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# RF LABORATORY UE BENCH TEST PLANS AND REQUIREMENTS

## VOLUME 3. STANDARD RECEIVER TESTS

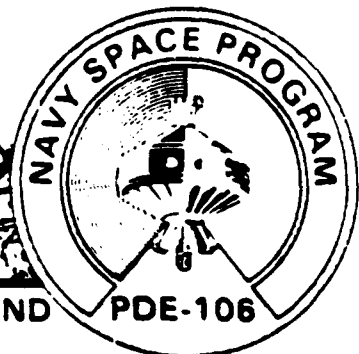
AND

## ANTENNA BENCH TESTS

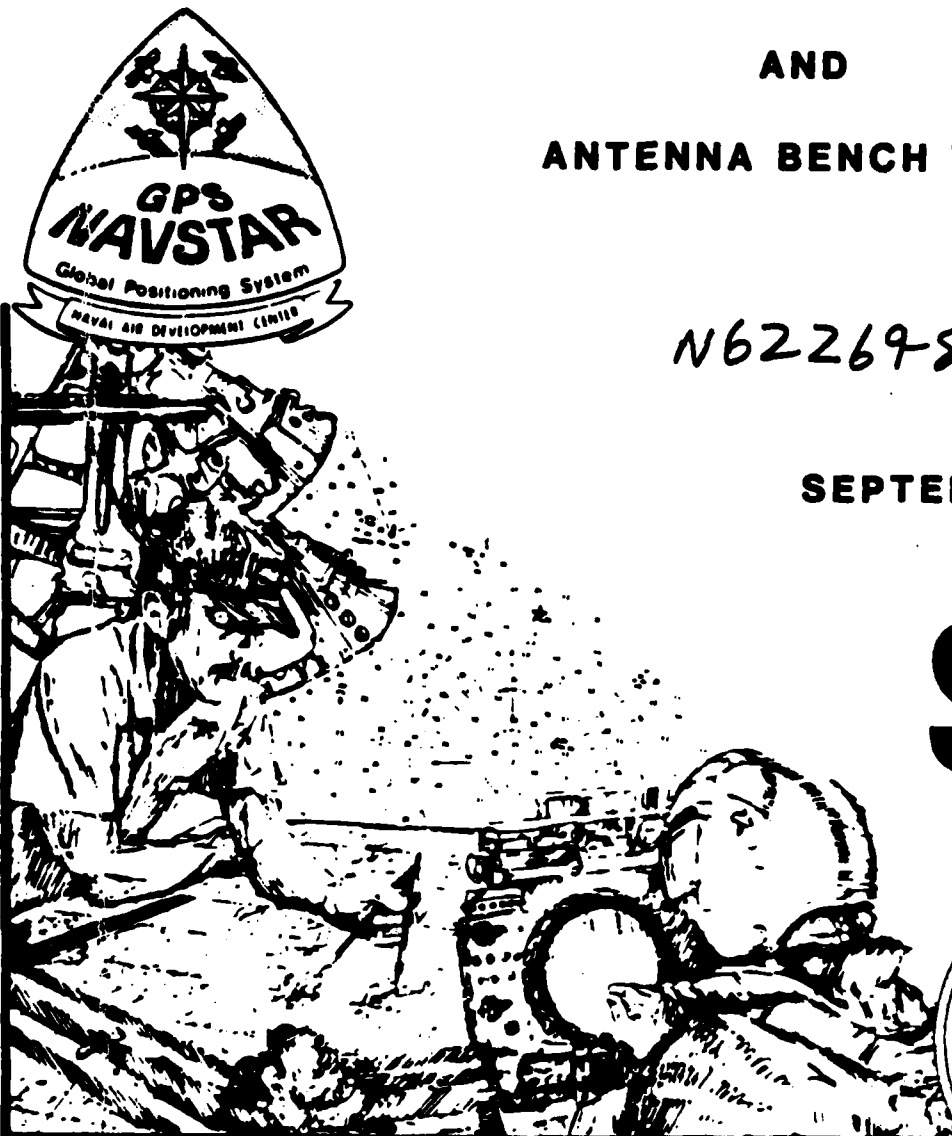
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**UE BENCH TEST PLANS  
AND REQUIREMENTS**

**VOLUME 3. STANDARD RECEIVER TESTS AND  
ANTENNA BENCH TESTS**

**SEPTEMBER 1984**

**CEA-RFL-84-005**

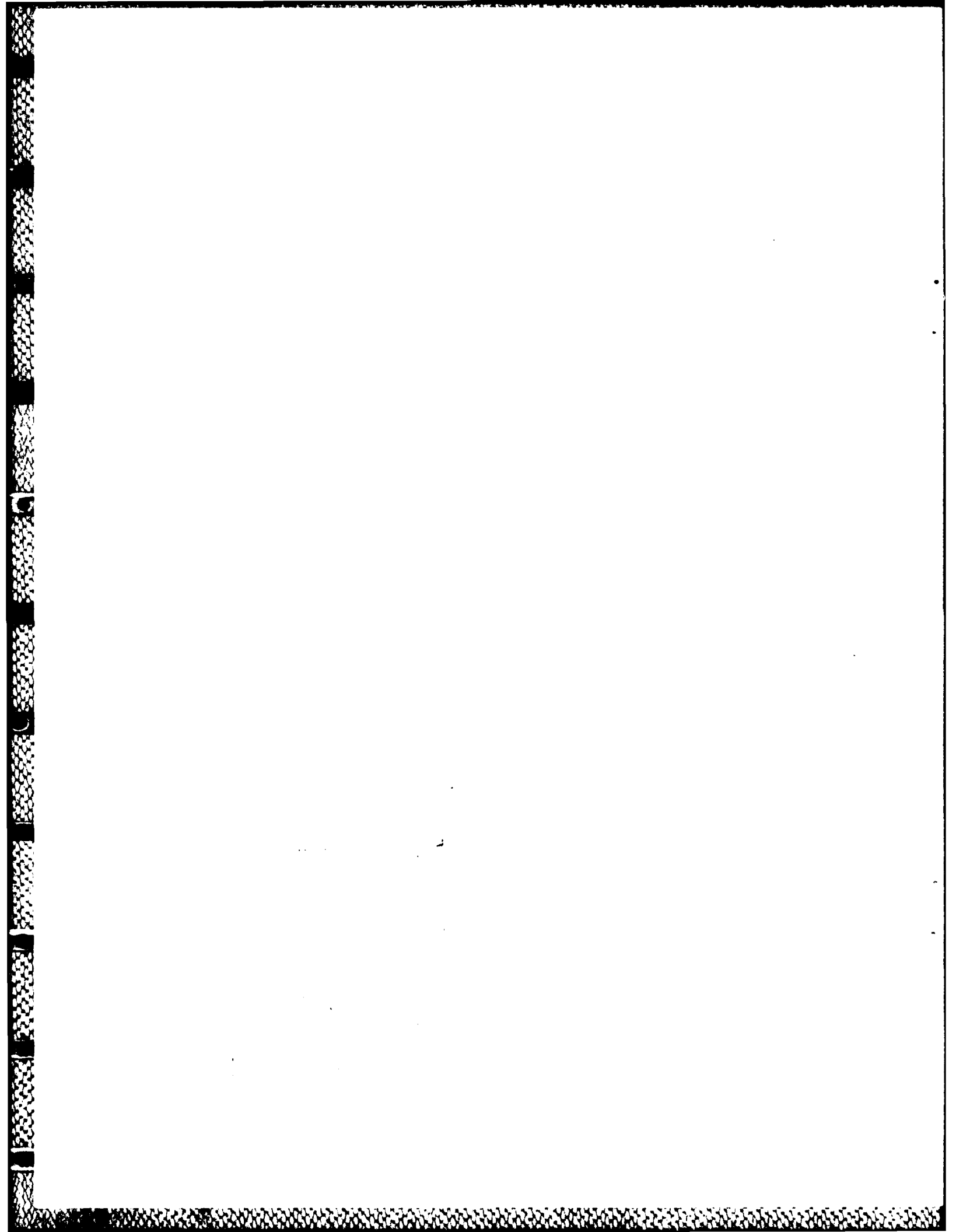
**Prepared for:**  
**Naval Air Development Center**  
**Warminster, PA 18974**

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# GPS UE BENCH TEST PLANS AND REQUIREMENTS

## VOLUME 3

### 1.0 PURPOSE

The purpose of this report is to provide a basis for defining the hardware and software required to perform Standard Receiver test and Antenna bench tests in the RF Laboratory of the GPS Central Engineering Activity at NAVAIRDEVCEEN. For additional background information, see Volume 1.

### 1.1 SCOPE

This report contains general test requirements for each test defining the:

- level of test (UE, board, component),
- test objective (parameter/function),
- test inputs,
- tests outputs,
- equipment required for each input/output,
- initial test procedure,
- data reduction requirements,
- summary list of test equipment (standard/special),
- block diagram of test.

It is divided into four sections. Sections 3.1 and 3.2 deal with Standard Receiver tests and Antenna Bench tests respectively for both the Magnavox and Rockwell-Collins UE sets. The Antenna Bench tests will be computer controlled and will require special software to control the conditions, parameters and data collection needs of the test.

A section on special software requirements is provided which defines the software needs of each test in terms of flowcharts.

A section on special hardware requirements defining special test hardware that will be required to perform these tests on both the Magnavox and Rockwell-Collins UE sets is also included. It is limited, however, by the amount of information currently available on design and performance of UE RF functions.

## 2.0 LIST OF REFERENCE DOCUMENTS

- |                |  |               |
|----------------|--|---------------|
| 1. ICD-GPS-204 | GPS Instrumentation and<br>Connector Standards         | 5 June 1981   |
| 2. Harris      | LRU Performance Test<br>Procedures CRPA 1, 2,<br>and 3 | 15 April 1982 |

### 3.0 GENERAL TEST REQUIREMENTS

This section contains test requirements and procedures for receiver and antenna testing for both Magnavox and Collins.

#### 3.1 RECEIVER TEST REQUIREMENTS

The receiver tests are standard performance tests which will measure the receiver's ability to acquire, track and demodulate GPS signals and data under a variety of conditions. These tests can be performed before and after developmental testing in order to compare performance at later stages in development to a baseline performance level. These will be performed using the Satellite Signal Generator (SSG) as the stimulus equipment. Data collection will require special purpose hardware which will be discussed in Section 5.0, and will be collected via the Instrumentation Port where possible.

##### 3.1.1 Receiver Test Procedures

The following sheets contain the initial test requirements and procedures as listed in Section 1.1 for both the Magnavox and Collins receivers. These sheets will be refined and new sheets will be added as more information becomes available.

3.1.1.1 MAGNAVOX AND COLLINS STANDARD RECEIVER TEST PROCEDURES

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 1-5

Test Objective: To measure time to acquire under various conditions of signal strength, jamming, frequency choice, etc. (Tests # 3, 4 for 5 channel sets only).

Inputs

<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1. <u>1575.42MHz (Test # 1,3,5)</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2. <u>1575.42MHz (Test # 2)</u>	<u>1227.6MHz @ -150dBw</u>	<u>Satellite Signal Generator</u>
3. <u>1227.6MHz (Test # 4)</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
4. <u>C/A Code (Test # 1,2,5)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5. <u>P Code (Test # 3,4)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6. <u>CPS Data (# 1-5)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
7. <u>Noise Modulated Jammer (# 1)</u>	<u>-139dBw100kHz BW @ 1227.6MHz</u>	<u>Satellite Signal Generator</u>
8. <u>Noise Modulated Jammer (# 5)</u>	<u>-129dBw2MHz BW @ 1227.6MHz</u>	<u>Satellite Signal Generator</u>
9. <u>CW Jammer (# 3,4)</u>	<u>-139dBw1575.42MHz</u>	<u>Satellite Signal Generator</u>
10. <u>Dynamic Profile Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
11. _____	_____	_____
12. _____	_____	_____

\* Test #5 requires that receiver undergo a cold soak at -40°C prior to testing.

Outputs

	<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1.	<u>Time to Acquire</u>	<u>TBD</u>	<u>TBD</u>
2.	<u>_____</u>	<u>_____</u>	<u>_____</u>
3.	<u>_____</u>	<u>_____</u>	<u>_____</u>
4.	<u>_____</u>	<u>_____</u>	<u>_____</u>
5.	<u>_____</u>	<u>_____</u>	<u>_____</u>

Test Procedure: Inject signal from Satellite Signal Generator into receiver front end (SSG signal for each test will be a combination of GPS and jamming signals, altered as necessary to simulate host vehicle dynamics, at the levels shown on page one for each test). Observe and record time to acquire GPS signals. Acquisition will be considered complete upon successful code lock and HOW demodulation. Receiver shall operate in State 1 for tests 1,2 and 5 and State 2 for tests 3 and 4.

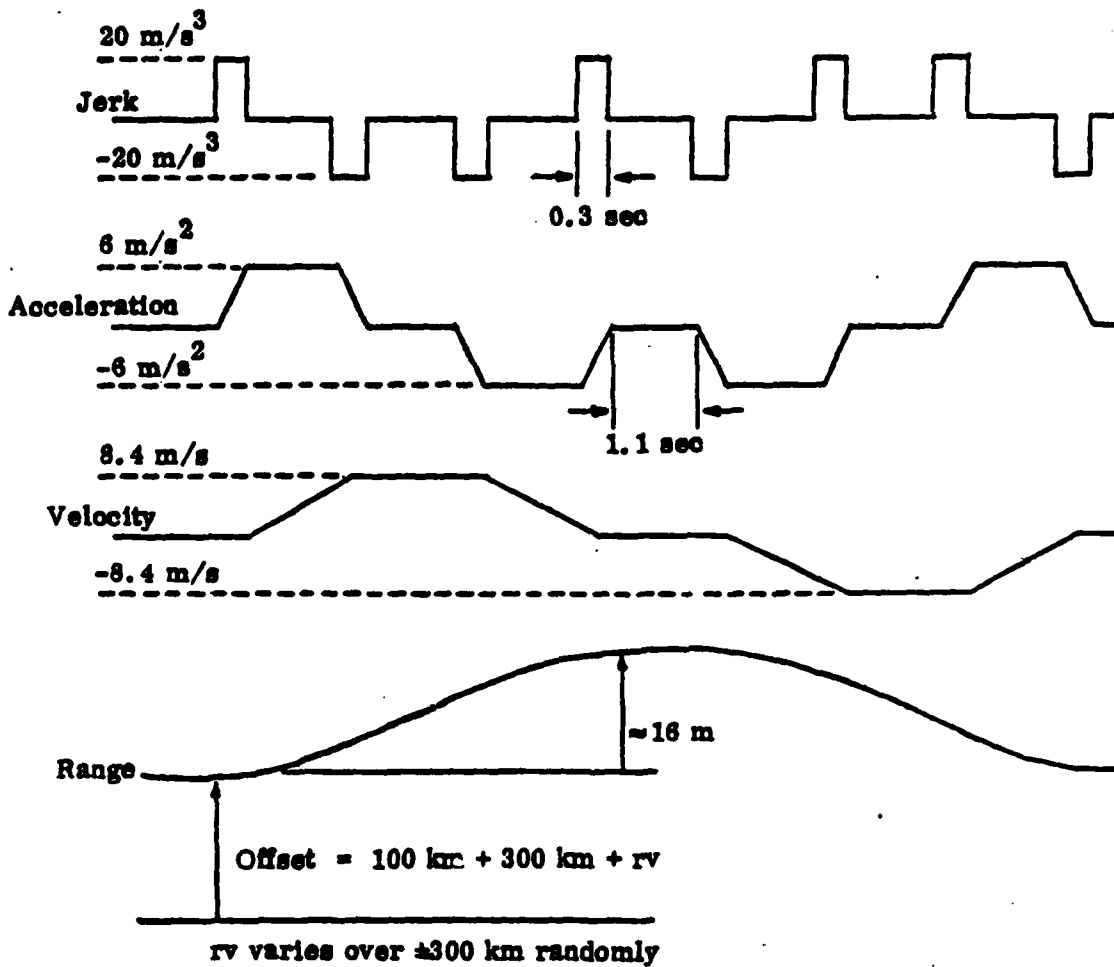
Data Reduction: Time to acquire will be recorded as will all input levels and conditions.

\_\_\_\_\_

\_\_\_\_\_

Equipment List:

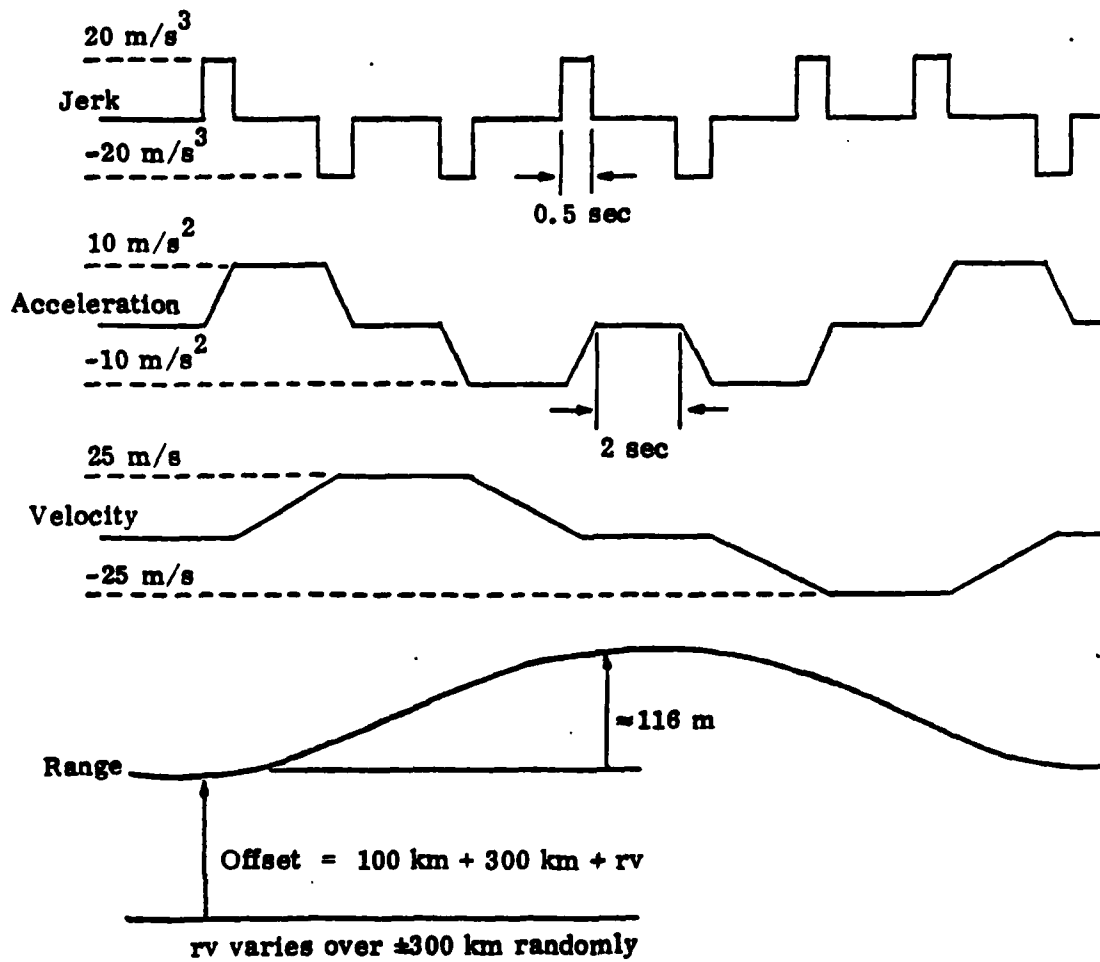
- |    |                              |    |              |    |              |
|----|------------------------------|----|--------------|----|--------------|
| 1. | <u>Satellite Signal Gen.</u> | 4. | <u>_____</u> | 7. | <u>_____</u> |
| 2. | <u>TBD</u>                   | 5. | <u>_____</u> | 8. | <u>_____</u> |
| 3. | <u>_____</u>                 | 6. | <u>_____</u> | 9. | <u>_____</u> |



**Note:** Jerk from SS-US-200, Table II, Category A  
 Acceleration from SS-US-200, 10.3.7.2.2.2  
 One sigma velocity from SS-US-200, 10.3.7.2.2  
 Position/time from SS-US-200, Table II, Category A  
 Time limited to 20 ms

FOR TESTS: 1,2,5

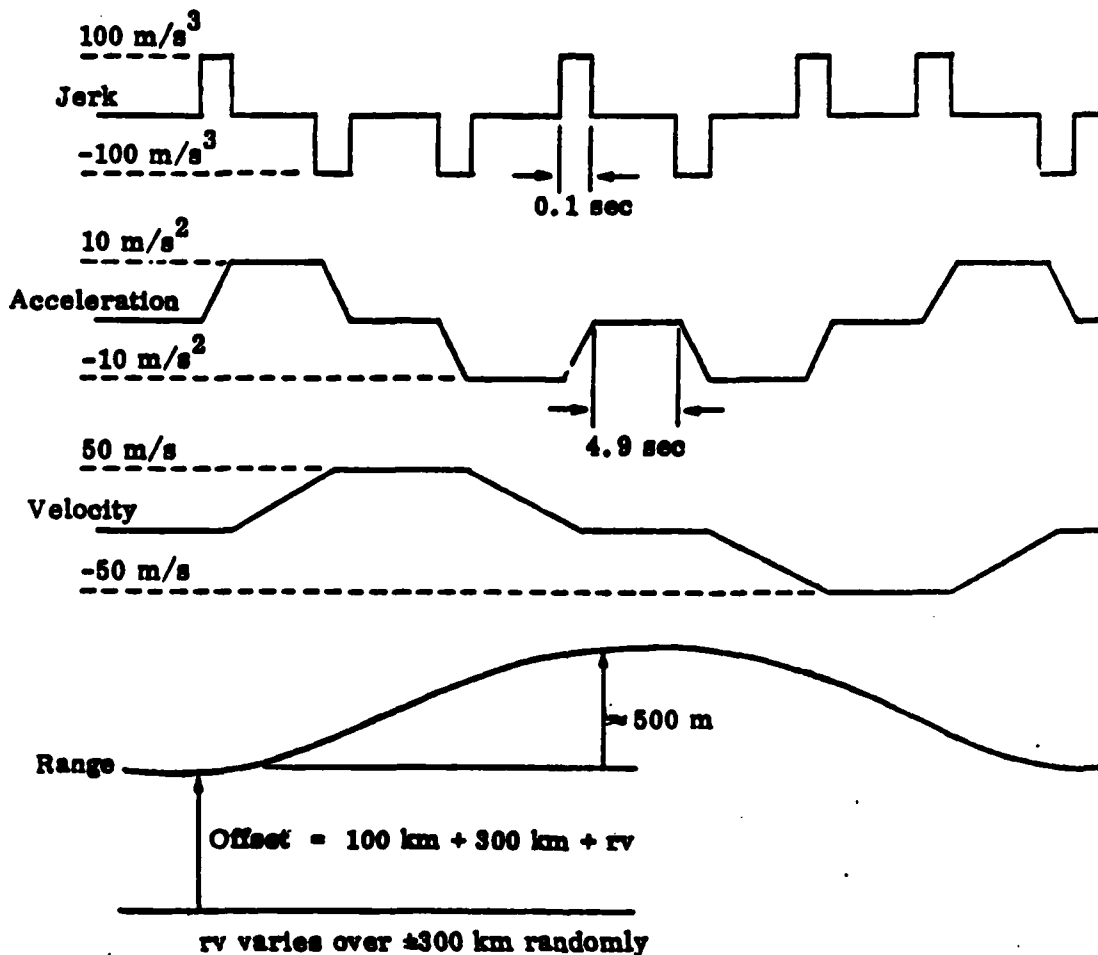
**Dynamic Profile — One Channel Receiver Normal (C/A) Acquisition**



Note: Jerk from SS-US-200, Table II, Category A  
 Acceleration from SS-US-200, Table II, Category A  
 Velocity (one sigma) from SS-US-200, Table II, Category A  
 Position from SS-US-200, Table II, Category A  
 Time limited to 20 ms

FOR TESTS: 1,2,5

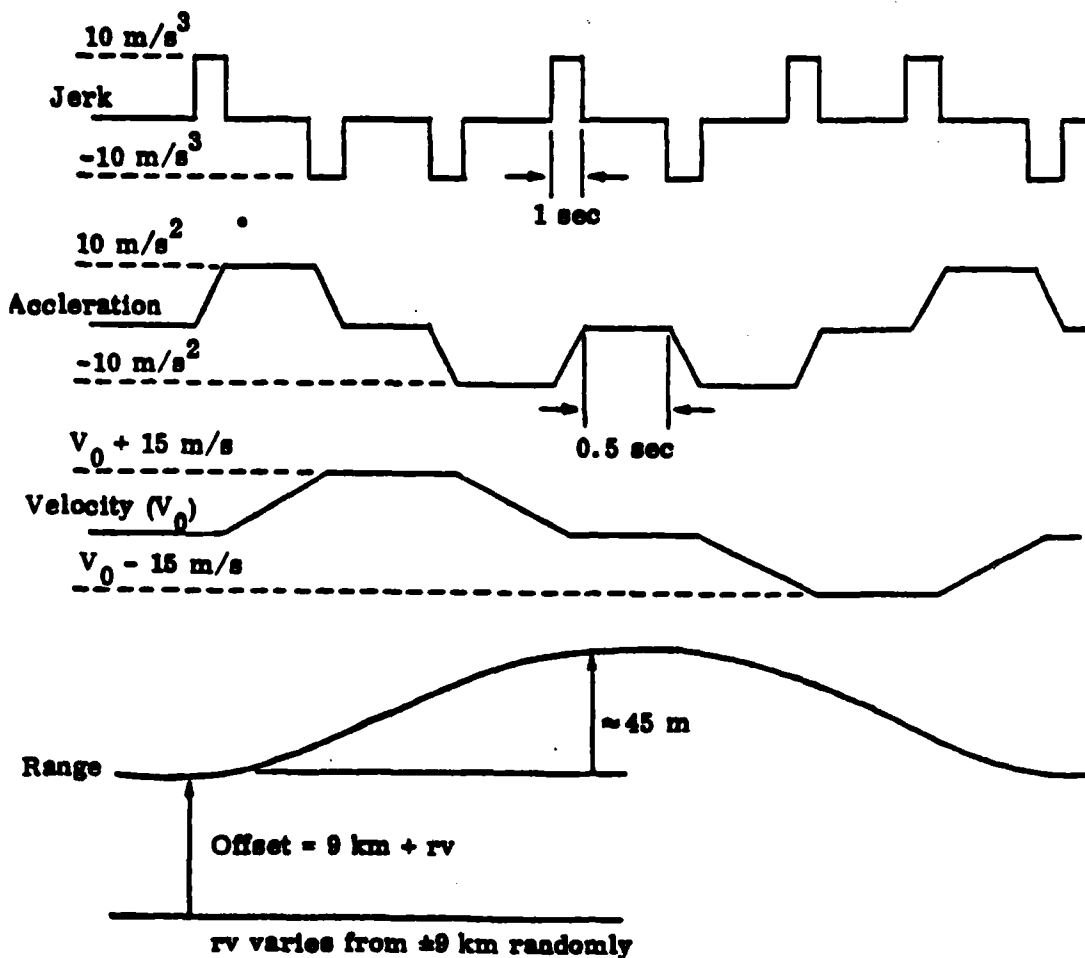
Dynamic Profile — Two Channel Receiver Normal (C/A) Acquisition



Note: Jerk from SS-US-200, 30.3.7.2.2.1  
 Acceleration from SS-US-200, Table II, Category A  
 Velocity from SS-US-200, 30.3.7.2.2.1  
 Range from SS-US-200, Table II, Category A  
 Time limited to 20 ms

FOR TESTS: 1,2,5

Dynamic Profile — Five Channel Receiver Normal (C/A) Acquisition



Note: Jerk from SS-US-200, Table II, Category C  
 Acceleration from SS-US-200, Table II, Category C  
 Velocity (3 sigma) from SS-US-200, Table II, Category C  
 Range from SS-US-200, Table II, Category C  
 Time from SS-US-200, Table II, Category C

$$18 \text{ km} = \sqrt{10^2 \text{ km} + 15.3^2 \text{ km}}$$

FOR TESTS: 3,4

**Dynamic Profile — Five Channel Receiver Direct P Acquisition**

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 6-12

Test Objective: To measure tracking reliability under various conditions of signal strength, jamming, frequency choice, etc... (5 channel sets only)

Inputs

<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1. <u>1575.42MHz (Test # 6,7,8)</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2. <u>1227.6MHz (Test # 9-12)</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
3. <u>C/A Code (Test # 8,9)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4. <u>P Code (Test # 6,7,10-12)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5. <u>GPS Data (Test # 6-12)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6. <u>CW Jammer (Test # 6,10)</u>	<u>GPS frequency at -122dBw</u>	<u>Satellite Signal Generator</u>
7. <u>CW Jammer (Test # 12)</u>	<u>1575.42MHz @ -116dBw</u>	<u>Satellite Signal Generator</u>
8. <u>*Pulsed CW Jammer (Test # 7,11)</u>	<u>GPS frequency @ -122dBw</u>	<u>Satellite Signal Generator</u>
9. <u>Noise Mod. Jammer (Test # 8,9)</u>	<u>-132dBw 100kHz BW @ GPS Freq.</u>	<u>Satellite Signal Generator</u>
10. <u>Dynamic Profile Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
11. _____	_____	_____
12. _____	_____	_____

\* Pulse width equals 1 usec. Pulse interval 0.1 to 10 msec.

Outputs

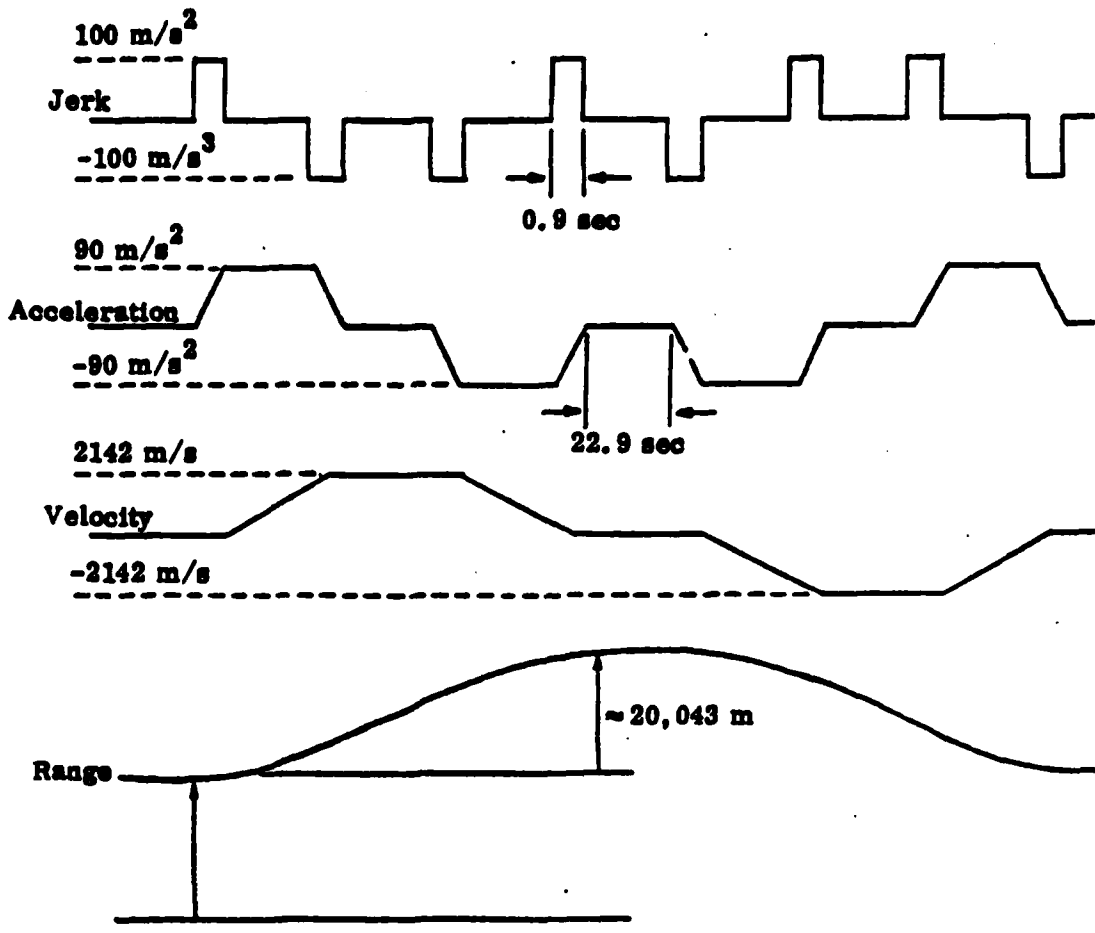
	<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1.	<u>Delta Range</u>	<u>TBD</u>	<u>TBD (inst. Port)</u>
2.	<u>Pseudo Range</u>	<u>TBD</u>	<u>TBD</u>
3.	<u>Loss of Track</u>	<u>----</u>	<u>TBD</u>
4.	<u>                    </u>	<u>                    </u>	<u>                    </u>
5.	<u>                    </u>	<u>                    </u>	<u>                    </u>

Test Procedure: Inject signal from Satellite Signal Generator into receiver front end (SSG signal for each test will be a combination of GPS and jamming signals, altered as necessary to simulate host vehicle dynamics, at the levels shown on page one for each test). Observe and record DR, PR and Loss of Lock. Receiver shall operate in State 5 for all tests. Dynamic profile for tests 8, 10 and 12 will be constant 900m/sec velocity. Profiles for other tests are attached.

Data Reduction: DR, PR, any loss of lock and all input levels and conditions will be recorded for each test.

Equipment List:

- |    |                             |    |                             |    |                             |
|----|-----------------------------|----|-----------------------------|----|-----------------------------|
| 1. | <u>SSG</u>                  | 4. | <u>                    </u> | 7. | <u>                    </u> |
| 2. | <u>TBD</u>                  | 5. | <u>                    </u> | 8. | <u>                    </u> |
| 3. | <u>                    </u> | 6. | <u>                    </u> | 9. | <u>                    </u> |



Note: Jerk from SS-US-200, 40.3.2.1.11  
 Acceleration from SS-US-200, 40.3.2.1.11  
 Velocity from SS-US-200, Table IV-IV, plus SV max velocity of 940 m/s

FOR TESTS: 6,7,9,11

**Dynamic Profile — Five Channel Receiver Tracking Tests**

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 13-16

Test Objective: To measure the pseudo range and delta range accuracy for one and two channel sets under various conditions.

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>1575.42MHz (Test # 13, 14)</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2.	<u>1227.6MHz (Test # 15, 16)</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
3.	<u>C/A Code (Test # 14, 15)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4.	<u>P Code (Test # 13, 16)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5.	<u>GPS data (Test # 13-16)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6.	<u>CW Jammer (13, 16)</u>	<u>GPS frequency @ -123dBw</u>	<u>Satellite Signal Generator</u>
7.	<u>Noise Mod. Jammer (14)</u>	<u>1227.6MHz at -133dBw (10MHz BW)</u>	<u>Satellite Signal Generator</u>
8.	<u>Noise Mod. Jammer (15)</u>	<u>1575.42MHz @ -133dBw (100kHz BW)</u>	<u>Satellite Signal Generator</u>
9.	<u>Dynamic Profile Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>

Outputs

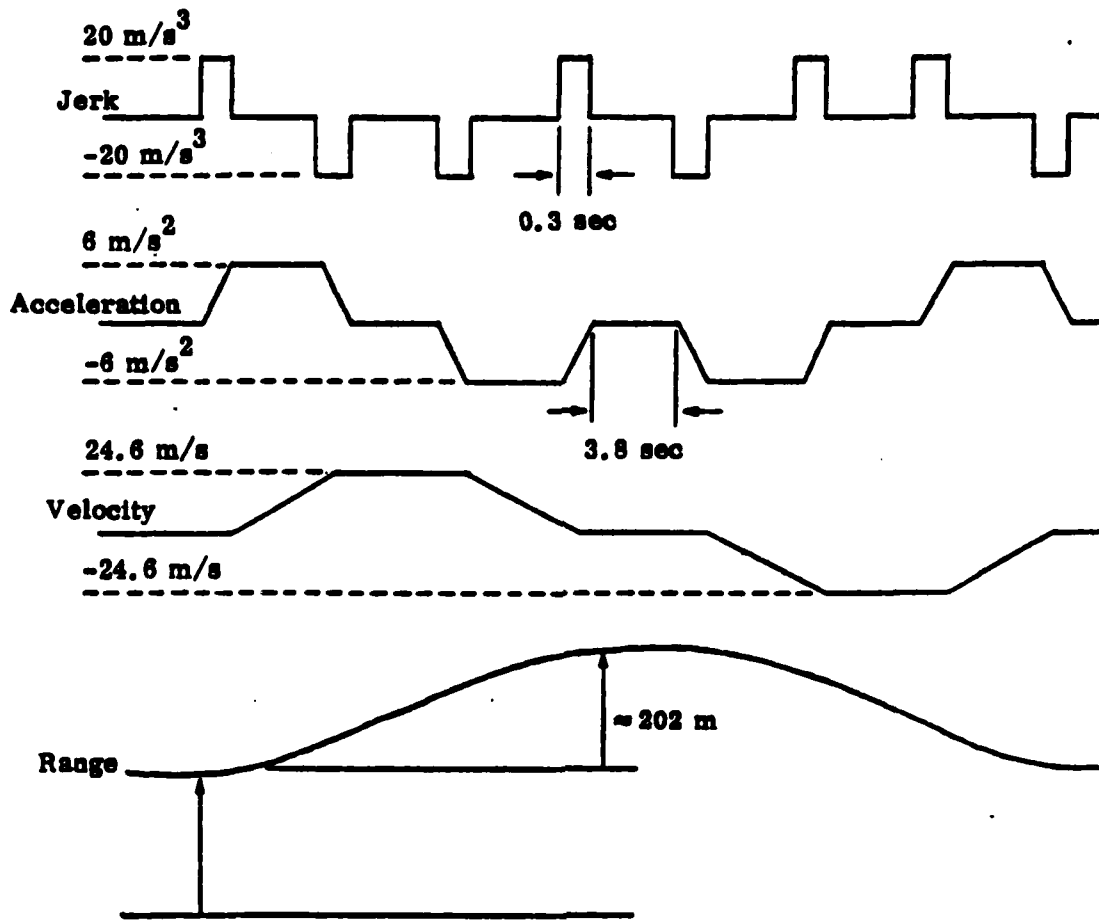
	<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1.	PR	TBD	TBD (Inst Port)
2.	DR	TBD	TBD (Inst Port)
3.			
4.			
5.			

Test Procedure: Inject signal from Satellite Signal Generator into receiver front end (SSG signal for each test will be a combination of GPS and jamming signals, altered as necessary to simulate host vehicle dynamics, at the levels shown on page one for each test). Observe and record DR and PR. Receiver shall operate in substate 5 of state 6 for all tests. Dynamic Profile for tests 13 and 15 will be constant 900m/sec velocity. Profiles for other tests are attached.

Data Reduction: DR, PR and all input levels and conditions will be recorded for each test.

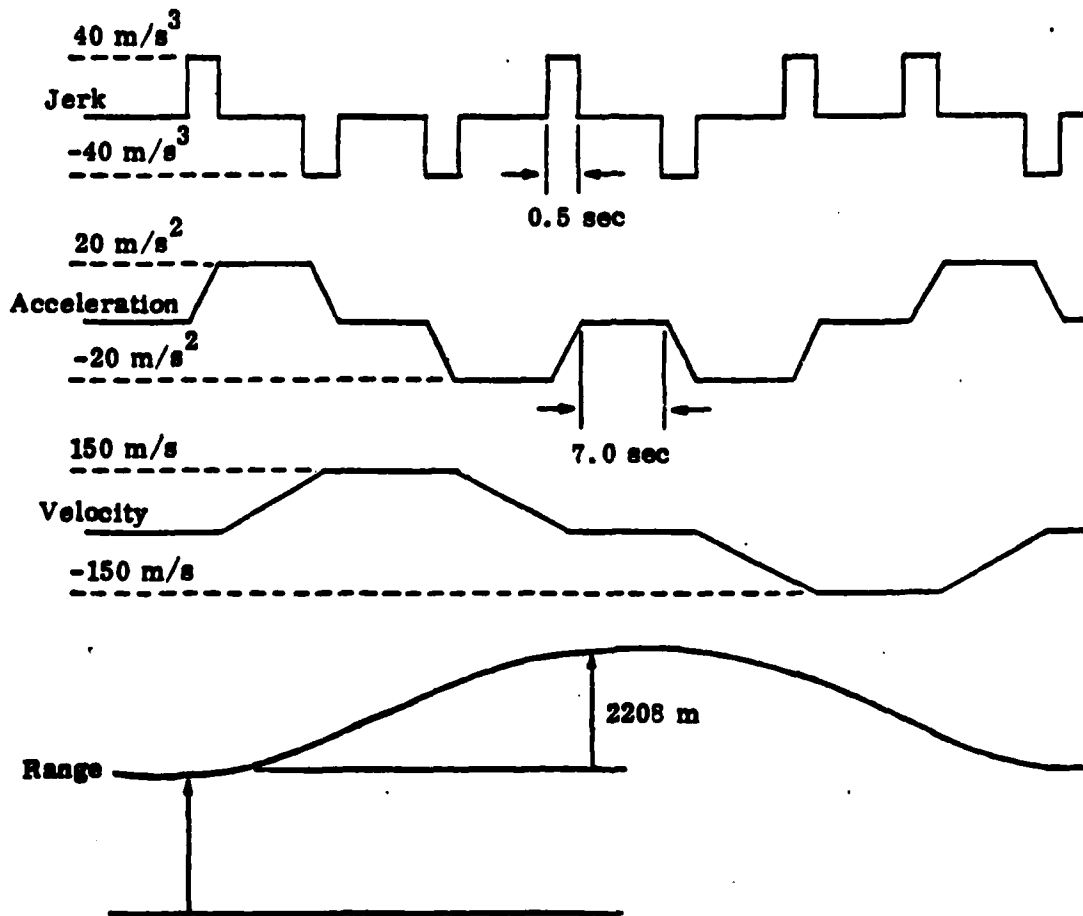
Equipment List:

- |    |     |    |  |    |  |
|----|-----|----|--|----|--|
| 1. | SSG | 4. |  | 7. |  |
| 2. | TBD | 5. |  | 8. |  |
| 3. |     | 6. |  | 9. |  |



Note: Jerk from SS-US-200, Table II, Category A  
 Acceleration from SS-US-200, Table I-IV  
 Velocity from SS-US-200, Table I-IV

**Dynamic Profile — One Channel Receiver Sequencing Tests**



Note: Jerk from SS-US-200, Table II-IV  
 Acceleration from SS-US-200, 20.3.2.1.11  
 Velocity from SS-US-200, Table II-V

**Dynamic Profile — Two Channel Receiver Sequencing Tests**

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 17-20

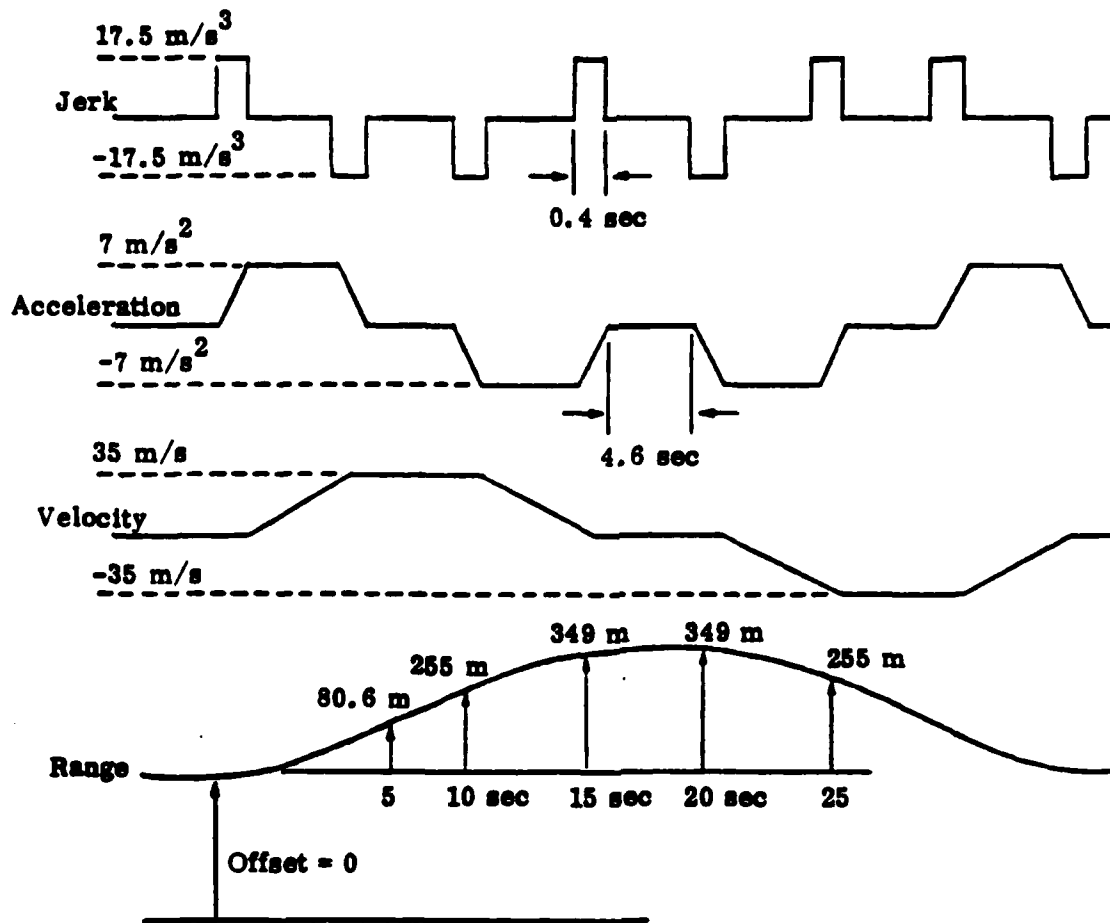
Test Objective: To measure reacquisition time for five channel sets  
under various conditions.

---

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>1575.42MHz (17, 18)</u>	<u>1227.6MHz at -163dBw</u>	<u>Satellite Signal Generator</u>
2.	<u>1227.6MHz (19, 20)</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
3.	<u>C/A Code (18, 20)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4.	<u>P Code (17, 19)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5.	<u>GPS Data (17-20)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6.	<u>CW Jammer (17, 19)</u>	<u>GPS freq. @ -123dBw</u>	<u>Satellite Signal Generator</u>
7.	<u>Noise Mod. Jammer (18)</u>	<u>1227.6MHz at -133dBw (2MHz BW)</u>	<u>Satellite Signal Generator</u>
8.	<u>Noise Mod. Jammer (20)</u>	<u>1575.42MHz @ -133dBw (10MHz BW)</u>	<u>Satellite Signal Generator</u>
9.	<u>Dynamic Profile Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>





10-sec signal outage is asynchronous with dynamic profile.

Note: Dynamic factors exceed one sigma values of SS-US-200, Table XI-V, so that the range offset achieved during signal outage will be consistent with the required statistical position uncertainty.

Dynamic Profile — Five Channel Receiver Reacquisition Test  
(State 5 Track)

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 21-22

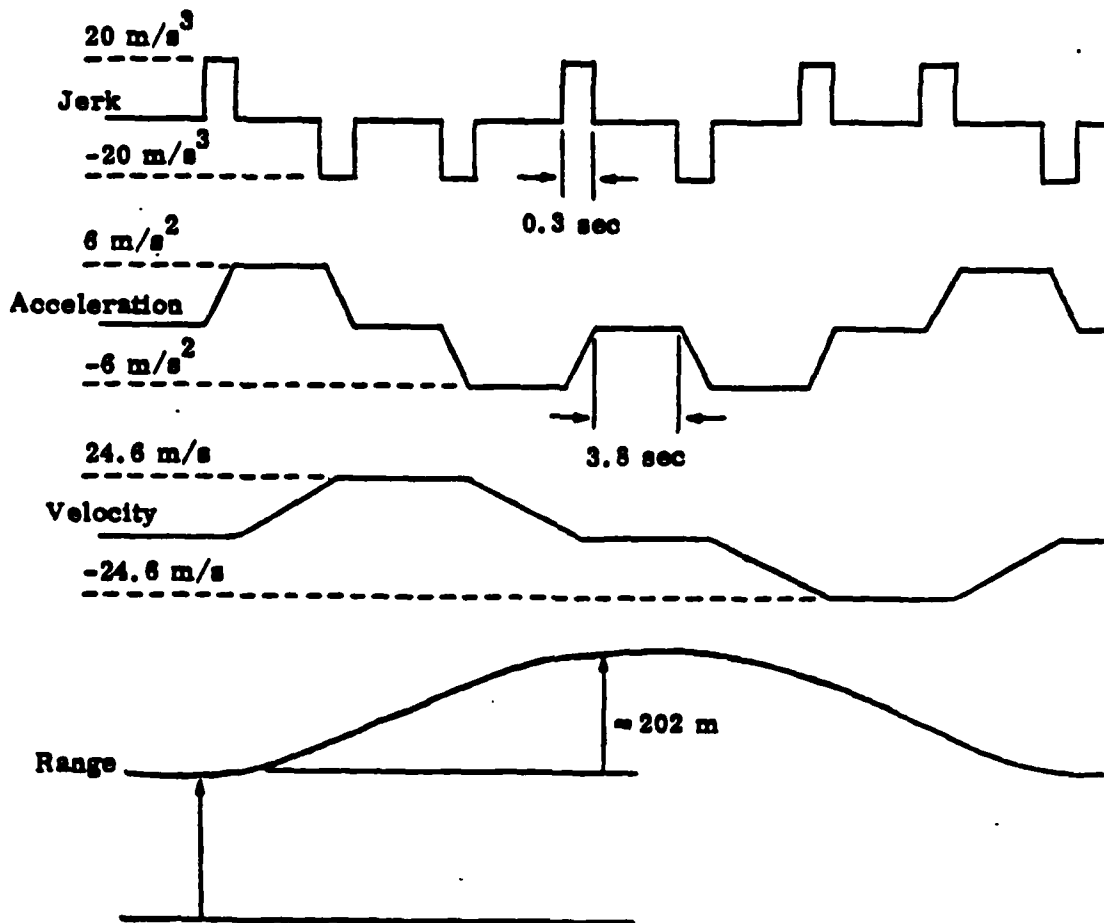
Test Objective: To determine receiver ability to measure ionospheric delay (Test 21 for 5 channel set. Test 22 for all other sets).

---

Inputs

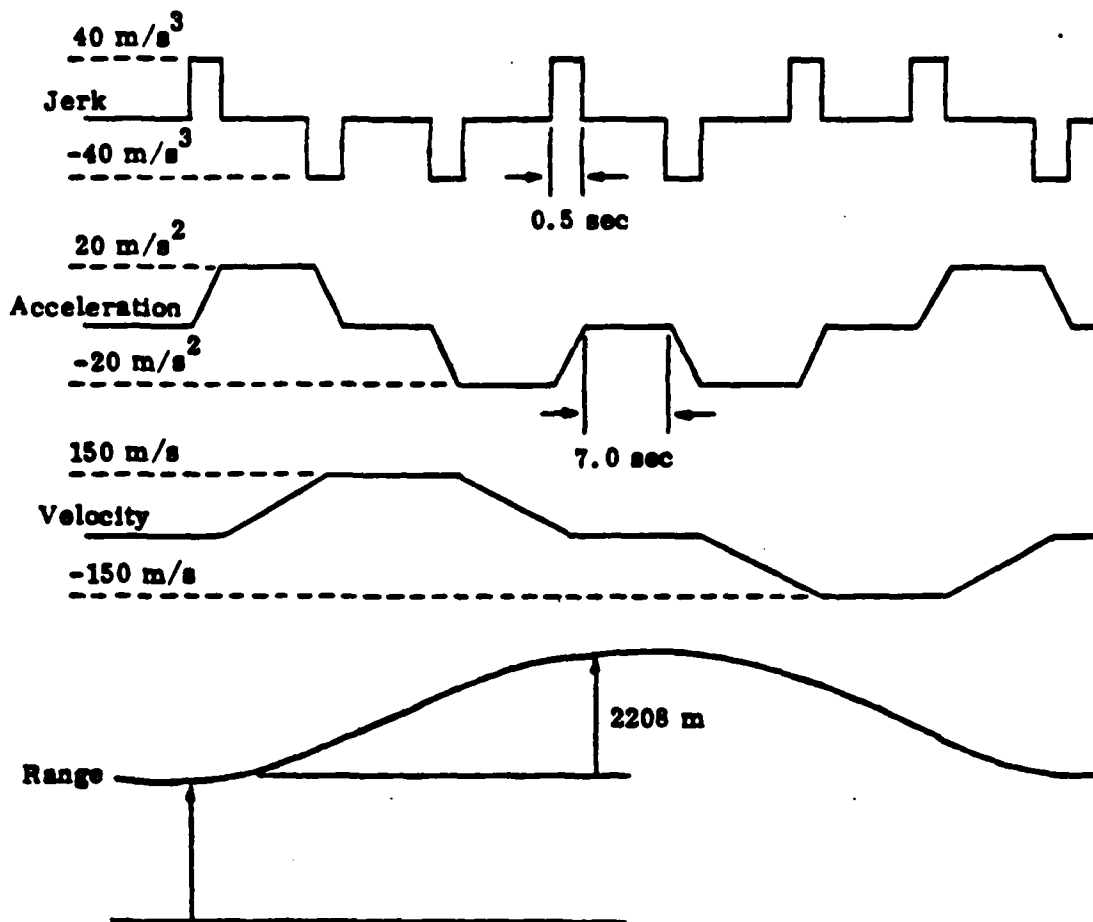
	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>1575.42MHz (21, 22)</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2.	<u>1227.6MHz (21, 22)</u>	<u>1575.42MHz @ -166dBw</u>	<u>Satellite Signal Generator</u>
3.	<u>P Code (21, 22)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4.	<u>GPS Data (21, 22)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5.	<u>CW Jammer</u>	<u>GPS freq. @ -126dBw to -122dBw</u>	<u>Satellite Signal Generator</u>
6.	<u>Dynamic Profile Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
7.	<u>_____</u>	<u>_____</u>	<u>_____</u>
8.	<u>_____</u>	<u>_____</u>	<u>_____</u>
9.	<u>_____</u>	<u>_____</u>	<u>_____</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>





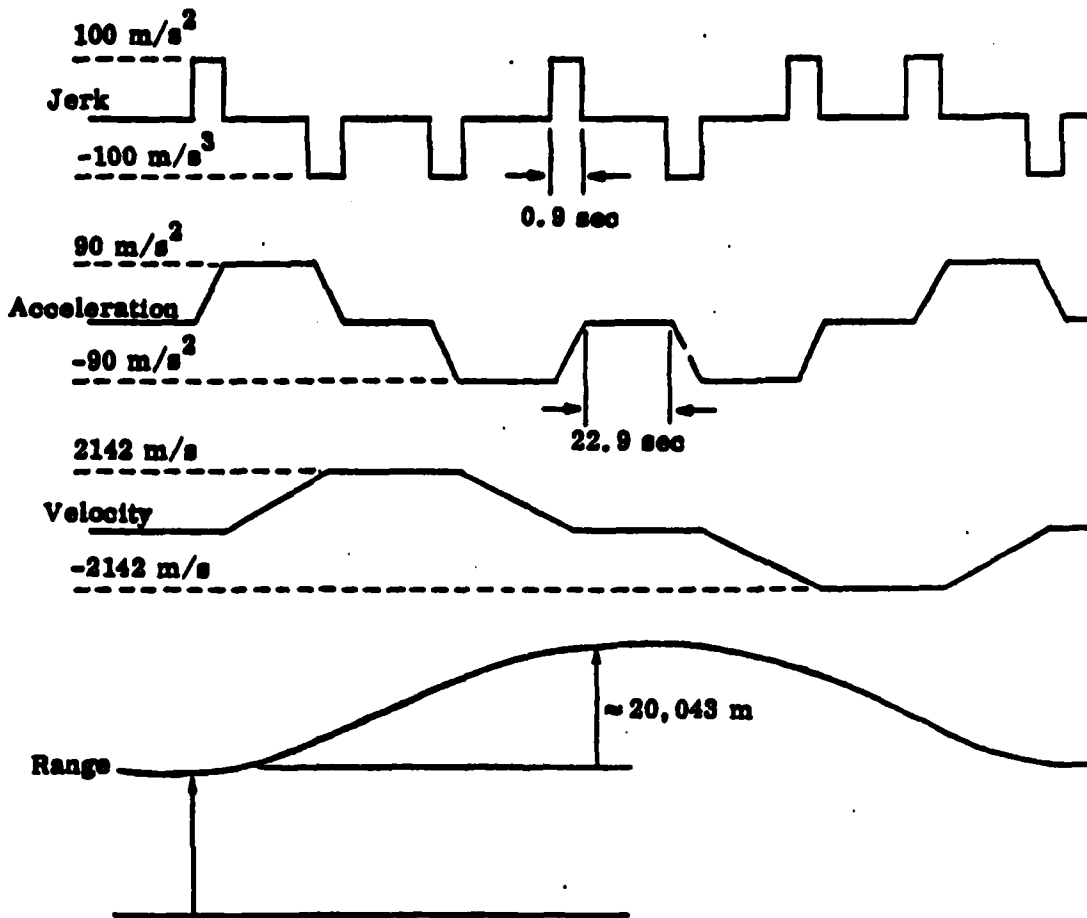
Note: Jerk from SS-US-200, Table II, Category A  
 Acceleration from SS-US-200, Table I-IV  
 Velocity from SS-US-200, Table I-IV

**Dynamic Profile** — One channel receiver Ionospheric Delay tests.



Note: Jerk from SS-US-200, Table II-IV  
 Acceleration from SS-US-200, 20.3.2.1.11  
 Velocity from SS-US-200, Table II-V

**Dynamic Profile** — Two channel receiver Ionospheric  
 Delay tests



Note: Jerk from SS-US-200, 40.3.2.1.11  
 Acceleration from SS-US-200, 40.3.2.1.11  
 Velocity from SS-US-200, Table IV-IV, plus SV max velocity of 940 m/s

**Dynamic Profile** — Five channel receiver Ionospheric Delay tests

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 23-24

Test Objective: Measure receiver calibration repeatability in eliminating channel to channel pseudo range biases (2 and 5 channel sets only).

---

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>1575.42MHz (23)</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2.	<u>1227.6MHz (24)</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
3.	<u>P Code (23, 24)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4.	<u>* Dynamics (HV)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5.	<u>GPS Data (23, 24)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6.	<u>_____</u>	<u>_____</u>	<u>_____</u>
7.	<u>_____</u>	<u>_____</u>	<u>_____</u>
8.	<u>_____</u>	<u>_____</u>	<u>_____</u>
9.	<u>_____</u>	<u>_____</u>	<u>_____</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>

\* Dynamics will be constant 900m/sec velocity.



Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests 25-28

Test Objective: Measure the ability of receiver to demodulate 50 bps navigation data under various conditions.

---

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>1575.42MHz (25, 26)</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2.	<u>1227.6MHz (27, 28)</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
3.	<u>C/A Code (26, 28)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4.	<u>P Code (25, 27)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5.	<u>GPS Data (25-28)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6.	<u>CW Jammer (25, 27)</u>	<u>GPS freq. @ -122dBw</u>	<u>Satellite Signal Generator</u>
7.	<u>Noise Mod. Jammer (26)</u>	<u>1227.6MHz @ -132dBw (100kHz BW)</u>	<u>Satellite Signal Generator</u>
8.	<u>Noise Mod. Jammer (28)</u>	<u>1575.42MHz @ -132dBw (2MHz BW)</u>	<u>Satellite Signal Generator</u>
9.	<u>Dynamic Profiles Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>

Outputs

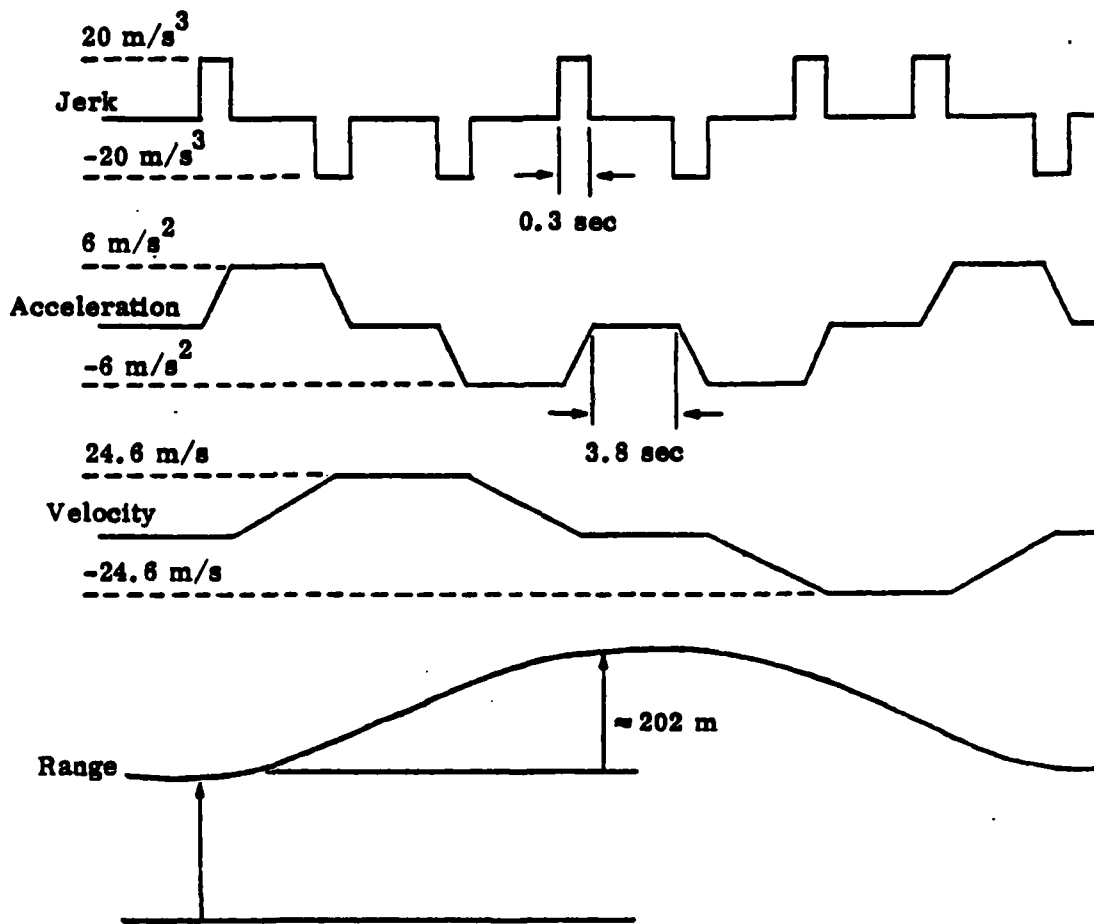
	<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1.	UBER	TBD	TBD
2.			
3.			
4.			
5.			

Test Procedure: Inject signal from Satellite Signal Generator into receiver front end (SSG signal for each test will be a combination of GPS and jamming signals, altered as necessary to simulate host vehicle dynamics, at the levels shown on page one for each test). Receiver shall be operating in State 5. UBER will be recorded. Repeat test for receiver operating in Substate 5 of State 6.

Data Reduction: Undetected BIT Error Rate (UBER) will be recorded. Input levels and conditions will be recorded also.

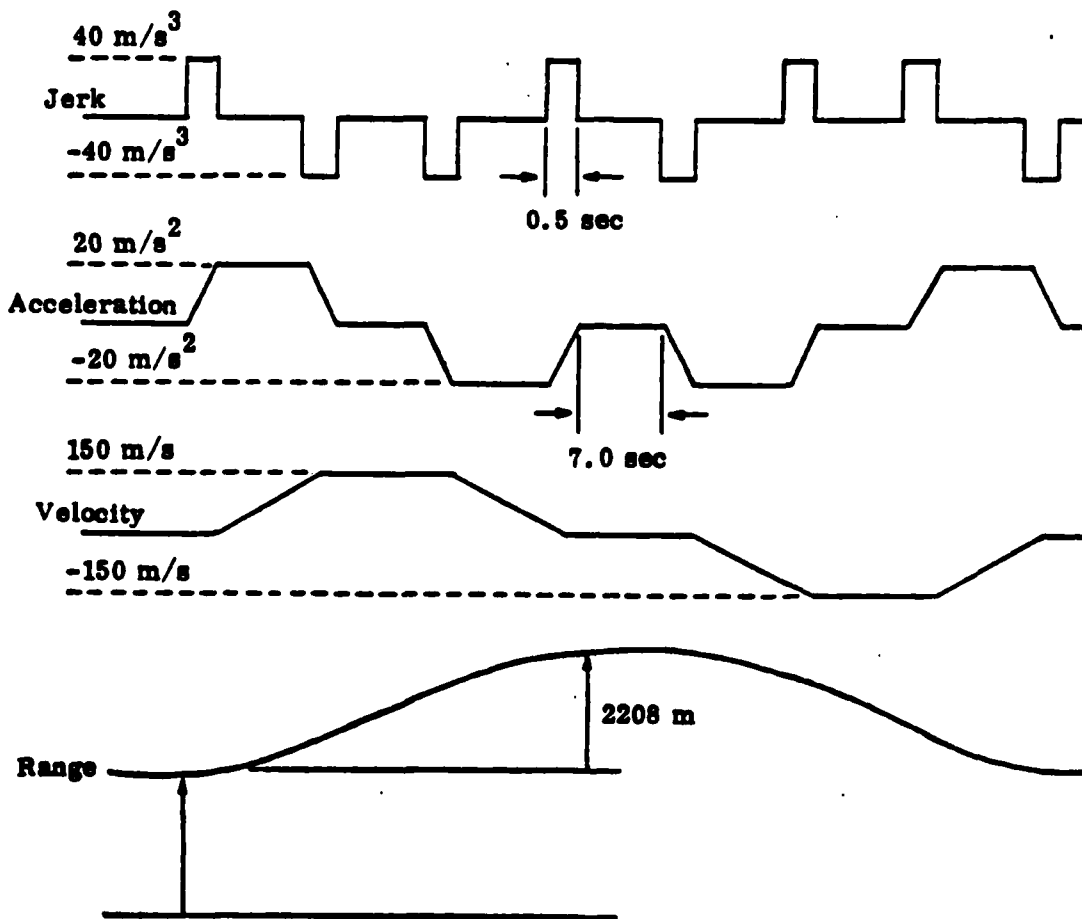
Equipment List:

- |    |     |    |  |    |  |
|----|-----|----|--|----|--|
| 1. | SSG | 4. |  | 7. |  |
| 2. | TBD | 5. |  | 8. |  |
| 3. |     | 6. |  | 9. |  |



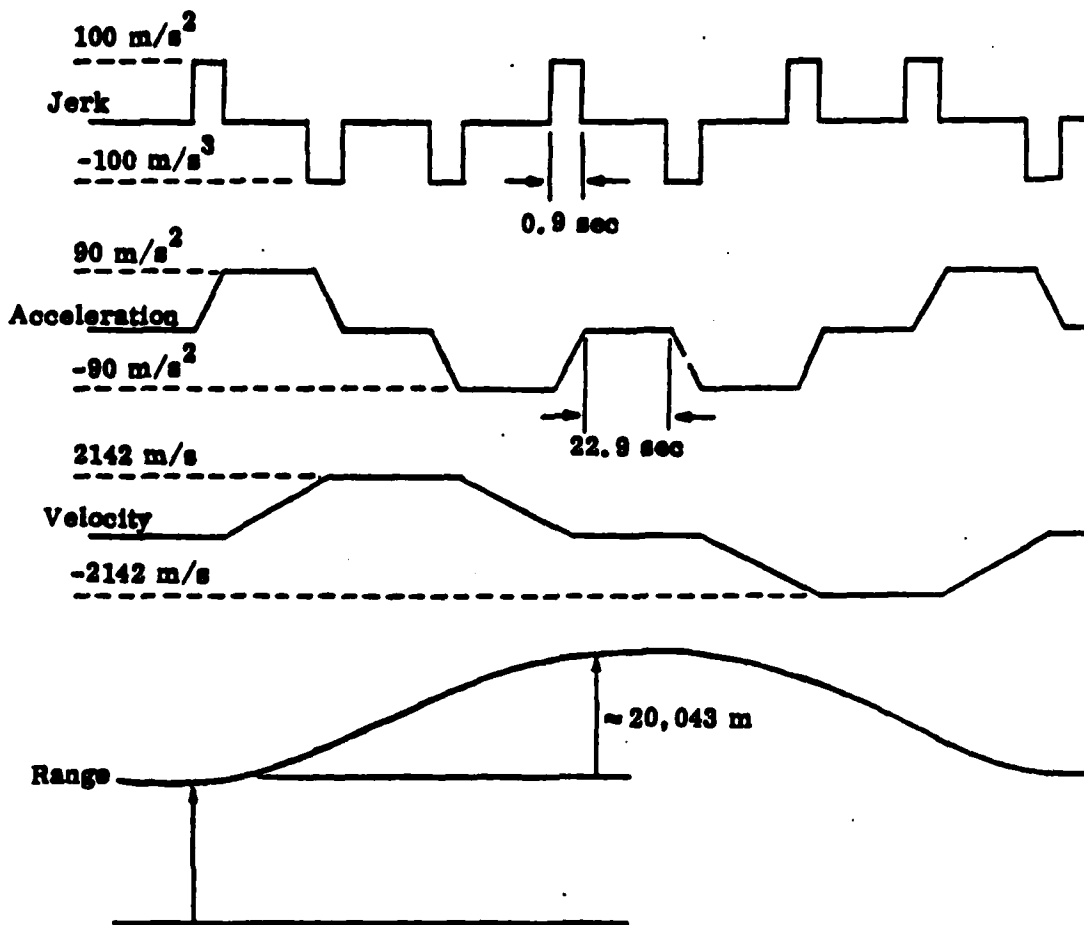
Note: Jerk from SS-US-200, Table II, Category A  
 Acceleration from SS-US-200, Table I-IV  
 Velocity from SS-US-200, Table I-IV

Dynamic Profile — One Channel Receiver Sequencing Tests



Note: Jerk from SS-US-200, Table II-IV  
 Acceleration from SS-US-200, 20.3.2.1.11  
 Velocity from SS-US-200, Table II-V

**Dynamic Profile — Two Channel Receiver Sequencing Tests**



Note: Jerk from SS-US-200, 40.3.2.1.11  
 Acceleration from SS-US-200, 40.3.2.1.11  
 Velocity from SS-US-200, Table IV-IV, plus SV max velocity of 940 m/s

**Dynamic Profile -- Five Channel Receiver Tracking Tests**

Contractor: Magnavox/Collins

Board Tested: Standard Receiver Tests (29-30)

Test Objective: Measure ability of receiver to estimate C/No level  
for various conditions.

<u>Inputs</u>		
<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1. <u>1575.42MHz (29)</u>	<u>1227.6MHz @ various levels</u>	<u>Satellite Signal Generator</u>
2. <u>1227.6MHz (30)</u>	<u>1575.42MHz @ various levels</u>	<u>Satellite Signal Generator</u>
3. <u>C/A Code (30)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4. <u>P Code (29)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5. <u>GPS Data (29-30)</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6. <u>CW Jammer (29)</u>	<u>1227.6MHz @ various levels</u>	<u>Satellite Signal Generator</u>
7. <u>Noise Mod. Jammer (30)</u>	<u>1575.42MHz @ various levels</u> <u>(10MHz BW)</u>	<u>Satellite Signal Generator</u>
8. <u>Dynamic Profiles Attached</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____

Outputs

	<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1.	C/No	TBD	TBD
2.			
3.			
4.			
5.			

Test Procedure: Inject signal from Satellite Signal Generator into receiver front end (SSG signal for each test will be a combination of GPS and jamming signals, altered as necessary to simulate host vehicle dynamics, at the levels shown on page one for each test). C/No test levels are attached. Tests shall be conducted for receiver operating in State 5 and in Substate 5 of State 6. C/No measurements will be recorded for various levels of signal and jammer power.

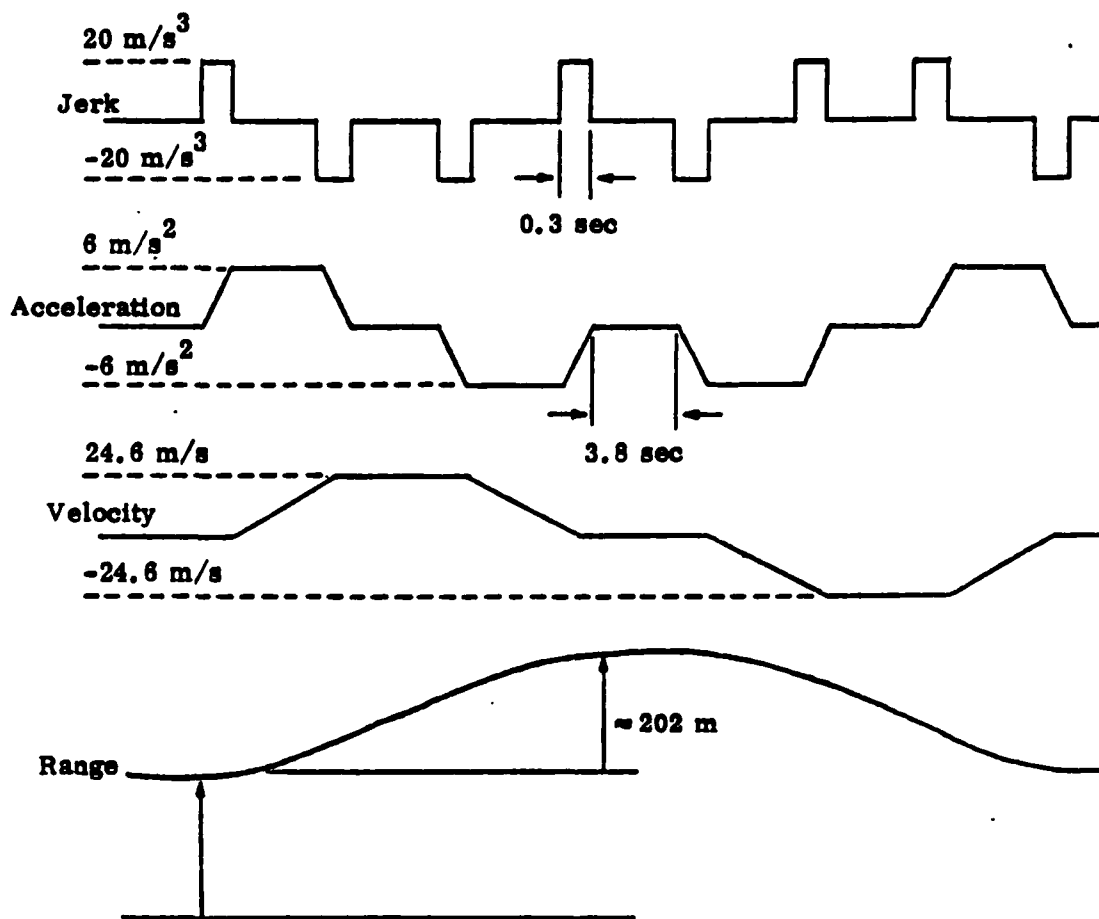
Data Reduction: Measured C/No will be compared with theoretical value and recorded. Input levels and conditions will be recorded also.

Equipment List:

1.	SSG	4.		7.	
2.	TBD	5.		8.	
3.		6.		9.	

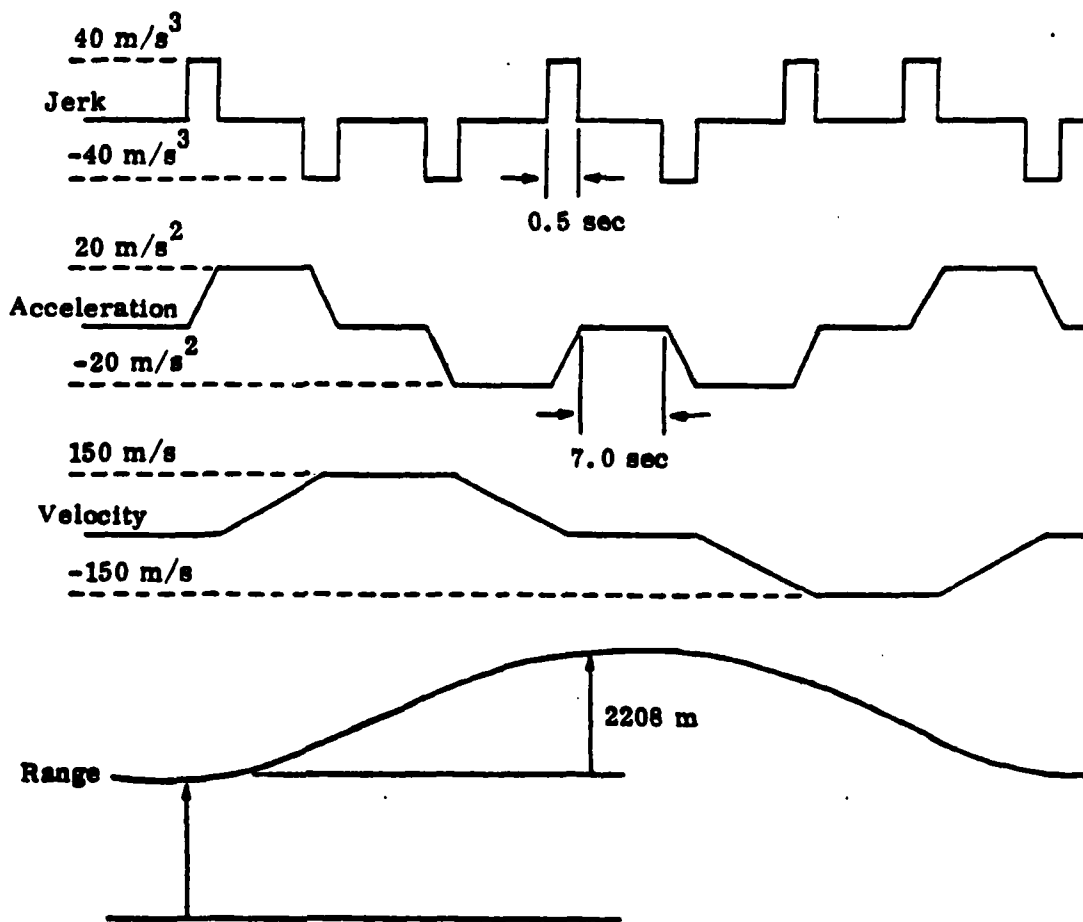
**C/N<sub>0</sub> TEST LEVELS**

<b>Signal Power Referenced to Preamp Input (dBW)</b>	<b>L<sub>1</sub> (P) J/S (dB)</b>	<b>L<sub>2</sub> (C/A) J/S (dB)</b>
1. -150	0	0
2. -156	0	0
3. -163	0	0
4. -163	30	20
5. -163	35	25
6. -163	40	30



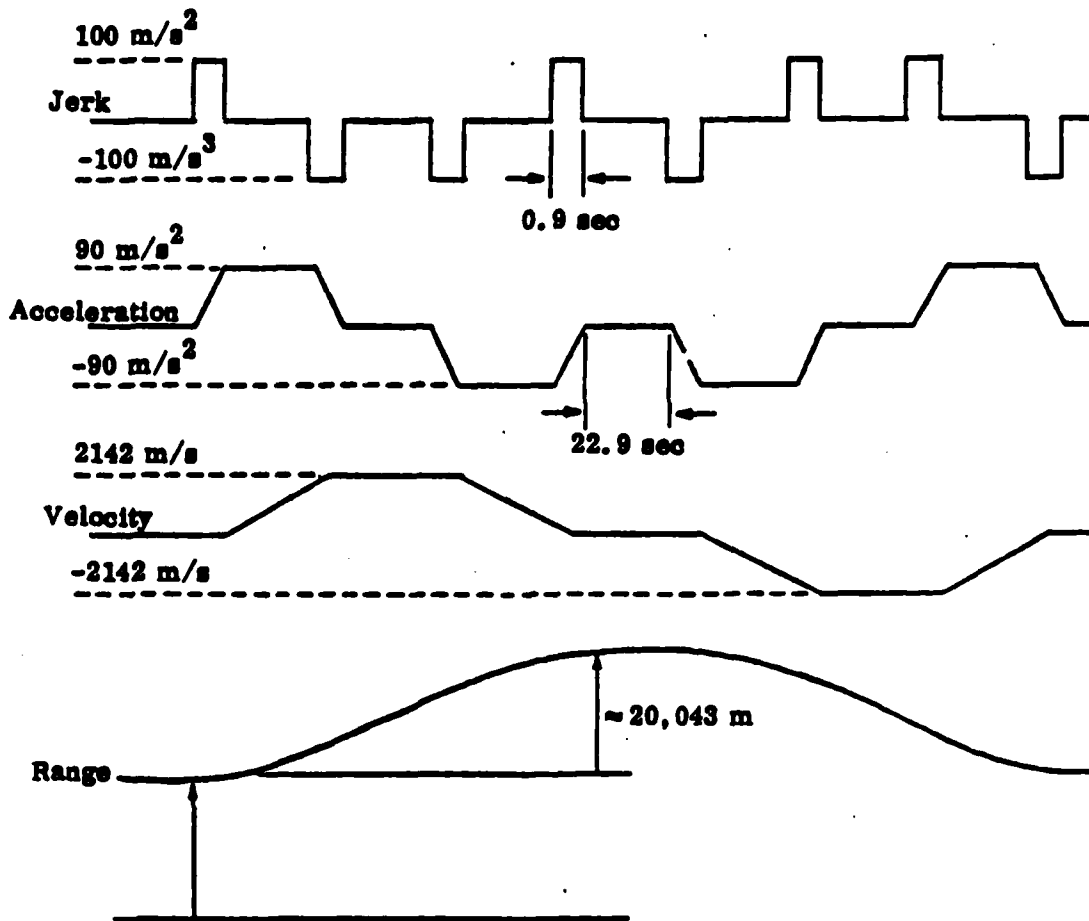
Note: Jerk from SS-US-200, Table II, Category A  
 Acceleration from SS-US-200, Table I-IV  
 Velocity from SS-US-200, Table I-IV

Dynamic Profile -- One Channel Receiver Sequencing Tests



Note: Jerk from SS-US-200, Table II-IV  
 Acceleration from SS-US-200, 20.3.2.1.11  
 Velocity from SS-US-200, Table II-V

**Dynamic Profile — Two Channel Receiver Sequencing Tests**



Note: Jerk from SS-US-200, 40.3.2.1.11  
 Acceleration from SS-US-200, 40.3.2.1.11  
 Velocity from SS-US-200, Table IV-IV, plus SV max velocity of 940 m/s

**Dynamic Profile — Five Channel Receiver Tracking Tests**

Contractor: Magnavox/Collins

Board Tested: Receiver

Test Objective: To test receiver operation under various  
conditions of multipath propagation.

---

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>1575.42MHz</u>	<u>1227.6MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
2.	<u>1227.6MHz</u>	<u>1575.42MHz @ -163dBw</u>	<u>Satellite Signal Generator</u>
3.	<u>P Code</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
4.	<u>C/A Code</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
5.	<u>GPS Data</u>	<u>TBD</u>	<u>Satellite Signal Generator</u>
6.	<u>_____</u>	<u>_____</u>	<u>_____</u>
7.	<u>_____</u>	<u>_____</u>	<u>_____</u>
8.	<u>_____</u>	<u>_____</u>	<u>_____</u>
9.	<u>_____</u>	<u>_____</u>	<u>_____</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>



### 3.2 ANTENNA TEST REQUIREMENTS

This section contains the antenna test requirements for the Fixed Reception Pattern Antenna (FRPA) and the Controlled Reception Pattern Antenna (CRPA) for both Magnavox and Rockwell-Collins. Most of the antenna tests will be performed in the Anechoic Chamber. This section is limited to the bench tests that will be performed on the antenna.

#### 3.2.1 Antenna Test Procedures

The following sheets contain the initial test requirements and procedures as listed in Section 1.1 for both Magnavox and Rockwell-Collins antennas. These sheets will be refined and new sheets will be added as more information becomes available.

3.2.1.1 COLLINS/MAGNAVOX ANTENNA BENCH TEST PROCEDURES  
AND BLOCK DIAGRAMS

Contractor: Collins/Magnavox  
Board Tested: FRPA Antenna  
Test Objective: Measure aperature VSWR of Fixed Reception Pattern  
Antenna.

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>S-Par Test Set</u>	<u>L1 (1575 <math>\pm</math> 10MHz) @ TED</u>	<u>Sweep Generator (HP-8340A)</u>
2.	<u>S-Par Test Set</u>	<u>L2 (1228 <math>\pm</math> 10MHz) @ TED</u>	<u>Sweep Generator (HP-8340A)</u>
3.	<u>S-Par Test Set</u>	<u>1070 to 1735 @ TBD</u>	<u>Sweep Generator (HP-8340A)</u>
4.	<u>_____</u>	<u>_____</u>	<u>Microwave Ctr. (HP-5342A)</u>
5.	<u>_____</u>	<u>_____</u>	<u>_____</u>
6.	<u>_____</u>	<u>_____</u>	<u>_____</u>
7.	<u>_____</u>	<u>_____</u>	<u>_____</u>
8.	<u>_____</u>	<u>_____</u>	<u>_____</u>
9.	<u>_____</u>	<u>_____</u>	<u>_____</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>

Outputs

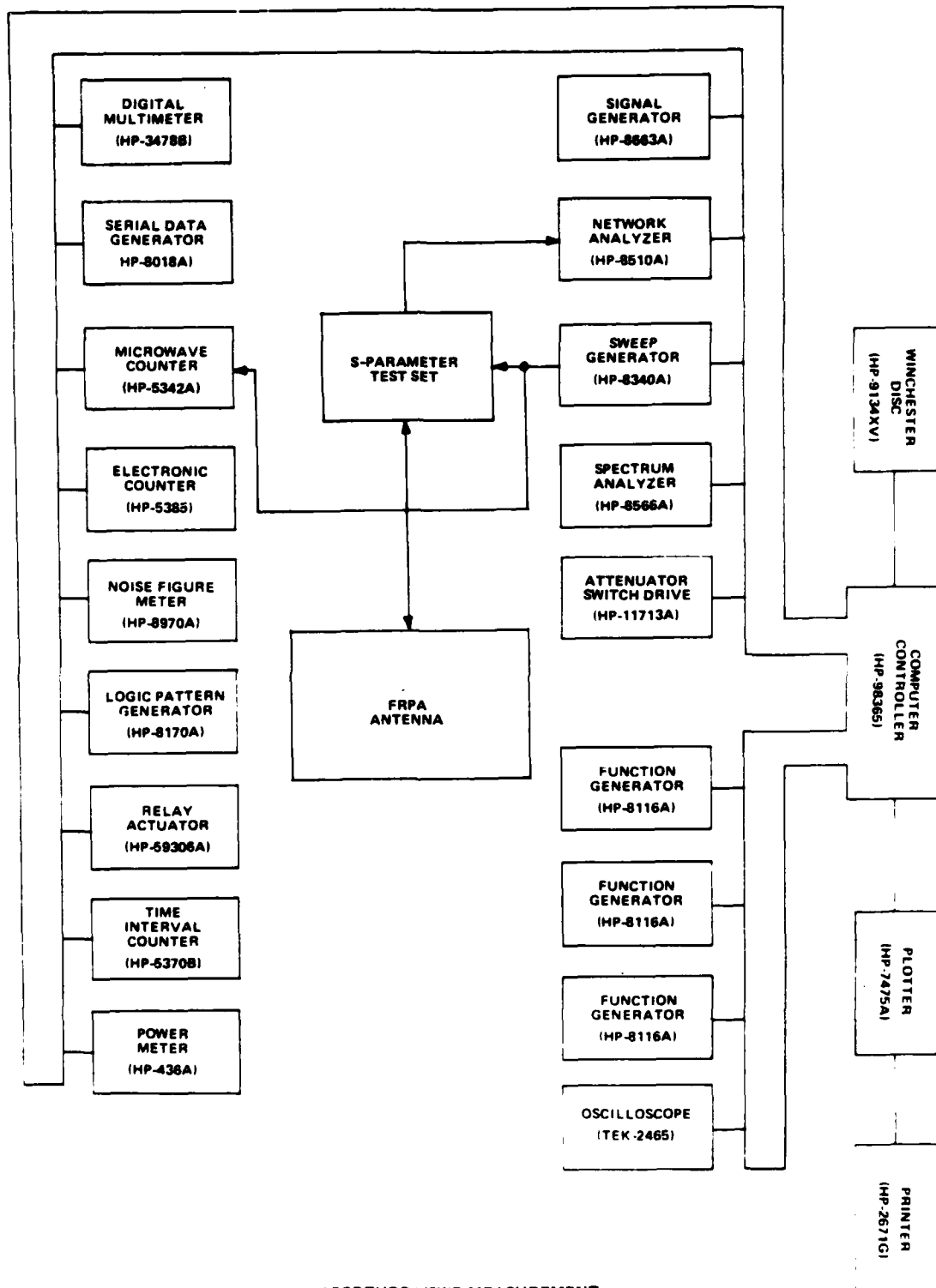
	<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1.	<u>FRPA Input (L1)</u>	<u>1.5:1</u>	<u>S-Par Test Set (HP-8515A)</u>
2.	<u>FRPA Input (L2)</u>	<u>1.5:1</u>	<u>Network Analyzer (HP-8510A)</u>
3.	<u>FRPA Input (range)</u>	<u>2.0:1</u>	<u></u>
4.	<u></u>	<u></u>	<u></u>
5.	<u></u>	<u></u>	<u></u>

Test Procedure: Turn on test equipment. Set measurement equipment  
to proper ranges. Set Sweep Generator to sweep through frequency range  
with markers at L1 and L2. Measure VSWR with Network Analyzer.

Data Reduction: Send input levels to printer. Output data from  
Network Analyzer will be plotted on a Smith Chart.

Equipment List:

- |    |                            |    |                                  |    |                                 |
|----|----------------------------|----|----------------------------------|----|---------------------------------|
| 1. | <u>Computer (HP-9836S)</u> | 4. | <u>Sweep Gen. (HP-8340A)</u>     | 7. | <u>Network Anal. (HP-8510A)</u> |
| 2. | <u>Printer (HP-2671G)</u>  | 5. | <u>Microwave Ctr (HP-5342A)</u>  | 8. | <u></u>                         |
| 3. | <u>Plotter (HP-7475A)</u>  | 6. | <u>S-Par Test Set (HP-8515A)</u> | 9. | <u></u>                         |



APERTURE VSWR MEASUREMENT

Contractor: Collins/Magnavox  
Board Tested: CRPA Antenna  
Test Objective: Measure aperature VSWR of Controlled Reception  
Pattern Antenna.

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>S-Par Test Set</u>	<u>L1 (1575 ± 10MHz) @ TBD</u>	<u>Sweep Generator (HP-8340A)</u>
2.	<u>S-Par Test Set</u>	<u>L2 (1227 ± 10MHz) @ TBD</u>	<u>Sweep Generator (HP-8340A)</u>
3.	<u>S-Par Test Set</u>	<u>1070-1735MHz @ TBD</u>	<u>Sweep Generator (HP-8340A)</u>
4.	<u>_____</u>	<u>_____</u>	<u>Microwave Ctr. (HP-5342A)</u>
5.	<u>_____</u>	<u>_____</u>	<u>_____</u>
6.	<u>_____</u>	<u>_____</u>	<u>_____</u>
7.	<u>_____</u>	<u>_____</u>	<u>_____</u>
8.	<u>_____</u>	<u>_____</u>	<u>_____</u>
9.	<u>_____</u>	<u>_____</u>	<u>_____</u>
10.	<u>_____</u>	<u>_____</u>	<u>_____</u>
11.	<u>_____</u>	<u>_____</u>	<u>_____</u>
12.	<u>_____</u>	<u>_____</u>	<u>_____</u>

Outputs

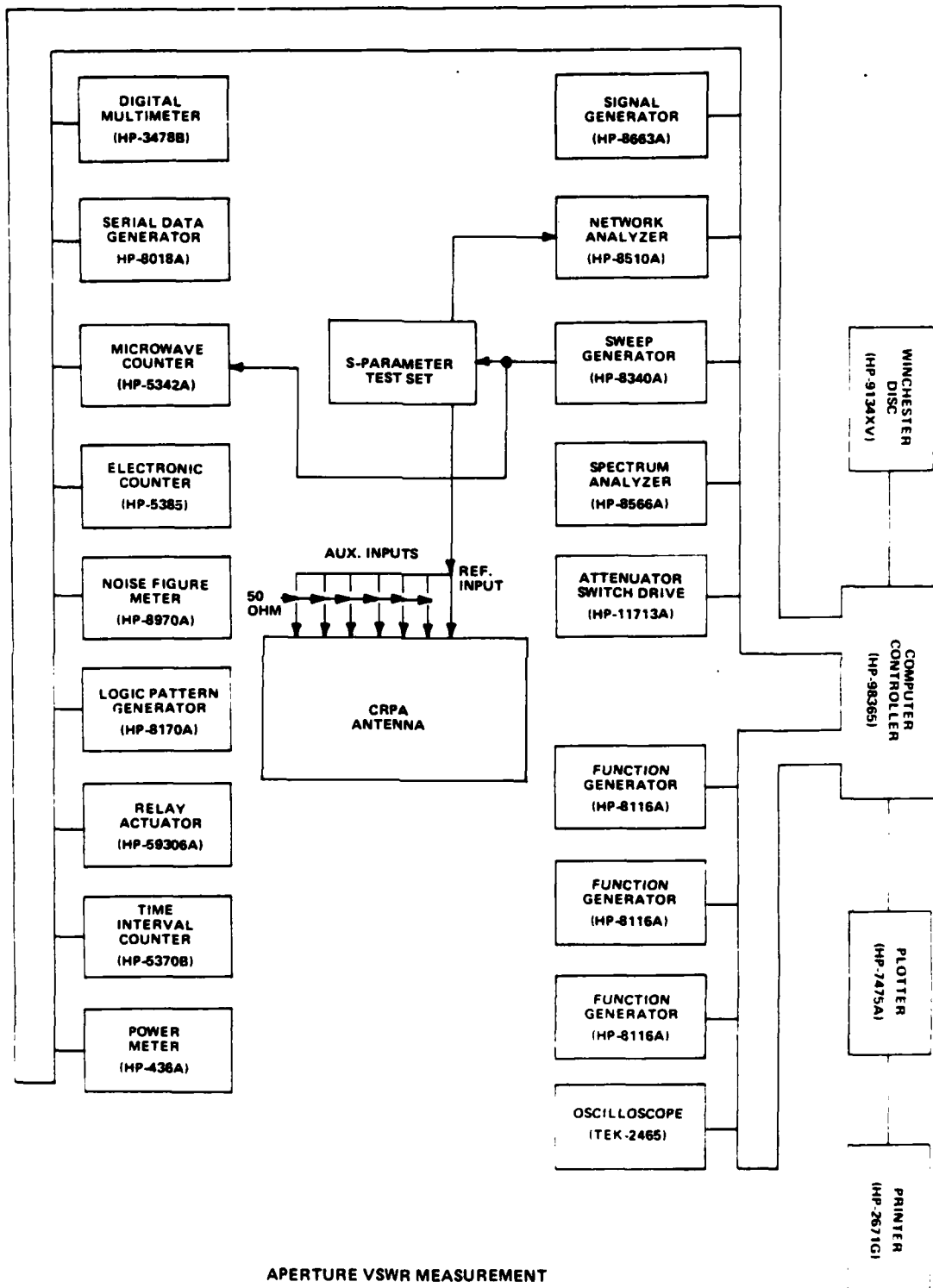
<u>Output Name</u>	<u>Output Level</u>	<u>Equipment Used</u>
1. <u>Reference Input (L1)</u>	<u>1.5:1</u>	<u>S-Par Test Set (HP-8515A)</u>
2. <u>Reference Input (L2)</u>	<u>1.5:1</u>	<u>Network Analyzer (HP-8510A)</u>
3. <u>Auxiliary Inputs (L1)</u>	<u>3.0:1</u>	<u></u>
4. <u>Auxiliary Inputs (L2)</u>	<u>3.0:1</u>	<u></u>
5. <u>Aux. Inputs (entire range)</u>	<u>5.0:1</u>	<u></u>

Test Procedure: Turn on test equipment. Set measurement equipment  
to proper ranges. Set Sweep Generator to sweep L1. Measure VSWR vs.  
frequency of Reference Channel and Auxiliary Channel Inputs. Repeat for L2.

Data Reduction: Send input levels to printer. Output data from  
Network Analyzer will be plotted on a Smith Chart.

Equipment List:

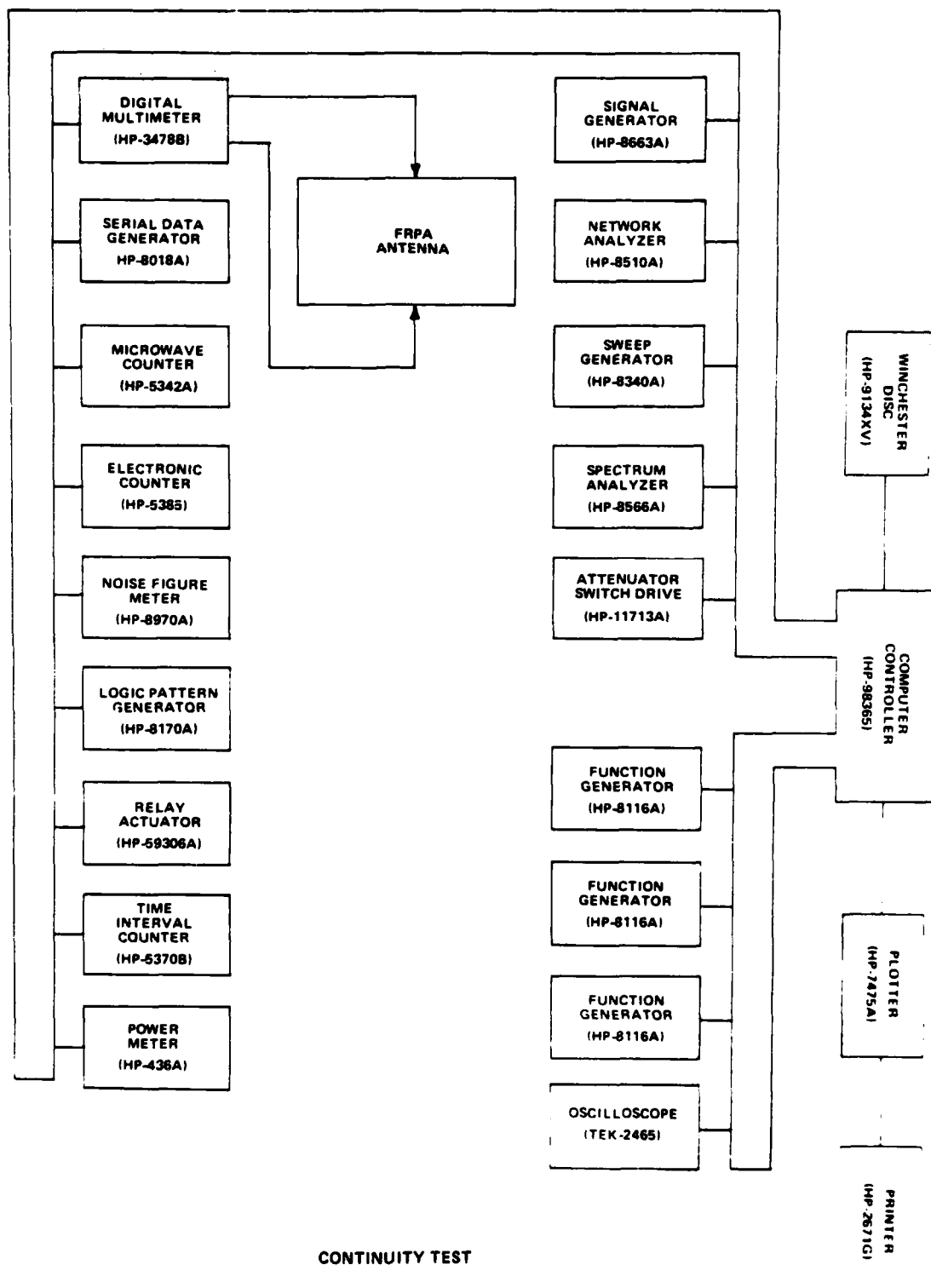
- |                               |                                      |                                    |
|-------------------------------|--------------------------------------|------------------------------------|
| 1. <u>Computer (HP-9836S)</u> | 4. <u>Sweep Gen. (HP-8340A)</u>      | 7. <u>Network Anal. (HP-8510A)</u> |
| 2. <u>Printer (HP-2671G)</u>  | 5. <u>Microwave Ctr. (HP-5342A)</u>  | 8. <u></u>                         |
| 3. <u>Plotter (HP-7475A)</u>  | 6. <u>S-Par. Test Set (HP-8515A)</u> | 9. <u></u>                         |



APERTURE VSWR MEASUREMENT







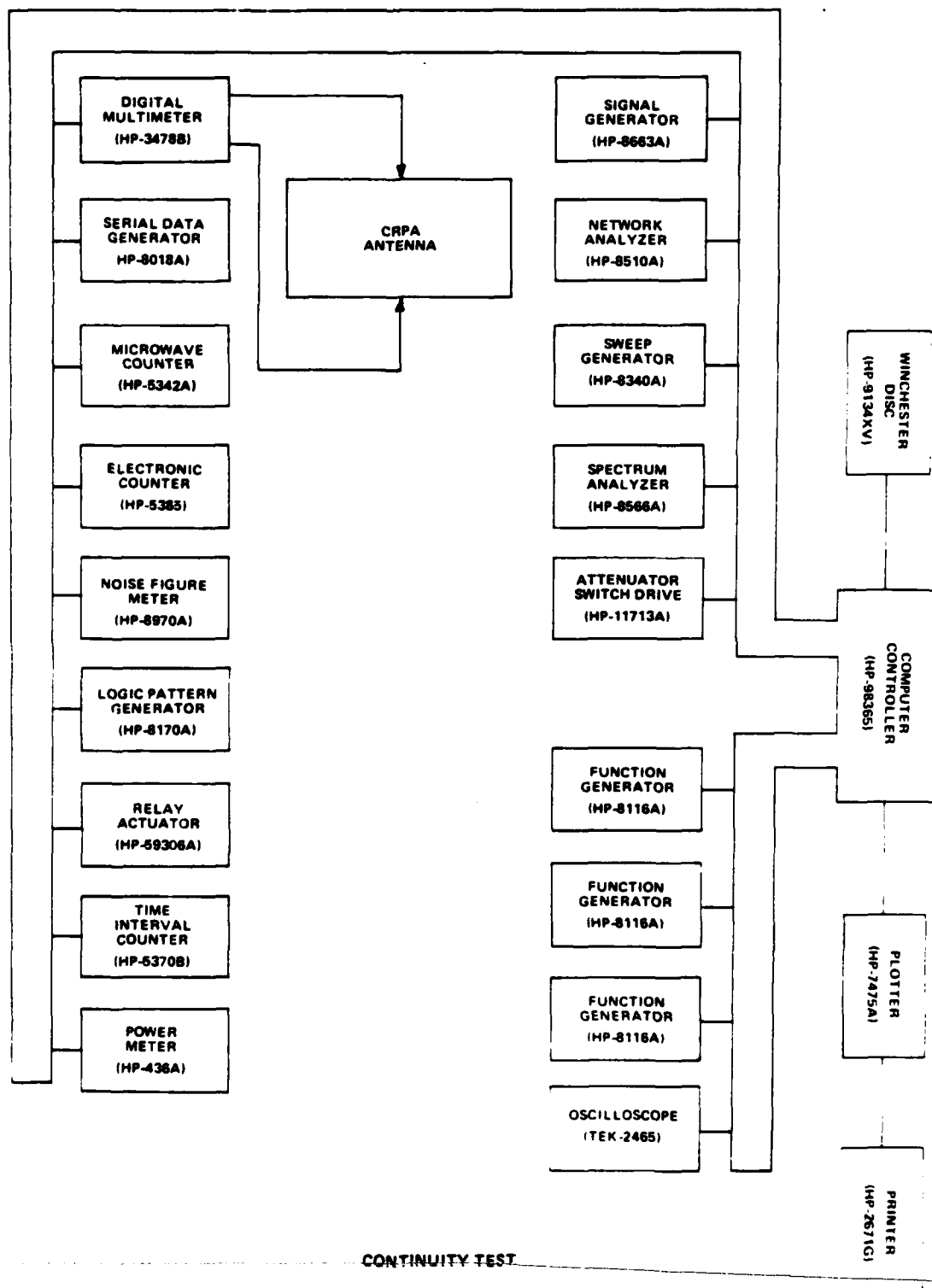
CONTINUITY TEST

Contractor: Collins/Magnavox  
Board Tested: CRPA Antenna  
Test Objective: Continuity test for Controlled Reception Pattern  
Antenna. \_\_\_\_\_  
 \_\_\_\_\_

Inputs

	<u>Input Name</u>	<u>Input Level</u>	<u>Equipment Used</u>
1.	<u>Inner Conductor</u>	<u>----</u>	<u>Digital Multi. (HP-3478B)</u>
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
11.	_____	_____	_____
12.	_____	_____	_____





CONTINUITY TEST

#### 4.0 SOFTWARE REQUIREMENTS

This sections contains the software requirements for the Antenna bench test procedures defined in Section 3.2. These software requirements are defined in terms of flowcharts.

The software requirements contained herein are written at the functional level. There is a flowchart for each test procedure that illustrates the sequence of events that will be required in order to perform these tests by computer. In addition to these requirements, all tests will include the following capabilities:

- o menu driven testing will prompt operator through:
  1. test set-ups
  2. testing
  3. data reduction/storage/hardcopy
- o Each test will have a program module number and will be contained in a testing menu. All tests with the same set-ups can be grouped together to be run one after the other.
- o Each test will incorporate a full error-checking capability during operator inputs so that no manual error can be entered into the system.
- o Data reduction based on baseline data and/or range limits. The specified range values and/or tolerance will be stored and compared to the results obtained from the actual test. The values will be displayed and any differences can quickly be seen.
- o There will be real-time monitoring for any bus available information during testing.
- o There will be off-line storage or transfer of data for interfacing with the DPSSF/NSL system capabilities. This capability will be used for any information that is needed for the DPSSF, NSL or for RFL data reduction requirements.

o All software will be stored including back-up disks and hardcopy listings in a library which will contain as a minimum the following information in its catalog:

1. program module name and number (disk #)
2. back-up copy # (disk #)
3. date written, by whom
4. date last revised, by whom

There are two floppy disk drives which have a memory of 170k each built into the computer. All information will be stored on either of these floppy disks. There is also a Winchester hard disk provided. This can be used as a temporary storage for data and information obtained while testing, if needed. For example, if a series of tests are being run and many data points are needed to be stored and all of the memory is being used in the computer, this information is stored temporarily on the Winchester disk until processing is complete and then archived onto the floppy disks.

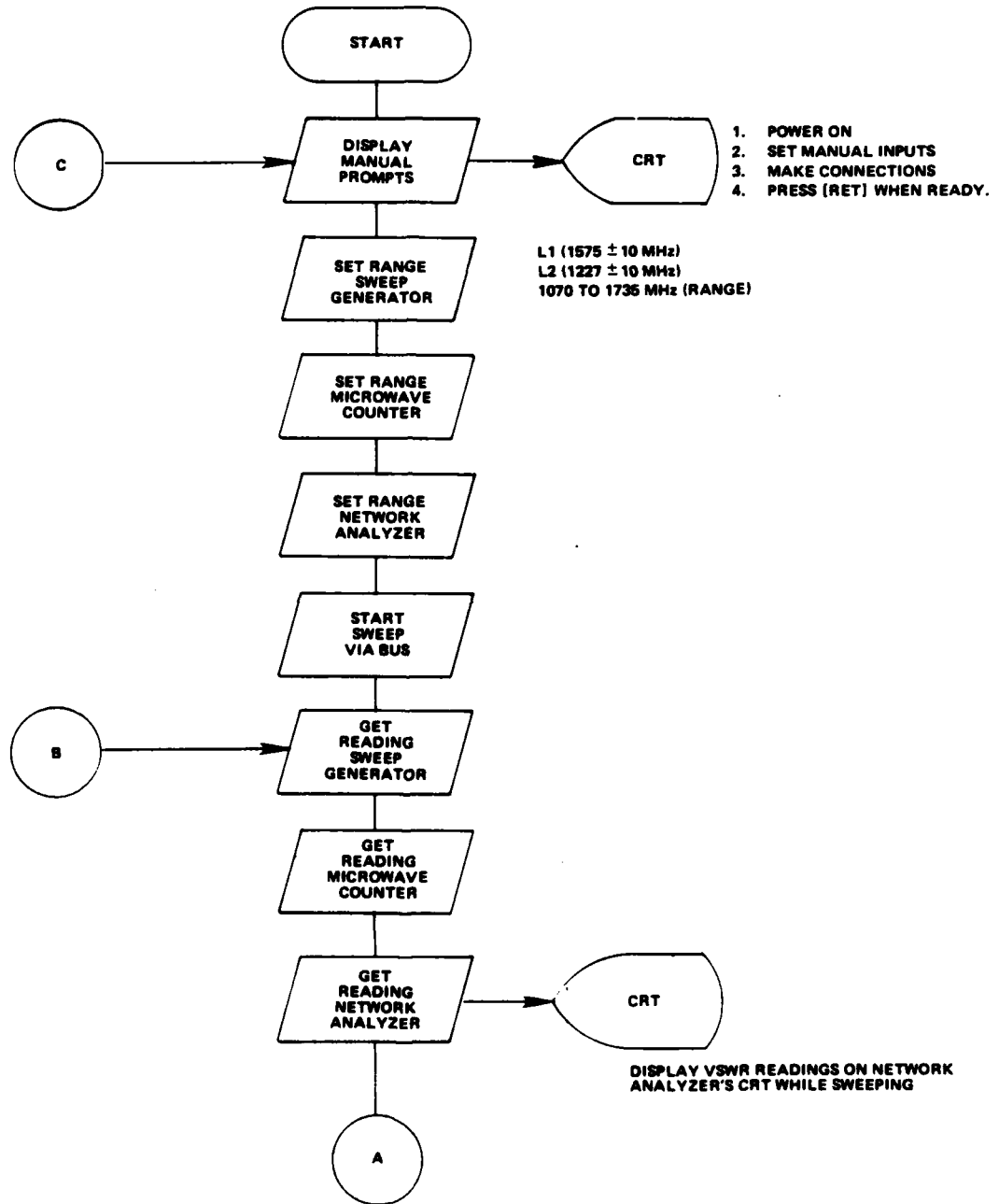
#### 4.1 ANTENNA SOFTWARE REQUIREMENTS

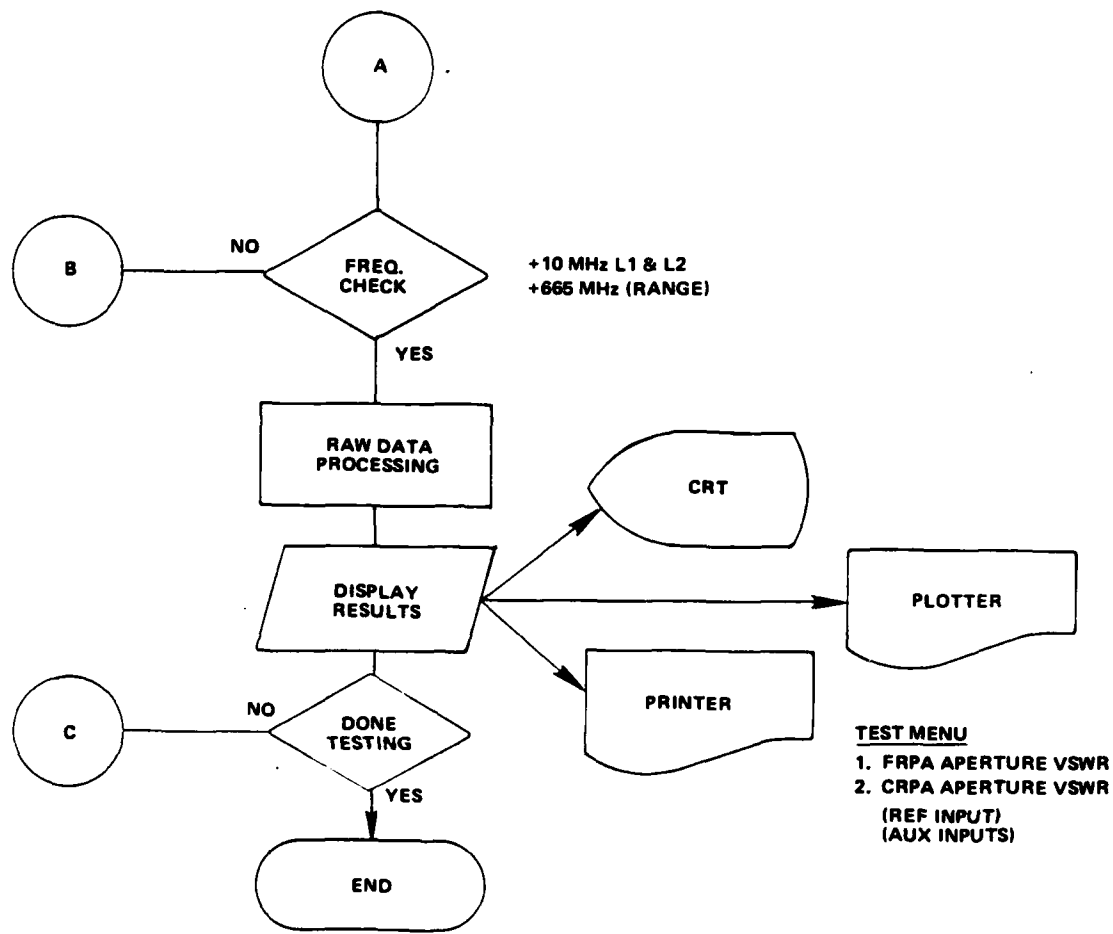
The following sheets contain the software requirements for the Antenna bench test procedures defined in Section 3.2. These software requirements will also be refined and expanded as more detailed information becomes available for the bench tests.

4.1.1 ROCKWELL-COLLINS/MAGNAVOX ANTENNA  
SOFTWARE REQUIREMENTS

APERTURE VSWR MEASUREMENT

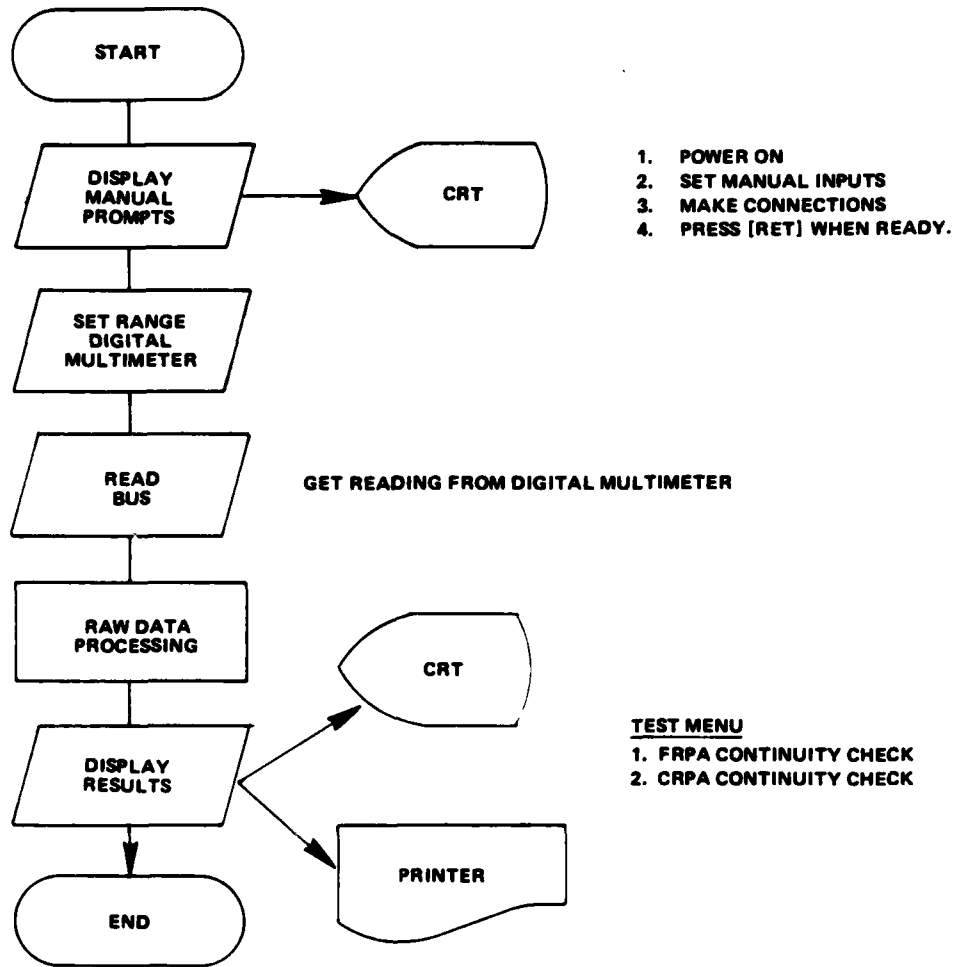
PROGRAM MODULE NAME: \_\_\_\_\_





**CONTINUITY CHECK**

**PROGRAM MODULE NAME:** \_\_\_\_\_



## 5.0 SPECIAL HARDWARE REQUIREMENTS

This section contains the special purpose hardware requirements needed to perform the bench tests on the GPS UE. This section is limited in detail due to the lack of information currently available. This section will be expanded as more detailed information becomes available.

The GPS signal simulation will be produced by the Satellite Signal Generator (SSG). The SSG is capable of generating numerous signals. For example, the SSG can generate in addition to the composite GPS signal, the P-code, C/A code, square waves at the P and C/A chip rates, IF frequencies, etc. Any combination of these may also be selected. With this capability there is no need to purchase any special coders and generators.

It will be necessary to buy some attenuators to control the output level, combiners, and mixers to provide some of the various signal combinations. Several breakout boards will be needed to provide various signal levels from one input.

END

DTic

5-86