UNCLASSIFIED

DEVELOPMENT OF RADIO RECEIVER R-902(XE-1)/PRD
FOR DIRECTION FINDER SET AN/PRD-7

FINAL REPORT
PERIOD OF 30 JUNE 1959 TO 15 APRIL 1961

CONTRACT NO. DA-36-039 sc-78351
DEPT. OF ARMY PROJECT NO. 3-44-02-506

U.S.ARMY SIGNAL RESEARCH AND DEVELOPMENT LABORATORY
FORT MONMOUTH, NEW JERSEY

P. R. MALLORY & CO. INC.
INDIANAPOLIS, INDIANA

AD ______________ ACCESSION NO. ______________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-A1-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-4634. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design

2. Signal Corps Contract DA-36-039 sc-78351

AD ______________ ACCESSION NO. ______________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-A1-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-4634. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design

2. Signal Corps Contract DA-36-039 sc-78351

AD ______________ ACCESSION NO. ______________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-A1-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-4634. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design

2. Signal Corps Contract DA-36-039 sc-78351

AD ______________ ACCESSION NO. ______________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-A1-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902 (XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-4634. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design

2. Signal Corps Contract DA-36-039 sc-78351

AD ________________ ACCESSION NO. ________________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-44-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-5483A. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design
2. Signal Corps Contract DA-36-039 sc-78351

AD ________________ ACCESSION NO. ________________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-44-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-5483A. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design
2. Signal Corps Contract DA-36-039 sc-78351

AD ________________ ACCESSION NO. ________________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-44-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-5483A. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design
2. Signal Corps Contract DA-36-039 sc-78351

AD ________________ ACCESSION NO. ________________

P. R. MALLORY & CO. Inc., Indianapolis, Indiana

DEVELOPMENT OF RECEIVER, RADIO R-902 ( )/PRD FOR DIRECTION FINDER SET AN/PRD-7

BY MILES M. RIDDLE

FINAL REPORT, 30 JUNE 1959 to 15 APRIL 1961, 48 pp-ILLUS-GRAPHS, Signal Corps Contract No. DA-36-039 sc-78351, DA Task No. 3-44-02-506, unclassified report.

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-5483A. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902(XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

UNCLASSIFIED

1. VHF-UHF Radio Receiver Design
2. Signal Corps Contract DA-36-039 sc-78351

**DESIGN AND FABRICATION OF
RECEIVER, RADIO R-902(XE-1)/PRD**

FINAL REPORT

The objective of this program is the design and fabrication of a low power consumption, portable 100 to 400 mcs Receiver

SIGNAL CORPS CONTRACT NO. DA-36-039 sc-78351

SIGNAL CORPS SPECIFICATION OR TECHNICAL REQUIREMENTS NO. SCL-5483A, Dated 9 September 1958, and Amendment No. 1 dated 4 June 1959

DEPARTMENT OF ARMY TASK NO. 3-44-02-506

PERIOD:
30 June 1959 to
15 April 1961

REPORT PREPARED BY:
M. M. Riddle

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I PURPOSE

The purpose of this contract is to develop a 100-400 mc portable radio direction finder receiver operating on minimum battery power. Provisions for vehicular operation, band ranging and field maintenance will also be incorporated. During vehicular operation, provision for increased sensitivity and operation from the vehicle power source is necessary.

The development work on this contract was divided into three phases and the overall equipment was separated into five basic sections. The phases include (1) basic theoretical design and verification of electrical parameters and design assumptions, (2) build-up and test of overall equipment and (3) calibration and modification as necessary to fulfill specifications. The basic sections of the equipment include (a) overall radio receiver, (b) 100-400 mc RF tuner and dial assembly, (c) 30 mc i-f amplifier strip including detectors, crystal marker oscillator, chopper, and audio amplifiers, (d) vehicular power supply, and (e) case, chassis, panel and associated vehicular mounting.

II ABSTRACT

This report describes design work and test results on the experimental model of Radio Receiver R-902(XE-1)/PRD in accordance with the Signal Corps Technical Requirements SCL-5483A. This receiver is a portable, low battery drain equipment covering the 100 to 400 mcs range. Final performance of the experimental model of Radio Receiver R-902 (XE-1)/PRD and the major subassemblies thereof are discussed. Also discussed are problem areas and measures taken to improve the receiver after delivery to the contractor's technical representatives.

III PUBLICATIONS, LECTURES, REPORTS AND CONFERENCES

PUBLICATIONS, LECTURES AND REPORTS

None.

CONFERENCES

1. A conference was held at P. R. Mallory & Co., Inc. on 5 August 1959 to discuss the receiver in general and to clarify some sections of the specifications. It was concluded that tubes of the 6611 and 6612 variety would be preferable to transistors. Layouts, designs, etc. should be approved by SRDL before incorporation into the receiver. Provision for momentary R.F. Amplifier operation in battery position may be waived when more data is obtained.

2. A conference was held at Evans, SRDL on 6 November 1959 to discuss the progress to date and to show a working model of the R.F. amplifier, oscillator and I.F. strip. The working models displayed were deemed staisfactory. The R.F. amplifier will not have the capability of being operated for a short period of time in battery operation due to the heavy heater current drain. Diode output connector will be an Amphenol #26-215 not a BNC coaxial due to the similarity to the antenna connectors.

3. A conference was held at P. R. Mallory & Co., Inc. on 25 January 1960 to discuss engineering progress on the R-902 Receiver

and it was concluded that we are about one and one-half months behind our proposed work schedule for the first model. Progress has been slowed by the difficulties encountered in tracking the r-f tuner and the necessity of building additional interim models. It is not necessary to indicate that the R.F. Amplifier is in operation when in vehicular operation. Change BAND WIDTH indication for BROAD and NARROW to 100 kc and 25 kc. Add VEH ONLY to the 6.3 v test position on the front panel.

4. A conference was held at P. R. Mallory & Co., Inc. on 21 April 1960 to discuss the problem areas in the design of the R-902 Receiver. The major problem is the tracking of the tuner. The crystal mixer circuitry has some resonances in the band. New diodes and circuitry will be tried to eliminate these resonances. A considerable problem has developed concerning the 100 kc crystal filters and a long delay in obtaining these parts is anticipated. A proposed change in delivery time was discussed. This change is due to the long delivery time on some items and to the difficulty in tracking the tuner.

5. A conference was held at P. R. Mallory & Co., Inc. on 1 August 1960 to discuss engineering progress on the R-902 Radio Receiver. It was concluded that it would be to the Government's benefit to extend the delivery time to about 1 December 1960 to allow for additional work on the tuner tracking, i-f gain, discriminator, and audio stage. It was also decided that additional funds would have to be made available to the Mallory Company if the contract were to be extended.

6. A conference was held at P. R. Mallory & Co., Inc. on 21 November 1960 to discuss the progress on the receiver, the problems

recently encountered and how they affect the delivery date and performance. The anticipated delivery date is 5 December 1960. The receiver was then inspected and several of the technical characteristics were checked by the SRDL personnel. The Microdot toggle actuated switches #90-01 failed after about 200 cycles of operation. The Solid State Devices Chopper is not satisfactory at -40°C.

7. A conference was held at SRDL on 22 December 1960 to discuss the problem areas remaining and to deliver the experimental model of the R-902(XE-1)/PRD Radio Receiver. Our test data was generally verified by the SRDL personnel. The DIODE OUTPUT was not satisfactory to operate the indicator to be used with the receiver. The sensitivity of the receiver was measured from 0.1 mw to 1.0 mw instead of from 1.0 mw to 10 mw because of lack of output.

8. A conference was held at P. R. Mallory & Co., Inc. on 20 March 1961 to discuss the problem areas as pointed out by SRDL when the receiver was returned for rework and the approaches taken by Mallory in the solution of these problems, both satisfactory and unsatisfactory. The receiver was then checked pursuant to the list of discrepancies originated at SRDL. The audio output power was increased by redesigning the audio stage and increasing the i-f gain. The DIODE OUTPUT was increased by increasing the i-f gain and using a doubler detector circuit. However, the diode output is not within specifications in the 25 kc position. The FM sensitivity was improved with the increased gain in the i-f strip.

9. A conference was held at SRDL on 29 March 1961 to discuss the redesigned R-902 Receiver and how the next units can be improved. The data taken on the redesigned R-902(XE-1)/PRD Receiver was verified by SRDL personnel. Removal of the 100 kc crystal filter was discussed and a decision was made to remove the filter after all electrical performances had been verified. A recheck of the performance of the receiver was then to be made. If the performance is satisfactory, the filter will be omitted on subsequent models.

IV FACTUAL DATA

The development work on Radio Receiver R-902(XE-1)/PRD was divided into three phases and the overall equipment was separated into five basic sections. The phases were: (1) basic theoretical design and verification of electrical parameters and design assumptions, (2) build-up and test of overall equipment, and (3) calibration and modification as necessary to fulfill the specifications. The sections were: (a) the overall Radio Receiver, (b) 100-400 mcs r-f tuner and dial assembly, (c) 30 mcs i-f amplifier strip, detectors, crystal marker oscillator, chopper, and audio amplifier, (d) vehicular power supply, and (e) dust cover, front panel, vehicular mount, and associated equipment.

Summarized below are the problems encountered in the design and construction of the R-902 Receiver, their solutions and/or compromises to achieve the unit delivered. Theoretical design considerations and calculations are shown in the quarterly reports for this contract.

a. Overall Radio Receiver

The experimental model of Radio Receiver R-902(XE-1)/PRD was designed to meet the requirements of SCL-5483A, dated 9 September 1958 as amended. When the experimental model of the Radio Receiver R-902

(XE-1)/PRD was initially delivered, it deviated considerably from a few of the requirements of SCL-5483A. These deviations were due to the limitations of components and the difficulties encountered in the construction of the sub-assemblies. The main deviations were in sensitivity and diode output. These problems are discussed fully in sections of this report concerning the sub-assemblies. The requirements of SCL-5483A and the performance of the initial model of Radio Receiver R-902(XE-1)/PRD are shown in Figures 1 to 4.

The receiver was tested by SRDL and returned for rework. Several new approaches were investigated to determine if they would be practical to use in this receiver. The performance of the reworked receiver is shown in Figures 5 to 9. This improved version of the experimental model of Radio Receiver R-902(XE-1)/PRD was resubmitted to SRDL. Pictures of the unit as resubmitted are shown in Figures 10 to 12. The details of the redesign are explained in the section of this report concerning the individual sub-assemblies.

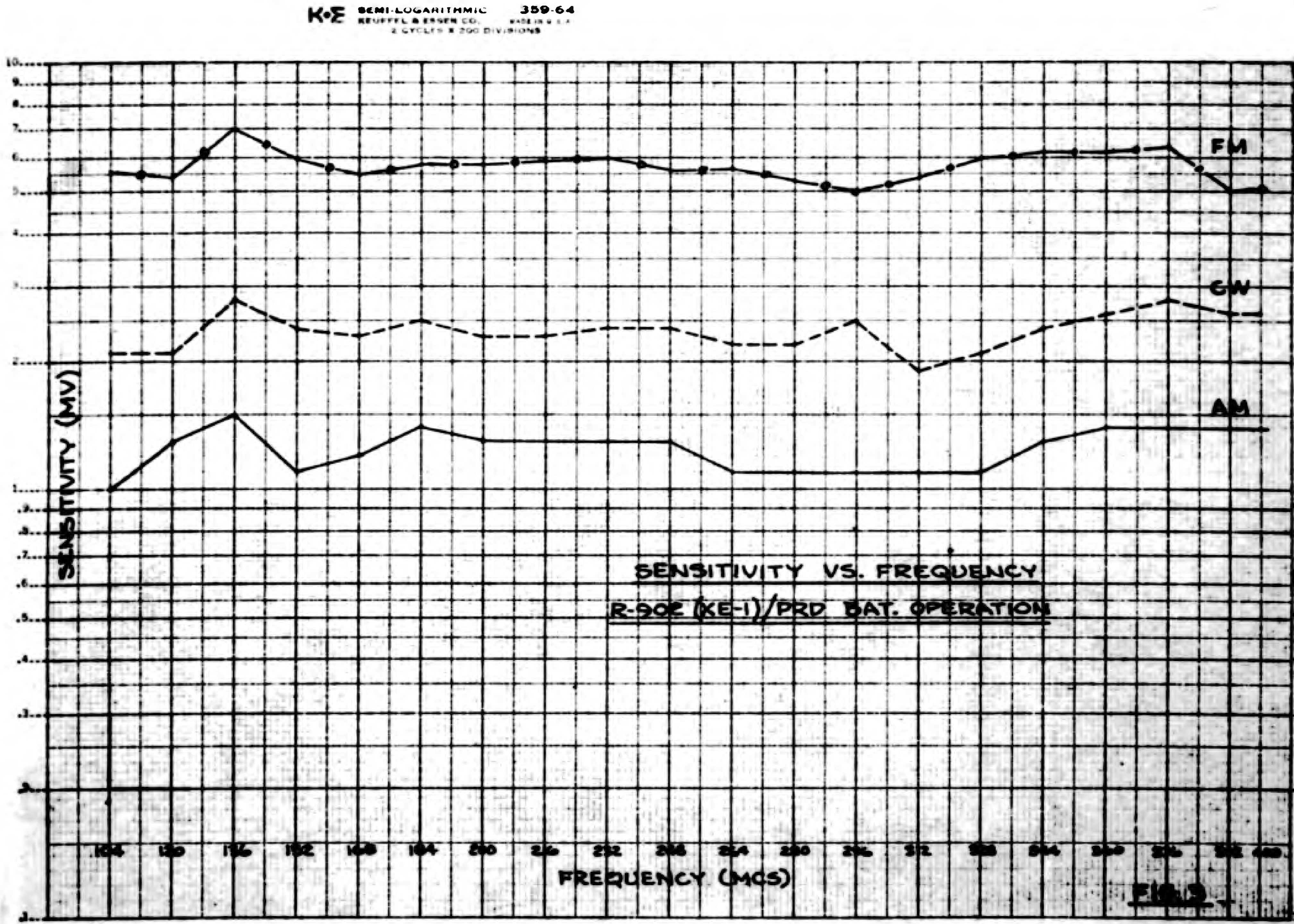

K+E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO.
2 CYCLES X 200 DIVISIONS
FM
CW
AM
SENSITIVITY VS. FREQUENCY
R-902 (XE-1)/PRD BAT. OPERATION
SENSITIVITY (MV)
FREQUENCY (MCS)

FIG. 3

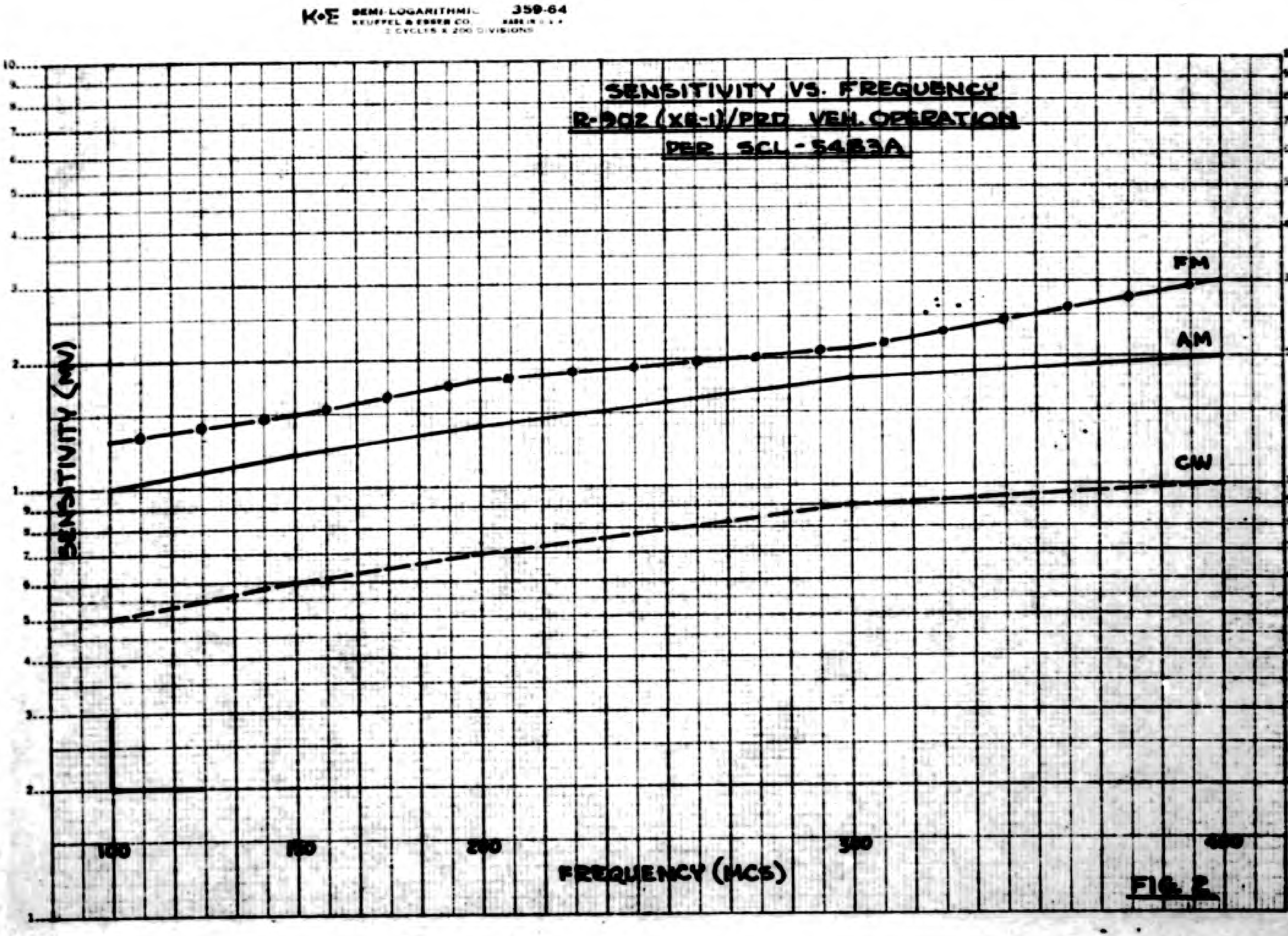
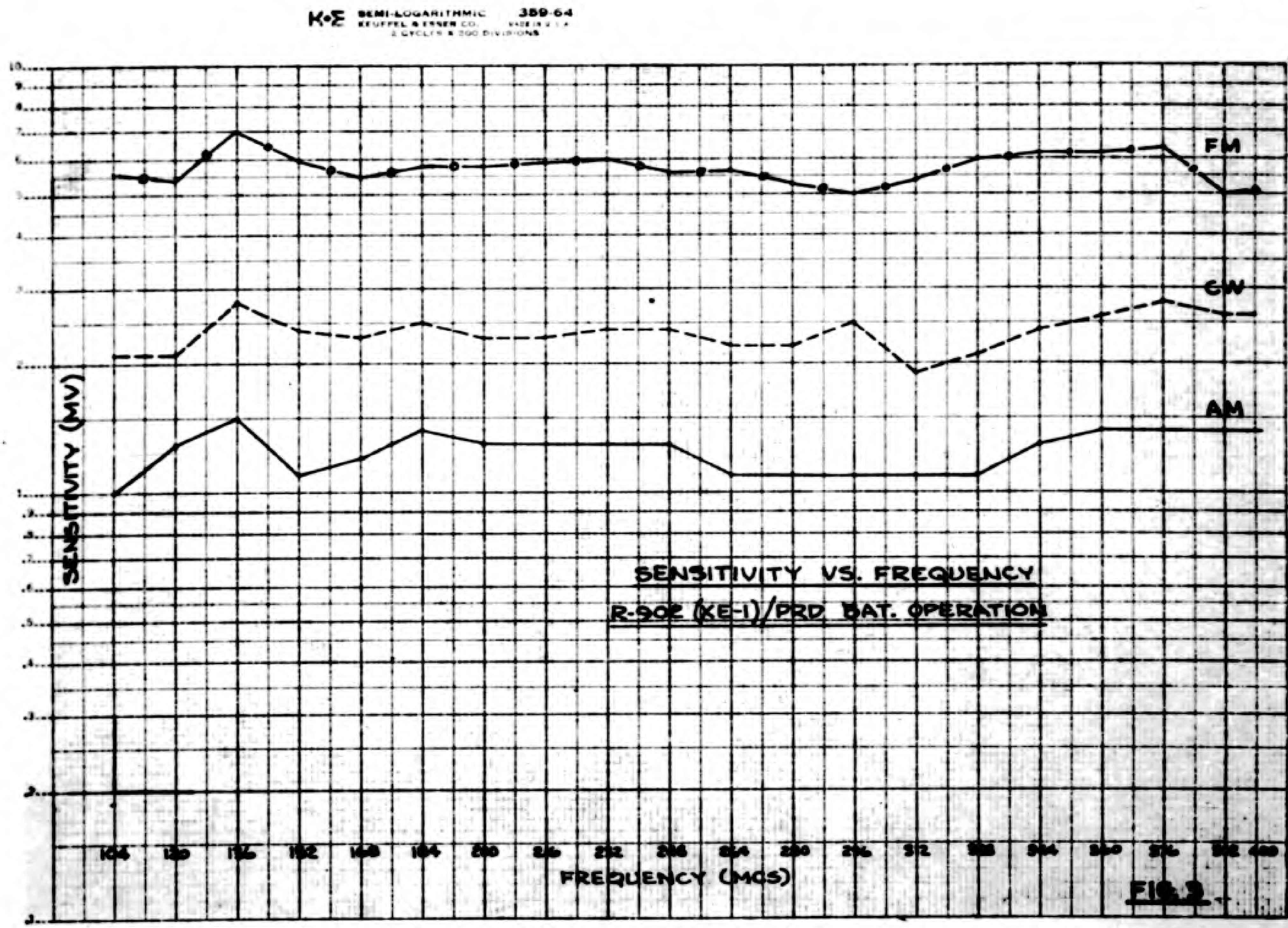
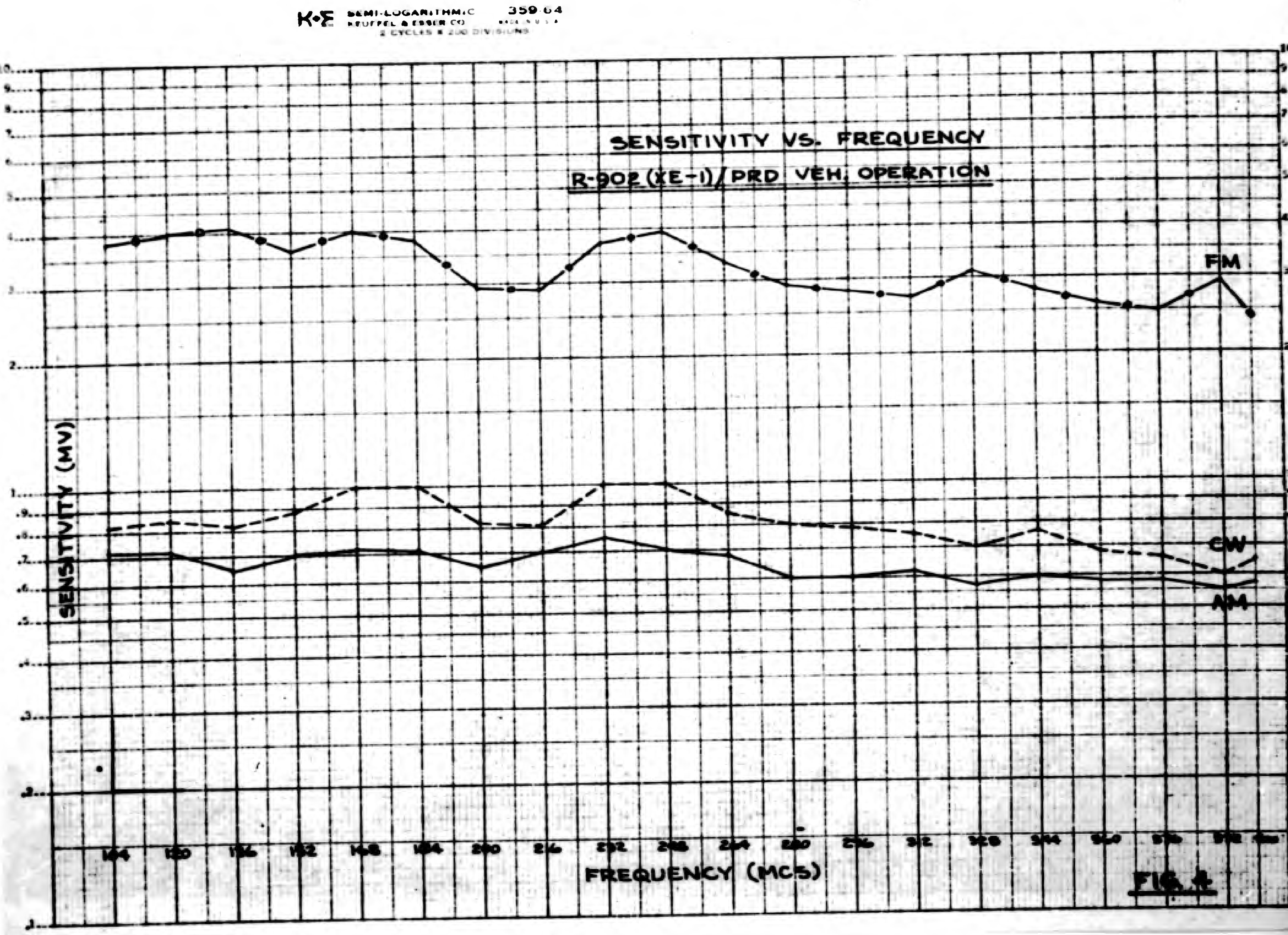

K+E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO.
2 CYCLES X 200 DIVISIONS
SENSITIVITY VS. FREQUENCY
R-902 (XE-1)/PRD VEH. OPERATION
PER SCL-5483A
FM
AM
CW
SENSITIVITY (MV)
100
150
200
300
400
FREQUENCY (MCS)

FIG. 2


K+E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO.
2 CYCLES X 200 DIVISIONS
FM
CW
AM
SENSITIVITY (MV)
SENSITIVITY VS. FREQUENCY
R-902 (KE-1)/PRD BAT. OPERATION
104
120
136
152
168
184
200
216
232
248
264
280
296
312
328
344
360
376
392
400
FREQUENCY (MCS)
FIG. 3


K&E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO.
2 CYCLES X 200 DIVISIONS
SENSITIVITY VS. FREQUENCY
R-902 (XE-1)/PRD VEH. OPERATION
FM
CW
AM
SENSITIVITY (MV)
FREQUENCY (MCS)
FIG. 4

K+E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO.
2 CYCLES X 200 DIVISIONS

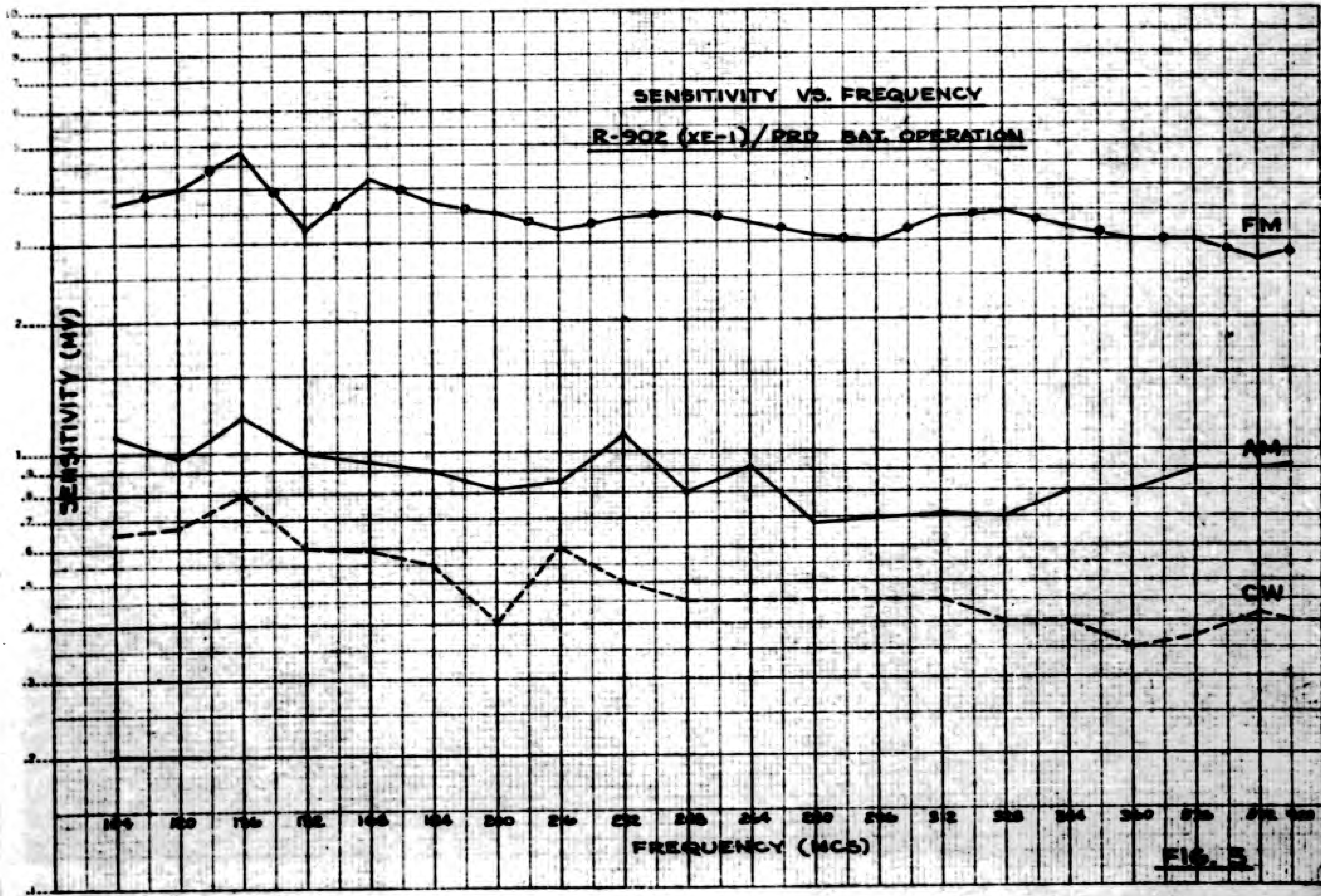


FIG. 5

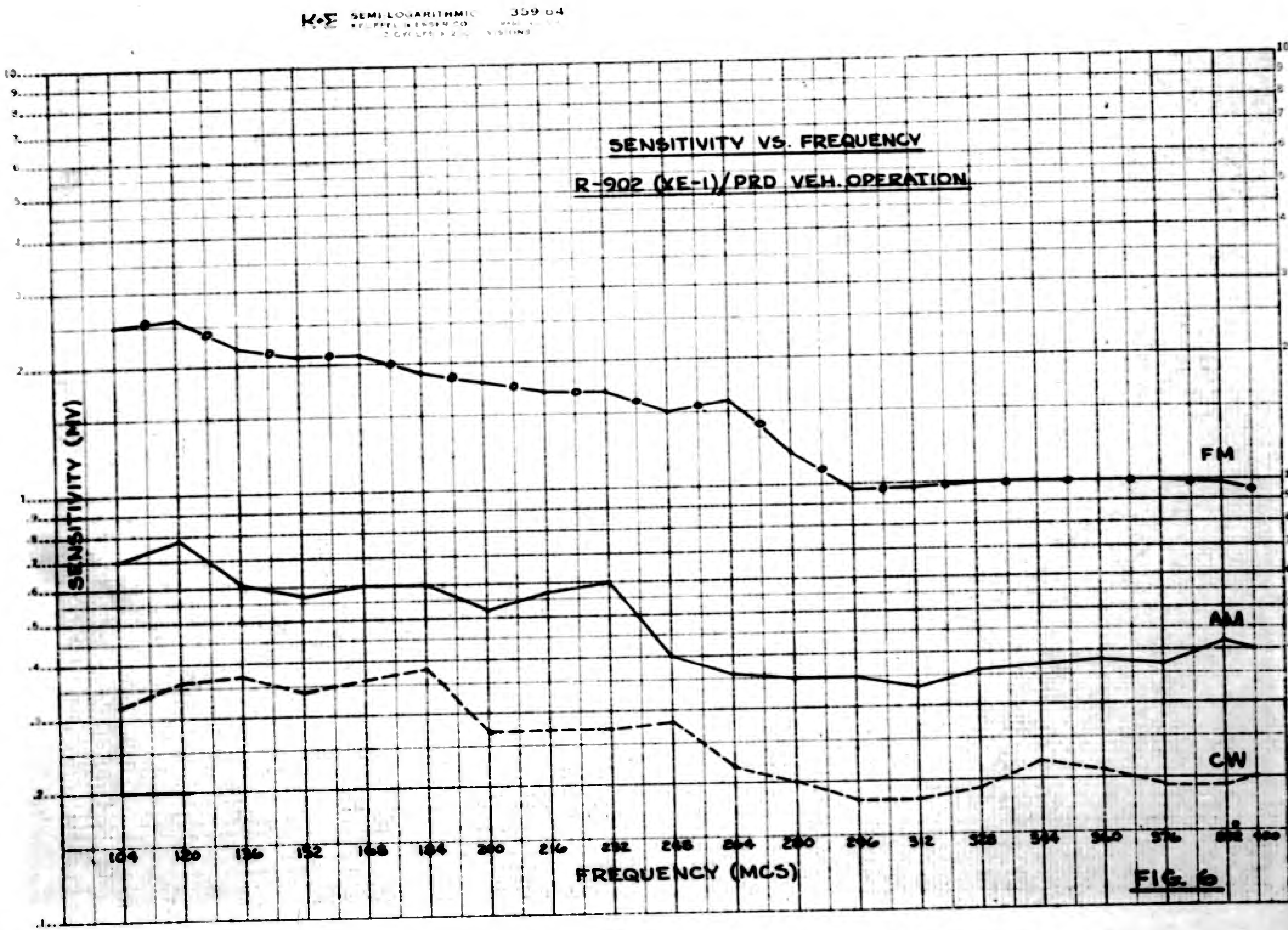

K+E SEMI-LOGARITHMIC 359-64
SENSITIVITY VS. FREQUENCY
R-902 (XE-1)/PRD VEH. OPERATION
SENSITIVITY (MV)
FM
AM
CW
104
120
136
152
168
184
200
216
232
248
264
280
296
312
328
344
360
376
392
400
FREQUENCY (MCS)

FIG. 6

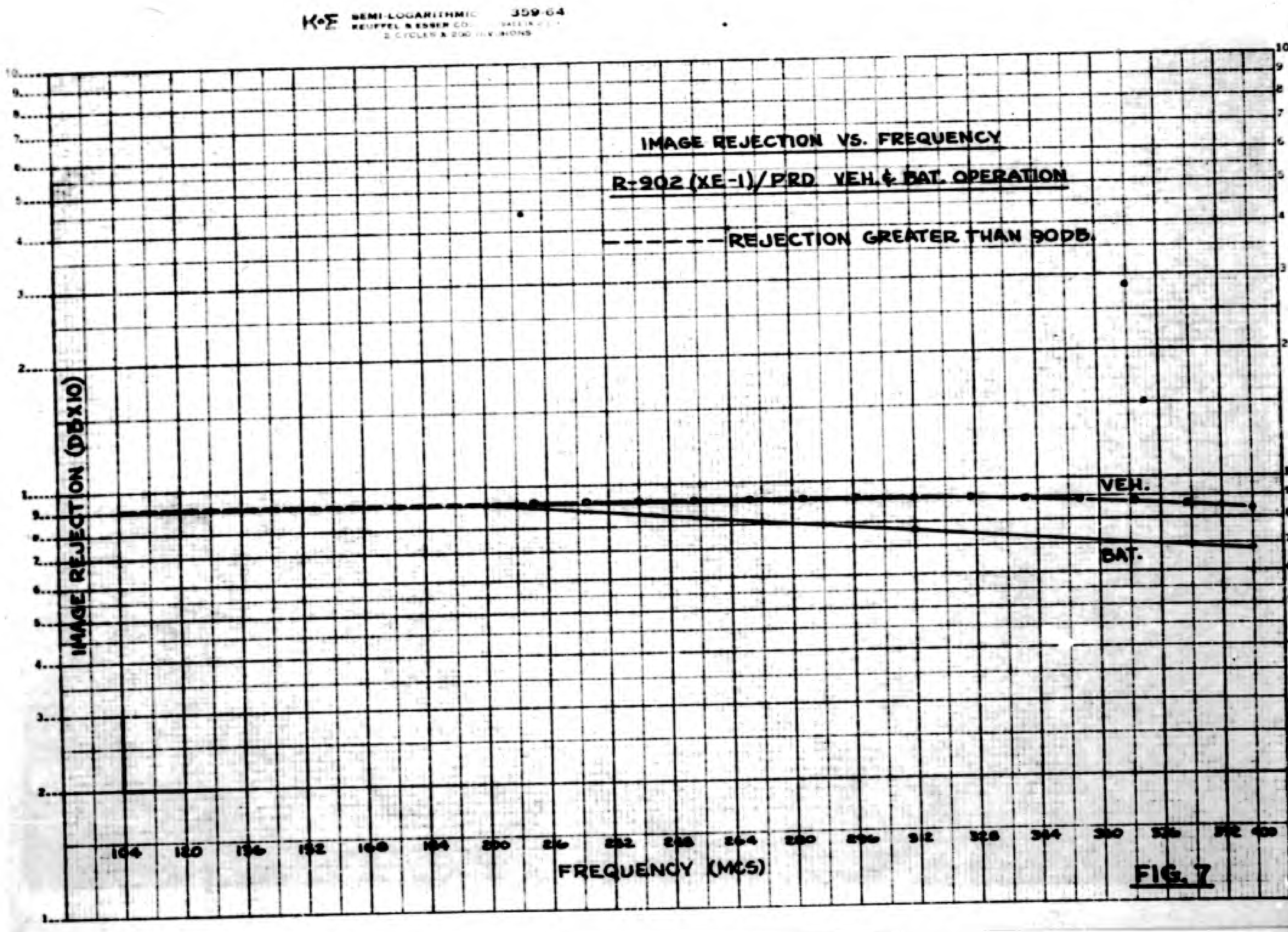

K+E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO.
2 CYCLES X 200 DIVISIONS
IMAGE REJECTION VS. FREQUENCY
R-902 (XE-1)/PRD VEH. & BAT. OPERATION
------- REJECTION GREATER THAN 90DB.
VEH.
BAT.
IMAGE REJECTION (DBX10)
104 120 136 152 168 184 200 216 232 248 264 280 296 312 328 344 360 376 392 400
FREQUENCY (MCS)

FIG. 7

K&E SEMI-LOGARITHMIC 359-64
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 200 DIVISIONS

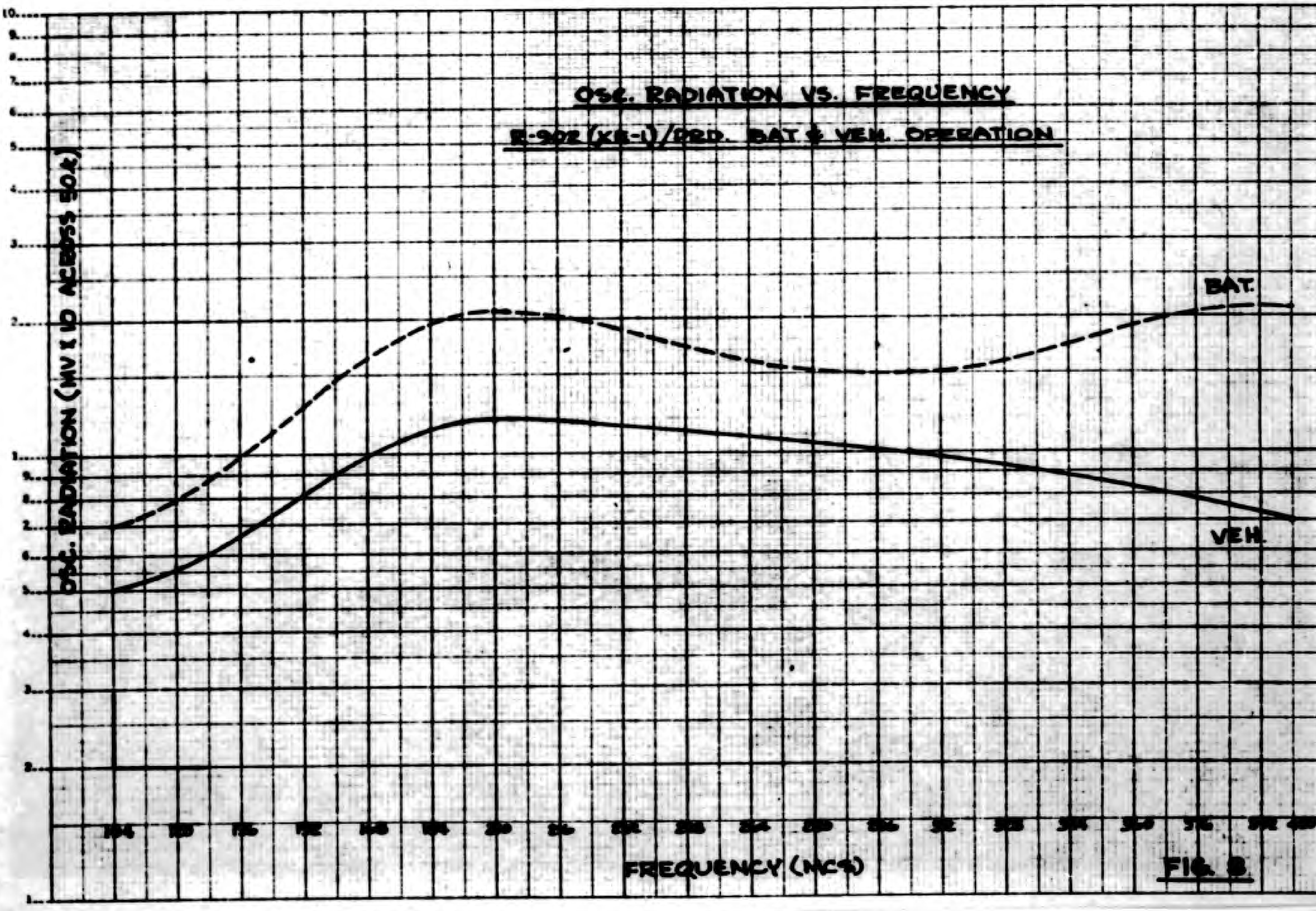


FIG. 8

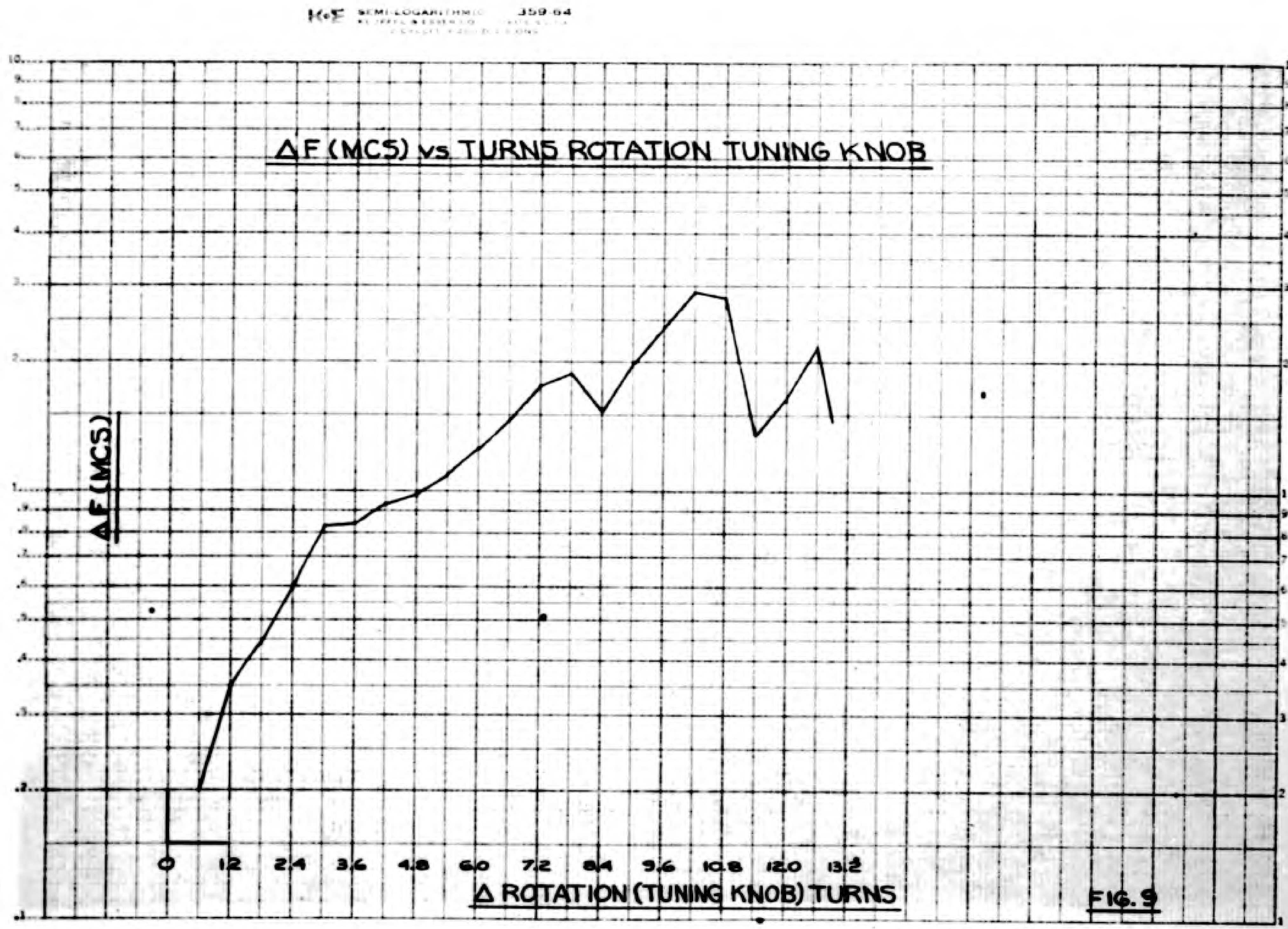

K+E SEMI-LOGARITHMIC 359-64
ΔF (MCS) vs TURNS ROTATION TUNING KNOB
ΔF (MCS)
0 1.2 2.4 3.6 4.8 6.0 7.2 8.4 9.6 10.8 12.0 13.2
Δ ROTATION (TUNING KNOB) TURNS

FIG. 9

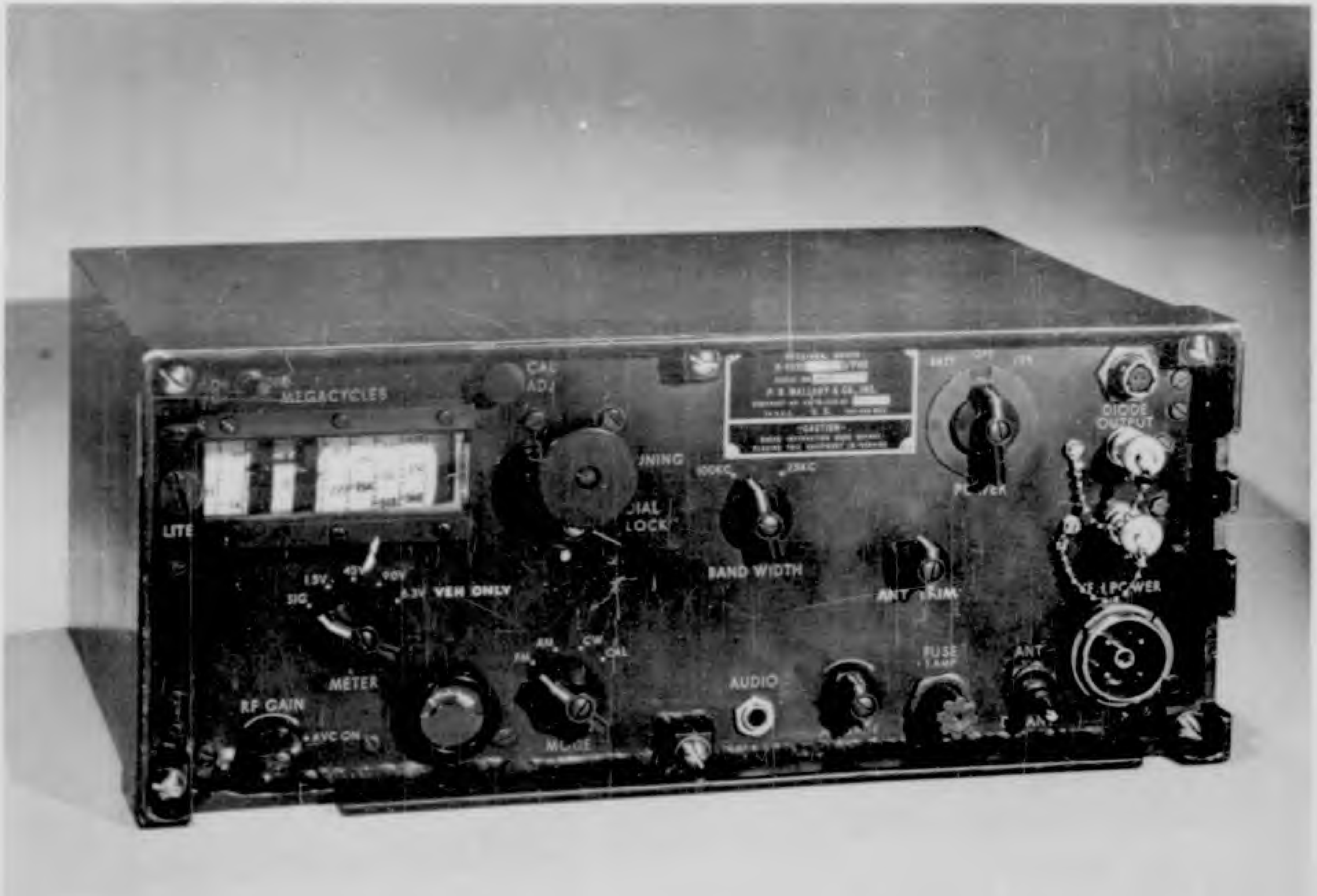

MEGACYCLES
LITE
BAND WIDTH
100KC
25KC
ANT TRIM
DIODE OUTPUT
VEH ONLY
SIG
METER
RF GAIN
FM
AM
CW
CAL
AUDIO
FUSE
ANT

FIG. 10

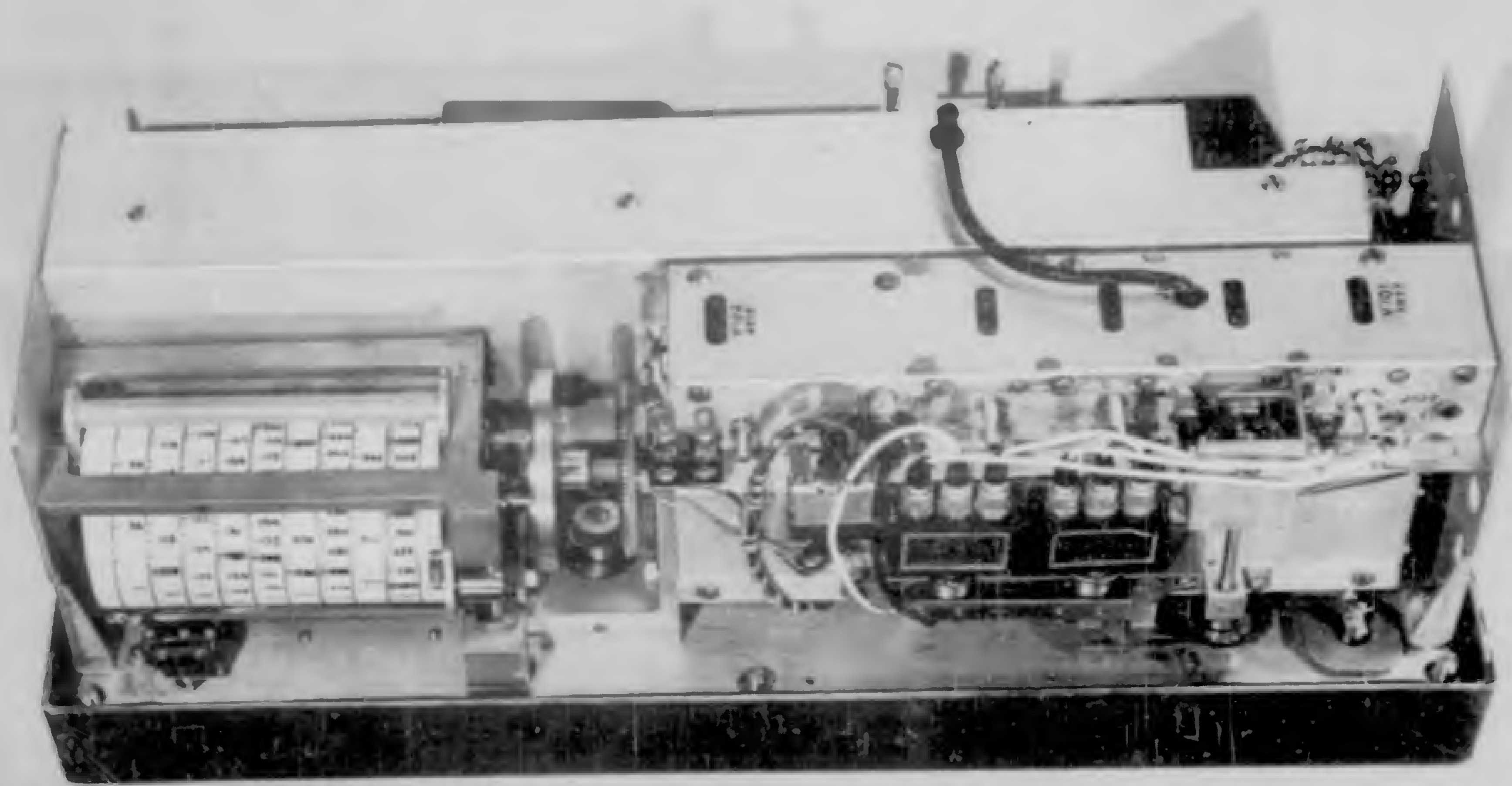


FIG. 11

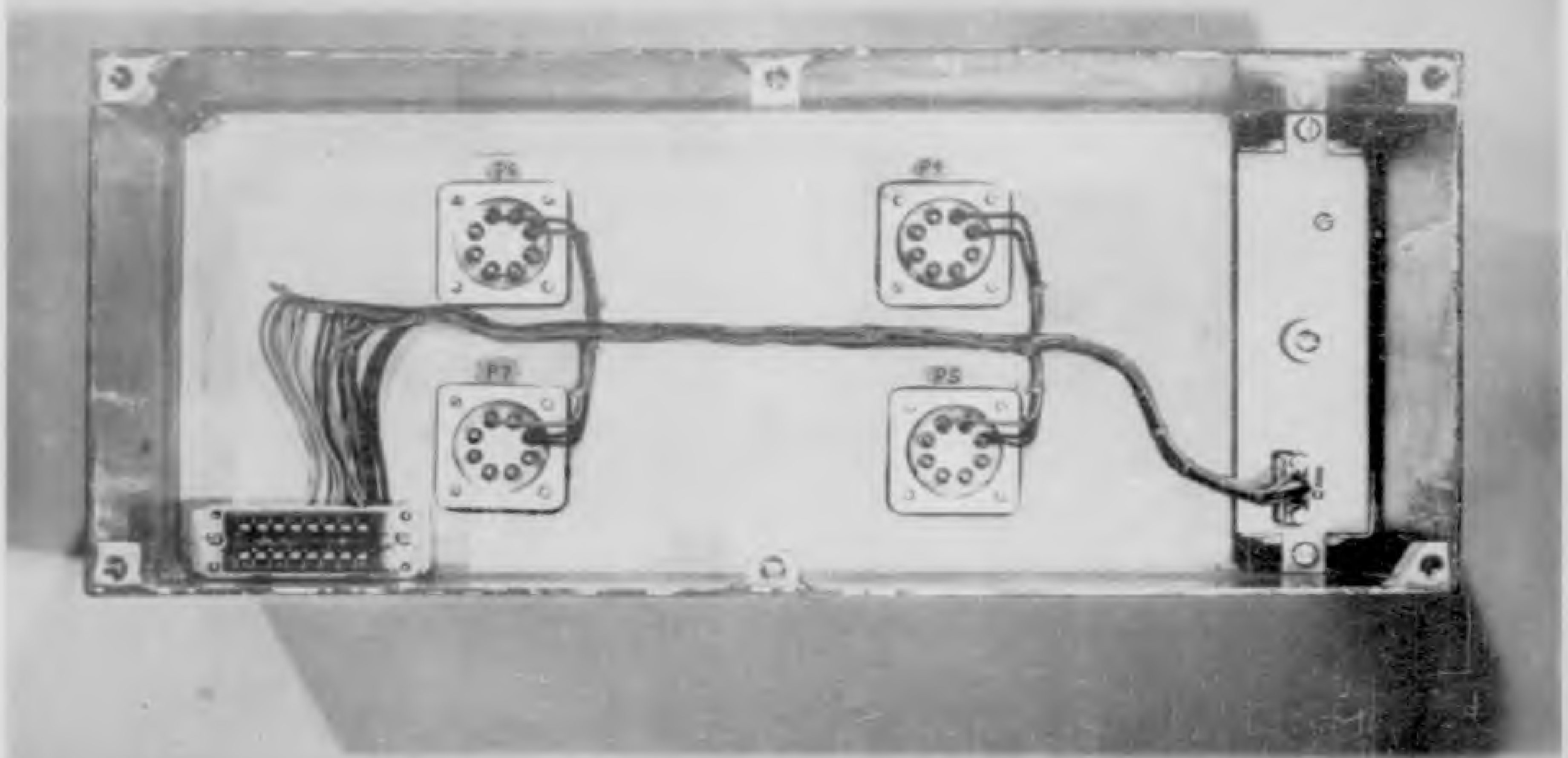


FIG. 12

b. 100-400 mcs R.F. Tuner and Dial Assembly

This assembly is composed of four individual sections, all with their inherent design problems. They are as follows: (1) oscillator, (2) r-f amplifier, (3) passive preselector, and (4) crystal mixer.

1. Oscillator - The local oscillator presented the most difficult design problem. The major considerations were: current drain, frequency coverage, stability and tracking with the other sections of the tuner.

Several tubes and transistors were tested in an effort to obtain an oscillator that was stable, had low current drain and would cover the frequency range with the Mallory Inductuner as the tuning element. It had previously been determined that an inductuner was the best available tuning device to cover this frequency ratio and range in one band.(1)

Transistors were found that would oscillate to the required frequency. However, due to temperature problems and lack of uniformity, they were discarded. The Amperex 6375 tube was found to have the best characteristics with the least power consumption of the several low drain tubes tested, as shown in Table I.

(1) "Miniaturized Components for Stable, Tunable Resonant Circuits" -
P. R. Mallory & Co., Inc., Indianapolis, Indiana
E. D. Aldred, C. W. Everhart, F. T. Hiatt, W. H. Kennedy and D. E. Webb
Contract No. DA-36-039-SC-64640, 1956

TABLE I - UHF OSCILLATORS

Tube	Filament Volts	Filament Current	Plate Volts	Plate Current	Circuit	Tuning Range	Power Output Across Band Max.	Power Output Across Band Min.	Remarks
QF894	1.25	150 ma.	80	5 ma.	tuned Plate	123-438	25	0.4	Low Output
6375	1.25	200 ma.	75	15 ma.	Tuned Plate	101-438	12	5.0	Most Promising
A15133 Nuvistor	6.3	140 ma.	45	8.0.ma.	Tuned Plate	125-431	22	4.0	High Fil. Current
A15133	6.3	140 ma.	45	7 ma.	Gnded Plate	132-439	6.7	4.6	High Fil. Current
5703	6.3	200 ma.	100	7 ma.	Tuned Plate	141-502	-	-	High Fil. Current
5971	1.25	80 ma.	60	3 ma.	Tuned Plate	129-225	-	-	*
6050	1.25	120 ma.	125	3 ma.	Tuned Plate	135-453	-	-	Low Output
6612	1.25	80 ma.	45	4 ma.	Tuned Plate	119-317	-	-	*
QF912	1.25	80 ma.	80	5 ma.	Tuned Plate	123-405	22	0.4	Low Output

*Tube would not oscillate above frequency shown.

An Inductuner section was designed that would cover the oscillator frequency range and was not resonant in the band. An oscillator was constructed using this section and a 6375 tube that covered the required range of 125 to 435 mcs with greater than 1 mw of output across the band. This section was later married with the remaining sections of the tuner and is discussed later in this report.

2. R.F. Amplifier - Considerable design time and effort was spent in developing a tunable r-f amplifier that would cover the range 95-405 mcs with sufficient gain to improve the sensitivity of the receiver by 6 db. The major considerations in the design of the r-f amplifier were tracking, current drain, size, and gain. Another consideration was for momentary operation from the receiver's self-contained batteries. After testing several filamentary tubes, it was decided that momentary operation was not practical due to the high power consumption of any tube that would amplify at 400 mcs with an Inductuner section as the tuning element.

The 7077 tube and the A-15133 Nuvistor were selected as the two devices best suited for this application when all of the above factors are considered. The Nuvistor provided higher gain at 400 mcs with less power consumption and seemed at first to be the logical choice. However, after more extensive tests, the frequency range of 95 to 405 mcs could not be covered due to the high output capacity of the tube. Therefore, the 7077 was selected as the best r-f amplifier available at the time. Test results are shown in Table II.

TABLE II - UHF AMPLIFIERS

Tube	Filament		Plate		Tuning Range	DB GAIN		Remarks
	Volts	Current	Volts	Current		Low Freq.	High Freq.	
Nuvistor A-15133	6.3	140 ma.	40	7 ma.	120-414	11 db	16 db	Most Promising
7077	6.3	240 ma.	100	4 ma.	122-415	11 db	12 db	High F.L. Current & High Plate E.
6375	1.25	200 ma.	70	14 ma.	-	-	-	Gm too Low at High Freq. End.

Spurious resonances presented a problem with the separate r-f amplifier. Considerable effort was expended in parts placement and construction methods to eliminate these resonances. One large resonance was eliminated by utilizing two chokes, with a 10 to 1 ratio in values, in the filament leads of the r-f amplifier tube. This condition existed because a larger value of choke was needed at the low end of the band. However, this choke became self-resonant in the frequency range of the receiver, so a 10 times smaller choke, that is not resonant in the range of the receiver, was connected in series with the larger choke. This gives the effect of a large choke at the low end of the band and a small choke at the high end of the band. This unit was married with the remainder of the tuner and is discussed in a later section.

3. Passive Preselector - This was the simplest of the tuner sections to design and construct. However, some difficulty was experienced in tracking the preselector sections and in obtaining an Inductuner element to cover the range. A modified Inductuner element was tried at first with little success. A new four and one-half turn Inductuner element was then designed and, after some alteration, a satisfactory Inductuner element was obtained and a three section passive preselector was fabricated. This three section passive preselector was then married with the other sections of the tuner as discussed in a later section.

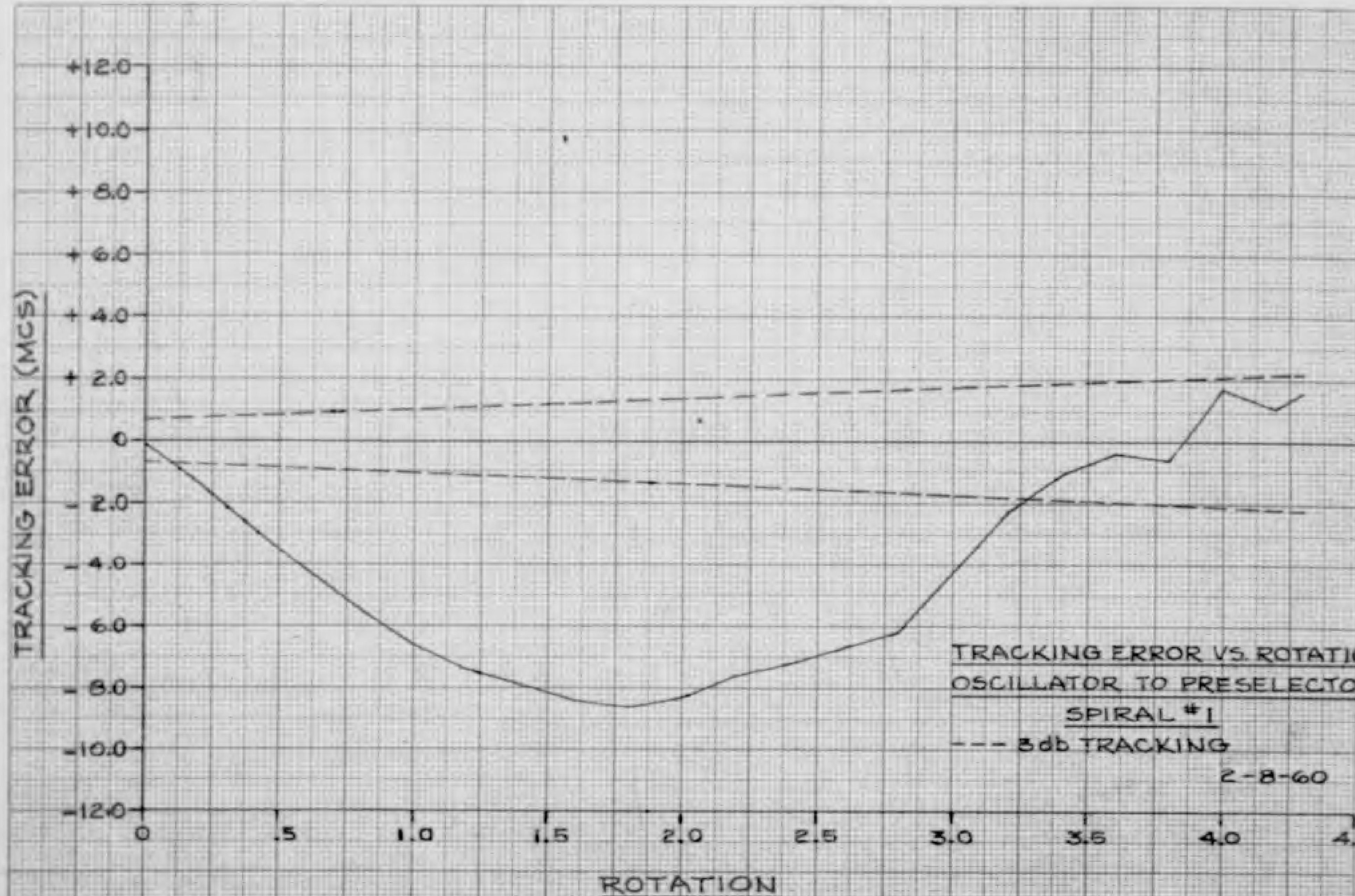
4. Crystal Mixer - The major considerations in the design of the crystal mixer were loss, selectivity, and noise figure. Several

mixer diodes and circuits were investigated and the IN21F eventually selected. The IN21F gave approximately 3 db less loss than the IN82A which was the next best mixer diode tested. There was considerable variation in the mixer loss due to tracking with the original highly selective circuit. A broader, less selective circuit was used to minimize the variation in loss through the mixer. The mixer was married with the other sections of the tuner as described in a later section.

After the sections were operating separately, a single chassis was designed to accept all of the separate sections of the tuner. When this integral tuner was built, several problems were encountered. The major one was in tracking the four sections of the tuner to within 3 db. This error was determined from past experience in similar tuners to be the tightest practical tracking error that we could reasonably attain.

Considerable time and effort were spent in fabricating new Inductuner sections to make the different sections track each other more closely. Samples of the many tracking curves run are shown in Figures 13 through 20.

The 6375 oscillator tube was changed three times after the tuner had been tracked to within 3 db. It was found that the tubes were very uniform. Only slight changes of the alignment screws were required to return the oscillator to within a few kilocycles of the original oscillator frequency. Consequently, replacement of the oscillator tube in the field will not be very difficult even though



TRACKING ERROR (MCS)
+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION
TRACKING ERROR VS. ROTATION
OSCILLATOR TO PRESELECTOR
SPIRAL #1
--- 3db TRACKING
2-8-60

FIGURE 13

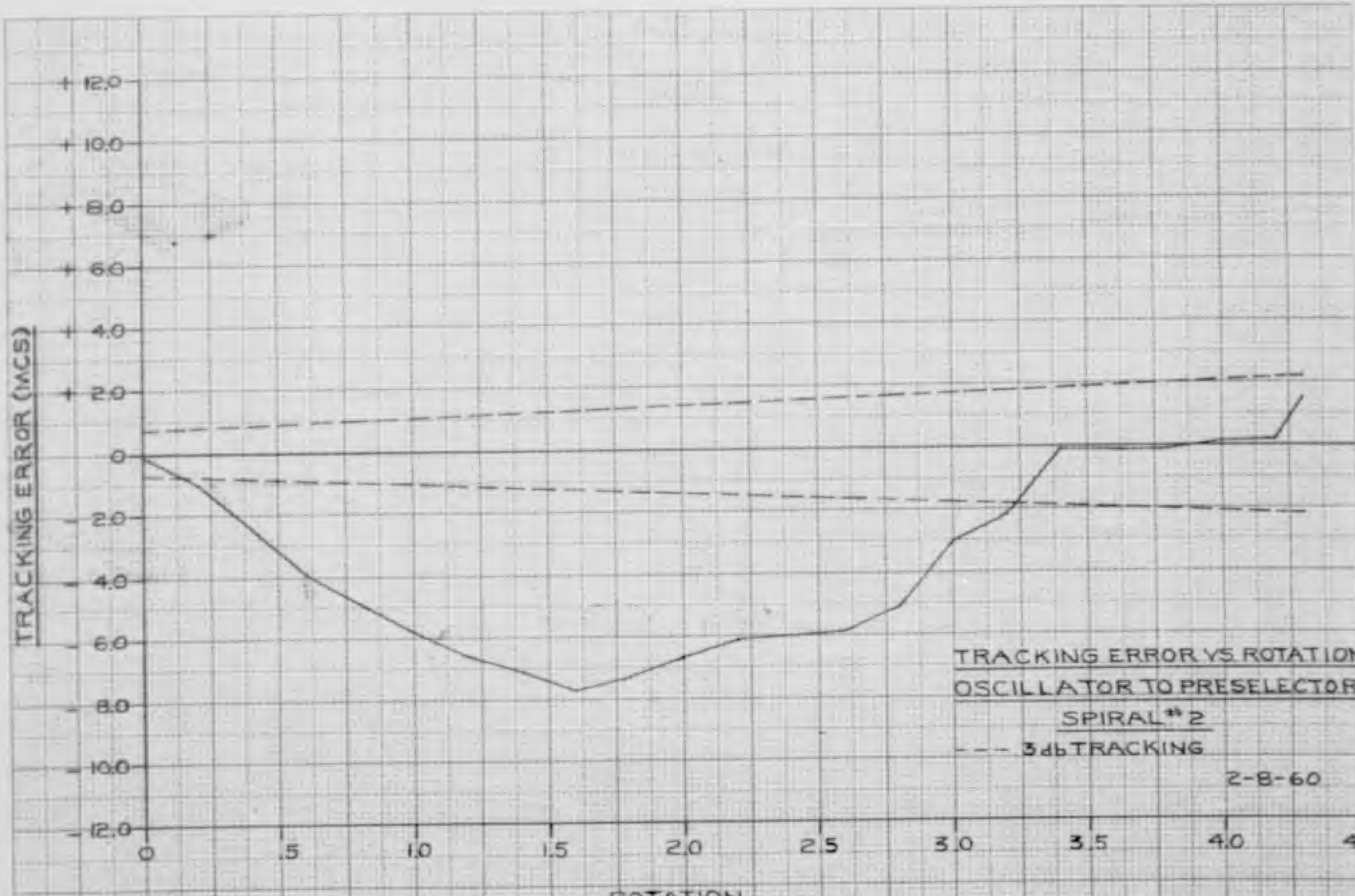
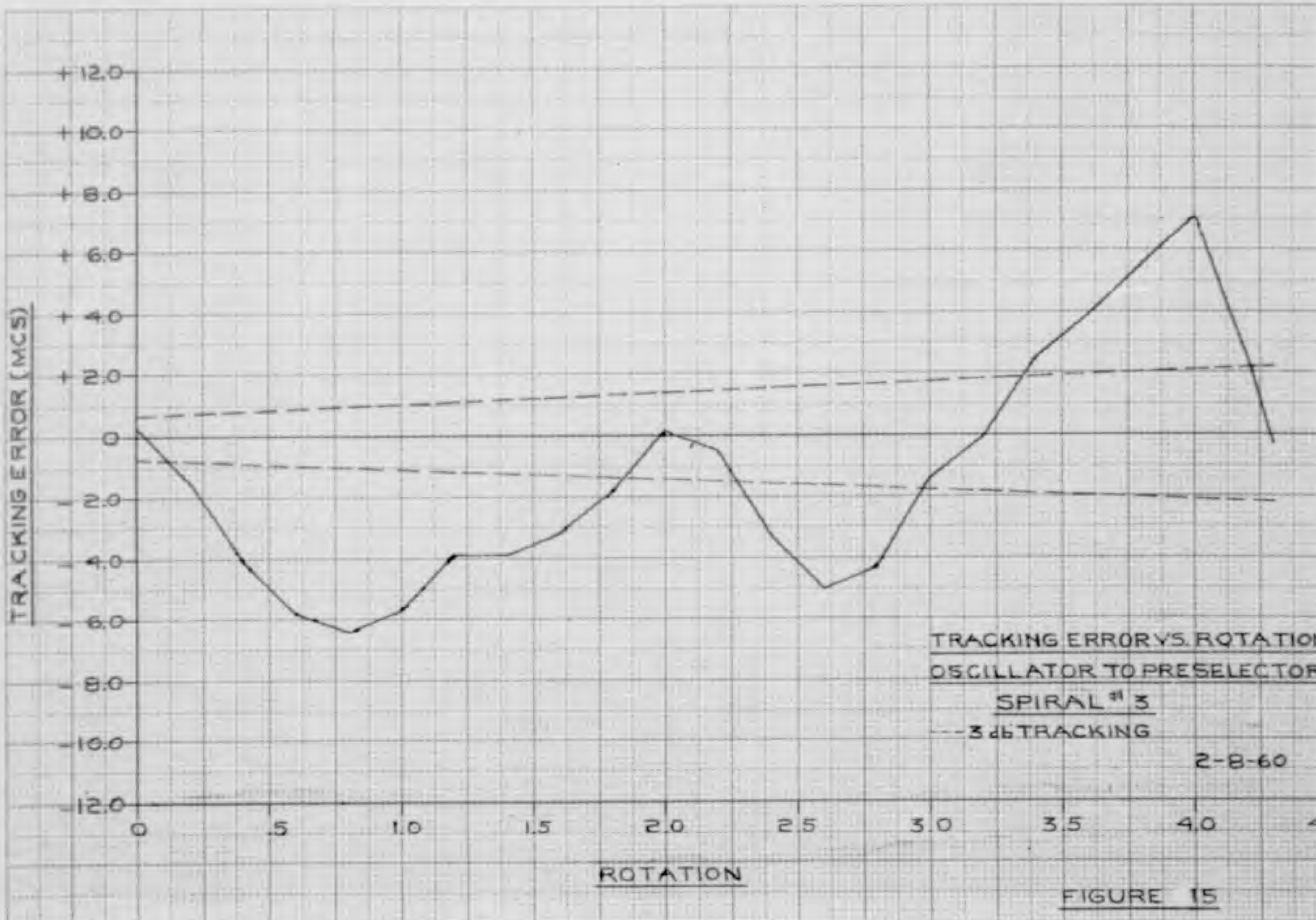

TRACKING ERROR VS ROTATION
OSCILLATOR TO PRESELECTOR
SPIRAL #2
--- 3db TRACKING
2-8-60
TRACKING ERROR (MCS)
+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION

FIGURE 14



+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
TRACKING ERROR (MCS)
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION
TRACKING ERROR VS. ROTATION
OSCILLATOR TO PRESELECTOR
SPIRAL # 3
---3 db TRACKING
2-8-60

FIGURE 15

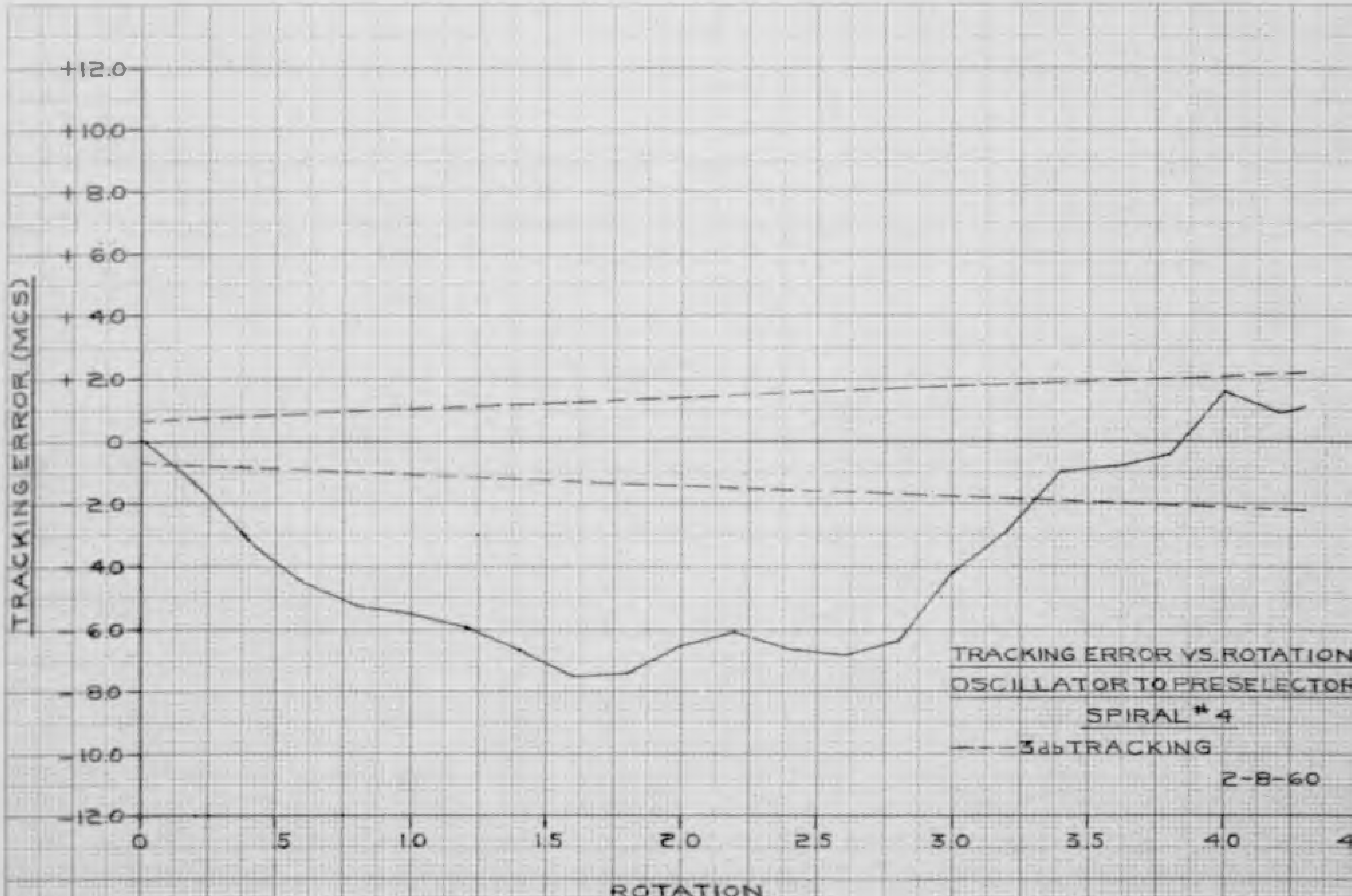

TRACKING ERROR VS. ROTATION
OSCILLATOR TO PRESELECTOR
SPIRAL # 4
- - - 3db TRACKING
2-8-60
TRACKING ERROR (MCS)
+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION

FIGURE 16

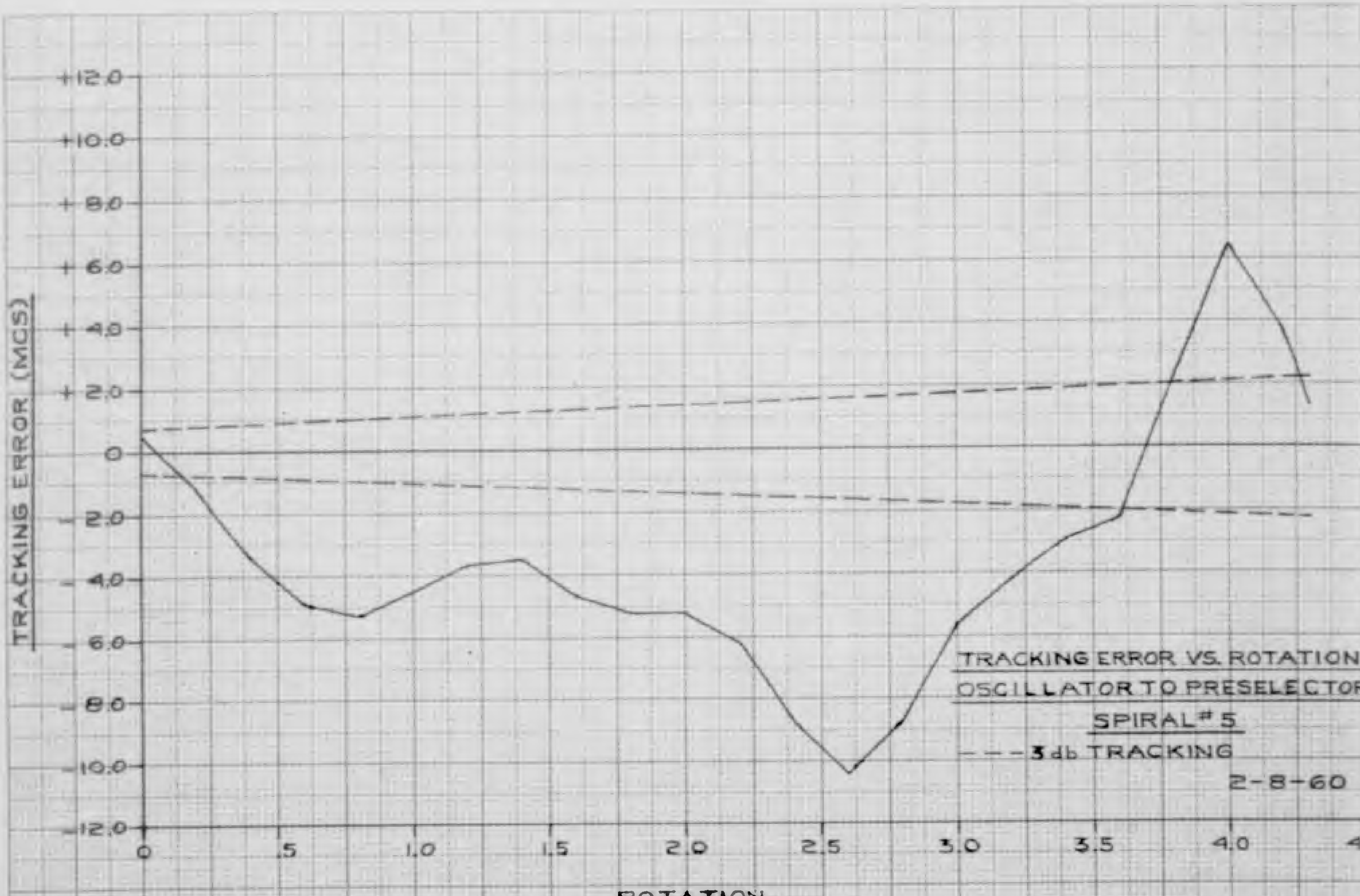

+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
TRACKING ERROR (MCS)
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION
TRACKING ERROR VS. ROTATION
OSCILLATOR TO PRESELECTOR
SPIRAL # 5
- - - 3 db TRACKING
2-8-60

FIGURE 17

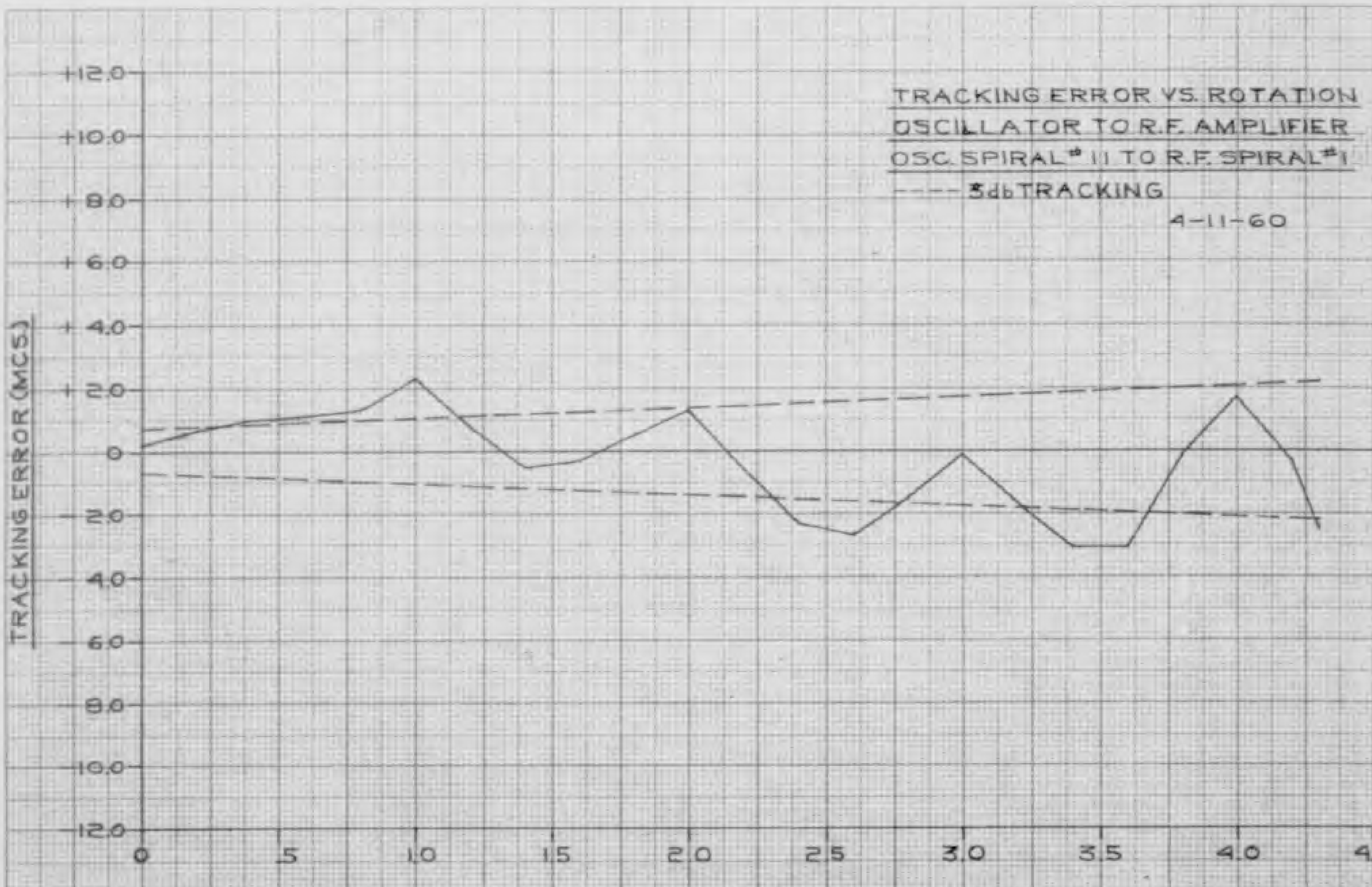

TRACKING ERROR VS. ROTATION
OSCILLATOR TO R.F. AMPLIFIER
OSC. SPIRAL #11 TO R.F. SPIRAL #1
---- 3db TRACKING
4-11-60
TRACKING ERROR (MCS.)
+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION

FIGURE 18

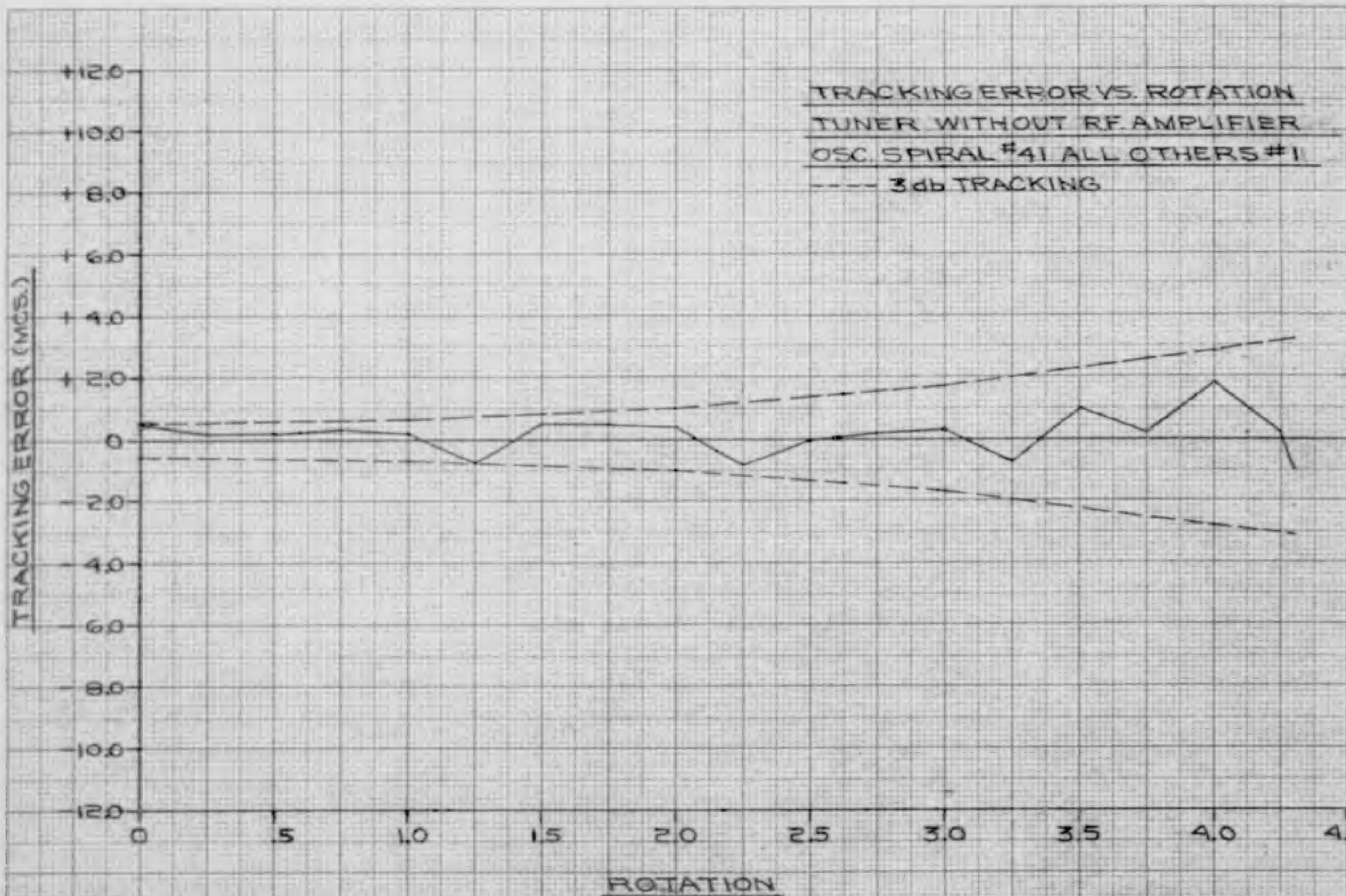
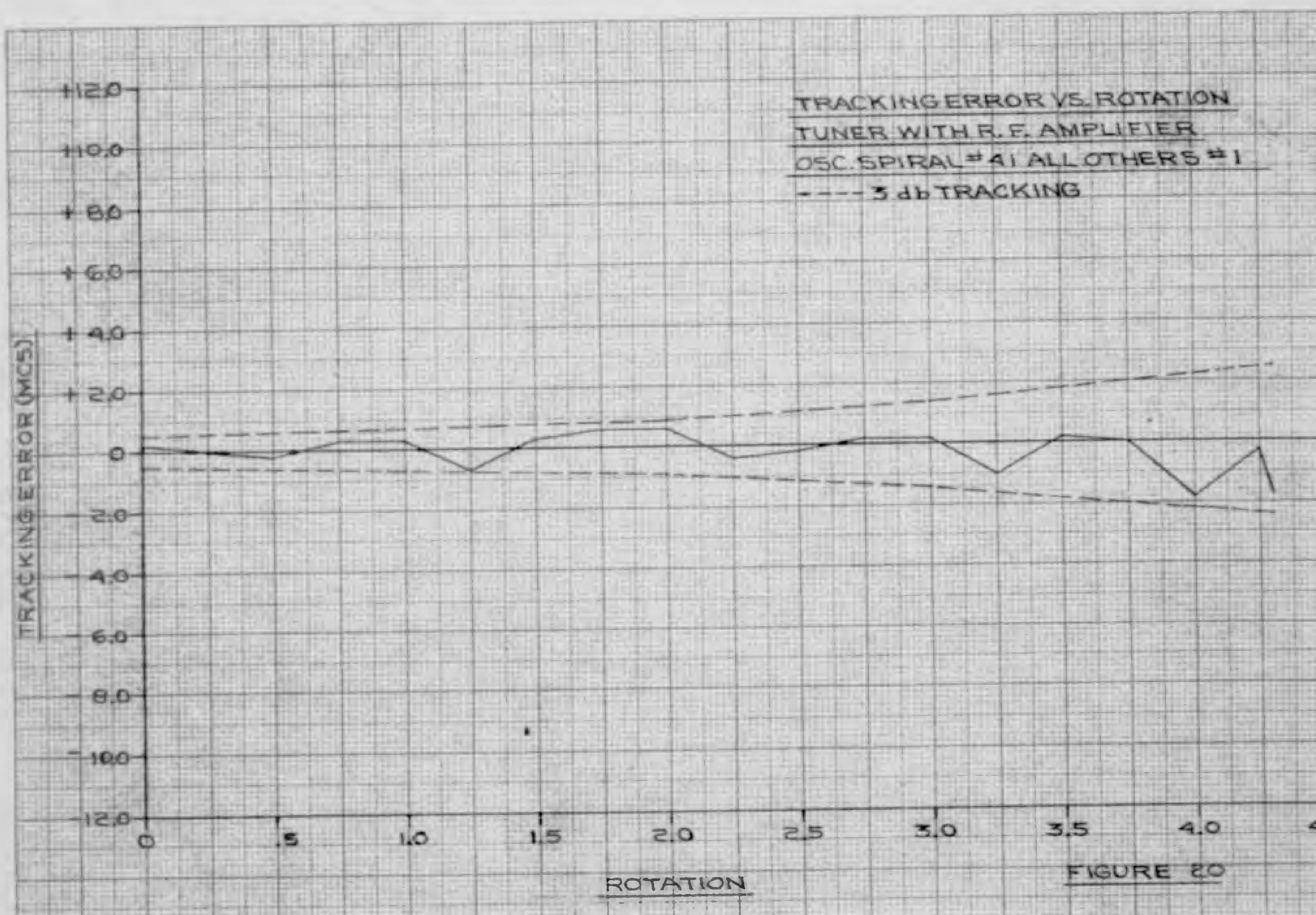

TRACKING ERROR VS. ROTATION
TUNER WITHOUT RF. AMPLIFIER
OSC. SPIRAL #41 ALL OTHERS #1
---- 3db TRACKING
TRACKING ERROR (MCS.)
+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION

FIGURE 19


TRACKING ERROR VS. ROTATION
TUNER WITH R. F. AMPLIFIER
OSC. SPIRAL #41 ALL OTHERS #1
---- 3 db TRACKING
TRACKING ERROR (MCS)
+12.0
+10.0
+8.0
+6.0
+4.0
+2.0
0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
ROTATION
FIGURE 20

the leads are soldered in place.

The dial is a nine-turn drum type with calibration marks every 8 mcs beginning at 96 mcs. These marks are red to make location easier. The dial has marks every 250 kcs from 95-250 mcs and marks every 500 kcs from 250-405 mcs. The difference in spacing is due to the inherent nonlinearity of this tuner design.

c. 30 mcs I-F Amplifiers, Detectors, Crystal Marker Oscillator, Chopper and Audio Amplifier

This assembly is composed of six 30 mcs i-f amplifier stages, a discriminator stage, a crystal marker oscillator stage, a chopper stage, and an audio amplifier stage. All of the above stages are of plug-in printed circuit construction.

The 30 mcs plug-in printed circuit i-f amplifier strip proved to be more difficult than originally anticipated. The first attempt at building a six stage i-f strip was unsuccessful. This approach was with a triode connected 6612 tube for the first stage and pentode connected 6611 tubes for the successive five stages. The triode connected 6612 stage was unstable and after considerable work to stabilize the circuit, it was abandoned. A pentode connected 6612 was tried in the first i-f stage. Twenty (20) db of gain was realized when the output of the stage was loaded with a 20 k resistor.

The pentode connected first stage was tied to five identical pentode connected stages using 6611 tubes. With each stage loaded, a gain measurement was taken and found to be about 106 db. However, the strip was regenerative and tended to be very unstable. Techniques of shielding and grounding improved the stability to some extent. However, the i-f strip was still regenerative. Shielded coils were next investigated, but no shielded, miniaturized variable inductors with a Q of 150 were available for use at 30 mcs.

The next approach was to redesign all of the i-f stages to facilitate the use of a torodial inductor and a variable capacitor for the tuned circuits of the i-f strip. At the same time a new chassis was designed and constructed that would house the six i-f stages, a discriminator stage, a chopper stage, an audio stage, and calibration oscillator stage. These tuned circuits would replace the tuned circuits composed of variable coils would on C.T.C. coil forms #2270-3 with fixed capacitors across them, used in the first i-f strip. After a thorough examination of several available types of toroidal coils, for variation of permeability and Q with temperature, coils made using Radio Cores #57-1543-0 toroid cores were selected. The new i-f strip employing the toroidal inductors did not have any tendency to oscillate.

The 100 kc and 25 kc crystal filters were then inserted between stages one and two and two and three respectively. The input and output impedances of stages one, two, three, and four were modified as necessary to match the 500 ohm impedance of the crystal filters. The addition of these crystal filters and/or their high impedance coupling loops caused the i-f strip to become regenerative. The gain of the i-f strip was reduced by the insertion loss of the crystal filters; this insertion loss was about 9 db. The pass band also had many ripples due to the fact that several crystals are employed in the 100 kc filter to obtain the proper band width of 100 kcs. The i-f strip was stabilized employing grounding techniques to remove ground loops, and by improving the decoupling network.

The first audio stage was constructed using 6611 tubes. It was composed of a driver and output stage. This arrangement had insufficient output power across a 600 ohm load. The 6611 driver was replaced with a 6612 tube and the output power was improved. The output power across 600 ohms was about 13 mw.

An audio stage was designed that had a 6611 driver and two 6611 tubes in Push-Pull for the output. The stage had interstage and output transformers. This arrangement provided the required 20 mw of power output. However, the stage was microphonic. The microphonics were traced to the 6611 driver stage. Due to the filamentary construction of the 6611 tubes, nothing could be done about the microphonics. Several other low drain tubes were tried in the circuit. They were microphonic also and due to their higher current drain were discarded. The above tube approaches were taken due to the contracting agency's desire not to have transistors in the receiver.

A transistorized audio stage was constructed using a 2N498 transistor and a 2N697 transistor connected as emitter followers. Feedback from 2N697 emitter to the 2N498 base increased the input impedance. These transistors were followed by a ST 4161 as a driver and two 2N697's connected in a Push-Pull output circuit. This arrangement provided 20 mw of low distortion audio. This elaborate circuitry was used to keep the audio stage from loading the discriminator.

When the receiver was returned for rework, the audio stage was redesigned to eliminate the variations in output impedance with output level noted by SRDL. The new audio section consists of three 2N1700 transistors connected as common emitter Class A amplifiers. Feedback from emitter to base at the first transistor stage determines the input impedance. The 120 k input impedance did not load the redesigned discriminator and the elaborate circuitry of the previous design was not necessary.

The AM detector was connected to the plate at the 6th i-f stage. The AVC detector and diode output chopper detector were connected to loops around the toroidal inductor in the plate tuned circuit of the 6th i-f stage. The number of turns of the loops were adjusted to give proper AVC action and maximum diode output. The discriminator was loop coupled off of the 6th i-f inductor. The AM, AVC, and diode output-chopper detectors were all located on the 6th i-f board.

When the receiver was returned for redesign, the detector circuits were replaced by a single doubler detector as shown in the schematic Appendix A. This doubler detector, along with increased gain in the i-f strip, increased the diode output by six to one. Also, the detector circuits were considerably simpler. This increased diode output, .09 v and .3 v in the 25 kc and 100 kc bandwidth positions respectively, was considered satisfactory by SRDL.

During the time of the redesign, two other approaches for increasing the diode output were pursued. This first approach was to amplify the existing diode output with a solid state d.c. amplifier. The simpler d.c. amplifiers were very temperature sensitive and, consequently, would not meet the stability requirements of the specifications. The relatively stable d.c. amplifiers were so complex and expensive that they were not practical for this application. The second was to run the chopper stage all of the time and amplify the output at the chopper with a separate audio amplifier and then detect the output of the separate audio amplifier. This approach provided the required .5 v dc diode output due to noise. However, it decreased the already short battery life and required additional parts and circuitry. SRDL decided not to accept this approach that provided the proper output, but to accept the doubler detector previously described.

When the two approaches above did not prove completely satisfactory for one reason or another, SRDL requested that we remove the 100 kc crystal filter in order to obtain more diode output and better f.m. sensitivity. The 100 kc crystal filter was removed and the i-f coupling loops appropriately adjusted. With the removal of the 100 kc crystal filter, the diode output in the wide band width position was increased to better than -0.5 v d.c. in all modes of operation. This -0.5 v d.c. output meets the requirements of the original specifications.

With the removal of the 100 kc crystal filter, the 6 db band width of the i-f strip in the WIDE band width position is about 230 kcs.

The 60 db band width is about 1.3 mcs.

Several discriminator circuits were designed and tested to obtain the greatest slope, or output, for the given 15 kc frequency deviation. Also, several coils were designed and tested. The best coil found was 10 turns of #20 wire wound on a one-half inch rexolite rod and center tapped. However, due to the stray radiation from this coil, it was not used. A toroidal coil of the same type used in the i-f stages was used to cut down the stray radiations. The discriminator circuit that performed the best and was the easiest to align was a modified Foster-Seely circuit. This was the circuit used. The modification was the elimination of the inductive coupling between the last i-f stage plate load impedance and the discriminator tank circuit.

Since tuning a receiver to a CW signal with a 30 mcs i-f is very difficult and requires very stable circuitry, a chopper stage was designed to replace the B.F.O. stage to take advantage of its wider bandwidth characteristic.

The chopper stage was designed using a "solid state device" Model #50 chopper, driven with a 6611 audio frequency oscillator. However, the "Solid State Device" chopper was not properly temperature compensated and the CW sensitivity was degraded by 14 db at -40°C. We obtained an improved version of their chopper, Model #60, and it was tested in the same circuitry. The Model #60 was considerably better than the Model #50; however, it degraded the CW sensitivity at -40°C more than the specifications allow.

A new chopper stage was designed using a single 2N1408 transistor and the 6611 audio oscillator. This stage performed satisfactorily and met all of the specifications for CW sensitivity at the temperature extremes.

An eight megacycle crystal controlled calibration oscillator was designed using a 6611 tube. This circuit was connected to a harmonic generator and tested. At this time, the harmonic generator produced harmonics up to the required 400 mcs with sufficient output to produce strong calibration markers in the receivers. However, when the harmonic generator was placed in the first preselector cavity and connected to the oscillator with a length of RG-174/AU coaxial cable, the harmonics were not present at the high end of the band. This was due to the capacity of the coaxial cable. The 6611 oscillator tube was replaced with a 6612 tube. This produced all but the two highest frequency calibration marks, 392 and 400 mcs, sufficient to be heard through the receiver.

The output of the 6612 oscillator was increased with very little success. A coaxial connector was fastened to the calibration oscillator board and a hole drilled in the i-f cover so that a coaxial cable could be attached. This shortened the cable length by a factor of three to one and, as a result of the smaller capacity, all of the calibration points were adequately generated.

d. Vehicular Power Supply

On request of SRDL, the transistorized vehicular power supply was designed to utilize as many of the parts in the PP-1481/PRR power supply for the R-744 receiver as possible. The power supply is of similar design, with a larger number of output voltages.

The vehicular power supply operates from the nominal 24 volt vehicle supply and supplies all of the circuits of the receiver normally supplied by its internal batteries. In addition, it supplies 6.3 volts to the heater of the r-f amplifier stage. Reference to the schematic in Appendix A should be made along with the following description of its major circuits.

The oscillator circuit consists of the transistors Q1202 and Q1203, resistor R1202, capacitor C1210, and the primary and feedback windings of transformer T1201. It is a conventional circuit employing inductive feedback between the collectors and the emitters of the transistors. Resistor R1202 controls the bias on the bases. Capacitor C1210 provides base bias stabilization during switching conditions. The frequency of this type of oscillator depends on the input voltage and transformer windings and core.

The voltage regulator consists of series transistor Q1201, amplifier transistor Q1204, reference Zener diodes VR 1201 and VR 1202 and the reference diode series bias resistor R1201. Transistor Q1201 acts as a variable voltage dropping resistance between the input voltage from the vehicular battery and the voltage applied to the oscillator.

The transistor Q1204 has its collector connected to the base of Q1201 so that any change in collector current of Q1204 produces an identical change at the base of Q1201. The difference between the Zener reference voltage and the output voltage is the emitter to base voltage of Q1204. As this voltage changes, it changes Q1204 collector current and base current of Q1201 which varies the effective series resistance of Q1201.

When the input voltage starts to rise, the regulator output voltage also starts to rise. This rise causes the difference between the reference voltage and the output voltage to decrease, which also decreases the emitter to base voltage of Q1204. This decrease in emitter to base voltage decreases the collector current of Q1204 and hence decreases the base current of Q1201. This decrease in base current causes the effective series resistance of Q1201 to increase which reduces the output voltage to near its original value. When the input voltage starts to decrease, the reverse action takes place.

Resistor R1201 provides bias to obtain the proper operating point for VR 1201 and VR 1202. Inductor L1201 and capacitors C1201 and C1202 act as a radio interference filter for the input voltage line.

Transformer T1201 has four secondary windings. The first of these supplies a full wave rectifier made up of diodes CR1201 and CR1202. The output of this rectifier is filtered by the inductor L1202 and the two capacitors C1203 and C1204. It also includes the two voltage regulating diodes VR 1205 and VR 1206. It supplies 1.4 ± .05 volts at 650 ma, with less than 10 mv peak to peak of ripple. Polarity with respect to ground is positive.

The second of the secondary windings supplies the full wave rectifier consisting of diodes CR1203 and CR1204. Since this is a heater supply, sufficient filtering is provided by capacitor C1205. Its output voltage is 6.3 ± .3 volts at 245 ma, with less than 300 mv peak to peak of ripple. Polarity with respect to ground is positive.

The third secondary supplies a bridge rectifier made up of diodes CR1205, CR1206, CR1207 and CR1208. The output of this rectifier is filtered by choke L1203 and capacitor C1206 and C1207. Its output is 43 volts ± 2.5 volts at 40 ma, with less than 25 mv peak to peak of ripple. Polarity with respect to ground is positive.

The fourth secondary supplies a bridge rectifier made up of diodes CR1209, CR1210, CR1211 and CR1212. The output is filtered by choke L1204 and capacitors C1208 and C1209. It supplies 90 ± 5 volts at 15 ma, with less than 25 mv peak to peak of ripple. The output polarity is positive with respect to ground.

e. Dust Cover, Front Panel, Vehicular Mount and Associated Equipment

The dust cover is a rectangular aluminum case approximately 14-1/4" wide, 8-7/8" deep, 6" high, and made of .062" thick material. The front is open and has six nut blocks to hold the front panel. The rear has a removable cover to provide access to the battery compartment. The battery cover is secured and sealed with six quarter turn fasteners and a rubber gasket. Three BA-418/U and one BA-405/U batteries are housed in the battery compartment to operate the receiver. The receiver compartment is watertight and sealed off from the battery compartment which may be subject to leaking depending on degree of sealing obtained with the removable battery cover.

Battery connections are made with a hermetically sealed 8 pin male connectors soldered into a suitable mounting flange and sealed to the bottom of the battery compartment with a rubber gasket. The batteries are guided on to the plugs with guide rails fastened to the side of the case. The dust cover is pictured in Figure 12.

The front panel was fabricated from 1/8" thick sheet aluminum and has a rim welded around the outside to stiffen it and provide protection for the controls. The rim also extended beyond the rear of the front panel to help retain a rubber gasket used as a seal between the front panel and dust cover.

The location of many of the controls on the front panel was determined by the location of their associated assembly or component. The controls not affected by these limitations were located to provide for convenience of operation and standardization within this series of equipments. The power and antenna connectors are on the right side of the panel and are oriented in such a manner that all cables will come in from the side rather than from the bottom. The front panel is pictured in Figure 10.

The controls, plugs and switches that penetrate the front panel are of a waterproof self-sealing type or are made so by the addition of rubber boots and sealing washers. The front panel is waterproof and is sealed to the dust cover by a rubber gasket held in place by six captive screws.

The vehicular mount for the receiver is a shock mounted aluminum frame designed to mount the receiver when used in mobile operations. Four bolts are used to fasten the mounting base to the vehicle. The receiver is firmly secured to the base by means of guide pins on the base which engage holes in the rear of the outer case of the receiver and two screw-actuated clamps located at the front of the vehicular mount. Vehicular mount is shown in Figure 21.

There was no requirement for associated equipment, such as spare parts kit, on this contract.

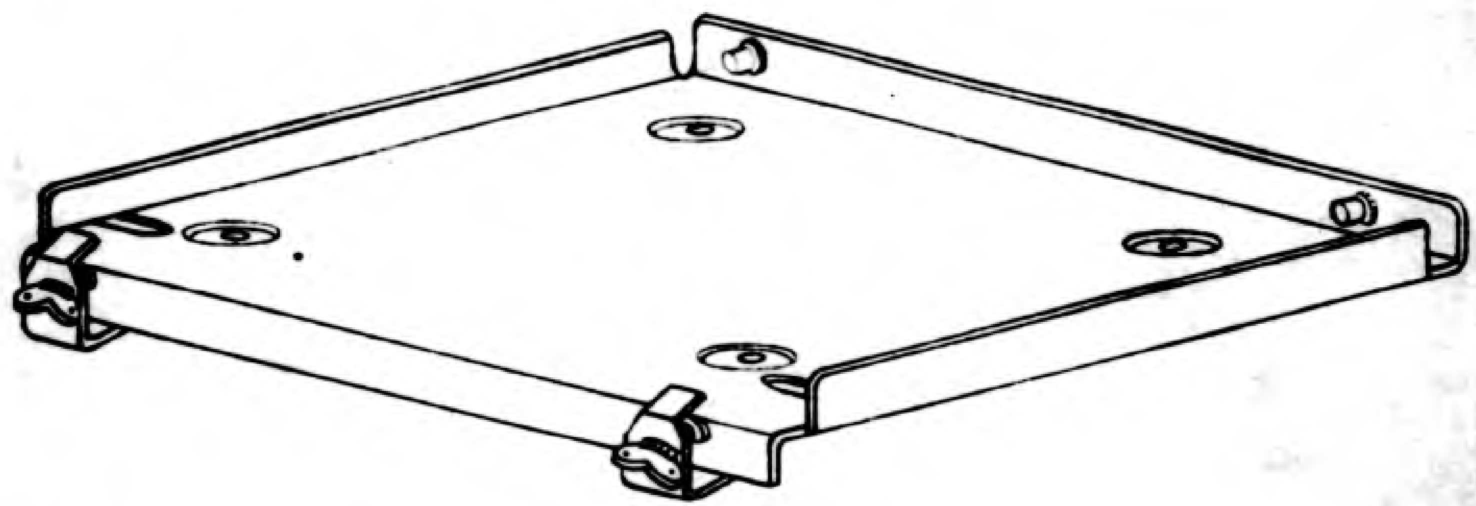


FIGURE 21
VEHICULAR MOUNT

V OVERALL CONCLUSIONS

The specifications, as outlined in SCL-5483A, dated 9 September 1958 as amended, represent an ideal receiver for this frequency range. The Radio Receiver R-902(XE-1)/PRD, as finally delivered, reasonably meets these specifications. Most of the deviations from these specifications were due to the inherent limitations of available components and their associated circuitry. Components, tubes and transistors in particular, that operate satisfactorily at the frequency of this receiver, with low power consumption, are state of the art devices. The effects of these component limitations upon the overall equipment operation were discussed in detail in the text of this report. When better low current components are developed, a receiver that more closely approximates the ideal can be built.

VI RECOMMENDATIONS

After a thorough examination of the characteristics and performance of the experimental model of the Radio Receiver R-902(XE-1)/PRD, the following recommendations are made.

The 100 kc crystal filter should be eliminated because of the ripples in the pass band. These ripples cause the discriminator to be very hard to align. The distortion is increased considerably because of the filter. Very little is gained in bandwidth, since the i-f 6 db bandwidth is less than 200 kc wide.

An additional i-f stage should be installed in the space vacated by the 100 kc crystal filter to determine whether additional stable i-f gain can be obtained with this stage. If additional stable i-f gain can be obtained, the FM sensitivity of the receiver can be improved.

A low current drain R-F amplifier tube or transistor should be developed that has 6 db or more of gain with a low Q tuning device at 400 mcs. This low current drain tube could be used in battery operation; thus improving the sensitivity. This would simplify the construction of the front end considerably by eliminating the complex switching necessary to insert the r-f amplifier into the circuit in vehicular operation.

A single 90 v battery should be substituted for the two BA 418/U 45 v batteries presently being used to obtain 90 v for the receiver. A BA 405/U, 1.5 v, battery should be substituted for one of the replaced BA 418/U batteries and connected in parallel with the existing BA 405/U, 1.5 v battery. This will improve the battery life of the receiver by almost two to one.

VII IDENTIFICATION OF KEY PERSONNEL

Engineering hours spent on the contract for the period of 30 June 1959 to 15 April 1961.

E. D. Aldred - Section Engineer	750 hours
M. M. Riddle - Project Engineer	3,633 hours
B. L. Borman - Junior Engineer	1,522 hours
C. H. Everhart - Senior Engineer	159 hours
F. T. Hiatt - Section Engineer	127 hours
R. L. Gillman - Senior Engineer	120 hours
R. R. Pitt - Junior Engineer	332 hours
H. F. Keck - Senior Mechanical Engineer	991 hours
J. Medeiros - Mechanical Engineer	376 hours
J. Stultz - Junior Mechanical Engineer	348 hours
C. Dunham - Junior Mechanical Engineer	1,224 hours
Miscellaneous	9,209 hours
TOTAL	18,791 hours

The resumes of additional engineering personnel are listed below:

F. T. Hiatt - Section Engineer

Purdue University, BSEE - 1951

Purdue University, MSEE - 1952

Specialization in Communication Networks, Modulation and Noise

P. R. Mallory & Co. Inc., Tuner Division, 1952-1956

Technical Products, Inc., 1956-1957

P. R. Mallory & Co. Inc., Electronics Division,
1958-Present

Richard L. Gillman - Senior Engineer

Purdue University, BSEE - 1955

U. S. Naval Avionics Facilities - 1955-1960

P. R. Mallory & Co. Inc., Electronics Division - 1960

R. R. Pitt - Junior Engineer

Centralia Junior College - 1950-1952

USAF Radio Operator - 1952-1956

Southern Illinois University, Technical Division -
1956-1957

P. R. Mallory & Co. Inc., Electronics Division -
1957-Present

Report Prepared by:

Miles M. Riddle, Project Engineer
Mallory Electronics Div.
P. R. Mallory & Co. Inc.

Approved by:

A. H. Gary, Chief Engineer
Mallory Electronics Div.
P. R. Mallory & Co. Inc.

DISTRIBUTION LIST OF REPORTS

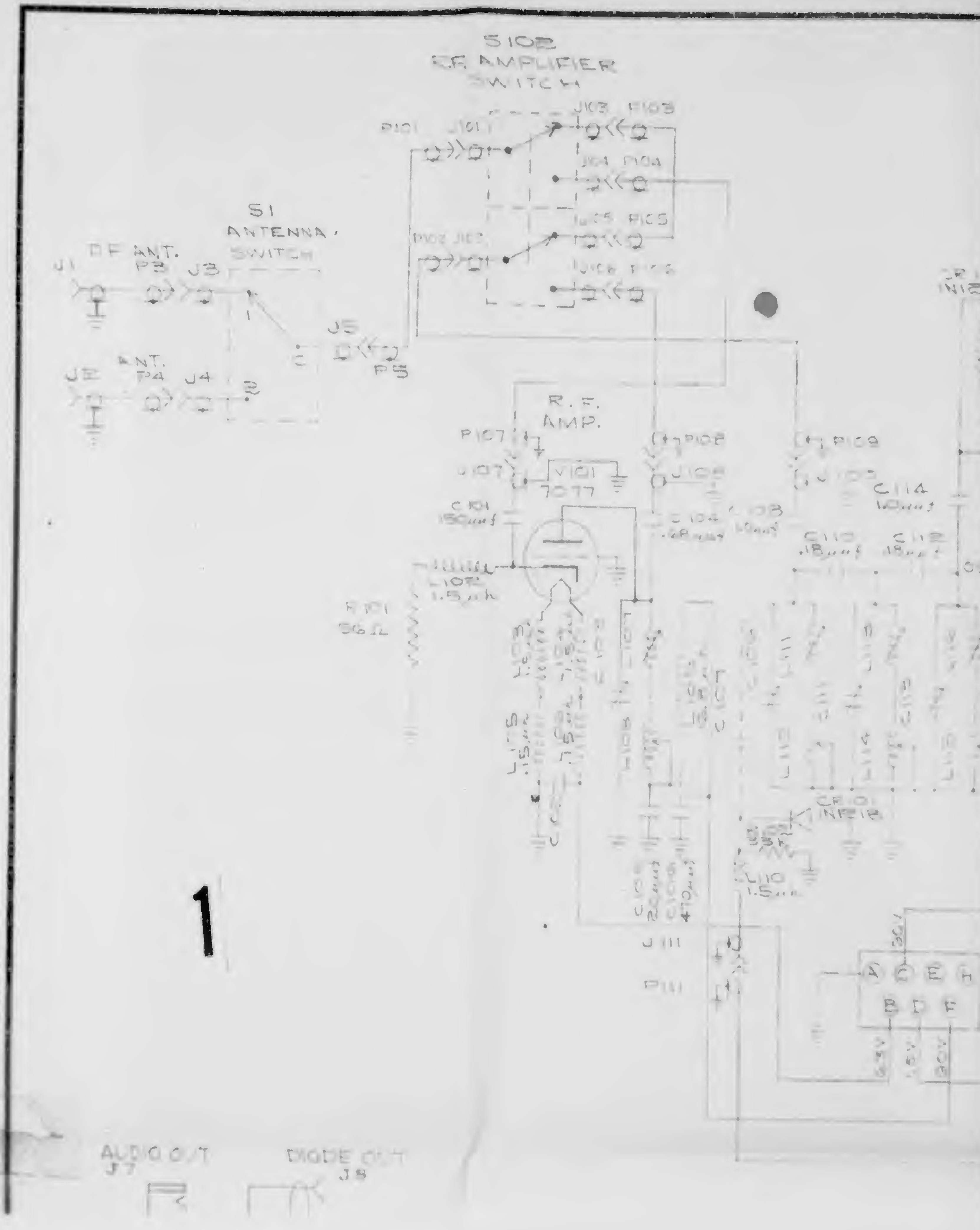
ISSUED UNDER CONTRACT DA 36-039 sc-78351

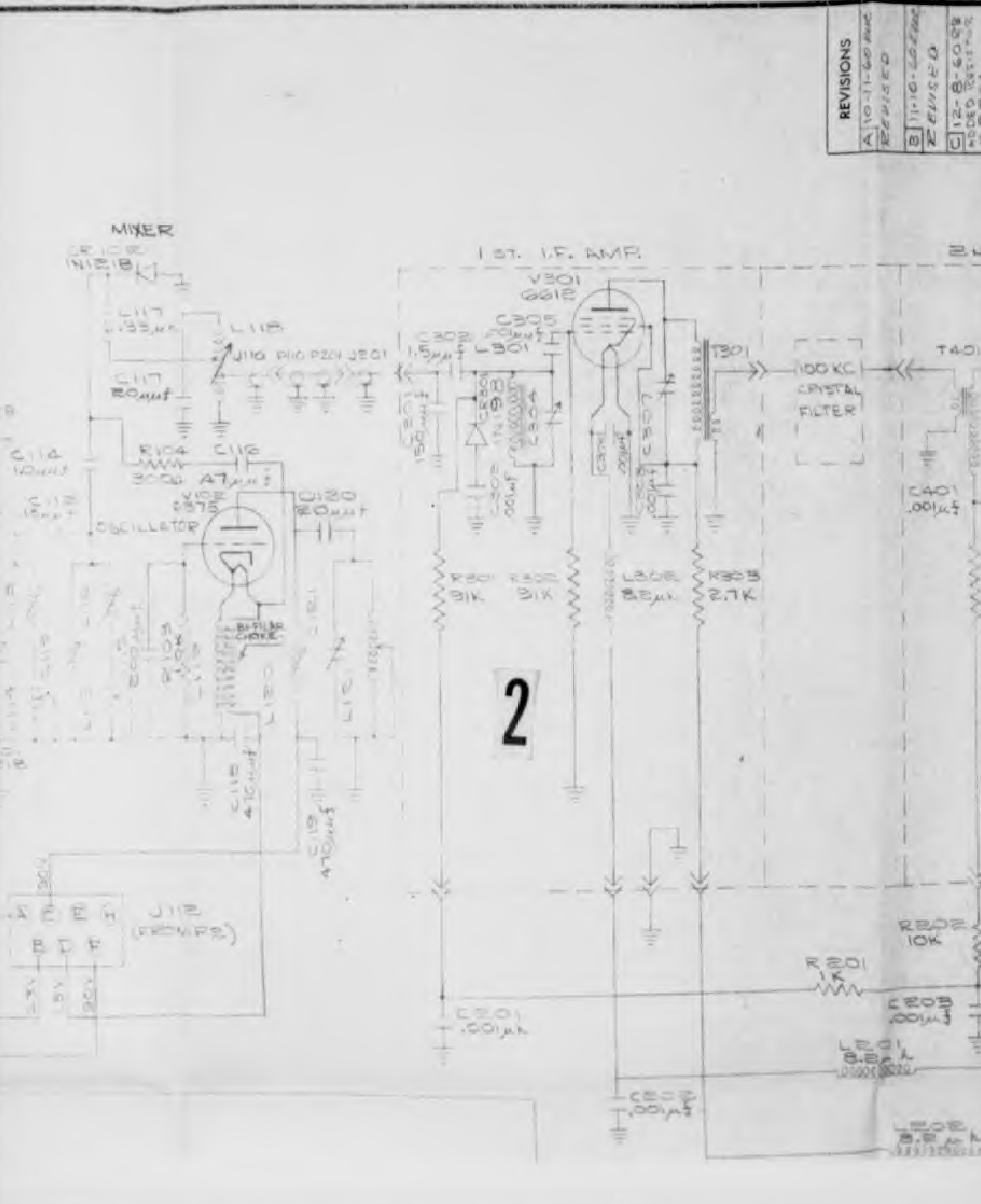
	No. Copies
Office of the Assistant Secretary of Defense (R&D) Technical Library Room 3E1065, The Pentagon Washington 25, D. C.	1
Chief of Research and Development OCS, Dept. of the Army Washington 25, D. C.	1
Chief Signal Officer Department of the Army Washington 25, D.C. ATTN: SIGPD-8b1	2
Chief Signal Officer Department of the Army Washington 25, D.C. ATTN: SIGRD-9	1
Director, U.S. Naval Research Laboratory Washington 25, D.C. ATTN: Code 2027	1
Commanding Officer and Director U.S. Navy Electronics Laboratory San Diego 52, California	1
Commander Wright Air Development Center Wright-Patterson Air Force Base, Ohio ATTN: WCOSI-3	2
Commander, Air Force Cambridge Research Center L. G. Hanscom Field Bedford, Mass. ATTN: CROTR	1
Commander, Rome Air Development Center Air Research and Development Command Griffiss Air Force Base, New York ATTN: RCSSLD	1

	No. Copies
Commanding General U.S. Army Electronic Proving Ground Fort Huachuca, Arizona	1
Commander Armed Services Technical Information Agency Arlington Hall Station Arlington 12, Virginia	10
Commanding Officer Diamond Ordnance Fuze Laboratories Washington 25, D. C. ATTN: Library, Rm. 211, Bldg. 92	1
Commanding Officer, 9560th TSU U.S. Army Signal Electronics Research Unit P. O. Box 205 Mountain View, California	1
Commanding Officer U.S. Army Signal Equipment Support Agency Fort Monmouth, New Jersey ATTN: SIGFM/ES-ADJ	1
U. S. Continental Army Command Liaison Office U. S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey	3
Corps of Engineers Liaison Office U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey	1
U. S. Navy Electronics Liaison Office U. S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey	1
Marine Corps Liaison Office U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey	1
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Logistics Division Marked for: Mr. D. Pfaff	3

	No. Copies
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Director of Engineering	1
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Technical Documents Center Surveillance Department	1
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: SIGFM/EL-ADJ (File Unit #4, Mail & Records Surveillance Department	1
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Technical Information Division	5
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Director, Countermeasures Division	1
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Chief, Detection & Location Branch	1
Deputy President U.S. Army Security Agency Board Arlington Hall Station Arlington 12, Virginia	1
Chief, U.S. Army Security Agency Arlington Hall Station Arlington 12, Virginia ATTN: IALOG	2

	No. Copies
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Chief, Jamming & Deception Branch	
Commanding Officer U.S. Army Signal Research & Development Laboratory Fort Monmouth, New Jersey ATTN: Chief, CM Systems Branch	2


S102
R.F. AMPLIFIER
SWITCH
P101
J101
J103
P103
J104
P104
J105
P105
P102
J102
J106
S1
ANTENNA
SWITCH
RF ANT.
J1
P3
J3
J5
P5
ANT.
J2
P4
J4
R.F.
AMP.
P107
J107
V101
7077
P108
J108
P109
C114
C101
150μμf
C104
C103
L102
1.5μh
R101
56Ω
C110
C112
L115
.15μh
L110
1.5μh
CR101
IN21B
J111
P111
A
C
E
H
B
D
F
AUDIO OUT
J7
DIODE OUT
J8
1



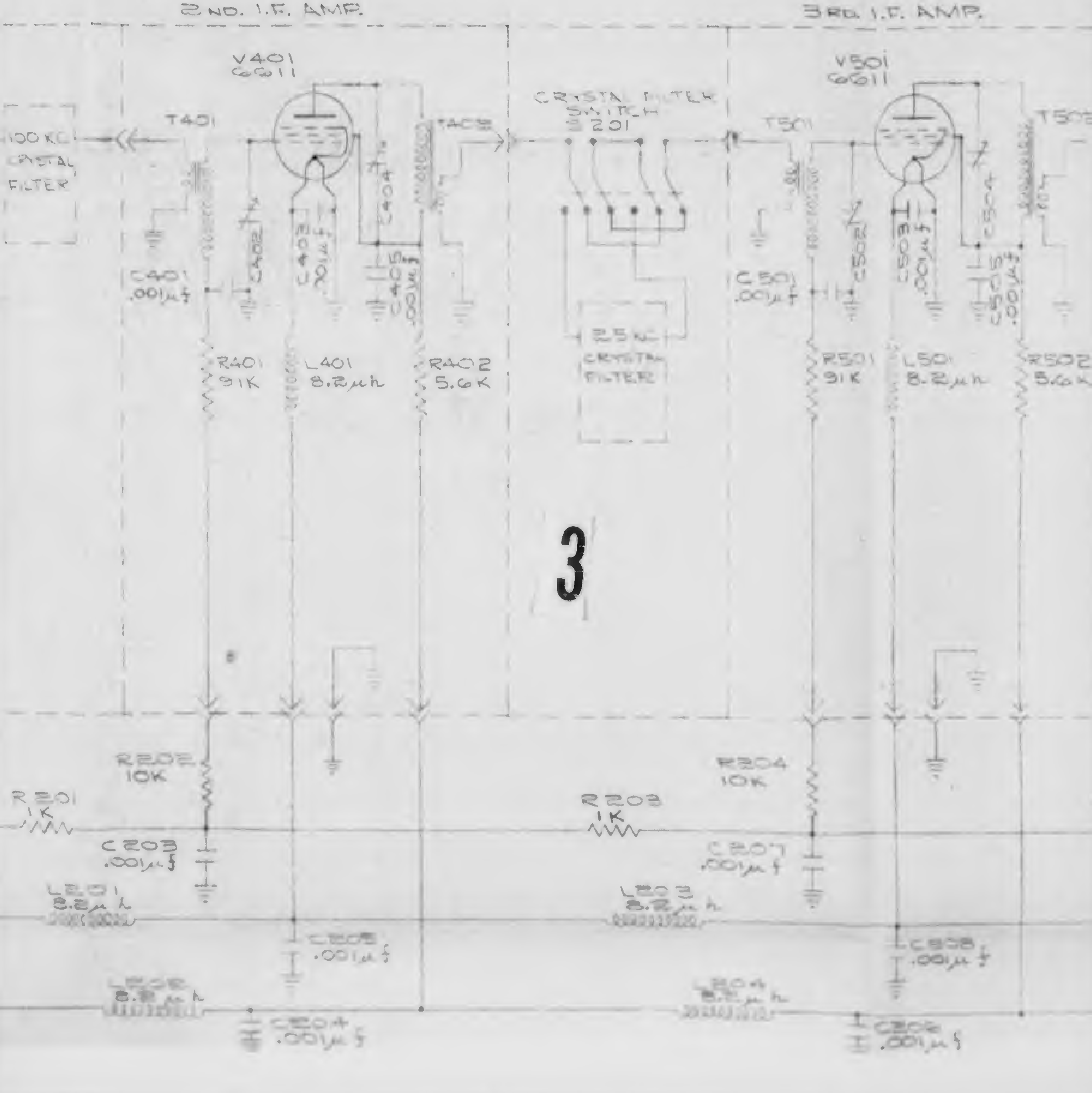
REVISIONS
A 10-11-60
REVISED
B 11-10-60
REVISED
C 12-8-60
MIXER
CR102
1N21B
OSCILLATOR
V102
1ST. I.F. AMP.
V301
6612
C305
C302
1.5μμf
L301
T301
100 KC
CRYSTAL
FILTER
T401
C401
.001μf
R301
91K
R302
91K
L302
8.2μh
R303
2.7K
BIFILAR
CHOKE
J112
(FROM PS)
R201
1K
R202
10K
C201
.001μh
C203
.001μf
L201
8.2μh
C202
.001μf
L202
8.2μh
2

REVISIONS

A	10-11-60 REVISED
B	11-10-60 REVISED
C	12-8-60 ADDED RESISTOR #R301
D	3-24-61

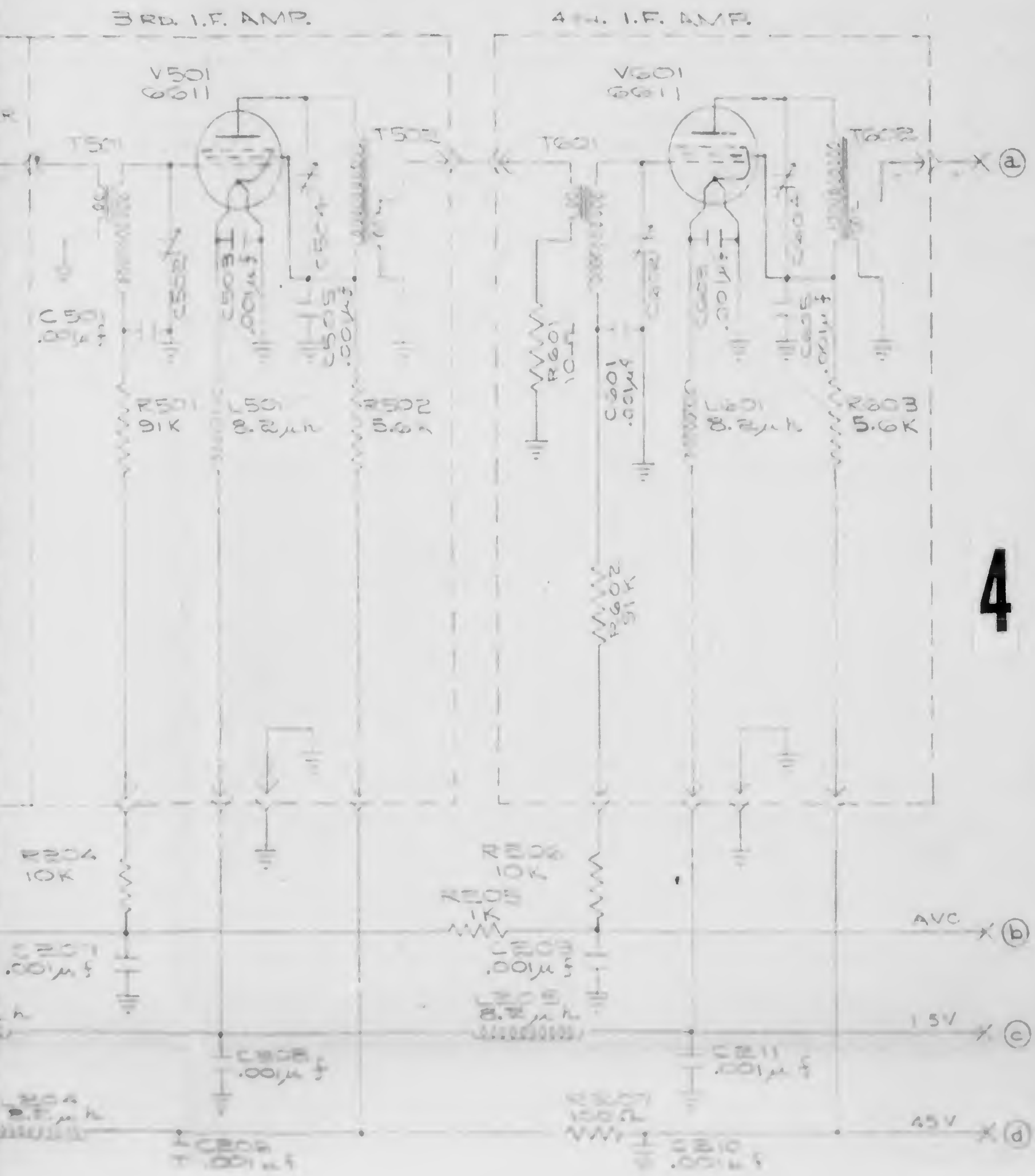
MALL...

SCALE:	
PART	ITEM

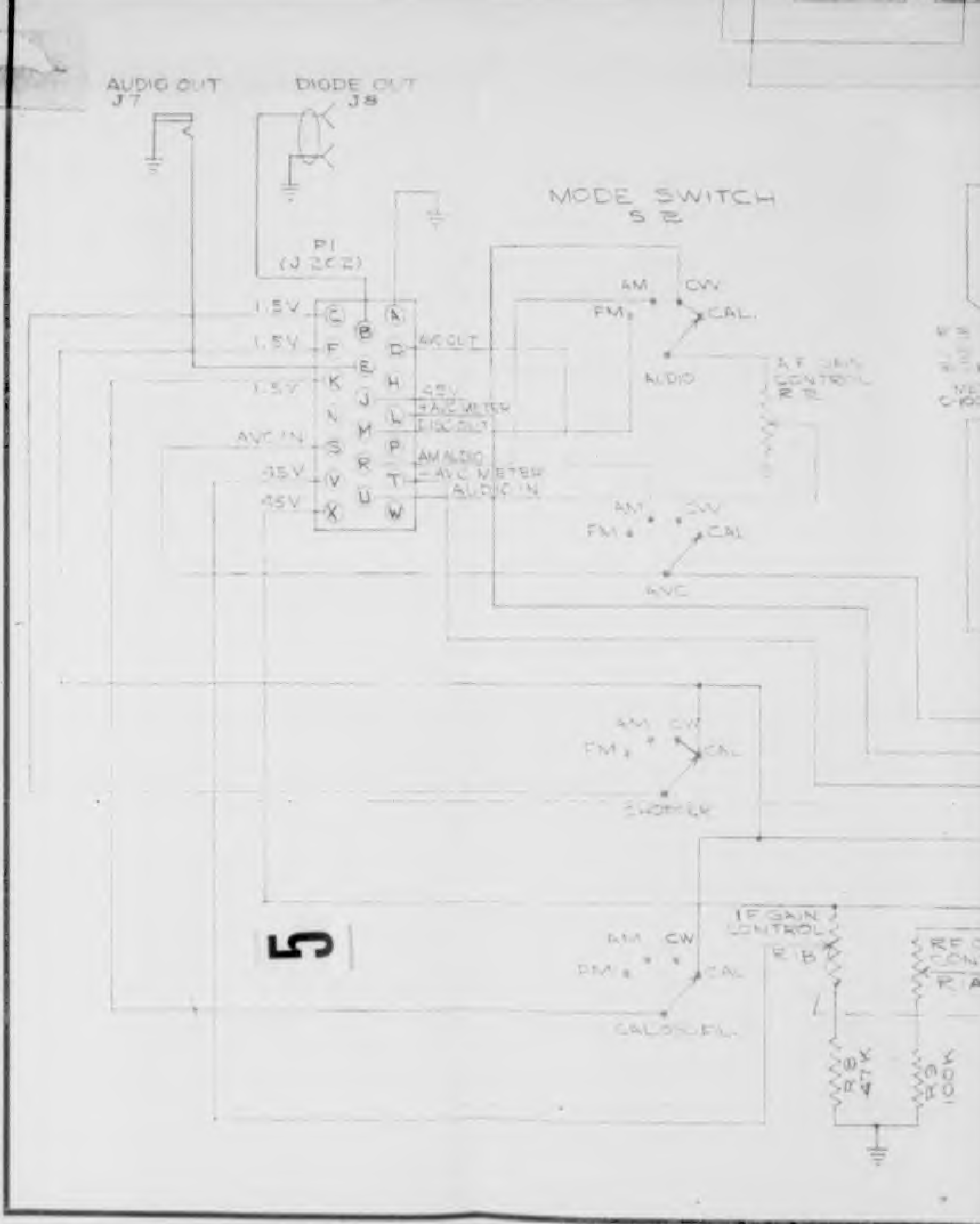


MALLORY Main Office: Indianapolis, Ind., U.S.A.	DRAWN BY: NLF DATE: 5-5-60	TITLE: SCHEMATIC DIAGRAM FOR RADIO RECEIVER R-902 (XE-1)/PRD-7	EAX-1337
SCALE: — APPR.	DIST.		UNLESS OTHERWISE SPECIFIED DECIMALS ± .005—FRACTIONS ± 1/64". DO NOT SCALE—ALL DIMENSIONS IN INCHES DIMENSIONS BEFORE PLATING

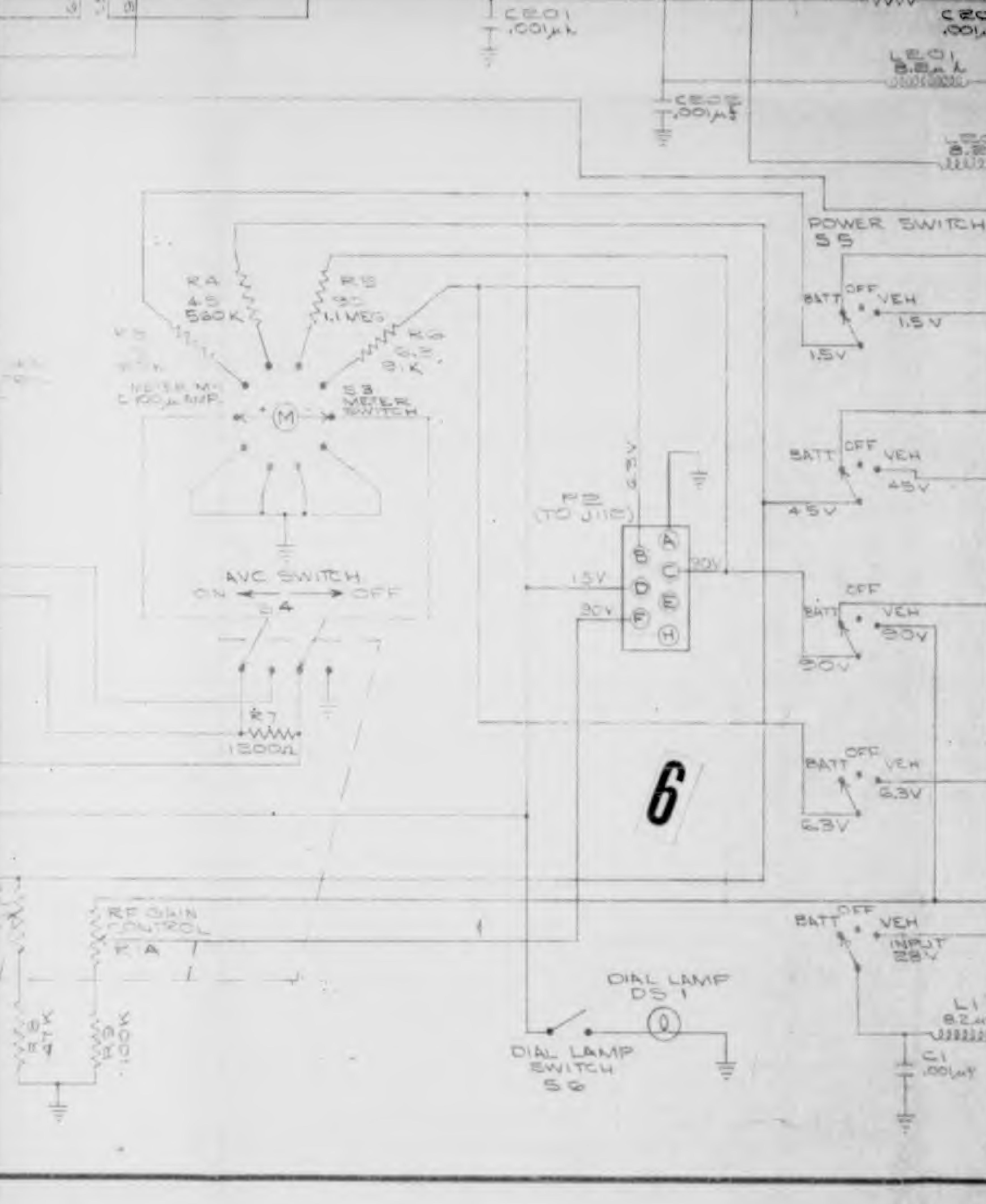
PART	ITEM	QUAN.	MATERIAL - DESCRIPTION	CODE	FINISH	WT/M

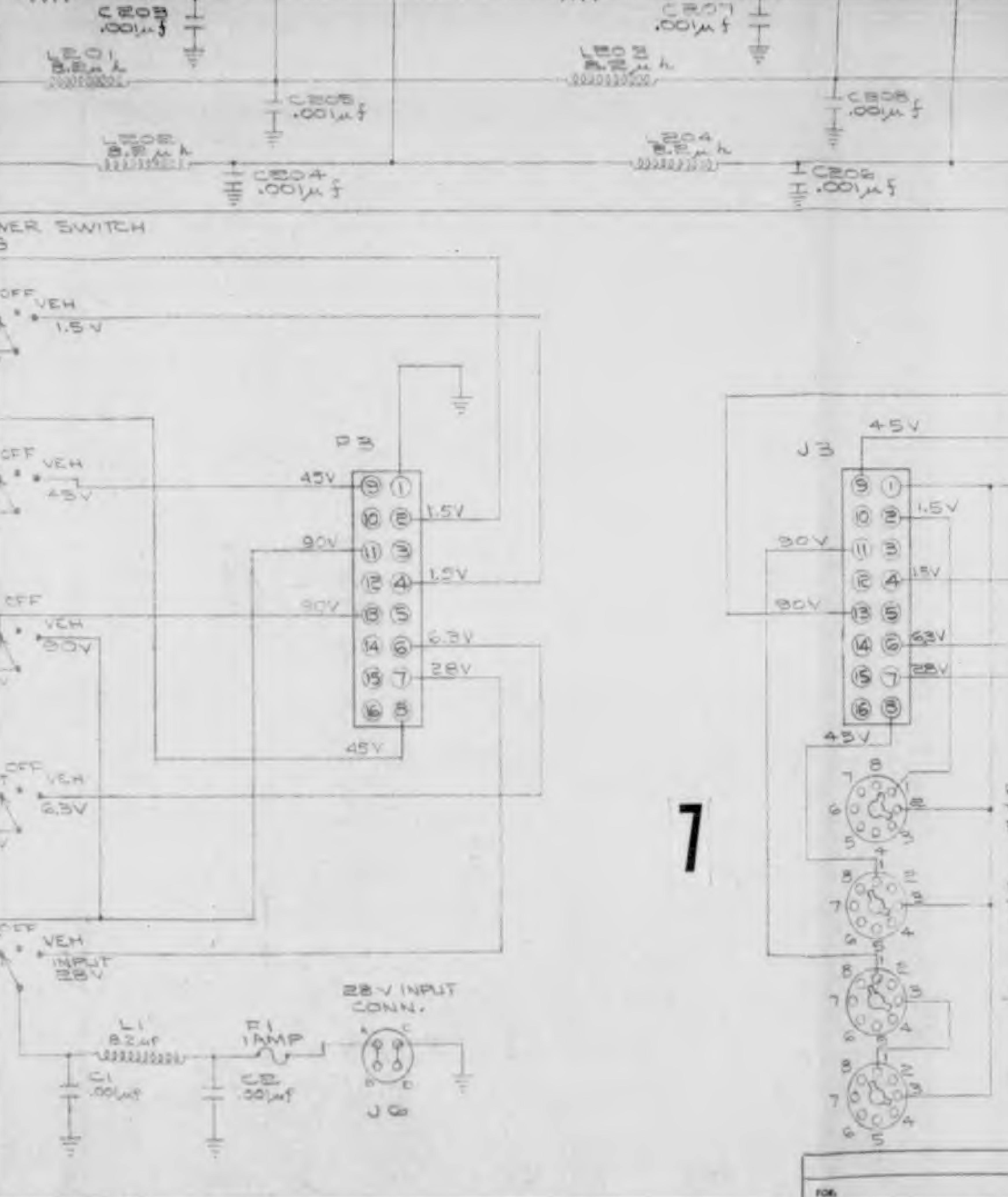


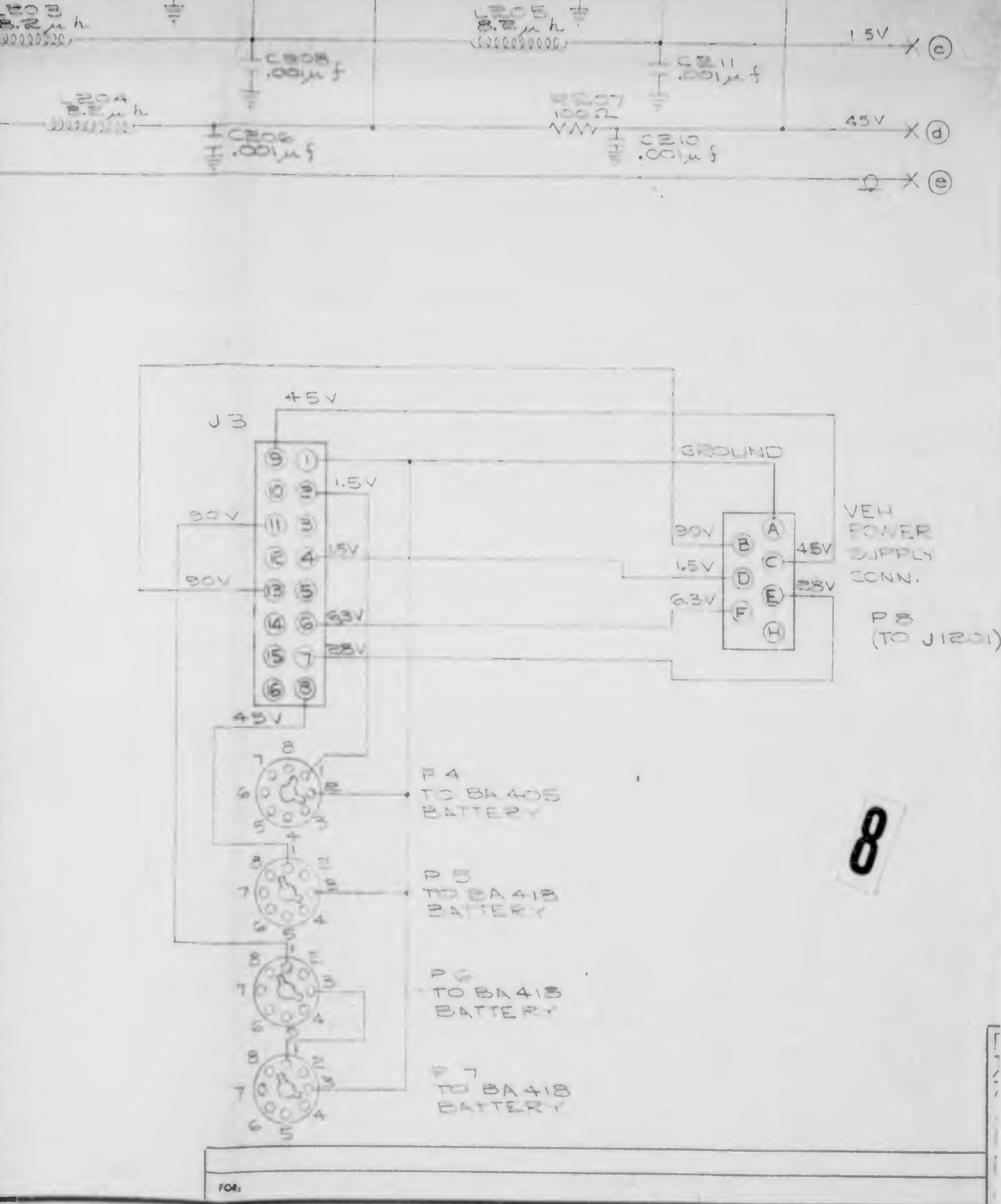
4



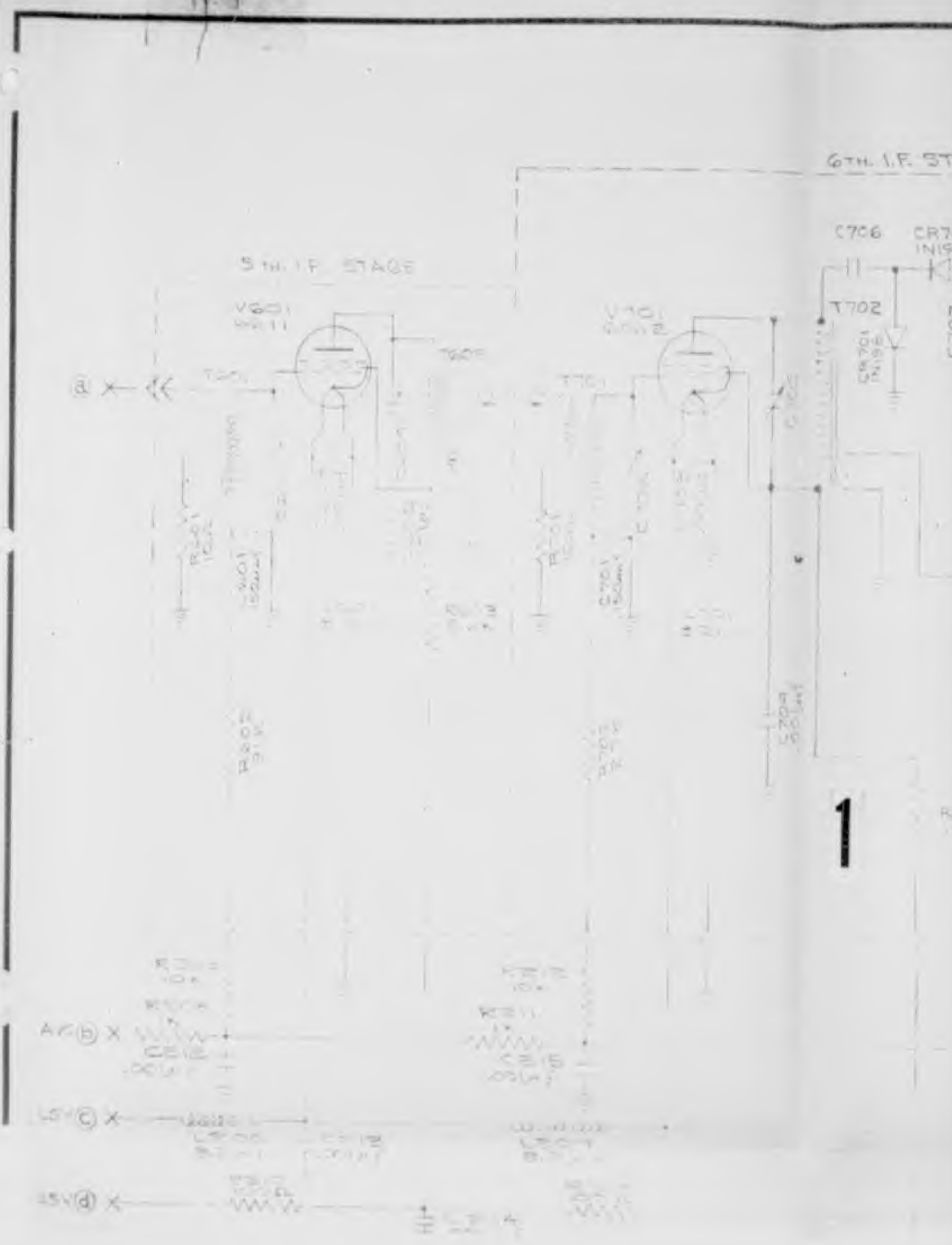
AUDIO OUT
J7
DIODE OUT
J8
MODE SWITCH
S2
P1
1.5V
C
B
A
1.5V
F
D
AVC OUT
E
K
H
J
45V
+AVC METER
N
M
L
DISC OUT
AVC IN
S
P
AM AUDIO
45V
V
R
T
-AVC METER
45V
X
U
W
AUDIO IN
AM
CW
FM
CAL.
AUDIO
AVC
IF GAIN
CONTROL
5

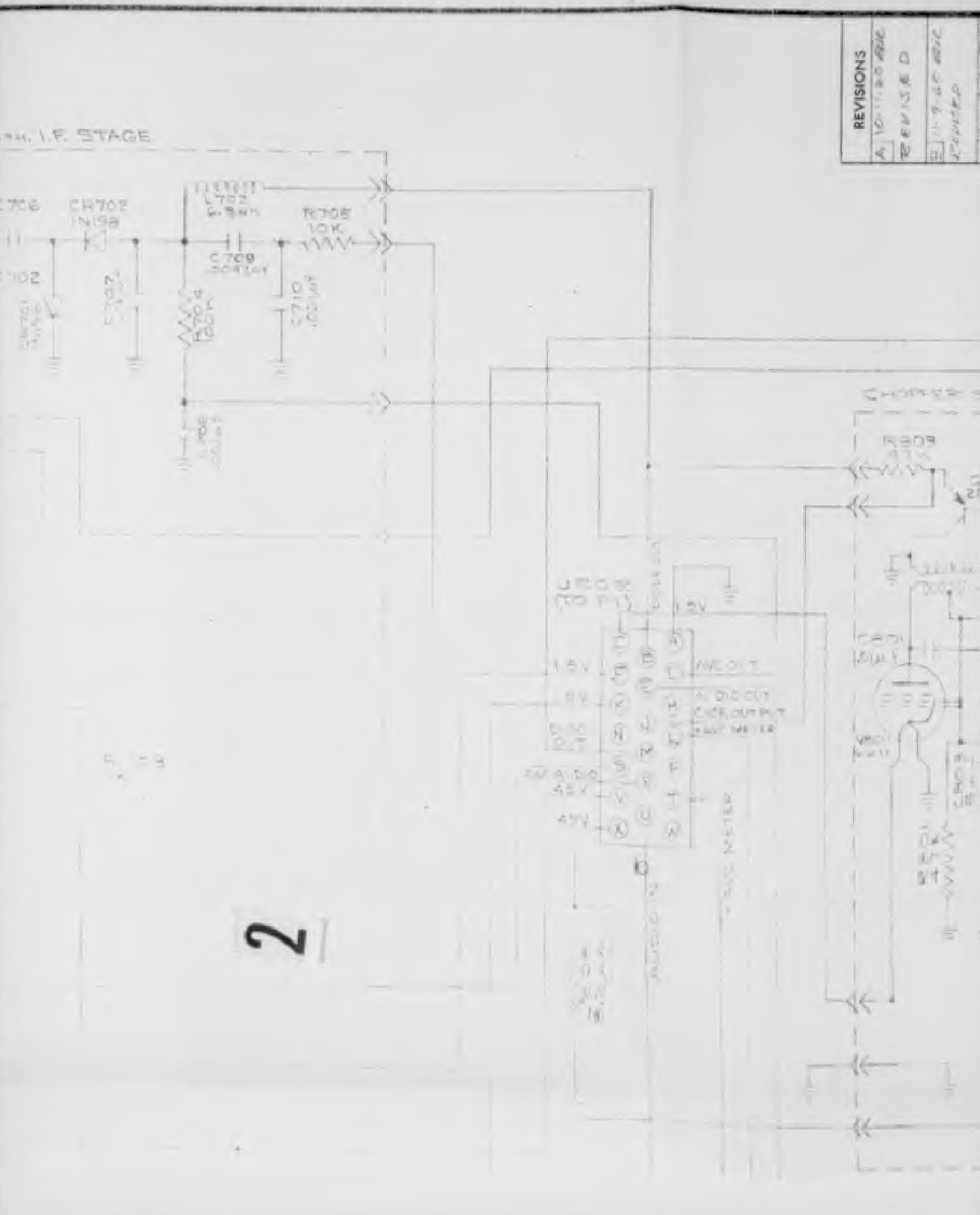

CE01
.001µf
CE02
.001µf
LE01
8.2µh
POWER SWITCH
S5
BATT
OFF
VEH
1.5V
45V
90V
6.3V
INPUT
28V
C1
.001µf
RA
45
560K
RB
90
1.1MEG
R6
6.3
9.1K
S3
METER
SWITCH
M
P3
(TO J112)
AVC SWITCH
ON
OFF
S4
R7
1200Ω
RF GAIN
CONTROL
DIAL LAMP
DS 1
DIAL LAMP
SWITCH
S6
6


C203 .001µf
C207 .001µf
L201 8.2µh
L203 8.2µh
C205 .001µf
C208 .001µf
L202 8.2µh
L204 8.2µh
C204 .001µf
C206 .001µf
VER SWITCH
OFF VEH 1.5V
OFF VEH 45V
OFF VEH 90V
OFF VEH 6.3V
OFF VEH INPUT 28V
P3
J3
45V
1.5V
90V
6.3V
28V
L1 8.2µf
F1 1AMP
C1 .001µf
C2 .001µf
28-V INPUT CONN.
J6
7
FOR


L203 8.2 μh
L205 8.2 μh
C208 .001 μf
C211 .001 μf
L204 8.2 μh
R207 100 Ω
C206 .001 μf
C210 .001 μf
1.5V
45V
(c)
(d)
(e)
J3
45V
1.5V
90V
1.5V
90V
6.3V
28V
45V
GROUND
90V
1.5V
6.3V
45V
28V
VEH POWER SUPPLY CONN.
P8 (TO J1201)
P4 TO BA 405 BATTERY
P5 TO BA 418 BATTERY
P6 TO BA 418 BATTERY
P7 TO BA 418 BATTERY

8


6TH. I.F. ST
C706
CR7
T702
5TH. I.F. STAGE
V601
V701
1

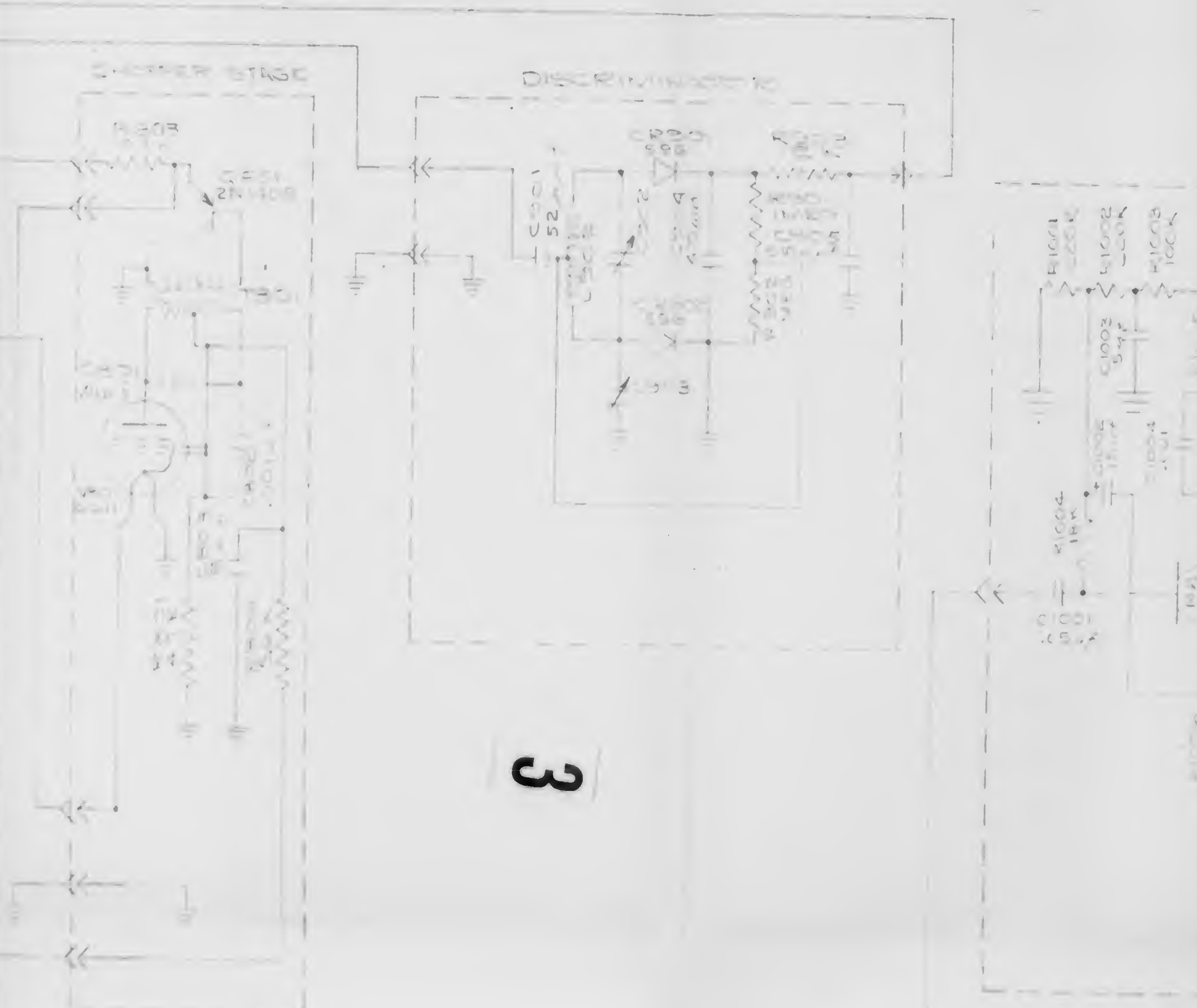

REVISIONS
REVISED
4TH. I.F. STAGE
C706
CR702
1N198
L702
6.8MH
R708
10K
C709
C710
CHOPPER
R809
47K
1.5V
A. DISC OUT
CHOP. OUTPUT
2

REVISIONS	
A	REVISED
B	REVISED
C	3-24-61 REVISED

MA...

SCALE:

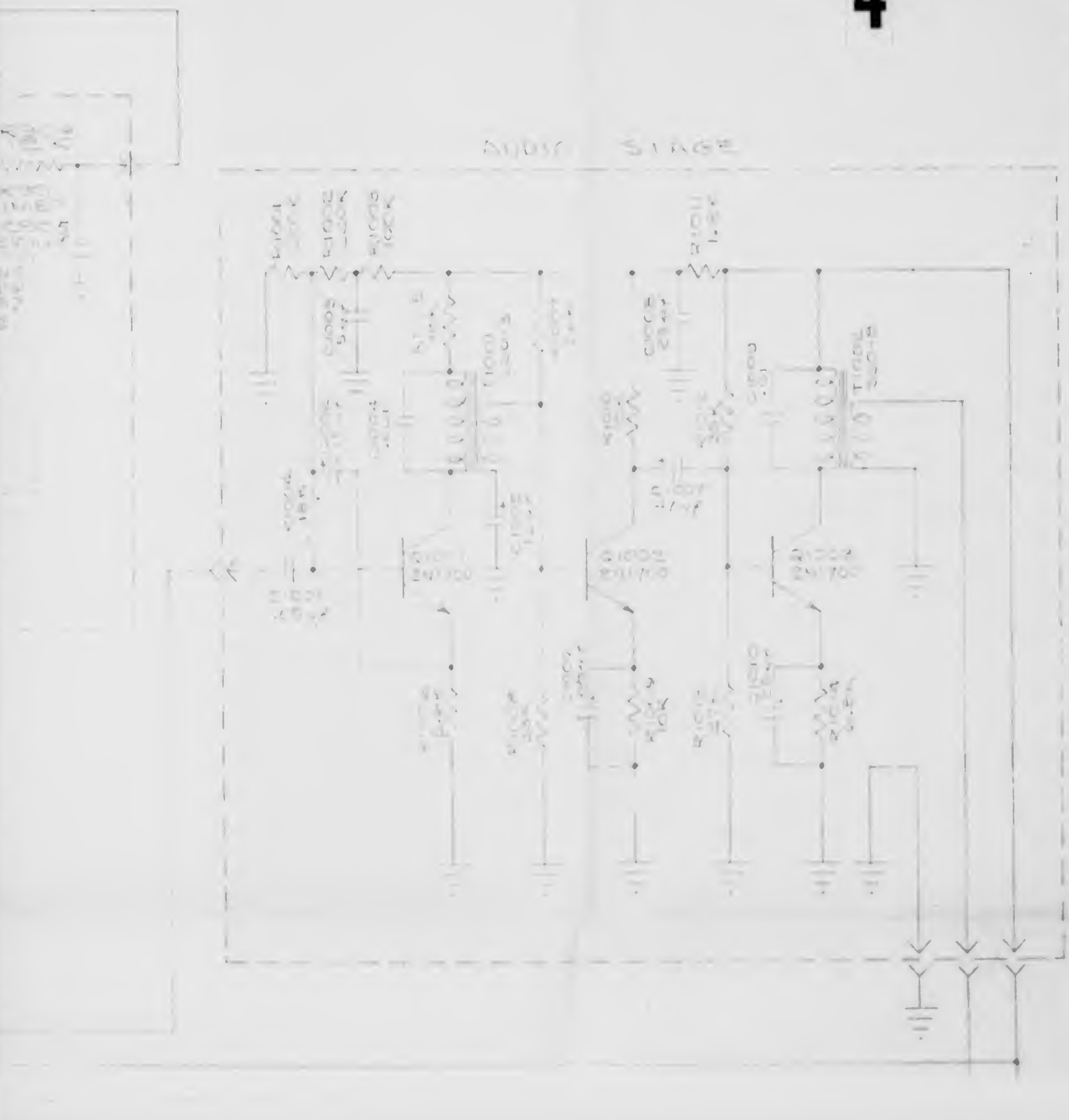
PART	ITEM

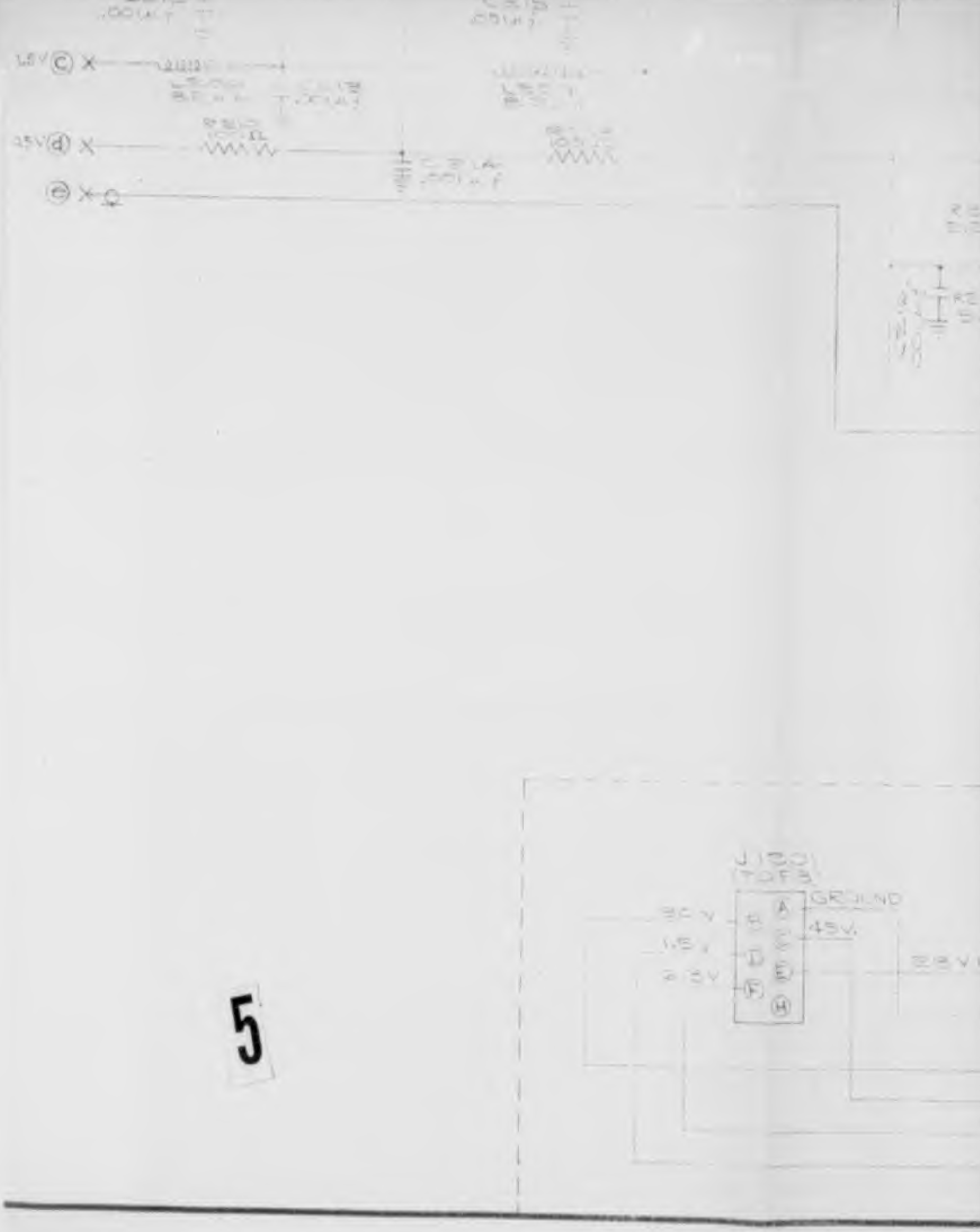


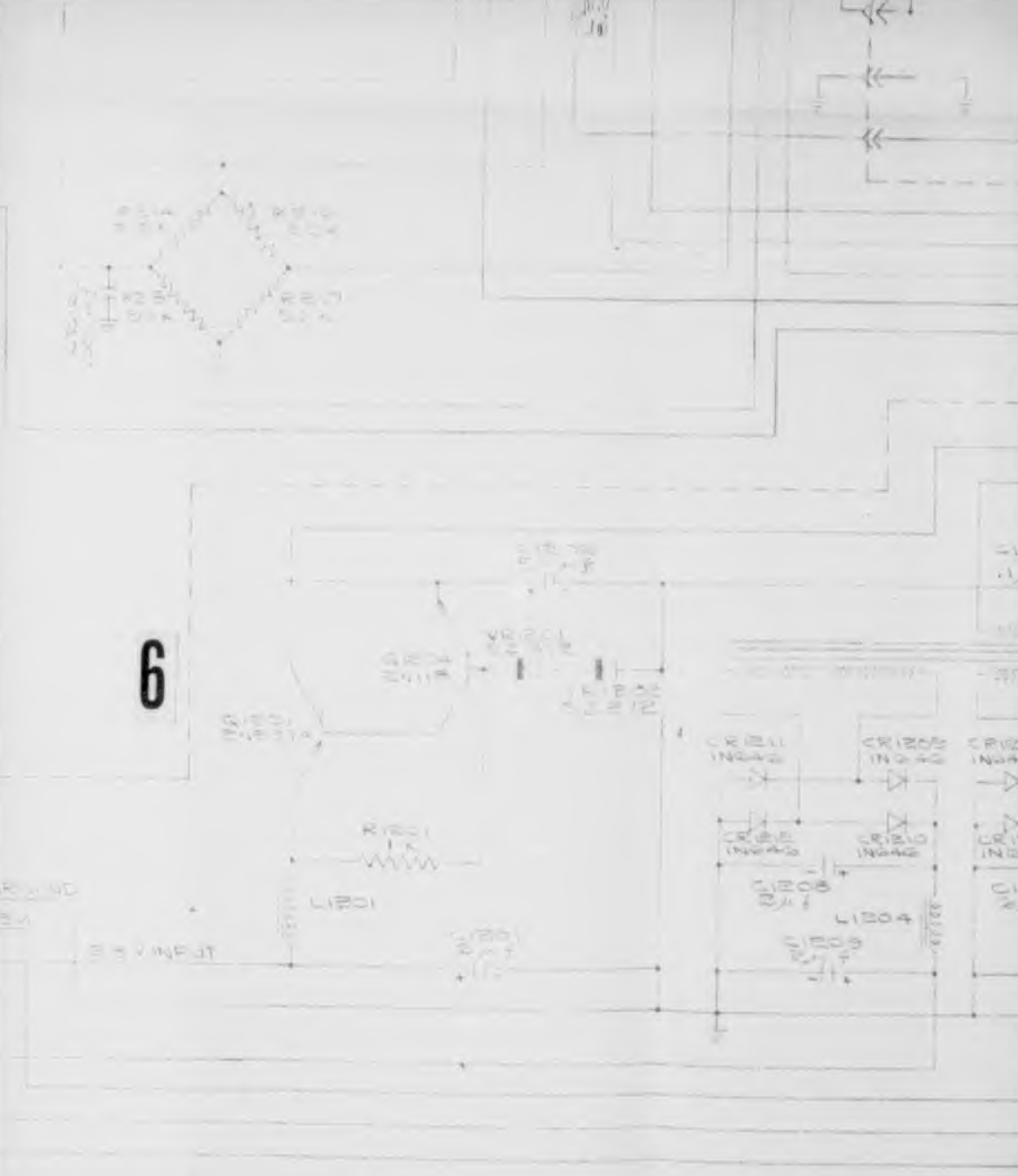
MALLORY Main Office: Indianapolis, Ind., U.S.A.	DRAWN BY: NLF DATE:	TITLE: SCHEMATIC DIAGRAM FOR RADIO RECEIVER	EAX-1337
SCALE: — APPR.	DIST.		UNLESS OTHERWISE SPECIFIED DECIMALS ± .005—FRACTIONS ± 1/64" DO NOT SCALE—ALL DIMENSIONS IN INCHES DIMENSIONS BEFORE PLATING

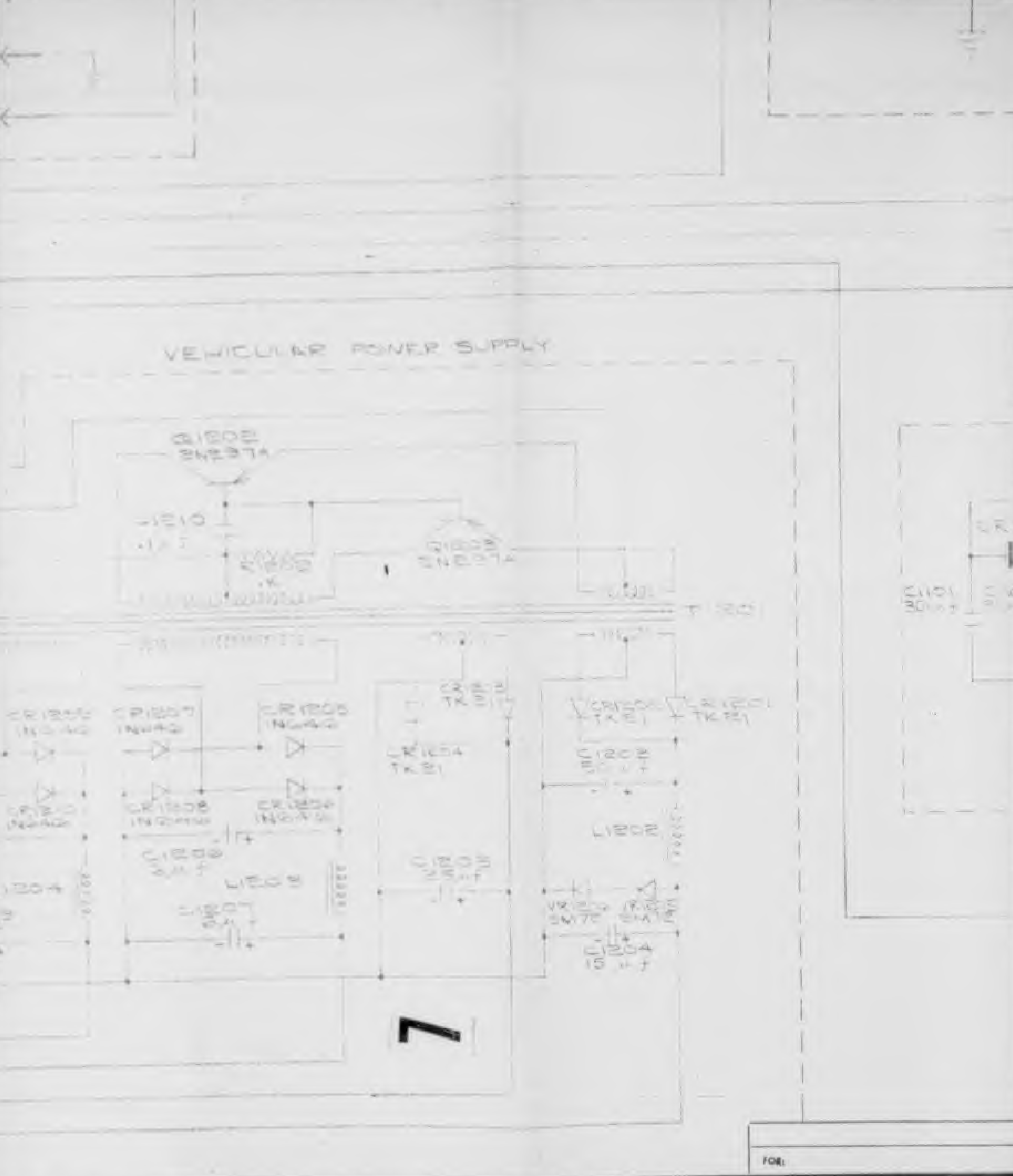
PART	ITEM	QUAN	MATERIAL - DESCRIPTION	CODE	FINISH	WT/M

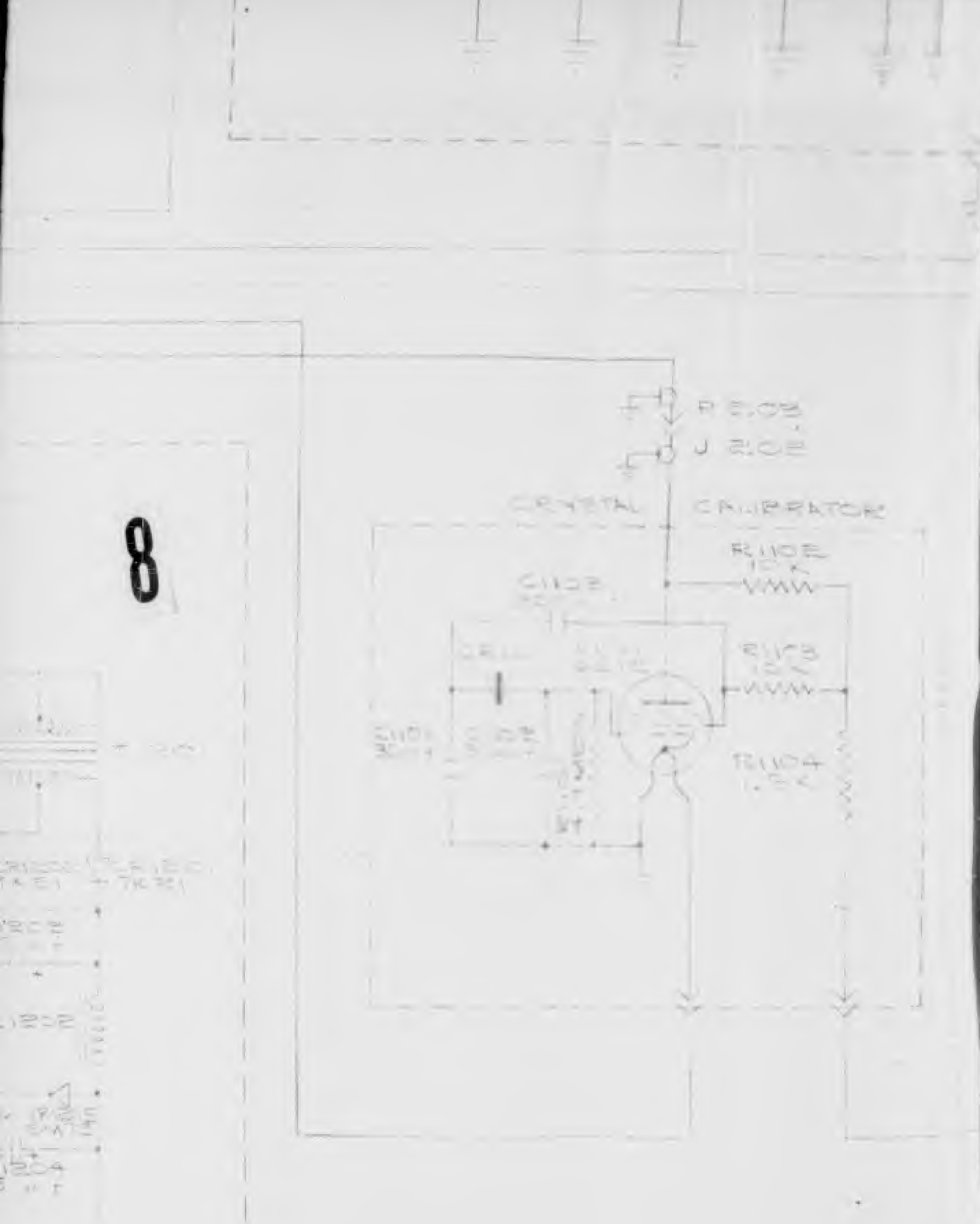
4




GROUND
45V.
5


6
R1201
L1201
C1208
L1204
C1209


VEHICULAR POWER SUPPLY
Q1202
Q1203
R1202
T1201
CR1204
C1202
L1202
C1203
C1204
15 µf
L1203
7
FOR:



FOR: