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July 5, 1962

AD402262

QUARTERLY REPORT

Prepared On
CONTRACT NO. N0ber 81262

Prepared For
BUREAU OF SHIPS
Department of the Navy
Washington 25, D. C.

491-01

Prepared By
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1.0 ABSTRACT

1.10 This report covers the work done on the development of an RF Spectroscope in the range from 100 MC to 1000 MC for the three month period from February 1, 1962 to April 30, 1962. It deals with the following subjects:

1.11 Purpose for the development.

1.12 Names of technical personnel engaged in the development program, together with a summary of the man hours work performed by each.

1.13 A description of the work done during the period from February 1, 1962 to April 30, 1962.

1.14 A project performance and schedule chart is included.

1.15 Program for the next three month interval.

2.0 PURPOSE FOR THE DEVELOPMENT

- 2.10 The RF Spectroscope shall be developed for the visual display of amplitude and frequency of RF signals in the frequency range of 100 MC to 1000 MC.
- 2.20 The frequency range of 100 MC to 1000 MC shall be displayed in four swept bands on a 5" oscilloscope screen.
- 2.30 The spectroscope shall have sweep coverage up to 300 MC electronically with high resolution, with no spurious responses and no internally generated interference.
- 2.40 It shall be useful as a search receiver, spectrum analyzer, noise interference analyzer or as monitoring equipment.

3.0 TECHNICAL PERSONNEL ENGAGED IN THE PROGRAM AND MAN HOURS

3.10 The following is a list of technical personnel engaged in the development of the spectroscope together with the total number of hours spent by each during the period from February 1, 1962 to April 30, 1962.

<u>Name</u>	<u>Total Hours Per Man</u>
Martin Heller	458.75
Leonard Pollachek	169.25
Earl Morrison	191.75
Frank Sokolski	341.50
Charles Copp	21.00
Joseph Fazzino	67.50
Daniel Smoley	16.50
Harry Brown	10.75
Al Kennard	<u>57.25</u>
	1,334.25

4.0 DESCRIPTION OF WORK

4.10 During the period covered by this report the following tasks have been undertaken.

4.11 A survey of the scope of work required to complete the development of the spectroscope was firmed up. It was decided that the spectroscope would comprise the following packages:

4.11.1 The Control Package - This package includes all switching and control functions such as channel and band selectivity and RF and IF signal attenuators. A metering facility for self-checking and troubleshooting is provided. All sweep functions are controlled, including dispersion, under frequency and sweep rate. Power switching and overload protection are included in this package.

4.11.2 The RF Heads - Each RF head consists of a bandpass filter, RF preamplifier, converter, post amplifier (IF) and self-contained power pack. The four RF units encompass the range from 100 MC to 1000 MC in the following steps:

Unit 1A3 - 100 MC to 200 MC

Unit 1A4 - 200 MC to 400 MC

Unit 1A5 - 400 MC to 700 MC

Unit 1A6 - 700 MC to 1000 MC

4.11.3 The Power Supply Package - This package contains the power supplied to all circuitry not included in the RF heads.

4.11.4 The Sweep Oscillator Package - This package contains

the two sweep local oscillators encompassing the sweep span from 875 MC to 1475 MC in two ranges as follows:

Unit 1A2A1 - 875 MC to 1175 MC

Unit 1A2A2 - 1175 MC to 1475 MC

In addition, the package contains coaxial switches for selecting the desired sweep range.

4.11.5 The IF Amplifier Package - This package includes two IF amplifiers, IF bandpass filters, the lin-log amplifier, the power IF amplifier, linear detector and video output stage.

4.11.6 A block diagram of the unit is shown in Figure 1, Dwg. No. R700458.

4.12 A paper design of a lin-log amplifier was nearly completed during this period. The unit combines logarithmic and linear amplification in a single amplifier. A selector switch on the control panel will enable the choice of either function. The logarithmic response is obtained by a feedback arrangement which controls the conduction of diodes shunting the plate circuits of the IF amplifier. A video detector followed by a DC coupled transistorized video amplifier develops the control voltage for the plate loading diodes. For linear amplification, the video amplifier is disabled while the loading diodes are slightly back biased so that they cannot load the interstage networks. In this mode, the amplifier has a linear response. A partial schematic of the lin-log amplifier is shown in Figure 2, Dwg. No. B600760.

- 4.13 During this period, work was performed in trying to improve the stability of the 1250 MC oscillator in the 475 to 775 MC converter. The oscillator tank circuit comprises a strip line which is inherently stable and rugged. The unit was paper designed, breadboarded and aligned. A partial schematic diagram of the unit is shown in Figure 3, Dwg. No. B600784.
- 4.14 Circuitry was designed and breadboarded to improve frequency linearity versus sweep voltage for the varactor swept oscillators. The sweep voltage is fed to a passive network matrix which combines the sweep with the DC center frequency voltage. The combined output is amplified and fed to shaping circuitry which properly shapes the sweep voltage to give the desired linearity. The passive network matrix shown in Figure 4, Dwg. No. 600759, combines the DC center frequency voltage and the sweep voltage in such a way as to maintain the correct balance between these two to permit proper shaping while varying the setting of the dispersion control. The shaped sweep voltage is then fed to a difference amplifier, the output of which is applied to the varactor of the sweep oscillator. Figure 5, Dwg. No. A700464, is a block diagram of the control and shaping circuitry.
- 4.15 A 402.5 MC oscillator with dual output was designed and breadboarded during this period. Each of the dual outputs feeds a converter. One converter translates the 775 MC IF signal to 30 MC. The other converts the 30 MC signal back to 775 MC. The 775 MC reconverted signal is then fed to the lin-log amplifier. Either a 5 KC crystal filter or a 25 KC crystal filter, each centered at 30 MC, is interposed between the 775 MC

to 30 MC converter and the 30 MC to 775 MC converter to obtain the greatest resolving capability of the spectroscope. The second harmonic of the 402.5 MC dual output oscillator, or 805 MC, is used as the injection frequency to convert the 775 MC signal to 30 MC and then the 30 MC signal back to 775 MC respectively. Since the oscillator feeds both converters, the intention is to isolate the two oscillator outputs from one another at the signal frequency of 775 MC. This is accomplished by using a low pass filter at each of the two outputs of the oscillator which passes 402.5 MC and rejects 775 MC. Figure 6, Dwg. No. B600783, is a schematic diagram of the original 402.5 MC oscillator. Figure 7, Dwg. No. A600812, is the improved version of the same 402.5 MC oscillator.

- 4.16 The 775 MC to 30 MC converter has been paper designed and breadboarded during this period. It consists of a single grounded grid mixer using tube type 7784, a "pi" section at the input matched at 775 MC and a "pi" section at the output matched at 30 MC. The second harmonic of 402.5 MC, or 805 MC, is generated at the input of the type 7784 tube due to its non-linearity. Figure 8, Dwg. No. B600782, is a schematic diagram of the converter.
- 4.17 A low pass filter has been paper designed. It has a rejection of better than 60 DB at 775 MC. Two of these will be used on either side of the 402.5 MC oscillator, as discussed in paragraph 4.15. A schematic diagram of the unit is shown in Figure 9, Dwg. No. B600781.
- 4.18 The following units have been completed by engineering and released for fabrication during this period:

- A. One LP-HP Bandpass Filter, 100-200 MC, Unit 1A3A1.
- B. One LP-HP Bandpass Filter, 200-400 MC, Unit 1A4A1.
- C. One LP-HP Bandpass Filter, 400-700 MC, Unit 1A5A1.
- D. One LP-HP Bandpass Filter, 700-1000 MC, Unit 1A6A1.
- E. Two 775 MC IF Amplifiers, Figure 10, Dwg. No. C600750.
- F. One 400-700 MC/775 MC Amplifier/Converter in the 400 to 700 MC RF head, Figure 11, Dwg. No. D600747.
- G. One 700-1000 MC/475 MC Amplifier Converter in the 700 to 1000 MC RF head, Figure 12, Dwg. No. D600734.

4.19 A project performance and schedule chart is given in Figure 13, Dwg. No. SF-138.

5.0 PROGRAM FOR THE NEXT THREE MONTH INTERVAL

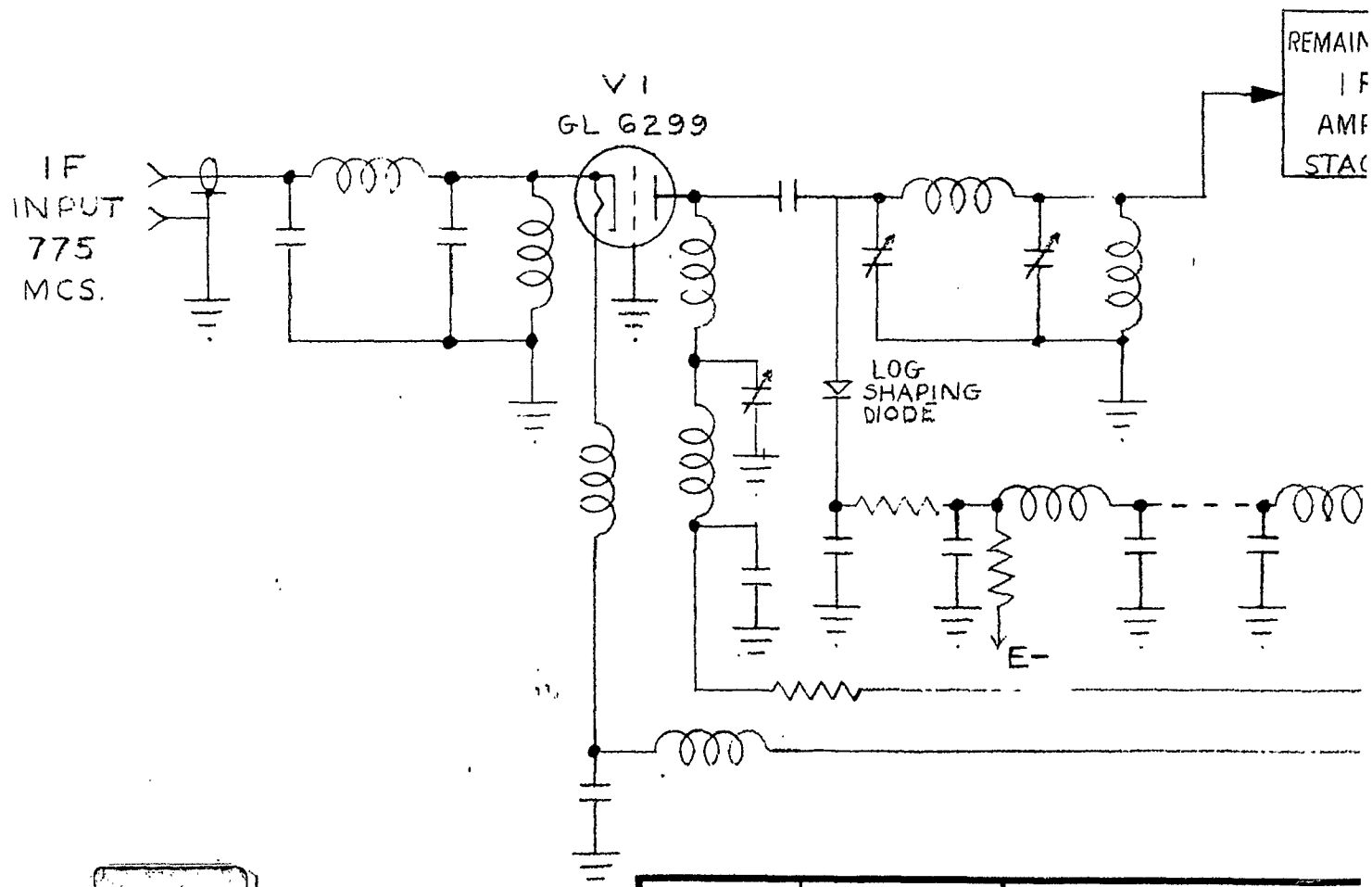
5.10 During the next interval, it is hoped that the following tasks will be completed.

5.11 The power supplies, oscilloscope and crystal filters will be ordered and delivered to the laboratory.

5.12 All individual units will be fabricated.

5.13 The cabinet will be ordered and delivered to the laboratory.

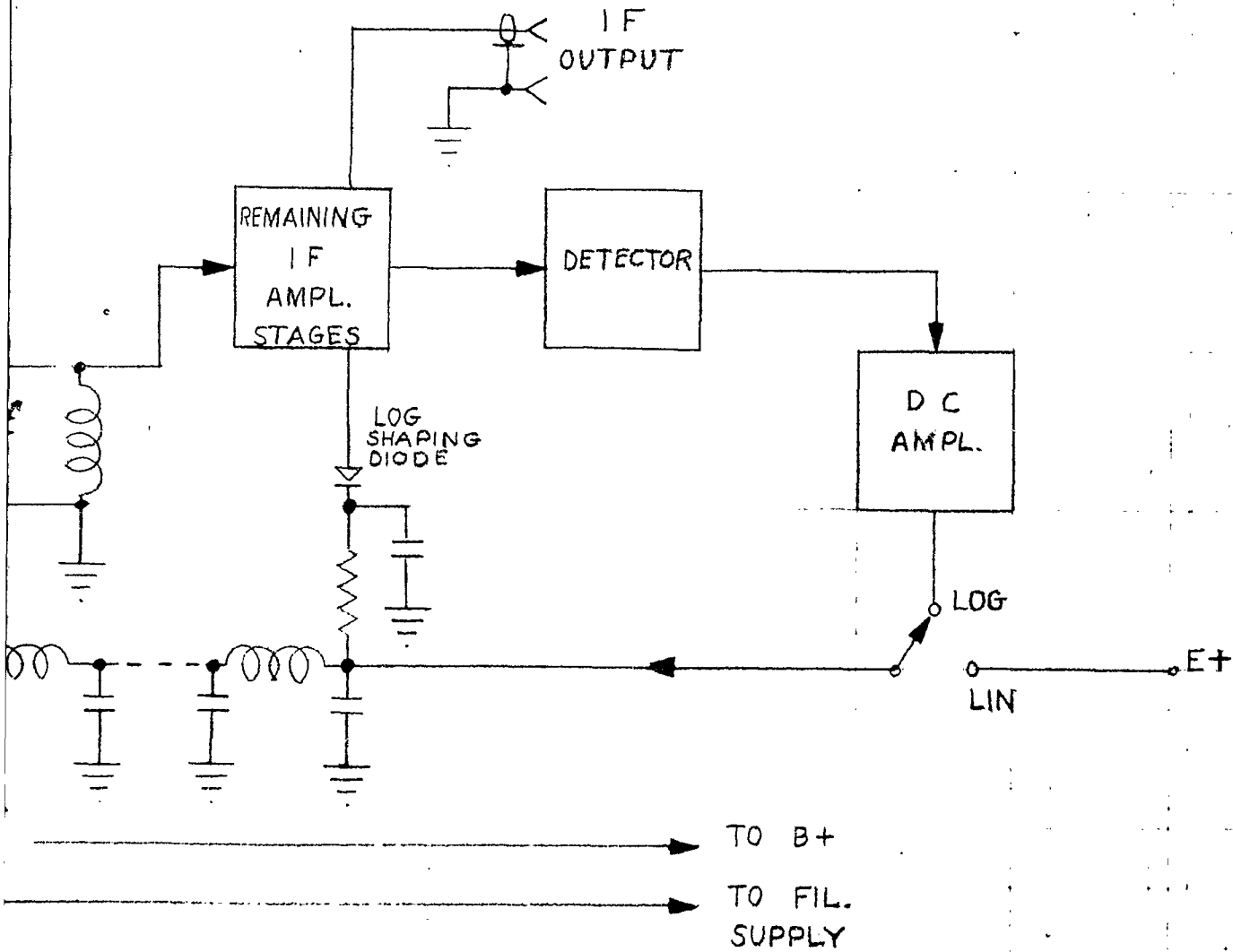
5.14 The assembly of the total system will be completed.



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		FRACTIONS $\pm 1/64$	ANGLES $\pm 1/2$
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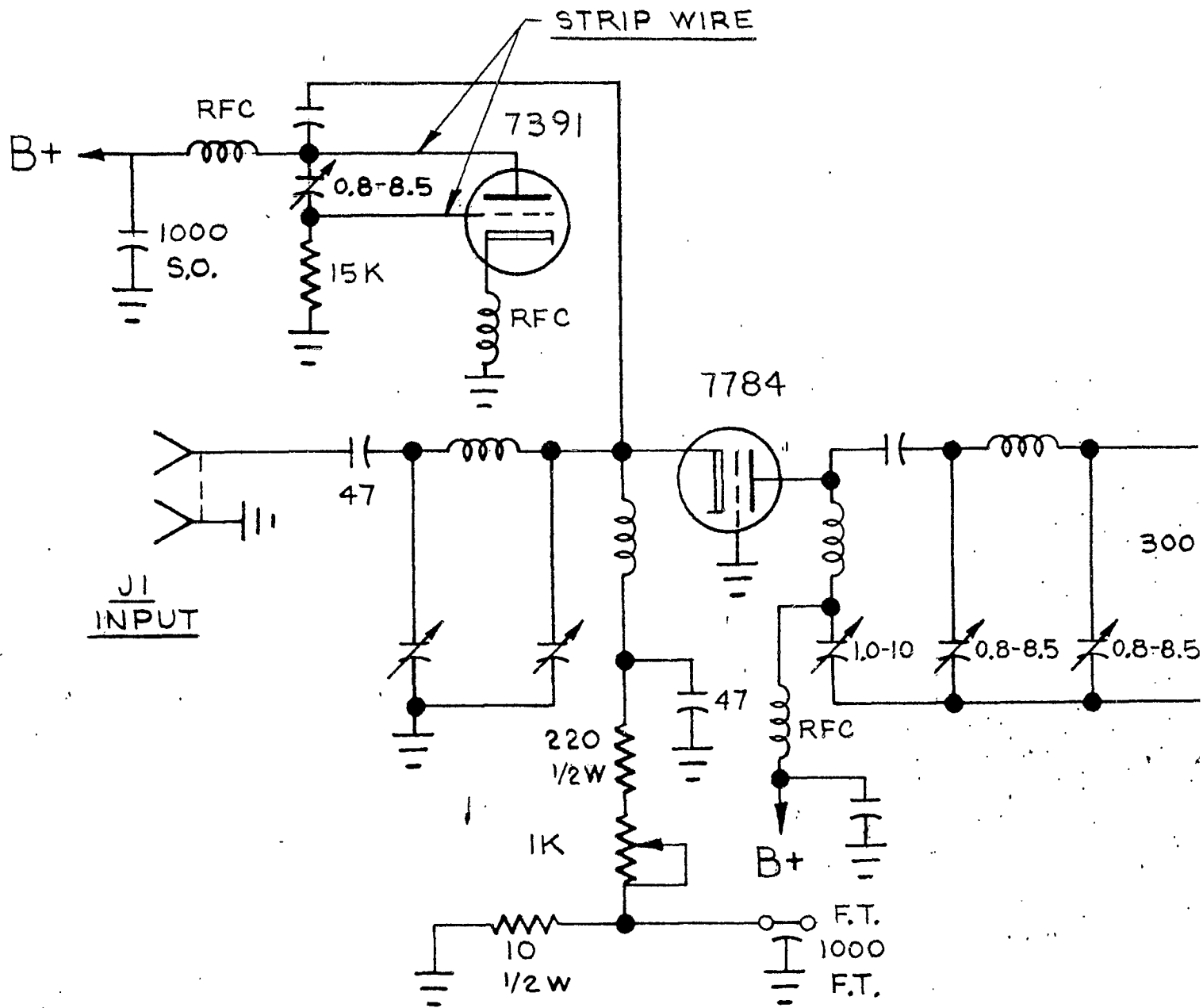
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DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES: FRACTIONS ± 1/64 ANGLES ± 1/2° DECIMALS .XX ± .010 .XXX ± .005	DRAWN 4-3-62	PARTIAL SCHEMATIC OF LIN LOG AMPLIFIER	APPLIED RESEARCH INC. PORT WASHINGTON NEW YORK	
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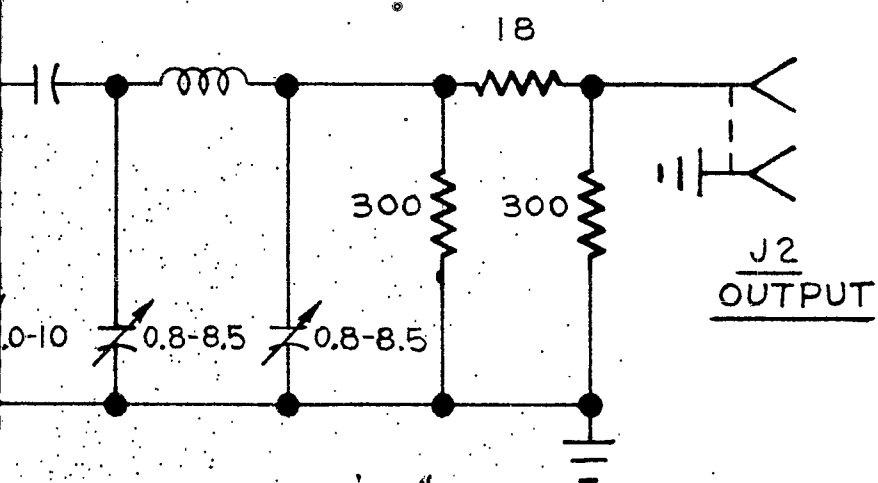


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NOTE:

- 1. UNLESS OTHERWISE SPECIFIED
- (A) ALL CAPACITORS ARE IN μmf
- (B) ALL RESISTORS ARE IN OHMS

ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:
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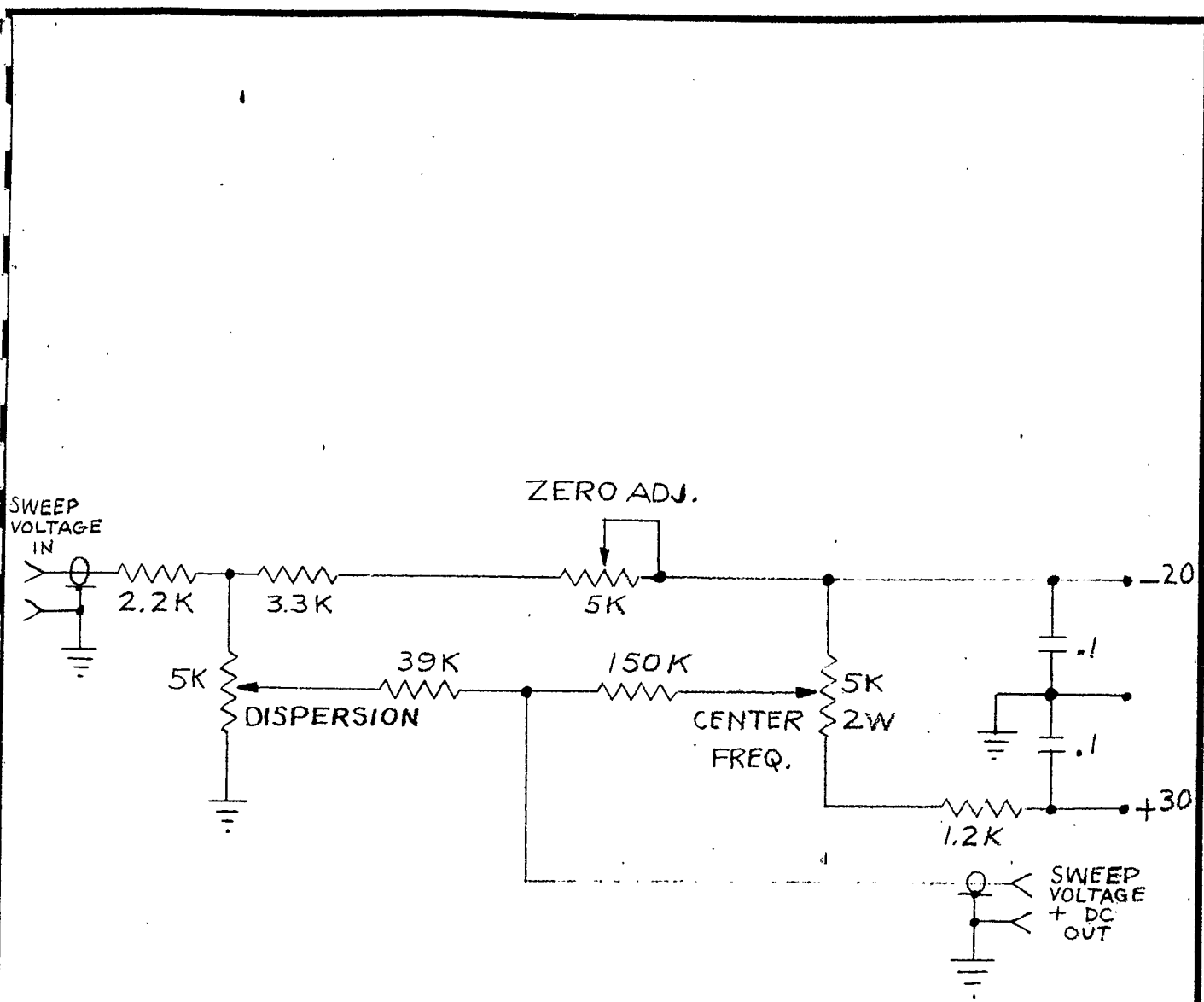
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475/775 MC
CONVERTER

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ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:
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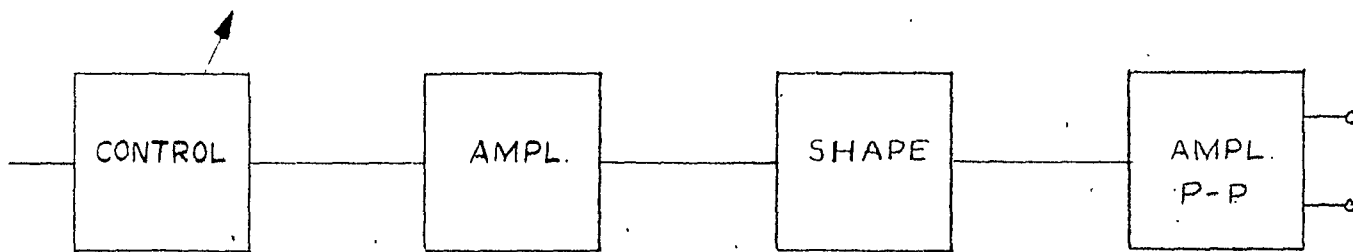
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 PORT WASHINGTON
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 DECIMALS $.XX \pm .010$ $.XXX \pm .003$

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BLOCK DIAGRAM
 OF CONTROL &
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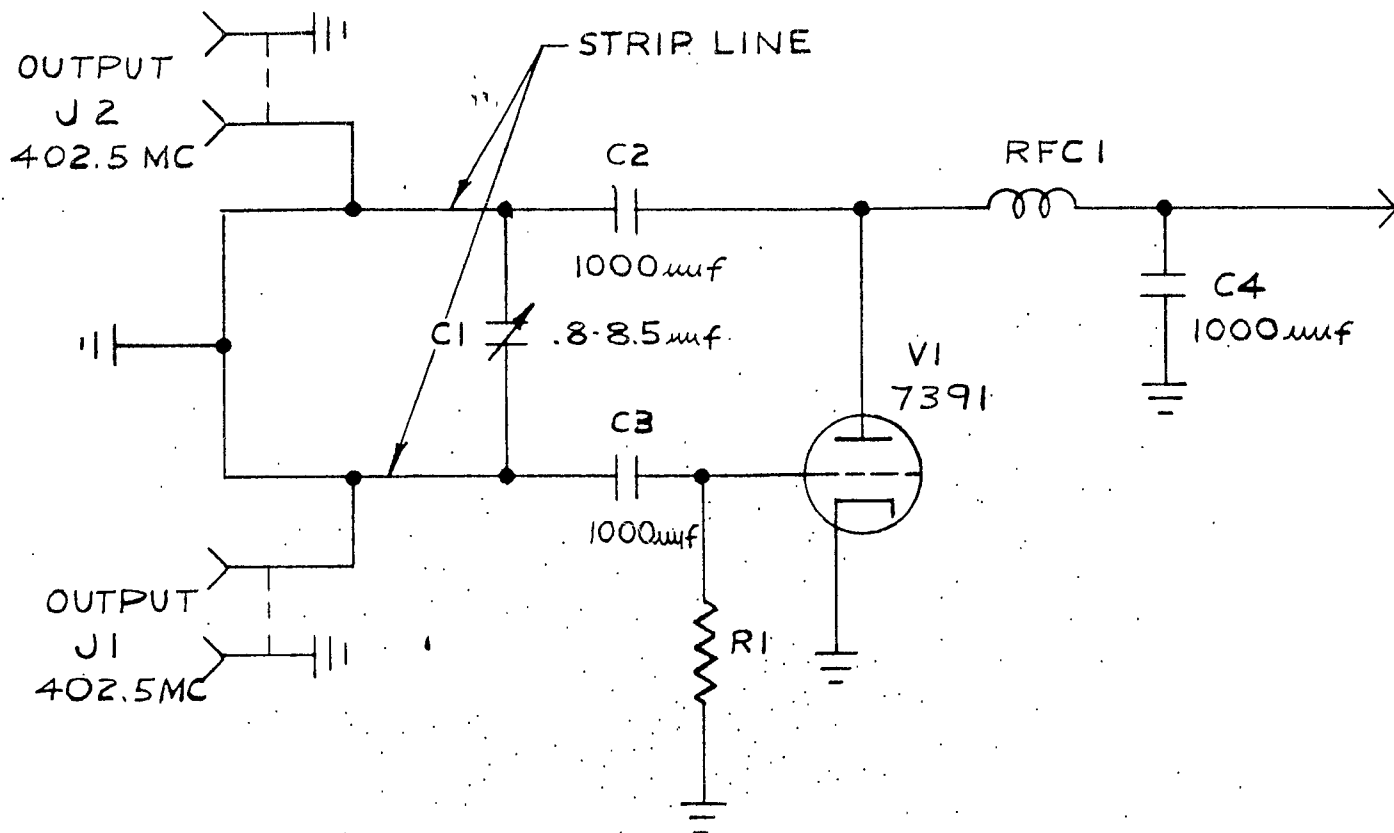
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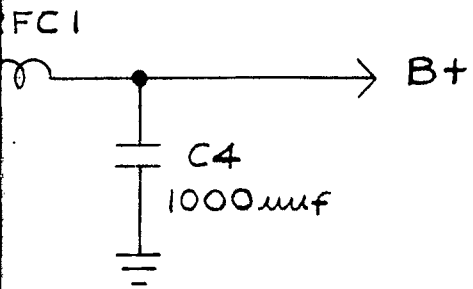
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DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:
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405.2 MC OSCILLATOR

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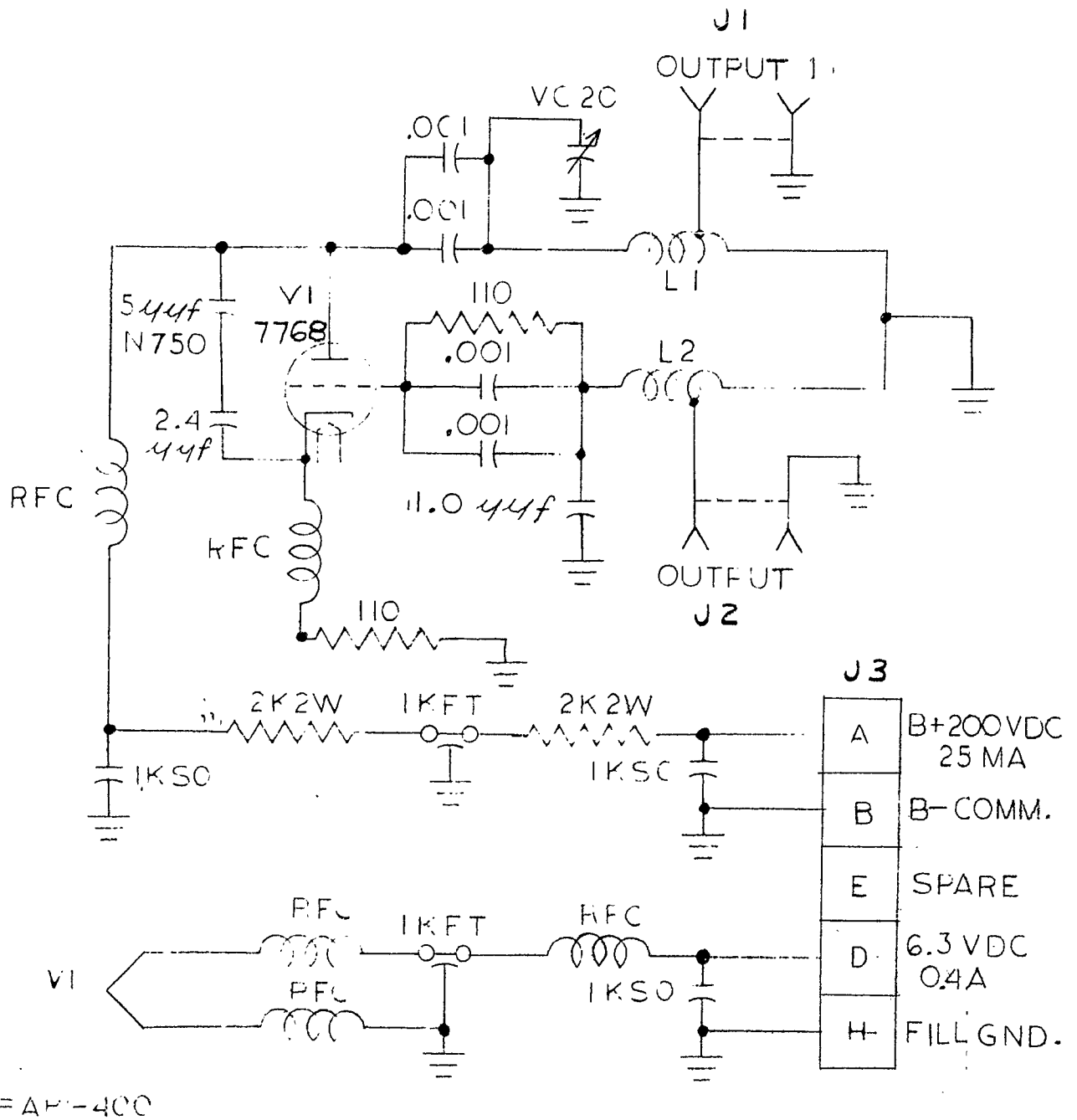
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ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:
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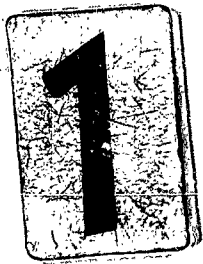
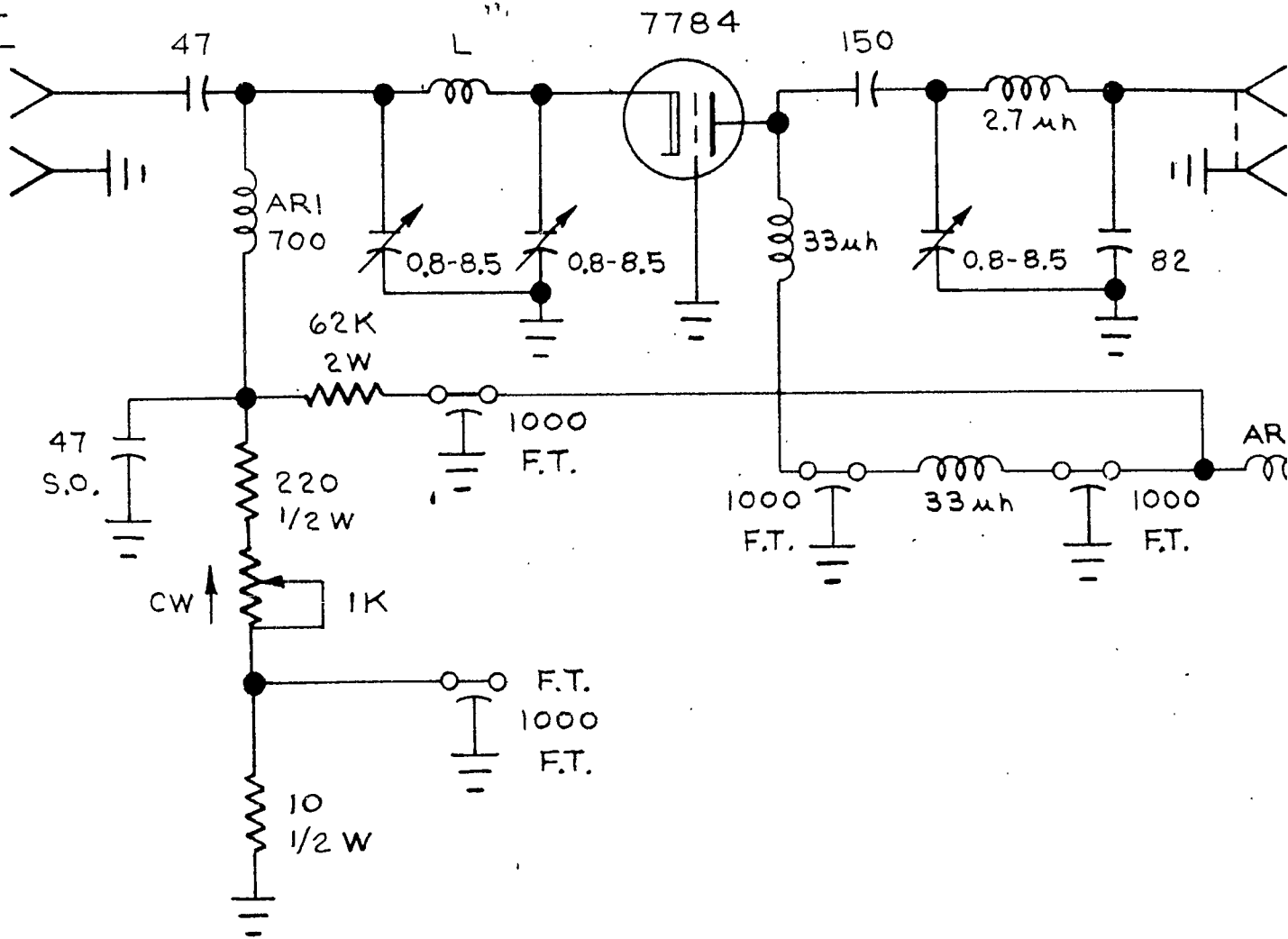
SCHMATIC
STRIP LINE
LOCAL OSCILLATOR
UNIT 1A7A13

APPLIED RESEARCH INC.
 PORT WASHINGTON
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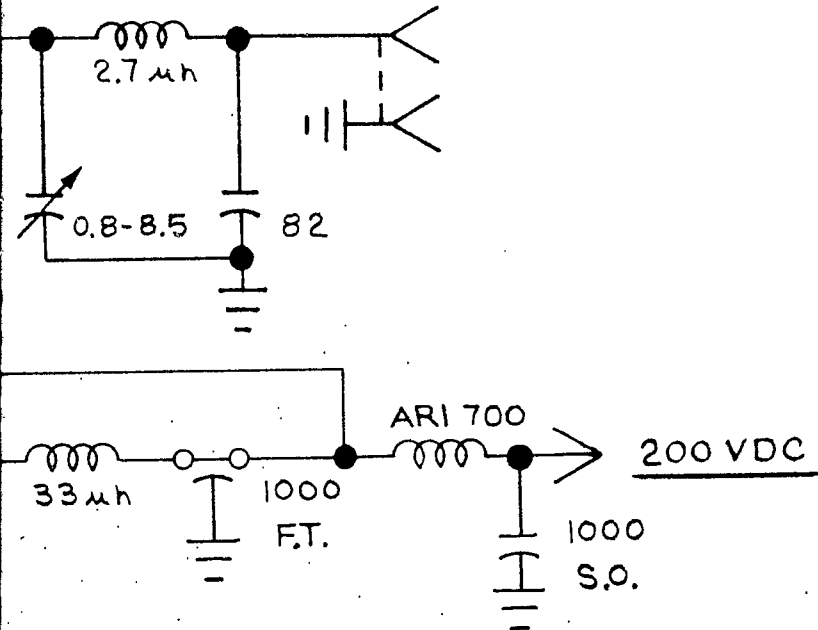


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J2
OUTPUT



2

NOTE:

- I. UNLESS OTHERWISE SPECIFIED
- (A) ALL CAPACITORS ARE IN μμF
- (B) ALL RESISTORS ARE IN OHMS

ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:
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SCHEMATIC
775 MC/30 MC
CONVERTER

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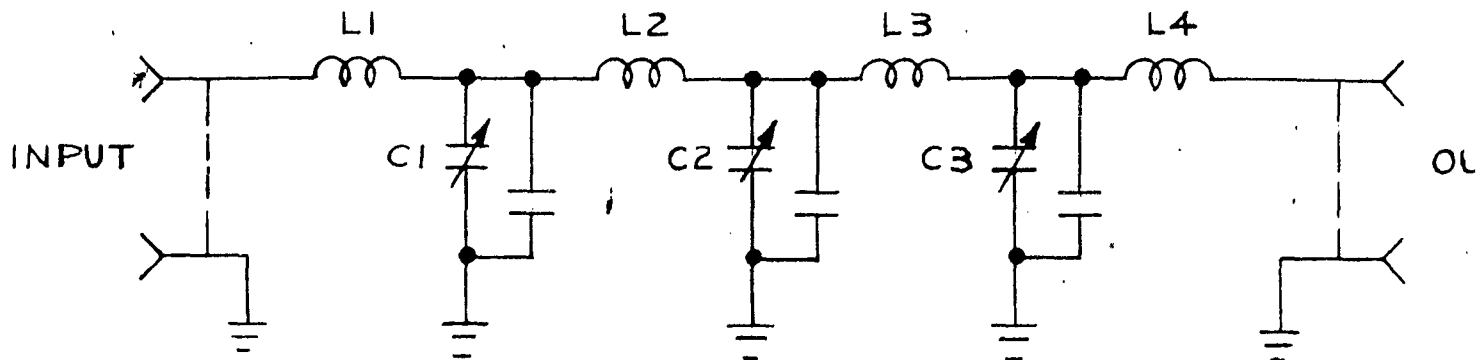
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ELECTRICAL REQ'S

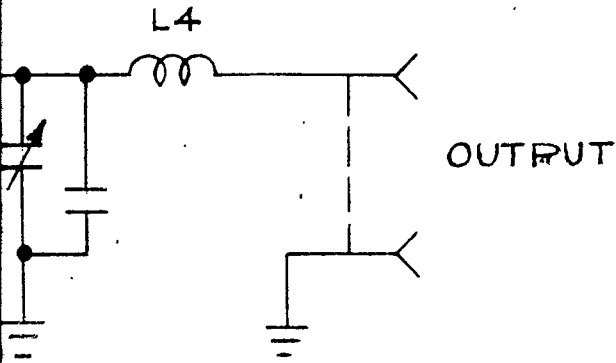
- 1- 3db PT = 415 MC
- 2- 60db PT = 770 MC
- 3- RIPPLe = 0.1db
- 4- $Z_{IN} = 50 \Omega$
- 5- $Z_{OUT} = 50 \Omega$



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LOW PASS FILTER

APPLIED RESEARCH INC.
PORT WASHINGTON
NEW YORK

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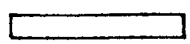
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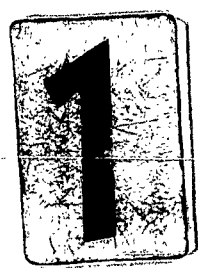
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2. MECHANICAL DESIGN		████████████████████			
3. FABRICATION			██████████		
4. FINAL TEST					



WORK COMPLETED



WORK TO BE COMPLETED



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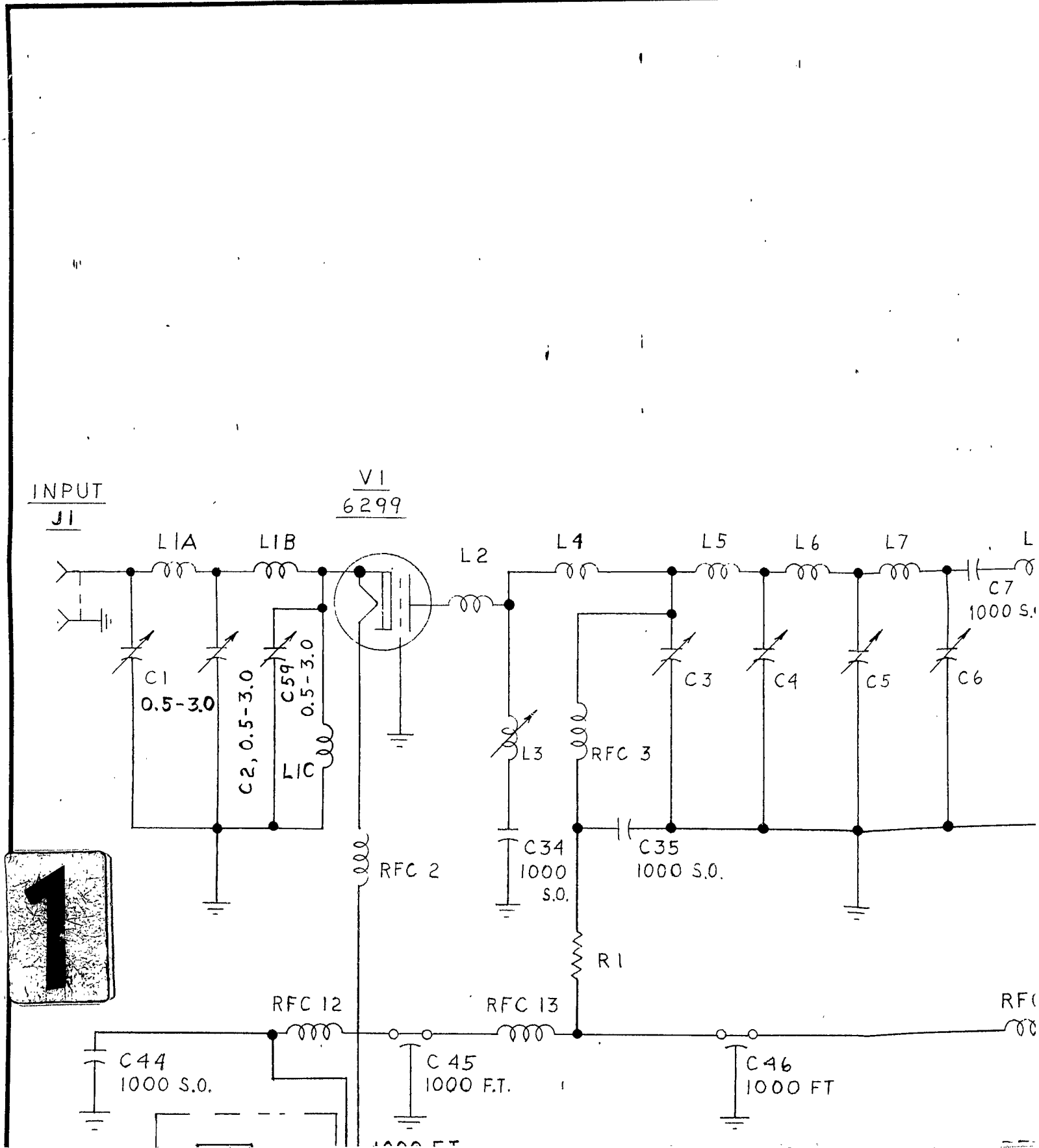
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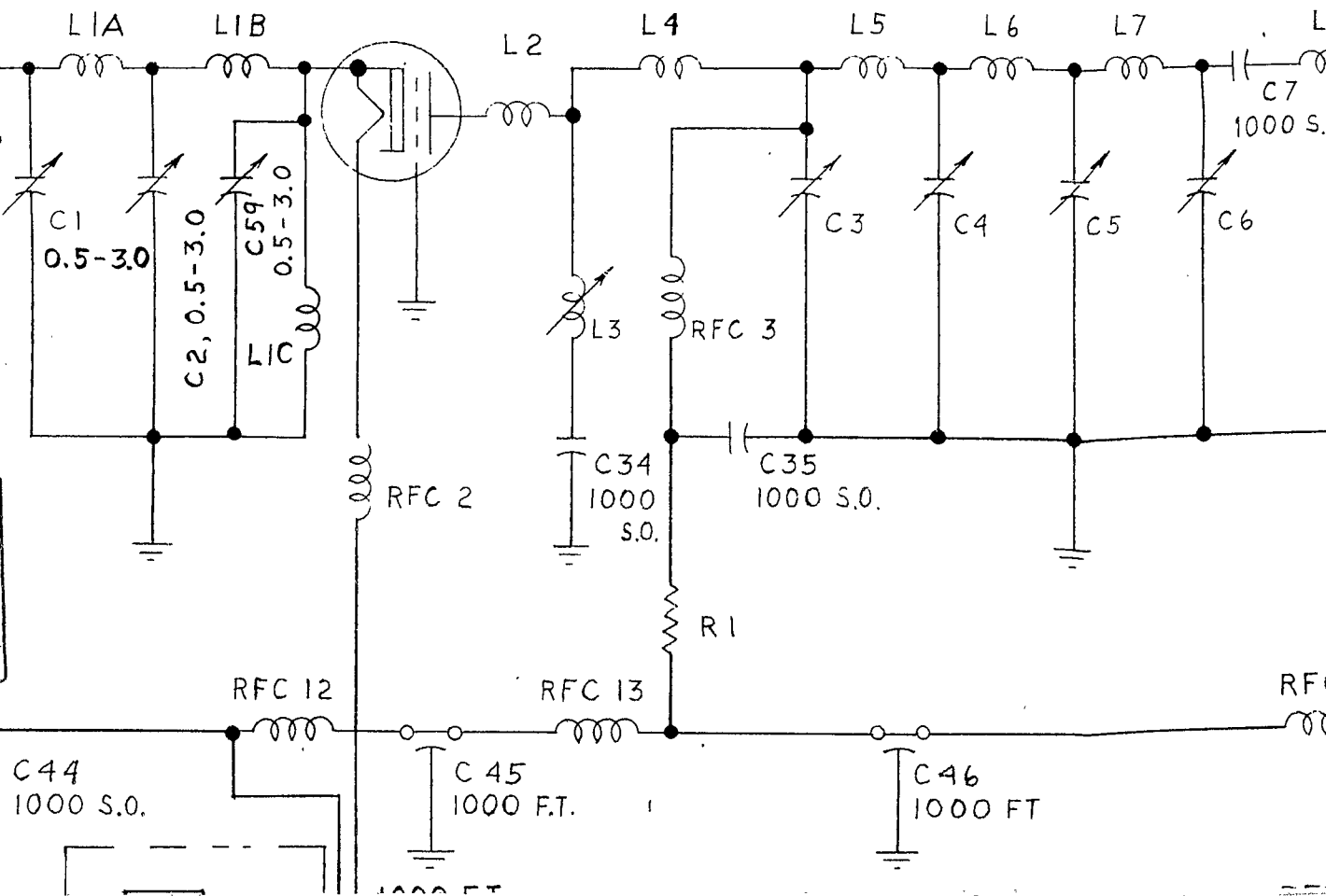
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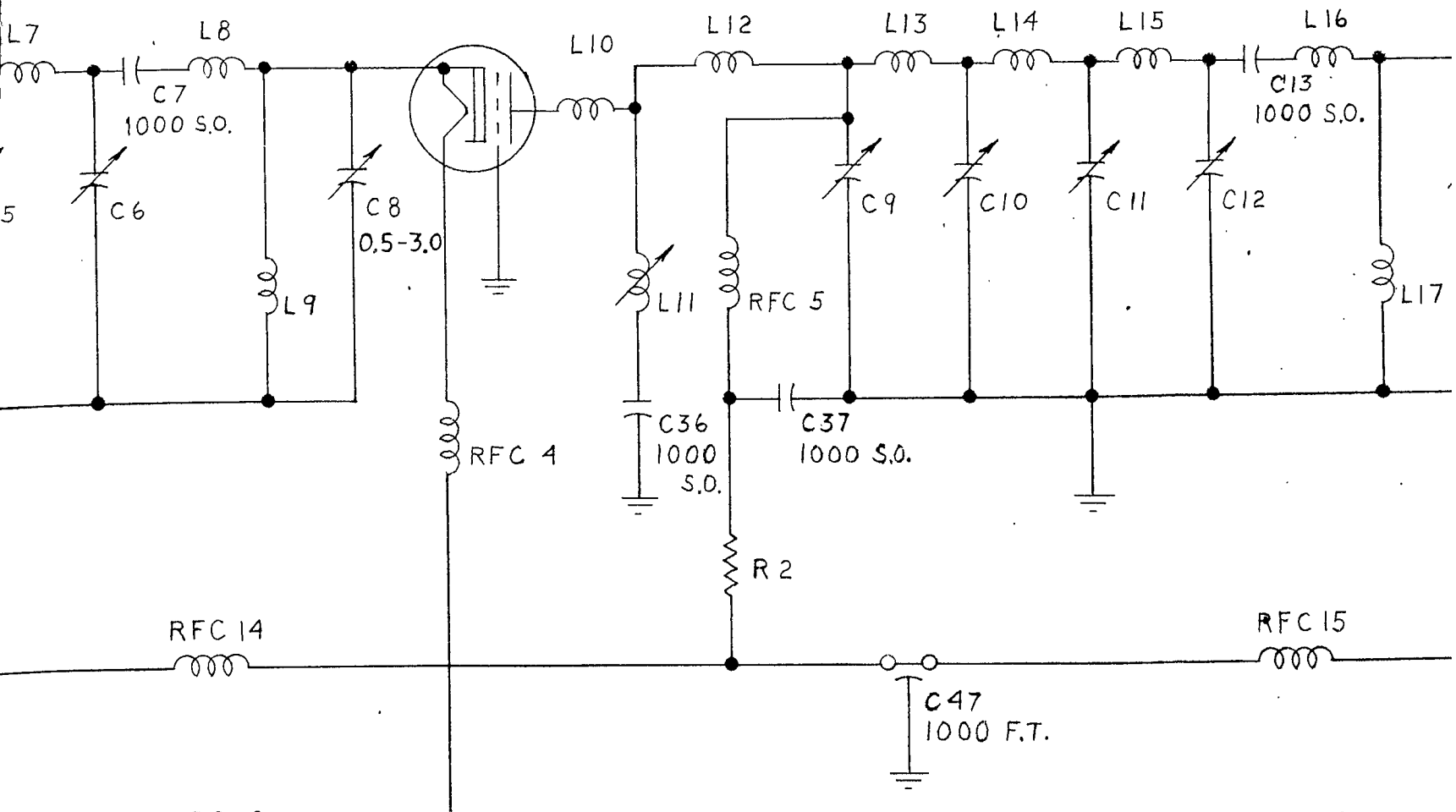
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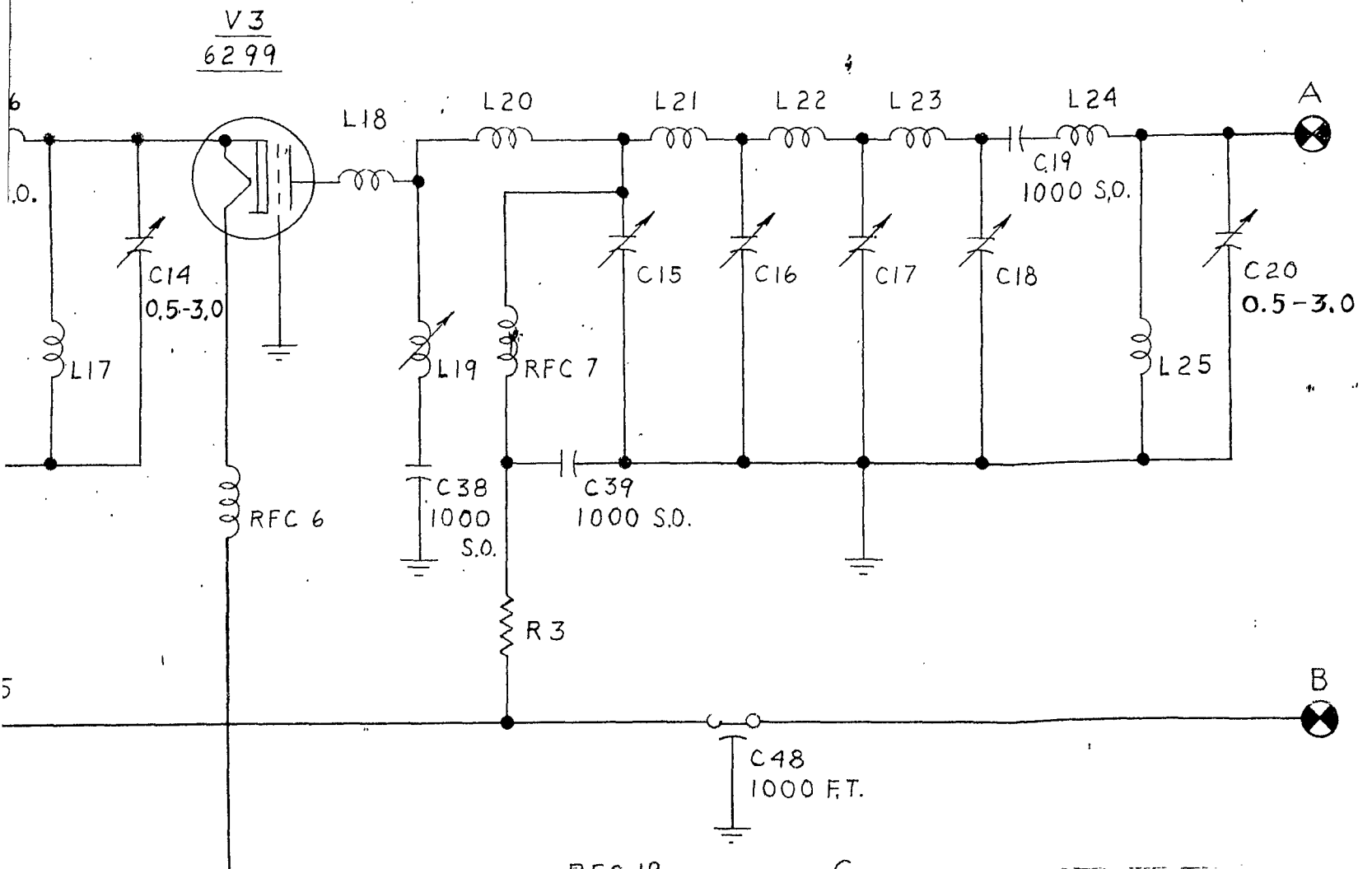


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V2
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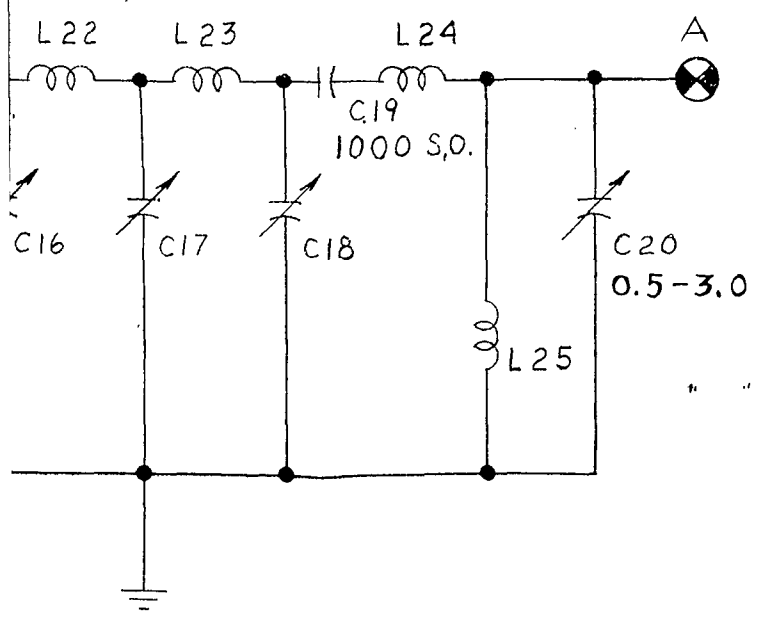


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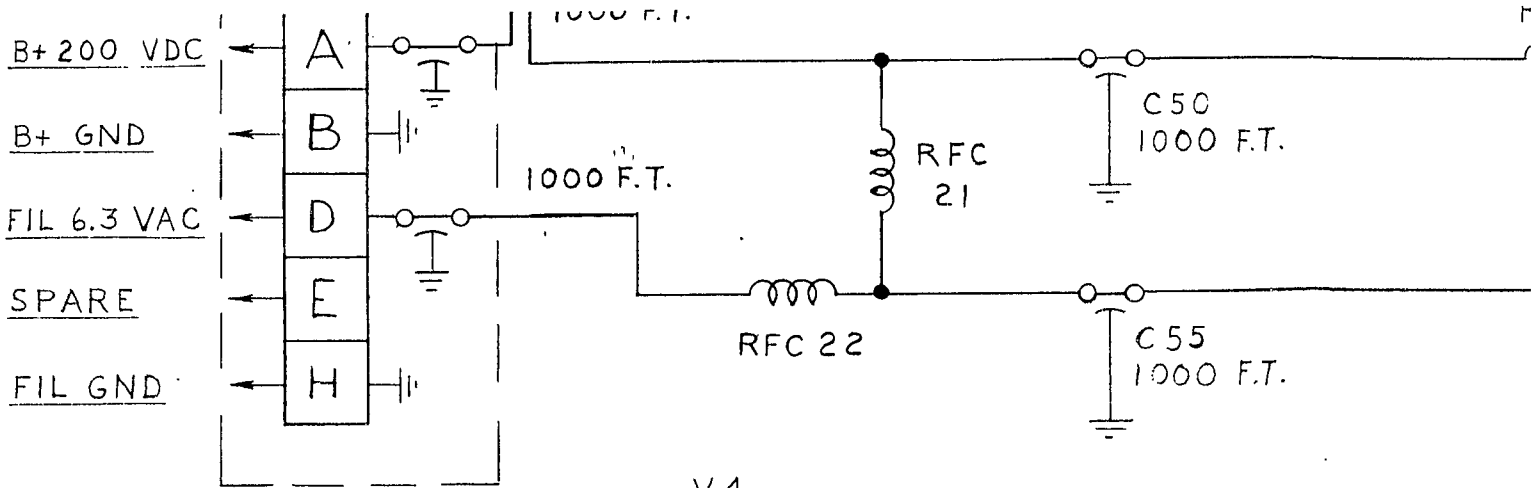
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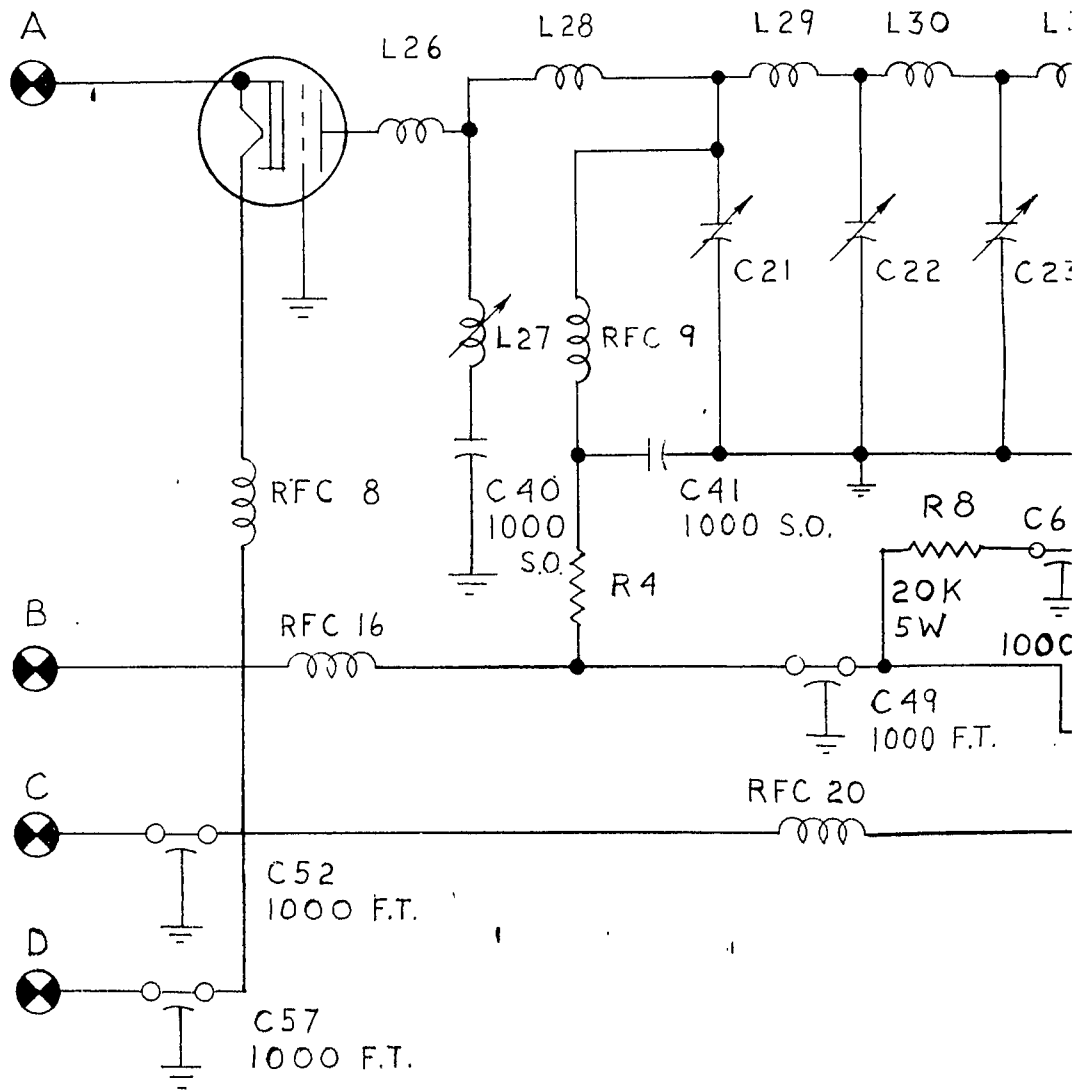


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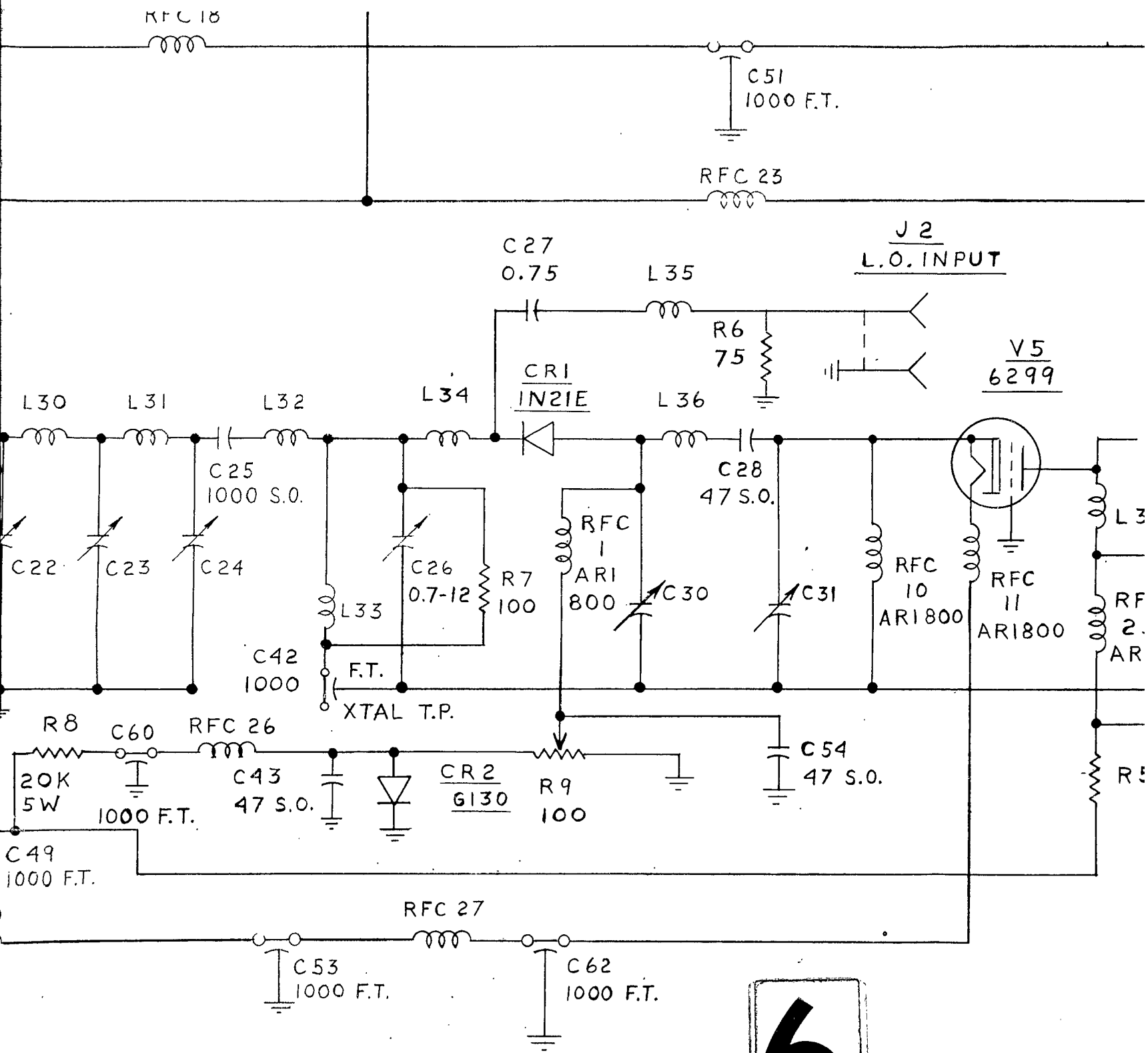


J4
B800170
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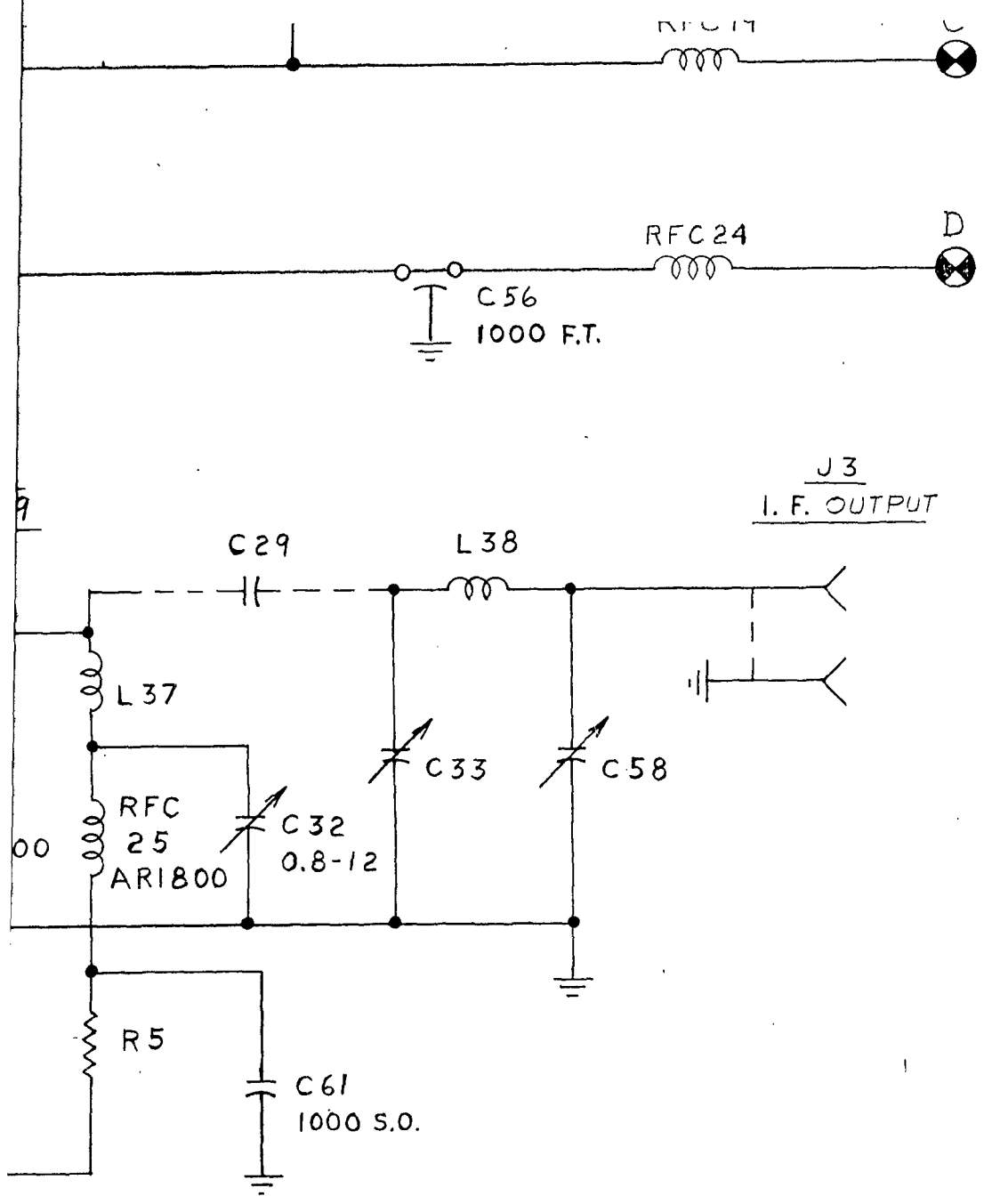
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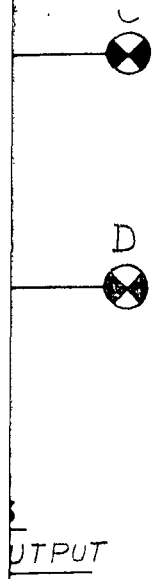


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NOTES -

- 1- R1 THRU R5 SELECTED FOR
10 MA TUBE CURRENT
- 2- UNLESS OTHERWISE NOTED - ALL RES. ARE 1/2 W,
ALL RFC ARE A.R.I. 500,
ALL CAP. VAR. 0.7-8.5,
ALL CAP. ARE IN μmf
- 3- REF. DESIG. ARE ABBREVIATED -
PREFIX THE DESIG. WITH UNIT NO.
OR ASSEMBLY DESIG. OR BOTH

LAST COMP. REF. DESIG.					
V	J	L	C	R	RFC
5	4	38	62	9	27

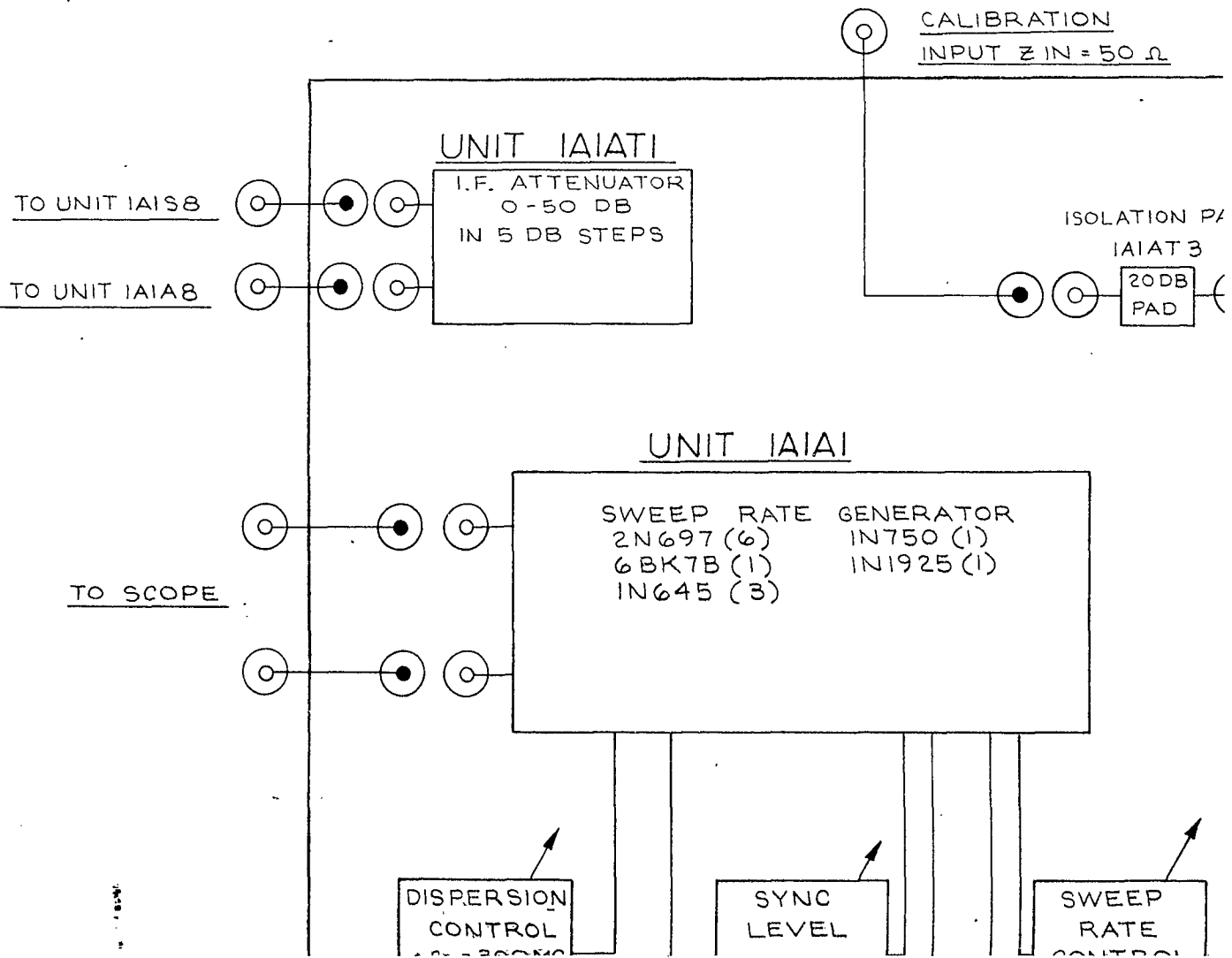
8

ISSUE A
600747

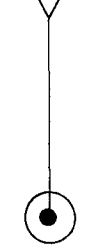
ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES: FRACTIONS $\pm 1/64$ ANGLES $\pm 1/2^\circ$ DECIMALS .XX $\pm .010$.XXX $\pm .005$	DRAWN 3-28-62	<u>SCHEMATIC</u> HFW-C(A)4070-775/15 <hr/> <u>CONVERTER</u> <hr/> <u>UNIT-1A5A2</u>	APPLIED RESEARCH INC. PORT WASHINGTON NEW YORK		
	DRAWN BY AW		DWG. SIZE D	600747	
	CHECKED			ISSUE- A	
	APPROVED			SCALE	UNIT WT.
MATERIAL:	APPROVED				
FINISH:					

Fig. 11

1



100-1000 MC
ANTENNA



RF INPUT
Z IN = 50 Ω

TO UNITS	FROM UNITS
1A2	1A2
1A3	1A3
1A4	1A4
1A5	1A5

ATTENUATION PAD
IAIAT3
20 DB
PAD

ANTENNA
ATTENUATOR
0 - 59 DB
IN 1 DB STEPS
TELEONIC

UNIT IAIAT2

UNIT IAISI
SELECTIVITY
SWITCH
1-5 MC



UNIT IAIA2

I.F. AMPLIFIER
f₀ = 775 MC
BW = 6.1 MC
GAIN = 31 DB
GL6299 (2)

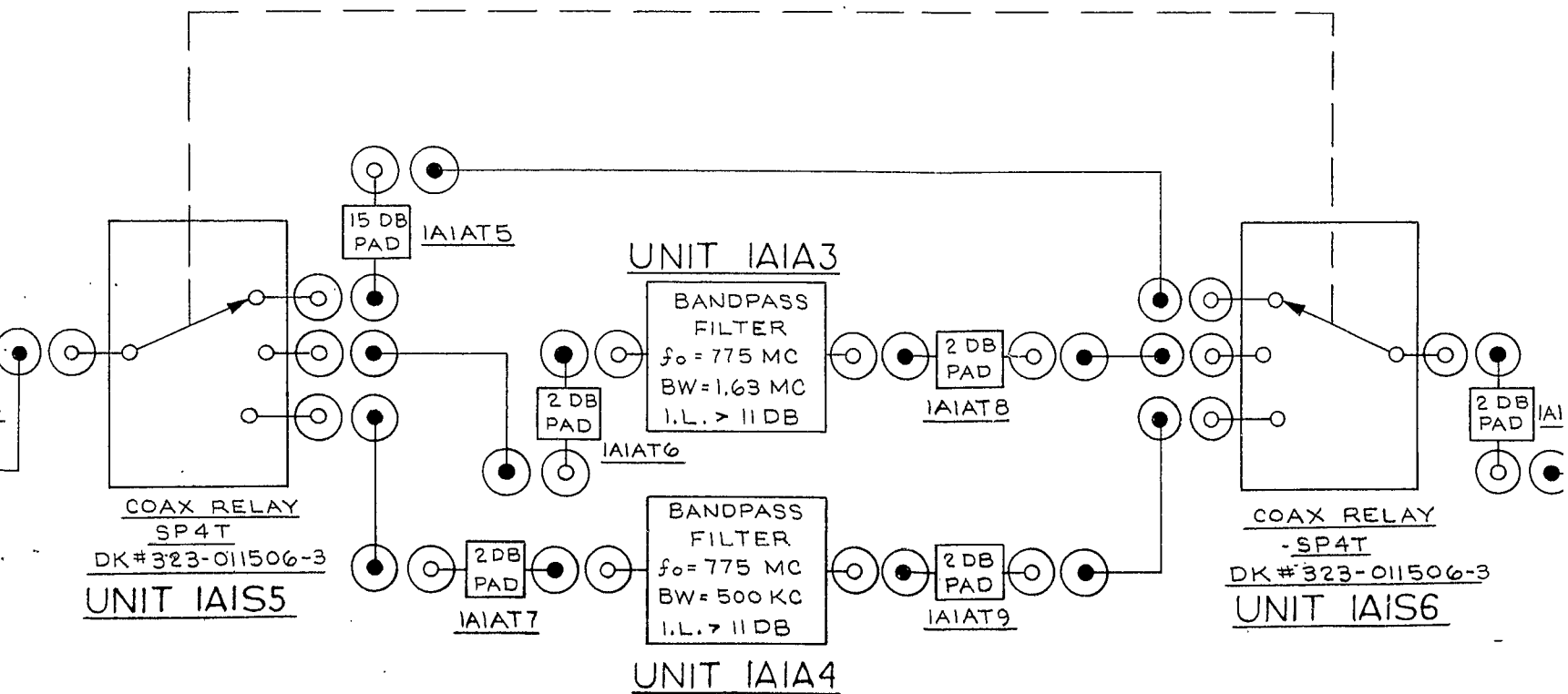
2 DB
PAD
IAIAT4

COAX RE
SP4T
DK#323-011
UNIT IAIS

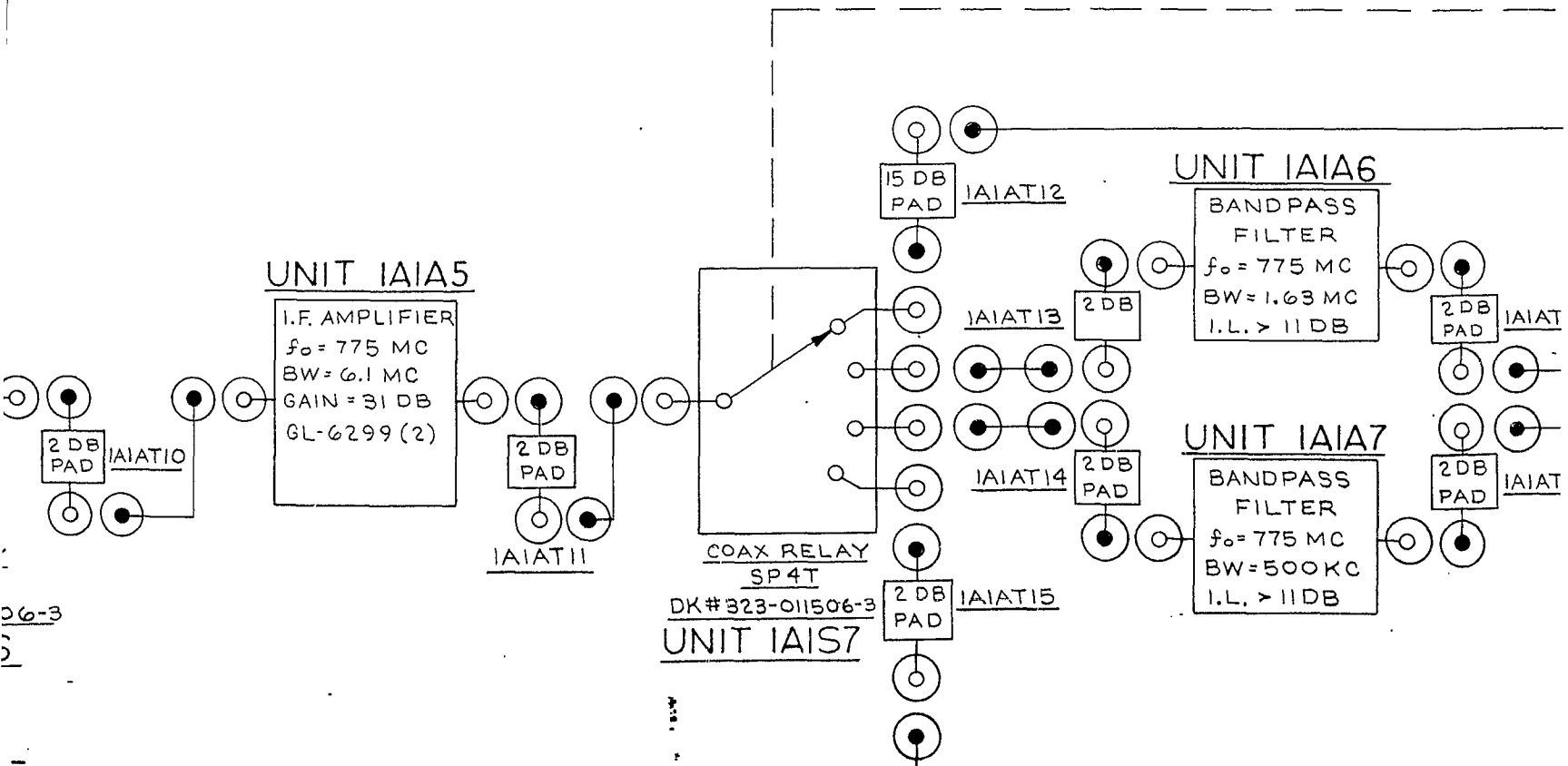
IP
E
20

3

UNIT IA1



4

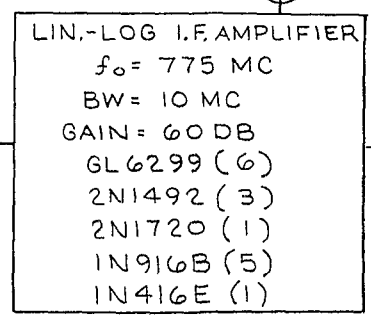
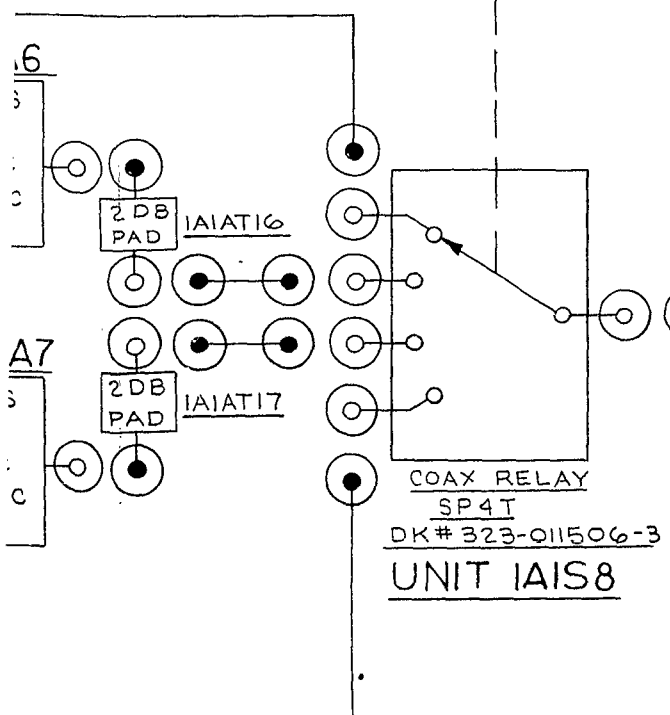


06-3
2

(UNIT 1A1A1)
TO IF ATTENUATOR

(UNIT 1A1S2)
TO LIN-LOG SWITCH

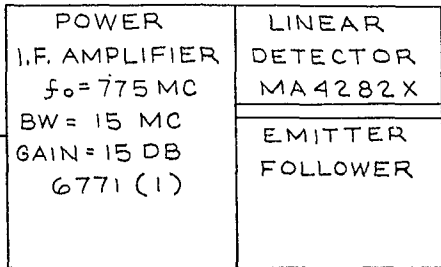
5



UNIT 1A1A8

6

UNIT 1A1A9

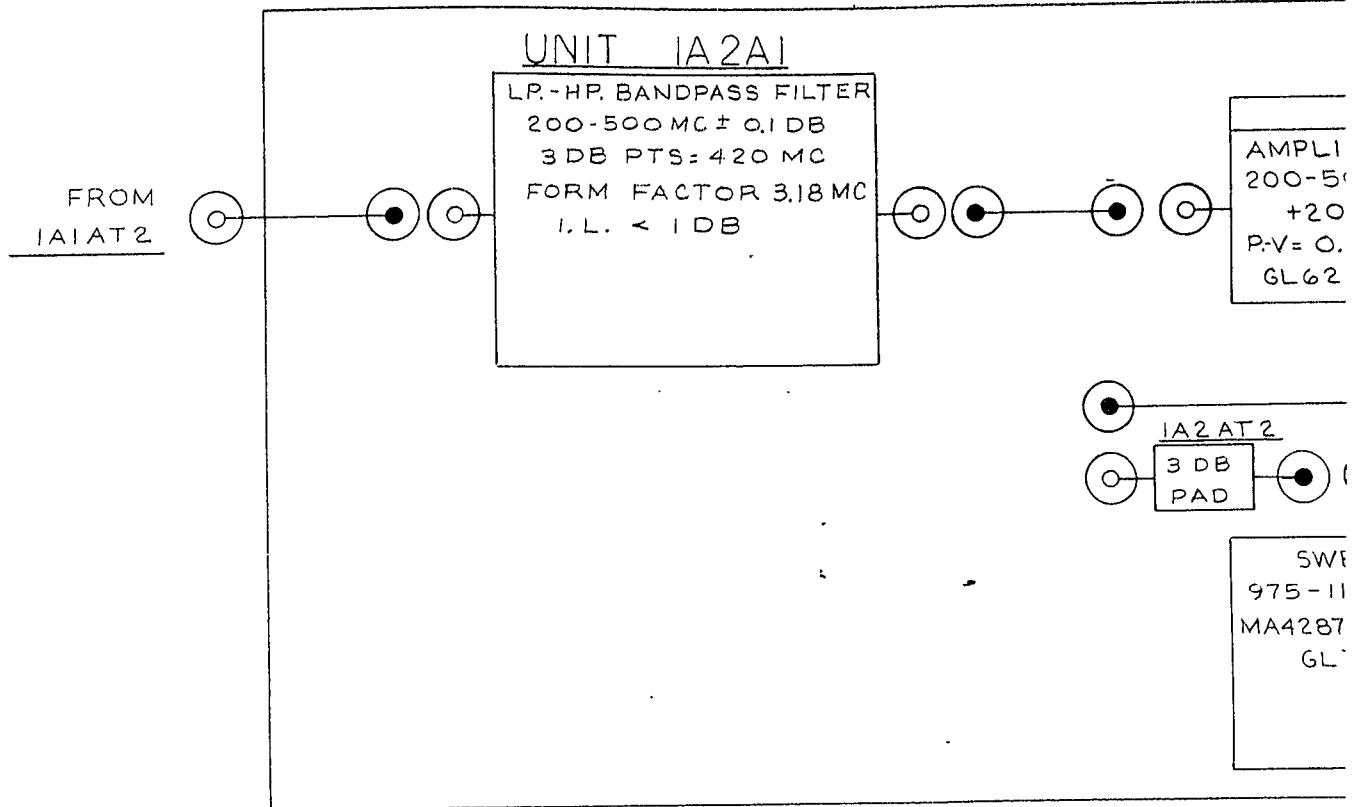


DB
AD
AT18

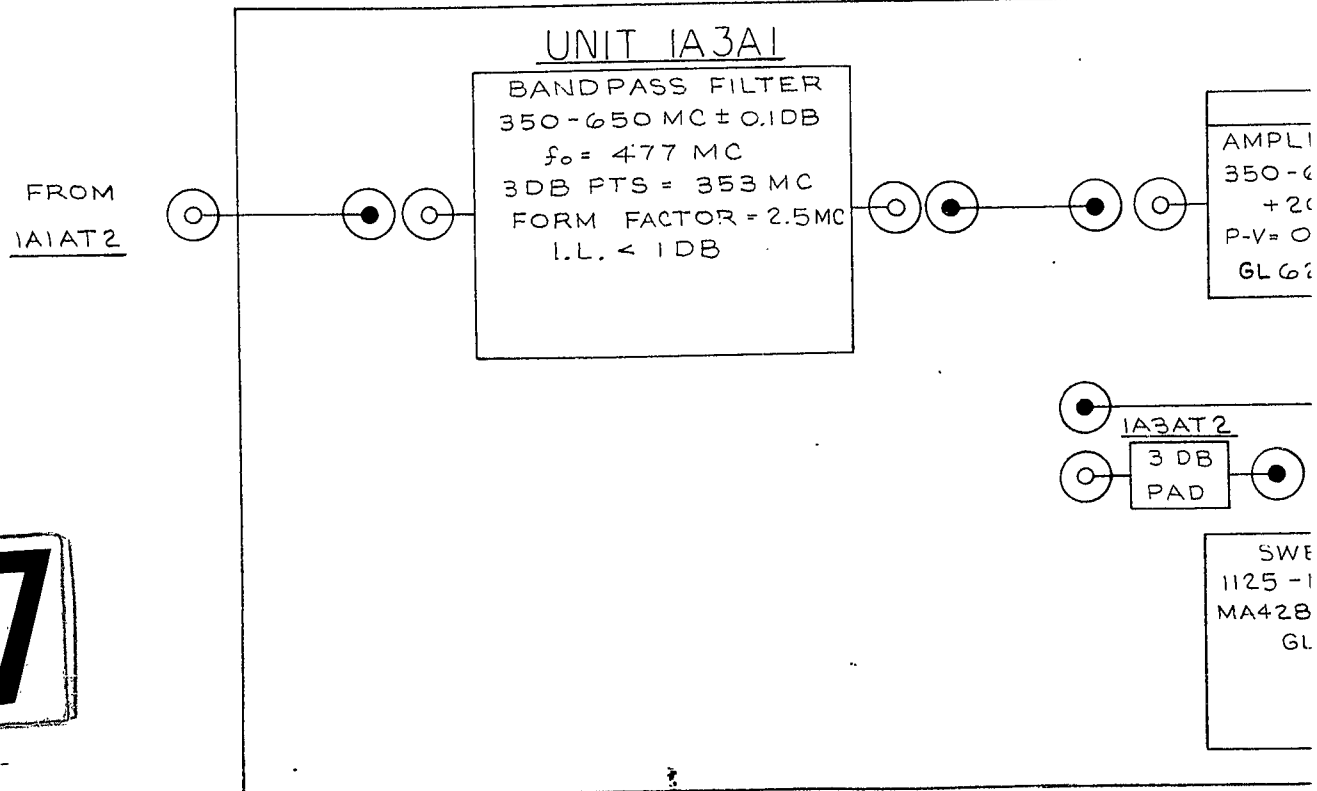
VIDEO OUTPUT
TO SCOPES
 $Z = 1000 \Omega$

1000

UNIT IA2



UNIT IA3



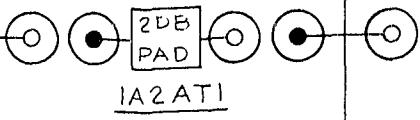
7

1A2

UNIT 1A2A2

CONVERTER

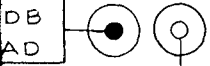
AMPLIFIER 200-500 MC +20 DB P-V= 0.4 DB GL 6299 (3)	MIXER 1N416E -6 DB	I.F. AMPLIFIER $f_0 = 775$ MC BW= 15 MC +11 DB GL 6299 (1)
---	--------------------------	--



TO 1A1A2



2 AT 2



SWEEP L.O. 975-1175 MC MA4287X VARACTOR GL 7644 (1)
--

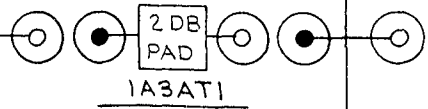
UNIT 1A2A3

1A3

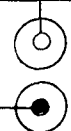
UNIT 1A3A2

CONVERTER

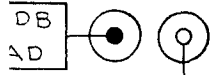
AMPLIFIER 350-650 MC +20 DB P-V= 0.4 DB GL 6299 (3)	MIXER 1N416E -6 DB	I.F. AMPLIFIER $f_0 = 775$ MC BW= 15 MC +11 DB GL 6299 (1)
---	--------------------------	--



TO 1A1A2



AT 2



SWEEP L.O. 1125-1425 MC MA4285X VARACTOR GL 7644 (1)

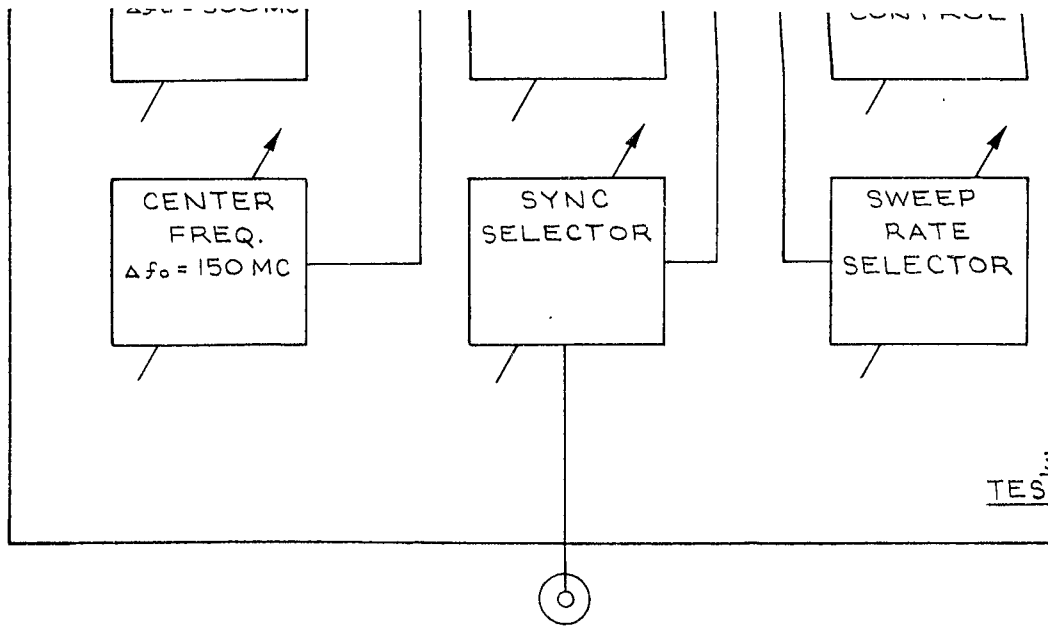
UNIT 1A3A3



REVISIONS

ISSUE	DESCRIPTION	DATE	BY

9



10

2- 1.5 MC
3- 400 KC
4- 25 KC
5- 5 KC

UNIT IAIS2

LIN. - LOG.
SELECTOR
SWITCH

UNIT IAICBI

MAW
CIRCUIT
BREAKER

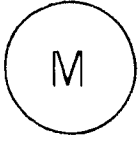
UNIT IAIS3

PLATE
SWITCH

UNIT IAIMI

UNIT IAIS4

METER
CIRCUIT
SWITCH



3" DIA
TEST METER

11

UNIT IA6

UNIT IA6PS1

DC POWER
SUPPLY
REGULATED
+6.3V @ 10 A

(TO UNITS IA1
THRU IA5)

UNIT IA6PS2

DC POWER
SUPPLY
REGULATED
+30V @ 325 MA

(TO UNIT IA1)

UNIT IA6PS3

DC POWER
SUPPLY
REGULATED
-20 V @ 425 MA

(TO UNIT IA1)

UNIT IA6PS4

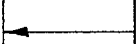
DC POWER
SUPPLY
REGULATED
+200V @ 90 MA IN
+180V @ 75 MA OUT

(TO UNITS IA1
& IA4)

UNIT IA6PS5

DC POWER
SUPPLY
REGULATED
+200V @ 90 MA IN
+180V @ 75 MA OUT

(TO UNITS IA1
& IA4)



IF OUTPUT
TO 30 MC
CONVERTER

IF INPUT
FROM 30 MC
CONVERTER

UNIT IA6PS5

DC POWER
SUPPLY
REGULATED
+200V@450MA

(TO UNITS IA1
THRU IA5)

UNIT IA6PS6

DC POWER
SUPPLY
REGULATED
+30V@325MA

(TO UNIT IA1)

13

RC

14

FROM
IAIAT2

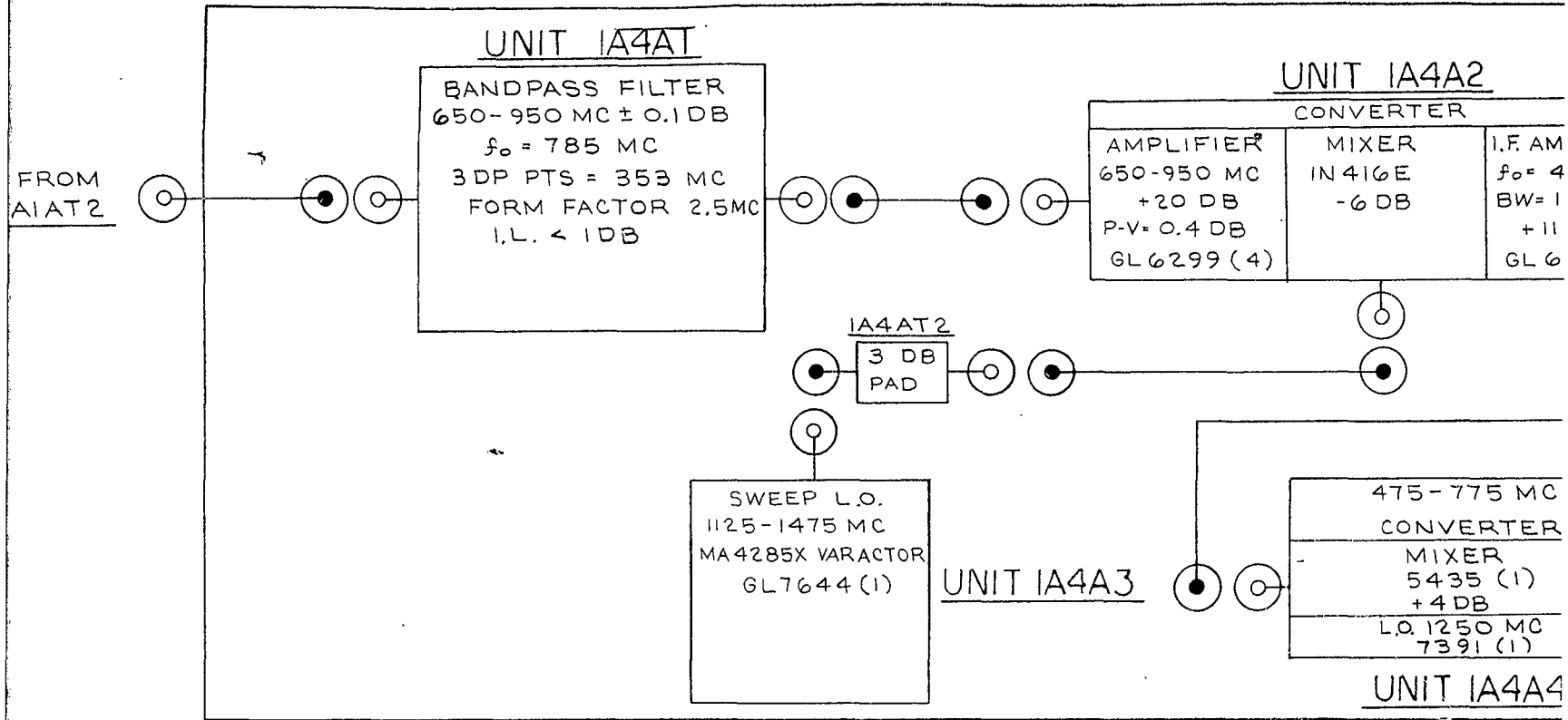


FROM
IAIAT2

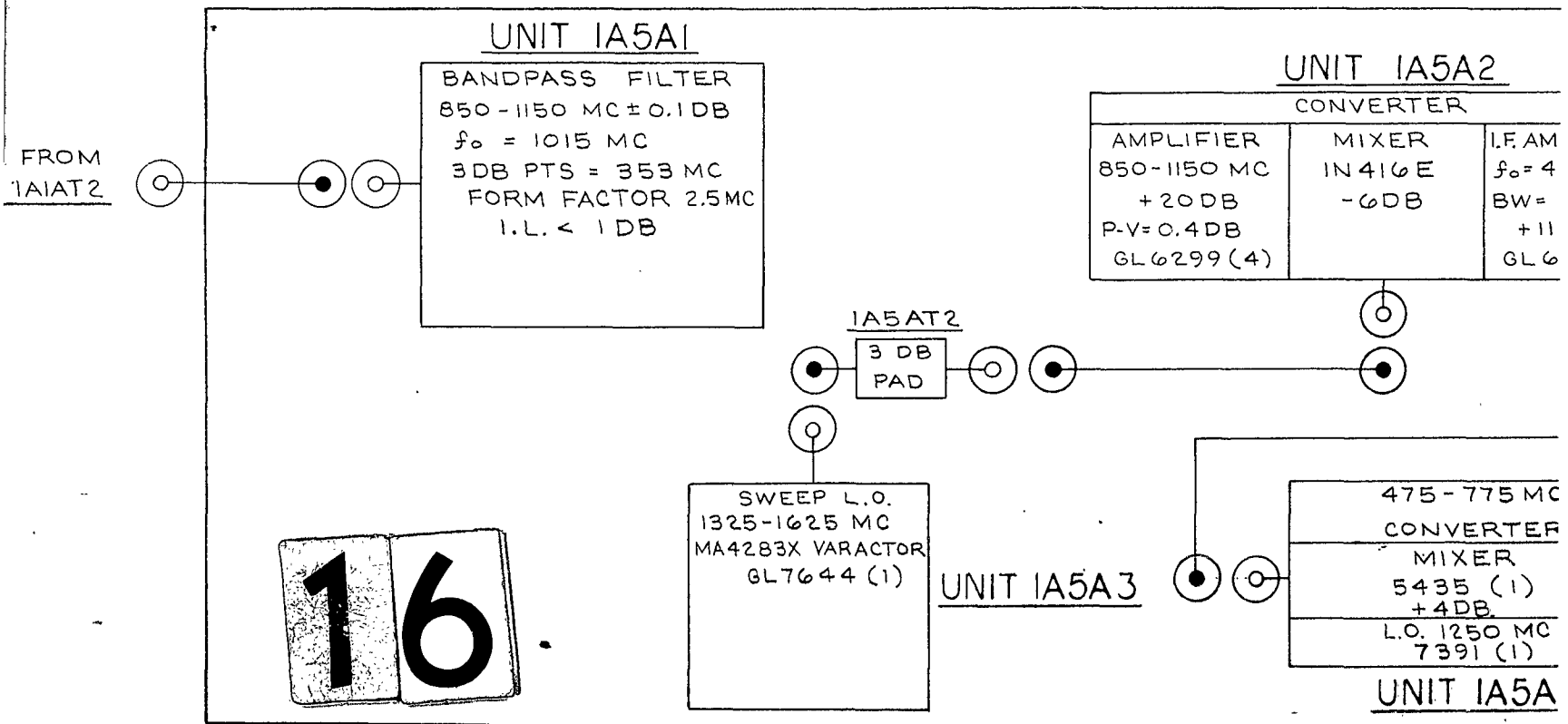


15

UNIT IA4

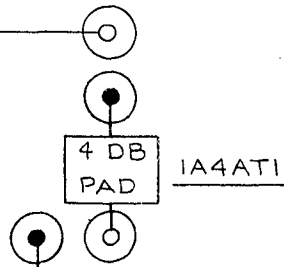


UNIT IA5



1A4A2

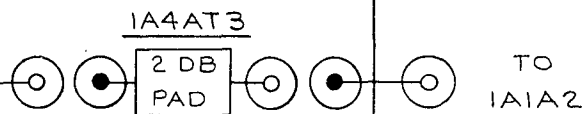
FILTER	
IF AMPLIFIER	
$f_0 = 475 \text{ MC}$	
$\text{BW} = 15 \text{ MC}$	
+11 DB	
GL 6299 (1)	



75-775 MC

CONVERTER

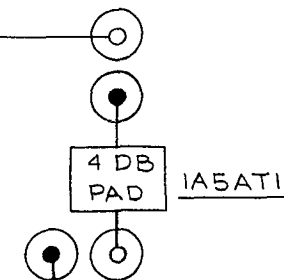
MIXER	
5435 (1)	
+4 DB	
L.O. 1250 MC	
7391 (1)	



UNIT 1A4A4

1A5A2

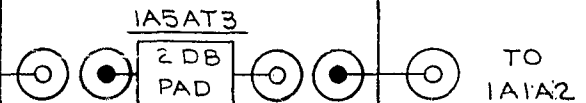
FILTER	
IF AMPLIFIER	
$f_0 = 475 \text{ MC}$	
$\text{BW} = 15 \text{ MC}$	
+11 DB	
GL 6299 (1)	



475-775 MC

CONVERTER

MIXER	
5435 (1)	
+4 DB	
L.O. 1250 MC	
7391 (1)	



UNIT 1A5A4

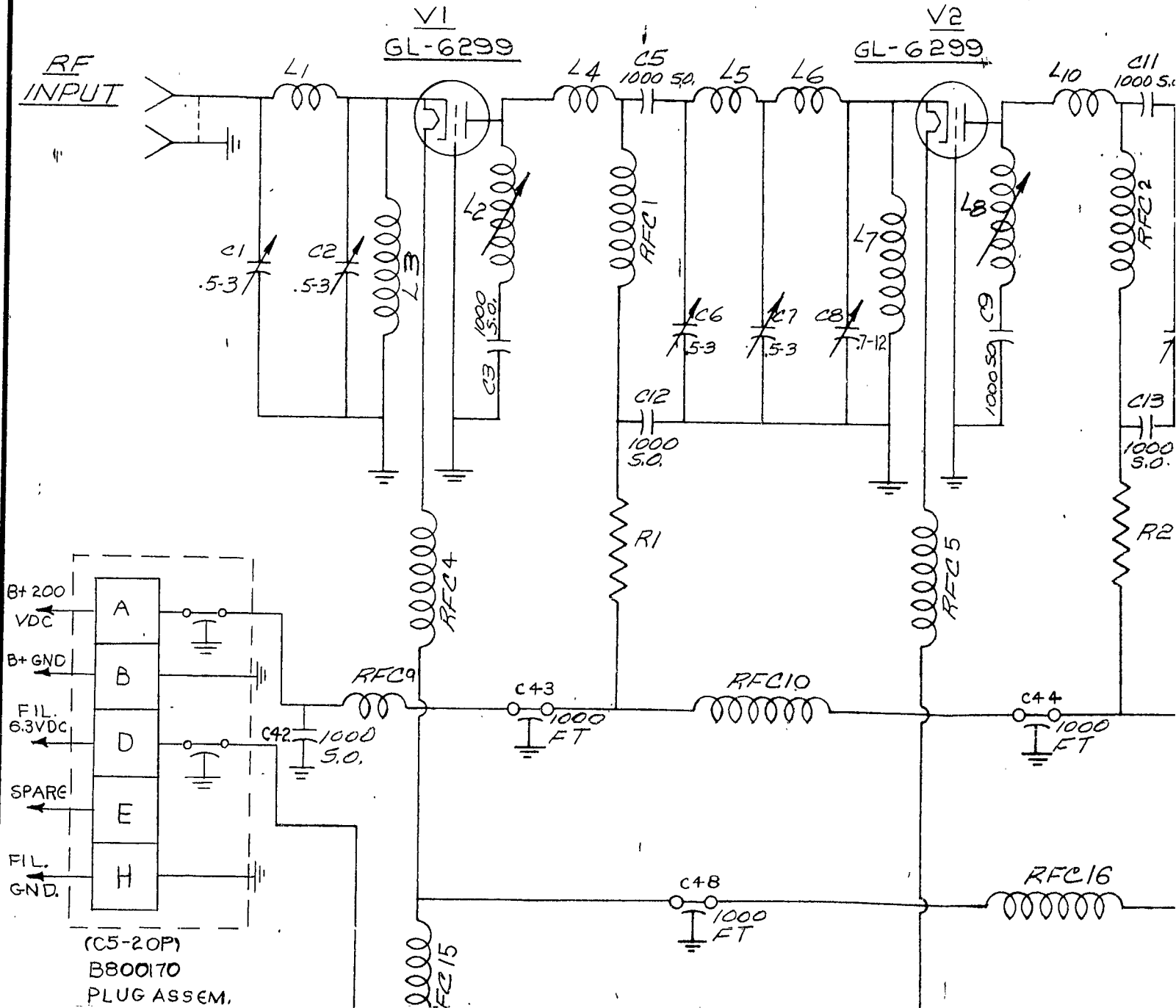
17

431-02	JOB NO.	NEXT ASSEMBLY	ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:		DRAWN
			FRACTIONS $\pm 1/64$	ANGLES $\pm 1/2^\circ$	3-22-62
			DECIMALS .XX $\pm .010$.XXX $\pm .005$	DRAWN BY
			MATERIAL:		<i>A. Kennard</i>
			FINISH:		CHECKED
					APPROVED
			APPLICATION		APPROVED
					SCALE

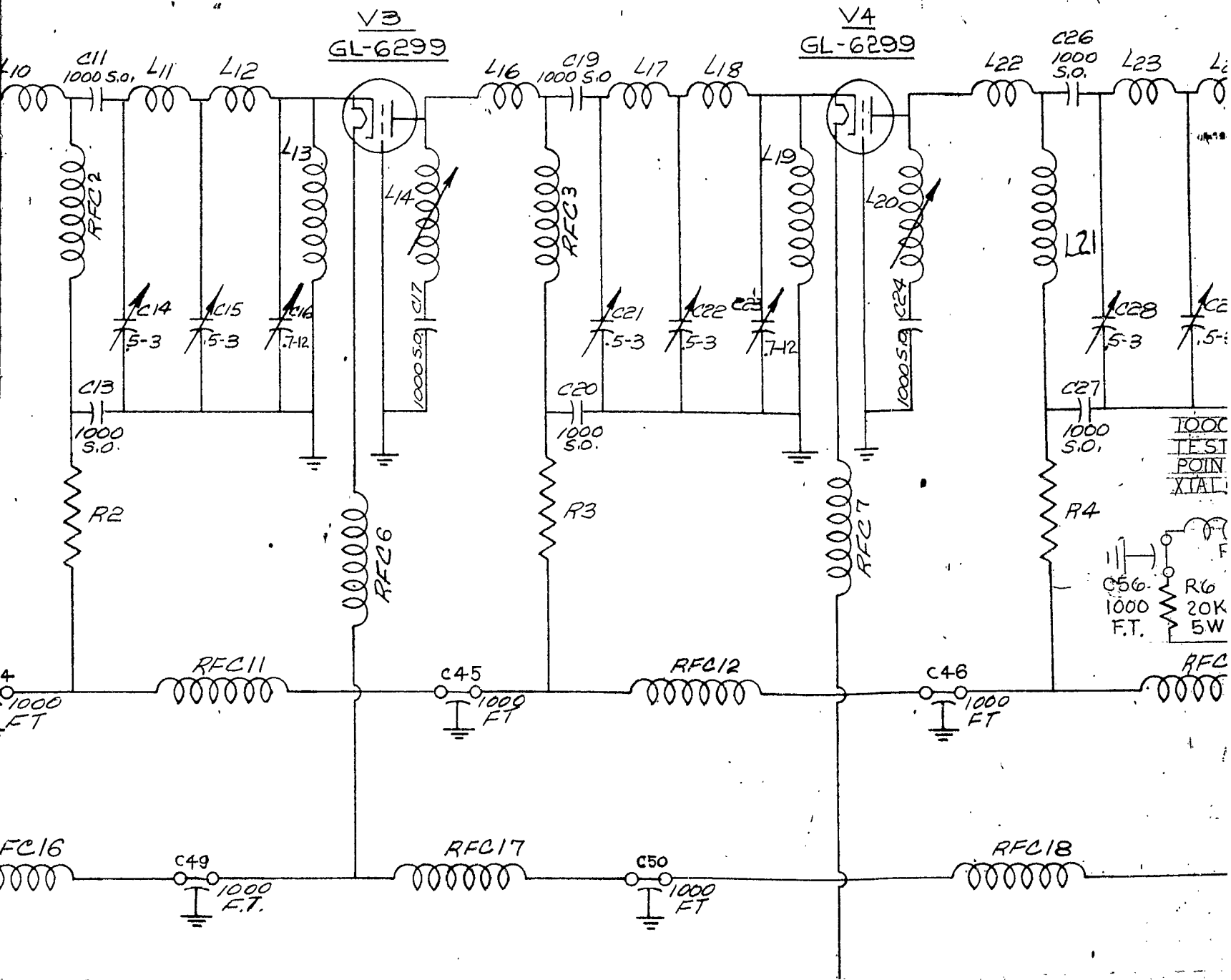
18

431-02	APPLICATION	ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES: FRACTIONS $\pm 1/64$ ANGLES $\pm 1/2^\circ$ DECIMALS .XX $\pm .010$.XXX $\pm .005$	DRAWN 3-22-62	BLOCK DIAGRAM RF SIGNAL SURVEILLANCE SYS.	APPLIED RESEARCH INC. PORT WASHINGTON NEW YORK		
		MATERIAL: ~	DRAWN BY <i>R. Kennard</i>		DWG. # R	700458	
JOB NO.	NEXT ASSEMBLY	FINISH: ~	CHECKED		SCALE ~	UNIT WT. ~	ISSUE A
APPLICATION			APPROVED				

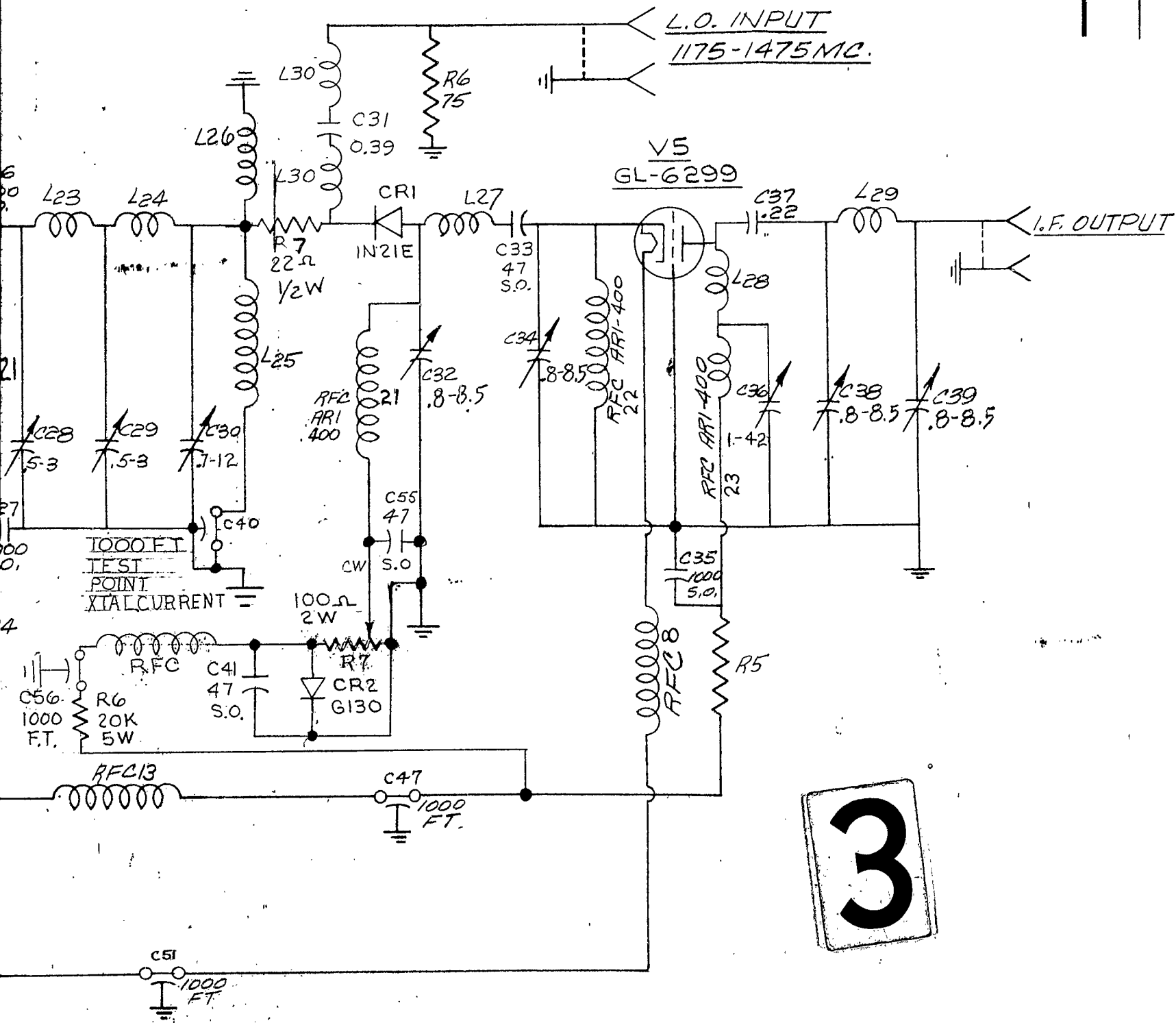
1



2



ISSUE	
B	R.



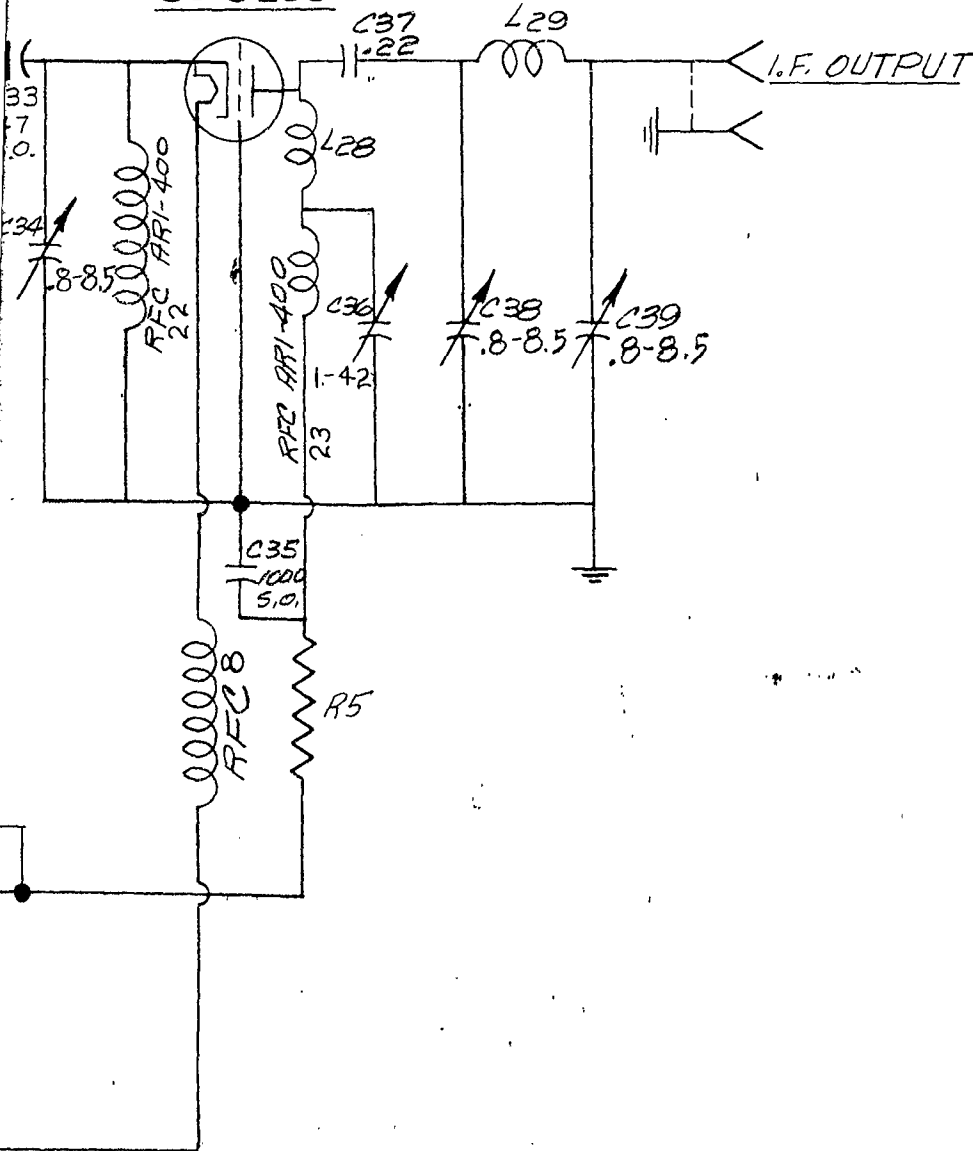
3

REVISIONS

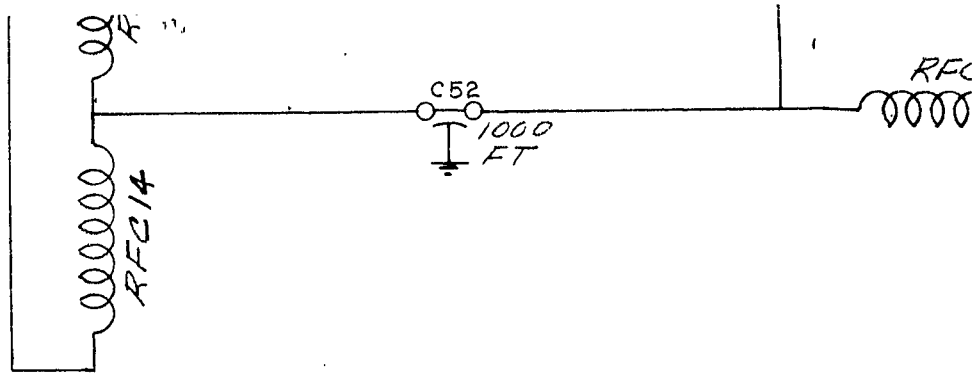
ISSUE	DESCRIPTION	DATE	BY
B	REVISED	4-7-62	ack

L.O. INPUT
1175-1475 MC.

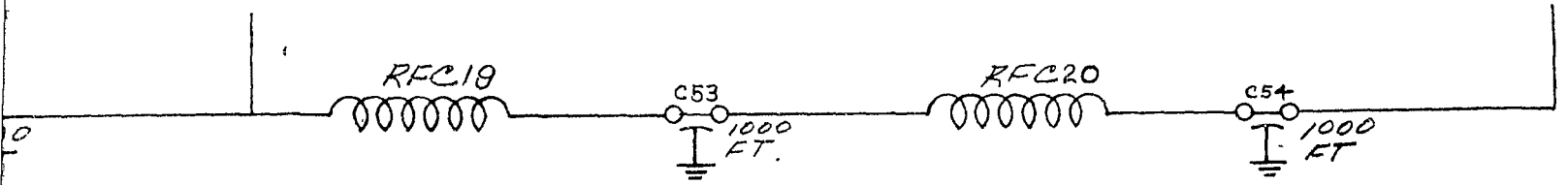
V5
GL-6299



4



5



HIGHEST COMPONENT DESIGNATION				
C56	L30	R7	RFC 23	V 5 D2

6

000
T

NOTE

1. ALL CAPACITORS

2. ALL RESISTORS

3. R1 THRU R5, SE

10 MA TUBE CL

4. RF = 700 - 1000 MCS

IF = 475 MCS

5. RFC1-20 = ARI 80

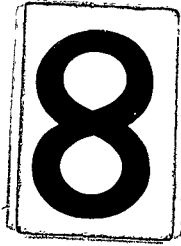
INATION
Y 5 D2

7

		ALL DIMENSIONS IN INCH OTHERWISE SPECIFIED TO FRACTIONS $\pm 1/64$ ANG DECIMALS .XX $\pm .010$
		MATERIAL:
		FINISH:
491-01		
JOB NO.	NEXT ASSEMBLY	
APPLICATION		

ISSUE B
D 600734

ALL CAPACITORS IN μ M F
ALL RESISTORS 1 WATT UNLESS OTHERWISE SPECIFIED
R1 THRU R5, SELECTED FOR
10 MA TUBE CURRENT
00-1000 MCS
F = 475 MCS
FC1-20 = ARI 800



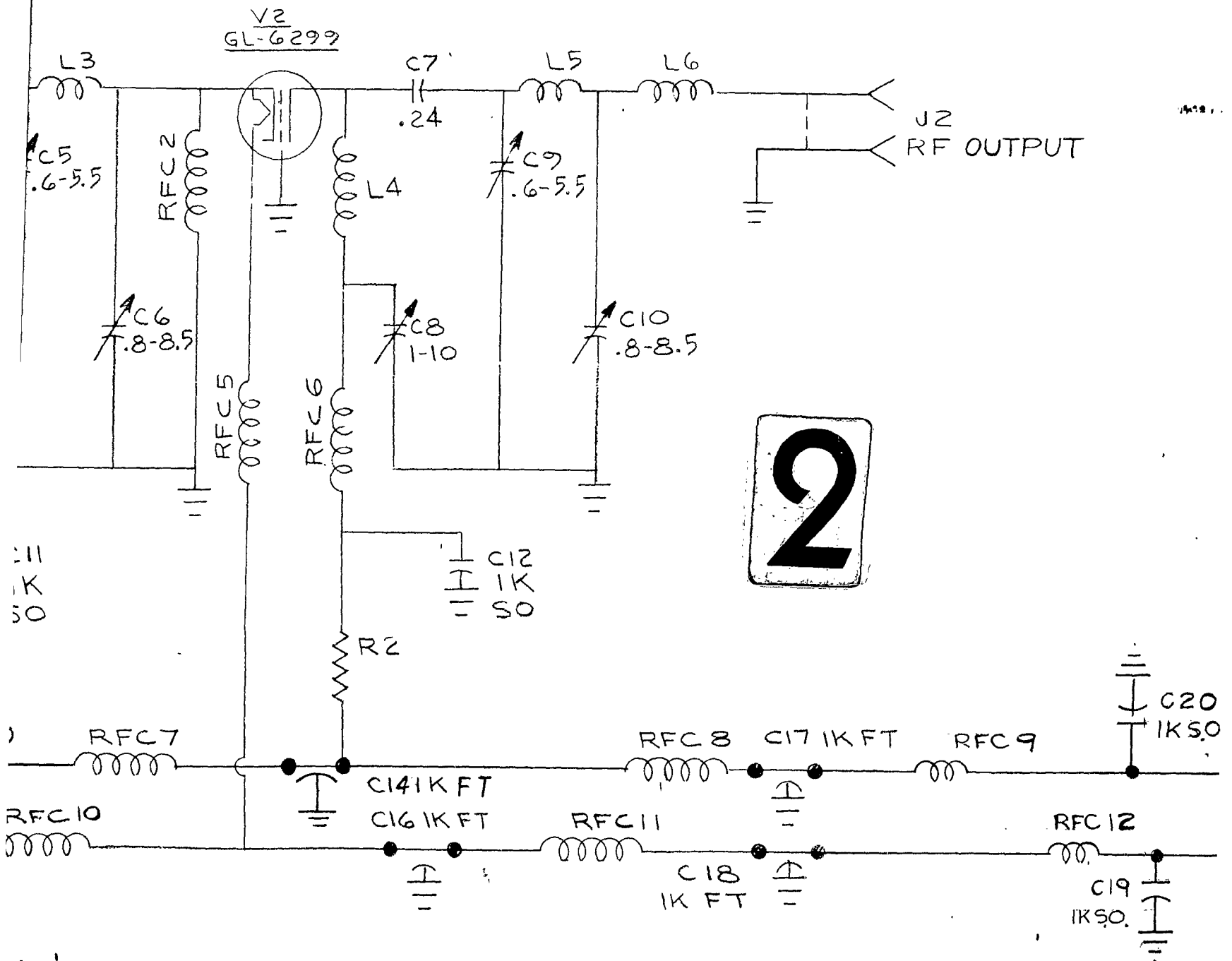
ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES: FRACTIONS $\pm 1/64$ ANGLES $\pm 1/2^\circ$ DECIMALS .XX $\pm .010$.XXX $\pm .005$	DRAWN 3-19-62	SCHEMATIC <u>UH-CAA70100-475/15</u> CONVERTER UNIT 1A6A2	APPLIED RESEARCH INC. PORT WASHINGTON NEW YORK		
	DRAWN BY PJS		DWG. SIZE D	600734	
	CHECKED		APPROVED	ISSUE B	
	APPROVED		APPROVED	SCALE _____	UNIT WT. _____

UNIT 5150

FIG. 12

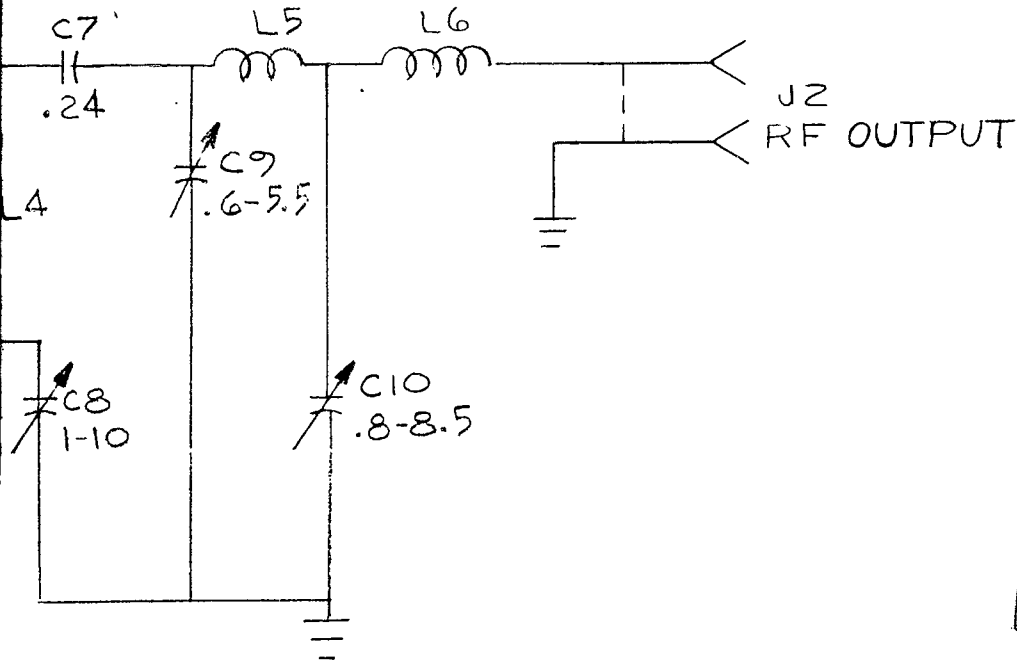
REVISION

ISSUE	DESCRIPTION
B	ELEC. REVISED
C	REVISED

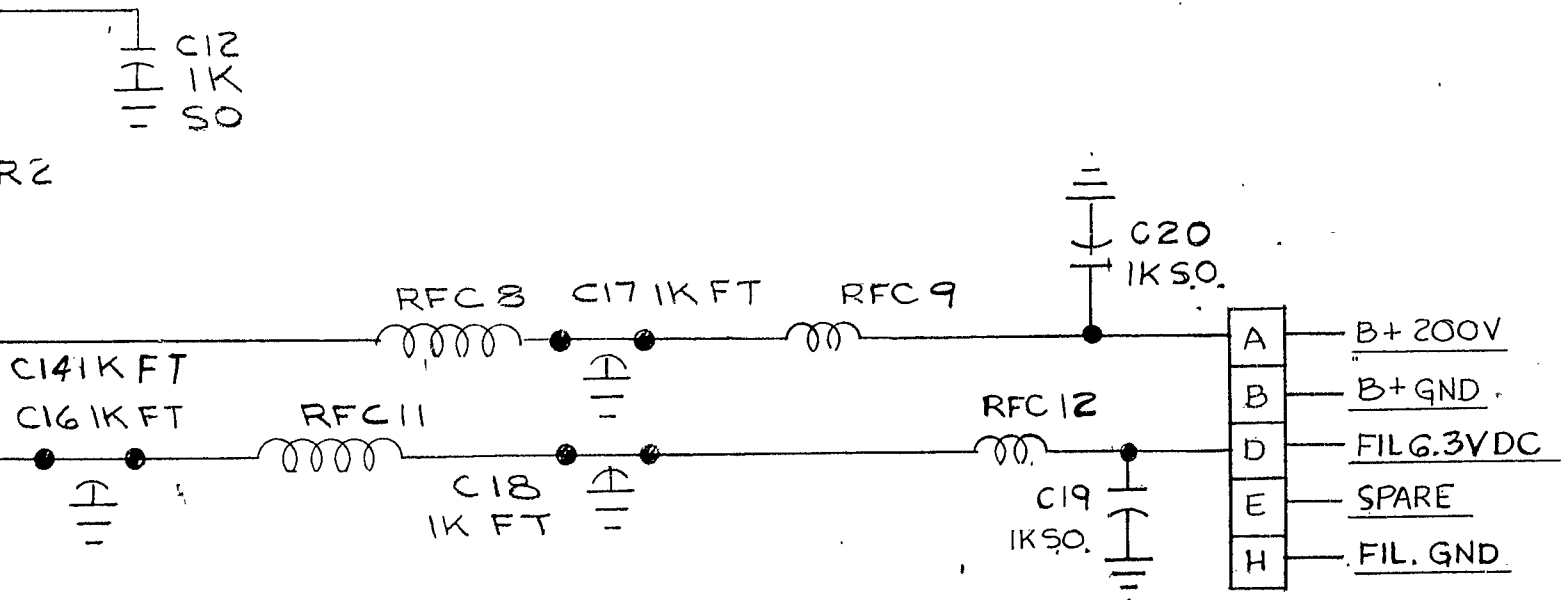


REVISIONS

ISSUE	DESCRIPTION	DATE	BY
B	ELEC. REVISED	5-22-62	M.M.
C	REVISED	6-15-62	JSF

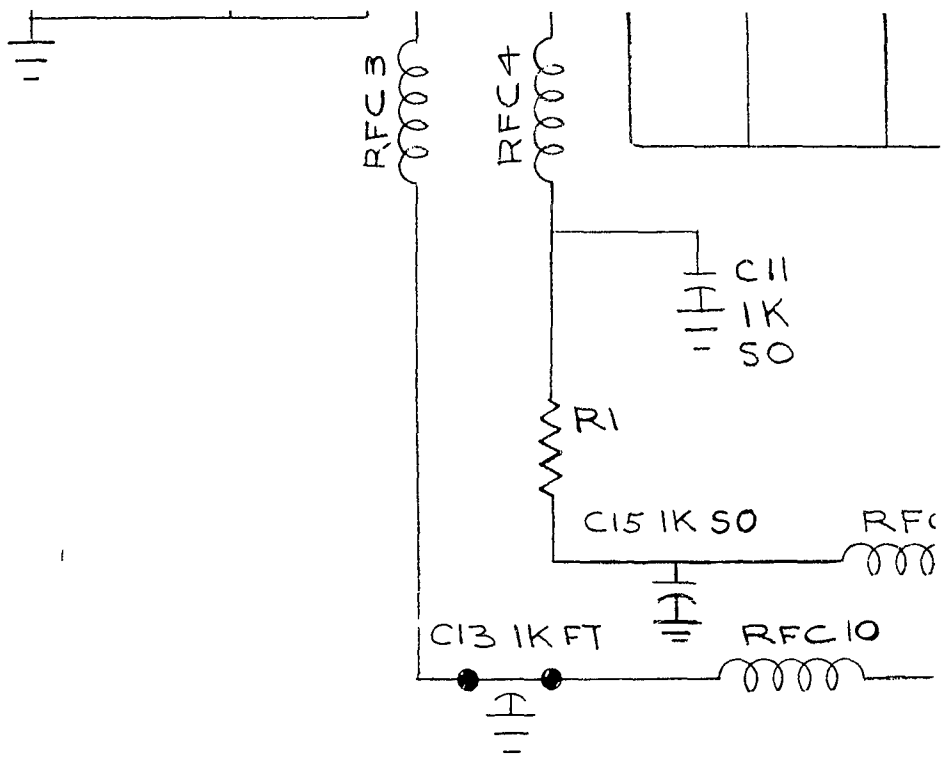


3

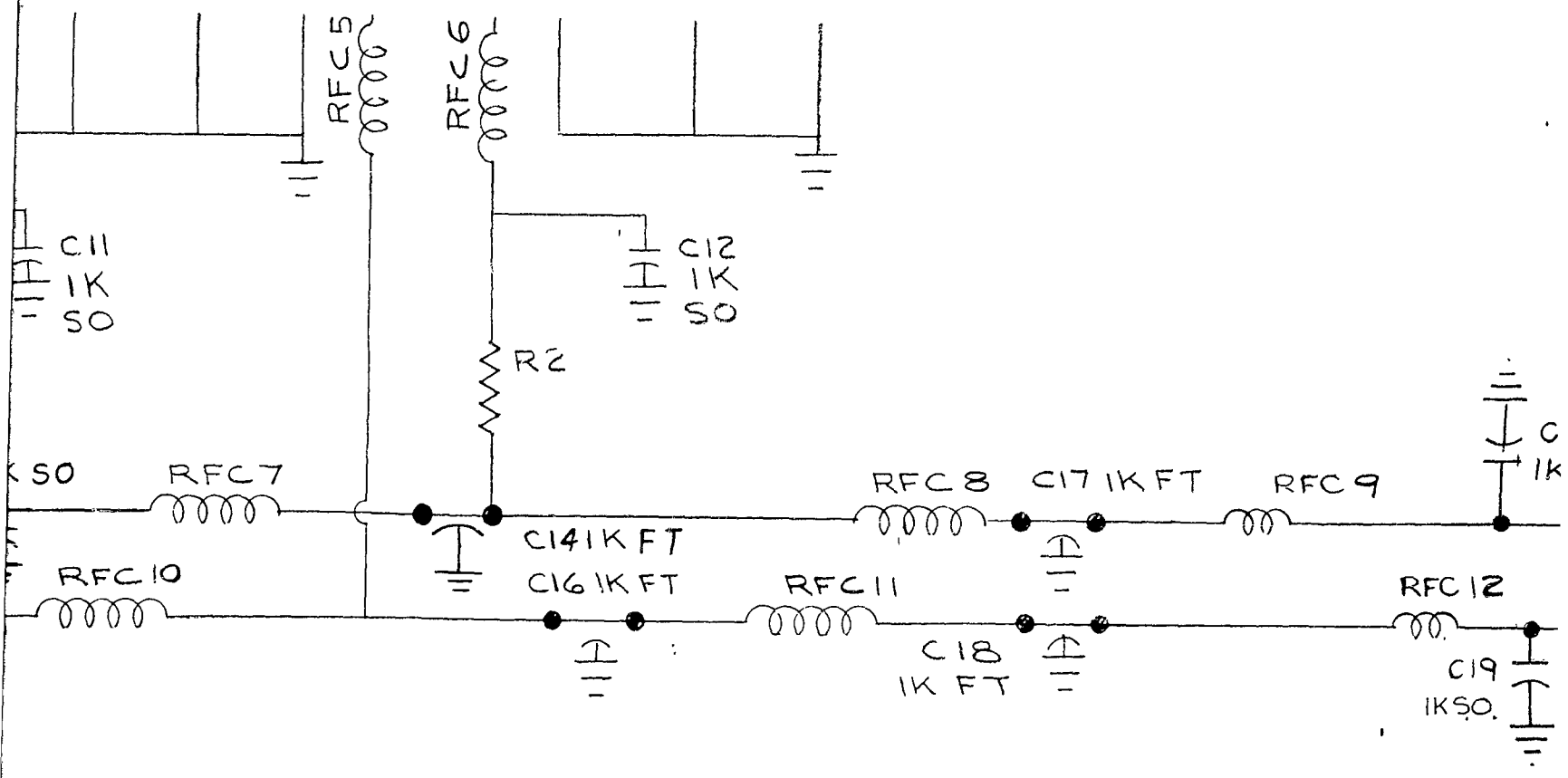


ISSUE

600750



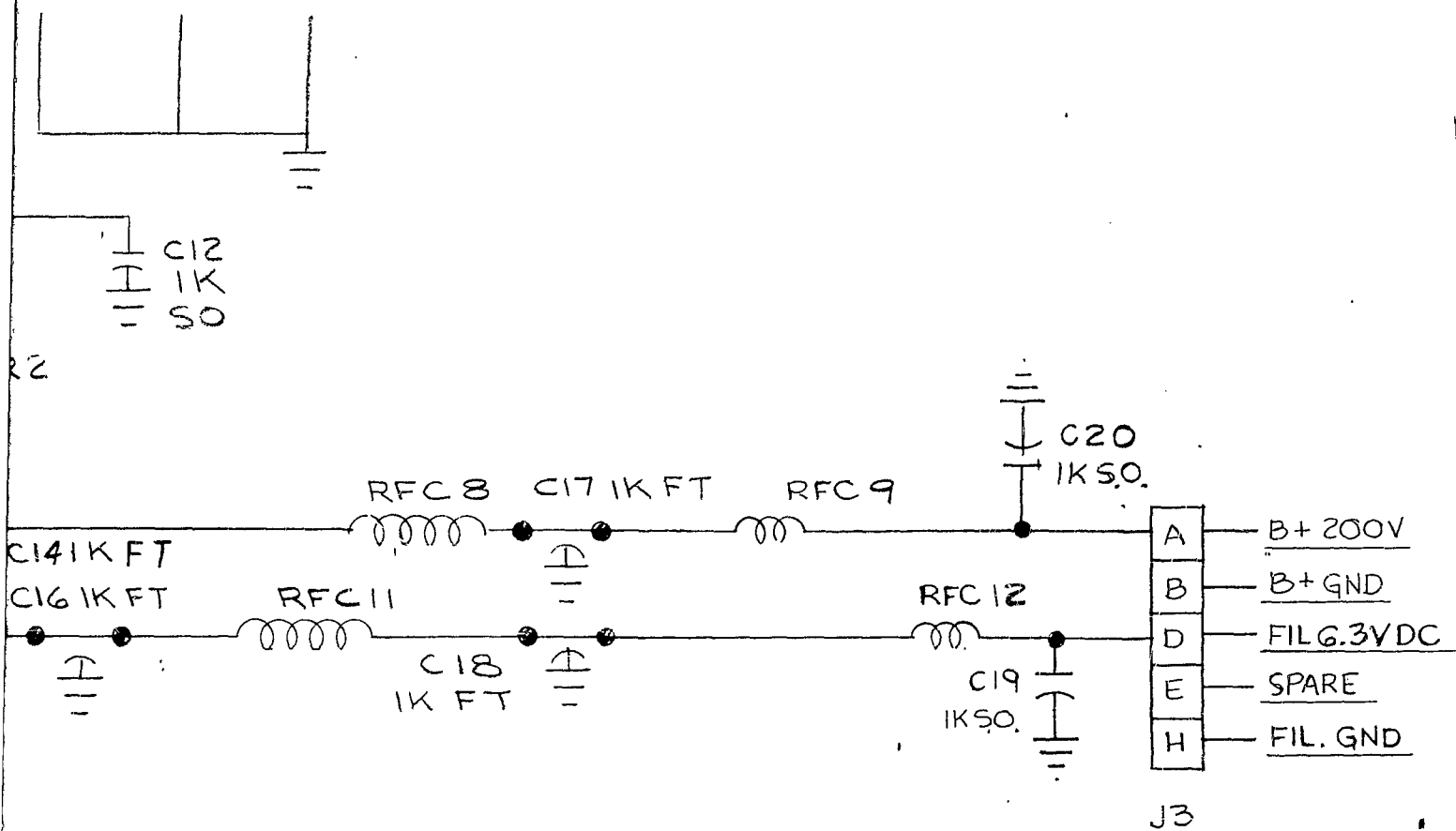
4



- NOTES
1. R1 & R2 SELECTED I
TUBE CURRENT.
 2. F₀ = 775 MC

5

491-01		ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES: FRACTIONS ± 1/64 ANGLES ± 1/2° DECIMALS .XX ± .010 .XXX ± .005	DRAWN 3-29-62	<u>SCHEMATIC</u>	
		MATERIAL: _____	DRAWN BY <i>P. Kennard</i>	<u>E-2(A) 775/6 AMPLIFIE</u>	
JOB NO.	NEXT ASSEMBLY	FINISH: _____	CHECKED	<u>UNIT 1A7A1 & 1A7A4</u>	
APPLICATION			APPROVED	APPROVED	SCALE _____
					UNIT WT.



NOTES
 1. R1 & R2 SELECTED FOR 10 MA
 TUBE CURRENT.
 2. $F_0 = 775 \text{ MC}$

6

ISSUE C
600750

ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES: FRACTIONS $\pm 1/64$ ANGLES $\pm 1/2^\circ$ DECIMALS .XX $\pm .010$.XXX $\pm .005$	DRAWN 3-29-62	<h2 style="margin: 0;">SCHEMATIC</h2> <h3 style="margin: 0;">E-2(A) 775/6 AMPLIFIER</h3> <h3 style="margin: 0;">UNIT 1A7A1 & 1A7A4</h3>	APPLIED RESEARCH INC. PORT WASHINGTON NEW YORK		
	DRAWN BY <i>A. Kennard</i>		DWG. SIZE C	600750	
	CHECKED			ISSUE: <i>C</i>	
	APPROVED			SCALE _____	UNIT WT.
FINISH:	APPROVED				

Fig. 10.