

TEST REPORT

of

ARIB STD-T66

Equipment Under Test : Portable Navigation Device
Model Name : PNM75F
Variant Model Names : PNM76F, PNM77F, PNM78F, PNM79F, PNM85F,
PNM86F, PNM87F, PNM88F, PNM89F
Applicant : SEIWA Co., Ltd.
Manufacturer : Mobidic Co., Ltd.
Date of Receipt : 2018.05.18
Date of Test(s) : 2018.05.20 ~ 2017.05.27
Date of Issue : 2018.05.31

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



James Bae

Date:

2018.05.31

Technical
Manager:



Harim Lee

Date:

2018.05.31

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

Table of contents

1. General information -----	3
2. Frequency Tolerance -----	6
3. Occupied Bandwidth (99 %) and Spread Bandwidth (90 %) -----	13
4. Spurious Emission Intensity -----	21
5. Antenna Power -----	26
6. Secondary Radiated Emissions -----	33
7. Dwell Time-----	39
8. Test Methodology & Conditions -----	44

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

1. General information

1.1. Testing laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +82 31 688 0901

Fax No. : +82 31 688 0921

1.2. Details of applicant

Applicant : SEIWA CO., LTD.

Address : 3000, Ichinoe-Cho, Edogawa-Ku, 134-0092, Tokyo

Contact Person : Makabe Akinobu

Phone No. : +81 3 3877 5550

1.3. Description of EUT

Kind of Product	Portable Navigation Device
Model Name	PNM75F
Variant Model Names	PNM76F, PNM77F, PNM78F, PNM79F, PNM85F, PNM86F, PNM87F, PNM88F, PNM89F
Power Supply	DC 12.00 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth)
Modulation Technique	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels	79 channels (Bluetooth)
Antenna Type	PCB Pattern Antenna
Antenna Gain	2 402 MHz ~ 2 480 MHz: 0.29 dBi
H/W Version	TJ100_MP_2018.04.28
S/W Version	OS_0.80 / Program_0.25

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

1.4. Test Equipment List

Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. Authority	Cal. Method
Spectrum Analyzer	R&S	FSV30	101004	Jun. 21, 2017	SICT	c)
Signal Generator	Agilent	E8257D	MY51501169	Jul. 07, 2017	SICT	c)
Directional Coupler	KRYTAR	152613	122661	Feb. 22, 2018	SICT	c)
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jun. 16, 2017	SICT	c)
DC Power Supply	R&S	HMP2020	019922876	Apr. 26, 2018	SICT	c)
DIGITAL MULTIMETER	HIOKI	DT4211	N0301231	Sep. 22, 2017	SICT	c)

Note;

- a): Calibration conducted by the National Institute of Information and Communications Technology or a designated calibration agency under Article 102-18 paragraph (1).
- b): Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law. (Law No. 51 of 1992)
- c): Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
- d): Calibration conducted by using other equipment that listed above from a) to c).

1.5. Test method

Measurement was conducted by the following test method:

the test method of Ordinance Concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment in Annex 1, the Ministry of Internal Affairs and Communication notification in Annex 43 of Article 88, Paragraph 1 and Annex 43 or the test method more than equivalent.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

1.6. Summary of test results

The EUT has been tested according to the following specifications:

Applied standard : Radio equipment regulations and ARIB STD-T66		
Article Reference	Test item	Result
STD-T66 3.2	Frequency Tolerance	Complied
STD-T66 3.2	Occupied Bandwidth (99 %) and Spread Bandwidth (90 %)	Complied
STD-T66 3.2	Spurious Emission Intensity	Complied
STD-T66 3.2	Antenna Power	Complied
STD-T66 3.3	Secondary Radiated Emissions	Complied
STD-T66 3.2	Dwell Time	Complied

1.7. Test report revision

Revision	Report number	Date of issue	Description
0	F690501/RF-RTL012712	2018.05.28	Initial
1	F690501/RF-RTL012712-1	2018.05.30	The model name has been changed from PNMxxF to PNM75F. Derived model information has been added.
2	F690501/RF-RTL012712-2	2018.05.31	The value of antenna power on page 28 is indicated to the third decimal point.

1.8 Information of Variant Model

Model name	Information
PNM75F	- Basic model.
PNM76F, PNM77F, PNM78F, PNM79F, PNM85F, PNM86F, PNM87F, PNM88F, PNM89F	- In the basic model, only the S/W version is different for each model

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

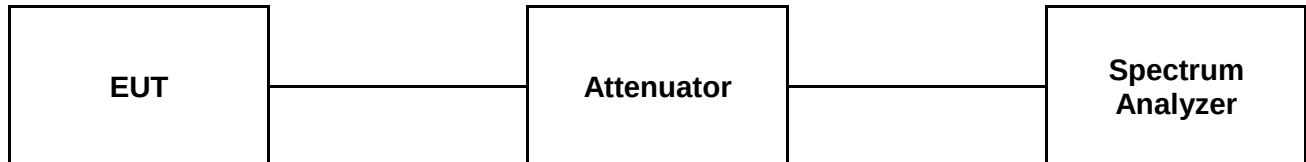
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

2. Frequency Tolerance

2.1. Test Setup



2.2. Limit

$\pm 50 \times 10^{-6}$ (50 ppm or below)

2.3. Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be transmitting at low, middle and high channel.
3. Frequency Tolerance is measured by following setting:
 - 1) Setting for 20 MHz system

Center Frequency:	2 402 MHz, 2 441 MHz, 2 480 MHz
Span:	1 MHz
RBW:	10 kHz
VBW:	10 kHz
Sweep data points:	1 001 or greater
Sweep time:	Auto
Detector mode:	Positive peak
Indication mode:	Max hold
4. Find the peak carrier signal and measure its frequency.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

2.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

- GFSK

	Low Ch. (2 402 MHz)	Middle Ch. (2 441 MHz)	High Ch. (2 480 MHz)
Reading frequency (MHz)	2 401.963 000	2 440.963 000	2 479.962 000
Frequency tolerance (ppm)	-15.40	-15.16	-15.32

- π/4DQPSK

	Low Ch. (2 402 MHz)	Middle Ch. (2 441 MHz)	High Ch. (2 480 MHz)
Reading frequency (MHz)	2 401.963 000	2 440.963 000	2 479.962 000
Frequency tolerance (ppm)	-15.40	-15.16	-15.32

- 8DPSK

	Low Ch. (2 402 MHz)	Middle Ch. (2 441 MHz)	High Ch. (2 480 MHz)
Reading frequency (MHz)	2 401.963 000	2 440.963 000	2 479.962 000
Frequency tolerance (ppm)	-15.40	-15.16	-15.32

Note;

$$1. FT (ppm) = [(RF - MF) / MF] \times 10^6$$

- FT: Frequency Tolerance, RF: Reading Frequency and MF: Measurement Frequency

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

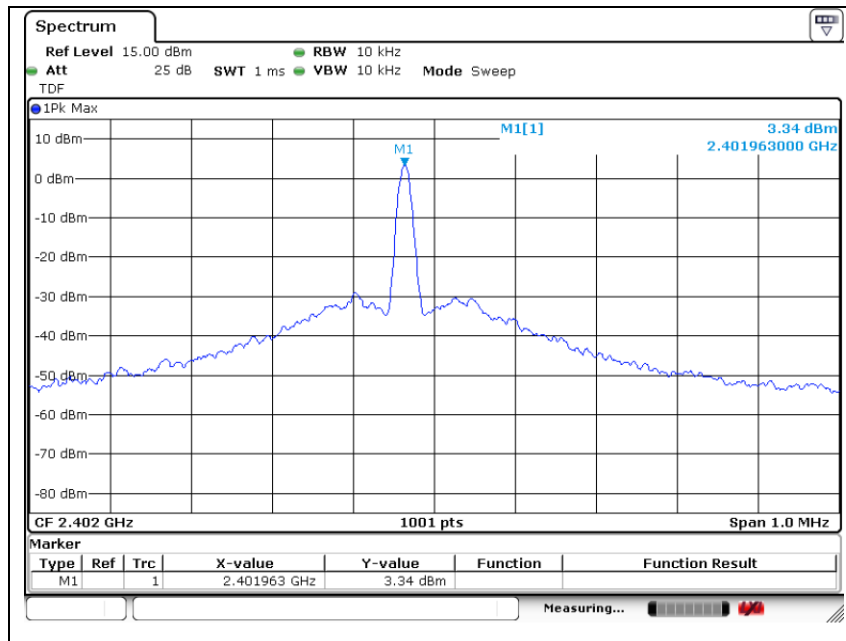
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

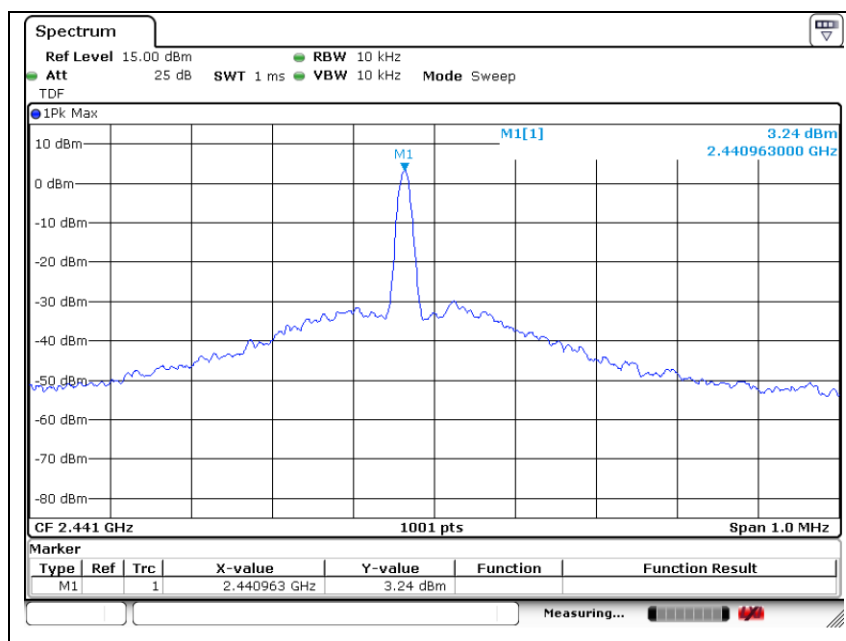
Frequency Tolerance

- Test mode: GFSK

2 402 MHz



2 441 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

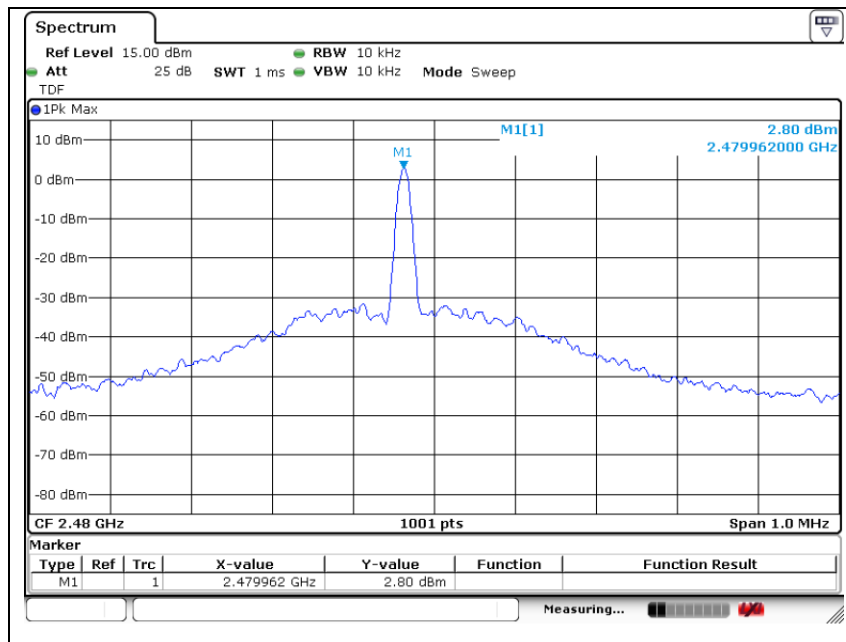
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

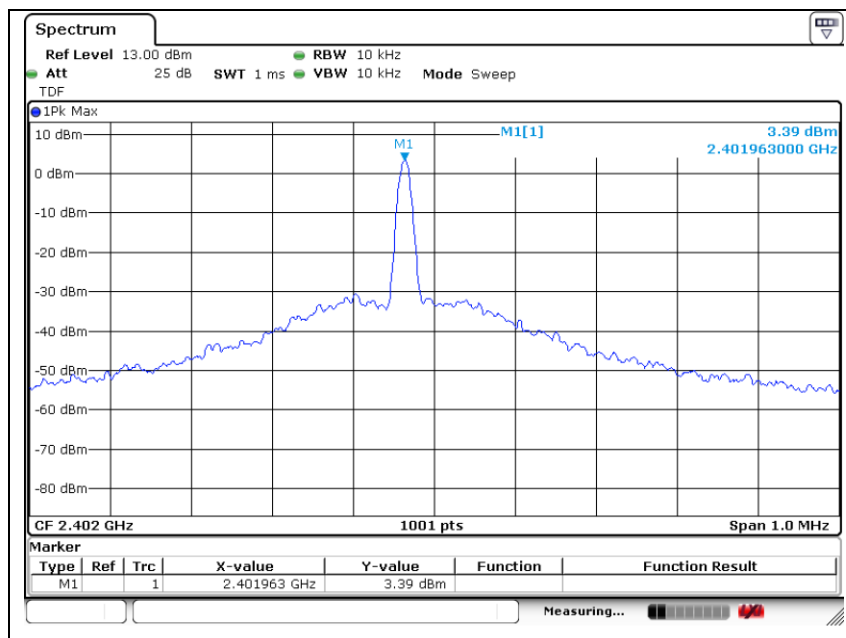
A4(210mm x 297mm)

2 480 MHz



- Test mode: $\pi/4$ DQPSK

2 402 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

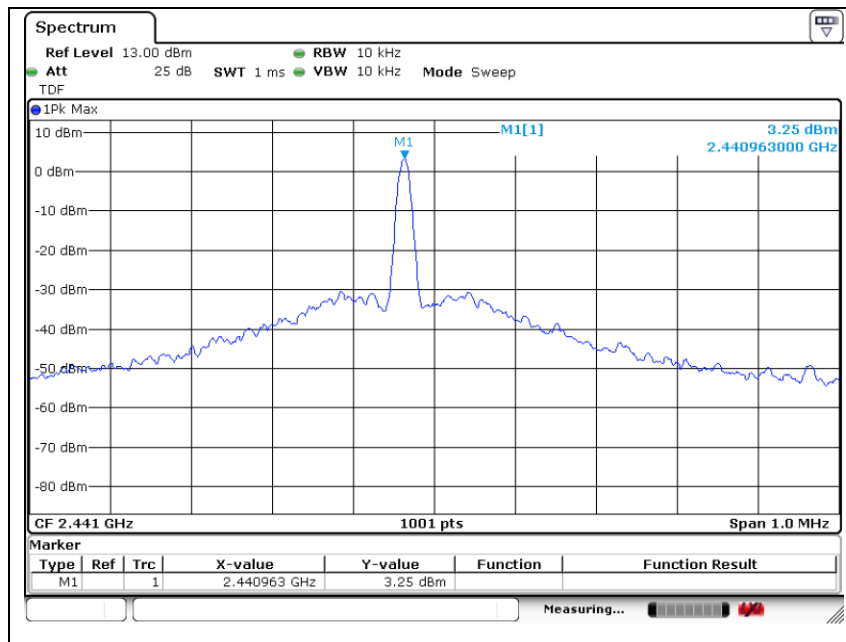
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

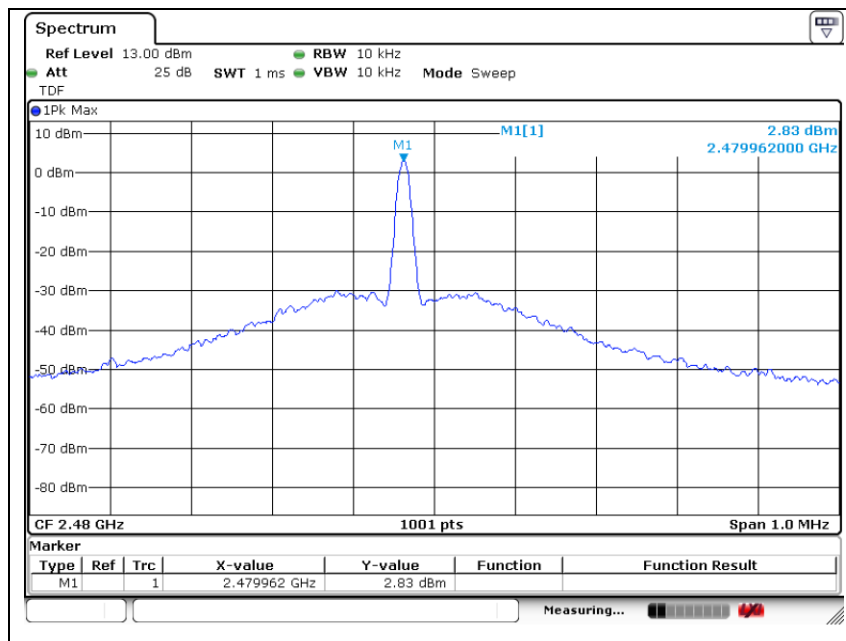
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

2 441 MHz



2 480 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

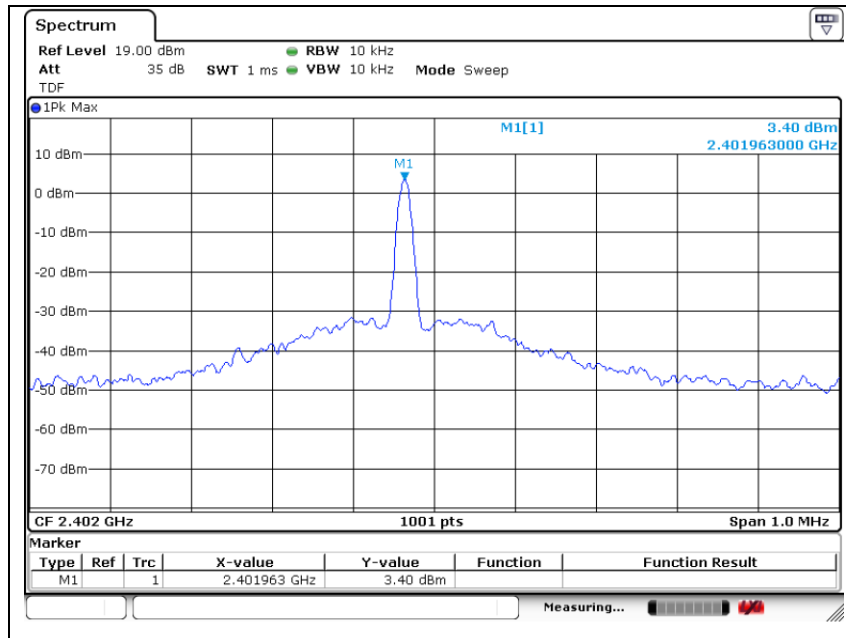
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

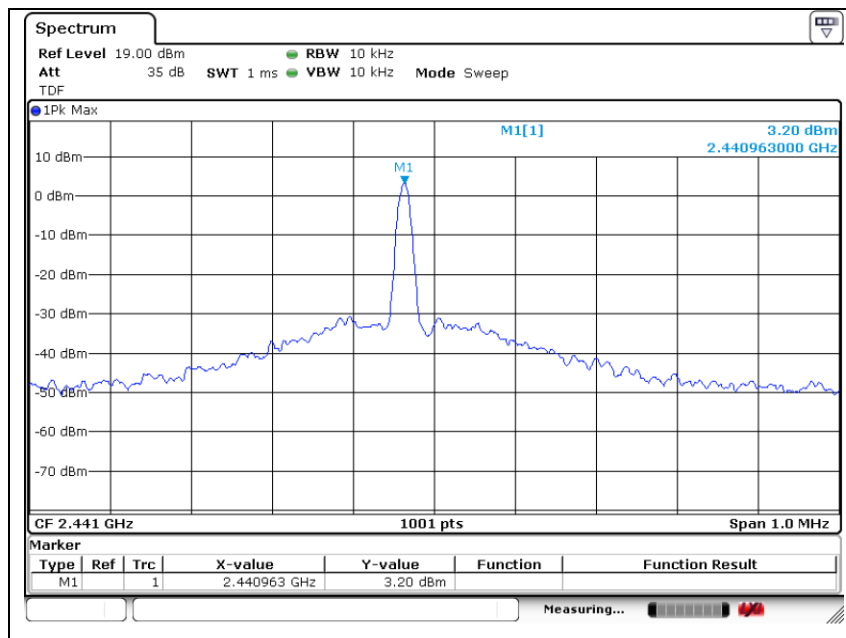
A4(210mm x 297mm)

- Test mode: 8DPSK

2 402 MHz

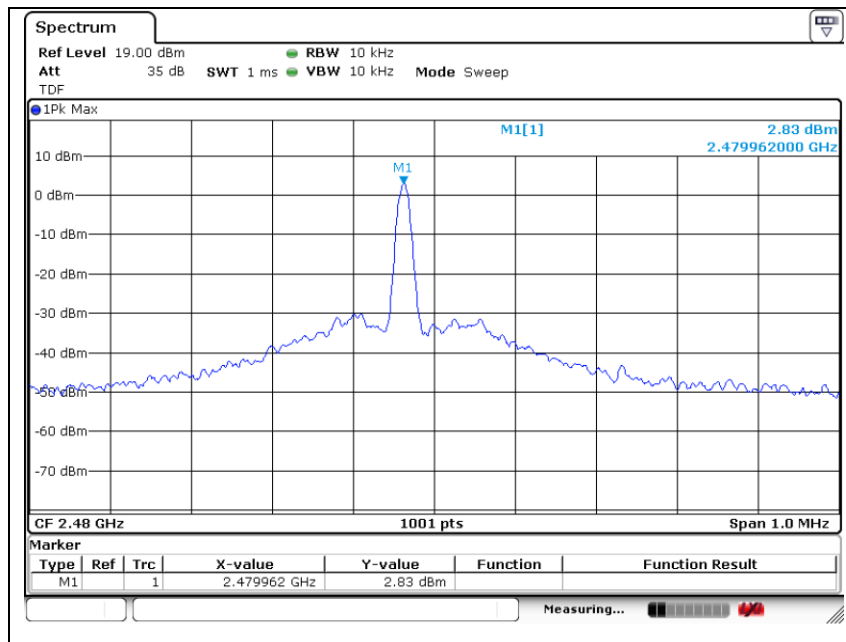


2 441 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

2 480 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

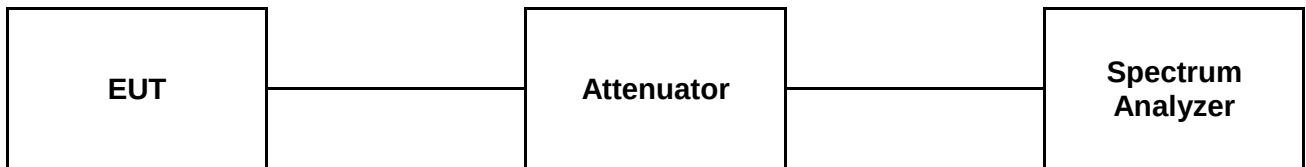
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

3. Occupied Bandwidth (99 %) and Spread Bandwidth (90 %)

3.1. Test Setup



3.2. Limit

[Occupied Bandwidth]

BDR, EDR: 83.5 MHz or less

[Spread Bandwidth]

BDR, EDR: 500 kHz or more

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

3.3. Test Procedure

3.3.1. Occupied Bandwidth (99 %)

1. Connect transmitter output to the spectrum analyzer input port.
2. Set the EUT to transmit using the 79-channel hopping mode.
3. Measure the signal bandwidth using a spectrum analyzer.
4. Set the spectrum analyzer to below.
[Occupied Bandwidth (99 %)]

Center frequency:	BDR, EDR	2 441 MHz
Span:	BDR, EDR	160 MHz
RBW:		300 kHz
VBW:		300 kHz
Sweep time		Auto
Sweep data points:		1 001 or greater
Detector mode		Positive peak
Indication mode		Max hold
BW setting:		99 %

3.3.2. Spread Bandwidth (90 %)

1. Connect transmitter output to the spectrum analyzer input port.
2. Set the EUT to transmit using the 79-channel hopping mode.
3. Measure the signal bandwidth using a spectrum analyzer.
4. Set the spectrum analyzer to below.
[Spectrum spread bandwidth (90 %)]

Center frequency:	2 441 MHz
Span:	160 MHz
RBW:	300 kHz
VBW:	300 kHz
Sweep time:	Auto
Sweep data points:	1 001 or greater
Detector mode:	Positive peak
Indication mode:	Max hold
BW setting:	90 %
5. In case of AFH mode, find the frequency of highest amplitude (f_{HA}) in the signal bandwidth.
6. Set 20-channel hopping mode according to below.
 - Frequency Range (A) –if f_{HA} occupies in the middle section (2 411 MHz to 2 471 MHz) of the 79-channel band, then set the 20-channel continuous hopping so that f_{HA} is located between the 10th and 11th channels.
7. Measure the signal bandwidth using a spectrum analyzer.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

3.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

	Occupied Bandwidth (99 %)		Spread Bandwidth (90 %)	
	Result(MHz)	Limit	Result(MHz)	Limit
GFSK (NON AFH)	78.32	83.50 MHz or less	70.97	500 kHz or more
GFSK (AFH)	-		18.06	
π/4DQPSK (NON AFH)	78.32		70.81	
π/4DQPSK (AFH)	-		18.38	
8DPSK (NON AFH)	78.32		71.29	
8DPSK (AFH)	-		18.38	

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

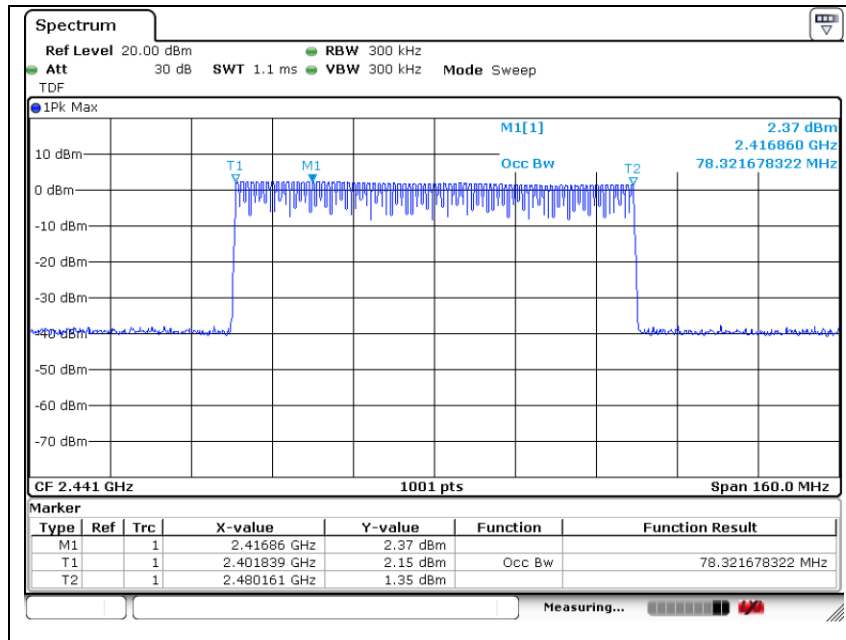
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

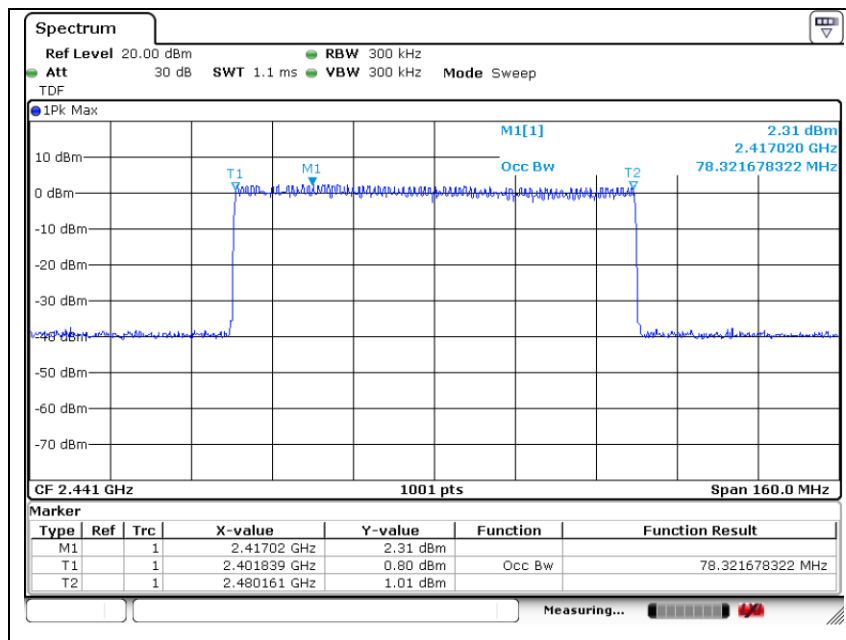
A4(210mm x 297mm)

Occupied Bandwidth (99 %)

- Test mode: GFSK (NON AFH)

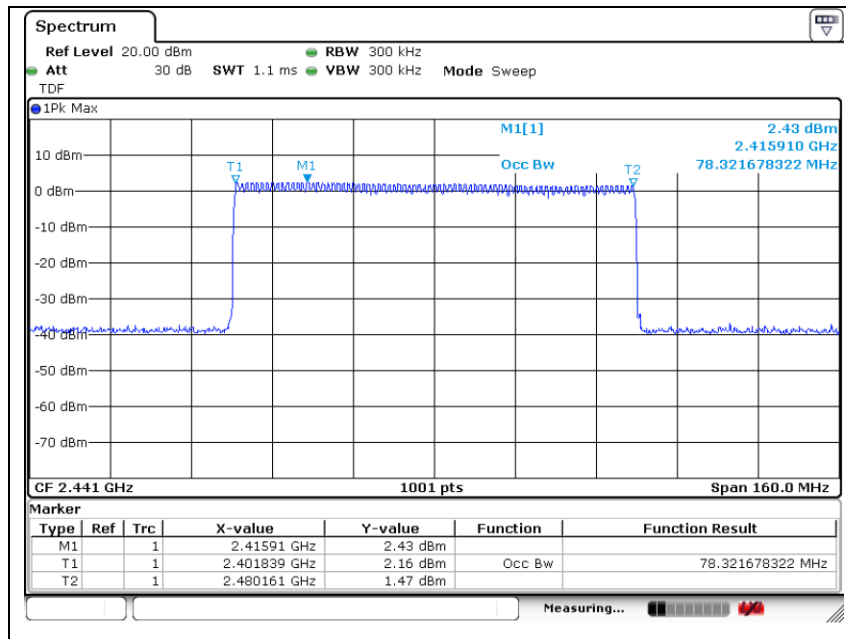


- Test mode: $\pi/4$ DQPSK (NON AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

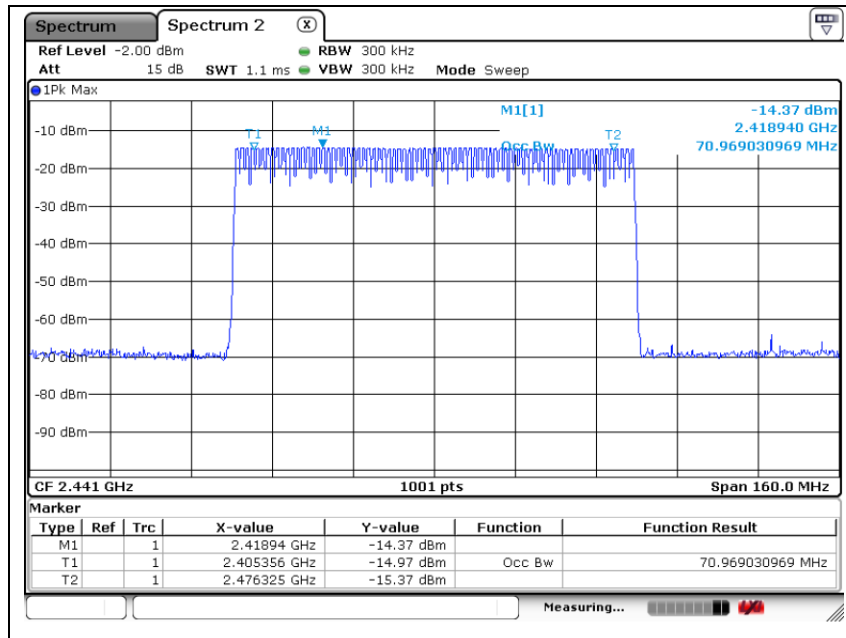
- Test mode: 8DPSK (NON AFH)



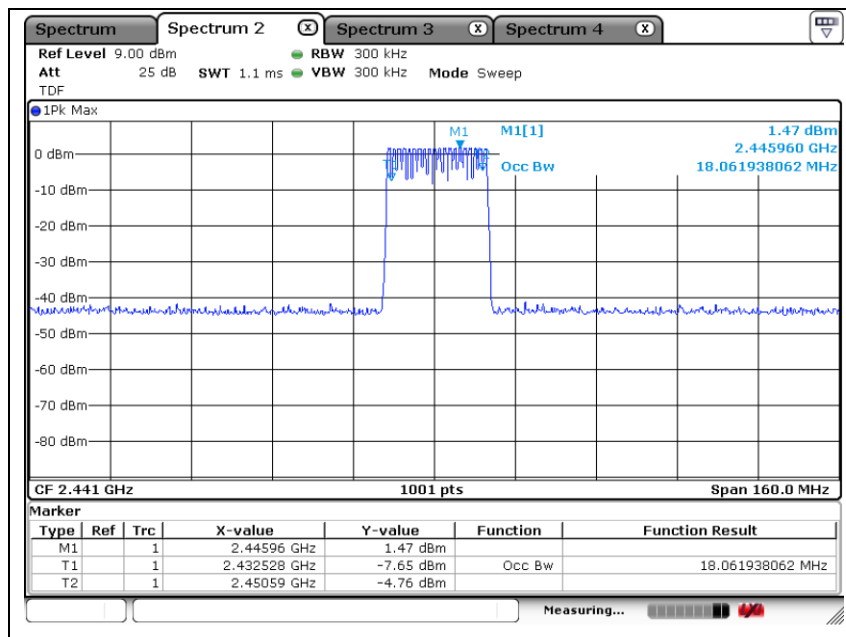
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

Spread Bandwidth (90 %)

- Test mode: GFSK (NON AFH)

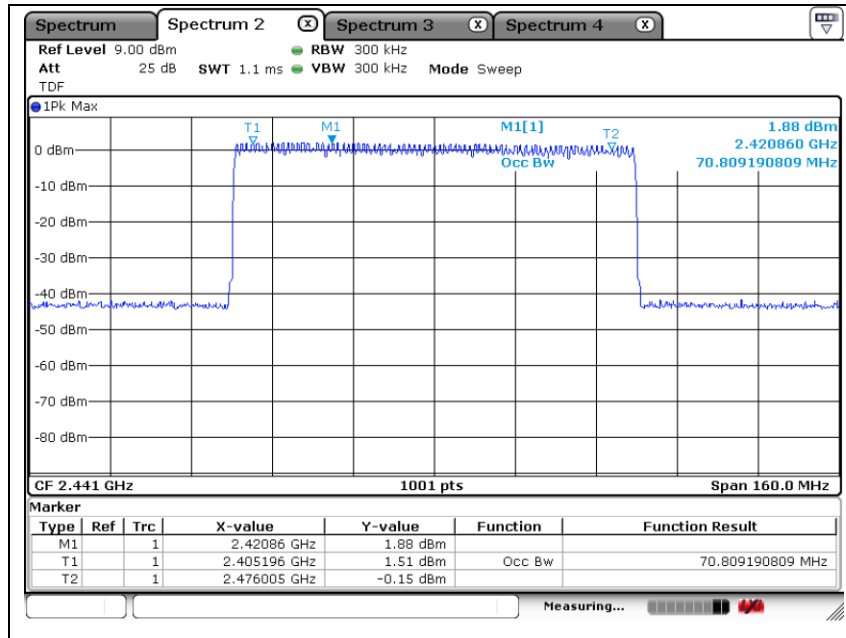


- Test mode: GFSK (AFH)

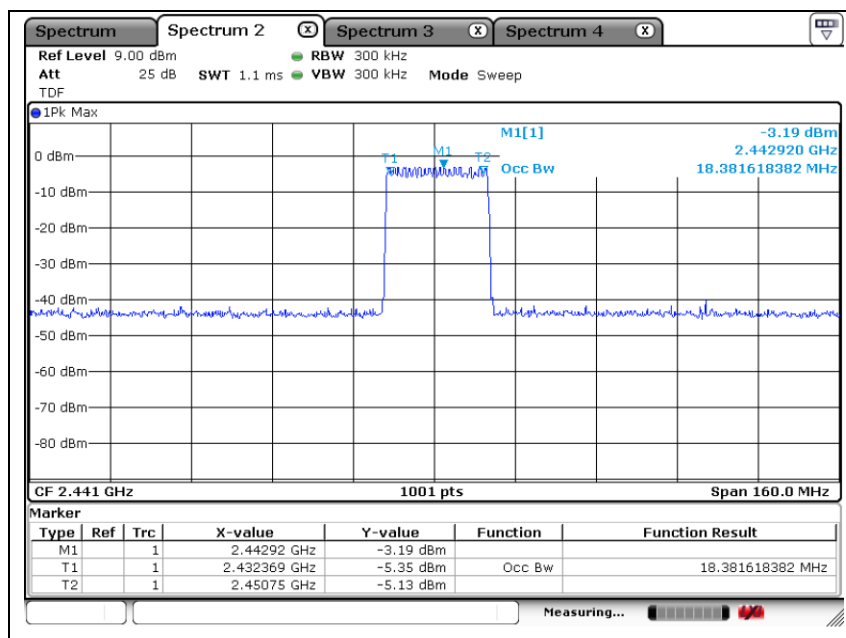


The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: $\pi/4$ DQPSK (NON AFH)

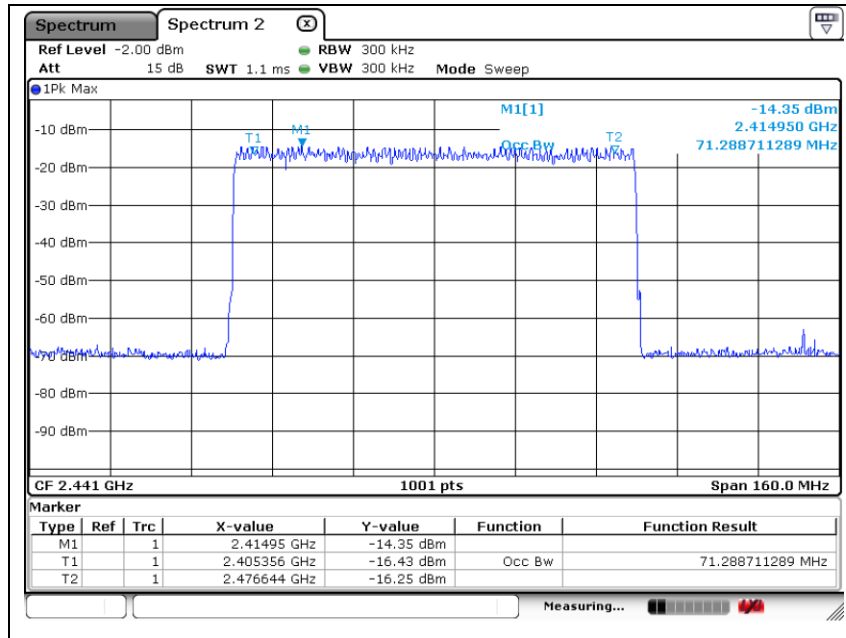


- Test mode: $\pi/4$ DQPSK (AFH)

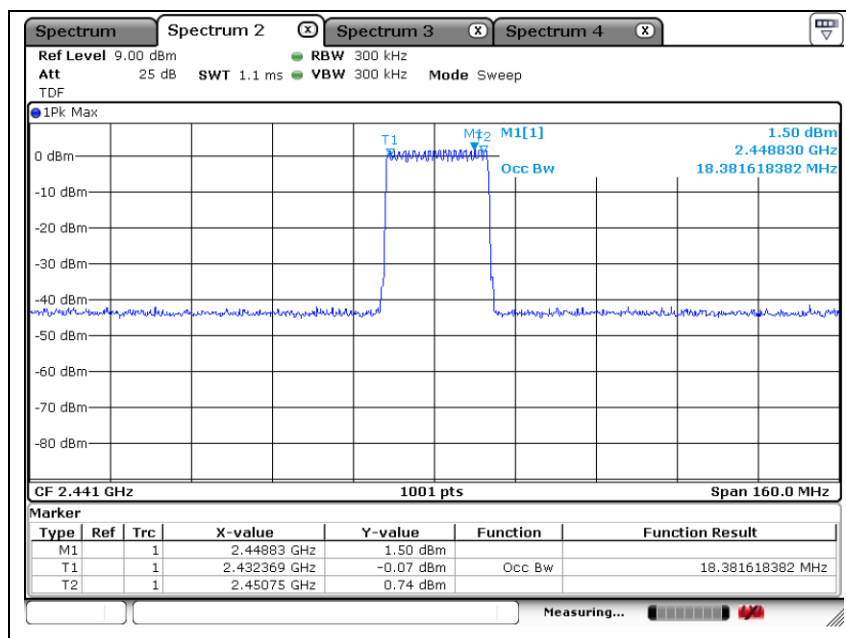


The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: 8DPSK (NON AFH)



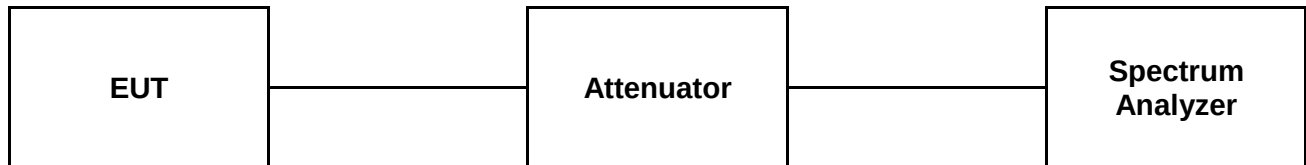
- Test mode: 8DPSK (AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

4. Spurious Emission Intensity

4.1. Test Setup



4.2. Limit

- Below 2 387 MHz: 2.5 μ W (-26 dB m)/MHz or less
 2 387 to 2 400 MHz: 25.0 μ W (-16 dB m)/MHz or less
 2 483.5 to 2 496.5 MHz: 25.0 μ W (-16 dB m)/MHz or less
 Over 2 496.5 MHz: 2.5 μ W (-26 dB m)/MHz or less

4.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. Configure the EUT
 - Hopping using all channels
 - Modulated
 - Maximum payload size (BDR: DH5, EDR: 3DH5)

Set the Spectrum Analyzer to below

[Setting 1]

Frequency range:	BDR, EDR	30 MHz to 12.5 GHz, except for 2 374 MHz to 2 509.5 MHz
RBW:		1 MHz
VBW:		1 MHz
Sweep time:		Minimum time required to make an accurate measurement
Sweep data points:		1 001 or greater
Detector mode:		Positive peak
Indication mode:		Max hold

Note: sweep shall be repeated until the max hold waveform is stable.

[Setting 2]

Frequency range:	BDR, EDR	2 374 MHz to 2 400 MHz 2 483.5 MHz to 2 509.5 MHz
RBW:		30 kHz
VBW:		30 kHz
Sweep time:		Minimum time required to make an accurate measurement.
Sweep data points:		1 001 or greater
Detector mode:		Positive peak
Indication mode		Max hold

Calculate the spurious value (Calculated Value) using following formula:

Calculated Value = (Measured Value using [Setting 2] + 15.2 dB)

Note: 15.2 dB adjustment is derived from the Conversion Factor of RBW

Conversion Factor of RBW = $10 \times \log(\text{Reference Bandwidth} / \text{RBW of measurement}) = 15.2 \text{ [dB]}$

Where: Reference Bandwidth = 1 MHz

RBW of measurement = 30 kHz

3. Search for spurious emissions from 30 MHz to 12.5 GHz.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

4.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

- Test mode: GFSK (NON AFH)

	Measured frequency	Measured level	Limit
30 MHz to 2 374 MHz	2.371 GHz	0.013 740 μ W/MHz	2.5 μ W/MHz
		-48.62 dB m/MHz	-26 dB m/MHz
2 374 MHz to 2 387 MHz	2.382 GHz	0.014 388 μ W/MHz	2.5 μ W/MHz
		-48.42 dB m/MHz	-26 dB m/MHz
2 387 MHz to 2 400 MHz	2.400 GHz	0.016 069 μ W/MHz	25 μ W/MHz
		-47.94 dB m/MHz	-16 dB m/MHz
2 483.5 MHz to 2 496.5 MHz	2.485 GHz	0.010 280 μ W/MHz	25 μ W/MHz
		-49.88 dB m/MHz	-16 dB m/MHz
2 496.5 MHz to 2 509.5 MHz	2.503 GHz	0.011 940 μ W/MHz	2.5 μ W/MHz
		-49.23 dB m/MHz	-26 dB m/MHz
2 509.5 MHz to 12.5 GHz	7.236 GHz	0.069 502 μ W/MHz	2.5 μ W/MHz
		-41.58 dB m/MHz	-26 dB m/MHz

- Test mode: GFSK (AFH)

	Measured frequency	Measured level	Limit
30 MHz to 2 374 MHz	2.336 GHz	0.012 972 μ W/MHz	2.5 μ W/MHz
		-48.87 dB m/MHz	-26 dB m/MHz
2 374 MHz to 2 387 MHz	2.379 GHz	0.011 169 μ W/MHz	2.5 μ W/MHz
		-49.52 dB m/MHz	-26 dB m/MHz
2 387 MHz to 2 400 MHz	2.397 GHz	0.006 237 μ W/MHz	25 μ W/MHz
		-52.05 dB m/MHz	-16 dB m/MHz
2 483.5 MHz to 2 496.5 MHz	2.492 GHz	0.006 998 μ W/MHz	25 μ W/MHz
		-51.55 dB m/MHz	-16 dB m/MHz
2 496.5 MHz to 2 509.5 MHz	2.510 GHz	0.011 614 μ W/MHz	2.5 μ W/MHz
		-49.35 dB m/MHz	-26 dB m/MHz
2 509.5 MHz to 12.5 GHz	4.888 GHz	0.056 754 μ W/MHz	2.5 μ W/MHz
		-42.46 dB m/MHz	-26 dB m/MHz

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: 8DPSK (NON AFH)

	Measured frequency	Measured level	Limit
30 MHz to 2 374 MHz	2.359 GHz	0.009 290 μ W/MHz	2.5 μ W/MHz
		-50.32 dB m/MHz	-26 dB m/MHz
2 374 MHz to 2 387 MHz	2.382 GHz	0.014 388 μ W/MHz	2.5 μ W/MHz
		-48.42 dB m/MHz	-26 dB m/MHz
2 387 MHz to 2 400 MHz	2.400 GHz	0.015 488 μ W/MHz	25 μ W/MHz
		-48.10 dB m/MHz	-16 dB m/MHz
2 483.5 MHz to 2 496.5 MHz	2.495 GHz	0.009 419 μ W/MHz	25 μ W/MHz
		-50.26 dB m/MHz	-16 dB m/MHz
2 496.5 MHz to 2 509.5 MHz	2.508 GHz	0.011 220 μ W/MHz	2.5 μ W/MHz
		-49.50 dB m/MHz	-26 dB m/MHz
2 509.5 MHz to 12.5 GHz	4.854 GHz	0.059 566 μ W/MHz	2.5 μ W/MHz
		-42.25 dB m/MHz	-26 dB m/MHz

- Test mode: 8DPSK (AFH)

	Measured frequency	Measured level	Limit
30 MHz to 2 374 MHz	2.339 GHz	0.008 511 μ W/MHz	2.5 μ W/MHz
		-50.70 dB m/MHz	-26 dB m/MHz
2 374 MHz to 2 387 MHz	2.386 GHz	0.009 162 μ W/MHz	2.5 μ W/MHz
		-50.38 dB m/MHz	-26 dB m/MHz
2 387 MHz to 2 400 MHz	2.387 GHz	0.006 714 μ W/MHz	25 μ W/MHz
		-51.73 dB m/MHz	-16 dB m/MHz
2 483.5 MHz to 2 496.5 MHz	2.492 GHz	0.007 278 μ W/MHz	25 μ W/MHz
		-51.38 dB m/MHz	-16 dB m/MHz
2 496.5 MHz to 2 509.5 MHz	2.504 GHz	0.007 396 μ W/MHz	2.5 μ W/MHz
		-51.31 dB m/MHz	-26 dB m/MHz
2 509.5 MHz to 12.5 GHz	7.320 GHz	0.050 816 μ W/MHz	2.5 μ W/MHz
		-42.94 dB m/MHz	-26 dB m/MHz

Note;

The levels within 2 374 ~ 2 400 MHz and 2 483.5 ~ 2 509.5 MHz are final results investigated by Resolution Bandwidth 30 kHz and considered by conversion factor of RBW.

Conversion factor: $10\log(1 \text{ MHz}/30 \text{ kHz})=15.2 \text{ dB}$

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

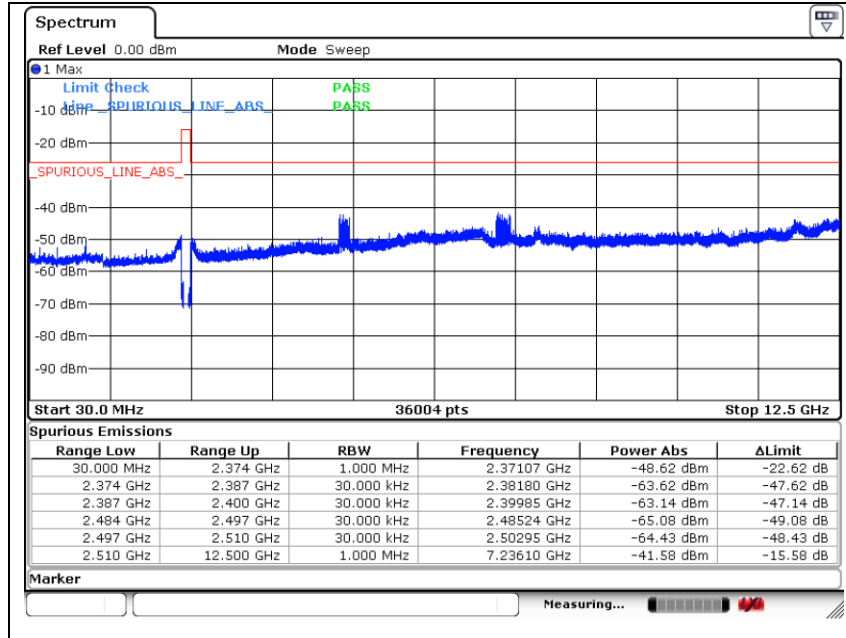
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

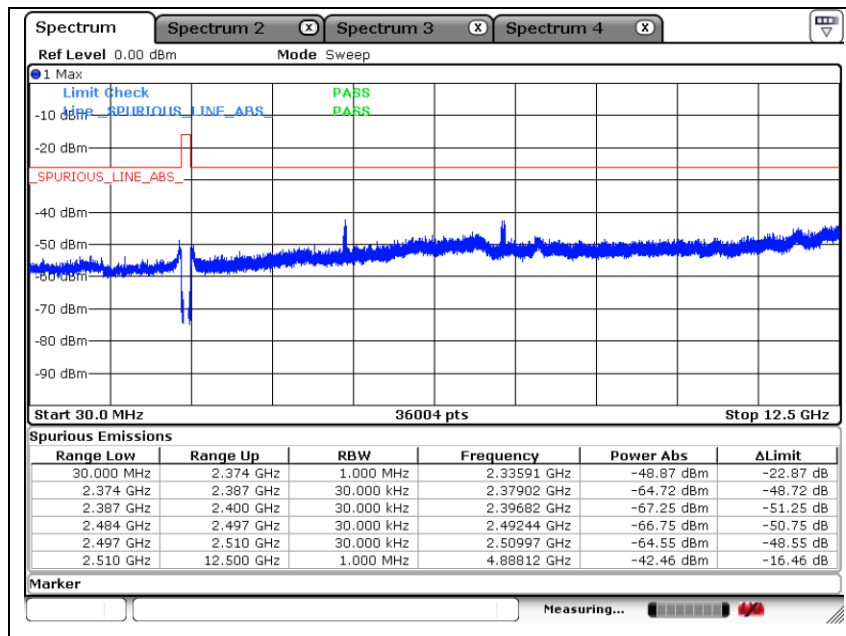
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

- Test mode: GFSK (NON AFH)

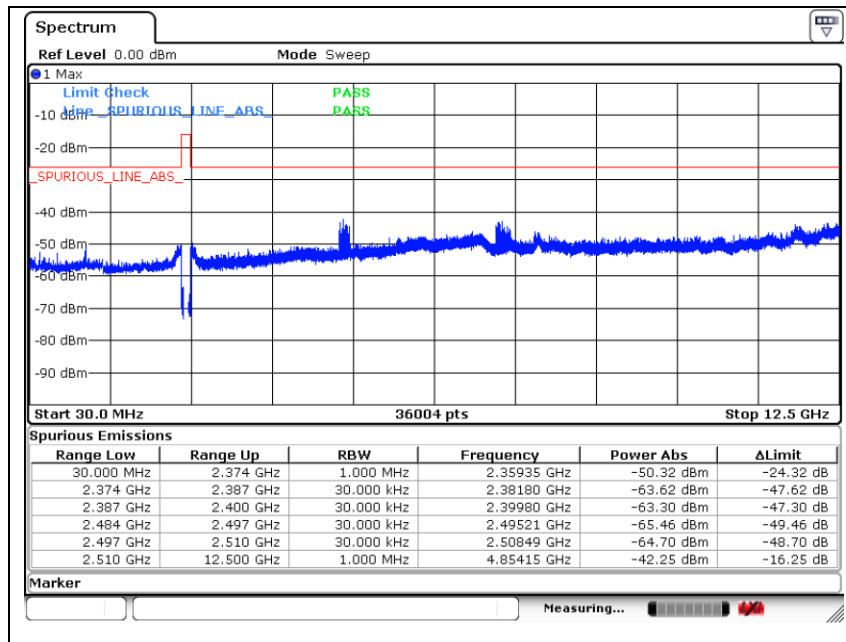


- Test mode: GFSK (AFH)

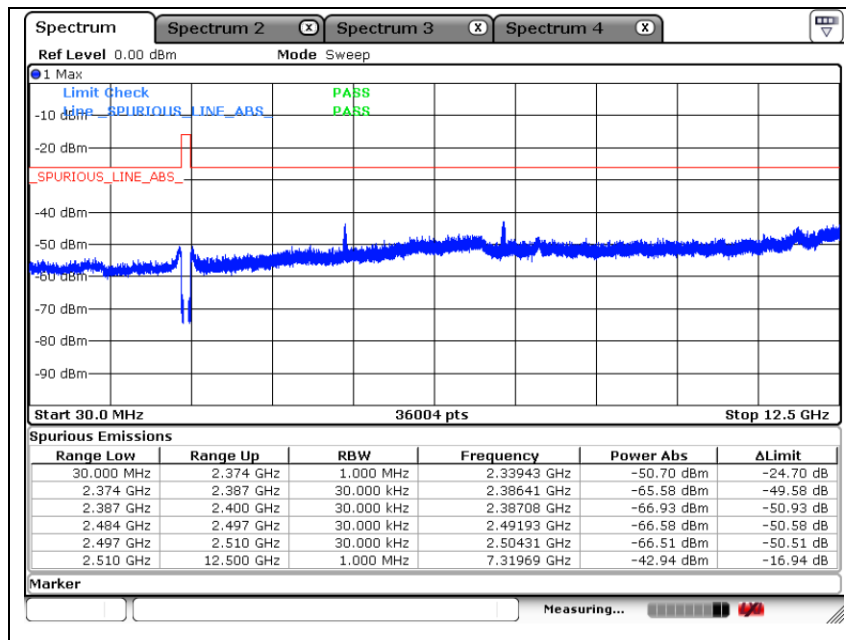


The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: 8DPSK (NON AFH)



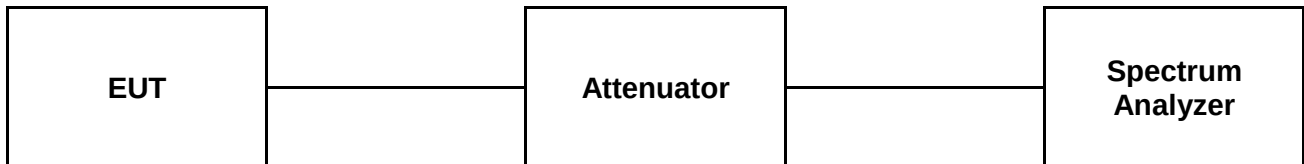
- Test mode: 8DPSK (AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

5. Antenna Power

5.1. Test Setup



5.2. Limit

The difference between measured output power and the rated output power shall be within a tolerance of +20 % to -80 %. In addition, the rated output power shall not be over the limits shown below.

Limit (rated output power, upper limit)

- BDR, EDR: 3 mW/MHz or less

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

5.3. Test Procedure

1. Connect transmitter output to the spectrum analyzer input port.

2. Configure the EUT

- Hopping over all channels
- Maximum payload size (BDR: DH5, EDR: 3DH5)

–Search for peak power frequency according to below settings.

Center frequency:	BDR, EDR	2 441 MHz
Span:	BDR, EDR	100 MHz
RBW:		1 MHz
VBW:		3 MHz
Sweep time:		Auto
Sweep data points:		1 001 or greater
Detector mode:		Positive peak
Indication mode:		Max hold

Find the frequency of maximum transmitted power.

–Measurement of average antenna power according to below settings.

Center frequency:	Frequency of peak power
Span:	0 Hz
RBW:	3 MHz
Detector mode:	Sample
Sweep time:	10 ms
	Minimum time required to make an accurate measurement.
	For burst type (intermittent) transmission, sweep time shall be greater than one burst interval.
Sweep data points:	1 001 or greater

Measure the Average Burst Power of the frequency.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

5.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

	GFSK (NON AFH)	GFSK (AFH)	8DPSK (NON AFH)	8DPSK (AFH)
Average Burst Power (mW)	1.18	1.49	1.57	1.63
Average Burst Power (dB m)	0.71	1.74	1.95	2.12
Spread Bandwidth (MHz)	70.97	18.06	71.29	18.38
Antenna Power (mW/MHz)	0.017	0.083	0.022	0.089
Rated Output Power (mW/MHz)	0.04	0.16	0.04	0.16
Power Tolerance (%)	-57.50	-48.13	-45.00	-44.38

Note;

Antenna Power (mW/MHz) = Average Burst Power (mW) / Spread Bandwidth (MHz)

Power Tolerance (%) = {[Antenna Power (mW/MHz) - Rated Output Power (mW/MHz)] ÷ Rated Output Power (mW/MHz)} × 100

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

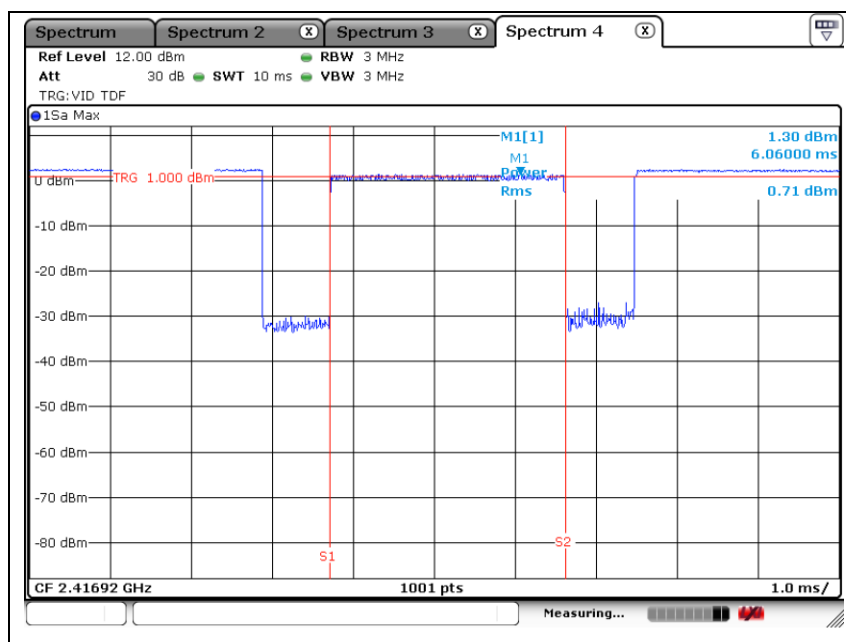
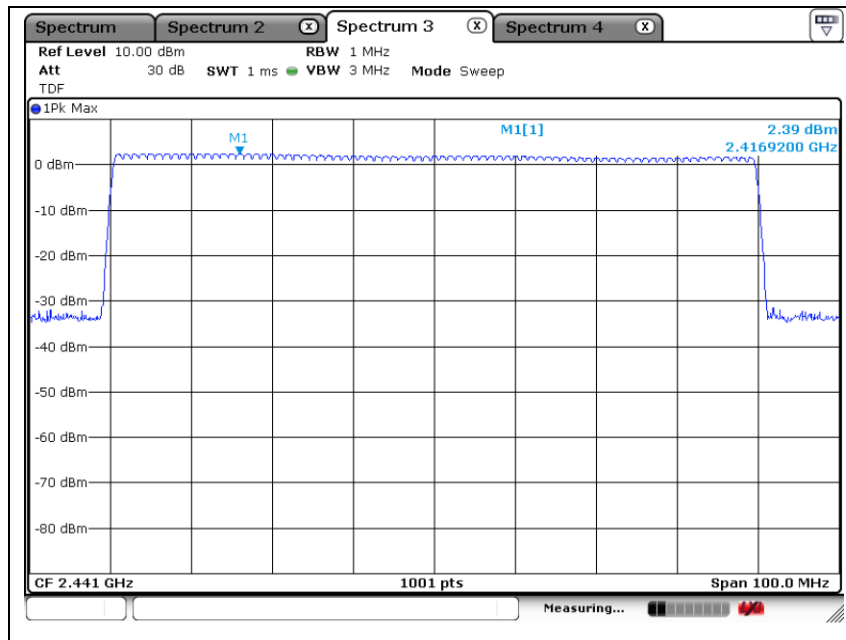
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm × 297mm)

- Test mode: GFSK (NON AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

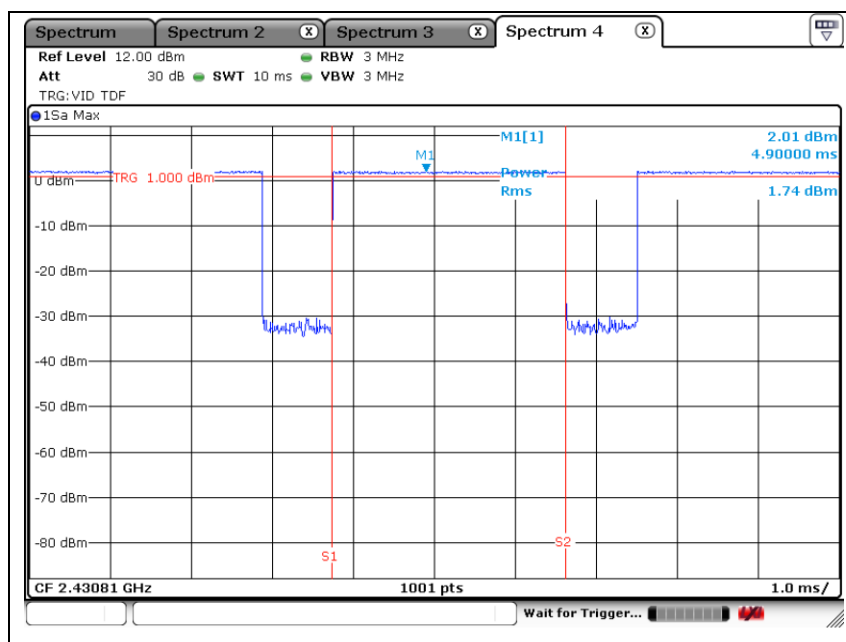
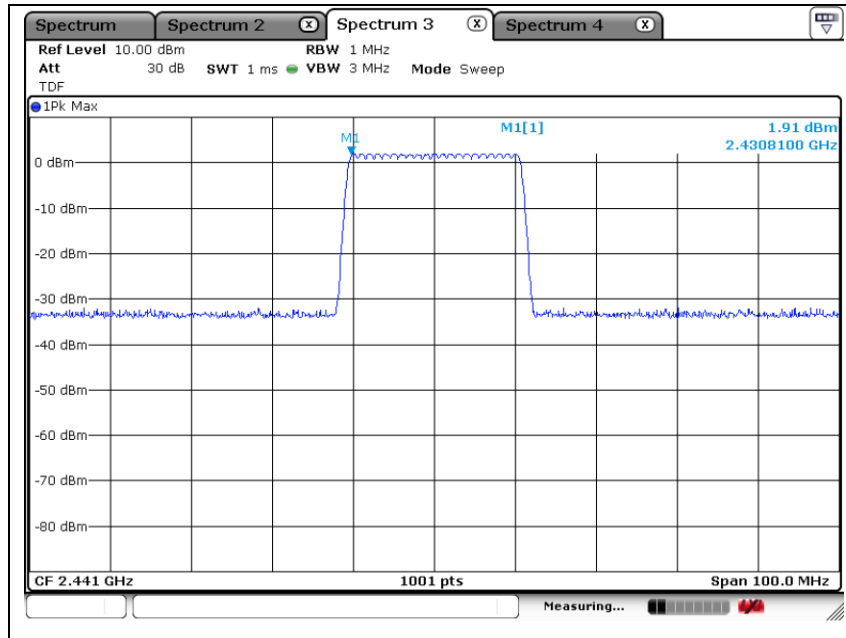
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

- Test mode: GFSK (AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

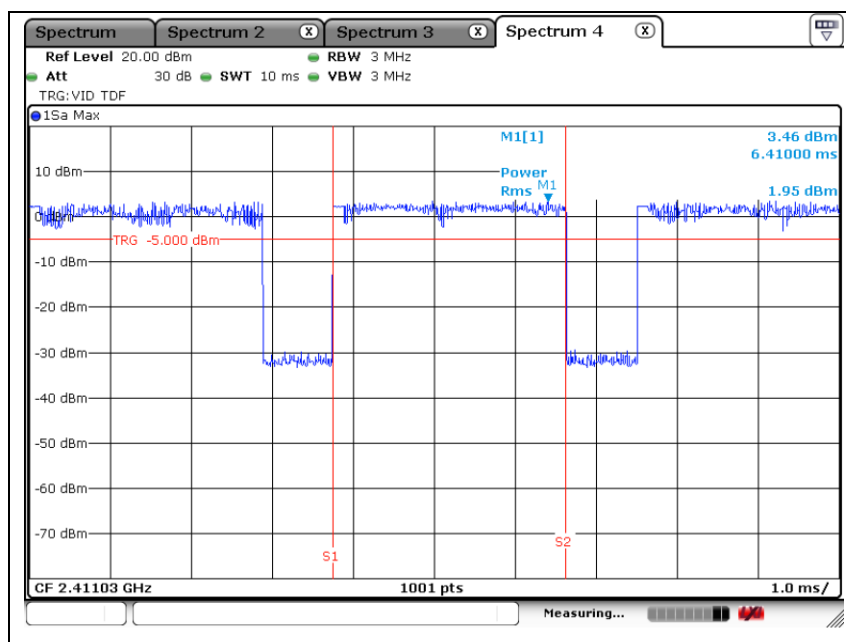
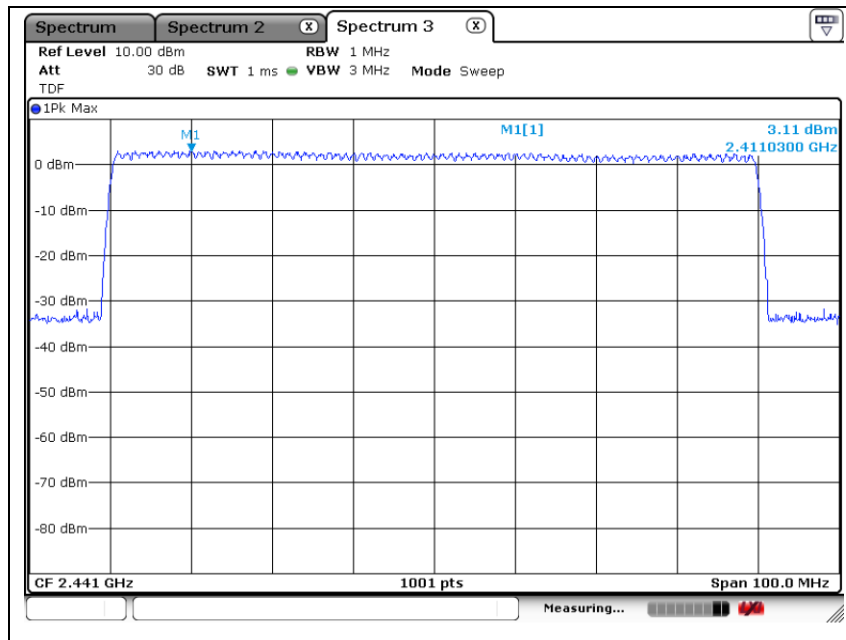
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

- Test mode: 8DPSK (NON AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

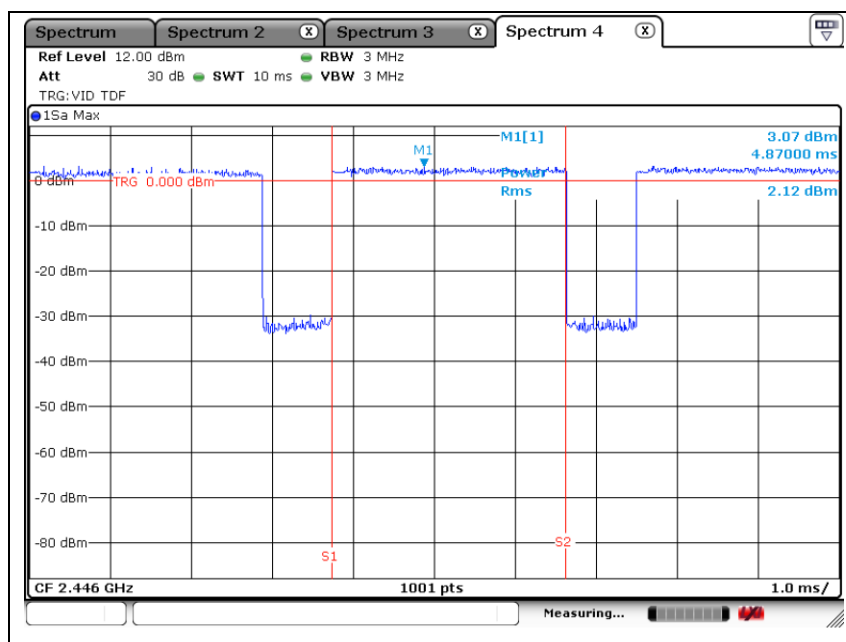
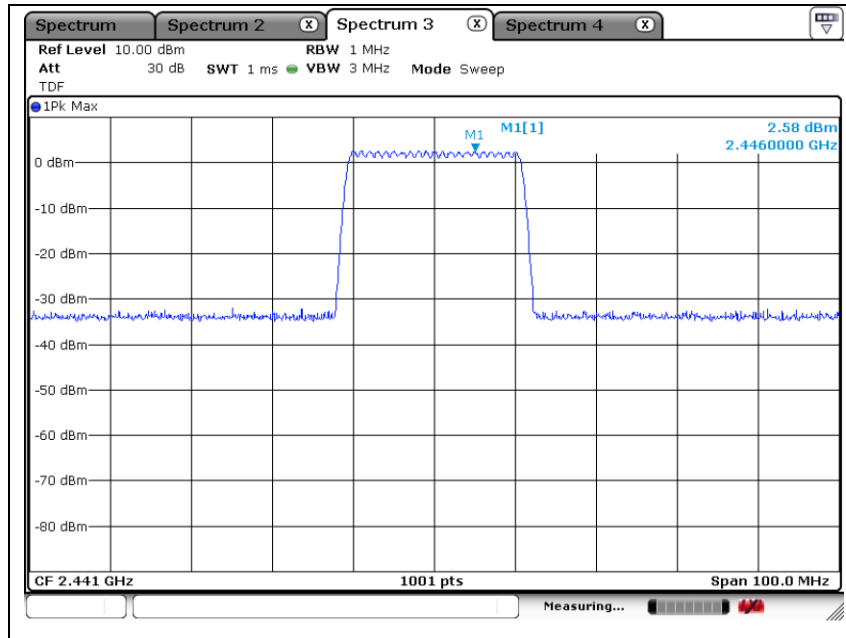
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

- Test mode: 8DPSK(AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

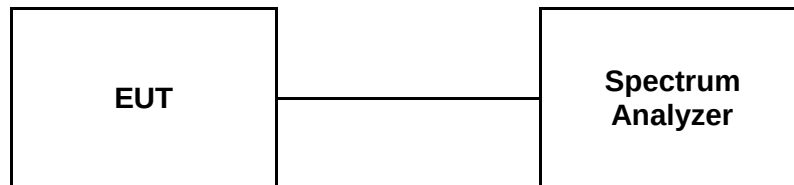
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

6. Secondary Radiated Emissions

6.1. Test Setup



6.2. Limit

Below 1 GHz: 4 nW (-54 dB m) or less

Above 1 GHz: 20 nW (-47 dB m) or less

6.3. Test Procedure

1. Configure the spectrum analyzer to below.

Frequency range:	30 MHz –12.5 GHz
RBW:	Below 1 GHz: 100 kHz
	Above 1 GHz: 1 MHz
VBW:	Below 1 GHz: 100 kHz
	Above 1 GHz: 1 MHz
Sweep time:	Auto
Sweep data points:	1 001 or greater
Detector mode:	Positive peak
Indication mode:	Max hold

Search for spurious emissions in the range 30 MHz to 12.5 GHz.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

6.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

- Test mode: GFSK

2 402 MHz

	Measured frequency	Measured level	Limit
30 MHz to 1 000 MHz	0.893 GHz	0.005 370 nW	4 nW
		-82.70 dB m	-54 dB m
1 000 MHz to 12.5 GHz	4.802 GHz	0.391 742 nW	20 nW
		-64.07 dB m	-47 dB m

2 441 MHz

	Measured frequency	Measured level	Limit
30 MHz to 1 000 MHz	0.608 GHz	0.011 402 nW	4 nW
		-79.43 dB m	-54 dB m
1 000 MHz to 12.5 GHz	4.880 GHz	0.402 717 nW	20 nW
		-63.95 dB m	-47 dB m

2 480 MHz

	Measured frequency	Measured level	Limit
30 MHz to 1 000 MHz	0.608 GHz	0.007 261 nW	4 nW
		-81.39 dB m	-54 dB m
1 000 MHz to 12.5 GHz	4.958 GHz	0.400 867 nW	20 nW
		-63.97 dB m	-47 dB m

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

- Test mode: 8DPSK

2 402 MHz

	Measured frequency	Measured level	Limit
30 MHz to 1 000 MHz	0.998 GHz	0.009 727 nW	4 nW
		-80.12 dB m	-54 dB m
1 000 MHz to 12.5 GHz	4.801 GHz	0.390 841 nW	20 nW
		-64.08 dB m	-47 dB m

2 441 MHz

	Measured frequency	Measured level	Limit
30 MHz to 1 000 MHz	0.608 GHz	0.012 190 nW	4 nW
		-79.14 dB m	-54 dB m
1 000 MHz to 12.5 GHz	4.880 GHz	0.413 048 nW	20 nW
		-63.84 dB m	-47 dB m

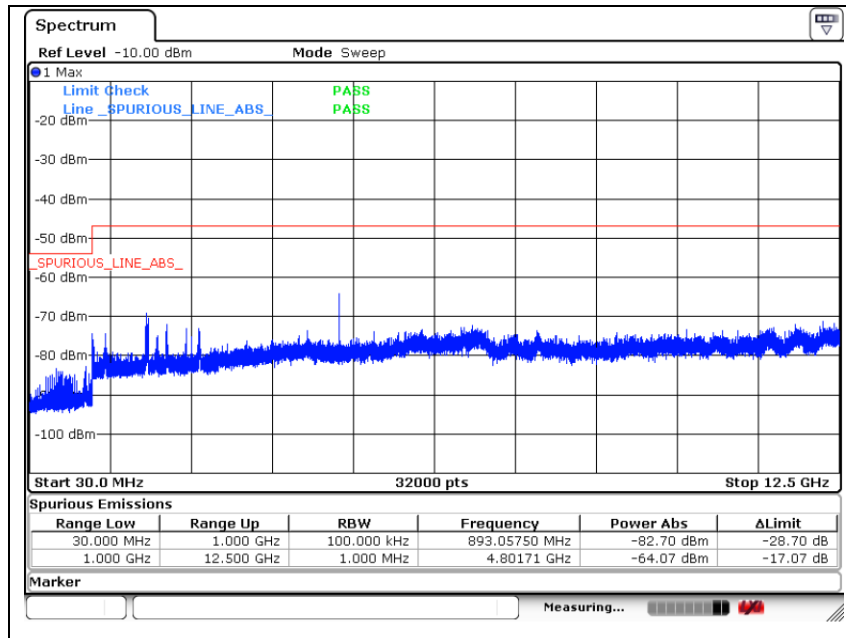
2 480 MHz

	Measured frequency	Measured level	Limit
30 MHz to 1 000 MHz	0.608 GHz	0.005 559 nW	4 nW
		-82.55 dB m	-54 dB m
1 000 MHz to 12.5 GHz	4.958 GHz	0.399 025 nW	20 nW
		-63.99 dB m	-47 dB m

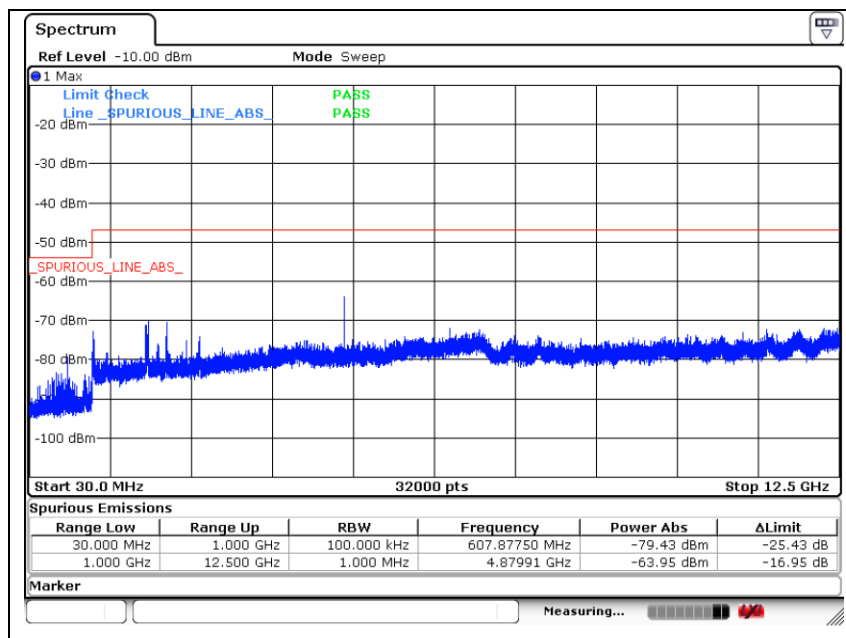
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: GFSK

2 402 MHz



2 441 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

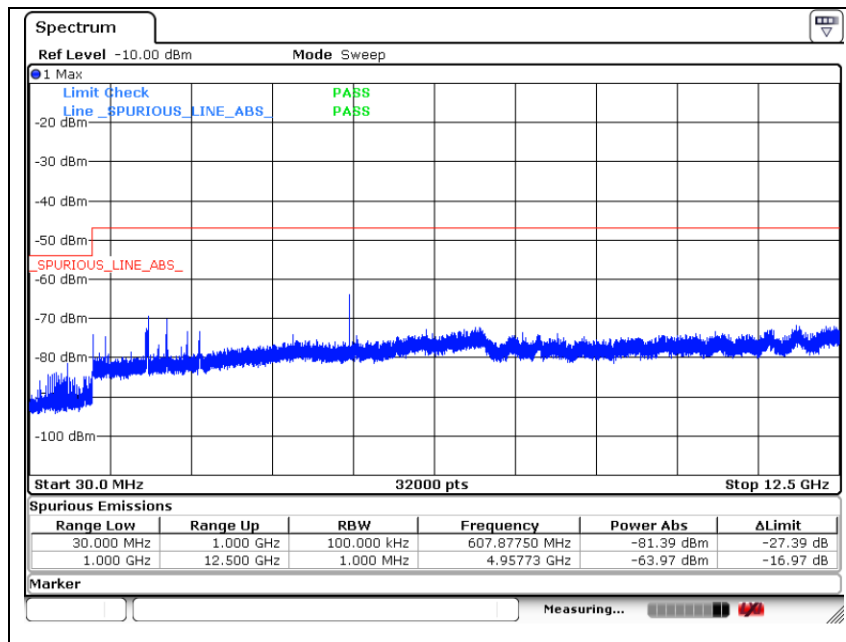
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

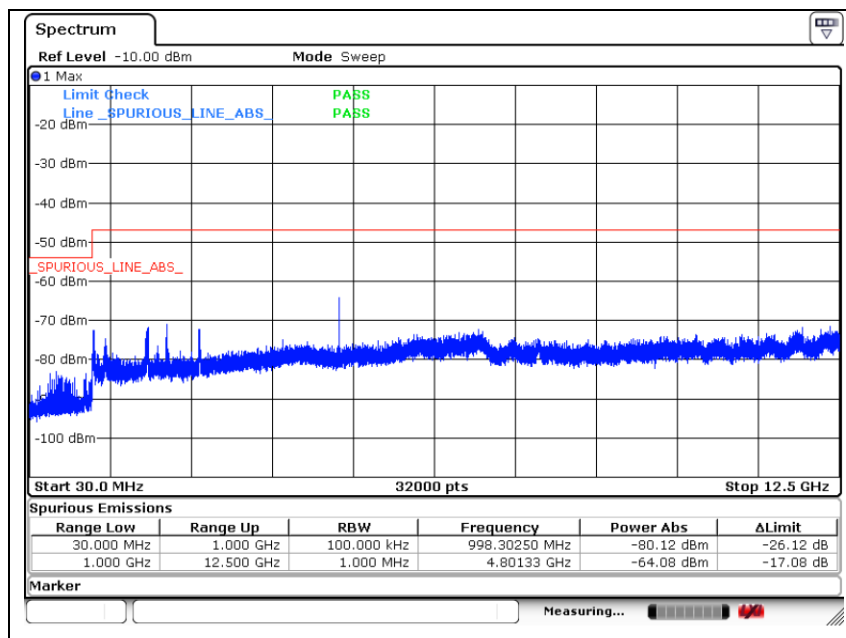
A4(210mm x 297mm)

2 480 MHz



- Test mode: 8DPSK

2 402 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

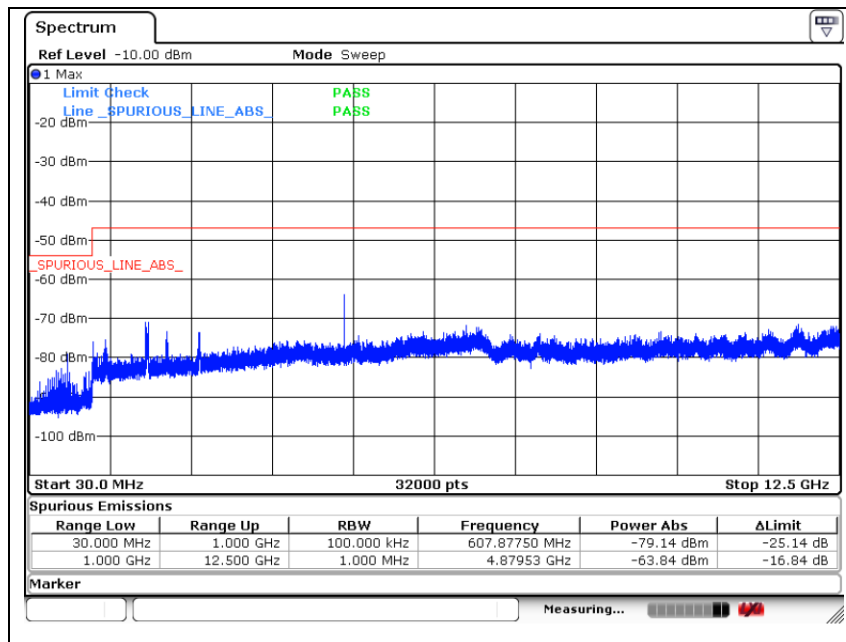
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

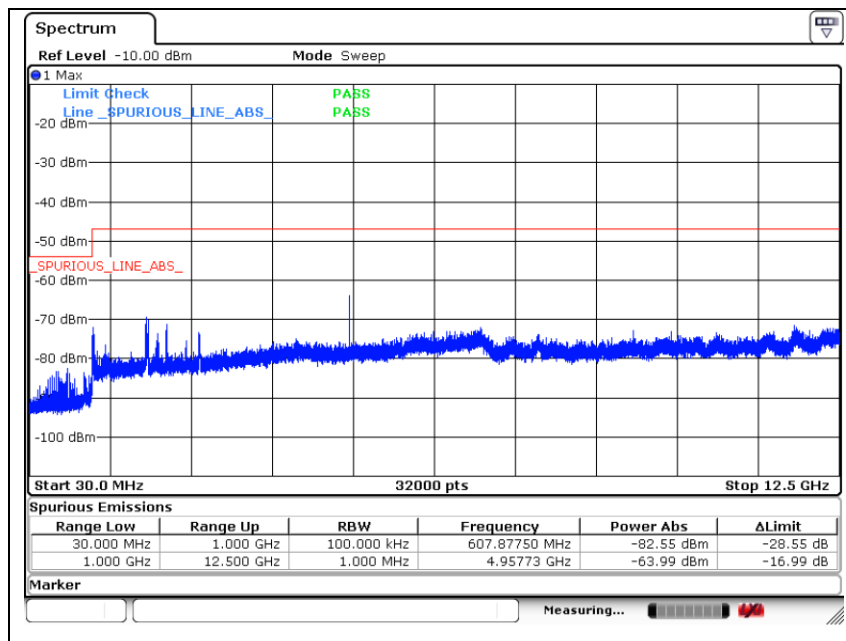
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

2 441 MHz



2 480 MHz



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

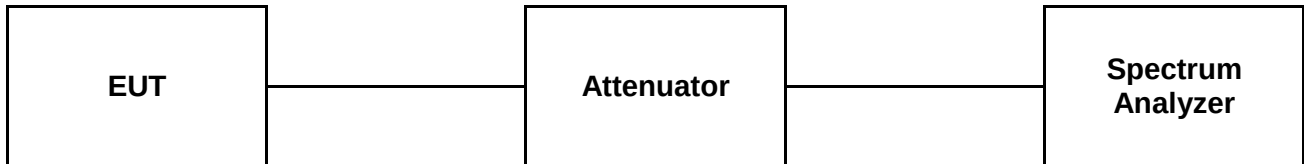
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

7. Dwell Time

7.1. Test Setup



7.2. Limit

- Transmit ON Time shall be less than 0.4 seconds
- Total Dwell Time shall be less than 0.4 seconds

7.3. Test Procedure

1. Configure the spectrum analyzer to below

Frequency: 2 441 MHz
 Span: 0 Hz
 RBW: 1 MHz
 VBW: 1 MHz
 Detection mode: Positive peak

Measure the Burst Cycle and Transmit ON time

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

7.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

	Packet type	Total Dwell time(ms)	Limit (ms)
GFSK (NON AFH)	DH5	276.71	400
GFSK (AFH)	DH5	276.66	400
$\pi/4$ DQPSK (NON AFH)	2DH5	274.62	400
$\pi/4$ DQPSK (AFH)	2DH5	281.57	400
8DPSK (NON AFH)	3DH5	277.96	400
8DPSK (AFH)	3DH5	283.52	400

Total Dwell Time

GFSK (NON AFH) : $(0.4 * 70.97 * 2.88) / (3.74 * 79) = 276.71$ (ms)
GFSK (AFH) : $(0.4 * 18.06 * 2.88) / (3.76 * 20) = 276.66$ (ms)
 $\pi/4$ DQPSK (NON AFH) : $(0.4 * 70.81 * 2.88) / (3.76 * 79) = 274.62$ (ms)
 $\pi/4$ DQPSK (AFH) : $(0.4 * 18.38 * 2.88) / (3.76 * 20) = 281.57$ (ms)
8DPSK (NON AFH) : $(0.4 * 71.29 * 2.88) / (3.74 * 79) = 277.96$ (ms)
8DPSK (AFH) : $(0.4 * 18.38 * 2.90) / (3.76 * 20) = 283.52$ (ms)

Note;

Total Dwell Time = (0.4 x Spreading Rate x Transmit ON Time) / (Burst Cycle x Number of Hopping Channels)

1. Spreading Rate = Spread Bandwidth (measured value) / Transmission Rate
2. Transmit ON Time and Burst Cycle are both measured in Seconds

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

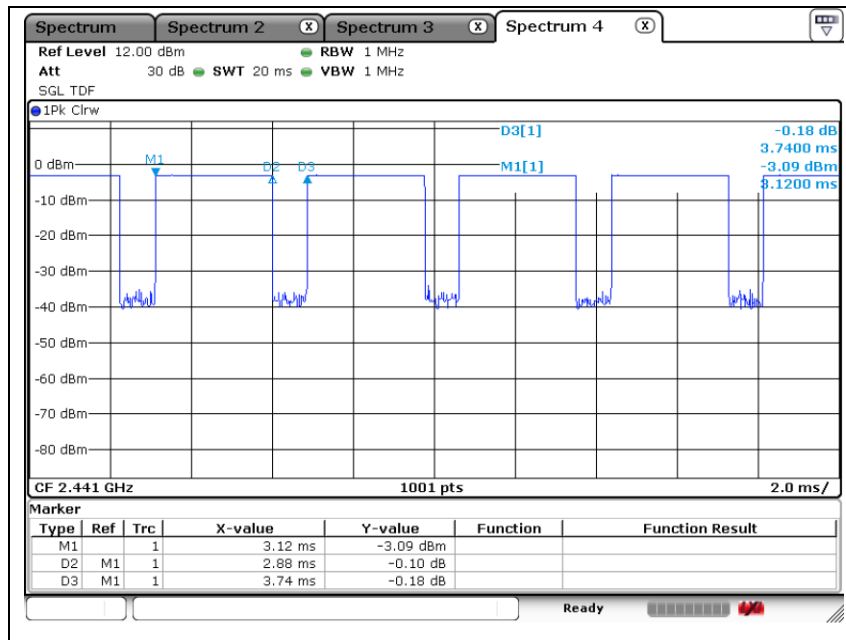
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

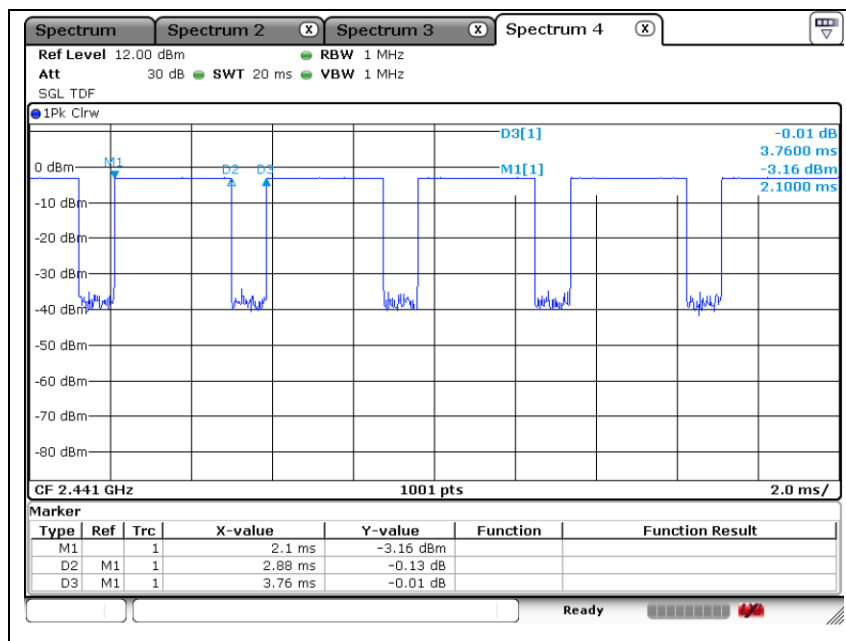
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)

- Test mode: GFSK (NON AFH)

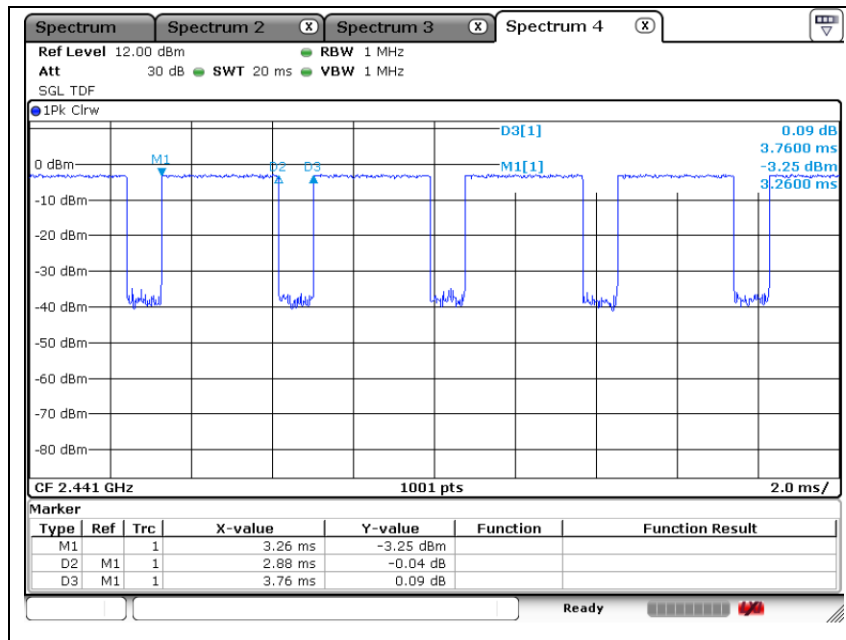


- Test mode: GFSK (AFH)

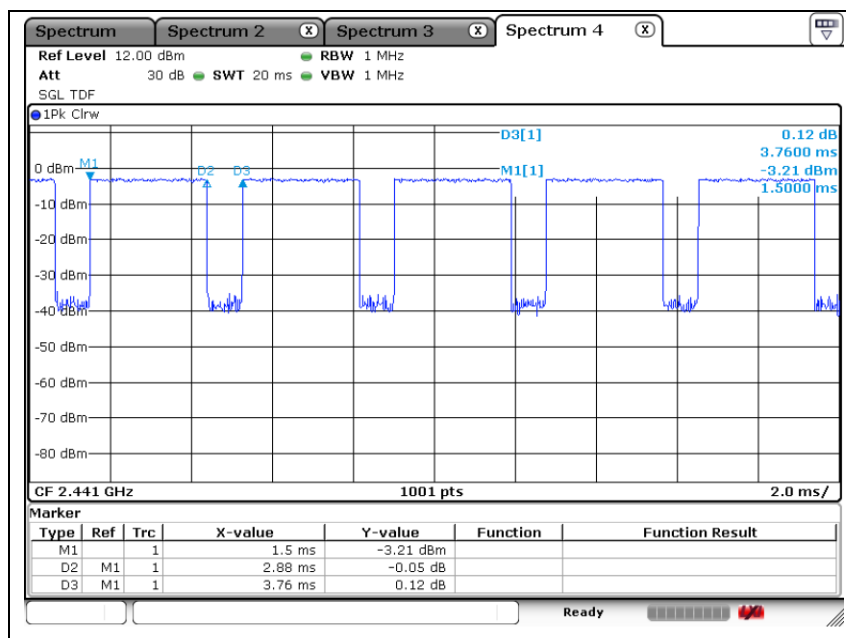


The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: $\pi/4$ DQPSK (NON AFH)

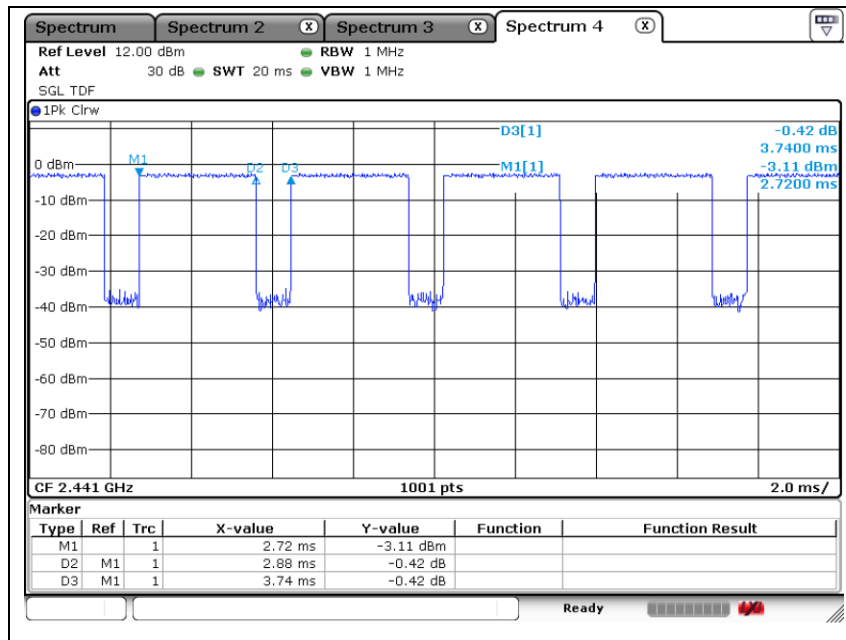


- Test mode: $\pi/4$ DQPSK (AFH)

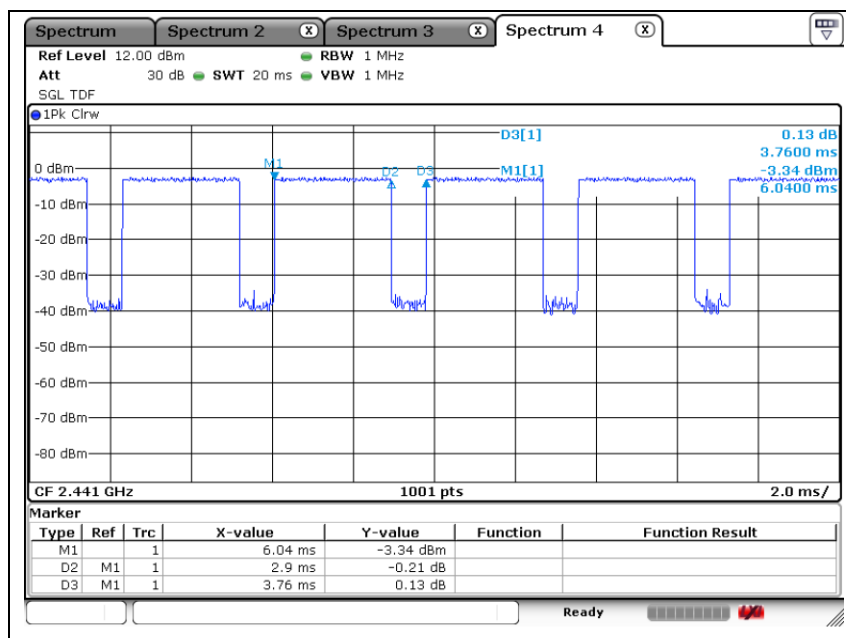


The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

- Test mode: 8DPSK (NON AFH)



- Test mode: 8DPSK (AFH)



The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

8. Test Methodology & Conditions

8.1. Test Condition

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

Voltage Fluctuation Test	Normal Voltage	High voltage + 10 % of normal voltage	Low voltage - 10 % of normal voltage
EUT Input voltage (V _{dc})	12.00	13.20	10.80
RF Part Output voltage (V _{dc})	3.30	3.30	3.30

Voltage Variation (%) = (Output high or Low Voltage – Output normal voltage) / Output normal voltage * 100
During the input supply voltage to the EUT from the external power source is varied by +/- 10 % if output voltage had been confirmed that the fluctuation of power supply to the RF circuit of EUT (excluding power source) is equal to or less than +/- 1 %. Exempt extremely high and low supply voltage condition tests, EUT only operated in normal voltage to test all regulations.

- End of the Test Report -

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210mm x 297mm)