EMC
TEST REPORT

Report No.: TS12060057-EME
Model No.: TS112W
Issued Date: Jun. 25, 2012

Applicant:	**ION AUDIO, LLC** **200 Scenic View Drive, Suite 201, Cumberland, RI 02864, U.S.A.**
Test Method/ Standard:	**FCC Part 15 Subpart C Section §15.205, §15.207, §15.209, §15.247, DA 00-705 and ANSI C63.4/2003.**
Test By:	**Intertek Testing Services Taiwan Ltd.** **No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,** **Shiang-Shan District, Hsinchu City, Taiwan**

Testing Laboratory
0597

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The test report was reviewed by: Jimmy Yang

Name Jimmy Yang
Title Engineer

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Summary of Tests

Test Item	Reference	Results
20dB Bandwidth test	15.247(a)(1)	Pass
Carrier Frequency Separation test	15.247(a)(1)	Pass
Number of hopping frequencies test	15.247(a)(1)	Pass
Time of Occupancy (dwell time) test	15.247(a)(1)	Pass
Maximum Output Power test	15.247(b)	Pass
RF Antenna Conducted Spurious test	15.247(d)	Pass
Radiated Spurious Emission test	15.205, 15.209	Pass
Emission on the Band Edge test	15.247(d)	Pass
AC Power Line Conducted Emission test	15.207	Pass

1. General information

1.1 Identification of the EUT

Product:	Speaker
Model No.:	TS112W
FCC ID.:	Y4O-TS112W
Frequency Range:	2402 MHz ~ 2480 MHz
Channel Number:	79 channels
Frequency of Each Channel:	2402 + k MHz; k = 0~78
Type of Modulation:	GFSK, π/4DPSK, 8DPSK
Rated Power:	110-120Vac, 50-60Hz
Power Cord:	N/A
Sample Received:	Jun. 05, 2012
Test Date(s):	Jun. 11, 2012 ~ Jun. 19, 2012
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

The EUT is Speaker, and was defined as home appliance.

For more detail features, please refer to User's manual as file name “Installation guide.pdf”.

1.3 Antenna description

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 2.0 dBi
Antenna Type : Dipole antenna
Connector Type : IPEX

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.
Notebook PC	DELL	Latitude D610	JXWZK1S
Function Generator	HP	33120A	US3637410
Dummy Load	N/A	N/A	N/A
Modem	Dynalink	V1456VQE	00V230A00116311

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Section § 15.205, §15.207, §15.209, §15.247, DA 00-705 and ANSI C63.4/2003.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band was all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

The EUT was supplied with 120 Vac, 60 Hz and was run in TX mode that was controlled by "CSR Bluetest 3" program.

2.3 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2011/12/6	2012/12/4
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2012/6/25	2013/6/25
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2012/2/6	2013/2/5
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2010/8/31	2012/8/30
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2010/9/3	2012/9/2
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2011/7/26	2013/7/25
Pre-Amplifier	MITEQ	AFS44-00102650--42-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2010/9/8	2012/9/7
Power Meter	Anritsu	ML2495A	0844001	2011/10/13	2012/10/12
Power Senor	Anritsu	MA2411B	0738452	2011/10/13	2012/10/12
Temperature&Humidity Test Chamber	TERCHY	MHU-225LRU (SA)	950838	2012/6/15	2013/6/15
Two-Line V-Network	Rohde&schwarz	ESH3-Z5	838979/014	2011/10/19	2012/10/18
WiMAX PSA Spectrum Analyzer 3Hz-26.5GHz	Agilent	E4440A	MY46186191	2012/6/1	2013/6/1

Note: The above equipments are within the valid calibration period.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature:	23	℃
Relative Humidity:	55	%
Atmospheric Pressure:	1008	hPa

3.2 Test setup & procedure

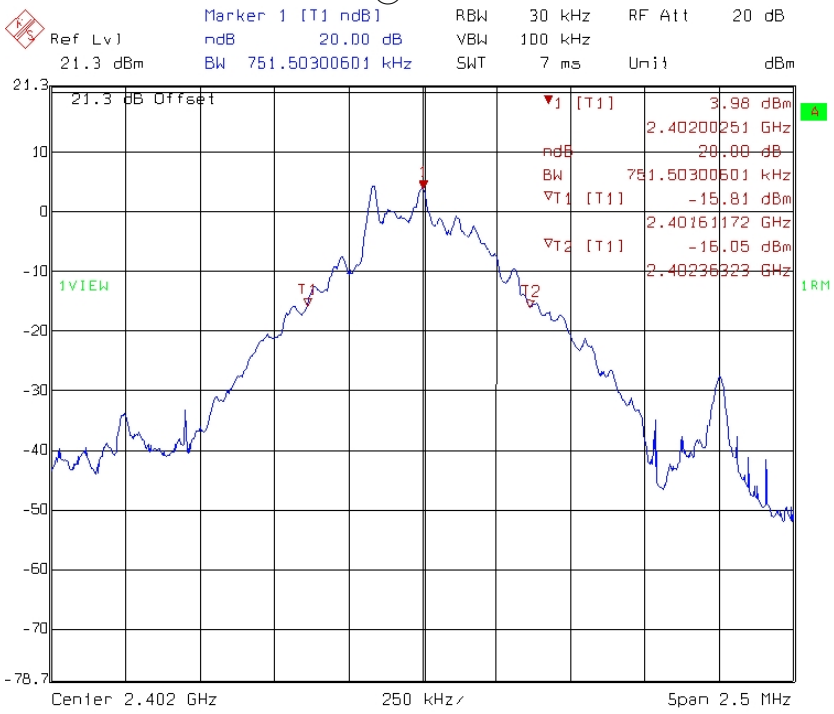
The test procedure was according to FCC measurement guidelines DA 00-705.
The 20dB bandwidth per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set≧1% of the Span, the video bandwidth≧RBW, and the SPAN may equal to approximately 2 to 3 times the 20dB bandwidth. The test was performed at 3 channels (lowest, middle and highest channel). The maximum 20dB modulation bandwidth is in the following Table.

3.3 Measured data of modulated bandwidth test results

Mode	Channel	Frequency (MHz)	20dB Bandwidth (MHz)
GFSK	0	2402	0.752
	39	2441	0.801
	78	2480	0.787
π/4DPSK	0	2402	1.212
	39	2441	1.212
	78	2480	1.192
8DPSK	0	2402	1.212
	39	2441	1.207
	78	2480	1.197

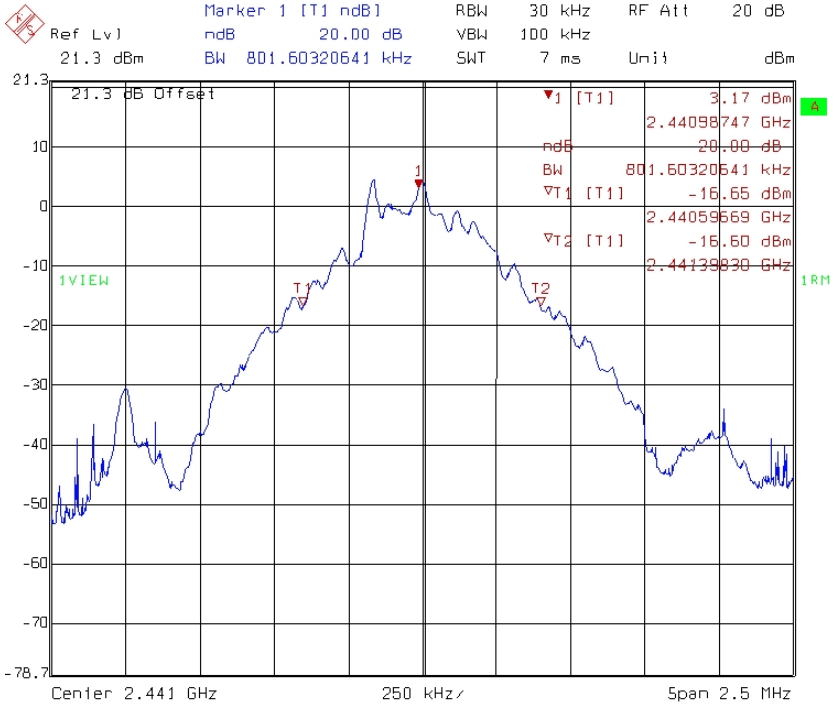
Please see the plot below.

20 dB Bandwidth @ GFSK mode channel 0



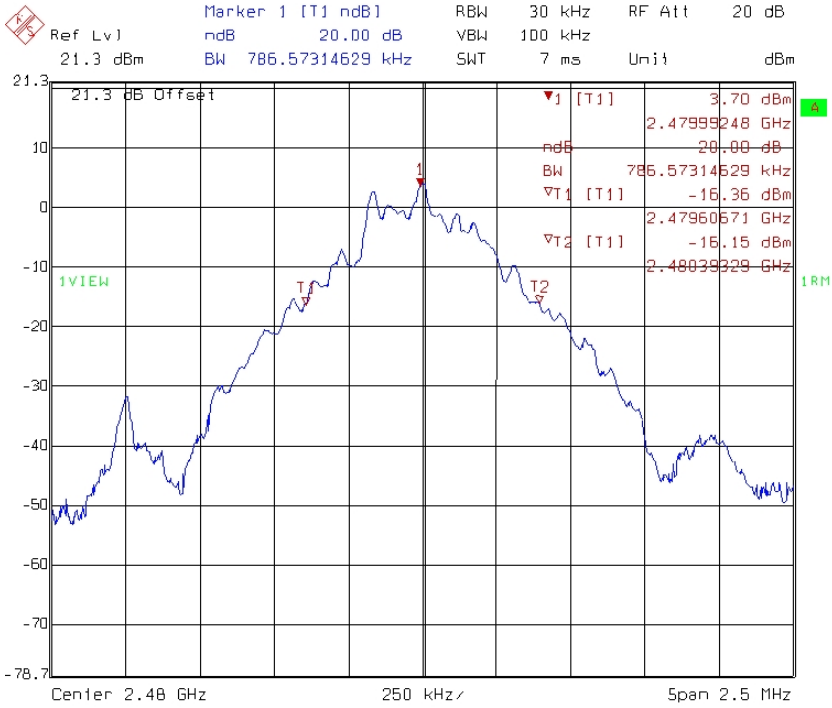
Title: 20dB Bandwidth
Comment A: GFSK ch0 2402 DH1
Date: 12.JUN.2012 11:28:32

20 dB Bandwidth @ GFSK mode channel 39



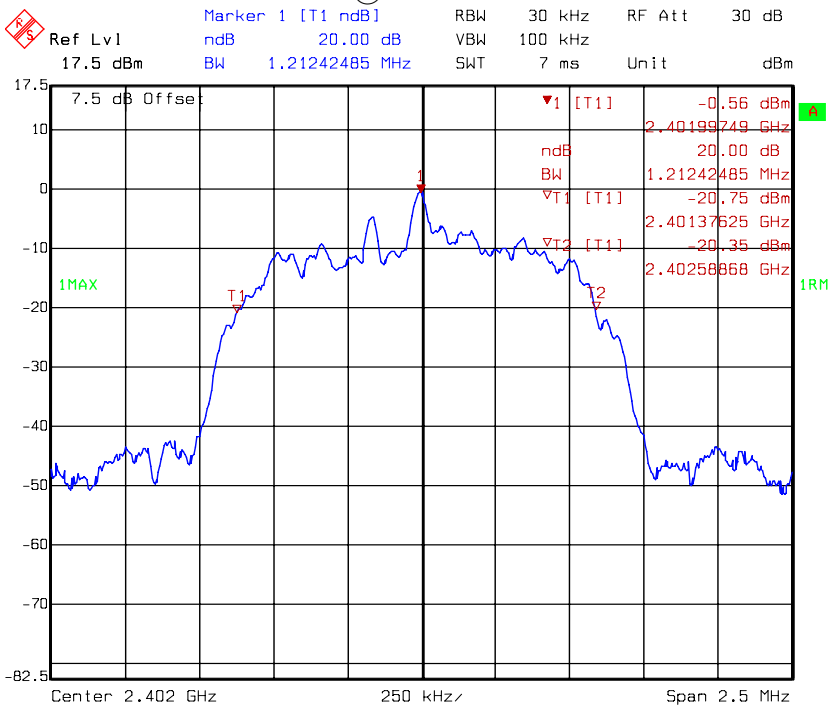
Title: 20dB Bandwidth
Comment A: GFSK ch39 2441 DH1
Date: 12.JUN.2012 11:52:33

20 dB Bandwidth @ GFSK mode channel 78



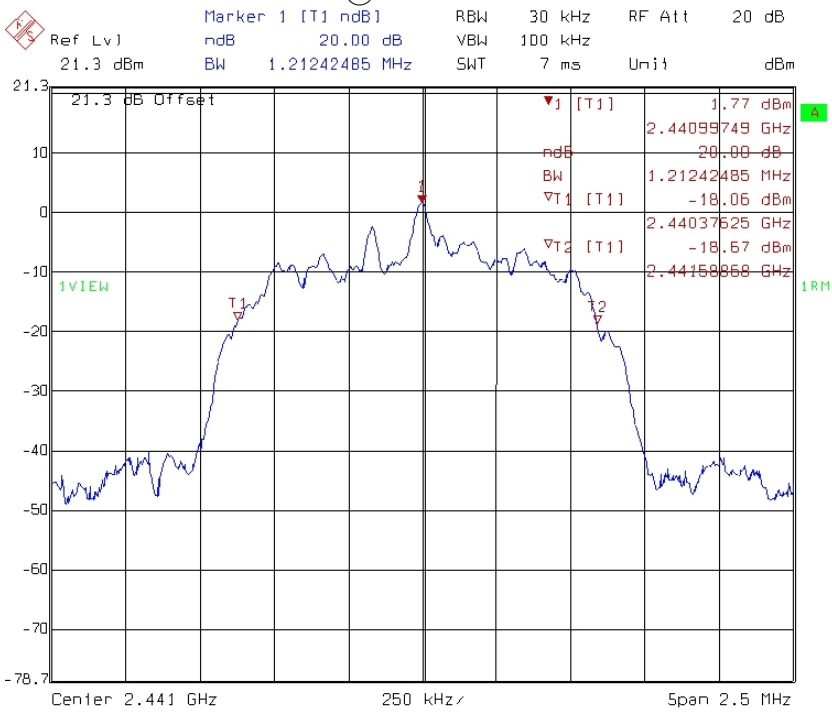
Title: 20dB Bandwidth
Comment A: GFSK ch78 2480 DH1
Date: 12.JUN.2012 11:59:59

20 dB Bandwidth @ π/4DPSK mode channel 0



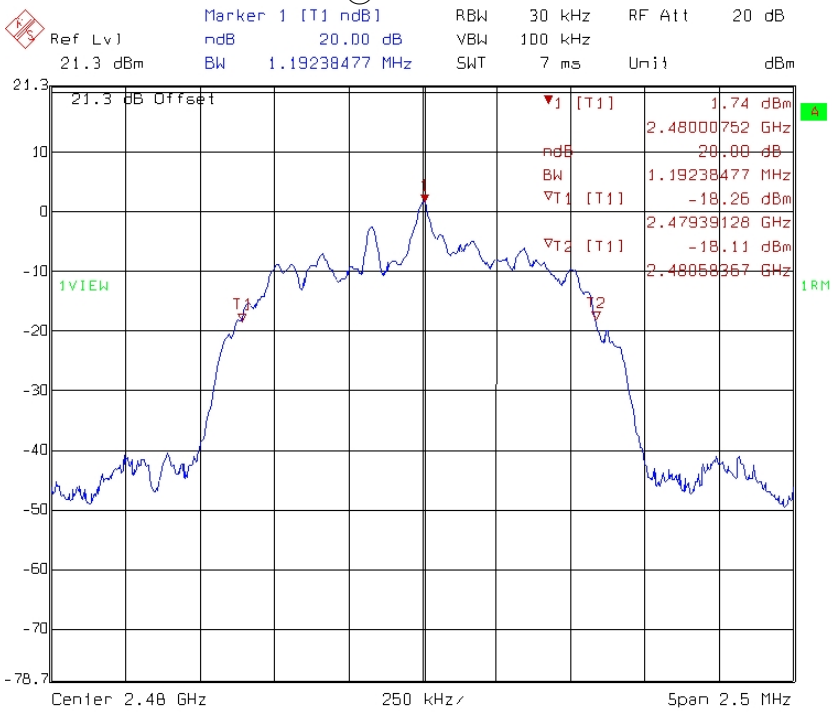
Title: 20dB Bandwidth
Comment A: pi/4-QPSK ch0 2402 DH1
Date: 02.JUL.2012 16:40:04

20 dB Bandwidth @ π/4DPSK mode channel 39



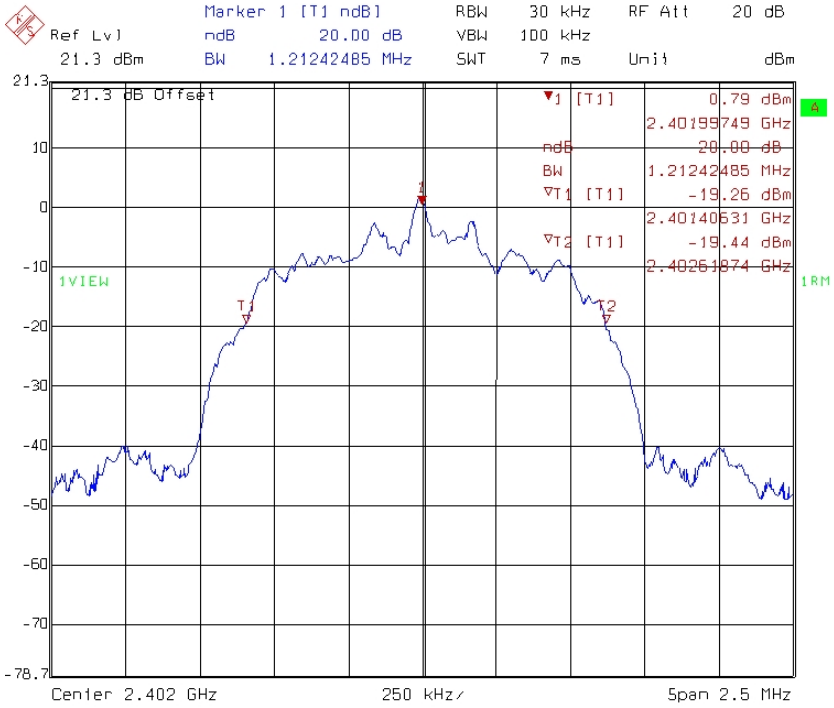
Title: 20dB Bandwidth
Comment A: pi/4-QPSK ch39 2441 DH1
Date: 13.JUN.2012 15:40:15

20 dB Bandwidth @ π/4DPSK mode channel 78



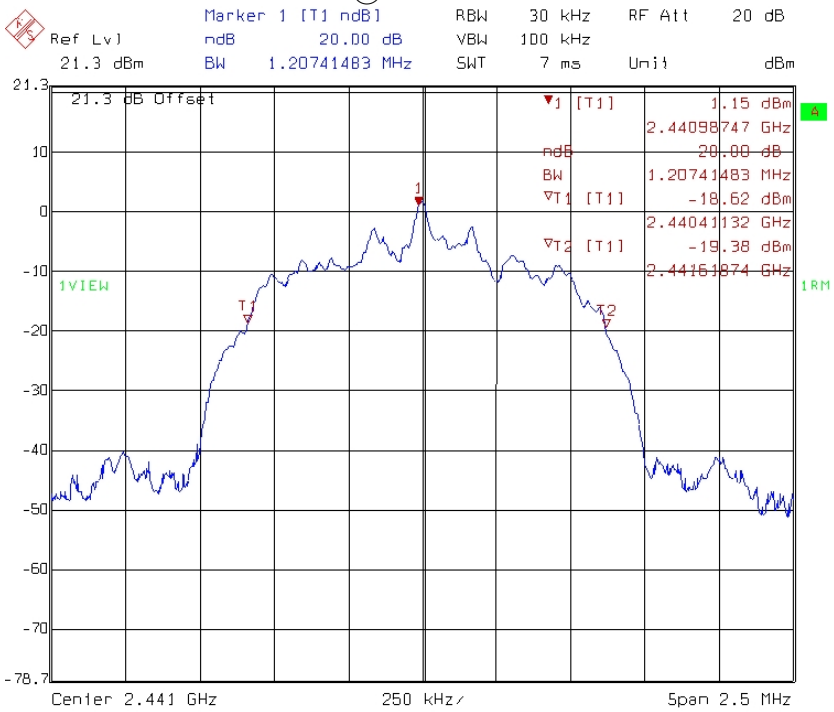
Title: 20dB Bandwidth
Comment A: pi/4-QPSK ch78 2480 DH1
Date: 13.JUN.2012 16:03:43

20 dB Bandwidth @ 8-DPSK mode channel 0



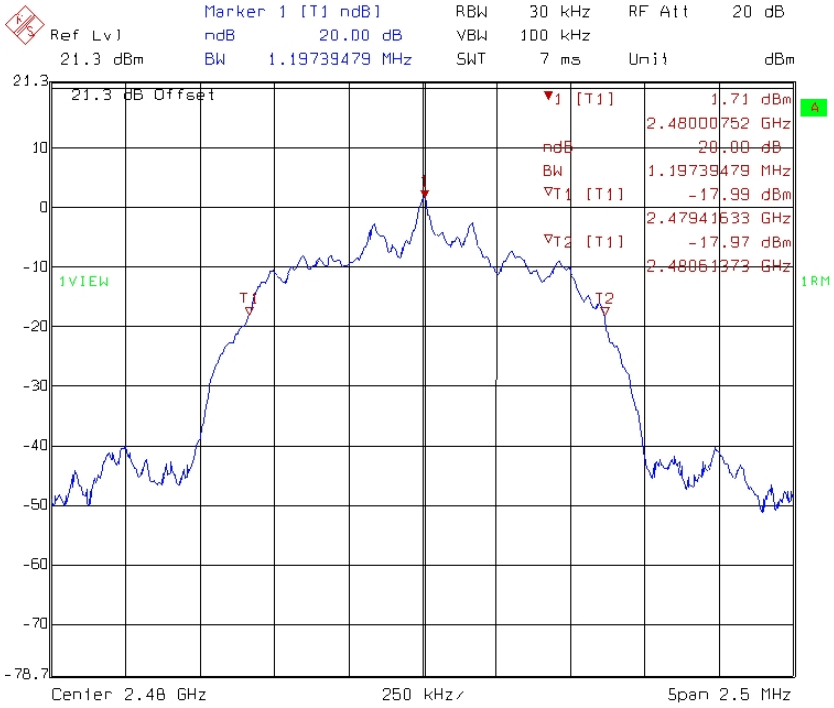
Title: 20dB Bandwidth
Comment A: 8DPSK ch0 2402 DH1
Date: 13.JUN.2012 16:09:52

20 dB Bandwidth @ 8-DPSK mode channel 39



Title: 20dB Bandwidth
Comment A: 8DPSK ch39 2441 DH1
Date: 13.JUN.2012 16:18:58

20 dB Bandwidth @ 8DPSK mode channel 78



Title: 20dB Bandwidth
Comment A: 8DPSK ch78 2480 DH1
Date: 13.JUN.2012 16:22:07

4. Carrier Frequency Separation test

4.1 Operating environment

Temperature:	23	℃
Relative Humidity:	55	%
Atmospheric Pressure:	1008	hPa

4.2 Test setup & procedure

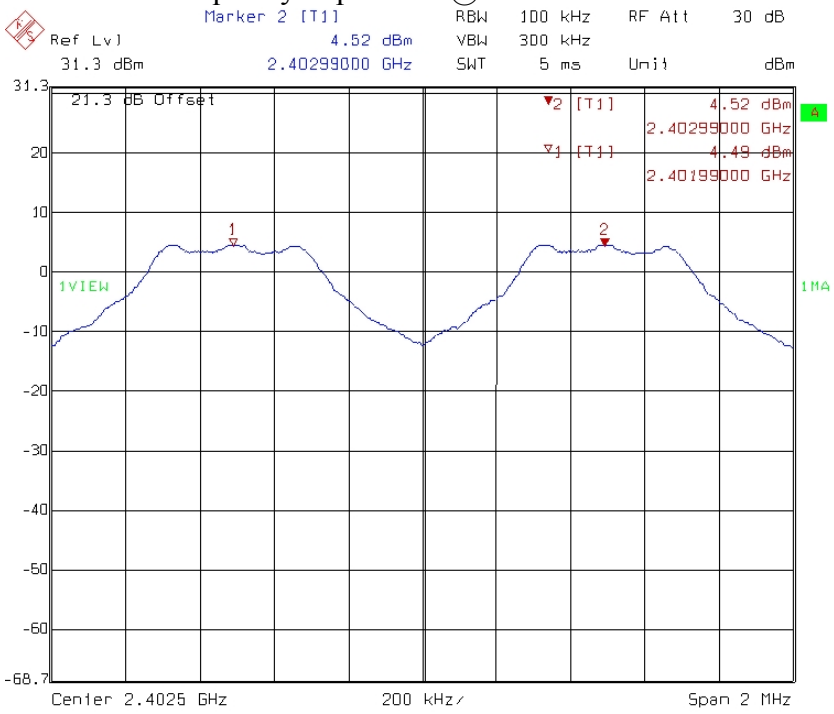
The test procedure was according to FCC measurement guidelines DA 00-705.
The carrier frequency separation per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at ≧1% of the span, the video bandwidth≧RBW, and the SPAN was wide enough to capture the peaks of two adjacent channels. The carrier frequency separation result is in the following Table.

4.3 Measured data of Carrier Frequency Separation test result

Mode	Channel	Frequency (MHz)	Carrier freq. Separation (MHz)	Limit 20dB BW*2/3(kHz)
GFSK	0	2402	2402.99	500.87
	39	2441	2441.99	534.40
	78	2480	2481.00	525.38

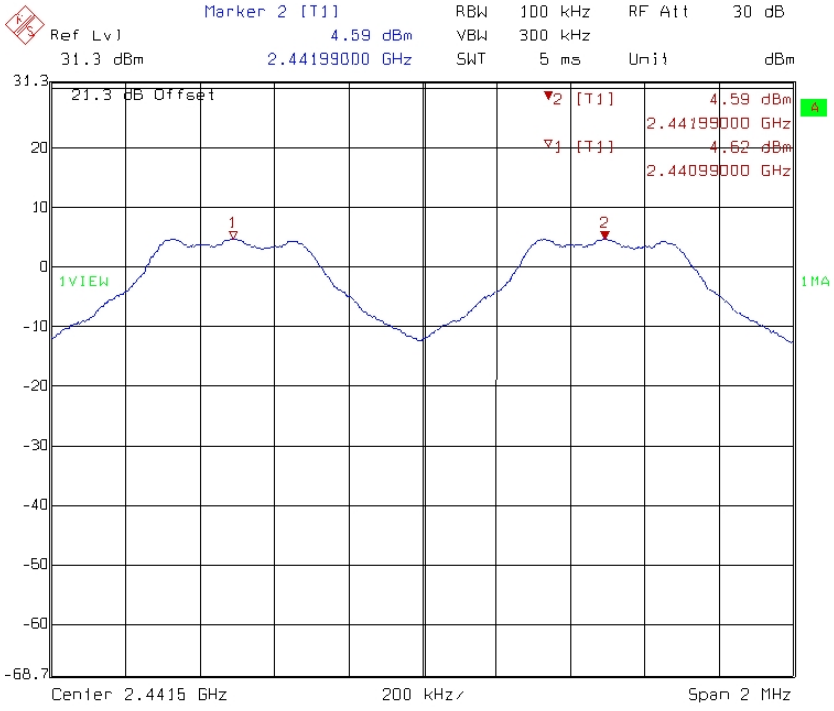
Please see the plot below.

Carrier Frequency Separation @ GFSK mode channel 0



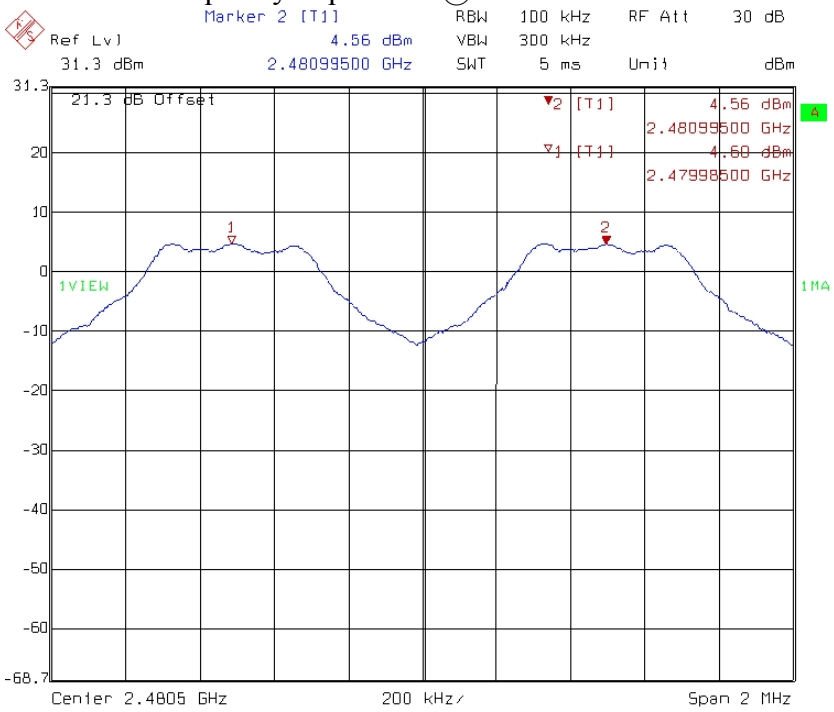
Title: Carrier freq. separation
Comment A: GFSK ch0 2402 DH1
Date: 12.JUN.2012 11:32:17

Carrier Frequency Separation @ GFSK mode channel 39



Title: Carrier freq. separation
Comment A: GFSK ch39 2441 DH1
Date: 12.JUN.2012 11:54:23

Carrier Frequency Separation @ GFSK mode channel 78



Title: Carrier freq. separation
Comment A: GFSK ch78 2480 DH1
Date: 12.JUN.2012 11:58:29

5. Number of hopping frequencies test

5.1 Operating environment

Temperature:	25	℃
Relative Humidity:	55	%
Atmospheric Pressure:	1008	hPa

5.2 Test setup & procedure

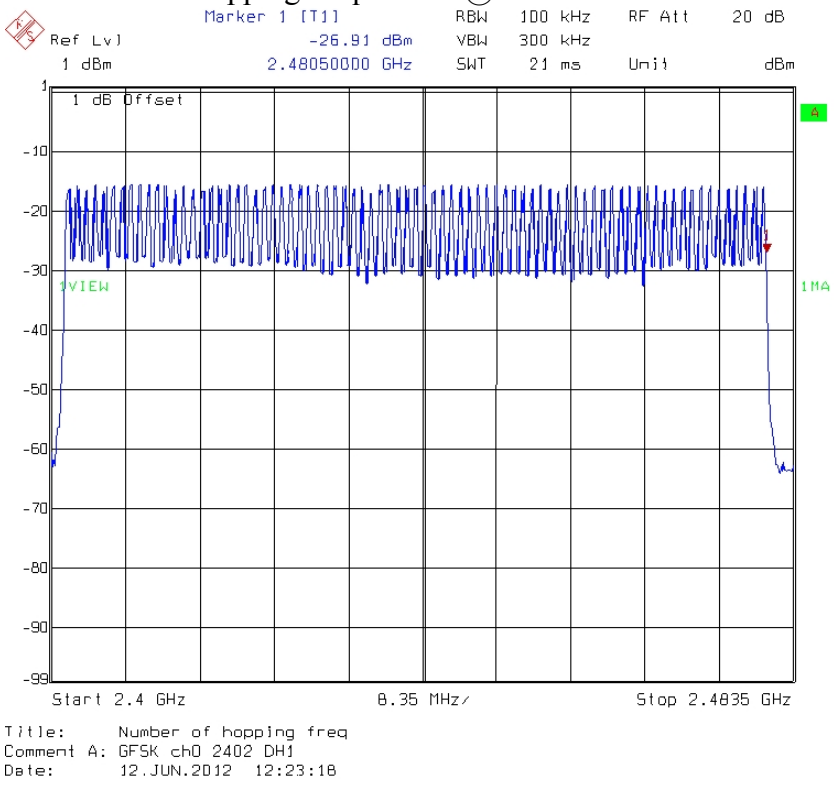
The test procedure was according to FCC measurement guidelines DA 00-705.
The number of hopping frequencies per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at ≧1% of the span, the video bandwidth≧RBW, and the SPAN was the frequency band of operation. The carrier frequency separation result is in the following Table.

5.3 Measured data of number of hopping frequencies test result

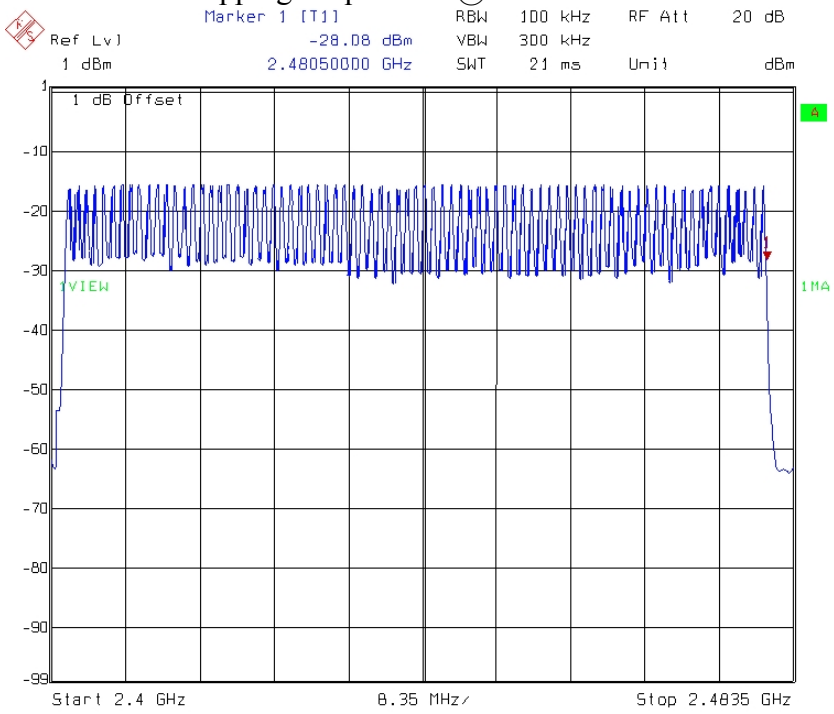
Frequency Range (MHz)	Total hopping channels
2400 ~ 2483.5	79

Please see the plot below.

Number of hopping frequencies @ GFSK mode channel 0

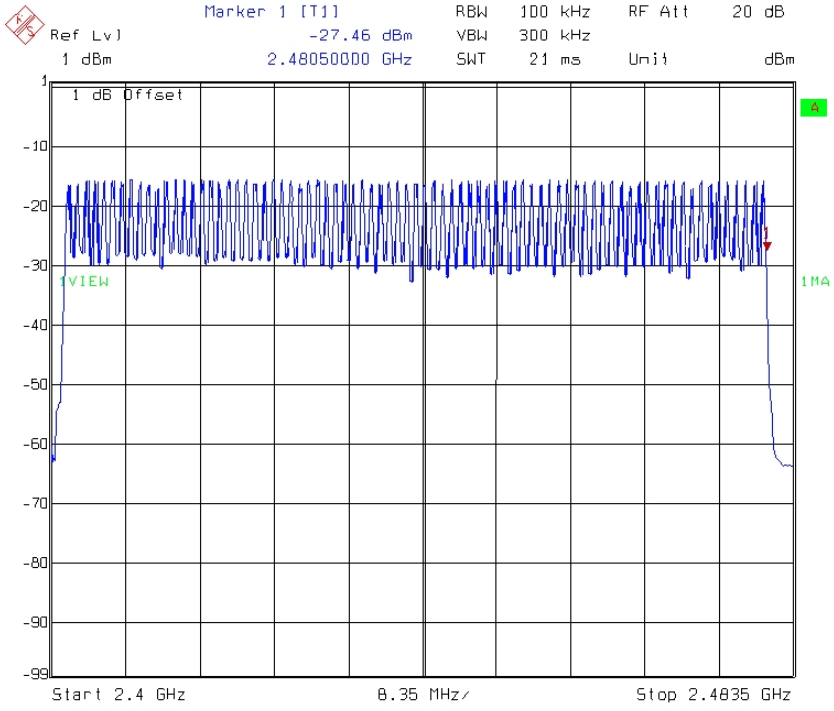


Number of hopping frequencies @ GFSK mode channel 39



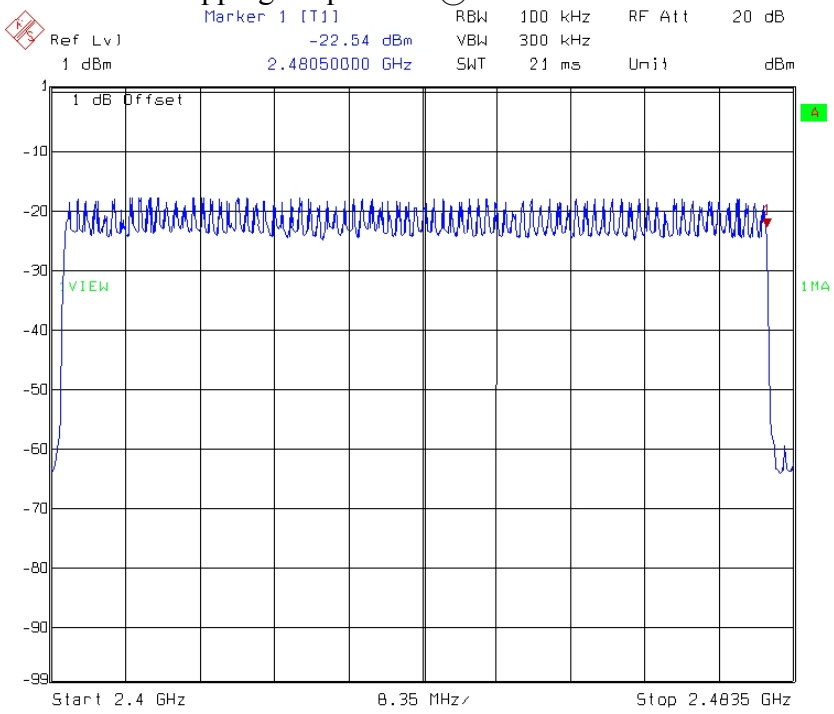
Title: Number of hopping freq
Comment A: GFSK ch39 2441 DH1
Date: 12.JUN.2012 12:14:52

Number of hopping frequencies @ GFSK mode channel 78



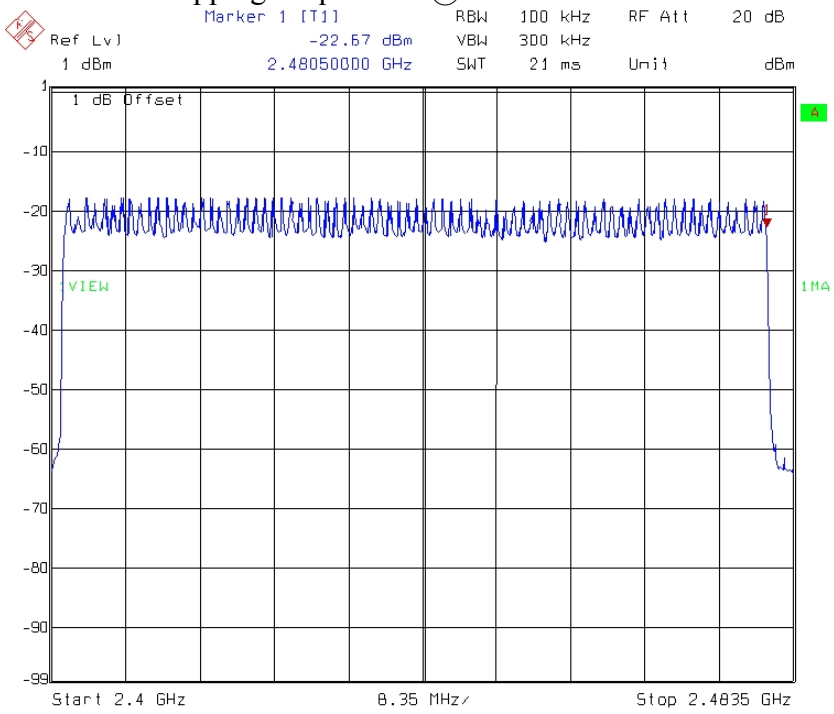
Title: Number of hopping freq
Comment A: GFSK ch78 2480 DH1
Date: 12.JUN.2012 12:25:37

Number of hopping frequencies @ π/4-DPSK mode channel 0



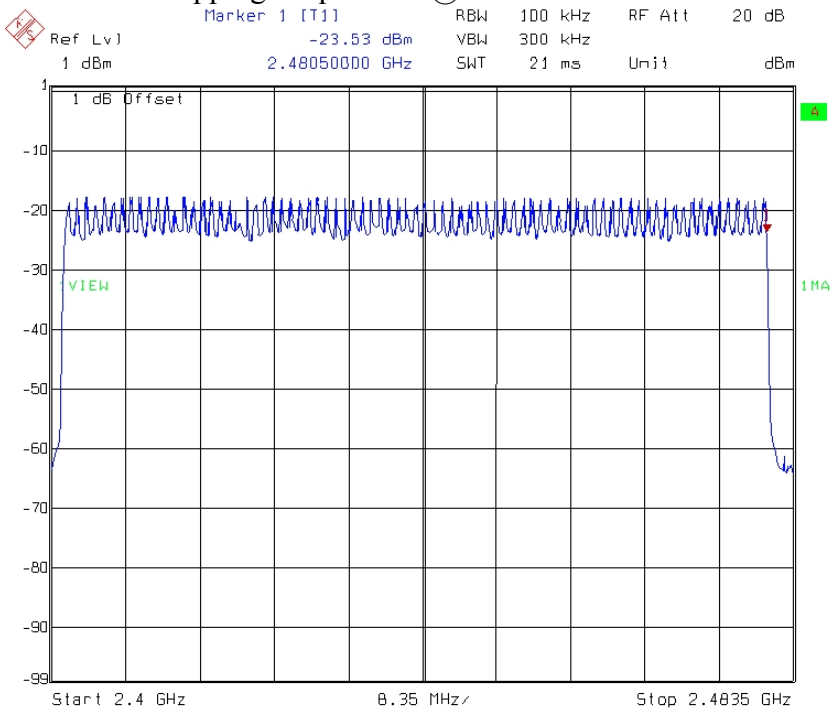
Title: Number of hopping freq
Comment A: pi/4-QPSK ch0 2402 DH1
Date: 13.JUN.2012 15:34:39

Number of hopping frequencies @ π/4-DPSK mode channel 39



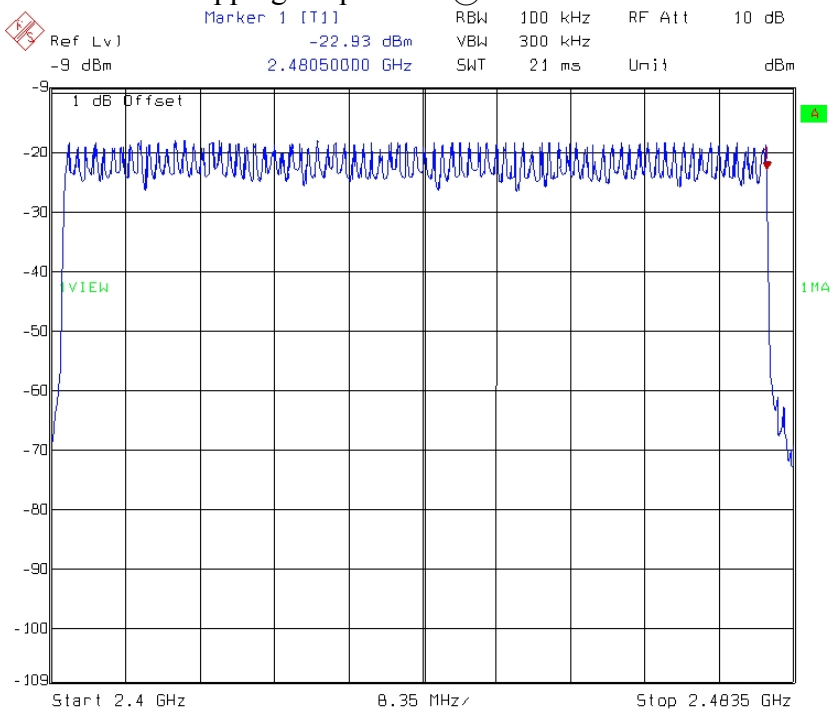
Title: Number of hopping freq
Comment A: pi/4-QPSK ch39 2441 DH1
Date: 13.JUN.2012 15:54:05

Number of hopping frequencies @ π/4-DPSK mode channel 78



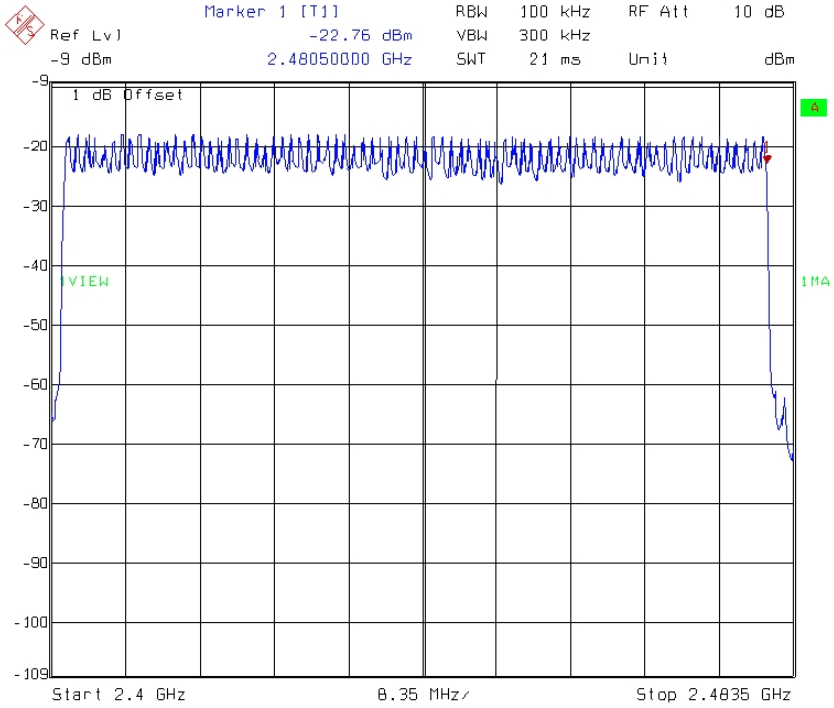
Title: Number of hopping freq
Comment A: pi/4-QPSK ch39 2441 DH1
Date: 13.JUN.2012 16:01:09

Number of hopping frequencies @ 8-DPSK mode channel 0



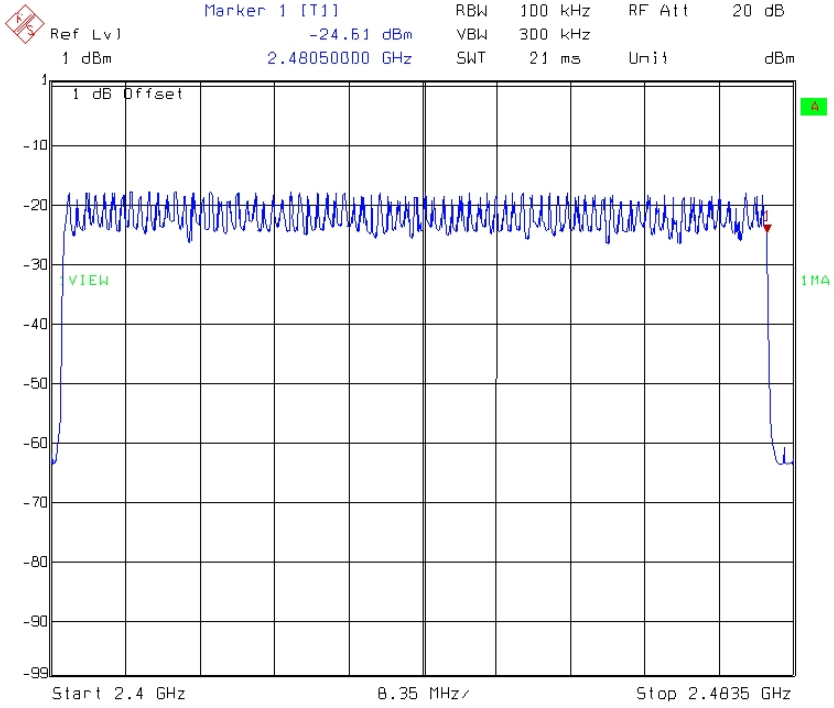
Title: Number of hopping freq
Comment A: 8DPSK ch0 2402 DH1
Date: 13.JUN.2012 16:13:53

Number of hopping frequencies @ 8-DPSK mode channel 39



Title: Number of hopping freq
Comment A: 8DPSK ch39 2441 DH1
Date: 13.JUN.2012 16:17:03

Number of hopping frequencies @ 8-DPSK mode channel 78



Title: Number of hopping freq
Comment A: 8DPSK ch78 2480 DH1
Date: 13.JUN.2012 16:30:13

6. Time of Occupancy (dwell time) & Duty Cycle Correction Factor test

6.1 Operating environment

Temperature:	23	℃
Relative Humidity:	55	%
Atmospheric Pressure:	1008	hPa

6.2 Test setup & procedure

The test procedure was according to FCC measurement guidelines DA 00-705.
The time of occupancy (dwell time) per FCC §15.247(a)(1) was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 1MHz, the video bandwidth≧RBW, and the zero span function of spectrum analyzer was enable. The EUT has its hopping function enable.

The system makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels.

The total sweep time is 0.4(79) =31.6 seconds
Due to the number of hops in the 31.6s sweep we determined to reduce the sweep time to 3.16s, count the number of hops and multiply by 10. The total number of hops will be multiplied by the measured time of one pulse.

Time of occupancy (dwell time) for DH1
Number of Hops in 3.16s=32, Total Number of Hops in 31.6s = 32(10) =320
Single Pulse Width = 0.0003983 sec
Dwell time = Pulse Width * 320= 127.5 ms

Time of occupancy (dwell time) for DH3
Number of Hops in 3.16s=17, Total Number of Hops in 31.6s = 17(10) =170
Single Pulse Width = 0.001655 sec
Dwell time = Pulse Width * 170= 281.4 ms

Time of occupancy (dwell time) for DH5
Number of Hops in 3.16s=11, Total Number of Hops in 31.6s = 11(10) =110
Single Pulse Width = 0.0029 sec
Dwell time = Pulse Width * 110= 319 ms

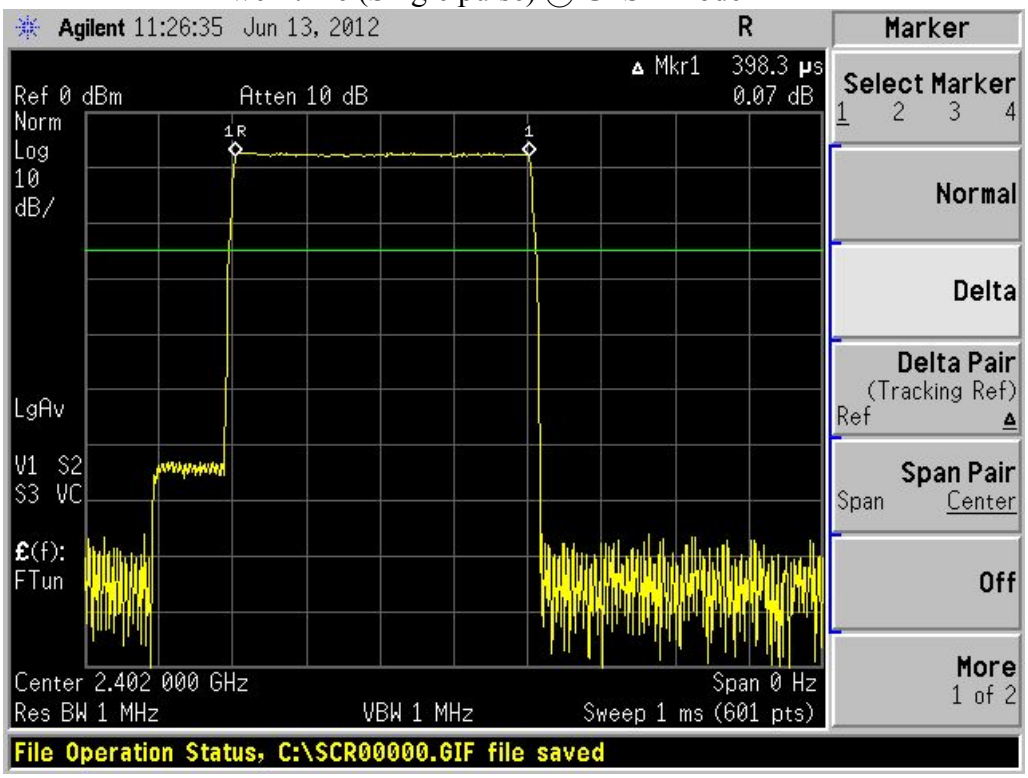
Mode	Packet type	Pulse duration (ms)	Number of pulse	Measure time (s)	Dwell time (s)	Limit (s)
GFSK	DH1	0.3983	32	3.16	0.1275	0.4
	DH3	1.6550	17	3.16	0.2814	0.4
	DH5	2.9000	11	3.16	0.3190	0.4
π/4-DPSK	DH1	0.4117	33	3.16	0.1359	0.4
	DH3	1.6650	17	3.16	0.2831	0.4
	DH5	2.9080	11	3.16	0.3199	0.4
8-DPSK	DH1	0.4100	32	3.16	0.1312	0.4
	DH3	1.6600	17	3.16	0.2822	0.4
	DH5	2.9170	11	3.16	0.3209	0.4

Mode	Packet type	Pulse time (ms)	Number of pulse during time period	Time period (ms)	Duty cycle %	Duty cycle correction factor
GFSK	DH1	0.3983	1	98.8	0.40	-47.89
	DH3	1.6550	1	100	1.66	-35.62
	DH5	2.9000	1	100	2.90	-30.75
π/4-DPSK	DH1	0.4117	1	98.8	0.42	-47.60
	DH3	1.6650	1	100	1.67	-35.57
	DH5	2.9080	1	100	2.91	-30.73
8-DPSK	DH1	0.4100	1	98.8	0.41	-47.64
	DH3	1.6600	1	100	1.66	-35.60
	DH5	2.9170	1	100	2.92	-30.70

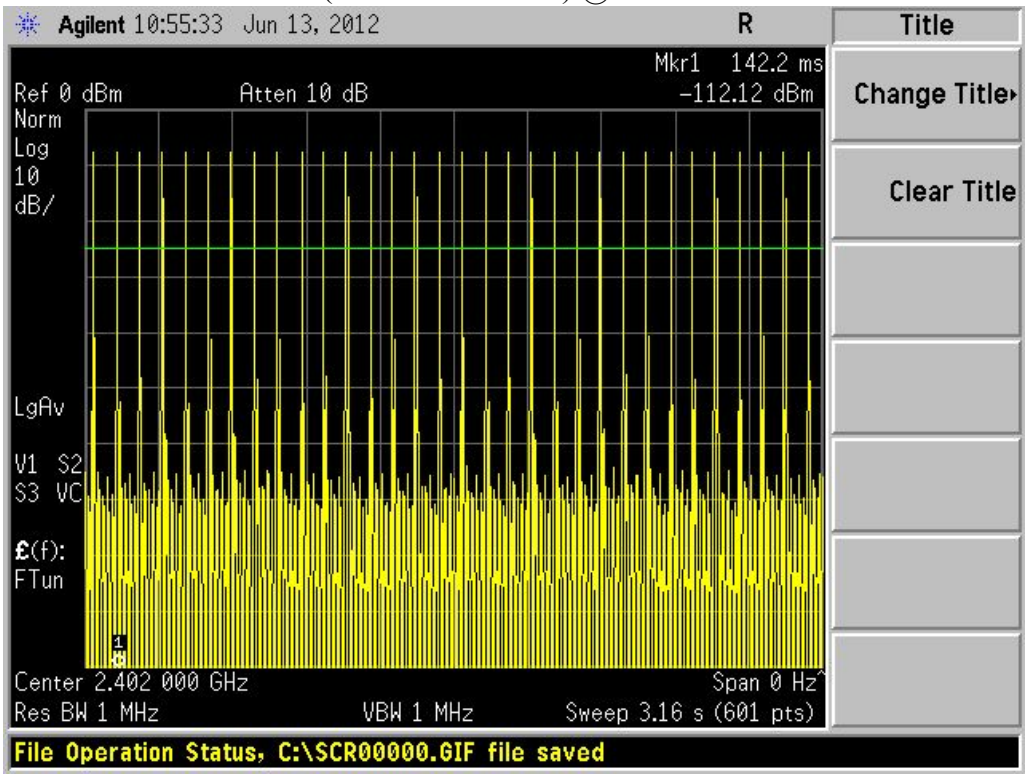
Remark:
1. The time period over which the duty cycle is measured in 100 ms or the repetition cycle, whichever is a shorter time frame.
2. Duty Cycle = (Pulse time)/(Time period)*100%
3. Duty Cycle Correction Factor = 20 log (Duty cycle)
4. The worst case of GFSK mode is -30.75
   The worse case of π/4-DPSK mode is –30.73
   The worse case of 8-DPSK mode is –30.70

Please see the plot below.

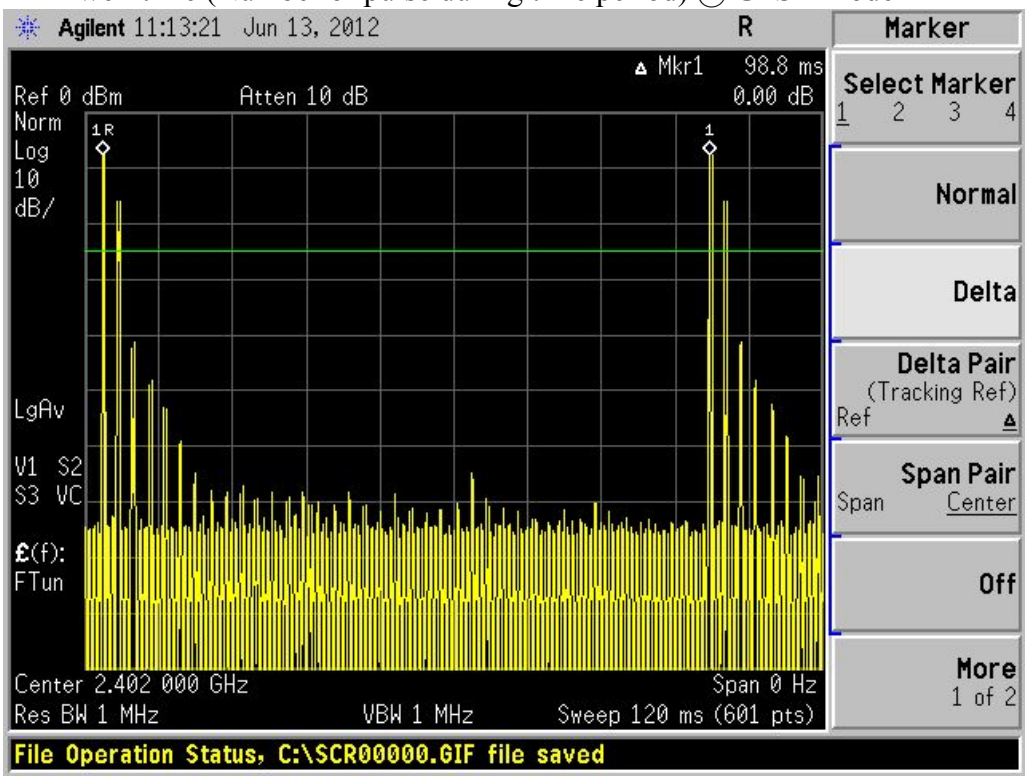
Dwell time (Single pulse) @ GFSK mode DH 1



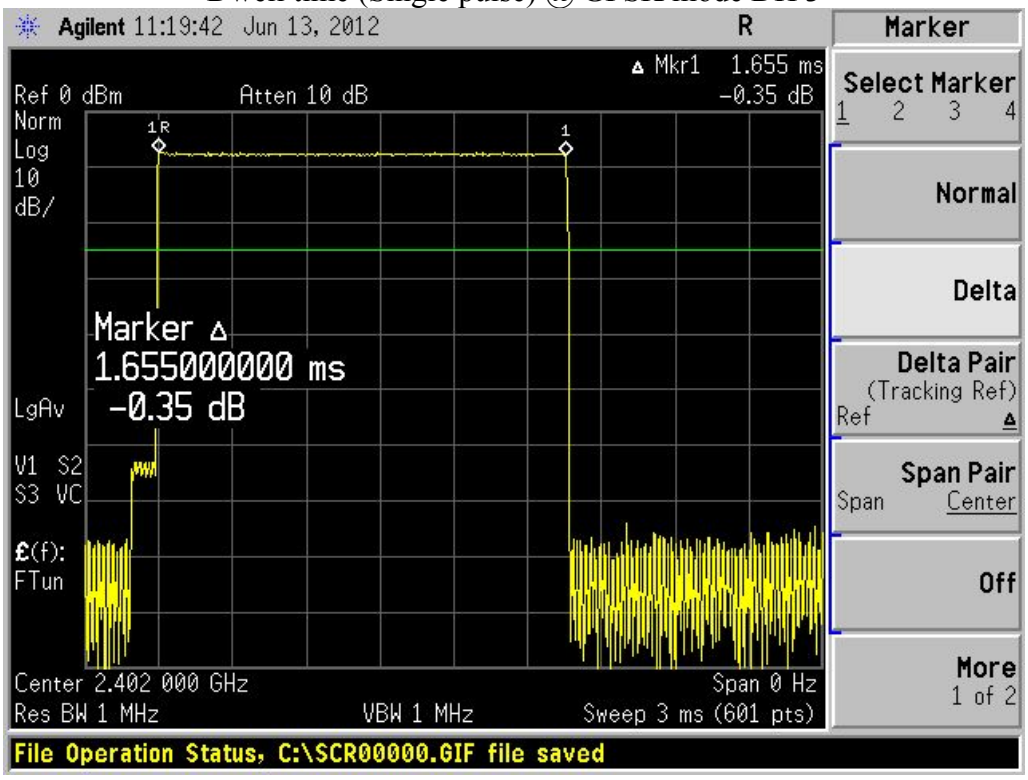
Dwell time (Number of Pulses) @ GFSK mode DH 1



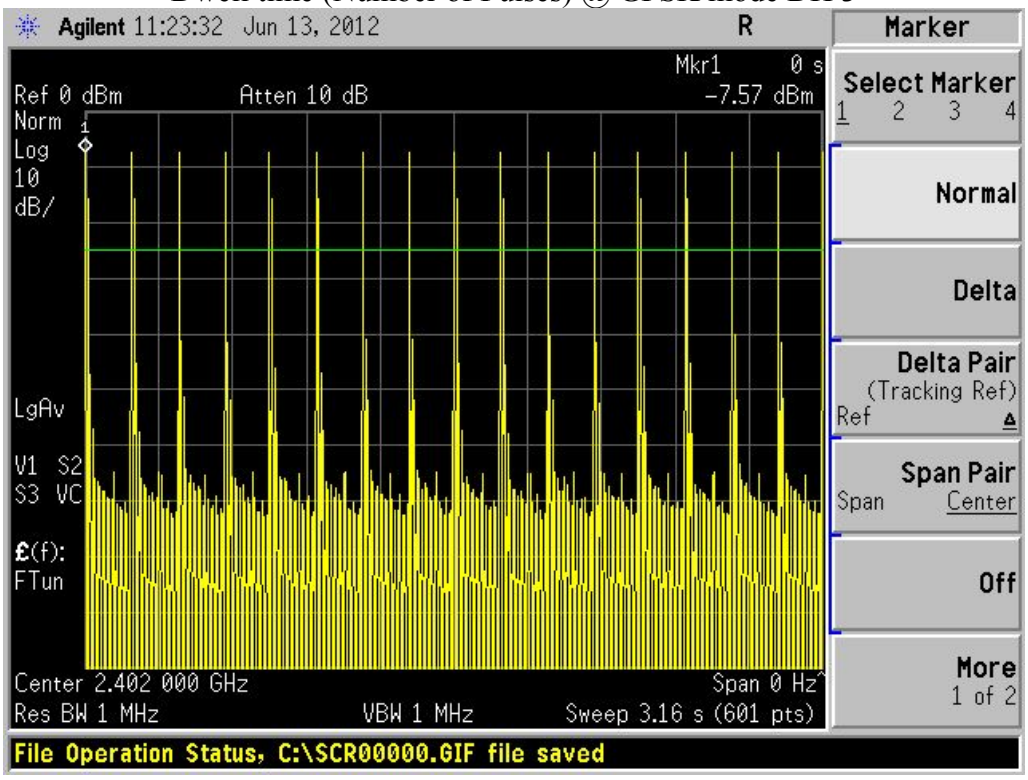
Dwell time (Number of pulse during time period) @ GFSK mode DH 1



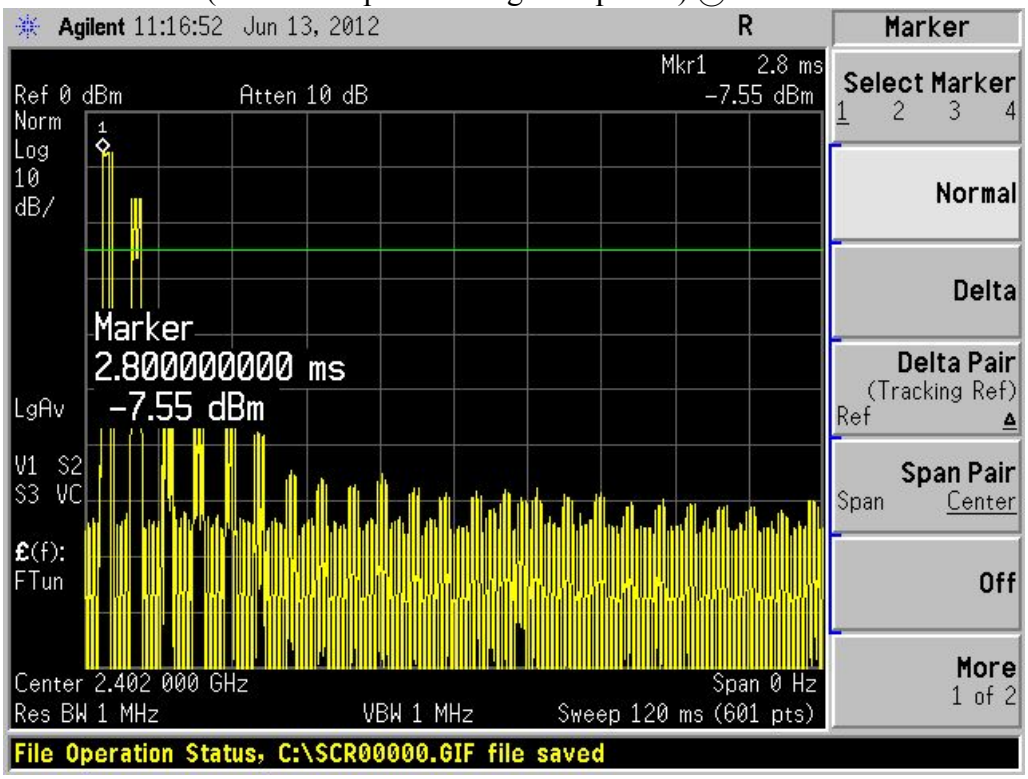
Dwell time (Single pulse) @ GFSK mode DH 3



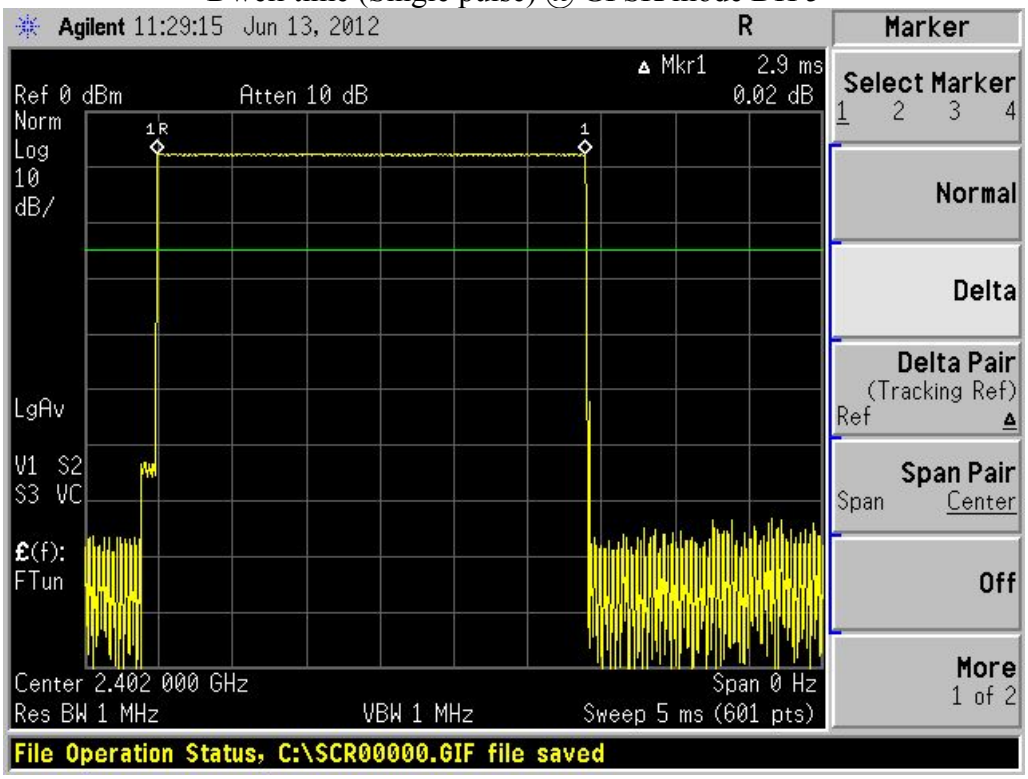
Dwell time (Number of Pulses) @ GFSK mode DH 3



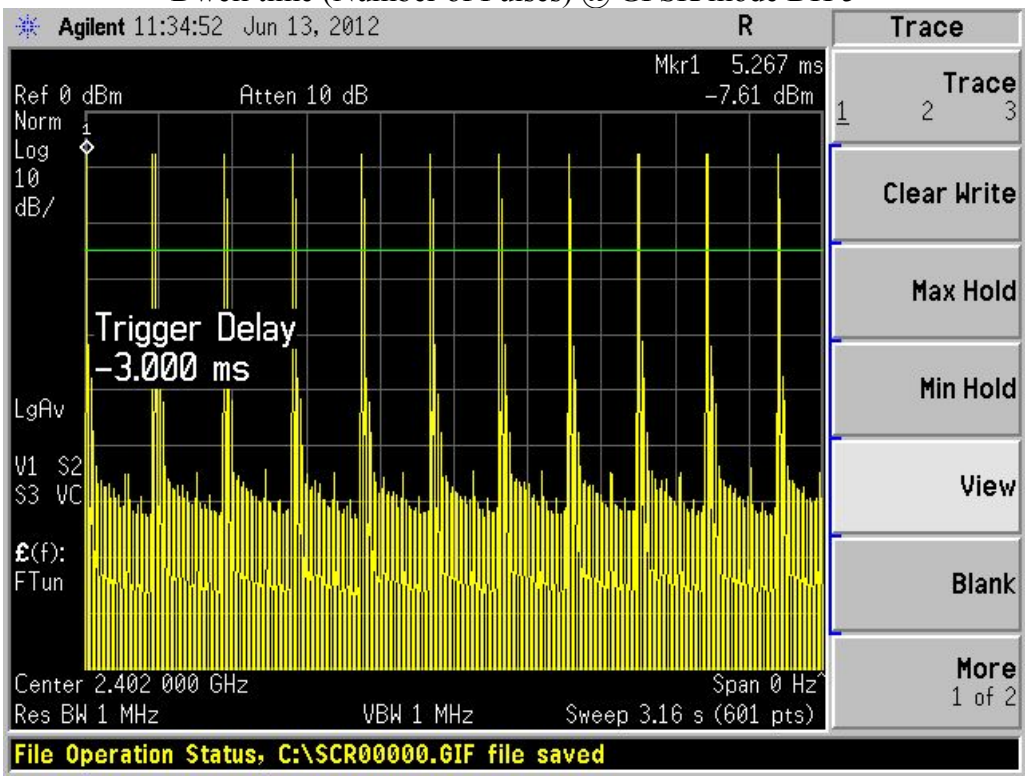
Dwell time (Number of pulse during time period) @ GFSK mode DH 3



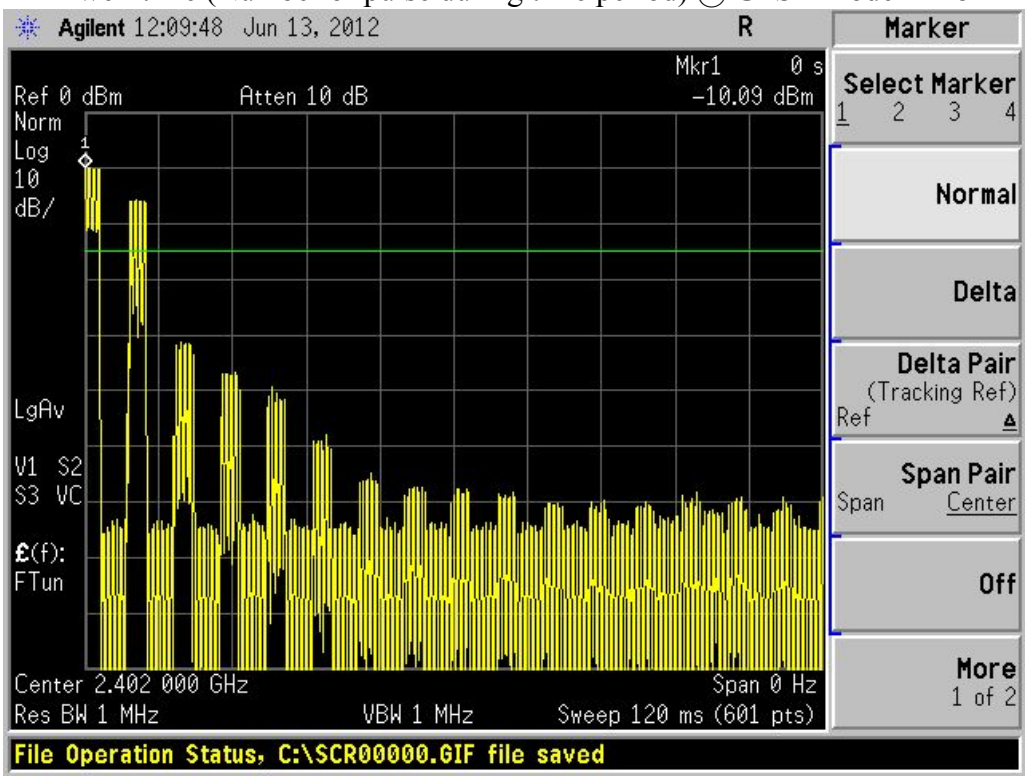
Dwell time (Single pulse) @ GFSK mode DH 5



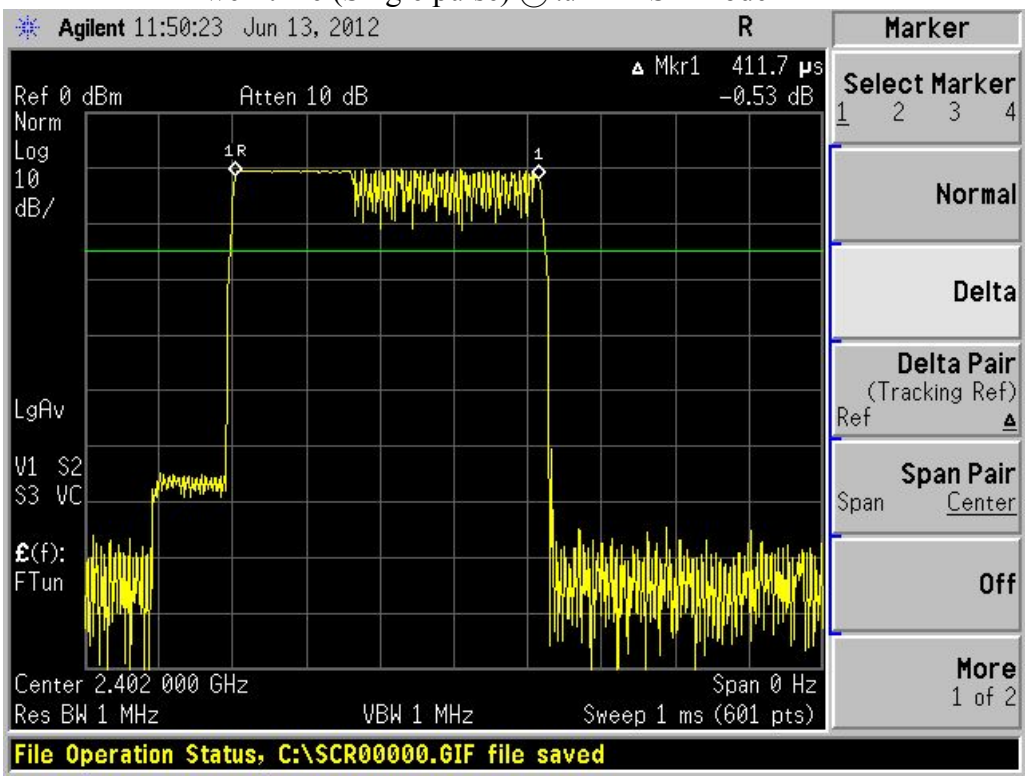
Dwell time (Number of Pulses) @ GFSK mode DH 5



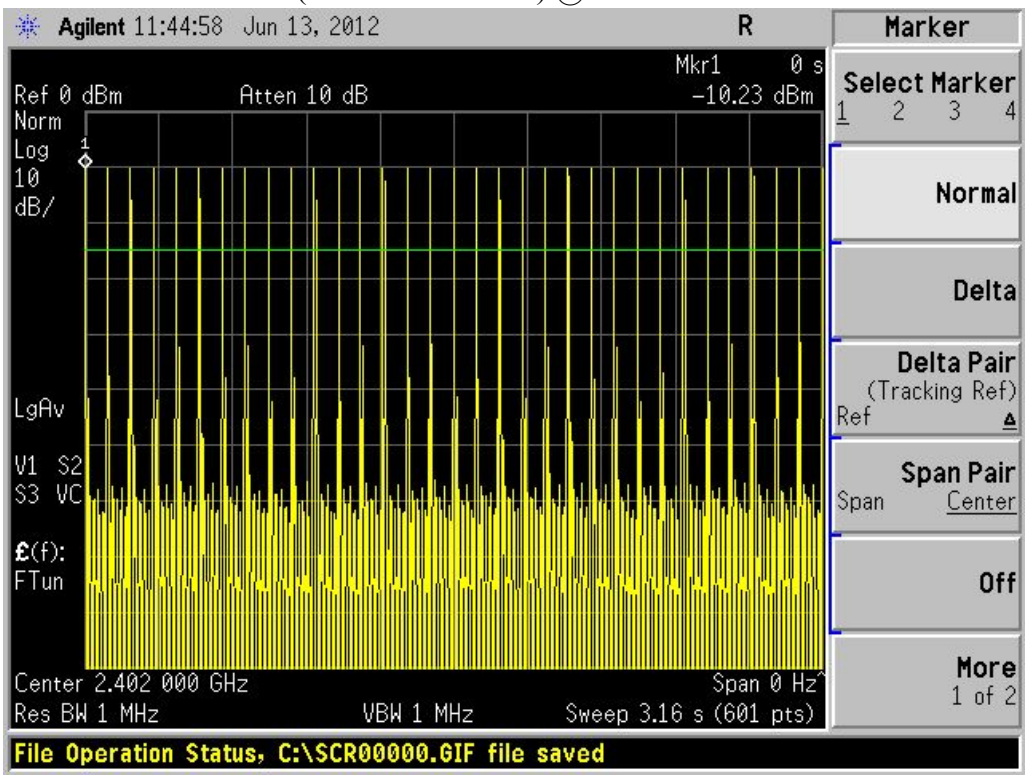
Dwell time (Number of pulse during time period) @ GFSK mode DH 5



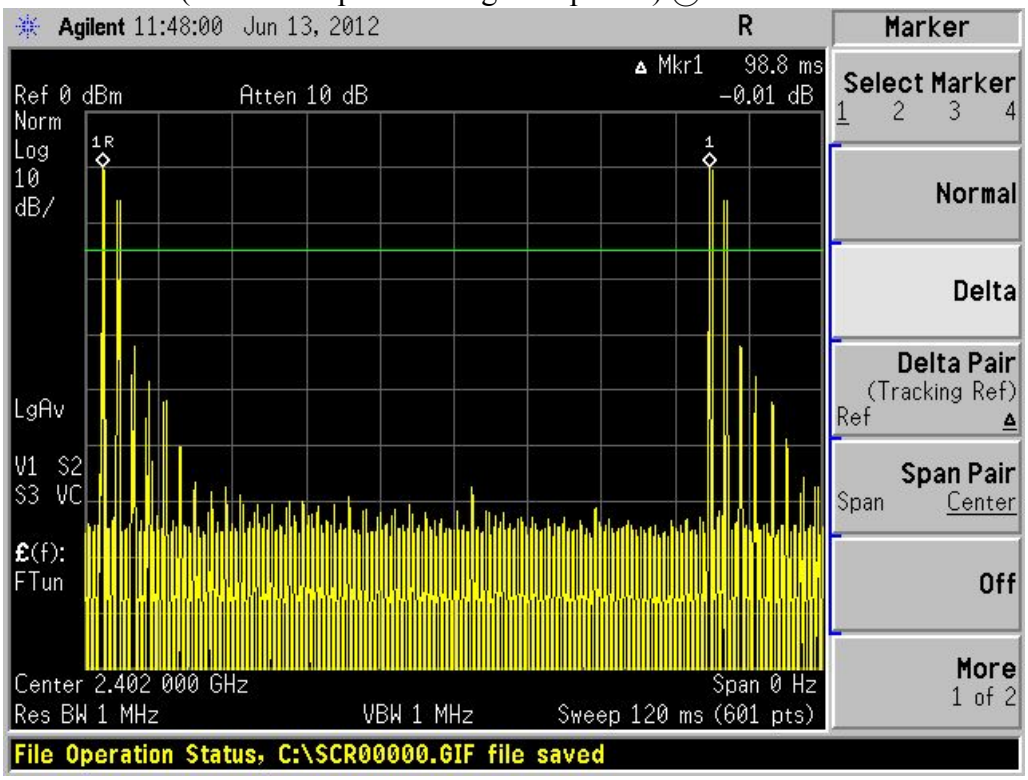
Dwell time (Single pulse) @ π/4-DPSK mode DH 1



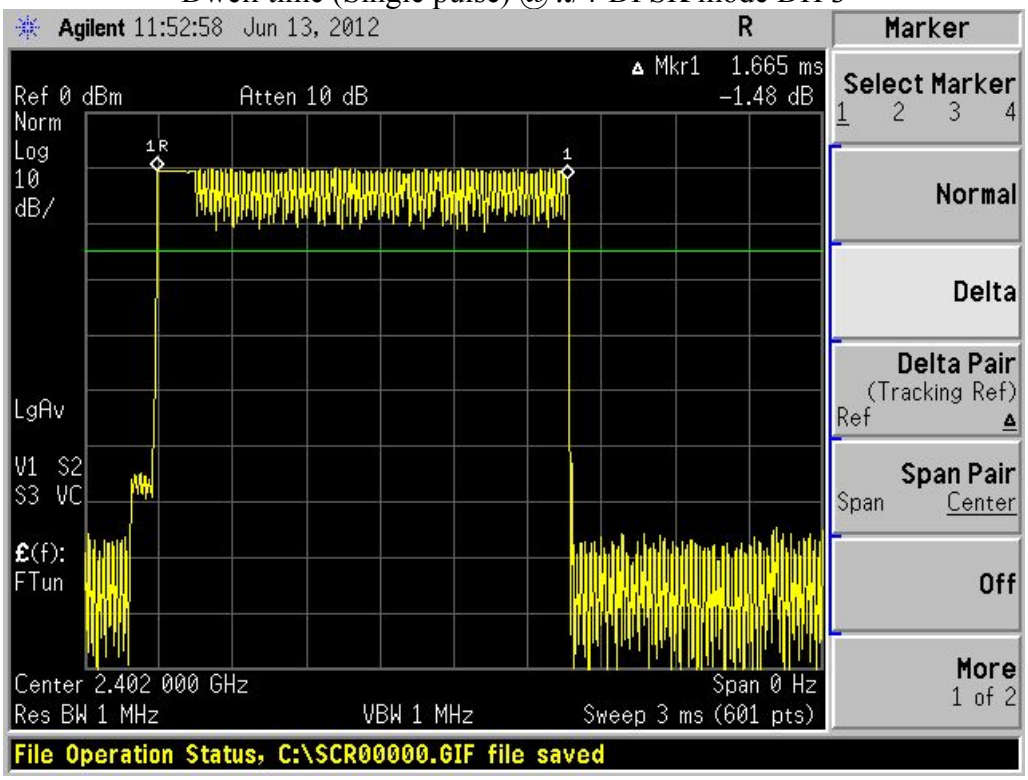
Dwell time (Number of Pulses) @ π/4-DPSK mode DH 1



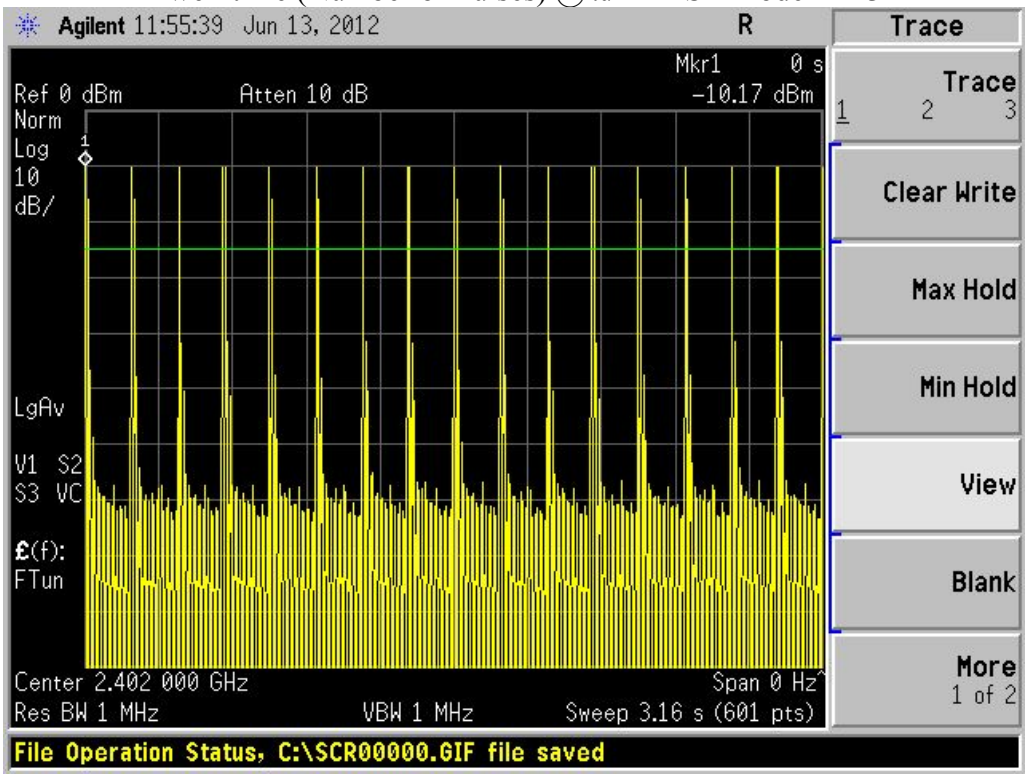
Dwell time (Number of pulse during time period) @ π/4-DPSK mode DH 1



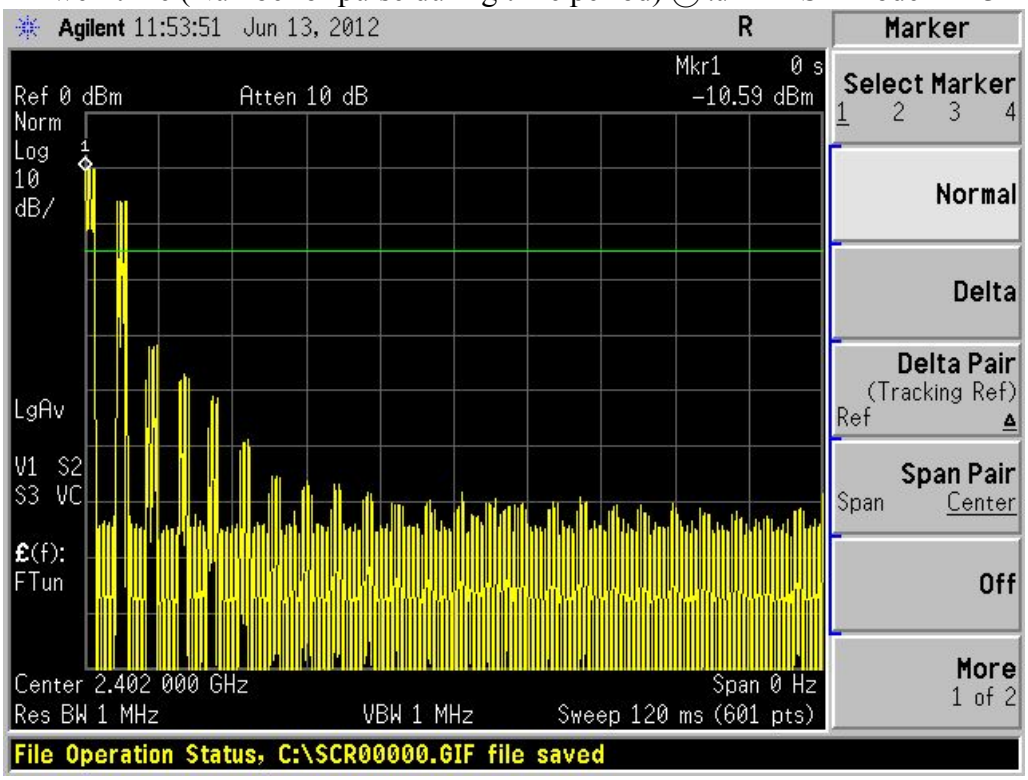
Dwell time (Single pulse) @ π/4-DPSK mode DH 3



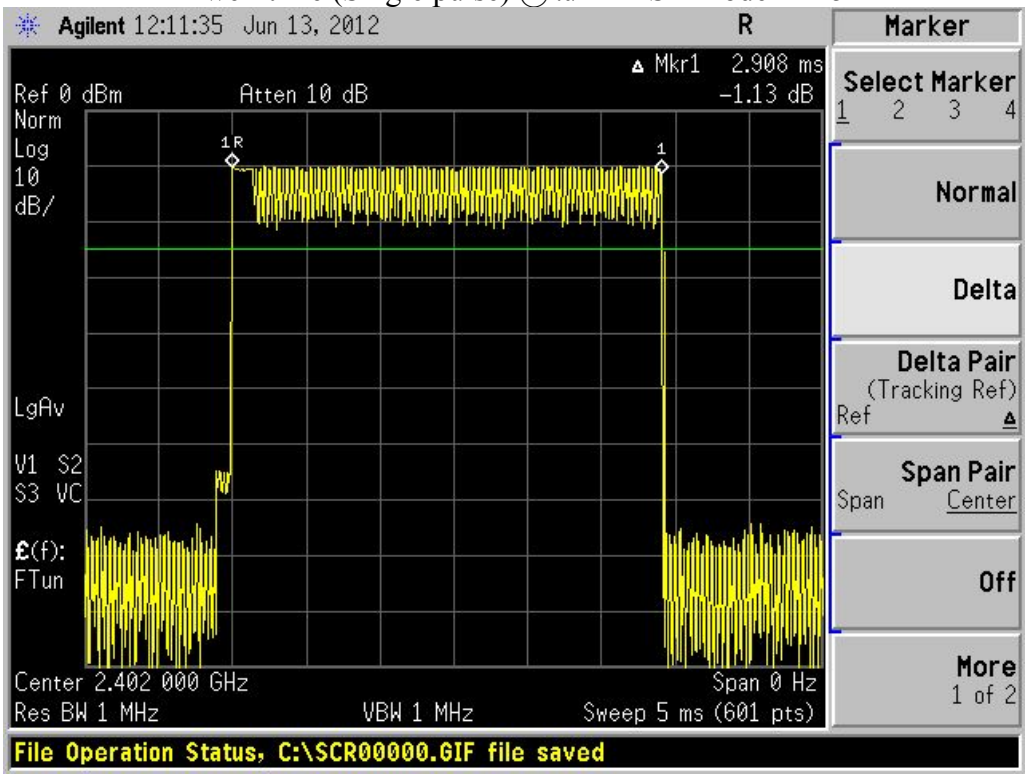
Dwell time (Number of Pulses) @ π/4-DPSK mode DH 3



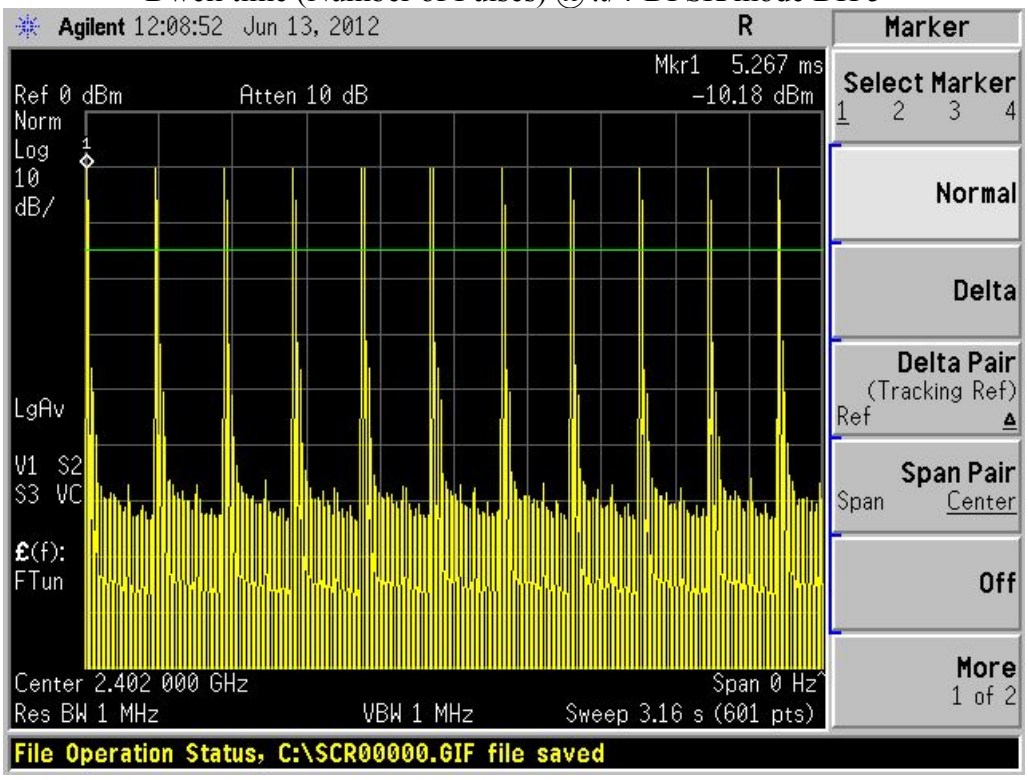
Dwell time (Number of pulse during time period) @ π/4-DPSK mode DH 3



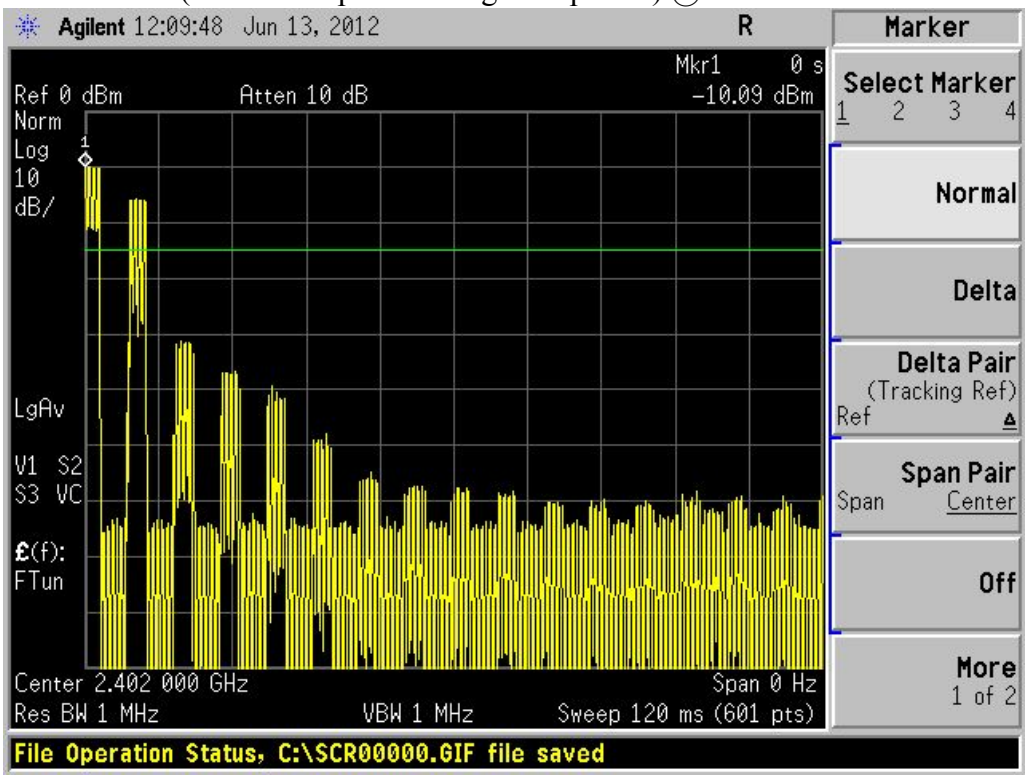
Dwell time (Single pulse) @ π/4-DPSK mode DH 5



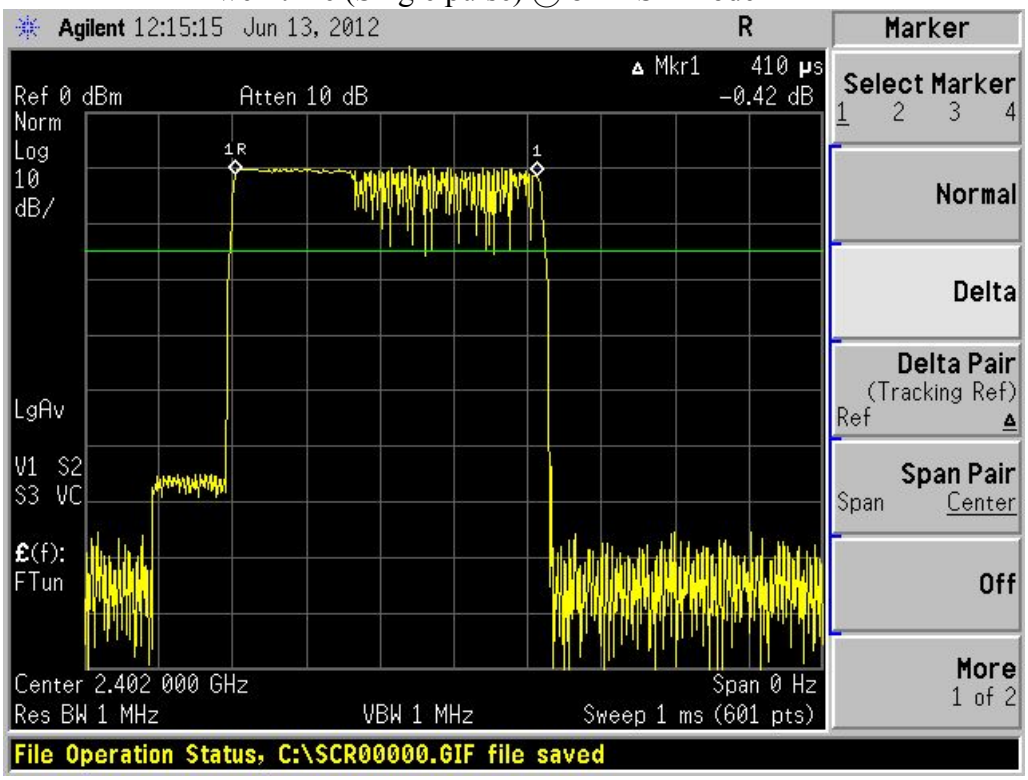
Dwell time (Number of Pulses) @ π/4-DPSK mode DH 5



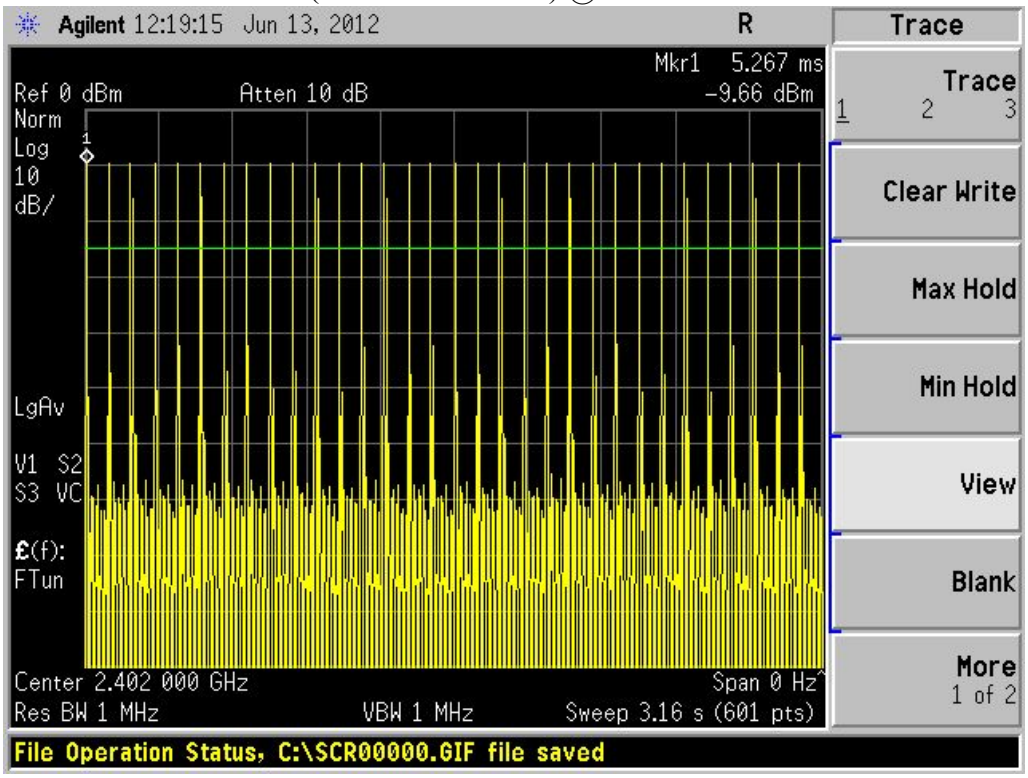
Dwell time (Number of pulse during time period) @ π/4-DPSK mode DH 5



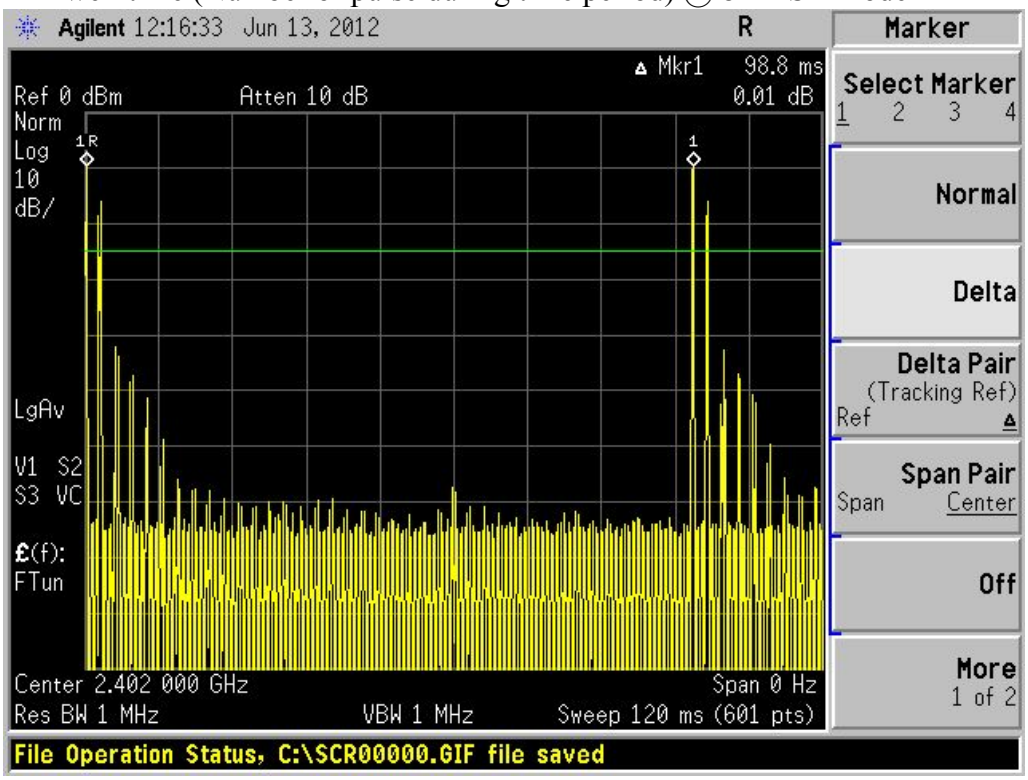
Dwell time (Single pulse) @ 8-DPSK mode DH 1



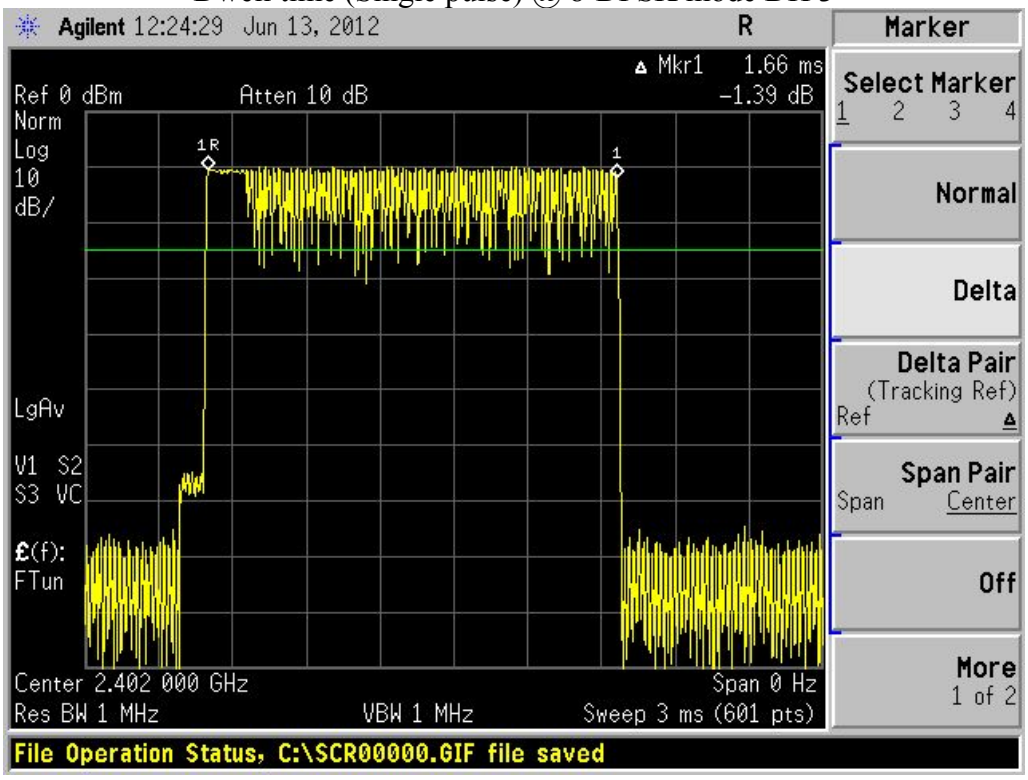
Dwell time (Number of Pulses) @ 8-DPSK mode DH 1



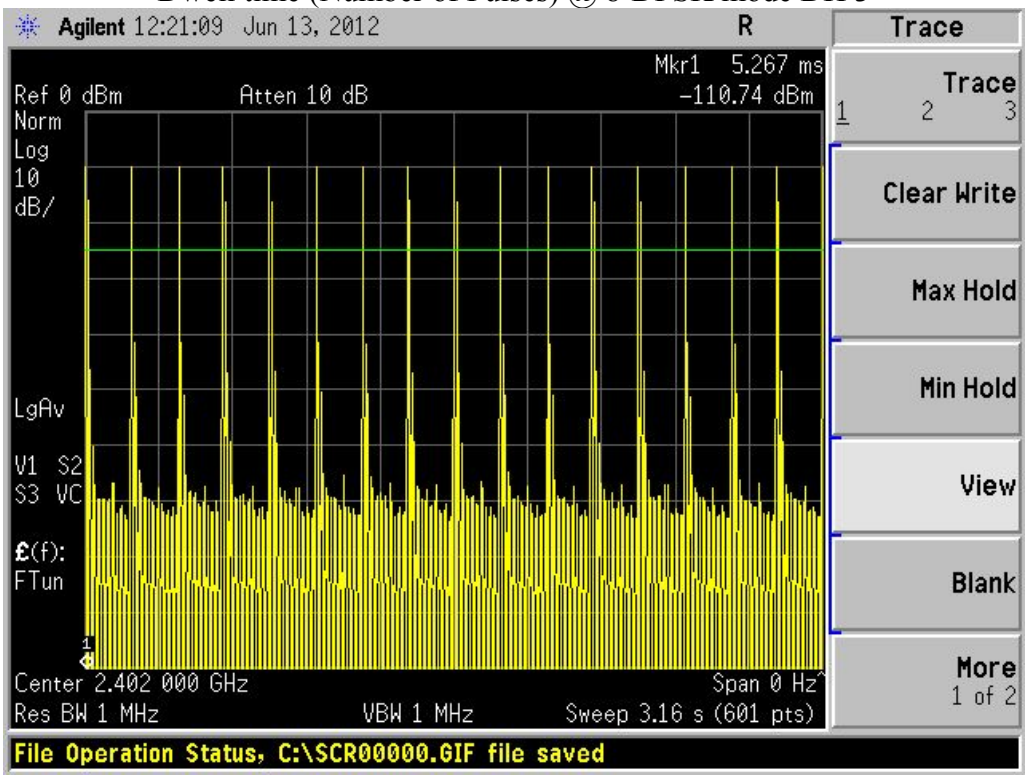
Dwell time (Number of pulse during time period) @ 8-DPSK mode DH 1



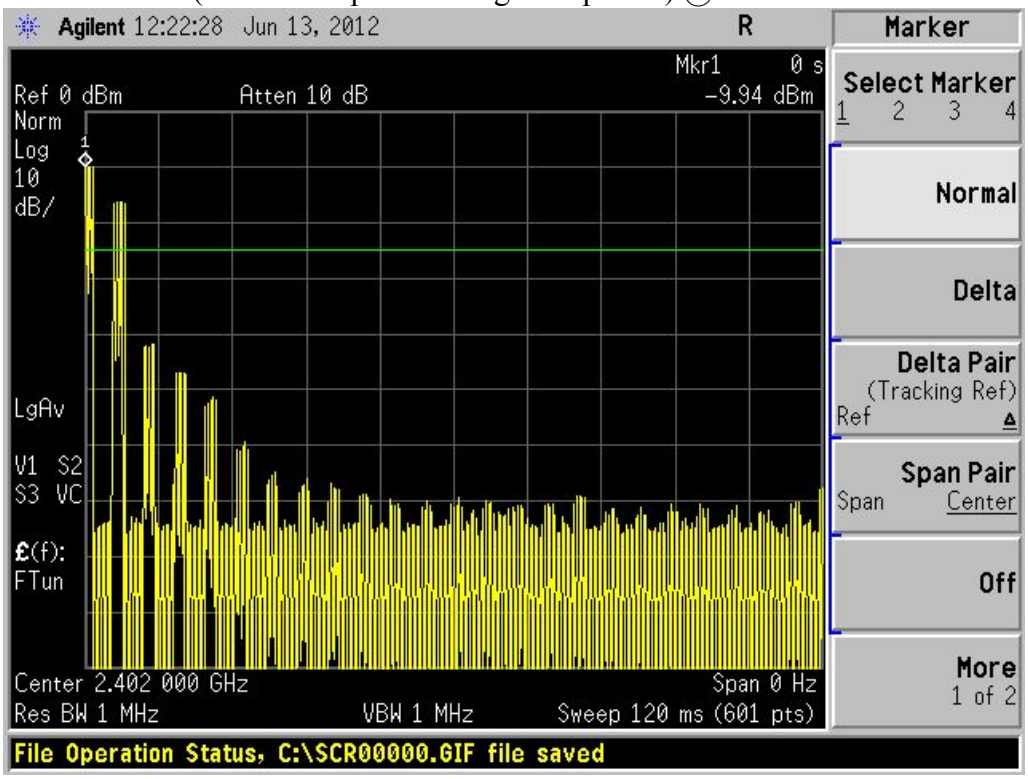
Dwell time (Single pulse) @ 8-DPSK mode DH 3



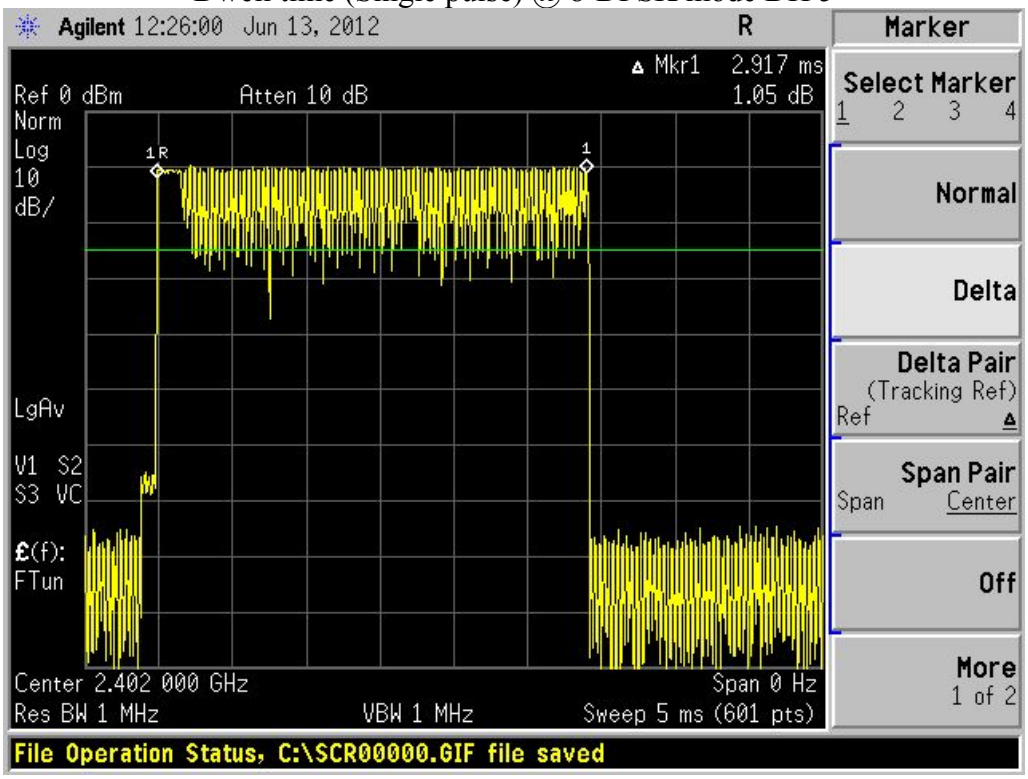
Dwell time (Number of Pulses) @ 8-DPSK mode DH 3



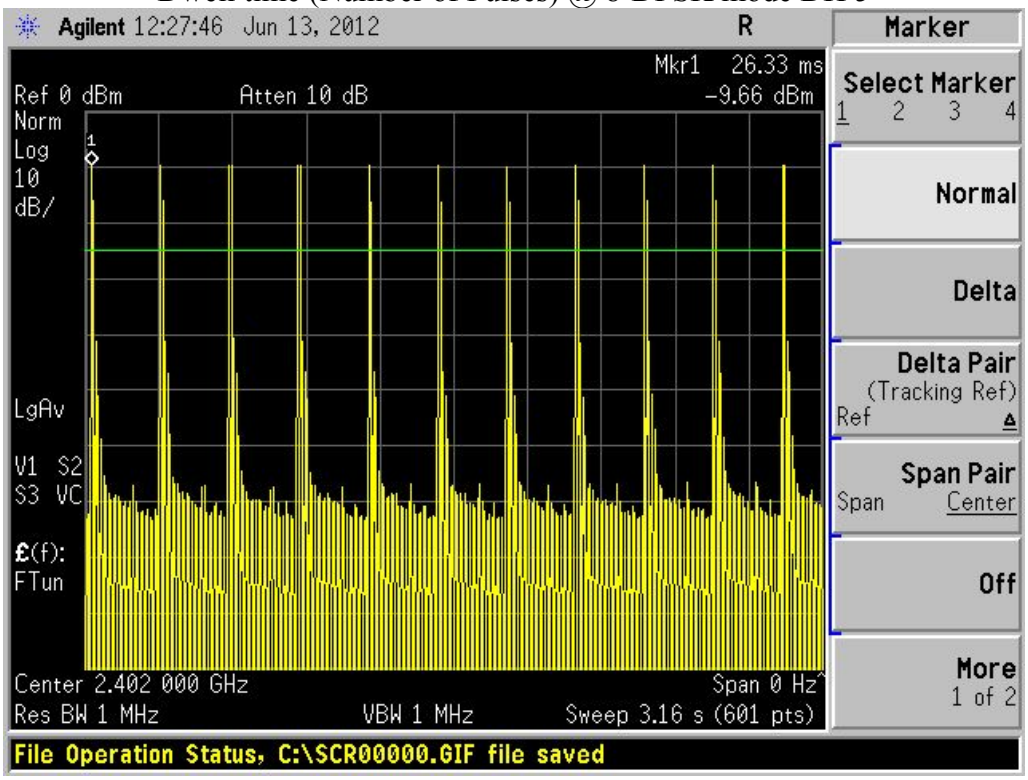
Dwell time (Number of pulse during time period) @ 8-DPSK mode DH 3



Dwell time (Single pulse) @ 8-DPSK mode DH 5



Dwell time (Number of Pulses) @ 8-DPSK mode DH 5



Dwell time (Number of pulse during time period) @ 8-DPSK mode DH 5