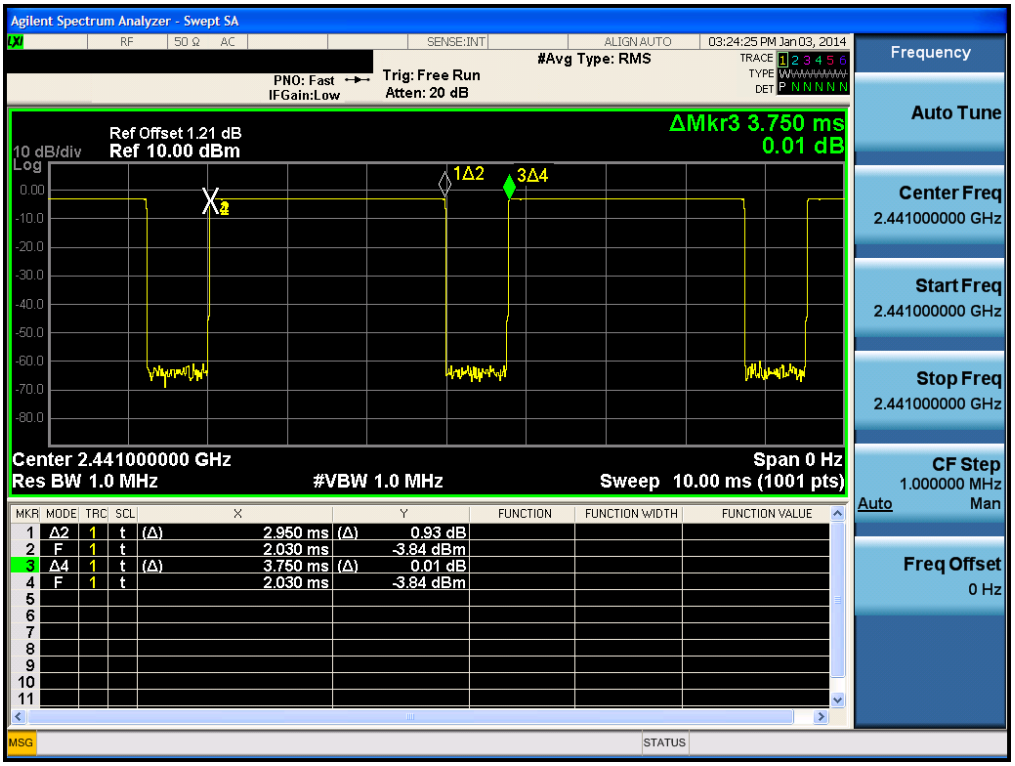
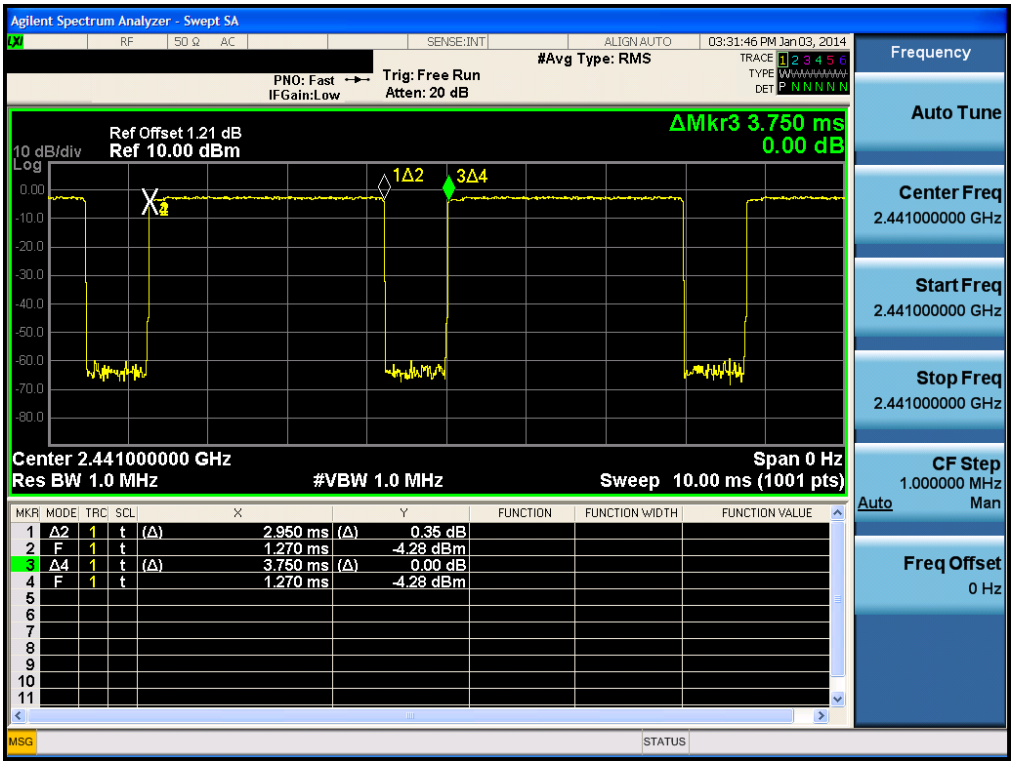
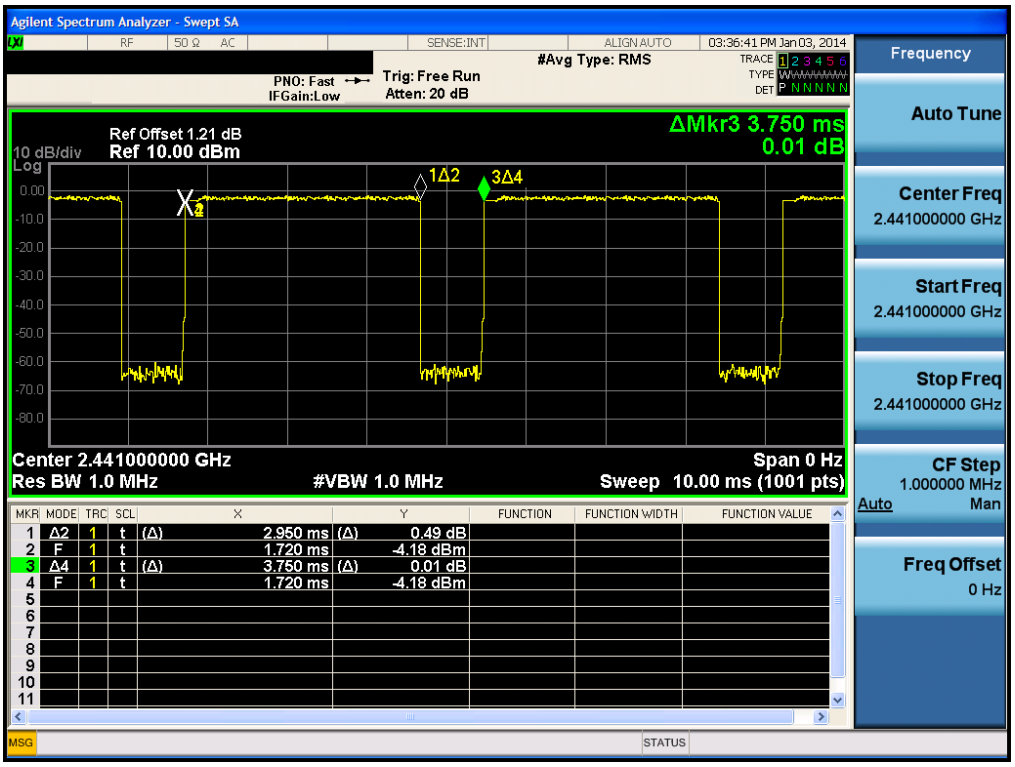
Time of Occupancy (FH) Hopping mode: Enable & GFSK



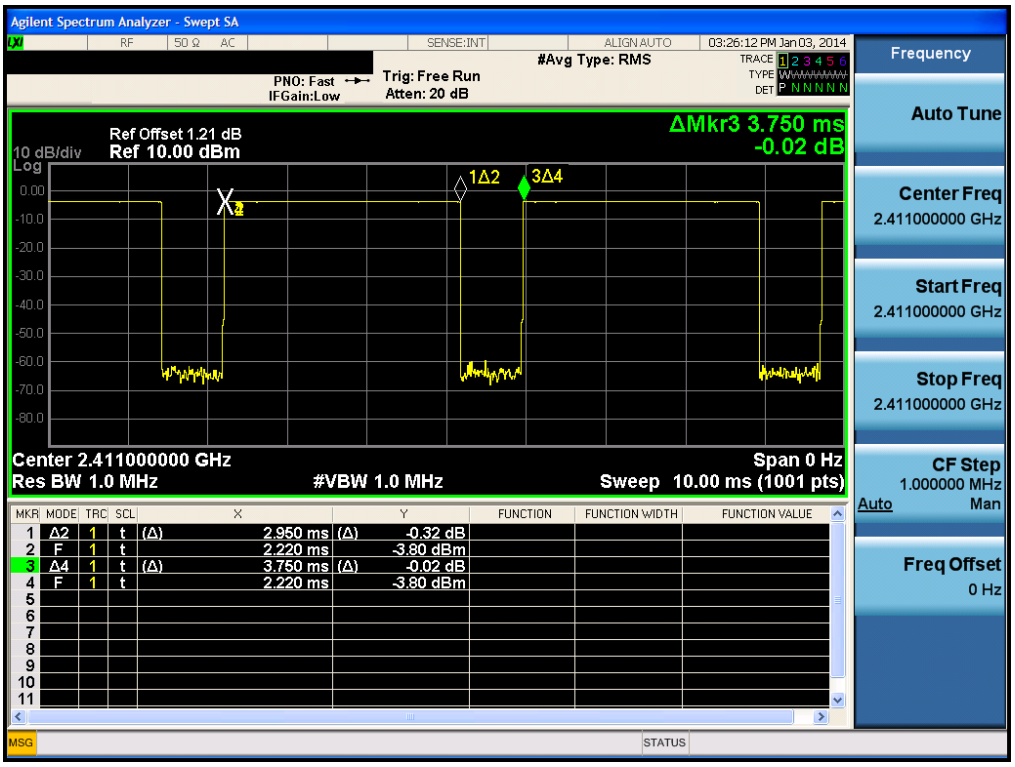
Time of Occupancy (FH) Hopping mode: Enable & π/4DQPSK



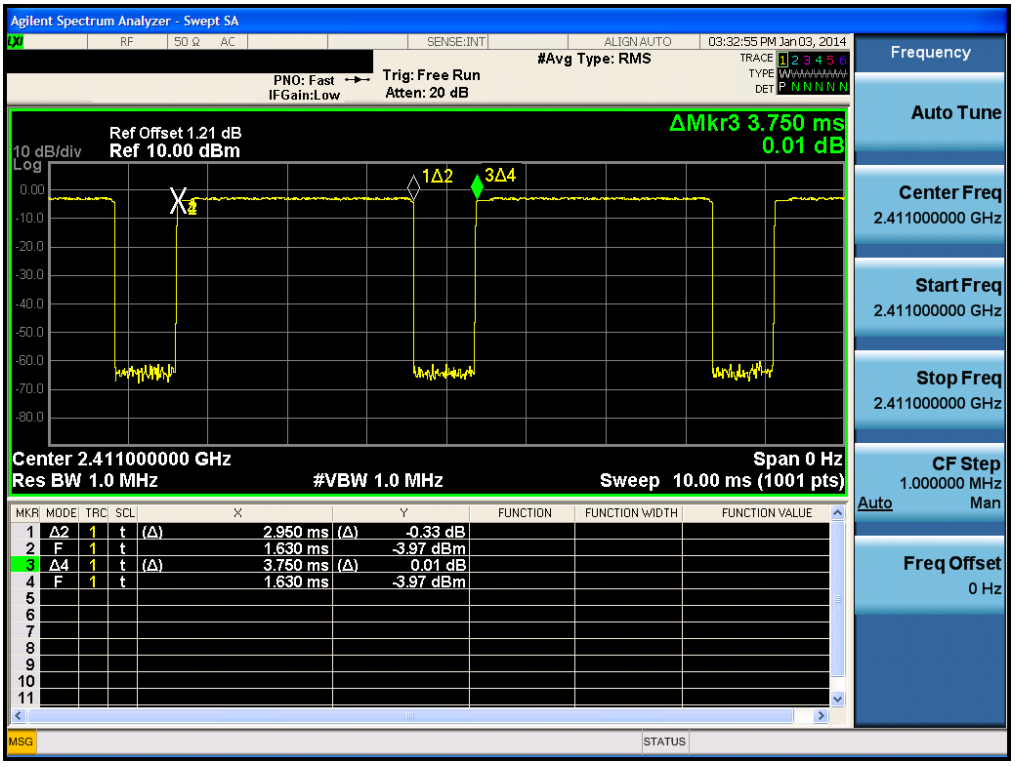
Time of Occupancy (FH) Hopping mode: Enable & 8DPSK



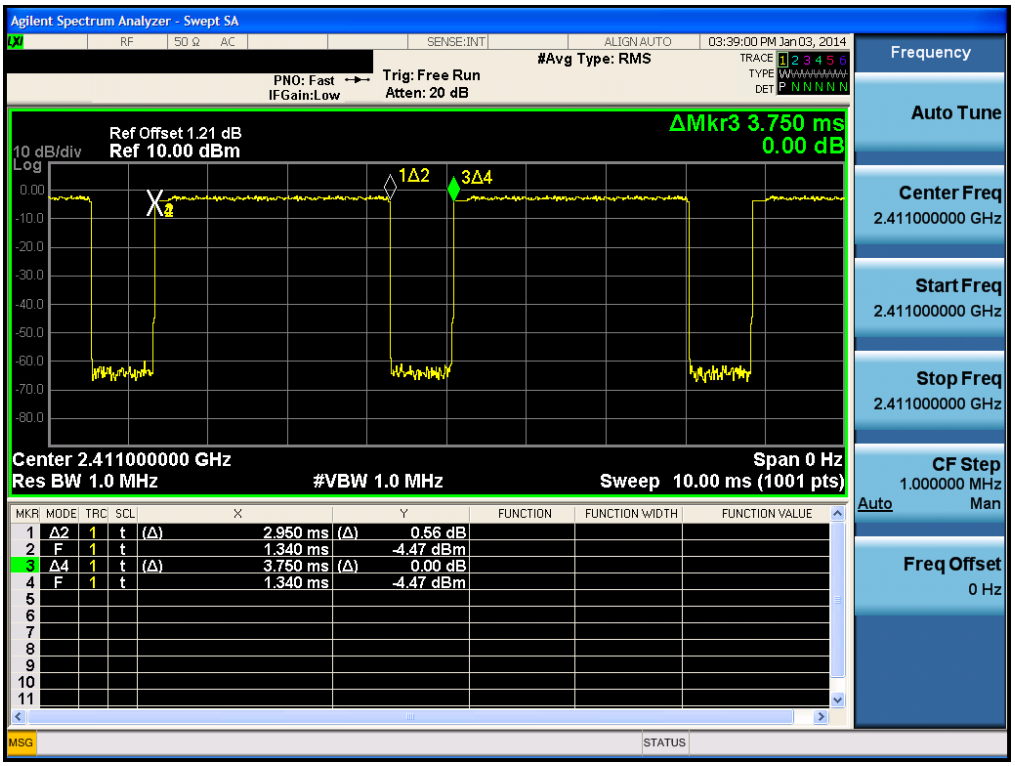
Time of Occupancy (AFH) Hopping mode: Enable & GFSK



Time of Occupancy (AFH) Hopping mode: Enable & π/4DQPSK



Time of Occupancy (AFH) Hopping mode: Enable & 8DPSK



L41SK2

Ambient temperature : 24°C
Relative humidity : 48 %

- FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.95	3.75	0.315
	2 DH 5	79	2.95	3.75	0.315
	3 DH 5	79	2.95	3.75	0.315

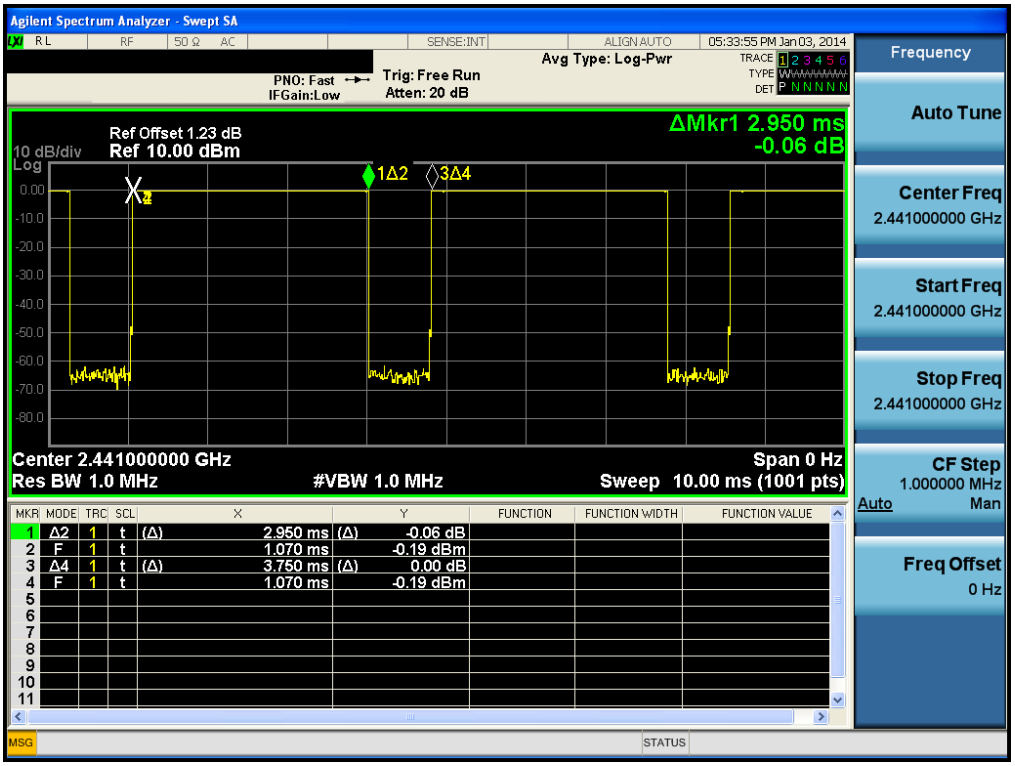
- AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.95	3.75	0.157
	2 DH 5	20	2.95	3.75	0.157
	3 DH 5	20	2.95	3.75	0.157

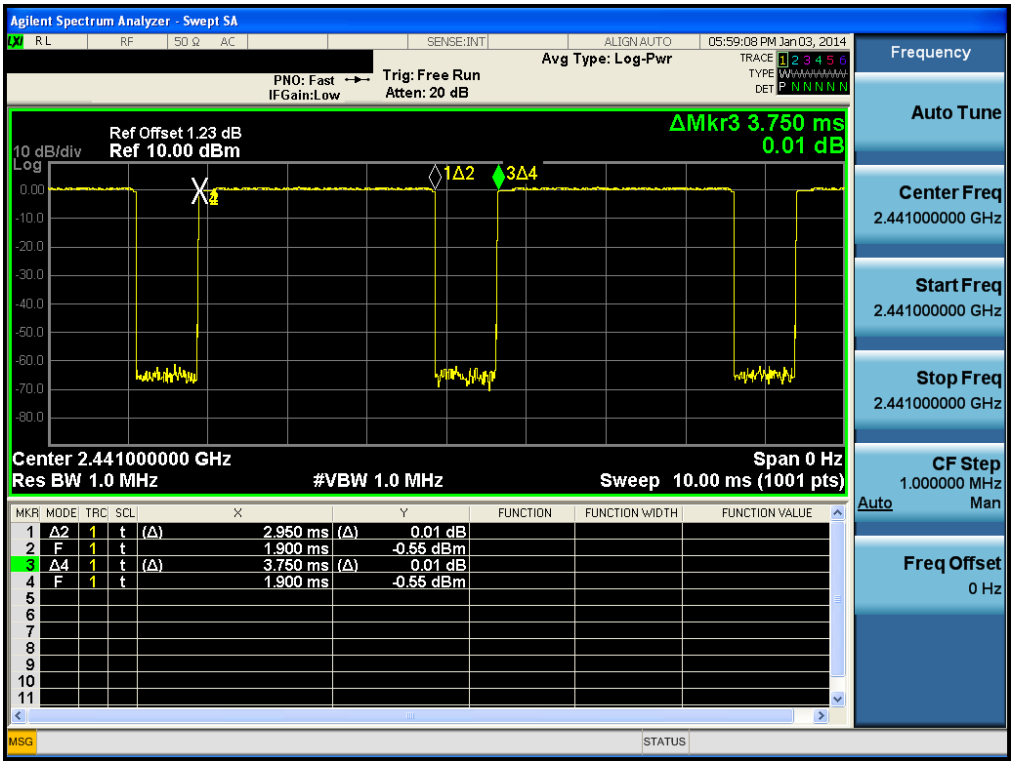
Note 1: Dwell Time = 0.4 × Hopping channel × Burst ON time × ((Hopping rate ÷ Time slots) ÷ Hopping channel)
- Time slots for DH5 = 6 slots(TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

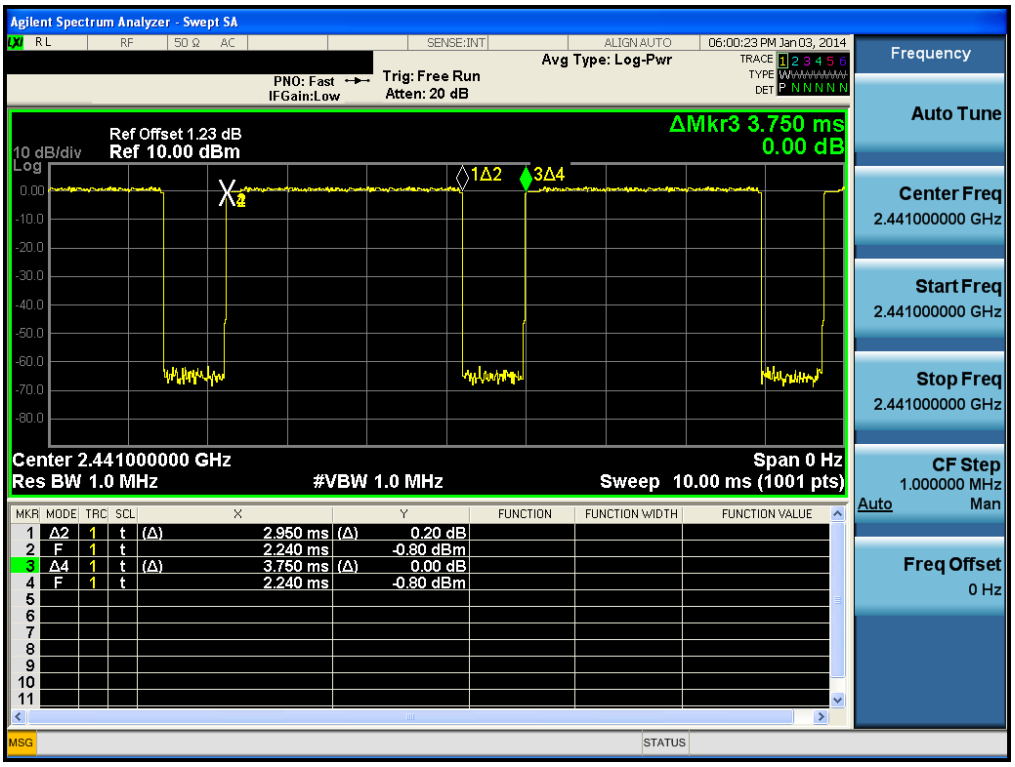
Time of Occupancy (FH) Hopping mode: Enable&GFSK



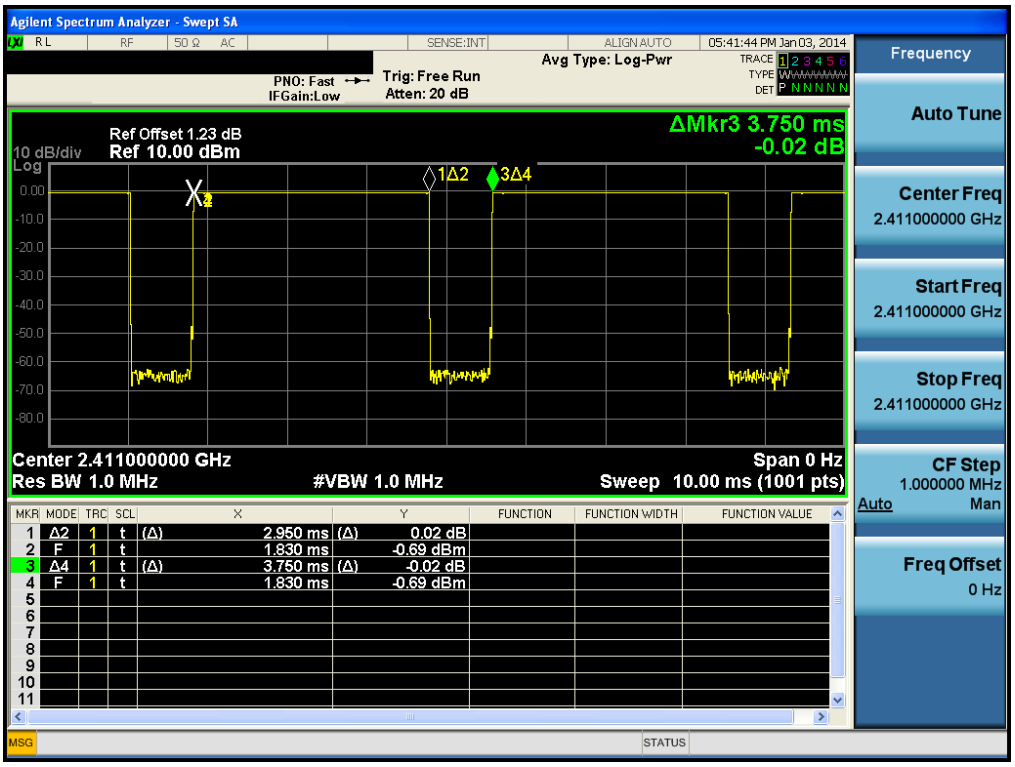
Time of Occupancy (FH) Hopping mode: Enable&π/4DQPSK



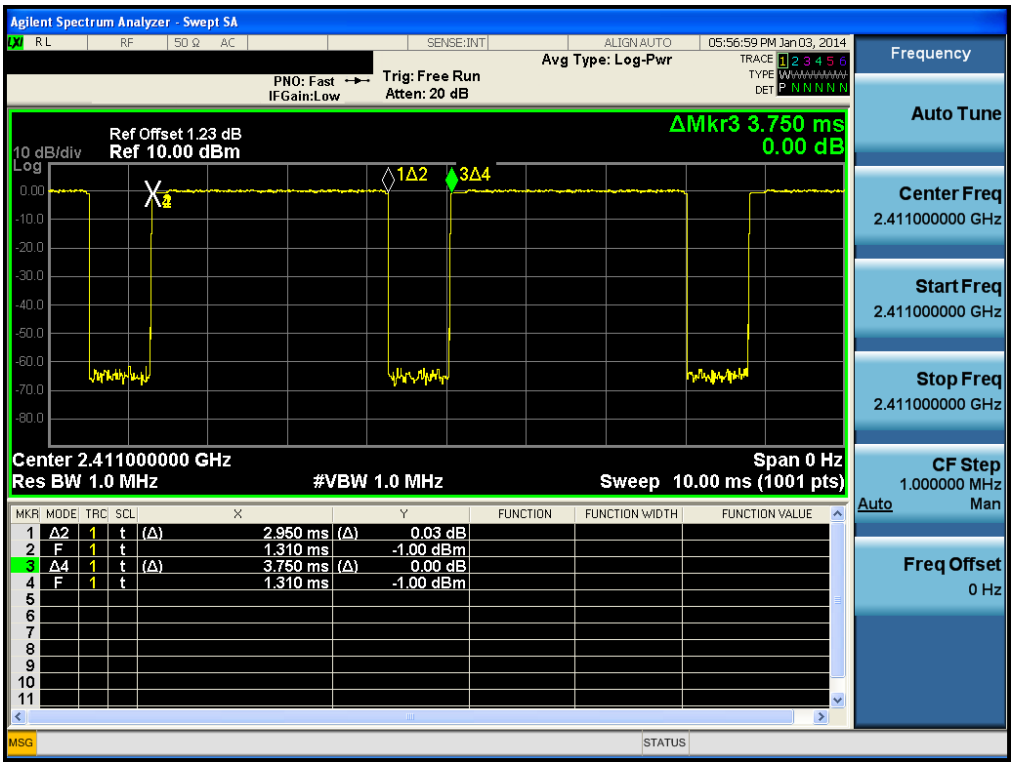
Time of Occupancy (FH) Hopping mode: Enable&8DPSK



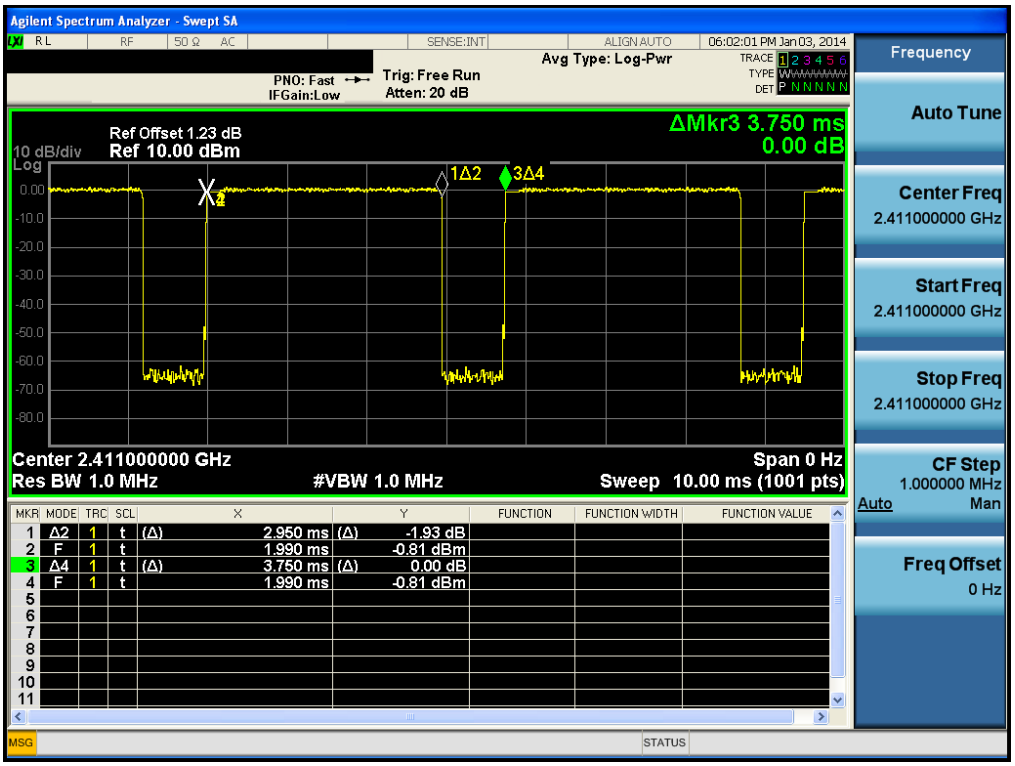
Time of Occupancy (AFH) Hopping mode: Enable&GFSK



Time of Occupancy (AFH) Hopping mode: Enable&π/4DQPSK



Time of Occupancy (AFH) Hopping mode: Enable&8DPSK



L41VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

- FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.95	3.75	0.315
	2 DH 5	79	2.95	3.75	0.315
	3 DH 5	79	2.95	3.75	0.315

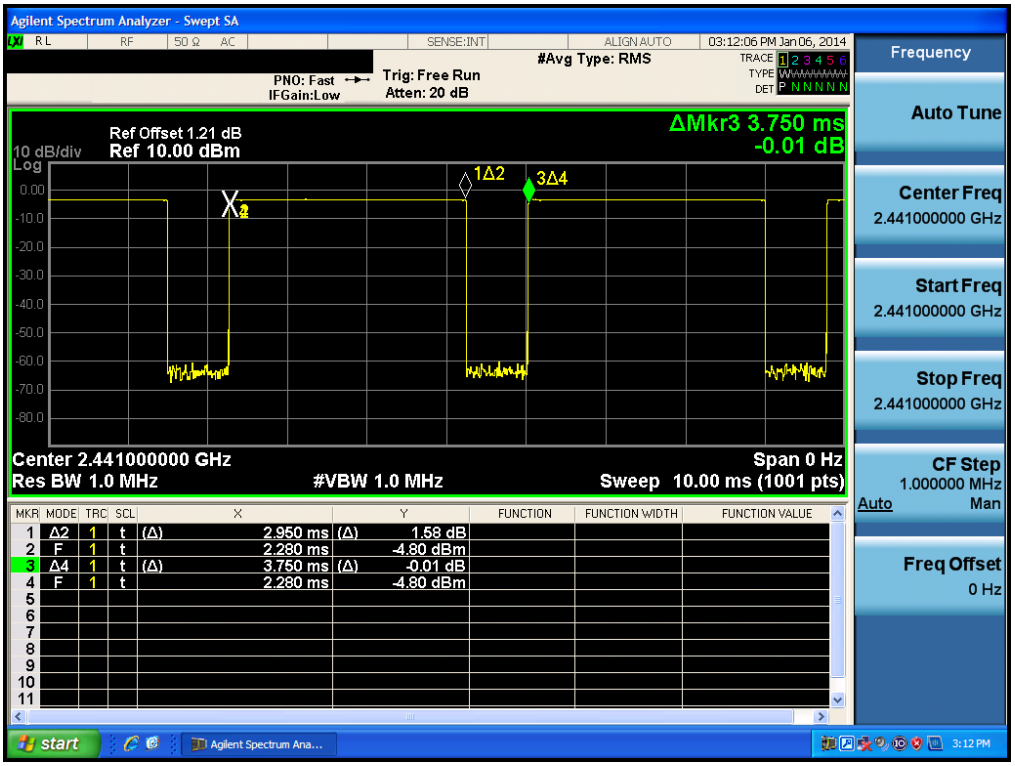
- AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.95	3.75	0.157
	2 DH 5	20	2.95	3.75	0.157
	3 DH 5	20	2.95	3.75	0.157

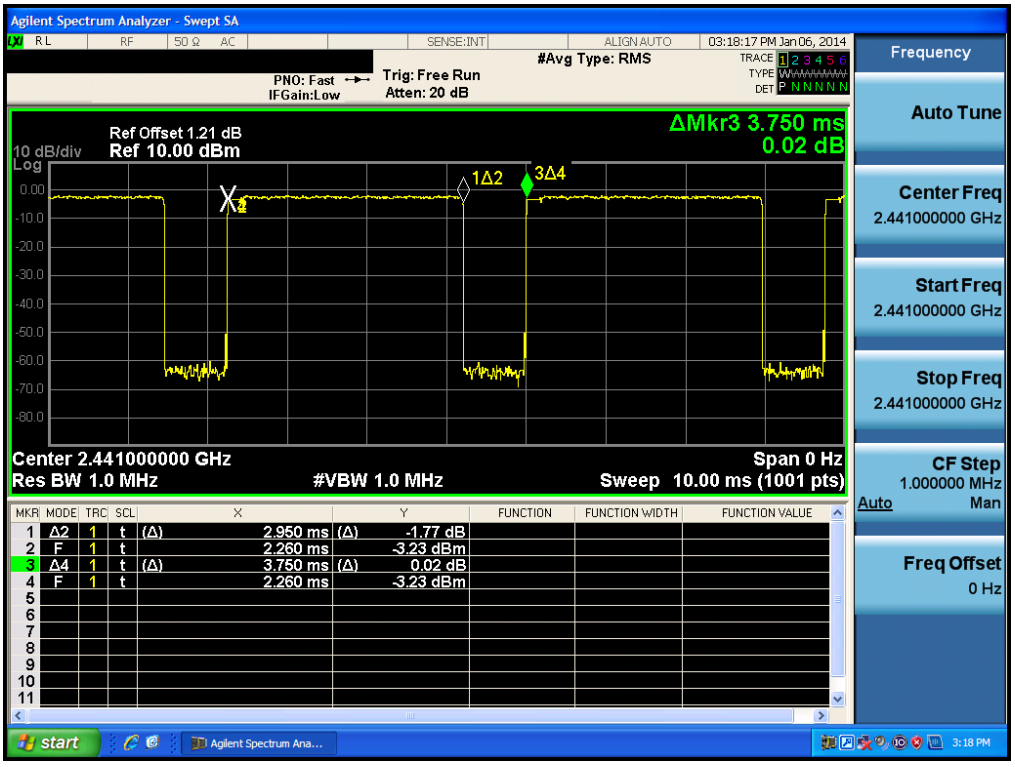
Note 1: Dwell Time = 0.4 × Hopping channel × Burst ON time × ((Hopping rate ÷ Time slots) ÷ Hopping channel)
- Time slots for DH5 = 6 slots(TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

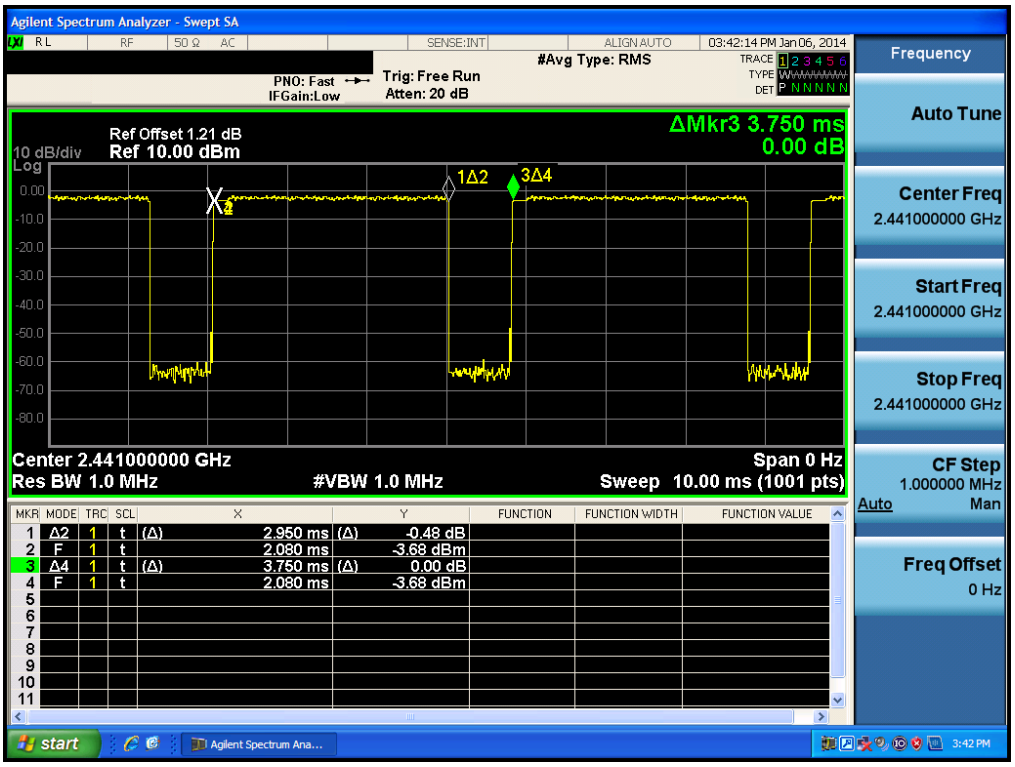
Time of Occupancy (FH) Hopping mode: Enable & GFSK



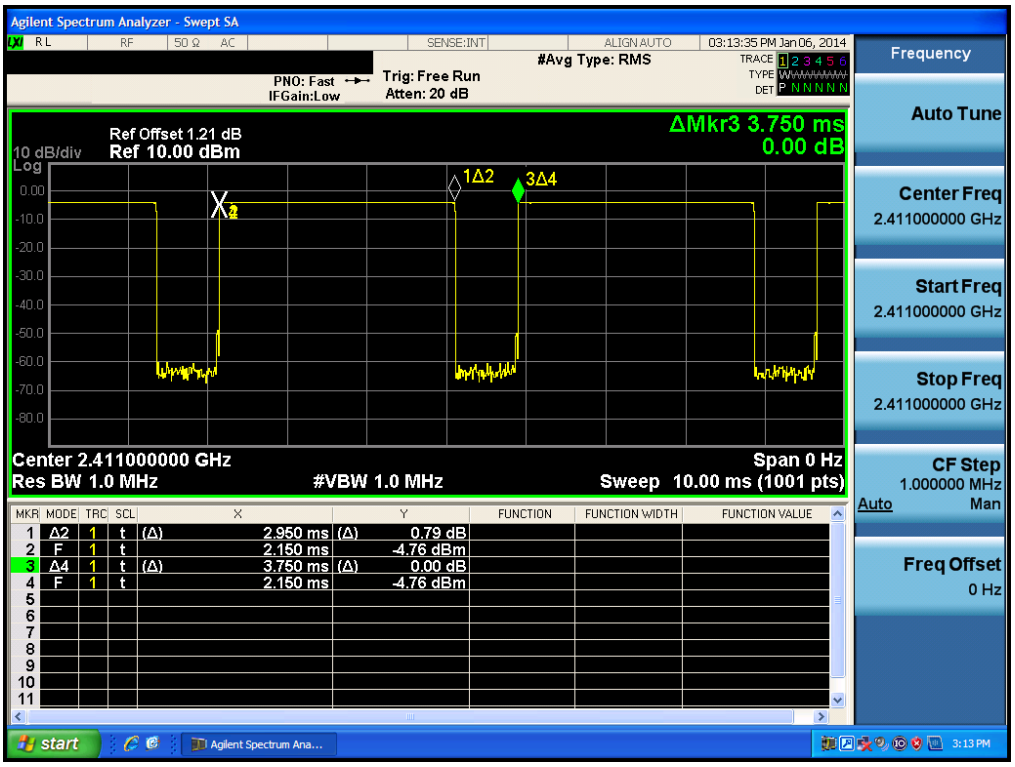
Time of Occupancy (FH) Hopping mode: Enable & π/4DQPSK



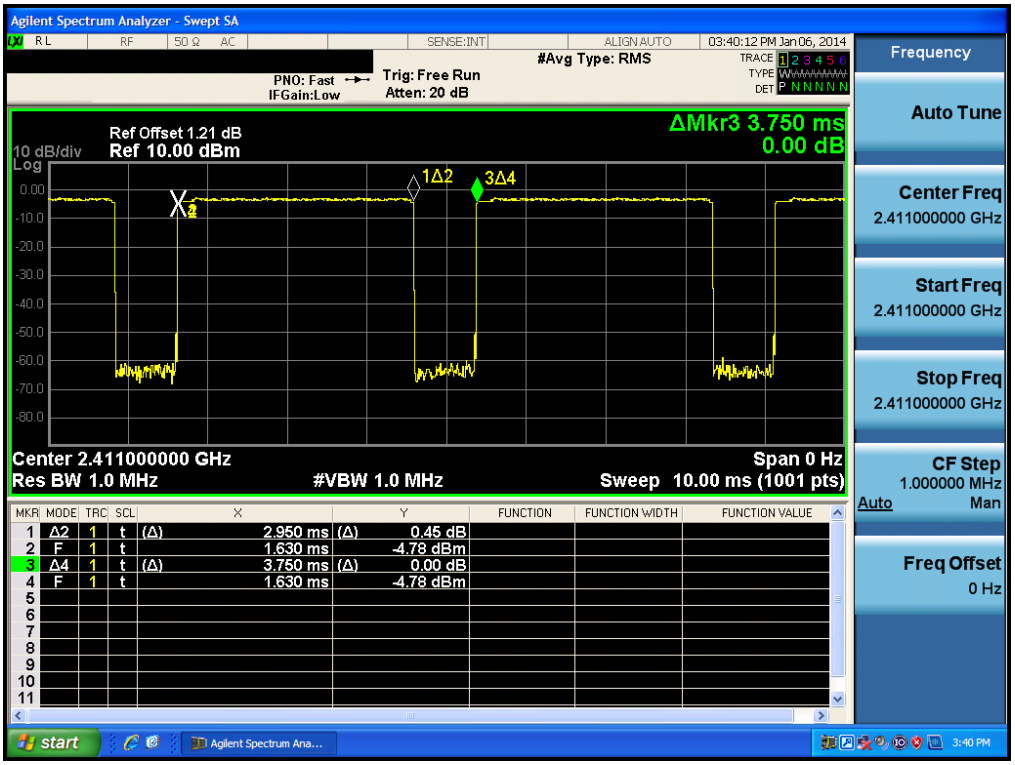
Time of Occupancy (FH) Hopping mode: Enable & 8DPSK



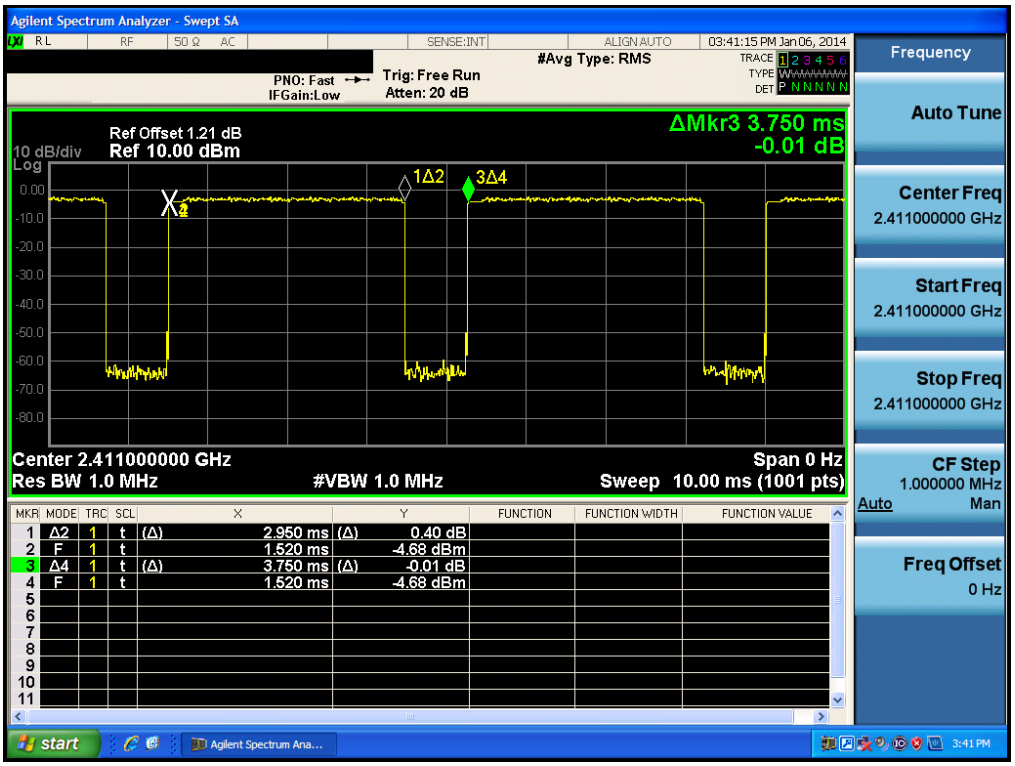
Time of Occupancy (AFH) Hopping mode: Enable & GFSK



Time of Occupancy (AFH) Hopping mode: Enable & π/4DQPSK



Time of Occupancy (AFH) Hopping mode: Enable & 8DPSK



L42VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

- FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.95	3.75	0.315
	2 DH 5	79	2.95	3.75	0.315
	3 DH 5	79	2.95	3.75	0.315

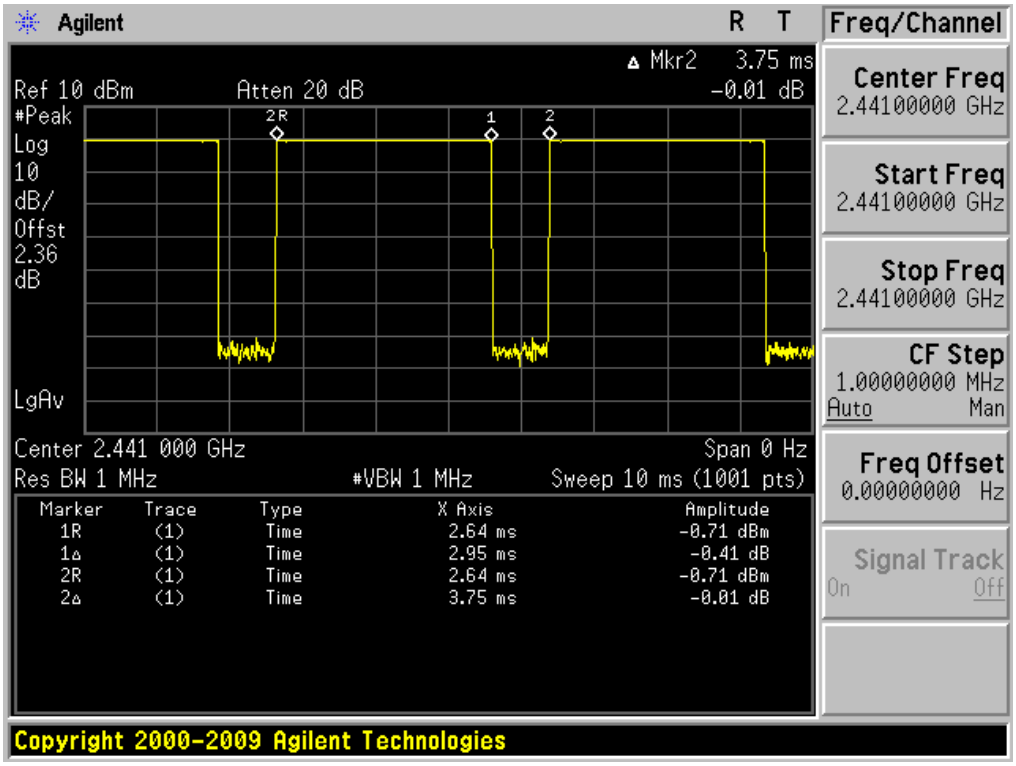
- AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.95	3.75	0.157
	2 DH 5	20	2.95	3.75	0.157
	3 DH 5	20	2.95	3.75	0.157

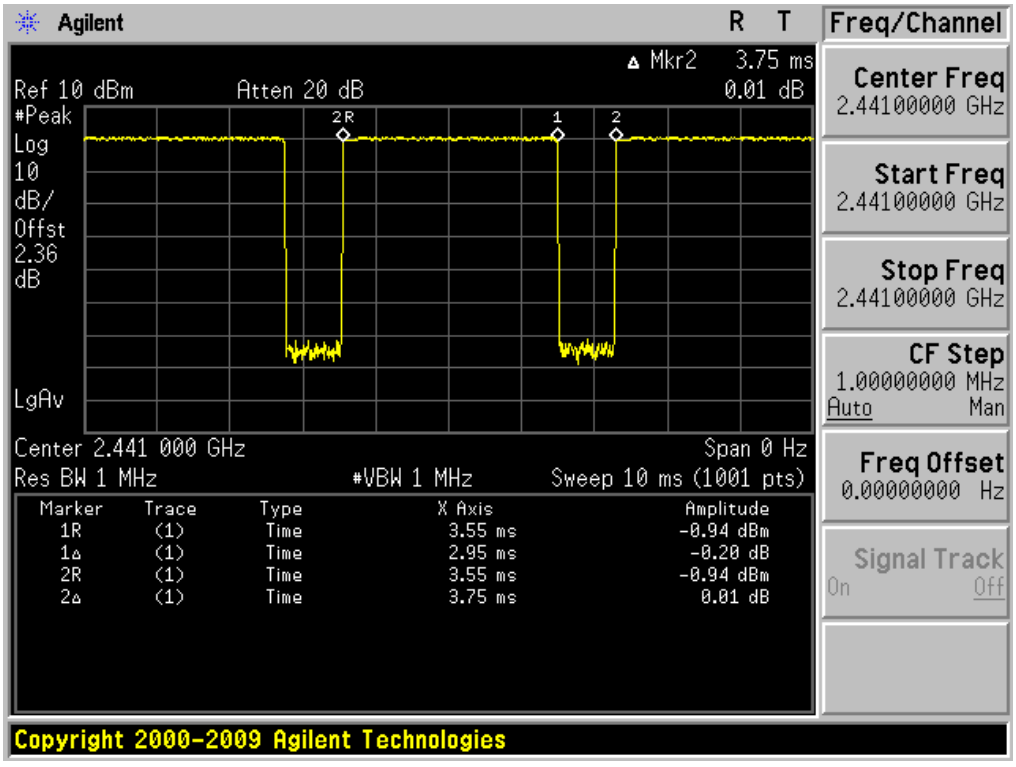
Note 1: Dwell Time = 0.4 × Hopping channel × Burst ON time × ((Hopping rate ÷ Time slots) ÷ Hopping channel)
- Time slots for DH5 = 6 slots(TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

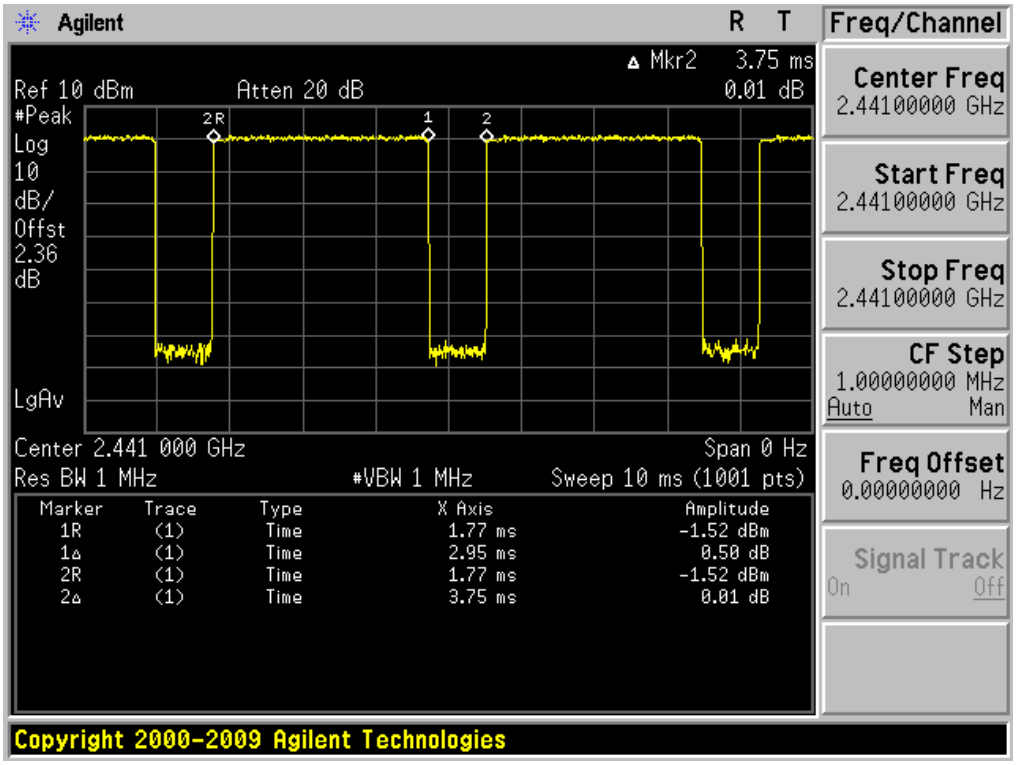
Time of Occupancy (FH) Hopping mode: Enable & GFSK



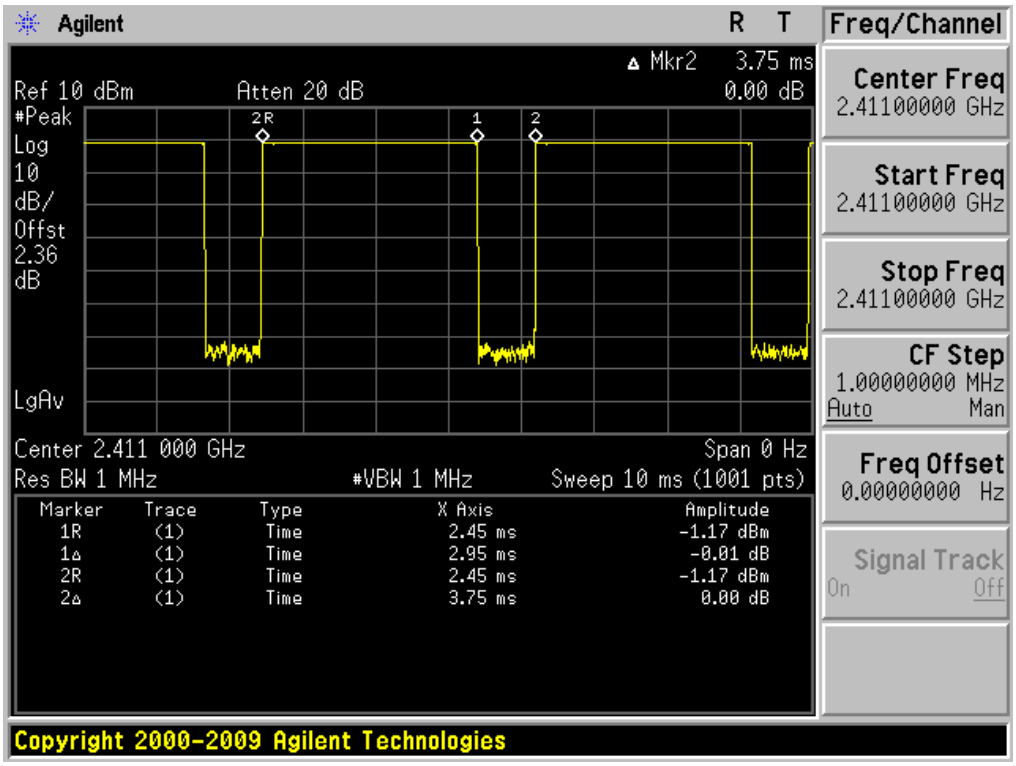
Time of Occupancy (FH) Hopping mode: Enable & π/4DQPSK



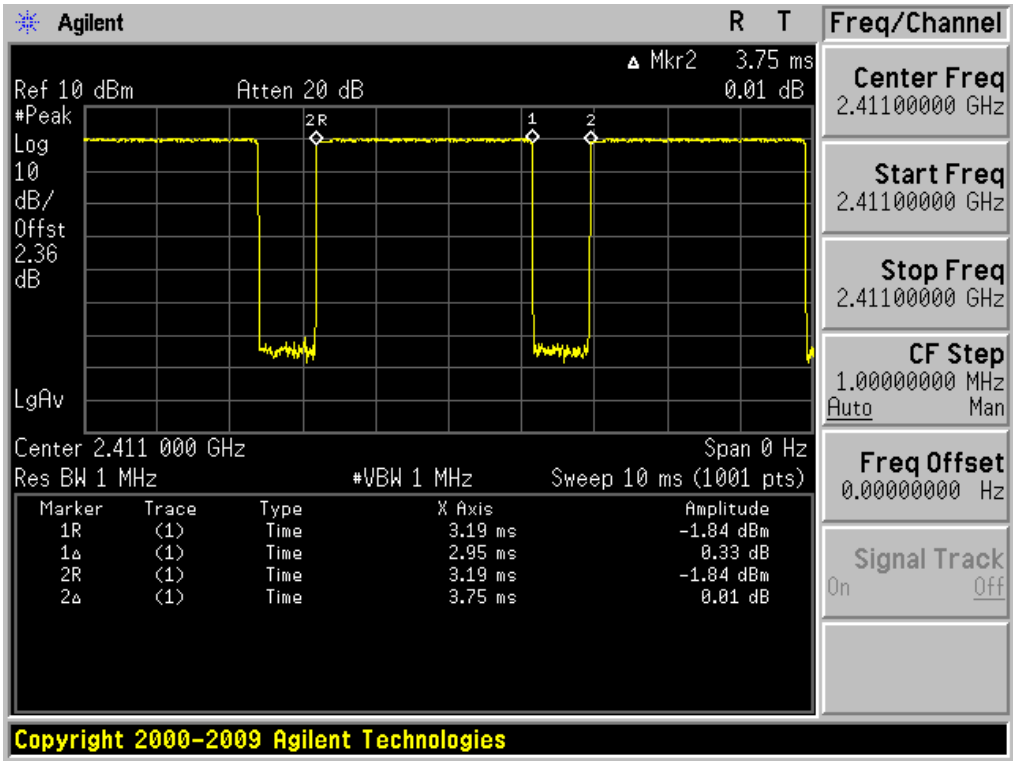
Time of Occupancy (FH) Hopping mode: Enable & 8DPSK



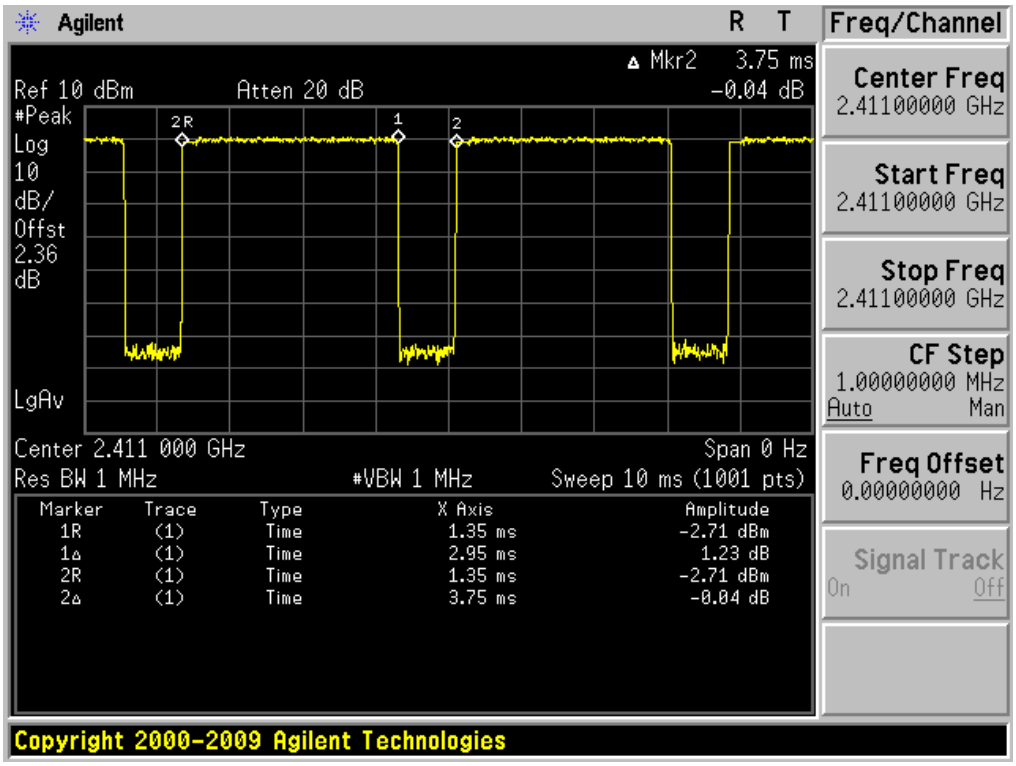
Time of Occupancy (AFH) Hopping mode: Enable & GFSK



Time of Occupancy (AFH) Hopping mode: Enable & π/4DQPSK



Time of Occupancy (AFH) Hopping mode: Enable & 8DPSK



L52SK2

Ambient temperature : 24°C
Relative humidity : 48 %

- FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.95	3.75	0.315
	2 DH 5	79	2.95	3.75	0.315
	3 DH 5	79	2.95	3.75	0.315

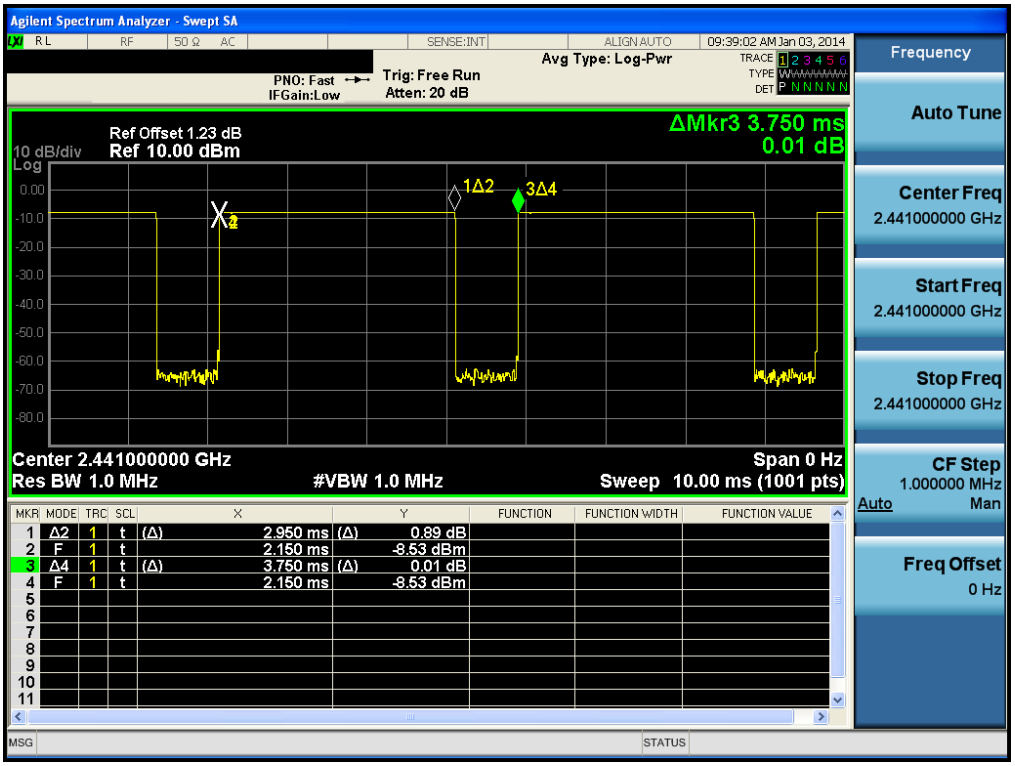
- AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.95	3.75	0.157
	2 DH 5	20	2.95	3.75	0.157
	3 DH 5	20	2.95	3.75	0.157

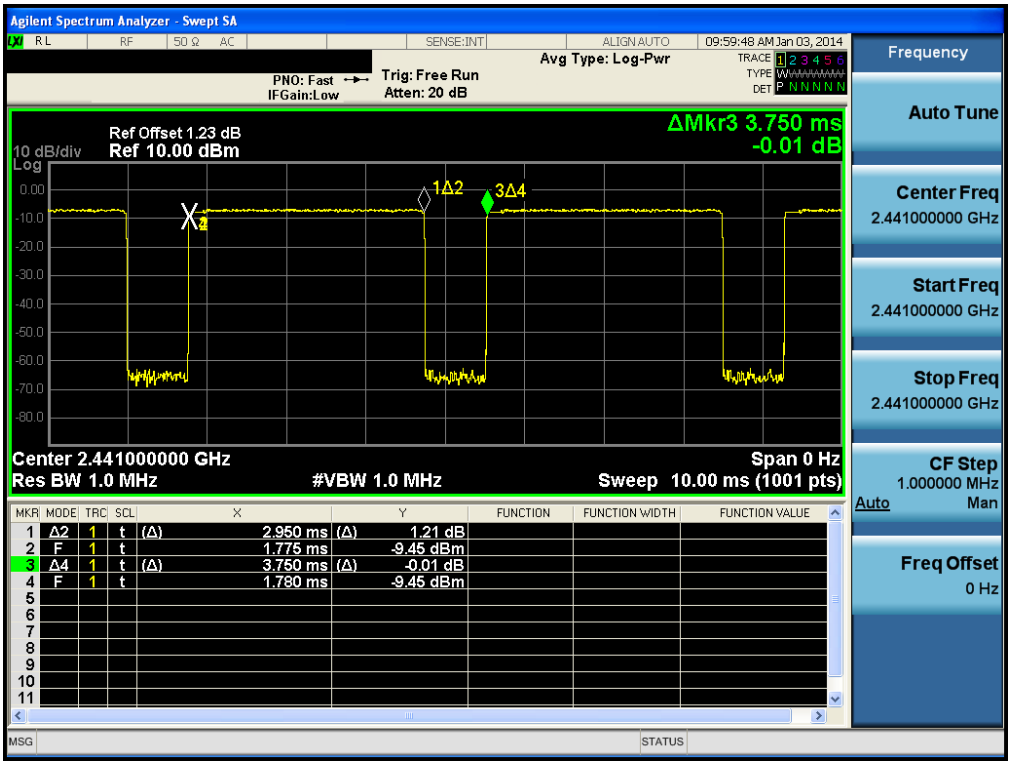
Note 1: Dwell Time = 0.4 × Hopping channel × Burst ON time × ((Hopping rate ÷ Time slots) ÷ Hopping channel)
- Time slots for DH5 = 6 slots(TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

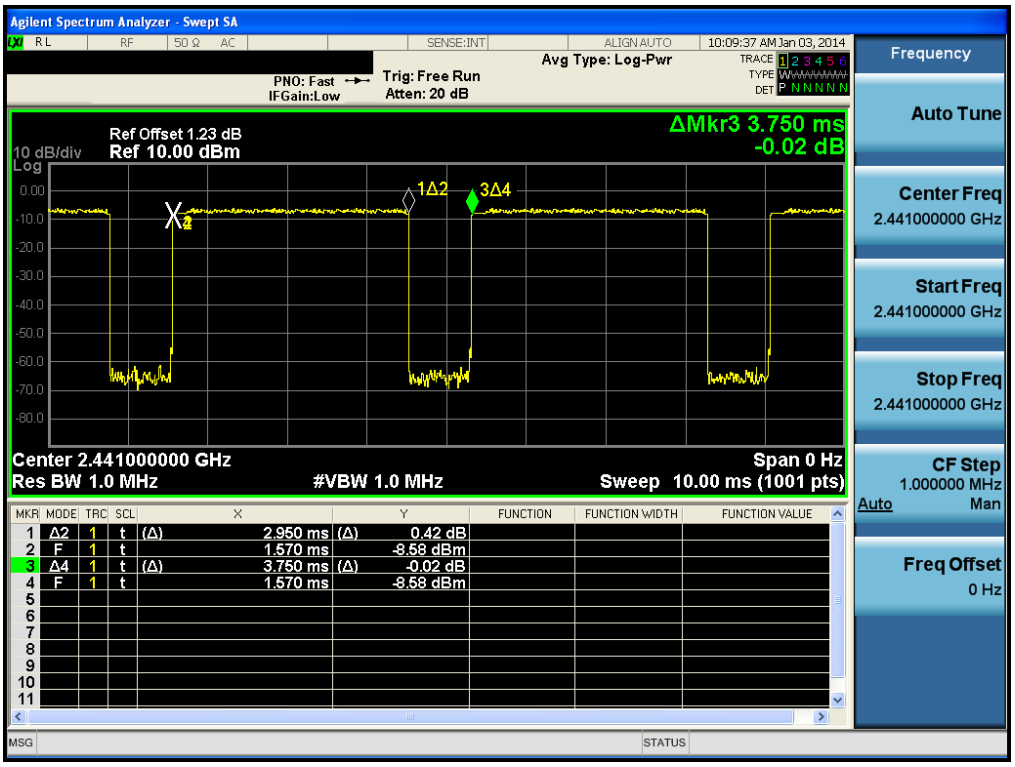
Time of Occupancy (FH) Hopping mode: Enable&GFSK



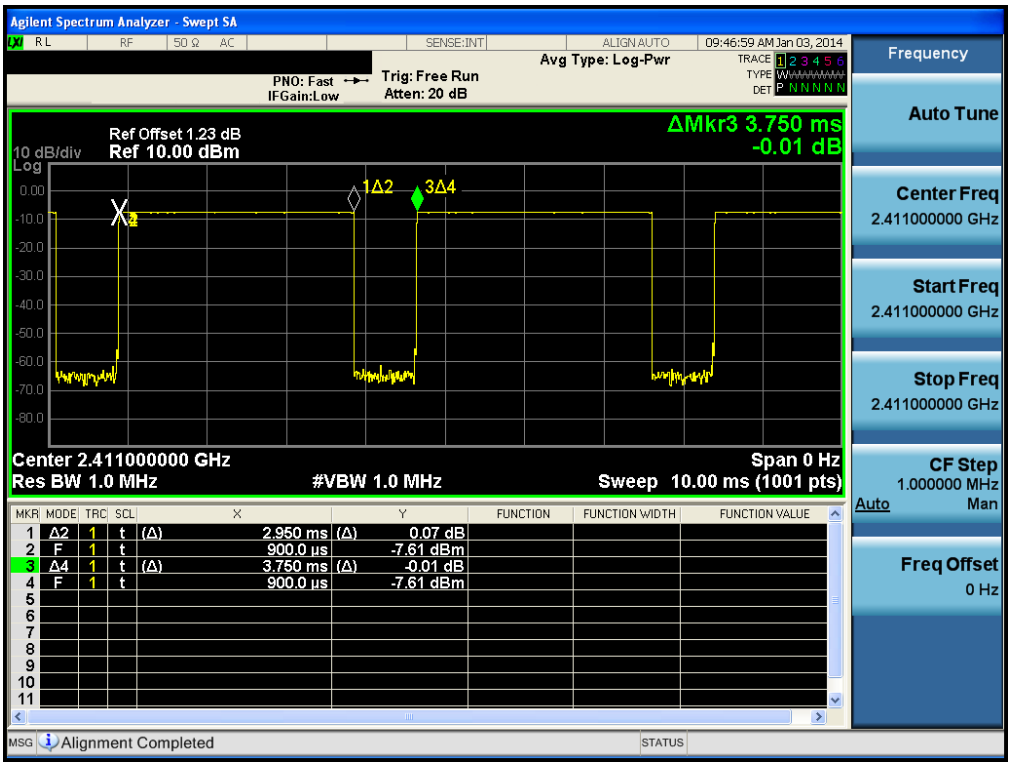
Time of Occupancy (FH) Hopping mode: Enable&π/4DQPSK



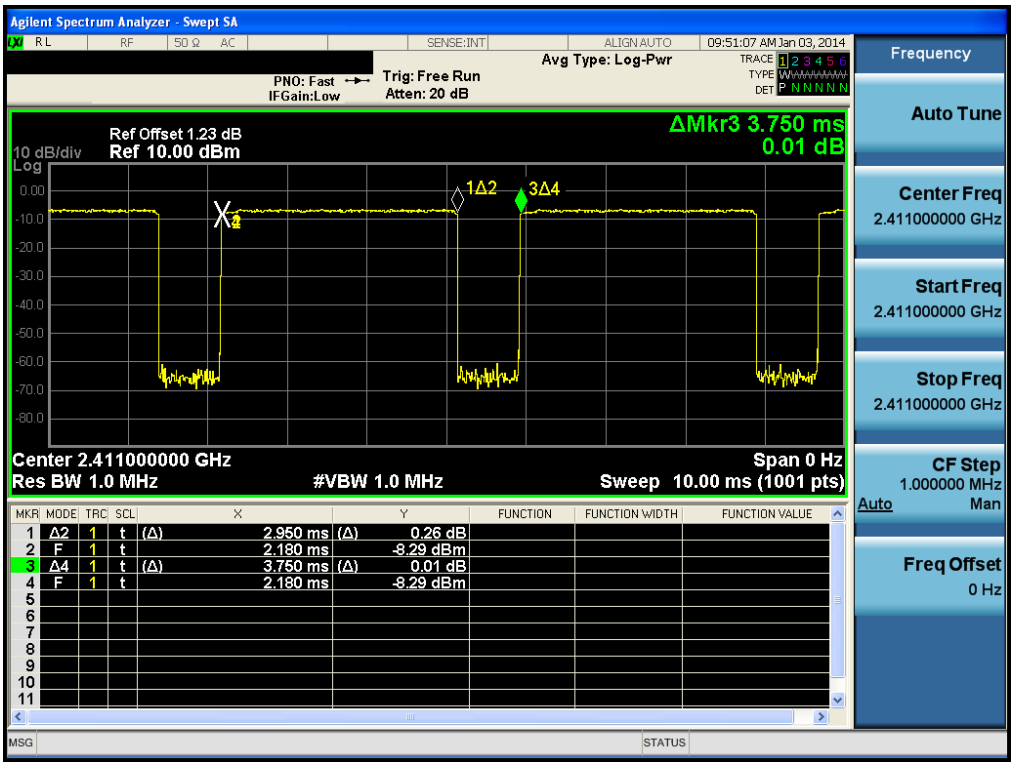
Time of Occupancy (FH) Hopping mode: Enable&8DPSK



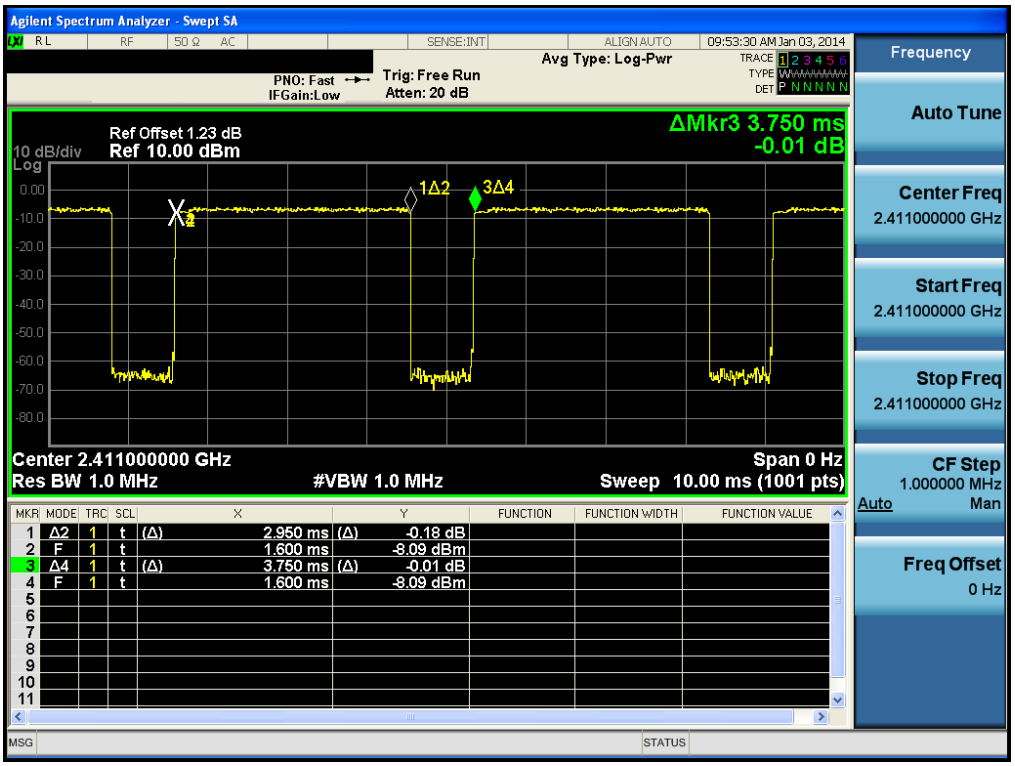
Time of Occupancy (AFH) Hopping mode: Enable&GFSK



Time of Occupancy (AFH) Hopping mode: Enable&π/4DQPSK



Time of Occupancy (AFH) Hopping mode: Enable&8DPSK



L53VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

- FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.95	3.75	0.315
	2 DH 5	79	2.95	3.75	0.315
	3 DH 5	79	2.95	3.75	0.315

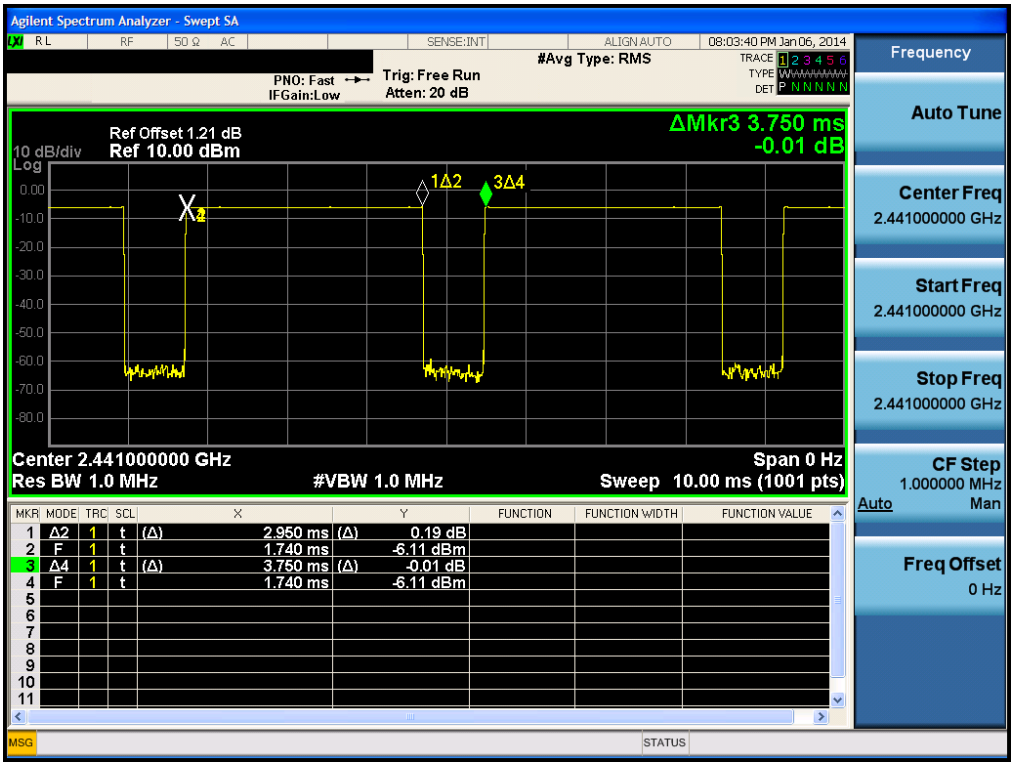
- AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.95	3.75	0.157
	2 DH 5	20	2.95	3.75	0.157
	3 DH 5	20	2.95	3.75	0.157

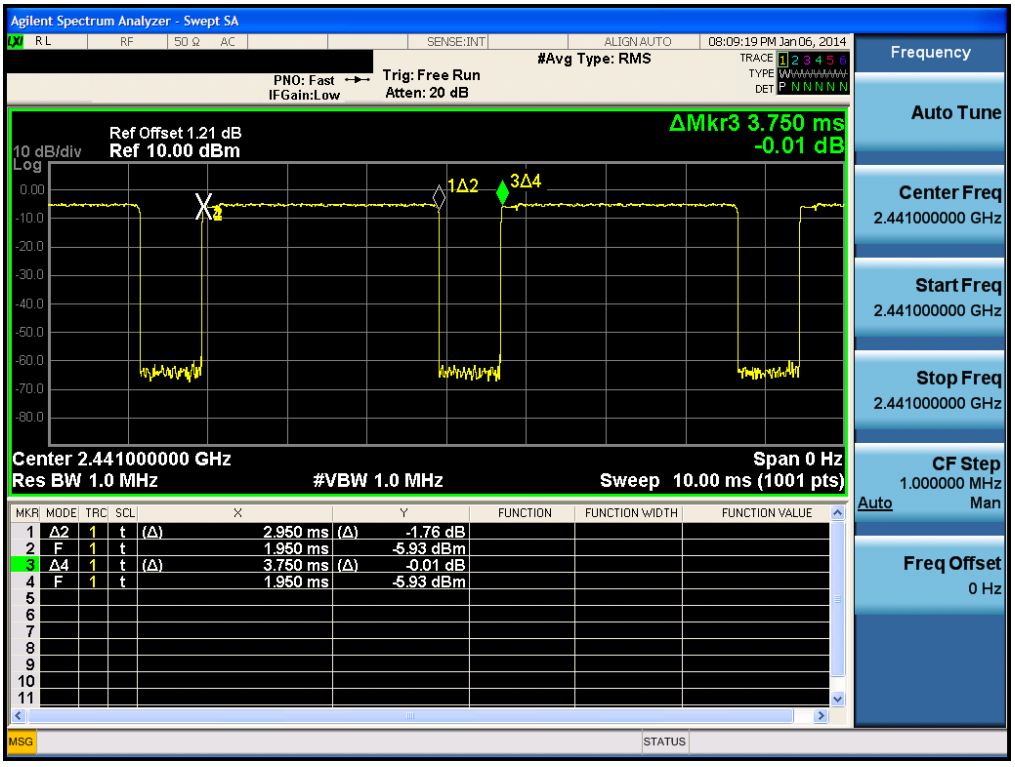
Note 1: Dwell Time = 0.4 × Hopping channel × Burst ON time × ((Hopping rate ÷ Time slots) ÷ Hopping channel)
- Time slots for DH5 = 6 slots(TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

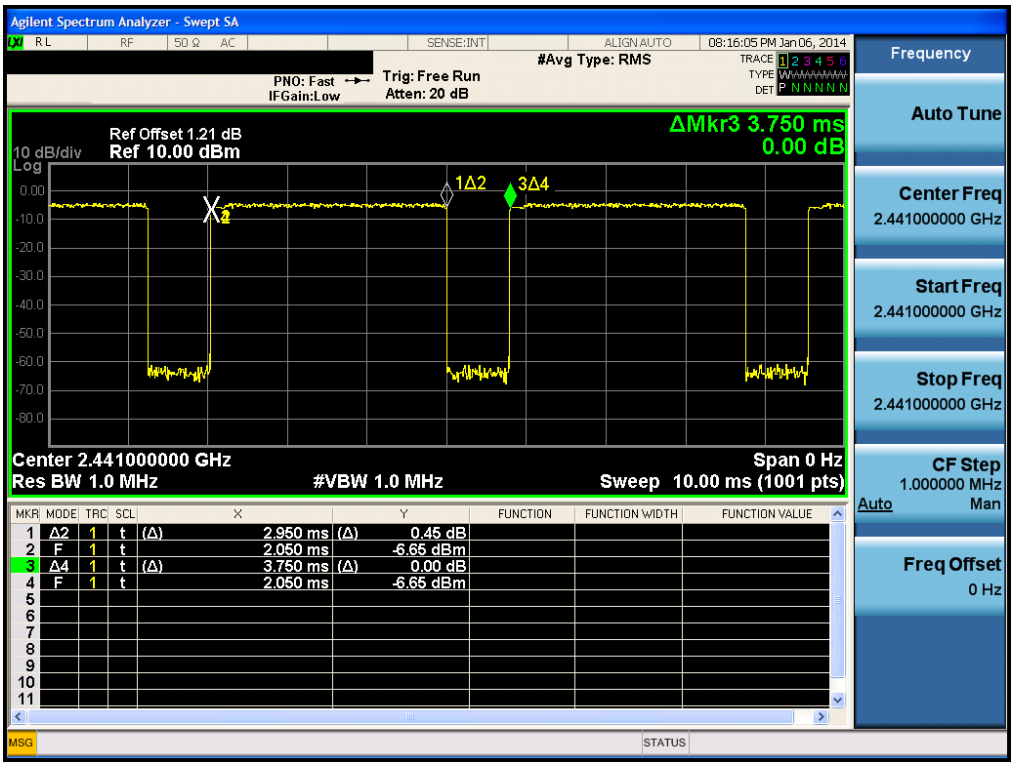
Time of Occupancy (FH) Hopping mode: Enable & GFSK



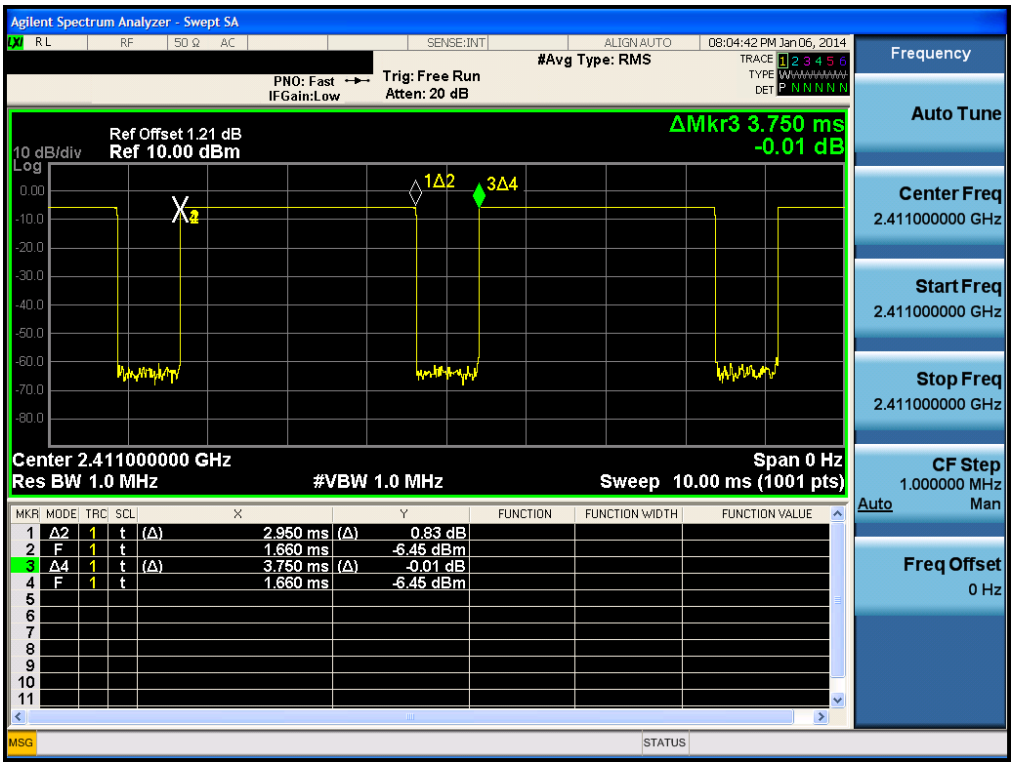
Time of Occupancy (FH) Hopping mode: Enable & π/4DQPSK



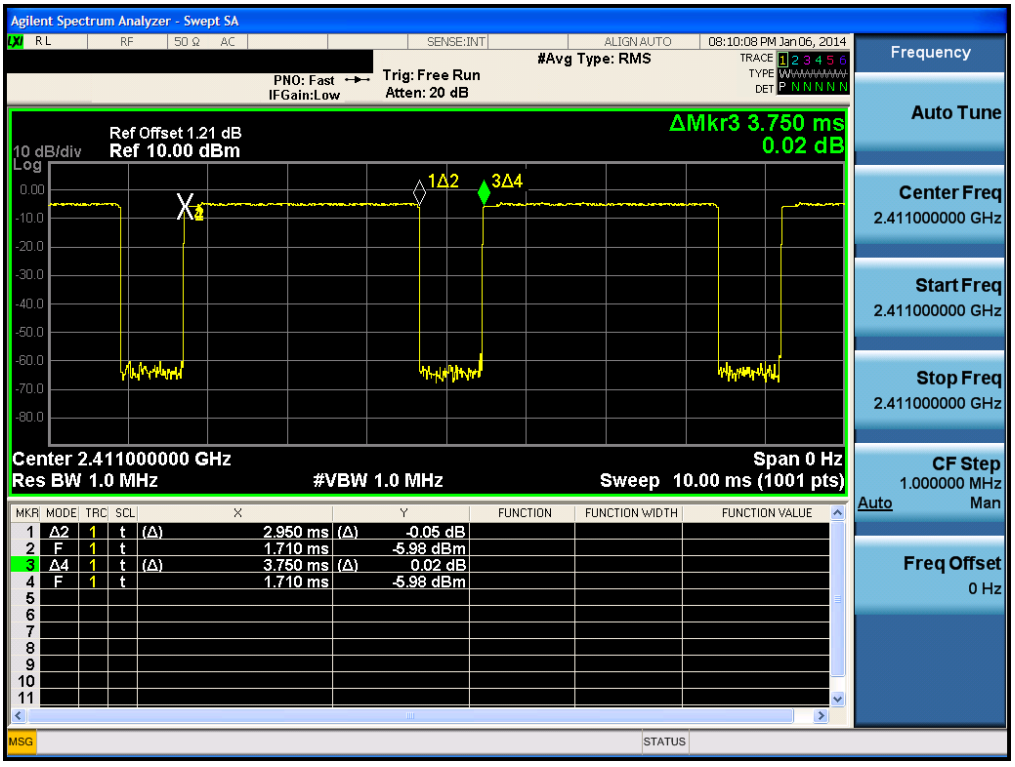
Time of Occupancy (FH) Hopping mode: Enable & 8DPSK



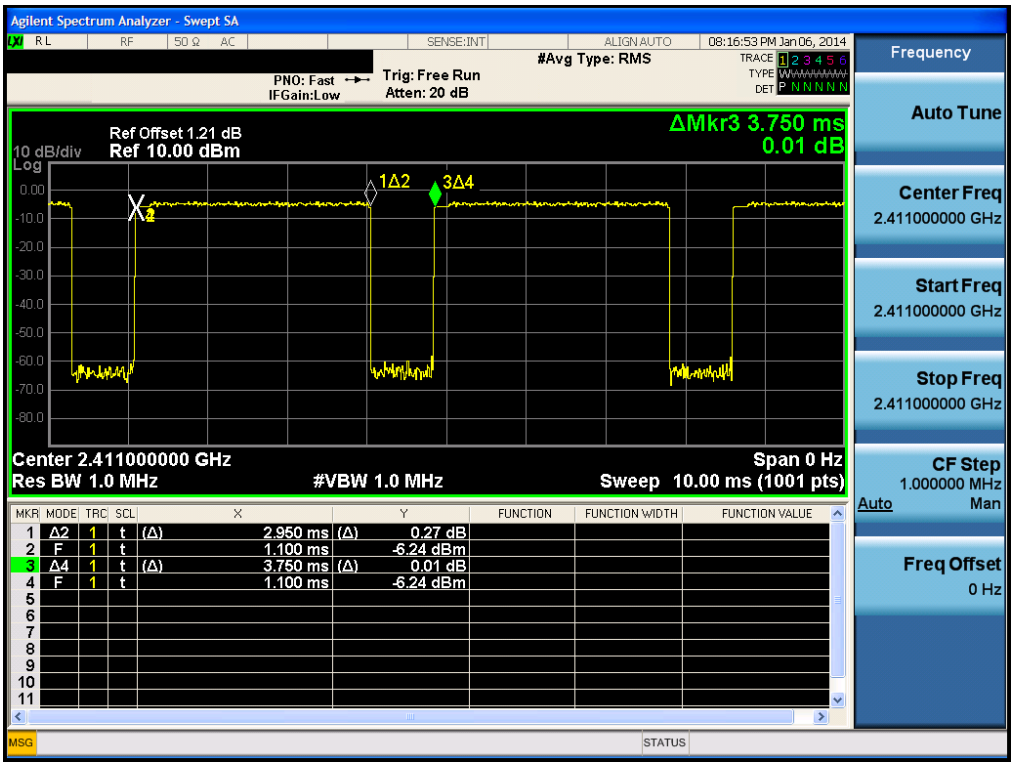
Time of Occupancy (AFH) Hopping mode: Enable & GFSK



Time of Occupancy (AFH) Hopping mode: Enable & π/4DQPSK



Time of Occupancy (AFH) Hopping mode: Enable & 8DPSK



7. Maximum Peak Output Power Measurement

7.1. Test Setup

Refer to the APPENDIX I.

7.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following :

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

2. §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 ㎒ band: 1 Watt.

7.3. Test Procedure

1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ;
   Span = approximately 5 times the 20 ㏈bandwidth, centered on a hopping channel
   RBW ≥ 20㏈BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

7.4. Test Results

L40SE2

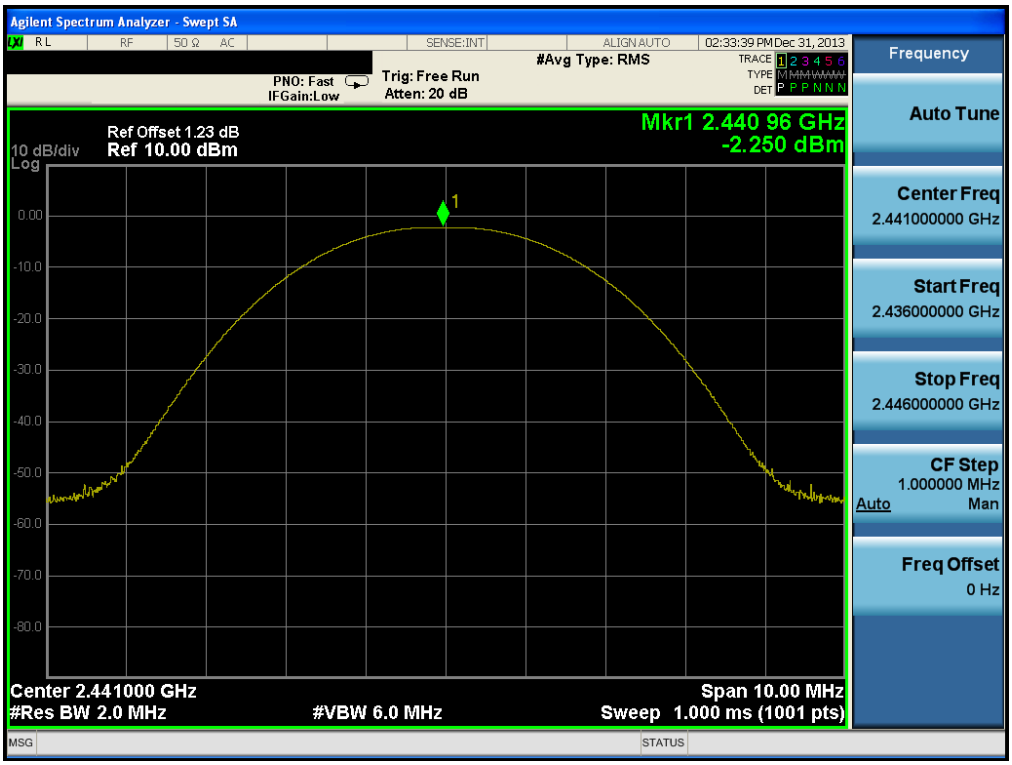
Ambient temperature : 24°C
Relative humidity : 48 %

Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	- 3.293	0.468
	Middle	- 2.250	0.596
	Highest	**- 1.920**	**0.643**
π/4DQPSK	**Lowest**	- 1.580	0.695
	Middle	- 0.590	0.873
	Highest	**- 0.215**	**0.952**
8DPSK	**Lowest**	- 1.183	0.762
	Middle	- 0.170	0.962
	Highest	**0.196**	**1.046**

Note 1: See next pages for actual measured spectrum plots.

Peak Output Power ***Lowest Channel***&Modulation: ***GFSK***

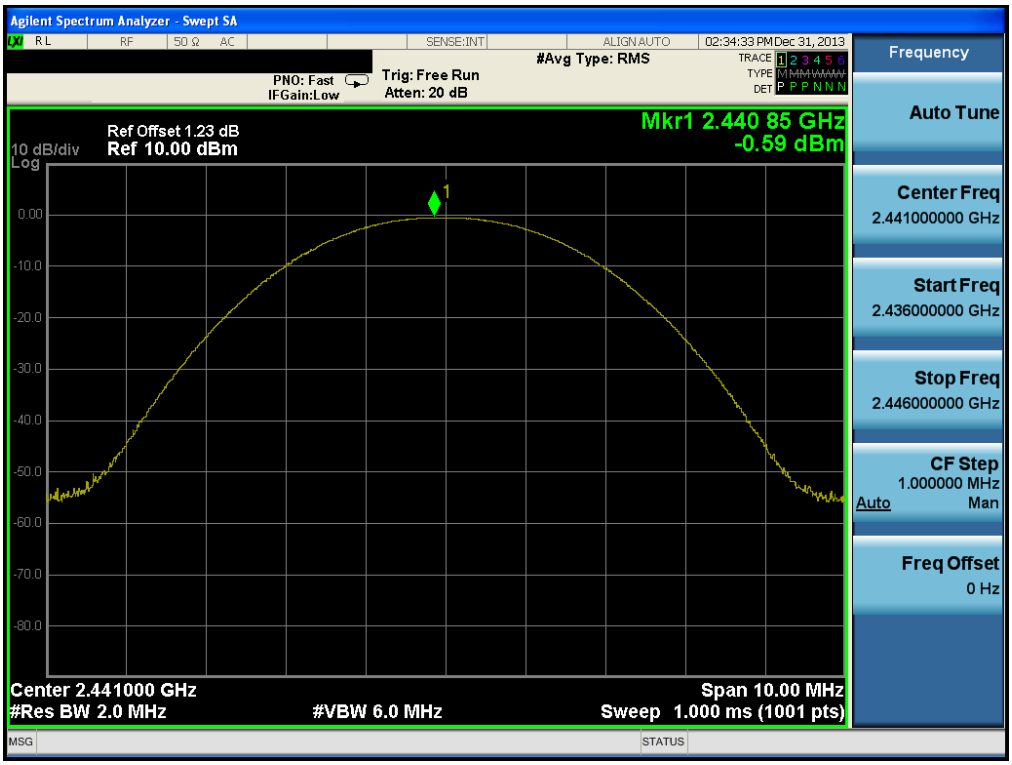
Peak Output Power ***Middle Channel***&Modulation: ***GFSK***



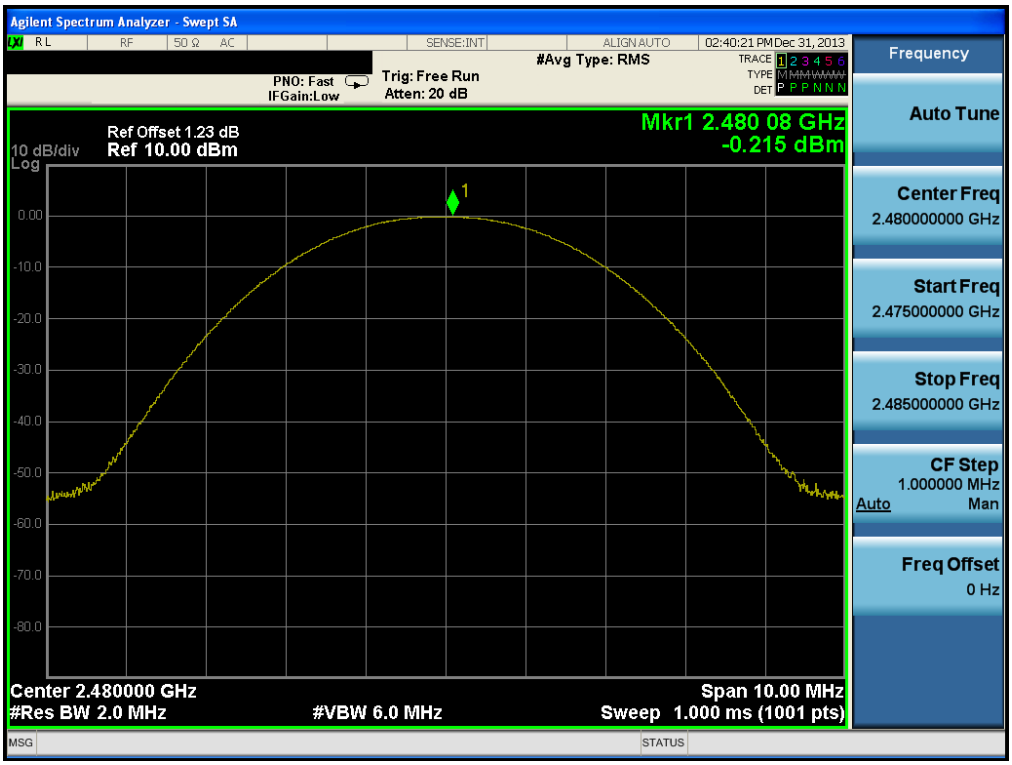
Peak Output Power ***Highest Channel***&Modulation: ***GFSK***

Peak Output Power ***Lowest Channel***&Modulation: ***π/4DQPSK***

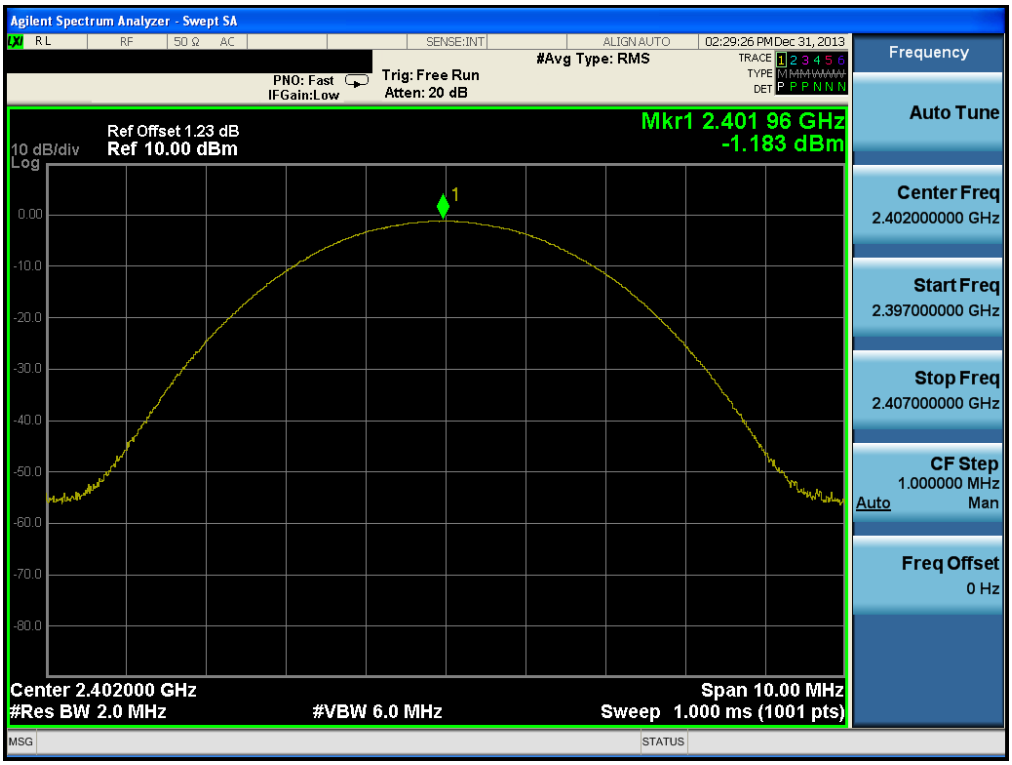
Peak Output Power ***Middle Channel***&Modulation: ***π/4DQPSK***



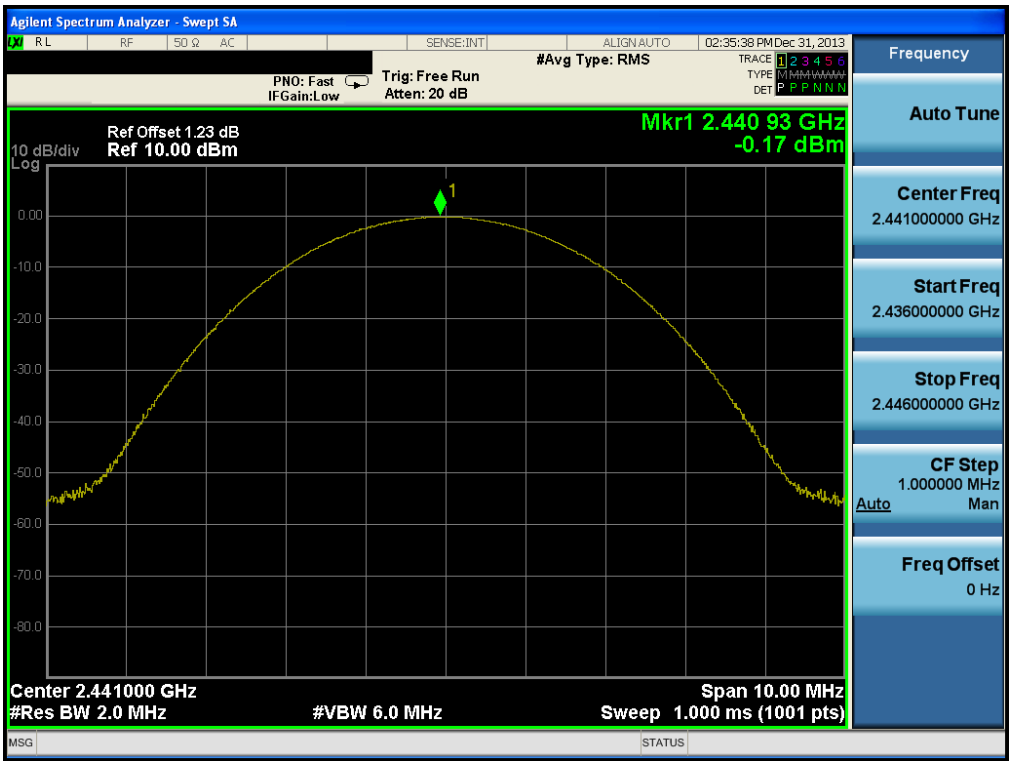
Peak Output Power ***Highest Channel***&Modulation: ***π/4DQPSK***



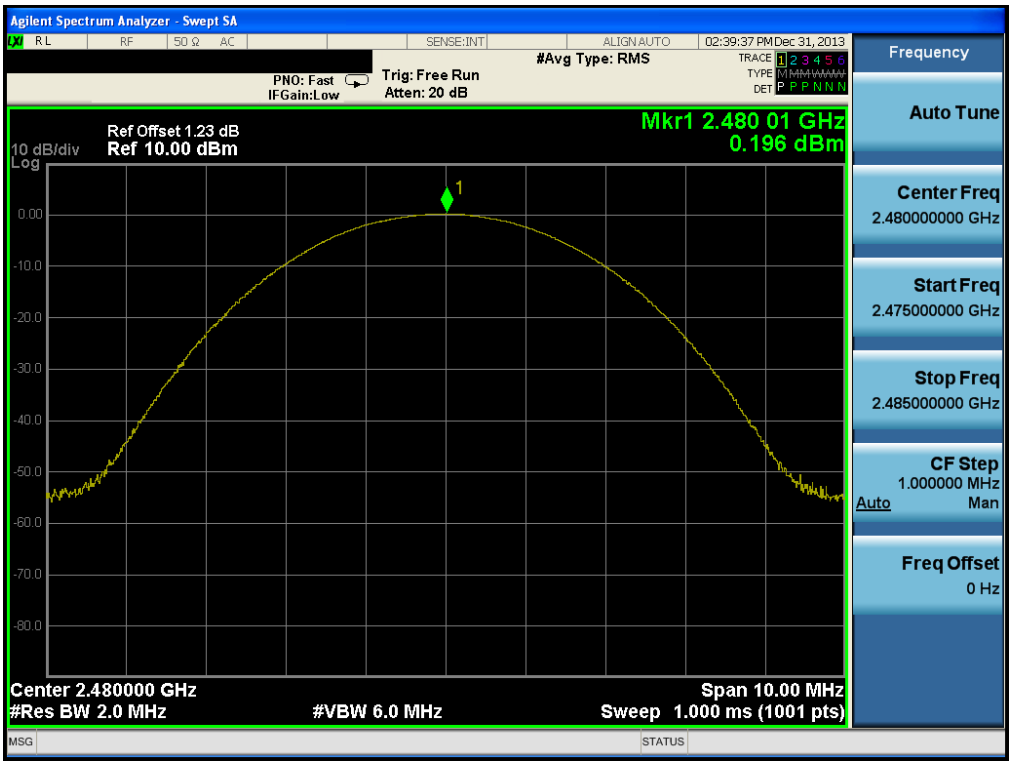
Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***



L40SK2

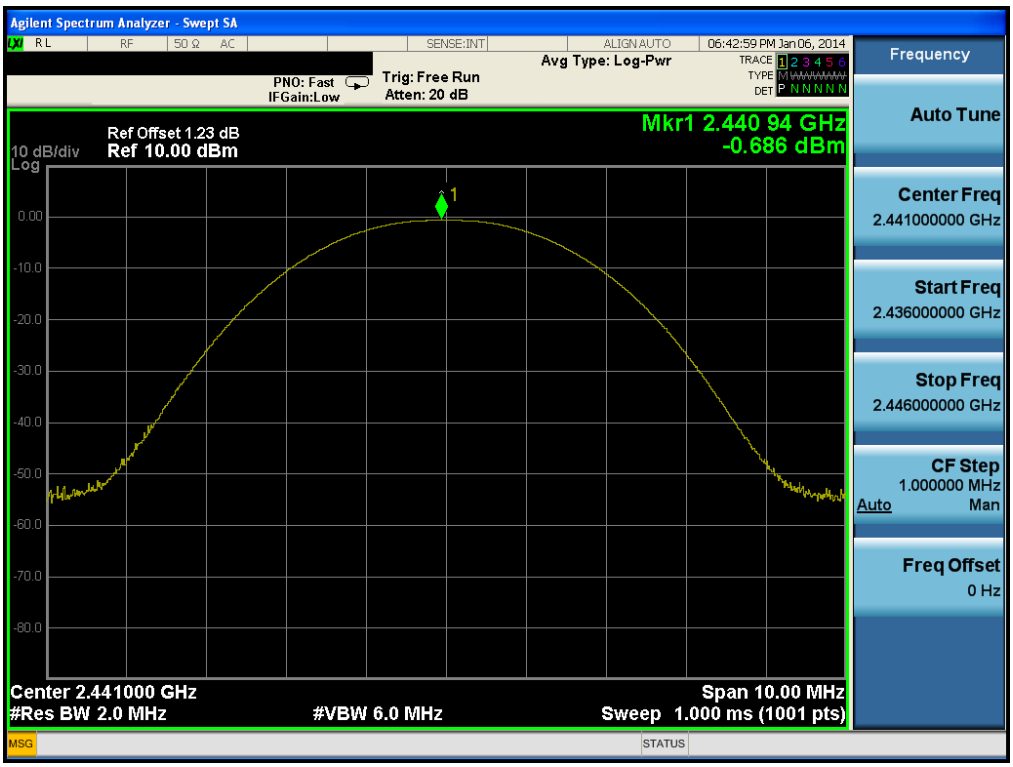
Ambient temperature : 24°C
Relative humidity : 48 %

Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	-1.16	0.765
	Middle	-0.69	0.854
	Highest	**- 0.58**	**0.874**
π/4DQPSK	**Lowest**	0.45	1.109
	Middle	0.99	1.255
	Highest	**1.10**	**1.287**
8DPSK	**Lowest**	1.01	1.263
	Middle	1.50	1.413
	Highest	**1.61**	**1.448**

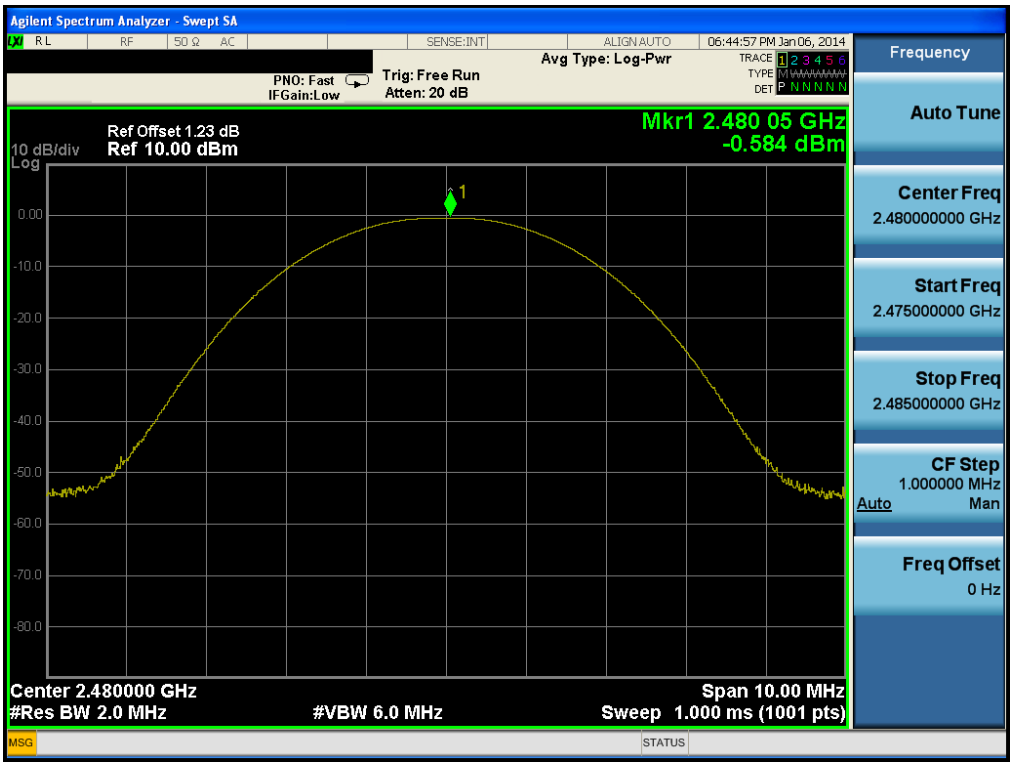
Note 1: See next pages for actual measured spectrum plots.

Peak Output Power ***Lowest Channel***&Modulation: ***GFSK***

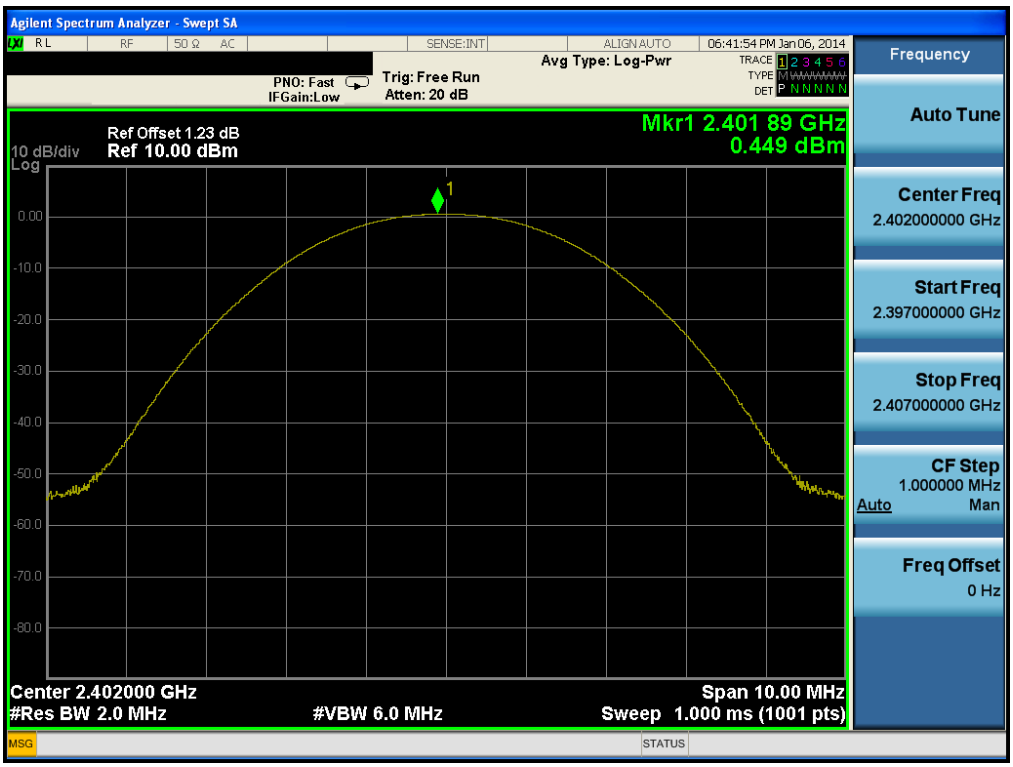
Peak Output Power ***Middle Channel***&Modulation: ***GFSK***



Peak Output Power ***Highest Channel***&Modulation: ***GFSK***

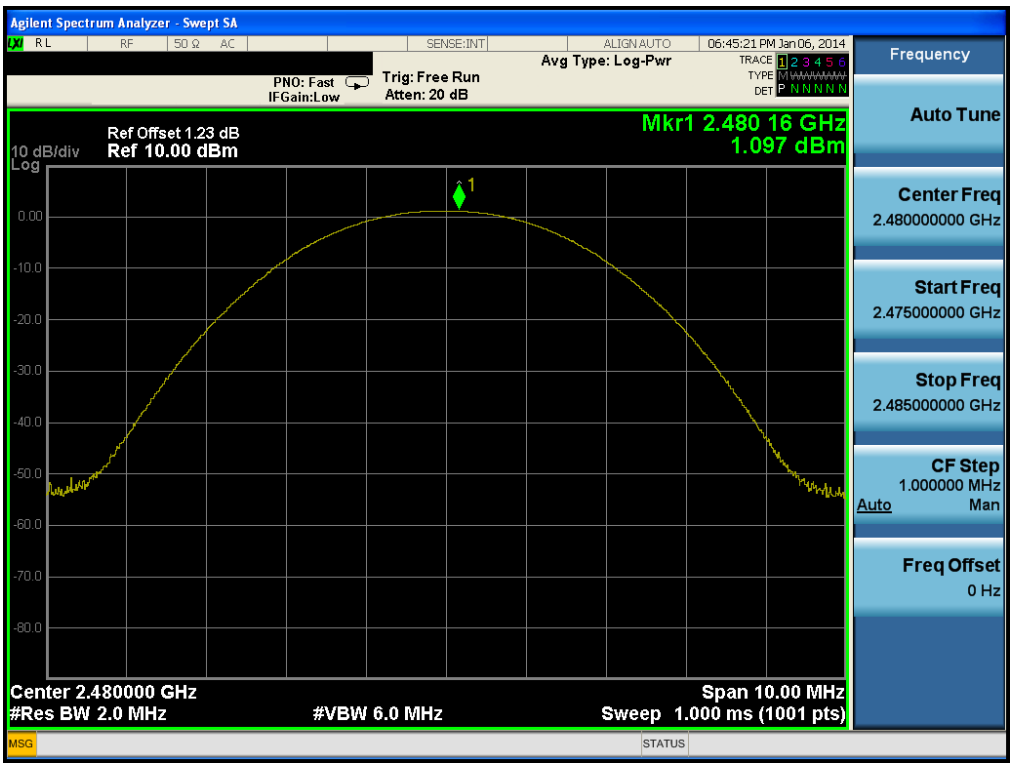


Peak Output Power ***Lowest Channel***&Modulation: ***π/4DQPSK***



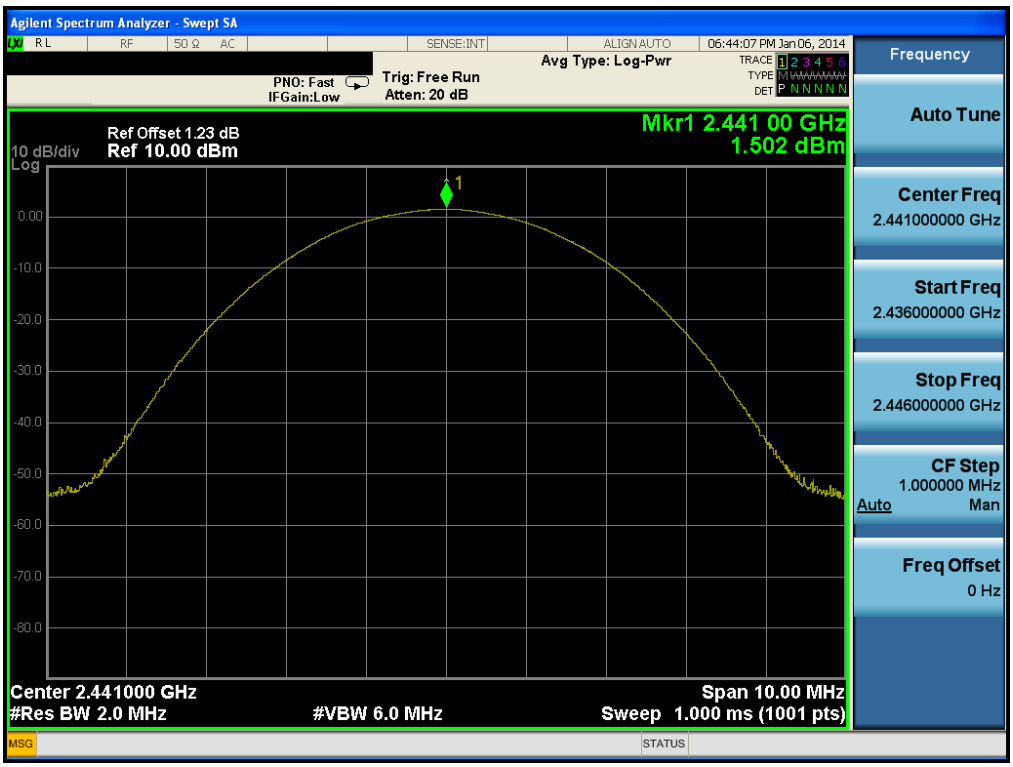
Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***

Peak Output Power ***Highest Channel***&Modulation: ***π/4DQPSK***



Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***

Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***

L40VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	- 3.49	0.448
	Middle	- 2.89	0.514
	Highest	**- 2.60**	**0.550**
π/4DQPSK	**Lowest**	- 1.88	0.649
	Middle	- 1.22	0.755
	Highest	**- 0.91**	**0.811**
8DPSK	**Lowest**	- 1.39	0.726
	Middle	- 0.75	0.841
	Highest	**- 0.48**	**0.895**

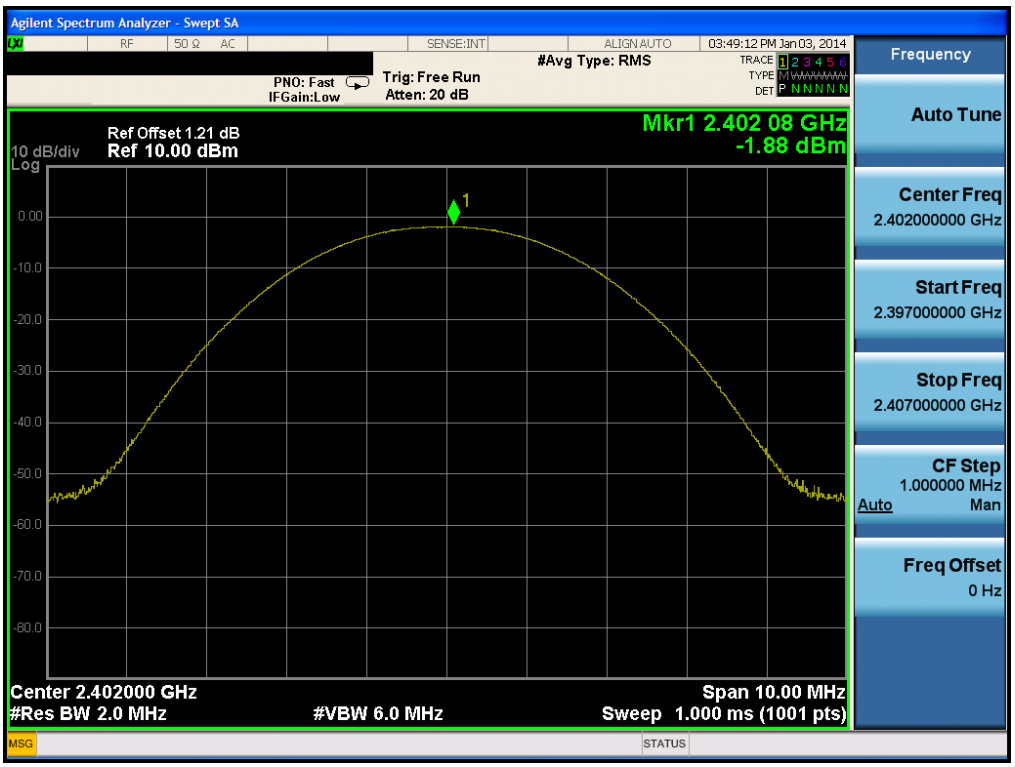
Note 1: See next pages for actual measured spectrum plots.

Peak Output Power ***Lowest Channel*** & Modulation: ***GFSK***

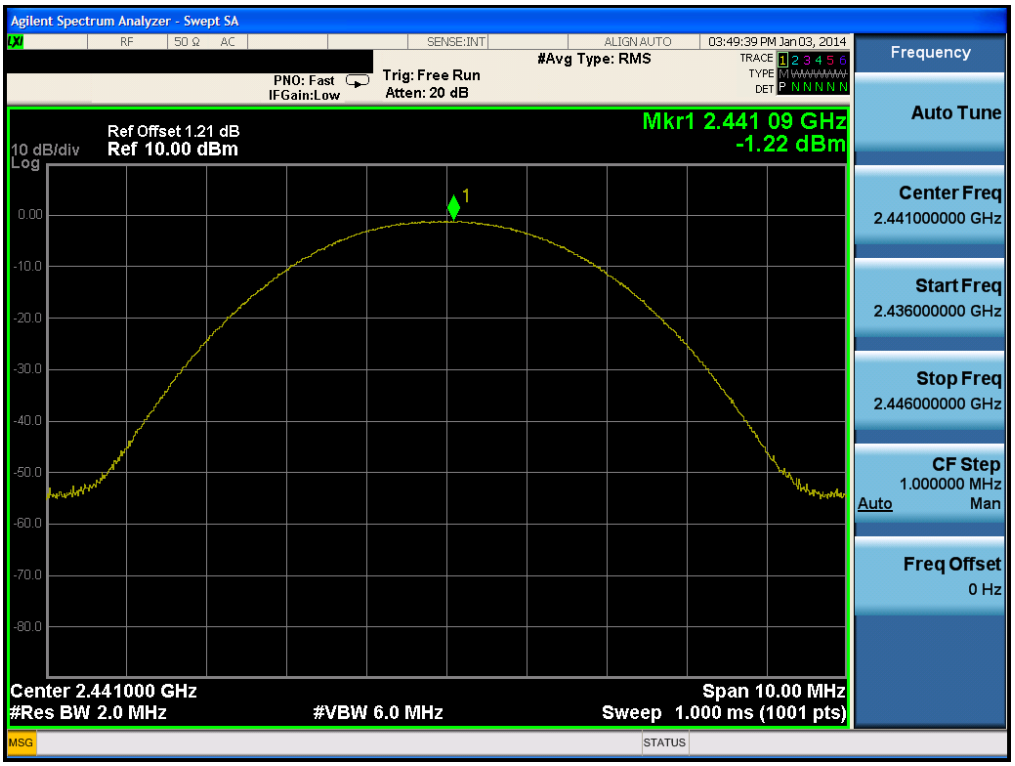
Peak Output Power ***Middle Channel*** & Modulation: ***GFSK***

Peak Output Power ***Highest Channel*** & Modulation: ***GFSK***

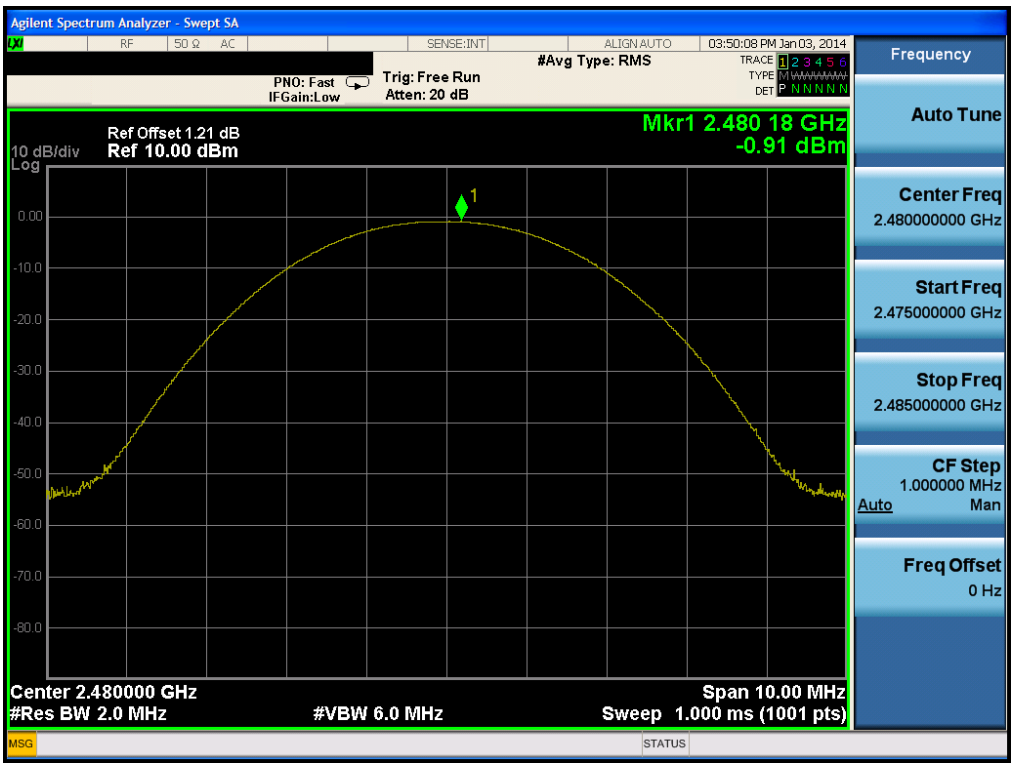
Peak Output Power ***Lowest Channel*** & Modulation: ***π/4DQPSK***



Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***

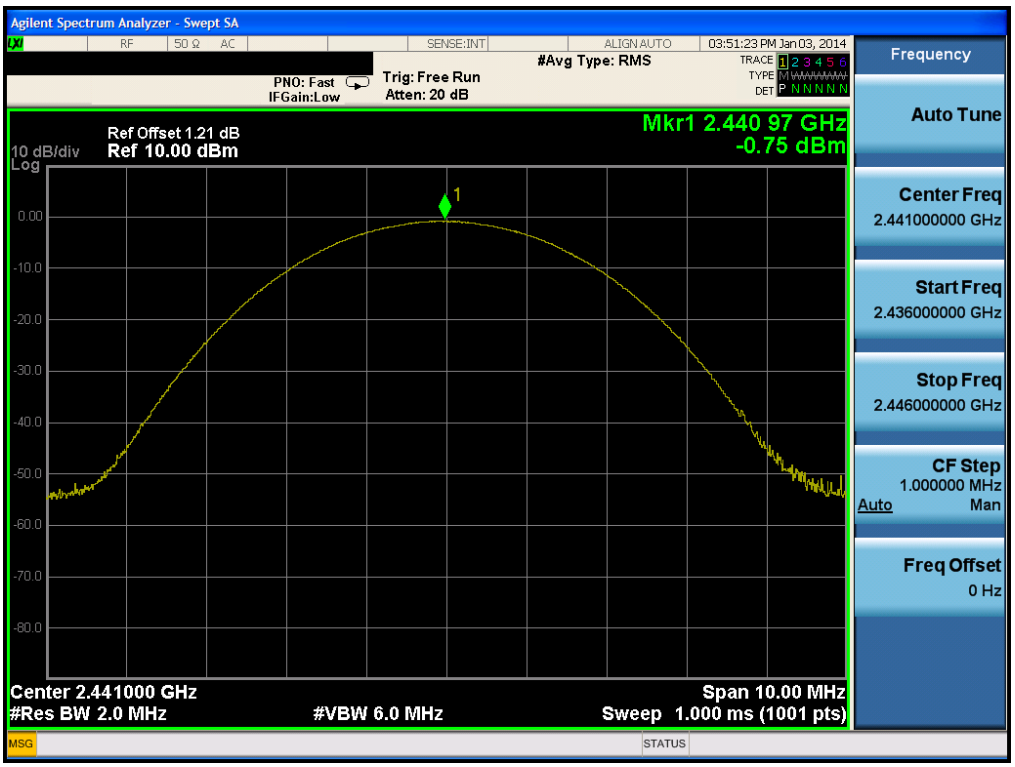


Peak Output Power ***Highest Channel*** & Modulation: ***π/4DQPSK***

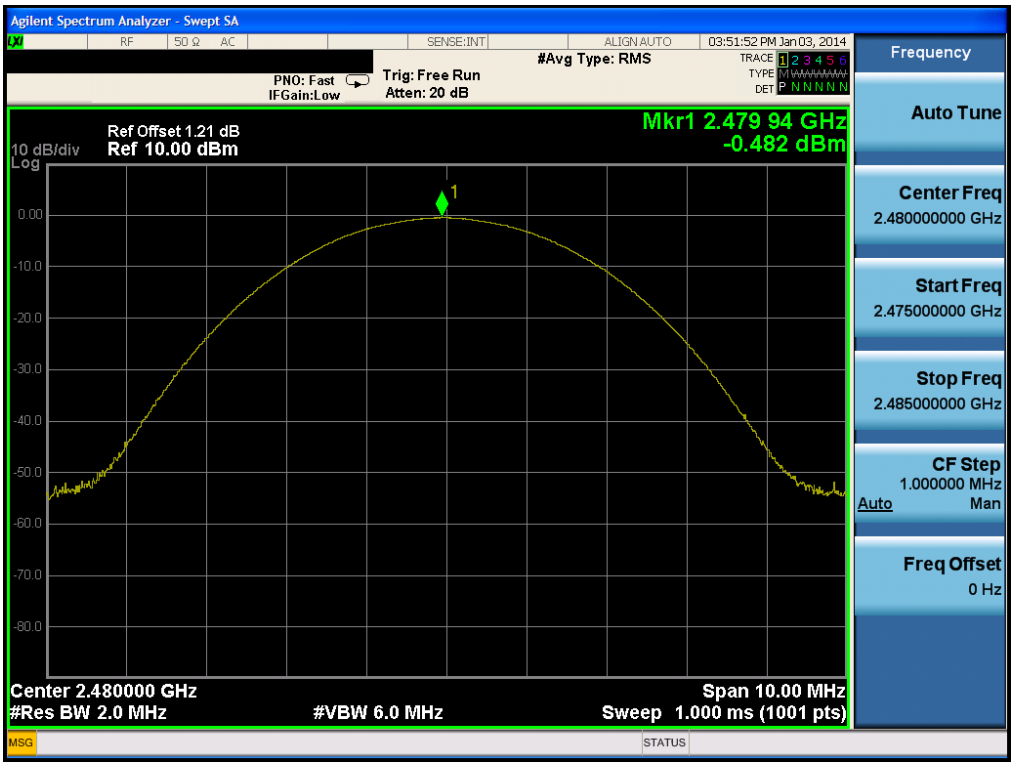


Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***

Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***



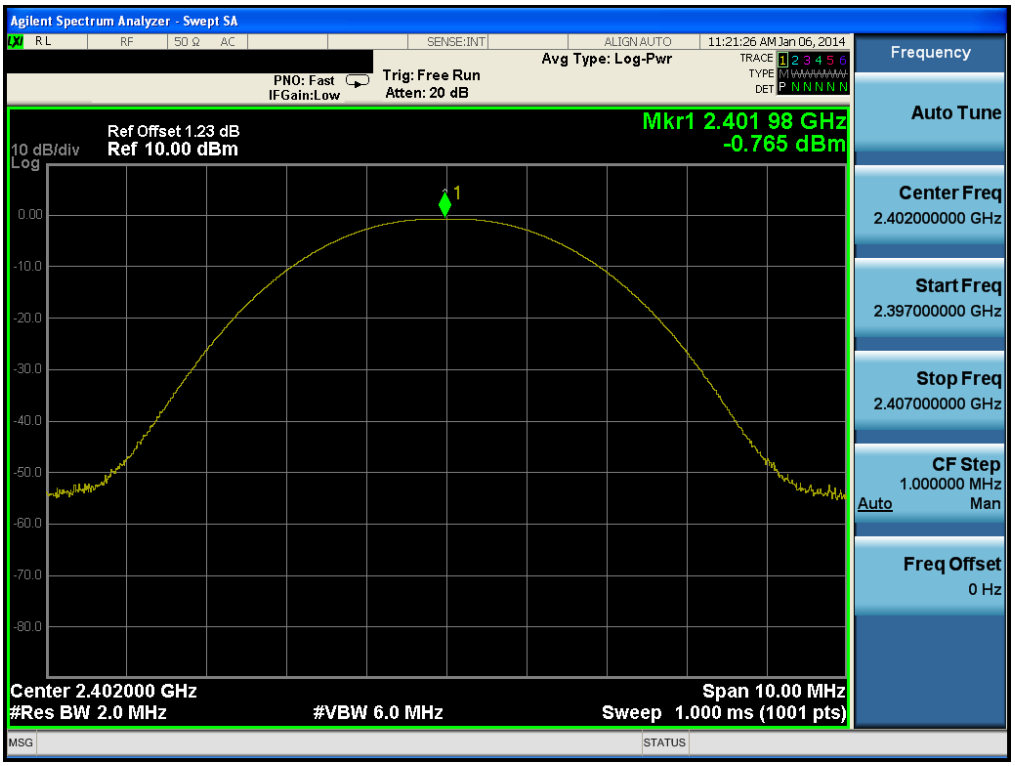
L41SK2

Ambient temperature : 24°C
Relative humidity : 48 %

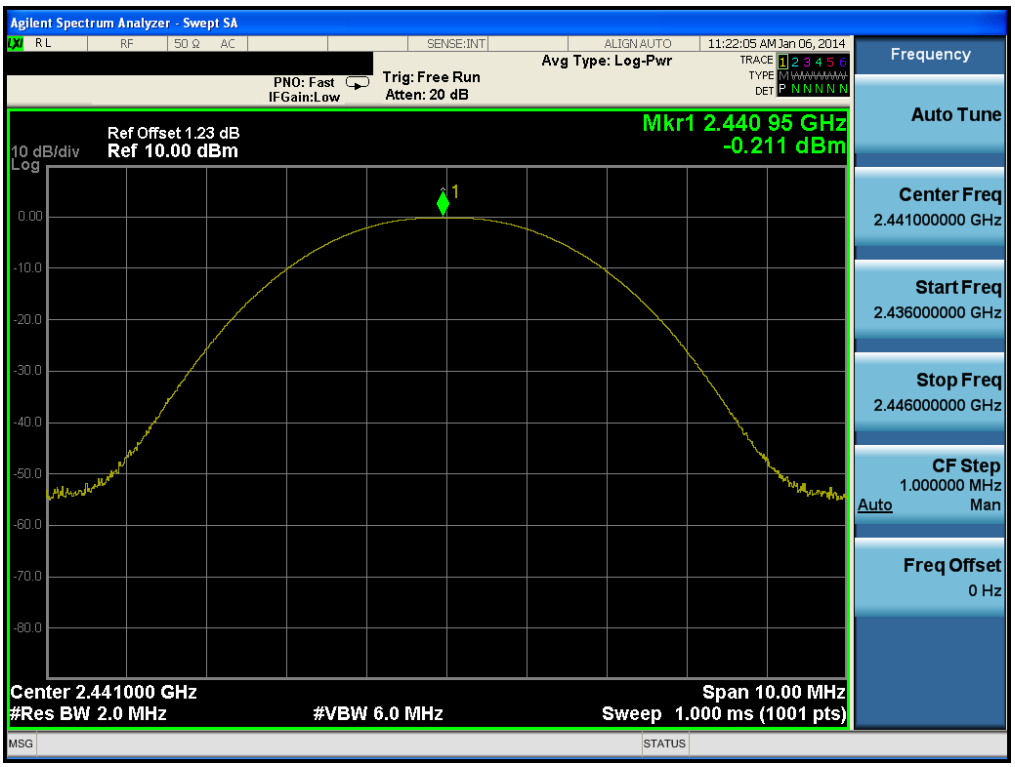
Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	-0.77	0.838
	Middle	-0.21	0.953
	Highest	**- 0.19**	**0.958**
π/4DQPSK	**Lowest**	0.95	1.243
	Middle	1.51	1.417
	Highest	**1.55**	**1.428**
8DPSK	**Lowest**	1.37	1.370
	Middle	1.96	1.569
	Highest	**1.99**	**1.579**

Note 1: See next pages for actual measured spectrum plots.

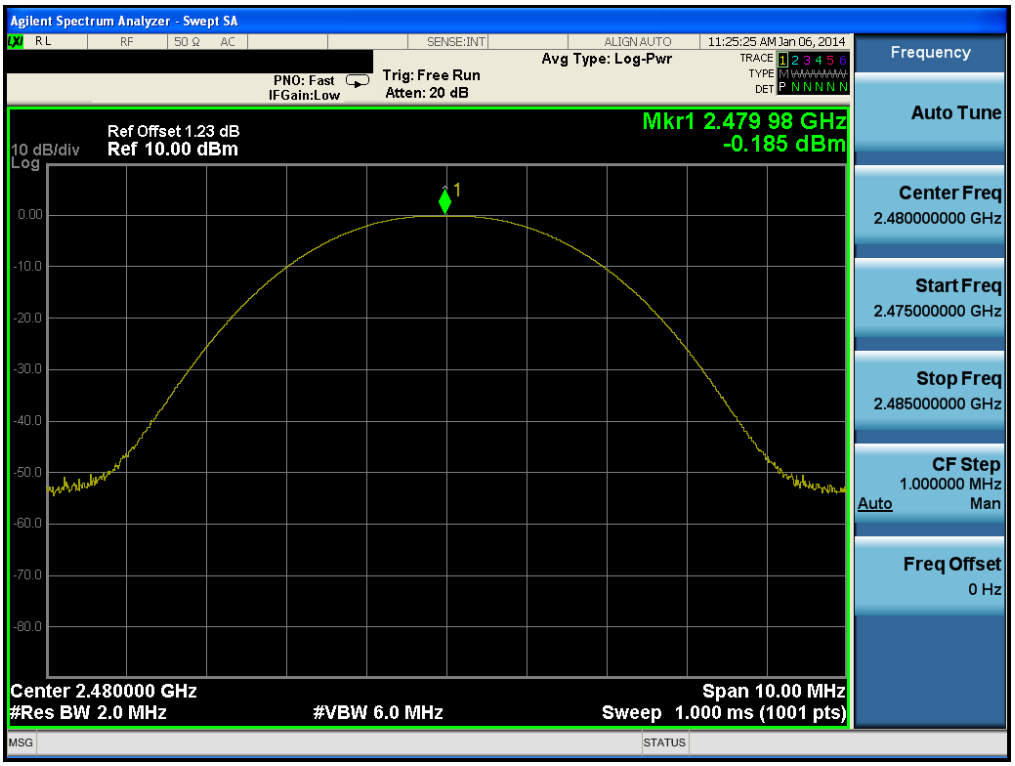
Peak Output Power ***Lowest Channel***&Modulation: ***GFSK***



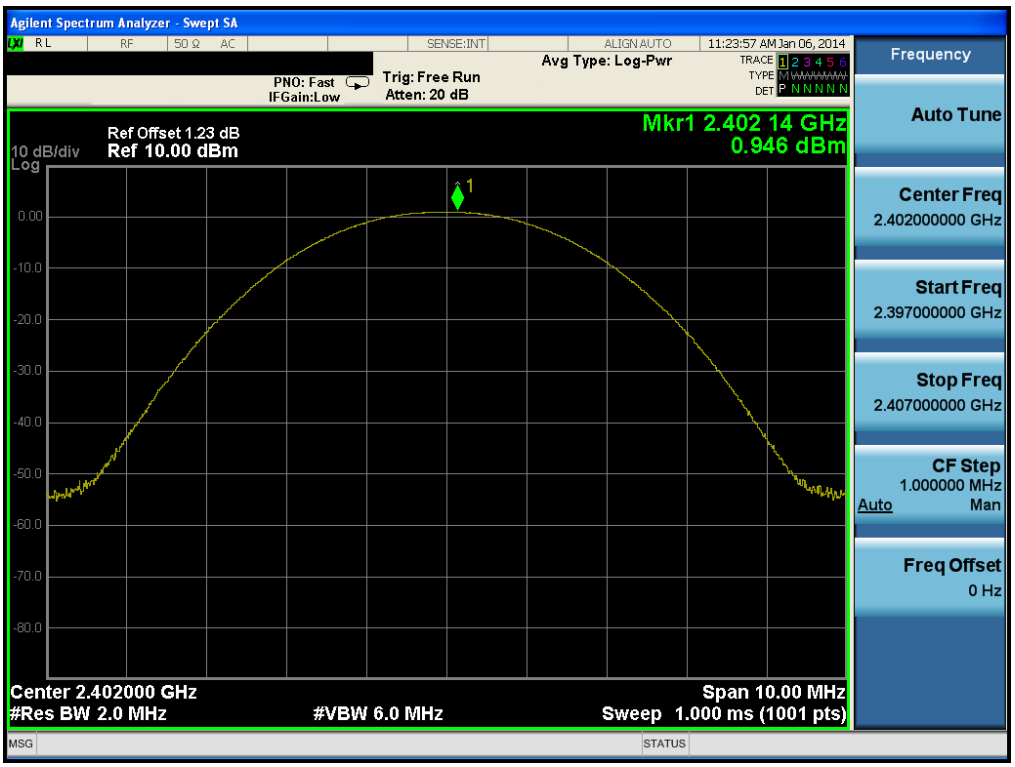
Peak Output Power ***Middle Channel***&Modulation: ***GFSK***



Peak Output Power ***Highest Channel***&Modulation: ***GFSK***



Peak Output Power ***Lowest Channel***&Modulation: ***π/4DQPSK***

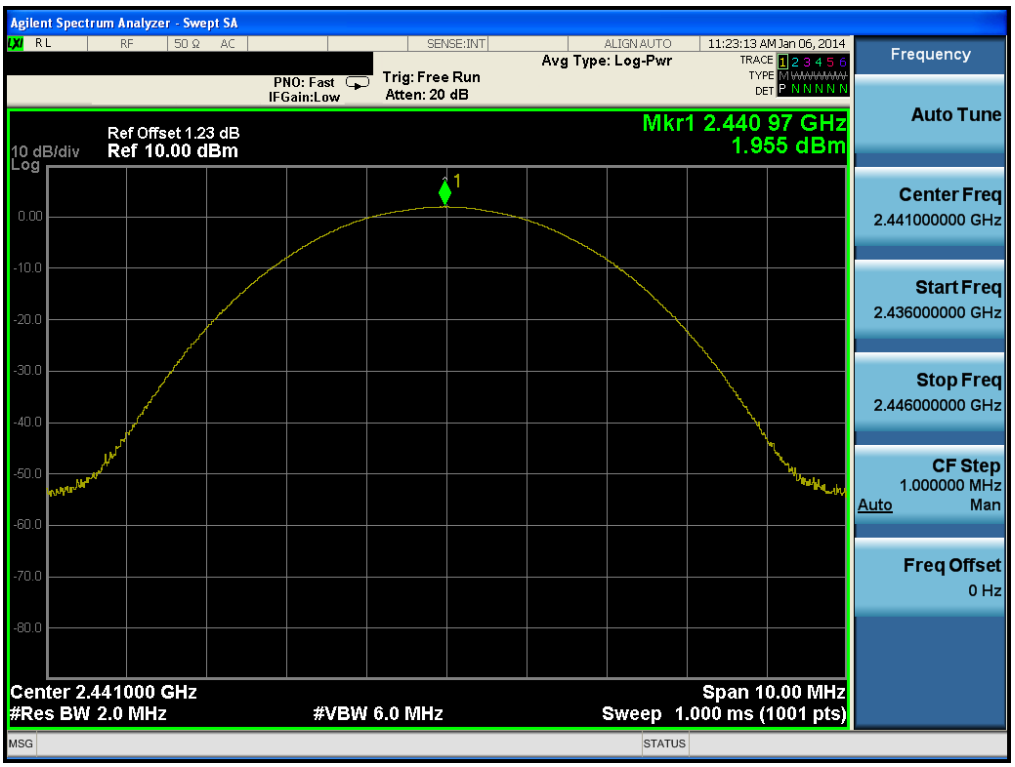


Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***

Peak Output Power ***Highest Channel***&Modulation: ***π/4DQPSK***

Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***

Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***

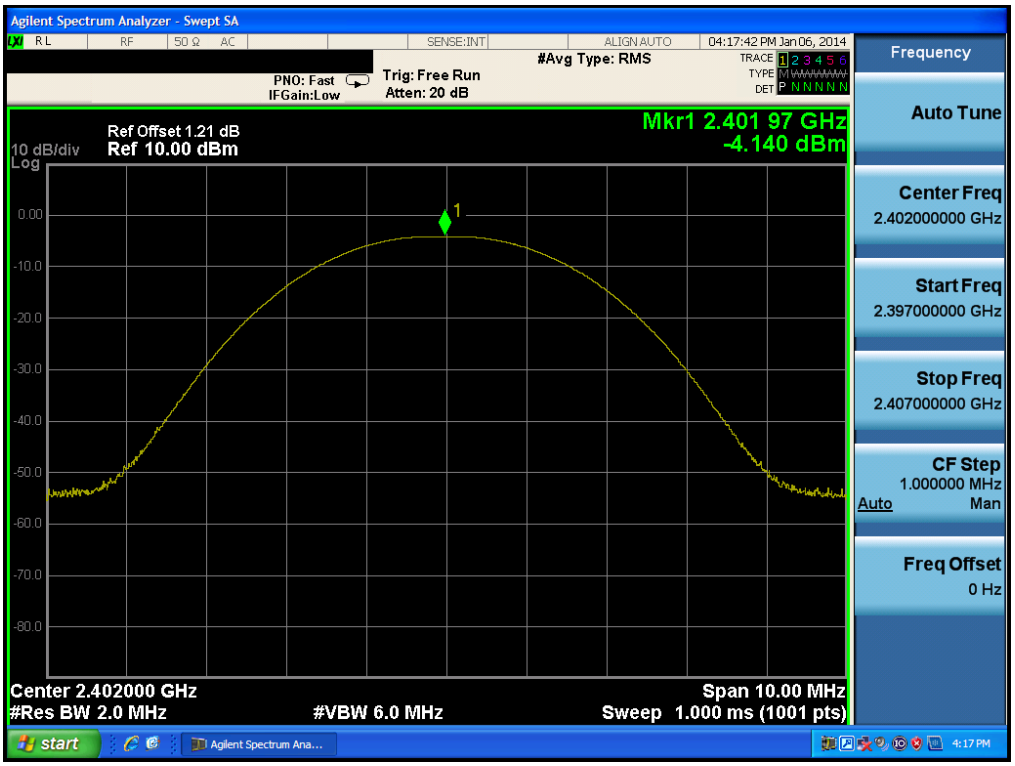
L41VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

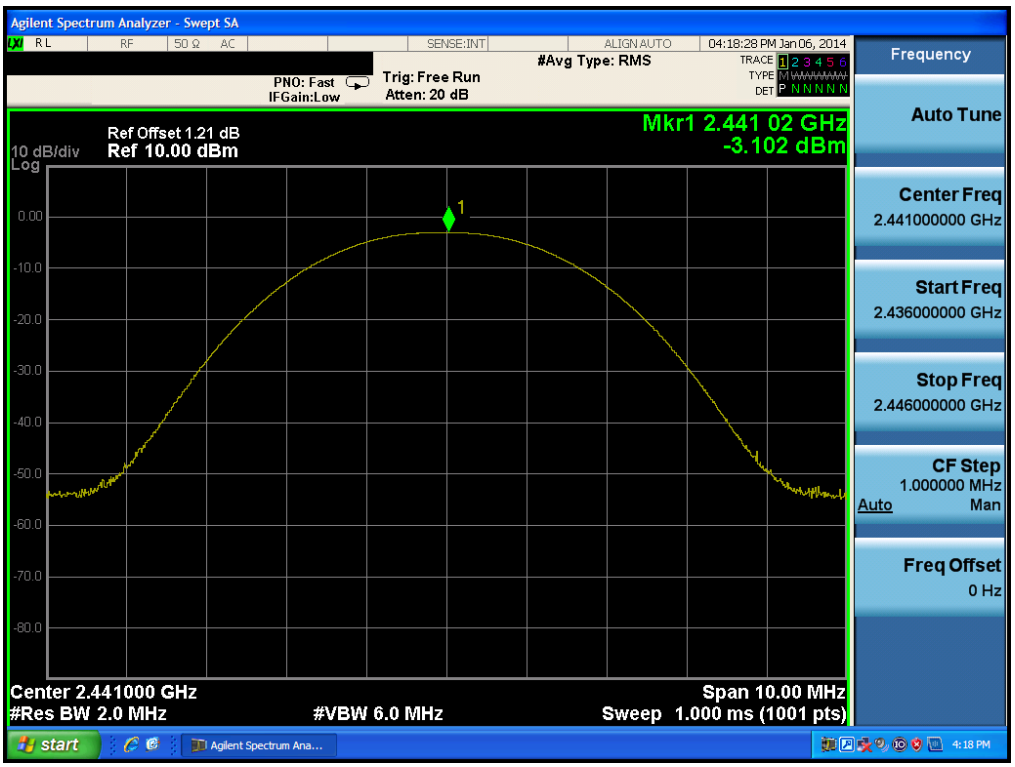
Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	- 4.14	0.385
	Middle	- 3.10	0.490
	Highest	**- 2.98**	**0.503**
π/4DQPSK	**Lowest**	- 2.46	0.567
	Middle	- 1.44	0.718
	Highest	**- 1.30**	**0.741**
8DPSK	**Lowest**	- 1.97	0.636
	Middle	- 0.92	0.809
	Highest	**-0.79**	**0.834**

Note 1: See next pages for actual measured spectrum plots.

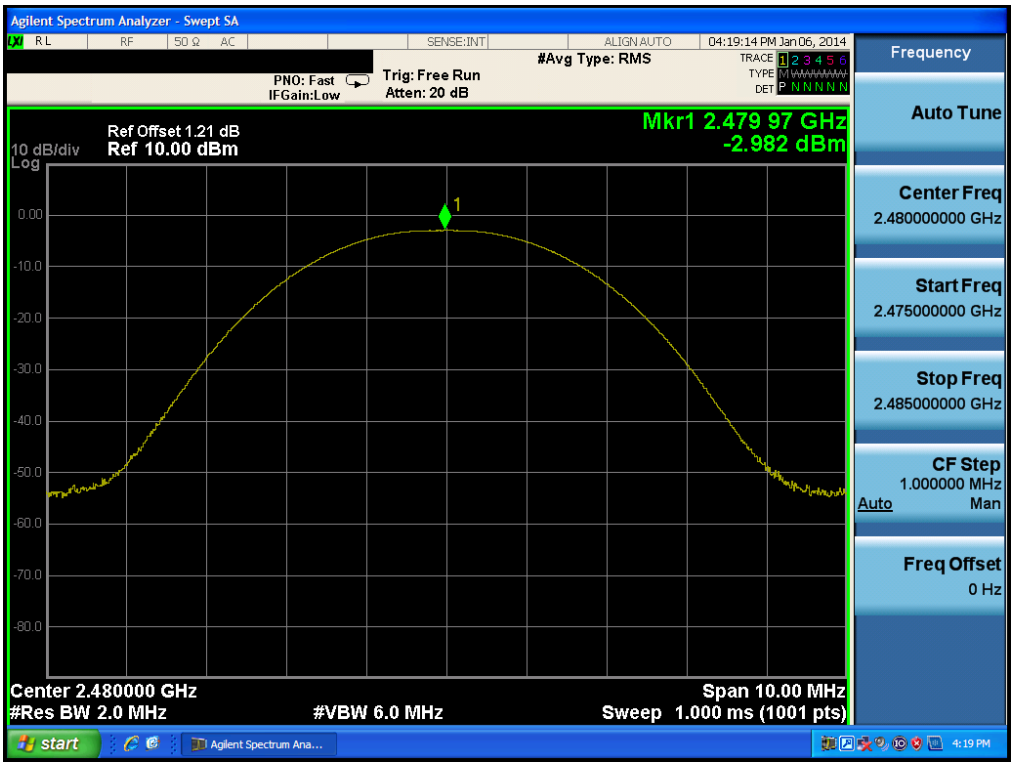
Peak Output Power ***Lowest Channel*** & Modulation: ***GFSK***



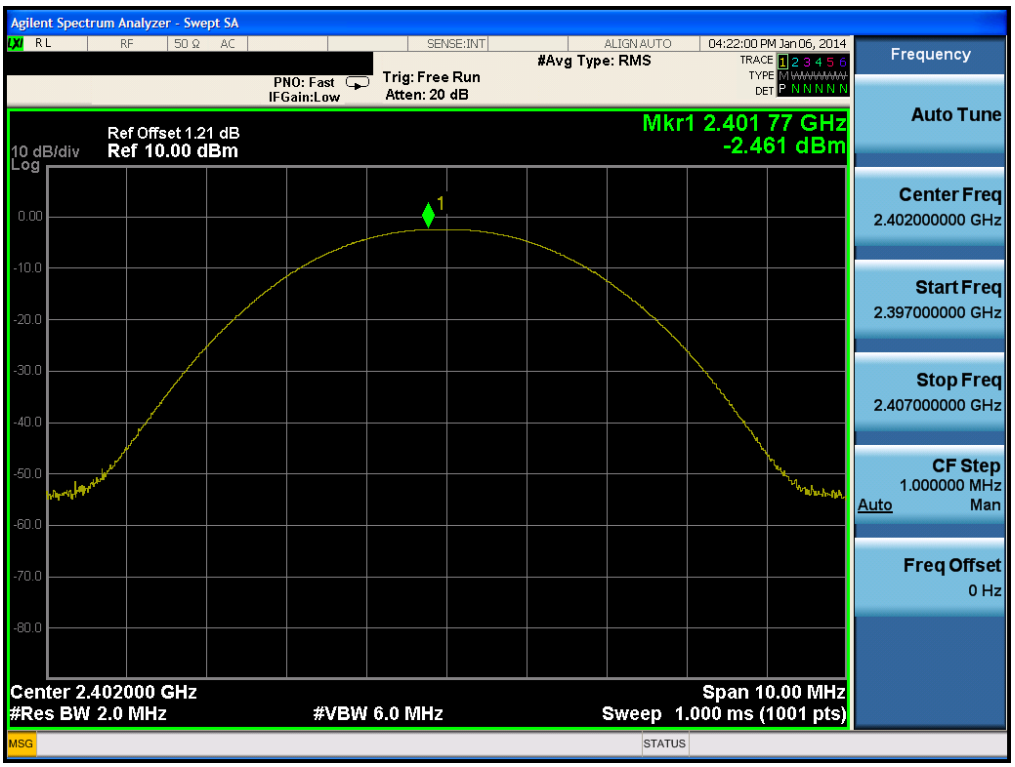
Peak Output Power ***Middle Channel*** & Modulation: ***GFSK***



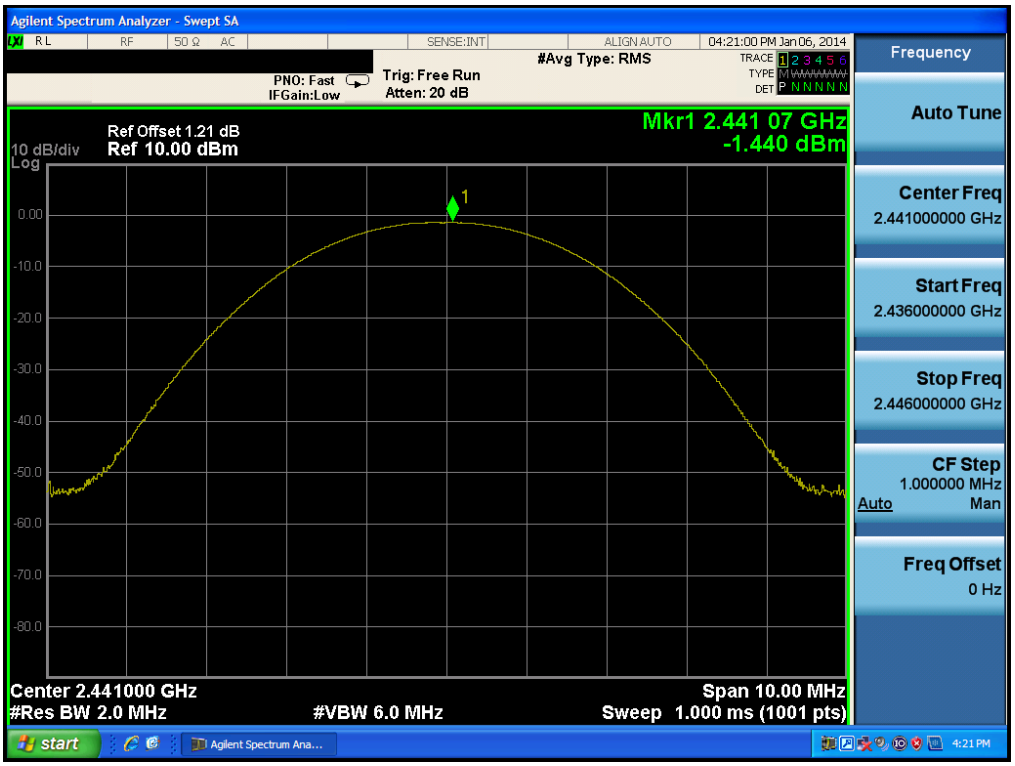
Peak Output Power ***Highest Channel*** & Modulation: ***GFSK***



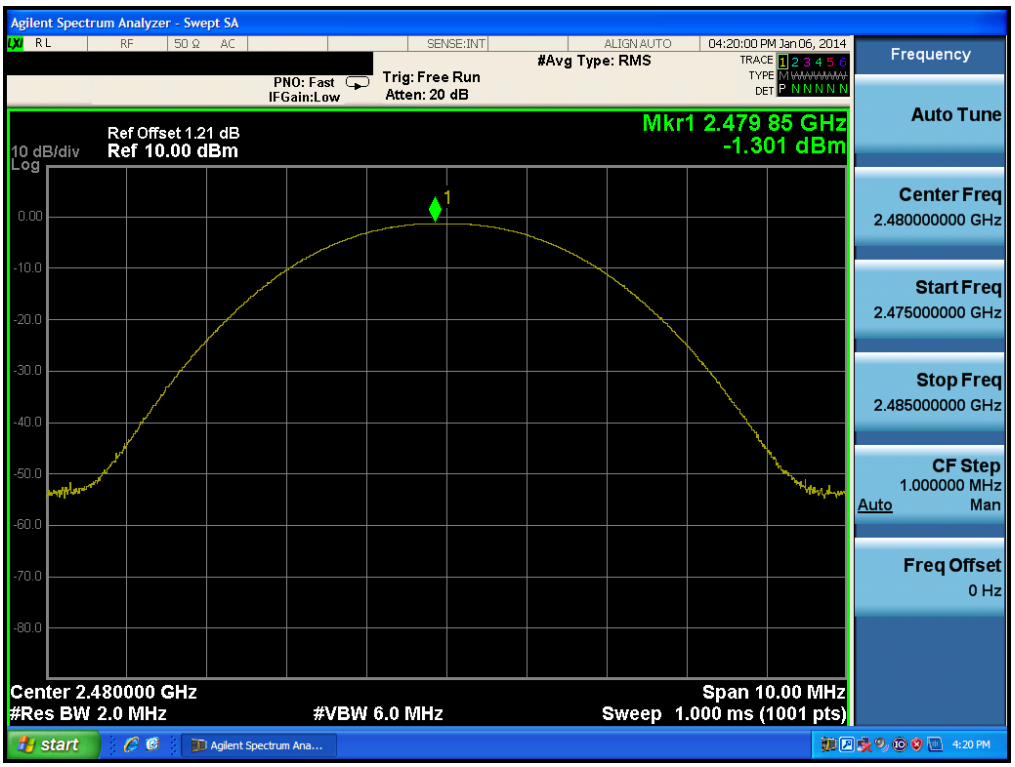
Peak Output Power ***Lowest Channel*** & Modulation: ***π/4DQPSK***



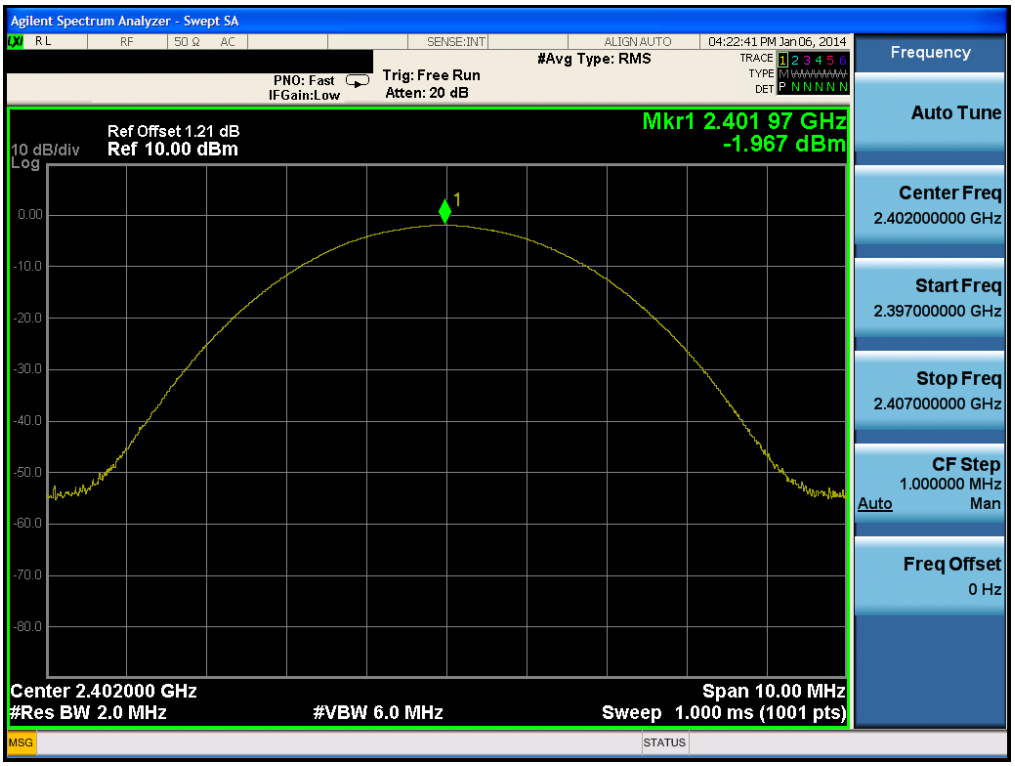
Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***



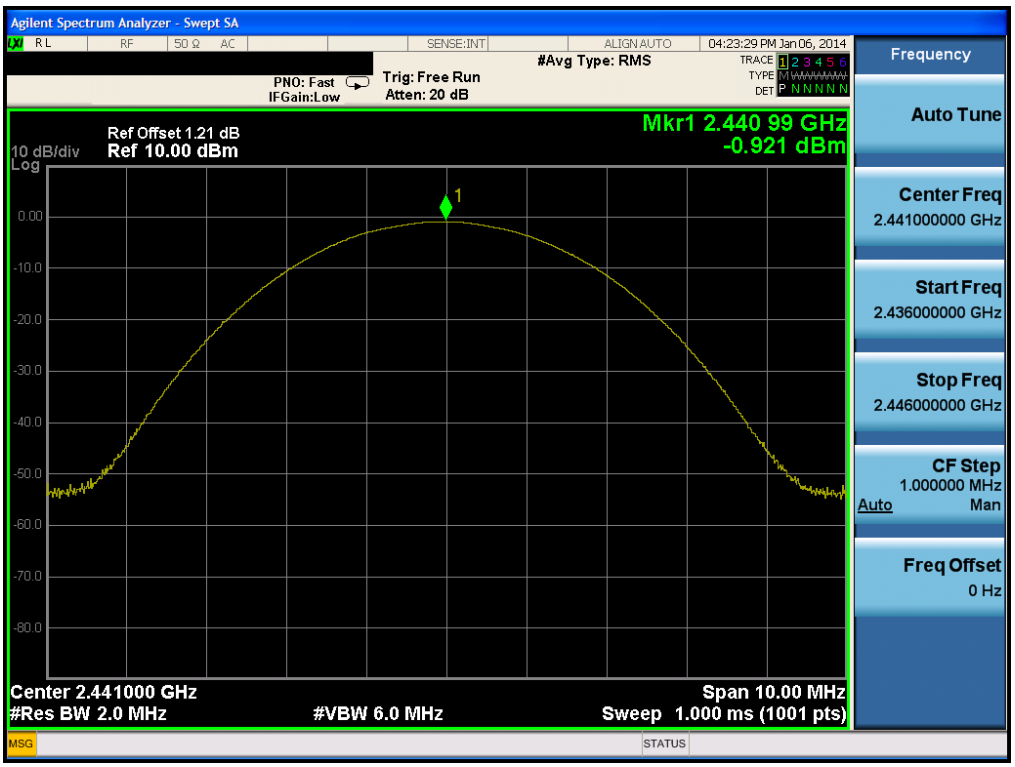
Peak Output Power ***Highest Channel*** & Modulation: ***π/4DQPSK***



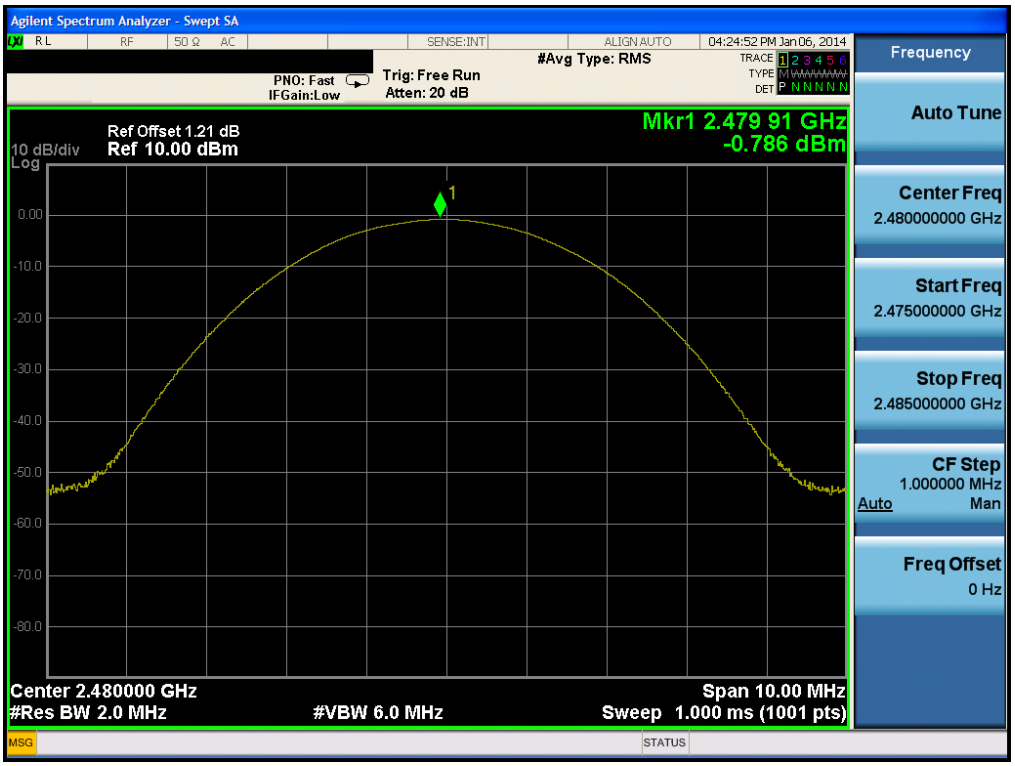
Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***



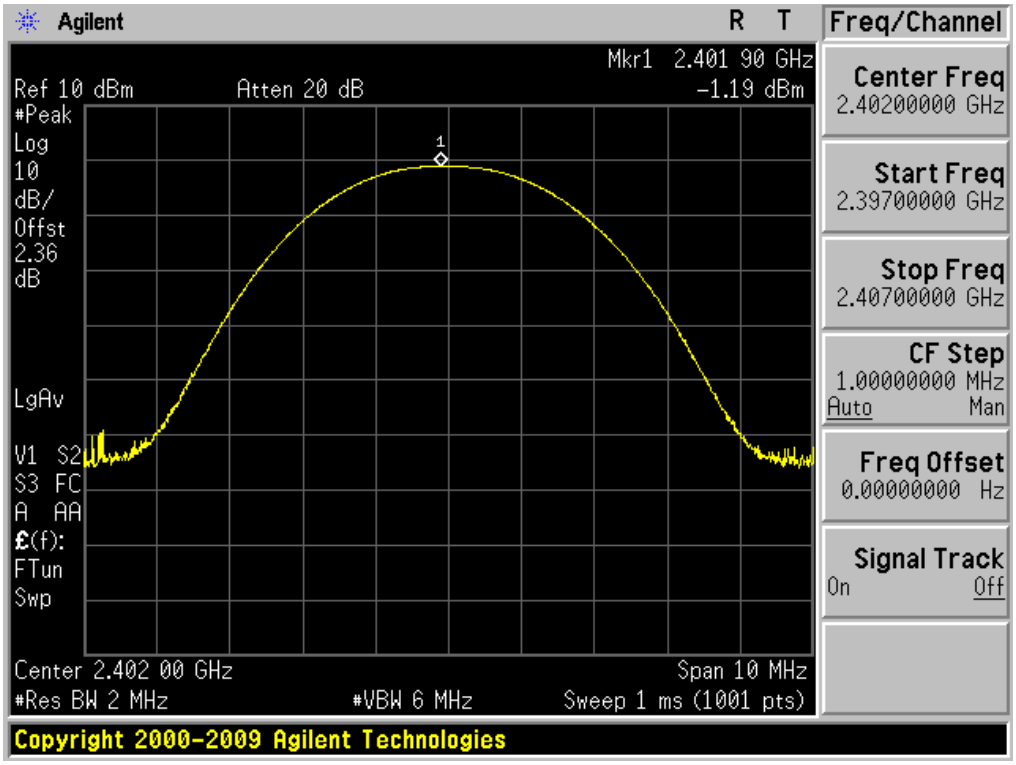
L42VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

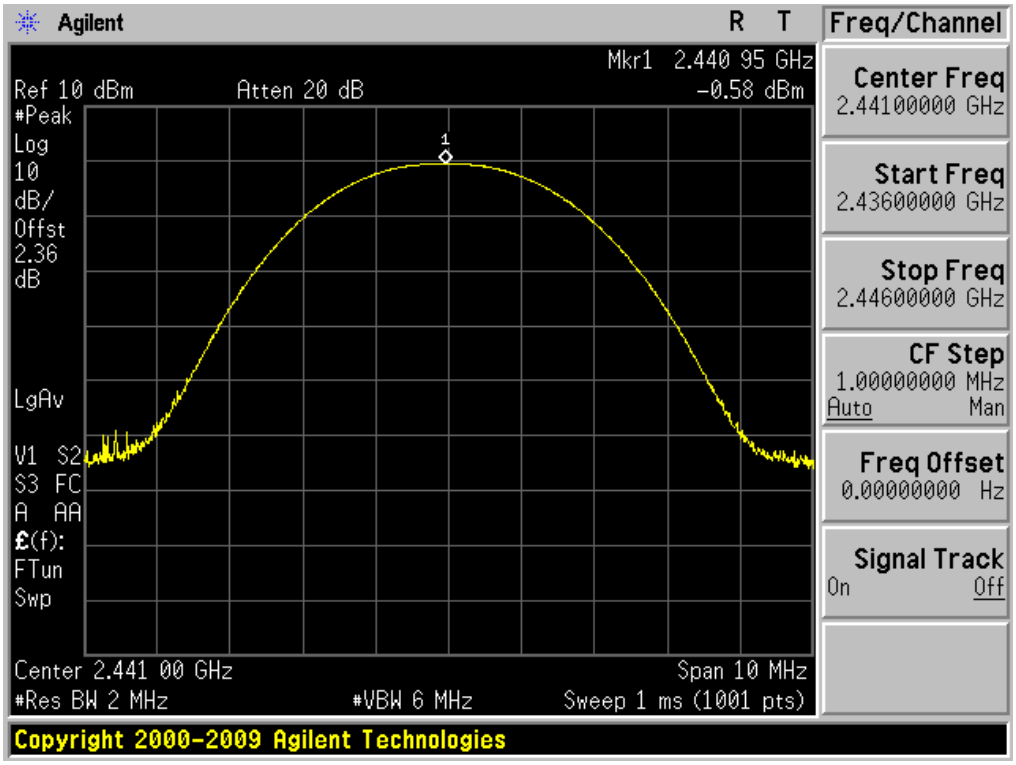
Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	- 1.19	0.760
	Middle	- 0.58	0.875
	Highest	**- 0.48**	**0.895**
π/4DQPSK	**Lowest**	0.45	1.109
	Middle	1.09	1.285
	Highest	**1.20**	**1.318**
8DPSK	**Lowest**	0.92	1.236
	Middle	1.56	1.432
	Highest	**1.66**	**1.466**

Note 1: See next pages for actual measured spectrum plots.

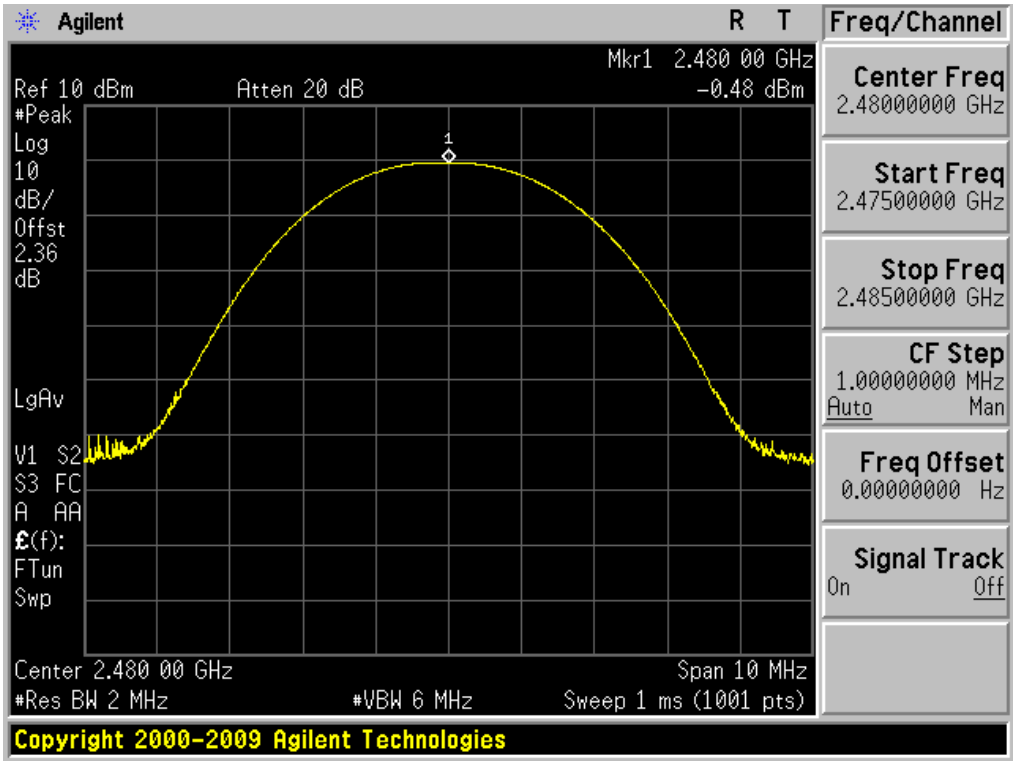
Peak Output Power ***Lowest Channel*** & Modulation: ***GFSK***



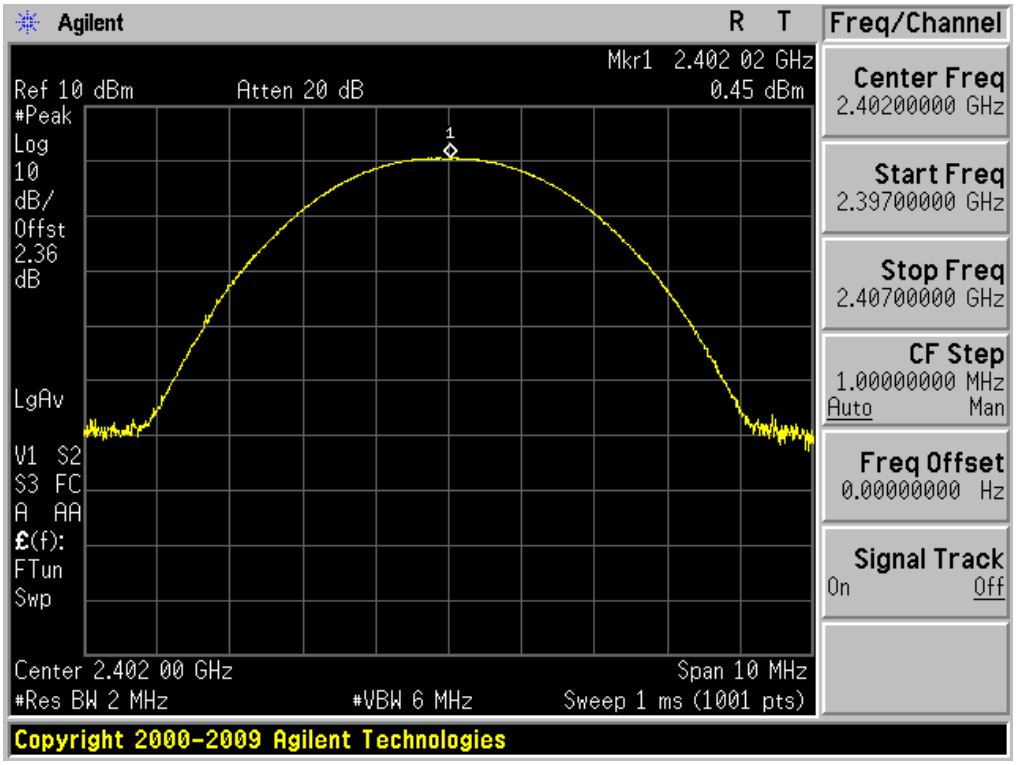
Peak Output Power ***Middle Channel*** & Modulation: ***GFSK***



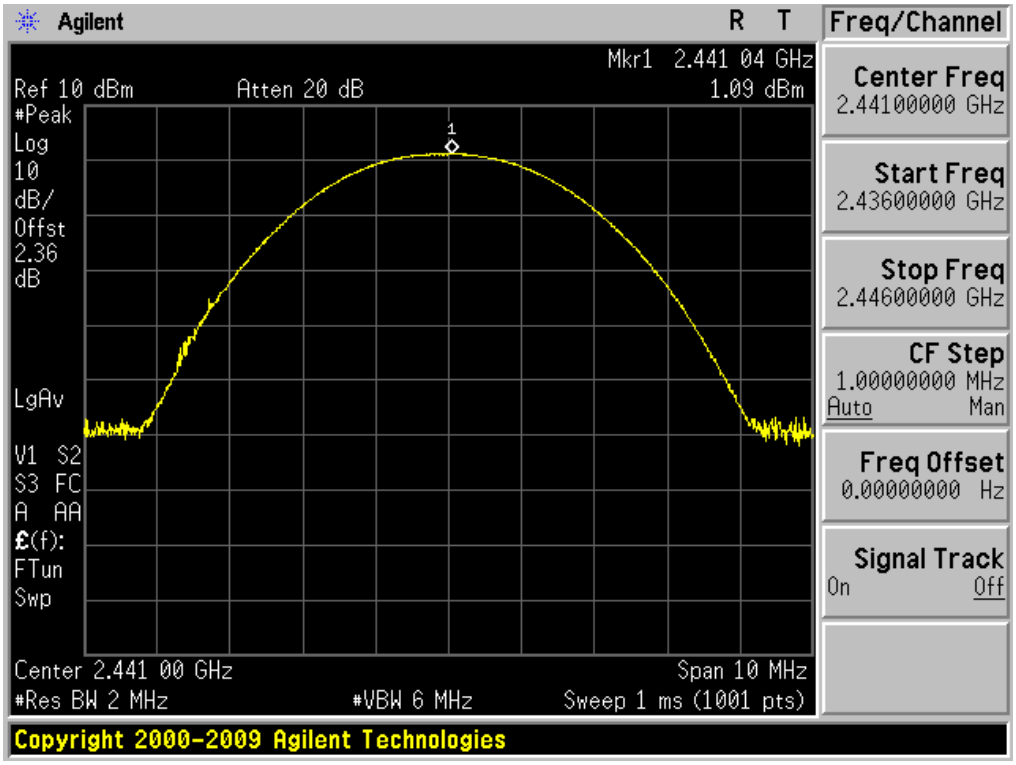
Peak Output Power ***Highest Channel*** & Modulation: ***GFSK***



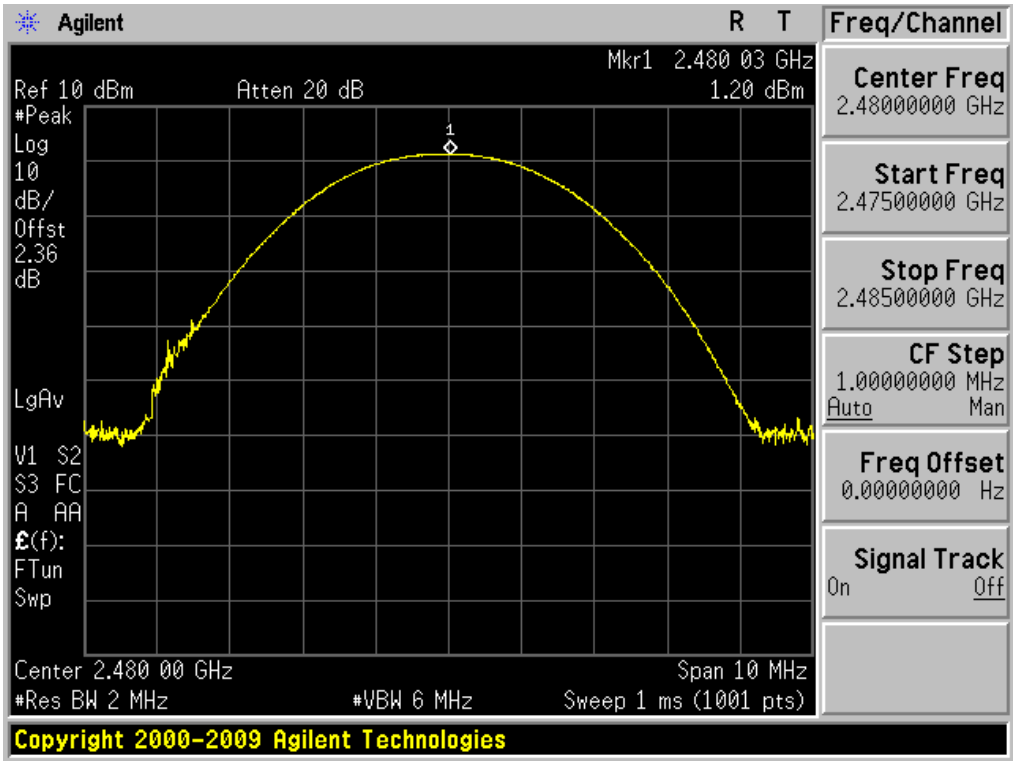
Peak Output Power ***Lowest Channel*** & Modulation: ***π/4DQPSK***



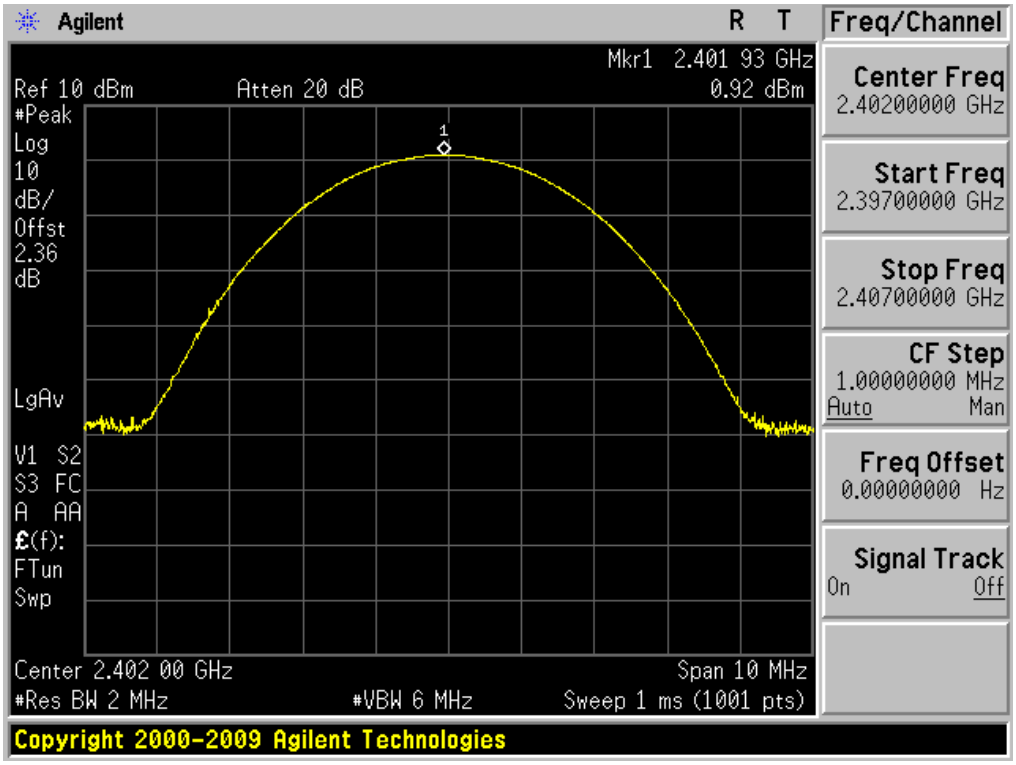
Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***



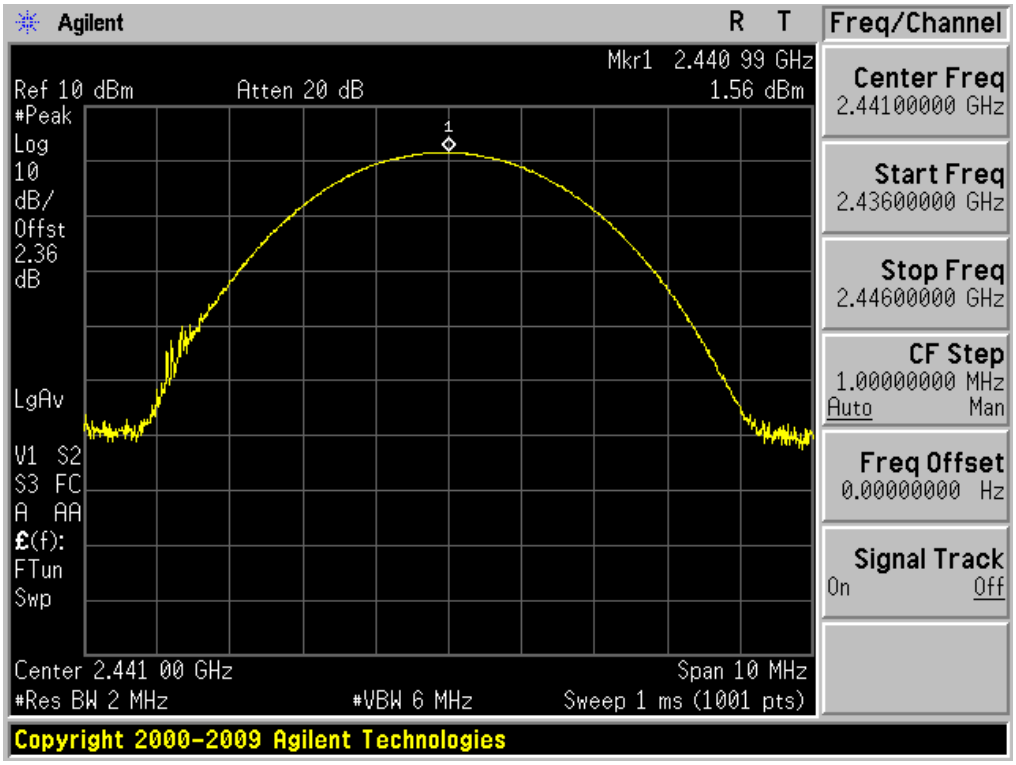
Peak Output Power ***Highest Channel*** & Modulation: ***π/4DQPSK***



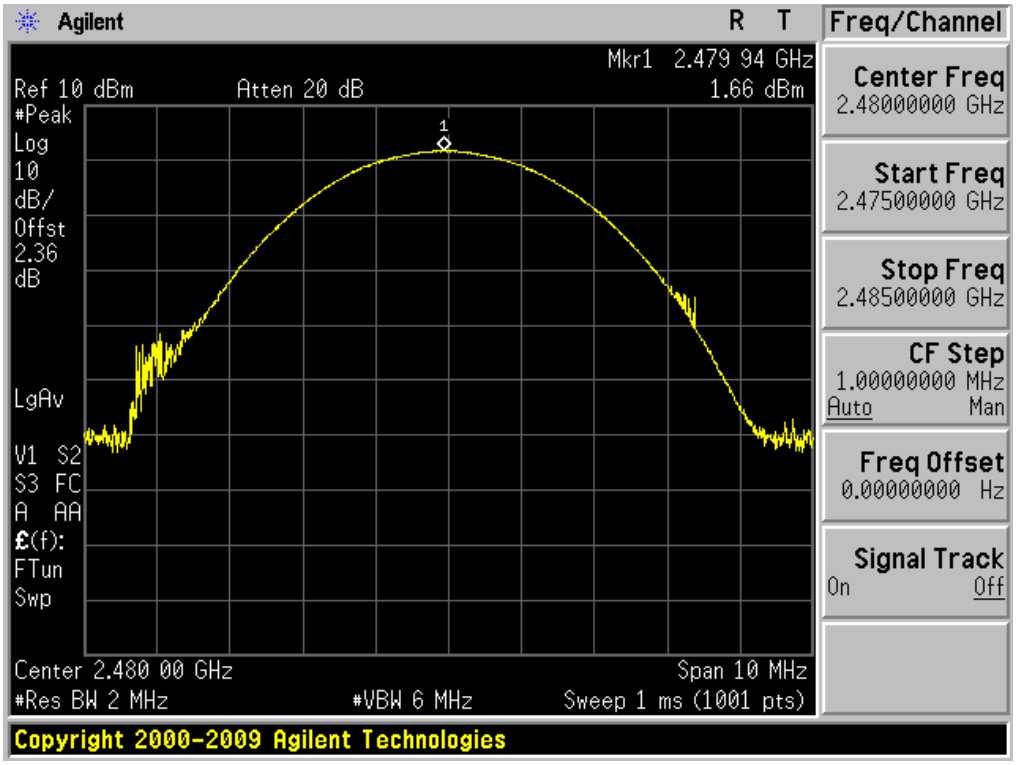
Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***



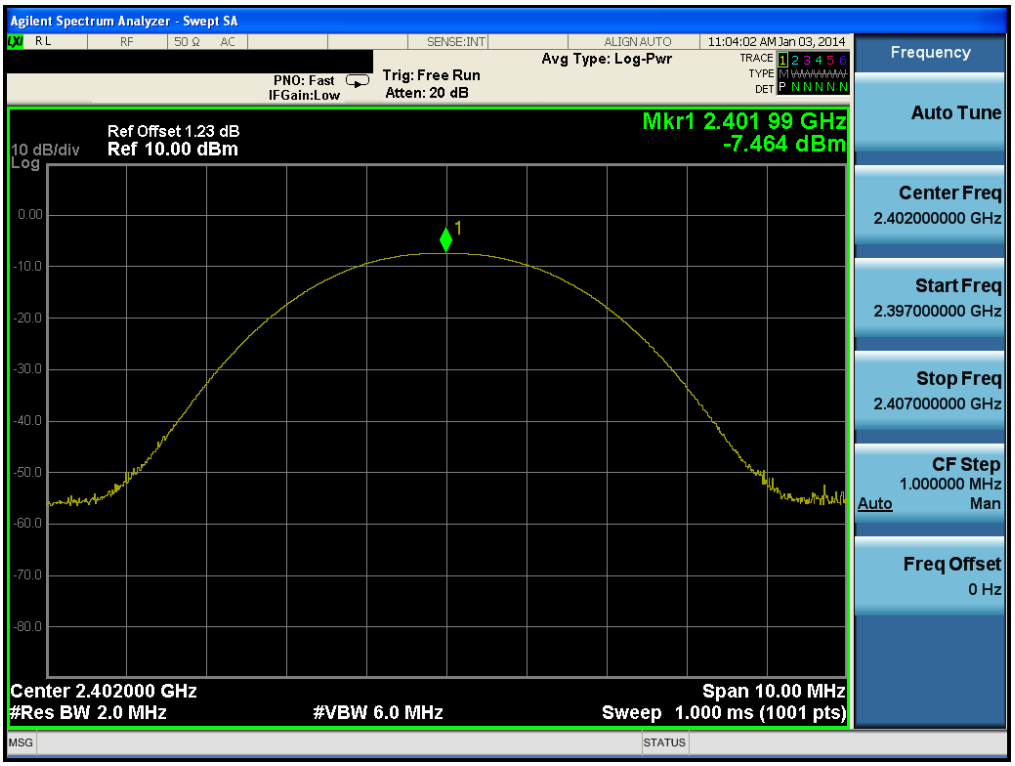
L52SK2

Ambient temperature : 24°C
Relative humidity : 48 %

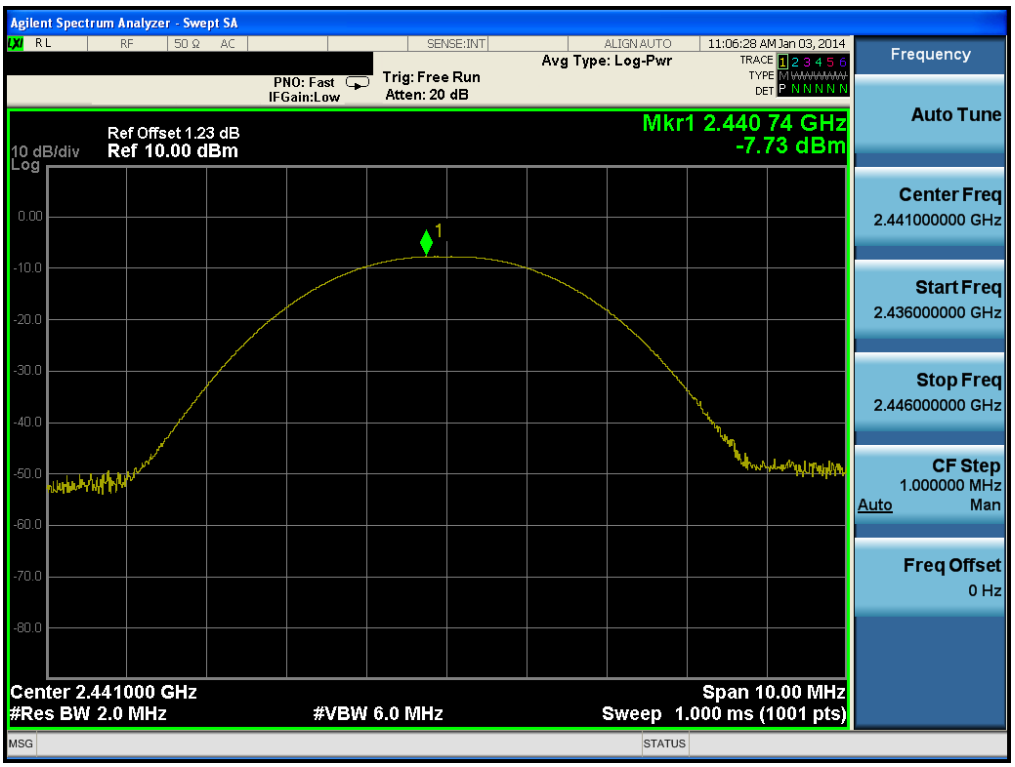
Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	**-7.46**	**0.179**
	Middle	-7.73	0.169
	Highest	-9.15	0.122
π/4DQPSK	**Lowest**	**-5.96**	**0.254**
	Middle	-6.00	0.251
	Highest	-7.54	0.176
8DPSK	**Lowest**	**-5.48**	**0.283**
	Middle	-5.56	0.278
	Highest	-7.01	0.199

Note 1: See next pages for actual measured spectrum plots.

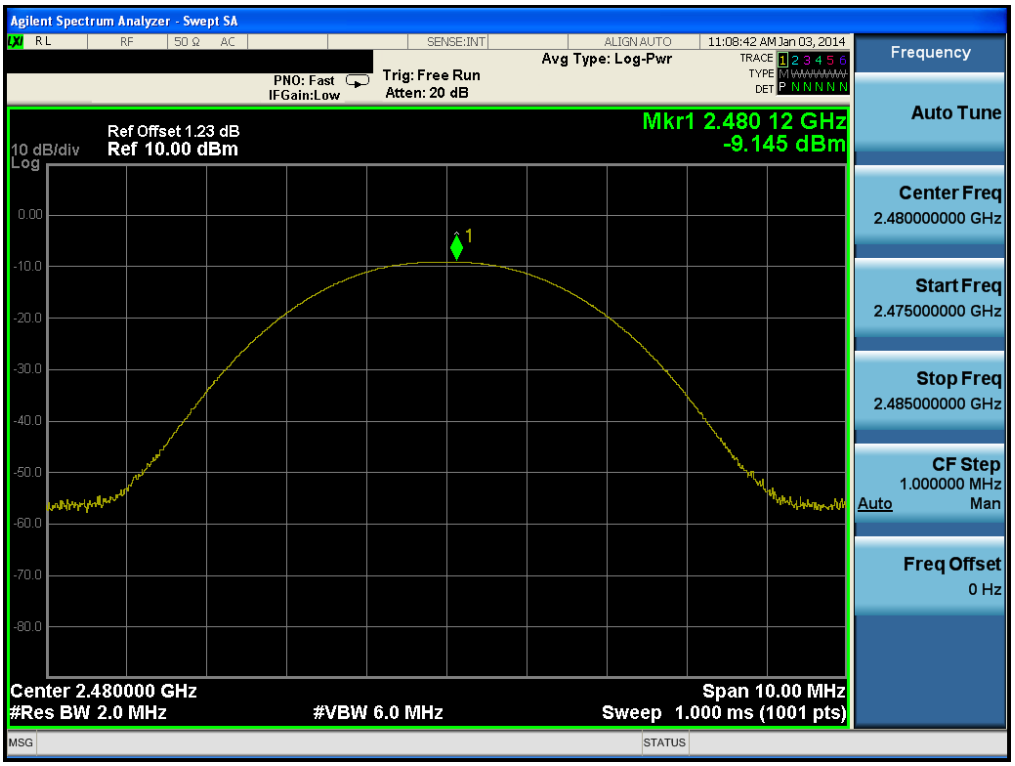
Peak Output Power ***Lowest Channel***&Modulation: ***GFSK***



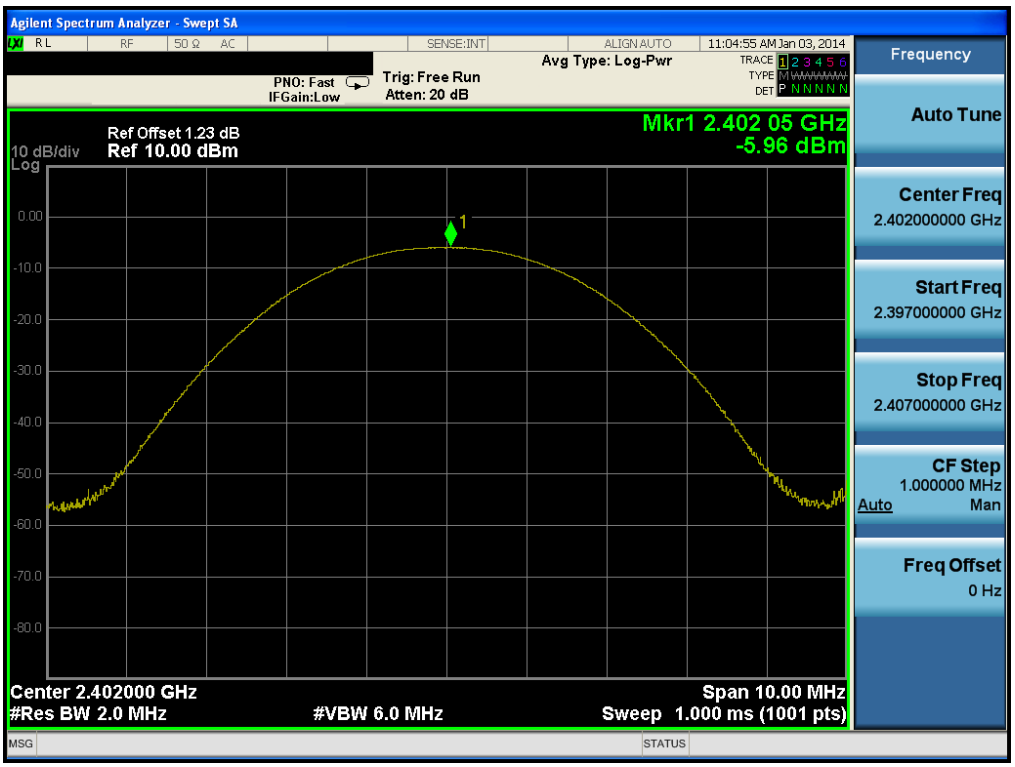
Peak Output Power ***Middle Channel***&Modulation: ***GFSK***



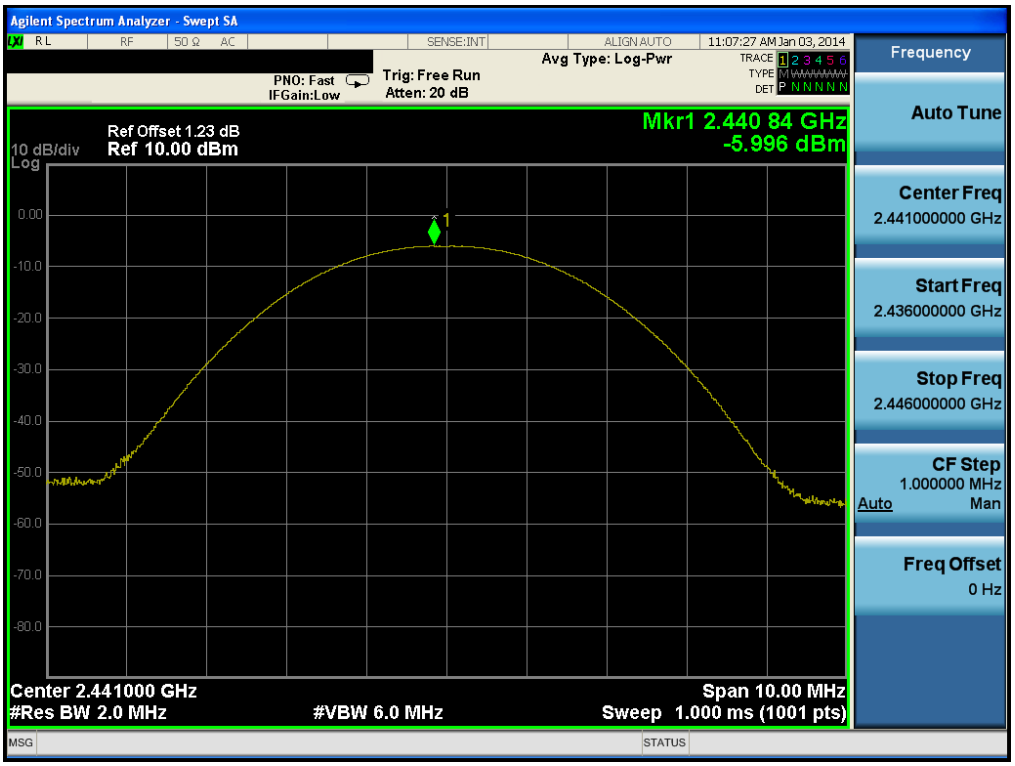
Peak Output Power ***Highest Channel***&Modulation: ***GFSK***



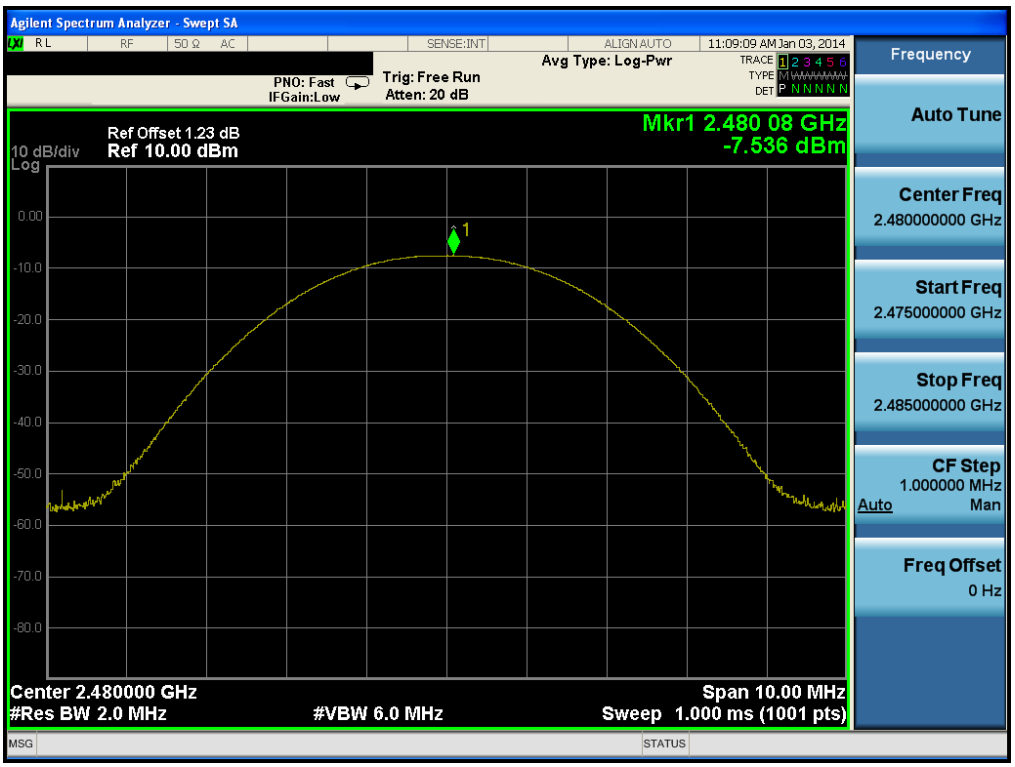
Peak Output Power ***Lowest Channel***&Modulation: ***π/4DQPSK***



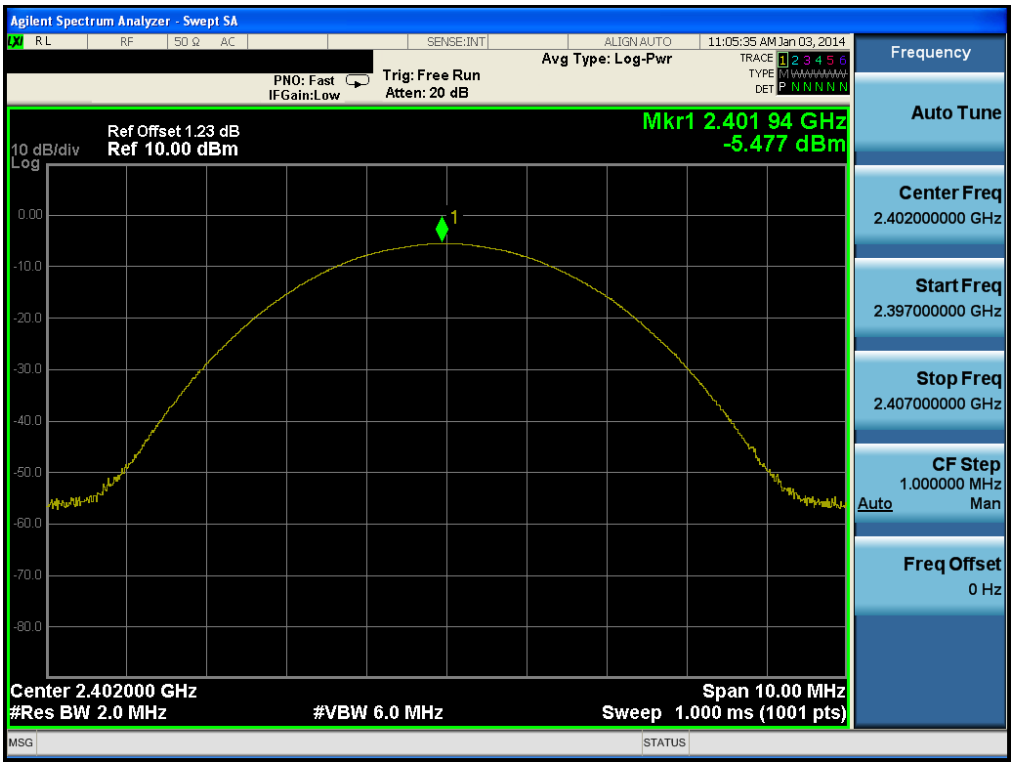
Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***



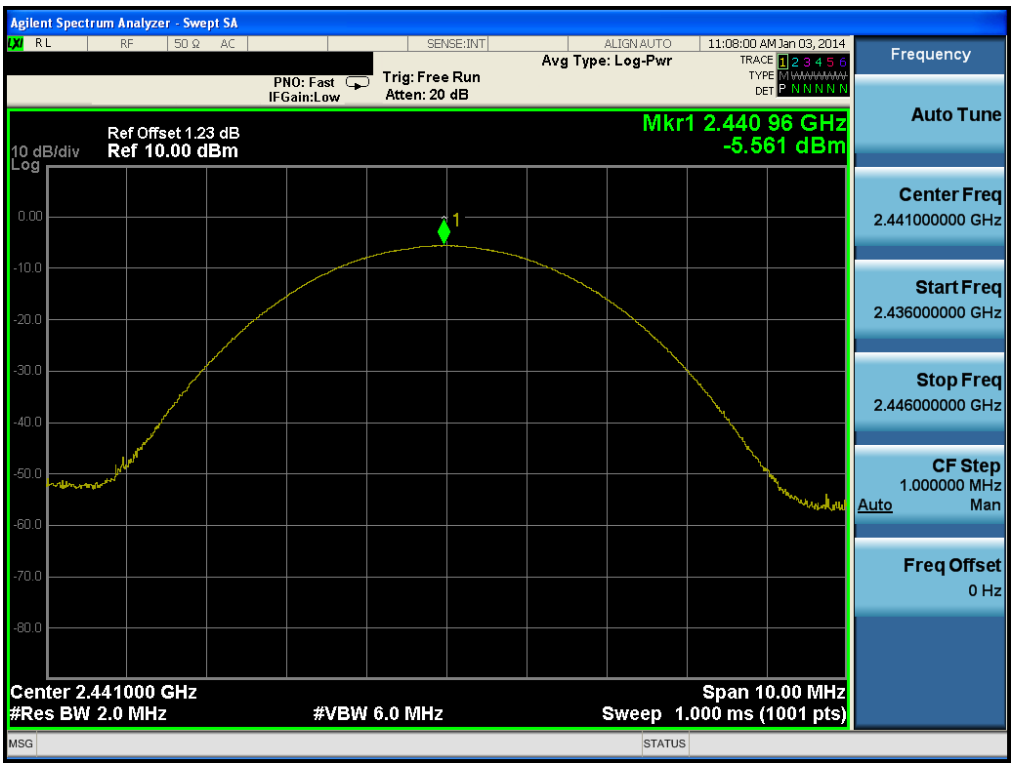
Peak Output Power ***Highest Channel***&Modulation: ***π/4DQPSK***



Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***

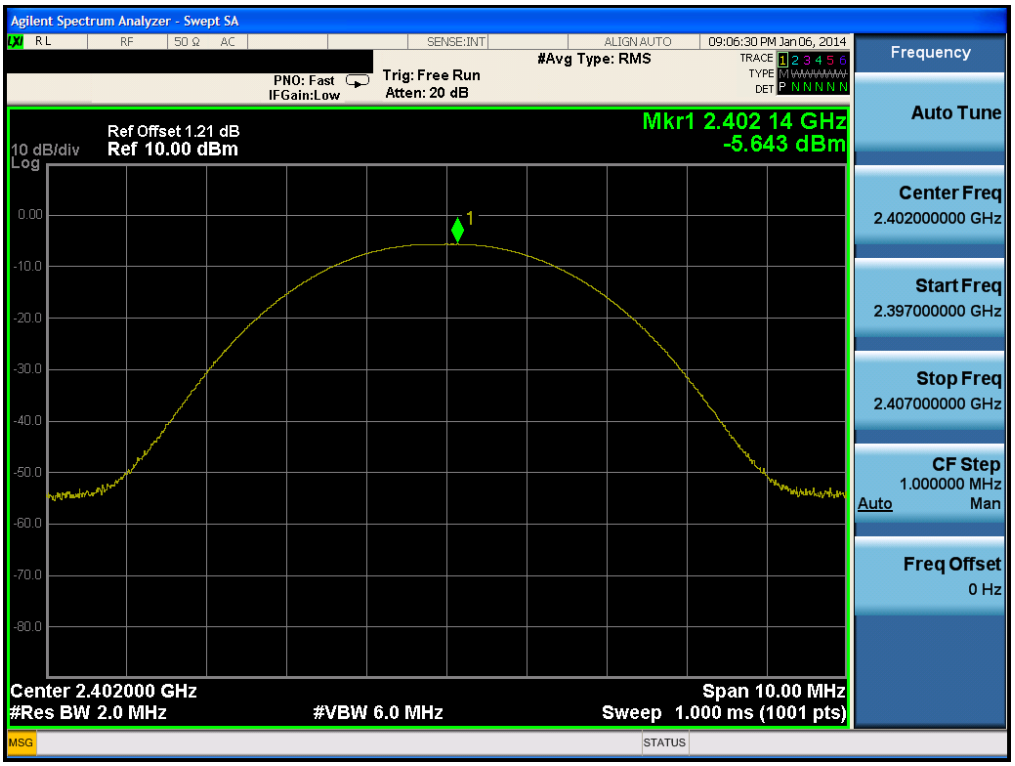
L53VW2

Ambient temperature : 24 °C
Relative humidity : 48 %

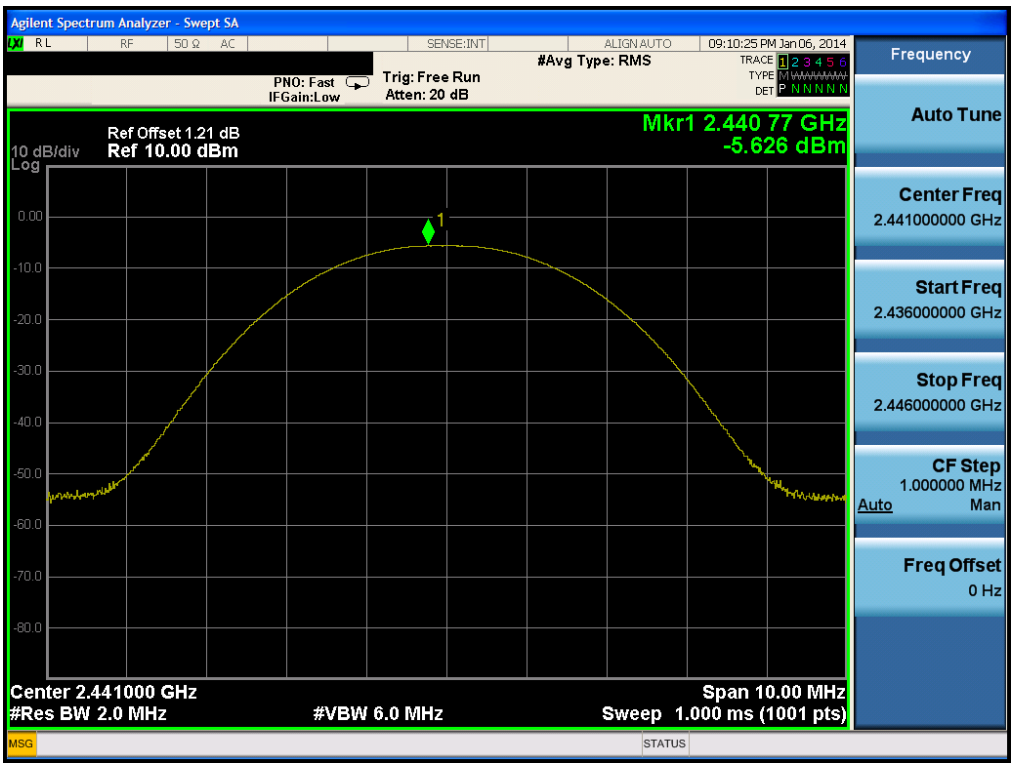
Modulation	Tested Channel	Peak Output Power	
		dBm	mW
GFSK	**Lowest**	- 5.64	0.273
	Middle	**- 5.63**	**0.274**
	Highest	- 7.39	0.182
π/4DQPSK	**Lowest**	- 4.01	0.397
	Middle	**- 3.98**	**0.400**
	Highest	- 5.70	0.269
8DPSK	**Lowest**	**- 3.51**	**0.446**
	Middle	- 3.53	0.444
	Highest	- 5.23	0.300

Note 1: See next pages for actual measured spectrum plots.

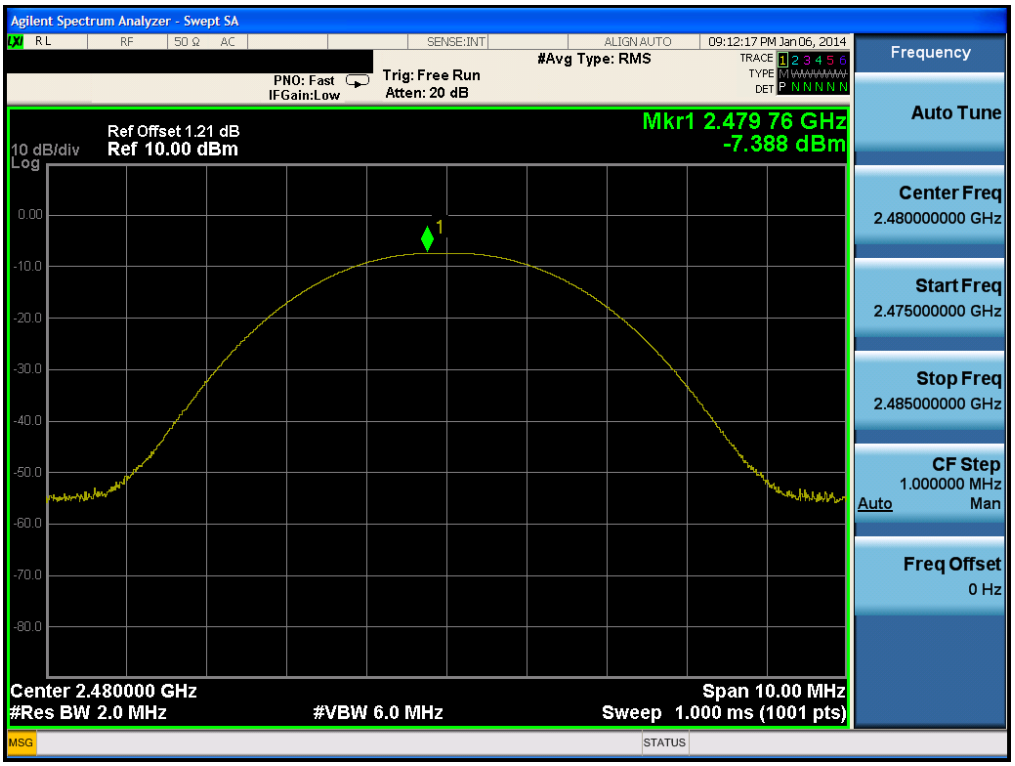
Peak Output Power ***Lowest Channel*** & Modulation: ***GFSK***



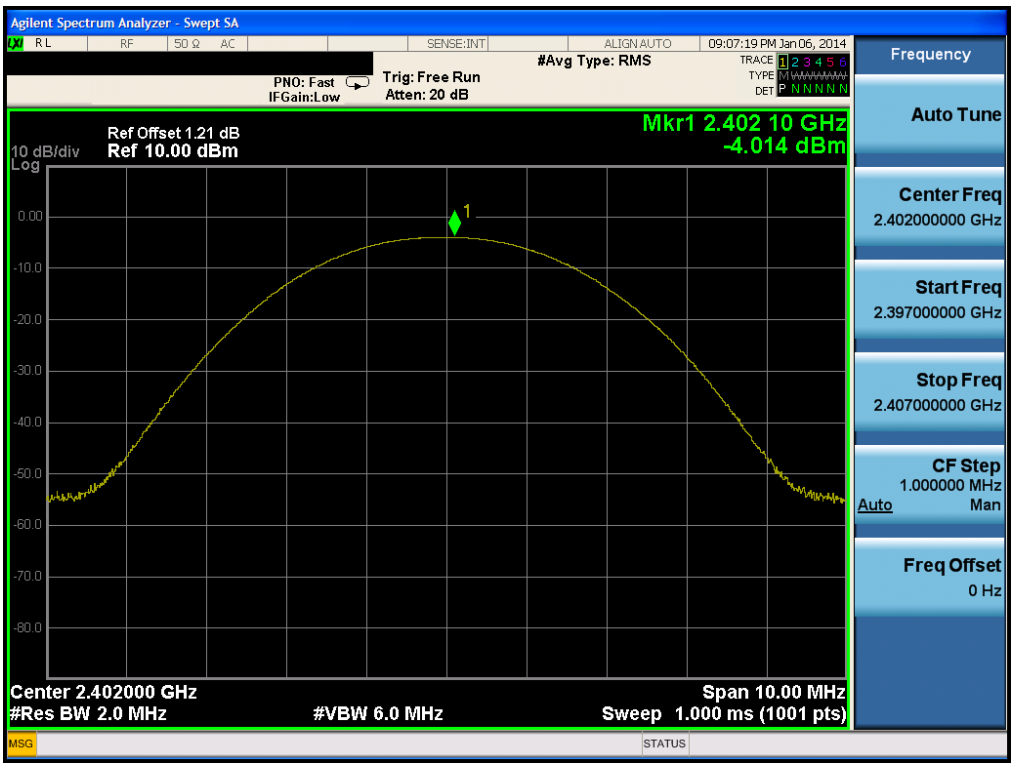
Peak Output Power ***Middle Channel*** & Modulation: ***GFSK***



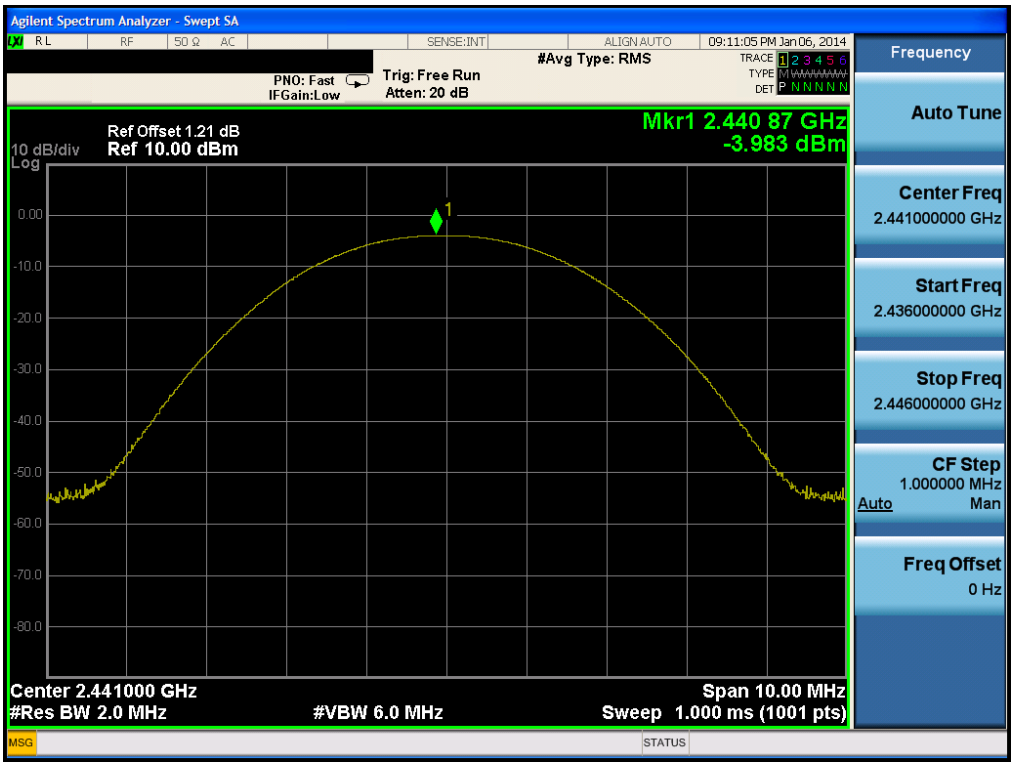
Peak Output Power ***Highest Channel*** & Modulation: ***GFSK***



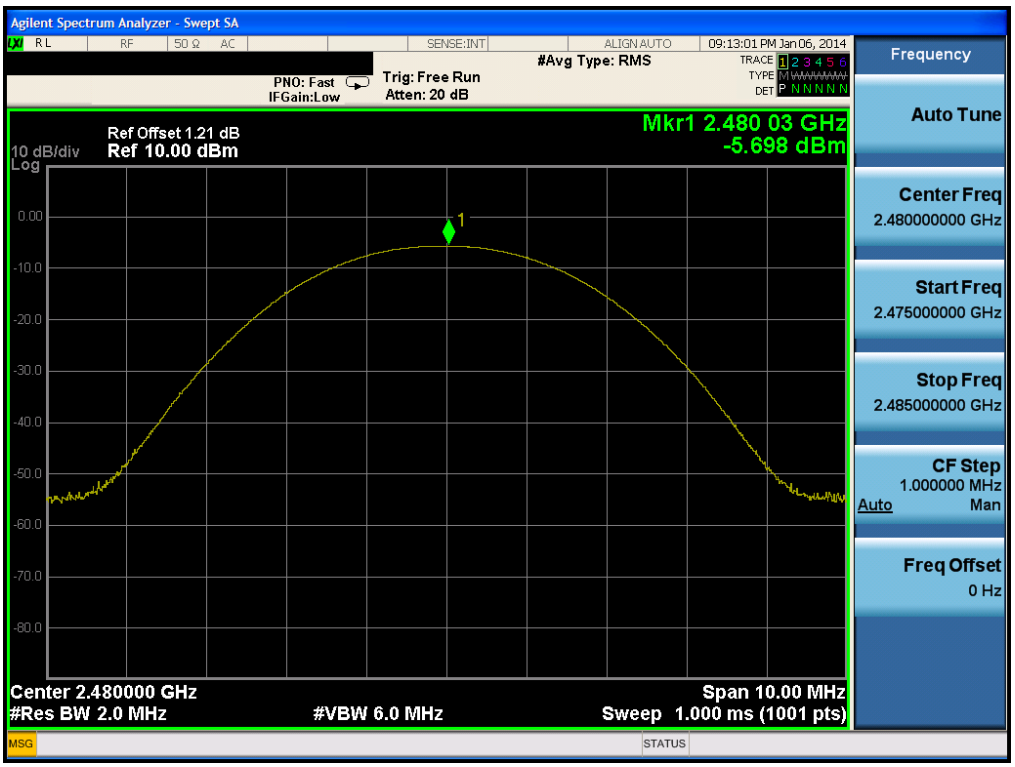
Peak Output Power ***Lowest Channel*** & Modulation: ***π/4DQPSK***



Peak Output Power ***Middle Channel*** & Modulation: ***π/4DQPSK***

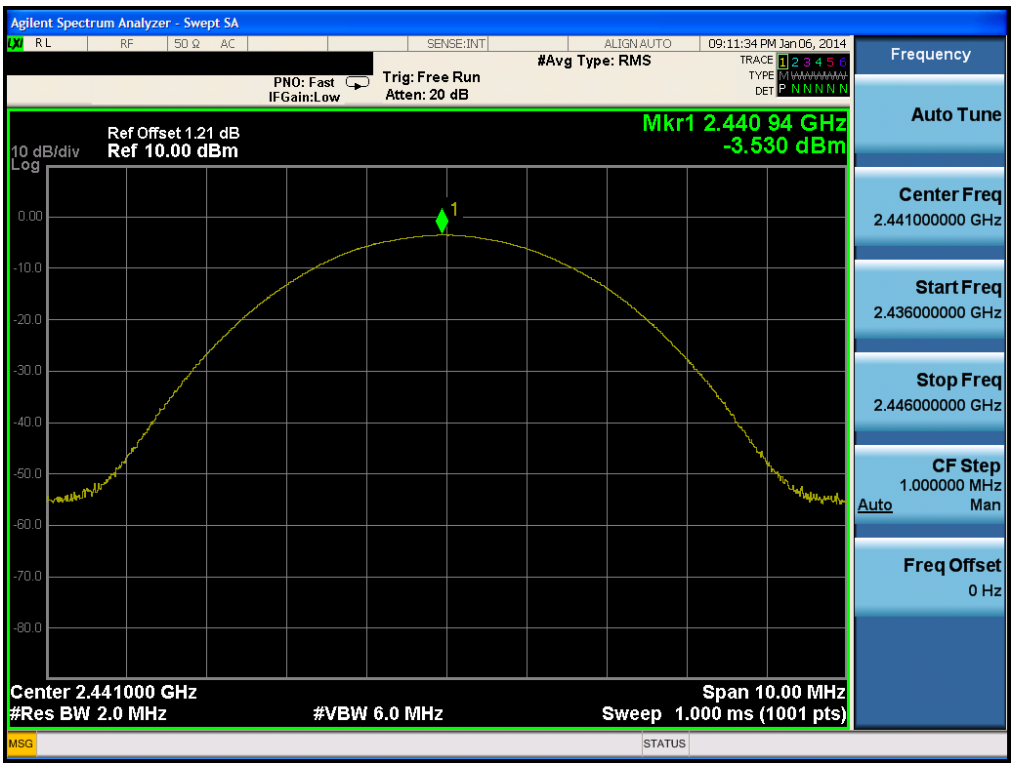


Peak Output Power ***Highest Channel*** & Modulation: ***π/4DQPSK***

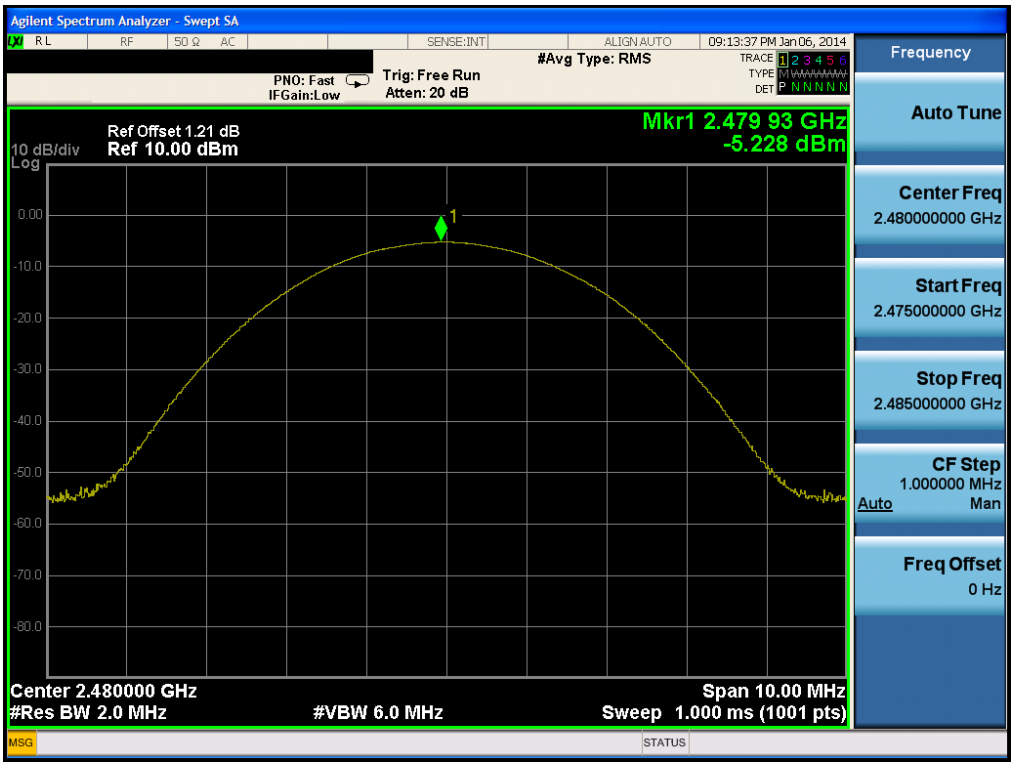


Peak Output Power ***Lowest Channel*** & Modulation: ***8DPSK***

Peak Output Power ***Middle Channel*** & Modulation: ***8DPSK***



Peak Output Power ***Highest Channel*** & Modulation: ***8DPSK***



8. Transmitter AC Power Line Conducted Emission

8.1. Test Setup

Refer to test setup photo.

8.2. Limit

According to §15.207(a) 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 50 uH/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 frequency ranges.

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

8.3. Test Procedures

Conducted emissions from the EUT were measured according to the dictates of ANSI C63.4-2009

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4. Test Results: N/A

9. Antenna Requirement

▣ **Procedure:**

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

▣ **Conclusion:** **Comply**

The antenna is permanently attached.(Refer to Internal Photo file.)

▣ **Minimum Standard:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.

10. Occupied Bandwidth(99%)

- Procedure:(RSS-Gen Issue 3)
- The 99% power bandwidth was measured with a calibrated spectrum analyzer.
- Spectrum analyzer plots are included on the following pages.

- Measurement Data:NA

- **Minimum Standard:**

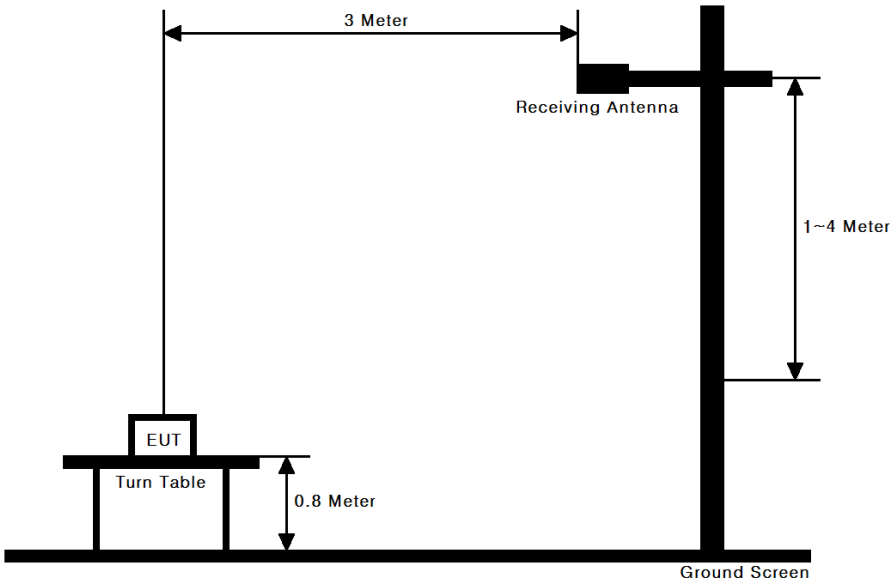
N/A

APPENDIX I

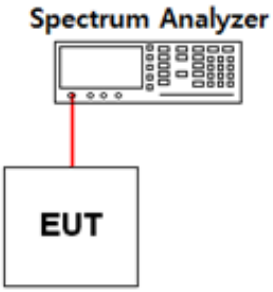
Test set up Diagrams&Path lossInformation

▪Radiated Measurement

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 25㎓ Emissions.



▪Conducted Measurement



Offset value information (L40SE2, L40SK2, L41SK2, L52SK2)

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.42	15	2.75
1	0.87	20	2.88
2.402 & 2.441 & 2.480	1.23	26.5	3.82
5	2.38	-	-
10	2.45	-	-

Offset value information (L40VW2, L41VW2, L53VW2)

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.15	15	2.86
1	0.75	20	3.42
2.402 & 2.441 & 2.480	1.21	26.5	3.89
5	2.04	-	-
10	2.55	-	-

Offset value information (L42VW2)

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.11	15	4.21
1	1.47	20	4.45
2.402 & 2.441 & 2.480	2.36	26.5	4.90
5	2.98	-	-
10	3.55	-	-

Note. 1: The path loss from EUT to Spectrum analyzer were measured and used for test.
Path loss (= S/A's Offset value) = Cable

Note. 2: For conducted spurious emissions, the offset values were saved as the transducer factors on the spurious measurement function of the spectrum analyzer and the transducer factor of tested frequency is calculated and corrected automatically by the spectrum analyzer's measurement function.