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Best Available Copy
March 25, 1963

(QUARTERLY REPORT, Jan 62 - Mar 62)
Prepared On

CONTRACT NO. NOber 81262

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

491-01
Prepared By
APPLIED RESEARCH INC.
76 South Bayles Avenue
Port Washington, N.Y.
1.0 ABSTRACT

1.10 This report covers work done on the development of an RF Spectrum Analyzer in the range from 100 MC to 1000 MC for the three month period from November 1, 1962 to January 31, 1963. 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 November 1, 1962 to January 31, 1963.

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 Spectrum Analyzer 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 RF Spectrum Analyzer together with the total number of hours spent by each during the period from November 1, 1962 to January 31, 1963.

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<thead>
<tr>
<th>Name</th>
<th>Total Hours Per Man</th>
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<tbody>
<tr>
<td>Braffman, R.</td>
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<td>Brown, H.</td>
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<td>Garbauskas, A.</td>
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<td>Heller, M.</td>
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<td>Pollacher, L.</td>
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4.0 DESCRIPTION OF WORK

4.10 During the period of this report the power IF amplifier/linear detector, Unit 1A7A8, was fabricated, aligned and tested. A schematic diagram of this unit is shown in Dwg. No. D600802, Figure 1. For convenience, a block diagram of the RF Spectrum Analyser is given in Dwg. No. R700449, Figure 2. Unit 1A7A8 was found to have the following characteristics:

- **Center Frequency**: 775 MC
- **Peak to Valley Ratio**: 0.1 DB at 775 MC ±2.75 MC
- **Bandwidth 3 DB**: 11.8 MC
- **Gain**: 26.5 DB
- **Input VSWR**: <1.5±1 (at 50 ohms)

4.11 The lin-log preamplifier, Unit 1A7A17, Dwg. No. C600853, Figure 3, fabricated in late August of 1962 was aligned and checked during this period. It consists of two stages of amplification with a shaping diode across the output of each stage. In the linear mode of operation, the diodes are back-biased and present a high impedance at the output of each stage. In the log mode of operation, the diodes are forward biased. In system operation, the biasing voltage is a DC feedback voltage derived from a feedback amplifier stage in the lin-log IF amplifier, Unit 1A7A7, and introduced via J3. See Figure 1. Gain, bandwidth, and peak to valley of the passband of Unit 1A7A17 were measured for different levels of DC voltage introduced at J3. The results are presented in Table I below.
TABLE I

Characteristics of Lin-Log IF Preamplifier, Unit 1A7A17

<table>
<thead>
<tr>
<th>DC Bias Voltage at J3</th>
<th>Bandwidth 3 DB</th>
<th>Peak to Valley Ratio</th>
<th>Gain</th>
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<tr>
<td>-20 volts</td>
<td>13 MC</td>
<td>0 771.75 MC 778.25 MC</td>
<td>+22 DB</td>
</tr>
<tr>
<td>-10 volts</td>
<td>19.5 MC</td>
<td>0.5 769.25 MC 780.25 MC</td>
<td>+19 DB</td>
</tr>
<tr>
<td>0 volts</td>
<td>23 MC</td>
<td>1.0 769 MC 781 MC</td>
<td>+15 DB</td>
</tr>
<tr>
<td>+0.2 volts</td>
<td>22 MC</td>
<td>1.0 767 MC 783 MC</td>
<td>+9 DB</td>
</tr>
<tr>
<td>+0.23 volts</td>
<td>23.1 MC</td>
<td>1.0 768 MC 783 MC</td>
<td>+6 DB</td>
</tr>
<tr>
<td>+0.38 volts</td>
<td>23 MC</td>
<td>3 768 MC 783 MC</td>
<td>-3 DB</td>
</tr>
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</table>

4.12 Two +200 volt power supplies used in the RF heads were returned to the vendor for repair in August of 1962. The reason is that one supply became excessively noisy after one hour of operation. The other supply kept blowing fuses. One of the two supplies sent back was lost on its way to the vendor. Its whereabouts could not be established. Therefore, an ARI regulated +200 volt DC power supply was tested during this period. This supply was considered as a possible replacement for the one lost. The unit when first tested exhibited a 40 millivolt to 50 millivolt bounce at its output. It was found that an oscillation of 800 KC was present at its output. A .01 μfd capacitor was connected from collector to ground of the regulating transistor in this power supply which removed the oscillation. The unit was then tested at no load to full load at a line frequency of 60 CPS and at 400 CPS. The measured results are presented in Table II below.
### TABLE II

**Measured Regulation and Ripple of +200 VDC Supply**

<table>
<thead>
<tr>
<th>Line Frequency</th>
<th>Volts</th>
<th>Ripple (MV)</th>
<th>Regulation (MV)</th>
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<tr>
<td>60 cps</td>
<td>105</td>
<td>0.8</td>
<td>1.3</td>
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<tr>
<td>60 cps</td>
<td>115</td>
<td>1.0</td>
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<tr>
<td>60 cps</td>
<td>125</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>400 cps</td>
<td>105</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>400 cps</td>
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</tr>
<tr>
<td>400 cps</td>
<td>125</td>
<td>1.0</td>
<td>1.0</td>
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</table>

4.13 The +200 volt DC supply of Paragraph 4.12 was temperature tested. The DC voltage was set to +200 volts under 100 mA load at room temperature (+21°C) after sufficient warm-up. The temperature was raised to 62°C and allowed to stabilize. The output voltage decreased to +199 volts. The ARI supply exhibits similar stability characteristics to the purchased supplies. The ARI supply has greater reliability and availability.

4.14 During this period the +33 volt, +30 volt DC supply, Unit 1A8PS4, was received from the vendor and was tested at room temperature. It proved to be within spec. The 30 volt output was accidentally shorted. The 0.5 amp fuse in that section blew and was replaced. In subsequent testing of the unit, it was found that ripple from the 33 volt output increased rapidly as the line voltage was reduced below 118 volts at 60 CPS and with both the +33 volt and +30 volt DC outputs under full load. The unit had evidently been damaged by the shorting. The unit was returned to the vendor for correction.
4.15 During this period the vendor sent back to Applied Research the +30 volt/+33 volt DC supply, Unit 1A8PS2, after having corrected the unit to meet specifications. The vendor also temperature tested the unit. The unit was then tested at Applied Research at 60 CPS under no load, full load, and low line, high line conditions. The 30 volt output was within specification with respect to ripple and regulation. The +33 volt output did not meet every specification but was considered adequate for trial in the system.

4.16 The -20 volt, -23 volt supply, Unit 1A8PS3, was received from the vendor. It was checked at room temperature from no load to full load and at low line and high line. The unit was found to be within spec. The unit was returned to the vendor, since he had failed to test it under varying temperature conditions. During this period, the vendor returned the -20 volt/-23 volt DC power supply, Unit 1APS3, after having temperature tested this unit. The unit was tested at Applied Research under no load to full load conditions and under low and high line at 60 CPS and found to be within spec.

4.17 The 6.3 volt DC power supply, Unit 1APS4, was returned by the vendor during this period after the vendor had given the unit a temperature test. The unit was tested under the same conditions as in Paragraph 4.16 and was found to be within spec.

4.18 The +28 volt DC supply, Unit 1A8PS5, was returned from the vendor after having been temperature cycled during this period. It was tested under the same conditions as in Paragraph 4.16 and found to be within spec.
During this period two low pass filters, Units 1A7A15 and 1A7A16, reworked in manufacturing were returned to the lab. The components of each filter were better shielded from each other to prevent feed-through. The filters were tested. The measured characteristics of low pass filter, Unit 1A7A16, are as follows:

(a) 0.2 DB attenuation at 400 MC  
(b) 3 DB attenuation at 430 MC  
(c) 4 DB attenuation at 610 MC  
(d) 60 DB attenuation at 635 MC  
(e) 90 DB attenuation at 775 MC  
(f) VSWR Input: <1.5 up to 402.5 MC  
(g) VSWR Output: <1.5 up to 402.5 MC  

The measured characteristics of low pass filter, Unit 1A7A15, are as follows:

(a) 0.1 DB attenuation at 400 MC  
(b) 3.0 DB attenuation at 435 MC  
(c) 40.0 DB attenuation at 588 MC  
(d) 60 DB attenuation at 705 MC  
(e) 90 DB attenuation at 775 MC  
(f) Input VSWR: <1.5:1 up to 402.5 MC  
(g) Output VSWR: <1.5:1 up to 402.5 MC  

The 25 KC crystal filter centered at 30 MC, Unit 1A7All, was tested during this period. The unit was found to be substantially within spec. It has the following measured characteristics:

Center Frequency: 30 MC  
Bandwidth 3 DB: 24.4 KC
Bandwidth 6 DB: 27.2 KC
Bandwidth 60 DB: 49 KC
Shape Factor (BW60DB): 1.82:1
Insertion Loss at 30 MC: 3.25 DB
Spurious Responses: >60 DB

4.22 The 30 MC 5 KC wide crystal filter, Unit 1A7A12, received from the vendor in July was returned to him for correction of excessive spurious responses outside the pass band. During the period of the report, the filter was returned to Applied Research. It was tested and found to be within spec. Its measured characteristics are as follows:

Center Frequency: 30 MC
Bandwidth 3 DB: 4.8 KC
Bandwidth 6 DB: 5.2 KC
Bandwidth 30 DB: 9.2 KC
Bandwidth 60 DB: 13.4 KC
Spurious Responses: None Discernible
Shape Factor (BW60DB): 2.57:1

4.23 A preliminary subsystem bench test was made on the section involved in the 775 MC to 30 MC to 775 MC conversion during this period. This included the bicooupler, Unit 1A7A9; the 775 MC to 30 MC converter, Unit 1A7A10; the 30 MC crystal filter, Unit 1A7A11; the 30 to 775 MC converter, Unit 1A7A1A; the 402.5 MC local oscillator, Unit 1A7A15, and the two low pass filters, Units 1A7A15 and 1A7A16. See the block diagram, Figure 1. A swept signal centered at 775 MC was applied
at J3 of Unit 1A7A9 and the output of Unit 1A7A14 was observed. A loss of -18 DB was found from input to output instead of the design objective of -15 DB. The 775 MC to 30 MC converter, Unit 1A7A10, exhibited a conversion loss of -4 DB instead of the expected 0 DB while the 30 MC to 775 MC converter, Unit 1A7A14, exhibited a conversion gain of +1 DB instead of the expected 0 DB. An attempt will be made to modify the 30 MC conversion units to achieve a lower overall loss while still retaining the basic design concepts and module sizes.

4.30 A project performance and schedule chart is given in Dwg. No. BSF-136, Sheets 1 and 2, Figures 4 and 5.
5.0 PROGRAM FOR THE NEXT THREE MONTH INTERVAL

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

5.11 The console will be completely assembled and wired.

5.12 Final system testing will be completed.

5.13 The Spectrum Analyzer will be shipped.
J2
OUTPUT

1C15
47uf
35V

R10
100K FT

R11
6.8K
1W

R12
4.7K

R9
22

16
000FT

C

J3

+33VDC
45 MA

YEL

A

BLK

B

-33VDC
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**Diagram:**

- **J2**
  - **OUTPUT**

- **J3**
  - **A** → +33VDC
  - **B** → -33VDC
### COMP, REF, DESIGN

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<td>15</td>
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### Note

1. Unless otherwise noted:
   - All capacitors in UUF
   - All RFC = ARI 800
   - All resistors are 1/2W

### Schematic

**Power Amplifier**

**Detector**

**Unit 1A7A8**

---

**Material:**

**Drawn by:**

**Drawn:** 5-24-62

**Checked:**

**Approved:**

**Scale:**

**Unit Wt.:**

**Applied Research Inc.**

**Port Washington, New York**

**Dwg. Size:** 600802

**Issue:** B

---

**Fig. - 1**
UNIT IA9

5\" SCOPE

TEKT-O-MIX MODEL "R115-MOD101

J2   J1

J4   J3

J6   J5

(UNIT IA1A1) TO IF ATTENUATOR

TO IA1J21 TO IA1J20

UNIT IA7A2

BANKS FILTER 17SC

15DB PFL 147RE

J1

J2 4DB
UNIT 1A8PS5

NOTE:
1. UNLESS OTHERWISE SPECIFIED, ALL RF CABLE TO BE RG 55 B/U.
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ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:

FRACTIONS ± \( \frac{1}{64} \)
ANGLES ± \( \frac{1}{8} \)

FRACT. DECIMAL XX ± 0.010 ANGLES ± 0.015

FINISH: 

APPLIED RESEARCH INC.
PORT WASHINGTON
NEW YORK

JOB NO. NEXT ASSEMBLY APPLICATION

BLOCK DIAGRAM
RF SPECTRUM ANALYZER

421.21
NOTE
1. ALL CAPACITORS IN \mu F
2. R3 & R4 SELECTED FOR 10 MA TUBE CURRENT
3. F0 = 775 MC
NOTE
1. ALL CAPACITORS IN \mu F
2. R3 & R4 SELECTED FOR IOMA TUBE CURRENT
3. \text{F}_0 = 775 MC

\text{C5-20PVRN}

\text{J4}

\text{B+ 200V}
\text{B+ GND}
\text{FIL G.3VDC}
\text{SPARE}
\text{FIL GND.}

\text{RFC 4}
\text{47 FT.}

\text{RFC 5}

\text{CR2}
\text{IN916B}

\text{C7}
\text{.39}

\text{L5}
\text{L6}

\text{C9}
\text{G-5.5}

\text{RFC 9}

\text{RFC 10}

\text{RFC 11}
\text{1K FT.}

\text{RFC 12}

\text{RFC 13}

\text{RFC 14}
\text{1K FT.}

\text{RFC 15}

\text{RFC 16}

\text{RFC 17}

\text{RFC 18}

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\text{RF OUTPUT}

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- **WORK COMPLETED**
- **WORK TO BE COMPLETED**

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ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:

- FRACTIONS \( \pm \frac{1}{64} \)
- ANGLES \( \pm \frac{1}{2}^\circ \)
- DECIMALS \( .XX \pm .010 \)
- \( .XXX \pm .005 \)

MATERIAL: """"

FINISH: """

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1962

**SPEKTRM ANALYZER PROJECT PERFORMANCE AND SCHEDULE CHART**

APPLIED RESEARCH INC.
PORT WASHINGTON
NEW YORK

FIG. 4
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ALL DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED TOLERANCES:
- FRACTIONS ± 1/64
- ANGLES ± 1/2°
- DECIMALS .XXX ± .010
- XXX ± .005

MATERIAL: ___________

JOB NO. NEXT ASSEMBLY

APPLICATION
## REVISIONS

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**SPECTRUM ANALYZER PROJECT PERFORMANCE AND SCHEDULE CHART**

**APPLIED RESEARCH INC.**
**PORT WASHINGTON NEW YORK**

**DWG. SIZE**

**SF138**

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**FIG. 5**

2 OF 2