, R471, and C446 effectively damp the higher order resonances of the plate tank circuit.

As stated previously, power amplifier V407 operates as a grounded screen amplifier. Actually, the screen is slightly above r-f ground to provide screen neutralization of the tube. Neutralization is accomplished by balancing the capacitance bridge formed by the plate-to-control grid capacitance, the plate-to-screen grid capacitance, and the screen-to-control grid capacitance. This is accomplished by adding a small variable inductance, L406, to form an r-f voltage from the screen-to-control grid 180 degrees out of phase with the plate-to-control grid r-f. This additional impedance balances the bridge to neutralize the tube for a fixed operating frequency.

Plate voltage is obtained from a conventional 3-phase power supply, which, when connected in series with the screen power supply, forms the plate voltage. The power supply transformer is connected in a delta primary and a wye secondary configuration. Six mercury-vapor rectifier tubes, V401 through V406, are arranged in a 3-phase full-wave bridge rectifier circuit. Silicon diode rectifiers are optional. A P.A. PLATE CURRENT meter, M402, is placed in the ground side of the plate supply to indicate only plate current. As the screen supply is in series with the plate supply, the P.A. PLATE VOLTAGE meter, M403, is placed across both the screen and plate supplies to indicate the cathode-to-plate voltage. The plate supply output is approximately 5700 volts d-c at 2.5 amperes. When the plate supply voltage is added to the screen supply voltage, the total, 6450 volts, equals the total plate voltage.

Screen voltage is obtained from a conventional 3-phase semiconductor power supply. A transient suppressor, R506, R507, and C411, reduces transients formed when the power supply is turned on or off. The screen supply output is approximately 750 volts at 2.6 amperes.

The control grid bias supply is a single-phase, semiconductor power supply. A resistor and capacitor placed in parallel with each diode equalize currents and minimize transients in each diode. A transient suppressor, C412 and R430, reduces transients when power is turned on or off. The positive end of the grid bias supply is connected to the fixed side of POWER OUTPUT ADJUST potentiometer R405. This permits R405 to control both the bias voltage and screen voltage when R405 is adjusted. The negative end of the bias supply is tied into the control grid through a meter shunt resistor and a filtering network. The control grid bias supply output is approximately -300 volts at 300 ma. Bias voltage is made adjustable by R417.

The filament of power amplifier V407 is below d-c ground because of the grounded screen configuration. The filament-to-ground potential will then be the screen voltage. Capacitors placed across the filament, and from each side of the filament to ground, provide r-f grounding.

Metering circuits are provided to measure the filament voltage, control grid bias voltage, control grid current, screen current, and screen grid voltage. In addition, an external metering position is available for connection to the multimeter. The customer may employ this extra meter position for any use that he may desire. The external meter movement input is 0-1 ma at 100 ohms.

The filament voltage metering circuit employs a full-wave bridge rectifier to change the a-c filament voltage to d-c. The bridge output is filtered by R418 and C410, and the complete circuit is calibrated by R415. The grid bias metering circuit is a voltage measuring device which measures the control grid bias voltage directly through the use of meter multiplier resistor R416. Grid current is metered by shunt resistors R428 and R492. Screen current is measured by placing the MULTIMETER across shunt resistors R413 and R414. As the screen is grounded, only screen current will flow through these resistors. Screen voltage is measured directly by the use of meter multiplying resistor R495. External meter readings may be made by connecting to the proper terminals on TB405 (not shown on simplified schematic diagram, figure 2-3). (See figure 5-1.) The MULTIMETER is shunted with capacitor C450 to prevent any stray r-f from damaging the meter movement.

2.2 Control Functions.

The following paragraphs describe the functions of all controls in F830-1 10-Kw FM Power Amplifier. Refer to figure 2-4 for control locations.

The controls located on the front panel directly under the meters include the FILAMENT ON, FILAMENT OFF, PLATE OFF, and PLATE ON controls. The green filament on indicator and red plate on indicator are placed in line with the above-mentioned controls.

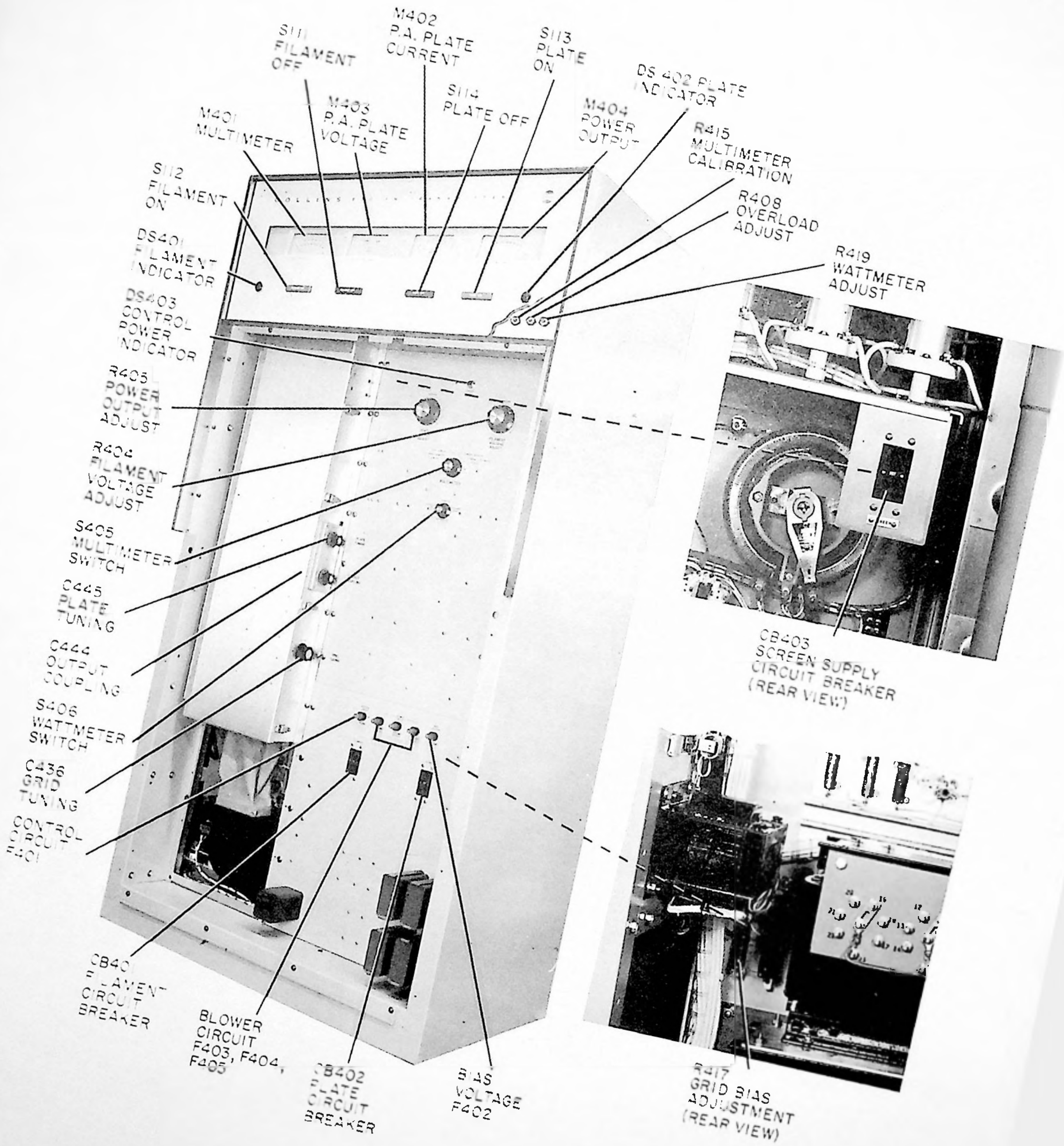


Figure 2-4. F830-1 Control and Adjustment Locations

The FILAMENT ON switch, S112, energizes the filaments, the blowers, and the bias supply and will turn on the driver filament and the exciter if connected correctly. The FILAMENT OFF switch, S111, de-energizes all transmitter circuits. The PLATE ON switch, S113, energizes the plate and screen power supplies and the driver plate supply. The PLATE OFF switch, S114, removes plate and screen voltage. The green filament indicator light, DS401, lights when the FILAMENT ON switch is pressed and the PA blower has activated the PA blower interlock. DS401 indicates that voltage is available to the filament control contactor. The filament control contactor starts the cabinet blower and the bias supply and supplies the necessary voltage to the F830-1 filaments. The red plate-on indicator light, DS402, indicates plate voltage has been applied to the power amplifier. The following controls are located directly under the right front door on the power amplifier panel. The POWER OUTPUT ADJUST potentiometer, R405, adjusts the power amplifier screen potential thus changing the output power. The FILAMENT VOLTAGE ADJUST potentiometer, R404, adjusts the filament transformer input voltage thus changing the filament voltage of V407. The WATTMETER switch, S406, connects the R.F. WATTMETER to either the reflected power or forward power section of the directional coupler. The WATTMETER switch is normally left in the FORWARD position. In addition, the WATTMETER switch has a third position for connecting both forward and reflected output power voltages from the directional coupler to remote lines. The MULTIMETER switch, S405, selects either filament voltage, bias voltage, control grid current, screen current, or screen voltage. In addition, an external position is available for use by the customer. Table 3-1 lists the MULTIMETER switch positions and typical indications for each of the four meter positions.

The following controls are located directly behind the left front door on the power amplifier resonator. The PLATE TUNING control, C445, tunes the plate to resonance and is set near the minimum indication on the P.A. PLATE CURRENT meter, M402. At this point, the power output should be at the peak as indicated on R.F. WATTMETER M404. The OUTPUT COUPLING control, C444, adjusts the coupling of the load to the plate coaxial line resonator center conductor. The GRID TUNING control, C436, tunes the grid resonator.

The following controls are located on the power panel directly behind the bottom front panel of the power amplifier cabinet. The PLATE circuit breaker, CB402, is a protective device which monitors the plate and screen supply transformer primary currents. The circuit breaker will open when the current exceeds 50 amperes. The CONTROL circuit breaker, CB401, monitors the total control circuit current. This current includes the power fed to the driver and exciter. The circuit breaker will open when the control circuit current exceeds 8 amperes. The 5-ampere CONTROL CIRCUIT fuse, F401, protects the control circuits from overloads. The 1/4-ampere BIAS VOLTAGE fuse, F402, protects the bias supply from overloads. Blower fuses, F403, F404, and F405 protect PA blower B401.

The following adjustments are located directly below the P.A. PLATE CURRENT and R.F. WATTMETER indicators when the upper switch and meter panel is raised. The left potentiometer, located behind the panel, is filament voltmeter calibrating potentiometer R415. The filament metering circuit calibrating adjustment is set at the factory and normally will not require adjustment. The center potentiometer is the overload adjusting potentiometer, R408. The overload adjustment normally is set for a plate current of 2.6 amperes. The right potentiometer is wattmeter adjusting resistor R419. This potentiometer, set at the factory, should not require adjustment. The control grid adjustable resistor, R417, is located in the left bottom rear of the power amplifier cabinet. The resistor is set for approximately 500 ma maximum of plate current with no drive to the power amplifier. The screen circuit breaker CB403, is located behind the left rear door, and is attached to the rectifier panel. The circuit breaker protects the screen power supply from overloads above 10 amperes.

section 3

maintenance

3.1 General.

This section contains information concerning the maintenance of F830-1 10-Kw FM Power Amplifier.

WARNING

Voltages present in this equipment are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the F830-1 cabinet when high voltage is applied. Do not depend entirely on door interlocks. Always shut down the F830-1 before doing any work inside the F830-1 cabinet. Immediately upon opening the rear doors, short out all high-voltage points using the shorting stick located inside the left rear door.

3.2 Preventive Maintenance.

Most service interruptions in equipment of this type are caused by dirt and corrosion. Corrosion is accelerated by the presence of moisture and dust. Dust should be removed periodically with a soft brush or a dry, oil-free air jet. Remove dust as often as a perceptible quantity accumulates at any point in the power amplifier.

When the F830-1 is operated near salt water or in other corrosive atmospheres, inspect and clean interlock switches, cable connectors, tube prongs, and other metal parts more frequently to keep the equipment in top operating condition.

3.2.1 AIR FILTER CLEANING.

At least once each month, or more often if needed, clean the air filter according to the following procedure:

a. Remove the air filter from the F830-1 cabinet by loosening the two thumb screws located above the air filter. Slide the air filter to the extreme right, and pull the left side of the air filter out as soon as the filter clears the panel. Slide the air filter to the left and remove.

b. Mark with an arrow the direction of the airflow.

c. Wash by passing a fine spray of hot water through the filter in the direction opposite that of the airflow. Gently shake the water out of the filter.

d. Dip the filter in water-soluble oil, such as Filter-kote M (Collins part number 005-0609-00), available from Collins Radio Company Service Parts Department, Cedar Rapids, Iowa.

e. Remove the filter from the oil; lay the filter face down until oil ceases to drip from the filter.

f. Replace the filter into the lower rear panel with the airflow arrows (marked when the filter was removed) pointing in the direction of the airflow. Tighten the two thumb screws.

g. Replacement filters are Collins part number 009-1069-00.

3.2.2 PA TUBE CLEANING.

The power amplifier tube depends upon a stream of air passing through the fins to cool the anode. When these fins become dirty, the airflow is reduced, and the tube life is shortened. The radiator fins should be cleaned as follows:

a. Remove the r-f amplifier tube as described in paragraph 3.2.2.1.

CAUTION

Special care must be used in removing or installing the power amplifier tube.

b. Direct a low-pressure (50 psi) air stream through the fins in the direction opposite to the normal airflow until all dust is removed.

c. Replace the r-f amplifier tube as described in paragraph 3.2.2.1.d.

3.2.2.1 PA TUBE REMOVAL.

WARNING

Voltages present within the plate compartment are dangerous to life. Shut down the F830-1 before doing any work inside the compartment.

The power tube may be removed as follows:

a. Open the power amplifier resonator door.

b. Loosen the slider clamp, and raise the center conductor straight up until it clears the tube completely. Make sure the slider stays in its original position while raising the center conductor.

c. While holding up the center conductor, grasp the tube handle and remove the tube from its socket. It may be necessary to push the tube partially into the center conductor so the tube will clear the tube socket shield before complete tube removal.

d. Tube replacement is the reverse of removal. After tube replacement, check the plate slider for proper distance from the deck plate for the station frequency. See System Instructions, Frequency Change, for this approximate distance. Be sure the tube is seated firmly in the tube socket before replacing the center transmission line.

3.2.3 INSPECTION.

Once a week, check and clean the three interlock switches at the rear of the F830-1 cabinet to be sure they are in good working order. Once each month, check all connections in the F830-1. Tighten any nuts, bolts, or screws that may be loose. Check cable connections to see that they are clean and mechanically secure. Check moving parts, such as tuning controls, for excessive wear. Check the plate and grid sliders for oxidation around ground springs.

Silicon rectifier diodes should be checked for shorts approximately every six months. To check for diode shorts, place a reverse voltage from an ohmmeter across each diode. If any diode reads shorted, replace the diode. Normally, a high resistance will be noticed across each diode caused by the diode parallel resistor or by diode leakage.

3.2.4 LUBRICATION.

The PA blower has bearings that are lubricated for the life of the equipment. Lubricate each of the cabinet fan bearings every 6 months with 3 drops of SAE #20 nondetergent oil. The rear cabinet fan bearing oil hole may be reached through the air filter opening, with the air filter removed.

3.2.5 TUBE MAINTENANCE.

Power amplifier V401 should be inspected (tube in place) once each week to ensure that an accumulation of dust does not build up on the radiator fins. If dust is present, clean as described in paragraph 3.2.2. When tuning the F830-1, care should be taken not to exceed the maximum plate current shown in table 3-1.

If mercury-vapor tubes are used in the plate power supply, spare, preaged mercury-vapor rectifier tubes should be available for immediate replacement. To ready these tubes for emergency use, place them in the power amplifier during off-the-air hours, and run them for twenty minutes with only the filaments lighted. This will remove the mercury coating from the tube elements. Then carefully remove the tubes from the F830-1, and store them in an upright position where they will not be inverted or agitated. When these preaged tubes are placed in the F830-1, handle them carefully to avoid the twenty-minute warmup period that will be required if mercury comes in contact with the tube elements. Never apply plate voltage to mercury-vapor rectifier tubes that have not been aged long enough to remove all mercury from the tube elements.

3.3 Trouble Shooting.

The most common cause of trouble will probably be traced to tube failure. If a tube is suspected of failure,

TABLE 3-1. TYPICAL METER INDICATIONS

METER	METER SWITCH POSITION	INDICATION
MULTIMETER	FIL V 8V FS	7.5 volts
MULTIMETER	BIAS V 400V FS	180-220 volts
MULTIMETER	GRID 80MA FS	45-60 ma
MULTIMETER	SCREEN 400MA FS	150-225 ma
MULTIMETER	SCREEN 800V FS	750 volts
PA PLATE VOLTAGE		6400-6500 volts
PA PLATE CURRENT		Approx. 2.25 A
R.F. WATTMETER	FORWARD 15KW	10 kw
R.F. WATTMETER	REFLECTED 5KW	Less than 500 watts

replace it with a tube of known quality, and note any change in performance. A small loss in emission of V407 can be compensated by a change in the setting of the POWER OUTPUT ADJUST potentiometer.

Four meters are located on the F830-1 front panel to assist in locating any trouble which may occur. Table 3-1 contains typical meter indications. These average indications are obtained from several production power amplifiers. The indications of certain F830-1 may vary slightly outside the given limits without affecting power amplifier performance. A list of panel meter indications for each individual power amplifier should be taken when the F830-1 is operating properly in its particular installation. Any abnormal deviation from these values will be apparent during a check of meter indications.

3.4 Cable Chart.

Table 3-2 contains from-to information for cables installed in F830-1 10-Kw FM Power Amplifier. The table is useful in locating point-to-point wiring within the F830-1 cabinet. The from column is listed in alphabetical and numerical order. To find a particular wire, establish the point on the F830-1 from which wire tracing is to be initiated. Find this point in the from column of table 3-2, and the to column will give the location of the other end of that particular wire. The wire information given in table 3-2 pertains only to those wires located in the main cable of the F830-1.

TABLE 3-2. CABINET FROM-TO INFORMATION

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
B401-1	K401-2	RD90	CB401-4	T402-2	RC5
B401-2	K401-4	RD92	CB401-4	TB402-2	RE5
B401-3	K401-6	RD95	CB401-4	XF403-1 (top)	RD95
C401-1	L401-2	VC905	CB401-5	K402-3	RD92
C401-2	T402-4	RB91	CB401-5	TB402-1	RE2
C401-2	TB406-12	VC902	CB401-5	XF404-1 (top)	RD92
C402-1	L402-2	VC906	CB401-6	K402-1	RD93
C402-1	R417-1	VC92	CB401-6	T401-5	RD93
C402-2	R431-2	VC91	CB401-6	XF405-1 (top)	RD93
C403-1	R405-1	VE92	CB402-1	CB401-3	H9
C403-1	R412-1	VE92	CB402-1	TB401-1	H9
C403-1	S412-B	VE92	CB402-2	CB401-2	H9
C403-2	R412-2	RE92	CB402-2	TB401-2	H9
C404-1	L404-2	VE92	CB402-3	CB401-1	H9
C404-1	R431-2	VC95	CB402-3	TB401-3	H9
C408-2	E407	VE93	CB402-4	K405-3	H9
C408-2	R411-2	VE92	CB402-5	K405-5	H9
C427	R415-3	RC93	CB402-6	K405-7	H9
C428	TB407-2	VB93	CB403-1	K406-6	RE5
C429	R404-2	RC90	CB403-2	K406-4	RE2
C430	K402-4	RC92	CB403-3	K406-2	RE90
C431	R405-2	JE2	CB403-4	T404-15	RE5
C432	S405-13	VB91	CB403-5	T404-8	RE2
CB401-1	CB402-3	H9	CB403-6	T404-1	RE90
CB401-2	CB402-2	H9	DC401 (red)	S406-11	DAS2
CB401-3	CB402-1	H9	DC401 (yellow)	S406-4	DAS9
CB401-4	T401-1	RD95	E401 (grd)	K401-8	RC9

TABLE 3-2. CABINET FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
E401 (grd)	E402 (grd)	RE9	K402-5	T401-1	RC923
E401 (grd)	K403-6	RC9	K402-6	J401-1	RC95
E401 (grd)	K405-2	RC9	K402-6	T406-2	RC95
E401 (grd)	K406-10	RC9	K402-7	T401-5	RD90
E401 (grd)	M404-1 (+)	RC9	K402-8	J401-2	RC90
E401 (grd)	S112-1	RC9	K402-8	T406-1	RC90
E401 (grd)	S405-15	VB9	K402-8	XF402-1	RC90
E401 (grd)	R413-2	VE9	K402-9	K401-9	RC935
E401 (grd)	T401-9	RC9	K402-9	K403-13	RC91
E402 (grd)	E401 (grd)	RE9	K402-9	TB404-5	RC935
E402 (grd)	TB402-4	RE9	K402-9	XDS401-1	RC936
E402 (grd)	TB403-10	RE9	K402-10	S407-1	RC936
E407	C408-2	VE93	K402-10	TB407-12	RC902
E407	M402-2(-)	VE92	K403-1	K406-7	RC6
E410	TB407-3	VC92	K403-1	XF401-1	RD96
E411	S405-12	VB93	K403-3	K406-8	RC6
E411	TB407-1	VB93	K403-4	K401-7	RC93
E418	R405-2	VB92	K403-4	S407-2	RC93
E422 (grd)	TB407-20	RC9	K403-6	E401 (grd)	RC9
J401-1	K402-6	RC95	K403-7	K404-7	RC923
J401-2	K402-8	RC90	K403-7	K407-3	RC923
K401-1	XF405-2 (side)	RD93	K403-9	TB403-2	RC923
K401-2	B401-1	RD90	K403-10	TB404-3	RC925
K401-3	XF404-2 (side)	RD92	K403-12	K403-14	RC926
K401-4	B401-2	RD92	K403-12	K405-11	RC926
K401-5	XF403-2 (side)	RD95	K403-13	K402-9	RC91
K401-6	B401-3	RD95	K403-13	K406-12	RC91
K401-7	K401-10	RC93	K403-14	K403-12	RC926
K401-7	K403-4	RC93	K403-14	S113-2	RC905
K401-8	E401 (grd)	RC9	K403-14	TB404-4	RC926
K401-9	K402-9	RC935	K404-1	K404-6	RC4
K401-9	TB403-8	RC935	K404-2	TB404-10	RC7
K401-10	K401-7	RC93	K404-3	K406-8	RC6
K401-10	S112-2	RC93	K404-4	K405-1	RC6
K401-10	TB403-6	RC93	K404-6	K404-1	RC4
K402-1	CB401-6	RD93	K404-6	TB403-5	RC4
K402-2	R404-1	RC902	K404-7	K403-7	RC923
K402-3	CB401-5	RD92	K405-1	K404-4	RC6
K402-4	C430	RC92	K405-2	E401 (grd)	RC9

TABLE 3-2. CABINET FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
K405-3	CB402-4	H9	L402-1	L401-2	VC6
K405-4	K406-1	H9	L402-2	C402-1	VC906
K405-5	CB402-5	H9	L404-1	Z404-5	VE93
K405-6	K406-3	H9	L404-2	C404-1	VE92
K405-7	CB402-6	H9	M401-1 (+)	S405-11	VB92
K405-8	K406-5	H9	M401-2 (-)	S405-2	VB90
K405-11	K403-12	RC926	M402-1 (+)	R407-1	RE92
K405-12	K406-11	RC91	M402-2 (-)	E407	VE92
K406-1	K405-4	H9	M403-1 (+)	TB407-7	VC906
K406-1	R401-1	H9	M403-2 (-)	TB407-15	VC905
K406-2	CB403-3	RE90	M404-1 (+)	E401 (grd)	RC9
K406-2	R401-2	H9	M404-2 (-)	R419-3	RC91
K406-2	T403-1	H9	R401-1	K406-1	H9
K406-3	K405-6	H9	R401-2	K406-2	H9
K406-3	R402-1	H9	R402-1	K406-3	H9
K406-4	CB403-2	RE2	R402-2	K406-4	H9
K406-4	R402-2	H9	R403-1	K406-5	H9
K406-4	T403-8	H9	R403-2	K406-6	H9
K406-5	K405-8	H9	R404-1	K402-2	RC902
K406-5	R403-1	H9	R404-2	C429	RC90
K406-6	CB403-1	RE5	R405-1	C403-1	VE92
K406-6	R403-2	H9	R405-2	C431	VE2
K406-6	T403-15	H9	R405-2	E418	VB92
K406-7	K403-1	RC6	R405-2	TB407-14	VC92
K406-8	K403-3	RC6	R407-1	M402-1 (+)	RE92
K406-8	K404-3	RC6	R407-1	TB415-G	VC92
K406-9	TB407-5	RC902	R407-2	TB415-L	VC91
K4-6-10	E401 (grd)	RC9	R408-1	R413-1	VB93
K406-11	K405-12	RC91	R408-2	K407-1	VB95
K406-12	K403-13	RC91	R409-1	K407-2	VB92
K406-12	XDS402-1	RC91	R409-1	Z404-4	RE92
K407-1	R408-2	VB95	R411-2	C408-2	VE92
K407-2	R409-1	VC92	R412-1	C403-1	VE92
K407-3	K403-7	RC923	R412-2	C403-2	RE92
K407-3	TB403-7	RC92	R413-1	R408-1	VB93
K407-4	S408-1	RC923	R413-1	S405-6	VB91
L401-1	TB406-5	VC903	R413-2	E401 (grd)	VE9
L401-2	C401-1	VC905	R414-2	TB415-K	VC9
L401-2	L402-1	VC6	R415-3	C427	RC93

TABLE 3-2. CABINET FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
R417-1	C402-1	VC92	S410-2	S114-4	RC923
R417-3	S405-5	VB90	S412-B	C403-1	VE92
R419-2	S406-2	DAS3	S412-1	S111-2	RC1
R419-3	M404-2 (-)	RC91	S412-2	TB403-3	RC91
R431-2	C402-2	VC91	S413-B	S414-B	VE903
R431-2	C404-1	VC95	S414-B	S413-B	VE903
S111-3	TB404-7	RC1	T401-1	CB401-4	RD95
S111-4	S412-1	RC1	T401-1	K402-5	RC923
S111-4	XDS403-1	RC1	T401-5	CB401-6	RD93
S112-1	E401 (grd)	RC9	T401-5	K402-7	RD90
S112-2	K401-10	RC93	T401-8	XF401-2	RC6
S113-1	S114-1	RC925	T401-9	E401 (grd)	RC9
S113-1	TB404-3	RC925	T402-1	XF402-2	RC90
S113-2	K403-14	RC905	T402-2	CB401-4	RC5
S114-3	S113-1	RC925	T402-3	TB406-1	RB90
S114-4	S410-2	RC923	T402-4	C401-2	RB91
S405-2	M401-2 (-)	VB90	T402-5	TB406-7	RB92
S405-5	R417-3	VB90	T403-1	K406-2	H9
S405-6	R413-1	VB91	T403-8	K406-4	H9
S405-7	S405-15	RC9	T403-15	K406-6	H9
S405-8	TB405-7	VB902	T404-1	CB403-6	RE90
S405-11	M401-1 (+)	VB92	T404-8	CB403-5	RE2
S405-12	E411	VB93	T404-15	CB403-4	RE5
S405-13	C432	VB91	T404-22	Z404-3	VD91
S405-15	E401 (grd)	VB9	T404-23	Z404-1	VD95
S405-15	S405-7	RC9	T404-24	Z404-2	VD96
S405-17	TB405-8	VB96	T406-1	K402-8	RC90
S406-2	R419-2	DAS3	T406-2	K402-6	RC95
S406-4	DC401 (yellow)	DAS9	TB401-1	CB402-1	H9
S406-5	TB410-16	RA95	TB401-2	CB402-2	H9
S406-6	TB410-15	RA90	TB401-3	CB402-3	H9
S406-11	DC401 (red)	DAS2	TB401-4	E402 (grd)	RE9
S407-1	K402-10	RC936	TB401-4	TB402-3	RE9
S407-2	K403-4	RC93	TB402-1	CB401-5	RE2
S408-1	K407-4	RC923	TB402-2	CB401-4	RE5
S408-2	S409-1	RC92	TB402-3	TB401-4	RE9
S409-1	S408-2	RC92	TB403-1	TB404-9	RB90
S409-2	S410-1	RC92	TB403-2	K403-9	RC923
S410-1	S409-2	RC92	TB403-3	S412-2	RC91

TABLE 3-2. CABINET FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
TB403-5	K404-6	RC4	TB407-4	XDS402-2	RC902
TB403-6	K401-10	RC93	TB407-5	K406-9	RC902
TB403-6	TB404-6	RC93	TB407-6	TB405-2	VC91
TB403-7	K407-3	RC92	TB407-7	M403-1 (+)	VC906
TB403-8	K401-9	RC935	TB407-12	K402-10	RC902
TB403-9	TB404-2	RC1	TB407-13	XDS401-2	RC902
TB403-10	E402 (grd)	RE9	TB407-14	R405-2	VC92
TB403-11	TB410-1	RA91	TB407-15	M403-2 (-)	VC905
TB404-2	TB403-9	RC1	TB407-15	TB405-1	VC92
TB404-3	K403-10	RC925	TB407-20	E422 (grd)	RC9
TB404-3	S113-1	RC925	TB408-1*	TB405-12	VB96
TB404-4	K403-14	RCR26	TB408-2*	TB405-13	VB93
TB404-5	K402-9	RC935	TB409-1*	TB405-10	VB92
TB404-6	TB403-6	RC93	TB409-2*	TB405-9	VB91
TB404-7	S111-3	RC1	TB410-1	TB403-11	RA91
TB404-8	TB405-11	VB95	TB410-1	TB411-1	RA91
TB404-8	XF401-1	RD96	TB410-2	TB411-2	RA91
TB404-9	TB403-1	RB90	TB410-3	TB411-3	RA93
TB404-10	K404-2	RC7	TB410-4	TB411-4	RA95
TB405-1	TB407-15	VC92	TB410-5	TB411-5	RA96
TB405-2	TB407-6	VC91	TB410-15	S406-6	RA90
TB405-3	TB415-B	VC93	TB410-16	S406-5	RA95
TB405-4	TB415-H	VC95	TB411-1	TB410-1	RA91
TB405-7	S405-8	VB902	TB411-2	TB410-2	RA91
TB405-8	S405-17	VB96	TB411-3	TB410-3	RA93
TB405-9	TB409-2*	VB91	TB411-4	TB410-4	RA95
TB405-10	TB409-1*	VB92	TB411-5	TB410-5	RA96
TB405-11	TB404-8	VB95	TB415-B	TB405-3	VC93
TB405-12	TB408-1*	VB96	TB415-G	R407-1	VC92
TB405-13	TB408-2*	VB93	TB415-H	TB405-4	VC95
TB406-1	T402-3	RB90	TB415-K	R414-2	VC9
TB406-5	L401-1	VC903	TB415-L	R407-2	VC91
TB406-7	T402-5	RB92	XDS401-1	K402-9	RC936
TB406-12	C401-2	VC902	XDS401-2	TB407-13	RC902
TB407-1	E411	VB93	XDS402-1	K406-12	RC91
TB407-2	C428	VB93	XDS402-2	TB407-4	RC902
TB407-3	E410	VC92	XDS403-1	S111-4	RC1

*For remote control only. Otherwise, tie in cable.

TABLE 3-2. CABINET FROM-TO INFORMATION (Cont)

FROM	TO	WIRE CODE	FROM	TO	WIRE CODE
XF401-1	K403-1	RD96	XF404-2 (side)	K401-3	RD92
XF401-1	TB404-8	RD96	XF405-1 (top)	CB401-6	RD93
XF401-2	T401-8	RC6	XF405-2 (side)	K401-1	RD93
XF402-1	K402-8	RC90	Z404-1	T404-23	VD95
XF402-2	T402-1	RC90	Z404-2	T404-24	VD96
XF403-1 (top)	CB401-4	RD95	Z404-3	T404-22	VD91
XF403-2 (side)	K401-5	RD95	Z404-4	R409-1	RE92
XF404-1 (top)	CB401-5	RD92	Z404-5	L404-1	VE93

section 4

parts list

This section contains a list of all replaceable electrical, electronic, and critical mechanical parts for F830-1 10-Kw Power Amplifier 522-2981-000. The manufacturers' codes appearing in the MFR CODE column of the parts list are listed in numerical order at the end of the parts list. The code list provides manufacfacturers' names and addresses as shown in the Federal Supply Code for Manufacturers, Handbook H4-1. Manufacturers not listed in Handbook H4-1 are assigned a five-letter code and will appear first in the code list.

F830-1 Illustrations 20
F830-1 Parts List 35
Rectifier Illustrations 46
Rectifier Parts List 47/48

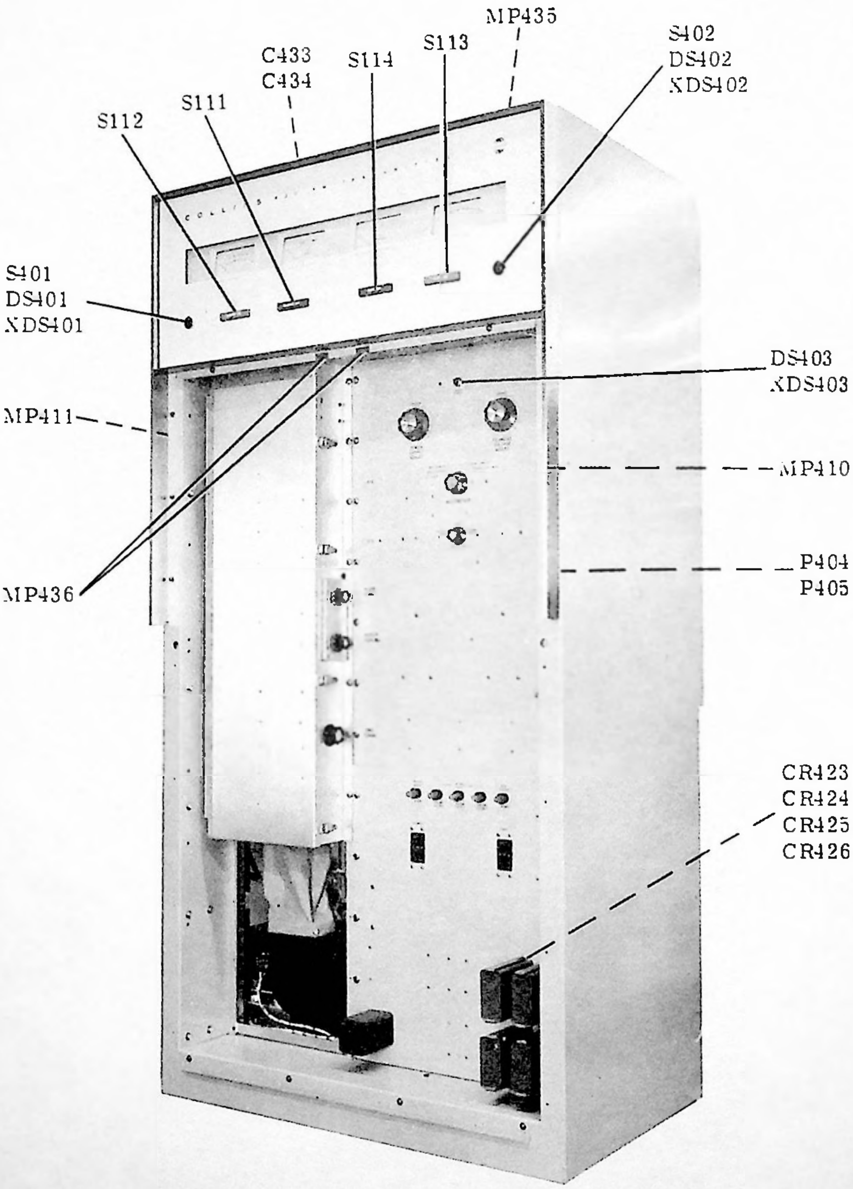


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 1 of 15)

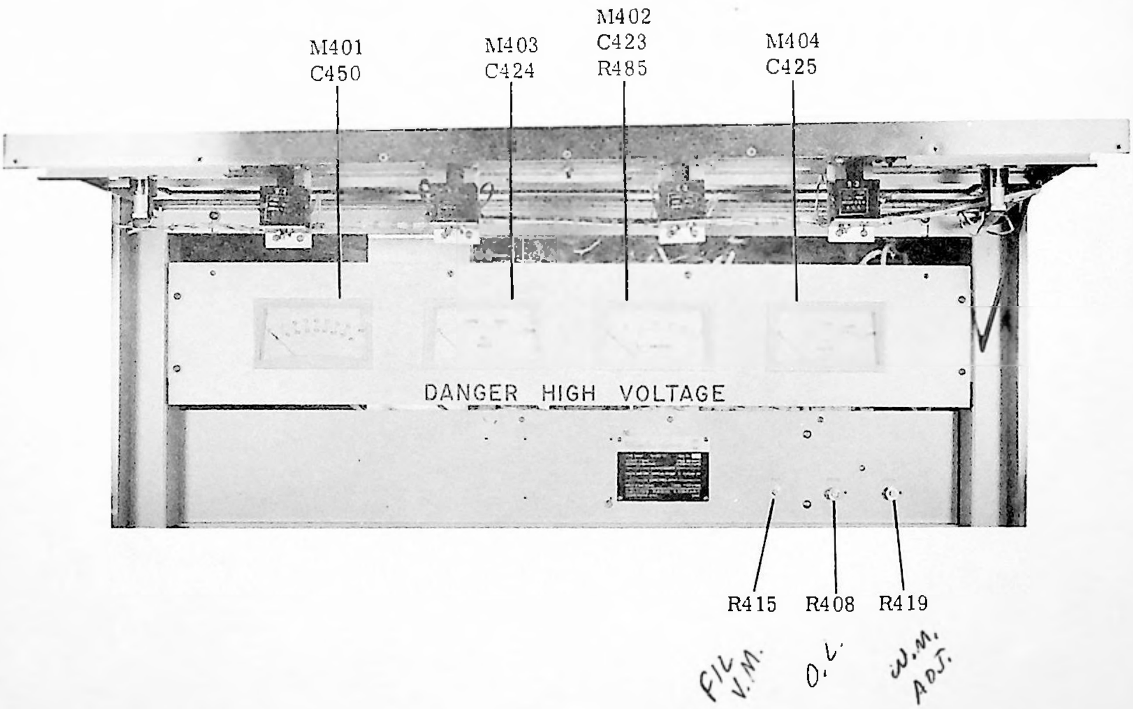


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 2 of 15)

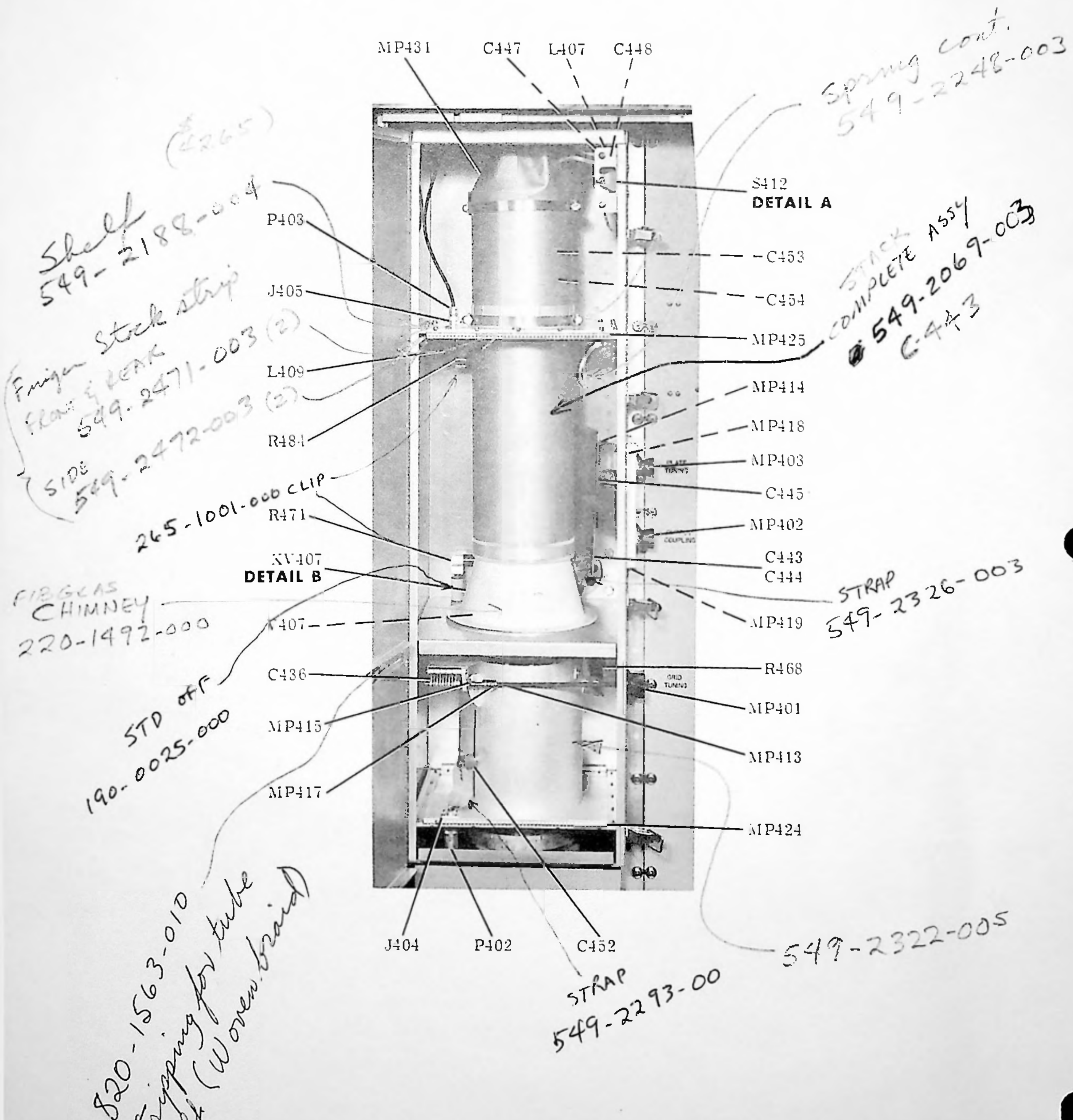


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 3 of 15)

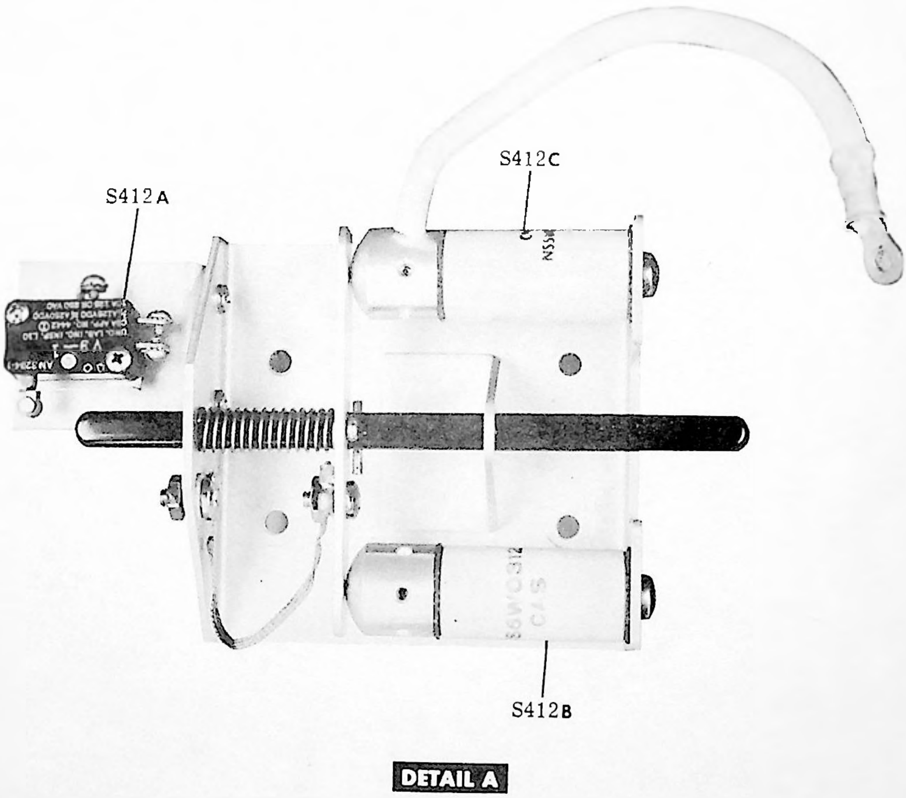
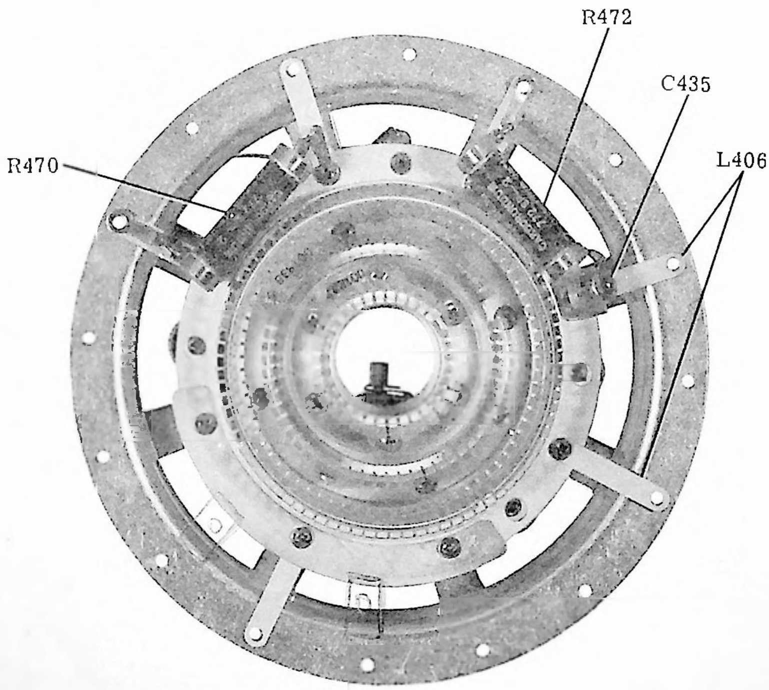


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 4 of 15)

XY407 SOCKET
220-1491-000

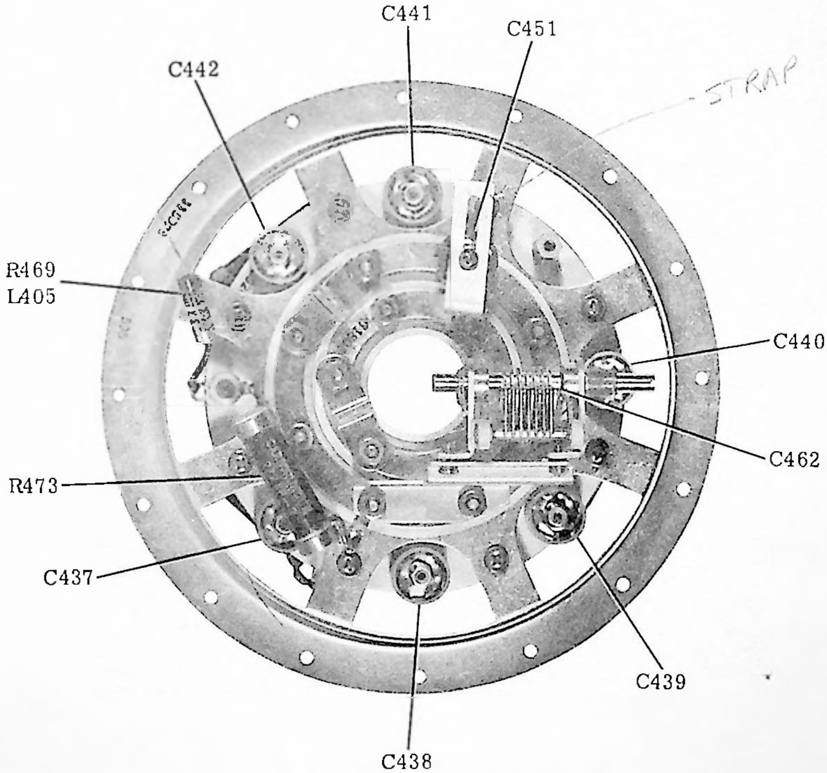


DETAIL B

TOP VIEW

Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 5 of 15)

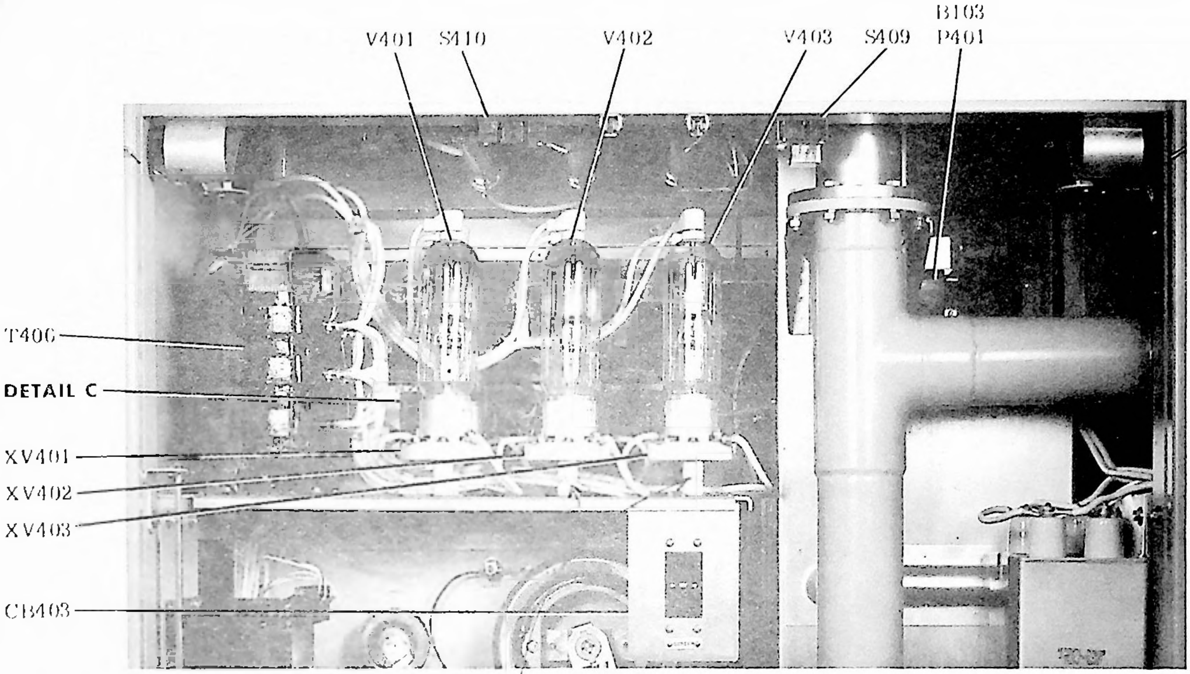
C463 & 464
CPN 220-1500-000
(FIL BYPASSES)



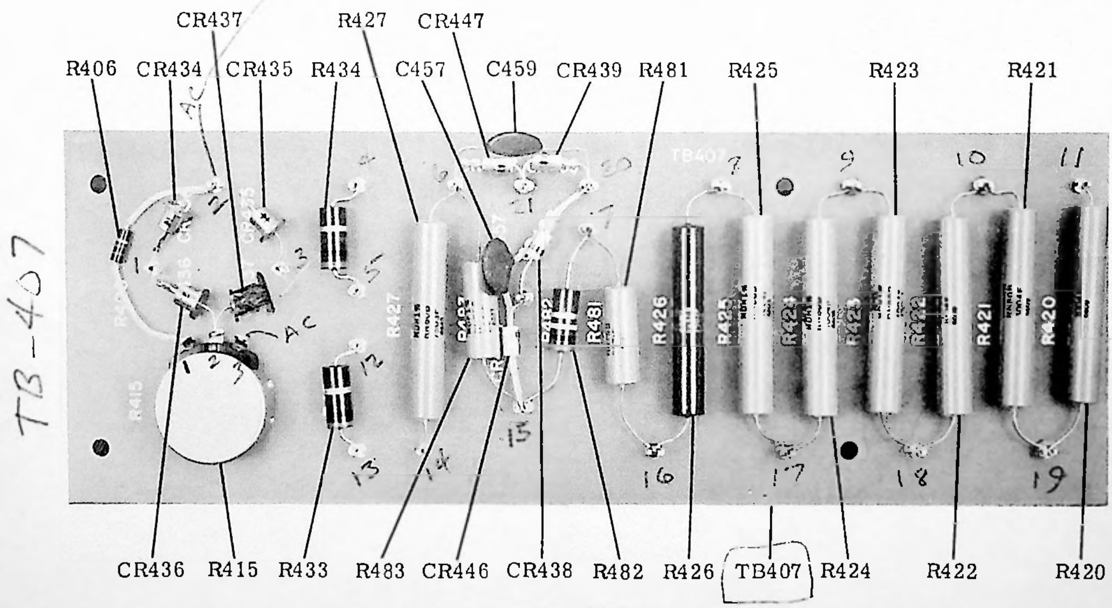
DETAIL B

BOTTOM VIEW

Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 6 of 15)



190-0025-000
150 STD off



DETAIL C

Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 7 of 15)

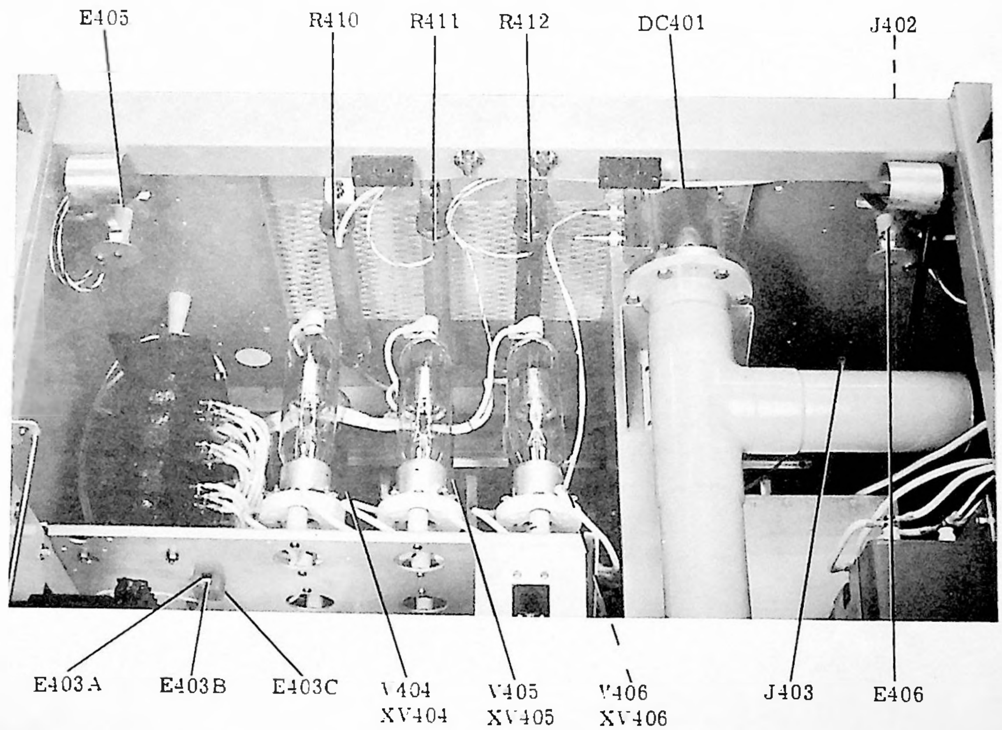


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 8 of 15)

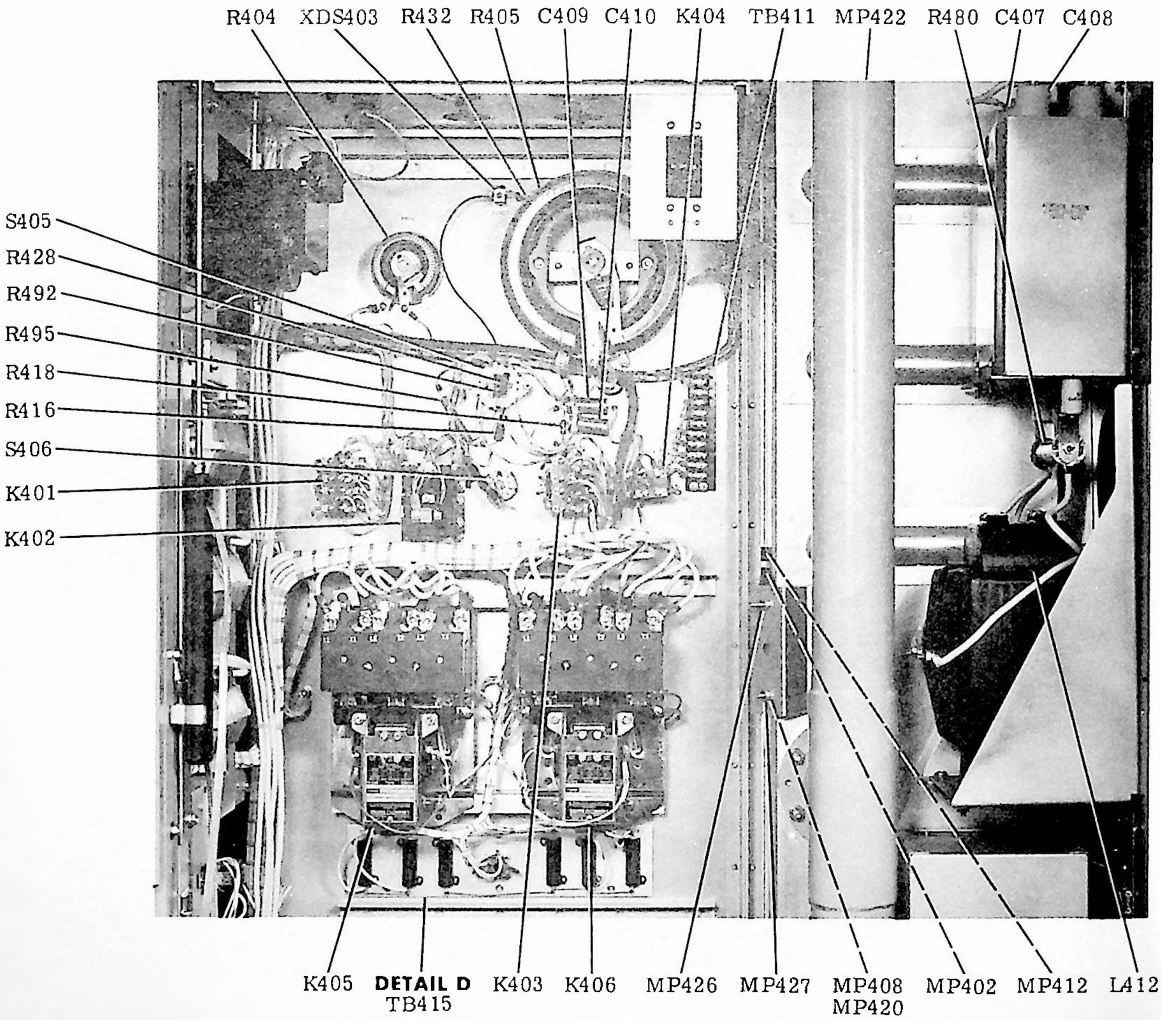


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 9 of 15)

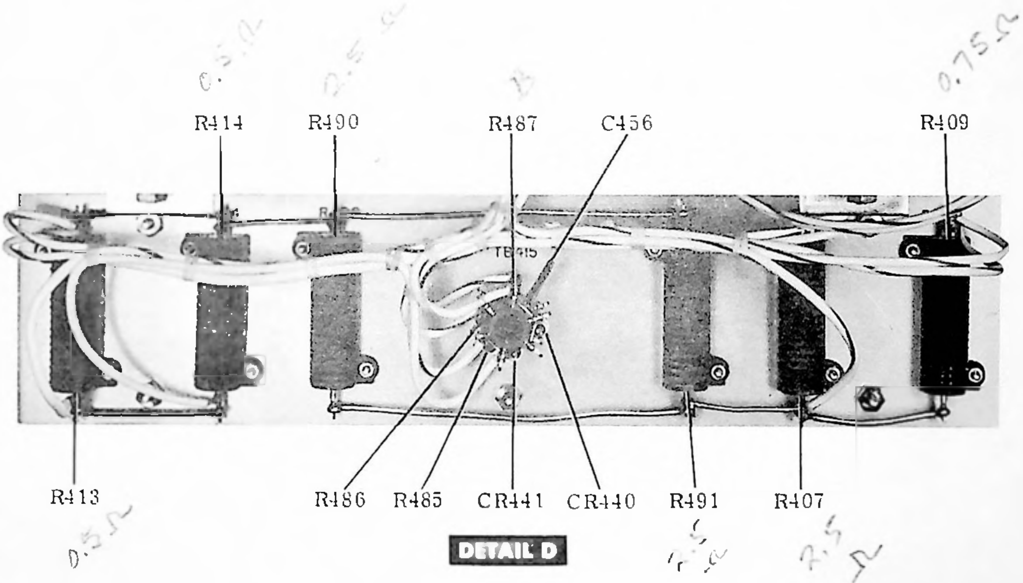


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 10 of 15)

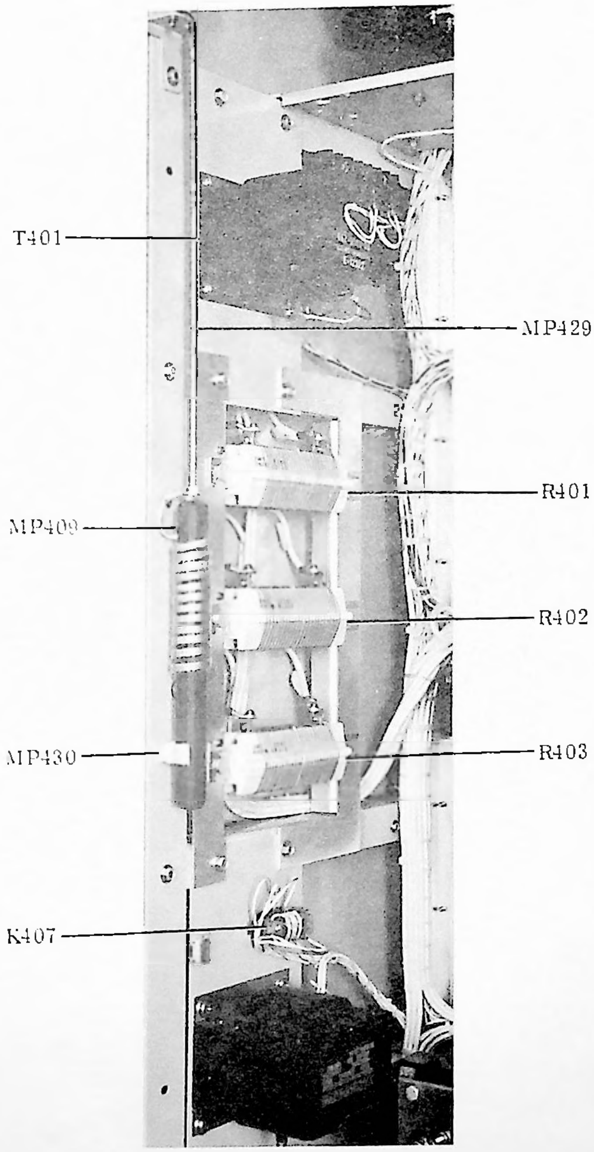


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 11 of 15)

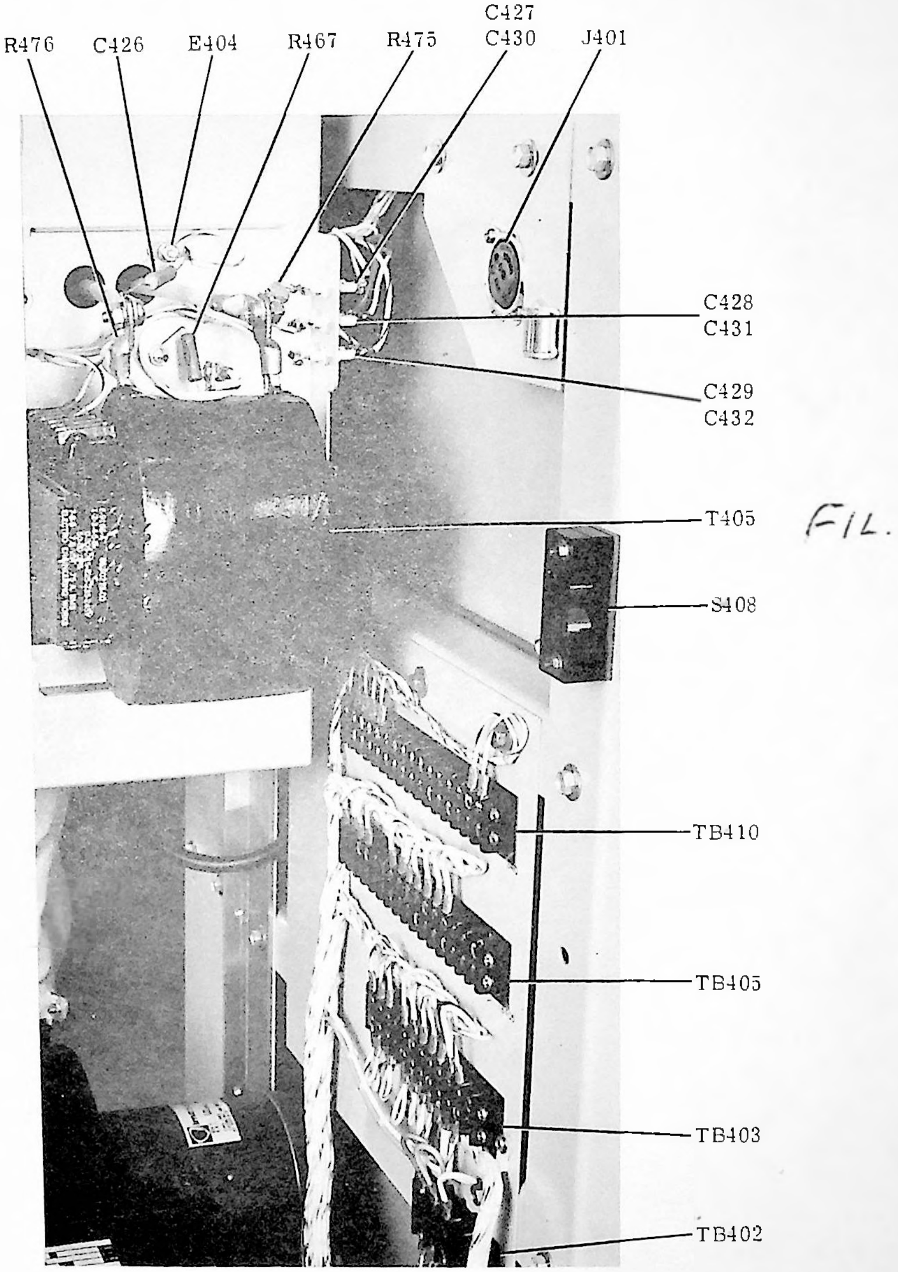


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 12 of 15)

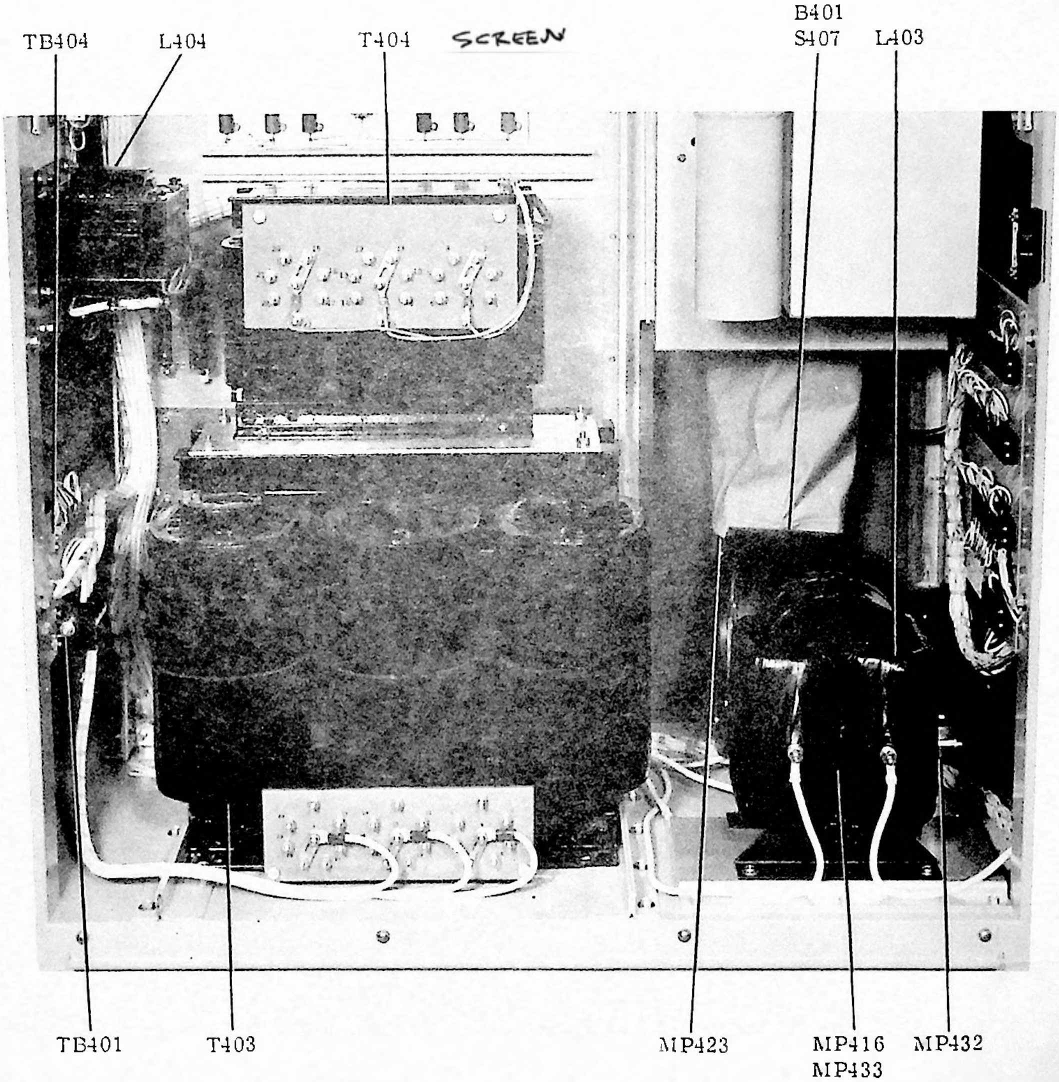


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 13 of 15)

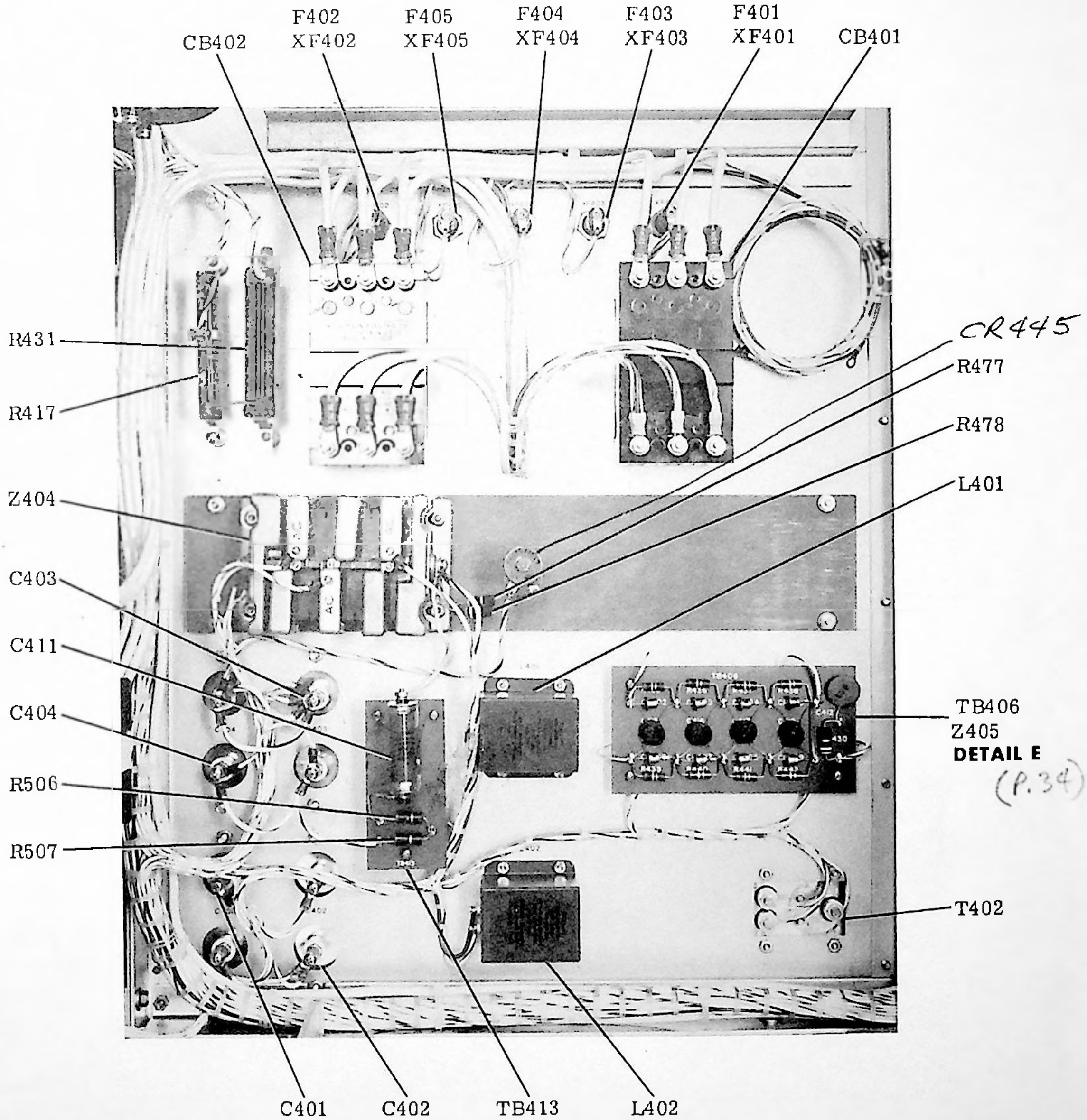
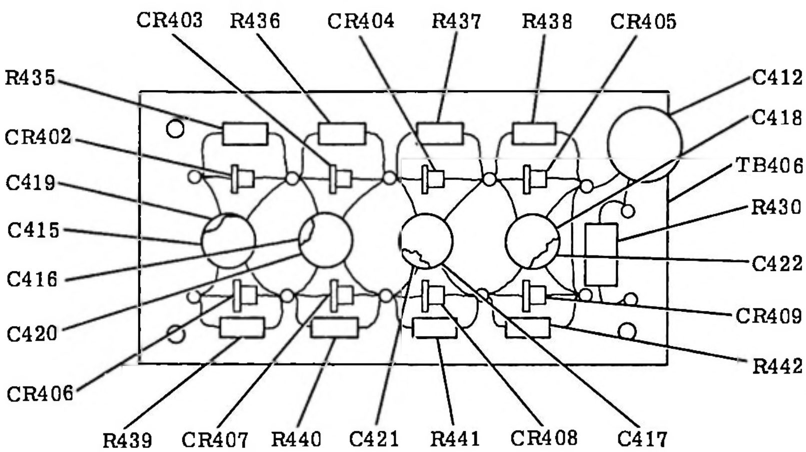


Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 14 of 15)



DETAIL E

TB406
2405
(P33)

Figure 4-1. F830-1 10-Kw FM Power Amplifier (Sheet 15 of 15)

MOTOR MOUNTS 200-1957-000
" -1961-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	F830-1 10-KW FM POWER AMPLIFIER			522-2981-000
B103	MOTOR, DIRECT CURRENT PERMANENT MAGNET, REVERSIBLE MOTOR WITH PINION GEAR	5KSP29BK1033A	03511	230-0448-000
B401	FAN, CENTRIFUGAL 230 VAC, 50/60 CPS (TUBE BLOWER)	BT3830B-19	92702	009-1621-000
C401	CAPACITOR, FXD, PAPER 10 UF, 10% TOL, 1000 VDC	CP70F1FG106K1	81349	962-4360-000
C402	SAME AS C401			
C403	SAME AS C401			
C404	SAME AS C401			
C405	NOT USED			
C406	NOT USED			
C407	CAPACITOR, FXD, PAPER 2 UF, 10% TOL, 7500 VDC	Y9477	56289	930-0330-000
C408	SAME AS C407			
C409	CAPACITOR, FXD, PAPER 1 UF, 20% TOL, 100 VDC	SDB1K01105M	56289	931-4500-000
C410	SAME AS C409			
C411	CAPACITOR, FXD, CERAMIC 0.005 UF, 20% TOL, 3000 VDC 0.1, 300V	DA172-062CB	71590	913-3512-000 933-0018-000
C412	SAME AS C411			
C413	NOT USED			
C414	NOT USED			
C415	CAPACITOR, FXD, CERAMIC 0.02 UF, 20% TOL, 500 VDC	33C2	01939	913-2142-000
C416	SAME AS C415			
C417	SAME AS C415			
C418 THROUGH C422	NOT USED			
C423	CAPACITOR, FXD, CERAMIC 100 UF, 5% TOL, 500 VDC	308611U2J010ZJ	72982	916-4059-000
C424	SAME AS C423			
C425	SAME AS C423			
C426	CAPACITOR, FXD, CERAMIC 1000 UUF, 1600 VDC	2432000X5U0102P	72982	913-0154-000
C427 THROUGH C430	SAME AS C426			
C431	CAPACITOR, FXD, CERAMIC 75 UUF, 5% TOL, 3500 VDC	850575ZPORM5PCT	71590	913-0830-000
C432	SAME AS C426			
C433	CAPACITOR, FXD, CERAMIC 100 UUF, 10% TOL, 5000 VDC	850S100NPORM10-PCT	71590	913-0821-000
C434	SAME AS C433			
C435	CAPACITOR, FXD, CERAMIC 2 UF, 5000 VDC	DA854-025	71590	913-0757-000
C436	CAPACITOR, VAR, AIR 20.7 UUF, 4500 VDC	PL1752	71313	922-0571-000
C437	CAPACITOR, FXD, CERAMIC 20 UUF, 5% TOL, 4000 VDC	850S20Z	71590	913-0838-000
C438 THROUGH C442	SAME AS C437			
C443	CAPACITOR, FXD, PLASTIC BRASS CAPACITOR RING, 3-7/8 INCHES BY 5-1/8 INCHES	Chimney		549-2069-003
C444	CAPACITOR, PLATE ALUMINUM, 0.090 INCHES THICK BY 3.750 INCHES LONG			549-2510-003
C445	CAPACITOR, PLATE ALUMINUM, 0.090 INCHES THICK BY 3.500 INCHES LONG			549-2181-003
C446	NOT USED			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
C447	CAPACITOR, FXD, CERAMIC 500 UUF, 50% TOL, 20,000 VDC			913-1101-000
C448	SAME AS C447			
C449	NOT USED			
C450	SAME AS C423			
C451	CAPACITOR, FXD, CERAMIC 75 UUF, 5% TOL, 3500 VDC	8505752P0RM5PCT	71590	913-0830-000
C452	CAPACITOR, FXD, CERAMIC 100 UUF, 10% TOL, 5000 VDC	850S100N	71590	913-0822-000
C453	SAME AS C452			
C454	SAME AS C452			
C455	NOT USED			
C456	CAPACITOR, FXD, CERAMIC 10,000 UUF, 20% TOL, 500 VDC	CK63AW103M	81349	913-1188-000
C457	SAME AS C456			
C458	NOT USED			
C459	SAME AS C456			
C460	NOT USED			
C461	NOT USED			
C462	CAPACITOR, VAR, AIR SINGLE SECTION, 7 UUF TO 100 UUF			922-0025-000
CB401	CIRCUIT BREAKER 10 AMP CURRENT RATING	33635	74193	260-0407-000
CB402	CIRCUIT BREAKER 50.0 AMP CURRENT RATING			260-1569-000
CB403	SAME AS CB401			
CR401	NOT USED			
CR402	SEMICONDUCTOR DEVICE, DIODE			353-1546-000
CR403 THROUGH CR409	SAME AS CR402			
CR410	SEMICONDUCTOR DEVICE, RECTIFIER	66-6794	81483	353-6259-000
CR411 THROUGH CR421	NOT USED			
CR422	SEMICONDUCTOR DEVICE, DIODE	MR326R	04713	353-1453-000
CR423 THROUGH CR426	SAME AS CR422			
CR427 THROUGH CR433	NOT USED			
CR434	SEMICONDUCTOR DEVICE, DIODE			353-1546-000
CR435	SAME AS CR434			
CR436	SAME AS CR434			
CR437	SAME AS CR434			
CR438	SEMICONDUCTOR DEVICE, DIODE	1N3044A	07688	353-1339-000
CR439	SAME AS CR438			
CR440	SEMICONDUCTOR DEVICE, DIODE	1N3016B	07688	353-3121-000
CR441	SAME AS CR440			
CR442 THROUGH CR444	NOT USED			
CR445	SEMICONDUCTOR DEVICE, DIODE	4M 6RS21SA3H3 AD	03508	353-0289-000
CR446	SAME AS CR438			
CR447	SAME AS CR438			
DC401	COUPLER, DIRECTIONAL DOUBLE COUPLER WITH CENTER CONDUCTOR, 12,000 WATTS	442E3	16973	277-0183-000
DS401	LAMP, INCANDESCENT PILOT LIGHT BULB	3S6-5	24446	262-3310-000
DS402	SAME AS DS401			
DS403	LAMP, GLOW 1/25 WATT, 65 VAC	NE51	24455	262-0021-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
E401	LENS, INDICATOR LIGHT GLASS, GREEN TRANSLUCENT	75A101GRN	72765	262-0258-000
E402	LENS, INDICATOR LIGHT GLASS, RED TRANSLUCENT	75A101RED	72765	262-0259-000
E403A	DISCHARGER, ELECTROSTATIC CONSISTING OF ONE PLAIN CARBON BLOCK	P1385	77554	975-0008-000
		BLOCK CERAMIC		975-0009-000
E403B	SAME AS E403A			
E403C	ARRESTOR			HOLDER 549-2453-002
E404	TERMINAL LUG PREINSULATED SOLDERLES RING TONGUE	MS25036	00779	304-0253-000
E405	SPRING, DUAL INTERLOCK			549-2315-003
E406	SAME AS 405			
F401	FUSE, CARTRIDGE 5.0 AMPS, 0.03 OHMS, 250 VDC	F02A250U5AS	81349	264-4090-000
F402	FUSE CARTRIDGE 0.250 AMPS, 250 VDC	F02B250V1-4AS	81349	264-4240-000
F403	FUSE CARTRIDGE 2 AMPS	F02B125V2AS	81349	264-0008-000
F404	SAME AS F403			
F405	SAME AS F403			
J401	CONNECTOR, ELECTRICAL 3 CONTACTS	7484	74545	368-0014-000
J402	CONNECTOR, ELECTRICAL 50 OHMS, 500 VOLTS	UG1187U	80058	357-9476-000
J403	CONNECTOR, ELECTRICAL COPPER CONTACTS	000C75	94375	357-9248-000
J404	CONNECTOR, ELECTRICAL 1 CONTACT	UG58AU	80058	357-9003-000
J405	CONNECTOR, ELECTRICAL 1 CONTACT	UG1094U	80058	357-9183-000
K401	RELAY, ARMATURE 4C CONTACT ARRANGEMENT	83-4544	04221	970-1933-000
K402	RELAY, POWER 10 AMPS, 600 VAC, 50 CPS	700B400A110V60	01121	405-0428-000
K403	SAME AS K401			
K404	RELAY, ARMATURE 2C CONTACT ARRANGEMENT	83-3598-	04221	970-1934-000
K405	RELAY, POWER 50 AMPS, 110 VAC, 60 CPS	8502	81487	405-0298-000
K406	SAME AS K405			
K407	RELAY, ARMATURE 1C CONTACT ARRANGEMENT	95062	78277	408-1114-000
L401	REACTOR 100 MA DC, 280 OHMS, 1000 VOLTS	18892	97965	678-0584-000
L402	SAME AS L401			
L403	REACTOR 3.0 AMPS, 7 OHMS	E11868	80008	668-0089-000
L404	REACTOR 2.6 AMPS, 10 OHMS	E12631	80008	668-0032-000
L405	COIL, RADIO FREQUENCY 0.50 OHMS, 3.9 UH, 1145 MA CURRENT	LT7K193	81349	240-0177-000
L406	NOT USED			
L407	CHOKE	LT7K189	81349	240-0173-000
L408	NOT USED			
L409	COIL, RADIO FREQUENCY SOLDERED, 1/2 INCH BY 1-1/8 INCHES LONG BY 5/8 INCHES			549-2297-003
L410	NOT USED			
L411	NOT USED			
L412	SAME AS L403			
M401	METER, ELECTRICAL 1 MA DC METER RANGE, 100 OHMS			548-0649-000
M402	AMMETER	56-0824-0000	80145	458-0658-000

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	3 AMP METER RANGE			
M403	METER, ELECTRICAL 1 MA DC, 1% ACCURACY	56-0423-0000	80145	458-0644-000
M404	WATTMETER 0-200 METER RANGE, 900 OHMS	56-4752-000	80147	458-0652-000
MP401	KNOB BLACK PHENOLIC			548-1293-003
MP402	SAME AS MP401			
MP403	SAME AS MP401			
MP404	SAME AS MP401			
MP405	NOT USED			
MP406	NOT USED	TUNING BEAD CHAIN		015-1888-000
MP407	NOT USED			
MP408	CHAIN ASSEMBLY SINGLE LEG, TERMINATED WITH HOOK	FOR FRONT DOOR		548-3592-002
MP409	ROD ASSEMBLY, SHORTING BRASS, WITH PLASTIC HANDLE 24.938 INCHES LONG			549-2186-003
MP410	BAR, ADJUSTING ALUMINUM, 0.375 INCHES BY 1 INCH BY 5.250 INCHES OVERALL			549-2294-003
MP411	BAR, ADJUSTING FIBER GLASS, 0.375 INCHES BY 1 INCH BY 5.250 INCHES OVERALL			549-2295-003
MP412	SPROCKET WHEEL BRASS, 0.646 INCHES DIAMETER BY 0.187 INCHES LONG			549-2168-003
MP413	SHAFT, SHOULDER MELAMINE ROD, 0.250 INCHES OUTSIDE DIAMETER BY 8-1/8 INCHES LONG			549-2223-002
MP414	SHAFT, SPROCKET ALUMINUM, 0.249 INCH DIAMETER BY 1-5/16 INCHES LONG			549-2225-002
MP415	SHAFT, FLAT PASSIVATE FINISH, 0.310 INCH DIAMETER BY 0.244 INCHES BY 5-7/32 INCHES LONG			549-2242-003
MP416	REDUCER, SHAFT BRASS, 5/8 INCH DIAMETER UNDERCUT TO 0.250 INCH DIAMETER BY 7/8 INCHES LONG			549-2275-002
MP417	EXTENSION, SHAFT PASSIVATE FINISH, 0.250 INCHES IN DIAMETER BY 1 INCH LONG			549-2284-002
MP418	SPROCKET WHEEL BRASS, 60 SPROCKETS			549-2352-002
MP419	SAME AS MP418			
MP420	SAME AS MP412			
MP421	NOT USED			
MP422	FILTER, LOW PASS 50 OHMS, 4 FEET LONG			549-2192-004
MP423	TRANSITION, AIR PLASTIC, 5.132 INCHES BY 10.125 INCHES BY 12 INCHES			549-2254-004
MP424 THROUGH MP430	NOT USED			
MP431	TRANSITION, AIR-OUTLET GLOSSTEX, 5-9/16 INCH INSIDE DIAMETER BY 9-11/16			549-2518-004

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	INCHES LONG			
MP432	MOUNT, RESILIENT CADMIUM ISOLATOR, 0.169 INCHES WIDE BY 0.169 LONG	100PH377-2	76005	200-1957-000
MP433	MOUNT, RESILENT CADMIUM ISOLATOR, 0.169 INCHES WIDE BY 0.169 INCHES LONG	100PH377-8	76005	200-1961-000
MP434	NOT USED			
MP435	SAME AS MP408			
MP436	LATCH, MAGNETIC ALUMINUM, SUPPLIED WITH OR WITHOUT STRIKER PLATE	ADPL100DCST1	84792	015-0899-000
P401	CONNECTOR, ELECTRICAL 3, WIRE MIDGET, TWIST LOCK, 10 AMPS, 250 VOLTS			368-0013-000
P402	CONNECTOR, ELECTRICAL BRASS, 3/4 INCH DIAMETER BY 1-1/2 INCHES LONG	UG1185AU	81349	357-9326-000
P403	CONNECTOR, ELECTRICAL 1 CONTACT	MS35168-88E	96906	357-9292-000
P404	SAME AS P402			
P405	SAME AS P402			
R401	RESISTOR, FXD, WIRE WOUND 3.4 OHMS, 10% TOL, 8.3 AMPS	41162-2	44655	714-1612-000
R402	SAME AS R401			
R403	SAME AS R401			
R404	RESISTOR, FXD, WIRE WOUND 7.5 OHMS, 10% TOL, 100 WATTS	R100W7-5-10PCT7-8	94310	738-0025-000
R405	RHEOSTAT 50 OHMS, 10% TOL, 500 WATTS	50446	44655	735-5300-000
R406	RESISTOR, FXD, COMPOSITION 270 OHMS, 10% TOL, 1/2 WATT	RC20GF271K	81349	745-1328-000
R407	RESISTOR, FXD, WIRE WOUND 2.5 OHMS, 3% TOL, 50 WATTS	RH50-2R500G	91637	747-8697-000
R408	RESISTOR, VAR, WIRE WOUND 50 OHMS, 10% TOL, 2 WATTS			377-0619-000
R409	RESISTOR, FXD, WIRE WOUND 0.75 OHMS, 5% TOL, 50 WATTS	M50W-75-5	00213	747-9566-000
R410	RESISTOR, FXD, WIRE WOUND 100K OHMS, 5% TOL, 210 WATTS	RW47V104	81349	746-6737-000
R411	SAME AS R410			
R412	RESISTOR, FXD, WIRE WOUND 4K OHMS, 5% TOL, 210 WATTS	HL225-4000J	91637	746-6709-000
R413	RESISTOR, FXD, WIRE WOUND 0.5 OHMS, 5% TOL, 50 WATTS	M50W0-5-5	00213	747-9564-000
R414	SAME AS R413			
R415	RESISTOR, FXD, FILM 1/4 WATT, 1% TOL			705-0519-000
R416	RESISTOR, FXD, FILM 402K OHMS, 1% TOL, 1 WATT	RN75B4023F	81349	705-3287-000
R417	RESISTOR, ADJUSTABLE, WIRE WOUND 1500 OHMS, 10% TOL, 50 WATTS			716-0026-000
R418	RESISTOR, FXD, COMPOSITION 3900 OHMS, 10% TOL, 1 WATT	RC32GF392K	81349	745-3377-000
R419	RESISTOR, VAR, COMPOSITION 10K OHMS, 20% TOL, 2 WATTS	RV4LAYSA103B	81349	380-2757-000
R420	RESISTOR, FXD, FILM 1K OHMS, 1% TOL, 2 WATTS	RN80B1004F	81349	705-4254-000
R421 THROUGH	SAME AS R420			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R425 R426	RESISTOR, FXD, FILM 750K OHMS, 1% TOL, 2 WATTS	RN8087503K	81349	705-4251-000
R427	SAME AS R426			
R428	RESISTOR, FXD, WIRE WOUND 2.5 OHMS, 3% TOL, 5 WATTS	155062-5-3PCT	00213	747-9748-000
R429	NOT USED			
R430	RESISTOR, FXD, COMPOSITION 390 OHMS, 10% TOL, 2 WATTS	RC42GF391K	81349	745-5635-000
R431	RESISTOR, FXD, WIRE WOUND 1600 OHMS, 5% TOL, 55 WATTS	RW35V162	81349	747-2751-000
R432	RESISTOR, FXD, COMPOSITION 27K OHMS, 10% TOL, 1 WATT	RC32GF273K	81349	745-3412-000
R433	RESISTOR, FXD, COMPOSITION 1K OHMS, 10% TOL, 2 WATTS	RC42GF102K	81349	745-5652-000
R434	SAME AS R433			
R435	RESISTOR, FXD, COMPOSITION 100K OHMS, 10% TOL, 1 WATT	RC32GF104K	81349	745-3436-000
R436	SAME AS R435			
R437	SAME AS R435			
R438	SAME AS R435			
R439 THROUGH R442	SAME AS R435			
R443 THROUGH R466	NOT USED			
R467	RESISTOR, FXD, WIRE WOUND 220 OHMS, 5% TOL, 6.5 WATTS	RC42BF184K	81349	747-5447-000
R468	RESISTOR, FXD, COMPOSITION 3300 OHMS, 1% TOL, 6.5 WATTS	886AS3300	10646	712-4224-000
R469	RESISTOR, FXD, COMPOSITION 470 OHMS, 10% TOL, 2 WATTS	RC42GF471K	81349	745-5638-000
R470	RESISTOR, FXD, SILICON 22 OHMS, 20% TOL, 15 WATTS	772SP2	10646	712-0002-000
R471	RESISTOR, FXD, CERMET 50 OHMS, 20% TOL, 60 WATTS	218SP9	10646	712-0070-000
R472	SAME AS R470			
R473	SAME AS R467			
R474	NOT USED			
R475	RESISTOR, FXD, WIRE WOUND 100 OHMS, 5% TOL, 5 WATTS	RW67V101	81349	747-5440-000
R476	SAME AS R475			
R477	RESISTOR, FXD, COMPOSITION 39 OHMS, 10% TOL, 2 WATTS	RC42GF390K	81349	745-5593-000
R478	SAME AS R477			
R479	NOT USED			
R480	RESISTOR, FXD, WIRE WOUND 20 OHMS, 5% TOL, 55 WATTS	RW35V200	81349	747-2713-000
R481	RESISTOR, FXD, FILM 2870 OHMS, 1% TOL, 1 WATT	RN75B2871F	81349	705-3272-000
R482	RESISTOR, FXD, COMPOSITION 10K OHMS, 10% TOL, 2 WATTS	RC42GF103K	81349	745-5694-000
R483	SAME AS R481			
R484	SAME AS R471			
R485	RESISTOR, FXD, FILM 1200 OHMS, 5% TOL, 1 WATT	RL325122J	81349	745-3946-000
R486	SAME AS R485			
R487	RESISTOR, FXD, FILM 3600 OHMS, 5% TOL, 1 WATT	RL325362J	81349	745-3974-000
R488	NOT USED			
R489	NOT USED			
R490	SAME AS R407			
R491	SAME AS R407			
R492	RESISTOR, FXD, WIRE WOUND 2.5 OHMS, 3% TOL, 5 WATTS	1550552-5-3PCT	00213	747-9748-000
R493	SAME AS R467			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
R494	NOT USED			
R495	RESISTOR, FXD, FILM 825K OHMS, 1% TOL, 2 WATTS	RN80B8253F	81349	705-4269-000
R496 THROUGH R505	NOT USED			
R506	RESISTOR, FXD, COMPOSITION 1200 OHMS, 10% TOL, 2 WATTS	RC42GF122K	81349	745-5656-000
R507	SAME AS R506			
S111	SWITCH, PUSH DPST CONTACT ARRANGEMENT	B2BL	04009	260-2020-000
S112	SAME AS S111			
S113	SAME AS S111			
S114	SAME AS S111			
S401	SWITCH, PUSHBUTTON NORMALLY OPEN CONTACTS, 3 AMPS AT 110 VAC RATING	B2BL	04009	260-2020-000
S402 THROUGH S404	SAME AS S401			
S405	SWITCH, ROTARY 2 CONTACTS	230-307	71590	259-0113-000
S406	SWITCH, ROTARY 1 SECTION, 2 CIRCUITS, 3 POSITIONS, 2 POLES	228556F1E	76854	259-1808-000
S407	SWITCH, AIRFLOW INTERLOCK SPOT CONTACT ARRANGEMENT	1000	82877	266-8309-000
S408A	CONTACT ASSEMBLY, ELECTRICAL 5/8 INCHES BY 11/16 INCHES BY 1-7/8 INCHES			260-4040-000
S409A	SAME AS S408A			
S410A	SAME AS S408A			
S411	SWITCH, TOGGLE 10 AMPS, 250 VAC, 3 LUG TYPE TERMINALS	7611K2	15605	260-2274-000
S412	ELEMENT SECTION, ANTENNA NO.1			
S412A	SWITCH, SENSITIVE 6 AMPS, 28.5 VDC			260-0025-000
S412B	PART OF S412			
S412C	PART OF S412			
T401	TRANSFORMER, STEP-DOWN 250 VOLTS, 50 TO 60 CPS	E12322	8C008	662-0043-000
T402	TRANSFORMER, STEP-UP 230 VOLTS, 60 CPS	31260	97965	662-0049-000
T403	TRANSFORMER, STEP-UP PLATE 230 VOLTS, 50 TO 60 CPS	E12628	80008	664-0017-000
T404	TRANSFORMER, STEP-UP 250 VOLTS, 50 TO 60 CPS	E12632	80008	664-0018-000
T405	TRANSFORMER, STEP-~~UP~~ FIL. 245 VOLTS, 50 TO 60 CPS	E9186A	80008	662-0213-000
T406	TRANSFORMER, STEP-DOWN 230 VOLTS, 50 TO 60 CPS	E10240C	80008	662-0273-000
TB401	TERMINAL BOARD, ELECTRICAL HEAVY DUTY, 3 CONDUCTOR TERMINAL BLOCK	9080U3	90211	367-1188-000
TB402	TERMINAL STRIP 4 TERMINALS	4-142	71785	367-5040-000
TB403	TERMINAL STRIP 12 TERMINALS	12-141	71785	367-4120-000
TB404	SAME AS TB403			
TB405	TERMINAL BOARD 16 TERMINALS			267-4160-000
TB406	TERMINAL BOARD			549-2234-003
TB407	TERMINAL BOARD LAMINATED GLASS CLOTH, 1/8 INCH THICK, 4-1/4 INCHES WIDE BY 12 INCHES LONG			549-2264-003

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
TB408	TERMINAL BOARD 4 TERMINALS, FOR USE WITH OPTIONAL REMOTE CONTROL EQUIPMENT	600-4	75382	367-0002-000
TB409	SAME AS TB408			
TB410	SAME AS TB405			
TB411	TERMINAL STRIP 10 TERMINALS	10-141	71785	367-4100-000
TB412	TERMINAL BOARD PLASTIC, 1/16 INCHES THICK BY 2-1/8 INCHES BY 4-9/16 INCHES LONG			533-5766-003
TB413	SAME AS TB412			
TB414	NOT USED			
TB415	TERMINAL BOARD TWO RINGS OF 6 TERMINALS EACH	6H12	00534	306-0909-000
V401	ELECTRON TUBE GLASS ENVELOPE, RECTIFIER	872A872	72092	256-0037-000
V402 THROUGH V406	SAME AS V401			
V407	ELECTRON TUBE TETRODE	1X2AB	49671	256-0122-000
XDS401A	LAMPHOLDER PANEL MOUNTING, USE WITH CANDELABRA SCREW BASE LAMP	75LESSLENS	72765	262-0255-000
XDS402A	SAME AS XDS401A			
XDS403A	LAMPHOLDER MOUNTING BRACKET	50	72765	262-1260-000
XF401	FUSEHOLDER	HKLJRWZZ	71400	265-1040-000
XF402	SAME AS XF401			
XF403	SAME AS XF401			
XF404	SAME AS XF401			
XF405	SAME AS XF401			
XV401	SOCKET, ELECTRON TUBE 4 PIN BAYONET BASE TUBE SOCKET, 20 AMP	123-211-30	74970	220-1460-000
XV402 THROUGH XV406	SAME AS XV401			
XV407	SOCKET, ELECTRON TUBE AIR SYSTEM SOCKET	Y291	06980	220-1491-000
Z401	NOT USED			
Z402	NOT USED			
Z403	NOT USED			
Z404	SEMICONDUCTOR DEVICE, RECTIFIER THREE PHASE BRIDGE, 400 CPS	67-7304	81483	353-6273-000
Z405	RECIFIER ASSEMBLY BIAS 0.062 INCHES BY 3.500 INCHES BY 6.625 INCHES			549-2259-004
Z406	SEMICONDUCTOR DEVICE, RECTIFIER SILICON, THREE PHASE FULL WAVE BRIDGE VOLTAGE DOUBLER. OPTIONAL ASSEMBLY. SEE BREAKDOWN ON PAGE 47/48	67-7303	81483	756-8563-000

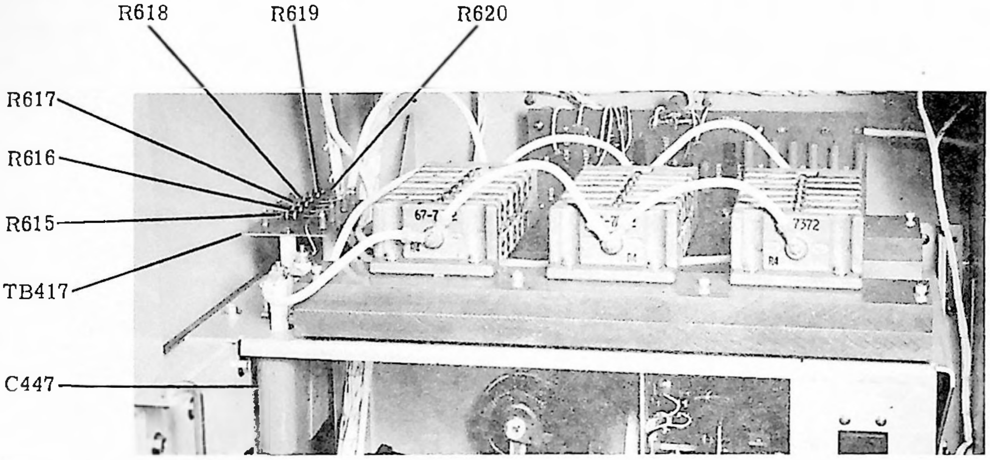
MANUFACTURERS CODES

CODE	MANUFACTURER
EIMAC	EIMAC
00213	SAGE ELECTRONICS CORP P.O. BOX 3926 ROCHESTER, N.Y.

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
00534	VECTOR MFG. CO. 5616 LAWNDALE HOUSTON, TEXAS			
01121	ALLEN-BRADLEY CO. 1201 SOUTH 2ND STREET MILWAUKEE, WIS.			
01939	SPRAGUE ELECTRIC CO. OF WIS. GRAFTON			
03511	GENERAL ELECTRIC CO. SPECIALTY MOTOR DEPT. FORT WAYNE, IND.			
04009	ARROW-HART AND HEGEMAN ELECTRIC CO. HARTFORD, CONN.			
04221	TELEX-AEMCO MANKATO, MINN.			
04713	MOTOROLA INC. SEMICONDUCTOR PRODUCTS DIVISION 5005 EAST MC DOWELL ROAD PHOENIX, ARIZONA			
06980	EITEL-MCCULOUGH INC. 301 INDUSTRIAL WAY SAN CARLOS, CALIF.			
07688	JOINT ELECTRON DEVICE ENGINEERING COUNCIL WASHINGTON, D.C.			
10646	CARBORUNDUM CO. BUFFALO AVE. NIAGARA FALLS, N.Y.			
15605	CUTLER-HAMMER INC. MILWAUKEE, WIS.			
16973	DENVER FIRE CLAY CO. 3033 BLAKE STREET DENVER, COLO.			
24446	GENERAL ELECTRIC CO. SCHENECTADY, N.Y.			
24455	GENERAL ELECTRIC CO. LAMP DIVISION OF CONSUMER PRODUCTS GROUP NELA PARK CLEVELAND, OHIO			
44655	OHMITE MFG. CO. 3601 HOWARD STREET SKOKIE, ILL.			
49671	RADIO CORP OF AMERICA NEY YORK CITY, N.Y.			
56289	SPRAGUE ELECTRIC CO. NORTH ADAMS, MASS.			
71313	CARDWELL CONDENSER CORP. 80 EAST MONTAUK HIGHWAY LINDENHURST LONG ISLAND, NEW YORK			
71400	BUSSMANN MFG. DIVISION OF MCGRAW-EDISON CO. 2538 WEST UNIVERSITY ST. ST. LOUIS, MO.			
71590	CENTRALAB DIVISION OF GLOBE-UNION INC. 932 EAST KEEFE AVE. MILWAUKEE, WIS.			
71785	CINCH MFG. CO. AND HOWARD B. JONES DIVISION 1026 SOUTH HOMAN AVE. CHICAGO, ILL.			
72619	DIALIGHT CORP. BROOKLYN, N.Y.			
72765	DRAKE MFG. CO. 4626 NORTH OLCOTT AVE. CHICAGO, ILL.			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
72982	ERIE TECHNOLOGICAL PRODUCTS INC. 644 WEST 12TH STREET ERIE, PA.			
74193	HEINEMANN ELECTRIC CO. 2612 BRUNSWICK PIKE TRENTON, N.J.			
74545	HUBBELL HARVEY INC. BRIDGEPORT, CONN.			
74970	E.F. JOHNSON CO. 297 TENTH AVE. S.W. WASECA, MINN.			
75382	KULKA ELECTRIC CORP. MT. VERNON, N.Y.			
76005	LORD MFG. CO. 1635 WEST 12TH STREET ERIE, PA			
76854	OAK MFG. CO. SOUTH MAIN CRYSTAL LAKE, ILL.			
78277	SIGMA INSTRUMENTS INC. 170 PEARL ST. SOUTH BRAINTREE, MASS.			
80008	ELECTRO ENGINEERING WORKS OAKLAND, CALIF.			
80058	JOINT ELECTRONIC TYPE DESIGNATION SYSTEM			
80145	ASSEMBLY PRODUCTS INC. 7100 WILSON MILLS ROAD CHESTERLAND, OHIO			
80147	BIGGS STEEL FOUNDRY AND FABRICATING CO. AKRON, OHIO			
81349	MILITARY SPECIFICATIONS PROMULGATED BY STANDARDIZATION DIVISION DIRECTORATE OF LOGISTIC SERVICES DSA			
81483	INTERNATIONAL RECTIFIER CORP. 1523 EAST GRAND AVE. EL SEGUNDO, CALIF.			
81487	SQUARE D CO. INDUSTRIAL CONTROLLER DIVISION 4041 NORTH RICHARDS ST. MILWAUKEE, WIS.			
82877	ROTRON MFG. CO. INC. 7-9 HASBROUCK LANE WOODSTOCK, N.Y.			
84792	HEPPNER MFG. CO. P.O. BOX Q ROUND LAKE, ILL.			
85107	NEPTUNE ELECTRONICS CO. 30 WEST 15TH. STREET NEW YORK, N.Y.			
90211	SQUARE D CO. 9405 RIVER CHICAGO, ILL			
91637	DALE ELECTRONICS INC. COLUMBUS, NEBR			
92702	IMC MAGNETICS CORP. EASTERN DIVISION 570 MAIN STREET WESTBURY LONG ISLAND, N.Y.			
94310	TRU-OHM PRODUCTS MEMCOR COMPONETS DIVISION P.O. BOX 890 HUNTINGTON, IND.			

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
94375	AUTOMATIC METAL PRODUCTS CO. 315 BERRY BROOKLYN, N.Y.			
96906	MILITARY STANDARD PROMULGATED BY STANDIZA-TION DIVISION DIRECTORATE OF LOGISTIC SERVICES DSA			



1N3673A
Diodes

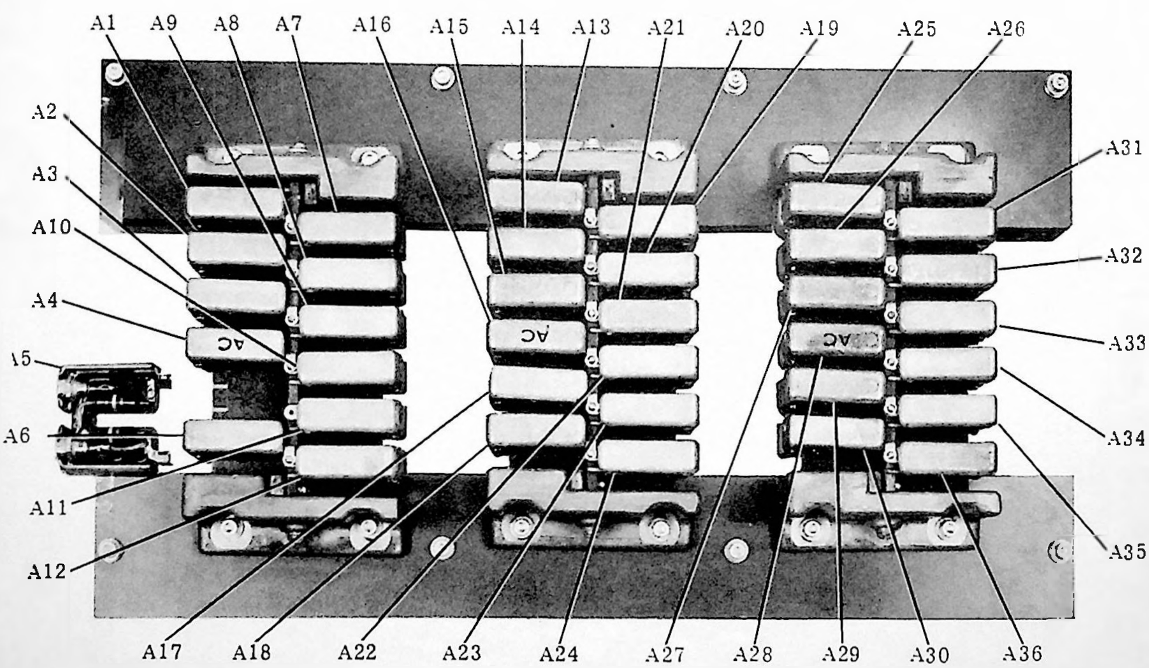


Figure 4-2. Semiconductor Device, Rectifier

SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	COLLINS PART NUMBER
	SEMICONDUCTER DEVICE, RECTIFIER (COMPLETE SHELF)			756-8563-000 353-6257-000
	ONE LEG OF RECTIFIER SHELF			353-6258-000
A1	MODULE ASSEMBLY REPLACE ENTIRE ASSEMBLY	66-6794	81483	353-6259-000
A2	SAME AS A1			
A3	SAME AS A1			
A4	MODULE ASSEMBLY REPLACE ENTIRE ASSEMBLY	66-6795	81483	353-6260-000
A5 THROUGH A15	SAME AS A1			
A16	SAME AS A4			
A17 THROUGH A27	SAME AS A1			
A28	SAME AS A4			
A29 THROUGH A36	SAME AS A1			
C447	CAPACITOR, FXD, CERAMIC 500 UUF, PLUS 50% MINUS 20%, 20,000 VDCW			913-1101-000
R615	RESISTOR, FXD, COMPOSITION 56 OHMS, 10% TOL, 2 WATTS	RC42GF560K	81349	745-5600-000
R616 THROUGH R620	SAME AS R615			
TB417	TERMINAL BOARD			756-3671-002

263[illegible]
1-10-69

MANUFACTURERS CODES

	MANUFACTURER
81349	MILITARY SPECIFICATIONS
81483	INTERNATIONAL RECTIFIER CORP. 1523 EAST GRAND AVE. EL SEGUNDO, CALIF.

1N3673A
1000 V PIV @ 12A.

Figure 5-1. F830-1 10-Kw FM Power Amplifier, Schematic Diagram

COLLINS

https://bh.hallikainen.org