# Test Report for FCC

FCC ID : X59-H3G-900

| | | | | |
|---|---|---|---|---|
| Report Number | | ESTRFC1703-004 | | |
| Applicant | Company name | H3 SYSTEM Co., Ltd. | | |
| | Address | 1F, 283, Baeul 1-ro, Yuseong-gu, Daejeon, Korea | | |
| | Telephone | +82-42-862-9314 | | |
| | Contack person | Sung-Dae Lim | | |
| Product | Product name | LTE tele-health modem | | |
| | Model No. | H3G-900 | Manufacturer | H3 SYSTEM Co., Ltd. |
| | Serial No. | NONE | Country of origin | KOREA |
| Test date | 2017-02-10 ~ 2017-03-10 | | Date of issue | 28-Mar-17 |
| Testing location | ESTECH Co., Ltd.<br>97-1, Hoeeok-ri, Majang-myun, Ichion-city, Gyonggi-do, South Korea | | | |
| Standard | FCC PART 15 Subpart C (15.247), ANSI C 63.10(2013) | | | |
| Measurement facility registration number | 659627 | | | |
| Tested by | Senior Engineer K.I. Hong | (Signature) | | |
| Reviewed by | Engineering Manager K.B. Lee | (Signature) | | |
| Abbreviation | OK, Pass = Passed, Fail = Failed, N/A = not applicable | | | |

* Note

- This test report is not permitted to copy partly without our permission
- This test result is dependent on only equipment to be used
- This test result based on a single evaluation of one sample of the above mentioned

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# 1. Laboratory Information

## 1.1 General

This EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards and is tested in accordance with the measurement procedures as indicated in this report.
ESTECH Lab attests to accuracy of test data. All measurement reported herein were performed by ESTECH Co., Ltd.
ESTECH Lab assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

## 1.2 Test Lab.

Corporation Name : ESTECH Co., Ltd.

Head Office : Suite 1015 World Meridian III , 123 Gasan Digital 2-ro, Geumcheon-gu,
Seoul 153-759, R.O. Korea

EMC/Telecom/Safety Test Lab : 347-69, Jungbu-daero 147beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do 467-811, R. O. Korea

## 1.3 Official Qualification(s)

MSIP : Granted Accreditation from Ministry of Information & Communication for EMC, Safety and Telecommunication

KOLAS : Accredited Lab By Korea Laboratory Accreditation Schema base on CENELEC requirements

FCC : Conformity Assessment Body(CAB) with registration number 659627 under APEC TEL MRA between the RRA and the FCC

VCCI : Granted Accreditation from Voluntary Control Council for Interference from ITE

# 2. Description of EUT

## 2.1 Summary of Equipment Under Test (Bluetooth)

| | |
|---|---|
| Modulation Type | : GFSK(FHSS) , 8DPSK |
| Transfer Rate | : 3 Mbps |
| Number of Channel | : 79 ch |
| Channel Spacing | : 1 MHz |
| PEAK Output Power | : GFSK : 6.07 mW 8DPSK : 4.87 mW |
| Rating | : INPUT : AC (100 - 240) V, (50 - 60) Hz , 0.5 A<br>DC OUTPUT : DC 5.0 V, 3.0 A |
| Receipt Date | : 17-Jan-17 |

## 2.2 General descriptions of EUT

| Item | Specification | | |
|---|---|---|---|
| MCU | STM32F207VC 32bit Cortex-M3 | | |
| MEMORY | Internal FLASH | | 256KB |
| | External FLASH | | 1MB |
| | SRAM | | 128KB |
| RF Transceiver | 15C | Freq. Range | 2402.0 ~ 2480.0 MHz |
| | | POWER | 0.343mW/MHz(Typ) / Class2 |
| | | Freq. Range | |
| | | POWER | |
| | | Freq. Range | |
| | | POWER | |
| INTERFACE | ANT | | SMA Type |
| | USB | | OTG |
| | Upgrade | | 4pole jack |
| Operating Environment | Temperature | | -10℃ ~ 40℃(14 ℉ to 104 ℉) |
| | Humidity | | < 90% |
| POWER | Adapter | | DC 5V/3A<br>Rechargeable(Li-polymer Battery 4.2V) |
| Dimension | Size | | 125 x 100 x 33 mm |
| | Weight | | 160g |

# 3. Test Standards

Test Standard : FCC PART 15 Subpart C (15.247)

This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

Test Method : ANSI C 63.10 (2013)

This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain decides that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment These method apply to the measurement of individual units or systems comprised of multiple units

Summary of Test Results

| Applied Satandard : 47 CFR Part 15 Subpart C | | | | remark |
|---|---|---|---|---|
| FCC Standard | Test Type | Result | Remark | Limit |
| 15.207 | AC Power Conducted Emission | Pass | Meet the requirement | |
| 15.205 & 15.209 | Intentional Radiated Emission | Pass | Meet the requirement | |
| 15.247(a)(1) | Carrier Frequency Separation & 20 Bandwidth ,99% Bandwidth | Pass | Meet the requirement | >25 kHz |
| 15.247(b) | Maximum Peak ouput power | Pass | Meet the requirement | 30dBm(1W) |
| 15.247(a)(1)(ii) | Number of Hopping Frequency | Pass | Meet the requirement | >75 |
| 15.247(c) | Transmitter Radiated Emission | Pass | Meet the requirement | |
| 15.247(a)(1)(iii) | Time of Occupancy (Dwell Time) | Pass | Meet the requirement | <400ms |
| 15.247(d) | Band Edge Measurement | Pass | Meet the requirement | |

# 4. Measurement Condition

## 4.1 EUT Operation

a. Channel

| Ch. | Frequency | Ch. | Frequency |
|---|---|---|---|
| 0 | 2402 MHz | 40 | 2442 MHz |
| 1 | 2403 MHz | 41 | 2443 MHz |
| 2 | 2404 MHz | 42 | 2444 MHz |
| 3 | 2405 MHz | 43 | 2445 MHz |
| 4 | 2406 MHz | … | … |
| … | … | 78 | 2480 MHz |
| 39 | 2441 MHz | | |

b. Measurement Channel : Low (2402 MHz), Middle (2441 MHz), High (2480 MHz)

c. Test Mode : 8DPSK, GFSK (worst case)

d. Test rate : 3 Mbps

## 4.2 EUT Operation.

* The EUT was in the following operation mode during all testing

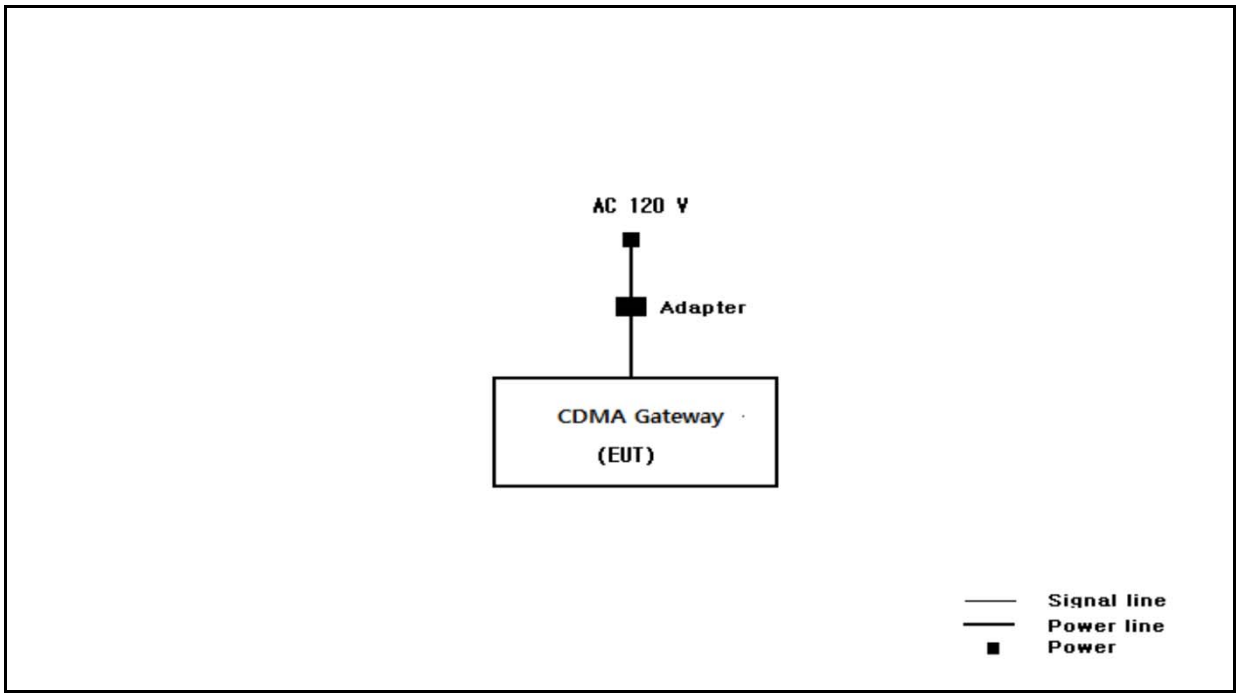
* The operational conditions of the EUT was determined by the manufacturer according to emission

* Execute a RF test program to enable EUT under transmission/receiving condition continuously at specific channel frequency.

* Transmit mode was each test. Each channel (low, middle, high), also set the test after

* The EUT was measured up to tenth harmonic or 40 GHz of the highest operating frequencies.

## 4.3 Configuration and Peripherals



## 4.4 EUT and Support equipment

| Equipment Name | Model Name | S/N | Manufacturer | Remark (FCC ID) |
|---|---|---|---|---|
| LTE tele-health modem | H3G-900 | NONE | H3 SYSTEM Co., Ltd. | EUT |
| Adapter | BPI020S05N04 | NONE | BridgePower Corp. | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## 4.5 Cable Connecting

| Start Equipment | | End Equipment | | Cable Standard | | Remark |
|---|---|---|---|---|---|---|
| Name | I/O port | Name | I/O port | Length | Shielded | |
| LTE tele-health modem | Power | Adapter | - | 2.0 | Unshielded | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# 5. Carrier Frequency Separation

## 5.1 Test procedure

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

## 5.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 30 KHz

. VBW= 300 KHz

. Span= 3 MHz

. Sweep= suitable duration based on the EUT specification.

20dB Bandwidth Test Instruments

| Description | Model | Serial Number | Cal. Due Date |
|---|---|---|---|
| Spectrum Analyzer | E4440A | US42041291 | 2018-01-04 |
| -Spectrum Analyzer <=> EUT | Loss: 1.0dB | - | |

## 5.3 Measurement results

| EUT | LTE tele health modem | MODEL | H3G-900 |
|---|---|---|---|
| MODE | GFSK,8DPSK | ENVIRONMENTAL CONDITION | 22 ℃, 40 % R.H . |
| INPUT POWER | DC 5 V | | |

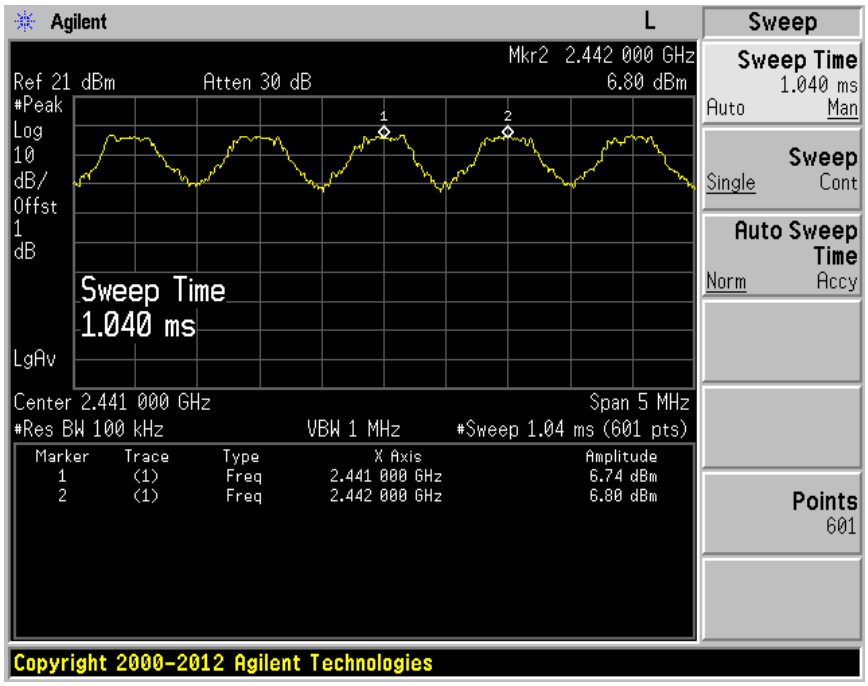
| CHANNEL | Channel Frequency (MHz) | Bandwidth at 99% (kHz) | Bandwidth at 20dB below(kHz) | Channel Separation (kHz) | Limit (kHz) | PASS/FAIL |
|---|---|---|---|---|---|---|
| 0 | 2402 | 871 | 940 | 1000 | 627 | PASS |
| 39 | 2441 | 861 | 929 | 1000 | 619 | PASS |
| 78 | 2480 | 894 | 958 | 1000 | 639 | PASS |

( 8DPSK )

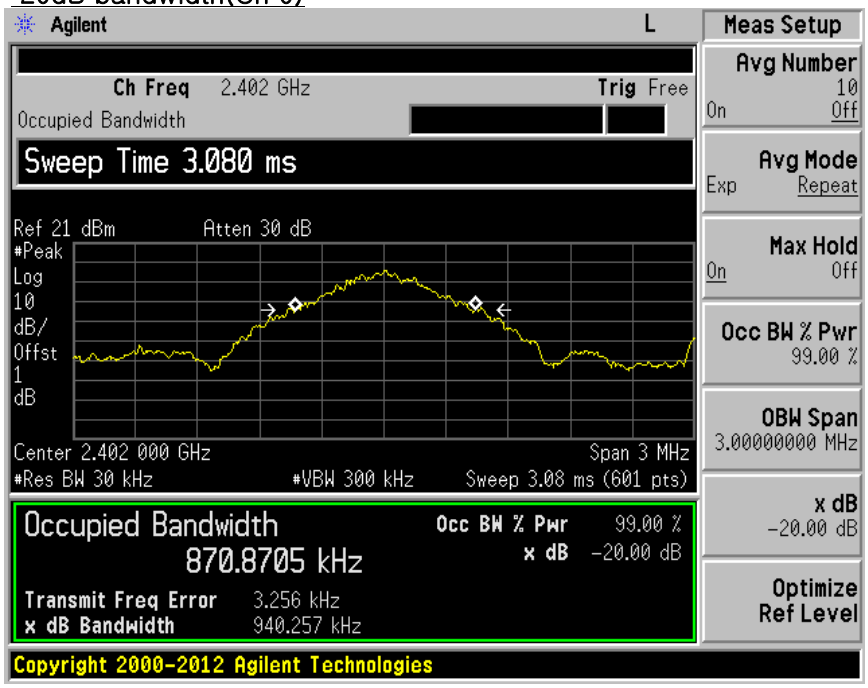
| CHANNEL | Channel Frequency (MHz) | Bandwidth at 99% (MHz) | Bandwidth at 20dB below(kHz) | Channel Separation (kHz) | Limit (kHz) | PASS/FAIL |
|---|---|---|---|---|---|---|
| 0 | 2402 | 1.201 | 1285 | 1000 | 857 | PASS |
| 39 | 2441 | 1.181 | 1281 | 1000 | 854 | PASS |
| 78 | 2480 | 1.187 | 1324 | 1000 | 883 | PASS |

## 5.4 Trace data ( GFSK )

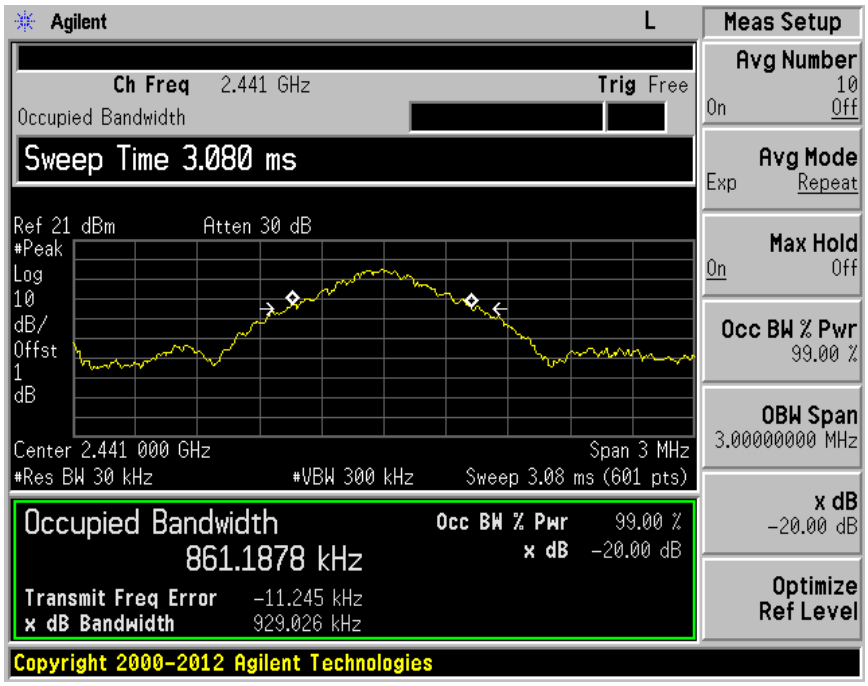
Channel Separation



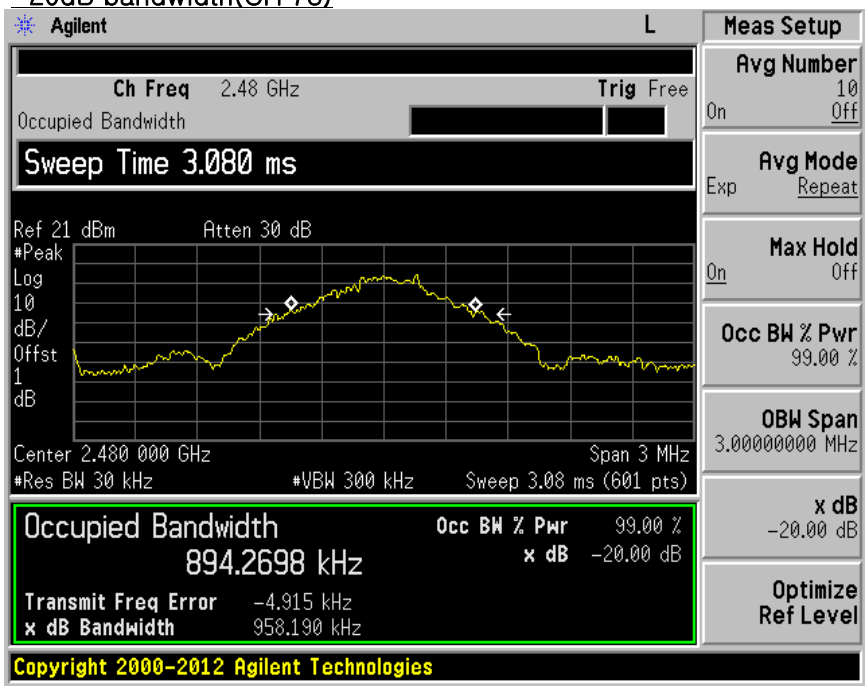

20dB bandwidth(Ch 0)



20dB bandwidth(CH 39)

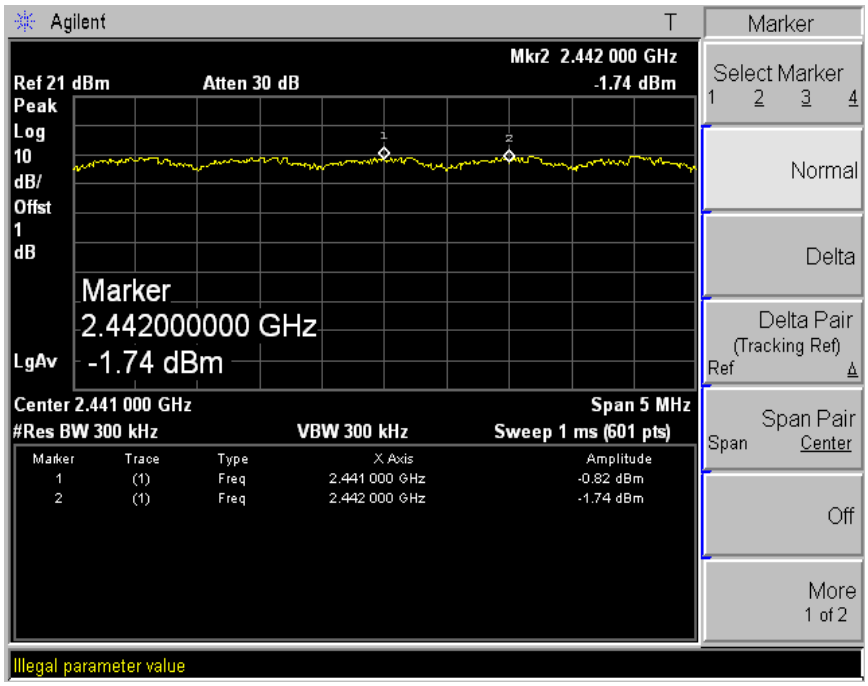



20dB bandwidth(CH 78)

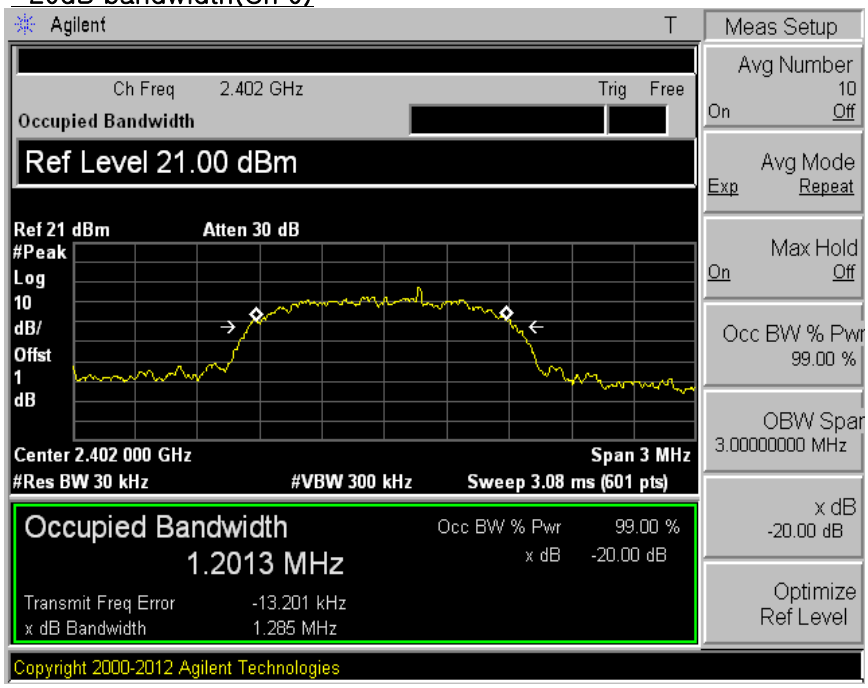


( 8DPSK )

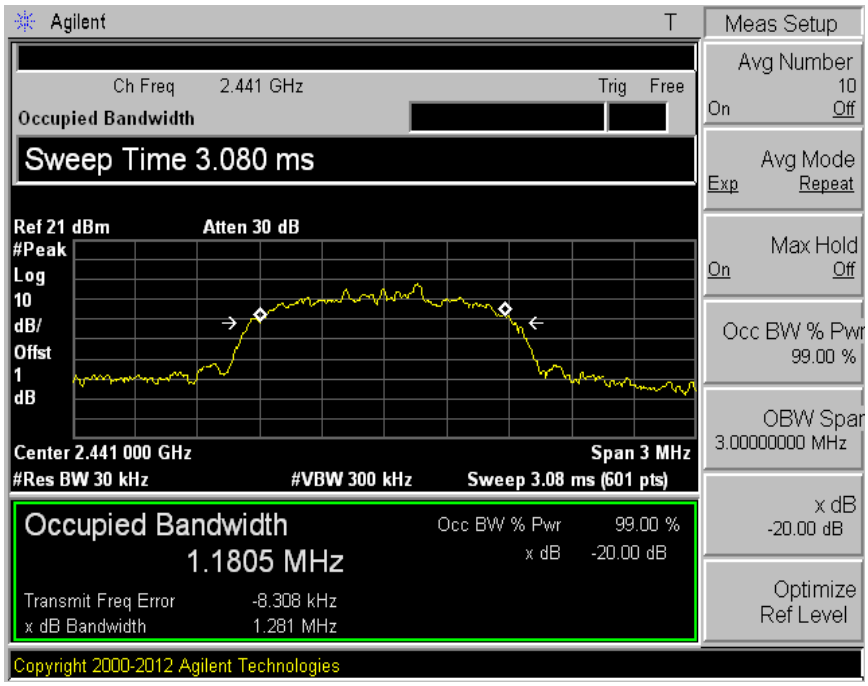
Channel Separation



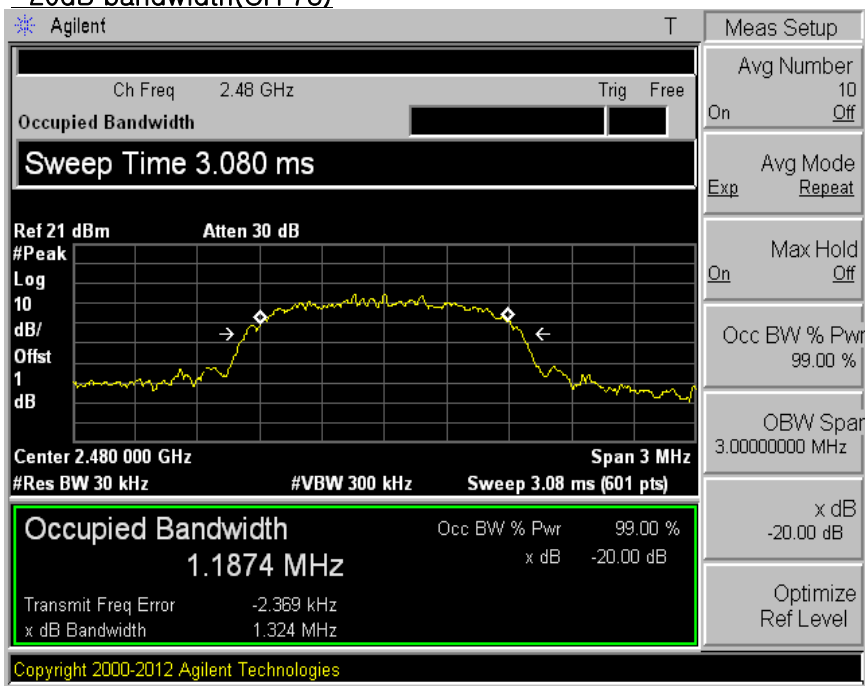

20dB bandwidth(Ch 0)



20dB bandwidth(CH 39)




20dB bandwidth(CH 78)



# 6. MAXIMUM PEAK OUTPUT POWER

## 6.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum peak output power measurement is 30 dBm.

| Description | Model | Serial Number | Cal. Due Date |
|---|---|---|---|
| Power Meter | NRVS | 849622/045 | 2017-11-15 |
| Power Sensor | NRV-251 | 325948/013 | 2017-11-15 |
| Power Meter <=> EUT | Loss: 1.0dB | - | |

## 6.2 Measurement results

| EUT | LTE tele-health modem | MODEL | H3G-900 |
|---|---|---|---|
| MODE | GFSK,8DPSK | ENVIRONMENTAL CONDITION | 23 ℃, 41 % R.H. |
| INPUT POWER | DC 5 V | | |

GFSK

| CHANNEL | Channel Frequency (MHz) | Peak Power Output(dBm) | | Limit[mW] | PASS/ FAIL |
|---|---|---|---|---|---|
| | | (dBm) | (mW) | | |
| 0 | 2402 | 7.83 | 6.07 | 125 | PASS |
| 39 | 2441 | 8.00 | 6.31 | 125 | PASS |
| 78 | 2480 | 7.58 | 5.73 | 125 | PASS |

8DPSK

| CHANNEL | Channel Frequency (MHz) | Peak Power Output(dBm) | | Limit[mW] | PASS/ FAIL |
|---|---|---|---|---|---|
| | | (dBm) | (mW) | | |
| 0 | 2402 | 6.81 | 4.80 | 125 | PASS |
| 39 | 2441 | 6.78 | 4.76 | 125 | PASS |
| 78 | 2480 | 6.22 | 4.19 | 125 | PASS |

Note : 8DPSK mode is max power in three different modulations.

# 7. Number of Hopping Frequency

## 7.1 Test procedure

According to §15.247(a)(1)(ii), Frequency hopping systems operating in the 2 400 MHz – 2 483.5 MHz bands shall use at least 15 hopping frequencies.

## 7.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 100 KHz

. VBW= 100 KHz

. Span= the frequency band of operation

. Sweep= suitable duration based on the EUT specification.

The Number of Hopping Frequency Test Instruments

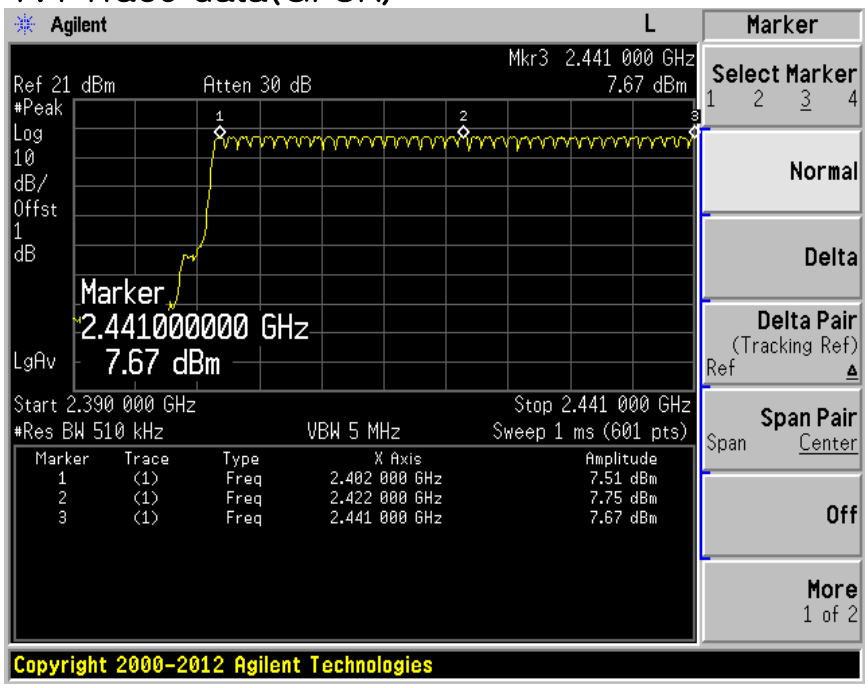
| Description | Model | Serial Number | Cal. Due Date |
|---|---|---|---|
| Spectrum Analyzer | E4440A | US42041291 | 2018-01-04 |
| -Spectrum Analyzer <=> EUT | Loss: 1.0dB | | |

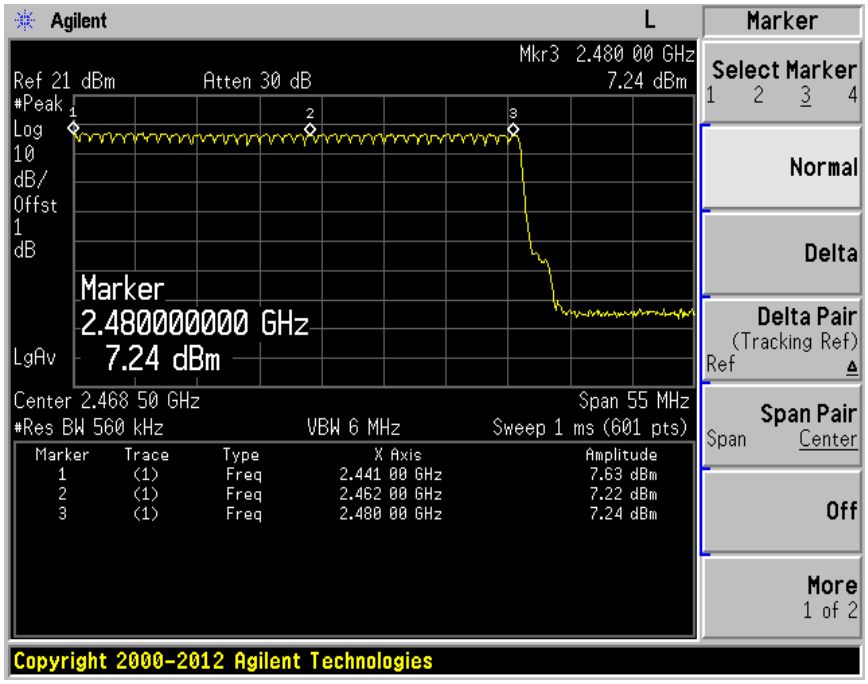
## 7.3 Measurement results

| | | | |
|---|---|---|---|
| EUT | LTE tele-health modem | MODEL | H3G-900 |
| MODE | GFSK,8DPSK | ENVIRONMENTAL CONDITION | 23 ℃, 42 % R.H. |
| INPUT POWER | DC 5 V | | |

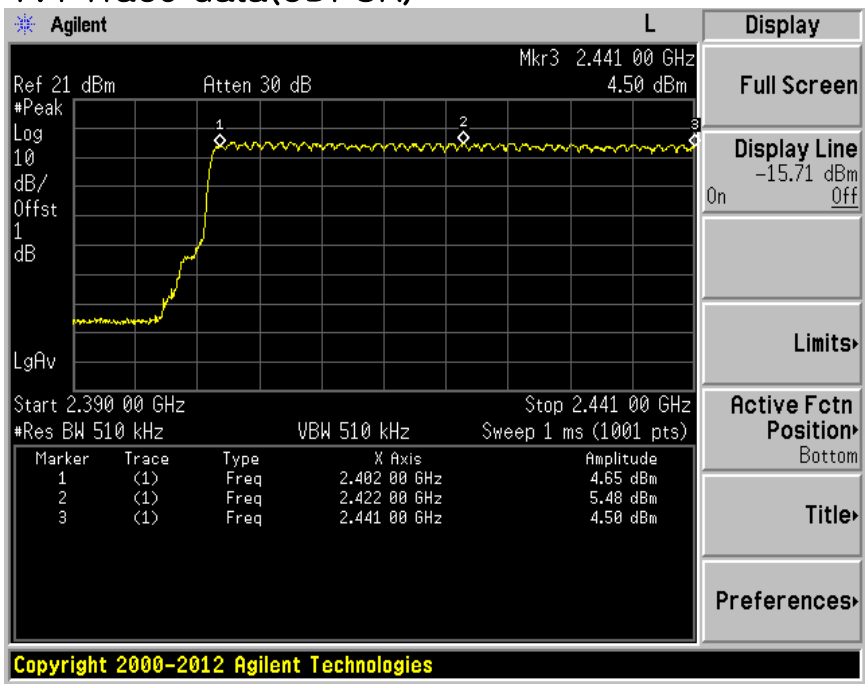
| Number of CH | Limit (Number of CH) | PASS/FAIL |
|---|---|---|
| 79 | >15 | PASS |

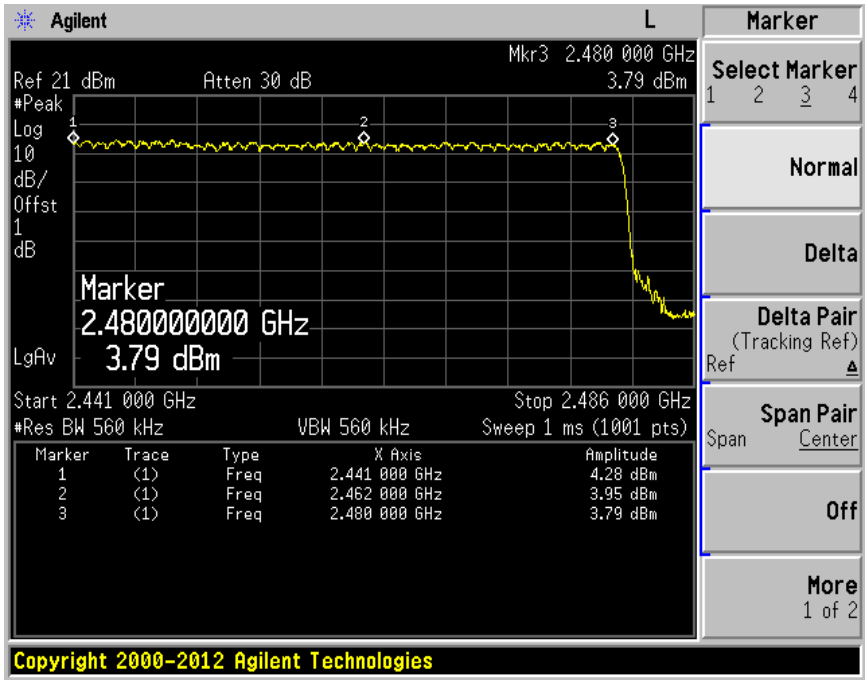
## 7.4 Trace data(GFSK)




Agilent
L
Marker
Mkr3 2.480 00 GHz
Ref 21 dBm
Atten 30 dB
7.24 dBm
#Peak
Log
10
dB/
Offst
1
dB
Marker
2.480000000 GHz
7.24 dBm
LgAv
Center 2.468 50 GHz
Span 55 MHz
#Res BW 560 kHz
VBW 6 MHz
Sweep 1 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.441 00 GHz 7.63 dBm
2 (1) Freq 2.462 00 GHz 7.22 dBm
3 (1) Freq 2.480 00 GHz 7.24 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

## 7.4 Trace data(8DPSK)




Agilent
L
Marker
Mkr3 2.480 000 GHz
Ref 21 dBm
Atten 30 dB
3.79 dBm
#Peak
Log
10
dB/
Offst
1
dB
Marker
2.480000000 GHz
3.79 dBm
LgAv
Start 2.441 000 GHz
Stop 2.486 000 GHz
#Res BW 560 kHz
VBW 560 kHz
Sweep 1 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.441 000 GHz 4.28 dBm
2 (1) Freq 2.462 000 GHz 3.95 dBm
3 (1) Freq 2.480 000 GHz 3.79 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

# 8. Time of Occupancy (Dwell Time)

## 8.1 Test procedure

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2 400 MHz – 2 483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

## 8.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 1 MHz

. VBW= 1 MHz

. Span= zero span, centered on a hoppong channel

. Sweep = as necessary to capture the entire dwell time per hoppong channel

. Detector function = Peak

. Trace = Max hold

The Time of Occupancy Test Instruments

| Description | Model | Serial Number | Cal. Due Date |
|---|---|---|---|
| Spectrum Analyzer | E4440A | US42041291 | 2018-01-04 |
| -Spectrum Analyzer <=> EUT | Loss: 1 dB | | |

## 8.3 Measurement results

| | | | |
|---|---|---|---|
| EUT | LTE tele-health modem | MODEL | H3G-900 |
| MODE | GFSK,8DPSK | ENVIRONMENTAL CONDITION | 23 ℃, 43 % R.H. |
| INPUT POWER | DC 5 V | | |

A. DH1 Mode

One peiod for each particular channel : 0.4142 ms X 320.1 = 132.59 ms

| Channel | Pulse Time(ms) | Limit(ms) | PASS/FAIL |
|---|---|---|---|
| 39 | 132.59 | 400 | PASS |

Calculation:The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH1 data rate operates on a one-slot transmission and one-slot receiving basis. Thus there are 1600/(1+1)=800 transmissions per second. In one period for each particular channel there are 10.13x31.6=320.1 times of tramsmissions.

B. DH3 Mode

One peiod for each particular channel : 1.676 ms X 159.9 = 267.99 ms

| Channel | Pulse Time(ms) | Limit(ms) | PASS/FAIL |
|---|---|---|---|
| 39 | 267.99 | 400 | PASS |

Calculation: The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH3 data rate operates on a three-slot transmission and one-slot receiving basis. Thus there are 1600/(3+1)=400 transmissions per second. In one period for each particular channel there are 5.06x31.6=159.9 times of tramsmissions.

C. DH5 Mode

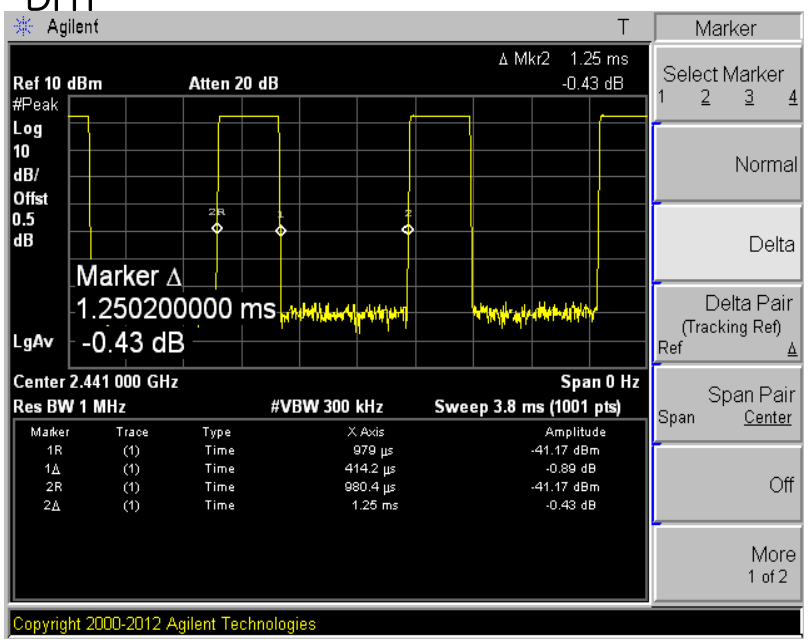
One peiod for each particular channel : 2.948 ms X 106.81 = 314.88 ms

| Channel | Pulse Time(ms) | Limit(ms) | PASS/FAIL |
|---|---|---|---|
| 39 | 314.88 | 400 | PASS |

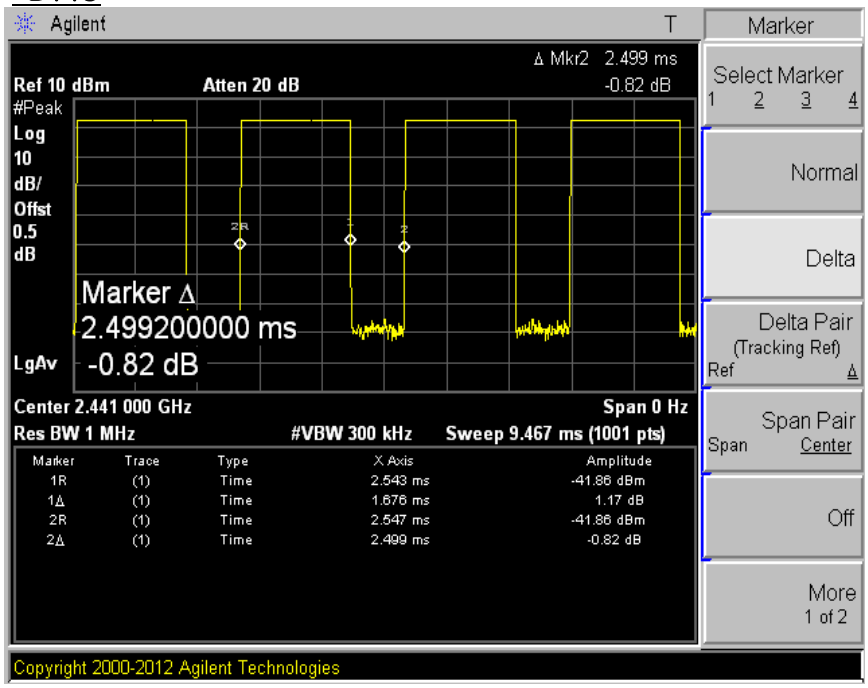
Calculation: The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second, the DH5 data rate operates on a five-slot transmission and one-slot receiving basis. Thus there are 1600/(5+1)=266.7 transmissions per second. In one period for each particular channel there are 3.38x31.6=106.81 times of tramsmissions.

## 8.4 Trace data

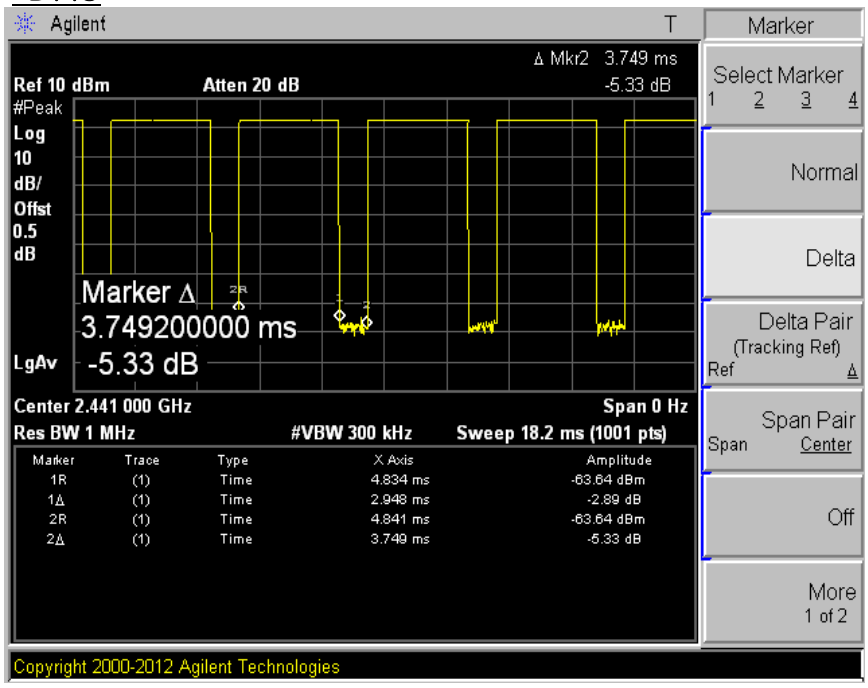
DH1



DH3


Agilent
T
Marker
Δ Mkr2 2.499 ms
-0.82 dB
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
0.5
dB
Marker Δ
2.499200000 ms
LgAv -0.82 dB
Center 2.441 000 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 300 kHz
Sweep 9.467 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 2.543 ms -41.86 dBm
1Δ (1) Time 1.676 ms 1.17 dB
2R (1) Time 2.547 ms -41.86 dBm
2Δ (1) Time 2.499 ms -0.82 dB
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Δ
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

DH5


Agilent
T
Marker
Δ Mkr2 3.749 ms
-5.33 dB
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
0.5
dB
Marker Δ
3.749200000 ms
LgAv -5.33 dB
Center 2.441 000 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 300 kHz
Sweep 18.2 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 4.834 ms -63.64 dBm
1Δ (1) Time 2.948 ms -2.89 dB
2R (1) Time 4.841 ms -63.64 dBm
2Δ (1) Time 3.749 ms -5.33 dB
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Δ
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

8DPSK

A. DH1 Mode

One peiod for each particular channel : 0.44 ms X 320.1 = 140.84 ms

| Channel | Pulse Time(ms) | Limit (ms) | PASS/FAIL |
|---|---|---|---|
| 39 | 140.84 | 400 | PASS |

B. DH3 Mode

One peiod for each particular channel : 1.687 ms X 159.9 = 269.75 ms

| Channel | Pulse Time(ms) | Limit (ms) | PASS/FAIL |
|---|---|---|---|
| 39 | 269.75 | 400 | PASS |

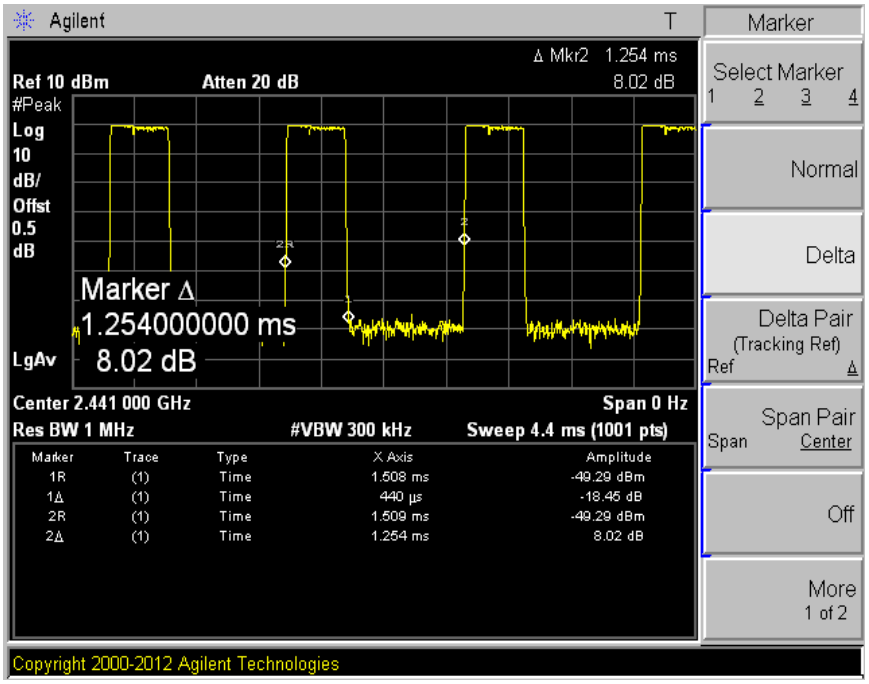
C. DH5 Mode

One peiod for each particular channel : 2.983 ms X 106.81 = 318.61 ms

| Channel | Pulse Time(ms) | Limit (ms) | PASS/FAIL |
|---|---|---|---|
| 39 | 318.61 | 400 | PASS |

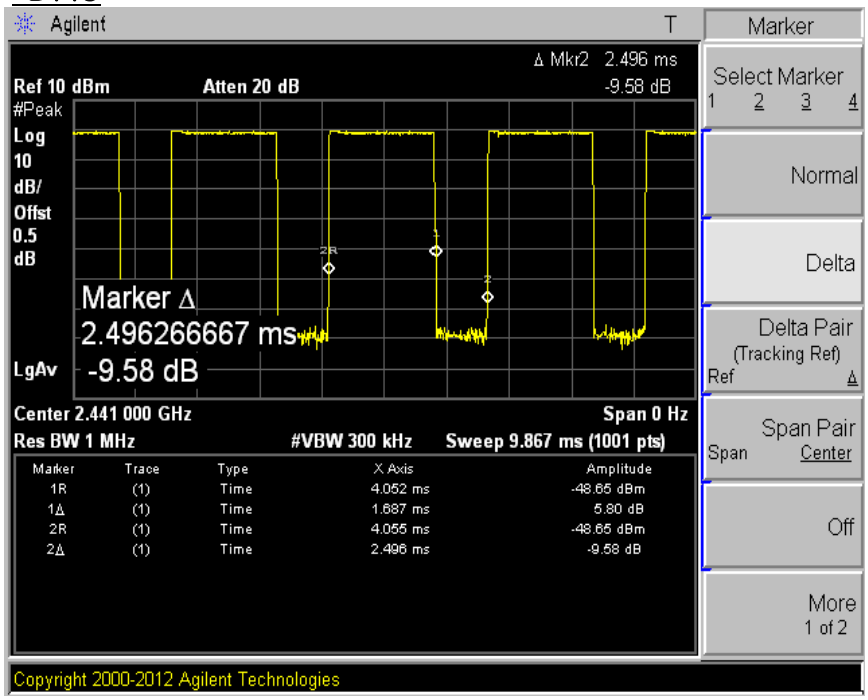
## 8.5 Trace data

DH1

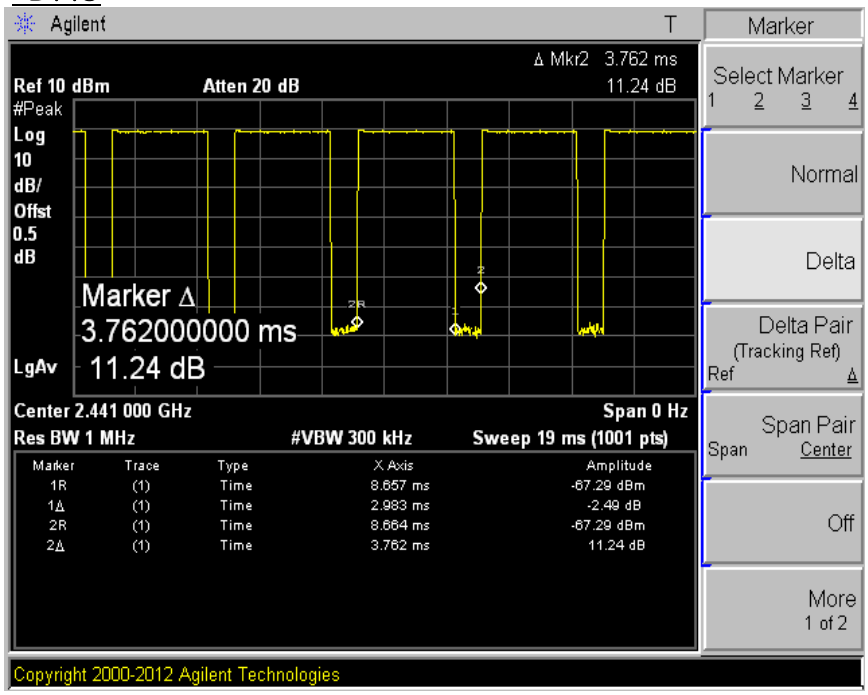


8DPSK

DH3




DH5



# 9. band-edge and out of band emissions.

## 9.1 Test procedure

The radio frequecy power at 20dB down from the highest inband power level is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The band edge&out of band emission shall be at least 20dB below of the highest inband power level.

## 9.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 100 KHz

. VBW= >100 KHz

. Span= suitable frequency span

. Sweep= suitable duration based on the EUT specification.

Band Edge&Out of Emission Test Instruments

| Description | Model | Serial Number | Cal. Due Date |
|---|---|---|---|
| Spectrum Analyzer | E4440A | US42041291 | 2018-01-04 |
| -Spectrum Analyzer <=> EUT | Loss: 1.0dB | | |

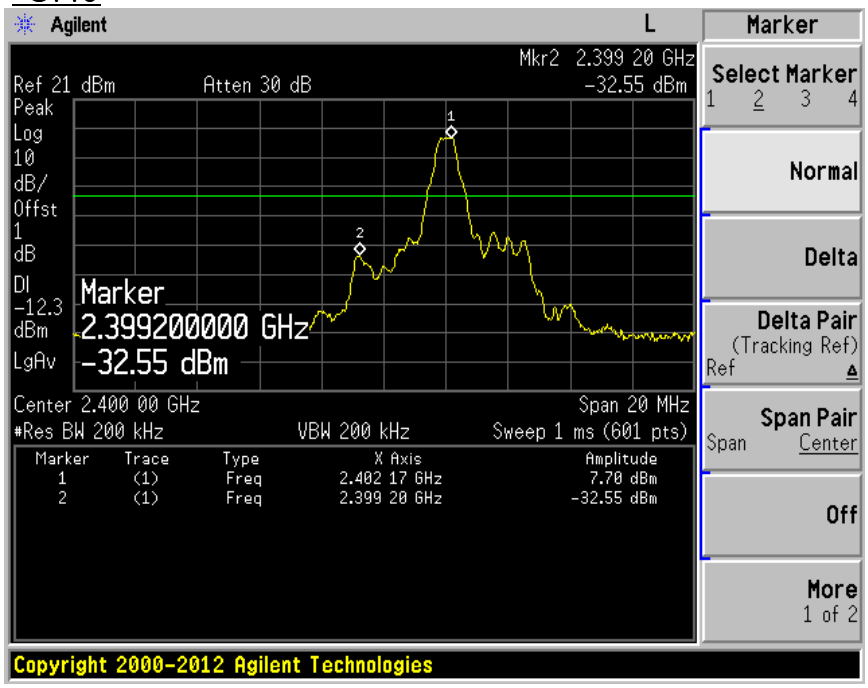
## 9.3 Measurement results of band-edge & out of emission

| | | | |
|---|---|---|---|
| EUT | LTE tele-health modem | MODEL | H3G-900 |
| MODE | GFSK,8DPSK | ENVIRONMENTAL CONDITION | 23 ℃, 42 % R.H. |
| INPUT POWER | DC 5 V | | |

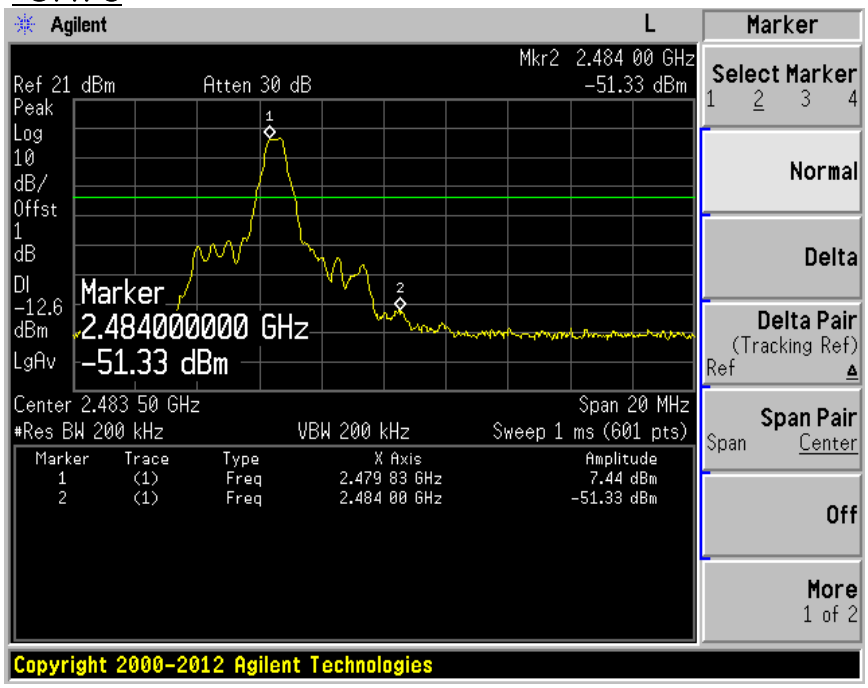
* Refer to attach spectrum analyzer data chart.

## 9.4 Trace data of band-edge & Out of Emission

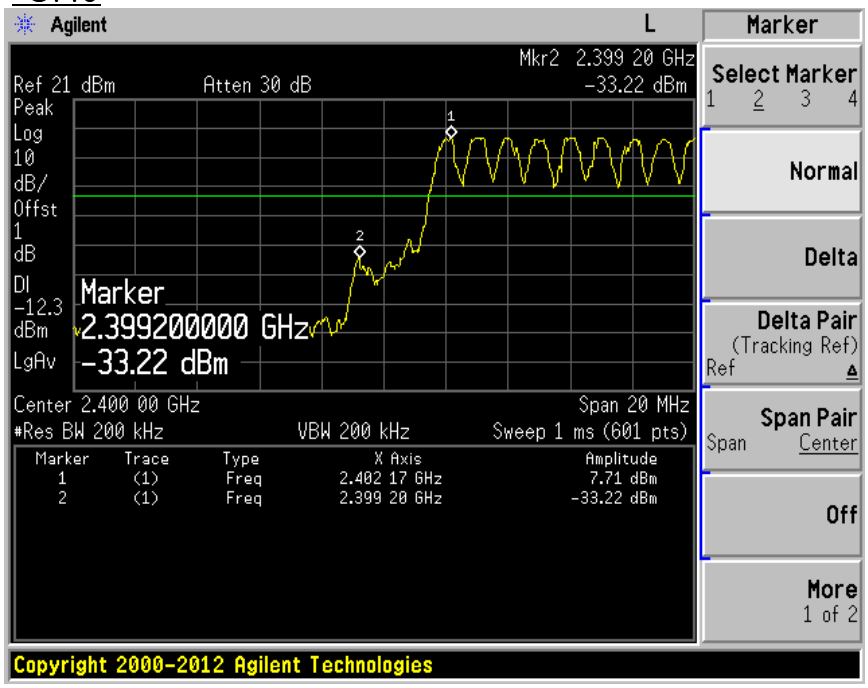
CH0




CH78



CH0


Agilent
L
Marker
Mkr2 2.399 20 GHz
Ref 21 dBm
Atten 30 dB
-33.22 dBm
Peak
Log
10
dB/
Offst
1
dB
DI
-12.3
dBm
LgAv
Marker
2.399200000 GHz
-33.22 dBm
Center 2.400 00 GHz
Span 20 MHz
#Res BW 200 kHz
VBW 200 kHz
Sweep 1 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.402 17 GHz 7.71 dBm
2 (1) Freq 2.399 20 GHz -33.22 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
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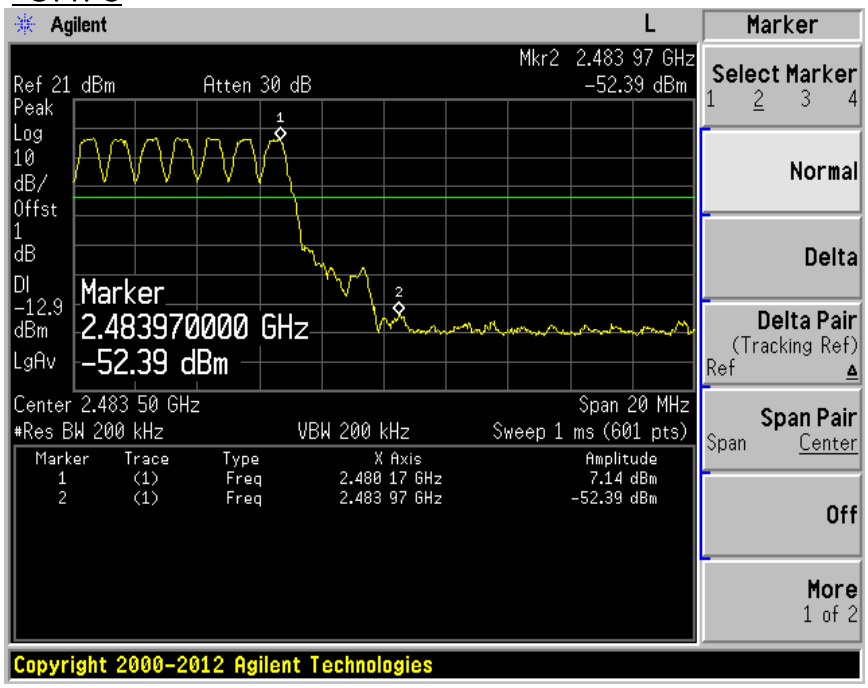
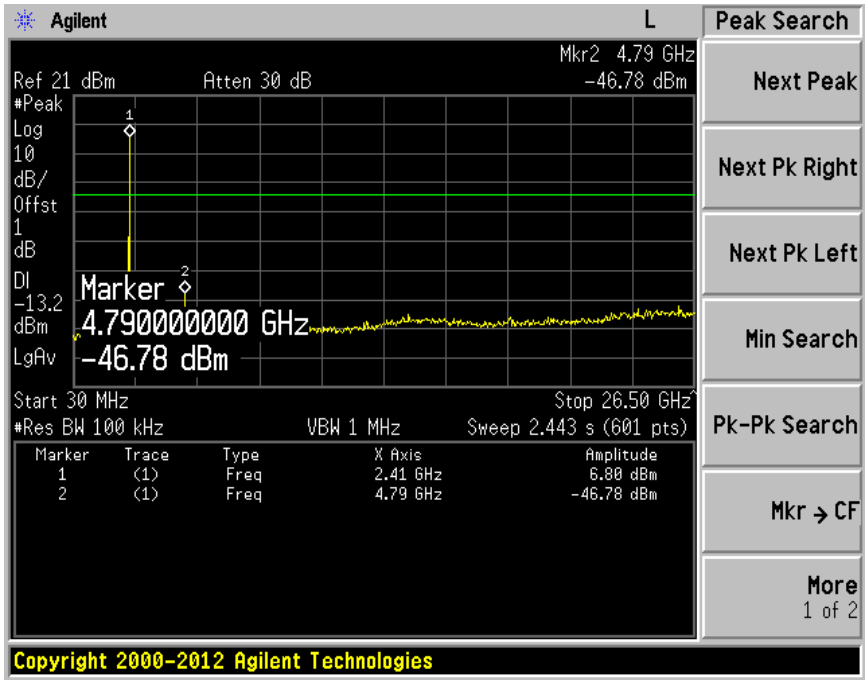
CH78


Agilent
L
Marker
Mkr2 2.483 97 GHz
Ref 21 dBm
Atten 30 dB
-52.39 dBm
Peak
Log
10
dB/
Offst
1
dB
DI
-12.9
dBm
LgAv
Marker
2.483970000 GHz
-52.39 dBm
Center 2.483 50 GHz
Span 20 MHz
#Res BW 200 kHz
VBW 200 kHz
Sweep 1 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.480 17 GHz 7.14 dBm
2 (1) Freq 2.483 97 GHz -52.39 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

CH0


Agilent
L
Peak Search
Mkr2 4.79 GHz
Ref 21 dBm
Atten 30 dB
-46.78 dBm
Next Peak
#Peak
Log
10
dB/
Offst
1
dB
Next Pk Right
Next Pk Left
DI
-13.2
dBm
LgAv
Marker
4.790000000 GHz
-46.78 dBm
Min Search
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.443 s (601 pts)
Pk-Pk Search
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.41 GHz 6.80 dBm
2 (1) Freq 4.79 GHz -46.78 dBm
Mkr → CF
More
1 of 2
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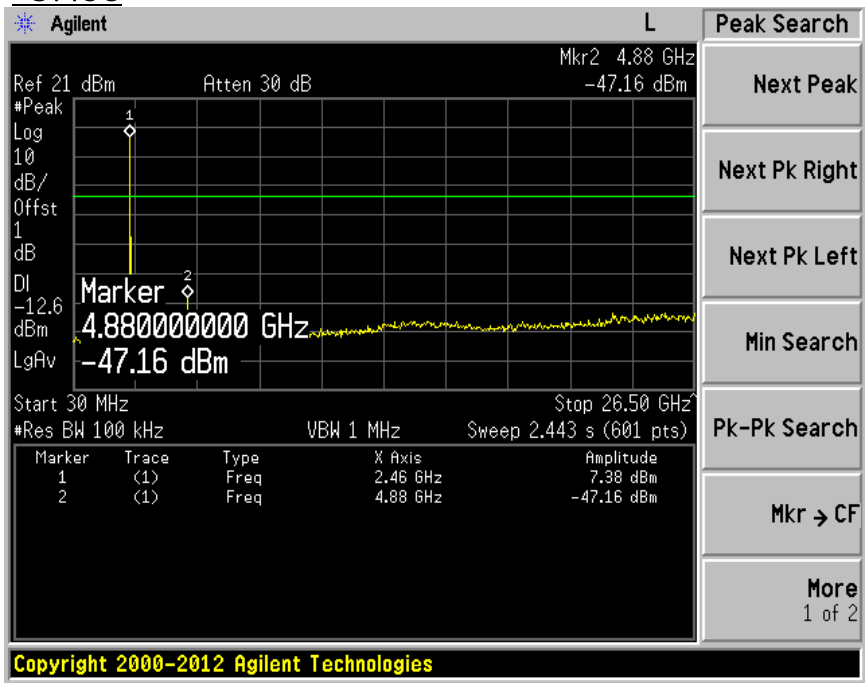
CH38


Agilent
L
Peak Search
Mkr2 4.88 GHz
Ref 21 dBm
Atten 30 dB
-47.16 dBm
Next Peak
#Peak
Log
10
dB/
Offst
1
dB
Next Pk Right
Next Pk Left
DI
-12.6
dBm
LgAv
Marker
4.880000000 GHz
-47.16 dBm
Min Search
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.443 s (601 pts)
Pk-Pk Search
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.46 GHz 7.38 dBm
2 (1) Freq 4.88 GHz -47.16 dBm
Mkr → CF
More
1 of 2
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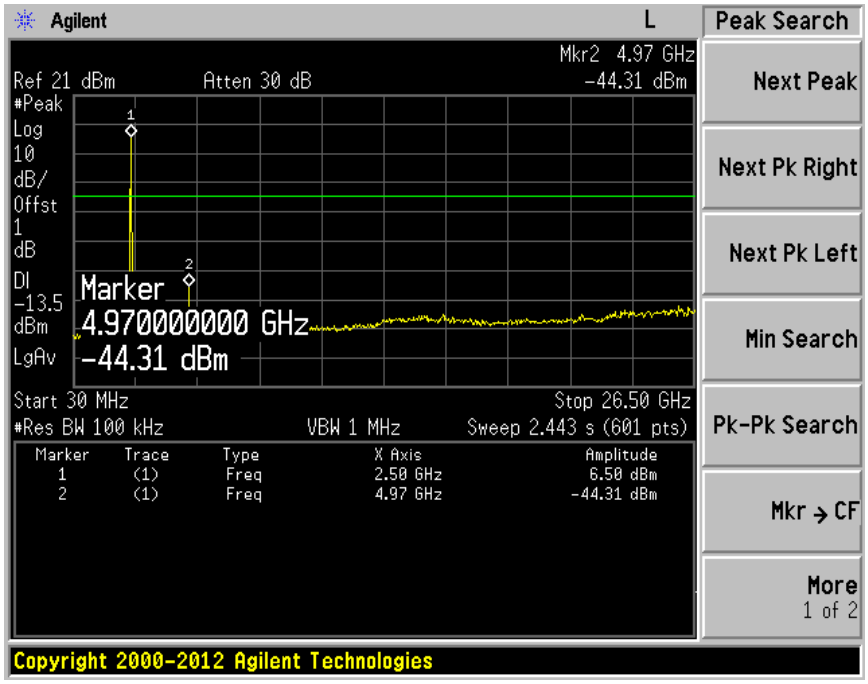
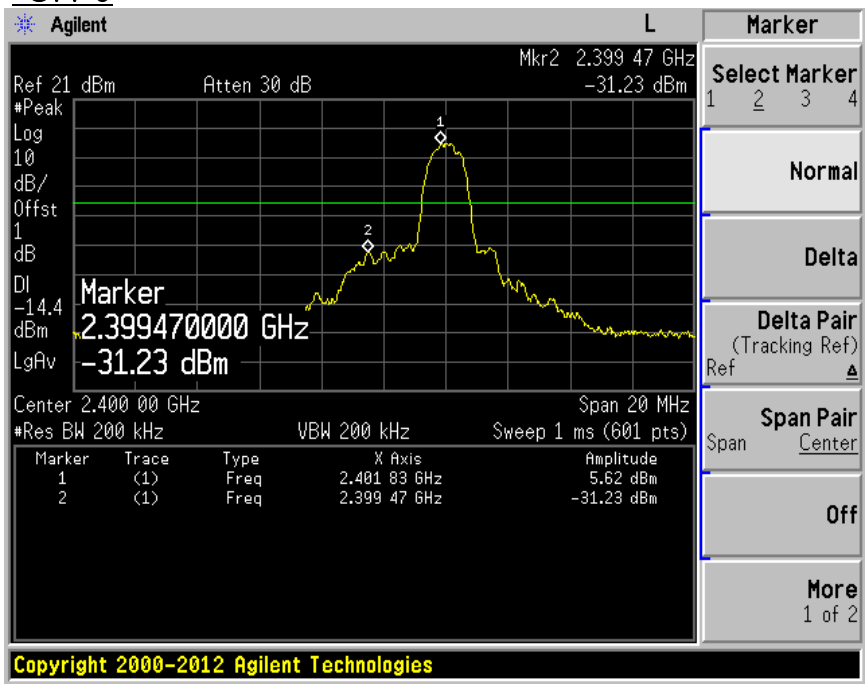
CH79

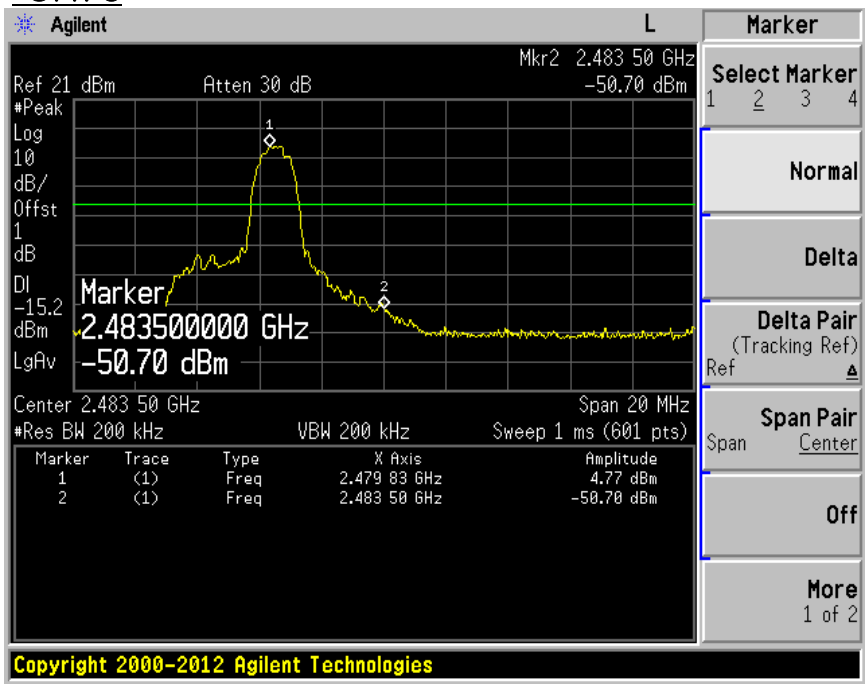

Agilent
L
Peak Search
Mkr2 4.97 GHz
Ref 21 dBm
Atten 30 dB
-44.31 dBm
Next Peak
#Peak
Log
10
dB/
Offst
1
dB
Next Pk Right
Next Pk Left
DI
-13.5
dBm
LgAv
Marker
4.970000000 GHz
-44.31 dBm
Min Search
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 1 MHz
Sweep 2.443 s (601 pts)
Pk-Pk Search
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.50 GHz 6.50 dBm
2 (1) Freq 4.97 GHz -44.31 dBm
Mkr → CF
More
1 of 2
Copyright 2000-2012 Agilent Technologies

8DPSK

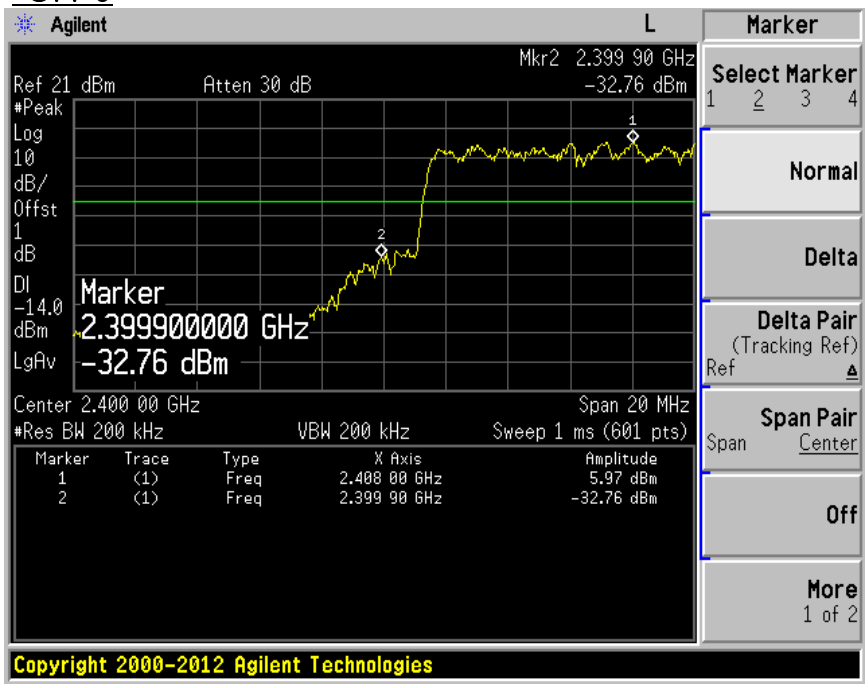
CH 0



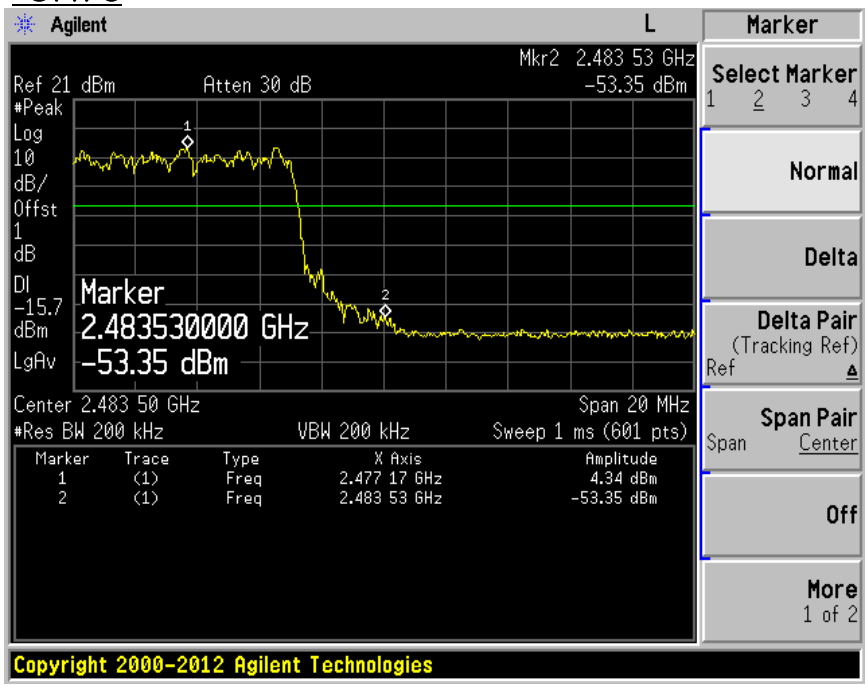

CH78



CH 0


Agilent
L
Marker
Mkr2 2.399 90 GHz
Ref 21 dBm
Atten 30 dB
-32.76 dBm
#Peak
Log
10
dB/
Offst
1
dB
DI
-14.0
dBm
LgAv
Marker
2.399900000 GHz
-32.76 dBm
Center 2.400 00 GHz
Span 20 MHz
#Res BW 200 kHz
VBW 200 kHz
Sweep 1 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.408 00 GHz 5.97 dBm
2 (1) Freq 2.399 90 GHz -32.76 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2012 Agilent Technologies

CH78


Agilent
L
Marker
Mkr2 2.483 53 GHz
Ref 21 dBm
Atten 30 dB
-53.35 dBm
#Peak
Log
10
dB/
Offst
1
dB
DI
-15.7
dBm
LgAv
Marker
2.483530000 GHz
-53.35 dBm
Center 2.483 50 GHz
Span 20 MHz
#Res BW 200 kHz
VBW 200 kHz
Sweep 1 ms (601 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.477 17 GHz 4.34 dBm
2 (1) Freq 2.483 53 GHz -53.35 dBm
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
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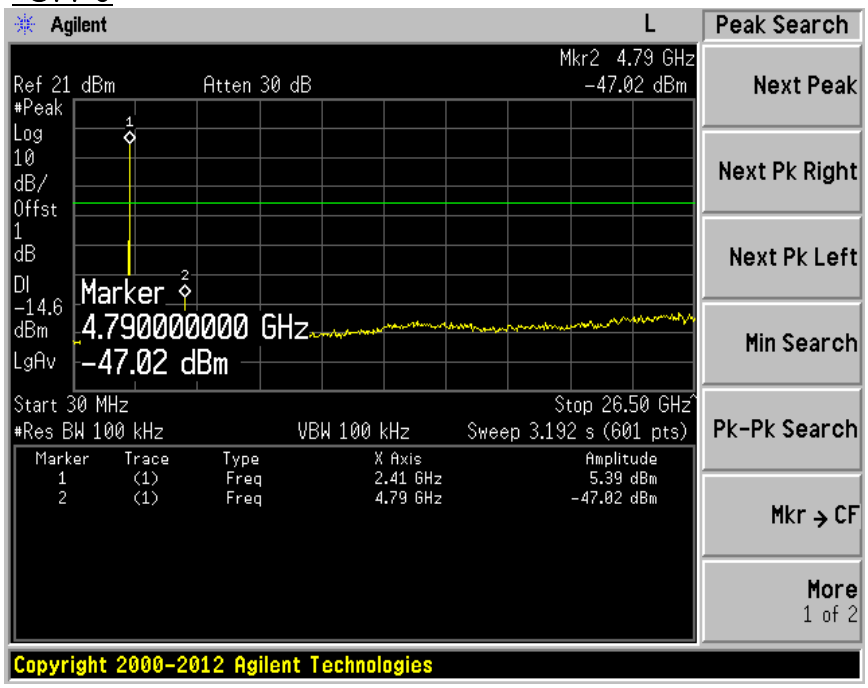
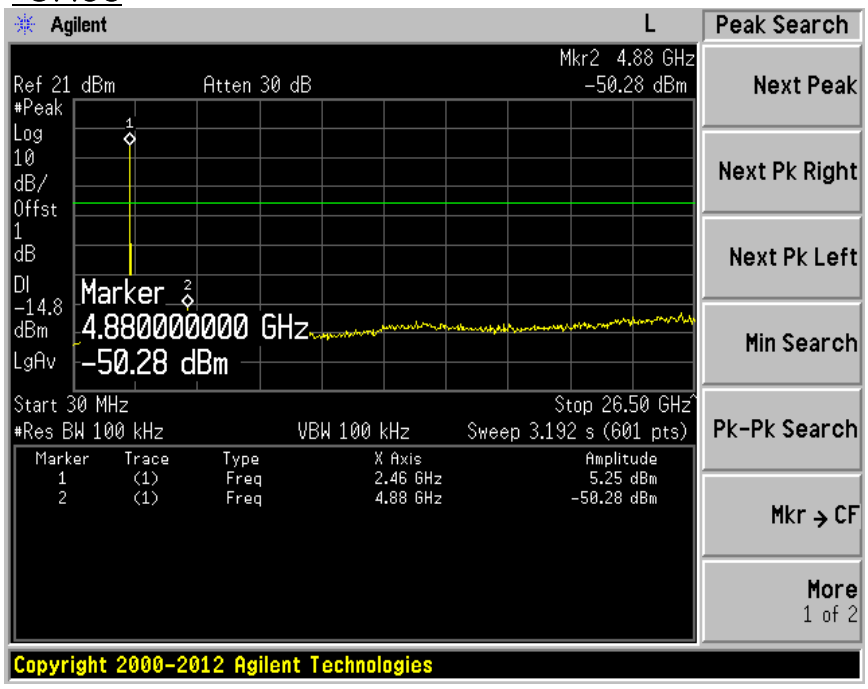
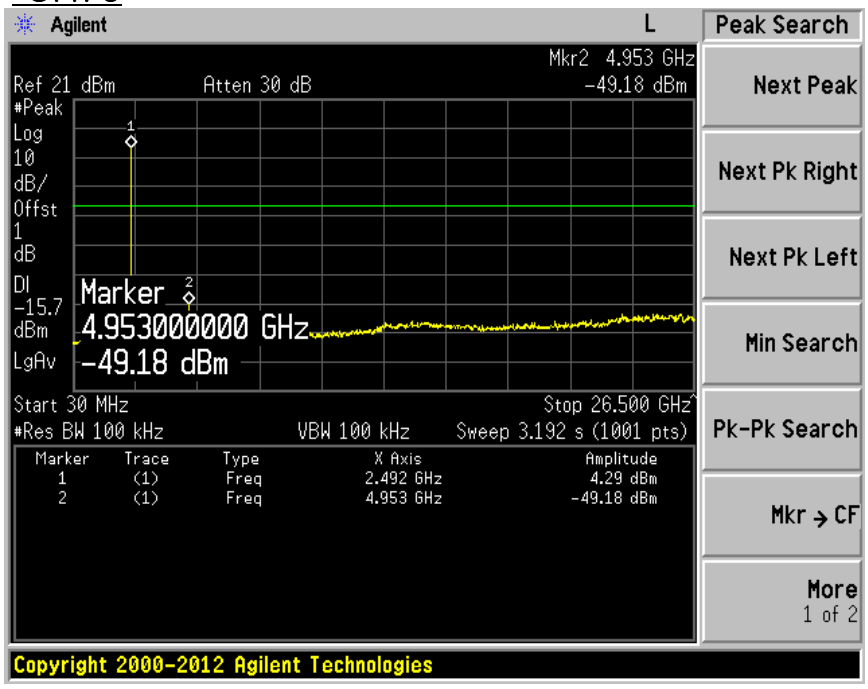
CH 0


Agilent
L
Peak Search
Mkr2 4.79 GHz
Ref 21 dBm
Atten 30 dB
-47.02 dBm
Next Peak
#Peak
Log
10
dB/
Offst
1
dB
Next Pk Right
Next Pk Left
DI
-14.6
dBm
LgAv
Marker
4.790000000 GHz
-47.02 dBm
Min Search
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 3.192 s (601 pts)
Pk-Pk Search
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.41 GHz 5.39 dBm
2 (1) Freq 4.79 GHz -47.02 dBm
Mkr → CF
More
1 of 2
Copyright 2000-2012 Agilent Technologies

CH38


Agilent
L
Peak Search
Mkr2 4.88 GHz
Ref 21 dBm
Atten 30 dB
-50.28 dBm
Next Peak
#Peak
Log
10
dB/
Offst
1
dB
Next Pk Right
Next Pk Left
DI
-14.8
dBm
LgAv
Marker
4.880000000 GHz
-50.28 dBm
Min Search
Start 30 MHz
Stop 26.50 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 3.192 s (601 pts)
Pk-Pk Search
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.46 GHz 5.25 dBm
2 (1) Freq 4.88 GHz -50.28 dBm
Mkr → CF
More
1 of 2
Copyright 2000-2012 Agilent Technologies

CH79


Agilent
L
Peak Search
Mkr2 4.953 GHz
Ref 21 dBm
Atten 30 dB
-49.18 dBm
Next Peak
#Peak
Log
10
dB/
Offst
1
dB
Next Pk Right
Next Pk Left
DI
-15.7
dBm
LgAv
Marker 2
4.953000000 GHz
-49.18 dBm
Min Search
Start 30 MHz
Stop 26.500 GHz
#Res BW 100 kHz
VBW 100 kHz
Sweep 3.192 s (1001 pts)
Pk-Pk Search
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.492 GHz 4.29 dBm
2 (1) Freq 4.953 GHz -49.18 dBm
Mkr → CF
More
1 of 2
Copyright 2000-2012 Agilent Technologies

# 10. Measurement of radiated disturbance

Above 30 MHz Electric Field strength was measured in accordance with FCC PART 15.205, 15.209. The test setup was made according to ANSI C 63.10 (2013) Semi-anechoic chamber, which allows a 3 m distance measurement. The EUT was placed in the center of styrofoam turntable. The height of this table was 0.8 m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated. For further description of the configuration refer to the picture of the test setup.

## 10.1 Measurement equipments

| Equipment Name | Type | Manufacturer | Serial No. | Next Calibration date |
|---|---|---|---|---|
| TEST Receiver | ESCI7 | ROHDE & SCHWARZ | 100916 | 15-Nov-17 |
| Logbicon Antenna | VULB 9168 | SCHWARZBECK | 193 | 11-Mar-17 |
| Turn Table | DT3000-2t | Innco System GmbH | N/A | - |
| Antenna Mast | MA4000-EP | Innco System GmbH | N/A | - |
| PREAMPLIFIER | 8449B | AGILENT | 3008A00581 | 15-Nov-17 |
| Horn Antenna | BBHA9120D | SCHWARZBECK | 469 | 25-Aug-17 |
| Test Receiver | ESPI7 | ROHDE & SCHWARZ | 100185 | 15-Nov-17 |
| Spectrum Analyzer | R3273 | ADVANTEST | 121200664 | 21-Oct-17 |
| Turn Table | DT1500-S | Innco System GmbH | N/A | - |
| Antenna Mast | MA4000-EP | Innco System GmbH | N/A | - |
| Pyramidal Horn Antenna | 3160-09-01 | EST-LINDGREN | 102642 | 25-Aug-17 |
| Antenna Master & Turn table controller | CO2000-P | Innco System GmbH | CO2000/642 /28051111/L | - |

## 10.2 Environmental Condition

Below 1 GHz -Test Place : 10 m Semi-anechoic chamber

BT Basic Rate Mode
Temperature (°C) : 22.4 ℃
Humidity (% R.H.) : 43.5 % R.H.

BT EDR Mode
Temperature (°C) : 22.4 ℃
Humidity (% R.H.) : 47.0 % R.H.

Above 1 GHz-Test Place : 3 m Semi-anechoic chamber

BT Basic Rate Mode
Temperature (°C) : 20.1 ℃
Humidity (% R.H.) : 53.0 % R.H.

BT EDR Mode
Temperature (°C) : 20.4 ℃
Humidity (% R.H.) : 51.5 % R.H.

## 10.3 Test Data for Bluetooth (Basic Rate)

Test Date : 24-Feb-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Result Value | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| 110.40 | 13.80 | V | 1.0 | 9.96 | 1.81 | 43.50 | 25.56 | 17.94 |
| 152.10 | 18.32 | V | 1.0 | 13.06 | 2.11 | 43.50 | 33.49 | 10.01 |
| 180.00 | 20.29 | V | 1.0 | 11.69 | 2.29 | 43.50 | 34.27 | 9.23 |
| 192.00 | 19.76 | V | 1.0 | 10.69 | 2.37 | 43.50 | 32.82 | 10.68 |
| 408.10 | 7.95 | H | 1.0 | 15.81 | 3.43 | 46.00 | 27.19 | 18.81 |
| 420.00 | 11.75 | H | 3.0 | 16.07 | 3.48 | 46.00 | 31.30 | 14.70 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| | |
|---|---|
| Remark | H : Horizontal, V : Vertical Bluetooth (Basic Rate , 39 CH , 2 441 MHz)<br><br>*CL = Cable Loss (In case of below 1 000 MHz)<br>*The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.<br>*Result Value = Reading + Ant Factor + Cable loss<br>*Margin = Limit - Result |

Estech
your best partner

## 10.3-1 Test Data for Bluetooth(Basic Rate)

Test Date : 24-Feb-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Duty Cycle Correction (dB) | Result Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| PEAK(RBW:1 MHz VBW:3 MHz) | | | | | | | | | |
| 2342.00 | 47.82 | H | 1.0 | 26.01 | -30.14 | 0.00 | 74.00 | 43.69 | 30.31 |
| 2332.40 | 48.33 | V | 1.0 | 25.99 | -30.15 | 0.00 | 74.00 | 44.17 | 29.83 |
| 4804.00 | 52.12 | H | 1.5 | 30.93 | -27.04 | 0.00 | 74.00 | 56.01 | 17.99 |
| 4804.00 | 51.28 | V | 1.5 | 30.93 | -27.04 | 0.00 | 74.00 | 55.17 | 18.83 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Average (RBW:1 MHz VBW:1 kHz) | | | | | | | | | |
| 2357.60 | 42.15 | H | 1.5 | 26.04 | -30.12 | 1.04 | 54.00 | 39.11 | 14.89 |
| 2359.20 | 41.49 | V | 1.5 | 26.05 | -30.12 | 1.04 | 54.00 | 38.46 | 15.54 |
| 4804.00 | 42.57 | H | 1.5 | 30.93 | -27.04 | 1.04 | 54.00 | 47.51 | 6.49 |
| 4804.00 | 41.54 | V | 1.5 | 30.93 | -27.04 | 1.04 | 54.00 | 46.48 | 7.52 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Remark**

H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH0 (2 402 MHz)

*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.
FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

## 10.3-2 Test Data for Bluetooth(Basic Rate)

Test Date : 24-Feb-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Duty Cycle Correction (dB) | Result Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| PEAK(RBW:1 MHz VBW:3 MHz) | | | | | | | | | |
| 4882.00 | 52.94 | H | 1.5 | 31.15 | -26.82 | 0.00 | 74.00 | 57.28 | 16.72 |
| 4882.00 | 52.26 | V | 1.5 | 31.15 | -26.82 | 0.00 | 74.00 | 56.60 | 17.40 |
| | | | | | | | | | |
| | | | | | | | | | |
| Average (RBW:1 MHz VBW:1 kHz) | | | | | | | | | |
| 4882.00 | 43.57 | H | 1.5 | 31.15 | -26.82 | 1.04 | 54.00 | 48.95 | 5.05 |
| 4882.00 | 43.70 | H | 1.7 | 31.15 | -26.82 | 1.04 | 54.00 | 49.08 | 4.92 |
| | | | | | | | | | |
| | | | | | | | | | |

**Remark**

H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic Rate-CH39 (2 441 MHz)

*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.
FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

## 10.3-3 Test Data for Bluetooth(Basic Rate)

Test Date : 24-Feb-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Duty Cycle Correction (dB) | Result Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| PEAK(RBW:1 MHz VBW:3 MHz) | | | | | | | | | |
| 2483.50 | 49.21 | H | 1.5 | 26.30 | -29.93 | 0.00 | 74.00 | 75.51 | -1.51 |
| 2483.50 | 59.88 | V | 1.5 | 26.30 | -29.93 | 0.00 | 74.00 | 56.25 | 17.75 |
| 4960.00 | 52.44 | H | 1.5 | 31.38 | -26.70 | 0.00 | 74.00 | 57.12 | 16.88 |
| 4960.00 | 52.62 | V | 1.7 | 31.38 | -26.70 | 0.00 | 74.00 | 57.30 | 16.70 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Average (RBW:1 MHz VBW:1 kHz) | | | | | | | | | |
| 2483.50 | 45.57 | H | 1.5 | 26.30 | -29.93 | 1.04 | 54.00 | 42.98 | 11.02 |
| 2483.50 | 52.63 | V | 1.5 | 26.30 | -29.93 | 1.04 | 54.00 | 50.04 | 3.96 |
| 4960.00 | 44.50 | H | 1.5 | 31.38 | -26.70 | 1.04 | 54.00 | 50.22 | 3.78 |
| 4960.00 | 45.17 | V | 1.7 | 31.38 | -26.70 | 1.04 | 54.00 | 50.89 | 3.11 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Remark**

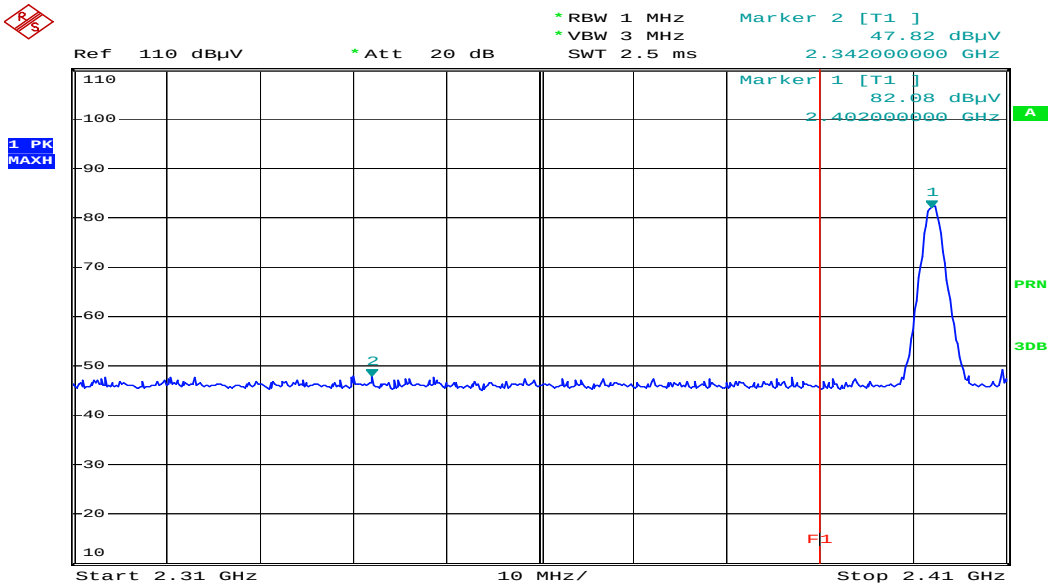
H : Horizontal, V : Vertical TEST MODE : Bluetooth Basic rate-CH78 (2 480 MHz)

*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.
FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= $\Delta t = \tau$ [ms] x 79 channels = 241.582 ms, where $\tau$ = pulse width
b. 100 ms/ $\Delta t$ [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = $\tau$ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

## 10.4 Restricted Band Edges for BT(Basic Rate)

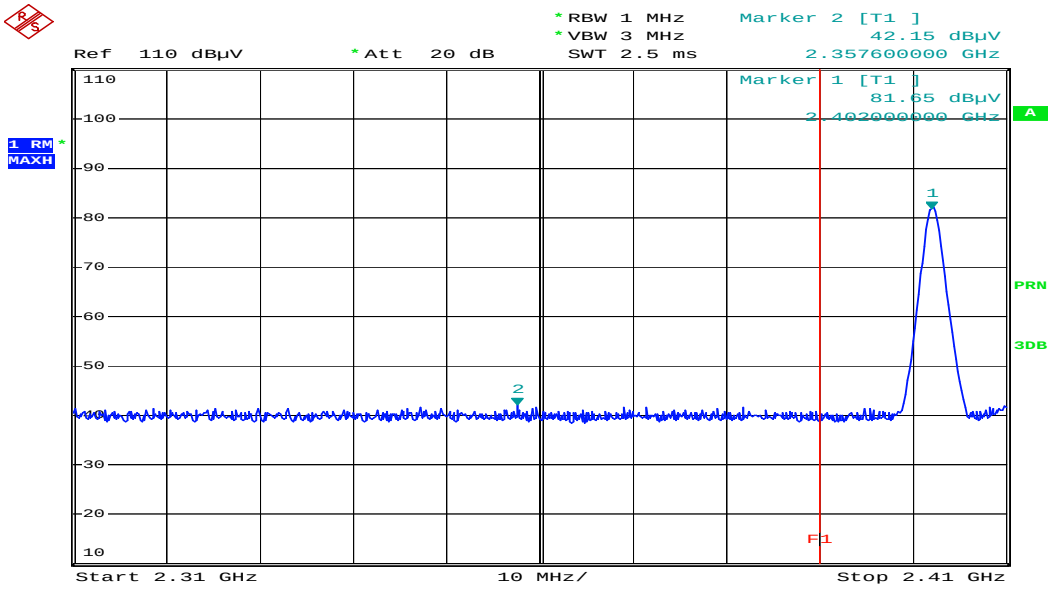
Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal




Comment: H3G-900

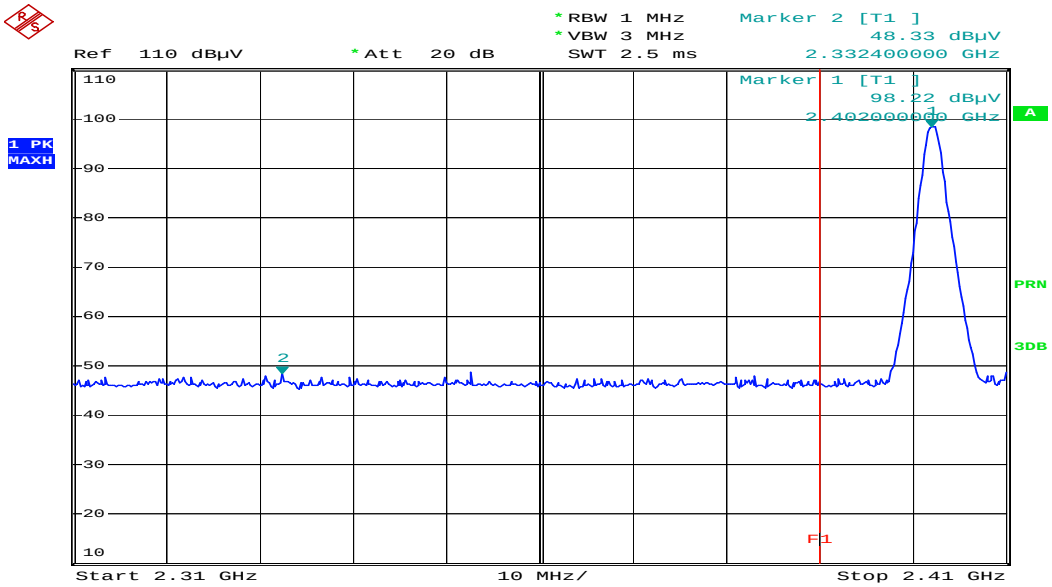
Detector mode:Average Polarity:Horizontal




Comment: H3G-900

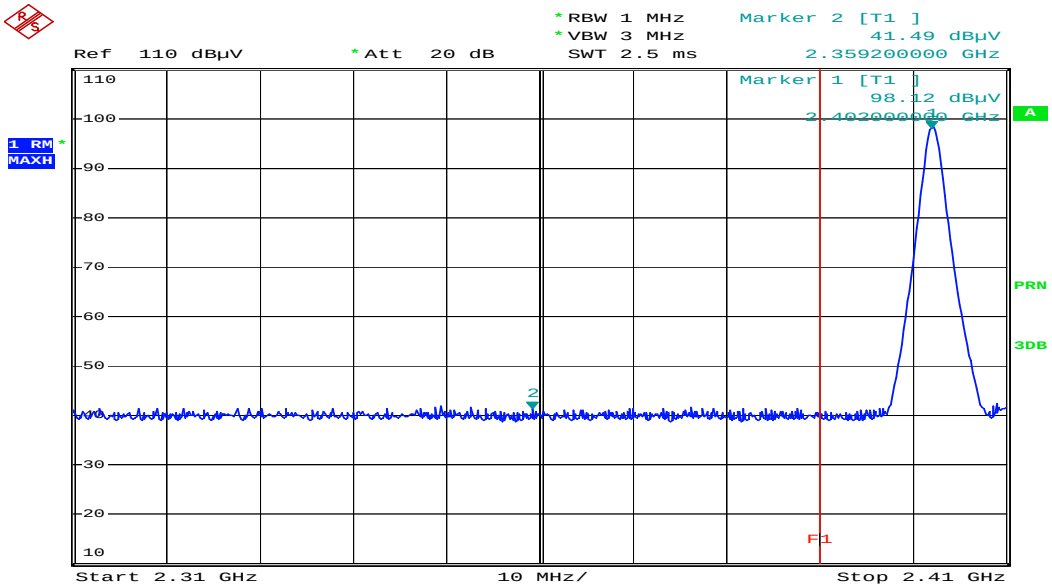
Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical




Comment: H3G-900

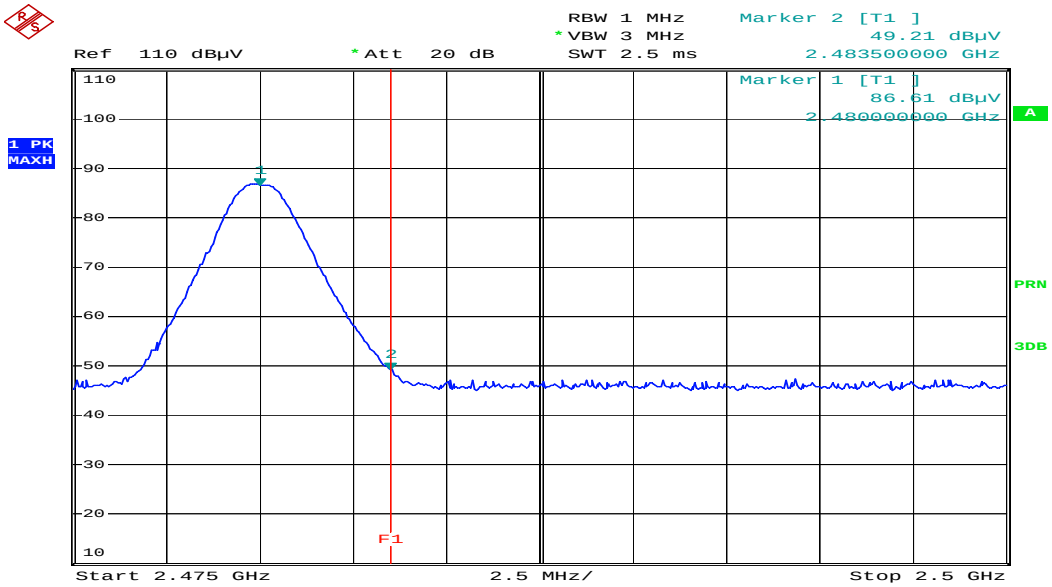
Detector mode:Average Polarity:Vertical




Comment: H3G-900

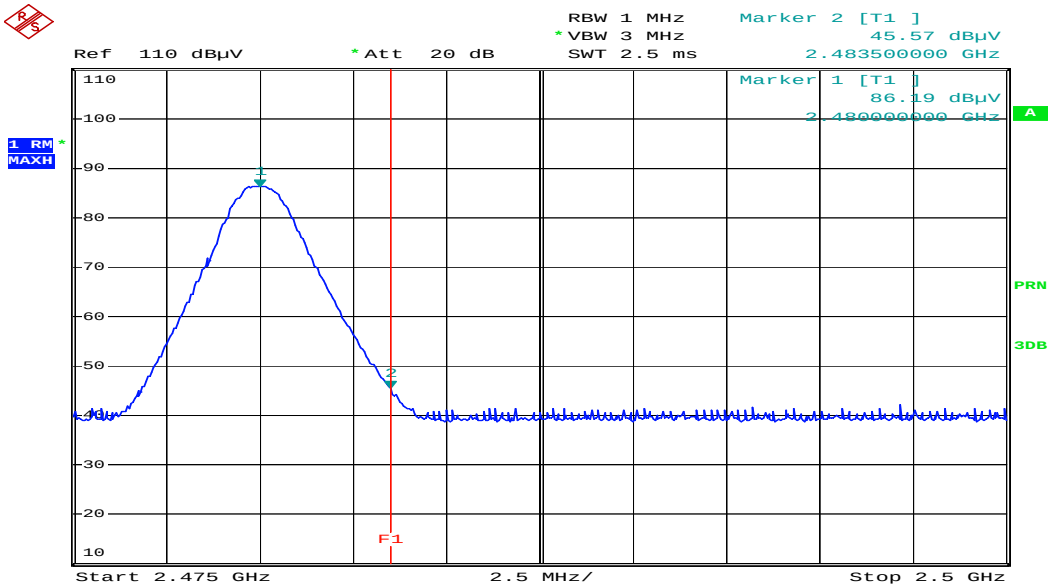
Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal




Comment: ESTE-17-02092-HOR

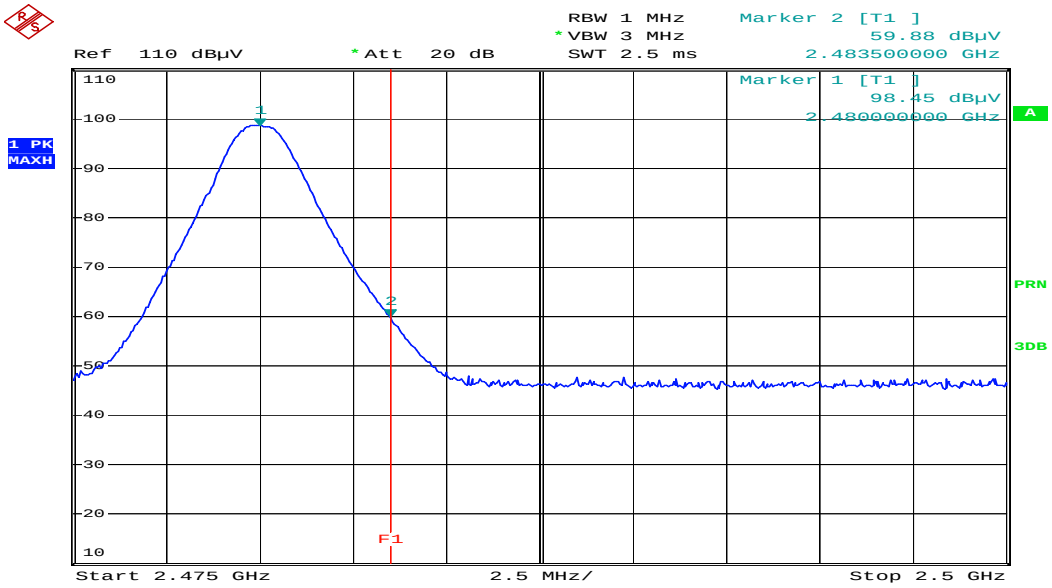
Detector mode:Average Polarity:Horizontal




Comment: ESTE-17-02092-HOR

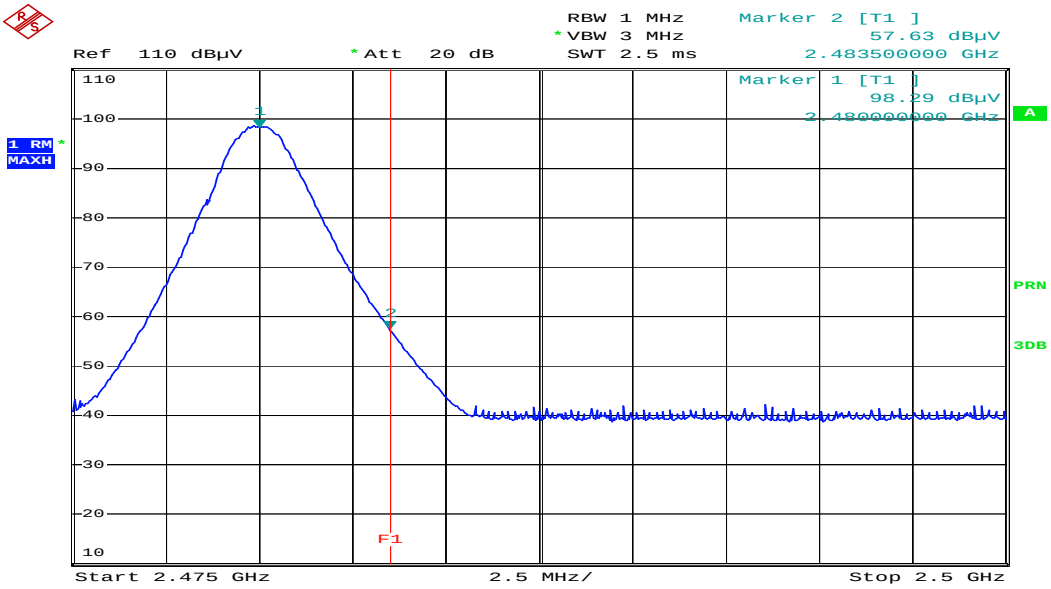
Band Edges(CH High)

Detector mode:Peak Polarity:Vertical




Comment: ESTE-17-02092-HOR

Detector mode:Average Polarity:Vertical




Comment: ESTE-17-02092-HOR

## 10.5 Test Data for Bluetooth (EDR)

Test Date : 3-Mar-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Result Value | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| 148.00 | 15.61 | V | 1.0 | 12.92 | 2.09 | 43.50 | 30.61 | 12.89 |
| 180.00 | 21.61 | H | 1.0 | 11.69 | 2.29 | 43.50 | 35.59 | 7.91 |
| 180.00 | 21.97 | V | 3.0 | 11.69 | 2.29 | 43.50 | 35.95 | 7.55 |
| 190.60 | 19.76 | V | 1.0 | 10.80 | 2.36 | 43.50 | 32.92 | 10.58 |
| 192.00 | 18.62 | H | 1.0 | 10.69 | 2.37 | 43.50 | 31.68 | 11.82 |
| 499.10 | 15.93 | V | 1.0 | 17.82 | 3.81 | 46.00 | 37.56 | 8.44 |
| | | | | | | | | |
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| | |
|---|---|
| Remark | H : Horizontal, V : Vertical Bluetooth (EDR , 39 CH , 2 441 MHz)<br><br>*CL = Cable Loss(In case of below 1 000 MHz)<br>*The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.<br>*Result Value = Reading + Ant Factor + Cable loss<br>*Margin = Limit - Result |

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## 10.5-1 Test Data for Bluetooth(EDR)

Test Date : 3-Mar-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Duty Cycle Correction (dB) | Result Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| PEAK(RBW:1 MHz VBW:3 MHz) | | | | | | | | | |
| 2369.20 | 47.45 | H | 1.5 | 26.07 | -30.11 | 0.00 | 74.00 | 43.41 | 30.59 |
| 2362.40 | 48.11 | V | 1.7 | 26.05 | -30.12 | 0.00 | 74.00 | 44.04 | 29.96 |
| 4804.00 | 51.74 | H | 1.0 | 30.72 | -24.20 | 0.00 | 74.00 | 58.26 | 15.74 |
| 4804.00 | 51.40 | V | 1.0 | 30.72 | -24.20 | 0.00 | 74.00 | 57.92 | 16.08 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Average (RBW:1 MHz VBW:1 kHz) | | | | | | | | | |
| 2347.00 | 42.15 | H | 1.5 | 26.02 | -30.14 | 1.01 | 54.00 | 39.04 | 14.96 |
| 2374.40 | 41.78 | V | 1.7 | 26.08 | -30.10 | 1.01 | 54.00 | 38.76 | 15.24 |
| 4804.00 | 44.46 | H | 1.5 | 30.93 | -27.04 | 1.01 | 54.00 | 49.36 | 4.64 |
| 4804.00 | 43.49 | V | 1.7 | 30.93 | -27.04 | 1.01 | 54.00 | 48.39 | 5.61 |
| | | | | | | | | | |
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| | | | | | | | | | |

**Remark**

H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH0 (2 402 MHz)

*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.

FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

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## 10.5-2 Test Data for Bluetooth(EDR)

Test Date : 3-Mar-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Duty Cycle Correction (dB) | Result Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| PEAK(RBW:1 MHz VBW:3 MHz) | | | | | | | | | |
| 4882.00 | 51.84 | H | 1.5 | 31.15 | -26.82 | 0.00 | 74.00 | 56.18 | 17.82 |
| 4882.00 | 51.64 | V | 1.7 | 31.15 | -26.82 | 0.00 | 74.00 | 55.98 | 18.02 |
| | | | | | | | | | |
| | | | | | | | | | |
| Average(RBW:1 MHz VBW:1 kHz) | | | | | | | | | |
| 4882.00 | 43.29 | H | 1.5 | 31.15 | -26.82 | 1.01 | 54.00 | 48.63 | 5.37 |
| 4882.00 | 43.46 | V | 1.7 | 31.15 | -26.82 | 1.01 | 54.00 | 48.80 | 5.20 |
| | | | | | | | | | |
| | | | | | | | | | |

**Remark**

H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH39 (2 441 MHz)

*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.

FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

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## 10.5-3 Test Data for Bluetooth(EDR)

Test Date : 3-Mar-17 Measurement Distance : 3 m

| Frequency (MHz) | Reading (dBμV) | Position (V/H) | Height (m) | Correction Factor | | Duty Cycle Correction (dB) | Result Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Ant Factor (dB) | Cable (dB) | | Limit (dBμV/m) | Result (dBμV/m) | Margin (dB) |
| PEAK(RBW:1 MHz VBW:3 MHz) | | | | | | | | | |
| 2483.50 | 56.55 | H | 1.5 | 26.30 | -29.93 | 0.00 | 74.00 | 52.92 | 21.08 |
| 2483.50 | 47.05 | V | 1.7 | 26.30 | -29.93 | 0.00 | 74.00 | 43.42 | 30.58 |
| 4960.00 | 51.78 | H | 1.5 | 31.38 | -26.70 | 0.00 | 74.00 | 56.46 | 17.54 |
| 4960.00 | 51.84 | V | 1.7 | 31.38 | -26.70 | 0.00 | 74.00 | 56.52 | 17.48 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| Average (RBW:1 MHz VBW:1 kHz) | | | | | | | | | |
| 2483.50 | 49.96 | H | 1.5 | 26.30 | -29.93 | 1.01 | 54.00 | 47.34 | 6.66 |
| 2483.50 | 41.68 | V | 1.7 | 26.30 | -29.93 | 1.01 | 54.00 | 39.06 | 14.94 |
| 4896.00 | 43.67 | H | 1.5 | 31.19 | -26.78 | 1.01 | 54.00 | 49.09 | 4.91 |
| 4896.00 | 44.02 | V | 1.7 | 31.19 | -26.78 | 1.01 | 54.00 | 49.44 | 4.56 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Remark**

H : Horizontal, V : Vertical TEST MODE : Bluetooth EDR-CH78 (2 480 MHz)

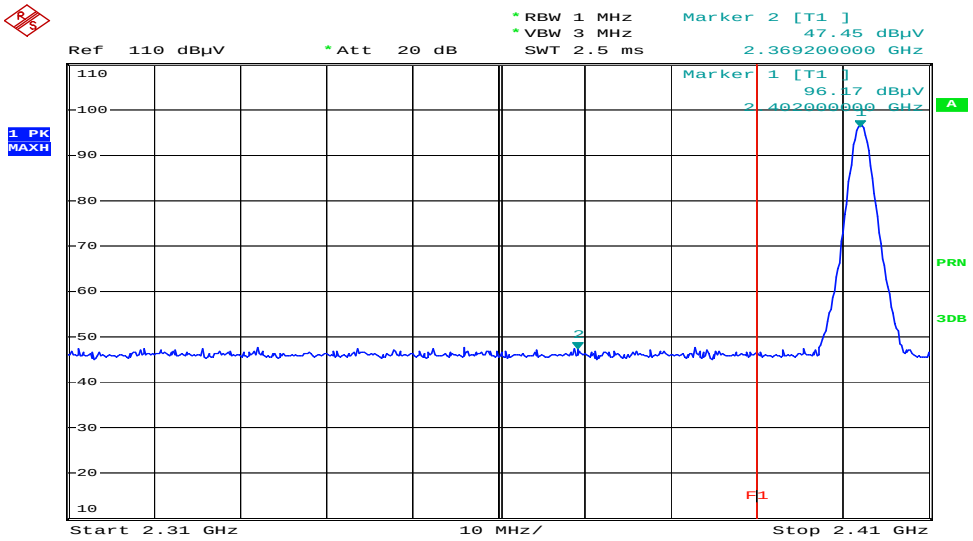
*The TX signal wasn't detected from 3th harmonics.
*Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor
*Margin = Limit - Result
*The resolution bandwidth and video bandwidth of spectrum analyzer is 1 MHz and 1 kHz for average detection at frequency above 1 GHz.

FYI : Duty Cycle Correction Factor (79 channel hopping)
a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 241.582 ms, where τ = pulse width
b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' =1
c. Worst Case Dwell Time = τ [ms] x H ' = 3.058ms
d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = - 30.29 dB

## 10.6 Restricted Band Edges for BT(EDR)

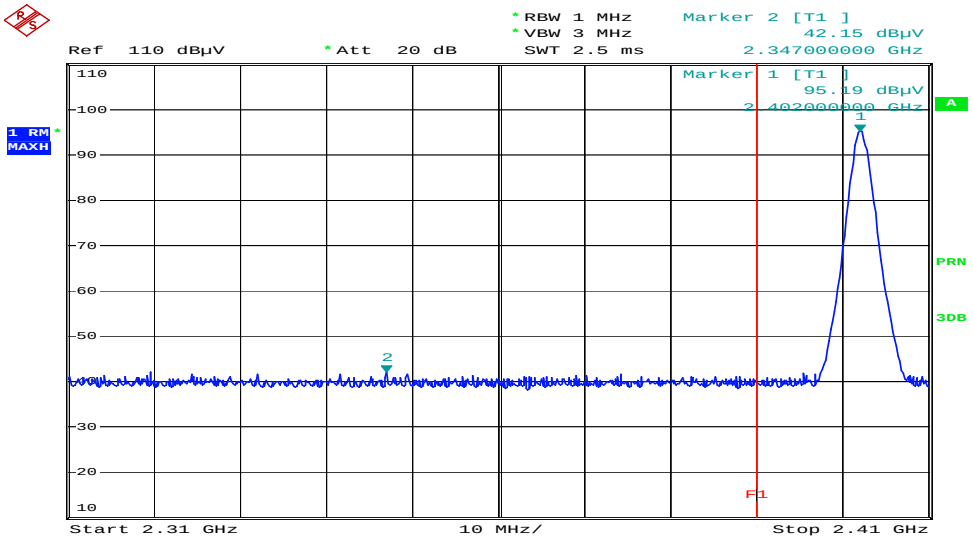
Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal




Comment: ESTE-17-02092-HOR

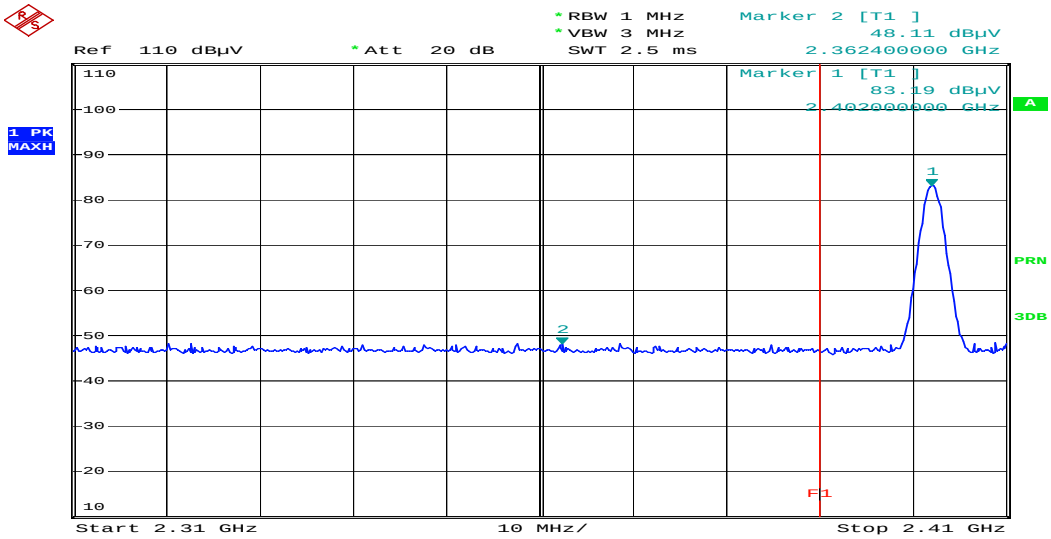
Detector mode:Average Polarity:Horizontal




Comment: ESTE-17-02092-HOR

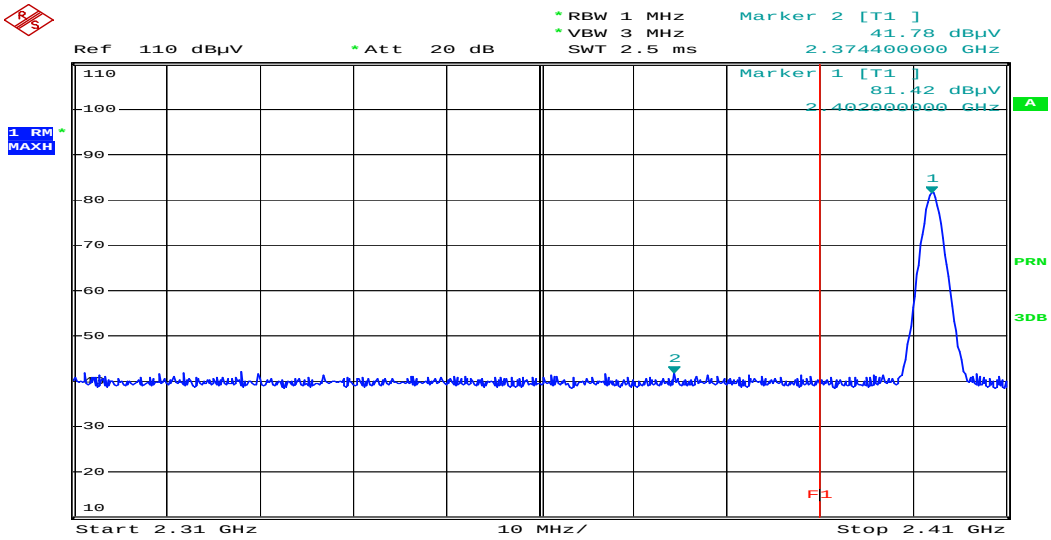
Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical




Comment: ESTE-17-02092-HOR

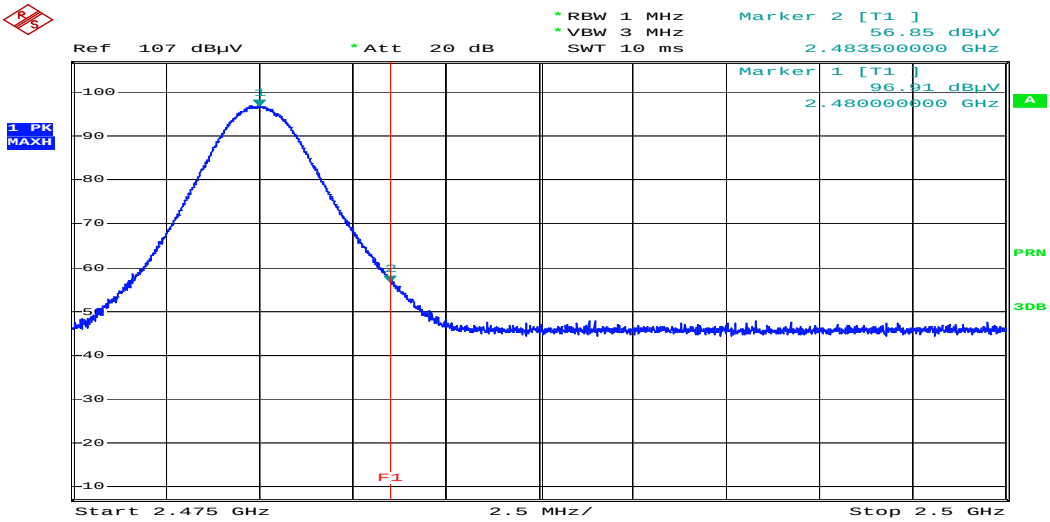
Detector mode:Average Polarity:Vertical




Comment: ESTE-17-02092-HOR

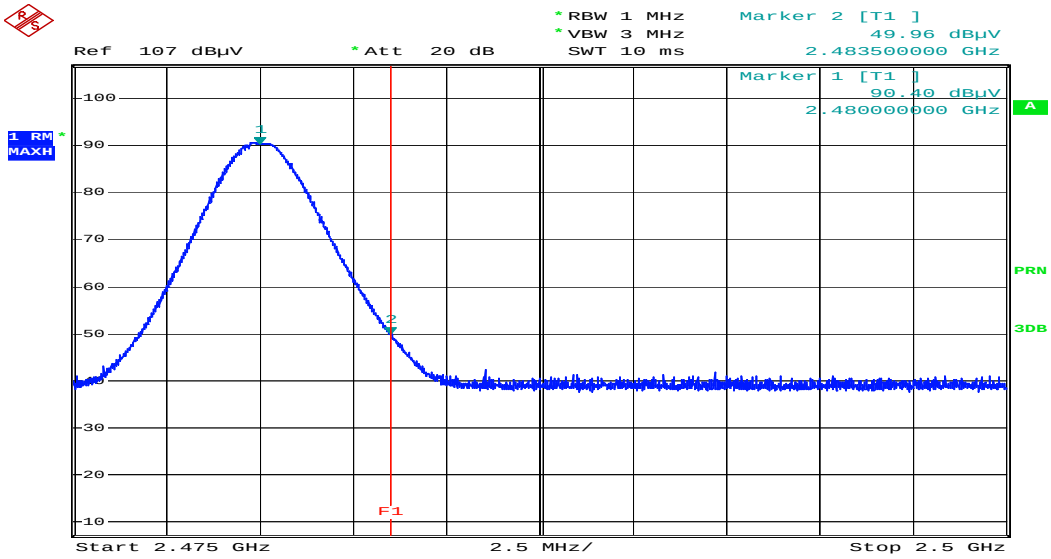
Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal




Comment: H3G-900

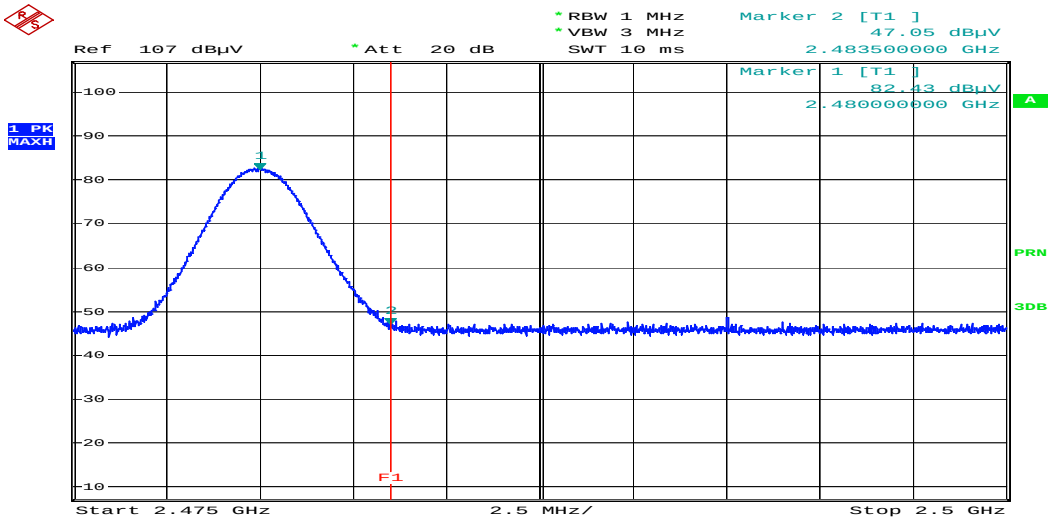
Detector mode:Average Polarity:Horizontal




Comment: H3G-900

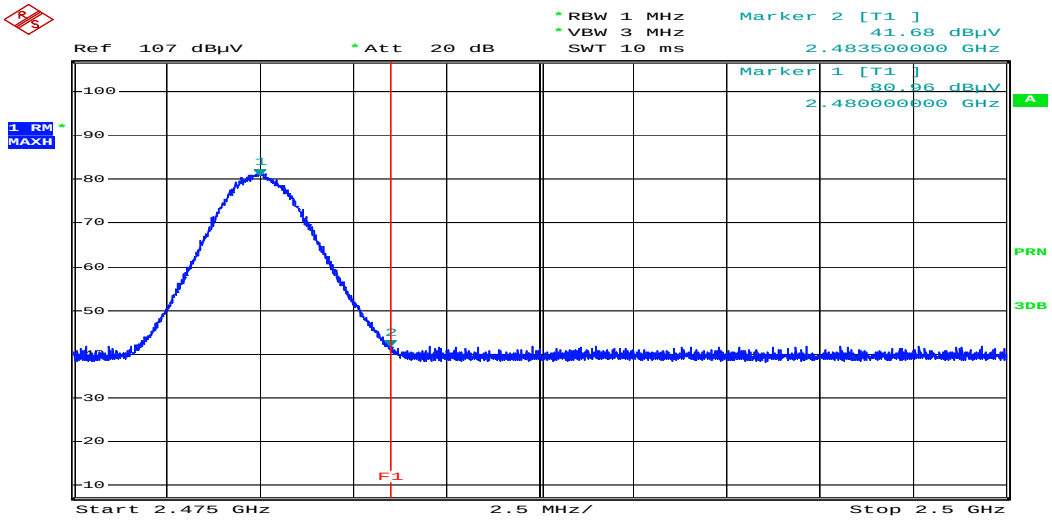
Band Edges(CH High)

Detector mode:Peak Polarity:Vertical




Comment: H3G-900

Detector mode:Average Polarity:Vertical




Comment: H3G-900

# 11. Measurement of conducted disturbance

The continuous disturbance voltage of AC Mains in the frequency from 0.15 MHz to 30 MHz was measured in accordance to FCC PART 15.207. The test setup was made according to ANSI C 63.4 (2009) in a shielded room. The EUT was placed on a non-conductive table at least 0.8 m above the ground plan. A grounded vertical reference plane was positioned in a distance of 0.4 m from the EUT. The distance from the EUT to other metal surfaces was at least 0.8 m. The EUT was only earthen by its power cord through the line impedance stabilizing network. The power cord has been bundled to a length of 1.0 m. The test receiver with Quasi Peak detector complies with CISPR 16.

## 11.1 Measurement equipments

| Equipment Name | Type | Manufacturer | Serial No. | Next Calibration date |
|---|---|---|---|---|
| TEST RECEIVER | ESPI | Rohde & Schwarz | 100005 | 15-Nov-17 |
| LISN | ESH3-Z5 | Rohde & Schwarz | 836679/025 | 15-Nov-17 |
| Pulse Limiter | ESH3Z2 | Rohde & Schwarz | NONE | 15-Nov-17 |
| | | | | |
| | | | | |

## 11.2 Environmental Condition

Test Place : Shielded Room

BT Basic Mode

Temperature (°C) : 22.5 ℃

Humidity (% R.H.) : 43.6 % R.H.

BT EDR Mode

Temperature (°C) : 22.3 ℃

Humidity (% R.H.) : 47.1 % R.H.

## 11.3-1 Test Data for Bluetooth (Basic Rate)

Test Date : 24-Feb-17

| Frequency (MHz) | Correction Factor | | Line (H/N) | Quasi-peak Value | | | Average Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lisn (dB) | Cable (dB) | | Limit (dBμV) | Reading (dBμV) | Result (dBμV) | Limit (dBμV) | Reading (dBμV) | Result (dB) |
| 0.16 | 0.09 | 0.13 | N | 65.67 | 46.67 | 46.89 | 55.67 | 34.81 | 35.03 |
| 0.16 | 0.16 | 0.14 | H | 65.36 | 42.91 | 43.21 | 55.36 | 29.18 | 29.48 |
| 0.17 | 0.09 | 0.15 | N | 64.91 | 48.99 | 49.23 | 54.91 | 34.38 | 34.62 |
| 0.19 | 0.09 | 0.19 | N | 63.95 | 45.43 | 45.71 | 53.95 | 31.02 | 31.30 |
| 0.21 | 0.09 | 0.20 | N | 63.09 | 42.43 | 42.72 | 53.09 | 28.09 | 28.38 |
| 0.23 | 0.16 | 0.20 | H | 62.52 | 37.56 | 37.92 | 52.52 | 23.60 | 23.96 |
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| | | | | | | | | | |
| Remark | H : Hot Line, N : Neutral Line TEST MODE : Bluetooth Basic Rate CH39 (2 441 MHz)<br>*Correction Factor = Lisn + Cable<br>*Result = Correction Factor + Reading | | | | | | | | |

## 11.3-2 Test Data for Bluetooth (EDR)

Test Date : 3-Mar-17

| Frequency (MHz) | Correction Factor | | Line (H/N) | Quasi-peak Value | | | Average Value | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lisn (dB) | Cable (dB) | | Limit (dBμV) | Reading (dBμV) | Result (dBμV) | Limit (dBμV) | Reading (dBμV) | Result (dB) |
| 0.15 | 0.09 | 0.12 | N | 65.84 | 50.52 | 50.73 | 55.84 | 33.62 | 33.83 |
| 0.16 | 0.16 | 0.14 | H | 65.36 | 45.97 | 46.27 | 55.36 | 28.37 | 28.67 |
| 0.17 | 0.16 | 0.15 | H | 64.91 | 49.78 | 50.09 | 54.91 | 35.02 | 35.33 |
| 0.17 | 0.09 | 0.15 | N | 64.91 | 49.20 | 49.44 | 54.91 | 33.59 | 33.83 |
| 0.19 | 0.16 | 0.19 | H | 63.95 | 46.56 | 46.91 | 53.95 | 32.59 | 32.94 |
| 0.19 | 0.09 | 0.19 | N | 63.95 | 45.65 | 45.93 | 53.95 | 30.58 | 30.86 |
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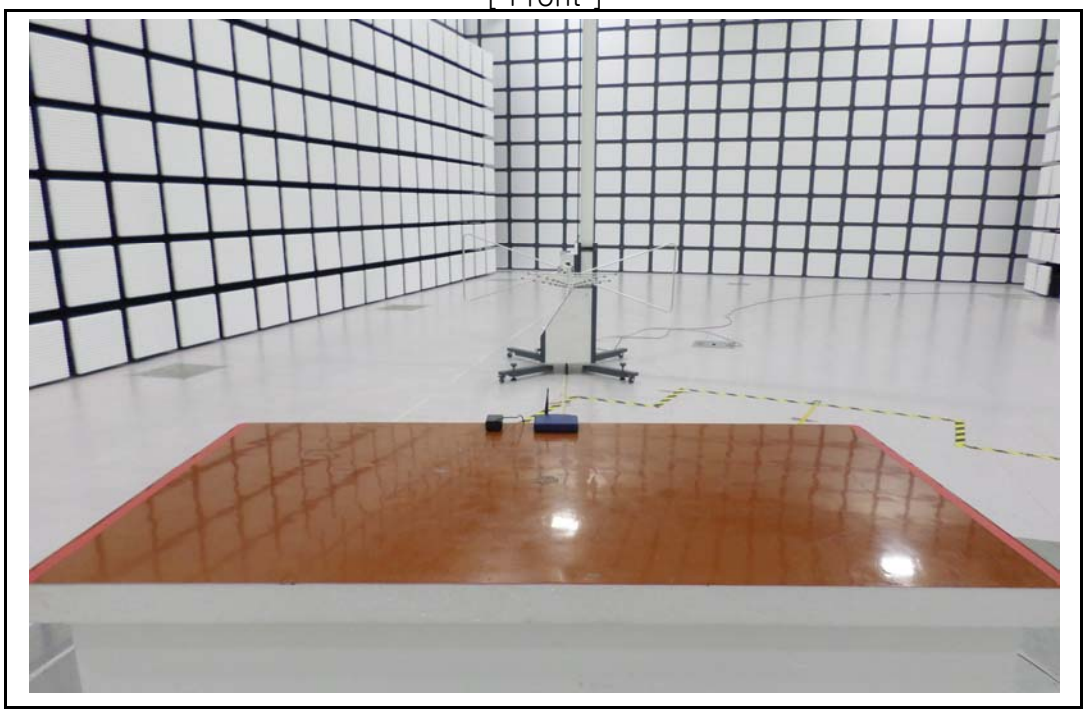
| | | | | | | | | | |
| Remark | H : Hot Line, N : Neutral Line TEST MODE : Bluetooth EDR-CH39 (2 441 MHz)<br>*Correction Factor = Lisn + Cable<br>*Result = Correction Factor + Reading | | | | | | | | |

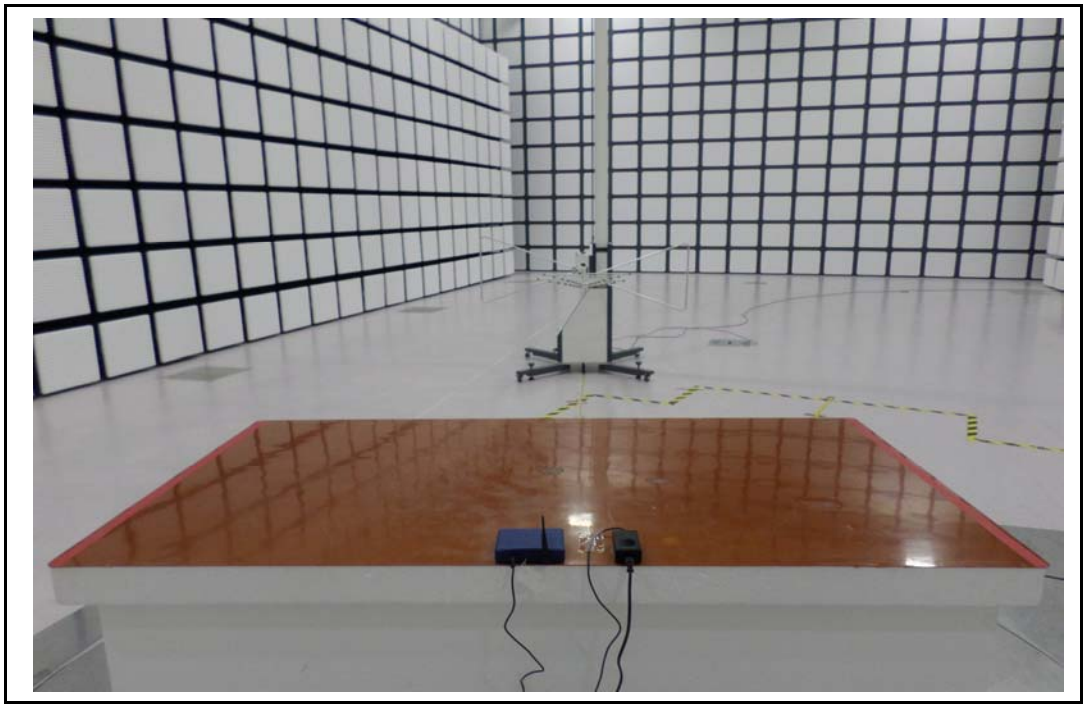
# 12. Photographs of test setup

## 12.1.Setup for Radiated Test : (30 ~ 1 000) MHz

[ Front ]

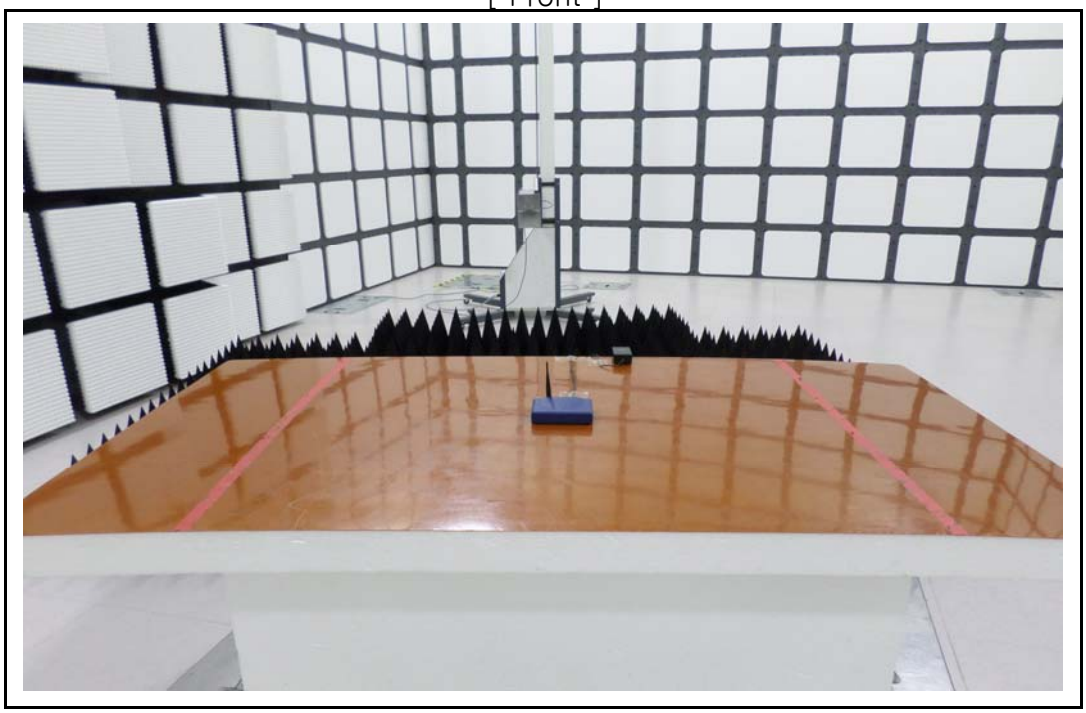


[ Rear ]

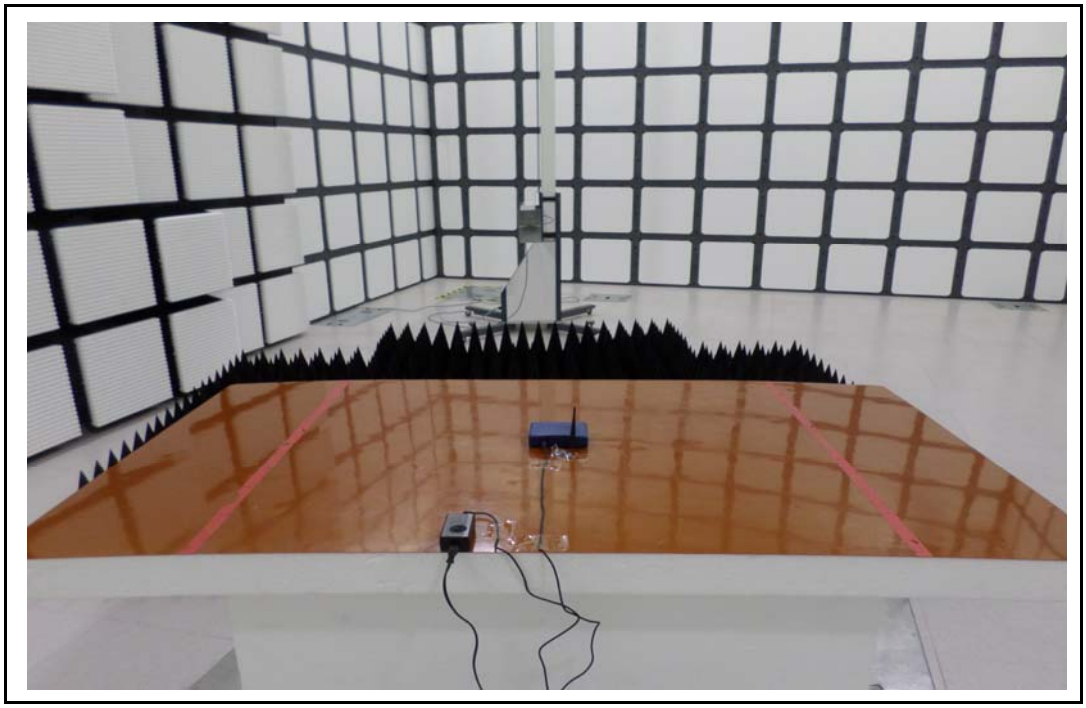


## 12.2. Setup for Radiated Test : Above 1 000 MHz

[ Front ]



[ Rear ]



## 12.3. Setup for Conducted Test : (0.15 ~ 30) MHz

[ Front ]

[ Rear ]

## 12.4. Photographs of EUT

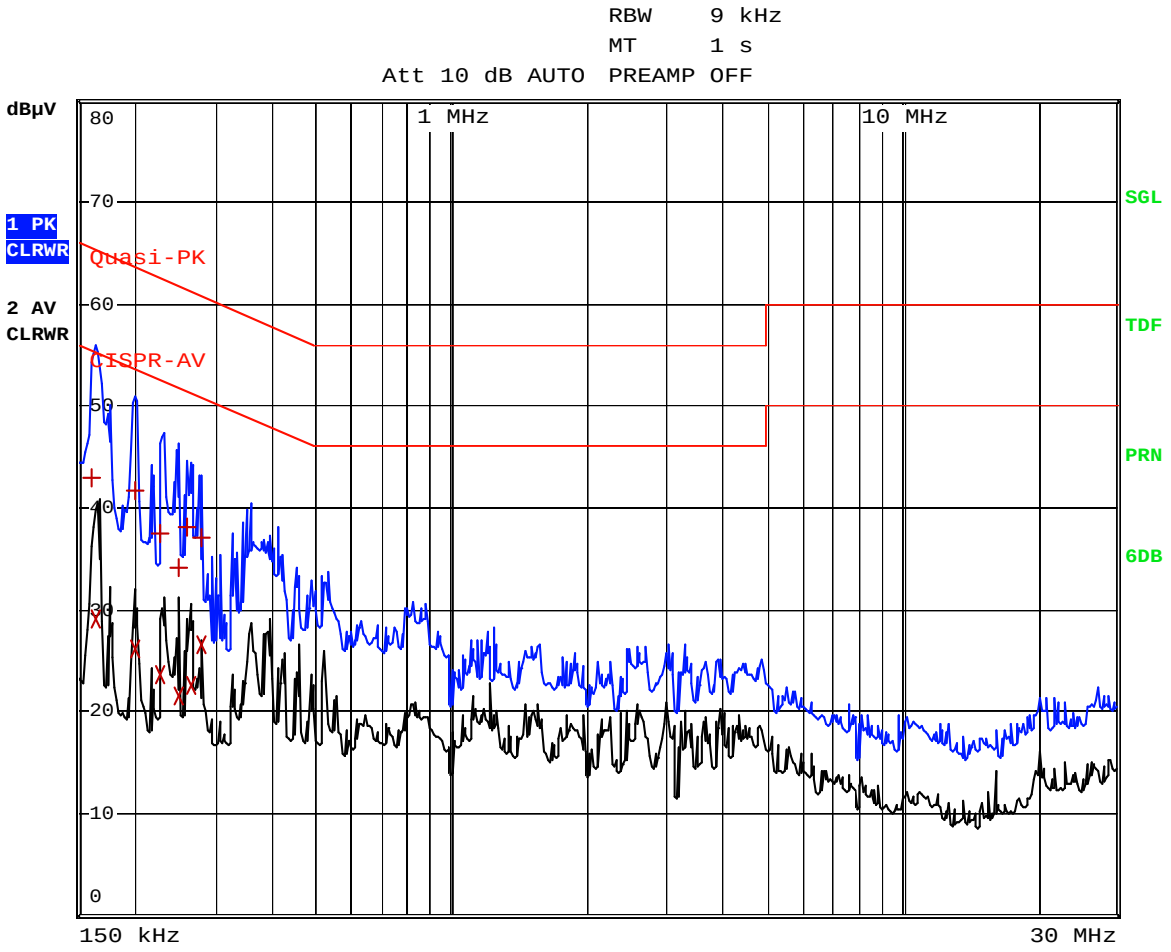
[ Front ]

[ Rear ]

# Appendix 1. Special diagram for Bluetooth (Basic Rate)

Bluetooth – CH 39

*HOT

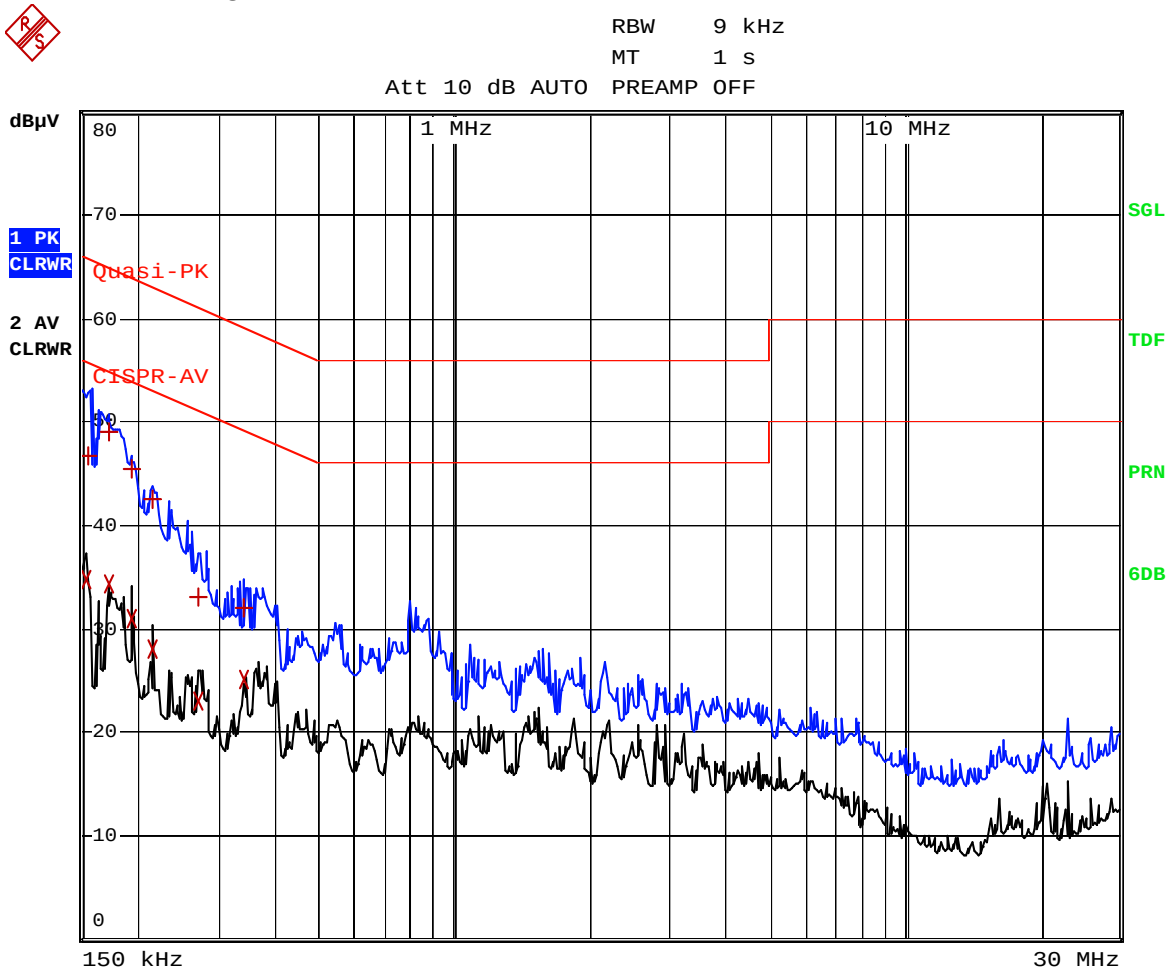



Comment: HOT LINE

# Special diagram for Bluetooth (Basic Rate)

Bluetooth – CH 39

*NEUTRAL

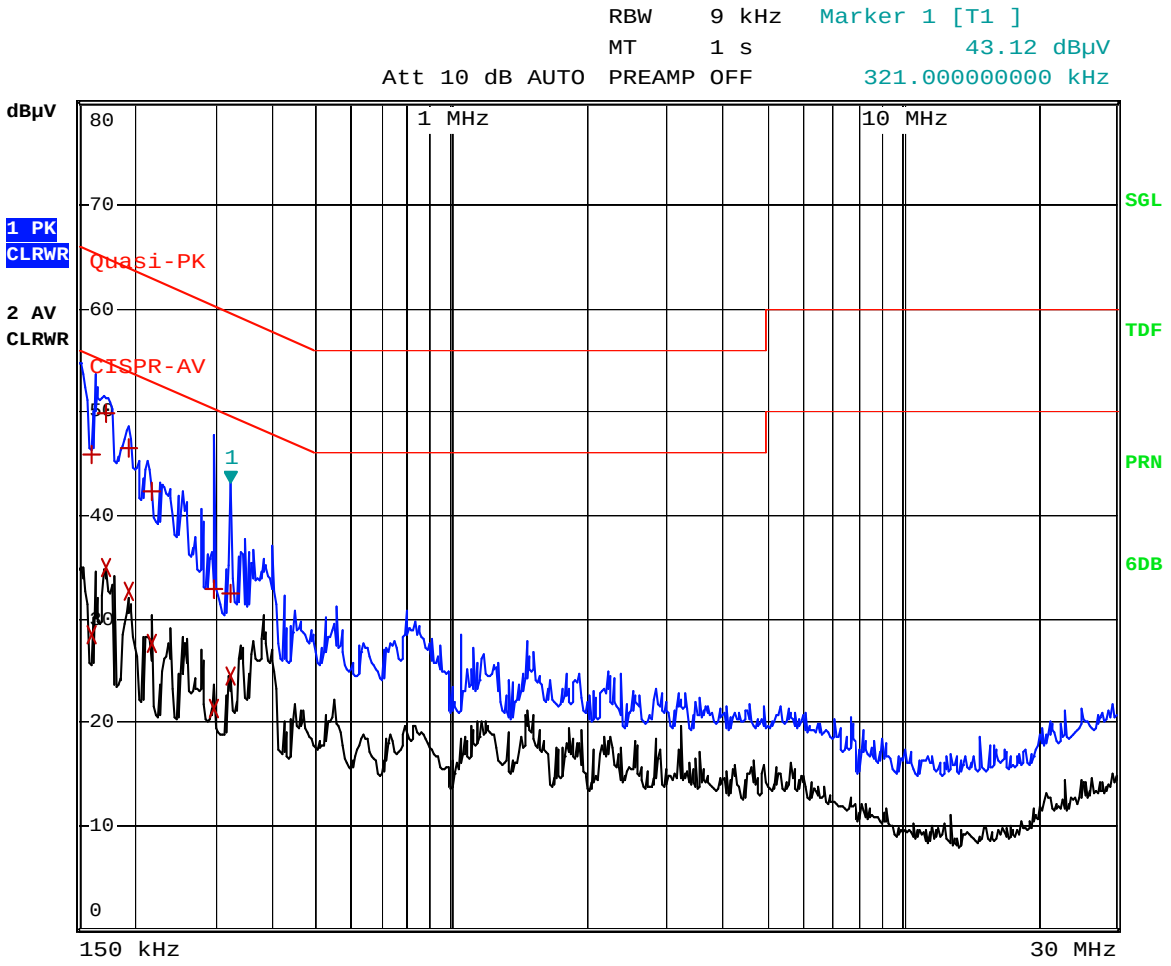



Comment: NEUTRAL LINE

# Special diagram for Bluetooth EDR

Bluetooth – CH 39

*HOT

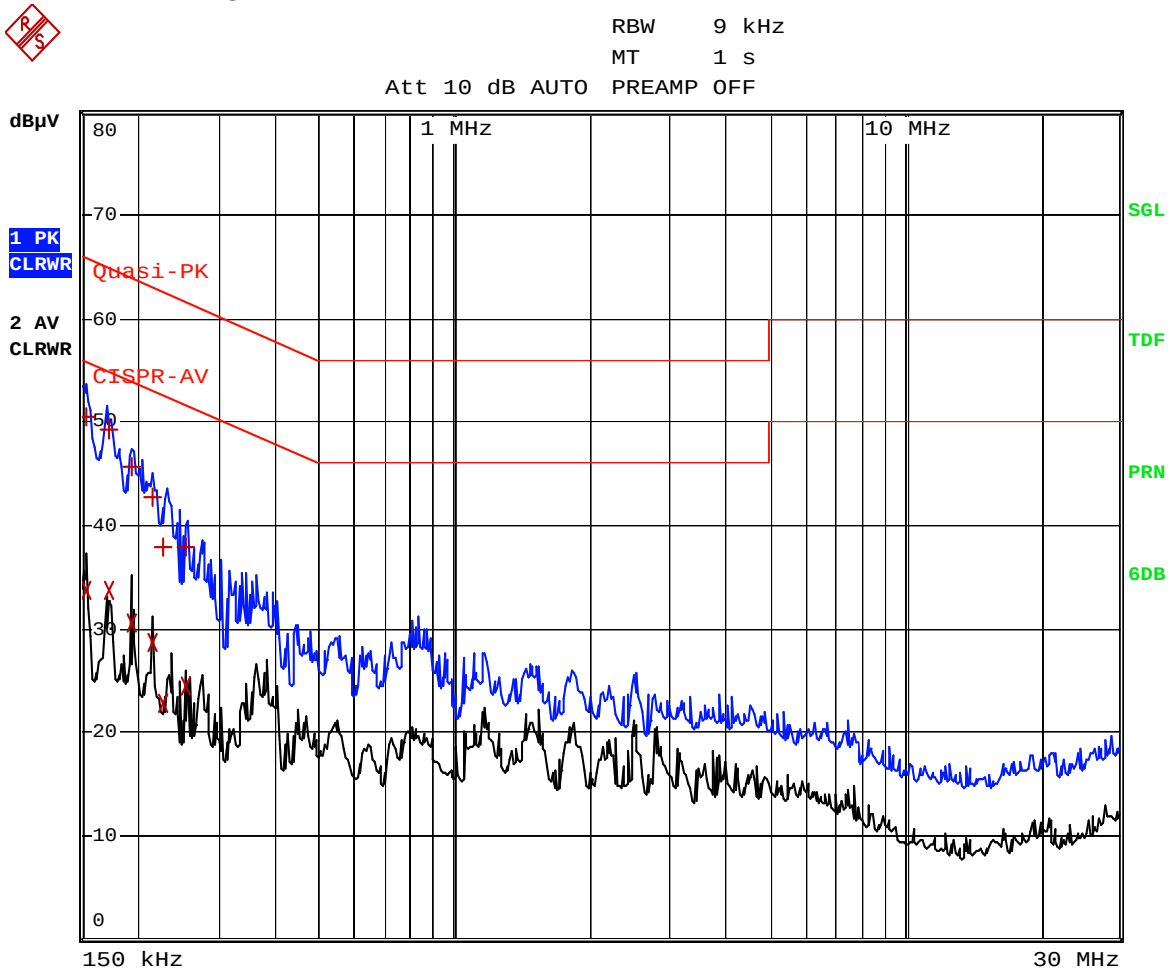



Comment: H3G-900

# Special diagram for Bluetooth EDR

Bluetooth – CH 39

*NEUTRAL




Comment: H3G-900

# Appendix 2. Antenna Requirement

# 1. Antenna Requirement

## 1.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.24

## 1.2 Antenna Connected Construction

The antenna types used in this product are Intergrated Sandwich antenna .
The maximum Gain of this antenna is 3.5 dBi.