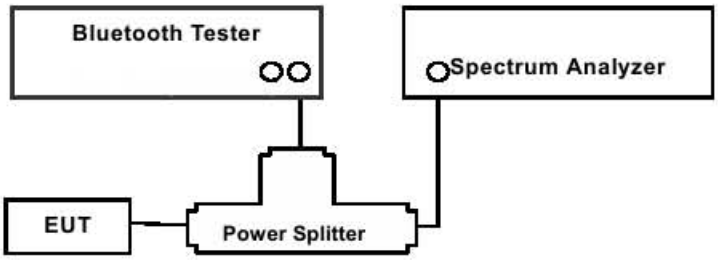
8.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)

LIMIT

According to §15.247(a)(1), 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.

Test Configuration



TEST PROCEDURE

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (DA 00-705)

Span = wide enough to capture the peaks of two adjacent channels

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

TEST RESULTS

No non-compliance noted

Test Data

Channel Separation (kHz)			20dB Bandwidth (kHz)				Limit (kHz)	Result
GFSK	8DPSK	π/4DQPSK	Channel	GFSK	8DPSK	4DQPSK		
845	995	995	Low CH	941.6	1280.0	1280.0	>25 or >2/3 of the 20dB BW	Pass
			Middle CH	942.9	1253.0	1260.0		
			High CH	941.8	1279.0	1281.0		

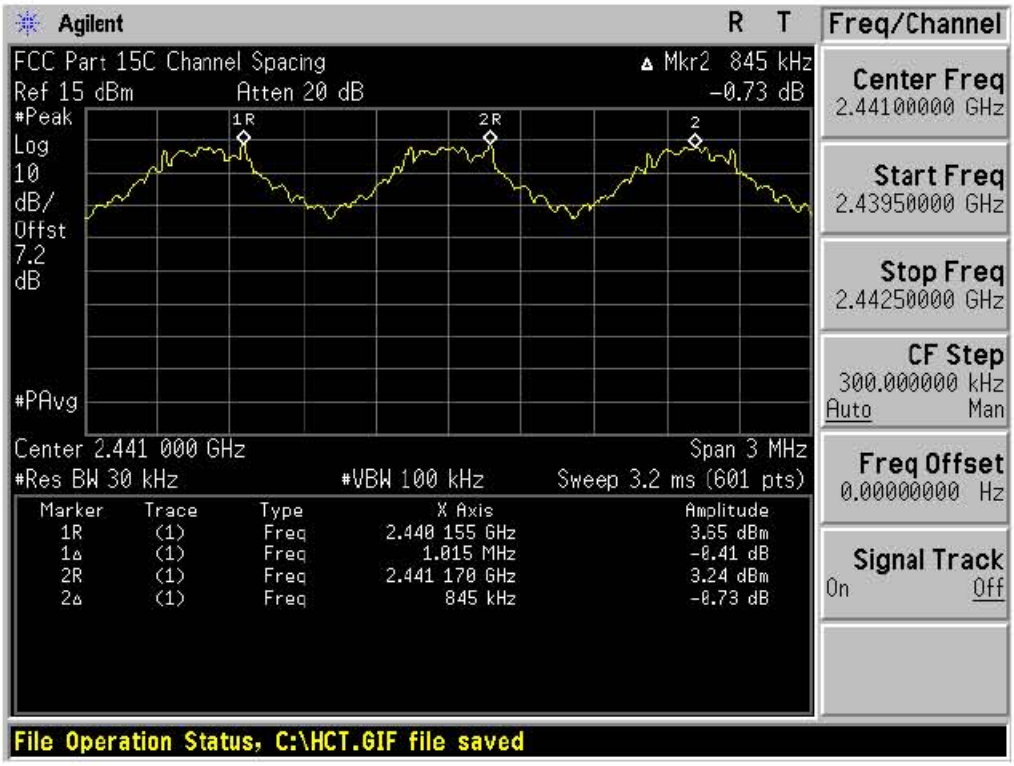
Occupied Bandwidth (99% BW)

99% BW (kHz)			
Channel	GFSK	8DPSK	4DQPSK
Low CH	867.8	1160.2	1154.8
Middle CH	868.4	1146.8	1156.7
High CH	868.3	1159.7	1154.8

Note : We can not know what use channel in AFH mode. So, we can not test in AFH mode. Also, if the test performs some channel in AFH mode, the test result is not different with normal mode.

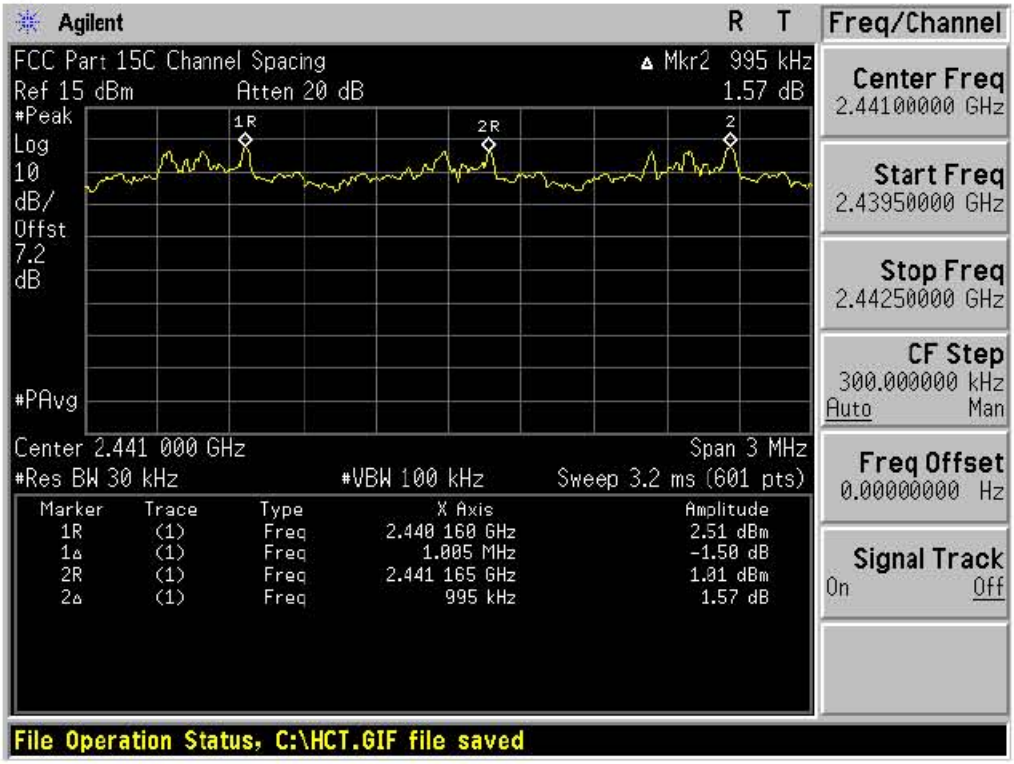
Test Plots (GFSK)

Channel Separation



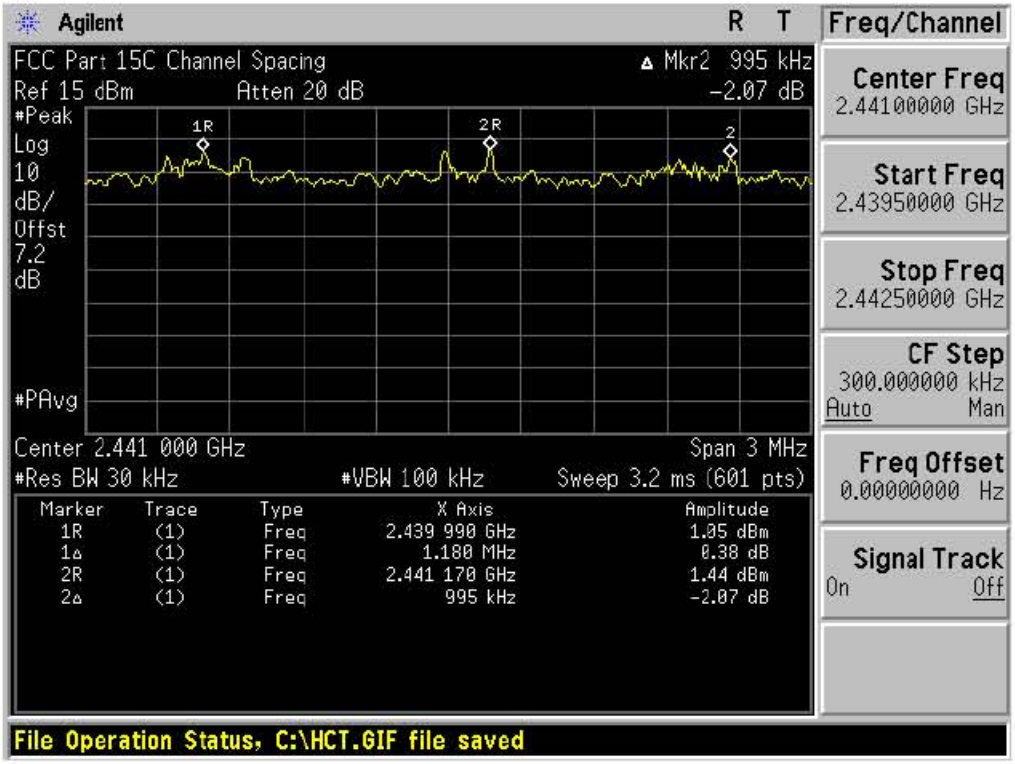
Test Plots (8DPSK)

Channel Separation



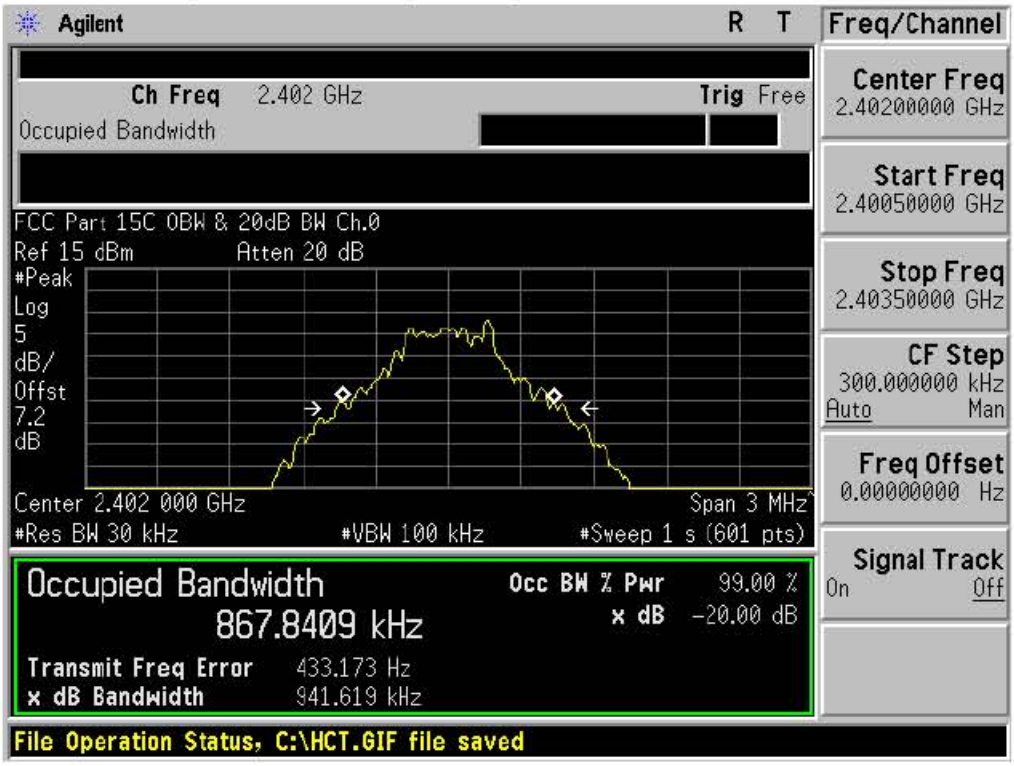
Test Plots (π/4DQPSK)

Channel Separation



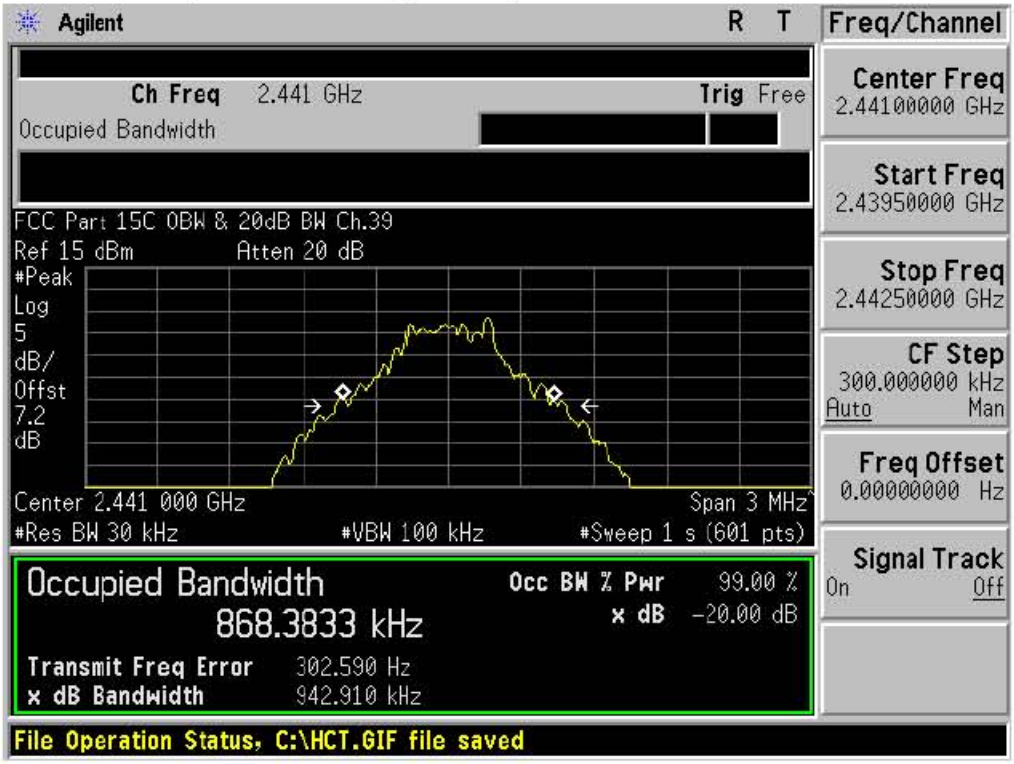
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)



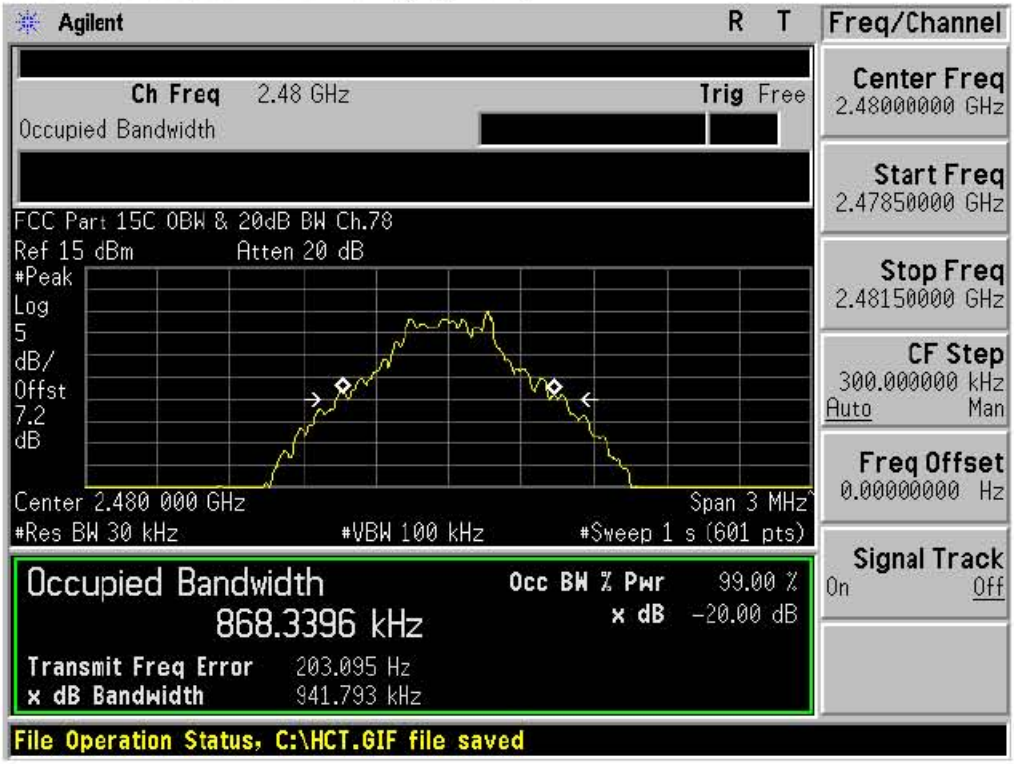
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (Mid-CH)



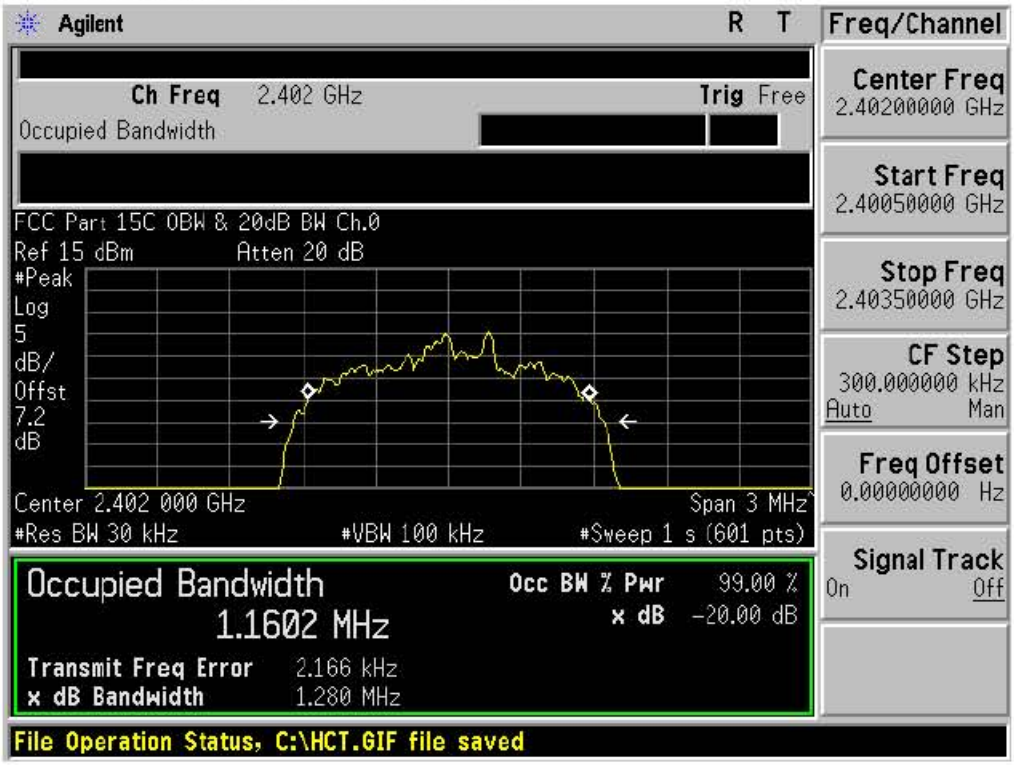
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (High-CH)



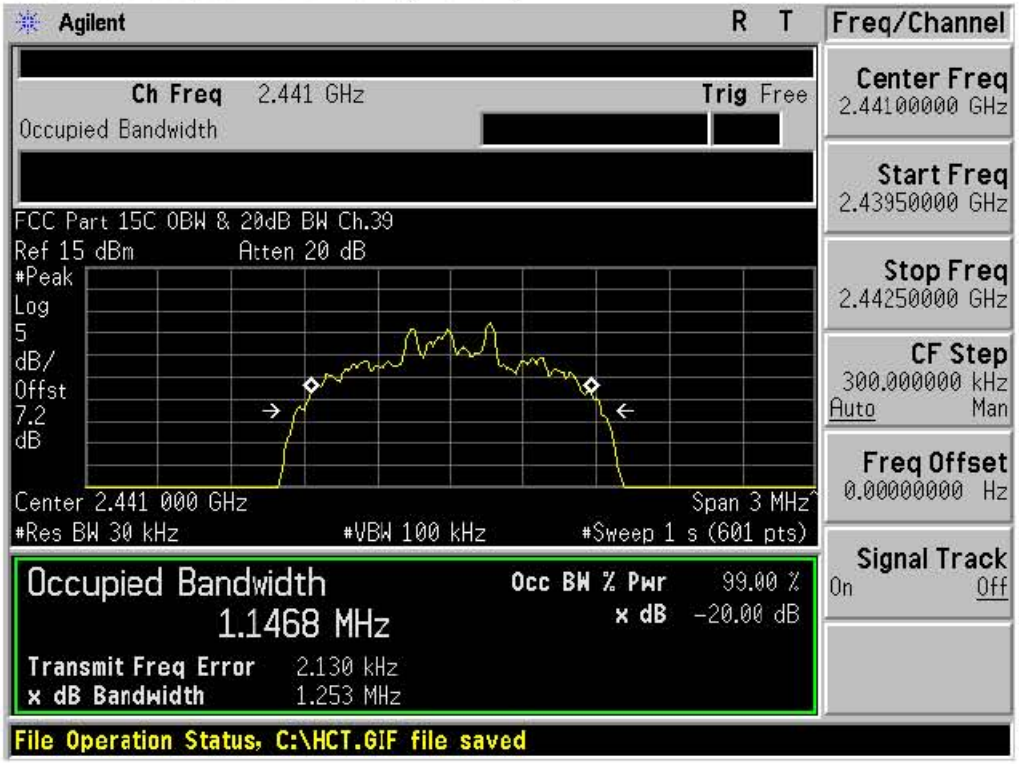
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)



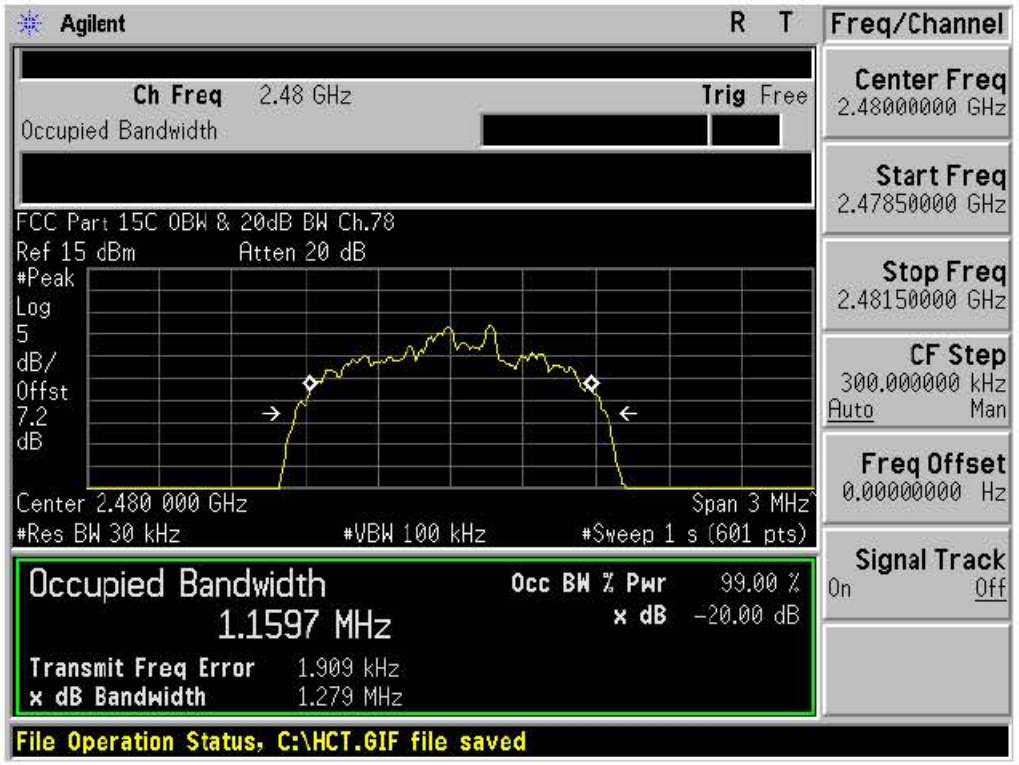
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (Mid-CH)



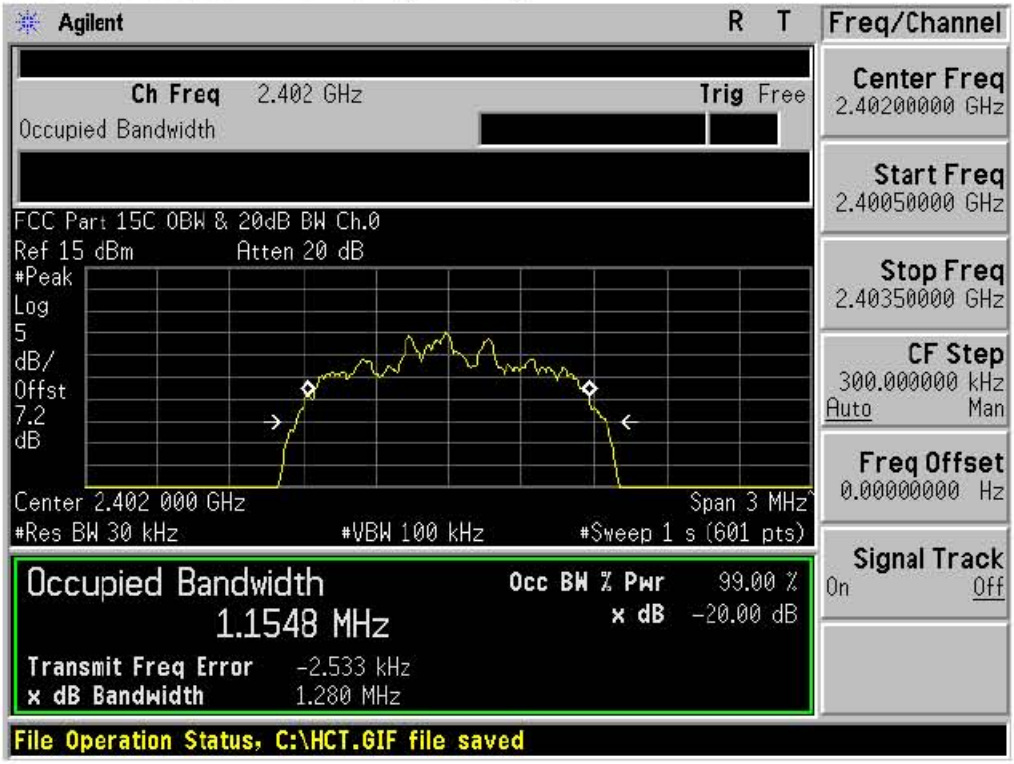
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (High-CH)



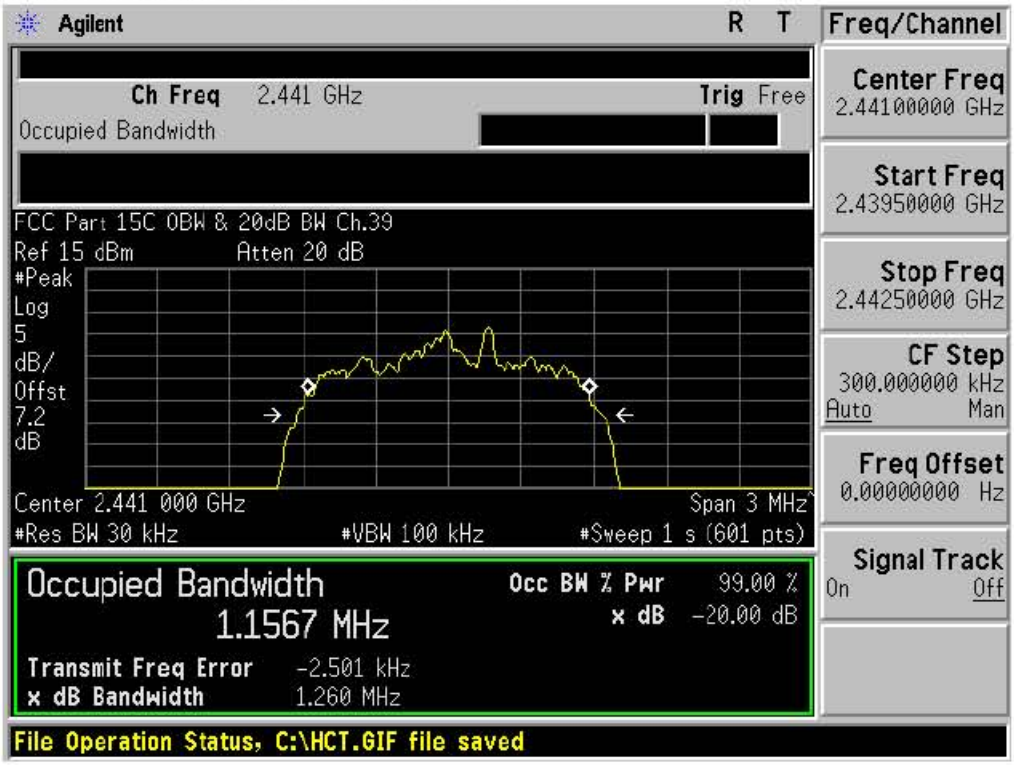
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)



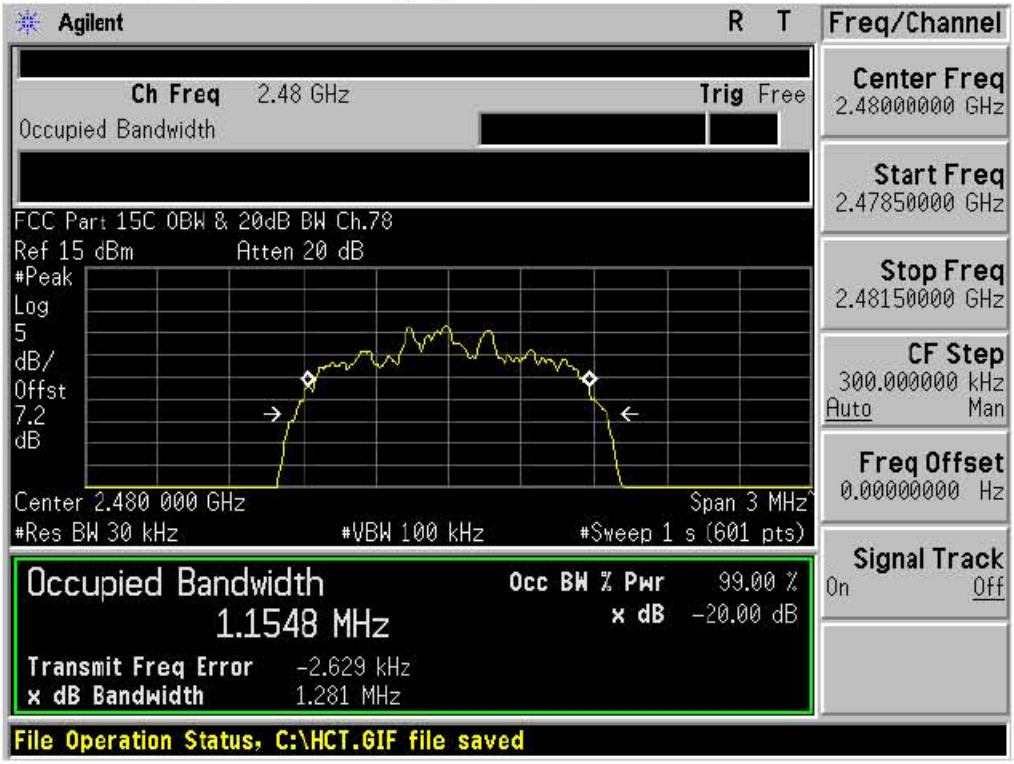
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (Mid-CH)



Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (High-CH)

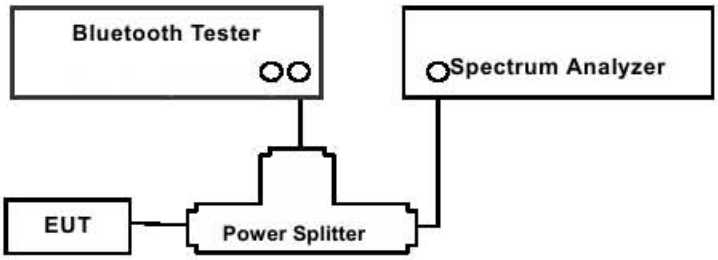


8.4 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (DA 00-705)

Span = the frequency band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

The trace was allowed to stabilize.

TEST RESULTS

No non-compliance noted

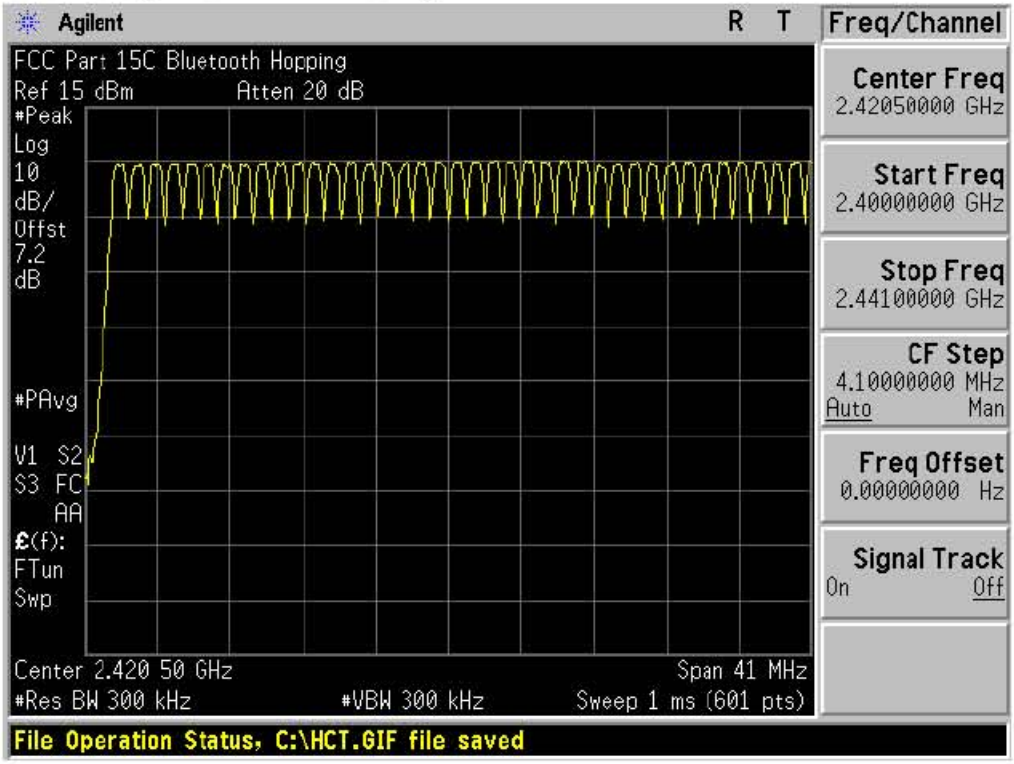
Test Data

Result (No. of CH)			Limit	Result
GFSK	8DPSK	π/4DQPSK		
79	79	79	>15	Pass

Note : In case of AFH mode, minimum number of hopping channels is 20.

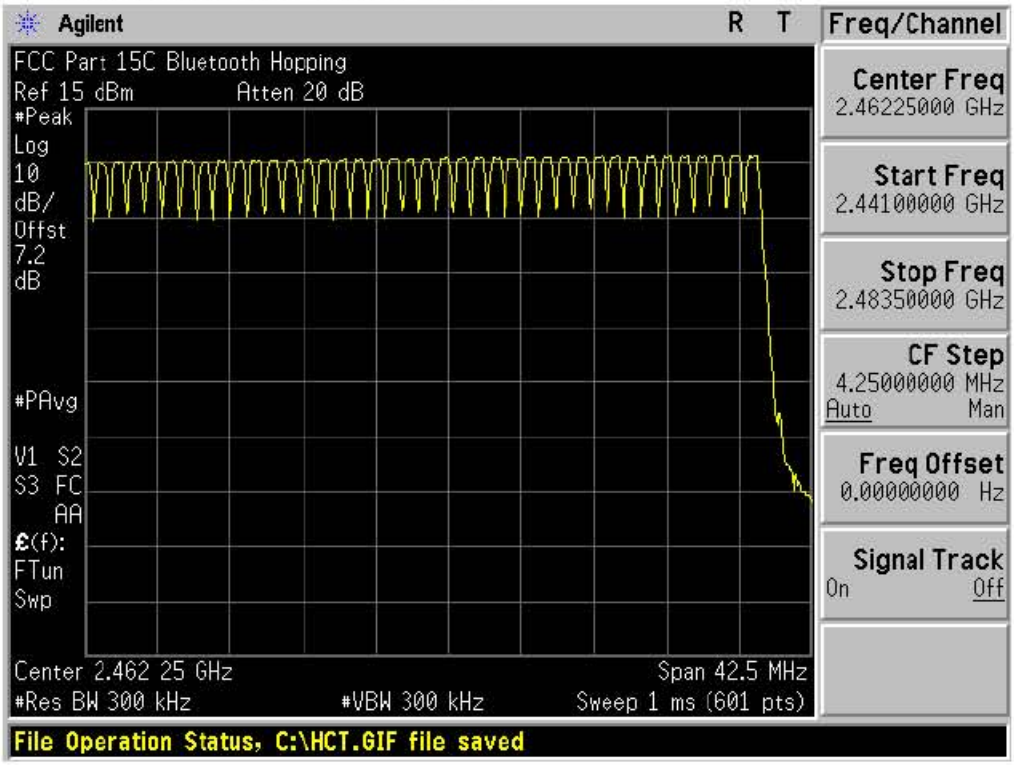
Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



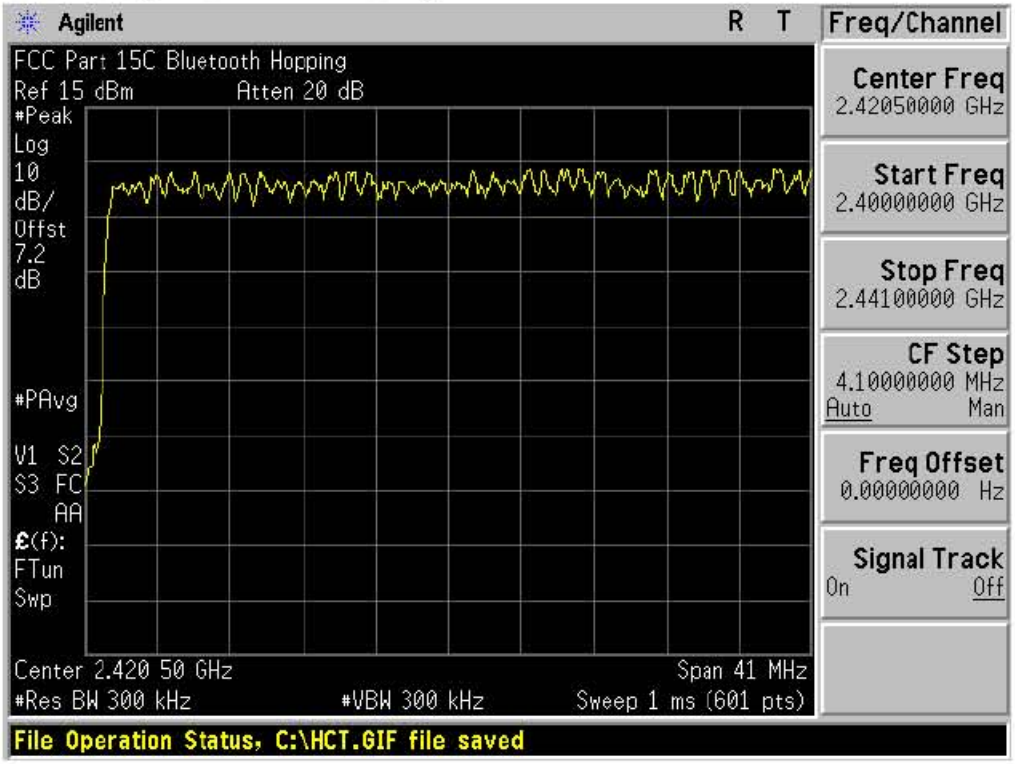
Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



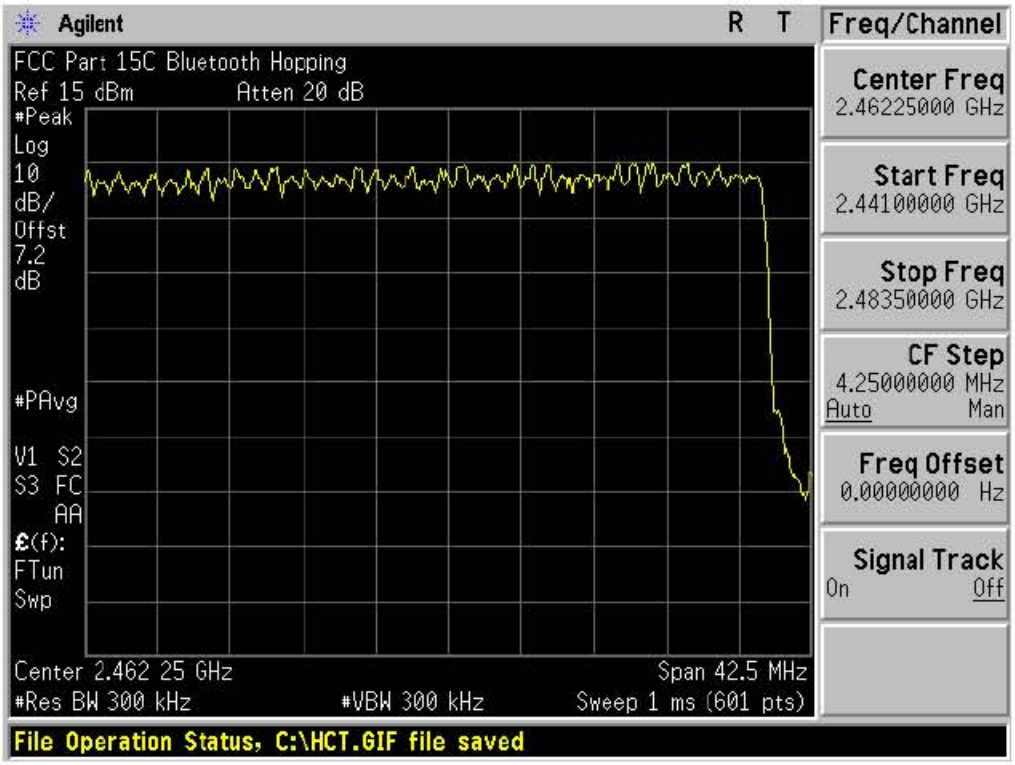
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



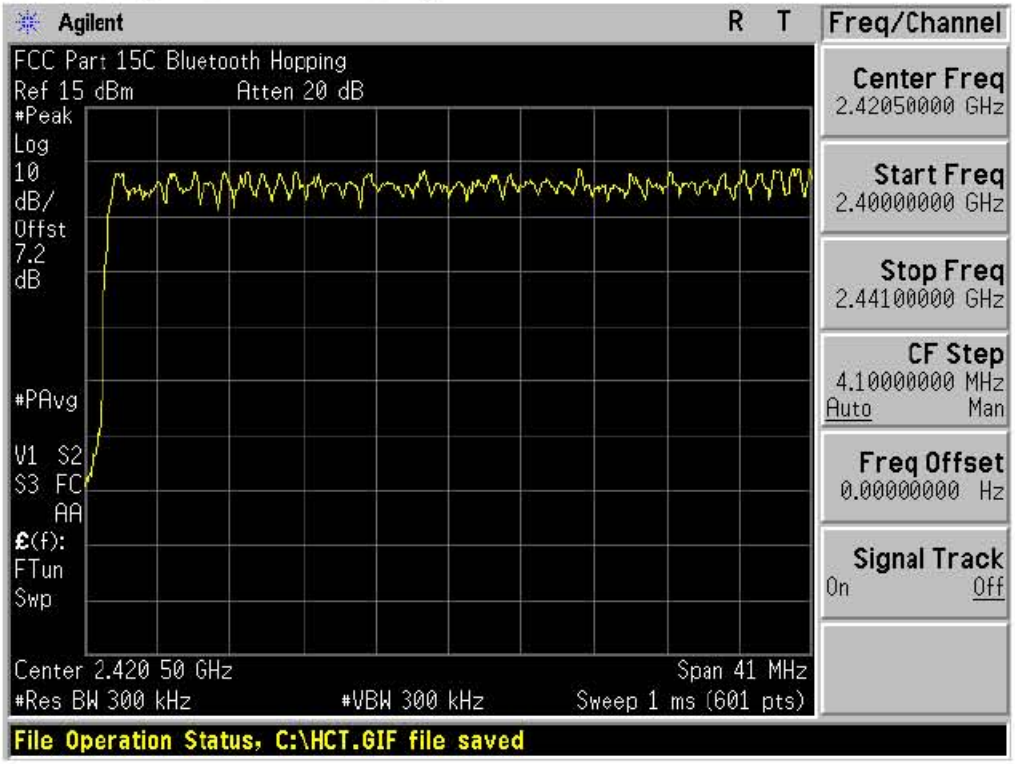
Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



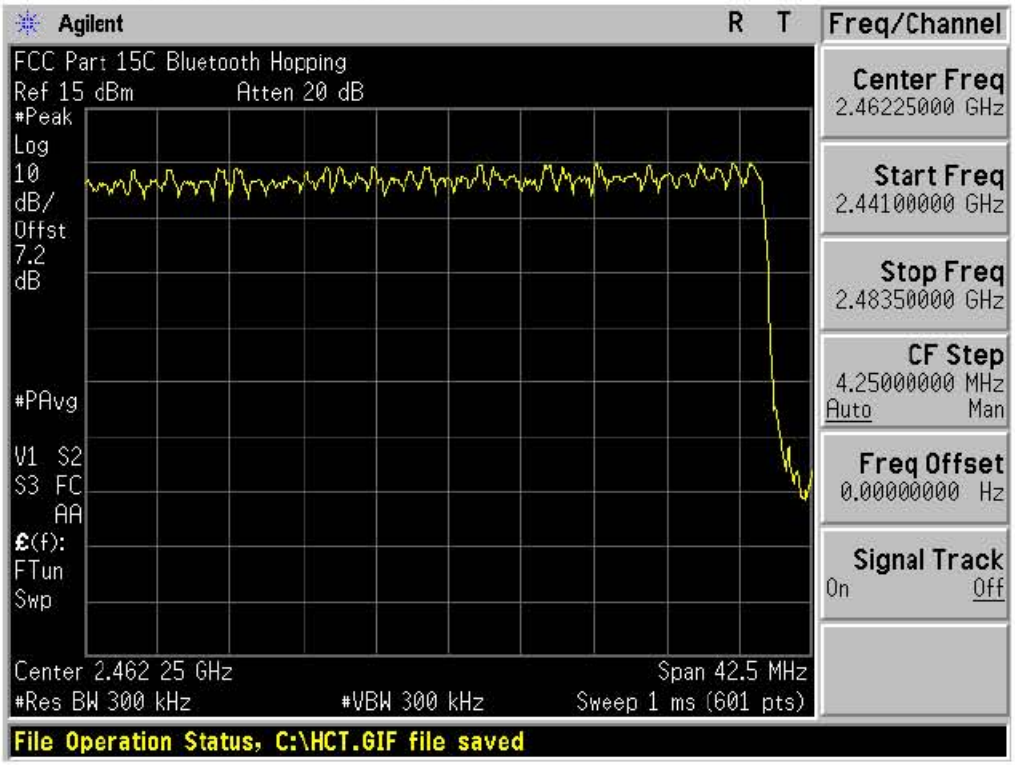
Test Plots (π/4DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (π/4DQPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)

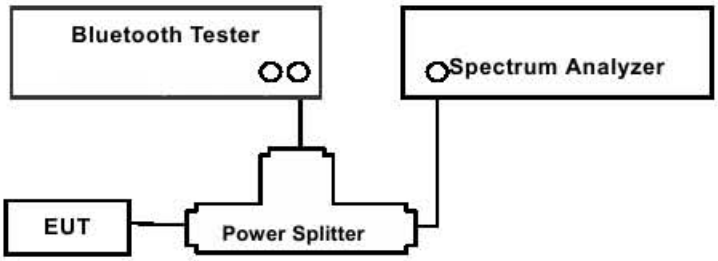


8.5 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off.

EUT was set to transmit the longest packet type (DH5)

The Spectrum Analyzer is set to (DA 00-705)

Span = Zero span, Centered on a hopping channel

RBW = 1 MHz

VBW ≥ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector = Peak

Trace = Max hold

The marker-delta function was used to determine the dwell time.

Normal Mode / EDR Mode

DH 5(The longest packet type for GFSK)

CH Mid : 2.867 * (1600/6)/79 * 31.6 = 305.81 (ms)

2-DH 5(The longest packet type for π/4DQPSK)

CH Mid : 2.875 * (1600/6)/79 * 31.6 = 306.67 (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : 2.875 * (1600/6)/79 * 31.6 = 306.67 (ms)

AFH Mode

DH 5(The longest packet type for GFSK)

CH Mid : 2.867 * (800/6)/20 * 8.0 = 152.91 (ms)

2-DH 5(The longest packet type for π/4DQPSK)

CH Mid : 2.875 * (800/6)/20 * 8.0 = 153.33 (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : 2.875 * (800/6)/20 * 8.0 = 153.33 (ms)

Note :

A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.7 times of appearance.

Each tx-time per appearance of DH5 is 2.883 ms.

Dwell time = Tx-time * 106.7

TEST RESULTS

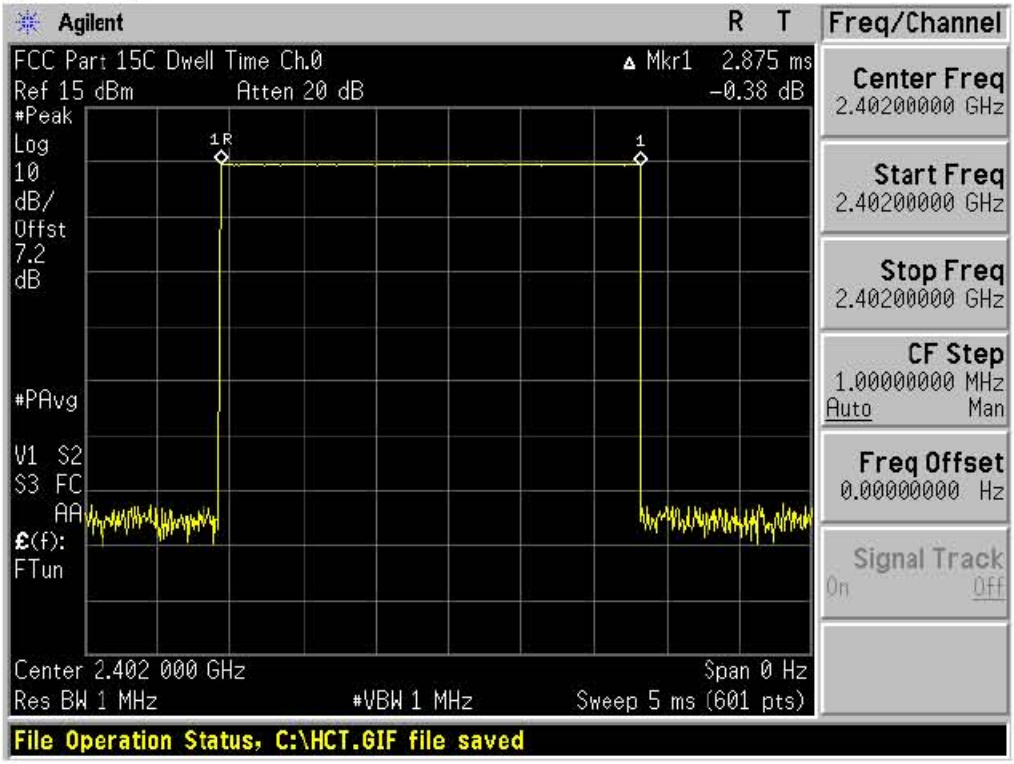
See the table.

Channel	Pulse Time (ms)		Total of Dwell (ms)		Period Time (s)	Limit (ms)	Result
	GFSK	8DPSK	GFSK	8DPSK			
Low	2.875	2.883	306.67	307.52	31.6	400	PASS
Mid	2.867	2.875	305.81	306.67	31.6		PASS
High	2.875	2.875	306.67	306.67	31.6		PASS

Channel	Pulse Time (ms)	Total of Dwell (ms)	Period Time (s)	Limit (ms)	Result
	π/4DQPSK				
Low	2.875	306.67	31.6	400	PASS
Mid	2.875	306.67	31.6		PASS
High	2.875	306.67	31.6		PASS

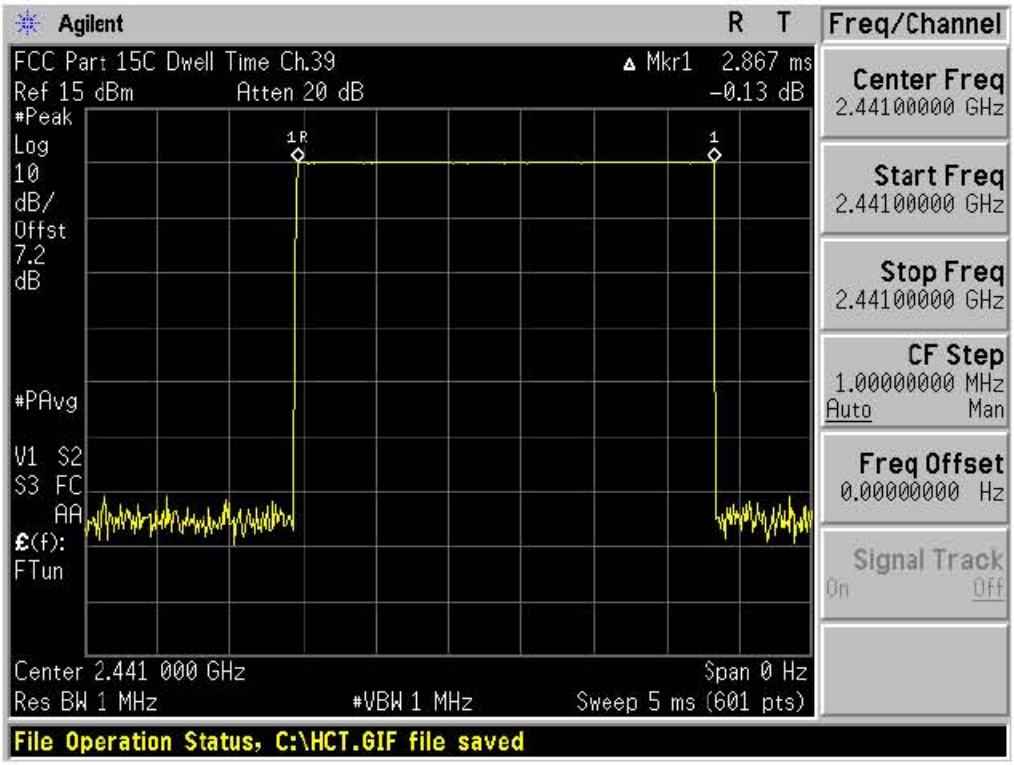
Test Plots (GFSK)

Dwell Time (Low-CH)



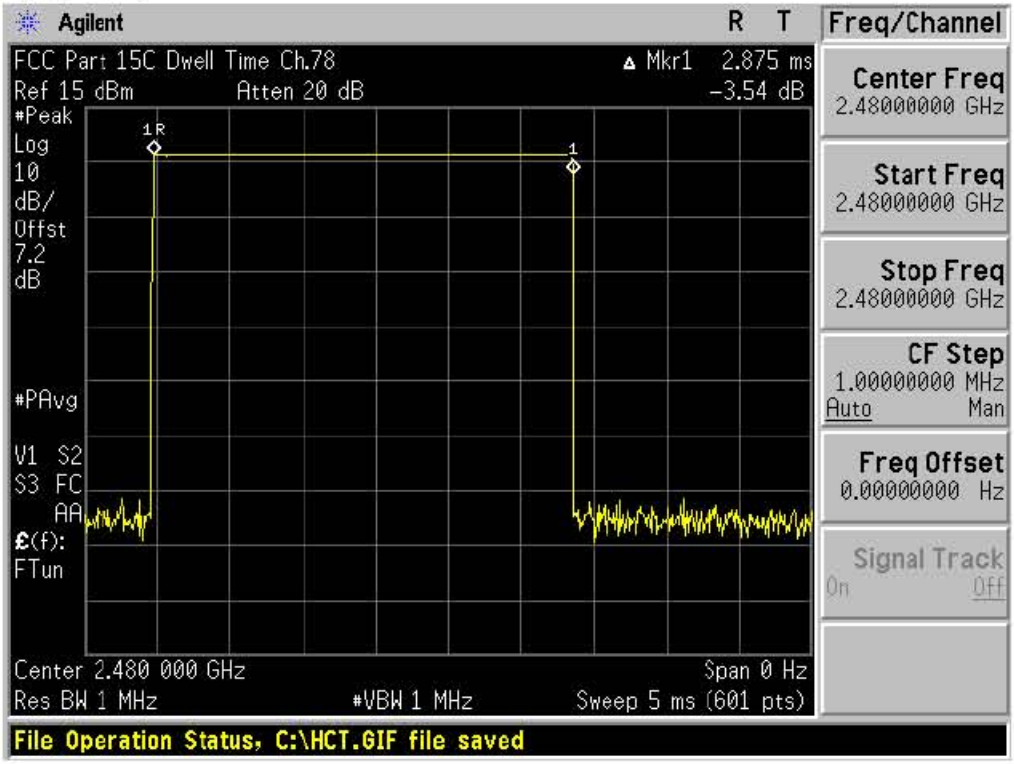
Test Plots (GFSK)

Dwell Time (Mid-CH)



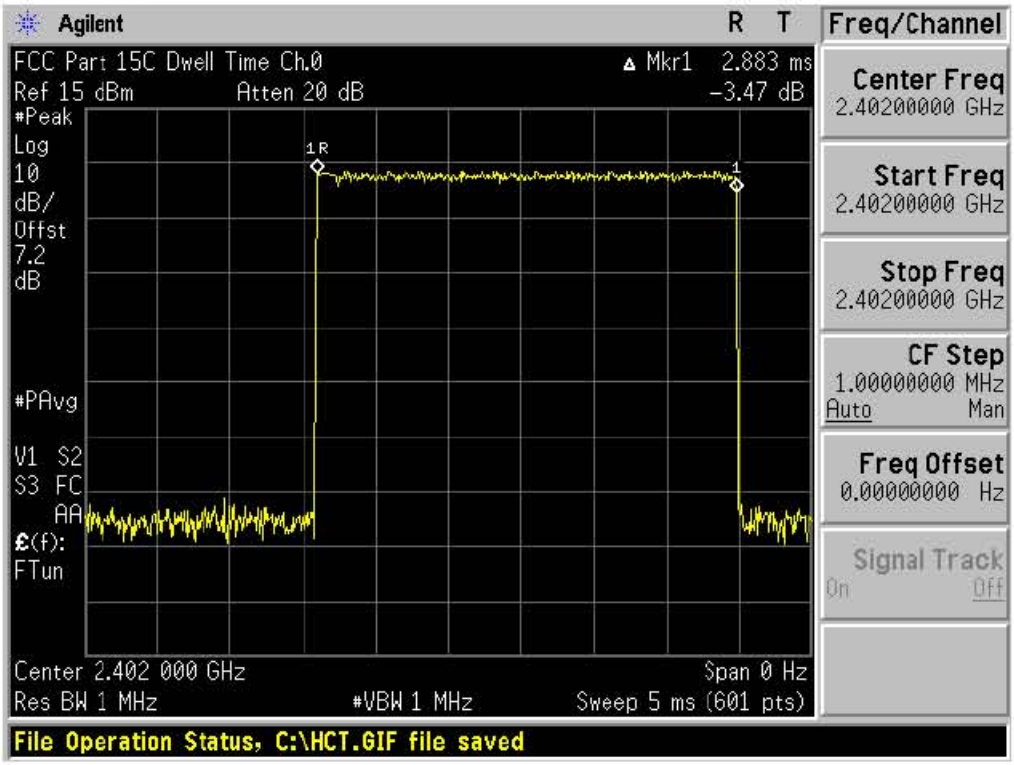
Test Plots (GFSK)

Dwell Time (High-CH)

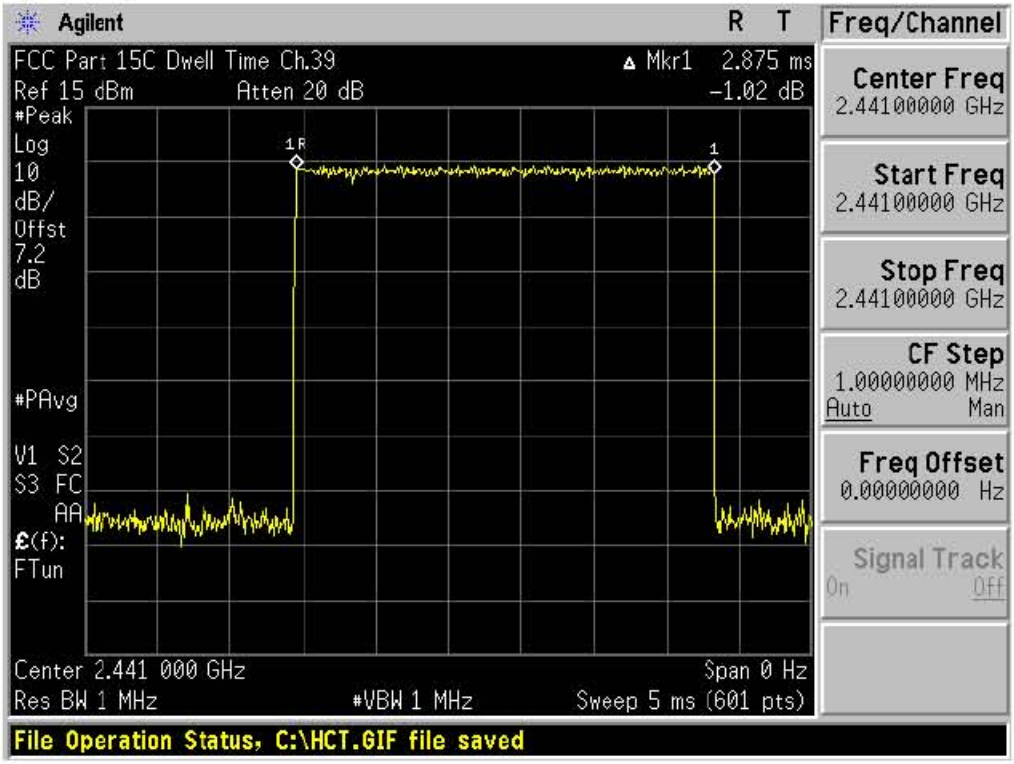


Test Plots (8DPSK)

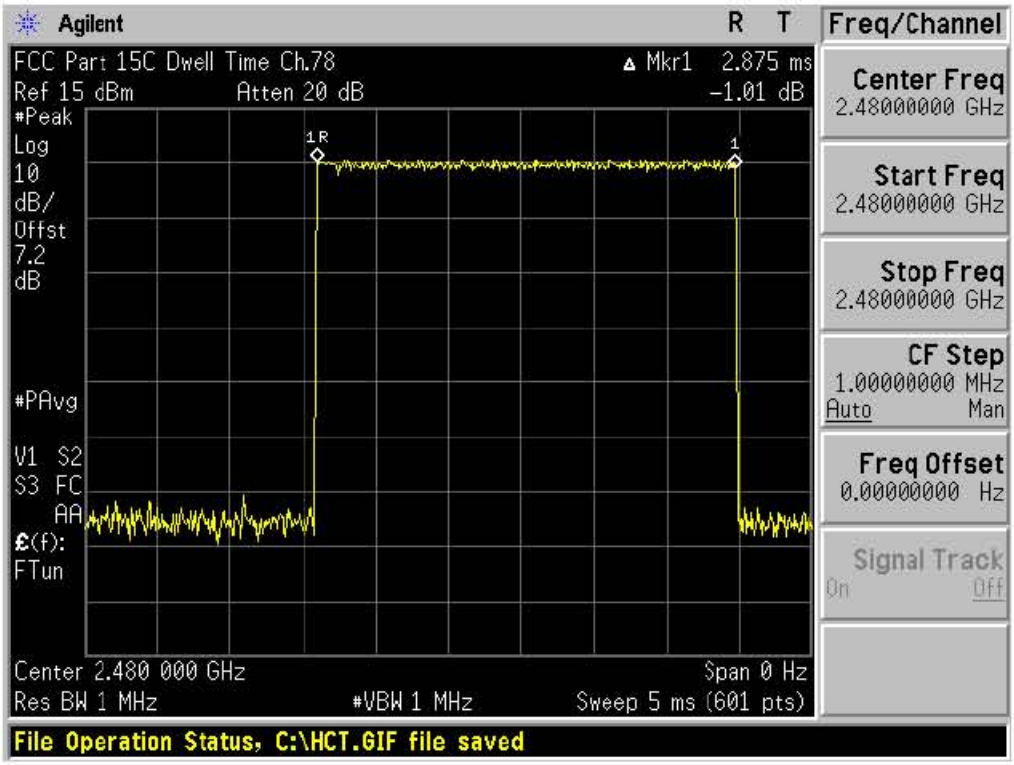
Dwell Time (Low-CH)



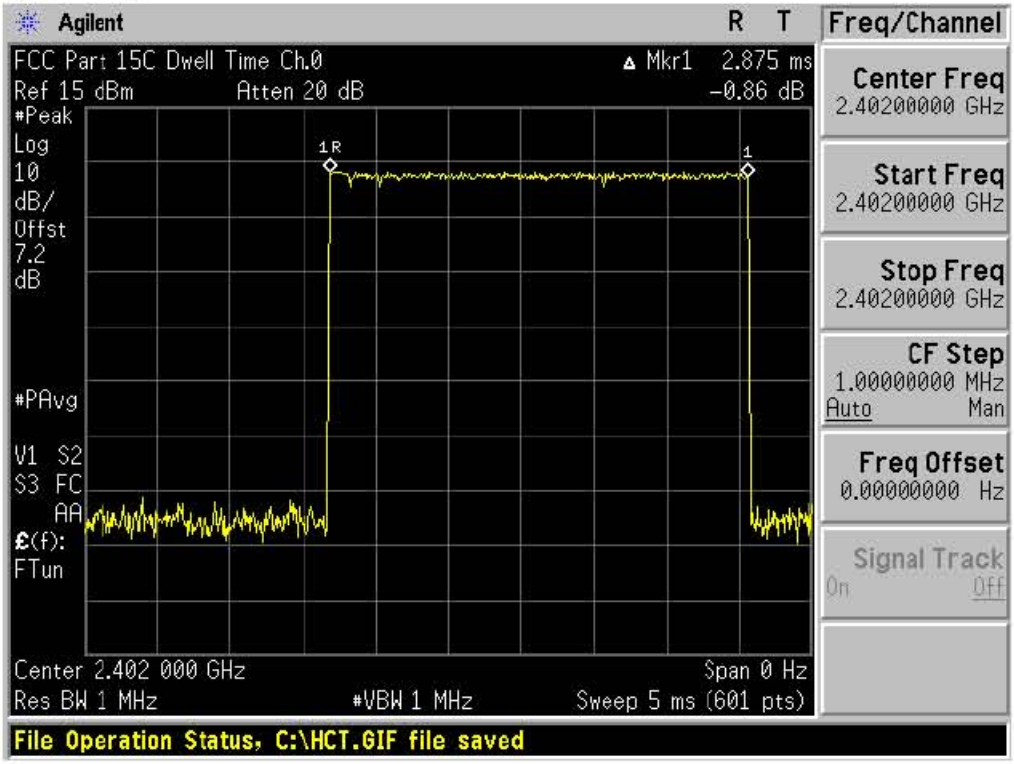
Test Plots (8DPSK)
Dwell Time (Mid-CH)



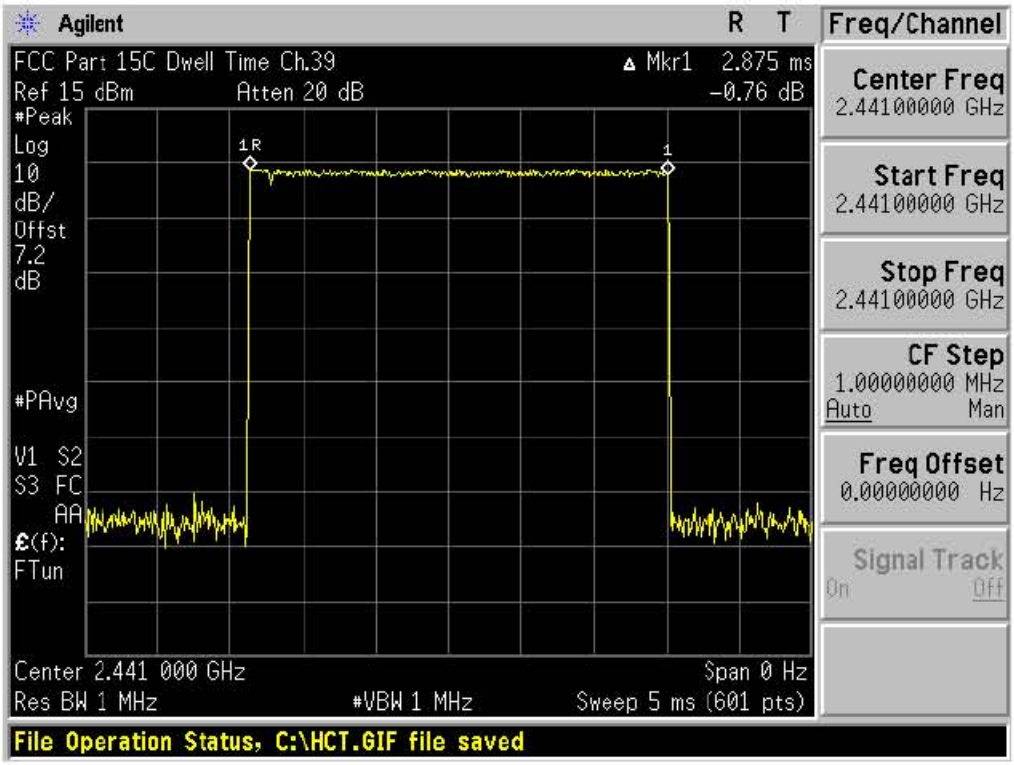
Test Plots (8DPSK)
Dwell Time (High-CH)



Test Plots (π/4DQPSK)
Dwell Time (Low-CH)



Test Plots (π/4DQPSK)
Dwell Time (Mid-CH)



Test Plots (π/4DQPSK)
Dwell Time (High-CH)