

# **TEST REPORT**

of

FCC Part 15 Subpart C §15.247 RSS-247 Issue 2, RSS-Gen Issue 5

FCC ID: TQ8-ADB30G5AN IC Certification: 5074A-ADB30G5KN

Equipment Under Test	:	DISPLAY CAR SYSTEM
FCC Model Name	:	ADB30G5AN
IC Model Name	:	ADB30G5KN
Applicant	:	Hyundai Mobis Co., Ltd.
Manufacturer	:	Hyundai Mobis Co., Ltd.
Date of Receipt	:	2019.05.23
Date of Test(s)	:	2019.05.30 ~ 2019.07.02
Date of Issue	:	2019.07.02

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

Tested By:	A	Date:	2019.07.02
-	Jinhyoung Cho		
Technical Manager:	Jun	Date:	2019.07.02
	Jungmin Yang		

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 A4(210 mm × 297 mm)



# **INDEX**

Table of Contents	Page
1. General Information	3
2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	10
3. 20 dB Bandwidth & 99 % Bandwidth	37
4. Maximum Peak Conducted Output Power	49
5. Carrier Frequency Separation	51
6. Number of Hopping Frequencies	55
7. Time of Occupancy(Dwell Time)	59
8. Antenna Requirement	73



# **1. General Information**

# 1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

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- Designation number: KR0150

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# 1.2. Details of Applicant

Applicant	:	Hyundai Mobis Co., Ltd.
Address	:	203, Teheran-ro, Gangnam-gu, Seoul, South Korea, 135-977
Contact Person	:	Choe, Seung-hoon
Phone No.	:	+82 31 260 0098

# 1.3. Details of Manufacturer

Company	:	Same as applicant
Address	:	Same as applicant

# 1.4. Description of EUT

Kind of Product	DISPLAY CAR SYSTEM
FCC Model Name	ADB30G5AN
IC Model Name	ADB30G5KN
Power Supply	DC 14.4 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth)
Modulation Technique	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79 channel (Bluetooth)
Antenna Type	PCB pattern antenna
Antenna Gain	0.07 dB i



# 1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMR40	100272	Jun. 07, 2019	Annual	Jun. 07, 2020
Signal Generator	R&S	SMBV100A	255834	Jun. 10, 2019	Annual	Jun. 10, 2020
Spectrum Analyzer	R&S	FSV30	103210	Dec. 05, 2018	Annual	Dec. 05, 2019
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 21, 2018	Annual	Sep. 21, 2019
Bluetooth Tester	TESCOM	TC-3000C	3000C000560	Sep. 18, 2018	Annual	Sep. 18, 2019
Directional Coupler	KRYTAR	152613	122660	Jun. 12, 2019	Annual	Jun. 12, 2020
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-10SS	344	May 21, 2019	Annual	May 21, 2020
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	15	Jun. 05, 2019	Annual	Jun. 05, 2020
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-2	Feb. 19, 2019	Annual	Feb. 19, 2020
Power Sensor	R&S	NRP-Z81	101421	Dec. 17, 2018	Annual	Dec. 17, 2019
DC Power Supply	R&S	HMP2020	019258024	Nov. 06, 2018	Annual	Nov. 06, 2019
Preamplifier	H.P.	8447F	2944A03909	Aug. 07, 2018	Annual	Aug. 07, 2019
Preamplifier	Agilent	8449B	3008A01932	Feb. 22, 2019	Annual	Feb. 22, 2020
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 23, 2017	Biennial	Aug. 23, 2019
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	01126	Mar. 26, 2018	Biennial	Mar. 26, 2020
Horn Antenna	R&S	HF906	100326	Feb. 14, 2018	Biennial	Feb. 14, 2020
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	BBHA9170431	Sep. 10, 2018	Biennial	Sep. 10, 2020
Test Receiver	R&S	ESU26	100109	Jan. 31, 2019	Annual	Jan. 31, 2020
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/383 30516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/383 30516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SUCOFLEX	104 (3 m)	MY3258414	Jan. 04, 2019	Semi- annual	Jul. 04, 2019
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jan. 04, 2019	Semi- annual	Jul. 04, 2019
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 01/20	Feb. 28, 2019	Semi- annual	Aug. 28, 2019
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 05/20	Feb. 28, 2019	Semi- annual	Aug. 28, 2019
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 10/20	Feb. 28, 2019	Semi- annual	Aug. 28, 2019



# 1.6. Declaration by the Manufacturer

- Adaptive Frequency Hopping is supported and use at least 20 channels.

# 1.7. Information about the FHSS characteristics:

#### 1.7.1. 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.

#### 1.7.2. Equal Hopping Frequency Use

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

#### 1.7.3. 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

### 1.7.4. 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.

### 1.7.5. Equipment Description

15.247(a)(1) that the Rx input bandwidths 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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# 1.8. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15 Subpart C, RSS-247 Issue 2, RSS-Gen Issue 5					
Section in FCC Section in IC Test Item		Test Item	Result		
15.205(a) 15.209 15.247(d)	RSS-247 Issue 2 5.5 RSS-Gen Issue 5 8.9	Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	Complied		
15.247(a)(1)	RSS-247 Issue 2 5.1(b) RSS-Gen Issue 5 6.7	20 dB Bandwidth and 99 % Bandwidth	Complied		
15.247(b)(1)	RSS-247 Issue 2 5.1(b) 5.4(b)	Maximum Peak Conducted Output Power	Complied		
15.247(a)(1)	RSS-247 Issue 2 5.1(b)	Carrier Frequency Separation	Complied		
15.247(a)(1)(iii)	RSS-247 Issue 2 5.1(d)	Number of Hopping Frequencies	Complied		
15.247(a)(1)(iii)	RSS-247 Issue 2 5.1(d)	Time of Occupancy (Dwell Time)	Complied		

# 1.9. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 15.247 Meas Guidance v05r02 were used in the measurement of the DUT.

# 1.10. Sample Calculation

Where relevant, the following sample calculation is provided:

### 1.10.1. Conducted Test

Offset value (dB) = Directional coupler (dB) + Cable loss (dB)

### 1.10.2. Radiation Test

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



# 1.11. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
RF Output Power	<b>± 0.40</b> dB
Occupied Bandwidth	± 9.66 kHz
Conducted Spurious Emission	<b>± 0.76</b> dB
Radiated Emission, 9 kHz to 30 MHz	<b>± 3.59</b> dB
Radiated Emission, below 1 GHz	<b>± 5.88</b> dB
Radiated Emission, above 1 GHz	<b>± 5.94</b> dB

Uncertainty figures are valid to a confidence level of 95 %.

# 1.12. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501/RF-RTL014032	2019.07.02	Initial



# 1.13. Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Operation Mode	Data Rate (Mbps)	Channel	Frequency (⊮₂)	RF Output Power (dB m)
		Low	2 402	<u>0.68</u>
GFSK	1	Middle	2 441	0.43
		High	2 480	0.34
		Low	2 402	<u>1.22</u>
π/4DQPSK	2	Middle	2 441	1.00
		High	2 480	1.07
		Low	2 402	<u>1.77</u>
8DPSK	3	Middle	2 441	1.57
		High	2 480	1.51

#### Note;

1. For transmitter radiated spurious emissions, conducted spurious emission, carrier frequency separation and number of hopping frequencies, GFSK / DH5 and 8DPSK / 3DH5 are tested as worst condition.

2. For 20 dB bandwidth and maximum peak conducted output power, GFSK / DH5,  $\pi$ /4DQPSK / 2DH5 and 8DPSK / 3DH5 are tested as worst condition.

3. For Time of Occupancy, GFSK / DH1, DH3, DH5 and 8DPSK / 3DH1, 3DH3, 3DH5 are tested as worst condition.

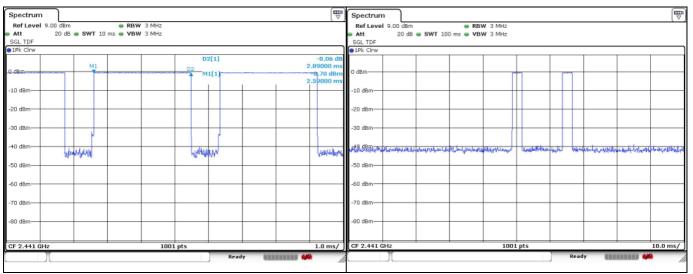


# **1.14. Duty Cycle Correction Factor of EUT**

According to KDB 558074 D01 15.247 Meas Guidance v05r02, 9, as a "duty cycle correction factor", pulse averaging with 20 log (worst case dwell time / 100 ms) has to be used for average result.

#### DH5 on time (One Pulse) Plot on Channel 39

#### DH5 on time (Count Pulses) Plot on Channel 39



In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed;

the period to have DH5 packet completing one hopping sequence is 2.89 ms x 20 channels = 57.80 ms

There cannot be 2 complete hopping sequences within 100 ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100 ms / 57.80 ms] = 2 hops

Thus, the maximum possible ON time:

2.89 ms x 2 = 5.78 ms

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time:

20 log (5.78 ms/100 ms) = -24.76 dB

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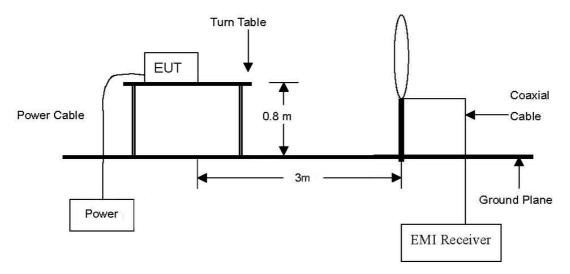


# 2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

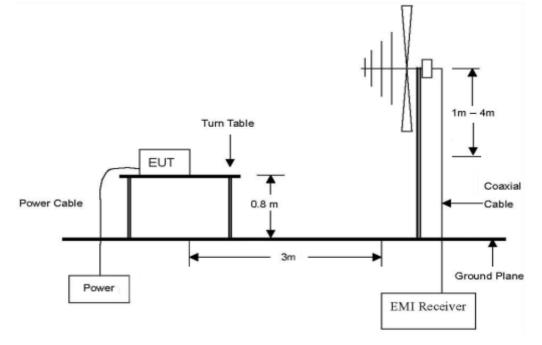
# 2.1. Test Setup

# 2.1.1. Transmitter Radiated Spurious Emissions

The diagram below shows the test setup that is utilized to make the measurements for emission from 9  $\,\rm klt$  to 30  $\,\rm Mk$ 



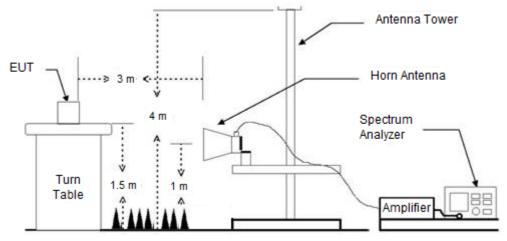
The diagram below shows the test setup that is utilized to make the measurements for emission from 30  $\,\rm Mz$  to 1  $\,\rm Gz$ 





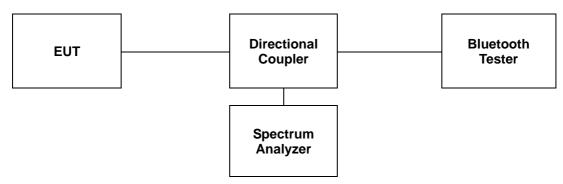


The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 1 GHz to the 10<sup>th</sup> harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.





# 2.1.2. Conducted Spurious Emissions



# 2.2. Limit

#### 2.2.1. FCC

According to \$15.247(d), in any 100 kt 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 kt 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 fall in the restricted bands, as defined in section \$15.205(c)).

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (쌘)	Field Strength (µV/m)	Measurement Distance (Meters)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

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



#### 2.2.2. IC

According to RSS-247 Issue 2, 5.5, in any 100 kt bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kt bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen Issue 5, 8.9, except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Frequency (ﷺ)	Field Strength ( <i>µ</i> V/m at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

#### Table 5 – General Field Strength Limits at frequencies above 30 Mb

#### Table 6 – General Field Strength Limits at frequencies below 30 Mb

Frequency	Magnetic Field Strength (H-Field) (µA/m)	Measurement Distance (meters)
9-490 kHz 1	6.37/F (F in klz)	300
<b>490-1 705</b> kHz	63.7/F (F in k⊞)	30
1.705-30 Mz	0.08	30

**Note<sup>1</sup>:** The emission limits for the ranges 9-90 klz and 110-490 klz are based on measurements employing a linear average detector.



# 2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

# 2.3.1. Test Procedures for emission below 30 $\,{\rm Me}$

- 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 and perpendicular 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 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.

# 2.3.2. Test Procedures for emission from above 30 $\,{\rm M}_{\rm \! Z}$

- 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 below 1 GHz and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
- 3. The antenna is a bi-log antenna, a horn antenna and its height is 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.
- 4. 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.
- 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

#### Note;

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
- 2. For frequency above 1 GHz, set spectrum analyzer detector to peak, and resolution bandwidth is 1 MHz and video bandwidth is 3 MHz.
- 3. Definition of DUT Axis.
  - Definition of the test orthogonal plan for EUT was described in the test setup photo. The test orthogonal plan of EUT is X axis during radiation test.

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### 2.3.3. Test Procedures for Conducted Spurious Emissions

#### 2.3.3.1. Band-edge Compliance of RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. RBW ≥ 100 kHz VBW = 300 kHz Sweep = autoDetector function = peak Trace = max hold

#### 2.3.3.2. Spurious RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer. RBW = 1 Mb VBW = 3 ₩z Sweep = autoDetector function = peak Trace = max hold

#### 2.3.3.3. TDF function

- For plots showing conducted spurious emissions from 9 klz to 25 Glz, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function. So, the reading values shown in plots were final result.



# 2.4. Test Results

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

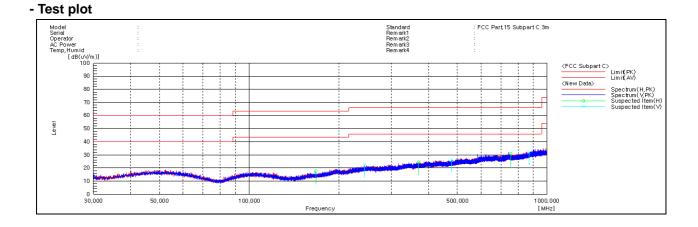
#### 2.4.1. Radiated Spurious Emission below 1 000 Mb

The frequency spectrum from 9 kt to 1 000 Mt was investigated. All reading values are peak values.

Radiated Emissions			Ant.	Correctio	n Factors	Total	Limit	
Frequency (Mb)	Reading (dBµV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
478.14	27.00	Peak	V	22.56	-23.09	26.47	46.00	19.53
754.51	26.90	Peak	Н	26.80	-22.23	31.47	46.00	14.53
869.66	26.60	Peak	V	27.69	-21.80	32.49	46.00	13.51
Above 900.00	Not detected	-	-	-	-	-	-	-

#### Remark;

- 1. Spurious emissions for all channels and modes were investigated and almost the same below 1 GHz.
- Reported spurious emissions are in EDR / 3DH5 / Low channel as worst case among other modes. 2.
- Radiated spurious emission measurement as below. 3. (Actual = Reading + AF + AMP + CL)
- 4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.



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### 2.4.2. Radiated Spurious Emission above 1 000 Mb

The frequency spectrum above 1 000 № was investigated. All reading values are peak values.

#### **Operating Mode: GFSK (1 Mbps)**

A. Low Channel (2 402 Mb)

Radia	Radiated Emissions			Corr	ection Fac	tors	Total Limit		it
Frequency (쌘)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
*2 310.00	25.55	Peak	V	28.54	10.56	-	64.65	74.00	9.35
*2 310.00	-	-	-	-	-	-24.76	39.89	54.00	14.11
*2 353.83	27.38	Peak	V	28.72	10.60	-	66.70	74.00	7.30
*2 353.83	-	-	-	-	-	-24.76	41.94	54.00	12.06
*2 390.00	25.53	Peak	V	28.94	10.65	-	65.12	74.00	8.88
*2 390.00	-	-	-	-	-	-24.76	40.36	54.00	13.64

Radiated Emissions		Ant.	Corr	Correction Factors			Limit		
Frequency (Mb)	Reading (dBµV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	<b>DF</b> (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (2 441 Mz)

Radiated Emissions			Ant.	Corr	ection Fact	ors	Total	Lim	it
Frequency (Mb)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dBµN/m)	Limit (dBµV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-



### C. High Channel (2 480 Mz)

Radia	Radiated Emissions			Corr	ection Fac	tors	Total	Total Limit	
Frequency (Mb)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
*2 483.50	25.33	Peak	V	29.17	10.74	-	65.24	74.00	8.76
*2 483.50	-	-	-	-	-	-24.76	40.48	54.00	13.52
*2 498.32	27.57	Peak	V	29.20	10.75	-	67.52	74.00	6.48
*2 498.32	-	-	-	-	-	-24.76	42.76	54.00	11.24
*2 500.00	25.98	Peak	V	29.20	10.75	-	65.93	74.00	8.07
*2 500.00	-	-	-	-	-	-24.76	41.17	54.00	12.83

Radiated Emissions		Ant.	Corr	ection Fact	ors	Total	Lim	it	
Frequency (Mb)	Reading (dBµV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	<b>DF</b> (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-



#### **Operating Mode: 8DPSK (3 Mbps)**

A. Low Channel (2 402 Mb)

Radia	Radiated Emissions			Corr	ection Fac	tors	Total	Total Limit	
Frequency (畑)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	<b>DF</b> (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
*2 310.00	25.31	Peak	V	28.54	10.56	-	64.41	74.00	9.59
*2 310.00	-	-	-	-	-	-24.76	39.65	54.00	14.35
*2 354.49	26.72	Peak	V	28.73	10.60	-	66.05	74.00	7.95
*2 354.49	-	-	-	-	-	-24.76	41.29	54.00	12.71
*2 390.00	25.32	Peak	V	28.94	10.65	-	64.91	74.00	9.09
*2 390.00	-	-	-	-	-	-24.76	40.15	54.00	13.85

Radiated Emissions		Ant.	Corr	Correction Factors		Total	Lim	it	
Frequency (Mb)	Reading (dBµV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	<b>DF</b> (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (2 441 Mtz)

Radiated Emissions		Ant.	Corr	ection Fact	ors	Total	Lim	it	
Frequency (Mb)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	<b>DF</b> (dB)	Actual (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-



A4(210 mm × 297 mm)

#### C. High Channel (2 480 Mb)

Radia	Ant.	Corr	ection Fac	tors	Total	Limit			
Frequency (Mb)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
*2 483.50	25.61	Peak	V	29.17	10.74	-	65.52	74.00	8.48
*2 483.50	-	-	-	-	-	-24.76	40.76	54.00	13.24
*2 488.66	27.63	Peak	V	29.18	10.75	-	67.56	74.00	6.44
*2 488.66	-	-	-	-	-	-24.76	42.80	54.00	11.20
*2 500.00	25.09	Peak	V	29.20	10.75	-	65.04	74.00	8.96
*2 500.00	-	-	-	-	-	-24.76	40.28	54.00	13.72

Radiated Emissions			Ant.	Corr	ection Fact	ors	Total	Limit	
Frequency (Mb)	Reading (dBµN)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	<b>DF</b> (dB)	Actual (dBµN/m)	Limit (dBµN/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

#### Remark;

- 1. "\*" means the restricted band.
- 2. Measuring frequencies from 1  $\mathbb{G}_{\mathbb{Z}}$  to the 10<sup>th</sup> harmonic of highest fundamental frequency.
- 3. Radiated emissions measured in frequency above 1 000 № were made with an instrument using peak/average detector mode.
- 4. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
- 5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.
- 6. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

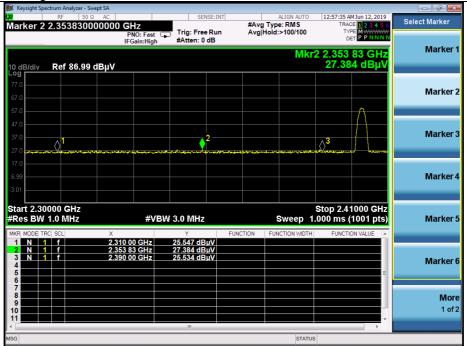
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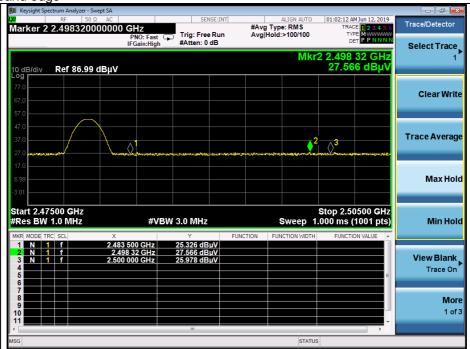
#### - Test plots

#### **Operating Mode: GFSK (1 Mbps)**

Low channel band edge



#### High channel band edge



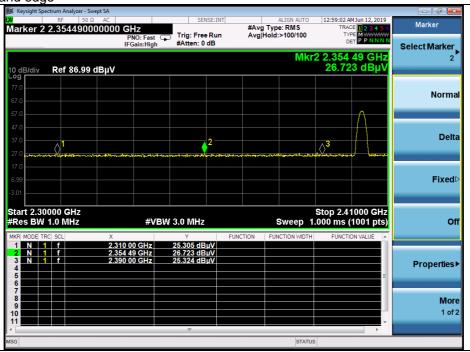
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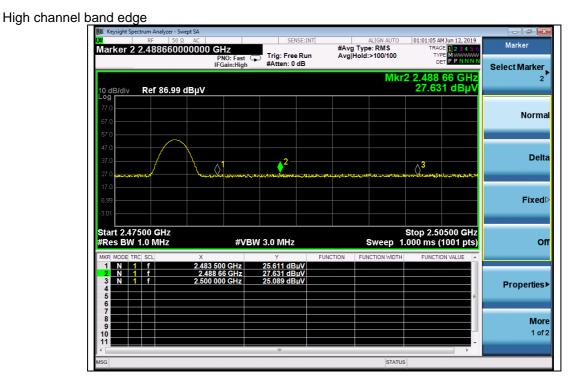
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 http://www.sgsgroup.kr A4(210 mm × 297 mm)



#### **Operating Mode: 8DPSK (3 Mbps)**

#### Low channel band edge





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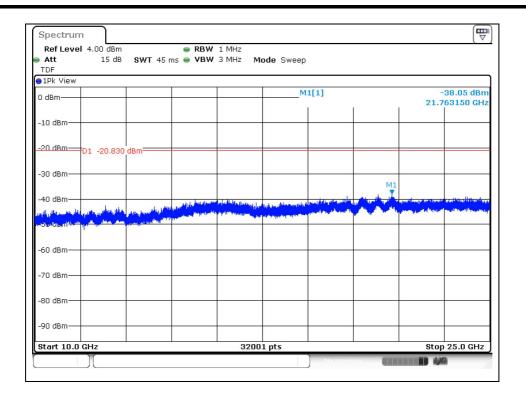
# 2.4.3. Spurious RF Conducted Emissions

#### **Operating Mode: GFSK (1 Mbps)**

Low channel

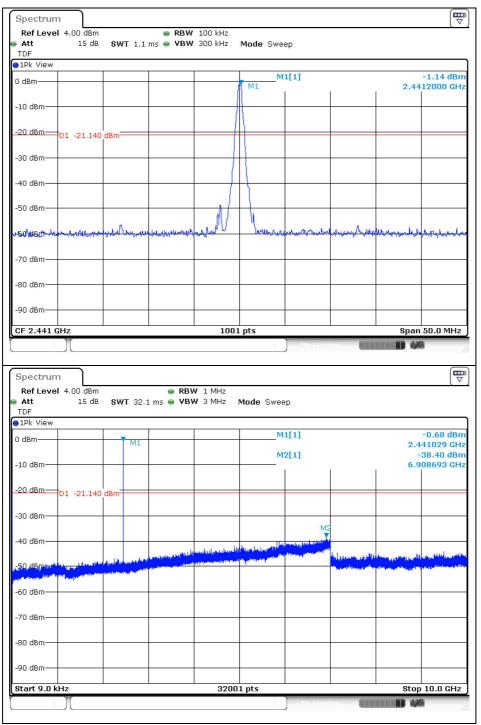
Ref Level 4.00 dem              e RBW 100 kHz             Mode Sweep             TDF             DF	Spectrur	m )									Ē
Topi         Topic         0.030 dbm           10 dbm         0.030 dbm         0.030 dbm         0.030 dbm           20 dbm         01 - 20.830 dbm         0.030 dbm         0.030 dbm         0.030 dbm           20 dbm         01 - 20.830 dbm         0.030 dbm         0.030 dbm         0.030 dbm         0.030 dbm           20 dbm         01 - 20.830 dbm         0.030	-	el 4.00 d									( *
19k View       -0.03 dBr       -0.03 dBr       2.40200 GH         10 dBm       M2[1]       2.392000 GH         20 dBm       01 -20.630 dBm       M2[1]       2.392000 GH         30 dBm       m31       2.392000 GH       2.392000 GH         30 dBm       m33       m42[1]       2.392000 GH         30 dBm       m33       m34       m42[1]       2.392000 GH         30 dBm       m33       m34       m44       m44       m44         30 dBm       m33       m44       m44       m44       m44       m44       m44         30 dBm       m44       m44 <t< td=""><td>Att TDF</td><td>15</td><td>dB SV</td><td>NT 1.1</td><td>ms 😑 V</td><td>'<b>BW</b> 300 kHz</td><td>Mode Swe</td><td>ер</td><td></td><td></td><td></td></t<>	Att TDF	15	dB SV	NT 1.1	ms 😑 V	' <b>BW</b> 300 kHz	Mode Swe	ер			
M1       22.402200 GH         20 dBm       M2[1]         20 dBm       2.3900000 GH         20 dBm       90 dBm         00 dBm       90 dBm         90 dBm       100 pts         Spectrum       80 dBm         Ref Level 5.00 dBm       90 dBm         90 dBm       91 dBm </td <td>1Pk View</td> <td></td>	1Pk View										
10 d8m       1 20.830 d8m       1 20.830 d8m       2.3900000 GH         20 d8m       1 20.830 d8m       1 20.830 d8m       1 20.830 d8m         30 d8m       1 20.830 d8m       1 20.830 d8m       1 20.830 d8m         30 d8m       1 20.830 d8m       1 20.830 d8m       1 20.830 d8m         30 d8m       1 20.830 d8m       1 20.830 d8m       1 20.830 d8m         30 d8m       1 20.830 d8m       1 20.830 d8m       1 20.830 d8m         30 d8m       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M2       1 2.930 d8m       51.39 d8m       1 2.930 d8m         M3       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M4       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M4       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M4       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M3       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M4       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M3       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M4       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m         M4       1 2.930 d8m       1 2.930 d8m       1 2.930 d8m	) dBm	-			<b>—</b>		M1 M	1[1]		2.40	-0.83 dBm
20 dBm 01 -20.830 dBm 64	10 dBm—						∭м	2[1]			-58.91 dBm
30 dBm       M2	20 dBm—	-01 -20	920 dBm						ļ	2.39	900000 GHz
00 dBm       M2		101 -20	.030 00								
50 dbm       M2         Fullem value       Fullem value         Fullem value       Function         M1       2.4022 GHz         1       2.4022 GHz         -0.63 dbm       Function Result         M3       1         1       2.4022 GHz         -50.91 dbm       Function Result         M4       1         2.4 GHz       -50.81 dbm         M3       1         1       2.4022 GHz         Spectrum       Ref Level 5.00 dbm         Ref Level 5.00 dbm       RBW 1 MHz         Att       15 dB         SWT 32.1 ms       RBW 1 MHz         M2       M2         0 dbm       M1         M2       M2         0 dbm       M1		T					T				T
50 dBm		1				INTER	11				
Construction       Construction       Construction       Construction       Construction         S00 dBm       Construction       Function       Function Result       Construction         S00 dBm       Construction       Function       Function Result       Construction         M1       1       2.4022 GHz       -0.63 dBm       Function Result       Construction         M2       1       2.399 GHz       -58.91 dBm       Construction       Function Result         M3       1       2.399 GHz       -58.91 dBm       Construction       Function Result         M3       1       2.399 GHz       -58.91 dBm       Construction       Function Result         M4       1       2.4022 GHz       -50.84 dBm       Construction       Construction         Spectrum       Construction       Construction       Construction       Construction       Construction         Ref Level       5.00 dBm       Construction       Construction       Construction       Construction       Construction         Ibk View       M1       M1[1]       Construction       Construction       Construction       Construction       Construction       Construction       Construction       Construction       Construction       Construction <t< td=""><td>50 dBm—</td><td>+</td><td></td><td></td><td></td><td>N</td><td>+ {</td><td></td><td></td><td></td><td></td></t<>	50 dBm—	+				N	+ {				
80 dBm       Image: start	Belidera +++	wood of the second	town of the second	And wall	Pack And	Works why V	)manhahad	<del>~~~~~</del> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	ogen and a strengt	- martin marchales	Asther row wether we
D0 dBm       Image: Constraint of the second s	70 dBm—	+									
F2.402 GHz       Spen 50.0 MHz         arker       Spen 50.0 MHz         Type Ref Trc X-value Y-value Function Function Result         M1       1       2.4022 GHz       -0.83 dBm       Function       Function Result         M2       1       2.399 GHz       -58.91 dBm       Function       Function Result         M3       1       2.399 GHz       -51.93 dBm       Model       Model       Model         M4       1       2.399 GHz       -51.93 dBm       Model       Model       Model         Spectrum       @       RBW 1 MHz       Mtl       Model       Model       Model       Model         Spectrum       @       RBW 1 MHz       Model       Multiple       Model	80 dBm—										
F2.402 GHz       Spen 50.0 MHz         arker       Spen 50.0 MHz         Type Ref Trc X-value Y-value Function Function Result         M1       1       2.4022 GHz       -0.83 dBm       Function       Function Result         M2       1       2.399 GHz       -58.91 dBm       Function       Function Result         M3       1       2.399 GHz       -51.93 dBm       Model       Model       Model         M4       1       2.399 GHz       -51.93 dBm       Model       Model       Model         Spectrum       @       RBW 1 MHz       Mtl       Model       Model       Model       Model         Spectrum       @       RBW 1 MHz       Model       Multiple       Model	90 dBm—										
Barker         Function         Function         Function Result           M1         1         2.4022 GHz         -0.83 dBm         Function         Function Result           M2         1         2.399 GHz         -58.91 dBm         Function         Function Result           M3         1         2.399 GHz         -51.39 dBm         Function         Function Result           M4         1         2.399 GHz         -51.39 dBm         Function         Function Result           Spectrum         Ref Level         5.00 dBm         Ref W1 MHz         Function         Function           Ref Level         5.00 dBm         RBW 1 MHz         Mtd         Function         Function           Spectrum         Ref View         Function         Function         Function         Function           Ib         M1         M12         M12         -0.62 dBn         -0.62 dBn           Ib         M2         M2[1]         -38.91 dBn         -38.91 dBn         -38.91 dBn           Ib         M2         M2[1]         -38.91 dBn         -38.91 dBn         -38.91 dBn           Ib         M2         M2[1]         -38.91 dBn         -39.91 dBn         -39.91 dBn         -39.91 dBn         -39.91 dBn		GHz					1 pts			Span	1 50.0 MHz
M1     1     2.4022 GHz     -0.83 dBm       M2     1     2.3998521 GHz     -55.39 dBm       M4     1     2.3998521 GHz     -51.39 dBm       M4     1     2.4 GHz     -50.84 dBm       Ref Level 5.00 dBm     Image: Constraint of the second of th	larker										
M2       1       2.39 GHz      58.91 dBm         M3       1       2.399821 GHz      51.39 dBm         M4       1       2.4 GHz      50.84 dBm         Spectrum       With and the second manual second m								tion	Fund	ction Result	t
M3       1       2.3998521 GHz       -51.39 dBm         M4       1       2.4 GHz       -50.84 dBm       Mile source         Spectrum       Ref Level 5.00 dBm       RBW 1 MHz       Mile         Att       15 dB       SWT 32.1 ms       VBW 3 MHz       Mode Sweep         DF       M1											
Mexanization         Mexanization           Spectrum              • RBW 1 MHz             • RBW 1 MHz             • Att 15 dB SWT 32.1 ms • VBW 3 MHz Mode Sweep             TOF               • O.62 dBn             • O.62 dBn            • O.62 d	MЗ	1	2	2.399852	21 GHz	-51.39 d	Bm				
Ref Level         S.00 dBm         RBW 1 MHz           Att         15 dB         SWT 32.1 ms         VBW 3 MHz         Mode Sweep           TDF         IPk View         M1         M1[1]         -0.62 dBm           dBm         M1         M1[1]         -0.62 dBm           10 dBm         M1         M2[1]         -38.91 dBm           10 dBm         M2[1]         -38.91 dBm         6.755573 GH           20 dBm         01 -20.830 dBm         M2         M2           30 dBm         M2         M2         M2           40 dBm         M2         M2         M2           50 dBm         M1 MI M Apply MI M Apply M1 M Apply	M4	1		2	.4 GHz	-50.84 d	8m				
MI         MI[1]         -0.62 dbm           dBm         M1         M1[1]         -0.62 dbm           10 dBm         M2[1]         -38.91 dbm         -38.91 dbm           20 dBm         D1 -20.830 dBm         M2         -40         -40           30 dBm         M2         M2         -40         -40         -40           30 dBm         M2         M2         -40	Spectrur	n )						-			
1Pk View       M1       M1[1]       -0.62 dBn         dBm       2.402279 GH       -38.91 dBn         10 dBm       M2[1]       -38.91 dBn         20 dBm       D1 -20.830 dBm       6.755573 GH         30 dBm       M2       M2         40 dBm       M2       M2         50 dBm       M2       M2         30 dBm       M2       M2         40 dBm       M2       M2         50 dBm       M2       M2         30 dBm       M2       M2         40 dBm       M2       M2         50 dBm	Ref Leve	el 5.00 d						-			
dBm     2.402279 GH       10 dBm     -38.91 dBm       20 dBm     01 -20.830 dBm       30 dBm     M2       40 dBm     M2       50 dBm		el 5.00 d					Mode Swee	p			
10 dBm     M2[1]     -38.91 dBm       20 dBm     01 -20.830 dBm     6.755573 GH       30 dBm     M2       40 dBm     M2       50 dBm     M2       6.755573 GH     M2       70 dBm     M2       30 dBm     M2       6.755573 GH     M2       6.755573 GH     M2       10 dBm	Ref Leve Att	el 5.00 d 15	idB SV	WT 32.1							
20. dBm     0120.830 dBm       30 dBm     M2       40 dBm     M2       40 dBm     M2       50 dBm     M2       50 dBm     M2       60 dBm     M2       50 dBm     M2 <td>Ref Leve Att TDF</td> <td>el 5.00 d 15</td> <td>idB SV</td> <td>WT 32.1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2.4</td> <td>(⊽ -0.62 dBm</td>	Ref Leve Att TDF	el 5.00 d 15	idB SV	WT 32.1						2.4	(⊽ -0.62 dBm
30 dBm     M2       40 dBm     M2       40 dBm     M2       50 dBm     M2 <t< td=""><td>Ref Leve Att TDF 1Pk View</td><td>el 5.00 d 15</td><td>idB SV</td><td>WT 32.1</td><td></td><td></td><td>M</td><td>1[1]</td><td></td><td></td><td>-0.62 dBm i02279 GHz -38.91 dBm</td></t<>	Ref Leve Att TDF 1Pk View	el 5.00 d 15	idB SV	WT 32.1			M	1[1]			-0.62 dBm i02279 GHz -38.91 dBm
30 dBm     M2       40 dBm     M2       40 dBm     M2       50 dBm     M2 <t< td=""><td>Ref Leve Att TDF 1Pk View</td><td>el 5.00 d 15</td><td>idB SV</td><td>WT 32.1</td><td></td><td></td><td>M</td><td>1[1]</td><td>1</td><td></td><td>-0.62 dBm i02279 GHz -38.91 dBm</td></t<>	Ref Leve Att TDF 1Pk View	el 5.00 d 15	idB SV	WT 32.1			M	1[1]	1		-0.62 dBm i02279 GHz -38.91 dBm
40 dBm M2 M2 M3 M4	Ref Leve Att TDF ) 1Pk View ) dBm		idB SV	MT 32.1			M	1[1]			-0.62 dBm i02279 GHz -38.91 dBm
40 dBm Hiteland Handler	Ref Leve Att TDF ) 1Pk View ) dBm		idB SV	MT 32.1			M	1[1]			-0.62 dBm i02279 GHz -38.91 dBm
50/dBm     4 <td< td=""><td>Ref Leve Att TDF 1Pk View</td><td></td><td>idB SV</td><td>MT 32.1</td><td></td><td></td><td>M</td><td>1[1] 2[1]</td><td></td><td></td><td>-0.62 dBm i02279 GHz -38.91 dBm</td></td<>	Ref Leve Att TDF 1Pk View		idB SV	MT 32.1			M	1[1] 2[1]			-0.62 dBm i02279 GHz -38.91 dBm
50 dBm	Ref Leve Att TDF 1Pk View 0 dBm 10 dBm 20 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
70 dBm	Ref Leve           Att           TDF           11Pk View           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
70 dBm	Ref Leve           Att           TDF           )1Pk View           ) dBm           10 dBm           20 dBm           30 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
30 dBm	Ref Leve           Att           TDF           11Pk View           10 dBm           10 dBm           30 dBm           40 dBm           50 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
20 dBm	Ref Leve           Att           TDF           11Pk View           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm 402279 GHz -38.91 dBm
20 dBm	Ref Leve           Att           TDF           11Pk View           10 dBm           10 dBm           30 dBm           40 dBm           50 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
tart 9.0 kHz 32001 pts Stop 10.0 GHz	Ref Leve           Att           TDF           11Pk View           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm           70 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm 402279 GHz -38.91 dBm
	Ref Leve           Att           TDF           11Pk View           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
Measuring	Ref Leve           Att           TDF           11Pk View           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm           70 dBm		idB SV	MT 32.1	1 ms •	VBW 3 MHz	M	1[1] 2[1] M2			-0.62 dBm i02279 GHz -38.91 dBm
	Ref Leve           Att           TDF           11Pk View           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm           70 dBm           80 dBm           90 dBm	D1 -20	idB SV	MT 32.1	1 ms •	VBW         3 MHz		1[1] 2[1] M2		- 6.7	-0.62 dBm t02279 GHz -38.91 dBm 555573 GHz



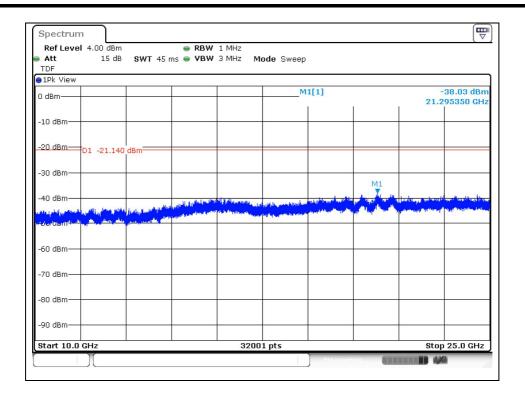




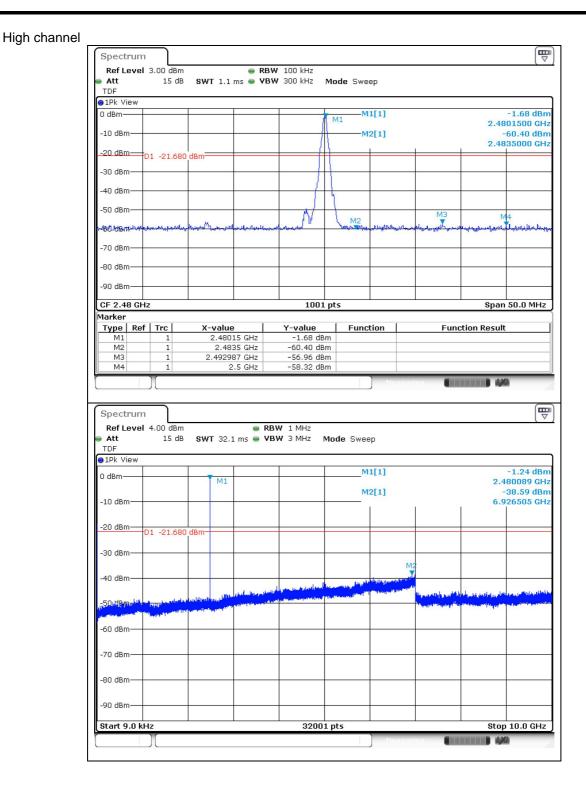
Middle channel



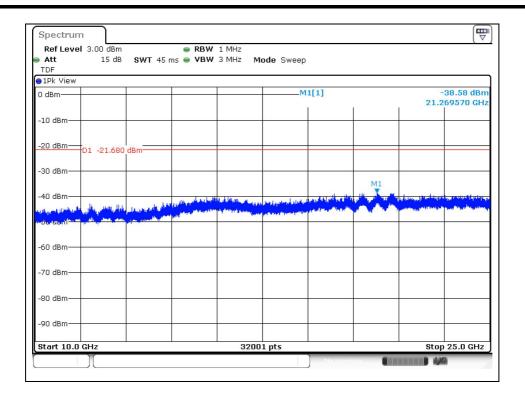








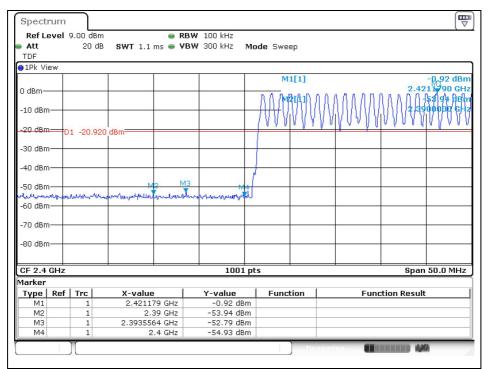




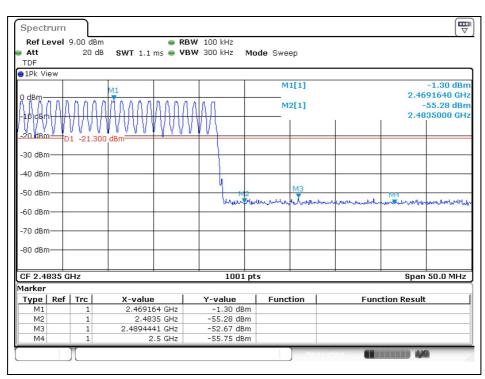


#### Band edge compliance with hopping enabled

#### Low channel



#### High channel



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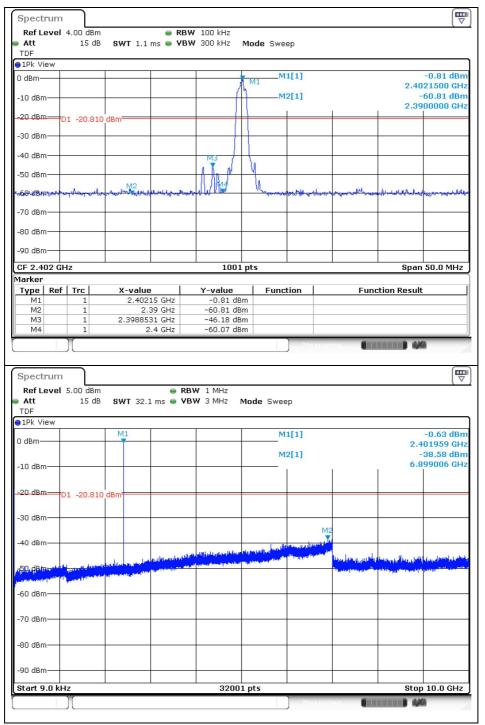
 SGS Korea Co., Ltd. (Gunpo Laboratory)
 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
 http://www.sgsgroup.kr

 RTT5041-19(2019.04.24)(1)
 Tel. +82 31 428 5700 / Fax. +82 31 427 2370
 A4(210 mm × 297 mm)

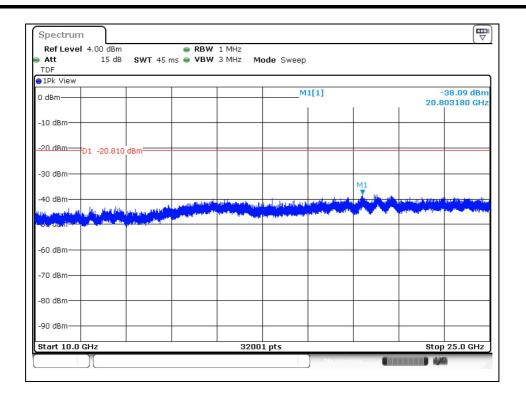


#### **Operating Mode: 8DPSK (3 Mbps)**

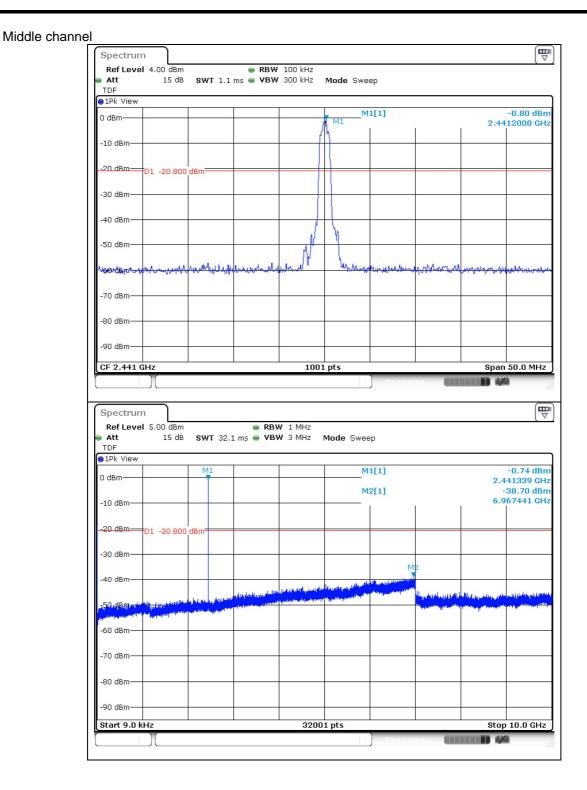
#### Low channel



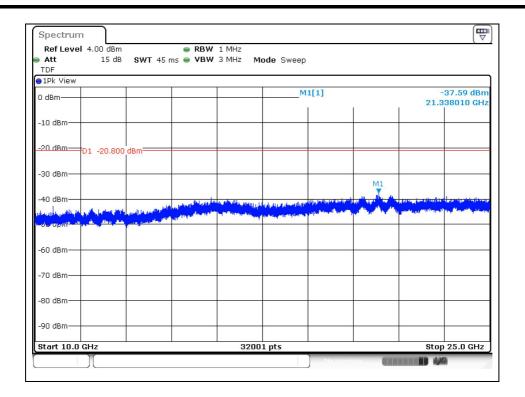




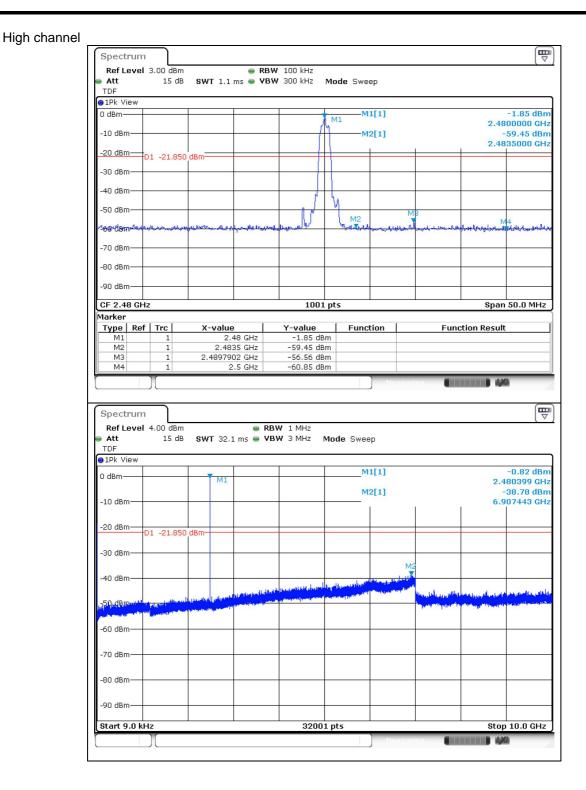




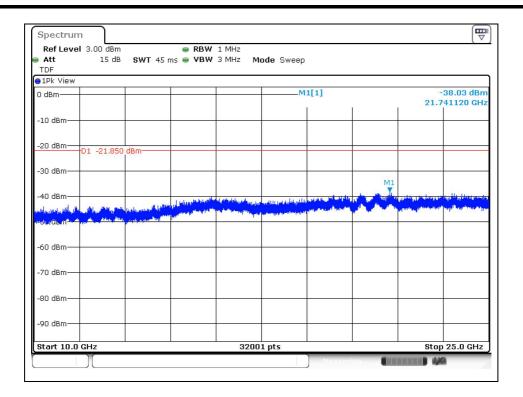








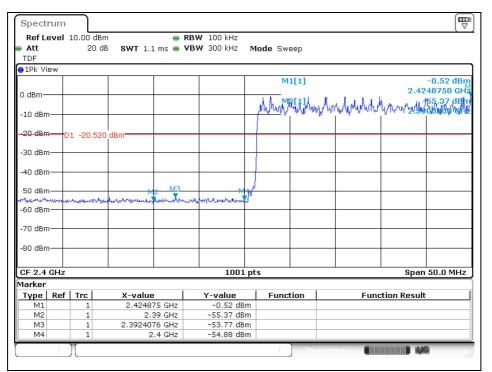






#### Band edge compliance with hopping enabled

#### Low channel



#### High channel

Spect	rum						( <del>\</del>
Ref Lo	evel	9.00 dBn	n 🖷 🗑 🗑	3W 100 kHz			
Att		20 di	3 SWT 1.1 ms 👄 VI	3W 300 kHz Mc	de Sweep		
TDF							
∋1Pk Vi	ew						
		M1			M1[1]		-0.95 dBi
0 dBm—							2.4671660 GH
in rollin	h ALAK	A Now	who have been to be the	Mussh	M2[1]		-55.53 dB
-to deh		1 9 4 4	in the day on a date of	1 TO		ī ī	2.4835000 GH
00.40							
-20 dBm	D	1 -20.95	i0 dBm				
-30 dBm							
SS GDI	.						
-40 dBm							
				he	Ma		
-50 dBm				1 M2		10	4
-60 dBm				www.	way was a second	when when a second	our our have the second
-00 4011	'						
-70 dBm	n——						
-80 dBm							
CF 2.4	335 G	Hz		1001 pt	s		Span 50.0 MH:
Marker							
Туре	Ref		X-value	Y-value	Function	Functio	n Result
M1		1	2.467166 GHz	-0.95 dBm			
M2		1	2.4835 GHz	-55.53 dBm			
M3 M4		1	2.4908926 GHz 2.5 GHz	-53.52 dBm -55.68 dBm			
1014	_		2.5 GHZ	33,00 UDIII			-
					Me	asuring	

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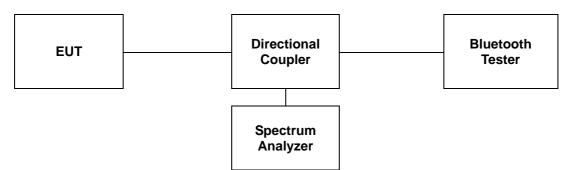
 SGS Korea Co., Ltd. (Gunpo Laboratory)
 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
 http://www.sgsgroup.kr

 RTT5041-19(2019.04.24)(1)
 Tel. +82 31 428 5700 / Fax. +82 31 427 2370
 A4(210 mm × 297 mm)



# 3. 20 dB Bandwidth and 99 % Bandwidth

## 3.1. Test Setup



## 3.2. Limit

Limit: Not Applicable

## 3.3. Test Procedure

### **3.3.1. 20** dB **Bandwidth**

The test follows ANSI C63.10-2013.

The 20 dB bandwidth was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.

Use the following spectrum analyzer setting:

- 1. Span = approximately 2 to 5 times the 20 dB bandwidth.
- 2. RBW  $\geq$  1 % to 5 % of the 20 dB bandwidth.
- 3. VBW ≥ 3 x RBW
- 4. Sweep = auto
- 5. Detector = peak
- 6. Trace = max hold

The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.



### 3.3.2. 99 % Bandwidth

• The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

• The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

• The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



## 3.4. Test Results

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

Operation Mode	Data Rate (Mbps)	Channel	Frequency (M৳)	20 dB Bandwidth (Mtz)	99 % Bandwidth (쌘)
GFSK	1	Low	2 402	1.043	0.908
		Middle	2 441	1.046	0.911
		High	2 480	1.049	0.914
π/4DQPSK	2	Low	2 402	1.286	1.151
		Middle	2 441	1.289	1.148
		High	2 480	1.286	1.151
8DPSK	3	Low	2 402	1.286	1.151
		Middle	2 441	1.289	1.151
		High	2 480	1.283	1.151

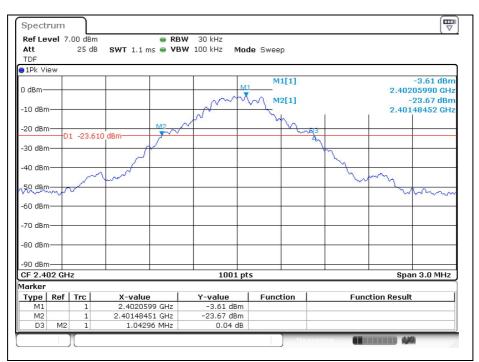


### - Test plots

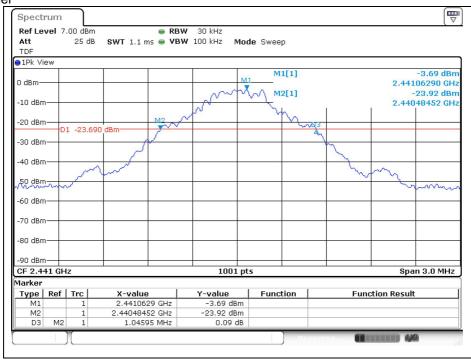
#### $20 \hspace{0.1 cm} \text{dB} \hspace{0.1 cm} \text{Bandwidth}$

#### **Operating Mode: GFSK**

Low Channel



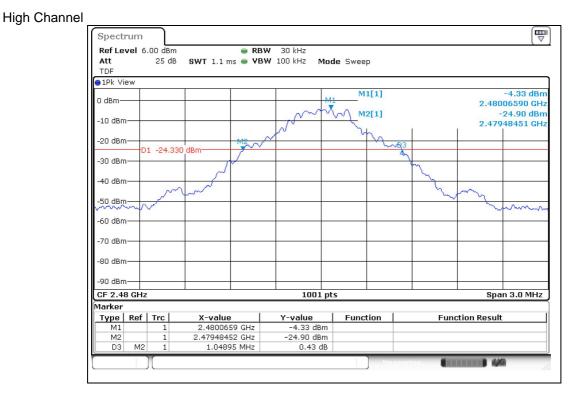
#### Middle Channel



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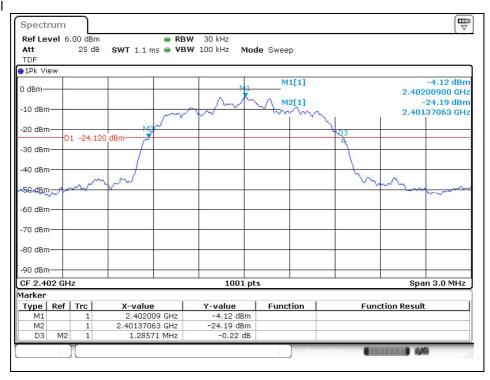
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### Operating Mode: π/4DQPSK

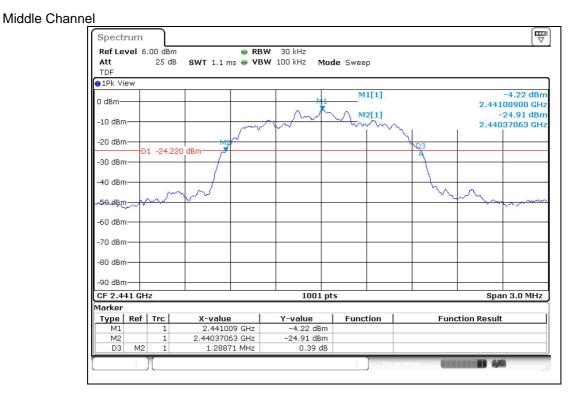
Low Channel



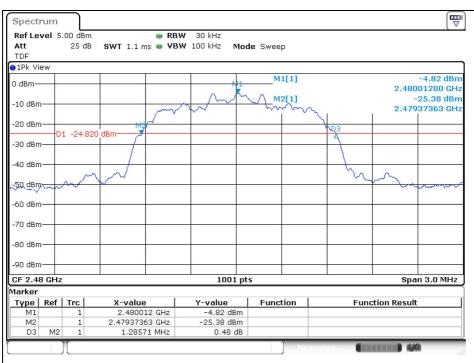
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### High Channel

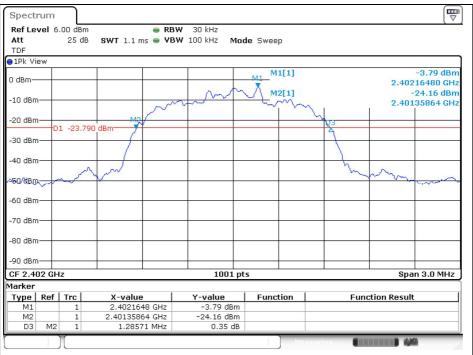


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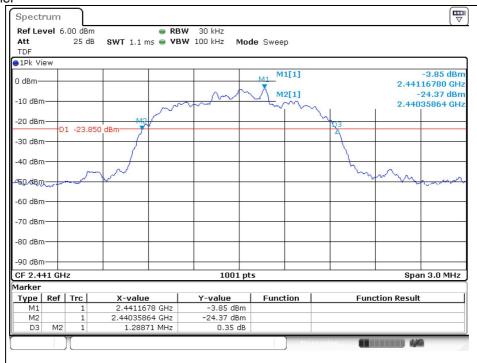


#### **Operating Mode: 8DPSK**

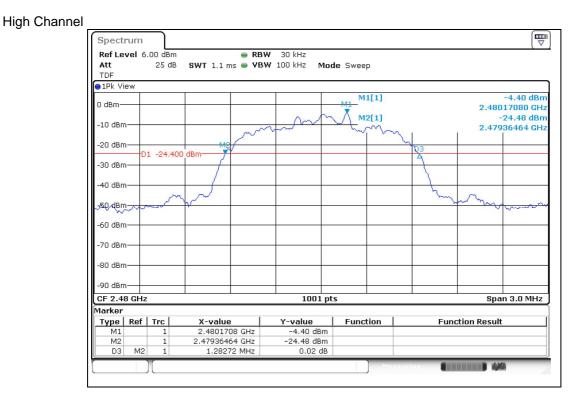
#### Low Channel



#### Middle Channel



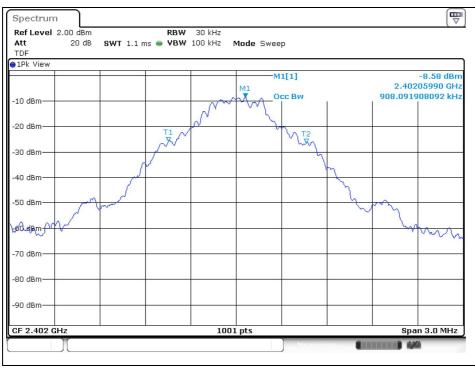




#### 99% Bandwidth

### **Operating Mode: GFSK**

Low Channel



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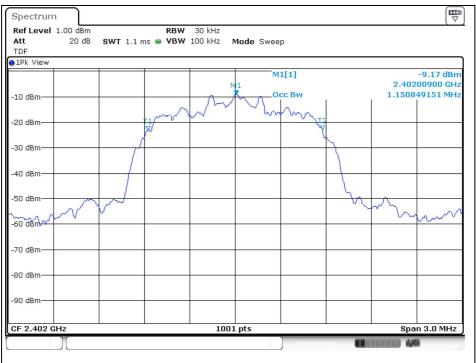


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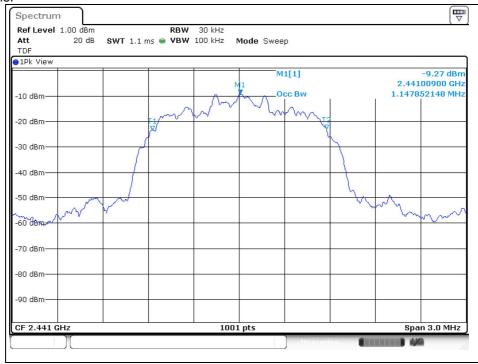


### Operating Mode: π/4DQPSK

#### Low Channel

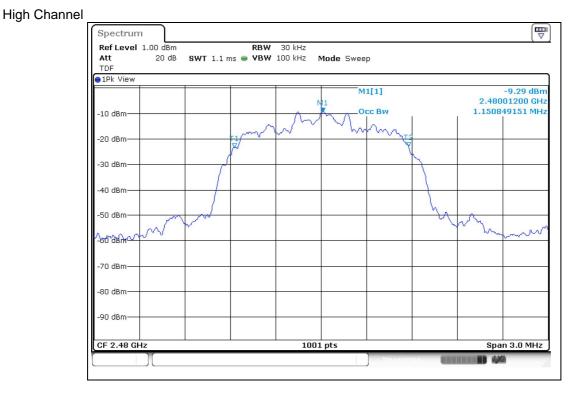


#### Middle Channel



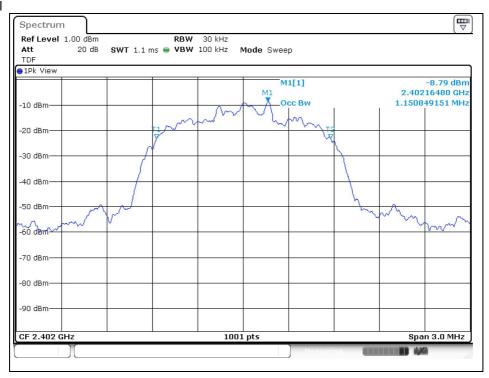
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### **Operating Mode: 8DPSK**

Low Channel



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