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# **TEST REPORT**

# Part 15 Subpart C 15.247

Equipment under test In-vehicle Infortainment System

Model name XSG4

FCC ID YE4XSG4

Applicant Glosys Inc.

Manufacturer Glosys Inc.

Date of test(s) 2020.10.28 ~ 2020.11.17

**Date of issue** 2020.11.25

## **Issued** to

**Glosys Inc.** 

#510, 40, Omokcheon-ro 152beon-gil, Gwonseon-gu, Suwon-si, Gyeonggi-do, Korea Tel: +82-31-291-1450 / Fax: +82-32-291-1451

Issued by KES Co., Ltd. 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea Tel: +82-31-425-6200 / Fax: +82-31-424-0450

| Test and report completed by : | Report approval by : |
|--------------------------------|----------------------|
|                                | lel                  |
| Yeong-Jun, Cho                 | Young-Jin, Lee       |
| Test engineer                  | Technical manager    |



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## **Revision history**

| Revision | Date of issue | Test report No. | Description |
|----------|---------------|-----------------|-------------|
| -        | 2020.11.25    | KES-RF1-20T0226 | Initial     |
|          |               |                 |             |



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## 1. General information

| Applicant:              | Glosys Inc.   |  |  |  |
|-------------------------|---|--|--|--|
| Applicant address:      | #510, 40, Omokcheon-ro 152beon-gil, Gwonseon-gu, Suwon-si, Gyeonggi-do, Korea |  |  |  |
| Test site:              | KES Co., Ltd.   |  |  |  |
| Test site address:      | 3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si,                      |  |  |  |
|                         | Gyeonggi-do, 14057, Korea   |  |  |  |
|                         | 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea                                |  |  |  |
| Test Facility           | FCC Accreditation Designation No.: KR0100, Registration No.: 444148           |  |  |  |
| FCC rule part(s):       | 15.247  |  |  |  |
| FCC ID:                 | YE4XSG4   |  |  |  |
| Test device serial No.: | Production Pre-production Engineering   |  |  |  |

## **1.1. EUT description**

| Equipment under test  | In-vehicle Infortainment System  |
|-----------------------|--|
| Frequency range       | $2 402 \text{ MHz} \sim 2 480 \text{ MHz} (BDR / EDR)$   |
| Model:                | XSG4   |
| Modulation technique  | GFSK, $\pi/4$ DQPSK, 8DPSK   |
| Number of channels    | 2 402 MHz ~ 2 480 MHz (BDR / EDR) : 79ch   |
| Antenna specification | Antenna type : PCB Antenna // Peak gain: -4.54 dBi   |
| Power source          | DC 12 V  |
| H/W version           | CPU BOARD : G4 MEDIA V1.2<br>AV BOARD : G4 AV V2.1   |
| S/W version           | SYSTEM OS : Android 4.4.2 sw version 1.6.9(KA13)<br>NAVI OS : Android 4.4.2 sw version 1.6.9<br>MICOM : GX4A0012-00(KA08-B)-Ff<br>Scaler : GX4B1012-02(KA08-0)-D |



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#### **1.2.** Requirements for Bluetooth transmitter

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted signals.

#### **Pseudorandom frequency hopping sequence**

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

#### Equal hopping frequency use

The channels of this system will be used equally over the long-term distribution of the hopsets.

#### Example of a 79 hopping sequence in data mode:

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 16, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 05, 16, 68, 74, 59, 63, 55

#### System receiver input bandwidth

Each channel bandwidth is 1 Mtz.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.



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## **1.3.** Test configuration

The Glosys Inc. // In-vehicle Infortainment System // XSG4 // FCC ID: YE4XSG4 was tested according

to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Subpart C 15.247 KDB 558074 D01 V05r02 ANSI C63.10-2013

### **1.4.** Device modifications

N/A

#### **1.5.** Accessory information

| Equipment | Manufacturer | Model | Serial No. | Power source |
|-----------|--------------|-------|------------|--------------|
| -         | -            | -     | -          | -            |

#### **1.6.** Sample calculation

Where relevant, the following sample calculation is provided

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).= 0.51 + 10 = 10.51 (dB)

For Radiation test :

Field strength level  $(dB\mu / m) =$  Measured level  $(dB\mu / m) +$  Antenna factor (dB) + Cable loss (dB) - Amplifier gain (dB)

#### **1.7.** Measurement Uncertainty

| Test Item   |            | Uncertainty |  |  |
|---|------------|-------------|--|--|
| Uncertainty for Conduction emission test  |            | 2.46 dB     |  |  |
| Uncertainty for Radiation emission test Below 1GHz  |            | 4.40 dB     |  |  |
| (include Fundamental emission)  | Above 16Hz | 5.94 dB     |  |  |
| Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. |            |             |  |  |



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## **1.8.** Frequency/channel operations

| Ch.     | Frequency (Mb) | Rate(Mbps)  |
|---------|----------------|-------------|
|         |                | BDR 1 Mbps, |
| 00      | 2402           | EDR 2 Mbps, |
|         |                | EDR 3 Mbps  |
|         |                |             |
|         |                | BDR 1 Mbps, |
| 40      | 2442           | EDR 2 Mbps, |
|         |                | EDR 3 Mbps  |
| · · · · |                |             |
|         |                | BDR 1 Mbps, |
| 78      | 2480           | EDR 2 Mbps, |
|         |                | EDR 3 Mbps  |



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## 2. Summary of tests

| Reference         | Test description                              | Test results       |
|-------------------|---|--------------------|
| 15.247(a)(1)(iii) | 20 dB bandwidth                               | Pass               |
| 15.247(b)(1)      | Output power                                  | Pass               |
| 15.247(a)(1)      | Channel separation                            | Pass               |
| 15.247(a)(1)(iii) | Number of channels                            | Pass               |
| 15.247(a)(1)(iii) | Time of occupancy                             | Pass               |
| 15.205, 15.209    | Radiated restricted band and emission         | Pass               |
| 15.207(a)         | AC conducted emissions                        | N/A <sup>(1)</sup> |
| 15.207(d)         | Conducted band edge and out of band emissions | Pass               |

Note.

1. This device uses a DC 12 V power supply and does not have an AC conducted emissions test.



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#### 3. Test results

3.1. 20 dB bandwidth

#### Test procedure

ANSI 63.10-2013

#### **Test setup**

| DUT | Attonuator | Speetrum analyzer |
|-----|------------|-------------------|
| EUI | Attenuator | Spectrum analyzer |

## Test setting

- 1. Span = Set between two times and five times the OBW
- 2.  $RBW \ge 1$  % to 5 % of the OBW
- 3. VBW  $\geq$  3 \* RBW
- 4. Sweep = Auto
- 5. Detector function = Peak
- 6. Sweep = Auto couple
- 7. Trace mode = Max hold
- 8. All the trace to stabilize

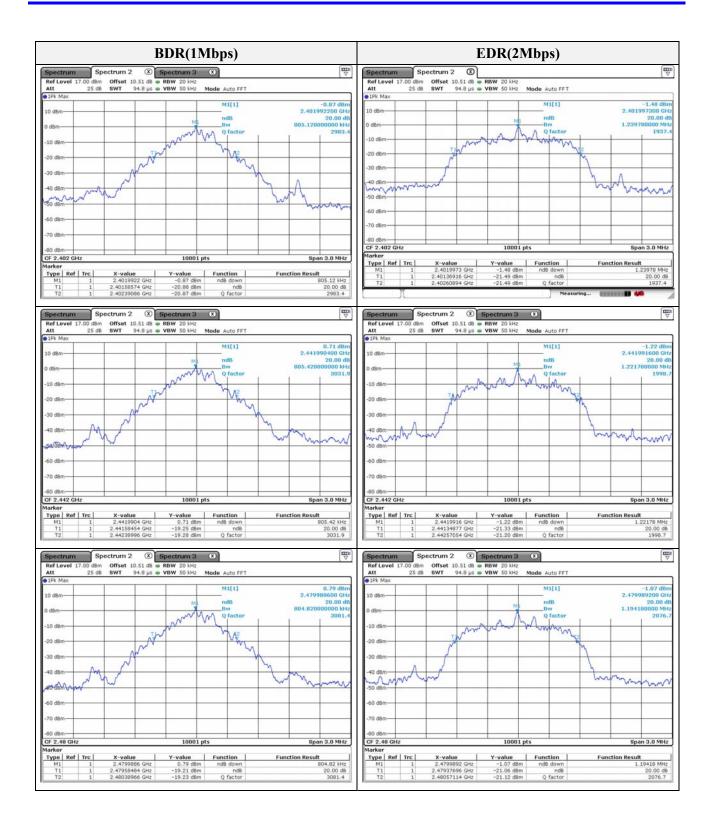
#### Limit

Not applicable

| Frequency(Mz) | Channel no. | Data rate(Mbps) | Measured bandwidth(Mz) |
|---------------|-------------|-----------------|------------------------|
| 2 402         | 00          |                 | 0.805                  |
| 2 442         | 40          | BDR 1 Mbps      | 0.805                  |
| 2 480         | 78          |                 | 0.805                  |
| 2 402         | 00          |                 | 1.240                  |
| 2 442         | 40          | EDR 2 Mbps      | 1.222                  |
| 2 480         | 78          |                 | 1.194                  |
| 2 402         | 00          |                 | 1.209                  |
| 2 442         | 40          | EDR 3 Mbps      | 1.204                  |
| 2 480         | 78          |                 | 1.203                  |

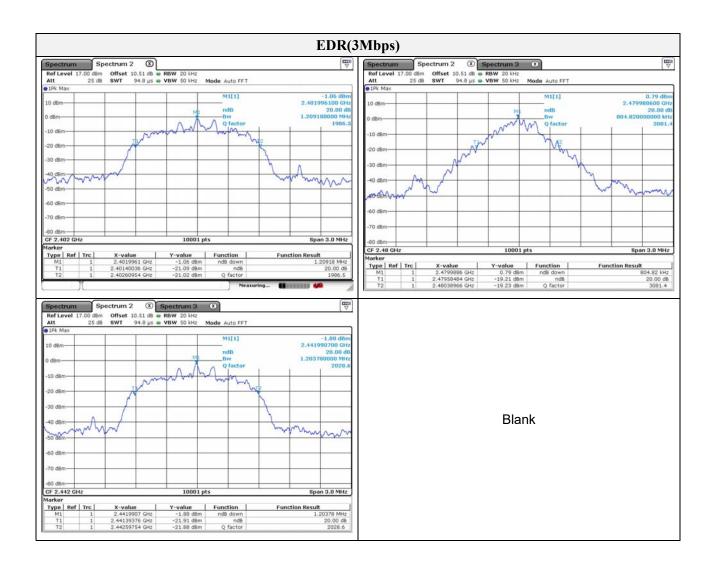


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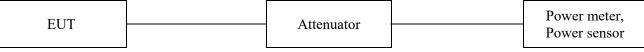


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#### 3.2. Output power

**Test procedure** KDB 558074 v05r02 & ANSI 63.10-2013 – Section 11.9.2.1 and 11.9.2.3.2

#### **Test setup**



#### **Test setting**

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

#### Limit

According to \$15.247(a)(1), 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, provided the systems operate with an output power no greater than 125 mW.

According to \$15.247(b)(1), For frequency hopping systems operating in the 2 400 ~ 2 483.5 Mz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 ~ 5 805 Mz band: 1 Watt.

According to \$15.247(a)(4), The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.



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#### **Test results**

| Frequency(Mbz) | Channel no. | Data rate(Mbps) | Average<br>Power (dBm) | Peak<br>Power (dBm) | Power Limit (dBm) |
|----------------|-------------|-----------------|------------------------|---------------------|-------------------|
| 2 402          | 00          |                 | 1.53                   | 1.93                | 20.97             |
| 2 442          | 40          | BDR 1 Mbps      | 2.70                   | 3.05                | 20.97             |
| 2 480          | 78          |                 | 0.96                   | 1.33                | 20.97             |
| 2 402          | 00          | EDR 2 Mbps      | -1.38                  | 0.96                | 20.97             |
| 2 442          | 40          |                 | -0.49                  | 2.14                | 20.97             |
| 2 480          | 78          |                 | -0.47                  | 2.14                | 20.97             |
| 2 402          | 00          |                 | -1.32                  | 1.10                | 20.97             |
| 2 442          | 40          | EDR 3 Mbps      | -0.35                  | 2.24                | 20.97             |
| 2 480          | 78          |                 | -0.50                  | 2.20                | 20.97             |



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## **3.3.** Carrier frequency separation

**Test procedure** 

KDB 558074 v05r02 & ANSI 63.10-2013

#### Test setup

| EUT |  | Attenuator |  | Spectrum analyzer |
|-----|--|------------|--|-------------------|
|-----|--|------------|--|-------------------|

#### Test Setting

- 1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
- 2. Span = wide enough to capture the peaks of two adjacent channels

3. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

- 4. Video (or Average) Bandwidth (VBW)  $\geq$  RBW
- 5. Sweep = auto
- 6. Detector function = peak
- 7. Trace = max hold
- 8. Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

#### Limit

According to 15.247(a)(1), frequency hopping system operating in 2 400 ~ 2 483.5 MHz. Band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.



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### **Test results**

| Frequency(Mz) | Channel no. | Data rate(Mbps) | Data rate(Mbps) Channel Separation (Mz) |         |
|---------------|-------------|-----------------|---|---------|
| 2 442         | 40          | BDR 1 Mbps      | 0.994                                   | ≥ 0.537 |
| 2 442         | 40          | EDR 3 Mbps      | 1.002                                   | ≥ 0.803 |

| Hopping mode_BDR(1Mbps)   | Hopping mode_EDR(3Mbps)  |
|---|--|
| Spectrum         Spectrum 2         Spectrum 3         Image: Constraint of the sector of t | Spectrum         Spectrum 2         Spectrum 3         Time           Ref Level 17.00 dbm         Offset 10.51 db @ RBW         30 kHz           Att         25 dB         SWT         63.3 µs @ VBW 100 kHz         Mode Auto FFT           @1Pk Max  |
| 10 dem  | 10 dBm 10.72 BM 10.72 |
| -60 dBm   | -60 d8m  |
| -80 dBm CF 2.442 GHz Span 3.0 MHz   | -80 dBm GF 2.442 GHz 10001 pts Span 3.0 MHz  |



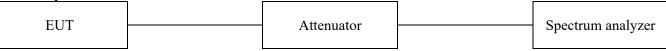
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## **3.4.** Number of hopping frequency

**Test procedure** 

KDB 558074 v05r02 & ANSI 63.10-2013

#### Test setup



#### Test setting

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings.

- 1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- 2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- 3. VBW  $\geq$  RBW.
- 4. Sweep = auto
- 5. Detector function = peak
- 6. Trace = max hold

All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

#### Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 Mz bands shall use at least 15 hopping frequencies.



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#### **Test results**

| Frequency Data rate(Mbps) |            | Number of hopping frequency | Limit |
|---------------------------|------------|-----------------------------|-------|
| $2402 \sim 2480$ MHz      | BDR 1 Mbps | 79                          | ≥15   |
| 2402 ~ 2480 MHz           | EDR 3 Mbps | 79                          | ≥15   |

| Нор   | ping mode_BDR(1Mb)                                       | ps)             | Hopping mo   | de_EDR(3Mbps)                          |
|---|--|-----------------|--|--|
| Spectrum Spectrum   |  |                 | Spectrum 2 Spectrum 2 Spectru  |  |
|   | 10.51 dB • RBW 300 kHz<br>10.1 ms • VBW 1 MHz Mode Sweep |                 | Ref Level         32.51 dBm         Offset         10.51 dB         m RBW         34           Att         40 dB         SWT         10.1 ms         m VBW   |  |
| • 1Pk Max   |  |                 | 1Pk Max  |  |
| 30 dBm-   |  |                 | 30 d8m-  |  |
| 20 dBm-   |  |                 | 20 dBm   |  |
|   |  |                 |  |  |
| 10 dBm  |  |                 | 10 dBm-  |  |
| 0 dBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA  |  | nnnnnnnnnnn     |  |  |
| TYVYYYYYYYY   | . A A A A A A A A A A A A A A A A A A A                  |                 | o garan and a start when   | a hard a second that the second second |
| -10 dBm   | +++++++++++++++++++++++++++++++++++++++                  | THE FEETEN      | -10 dBm  |  |
| -20 dBm-  |  |                 | 29 dBm   |  |
| -ad one   |  |                 |  |  |
| -30 dBm   |  |                 | D dBm  |  |
| 40 d9m  |  |                 | 10 40  |  |
| -40 dBm-  |  |                 | 40 dBm   |  |
| -50 dBm   |  |                 | -50 d8m  |  |
|   |  |                 |  |  |
| -60 dBm   |  |                 | -60 dBm  |  |
| Start 2.4 GHz   | 10001 pts  | Stop 2.4415 GHz | CF 2.42075 GHz   | 10001 pts Span 41.5 MHz                |
| (and the second | 2 3 Spectrum 3 (X)                                       |                 | Spectrum 2 3 Spectrum  | m 3 🗶                                  |
| Spectrum Spectrum 2<br>Ref Level 32.00 d8m Offset   | 2 (Spectrum 3 (X)<br>10.51 dB • RBW 300 kHz              | ♥               | Spectrum 2 Spectrum 2 Spectrum<br>Ref Level 32.00 dBm Offset 10.51 dB • RBW 30   |  |
|   | 10.1 ms 🖶 VBW 1 MHz Mode Sweep                           | 1               | Att 40 dB SWT 10.1 ms • VBW  | 1 MHz Mode Sweep                       |
| 30 dBm  |  |                 | 30 dBm-  |  |
| 3876-4 9232   |  |                 |  |  |
| 20 dBm  |  |                 | 20 dBm   |  |
| 10 dBm  |  |                 | 10 dBm-  |  |
|   |  | 0000000         |  |  |
| Dasm + + + + + + + + + + + + + + + + + + +  | <u> </u>   | WWWWW           | and a hard a second and a second a se | MANAMANA MANAMA                        |
| -10 cBm   | *                  | 1111111         | -10 dBm  |  |
|   |  |                 |  |  |
| -20 dBm   |  |                 | 20 dBm   |  |
| -30 dBm   |  |                 | -30 dBm  |  |
| -av well  |  | Column          |  | Marcol                                 |
| -40 d8m   |  |                 | 40 dBm   |  |
| 50 dbm  |  |                 | FO day   |  |
| -50 dBm-  |  |                 | 50 dBm   |  |
| -60 dBm   |  |                 | -60 dBm  |  |
|   |  |                 |  |  |
| CF 2.4625 GHz   | 10001 pts  | Span 42.0 MHz   | CF 2.4625 GHz 1  | 10001 pts Span 42.0 MHz                |



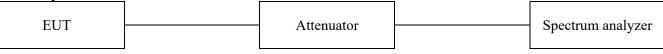
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## **3.5.** Time of occupancy

Test procedure

KDB 558074 v05r02 & ANSI 63.10-2013

#### Test setup



#### Test setting

- 1. The EUT must have its hopping function enabled.
- 2. Span = zero span, centered on a hopping channel
- 3. RBW shall be  $\leq$  channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
- 4. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- 5. Detector function = peak
- 6. Trace = max hold

#### Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 Mz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time =  $0.4(s) \times 79 = 31.6(s)$ 

Time of occupancy on the TX channel in 31.6 sec

= time domain slot length  $\times$  (hop rate  $\div$  number of hop per channel)  $\times$  31.6



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#### Operation mode: GFSK , π/4-DQPSK, 8DPSK

| Packet type | Frequency<br>(Mz) | Dwell time<br>(ms) | Time of occupancy on the Tx<br>channel in 31.6 sec<br>(ms) | Limit for time of occupancy on the<br>Tx channel in 31.6 sec (ms) |
|-------------|-------------------|--------------------|--|---|
| DH1         | 2 442             | 0.421              | 134.72   | 400   |
| DH3         | 2 442             | 1.682              | 269.12   | 400   |
| DH5         | 2 442             | 2.930              | 312.53   | 400   |
| 2-DH1       | 2 442             | 0.435              | 139.20   | 400   |
| 2-DH3       | 2 442             | 1.686              | 269.76   | 400   |
| 2-DH5       | 2 442             | 2.935              | 313.07   | 400   |
| 3-DH1       | 2 442             | 0.434              | 138.88   | 400   |
| 3-DH3       | 2 442             | 1.686              | 269.76   | 400   |
| 3-DH5       | 2 442             | 2.936              | 313.17   | 400   |

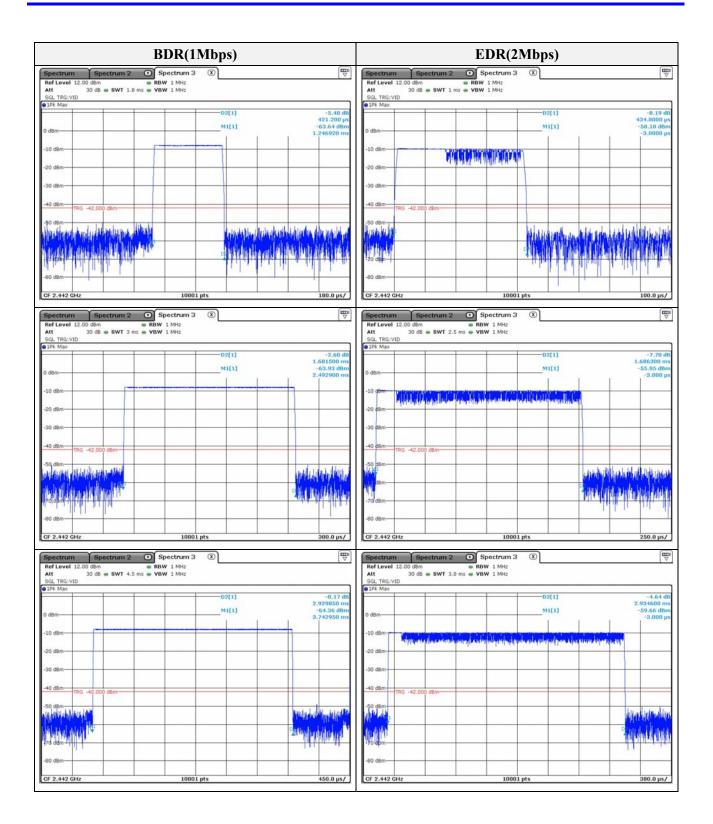
#### Note:

#### **Normal Mode**

DH1: Dwell time (ms) ×  $[(1\ 600\ \div\ 2)\ \div\ 79]$  × 31.6(s) = 134.72 (ms) DH3: Dwell time (ms) ×  $[(1\ 600\ \div\ 4)\ \div\ 79]$  × 31.6(s) = 269.12 (ms) DH5: Dwell time (ms) ×  $[(1\ 600\ \div\ 6)\ \div\ 79]$  × 31.6(s) = 312.53 (ms) 2-DH1: Dwell time (ms) ×  $[(1\ 600\ \div\ 2)\ \div\ 79]$  × 31.6(s) = 139.20 (ms) 2-DH3: Dwell time (ms) ×  $[(1\ 600\ \div\ 4)\ \div\ 79]$  × 31.6(s) = 269.76 (ms) 2-DH5: Dwell time (ms) ×  $[(1\ 600\ \div\ 6)\ \div\ 79]$  × 31.6(s) = 313.07 (ms) 3-DH1: Dwell time (ms) ×  $[(1\ 600\ \div\ 2)\ \div\ 79]$  × 31.6(s) = 138.88 (ms) 3-DH3: Dwell time (ms) ×  $[(1\ 600\ \div\ 4)\ \div\ 79]$  × 31.6(s) = 269.76 (ms) 3-DH3: Dwell time (ms) ×  $[(1\ 600\ \div\ 4)\ \div\ 79]$  × 31.6(s) = 269.76 (ms) 3-DH3: Dwell time (ms) ×  $[(1\ 600\ \div\ 4)\ \div\ 79]$  × 31.6(s) = 269.76 (ms) 3-DH5: Dwell time (ms) ×  $[(1\ 600\ \div\ 6)\ \div\ 79]$  × 31.6(s) = 313.17 (ms)

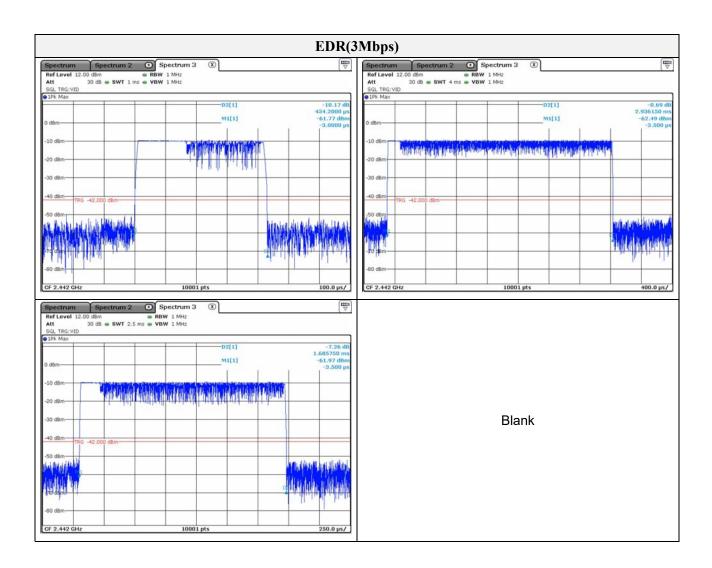


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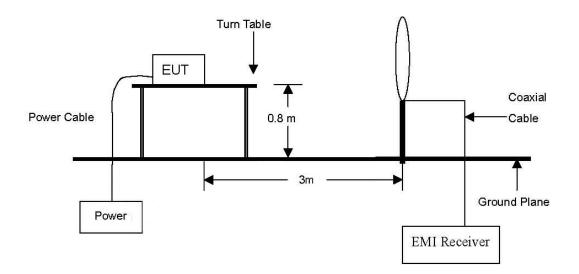


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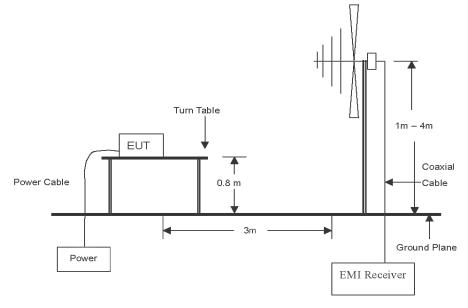
## 3.6. Radiated restricted band and emissions

#### Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.

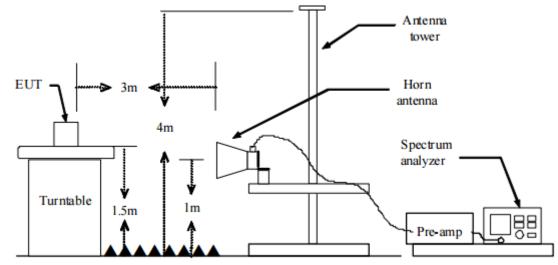


The diagram below shows the test setup that is utilized to make the measurements for emission from 30 Mz to 1 Gz emissions.





The diagram below shows the test setup that is utilized to make the measurements for emission from 1  $\mathbb{G}$  to the tenth harmonic of the highest fundamental frequency or to 40  $\mathbb{G}$  emissions, whichever is lower.



#### **Test procedure**

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

#### Test procedure below 30 Mz

- 1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel, ground parallel and perpendicular of the antenna are set to make the measurement. It was determined that **parallel** was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **parallel**.
- 3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum hold mode.

#### Test procedure above 30 MHz

- 1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. The antenna is a bi-log antenna, a horn antenna ,and its height are varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 3. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 4. The test receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

The authenticity of the test report, contact shchoi@kes.co.kr

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- 5. Spectrum analyzer settings for f < 1 GHz:
  - ① Span = wide enough to fully capture the emission being measured
  - 2 RBW = 100 kHz
  - ③ VBW  $\ge$  RBW
  - ④ Detector = quasi peak
  - 5 Sweep time = auto
  - 6 Trace = max hold
- 6. Spectrum analyzer settings for  $f \ge 1$  GHz: Peak
  - ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
  - 2 RBW = 1 Mz
  - ③ VBW  $\ge$  3 MHz
  - (4) Detector = peak
  - 5 Sweep time = auto
  - $\bigcirc$  Trace = max hold
  - $\bigcirc$  Trace was allowed to stabilize
- 7. Spectrum analyzer settings for  $f \ge 1$  GHz: Average
  - ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
  - 2 RBW = 1 MHz
  - (3)  $VBW \ge 3 \times RBW$
  - (4) Detector = RMS, if span/(# of points in sweep)  $\leq$  (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
  - (5) Averaging type = power(i.e., RMS)
    - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
    - 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
  - 6 Sweep = auto
  - $\bigcirc$  Trace = max hold
  - 8 Perform a trace average of at least 100 traces.
  - (9) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
    - 1) If power averaging (RMS) mode was used in step (5), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
    - 2) If linear voltage averaging mode was used in step (5), then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
    - 3) If a specific emission is demonstrated to be continuous ( $\geq 98$  percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.



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#### Note.

- 1. f < 30 Mz, extrapolation factor of 40 dB/decade of distance.  $F_d = 40\log(D_m/Ds)$ 
  - $f \ge 30$  Mz, extrapolation factor of 20 dB/decade of distance.  $F_d = 20\log(D_m/Ds)$  Where:
    - $F_d$  = Distance factor in dB
    - $D_m$  = Measurement distance in meters
    - $D_s$  = Specification distance in meters
- 2. Field strength( $dB\mu N/m$ ) = Level( $dB\mu N$ ) + CF (dB) + or DCF(dB)
- 3. Margin(dB) = Limit(dB $\mu$ V/m) Field strength(dB $\mu$ V/m)
- 4. Emissions below 18 GHz were measured at a 3 meter test distance while emissions above 18 GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 7. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that <u>X orientation</u> was worst-case orientation; therefore, all final radiated testing was performed with the EUT in <u>X orientation</u>.
- 8. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
- 9. According to exploratory test no any obvious emission were detected from 9 kHz to 30 MHz. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

#### Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

| Frequency (Mz)     | Distance (Meters) | Radiated (µV/m) |
|--------------------|-------------------|-----------------|
| $0.009 \sim 0.490$ | 300               | 2400/F(kllz)    |
| $0.490 \sim 1.705$ | 30                | 24000/F(kHz)    |
| 1.705 ~ 30.0       | 30                | 30              |
| 30~88              | 3                 | 100**           |
| 88~216             | 3                 | 150**           |
| 216~960            | 3                 | 200**           |
| Above 960          | 3                 | 500             |

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands  $54 \sim 72$  Mz,  $76 \sim 88$  Mz,  $174 \sim 216$  Mz or  $470 \sim 806$  Mz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.



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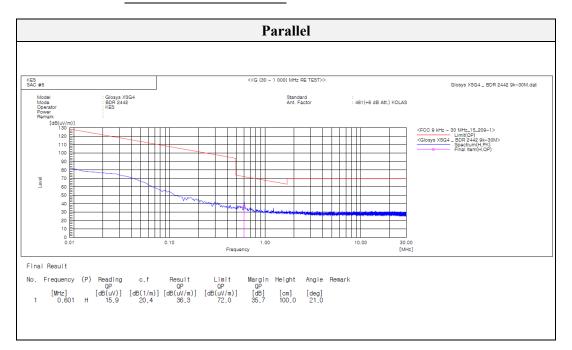
| Test results | (Below 30 | M₽z) |
|--------------|-----------|------|
|--------------|-----------|------|



Distance of measurement: <u>3 meter</u>

Channel:

40(Worst case)





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| Test results (Below 1 000 | Mz) – Worst case |
|---------------------------|------------------|
| Mode:                     | BDR              |
| Distance of measurement:  | 3 meter          |
| Channel:                  | 40(Worst case)   |

Channel:

Horizontal // Vertical <<G (30 - 1 000) MHz RE TEST>> KES SAC #5 Glosys XSG4 \_ BDR 2442 30M-1G.dat Model Mode Operator Power Glosys XSG4 BDR 2442 Standard Ant. Factor FCC Part.15 Class B 3m 461(+6 dB Att.) KOLAS [dB(uV/ 130 <u>س</u>) ا <FCC B> 120 <Glosys XSG4 \_ 1G> 110 100 90 80 70 Leve 60 50 40 Markel Markel Market 30 20 10 30.00 50.00 100.00 500.00 1000.00 [MHz] Frequency -----Final Result Margin QP (P) Reading No. Frequency c.f Result Limit Height Angle Remark QP QP QP [dB(uV/m)][deg] [MHz] [dB(uV)][dB(1/m)] [dB(uV/m)] [dB] [cm] 159,980 161,920 249,948 31.8 27.8 35.8 43.5 43.5 46.0 187.0 44.6 40.7 -12.8 -12.9 261.8 223.2 Н 11.71 15.7 10.2 168.0 171.0 2345678 Н 49.8 -14.0 311.9 Н 40.7 5,3 46.0 -10.9 370,591 Н 51.6 108.0 73.9 411.574 Н 41.8 -9.732.1 46.0 13.9 106.0 275.1 42.8 30.2 34.7 460,801 -8.1 34.7 46.0 11.3 170,2 111.0 Н 22.6 24.2 20.5 22.1 103.0 102.0 17.4 47,945 V -12.8 40.0 93.0 119,968 ۷ -15.419.3 43.5 50,9 9 39.5 -14.0 25.5 46.0 236.0 250.5 249,948 V 23.9 10 460,801 ۷ 32.0 -8.1 46.0 104.0 260.9 37.1 16.3 11 519,001 ۷ -7.4 29.7 46.0 104.0 171.8 27.2 12 ۷ 645,223 32.1 -4.946.0 18.8 221.0 140.0



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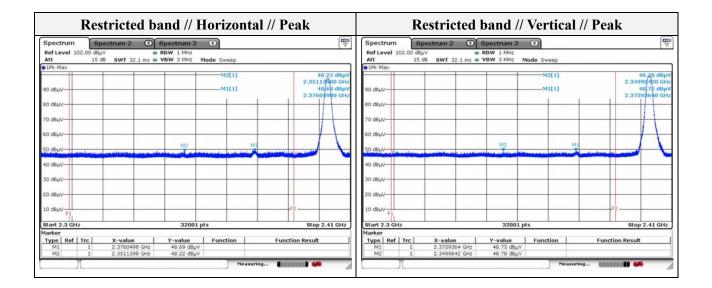
| Test results (Above 1 000 Mb) |         |  |  |  |  |  |
|-------------------------------|---------|--|--|--|--|--|
| Mode:                         | BDR     |  |  |  |  |  |
| Distance of measurement:      | 3 meter |  |  |  |  |  |
| Channel:                      | 00      |  |  |  |  |  |

#### Spurious

| Frequency<br>(Mz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµV/m) | Margin<br>(dB) |
|-------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 1 037.72          | 53.30           | Peak        | Н                  | -10.96     | -           | 42.34                      | 74.00             | 31.66          |
| 1 037.72          | 52.06           | Peak        | V                  | -10.96     | -           | 41.10                      | 74.00             | 32.90          |
| -                 | -               | -           | -                  | -          | -           | -                          | -                 | -              |
| -                 | -               | -           | -                  | -          | -           | -                          | -                 | -              |

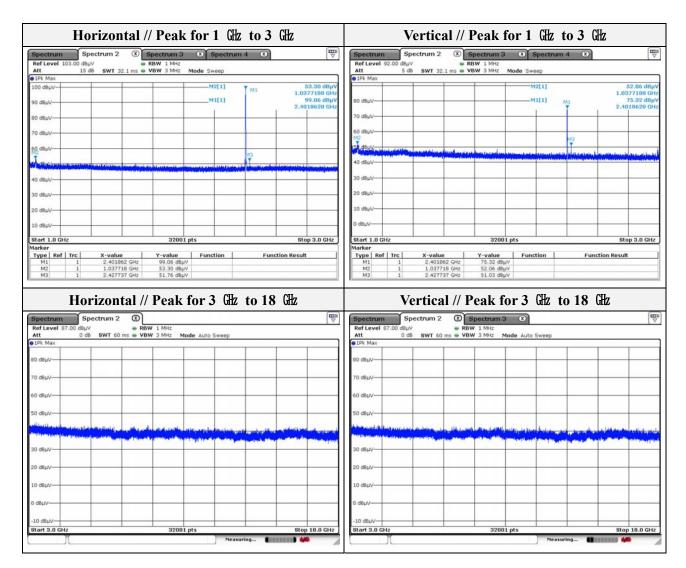
#### - Band edge

| Frequency<br>(Mz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµV/m) | Limit<br>(dBµN/m) | Margin<br>(dB) |
|-------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 2 349.96          | 48.78           | Peak        | V                  | -2.94      | -           | 45.84                      | 74.00             | 28.16          |
| 2 351.11          | 48.22           | Peak        | Н                  | -2.93      | -           | 45.29                      | 74.00             | 28.71          |
| 2 375.94          | 48.75           | Peak        | V                  | -2.83      | -           | 45.92                      | 74.00             | 28.08          |
| 2 376.05          | 48.69           | Peak        | Н                  | -2.83      | -           | 45.86                      | 74.00             | 28.14          |





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#### Note.

1. No spurious emission were detected above 3 GHz.

2. Average test would be performed if the peak result were greater than the average limit.



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| Mode:                    | BDR     |
|--------------------------|---------|
| Distance of measurement: | 3 meter |
| Channel:                 | 40      |

| Frequency<br>(Mb) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµN/m) | Margin<br>(dB) |
|-------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 1 037.91          | 55.15           | Peak        | Н                  | -10.96     | -           | 44.19                      | 74.00             | 29.81          |
| 1 037.91          | 53.93           | Peak        | V                  | -10.96     | -           | 42.97                      | 74.00             | 31.03          |
| 1 326.96          | 51.99           | Peak        | V                  | -9.42      | -           | 42.57                      | 74.00             | 31.43          |
| 1 332.83          | 57.28           | Peak        | Н                  | -9.39      | -           | 47.89                      | 74.00             | 26.11          |

| Horiz   | ontal // Peak   | for 1 GHz                   | to 3 GHz                |  |   | Vertical //                   | Peak I  | or I unz              | to 3           | illz                                  |
|---|---|-----------------------------|-------------------------|--|---|-------------------------------|---|-----------------------|----------------|---------------------------------------|
| Spectrum  | n 2 🛞 Spectrum 3  | Spectrum -                  | 4 💌                     | tin  | Spectrum  | Spectrum 2 🛞                  | Spectrum 3                                      | (X) Spectr            | um 4 🙁         |                                       |
| ef Level 103.00 dBµV<br>tt 15 dB SV   | RBW 1 MHz<br>VT 32.1 ms • VBW 3 MHz   |                             |                         |  | Ref Level 98.00 df<br>Att 10  | dB SWT 32.1 ms                | RBW 1 MHz                                       |                       |                |                                       |
| Pk Max  | 1 32.1 ms • VBW 3 MH2   | Mode Sweep                  |                         |  | 10     10     10     10   | 08 SWI 32.1 ms                | YBW 3 MH2 N                                     | tode Sweep            |                |                                       |
| 0 dBµV  |   | M3[1]                       | MI                      | 55.15 dBpV   |   |                               |   | M2[1]                 | M1             | 51.99 c                               |
|   |   | M1[1]                       |                         | 379050 GHz   | 90 dBµV   |                               | + +   | M1[1]                 |                | 1.3269590                             |
| dBµV  |   |                             |                         | 419240 GHz   | 80 dBuV   |                               |   |                       |                | 2.4419240                             |
| dBµV  |   |                             |                         |  |   |                               |   |                       |                |                                       |
| dBµV-   |   |                             |                         |  | 70 dBµV   |                               |   |                       |                |                                       |
| ODDA.   |   |                             |                         |  | 60, d8µV  |                               |   |                       |                |                                       |
| dBµV M2   |   |                             |                         | -  | M2  |                               |   |                       |                |                                       |
| 10 minutes and and  |   |                             |                         |  | A dawy  | and a shall be and the surger | al and carries                                  | and the second second | يديب أللك درده | A A A A A A A A A A A A A A A A A A A |
|   |   | Manufacture in the internet | al provinsi dell'anclus |  | 40 dBµV   |                               | 900 (100 (100 (100 (100 (100 (100 (100 (        |                       |                |                                       |
| dBµV-   |   |                             |                         |  |   |                               |   |                       |                |                                       |
| dBuV-   |   |                             | -                       | -  | 30 dBµV   |                               |   |                       |                |                                       |
|   |   |                             |                         |  | 20 dBµV   |                               |   |                       |                |                                       |
| dBµV  |   |                             |                         | -  | 10 dBuV   |                               |   |                       |                |                                       |
| dBµV-   |   |                             | -                       |  | 10.0804   |                               |   |                       |                |                                       |
|   |   |                             |                         |  | 0 dBµV  |                               |   |                       | _              | + +                                   |
| rt 1.0 GHz<br>ker   | 32001 p   | uts                         | st                      | op 3.0 GHz   | Start 1.0 GHz<br>Marker   |                               | 32001   | pts                   |                | Stop 3.0 (                            |
| M3 1 1.   | 57.28 dbµv<br>037905 GHz 55.15 dbµv<br>55.15 dbµv   |                             | to 18 GHz               |  | M2 1<br>M3 1  | 1.326959 GHz<br>1.037905 GHz  | 51.99 dByv<br>53.93 dByv<br>Peak fo             |                       | to 18          | GHz                                   |
| M3 1 1.1.<br>Horizo   | ontal // Peak 1   |                             | to 18 GHz               |  | M3 1<br>Spectrum  | 1.037905 GHz                  | 53.93 dBpV<br>Peak fo<br>Spectrum 3             | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizo           Spectrum           FLevel 87.00 dBµV         c         0 dB swV   | ontal // Peak f   | for 3 GHz                   | to 18 GHz               |  | M3 1<br>Spectrum<br>Ref Level 67.00 dt<br>Att 0   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3 1 1.1<br>Horizo  | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               | (The second seco | M3 1 Spectrum Ref Level 87.00 d8  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3 1 1.1.1<br>Horizo<br>ectrum Spectrum<br>f Level 67.00 dB <sub>U</sub> V<br>t 0 dB SWT<br>k Max   | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               |  | M3 1<br>Spectrum<br>Ref Level 67.00 dt<br>Att 0   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | CHz                                   |
| M3 1 1.1.1<br>Horizo<br>ectrum Spectrum<br>f Level 67.00 dBµV<br>t 0 dB swr   | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               |  | M3 1<br>Spectrum<br>Ref Level 87.00 db<br>Att 0<br>@ IPK Max  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | CHz                                   |
| MB         1         1.1           Horizc           Spectrum           f Level 07.00 dBµV         0 dB swill           K Maac         0 dB swill  | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               | (TTP)  | M3 1<br>Spectrum<br>Ref Level 87.00 db<br>Att 0<br>@ IPK Max  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizce           spectrum           Spectrum         Spectrum           fluwel 57.00 dBµV         0 dB swr           dBµV         0 dB swr           dBµV         0 dB swr  | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               |  | M3         1           Spectrum         diamond           Ref Level 07.00 df         diamond           ● 1Pk. Max         0           00 dBµV         0           70 dBµV         0   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3 1 1 1.1<br>Horizce<br>ectrum Spectrum<br>F Level 67.00 dByV<br>t Max<br>Max<br>ByV   | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               | (TTP)  | M3         1           Spectrum         Ref Level 67.00 df           Att         0           PJPk Max         80           80 dBµV         80   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizc           ectrum         Spectrue           Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"           Ectrum         Spectrue           Colspan="2">Colspan="2">Colspan="2"           Colspan="2">Colspan="2"           Colspan="2">Colspan="2"           Colspan="2">Colspan="2"           Colspan="2"   | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               | (ttp)  | M3         1           Spectrum         diamond           Ref Level 07.00 df         diamond           ● 1Pk. Max         0           00 dBµV         0           70 dBµV         0   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| MB         1         1.4           Horizce           ectrum         Spectrum           FLevel 67.00 dBµV         0 dB swrt         0 dB swrt           dBµV         0 dB swrt         0 dB swrt         0 dB swrt           dBµV         0 dB swrt         0 dB swrt         0 dB swrt           dBµV         0 dB swrt         0 dB swrt         0 dB swrt   | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               |  | M3         1           Spectrum         Ref Level 67.00 dt<br>Att         0           ● 1Pk Max         0         0           0 dbµV         0         0           70 dbµV         0         0           60 dbµV         0         0  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          |                                       |
| MB         1         1.4           Horizce           spectrum           FLevel 67.00 dBµV         0 dB swr           t         0 dB swr         0 dB swr           BµV         0 dB swr         0 dB swr  | ontal // Peak 1   | for 3 GHz                   | to 18 GHz               |  | M3         1           Spectrum         Ref Level 67.00 dt<br>Att         0           ● 1Pk Max         0         0           0 dbµV         0         0           70 dbµV         0         0           60 dbµV         0         0  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.4           Horizce           Spectrum           f Level 67.00 dBµV         0 dB swr           dBµV           dBµV         0 dB swr  | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz                   | to 18 GHz               |  | M3         1           Spectrum         And the set of | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizo           Spectrum           Baby           dBaby   | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         1           Spectrum         Ref Level 67.00 dt<br>Att         0           ● IPK Max         0         0           0 dbµV         0         0           70 dbµV         0         0           60 dbµV         0         0  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.4           Horizce           ectrum         Spectrue           I         0.db         swith           K         M3x         0.db         swith           dbu/v         0.db         swith         db  | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         1           Spectrum         Annotation           Ref Level 07.00 dl         0           0 dBµV         0           0 dBµV         0           60 dBµV         0           50 dBµV         0           60 dBµV         0           60 dBµV         0           60 dBµV         0   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizc           Bectrum           Spectrum           Spectrum           GBUV           dBUV  | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         I           Spectrum         Ref Level 67.00 df Att           0         IPk Max           80 dBµV         0           70 dBµV         0           60 dBµV         50 dBµV           30 dBµV         1  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          |                                       |
| M3         1         1.1           Horizce           Spectrum           f tweel 67.00 dbuV         0 db swit           ft wat         0 db swit           k         Max           dbuV         0 db swit           k         dbuV           dbuV         0 db swit   | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         I           Spectrum         Ref Level 67.00 df Att           0         IPk Max           80 dBµV         0           70 dBµV         0           60 dBµV         50 dBµV           30 dBµV         1  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizce           Spectrum           dBuV   | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         1           Spectrum         All           Ref Level 87.00 dt         All           0 dbµV         0           0 dbµV         0           60 dbµV         0           50 dbµV         0           90 dbµV         0           10 dbµV         0           10 dbµV         10   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizce           Spectrum           dBuV   | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         1           Spectrum         Ref Level 97.00 dt           Att         0           9 1Pk Max         0           80 dbµV         0           70 dbµV         0           60 dbµV         0           50 dbµV         0           30 dbµV         0           20 dbµV         0  | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizce           Spectrum           Spectrum           Spectrum           Colspan="2">Spectrum           Spectrum           Colspan="2">Spectrum           Spectrum           Spectrum           Colspan="2">Spectrum           Spectrum           Colspan="2">Spectrum           Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"Colspan="2 | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz<br>de Auto Sweep  |                         |  | M3         1           Ref Level 67.00 df<br>Att         0           0 IPk Max         0           0 dBµV         0           70 dBµV         0           60 dBµV         0           50 dBµV         0           30 dBµV         0           10 dBµV         0           10 dBµV         0           10 dBµV         0   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | GHz                                   |
| M3         1         1.1           Horizce           Spectrum           dBµV   | 2000 042     5.15 dBy/      0ntal // Peak 1     1     0 | for 3 GHz                   |                         |  | M3         1           Spectrum         All           Ref Level 87.00 dt         All           0 dbµV         0           0 dbµV         0           60 dbµV         0           50 dbµV         0           90 dbµV         0           10 dbµV         0           10 dbµV         10   | 1.037905 GHz                  | 53.93 dBµV<br>Peak fo<br>Spectrum 3<br>BW 1 MHz | or 3 GHz              | to 18          | CH2                                   |

#### Note.

1. No spurious emission were detected above 3 GHz.

2. Average test would be performed if the peak result were greater than the average limit.

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The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

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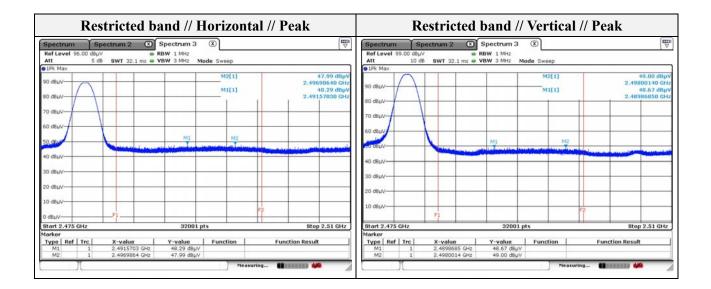
| Mode:                    | BDR     |
|--------------------------|---------|
| Transfer rate:           | 1 Mbps  |
| Distance of measurement: | 3 meter |
| Channel:                 | 78      |

#### - Spurious

| Frequency<br>(Mbz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµV/m) | Limit<br>(dBµN/m) | Margin<br>(dB) |
|--------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 1 042.03           | 53.57           | Peak        | Н                  | -10.94     | -           | 42.63                      | 74.00             | 31.37          |
| 1 042.03           | 53.25           | Peak        | V                  | -10.94     | -           | 42.31                      | 74.00             | 31.69          |
| 1 328.02           | 53.76           | Peak        | V                  | -9.41      | -           | 44.35                      | 74.00             | 29.65          |
| 1 329.96           | 53.67           | Peak        | Н                  | -9.40      | -           | 44.27                      | 74.00             | 29.73          |

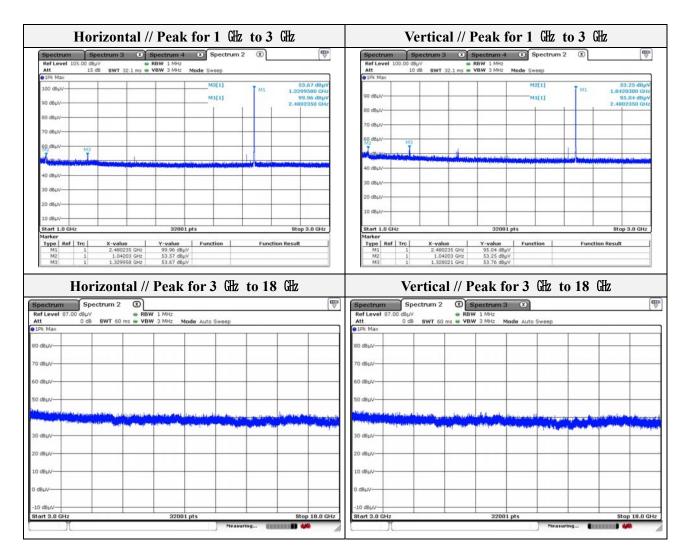
#### - Band edge

| Frequency<br>(Mbz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµV/m) | Limit<br>(dBµN/m) | Margin<br>(dB) |
|--------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 2 489.87           | 48.67           | Peak        | V                  | -2.37      | -           | 46.30                      | 74.00             | 27.70          |
| 2 491.57           | 48.29           | Peak        | Н                  | -2.37      | -           | 45.92                      | 74.00             | 28.08          |
| 2 496.99           | 47.99           | Peak        | Н                  | -2.35      | -           | 45.64                      | 74.00             | 28.36          |
| 2 498.00           | 49.00           | Peak        | V                  | -2.34      | -           | 46.66                      | 74.00             | 27.34          |





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Note.

1. No spurious emission were detected above 3 GHz.

2. Average test would be performed if the peak result were greater than the average limit.



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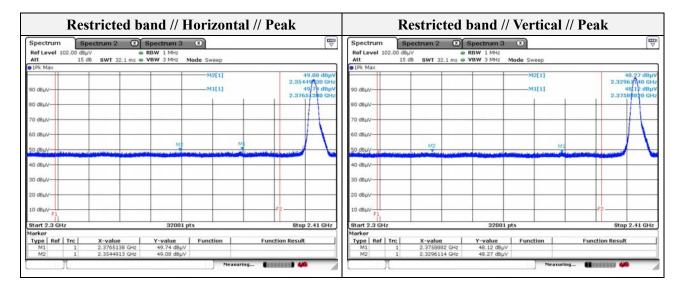
| Mode:                    | EDR                |
|--------------------------|--------------------|
| Transfer rate:           | 3 Mbps(Worst case) |
| Distance of measurement: | 3 meter            |
| Channel:                 | 00                 |

#### - Spurious

| Frequency<br>(Mb) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµV/m) | Margin<br>(dB) |
|-------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 1 038.28          | 53.98           | Peak        | Н                  | -9.41      | -           | 43.02                      | 74.00             | 30.98          |
| 1 041.34          | 54.16           | Peak        | V                  | -10.96     | -           | 43.22                      | 74.00             | 30.78          |
| 1 327.58          | 57.02           | Peak        | Н                  | -10.94     | -           | 47.61                      | 74.00             | 26.39          |
| 1 496.95          | 52.85           | Peak        | V                  | -8.50      | -           | 44.35                      | 74.00             | 29.65          |

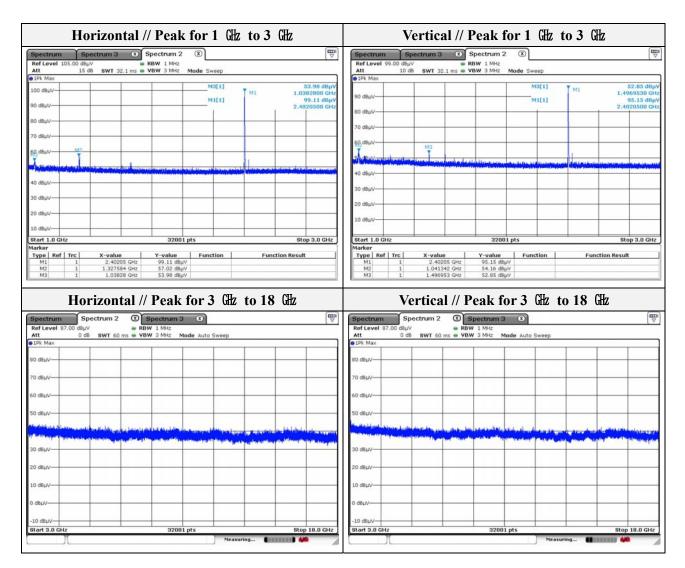
#### - Band edge

| Frequency<br>(Mz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµN/m) | Margin<br>(dB) |
|-------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 2 329.61          | 48.27           | Peak        | V                  | -3.03      | -           | 45.24                      | 74.00             | 28.76          |
| 2 354.49          | 49.08           | Peak        | Н                  | -2.92      | -           | 46.16                      | 74.00             | 27.84          |
| 2 375.89          | 48.12           | Peak        | V                  | -2.83      | -           | 45.29                      | 74.00             | 28.71          |
| 2 376.51          | 49.74           | Peak        | Н                  | -2.82      | -           | 46.92                      | 74.00             | 27.08          |





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#### Note.

1. No spurious emission were detected above 3 GHz.

2. Average test would be performed if the peak result were greater than the average limit.



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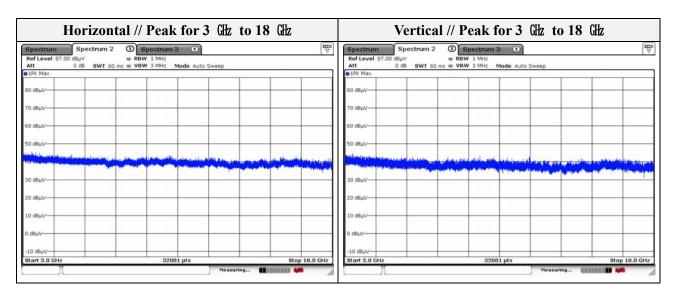
| Mode:                    | EDR                |
|--------------------------|--------------------|
| Transfer rate:           | 3 Mbps(Worst case) |
| Distance of measurement: | 3 meter            |
| Channel:                 | 40                 |

| - Spurio           | us              |             |                    |            |             |                            |                   |                |
|--------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| Frequency<br>(Mbz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµV/m) | Margin<br>(dB) |
| 1 000.22           | 55.69           | Peak        | V                  | -11.16     | -           | 44.53                      | 74.00             | 29.47          |
| 1 040.09           | 54.56           | Peak        | Н                  | -10.95     | -           | 43.61                      | 74.00             | 30.39          |
| 1 327.46           | 55.62           | Peak        | Н                  | -9.41      | -           | 46.21                      | 74.00             | 27.79          |
| 1 331.58           | 55.48           | Peak        | V                  | -9.39      | -           | 46.09                      | 74.00             | 27.91          |

| Horizontal // Peak for 1 GHz to 3 GHz   | Vertical // Peak for 1 GHz to 3 GHz  |
|---|--|
| Spectrum         Spectrum 3         Spectrum 2         Spectrum 4         Spectrum 4           Ref Level         105:00 d8µV         @ RBW 1 MHz           Att         15 d8         SWT 32.1 ms         VBW 3 MHz         Mode Sweep   | Image: Spectrum         Spectrum         Spectrum         Spectrum         Spectrum         Image: Spectrum         Spectrum         Image: Spectrum         Spectrum         Image: Spectrum  |
| Pk Max  | IPk Max  |
| M1[1]   | \$4.56 dBµV         M2[1]         \$55,56 dB           \$90 dBµV         90 dBµV         M1         1.0002100 C           \$7.55 dBµV         M1[1]         94.34 dB         2.4417990 C           \$17990 GHz         80 dBµV         2.4417990 C         2.4417990 C   |
| 80 dbµ/   | 70 dbu/  |
|   |  |
| 40 d8µV   | 40 dbu/v-<br>30 dbu/v-   |
| 20 dBuV-  | 20 dbuV  |
| 10 d8µV   | 10 dBuV  |
| Start 1.0 GHz 32001 pts 5   | p 3.0 GHz Stort 1.0 GHz Stop 3.0 GH  |
| Marker  | Marker   |
| Type         Ref         Trc         X-value         Y-value         Function         Function Res           M1         2.441799 OHt         97.55 dBµV         97.55 dBµV         97.55 dBµV         97.55 dBµV           M2         1         1.241799 OHt         55.62 dBµV         94.55 dBµV         94.55 dBµV           M3         1         1.04092 OHt         54.56 dBµV         94.55 dBµV         94.55 dBµV | Image: Second |



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Note.

1. No spurious emission were detected above 3 GHz.

2. Average test would be performed if the peak result were greater than the average limit.



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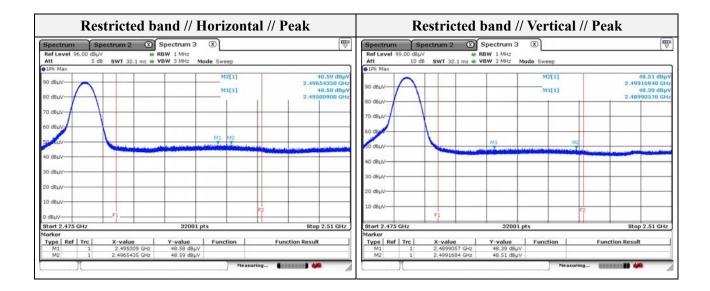
| Mode:                    | EDR                |
|--------------------------|--------------------|
| Transfer rate:           | 3 Mbps(Worst case) |
| Distance of measurement: | 3 meter            |
| Channel:                 | 78                 |

## - Spurious

| Frequency<br>(Mbz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµN/m) | Margin<br>(dB) |
|--------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 1 038.47           | 53.75           | Peak        | V                  | -10.96     | -           | 42.79                      | 74.00             | 31.21          |
| 1 040.09           | 53.92           | Peak        | Н                  | -10.95     | -           | 42.97                      | 74.00             | 31.03          |
| 1 328.65           | 56.06           | Peak        | Н                  | -9.41      | -           | 46.65                      | 74.00             | 27.35          |
| 1 332.90           | 54.09           | Peak        | V                  | -9.39      | -           | 44.70                      | 74.00             | 29.30          |

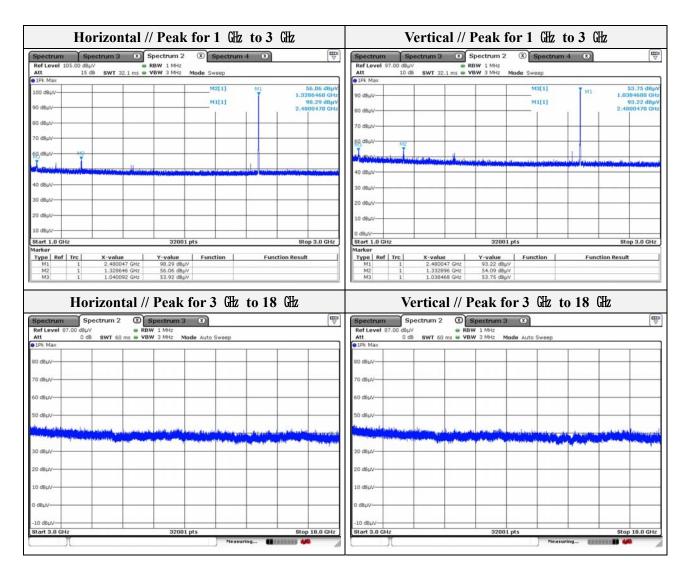
#### - Band edge

| Frequency<br>(Mz) | Level<br>(dBµV) | Detect mode | Ant. Pol.<br>(H/V) | CF<br>(dB) | DCF<br>(dB) | Field strength<br>(dBµN/m) | Limit<br>(dBµV/m) | Margin<br>(dB) |
|-------------------|-----------------|-------------|--------------------|------------|-------------|----------------------------|-------------------|----------------|
| 2 489.91          | 48.39           | Peak        | V                  | -2.37      | -           | 46.02                      | 74.00             | 27.98          |
| 2 495.01          | 48.58           | Peak        | Н                  | -2.35      | -           | 46.23                      | 74.00             | 27.77          |
| 2 496.54          | 48.59           | Peak        | Н                  | -2.35      | -           | 46.24                      | 74.00             | 27.76          |
| 2 499.17          | 48.51           | Peak        | V                  | -2.34      | -           | 46.17                      | 74.00             | 27.83          |





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#### Note.

1. No spurious emission were detected above 3 GHz.

2. Average test would be performed if the peak result were greater than the average limit.



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| Test results (18 GHz to 30 | (Hz) – Worst case |
|----------------------------|-------------------|
| Mode:                      | BDR               |
| Transfer rate:             | 1 Mbps            |
| Distance of measurement:   | 3 meter           |
| Channel:                   | 40(Worst case)    |

| Horizontal  | Vertical   |  |  |  |  |
|---|--|--|--|--|--|
| Spectrum         Spectrum 2         ③         ∰           Ref Level 100.00 dBµV         ■ RBW 1 MHz         ■         ₩           Att         10 dB         SWT 48 ms ● VBW 3 MHz         Mode Auto Sweep           DFK Max         ■         ■         ■ | Spectrum         Spectrum 2         Spectrum 3         ™           Ref Level         100.00 dBµV         ● RBW 1 MHz         ●         ●         ■         ●         ■         ■         ™         ♥         ●         ■         ●         ■         ■         ■         ●         ■ |  |  |  |  |
| 90 dBµV   | 90 dBuV-<br>80 dBuV-<br>70 dBuV-<br>60 dBuV-   |  |  |  |  |
| 50 dBuV   | 50 dBuV-<br>20 dBuV-<br>20 dBuV-<br>20 dBuV-<br>20 dBuV-   |  |  |  |  |
| 10 dBµV<br>Start 18.0 GHz 32001 pts Stop 30.0 GHz   | 10 dBµV-<br>Start 18.0 GHz 32001 pts Stop 30.0 GHz Neasuring   |  |  |  |  |

Note.

1. No spurious emission were detected above 18 GHz.



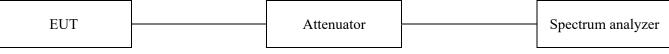
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## 3.7. Conducted band edge and out of band emissions

**Test procedure** 

KDB 558074 v05r02 & ANSI 63.10-2013

#### Test setup



#### Test setting

- 1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
- 2. RBW = 100 kHz
- $3. \text{VBW} \geq 300 \text{ kHz}$
- 4. Detector = Peak
- 5. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
- 7. Trace mode = max hold
- 8. Sweep time = auto couple
- 9. The trace was allowed to stabilize

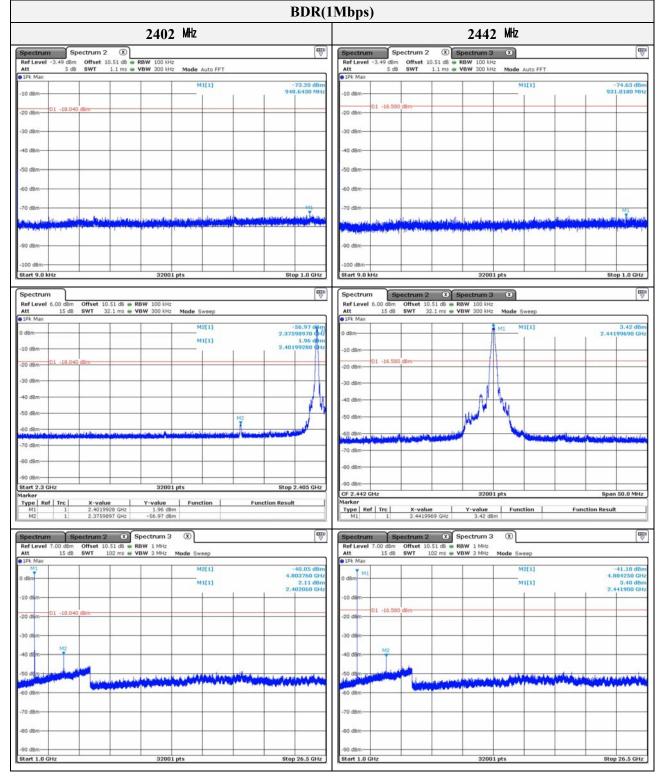
#### Limit

According to 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))



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## **Test results**



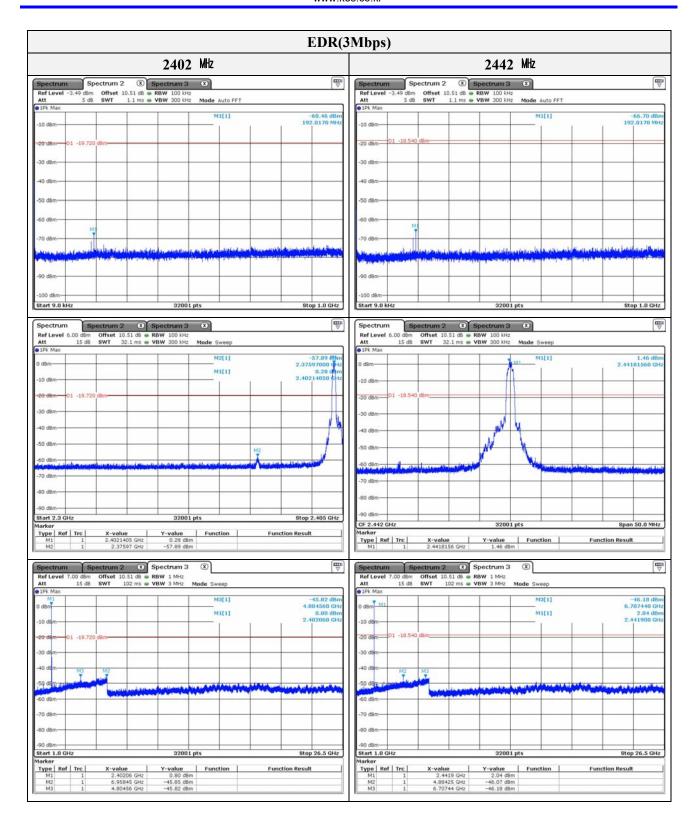


3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea Tel: +82-31-425-6200 / Fax: +82-31-424-0450 www.kes.co.kr Report No.: KES-RF1-20T0226 Page ( 42 ) of ( 47 )

| BDR(1Mbps)  |  |       |  |  |  |  |
|---|--|-------|--|--|--|--|
| 248   | 0 MHz  | -     |  |  |  |  |
| Spectrum         Spectrum | 3 X (17)   |       |  |  |  |  |
| 10 dBm     01 -16.680 dBm   | M1[1] -74.37 dBm<br>949.0180 MHz                                   |       |  |  |  |  |
| -20 dBm   |  |       |  |  |  |  |
| -40 d8m   |  | BLANK |  |  |  |  |
| -60 dBm   |  |       |  |  |  |  |
| Lingsterne of enderstand and standard and standard and a standard and a standard and a standard and a standard<br>-90 dBm   |  |       |  |  |  |  |
| -100 dBm  | 11 pts Stop 1.0 GHz  |       |  |  |  |  |
| Spectrum         Spectrum 2         Spectrum 3           Ref Level         6.00 dBm         Offset         10.51 dB         RBW         100 kHz           Att         15 dB         SWT         32.1 ms         VBW         300 kHz           JPk Max           32.1 ms         VBW         300 kHz   | 2  |       |  |  |  |  |
| 0 dBm Mii   | M3[1] -46.19 dBm<br>2.492455630 GHz<br>3.32 dBm<br>2.490142420 GHz |       |  |  |  |  |
| -20 dBm   |  |       |  |  |  |  |
| AD dem  |  | BLANK |  |  |  |  |
| -70 dBm   |  |       |  |  |  |  |
| -90 dBm         3200           Start 2.475 GHz         3200           Marker         Trope Ref Trc         X-value           M1         1         2.46014242 GHz         3.32 dit   | 11 pts Stop 2.5 GHz  |       |  |  |  |  |
| M2         1         2.48200095 GHz         -43.13 dl           M3         1         2.48245563 GHz         -46.13 dl           Spectrum         Spectrum 2         Spectrum 3  | Bm   | 1     |  |  |  |  |
| Ref Level         7.00 dBm         Offset         10.51 dB         RBW         1 MHz           Att         15 dB         SWT         102 ms         VBW 3 MHz           1Pk Max   | Mode Sweep<br>M2[1] -42.09 dBm                                     |       |  |  |  |  |
| 0 dBm   | 4,359950 GHz<br>MI[1] 3,52 dBm<br>2,400150 GHz                     |       |  |  |  |  |
| -20 dBm   |  |       |  |  |  |  |
| -40 dBm   |  | BLANK |  |  |  |  |
| 50 dBm 2  |  |       |  |  |  |  |
| -80 d8m   |  |       |  |  |  |  |
|   | 11 pts Stop 26.5 GHz   |       |  |  |  |  |



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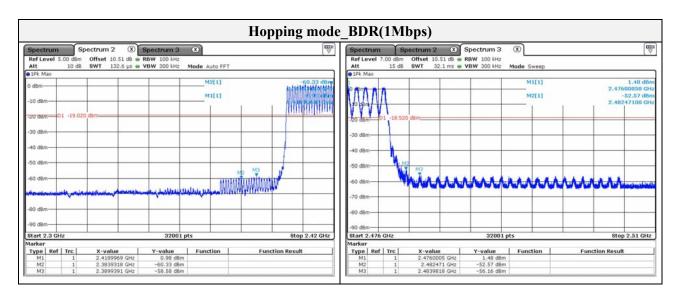


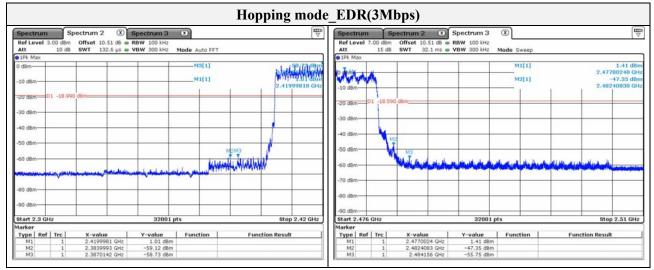
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| EDR(3Mbps)   |       |  |  |  |  |  |
|--|-------|--|--|--|--|--|
| 2480 MHz   | -     |  |  |  |  |  |
| Spectrum         Spectrum 2         ③         Spectrum 3         ○           Ref Level -3.49 dbm         Offset 10.51 db ⊕ RBW 100 bHz         □         □         □   |       |  |  |  |  |  |
| Att         5 dB         SWT         1.1 ms ⊕ VBW         Wode Auto FFT           ●1Pk Max   |       |  |  |  |  |  |
| -20 dgm 01 -18.460 dBm   |       |  |  |  |  |  |
| -30 dbm  |       |  |  |  |  |  |
| -40 dBm  | BLANK |  |  |  |  |  |
| -60 dBm.   |       |  |  |  |  |  |
|  |       |  |  |  |  |  |
| -90 dBm  |       |  |  |  |  |  |
| -100 dBm   |       |  |  |  |  |  |
| Spectrum         Spectrum 2         Spectrum 3         Image: Constraint of the system         Image: Constrais of the system         Image: Constraint of the syste |       |  |  |  |  |  |
| 19k Max     0 dBm     10 dBm     10 dBm     11 M1     12.492343130 GHz     1.54 dBm  |       |  |  |  |  |  |
| -10 dBm 2.400154140 GHz  |       |  |  |  |  |  |
| -30 dBm  |       |  |  |  |  |  |
| 50 dbm   | BLANK |  |  |  |  |  |
| -70 dBm  |       |  |  |  |  |  |
| -80 dBm<br>-90 dBm<br>Start 2.475 GHz 32001 pts Stop 2.5 GHz   |       |  |  |  |  |  |
| Marker         Yee         Function         Function Result           M1         1         2.46015414 GHz         1.54 dBm   |       |  |  |  |  |  |
| M3 1 2.48234313 GHz -47.51 dBm   |       |  |  |  |  |  |
| Spectrum         Spectrum 3         X         W/w           Ref Level 7.00 dbm         Offset 10.51 db ⊕ RBW 1 M4z         W/w         W/w         W/w           Att         15 db         SWT         102 ms ⊕ VBW 3 MHz         Mode Sweep         W/w           ● IPk Max         X         X         X         X         X         X   |       |  |  |  |  |  |
| 0 dBm M1   |       |  |  |  |  |  |
| -20 dBm 01 -18.460 dBm   |       |  |  |  |  |  |
| -30 dBm  |       |  |  |  |  |  |
|  | BLANK |  |  |  |  |  |
| -70 dBm  |       |  |  |  |  |  |
| -90 dBm<br>Start 1.0 GHz 32001 pts Stop 26.5 GHz<br>Marker   |       |  |  |  |  |  |
| Type         Ref         Trc         X-value         Y-value         Function         Function Result           M1         1         2.46015 GHz         2.11 dBm  |       |  |  |  |  |  |
| initial al actante anel indee anni   |       |  |  |  |  |  |



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| Equipment                              | Manufacturer         | Model         | Serial No.      | Calibration<br>interval | Calibration<br>due. |
|--|----------------------|---------------|-----------------|-------------------------|---------------------|
| Spectrum Analyzer                      | R&S                  | FSV40         | 101725          | 1 year                  | 2021.06.24          |
| 8360B Series Swept<br>Signal Generator | HP                   | 83630B        | 3844A00786      | 1 year                  | 2021.01.15          |
| SIGNAL GENERATOR                       | KEYSIGHT             | N5182B        | MY59100115      | 1 year                  | 2021.05.12          |
| Power Meter                            | Anritsu              | ML2495A       | 2010001         | 1 year                  | 2021.05.12          |
| Pulse Power Sensor                     | Anritsu              | MA2411B       | 1911111         | 1 year                  | 2021.05.12          |
| Attenuator                             | Mini-Circuits        | BW-S10-2W263+ | 1               | 1 year                  | 2021.01.17          |
| Attenuator                             | F04-C1206-01         | SRT           | 20022403        | 1 year                  | 2021.05.06          |
| Loop Antenna                           | Schwarzbeck          | FMZB1513      | 225             | 2 years                 | 2021.02.15          |
| BILOG ANTENNA                          | Schwarzbeck          | VULB 9168     | 9168-461        | 2 years                 | 2022.05.26          |
| Horn Antenna                           | A.H                  | SAS-571       | 414             | 1 years                 | 2021.01.31          |
| Horn Antenna                           | SCHWARZBECK          | BBHA9170      | BBHA<br>9170550 | 1 years                 | 2021.01.20          |
| Amplifier                              | SONOMA<br>INSTRUMENT | 310N          | 401123          | 1 year                  | 2021.06.08          |
| PREAMPLIFIER                           | 8449B                | AGILENT       | 8008A01640      | 1 year                  | 2021.04.01          |
| EMI Test Receiver                      | R&S                  | ESU26         | 100552          | 1 year                  | 2021.04.01          |
| DC Power supply                        | Agilent              | 6632B         | MY43004090      | 1 year                  | 2021.06.22          |

### Appendix A. Measurement equipment

#### **Peripheral devices**

| Device            | evice Manufacturer Model No. |       | Serial No.    |  |
|-------------------|------------------------------|-------|---------------|--|
| Notebook computer | LG Electronics Inc.,         | LGS53 | 306QCZP560949 |  |
| Test Jig Board    | N/A                          | N/A   | N/A           |  |