



DATE: 17 November 2015

**I.T.L. (PRODUCT TESTING) LTD.
FCC Radio Test Report**

for

AeroScout Industrial

Equipment under test:

Asset Tag

T23T Tag; T23 Tag*; T23W Tag*

*See customer's Declaration on page 5

Tested by:

M. Zohar

Approved by:

D. Shidlowsky

This report must not be reproduced, except in full, without the written permission of I.T.L. (Product Testing) Ltd.

This report relates only to items tested.



TABLE OF CONTENTS

1.	GENERAL INFORMATION	4
1.1	Administrative Information	4
1.2	List of Accreditations	6
1.3	Product Description	7
1.4	Test Methodology	7
1.5	Test Facility	7
1.6	Measurement Uncertainty	7
2.	SYSTEM TEST CONFIGURATION	8
2.1	Justification	8
2.2	EUT Exercise Software	8
2.3	Special Accessories	8
2.4	Equipment Modifications	8
2.5	Configuration of Tested System	9
3.	TEST SETUP PHOTOS	10
4.	UWB BANDWIDTH	13
4.1	Test Specification	13
4.2	Test Procedure	13
4.3	Test Results	13
4.4	Test Equipment Used; UWB Bandwidth	15
5.	RADIATED EMISSIONS AND GPS BAND	16
5.1	Test Specification	16
5.2	Test Procedure	16
5.3	Test Results	17
5.4	Test Equipment Used; Radiated Emissions and GPS Band	21
6.	PEAK LEVEL EMISSION	22
6.1	Test Specification	22
6.2	Test Procedure	22
6.3	Test Results	22
6.4	Test Equipment Used; Peak Level Emissions	25
7.	R.F EXPOSURE/SAFETY	26
8.	CORRECTION FACTORS	27
8.1	Correction factors for 35M Coaxial cable for OATS	27
8.2	Correction factors for Horn Antenna	28
8.3	Correction factors for ACTIVE LOOP ANTENNA	29
8.4	Correction factors for Biconical log ANTENNA	30
8.5	Correction factors for Horn ANTENNA	31
8.6	Correction factors for Horn Antenna Ka Band	32



1. General Information

1.1 Administrative Information

Manufacturer:	AeroScout Industrial
Manufacturer's Address:	2 Ilan Ramon Street Ness Ziona, 7403635, Israel Tel: +972-8-936-9393 Fax: +972-8-936-5977
Manufacturer's Representative:	Eli Basri
Equipment Under Test (E.U.T):	Asset Tag
Equipment Model No.:	T23T Tag; T23 Tag*; T23W Tag*
Equipment Part No.:	Not Designated
Date of Receipt of E.U.T:	22.04.2015
Start of Test:	22.04.2015
End of Test:	19.08.2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	FCC Part 15 Subpart F

*See customer's Declaration on following page.



STANLEY.

AeroScout
Industrial

Date: September 8, 2015

DECLARATION

I HEREBY DECLARE THAT THE

T23T TAG

Is A Maximum CONFIGURATION MODEL.

OTHER MODELS, WHICH INCLUDE

T23 TAG

T23W TAG

**DIFFER FROM THE T23T TAG ONLY BY SOFTWARE AND/OR EXTRACTED
COMPONENTS/ASSEMBLIES.**

**All the models contain the identical 125 kHz receiver, UWB transmitter and
WIFI transmitter.**

**Please relate to them all (from a Radio point of view) as the same
product.**

Thank you,

Signature:

Eli Basri

Engineer

AeroScout Industrial Ltd.



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.), FCC Designation Number US1004.
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, 4025A-2.

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 T23 Bi-directional Asset Tag is a component of AeroScout Industrial's suite of enterprise visibility solutions for location-based applications. The T23 Tag adds further flexibility and scalability to track assets across a wide variety of applications.

T23 operates on 2x3.6VDC battery.

Once deployed, the tag uses its bi-directional functionality to receive firmware and configuration updates from MobileView. This removes the need to manually collect, update and re-deploy tags in the field.

T23 consist of an LF receiver, WiFi transceiver and UWB transceiver.

1.4 Test Methodology

Radiated testing were performed according to the procedures in ANSI 63-4: 2009. Radiated testing was performed at an antenna to EUT distance of 1 meters.

1.5 Test Facility

Radiated emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is US1004.

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):

± 4.98 dB

Note: See ITL Procedure No. PM 198.



2. System Test Configuration

2.1 Justification

Exploratory testing was performed in 3 orthogonal polarities to determine the worst case.

The fundamental results are shown in the below table:

Frequency (MHz)	Channel	X axis (dBuV/m)	Y axis (dBuV/m)	Z axis (dBuV/m)
3993.6 MHz	2	-73.0	-77.0	-73.8
6489.6 MHz	5	-57.8	-58.2	-64.3

Figure 1. Screening Results

In all axes the spurious levels were under the noise level.
According to the above results the worst case was the Y axis.

2.2 EUT Exercise Software

No exercise software was used.

2.3 Special Accessories

No special accessories were needed in order to achieve compliance.

2.4 Equipment Modifications

No equipment modifications were needed to achieve compliance.

2.5 Configuration of Tested System

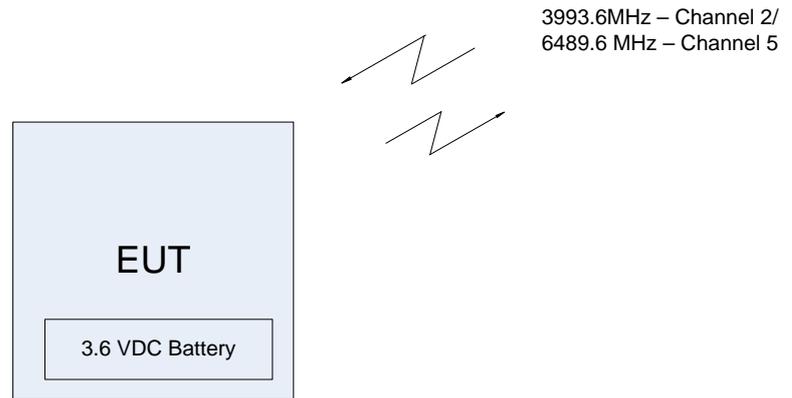


Figure 2. Configuration of Tested System

3. Test Setup Photos



Figure 3. Radiated Emission Test Setup



Figure 4. Radiated Emission Test Setup

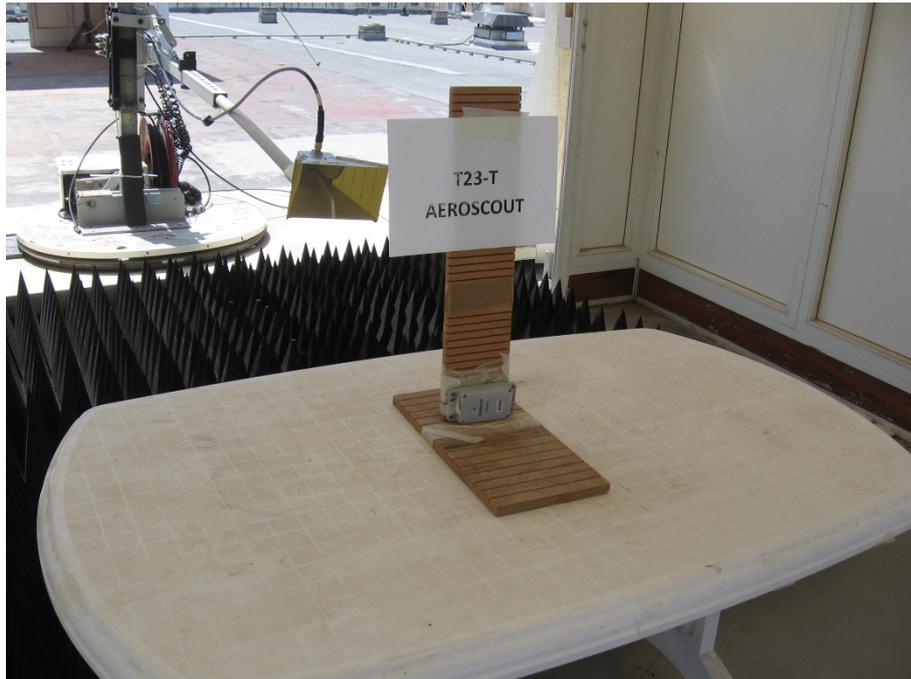


Figure 5. Radiated Emission Test Setup -1 GHz-18 GHz



Figure 6. Radiated Emission Test Setup – 18 GHz-26.5 GHz



Figure 7. Radiated Emission Test Setup – 26.5 GHz-40 GHz

4. UWB Bandwidth

4.1 Test Specification

F.C.C., Part 15, Subpart F, Section 15.517(b)

4.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 2.

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

RBW was set to 1MHz and VBW was set to 10MHz with RMS detector.

The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission as based on the complete transmission system including the antenna.

The evaluation was performed for each operation frequency.

The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

4.3 Test Results

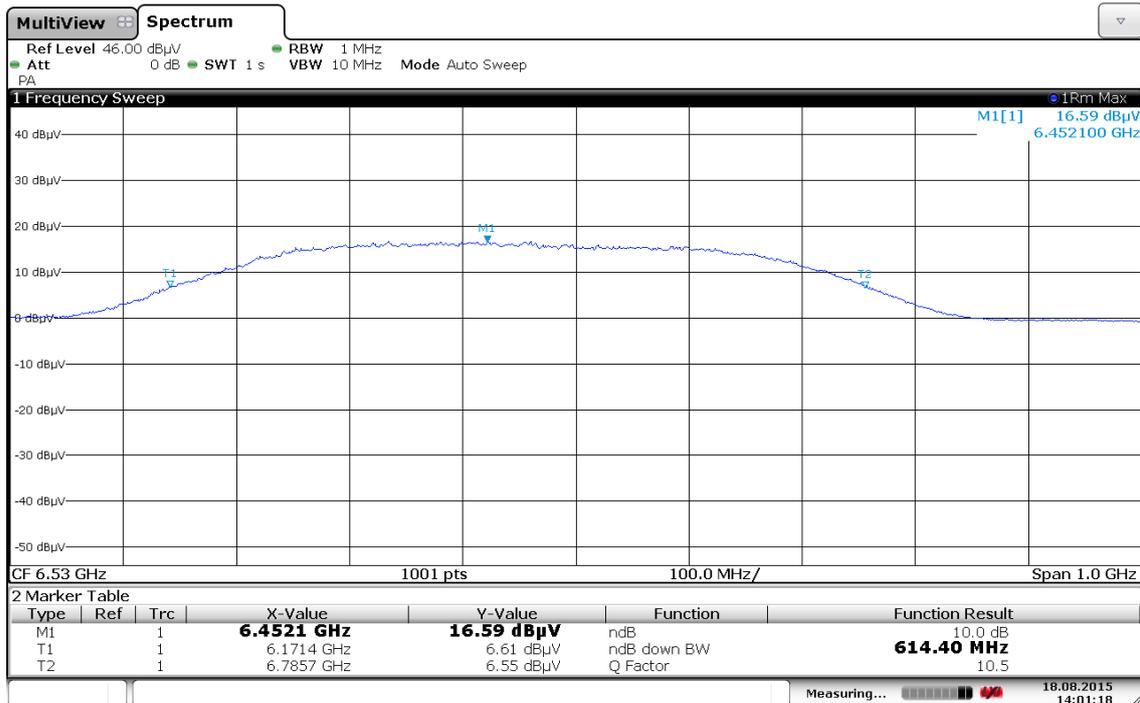
Operational Channel	Bandwidth (MHz)	Frequency Range (MHz)
2	620.40	3711.3 – 4331.7
5	614.40	6171.4 – 6785.7

Figure 8. UWB Bandwidth Test Results



Date: 18.AUG.2015 14:27:07

Figure 9 UWB bandwidth for Channel 2 = 620.4 MHz



Date: 18.AUG.2015 14:01:17

Figure 10 UWB bandwidth for Channel 5 = 614.4 MHz



4.4 Test Equipment Used; UWB Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Signal Analyzer	R&S	FSW	1608688E	August 7, 2015	1 year
Horn Antenna 1GHz-18GHz	ETS	3115	6142	May 19 2015	3 years
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 11 Test Equipment Used UWB Bandwidth

5. Radiated Emissions and GPS Band

5.1 Test Specification

F.C.C., Part 15, Subpart F, Sections 15.517(c) (d), 15.209

5.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 2.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 1 meters, using peak detection mode and broadband antennas. The frequency range 9 kHz-40000 MHz was scanned.

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 2*.

The distance between the E.U.T. and test antenna was 1 meter.

The frequency range 9 kHz-40000 MHz was scanned.

For emission measurements below 960 MHz, a quasi-peak detector is used with RBW of 120 kHz.

For emission measurements above 960MHz, a RMS detector is used with RBW of 1000 kHz and a 1 millisecond or less averaging time.

For emission measurements in the frequency ranges 1164-1240 and 1559.0-1610.0 MHz, a RMS detector is used with RBW of 1 kHz and a 1 millisecond or less averaging time.

Trace was set to “max hold”.

“Measurement distance” correction factor was calculated for the final results as per the following equation: $20 \log (D/3)$ where D is the measurement distance in meters=1m

So the measurement distance” correction factor is $20 \log (1/3) = -9.54 \text{ dB}$.

Frequency (MHz)	Eirp (dBm)	Eirp (dB μ V/m)@3m	RBW
0.009-960.0	-	As specified in section 15.209	9kHz/120kHz
960.0-1610.0	-75.3	19.9	1 MHz
1610.0-1990.0	-53.3	41.9	1 MHz
1990.0-3100.0	-51.3	43.9	1 MHz
3100.0-10600.0	-41.3	53.9	1 MHz
10600.0-40000.0	-51.3	43.9	1 MHz
1164.0-1240.0(GPS BAND)	-85.3	9.9	1 kHz
1559.0-1610.0(GPS BAND)	-85.3	9.9	1 kHz

Figure 12 Limit Table



5.3 Test Results

The EUT met the FCC Part 15, 15.517(c) (d), 15.209 specification requirements.

JUDGEMENT: Passed by 1.5 dB

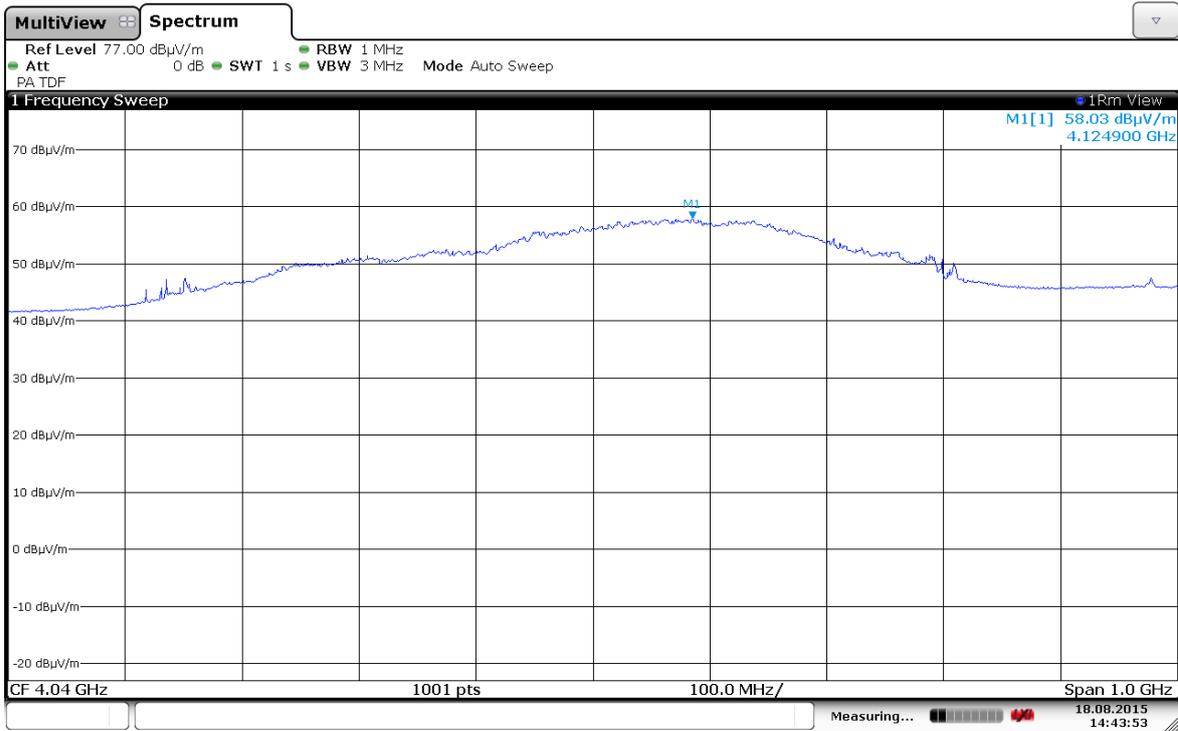
For both Channel 2 and Channel 5, at the 0.009M-960M band, all emissions were less than the EMI receiver noise level which is at least 6dB below the specification limit.

The details of the highest emissions are given in *Figure 13 to Figure 18*.

Frequency (MHz)	Polarity (V/H)	Avg Reading@1m (dbuV/m)	Distance FACTOR (dB)	Avg Reading@3m (dbuV/m)	Avg Spec@3m (dbuV/m)	Margin (dB)
1430.0	H	27.9	-9.5	18.4	19.9	-1.5
1430.0	V	27.8	-9.5	18.3	19.9	-1.6
2130.0	H	39.3	-9.5	29.8	43.9	-14.1
2130.0	V	39.5	-9.5	30.0	43.9	-13.9
2440.0	H	41.3	-9.5	31.8	43.9	-12.1
2440.0	V	41.5	-9.5	32.0	43.9	-11.9
Channel 2 Carrier Level*	H	56.5	-9.5	47.0	53.9	-6.9
	V	58.0	-9.5	48.5	53.9	-5.4
7988.2	H	49.3	-9.5	39.8	53.9	-14.1
7988.2	V	50.0	-9.5	40.5	53.9	-13.4
37153.3	H	42.0	-9.5	32.5	43.9	-11.4
37153.3	V	42.0	-9.5	32.5	43.9	-11.4

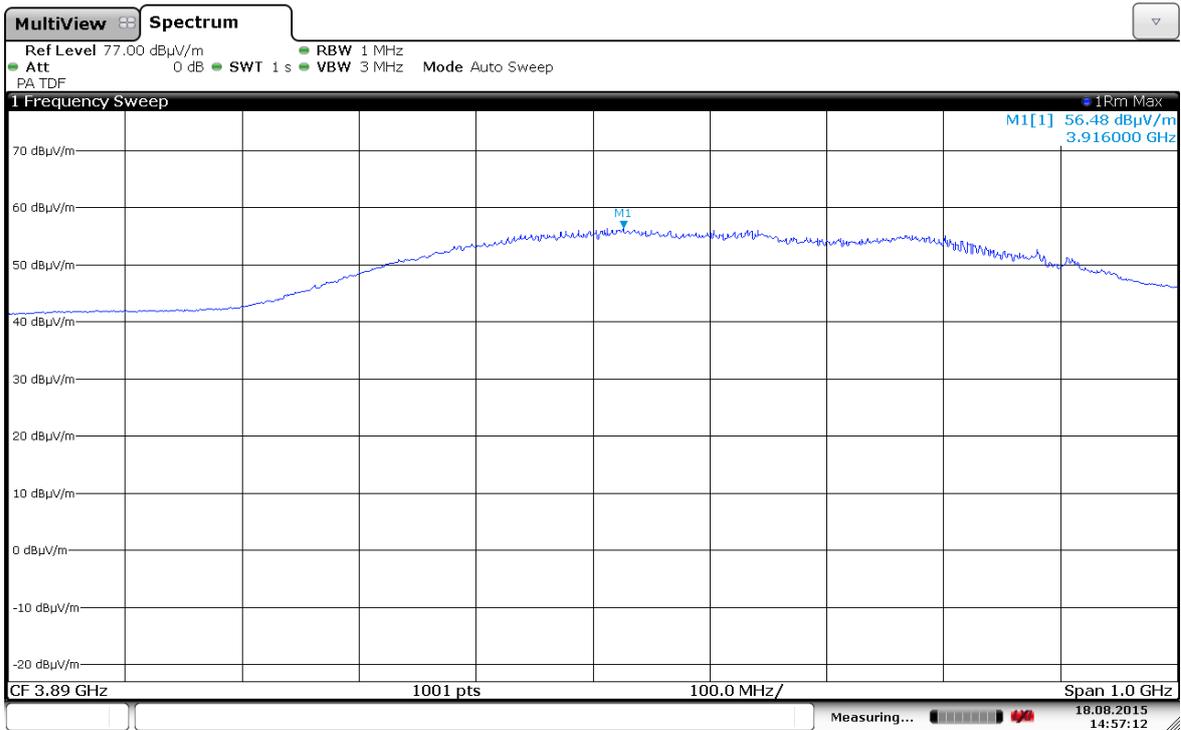
Figure 13 Channel 2 Frequency Range - 960M-40000M

* See plots in Figure 14 and Figure 15.



Date: 18.AUG.2015 14:43:53

Figure 14 Channel 2 Radiated Emission - Vertical



Date: 18.AUG.2015 14:57:11

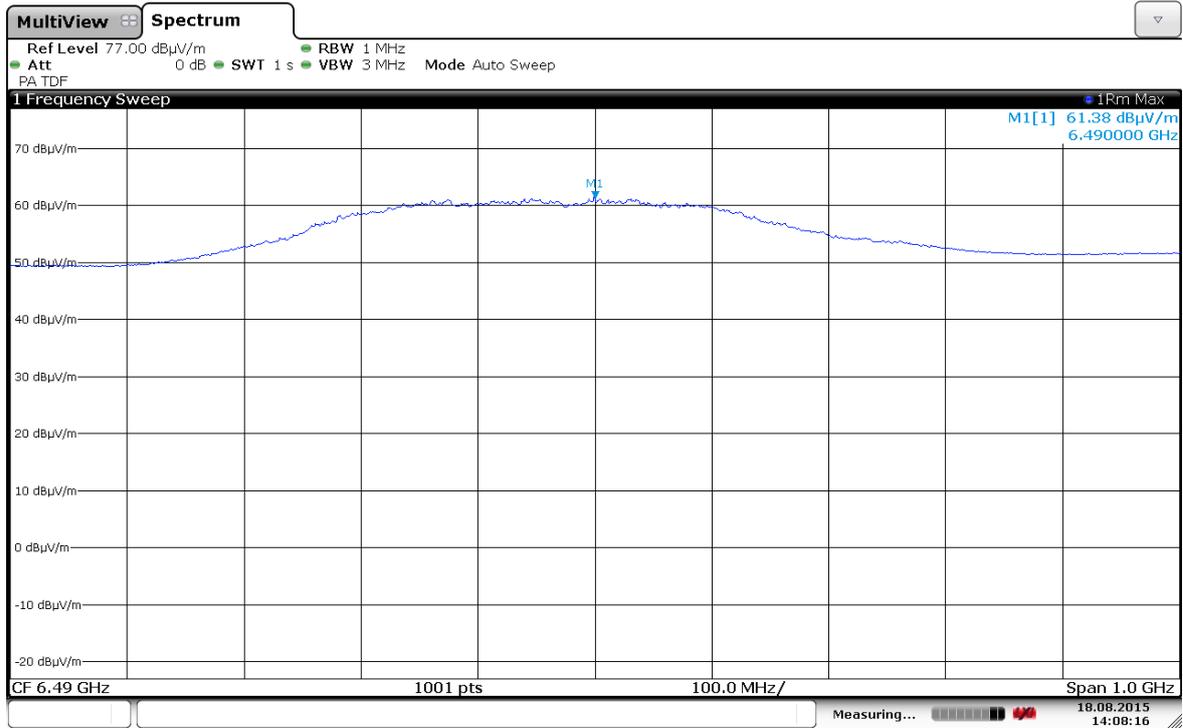
Figure 15 Channel 2 Radiated Emission - Horizontal



Frequency (MHz)	Polarity (V/H)	Avg Reading@1m (dbuV/m)	Distance FACTOR (dB)	Avg Reading@3m (dbuV/m)	Avg Spec@3m (dbuV/m)	Margin (dB)
1430.0	H	27.8	-9.5	18.3	19.9	-1.6
1430.0	V	27.6	-9.5	18.1	19.9	-1.8
2130.0	H	40.0	-9.5	30.5	43.9	-13.4
2130.0	V	40.2	-9.5	30.7	43.9	-13.2
2440.0	H	41.1	-9.5	31.6	43.9	-12.3
2440.0	V	40.9	-9.5	31.4	43.9	-12.5
Channel5 Carrier Level*	H	58.1	-9.5	48.6	53.9	-5.3
	V	61.4	-9.5	51.9	53.9	-2.0
12961.2	H	50.8	-9.5	41.3	43.9	-2.6
12961.2	V	49.6	-9.5	40.1	43.9	-3.8
37106.1	H	41.9	-9.5	32.4	43.9	-11.5
37106.1	V	41.7	-9.5	32.2	43.9	-11.7

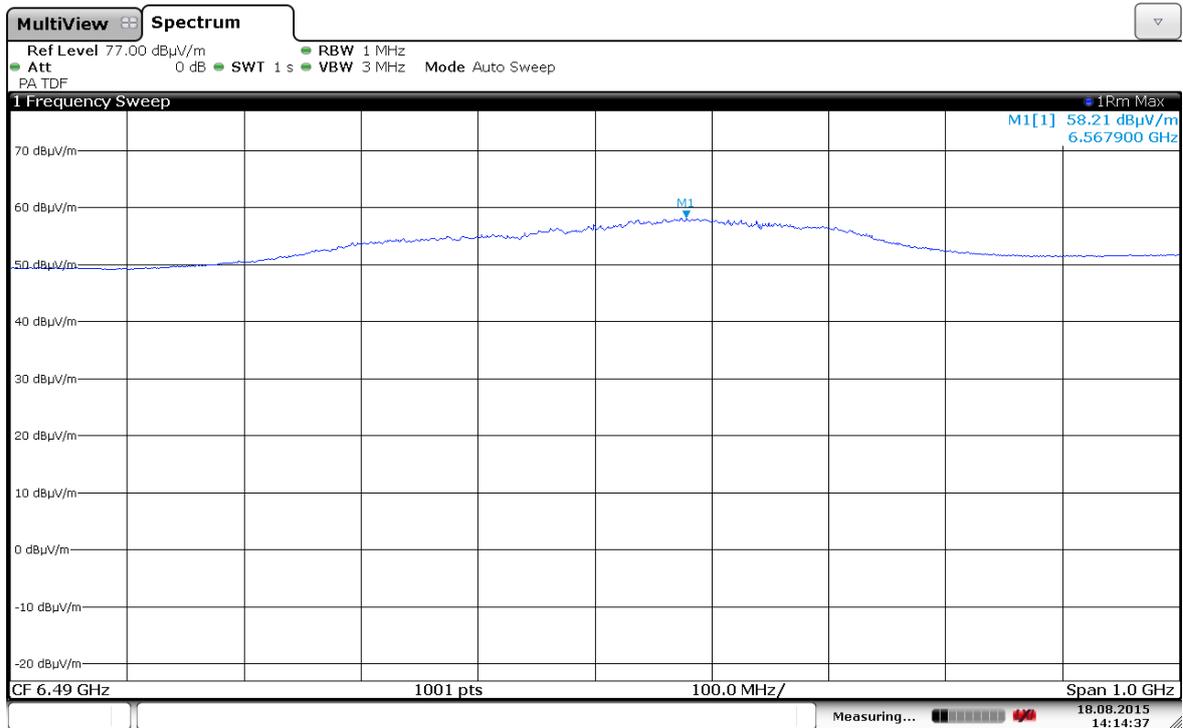
Figure 16 Channel 5 Frequency Range - 960M-40000M

* See plots in Figure 17 and Figure 18.



Date: 18.AUG.2015 14:08:15

Figure 17 Channel 5 Radiated Emission - Vertical



Date: 18.AUG.2015 14:14:37

Figure 18 Channel 5 Radiated Emission - Horizontal

5.4 Test Equipment Used; Radiated Emissions and GPS Band

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Signal Analyzer	R&S	FSW	1608688E	August 7, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142B	1250	May 22, 2014	1 year
Horn Antenna 1GHz-18GHz	ETS	3115	6142	May 19 2015	3 years
Horn Antenna 18GHz-26GHz	ARA	SWH-28	1007	March 30, 2014	2 years
Horn Antenna 26GHz-40GHz	OSR Electronics	PE9850R-20	J202021732	February 1, 2015	1 year
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	August 22, 2014	1 year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	August 29, 2014	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 19 Test Equipment Used Radiated Emissions and GPS Band

6. Peak Level Emission

6.1 Test Specification

F.C.C., Part 15, Subpart F, Section 15.517(e)

6.2 Test Procedure

The E.U.T was placed on a remote-controlled turntable in the O.A.T.S. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 2.

The distance between the E.U.T. and test antenna was 1 meter.

The turntable and antenna were adjusted for maximum level reading on the EMI receiver. The EMI receiver was set to the following:

Detector: peak

Trace: max hold

RBW: 50MHz

VBW: 80MHz

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 emission occurs, fM. That limit is 0 dBm EIRP.

This results were converted to a peak field strength level at 3 meters using the equation appearing in Section 15.521(g), $E(\text{dBuV/m}) = P(\text{dBm EIRP}) + 95.2$.

6.3 Test Results

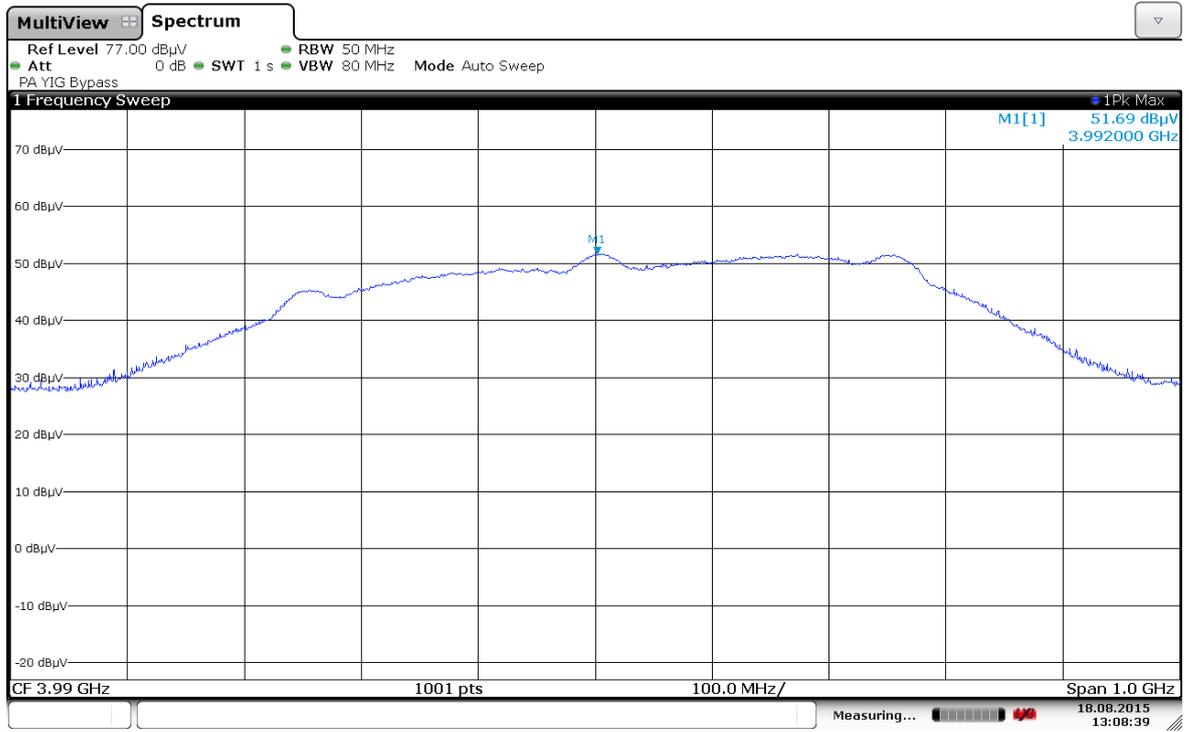
Channel	Polarity (V/H)	Peak Reading (dbuV)	Correction Factor* (dbuV/m)	Peak Result @ 1m** (dbuV/m)	Distance Factor (dB)	Peak Result @ 3m*** (dbuV/m)	Peak Result @ 3m (dBm)	Limit (dBm)	Margin (dB)
Channel 2	H	41.9	44.2	86.1	-9.5	76.6	-18.6	0.0	-18.6
	V	51.7	44.2	95.9	-9.5	86.4	-8.8	0.0	-8.8
Channel 5	H	46.0	51.1	97.1	-9.5	87.6	-7.6	0.0	-7.6
	V	52.5	51.1	103.6	-9.5	94.1	-1.1	0.0	-1.1

*Correction factor consists of test antenna factor + cable loss

** Peak Result @ 1m = Peak Reading + Correction Factors.

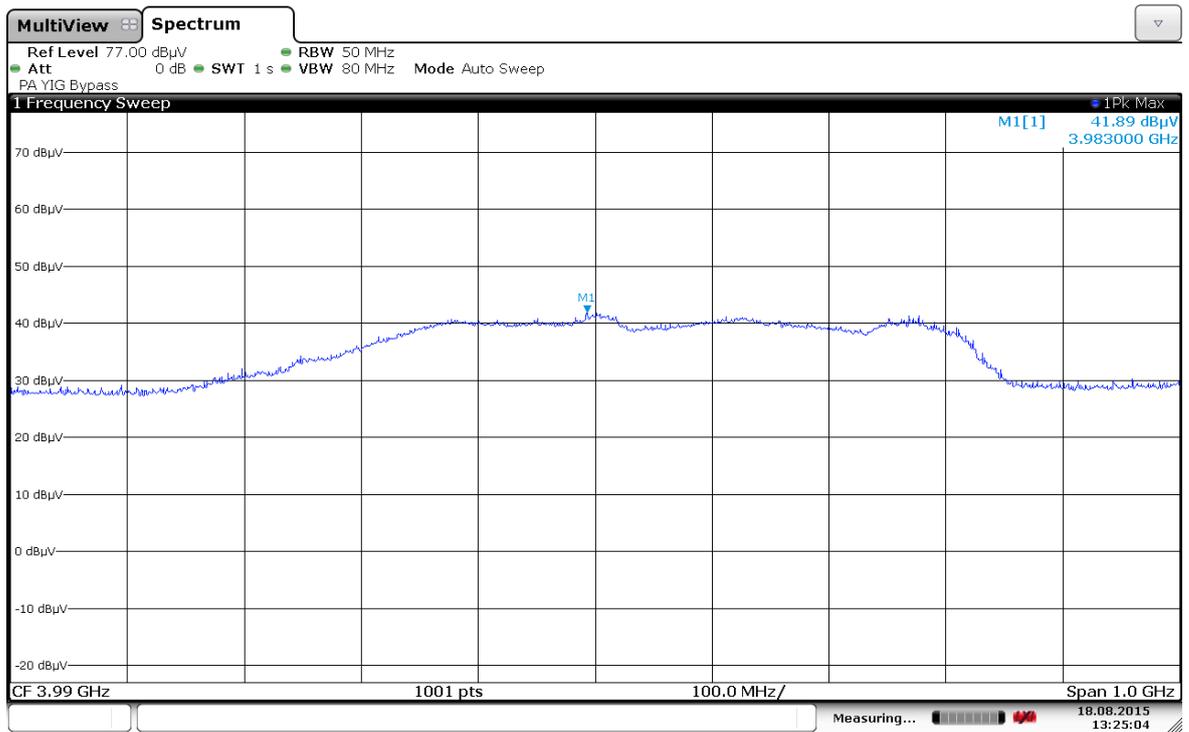
*** Peak Result @ 3m = Peak Result @ 1m + Distance Factor

Figure 20 Peak Level Emission Test Results



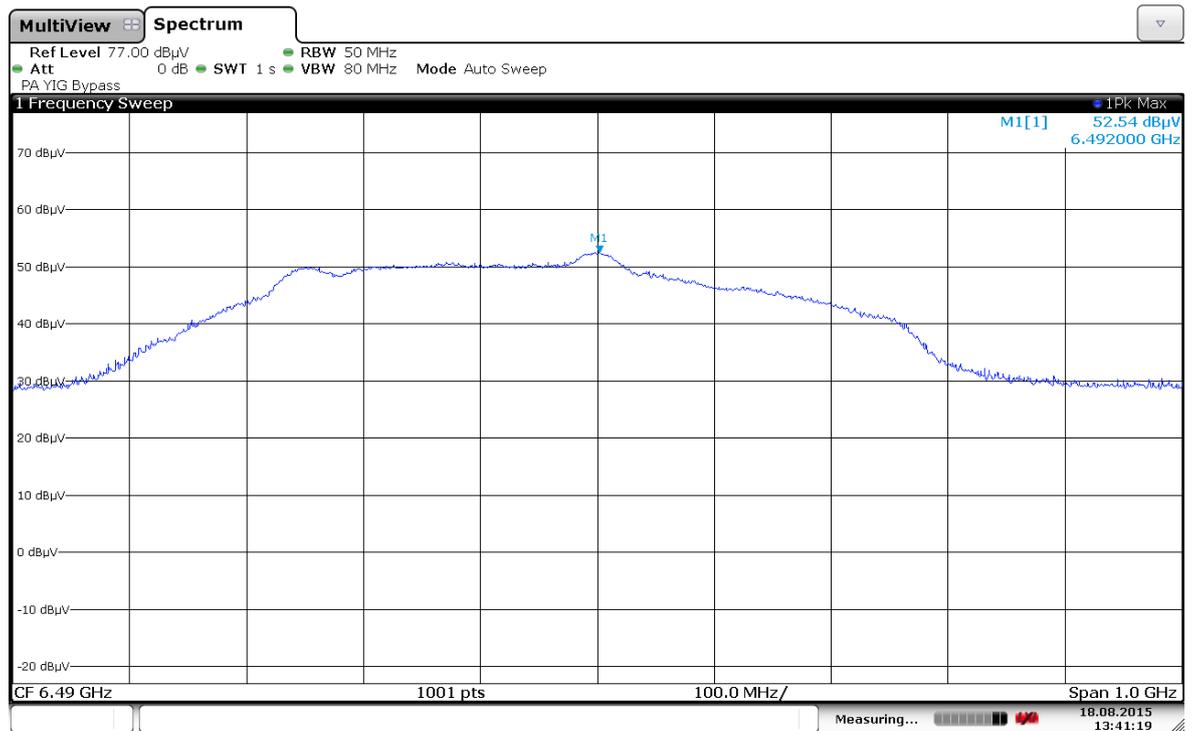
Date: 18.AUG.2015 13:08:39

Figure 21 Channel 2 EIRP Peak Level - Vertical



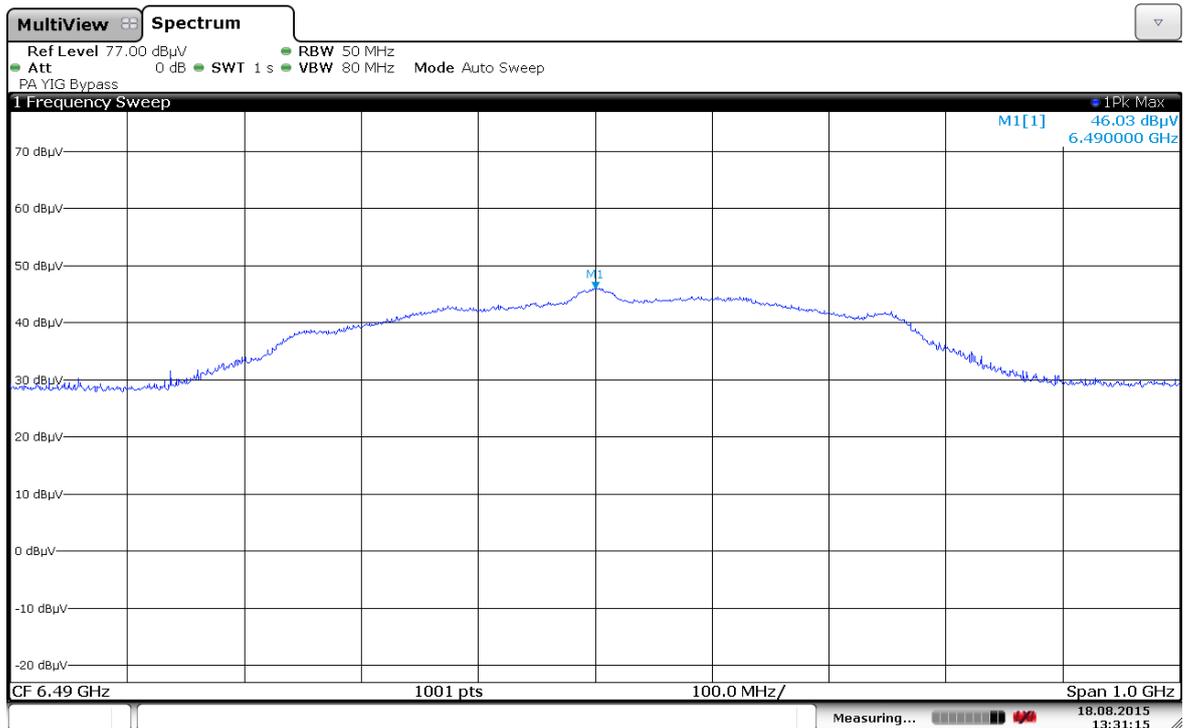
Date: 18.AUG.2015 13:25:04

Figure 22 Channel 2 EIRP Peak Level - Horizontal



Date: 18.AUG.2015 13:41:19

Figure 23 Channel 5 EIRP Peak Level - Vertical



Date: 18.AUG.2015 13:31:15

Figure 24 Channel 5 EIRP Peak Level - Horizontal



6.4 Test Equipment Used; Peak Level Emissions

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
Signal Analyzer	R&S	FSW	1608688E	August 7, 2015	1 year
Horn Antenna 1GHz-18GHz	ETS	3115	6142	May 19 2015	3 years
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 25 Test Equipment Used Peak Level Emissions



7. R.F Exposure/Safety

Typical use of the E.U.T. is as an asset tag.

The typical placement of the E.U.T. is mounted either x y or z axes. The minimum distance between the E.U.T. and the user is at least 20.0 cm.

Calculation of Maximum Permissible Exposure (MPE)

Based on FCC Section 1.1310 Requirements

(a) FCC limits at above 1 MHz is:

$$1 \frac{mW}{cm^2}$$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

For Channel 2:

P_t- Calculated Transmitted Power = 48.5 dBuV/m (Peak Result @3m) = 0.00002 mW

R- Distance from Transmitter using 20.0 cm worst case

The peak power density is:

$$\frac{0.00002}{4\pi(20)^2} = 3.978 \times 10^{-9} \frac{mW}{cm^2}$$

For Channel 5:

P_t- Calculated Transmitted Power = 51.9 dBuV/m (Peak Result @3m) = 0.00005 mW

R- Distance from Transmitter using 20.0 cm worst case

The peak power density is:

$$\frac{0.00005}{4\pi(20)^2} = 9.947 \times 10^{-9} \frac{mW}{cm^2}$$

(c) This is below the FCC limit.



8. Correction Factors

8.1 Correction factors for 35M Coaxial cable for OATS

Manufacturer: Huber Zoner

Model number: SPUMA400-FR-50

Frequency (MHz)	Ref. (dBm)	Tested (dBm)	Cable loss (dB)
10	-29.7	-29.4	0.3
20	-29.6	-29.4	0.2
50	-29.8	-29.9	-0.1
100	-29.9	-30.5	-0.6
200	-29.9	-31.1	-1.2
500	-30.0	-32.3	-2.3
1000	-30.0	-33.6	-3.6
2000	-30.2	-36.0	-5.8
5000	-11.5	-22.6	-11.1
10,000	-12.4	-29.5	-17.1
15,000	-16.0	-39.3	-23.3
18,000	-20.0	-43.6	-23.6



8.2 Correction factors for

**Horn Antenna
Model: SWH-28
at 1 meter range.**

FREQUENCY (GHz)	AFE (dB /m)	Gain (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4



8.3 Correction factors for ACTIVE LOOP ANTENNA

**Model 6502
S/N 9506-2950**

FREQUENCY (MHz)	Magnetic Antenna Factor (dB)	Electric Antenna Factor (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



8.4 Correction factors for Biconical log ANTENNA

Model: 3142

Antenna serial number: 1250

3 meter range

FREQUENCY	APE	FREQUENCY	APE
(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		



8.5 Correction factors for Horn ANTENNA

Model: 3115

Antenna serial number: 6142

10 meter range

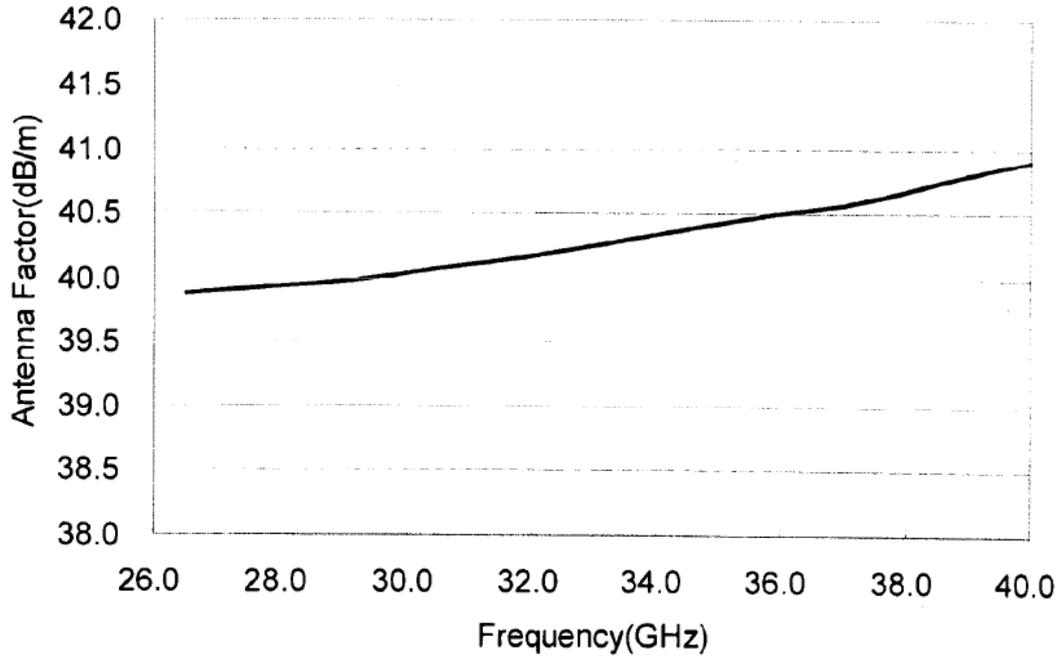
FREQUENCY	Antenna Factor	FREQUENCY	Antenna Factor
(GHz)	(dB/m)	(GHz)	(dB/m)
1	23.2	10	37.0
2	25.3	11	36.3
3	30.7	12	40.3
4	30.6	13	39.1
5	34.5	14	41.3
6	31.5	15	39.8
7	34.4	16	38.2
8	35.8	17	41.8
9	37.2	18	43.1

8.6 Correction factors for

Horn Antenna Ka Band

Model: PE9850R-20

Serial No: J202021732



Frequency(GHz)	Gain(dB)	Antenna Factor(dB/m)
26.50	18.80	39.87
27.85	19.18	39.93
29.20	19.53	39.99
30.55	19.83	40.08
31.90	20.12	40.17
33.25	20.37	40.28
34.60	20.60	40.39
35.95	20.82	40.50
37.30	21.05	40.59
38.65	21.20	40.75
40.00	21.34	40.91