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TESTING Cert No.1152.01

DATE: 07 October 2015

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Topscan Ltd.

Equipment under test:

Scanmarker Air

2.0

Tested by: _____

M. Zohar

Approved by: _____

D. Shidlowsky

Measurement/Technical Report for

Topscan Ltd.

Scanmarker Air

2.0

FCC ID: 2AFKZ-SCANAIR

This report concerns:	Original Grant: X Class I Change: Class II Change:
Equipment type:	Digital Transmission System
Limits used:	47CFR15 Section 15.247

Measurement procedure used is KDB 558074 D01 v03r03 and ANSI C63.4-2009

Application for Certification prepared by:

R. Pinchuck
ITL (Product Testing) Ltd
1 Bat Sheva St.
Lod 7116002
Israel
e-mail Rpinchuck@itl.co.il

Applicant for this device: (different from "prepared by")

Victor Korsensky
Topscan Ltd.
5 Etgar St.
Tirat Carmel, 3903216
Israel
Tel: +972 4 8580582
Fax: +972 4 8570758
E-Mail: victor@scanmarker.com

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1. General Information

1.1 *Administrative Information*

Manufacturer:	Topscan Ltd.
Manufacturer's Address:	5 Etgar Street Tirat Carmel, 3903216 Israel Telephone: +972 4 858 0582 Fax: +972 4 857 0758
Manufacturer's Representative:	Victor Korsensky
Equipment Under Test (E.U.T):	Scanmarker Air
Equipment Model No.:	2.0
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	01.06.2015
Start of Test:	01.06.2015
End of Test:	04.06.2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	FCC Part 15, Subpart C, Section 15.247

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 No. 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-1350, R-1285.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025A-1.

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 E.U.T. is a portable hand-driven scanner to capture one string of printed text per passage and send it to a host (Windows, OS/X, iOS or Android platform) either through USB or Bluetooth LE link for farther processing and storing. After passing the OCR engine (Optical Character Recognition) the scanned text can be processed, using any common text editors, translated to more than 50 languages with speak option, and archived. The processing performs either locally or in the cloud environment.

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v03r03 and ANSI C63.4: 2009. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 *Test Facility*

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*

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
0.15 – 30 MHz:
Expanded Uncertainty (95% Confidence, K=2):
± 3.44 dB

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)	Y axis (dBuV/m)	X axis (dBuV/m)	Z axis (dBuV/m)
2402.0	81.1	79.1	77.0
2440.0	82.3	81.0	80.8
2480.0	79.0	78.1	76.2

Figure 1. Screening Results

In all axes the spurious levels were under the noise level.

According to above results the worst case was the y axis.

The unit evaluated when transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz).

2.2 *EUT Exercise Software*

No special exercise software was used.

2.3 *Special Accessories*

No special accessories were needed to achieve compliance.

2.4 *Equipment Modifications*

No modifications were necessary in order to achieve compliance.

2.5 *Configuration of Tested System*

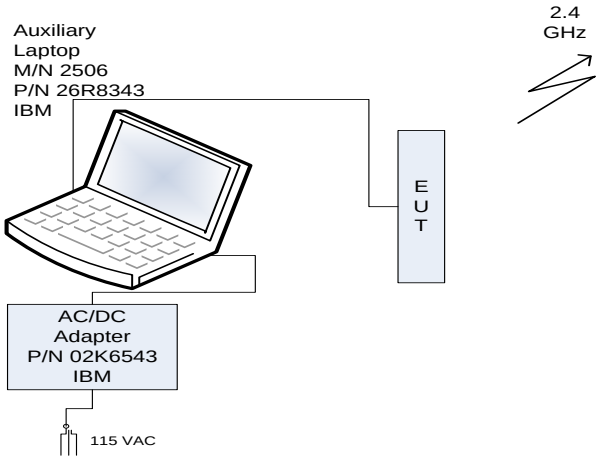

Figure 2. Configuration of Tested System

3. Conducted & Radiated Measurement Test Set-up Photos

Figure 3. Conducted Emission from AC Power Line Test

Figure 4. Radiated Emission Test

Figure 5. Radiated Emission Test

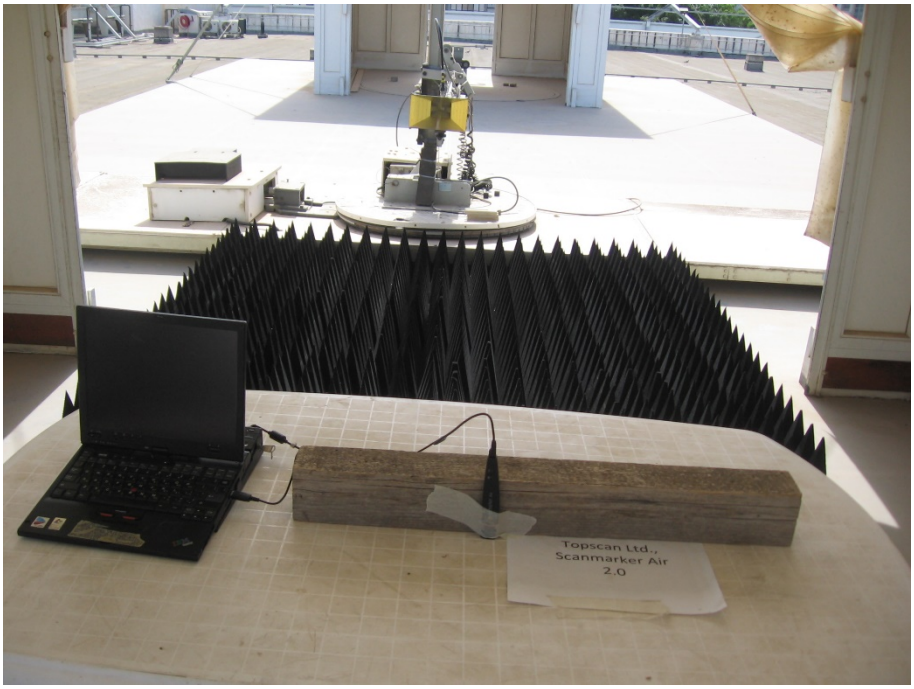

Figure 6. Radiated Emission Test

4. Conducted Emission From AC Mains

4.1 *Test Specification*

FCC Part 15, Subpart C, Section 15.207

4.2 *Test Procedure*

The E.U.T operation mode and test setup are as described in Section 4.1. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room (see Section 3), with the E.U.T placed on an 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 µHn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in the photograph, *Figure 3. Conducted Emission from AC Power Line Test.*

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was evaluated in TX operation mode

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

4.3 *Test Results*

JUDGEMENT: Passed by 7.54 dB

The margin between the emission levels and the specification limit is, in the worst case, 10.25 dB for the phase line at 3.374 MHz and 7.54 dB at 3.374 MHz for the neutral line.

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

The details of the highest emissions are given in *Figure 7* to *Figure 10*.

Conducted Emission

E.U.T Description	Scanmarker Air
Type	2.0
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Phase
Detectors: :	Peak, Quasi-peak, Average
Power Operation	USB

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	190 kHz	34.08	-29.95
2	Average	246 kHz	19.44	-32.44
1	Quasi Peak	318 kHz	32.30	-27.45
2	Average	346 kHz	22.17	-26.87
2	Average	598 kHz	31.24	-14.75
1	Quasi Peak	602 kHz	39.43	-16.56
2	Average	1.066 MHz	24.67	-21.33
1	Quasi Peak	1.074 MHz	33.41	-22.59
2	Average	1.538 MHz	24.27	-21.72
1	Quasi Peak	1.882 MHz	30.08	-25.91
1	Quasi Peak	3.374 MHz	45.74	-10.25
2	Average	3.374 MHz	31.54	-14.45
1	Quasi Peak	3.73 MHz	40.12	-15.87
2	Average	4.254 MHz	29.09	-16.90
2	Average	6.122 MHz	25.51	-24.49
1	Quasi Peak	10.39 MHz	32.73	-27.26
1	Quasi Peak	10.906 MHz	35.33	-24.66
2	Average	11.23 MHz	26.47	-23.52
1	Quasi Peak	24.15 MHz	47.90	-12.10
2	Average	24.622 MHz	30.44	-19.55

Date: 4.JUN.2015 11:26:54

Figure 7. Detectors: Peak, Quasi-peak, AVERAGE

Note: QP Delta/Av Delta 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.

Conducted Emission

E.U.T Description	Scanmarker Air
Type	2.0
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Phase
Detectors:	Peak, Quasi-peak, Average
Power Operation	USB

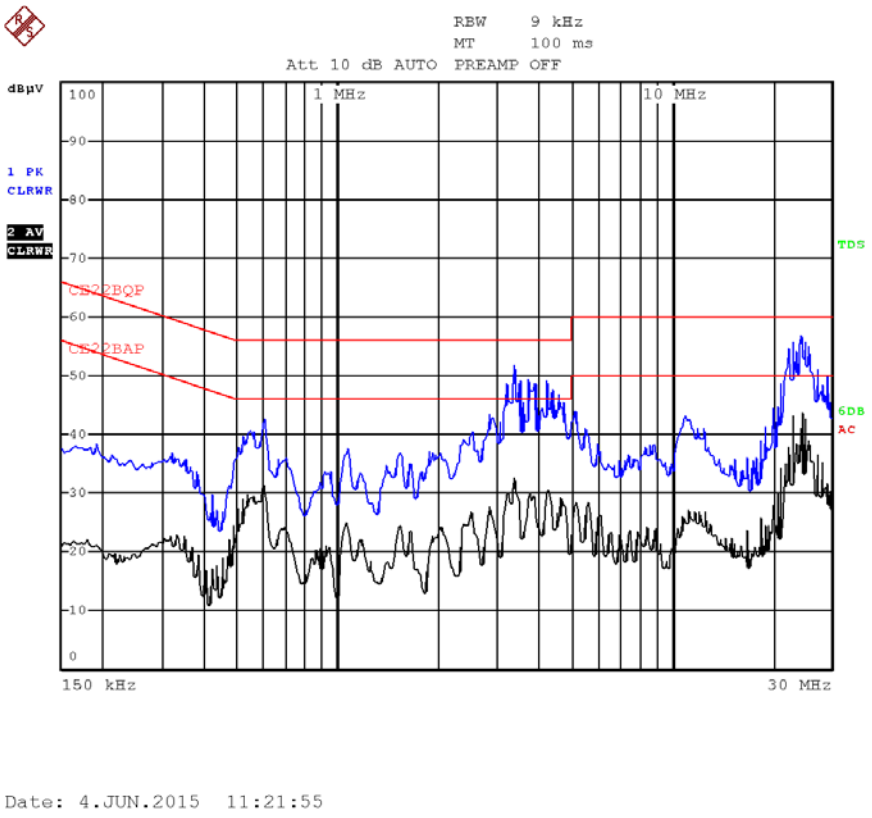

Figure 8. Detectors: Peak, Quasi-peak, Average

Notes:

1. *Horizontal axis shows logarithmic frequency scale.*
2. *The vertical axis shows amplitude (in dB µV).*
3. *Peak detection is designated by the top of each vertical line.*
4. *Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.*
5. *Average detection is designated by the second dash mark (from the top) of each vertical line.*

Conducted Emission

E.U.T Description	Scanmarker Air
Type	2.0
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Neutral
Detectors:	Peak, Quasi-peak, Average
Power Operation	USB

EDIT PEAK LIST (Final Measurement Results)

Trace1: CE22BQP
Trace2: CE22BAP
Trace3: ---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
2	Average	178 kHz	21.97	-32.60
1	Quasi Peak	190 kHz	33.37	-30.66
1	Quasi Peak	322 kHz	31.64	-28.00
2	Average	418 kHz	20.40	-27.08
1	Quasi Peak	594 kHz	42.51	-13.48
2	Average	606 kHz	32.13	-13.86
2	Average	1.066 MHz	25.52	-20.47
1	Quasi Peak	1.07 MHz	35.66	-20.34
1	Quasi Peak	2.058 MHz	37.00	-19.00
2	Average	2.058 MHz	25.56	-20.43
1	Quasi Peak	3.374 MHz	48.45	-7.54
2	Average	3.398 MHz	34.79	-11.20
1	Quasi Peak	3.89 MHz	46.54	-9.45
2	Average	3.89 MHz	32.27	-13.72
2	Average	6.178 MHz	26.97	-23.02
1	Quasi Peak	8.886 MHz	36.93	-23.06
1	Quasi Peak	11.23 MHz	38.42	-21.57
2	Average	11.294 MHz	28.26	-21.73
1	Quasi Peak	24.918 MHz	50.05	-9.94
2	Average	25.69 MHz	28.92	-21.07

Date: 4.JUN.2015 11:33:04

Figure 9. Detectors: Peak, Quasi-peak, AVERAGE

Note: QP Delta/Av Delta 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.

Conducted Emission

E.U.T Description	Scanmarker Air
Type	2.0
Serial Number:	Not designated

Specification:	FCC Part 15, Subpart C
Lead:	Neutral
Detectors:	Peak, Quasi-peak, Average
Power Operation	USB

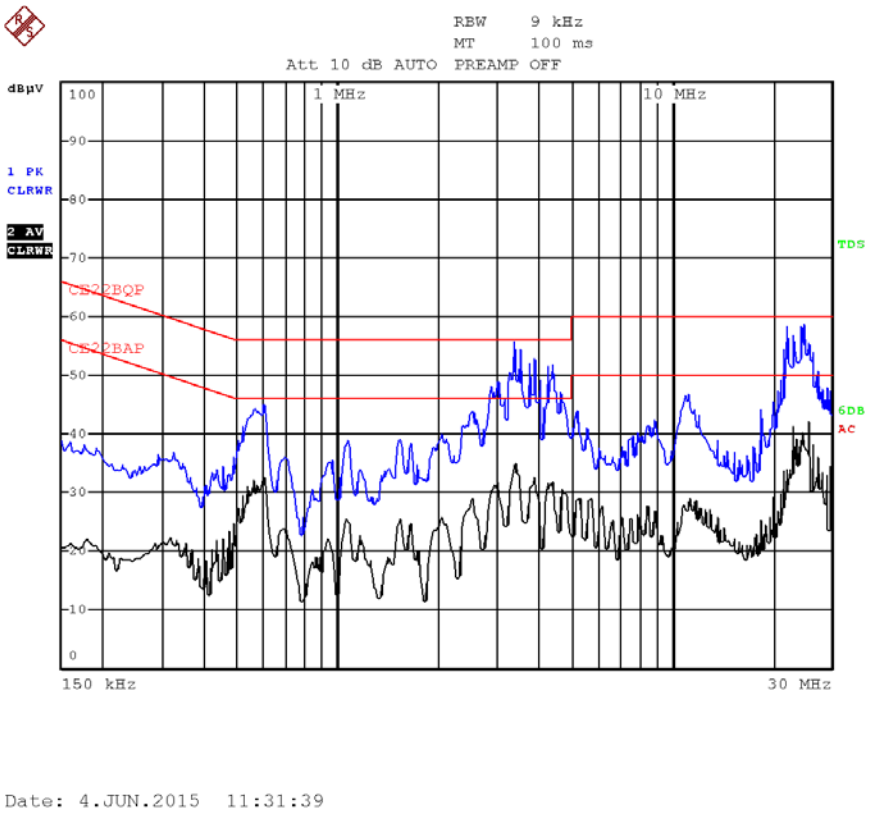

Figure 10 Conducted Emission: NEUTRAL
Detectors: Peak, Quasi-peak, Average

Notes:

1. *Horizontal axis shows logarithmic frequency scale.*
2. *The vertical axis shows amplitude (in dB µV).*
3. *Peak detection is designated by the top of each vertical line.*
4. *Quasi-peak detection is designated by the first dash mark (from the top) of each vertical line.*
5. *Average detection is designated by the second dash mark (from the top) of each vertical line.*

4.1 *Test Equipment Used; Conducted Emission*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
LISN	Fischer	FCC-LISN-25A	127	March 16, 2015	1 year
Transient Limiter	HP	11947A	3107A03041	May 13, 2015	1 year
EMI Receiver	Rohde & Schwarz	ESCI7	100724	January 4, 2015	1 year

5. 6 dB Minimum Bandwidth

5.1 *Test Specification*

FCC Part 15, Subpart C, Section 247(a)(2)

5.2 *Test Procedure*

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

See Section 2.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

The E.U.T was tested at 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 spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

5.3 *Test Results*

Operation Frequency (MHz)	Reading (MHz)	Specification (MHz)
Low	0.871	>0.5
Mid	0.741	>0.5
High	0.761	>0.5

Figure 11 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 12 to Figure 14.*

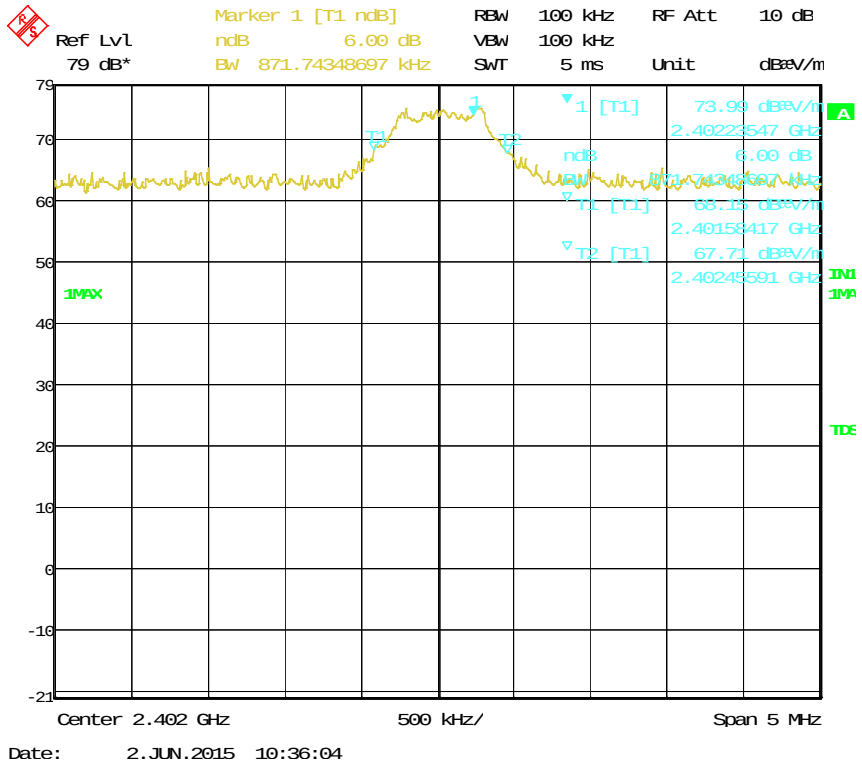

Figure 12. Low Channel

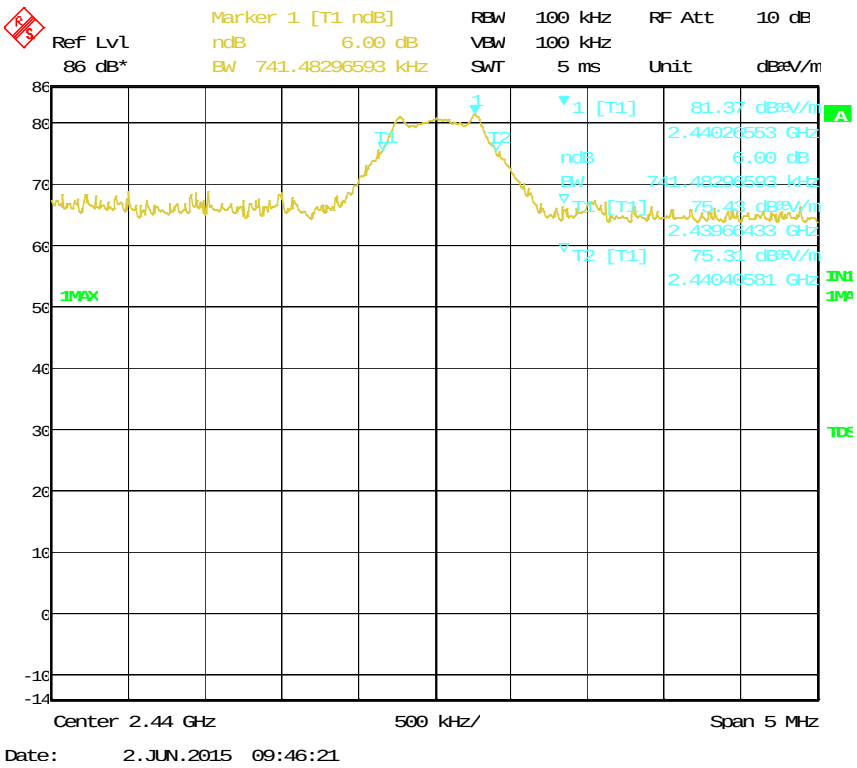

Figure 13. Mid Channel

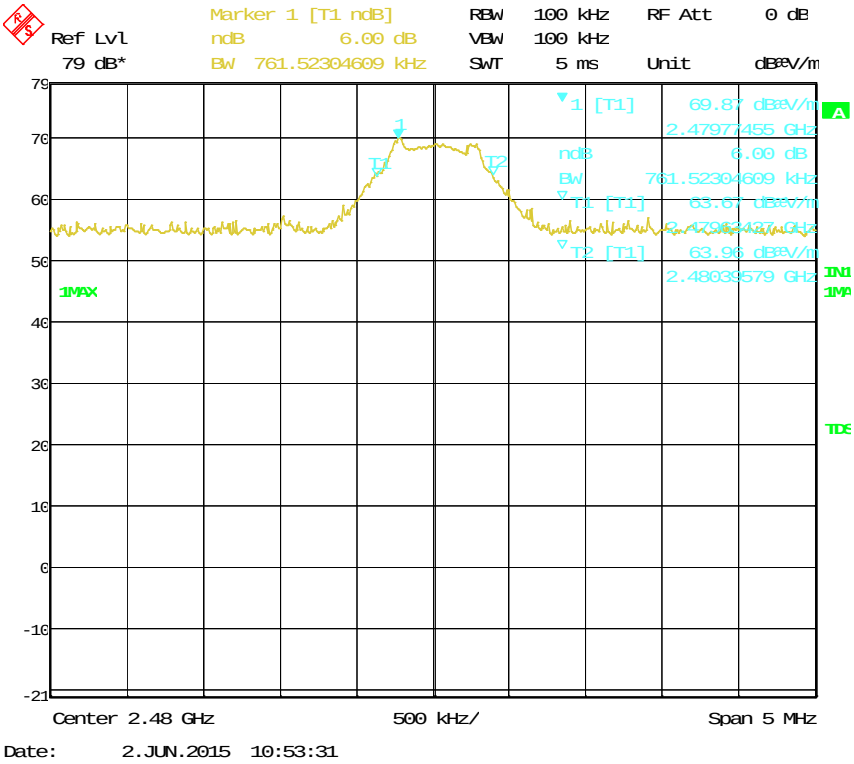

Figure 14. High Channel

5.4 *Test Equipment Used; 6dB Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	May 19, 2015	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 15 Test Equipment Used

6. 26 dB Minimum Bandwidth

6.1 *Test Specification*

FCC, Part 2, Section 2.1049

6.2 *Test Procedure*

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

See Section 2.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

The E.U.T was tested at 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 spectrum bandwidth of the E.U.T. at the point of 26 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

6.3 *Test Results*

Operation Frequency (MHz)	Reading (MHz)
Low	1.43
Mid	1.39
High	1.57

Figure 16 26 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 17* to *Figure 19.*

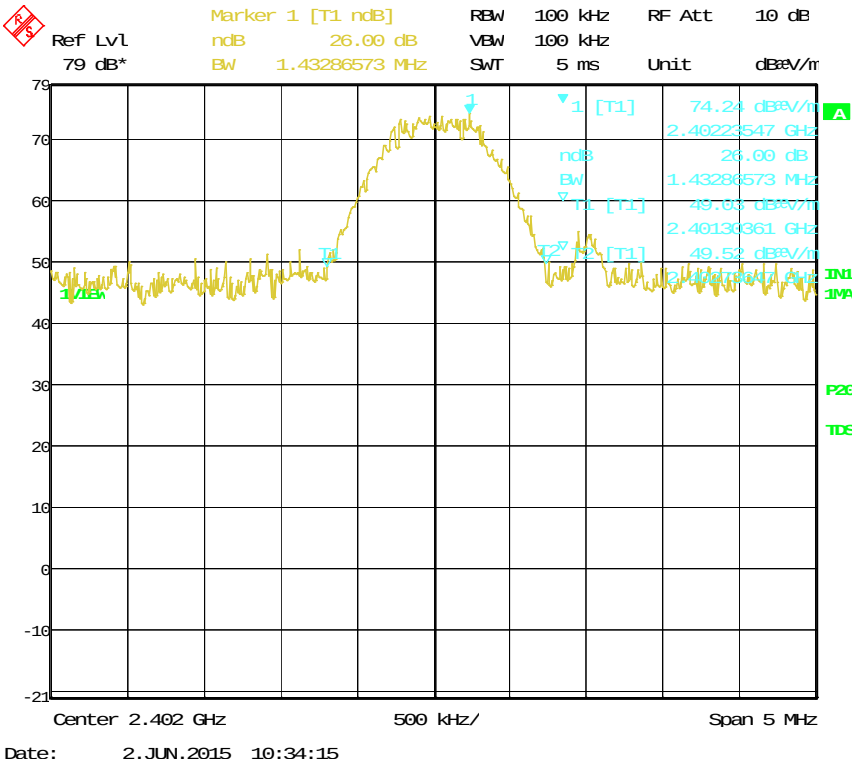

Figure 17. Low Channel

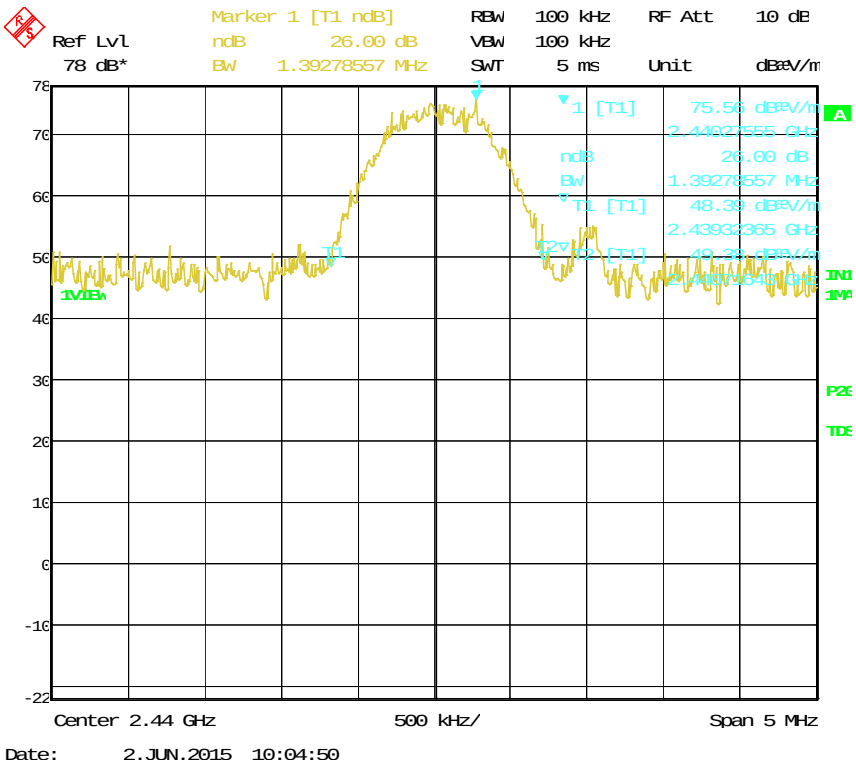

Figure 18. Mid Channel

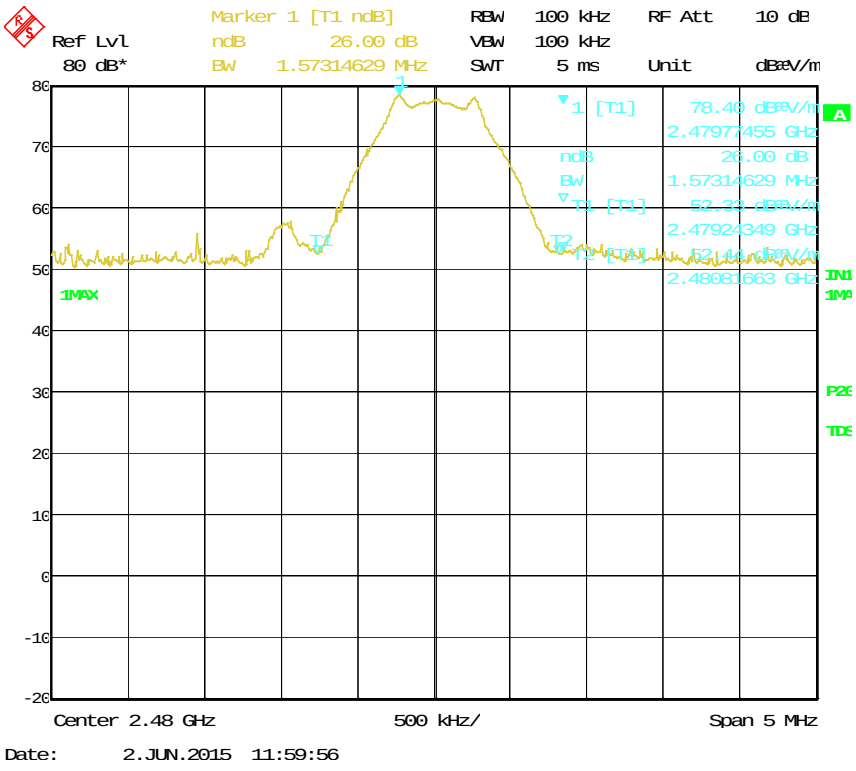

Figure 19. High Channel

6.4 *Test Equipment Used; 26dB Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	May 19, 2015	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 20 Test Equipment Used

7. Maximum Transmitted Peak Power Output

7.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(b)(3)

7.2 *Test Procedure*

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

See Section 2.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

The E.U.T was tested at 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 E.U.T was evaluated in 3 channels: Low, Mid and High.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \text{ [W]}$$

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

7.1 *Test Results*

Operation Frequency (MHz)	Polarization (V/H)	Power (dBuV/m)	Power (dBm)	Power (W)	Specification (W)	Margin (W)
Low	V	82.5	-12.7	0.0000537	1.0	-0.9999463
Low	H	84.6	-10.6	0.0000871	1.0	-0.9999129
Mid	V	83.2	-12.0	0.0000631	1.0	-0.9999369
Mid	H	82.9	-12.3	0.0000589	1.0	-0.9999411
High	V	84.1	-11.1	0.0000776	1.0	-0.9999224
High	H	84.3	-10.9	0.0000813	1.0	-0.9999187

Figure 21 Maximum Peak Power Output

JUDGEMENT: Passed by 0.999129 W

For additional information see *Figure 22* to *Figure 27.*

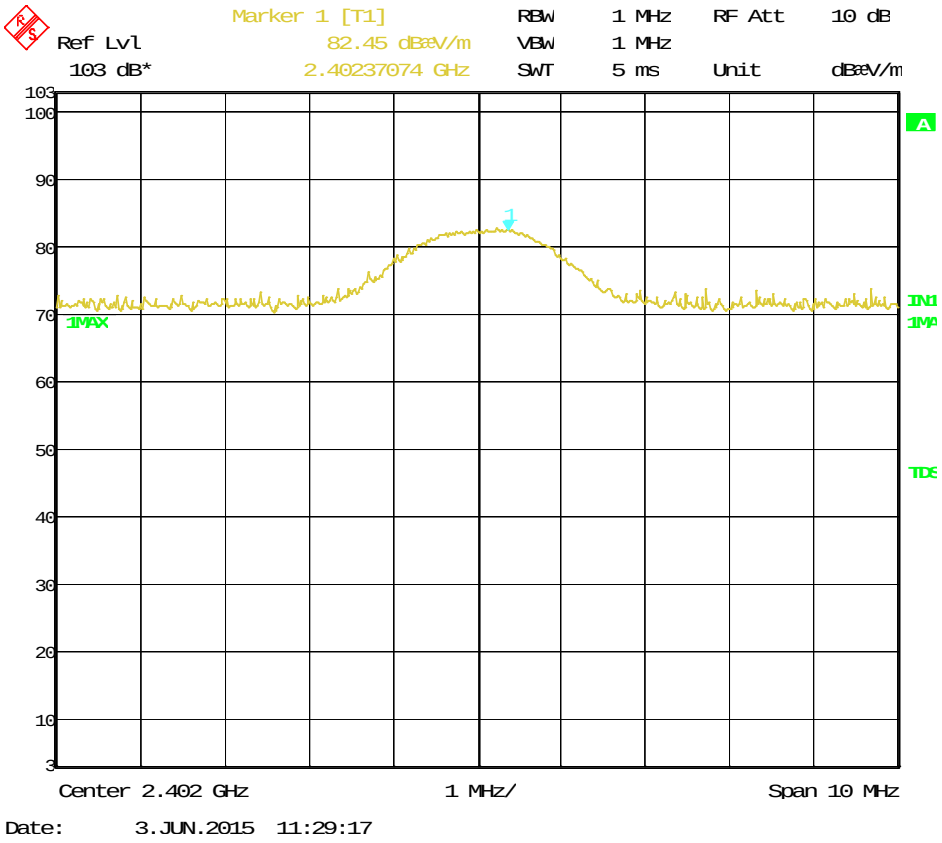

Figure 22 2402.0 MHz – Vertical

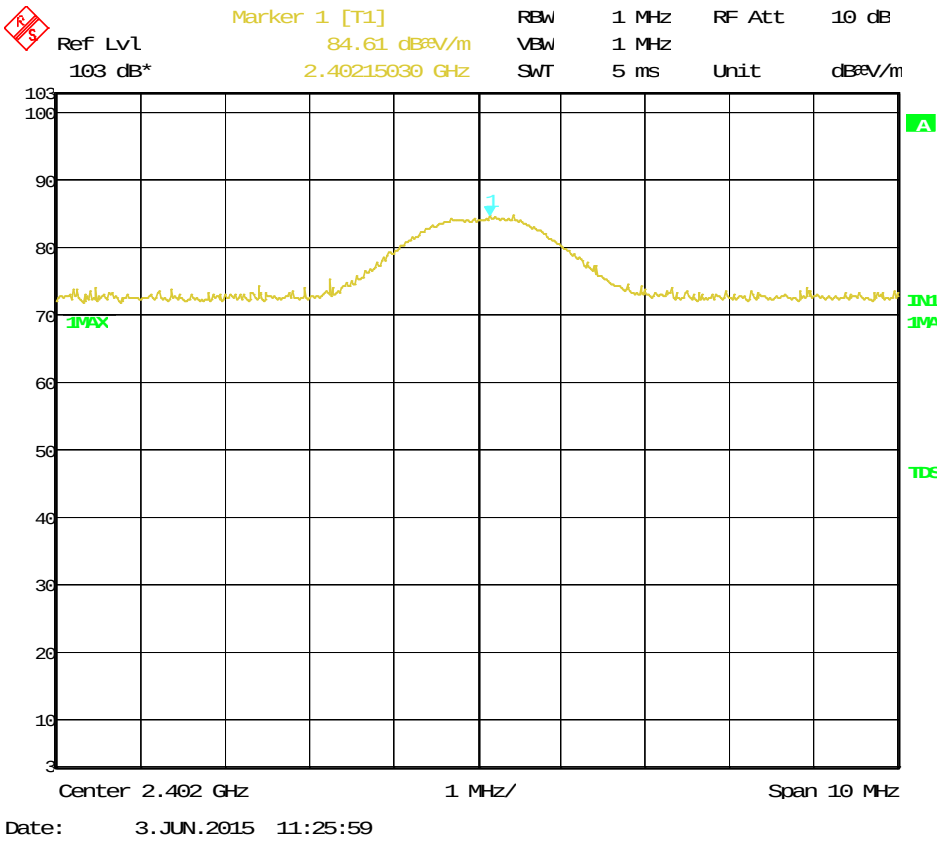

Figure 23 2402.0 MHz – Horizontal

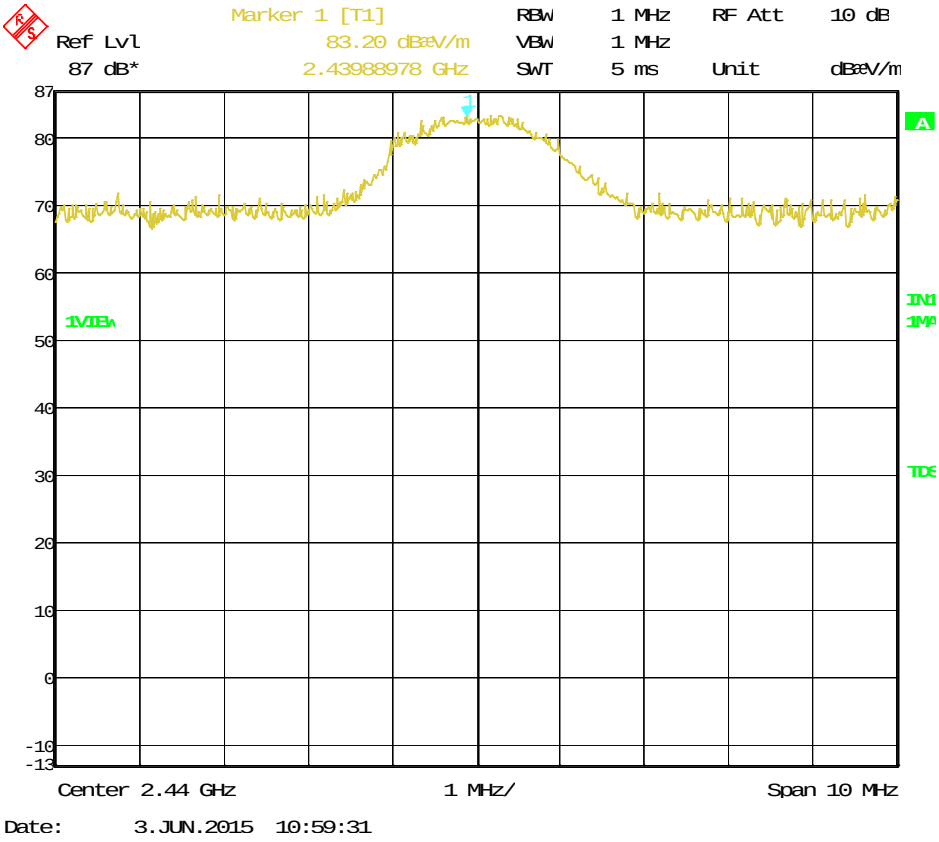

Figure 24 2440.0 MHz – Vertical

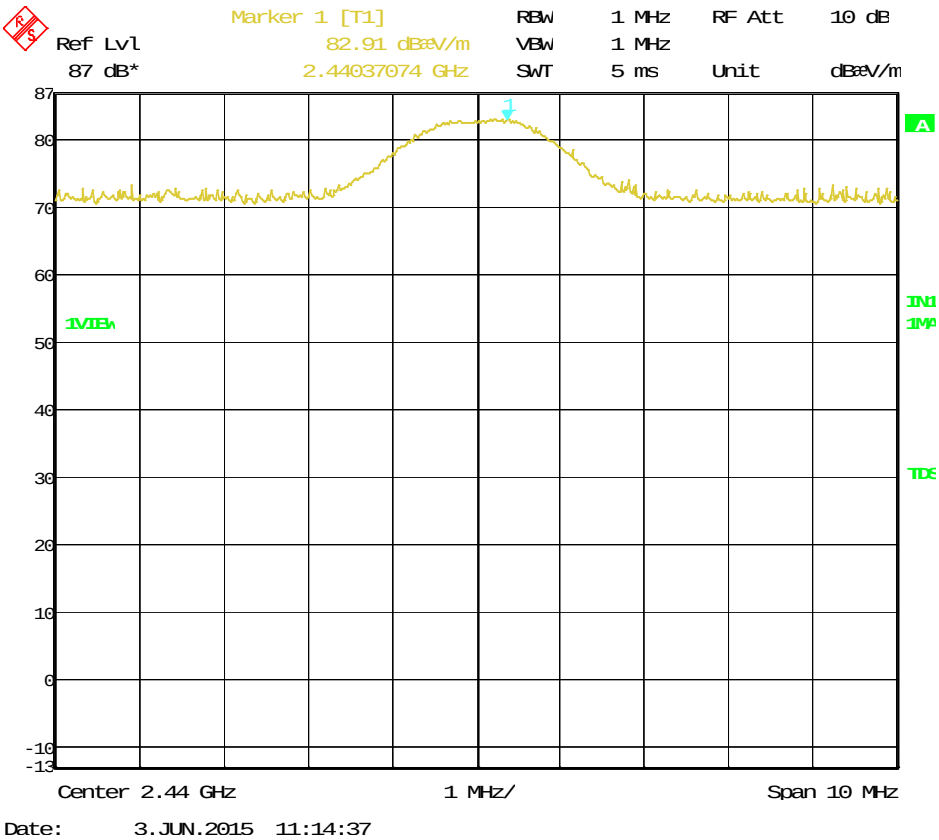

Figure 25 2440.0 MHz – Horizontal

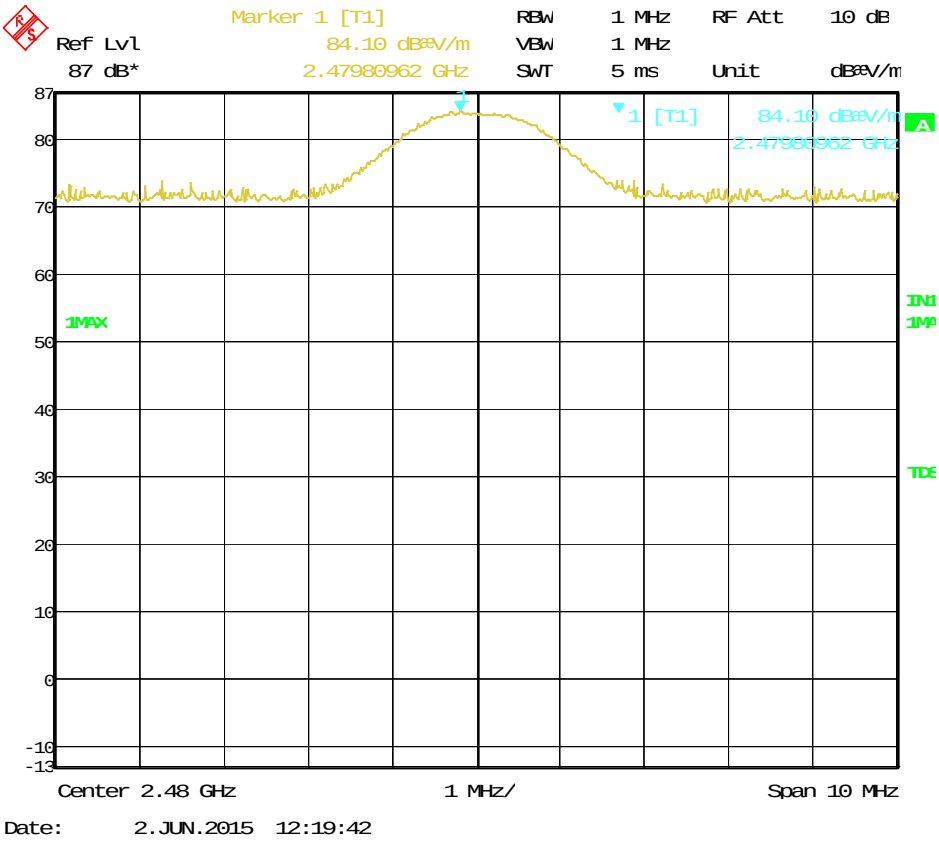

Figure 26 2480.0 MHz – Vertical

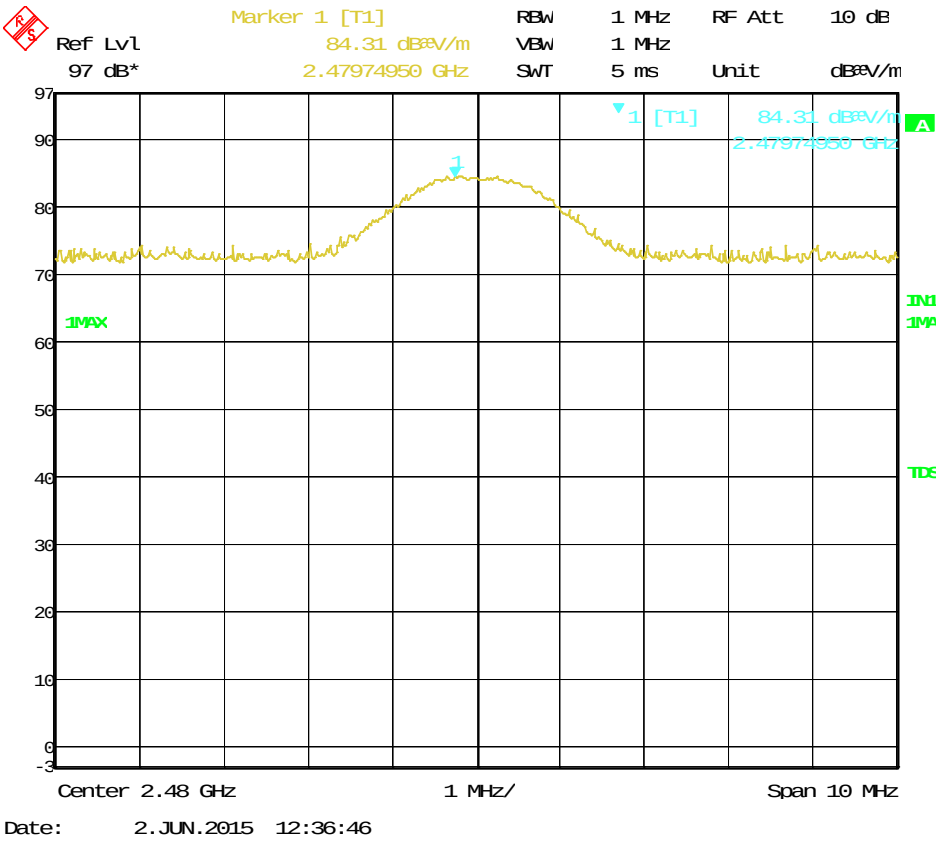

Figure 27 2480.0 MHz – Horizontal

7.2 *Test Equipment Used; Maximum Peak Power Output*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	May 19, 2015	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 28 Test Equipment Used

8. Band Edge Spectrum

8.1 *Test Specification*

FCC, Part 15, Subpart C, Section 15.247(d)

8.2 *Test Procedure*

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

See Section 2.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

The E.U.T was tested at 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 E.U.T was evaluated in 2 channels: Low and High and with horizontal test antenna polarization as worst case.

The RBW was set to 100 kHz.

8.3 *Test Results*

Operation Frequency (MHz)	Modulation	Band Edge Frequency (MHz)	Spectrum Level (dBµV/m)	Specification (dBµV/m)	Margin (dB)
Low	BLE	2400.0	54.4	60.5	-6.1
High	BLE	2483.5	57.3	61.6	-4.3

Figure 29 Band Edge Spectrum

JUDGEMENT: Passed by 4.3 dB

For additional information see *Figure 30* to *Figure 31*.

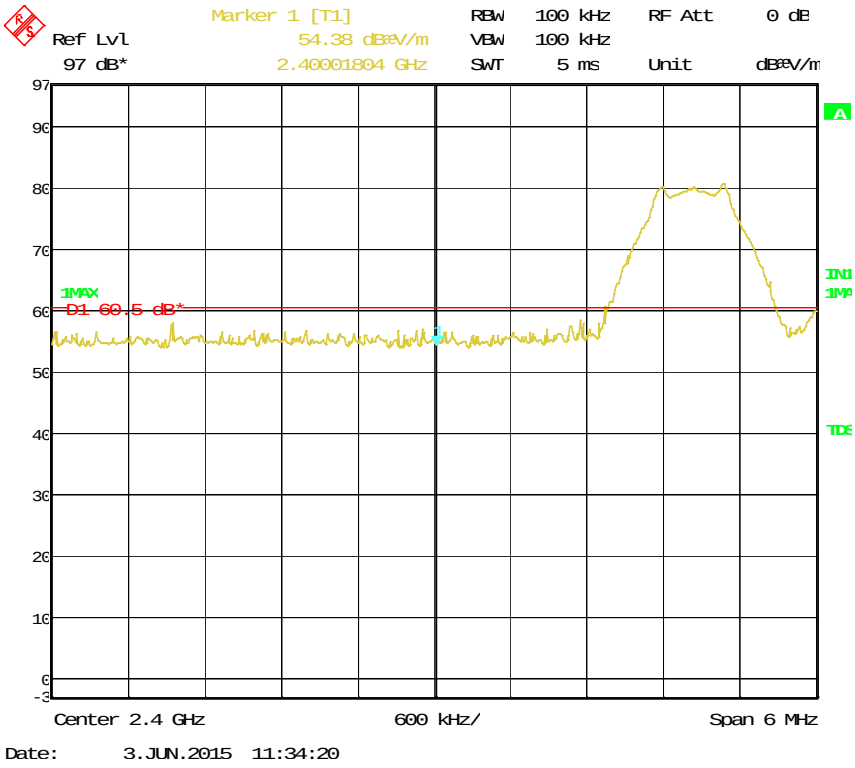

Figure 30 —Lower Band Edge

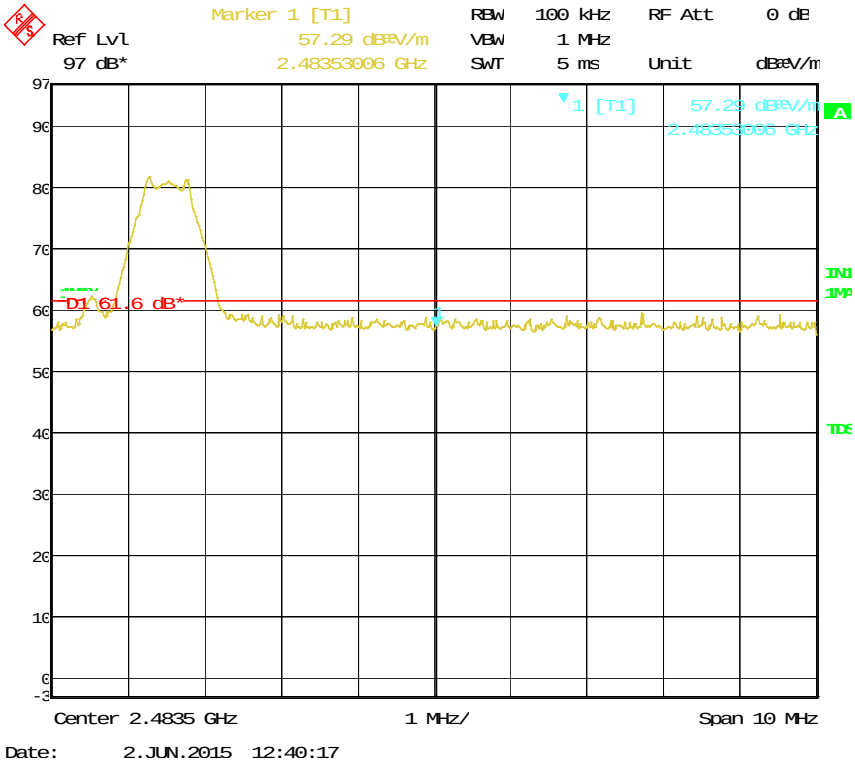

Figure 31 —Upper Band Edge

8.4 *Test Equipment Used; Band Edge Spectrum*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	May 19, 2015	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 32 Test Equipment Used

9. Radiated Emission, 9 kHz – 30 MHz

9.1 *Test Specification*

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

9.2 *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 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 2*.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements.

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.

The E.U.T. was operated at the low, mid and high channels using a peak detector.

9.3 *Test Results*

JUDGEMENT: Passed

All emissions were more than the EMI receiver noise level which is more than 6dB below the specification limit.

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

9.4 *Test Instrumentation Used, Radiated Measurements*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	May 19, 2015	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 33 Test Equipment Used

9.5 *Field Strength Calculation*

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

$$FS = RA + AF + CF$$

FS:	Field Strength [dBμv/m]
RA:	Receiver Amplitude [dBμv]
AF:	Receiving Antenna Correction Factor [dB/m]
CF:	Cable Attenuation Factor [dB]

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

No external pre-amplifiers are used.

10. Spurious Radiated Emission, 30 – 25000 MHz

10.1 *Test Specification*

FCC, Part 15, Subpart C, Sections 15.209, 15.247

10.2 *Test Procedure*

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

See Section 2.1 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, 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* 2.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

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.

In the frequency range 30-6000MHz, the readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. A computerized EMI receiver complying with CISPR 16 requirements was used.
In the frequency range 6.0-25.0 GHz, a spectrum analyzer including a low noise amplifier was used. During average measurements, the IF bandwidth was 1 MHz and the video bandwidth was 100Hz. During peak measurements, the IF bandwidth was 1 MHz and the video bandwidth was 3 MHz.
The test distance was 3 meters.
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 E.U.T. was operated at the low, mid and high channels.

10.3 *Test Results*

JUDGEMENT: Passed

For Restricted Bands:

For the operation frequency of 2402 MHz, the margin between the emission level and the specification limit is in the worst case 1.1 dB at the frequency of 2390 MHz, vertical polarization.

For 20 dBc:

Based on the fundamental levels appearing in Figure 30 and Figure 31, the limits were 60.5 dBµV/m or the lower channel and 61.6 dBµV/m for the upper channel.

The worst case was for operation at 2480 MHz (Upper Channel) -4.3 dB below the specification

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

The details of the highest emissions are given in *Figure 34* to *Figure 35*.

Radiated Emission

E.U.T Description Scanmarker Air
Type 2.0
Serial Number: Not designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Peak

Operation Frequency (MHz)	Freq. (MHz)	Polarity (H/V)	Peak Reading (dBµV/m)	Peak. Specification (dB µV/m)	Peak. Margin (dB)
2402.0	2390.0	H	62.2	74.0	-11.8
2402.0	2390.0	V	63.7	74.0	-10.3
2402.0	4804.0	H	58.4	74.0	-15.6
2402.0	4804.0	V	61.3	74.0	-12.7
2440.0	4880.0	H	58.8	74.0	-15.2
2440.0	4880.0	V	59.1	74.0	-14.9
2480.0	4960.0	H	60.9	74.0	-13.1
2480.0	4960.0	V	60.6	74.0	-13.4
2480.0	2483.5	H	61.0	74.0	-13.0
2480.0	2483.5	V	62.3	74.0	-11.7

Figure 34. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Peak

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.

"Peak Amp" includes correction factor.

* "Correction Factor" = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission

E.U.T Description Scanmarker Air
Type 2.0
Serial Number: Not designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters
Detector: Average

Operation Frequency (MHz)	Freq. (MHz)	Polarity (H/V)	Average Reading (dBµV/m)	Average Specification (dB µV/m)	Average Margin (dB)
2402.0	2390.0	H	52.8	54.0	-1.2
2402.0	2390.0	V	52.9	54.0	-1.1
2402.0	4804.0	H	49.8	54.0	-4.2
2402.0	4804.0	V	50.1	54.0	-3.9
2440.0	4880.0	H	48.3	54.0	-5.7
2440.0	4880.0	V	48.2	54.0	-5.8
2480.0	4960.0	H	50.7	54.0	-3.3
2480.0	4960.0	V	47.9	54.0	-6.1
2480.0	2483.5	H	50.0	54.0	-4.0
2480.0	2483.5	V	41.9	54.0	-12.1

Figure 35. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Average

Notes:

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.

"Average Amp" includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

10.4 *Test Instrumentation Used, Radiated Measurements Above 1 GHz*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142B	1250	May 22, 2014	2 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 36 Test Equipment Used

11. Transmitted Power Spectral Density

11.1 *Test Specification*

FCC, Part 15, Subpart C, Section 247(e)

11.2 *Test Procedure*

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

See Section 2.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

The E.U.T was tested at 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 spectrum analyzer was set to 3 kHz RBW and VBW to 10 kHz.

The E.U.T was evaluated in 3 channels: Low, Mid and High.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \text{ [W]}$$

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

11.3 *Test Results*

Operation Frequency (MHz)	Reading Spectrum Analyzer (dBµV/m)	Reading Spectrum Analyzer (dBm)	Specification (dBm)	Margin (dB)
Low	68.9	-26.3	8.0	-34.3
Mid	68.5	-26.7	8.0	-34.7
High	70.4	-24.8	8.0	-32.8

Figure 37 Transmitted Power Spectral Density Results

JUDGEMENT: Passed by 32.8 dB

For additional information see *Figure 38* to *Figure 40.*

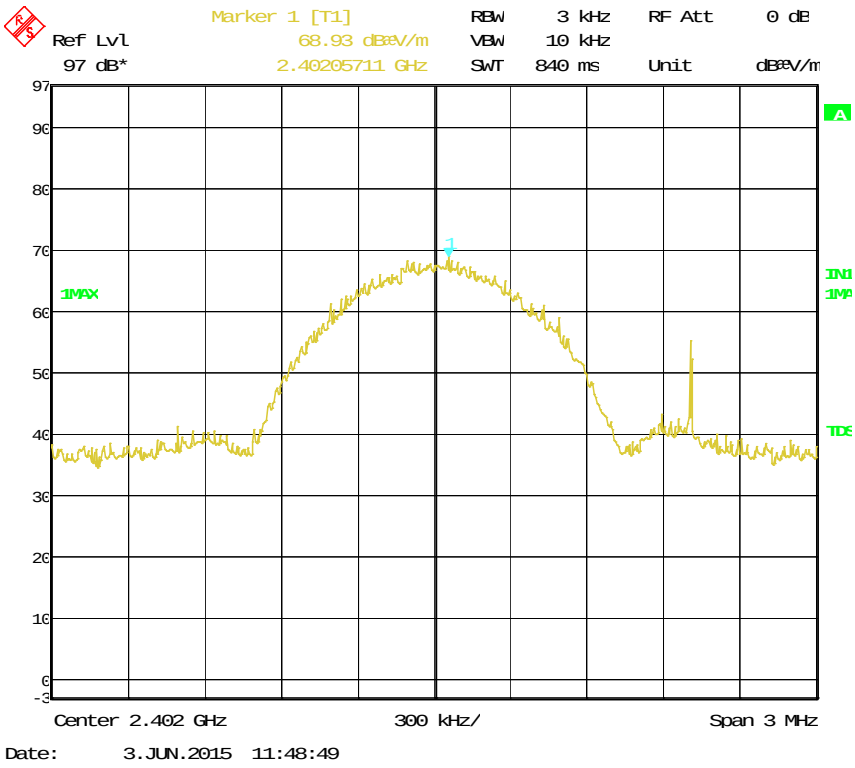

Figure 38 — Low Channel

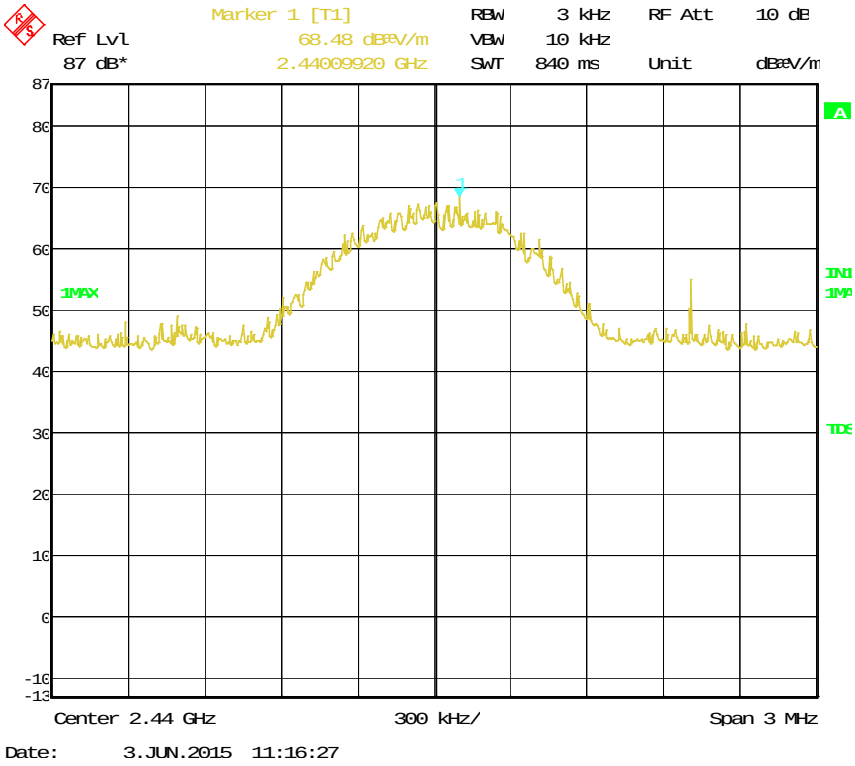

Figure 39 — Mid Channel

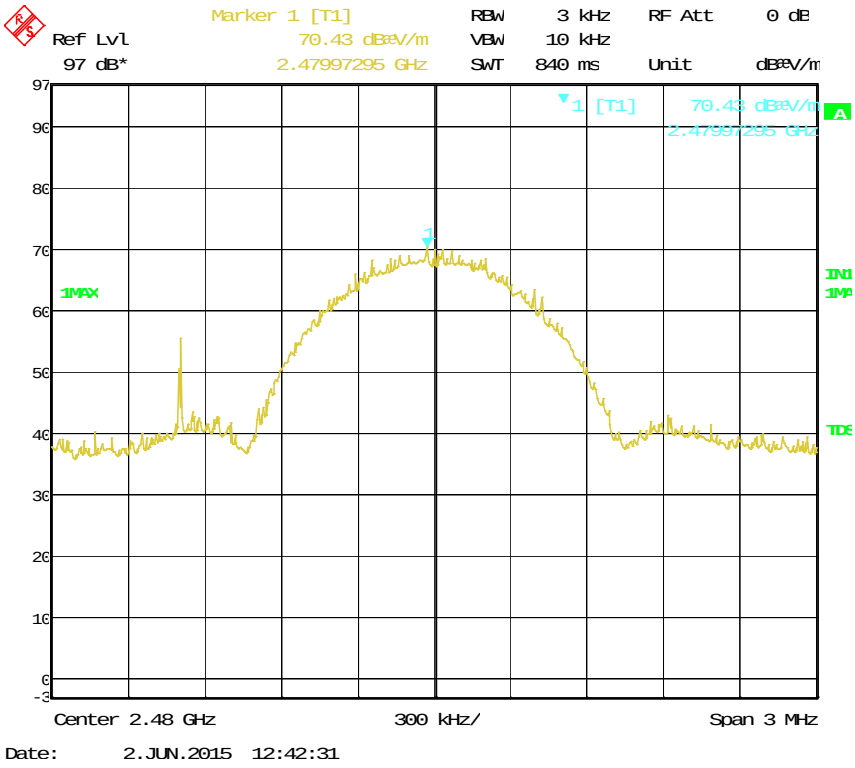

Figure 40 — High Channel

11.4 *Test Equipment Used; Transmitted Power Spectral Density*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	R&S	ESIB7	100120	January 4, 2015	1 year
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	1 year
Active Loop Antenna	EMCO	6502	2950	November 4, 2014	1 year
Biconilog Antenna	EMCO	3142	1250	May 22, 2014	2 years
Horn Antenna	ETS	3115	6142	May 19, 2015	3 years
Horn Antenna	ARA	SWH-28	1007	March 30, 2014	3 years
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	1 year
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	1 year
Low Noise Amplifier	DBS MICROWAVE	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 41 Test Equipment Used

12. Antenna Gain/Information

The antenna gain is 0.5 dBi, integral.

2450 MHz Antenna P/N 2450AT18B100

13. R.F Exposure/Safety

Typical use of the E.U.T. is a portable hand scanner.

The typical distance between the E.U.T. and the user in the worst case application, is 0.25 cm.

Calculation of Maximum Permissible Exposure (MPE)

Based on FCC Section 1.1310 and IC RSS 102, Issue 5 Section 2.5.2 Requirements

(a) FCC limits at 2402 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

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

P_t- Transmitted Power 84.6 dBuV/m (Peak) = -10.6dBm = 0.087 mW (testing performed radiated; power results include antenna gain).

G_T- Antenna Gain, 0.5 dBi

R- Distance from Transmitter using 0.25 cm worst case

(c) The peak power density is:

$$S = \frac{(0.087)}{4\pi(0.25)^2} = 0.11\frac{mW}{cm^2}$$

(d) This is below the FCC limit.

14. APPENDIX A - CORRECTION FACTORS

14.1 *Correction factors for CABLE* from EMI receiver to test antenna at 3 meter range.

Frequency (MHz)	Cable Loss (dB)
0.010	0.4
0.015	0.2
0.020	0.2
0.030	0.3
0.050	0.3
0.075	0.3
0.100	0.2
0.150	0.2
0.200	0.3
0.500	0.4
1.00	0.4
1.50	0.5
2.00	0.5
5.00	0.6
10.00	0.8
15.00	0.9
20.00	0.8

Frequency (MHz)	Cable Loss (dB)
50.00	1.2
100.00	0.7
150.00	2.1
200.00	2.3
300.00	2.9
500.00	3.8
750.00	4.8
1000.00	5.4
1500.00	6.7
2000.00	9.0
2500.00	9.4
3000.00	9.9
3500.00	10.2
4000.00	11.2
4500.00	12.1
5000.00	13.1
5500.00	13.5
6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

14.2 *Correction factors for Correction factors for Bilog ANTENNA*

Model: 3142
Antenna serial number: 1250
3 meter range

FREQUENCY (MHz)	AFE (dB/m)	FREQUENCY (MHz)	AFE (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		

14.3 *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

14.4 *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