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**SYRACUSE
UNIVERSITY
RESEARCH
CORPORATION**

SEMI-ANNUAL PROGRESS REPORT

1 January 1966 to 30 June 1966

DSL R-149

**Prepared under Navy
Office of Naval Research
Contract N00014-66-C0118**

15 July 1966

**DEFENSE
SYSTEMS
LABORATORY**

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1 January 1966 to 30 June 1966

DSL R-149

Prepared under Navy
Office of Naval Research
Contract N00014-66-C0118
Contract Authority No. NR 259-029/11-4-65

Gordon H. LaTourette

15 July 1966

DEFENSE SYSTEMS LABORATORY
SYRACUSE UNIVERSITY RESEARCH CORPORATION

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PURPOSE

The Contractor shall furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct research to provide low level improvements to the tactical intercept system developed under Contract NOnr 2556(00).

ABSTRACT

The Light Signal Monitor Facility AN/TSQ-() successfully withstood installation and environmental testing at the Marine Corps Supply Center, Albany Georgia. Improved equipment mounting techniques used in that system have since been incorporated into the 2 1/2-ton Green Elephant system. The entire microwave receiver/display equipment (including all modifications recommended by DSL) used in the 2 1/2-ton Green Elephant system has been designated the Polarad Model TB-A. A video spectrum display is recommended for inclusion in the Light Signal Monitor Facility AN/TSQ-(). Further improvements have been made in the Birdie Oscillator circuitry used in the Frequency Demultiplexers for the 2 1/2-ton Green Elephant system. An improved TTY keyer has been selected for use in all Green Elephant systems. A rack mounting arrangement for mounting up to four of the new keyers in the rack space formerly occupied by one keyer has been designed. A magnetic tape storage drawer, capable of storing up to 18 tape reels while permitting easy identification of individual tapes, has been designed and fabricated.

CONFERENCES

Date: January 11, 1966
Place: Defense Systems Laboratory, Syracuse, New York
Subject: ONR Contracts
Attendees: Capt. T. Smyth, USMC, Code AO2F
Mr. G. LaTourette, DSL
Conclusions: (1) Tentative plans for delivery of 3/4-ton systems.
(2) Tentative plans for delivery of 2 1/2-ton systems.
(3) Reviewed status of GFM.

Date: February 8 - 10, 1966
Place: Hdqs., USMC, Washington, D. C.
Subject: ONR Contracts
Attendees: Capt. T. Smyth, USMC, Code AO2F
Mr. R. Paulson, USMC (CSY 3)
Mr. G. LaTourette, DSL
Conclusions: (1) Detailed plans for delivery of 3/4-ton systems.
(2) Reviewed status of GFM.

Date: March 7 - 8, 1966
Place: MCSC, Albany, Georgia
Subject: 3/4-ton Green Elephant systems
Attendees: Mr. J. Fredericks, MCSC
Mr. S. Mackey, MCSC
Mr. G. LaTourette, DSL
Mr. R. Russell, DSL
Conclusions: (1) Delivery of 3/4-ton systems
(2) Discussed MCSC/SURC cooperation during MCSC fabrication program.

Date: March 9, 1966
Place: Hdqs., USMC, Washington, D. C.
Subject: ONR Contracts
Attendees: Maj. E. Resnik, USMC, Code AO2F
Capt. T. Smyth, USMC, Code AO2F
Mr. R. Paulson, USMC (CSY 3)
Capt. J. Adams, MCSC, Albany, Georgia
Mr. T. Duke, MCSC, Albany, Georgia
Representatives from MCSA, Philadelphia, Pa.
Mr. G. LaTourette, DSL

Conclusions: (1) Attended provisioning conference.
(2) Discussed documentation for Green Elephant systems.
(3) Reviewed status of GFM.

Date: March 16, 1966
Place: Hdqs., USMC, Washington, D. C.
Subject: ONR Contracts
Attendees: Capt. T. Smyth, USMC, Code AO2F
Mr. G. LaTourette, DSL

Conclusions: (1) Planned testing of 3/4-ton system.
(2) Reviewed status of GFM.
(3) Technical discussions of Green Elephant equipment.

Date: March 17 - 18, 1966
Place: MCSC, Albany, Georgia
Subject: 3/4-ton Green Elephant systems
Attendees: Capt. T. Smyth, USMC, Code AO2F
Capt. J. Adams, MCSC, Albany, Georgia
Mr. T. Duke, MCSC, Albany, Georgia
Mr. S. Mackey, MCSC, Albany, Georgia
Mr. C. Casey, MCSC, Albany, Georgia
Mr. G. LaTourette, DSL
Mr. R. Russell, DSL

Conclusions: (1) Set up test schedule for 3/4-ton system.
(2) Commenced testing of 3/4-ton system.

Date: March 28 - 30, 1966
Place: MCSC, Albany, Georgia
Subject: 3/4-ton Green Elephant systems
Attendees: Mr. T. Duke, MCSC, Albany, Georgia
Mr. S. Mackey, MCSC, Albany, Georgia
Mr. C. Casey, MCSC, Albany, Georgia
Mr. G. LaTourette, DSL
Mr. R. Russell, DSL

Conclusions: (1) Completed 3/4-ton system testing.
(2) Critique of tests.

Date: March 31, 1966
Place: Hdqs., USMC, Washington, D. C.
Subject: ONR Contracts
Attendees: Capt. T. Smyth, USMC, Code AO2F
Mr. G. LaTourette, DSL
Conclusions: Reviewed status of GFM.

Date: April 14, 1966
Place: Hdqs., USMC, Washington, D. C.
Subject: Contract N00014-66-CO118
Attendees: Capt. T. Smyth, USMC, Code AO2F
Mr. G. LaTourette, DSL
Conclusions: Technical discussions of Green Elephant equipment.

Date: June 8 - 10, 1966
Place: Hdqs., USMC, Washington, D. C.
Subject: Contract N00014-66-CO118
Attendees: Maj. E. Resnik, USMC, Code AO2F
Capt. T. Smyth, USMC, Code AO2F
Mr. G. LaTourette, DSL
Conclusions: Discussion of equipment improvement program.

SYSTEM TESTS AT ALBANY, GEORGIA

As directed by Commandant of the Marine Corps (CSY-3-rep) letter to commanding General, Marine Corps Supply Center (MCSC), Albany, Georgia, Subject: Project Order 5-0038 Special Signal Reconnaissance System; testing of, dated 25 March 1966, one light Signal Monitor Facility AN/TSQ-() was subjected to the following tests at the Marine Corps Supply Center, Albany, Georgia:

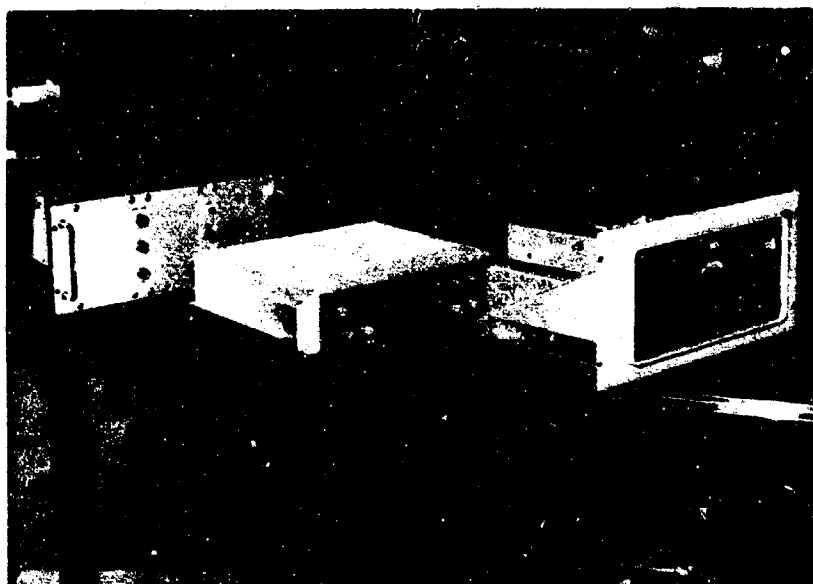
1. Rail Transport - The shelter, mounted on an M37 truck with all components mounted for transit, shall be placed on a railway flat car and impacted into a stationary mass of five times its weight at speeds of five (5) miles per hour for one impact and nine (9) miles an hour for four (4) impacts. The system shall be fully operable after each impact.
2. Truck Transport - The shelter shall be mounted on an M37 truck with all components mounted for transit and transported over paved and unpaved roads at speeds up to fifty (50) miles per hour on paved roads, and twenty (20) miles per hour on unpaved roads for a total distance of five hundred (500) miles. During the course of the test there shall be at least ten (10) abrupt stops from speeds of fifteen (15) miles per hour. The equipment shall further be transported ten (10) miles cross country. The system shall be fully operable at the completion of the test. Operational checks shall be performed after each fifty (50) mile segment of the test.
3. Enclosure Test - The system with all components installed for transit shall be subjected to the enclosure test as specified in paragraph 5.2.26 of MIL-STD-108 for water tight enclosures.

4. Heat Test - The system with all components installed shall be operated continuously with all components on for a period of eight (8) hours. The air conditioner shall remain off and the blower fans on during the test. At the end of the test there should be no damage to the system or its components.
5. Drop Test - The system with all components installed for transit shall be suspended by four corners at a height of one (1) foot and dropped once on a hard earth surface. There should be no damage to the system or its components.
6. Tilt Test - The system, with all components installed for transit, shall be lifted by each pair of corners until it hangs suspended from the surface by the lifting device, then lowered without dropping. There shall be no damage to the system or the components.

Personnel and facilities for the testing were provided by the Marine Corps Supply Center which also performed the tests. The system met or exceeded the requirements of all tests to which it was subjected. Although minor damage was sustained by the shelter as a result of the drop test, the electronic equipment continued to operate properly. A transistor failure experienced in the AN/PRC-47 Radio Set when it was switched to high power was determined by MCSC personnel to be unrelated to the system testing. Details of the testing and recommendations for procurement systems have been published in DSL Report R-146.

EQUIPMENT MOUNTING

Prior to the installation and environmental testing of the AN/TSQ-() Light Signal Monitor Facility, mounting brackets were installed on the sides of each item of electronic equipment as shown in Figure 1. Mating brackets were installed at appropriate



**FIGURE 1 MOUNTING BRACKETS INSTALLED ON ELECTRONIC
EQUIPMENT**

locations in the racks as shown in Figures 2 and 3. This same procedure has been followed in the mounting of equipment in the 2 1/2-ton Green Elephant systems (Figures 4, 5, 6, and 7).

This bracket arrangement provides a shelf-type mounting for each piece of electronic equipment, distributing shock and vibration effects along the length of each bracket while still permitting free air flow through the rack for equipment cooling. An improved shock mounting arrangement for the VR-1500 video tape recorder is also being designed.

LOG-PERIODIC ANTENNAS

Eight AS-1898G Log-Periodic Antennas were ordered during this reporting period. Delivery of these antennas is expected during July.

MICROWAVE RECEIVERS

The complete microwave receiver/display equipment used in the 2 1/2-ton Green Elephant systems and defined below has been designated the Polarad Model TB-A:

1. Model TB Basic Unit and Power Supply (modified as follows):
 - a) Provision for mounting in standard 19-inch equipment rack.
 - b) Additional IF bandwidth of 50 kHz.
 - c) Removable AC power cord.
 - d) Video output at rear of receiver.
 - e) 140 MHz IF output at rear of receiver.
 - f) Internal relay for remote indication of receiver on/off status.



FIGURE 2 MOUNTING BRACKETS INSTALLED IN RACKS



FIGURE 3 MOUNTING BRACKETS INSTALLED IN RACKS

1376-D



FIGURE 4 MOUNTING BRACKETS INSTALLED IN RACKS

1377-D

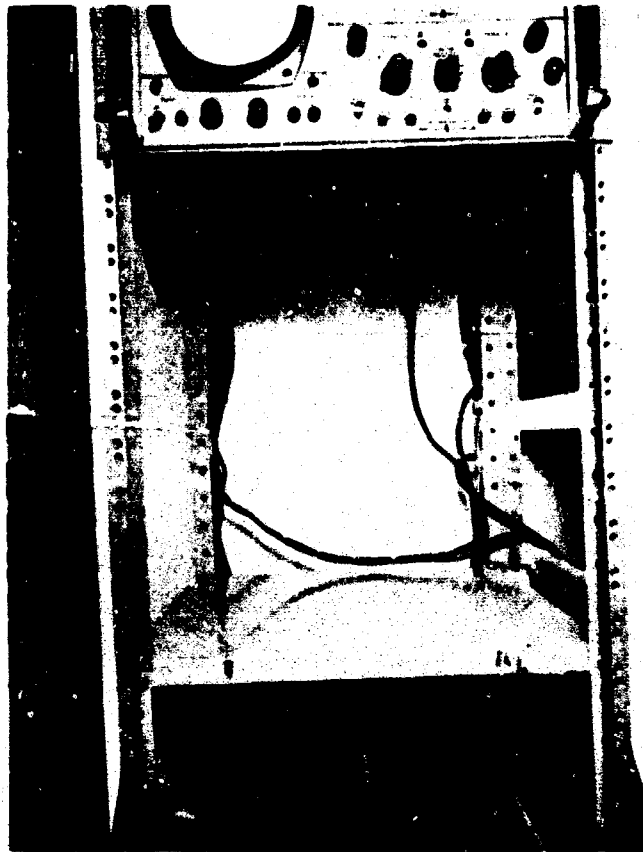


FIGURE 5 MOUNTING BRACKETS INSTALLED IN RACKS

1978-D

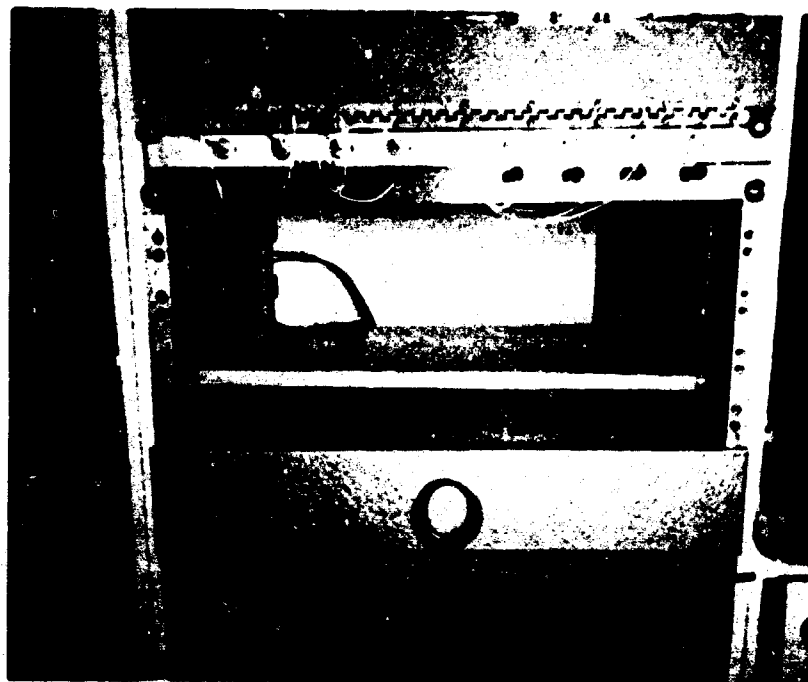


FIGURE 6 MOUNTING BRACKETS INSTALLED IN RACKS

1379-0

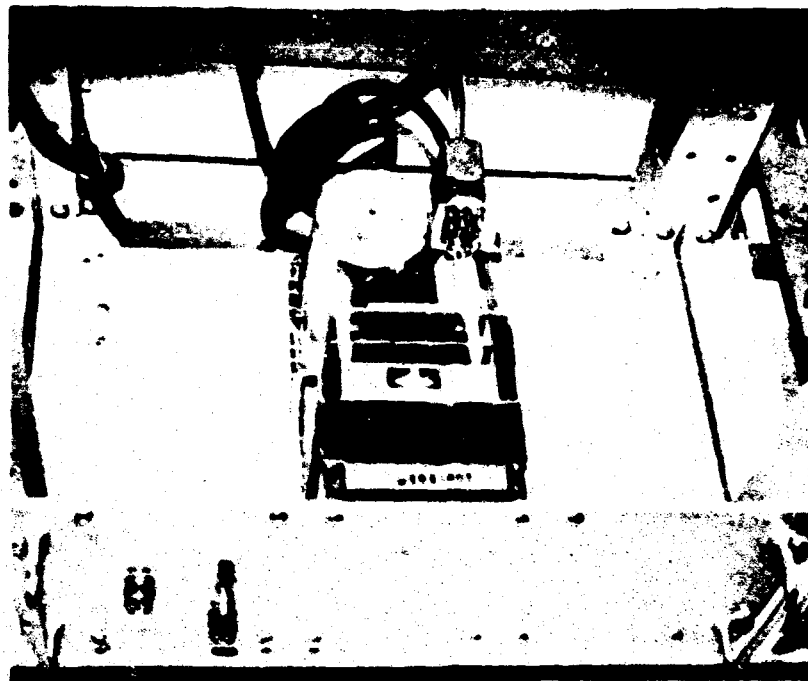


FIGURE 7 MOUNTING BRACKETS INSTALLED IN RACKS

2. Model T-RL Plug-in Tuning Unit
3. Model T-RS Plug-in Tuning Unit
4. Model T-RM Plug-in Tuning Unit
5. Model T-RX Plug-in Tuning Unit
6. Model DM-1 Display Monitor (modified as follows):
 - a) Provision for mounting in standard 19-inch equipment rack.
 - b) Signal input at rear of display.
 - c) Removable AC power cord.

The Model TB-A as herein defined is now a standard item in both the 2 1/2-ton Green Elephant systems and the Modular Kit systems being developed under Contract NOnr 4858(00).

VIDEO SPECTRUM DISPLAY

The video spectrum display used in the 2 1/2-ton Green Elephant system performs the following functions:

1. Enables the operator to determine the sub-channel characteristics of a received frequency division multiplexed signal.
2. Permits operator surveillance of a number of multiplexed sub-channels while actually monitoring only those which are active.
3. Facilitates rapid Frequency Demultiplexer acquisition of a previously inactive sub-channel when it becomes active.

Although the operational advantages of this type of display are extensive, the technical requirements levied on a spectrum analyzer in the performance of these functions are not stringent. A spectrum analyzer specification based on known Green Elephant requirements is shown in Table 1.

TABLE I

GREEN ELEPHANT
REQUIREMENTS

PSA-033

<u>CHARACTERISTIC</u>		
Center Frequency Range	200 Hz to 400 kHz	150 Hz to 500 kHz
Dispersion (sweep width)	3 kHz to 20 kHz	2.5 kHz to 150 kHz
Resolution Bandwidth	At least 500 Hz	150 Hz to 2 kHz
Sensitivity	0.1 v/cm deflection (min.)	85 μ v/cm deflection (min.)
Amplitude Response Flatness	± 2 db	± 1 db
Input Attenuator	60 db range in 20 db steps	80 db range in 20 db steps
Input Impedance	At least 10 k Ω	1 megohm
Incidental FM	Less than 5% of narrowest resolution bandwidth.	Less than 1% of narrowest resolution bandwidth.
IF Attenuator	40 db range	40 db range

The Singer-Metrics Model SPA-3a Spectrum Analyzer used in the 2 1/2-ton Green Elephant system possesses analysis capability well in excess of known requirements. However, in this echelon of equipment, it is operationally desirable to provide additional analysis capability to aid in the identification of unknown signals.

The Light Signal Monitor Facility AN/TSQ-() possesses no video spectrum display capability, since at the time electronic equipment was selected for inclusion in that system, no known instrument with sufficient capability met the size, weight and power requirements imposed by other system considerations. However, recent investigation has uncovered the Nelson-Ross Model PSA-033 Frequency Base Plug-in Unit (Figure 8) designed specifically for use with the Hewlett-Packard Model 140A Oscilloscope (the oscilloscope already in use in the system). Table I shows that the PSA-033 meets or exceeds all known Green Elephant requirements. The PSA-033 also meets the size, weight and power requirements for inclusion in the Light Signal Monitor Facility AN/TSQ-(). It has therefore been recommended that the PSA-033 be considered for inclusion in procurement models of the Light Signal Monitoring Facility.

FREQUENCY DEMULTIPLEXERS

In addition to the Birdie Oscillator improvements already made and discussed in DSL Report R-141, feedback circuitry and improved bias circuitry have been added to the Birdie Oscillator output amplifier. This circuitry is designed to prevent frequency-dependent variations in the output level of the oscillator from over-driving the output amplifier, causing spurious output signals. Figure 9 is a schematic diagram of the Birdie Oscillator showing the improved output amplifier

1380-D

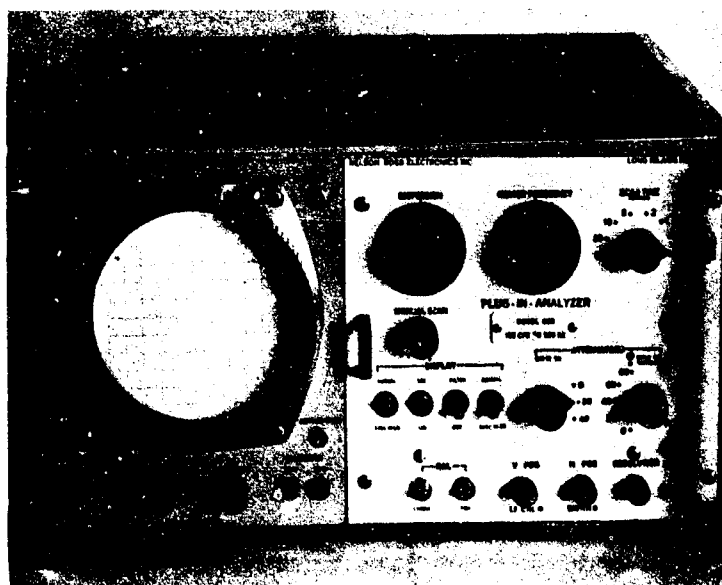


FIGURE 8 NELSON-ROSS MODEL PSA-033
FREQUENCY BASE PLUG-IN UNIT

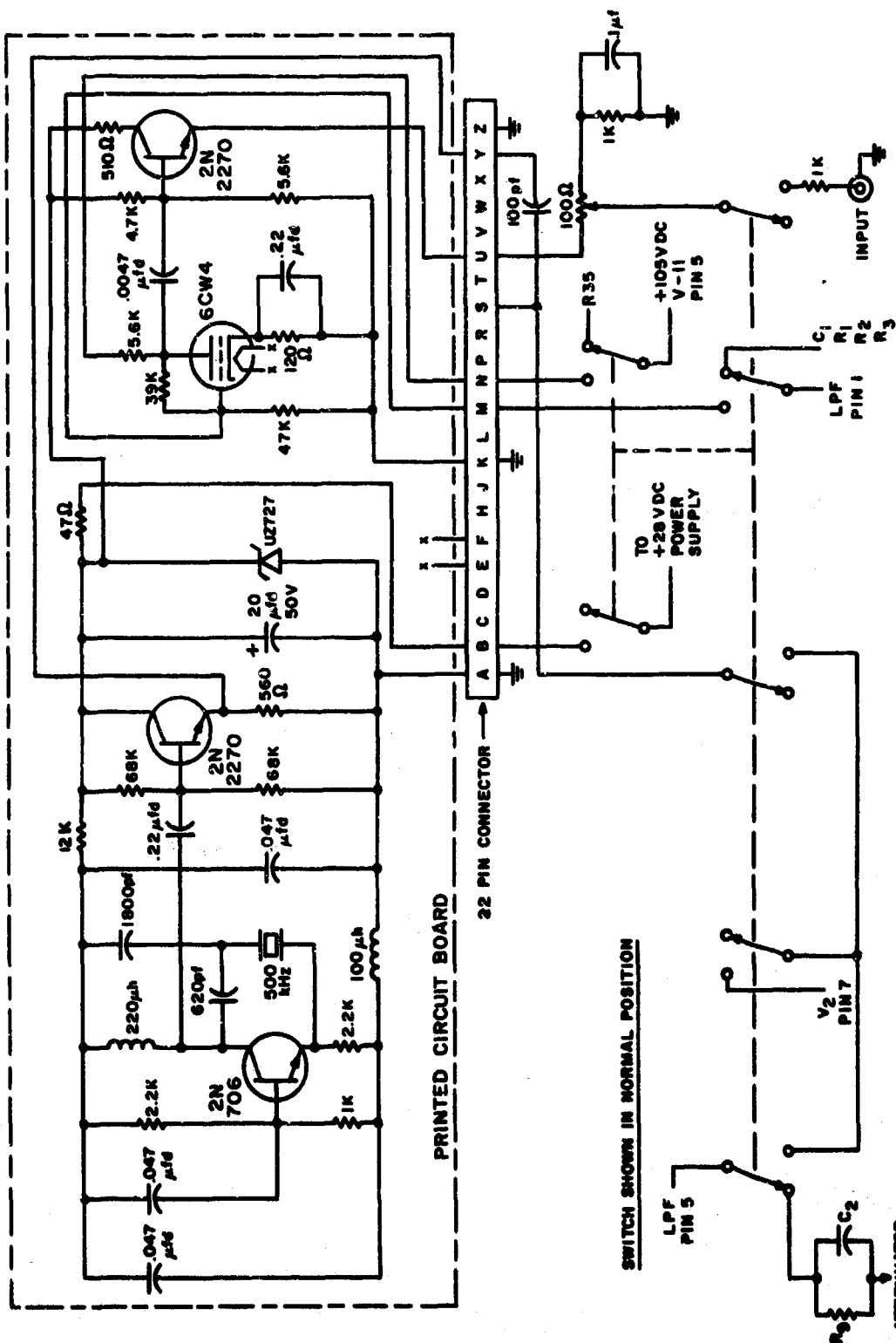


Figure 9 SCHEMATIC DIAGRAM OF BIRDIE OSCILLATOR

circuit Figure 10 shows time-base and frequency-base displays which illustrate the operational results of the circuit improvements.

IMPROVED TTY KEYER

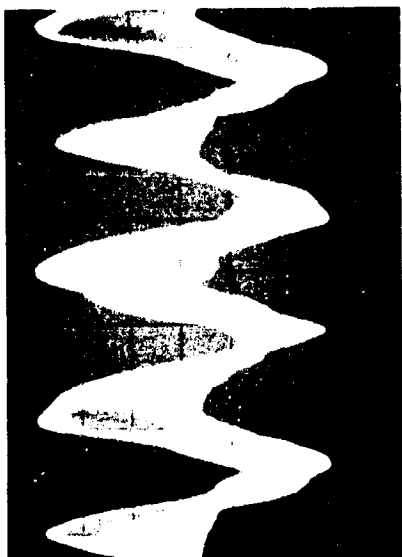
Based on size, weight and primary power considerations, the AFSAV 39C Rekeyer used in the Green Elephant R & D systems will be replaced with the KY-463A/FGC Keyer. Design of a combination mounting shelf and front panel, capable of rack-mounting four KY-463A/FGC Keyers, has been completed. The mounting panel requires the same rack space formerly occupied by one AFSAV 39C Rekeyer. The following controls and indicators from each keyer have been brought out to the front panel:

- POWER ON-OFF Switch
- POWER ON Pilot Light
- POLARITY Switch
- Phone Jack

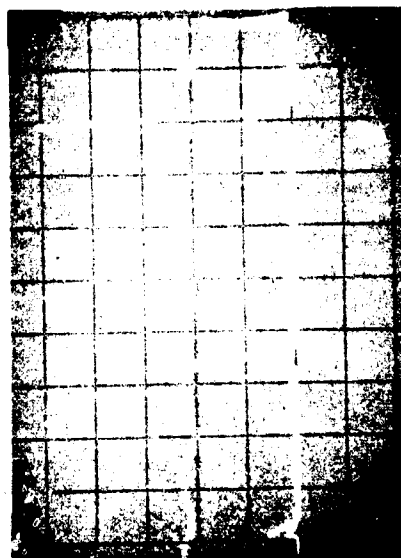
Mounting panels are now being fabricated for installation in the Green Elephant R & D systems, although the keyers are not expected to be available until the second quarter of fiscal year 1967. Installation of the keyers and panels in the systems can easily be accomplished in the field, if necessary.

MAGNETIC TAPE STORAGE DRAWERS

Design and fabrication of a magnetic tape storage drawer, for installation in both the 3/4-ton and 2 1/2-ton Green Elephant systems, has been completed. The drawer will hold up to 18 tape reels in a vertical position with spacing between the reels sufficient to permit easy identification of individual tapes. The drawer will accommodate both loose reels and reels stored in protective cans.



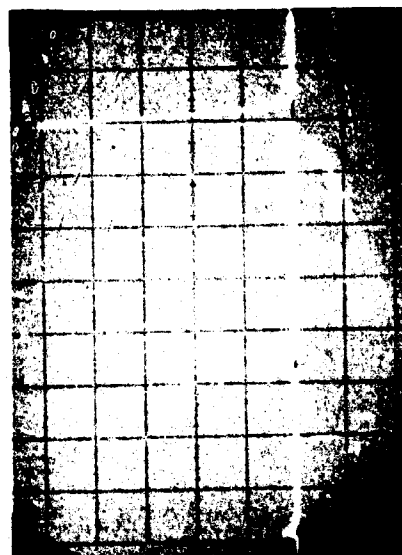
Band "F", 370 kHz - Old Birdie Oscillator
Time-Base Display



Band "F", 370 kHz - Old Birdie Oscillator
Frequency-Base Display



Band "F", 370 kHz - New Birdie Oscillator
Time-Base Display



Band "F", 370 kHz - New Birdie Oscillator
Frequency-Base Display

FIGURE 10

Tape storage drawers have been installed in all R & D Green Elephant systems (Figure 11).

DOCUMENTATION

The current status of the Light Signal Monitor Facility AN/TSQ-() documentation is as follows:

- Data Package 95% completed.
- Preliminary Operation Manual 95% completed.
- Preliminary Maintenance Manual 45% completed.

The current status of the 2 1/2-ton Green Elephant system documentation is as follows:

- Data Package 50% completed.

0-1851

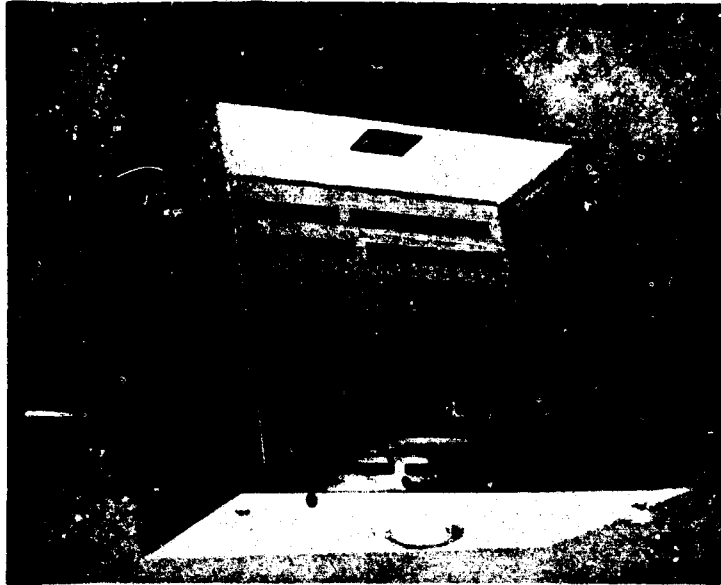


FIGURE 11 MAGNETIC TAPE STORAGE DRAWER

PERSONNEL

J. D. Rodems, Director

B. E. Simmons, Associate Director

G. E. Mader, Assistant Director

Gordon H. LaTourette, Engineer

Richard G. Russell, Engineer

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1. ORIGINATING ACTIVITY (Corporate author) Defense Systems Laboratory Syracuse University Research Corporation P. O. Box 26, University Station, Syracuse, N. Y.		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
3. REPORT TITLE SEMI-ANNUAL PROGRESS REPORT (U)		2b. GROUP NONE	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Semi-Annual Progress Report - 1 January 1966 to 30 June 1966			
5. AUTHOR(S) (Last name, first name, initial) LaTourette, Gordon H.			
6. REPORT DATE 15 July 1966		7a. TOTAL NO. OF PAGES 29(v)	7b. NO. OF REFS 0
8a. CONTRACT OR GRANT NO. N00014-66-C0118		8b. ORIGINATOR'S REPORT NUMBER(S) DSL R-149	
9. PROJECT NO.		8c. OTHER REPORT NO(S) (Any other no. here that may be assigned this report) NONE	
10. AVAILABILITY/LIMITATION NOTICE NONE			
11. SUPPLEMENTARY NOTES NONE		12. SPONSORING MILITARY ACTIVITY Office of Naval Research Department of the Navy	
13. ABSTRACT The Light Signal Monitor Facility AN/TSQ-() successfully withstood installation and environmental testing at the Marine Corps Supply Center, Albany, Georgia. Improved equipment mounting techniques used in that system have since been incorporated into the 2 1/2-ton Green Elephant system. The entire microwave receiver/display equipment (including all modifications recommended by DSL) used in the 2 1/2-ton Green Elephant system has been designated the Polarad Model TB-A. A video spectrum display is recommended for inclusion in the Light Signal Monitor Facility AN/TSQ-(). Further improvements have been made in the Birdie Oscillator circuitry used in the Frequency Demultiplexers for the 2 1/2-ton Green Elephant system. An improved TTY keyer has been selected for use in all Green Elephant systems. A rack mounting arrangement for mounting up to four of the new keyers in the rack space formerly occupied by one keyer has been designed. A magnetic tape storage drawer, capable of storing up to 18 tape reels while permitting easy identification of individual tapes, has been designed and fabricated. (U)			

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Electronic Countermeasures Radio Receivers Shelters Tape Recording Teletype Processing Spectra Display						

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