**Report No.:** DDT-R15Q0817-1E2

**Issued Date:** Aug. 20, 2015

# FCC AND IC CERTIFICATION TEST REPORT

## FOR

| | | |
|---|---|---|
| **Applicant** | : | Harman International Industries, Incorporated |
| **Address** | : | 8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES |
| **Equipment under Test** | : | Car amplifier |
| **Model No** | : | GTR-104, K4 |
| **Trade Mark** | : | JBL/Infinity |
| **FCC ID** | : | APIJBLGTR104 |
| **IC** | : | 6132A-JBLGTR104 |
| **Manufacturer** | : | Harman International Industries, Incorporated |
| **Address** | : | 8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES |


**Issued By: Dongguan Dongdian Testing Service Co., Ltd.**

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REPORT

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# TEST REPORT DECLARE

| | | |
|---|---|---|
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| **Equipment under Test** | : | Car amplifier |
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| **Trade Mark** | : | JBL/Infinity |
| **FCC ID** | : | APIJBLGTR104 |
| **IC** | : | 6132A-JBLGTR104 |
| **Manufacturer** | : | Harman International Industries, Incorporated |
| **Address** | : | 8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES |

**Test Standard Used:**

FCC Rules and Regulations Part 15 Subpart C: 2015, 2015, RSS-247 Issue 1 May 2015.

**Test procedure used:**

ANSI C63.10:2013, ANSI C63.4:2014, RSS-Gen Issue 4, Nov. 2014.

**We Declare:**

The equipment described above is tested by Dongguan Dongdian Testing Service Co., Ltd and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Dongguan Dongdian Testing Service Co., Ltd is assumed of full responsibility for the accuracy and completeness of these tests.

**After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC&IC standards.**

| | | | |
|---|---|---|---|
| **Report No:** | DDT-R15Q0817-1E2 | | |
| **Date of Test:** | Aug. 14, 2015~Aug. 20, 2015 | **Date of Report**: | Aug. 20, 2015 |

***Prepared By:*** ***Approved By:***

***Leo Liu/Engineer*** ***Kevin Feng/EMC Manager***

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Dongguan Dongdian Testing Service Co., Ltd.

# 1. Summary of test results

| Description of Test Item | Standard | Results |
|---|---|---|
| Maximum Peak Output Power | FCC Part 15: 15.247(b)(1)<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1 | PASS |
| 20dB Bandwidth and 99% Bandwidth | FCC Part 15: 15.215<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1 | PASS |
| Carrier Frequency Separation | FCC Part 15: 15.247(a)(1)<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1 | PASS |
| Number Of Hopping Channel | FCC Part 15: 15.247(a)(1)(iii)<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1 | PASS |
| Dwell Time | FCC Part 15: 15.247(a)(1)(iii)<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1 | PASS |
| Radiated Emission | FCC Part 15: 15.209<br>FCC Part 15: 15.247(d)<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1<br>RSS-Gen Issue 4 clause 7.2.2<br>RSS-Gen Issue 4 clause 7.2.5 | PASS |
| Band Edge Compliance | FCC Part 15: 15.247(d)<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-247 Issue 1 clause 5.1<br>RSS-Gen Issue 4 clause 7.2.2<br>RSS-Gen Issue 4 clause 7.2.5 | PASS |
| Power Line Conducted Emissions | FCC Part 15: 15.207<br>ANSI C63.10 :2013<br>ANSI C63.4:2014<br>RSS-Gen Issue 4 clause 7.2.4 | N/A |
| Antenna requirement | FCC Part 15: 15.203<br>ANSI C63.4:2014<br>RSS-Gen Issue 4 clause 7.1.2 | PASS |
| Remark: N/A is an abbreviation for Not Applicable. | | |

# 2. General test information

## 2.1. Description of EUT

| | | |
|---|---|---|
| EUT* Name | : | Car amplifier |
| Model Number | : | GTR-104, K4 |
| Difference of Model | : | All models are electrically identical, only the appearance, color, trade name and model No. are different .So we prepare GTR-104 for test only. |
| EUT function description | : | Please reference user manual of this device |
| Power supply | : | DC 12V |
| Radio Specification | : | Bluetooth V3.0 (BDR/EDR) |
| Operation frequency | : | 2402MHz -2480MHz |
| Modulation | : | GFSK, π/4 QPSK, 8-DPSK |
| Data rate | : | 1Mbps, 2Mbps, 3Mbps |
| Antenna Type | : | Integrated PCB antenna, maximum PK gain: 0.72dBi |
| Date of Receipt | : | 2015/8/14 |
| Sample Type | : | Series production |

Note : EUT is the ab. of equipment under test.

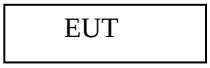
## 2.2. Accessories of EUT

| Description of Accessories | Manufacturer | Model number or Type | Serial No. | Other |
|---|---|---|---|---|
| / | / | / | / | / |

## 2.3. Assistant equipment used for test

| Description of Assistant equipment | Manufacturer | Model number or Type | EMC Compliance | Other |
|---|---|---|---|---|
| / | / | / | / | / |

## 2.4. Block diagram of EUT configuration for test




The test software was used to control EUT work in Continuous TX mode, and select test channel, wireless mode as blow table.

| Tested mode, channel, information | | |
|---|---|---|
| Mode | Channel | Frequency (MHz) |
| GFSK hopping on Tx Mode | CH0 to CH78 | 2402 to 2480 |
| π /4 QPSK Hopping on TX mode | CH0 to CH78 | 2402 to 2480 |
| 8-DPSK hopping on Tx Mode | CH0 to CH78 | 2402 to 2480 |
| GFSK hopping off Tx Mode | CH0 | 2402 |
| | CH39 | 2441 |
| | CH78 | 2480 |
| π/4 QPSK hopping off Tx Mode | CH0 | 2402 |
| | CH39 | 2441 |
| | CH78 | 2480 |
| 8-DPSK hopping off Tx Mode | CH0 | 2402 |
| | CH39 | 2441 |
| | CH78 | 2480 |

Note: For π/4 QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.

Test software for active EUT

| Software | Manufacturer | Model No. | Version | Memo |
|---|---|---|---|---|
| CSR BlueSuite | Cambridge Silicon Radio Limited | BlueTest3 | 2.4.8 | / |

## 2.5. Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature range: | 21-25℃ |
| Humidity range: | 40-75% |
| Pressure range: | 86-106kPa |

## 2.6. Deviations of test standard

No Deviation

## 2.7. Test laboratory

Dongguan Dongdian Testing Service Co., Ltd

Add: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China, 523808 Tel: +86-0769-22891499 http://www.dgddt.com

FCC Registration Number: 270092

## 2.8. Measurement uncertainty

| Test Item | Uncertainty |
|---|---|
| Occupied Channel Bandwidth | ±1% |

| | |
|---|---|
| Uncertainty for radio frequency | $1\times10^{-9}$ |
| RF Output power, conducted | ±0.6dB |
| Power Spectral Density, Conducted | ±1.2dB |
| Unwanted Emissions, Conducted | ±0.6dB |
| Temperature | ±0.2℃ |
| Humidity | ±1% |
| DC and Low frequency voltage | ±0.5% |
| Time | ±1% |
| Duty Cycle | ±1% |
| Uncertainty for Radiation Emission test (30MHz-1GHz) | 3.14 dB (Polarize: V) |
| | 3.16 dB (Polarize: H) |
| Uncertainty for Radiation Emission test (1GHz to 25GHz) | 2.08dB(Polarize: V) |
| | 2.56dB (Polarize: H) |
| Uncertainty for Conduction emission test | 2.44dB |
| Uncertainty for Radiation Emission test (150KHz-30MHz) | 3.21dB |

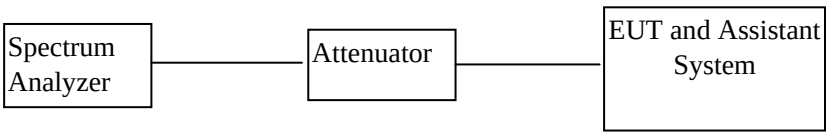
Note：This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

# 3. Maximum Peak Output Power

## 3.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 2 | Attenuator | Mini-Circuits | BW-S10W2 | 101109 | 2014/10/25 | 1 Year |
| 3 | RF Cable | Micable | C10-01-01-1 | 100309 | 2014/10/25 | 1 Year |

## 3.2. Block diagram of test setup



## 3.3. Limits

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts, the e.i.r.p shall not exceed 4W.

## 3.4. Test Procedure

(1) Configure EUT and assistant system according clause 2.4 and 3.2

(2) Connect EUT's antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.4.

(4) Measure the maximum output power of EUT by spectrum analyzer with PK detector and RBW=2MHz(above 20dB bandwidth of measured signal), VBW=3MHz

Note: The attenuator loss was inputted into spectrum analyzer as amplitude offset.

## 3.5. Test Result

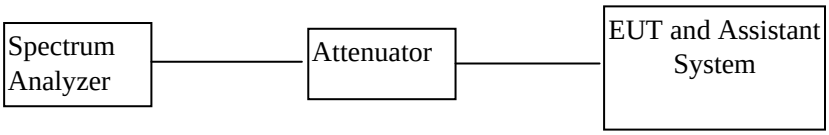
| EUT: Car amplifier M/N: GTR-104 | | | | |
|---|---|---|---|---|
| Mode | Freq (MHz) | Result (dBm) | Limit (dBm) | Conclusion |
| GFSK | 2402 | 1.92 | 30 | PASS |
| | 2441 | 1.17 | 30 | PASS |
| | 2480 | 0.75 | 30 | PASS |
| π/4 QPSK | 2402 | 0.65 | 21 | PASS |
| | 2441 | -0.32 | 21 | PASS |
| | 2480 | -0.94 | 21 | PASS |
| 8-DPSK | 2402 | 0.86 | 21 | PASS |
| | 2441 | -0.26 | 21 | PASS |
| | 2480 | -0.72 | 21 | PASS |
| Test Date : 2015/8/14 | | | Test Engineer : Leo | |

# 4. 20dB Bandwidth and 99% Bandwidth

## 4.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 2 | Attenuator | Mini-Circuits | BW-S10W2 | 101109 | 2014/10/25 | 1 Year |
| 3 | RF Cable | Micable | C10-01-01-1 | 100309 | 2014/10/25 | 1 Year |

## 4.2. Block diagram of test setup




## 4.3. Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

## 4.4. Test Procedure

(1) Configure EUT and assistant system according clause 2.4 and 4.2.

(2) Connect EUT’s antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.4.

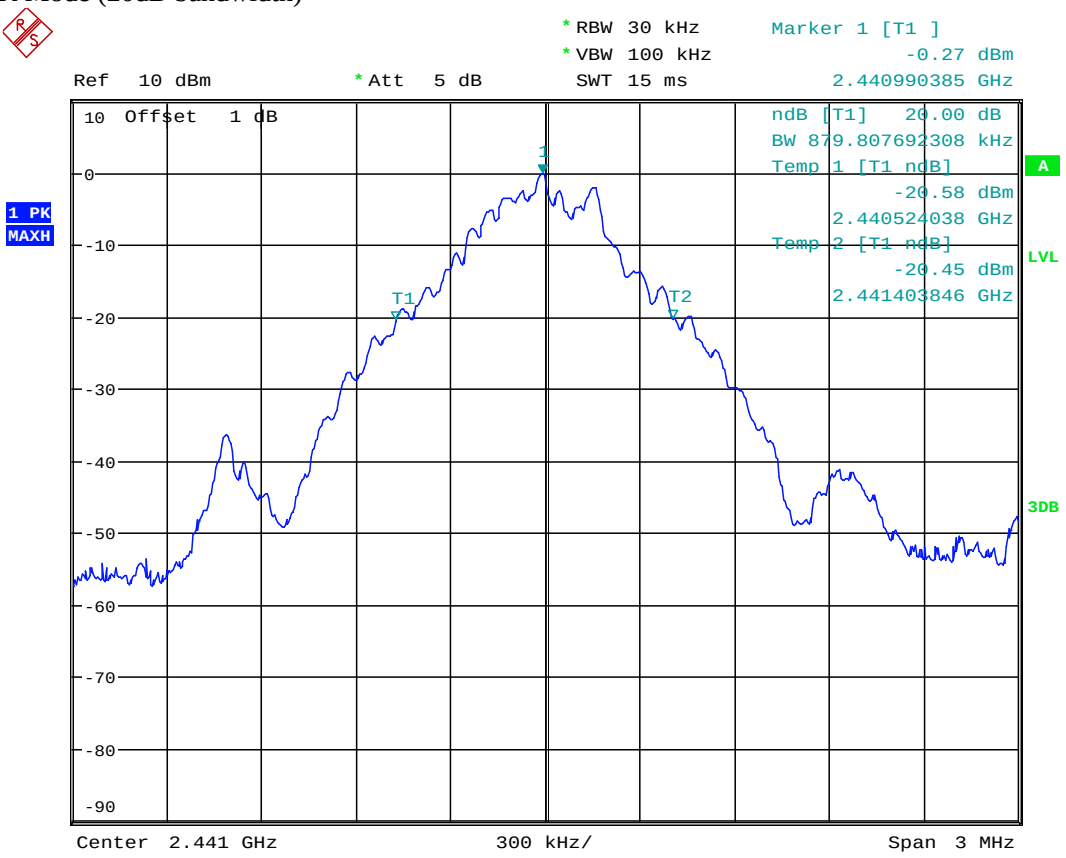
(4) The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 kHz RBW and 100 kHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

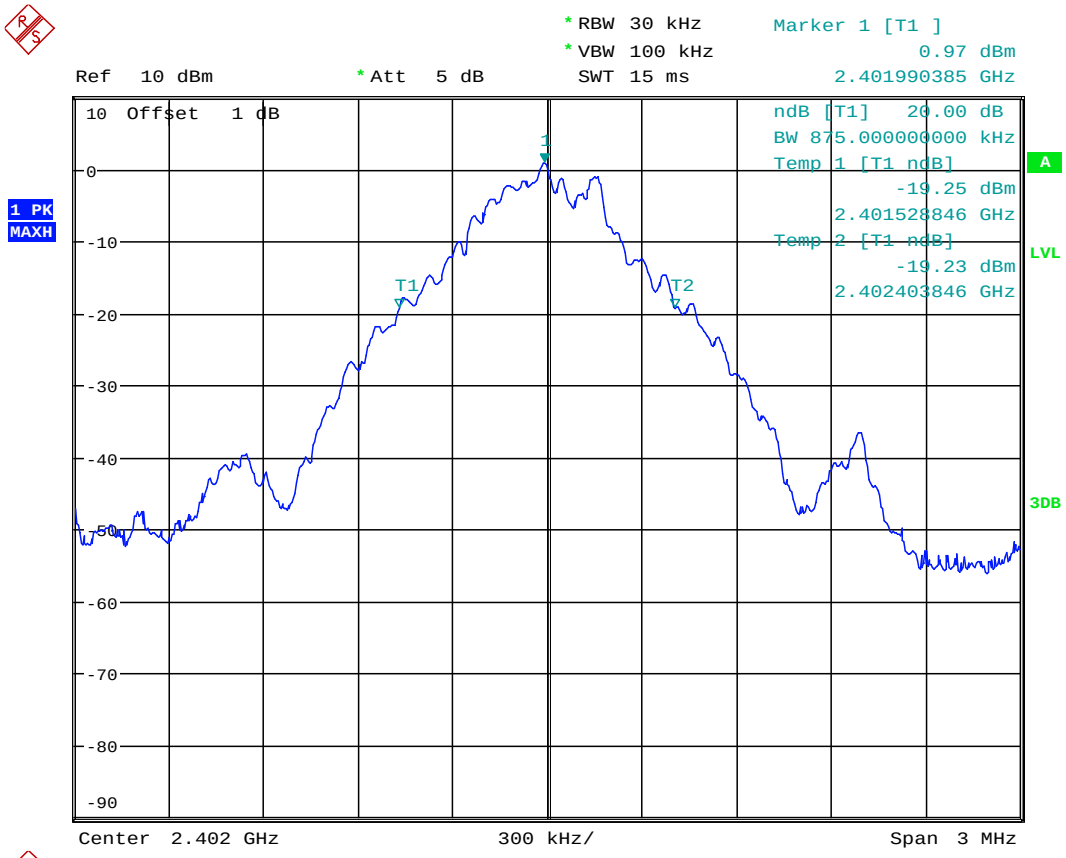
## 4.5. Test Result

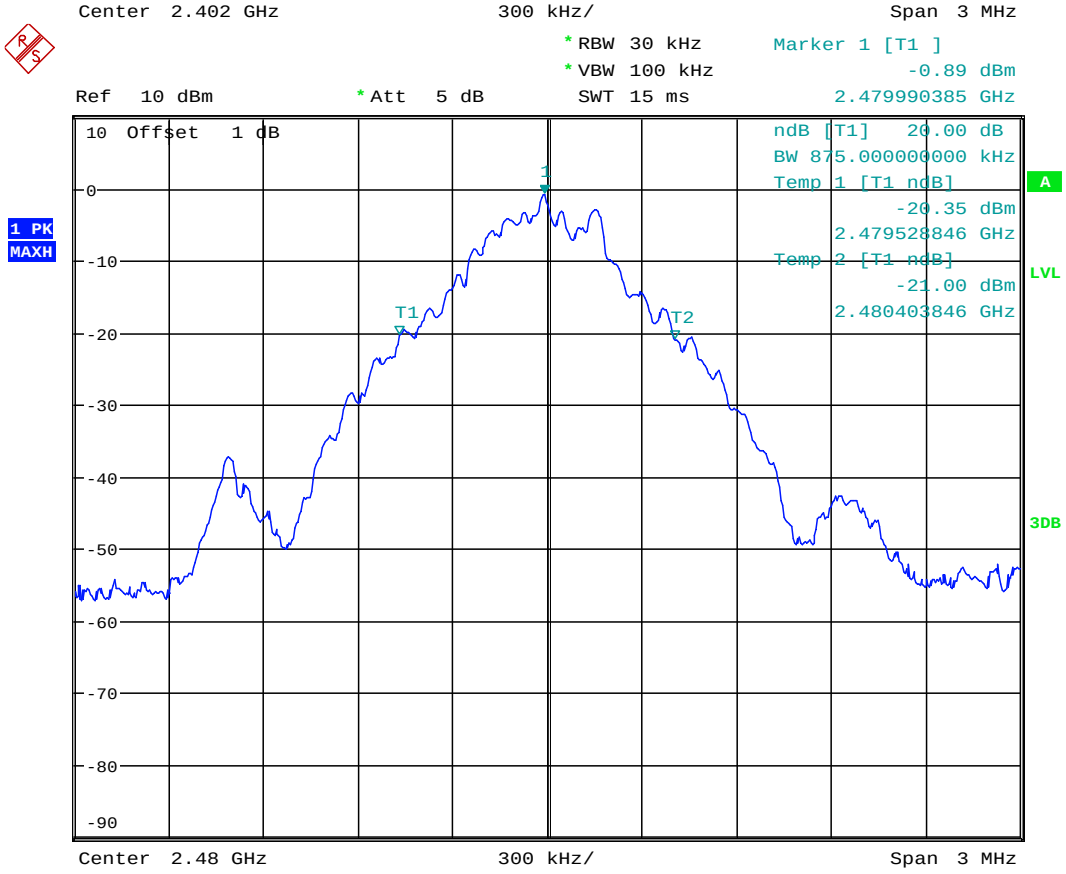
| EUT: Car amplifier M/N: GTR-104 | | | | | | |
|---|---|---|---|---|---|---|
| Mode | Freq (MHz) | 20dB bandwidth Result (MHz) | 99% bandwidth Result (MHz) | Limit (MHz) | Margin (MHz) | Conclusion |
| GFSK | 2402 | 0.875 | 0.861 | / | / | PASS |
| | 2441 | 0.880 | 0.861 | / | / | PASS |
| | 2480 | 0.875 | 0.861 | / | / | PASS |
| 8-DPSK | 2402 | 1.284 | 1.207 | / | / | PASS |
| | 2441 | 1.284 | 1.183 | / | / | PASS |
| | 2480 | 1.274 | 1.173 | / | / | PASS |
| Test Date : 2015/8/14 | | | | Test Engineer: Leo | | |

## 4.6. Original test data

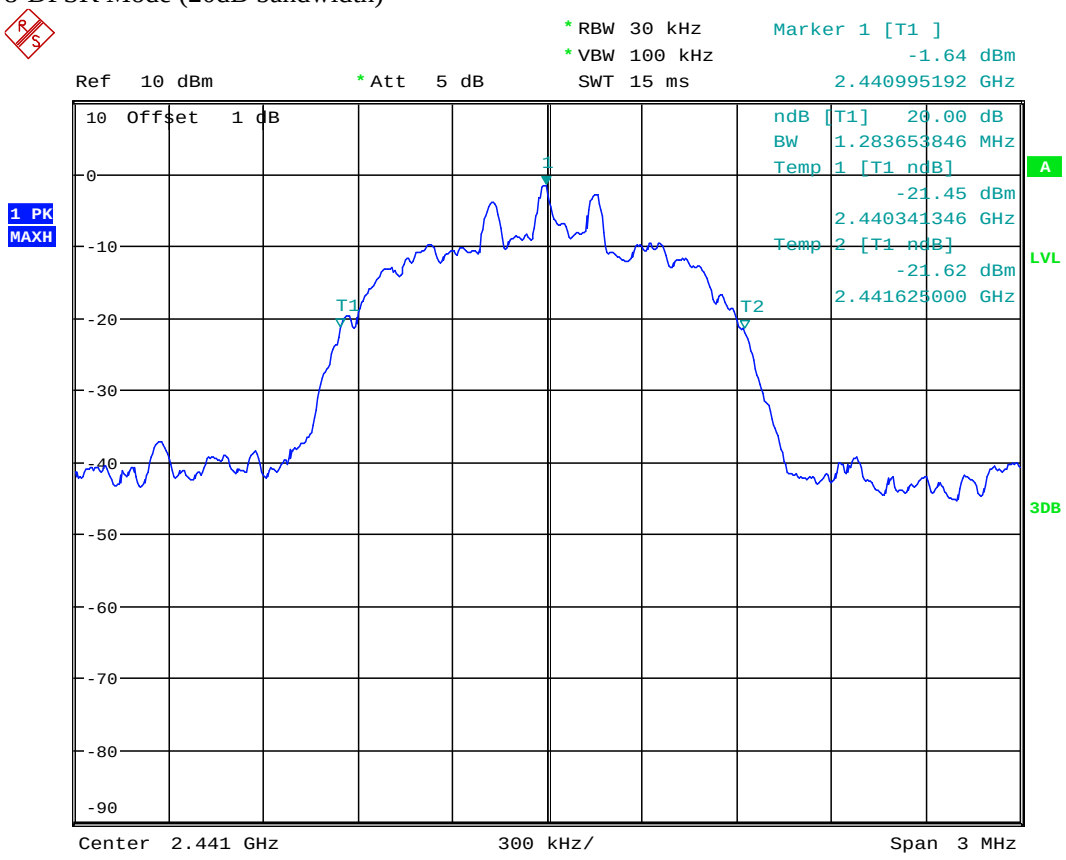
GFSK Mode (20dB bandwidth)

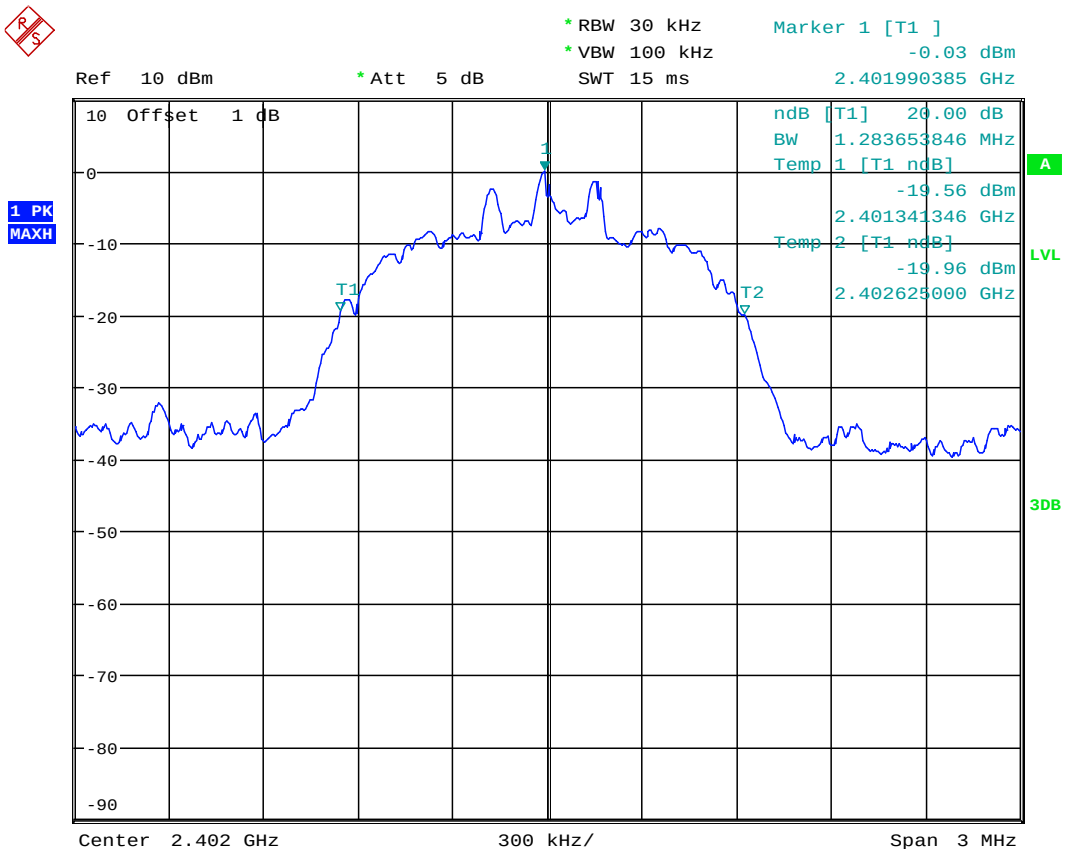


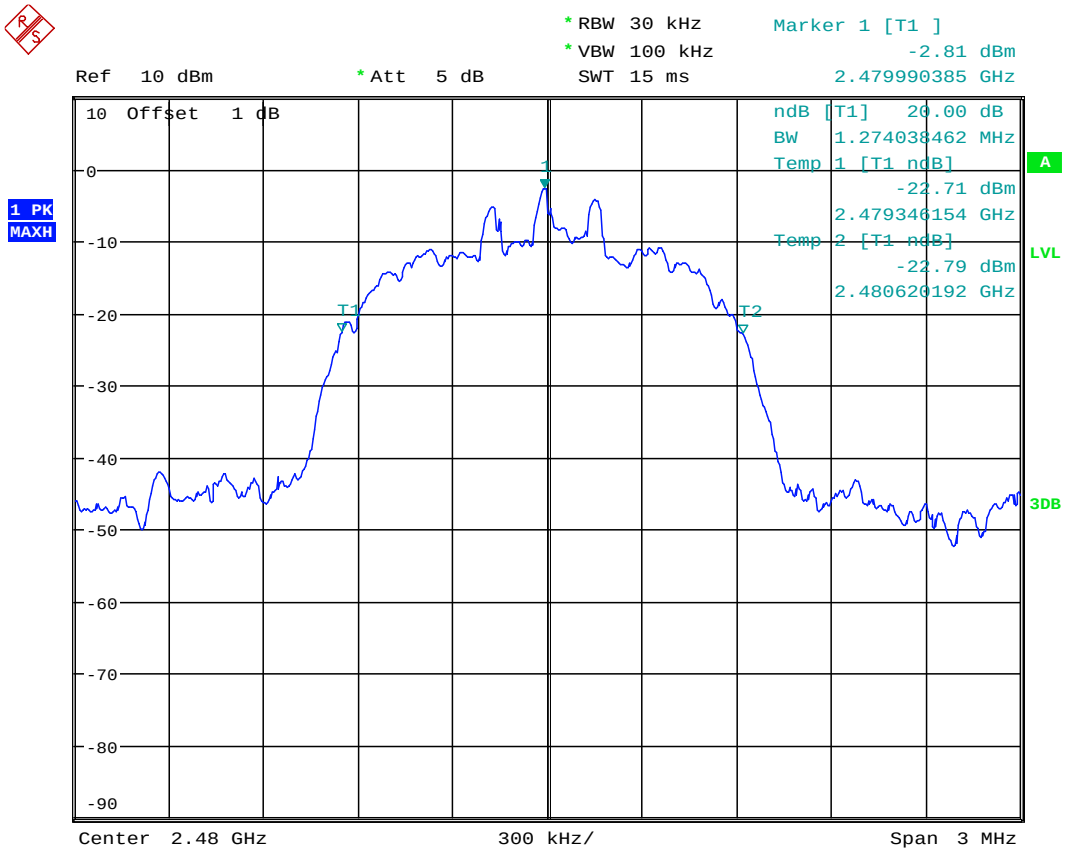

*RBW 30 kHz
*VBW 100 kHz
Ref 10 dBm
*Att 5 dB
SWT 15 ms
Marker 1 [T1 ]
0.97 dBm
2.401990385 GHz
10 Offset 1 dB
ndB [T1] 20.00 dB
BW 875.000000000 kHz
Temp 1 [T1 ndB]
-19.25 dBm
2.401528846 GHz
Temp 2 [T1 ndB]
-19.23 dBm
2.402403846 GHz
1 PK
MAXH
A
LVL
3DB
T1
T2
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.402 GHz
300 kHz/
Span 3 MHz


*RBW 30 kHz
*VBW 100 kHz
Ref 10 dBm
*Att 5 dB
SWT 15 ms
Marker 1 [T1 ]
-0.89 dBm
2.479990385 GHz
10 Offset 1 dB
ndB [T1] 20.00 dB
BW 875.000000000 kHz
Temp 1 [T1 ndB]
-20.35 dBm
2.479528846 GHz
Temp 2 [T1 ndB]
-21.00 dBm
2.480403846 GHz
1 PK
MAXH
A
LVL
3DB
T1
T2
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48 GHz
300 kHz/
Span 3 MHz

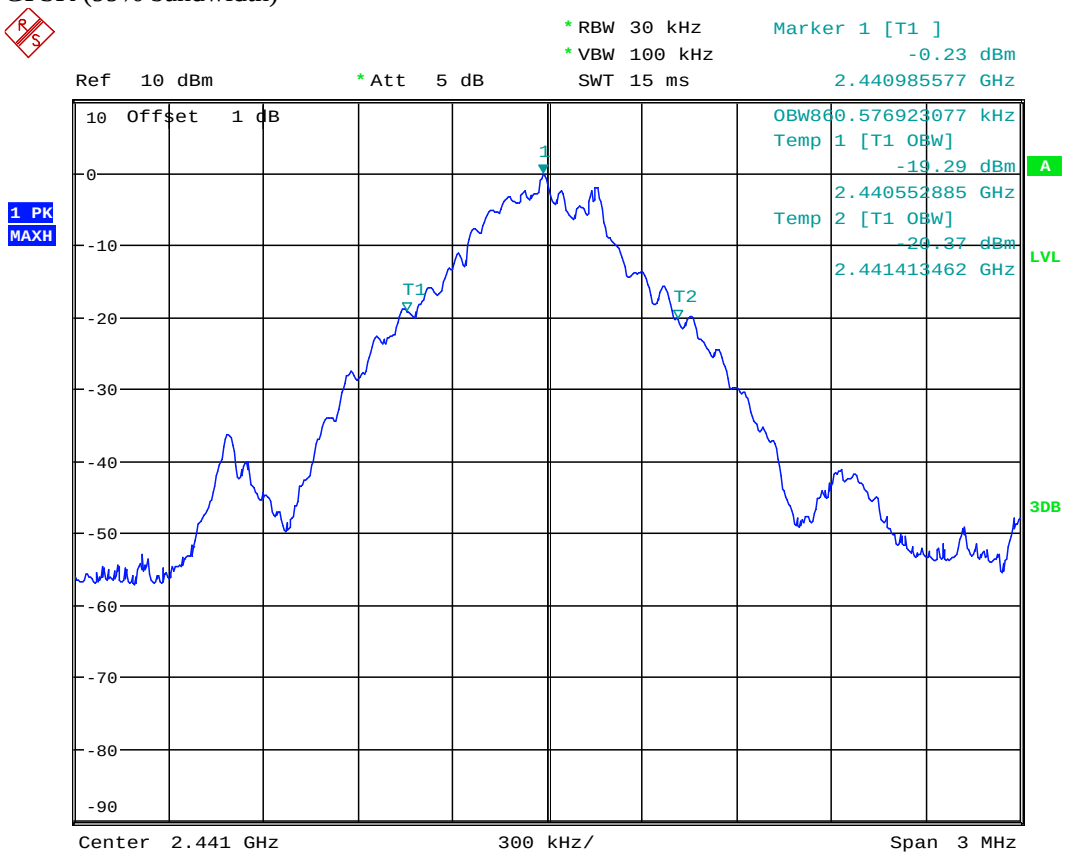
8-DPSK Mode (20dB bandwidth)

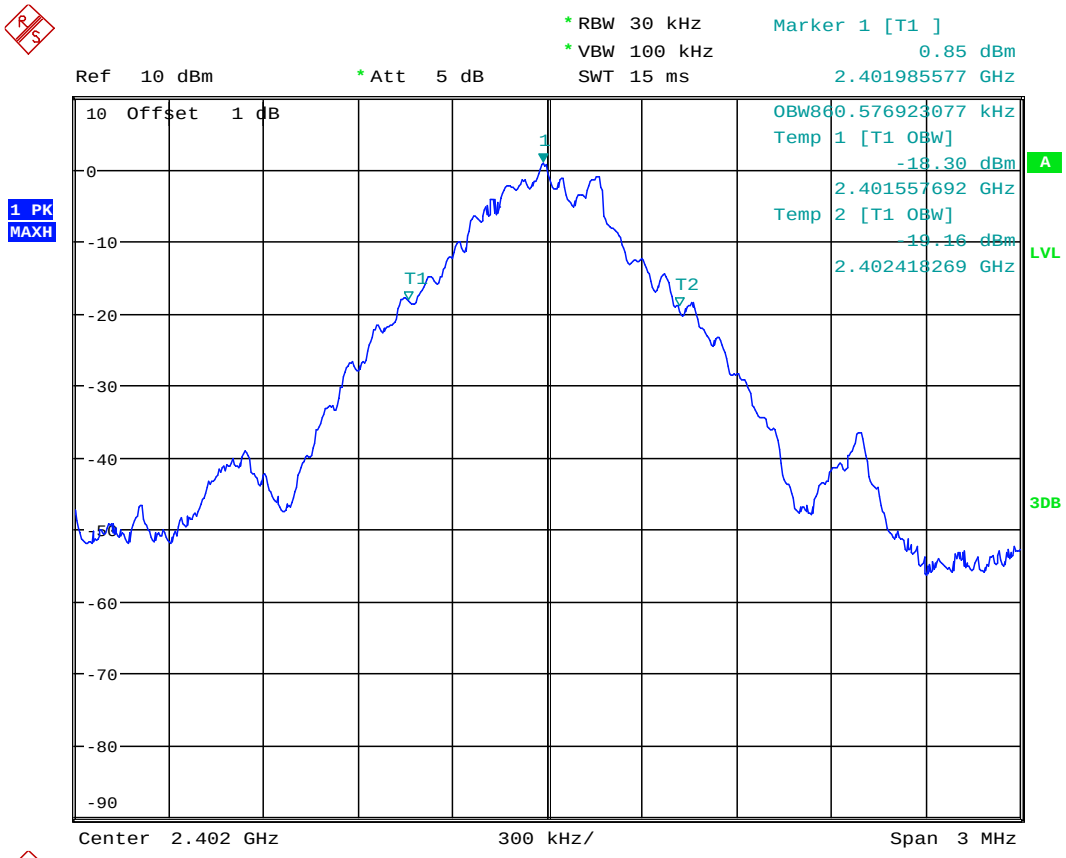


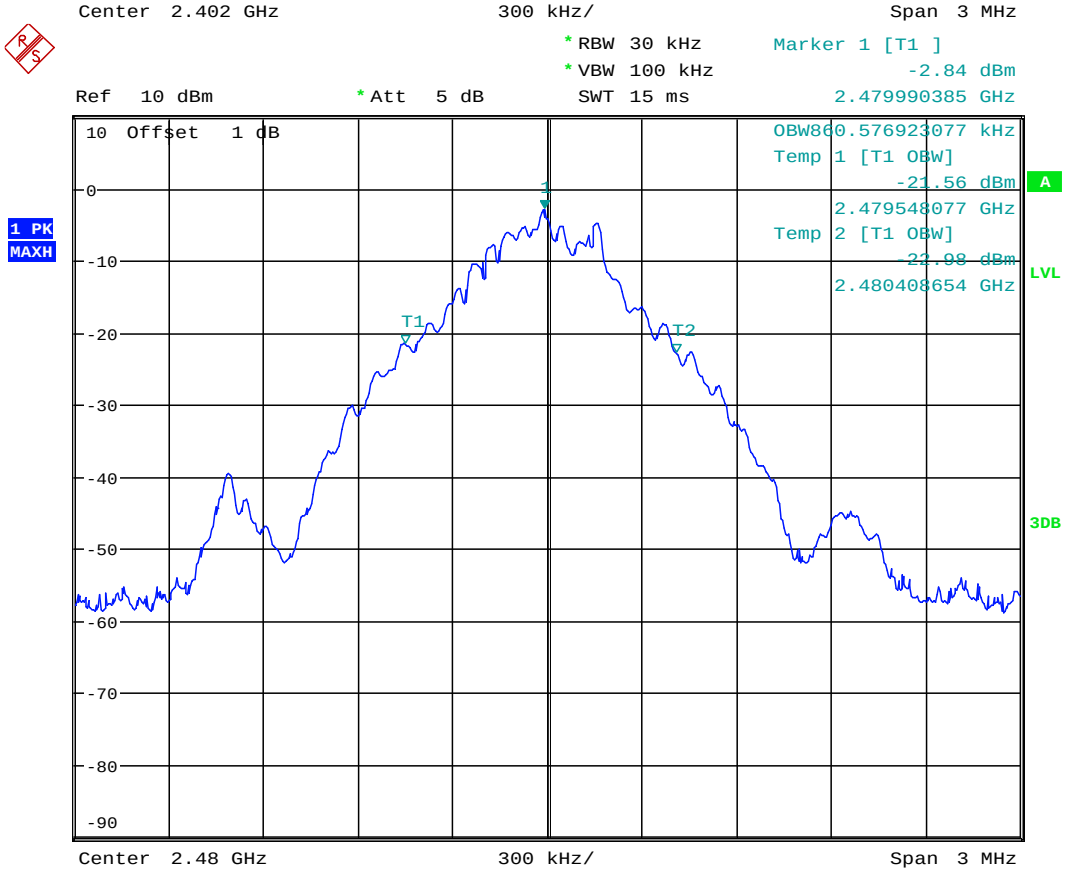





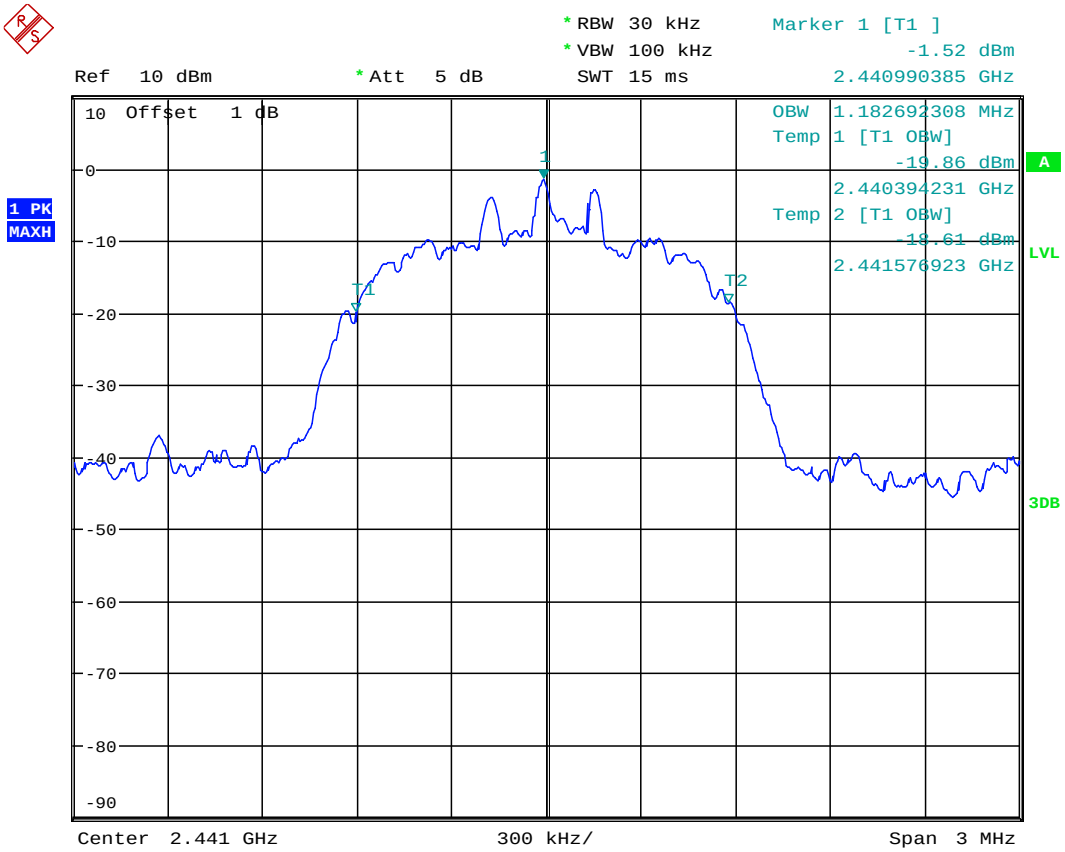

GFSK (99% bandwidth)

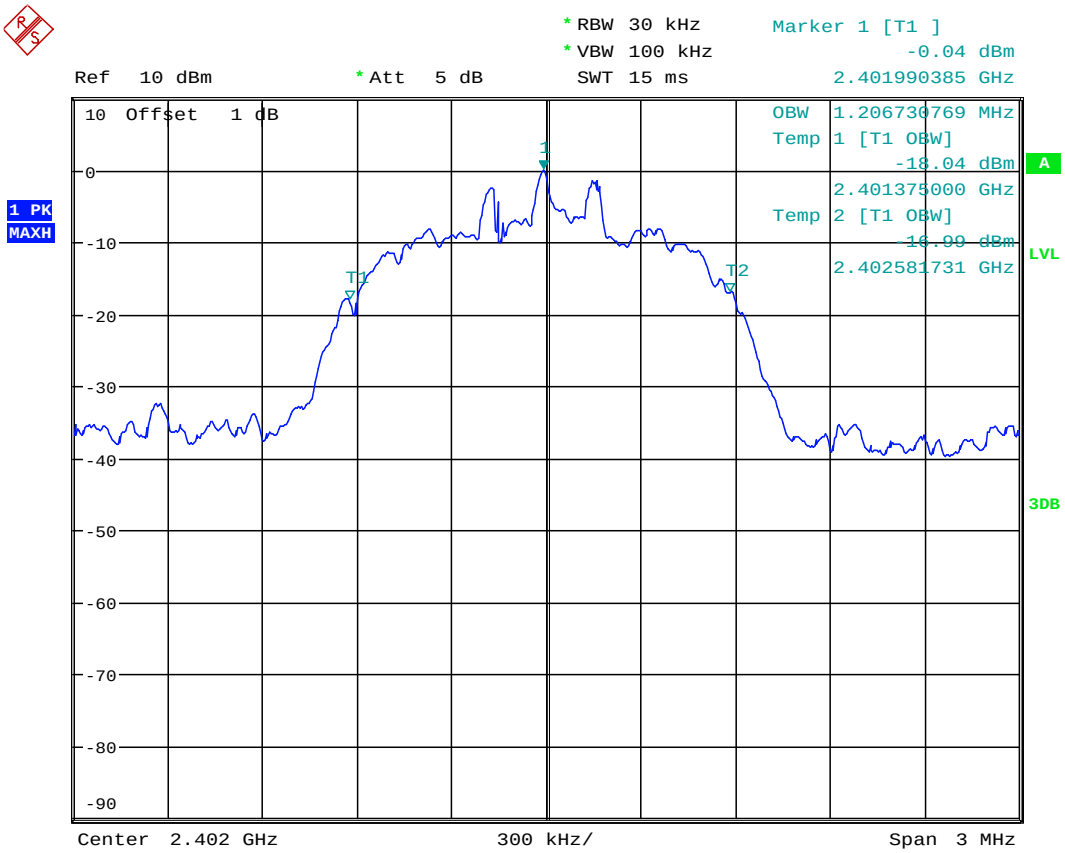


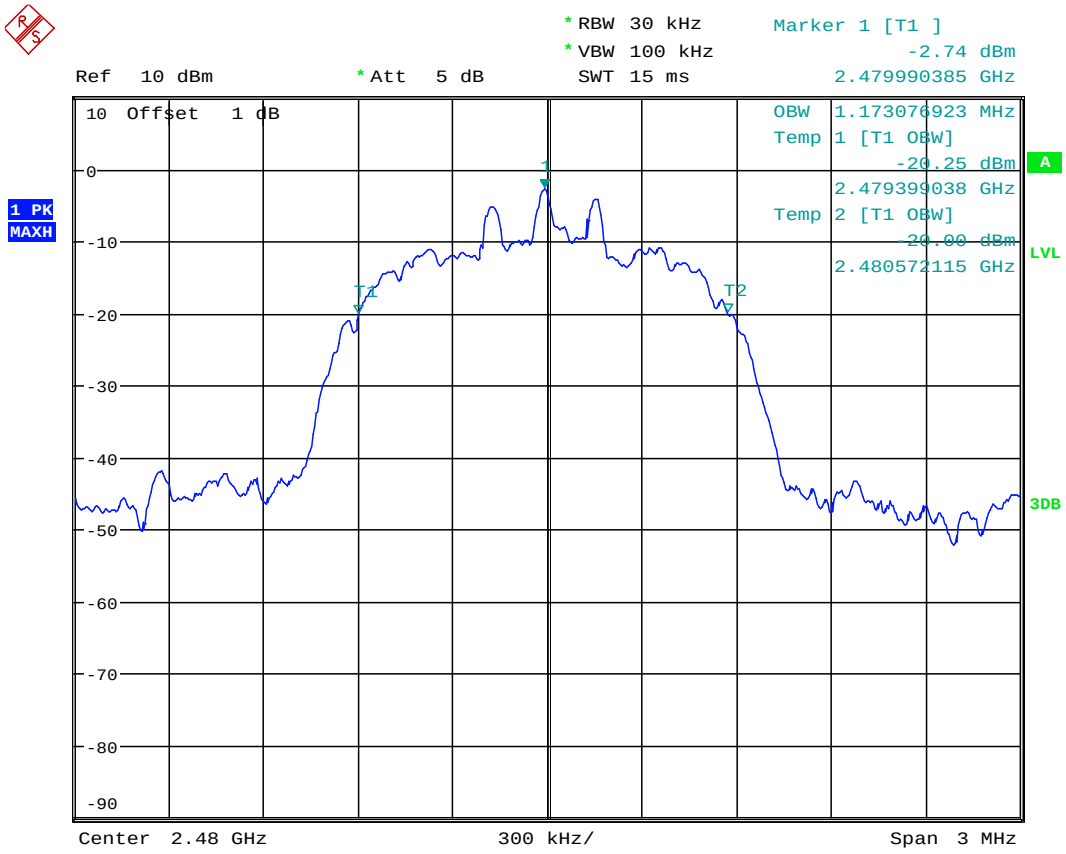

*RBW 30 kHz
*VBW 100 kHz
SWT 15 ms
Marker 1 [T1 ]
0.85 dBm
2.401985577 GHz
Ref 10 dBm
*Att 5 dB
10 Offset 1 dB
OBW860.576923077 kHz
Temp 1 [T1 OBW]
-18.30 dBm
2.401557692 GHz
Temp 2 [T1 OBW]
-19.16 dBm
2.402418269 GHz
1 PK
MAXH
A
LVL
3DB
T1
T2
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.402 GHz
300 kHz/
Span 3 MHz


*RBW 30 kHz
*VBW 100 kHz
SWT 15 ms
Marker 1 [T1 ]
-2.84 dBm
2.479990385 GHz
Ref 10 dBm
*Att 5 dB
10 Offset 1 dB
OBW860.576923077 kHz
Temp 1 [T1 OBW]
-21.56 dBm
2.479548077 GHz
Temp 2 [T1 OBW]
-22.98 dBm
2.480408654 GHz
1 PK
MAXH
A
LVL
3DB
T1
T2
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48 GHz
300 kHz/
Span 3 MHz

8-DPSK (99% bandwidth)



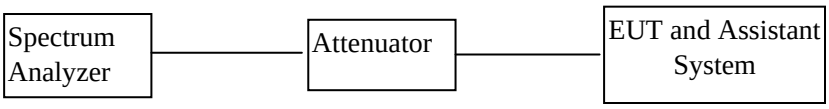

*RBW 30 kHz
*VBW 100 kHz
SWT 15 ms
Marker 1 [T1 ]
-2.74 dBm
2.479990385 GHz
Ref 10 dBm
*Att 5 dB
10 Offset 1 dB
OBW 1.173076923 MHz
Temp 1 [T1 OBW]
-20.25 dBm
2.479399038 GHz
Temp 2 [T1 OBW]
-20.00 dBm
2.480572115 GHz
1 PK
MAXH
A
LVL
3DB
T1
T2
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48 GHz
300 kHz/
Span 3 MHz

# 5. Carrier Frequency Separation

## 5.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 2 | Attenuator | Mini-Circuits | BW-S10W2 | 101109 | 2014/10/25 | 1 Year |
| 3 | RF Cable | Micable | C10-01-01-1 | 100309 | 2014/10/25 | 1 Year |

## 5.2. Block diagram of test setup




## 5.3. Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

## 5.4. Test Procedure

(1) Configure EUT and assistant system according clause 2.4 and 5.2

(2) Connect EUT's antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.4.

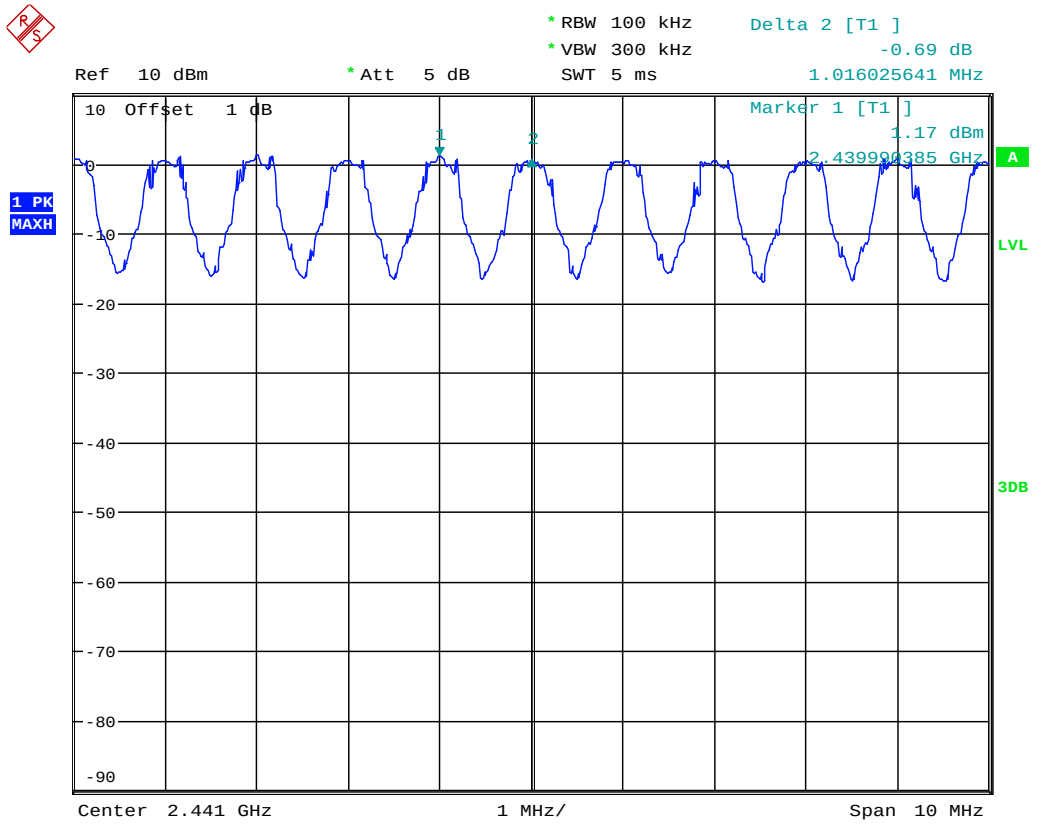
(4) The carrier frequency was measured by spectrum analyzer with 100 KHz RBW and 300KHz VBW.

## 5.5. Test Result

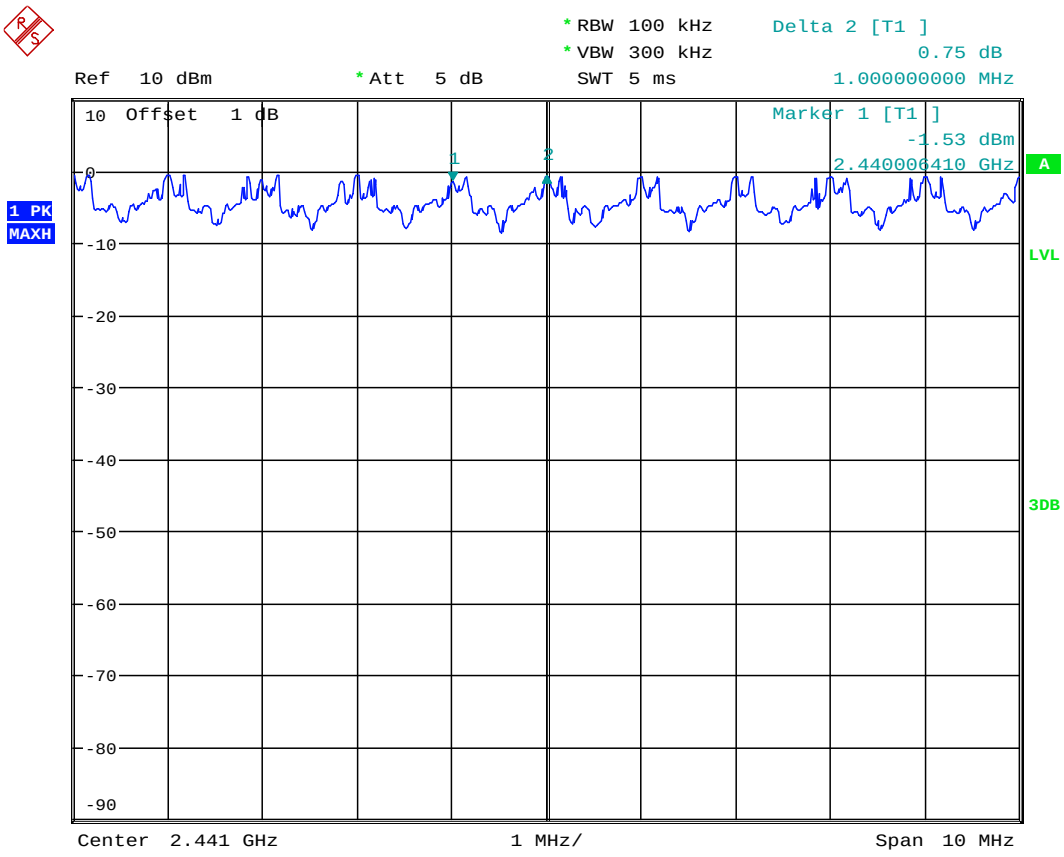
| EUT: Car amplifier M/N: GTR-104 | | | | |
|---|---|---|---|---|
| Mode | Channel separation (MHz) | 20dB Bandwidth (MHz) | Limit (MHz) 2/3 of 20dB bandwidth | Conclusion |
| GFSK | 1.02 | 0.880 | 0.587 | PASS |
| 8-DPSK | 1 | 1.284 | 0.856 | PASS |
| Test Date : 2015/8/14 | | | Test Engineer : Leo | |

## 5.6. Original test data

GFSK




8-DPSK

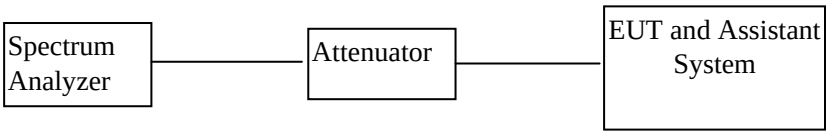


# 6. Number Of Hopping Channel

## 6.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 2 | Attenuator | Mini-Circuits | BW-S10W2 | 101109 | 2014/10/25 | 1 Year |
| 3 | RF Cable | Micable | C10-01-01-1 | 100309 | 2014/10/25 | 1 Year |

## 6.2. Block diagram of test setup




## 6.3. Limits

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

## 6.4. Test Procedure

(1) Configure EUT and assistant system according clause 2.4 and 6.2

(2) Connect EUT's antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.4.

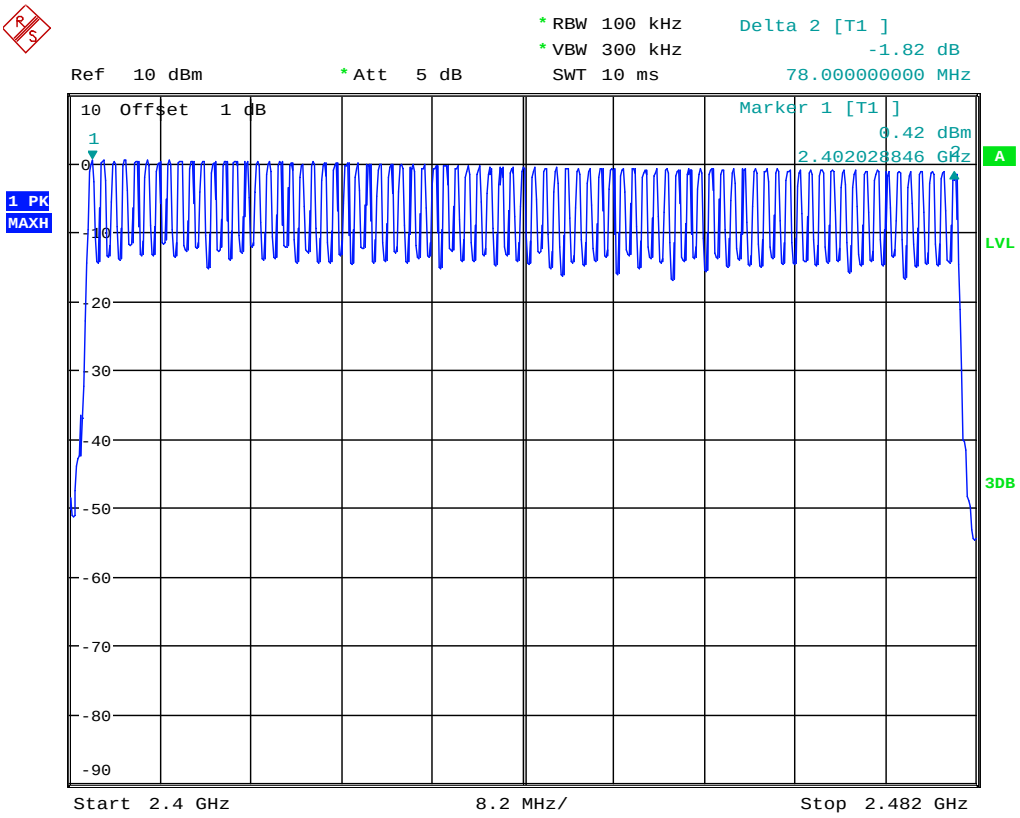
(4) The number of hopping channel was measured by spectrum analyzer with 100 kHz RBW and300KHz VBW.

## 6.5. Test Result

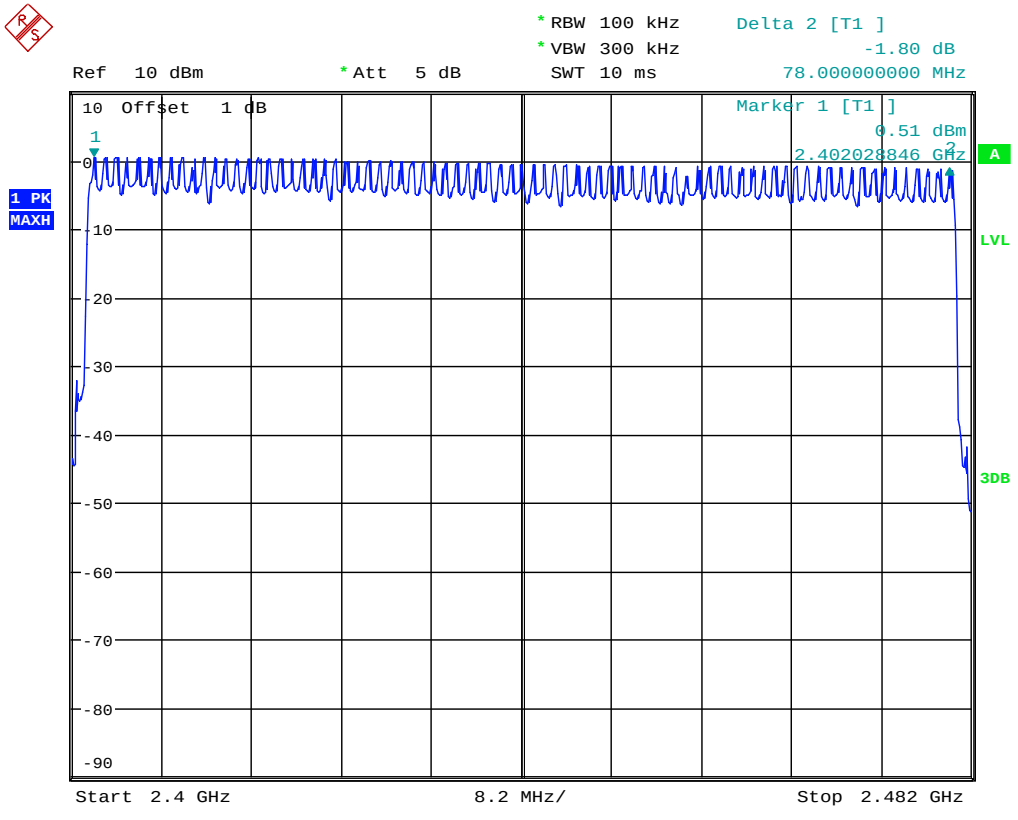
| EUT: Car amplifier M/N: GTR-104 | | | |
|---|---|---|---|
| Mode | Number of hopping channel | Limit | Conclusion |
| GFSK | 79 | >15 | PASS |
| 8-DPSK | 79 | >15 | PASS |
| Test Date : 2015/8/14 | | Test Engineer : Leo | |

## 6.6. Original test data

GFSK:




8-DPSK:

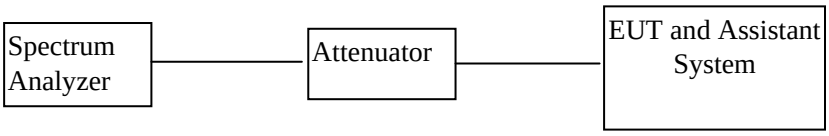


# 7. Dwell Time

## 7.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 2 | Attenuator | Mini-Circuits | BW-S10W2 | 101109 | 2014/10/25 | 1 Year |
| 3 | RF Cable | Micable | C10-01-01-1 | 100309 | 2014/10/25 | 1 Year |

## 7.2. Block diagram of test setup




## 7.3. Limits

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

## 7.4. Test Procedure

(1) Configure EUT and assistant system according clause 2.3 and 7.2

(2) Connect EUT's antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.3.

(4) Measure the hopping number and on time of each pulse with spectrum analyzer in zero span set, and calculate dwell time with formula Dwell time = total hops *pulse's on time.

DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So, total hops is 10.12 x 31.6 = 320.

DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So, total hops is 5.06 x 31.6 = 160.

DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, total hops is 3.37 x 31.6 = 106.6.

3DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So, total hops is 10.12 x 31.6 = 320.

3DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So, total hops is 5.06 x 31.6 = 160.

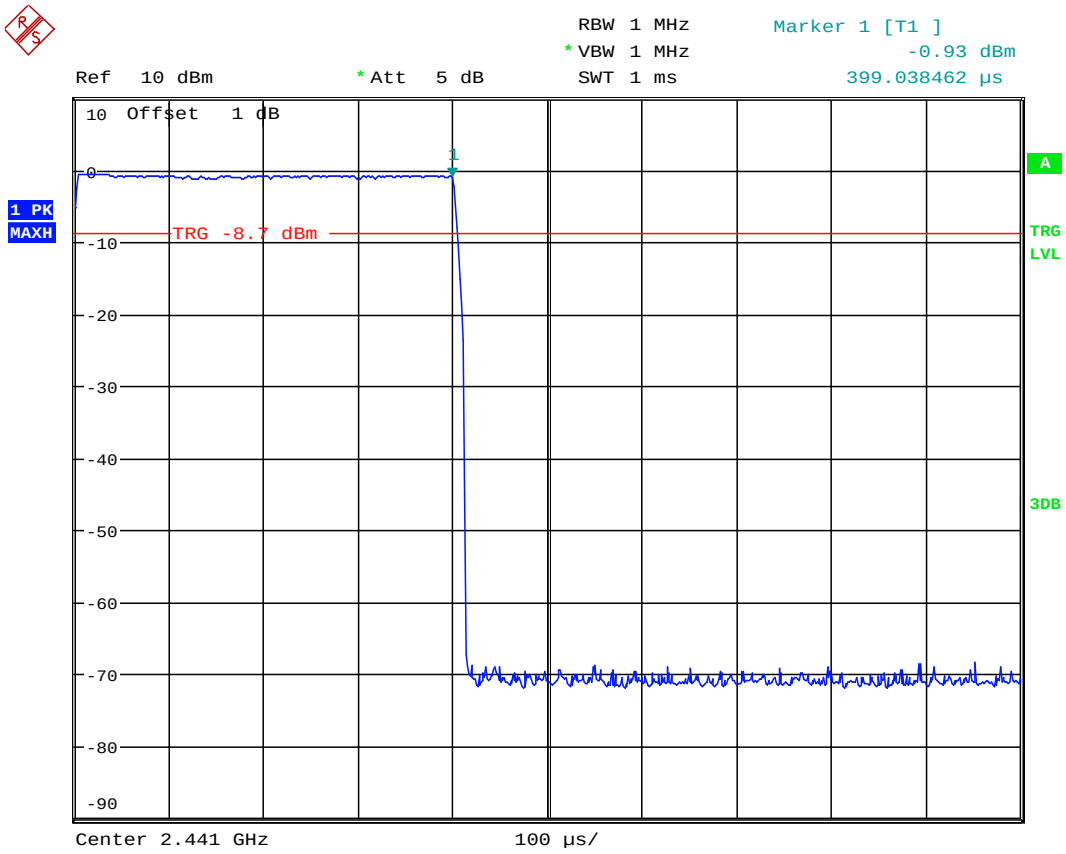
3DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, total hops is 3.37 x 31.6 = 106.6.

## 7.5. Test Result

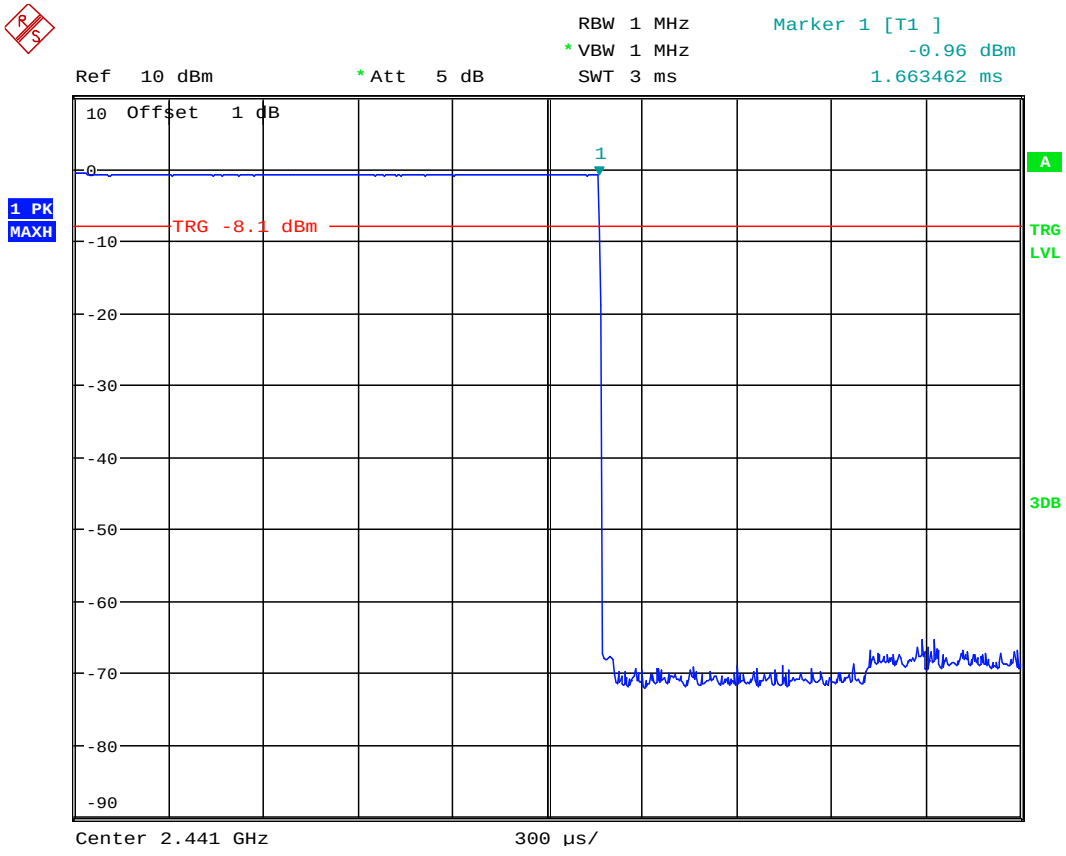
| EUT: Car amplifier | | M/N: GTR-104 | | | |
|---|---|---|---|---|---|
| Mode | Dwell time | Pulse's on time | Total hops | Limit | Conclusion |
| DH1 | 127.68ms | 0.399ms | 320 | <400ms | PASS |
| DH3 | 266.08ms | 1.663ms | 160 | <400ms | PASS |
| DH5 | 308.82ms | 2.897ms | 106.6 | <400ms | PASS |
| 3-DH1 | 131.20ms | 0.410ms | 320 | <400ms | PASS |
| 3-DH3 | 266.08ms | 1.663ms | 160 | <400ms | PASS |
| 3-DH5 | 308.39ms | 2.893ms | 106.6 | <400ms | PASS |
| Test Date : 2015/8/14 | | | Test Engineer : Leo | | |
| Note: Dwell time = total hops *pulse's on time. | | | | | |

## 7.6. Original test data

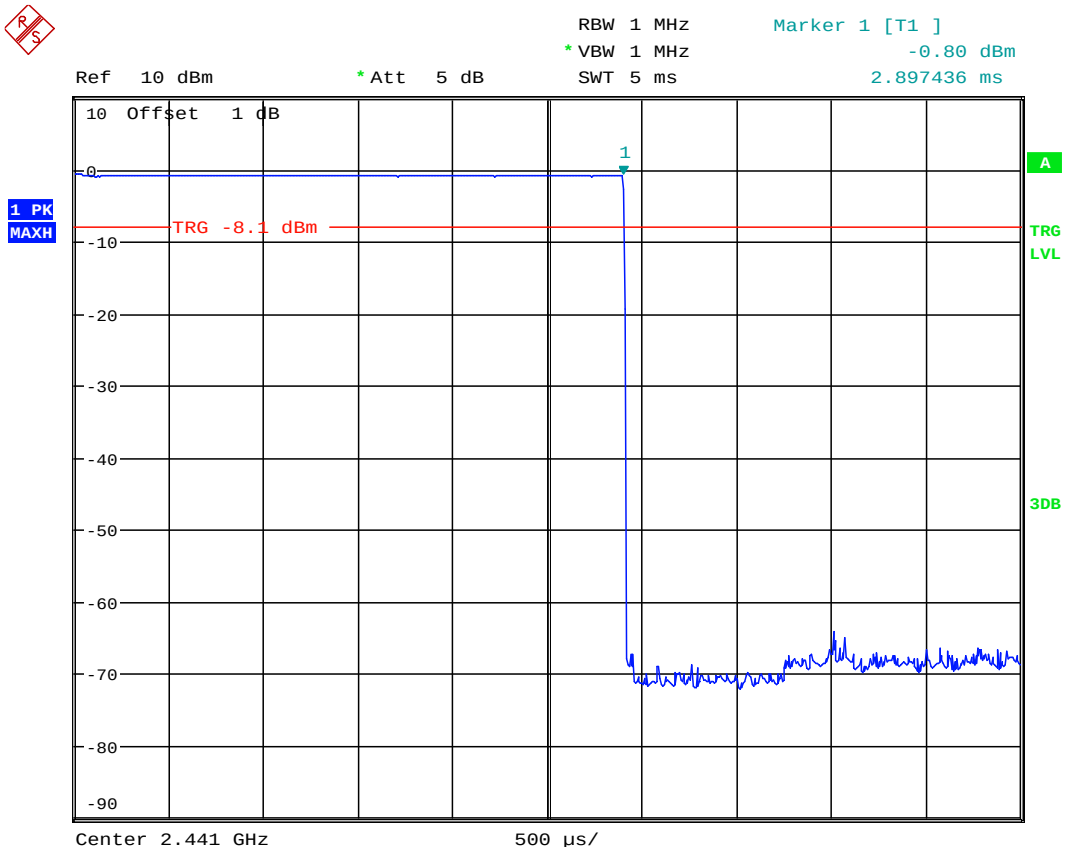
DH1



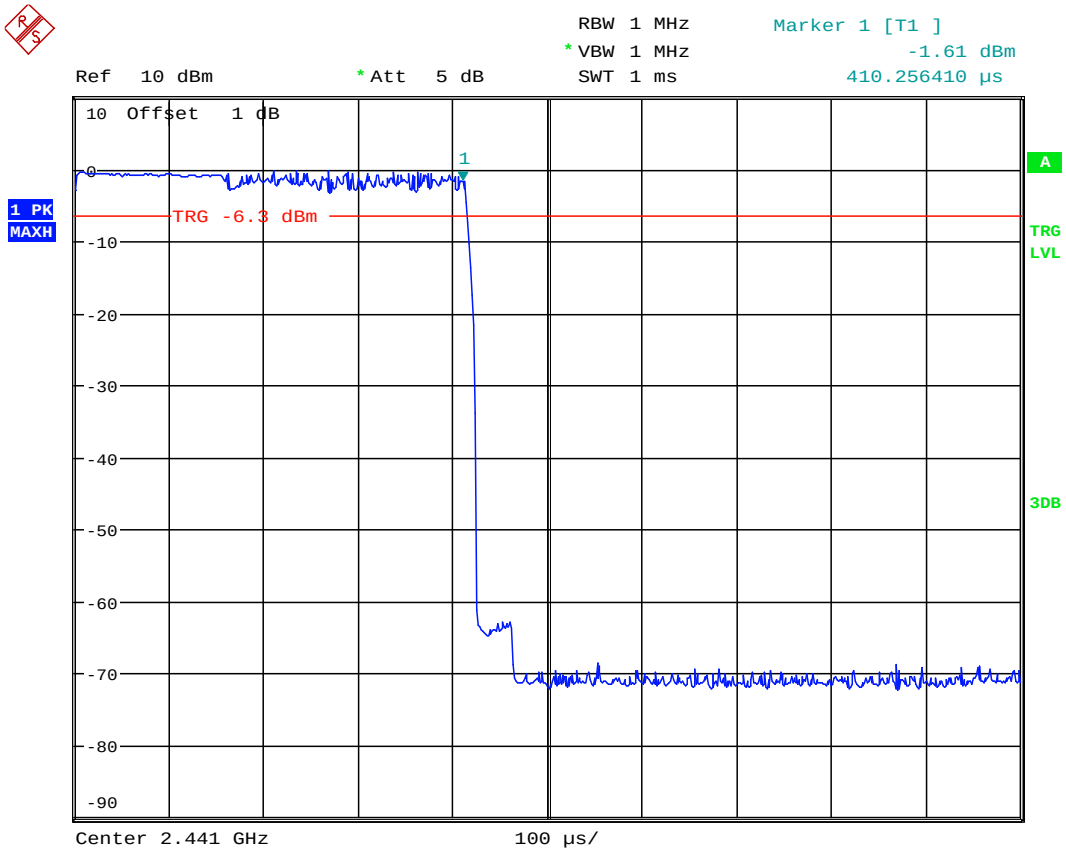

DH3



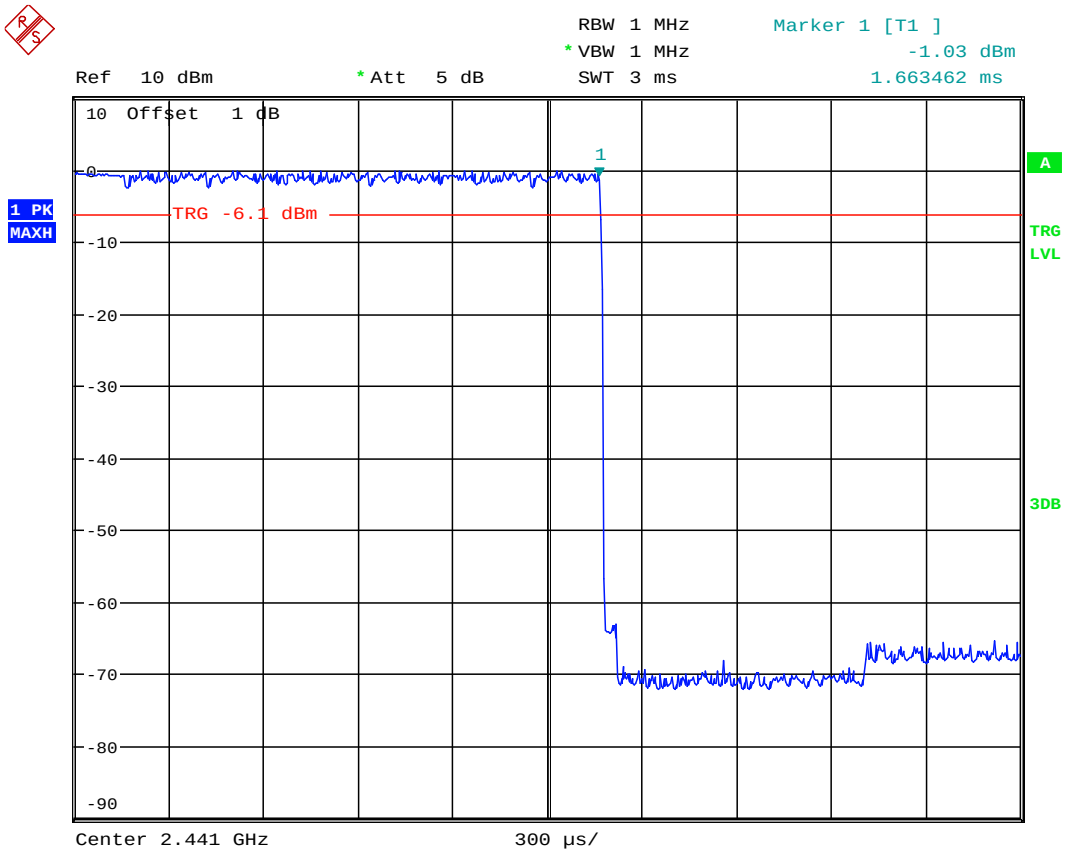
DH5


RBW 1 MHz
*VBW 1 MHz
SWT 5 ms
Marker 1 [T1 ]
-0.80 dBm
2.897436 ms
Ref 10 dBm
*Att 5 dB
10 Offset 1 dB
1 PK
MAXH
TRG -8.1 dBm
A
TRG
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.441 GHz
500 µs/

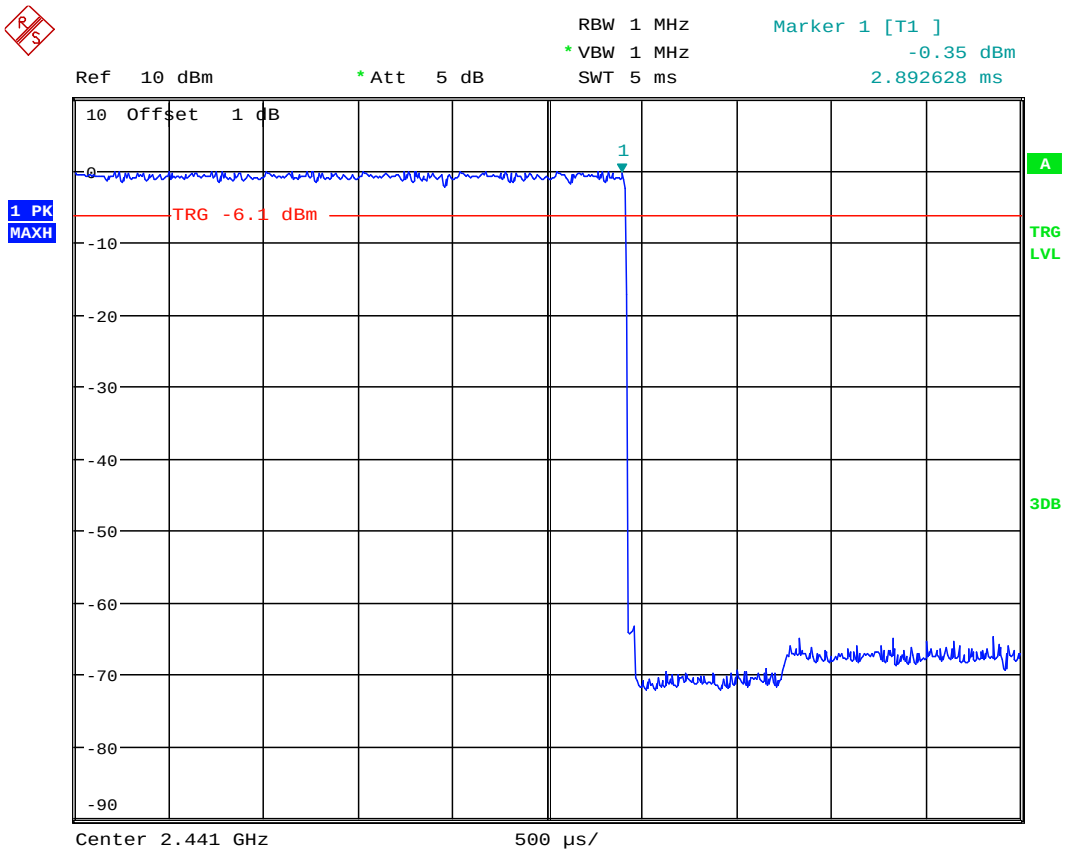
3-DH1


RBW 1 MHz
*VBW 1 MHz
SWT 1 ms
Marker 1 [T1 ]
-1.61 dBm
410.256410 µs
Ref 10 dBm
*Att 5 dB
10 Offset 1 dB
1 PK
MAXH
TRG -6.3 dBm
A
TRG
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.441 GHz
100 µs/

3-DH3


RBW 1 MHz
Marker 1 [T1 ]
*VBW 1 MHz
-1.03 dBm
Ref 10 dBm
*Att 5 dB
SWT 3 ms
1.663462 ms
10 Offset 1 dB
1 PK
MAXH
TRG -6.1 dBm
A
TRG
LVL
3DB
Center 2.441 GHz
300 µs/

3-DH5


RBW 1 MHz
Marker 1 [T1 ]
*VBW 1 MHz
-0.35 dBm
Ref 10 dBm
*Att 5 dB
SWT 5 ms
2.892628 ms
10 Offset 1 dB
1 PK
MAXH
TRG -6.1 dBm
A
TRG
LVL
3DB
Center 2.441 GHz
500 µs/

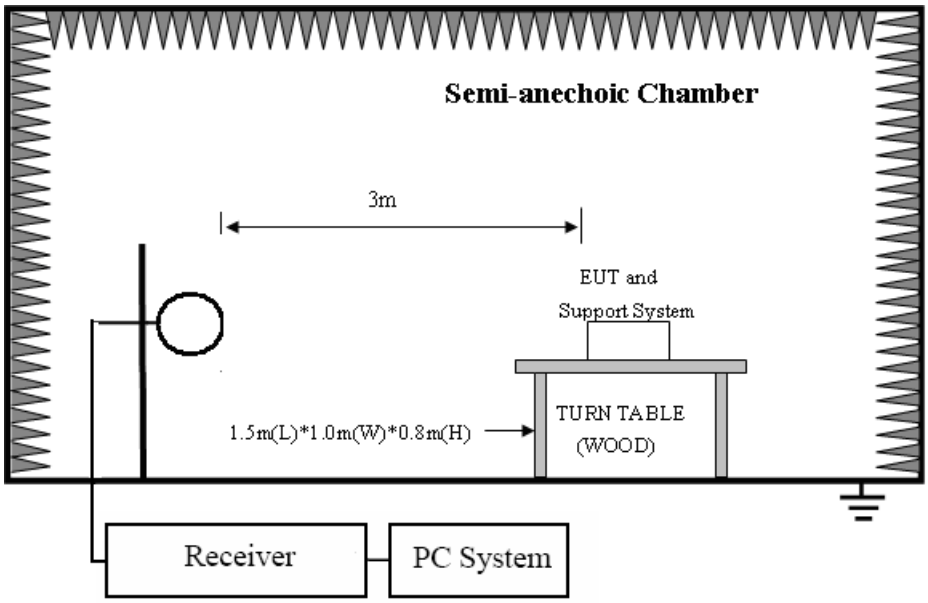
# 8. Radiated emission

## 8.1. Test equipment

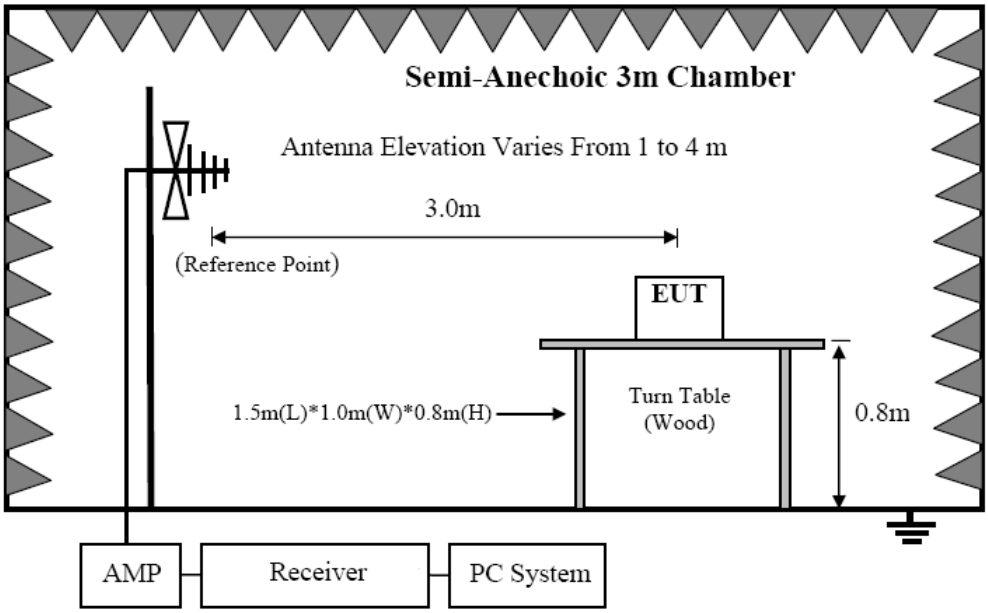
| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | EMI Test Receiver | R&S | ESU8 | 100316 | 2014/10/25 | 1 Year |
| 2 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 3 | Loop antenna | TESEQ | HLA6120 | 20129 | 2015/05/30 | 1 Year |
| 4 | Trilog Broadband Antenna | Schwarzbeck | VULB9163 | 9163-462 | 2015/05/30 | 1 Year |
| 5 | Double Ridged Horn Antenna | R&S | HF907 | 100276 | 2014/11/01 | 1 Year |
| 6 | Horn Antenna | EMCO | 3116 | 00060095 | 2015/05/30 | 1 Year |
| 7 | Pre-amplifier | A.H. | PAM-1840VH | 562 | 2014/10/25 | 1 Year |
| 8 | RF Cable | R&S | R01 | 10403 | 2014/10/25 | 1 Year |
| 9 | RF Cable | R&S | R02 | 10512 | 2014/10/25 | 1 Year |
| 10 | Test software | Audix | E3 | V 6.11111b | / | / |

## 8.2. Block diagram of test setup

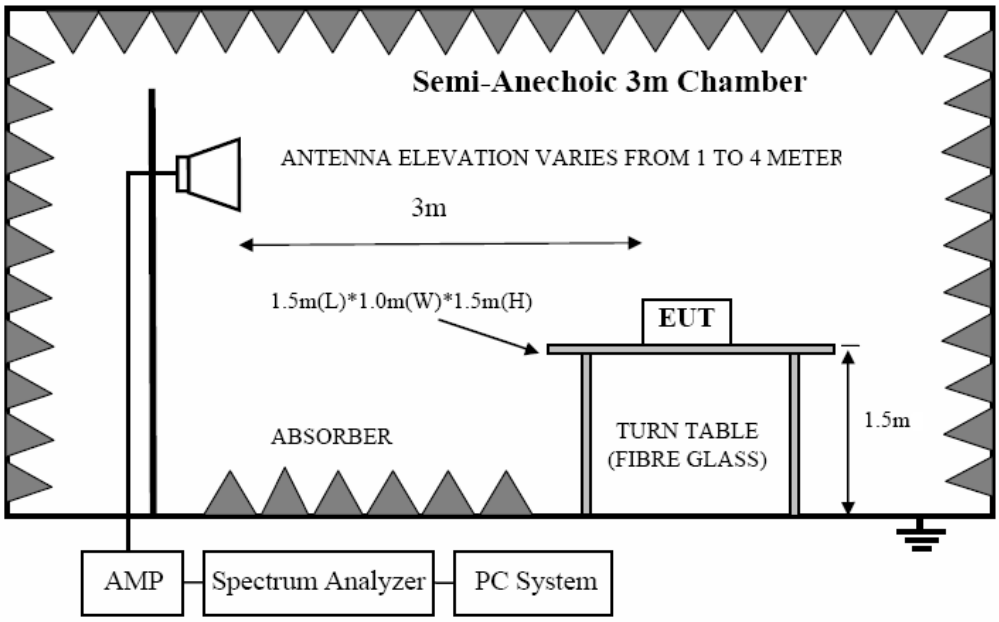
In 3m Anechoic Chamber Test Setup Diagram for 9KHz-30MHz



In 3m Anechoic Chamber Test Setup Diagram for below 1GHz




In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz



Note: For harmonic emissions test a appropriate high pass filter was inserted in the input port of AMP.

## 8.3. Limit

8.3.1 FCC 15.205 Restricted frequency band

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| [1]0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2690 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | ([2]) |

8.3.2 FCC 15.209 Limit.

| FREQUENCY MHz | DISTANCE Meters | FIELD STRENGTHS LIMIT | |
|---|---|---|---|
| | | μV/m | dB(μV)/m |
| 0.009 ~ 0.490 | 300 | 2400/F(KHz) | 67.6-20log(F) |
| 0.490 ~ 1.705 | 30 | 24000/F(KHz) | 87.6-20log(F) |
| 1.705 ~ 30.0 | 30 | 30 | 29.54 |
| 30 ~ 88 | 3 | 100 | 40.0 |
| 88 ~ 216 | 3 | 150 | 43.5 |
| 216 ~ 960 | 3 | 200 | 46.0 |
| 960 ~ 1000 | 3 | 500 | 54.0 |
| Above 1000 | 3 | 74.0 dB(μV)/m (Peak)<br>54.0 dB(μV)/m (Average) | |

Note: (1)The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz and above 1000MHz.Radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer then that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$$Limit_{3m}(dBuV/m) = Limit_{30m}(dBuV/m) + 40Log(30m/3m)$$

8.3.3 Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

## 8.4. Test Procedure

(1) EUT was placed on a non-metallic table, 150 cm above the ground plane inside a semi-anechoic chamber.

(2) Setup EUT and assistant system according clause 2.4 and 8.2

(3) Test antenna was located 3m from the EUT on an adjustable mast, and the antenna used as below table.

| Test frequency range | Test antenna used |
|---|---|
| 9KHz-30MHz | Active Loop antenna |
| 30MHz-1GHz | Trilog Broadband Antenna |
| 1GHz-18GHz | Double Ridged Horn Antenna(1GHz-18GHz) |
| 18GHz-40GHz | Horn Antenna(18GHz-40GHz) |

According ANSI C63.10:2013 clause 6.4.4.2 and 6,5.3, for measurements below 30 MHz, the loop antenna was positioned with its plane vertical from the EUT and rotated about its vertical axis for maximum response at each azimuth position around the EUT. And the loop antenna also be positioned with its plane horizontal at the specified distance from the EUT. The center of the loop is 1 m above the ground. for measurement above 30MHz, the Trilog Broadband Antenna or Horn Antenna was located 3m from EUT, Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

(4) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9KHz to 25GHz:

(a) Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1m to 4m(Except loop antenna, it's fixed 1m above ground.)

(b) Change work frequency or channel of device if practicable.

(c) Change modulation type of device if practicable.

(d) Change power supply range from 85% to 115% of the rated supply voltage

(e) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions.

Spectrum frequency from 9KHz to 25GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 18GHz to 25GHz, so below final test was performed with frequency range from 9KHz to 18GHz.

(5) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10 2013 on Radiated Emission test.

(6) The emissions from 9KHz to 1GHz were measured based on CISPR QP detector except for the

frequency bands 9-90KHz, 110-490KHz, for emissions from 9KHz-90KHz,110KHz-490KHz and above 1GHz were measured based on average detector, for emissions above 1GHz, peak emissions also be measured and need comply with Peak limit.

(7) The emissions from 9KHz to 1GHz, QP or average values were measured with EMI receiver with below RBW

| Frequency band | RBW |
|---|---|
| 9KHz-150KHz | 200Hz |
| 150KHz-30MHz | 9KHz |
| 30MHz-1GHz | 120KHz |

(8) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure; RMS detector RBW 1MHz VBW 3MHz for Average measure(according ANSI C63.10:2013 clause 4.2.3.2.3 procedure for average measure).

(9) X axis, Y axis, Z axis are tested, and worse setup X axis is reported.

## 8.5. Test result

## PASS. (See below detailed test result)

All the emissions except fundamental emission from 9 KHz to 25GHz were comply with 8.3.2 limit.

Note1: According exploratory test no any obvious emission were detected from 9KHz to 30MHz and 18GHz to 25GHz, so the final test was performed with frequency range from 30MHz to 18GHz and recorded in below.

Note2: For emissions below 1GHz, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1GHz, the final test was only performed with EUT working in GFSK, Tx 2441MHz mode.

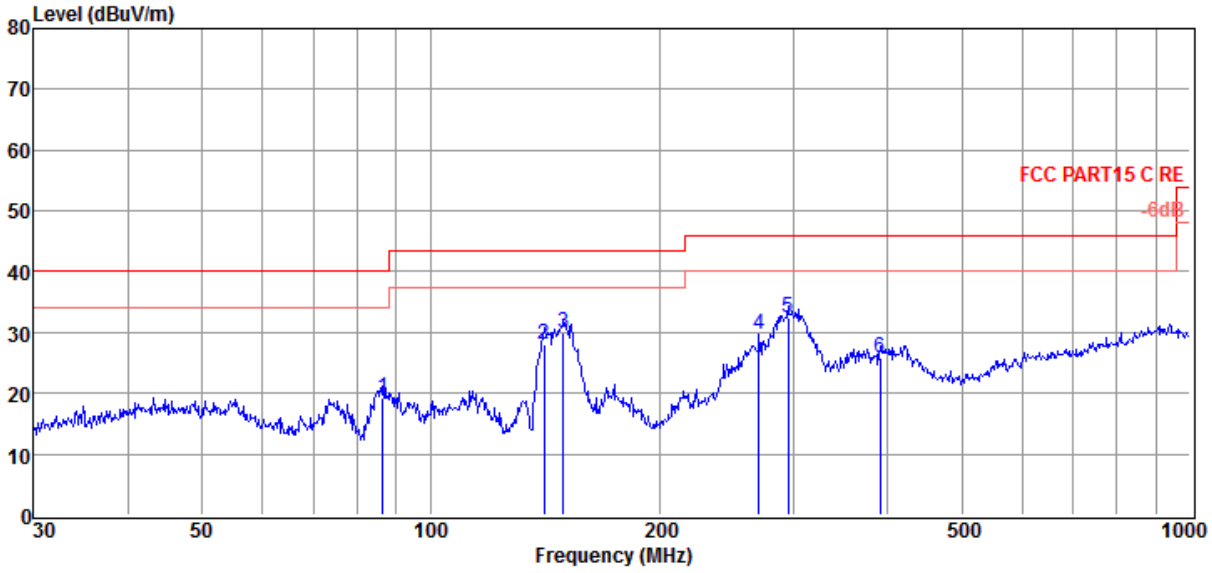
Note3: For emissions above 1GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit.

**Radiated Emission test (below 1GHz)**

# TR-4-E-009 Radiated Emission Test Result

| | | | |
|---|---|---|---|
| **Test Site** | : DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | |
| **Test Date** | : 2015-08-20 | **Tested By** | : Toby |
| **EUT** | : Car amplifier | **Model Number** | : GTR-104 |
| **Power Supply** | : DC 12V | **Test Mode** | : TX Mode |
| **Condition** | : Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : 2014 VULB 9163/3m/HORIZONTAL |
| **Memo** | : | | |

Data: 1



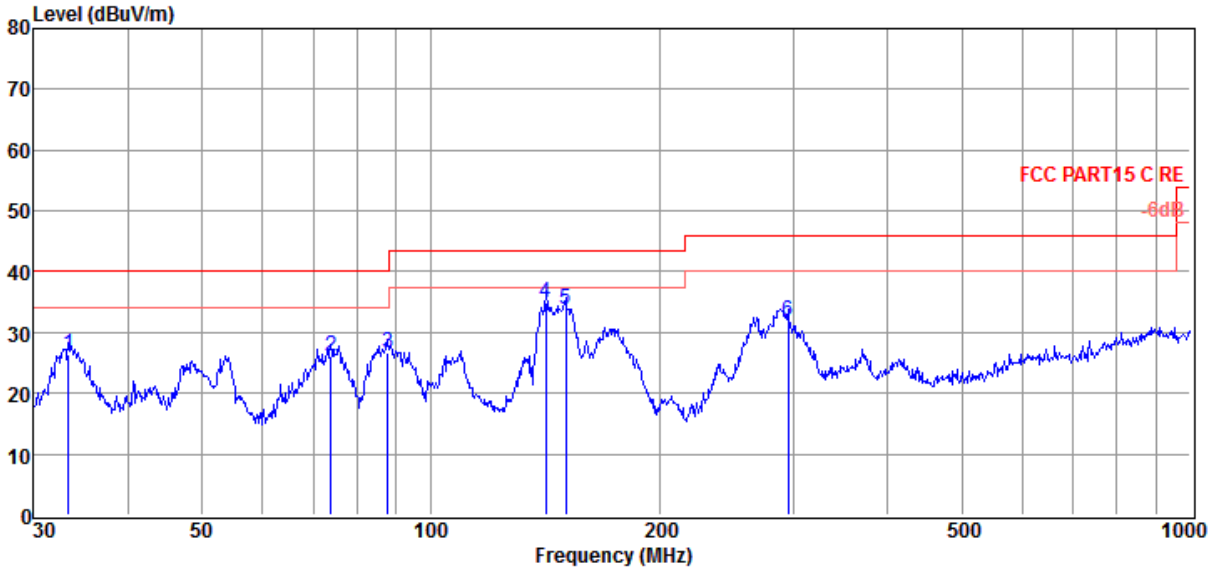

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 86.50 | 7.65 | 10.20 | 1.40 | 19.25 | 40.00 | -20.75 | QP | HORIZONTAL |
| 2 | 140.84 | 17.63 | 8.83 | 1.70 | 28.16 | 43.50 | -15.34 | QP | HORIZONTAL |
| 3 | 149.49 | 19.56 | 8.67 | 1.80 | 30.03 | 43.50 | -13.47 | QP | HORIZONTAL |
| 4 | 270.38 | 13.62 | 13.40 | 2.59 | 29.61 | 46.00 | -16.39 | QP | HORIZONTAL |
| 5 | 295.15 | 15.44 | 14.27 | 2.69 | 32.40 | 46.00 | -13.60 | QP | HORIZONTAL |
| 6 | 390.72 | 6.96 | 15.70 | 3.21 | 25.87 | 46.00 | -20.13 | QP | HORIZONTAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.
2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | |
|---|---|---|---|
| **Test Site** | : DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | |
| **Test Date** | : 2015-08-20 | **Tested By** | : Toby |
| **EUT** | : Car amplifier | **Model Number** | : GTR-104 |
| **Power Supply** | : DC 12V | **Test Mode** | : TX Mode |
| **Condition** | : Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : 2014 VULB 9163/3m/VERTICAL |
| **Memo** | : | | |

Data: 2




| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 33.33 | 13.52 | 11.95 | 0.93 | 26.40 | 40.00 | -13.60 | QP | VERTICAL |
| 2 | 73.88 | 17.59 | 7.20 | 1.26 | 26.05 | 40.00 | -13.95 | QP | VERTICAL |
| 3 | 87.73 | 13.70 | 11.60 | 1.42 | 26.72 | 40.00 | -13.28 | QP | VERTICAL |
| 4 | 141.83 | 24.41 | 8.83 | 1.71 | 34.95 | 43.50 | -8.55 | QP | VERTICAL |
| 5 | 150.54 | 23.35 | 8.60 | 1.84 | 33.79 | 43.50 | -9.71 | QP | VERTICAL |
| 6 | 295.15 | 14.93 | 14.27 | 2.69 | 31.89 | 46.00 | -14.11 | QP | VERTICAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.
2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

## Radiated Emission test (above 1GHz)

| Freq (MHz) | Read level (dBμV) | Antenna Factor (dB/m) | PRM Factor (dB) | Cable Loss (dB) | Result Level (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector type | Polarization |
|---|---|---|---|---|---|---|---|---|---|
| GFSK Tx mode 2402MHz | | | | | | | | | |
| 4804.00 | 34.58 | 35.40 | 29.13 | 8.09 | 48.94 | 74.00 | -25.06 | Peak | HORIZONTAL |
| 8769.00 | 36.49 | 37.75 | 32.28 | 10.53 | 52.49 | 74.00 | -21.51 | Peak | HORIZONTAL |
| 4804.00 | 33.69 | 35.40 | 29.13 | 8.09 | 48.05 | 74.00 | -25.95 | Peak | VERTICAL |
| 5828.00 | 34.97 | 35.82 | 29.16 | 8.77 | 50.40 | 74.00 | -23.60 | Peak | VERTICAL |
| 7562.00 | 32.64 | 37.41 | 30.42 | 10.15 | 49.78 | 74.00 | -24.22 | Peak | VERTICAL |
| GFSK Tx mode 2441MHz | | | | | | | | | |
| 4882.00 | 33.49 | 35.51 | 29.08 | 8.14 | 48.06 | 74.00 | -25.94 | Peak | HORIZONTAL |
| 7698.00 | 35.55 | 37.44 | 30.69 | 10.23 | 52.53 | 74.00 | -21.47 | Peak | HORIZONTAL |
| 4882.00 | 35.04 | 35.51 | 29.08 | 8.14 | 49.61 | 74.00 | -24.39 | Peak | VERTICAL |
| 6933.00 | 34.85 | 36.98 | 29.41 | 9.82 | 52.24 | 74.00 | -21.76 | Peak | VERTICAL |
| 12815.00 | 35.89 | 39.45 | 34.95 | 12.74 | 53.13 | 74.00 | -20.87 | Peak | VERTICAL |
| GFSK Tx mode 2480MHz | | | | | | | | | |
| 4960.00 | 35.61 | 35.64 | 29.04 | 8.18 | 50.39 | 74.00 | -23.61 | Peak | HORIZONTAL |
| 7358.00 | 34.78 | 37.32 | 29.95 | 10.01 | 52.16 | 74.00 | -21.84 | Peak | HORIZONTAL |
| 4960.00 | 33.01 | 35.64 | 29.04 | 8.18 | 47.79 | 74.00 | -26.21 | Peak | VERTICAL |
| 7256.00 | 35.07 | 37.26 | 29.74 | 9.95 | 52.54 | 74.00 | -21.46 | Peak | VERTICAL |
| Result: Pass | | | | | | | | | |
| Test Date : 2015/8/19 | | | | | | | Test Engineer : Leo | | |

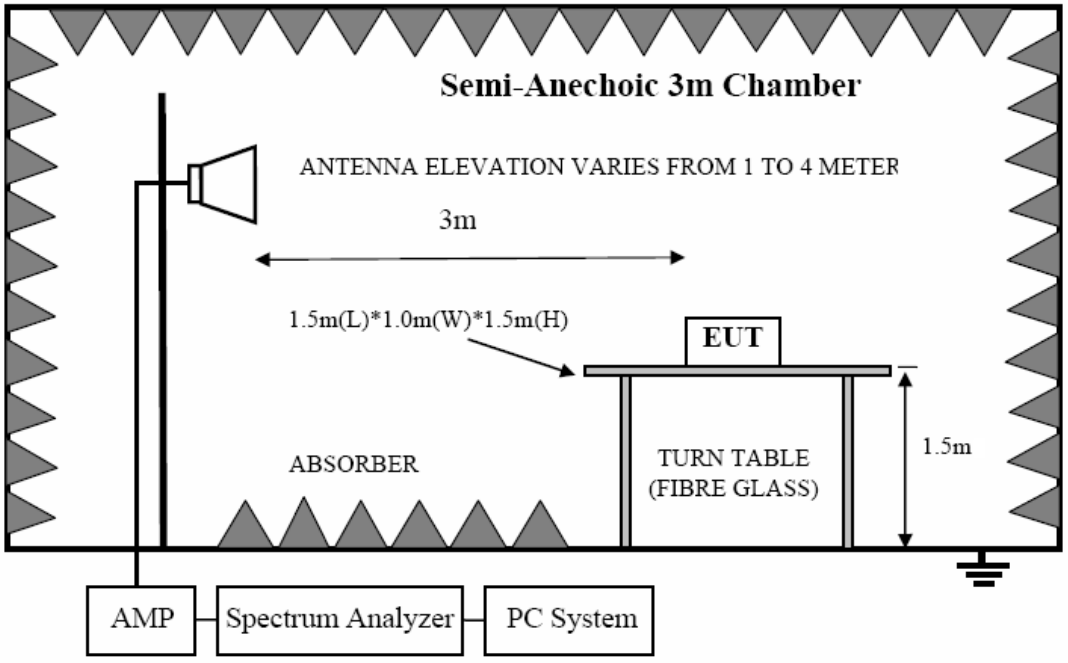
Note: 1.30MHz~18GHz: (Scan with GFSK, π/4 QPSK, 8-DPSK, the worst case is GFSK Mode)
2. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.

# 9. Band Edge Compliance (radiated method)

## 9.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | EMI Test Receiver | R&S | ESU8 | 100316 | 2014/10/25 | 1 Year |
| 2 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 3 | Trilog Broadband Antenna | Schwarzbeck | VULB9163 | 9163-462 | 2015/05/30 | 1 Year |
| 4 | Double Ridged Horn Antenna | R&S | HF907 | 100276 | 2014/11/01 | 1 Year |
| 5 | Pre-amplifier | A.H. | PAM0-0118 | 360 | 2015/05/30 | 1 Year |
| 6 | RF Cable | R&S | R01 | 10403 | 2014/10/25 | 1 Year |
| 7 | RF Cable | R&S | R02 | 10512 | 2014/10/25 | 1 Year |
| 8 | Test software | Audix | E3 | V 6.11111b | / | / |

## 9.2. Block diagram of test setup




## 9.3. Limit

All restriction band should comply with 15.209, other emission should be at least 20dB blow the fundamental.

## 9.4. Test Procedure

Same with clause 8.4 except change investigated frequency range from 2310MHz to 2415MHz and 2475MHz to 2500MHz.

Remark: All restriction band have been tested, and only the worse case is shown in report.

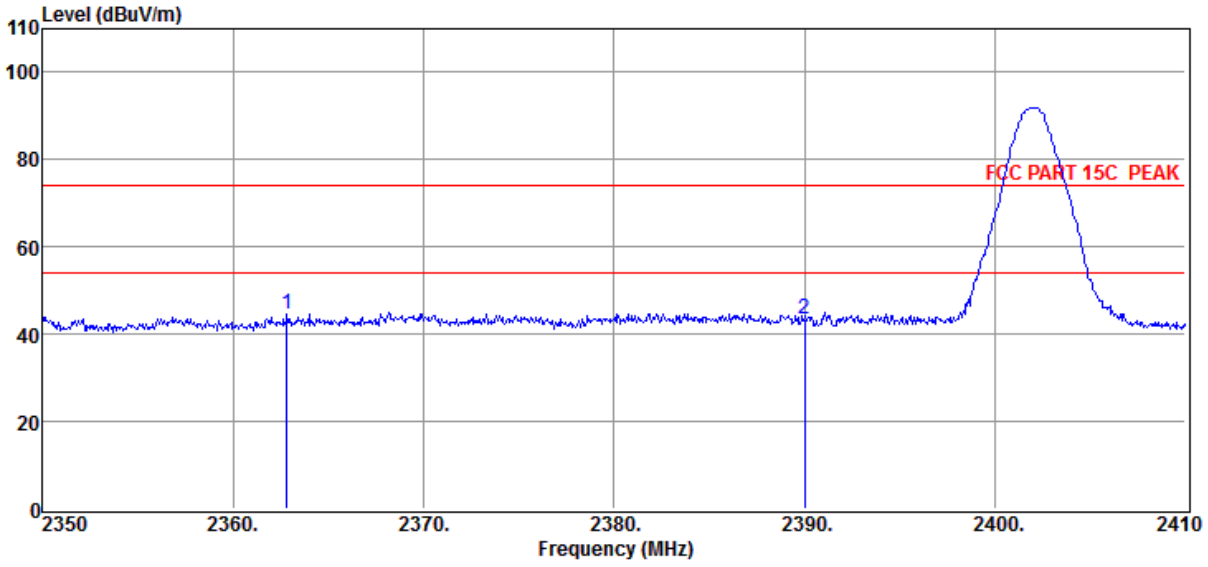
### 9.5. Test result

**PASS. (See below detailed test result)**
**Remark: hopping on and hopping off mode all have been test, hopping off mode is worse and reported only.**

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode GFSK CH0 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/HORIZONTAL |
| **Memo** | : | | | | |

Data: 9



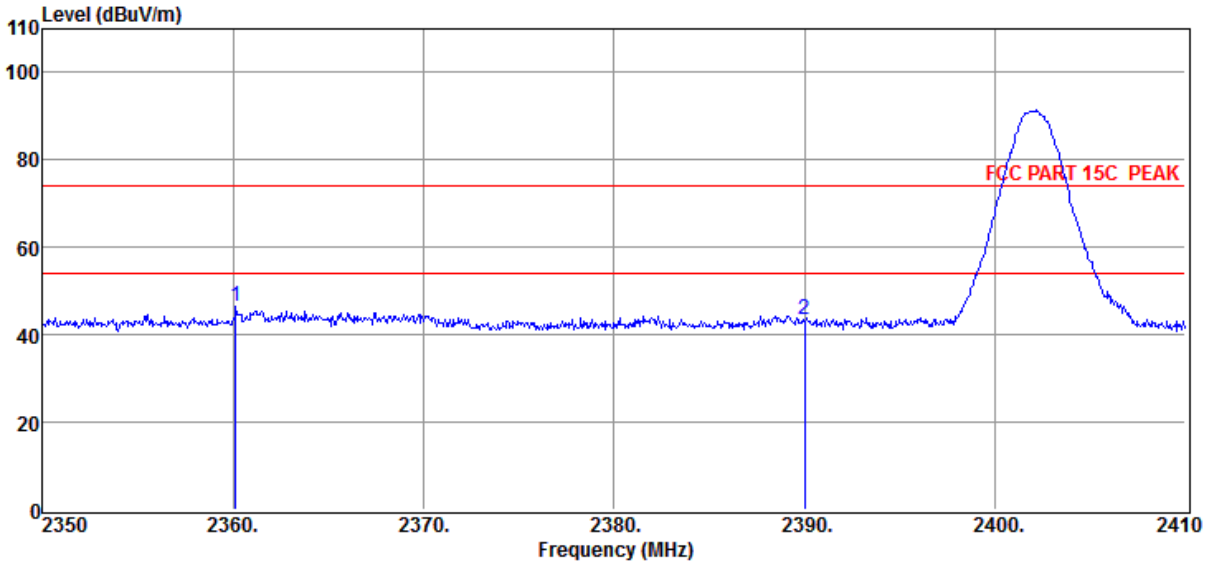

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2362.84 | 39.79 | 29.89 | 30.19 | 5.11 | 44.60 | 74.00 | -29.40 | Peak | HORIZONTAL |
| 2 | 2390.00 | 38.38 | 29.99 | 30.21 | 5.17 | 43.33 | 74.00 | -30.67 | Peak | HORIZONTAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode GFSK CH0 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/VERTICAL |
| **Memo** | : | | | | |

Data: 10



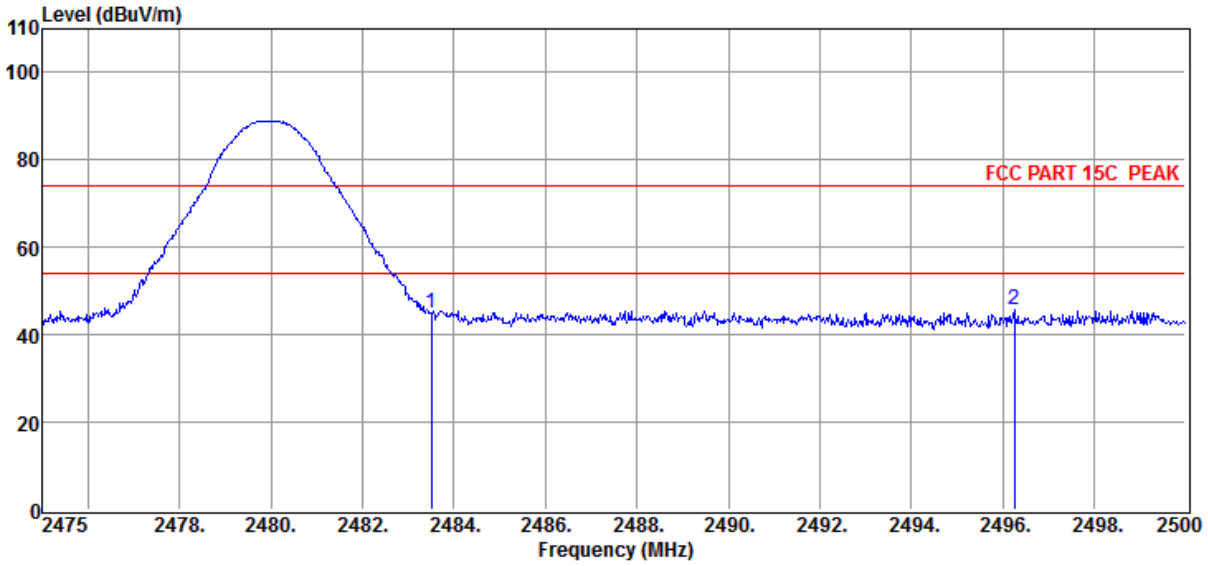

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2360.14 | 41.74 | 29.89 | 30.19 | 5.11 | 46.55 | 74.00 | -27.45 | Peak | VERTICAL |
| 2 | 2390.00 | 38.68 | 29.99 | 30.21 | 5.17 | 43.63 | 74.00 | -30.37 | Peak | VERTICAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode GFSK CH78 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/HORIZONTAL |
| **Memo** | : | | | | |

Data: 15



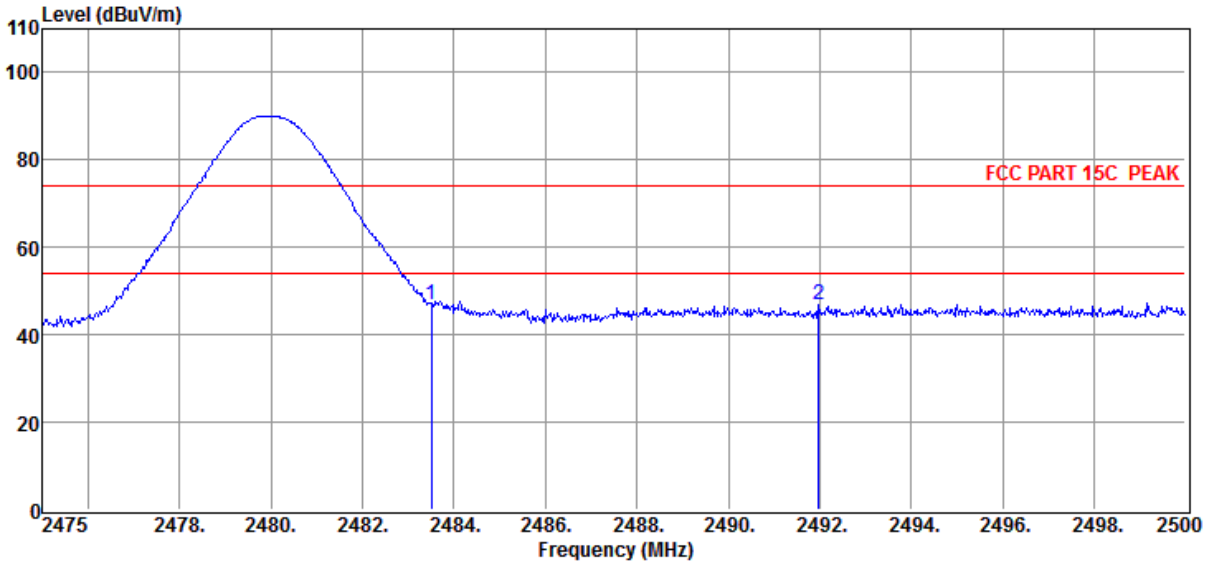

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2483.50 | 39.70 | 30.25 | 30.25 | 5.31 | 45.01 | 74.00 | -28.99 | Peak | HORIZONTAL |
| 2 | 2496.25 | 40.47 | 30.30 | 30.27 | 5.38 | 45.88 | 74.00 | -28.12 | Peak | HORIZONTAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode GFSK CH78 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/VERTICAL |
| **Memo** | : | | | | |

Data: 16



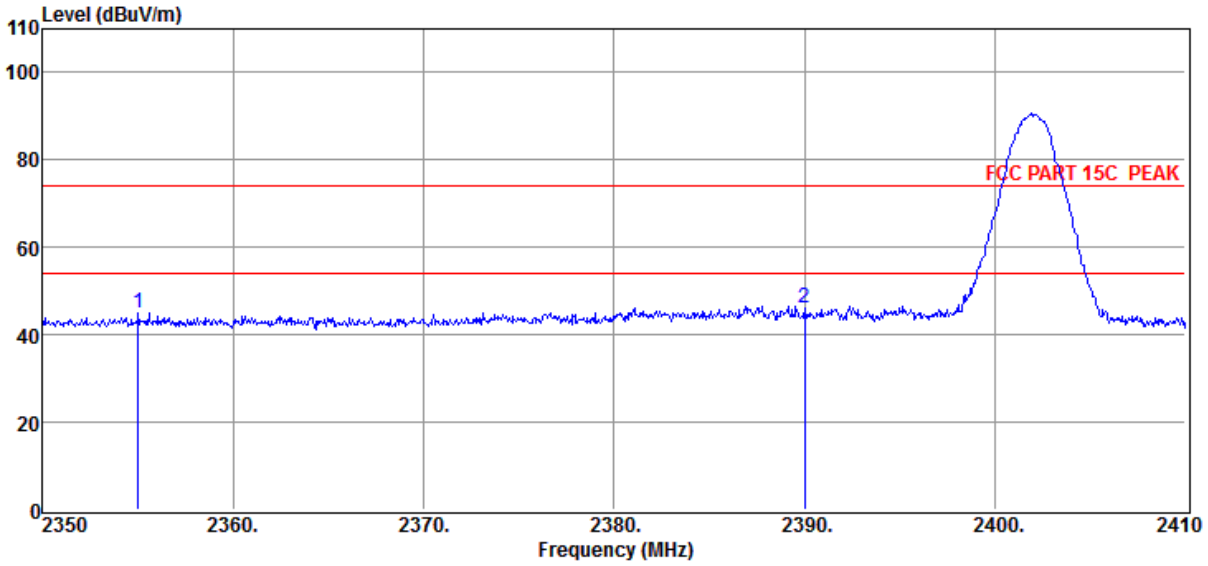

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2483.50 | 41.43 | 30.25 | 30.25 | 5.31 | 46.74 | 74.00 | -27.26 | Peak | VERTICAL |
| 2 | 2491.98 | 41.52 | 30.30 | 30.25 | 5.31 | 46.88 | 74.00 | -27.12 | Peak | VERTICAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode 8-DPSK CH0 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/HORIZONTAL |
| **Memo** | : | | | | |

Data: 19



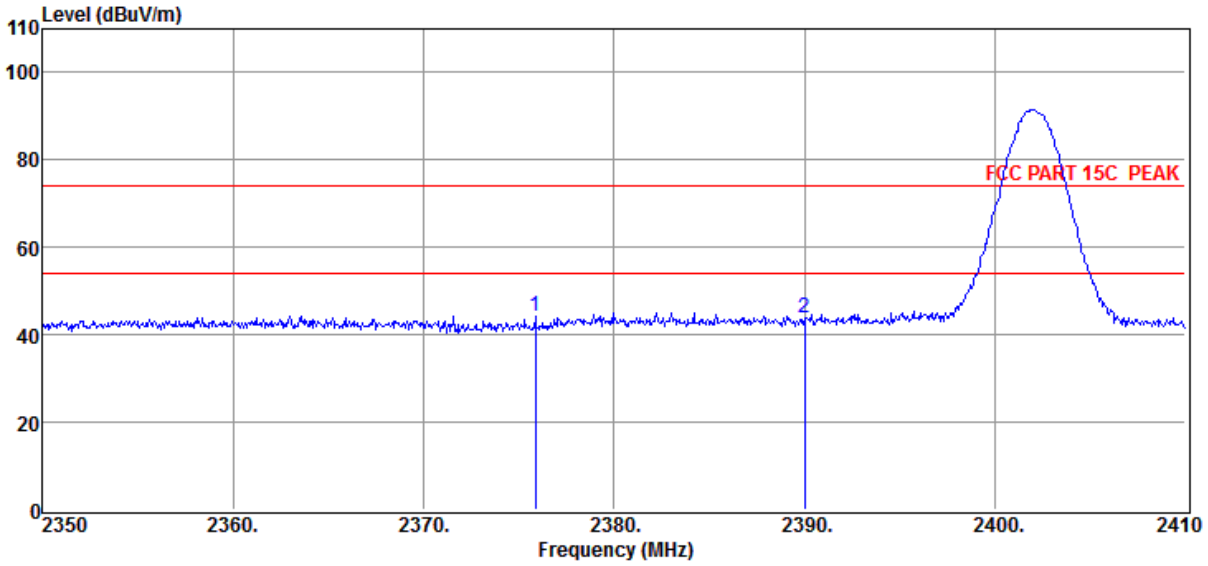

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2355.04 | 40.05 | 29.89 | 30.19 | 5.11 | 44.86 | 74.00 | -29.14 | Peak | HORIZONTAL |
| 2 | 2390.00 | 41.30 | 29.99 | 30.21 | 5.17 | 46.25 | 74.00 | -27.75 | Peak | HORIZONTAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode 8-DPSK CH0 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/VERTICAL |
| **Memo** | : | | | | |

Data: 20



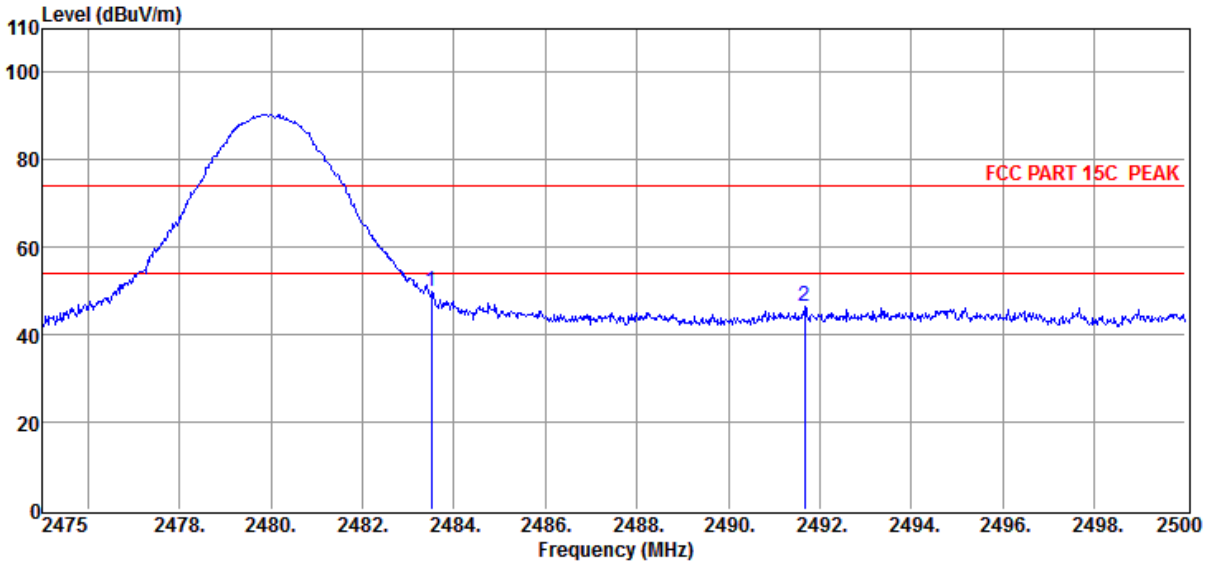

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2375.86 | 39.30 | 29.94 | 30.19 | 5.11 | 44.16 | 74.00 | -29.84 | Peak | VERTICAL |
| 2 | 2390.00 | 39.02 | 29.99 | 30.21 | 5.17 | 43.97 | 74.00 | -30.03 | Peak | VERTICAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode 8-DPSK CH78 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/VERTICAL |
| **Memo** | : | | | | |

Data: 25



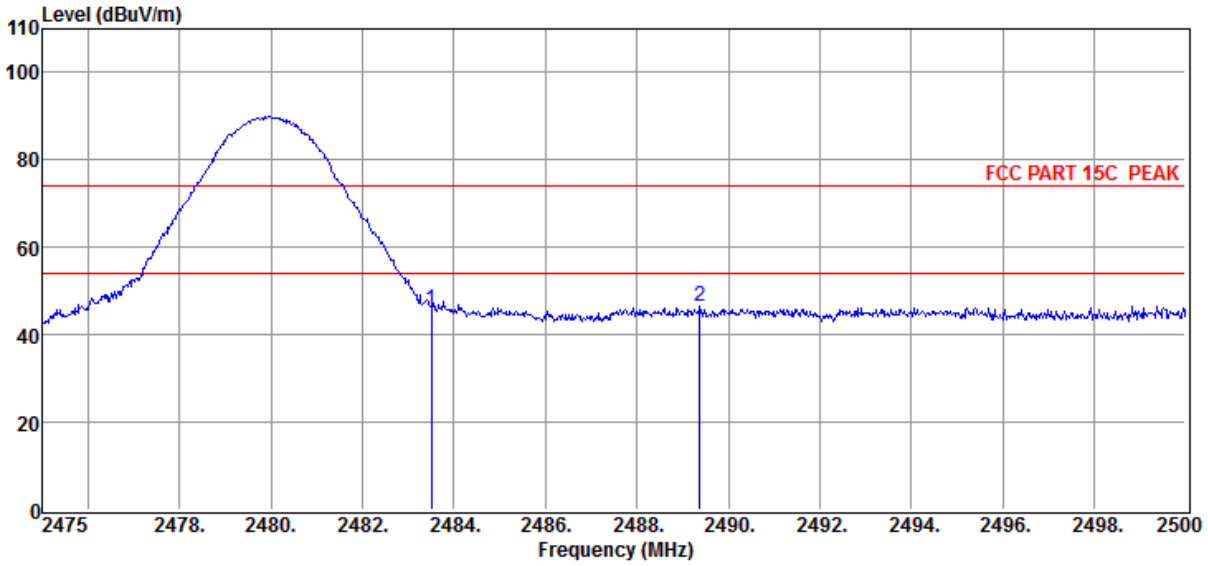

| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2483.50 | 44.62 | 30.25 | 30.25 | 5.31 | 49.93 | 74.00 | -24.07 | Peak | VERTICAL |
| 2 | 2491.68 | 41.25 | 30.30 | 30.25 | 5.31 | 46.61 | 74.00 | -27.39 | Peak | VERTICAL |

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# TR-4-E-009 Radiated Emission Test Result

| | | | | | |
|---|---|---|---|---|---|
| **Test Site** | : | DDT 3m Chamber | E:\2015 Report Data\15Q0817-1\RF.EM6 | | |
| **Test Date** | : | 2015-08-19 | **Tested By** | : | Toby |
| **EUT** | : | Car amplifier | **Model Number** | : | GTR-104 |
| **Power Supply** | : | DC 12V | **Test Mode** | : | Tx mode 8-DPSK CH78 |
| **Condition** | : | Temp:24.5'C,Humi:55%, Press:100.1kPa | **Antenna/Distance** | : | 2014 HF907/3m/HORIZONTAL |
| **Memo** | : | | | | |

Data: 26




| Item (Mark) | Freq (MHz) | Read Level (dBµV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss dB | Result Level (dBµV/m) | Limit Line (dBµV/m) | Over Limit (dB) | Detector | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2483.50 | 40.48 | 30.25 | 30.25 | 5.31 | 45.79 | 74.00 | -28.21 | Peak | HORIZONTAL |
| 2 | 2489.38 | 41.18 | 30.30 | 30.25 | 5.31 | 46.54 | 74.00 | -27.46 | Peak | HORIZONTAL |

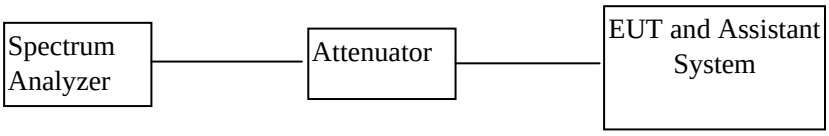
Note: 1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 1 MHz, VBW: 3 MHz, Sweep time: auto.

# 10. Band Edge Compliance (conducted method)

## 10.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Spectrum analyzer | R&S | FSU | 1166.1660.26 | 2014/10/25 | 1 Year |
| 2 | Attenuator | Mini-Circuits | BW-S10W2 | 101109 | 2014/10/25 | 1 Year |
| 3 | RF Cable | Micable | C10-01-01-1 | 100309 | 2014/10/25 | 1 Year |

## 10.2. Block diagram of test setup




## 10.3. Limit

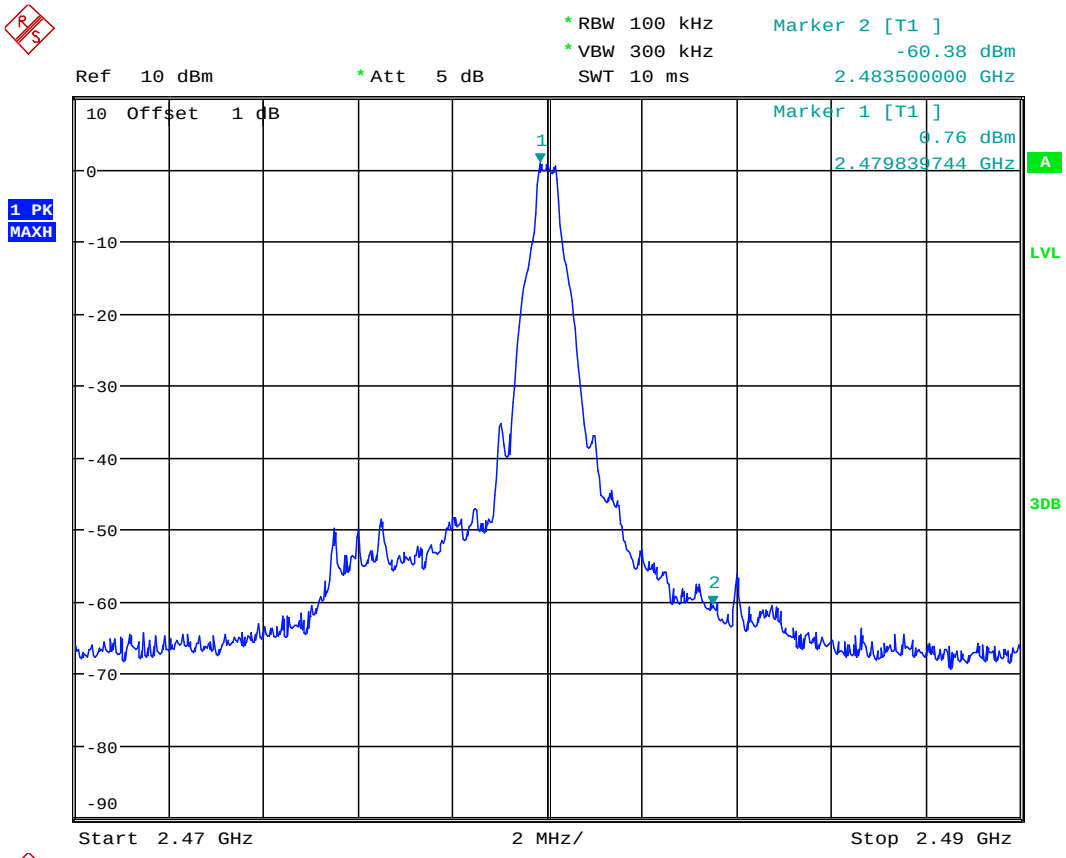
All restriction band should comply with 15.209, other emission should be at least 20dB blow the fundamental.

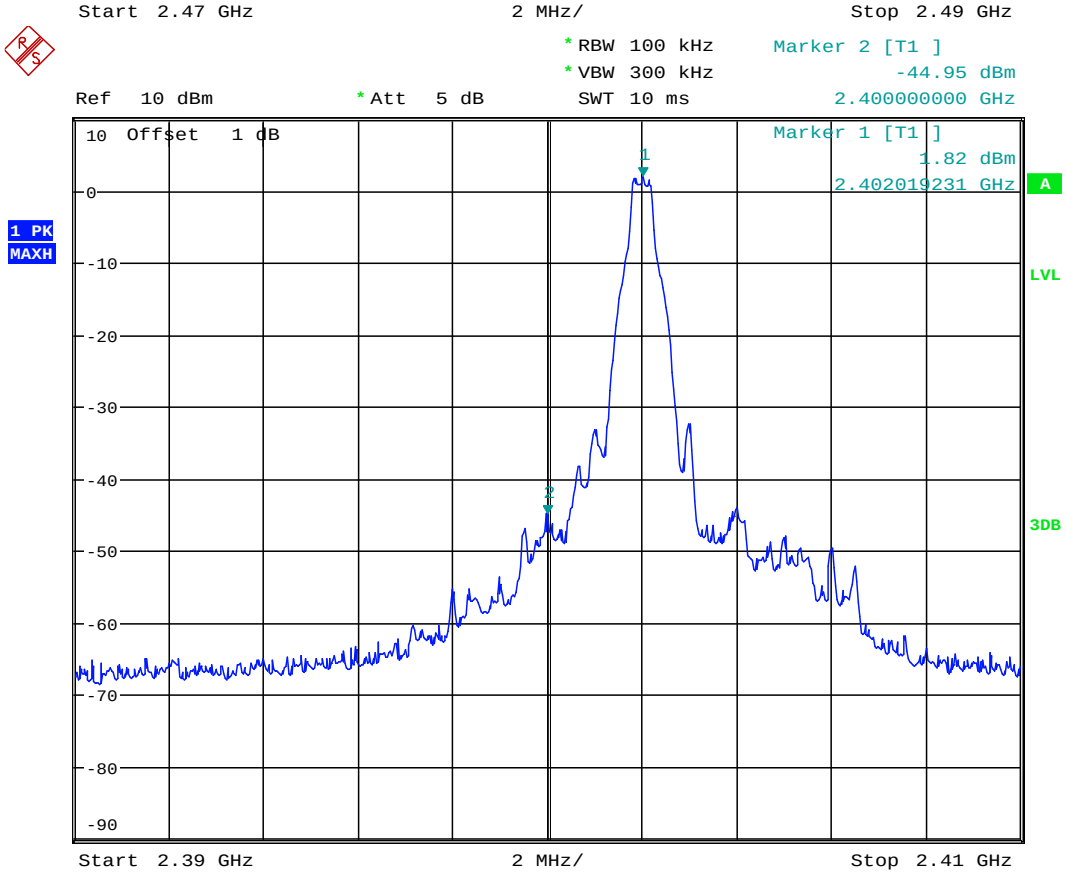
## 10.4. Test result

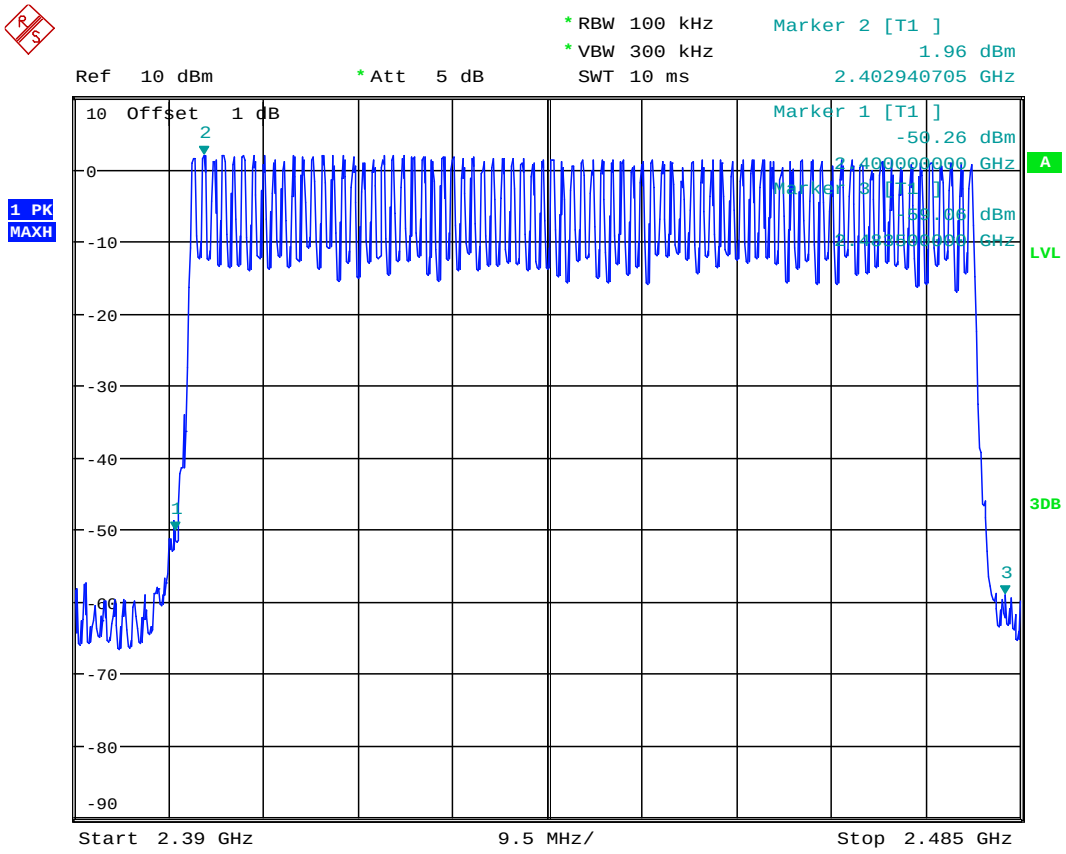
| EUT: Car amplifier M/N: GTR-104 | | |
|---|---|---|
| Mode | Freq (MHz) | Conclusion |
| GFSK | Hopping off 2402 | PASS |
| | Hopping off 2480 | PASS |
| | Hopping on | PASS |
| 8-DPSK | Hopping off 2402 | PASS |
| | Hopping off 2480 | PASS |
| | Hopping on | PASS |
| Test Date : 2015/8/14 | | Test Engineer : Leo |

## 10.5. Original test data

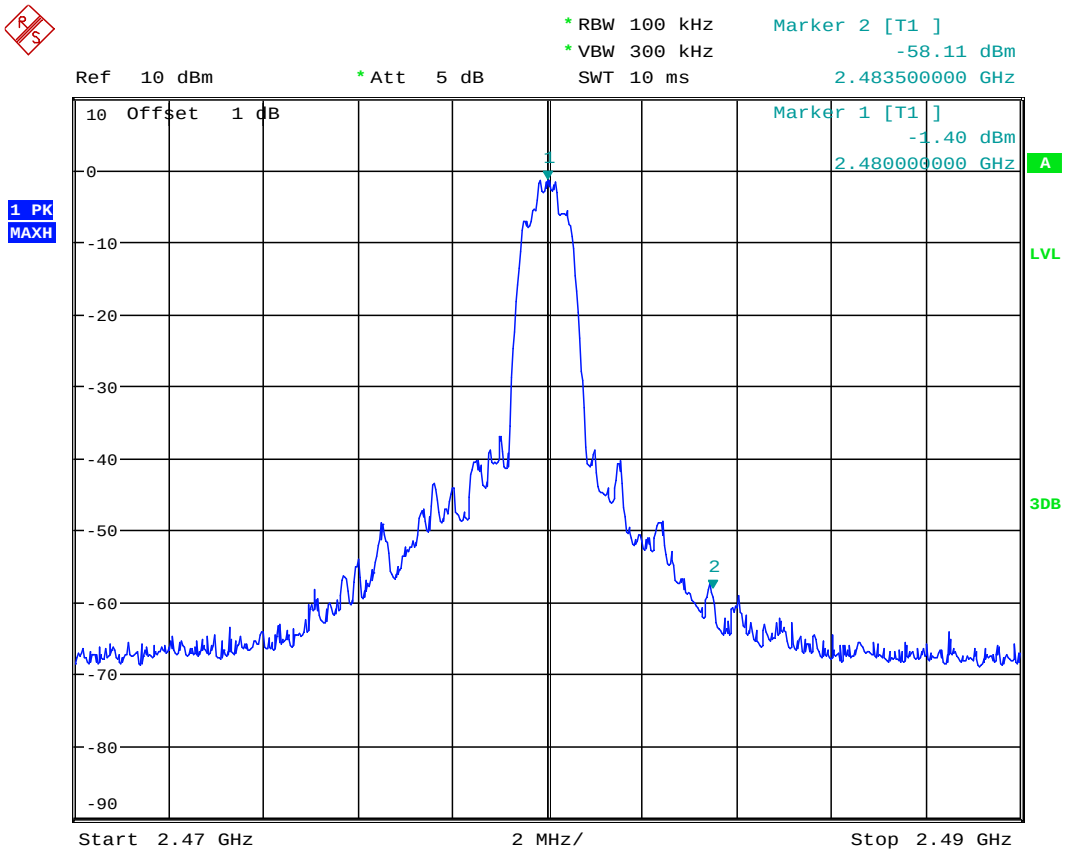
GFSK

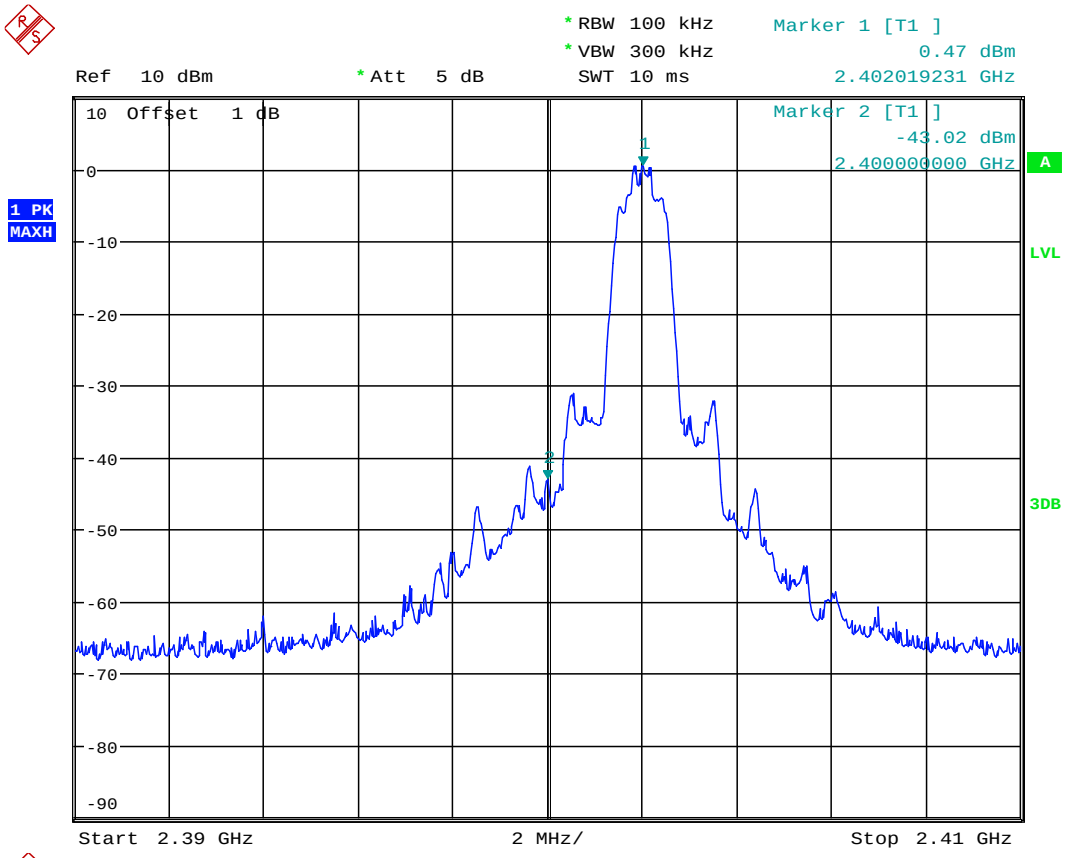

*RBW 100 kHz
*VBW 300 kHz
Ref 10 dBm
*Att 5 dB
SWT 10 ms
Marker 2 [T1 ]
-60.38 dBm
2.483500000 GHz
10 Offset 1 dB
Marker 1 [T1 ]
0.76 dBm
2.479839744 GHz
1 PK
MAXH
A
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 2.47 GHz
2 MHz/
Stop 2.49 GHz

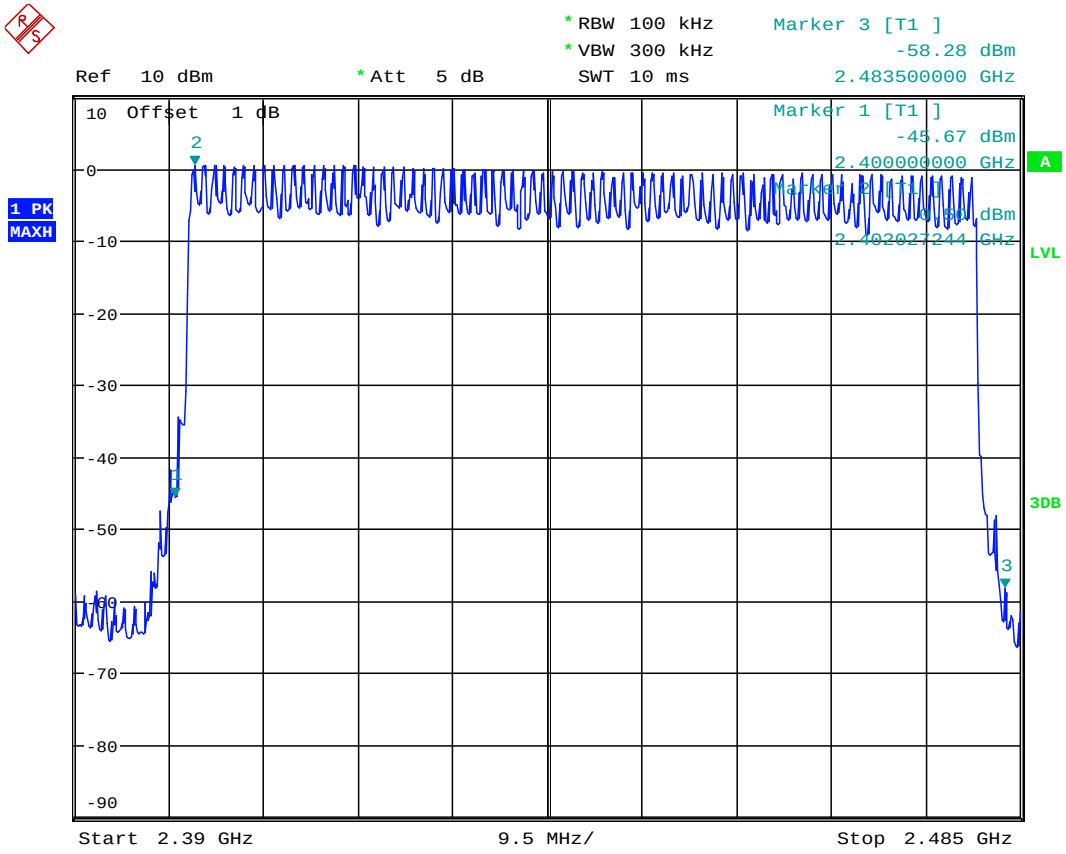

*RBW 100 kHz
*VBW 300 kHz
Ref 10 dBm
*Att 5 dB
SWT 10 ms
Marker 2 [T1 ]
-44.95 dBm
2.400000000 GHz
10 Offset 1 dB
Marker 1 [T1 ]
1.82 dBm
2.402019231 GHz
1 PK
MAXH
A
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 2.39 GHz
2 MHz/
Stop 2.41 GHz


RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 2 [T1 ]
1.96 dBm
2.402940705 GHz
Ref 10 dBm
Att 5 dB
10 Offset 1 dB
Marker 1 [T1 ]
-50.26 dBm
2.400000000 GHz
Marker 3 [T1 ]
-58.06 dBm
1 PK
MAXH
A
LVL
3DB
Start 2.39 GHz
9.5 MHz/
Stop 2.485 GHz

8-DPSK


RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 2 [T1 ]
-58.11 dBm
2.483500000 GHz
Ref 10 dBm
Att 5 dB
10 Offset 1 dB
Marker 1 [T1 ]
-1.40 dBm
2.480000000 GHz
1 PK
MAXH
A
LVL
3DB
Start 2.47 GHz
2 MHz/
Stop 2.49 GHz


*RBW 100 kHz
*VBW 300 kHz
Ref 10 dBm
*Att 5 dB
SWT 10 ms
Marker 1 [T1 ]
0.47 dBm
2.402019231 GHz
10 Offset 1 dB
Marker 2 [T1 ]
-43.02 dBm
2.400000000 GHz
1 PK
MAXH
A
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 2.39 GHz
2 MHz/
Stop 2.41 GHz

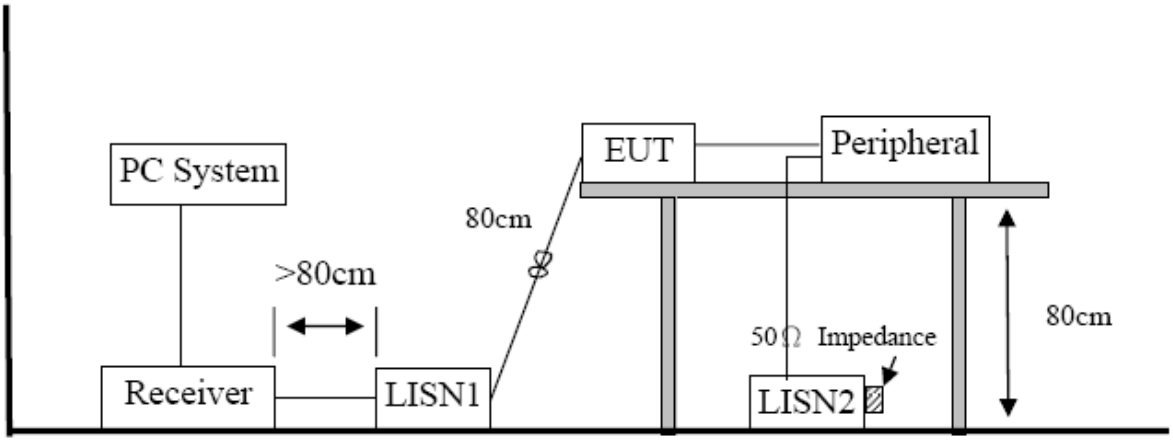

*RBW 100 kHz
*VBW 300 kHz
Ref 10 dBm
*Att 5 dB
SWT 10 ms
Marker 3 [T1 ]
-58.28 dBm
2.483500000 GHz
10 Offset 1 dB
Marker 1 [T1 ]
-45.67 dBm
2.400000000 GHz
Marker 2 [T1 ]
3.98 dBm
2.402027244 GHz
1 PK
MAXH
A
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Start 2.39 GHz
9.5 MHz/
Stop 2.485 GHz

# 11. Power Line Conducted Emission

## 11.1. Test equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1 | Test Receiver | R&S | ESU8 | 100316 | 2014/10/25 | 1 Year |
| 2 | LISN 1 | R&S | ENV216 | 101109 | 2014/10/25 | 1 Year |
| 3 | LISN 2 | R&S | ESH2-Z5 | 100309 | 2014/10/25 | 1 Year |
| 4 | Pulse Limiter | R&S | ESH3-Z2 | 101242 | 2014/10/25 | 1 Year |
| 5 | Test software | Audix | E3 | V 6.11111b | / | / |

## 11.2. Block diagram of test setup




## 11.3. Power Line Conducted Emission Limits(Class B)

| Frequency | Quasi-Peak Level dB(μV) | Average Level dB(μV) |
|---|---|---|
| 150kHz ~ 500kHz | 66 ~ 56* | 56 ~ 46* |
| 500kHz ~ 5MHz | 56 | 46 |
| 5MHz ~ 30MHz | 60 | 50 |

Note 1: * Decreasing linearly with logarithm of frequency.

Note 2: The lower limit shall apply at the transition frequencies.

## 11.4. Test Procedure

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.4 and test equipment as described in clause 10.2 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.

All support equipment power received from a second LISN.

Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in clause 2.4 were scanned during the preliminary test.

After the preliminary scan, we found the test mode producing the highest emission level.

The EUT configuration and worse cable configuration of the above highest emission levels were recorded for reference of the final test.

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.

A scan was taken on both power lines, Neutral and Line, recording at least the six highest emissions.

Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.

The test data of the worst-case condition(s) was recorded.

The bandwidth of test receiver is set at 9 KHz.

### 11.5. Test Result

Not Applicable

# 12. Antenna Requirements

### 12.1. Limit

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 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 12.2. Result

The antennas used for this product are PCB antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 0.72dBi.

**END OF REPORT**