



***Test Report No. 9612319569***

***Applicant: Maytronics Ltd.***

***Equipment Under Test:***

***Single channel transmitter***

***Models: 99954735LF***

***From The Standards Institution  
Of Israel  
Industry Division  
Electronics & Telematics Laboratory  
EMC Branch***



**Certificate Number: AT-1359**



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**Title:** Single channel transmitter

**Model:** 99954735LF

**FCC ID:** WCH99956RF

|                                     |                                |
|-------------------------------------|--------------------------------|
| <b>Applicant:</b>                   | Maytronics Ltd.                |
| <b>Address:</b>                     | Kibbutz Yizre'el, 19350 Israel |
| <b>Sample for test selected by:</b> | The customer                   |
| <b>The date of tests:</b>           | 10 March 2016                  |

|                                                   |                             |
|---------------------------------------------------|-----------------------------|
| <b>Description of Equipment Under Test (EUT):</b> | Single channel transmitter. |
| <b>Model:</b>                                     | 99954735LF                  |
| <b>Software version of brain unit</b>             | Revision 011                |
| <b>Hardware version of brain unit</b>             | Revision 01                 |
| <b>Manufactured by:</b>                           | Maytronics Ltd.             |

**Reference Documents:**

- ❖ CFR 47 FCC: Rules and Regulations; Part 15. "Radio frequency devices";  
Subpart C: "Intentional radiators" (2015).  
Section 15.209. "Radiated emission limits, general requirements".  
"Radiated Emission Limits, Additional Provisions";  
Section 15.249. "Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 - 24.25 GHz".

This Test Report contains 23 pages  
and may be used only in full.

This Test Report applies only to the specimen tested and may not  
be applied to other specimens of the same product.



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## 1. EUT Description and operation

### 1.1. General description:

\* Note: the customer supplied all information in clause below.

The EUT, is a communication module and is used to communicate by single channel RF transmission with a RCU by RF-FSK communication.

The power supply module provides the voltage to operate the module.

This power supply is connected to the mains and is outputting to the robot 29VDC. This is an outdoor appliance.

|                                  |                 |
|----------------------------------|-----------------|
| Single channel frequency:        | 2433 MHz        |
| Type of modulation:              | FSK             |
| Effective radiated output power: | < 0 dBm         |
| Antenna type:                    | Internal on PCB |

The communication module mounted as power supply front panel.  
External view is presented in photo # 1.



Photo 1. Front panel of P.S. view.

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## 2. Test summary

| Parameter                                                  | FCC Part 15<br>Reference paragraph                                    | Verdict |
|------------------------------------------------------------|-----------------------------------------------------------------------|---------|
| Test of field strength emission from intentional radiators | "Radiated Emission Limits, Additional Provisions";<br>Section 15.249. | Comply  |

Electronics & Telematics  
Laboratory

May 2016

Name: Eng. Yuri Rozenberg  
Position: Head of EMC  
BranchName: Michael Feldman  
Position: Test Technician

### Measurement uncertainty.

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.

The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

In the following table the uncertainty calculation is given.

| Type of disturbance<br>Test description                                                                                    | Calculated uncertainty<br>$U_{LAB}$ |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b><u>Radiated disturbance</u></b><br>electric field strength in a SAR at 3 m distance<br>9kHz – 30MHz<br>30 MHz – 1.0 GHz | $\pm 2.54$ dB<br>$\pm 4.32$ dB      |
| electric field strength in a FAR at 3 m distance<br>1.0 – 18 GHz.<br>18 – 40 GHz.                                          | $\pm 4.47$ dB<br>$\pm 2.78$ dB      |



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**Normative References.**

|                                     |                                                                                                                                                                     |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC 47 CFR Part 15, Subpart C, 2015 | Radio Frequency Devices Subpart C – Intentional Radiators                                                                                                           |
| ANSI C63.4: 2009                    | American National Standard for Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10: 20013                  | American National Standard for Testing of Unlicensed Wireless Devices.                                                                                              |

**Test Report No.:** 9612319569**Page 7 of 23 pages****Title:** Single channel transmitter**Model:** 99954735LF**FCC ID:** WCH99956RF**2.1. Potential emission sources:**

The potential emission sources are detailed in Table 1.

**Table 1. Potential emission sources**

| Frequency | Location              |
|-----------|-----------------------|
| 26 MHz    | CC2510 MCU main clock |
| 32.0 MHz  | CC2541 MCU main clock |
| 2433 MHz  | RF signal             |

**2.2. EUT setup and operation:**

Test was performed in continuous transmission mode on single transmit carrier frequency 2433 MHz of 2400 – 2483.5 MHz frequency band.

**3. Measurements and derived results****3.1. Location of the Test Site:**

Radiated test was conducted at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

**3.2. Test condition:**

Temperature: 22 °C. Humidity: 49 %. Atmospheric pressure: 1009 mbar.



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### **3.3. Radiated emission test.**

#### **3.3.1. General:**

Per FCC Part 15 Subpart C Sections 15.209, 15.249.

- \* Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.
- \* A tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Peak, QP or Average detectors.

#### **3.3.2. Radiated emission measurements:**

Preliminary investigation was performed from the lowest radio frequency signal generated in the equipment up to ten harmonic of a carrier frequency.

The final radiated emission measurements were performed in the semi Anechoic chamber at 3 m test distances. The EUT was operated in continue transmission mode. The transmitter was installed on a turn - table. Active Loop, Biconilog and Double Ridged Guide antennas were used. The measurements were performed at frequencies at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360° and changing antenna-to-EUT polarization from vertical to horizontal. The worse case result was noted in tables.

#### **3.3.3. Radiated emission test results:**

Final result measurements are presented in tables and plots ## 1 - 10 in section 3.4.5.

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### 3.4. Test of field strength emission from intentional radiator.

#### 3.4.1. General:

Per FCC Part 15 Subpart C clause 15.249.

#### 3.4.2. Requirements:

The field strength emissions from intentional radiators operated according to section 15.249 (a) shall comply with the follow limits.

**Table 2. Section 15.249 limit.**

| Specified field strength limit of<br>Fundamental<br>mV/m/dB $\mu$ V/m | Specified field strength limit of<br>Harmonics<br>mV/dB $\mu$ V/m |
|-----------------------------------------------------------------------|-------------------------------------------------------------------|
| 50/94.0                                                               | 500/54.0                                                          |

Notes:

15.249 (d). The field strength for frequencies above 1000 MHz based on average limits. The field strength of emissions radiated on any frequency outside of the specified band, except for harmonics shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emissions limits in section 15.209 whichever is lesser attenuation.

15.249 (e). According to section 15.35(b). Any peak straight emissions shall not exceed permitted average limit by more than 20 dB.

#### 3.4.3. Test procedure:

The test was conducted according to clause 15.249.

#### 3.4.4. Test summary:

The tested unit meets the standard requirement.

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| Carrier frequency, MHz | Antenna pol. V/H | Peak Ampl. dB $\mu$ V/m | Peak. limit dB $\mu$ V/m | Specified Avg. limit dB $\mu$ V/m | Peak result below peak limit margin. dB | Peak result below average limit margin. dB | Ref. to plot # |
|------------------------|------------------|-------------------------|--------------------------|-----------------------------------|-----------------------------------------|--------------------------------------------|----------------|
| 2433.0                 | Hor.             | 88.6                    | 114.0                    | 94.0                              | 25.4                                    | 5.4                                        | 1              |

**Spurious emission results.**

| Freq. MHz | Antenna pol. V/H | Peak Ampl. dB $\mu$ V/m | Peak Ampl. limit, dB $\mu$ V/m | Margin dB | Avg Ampl. dB $\mu$ V/m | Specified @3m limit, dB $\mu$ V/m | Margin dB | Ref. to plot # |
|-----------|------------------|-------------------------|--------------------------------|-----------|------------------------|-----------------------------------|-----------|----------------|
| 41.9      | V                | -                       | -                              | -         | 24.3(QP)               | 40.0                              | 15.7      | 4              |
| 75.7      | V                | -                       | -                              | -         | 20.7(QP)               | 40.0                              | 19.3      | 4              |
| 2399.2    | H                | 56.7                    | 74.0                           | 17.3      | 40.6                   | 54.0                              | 13.4      | 6              |
| 2484.2    | H                | 55.0                    | 74.0                           | 19.0      | 42.6                   | 54.0                              | 11.4      | 7              |
| 4866      | H                | 60.9                    | 74.0                           | 13.1      | 51.0                   | 54.0                              | 3.0       | 8              |
| 7299      | H                | 55.0                    | 74.0                           | 19.0      | 44.0                   | 54.0                              | 10.0      | 9              |
| 23750     | H                | 50.3                    | 74                             | >20       | -                      | -                                 | -         | 11             |
| 23800     | H                | -                       | -                              | -         | 37.9                   | 54.0                              | 16.1      | 11             |



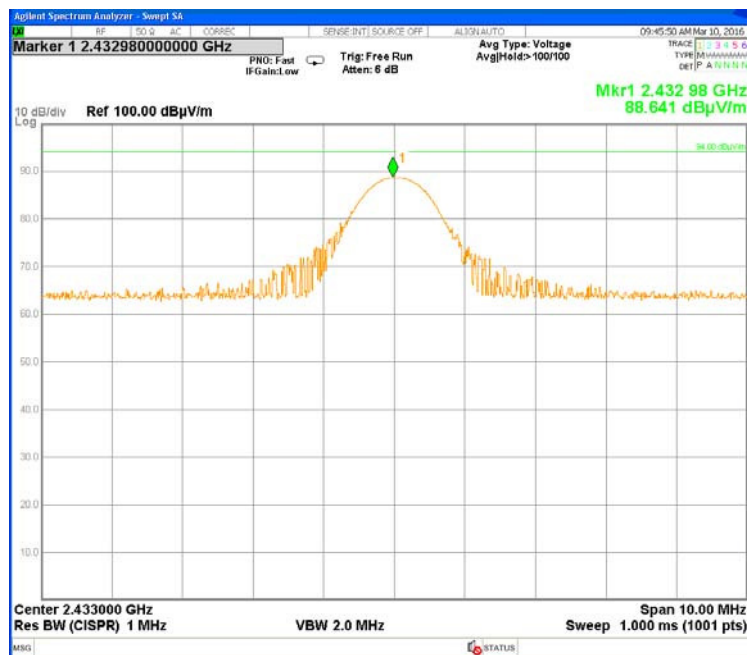
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**Plot # 1. Fundamental frequency test.**



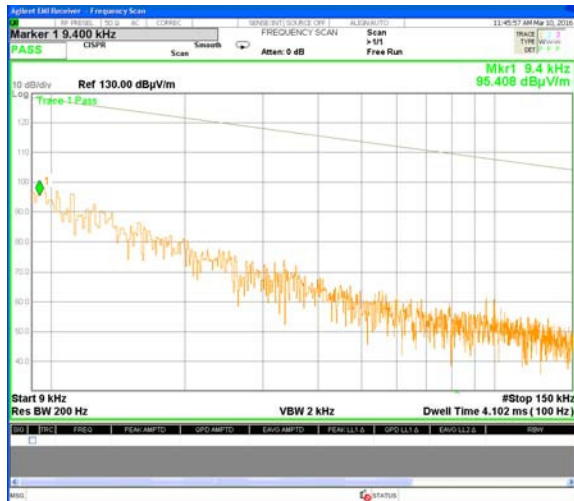
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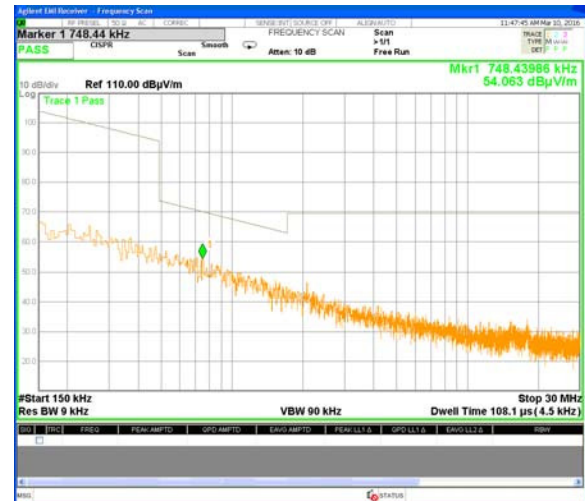
Title: Single channel transmitter

Model: 99954735LF

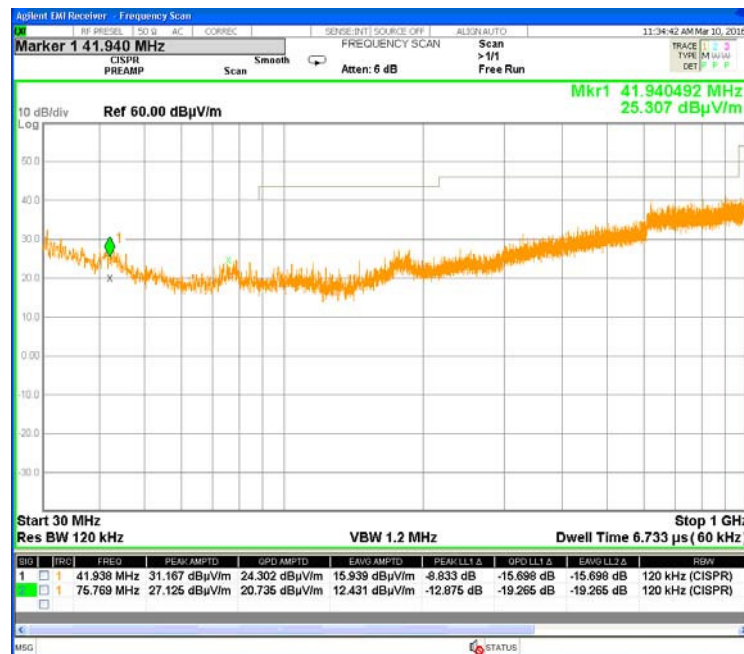
FCC ID: WCH99956RF



Plot # 2. Emissions scan 0.009 – 0.15 MHz.



Plot # 3. Emissions scan 0.15 MHz – 30 MHz.



Plot # 4. Spurious emissions scan in 30 MHz to 1000 MHz band.



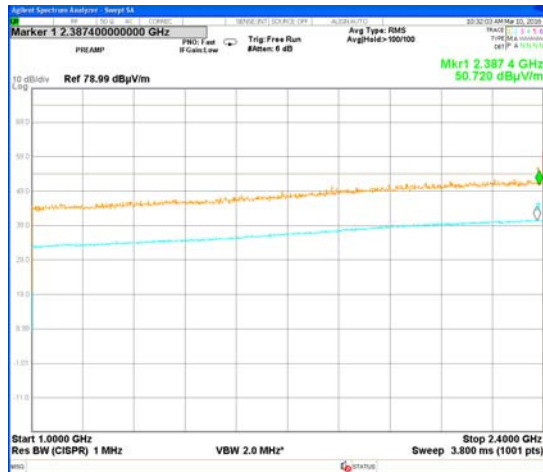
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Plot # 5.



Plot # 6.



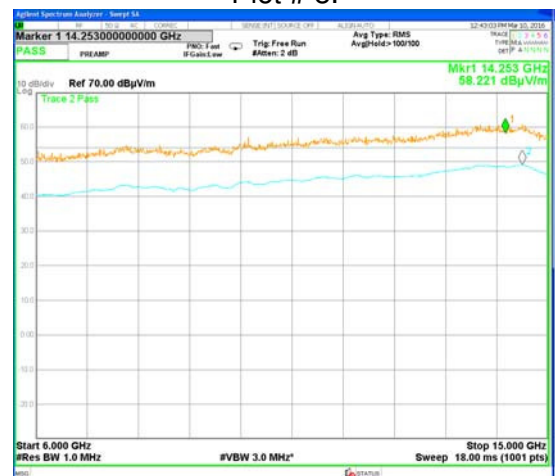
Plot # 7.



Plot # 8.



Plot # 9.



Plot # 10



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Plot # 11.

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| Frequency,<br>MHz | Conducted limit, dB $\mu$ V |          |
|-------------------|-----------------------------|----------|
|                   | QP                          | AVRG     |
| 0.15 - 0.5        | 66 - 56*                    | 56 - 46* |
| 0.5 - 5           | 56                          | 46       |
| 5 - 30            | 60                          | 50       |

\* Decreases linearly with the logarithm of the frequency.

EUT was placed on a wooden table in a shielded chamber at a height of 80 cm from the floor and 40 cm from the vertical reference plane. The measurements were performed at mains terminals by means of LISN, connected to spectrum analyzer in the frequency range as referred to in the table above. The measurements were made with quasi-peak (CISPR) and average detectors. The position of the EUT cables was varied to determine maximum emission level.

**3.5.2. Test results:**

Any results, (except of the presented in plots below) are found at least 20 dB below the specified limits.

Test result for line Phase present in plot # 12. For line Neutral in plot # 13.



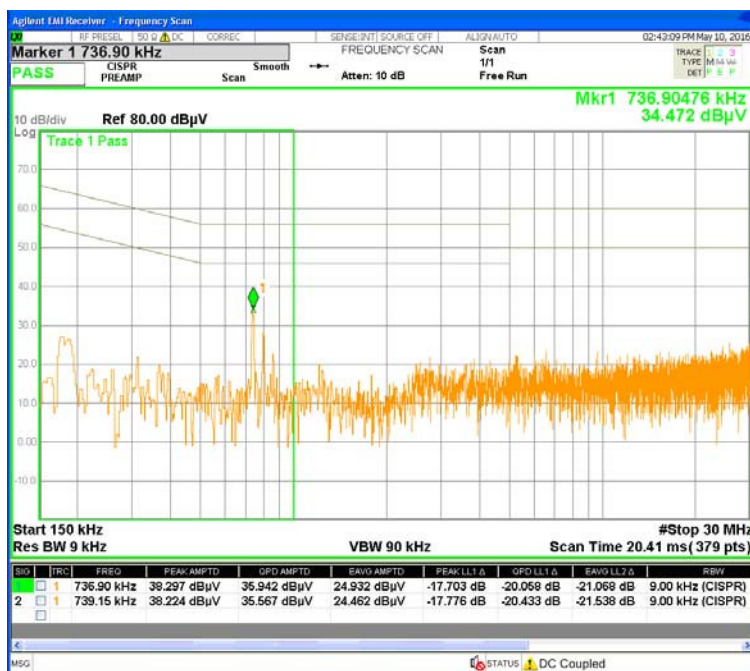
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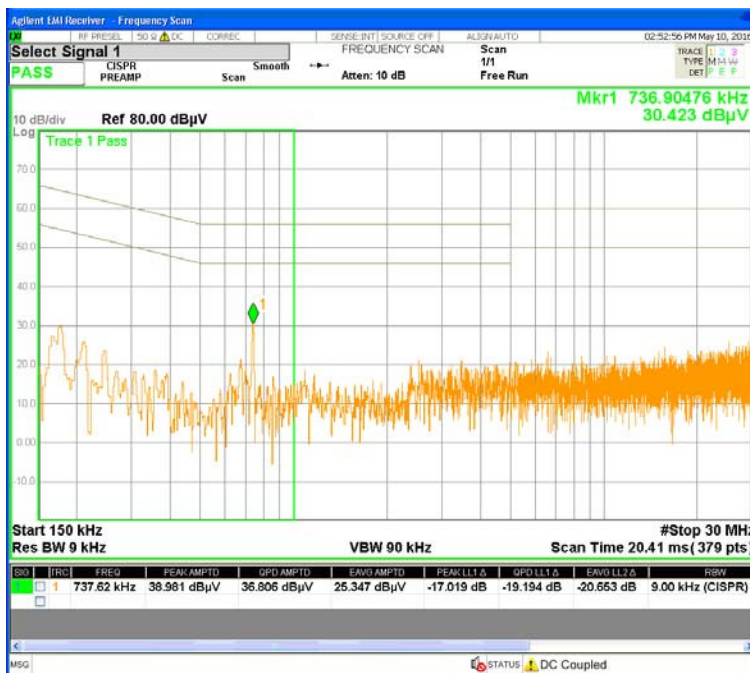
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Plot # 12. 120VAC, line PH.



Plot # 13. 120VAC, line N.

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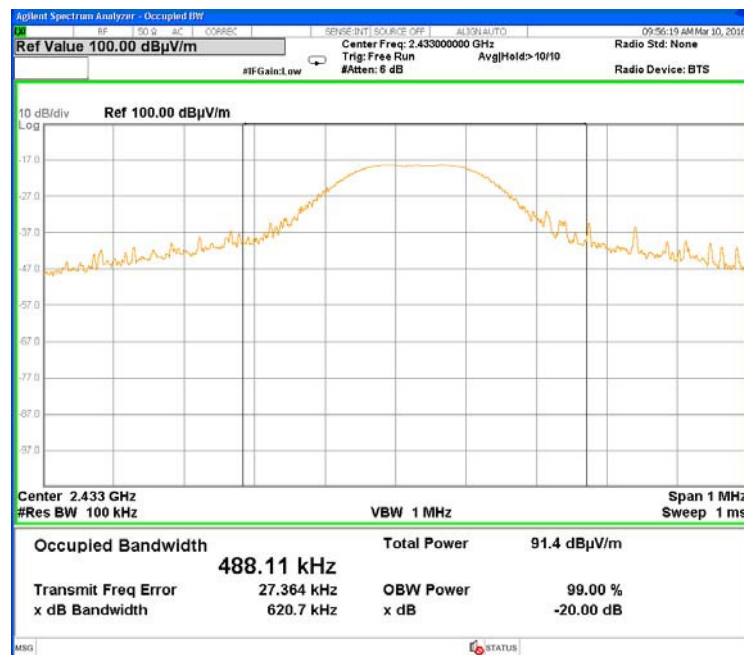
### 3.6. Test of occupied bandwidth per 15.215(c)

#### 3.6.1. Requirements:

Intentional radiator must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band.

#### 3.6.2. Test results:

Test result presented in plot below.



**Plot # 14. Occupied bandwidth test result**

#### 3.6.3. Test summary:

20 dB occupied bandwidth is 620.7 kHz.  
The tested unit meets the standard requirement.

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#### 4. Appendix 1. Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

##### Test equipment used

| No | Description                                        | Manufacturer information           |                  |            | Due Calibration date |
|----|----------------------------------------------------|------------------------------------|------------------|------------|----------------------|
|    |                                                    | Name                               | Model            | Serial No  |                      |
| 1  | MXE EMI Receiver<br>20 Hz -26.5 GHz                | Agilent                            | N9038A           | SII 650114 | March 2017           |
| 2  | Cable RF 1m                                        | Huber-Suhner                       | Sucoflex 104     | 21325/4PE  | October 2016         |
| 3  | Double Ridged Guide Antenna<br>0.75 – 18 GHz       | ETS-Lindgren                       | 3115             | 00143138   | December 2016        |
| 4  | Broadband Horn antenna<br>15 – 40 GHz              | Schwarzbeck<br>Mess-<br>Elektronik | BBHA 9170        | 9170-341   | December 2016        |
| 5  | Double Ridged Waveguide<br>Horn Antenna 1 – 18 GHz | ETS-Lindgren                       | 3117             | 00139055   | December 2016        |
| 6  | Antenna Biconilog<br>26 – 6000 MHz                 | ETS-Lindgren                       | 31142D           | 0146490    | December 2016        |
| 7  | Spectrum analyzer<br>20 Hz-40 GHz                  | Rohde&Schwarz                      | ESU 40           | 100168     | November 2016        |
| 8  | MXG Signal Generator<br>100 KHz - 20 GHz           | Agilent                            | N5183A           | 6501148    | May 2016             |
| 9  | Attenuator 3 dB<br>DC – 12.4 GHz                   | HP                                 | 8491A            | 50469      | October 2016         |
| 10 | USB preamplifier<br>2 GHz – 50 GHz                 | Keysight                           | U7227F           | MY55380004 | January 2016         |
| 11 | EMI Receiver 9 kHz-6.5 GHz                         | HP                                 | 8546A+85460A     | SII 4068   | May 2016             |
| 12 | LISN 9 kHz – 30 MHz                                | FCC                                | LISN 250-32-4-16 | SII5023    | October 2016         |
| 13 | Transient limiter<br>0.009-200 MHz                 | HP                                 | 11947A           | 3107105    | August 2016          |
| 14 | Cable RF 4m                                        | Huber-Suhner                       | Sucoflex 104PE   | 21329/4PE  | October 2016         |
| 15 | Cable RF 0.5m                                      | Huber-Suhner                       | Multiflex 141    | 520201     | October 2016         |
| 16 | Active Loop antenna<br>1.0 kHz – 30 MHz            | ETS-Lindgren                       | 6507             | 00144641   | December 2016        |

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## 5. Appendix 2: Antenna Factor and Cable Loss

Cable Loss. Mast 6 m set cable.

| Point | Frequency, MHz | Cable Loss, dB | Point | Frequency, MHz | Cable Loss, dB |
|-------|----------------|----------------|-------|----------------|----------------|
| 1     | 30             | 0.3            | 21    | 1000           | 2.5            |
| 2     | 50             | 0.4            | 22    | 1100           | 2.6            |
| 3     | 100            | 0.6            | 23    | 1200           | 2.8            |
| 4     | 150            | 0.8            | 24    | 1300           | 2.9            |
| 5     | 200            | 1.0            | 25    | 1400           | 3.1            |
| 6     | 250            | 1.1            | 26    | 1500           | 3.2            |
| 7     | 300            | 1.2            | 27    | 1600           | 3.3            |
| 8     | 350            | 1.3            | 28    | 1700           | 3.5            |
| 9     | 400            | 1.5            | 29    | 1800           | 3.6            |
| 10    | 450            | 1.6            | 30    | 1900           | 3.7            |
| 11    | 500            | 1.7            | 31    | 2000           | 3.9            |
| 12    | 550            | 1.8            | 32    | 2100           | 4.0            |
| 13    | 600            | 1.9            | 33    | 2200           | 4.1            |
| 14    | 650            | 1.9            | 34    | 2300           | 4.2            |
| 15    | 700            | 2.0            | 35    | 2400           | 4.4            |
| 16    | 750            | 2.1            | 36    | 2500           | 4.6            |
| 17    | 800            | 2.1            | 37    | 2600           | 4.7            |
| 18    | 850            | 2.2            | 38    | 2700           | 4.8            |
| 19    | 900            | 2.3            | 39    | 2800           | 4.9            |
| 20    | 950            | 2.4            | 40    | 2900           | 5.0            |

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Antenna factor

Biconilog Antenna, ETS-Lindgren mod. 31142D, S/N: 0146490 3m calibration.

| No. | f / MHz | AF / dB/m | f / MHz | AF / dB/m | f / MHz | AF / dB/m |
|-----|---------|-----------|---------|-----------|---------|-----------|
| 1   | 30      | 18.7      | 250     | 12.0      | 2750    | 31.0      |
| 2   | 35      | 15.7      | 300     | 13.8      | 3000    | 31.2      |
| 3   | 40      | 12.9      | 400     | 16.2      | 3250    | 32.7      |
| 4   | 45      | 10.6      | 500     | 18.6      | 3500    | 34.5      |
| 5   | 50      | 9.0       | 600     | 20.2      | 3750    | 34.3      |
| 6   | 60      | 7.3       | 700     | 21.8      | 4000    | 34.5      |
| 7   | 70      | 7.7       | 800     | 22.9      | 4250    | 35.3      |
| 8   | 80      | 8.2       | 900     | 24.1      | 4500    | 35.5      |
| 9   | 90      | 9.2       | 1000    | 24.8      | 4750    | 36.1      |
| 10  | 100     | 9.4       | 1250    | 26.9      | 5000    | 37.4      |
| 11  | 120     | 8.5       | 1500    | 30.2      | 5250    | 38.4      |
| 12  | 140     | 8.5       | 1750    | 28.5      | 5000    | 39.9      |
| 13  | 160     | 9.1       | 2000    | 28.9      | 5750    | 38.2      |
| 14  | 180     | 10.5      | 2250    | 29.8      | 6000    | 39.1      |
| 15  | 200     | 10.9      | 2500    | 32.5      | -       | -         |



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**Antenna Factor**  
**Double Ridged Guide Antenna mfr ETS-Lindgren model 3115 1m calibration**

| Point | Frequency (MHz) | Antenna Factor (dB/m) |
|-------|-----------------|-----------------------|
| 1     | 1000            | 23.7                  |
| 2     | 2000            | 28.5                  |
| 3     | 3000            | 29.6                  |
| 4     | 4000            | 32.5                  |
| 5     | 4500            | 32.6                  |
| 6     | 5000            | 33.5                  |
| 7     | 6000            | 36.1                  |
| 8     | 6500            | 36.5                  |
| 9     | 7000            | 37.3                  |
| 10    | 7500            | 38.0                  |
| 11    | 8000            | 37.3                  |
| 12    | 8500            | 37.9                  |
| 13    | 9000            | 38.1                  |
| 14    | 9500            | 38.5                  |
| 15    | 10000           | 38.7                  |
| 16    | 10500           | 38.8                  |
| 17    | 11000           | 38.6                  |
| 18    | 11500           | 38.8                  |
| 19    | 12000           | 38.9                  |
| 20    | 12500           | 39.3                  |
| 21    | 13000           | 40.2                  |
| 22    | 13500           | 40.8                  |
| 23    | 14000           | 40.6                  |
| 24    | 14500           | 40.4                  |
| 25    | 15000           | 39.6                  |
| 26    | 15500           | 39.5                  |
| 27    | 16000           | 39.8                  |
| 28    | 16500           | 40.4                  |
| 29    | 17000           | 41.3                  |
| 30    | 17500           | 42.8                  |
| 31    | 18000           | 43.2                  |

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| Point | Frequency, GHz | Cable Loss, dB |
|-------|----------------|----------------|
| 1     | 0.0-1.0        | 1.7            |
| 2     | 1.0- 3.5       | 3.2            |
| 3     | 3.5- 5.5       | 4.0            |
| 4     | 5.5 - 7.5      | 4.7            |
| 5     | 7.5 - 9.5      | 5.3            |
| 6     | 9.5 - 10.5     | 5.6            |
| 7     | 10.5 - 12.5    | 6.2            |
| 8     | 12.5 - 14.5    | 6.8            |
| 9     | 14.5 - 16.5    | 7.5            |
| 10    | 16.5 - 18.0    | 8.1            |

**Active Loop antenna mfr.ETS-Lindgren mod. 6507 S/N 144641.**

| Frequency, MHz | Magnetic Antenna factor dBS/m | Electric Antenna factor dB/m |
|----------------|-------------------------------|------------------------------|
| 0.009          | -20.0                         | 31.5                         |
| 0.010          | -21.0                         | 30.5                         |
| 0.020          | -26.7                         | 24.9                         |
| 0.075          | -32.4                         | 19.1                         |
| 0.100          | -32.7                         | 18.8                         |
| 0.150          | -32.9                         | 18.6                         |
| 0.250          | -33.0                         | 18.5                         |
| 0.500          | -33.0                         | 18.5                         |
| 0.750          | -33.0                         | 18.5                         |
| 1.000          | -32.8                         | 18.7                         |
| 2.000          | -32.7                         | 18.8                         |
| 3.000          | -32.9                         | 18.7                         |
| 4.000          | -33.2                         | 18.3                         |
| 5.000          | -33.4                         | 18.2                         |
| 10.000         | -34.0                         | 17.6                         |
| 15.000         | -34.2                         | 17.3                         |
| 20.000         | -34.4                         | 17.1                         |
| 25.000         | -34.8                         | 16.7                         |
| 30.000         | -35.0                         | 16.5                         |

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## 6. Appendix 3: Test setups photo.



Photo 2.



Photo 3.



Photo 4.



Photo 5.