Intertek Testing Services
ETL SEMKO

TEST REPORT

Report Number: 0224466uwb.doc
Revision 1
Project Number: 3034466
December 16, 2002

Evaluation of the
EVK
Model Number: 100-0017 A
to

CFR 47 Part 15, Subpart F

For
Time Domain Corporation

Test Performed by:	Test Authorized by:
Intertek Testing Services 1950 Evergreen Blvd, Suite 100 Duluth, GA 30096	Time Domain Corporation 7057 Old Madison Pike Huntsville, AL 35806

Prepared by: _____ Date: 12/16/02
Matthew Van Steen

Reviewed by: _____ Date: 12/16/02
David J. Schramm

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Executive Summary

Testing performed for: Time Domain Corporation

Equipment Under Test: EVK, Model: 100-0017 A

Test Description	FCC Section	Pass/Fail Comments
• Operational limitations	15.517(a)	Time Domain Corporation has been notified of these requirements
• UWB bandwidth	15.517(b)	Pass
• Radiated Emissions	15.517(c) 15.209	Pass
• Radiated emissions in GPS bands	15.517(e)	Pass
• Peak emission within a 50 MHz bandwidth	15.517(f)	Pass
• Labeling requirements	15.517(g)	Time Domain Corporation has been notified of these requirements
• Conducted emissions, AC Mains	15.207	Pass

1 JOB DESCRIPTION

1.1 Client information

The EVK has been tested at the request of

Company: Time Domain Corporation
7057 Old Madison Pike
Huntsville, AL 35806

Name of contact: Pawan Mathur
Telephone: (256) 428-6591
Fax: (256) 922-0387

1.2 Test plan reference:

Tests were performed to the following standards:

- CFR 47 Part 15, Subpart C rules for an intentional radiator
- CFR 47 Part 15, Subpart F rules for a UWB device

The test procedures described in American National Standards Institute C63.4: 1992, CISPR 16-1: 1993, and CFR 47 Part 15, Subpart F were employed.

"Radiated Emissions Test Procedure for Indoor UWB Devices," written by Time Domain Corporation, was also used as a reference.

1.3 Equipment Under Test (EUT)

Equipment Under Test		
Description	**Model Number**	**Serial Number**
EVK	100-0017 A	P2HA0001 (115)
Switching Power Supply (Globtek, Inc.)	SA-072AOF-11	006700

EUT receive date: November 11, 2002

EUT receive condition: The EUT was received in good condition with no apparent damage.

Test start date: November 11, 2002

Test completion date: November 13, 2002

The test results in this report pertain only to the item tested.

The following description of the EVK was supplied by Time Domain Corporation:

The EVK is an AC mains powered ultra-wideband transceiver for indoor use.

1.3.1 System Support Equipment

Table 1-1 contains the details of the support equipment associated with the Equipment Under Test.

Table 1-1: System Support Equipment

Description	Manufacturer	Model Number	Serial Number	FCC ID number
Laptop computer	Dell	PPX Inspiron 3800	33-460-78	Not labeled

1.3.2 Cables associated with EUT

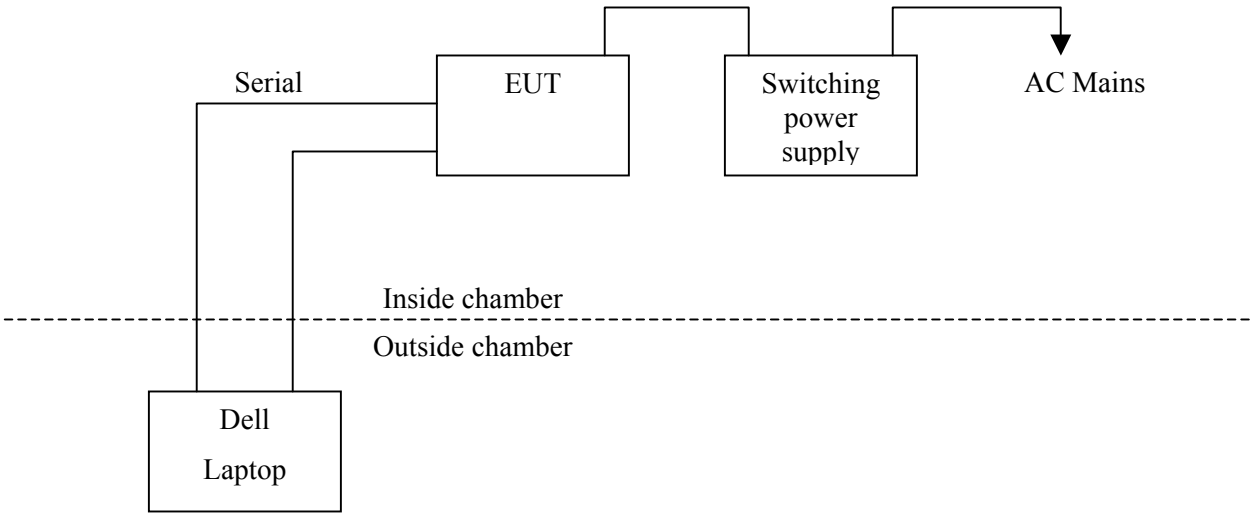
Table 1-2 contains the details of the cables associated with the EUT.

Table 1-2: Interconnecting cables between modules of EUT

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
AC Power cable	1.6 m	None	None	Power supply	AC Mains
DC Power cable	1.5 m	None	None	Power supply	EUT
Serial cable	7 m	Foil	None	EUT	Laptop computer
Ethernet cable	7 m	None	None	EUT	Laptop computer

1.3.3 System Block Diagram

The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.



1.3.4 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst-case emissions.

The EUT was configured to transmit continuously.

All interconnecting cables dropped from the rear of the turntable, but none were within 40 cm of the groundplane.

The arrangement of the cables dangling from the rear of the table was varied to the extent possible to produce the maximum emissions.

To insure maximum emissions were detected, the system was rotated 360 degrees, the antenna height was varied from 1 to 4 meters above the ground plane in both horizontal and vertical polarizations. These maximum emissions are represented in Section 4, Section 5, Section 6, and Section 7.

Above 960 MHz, the measurements were made at 1 meter due to the extremely low emission limit. At 3 meters, the instrument noise floor is at or above the limits specified in 15.517(c) and (e).

Frequency determining parameters

The highest frequency employed in CFR 47 Section 15.33 to determine the frequency range over which radiated emissions are made were based on the center frequency, f_c., unless a higher frequency was generated within the UWB device. For measuring emission levels, the spectrum were investigated from the lowest frequency generated in the UWB, without going below 9 kHz, up to the frequency range shown in Section 15.33(a) of CFR 47 or up to f_c + 3/(pulse width in seconds), whichever was higher. There is no requirement to measure emissions beyond 40 GHz provided f_c was less than 10 GHz; beyond 100 GHz if f_c was at or above 10 GHz and below 30 GHz; or beyond 200 GHz if f_c was at or above 30 GHz.

The center frequency f_c was found to be 4850 MHz.

The pulse width of the EUT was 500 picoseconds.

The highest frequency scanned was 40 GHz.

1.3.5 Mode(s) of operation

The EUT was powered from 120 Vac, 60 Hz.

Pulse repetition frequency (PRF) was set to 9.6 MHz.

1.4 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

2 TEST ENVIRONMENT

2.1 Test Facility

The Duluth 10-meter chamber site is located at 1950 Evergreen Blvd., Suite 100, Duluth, Georgia. The test site is a 10-meter semi-anechoic chamber. The site meets the characteristics of CISPR 16-1: 1993 and ANSI C63.4: 1992. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.

The A2LA accreditation code for this site is 121624 under certificate number 1455.01.

2.2 Test Equipment

Table 2-1 contains a list of the test equipment used during the testing.

Table 2-1 List of Test Equipment

Duluth Test Equipment for Radiated Emissions				
Description	**Make**	**Model**	**Serial #**	**Cal Due Date**
EMI Receiver	HP	85462A	3650A00362	3/28/2003
RF Filter Selector	HP	85460A	3704A00331	3/28/2003
Spectrum Analyzer	HP	8566B	2134A01032	12/3/2002
Spectrum Analyzer	HP	8564E	3946A00149	6/18/2003
PreAmp	HP	8449B	3008A00989	4/30/2003
PreAmp	HP	8447D	2648A04296	2/22/2003
PreAmp	HP	83051A	3332A00283	10/08/2003
PreAmp	Miteq	JS2-00100400-10-10A	386277	12/6/2002
BiLog Antenna	Chase	CBL6112B	2622	8/26/2003
Horn Antenna	AH Systems	SAS 200/571	246	1/13/2003
Horn Antenna	EMCO	3116	9310-2222	2/18/2003
Cable	N/A	Cable N2	ITS# 211999a2	12/12/2002
Cable	Huber Suhner	HS 7000	HS7kNSma	12/12/2002
Cable	Huber Suhner	HS 4000	HS7kNN	12/12/2002
Cable	N/A	CableTW3	ITS# 211412	12/12/2002
LISN	Fischer	FCC-LISN-50-50-M	2020	12/7/2002
LISN	Fischer	FCC-LISN-50-50-M	2019	12/7/2002
Cable	N/A	Cable TT4	ITS# 211404	12/12/2002

2.3 Measurement Calculations

2.3.1 Example Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – PA

Where FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude (including preamplifier) in dB(μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(1/m)
PA= Preamplifier Factor in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB(μV/m).

RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
PA = 29.0 dB
FS = RF + AF + CF – PA
FS = 52.0 + 7.4 + 1.6 – 29.0
FS = 32 dB(μV/m)

2.3.2 EIRP Calculations

As defined in CFR 47 Part 15.503(k), EIRP is the equivalent isotropic radiated power, i.e. the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna. The EIRP, in terms of dBm, can be converted to a field strength, in dBμV/m at 3 meters, by adding 95.2. As used in Subpart F, EIRP refers to the highest signal strength measured in any direction and at any frequency from the UWB device, as tested in accordance with the procedures specified in 15.31(a) and 15.523 of CFR 47.

2.4 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.

The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.5 dB at 10m

±3.8 dB at 3m

The expanded uncertainty (k = 2) for radiated emissions from 1 to 18 GHz has been determined to be:

±4.6 dB at 3m

±4.5 dB at 1m

The expanded uncertainty (k = 2) for radiated emissions from 18 to 40 GHz has been determined to be:

±4.2 dB at 1m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±2.6 dB

3 OPERATIONAL LIMITATIONS

CFR 47 Section 15.517(a)(1)

Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.

The EVK, Model Number 100-0017 A, operates solely through the AC mains. It is not intended to operate from any other power source.

CFR 47 Section 15.517(a)(2)

The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway, to perform an outside function, such as the detection of persons about to enter a building.

Time Domain Corporation has been informed of this requirement.

CFR 47 Section 15.517(a)(3)

The use of outdoor antennas, e.g., antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.

Time Domain Corporation has been informed of this requirement.

CFR 47 Section 15.517(a)(4)

Field disturbance sensors installed inside of metal or underground storage tanks are considered to operate indoors provide emissions are directed towards the ground.

CFR 47 Section 15.517(a)(5)

A communications system shall transmit only when the intentional radiator is sending information to an associated receiver.

Time Domain Corporation has been informed of this requirement.

4 UWB BANDWIDTH

CFR 47 Section 15.517(c)

The UWB bandwidth of a UWB system operating under the provisions of CFR 47 Section 15.517 must be contained between 3100 MHz and 10,600 MHz.

4.1 Test Procedure

Due to the extremely wide nature of UWB emissions, special considerations were taken to make the bandwidth measurements. The emissions were measured in a manner similar to those stated in Section 5.2 of this document.

The resolution bandwidth was set to 1 MHz. The video bandwidth was set to 3 MHz. The test distance was 1 meter.

A computer runs the maximization routine and records the highest emissions over a frequency range of 3 to 11 GHz. The maximization routine rotates the table through 360 degrees and moves the measurement antenna from 1 to 4 meters above the ground plane.

4.2 Test Results

The bandwidth of the EVK, Model Number 100-0017 A, was found to comply with the requirements of CFR 47 Section 15.517(c). A bandwidth plot is located in Figure 4-1.

f_L = 3.32 GHz, f_H = 6.38 GHz, f_M = 4.155 GHz, and Bandwidth = 3.06 GHz

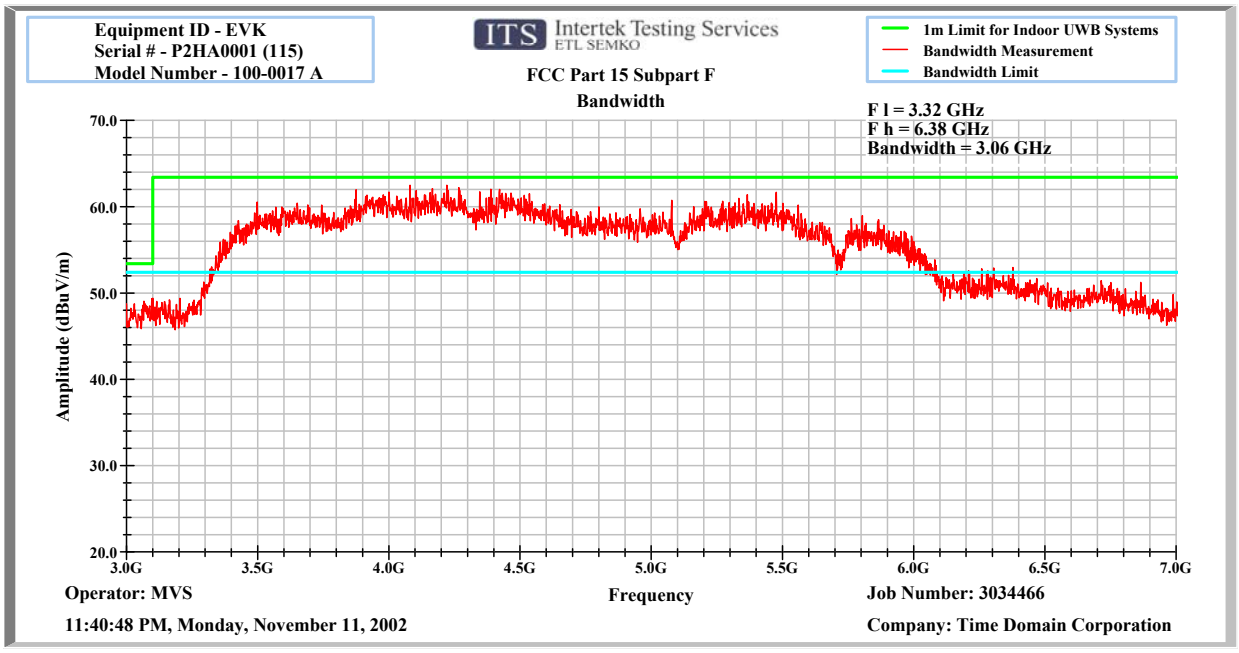


Figure 4-1: Composite Bandwidth Plot

5 RADIATED EMISSIONS

5.1 Test limits

The radiated emissions at or below 960 MHz from a device operating under the provisions of CFR 47 Section 15.517 shall not exceed the emission level in CFR 47 Section 15.209. The radiated emissions above 960 MHz from a device operating under CFF 47 Section 15.517 shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Table 5-1 Radiated emission limits for UWB transmitters

Frequency MHz	EIRP dBm	Measurement distance meters
960 to 1610	-75.3	3
1610 to 1990	-53.3	3
1990 to 3100	-51.3	3
3100 to 10600	-41.3	3
Above 10600	-51.3	3

From CFR 47 Section 15.521 (c): As noted in Section 15.3(k) of this chapter, digital circuitry that is used only to enable the operation of a transmitter and that does not control additional functions or capabilities is not classified as a digital device. Instead, the emissions from that digital circuitry are subject to the same limits as those applicable to the transmitter. If it can be clearly demonstrated that an emissions from a UWB transmitter is due solely to the emissions from digital circuitry contained within the transmitter and that the emission is not intended to be radiated from the transmitter's antenna, the limits shown in CFR 47 Section 15.209 shall apply to that emission rather than the limits specified in CFR 47 Section 15 Subpart F.

Table 5-2 Radiated emission limits, general requirements

Frequency (MHz)	Field strength (μV/m)	Measurement distance (meters)
0.009 to 0.490	2400/F(kHz)	300
0.490 to 1.705	24000/F(kHz)	30
1.705 to 30	30	30
30 to 88	100	3
88 to 216	150	3
216 to 960	200	3
960 and up	500	3

5.2 Test Procedure

Measurements in the frequency range of 30 MHz to 960 MHz were conducted with a measurement receiver equipped with a quasi-peak detector. Measurements above 960 MHz were based on RMS average measurements over a 1 MHz resolution bandwidth.

An RMS detector was not available during testing, therefore the spectrum analyzer resolution bandwidth was set to a 1 MHz, the video bandwidth was set to 1 MHz, and the detector set to sample. The spectrum analyzer trace was exported to a spread sheet and post processed to determine the RMS value of the emission. The procedure described in Appendix F of CFR 47, Part 15, Subpart F, Paragraph (3) was used.

Measurements of the radiated field from 30 MHz to 960 MHz were made with the measurement antenna located at a distance of 3 meters from the EUT unless specified otherwise in the measurement results.

Measurements of the radiated field above 960 MHz were made with the measurement antenna located at a distance of 1 meter from the EUT unless specified otherwise in the measurement results.

The antenna was adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth was varied from zero to 360 degrees during the measurement to find the maximum field-strength readings.

The antenna polarization was varied (horizontal to vertical) during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, was placed on a table whose top is 0.8m above the ground plane. The table was constructed of non-conductive materials. Its dimensions were 1m by 1.5m.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4: 1992.

5.3 Test Results

The EVK met the radiated emission requirements of FCC CFR 47 Section 15.517(c). The results are located in Table 5.3, Table 5.4 and Table 5.5. There were no other emissions detected above 8.5 GHz. The maximum frequency scanned was 40 GHz.

Table 5-3 Radiated Emissions, 30 to 960 MHz, receive mode

Company: **Time Domain Corporation**
Model: **EVK 100-0017 A**
Project No.: **3034466**
Date: 11/12/02
Standard: FCC15
Class: B Group: None
Notes: Receive mode

Tested by: Matthew Van Steen
Location: Duluth
Detector: HP8546
Antenna: CHAS2622
PreAmp: HP8447d
Cable(s): CABLEN2 TW3 + HS4000 N-N
Distance: **3**

Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB
V	32.588	40.2	17.6	0.9	26.2	0.0	32.5	40.0	-7.5
V	43.813	43.3	11.6	1.0	26.1	0.0	29.8	40.0	-10.2
V	55.263	46.9	6.9	1.3	26.2	0.0	28.9	40.0	-11.1
V	66.250	52.7	6.3	1.4	26.1	0.0	34.3	40.0	-5.7
V	106.700	46.2	11.3	1.8	26.0	0.0	33.2	43.5	-10.3
H	921.520	41.8	20.4	5.6	26.1	0.0	41.6	46.0	-4.4

Note: Experimentation has shown that in the range from 30 to 960 MHz, the receive mode generated the highest emissions.

Table 5-4 Radiated Emissions, 960 to 3100 MHz, transmit mode

Company: **Time Domain Corporation**
Model: **EVK 100-0017 A**
Project No.: **3034466**
Date: 11/13/02
Standard: FCC Part 15.517 (c)
Notes: RBW 1MHz, VBW 1MHz
Transmitter ON
Post processed for RMS reading

Tested by: Matthew Van Steen
Location: Duluth
Detector: HP8546
Antenna: AH571
PreAmp: MultiAmp
Cable(s): MultiCable
Distance: **1**

Ant. Pol. (V/H)	Frequency MHz	RMS Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Convert to dBm	Net dBm	1 meter Limit dBm	Margin dB	
V	1054.550	63.8	24.6	7.3	70.7	95.2	-70.2	-65.8	-4.4	
H	1152.000	70.0	24.9	7.6	70.7	95.2	-63.3	-65.8	+2.5	*
V	1228.875	71.9	25.2	7.9	70.4	95.2	-60.6	-65.8	+5.2	*
V	1382.467	69.1	25.7	8.4	69.9	95.2	-61.8	-65.8	+4.0	*
V	1950.000	55.2	29.7	10.3	69.3	95.2	-69.3	-43.8	-25.5	
V	2300.000	55.8	30.3	11.3	69.1	95.2	-66.9	-41.8	-25.1	
Removed antenna and terminated port										
H	1152.000	70.9	24.9	7.6	70.7	95.2	-62.4	-65.8	+3.4	*
V	1228.875	70.8	25.2	7.9	70.4	95.2	-61.7	-65.8	+4.1	*
V	1382.467	69.6	25.7	8.4	69.9	95.2	-61.4	-65.8	+4.4	*

Note: By removing the antenna from the EUT and terminating the antenna port with a 50 ohm load, it was clearly shown that the emissions were not intentional/UWB and should be compared to the FCC Part 15 B limit for determination of compliance.

Table 5-5 Radiated Emissions, 3100 to 11600 MHz, transmit mode

Company: **Time Domain Corporation**
Model: **EVK 100-0017 A**
Project No.: **3034466**
Date: 11/11/02
Standard: FCC15, Subpart H

Notes: Post processed for RMS reading
S/N - P2HA0001 (115)

Tested by: Matthew Van Steen
Location: Duluth
Detector: HP 8593
Antenna: AH571
PreAmp: hp8449b
Cable(s): HS7000 N-SM TW3 + HS4000 N-N
Distance: **1**

Ant. Pol. (V/H)	Frequency MHz	RMS Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Convert to dBm	Net dBm	1 meter Limit dBm	Margin dB	
V	3644.515	50.8	32.3	12.3	36.6	95.2	-36.4	-31.8	-4.6	
V	3964.650	50.2	33.4	13.1	36.1	95.2	-34.6	-31.8	-2.8	
V	4155.625	50.7	33.6	13.7	36.2	95.2	-33.4	-31.8	-1.6	*
V	4197.267	50.1	33.6	13.9	36.2	95.2	-33.9	-31.8	-2.1	
V	4223.650	49.9	33.6	13.9	36.2	95.2	-34.0	-31.8	-2.2	
V	5396.860	45.6	35.2	16.0	36.1	95.2	-34.5	-31.8	-2.7	

Table 5-6 Radiated Emissions, 960 to 11000 MHz, receive mode

Company: **Time Domain Corporation**
Model: **EVK 100-0017 A**
Project No.: **3034466**
Date: 11/12/02
Standard: FCC15
Class: B Group: None
Notes:

Tested by: Matthew Van Steen
Location: Duluth
Detector: HP8546
Antenna: AH571
PreAmp: hp8449b
Cable(s): HS7000 N-SM TW3 + HS4000 N-N
Distance: **3**

Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB
V	1228.980	45.8	25.2	6.7	38.1	0.0	39.6	54.0	-14.4
H	1132.700	47.1	24.9	6.4	38.3	0.0	40.0	54.0	-14.0

Figure 5-1 Radiated Emissions, 960 to 3100 MHz, transmit mode

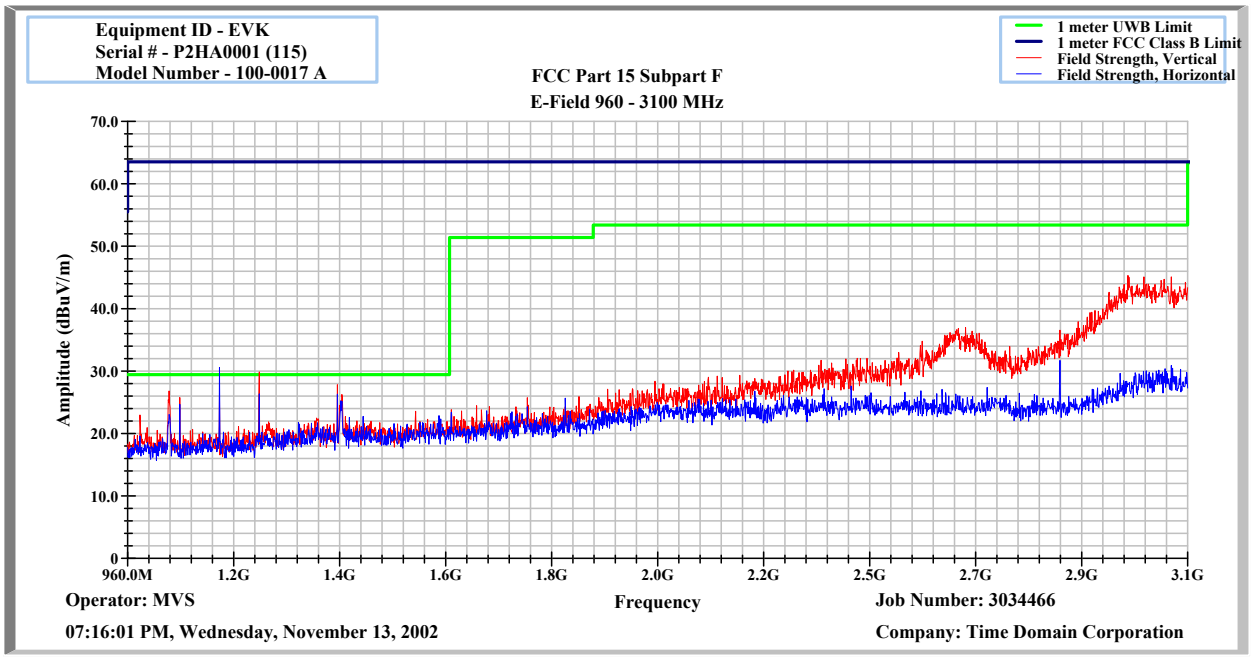


Figure 5-2 Radiated Emissions, 2.8 to 11 GHz, transmit mode

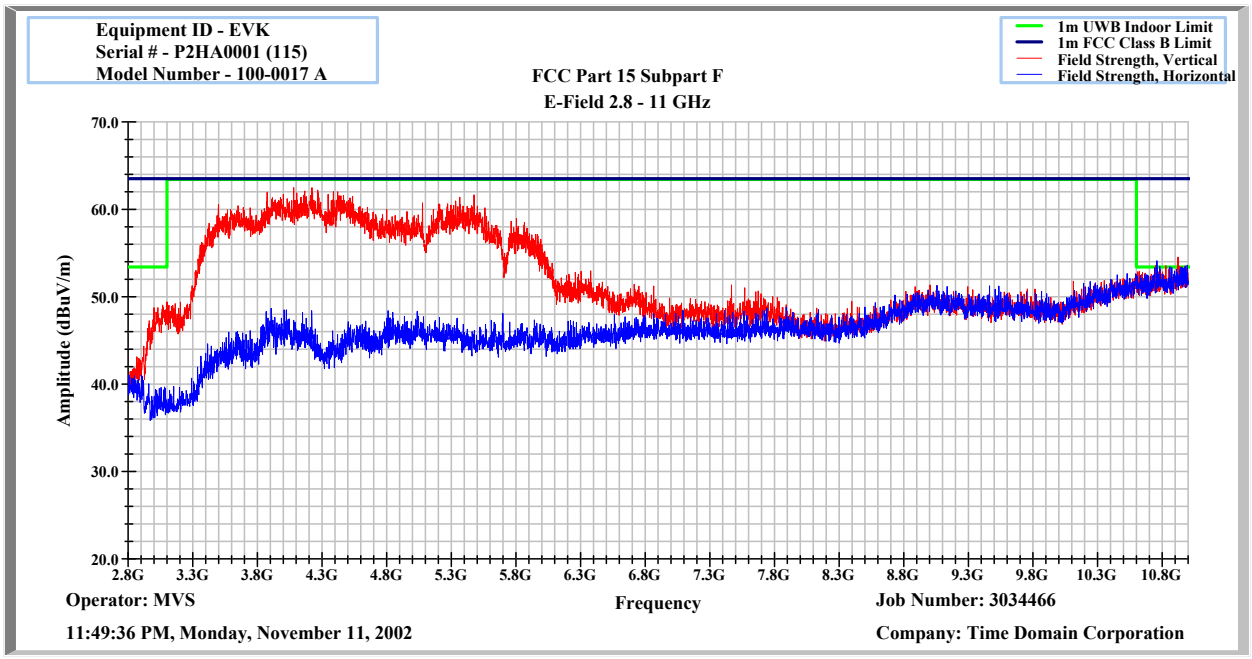


Figure 5-3 Radiated Emissions, 30 to 1000 MHz, receive mode

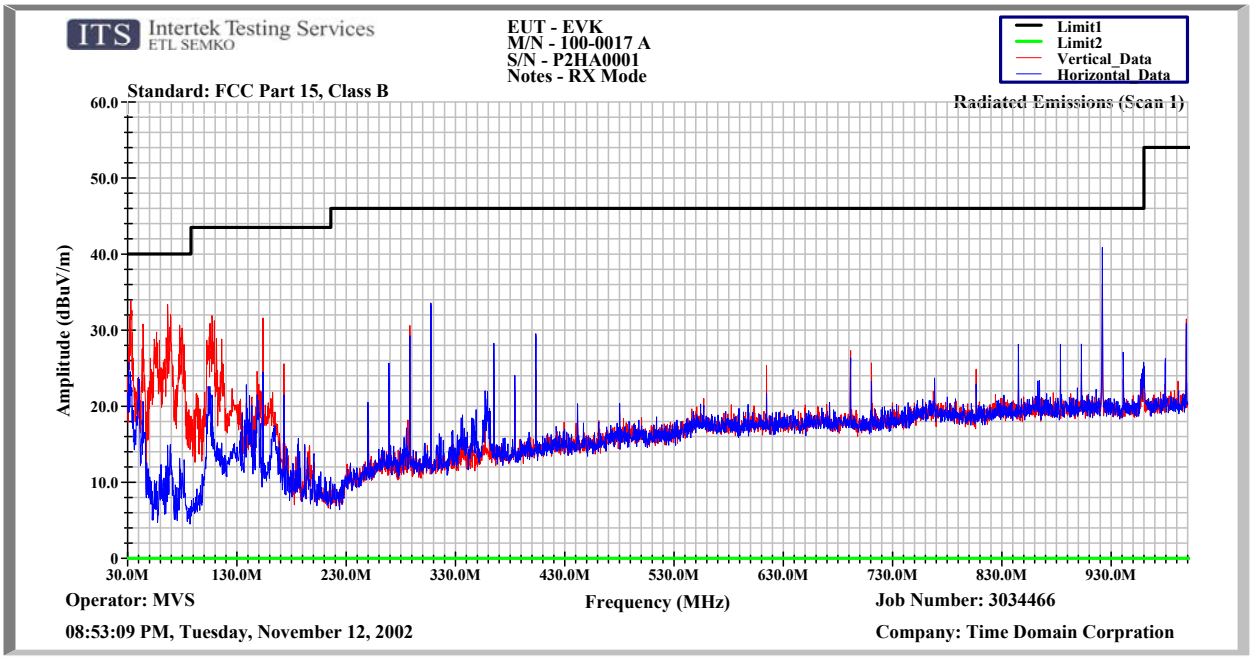
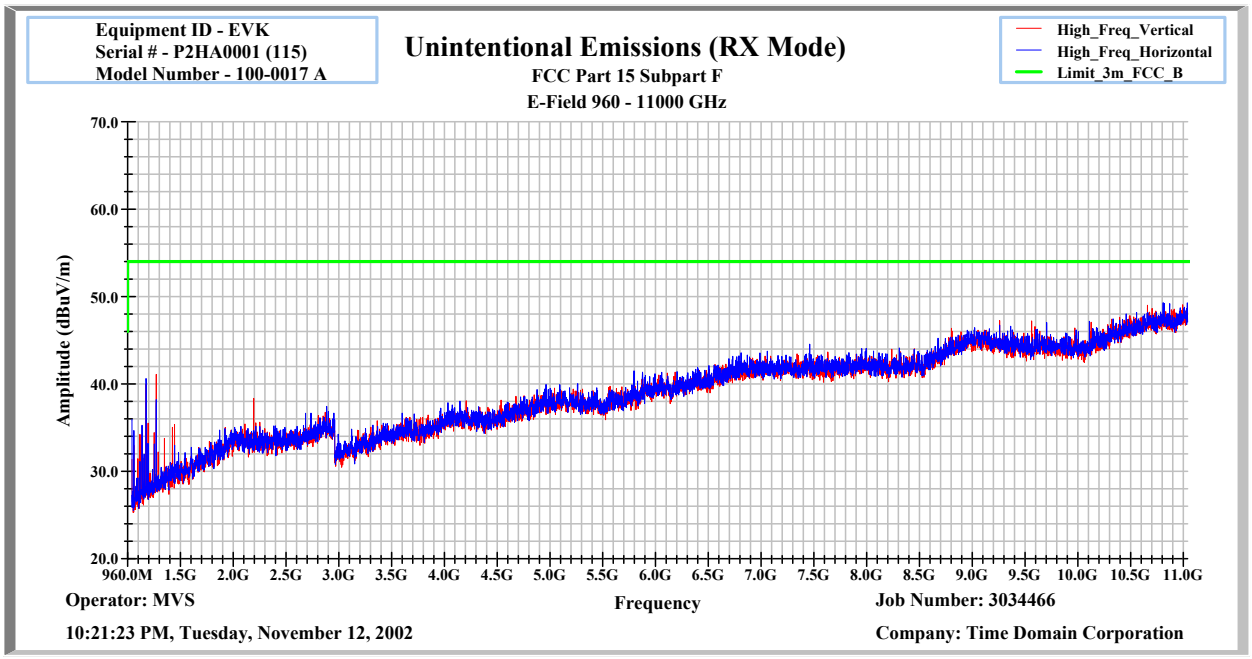


Figure 5-4 Radiated Emissions, 960 to 11000 MHz, receive mode



5.4 Test Configuration Photograph

Figure 5-5 and Figure 5-6 show the testing configurations used.

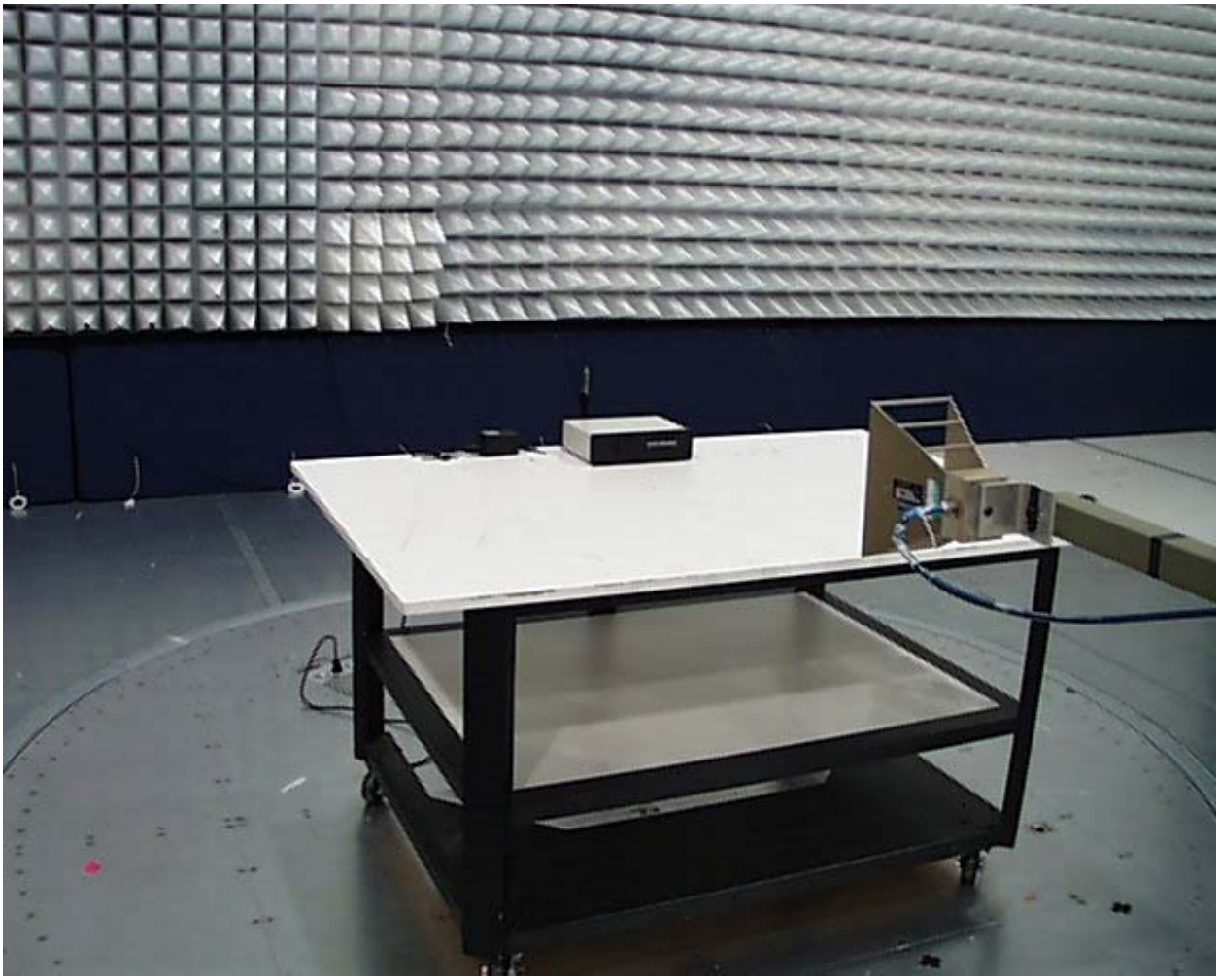


Figure 5-5: Configuration photograph, radiated disturbance, front view

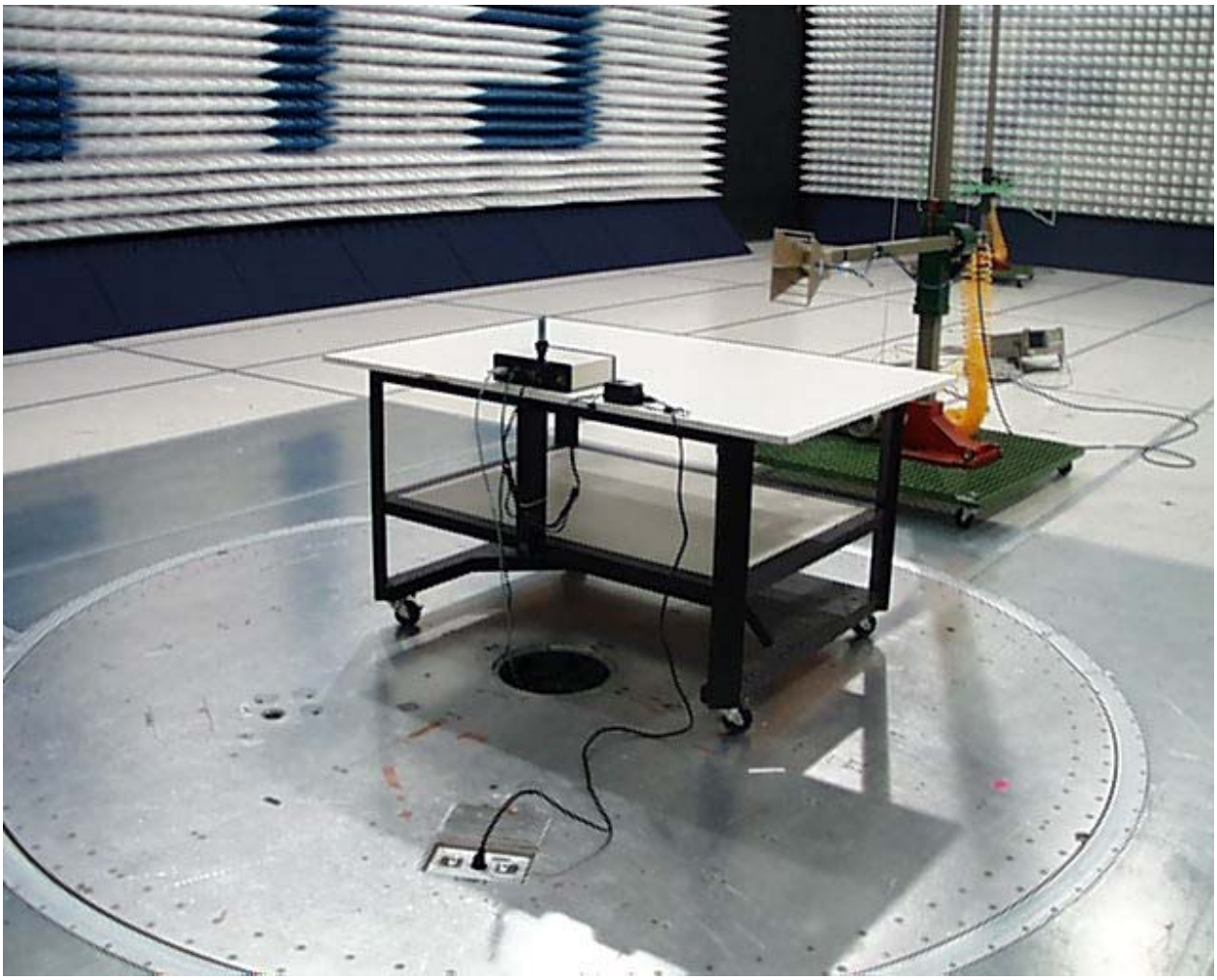


Figure 5-6: Configuration photograph, radiated disturbance, rear view

6 RADIATED EMISSIONS IN GPS BANDS

6.1 Test limits

In addition to the radiated emission limits specified in Table 5-1, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz.

Table 6-1 Radiated emission limits for UWB transmitters using RBW of ≥ 1kHz.

Frequency in MHz	EIRP at 3 meters dBm
1164 to 1240	-85.3
1559 to 1610	-85.3

6.2 Test Procedure

Measurements in this section were made using a resolution bandwidth of 1 kHz (or greater), a video bandwidth of 30 kHz, and the detector set to sample. The spectrum analyzer trace was exported to a spread sheet and post processed to determine the RMS value of the emission. The procedure described in Appendix F of CFR 47, Part 15, Subpart F, Paragraph (3) was used.

Measurements of the radiated field were made with the measurement antenna located at a distance of 1 meter from the EUT unless specified otherwise in the measurement results.

The antenna was adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth was varied from zero to 360 degrees during the measurement to find the maximum field-strength readings.

The antenna polarization was varied (horizontal to vertical) during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, was placed on a table whose top is 0.8m above the ground plane. The table was constructed of non-conductive materials. Its dimensions were 1m by 1.5m

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4: 1992.

6.3 Test Results

The EVK met the radiated emission requirements of FCC CFR 47 Section 15.517(e). The results are located in Table 6.2.

Table 6-2 Radiated Emissions, 1164 to 1240 MHz and 1559 to 1610 MHz

Company: **Time Domain Corporation**
Model: **EVK 100-0017 A**
Project No.: **3034466**
Date: 11/13/02
Standard: FCC Part 15.517 (e)
Notes: RBW 10kHz, VBW 10 kHz
Transmitter ON

Tested by: Matthew Van Steen
Location: Duluth
Detector: HP8546
Antenna: AH571
PreAmp: MultiAmp
Cable(s): MultiCable
Distance: **1**

Ant. Pol. (V/H)	Frequency MHz	Average Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Convert to dBm	Net dBm	1 meter Limit dBm	Margin dB
V	1176.000	34.0	25.0	7.7	70.7	95.2	-99.1	-75.8	-23.3
V	1227.000	34.3	25.2	7.9	70.4	95.2	-98.2	-75.8	-22.4
V	1575.000	32.6	26.7	9.1	69.7	95.2	-96.5	-75.8	-20.7
V	1228.803	70.9	25.2	7.9	70.4	95.2	-61.6	-75.8	+14.2
H	1228.803	68.1	25.2	7.9	70.4	95.2	-64.3	-75.8	+11.5
Measured with antenna disconnected and port terminated									
V	1228.803	70.1	25.2	7.9	70.4	95.2	-62.4	-75.8	+13.4
H	1228.803	66.0	25.2	7.9	70.4	95.2	-66.4	-75.8	+9.4

Note: By terminating the antenna port with a non-radiating 50 ohm load and re-measuring the data at 1228.803 MHz, we clearly demonstrated that the emissions are digital in nature and not UWB. This emission was also recorded during the scan with the EUT set in receive only mode. When that emission was compared to the FCC Class B limit, it passed by 14.4 dB.

Figure 6-1 Radiated emissions, 1164 to 1240 MHz

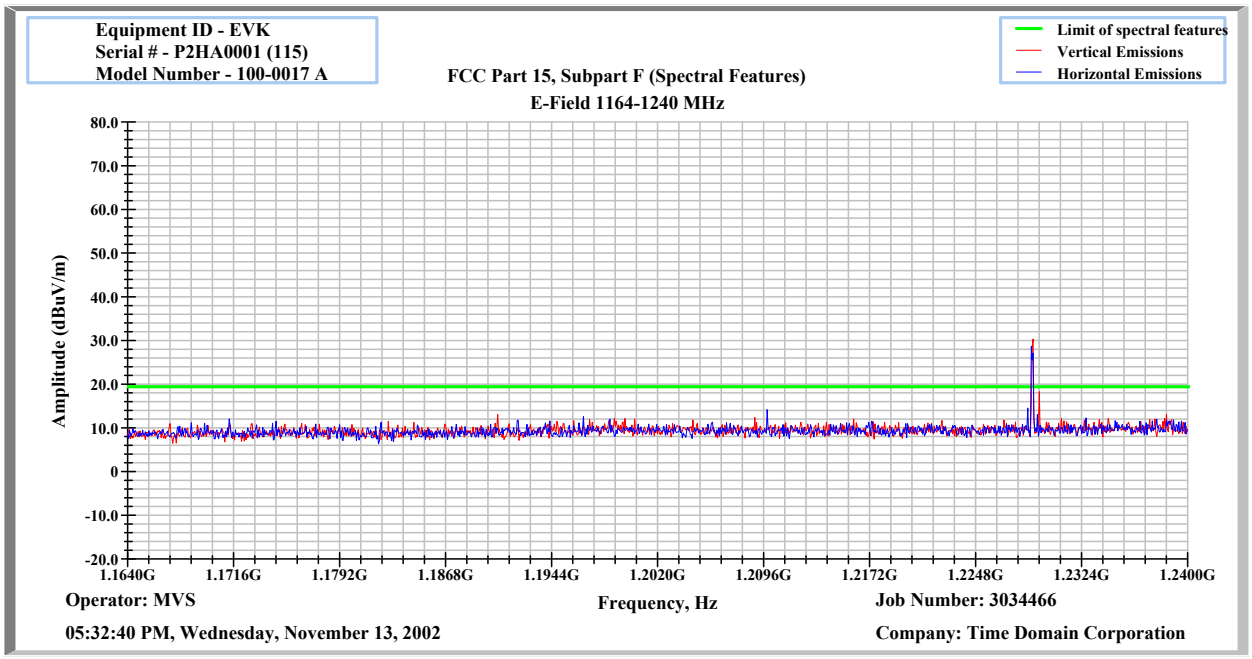
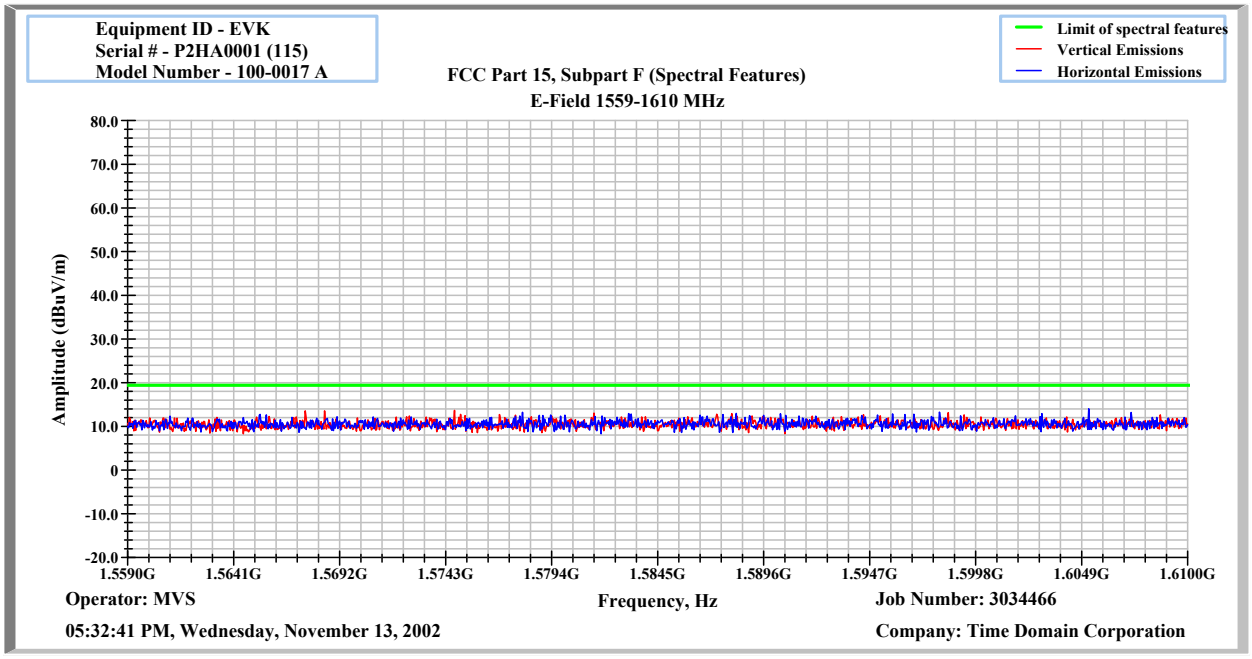


Figure 6-2 Radiated Emissions, 1559 to 1610 MHz



7 PEAK EMISSION WITHIN A 50 MHZ BANDWIDTH

7.1 Test limit

There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emissions occurs, f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit.

7.2 Test procedure

When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified CFR 47 Part 15, Subpart F. The resolution bandwidth was set to 3 MHz, and the measurement was centered on the frequency at which the highest radiated emission occurred, f_M. Since a resolution bandwidth other than 50 MHz was employed, the peak EIRP limit was lowered by 20log (RBW/50) dB, where RBW was the resolution bandwidth in megahertz that was employed. This calculates to a correction factor of–24.4 dB. Testing was performed at 1 meter, therefore the limit in a 50 MHz bandwidth was adjusted to 9.5 dBm.

The measurements recorded in this section were obtained using a resolution bandwidth of 3 MHz, a video bandwidth of 3 MHz, and with peak detector with the trace set to maximum-hold.

Measurements of the radiated field were made with the measurement antenna located at a distance of 1 meter from the EUT unless specified otherwise in the measurement results.

The antenna was adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth was varied from zero to 360 degrees during the measurement to find the maximum field-strength readings.

The antenna polarization was varied (horizontal to vertical) during the measurements to find the maximum field-strength readings.

The EUT was placed on a table whose top is 0.8m above the ground plane. The table was constructed of non-conductive materials. Its dimensions were 1m by 1.5m

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4: 1992.

7.3 Test Results

The EVK met the radiated emission requirements of FCC CFR 47 Section 15.517(f).

Table 7-1 UWB Radiated Emissions

Company:	**Time Domain Corporation**	Tested by:	Matthew Van Steen
Model:	**EVK 100-0017 A**	Location:	Duluth
Project No.:	**3034466**	Detector:	HP8546
Date:	11/12/02	Antenna:	AH571
Standard:	FCC15	PreAmp:	hp8449b
Class:	B	Cable(s):	HS7000 N-SMA TW3
Notes:	Peak Emissions in 50 MHz band	Distance:	**1**

Ant. Pol. (V/H)	Frequency MHz	Peak Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Convert to dBm	3 MHz to 50 MHz BW Correction dB	Net dBm	1 meter EIRP Limit dBm	Margin dB
V	3644.515	58.6	32.3	9.9	36.6	95.2	24.4	-6.7	9.5	-16.2
V	3964.650	58.4	33.4	10.3	36.1	95.2	24.4	-4.7	9.5	-14.3
V	4155.625	57.9	33.6	10.9	36.2	95.2	24.4	-4.6	9.5	-14.1
V	4197.267	58.2	33.6	11.1	36.2	95.2	24.4	-4.1	9.5	-13.6
V	4223.650	57.2	33.6	11.1	36.2	95.2	24.4	-5.1	9.5	-14.7
V	5396.860	52.5	35.2	12.7	36.1	95.2	24.4	-6.5	9.5	-16.1

8 AC MAINS LINE-CONDUCTED DISTURBANCE

8.1 Test Limits

Table 8-1 FCC Part 15.207 Limits
for Conducted Disturbance at the Mains Ports

Frequency band MHz	Class B Limit dB(μV)
	Quasi-Peak
0.45-1.705	48
1.705-30	48

8.2 Test Procedure

Measurements were carried out using quasi-peak and average detector receivers in accordance with ANSI C63.4: 1992. An LISN was required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An LISN as defined in ANSI C63.4: 1992 was used.

The EUT was located so that the distance between the boundary of the EUT and the closest surface of the LISN is 0.8m.

Where a flexible mains cord was provided by the manufacturer, it was 1m long or if in excess of 1m, the excess cable was folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT was arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance was measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values were reported.

The EUT was placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane was placed 0.4m from the EUT. The vertical metal reference-plane was at least 2m by 2m. The EUT was kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table was constructed of non-conductive materials. Its dimensions were 1m by 1.5m, but may have been extended for larger EUT.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4: 1992.

8.3 Test Results

The EVK met the conducted disturbance requirements of FCC Part 15.207. The test results are located in Table 8-2.

Table 8-2 FCC Part 15.207 Conducted Disturbance at AC Mains

Company: **Time Domain Corporation**
Model: **EVK 100-0017 A**
Job No.: **3034466**
Date: 11/11/02
Standard: FCC Part 15, Subpart C

Tested by: Matthew Van Steen
Location: Duluth
Detector: HP8546
Cable(s): Cable TT4
Limiter: no

Notes: S/N - P2HA0001 (115)

Frequency MHz	Reading Side A dB	Reading Side B dB	Attenuator Factor dB	System Loss dB	Quasi-Peak Net dB(uV)	Quasi-Peak Limit dB(uV)	Quasi-Peak Margin dB
0.450	24.7	27.9	0.0	1.0	28.9	48.0	-19.1
1.549	36.8	35.4	0.0	1.0	37.8	48.0	-10.2
1.681	37.8	37.5	0.0	1.0	38.8	48.0	-9.2
1.822	35.0	37.5	0.0	1.0	38.5	48.0	-9.5
3.084	35.9	35.1	0.0	1.0	36.9	48.0	-11.1
3.544	33.3	32.3	0.0	1.1	34.4	48.0	-13.6

8.4 Test Configuration Photographs

Figure 8-1 and Figure 8-2 show the testing configurations used.

Figure 8-1: Configuration photograph, conducted emissions, front view

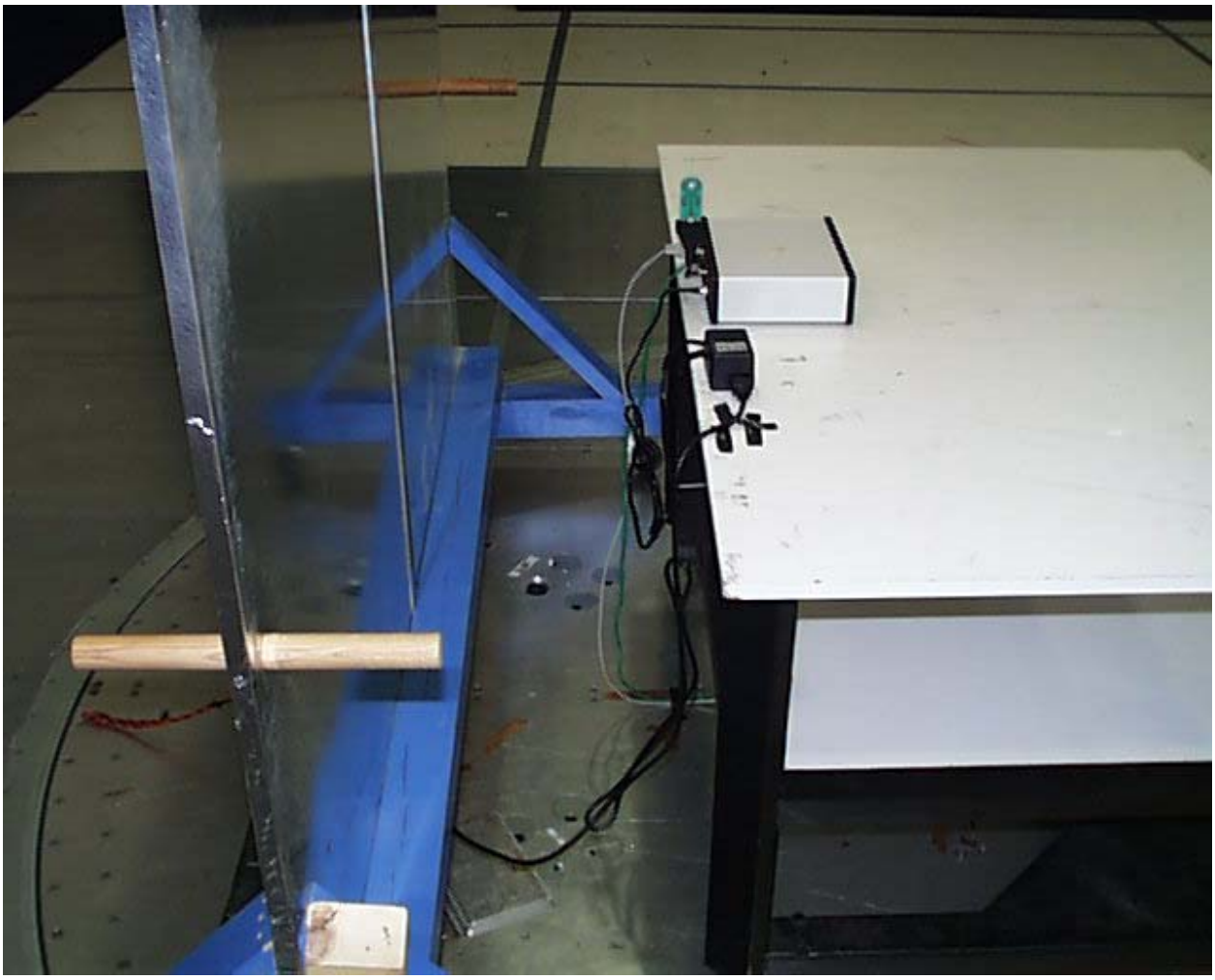


Figure 8-2: Configuration photograph, conducted emissions, rear view

9 REVISION HISTORY

Issue Date:	November 27, 2002
Revision 1:	December 16, 2002. Added revision history. Corrected calibration due dates for HP 8449B and Chase CBL6112B (dates listed originally were calibration dates, not calibration due dates).