TEST REPORT

Report Number: 30394452
Project Number: 3039445
Report Date: June 20, 2003
Revised: July30, 2003

Testing performed on the

Hiper Lite
Model: 01-840802-03
FCC ID: LCB-840802
to
FCC Part 15.247

for
Topcon Positioning Systems

Test Performed by:
Intertek
1365 Adams Court
Menlo Park, CA 94025

Test Authorized by:
Topcon Positioning Systems
5758 West Las Positas Blvd.P
Pleasanton, CA 94588

Prepared by: David Chernomordik **Date:** 07/30/03
David Chernomordik, EMC Technical Manager

TABLE OF CONTENTS

1.0 Introduction

The Equipment under Test is a composite device with two Spread Spectrum Transceivers operating in the 2.4 GHz and 900 MHz frequency bands.
This report is designed to show compliance of the 2.4 GHz transceiver with FCC Part 15.247 requirements.

1.1 Summary of Tests

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	Complies
20 dB Bandwidth	15.247(a)(1)	Complies
Min. Channel Separation	15.247(a)(1)	Complies
Min. Hopping Channels	15.247(a)(1)	Complies
Average Channel Occupancy Time	15.47(a)(1)	Complies
Out-of-band Antenna Conducted Emission	15.247(c)	Complies
Out of Band Radiated Emission	15.247(c)	Not Applicable. The device passed Out-of-band Antenna Conducted Emission
Radiated Emission in Restricted Bands	15.247(c), 15.205	Complies
AC Conducted Emission	15.207	Complies
Radiated Emission from Digital Part	15.109	Complies
Radiated Emission from Receiver L.O.	15.109	Not Applicable. The receiver tuned frequency is above 960 MHz
Antenna Requirement	15.203	Complies

2.0 General Description

2.1 Product Description

The EUT is a Dual Frequency GNSS receiver with GPS, with 900 MHz Spread Spectrum modem and Bluetooth module. In normal operation the EUT tracks a satellite, receives reference data from a base station via radio modem, and measures the position.

Overview of the EUT

Applicant	Topcon Positioning Systems 5758 West Las Positas Blvd.P Pleasanton, CA 94588
Manufacturer name & address	Topcon Positioning Systems 5758 West Las Positas Blvd.P Pleasanton, CA 94588
Trade Name & Model No.	Hiper Lite, 01-840802-03
FCC Identifier	LCB-840802
Use of Product	GPS Survey Receiver
Manufacturer & Model of Spread Spectrum Module	USI Bluetooth Module, UB1-1111
Type of Transmission	Spread Spectrum, Frequency Hopping
Rated RF Output	1 mW
Frequency Range	2402-2480 MHz
Number of Channel(s)	79
Modulation Type	GFSK
Data Rates	1 Mbps
Antenna(s) type & Gain	Omnidirectional Dipole, 0.5 dBi
Antenna Requirement	The antenna is a fixed internal module, not user replaceable

A production version of the sample was received on March 28, 2003 in good condition. As declared by the Applicant, it is identical to production units.

Test start date: March 28, 2003
Test end date: June 16, 2003

2.2 Related Submittal(s) Grants

The FCC Part 15.247 Application for FHSS transmitter, operating in the 902-928 MHz band, is filed simultaneously with the same FCC ID.

2.3 Test Methodology

Radiated and AC Line conducted emissions measurements were performed according to the procedures in ANSI C63.4 (1992). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Data Sheet"** of this Application. All other measurements were made in accordance with the procedures described in DA 00-705.

2.4 Test Facility

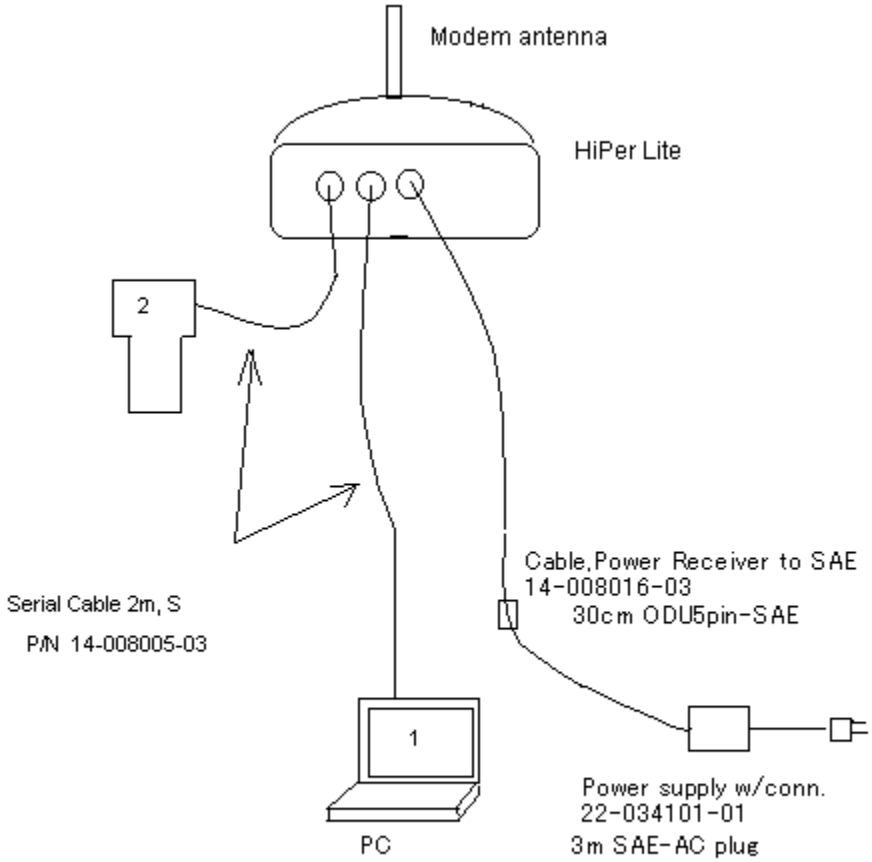
Then radiated emission test site and conducted measurement facility used to collect the data is site 1 located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC.

3.0 System Test Configuration

3.1 Support Equipment

Item #	Description	Model No.
1	Compaq Laptop	Armada E 500
2	External controller	Ranger 51155T

3.2 Block Diagram of Test Setup



3.3 Justification

For radiated emission measurements the EUT is placed on a plastic table. The EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power. During testing, all cables are manipulated to produce worst-case emissions.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

In normal operation the EUT may be powered from internal battery or from AC mains using an AC/DC adapter. When the adapter is used, the internal battery is charging. The "charging mode" requires additional cables to be connected to the EUT. The worst case radiated emissions is concidered to be in this mode. Therefore, radiated and conducted emission measurements were performed in the charging mode.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was "Survey-Pro for Ranger" which exercised the various system components in a manner similar to a typical use.

3.5 Mode of Operation During Test

The EUT was tested in test mode allowed to control the device from a computer (laptop). With hopping disable, the EUT was setup to transmit continuously at the lowest, middle, and highest channels (frequencies). Some tests were performed with hopping enabled.

3.6 Modifications Required for Compliance

No modifications were installed by Intertek during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by Topcon prior to compliance testing).

4.0 Measurement Results

4.1 Conducted Output Power at Antenna Terminal
FCC 15.247(b)(1)

Requirements

For systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum peak output power is 1 watt (30 dBm), for all other systems – 0.125 W (21 dBm).

Procedure

The antenna port of the EUT was connected to the input of a peak power meter. Power was read directly and cable loss correction was added to the reading to obtain the power at the EUT antenna terminal.

Test Results

Frequency MHz	Output Power dBm	Output Power mW
2402	-0.4	0.91
2440	-0.5	0.89
2480	0.1	1.02

NOTE: Hopping function was disabled during test

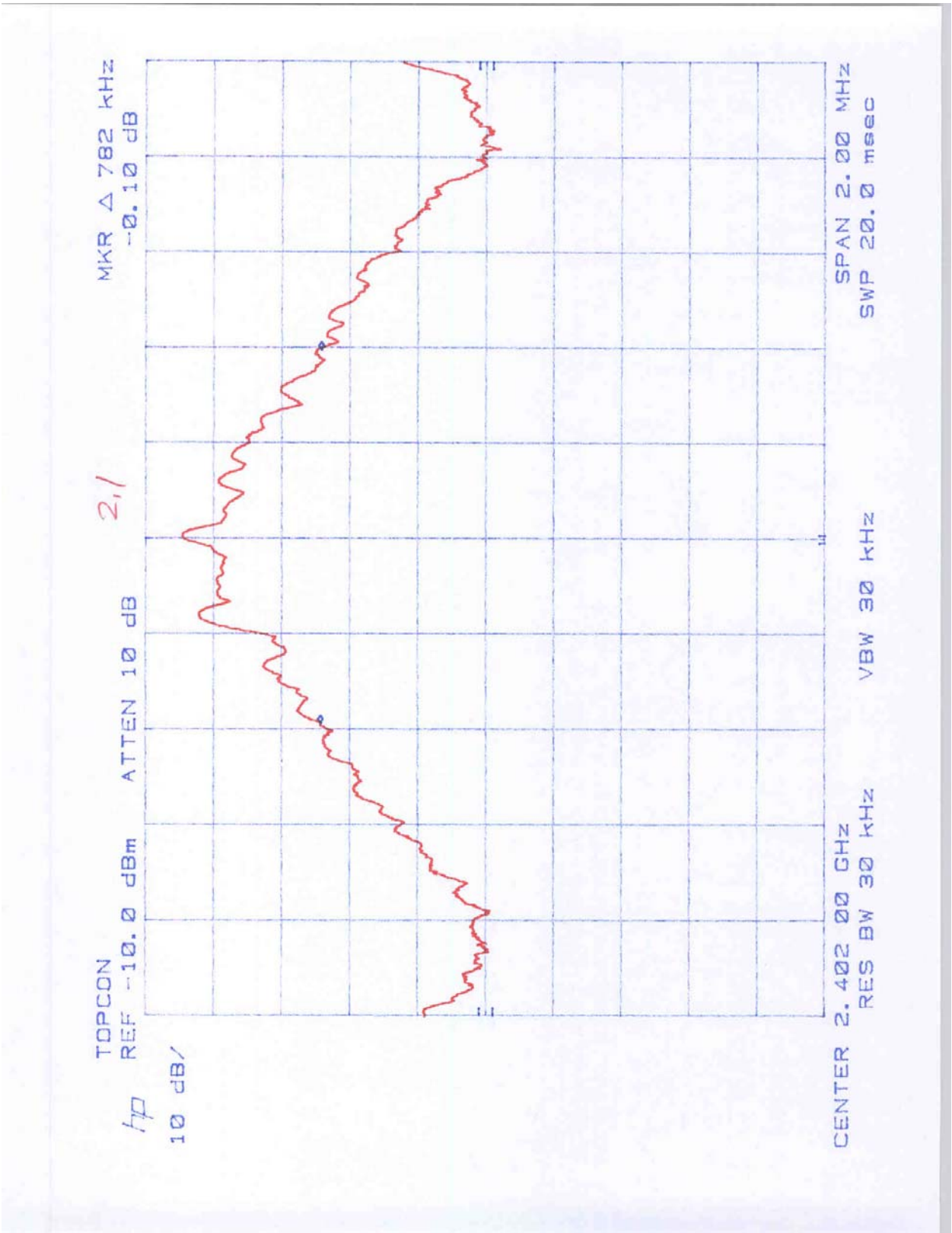
4.2 Hopping Channel 20-dB Bandwidth
FCC 15.247(a)(ii)(iii)

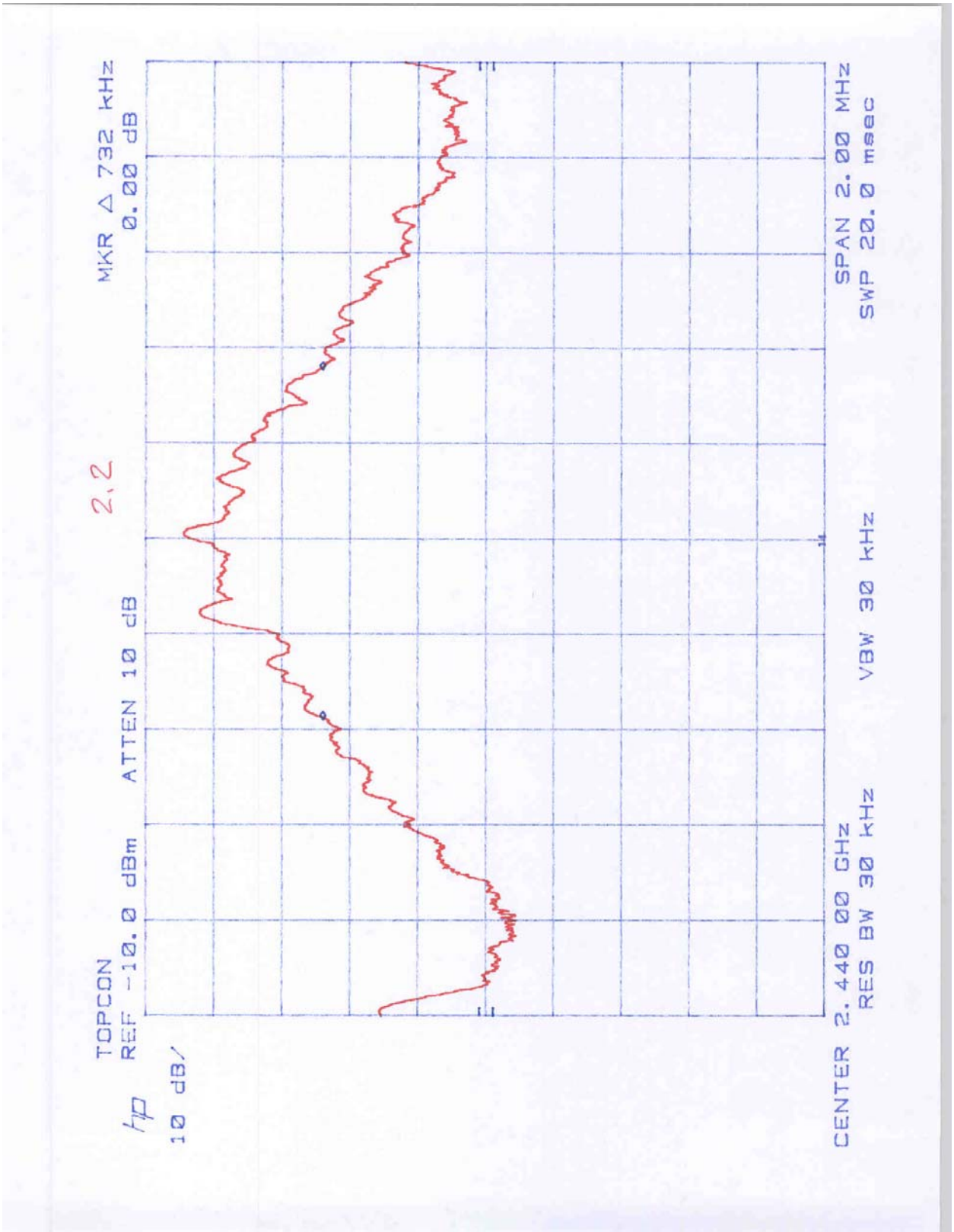
Requirements

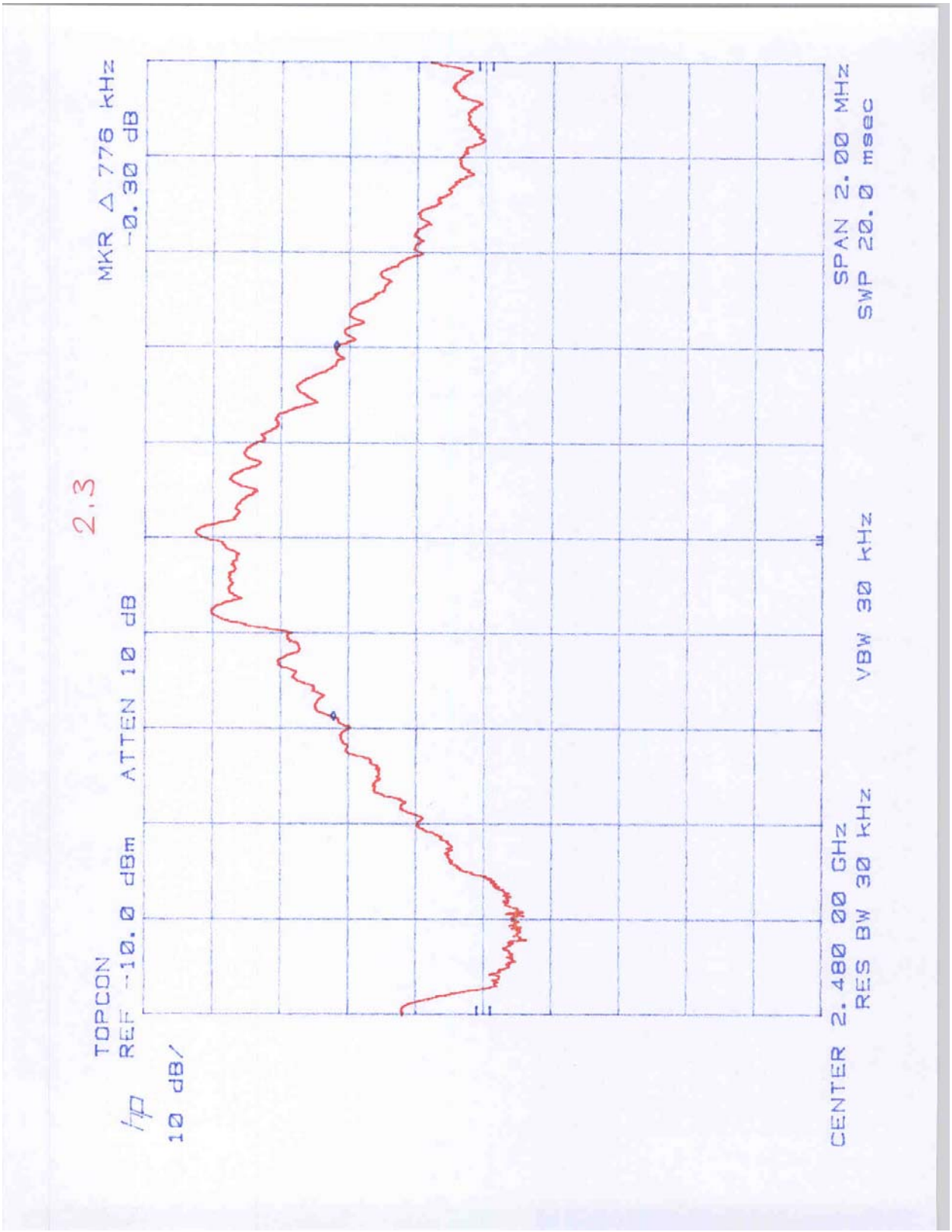
For systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum 20 dB bandwidth of the hopping channel is 1 MHz. Systems may utilize hopping channels whose 20 dB bandwidth is greater than 1 MHz provided the system use at least 15 non-overlapping channels.

Test Results

Frequency MHz	20-dB channel bandwidth MHz	Plot
2402	0.782	2.1
2440	0.732	2.2
2480	0.776	2.3


TOPCON
REF -10.0 dBm
ATTEN 10 dB
10 dB/
MKR Δ 782 kHz
-0.10 dB
SPAN 2.00 MHz
SWP 20.0 msec
VBW 30 kHz
CENTER 2.402 00 GHz
RES BW 30 kHz
2,1


TOPCON
REF -10.0 dBm
ATTEN 10 dB
10 dB/
hp
MKR Δ 732 kHz
0.00 dB
2.2
CENTER 2.440 00 GHz
RES BW 30 kHz
VBW 30 kHz
SPAN 2.00 MHz
SWP 20.0 msec


2.3
TOPCON
REF -10.0 dBm
10 dB/
ATTEN 10 dB
MKR Δ 776 kHz
-0.30 dB
CENTER 2.480 00 GHz
RES BW 30 kHz
VBW 30 kHz
SPAN 2.00 MHz
SWP 20.0 msec

4.3 Hopping Channel Carrier Frequency Separation
FCC Ref: 15.247(a)(1)

Requirements

Systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth, whichever is greater.

Procedure

Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit.

Test Results

Please refer to the attached spectrum analyzer plot # 4.2, report section 4.4, page 15, for the test result. The channel separation is 1.05 MHz.

4.4 Number of Hopping Channels
FCC Ref: 15.247(a)(1)(i&ii)

Requirements

Systems operating in the 2400-2483.5 MHz band shall use at least 75 hopping channels having the 20 dB bandwidth of 1 MHz or less, and at least 15 non-overlapping channels having the 20 dB bandwidth of more than 1 MHz.

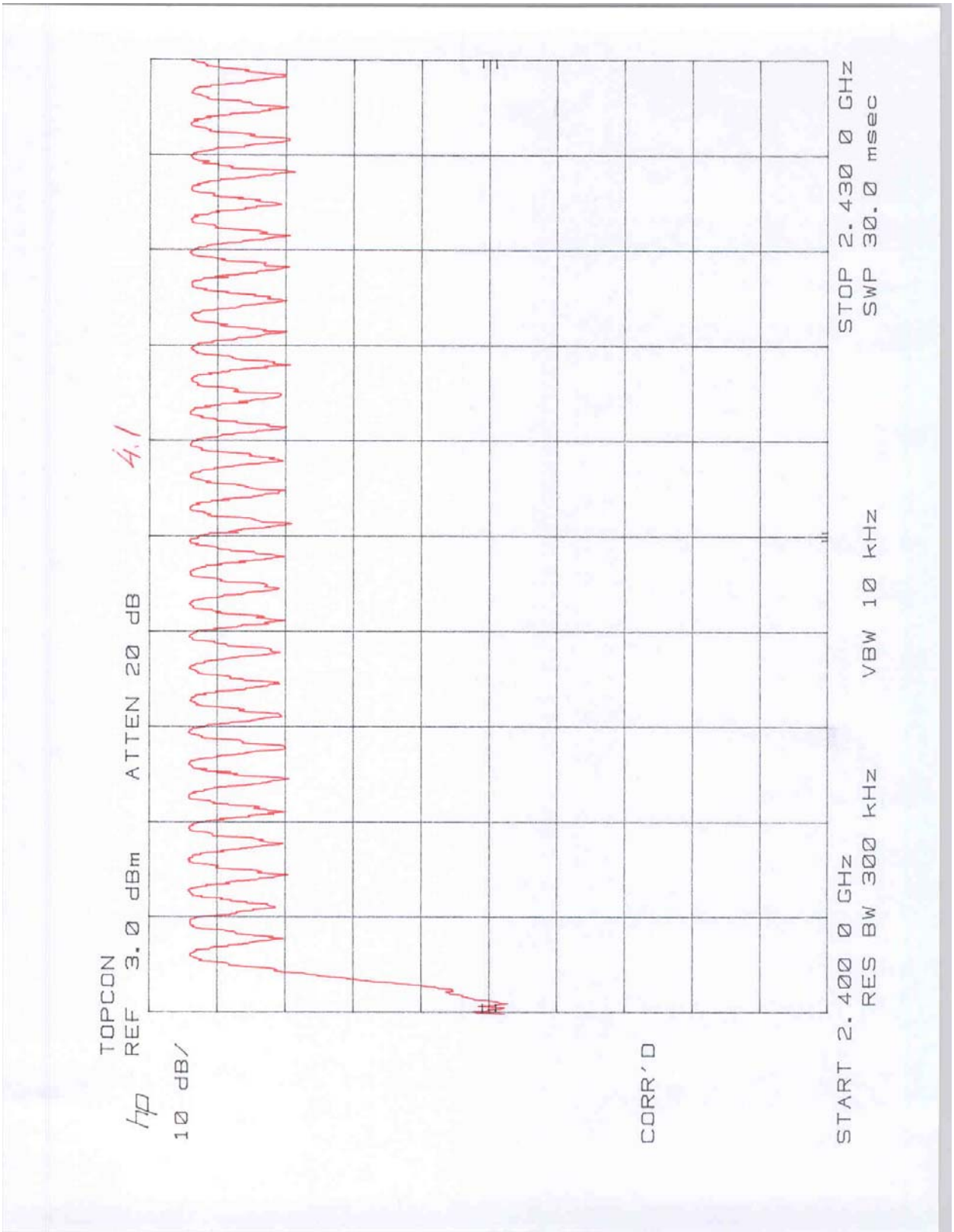
Procedure

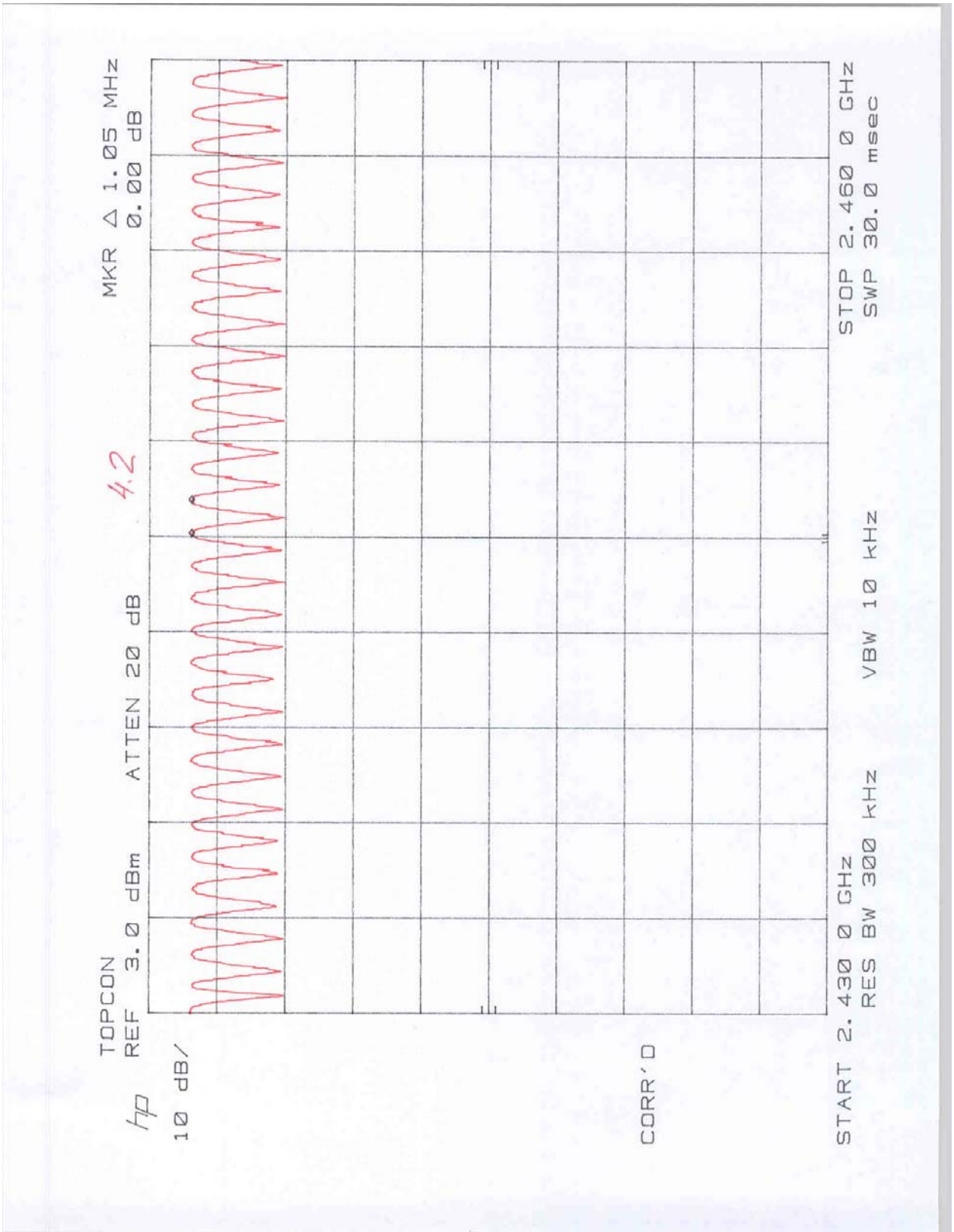
The RF passband of the EUT was divided into 3 approximately equal bands. With the analyzer set to MAX HOLD, readings were taken for 2 - 3 minutes in each band. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

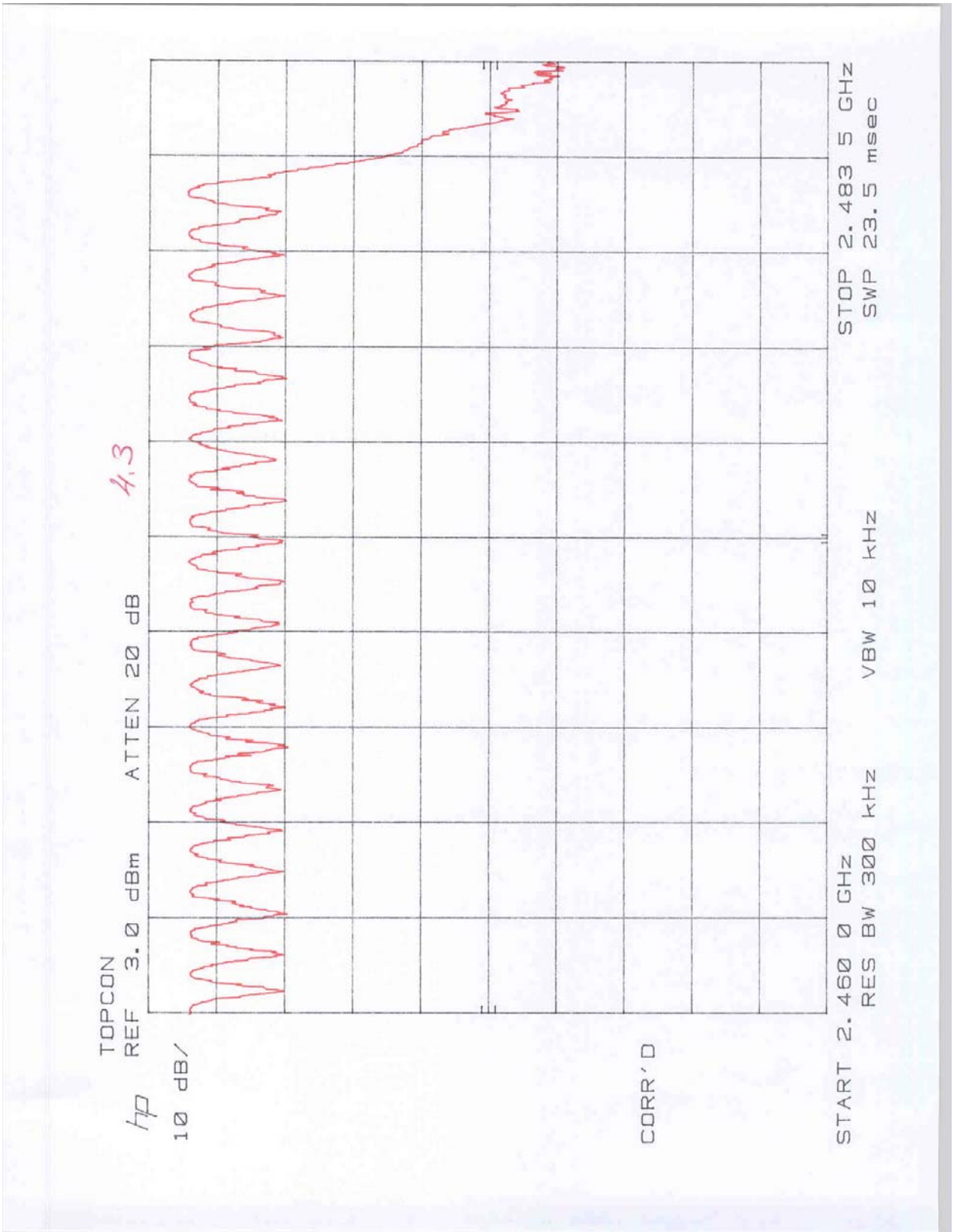
Test Results

Number of hopping channels with the bandwidth of 1 MHz or less	79

Refer to attached spectrum analyzer charts: Plots 4.1-4.3.


TOPCON
REF 3.0 dBm
ATTEN 20 dB
10 dB/
CORR'D
START 2.400 0 GHz
RES BW 300 kHz
VBW 10 kHz
STOP 2.430 0 GHz
SWP 30.0 msec
4.1


TOPCON
REF 3.0 dBm
ATTEN 20 dB
10 dB/
MKR Δ 1.05 MHz
0.00 dB
4.2
CORR'D
START 2.430 0 GHz
RES BW 300 kHz
VBW 10 kHz
STOP 2.460 0 GHz
SWP 30.0 msec


TOPCON
REF 3.0 dBm
ATTEN 20 dB
10 dB/
4.3
CORR'D
START 2.460 0 GHz
RES BW 300 kHz
VBW 10 kHz
STOP 2.483 5 GHz
SWP 23.5 msec

4.5 Average Channel Occupancy Time
FCC 15.247(a)(1)(ii)(iii)

Requirements

For systems operating in the 2400-2483.5 MHz band and using at least 75 hopping channels with the 20-dB bandwidth of 1 MHz or less, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 30 second period.
For systems operating in the 2400-2483.5 MHz band and using at least 15 hopping channels with the 20-dB bandwidth greater than 1 MHz, the average time of occupancy on any frequency shall not be greater than 0.4 second within the time period required to hop through all channels.

Procedure

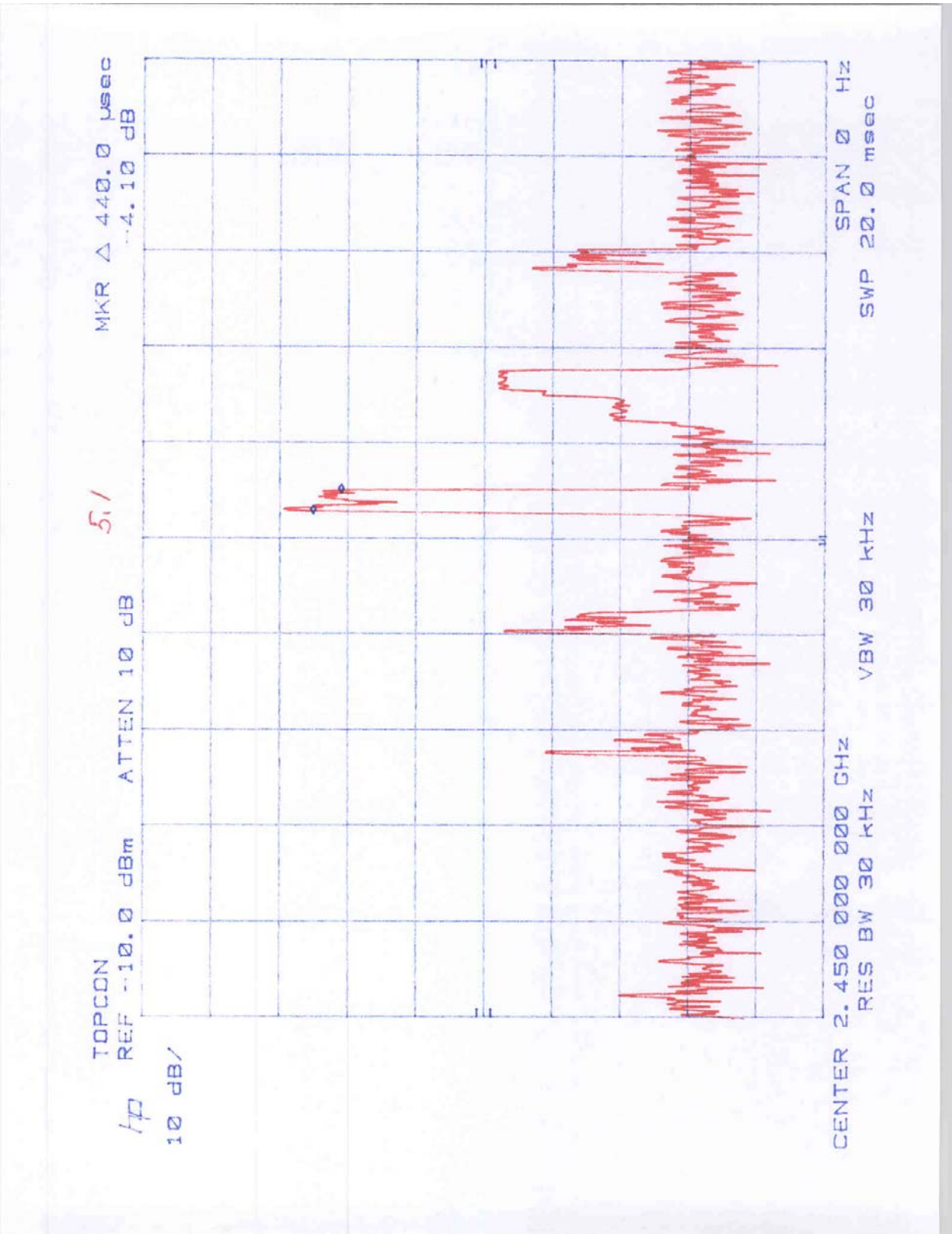
The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 0.4 second, the SPAN was set to ZERO SPANS, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

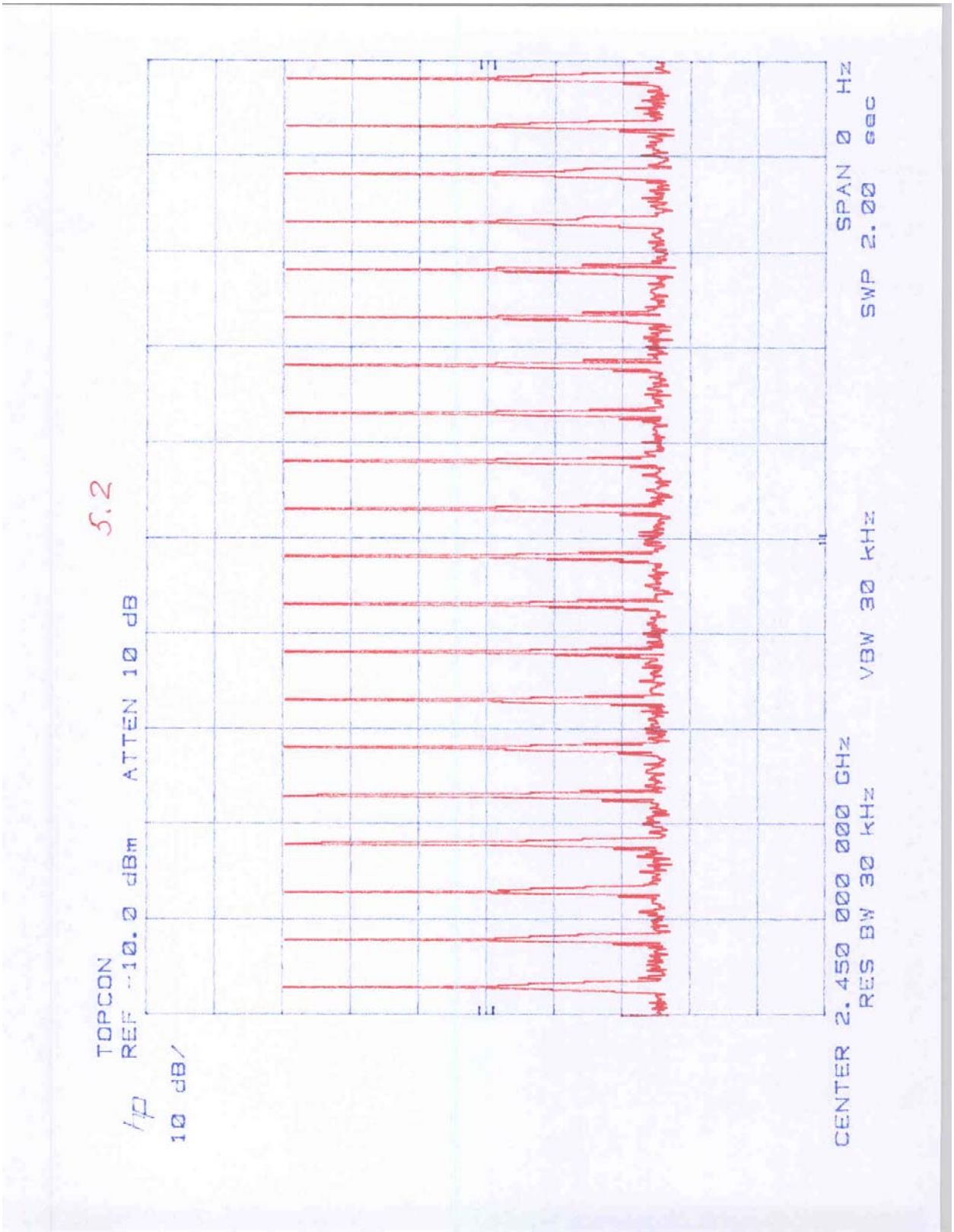
The SWEEP was then set to the time required by the regulation (30 seconds). The analyzer was set to SINGLE SWEEP, the total ON time was added and compared against the limit (0.4 seconds).

Test Results

The average time occupancy is: $0.44 \times 20 \times 15 = 132$ ms.

Refer to attached spectrum analyzer plots 5.1-5.2 for details.


TOPCON
REF -10.0 dBm
ATTEN 10 dB
10 dB/
MKR Δ 440.0 µsec
-4.10 dB
CENTER 2.450 000 000 GHz
RES BW 30 kHz
VBW 30 kHz
SPAN 0 Hz
SWP 20.0 msec


5.2
TOPCON
REF -10.0 dBm
ATTEN 10 dB
10 dB/
CENTER 2.450 000 000 GHz
RES BW 30 kHz
VBW 30 kHz
SPAN 0 Hz
SWP 2.00 sec

4.6 Out-of-Band Conducted Emissions
FCC 15.247(c)

Requirements

In any 100 kHz bandwidth outside the EUT pass-band, the RF power shall be at least 20 dB below that of the maximum in-band 100 kHz emission.

Procedure

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 10 MHz to 25 GHz.

Test Result

Refer to the plots for the test result in Appendix A:

Out-of-Band conducted emissions	
Plots 6.1 a – 6.1 g	Out-of-band Emissions, low channel
Plots 6.2.a – 6.2.g	Out-of-band Emissions, middle channel
Plots 6.3.a – 6.3.g	Out-of-band Emissions, high channel

4.7 Out-of-Band Radiated Emissions (except emissions in restricted bands) FCC 15.247(c)

For out of band radiated emissions (except for frequencies in restricted bands) that are close to or that exceed the 20 dB attenuation requirement described in the specification, radiated measurements were performed at a 3 m separation distance to determine whether these emissions complied with the general radiated emission requirement.

Test was not performed, the EUT passed out-of-band antenna conducted emission test.

4.8 Transmitter Radiated Emissions in Restricted Bands FCC 15.247 (c), 15.205

Procedure

Radiated emission measurements were performed from 30 MHz to 25,000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz - for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

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 - AG
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
AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μV) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μV/m). This value in dB(μV/m) was converted to its corresponding level in μV/m.
RA = 52.0 dB(μV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB
FS = 52.0+7.4+1.6-29.0 = 32 dB(μV/m)
Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m

Result

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

The field strength at the Band-edge frequencies was calculated as $E_F = E_o - \Delta$.

Where:

E_F = Field Strength of Band-edge Frequency

E_O = Field Strength of Fundamental Frequency

Δ = Delta between the levels of emissions at Fundamental Frequency and at Band-edge Frequency

The EUT passed the test by 3.2 dB.

Test Result										
FCC Part 15.247 Radiated Emission in Restricted Bands										
Temperature: 21.5 C							Topcon Positioning Systems			
Humidity: 40.0%							Model: Hiper Lite, 01-840802-03			
Test distance = 1 m							Engineer: A. Kaplan			
Test date: March 29, 2003										
Frequency MHz	Polarity	Detector	SA reading dB(uV)	Cable loss dB	Pre- amp gain dB	Ant. factor dB(1/m)	D.C.F dB	Field Strength dB(uV/m)	Limit dB(uV/m)	Margin dB
Tx, @ 2.402 GHz										
4804.0	V	Peak	42.5	5.0	35.8	34.9	-9.5	37.1	74.0	-36.9
4804.0	V	Aver	35.5	5.0	35.8	34.9	-9.5	30.1	54.0	-23.9
12010.0	V	Peak	42.5*	10.0	37.1	41.2	-9.5	47.1	74.0	-26.9
12010.0	V	Aver	31.7*	10.0	37.1	41.2	-9.5	36.3	54.0	-17.7
Tx, @ 2.440 GHz										
4880.0	V	Peak	45.0	5.0	35.8	34.9	-9.5	39.6	74.0	-34.4
4880.0	V	Aver.	39.5	5.0	35.8	34.9	-9.5	34.1	54.0	-19.9
7320.0	V	Peak	47.3	6.0	35.4	37.7	-9.5	46.1	74.0	-27.9
7320.0	V	Aver	39.8	6.0	35.4	37.7	-9.5	38.6	54.0	-15.4
12200.0	V	Peak	41.2*	10.0	37.1	41.2	-9.5	45.8	74.0	-28.2
12200.0	V	Aver	30.5*	10.0	37.1	41.2	-9.5	35.1	54.0	-18.9
Tx, @ 2.480 GHz										
4960.0	V	Peak	42.2	5.0	35.8	34.9	-9.5	36.8	74.0	-37.2
4960.0	V	Aver	33.7	5.0	35.8	34.9	-9.5	28.3	54.0	-25.7
7440.0	V	Peak	44.5	6.0	35.4	37.7	-9.5	43.3	74.0	-30.7
7440.0	V	Aver	34.0	6.0	35.4	37.7	-9.5	32.8	54.0	-21.2
12400.0	V	Peak	41.8*	10.0	37.1	41.2	-9.5	46.4	74.0	-27.6
12400.0	V	Aver	31.5*	10.0	37.1	41.2	-9.5	36.1	54.0	-17.9
22300.0	V	Peak	27.7*	11.0	24.0	40.3	-9.5	45.5	74.0	-28.5
22300.0	V	Aver	20.5*	11.0	24.0	40.3	-9.5	38.3	54.0	-15.7

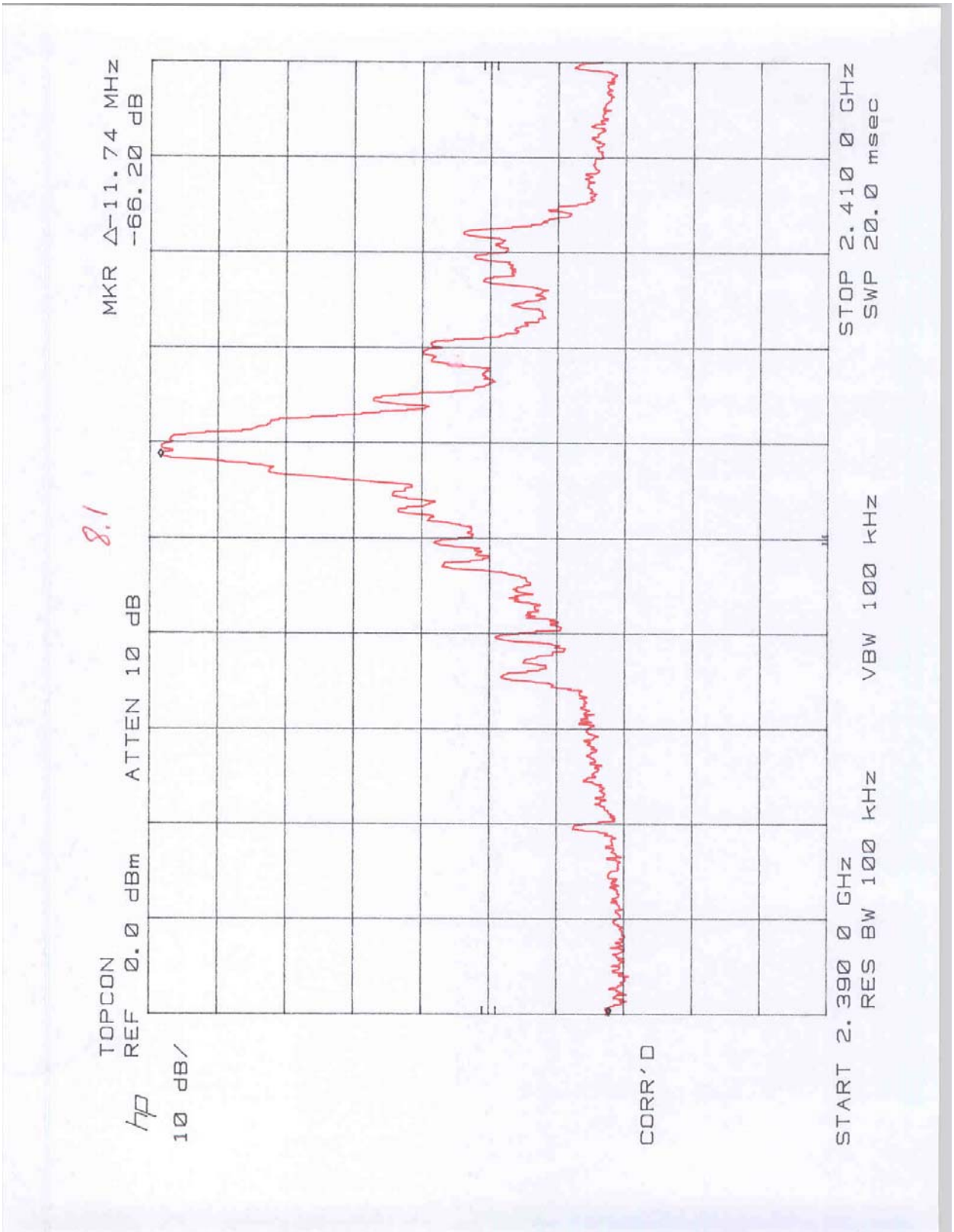
a) RBW = 1 MHz, VBW = 1 MHz - for peak measurements
RBW = 1MHz, VBW = 1 KHz - for average measurements
b) * Noise floor

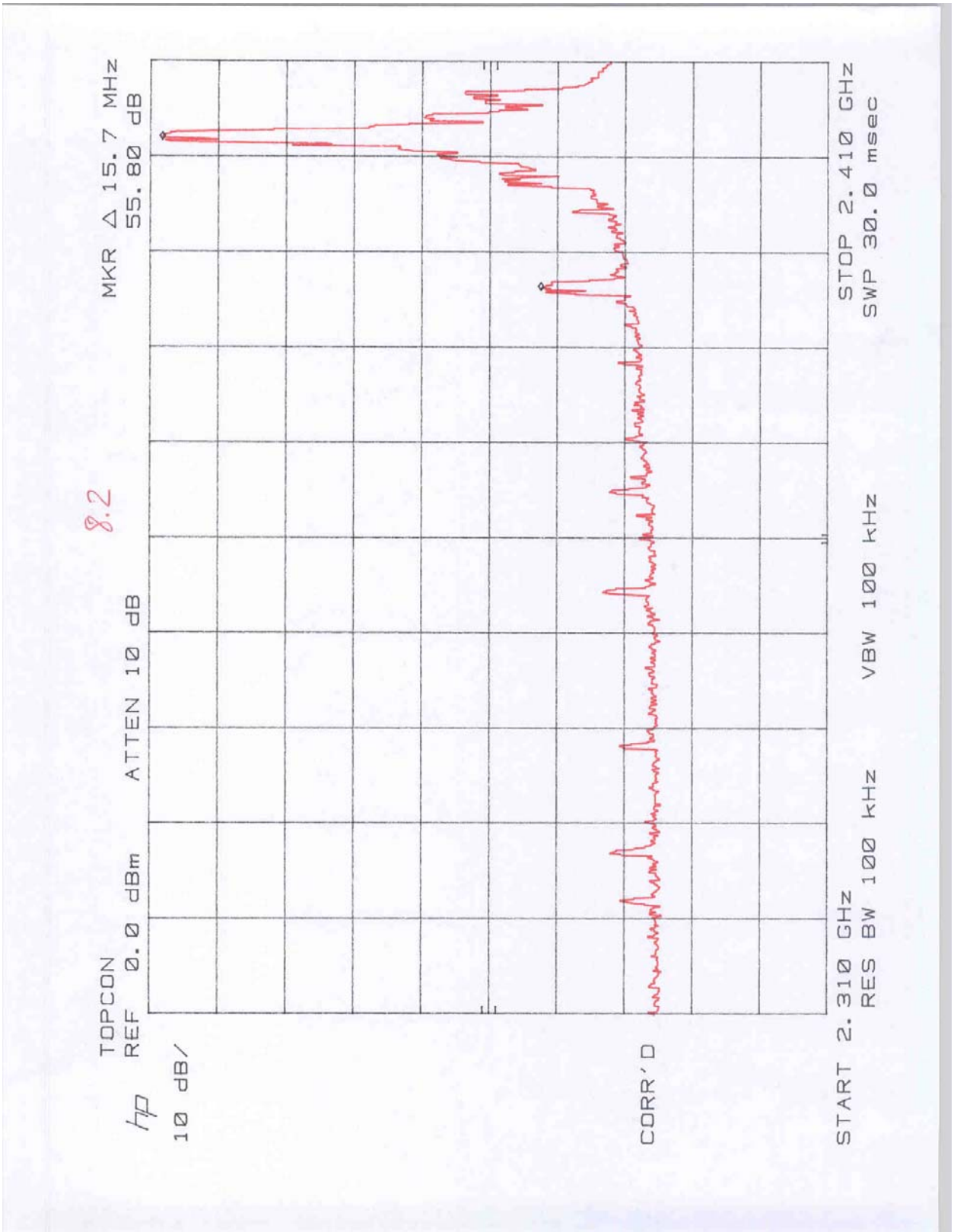
Radiated Emission in Restricted Bands at the band-edge frequencies
(measured using the "delta" method)

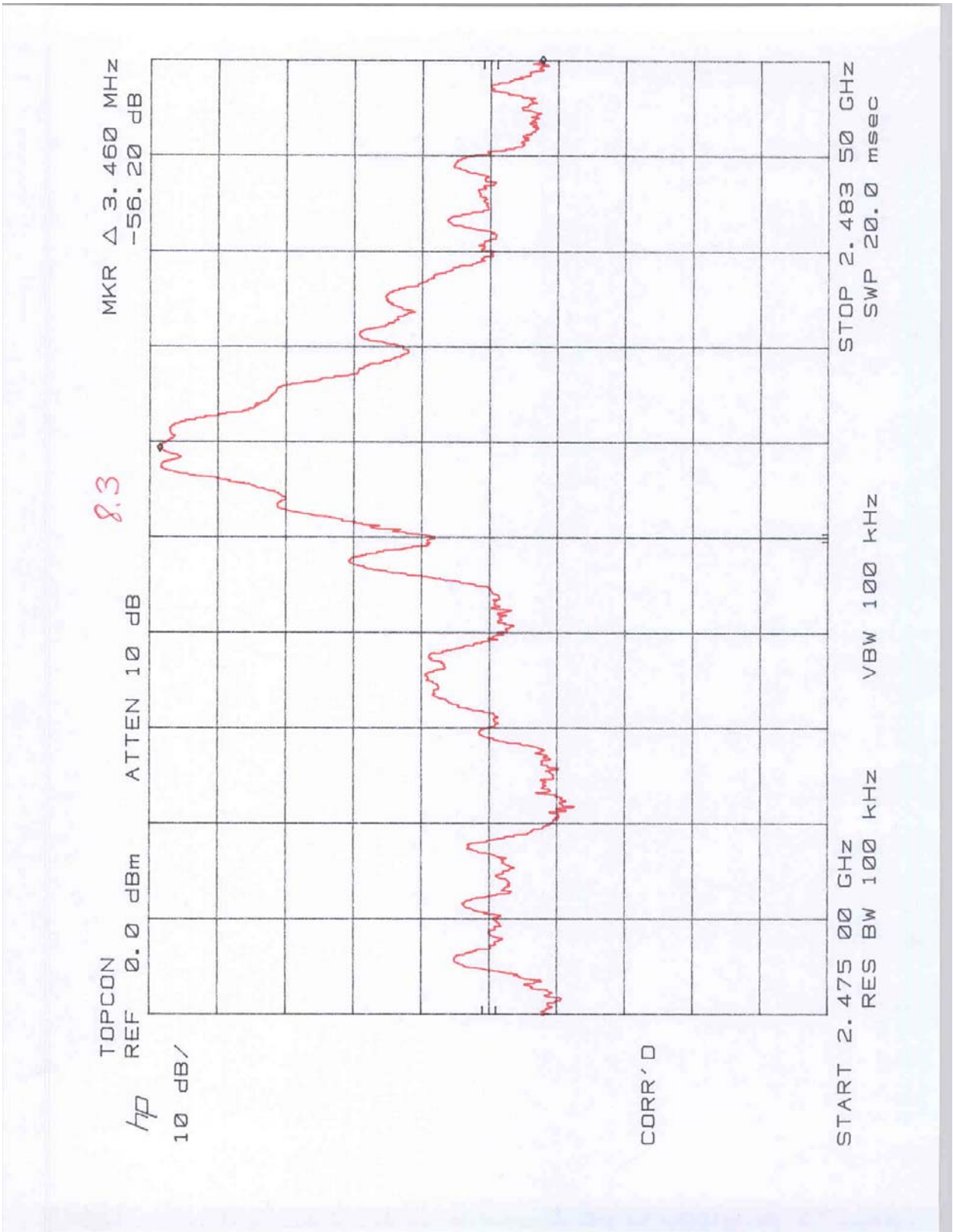
Frequency MHz	Polarity	Detector	SA reading dB(uV)	Cable loss dB	Pre- amp gain dB	Ant. factor dB(1/m)	Field Strength at 3 m dB(uV/m)	Limit at 3 m dB(uV/m)	Margin dB
2402.0	V	Aver.	65.0	4.7	0	30.5	100.2	-	-
2310 - 2390							100.2 - 55.8=44.4*	54	-9.6
2480.0	V	Aver.	65.5	4.7	0	30.5	100.7	-	-
2483.5 - 2500							100.7 - 49.9=50.8**	54	-3.2

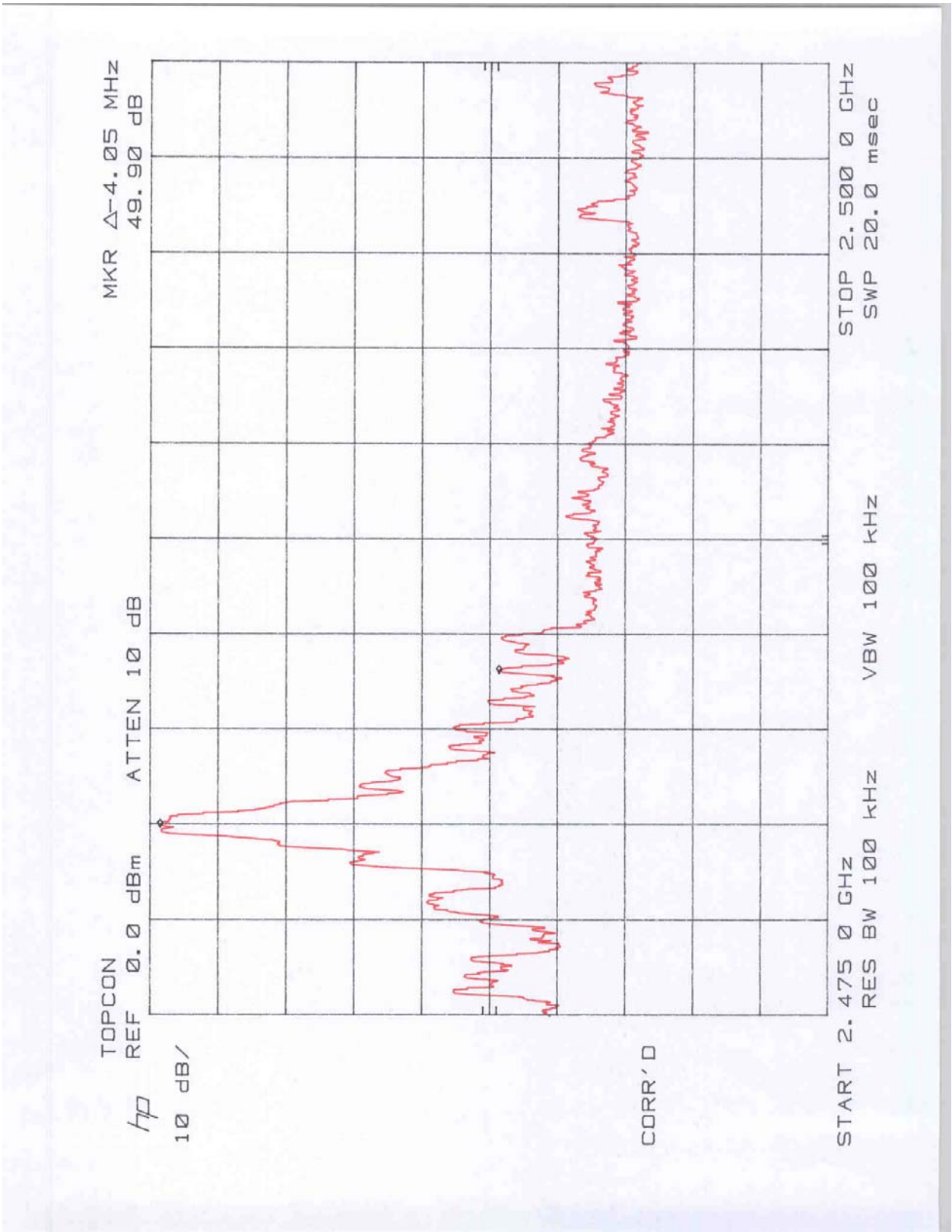
* delta = 55.8 dB is obtained from plot 8.2
** delta = 49.9 dB is obtained from plot 8.3

Since the difference between the Peak and Average levels in worst case is no more than 10 dB, the EUT is in compliance with the requirement of the Peak Field Strength (Limit is 74 dB(uV/m)) on the band-edge frequencies.


TOPCON
hp
REF 0.0 dBm
10 dB/
ATTEN 10 dB
CORR'D
MKR Δ-11.74 MHz
-66.20 dB
START 2.390 0 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 2.410 0 GHz
SWP 20.0 msec
8.1


8.2
TOPCON
REF 0.0 dBm
ATTEN 10 dB
10 dB/
MKR Δ 15.7 MHz
55.80 dB
CORR'D
START 2.310 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 2.410 GHz
SWP 30.0 msec


MKR Δ 3.460 MHz
-56.20 dB
8.3
TOPCON
REF 0.0 dBm
ATTEN 10 dB
10 dB/
CORR'D
START 2.475 00 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 2.483 50 GHz
SWP 20.0 msec

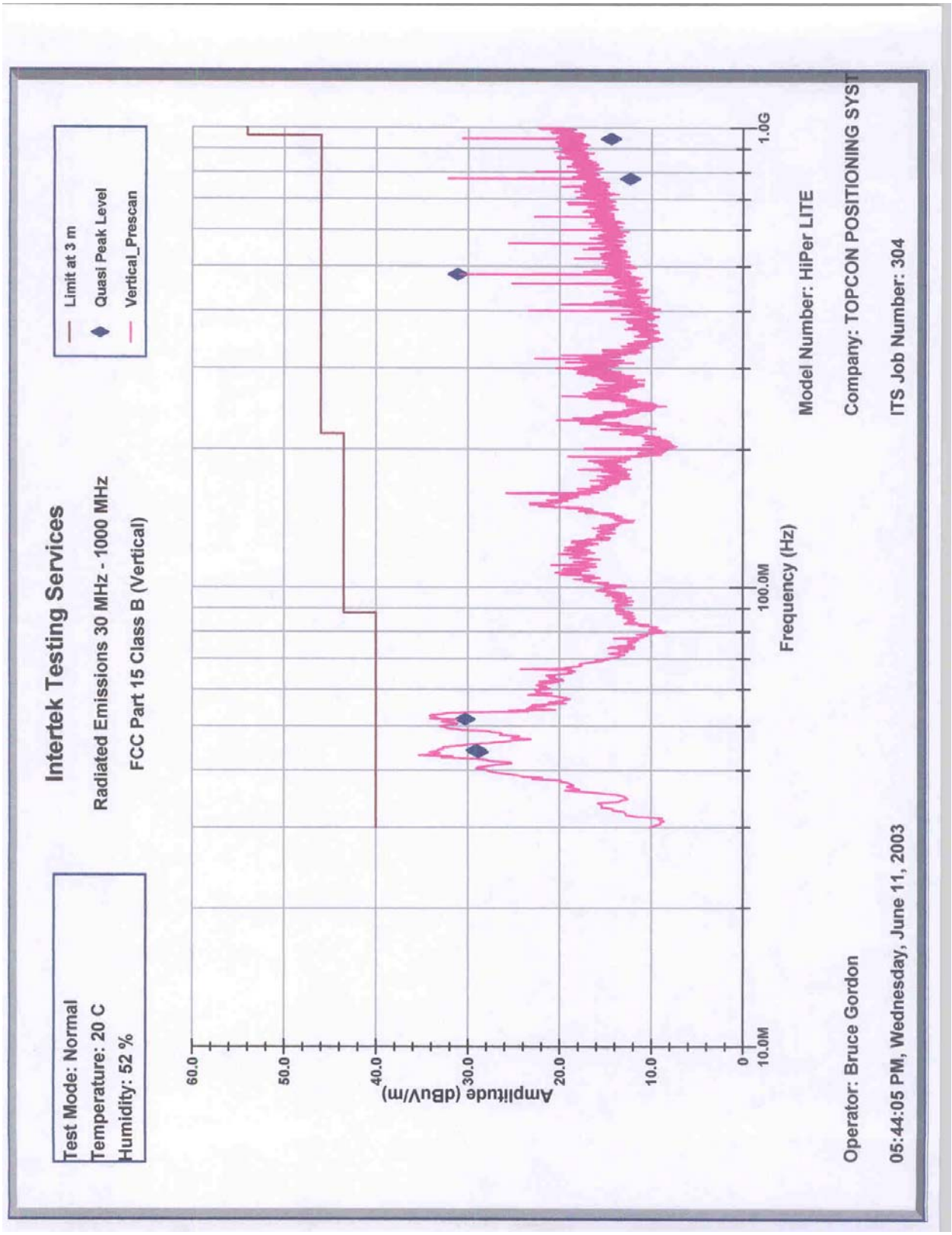

MKR Δ-4.05 MHz
49.90 dB
TOPCON
REF 0.0 dBm
ATTEN 10 dB
10 dB/
CORR'D
START 2.475 0 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 2.500 0 GHz
SWP 20.0 msec

4.9 Radiated Emissions from Digital parts of Transceiver (Transmitter)
FCC Ref: 15.109

Radiated emission measurements were performed from 30 MHz to 2000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz for frequencies below 1 GHz, and 1 MHz for frequencies above 1 GHz. See also section 4.8.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

The EUT passed by 9.7 dB.


Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (Vertical)
Test Mode: Normal
Temperature: 20 C
Humidity: 52 %
Limit at 3 m
Quasi Peak Level
Vertical_Prescan
Amplitude (dBuV/m)
60.0
50.0
40.0
30.0
20.0
10.0
0
10.0M
100.0M
1.0G
Frequency (Hz)
Model Number: HiPer LITE
Company: TOPCON POSITIONING SYST
ITS Job Number: 304
Operator: Bruce Gordon
05:44:05 PM, Wednesday, June 11, 2003

Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (QP-Vertical)

Operator: Bruce Gordon

Model Number: HiPer LITE
ITS Job Number: 304

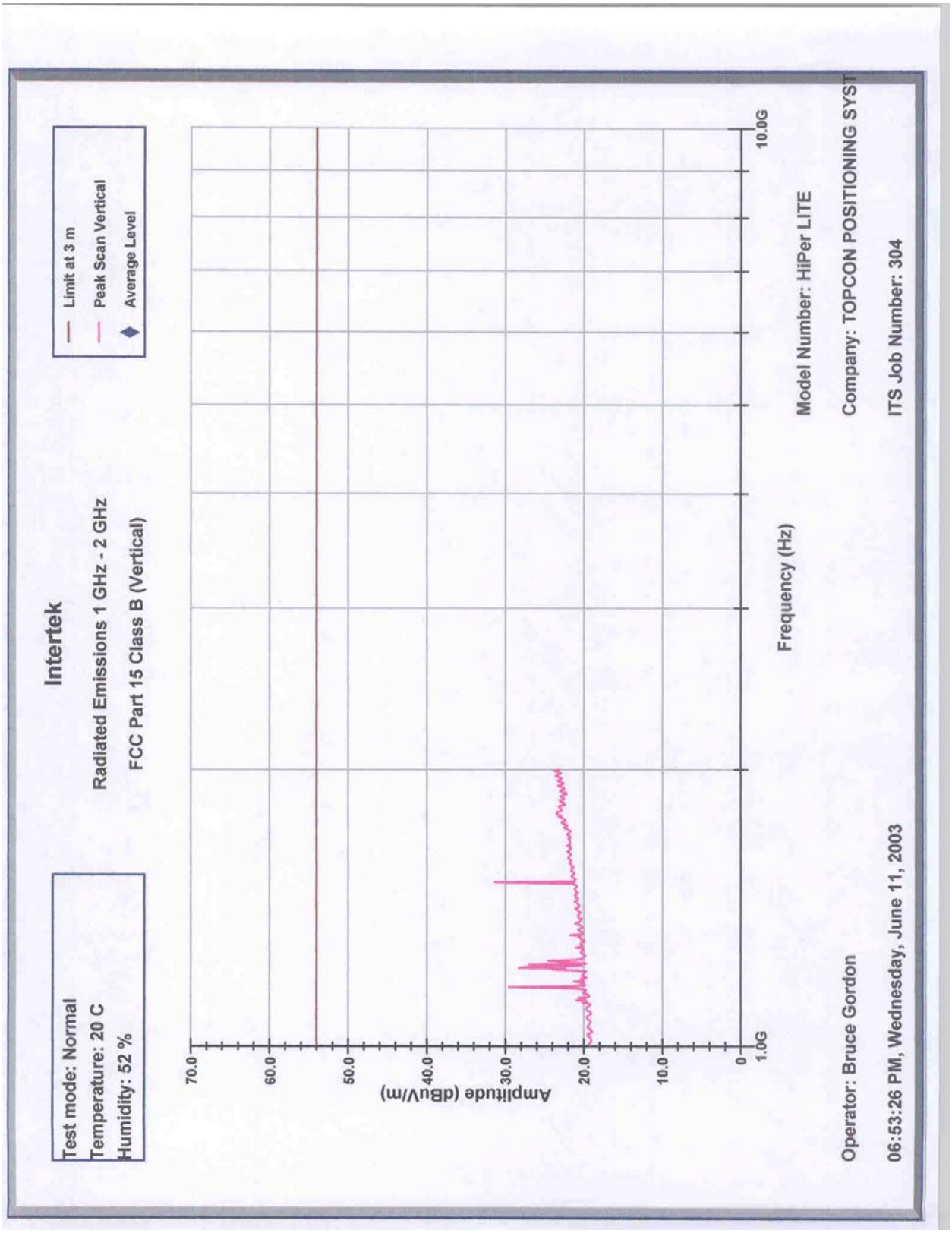
06:35:07 PM, Wednesday, June 11, 2003

Company: TOPCON POSITIONING SYSTEMS

	1	2	3	4	5	6	7	8
Frequency	Quasi Pk FS	Limit@3	Margin	RA	AG	CF	AF	Atten
MHz	dB(uV/m)	dB(uV/m)	dB	dB(uV)	dB	dB	dB(1/m)	dB
43.817 MHz	28.8	40.0	-11.2	48.7	32.4	0.6	8.9	3.0
44.215 MHz	29.1	40.0	-10.9	49.0	32.4	0.6	8.8	3.0
51.6825 MHz	30.3	40.0	-9.7	53.0	32.4	0.6	6.0	3.0
479.9995 MHz	31.1	46.0	-14.9	40.7	32.4	1.9	17.9	3.0
773.717 MHz	12.3	46.0	-33.7	18.4	32.5	2.5	20.9	3.0
945.832 MHz	14.4	46.0	-31.6	18.0	31.6	2.9	22.1	3.0

Test Mode: Normal
Temperature: 20 C
Humidity: 52 %

Page 1


Intertek
Radiated Emissions 1 GHz - 2 GHz
FCC Part 15 Class B (Vertical)
Test mode: Normal
Temperature: 20 C
Humidity: 52 %
Limit at 3 m
Peak Scan Vertical
Average Level
Amplitude (dBuV/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
1.0G
10.0G
Frequency (Hz)
Model Number: HiPer LITE
Company: TOPCON POSITIONING SYST
ITS Job Number: 304
Operator: Bruce Gordon
06:53:26 PM, Wednesday, June 11, 2003

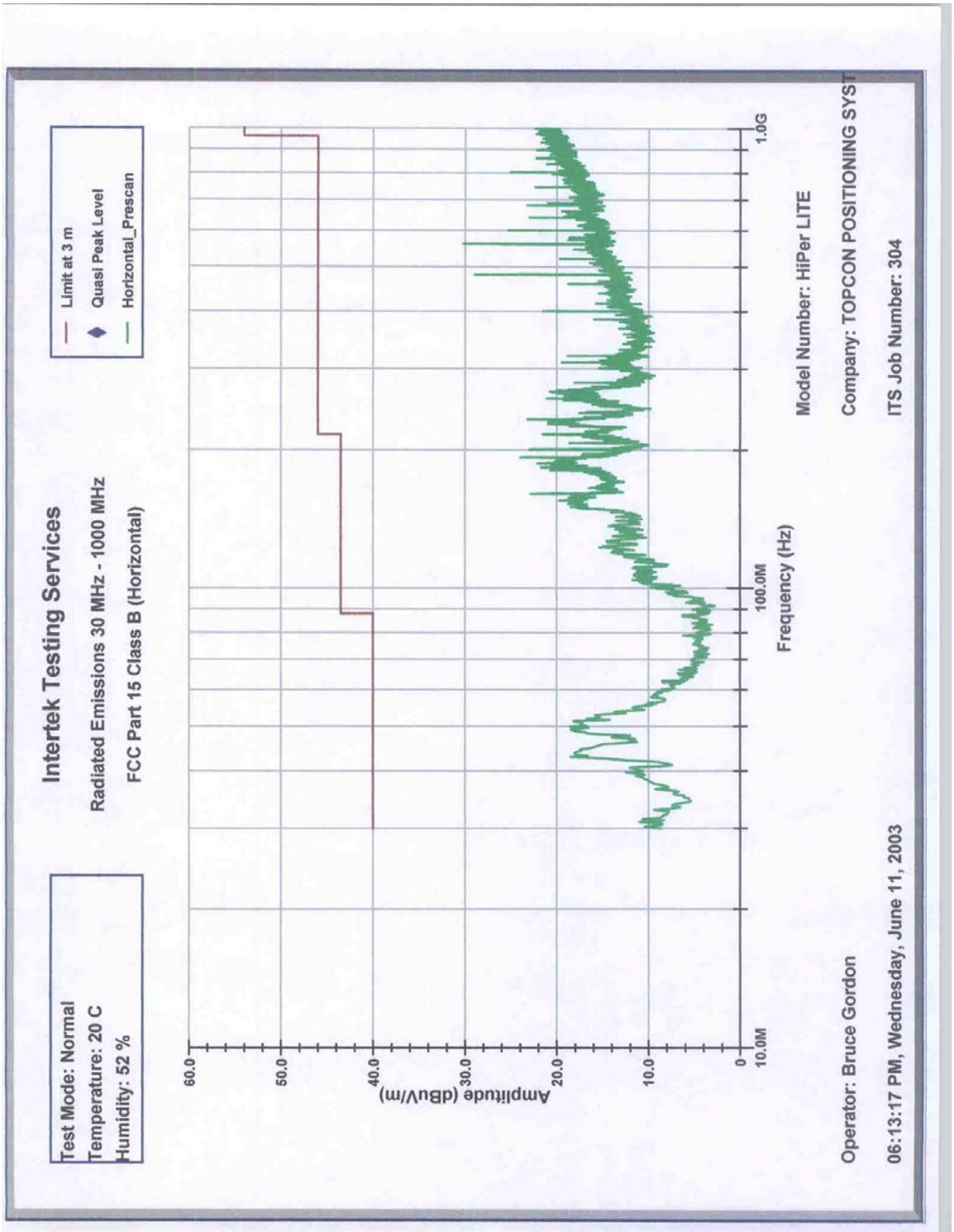
Intertek
Radiated Emissions 1 GHz - 2 GHz
FCC Part 15 Class B (Pk-Vertical)

Operator: Bruce Gordon
Model Number: HiPer LITE
ITS Job Number: 304
06:53:26 PM, Wednesday, June 11, 2003
Company: TOPCON POSITIONING SYSTEMS

	1	2	3	4	5	6	7	8
Frequency	Pk Level	Limit@3m	Pk Margin	Raw	Cable	Preamp	AF	Att.
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(dB)	(dB)	dB(1/m)	(dB)
1.16 GHz	29.6	54.0	-24.4	34.1	3.3	36.5	25.7	3.0
1.2175 GHz	28.3	54.0	-25.7	32.5	3.4	36.5	25.9	3.0
1.2275 GHz	27.0	54.0	-27.0	31.2	3.4	36.5	25.9	3.0
1.51 GHz	31.4	54.0	-22.6	34.4	3.8	36.5	26.7	3.0

Test mode: Normal
Temperature: 20 C
Humidity: 52 %

Page 1


Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (Horizontal)
Test Mode: Normal
Temperature: 20 C
Humidity: 52 %
Limit at 3 m
Quasi Peak Level
Horizontal_Prescan
Amplitude (dBuV/m)
60.0
50.0
40.0
30.0
20.0
10.0
0
10.0M
100.0M
1.0G
Frequency (Hz)
Model Number: HiPer LITE
Company: TOPCON POSITIONING SYST
ITS Job Number: 304
Operator: Bruce Gordon
06:13:17 PM, Wednesday, June 11, 2003

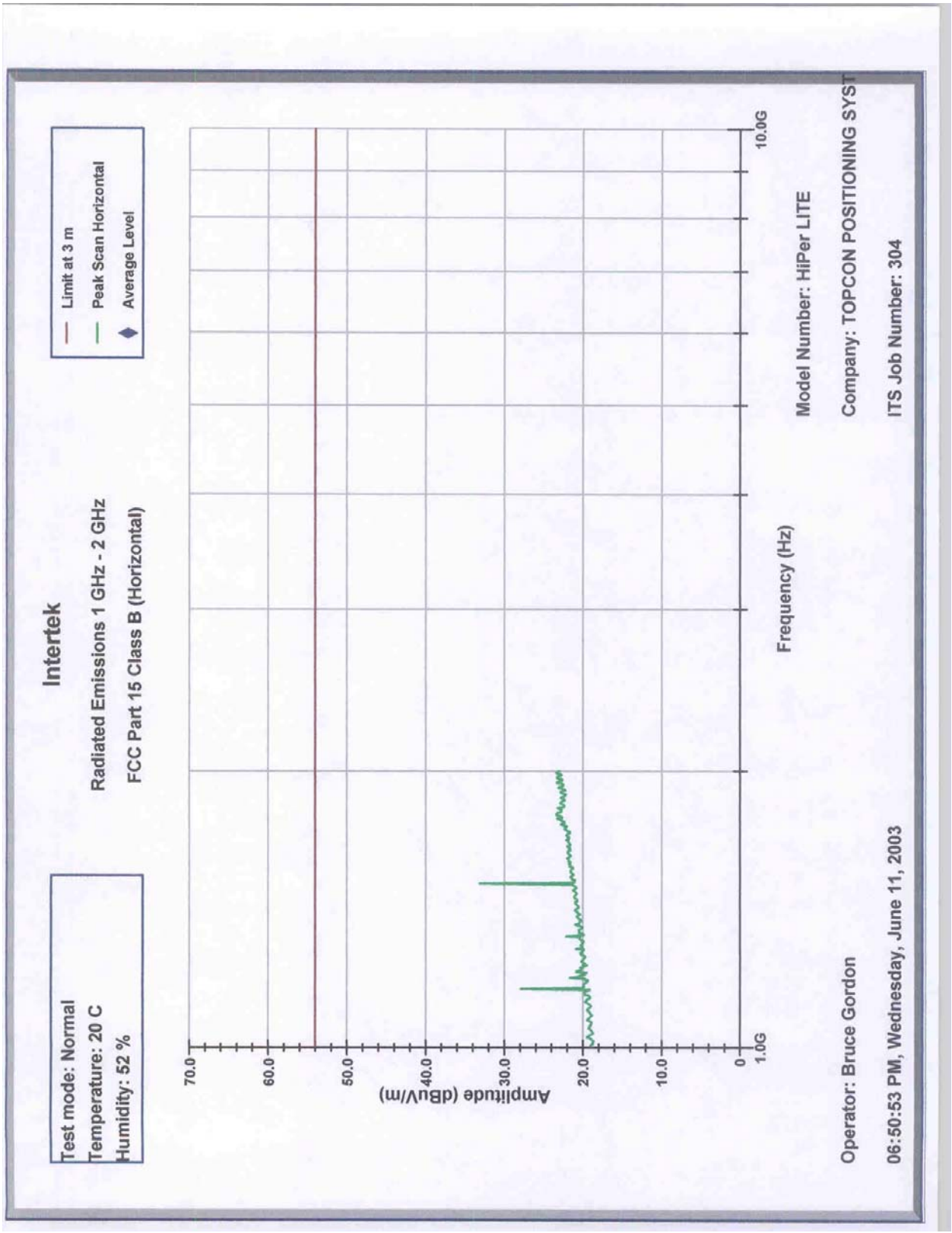
Intertek Testing Services
Radiated Emissions 30 MHz - 1000 MHz
FCC Part 15 Class B (Pk-Horizontal)

Operator: Bruce Gordon
Model Number: HiPer LITE
ITS Job Number: 304
06:13:14 PM, Wednesday, June 11, 2003
Company: TOPCON POSITIONING SYSTEMS

	1	2	3	4	5	6	7	8
Frequency	Pk	Limit@3m	Margin	RA	PA	CF	AF	Atten
(MHz)	dB(uV/m)	dB(uV/m)	dB	dB(uV)	dB	dB	dB(1/m)	dB
49.885 MHz	18.5	40.0	-21.5	40.4	32.4	0.6	6.9	3.0
160.2225 MHz	22.8	43.5	-20.7	42.1	32.3	1.1	8.9	3.0
192.2325 MHz	24.0	43.5	-19.5	41.9	32.3	1.3	10.0	3.0
200.235 MHz	23.0	43.5	-20.5	39.8	32.3	1.3	11.2	3.0
206.7825 MHz	18.6	43.5	-24.9	35.8	32.3	1.3	10.7	3.0
216.24 MHz	21.5	46.0	-24.5	38.0	32.2	1.4	11.4	3.0
232.4875 MHz	23.2	46.0	-22.8	39.5	32.2	1.4	11.6	3.0
258.435 MHz	21.1	46.0	-24.9	36.2	32.2	1.5	12.6	3.0
310.0875 MHz	19.5	46.0	-26.5	32.7	32.2	1.9	14.1	3.0
320.2725 MHz	18.9	46.0	-27.1	31.3	32.2	2.2	14.6	3.0
400.2975 MHz	21.5	46.0	-24.5	32.4	32.3	1.9	16.4	3.0
458.4975 MHz	18.8	46.0	-27.2	28.3	32.3	1.9	17.9	3.0
480.3225 MHz	29.0	46.0	-17.0	38.0	32.4	1.9	18.4	3.0
520.0925 MHz	19.7	46.0	-26.3	27.8	32.4	2.2	19.2	3.0
560.3475 MHz	30.2	46.0	-15.8	37.8	32.5	2.1	19.7	3.0
600.36 MHz	25.3	46.0	-20.7	33.0	32.5	2.3	19.5	3.0
640.3725 MHz	23.0	46.0	-23.0	29.2	32.5	2.3	21.0	3.0
680.1425 MHz	23.3	46.0	-22.7	29.6	32.6	2.3	20.9	3.0
744.6475 MHz	22.4	46.0	-23.6	27.8	32.5	2.5	21.6	3.0
802.12 MHz	25.1	46.0	-20.9	29.8	32.4	2.8	21.9	3.0

Test Mode: Normal
Temperature: 20 C
Humidity: 52 %

Page 1


Intertek
Radiated Emissions 1 GHz - 2 GHz
FCC Part 15 Class B (Horizontal)
Test mode: Normal
Temperature: 20 C
Humidity: 52 %
Limit at 3 m
Peak Scan Horizontal
Average Level
Amplitude (dBuV/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
1.0G
10.0G
Frequency (Hz)
Model Number: HiPer LITE
Company: TOPCON POSITIONING SYST
ITS Job Number: 304
Operator: Bruce Gordon
06:50:53 PM, Wednesday, June 11, 2003

Intertek
Radiated Emissions 1 GHz - 2 GHz
FCC Part 15 Class B (Pk-Horizontal)

Operator: Bruce Gordon

Model Number: HiPer LITE
ITS Job Number: 304
Company: TOPCON POSITIONING SYSTEMS

06:50:52 PM, Wednesday, June 11, 2003

	1	2	3	4	5	6	7	8
Frequency	Pk Level	Limit@3m	Pk Margin	Raw	Cable	Preamp	AF	Att.
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(dBuV)	(dB)	(dB)	dB(1/m)	dB
1.16 GHz	27.9	54.0	-26.1	32.7	3.3	36.5	25.5	3.0
1.51 GHz	33.1	54.0	-20.9	36.2	3.8	36.5	26.7	3.0

Test mode: Normal
Temperature: 20 C
Humidity: 52 %

Page 1

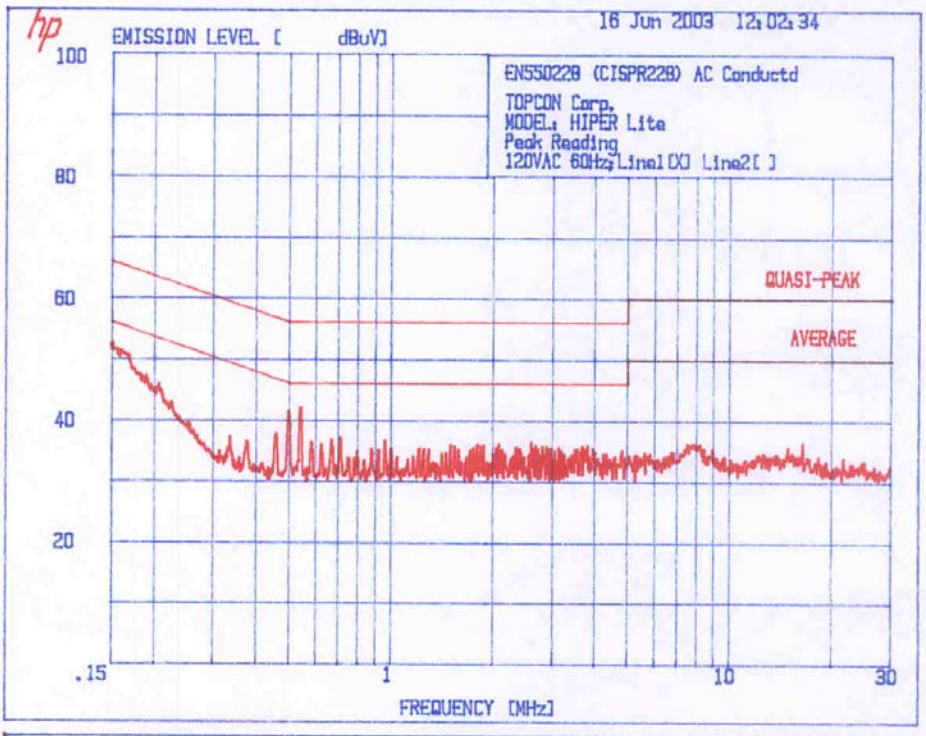
4.10 Radiated Emissions from Receiver part of Transceiver (L.O. Radiation) FCC 15.109, 15.111

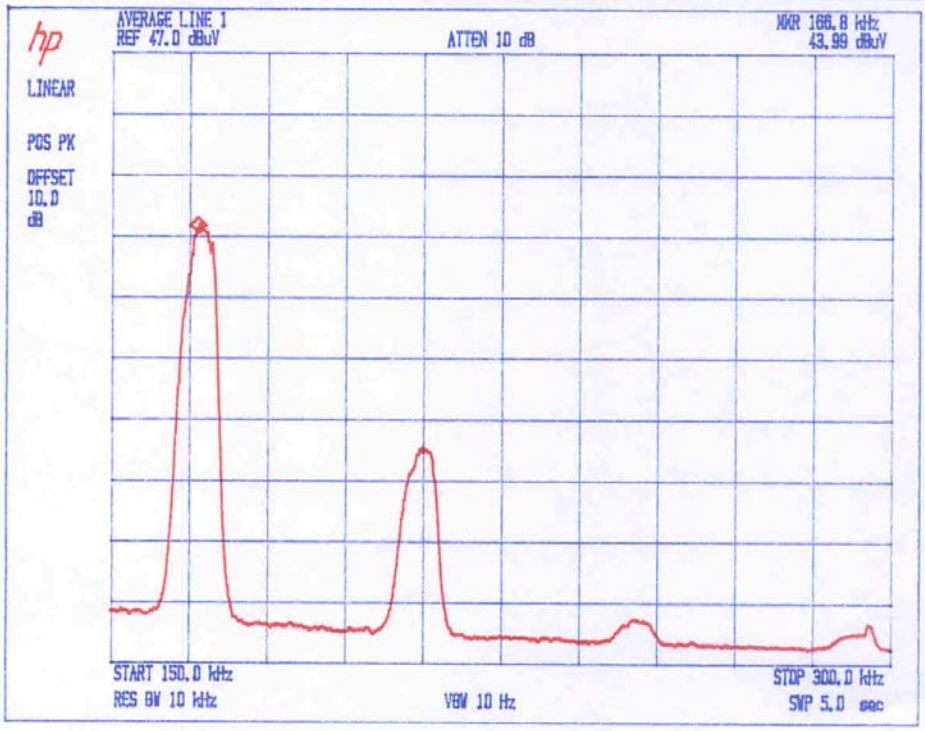
Not required – The receiver tuned frequency is above 960 MHz.

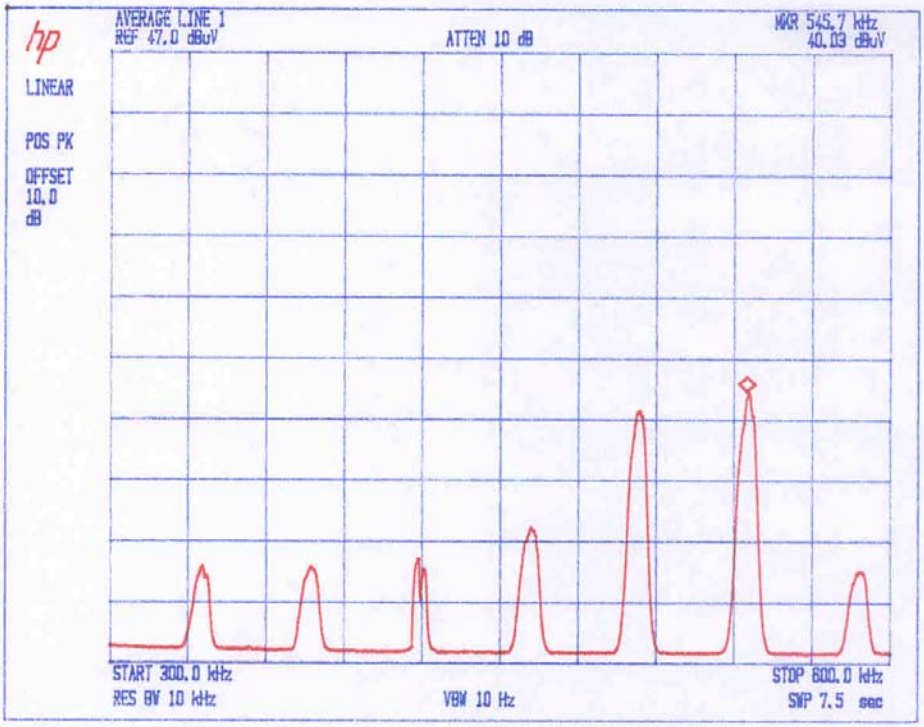
4.11 AC Line Conducted Emission
FCC 15.207:

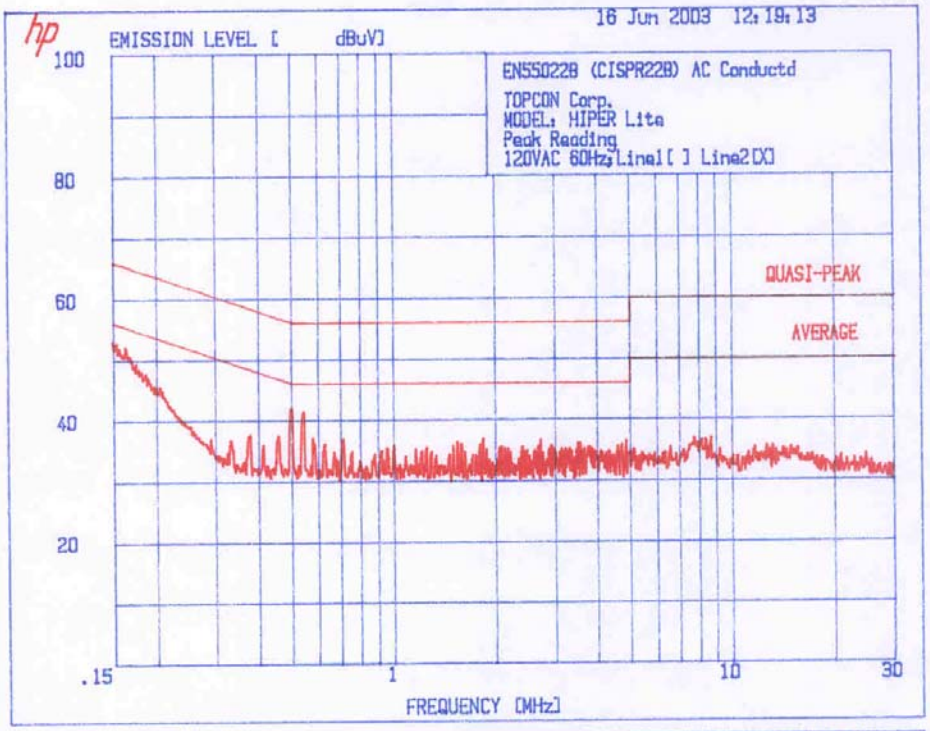
AC line conducted emission test was performed according the ANSI C63.4 standard. The EUT was connected to AC Line through the LISNs.

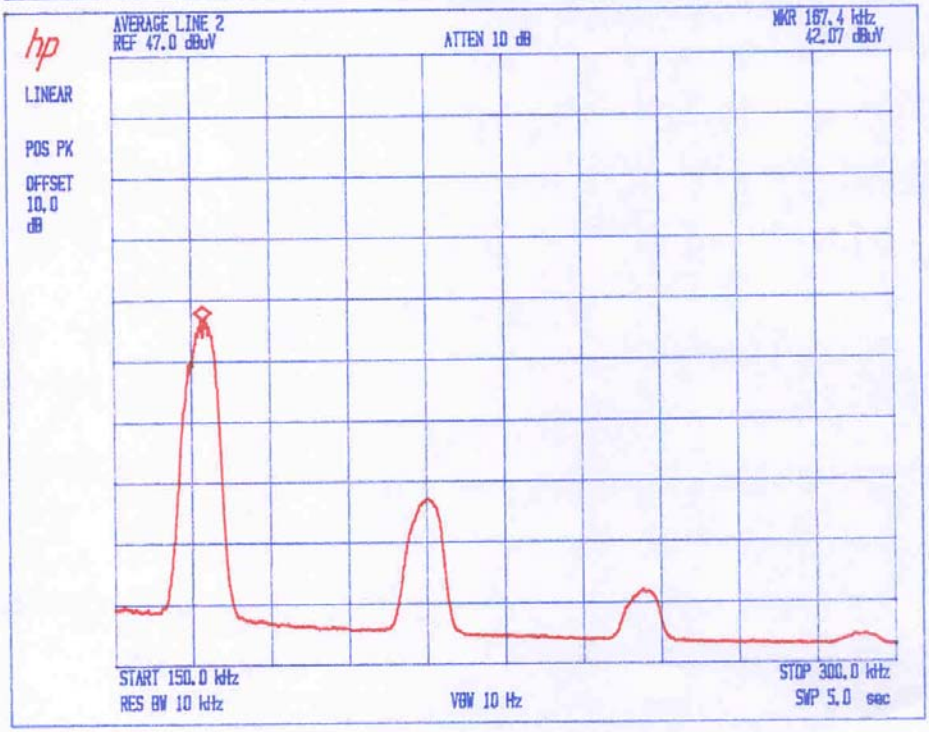
For the test result, see attached plots.
The EUT passed by 4.2 dB.

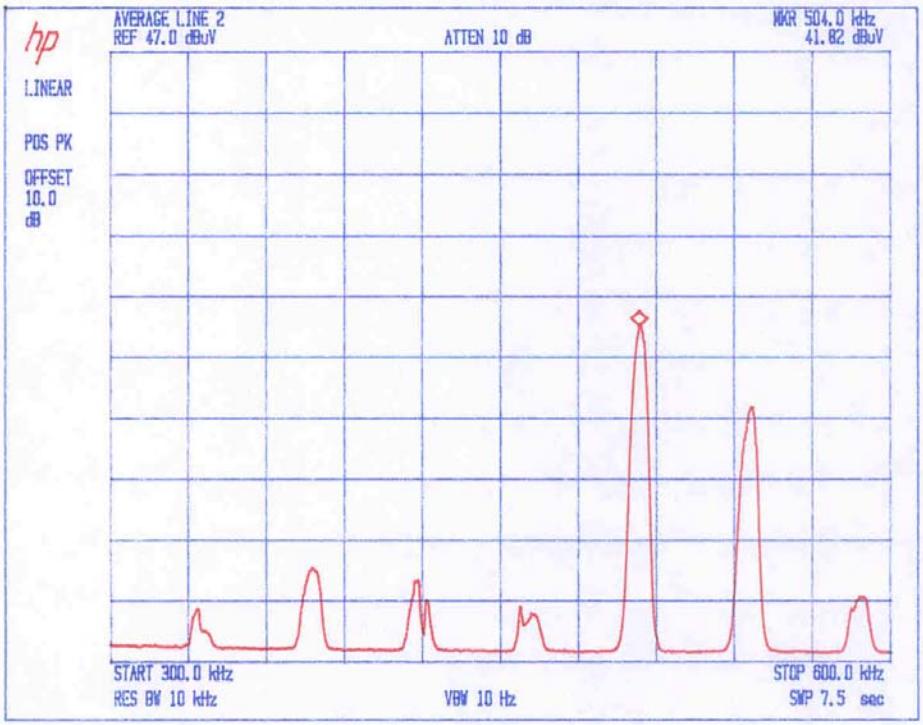

EMISSION LEVEL [dBuV]
16 Jun 2003 12:02:34
EN550228 (CISPR228) AC Conductd
TOPCON Corp.
MODEL: HIPER Lite
Peak Reading
120VAC 60Hz Line1[X] Line2[ ]
QUASI-PEAK
AVERAGE
100
80
60
40
20
.15
1
10
30
FREQUENCY [MHz]


AVERAGE LINE 1
REF 47.0 dBuV
ATTEN 10 dB
MKR 166.8 kHz
43.99 dBuV
LINEAR
POS PK
OFFSET
10.0
dB
START 150.0 kHz
RES BW 10 kHz
VBW 10 Hz
STOP 300.0 kHz
SWP 5.0 sec


AVERAGE LINE 1
REF 47.0 dBuV
ATTEN 10 dB
MKR 545.7 kHz
40.03 dBuV
LINEAR
POS PK
OFFSET
10.0
dB
START 300.0 kHz
RES BW 10 kHz
VBW 10 Hz
STOP 800.0 kHz
SWP 7.5 sec


hp
EMISSION LEVEL [dBuV]
16 Jun 2003 12:19:13
EN55022B (CISPR22B) AC Conductd
TOPCON Corp.
MODEL: HIPER Lite
Peak Reading
120VAC 60Hz,Line1[ ] Line2[X]
QUASI-PEAK
AVERAGE
100
80
60
40
20
.15
1
10
30
FREQUENCY [MHz]


hp
AVERAGE LINE 2
REF 47.0 dBuV
ATTEN 10 dB
MKR 167.4 kHz
42.07 dBuV
LINEAR
POS PK
OFFSET
10.0
dB
START 150.0 kHz
RES BW 10 kHz
VBW 10 Hz
STOP 300.0 kHz
SWP 5.0 sec


AVERAGE LINE 2
REF 47.0 dBuV
ATTEN 10 dB
MKR 504.0 kHz
41.82 dBuV
LINEAR
POS PK
OFFSET
10.0
dB
START 300.0 kHz
RES BW 10 kHz
VBW 10 Hz
STOP 600.0 kHz
SWP 7.5 sec

5.0 RF Exposure information

The EUT is a Bluetooth device used in mobile application, at least 20 cm from any body part of the user or near by persons.

The maximum conducted power is 1 mW; antenna is fix-mounted, 0.5 dBi gain. Therefore, to comply with RF Exposure Requirement, the MPE is calculated.

The maximum Peak EIRP calculated is 0.5 dBm or 1.1 mW. The Power Density can be calculated using the formula

$$S = EIRP/ 4\pi D^2$$

Where: S is Power Density in W/m^2
D is the distance from the antenna.

In the table below, the calculated Power Density at 5 cm and 20 cm distances and MPE Limit for general population/uncontrolled exposure is presented.

Distance, m	Power Density, W/m^2	MPE, W/m^2
0.05	0.035	10.0
0.20	0.002	10.0

As can be seen from the data, the MPE is well below the limit at 5 cm and greater.

6.0 List of test equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
BI-Log Antenna	EMCO	3143	9509-1160	12	9/19/03
Horn Antenna	EMCO	3115	8812-3049	12	4/08/04
Horn Antenna	EMCO	3160-09	ITS51	#	#
Pre-Amplifier	ITS	ITSPA-1	44156	12	8/16/03
Pre-amplifier	CTT	ACO/400	47526	12	10/5/03
Pre-Amplifier	Avantek	AFT-18855	8723H705	12	10/5/03
Power Meter	Hewlett Packard	8900D	3607U00673	12	1/02/04
Spectrum Analyzer w/85650 QP Adapter	Hewlett Packard	8566B	2416A00317 2043A00251	12	10/29/03
Spectrum Analyzer Display w/85650 QP Adapter	Hewlett Packard	85662B	2403A06796	12	10/29/03
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	7/16/03
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	7/16/03
Spectrum Analyzer w/8650 QP Adapter	Hewlett Packard	8568B	1912A0053 2521A01021	12	11/20/03
LISN	FCC	FCC-LISN-50-50-M-H	2012	12	1/23/04
Pulse Limiter	Hewlett Packard	11947A	2820A00184	12	9/3/03

No Calibration required

7.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / 3039445	DC	June 20, 2003	Original document
2.0 / 3039445	DC	July 30, 2003	Corrections on the pages 5, 6 and 25