NASA CR-
147800

DESIGN DOCUMENT
FOR
NAVIGATION AID CONSOLE
(SDD 36115461)

Job Order 17-069

(NASA-CR-147800) DESIGN DOCUMENT FOR NAVIGATION AID CONSCLE (SDD 36115461) (Lockheed Electronics Co.) 36 p HC $4.00 CSCL 14B

N76-27308

Unclas
G3/14 45768

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
June 1976

LEC-8380
SHUTTLE

TECHNICAL REPORT INDEX/ABSTRACT
(See instructions on reverse side.)

1. TITLE AND SUBTITLE OF DOCUMENT DESIGN DOCUMENT FOR NAVIGATION AID CONSOLE (SDD 36115461)	2. JSC NO. JSC- 11140
3. CONTRACTOR/ORGANIZATION NAME Lockheed Electronics Company, Inc.	4. CONTRACT OR GRANT NO. NAS 9-12200
5. CONTRACTOR/ORIGINATOR DOCUMENT NO. LEC-8380	6. PUBLICATION DATE (THIS ISSUE) June 1976
7. SECURITY CLASSIFICATION Unclassified	8. OPR (OFFICE OF PRIMARY RESPONSIBILITY) W. C. Long
9. LIMITATIONS GOVERNMENT HAS UNLIMITED RIGHTS [X] YES [ ] NO IF NO, STATE LIMITATIONS AND AUTHORITY N/A	10. AUTHOR(S) George D. Doland
11. DOCUMENT CONTRACT REFERENCES	12. HARDWARE CONFIGURATION
WORK BREAKDOWN STRUCTURE NO.	SYSTEM
CONTRACT EXHIBIT NO.	SUBSYSTEM
DPL NO. AND REVISION	MAJOR EQUIPMENT GROUP
DRL LINE ITEM NO.	

13. ABSTRACT

This document is a design document for the Navigation Aid Console to be used in the Shuttle Avionics Integration Laboratory for flight simulation operation.

14. SUBJECT TERMS

JSC-11140

DESIGN DOCUMENT
FOR
NAVIGATION AID CONSOLE
(SDD 36115461)

Job Order 17-069

PREPARED BY

G. D. Doland

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

APPROVED BY

LEC

A. L. Roelse

A. L. Roelse, Supervisor
Spacecraft Systems Test Section

J. S. Creamer

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

NASA

William C. Long

W. C. Long, Office Head
Spacecraft Systems Test Office

D. Dittmar 6/15/76

D. C. Dittmar
Quality Engineering

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

June 1976

LEC-8380
SHUTTLE

JSC-11140

DESIGN DOCUMENT
FOR
NAVIGATION AID CONSOLE
(SDD 36115461)

Job Order 17-069

APPROVED BY

D. Dittmar 6/15/76
D. C. Dittmar
Quality Engineering

William C. Long
W. C. Long, Office Head
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

June 1976

LEC-8380
SHUTTLE

ACKNOWLEDGMENT

This document was prepared in response to Action Document 76-17-069-45 submitted by the Technical Monitor, William C. Long, Manager, Spacecraft Systems Test Office of the Tracking and Communications Development Division. George D. Doland of the Spacecraft Systems Test Section of Lockheed Electronics Company, Inc., prepared this design document for the Navigation Aid Console to be used in the Shuttle Avionics Integration Laboratory for flight simulation operation. Individual test sets were procured and provided to the Spacecraft Systems Test Office by the Tracking Techniques Branch, EE6.

CONTENTS

FIGURES

ABBREVIATIONS AND ACRONYMS

ALT	Approach and Landing Test
ATA	Avionics Test Article
BCD	Binary coded decimal
dB	Decibel
FSP	Forced short pulse
GSE	Ground support equipment
ICD	Interface Control Document
JSC	Johnson Space Center
LIU	Logic Interface Unit
MSBLS	Microwave Scanning Beam Landing System
NASA	National Aeronautics and Space Administration
NAVAIDS	Navigation aids
OVEIS	Orbiter vehicle end item specification
PRF	Pulse repetition frequency
RAS	Radar altimeter stimulator
RF	Radio frequency
SAIL	Shuttle Avionics Integration Laboratory
SIS	Shuttle Interface Subsystem
SSO	Space Shuttle Orbiter
SSTL	Spacecraft Systems Test Laboratory
SSTO	Spacecraft Systems Test Office
TACAN	Tactical Air Navigation
TPS	Test Preparation Sheet

1. INTRODUCTION

The Space Shuttle Orbiter (SSO) navigation aid equipment consists of the Tactical Air Navigation (TACAN) equipment, radar altimeter (RA), and Microwave Scanning Beam Landing System (MSBLS). In order to utilize these items in the Shuttle Avionics Integration Laboratory (SAIL), it is necessary to provide radio frequency (RF) signals from signal generating sources referred to as stimulators. These stimulators are being procured by the Electromagnetic Systems Branch and will be provided to the Spacecraft Systems Test Office (SSTO) and ultimately to SAIL. The purpose of this document is to specify the design requirements, describe the proposed design, and indicate the test plan for console tests and the test plan for acceptance of the completed equipment. The stimulators are to be remotely controlled in the SAIL via the Shuttle Interface Subsystem (SIS) for flight simulation tests.

1.1 TACAN STIMULATOR

The TACAN stimulator is a ground station beacon which transmits coded RF signals to indicate the azimuth angle of the SSO with respect to the beacon location. The TACAN stimulator also receives signals from the TACAN equipment and generates coded RF reply signals from which the range can be determined.

1.2 MSBLS STIMULATOR

The MSBLS stimulator is similar to the TACAN stimulator. It represents the ground station and generates RF signals which are received by the MSBLS in the SSO. The MSBLS stimulator provides course deviation, elevation, and range. Course deviation is also referred to as azimuth angle although the reference is the runway centerline.

1.3 RA STIMULATOR

The RA stimulator provides two video pulses to the RA ground support equipment (GSE) test connector. One pulse is a time-zero reference pulse, and the second pulse is used to trigger the RA transmitter after a selected delay representing altitude. An RF path is required between the RA transmitter output port and the RA receiver input port. This path is required for RA operation.

2. REQUIREMENTS

The basic requirements for the operation of the navigation aids (NAVAIDS) which include the TACAN, MSBLS, and RA are specified in the Orbiter vehicle end item specification (OVEIS):

Orbiter Vehicle End Item Specification
MJ 070-0001-1A dated December 20, 1973
Changes through #8 dated June 20, 1975.

The OVEIS paragraphs of particular interest are contained in sections 3.3.5.2.2.7.2.1 and 3.3.5.2.2.7.2.2.

2.1 APPLICABLE DOCUMENTS

The following documents are applicable to the design of the Navigation Aid Console.

VS70-740152 Schematic Diagram, Communication and Tracking, Radar Altimeter

VS70-740172 Schematic Diagram, Communication and Tracking, TACAN Subsystem

VS70-740562 Schematic Diagram, Microwave Scanning Beam Landing System

2.1.1 STIMULATOR PROCUREMENT SPECIFICATIONS

The NAVAID stimulators were procured under the following specifications:

Exhibit A, Technical Specifications for TACAN Beacon Simulator, dated March 15, 1975
Purchase Request Project Number 5-069-014
Contract No. NAS-9-14647.

Technical Specifications for Microwave Scanning Beam Landing System Ground Station Simulator
Spec. No. 00752-501016
Revision A dated July 22, 1975.

Radar Altimeter Simulator
Statement of Work and Technical Description
Contract No. NAS-9-14660, dated May 6, 1975.

2.1.2 INTERFACE CONTROL DOCUMENTS

The applicable Interface Control Documents (ICD's) are as follows:

SAIL Project Interface Control Document
SDS/NAVAIDS Stimulator/Facilities Interface
FSB-001, dated December 11, 1975

SAIL ALT PHASE Interface Control Document
TACAN Stimulator Input (RF) #27
ICD No. 3-1603-03, dated June 26, 1975

SAIL ALT PHASE Interface Control Document
MSBLS (Simulated RF Input) #28
ICD No. 3-1603-03, dated June 26, 1975.

SAIL ALT PHASE Interface Control Document
Radar Altimeter Simulated Input (RF) #29
ICD No. 3-1603-03, dated June 26, 1975.

2.1.3 NAVIGATION AID SPECIFICATIONS

There are three types of NAVAID equipment. The specifications for these items are as follows:

Receiver-Transmitter, Air Navigation Set, Tactical
Specification Number MC409-0014
Revision A, dated November 27, 1973
by Rockwell International.

Altimeter, Radar
Specification Number MC409-0015
Revision A, dated September 3, 1974
by Rockwell International.

Navigation Set, Microwave Scanning Beam Landing System
Specification Number MC409-0017
Revision A, dated May 10, 1974
by Rockwell International.

2.2 DESIGN REQUIREMENTS

Specific requirements were specified for the NAVAIDS Console which were not covered in the specification and interface documents. These requirements are described in the following subparagraphs.

2.2.1 RF REQUIREMENTS

2.2.1.1 RF Paths

RF paths shall be provided in the console so that two TACAN stimulators can drive three TACAN flight packages, and two MSBLS stimulators can drive three MSBLS flight packages. An RF path shall be provided for each of the two RA flight packages.

2.2.1.2 Remotely Programmable RF Level Control

The RF signal levels shall be computer-controlled so that the signal input to the NAVAIDS can be dynamically controlled to provide representative signal levels during SAIL flight simulation operations.

2.2.1.3 Manual RF Level Control

The programmable attenuators shall also have the capability for local control at the NAVAID Console for open loop testing.

2.2.1.4 DC Blocking Couplers

Direct current (dc) blocking couplers shall be used in each RF cable when necessary to isolate the RF path components in the Navigation Aid Console from the Console power ground and from signal returns to the flight packages.

2.2.2 RADAR ALTIMETER REQUIREMENTS

2.2.2.1 Dual Radar Altimeter Operation

The RA stimulator (RAS) requires the capability to drive two flight type RA packages independently of each other. The procured RAS equipment shall be modified to provide two independent altitude outputs each controllable by manual means and by the computer. A mode switch is required to select between computer control and local manual control.

2.2.2.2 Altitude Indicator

Indicator circuits are required to provide an altitude signal display for the second output obtained by modifying the procured RAS.

2.2.2.3 Single/Dual Altitude Operation

When the same altitude setting is required for both flight type RA packages, the altitude setting for both RA packages shall be provided using a common delay generator. When two different altitude settings are required, the altitude setting shall be derived by two independent delay generators. A switch shall be provided to select the single or dual altitude operations. This switch position shall be capable of computer control or local manual control.

2.2.2.4 Test Mode Switch

A control is required to allow selection of either an RA test mode or normal mode for each RA flight package. This control shall be capable of local manual control or automatic operation using signals from the RA flight package. Automatically controlled operation shall be obtained when remote control is selected. An override function by the computer is optional.

The control shall be labeled PRF OFF when using the RAS, and PRF ON when using the RA flight package.

2.2.2.5 Forced Short Pulse

In normal operation of the RA flight package, the length of the pulse transmitted changes from a short pulse at low altitude to a longer pulse at a specified altitude. The RA can be operated for test purposes using the short pulse. Controls shall be provided to select the forced short pulse (FSP) operation. These controls shall be manually controlled but may be implemented for computer control as optional.

2.2.3 GENERAL REQUIREMENTS

2.2.3.1 Controls and Indicators

A control panel shall be provided to contain the controls specified in the above paragraphs. Each control shall have associated illuminated indicators which depict the operation whether in local manual control or remote computer control. Indicators shall also be provided for each RF path attenuator, the RA mode of operation, the delay time for the second radar altimeter signal, and indicators required for local manual operation.

2.2.3.2 Running Time Indicator

A chemical type running time indicator shall be provided on the control panel.

2.2.3.3 SIS Interface

One or two digital Logic Interface Units (LIU) using optical couplers shall be provided to the SSTO for mounting in the NAVAID Stimulator Console. Mounting provisions and space shall be provided in the Navigation Aid Console for the LIU and these units shall be installed when received.

2.2.3.4 Equipment Rack

The Navigation Aid Console shall consist of a three-bay equipment rack approximately 7 feet high using standard 19-inch wide panels. All items shall be installed within the equipment rack except cables for signals, control and power.

2.2.3.5 Radar Altimeter Stimulator Installation

The RAS shall be installed in the Navigation Aid equipment rack using nonconducting materials so that the RAS is isolated from the equipment rack. The RAS shall be grounded via the signal cables to the Avionics Test Article (ATA).

2.2.3.6 Grounding

The SAIL shall provide grounding for the Navigation Aid Console.

2.2.3.7 Cables

Internal cables and cables from the Navigation Aid Console to the ATA spacecraft packages shall be constructed. Power and control line cables from the SAIL facility to the Navigation Aid Console will be provided.

3. DESIGN DESCRIPTION AND IMPLEMENTATION PLAN

The effort described in this section covers only the design and testing effort to be accomplished by the Spacecraft Systems Test Office (SSTO) and the support contractor for this office.

3.1 STIMULATOR OPERATIONAL TESTS

The stimulators will be procured by the Electromagnetics Systems Branch and acceptance tested at the manufacturer's plant prior to delivery to the Johnson Space Center (JSC). Data supplied by the vendor with the stimulators plus supplemental SSTL test data will be provided to the SAIL with delivery of the stimulators. Detailed performance tests require the use of spacecraft units and associated interface and display equipment located in the SAIL that is not available in the Spacecraft Systems Test Laboratory (SSTL). Therefore, the final tests cannot be done in the SSTL but will be performed in the SAIL.

3.2 PRELIMINARY SAIL TESTS

The stimulators, as delivered by the manufacturer, will be provided to SAIL for initial integration tests as required. These tests will be performed using either approved procedures or test preparation sheets (TPS's) prepared by Rockwell International SAIL personnel. The SSTO support contractor will assist in the performance of these initial tests. These tests will be limited to manual open loop operation of the stimulators and manual control of RF signal levels.

3.3 CONSOLE CONFIGURATION

The NAVAIDS stimulator consists of one three-bay equipment console. Preliminary design information indicates that the equipment can be contained within the specified console. The equipment to be contained in the NAVAID Console consists of the following assemblies and instruments:

1. Radar Altimeter Stimulator
2. TACAN Beacon 1
3. TACAN Beacon 2
4. MSBLS Stimulator 1
5. MSBLS Stimulator 2
6. Digital Delay Generator
7. Altitude 2 Assembly
8. TACAN RF Path
9. Radar Altimeter RF Path
10. MSBLS RF Path
11. Control and Display Panel
12. Digital Logic Boards
13. Digital Logic Assembly
14. Cooling System
15. Cabinet Assemblies
16. SIS Optical Logic 1
17. SIS Optical Logic 2
18. 5 Volt Power Supply
19. -15 Volt Power Supply
20. +15 Volt Power Supply
21. +28 Volt Power Supply
22. Intra-Rack Cables

The proposed console configuration is shown in figure 1.

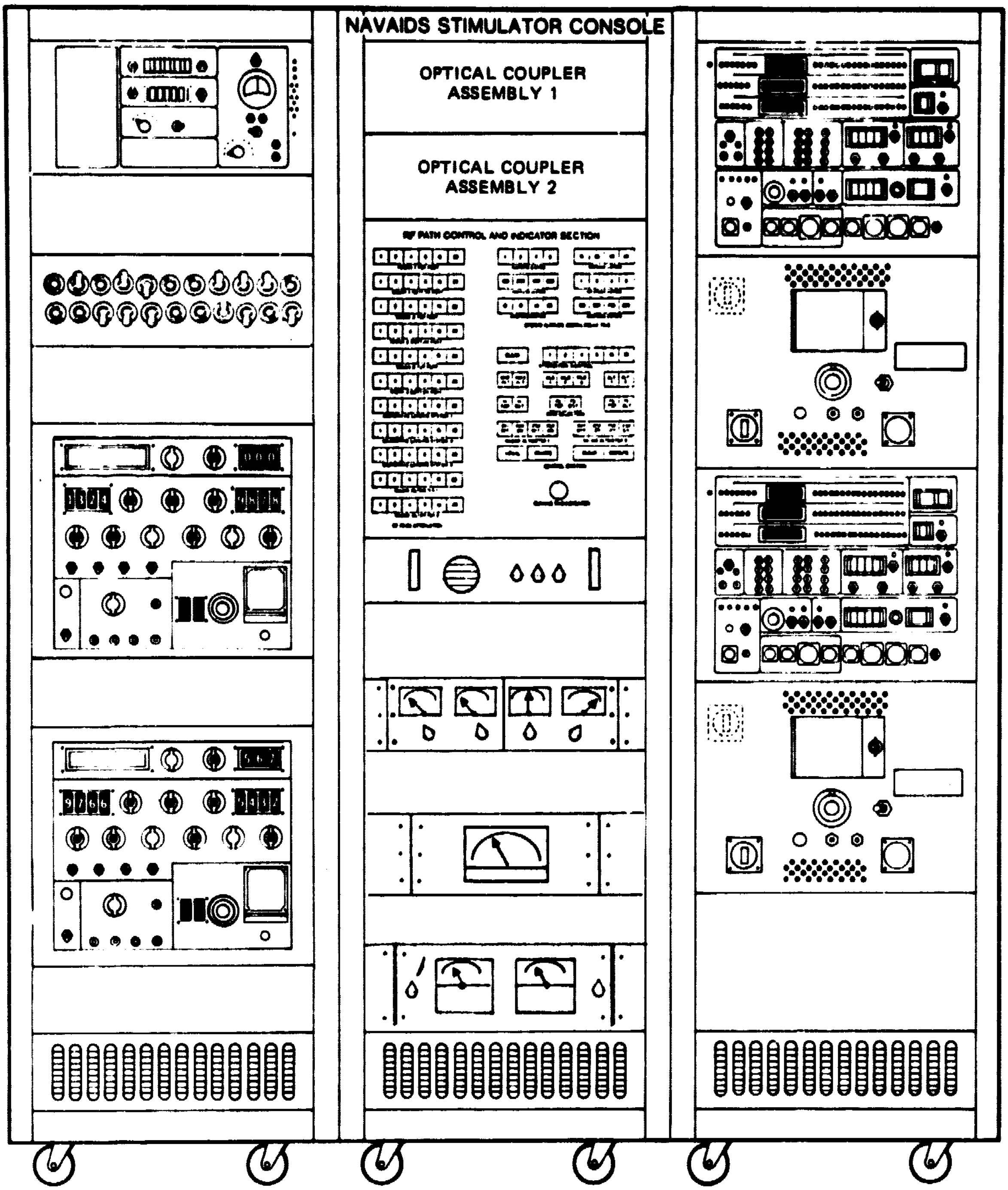

Figure 1. – NAVAIDS Stimulator Console.

3.4 RF PATH DESIGN

The RF path will use pin diode absorbtion modulator for control of the signal level. These devices will contain digital-to-analog conversion, a linearity correction circuit, and pin diode modulator. The attenuation will be controllable in one decibel (dB) steps without transients. The RF paths for TACAN, RA, and MSBLS are shown in figures 2, 3, and 4, respectively.

3.5 RF PATH CONTROL

The RF paths are primarily intended for computer control, but for some tests the paths are to be controlled manually at the NAVAIDS Console. This is achieved by a local RF Path Control Panel containing a local/remote switch. When in remote control, the computer has complete control of the signal level. When in local control, push-type switches will be used to enter and store data in a temporary storage unit. Another set of switches will be used to select the particular RF signal level to be changed. Finally, an execute switch will cause the data entered and stored to be routed to the RF path selected. Illuminated switches will serve to display the attenuator settings, the entered data, and the RF path selected. These functions will be performed using digital logic compatible with the computer controlled signals and the programmable attenuators. Figure 5 is a sketch of the proposed control panel with a section devoted to the second altitude signal time delay display.

3.6 RADAR ALTIMETER STIMULATOR DESIGN

Normally the RA generates a pulse which is transmitted, reflected from the ground, received, detected, time delay between the transmitted and received signal measured, and altitude determined from the measured delay time. In SAIL operation, using the RAS, the pulse repetition frequency (PRF) generator function

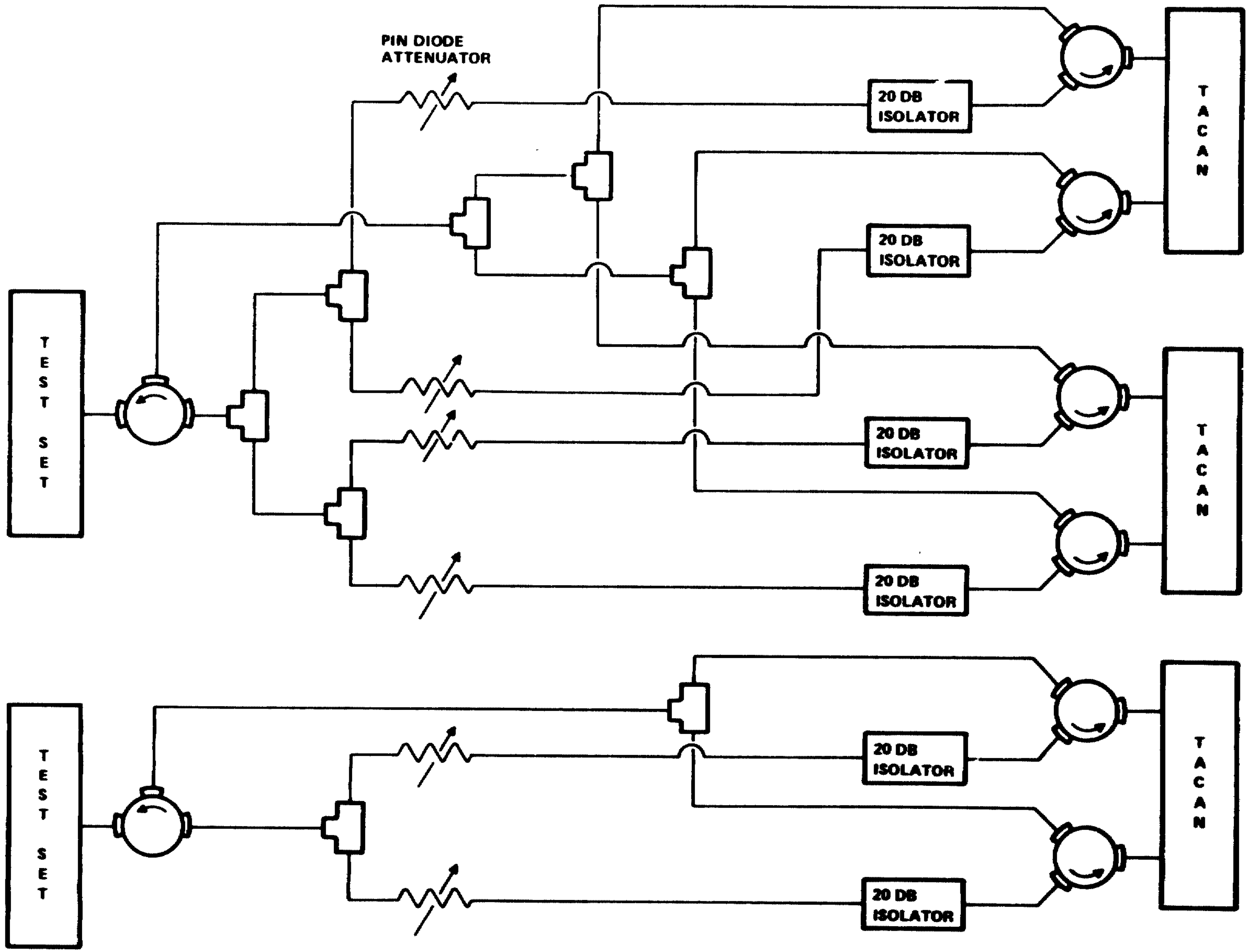

Figure 2. — TACAN RF path.

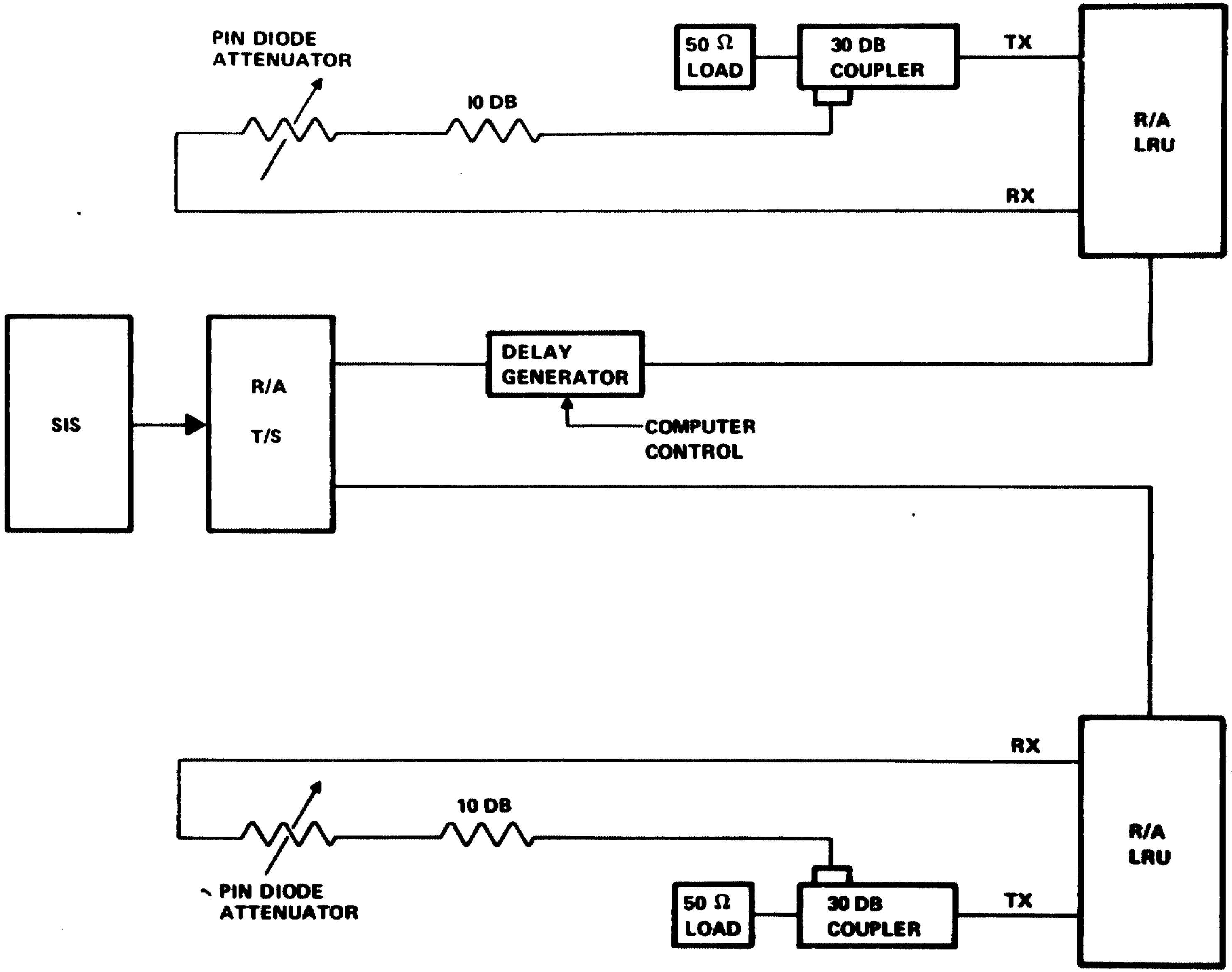

Figure 3. — Radar altimeter RF path.

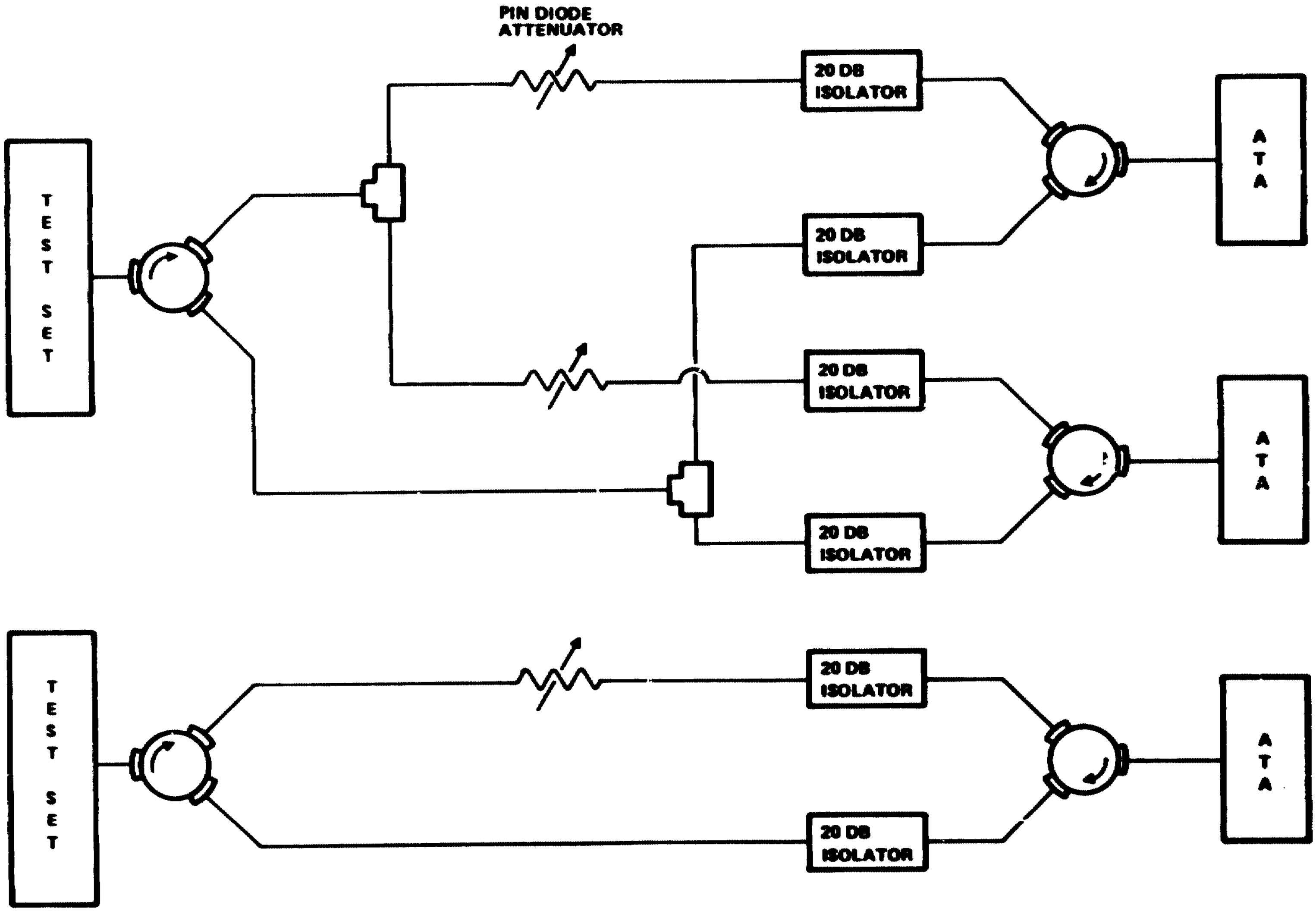

Figure 4. – MSBLS RF path.

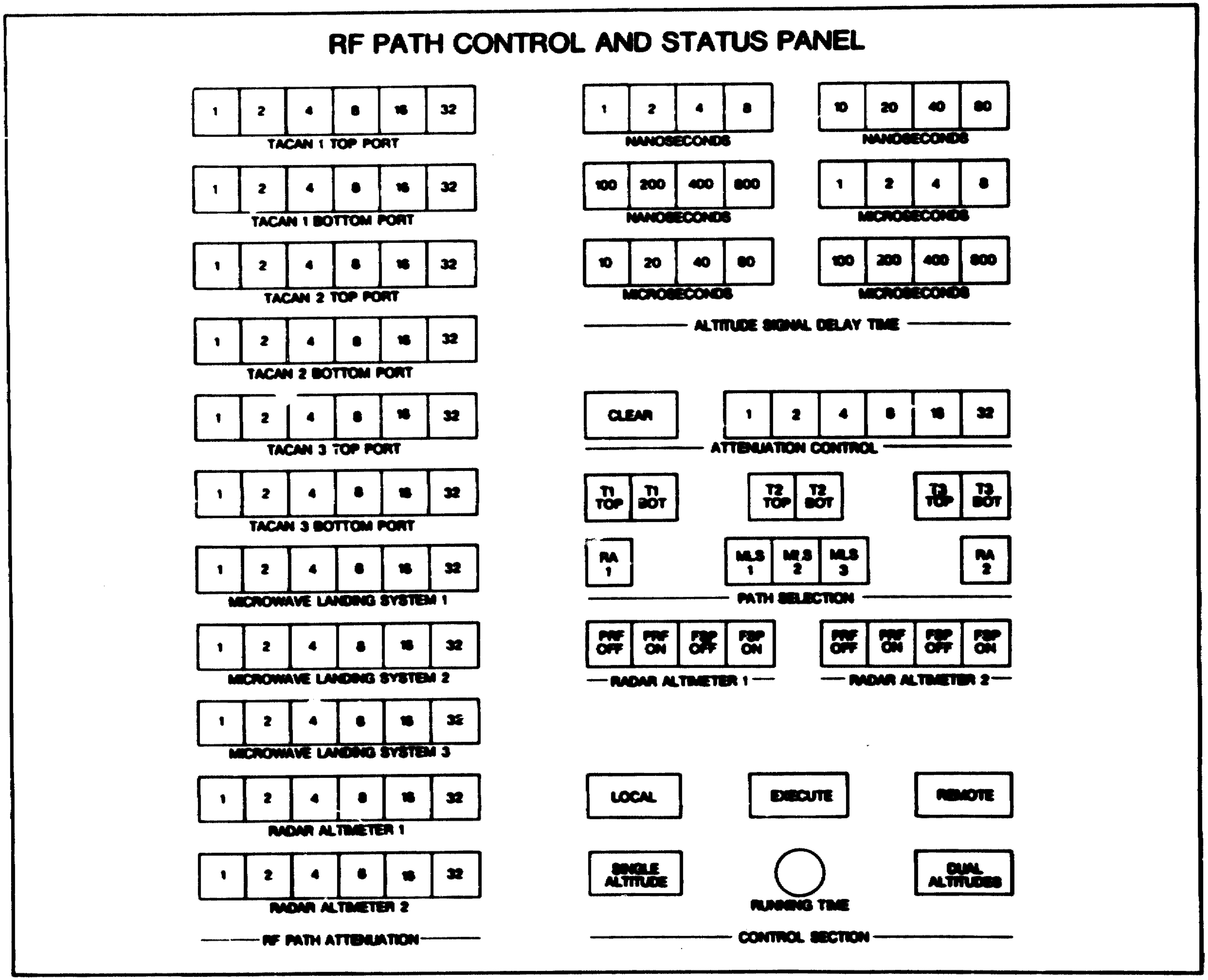

Figure 5. - RF path control and status panel.

within the RA is inhibited. A time-zero pulse and a delayed pulse are supplied by the stimulator. The delayed pulse initiates a signal which is then transmitted, returned to the receiver via a simulated RF path, detected, time between the time-zero pulse and the received pulse measured, and the altitude determined. The RAS provides the time-zero pulses and the delayed pulses for both RA flight packages. In the equal-altitude mode of operation, a single delay generator located in the RAS provides the delay for both sets of delayed pulses. In the independent altitude mode of operation a second digital delay generator provides the delayed signal for one of the RA flight packages.

The RAS will be modified to provide two different altitude readings. The changes to the RAS may require several additional connectors on the Range Programming Module. There is one type BNC connector in the Range Programming Module. A second type BNC connector will be added so independent input signals can be provided to the two drivers in the RAS. One signal will be obtained from the digital delay generator in the RAS while the second signal will be obtained from a digital delay generator installed in the console.

A coaxial relay will be used to switch the delayed signal input for one driver to the output of the Digital Delay Module in the RAS for the equal altitude mode of operation or to the output of the Digital Delay Generator for the independent altitude mode of operation.

A circuit will be provided in the NAVAIDS Console to inhibit the RA PRF for the SAIL operational mode. This circuit will be automatially controlled when remote operation is selected.

3.7 DIGITAL DELAY GENERATOR OPERATION

An additional Digital Delay Generator shall be provided to obtain an independent altitude control. One altitude reading can be obtained directly from the RAS unmodified circuit. A type T connector will be inserted in the line from the Range Programming Module to the Digital Delay Module of the RAS to provide an input pulse to the added Digital Delay Generator. The output pulse from the added Digital Delay Generator will be fed to the coaxial switch described in section 3.6.

The added Digital Delay Generator will also have a programmable delay capability that can be remotely controlled using binary coded decimal (BCD) signals from the SIS Optical Logic Drawer. Parallel lines from the SIS optical drawer will provide signals to indicator ciruits which will depict the altitude in BCD form. The delay will be measured in nanoseconds with a conversion table or nomograph provided to convert the measurements to feet.

The coaxial relay will permit one altitude reading for both RA flight packages, or by switching to the second position, will provide two different independent altitude settings.

3.8 SYSTEM CABLES

System cables pertain to the cables between the NAVAID Console and the ATA navigation aid equipment, and the cables from the Shuttle Interface Subsystem and facility power source to the NAVAID Consoles. These cables have been identified and are symbolically shown in figure 6.

3.9 INTRA-RACK CABLES

Figure 7 is a sketch showing key intra-rack cabling. This diagram is symbolic and does not represent the exact cabling.

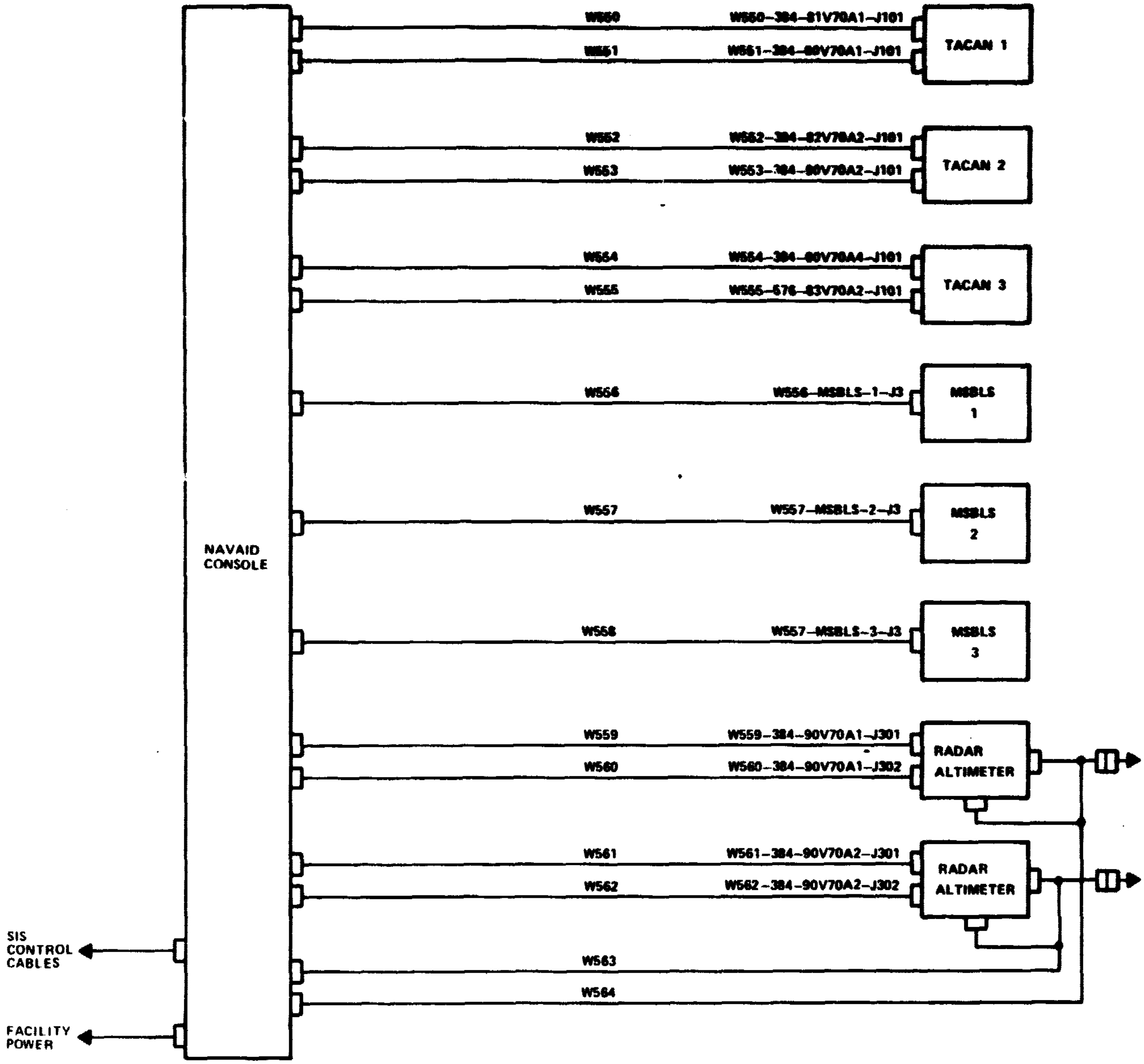

Figure 6. — System cables diagram.

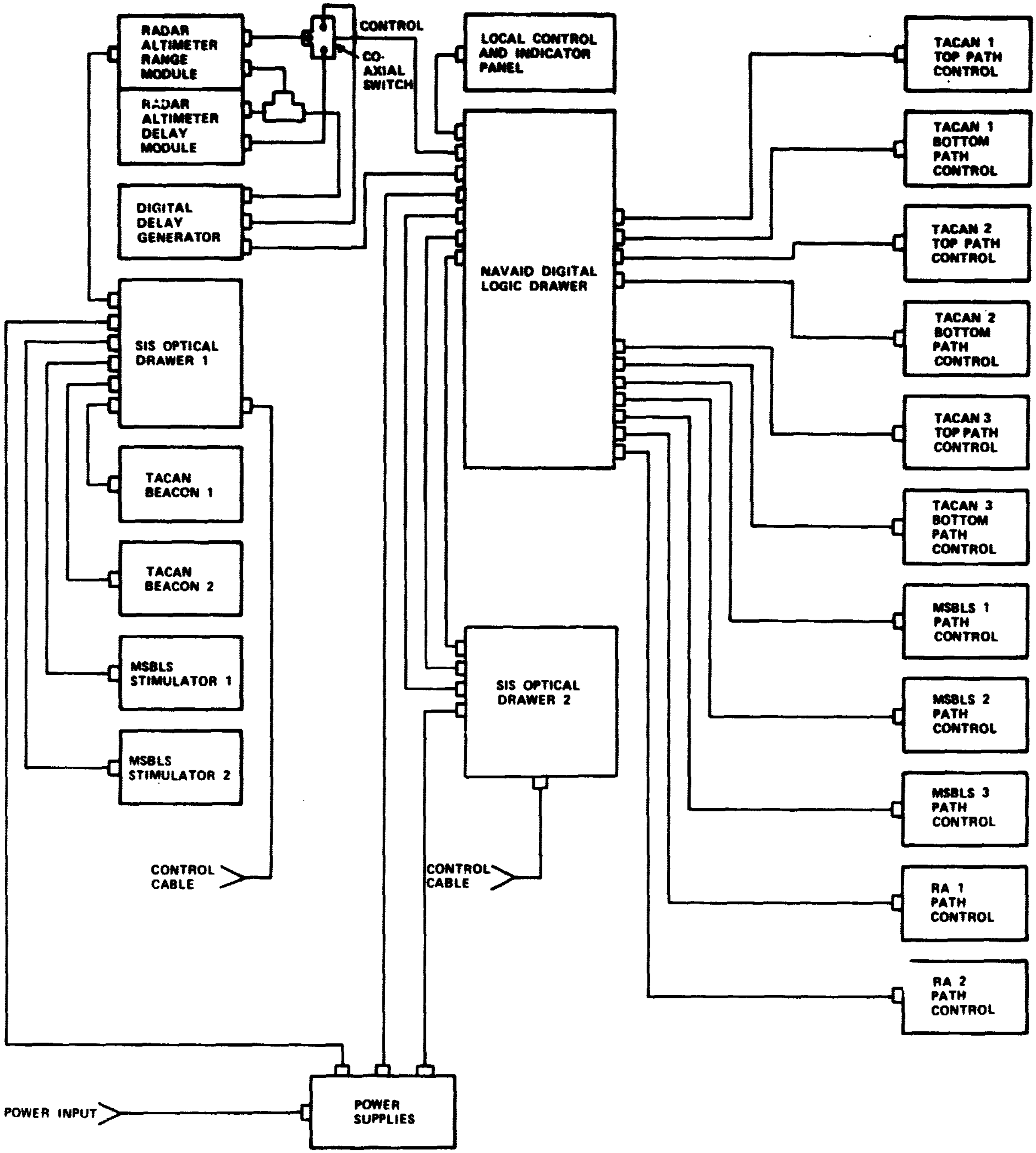

Figure 7. – Intra-rack cable diagram.

The complete cabling diagram will be provided in the NAVAID Console drawings. The details of the RF paths are not included in figure 7 but are shown in figures 2, 3 and 4.

3.10 ISOLATION

Direct current blocks will be installed in RF cables for isolating the NAVAID Console from the ATA. The RAS will be isolated from the NAVAID Console grounds and grounded through the GSE cable to the RA flight package in the ATA.

4. NAVAID STIMULATOR TEST PLAN

The purpose for the NAVAID Stimulator console tests is to ensure that the wiring has been correctly completed prior to performing more extensive system and other extensive tests with the individual stimulators installed. Console tests are to be conducted prior to delivery of console to SAIL as a completed item.

4.1 TACAN BEACON TEST

The TACAN beacons will be given a functional test where the transmitted output will be observed on a spectrum analyzer and the spectrum photographed. If suitable equipment can be made available, the receiver section will be tested in the SSTL. Tests conducted by the Tracking Techniques Branch will be witnessed by SSTL personnel.

4.2 MSBLS STIMULATOR TEST

The output of the MSBLS stimulator will be given a functional test where the transmitted output will be observed on a spectrum analyzer and the spectrum photographed. If suitable equipment can be made available, the receiver section will be tested in the SSTL. Tests conducted by the Tracking Techniques Branch will be witnessed by SSTL personnel.

4.3 RA STIMULATOR TEST

The time-zero and delayed pulse output will be observed on an oscilloscope and the pulse shape and duration determined for each pulse output in the single altitude mode.

4.4 DIGITAL DELAY GENERATOR TEST

The radar altimeter stimulator capability will be modified to provide independent dual altitude control. The time-zero and delayed pulse outputs will be observed on an oscilloscope, the pulse shape and duration determined for each pulse output in the dual altitude modes, and compared for correlation at specific selected altitudes.

4.5 RF PATH

All cables requiring calibration will be calibrated prior to final installation and wiring verification.

4.6 LOCAL CONTROLS

All local controls for RF path attenuation settings will be verified by ensuring that the controls function properly, the correct indication is shown on the control panel, the signals appear at the programmable attenuator connector pins, and the attentuation changes comply with nominal values.

4.7 REMOTE CONTROL OF ALTITUDE STATUS INDICATOR

The remote control mode will be selected and signals will be applied to the cables which connect to the SIS Optical Logic Drawer and carries control signals to the Digital Delay Generator. The altitude indicator will be observed for normal operation by monitoring the status lights.

4.8 REMOTE CONTROL OF RF PATH ATTENUATION

The RF path attenuation when operated by remote control will be tested for each RF path element to insure correct operation. Voltages will be applied to the cables which connect to the SIS Optical Logic Drawer which controls the programmable RF attenuators. The status lights will be observed on the control panel to verify operation.

5. ACCEPTANCE TEST PLAN

Complete performance of the NAVAID Console cannot be accomplished prior to integration with the associated flight packages and SAIL type ground equipment. The following tests are required to ensure proper operation of the NAVAIDS stimulators and require joint effort between SSTO and SAIL personnel. The SSTO support personnel will assist in preparing the required test procedures relative to the NAVAIDS Console only.

5.1 MANUAL OPERATION FOR TACAN

The equipment will be placed in the manual local mode, and range and bearing signals will be selected. The range and bearing signals will be verified at the Shuttle cockpit indicators for the three TACAN flight units.

5.2 MANUAL OPERATION FOR RADAR ALTIMETER

The equipment will be placed in the manual local mode and altitude setting will be selected. The altitude signal will be verified at the Shuttle cockpit indicators. Both one and two altitude modes will be tested. The change in the transmitted pulse duration will be monitored or measured. This may be accomplished either with a diode detector in the RF line or by using a spectrum analyzer.

5.3 MANUAL OPERATION FOR MSBLS

The equipment will be placed in the manual local mode, and range, elevation, and course deviation signals will be selected. The selected values will be verified at the Shuttle cockpit indicators for the three MSBLS flight units.

5.4 MANUAL RF PATH CONTROL

Local/manual control will be selected and all NAVAID stimulators will be used to provide signals to the ATA. The RF path attenuation will be increased until there is a loss of signal at each of the test articles. The thresholds will be measured in terms of attenuation required for loss of signal indication.

5.5 REMOTE OPERATION FOR TACAN

The system will be placed in remote operation and the NAVAID stimulator will be controlled by the SIS. The operation of the equipment will be verified by normal operation of the Shuttle cockpit indicators.

5.6 REMOTE OPERATION FOR RADAR ALTIMETER

With remote operation selected, a test will be performed where the altitude is controlled for both single and two-altitude operation with the altitudes verified at the cockpit indicators.

5.7 REMOTE OPERATION FOR MSBLS

With remote operation selected, a test will be performed where the range, elevation, and course deviation is controlled by the computer and the operation verified at the cockpit indicators.

5.8 REMOTE RF PATH CONTROL

With remote operation selected, all NAVAID stimulators and RF paths to the ATA will be made operative. Various RF path attenuation settings will be selected by the computer. The setting will be verified by the indicators on the NAVAID Console.

5.9 RADAR ALTIMETER CALIBRATION

As a part of the acceptance test, the RAS shall be calibrated for both single and dual modes of operation. This procedure will compensate for differences in cable delays and RF path delays. The basic process will consist of setting the altitude control manually to a predetermined altitude and setting the maintenance control on the RAS for the correct altitude as indicated in the ATA cockpit. The calibration will be verified using the computer.