# Radio
# Measurement and Test Report

**For**

**Shenzhen Wonlex Technology Co., Ltd.**

Room 807, Shi Feng Building, 6267 Bao'an Road, Bao'an District, Shenzhen, China.

| | |
|---|---|
| **Test Standards:** | EN 300 328 V1.8.1 (2012-06) |
| **Product Description:** | Kids GPS Watches |
| **Tested Model:** | H1 |
| **Report No.:** | GST1512241260W |
| **Tested Date:** | 2015-12-25 to 2015-12-29 |
| **Issued Date:** | 2015-12-29 |
| **Tested By:** | Jerry Hu / Engineer |
| **Reviewed By:** | Tim Sun |
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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen GST Co., Ltd.

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# 1. GENERAL INFORMATION

## 1.1 Product Description for Equipment Under Test (EUT)

**Client Information**

| | |
|---|---|
| Applicant: | Shenzhen Wonlex Technology Co., Ltd. |
| Address of applicant: | Room 807, Shi Feng Building, 6267 Bao'an Road, Bao'an District, Shenzhen, China. |
| Manufacturer: | Shenzhen Wonlex Technology Co., Ltd. |
| Address of manufacturer: | 2nd Floor, Building D, Funing Hi-tech Industry Park, Xintian Road, Bao'an District, Shenzhen City, China. |

| **General Description of EUT** | |
|---|---|
| Product Name: | Kids GPS Watches |
| Model No.: | H1 |
| Rated Voltage: | DC 3.7V |
| | |
| | |
| | |
| | |
| *Note: The test data is gathered from a production sample, provided by the manufacturer.* | |

| **Technical Characteristics of EUT** | |
|---|---|
| Bluetooth Version: | V3.0 |
| Frequency Range: | 2402-2480MHz |
| RF Output Power: | 3.499dBm (EIRP) |
| Type of Modulation: | GFSK, Pi/4 DQPSK, 8DPSK |
| Data Rate: | 1Mbps, 2Mbps, 3Mbps |
| Quantity of Channels | 79 |
| Channel Separation: | 1MHz |
| Type of Antenna: | PCB |
| Antenna Gain: | 2.0dBi |
| | |

## 1.2 Test Standards

The following report is prepared on behalf of the GOYA IMPORTACIONES&DISTRIBUCIONES S.L. in accordance
with ETSI EN 300328, Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive.

The objective of the manufacturer is to demonstrate compliance with ETSI EN 300328.

***Maintenance of compliance*** is the responsibility of the manufacturer. Any modification of the product maybe which result in lowering the emission/immunity should be checked to ensure compliance has been maintained

## 1.3 Test Methodology

All measurements contained in this report were conducted with ETSI EN 300328, Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive.

## 1.4 EUT Setup and Test Mode

The equipment under test (EUT) was configured to measure its highest possible emission/immunity level. The test modes were adapted according to the operation manual for use, the EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements, more detailed description as follows:

| **Test Mode List** | | |
|---|---|---|
| Test Mode | Description | Remark |
| TM1 | Low Channel | 2402MHz |
| TM2 | Middle Channel | 2441MHz |
| TM3 | High Channel | 2480MHz |
| TM4 | Hopping | 2402-2480MHz |

| **Modulation Configure** | | | |
|---|---|---|---|
| Modulation | Packet | Packet Type | Packet Size |
| GFSK | DH1 | 4 | 27 |
| | DH3 | 11 | 183 |
| | DH5 | 15 | 339 |
| Pi/4 DQPSK | 2DH1 | 20 | 54 |
| | 2DH3 | 26 | 367 |
| | 2DH5 | 30 | 379 |
| 8DPSK | 3DH1 | 24 | 83 |
| | 3DH3 | 27 | 552 |
| | 3DH5 | 31 | 1021 |
| Note: The bluetooth has been tested on the modulation of GFSK, (Pi/4)DQPSK and 8DPSK, compliance test and record the worst case. | | | |

| **Test Conditions** | | | | | |
|---|---|---|---|---|---|
| | Normal | LTLV | LTHV | HTHV | HTLV |
| Temperature (℃) | 20 | -20 | -20 | 55 | 55 |
| Voltage (V) | 3.7 | 3.3 | 4.2 | 4.2 | 3.3 |

| **EUT Cable List and Details** | | | |
|---|---|---|---|
| Cable Description | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| USB Cable | 0.6 | Unshielded | Without Ferrite |
| Audio cable | 0.6 | Unshielded | Without Ferrite |

| **Special Cable List and Details** | | | |
|---|---|---|---|
| Cable Description | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| / | / | / | / |

| Auxiliary Equipment List and Details | | | |
|---|---|---|---|
| Description | Manufacturer | Model | Serial Number |
| Computer | Lenovo | 20007 | EB12648265 |

## 1.5 Measurement Uncertainty

| Measurement uncertainty | | |
|---|---|---|
| Parameter | Conditions | Uncertainty |
| RF Output Power | Conducted | ±0.42dB |
| Occupied Bandwidth | --- | ±1×10-7 |
| Transmitter Spurious Emissions | Radiated | ±5.2dB |
| Receiver Spurious Emissions | Radiated | ±5.2dB |

## 2. SUMMARY OF TEST RESULTS

| Standards | Reference | Description of Test Item | Result |
|---|---|---|---|
| EN 300328 V1.8.1 (2012-06) | 4.3.1.1 | RF Output Power | Pass |
| | 4.3.1.2 | Duty Cycle, Tx-sequence, Tx-gap | N/A |
| | 4.3.1.3 | Dwell time, Minimum Frequency Occupation and Hopping Sequence | Pass |
| | 4.3.1.4 | Hopping Frequency Separation | Pass |
| | 4.3.1.5 | Medium Utilisation (MU) Factor | N/A |
| | 4.3.1.6 | Adaptivity (Adaptive Frequency Hopping) | Pass |
| | 4.3.1.7 | Occupied Channel Bandwidth | Pass |
| | 4.3.1.8 | Transmitter Unwanted Emissions in the Out-of-band Domain | Pass |
| | 4.3.1.9 | Transmitter Unwanted Emissions in the Spurious Domain | Pass |
| | 4.3.1.10 | Receiver Spurious Emissions | Pass |
| | 4.3.1.11 | Receiver Blocking | N/A |

Pass: The EUT complies with the essential requirements in the standard
Fail: The EUT does not comply with the essential requirments in the standard
N/A: not applicable

# 3. RF Output Power

## 3.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4402B | US41192821 | 2015-05-07 | 2016-05-06 |
| Attenuator | ATTEN | ATS100-4-20 | / | 2015-05-07 | 2016-05-06 |

## 3.2 Standard Applicable

According to Section 4.3.1.1.2, The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm. The maximum RF output power for non-adaptive Frequency Hopping equipment, shall be declared by the supplier. The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20 dBm.

## 3.3 Test Procedure

According to section 5.3.2.2.1.1 of the standard EN 300328, the test procedure shall be as follows:

1. Using a suitable means, the output of the transmitter shall be connected to the spectrum analyzer, the spectrum analyzer shall be capable of faithfully reproducing the envelope peaks.

2. The average output power of the transmitter shall be determined using the spectrum analyzer. The observed value shall be recorded as "A" (in dBm).

3. The e.i.r.p. shall be calculated from the above measured power output A, the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:
P = A + G;

4. The measurement shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range.These frequencies shall be recorded. FHSS equipment shall be made to hop continuously to each of these three frequencies separately. These measurements shall be performed at normal and extreme test conditions.

## 3.4 Summary of Test Results

| Test Conditions | Measured Value | Antenna Gain | EIRP | Limit |
|---|---|---|---|---|
| | dBm | dBi | dBm | dBm |
| GFSK Lowest Channel (2402MHz) | | | | |
| Normal | 1.499 | 2 | 3.499 | 20 |
| LTLV | 1.491 | 2 | 3.491 | 20 |
| LTHV | 1.493 | 2 | 3.493 | 20 |
| HTHV | 1.495 | 2 | 3.495 | 20 |
| HTLV | 1.497 | 2 | 3.497 | 20 |
| GFSK Middle Channel (2441MHz) | | | | |
| Normal | 0.712 | 2 | 2.712 | 20 |
| LTLV | 0.705 | 2 | 2.705 | 20 |
| LTHV | 0.707 | 2 | 2.707 | 20 |
| HTHV | 0.708 | 2 | 2.708 | 20 |
| HTLV | 0.711 | 2 | 2.711 | 20 |
| GFSK Highest Channel (2480MHz) | | | | |
| Normal | 0.855 | 2 | 2.855 | 20 |
| LTLV | 0.849 | 2 | 2.849 | 20 |
| LTHV | 0.851 | 2 | 2.851 | 20 |
| HTHV | 0.852 | 2 | 2.852 | 20 |
| HTLV | 0.854 | 2 | 2.854 | 20 |
| 8DPSK Lowest Channel (2402MHz) | | | | |
| Normal | 0.557 | 2 | 2.557 | 20 |
| LTLV | 0.551 | 2 | 2.551 | 20 |
| LTHV | 0.552 | 2 | 2.552 | 20 |
| HTHV | 0.554 | 2 | 2.554 | 20 |
| HTLV | 0.556 | 2 | 2.556 | 20 |
| 8DPSK Middle Channel (2441MHz) | | | | |
| Normal | -0.388 | 2 | 1.612 | 20 |
| LTLV | -0.395 | 2 | 1.605 | 20 |
| LTHV | -0.393 | 2 | 1.607 | 20 |
| HTHV | -0.391 | 2 | 1.609 | 20 |
| HTLV | -0.389 | 2 | 1.611 | 20 |
| 8DPSK Highest Channel (2480MHz) | | | | |
| Normal | -0.062 | 2 | 1.938 | 20 |
| LTLV | -0.070 | 2 | 1.930 | 20 |
| LTHV | -0.068 | 2 | 1.932 | 20 |
| HTHV | -0.065 | 2 | 1.935 | 20 |
| HTLV | -0.064 | 2 | 1.936 | 20 |

# 4. Dwell Time, Minimum Frequency Occupation and Hopping Sequence

## 4.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4402B | US41192821 | 2015-05-07 | 2016-05-06 |
| Attenuator | ATTEN | ATS100-4-20 | / | 2015-05-07 | 2016-05-06 |

## 4.2 Standard Application

According to section 4.3.1.3.2, Adaptive Frequency Hopping systems shall be capable of operating over a minimum of 70 % of the 2400 to 2483.5MHz band. The maximum accumulated dwell time on any hopping frequency shall be 400 ms within any period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used. The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. The Minimum Frequency Occupation Time shall be equal to one dwell time within a period not exceeding four times the product of the dwell time per hop and the number of hopping frequencies in use.

## 4.3 Test procedure

According to section 5.3.4.2.1, the test procedure shall be as follows:
Step 1:
• The output of the transmitter shall be connected to a spectrum analyzer or equivalent.
• The analyzer shall be set as follows:
- Centre Frequency: Equal to the hopping frequency being investigated
- Frequency Span: 0 Hz
- RBW: ~ 50 % of the Occupied Channel Bandwidth
- VBW: ≥ RBW
- Detector Mode: RMS
- Sweep time: Equal to the Dwell Time × Minimum number of hopping frequencies (N)
- Number of sweep points: 30 000
- Trace mode: Clear / Write
- Trigger: Free Run

Step 2:
• Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:
• Indentify the data points related to the frequency being investigated by applying a threshold.

The data points resulting from transmissions on the hopping frequency being investigated are assumed to have much higher levels compared to data points resulting from transmissions on adjacent hopping frequencies. If a clear determination between these transmissions is not possible, the RBW in step 1 shall be further reduced. In

addition, a channel filter may be used.

• Count the number of data points identified as resulting from transmissions on the frequency being investigated and multiply this number by the time difference between two consecutive data points.

Step 4:

• The result in step 3 is the accumulated Dwell Time which shall comply with the limit provided in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2 and which shall be recorded in the test report.

Step 5:

• Make the following changes on the analyzer and repeat steps 2 and 3.

Sweep time: 4 × Dwell Time × Actual number of hopping frequencies in use

The hopping frequencies occupied by the system without having transmissions during the dwell time (blacklisted frequencies) should be taken into account in the actual number of hopping frequencies in use. If this number can not be determined (number of blacklisted frequencies unknown) it shall be assumed that the equipment uses the minimum number of hopping frequencies as defined in clauses 4.3.1.4.2.1 or 4.3.1.4.2.2.

• The result shall be compared to the limit for the Minimum Frequency Occupation Time defined in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2. This value shall be recorded in the test report.

Step 6:

• Make the following changes on the analyzer:

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- RBW: ~ 50 % of the Occupied Channel Bandwidth (single hop)
- VBW: ≥ RBW
- Detector Mode: RMS
- Sweep time: Auto
- Trace Mode: Max Hold
- Trigger: Free Run

• When the trace has completed, indentify the number of hopping frequencies used by the hopping sequence. • The result shall be compared to the limit (value N) defined in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2. This value shall be recorded in the test report.

For equipment with blacklisted frequencies, it might not be possible to verify the number of hopping frequencies in use. However they shall comply with the requirement for accumulated Dwell time and Minimum Frequency Occupation Time assuming the minimum number of hopping frequencies defined in clauses 4.3.1.3.2.1 or 4.3.1.3.2.2 are in use.

Step 7:

• For adaptive systems, using the lowest and highest -20 dB points from the total spectrum envelope obtained in step 6, it shall be verified whether the system uses 70 % of the band specified in clause 1. The result shall be recorded in the test report.

## 4.4 Summary of Test Results/Plots

Test data is corrected with the worse case, which the packet length is DH5

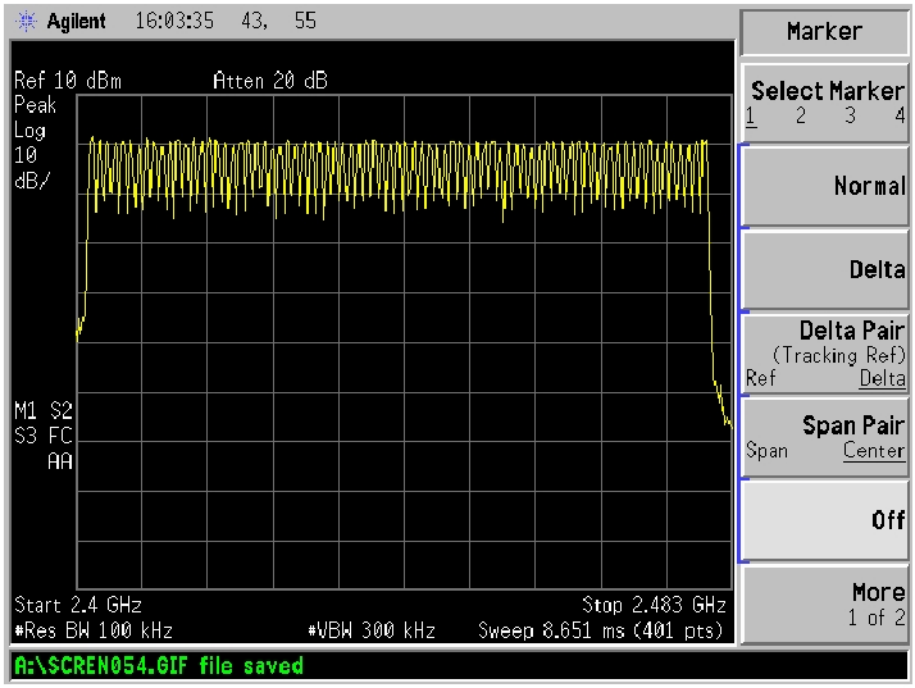
| Modulation | Test Channel | Packet | Maximum Accumulated Dwell Time | | |
|---|---|---|---|---|---|
| | | | Time Slot Length | Acc. Dwell Time | Limit |
| | | | ms | ms | ms |
| GFSK | 2402MHz | DH5 | 2.90 | 309.3 | 400 |
| | 2441MHz | DH5 | 2.90 | 309.3 | 400 |
| | 2480MHz | DH5 | 2.90 | 309.3 | 400 |
| Test Period: 400ms X Minimum number of hopping frequencis (N)<br>Accumulated Dwell Time = Time slot length (Dwell time) X Number of data points within a test period | | | | | |

| Modulation | Test Channel | Packet | Minimum Frequency Occupation Time | | |
|---|---|---|---|---|---|
| | | | Time Slot Length | Occupation Time | Limit |
| | | | ms | ms | ms |
| GFSK | 2402MHz | DH1 | 0.39 | 499.2 | 400 |
| | 2441MHz | DH1 | 0.39 | 499.2 | 400 |
| | 2480MHz | DH1 | 0.40 | 512.0 | 400 |
| Test Period: 4 X Dwell time X Minimum number of hopping frequencis (N)<br>Occupation Time = Time slot length (Dwell time) X Number of data points within a test period | | | | | |

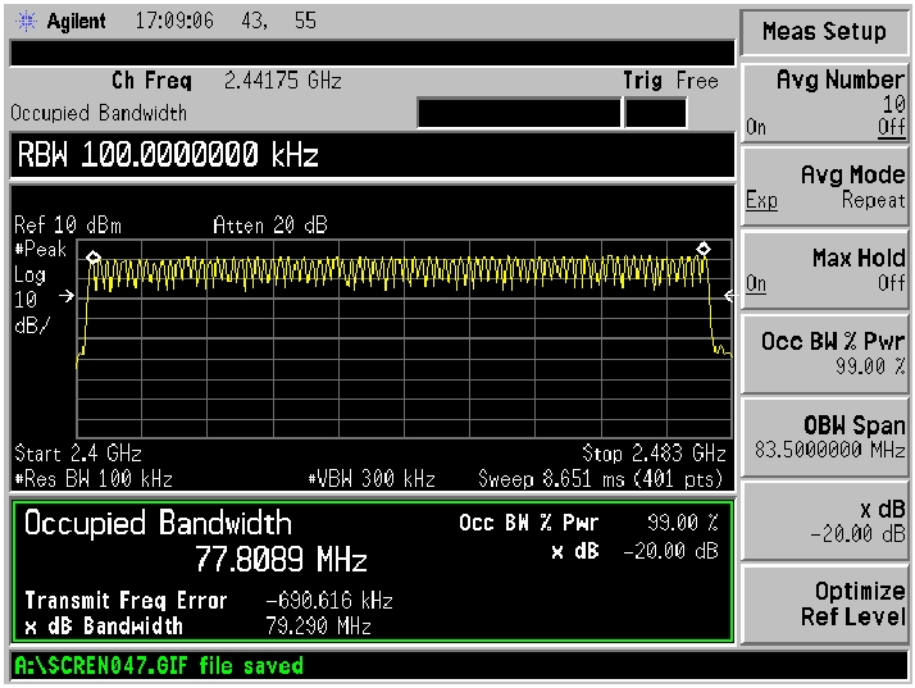
| Frequency Band | Number of Hopping Frequencies (N) | Limit | Result |
|---|---|---|---|
| 2400-2483.5MHz | 79 | 15 | Pass |
| | **-20dB Points Occupied Bandwidth** | **Limit** | **Result** |
| | 79.290 | 58.45MHz = 70% X 83.5MHz | Pass |

*Please refer to the test plots as below:*

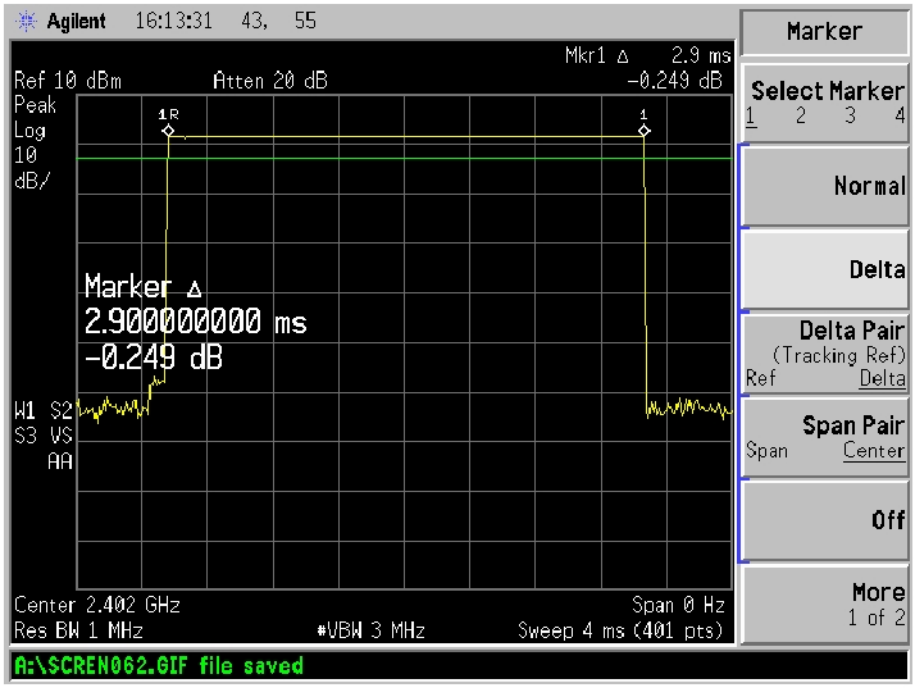
No.of Channel=79



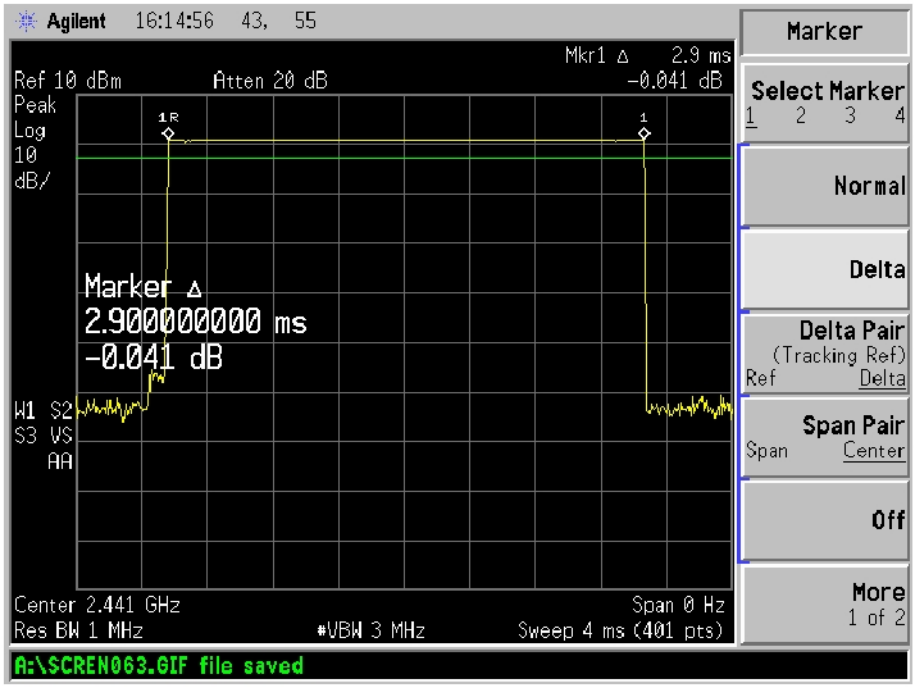

-20dB Bandwidth



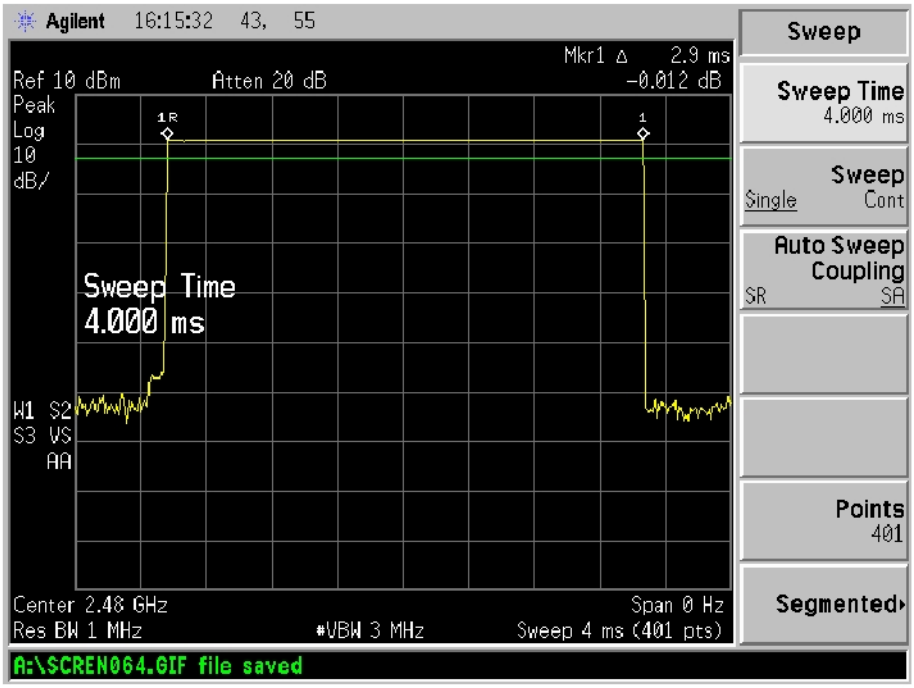
GFSK-DH5-Low



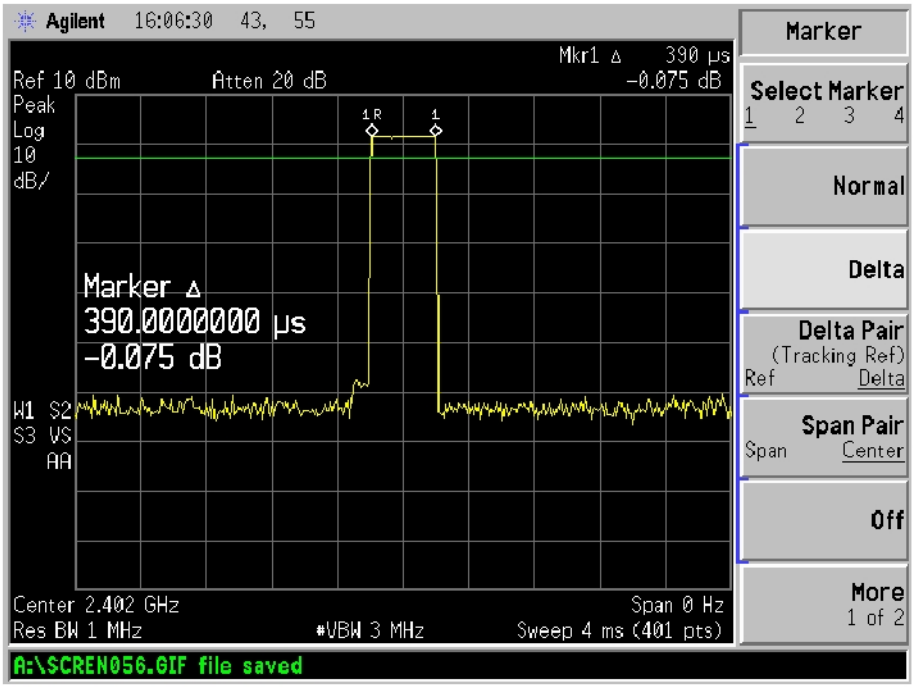

GFSK-DH5-Middle



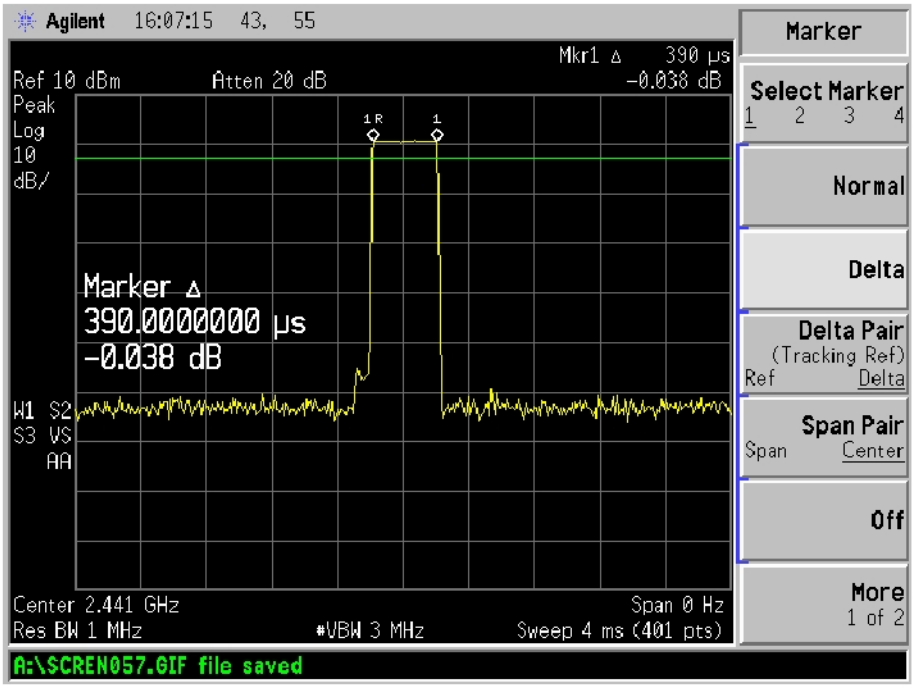
GFSK-DH5-High



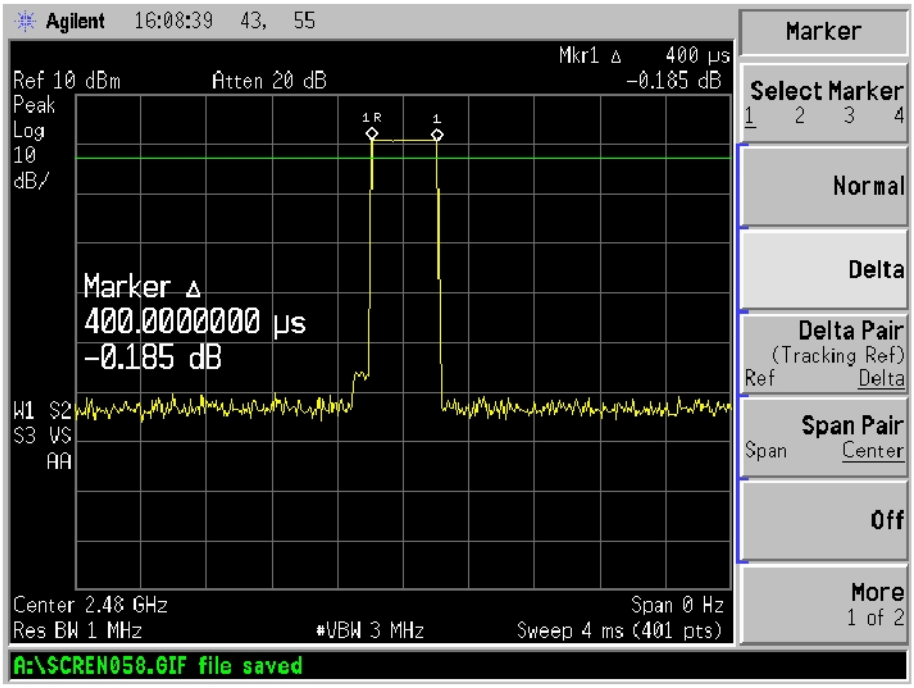

GFSK-DH1-Low



GFSK-DH1-Middle




GFSK-DH1-High



# 5. Hopping Frequency Separation

## 5.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4402B | US41192821 | 2015-05-07 | 2016-05-06 |
| Attenuator | ATTEN | ATS100-4-20 | / | 2015-05-07 | 2016-05-06 |

## 5.2 Standard Application

According to section 4.3.1.4.2, The minimum Hopping Frequency Separation shall be 100 kHz.

## 5.3 Test procedure

According to the section 5.3.5.2.1, the option 2 test method shall be used.
Step 1:
The output of the transmitter shall be connected to a spectrum analyzer or equivalent.
The analyzer shall be set as follows:
- Centre Frequency: Centre of the two adjacent hopping frequencies
- Frequency Span: Sufficient to see the complete power envelope of both hopping frequencies
- RBW: 1 % of the Span
- VBW: 3 × RBW
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep Time: Auto

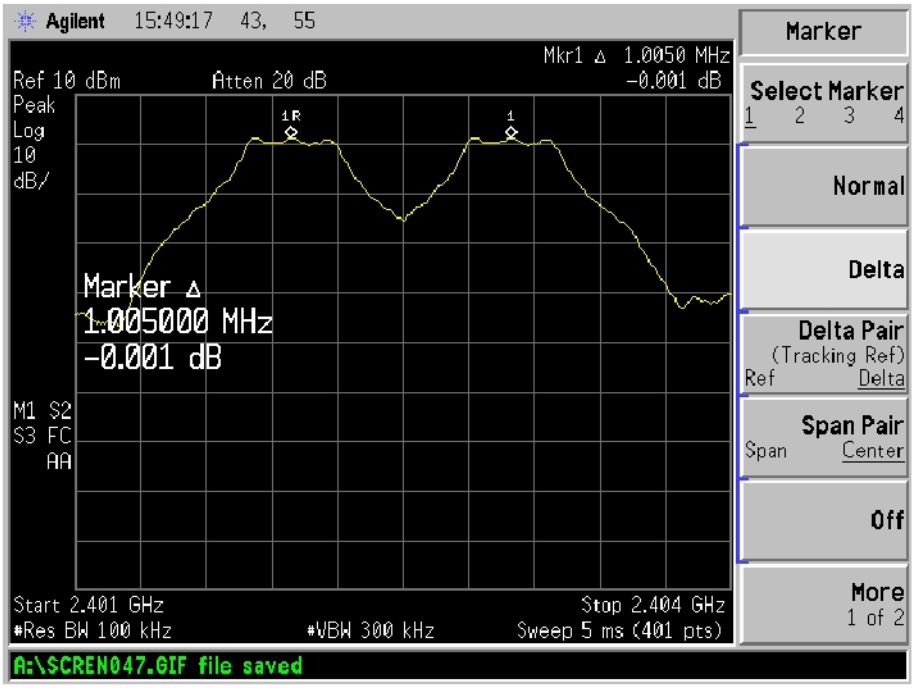
Step 2:
Allow the trace to stabilize.
Use the marker-delta function to determine the Hopping Frequency Separation between the peaks of the two adjacent hopping frequencies. This value shall be compared with the limits defined in clause 4.3.1.4.2 and shall be recorded in the test report.

## 5.4 Summary of Test Results/Plots

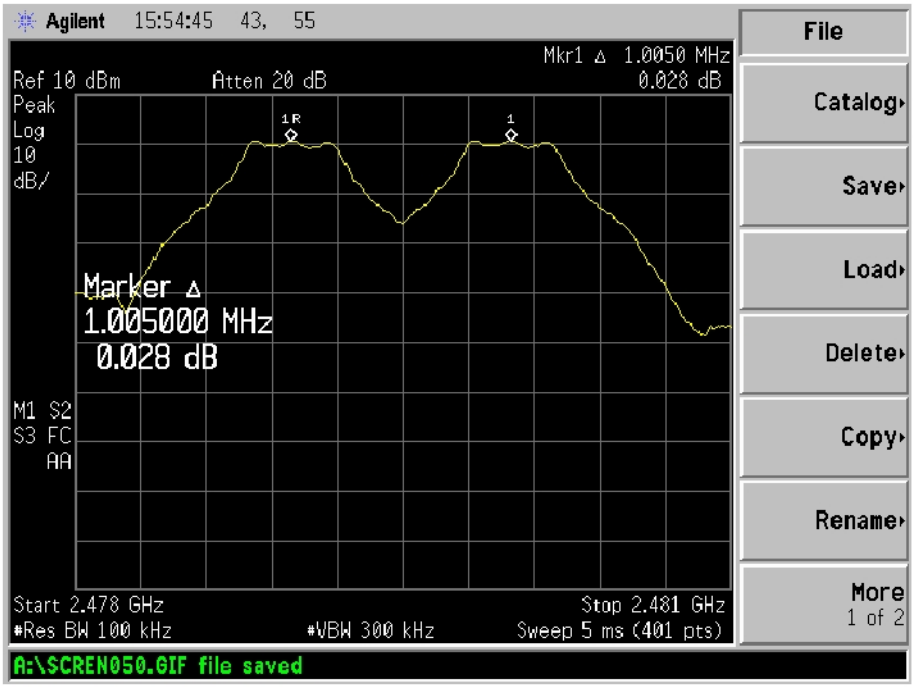
| Test Mode | Test Channel | Adjacent Channel | Channel Seaparation | Limit |
|---|---|---|---|---|
| | MHz | MHz | kHz | kHz |
| GFSK | 2402 | 2403 | 1005.0 | 100 |
| | 2480 | 2479 | 1005.0 | 100 |
| 8DPSK | 2402 | 2403 | 1005.0 | 100 |
| | 2480 | 2479 | 1005.0 | 100 |

*Please refer to the following test plots:*

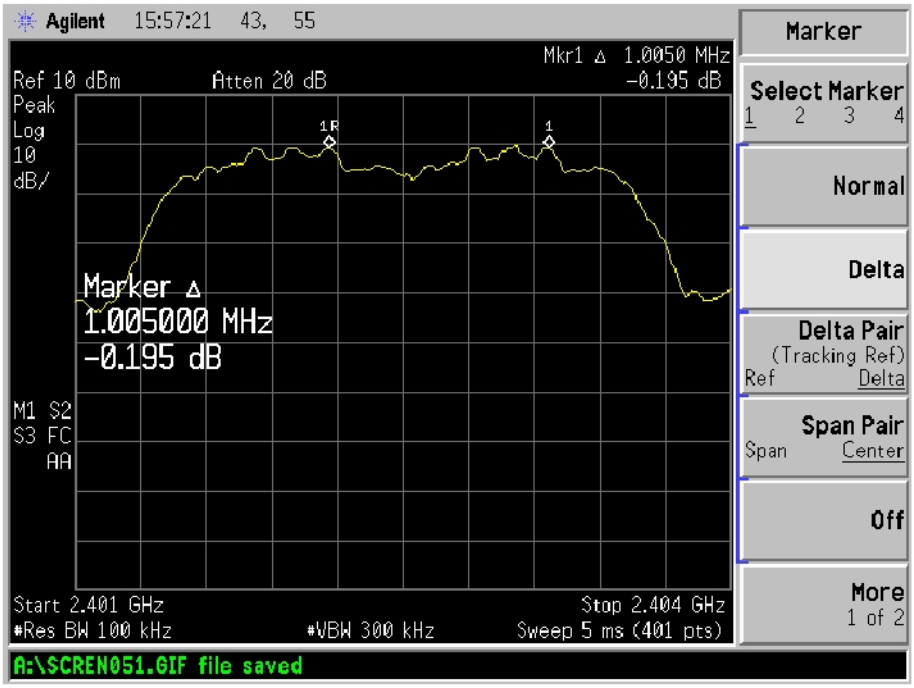
GFSK-low



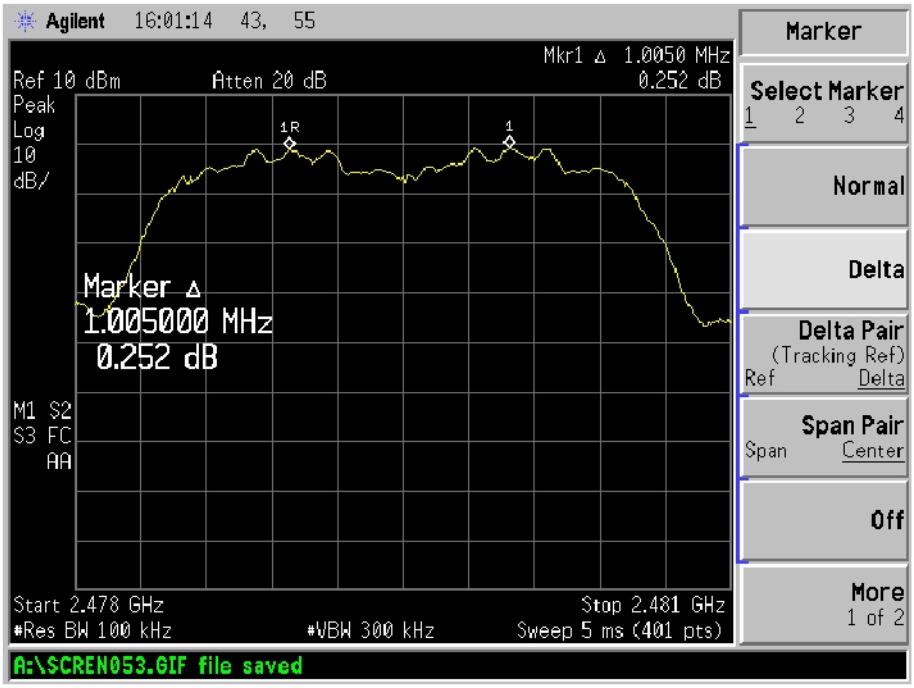

GFSK-high



8DPSK-low




8DPSK-high



# 6. Adaptivity (Adaptive Frequency Hopping)

## 6.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4402B | US41192821 | 2015-05-07 | 2016-05-06 |
| Attenuator | ATTEN | ATS100-4-20 | / | 2015-05-07 | 2016-05-06 |
| Power Divider | Weinschel | 1506A | PM204 | 2015-05-07 | 2016-05-06 |
| Signal Generator | Rohde & Schwarz | SMR20 | 100047 | 2015-05-07 | 2016-05-06 |

## 6.2 Standard Application

According to section 4.3.1.6.2, Adaptive Frequency Hopping equipment using LBT based DAA shall comply with the following minimum set of requirements:

1) At the start of every dwell time, before transmission on a hopping frequency, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The CCA observation time shall be not less than 0,2 % of the Channel Occupancy Time (see step 3) with a minimum of 20 μs. If the equipment finds the hopping frequency to be clear, it may transmit immediately (see step 3).

2) If it is determined that a signal is present with a level above the detection threshold defined in step 5. the hopping frequency shall be marked as 'unavailable'. Then the equipment may jump to the next frequency in the hopping scheme even before the end of the dwell time, but in that case the 'unavailable' channel can not be considered as being 'occupied' and shall be disregarded with respect to the requirement to maintain a minimum of 15 hopping frequencies. Alternatively, the equipment can remain on the frequency during the remainder of the dwell time. However, if the equipment remains on the frequency with the intention to transmit, it shall perform an extended CCA check in which the (unavailable) channel is observed for a random duration between the value defined for the CCA observation time in step 1 and 5 % of the Channel Occupancy Time defined in step 3. If the extended CCA check has determined the frequency to be no longer occupied, the hopping frequency becomes available again. The CCA observation time used by the equipment shall be declared by the supplier.

3) The total time during which an equipment has transmissions on a given hopping frequency without re-evaluating the availability of that frequency is defined as the Channel Occupancy Time.

The Channel Occupancy Time for a given hopping frequency, which starts immediately after a successful CCA, shall be less than 60 ms followed by an Idle Period of minimum 5 % of the Channel Occupancy Time with a minimum of 100 μs. After this, the procedure as in step 1 shall be repeated before having new transmissions on this hopping frequency during the same dwell time.

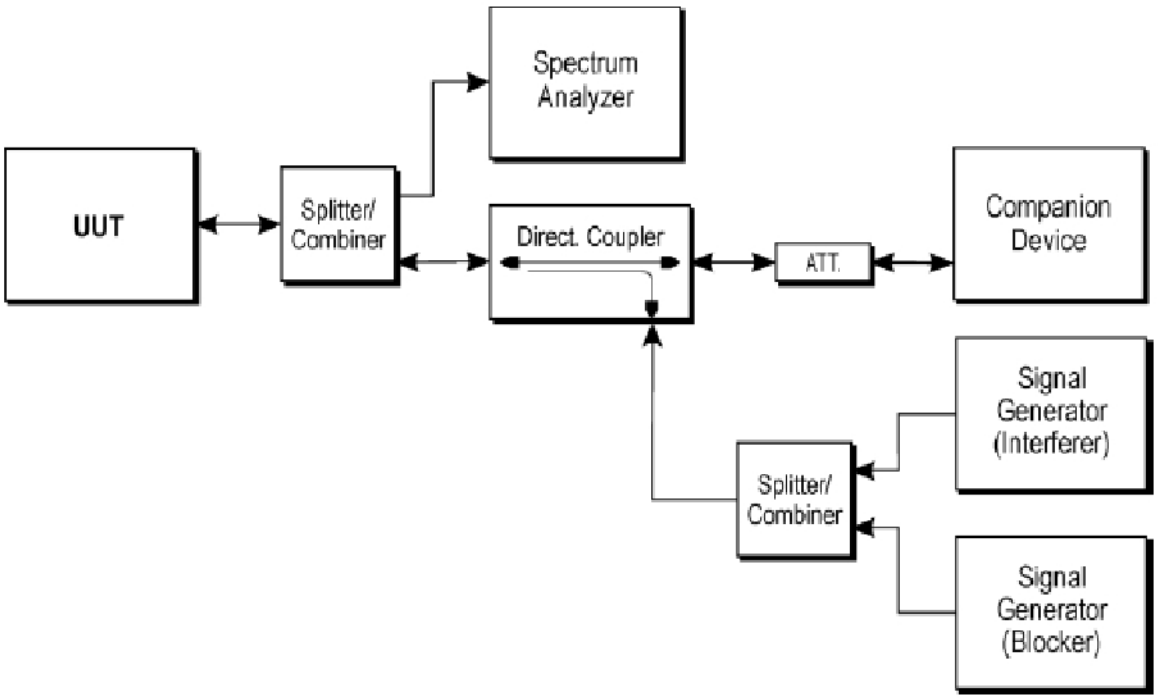
4) 'Unavailable' channels may be removed from or may remain in the hopping sequence, but in any case:
- there shall be no transmissions on 'unavailable' channels;
- a minimum of 15 hopping frequencies shall always be maintained.

5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna). For power levels below 20 dBm e.i.r.p., the detection threshold level may be relaxed to TL = -70 dBm/MHz + 20 - Pout e.i.r.p. (Pout in dBm).

If implemented, Short Control Signalling Transmissions shall have a maximum duty cycle of 10 % within an observation period of 50 ms or within an observation period equal to the dwell time, whichever is the shorter.

## 6.3 Test procedure

According to the section 5.3.7.2.1, the test block diagram shall be used.




All test procedure is carried to the section 5.3.7.2.1

## 6.4 Summary of Test Results/Plots

| Test Item | Limit | Measured Value | Result |
|---|---|---|---|
| Clear Channel Assessment (CCA) | >20us & 0.2%COT | 130us | Pass |
| Extended CCA | / | / | Pass |
| Channel Occupancy Time (COT) | <60ms | 14.56ms | Pass |
| Idle Period | >100us & 5%COT | 1.07ms | Pass |
| No Transmission on 'Unavailable' Channels | Yes | Yes | Pass |
| Quantity of Hopping Frequency | 15 | 16 | Pass |
| Detection Thershold Level (TL) | -70dBm/MHz | -80.74dBm/MHz | Pass |
| Short Control Signalling Transmissions | <10% (Duty Cycle) | / | Pass |

# 7. Occupied Channel Bandwidth

## 7.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4402B | US41192821 | 2015-05-07 | 2016-05-06 |
| Attenuator | ATTEN | ATS100-4-20 | / | 2015-05-07 | 2016-05-06 |

## 7.2 Standard Application

According to section 4.3.1.7.2. The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in clause 1. For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the value declared by the supplier. This declared value shall not be greater than 5 MHz.

## 7.3 Test procedure

According to the section 5.3.5.2.1, the measurement procedure shall be as follows:
Step 1:
Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: ~ 1 % of the span without going below 1 %
- Video BW: 3 × RBW
- Frequency Span: 2 × Occupied Channel Bandwidth
- Detector Mode: RMS
- Trace Mode: Max Hold

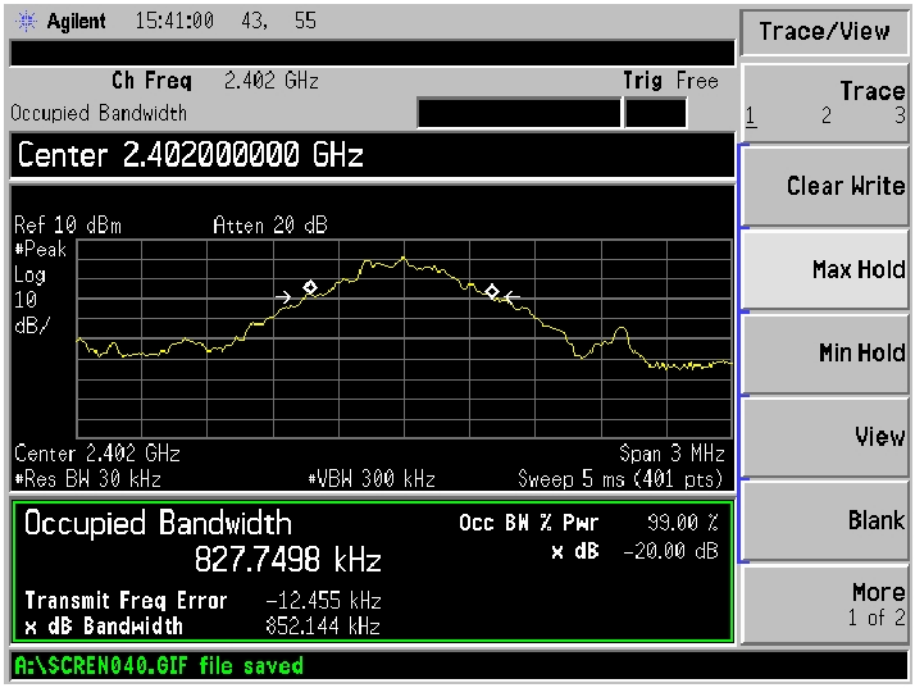
Step 2:
Wait until the trace is completed.
Find the peak value of the trace and place the analyser marker on this peak.
Step 3:
Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.

## 7.4 Summary of Test Results/Plots

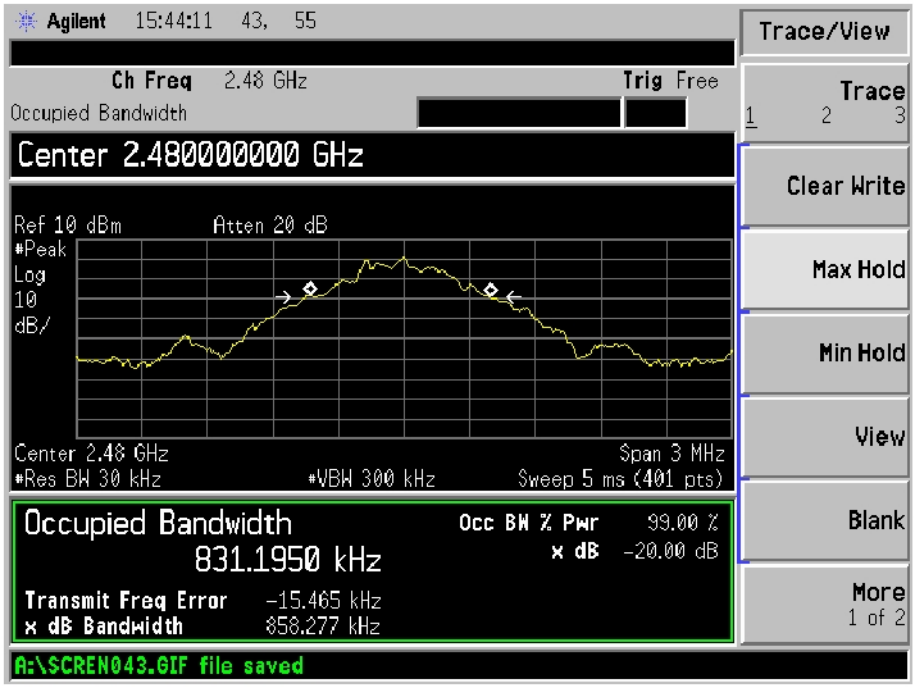
| Test Mode | Test Channel | Measured Value | Result |
|---|---|---|---|
| | MHz | kHz | |
| GFSK | 2402 | 827.7498 | Pass |
| | 2480 | 831.1950 | Pass |
| 8DPSK | 2402 | 1191.0 | Pass |
| | 2480 | 1188.2 | Pass |

*Please refer to the test plots as below:*

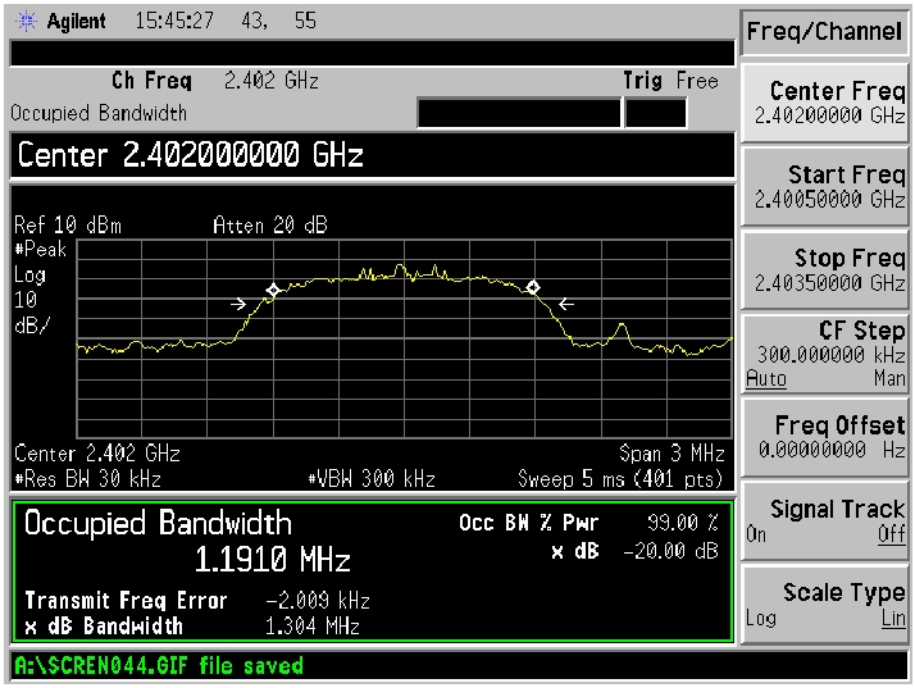
GFSK-low



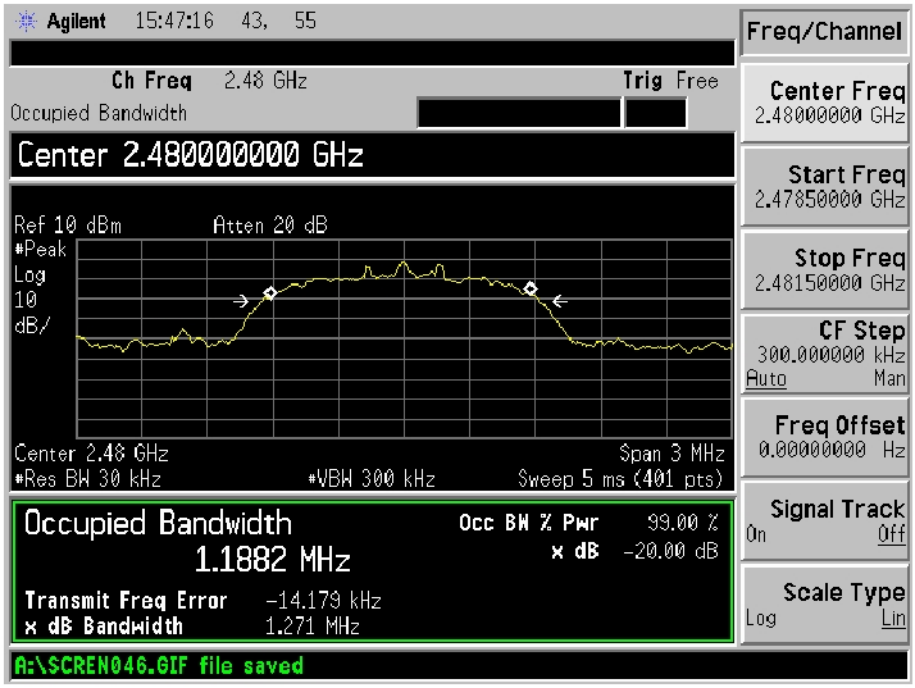

GFSK-High



8DPSK-low




8DPSK-high



# 8. Transmitter Unwanted Emissions in the Out-of-band Domain

## 8.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4402B | US41192821 | 2015-05-07 | 2016-05-06 |
| Attenuator | ATTEN | ATS100-4-20 | / | 2015-05-07 | 2016-05-06 |

## 8.2 Standard Application

According to section 4.3.1.8.2. The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 1.

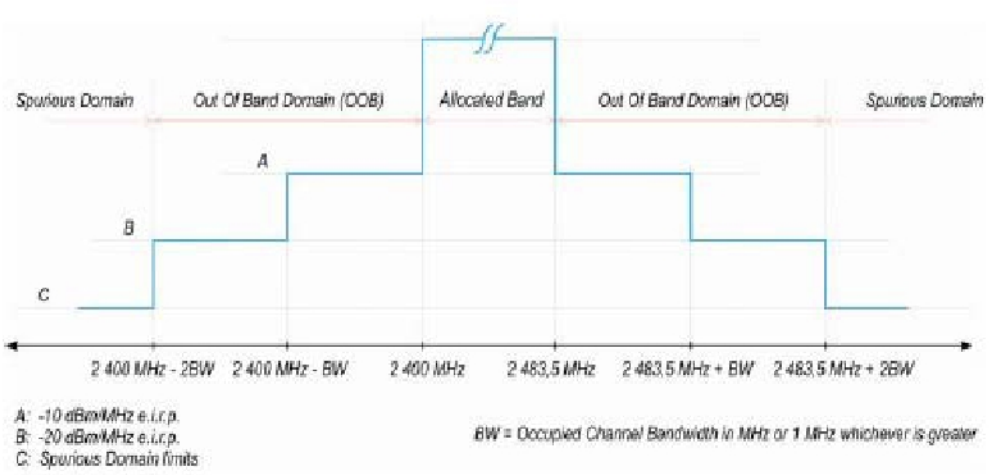



**Figure 1: Transmit mask**

## 8.3 Test procedure

According to the section 5.3.9.2.1, the measurement procedure shall be as follows:
The Out-of-band emissions within the different horizontal segments of the mask provided in figures 1 and 3 shall be measured using the steps below. This method assumes the spectrum analyser is equipped with the Time Domain Poweroption.

Step 1:

• Connect the UUT to the spectrum analyser and use the following settings:

- Centre Frequency: 2 484 MHz
- Span: 0 Hz
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Clear / Write - Sweep

Mode: Continuous

- Sweep Points: 5 000
- Trigger Mode: Video trigger
- Sweep Time: Suitable to capture one transmission burst

Step 2: (segment 2 483,5 MHz to 2 483,5 MHz + BW)

• Adjust the trigger level to select the transmissions with the highest power level.

• For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.

• Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.

• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.

• Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3: (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW)

• Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz.

Step 4: (segment 2 400 MHz - BW to 2 400 MHz)

• Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

Step 5: (segment 2 400 MHz - 2BW to 2 400 MHz - BW)

• Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

Step 6:

• In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figures 1 or 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.

These measurements have to be performed at normal environmental conditions and shall be repeated at the extremes of the operating temperature range.

## 8.4 Summary of Test Results/Plots

| Test CH. | Test Segment MHz | Max. Emissions Reading (dBm) Normal | LTLV | LTHV | HTHV | HTLV | Limit dBm |
|---|---|---|---|---|---|---|---|
| Test Mode: ☐ GFSK | | | | | | | |
| Lowest | 2400-BW to 2400 | -35.1 | -35.2 | -35.4 | -35.1 | -35.2 | -10 |
| | 2400-2BW to 2400-BW | -45.0 | -45.3 | -45.5 | -46.2 | -45.3 | -20 |
| Highest | 2483.5 to 2483.5+BW | -35.8 | -35.1 | -35.6 | -35.1 | -35.2 | -10 |
| | 2483.5+BW to 2483.5+2BW | -45.5 | -46.1 | -45.5 | -45.3 | -45.7 | -20 |
| Note: BW please refer to section 7.4. | | | | | | | |

# 9. Transmitter Unwanted Emissions in the Spurious Domain

## 9.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSP | 836079/035 | 2015-05-07 | 2016-05-06 |
| Pre-amplifier | Agilent | 8447F | 3113A06717 | 2015-05-07 | 2016-05-06 |
| Pre-amplifier | Compliance Direction | PAP-0118 | 24002 | 2015-05-07 | 2016-05-06 |
| Trilog Broadband Antenna | SCHWARZBECK | VULB9163 | 9163-333 | 2015-04-20 | 2016-04-19 |
| Horn Antenna | ETS | 3117 | 00086197 | 2015-04-20 | 2016-04-19 |

## 9.2 Standard Applicable

According to section 4.3.1.9.2. The transmitter unwanted emissions in the spurious domain shall not exceed the values given in the following table.

Transmitter limit for spurious emissions

## 9.3 Test Procedure

The device under test has an integral antenna and the radiated measurement shall apply to the device, using the method of measurement as described in the EN300328 section 5.3.10.2.

## 9.4 Environmental Conditions

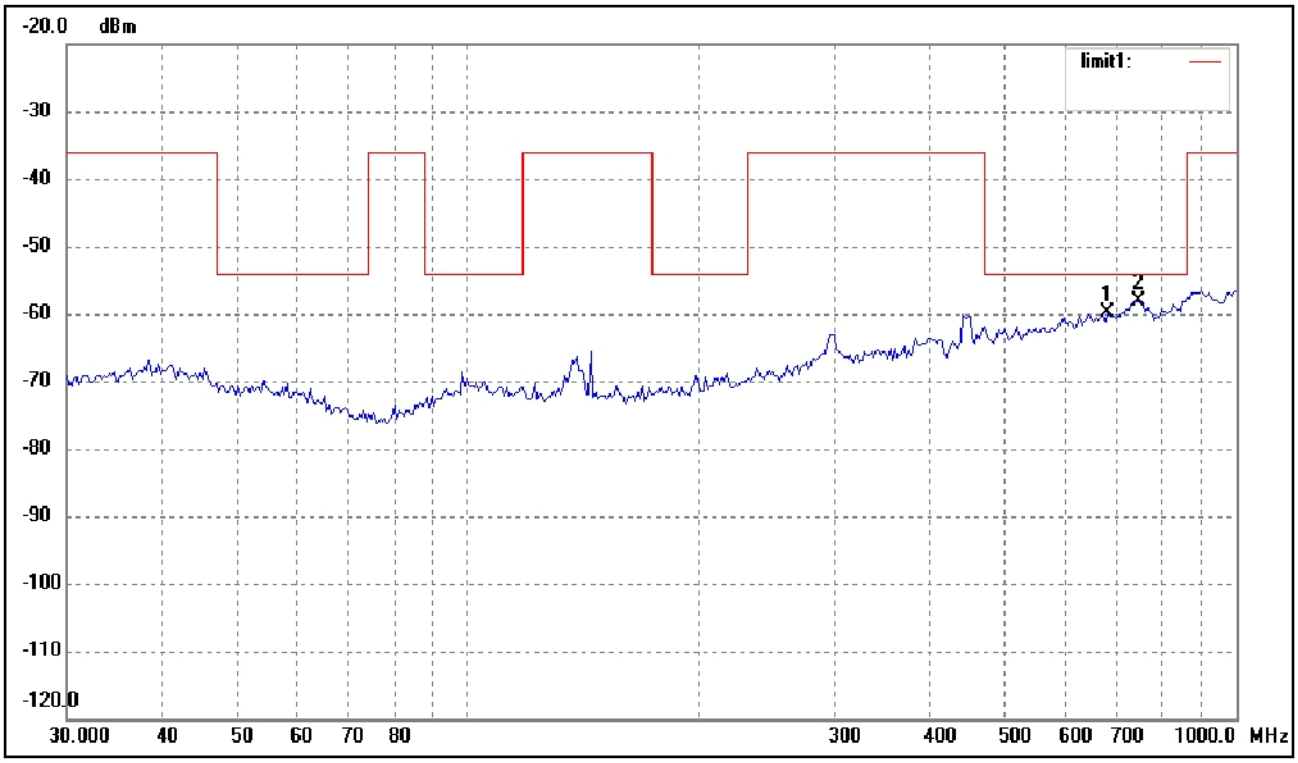
| | |
|---|---|
| Temperature: | 20° C |
| Relative Humidity: | 54% |
| ATM Pressure: | 1012 mbar |

## 9.5 Summary of Test Results/Plots

According to the data, the EUT complied with the EN 300328 standards, and had the worst cases:

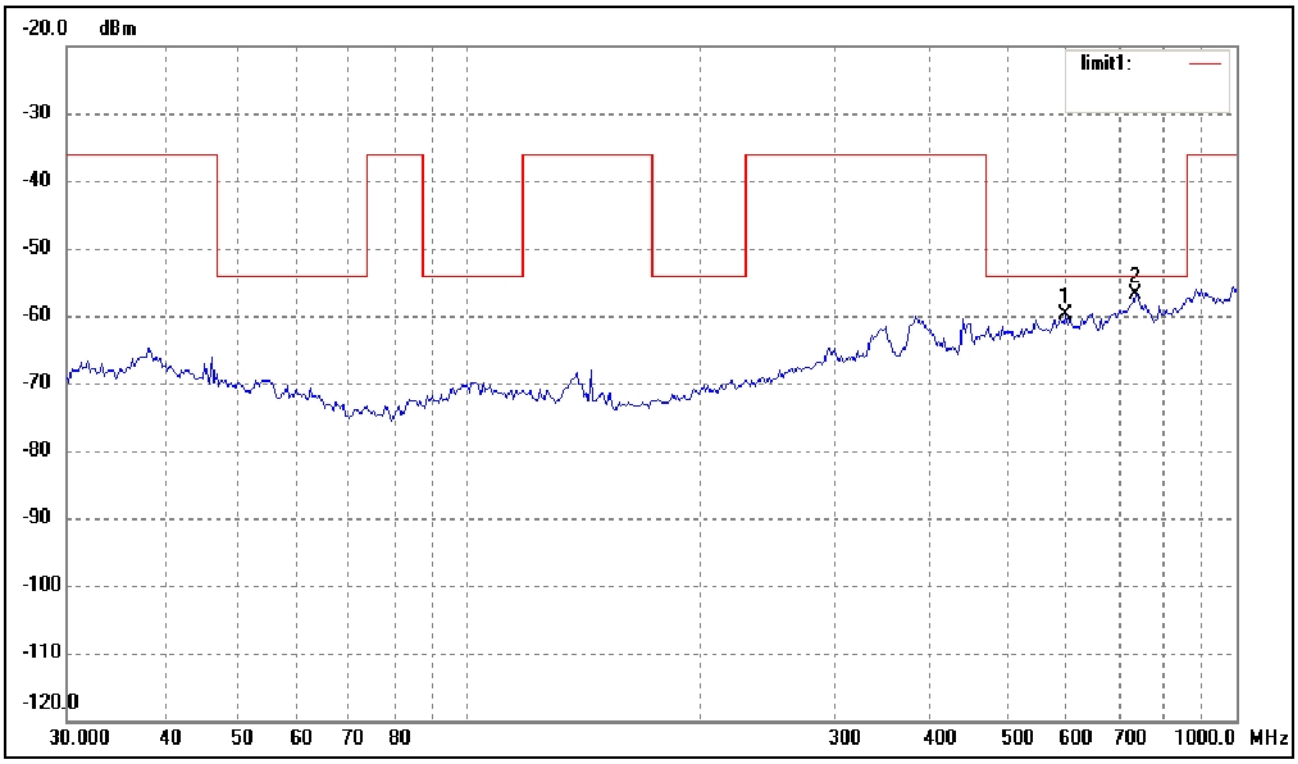
***Note:*** *this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

*Spurious Emission from 30MHz to 1GHz Test*
*Mode: Transmitting-Lowest channel*
*Horizontal:*




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | |
| 1 | 679.9600 | -87.29 | 27.35 | -59.94 | -54.00 | -5.94 | ERP |
| 2 | 744.8661 | -87.79 | 29.75 | -58.04 | -54.00 | -4.04 | ERP |

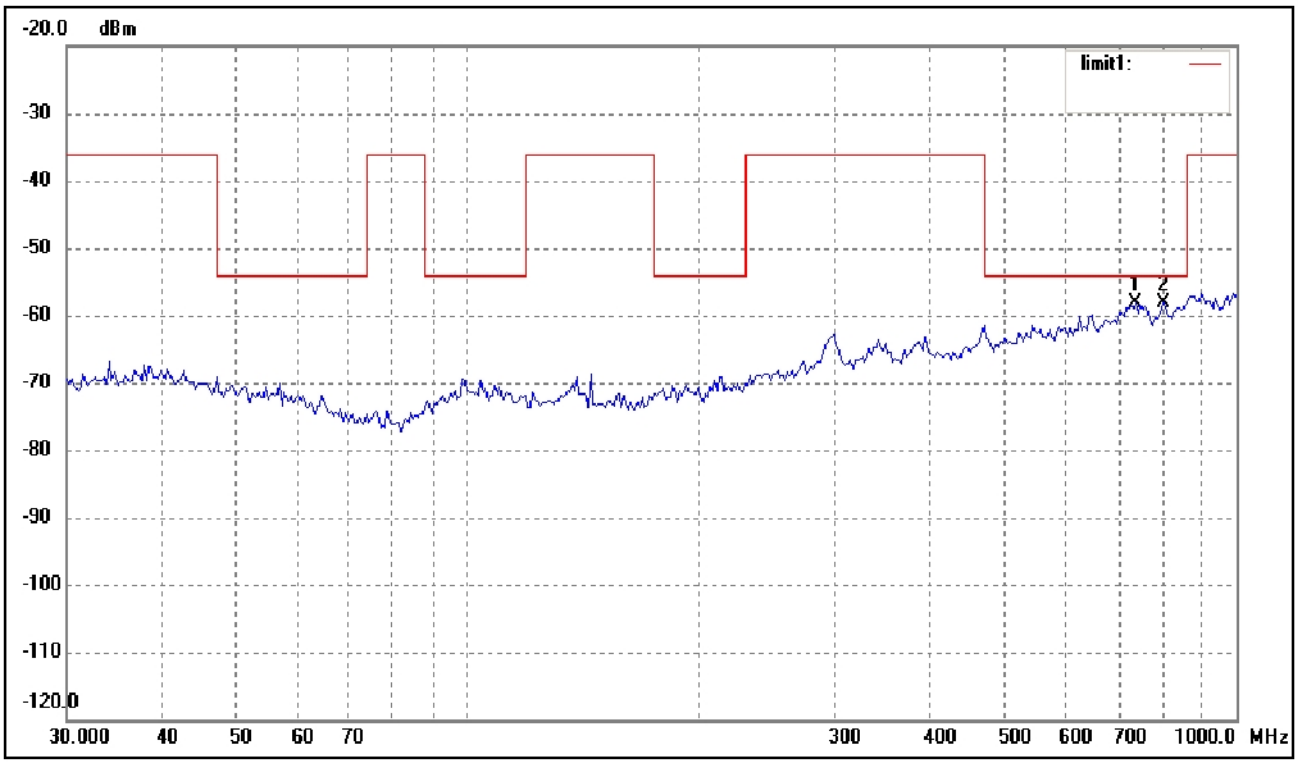
*Vertical:*




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | |
| 1 | 599.3213 | -86.37 | 26.56 | -59.81 | -54.00 | -5.81 | ERP |
| 2 | 739.6605 | -86.84 | 29.87 | -56.97 | -54.00 | -2.97 | ERP |

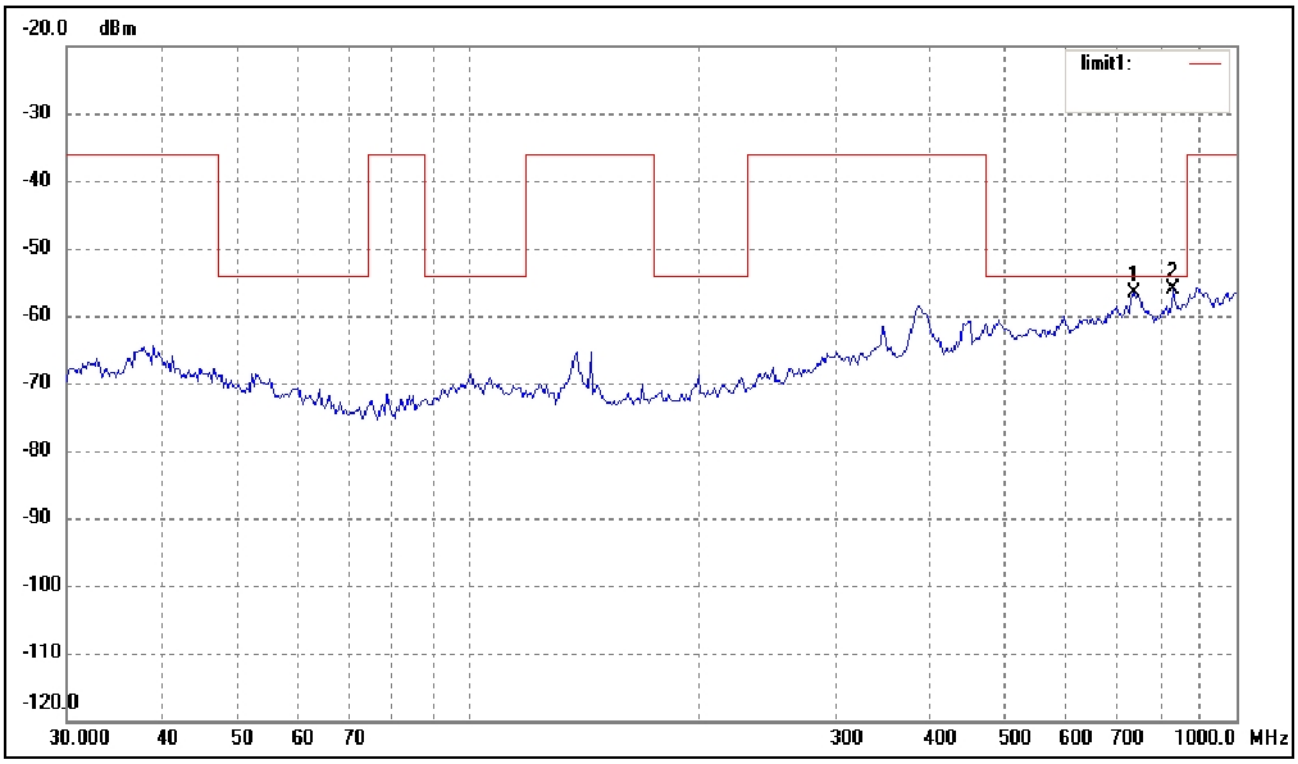
*Test Mode: Transmitting-Highest channel*

*Horizontal:*




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | |
| 1 | 739.6605 | -88.04 | 29.87 | -58.17 | -54.00 | -4.17 | ERP |
| 2 | 804.6028 | -86.46 | 28.22 | -58.24 | -54.00 | -4.24 | ERP |

*Vertical:*




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | |
| 1 | 734.4913 | -86.11 | 29.48 | -56.63 | -54.00 | -2.63 | ERP |
| 2 | 827.4934 | -84.78 | 28.78 | -56.00 | -54.00 | -2.00 | ERP |

*Spurious Emission Above 1GHz*

| Frequency | Reading | Correct | Result | Limit | Margin | Polar |
|---|---|---|---|---|---|---|
| (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | H/V |
| Lowest Channel-2402MHz | | | | | | |
| 4804 | -59.31 | 14.53 | -44.78 | -30.00 | -14.78 | |
| | H7206 | -62.55 | 17.74 | -44.81 | -30.00 | |
| | -14.81 | H4804 | -50.68 | 12.33 | -38.35 | |
| | -30.00 | -8.35 | V7206 | -62.90 | 15.54 | |
| | -47.36 | -30.00 | -17.36 | V | | |
| 4960 | -59.79 | 14.77 | -45.02 | -30.00 | -15.02 | |
| | H7440 | -61.82 | 17.85 | -43.97 | -30.00 | |
| | -13.97 | H4960 | -59.96 | 12.57 | -47.39 | |
| | -30.00 | -17.39 | V7440 | -62.58 | 15.65 | |
| | -46.93 | -30.00 | -16.93 | V | | |

*Note: Testing is carried out with frequency rang 30MHz to 12.75GHz, which above 4$^{th}$ Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*

# 10. Receiver Spurious Emissions

## 10.1 Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Cal. Date | Due. Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSP | 836079/035 | 2015-05-07 | 2016-05-06 |
| Pre-amplifier | Agilent | 8447F | 3113A06717 | 2015-05-07 | 2016-05-06 |
| Pre-amplifier | Compliance Direction | PAP-0118 | 24002 | 2015-05-07 | 2016-05-06 |
| Trilog Broadband Antenna | SCHWARZBECK | VULB9163 | 9163-333 | 2015-04-20 | 2016-04-19 |
| Horn Antenna | ETS | 3117 | 00086197 | 2015-04-20 | 2016-04-19 |

## 10.2 Standard Applicable

According to section 4.3.1.10.2, The spurious emissions of the receiver shall not exceed the values given in the following table .

Spurious emission limits for receivers

| Frequency range | Maximum power e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz) | Measurement bandwidth |
|---|---|---|
| 30 MHz to 1 GHz | -57 dBm | 100 kHz |
| 1 GHz to 12,75 GHz | -47 dBm | 1 MHz |

## 10.3 Test Procedure

The device under test has an integral antenna and the radiated measurement shall apply to the device, using the method of measurement as described in the EN300328 section 5.3.11.2.

## 10.4 Environmental Conditions

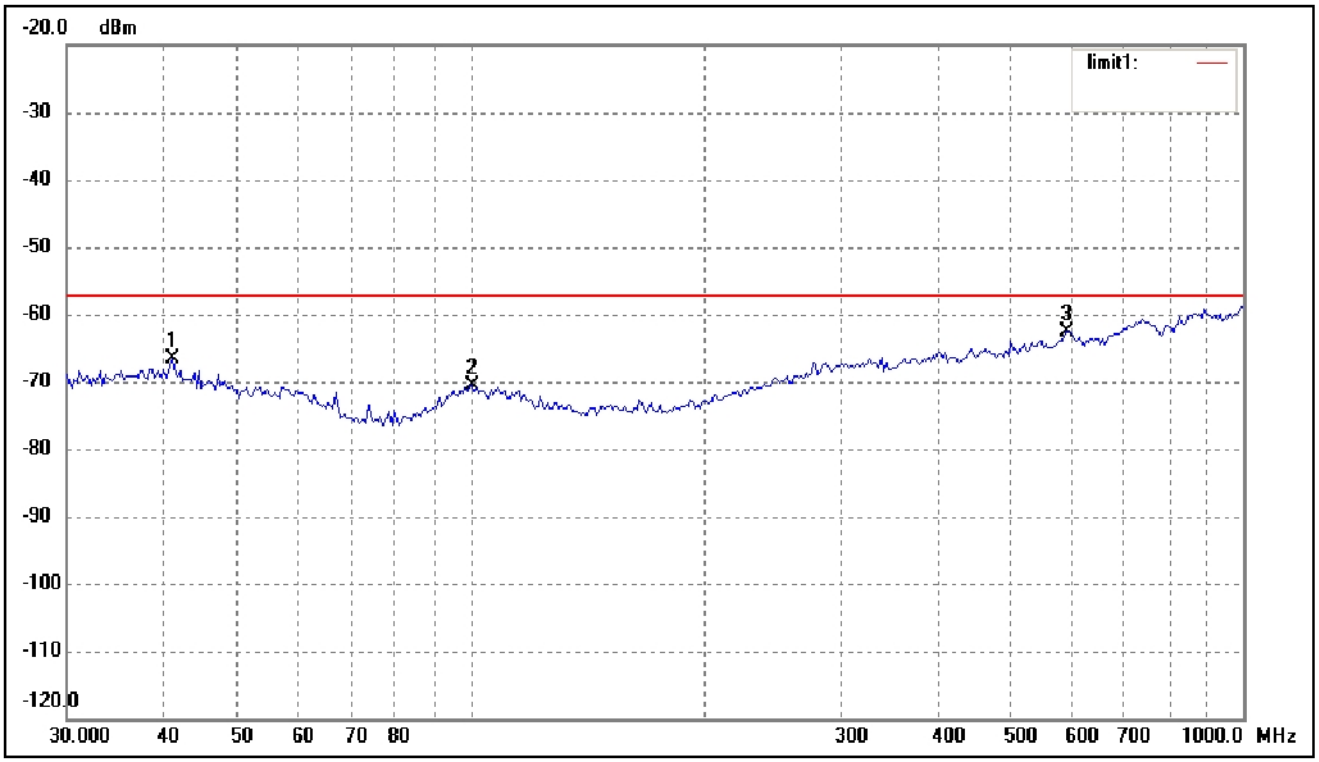
| | |
|---|---|
| Temperature: | 23° C |
| Relative Humidity: | 55% |
| ATM Pressure: | 1012 mbar |

## 10.5 Summary of Test Results/Plots

According to the data, the EUT complied with the EN 300328 standards, and had the worst case:

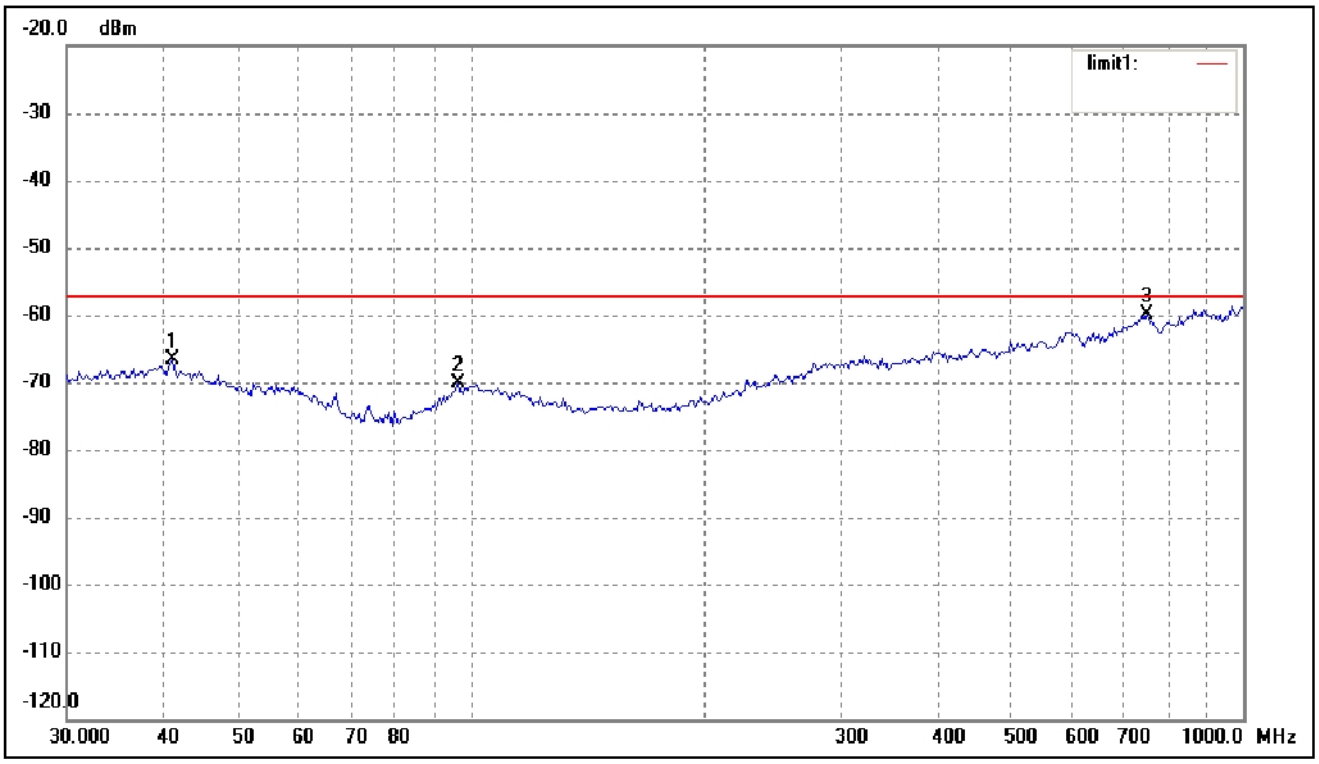
*Test Mode: Receiving*

*Horizontal:*




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | |
| 1 | 41.1320 | -86.95 | 20.33 | -66.62 | -57.00 | -9.62 | ERP |
| 2 | 100.2286 | -88.44 | 17.92 | -70.52 | -57.00 | -13.52 | ERP |
| 3 | 590.9737 | -87.24 | 24.68 | -62.56 | -57.00 | -5.56 | ERP |

*Vertical*




| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBm) | dB | (dBm) | (dBm) | (dB) | |
| 1 | 41.1320 | -86.95 | 20.33 | -66.62 | -57.00 | -9.62 | ERP |
| 2 | 96.0986 | -86.98 | 16.94 | -70.04 | -57.00 | -13.04 | ERP |
| 3 | 750.1083 | -86.67 | 26.87 | -59.80 | -57.00 | -2.80 | ERP |

*Note: Testing is carried out with frequency rang 30MHz to 12.75GHz, which above 1GHz are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*

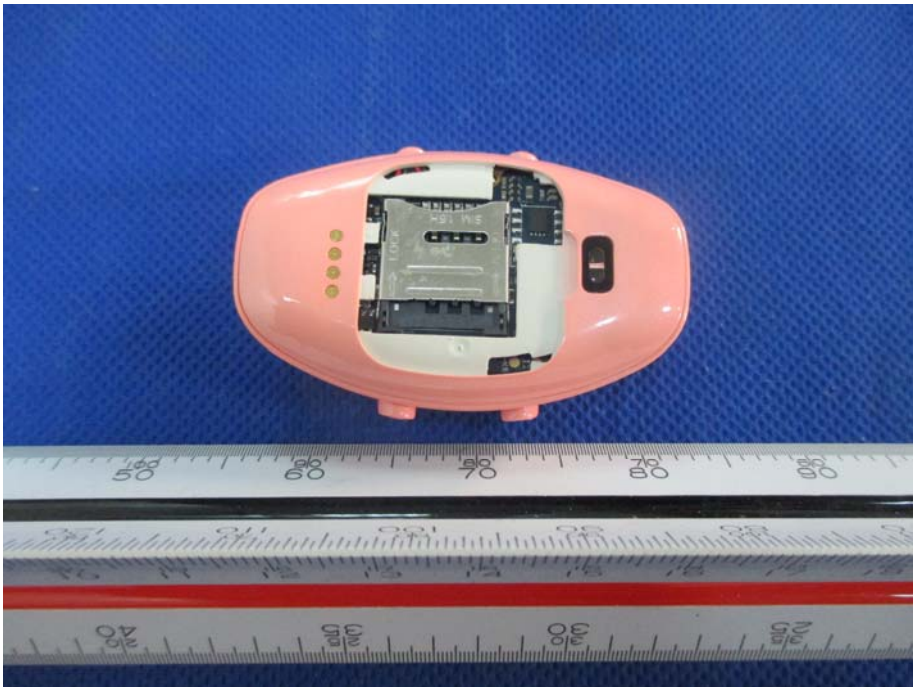
# EXHIBIT 1 - EUT PHOTOGRAPHS

**EUT View 1**

**EUT View 2**

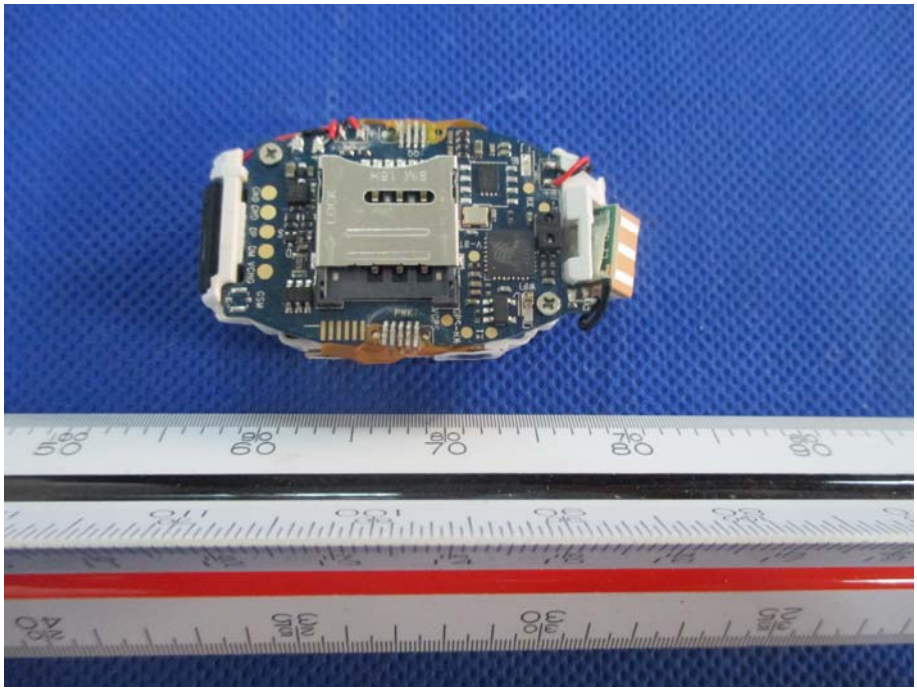
**EUT View 3**

**EUT View 4**

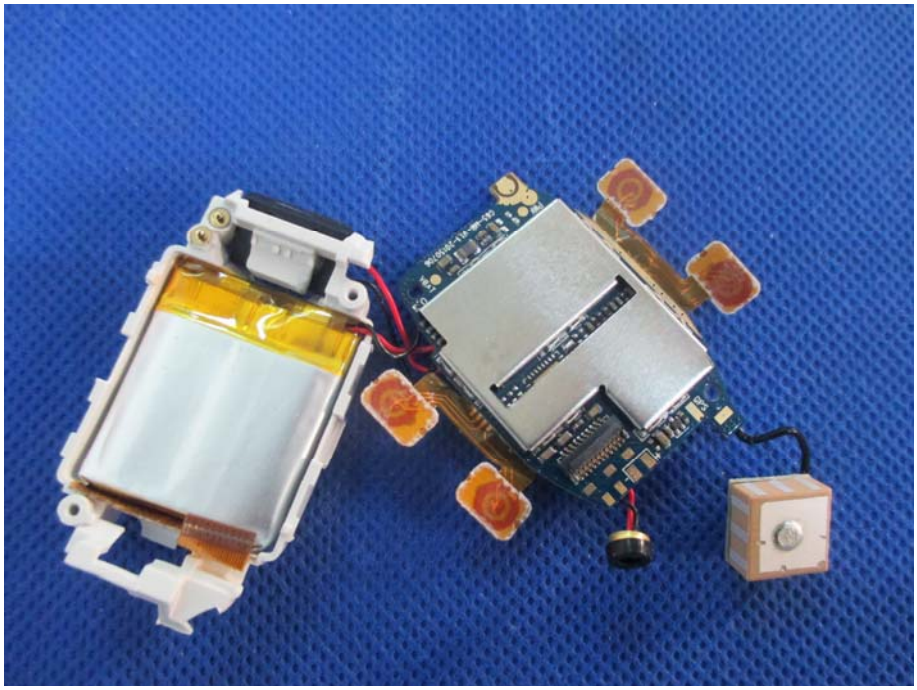


**EUT View 5**

**EUT View 6**



**EUT View 7**



**EUT View 8**


******* END OF REPORT *******