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DATE: 05 August 2015

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

FCC Radio Test Report

for

**Image Recognition Integrated
Systems S.A. (I.R.I.S. S.A.)**

Equipment under test:

IRISPen 7 Air

2.0

Tested by:


M. Zohar

Approved by:


D. Shidlovsky

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Measurement/Technical Report for

Image Recognition Integrated Systems S.A. (I.R.I.S. S.A.)

IRISPen 7 Air

2.0

FCC ID: 2ACJL-PENAIR7

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

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1. General Information

1.1 Administrative Information

| | |
|-----------------------------------|---|
| Manufacturer: | Image Recognition Integrated Systems S.A. (I.R.I.S. S.A.) |
| Manufacturer's Address: | Rue du Bosquet 10 1348 Louvain-La-Neuve, Belgium Telephone: 32 (0) 10 487 400 Fax: 32 (0) 10 487 400 |
| Manufacturer's Representative: | Yves Halleux |
| Equipment Under Test (E.U.T): | IRISPen 7 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**

E.U.T. is an AC powered scanner with rechargeable internal LiPo battery that scans any printed text and it appears automatically in any PC/MAC application. In tethered mode the scanner is powered from host's USB port. Operated by Bluetooth with BLE technology transmits in 2.4 GHz.

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) |
|-----------------|-----------------|-----------------|-----------------|
| 2442.0 | 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

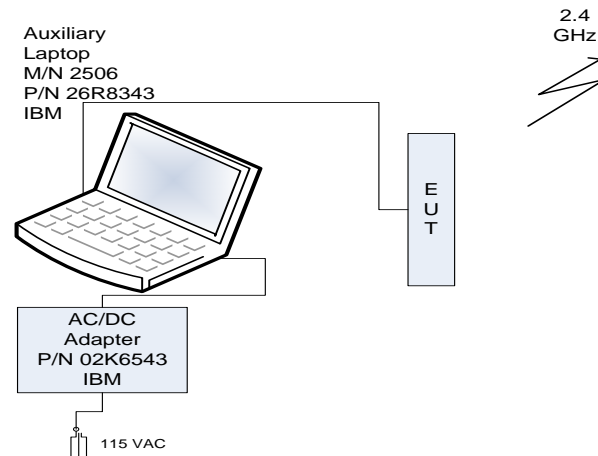


Figure 2. Configuration of Tested System

3. Radiated Measurement Test Set-up Photos



Figure 3. Conducted Emission from AC Power Line Test

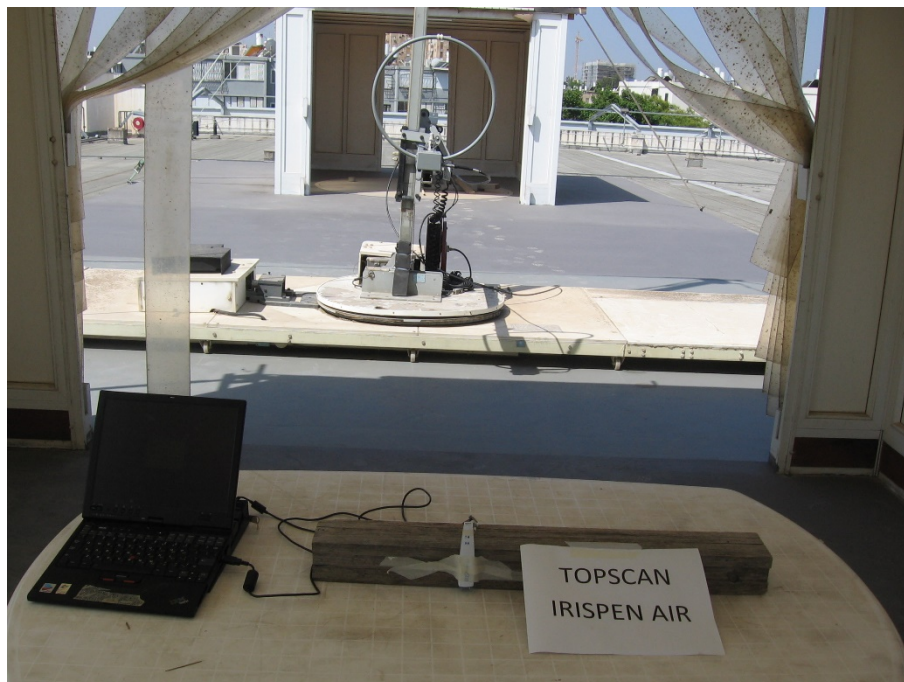


Figure 4. Radiated Emission Test



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 μ Hn 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 IRISPen 7 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

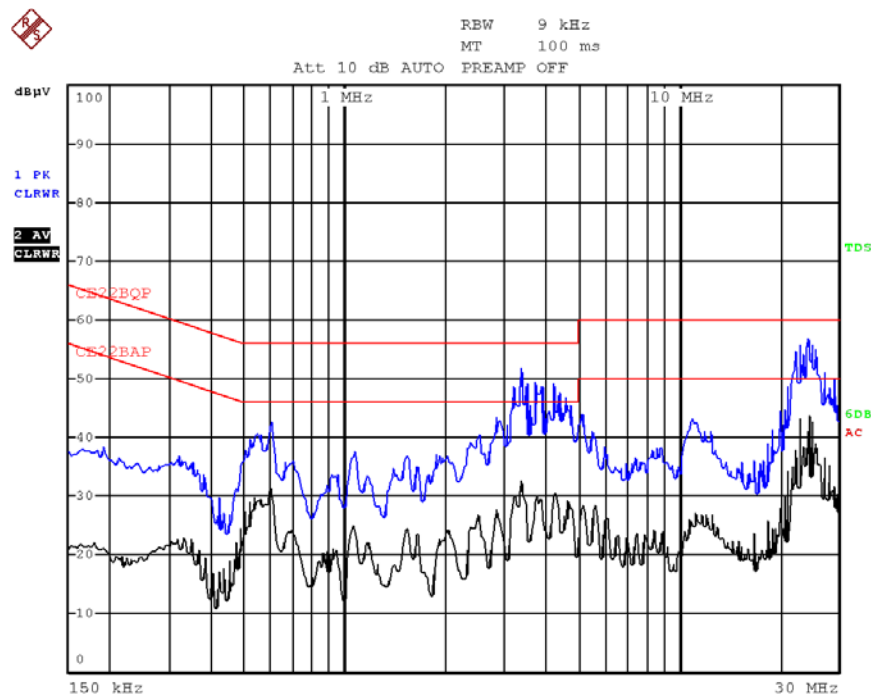
Figure 7. Detectors: Peak, Quasi-peak, AVERAGE

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 IRISPen 7 Air
Type 2.0
Serial Number: Not designated

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



Date: 4.JUN.2015 11:21:55

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 IRISPen 7 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

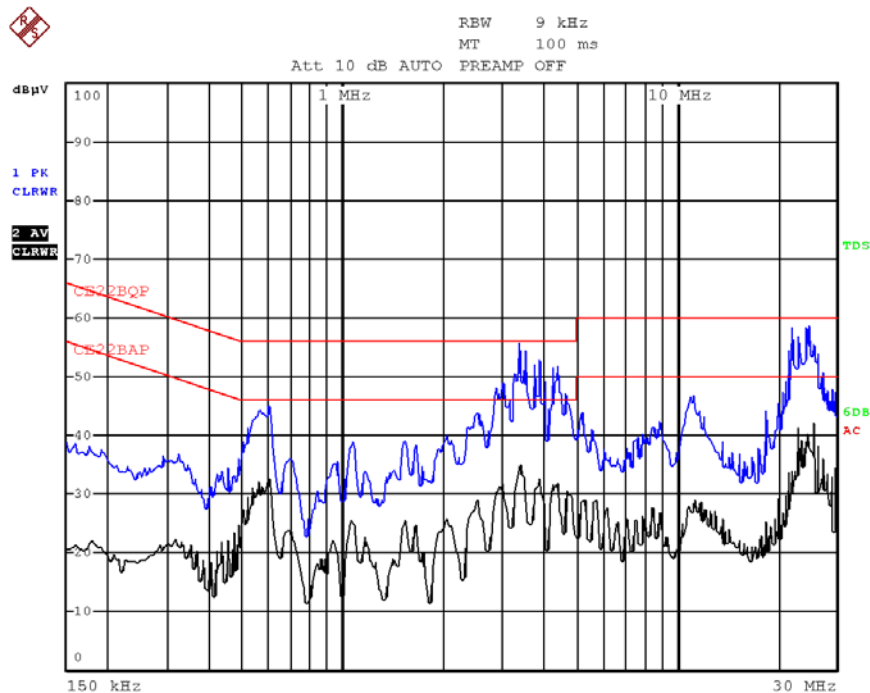
Figure 9. Detectors: Peak, Quasi-peak, AVERAGE

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 IRISPen 7 Air
Type 2.0
Serial Number: Not designated

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



Date: 4.JUN.2015 11:31:39

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 μ V).
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*.

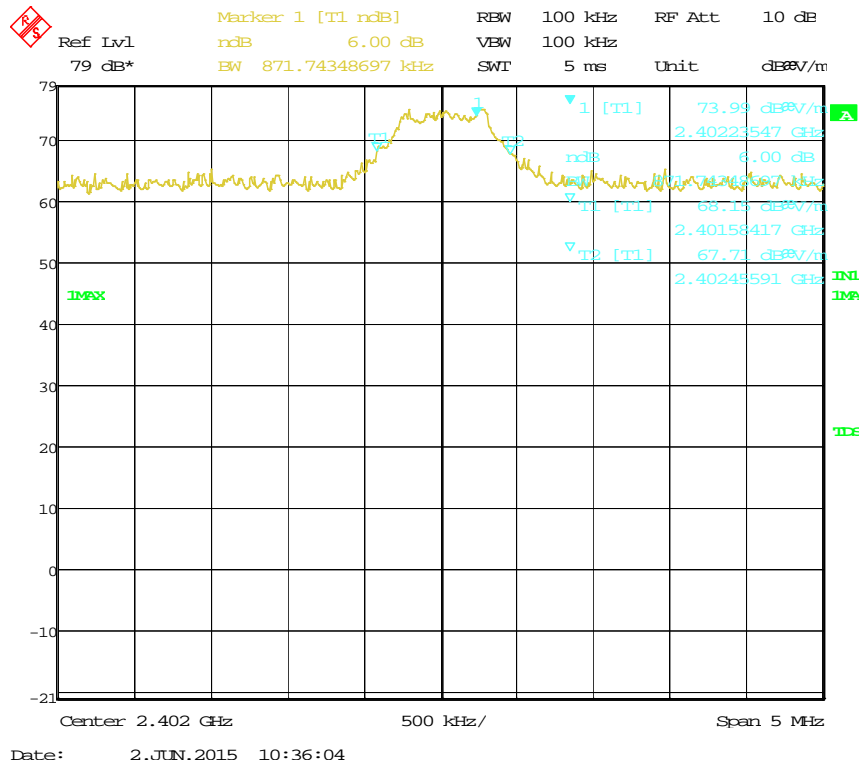


Figure 12. Low Channel

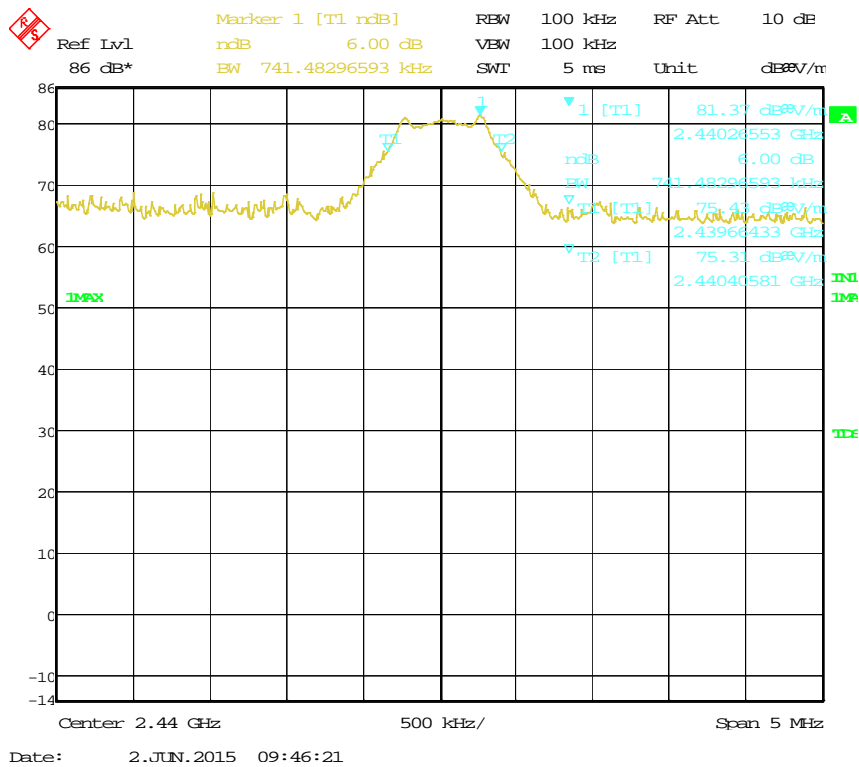


Figure 13. Mid Channel

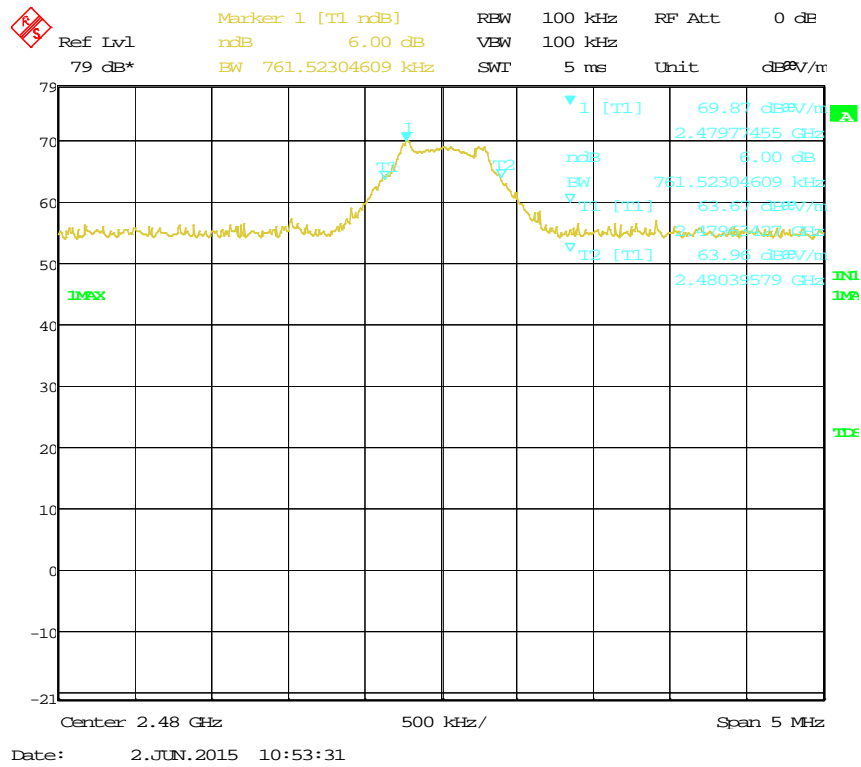


Figure 14. High Channel

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*.

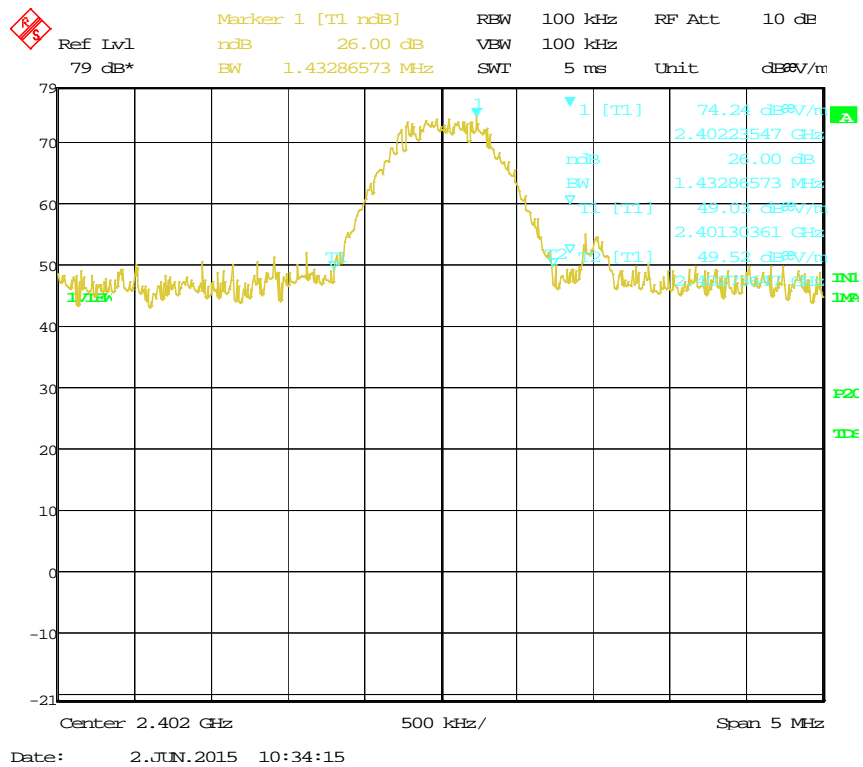


Figure 17. Low Channel

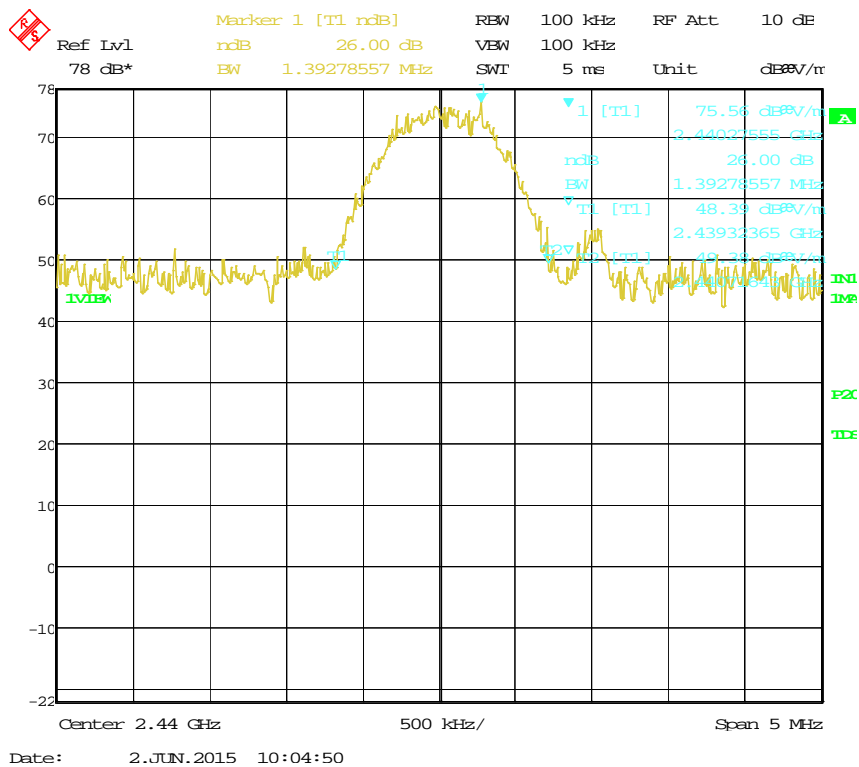


Figure 18. Mid Channel

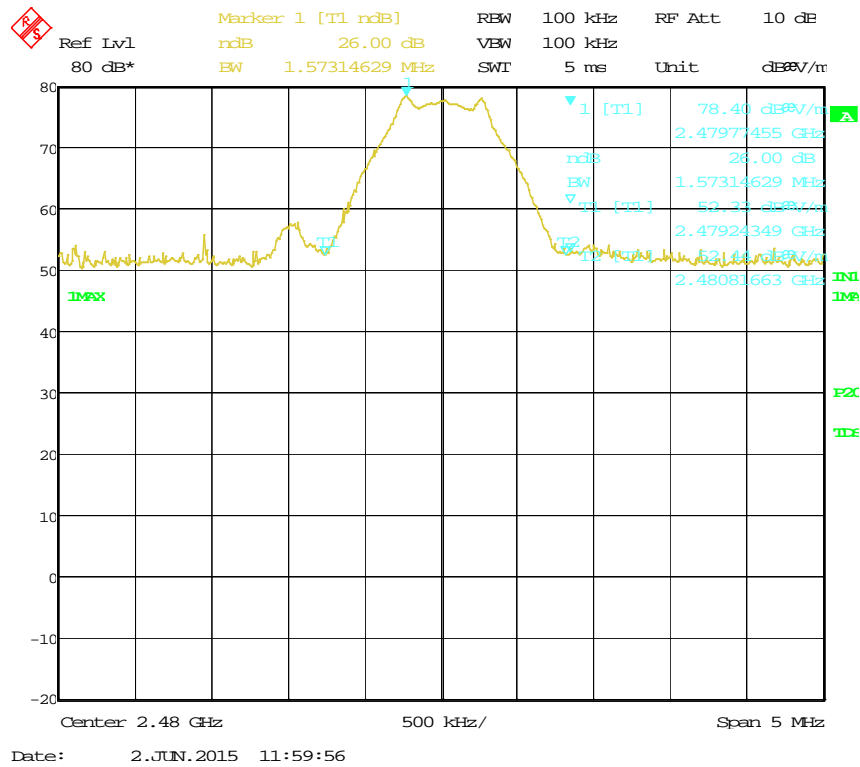


Figure 19. High Channel

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:

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

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*.

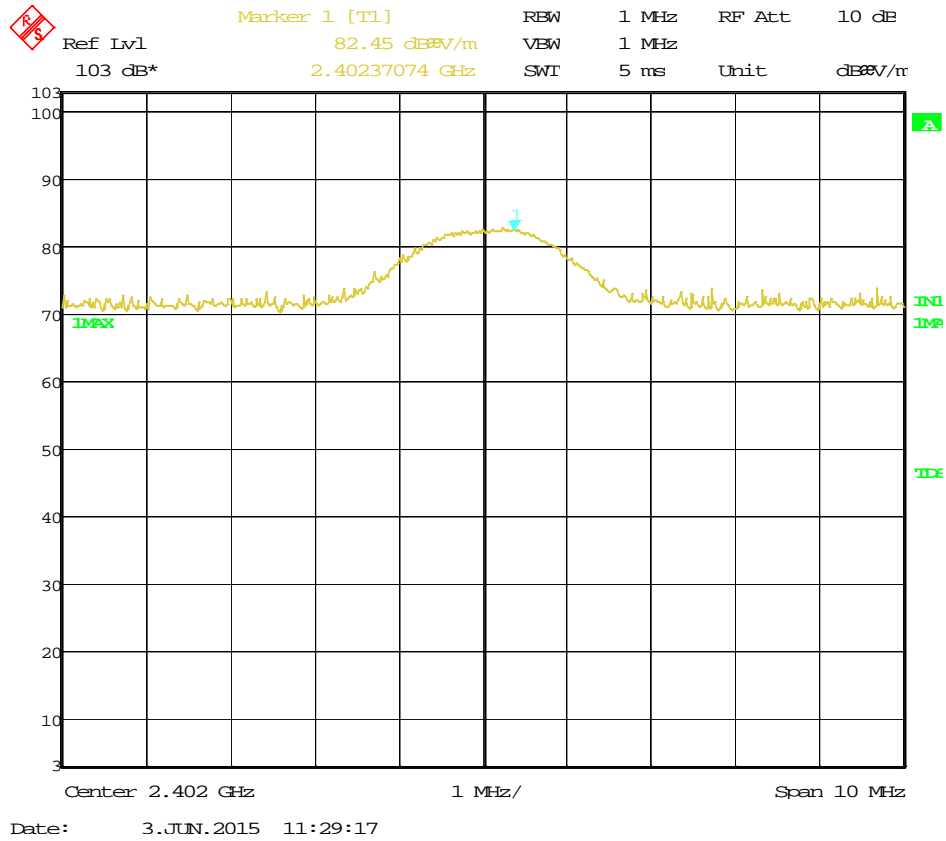


Figure 22 2402.0 MHz – Vertical

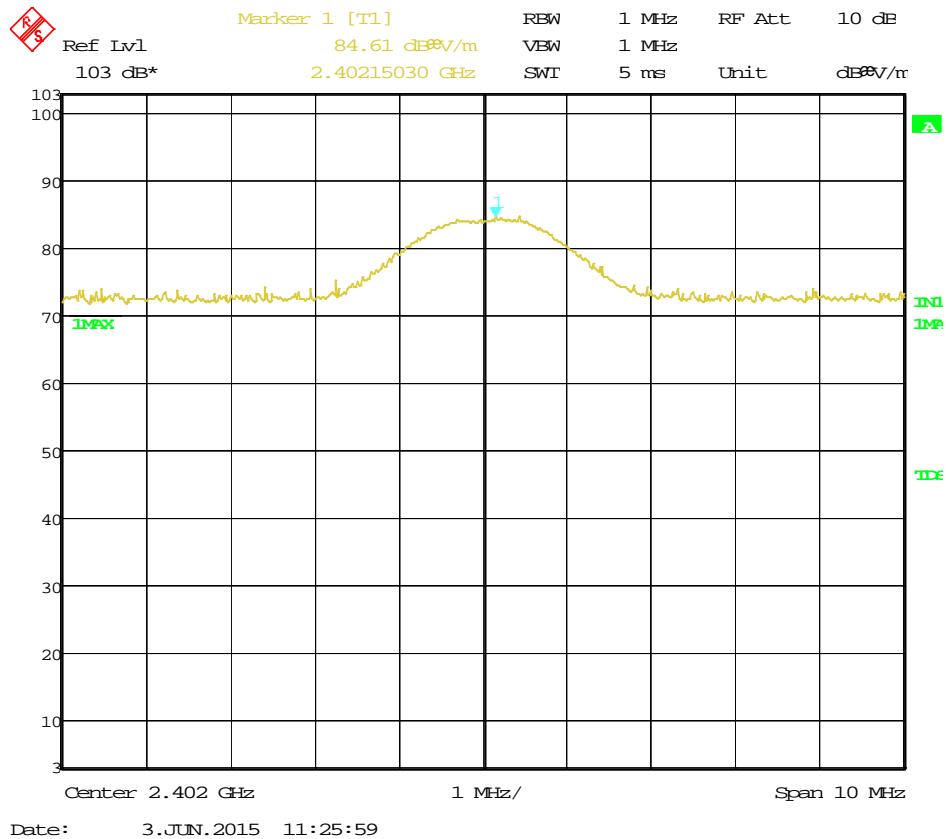


Figure 23 2402.0 MHz – Horizontal

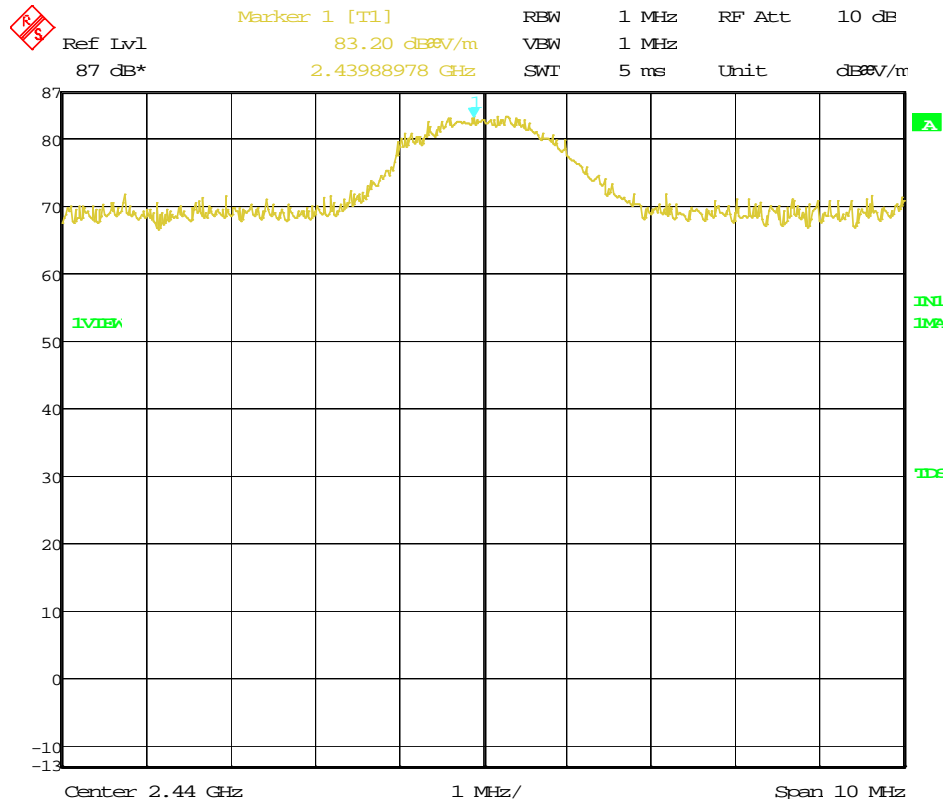


Figure 24 2440.0 MHz – Vertical

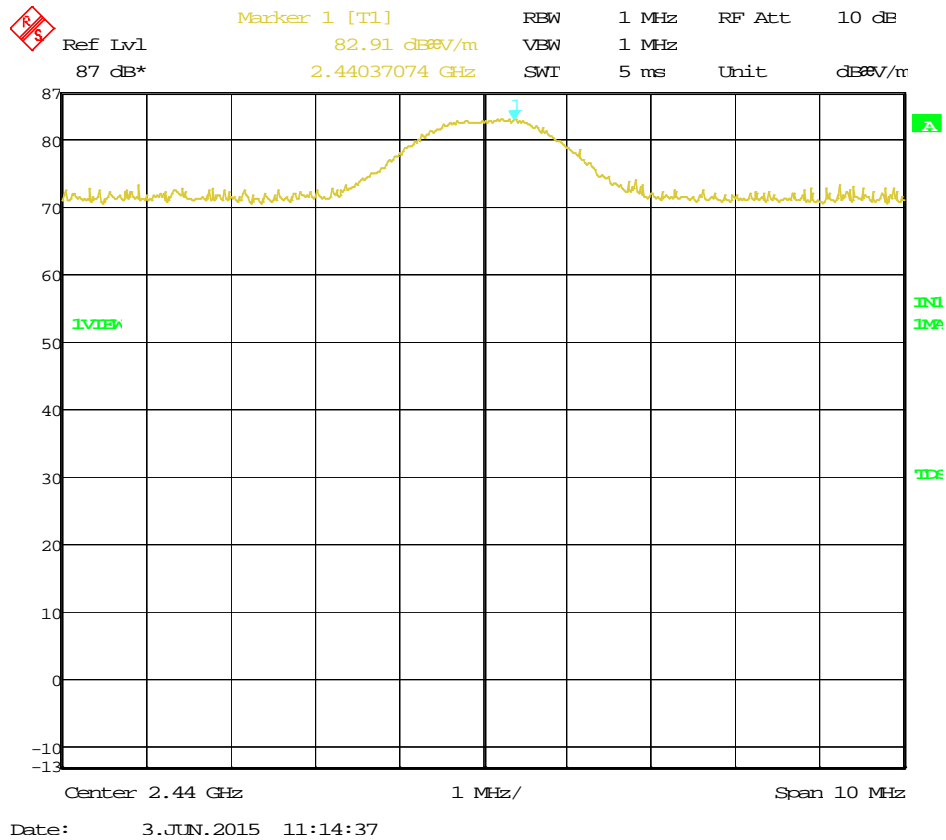


Figure 25 2440.0 MHz – Horizontal

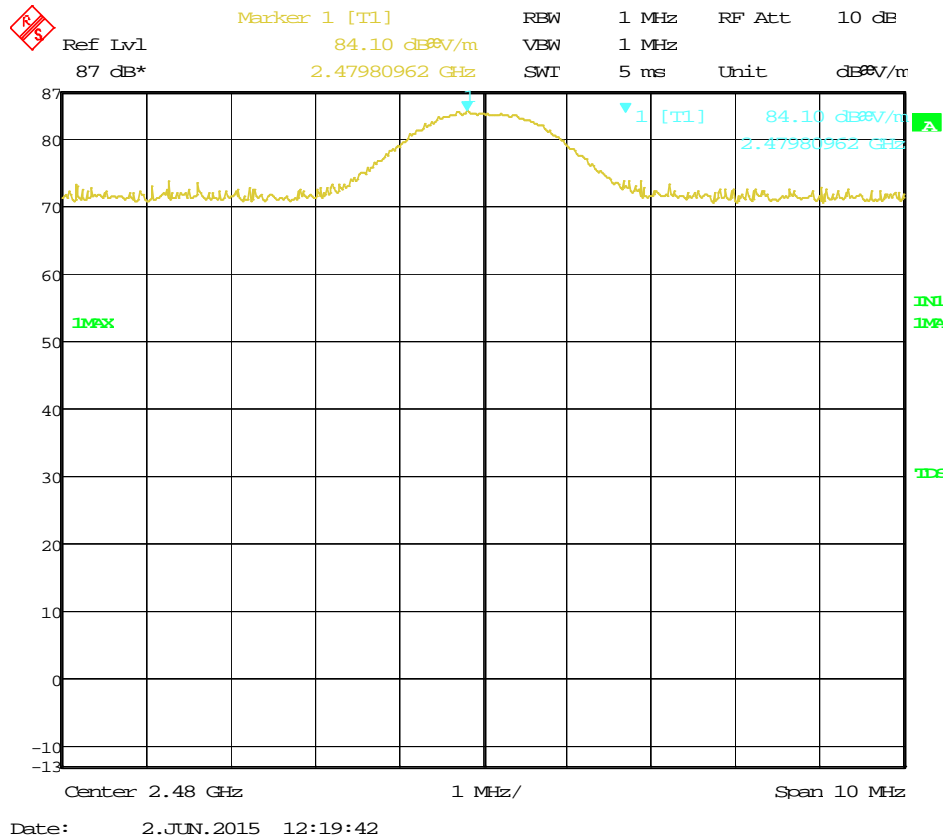


Figure 26 2480.0 MHz – Vertical

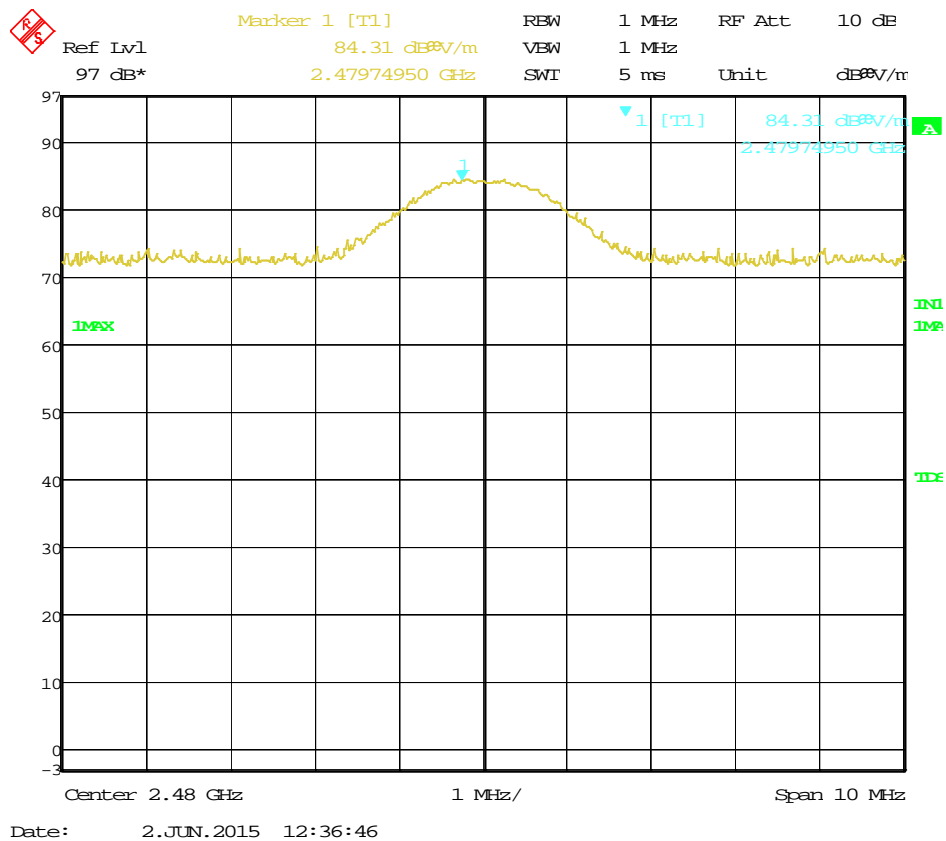


Figure 27 2480.0 MHz – Horizontal

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 (dBm) | Specification (dBm) | 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*.

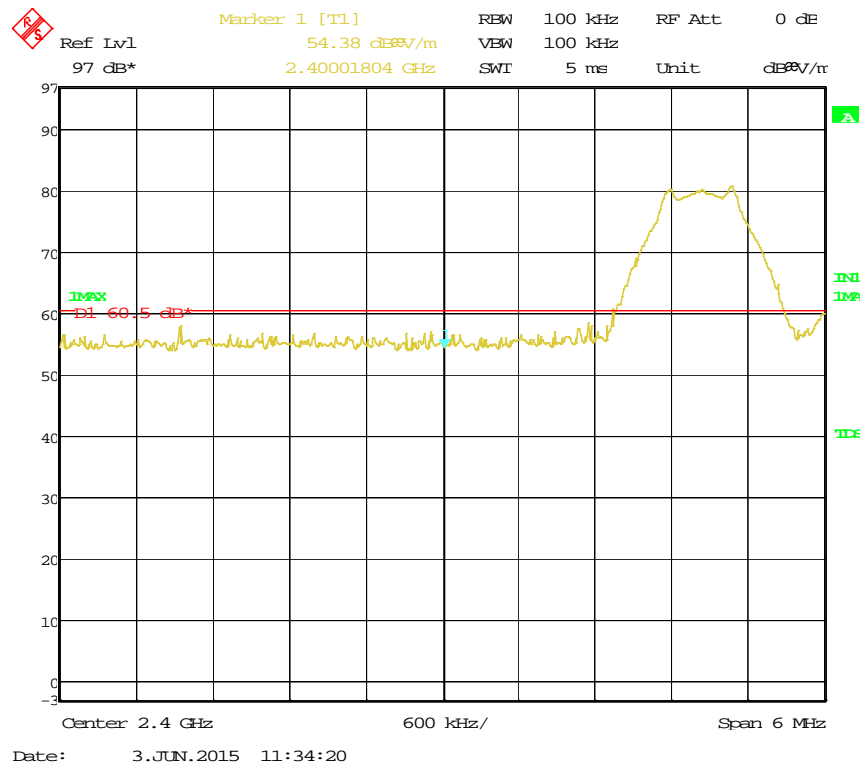


Figure 30 —Lower Band Edge

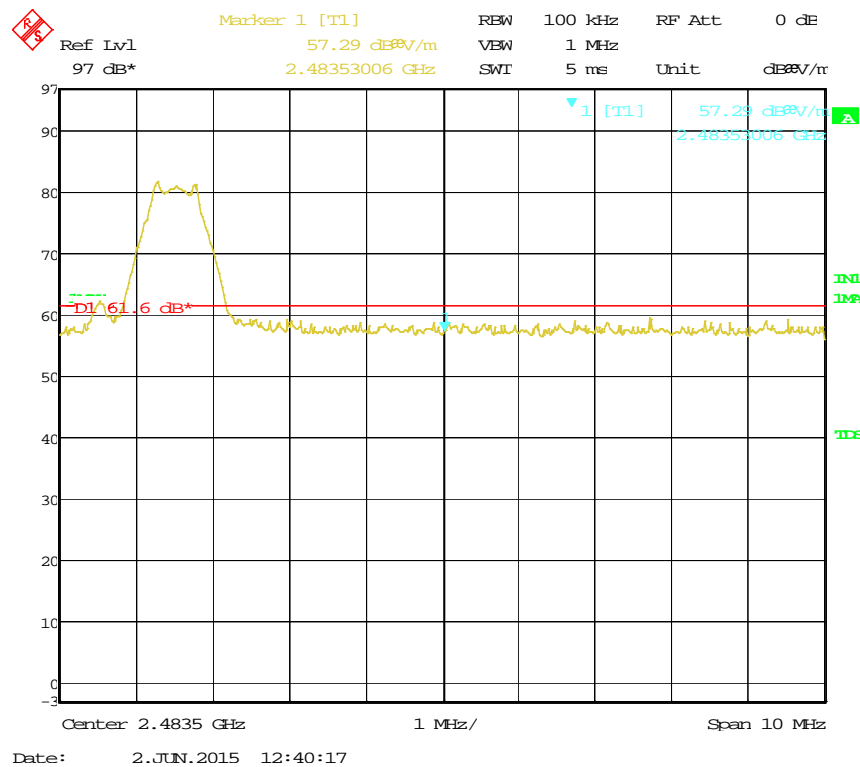


Figure 31 —Upper Band Edge

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 [dB μ V/m] |
| RA: | Receiver Amplitude [dB μ V] |
| AF: | Receiving Antenna Correction Factor [dB/m] |
| CF: | Cable Attenuation Factor [dB] |

Example: $FS = 30.7 \text{ dB}\mu\text{V (RA)} + 14.0 \text{ dB (AF)} + 0.9 \text{ dB (CF)} = 45.6 \text{ dB}\mu\text{V}$

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.

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 by 1.1 dB

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.

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 IRISPen 7 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 IRISPen 7 Air
Type 2.0
Serial Number: Not designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Test Distance: 3 meters

Frequency range: 1.0 GHz to 25.0 GHz
Detector: Average

| Operation Frequency (MHz) | Freq. (MHz) | Polarity (H/V) | Average Reading (dBμ V/m) | Average Specification (dB μ V/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 (dB μ V/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*.

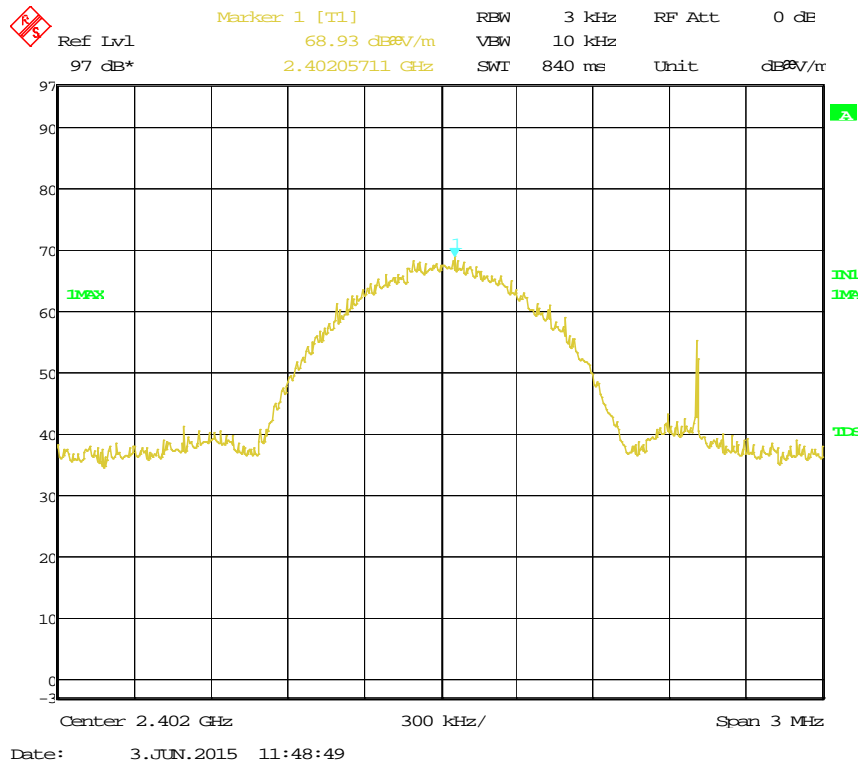


Figure 38 — Low Channel

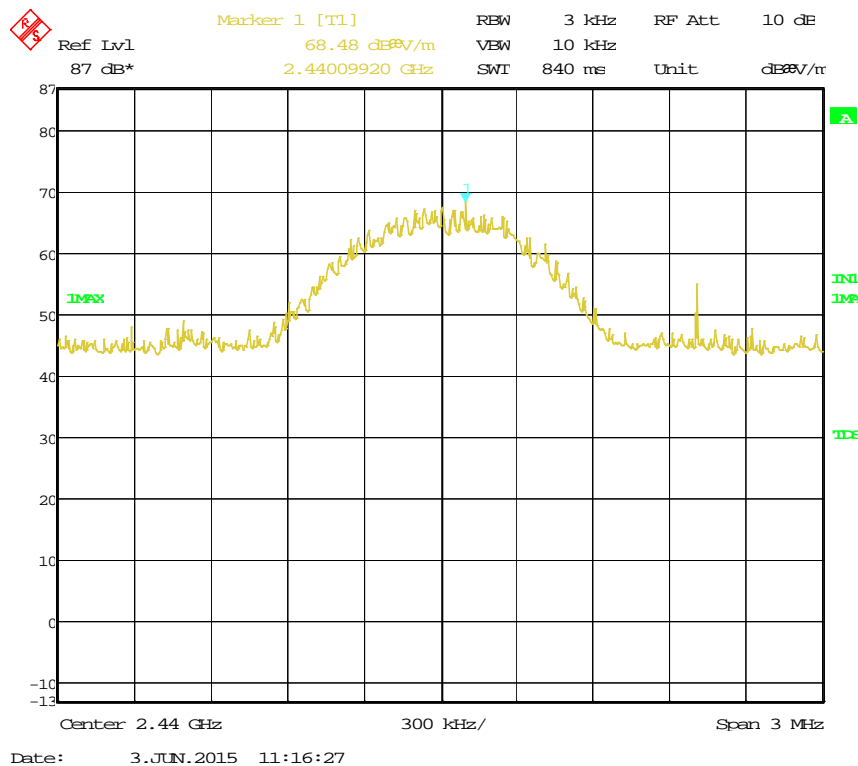


Figure 39 — Mid Channel

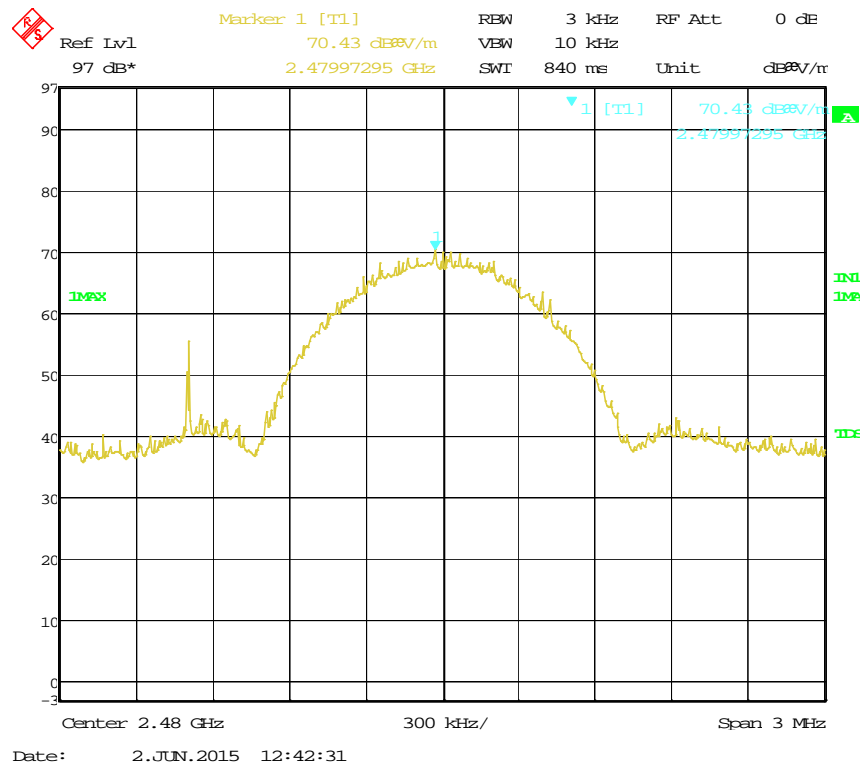


Figure 40 — High Channel

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 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 | | |



14.3 Correction factors for

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

| FREQUENCY (GHz) | APE (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 | 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 |