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MOUT THROUGH THE WALL SURVEILLANCE TECHNOLOGY DEVELOPMENT

Time Domain Corporation

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The objective of this effort was to develop a handheld impulse radar that would detect the presence of human beings through walls in a military operations and urbanized terrain environment. Particular emphasis was placed on minimizing the weight of the unit so that it conformed to an overall ensemble. The completed unit was then submitted to testing. Areas of testing conducted included system testing, EMI/EMS testing, and temperature and humidity testing. System testing was designed to determine the overall performance of the unit, including its ability to detect objects through walls. EMI/EMS testing measured both unintentional and intentional electromagnetic emissions from the radar and its susceptibility to electromagnetic radiation. Temperature and humidity testing determined the radar's ability to be stored and to operate over widely varying environmental conditions. A set of 119 requirements was created from the requirements of the Statement Of Work (SOW), including detailed performance of detection of moving objects through walls, the principal use of the unit. The testing results showed that the unit performed well, meeting 101 of the 119 requirements. The only SOW requirement which was not met was for unintentional radiation of electromagnetic interference. All tests of detecting moving objects through walls were passed.

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1. Introduction

This document is the final report for the SoldierVision™ 2000 (SV2000) UWB radar developed by Time Domain Corp. (TDC) for the U. S. Government under contract F30602-01-C-0085. The document presents the results of system-level testing, followed by the report of the Trade Studies/Lessons Learned.

For convenience, the test results are presented in the following three categories:

- System Testing - these tests were performed during late September 2002 at the high bay facility of Time Domain. The tests were designed to determine the overall performance of the unit, including its ability to detect objects through walls.
- EMI/EMS Testing – these tests were performed the week of September 17, 2002 at Parker Chomerics Lab, an independent military and commercial test lab in Boston, MA. The tests measured both unintentional and intentional electromagnetic emissions from the radar and its susceptibility to electromagnetic radiation.
- Temperature and Humidity Testing – these tests were performed September 26-27, 2002 at Wyle Lab, an independent military and commercial test lab in Huntsville, AL. The tests determined the radar's ability to be stored and to operate over widely varying environmental conditions.

The Statement of Work (SOW) for this contract contained approximately 28 requirements. As part of the project, a larger set of requirements was created, some as flow-downs from the SOW requirements and some as self-imposed requirements. In all, there are approximately 119 SV2000 requirements, including detailed performance of detection of moving objects through walls, the principal use of the device.

The testing results presented below show that the unit performed quite well, meeting 101 of the 119 requirements. All tests of detecting moving objects through walls were passed.

The only requirement which was not met but which was in the SOW is for unintentional radiation of electromagnetic interference. Although the unit appears to pass the unintentional radiation requirements of FCC Part 15 Class B, there were a few spurs around 100 kHz and around 100 MHz that exceeded the stringent RE102 levels of MIL-STD-461E. This is discussed in more detail in Section 3.1.

Each of the tests where performance did not meet requirements is discussed in detail in the following sections, along with a specific recommendation as to how to proceed in bringing the design completely within each specification.

2. System Testing

Section 5.1 contains the complete test procedure and the test results. As the procedure shows, tests were designed to ascertain compliance to each requirement contained in the SoldierVision / SV2000 Requirements Specification, document 410-0060.

The procedure calls for recording video of the LCD screen for some of the tests. The video tape accompanies this document.

The unit passed all through-the-wall detection and accuracy tests and all other system tests, with the following exceptions:

- The unit's housing is not "medium textured matte (scratch resistant)", requirement 18060.
- Button operating noise exceeded the limit in the available test environment, requirement 7050. Noise when placing the unit against a wall exceeded the limit in the available test environment, requirement 17080.
- The unit's housing failed in the drop test, requirement 20060. (The unit still functioned.)
- The unit did not completely reject moving objects behind its front face, requirement 22080.

Explanation and clarification of each of these is provided in the following paragraphs.

2.1 Textured Housing

The SV2000 housing is made of injection-molded Noryl plastic in huge, machined aluminum molds. When making injection molded parts, molds are first machined, then sample parts are molded and tested. Design changes are implemented and additional samples are run and retested. When this iterative process is concluded, that is, when the samples are deemed totally acceptable and no further design changes are anticipated, the mold is sent to the etch vendor to be textured. The etch vendor acid-etches the texture into the mold. Further mold changes after texturing are quite complicated and are avoided if at all possible.

When all changes are incorporated into the SV2000 mold (see drop test discussion below) the mold could be textured and textured housings could be run. The non-textured housings on the units could be replaced with textured ones.

NOTE: The requirement to have a textured finish was a self-imposed requirement, with no parent requirement in the contract Statement of Work.

Regarding the related (self-imposed) requirement to be scratch resistant, the housings are made of GE Noryl plastic. This material is quite tough, so the units are inherently scratch resistant.

2.2 Button and Placement Noise

Requirements 7050 and 17080 respectively are

- “When depressed or released, neither the On Switch, the Off Switch, nor the Soft Buttons shall make a noise greater than 40 dB SPL @ 1 meter where ambient noise <33 dB SPL.” and
- “The operator shall be able to place the SV2000 against an interior wall without making a noise greater than 40 dB SPL @ 1 meter where ambient noise <33 dB SPL.”

The SOW parent requirement for both of these derived requirements is presumably Paragraph 4.1.9.4, “The SV2000 shall not endanger the operator.”

Button noise was measured at 43.9 dB SPL and placement noise was measured at 44.5 dB SPL. Unfortunately, the quietest test environment ambient level that could be achieved was 37.5 dB SPL, well above the specified test environment of 33 dB SPL. Since the ambient noise and the true system noise combine, the test was inconclusive in determining whether or not the unit passes the 40 dB in a 33 dB environment requirement.

To perform a conclusive test, the SV2000 would need to be placed in an expensive acoustic test chamber and measured. In reality, the derived specification should probably have been set at a higher level, both for ambient and system noise.

2.3 Drop Test

Requirement 20060 is a self-imposed requirement (no parent requirement in the SOW) to survive without damage a 30” drop onto concrete. To test this requirement, the SV2000 was dropped 10 times, once on each of 6 faces and once on each of 4 edges. It survived 9 of these drops without damage. On one edge drop the housing was damaged. The unit continued to operate after all of the drops.

A design change to the housing has been made, strengthening the flange where the two halves of the housing join. It is anticipated that this change will cause the unit to survive drops on all faces and edges. Implementing this change requires a modification to the injection mold and should be made prior to texturing the mold, as noted above.

2.4 Detection Past 180°

Another self-imposed requirement is 22080, “The SV2000 shall reject moving objects behind its front face (beyond 180° FOV.)” In testing, the SV2000 responded to targets as far as 28° past its face. One way of remedying this would be to extend the antenna backplane farther on each side of the unit. This would cause the unit to be larger and heavier. A more desirable solution would be to solve this in the signal processing software, but this would require development to determine how to modify the existing software. Since this is a completely self-imposed requirement, feedback from users might first be solicited to determine whether or not improvement in this arena is really needed at all.

3. EMI/EMS Testing

Section 3 contains a description and the results of the electromagnetic interference (EMI) and electromagnetic susceptibility (EMS) testing.

3.1 EMI

In EMI testing it was found that the unit radiates at some frequencies above the limits specified. The unit was tested over the very wide frequency range of 10 kHz to 18 GHz and passed with a few exceptions, which can be categorized as follows:

- Unintentional radiation spikes around 100 kHz (68 kHz to 600 kHz) exceeded the limit by as much as approximately 30 dB.
- Unintentional radiation spikes around 100 MHz (100 MHz to 170 MHz) exceeded the limit by as much as 20 dB.

While the unit under test was still in the EMI test facility, the cable from the Interposer Board to the LCD screen was disconnected at the Interposer end. All of the bothersome energy around 100 kHz disappeared.

Although the test schedule at the EMI test facility did not allow monitoring the energy near 100 MHz during this “troubleshooting” test, TDC test and engineering personnel later performed tests within the screen room at TDC. The bothersome energy around 100 MHz similarly disappeared when the LCD cable was disconnected as before. Thus, a reasonable way to address all of these unintentional emissions simultaneously would be to add a choke around this LCD cable near the interposer end. This would be similar to the choke found on most PC monitor cables. Experimentation would be required to determine the right choke. The weight of the unit would increase slightly with the addition of this choke.

The unit passed the intentional radiation tests.

3.2 EMS

The SV2000 met all EMS requirements, operating successfully even when subjected to the specified high incident levels over a very wide frequency range.

4. Temperature and Humidity Testing

Section 6 contains the report of testing the SV2000's performance over various temperature and humidity ranges.

4.1 Temperature

The unit passed all temperature testing.

4.2 Humidity

The unit passed all humidity testing.

5. Test Results

5.1.1 Description and the results of the electromagnetic interference (EMI) and electromagnetic susceptibility (EMS) testing

5.1.2 EMI and EMS Test Results

Test Location

Test Name: Mil-STD 461E

Test Site: Chomerics Boston, MA

Test Date: September 17 to September 24, 2002

Test Personnel: Keven Trach

Motivation and Scope

The purpose of this testing is to verify that the Soldier vision met the test requirements of the test procedures listed below and to document any anomalies that might occur:

1. SV2000 Test Procedure
2. MIL-STD 461E
3. FCC 47 C.F.R. Part 15 Limited Waiver (Feb.2 1998, DA 98-222)

Test Descriptions

5.1.2.1 Intentional Emissions

The intentional emissions were measured at Chomerics three meter Open Area Test Site or "O.A.T.S.". These measurements were made one meter away from the soldier Vision (S/N: 008) with a spectrum analyzer and a standard gain horn antenna. The spectrum analyzer used a 1 MHz RBW and 10KHz VBW, video-averaging technique for the measurements. The peak emissions were found off the back of the unit (antenna array side) at about a 60-degree angle. The test results listed in Table 1.1 are compared to the FCC waiver. The test results in Table 1.2 are compared to the requirements in the Soldier VisionTM test procedure.

Power Mode	Meter Reading dBm	Convert to dB μ v	Cable Loss	Antenna Factor	Corrected Reading	dB Over the limit
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FCC	-70.07	107	1.5	27.4	65.83	2.29
Turbo	-59.81	107	1.5	27.4	76.09	12.55

Table 1.1

Power Mode	Frequency (Ghz)	EIR-PSD (dBm/Mhz)	Limit	Delta	Pass/Fail
FCC	2.1	-38.27	-35.0	-3.27	Pass
FCC	1.5	-44.80	-38.0	-6.80	Pass
FCC	1.0	-59.80	-46.0	-13.80	Pass
Turbo	2.1	-28.01	-35.0	6.99	Fail
Turbo	1.5	-36.31	-38.0	1.69	Fail
Turbo	1.0	-53.96	-46.0	-7.96	Pass

Table 1.2

5.1.2.2 Unintentional / RE102

The radiated emissions were measured at Chomerics inside a semi-anechoic chamber. These measurements were made one meter away from the Soldier Vision (S/N: 008) with a spectrum analyzer. A personal computer using H.P. software was configured to follow the MIL-STD-461E sweep time and bandwidth settings for the duration of testing. All test were performed at an antenna distance one meter away from the Soldier Vision. The radiated emissions tests were performed from 10 kHz to 18 Ghz with two antenna polarizations and three modes of operation. These three modes included Standby Mode, FCC Mode, and Turbo Mode. While the soldier Vision was operating in it's transmitted modes it ran with the following settings: 10 Meter/Fast/Motion/Static/and Symbol activated.

Ambient scans of each frequency range were taken before each test was started. The ambient plots were then verified to meet the requirements as called out in MIL-STD-461E. The Soldier Vision was placed inside a semi anechoic chamber with the handle and LCD screen facing the receive test antenna. The unit was positioned in this manner for all testing 10 kHz to 1 Ghz. For the testing that was performed from 1 Ghz to 18 Ghz the Soldier Vision was turned 135 degrees so the antenna array was facing the receive antenna. Brief summaries of the test results are listed

below of each frequency that was found.

<i>Frequency</i>	<i>Delta above limit</i>
68 kHz	30 dB
180 kHz	3 dB
200 kHz	20 dB
280 kHz	6 dB
300 kHz	6 dB
320 kHz	25 dB
400 kHz	6 dB
475 kHz	1 dB
520 kHz	6 dB
600 kHz	3 dB

10kHz to 2Mhz Vertical antenna polarization-**Failed**

Table 2.1

Note 1: Only the vertical antenna polarization was performed in this frequency range.

Note 2: When the cable from the L.C.D. was disconnected from the interposer board all of the emissions in table 2.1 were no longer present. The Soldier Vision was running with the backlight on.

Note 3: These emissions did not vary in frequency or amplitude with the mode of operation.

- 2Mhz to 1000 Mhz Horizontal antenna polarization-**Failed**

<i>Frequency</i>	<i>Delta above limit</i>
100 MHz	20 dB
105 MHz	17 dB
110 MHz	14 dB
115 MHz	4 dB
120 MHz	6 dB
130 MHz	3 dB

Table 2.2

Note 1: These emissions varied in amplitude with the mode of operation.

- 2Mhz to 1000 Mhz Vertical antenna polarization-Failed

<i>Frequency</i>	<i>Delta above limit</i>
100-170 Mhz	Up to 15 dB
Standby Mode	5 dB
FCC Mode	9 dB
Turbo Mode	15 dB

Table 2.3

Note 1: These emissions did vary in amplitude with the Soldier Vision's mode of operation.

Note 2: The emissions in this table acted as one broadband emission (about 70 Mhz wide) as opposed to several narrowband peaks.

- 1 Ghz to 18 Ghz Vertical antenna polarization

<i>Frequency</i>	<i>Delta above limit</i>
1-18 Ghz	Up to 9 dB
Standby Mode	Passed
FCC Mode	Passed
Turbo Mode	9 dB

Table 2.4

Note 1: These emissions did vary in amplitude with the Soldier Vision's mode of operation. The Soldier Vision in the Standby and FCC Mode passed. However with the unit in Turbo Mode the level at the peak (2.1 Ghz) was about 9dB over the limit.

- 1 Ghz to 18 Ghz Horizontal antenna polarization

<i>Frequency</i>	<i>Delta above limit</i>
1-18 Ghz	Up to 16 dB
Standby Mode	Passed
FCC Mode	8 dB
Turbo Mode	16 dB

Table 2.5

Note 1: These emissions did vary in amplitude with the Soldier Vision's mode of operation.

5.1.2.3 Susceptibility / RS103

The radiated susceptibility tests were performed at Chomerics inside a semi-anechoic chamber. The radiated susceptibility tests were performed from 1 Mhz to 40 Ghz with two antenna polarizations, two antenna positions, and one mode of operation (FCC Mode). These test were performed at an antenna distance no more then 1 meter away from the Soldier Vision (S/N: 008). The Soldier Vision was placed inside a semi anechoic chamber with the handle and LCD screen facing the test antenna for the first antenna position. For the second antenna position the Soldier Vision was rotated 180 degrees so the back of the unit would be facing the test antenna. While the soldier Vision was operating it ran with the following settings: 10 Meter / Fast / Motion / Static / and Symbol activated. Auto leveling was used throughout the test and the level was monitored at all time by the Chomerics staff. Brief summaries of the test results are listed below in the frequency range in which they were found.

- 1 Mhz to 10 Mhz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 10 Mhz to 200 Mhz Vertical and Horizontal antenna polarization-Passed

The LCD turned off of at the following frequencies and then returned without any operator intervention.

<i>Frequency</i>	<i>Screen Returned @</i>
61 Mhz	31 Volts per Meter
99 Mhz	37 Volts per Meter
172 Mhz	43 Volts per Meter
182 Mhz	43 Volts per Meter
215 Mhz	19 Volts per Meter

Table 3.1

- 200 Mhz to 300 Mhz Vertical and Horizontal antenna polarization-Passed

The LCD turned off of at the following frequencies and then returned without any operator intervention.

<i>Frequency</i>	<i>Screen Returned @</i>
256 Mhz	38 Volts per Meter

Table 3.2

- 300 Mhz to 500 Mhz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 500 Mhz to 1 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 1 Ghz to 2 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 2 Ghz to 4 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 4 Ghz to 8 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 8 Ghz to 18 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 18 Ghz to 26 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

- 26 Ghz to 40 Ghz Vertical and Horizontal antenna polarization-Passed

No anomalies were found

6. Environmental Trade Studies/ Lessons Learned

Test Location:

Test Name: Temperature / Humidity

Test Site: Huntsville, AL

Test Date: September 26 & September 27, 2002

Test Personnel: Keven Trach

Motivation and Scope

The purpose of this testing is to verify that the Soldier Vision™ met the test requirements of the SV2000 Test Procedure and to document any anomalies that might occur: Test Descriptions

6.1 Humidity-Passed

A baseline functional was performed on the Soldier Vision™ (S/N 007) prior to placing the unit inside the chamber. The Soldier Vision™ was operating in the FCC mode with the following settings: 10 Meter/Fast/Motion/Static/and Symbol activated. The Soldier Vision™ was powered with an external supply through the test connector however a battery was placed inside the unit for testing. The Soldier Vision™ was placed in the chamber in a manor, which the LCD could be viewed through a small window in the chamber. When the chamber reached 30% humidity and held there for 30 minutes the Soldier Vision was checked for functionality by viewing the LCD. We then proceeded to 90% humidity and held there for 30 minutes. The LCD was then inspected to verify the Soldier Vision was still functioning properly. The Soldier Vision™ was then removed from the chamber and a post-functional test was performed.

6.2 Storage-Passed

A baseline functional was performed on the Soldier Vision™ (S/N 005) prior to placing the unit inside the chamber. The Soldier Vision™ was not operating for this test. The Soldier Vision™ was placed in the chamber with a battery inside the unit for the duration of testing. The test was started at -20 degrees C to +60 degrees C as called out in the Soldier Vision™ 2000 Test Procedure. The chamber was programmed to hold at each temperature called out in the procedure for 1 hour. The Soldier Vision™ was then removed from the chamber the next morning and a post-functional test was performed.

6.3 Operational-Passed

A baseline functional was performed on the Soldier Vision™ (S/N 007) prior to placing the unit inside the chamber. The Soldier Vision™ was operating in the FCC mode with the following settings: 10 Meter/Fast/Motion/Static/and Symbol activated. The Soldier Vision™ was powered with an external supply through the test connector however a battery was placed inside the unit for testing. The test was started at -10 degrees C to +50 degrees C as called out in the Soldier Vision™ 2000 Test Procedure. The chamber was programmed to hold at each temperature called out in the procedure for 30 minutes. Following these 30-minute holds we went inside the chamber and performed a functional verification at each of the temperatures. The Soldier Vision™ was then removed from the chamber the next morning and a post-functional test was performed.

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System Functional Test Procedure – performed at Time Domain Corporation

1.1 Abstract

This plan provides a methodology to verify the SV2000 specifications. The testing will compose of a SV2000 unit under non-destructive and destructive conditions. Non-destructive testing will involve inspection and operational types of tests whereas destructive testing will involve stress testing.

1.2 Resources

1.2.1 TDC Test Product Identification

SV2000	SERIAL NUMBER	NOTES
UUT 1	SV2000006	System Verification Test
UUT 2		Radiated Emissions Test
UUT 3		Radiated Susceptibility Test
UUT 4		Temperature Test
UUT 5		Humidity Test
UUT 6		Shock Test
UUT 7		
UUT 8		

1.2.2 Test Computer Equipment

Equipment	Make / Model	NOTES
Digital Video Recorder	Sony Mini DV	
PC with USB	Windows 2000 Pro	

1.2.3 Test Equipment

Equipment	Make / Model	Quantity	Notes
Digital Multi Meter (DMM)	Agilent 34401A	1	
Power Supply	7.5V DC / 3 A	2	Current and Voltage Limit
Mechanical Target	20 in. Diam metal sphere	1	Radar Cross Section > -7dBsm
Sound Level Meter	Extech Model 407750.	1	
Interior Dry Wall	Dry Wall constructed with 2x6	1	With electrical wire and plumbing

1.2.4 Government Furnished Equipment

Equipment	Make / Model	Quantity	Notes
Monocular Night Vision Device	AN/PVS-14	1	
Rechargeable Battery	BB-2847-U	4	
Battery Charger	PP-8444A/U	2	NSN 6130-01-433-0970
Gloves	Wells-Lamont / 302L	2	Large Size

1.2.5 Test Facilities

The tests will be performed at the TDC high bay, Wyle Laboratory, and TBD test facilities. The TDC test coordinator will plan the scheduling, allocation of test equipment for each of the facilities, and test organization. The following table will map out the test locations and the requirements.

Requirement ID	Test Type	TDC	Wyle Labs	Chomerics Labs
6010	OPERATIONAL	X		
6020	OPERATIONAL	X		
6030	OPERATIONAL	X		
6040	OPERATIONAL	X		
6060	OPERATIONAL	X		
6070	OPERATIONAL	X		
6080	OPERATIONAL	X		
7010	OPERATIONAL	X		
7020	OPERATIONAL	X		
7040	OPERATIONAL	X		
7050	MECH. NOISE	X		
8010	INSPECTION	X		
8020	INSPECTION	X		
8030	INSPECTION	X		
8040	OPERATIONAL	X		
8050	INSPECTION	X		
8060	OPERATIONAL	X		
8070	OPERATIONAL	X		
8080	OPERATIONAL	X		
8090	OPERATIONAL	X		
8100	OPERATIONAL	X		
8110	INSPECTION	X		
9010	INSPECTION	X		
9020	OPERATIONAL	X		
9030	OPERATIONAL	X		
10010	OPERATIONAL	X		
10020	OPERATIONAL	X		
11010	OPERATIONAL	X		
11020	OPERATIONAL	X		
12010	ENVIRONMENTAL		X	
12020	OPERATIONAL	X		

Requirement ID	Test Type	TDC	Wyle Labs	Chomerics Labs
12030	6080	X		
12040	THERMAL		X	
12050	OPERATIONAL	X		
12060	OPERATIONAL	X		
12070	OPERATIONAL	X		
13010	OPERATIONAL	X		
13020	OPERATIONAL	X		
13030	OPERATIONAL	X		
13040	OPERATIONAL	X		
13050	OPERATIONAL	X		
13060	OPERATIONAL	X		
13070	OPERATIONAL	X		
14020	OPERATIONAL	X		
14030	OPERATIONAL	X		
14040	OPERATIONAL	X		
14050	OPERATIONAL	X		
14060	OPERATIONAL	X		
14070	OPERATIONAL	X		
14080	OPERATIONAL	X		
14090	OPERATIONAL	X		
14100	OPERATIONAL	X		
14110	OPERATIONAL	X		
14120	OPERATIONAL	X		
14130	OPERATIONAL	X		
15010	OPERATIONAL	X		
15020	OPERATIONAL	X		
15030	OPERATIONAL	X		
15040	OPERATIONAL	X		
15050	OPERATIONAL	X		
15060	RE 102			X
15070	OPERATIONAL	X		
15080	OPERATIONAL	X		
15090	OPERATIONAL	X		
15100	OPERATIONAL	X		
16010	RE 102			X
16020	RE 102			X
16030	INSPECTION	X		
16040	INSPECTION	X		
16050	INSPECTION	X		
16060	RE 102			X
16070	RS103			X
16080	RS103			X
17010	INSPECTION	X		
17020	INSPECTION	X		

Requirement ID	Test Type	TDC	Wyle Labs	Chomerics Labs
17030	INSPECTION	X		
17040	INSPECTION	X		
17050	7010	X		
17060	17010/17020	X		
17070	OPERATIONAL	X		
17080	MECH. NOISE	X		
18010	INSPECTION	X		
18020	INSPECTION	X		
18030	INSPECTION	X		
18040	INSPECTION	X		
18050	INSPECTION	X		
18060	INSPECTION	X		
19010	THERMAL		X	
20010	THERMAL		X	
20020	HUMIDITY		X	
20030	LIQUID INTRUS	X		
20050	FLOAT	X		
20060	SHOCK	X		
21010	OPERATIONAL	X		
21030	OPERATIONAL	X		
22010	OPERATIONAL	X		
22020	OPERATIONAL	X		
22030	OPERATIONAL	X		
22040	OPERATIONAL	X		
22050	OPERATIONAL	X		
22060	OPERATIONAL	X		
22070	OPERATIONAL	X		
22080	OPERATIONAL	X		
22090	OPERATIONAL	X		
22100	OPERATIONAL	X		
22110	OPERATIONAL	X		
23010	OPERATIONAL	X		

1.2.6 Recording of Test Results

The test results will be recorded in their appropriate sections and a summary will be maintained in **Appendix A** of this document and will be stored in the program record file by the Test Coordinator when testing is completed.

1.3 Verification & Validation Testing

1.3.1 Introduction

The V & V Test Plan will verify the System Requirements as identified by the Requirement ID in the SV2000 System Requirements and the IV&V Test Verification Plan. The tests are separated and itemized for clarity and tracking. The test name, the requirement ID number, and the requirement specification are from the Test Plan. The test setup drawings and the test procedure illustrate and guide the tester in a step-by-step manner. The result is based upon the Pass/Fail criteria and will be marked by the tester along with the testers initials and test conducted on date. The following is an explanation of a test.

Test Name (Requirement ID Number from Test Plan)

This is the requirement specification from the Test Plan.

- Step 1
- Step 2
- Step 3
- Step 4

Requirement ID Number	Test Name	PASS => Passing Criteria	Result	Date
		FAIL => Failing Criteria		Initial
Comments				

The test plan will address the following topics:

- Power Source
- Controls
- Display
- Test Connector
- Off / On / Startup State
- Operational State
- Standby State
- RF Emissions and Susceptibility
- Operating Position / Handles / Mounting
- Mechanical Specifications
- Storage & Operational Environment
- Field of View
- Object Detection

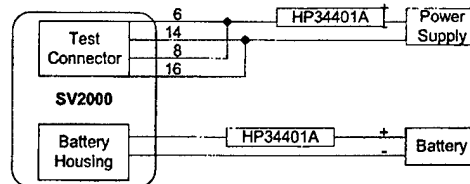
1.3.2 SV2000 Power Source

This test will check the power requirements for the SV2000. Power inputs with switchover feature, field maintainability, battery longevity, and power fault tolerance will be verified. The power inputs will be tested individually and in a combined mode.

1.3.2.1 Dual Power Supply Test (6010)

The SV2000 shall be powered by an operator-installed **Battery** (either Rechargeable Battery BB-2847-U or Primary Battery BB-5847) or by an alternate source of DC power supplied through its **Test Connector**. Both the Battery and an alternate source may be simultaneously connected, in which case power shall only be drawn from the alternate source.

- **Note: Battery BB-5847 will NOT be tested because it did not meet the SV2000 requirements.**
- Setup as shown below.



- Power ON both HP34401A and set to measure current.
- Set Power Supply Voltage to 8.0 Volts and Current Limit to 3.5 Amps.
- Power ON the SV2000
- Record the Test Connector CURRENT 2.62 (A) from the HP34401A.
- Record the Battery CURRENT 0.00 (A) from the HP34401A.

6010	Dual Power Supply Test	PASS => Battery current should be 0 A	Pass	9/24/02
		FAIL => Battery Current > Test Current <u>OR</u> Battery Current $\neq$ 0		

1.3.2.2 Battery Test

1.3.2.2.1 Field Replaceable Test (6020)

The Battery shall be field replaceable by the operator in less than 15 seconds.

- Record the TIME 12 (seconds) to replace the battery.

6020	Field Replaceable Test	PASS => Replaceable time $\leq$ 15 seconds	Pass	9/24/02
		FAIL => Replaceable time > 15 seconds		

1.3.2.2.2 Tools Needed Test (6030)

Replacement of the Battery shall not require the use of any tools.

- Record if any tools were used to replace the battery.

6030	Tools Needed Test	PASS => No tools used.	Pass	9/24/02
		FAIL => Tools used.		

1.3.2.3 Longevity Test

1.3.2.3.1 BB-2847-U (6040)

The SV2000 shall be able to operate for a minimum of 1 hour when using a fully charged BB-2847-U battery without requiring a change of battery.

- Disconnect Test Connector.
- Set the Time Out Duration to NEVER
- Insert a FULLY CHARGED battery (BB-2847-U) into the SV2000.
- Power ON the SV2000.
- Record the TIME 75 (minutes) the unit remains powered up.

6040	BB-2847-U Longevity Test	PASS => Time $\geq$ 60 minutes	Pass	9/27/02
		FAIL => Time < 60 minutes		

1.3.2.4 Charging Test (6060)

The Battery shall be removed from the SV2000 and connected to a separate Charging System for recharging.

- Insert the drained rechargeable battery (BB-2847-U) into the recharging station.
- Confirm recharging process

6060	Charging Test	PASS => Recharging	Pass	9/24/02
		FAIL => Not Recharging		

1.3.2.5 Polarity Test (6070)

The SV2000 **shall** be able to operate from its battery regardless of the battery's terminal (polarity) orientation.

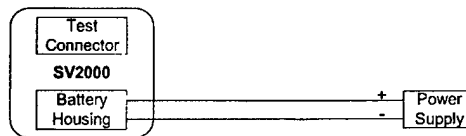
- Insert a battery into the SV2000 unit.
- Power ON the SV2000 unit and record the result: On (On/Off).
- Remove the battery, flip the orientation of the battery, and reinsert it into the SV2000 unit.
- Power ON the SV2000 unit and record the result: On (On/Off).

6070	Polarity Test	PASS => Both Power On	Pass	9/24/02
		FAIL => One Powers Off		

1.3.2.6 Power Fault Test (6080)

The SV2000 **shall** be able to detect and protect itself from **Power Faults**.

- Setup as shown below.



1.3.2.6.1 Over Voltage Test

- Set Power Supply to 9.2 V.
- Power ON the SV2000.
- Record power ON result Off (On / Off).

1.3.2.6.2 Under Voltage Test

- Set Power Supply to 5.8 V.
- Power ON the SV2000.
- Record power ON result Off (On / Off).

1.3.2.6.3 Over Current Test

- Results obtained from Power & Distribution Design Verification Test Pass (Pass/Fail).

6080	Power Fault Test	PASS => Off, Off, and Pass	Pass	9/24/02
		FAIL => One is On or Fail.		

1.3.3 SV2000 Controls

1.3.3.1 Glove Usage (7010)

All controls **shall** be usable by an operator with hands of size "Male -- Large" wearing gloves similar in construction to Wells-Lamont model 302L.

- Wear gloves (Wells-Lamont 302L) and power up the SV2000.
- Record the EASE of use Good (Good / Bad) through the menus using the soft buttons.

7010	Glove Usage	PASS => Good	Pass	9/26/02
		FAIL => Bad		

1.3.3.2 On & Off Switch (7020)

The SV2000 **shall** provide a single NOMC (Normally Open Momentary Contact) switch that controls the application of power to the unit. This switch is defined as the **On Switch**. The SV2000 **shall** provide a single NOMC switch that deactivates power to the unit. This switch is defined as the **Off Switch**.

- **Note: On/Off Switch is now the Power Switch.**
- Power ON the SV2000 by pressing the POWER button.
- Record the RESULT Power On (Power On / Power Off).
- Power OFF the SV2000 by pressing the POWER button.
- Record the RESULT Power Off (Power On / Power Off).

7020	On & Off Switch	PASS => Powers On and Off as commanded	Pass	9/24/02
		FAIL => No Response		

1.3.3.3 Soft Buttons (7040)

The SV2000 **shall** provide five, momentary contact pushbutton switches whose labels and functions are software controlled. These switches are designated as SB1, SB2, SB3, SB4, and SB5 and are collectively referred to as **Soft Buttons**.

- Power ON the SV2000.
- Exercise SB1, SB2, SB3, SB4, SB5 by pressing the buttons and using their respective menu functions.
- Record the RESULT Controllable (Controllable / Uncontrollable).

7040	Soft Buttons	PASS => Controllable	Pass	9/25/02
		FAIL => Uncontrollable		

1.3.4 SV2000 Display

1.3.4.1 Color LCD (8010)

The SV2000 *shall* incorporate a color LCD as its *Operator Display*.

- Inspect SV2000 for a color LCD display & record the result Present (Present / Not Present).

8010	Color LCD	PASS => Present	Pass	9/24/02
		FAIL => Not Present		

1.3.4.2 LCD Resolution (8020)

The Operator Display resolution *shall* be *QVGA, 320 x 240 pixels*.

- Inspect the SV2000 LCD part specification and record its RESOLUTION 320 x 240.

8020	LCD Resolution	PASS => 320 x 240 pixels OR Better	Pass	9/27/02
		FAIL => Other		

1.3.4.3 LCD Size (8030)

The Operator Display size *shall* have a diagonal measure comparable to the RV2000.

- Inspect the SV2000 LCD part specification and record its SIZE 5 1/2 "L x 4' 3/8" W.

8030	LCD Size	PASS => 4.64"L x 3.4"H or Better	Pass	9/24/02
		FAIL => Other		

1.3.4.4 Glare Reduction Filter (8110)

The SV2000 *shall* incorporate a glare-reduction filter.

- Inspect SV2000 for a glare reduction filter & record the result Present (Present / Not Present).

8110	Glare Reduction Filter	PASS => Present	Pass	9/24/02
		FAIL => Not Present		

1.3.4.5 Backlight (8050)

The Operator Display *shall* have an integral backlight.

- Place SV2000 unit in a dark room.
- Inspect SV2000 for an integrated backlight & record the result Present (Present / Not Present).

8050	Backlight	PASS => Present	Pass	9/24/02
		FAIL => Not Present		

1.3.4.6 Readability Test (8040)

The Operator Display *shall* be readable by the operator in varying ambient light conditions from direct sunlight to total darkness.

- Place SV2000 unit in a dark room.
- Record the READIBILITY Readable (Readable / Not Readable).
- Place SV2000 unit in ambient light or under Office Fluorescent Light
- Record the READIBILITY Readable (Readable / Not Readable).
- Place SV2000 unit in direct sunlight.
- Record the READIBILITY Readable (Readable / Not Readable).

8040	Readability Test	PASS => Readable for all 3 light conditions.	Pass	9/25/02
		FAIL => Not Readable for any 1 light condition.		

1.3.4.7 Brightness Adjustment Test (8060)

The operator *shall* have the ability to adjust the brightness of the Operator Display.

- Adjust the BRIGHTNESS control on the SV2000 from maximum to minimum.
- Record the result Adjustable (Adjustable / Not Adjustable).

8060	Brightness Adjustment Test	PASS => Adjustable	Pass	9/25/02
		FAIL => Not Adjustable		

1.3.4.8 Backlight Setting Recall Test (8070)

The Operator Display *shall* initialize at the backlight level held when last powered off.

- Power ON the SV2000.
- Change the BACKLIGHT Level and record the setting Dark.
- Power OFF and then power back ON the SV2000.
- Record the BACKLIGHT setting Dark.

8070	Backlight Setting Recall Test	PASS => Both settings are the same.	Pass	9/25/02
		FAIL => Both settings are NOT the same.		

1.3.4.9 Contrast Adjustment Test (8080)

The operator *shall* have the ability to adjust the contrast of the Operator Display.

- Adjust the CONTRAST level on the SV2000 from maximum to minimum.
- Adjust the CONTRAST level on the SV2000 from minimum to maximum.
- Record the result Adjustable (Adjustable / Not Adjustable).

8080	Contrast Adjustment Test	PASS => Adjustable	Pass	9/25/02
		FAIL => Not Adjustable		

1.3.4.10 Contrast Setting Recall Test (8090)

The Operator Display *shall* initialize at the contrast setting held when last powered-off.

- Power ON the SV2000.
- Change the CONTRAST Level and record the setting Bright.
- Power OFF and then power back ON the SV2000.
- Record the CONTRAST setting Bright.

8090	Contrast Setting Recall Test	PASS => Both settings are the same.	Pass	9/25/02
		FAIL => Both settings are NOT the same.		

1.3.4.11 Night Vision Compatibility Test (8100)

The SV2000 operator display **shall** be compatible with current in-service Image Intensifier night vision equipment.

- Place SV2000 in a dark room and power it ON.
- View the SV2000 LCD and the 6 push buttons via the Image Intensifier Night Vision Equipment.
- Record the READIBILITY Readable of the LCD and the Push Buttons Readable

8100	Night Vision Compatibility Test	PASS => Readable	Pass	9/26/02
		FAIL => NOT Readable		
Color blue is weak				

1.3.5 SV2000 Test Connector

1.3.5.1 Test Connector Verification (9010)

The SV2000 **shall** provide a Test Connector to interface with the Laboratory Test System.

- Inspect SV2000 for a Test Connector & record the result Present (Present / Not Present).

9010	Test Connector Verification	PASS => Present	Pass	9/25/02
		FAIL => Not Present		

1.3.5.2 Power Input (9020)

The Test Connector **shall** provide means for DC power to be supplied to the SV2000 for operation with or without a Battery.

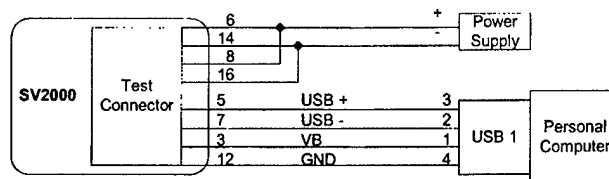
- To be performed in requirement 6010.

9020	Power Input	PASS => Result based on requirement 6010.	Pass	9/24/02
		FAIL => Result based on requirement 6010.		

1.3.5.3 Communications I/O (9030)

The Test Connector **shall** provide communication links and control circuits to support external, system-level test, diagnostic, and calibration equipment.

- Setup as shown below (Note the Test Connector Pins).



- Set Power Supply to 8 Volts and 3.5 Amps and power ON.
- Power ON the SV2000.
- Communicate with the Diagnostic/Test Bed Software to verify USB1 communication link.
- Record the USB 1 link result Working (Working / Not Working)

9030	Communications I/O	PASS => Working	Pass	9/25/02
		FAIL => Not Working		

1.3.6 SV2000 States & Transitions

1.3.6.1 Hierarchy

1.3.6.1.1 Top Level States (10010)

The SV2000 **shall** exist in one of two top-level states: **ON** or **OFF**.

- Power ON then power OFF the SV2000 and record the result Pass (Pass / Fail).

10010	Top Level States	PASS => ON to OFF	Pass	9/25/02
		FAIL => Did NOT power ON and/or power OFF		

1.3.6.1.2 Subordinate States (10020)

The ON state **shall** contain the following subordinate states: **StartUp**, **Operational**, **Standby**, and **Slave**. Figure 10-1 illustrates the relationship between SV2000 states.

- Power ON the SV2000.
- Record the result of START UP state test Pass (Pass / Fail).
- Wait for SV2000 to go into the Operational State.
- Record the result of OPERATIONAL state test Pass (Pass / Fail).
- Configure the SV2000 for Standby State.
- Record the result of the STANDBY state test Pass (Pass / Fail).
- Record the result of the SLAVE state test from requirement 9030 Pass (Pass / Fail).

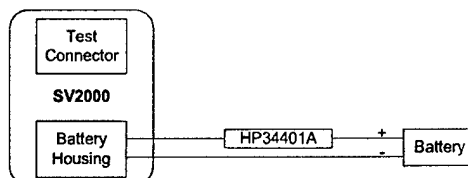
10020	Subordinate States	PASS => All States Pass	Pass	9/25/02
		FAIL => One State Fails		

1.3.6.2 Off State

1.3.6.2.1 Power Consumption (11010)

The SV2000 **shall** not draw power from the Battery when in the OFF state. A small amount of power may be drawn from the alternate power source (if present) to manage power source selection.

- Connect as shown below.



- Power ON & then power OFF the SV2000.
- Power ON HP34401A and set to measure current.
- Record the Battery CURRENT 0.000 (A) from the HP34401A.

11010	Power Consumption	PASS => Battery current < 50 uA	Pass	9/24/02
		FAIL => Battery Current >= 50 uA		

1.3.6.2.2 Off to On Transition (11020)

Transition from the OFF state **shall** be commanded by operating the Power Switch.

- Power ON the SV2000.
- Record the power ON result On (On / Off).

11020	Off to On Transition	PASS => On	Pass	9/24/02
		FAIL => Off		

1.3.6.3 On State

1.3.6.3.1 On to Off Transition

1.3.6.3.1.1 Environmental Condition (12010)

In the ON state, the SV2000 shall tolerate without damage or degradation the operating environments listed in the Operating Environment section. (20010 through 20060)

- Tested under requirements 20010 through 20060.

1.3.6.3.1.2 Normal Condition (12020)

Transition from the ON state shall be commanded by operating the Off Switch.

- Power ON the SV2000.
- Power OFF the SV2000.
- Record the power ON result On (On / Off).

12020	On to Off Transition	PASS => Off	Pass	9/24/02
		FAIL => On		

1.3.6.3.1.3 Power Fault (12030)

The SV2000 shall automatically transition from the ON state to the OFF state upon the occurrence of a Power Fault.

- Tested under requirement 6080.

12030	State Transition - Power Fault Test	PASS => Requirement 6080 Passed	Pass	9/24/02
		FAIL => Requirement 6080 Failed		

1.3.6.3.1.4 Time Out (12050)

The SV2000 shall transition to the OFF state upon elapse of an operator specified time-out duration. Candidate durations are: never, 1, 2, 3, . . . 10 minutes after last movement of the unit.

- Power ON the SV2000.
- Specify Time Out Duration of FIVE minute.
- Record the status of the SV2000 after 5 minutes Off (On / Off).
- Specify Time Out Duration of TEN minute.
- Record the status of the SV2000 after 10 minutes Off (On / Off).
- Specify Time Out Duration of NEVER.
- Record the status of the SV2000 after 15 minutes On (On / Off).

12050	Time Out	PASS => All OFF except the Never Case	Pass	9/25/02
		FAIL => One test remains ON (exception of the NEVER case)		

1.3.6.3.2 Recall User Settings (12070)

Upon transition to the ON state, all user-specified variables **shall** be re-initialized to the values held at the previous transition to the OFF state. Example variables include: backlight brightness setting, LCD contrast setting, FOV range, map update rate, and OFF timeout duration.

- Power ON the SV2000.
- Select, set, and record the BACKLIGHT BRIGHTNESS level Dark.
- Select, set, and record the LCD CONTRAST level Bright.
- Select, set, and record the FOV RANGE 5m.
- Select, set, and record the MAP UPDATE RATE Slow.
- Select, set, and record the OFF TIMEOUT DURATION 10 min.
- Select, set, and record the HIGH POWER setting to ON.
- Power OFF the SV2000.
- Power ON the SV2000.
- Record the BACKLIGHT BRIGHTNESS level Dark.
- Record the LCD CONTRAST level Bright.
- Record the FOV RANGE 5m.
- Record the MAP UPDATE RATE Slow.
- Record the OFF TIMEOUT DURATION 10 min.
- Record and verify the HIGH POWER setting Off (Off / On)

12070	Recall User Settings	PASS => Set Values = Read Values and High Power is Off	Pass	9/25/02
		FAIL => Set Values ≠ Read and/or High Power is On		

1.3.6.4 Startup State

1.3.6.4.1 Initialization (13010)

The StartUp state **shall** initialize the SV2000, conduct appropriate diagnostics, identify the possible presence of the Laboratory Test Set and select the appropriate transition from the StartUp state.

- Tested under requirement 9030.

13010	Startup Initialization	PASS => Result based on requirement 9030.	Pass	9/25/02
		FAIL => Result based on requirement 9030.		

1.3.6.4.2 Startup Screen (13020)

The StartUp state **shall** deploy the StartUp Screen.

- Power ON the SV2000.
- Verify and record the presence of the Start Up menu screen Yes (Yes / No).

13020	Startup Screen	PASS => YES	Pass	9/25/02
		FAIL => NO		

1.3.6.4.3 Unit Information (13030)

The StartUp Screen *shall* display unit identification, configuration, and diagnostic information. Such information may include: model number, TDC name, location and phone number, serial number, software configuration, contract number, and screen identifier. A notional **StartUp Screen** for the SV2000 is shown in Figure 13-1.

- Power ON the SV2000.
- Configure SV2000 to the Start Up mode.
- Verify CONTRACT NUMBER is displayed in the Start Up menu screen Yes (Yes / No).
- Verify SCREEN ID is displayed in the Start Up menu screen Yes (Yes / No).

13030	Unit Information	PASS => All are YES	Pass	9/27/02
		FAIL => One is NO		

1.3.6.4.4 Transitions

1.3.6.4.4.1 Off to On Switch (13040)

Transition to the StartUp state from the OFF state *shall* be commanded by the On/Off Switch.

- Tested under requirement 10020.

13040	Off to On Switch	PASS => Result based on requirement 10020.	Pass	9/25/02
		FAIL => Result based on requirement 10020.		

1.3.6.4.4.2 Startup to Operational (13050)

Transition from the StartUp state to the Operational state *shall* occur at the successful conclusion of StartUp state activity and in the absence of a Laboratory Test Set.

- Tested under requirement 10020.

13050	Startup to Operational	PASS => Result based on requirement 10020.	Pass	9/25/02
		FAIL => Result based on requirement 10020.		

1.3.6.4.4.3 Startup to Slave (13060)

Transition from the StartUp state to the Slave state **shall** occur at the conclusion of StartUp state activity (successful or unsuccessful) and in the presence of a Laboratory Test Set.

- Tested under requirement 9030.

13060	Startup to Slave	PASS => Result based on requirement 9030.	Pass	9/25/02
		FAIL => Result based on requirement 9030.		

1.3.6.4.5 Remain in Startup (13070)

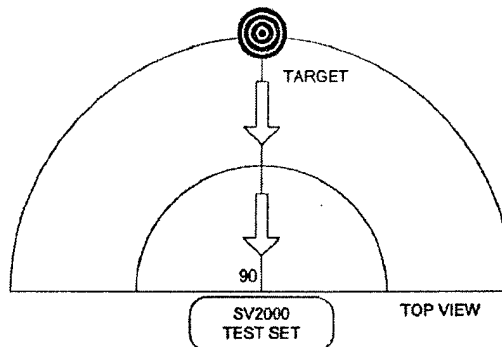
The SV2000 **shall** remain in the StartUp state in the absence of a Laboratory Test Set and unsuccessful conclusion of StartUp state activity.

- Not Testable

13070	Remain in Startup	PASS => Not Testable	X	9/25/02
		FAIL => Not Testable		

1.3.6.5 Operational State

- Setup as shown below.



1.3.6.5.1 Moving Objects (14020)

The Operational state **shall** sense moving objects in the FOV and generate Motion Maps showing the relative distance and direction to those objects.

- Power ON the SV2000.
- Start mechanical target into motion with speed of 0.7 ft/sec.
- Record the presence of the Motion Map Yes (Yes / No).
- Record the presence of RELATIVE DISTANCE on the Motion Map Yes (Yes / No).
- Record the presence of RELATIVE DIRECTION on the Motion Map Yes (Yes / No).

14020	Moving Objects	PASS => All YES.		9/25/02
		FAIL => One is a NO.		

1.3.6.5.2 Scanning Screen (14030)

The Operational state shall deploy the Scanning Screen.

- Power ON the SV2000.
- Verify and record the presence of the SCANNING screen in the Operational State Yes (Yes/No).

14030	Screen Functionality	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 14040

1.3.6.5.3 Scanning Screen Functionality (14040)

The Scanning Screen shall include at a minimum, the current Motion Map, Soft Button legend, and a message area for the operator.

- Verify and record the presence of the MOTION MAP Yes (Yes/No).
- Verify and record the presence of the SOFT BUTTON LEGEND Yes (Yes/No).
- Verify and record the presence of the MESSAGE AREA Yes (Yes/No).

14040	Scanning Screen Functionality	PASS => All YES.	Pass	9/25/02
		FAIL => One is a NO.		

- Continue to 14050

1.3.6.5.4 Alert Conditions (14050)

The Scanning Screen shall alert the operator to conditions affecting the interpretation of the Motion Map. These conditions are referred to as **Alert Conditions**.

- Tested under requirement 14060 & 14070.

14050	Alert Conditions	PASS => Result based on requirement 14060 & 14070.		9/27/02
		FAIL => Result based on requirement 14060 & 14070.		

1.3.6.5.4.1 Impenetrable Wall (14060)

The Scanning Screen shall present an Alert Condition message indicating that the SV2000 cannot penetrate a wall. A notional message associated with this condition could be "Signal Blocked."

- Place a 4'x8' sheet of insulation foam board, directly in front of the SV2000.
- Power ON the SV2000.
- Select Blocked Wall test on the SV2000.
- Verify and record the presence of the WALL BLOCKED message Yes (Yes/No).

14060	Impenetrable Wall	PASS => YES.	Pass	9/27/02
		FAIL => NO.		

Horizontal metal pipe co-polarized with the SV2K antennas. Pipe blocks return signal
--

1.3.6.5.4.2 Close Metal Object Present (14070)

The Scanning Screen **shall** present an Alert Condition message indicating that there is a significant metal object within 2 meters of the SV2000. A notional message associated with this condition could be "Close Metal Object."

- Place a horizontal metal cabinet (2 foot) & a vertical metal cabinet (5 foot), 1 meter behind the wall.
- Power ON the SV2000.
- Select Blocked Wall test on the SV2000.
- Verify and record the presence of the CLOSE METAL OBJECT MESSAGE Yes (Yes/No).

14070	Close Metal Object Present	PASS => YES.	Pass	9/27/02
		FAIL => NO.		
No Message. Used Block test				
***** After further review the results of this test have been determined to be invalid based on the current operating system. 12/18/02				

- Continue to 14080

1.3.6.5.5 Update Rates Shown (14080)

The Scanning Screen **shall** present updated motion maps at either the **High Update Rate** or the **Low Update Rate**.

14080	Update Rates Shown	PASS => Requirement 14090 AND 14100 Pass	Pass	9/25/02
		FAIL => One Fails		

1.3.6.5.5.1 High Update Rate (14090)

The High Update Rate **shall** be $\geq 3\text{Hz}$. The High Update Rate is intended to resolve the balance between motion map quality and motion map update rate with a preference for faster updates.

- Power ON the SV2000.
- Set the SV2000 Update rate to HIGH.
- Start mechanical target into motion.
- Using a stopwatch, measure & record the screen update rate Inconclusive (3 Hz or 3 times/sec).

Using a stop watch, measure to record the screen update rate. <u>Instructions</u> (5-110 of 2-1000-000)				
14090	High Update Rate	PASS => 3 Hz or 3 times/sec		9/25/02
		FAIL => Other		
Faster than one Hz				

1.3.6.5.5.2 Low Update Rate (14100)

The Low Update Rate **shall** be $\geq 1\text{Hz}$ and $\leq 3\text{Hz}$. The Low Update Rate is intended to resolve the balance between motion map quality and motion map update rate with a preference for motion map quality.

- Power ON the SV2000.
- Set the SV2000 Update rate to LOW.
- Using a stopwatch, measure & record the screen update rate 1Hz (1 Hz or 1 times/sec).

14100	Low Update Rate	PASS => 1 Hz or 1 times/sec	Pass	9/25/02
		FAIL => Other		

1.3.6.5.6 Motion Map Display

1.3.6.5.6.1 From On Switch (14110)

The Operational state **shall** display the first Motion Map within 12 seconds of the SV2000 On Switch being operated in the High Update Rate. Low Update Rate may take longer.

- Power ON the SV2000.
- Verify and record that HIGH Update Rate is displayed within 12 seconds 10s (Yes/No).

14110	Motion Map - From On Switch	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 14120.

1.3.6.5.6.2 Transition to Standby State (14120)

The Operational state **shall** provide means for the user to command transition to the Standby state.

- Set unit from OPERATIONAL State to STANDBY State and record the transition Yes(Yes/No).

14120	Motion Map - Transition to Standby State	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

1.3.6.5.6.3 From Standby State (14130)

The Operational state **shall** display the first Motion Map within 2 seconds of the SV2000 being commanded from the Standby state to the Operational state in the High Update Rate. Low Update Rate may take longer.

- Set unit from STANDBY State to OPERATIONAL State.
- Verify and record that HIGH Update Rate is displayed within 2 seconds 1Sec (Yes/No).

14130	Motion Map - From Standby State	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15010

1.3.6.6 Standby State

1.3.6.6.1 Brightness Setting (15010)

The Standby (optional Operational) state shall provide means for the operator to adjust the Operator Display brightness setting.

- Verify & record the accessibility to the BRIGHTNESS level setting Yes (Yes/No).
- Record the display BRIGHTNESS level N/A (Number of Bars or Numerical Scale).

15010	Standby State - Brightness Setting	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15020

1.3.6.6.2 Contrast Setting (15020)

The Standby (optional Operational) state shall provide means for the operator to adjust the Operator Display contrast setting.

- Verify & record the accessibility to the CONTRAST level setting Yes (Yes/No).
- Record the display CONTRAST level N/A (Number of Bars or Numerical Scale).

15020	Standby State - Contrast Setting	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15030

1.3.6.6.3 Motion Map Update Setting (15030)

The Standby (optional Operational) state shall provide means for the operator to select the motion map update rate.

- Verify & record the accessibility to the MOTION MAP UPDATE RATE setting Yes (Yes/No).

15030	Standby State - Motion Map Update Setting	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15040

1.3.6.6.4 Field of View Setting (15040)

The Standby (optional Operational) state **shall** provide means for the operator to select between the two FOV ranges of the SV2000.

- Verify & record the accessibility to the FIELD OF VIEW RANGE settings Yes (Yes/No).

15040	Standby State - Field of View Setting	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15050

1.3.6.6.5 Factory Default Setting (15050)

The Standby (optional Operational) state **shall** provide means for the user to command selection of factory default user settings.

- Verify & record the accessibility to the FACTORY DEFAULT settings Yes (Yes/No).

15050	Standby State - Factory Def. Setting	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15070

1.3.6.6.6 Standby Screen (15070)

The Standby state **shall** deploy the **Standby Screen**

- Verify & record the presence of the STANDBY SCREEN Yes (Yes/No).

15070	Standby State - Standby Screen	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15080

1.3.6.6.7 Current User Settings (15080)

The Standby Screen **shall** display current user settings.

- Verify & record the presence of the CURRENT USER SETTINGS Yes (Yes/No).

15080	Standby State - Current User Settings	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15090

1.3.6.6.8 Soft Button Legend (15090)

The Standby (and Operational) Screen **shall** present a legend for all active Soft Buttons.

- Verify & record the presence of the SOFT BUTTON MENU / LEGEND Yes (Yes/No).

15090	Standby State - Soft Button Legend	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 15100

1.3.6.6.9 Transition to Operational State (15100)

*The Standby state **shall** provide means for the user to command transition to the Operational state.*

- Transition from STANDBY State to OPERATIONAL Scan State and record the result
Yes(Yes/No).

15100	Standby State - Transition to Operational State	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

1.3.7 SV2000 RF Emissions & Susceptibility

1.3.7.1 Radiated Emissions (RE 102 of MIL-STD-461E) (16010)

The SV2000 **shall** be tested for unintentional electromagnetic radiation in accordance with method RE 102 of MIL-STD-461E. Table 16-2 identifies the acceptance criteria and supersedes the acceptance criteria contained in RE102-3 [Reference: Figure RE 102-3 for Fixed Wing External and Helicopters (10 KHz though 18 GHz) of the standard]. This requirement is applicable for every SV2000 state except the Slave and Operational states.

The SV2000 **shall** not electro-magnetically interfere with current military equipment.

- Use MIL-STD-461E guidelines for this test
- Use RE102 – Fixed Wing External (2 MHz to 18 GHz) and Helicopters curve for this test.
- Use the following test conditions for Intentional and Unintentional RE 102 testing.
 - One(1) antenna positions (Front or Back) at 1 meter.
 - Horizontal & Vertical Polarities

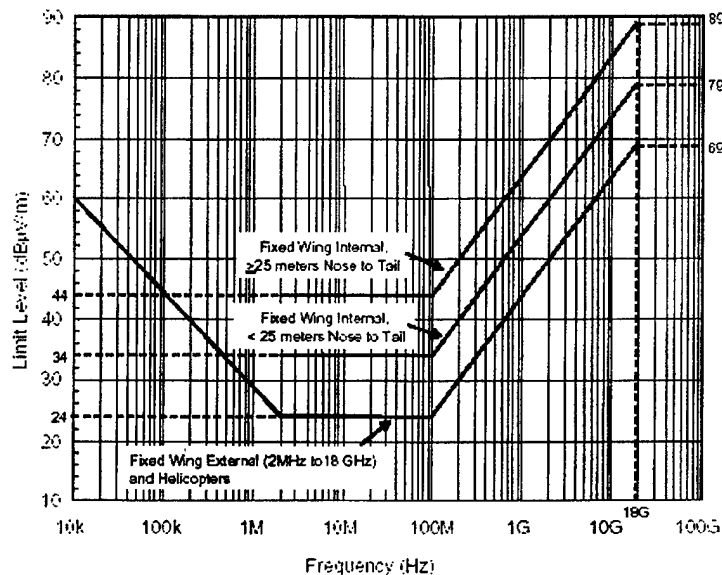


Figure 16010: RE102 limit for aircraft and space system applications.

Frequency Band	Amplitude Limit (dBμV/m)	
10 kHz to 2 MHz	60 down to 24 log/linear (slope = -16.36364 dB/decade)	Fail
2 MHz to 100 MHz	24	Pass
100 MHz to 18 GHz	24 up to 69 log/linear (slope = 20 dB/decade = 6dB/octave)	Pass

1.3.7.1.1 Unintentional EM Emissions (15060 & 16060)

The SV2000 **shall** not intentionally radiate while in the Standby state.

- Place the SV2000 unit in RF Chamber with the battery pack.
- Power OFF the SV2000.
- Place the antenna on the backside (LCD Side) of the SV2000 at 1m.
- Measure & Record AMBIENT emissions (Plot File or Printout) from 10KHz to 18 GHz.
- Power ON the SV2000.
- Configure SV2000 into STANDBY state.
- Measure & Record UNINTENTIONAL emissions (Plot File or Printout) from 10KHz to 18 GHz.

15060 & 16060	Unintentional Emissions	PASS => AMBIENT noise floor is 6 dB below limit line AND STANDBY State emissions are below limits	Fail	9/19/02
		FAIL => Over Limits		
"Standby State" 10khz to 2mhz				

1.3.7.1.2 Intentional EM Emissions (16020)

Intentional electromagnetic emissions **shall** only occur in the Operational state.

- Place the SV2000 unit in RF Chamber with the battery pack.
- Power ON the SV2000.
- Place the antenna on the front side (Opposite LCD Side) of the SV2000 at 1m.
- Wait for the SV2000 to go into OPERATIONAL state.
- Measure & Record the OPERATIONAL emissions (Plot File/Printout) from 10KHz to 18 GHz.
- Configure the SV2000 into TURBO mode (Experimental ONLY, Not for
- Measure & Record the TURBO emissions (Plot File/Printout) from 10KHz to 18 GHz.

Frequency Band	Operational State EIR-PSD (dBm /MHz)	Turbo State EIR-PSD (dBm /MHz)	
0-960 MHz	NA	NA	
960 – 1000 MHz	-59.8 @ 1.0 Ghz	-53.96 @ 1.0 Ghz	
1 GHz – 1.585 GHz	-44.80 @ 1.5 Ghz	-36.31 @ 1.5 Ghz	
≥ 1.585 GHz	-38.27 @ 2.129 Ghz	-28.01 @ 2.147 Ghz	

16020	Intentional Emissions	PASS => OPERATIONAL State emissions are below limits		Pass "FCC Mode"	9/18/02										
		<table><tr><th>Frequency Band</th><th>Operational State Energy Limit</th></tr><tr><td>0-960 MHz</td><td>EIR-PSD ≤ -54 dBm /MHz</td></tr><tr><td>960 – 1000 MHz</td><td>EIR-PSD ≤ -46 dBm /MHz</td></tr><tr><td>1 GHz – 1.585 GHz</td><td>EIR-PSD ≤ -38 dBm /MHz</td></tr><tr><td>≥ 1.585 GHz</td><td>EIR-PSD ≤ -35 dBm /MHz</td></tr></table>				Frequency Band	Operational State Energy Limit	0-960 MHz	EIR-PSD ≤ -54 dBm /MHz	960 – 1000 MHz	EIR-PSD ≤ -46 dBm /MHz	1 GHz – 1.585 GHz	EIR-PSD ≤ -38 dBm /MHz	≥ 1.585 GHz	EIR-PSD ≤ -35 dBm /MHz
		Frequency Band	Operational State Energy Limit												
		0-960 MHz	EIR-PSD ≤ -54 dBm /MHz												
		960 – 1000 MHz	EIR-PSD ≤ -46 dBm /MHz												
		1 GHz – 1.585 GHz	EIR-PSD ≤ -38 dBm /MHz												
		≥ 1.585 GHz	EIR-PSD ≤ -35 dBm /MHz												
Table 0-1 Intentional Radiation Power Limits															
FAIL => Over Limits		Fail "Turbo Mode"													

16010	Radiated Emissions (RE102)	PASS => Based on 15060, 16020, and 16060 passing	Fail	9/18/02
		FAIL => Based on 15060, 16020, or 16060 failing		

1.3.7.2 Radiated Susceptibility (RS 103 of MIL-STD-416E) (16070)

The SV2000 shall be tested for electromagnetic susceptibility in accordance with method RS 103 of MIL-STD-416E. The SV2000 may be reset if necessary by any means convenient to the operator at the conclusion of the test to restore useful function. The possible need for reset activity does not constitute a failure of the test. The SV2000 need not perform any useful function during the test.

- Use the following test conditions for RS 103 testing.
 - One (') antenna position (Front or Back)
 - Horizontal & Vertical Polarities
 - Use the RS 103 Field Strengths as listed in the Table 16-3.

Frequency	Field Strength @ 1 meter	Modulation
2 MHz – 300 MHz	50 Volts / Meter	1 KHz Pulse @ 50% Duty Cycle
300 MHz – 3 GHz	10 Volts / Meter	1 KHz Pulse @ 50% Duty Cycle
3 GHz – 40 GHz	50 Volts / Meter	1 KHz Pulse @ 50% Duty Cycle

Table 16-3: RS103 Field Strength

1.3.7.2.1 RS 103 Testing (16080)

The SV2000 shall survive test method RS 103 without damage at the field strengths shown in Table 16-3. This table supersedes the acceptance criteria contained in RS 103.

- Place the SV2000 unit in RF Chamber with the battery pack.
- Power ON the SV2000.
- Wait for the SV2000 to go into OPERATIONAL state.
- Measure & Record for the frequency ranges listed below (Plot File or Printout)
- For each frequency band verify whether the unit is Operational or Not Operational
 - Operational: Unit powers On (*The possible need for reset activity does not constitute a failure of the test.*)
 - Not Operational: Unit fails to Power On even after resetting.
 - Record the Frequency when the unit became Non Operational

16080	RS 103 Test	PASS => Pass	Pass	11/21/02
		FAIL => Fail		
16070	Radiated Susceptibility (RS103)	PASS => Result based on 16080.	Pass	9/19/02
		FAIL => Result based on 16080.		

1.3.8 SV2000 Code Verification

1.3.8.1 Pulse Repetition Interval (PRI) (16030)

The SV2000 shall emit pulses at an average rate of 10 MHz to yield an average pulse repetition interval (PRI) of 100 ns $\pm$ 1%.

- This will be verified by the TDC Systems Engineering group.

16030	Pulse Repetition Interval (PRI)	PASS => Verified	Pass	9/27/02
		FAIL => Other		
Average PRI = 100ns				

1.3.8.2 Code Verification (16040)

The instantaneous time spacing of each RF pulse shall be pseudo-randomly varied by 0 to ≥ 12.5 ns and 0 to ≤ 25 ns when compared to the theoretical spacing of pulses when code values are set to zero. Alternately stated, the Code Span of each unit's pseudo random code will be between 12.5 and 25 ns.

- This will be verified by the TDC Systems Engineering group.

16040	Code Verification	PASS => Verified	Pass	9/27/02
		FAIL => Other		
Code Span = 12.5ns				

1.3.8.3 Unit Dependent Code (16050)

Each SV2000 unit (unique serial number) shall operate with a unique set of pseudo random code sequences.

- This will be verified by the TDC Standard Production procedure.

16050	Unit Dependent Code	PASS => Verified	Pass	9/27/02
		FAIL => Other		

1.3.9 SV2000 Operating Position, Handles, & Mounting

1.3.9.1 Forearm Shield (17010)

The SV2000 **shall** be constructed to be held by the operator as a shield; a handle provided for the hand, and a means of being supported by the forearm. However, the SV2000 is **NOT** designed to be a shield and does **NOT** guarantee ANY physical protection.

- Secure a SV2000 on your LEFT hand and hold onto the HANDLE.
- Verify and record the presence of a support strap and a handle on the SV2000 Yes (Yes/No).

17010	Forearm Shield	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

- Continue to 17020.

1.3.9.2 Left Hand Design (17020)

The SV2000 **shall** be constructed to be held by the left hand/arm of the operator. There is no requirement to support being held by right hand/arm.

- Verify and record the result after securing of the SV2000 on the LEFT hand Yes (Yes/No).

17020	Left Hand Design	PASS => YES.	Pass	9/25/02
		FAIL => NO.		

1.3.9.3 Single Soldier Carry On (17030)

The SV2000 **shall** be of a size and configuration that can be carried by a single soldier or Marine in addition to his combat load.

- Determined via mechanical requirements 18010 through 18040.

17030	Single Soldier Carry On	PASS => Requirements 18010 through 18040 should ALL pass.	Pass	9/27/02
		FAIL => If one requirement 18010 through 18040 should fail.		

1.3.9.4 Electrical / Thermal / Chemical / Electromagnetic Danger (17040)

The SV2000 **shall** not present an electrical, chemical, thermal, or electromagnetic danger to the operator.

- Inspect the unit and record the result for any exposed ELECTRICAL hazards Pass (Pass/Fail).
- The SV2000 housing material will be verified by mechanical design for any potential CHEMICAL hazards Pass (Pass/Fail).

- Power ON the SV2000.
- Touch and feel the SV2000 for hot THERMAL spots Pass (Pass/Fail).
- Electromagnetic danger will be based on the result of Intentional Radiated Emissions Test (Requirement 16020).

17040	Electrical / Thermal / Chemical / Electromagnetic Danger	PASS => All Pass and Pass based on 16020	Pass	9/25/02
		FAIL => One Fails		

1.3.9.5 Operability (17050)

The SV2000 **shall** be operable by a soldier / Marine wearing his **Operational Ensemble**.

- Verified in Requirement 7010

17050	Operability	PASS => See result of Requirement 7010	Pass	9/26/02
		FAIL => See result of Requirement 7010		

1.3.9.6 Physical Interference (17060)

The SV2000 **shall** not physically interfere with the operation of other equipment. This requirement must be interpreted in light of requirements 17010 and 17020.

- Verified in Requirement 17010 and 17020.

17060	Physical Interference	PASS => See result of Requirement 17010 AND 17020	Pass	9/25/02
		FAIL => See result of Requirement 17010 AND 17020		

1.3.9.7 Right Hand Operation of On / Off Buttons (17070)

The SV2000 buttons **shall** be located such that the operator may easily activate them using the right hand while holding the SV2000 with the left hand/arm.

- Secure a SV2000 on your LEFT hand.
- With the RIGHT hand Power ON & then OFF the SV2000 and record the result Pass(Pass/Fail).

17070	Right Hand Operation of On / Off Buttons	PASS => Pass	Pass	9/25/02
		FAIL => Fail		

1.3.10 SV2000 Mechanical Specifications

1.3.10.1 Width (18010)

The maximum width of the SV2000 shall not exceed 22-inches.

- Measure and Record the WIDTH of the SV2000 22.0 (inches).

18010	Width	PASS => Width = 22 inches	Pass	9/25/02
		FAIL => Width $\neq$ 22 inches		

1.3.10.2 Height (18020)

The maximum height of the SV2000 shall not exceed 14-inches.

- Measure and Record the HEIGHT of the SV2000 14 (inches).

18020	Height	PASS => Height = 14 inches	Pass	9/25/02
		FAIL => Height $\neq$ 14 inches		

1.3.10.3 Depth (18030)

The maximum depth of the SV2000 shall not exceed 6-inches including handle(s).

- Note: The depth of 6" will not be met due to design, therefore a new depth was discussed.
- Measure and Record the DEPTH of the SV2000 8.0 (inches).

18030	Depth	PASS => Depth $\leq$ 8.5 inches	Pass	9/25/02
		FAIL => Depth > 8.5 inches		

1.3.10.4 Weight (18040)

The SV2000 shall weigh less than 10 pounds including the battery.

- Measure and Record the WEIGHT of the SV2000 9.606 (lbs).

18040	Weight	PASS => Weight = 10.5 lbs	Pass	9/27/02
		FAIL => Weight > 10.5 lbs		

1.3.10.5 Color (18050)

The color of the SV2000 shall be black.

- Verify and Record the COLOR of the SV2000 as black Yes (Yes/No).

18050	Color	PASS => Yes	Pass	9/25/02
		FAIL => No		

1.3.10.6 Finish (18060)

The finish of the SV2000 **shall** be medium textured matte (scratch resistant).

- Verify and Record the FINISH of the SV2000 as Medium Texture (Scratch Res.) No (Yes/No).

18060	Finish	PASS => Yes	Fail	9/27/02
		FAIL => No		

1.3.10.7 Button Operating Noise (7050)

When depressed or released, neither the On Switch, the Off Switch, nor the Soft Buttons **shall** make a noise greater than 40 dB SPL @ 1 meter where ambient noise < 33 dB SPL.

- Place SV2000 in a sound chamber 1 meter away from the measuring instrumentation
- Record the Ambient Noise in the room 37.5 (< 33 dB SPL).
- Press and release the ON/OFF Button & record the generated noise 43.9 (dB SPL).
- Press and release the SB1 Button & record the generated noise 41.6 (dB SPL).
- Press and release the SB2 Button & record the generated noise 41.0 (dB SPL).
- Press and release the SB3 Button & record the generated noise 42.2 (dB SPL).
- Press and release the SB4 Button & record the generated noise 40.6 (dB SPL).
- Press and release the SB5 Button & record the generated noise 43.9 (dB SPL).

7050	Button Operating Noise	PASS => On, Off, & SB1-SB5 Noise < 40 dB SPL	Fail	9/26/02
		FAIL => On, Off, & SB1-SB5 Noise > 40 dB SPL		

1.3.10.8 Placement Noise (17080)

The operator **shall** be able to place the SV2000 against an interior wall without making a noise greater than 40 dB SPL @ 1 meter where ambient noise < 33 dB SPL

- Record the Ambient Noise in the room 37.5 (dB SPL).
- Continue if Ambient Noise is < 33 dB SPL.
- Place SV2000 in a sound chamber 1 meter away from the measuring instrumentation
- Place the SV2000 against an Interior Wall & record the generated noise 44.5 (dB SPL).

17080	Placement Noise	PASS => Noise < 40 dB SPL	Fail	9/26/02
		FAIL => Noise > 40 dB SPL		

1.3.11 SV2000 Environmental Test

1.3.11.1 Storage Temperature (19010)

The SV2000 in the OFF State with or without its shipping/storage container **shall** withstand without damage, exposure to temperatures from -20° to 60° C.

- Power OFF the SV2000.
- Place SV2000 into a Temperature Controlled Chamber (TCC).
- Set the TCC temperature setting to -20°C & wait 20 minutes.
- Set the TCC temperature setting to 0°C & wait 20 minutes.
- Set the TCC temperature setting to +20°C & wait 20 minutes.
- Set the TCC temperature setting to +40°C & wait 20 minutes.
- Set the TCC temperature setting to +60°C & wait 20 minutes.
- Set the TCC temperature setting to +20°C & wait 20 minutes.
- Power ON the SV2000
- Verify and record the functionality of the SV2000 ____ (Functional/Non Functional).
- See attached Report # 47768-01

19010	Storage - Temperature	PASS => Functional	Pass	10/15/02
		FAIL => Non Functional		

1.3.11.2 Operational Temperature (20010) & Thermal Fault (12040)

The SV2000 in the ON State **shall** withstand without damage or performance degradation exposure to temperatures from -10 to 50° C. The SV2000 **shall** automatically transition from the ON state to the OFF state upon the occurrence of a Thermal Fault.

- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ12040 folder as REQ12040_Prelim.
- Power ON the SV2000.
- Place SV2000 into a Temperature Controlled Chamber (TCC).
- Set the TCC temperature setting to -10°C & wait 30 minutes.
- Verify and record the functionality of the LCD ____ (Functional/Non Functional).
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ12040 folder as REQ12040_M10C.
- Set the TCC temperature setting to +10° C & wait 30 minutes.
- Verify and record the functionality of the LCD ____ (Functional/Non Functional).
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ12040 folder as REQ12040_P10C.
- Set the TCC temperature setting to +30° C & wait 30 minutes.
- Verify and record the functionality of the LCD ____ (Functional/Non Functional).
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ12040 folder as REQ12040_M30C.
- Set the TCC temperature setting to +50° C & wait 30 minutes.
- Verify and record the functionality of the LCD ____ (Functional/Non Functional).
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ12040 folder as REQ12040_P50C.
- See attached Report # 47768-01

20010	Operational - Temperature	PASS => Functional between -10° C and +50° C.	Pass	10/15/02
		FAIL => Not Functional between -10° C and +50° C.		

12040	Thermal Fault	PASS => Functional between -10° C and +50° C.	Pass	10/15/02
		FAIL => Not Functional between -10° C and +50° C.		

1.3.11.3 Humidity (20020)

The SV2000 in the ON State **shall** withstand without damage or performance degradation, exposure to humidity from 0 to 90% non-condensing.

- Power ON the SV2000.
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ20020 folder as REQ20020_Prelim.
- Place SV2000 into a Humidity Controlled Chamber (HCC) at room temperature (+20° C).
- Set the humidity level to 30% Non Condensing and wait for 30 minutes.
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ20020 folder as REQ20020_30H.
- Verify and record the functionality of the SV2000 ____ (Functional/Non Functional).
- Set the humidity level to 90% Non Condensing and wait for 30 minutes.
- Collect data using the Radar Test Bed.
- Save collected data in the SV2K_IVV_REQ20020 folder as REQ20020_90H.
- Verify and record the functionality of the SV2000 ____ (Functional/Non Functional).
- See Attached Report # 47768-01

20020	Operational - Humidity	PASS => Functional	Pass	10/15/02
		FAIL => Non Functional		

1.3.11.4 Liquid Intrusion (20030)

The SV2000 **shall** be sealed against liquid intrusion from rain, blowing rain, or splash. (Fresh water only)

- Power OFF the SV2000.
- Place SV2000 vertically on top of a table.
- Point the garden hose spray gun skywards and let the RAIN fall on the unit naturally.
- Point the garden hose spray gun at the unit from 6 feet away.
- Spray it on its front, back, 2 sides, & top to simulate BLOWING RAIN.
- Splash the unit with a 12 oz glass of water on its front, back, 2 sides, & top to simulate SPLASH.
- Power ON the SV2000.
- Verify and record the functionality of the SV2000 ____ (Functional/Non Functional).

20030	Liquid Intrusion	PASS => Functional	Pass	9/27/02
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	Intrusion	FAIL => Non Functional		
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1.3.11.5 Flotation (20050)

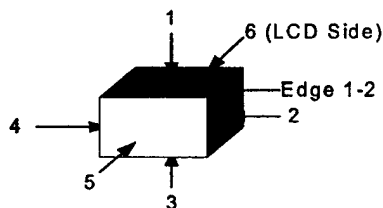
Upon retrieval from the float test, and the operator draining water from the battery compartment (if necessary), the SV2000 **shall** operate without degradation in performance. (Fresh water only)

- Power OFF the SV2000.
- Place the SV2000 (Face Down) into a body of fresh water.
- Verify and record that the SV2000 floated for at least 60 seconds Yes (Yes/No).
- Drain the battery compartment and insert a dry battery.
- Power ON the SV2000.
- Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).

20050	Flotation	PASS => Functional	Pass	9/27/02
		FAIL => Non Functional		

1.3.11.6 Shock (20060)

The SV2000 **shall not** be damaged such that its performance is impaired by the unit being dropped from a height of ≤ 30 " onto a flat concrete surface. Within the constraints of other requirements in this document, designers should strive to design the unit to support being dropped from heights as great as 5 feet.



- Power OFF the SV2000.
- Drop the SV2000 on side 5 from a height of 30 inches onto a flat concrete surface.
- Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
- Power ON the SV2000.
- Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
- Power OFF the SV2000.
- Drop the SV2000 on side 3 from a height of 30 inches onto a flat concrete surface.
- Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
- Power ON the SV2000.
- Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).

- Power OFF the SV2000.
 - Drop the SV2000 on side 2 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on side 1 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on side 6 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on side 4 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Damaged¹ (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on edge 2-3 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on edge 1-2 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Damaged² (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on edge 3-4 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Not Damaged (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).
-
- Power OFF the SV2000.
 - Drop the SV2000 on edge 1-4 from a height of 30 inches onto a flat concrete surface.
 - Record any housing damage of the SV2000 Damaged³ (Damaged/Not Damaged).
 - Power ON the SV2000.
 - Verify and record the functionality of the SV2000 Functional (Functional/Non Functional).

20060	Shock	PASS => All tests are Undamaged AND Functional	Pass	9/27/02
		FAIL => One is Non Functional or Damaged		
1- Insert Came loose, 2- Cracked at the corner between the flange and the wall, 3 – The hook on the right side broke, the battery door came out.				

SV2000 Field Of View (FOV) Test

1.3.11.7 Horizontal FOV (21010)

*The SV2000 horizontal FOV (to the operator's left and right) as determined by the 2-way, -6 dB points of its combined Tx and Rx antenna pattern **shall** be ≥ 120 and ≤ 180 degrees symmetrically balanced ($\pm 10\%$) left and right from the boresight, which extends perpendicular to the face of the SV2000.*

- Attach the SV2000 Antenna Measurement data. TDC RF Engineer will conduct this test.

21010	Horizontal FOV	PASS => 2-way, -6 dB points are in ≥ 120 and ≤ 180 degrees	Pass	9/27/02
		FAIL => Other		

1.3.11.8 FOV Range Changeability (21030)

*The SV2000 FOV Range **shall** be selectable between 5m and 10m.*

- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meter and then back to 5 meter.
- Verify and record the Changeability of the FOV Range Selection Yes (Yes/No).

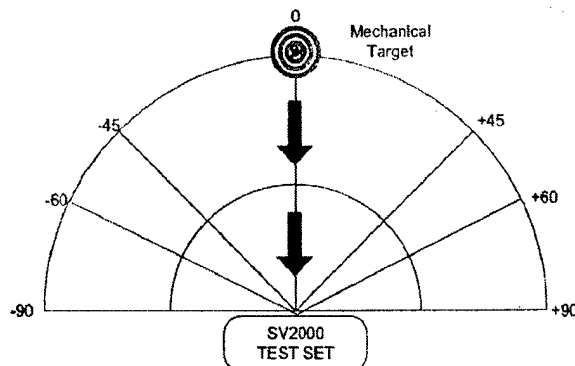
21030	FOV Range Changeability	PASS => Yes	Pass	9/25/02
		FAIL => No		

1.3.12 SV2000 Moving Object Detection & Display

1.3.12.1 Moving Object Detection (22010)

The SV2000 *shall* detect moving objects in its FOV.

- Setup as shown below.



- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meter.
- Start recording the Display Screen.
- Set the MECHANICAL target into motion starting at 0° and 10 meters away from the SV2000.
- Verify and record the detection of moving objects Detected (Detected/Not Detected).
- Stop recording when the target is 0 meters away from the SV2000.
- Save the recording as SV2K_IVV_REQ220_10_20_30.avi.

22010	Object Detection	PASS => Target Detected	Pass	9/25/02
		FAIL => Target not Detected		

- Continue to 22020.

1.3.12.2 Motion Map Display Screen (22020)

The SV2000 *shall* plot a two-dimensional representation of detected moving objects on its Operator Display scaled to show the relative range and direction to each moving object from a plan view. This two-dimensional plot is termed a Motion Map.

- Verify and record the presence of RANGE on the Motion Map Present (Present/Not Present).
- Verify and record the presence of DIRECTION on the Motion Map Present (Present/NotPresent).

22020	Motion Map Display Screen	PASS => Both Present	Pass	9/25/02
		FAIL => One NOT Present		

- Continue to 22030.

1.3.12.3 Scale Selection (22030)

The SV2000 **shall** be able to display Motion Maps using one of two scales, 5m or 10m, as selected by the operator.

- Verify and record the changeability of the FOV Range Scale from 10m to 5m on the Motion Map
Yes (Yes/No).

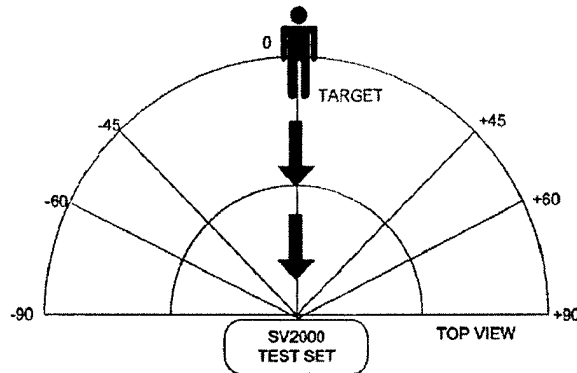
22030	Motion Map Display Screen	PASS => Yes	Pass	9/25/02
		FAIL => No		

- Continue to 22040.

1.3.12.4 Motion & Intensity (22040)

For a given object, the SV2000 **shall** display increased motion with an increase in intensity/color scheme on the Motion Map.

- Setup as shown below.



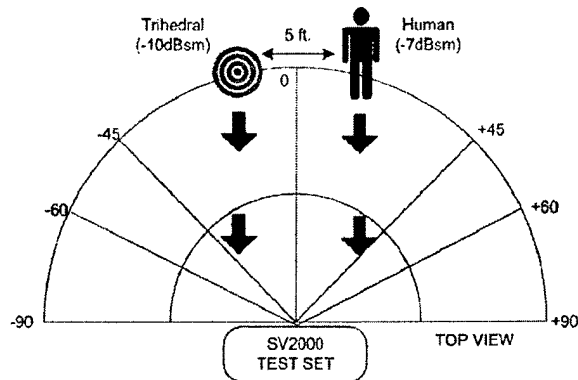
- Power ON the SV2000.
- Set the SV2000 into MANUAL threshold mode.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the HUMAN target into motion SLOWLY starting at 0° & 10 meters away from the SV2000.
- At the 5 meters mark INCREASE the speed of the HUMAN target.
- Stop recording when the target is 0 meters away from the SV2000.
- Verify and record the increase in IMAGE INTENSITY & COLOR with respect to START of motion Increase (Increase/No Change).
- Save the recording as SV2K_IVV_REQ22040.avi.

22040	Motion & Intensity	PASS => Increase in Intensity & Color	Pass	9/25/02
		FAIL => No Change in Intensity & Color		

1.3.12.5 RCS & Intensity (22050)

For a given motion, the SV2000 **shall** display an object with increased RCS with an increase in intensity/color scheme on the Motion Map.

- Setup as shown below.



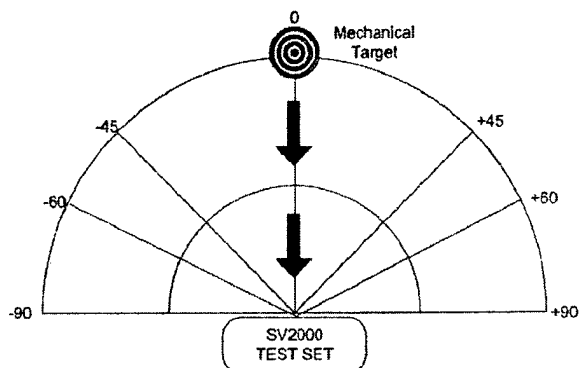
- Power ON the SV2000.
- Set the SV2000 into MANUAL threshold mode.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Start the MECHANICAL & HUMAN targets into motion from 0° & 10 meters away from the SV2000.
- Stop recording when the targets are 0 meters away from the SV2000.
- Verify and record the increase in IMAGE INTENSITY & COLOR with respect to INCREASED RCS Increase (Increase/No Change).
- Save the recording as SV2K_IVV_REQ22050.avi.

22050	RCS & Intensity	PASS => Increase in Intensity & Color	Pass	9/25/02
		FAIL => No Change in Intensity & Color		

1.3.12.6 False Negative (22060)

The probability of detection and display of the test case anywhere in the FOV **shall** be >98% in 5 seconds, excluding time for the initial Motion Map. Failure to detect and map a moving object in the FOV is considered a "false-negative" indication. False-negatives (target not indicated on display) should persist beyond 5 seconds in less than 2% of test cases. This requirement applies to a single target in an otherwise clear FOV (no wall and no RF clutter). The SV2000 should implement means to identify and map moving objects in spite of RF clutter objects in the FOV and wall induced RF distortions.

- Setup as shown below.



- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target into motion starting at 0° and 10 meters away from the SV2000.
- False Negative: Target NOT indicated on display in 5 seconds.
- Verify and record the detection of a FALSE NEGATIVE Not Detected (Detected/Not Detected).
- Re-run the MECHANICAL target in order to collect 100 intervals of 5 seconds each (8.33 minutes).
- Stop recording when the target is 0 meters away from the SV2000.
- Save the recording as SV2K_IVV_REQ22060.avi.

22060	False Negative	PASS => Failure Rate $\leq$ 2 cases	Pass	9/25/02
		FAIL => Failure Rate $\geq$ 3 cases		

1.3.12.7 False Positive (22070)

*The false-positive detection of moving objects **shall** be transient (does not persist for more than 5 seconds) for 98% of scan time. This requirement applies to no target and a clear FOV (no wall and no RF clutter). The SV2000 should implement means to reduce and suppress false indications resulting from RF clutter objects in the FOV and wall induced RF distortions.*

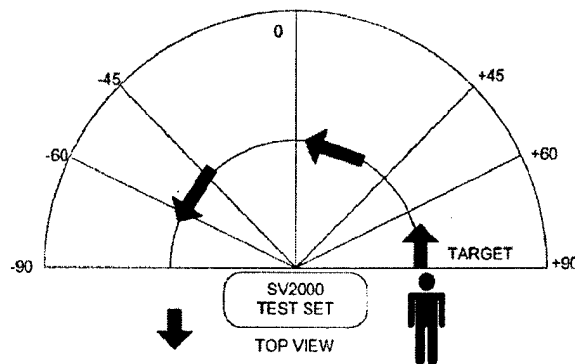
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target into motion starting at 0° and 10 meters away from the SV2000.
- False Positive: Target does NOT persist for more than 5 seconds.
- Verify and record the detection of a FALSE POSITIVE Not Detected (Detected/Not Detected).
- Re-run the MECHANICAL target in order to collect 100 intervals of 5 seconds each (8.33 min).
- Stop recording when the target is 0 meters away from the SV2000.
- Save the recording as **SV2K_IVV_REQ22070.avi**.

22070	False Positive	PASS => Failure Rate < = 2 cases	Pass	9/25/02
		FAIL => Failure Rate > = 3 cases		

1.3.12.8 Detection Past 180° (22080)

The SV2000 *shall* reject moving objects behind its front face (beyond 180 degree FOV).

- Setup as shown below.



- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Start the HUMAN target into motion from behind and 5 meters away from the SV2000.
- Stop recording when the target gets to -110°.
- Verify and record the TARGET REJECTION past +90° and -90° No (Yes/No).
- Save the recording as **SV2K_IVV_REQ22080.avi**.

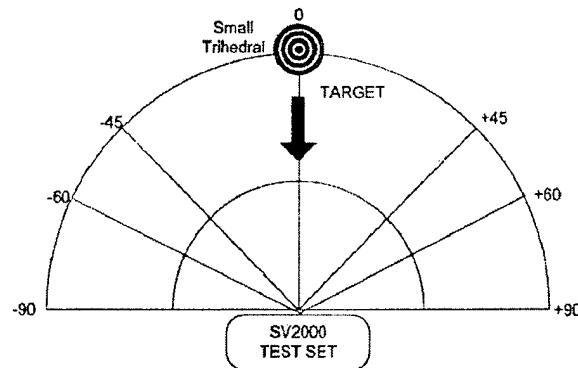
22080	Detection Past 180°	PASS => Yes	Fail	9/25/02
		FAIL => No		
See Target 28° behind				

- Continue to 22090

1.3.12.9 Line of Sight Accuracy (22090)

The SV2000 shall plot each moving object in its FOV with a range (line-of-sight distance) accuracy of 1m.

- Setup as shown below.



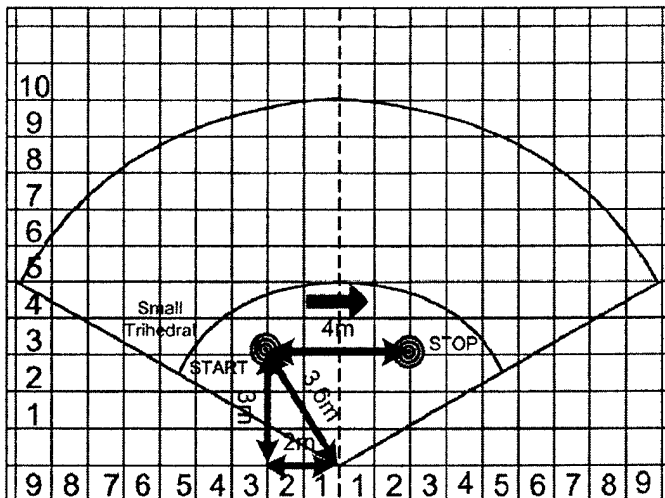
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target into motion (0.25 ft/sec) from 0° & 10 meters away from the SV2000.
- Stop the target at the 5 meters mark based on the SV2000 display.
- Measure the distance from the SV2000 to the target and record 4.29 (m).

22090	Line of Sight Accuracy	PASS => 4m ≤ Recorded Value ≤ 6m	Pass	9/25/02
		FAIL => Other		
14' 1"				

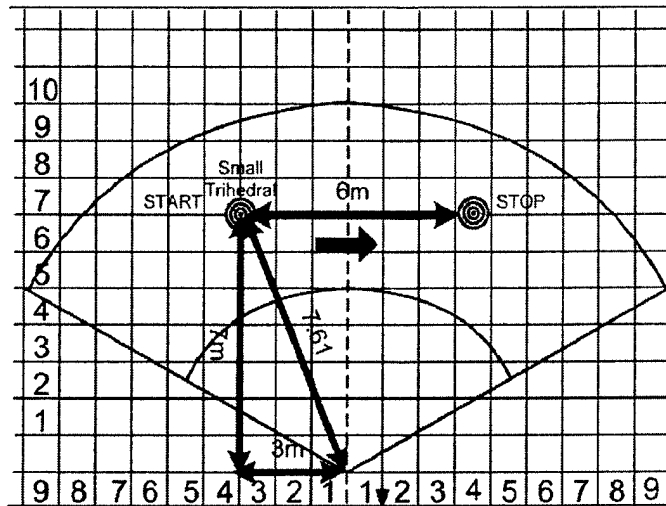
1.3.12.10 Cross Range Accuracy (22100)

The SV2000 shall plot each moving object in its FOV with a **cross range** location accuracy of $\leq \pm 1.5\text{m}$ for objects less than 5m in range, and $\leq \pm 3\text{m}$ for objects less than 10m in range.

- Setup as show below.



- Measure and mark 4 m on the ground. This will be the traveling distance.
- Set the Mechanical Target 3.6 m away from the SV2000 as shown above.
- Insert the Grid Overlay onto the SV2000 screen.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 5 meters.
- Start recording the Display Screen.
- Mark the START point on the Overlay with a permanent marker.
- Start the MECHANICAL target into motion with a velocity of 0.8 ft/sec
- Stop recording when the target gets to the 4 m mark on the ground.
- Mark the STOP point on the Overlay with a permanent marker.
- Record the distance traveled on the Grid Overlay 4.90 (meters).
- Save the recording as SV2K_IVV_REQ22100_3m.avi.



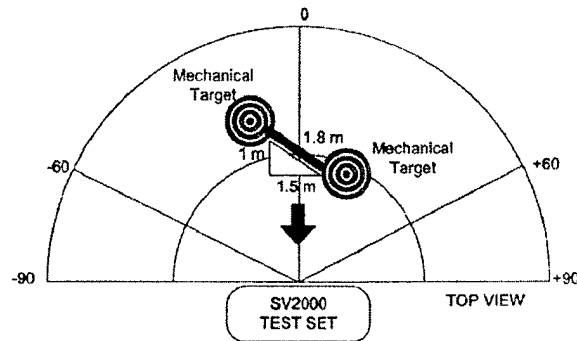
- Measure and mark 6 m on the ground. This will be the traveling distance.
- Set the Mechanical Target 7.61 m away from the SV2000 as shown above.
- Insert the Grid Overlay onto the SV2000 screen.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Mark the START point on the Overlay with a permanent marker.
- Start the MECHANICAL target into motion with a velocity of 0.8 ft/sec
- Stop recording when the target gets to the 8 m mark on the ground.
- Mark the STOP point on the Overlay with a permanent marker.
- Record the distance traveled on the Grid Overlay 7.50 (meters).
- Save the recording as SV2K_IVV_REQ22100_7m.avi.

22100	Cross Range Accuracy	PASS => (3m <= Recorded Value for 7m <= 9m) <u>AND</u> (2.5m <= Recorded Value for 3m <= 5.5m)	Pass	9/26/02
		FAIL => Other		

1.3.12.11 Target Resolution (22110)

Target Resolution: The SV2000 shall provide separate indications on the Motion Map for moving objects in its FOV separated by distances greater than the accuracy limits for range and cross range. For example, two moving objects located at ranges of 4m and 5m respectively must also be separated by more than 1.5m in cross range in order for the SV2000 to provide two separate indications on the Motion Map.

- Setup a shown below.



- Power ON the SV2000.
- Select the SV2000 FOV Range to 5 meters.
- Start recording the Display Screen.
- Set the combo MECHANICAL target at 0° and 5 meter away from the SV2000.
- Stop recording when the target gets to 0m.
- Verify & Record the TARGET SEPERATION past the 3.5 meters mark Yes (Yes/No).
- Save the recording as SV2K_IVV_REQ22110.avi.

22110	Target Resolution	PASS => Yes	Pass	9/26/02
		FAIL => No		

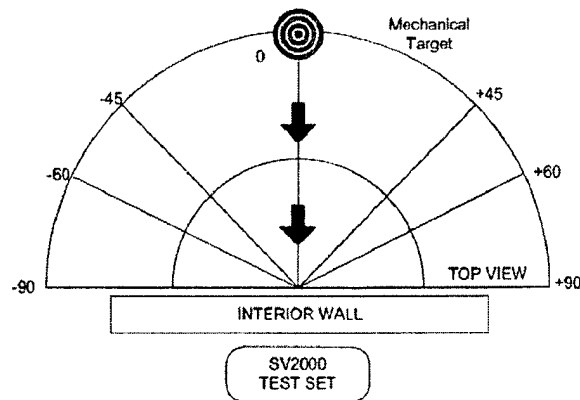
1.3.13 SV2000 Interior Wall Test (23010)

9/26/02

The SV2000 *shall* penetrate the interior wall defined in the Statement of Work, Annex 3, and map motion to a range of 10 meters in its FOV. This interior wall is composed of wooden 2x6, ½" drywall, insulation, ½" copper water pipes, 12 GA electrical wiring under 15A load, and a gas pipe.

1.3.13.1 Mechanical Target at 0°

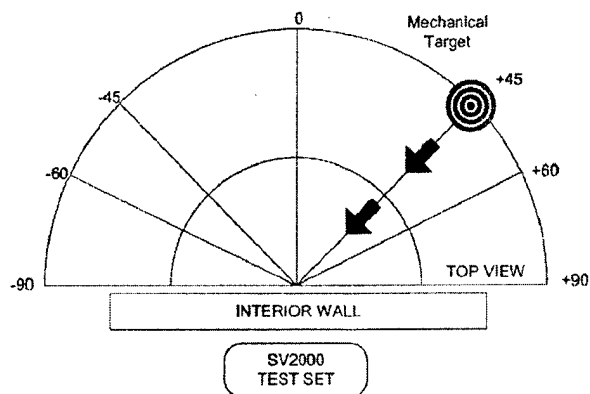
- Setup as shown below.



- Place SV2000 against the Interior Wall.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target at 0° and 10 meter away from the SV2000.
- Stop recording when the target gets to 0m.
- Save the recording as SV2K_IVV_REQ23010_M0.avi.

1.3.13.2 Mechanical Target at +45°

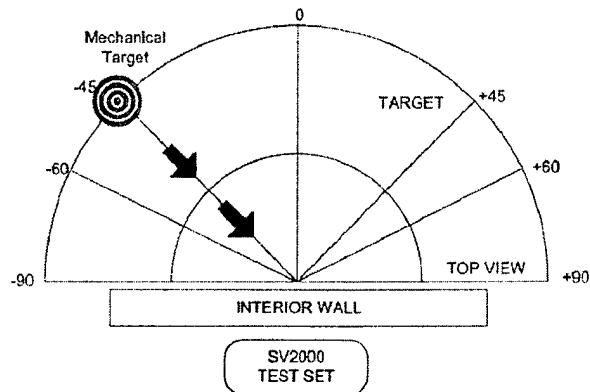
- Setup as shown below.



- Place SV2000 against the Interior Wall.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target at +45° and 10 meter away from the SV2000.
- Stop recording when the target gets to 0m.
- Save the recording as **SV2K_IVV_REQ22110_MP45.avi**.

1.3.13.3 Mechanical Target at -45°

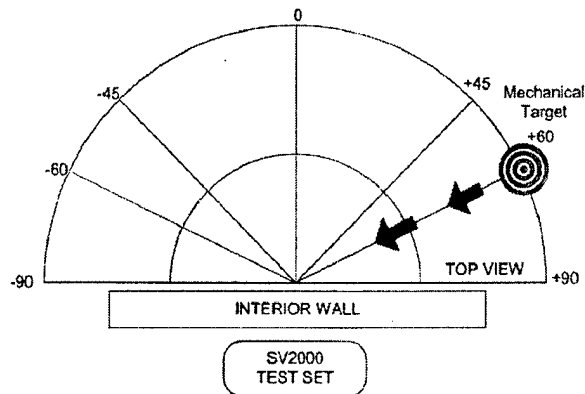
- Setup as shown below.



- Place SV2000 against the Interior Wall.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target at -45° and 10 meter away from the SV2000.
- Stop recording when the target gets to 0m.
- Save the recording as **SV2K_IVV_REQ22110_MN45.avi**.

1.3.13.4 Mechanical Target at +60°

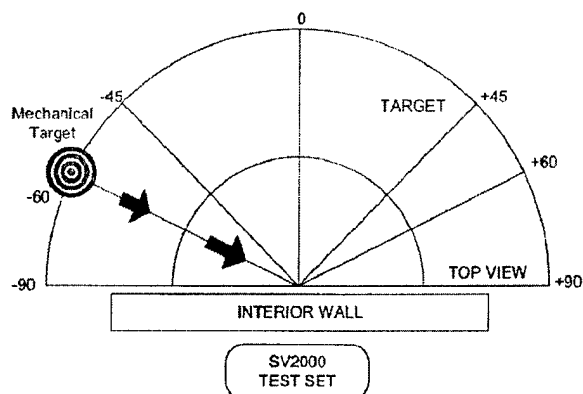
- Setup as shown below.



- Place SV2000 against the Interior Wall.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target at +60° and 10 meter away from the SV2000.
- Stop recording when the target gets to 0m.
- Save the recording as **SV2K_IVV_REQ22110_MP60.avi**.

1.3.13.5 Mechanical Target at -60°

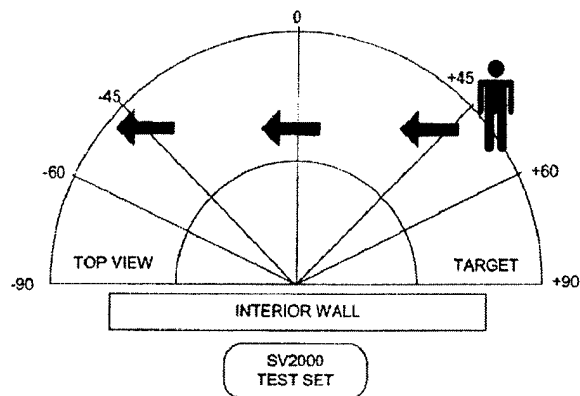
- Setup as shown below.



- Place SV2000 against the Interior Wall.
- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Set the MECHANICAL target at -60° and 10 meter away from the SV2000.
- Stop recording when the target gets to 0m.
- Save the recording as **SV2K_IVV_REQ22110_MP60.avi**.

1.3.13.6 Human Target at 7m

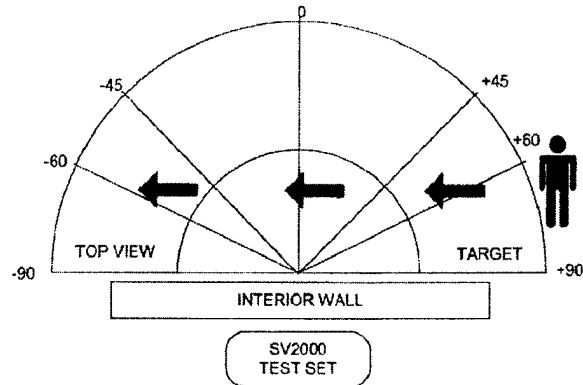
- Setup as shown below.



- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Start the HUMAN target into motion from +90° and 10 meters away from the SV2000.
- Stop recording when the target gets to -90°.
- Save the recording as **SV2K_IVV_REQ22110_H10.avi**.

1.3.13.7 Human Target at 3m

- Setup as shown below.



- Power ON the SV2000.
- Select the SV2000 FOV Range to 10 meters.
- Start recording the Display Screen.
- Start the HUMAN target into motion from +90° and 5 meters away from the SV2000.
- Stop recording when the target gets to -90°.
- Save the recording as **SV2K_IVV_REQ22110_H5.avi**.

23010	Interior Wall Test	PASS => Completed	
		FAIL => Not Completed	

2. Appendices

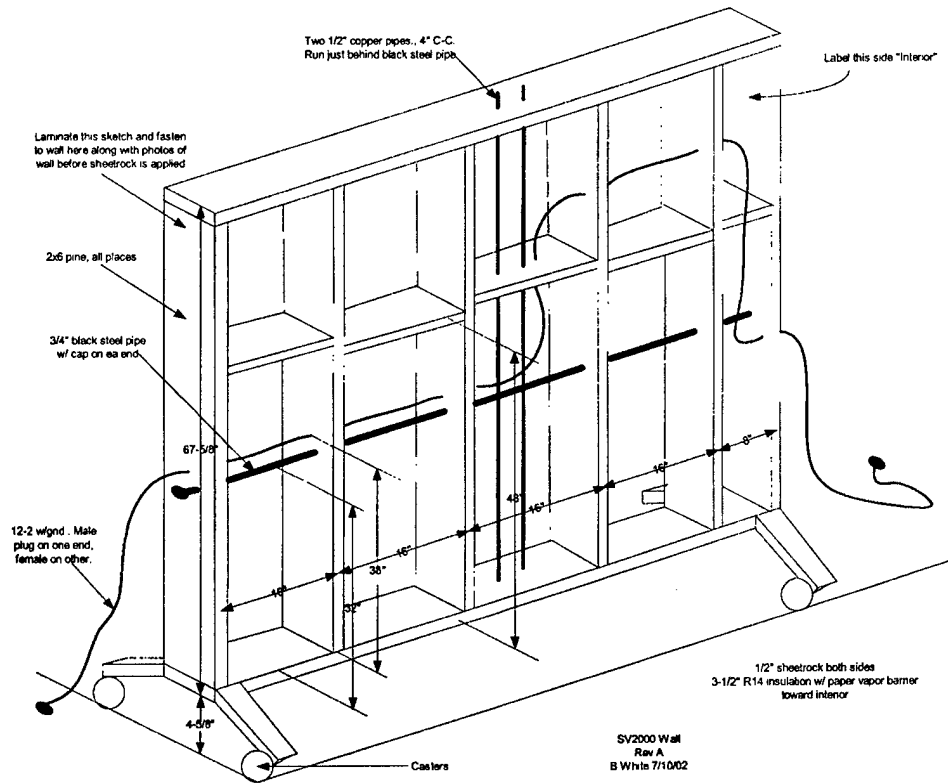
2.1 Appendix A: Test Result Summary

Requirement ID	Test Name	Pass	Fail	Note
6010	Dual Power Supply Test	X		
6020	Field Replaceable Test	X		
6030	Tools Needed Test	X		
6040	BB-2847-U Longevity Test	X		
6060	Charging Test	X		
6070	Polarity Test	X		
6080	Power Fault Test	X		
7010	Glove Usage	X		
7020	On & Off Switch	X		
7040	Soft Buttons	X		
7050	Button Operating Noise		X	
8010	Color LCD	X		
8020	LCD Resolution	X		
8030	LCD Size	X		
8040	Readability Test	X		
8050	Backlight	X		
8060	Brightness Adjustment Test	X		
8070	Backlight Setting Recall Test	X		
8080	Contrast Adjustment Test	X		
8090	Contrast Setting Recall Test	X		
8100	Night Vision Compatibility Test	X		
8110	Glare Reduction Filter	X		
9010	Test Connector Verification	X		
9020	Power Input	X		
9030	Communications I/O	X		
10010	Top Level States	X		
10020	Subordinate States	X		
11010	Power Consumption	X		
11020	Off to On Transition	X		
12010	See 20010 through 20060.			
12020	On to Off Transition	X		
12030	State Transition -Power Fault Test	X		
12040	Thermal Fault			
12050	Time Out	X		
12060	On to Off Transition	X		
12070	Recall User Settings	X		
13010	Startup Initialization	X		

Requirement ID	Test Name	Pass	Fail	Note
13020	Startup Screen	X		
13030	Unit Information	X		
13040	Off to On Switch	X		
13050	Startup to Operational	X		
13060	Startup to Slave	X		
13070	Remain in Startup			Not Testable
14020	Moving Objects	X		
14030	Screen Functionality	X		
14040	Scanning Screen Functionality	X		
14050	Alert Conditions			Tested under requirement 14060 & 14070
14060	Impenetrable Wall	X		
14070	Close Metal Object Present	X		
14080	Update Rates Shown	X		
14090	High Update Rate			Inconclusive
14100	Low Update Rate	X		
14110	Motion Map - From On Switch	X		
14120	Motion Map - Transition to Standby State	X		
14130	Motion Map - From Standby State	X		
15010	Standby State - Brightness Setting	X		
15020	Standby State - Contrast Setting	X		
15030	Standby State - Motion Map Update Setting	X		
15040	Standby State - Field of View Setting	X		
15050	Standby State - Factory Def. Setting	X		
15060	Unintentional Emissions		X	
15070	Standby State - Standby Screen	X		
15080	Standby State - Current User Settings	X		
15090	Standby State - Soft Button Legend	X		
15100	Standby State - Transition to Operational State	X		
16010	Radiated Emissions (RE102)		X	
16020	Intentional Emissions	X	X	Pass FCC Mode, Fail Turbo Mode
16030	Pulse Repetition Interval (PRI)	X		
16040	Code Verification	X		
16050	Unit Dependent Code	X		
16060	Unintentional Emissions		X	
16070	Radiated Susceptibility (RS103) (RS103)	X		
16080	RS 103 Test			
17010	Forearm Shield	X		
17020	Left Hand Design	X		
17030	Single Soldier Carry On	X		
17040	Electrical / Thermal / Chemical / Electromagnetic	X		
17050	Operability	X		
17060	Physical Interference	X		
17070	Right Hand Operation of On / Off Buttons	X		

Requirement ID	Test Name	Pass	Fail	Note
17080	Placement Noise		X	
18010	Width	X		
18020	Height	X		
18030	Depth	X		
18040	Weight	X		
18050	Color	X		
18060	Finish		X	
19010	Storage - Temperature			
19020	Vibration	-	-	Not Testing
20010	Operational - Temperature			
20020	Operational - Humidity			
20030	Liquid Intrusion	X		
20040	Liquid Immersion	-	-	Not Testing
20050	Flotation	X		
20060	Shock	X		
21010	Horizontal FOV	X		
21020	Vertical FOV	-	-	Not Testing
21030	FOV Range Changeability	X		
22010	Object Detection	X		
22020	Motion Map Display Screen	X		
22030	Motion Map Display Screen	X		
22040	Motion & Intensity	X		
22050	RCS & Intensity	X		
22060	False Negative	X		
22070	False Positive	X		
22080	Detection Past 180°		X	
22090	Line of Sight Accuracy	X		
22100	Cross Range Accuracy	X		
22110	Target Resolution	X		
23010	Interior Wall Test	X		

2.2 Appendix B: Interior Dry Wall



Appendix B Independent Test Results – Wyle Laboratories



7800 Highway 20 West
Huntsville, Alabama 35806
Phone (256) 837-4411 • Fax (256) 830-2109
www.wylelabs.com

REPORT NO.: 47768-01
WYLE JOB NO.: 47768
CLIENT P.O. NO.: 2832
CONTRACT: N/A
TOTAL PAGES (INCLUDING COVER): 36
DATE: October 11, 2002

TEST REPORT

TEST REPORT
ENVIRONMENTAL TESTING
ON TWO
SOLDIER VISION SV2000 UNITS
FOR
TIME DOMAIN SYSTEMS, INC.
WYLE JOB NO. 47768

Time Domain Systems, Inc.
7057 Old Madison Pike
Huntsville, AL. 35806

STATE OF ALABAMA }
COUNTY OF MADISON }

Robert L. Porter, Department Manager, being duly sworn,
deposes and says: The information contained in this report is the result of complete
and carefully conducted testing and is to the best of his knowledge true and correct
in all respects.

Robert L. Porter **SEAL**
SUBSCRIBED and sworn to before me this 17th day of October 2002

Elizabeth M. Davis
Notary Public in and for the State of Alabama at Large
My Commission expires Sept 22, 20 03

Wyle shall have no liability for damages of any kind to person or property, including
special or consequential damages, resulting from Wyle's providing the services
covered by this report.

TEST BY: Randy Cooper 10/15/02
Randy Cooper, Project Engineer Date

APPROVED BY: Rick Macklemann 10/16/02
David R. Bailey, Engineering Supervisor Date

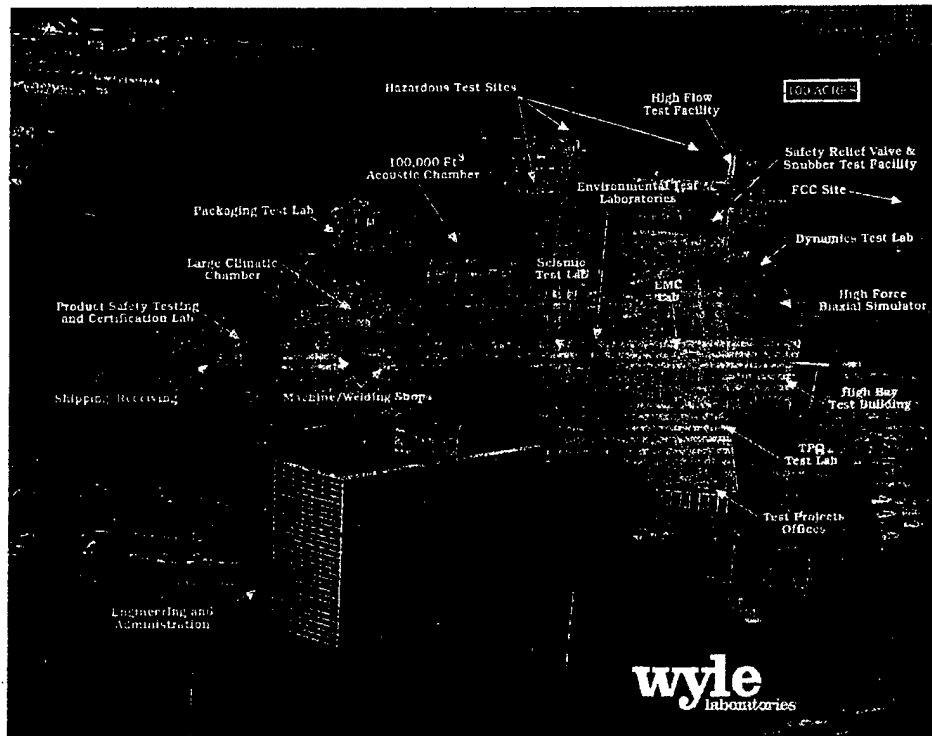
WYLE Q.A.: T.R. Hamilton 10/18/02
T.R. Hamilton, Quality Assurance Manager Date

(pap)



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HEREIN WITHOUT THE EXPRESS PRIOR PERMISSION OF WYLE LABORATORIES IS PROHIBITED. THE ACCEPTANCE OF A PURCHASE ORDER IN
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WH-1404, Rev. Feb '97



AERIAL VIEW OF WYLE/HUNTSVILLE

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WYLE LABORATORIES
Huntsville Facility

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1.0 INTRODUCTION

1.1 Scope

This report documents the test procedures followed and the results obtained during Environmental Testing performed on two Soldier Vision SV2000 Units for Time Domain Systems, Inc. The specimens were received at Wyle Laboratories on September 26, 2002. The receipt inspection revealed the specimens to be in good condition. Testing was performed at Wyle Laboratories' Huntsville, Alabama, Test Facility on September 26, 2002.

1.2 References

- Time Domain Systems, Inc. Purchase Order No. 2832
- Wyle Laboratories' Quotation No. 542/016705-R2/DB
- Time Domain Systems, Inc. Test Procedure SV2000
- Wyle Laboratories' Quality Assurance Program Manual, Revision 2
- ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment, General Requirements"
- ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment"
- MIL-STD-45662A, "Calibration System Requirements"

1.3 Test Specimen Description

The specimens tested were two Soldier Vision SV2000 Units identified with Part Number SV2000 and Serial Numbers 005 and 007.

1.4 Summary

The two Soldier Vision SV2000 Units were successfully subjected to Environmental Testing in accordance with the Time Domain Systems, Inc. Procedure SV2000. The testing was performed to verify the Soldier Vision SV2000 units' reliability upon being subjected to the test environment. The units were operational for all tests except for the Storage Temperature Test. The test results contained herein apply only to the two test specimens identified in this report. No anomalies were noted during Environmental Testing of the specimens.

2.0 TEST PROCEDURES AND RESULTS

2.1 Storage Temperature Test

One Soldier Vision SV2000 identified with Part Number SV2000 and Serial Number 007 was subjected to Storage Temperature Testing in accordance with the Time Domain Systems, Inc. Procedure SV2000, section 2.3.11.1. The specimen was non-operational during testing and was tested without the shipping/storage container. Testing was performed on September 26, 2002.

The Soldier Vision SV2000 was placed inside a temperature chamber and subjected to the following specifications:

Chamber Temperature (°F)	Duration (minutes)	Approximate Ramp Rate (°F/min)
-4	20	
Transition Period		.6
32	20	
Transition Period		.6
68	20	
Transition Period		.6
104	20	
Transition Period		.6
140	20	
Transition Period		1.2
68	20	

At the conclusion of the Storage Temperature Test, the Time Domain System's Technical Representative powered the unit and then verified and recorded its functionality. A visual inspection of the specimen was performed by Wyle Laboratories' personnel to verify that no physical degradation of the specimen had occurred. No anomalies were noted during the Storage Temperature Test.

A photograph of the test setup is presented in Attachment A. A circular chart showing chamber temperature is presented in Attachment B. The Instrumentation Equipment Sheet for the test setup is presented in Attachment E.

2.2 Operational Temperature and Thermal Fault Test

One Soldier Vision SV2000 identified with Part Number SV2000 and Serial Number 007 was subjected to Operational Temperature and Thermal Fault Testing in accordance with the Time Domain Systems, Inc. Procedure SV2000, section 2.3.11.2. The specimen was operational during testing and was tested without the shipping/storage container. Testing was performed on September 26, 2002.

Prior to initiating the Operational Temperature and Thermal Fault Test, the Time Domain System's Technical Representative collected data from the unit using Radar Test Bed and then saved the data. The Soldier Vision SV2000 was then powered and placed in the temperature chamber. The test was then initiated and transpired according to the following table:

Chamber Temperature (°F)	Duration (minutes)	Approximate Ramp Rate (°F/min)	Activities following specified duration*
14	30		Verify and record functionality of LCD, collect and save data
Transition Period		2.4	
50	30		Verify and record functionality of LCD, collect and save data
Transition Period		2.4	
86	30		Verify and record functionality of LCD, collect and save data
Transition Period		2.4	
122	30		Verify and record functionality of LCD, collect and save data

* Performed by the Time Domain System's Technical Representative.

The Time Domain System's Technical Representative monitored and recorded the status of the unit for correct functionality throughout the test, as documented in the above table. A visual inspection of the specimen was performed by Wyle Laboratories' Personnel to verify that no physical degradation of the specimen had occurred. No anomalies were noted during the Operational Temperature and Thermal Fault Test.

A photograph of the test setup is presented in Attachment A. A circular chart showing chamber temperature is presented in Attachment C. The Instrumentation Equipment Sheet for the test setup is presented in Attachment E.

2.3 Humidity Test

One Soldier Vision SV2000 identified with Part Number SV2000 and Serial Number 005 was subjected to Humidity Testing in accordance with the Time Domain Systems, Inc. Procedure SV2000, section 2.3.11.3. The specimen was operational during testing and was tested without the shipping/storage container. Testing was performed on September 26, 2002.

The Soldier Vision SV2000 was powered and data was collected and saved by the Time Domain System's Technical Representative. The unit was then placed inside a humidity test chamber and subjected to the following specifications:

Humidity (%) Non-condensing	Chamber Temperature (°F)	Duration (minutes)	Activities following specified duration*
30	68	30	Collect and save data, verify and record functionality of SV2000
90	68	30	Collect and save data, verify and record functionality of SV2000

* Performed by the Time Domain System's Technical Representative.

The Time Domain System's Technical Representative monitored and recorded the status of the unit for correct functionality throughout the test, as documented in the above table. A visual inspection of the specimen was performed by Wyle Laboratories' Personnel to verify that no physical degradation of the specimen had occurred. No anomalies were noted during the Humidity Test.

Photographs of the test setup are presented in Attachment A. A circular chart showing the wet and dry bulb temperature of the chamber is presented in Attachment D. The Instrumentation Equipment Sheet for the test setup is presented in Attachment E.

3.0 TEST EQUIPMENT AND INSTRUMENTATION

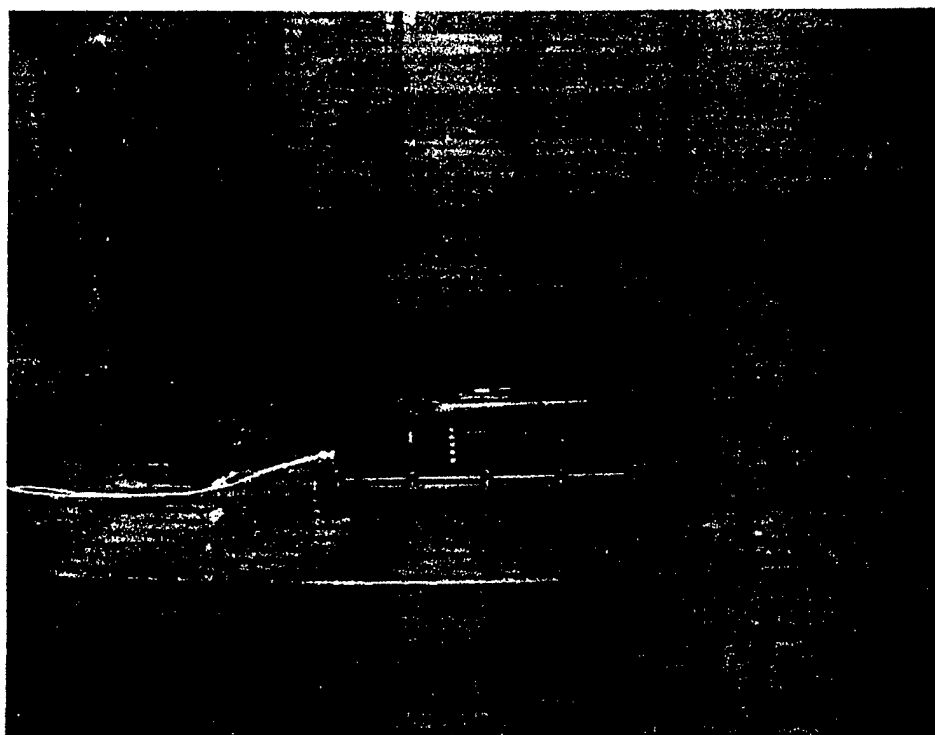
All instrumentation, measuring, and test equipment used in the performance of this test program were calibrated in accordance with Wyle Laboratories' Quality Assurance Program, which complies with the requirements of ANSI/NCSL Z540-1, ISO 10012-1, and Military Specification MIL-STD-45662A. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology (NIST) by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented.

4.0 QUALITY ASSURANCE PROGRAM

All work performed on this test program was completed in accordance with Wyle Laboratories' Quality Assurance Program.

The Wyle Laboratories, Huntsville Facility, Quality Management System is registered in compliance with the ISO-9001 International Quality Standard. Registration has been completed by Quality Management Institute (QMI), a Division of Canadian Standards Association (CSA).

ATTACHMENT A
PHOTOGRAPHS



Photograph No. 1
Storage Temperature and Operational Temperature and Thermal Fault Test Setup

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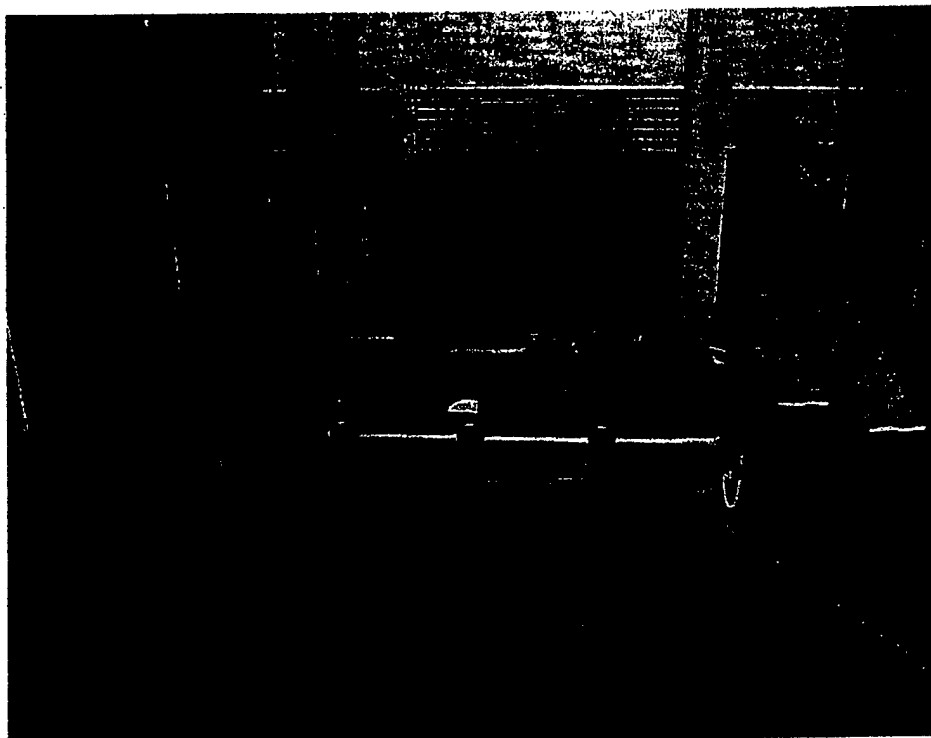
WYLE LABORATORIES
Huntsville Facility



Photograph No. 2
Equipment used during Operational Temperature and Thermal Fault Test

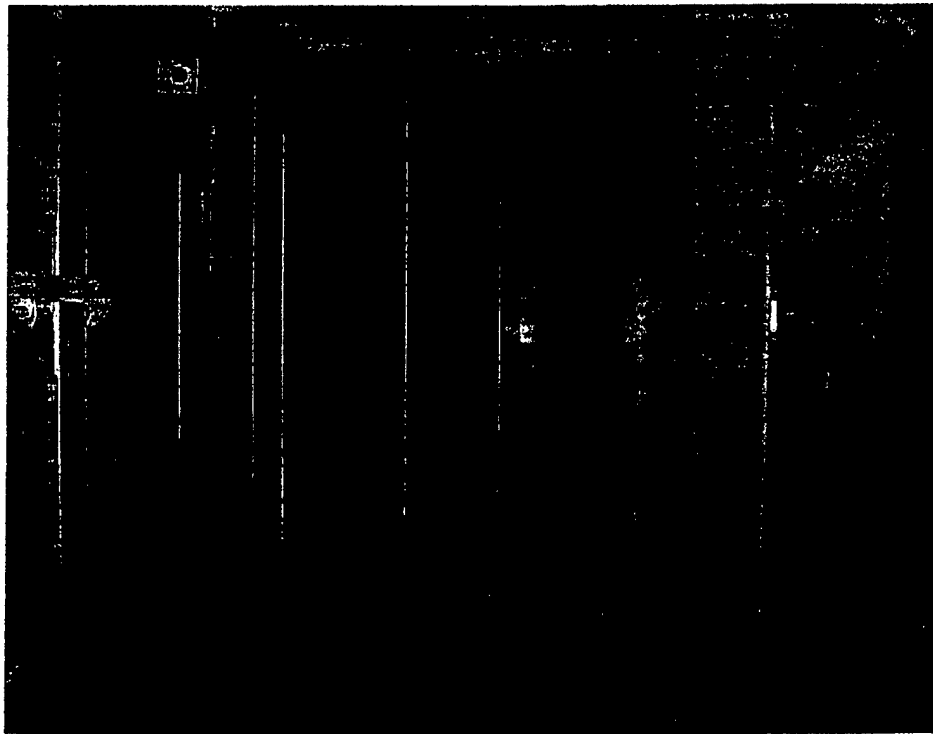
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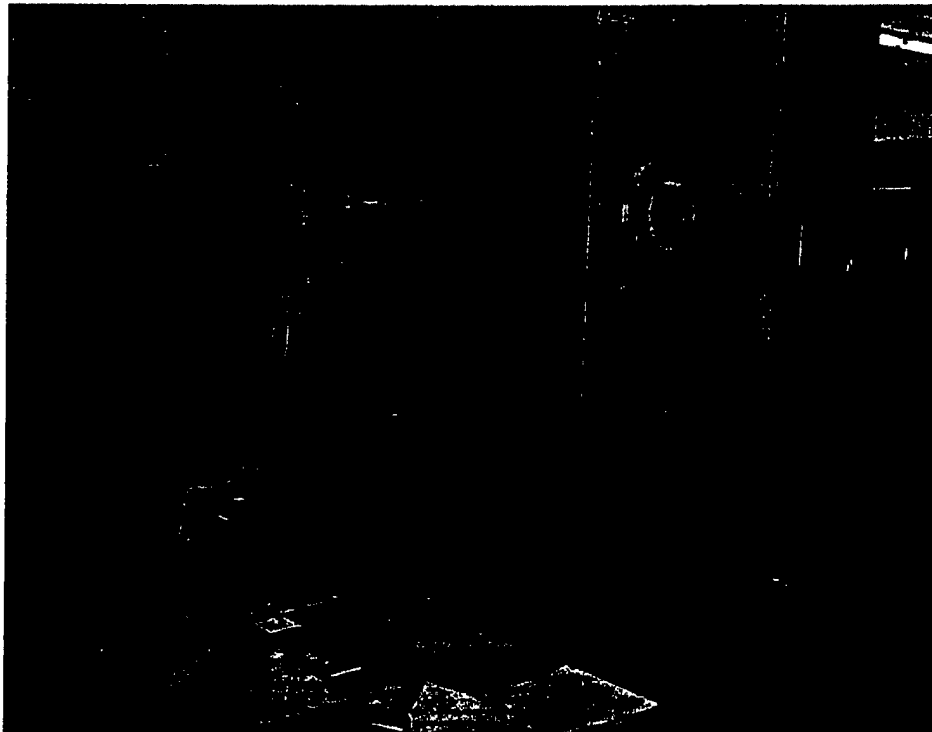
Photograph No. 3
Humidity Test Setup

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Photograph No. 4
Humidity Test Setup

WYLE LABORATORIES
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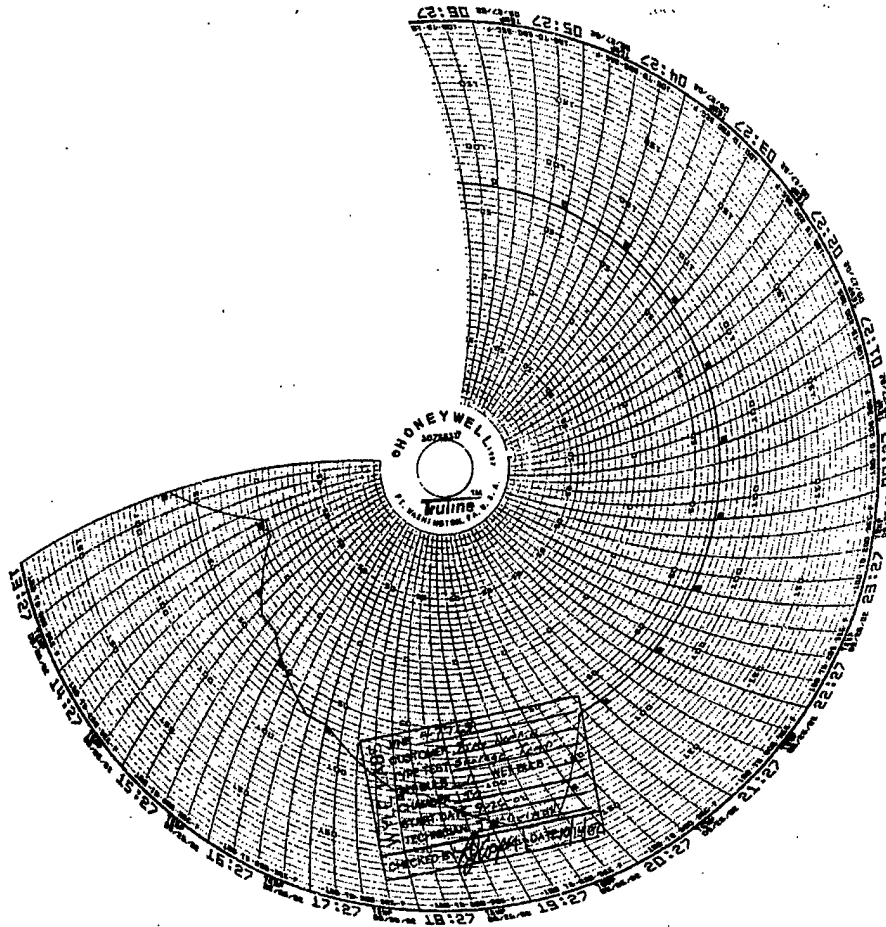


Photograph No. 5
Equipment used during Humidity Test

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ATTACHMENT B
STORAGE TEMPERATURE CIRCULAR CHARTS

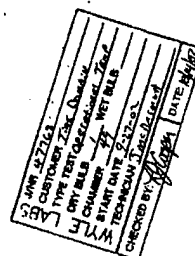
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ATTACHMENT C
OPERATIONAL TEMPERATURE/THERMAL FAULT CIRCULAR CHARTS

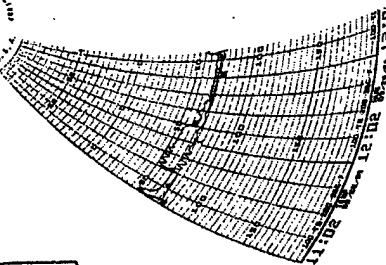
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ATTACHMENT D
HUMIDITY CIRCULAR CHARTS

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WYLE LAB	47768-01
CUSTOMER	Time Domain
TYPE TEST	Time & Hum
DRY BULB	1
WET BULB	2
CHAMBER	65
START DATE	9-26-07
TECHNICIAN	J. M. Davis
CHECKED BY	[Signature]
DATE	10/1/07

WYLE LABORATORIES
Huntsville Facility

ATTACHMENT E
INSTRUMENTATION EQUIPMENT SHEETS



INSTRUMENTATION EQUIPMENT SHEET

DATE: 9/26/02
TECHNICIAN: T.LANG

JOB NUMBER: 47768
CUSTOMER: TIME DOMAIN

TEST AREA: BNV CH 50
TYPE TEST: TEMP/HUMIDITY

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	UNCERTAINTY	CAL DATE	CAL DUE
1	TEMP ALARM	THERMOTRON	12005	263002	094751	-125-375°F	±25%	8/14/02	11/12/02
2	CONTROLLER	THERMOTRON	6800	783382	115947	-148 to 437°F	±25%	8/14/02	11/12/02
3	TEMP RECORDER	HONEYWELL	DR4500	9634Y6268573	112982	-200-600°F	4°F	8/14/02	11/12/02

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION

Troy Long 9-26-02

CHECKED & RECEIVED BY

Randy Cooper 9/26/02

Q.A.

D. Miller 09-26-02

W91-1028A, REV. APR 99

Storage Temperature Test

WYLE LABORATORIES
Huntsville Facility



INSTRUMENTATION EQUIPMENT SHEET

DATE: 9/26/02 JOB NUMBER: 47768 TEST AREA: CHAMBER 49
TECHNICIAN: J.MCDERMOTT CUSTOMER: TIME DOMAIN TYPE TEST: TEMP/HUMIDITY

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	UNCERTAINTY	CAL DATE	CAL DUE
1	TEMP CONTROLLE	RESEARCH	828-D10	7832	105296	-320-400°F	.1%FS	8/ 8/02	11/ 6/02
2	TEMP ALARM	NEWPORT	Q2001TDC	9390150	108415	-184-50°C	1.5%RD	8/ 8/02	11/ 6/02
3	TEMP RECORDER	HONEYWELL	DR4SAT	9521Y5212173	112365	-200-600°F	±.4°F	8/ 8/02	11/ 6/02
4	HUM IND	ROTRONIC	HT235R	36864	112337	100%	2%	5/28/02	11/28/02

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION

[Signature] 9-26-02

CHECKED & RECEIVED BY

[Signature] 9/26/02
[Signature] 9/26/02

WHL-1028A, REV. APR 99

Operational Temperature and Thermal Fault Test

WYLE LABORATORIES
Huntsville Facility



INSTRUMENTATION EQUIPMENT SHEET

DATE: 9/26/02
TECHNICIAN: T. LANG

JOB NUMBER: 47768
CUSTOMER: TIME DOMAIN

TEST AREA: ENV CH 55
TYPE TEST: TEMP/HUMIDITY

NO.	INSTRUMENT	MANUFACTURER	MODEL #	SERIAL #	WYLE #	RANGE	UNCERTAINTY	CAL DATE	CAL DUE
1	TEMP CONTROLLE	THERMOTRON	6800	N/A	105286	-148 to 437°F	±.25%	8/ 8/02	11/ 6/02
2	TEMP RECORDER	HONEYWELL	DR4500	9606Y6224083	112634	-200-600°F	±.4°F	8/ 8/02	11/ 6/02
3	TEMP ALARM	THERMOTRON	D12005	263002	001055	-125 to 375°F	.25%	8/ 8/02	11/ 6/02
4	POWER SUPPLY	MG	PS-10AD	114832	114832	20VDC	5%	8/ 7/02	2/ 3/03

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION

Q.A.

WH-1029A, REV. APR 79

Humidity Test

WYLE LABORATORIES
Huntsville Facility

Appendix C- Independent Test Results- Chomerics



TEST SERVICES

**EMC EVALUATION OF THE
TIME DOMAIN
SV2000**

Date: NOVEMBER 21, 2002
Test Report Number: EMI3443.02 REVISION 1

IN ACCORDANCE WITH MIL-STD 461E

**Prepared For: TIME DOMAIN CORPORATION
CUMMINGS RESEARCH PARK
7057 OLD MADISON PIKE
HUNTSVILLE, ALABAMA 35806
ATTENTION: KEVEN TRACH**

**Prepared By: MANUEL A. MARTINEZ
CHOMERICS TEST SERVICES
77 DRAGON COURT
WOBURN, MASSACHUSETTS 01888**

Test Technician or Engineer: _____

CTS Approved Signatory: _____

This report shall not be reproduced except in full without the
written approval of Chomerics Test Services.



TEST SERVICES

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1.1	Introduction
1.1.1	Purpose
1.1.2	Requirements
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1.3.2	Equipment Calibration
1.3.3	Test Equipment
1.3.4	Detection System Parameters
1.3.5	Test Personnel
1.4	Test Set-up
1.4.1	Test Site Matrix
1.4.2	Test Site Descriptions
1.4.3	Equipment Under Test
1.4.4	Block Diagram
1.5	Pass/Fail Criteria

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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- 2.1.2 Test Conditions
- 2.1.3 Test Method
- 2.1.4 Results
- 2.1.5 Test Data
- 2.1.6 Photographic Documentation

2.2 RS103 Radiated Susceptibility, Electric Field (10kHz to 18GHz)

- 2.2.1 Equipment Used
- 2.2.2 Test Conditions
- 2.2.3 Test Method
- 2.2.4 Results
- 2.2.5 Test Data
- 2.2.6 Photographic Documentation

2.3 EIRP Effective Isotropic Radiated Power

- 2.3.1 Equipment Used
- 2.3.2 Test Conditions
- 2.3.3 Test Method
- 2.3.4 Results
- 2.3.5 Test Data
- 2.3.6 Photographic Documentation

Appendix A: Detection System Parameters**Appendix B: Test Log****Appendix C: Customer Test Plan**

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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TEST SERVICES

LIST OF DEFINITIONS/ABBREVIATIONS

AC	Alternating Current
BB	Broadband
BW	Bandwidth
cm	Centimeter
C.P.U.	Calibrate Prior to Use
dB	Decibel
DC	Direct Current
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ER	Electric Radiation
EUT	Equipment Under Test
GHz	GigaHertz
Hz	Hertz
I-face	Interface
kHz	KiloHertz
m	Meter
MHz	MegaHertz
mm	Millimeter
mS	Millisecond
mV	MilliVolt
MR	Magnetic Radiation
NB	Narrowband
NCR	No Calibration Required
PLC	Power Line Conduction
PPS	Pulses Per Second
uF	MicroFarad
uH	MicroHenry
uS	Microsecond
uV	MicroVolt
UWC	Use With Calibrated Equipment

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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TEST SERVICES

1.0 GENERAL

1.1 Introduction

1.1.1 Purpose

The purpose of this test is to evaluate a sequence of electromagnetic interference tests. At the request of Time Domain, the tests were performed on the Time Domain SV2000 by Chomerics, Inc. of Woburn, Massachusetts. The assessment will determine the compliance or non-compliance to the some of the requirements set forth in MIL-STD 461E, (20 August 1999) for Navy Ships, metallic, below deck.

Keven Trach from Time Domain was present during testing. Testing was performed during the period of September 17 through September 20, 2002 under purchase order number 2826.

1.1.2 Requirements

The requirements for the sequence of tests performed on the Time Domain SV2000 were performed in accordance with the requirements set forth in MIL-STD 461E and was tested within the guidelines of MIL-STD 461E and MIL-STD 462.

1.2 Summary

The terms "Passed" or "Failed" in this section are intended to guide the reader as to whether or not the EUT met the MIL-STD 461E requirements. The "Results" paragraph in each test section to follow and the test data sheets will outline specifically how the EUT performed during each test.

RE102 Radiated E-Field Emissions	FAILED
RS103 Radiated E-Field Susceptibility	PASSED
EIRP Effective Isotropic Radiated Power	N/A – See data sheet

1.2.1 Summary of Recommendations

The Time Domain SV2000 will require modifications in order to ensure compliance with MIL-STD 461E.

Please note that if any modifications and or fixes were implemented to the EUT to achieve compliance, that other approaches to solving the problem may exist. In addition, any EMI/EMC shielding products listed in this report may be substituted with an equivalent.

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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TEST SERVICES

1.3 Administrative Data

1.3.1 Test Facility

Chomerics Test Services in Woburn, Massachusetts is an American Association for Laboratory Accreditation (A2LA) accredited facility as defined on Certification Number 1980-01. For Emissions and Immunity testing, the Scope of Accreditation is limited to the following tests: CFR 47, FCC Part 15 Subpart B, CISPR 11, EN 55011, CISPR 13, EN55013, CISPR 14, EN55014-1, CISPR 22, EN55022, AS/NZS 3548, CNS 13438, CNS 13783-1, VCCI, EN 61000-3-2, EN 61000-3-3, EN 50081-1, EN55081-2, EN61000-6-3, EN 61000-6-4, EN 61000-4-2, EN 61000-4-3, EN61000-4-4, EN 61000-4-5, EN 61000-4-6, EN61000-4-8, EN 61000-4-11, EN 50082-1, EN 50082-2, EN 61000-6-1, EN 61000-6-2, IEC/EN 60601-1-2, EN 300 386, EN 61362-1, CISPR 24, EN55024, CISPR 14, EN 55014-2, EN 50083-2, EN 55103-1, and EN 55103-2. Any tests in this report that are not listed above are not covered by the A2LA Accreditation.

Chomerics' Open Area Test Sites A and B are listed by the Federal Communications Corporation (FCC) for Radiated and Conducted Emissions testing under FCC Registration numbers 90498 and 90499 respectively.

Chomerics' Open Area Test Sites A and B are accredited for Radiated and Conducted Emissions through Industry Canada under file numbers IC2959A and IC2959B respectively.

Chomerics' Open Area Test Site B is accredited to the Voluntary Control Council for Interference (VCCI) for Radiated and Conducted Emissions testing under file R-1508 and C-1589 respectively.

Chomerics test facility operates under the current revision of Chomerics Quality Assurance (QA) Manual Document Number QA002.

The QA Manual has been constructed to reflect a quality program in accordance with the requirements of the National Institute of Standards and Technology (NIST), ISO 9002, ISO Guide 25, NIST Handbook 150, EN 45001, MIL-I-45208A, MIL-STD-461E, 462D and Chomerics Quality Assurance Program (QAP).

The QA Manual outlines and describes the procedures for establishing and maintaining the quality of analysis, research, inspection, and testing within Chomerics Test Service (CTS).

This test report does not represent an endorsement by the U.S. Government.

The results and/or conclusions within this test report refer and/or apply only to the unit(s) tested as defined by this report.

Measurements performed for this test are traceable to the National Institute of Standards and Technology (NIST) based on the fact that all test equipment used for the measurements were previously calibrated using standards traceable to NIST.

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No deviations, additions to, or exclusions from the test specification(s) were made.

The system amplitude accuracy for the measurements made during the radiated emission tests was $\pm 3\text{dB}$. Chomerics Test Services measurement uncertainty calculations are available for review upon request.

1.3.2 Equipment Calibration

The calibration of Chomerics test facility equipment is controlled under the current edition of Chomerics Laboratory Test Equipment Calibration Manual Document Number QA001.

The test equipment used throughout this test sequence conforms to laboratory calibration standards, MIL-STD-45662, traceable to the National Institute of Standards and Technology. The date of the next due scheduled calibration is listed in each test section for the applicable equipment.

All test equipment is calibrated in one year intervals.

1.3.3 Test Equipment

The instruments used for the conducted and radiated immunity tests were manually controlled by the test engineer while the EUT was monitored for any degradation of performance.

The measurement instrument used for the RE101 radiated emissions scans, was the Hewlett Packard Model HP8566B Spectrum Analyzer System / Watkins-Johnson Model 8940B receiver as defined in Section 3.2.

1.3.4 Detection System Parameters

The detection system parameters used for the test reflect the conditions to which the HP8566B was set to ensure that the room ambient condition was 6dB below the appropriate limit.

The following is a list of the test parameters and what each line means. This list is a line by line description of the test parameters. This list should help the reader, who is not familiar with EMI testing or the H/P 8566B automated test system, to understand the test parameters.

1. **Display Title:** Test title (CE101, CE103, RE101, etc.).
2. **Units:** Units of the test being performed.
3. **Dis. Ref. Level:** Top level of the test graph.
4. **Test Type:** Type of detection (Peak, NB/BB).

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5. **Freq. Uncert. (%)**: Accuracy of the frequency measured.
6. **Min Swp Time/Oct**: Sweep time of the test. Can be set for scan. 150 is equal to 10 minutes per decade.
7. **Range of**: Test range for a set of bandwidths. The number of ranges can vary per test.
8. **Start Frequency**: Start frequency of test.
9. **Stop Frequency**: Stop frequency of test.
10. **Transducer**: Antenna, current probe, LISN, or other device used in the test.
11. **Gain/Loss**: Gain or loss in test setup.
12. **SA Input**: What port to put test cable on spectrum analyzer.
13. **Presel Input**: What port to connect the Preselector to the spectrum analyzer.
14. **Quasi-Peak Bw**: Bandwidth of the quasi-peak detector. Not applicable for the range. Also known as the IF bandwidth.
15. **SA Res Bw**: Resolution bandwidth of the spectrum analyzer for the range. Also known as the IF bandwidth.
16. **Video Bw**: The video bandwidth selected for the range.
17. **Ref. Lvl dBuV**: The maximum that the spectrum analyzer shall measure, linearly, in the range.
18. **Int Atten**: Attenuation set in the spectrum analyzer.
19. **Presel Atten**: Attenuation set in the Preselector.
20. **Ext. Atten**: Attenuation placed on the Preselector or the spectrum analyzer.
21. **Setups**: The number of setups in a range.
22. **Sweeps/Setups**: The number of times a scan shall be made for each range.
23. **Msg.Sub.Cont**: Message subtitle or continue to next range.

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EMISSIONS

Freq. Uncert.(%): .1
Min. Swp. Time/Oct: 150

In all cases, the minimum scanning speed for each tuning band across the entire frequency range tested shall be no less than 10 minutes per decade.

The test matrices outlining the detection parameters for the HP8566B for emissions tests are located in Appendix A.

1.3.5 Test Personnel

The test personnel performing or supervising the tests are accredited by the National Association of Radio and Telecommunications Engineers, Inc. (NARTE) as Certified Electromagnetic Compatibility Engineers (N.C.E.) and Technicians (N.C.T.).

1.4 Test Setup

1.4.1 Test Site Matrix

The specific test locations used for the emissions and immunity testing of the SV2000 are as follows: (Refer to Section 1.4.2 for test site descriptions).

Emissions Test

E.I.R.P.
RE102 Radiated E-Field Emissions

Test Site

Open Area Test Site A
Test Chamber C

Susceptibility Test

RS103 Radiated E-Field Susceptibility

Test Site

Test Chamber C

1.4.2 Test Site Descriptions

The following is a general list of test sites and descriptions of each. Refer to Section 1.4.1 for specific test sites used for testing.

Open Area Test Site A: Chomerics' Open Area Test Site "A" if used for this test program is located in the lower parking lot attached to the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 1). Parking is permitted on one side of Test Site "A" at a discrete distance from the imaginary ellipse.

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The Open Area Test Site "A" enclosure is a wooden structure measuring 56 x 30 x 25 feet in size with galvanized steel sheet metal used as the ground plane. The structure is sized to allow 3 meter measurements and is heated and/or air conditioned.

The structure used to support equipment under test is an EMCO 4 foot diameter motorized turntable. For tabletop equipment, a wooden table measuring 1.5 x 1 meter in size is positioned at the center of the turntable, at the proper height above the ground plane.

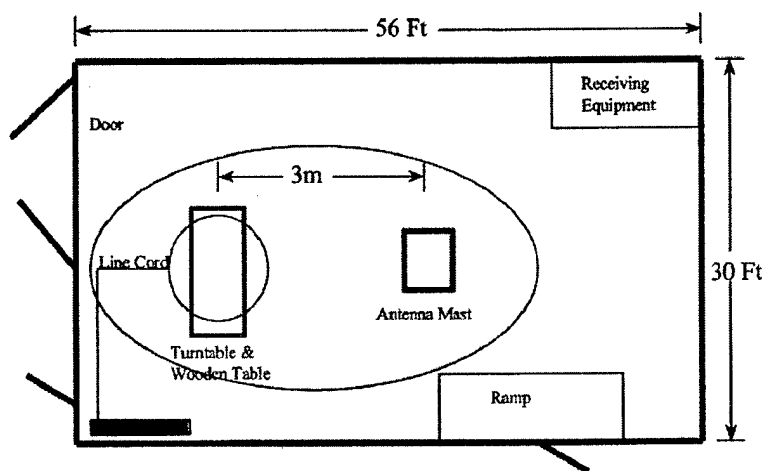
The area at the end of the Open Area Test Site "A" is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

The available AC power within Open Area Test Site "A" is 120V 60Hz Single Phase 60Amps; 208V 60Hz Three Phase 60Amps; 208V 60Hz Single Phase 60Amps; 230V 50Hz Single Phase 50Amps.

This Site is listed with the Federal Communications Commission (FCC) and approved by BSML, AUSTEL and CSA.

OPEN AREA TEST SITE A

Figure 1



Key:  = Power board

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Open Area Test Site B: Chomerics' Open Area Test Site "B" if used for this test program is located in the lower parking lot behind the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 2). Parking is permitted on one side of Test Site "B" at a discrete distance from the imaginary ellipse.

The Open Area Test Site "B" enclosure is a wooden structure measuring 56 x 30 x 25 feet in size with galvanized steel sheet metal used as the ground plane. The structure is sized to allow both 3 and 10 meter measurements and is heated and/or air conditioned.

The structure used to support equipment under test is a 14 foot diameter motorized turntable. The sheet metal surface is flush with the ground plane. To ground the turntable, copper fingers (1" x 1.5") are mounted around the outer edge of the turntable using machine screws. The spring fingers are equally spaced and provide a uniform interface between the turntable metal surface and ground plane. For tabletop equipment, a wooden table measuring 1.5 x 1 meter in size is positioned at the center of the turntable, at the proper height above the ground plane.

The addition at the end of the Open Area Test Site "B" is the location for the test personnel and equipment to ensure they are outside the imaginary ellipse.

The available AC power within Open Area Test Site "B" is 120V 60Hz Single Phase 60Amps; 208V 60Hz Three Phase 60Amps; 208V 60Hz Single Phase 60Amps; 230V 50Hz Single Phase 50Amps.

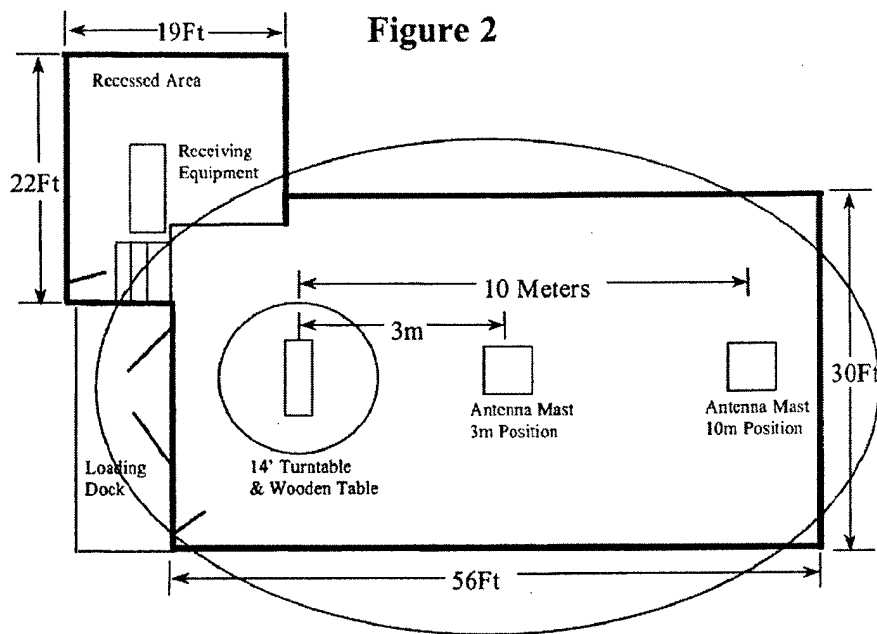
This Site is listed with the Federal Communications Commission (FCC) and approved by BSMI, AUSTEL and CSA.

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OPEN AREA TEST SITE B

Figure 2



Test Chamber A: Chomerics' Test Chamber "A", if used for this test program, is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 3). The shielded enclosures (test chambers) were manufactured and installed by Universal Shielding Corporation of Deer Park, New York. Attenuation tests have demonstrated that the shielded enclosures meet the attenuation requirements of MIL-STD-285 and NSA 65-6. The main test chamber is 22 x 10 x 10 feet in size with an adjacent enclosure that is 8 x 8 x 8 feet in size. The adjacent room used for support equipment and the main test chamber are connected together and referenced to the same single point ground.

When needed for tabletop equipment, a wooden table measuring 3 x 9 feet in size is positioned within the test chamber. When used for MIL-STD-461E tests the tabletop surface is covered with a copper sheet and grounded to the test chamber wall so that the resistance is less than 2.5 milliohms.

The power line filters supplying the power to the enclosure provide 100dB of attenuation from 10kHz to 10GHz. The adjacent room, used for support equipment, and the main test chamber have independent AC power obtained from independent AC power line filters.

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The available AC power in Test Chamber "A" is 120V 60Hz Single Phase 100Amps; 120V 400Hz Three Phase 50Amps; 208V 60Hz Three Phase 100Amps; 208V 60Hz Single Phase 100Amps; 230V 50Hz Single Phase 50Amps.

Test Chamber B: Chomerics' Test Chamber "B", if used for this test program, is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 3). The shielded enclosures (test chambers) were manufactured and installed by Universal Shielding Corporation of Deer Park, New York. Attenuation tests have demonstrated that the shielded enclosures meet the attenuation requirements of MIL-STD-285 and NSA 65-6.

The main test chamber is 22 x 10 x 10 feet in size with an adjacent enclosure that is 8 x 8 x 8 feet in size. The adjacent room used for support equipment and the main test chamber are connected together and referenced to the same single point ground.

Test Chamber "B" is lined with Rantec ferrite absorber tiles FT-100. All surfaces of the room are lined with FT-100 material. The floor is lined with removable tiles.

This absorber material allows the test chamber to meet the 0-6dB field uniformity requirements of IEC 1000-4-3 and ENV 50140.

There are two access panels between the main test chamber and the support room. The access panels are covered with absorber tiles. The absorber tiles can be removed from the access panels.

The power line filters supplying the power to the enclosures provide 100dB of attenuation from 10kHz to 10GHz. The adjacent rooms, used for support equipment, and the main test chamber have independent AC power obtained from independent AC power line filters.

The available AC power in Test Chamber "B" is 120V 60Hz Single Phase 30Amps; 208V 60Hz Three Phase 30Amps and 230V 50Hz Single Phase 30Amps. A wooden table 3 x 6 feet in size is used for tabletop equipment.

Test Chamber C: Chomerics' Test Chamber "C", if used for this test program, is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts (see Figure 3). The shielded enclosures (test chambers) were manufactured and installed by Universal Shielding Corporation of Deer Park, New York.

Attenuation tests have demonstrated that the shielded enclosures meet the attenuation requirements of MIL-STD-285 and NSA 65-6. The main test chamber is 16 x 20 x 10 feet in size with two adjacent enclosures on either side which are 8 x 8 x 8 and 8 x 12 x 10 feet in size, respectively.

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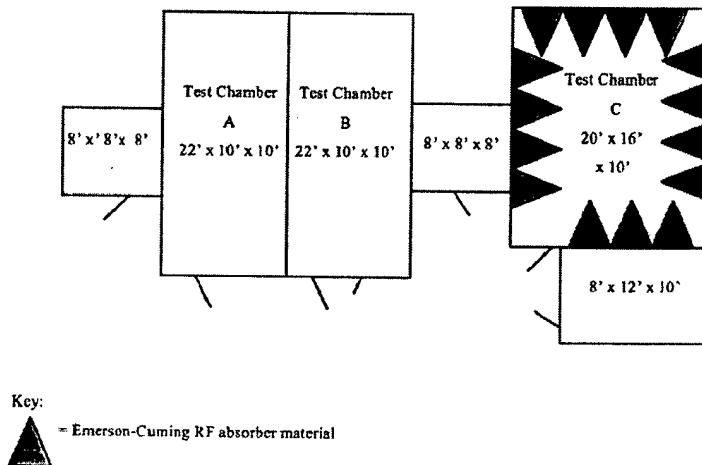
Test Chamber "C" is lined with Emerson-Cuming RF absorber material. This absorber material meets the following absorption specifications: 80MHz 6dB, 300MHz 30dB, 500MHz 35dB, 1GHz 40dB, and 3 to 24 GHz 50dB. Each of the two adjacent rooms used for support equipment and the main test chamber are connected together and referenced to the same single point ground.

When needed for tabletop equipment, a wooden table measuring 3 x 9 feet in size is positioned within the test chamber. When used for MIL-STD-461E tests, the tabletop surface is covered with a copper sheet and grounded to the test chamber wall so that the resistance is less than 2.5 milliohms. When used for radiated electromagnetic field tests, to some standards, the copper tabletop surface is removed.

The available AC power in Test Chamber "C" is 120V 60Hz AC Single Phase 60Amps; 230V 50Hz AC Single Phase 50Amps; 115V 400Hz AC Three Phase 30Amps (through access panel); 208V 60Hz AC Three Phase AC 30Amps (through access panel).

The power line filters supplying the power to the enclosures provide 100dB of attenuation from 10kHz to 10GHz. Each of the two adjacent rooms used for support equipment and the main test chamber has independent AC power obtained from independent AC power line filters.

**Immunity Lab Layout
Figure 3**



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EC Lab A: Chomerics' EC Lab "A" is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts.

EC Lab "A" is a typical room measuring 20 x 16 feet with an aluminum sheet metal (8 x 12 feet in size) in the center of the floor for a ground plane. When needed for tabletop equipment, a wooden table (0.8 meters in height) is placed on the metal ground plane that extends at least 0.1m beyond all sides of the table. A removable 3 x 6 foot sheet of aluminum is placed on top of the wooden table when a horizontal coupling plane is required.

The appropriate connections, as needed for each test, are used to interconnect the table horizontal coupling plane, ground plane floor, test equipment, and earth ground.

The available AC power in the EC Lab "A" is 120V 60Hz AC Single Phase 60Amps; 230V 50Hz AC Single Phase 50Amps; and 208V 60Hz AC Three Phase AC 30Amps.

The EC Lab "A" is equipped with air and water services for use with equipment that requires it.

The humidity in EC Lab "A" can be automatically controlled in the range of 20% to 60%.

EC Lab B: Chomerics' EC Lab "B" is located in the Seeger Building at Chomerics, 84 Dragon Court, Woburn, Massachusetts.

EC Lab "B" is a typical room measuring 12 x 14 feet with a copper sheet (6 x 8 feet in size) in the center of the floor for a ground plane. When needed for tabletop equipment, a wooden table (0.8 meters in height) is placed on the metal ground plane that extends at least 0.1m beyond all sides of the table. A removable 3 x 6 foot sheet of aluminum is placed on top of the wooden table when a horizontal coupling plane is required.

The appropriate connections, as needed for each test, are used to interconnect the table horizontal coupling plane, ground plane floor, test equipment, and earth ground.

The available AC power in the EC Lab "B" is 120V 60Hz AC Single Phase 60Amps, 230V 50Hz AC Single Phase 50Amps; and 208V 60Hz AC Three Phase AC 30Amps.

The humidity in EC Lab "B" can be automatically controlled in the range of 20% to 60%.

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1.4.3 Equipment Under Test

No support equipment was needed to run the SV2000 in the standby, FCC and turbo modes of operation.

The SV2000 operates on battery power supplied by Time Domain. There are no I/O connections.

The standby, FCC and turbo modes of operation were used for emissions tests and for immunity tests. The SV2000 was monitored during the immunity tests by Keven Trach of Time Domain.

The equipment under test was set up as illustrated in CTS-Form-014.

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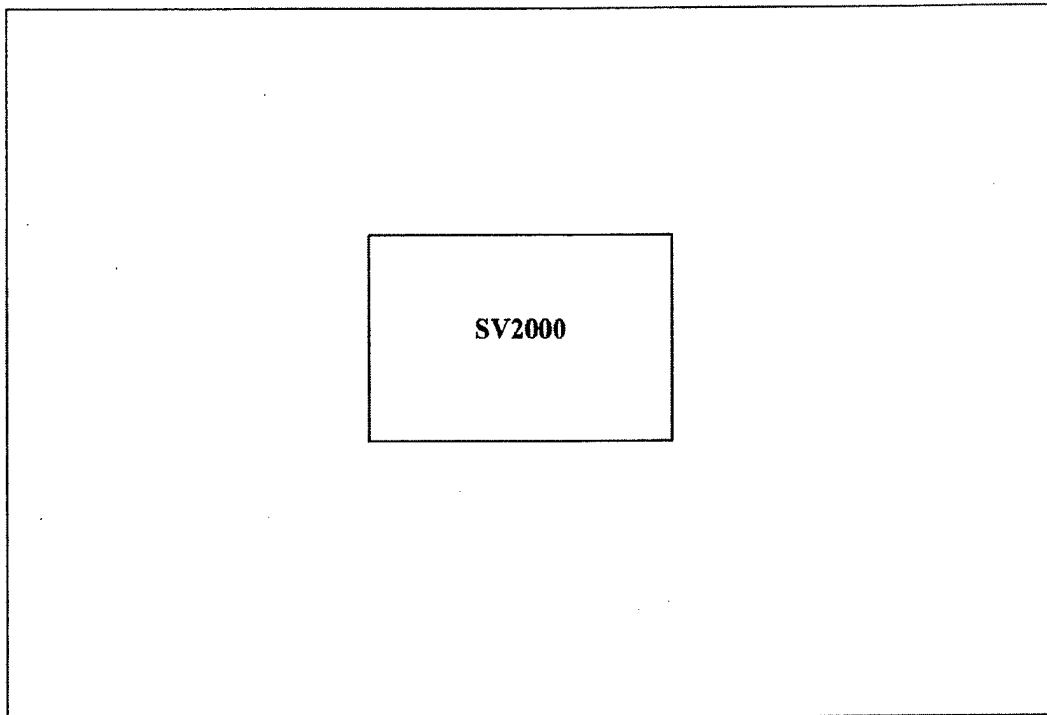


TEST SERVICES

1.4.4 Block Diagram

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000

DATE: SEPTEMBER 17, 2002
TESTED BY: MANUEL MARTINEZ



System Configuration Block Diagram – Provide a line drawing identifying the EUT, simulators, support equipment, I/O cables, and any other pertinent components to be used during testing. Use a dashed line to separate the equipment in the testing field versus equipment outside the testing field.

FORM CTS-014

1.5 Pass/Fail Criteria

During the emissions tests, the SV2000 shall not generate electromagnetic energy which exceeds the applicable limits. When performing the susceptibility tests, the SV2000 shall exhibit no degradation beyond the levels attributed to the interfering signals generated to the applicable levels.

Customer pass/fail criteria: The EUT passes if the unit powers back on after a shutdown.

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2.0 TESTS PERFORMED

2.1 RE102 - Radiated Emissions, Electric Field (10kHz to 18GHz)

2.1.1 Equipment Used

	Test Equipment	Asset #	Serial #	Cal Date
X	HP8566B Spectrum Analyzer	47	237A04064	7/03
X	HP85685A Preselector	48	2648A00483	7/03
X	Emco 3301B Vertical Rod Antenna	371	2901	1/03
	Emco 3301B Vertical Rod Antenna	426	1148	1/03
	Emco 3109 Biconical Antenna	87	2123	1/03
X	Emco 3109 Biconical Antenna	119	2414	1/03
X	Emco 3106 Ridge Guide Horn Antenna	117	2213	1/03
	Emco 3106 Ridge Guide Horn Antenna	120	2212	1/03
	Emco 3115 Ridge Guide Horn Antenna	376	2796	1/03
X	Emco 3115 Ridge Guide Horn Antenna	376	2175	1/03
X	Solar 7012106R 10uF Capacitor	186	N/A	1/03
X	Solar 7012106R 10uF Capacitor	187	N/A	1/03
	Solar 7012106R 10uF Capacitor	188	N/A	1/03
	Solar 7012106R 10uF Capacitor	189	N/A	1/03
X	Solar 6512-106R 10uF Capacitor	389	N/A	1/03
X	Solar 6512-106R 10uF Capacitor	387	N/A	1/03
	Solar 6512-106R 10uF Capacitor	388	N/A	1/03
	Solar LISN 8028-50TS-24-BNC	383	860623	1/03
X	Solar LISN 8028-50TS-24-BNC	385	8379275	1/03
X	Solar LISN 8028-50TS-24-BNC	381	852334	1/03
X	Solar LISN 8028-50TS-24-BNC	384	8305125	1/03
X	Solar LISN 8028-50TS-24-BNC	382	860622	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	584	NA	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	585	NA	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	594	NA	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	595	NA	1/03

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2.1.2 Test Conditions

The test conditions were set up in accordance with MIL-STD 461E, and method RE102 of MIL-STD 462.

The SV2000 was set up on the test bench inside the shielded room. The SV2000 was set up and powered by battery for radiated emission tests. The worst case signals detected were recorded and plotted.

The SV2000 was set to the standby, FCC and turbo modes to maximize the emissions. The SV2000 was set up and powered by battery for the RE102 test.

2.1.3 Test Method

The SV2000 was placed facing the antenna. There were no power and signal lines.

The appropriate antenna was placed 1 meter from the closest point of the SV2000 and scanned for electric field emissions. From 10kHz to 20MHz, a vertically polarized antenna was used. Above 20MHz, linearly polarized antennas were utilized and both polarities were scanned.

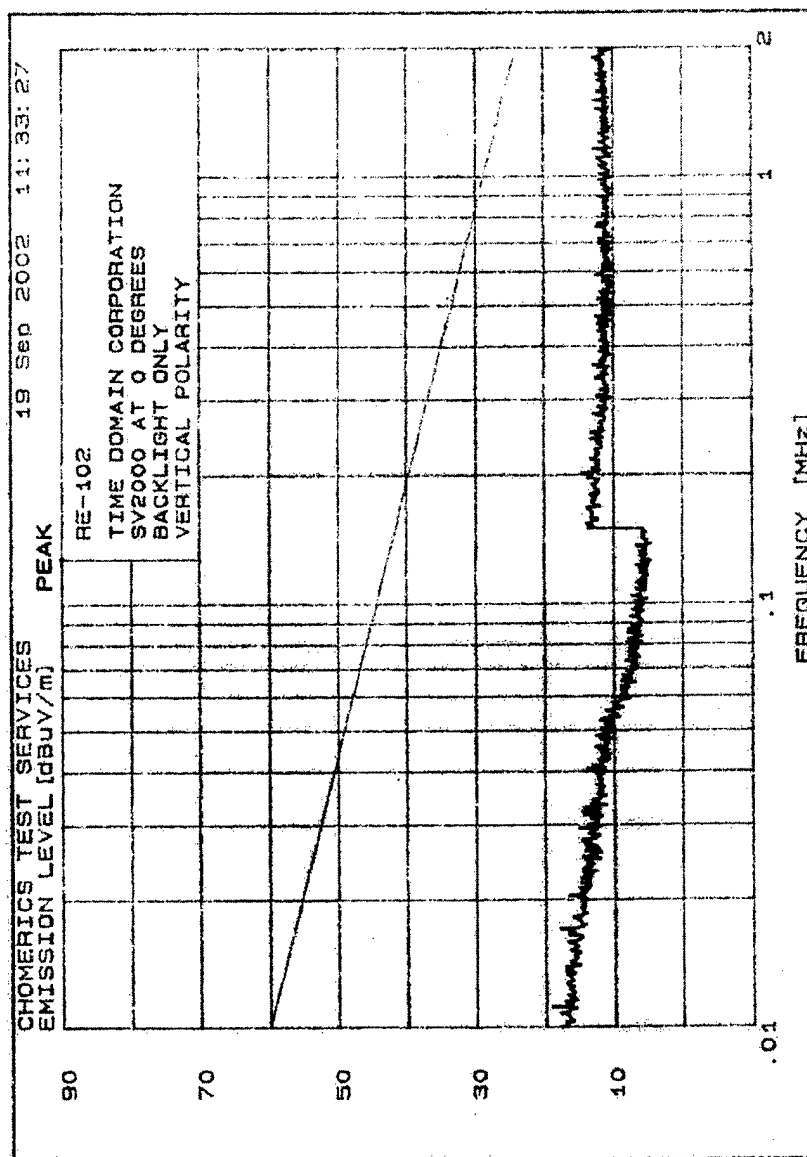
2.1.4 Results

The Time Domain SV2000 fails the radiated electric field requirements of MIL-STD 461E.

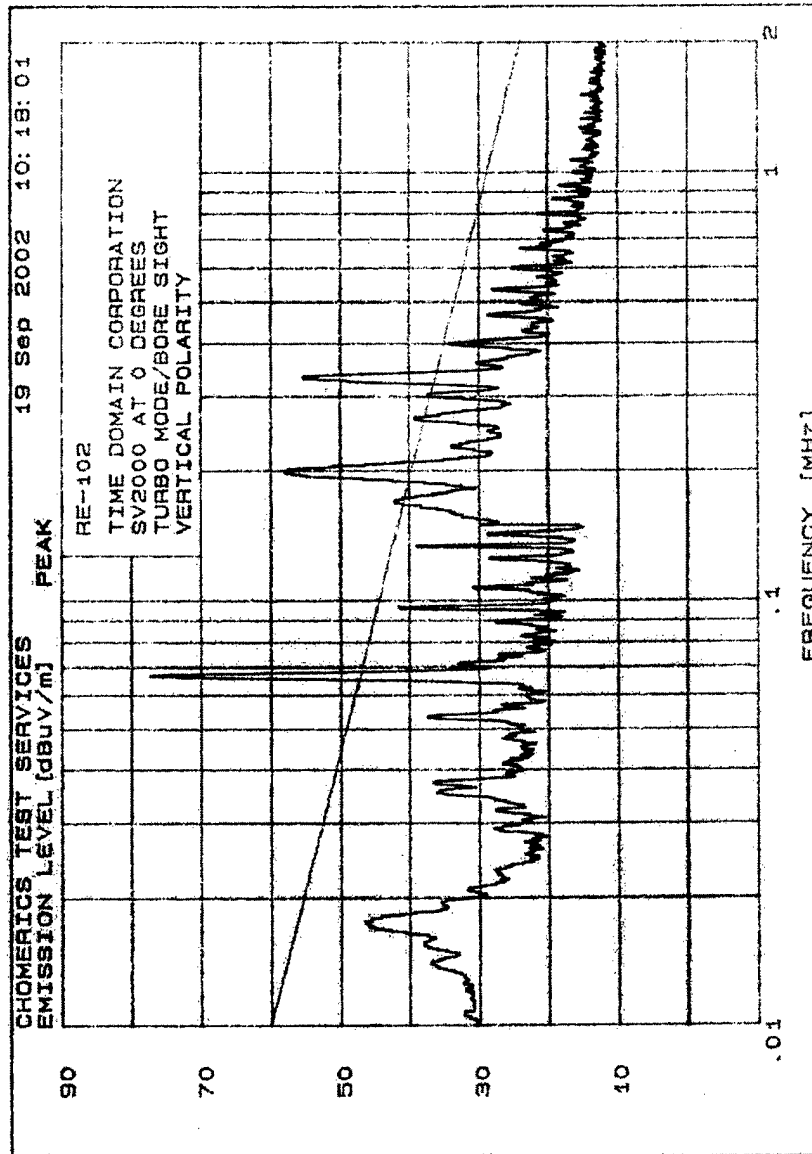
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2.1.5 Test Data

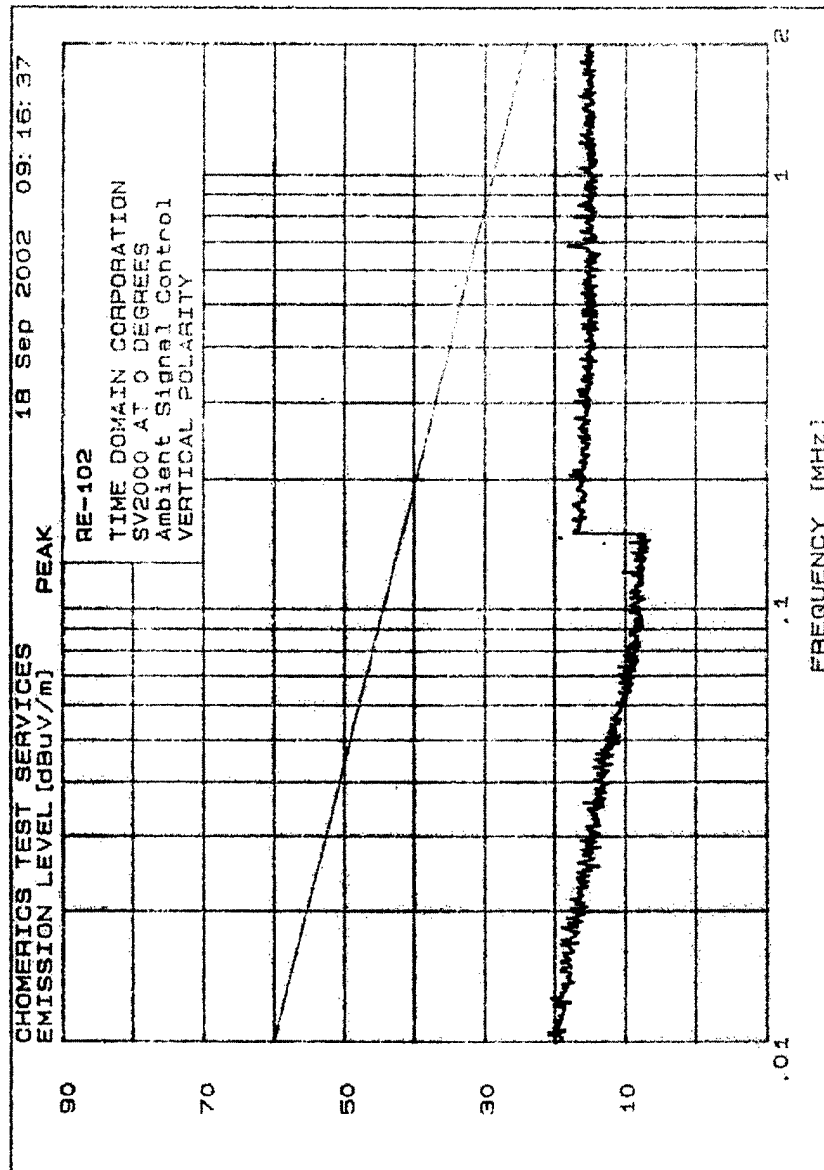


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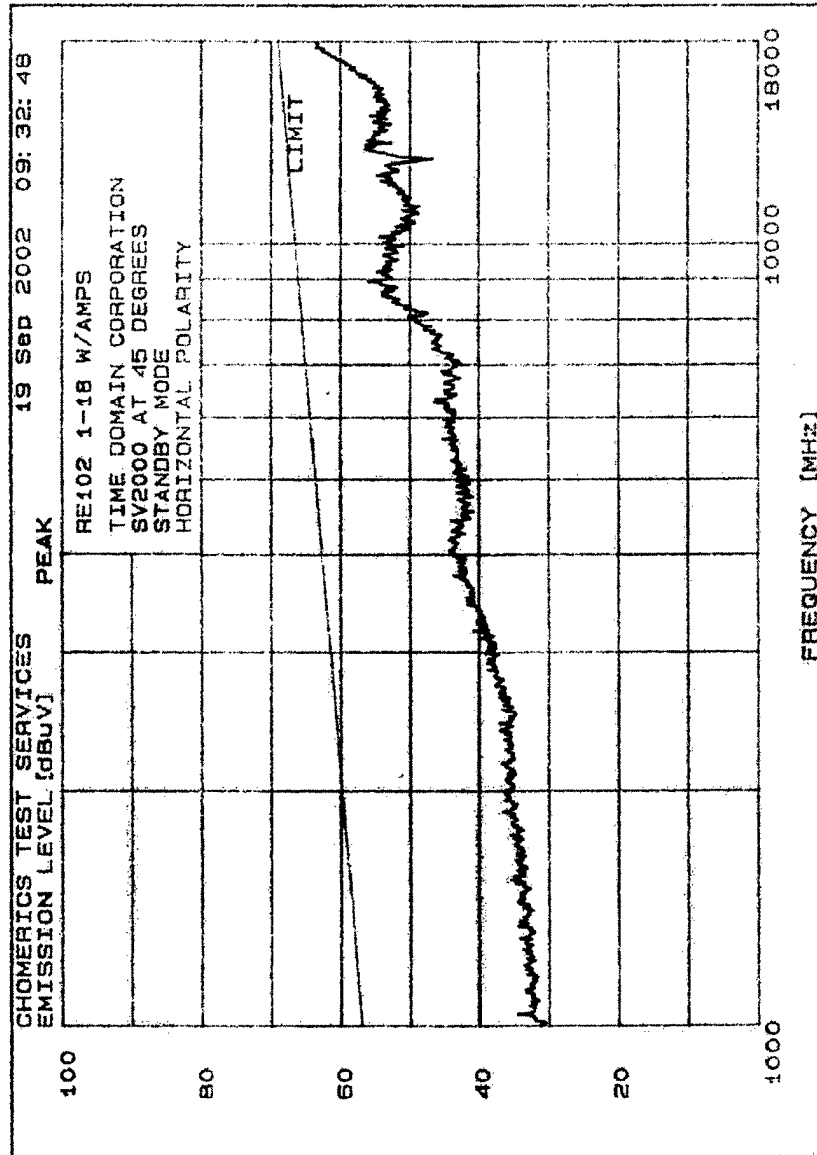
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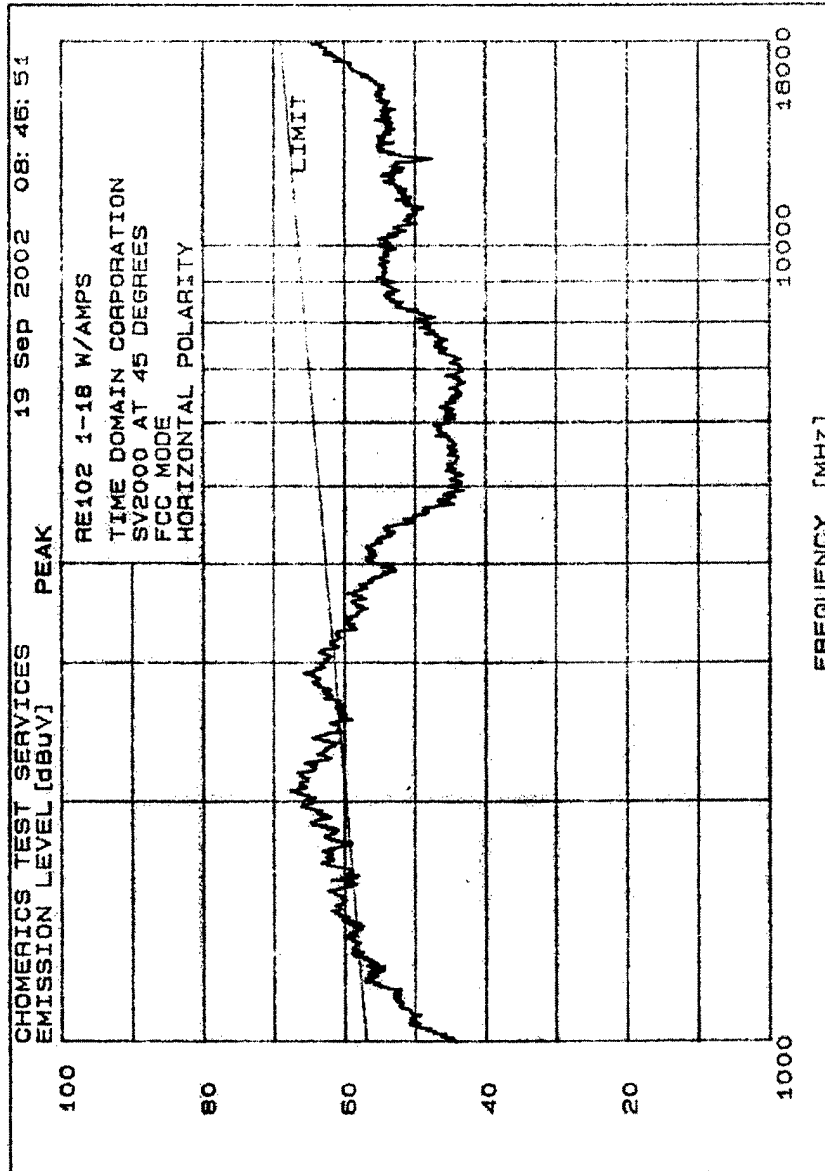
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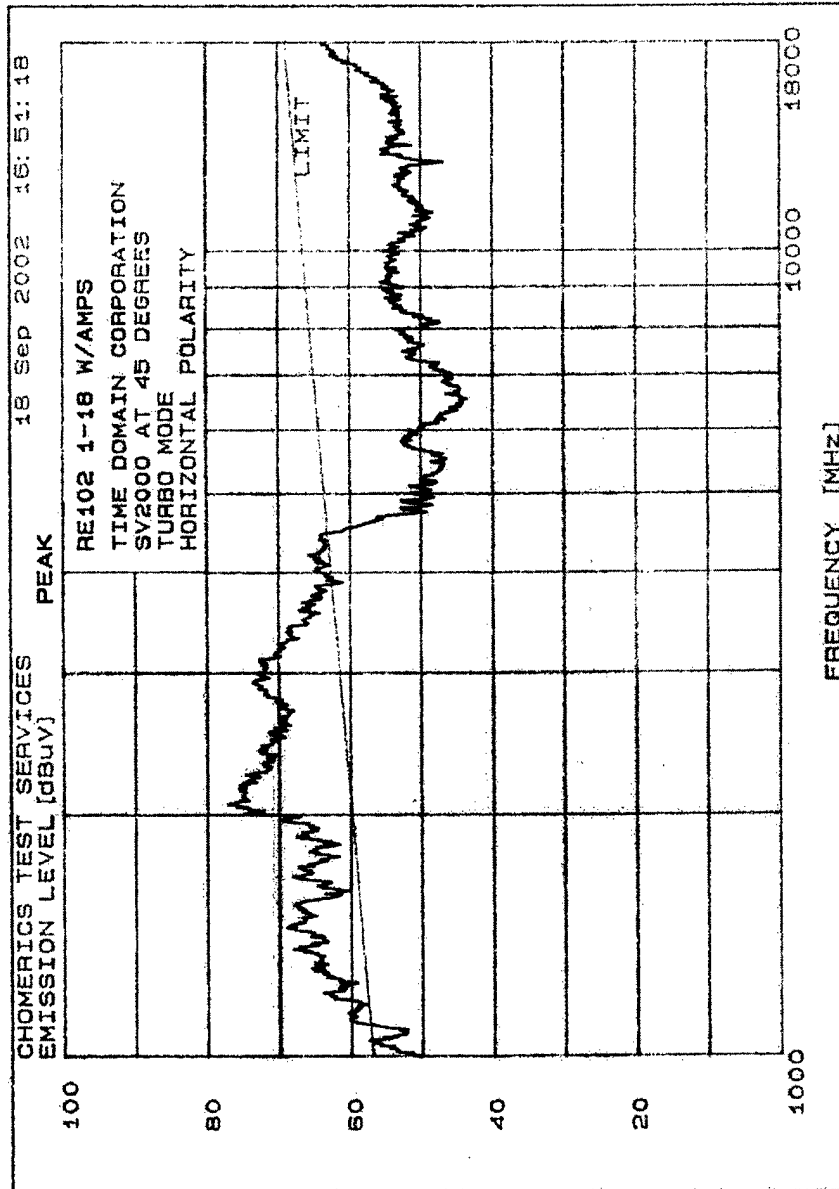
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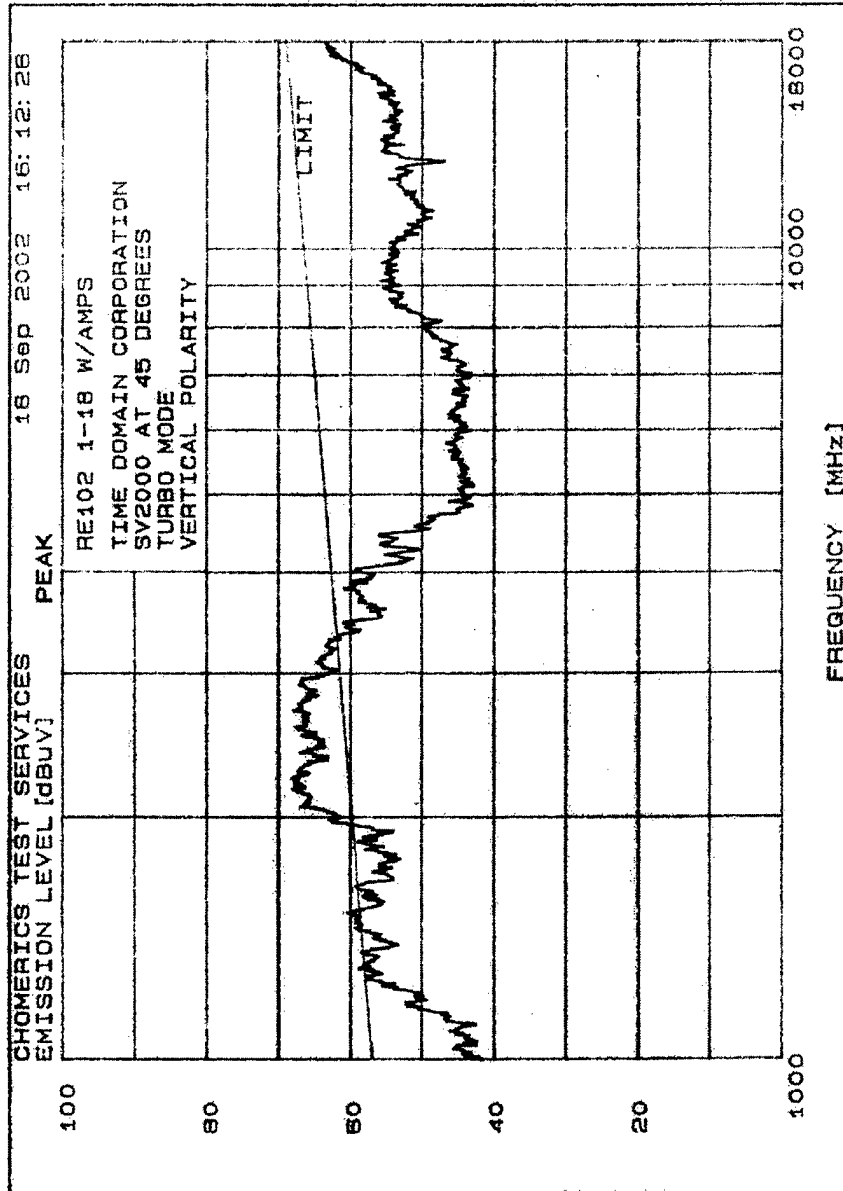
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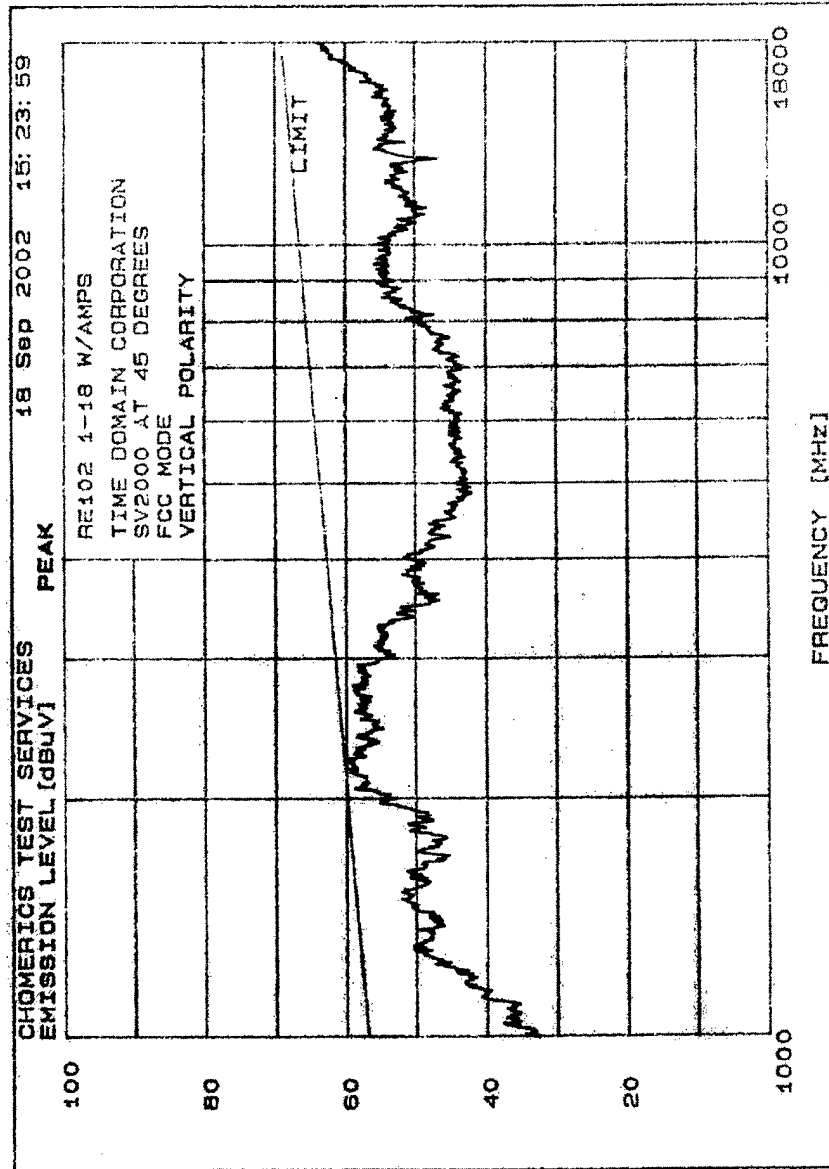
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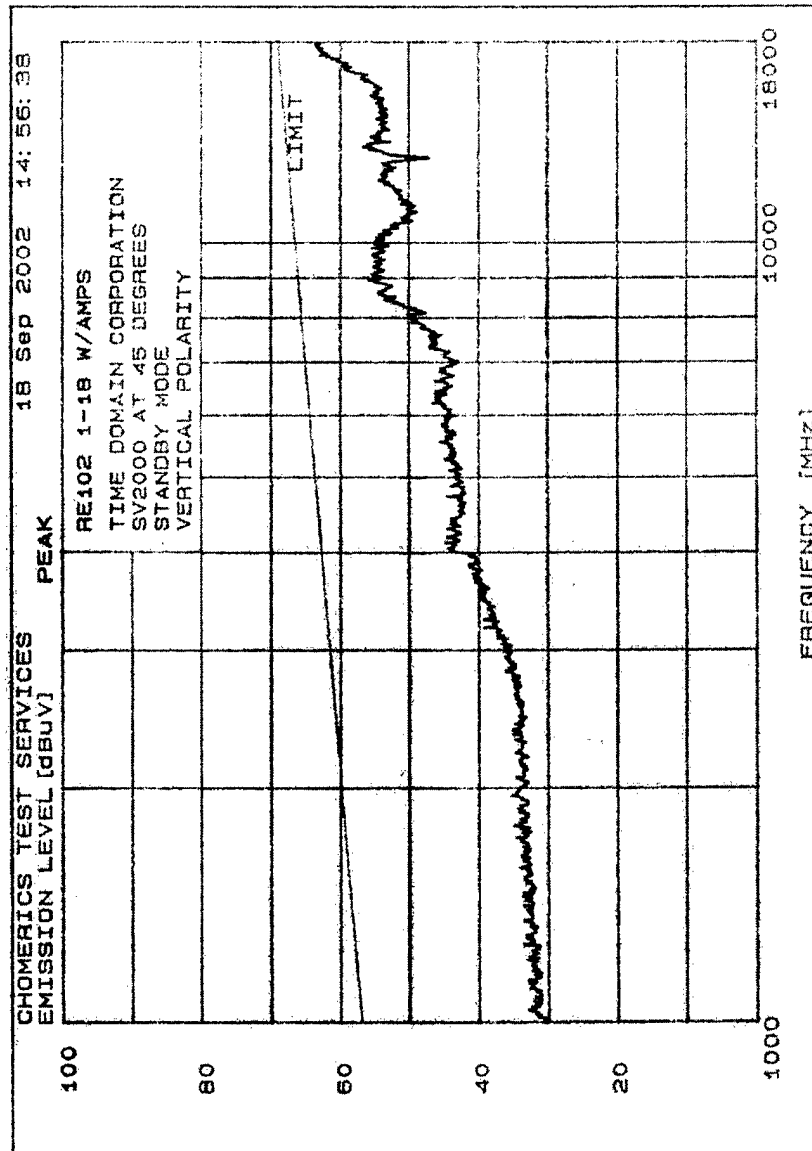


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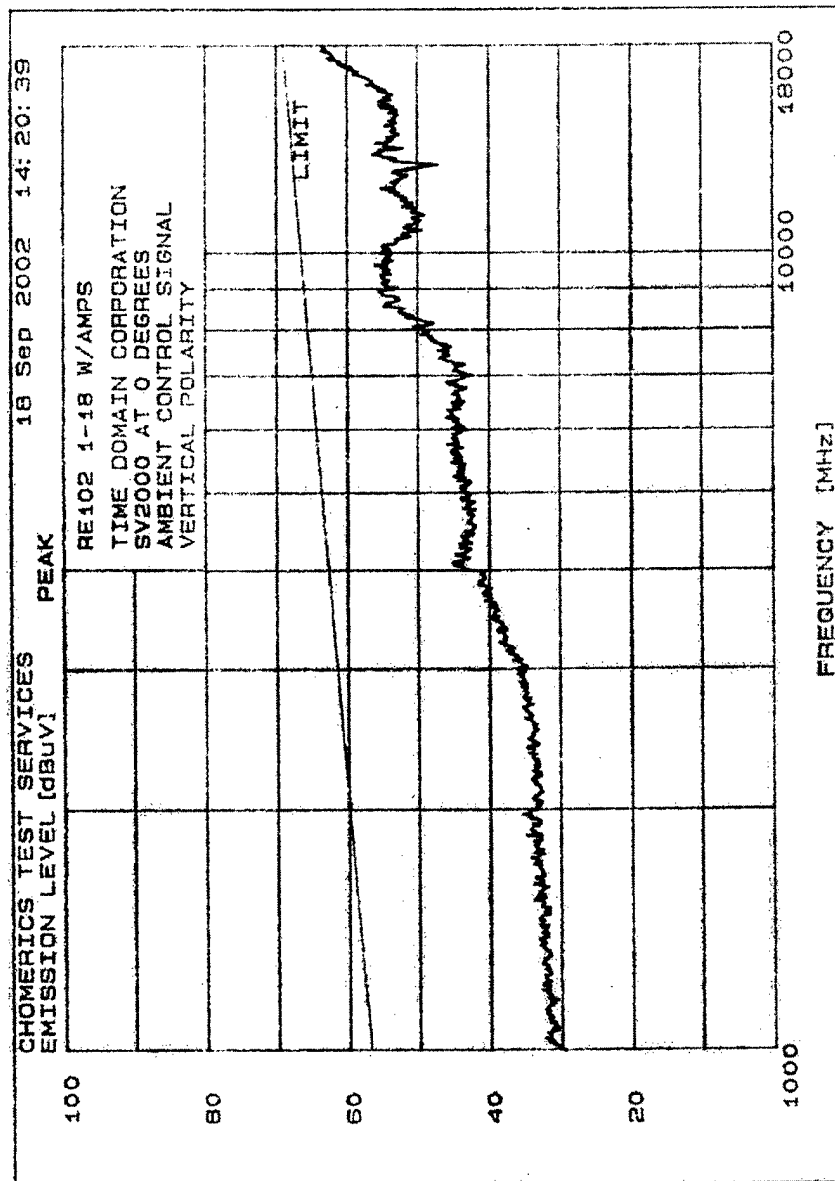


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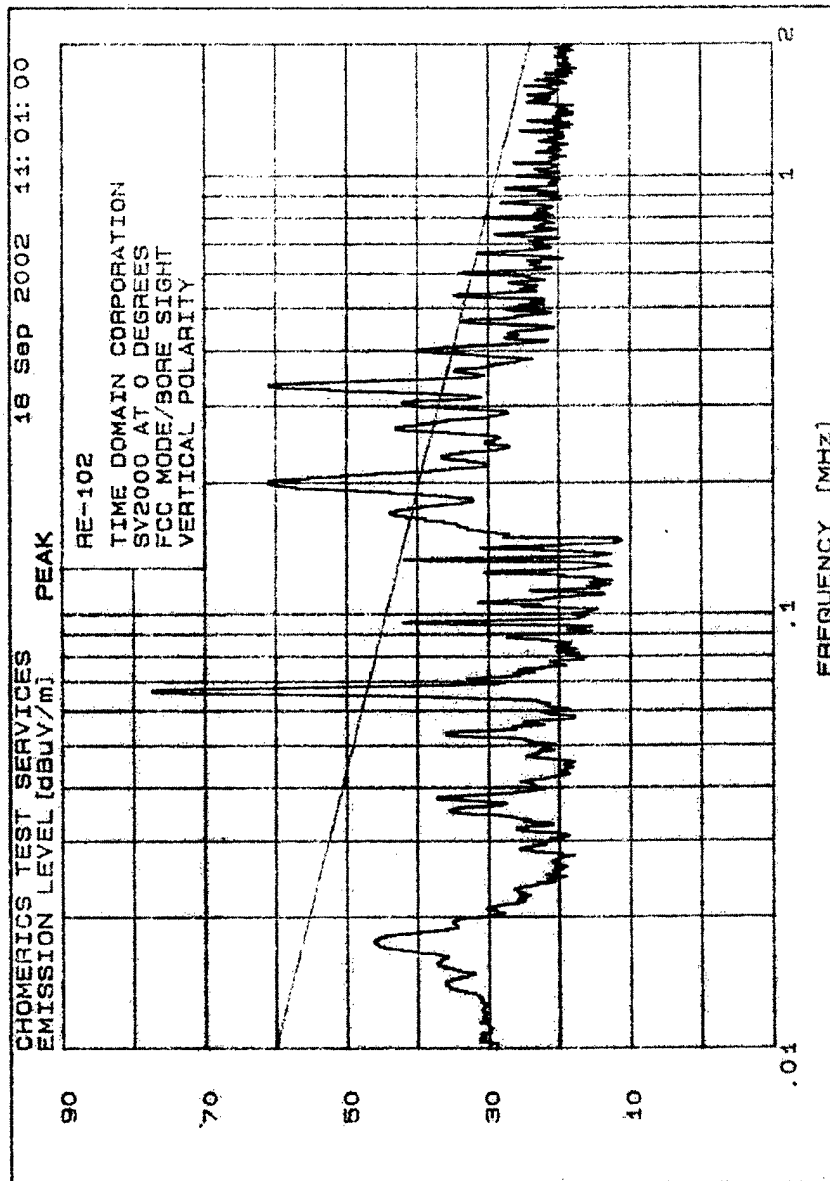
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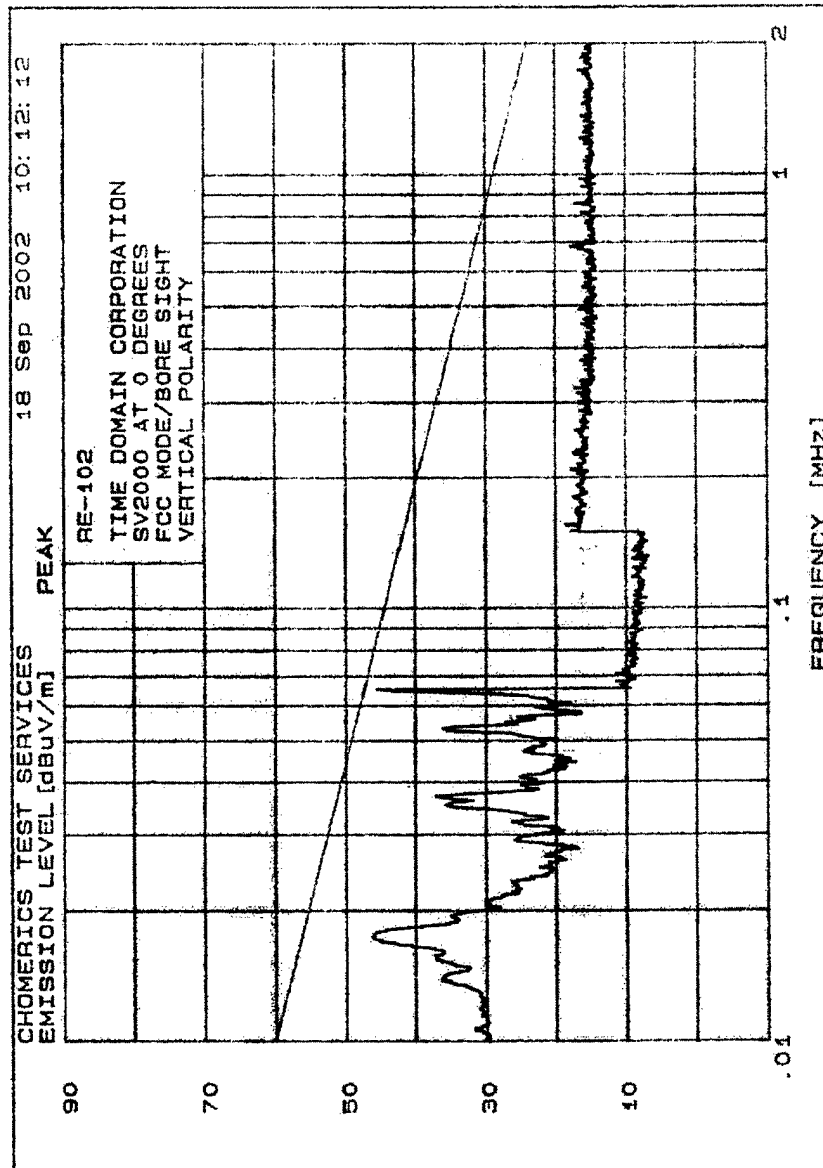
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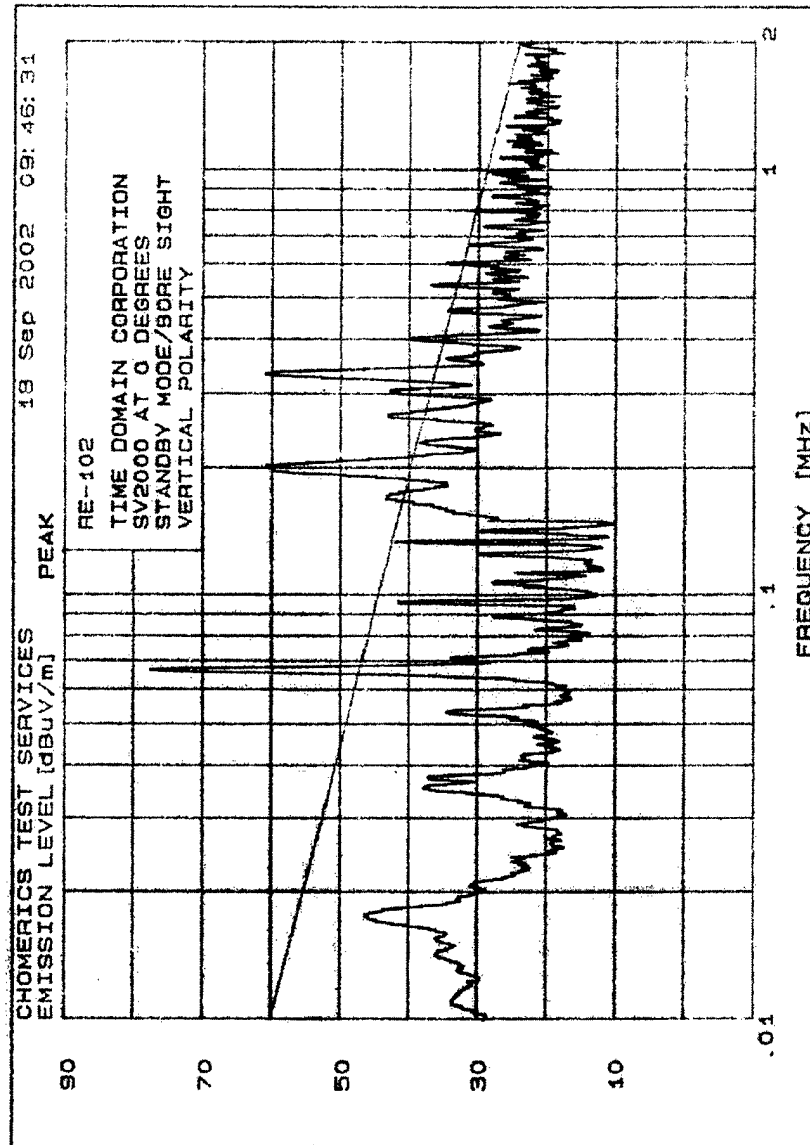


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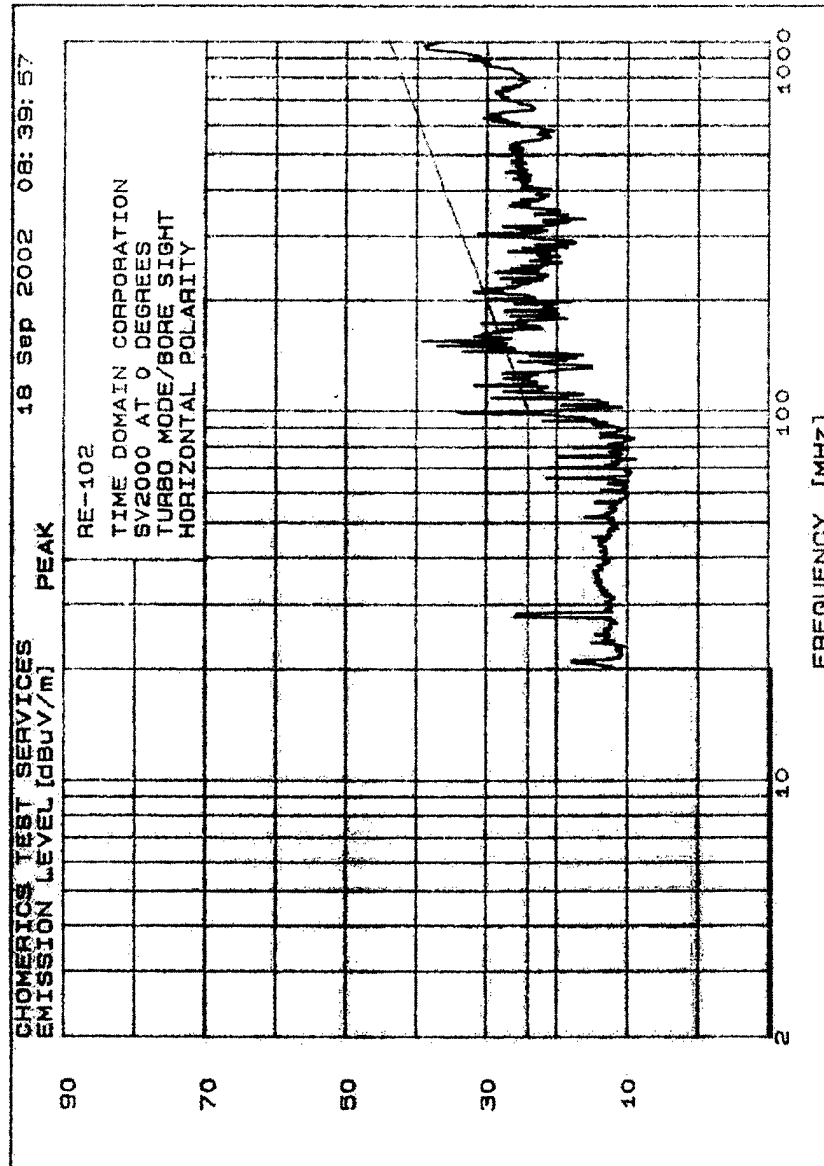


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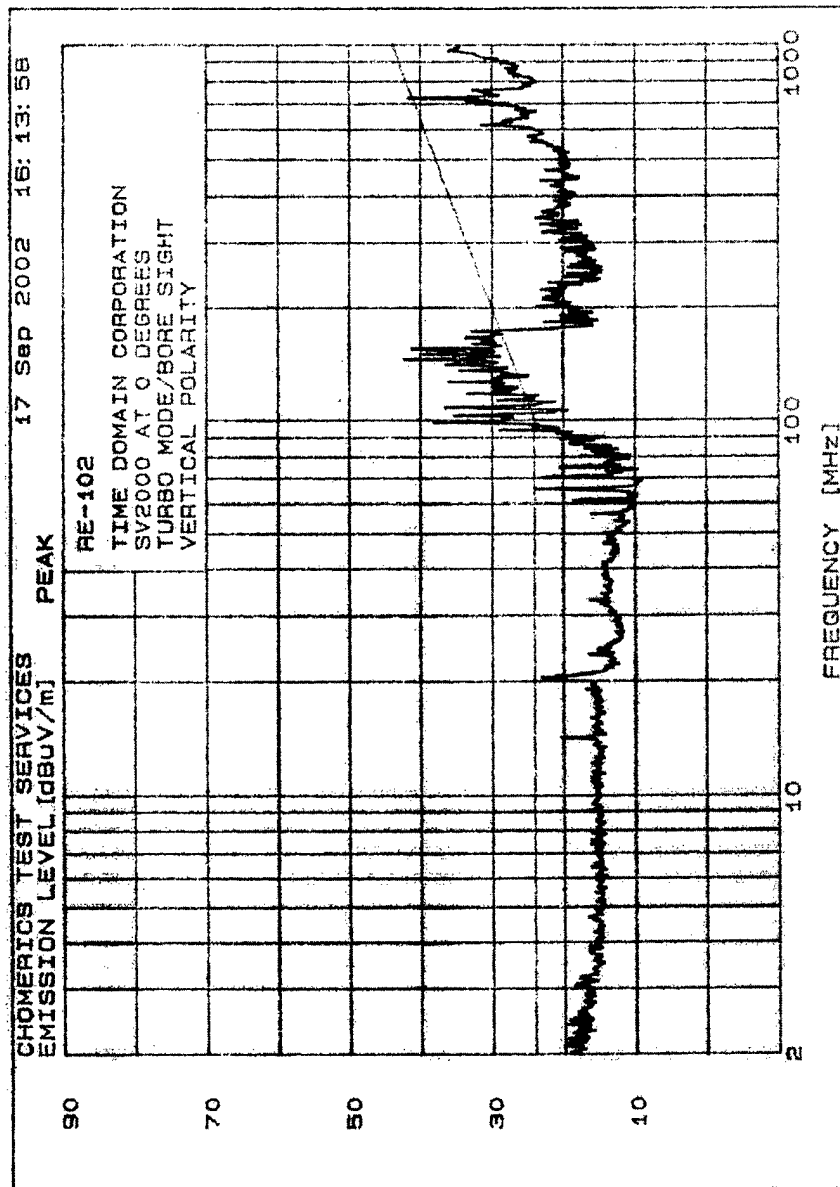
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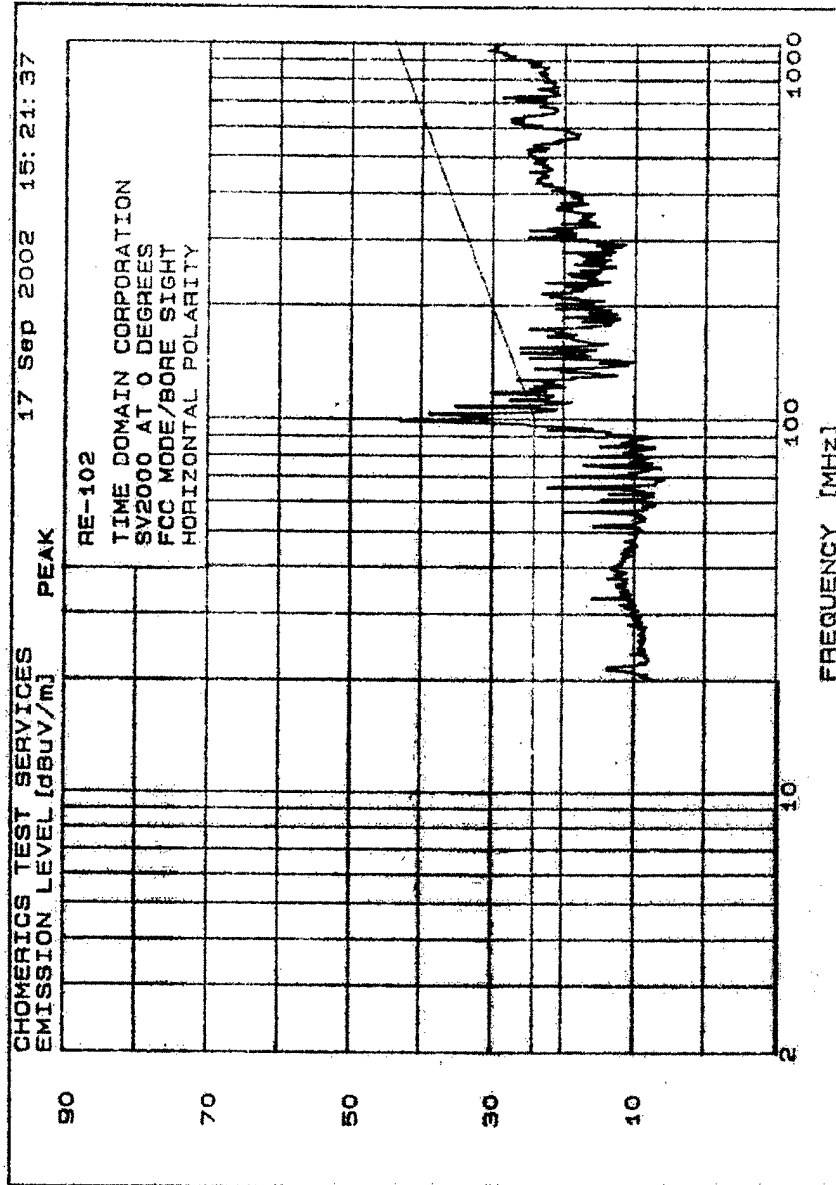
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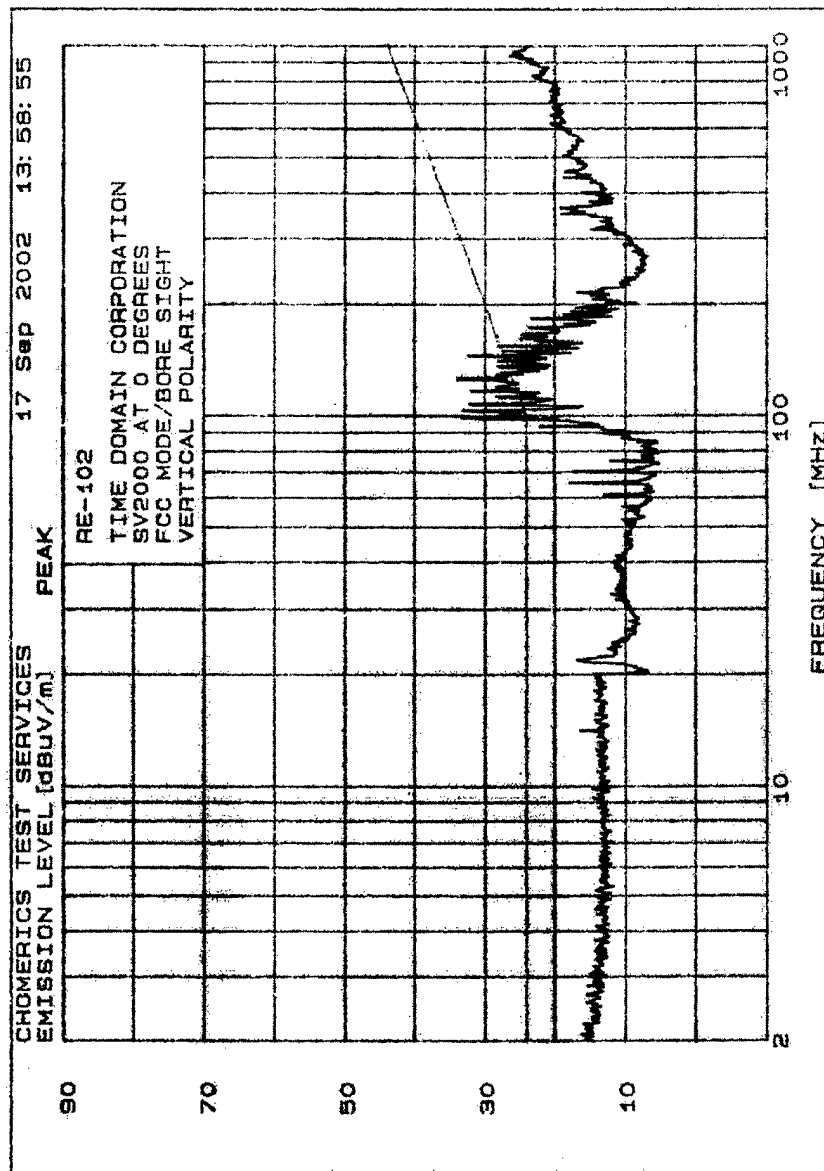
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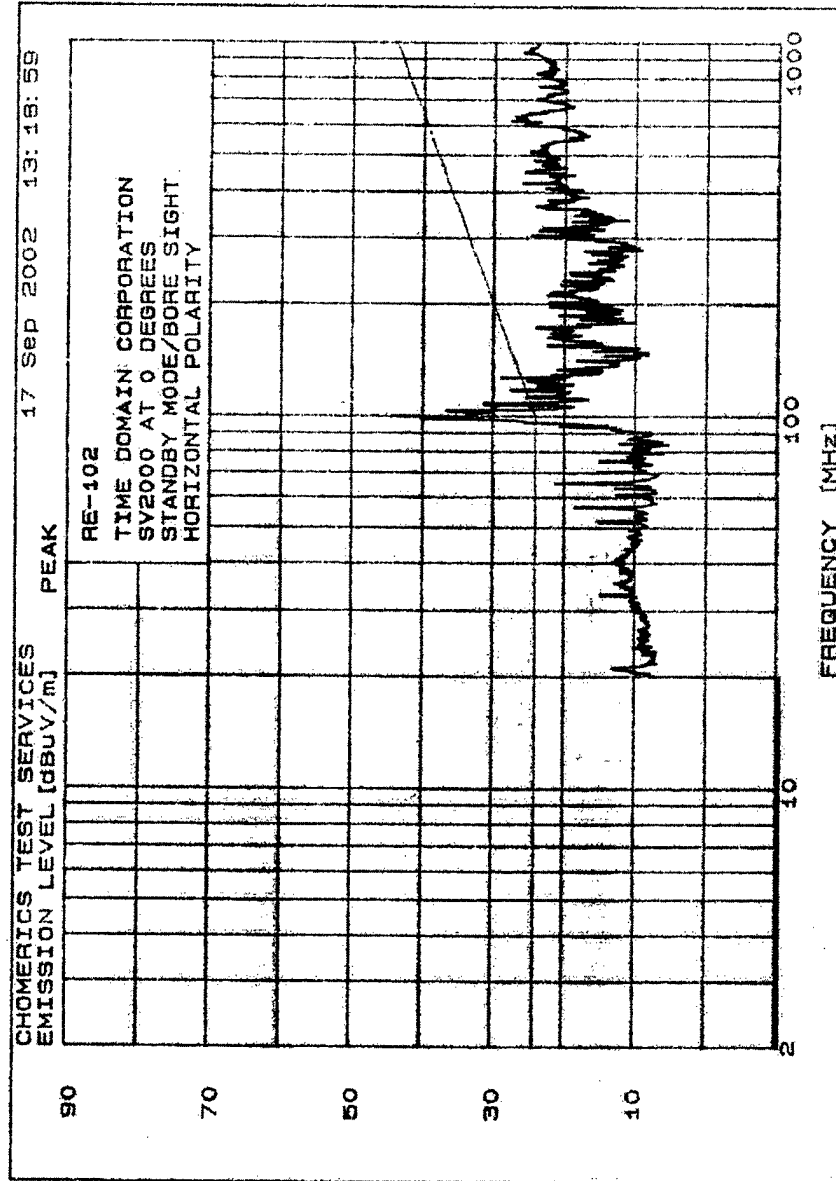
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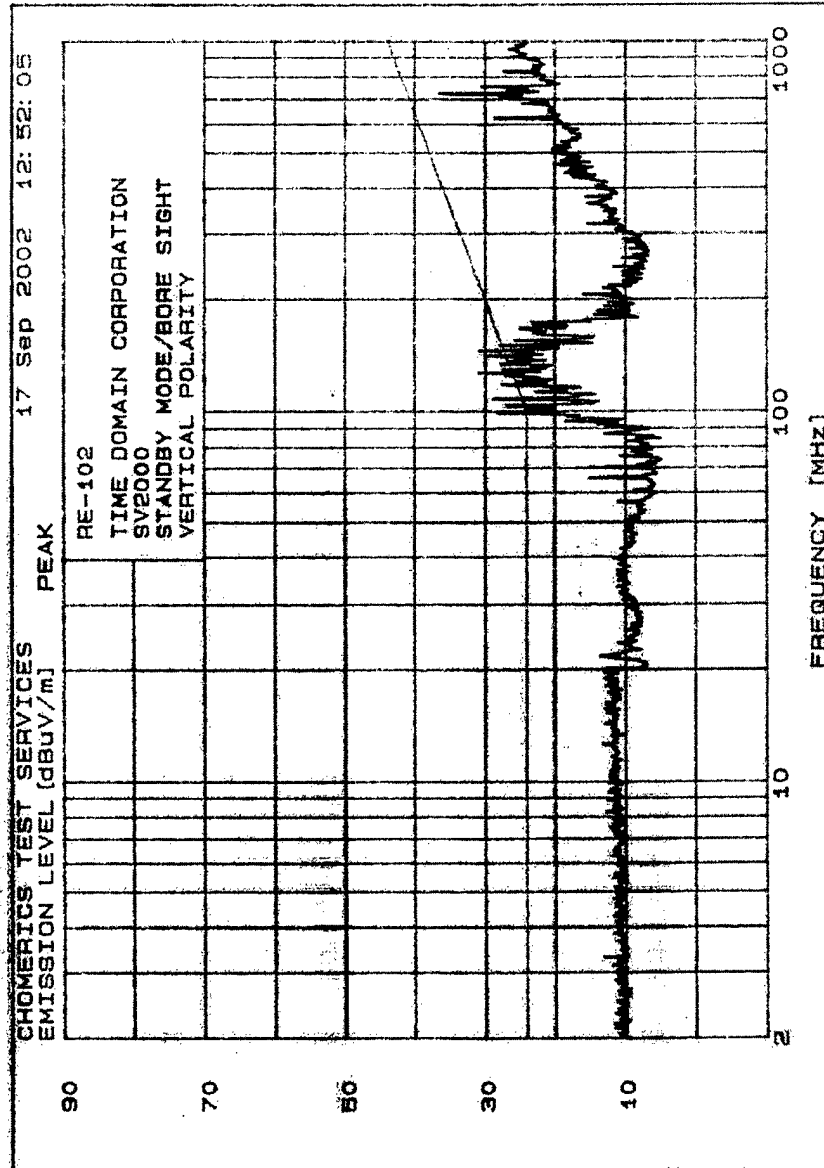
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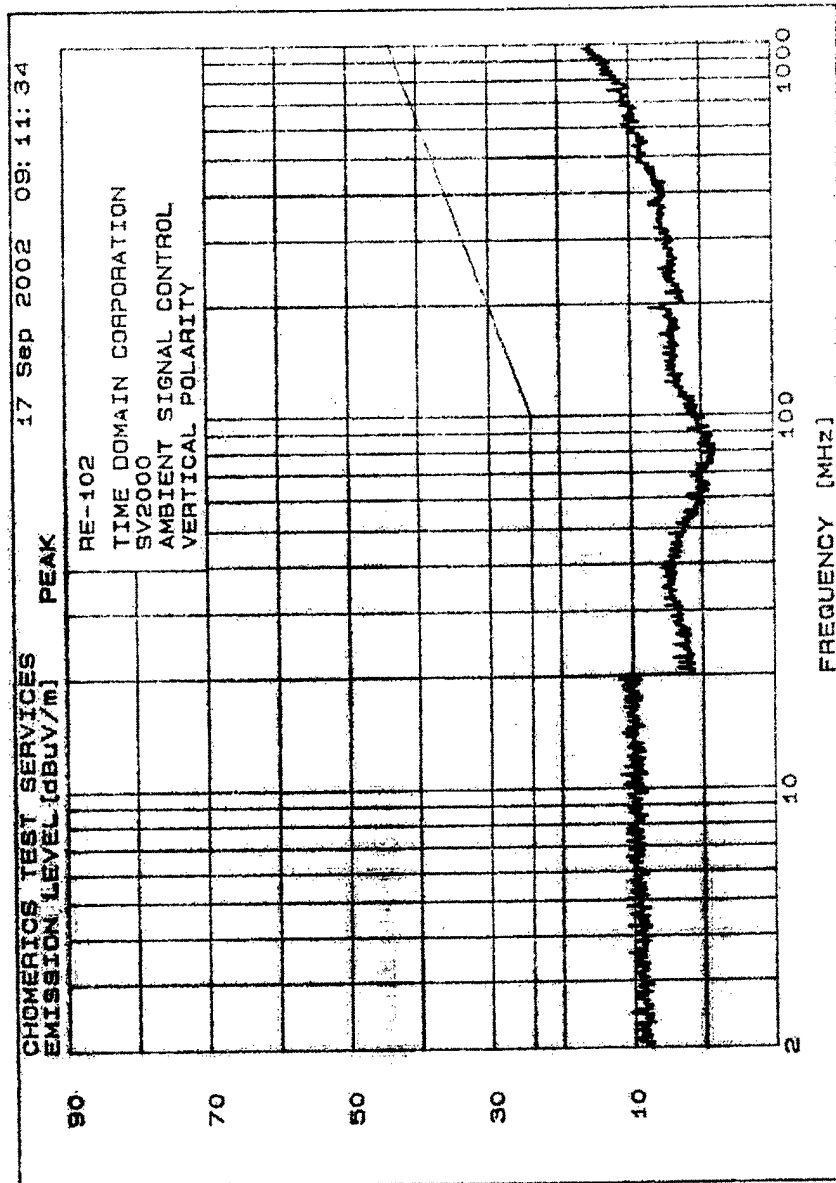
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CHOMERICS

Parker Seals

TEST SERVICES

2.1.6 Photographic Documentation

CUSTOMER: TIME DOMAIN

EQUIPMENT: SV2000

TESTED BY: MANUEL MARTINEZ

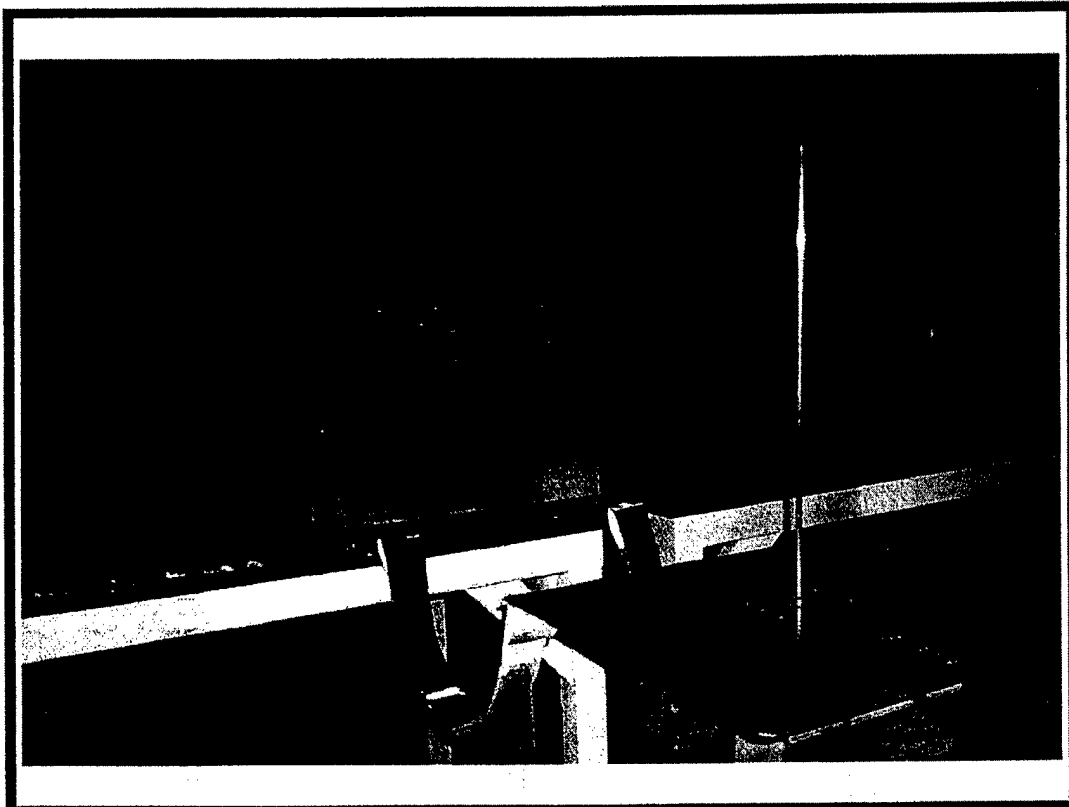
OPERATING MODE: STANDBY, FCC AND TURBO

DATE: 09/17/02 - 09/19/02

TEST NUMBER: ONE (1)

COUPLING DEVICE: MONOPOLE ANTENNA

TEST SPEC: RE-102



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

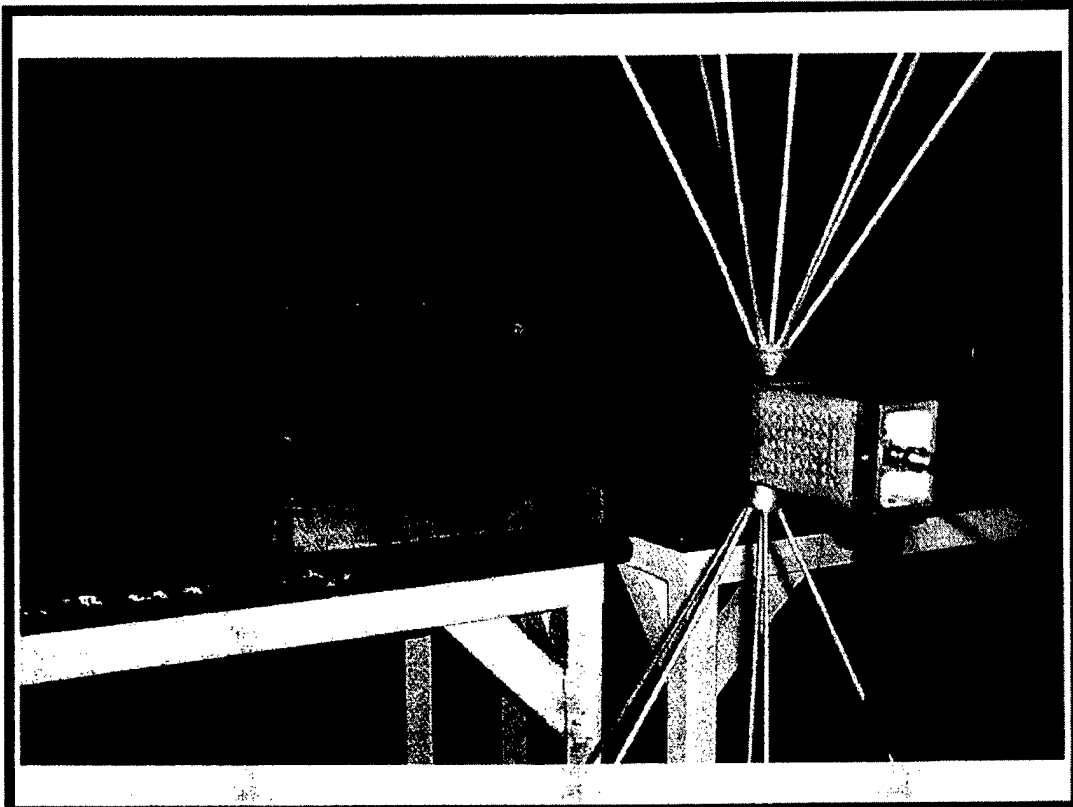
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TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: MANUEL MARTINEZ
OPERATING MODE: STANDBY, FCC AND TURBO

DATE: 09/17/02 - 09/19/02
TEST NUMBER: ONE (1)
COUPLING DEVICE: BICONICAL ANTENNA
TEST SPEC: RE-102



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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CHOMERICS

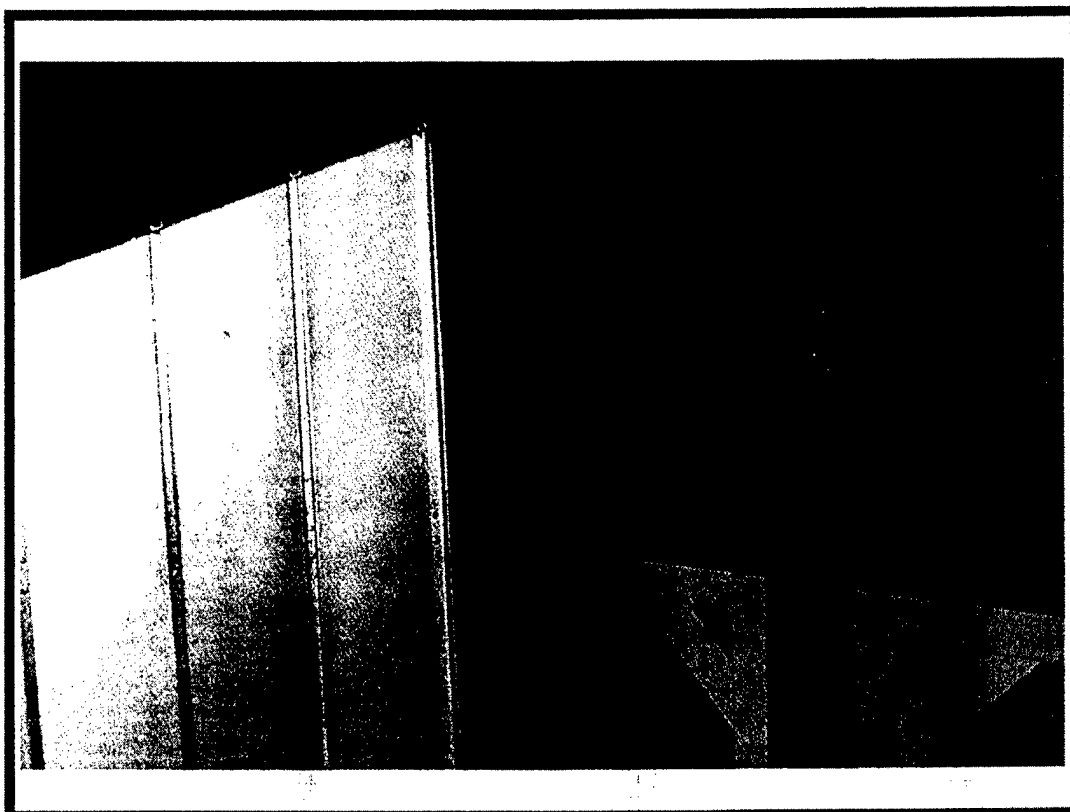
Parker Seals

TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: MANUEL MARTINEZ

DATE: 09/17/02 - 09/19/02
TEST NUMBER: ONE (1)
COUPLING DEVICE: LARGE RIDGED GUIDE HORN
ANTENNA
TEST SPEC: RE-102

OPERATING MODE: STANDBY, FCC AND TURBO



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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TEST SERVICES

2.2 RS103 - Radiated Susceptibility, Electric Field (1MHz to 40GHz)

2.2.1 Equipment Used

	Test Equipment	Asset #	Serial #	Cal Date
X	HP 3326A Signal Generator	37	2519A007503	4/03
X	HP 83640A Signal Generator	38	3009A00188	4/03
X	RF Power Labs PreAmp	563	N/A	NCR
X	Logimetrics A300L Amplifier	135	3091	NCR
X	Logimetrics A300/S-08 Amplifier	133	3016	NCR
X	Logimetrics A300/LJ Amplifier	134	3094	NCR
X	Tektronix 496 Spectrum Analyzer	77	B020852	12/02
X	AR 30W1000M7 Amplifier	480	15657	NCR
X	AR FM2000 Isolated Field Monitor	39	13009	4/03
X	AR FP2000 Isolated Field Probe	40	12914	4/03
X	AR 888 Leveling Preamplifier	491	15606	NCR
X	Narda 8616 Radiation Hazard Meter	417	27087	7/03
X	Narda 8621D Radiation Hazard Probe	428	27072	7/03
X	Tektronix TDS 380 Oscilloscope	516	B012231	4/03
X	IFI EFG-3B Billboard Antenna	122	453B	NCR
X	EMCO 3106 Double Ridge Guide Antenna	120	2212	1/03
X	EMCO 3115 Double Ridge Guide Antenna	376	2175	1/03
X	Solar 7012106R 10uF Capacitor	186	N/A	1/03
X	Solar 7012106R 10uF Capacitor	187	N/A	1/03
X	Solar 6512-106R 10uF Capacitor	389	N/A	1/03
X	Solar 6512-106R 10uF Capacitor	387	N/A	1/03
X	Solar LISN 8028-50TS-24-BNC	385	8379275	1/03
X	Solar LISN 8028-50TS-24-BNC	381	852334	1/03
X	Solar LISN 8028-50TS-24-BNC	384	8305125	1/03
X	Solar LISN 8028-50TS-24-BNC	382	860622	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	584	NA	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	585	NA	1/03
X	Bird 10-T-MN 10 watt 50 Ohm load	594	NA	1/03

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TEST SERVICES

2.2.2 Test Conditions

The test conditions were set up in accordance with MIL-STD 461E and method RS103 of MIL-STD 461E.

The SV2000 was configured to operate in the standby, FCC and turbo modes. The SV2000 was set up and powered by battery and exposed to the radiating antenna.

2.2.3 Measurements

With the Time Domain SV2000 operating, the frequency range of 1MHz to 40GHz was swept at a time of 10 minutes per decade.

The levels generated in volts per meter are given below.

ELECTRIC FIELD

<u>Frequency MHz</u>	<u>Field level V/m</u>
1 - 300	50
300 - 3000	10
3000 - 40000	50

The SV2000 was exposed to the required electric fields and monitored by Keven Trach of Time Domain and Manuel Martinez of Chomerics Test Services. Modulation was a 1kHz square wave at 50% duty cycle.

1MHZ TO 200MHZ: A manual scan was performed at a rate of 10 minutes per decade in this frequency range. A parallel plate billboard style antenna was used to generate a linearly polarized homogeneous electric field. The level was monitored with an electric field intensity meter with fiber optic coupler.

200MHZ TO 1000MHZ: A manual scan was performed at a rate of 10 minutes per decade in this frequency range. A log periodic antenna was used to generate a linearly polarized electric field. The level was monitored with an electric field intensity meter with fiber optic coupler. The test was performed in both vertical and horizontal polarities.

1000MHZ TO 40000MHZ: A manual scan was performed at a rate of 10 minutes per decade in this frequency range. Two double ridged guide antennas were used to generate a linearly polarized electric field. The level was determined by monitoring the field with a calibrated field strength meter. The test was performed in both vertical and horizontal polarities.

2.2.4 Results

The Time Domain SV2000 passes the electromagnetic field immunity requirements of MIL-STD 461E per customer pass/fail criteria. Changes in operation of the Time Domain SV2000 were detected. The EUT shutdown when the electromagnetic field was applied but recovered operation when the field was shut off.

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TEST SERVICES

2.2.5 Test Data

SUSCEPTIBILITY/IMMUNITY TEST DATA (RADIATED)

CUSTOMER: TIME DOMAIN

DATE: 09/20/02

EQUIPMENT: SV2000

TEST NUMBER: TWO (2)

TESTED BY: MANUEL MARTINEZ

COUPLING DEVICE: BILLBOARD, LOG PERIODIC AND
DOUBLE RIDGED GUIDE ANTENNAS

OPERATING MODE: STANDBY, FCC AND TURBO

TEST SPEC: RS-103

TEST FREQUENCY MHz	SIGNAL LEVEL UNITS V/M (MINIMUM)	SIGNAL MODULATION 1kHz 50% PM	ANTENNA POLARIZATION (H/V)	REMARKS
1	50	Yes	V	Pass
↓	50	Yes	V	Pass
20	50	Yes	V	Pass
20	50	Yes	V	Pass*
↓	50	Yes	V	Pass*
300	50	Yes	V	Pass*
300	10	Yes	V	Pass
↓	10	Yes	V	Pass
3000	10	Yes	V	Pass
3000	50	Yes	V	Pass
↓	50	Yes	V	Pass
40,000	50	Yes	V	Pass

P = PASS

F = FAIL

Ambient Temperature: 70°F

Humidity: 63%

Atmospheric Pressure: 30.4"

* The EUT shutdown when the electromagnetic field was applied but recovered operation when the field was shut off.

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Date: November 21, 2002

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TEST SERVICES

SUSCEPTIBILITY/IMMUNITY TEST DATA (RADIATED)

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: MANUEL MARTINEZ

DATE: 09/20/02
TEST NUMBER: TWO (2)
COUPLING DEVICE: BILLBOARD, LOG PERIODIC AND
DOUBLE RIDGED GUIDE ANTENNAS
TEST SPEC: RS-103

OPERATING MODE: STANDBY, FCC AND TURBO

TEST FREQUENCY MHz	SIGNAL LEVEL UNITS V/M	SIGNAL MODULATION 1kHz 50% PM	ANTENNA POLARIZATION (H/V)	REMARKS
1	50	Yes	H	Pass
↓	50	Yes	H	Pass
20	50	Yes	H	Pass
20	50	Yes	H	Pass*
↓	50	Yes	H	Pass*
300	50	Yes	H	Pass*
300	10	Yes	H	Pass
↓	10	Yes	H	Pass
3000	10	Yes	H	Pass
3000	50	Yes	H	Pass
↓	50	Yes	H	Pass
40,000	50	Yes	H	Pass

P = PASS

F = FAIL

Ambient Temperature: 70°F

Humidity: 63%

Atmospheric Pressure: 30.4"

* The EUT shutdown when the electromagnetic field was applied but recovered operation when the field was shut off.

FORM CTS-DS-008

Time Domain SV2000
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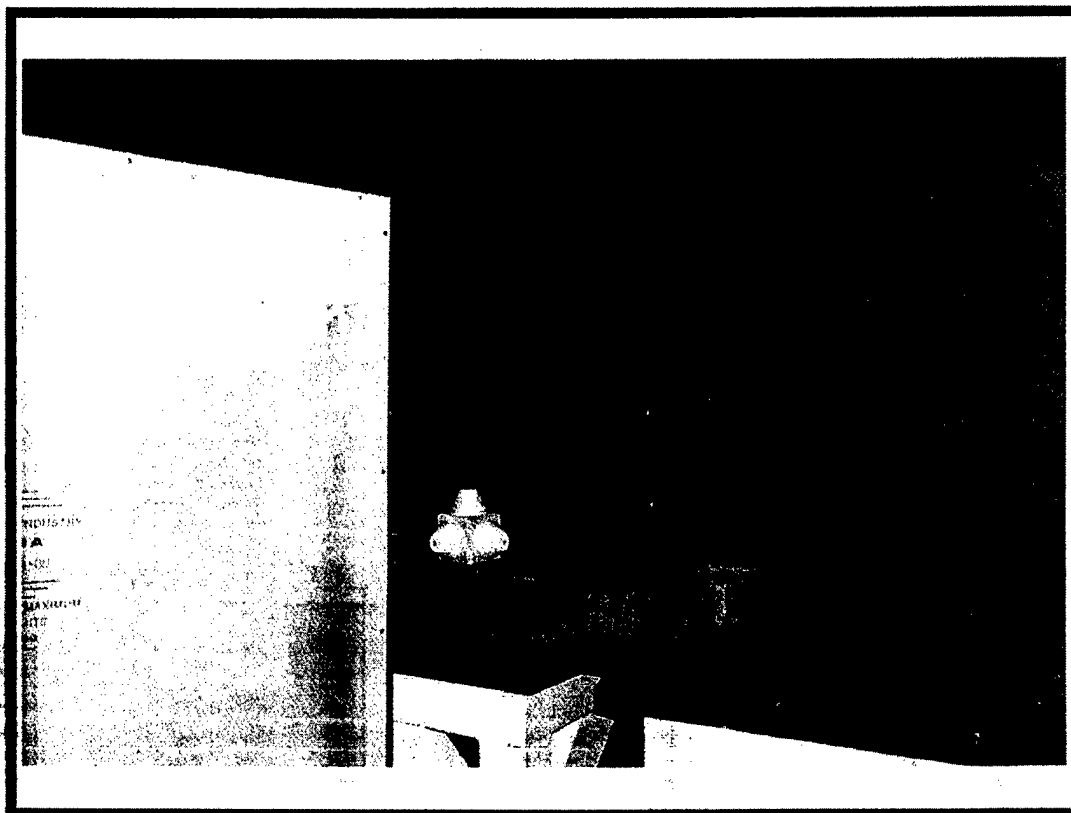
TEST SERVICES

2.2.6 Photographic Documentation

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: MANUEL MARTINEZ

OPERATING MODE: STANDBY, FCC AND TURBO

DATE: 09/20/02
TEST NUMBER: TWO (2)
COUPLING DEVICE: BILLBOARD, LOG PERIODIC AND
DOUBLE RIDGED GUIDE ANTENNAS
TEST SPEC: RS-103



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

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CHOMERICS

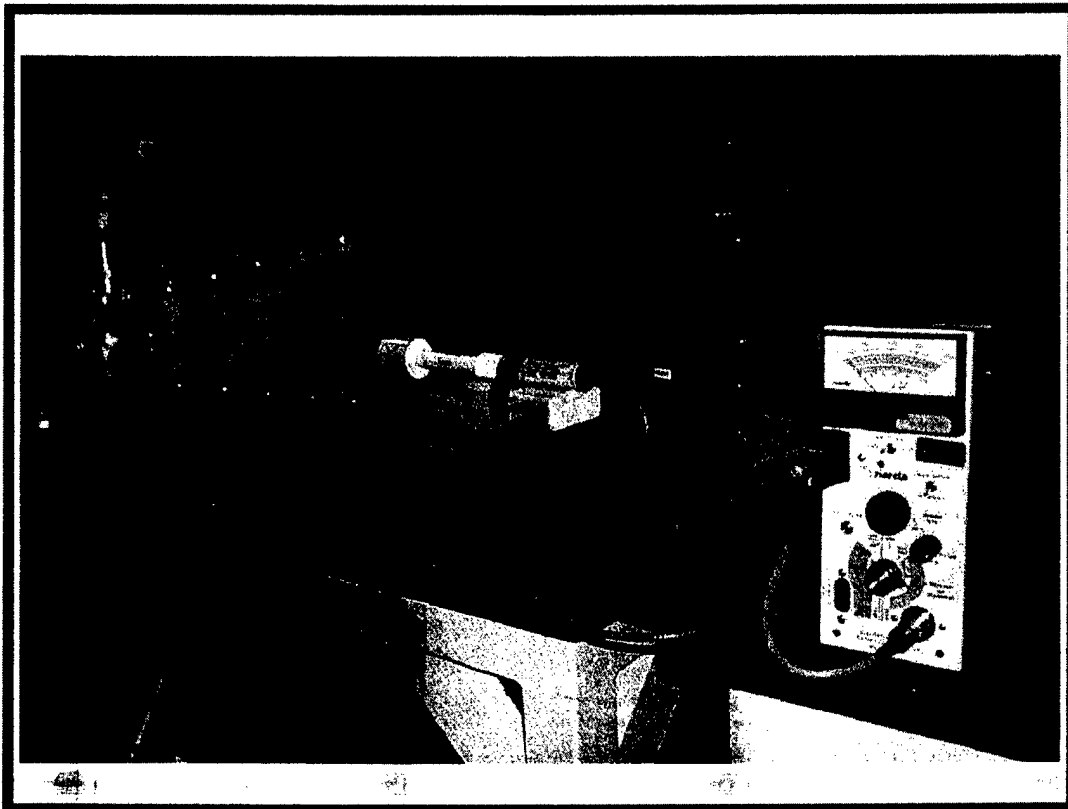
Parker Seals

TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: MANUEL MARTINEZ

DATE: 09/20/02
TEST NUMBER: Two (2)
COUPLING DEVICE: BILLBOARD, LOG PERIODIC AND
DOUBLE RIDGED GUIDE ANTENNAS
TEST SPEC: RS-103

OPERATING MODE: STANDBY, FCC AND TURBO



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
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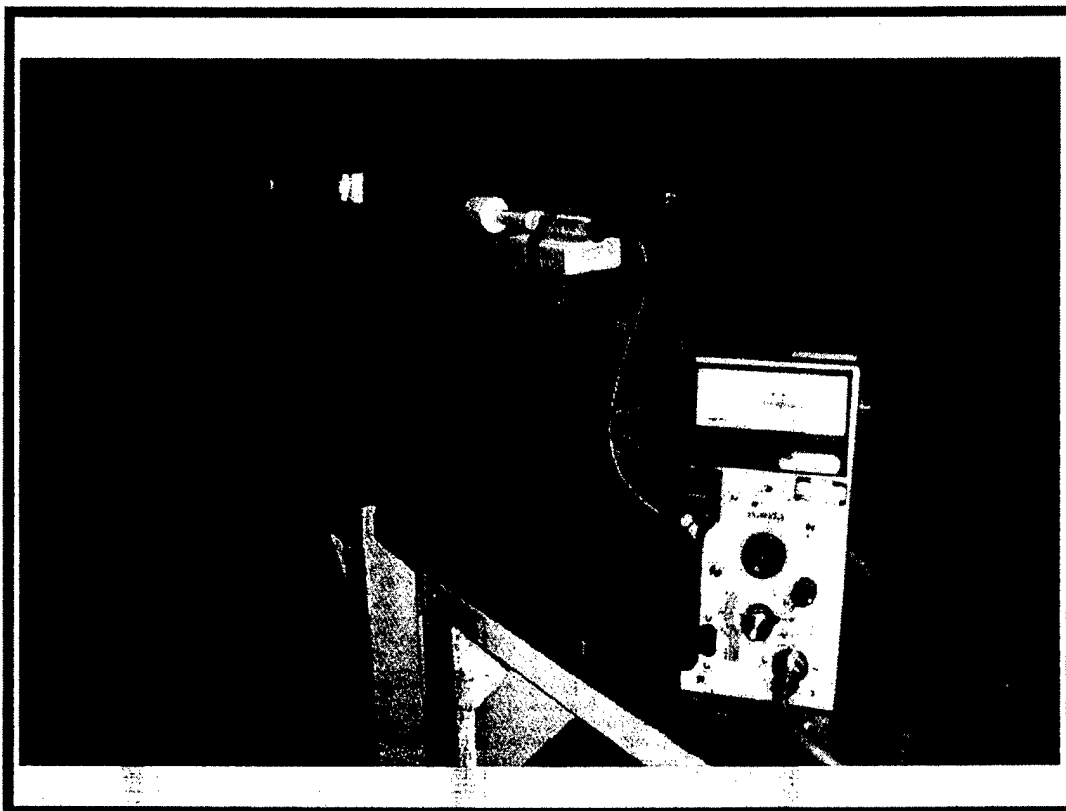


TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: MANUEL MARTINEZ

OPERATING MODE: STANDBY, FCC AND TURBO

DATE: 09/20/02
TEST NUMBER: TWO (2)
COUPLING DEVICE: BILLBOARD, LOG PERIODIC AND
DOUBLE RIDGED GUIDE ANTENNAS
TEST SPEC: RS-103



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
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TEST SERVICES

2.3 EIRP Effective Isotropic Radiated Power

2.3.1 Equipment Used

	Test Equipment	Asset #	Serial #	Cal Date
X	Emco 3115 Ridge Guide Horn Antenna	376	2796	1/03
X	Agilent E4440A Spectrum Analyzer	704	US41421236	1/03

2.3.2 Test Conditions

The test conditions were set up in accordance with EIA-TIA-603A. The SV2000 was set up on the wooden turntable located in Chomerics Open Area Test Site A. The receive antenna was placed three meters from the SV200. The SV2000 was set up and powered by battery for EIRP test.

2.3.3 Test Method

The SV2000 was placed in the transmitting mode of operation. The wooden turntable was rotated 360° to measure and record the worst-case emission. The signal was measured by a spectrum analyzer with a resolution bandwidth of 1MHz and a video bandwidth of 10kHz. The EIRP was measured with the SV2000 in the Operational and Turbo State.

The EIRP was calculated by measuring the peak output power of the emission with a 1MHz resolution bandwidth and adding cable loss and antenna factor.

2.3.4 Results

The Time Domain SV2000 EIRP is listed on the test data sheet.

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TEST SERVICES

2.3.5 Test Data

EFFECTIVE ISOTROPIC RADIATED POWER TEST DATA

CUSTOMER: TIME DOMAIN

DATE: 09/20/02

EQUIPMENT: SV2000

TEST NUMBER: THREE (3)

TESTED BY: ROBERT FOSTER

COUPLING DEVICE: EMCO 3115

OPERATING TURBO AND CONTINUOUS

Frequency MHz	Mode of Operation	Measured Field Strength	Cable Loss	Antenna Factor	EIRP
22147	Turbo	-59.81dBm	1.2	30.7	-27.9dBm/MHz
2129	Continuous	-70.07	1.2	30.7	-38.1dBm/MHz

Ambient Temperature: 70°F

Humidity: 63%

Atmospheric Pressure: 30.4"

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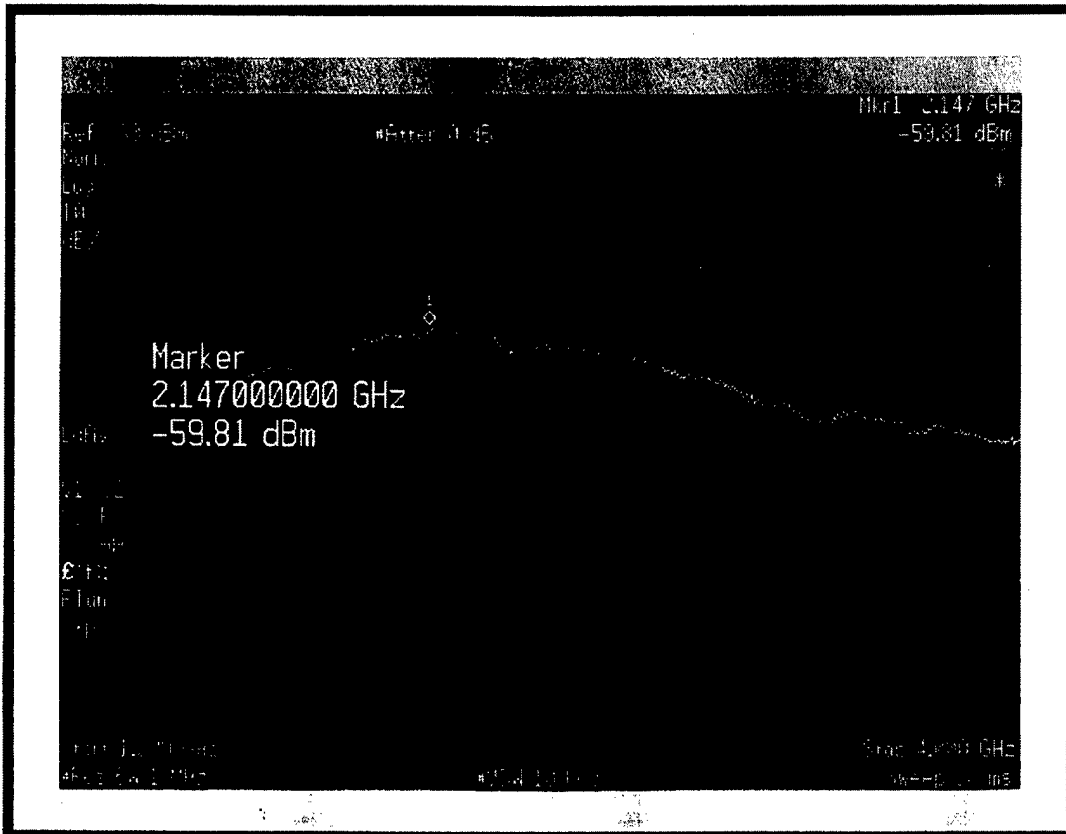
CHOMERICS

Parker Seals

TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: ROBERT FOSTER
OPERATING MODE: TURBO

DATE: 09/20/02
TEST NUMBER: THREE
COUPLING DEVICE: EMCO 3115
TEST SPEC: EIRP



Test Data

Time Domain SV2000
Document #: EMI3443.02 Rev. 1
Date: November 21, 2002

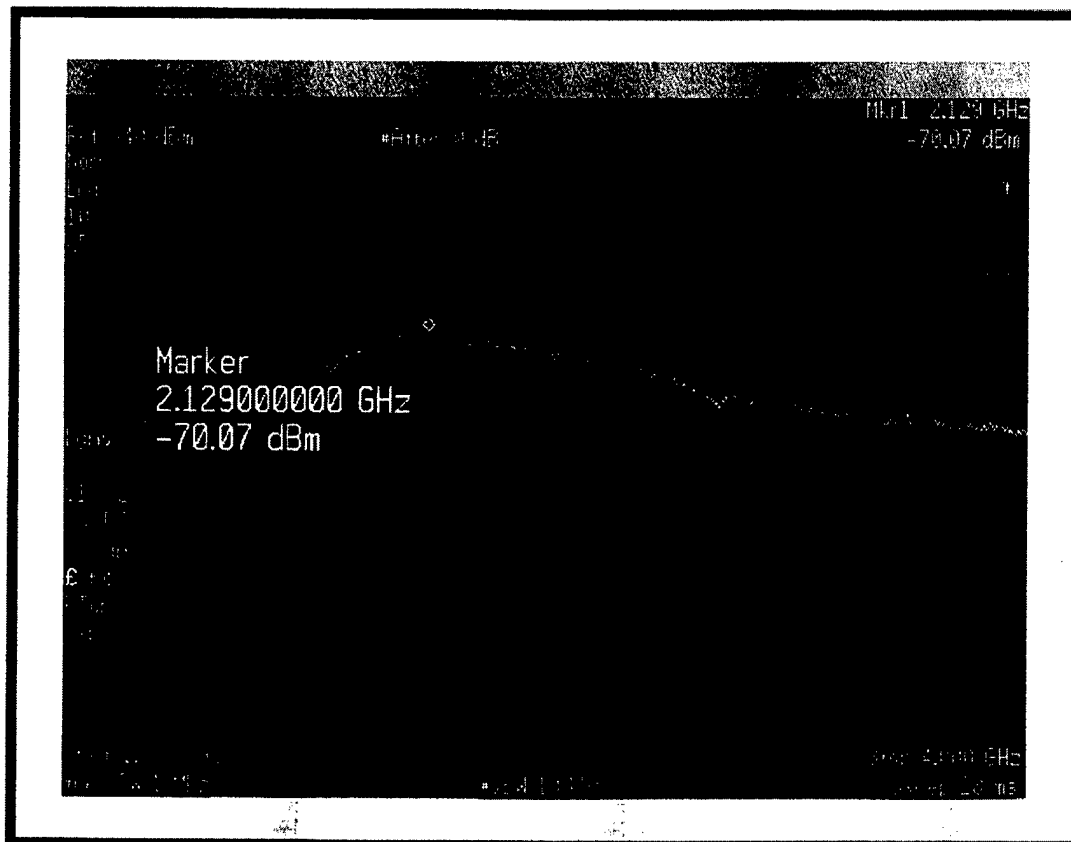
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TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: ROBERT FOSTER
OPERATING MODE: CONTINUOUS

DATE: 09/20/02
TEST NUMBER: THREE
COUPLING DEVICE: EMCO 3115
TEST SPEC: EIRP



Test Data

Time Domain SV2000
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CHOMERICS

Parker Seals

TEST SERVICES

2.3.6 Photographic Documentation

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: ROBERT FOSTER
OPERATING MODE: FCC AND TURBO

DATE: 09/20/02
TEST NUMBER: THREE
COUPLING DEVICE: EMCO 3115
TEST SPEC: EIRP



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
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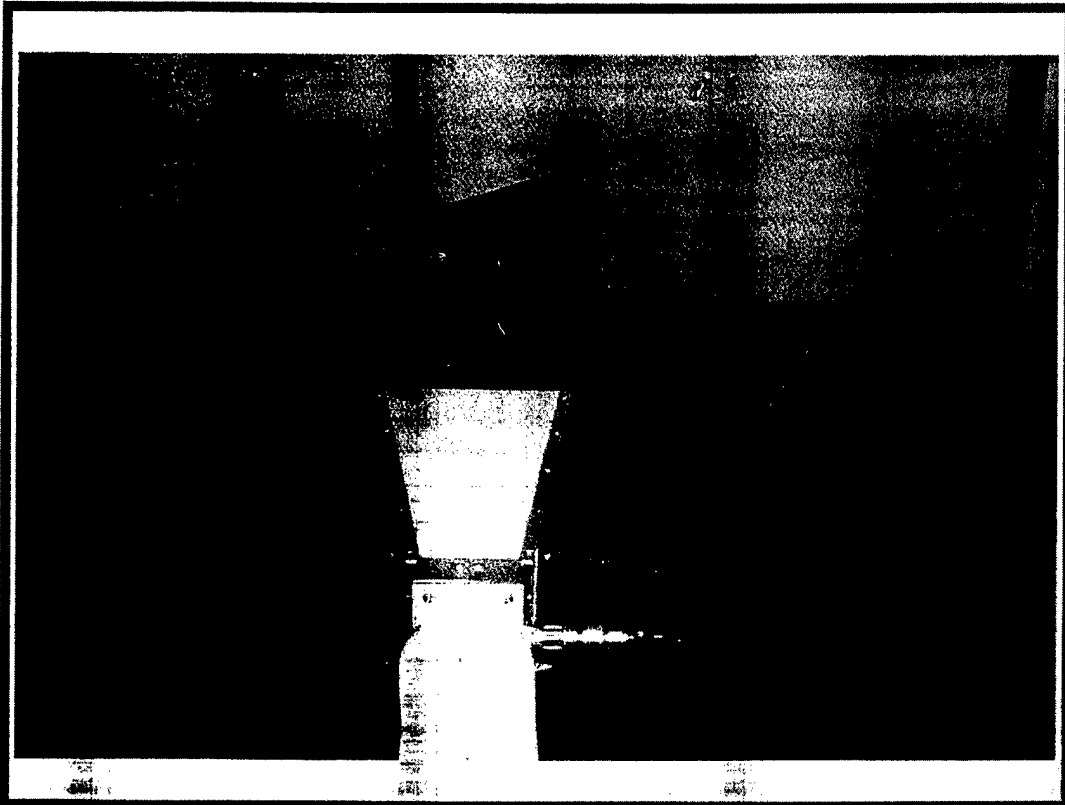
CHOMERICS

Parker Seals

TEST SERVICES

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000
TESTED BY: ROBERT FOSTER
OPERATING MODE: FCC AND TURBO

DATE: 09/20/02
TEST NUMBER: THREE
COUPLING DEVICE: EMCO 3115
TEST SPEC: EIRP



Photograph Description: Test Setup

FORM CTS PHOTO

Time Domain SV2000
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TEST SERVICES

APPENDIX A

DETECTION SYSTEM PARAMETERS

Time Domain SV2000
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TEST SERVICES

CHOMERICS TEST SERVICES

TEST SETUP TABLE

Library File : RE-102 PER TIME DOMAIN TEST PLAN

Display Title : RE-102 461E Surface Ships
Units Label : dBuV/m
Disp Ref Lvl (dB): 110
Test Type : PEAK
Freq Uncert. (%): .1
Min Swp Time/Oct : 150

Range 1 of 4

Start Freq (MHz): .01
Stop Freq (MHz): .15
Transducer : EMCO 3301B 2901 1/03
Gain/Loss : NONE
SA Input : LEFT
Presel/Input3 : LEFT
Quasi-Peak Bw : BYPASS
SA Res Bw (Hz): 1000
Video Bw (Hz): 10000
Ref. Lvl (dBuV): 87
Int Atten (dB): 10
Presel Atten : 10
Ext Atten (dB): 0
Setups : 1
Sweeps/Setup : 1
Msg, Sub, Cont : MESSAGE
Line #1 : CONNECT ACTIVE MONOPOLE ANTENNA
Line #2 : TO PRESELECTION INPUT

Range 2 of 4

Stop Freq (MHz): 30
Transducer : EMCO 3301B 2901 1/03
Gain/Loss : NONE
SA Input : LEFT
Presel/Input3 : LEFT
Quasi-Peak Bw : BYPASS
SA Res Bw (Hz): 10000
Video Bw (Hz): 100000
Ref. Lvl (dBuV): 87
Int Atten (dB): 10
Presel Atten : 10
Ext Atten (dB): 0
Setups : 1
Sweeps/Setup : 1
Msg, Sub, Cont : CONTINUE

Time Domain SV2000
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CHOMERICS

Parker Seals

TEST SERVICES

Range 3 of 4

Stop Freq (MHz): 200
Transducer : EMCO 3109 2414 1/03
Gain/Loss : NONE
SA Input : RIGHT
Presel/Input3 : RIGHT
Quasi-Peak Bw : BYPASS
SA Res Bw (Hz): 100000
Video Bw (Hz): 1.E+6
Ref. Lvl (dBuV): 87
Int Atten (dB): 0
Presel Atten : 10
Ext Atten (dB): 0
Setups : 1
Sweeps/Setup : 1
Msg,Sub,Cont : MESSAGE
Line #1 : CONNECT BICONICAL ANTENNA TO
Line #2 : PRESELECTION INPUT

Range 4 of 4

Stop Freq (MHz): 1000
Transducer : EMCO 3106 2213 1/03
Gain/Loss : NONE
SA Input : RIGHT
Presel/Input3 : RIGHT
Quasi-Peak Bw : BYPASS
SA Res Bw (Hz): 100000
Video Bw (Hz): 1.E+6
Ref. Lvl (dBuV): 87
Int Atten (dB): 0
Presel Atten : 10
Ext Atten (dB): 0
Setups : 1
Sweeps/Setup : 1
Msg,Sub,Cont : MESSAGE
Line #1 : CONNECT RIDGED HORN ANTENNA TO
Line #2 : PRESELECTION INPUT

Limit #1 Label : Limit #1
Limit #2 Label : NONE
Limit #3 Label : NONE

----- Test Setup Table Notes -----

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TEST SERVICES

CHOMERICS TEST SERVICES

TEST SETUP TABLE

Library File : RE-102 ARMY GROUND 1-18GHZ

Display Title : RE-102 461E SURFACE SHIPS
Units Label : dBuV/m
Disp Ref Lvl (dB): 110
Test Type : PEAK
Freq Uncert. (%): .1
Min Swp Time/Oct : 150

Range 1 of 2

Start Freq(MHz): 1000
Stop Freq(MHz): 2000
Transducer : EMCO 3115 2175 1/03
Gain/Loss : NONE
SA Input : RIGHT
Presel/Input3 : RIGHT
Quasi-Peak Bw : BYPASS
SA Res Bw (Hz): 1.E+6
Video Bw (Hz): 3.E+6
Ref. Lvl (dBuV): 77
Int Atten (dB): 0
Presel Atten : 0
Ext Atten (dB): 0
Setups : 1
Sweeps/Setup : 1
Msg,Sub,Cont : MESSAGE
Line #1 : CONNECT 3115 HORN TO
Line #2 : RIGHT INPUT

Range 2 of 2

Stop Freq (MHz): 18000
Transducer : EMCO 3115 2175 1/03
Gain/Loss : NONE
SA Input : RIGHT
Presel/Input3 : BYPASS
Quasi-Peak Bw : BYPASS
SA Res Bw (Hz): 100000
Video Bw (Hz): 100000
Ref. Lvl (dBuV): 77
Int Atten (dB): 0
Presel Atten : 0
Ext Atten (dB): 0
Setups : 1
Sweeps/Setup : 1
Msg,Sub,Cont : CONTINUE

Limit #1 Label : RE-102 Limit
Limit #2 Label : NONE
Limit #3 Label : NONE

----- Test Setup Table Notes -----

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TEST SERVICES

CHOMERICS TEST SERVICES

TRANSDUCER TABLE

Transducer Title : EMCO 3301B 2901 1/03

Sign of Trans. : PLUS

Freq Interpolat. : LOG

Number of Points : 14

Point	Frequency (MHz)	Trans Factor
1	.01	2.62
2	.02	2.56
3	.04	2.52
4	.1	2.49
5	.2	2.46
6	.5	2.44
7	1	2.5
8	4	3.19
9	5	3.33
10	10	3.85
11	15	4.17
12	20	4.52
13	25	4.91
14	30	5.46

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CHOMERICS**TEST SERVICES****CHOMERICS TEST SERVICES****TRANSDUCER TABLE**

Transducer Title : EMCO 3109 2414 1/03

Sign of Trans. : PLUS

Freq Interpolat. : LOG

Number of Points : 27

Point	Frequency (MHz)	Trans Factor
1	20	11
2	25	11.6
3	30	12.9
4	35	13.7
5	40	13.6
6	45	12.7
7	50	11.7
8	55	10.6
9	60	9.6
10	65	9.2
11	70	9.3
12	75	8.2
13	80	8
14	85	8.4
15	90	8.9
16	95	9.6
17	100	10.2
18	110	11.1
19	120	12.6
20	130	13.1
21	140	13.3
22	150	13.2
23	160	12.9
24	170	12.9
25	180	13
26	190	13.8
27	200	14.9

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TEST SERVICES

CHOMERICS TEST SERVICES

TRANSDUCER TABLE

Transducer Title : EMCO 3106 2213 1/03

Sign of Trans. : PLUS

Freq Interpolat. : LOG

Number of Points : 46

Point	Frequency (MHz)	Trans Factor
1	200	11.7
2	220	12.9
3	240	13.4
4	260	13
5	280	13.3
6	300	13.7
7	320	14.6
8	340	14.7
9	360	14.8
10	380	14.8
11	400	14.6
12	420	14.8
13	440	15.6
14	460	16.5
15	480	17.1
16	500	17.7
17	520	17.7
18	540	17.3
19	560	17.2
20	580	18.4
21	600	18.8
22	620	18.9
23	640	19.4
24	660	19.1
25	680	19.1
26	700	19.6
27	720	20
28	740	19.7
29	760	19.7
30	780	19.8
31	800	20.8
32	820	21.6
33	840	21.9
34	860	22.2
35	880	21.9
36	900	22.5
37	920	23.6
38	940	24
39	960	24.7
40	980	24.7
41	1000	24.6
42	1050	24
43	1100	24.7
44	1150	23.9
45	1200	24.3
46	1250	25.1

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TEST SERVICES

CHOMERICS TEST SERVICES

TRANSDUCER TABLE

Transducer Title : EMCO 3115 2175 1/03
Sign of Trans. : PLUS
Freq Interpolat. : LOG
Number of Points : 35

Point	Frequency (MHz)	Trans Factor
1	1000	23.5
2	1500	25
3	2000	27.4
4	2500	27.9
5	3000	30.2
6	3500	31.7
7	4000	33.1
8	4500	32.4
9	5000	32.8
10	5500	34.7
11	6000	35.2
12	6500	34.6
13	7000	36.9
14	7500	38
15	8000	37.5
16	8500	39.4
17	9000	38.7
18	9500	38.1
19	10000	38.2
20	10500	39.2
21	11000	38.9
22	11500	39
23	12000	40
24	12500	39.2
25	13000	40.2
26	13500	41.2
27	14000	40.5
28	14500	41.5
29	15000	40.9
30	15500	38.7
31	16000	37.7
32	16500	39.7
33	17000	41.2
34	17500	44.2
35	18000	45.8

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TEST SERVICES

APPENDIX B

TEST LOG

Time Domain SV2000
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Date: November 21, 2002

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TEST SERVICES

TEST LOG

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000

PROGRAM: MIL-STD 461E
TESTED BY: MANUEL MARTINEZ

Pre-Test Checklist	Date	Comments					
	09/17/02	Test Plan/Procedure: per Test Specification and customer plan in Appendix C Test Specification: MIL-STD 461E Chomerics Procedure: N/A EUT Power Requirement Verified: Voltage Battery Frequency N/A Phase N/A Voltage Frequency Phase EUT Functional Operational Check: [X] Pass [] Fail Environmental: Bonding/Grounding: N/A Safety Issues: N/A					
In-Process Test Checklist	Date	Test #	Test Type	Test Equipment Calibrated	Test Performed Properly – Data Accepted	EUT Set-up Check/Operational Check	EUT Pass/Fail
	09/17/02 – 09/19/02	1	RE102	Yes	Yes	Yes	Fail
	09/20/02	2	RS103	Yes	Yes	Yes	Pass
Post Test Checklist	Date:	EUT Functional Operation Check:					
	09/20/02	[X] Pass [] Fail		Test Engineer Tech _____ Approved Signatory _____			

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TEST LOG

CUSTOMER: TIME DOMAIN
EQUIPMENT: SV2000

PROGRAM: MIL-STD 461E
TESTED BY: ROBERT FOSTER

Pre-Test Checklist	Date	Comments					
	09/17/02	Test Plan/Procedure: per Test Specification and customer plan in Appendix C Test Specification: MIL-STD 461E Chomerics Procedure: N/A EUT Power Requirement Verified: Voltage Battery Frequency N/A Phase N/A Voltage Frequency Phase EUT Functional Operational Check: ☒ Pass ☐ Fail Environmental: Bonding/Grounding: N/A Safety Issues: N/A					
In-Process Test Checklist	Date	Test #	Test Type	Test Equipment Calibrated	Test Performed Properly – Data Accepted	EUT Set-up Check/Operational Check	EUT Pass/Fail
	09/20/02	3	E.I.R.P.	Yes	Yes	Yes	N/A
Post Test Checklist	Date: 09/20/02	EUT Functional Operation Check:					
		☒ Pass ☐ Fail		Test Engineer Tech		Approved Signatory	

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APPENDIX C CUSTOMER TEST PLAN

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1.1.1 SV2000 RF Emissions & Susceptibility

1.1.1.1 Radiated Emissions (RE 102 of MIL-STD-416E) (16010)

The SV2000 shall be tested for unintentional electromagnetic radiation in accordance with method RE 102 of MIL-STD-461E. Table 16-2 identifies the acceptance criteria and supersedes the acceptance criteria contained in RE102-3 [Reference: Figure RE 102-3 for Fixed Wing External and Helicopters (10 KHz through 18 GHz) of the standard]. This requirement is applicable for every SV2000 state except the Slave and Operational states.

The SV2000 shall not electro-magnetically interfere with current military equipment.

- Use MIL-STD-461E guidelines for this test
- Use RE102 - Fixed Wing External (2 MHz to 18 GHz) and Helicopters curve for this test.
- Use the following test conditions for Intentional and Unintentional RE 102 testing.
 - Two (2) antenna positions (Front, Back) at 1 meter.
 - Horizontal & Vertical Polarities

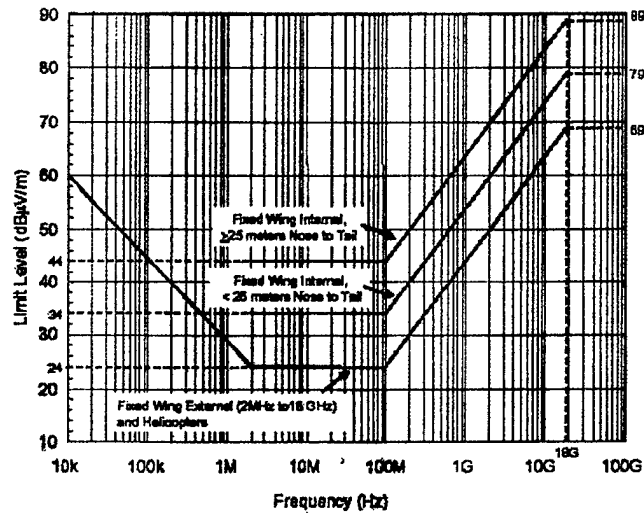


Figure 16010: RE102 limit for aircraft and space system applications.

Frequency Band	Amplitude Limit (dBμV/m)
10 kHz to 2 MHz	60 down to 24 log/linear (slope = -16.36364 dB/decade)
2 MHz to 100 MHz	24
100 MHz to 18 GHz	24 up to 69 log/linear (slope = 20 dB/decade = 6dB/octave)

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1.1.1.1.1 Unintentional EM Emissions (15060 & 16060)

The SV2000 shall not intentionally radiate while in the Standby state.

- Place the SV2000 unit in RF Chamber with the battery pack.
- Power OFF the SV2000.
- Measure & Record AMBIENT emissions (Plot File or Printout)
- Power ON the SV2000.
- Configure SV2000 into STANDBY state.
- Measure & Record UNINTENTIONAL emissions (Plot File or Printout)

15060 & 16060	Unintentional Emissions	PASS => AMBIENT noise floor is 6 dB below limit line AND STANDBY State emissions are below limits	
		FAIL => Over Limits	

1.1.1.1.2 Intentional EM Emissions (16020)

Intentional electromagnetic emissions shall only occur in the Operational state.

- Place the SV2000 unit in RF Chamber with the battery pack.
- Power ON the SV2000
- Wait for the SV2000 to go into OPERATIONAL state.
- Measure & Record the data for INTENTIONAL emissions (Plot File or Printout)
- Configure the SV2000 into TURBO mode (Experimental ONLY, Not for
- Measure & Record the data for INTENTIONAL emissions (Plot File or Printout)

Frequency Band	Operational State EIR-PSD (dBm /MHz)	Turbo State EIR-PSD (dBm /MHz)
0-960 MHz		
960 – 1000 MHz		
1 GHz – 1.585 GHz		
> 1.585 GHz		

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16020	Intentional Emissions	PASS ==> OPERATIONAL State emissions are below limits	
		Frequency Band Operational State Energy Limit 0-960 MHz EIR-PSD ≤ -54 dBm /MHz 960 - 1000 MHz EIR-PSD ≤ -46 dBm /MHz 1 GHz - 1.585 GHz EIR-PSD ≤ -38 dBm /MHz ≥ 1.585 GHz EIR-PSD ≤ -35 dBm /MHz Table Error! No text of specified style in document.-1 Intentional Radiation Power Limits	
		FAIL ==> Over Limits	
16010	Radiated Emissions (RE102)	PASS ==> Based on 15060, 16020, and 16060 passing	
		FAIL ==> Based on 15060, 16020, or 16060 failing	

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1.1.1.2 Radiated Susceptibility (RS 103 of MIL-STD-416E) (16070)

The SV2000 shall be tested for electromagnetic susceptibility in accordance with method RS 103 of MIL-STD-416E. The SV2000 may be reset if necessary by any means convenient to the operator at the conclusion of the test to restore useful function. The possible need for reset activity does not constitute a failure of the test. The SV2000 need not perform any useful function during the test.

- Use the following test conditions for RS 103 testing.
 - Two (2) antenna positions (Front, Back)
 - Horizontal & Vertical Polarities
 - Use the RS 103 Field Strengths as listed in the Table 16-3.

Frequency	Field Strength @ 1 meter	Modulation
2 MHz – 300 MHz	50 Volts / Meter	1 KHz Pulse @ 50% Duty Cycle
300 MHz – 3 GHz	10 Volts / Meter	1 KHz Pulse @ 50% Duty Cycle
3 GHz – 40 GHz	50 Volts / Meter	1 KHz Pulse @ 50% Duty Cycle

Table 16-3: RS103 Field Strength

1.1.1.2.1 RS 103 Testing (16080)

The SV2000 shall survive test method RS 103 without damage at the field strengths shown in Table 16-3. This table supersedes the acceptance criteria contained in RS 103.

- Place the SV2000 unit in RF Chamber with the battery pack.
- Power ON the SV2000.
- Wait for the SV2000 to go into OPERATIONAL state.
- Measure & Record for the frequency ranges listed below (Plot File or Printout)
- For each frequency band verify whether the unit is Operational or Not Operational
 - Operational: Unit powers On (The possible need for reset activity does not constitute a failure of the test.)
 - Not Operational: Unit fails to Power On even after resetting.

Record the Frequency when the unit became Non Operational

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