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STANFORD, CALIFORNIA 94305-4085

Gravity Probe B Relativity Mission

ELECTROMAGNETIC INTERFERENCE (EMI) TEST PROCEDURE FOR THE GYROSCOPE SUSPENSION SYSTEM (GSS)

P0701 Rev –

DUT PN: 26226-101 REV _____SN:
DUT PN: 26225-101 REV _____SN:

Date Performed:_____

Prepared by: Stephen Sawyer
EMCE Engineering, Inc

Approved by: William Bencze Date
Payload Electronics Manager.

Approved by: Dorrene Ross Date
GP-B Quality Assurance

Approved by: Richard Whelan Date
GP-B Systems Engineering

This procedure ☒ Does ☐ Does not provide formal verification of GP-B requirements.
This procedure ☐ Does ☒ Does not include constraints and restrictions for the Payload.
See Section 10.0

Table of Contents:

1.0 Revision History

Rev Level	Comments/notes	Date	Revised By
-	First release of this test procedure	06-Aug-2001	WJ Bencze

2.0 Acronyms and Abbreviations

Abbreviation	Meaning
A/D	Analog to Digital
AC	Alternating Current
ACU	Aft Control Unit
APU	Aft Power Unit
BIT	Built-In Test
CE	Conducted Emissions
CS	Conducted Susceptibility
CW	Continuous Wave
D/A	Digital to Analog
dB	Decibels
dB μA	Decibels above one microampere
dBμA/MHz	Decibels above one microampere per Megahertz of Bandwidth
dBμV	Decibels above one microvolt
dBμV/m	Decibels above one microvolt per meter
dBμV/m/MHz	Decibels above one microvolt per meter per Megahertz of Bandwidth
DC	Direct Current
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FSU	Forward Suspension Unit
FATP	Factory Acceptance Test Procedure
GP-B	Gravity Probe version B
GSE	Ground Support Equipment
GSS	Gyro Suspension System
hr. or hrs.	hour or hours
Hz	Hertz (cycles per second)
IAW	In accordance with
in.	inch
k	Kilo
LISC	Line Impedance Stabilizing Capacitor
m	meter
M	Mega
min.	minutes
ms	millisecond
℃	Degrees Celsius (or Centigrade)
℉	Degrees Fahrenheit
RE	Radiated Emission
RMS	Root Means Square (may also appear as rms)
RS	Radiated Susceptibility
SOW	Statement of Work
u or μ	micro

Abbreviation	Meaning
pF	pico-farad
ph	pico-henries
usec or µsec	microsecond
V/m	Volts per meter

3.0 Introduction

This document provides step-by-step procedures for the performance of the Electromagnetic Interference (EMI) / Susceptibility (EMS) (both EMI and EMS tests together are referred to as Electromagnetic Compatibility - EMC tests for the Stanford University Gravity Probe B (GP-B) Gyro Suspension System (GSS). The testing requirements are per Specification No. 3906C.

3.1. Scope.

The EMC test requirements and limits contained herein are in accordance with modified MIL-STD-461C limits for Class A2 equipment. The test procedures are in accordance with the test methods of MIL-STD-462, Notice 2. Table 1 contains a list of the EMC tests to be performed.

3.2. Purpose.

The purpose of this document is to define and address the hardware configurations which will be utilized for the EMC test program, as well as test strategy, data recording, test conditions, safety, and the step-by-step instructions for the performance of each test. It is intended to provide an independent evaluation of specific GSS components, the ACU, APU and FSU as well as their flight-like interconnect cables, here-in-after referred to as Equipment Under Test (EUT), manufactured by Stanford University or its vendors. In the event of a conflict, the information presented herein shall take precedence over that in any other document.

3.3. Objective

The EMC tests shall demonstrate that the ACU, APU and FSU (collectively named GSS) will operate in their electrical environments without experiencing degradation of performance or malfunction due to electromagnetic interference from any internal or external source or causing susceptibility to other co-located electronic equipment. Specifically, the GSS' ability to operate satisfactorily in an electric field, method RS03 or with frequency domain sinusoids, methods CS01 and CS02, and time domain transient signals, method CS06, injected onto its power leads will be established. Additionally, the conducted and radiated Emissions profile of the GSS will be evaluated by performing methods CE01, CE03 and RE02. This will show that other co-located electronics equipment will not be adversely effected by the GSS.

Susceptibility Tests			
Test Method	**Description**	**Frequency Range**	**Requirement**
CS01	Conducted Susceptibility, Power leads	30 Hz - 50 kHz	3.0 V P-P (1.06 Vrms)
CS02	Conducted Susceptibility, Power Leads	50 kHz - 10 MHz	3.0 VP-P (1.06 Vrms)
CS06	Conducted Susceptibility, Power Leads	Time domain	35 VPk spikes @ 0.15 and 10 uS duration
RS03	Radiated Susceptibility, Electric Fields	14 kHz-2.0 GHz 2.0GHz-18 GHz	1 V/m 2 V/m
Emissions Tests			
CE01	Narrowband Conducted Emissions	10 Hz-20 kHz	Tailored
CE03	Narrowband Conducted Broadband Conducted Emissions	20 kHz–50 MHz 20 kHz–50 MHz	Tailored Tailored
RE02	Narrowband Radiated Broadband Radiated Emissions	14 kHz–10 GHz 14 kHz– 1 GHz	MIL-STD, Notch @ 1.77 – 2.3GHz MIL-STD LIMITS

Table 1 – EMC Tests

4.0 Applicable Documents

Documents listed herein are those that are pertinent to this test procedure. These documents form a part of this test procedure to the extent specified herein. In the event of a conflict between the documents referenced and the test requirements described herein, this document shall take precedence.

4.1.	PLSE 13-1 Rev A	GSS Specification
4.2.	P0848A	GSS Science Mission Signal Simulation Procedure
4.3.	P0758	GSS GSE Electrical Test Procedure
4.4.	26226	Assembly Drawing for the Aft Suspension Unit (ASU)
4.5.	26225	Assembly Drawing for the Forward Suspension Unit (FSU)
4.6.	MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment
4.7.	MIL-STD-461C	REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE EMISSIONS AND SUSCEPTIBILITY
4.8.	MIL-STD-462	MEASUREMENT OF ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS

5.0 Test Facilities

EMCE Engineering, Inc.
44366 S. Grimmer Boulevard
Fremont, California 94538

6.0 QA Provisions:

6.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to he start of this procedure. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time:_____ Date/time:_____

GP-B QA (D. Ross) Gov't Rep (E. Ingraham)

6.2. Upon completion of this procedure, the GSS manager and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

7.0 Test Personnel

This test procedure is to be conducted only by the following personnel, or others designated by the GSS RE at the time of test (redline names in below as required)

7.1. William Bencze

7.2. Rick Bevan

7.3. Steve Battel, Battel Engineering

7.4. Ron Zilm

7.5. EMCE Engineering Personnel, as required.

8.0 General Instructions

8.1. Redlines can be initiated by the test personnel listed in Section 7.0 and must be approved by QA.

8.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.

8.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

8.4. Only the following persons have the authority to exit/terminate this test or perform a retest: test operators listed in Section 7.0 and GP-B QA.

9.0 Hardware Safety Requirements:

9.1. This assembly is ESD sensitive; special care shall be exercised per the "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment", MIL-STD-1686.

9.2. Ensure that power is removed from cable assemblies before connecting or disconnecting cable connectors.

9.3. Connector savers are to be used on all flight connector interfaces unless otherwise specified.

9.4. Examine all mating connectors before attempting to mate them. Remove any foreign particles. Look for any damaged pins or sockets. Do not force the coupling action if excessive resistance is encountered. Ensure that key-ways are aligned when mating connectors.

10.0 Requirements Verification

This test plan provides formal verification for the following GSS requirements per PLSE 13-1 Rev A

Paragraph	Title	Requirement	Verification Method
3.5.4	Electromagnetic Compatibility	The EMI/EMC characteristics for the unit will comply with electromagnetic requirements of CE01, CE03, CS01, CS02, CS06, RE02 and RS03 of MIL-STD-461C as tailored below.	**NA**
3.5.4.1	CE01, CE03 Narrowband	CE01, CE03: The unit's narrowband power-line conducted emissions shall be less than the levels indicated in Figure 3-6.	**T**
3.5.4.2	CE01, CE03 Wideband	CE01, CE03: The unit's broadband power-line conducted emissions shall be less than the levels indicated in Figure 3-7.	**T**
3.5.4.3	CS01,02	CS01,02: The unit shall operate properly with the signal span identified in Figure 3-8 superimposed on the nominal +28 Vdc prime power bus.	**T**
3.5.4.4	CS06	CS06: The unit shall operate properly with the broadband (spike) stimulus identified in Figure 3-9 superimposed on the nominal +35 Vdc prime power bus.	**T**
3.5.4.5	RE02 narrowband	RE02: The unit's narrowband radiated emissions shall be less than the levels indicated in Figure 3-10 using shielded signal bundles, and unshielded power lines.	**T**
3.5.4.6	RE02 wideband	RE02: The unit's broadband radiated emissions shall be less than the levels indicated in Figure 3-11 using shielded signal bundles, and unshielded power lines.	**T**
3.5.4.7	RS03	RS03: The unit shall operate properly when subjected to radiated energy as defined in Table 3-3.	**T**

External Test Equipment

10.1. The following support hardware will be used and the applicable information for the instruments shall be recorded below. Hand-written additions to this list may be made in the space provided.

10.2. Test equipment provided by EMCE Engineering is listed in subsequent sections.

Item	Equipment Description	Qty	Make	PN/Type	SN	Cal Due
1.	GSS FSU Flight unit	1	SU	26225		NA
2.	GSS ASU Flight unit	1	SU	26226 A		NA
3.	GSS Spacecraft Emulator	1	SU	NA		
4.	Sun timing cable	1	LMMS	8A02096GSE	NA	NA
5.	1553 patch cable	2	Trompeter	CA-2014-120	NA	NA
6.	2-stub 1553 coupler	2	MilesTek	90-50202		NA
7.	1553 terminator	4	MilesTek	10-06403-025	NA	NA
8.	T/Vac-FT GFAB 37 cable	1	SU	NA	001	NA
9.	Ext-FT GFAB 37 cable	1	SU	NA	001	NA
10.	T/Vac-FT GFAB 50 cable	1	SU	NA	001	NA
11.	Ext-FT GFAB 50 cable	1	SU	NA	001	NA
12.	Timing cable	2	LMMS	8A02084GSE-102	NA	NA
13.	Ext-FT ASU power cable	1	LMMS	8A02083GSE-101 or -104	NA	NA
14.	T/Vac-FT 1553 cable	2	LMMS	8A00673GSE-501	NA	NA
15.	T/Vac-FT timing cable	1	LMMS	8A02084GSE-101 or -104	NA	NA
16.	Power/HLD cable	2	LMMS	8A02083GSE-102	NA	NA
17.	Fwd/Aft power cable	1	LMMS	8A01471-101	NA	NA
18.	GFAB A cable	1	LMMS	8A01473-101	NA	NA
19.	GFAB B cable	1	LMMS	8A01474-101	NA	NA
20.	1553 address plug	1	SU	Address = 12	NA	NA
21.	Engineering GSS probe cables	8		NA	NA	NA
22.	Programmable dummy load (gyro simultator)	1	SU	NA	NA	NA
23.	2 meter test harness	1	Battel	BE06400141	NA	NA
24.	2 meter umbilical	1	Battel	BE06400142	NA	NA
25.	Power saver	1	Battel	BE06400143	NA	NA
26.	Power feed assy	1	Battel	BE06400144	NA	NA
27.	HLD harness	1	Battel	BE06400145	NA	NA
28.	Aluminum ground plate	1	SU	NA	NA	NA
29.	Copper tape			NA	NA	NA
30.	Aluminum foil			NA	NA	NA
31.	Ferrite EMI kit	1		NA	NA	NA

11.0 Equipment Pretest Requirements:

	P/F	Notes:
11.1. Verify P0758 has been run on the Spacecraft Emulator GSE within the past 60 days or since the rack has been moved to the current test location.		Date:

12.0 Devices Under Test (DUT):

Record the serial number of the Device Undergoing Test, or DUT.

26226-101 GSS Aft Suspension Unit (ASU)	SN:	
26225-101 GSS Fwd Suspension Unit (FSU)	SN:	

Test Director	Name:	

Start of test:	Date: Time:	

13.0 General Provisions

13.1. Pre-requisites

The EUT shall consist of an ACU, an APU, a FSU, a Gyro Simulator and Flight-like interconnect wiring. The EUT shall have successfully completed their full functional tests prior to this procedure.

13.2. Description of Test Facility

The EMC Tests shall be performed at the EMCE facility in Fremont, California. EMCE Engineering has a main shielded enclosure with a control chamber and peripheral chamber each having separate power from the main test chamber. All chambers share a common ground system. The control chamber has 115 VAC, 60 Hz power at 20 Amperes service. There is a two inch shielded conduit connecting the Control chamber to the test Chamber. The main Test chamber has 115/230 VAC 60 or 400 Hz power with 30 Amperes service. Separate power line filters are supplied for each line including neutrals. The Peripheral chamber has separate power line filters for providing power to peripheral equipments. There is a three inch shielded conduit from the peripheral chamber to the main test chamber.

The main test chamber has ceiling and walls covered with absorber material as described in MIL-STD-461D. The material does not fully cover all walls and the chamber is not referred to as anechoic.

13.3. Interconnecting Cables

13.3.1. All interconnect cables normally connecting the GSS to its support equipment shall be included in the test setup and properly installed. See Figures 1, 2, 3 and 4.

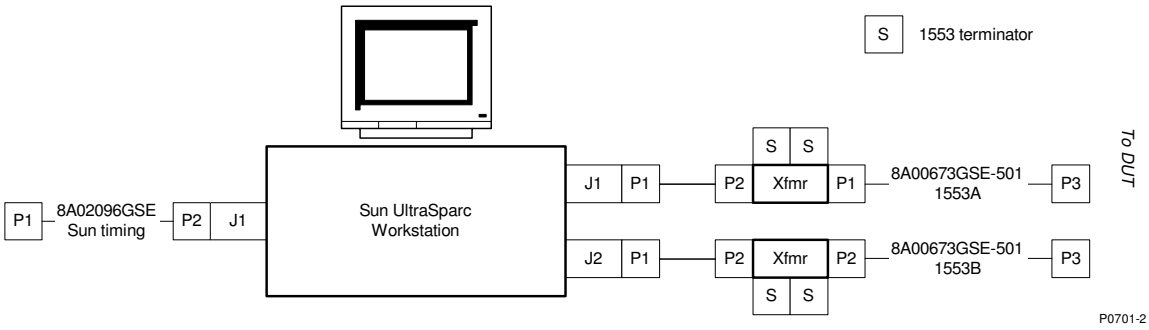

Figure 1 – Testset Connections

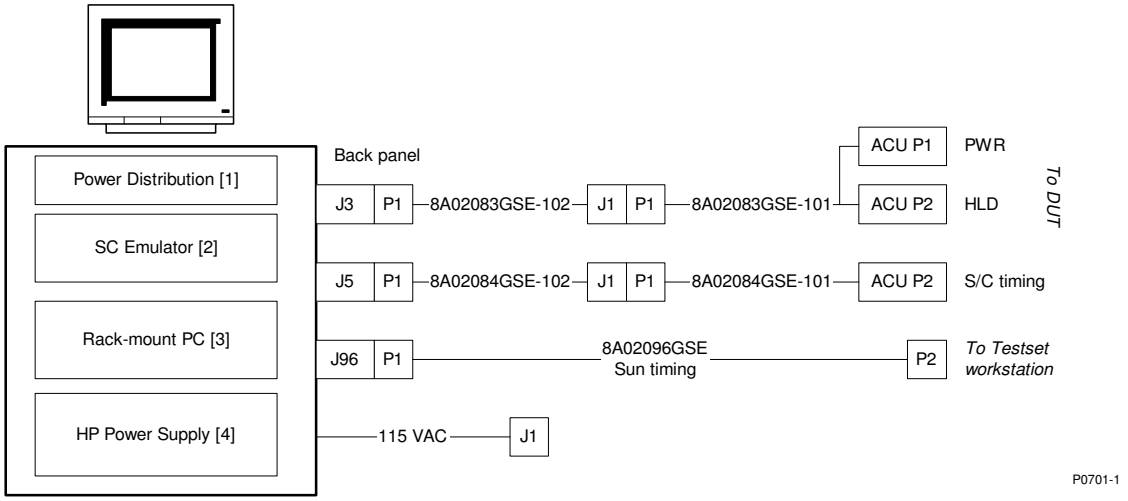

Figure 2 – HLD and Power Connections to Aft GSS

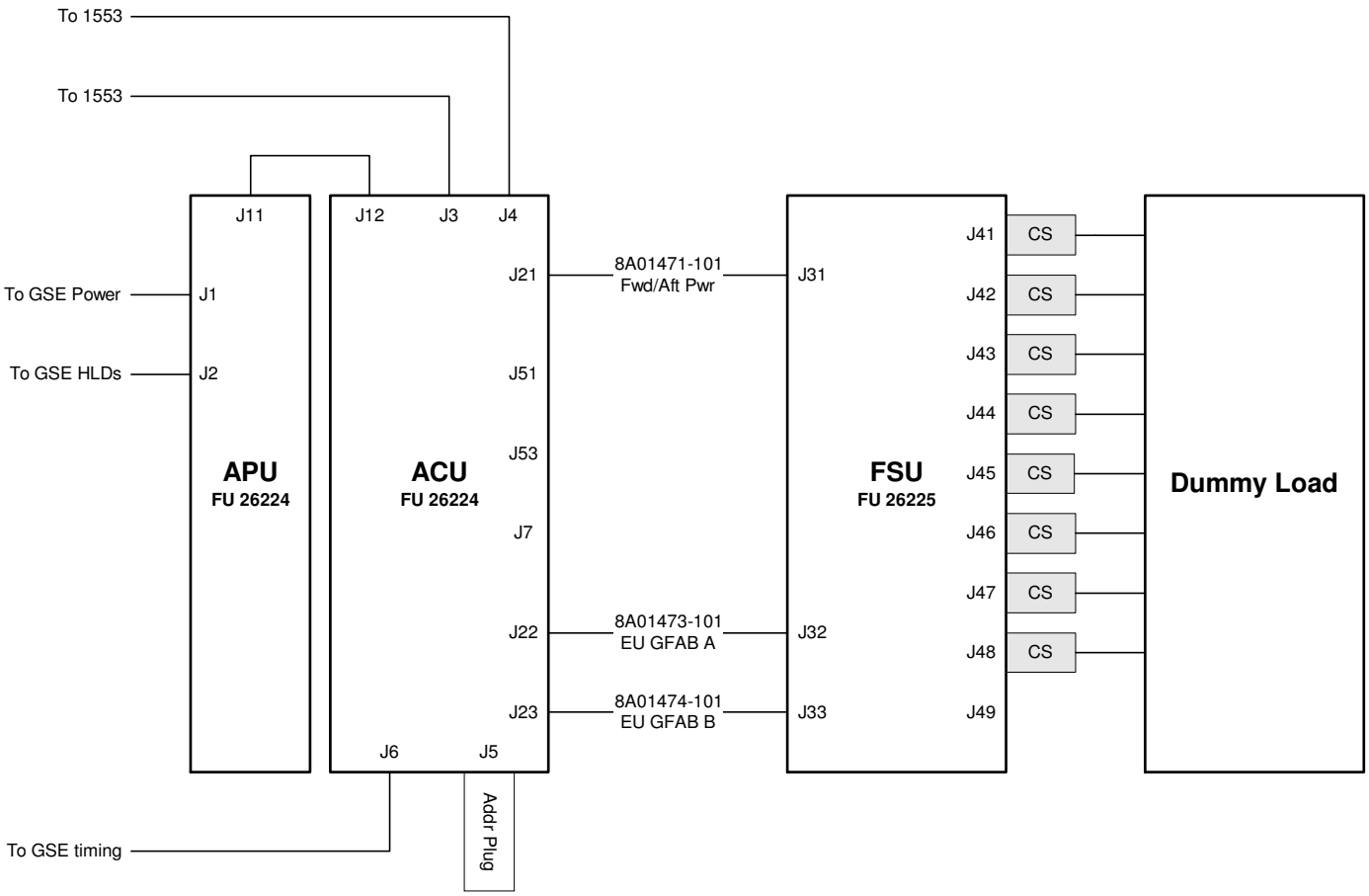

Figure 3 – Aft and Fwd box connections on mounting plate

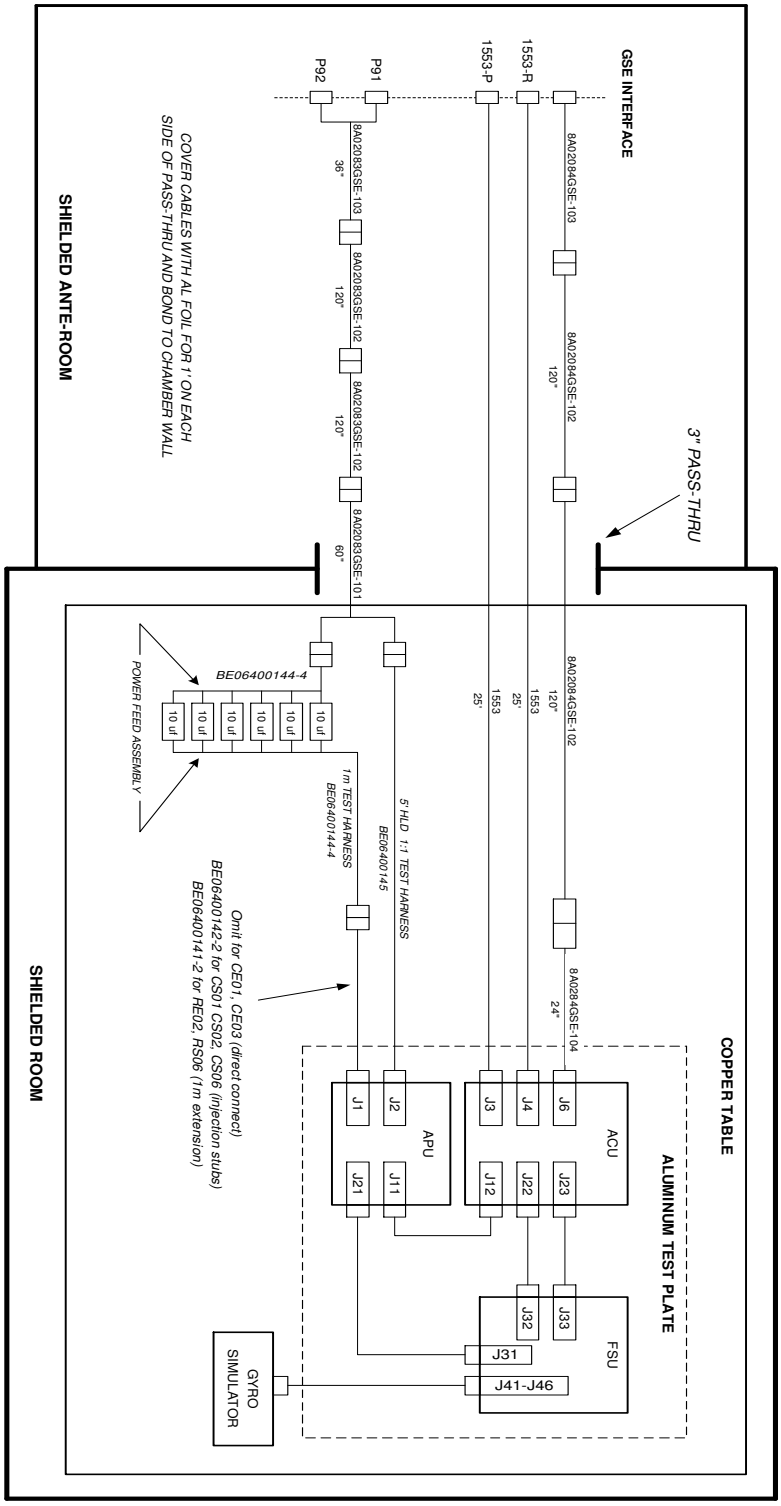

Figure 4 – Test Harness Connections

13.3.2. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be placed parallel to the front boundary of the setup and shall be arranged in a figure-8 lay-out. The cable closest to the front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

14.0 Formal Tests

14.1. Emissions Measurements.

Emissions measurement falls into two broad categories: 1) Conducted, and 2) Radiated. These two broad categories are further divided by definition according to their spectral content with respect to the measurement receivers Impulse Bandwidth (IBW). They are 1) Narrowband and 2) Broadband. Broadband signals are normalized to 1 Megahertz of IBW, therefore a factor, the Impulse Bandwidth Factor is added to the measured broadband signals. Narrowband signals are narrow with respect to the IBW and therefore have no factors added.

14.1.1. Conducted emissions tests are defined as:

14.1.1.1. Method CE01 for narrowband interference over the frequency range of 30 Hertz to 30 kHz

14.1.1.2. Method CE03 for narrowband and broadband interference over the frequency range of 20 kHz to 50 MHz.

14.1.2. Radiated emissions tests are defined as:

Method RE02 for narrowband and broadband interference over the frequency range of 14 kHz to 10 GHz (or 1 GHz for Broadband).

14.2. Susceptibility Measurements

Susceptibility tests are performed to confirm the EUTs ability to operate per design specifications when it is subjected to common electrical environments that it might encounter in its normal operating environment.

14.2.1. Conducted Susceptibility tests are:

14.2.1.1. Method CS01 couples unmodulated sinusoids onto the EUT power leads over the frequency range of 30 Hertz to 50 kHz.

14.2.1.2. Method CS02 couples modulated sinusoids onto the EUT power leads over the frequency range of 50 kHz to 10 MHz.

14.2.1.3. Method CS06 couples time domain spikes onto the EUT power leads. The Spikes are of two widths: 1) 0.15 μSeconds and 2) 10 μSeconds. They are free running at the rate of 10 PPS. Both positive and negative Spikes are injected.

14.2.2. Radiated Susceptibility tests are:

Method RS03 radiates modulated electric fields onto the EUT and its associated cabling over the frequency range of 14 kHz to 18 GHz.

15.0 Detailed Measurement Procedures

15.1. Conducted Emissions, Method CE01 Narrowband.

15.1.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Report.

Nomenclature	Manufacturer	Model Number
Spectrum Analyzer	Hewlett Packard Company	8566A/B
Signal Source	Hewlett Packard Company	3325A
Oscilloscope	Hewlett Packard Company	54501A
Voltmeter	Fluke	87
LISC (6 ea)	Solar Electronics Company	6512-106R
Current Probe	Solar Electronics Company	6741-1

15.1.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Each power lead of the Prime power, Redundant power and Computer power (6 in all) is to be tested individually. The Gyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.1.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with “C” clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.1.4. Orientation of the EUT

Orientation of the EUT is not particularly important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.1.5. Arrangement of wires and cables

15.1.5.1. Power Leads

Six each one-meter length of input power lead shall be routed between the EUT inputs and LISCs. The wires will be parallel to the front edge of the test bench. The 6 power leads shall be connected to the 6 LISCs at the source end. Power leads that are part of an interconnecting cable shall be separated for the first 30 centimeters between the LISC and the EUT. All power leads shall be supported 5 cm above the ground plane.

15.1.5.2. Interconnect Leads

The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a figure - 8 arrangement The cable closest to the front edge of the

ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.1.6. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated with either the actual equipment or loads which simulate the electrical properties (impedance, grounding and circuital balance) in the actual installation. Signal inputs shall be applied to all applicable electrical interfaces to exercise the EUT for operation and monitoring. Mechanical outputs shall be suitably loaded. Particular attention should be given to assure that active loads or sources are not themselves susceptible.

15.1.7. Operation of the EUT

15.1.7.1. The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.1.8. Measurement Procedures

15.1.8.1. With the EUT set-up on the Copper clad bench top as shown in Figure 4, connect the Current probe around the first power lead. Placement of the probe is not critical except that it must be within the first 30 cm between the EUT and LISC.

15.1.8.2. In the Control chamber, connect the Current Probe to the Spectrum Analyzer input connector.

15.1.8.3. With the Computer/Controller, select the ‘CE01’ Measurement program. Press the ‘RUN’ key on the Controller.

15.1.8.4. The program will query certain housekeeping information. Supply the information requested and press ‘ENTER’ each time.

15.1.8.5. After all housekeeping data has been entered the program will alert the operator that data collection can begin.

15.1.8.6. By pressing ‘ENTER’ when requested the Spectrum Analyzer will scan the first octave band (30 Hz to 60 Hz). The resolution bandwidth is set to 10 Hz. The Video Bandwidth is coupled. The sweep time is set for at least 30 seconds and the peak-detector is selected.

15.1.8.7. Upon completion of the scan, the program will cause the Spectrum Analyzer to measure the largest value within the 1000 data points of the sweep. The largest value and its corresponding frequency point will be saved to memory. A message on the Analyzer screen reminds the operator that the computer is formatting the 1000 data points just gathered.

15.1.8.8. Upon completion of the formatting, the computer gives us the choice of keeping the data just gathered or re-running that octave. Most times we will save the data. If we choose to go with the data just gathered and formatted, then the controller will set the Spectrum Analyzer to run the next octave.

15.1.8.9. The above two paragraphs are repeated over and over until the complete frequency range of CE01 (30 Hz to 20 kHz) has been successfully measured.

15.1.8.10. At the conclusion of data gathering, the controller will cause a plot of the formatted test data to be plotted on a semi-log graph showing the linear dBuA as plotted on the ‘Y’

coordinate at its corresponding logarithmically located frequency on the 'X' coordinate. The graph also has the specification limit plotted on it so that one can see at a glance whether the test is satisfactory.

15.1.8.11. After the graph has been completed, the controller will offer to print a Tabular summary of the exact frequency and magnitude of the largest interference signals in each octave. The Limit at each of these frequencies is also printed out. Also a PASS/FAIL message is printed for these maxima.

15.1.8.12. Carefully examine both hard copies of data and if failures occur, inform the Customers representative of the failure. The Customer representative will decide whether to stop or continue the test in this event. If no failures occur, place the hard copies of data in the test record and prepare to measure the next power lead.

15.1.8.13. Continue to measure the power lines as per paragraphs 15.1.8.3 through 15.1.8.12 above until all six have been successfully measured.

15.1.8.14. The current probe Transfer Impedance correction factors are programmed into the computer. They are shown in Appendices A and B.

15.1.8.15. The Narrowband specification limit is found in Figure 5 herein.

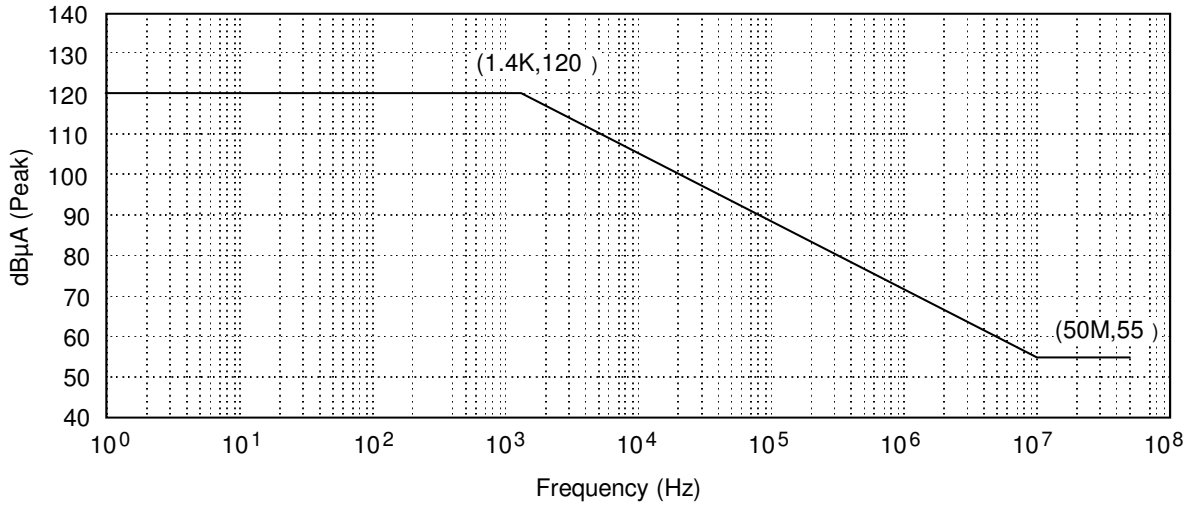

Figure 5. Narrowband Specification Limit

15.2. Conducted Emissions, Method CE03, Narrowband and Broadband.

15.2.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Report.

Nomenclature	Manufacturer	Model Number
Spectrum Analyzer	Hewlett Packard Company	8566A/B
Signal Source	Hewlett Packard Company	3325A
Oscilloscope	Hewlett Packard Company	54501A
Voltmeter	Fluke	87
LISC (6 ea)	Solar Electronics Company	6512-106R
Current Probe	Solar Electronics Company	6741-1
Pre-amplifier	Hewlett Packard Company	8447D

15.2.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Each power lead of the Prime power, Redundant power and Computer power (6 in all) is to be tested individually. The Gyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.2.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with “C” clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.2.4. Orientation of the EUT

Orientation of the EUT is not particularly important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.2.5. Arrangement of wires and cables

15.2.5.1. Power Leads

Six each one-meter length of input power lead shall be routed between the EUT inputs and LISCs. The wires will be parallel to the front edge of the test bench. The 6 power leads shall be connected to the 6 LISCs at the source end. Power leads that are part of an interconnecting cable shall be separated for the first 30 centimeters between the LISC and the EUT. All power leads shall be supported 5 cm above the ground plane.

15.2.5.2. Interconnect Leads

The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a zig-zag arrangement The cable closest to the front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.2.5.3. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated with either the actual equipment or loads that simulate the electrical properties (impedance, grounding and circuital balance) in the actual installation. Signal inputs shall be applied to all applicable electrical interfaces to exercise the EUT for operation and monitoring. Mechanical outputs shall be suitably loaded. Particular attention should be given to assure that active loads or sources are not themselves susceptible.

15.2.6. Operation of the EUT

15.2.6.1. The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.2.7. Measurement Procedures

15.2.7.1. With the EUT set-up on the Copper clad bench top as shown in Figure 4, connect the Current probe around the first power lead. Placement of the probe is not critical except that it must be within the first 30 cm between the EUT and LISC.

15.2.7.2. In the Control chamber, connect the Current Probe to the Spectrum Analyzer input connector.

15.2.7.3. With the Computer/Controller, select the ‘CE03’ Measurement program. Press the ‘RUN’ key on the Controller.

15.2.7.4. The program will query certain housekeeping information. Supply the information requested and press ‘ENTER’ each time.

15.2.7.5. After all housekeeping data has been entered the program will alert the operator that data collection can begin.

15.2.7.6. By pressing ‘ENTER’ when requested the Spectrum Analyzer will scan the first octave band (20 kHz to 40 kHz). The resolution bandwidth is set to 300 Hz. The Video Bandwidth is coupled. The sweep time is set for at least 30 seconds and the peak-detector is selected.

15.2.7.7. Upon completion of the scan, the program will cause the Spectrum Analyzer to measure the largest value within the 1000 data points of the sweep. The largest value and its corresponding frequency point will be saved to memory. A message on the Analyzer screen reminds the operator that the computer is formatting the 1000 data points just gathered.

15.2.7.8. Upon completion of the formatting, the computer gives us the choice of keeping the data just gathered or re-running that octave. Most times we will save the data. If we choose to go with the data just gathered and formatted, then the controller will set the Spectrum Analyzer to run the next octave.

15.2.7.9. When the measurement range is above 100 kHz, the Hewlett Packard 8447D pre-amplifier is inserted in series with the wire from the Current probe. The Pre-amp is used for all octaves above 100 kHz. In the final formatting of data, its gain is removed from the corrected value.

15.2.7.10. The above three paragraphs are repeated over and over until the complete frequency range of method CE03 (20 kHz to 50 MHz) has been successfully measured.

15.2.7.11. At the conclusion of data gathering, the controller will cause a plot of the formatted narrowband test data to be plotted on a semi-log graph showing the linear dBuA as plotted on the 'Y' coordinate at its corresponding logarithmically located frequency on the 'X' coordinate. The graph also has the specification limit plotted on it so that one can see at a glance whether the test is satisfactory.

15.2.7.12. After the graph has been completed, the controller will offer to print a Tabular summary of the exact frequency and magnitude of the largest narrowband interference signals in each octave. The Limit at each of these frequencies is also printed out. Also a PASS/FAIL message is printed for these maxima.

15.2.7.13. After the narrowband test data have been, the controller will remind the Operator to plot the Broadband test data similar to those for the narrowband. The Broadband data have a bandwidth correction factor added to each reading. Also, the tabular style Broadband data will be printed as described in paragraph 15.2.7.12 above.

15.2.7.14. Carefully examine both hard copies of Narrowband and Broadband data and if failures occur, inform the Customers representative of the failure. The Customers representative will decide whether to stop or continue the test in this event. If no failures occur, place the hard copies of data in the test record and prepare to measure the next power lead.

15.2.7.15. Continue to measure the power lines as per paragraphs 15.2.7.3 through 15.2.7.14 above until all six have been successfully measured.

15.2.7.16. The current probe Transfer Impedance correction factors are programmed into the computer. They are shown in Appendices C and D.

15.2.7.17. The Narrowband specification limit is found in Figure 5 herein. The Broadband specification limit is found in Figure 6.

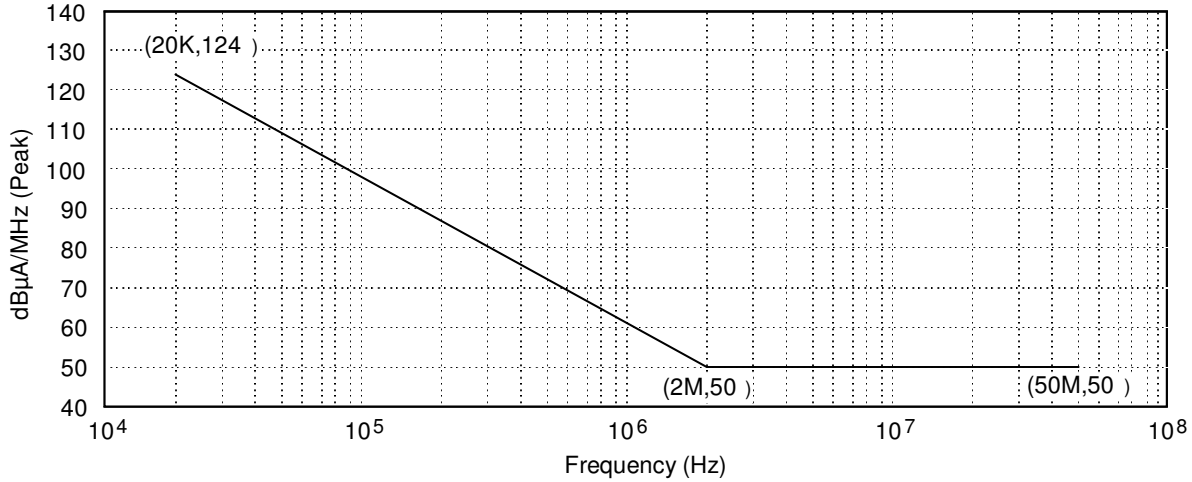

Figure 6. Broadband Specification Limit

15.3. Conducted Susceptibility, Method CS01.

15.3.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Report.

Nomenclature	Manufacturer	Model Number
Spectrum Analyzer	Hewlett Packard Company	8566A/B
Signal Source	Hewlett Packard Company	3325A
Audio Power Amp	Solar Electronics Company	6552-1A
Audio Isol'n Xfmr	Solar Electronics Company	6220-1
LISC (6 ea)	Solar Electronics Company	6512-106R

15.3.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Each power lead of the Prime power, Redundant power and Computer power (6 in all) is to be tested. Parallel injection techniques will be used. The Gyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.3.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with "C" clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.3.4. Orientation of the EUT

Orientation of the EUT is not particularly important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.3.5. Arrangement of wires and cables

15.3.5.1. Power Leads

Six each one-meter length of input power lead shall be routed between the EUT inputs and Audio Isolation Transformers secondary. The wires will be parallel to the front edge of the test bench. The 6 power leads shall be connected to 6 LISCs at the source end. The output of the LISCs will be connected to the Audio Isolation Transformer secondary. All power leads shall be supported 5 cm above the ground plane.

15.3.5.2. Interconnect Leads

The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a figure - 8 arrangement The cable closest to the front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.3.6. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated as per paragraph 15.1.6 above

15.3.7. Operation of the EUT

15.3.7.1. The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.3.8. Measurement Procedures

15.3.8.1. With the EUT set-up on the Copper clad bench top as shown in Figure 4, connect the Audio Isolation Transformer secondary to the first power lead (only the ungrounded supply leads will be injected).

15.3.8.2. The susceptibility signal originates at the computer controlled Signal Generator, the HPC-3325A and is amplified to the specification limit (in this instance 1.06 V rms) by the Solar Power Amplifier. Its magnitude is measured by taking the signal from the bifilar winding of the Audio Isolation Transformer and applying it to the Spectrum Analyzer. The Spectrum Analyzer measures the Susceptibility signal frequency and magnitude and reports the information to the Controller. The controller compares the reported Magnitude to the Specification Limit for that frequency and adjusts the susceptibility signal either up or down by 0.1 dB steps to match the Specification limit. This whole process takes long enough so that the EUT has sufficient time to respond to the susceptibility signal and the observer has time to react to any adverse responses.

15.3.8.3. The EUT operation is monitored by the Observer with Customer assistance. At the start of the test, the GSS shall be put into the PRIME arbiter state via P0848 with arbiter thresholds enabled. If the GSS arbiter switches out of the prime state (as indicated on the Testset monitor), the test will be halted, critical frequencies identified, and the GSS reset, and the test continues from there. These particular frequencies shall be investigated in more detail after the main sweep, including measuring the susceptibility threshold, that magnitude where the EUT just starts to show the unacceptable response. Inform the Customers representative if susceptibility is observed. Record the susceptibility thresholds if they occur.

15.3.8.4. The automatic scanning is performed over octave spans. Step size is controllable by specifying the number of measurements per octave.

15.3.8.5. As each octave is completed, the necessary test information is recorded on the data sheet. The information consists of the octave frequency span, the injected level, the limit level and a PASS/FAIL message. When each power lead is completely tested (30 Hz to 50 kHz), then the test data sheet is printed out and is placed in the test record.

15.3.8.6. Continue to test as per paragraphs 15.3.8.1 through 15.3.8.5 above until all power leads have been tested.

15.4. Conducted Susceptibility, Method CS02.

15.4.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Report.

Nomenclature	Manufacturer	Model Number
Spectrum Analyzer	Hewlett Packard Company	8566A/B
Signal Source	Hewlett Packard Company	3325A
Signal source	Hewlett Packard Company	8350/83592
Audio Power Amp	Solar Electronics Company	6552-1A
Power Amplifier	Instruments For Industry	406
RF Coupler	Solar Electronics Company	7415-3

15.4.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Each power lead of the Prime power, Redundant power and Computer power (6 in all) is to be tested. Parallel injection techniques will be used. The Gyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.4.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with “C” clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.4.4. Orientation of the EUT

Orientation of the EUT is not particularly important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.4.5. Arrangement of wires and cables

15.4.5.1. Power Leads

Six each one-meter length of input power lead shall be routed between the EUT inputs and power source. The wires will be parallel to the front edge of the test bench. All power leads shall be supported 5 cm above the ground plane.

15.4.5.2. Interconnect Leads

The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a figure - 8 arrangement The cable closest to the front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.4.6. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated as per paragraph 15.1.6 above

15.4.7. Operation of the EUT

15.4.7.1. The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.4.8. Measurement Procedures

15.4.8.1. With the EUT set-up on the Copper clad bench top as shown in Figure 4, connect the RF Coupler between the first power lead and the ground plane.

15.4.8.2. The susceptibility signal originates at the computer controlled Signal Generator, the HPC-3325A or 8350A and is amplified to the specification limit (in this instance 1.06 V rms) by the Power Amplifiers. Its magnitude is measured by taking the signal from the Attenuated port (-40 dB) of the RF coupler and applying it to the Spectrum Analyzer. The Spectrum Analyzer measures the Susceptibility signal frequency and magnitude and reports the information to the Controller. The controller compares the reported Magnitude to the Specification Limit for that frequency and adjusts the susceptibility signal either up or down in 0.1 dB steps to match the Specification limit. This whole process takes long enough so that the EUT has sufficient time to respond to the susceptibility signal and the observer has time to react to any adverse responses.

15.4.8.3. The EUT operation is monitored by the Observer with Customer assistance. At the start of the test, the GSS shall be put into the PRIME arbiter state via P0848 with arbiter thresholds enabled. If the GSS arbiter switches out of the prime state (as indicated on the Testset monitor), the test will be halted, critical frequencies identified, and the GSS reset, and the test continues from there. These particular frequencies shall be investigated in more detail after the main sweep, including measuring the susceptibility threshold, that magnitude where the EUT just starts to show the unacceptable response. Inform the Customers representative if susceptibility is observed. Record the susceptibility thresholds if they occur.

15.4.8.4. Automatic scanning is performed over octave frequency spans. Step size is controllable by specifying the number of measurements per octave.

15.4.8.5. As each octave is completed, the necessary test information is recorded on the data sheet. The information consists of the octave start and stop frequencies, the injected level, the limit level and a PASS/FAIL message. When each power lead is completely tested (50 kHz to 10 MHz), then the test data sheet is printed out and is placed in the test record.

15.4.8.6. If susceptible indications were noted, find the susceptibility threshold at each frequency by tuning to that frequency and increasing the susceptibility stimulus to the point where the EUT is responding. Then reduce the stimulus until the EUT does not show a response. Then carefully increase the stimulus until the EUT just begins to show a response. This magnitude is the susceptibility threshold at that frequency. Measure and record all susceptibility thresholds.

15.4.8.7. Continue to test as per paragraphs 15.4.8.1 through 15.4.8.6 above until all power leads (both supply and return leads) have been tested.

15.5. Conducted Susceptibility, Method CS06.

15.5.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Test Report.

Nomenclature	Manufacturer	Model Number
Digital Storage Oscilloscope	Hewlett Packard Company	54501A
Transient Generator	Solar Electronics Company	8282-1
Audio Isol'n Xfmr	Solar Electronics Company	6220-1
Resistor, 5Ω, non-inductive	Any	
Dot Matrix Printer	Hewlett Packard Company	2673A

15.5.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Parallel injection techniques will be used. Each power lead pair of the Prime power, Redundant power and Computer power (3 pairs) are to be tested. The Gyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.5.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with "C" clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.5.4. Orientation of the EUT

Orientation of the EUT is not particularly important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.5.5. Arrangement of wires and cables

15.5.5.1. Power Leads

Six each one-meter length of input power lead shall be routed between the EUT inputs and power source. The wires will be parallel to the front edge of the test bench. All power leads shall be supported 5 cm above the ground plane.

15.5.5.2. Interconnect Leads

The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a zig-zag arrangement The cable closest to the front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.5.6. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated as per paragraph 15.1.6 above

15.5.7. Operation of the EUT

15.5.7.1. The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.5.8. Measurement Procedures

15.5.8.1. With the EUT set-up on the Copper clad bench top as shown in Figure 4, connect the Transient Generator in parallel with the first power lead pair. The secondary of the Audio Isolation Transformer is connected in series with the power lead between the Transient Generator and power source. The Oscilloscope is connected across the output terminals of the Transient Generator.

15.5.8.2. Positive going transients of 10 microseconds duration, free-running at 6 to 10 pulses per second, at a magnitude of 35 V peak are to be superimposed on the DC power pair.

15.5.8.3. Allow the Spikes to free-run for 5 minutes minimum while monitoring the EUT for adverse effects caused by the Spikes. The EUT operation is monitored by the Observer with Customer assistance. At the start of the test, the GSS shall be put into the PRIME arbiter state via P0848 with arbiter thresholds enabled. If the GSS arbiter switches out of the prime state (as indicated on the Testset monitor), the test will be halted, critical frequencies identified, and the GSS reset, and the test continues from there. Should an adverse reaction occur, reduce the magnitude of the Spike until the reaction just disappears and then increase the Spike magnitude until the reaction just appears. This point is the Susceptibility threshold. Inform the Customers representative if susceptibility is observed. Record the susceptibility thresholds if they occur.

15.5.8.4. Power down the EUT and reduce the Transient Spike to zero Volts. Prepare to inject negative going Spikes by reversing the power leads attached to the Binding Posts marked ‘Parallel’ on the Transient Generator.

15.5.8.5. Re-apply power to the EUT and increase the 10 μsec Spike magnitude until it is 35 Volts peak in the negative direction. Allow the Spike to free-run at 6 to 10 PPS for at least 5 minutes while monitoring the EUT for susceptibility. Record any thresholds found.

15.5.8.6. Reduce the Transient Spike to zero Volts and prepare to inject negative going 0.15 microseconds. It is not necessary to remove power to the EUT at this time.

15.5.8.7. Increase the 0.15 μsec Spike magnitude until it is 35 Volts peak in the negative direction. Allow the Spike to free-run at 6 to 10 PPS for at least 5 minutes while monitoring the EUT for susceptibility. Record any thresholds found.

15.5.8.8. Power down the EUT and reduce the Transient Spike to zero Volts. Prepare to inject positive going Spikes by reversing the power leads attached to the Binding Posts marked ‘Parallel’ on the Transient Generator.

15.5.8.9. Re-apply power to the EUT and increase the 0.15 μsec Spike magnitude until it is 35 Volts peak in the positive direction. Allow the Spike to free-run at 6 to 10 PPS for at least 5 minutes while monitoring the EUT for susceptibility. Record any thresholds found.

15.5.8.10. Power-down the EUT and connect the Transient Generator to another DC Power input pair. Continue to test as per paragraphs 15.5.8.1 through 15.5.8.9 above until all power

pairs have been tested. Place all Test Data sheets in the Test Record.

15.5.8.11. After all power pairs have been tested, record both 10 μsec and 0.15 μsec Spike magnitudes and shapes (both positive and negative going) by making a print-out of the Oscilloscope CRT presentation of them. Place the print-outs in the Test Record.

15.6. Radiated Emissions, Method RE02

15.6.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Test Report.

Nomenclature	Manufacturer	Model Number
Spectrum Analyzer	Hewlett Packard Company	8566A/B
Antenna, Active Rod	Airborne Instruments Labs	95010-1
Antenna, Biconical	Electromechanics Company	3104
Antenna, Conical Log Spiral	Electromechanics Company	3101
Antenna, Microwave Horn	Polarad Electronics Corp.	CA-L
Antenna, Microwave Horn	Polarad Electronics Corp.	CA-S
Antenna, Microwave Horn	Polarad Electronics Corp.	CA-M
Antenna, Microwave Horn	Polarad Electronics Corp.	CA-X
Antenna Reflector, Parabolic	Polarad Electronics Corp.	CA-R2
Pre-amplifier	Hewlett Packard Company	8447D
Preamplifier, Microwave	DBS Microwave	0218T409

15.6.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Parallel injection techniques will be used. Each power lead pair of the Prime power, Redundant power and Computer power (3 pairs) are to be tested. The Gyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.6.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with “C” clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.6.4. Orientation of the EUT

Orientation of the EUT is important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.6.5. Arrangement of wires and cables

15.6.5.1. Power Leads

Six each two-meter lengths of input power leads shall be routed between the EUT inputs and power source. Each power lead will have an LISC installed in it. The wires will be parallel to the front edge of the test bench and shall be placed in a straight-line arrangement if possible. All power leads shall be supported 5 cm above the ground plane.

15.6.5.2. Interconnect Leads

The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the

front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a zig-zag arrangement The cable closest to the front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.6.6. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated as per paragraph 15.1.6 above

15.6.7. Operation of the EUT

15.6.7.1. The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.6.8. Measurement Procedures

15.6.8.1. The test is started with the antennas in a vertical attitude. Place the measurement antenna 1 meter from and centered on the middle of the test setup at a height of 80 to 120 cm. The antennas that are directional should be facing the EUT. The Rod antenna has a built-in pre-amplifier and must be powered-On. Also its counterpoise must be referenced to the Test Ground plane with a strap having a length to width ratio less than 5.0. The test antennas are connected to the Spectrum Analyzer by a double-shielded coaxial wire with length less than 4 meters.

15.6.8.2. Load the measurement program into the Computer Controller and press the ‘RUN’ key on the keyboard. The program will request housekeeping information (model number, serial number, Customer Name, Nomenclature, . ..) for the test. After the housekeeping data has been entered, the controller will set the Spectrum Analyzer for the first sweep (the start and Stop frequencies, resolution and video bandwidths, scan time, trigger method, . . .). Scans are in octave bands.

15.6.8.3. At the conclusion of each scan, the controller sorts and formats the data just collected. At frequencies above 25 MHz, external pre-amplifiers are used. The HPC-8447D is good to 1.5 GHz. Above that, use the DBF pre-amp to 10 GHz. The signals are sorted into narrowband or broadband categories, Impulse Bandwidth correction factors are added to the broadband signals, antenna correction factors are added, cable losses are added, pre-amplifier gains are subtracted. Antenna Factors are included Appendices E and F.

15.6.8.4. The operator is given the choice of keeping the data just gathered or discarding it and re-running the octave. The final formatted data is stored in an array for narrowband data and another one for broadband data. When the choice is made to keep the data, the Controller will set the Spectrum Analyzer controls for the next octave.

15.6.8.5. After all octaves have been measured, the controller will prompt that the operator should extract the hard copies in both graphical and tabular format. This process is the same as described above for conducted emissions. Broadband and Narrowband data sheets will be printed for inclusion in the test record. The data sheets should be examined for failure indications. If failures are noted, the Customers representative will be informed. In the event of failures, they will make the decision to halt or continue the tests. Test limits are found Figures 7 and 8.

15.6.8.6. When the vertically polarized data has been successfully completed, the test must be re-ran with horizontally oriented linear antennas. The Rod antenna is exempt from this

requirement because it can only be set-up in the Vertical attitude. The Conical log-spiral antenna is exempt from this requirement because it is circular polarized. Thus, the Biconical antenna and horn antennas are re-ran in the Horizontal attitude.

15.6.8.7. Upon successful conclusion of all vertical and horizontal measurement proceed to the next test.

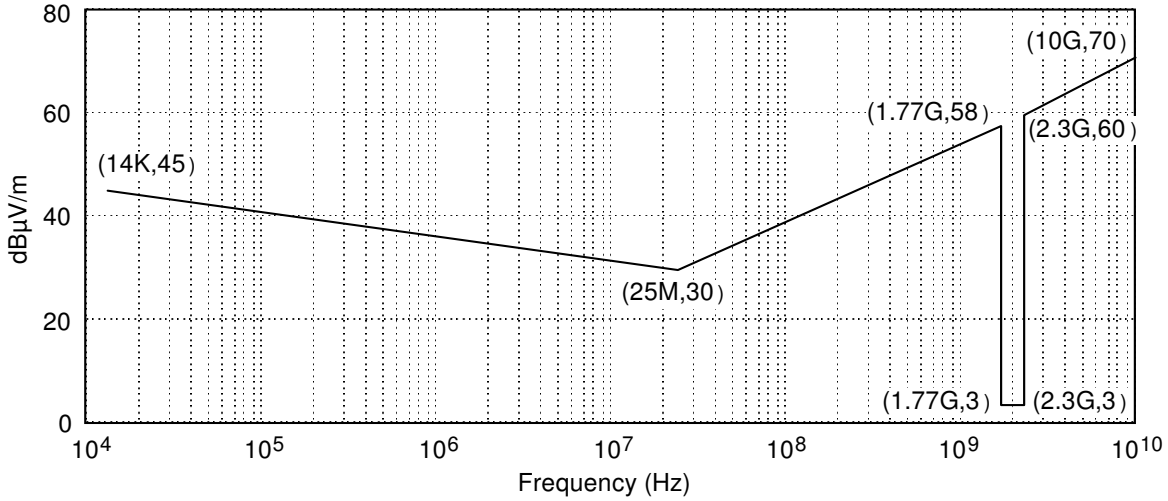

Figure 7. RE02 Narrowband Limits

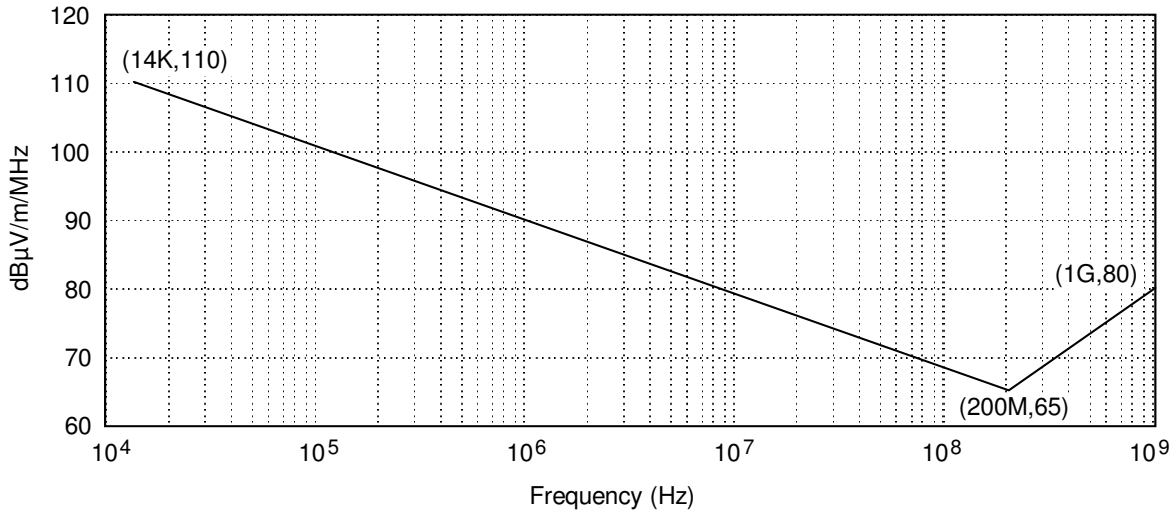

Figure 8. RE02 Broadband Limits

15.7. Radiated Susceptibility, Method RS03

15.7.1. Measurement Apparatus.

The following test equipments or their electrical equivalents shall be assembled and used for these measurements. Calibration information will be included in the Test Report.

Nomenclature	Manufacturer	Model Number
Spectrum Analyzer	Hewlett Packard Company	8566 A/B
Antenna, Active Rod	Airborne Instruments Labs	95010-1
Antenna, Biconical	Electromechanics Company	3104
Antenna, Conical Log Spiral	Electromechanics Company	3101
Antenna, M'wave Horn	Polarad Electronics Corp.	CA-L
Antenna, M'wave Horn	Polarad Electronics Corp.	CA-S
Antenna, M'wave Horn	Polarad Electronics Corp.	CA-M
Antenna, M'wave Horn	Polarad Electronics Corp.	CA-X
Antenna Reflector, Parabolic Reflector	Polarad Electronics Corp.	CA-R2
Pre-amplifier	Hewlett Packard Company	8447D
Preamplifier, Microwave	DBS Microwave	0218T409

15.7.2. Measurement Setup

The EUT shall be set up as it is normally installed in its end environment. The EUT will be connected to its simulated load and powered up for this test. Parallel injection techniques will be used. Each power lead pair of the Prime power, Redundant power and Computer power (3 pairs) are to be tested. TheGyro Simulator unit is connected as a load. Refer to Figure 4 for the test setup.

15.7.3. Bonding of the EUT

The EUT shall be mounted onto an Aluminum Test Plate. The Test plate shall be bonded to the test bench Ground Plane with "C" clamps. Oxidation of the Copper Ground plane shall be reduced so that the Bonding Resistance between the Aluminum plate and the Copper Ground plane is 2.5 milliohms or less.

15.7.4. Orientation of the EUT

Orientation of the EUT is important for this test. The EUT shall be located 10 (+/-) 2 cm from the front edge of the ground plane subject to allowances for providing adequate room for cable arrangement as specified below.

15.7.5. Arrangement of wires and cables

15.7.5.1. Power Leads. Six each two-meter lengths of input power leads shall be routed between the EUT inputs and power source. Each power lead will have an LISC installed in it. The wires will be parallel to the front edge of the test bench and shall be placed in a straight-line arrangement if possible. All power leads shall be supported 5 cm above the ground plane.

15.7.5.2. Interconnect Leads. The internal harness between the ACU and APU will be a flight-like item, as will the harness between the ACU and FSU. At least two meters (except for cable that are shorter in the actual installation) of each interconnecting cable shall be ran parallel to the front boundary of the setup. Any remaining cable lengths shall be routed to the back and shall be placed in a zig-zag arrangement The cable closest to the

front edge of the ground plane shall be placed 10 cm from the edge All cables shall be raised 5 cm above the ground plane.

15.7.6. Electrical and mechanical Interfaces

All electrical input and output interfaces shall be terminated as per paragraph 15.1.6 above.

15.7.7. Operation of the EUT

The GSS system shall be powered and configured in “high voltage” mode per P0848A. Record GSS 28 V bus current in the test log. Start a new bridge file for software data collection for this test and record file name in test log.

15.7.8. Measurement Procedures

15.7.8.1. The test is started with the antennas in a vertical attitude. Place the transmitting antenna 1 meter from and centered on the middle of the test setup at a height of 80 to 120 cm. The field monitoring antenna is placed 1 meter from the transmitting antenna but on the opposite side from the EUT setup. Transmitting antennas which are directional should be facing the EUT with the monitoring antenna in the vicinity of the EUT (1-meter from the transmitter) and facing the transmitting antenna. The monitor Rod antenna does not have a pre-amp. Its Antenna Factor is found in Appendix G. Also its counterpoise must be referenced to the Test Ground plane with a strap having a length to width ratio less than 5.0. The monitor antennas are connected to the Spectrum Analyzer by a double-shielded coaxial wire with length less than 4 meters.

15.7.8.2. Load the measurement program into the Computer Controller and press the `RUN' key. As usual, the program requests the housekeeping information. The overall test frequency range is 14 kHz to 18 GHz. Test limits are 1 Volt per meter from 14 kHz tot GHz and 2 Volts per meter from 2 GHz to 18 GHz. The Radiated susceptibility characteristic will be defined in the Vertical Plane over the entire frequency range and in the horizontal Plane over 25 MHz to 200 MHz and 1000 MHz to 18000 MHz. The measurement data will be in a tabular format.

15.7.8.3. When ready, command the Controller to start the test. Though the closed-loop measuring system tries to maintain the e-field level to within 0.5 dB of the limit, the test chamber must be free of personnel because of perturbations (20 to 30 dB and more) to the generated electric fields and possible undesired biological consequences to human tissue.

15.7.8.4. Scan the entire test frequency range in octave bands while monitoring the GSS for indications of undesirable response. The undesirable responses are described in paragraph 15.3.8.3 above. If undesirable responses are detected, note the frequency for subsequent examination. Also, notify the Customers representative.

15.7.8.5. If there are no catastrophic failures, complete the test, scanning in octave bands while changing the antennas, Signal Sources and Power Amplifiers as necessary.

15.7.8.6. Upon completion of the scans, resolve any susceptibility indications discovered earlier. The customers representative will determine if the test must be stopped for repairs or retrofit.

16.0 Completion of procedure:

		P/F	Notes
16.1.	Confirm power to DUT is **off**.		
16.2.	Remove all external cables from ASU		
16.3.	Return DUT to storage container.		
16.4.	Attach copy of test report to this procedure.		

17.0 Certification:

The undersigned certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer		Date	

This is to certify that the information obtained under this test procedure is as represented and the documentation is completed and correct.

GSS Representative		Date	
Quality Assurance		Date	