General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.

- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.

- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.

- This document is paginated as submitted by the original source.

- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

COMMUNICATIONS AND TRACKING SUBSYSTEM APPROACH AND LANDING TEST PHASE TASK 501 RF PATH CONSOLE ACCEPTANCE TEST REPORT

Job Order 17-069

Prepared By

Lockheed Electronics Company, Inc.
Aerospace Systems Division
Houston, Texas

Contract NAS 9-12200

For

SPACECRAFT SYSTEMS TEST OFFICE

TRACKING AND COMMUNICATIONS DEVELOPMENT DIVISION

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

May 1976

LEC-8634

JSC-11194

COMMUNICATIONS AND TRACKING SUBSYSTEM APPROACH AND LANDING TEST PHASE TASK 501 RF PATH CONSOLE ACCEPTANCE TEST REPORT

Job Order 17-069

G. D. Doland, Engineer
Spacecraft Systems Test Section
Lockheed Electronics Company, Inc.

APPROVED BY

LEC

A. L. Roelse, Supervisor
Spacecraft Systems Test Section

J. S. Creamer, Manager
Tracking and Communications
Systems Department

NASA

W. C. Long, Office
Spacecraft Systems Test Office

Prepared By

Lockheed Electronics Company, Inc.

For

Spacecraft Systems Test Office
Tracking and Communications Development Division

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

May 1976

LEC-8621
SHUTTLE

TECHNICAL REPORT INDEX/ABSTRACT

(See instructions on reverse side.)

1. TITLE AND SUBTITLE OF DOCUMENT

Communications and Tracking Subsystem
Approach and Landing Test Phase
Task 501 RF Path Console
Acceptance Test Report

2. JSC NO.

JSC-11194

3. CONTRACTOR/ORGANIZATION NAME

Lockheed Electronics Company, Inc.

4. CONTRACT OR GRANT NO.

NAS 9-12200

5. CONTRACTOR/ORIGINATOR DOCUMENT NO.

LEC 8634

6. PUBLICATION DATE (THIS ISSUE)

5/76

7. SECURITY CLASSIFICATION

Unclassified

8. OPR (OFFICE OF PRIMARY RESPONSIBILITY)

A. Roelse/J. S. Creamer

9. LIMITATIONS

GOVERNMENT HAS UNLIMITED RIGHTS [X] YES [ ] NO

IF NO, STATE LIMITATIONS AND AUTHORITY

N/A

10. AUTHOR(S)

George Doland

11. DOCUMENT CONTRACT REFERENCES

WORK BREAKDOWN STRUCTURE NO.

N/A

CONTRACT EXHIBIT NO.

N/A

DRL NO. AND REVISION

N/A

DRL LINE ITEM NO.

N/A

12. HARDWARE CONFIGURATION

SYSTEM

N/A

SUBSYSTEM

N/A

MAJOR EQUIPMENT GROUP

N/A

13. ABSTRACT

The RF downlink S-band path in the RF Path Console was tested under Quality Assurance inspection. The UHF RF paths were also tested. This document contains the acceptance test plans, procedures, and results of the acceptance tests.

14. SUBJECT TERMS

Shuttle | Orbiter/SCA

ALT

UHF RF

ACKNOWLEDGMENT

This document was prepared in response to Action Document 75-17-069-42 submitted by the Spacecraft Systems Test Office of the Tracking and Communications Development Division. William C. Long, Office Head, is technical monitor for this task. George D. Doland of the Spacecraft Systems Test Section of Lockheed Electronics Company, Inc., prepared this document. R. Davis engineered the design and construction of the RF Path Console. R. Davis also conducted the acceptance tests.

CONTENTS

ABBREVIATIONS

ALT	Approach and Landing Test
dB	Decibel
FM	Frequency modulation
RF	Radio frequency
SCA	Shuttle Carrier Aircraft
UHF	Ultra-high frequency

1. SUMMARY

The radio frequency (RF) downlink S-band path in the RF Path Console was tested under Quality Assurance inspection. The Ultra-High Frequency (UHF) RF paths were also tested. Each RF path had losses in the acceptable range. The RF Path Console was accepted for the Approach and Landing Tests (ALT).

2. INTRODUCTION

The RF Path console consists of individual RF paths used for specific tests. The S-band downlink path is required for the ALT compatability and performance testing using the ALT Frequency Modulation (FM) System. The UHF path is required for the Orbiter/Shuttle Carrier Aircraft (SCA) Audio and RF System testing with the ground station.

2.1 PURPOSE

These tests constituted acceptance tests for the RF Path Console for the ALT portion of the Shuttle Task 501 test program. These RF path tests do not need to be repeated even though the RF console is modified by the addition of other independent RF paths. However, the test must be repeated if any change is made to the RF paths tested and accepted.

2.2 REFERENCED DOCUMENT

The RF Path console design and testing was performed in accordance with the following document:

Communications and Tracking Subsystem
Approach and Landing Test Phase
Task 501 RF Path Console
Preliminary Design and Testing
Prepared by Lockheed Electronics Company, Inc.
Document number LEC-7584; JSC-10794, dated January 1976.

2.3 TEST EQUIPMENT

The specific test equipment used for the tests is contained in the table on the next page.

TEST EQUIPMENT USED

RF POWER METER

HP 431B	NSN 77779
CAL DATE 9/4/76	I.D. C09808

RF SIGNAL SOURCE

HP 608C SIGNAL GENERATOR	NSN 77416
CAL DATE	I.D. C08921
HP 8660B SIGNAL GENERATOR	NSN 10286
HP 86603 RF SECTION	NSN 106767

COUNTER

HP 5245L COUNTER	NSN 93298
CAL DATE 10/14/76	
PLUG-IN 5254A	NSN 74863
CAL DATE 10/14/76	
PLUG-IN 5253B	NSN 74864
CAL DATE	I.D. C00056

POWER AMP

HP 491L POWER AMP	NSN 69711

3. TEST PERFORMED

The test was performed in accordance with the following test plan and test procedure.

3.1 TEST PLAN

All RF Path Consoles are to be constructed under quality control to ensure the correct configuration. Tests will be performed to determine the RF path losses from each RF input port to each RF output port. No other tests will be performed as this completely checks the RF paths, but does not provide the path calibration. The following test procedure is to be used for console buy-off of the S-Band and UHF RF paths.

3.2 TEST PROCEDURE

The following test procedure is used to determine the performance for each RF path. Sample data sheets are shown in the appendix.

1. Record on the data sheet the equipment name, model number, serial or identification number, and calibration date for the RF Power Meter, any signal source used, and RF attenuators used which are external to equipment consoles.
2. Remove the cable from the input connector on the RF path panel and connect the signal source to the RF Power Meter using the cable normally connected to the RF path to be tested.
3. Energize the signal source; measure and record the power. After the reading, turn off the signal source.
4. Remove the cable from the RF Power Meter and connect to the RF path. Connect the RF Power Meter to the output connector for the RF path.

5. Energize the signal source, measure and record the RF power. After the measurement, turn off the signal source.

6. Remove the RF Power Meter from the RF path output and connect to a monitor point, if provided. Ensure the RF output port is terminated in the correct impedance (usually 50 ohms).

7. Energize the signal source, measure and record the RF power. Turn off the signal source after the measurement.

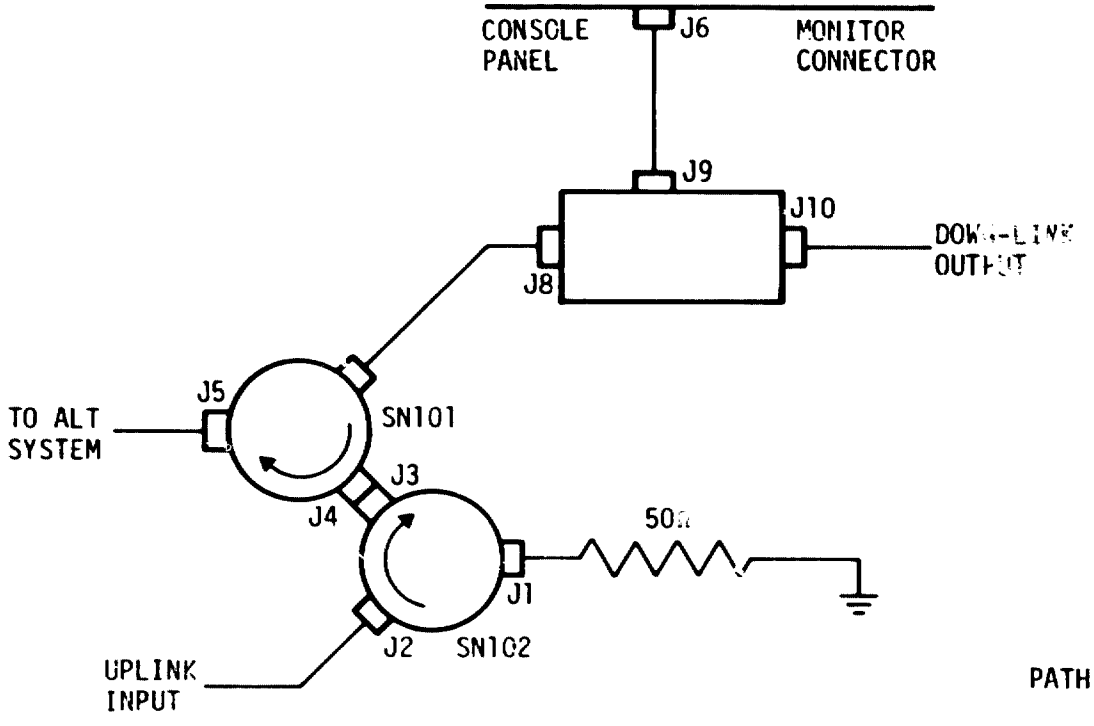
8. Restore the RF path configuration to the original configuration existing prior to the test.

9. Repeat steps 1 through 8 for each RF path. The test is to be repeated to obtain data for both directions.

4. ANALYSIS OF THE RESULTS

The loss in the S-band RF path for the direct signal was approximately 0.4 dB. The losses in the UHF path were 0.1 dB or less. Each path provided a monitor point. The nominal attenuation for each monitor point is 20 dB. The measured values were within a fraction of a decibel of the nominal attenuation. There were no losses above the nominal tolerance and expected values. The cables and connectors have been shown to be satisfactory.

The path configuration and measured losses are shown in figures 1 and 2.



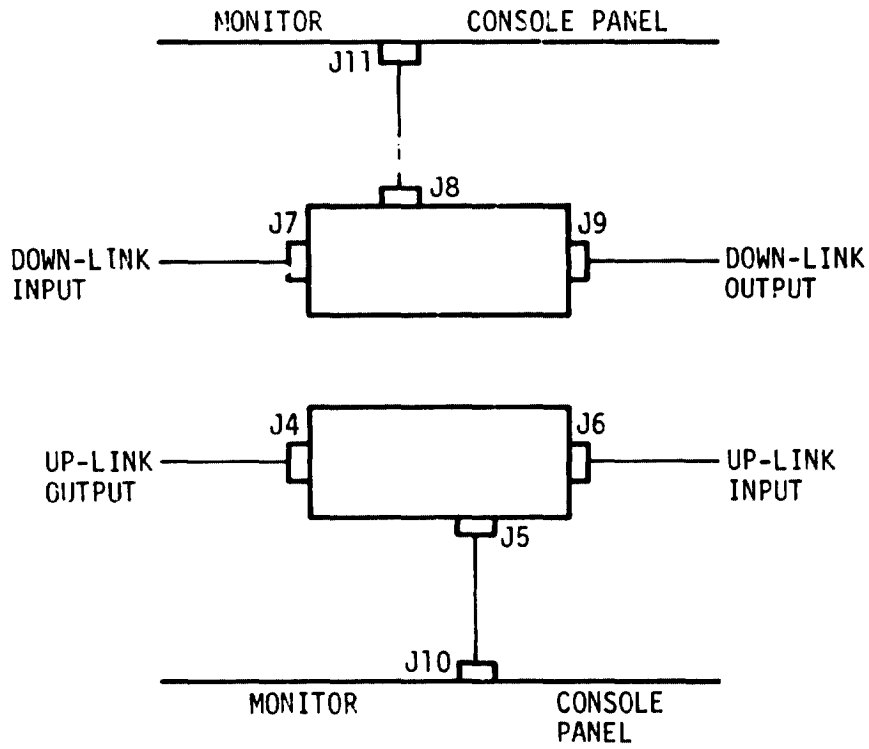
PATH	LOSS
J5 → J10	0.4 dB
J5 → J6	21.0 dB
J2 → J10	14.0 dB
J2 → J5	0.4 dB

CIRCULATORS E & M LABORATORY LS 10Y

DIRECTIONAL COUPLER NARDA 3003-20

FREQUENCY 2205 MHZ

Figure 1. – S-Band RF path data.



FREQUENCY	PATH	LOSS
259.7 MHz	J6 → J4	0.0 dB
259.7 MHz	J6 → J10	21.2 dB
296.8 MHz	J6 → J4	0.1 dB
296.8 MHz	J6 → J10	19.6 dB
259.7 MHz	J7 → J9	0.0 dB
259.7 MHz	J7 → J11	21.4 dB
296.8 MHz	J7 → J9	0.1 dB
296.8 MHz	J7 → J11	19.0 dB

DIRECTIONAL COUPLERS NARDA 3000-20

Figure 2. – UHF path data.

5. CONCLUSIONS

The RF Path Console is acceptable and ready for ALT FM System performance and compatibility tests.

APPENDIX

DATA SHEETS

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

RF PATH NAME S-BAND DOWNLINK
SEZ 3011 5234

1. RF POWER METER DATA

HP 431 B, CAL 9/4/76
ID # C09808

RF SIGNAL SOURCE DATA

HP 8614 B SIG. GEN
ID # C07663 2205 MHZ

ACCESSORIES USED

FREQUENCY COUNTER
HP 5245 L
ID # [redacted] C00284
CAL 10/14/76
PLUG IN 5255 A
C09806, 10/10/76

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

2. SIGNAL SOURCE CONNECTION J5 _____

3. SIGNAL SOURCE POWER -6 DBM _____

4. RF PATH OUTPUT CONNECTION J10 _____

5. RF PATH OUTPUT POWER -6.4 _____

6. MONITOR TEST CONFIGURATION J6 _____

7. MONITOR POINT OUTPUT POWER -27 DBM _____

8. RF PATH RECONFIGURED _____

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

RF PATH NAME UHF -DOWNLINK
SEZ 36115234

1. RF POWER METER DATA

HP431B, ID# C09808
CAL. 9/4/76

RF SIGNAL SOURCE DATA

HP 608C SIG GEN
ID# C08931 459.7 MHZ

ACCESSORIES USED

HP5245L COUNTER
ID# C02824 CAL. 10/14/76

PLUG IN 5253B
ID# C00056, CAL. 10/10/76

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

2. SIGNAL SOURCE CONNECTION J7 

3. SIGNAL SOURCE POWER +3.6 DBM 

4. RF PATH OUTPUT CONNECTION J9 

5. RF PATH OUTPUT POWER +3.6 DBM 

6. MONITOR TEST CONFIGURATION J11 

7. MONITOR POINT OUTPUT POWER -17.8 DBM 

8. RF PATH RECONFIGURED 

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

RF PATH NAME UHF UPLINK
SEZ 36115234

1. RF POWER METER DATA

HP431B, ID# C09208
CAL. 9/4/76

RF SIGNAL SOURCE DATA

HP608C SIG GEN.
ID# C08931 254.7 MHZ

ACCESSORIES USED

HP5245L COUNTER
ID# C02844 CAL 10/15/76

PLUG IN 5253B
ID# C00056 CAL 10/10/76

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

2. SIGNAL SOURCE CONNECTION J6 

3. SIGNAL SOURCE POWER +3.6 DBM 

4. RF PATH OUTPUT CONNECTION J4 

5. RF PATH OUTPUT POWER +3.6 DBM 

6. MONITOR TEST CONFIGURATION J10 

7. MONITOR POINT OUTPUT POWER −17.6 DBM 

8. RF PATH RECONFIGURED 

JSC-10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

RF PATH NAME UHF UP LINK
SEZ 36/15234

1. RF POWER METER DATA

HP 431B, ID # CC9806
CAL 9/4/76

RF SIGNAL SOURCE DATA

HP 608C SIG GEN
ID # CC2931 296.8 MHZ

ACCESSORIES USED

HP 5245L COUNTER
ID # CC2824 CAL 10/14/76

PLUG IN 5253B
ID # CCCC56 CAL 10/10/76

JSC - 10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

2. SIGNAL SOURCE CONNECTION J6 

3. SIGNAL SOURCE POWER 3  +4.8 DBM 

4. RF PATH OUTPUT CONNECTION J4 

5. RF PATH OUTPUT POWER 3.7 

6. MONITOR TEST CONFIGURATION J5 10 

7. MONITOR POINT OUTPUT POWER -15.8 

8. RF PATH RECONFIGURED 

JSC - 10794

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

RF PATH NAME UHF DOWNLINK
SEZ 3611 5234

1. RF POWER METER DATA

HP431B, ID# C09E0E
CAL 9/4/76

RF SIGNAL SOURCE DATA

HP606E SIG GEN.
ID# C0E921 296.8 MHZ

ACCESSORIES USED

HP5245L COUNTER
ID# C02224, CAL 10/14/76

PLUG IN 5253B
ID# C00056 CAL 10/10/76

APPROACH AND LANDING TEST PHASE
SHUTTLE TASK 501
RF PATH DATA SHEET

Date 5/4/76
Quality Control

2. SIGNAL SOURCE CONNECTION J7 _____

3. SIGNAL SOURCE POWER +3.8 DBM _____

4. RF PATH OUTPUT CONNECTION J9 _____

5. RF PATH OUTPUT POWER +3.7 DBM _____

6. MONITOR TEST CONFIGURATION J11 _____

7. MONITOR POINT OUTPUT POWER -15.2 DBM _____

8. RF PATH RECONFIGURED _____