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MONTHLY PROGRESS REPORT NO. 11

on

QRC-139A AEROSPACE GROUND EQUIPMENT (AGE)

Contract AF33(604)39443

LMED Requisition 32636

Period Covered: 8 January 1963 to 11 February 1963

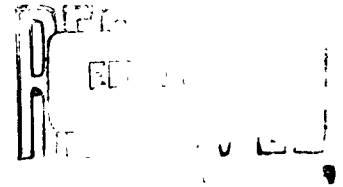
Date of Report: 11 February 1963

Prepared for

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## SECTION I

### INTRODUCTION

#### A. PROGRAM DESCRIPTION.

This report describes the work accomplished from 8 January 1963 to 11 February 1963 on the design and development of a Broadband Spectrum Analyzer (G-E Drawing No. 7633109G1), Converter-Measuring, Frequency "S" (G-E Drawing No. 7633120G1), and Converter-Measuring, Frequency "L" (G-E Drawing No. 7633119G1).

Work on these equipments and modification kits (G-E Drawing No. 7520905G1 and 7520906G1) was performed in accordance with letter contract AF33(604)39443, LMED Requisition 32636.

Additional work is being accomplished on Converter-Measuring, Frequency "X" (G-E Drawing No. 7633658G1) under contract AF33(657)9311, LMED Requisition 32065.

#### B. EQUIPMENT DESCRIPTION.

The spectrum analyzer contains ten wired boards and ten subchassis assemblies and is packaged in a combination case 19 inches wide, 19 inches high, and 27 inches deep. All wired boards slide into frames in various positions around a five-inch cathode ray tube. Cooling of the analyzer is accomplished by two fans, one of which has access to outside air. Primary power input is 115 V a-c  $\pm 5\%$ , 380-420 cps, single phase. The weight of the unit in transit condition, less the converter, is 111 pounds.

Converter-Measuring, Frequency "S" and Converter-Measuring, Frequency "L" have separate transit cases and plug into the analyzer to provide specific r-f band coverage. All a-c and d-c power for the converters is provided by the analyzer. The weight of the converter in the transit case is 29 pounds.

Modification kit (G-E Drawing No. 7520905G1) for the Servo-Noise Amplifier Test Set (G-E Drawing No. 7631547G1) contains input and output loads for the noise amplifier board, a replacement power transformer, a power relay, decals, miscellaneous wire and hardware, and installation instructions.

Modification kit (G-E Drawing No. 7520906G1) for the Noise Response Test Set (G-E Drawing No. 7732849G1) contains a dummy load for r-f inputs to the noise amplifier board, a coupling capacitor, a high power r-f load resistor, miscellaneous wire and hardware, decals, and installation instructions. Both kits were shipped in May, 1962.

## SECTION II

### BROADBAND SPECTRUM ANALYZER AND FREQUENCY-MEASURING CONVERTERS (S- AND L-BAND), PROGRAM STATUS

#### A. TROUBLESHOOTING OF CALIBRATOR CIRCUIT OF 1A15.

During this report period, troubleshooting of the calibrator circuit of subassembly 1A15 was completed. Layout of the 60 mc oscillator circuit wiring proved to be more critical than the original design. Several leads were shortened and two stabilizing resistors were added. A production model incorporating these changes was tested from 0° to 70° C and indicated minimum frequency drift and adequate power output stability. Minor re-work was required to the subchassis and drawings have been modified to incorporate these changes. The end item remains interchangeable with the first three QRC units.

#### B. QUALIFICATION TESTING.

##### 1. Radio Frequency Interference.

Radio frequency interference testing is 95% complete and results to date are within specification limits.

It was determined initially that the analyzer and converters were out of specification (MIL-I-6181D) in three areas:

- (1) 150-600 kc
- (2) 3510 mc
- (3) 7020 mc

In the 150 to 600 kc range, two sources of noise were found -- the face of the cathode ray tube and the total power measuring meter. The

noise at the face of the cathode ray tube was eliminated by the addition of two RC filters (one in the 8 kv power supply and the other near the anode cap on the cathode ray tube). The meter for measuring total power was found to be radiating harmonics of 22 kc into the 150-600 kc band. This noise source was eliminated by adding LC filters to the meter leads in the power meter amplifier, 1A13.

After adding these filters, the analyzer was retested and found to still be out of specification in the 150 to 600 kc range. It was found that the protective rubber jacket around the CRT anode cap had been damaged and was causing broadband transient interference, probably from arcing. After replacing the jacket, the interference remained; when removed, the interference was then below the receiver noise level, and was within the required specification.

At 3510 mc, an experimental shield was mounted around the L-band wavemeter to reduce radiation and susceptibility through the wave-meter viewing slot on the panel. This shield reduced the interference from -79.7 db to approximately -63 db (specification limit is -60 db).

After adding the shield, the L-band converter radiated a CW signal at 7020 mc. This was out of specification by 6 db. Previous testing, without the shield, had been within specification limits by 2 db at this frequency. Investigation is continuing on this problem.

It was noted that the converter produced spurious signals on the cathode ray tube when exposed to external radiation at 3400, 3640, 6930, and 7170 mc. After adding the shield, no signals were visible in the -40 dbm sensitivity position.

During initial RFI testing of the analyzer and S-band converter, radiated noise was 7 db out of specification at 3510 mc. This radiation was brought within specifications (reduced 8 db) by adding a cover shield to one side of the second local oscillator.

It appears that the difference in amount of radio interference in the L- and S-band mixers is a result of the differences in construction. Although both mixers are of sandwich type with internal stripline, the S-band mixer has more internal shielding around the mixer crystal than the L-band mixer.

## 2. Humidity.

The two-day humidity test performed on the analyzer and L-band converter was satisfactory except for two voltage breakdown problems and a temporary r-f sensitivity change of 10 db in the analyzer.

The two voltage breakdowns were traced to moisture short circuits; one was caused by the use of a wrong insulator part on BWO filament power supply, 1A1A1 and the second was on the insulated transistor mount on the BWO high voltage power supply (1A1). Four samples of the correct insulator were soaked in water and high potential performance was satisfactory. The correct part will be used on all future 1A1A1's. Dow Corning DC-4 compound was added to the transistor mount on 1A1 to eliminate the short circuit. This will be applied to all future units.

## 3. Temperature.

Temperature tests were not performed during this report period as had originally been scheduled because so much time was spent on the RFI testing. They will be performed during the next report interval.

**SECTION III**  
**PROGRAM FOR NEXT INTERVAL**

The following effort is scheduled for the next report period:

- (1) Complete the RFI testing on the S- and L-band converters at 3510 and 7020 mc.
- (2) Perform temperature, altitude, and shock tests on the analyzer and L-band converter.
- (3) Perform temperature tests on the analyzer and S-band converter.
- (4) Start writing first article test report.

## SECTION IV

### CONFERENCES

W. Cundiff, ASD, visited LMED, Utica, New York on 30 January through 1 February 1963 to observe First Article Tests on the analyzer and converters and to discuss the following possible product improvements to the analyzer which exceed contractual requirements:

- (1) Modify the power calibrator circuit so that it works on the 40 db setting as well as the 20 db setting.
- (2) Modify circuits so that power density accuracy is obtained up to 30 cps sweep rate. (The bolometer time constant presently reduces the accuracy of the power density display above about 15 cps.)
- (3) Add an additional stage of amplification to the i-f amplifier to increase its margin of safety so as to broaden the bandpass from 2 mc to 4 mc and simplify factory and field adjustments.
- (4) Modify the primary marker circuit so that this marker does not "jitter" so much particularly at low sweep speeds. (It should be noted that the present marker is well within performance specifications.)
- (5) Put one or more handles on the plug-in converters.

LMED Contract Administration will forward written recommendations on these suggested product improvements to ASD Engineering.

On 6 February 1963, L. Doak and A. Overend of LMED visited Headquarters, ASD to negotiate run-out costs on Contract AF33(604)39443. Contract definitization is expected during February 1963.

ASD disallowed some of the development costs such as the power calibrator, the integrated gearing between the spectrum width and center

frequency controls, graticule lighting and control, better than required sensitivity (-40 db or better provided, whereas -20 db would be acceptable), and BWO protection circuits which prevent circuit failures from damaging the \$2000 BWO tube. These analyzer features were considered desireable but not absolutely essential.

Costs of the performance exhibit initiated and written by LMED and the engineering time spent at Lockbourne were also disallowed.