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AD NO.

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REPEATER, TELEGRAPH TH-38 ()/G

Report No. 4

FOURTH QUARTERLY PROGRESS REPORT
1 DECEMBER 1962 TO 1 MARCH 1963

Signal Corps Contract DA-36-039, SC87254

Prepared for: U.S. Army Signal Research & Development Laboratory
Fort Monmouth, New Jersey

Prepared by: Radiation Incorporated
Melbourne, Florida

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Report No. 4

(6) REPEATER, TELEGRAPH TH-38 ()/G

(7) Quarterly Progress report 4, 1 Dec 62 - 1 Mar 63

Covering Period 1 December 1962 to 1 March 1963

Signal Corps Contract DA-36-039, SC87254

Signal Corps Technical Requirement SCL-4067 dated 28 October 1958

Amendment No. 1 dated September 1960

(15) Project No. 3B21-06-001-03

(11) 1 Mar 63

(12) 14P-

(13) NA
Object: The objective of this Contract is to develop a highly reliable Telegraph Repeater for field use.

(14) NA
(1-19) NA
Report Written By: R. D. Squires

(20) U.
(21) NA
Prepared By: Radiation Incorporated
Melbourne, Florida

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I PURPOSE

This project consists of the design, development and fabrication of 20 Telegraph Repeaters TH-38 ()/G along with documentation as required by the contract. The repeater must be designed to operate in two different modes; full duplex and half duplex-full duplex. Using the converter, circuits of differing characteristics may be interconnected and normal traffic established.

A prime requisite of the contract is to achieve a Mean Time Between Failure of 57,000 hours. Fabrication of the twenty repeaters will be divided into three phases. Two engineering test models will be fabricated and submitted to USASRDL for operational and environmental evaluation. Then eight more engineering test models, incorporating any required changes, will be built and put on life test along with the first two repeaters. The final phase will consist of the fabrication of ten service test models for field use.

→ Efforts were continued on ~~the~~ development and fabrication of telegraph repeater ^{TH-38(1)/G.} ~~TH-38(1)/G.~~

~~II ABSTRACT~~

The first ~~two~~ engineering test models were assembled and successfully tested electrically, ~~to the Test and Evaluation Plan.~~ Vibration testing was performed, and unit resonance at approximately 35 cycles was detected. A mechanical redesign was begun, ~~in order to insure compliance with the~~ mechanical requirements of SCL-4067.

III PUBLICATIONS, REPORTS AND CONFERENCES

A PUBLICATIONS

There were no publications presented as a result of the program during the fourth quarter.

B REPORTS

(1) Monthly Performance Summaries were prepared and submitted to USAERDL.

(2) Quarterly Report #3 was submitted to USAERDL.

C CONFERENCES

(1) Messrs. John Peco, Jim Lemig, and Art Youmann visited Radiation during the week of 4 February 1963. Project progress was reviewed, and a discussion and review of the Test and Evaluation Plan was held. The two engineering Test Models were examined and operationally demonstrated. The fact that some of the tests in the Test and Evaluation Plan were redundant was discussed, and it was tentatively agreed that it would be desirable to avoid the redundant testing in order to eliminate unnecessary and time-consuming testing, both at Ft. Monmouth and at Radiation.

John Peco and Jim Lemig requested:

(1) Preliminary patching information for the operational modes required by the test and evaluation plan (2) a preliminary parts list (3) the detailed specifications for the keyer transistor (4) an investigation into a protective circuit in the keyer and (5) information on the reliability of the lamp being used as a protective device in the output circuitry. Drawings and/or written information was supplied on Items 1 through 3, and a telecon was held with J. Peco concerning Items 4 and 5. Items 4 and 5 will be further discussed after the two engineering test models have been evaluated.

A second conference was held at Radiation on 7 March 1963. Mr. Ed DeForrest represented USAERDL, and R. Squires and D. Balser represented Radiation. The purpose of the conference was to discuss the mechanical problems of the TH-38 test models, specifically the mechanical resonance. Mr. DeForrest inspected the unit, and also witnessed vibration testing of the unit. He was given photographs of the unit, and returned to USAERDL to prepare an evaluation report of the mechanical problems presented in the unit. His conclusions at Radiation were that the unit did not presently satisfy the vibration specification, and that a mechanical redesign would be desirable if USAERDL project personnel would allow the time.

(2) Several telecons were held between J. Peco of USAERDL and R. Squires and W. Premaza of Radiation. The majority of these conferences

were held in order to discuss problems relative to the mechanical resonance present in the TH-38 Test Models. A later telecon between J. Futerfas and W. Premaza established that Radiation should proceed to insure that the resonance problem be eliminated.

IV FACTUAL DATA

A Checkout of Engineering Test Models

The two engineering test models were checked electrically in the following basic modes required by the specification:

- (1) Polar to Neutral
- (2) Neutral to Polar
- (3) Polar to Polar
- (4) Neutral to Neutral

Data taken during these tests verified that the units were performing within the specifications. Following is a tabulation of the basic mode tests and the distortion encountered in both units.

UNIT #1 EAST CHANNEL MEASUREMENTS

<u>Input</u>	<u>Output</u>	<u>Max. Distortion</u>	<u>Max. % Distortion</u>
P +M 10 ma	To N -M 60 ma	Approx. 250 microseconds	1.9%
N +M 20 ma	To P +M 20 ma	Approx. 300 microseconds	2.3%
P +M 10 ma	To P -M 25 ma	Approx. 250 microseconds	1.9%
N +M	To N -M	Approx. 300 microseconds	2.3%
20, 40, 60 ma	20, 40, 60 ma		

UNIT #1 WEST CHANNEL MEASUREMENTS

<u>Input</u>	<u>Output</u>	<u>Max. Distortion</u>	<u>Max. % Distortion</u>
P +M 10 ma To	N +M 60 ma	Approx. 110 microseconds	0.83%
N +M 20 ma To	P +M 20 ma	Approx. 250 microseconds	1.9%
P +M 10 ma To	P -M 25 ma	Approx. 250 microseconds	1.9%
N +M	To N -M	Approx. 250 microseconds	1.9%
20, 40, 60 ma	20, 40, 60 ma		

UNIT #2 EAST CHANNEL MEASUREMENTS

<u>Input</u>	<u>Output</u>	<u>Max. Distortion</u>	<u>Max. % Distortion</u>
P +M 10 ma To	N -M 60 ma	Approx. 160 microseconds	1.2%
N +M 20 ma To	P -M 25 ma	Approx. 80 microseconds	0.6%
P +M 10 ma To	P -M 25 ma	Approx. 40 microseconds	0.3%
N +M	To N -M	Approx. 160 microseconds	1.2%
20, 40, 60 ma	20, 40, 60 ma		

UNIT #2 WEST CHANNEL MEASUREMENTS

<u>Input</u>	<u>Output</u>	<u>Max. Distortion</u>	<u>Max. % Distortion</u>
P +M 10 ma To	N -M 60 ma	Approx. 250 microseconds	1.9%
N -M 20 ma To	P -M 25 ma	Approx. 40 microseconds	0.3%
P +M 10 ma To	P -M 25 ma	Approx. 60 microseconds	0.45%
N +M	To N -M	Approx. 250 microseconds	1.9%
20, 40, 60 ma	20, 40, 60 ma		

NOTE: (1) P = Polar, N = Neutral (2) Measurements made at 100 WPM.

The units were then tested in the following operational modes:

- (1) Full Duplex - Polar to Polar
- (2) Half Duplex/Full Duplex - Neutral to Polar

These tests were performed in the four-wire mode. Two-wire testing was not necessary, since for the purposes of laboratory testing both the four and two-wire hookups are identical electrically.

The outputs of the respective channels were used to drive 100 wpm printers in the above modes, and test messages were recorded.

Unit #1 was then submitted to testing in the above modes at the temperature extremes required. These tests were run at -45°C and $+60^{\circ}\text{C}$. No difficulties were encountered at the $+60^{\circ}\text{C}$ temperature. At -45°C the DC to DC converter power supply was not starting reliably. Checks showed that insufficient base drive was being applied due to the downward trend of the transistor betas at this temperature. Accordingly, the base circuit sensistors were decreased from 50 ohms to 25 ohms, effectively doubling the current available for the transistor base. All modes of tests were then normal, and the converter started reliably. The unit was then rechecked at $+60^{\circ}\text{C}$ to insure that the increased drive was not detrimental to the circuit at the higher temperatures and correspondingly higher betas. Operation was completely checked and found to be normal. Line voltage variations from 103 VAC to

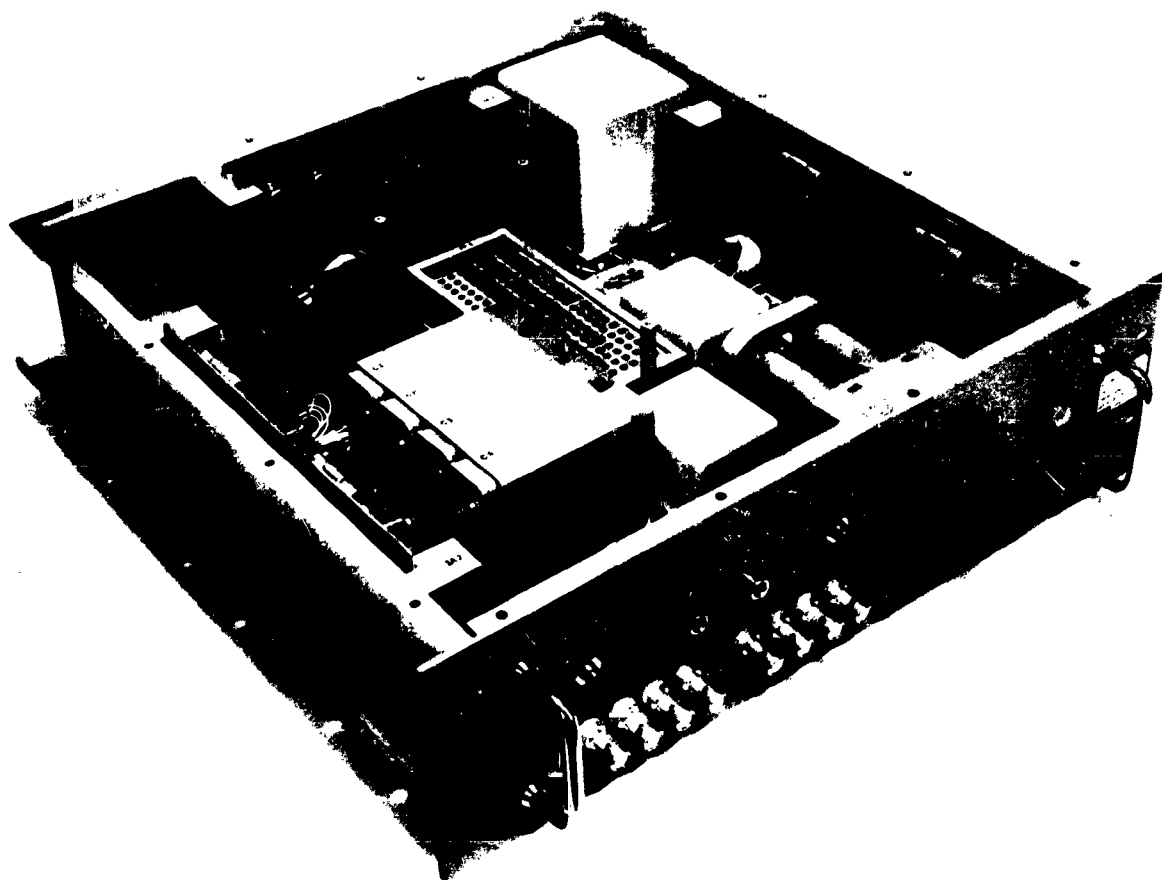
125 VAC were applied to the unit at both temperature extremes with no effect on the operation. No significant changes in the distortion measurements were noted at either temperature extreme or either line voltage extreme.

Unit #1 was then submitted to vibration testing according to Section 4 of SCL 4067. Resonance was found in the unit at approximately 35 cycles. The resonance was measured with accelerometers placed at strategic points on the chassis. The main chassis was reworked in an effort to eliminate or shift the resonance outside the undesired range. The rework, however, resulted only in a 2 to 3 cycle shift, and did not bring the unit into specification. The testing was then halted since it appeared that further rework of the existing chassis would probably not solve the problem.

B SYSTEM DESIGN

The major portion of this period was devoted to the assembly and testing of the two engineering test models. Due to the failure of the unit to meet the vibration requirements of the specification, however, a large scale mechanical redesign effort was begun. A study was made of the unit resonance problem, and the decision was made to repackage the unit on a more rugged main chassis.

The decision was made to use a cast chassis with strengthening rib



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Figure 1 Repeater, Telegraph TH 38 () /G

sections located at crucial points. Also, the heavier components were located strategically on the chassis, so as to take full advantage of the strengthening members. The original shape and dimensions of the unit were retained, but the entire unit will be of heavier structure and more rugged. All design considerations indicate that this chassis will meet the requirements of SCIL 40 67 relative to service conditions.

Work progressed on the redesign to a point where bids were received for the pattern making and casting of the new chassis. The bids received indicated that the new chassis design will afford the Signal Corps a more economical unit in the event that a number of follow-on units are constructed. The cost per unit of the initial units will be slightly higher, however, since the casting approach entails making new drawings and the fabrication of a casting pattern, both of which are fairly costly items. However, the long range benefits of this approach as far as follow-on work is concerned, should be obvious.

V

CONCLUSIONS

The electrical testing of the units, using the Test and Evaluation Plan as a guide, indicated that the units will satisfy the electrical operating requirements of SCL-4067. The redesign of the main chassis and the re-packaging of the unit should insure that the unit will meet the mechanical design specifications.

VI PROGRAM FOR NEXT INTERVAL

The new chassis will be procured and two new engineering test models will be assembled and tested. These units will be submitted to USAERDL for testing to the Test and Evaluation Plan, and for environmental testing.

VII KEY PERSONNEL

Following is a list of key personnel and the hours expended during the report period.

R. A. Cauble	20
R. D. Squires	179
F. A. Barry	232

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FOURTH QUARTERLY REPORT

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