Test Report for FCC & IC

Report Number		ESTRGC2304-004(1)		
Applicant	Company name	ID Secure LLC		
	Address	10 Crooked Hill Oakland New Jersey United States 07436		
	Telephone	+82+031-607-7537		
Product	Product name	Portable Data Collection Terminal		
	Model No.	RP1600X	Manufacturer	Gen2wave
	Serial No.	NONE	Country of origin	KOREA
Test date	27-Mar-23 ~ 30-Mar-23		Date of issue	15-Jun-23
Testing location	140-16, Eongmalli-ro, Majang-myeon, Icheon-si, Gyeonggi-do, Rep. of Korea			
FCC ID	2BA25-RP1600X			
ISED ID	30760-RP1600X			
FCC Rule Part(s)	FCC PART 15 Subpart C (15.247), ANSI C 63.10(2013)			
ISED Rule Part(s)	RSS-247 (2017)			
Test result				Complied
Measurement facility registration number	FCC:659627			
Measurement facility registration number	ISE:4475A			
Tested by	Engineer H.G. Lee			(Signature)
Reviewed by	Engineering Manager I.K. Hong			(Signature)
Abbreviation	OK, Pass = Complied, Fail = Failed, N/A = not applicable			

* Note
- This test report is not permitted to copy partly without our permission
- This test result is dependent on only equipment to be used
- This test report is not related to KOLAS accreditation
- This product is tested in a single channel at the request of the company.
- This is the reissue report due to the change of the applicant

Contents

1. Laboratory Information

1.1 General

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

1.2 Test Lab.

Corporation Name : ESTECH Co., Ltd.

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

EMC/Telecom/Safety Test Lab : 140-16, Eongmalli-ro, Majang-myeon, Icheon-si, Gyeonggi-do, Rep. of Korea

1.3 Official Qualification(s)

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

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

FCC : Filed Laboratory at Federal Communications Commission

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

ISED : Accredited Lab By Canada Laboratory Accreditation

2. Description of EUT

2.1 Summary of Equipment Under Test (Bluetooth)
Product : Portable Data Collection Terminal
Model Number : RP1600X
Serial Number : NONE
Manufacturer : Gen2wave
Transfer Rate : BDR, EDR
Modulation Type : GFSK,8DPSK
Channel Spacing : 1 MHz
PEAK Output Power : GFSK : 2.31 mW 8DPSK : 2.13 mW
Power Rating : INPUT: AC(100 - 240) V, (50-60)Hz, 0.58 A
OUTPUT: DC 5 V, 4.0 A
Conducted power : 3.7 V Battery
Receipt Date : 2023-Mar-13
X-tal list(s) or Frequencies generated : The highest operating frequency is 2480 MHz(Bluetooth)
Blutooth : 2.4 GHz

2.2 General descriptions of EUT

General Characteristics	CPU / RAM / ROM	Hexa core CPU (Cortex A72 Dual-core 1.8GHz, Cortex A53 Quad core 1.4Ghz)
	RAM / ROM	4GB RAM / 32GB ROM
	OS	Android 11
	Dimensions	139mm/5.47inch(W) x 230mm/2.87inch(H) x 28(22)mm, 1.10/(0.86)inch : (D)(Minimum Thickness)
	Weight	320g/11.3oz with 4,000mA battery
	Buttons	5 front buttons / 5 side buttons
	Battery / Backup battery	Standard : 1860mAh Li-Ion / Extended : 4000mAh Li-Ion / NFC, IC Card Battery : 2860mAh Li-Ion Backup battery : 200mAh Li-Polymer
	Audio / LED / Sensor	Audio : Speaker, Receiver, Mic / LED : 1 charging status Sensor : Acceleration, Compass, Proximity, Ambient Light Sensor
	Display / Touch	4.3 Inch, WVGA(480x800) / Capacitive, multi touch, Gorilla glass 3
	Expansion Slot / SAM	Micro SDXC / 2 SAM Slot
	Communication	USB Host/Client : USB2.0 High Speed, External Serial RS232C, RJ45 Port (Use 1Slot/4Slot Cradle)
	Power	DC Jack 5V / 3.5A Adaptor

Integrated Radio	Wireless LAN	IEEE 802.11 a/b/g/n/ac (2.4, 5GHz)
	Bluetooth	Bluetooth 4.2 BLE
	GPS	AGPS
DATA CAPTURE	Camera	Rear Camera : 13MP Auto Focus / 1 LED Flash
	RFID	NXP PN548 / HF 13.56Mhz / 14443A/B, 15693
	Contact Smart Card	Contact type Smart Card Reader : ISO7816 compliant
	Dual Iris Scanner	Camera : 5MP B&W CMOS sensor Operating Range : 320±40mm (11"~14") Resolution : Above 160 pixel/cm Iris Capture Volume : 130mm x 45mm x 80mm Illumination : IR LED Image : 2592 x 920 x 30 Frame
User Environment	Operating Temp	-20°C ~ 60°C (-4°F ~ 140°F)
	Storage Temp	-30°C ~ 70°C (-22°F ~ 158°F)
	Humidity	Non-condensing, 93%
	Drop	1.5m (5ft.)
Supported Software	Development Tools	Android Studio, Eclipse
	Development SDK	With Java SDK : Fingerprint, Smart card, Iris, Camera

Driver Version: 20.70.0.2
Hard ware Version: V1.1

3. Test Standards

Test Standard : FCC PART 15 Subpart C (15.247)
This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

Test Standard : RSS-247
RSS-Gen must be used in conjunction with other RSSs, as applicable to the specific type of radio apparatus, for assessing its compliance with ISED requirements.

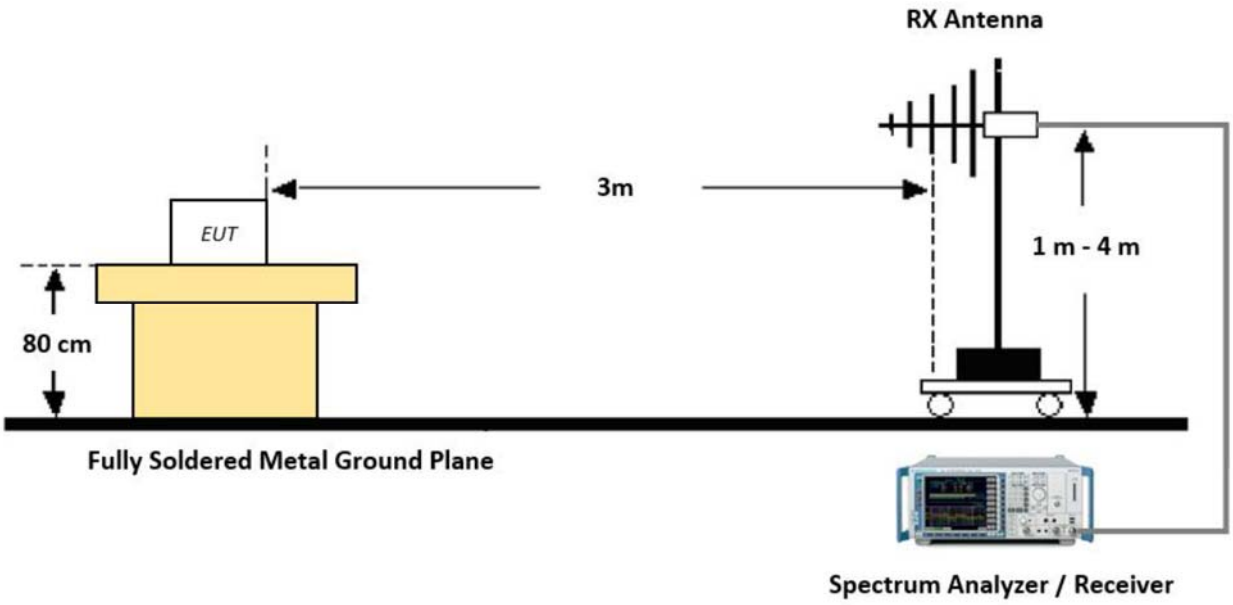
Test Method : ANSI C 63.10 (2013)
This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain decides that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment These method apply to the measurement of individual units or systems comprised of multiple units

BT Basic Data Rate / Enhanced Data Rate

Test Description	FCC Part Section(s)	ISED Part Section(s)	Test Result
Number of hopping channels	15.247 (a) (1) (iii)	RSS-247 Clause 5.1 (d)	Pass
20dB Bandwidth and Carrier frequency separation	15.247 (a) (1)	RSS-247 Clause 5.1 (a) and (b)	Pass
Time of Occupancy (Dwell Time)	15.247 (a) (1) (iii)	RSS-247 Clause 5.1 (d)	Pass
Maximum Peak Output Power and antenna gain	15.247 (b) (1)	RSS-247 Clause 5.4 (b)	Pass
Out-of-band Emissions (conducted)	15.247 (d)	RSS-247 Clause 5.5	Pass
Out-of-band Emissions (radiated)	15.247 (d) 15.209	RSS-247 Clause 5.5 RSS GEN Clause 8.9	Pass
AC Power Conducted Emissions	15.207	RSS-GEN	Pass

Notes:
1). No tests were applied because the fundamental level did not exceed the spurious limit per part 15.209.

30 MHz - 1 GHz



Test Procedure of Radiated spurious emissions (Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting

(1) Measurement Type (Peak):

- Measured Frequency Range: 30 MHz – 1 GHz
- Detector = Peak
- Trace = Max hold
- RBW = 100 kHz
- VBW ≥ 3*RBW

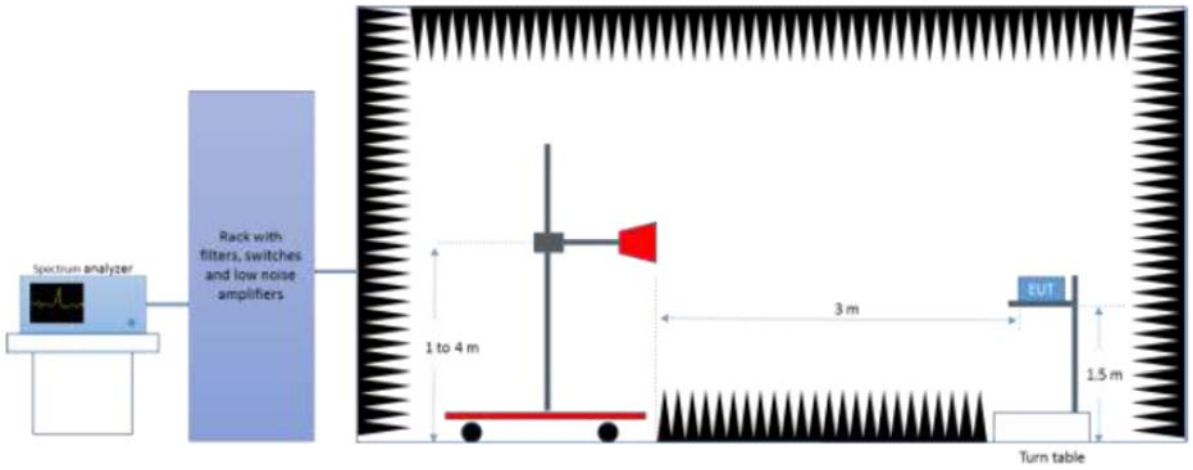
(2) Measurement Type(Quasi-peak):

- Measured Frequency Range: 30 MHz – 1 GHz
- Detector = Quasi-Peak
- RBW = 120 kHz

In general, the method (1) is mainly used

6. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)

1 GHz – 26.5 GHz



Test Procedure of Radiated spurious emissions (Above 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting

(1) Measurement Type (Peak):

- Measured Frequency Range: 1 GHz – 26.5 GHz
- Detector = Peak
- Trace = Max hold
- RBW = 1 MHz
- VBW ≥ 3*RBW

(2) Measurement Type(Average):

- Measured Frequency Range: 1 GHz – 26.5 GHz
- Detector = average or rms
- RBW = 1 MHz

In general, the method (1) is mainly used

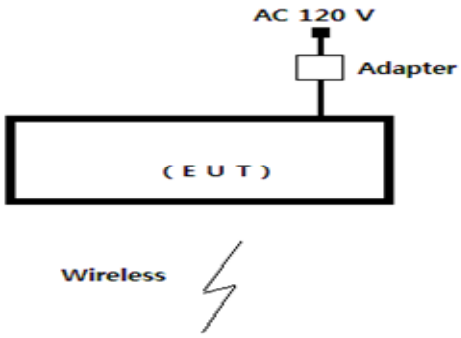
6. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)

4. Measurement Condition

4.1 EUT Operation.

* The EUT was in the following operation mode during all testing
* The operational conditions of the EUT was determined by the manufacturer according to emission
* Execute a RF test program to enable EUT under transmission/receiving condition continuously at specific channel frequency.
* Transmit mode was each test. Each channel (low, middle, high), also set the test after
* The EUT was measured up to tenth harmonic or 40 GHz of the highest operating frequencies.

4.2 Configuration and Peripherals



4.3 EUT and Support equipment

Equipment Name	Model Name	S/N	Manufacturer	Remark
Portable Data Collection Terminal	RP1600X	NONE	Gen2wave Co., Ltd.	EUT
Rugged Biometric Device	EID10 ALPHA	NONE	Gen2wave Co., Ltd.	
Cradle	RP1000 CRADLE	NONE	Gen2wave Co., Ltd.	
Adapter	ATS024T-A050	NONE	Adapter Technology Co.,Ltd.	

4.4 EUT Operation

a. Channel

Ch.	Frequency	Ch.	Frequency
0	2402 MHz	40	2442 MHz
1	2403 MHz	41	2443 MHz
2	2404 MHz	42	2444 MHz
3	2405 MHz	43	2445 MHz
4	2406 MHz	...	...
...	...	78	2480 MHz
38	2440 MHz		

b. Measurement Channel : Low (2402 MHz), Middle (2440 MHz), High (2480 MHz)
c. Test Mode : GFSK (worst case), 8-DPSK,
d. Test rate : 1 Mbps, 3 Mbps

4.5 Conducted Setup (Conducted Setup)

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E440A	US42041291	28-Nov-23
Spectrum Analyzer	FSV40	100939	28-Nov-23
RF Cable	Length: 30 cm	-	
-Spectrum Analyzer <=> EUT	Loss: 1 dB	-	

4.6 Measurement equipments(Radiated setup)

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESCI7	ROHDE & SCHWARZ	100916	29-Jun-23
Logbicon Antenna	VULB 9168	SCHWARZBECK	193	9-Dec-23
Turn Table	DT3000-2t	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
PREAMPLIFIER	8449B	HP	3008A00581	29-Jun-23
Horn Antenna	LB-42-15-C-SF	A-INFOMF	J2020079000055	11-Nov-23
Horn Antenna	BBHA9120D	SCHWARZBECK	469	08-Nov-23
TEST Receiver	ESU	ROHDE & SCHWARZ	100529	29-Jun-23
Turn Table	DT1500-S	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
Antenna Master & Turn table controller	CO2000-P	Innco System GmbH	CO2000/642 /28051111/L	-

4.7 Conducted Spurious Emission on AC Power lines Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESHS 30	Rohde & Schwarz	828765/002	29-Jun-23
LISN	ESH2-Z5	Rohde & Schwarz	836679/025	29-Jun-23
Pulse Limiter	ESH3-Z2	Rohde & Schwarz	NONE	29-Jun-23

5. 20dB Bandwidth and carrier frequency separation

5.1 Test Limits

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

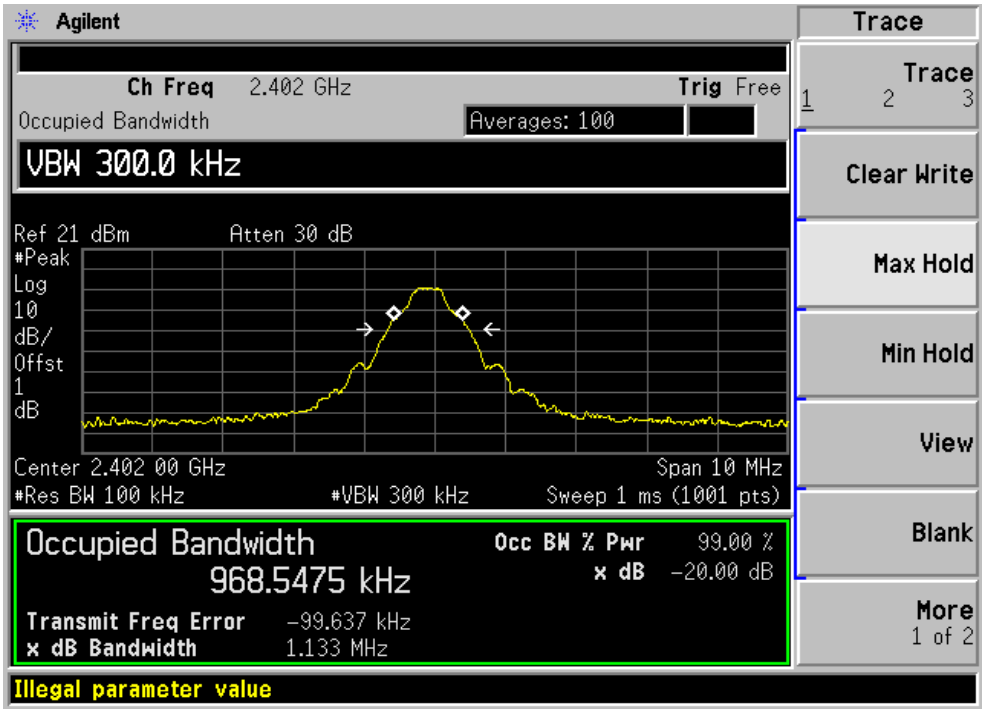
Fcc Part: 15.247(a) (1), RSS Part: RSS-247 Clause 5.1 (a) and (b)

5.2 Test results

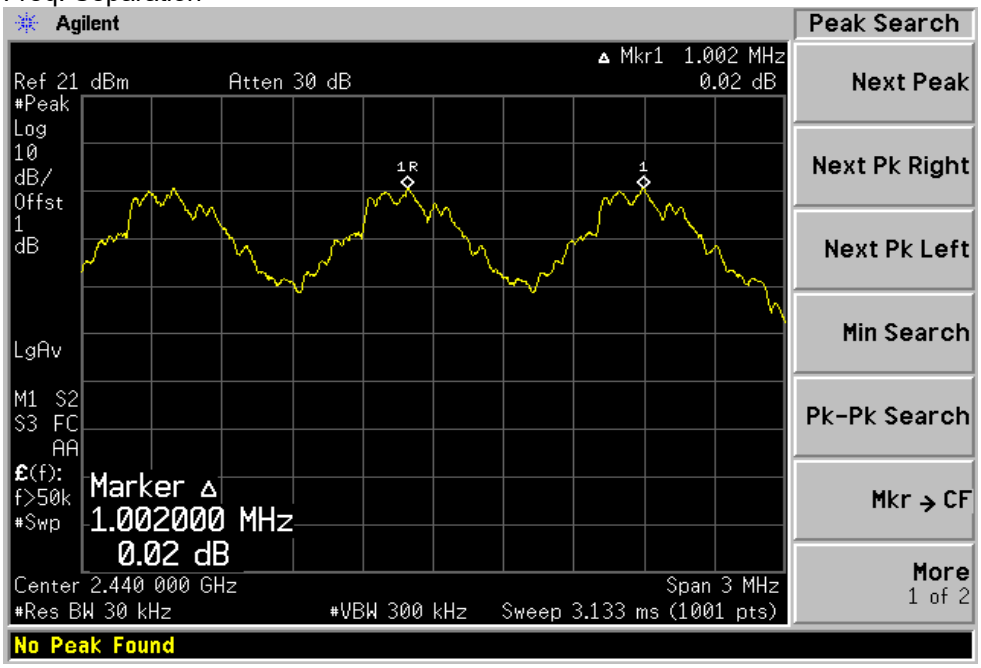
MODE	Packet Type	Channel Number	Frequency [MHz]	20dB BW [MHz]	Freq. Separation [kHz]
BDR (GFSK)	DH5	0	2 402	0.968	1000
		38	2 440	0.975	
		78	2 480	0.978	
EDR (8-DPSK)	3DH5	0	2 402	1.211	1000
		38	2 440	1.261	
		78	2 480	1.214	

5.3 Test Plots

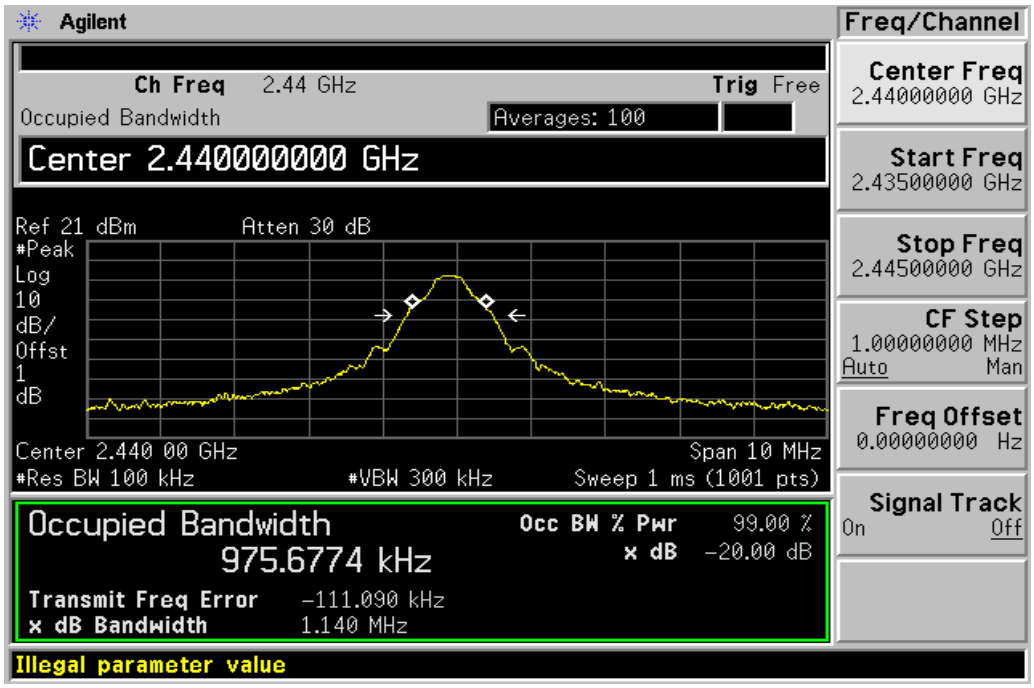
20 dB Bandwidth GFSK CH0



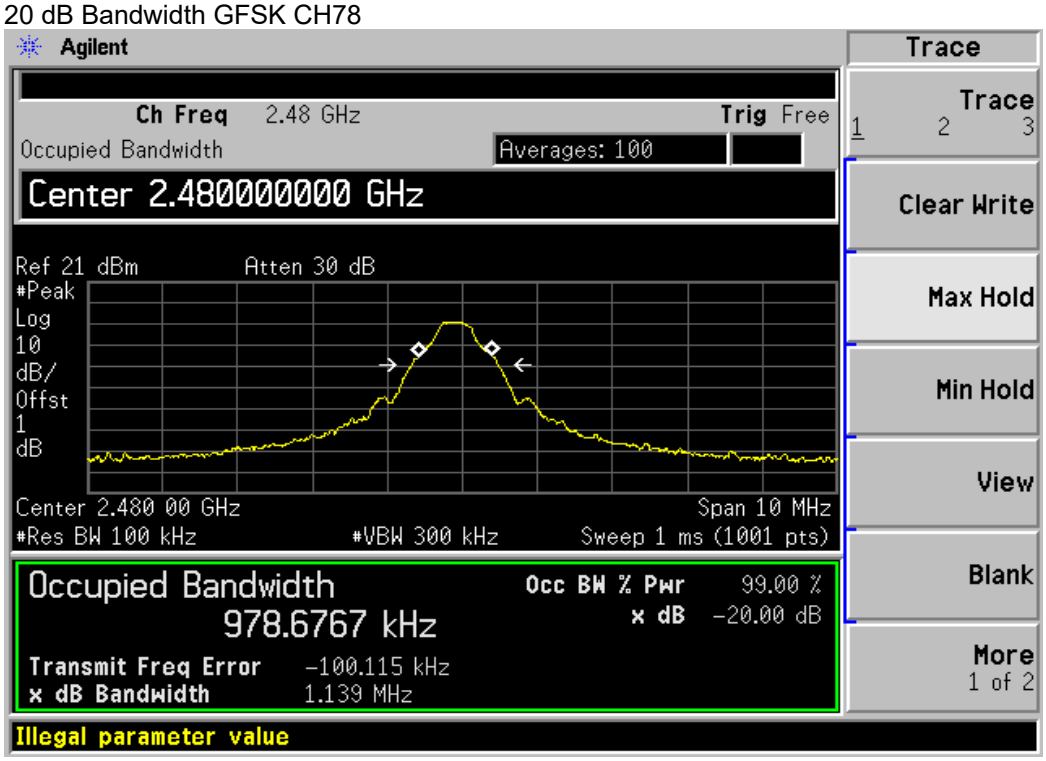
Freq. Separation



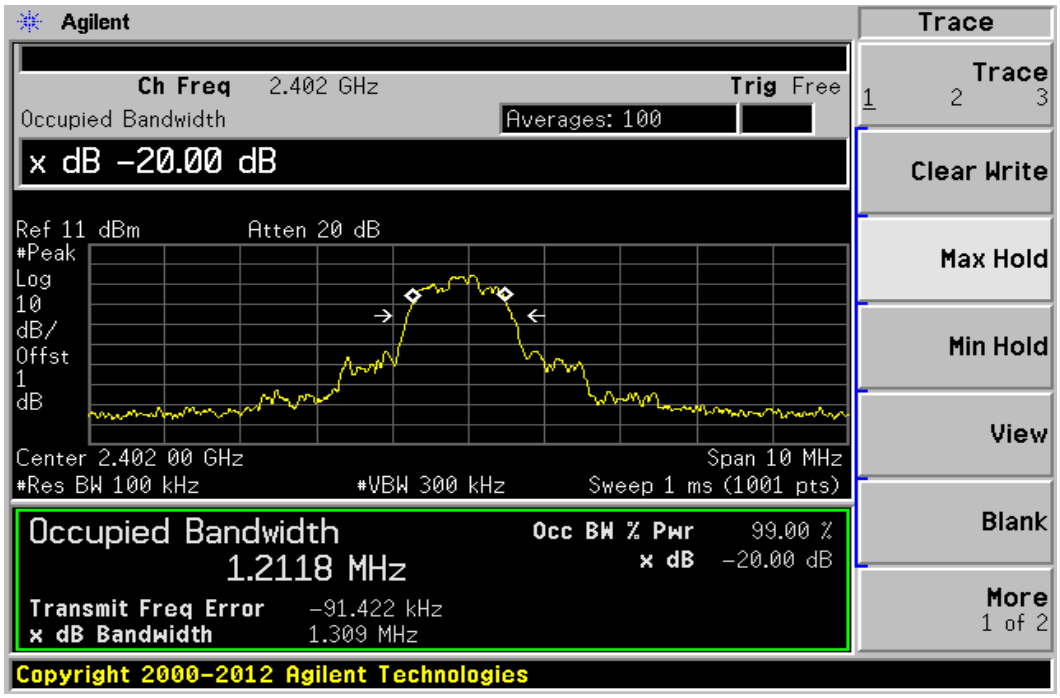
20 dB Bandwidth GFSK CH38



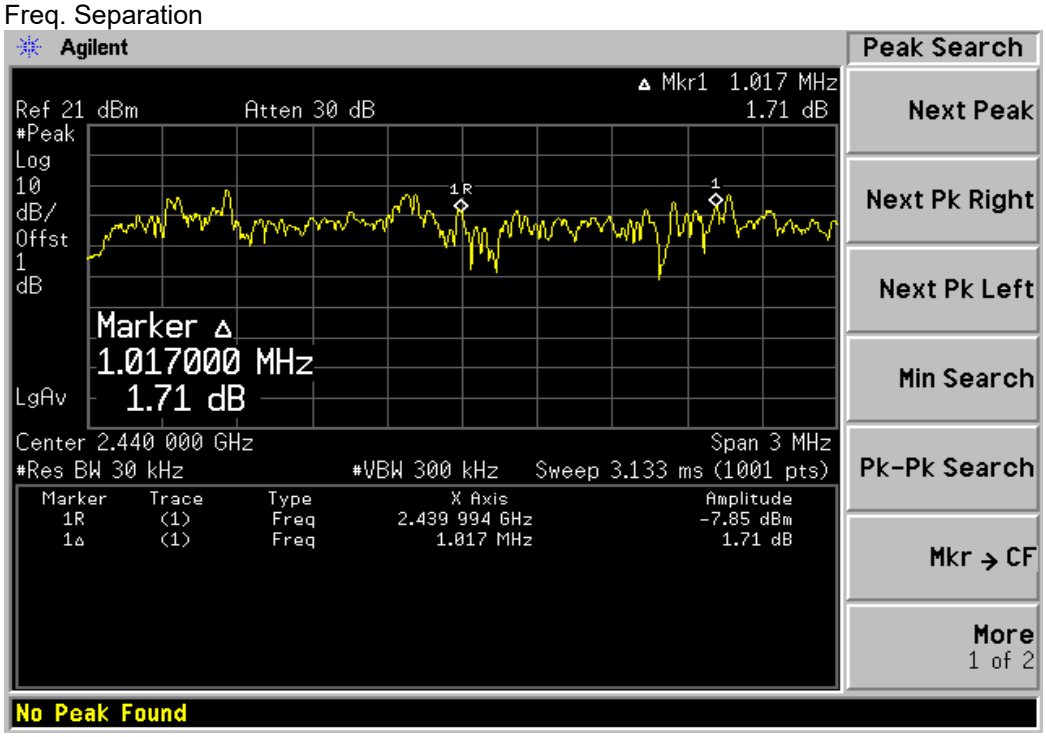
20 dB Bandwidth GFSK CH78



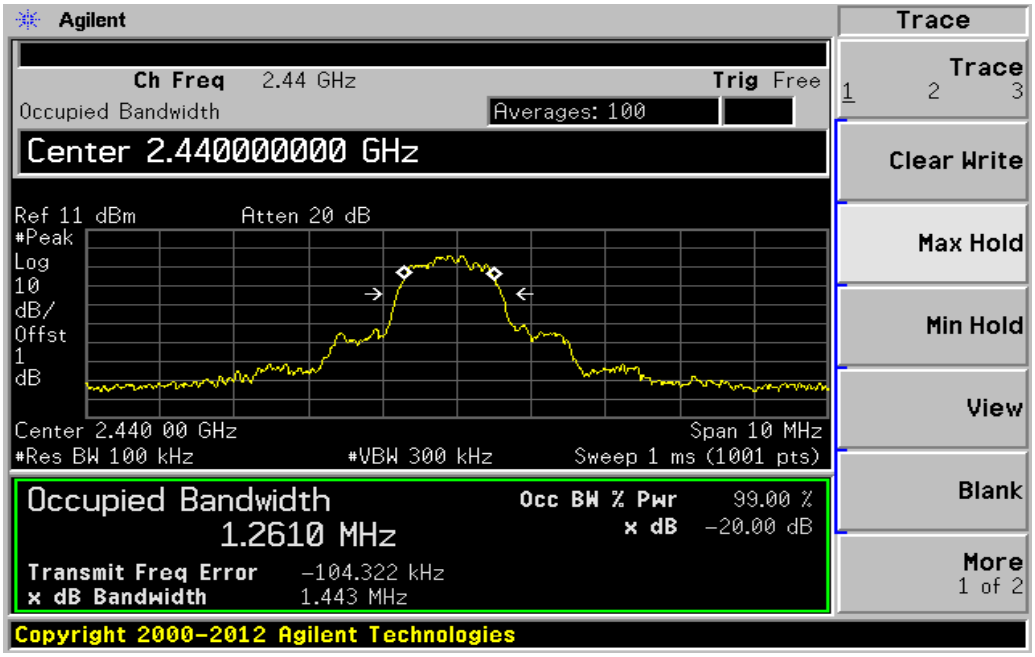
20 dB Bandwidth 8-DPSK CH0



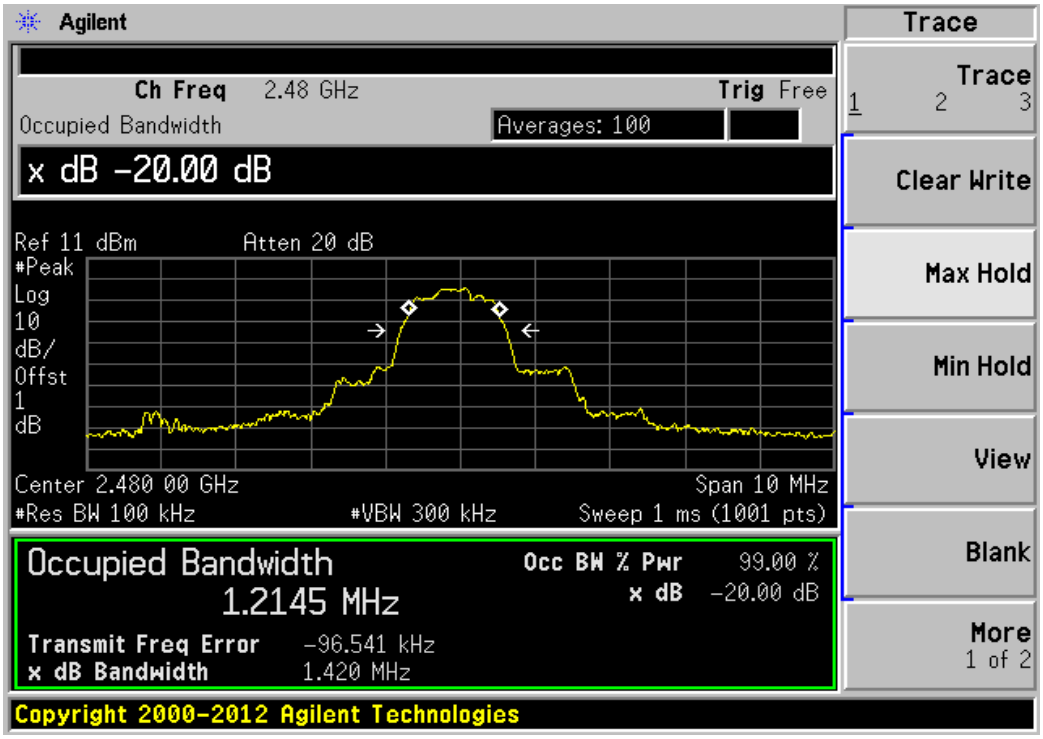
Freq. Separation



20 dB Bandwidth 8DPSK CH38



20 dB Bandwidth 8DPSK CH78



6. Number of hopping channels

6.1 Test Limits

According to §15.247(a)(1)(ii), & RSS-247 Frequency hopping systems operating in the 2 400 MHz - 2 483.5 MHz bands shall use at least 15 hopping frequencies.

Fcc Part: 15.247(a) (1) (iii), RSS Part: RSS-247 Clause 5.1 (d)

6.2 Test procedure

The setup below was used to measure the number of hopping channels. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

6.3 Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 100 KHz

. VBW= 100 KHz

. Span= the frequency band of operation

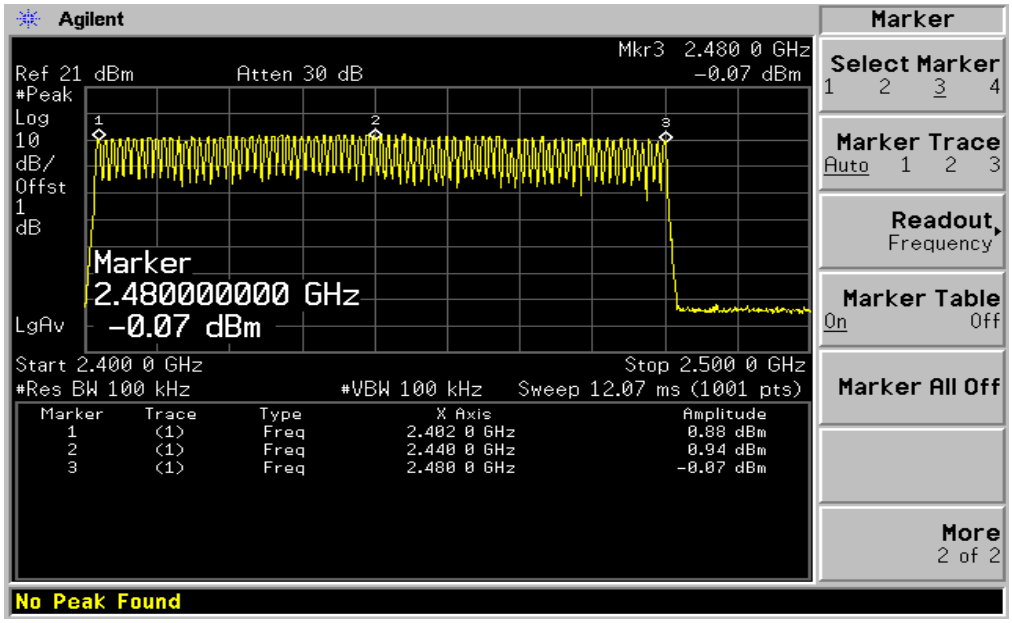
. Sweep= suitable duration based on the EUT specification.

6.4 Measurement results

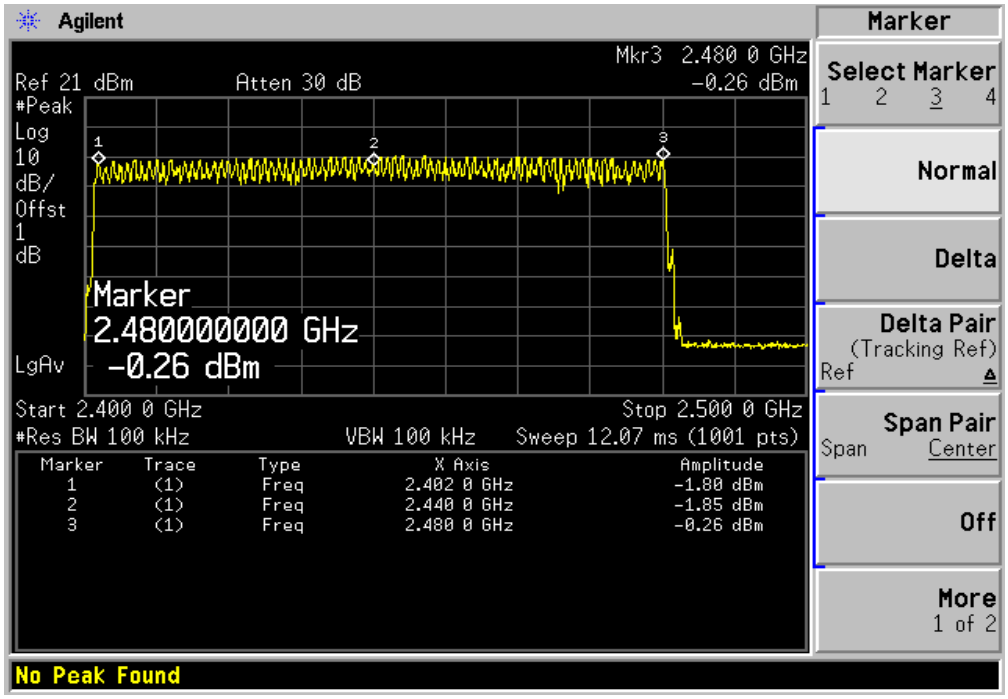
Mode	Packet Type	Number of hopping channels	Limit
BDR (GFSK)	DH5	79	<15
EDR (8-DPSK)	3DH5	79	<15

6.4 Test plots

BDR(GFSK)



EDR(8-DPSK)



7. Time of Occupancy (Dwell Time)

7.1 Test Limits
The average time of occupancy (Dwell Time) on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Fcc Part: 15.247(a) (1) (iii), RSS Part: RSS-247 Clause 5.1 (d)

7.2 Test procedure
The setup below was used to measure the dwell time. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

In the worst case, the system makes 1600 hops per second with 79 channels, providing a 1 timeslot length of 625μs. A DH1 packet, with independence of the modulation, needs 1 time slot for transmitting and 1 time slot for receiving.Then, the system makes in the worst case 1600/2 = 800 hops per second with 79 channels. So each channel appears 800/79 = 10.13 times per second and, for a period of 0.4 x 79 = 31.6 seconds, each channel appears 10.13 x 31.6 =320.11 times.

A DH3 packet, with independence of the modulation, needs 3 time slots for transmitting and 1 time slot for receiving.Then, the system makes in the worst case 1600/4 = 400 hops per second with 79 channels. So each channel appears 400/79 = 5.1 times per second and, for a period of 0.4 x 79 = 31.6 seconds, each channel appears 5.1 x 31.6 = 161.16 times.

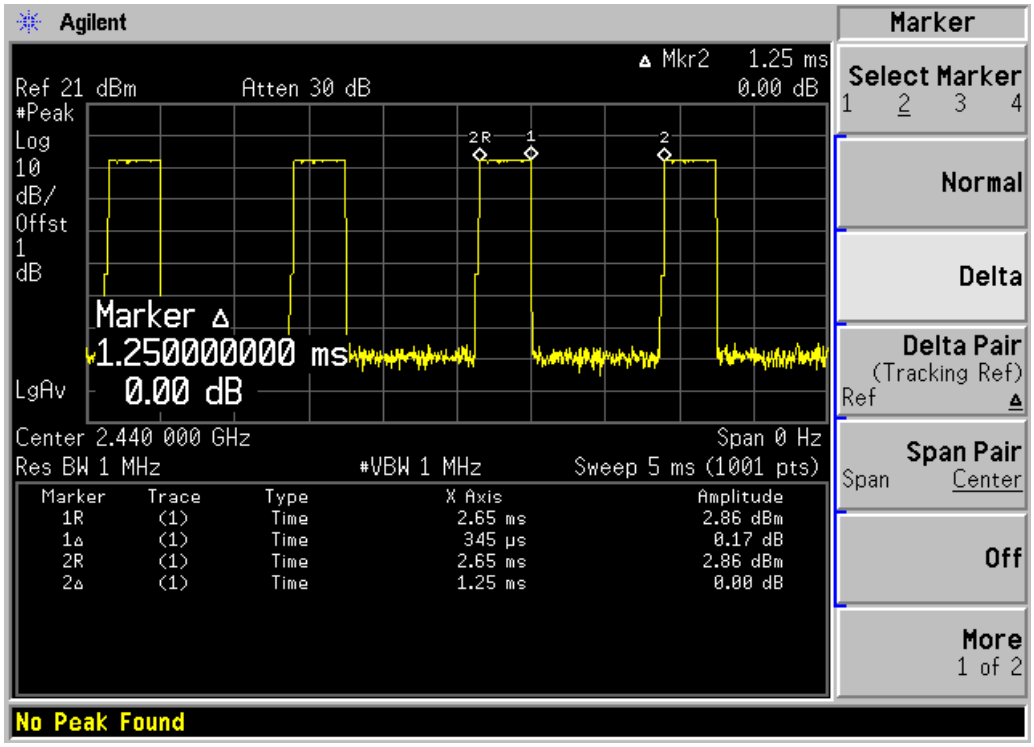
A DH5 packet, with independence of the modulation, needs 5 time slots for transmitting and 1 time slot for receiving.Then, the system makes in the worst case 1600/6 = 266.67 hops per second with 79 channels. So each channel appears 166.67/79 = 3.37 times per second and, for a period of 0.4 x 79 = 31.6 seconds, each channel appears 3.37 x 31.6 =106.49 times.

Thus, the total time of occupancy is obtained by multiplying the calculated maximum number of appearances per packet type and the measured Tx-time, as shown in the results screenshots.

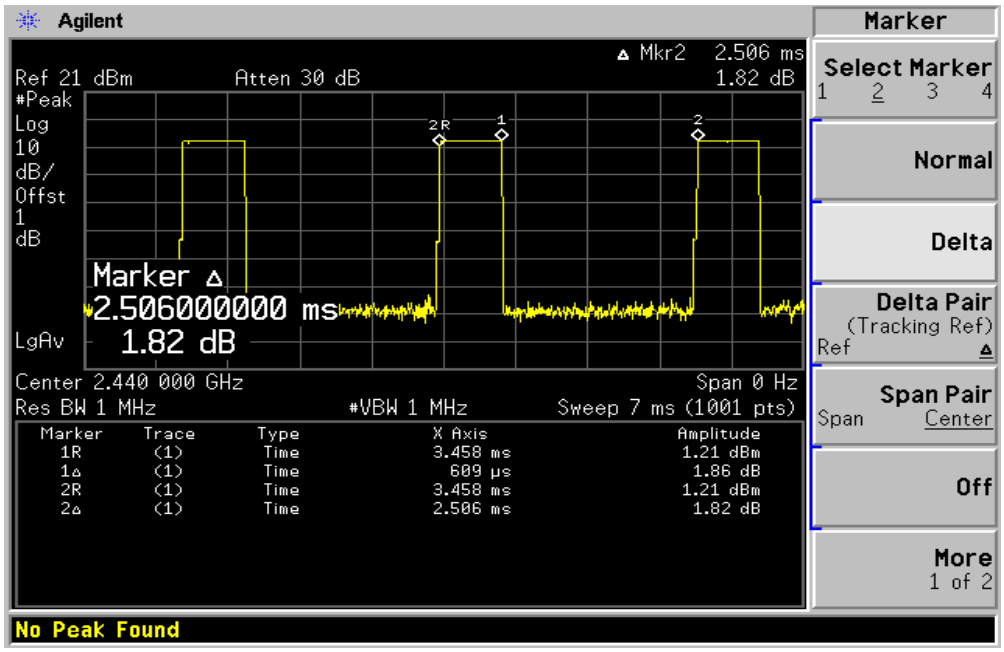
7.3 Results tables

Mode	Packet Type	Times of appearance	Tx-time [ms]	Dwell Time [ms]
BDR GFSK	DH1	320.11	0.345	110.43
	DH3	161.16	0.609	97.02
	DH5	106.49	0.602	64.85
EDR 8-DPSK	3DH1	320.11	0.440	140.84
	3DH3	161.16	0.595	95.89
	3DH5	106.49	0.609	64.85

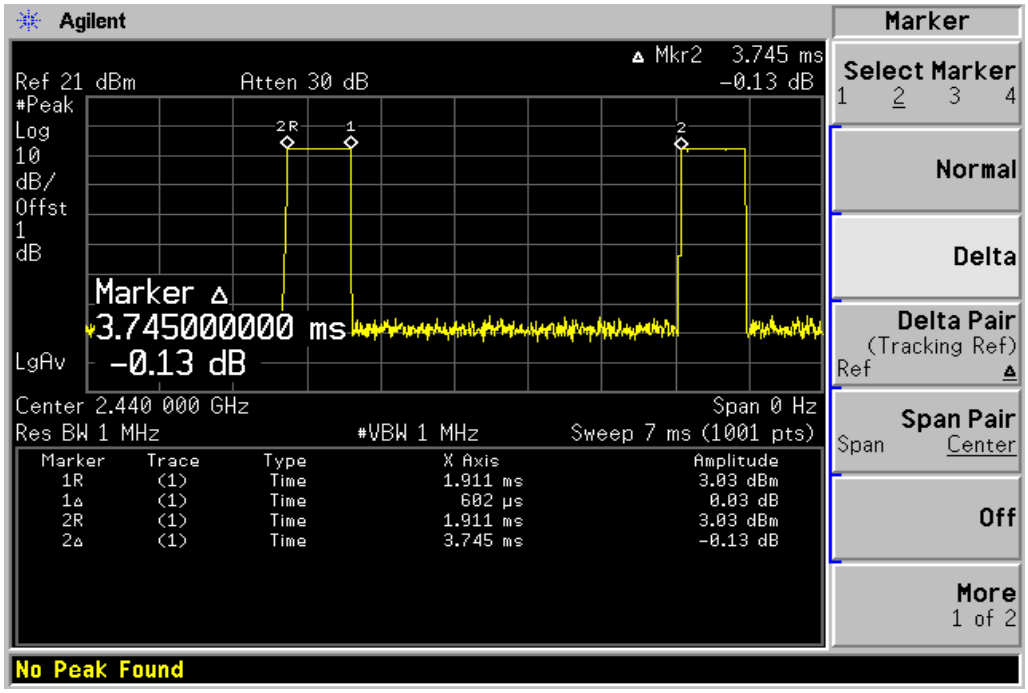
BDR (GFSK) DH1 TX-Time plot



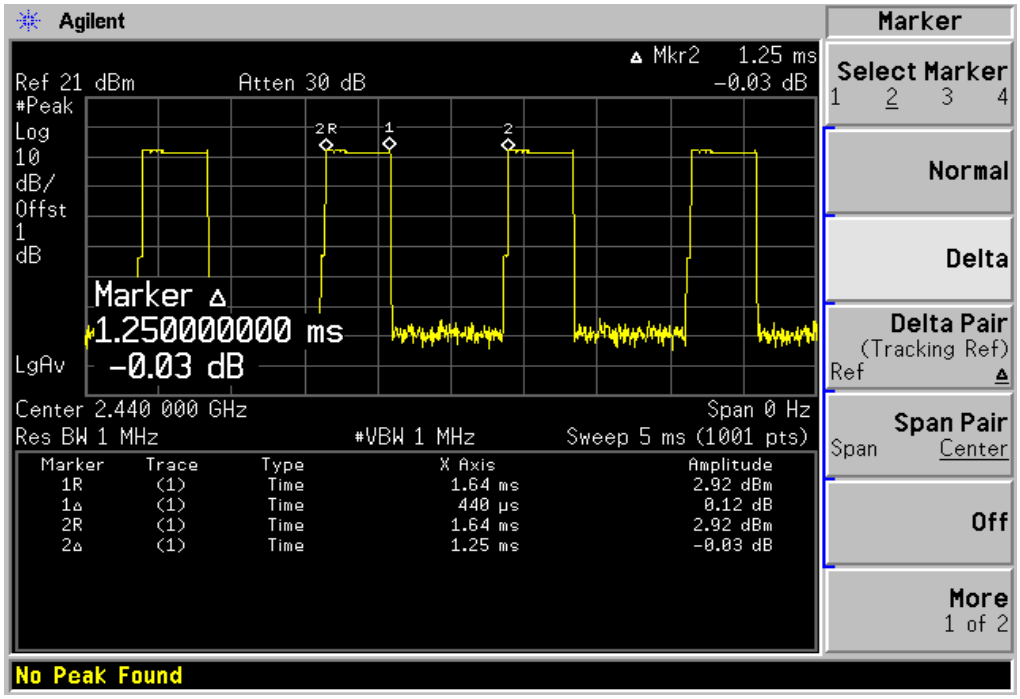
BDR (GFSK) DH3 TX-Time plot



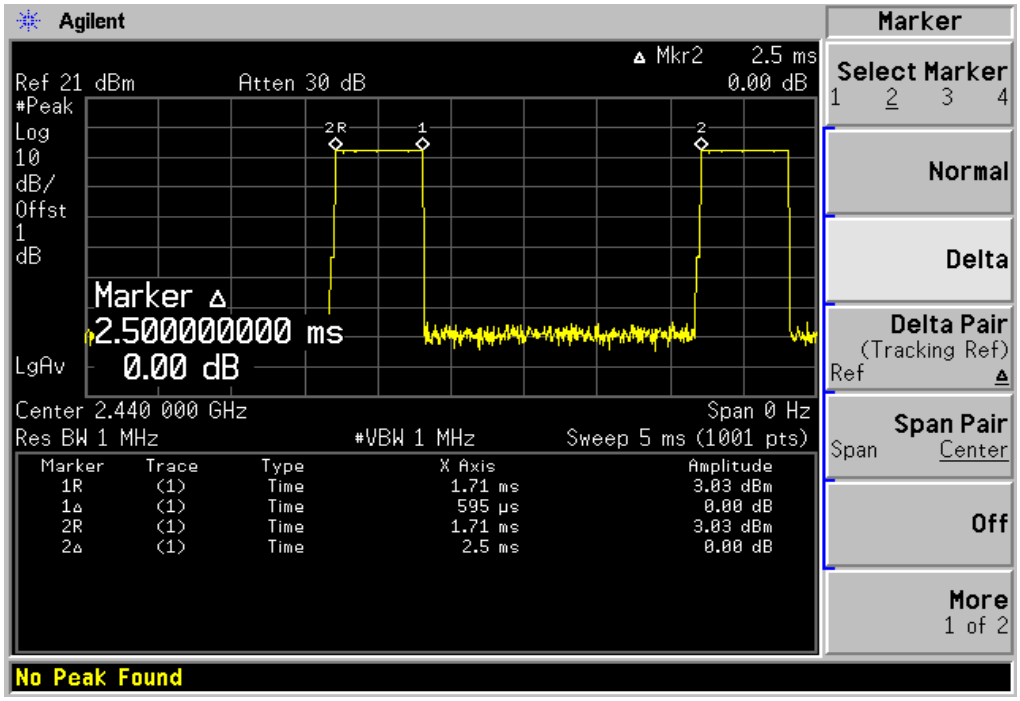
BDR (GFSK) DH5 TX-Time plot



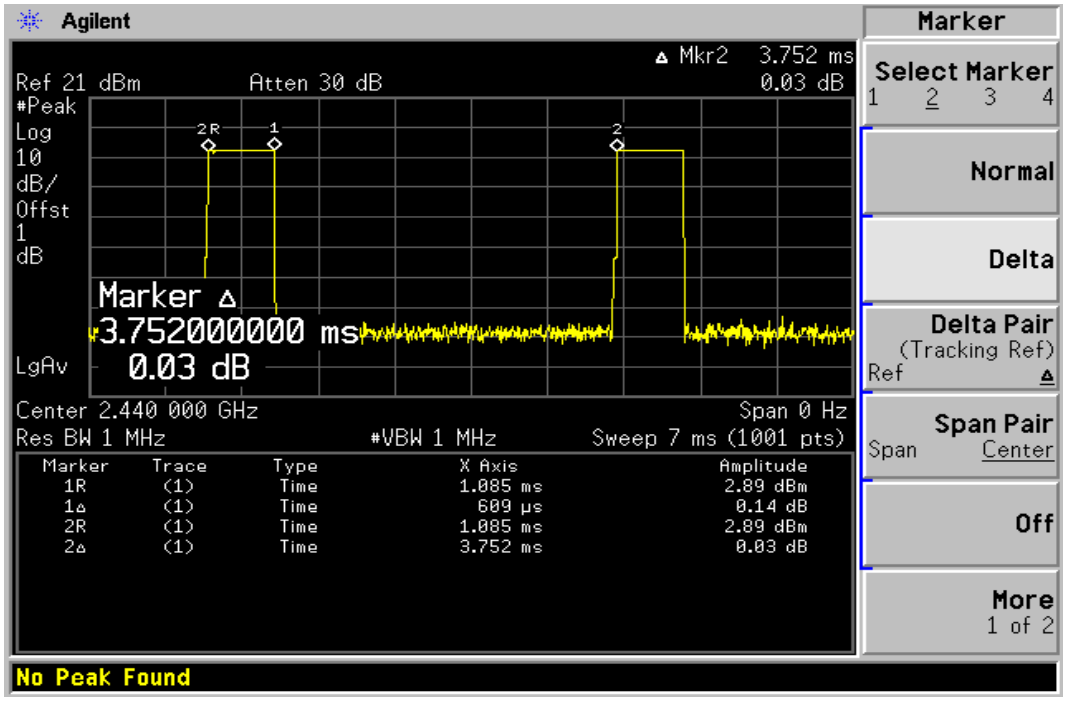
EDR (8-DPSK) 3DH1 TX-Time plot



EDR (8-DPSK) 3DH3 TX-Time plot



EDR (8-DPSK) 3DH5 TX-Time plot



8. Maximum Peak Output Power antenna gain

8.1 Test Limits
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

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

Fcc Part: 15.247(b) (1), RSS Part: RSS-247 Clause 5.4 (b)

8.2 Test procedure

The setup below was used to measure the maximum peak output power. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

The declared maximum antenna gain is 3.0322dBi.

8.3 Maximum Peak Output Power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Power Meter	N1921A	MY45100570	28-Nov-23
Power Sensor	N1921A	MY45240427	28-Nov-23
Power Meter <=> EUT	Loss: 1 dB	-	

8.4 Results tables

Mode	Packet Type	Channel Number	Frequency [MHz]	Peak Power [dBm]	Peak Power [mW]	Limit[mW]	PASS/FAIL
BDR GFSK	DH5	0	2 402	2.16	1.64	125	PASS
		38	2 440	3.63	2.31		PASS
		78	2 480	2.24	1.67		PASS
EDR 8-DPSK	3DH5	0	2 402	1.67	1.47	125	PASS
		38	2 440	3.29	2.13		PASS
		78	2 480	1.82	1.52		PASS

9. Out-of-band emission (conducted)

9.1 Test limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Fcc Part: 15.247(d), RSS Part: RSS-247 Clause 5.5

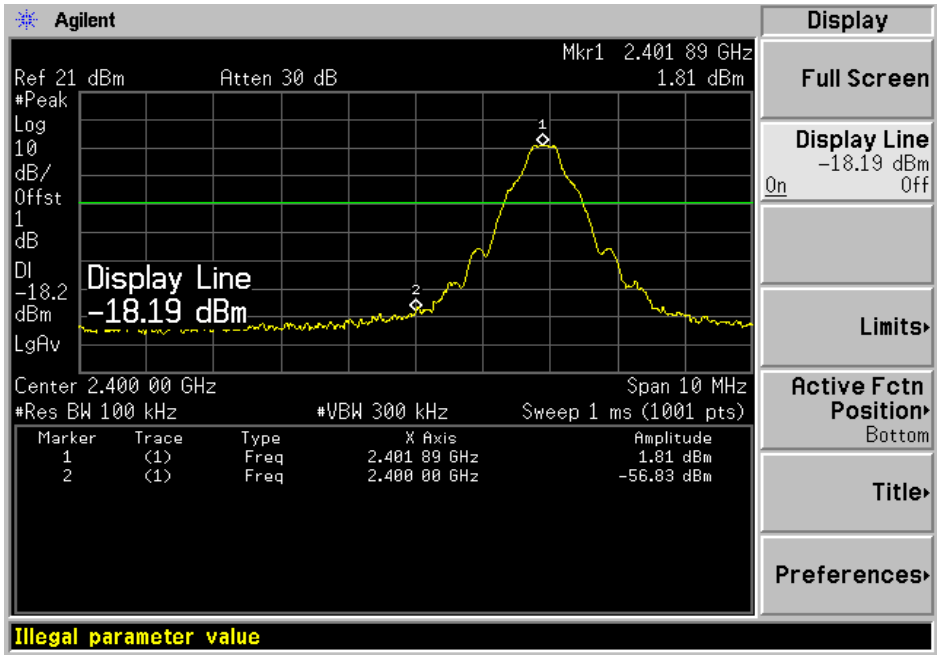
9.2 Test procedure

The setup below was used to measure the out-of-band emissions (conducted). The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

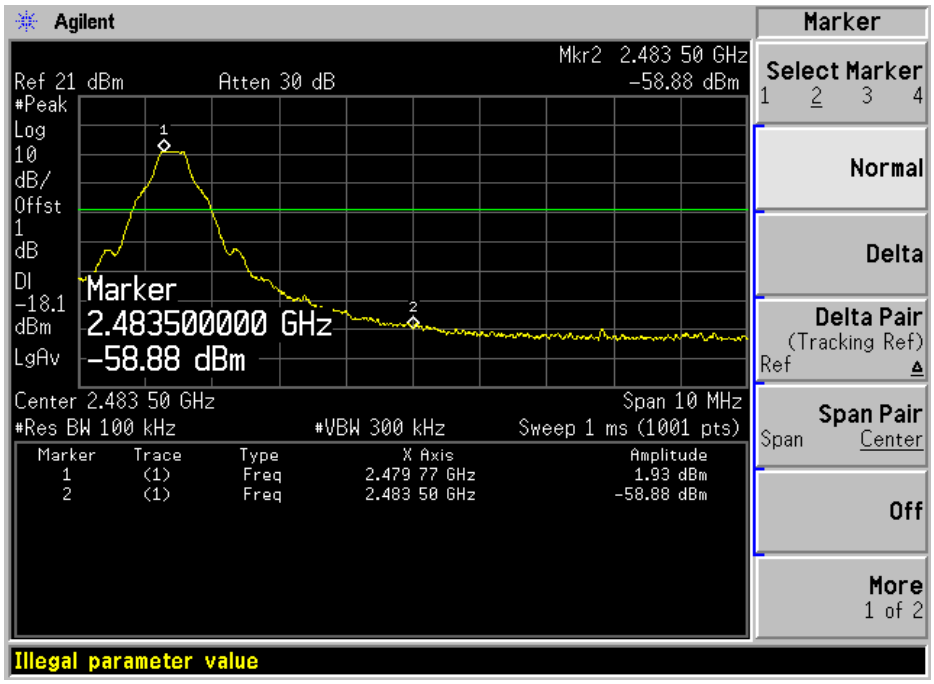
9.3 Results tables

Mode	Packet Type	Ch	Frequency [MHz]	PSD Peak [dBm]
BDR (GFSK)	DH5	0	2 402	1.81
		78	2 480	1.93
EDR (8-DPSK)	3DH5	0	2 402	-4.41
		78	2 480	-3.08

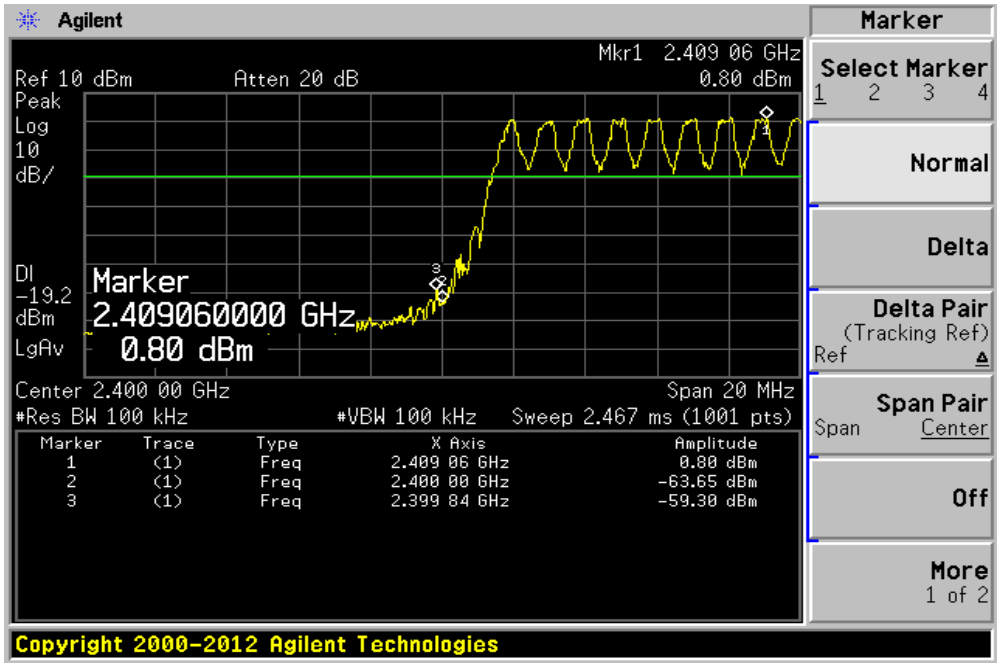
BDR (GFSK) CH 0



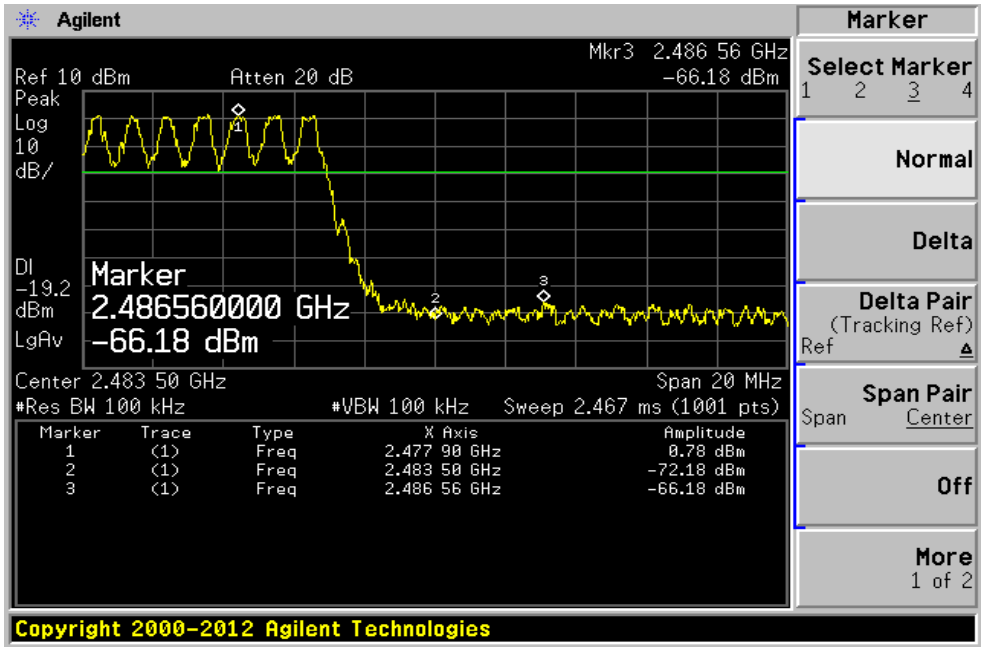
BDR (GFSK) CH 78



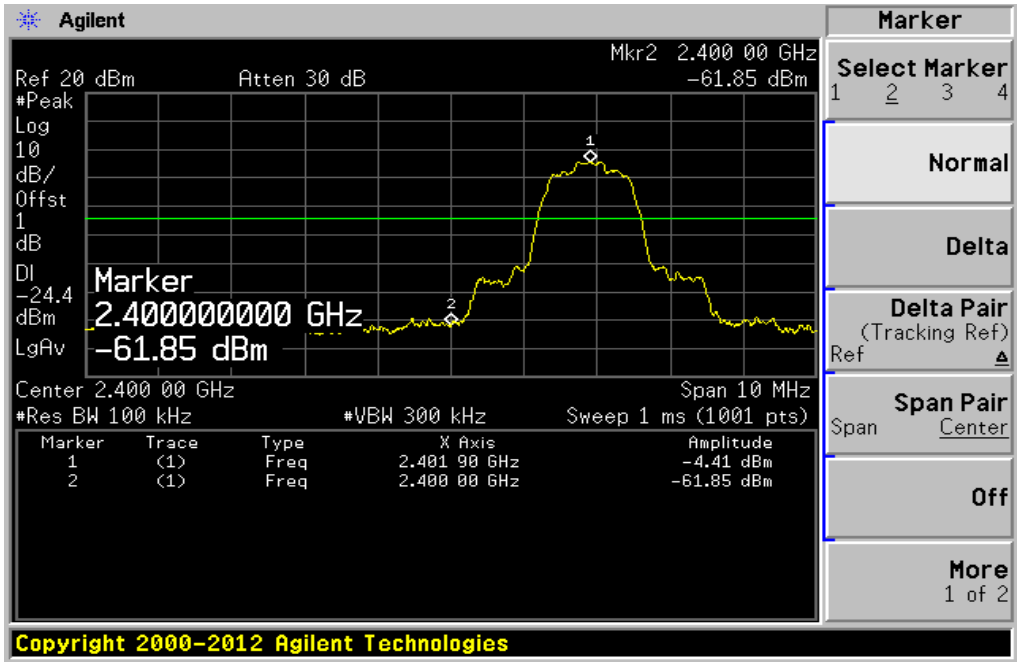
BDR (GFSK) CH 0-Hopping



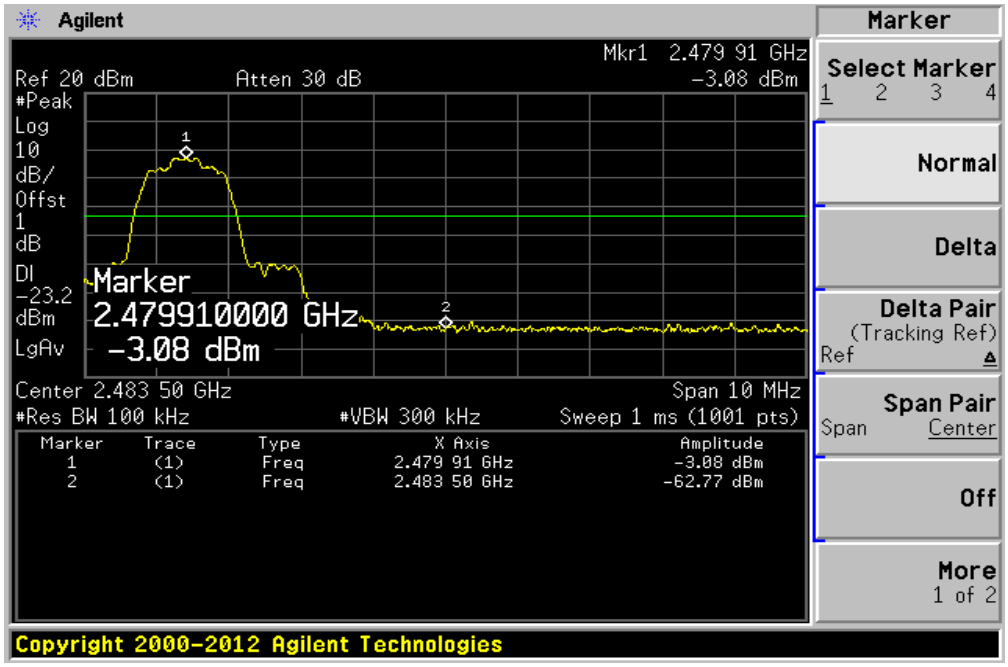
BDR (GFSK) CH 78-Hopping



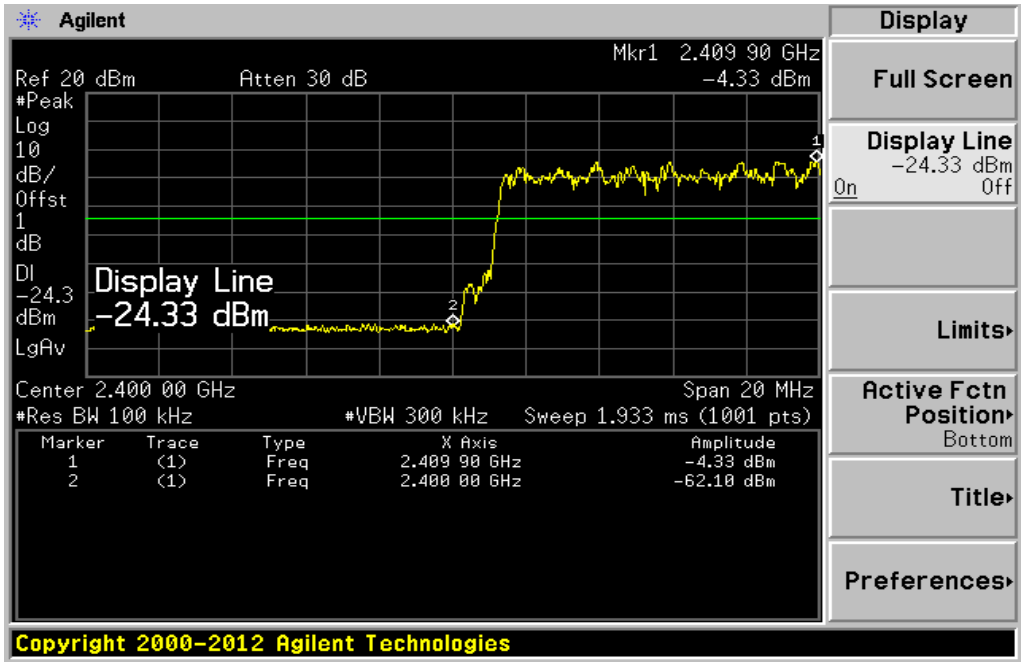
EDR (8-DPSK) CH 0



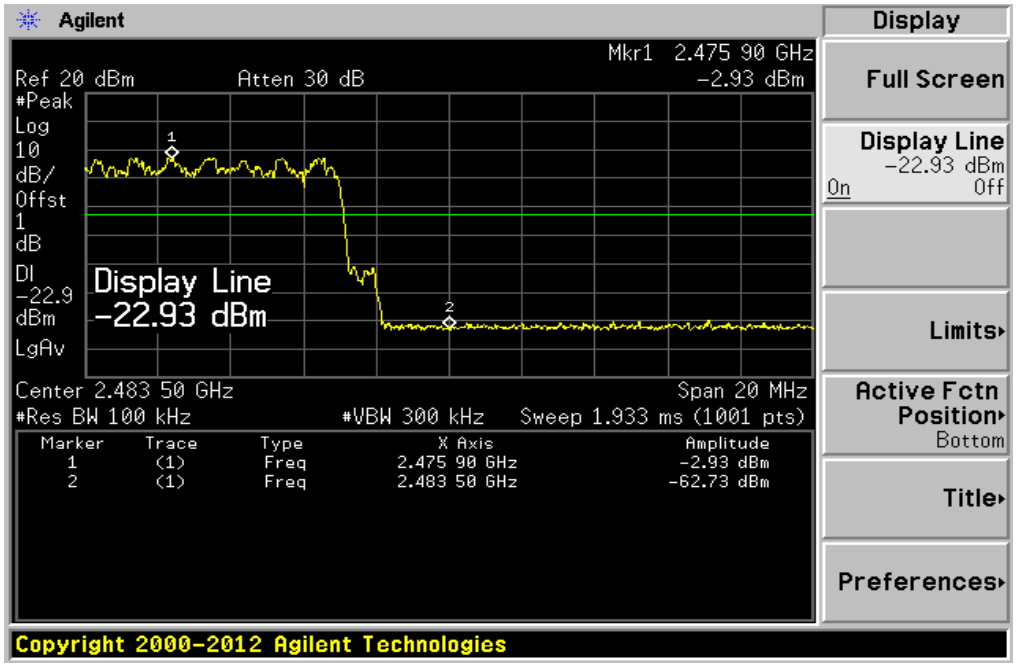
EDR (8-DPSK) CH 78



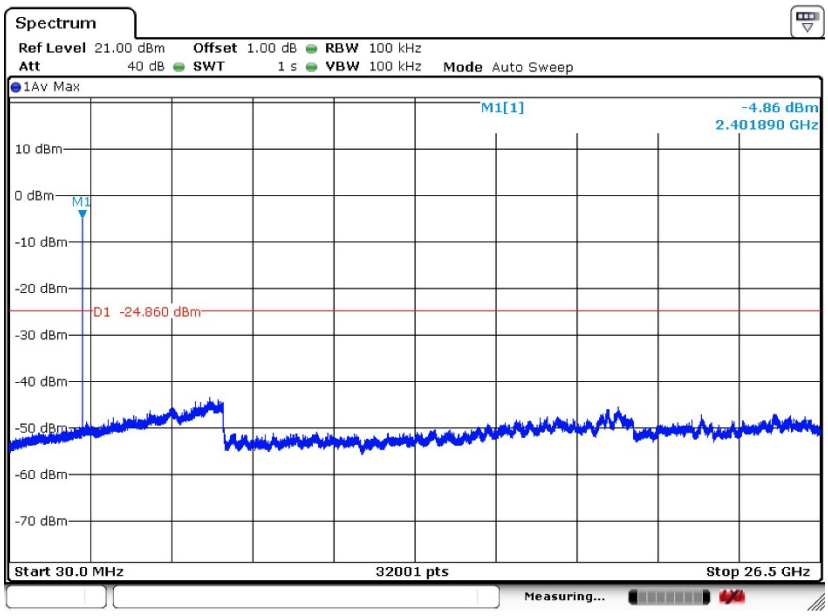
EDR (8-DPSK) CH 0-Hopping



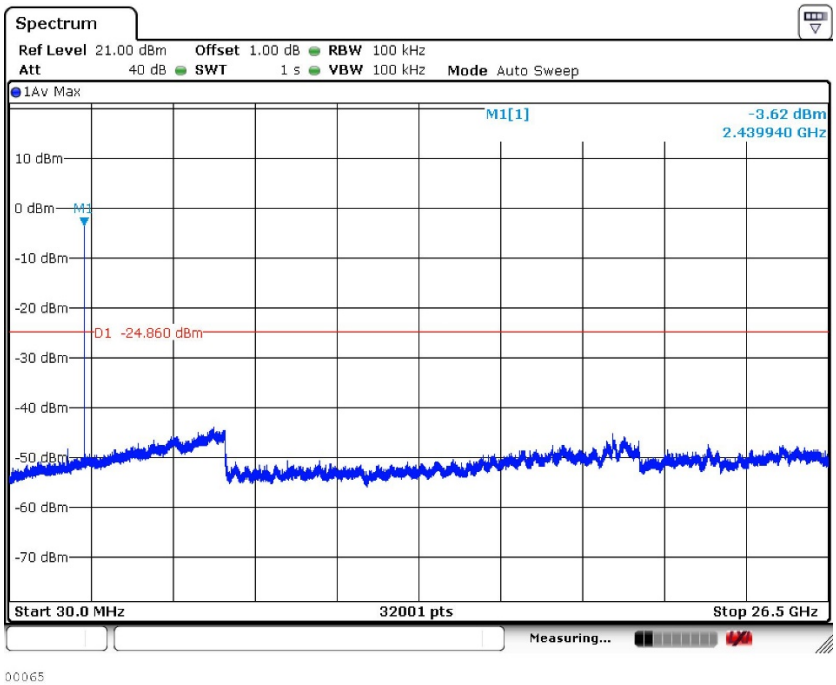
EDR (8-DPSK) CH 78-Hopping



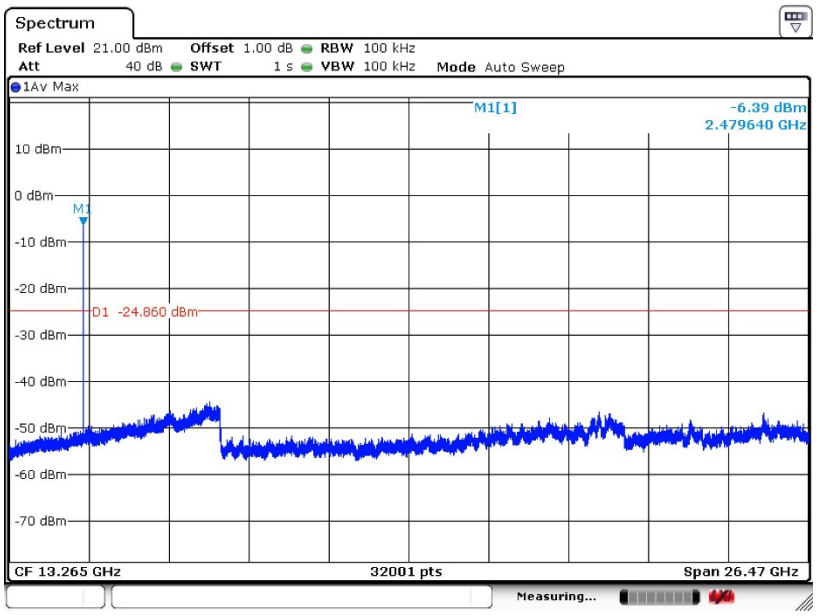
BDR (GFSK) CH 0-cond spur 30 MHz ~ 26.5 GHz



BDR (GFSK) CH 38-cond spur 30 MHz ~ 26.5 GHz



BDR (GFSK) CH 78-cond spur 30 MHz ~ 26.5 GHz



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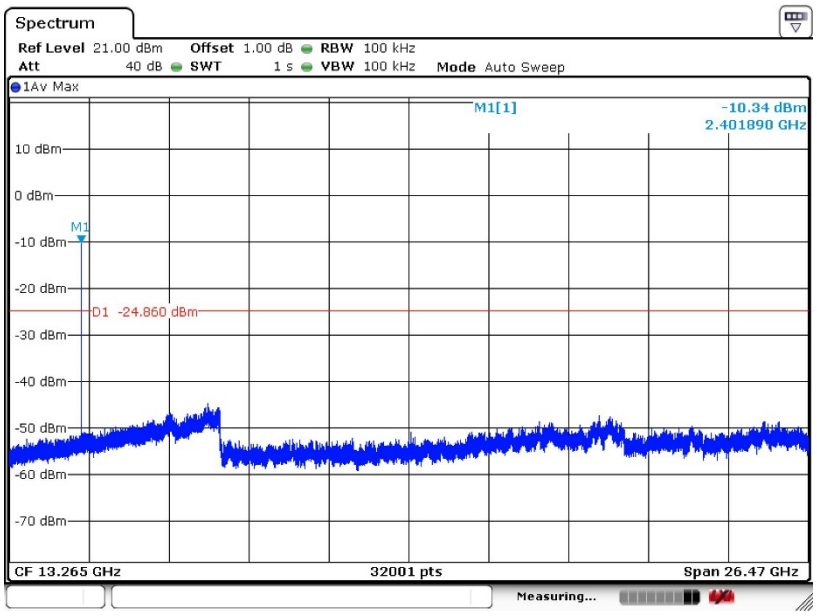
EDR (8-DPSK) CH 0-cond spur 30 MHz ~ 26.5 GHz



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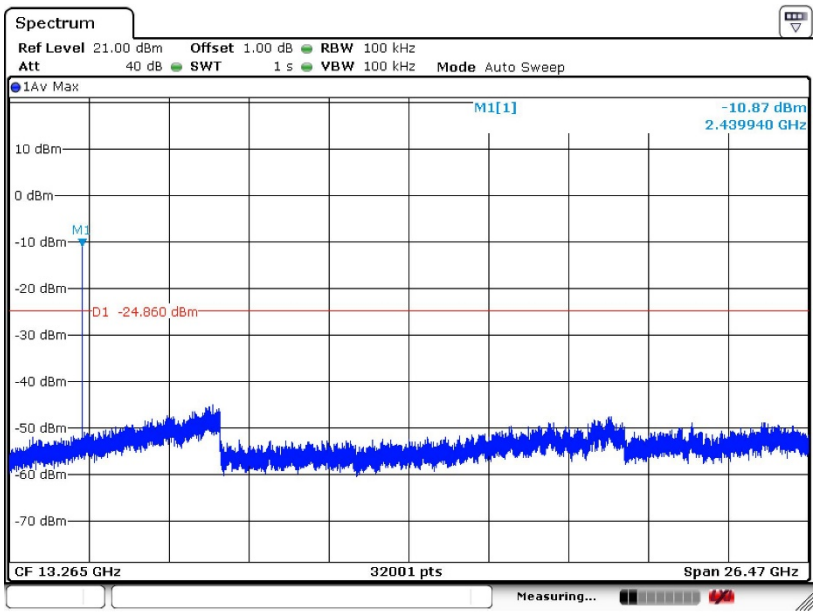
EDR (8-DPSK) CH 38-cond spur 30 MHz ~ 26.5 GHz



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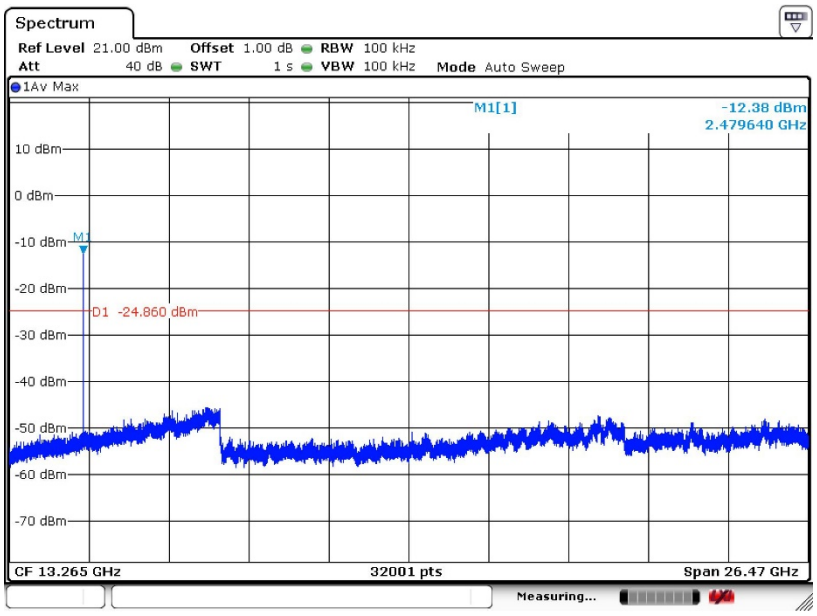
EDR (8-DPSK) CH 78-cond spur 30 MHz ~ 26.5 GHz



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10. Radiated spurious emission

10.1 Limits

Radiated emissions which fall in the restricted bands, as defined in §15.205(a),
must also comply with the radiated emission limits specified in §15.209(a):

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.

Fcc Part: 15.247(d),15.209 (a), RSS Part: RSS-247 Clause 5.5, RSS-GEN Clause 8.9

Freq Range (MHz)	Field Stregth (μV/m)	Field Stregth (dBμV/m)	Meas. Distance (m)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

10.2 Test procedure:

The setups below were used to measure the radiated spurious emissions.
Depending of the frequency range and bands being tested, different antennas and filters were used.
The final measurement is done by varying the antenna height as indicated in the setups below for each band, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
The radiated spurious emission was measured on the worst case configuration found.

10.3 Sample Calculation

The field strength is deduced from the radiated measurement using the following equation:
$E = 126.8 - 20\log(\lambda) + P - G$

Where
E is the field strength of the emission at the measurement distance, in dBμV/m
P is the power measured at the output of the test antenna, in dBm
λ is the wavelength of the emission under investigation [300/f_{MHz}], in m
G is the gain of the test antenna, in dBi

NOTE – The measured power P includes all applicable instrument correction factors up to the connection to the test Antenna e.g. cable losses, amplifier gains.

For field strength measurements made at other than the distance at which the applicable limit is specified, the field strength of the emission at the distance specified by the limit is deduced as follows:

$$E_{SpecLimit} = E_{Meas} + 20\log(D_{Meas}/D_{SpecLimit})$$

Where
$E_{SpecLimit}$ *is the field strength of the emission at the distance specified by the limit, in dBμV/m*
E_{Meas} *is the field strength of the emission at the measurement distance, in dBμV/m*
D_{Meas} *is the measurement distance, in m*
$D_{SpecLimit}$ *is the distance specified by the limit, in m*

10.4 Test Results

BDR (GFSK) 30 M -1 GHz								
Frequency (MHz)	Reading (dB ㎶)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dB ㎶/m)	Result (dB ㎶/m)	Margin (dB)
32.70	18.20	V	1.4	12.20	0.86	40.00	31.26	-8.74
400.00	18.88	V	1.8	15.50	1.87	46.00	36.25	-9.75
500.00	11.39	H	1.6	17.90	3.54	46.00	32.83	-13.17
550.40	11.06	V	1.6	18.69	3.71	46.00	33.46	-12.54
625.00	6.96	H	1.4	20.35	3.96	46.00	31.27	-14.73
875.00	11.24	H	1.6	23.10	4.70	46.00	39.04	-6.96
Remark	H : Horizontal, V : Vertical Measurement Distance :3 m *CL = Cable Loss (In case of below 1 000 MHz) *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz. *Result Value = Reading + Ant Factor + Cable loss *Margin = Limit - Result							

EDR (8-DPSK) 30 M -1 GHz								
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
32.70	18.94	V	1.0	12.20	0.86	40.00	32.00	-8.00
250.00	17.42	V	1.0	11.80	2.33	46.00	31.55	-14.45
400.00	20.22	V	1.2	15.50	1.87	46.00	37.59	-8.41
500.00	12.97	V	1.3	17.90	3.54	46.00	34.41	-11.59
625.00	8.38	V	1.4	20.35	3.96	46.00	32.69	-13.31
875.00	11.44	H	1.0	23.10	4.70	46.00	39.24	-6.76
Remark	H : Horizontal, V : Vertical Measurement Distance :3 m *CL = Cable Loss (In case of below 1 000 MHz) *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz. *Result Value = Reading + Ant Factor + Cable loss *Margin = Limit - Result							

BDR (GFSK)-CH0									
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2390.00	46.81	H	1.5	27.73	-29.72		74.00	44.82	-29.18
2390.00	46.05	V	1.5	27.73	-29.72		74.00	44.06	-29.94
4804.00	49.29	H	1.5	31.40	-27.26		74.00	53.43	-20.57
4804.00	48.32	V	1.5	31.40	-27.26		74.00	52.46	-21.54
Average (RBW:1 MHz VBW:3 MHz)									
2390.00	35.26	H	1.5	27.73	-29.72	0.00	54.00	33.27	-20.73
2390.00	35.27	V	1.5	27.73	-29.72	0.00	54.00	33.28	-20.72
4804.00	35.19	H	1.5	31.40	-27.26	0.00	54.00	39.33	-14.67
4804.00	35.29	V	1.5	31.40	-27.26	0.00	54.00	39.43	-14.57
Remark	H : Horizontal, V : Vertical *This test was radiated up to 26.5 GHz but no noise was measured. *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result * Duty Cycle Correction(dB)= duty 100% only test data								

BDR (GFSK)-CH38									
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
4880.00	48.53	H	1.5	31.56	-27.08		74.00	53.01	-20.99
4880.00	48.60	V	1.5	31.56	-27.08		74.00	53.08	-20.92
Average (RBW:1 MHz VBW:3 MHz)									
4880.00	35.58	H	1.5	31.56	-27.08	0.00	54.00	40.06	-13.94
4880.00	35.61	V	1.5	31.56	-27.08	0.00	54.00	40.09	-13.91
Remark	H : Horizontal, V : Vertical *This test was radiated up to 26.5 GHz but no noise was measured. *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result * Duty Cycle Correction(dB)= duty 100% only test data								

BDR (GFSK)-CH78									
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	55.00	H	1.5	27.70	-29.72		74.00	52.98	-21.02
2483.50	56.29	V	1.7	27.70	-29.72		74.00	54.27	-19.73
4960.00	47.97	H	1.5	31.78	-26.92		74.00	52.83	-21.17
4960.00	48.26	V	1.7	31.78	-26.92		74.00	53.12	-20.88
Average (RBW:1 MHz VBW:3 MHz)									
2483.50	43.55	H	1.5	27.70	-29.72	0.00	54.00	41.53	-12.47
2483.50	40.79	V	1.7	27.70	-29.72	0.00	54.00	38.77	-15.23
4960.00	34.87	H	1.5	31.78	-26.92	0.00	54.00	39.73	-14.27
4960.00	34.89	V	1.7	31.78	-26.92	0.00	54.00	39.75	-14.25
Remark	H : Horizontal, V : Vertical *This test was radiated up to 26.5 GHz but no noise was measured. *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result * Duty Cycle Correction(dB)= duty 100% only test data								

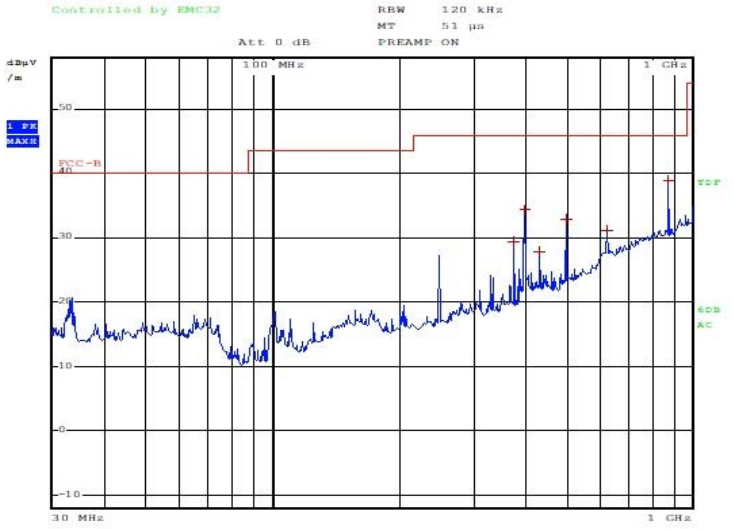
EDR (8-DPSK)-CH0									
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2390.00	46.99	H	1.6	27.73	-29.72		74.00	45.00	-29.00
2390.00	46.69	V	1.5	27.73	-29.72		74.00	44.70	-29.30
4804.00	49.11	H	1.6	31.40	-27.26		74.00	53.25	-20.75
4804.00	49.41	V	1.5	31.40	-27.26		74.00	53.55	-20.45
Average (RBW:1 MHz VBW:3 MHz)									
2390.00	35.23	H	1.6	27.73	-29.72	0.00	54.00	33.24	-20.76
2390.00	35.24	V	1.5	27.73	-29.72	0.00	54.00	33.25	-20.75
4804.00	35.46	H	1.6	31.40	-27.26	0.00	54.00	39.60	-14.40
4804.00	35.52	V	1.5	31.40	-27.26	0.00	54.00	39.66	-14.34
Remark	H : Horizontal, V : Vertical *This test was radiated up to 26.5 GHz but no noise was measured. *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result * Duty Cycle Correction(dB)= duty 100% only test data								

EDR (8-DPSK)-CH38									
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
4880.00	49.01	H	1.5	31.56	-27.08		74.00	53.49	-20.51
4880.00	48.56	V	1.7	31.56	-27.08		74.00	53.04	-20.96
Average (RBW:1 MHz VBW:3 MHz)									
4880.00	35.49	H	1.5	31.56	-27.08	0	54.00	41.03	-14.03
4880.00	35.60	V	1.7	31.56	-27.08	0	54.00	41.14	-13.92
Remark	H : Horizontal, V : Vertical *This test was radiated up to 26.5 GHz but no noise was measured. *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result * Duty Cycle Correction(dB)= duty 100% only test data								

EDR (8-DPSK)-CH78									
Frequency (MHz)	Reading (dB μV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μV/m)	Result (dB μV/m)	Margin (dB)
PEAK(RBW:1 MHz VBW:3 MHz)									
2483.50	56.83	H	1.5	27.70	-29.72		74.00	54.81	-19.19
2483.50	57.11	V	1.7	27.70	-29.72		74.00	55.09	-18.91
4960.00	47.72	H	1.5	31.78	-26.92		74.00	52.58	-21.42
4960.00	48.13	V	1.7	31.78	-26.92		74.00	52.99	-21.01
Average (RBW:1 MHz VBW:3 MHz)									
2483.50	43.74	H	1.5	27.70	-29.72	0.00	54.00	41.72	-12.28
2483.50	43.92	V	1.7	27.70	-29.72	0.00	54.00	41.90	-12.10
4960.00	34.86	H	1.5	31.78	-26.92	0.00	54.00	39.72	-14.28
4960.00	35.51	V	1.7	31.78	-26.92	0.00	54.00	40.37	-13.63
Remark	H : Horizontal, V : Vertical *This test was radiated up to 26.5 GHz but no noise was measured. *The TX signal wasn't detected from 3th harmonics. *Result Value = Reading + Ant Factor + Cable loss - Amplifier Gain + Duty Cycle Correction Factor *Margin = Limit - Result * Duty Cycle Correction(dB)= duty 100% only test data								

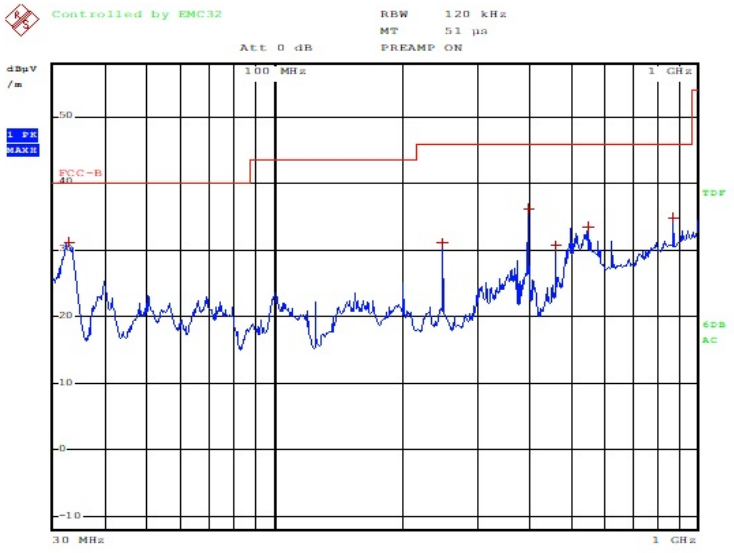
Test plot (BDR GFSK)

Polarity:Horizontal



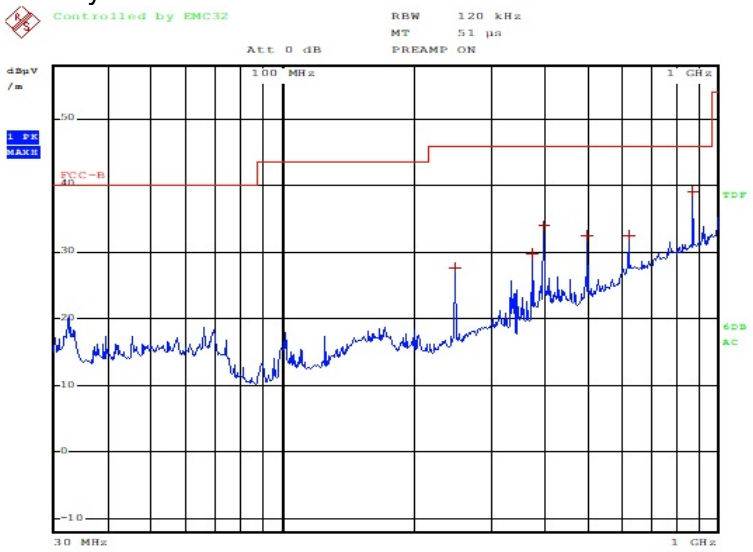
ESTR-23-00065

Polarity:Vertical



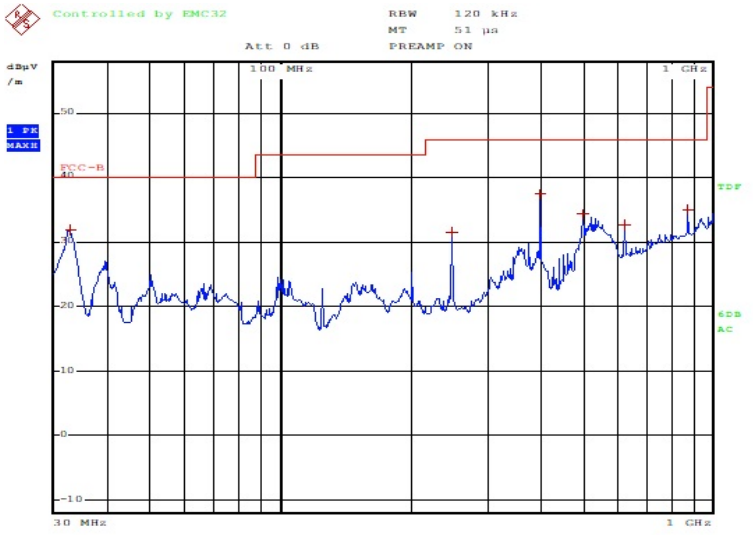
ESTR-23-00065

Test plot (EDR 8-DPSK)
Polarity:Horizontal



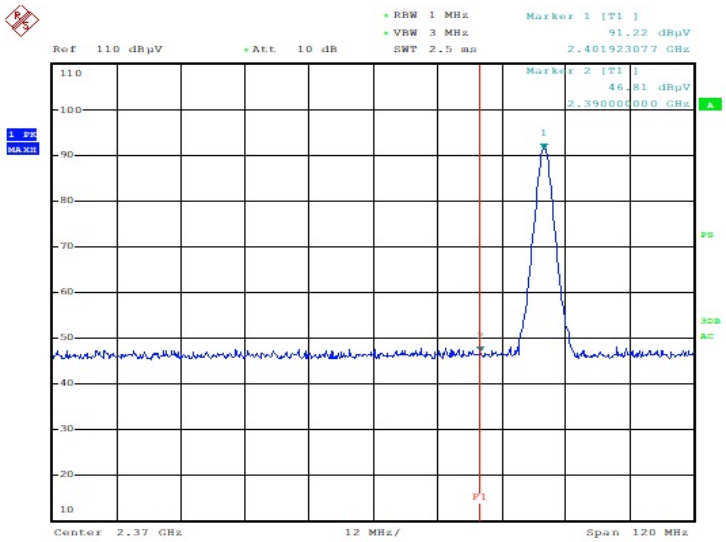
ESTR-23-00065

Polarity:Vertical



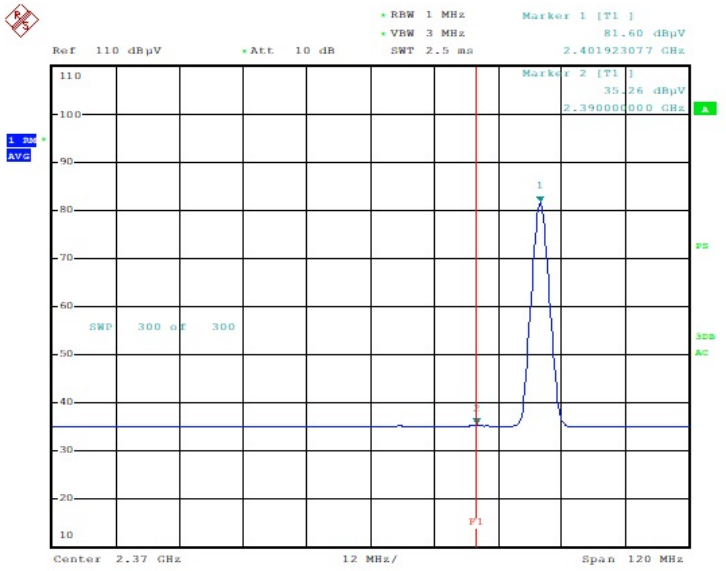
ESTR-23-00065

Restricted Band Edges for BT(BDR GFSK)
Detector mode:Peak CH0 Polarity:Horizontal



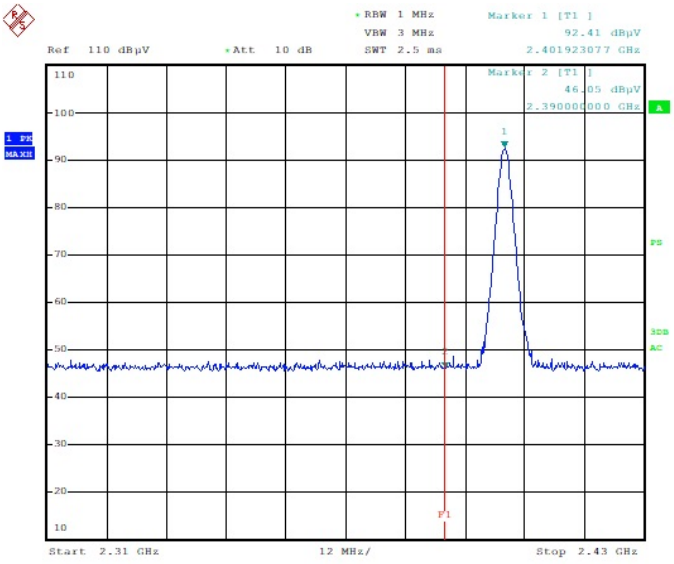
ESTR-23-00065

Detector mode:Average CH0 Polarity:Horizontal



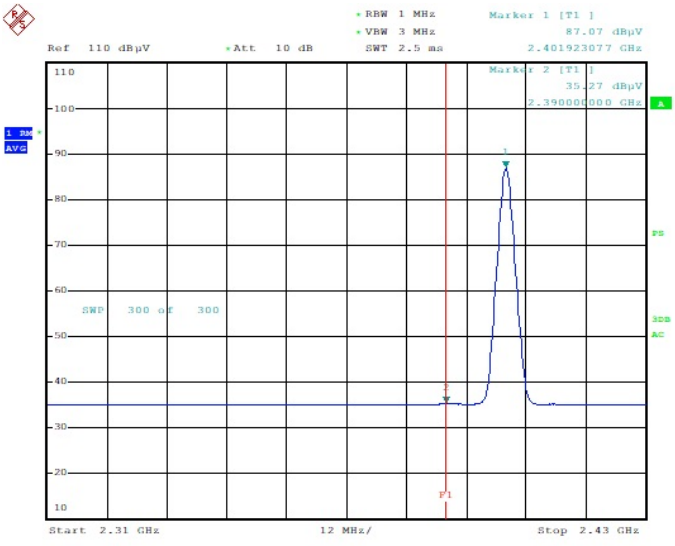
ESTR-23-00065

Detector mode:Peak CH0 Polarity:Vertical



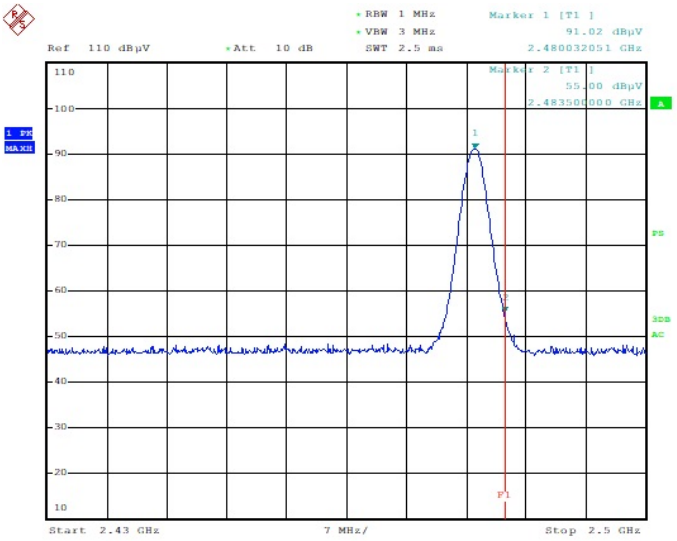
ESTR-23-00065

Detector mode:Average CH0 Polarity:Vertical



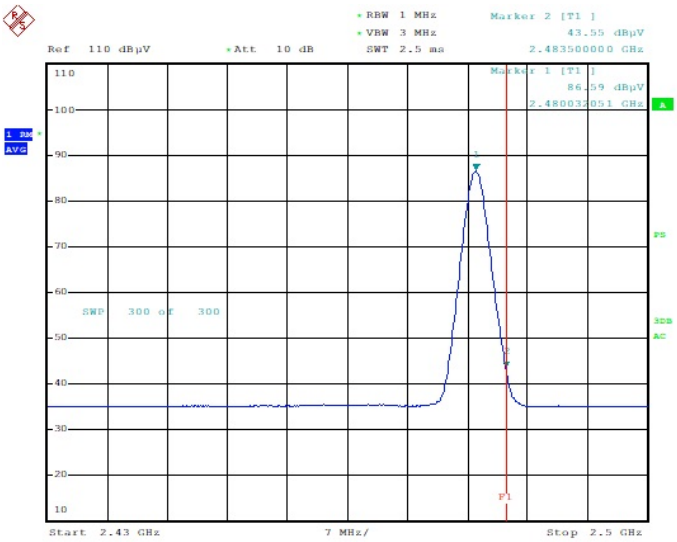
ESTR-23-00065

Detector mode:Peak CH78 Polarity:Horizontal



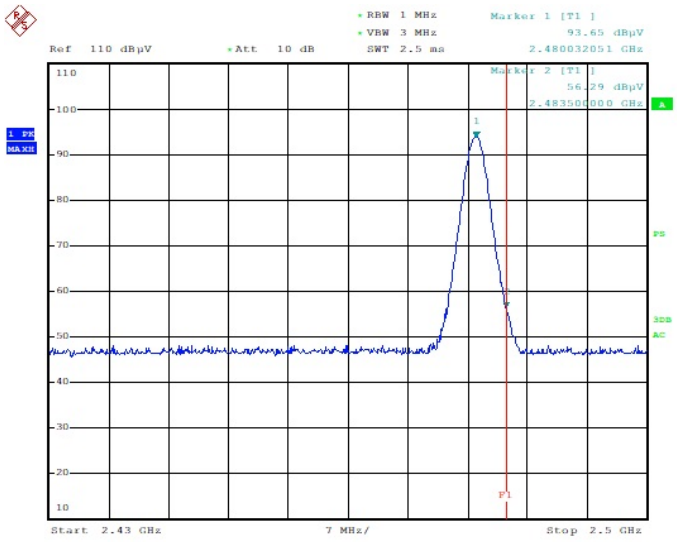
ESTR-23-00065

Detector mode:Average CH0 Polarity:Horizontal



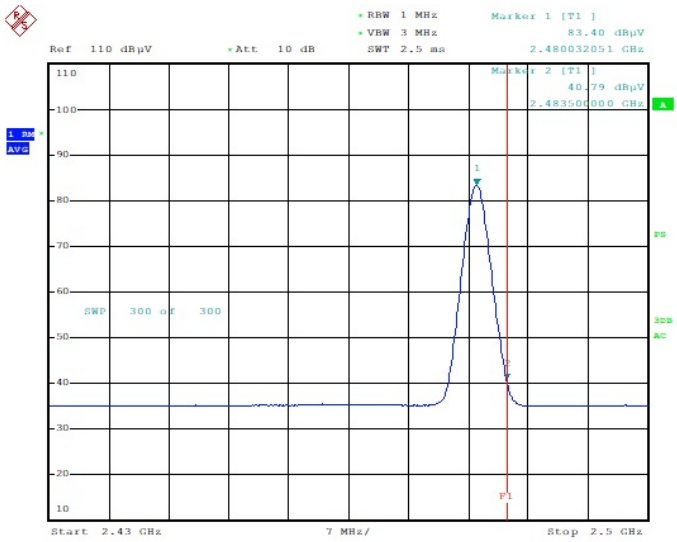
ESTR-23-00065

Detector mode:Peak CH78 Polarity:Vertical



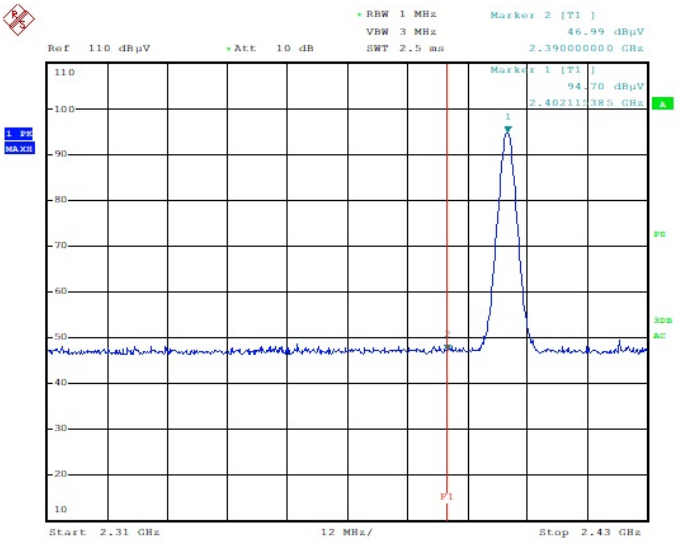
ESTR-23-00065

Detector mode:Average CH78 Polarity:Vertical



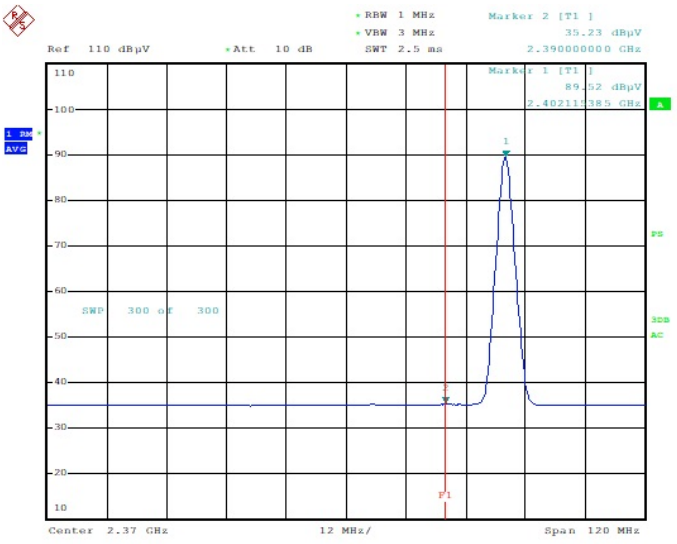
ESTR-23-00065

Restricted Band Edges for BT(EDR 8-DPSK)
Detector mode:Peak CH0 Polarity:Horizontal



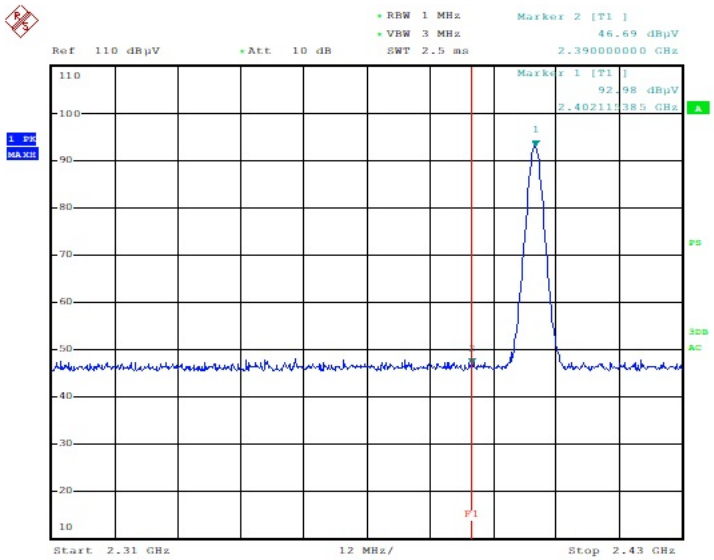
ESTR-23-00065

Detector mode:Average CH0 Polarity:Horizontal



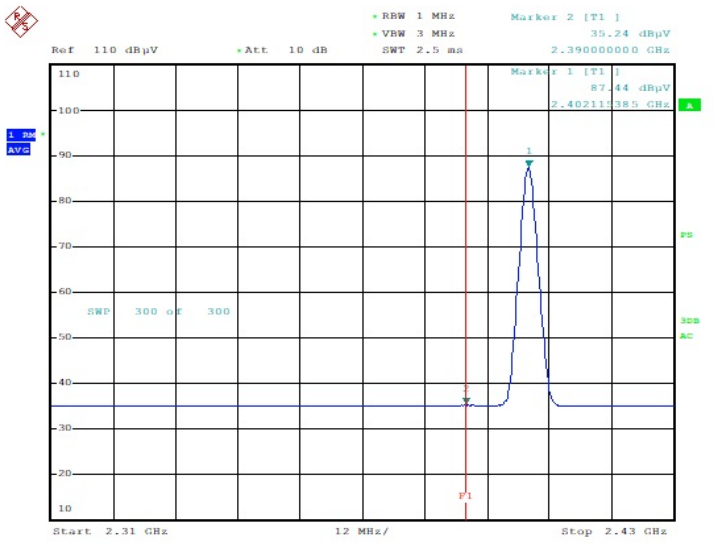
ESTR-23-00065

Detector mode:Peak CH0 Polarity:Vertical



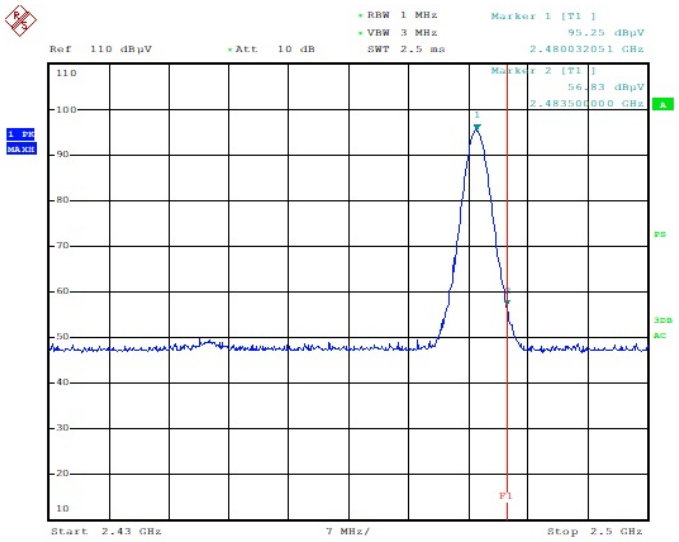
ESTR-23-00065

Detector mode:Average CH0 Polarity:Vertical



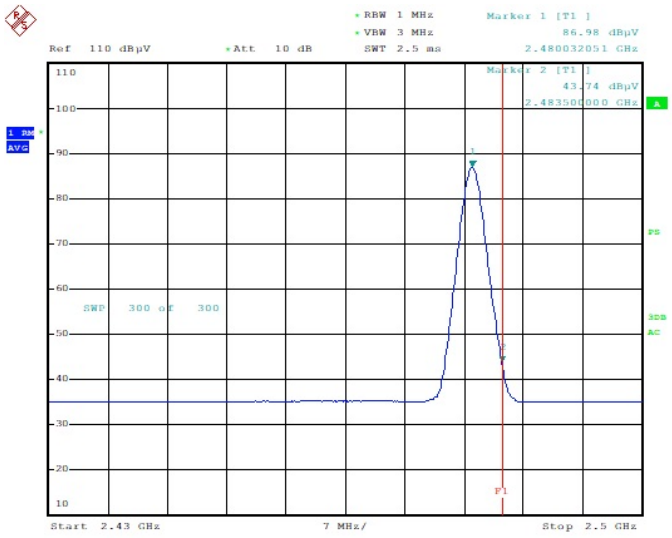
ESTR-23-00065

Detector mode:Peak CH78 Polarity:Horizontal



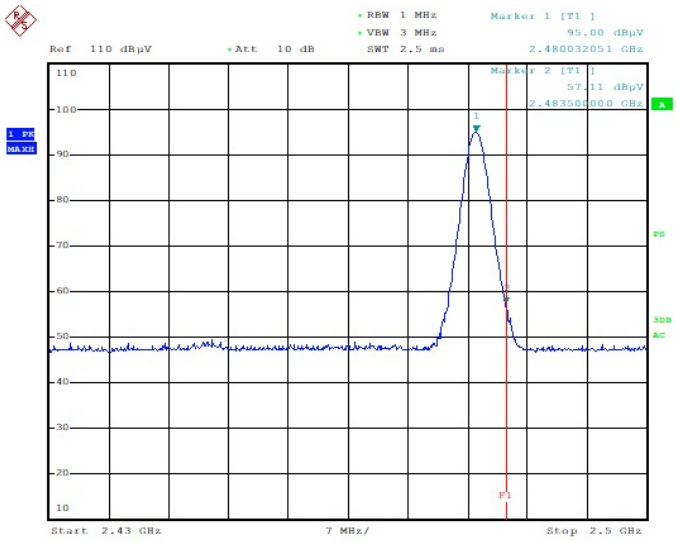
ESTR-23-00065

Detector mode:Average CH78 Polarity:Horizontal



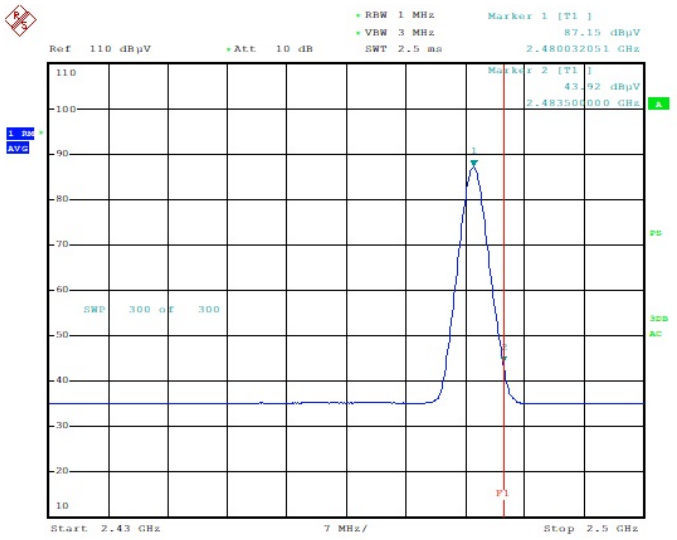
ESTR-23-00065

Detector mode:Peak CH78 Polarity:Vertical



ESTR-23-00065

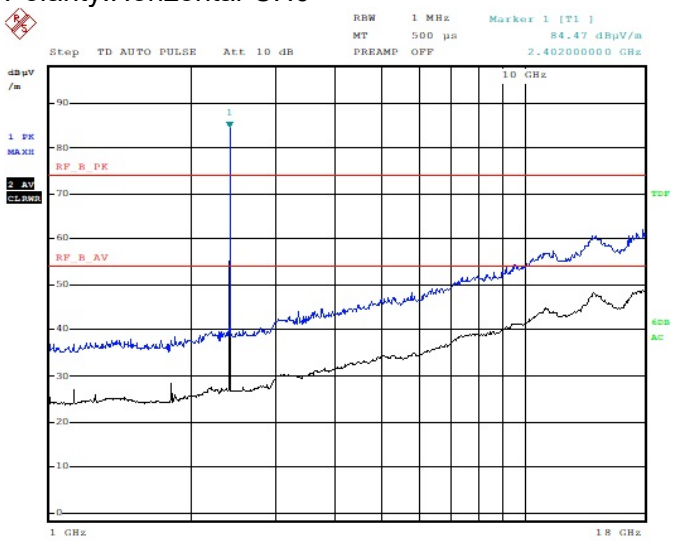
Detector mode:Average CH78 Polarity:Vertical



ESTR-23-00065

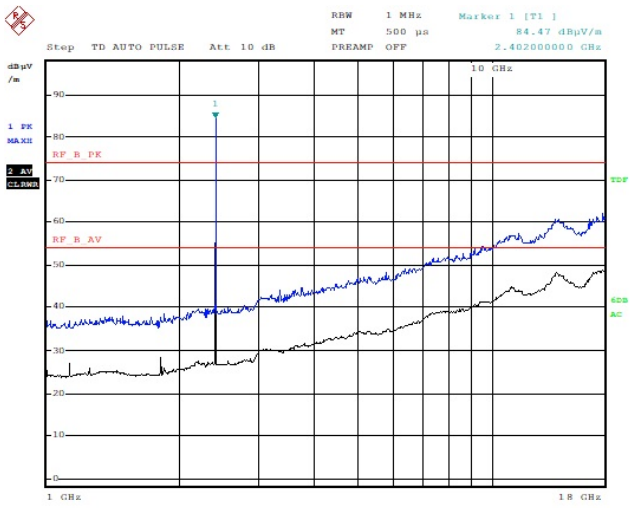
Restricted Band Edges for BT(BDR GFSK)

Polarity:Horizontal-CH0



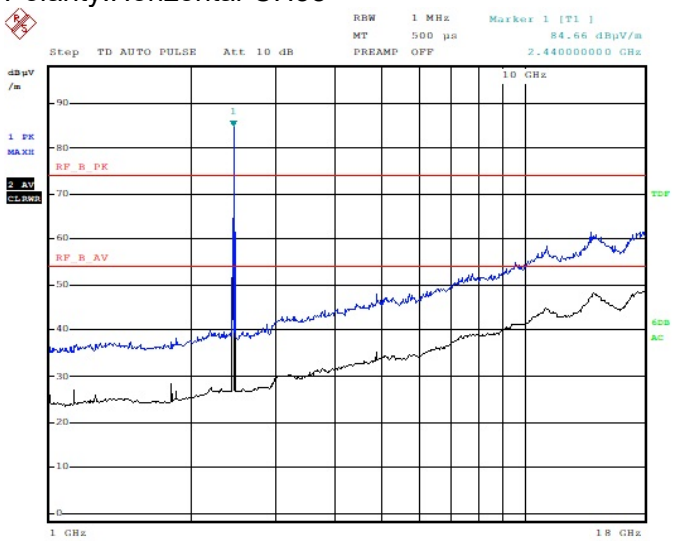
ESTR-23-00065

Polarity:Vertical-CH0



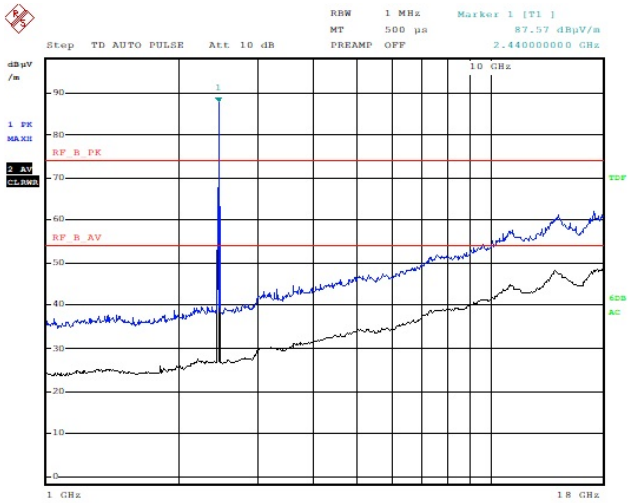
ESTR-23-00065

Polarity:Horizontal-CH38



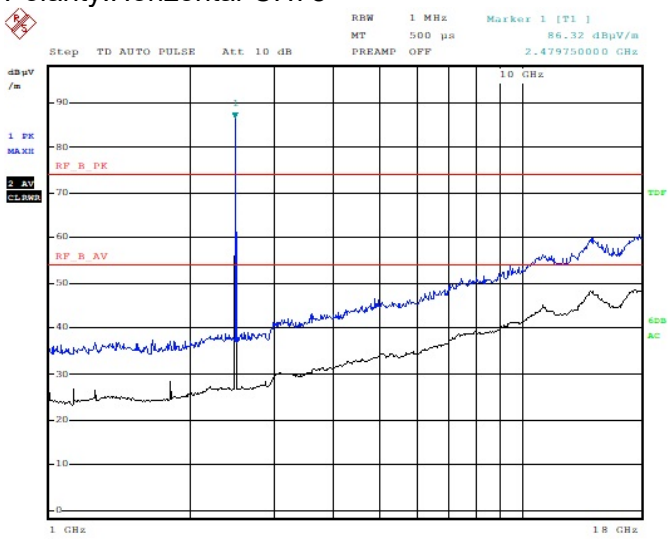
ESTR-23-00065

Polarity:Vertical-CH38



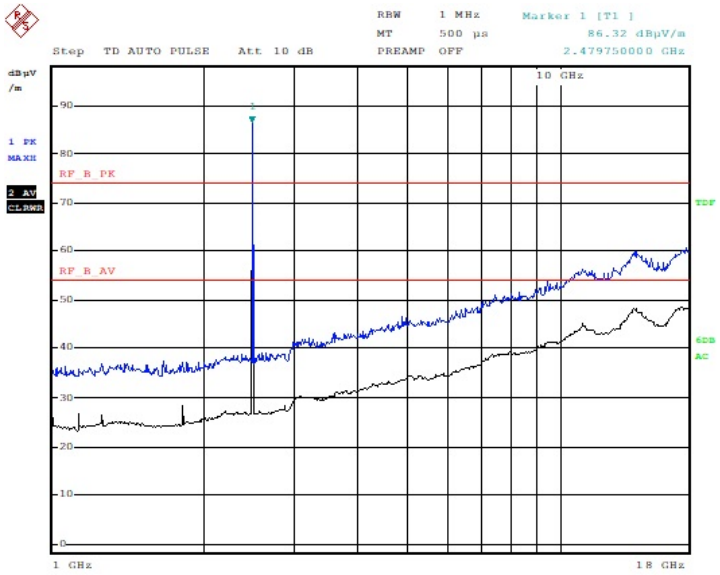
ESTR-23-00065

Polarity:Horizontal-CH78



ESTR-23-00065

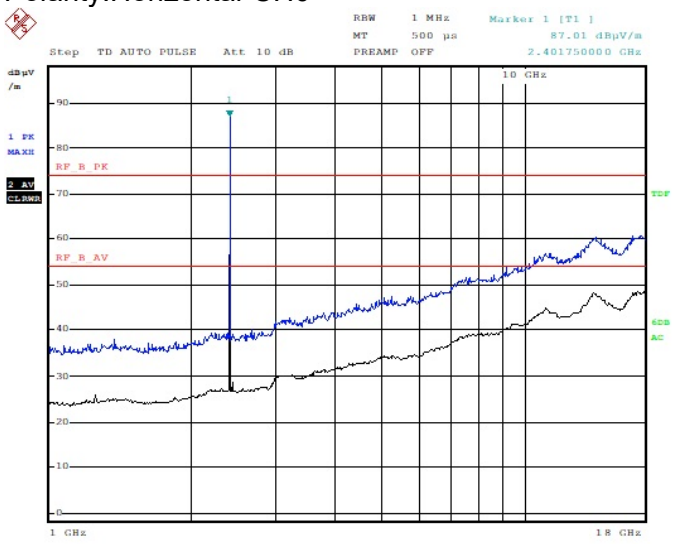
Polarity:Vertical-CH78



ESTR-23-00065

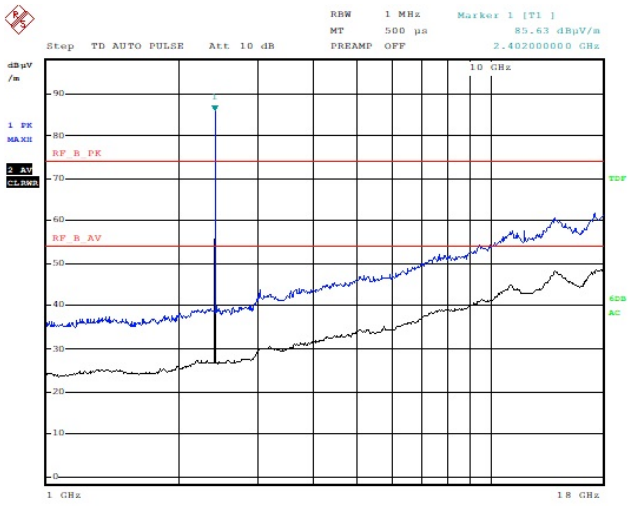
Restricted Band Edges for BT(EDR 8-DPSK)

Polarity:Horizontal-CH0



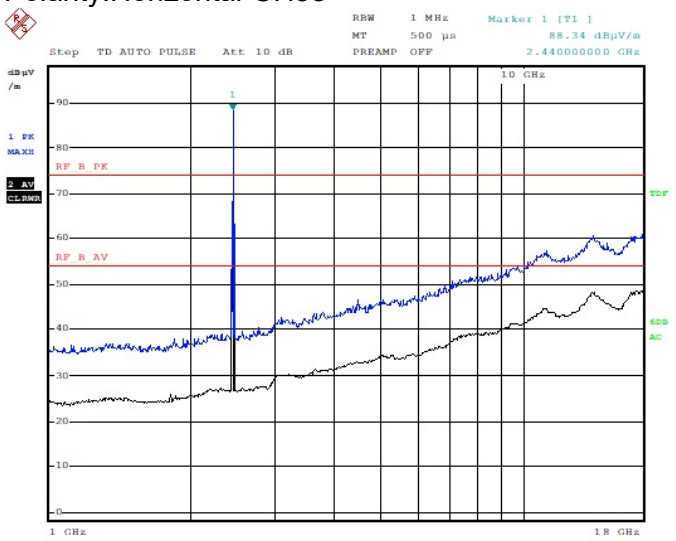
ESTR-23-00065

Polarity:Vertical-CH0



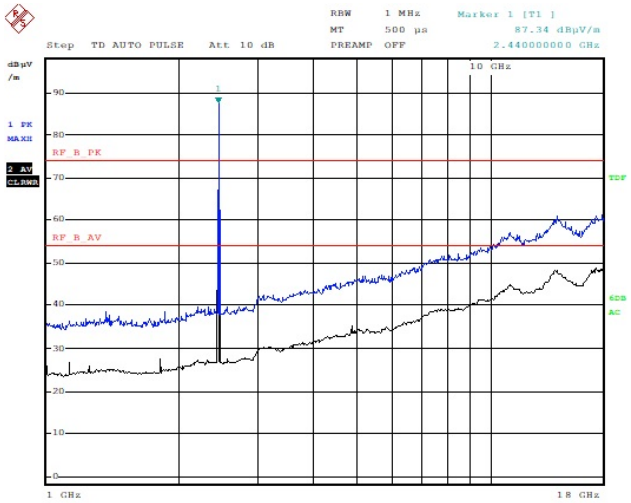
ESTR-23-00065

Polarity:Horizontal-CH38



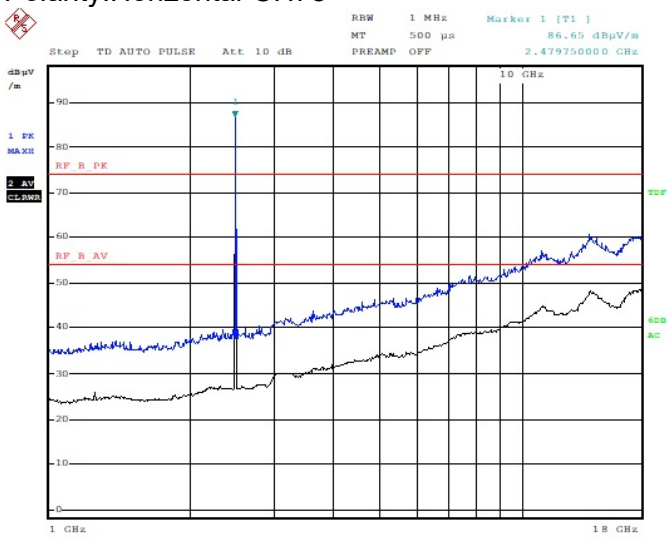
ESTR-23-00065

Polarity:Vertical-CH38



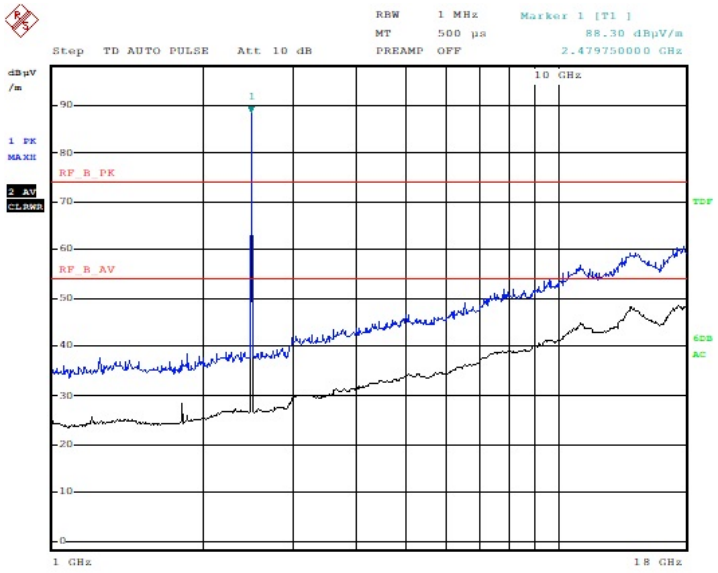
ESTR-23-00065

Polarity:Horizontal-CH78



ESTR-23-00065

Polarity:Vertical-CH78



ESTR-23-00065

11. AC Power Conducted Emissions

11.1 Limits

Fcc Part: 15.207, RSS Part: RSS-GEN Issue 5,Section 8.8

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak (dBμV)	Average (dBμV)
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

11.2 Test procedure:

According to for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

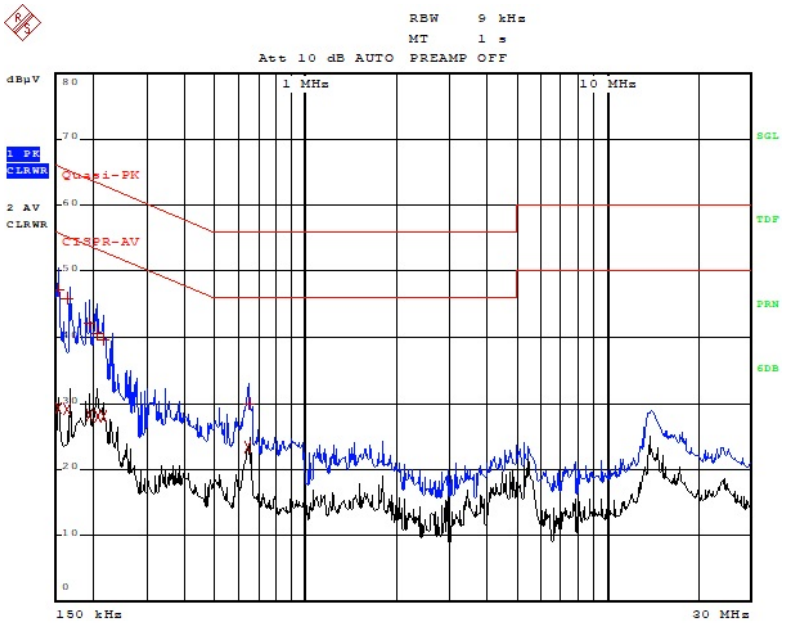
11.3 Test data (BDR GFSK)

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dB μV)	Reading (dB μV)	Result (dB μV)	Limit (dB μV)	Reading (dB μV)	Result (dB)
0.15	0.06	0.15	H	59.83	47.14	47.35	49.83	29.31	29.52
0.16	0.06	0.15	N	58.93	46.23	46.43	48.93	29.61	29.81
0.17	0.06	0.15	H	58.00	45.82	46.02	48.00	29.15	29.35
0.19	0.05	0.14	N	57.93	42.49	42.68	47.93	28.39	28.58
0.20	0.05	0.14	N	56.81	41.03	41.22	46.81	27.53	27.72
0.21	0.05	0.14	N	56.76	39.74	39.93	46.76	28.07	28.26
Remark	H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

(EDR 8-DPSK)

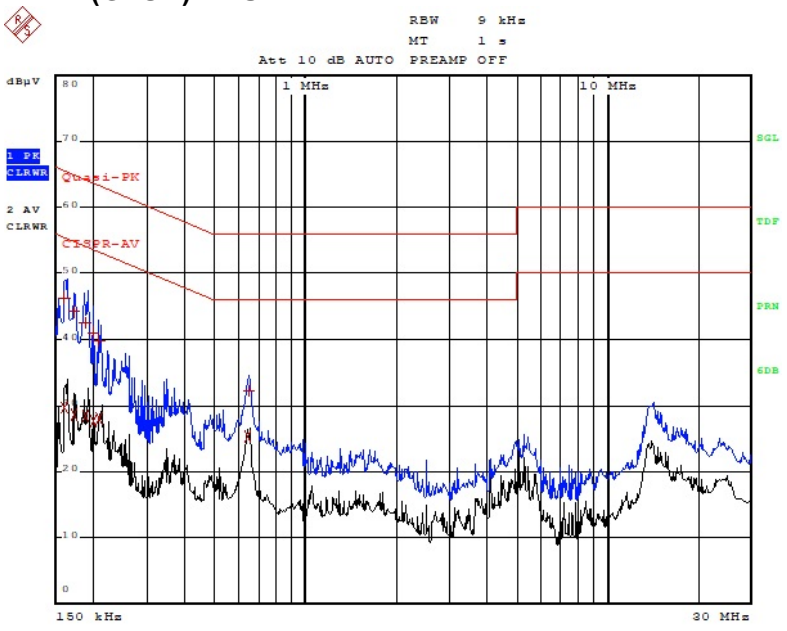
Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dB μV)	Reading (dB μV)	Result (dB μV)	Limit (dB μV)	Reading (dB μV)	Result (dB)
0.15	0.06	0.15	N	59.83	47.31	47.52	49.83	28.98	29.19
0.16	0.06	0.15	H	58.93	47.20	47.41	48.93	30.24	30.45
0.17	0.06	0.15	N	58.00	45.94	46.14	48.00	28.78	28.98
0.19	0.05	0.14	H	57.93	42.78	42.97	47.93	28.46	28.65
0.20	0.05	0.14	N	56.81	41.02	41.21	46.81	27.75	27.94
0.21	0.05	0.14	H	56.76	39.62	39.81	46.76	27.90	28.09
Remark	H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

BDR (GFSK) HOT LINE



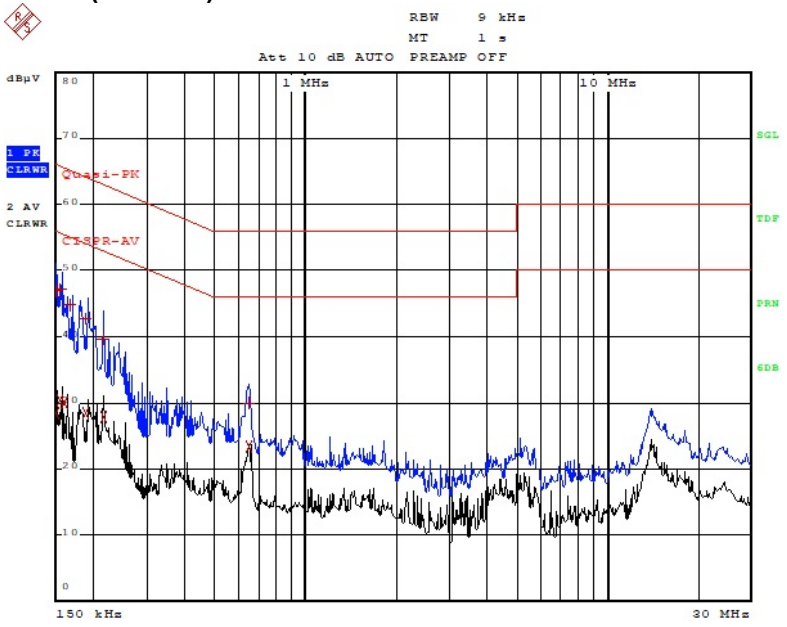
Comment: ESTR-23-00065

BDR (GFSK) NEUTRAL LINE



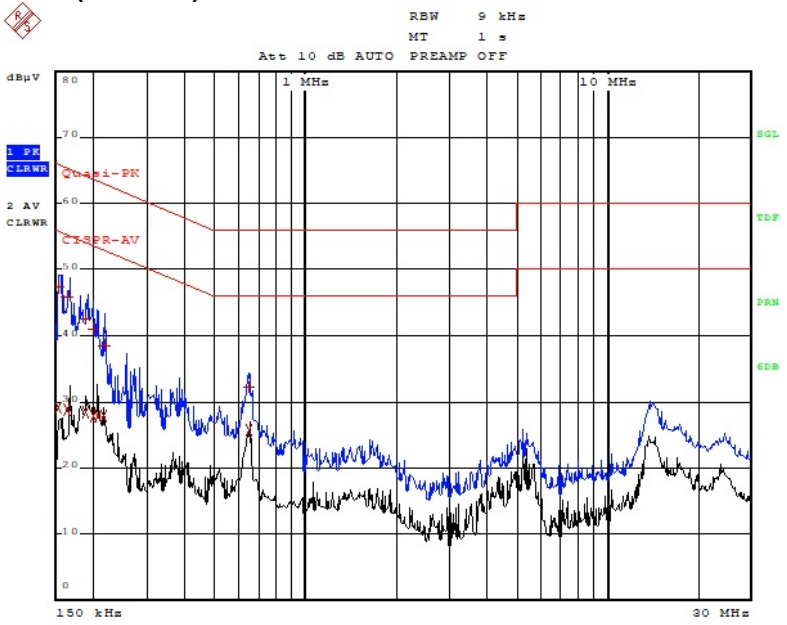
Comment: ESTR-23-00065

EDR (8-DPSK) HOT LINE



Comment: ESTR-23-00065

EDR (8-DPSK) NEUTRAL LINE



Comment: ESTR-23-00065