



DATE: 11 December 2012

I.T.L. (PRODUCT TESTING) LTD.
FCC Radio Test Report
for
B.T9 Ltd.

Equipment under test:
HiTag 2.0 Xsense Sensing Unit

WS-TH-20

Written by: _____

I. Smilansky, Documentation

Approved by: _____

A. Sharabi, Test Engineer

Approved by: _____

I. Raz, EMC Laboratory Manager

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This report relates only to items tested.



HiTag 2.0 Xsense Sensing Unit

WS-TH-20

FCC ID: QYGHITAG2

This report concerns:	Original Grant:	x
	Class I change:	
	Class II change:	

Equipment type: Part 15 Security/Remote Control Transceiver

47CFR15 Section 15231 e

Measurement procedure used is ANSI C63.4-2003.

Application for Certification
prepared by:
Ishaiahou Raz
ITL (Product Testing) Ltd.
Kfar Bin Nun
D.N. Shimshon 99780
Israel
Tel: +972-8-918-6117
Fax: +972-8-915-3101
Email: sraz@itl.co.il

Applicant for this device:
(different from "prepared by")
Yossi Pelech
B.T9 Ltd.
P.O.B. 54,
33 Dolev St.
Tefen 24959, Israel
Tel: 972-4-912-2800
Fax: 972-4-912-2801
Email: yPelech@bt9-tech.com

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1 General Information

1.1 Administrative Information

Manufacturer:	B.T9 Ltd.
Manufacturer's Address:	P.O.B. 54 33 Dolev St., Tefen, 24959 Israel Tel: +972-4-912-2800 Fax: +972-4-912-2801
Manufacturer's Representative:	Yossi Pelech
Equipment Under Test (E.U.T):	HiTag 2.0 Xsense Sensing Unit
Equipment Model No.:	WS-TH-20
Equipment Serial No.:	Not Designated
Date of Receipt of E.U.T:	16.09.12
Start of Test:	16.09.12
End of Test:	11.10.12
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 71100
Test Specifications:	FCC Part 15 Subpart C



1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 861911.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025A-1.
6. TUV Product Services, England, ASLLAS No. 97201.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.



1.3 Product Description

The HiTag 2.0 is a sensing unit of the Xsense Cold Chain Monitoring System. Placed inside one of the product cartons in a pallet, it monitors the temperature and relative humidity of the product's immediate environment. When an Xsense Communication Unit (CU) is in the vicinity, data is transmitted to the Xsense Server and immediately viewable to users via the secure, web-based Xsense application.

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

The radiated emissions tests were performed at I.T.L.'s testing facility at Lod, Israel. This site is a FCC listed test laboratory (FCC Registration No. 861911, date of listing June 30, 2010). I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

1.6 Measurement Uncertainty

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.96 dB

2 System Test Configuration

2.1 Justification

Radiated emission screening was performed in 3 orthogonal orientations. The worst case orientation was the vertical position.

The antenna wire was 69 cm long.

2.2 EUT Exercise Software

The EUT was tested when programmed with the formal, commercially released firmware, configured to transmit periodically at maximum transmission rate.

2.3 Special Accessories

No special accessories were needed.

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance

2.5 Configuration of Tested System

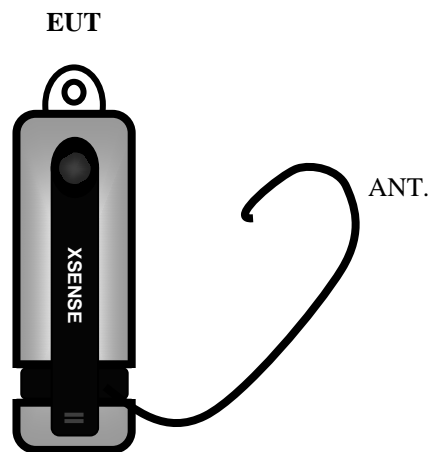


Figure 1. Configuration of Tested System

3 Radiated Measurement Test Set-up Photo



Figure 2. Radiated Emission Test

4 Average Factor Calculation

1. Transmission pulse duration = 1
2. Transmission pulse period = 1
3. Burst duration = 34.2 msec
4. Time between bursts = >100ms
5. Average Factor = $20 \log \left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within 100msec} \right]$

$$\text{Average Factor} = 20 \log \left[1 \times \frac{34.2}{100} \times 1 \right] = -9.3\text{dB}$$

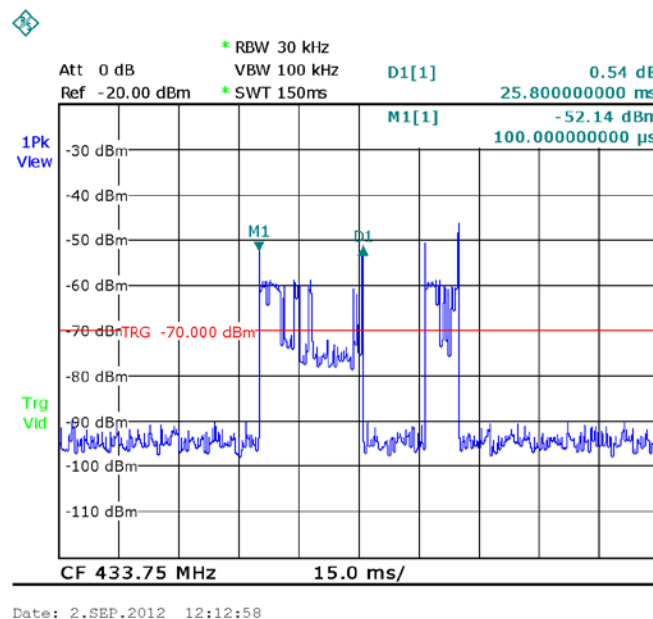


Figure 3. Burst #1 within 100ms

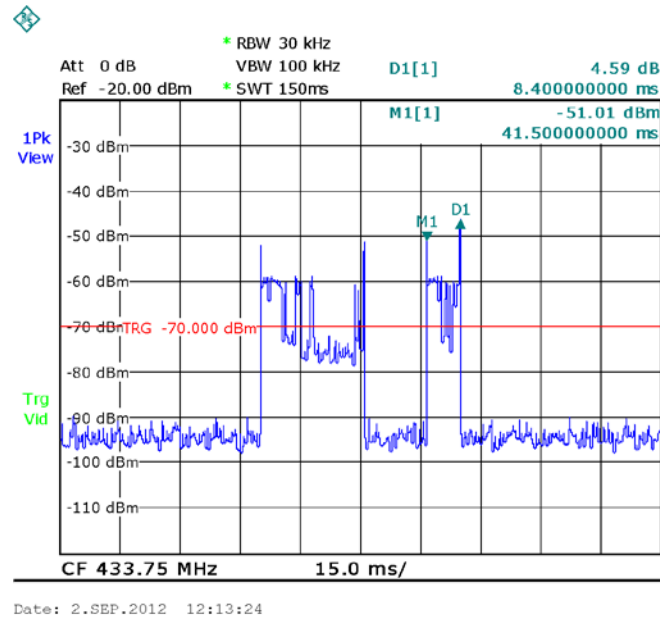


Figure 4. Burst #2 (total within 100ms=34.2msec)



4.1 Test Instrumentation Used, Average Factor Calculation

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	October 30, 2011	1 Year
Biconilog Antenna	EMCO	3142B	1250	September 5, 2012	1 Year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Turntable Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 5 Test equipment Used, Average Factor Calculation



5 Field Strength of Fundamental

5.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.231(e)

5.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

The E.U.T. was placed on a non-conductive table, 0.8 meters above the O.A.T.S. ground plane.

The EMI receiver was set to the E.U.T. Fundamental Frequency and Peak Detection.

The turntable and antenna mast were adjusted for maximum level reading on the EMI receiver.

The measurement was performed for vertical and horizontal polarizations of the test antenna.

The average result is:

Peak Level(dB μ V/m) + E.U.T. Duty Cycle Factor, in 100msec time window (dB)

5.3 Test Results

JUDGEMENT: Passed by 3.5 dB

The EUT met the FCC Part 15, Subpart C, Section 15.231(e) specification requirements.

The details of the highest emissions are given in Figure 5 to Figure 7.

TEST PERSONNEL:

Tester Signature: 

Date: 13.12.12

Typed/Printed Name: A. Sharabi



Field Strength of Fundamental

E.U.T Description HiTag 2.0 Xsense Sensing Unit
Type WS-TH-20
Serial Number: Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(e)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters

Detector: Peak

Frequency (MHz)	Polarity V/H	Peak Reading (dBμV/m)	Average Factor (dB)	Average Result (dBμV/m)	Average Specification (dBμV/m)	Margin (dB)
433.9	V	69.7	-9.3	60.4	72.9	-12.5
433.9	H	78.7	-9.3	69.4	72.9	-3.5

Figure 6. Field Strength of Fundamental. Antenna Polarization: HORIZONTAL/VERTICAL

Notes:

1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. "Peak Reading." (dBμV/m) included the "Correction Factors".
3. "Correction Factors" (dB) = Test Antenna Correction Factor(dB) + Cable Loss.
4. "Average Result" (dBμV/m)=Peak Reading (dBμV/m)+D.C.F. (dB)

Field Strength of Fundamental

E.U.T Description HiTag 2.0 Xsense Sensing Unit
Type WS-TH-20
Serial Number: Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(e)

Antenna Polarization: Horizontal

Test Distance: 3 meters

Detector: Peak

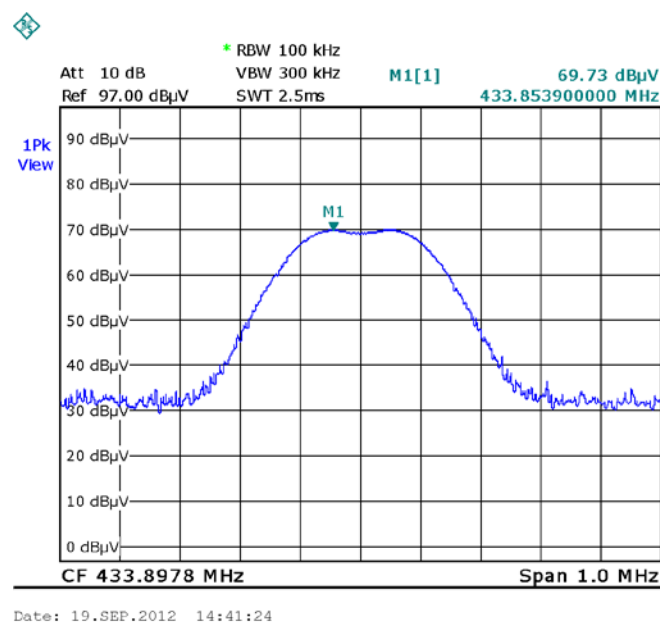


Figure 7. Field Strength of Fundamental Antenna Polarization: HORIZONTAL.

Field Strength of Fundamental

E.U.T Description HiTag 2.0 Xsense Sensing Unit
Type WS-TH-20
Serial Number: Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(e)

Antenna Polarization: Vertical

Test Distance: 3 meters

Detector: Peak

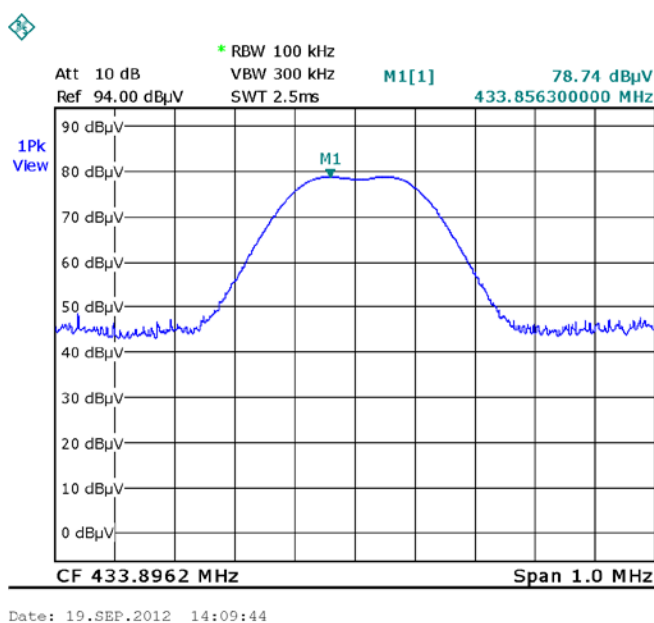


Figure 8. Field Strength of Fundamental Antenna Polarization: VERTICAL

5.4 Test Equipment Used, Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
Spectrum Analyzer	Rodhe & Schwarz	FSL6	100194	October 30, 2011	1 Year
Biconilog Antenna	EMCO	3142B	1250	September 5, 2012	1 Year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Turntable Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 9 Test Equipment Used, Field Strength of Fundamental



6 Spurious Radiated Emission, 9 kHz – 30 MHz

6.1 Test Specification

9 kHz-30 MHz, FCC, Part 15, Subpart C, Section 209

6.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The E.U.T. highest frequency source or used frequency is 433.9 MHz.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

6.3 Test Results

JUDGEMENT: Passed.

The EUT was tested and it met the requirements of the FCC Part 15, Subpart C, specification.

No signals were detected in 9 kHz – 30 MHz range.

TEST PERSONNEL:

Tester Signature: 

Date: 13.12.12

Typed/Printed Name: A. Sharabi

6.4 Test Equipment Used, Spurious Radiated Emission 9 kHz – 30 MHz

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMC Analyzer	HP	HP8593	3536A00120ADI	February 28, 2012	1 Year
Active Loop Antenna	EMCO	6502	9506-2950	October 19, 2011	1 Year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Turntable Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

**Figure 10 Test Equipment Used, Spurious Radiated Emission
9 kHz – 30 MHz**

6.5 Field Strength Calculation

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dB μ V/m]

RA: Receiver Amplitude [dB μ V]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dB μ V (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dB μ V

No external pre-amplifiers are used.

7 Spurious Radiated Emission 30 MHz – 4.5 GHz

7.1 Test Specification

30 – 4500 MHz, F.C.C., Part 15, Subpart C

7.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3. See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 1. The signals from the list of the highest emissions were verified and the list was updated accordingly.

The E.U.T. highest frequency source or used frequency is 433.9 MHz.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emissions in the frequency range of 30 MHz – 2.9 GHz were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 2.9 – 4.5 GHz, a spectrum analyzer including a low noise amplifier was used. The test distance was 3 meters. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

The emissions were measured at a distance of 3 meters.



7.3 Test Results

JUDGEMENT: Passed by 0.3 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

The margin between the emission level and the specification limit was 0.3 dB in the worst case at the frequency of 1301.01 MHz, vertical polarization.

TEST PERSONNEL:

Tester Signature:  _____

Date: 13.12.12

Typed/Printed Name: A. Sharabi



Radiated Emission

E.U.T Description HiTag 2.0 Xsense Sensing Unit
Type WS-TH-20
Serial Number: Not Designated

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 30 MHz to 4500MHz
Antenna: 3 meters distance Detectors: Peak, Quasi-peak

Frequency (MHz)	Antenna Polarity (H/V)	Peak Reading (dBμV/m)	Average Factor (dBμV/m)	Average Result dBμV/m)	Average Specification (dBμV/m)	Margin (dB)
867.8	H	56.3	-9.3	47.0	52.9	-5.9
867.8	V	61.5	-9.3	52.2	52.9	-0.7
1301.0	H	61.5	-9.3	52.2	54.0	-1.8
1301.0	V	63.0	-9.3	53.7	54.0	-0.3

Figure 11. Radiated Emission.

Antenna Polarization: VERTICAL/HORIZONTAL.

Detectors: Peak

Notes:

1. Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.
2. "Peak Reading." (dBμV/m) included the "Correction Factors".
3. "Correction Factors" (dB) = Test Antenna Correction Factor(dB) + Cable Loss.
4. "Average Result" (dBμV/m)=Peak Reading (dBμV/m)+ Average Factor (dB)

7.4 Test Equipment Used, Spurious Radiated Emission 30 MHz – 4.5 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMC Analyzer	HP	HP8593	3536A00120ADI	February 28, 2012	1 Year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS- 0411N313	013	November 5, 2011	1 Year
Biconilog Antenna	EMCO	3142B	1250	September 5, 2012	1 Year
Horn Antenna	ETS	3115	6142	March 14, 2012	1 Year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Turntable Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 12 Test equipment used, Spurious Radiated Emission
30 MHz – 4.5 GHz

7.5 Field Strength Calculation Below 1 GHz

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dB μ V/m]

RA: Receiver Amplitude [dB μ V]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dB μ V (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dB μ V

No external pre-amplifiers are used.

8 Bandwidth

8.1 Test Specification

Part 15, Subpart C Section 15.231(c)

8.2 Test Procedure

The transmitter unit operated with normal modulation. The spectrum analyzer was set to 100 kHz resolution BW and center frequency of the transmitter fundamental. The spectrum bandwidth of the transmitter unit was measured and recorded. The BW was measured at 20 dBc points. The EUT was set up as shown in Figure 1, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on the modulation envelope.


8.3 Test Results

Bandwidth Reading (kHz)	Specification (1) (kHz)	Margin (kHz)
373	1084	-711

Figure 13 Bandwidth

JUDGEMENT: Passed by 711 kHz

TEST PERSONNEL:

Tester Signature: 

Date: 13.12.12

Typed/Printed Name: A. Sharabi

(1) 0.25% of the E.U.T. fundamental frequency, Section 15.231(c).

Bandwidth

E.U.T Description HiTag 2.0 Xsense Sensing Unit
Type WS-TH-20
Serial Number: Not Designated

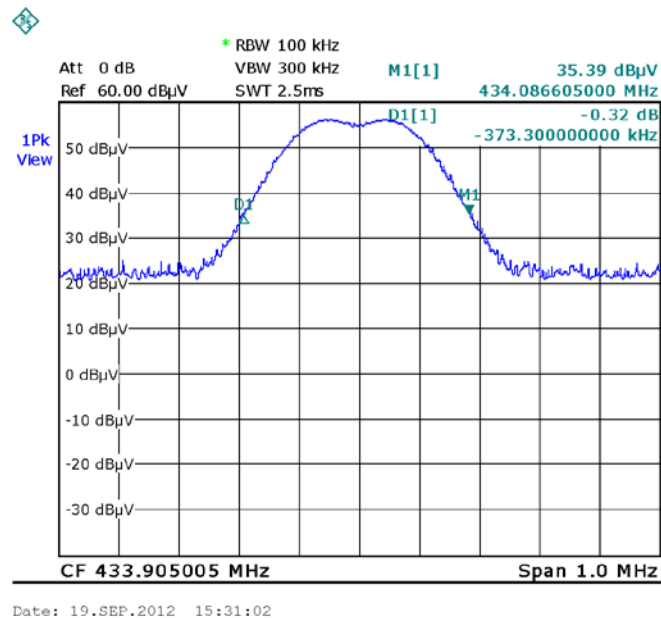


Figure 14 Bandwidth



8.4 Test Equipment Used, Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
sPECTRUM Analyzer	R&s	HP8593	3536A00120ADI	February 28, 2012	1 Year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 5, 2011	1 Year
Biconilog Antenna	EMCO	3142B	1250	September 5, 2012	1 Year
Horn Antenna	ETS	3115	6142	March 14, 2012	1 Year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Turntable Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 15 Test Equipment Used, Bandwidth

9 APPENDIX A - CORRECTION FACTORS

9.1 Correction factors for CABLE

from EMI receiver
to test antenna
at 3 AND 10 meter range.

FREQUENCY	CORRECTION FACTOR	FREQUENCY	CORRECTION FACTOR
(MHz)	(dB)	(MHz)	(dB)
30	1.96	700	11.25
35	2.08	800	12.53
40	2.26	900	13.86
45	2.43	1000	14.86
50	2.59	1200	15.7
55	2.65	1400	17.05
60	2.86	1600	18.2
65	2.96	1800	19.4
70	3.04	2000	21.3
75	3.27		
80	3.41		
85	3.54		
90	3.68		
95	3.77		
100	3.93		
110	4.19		
120	4.41		
130	4.6		
140	4.83		
150	5.06		
160	5.35		
170	5.57		
180	5.7		
190	5.84		
200	6.02		
250	6.86		
300	7.59		
350	8.09		
400	8.7		
450	9.15		
500	9.53		
550	9.82		
600	10.24		
650	10.74		

NOTES:

1. The cable type is RG-214/U



9.2 Correction factors for Bilog ANTENNA

Model: 3142

Antenna serial number: 1250

3 meter range

FREQUENCY	AFE	FREQUENCY	AFE
(MHz)	(dB/m)	(MHz)	(dB/m)
30	18.4	1100	25
40	13.7	1200	24.9
50	9.9	1300	26
60	8.1	1400	26.1
70	7.4	1500	27.1
80	7.2	1600	27.2
90	7.5	1700	28.3
100	8.5	1800	28.1
120	7.8	1900	28.5
140	8.5	2000	28.9
160	10.8		
180	10.4		
200	10.5		
250	12.7		
300	14.3		
400	17		
500	18.6		
600	19.6		
700	21.1		
800	21.4		
900	23.5		
1000	24.3		



9.3 Correction factors for *Horn ANTENNA*

Model: 3115

Antenna serial number: 6142

3 meter range

FREQUENCY	Antenna Factor	FREQUENCY	Antenna Factor
(MHz)	(dB/m)	(MHz)	(dB/m)
1000	23.9	10500	38.4
1500	25.4	11000	38.5
2000	27.3	11500	39.4
2500	28.5	12000	39.2
3000	30.4	12500	39.4
3500	31.6	13000	40.7
4000	33	14000	42.1
4500	32.7	15000	40.1
5000	34.1	16000	38.2
5500	34.5	17000	41.7
6000	34.9	17500	45.7
6500	35.1	18000	47.7
7000	35.9		
7500	37.5		
8000	37.6		
8500	38.3		
9000	38.5		
9500	38.1		
10000	38.6		



9.4 Correction factors for ACTIVE LOOP ANTENNA
Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2