

Page 9 of 72



Test procedure and test data

2.1 Occupied Bandwidth (99%)

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 6.9

- RBW: 1 to 5 % of OBW - $VBW > 3 \times RBW$ - Span: OBW x 1.5 to 5 - Trace: Max hold

Limitation

There are no limitations.

The measurement value is used for the emission designator.

Test equipment used (refer to List of utilized test equipment)

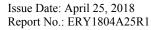
C A 10	CI 21	AT22		
SAIU	CL31	A133		

Test Date

20 degC Tested Date: March 13, 2018 Temperature: Humidity: 45 % Atmos. Press: 1020 hPa

Test results

Transmission Channel	Transmission Frequency [MHz]	99% OccupiedBandwidth [kHz]
DH5, 2402 MHz	2402	0.974
DH5, 2441 MHz	2441	0.969
DH5, 2480 MHz	2480	0.969
2DH5, 2402 MHz	2402	1.201
2DH5, 2441 MHz	2441	1.201
2DH5, 2480 MHz	2480	1.202
3DH5, 2402 MHz	2402	1.207
3DH5, 2441 MHz	2441	1.207
3DH5, 2480 MHz	2480	1.207

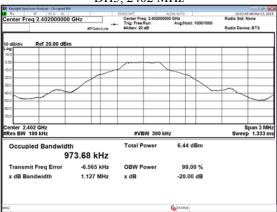


Page 10 of 72



[Chart]

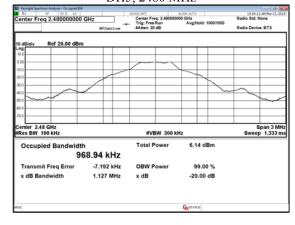


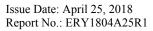


DH5, 2441 MHz



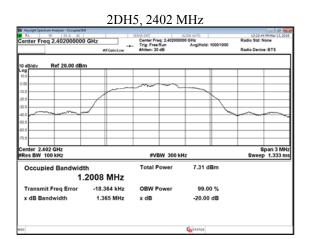
DH5, 2480 MHz



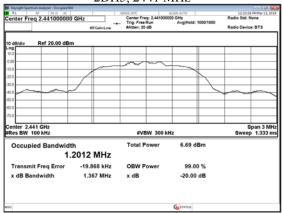


Page 11 of 72

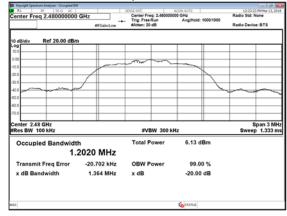


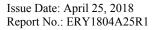


2DH5, 2441 MHz



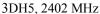
2DH5, 2480 MHz

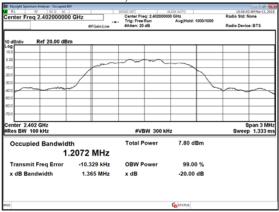




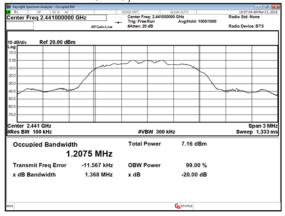




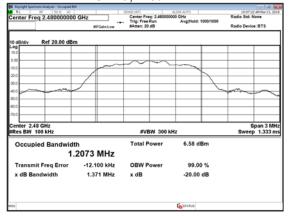


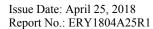


3DH5, 2441 MHz



3DH5, 2480 MHz





Page 13 of 72



2.2 Occupied Bandwidth (20 dB)

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 11.8

- RBW: 100 kHz - VBW: 300 kHz - Detector: Peak - Trace: Max hold

Applicable rule and limitation

15.247 (a) (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		

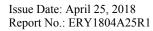
Test Date

Tested Date: March 13, 2018 Temperature: 20 degC Humidity: Atmos. Press: 1020 hPa 45 %

Test results - Complied with requirement

Test Data

Transmission Channel	Transmission Frequency	20dB OccupiedBandwidth
	[MHz]	[kHz]
DH5, 2402 MHz	2402	1.127
DH5, 2441 MHz	2441	1.122
DH5, 2480 MHz	2480	1.127
2DH5, 2402 MHz	2402	1.365
2DH5, 2441 MHz	2441	1.367
2DH5, 2480 MHz	2480	1.364
3DH5, 2402 MHz	2402	1.365
3DH5, 2441 MHz	2441	1.368
3DH5, 2480 MHz	2480	1.371

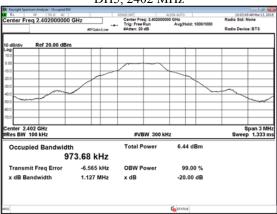


Page 14 of 72

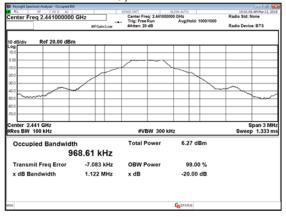


[Chart]

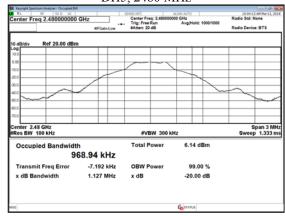


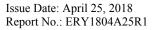


DH5, 2441 MHz



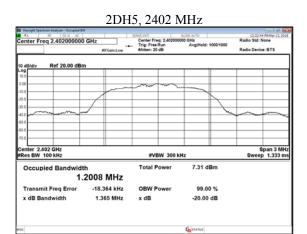
DH5, 2480 MHz



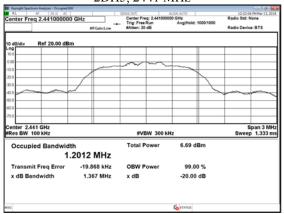




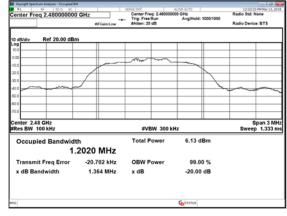


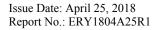


2DH5, 2441 MHz



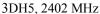
2DH5, 2480 MHz





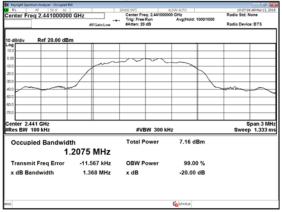




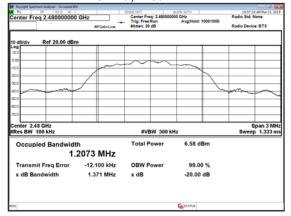


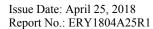


3DH5, 2441 MHz



3DH5, 2480 MHz









2.3 Hopping Carrier Frequency Separation

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.

Spectrum **EUT** Antenna Port Analyzer

Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 7.8.2

Span: Wide enough to capture the peaks of two adjacent channels.

Start with the RBW set to approximately 30 % of the channel spacing; adjust RBW:

as necessary to best identify the center of each individual channel.

VBW: More than RBW

Trace: Max Hold

Applicable rule and limitation

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, provided the systems operate with an output power no greater than 125 mW.

Test equipment used (refer to List of utilized test equipment)

	SA10	CL31	AT33			
--	------	------	------	--	--	--

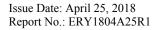
Test Date

Tested Date: 20 degC March 13, 2018 Temperature: Humidity: 45 % Atmos. Press: 1020 hPa

Test results - Complied with requirement

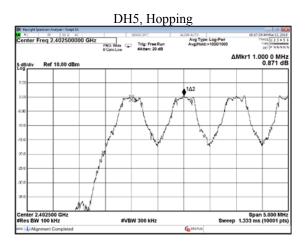
Test Data

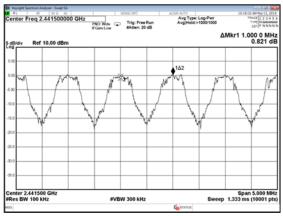
Transmission Mode	Transmission Frequency [MHz]	Frequency Separation [kHz]
DH5, Hopping	2402 - 2480	1000
2DH5, Hopping	2402 - 2480	1000
3DH5, Hopping	2402 - 2480	1000

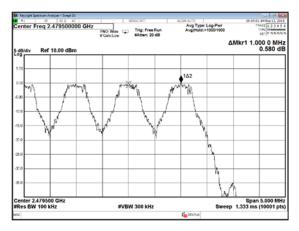


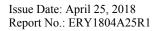
Page 18 of 72

[Chart]



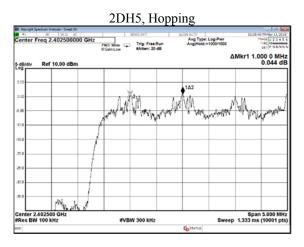




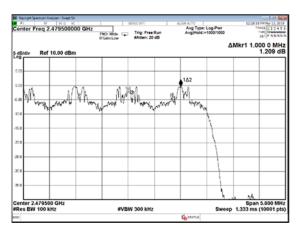


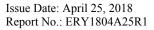
Page 19 of 72





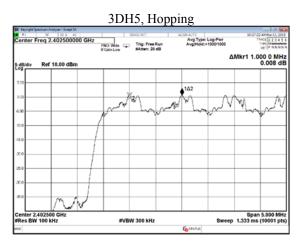




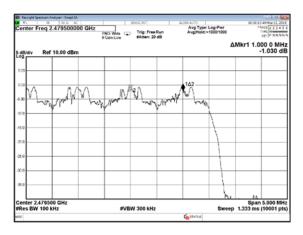


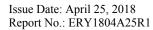
Page 20 of 72















2.4 Number of Hopping Channel

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 7.8.3

The frequency band of operation. Depending on the number of channels the

device supports, it may be necessary to divide the frequency range of

operation across multiple spans, to allow the individual channels to be clearly

RBW: To identify clearly the individual channels, set the RBW to less than 30 % of

the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW: More than RBW

Trace: Max Hold

Applicable rule and limitation

15.247 (a) (1) (iii) (iii) frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test equipment used (refer to List of utilized test equipment)

SA	10	CL31	AT33		

Test Date

Tested Date: March 13, 2018 Temperature: 20 degC Humidity: 45 % Atmos. Press: 1020 hPa

Test results - Complied with requirement

Test Data

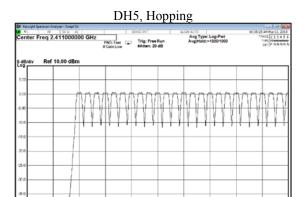
Transmission Mode	Transmission Frequency [MHz]	Number of hopping channels
DH5, Hopping	2402 - 2480	79
2DH5, Hopping	2402 - 2480	79
3DH5, Hopping	2402 - 2480	79



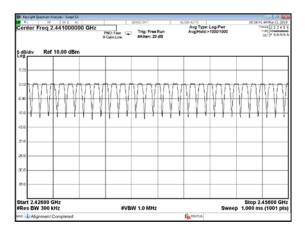
Issue Date: April 25, 2018 Report No.: ERY1804A25R1

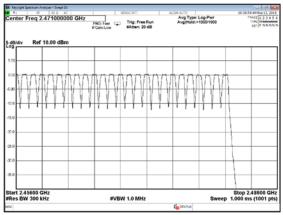
Page 22 of 72

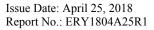
[Chart]



#VBW 1.0 MHz

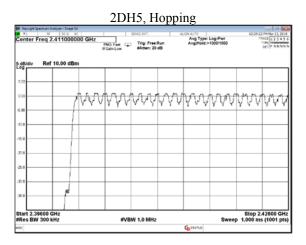


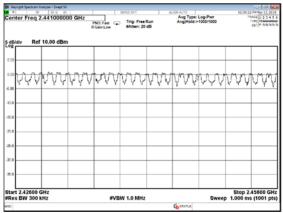


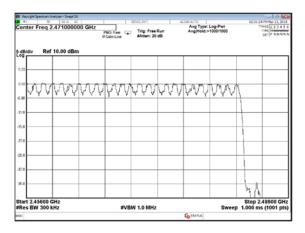


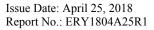
Page 23 of 72





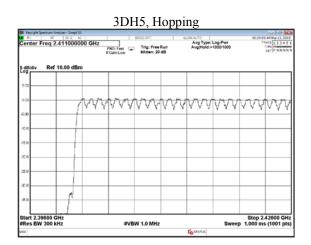


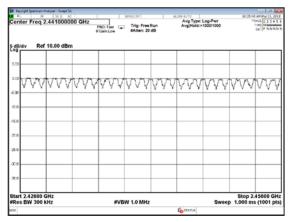


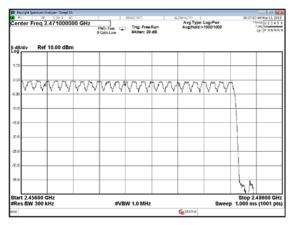


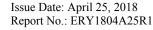
Page 24 of 72











Page 25 of 72



2.5 Average Time of Occupancy

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.

Spectrum **EUT** Antenna Port Analyzer

Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 7.8.4

Zero span, centered on a hopping channel. Span:

RBW: RBW shall be ≤ channel spacing and where possible RBW should be set >>

1/T, where T is the expected dwell time per channel.

Sweep: As necessary to capture the entire dwell time per hopping channel; where

> possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two

successive hops on a channel.

Trace: Max Hold

Applicable rule and limitation

15.247 (a) (1) (iii) The average time of occupancy 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.

Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		

Test Date

March 13, 2018 Temperature: Tested Date: 20 degC 45 % Atmos. Press: 1020 hPa Humidity:

Test results - **Complied with requirement**



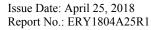
Issue Date: April 25, 2018 Report No.: ERY1804A25R1

Page 26 of 72

Test Data

Mode	Freq	Hopping Rate	Number of channels	Rx slot	Tx slot	Number of hops per sec *1	Number of hops per channel in one sec *2	Specified periods [ms] *3	Number of hops per channel in specified period *4	Transmit time per hop [ms]	Time of occupancy [ms] *5
DH1	2441	1600	79	1	1	800	10.13	31.6	320	0.3990	127.68
DH3	2441	1600	79	3	1	400	5.06	31.6	160	1.6530	264.48
DH5	2441	1600	79	5	1	267	3.38	31.6	106.67	2.8980	309.12
2DH1	2441	1600	79	1	1	800	10.13	31.6	320	0.4155	132.96
2DH3	2441	1600	79	3	1	400	5.06	31.6	160	1.6600	265.60
2DH5	2441	1600	79	5	1	267	3.38	31.6	106.67	2.9120	310.61
3DH1	2441	1600	79	1	1	800	10.13	31.6	320	0.4115	131.68
3DH3	2441	1600	79	3	1	400	5.06	31.6	160	1.6610	265.76
3DH5	2441	1600	79	5	1	267	3.38	31.6	106.67	2.9130	310.72

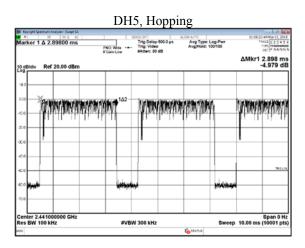
- *1: Number of hops per sec = Hopping rate / (Rx slot + Tx slot)
- *2: Number of hops per channel in one sec = Number of hops per sec / Number of channels
- *3: Specified periods = Number of channels / 0.4
- *4: Number of hops per channel in specified period = Number of hops per channel in one sec / Specified
- *5: Time of occupancy = Number of hops per channel in specified period * Transmit time per hop

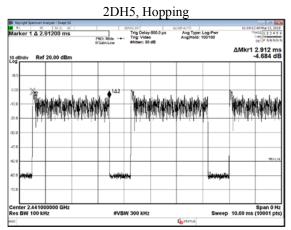


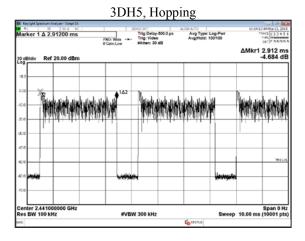
Page 27 of 72

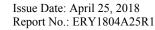


[Chart]









Page 28 of 72



2.6 Peak Output Power

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 7.8.5

Span: Approximately five times the 20 dB bandwidth, centered on a hopping

channel.

RBW: RBW > 20 dB bandwidth of the emission being measured.

VBW: $\geq RBW$ Max Hold Trace:

Applicable rule and limitation

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, provided the systems operate with an output power no greater than 125 mW (21 dBm)

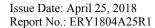
Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		

Test Date

Tested Date: March 13, 2018 Temperature: 20 degC 1020 hPa Humidity: 45 % Atmos. Press:

Test results - Complied with requirement





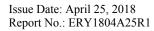


Test Data

Transmission Mode	Transmission Frequency	Peak Out	put power
	[MHz]	[dBm]	[mW]
DH5	2402	11.146	13.020
DH5	2441	10.971	12.505
DH5	2480	10.859	12.187
2DH5	2402	11.910	15.524
2DH5	2441	11.324	13.564
2DH5	2480	10.776	11.956
3DH5	2402	12.505	17.803
3DH5	2441	11.875	15.399
3DH5	2480	11.210	13.213

*For refference

Transmission Mode	Transmission Frequency	Average Output power	
	[MHz]	[dBm]	[mW]
DH5	2402	9.26	8.440
DH5	2441	9.17	8.270
DH5	2480	9.13	8.190
2DH5	2402	8.57	7.200
2DH5	2441	8.51	7.100
2DH5	2480	8.42	6.960
3DH5	2402	8.63	7.300
3DH5	2441	8.56	7.180
3DH5	2480	8.50	7.080

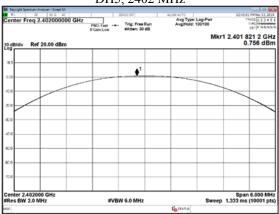


Page 30 of 72

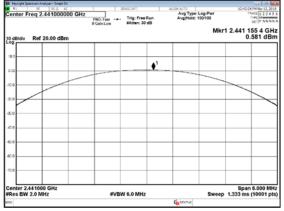


[Chart]

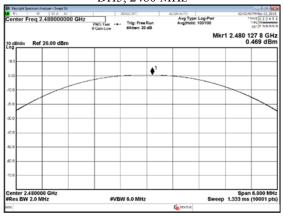


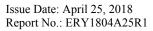


DH5, 2441 MHz



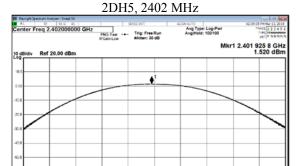
DH5, 2480 MHz





Page 31 of 72

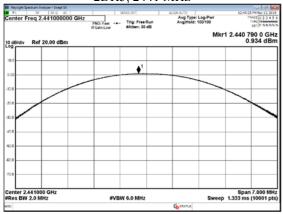




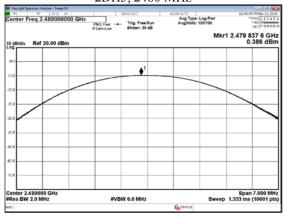
2DH5, 2441 MHz

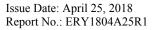
#VBW 6.0 MHz

Span 7.000 MH Sweep 1.333 ms (10001 pt



2DH5, 2480 MHz

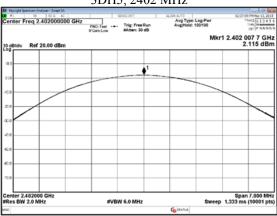




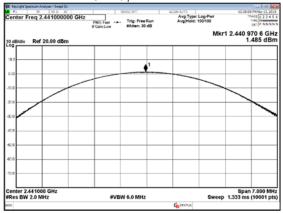




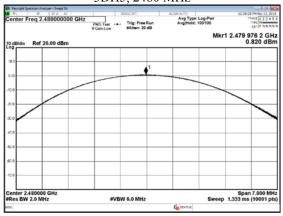


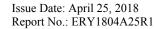


3DH5, 2441 MHz



3DH5, 2480 MHz





Page 33 of 72



2.7 Conducted Spurious Emissions

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 7.8.8

- RBW: 100 kHz - VBW: 300 kHz - Detector: Peak - Trace: Max hold

Limitation

15.247(d); 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.

Test equipment used (refer to List of utilized test equipment)

	SA10	CL31	AT33			
--	------	------	------	--	--	--

Test Date

(bandedge)

Tested Date: March 13, 2018 Temperature: 22 degC 1020 hPa Humidity: 45 % Atmos. Press:

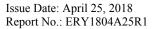
(without bandedge)

Tested Date: March 14, 2018 Temperature: 20 degC Humidity: 45 % Atmos. Press: 1020 hPa

Test results - Complied with requirement

Test Data

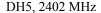
Refer to chart.

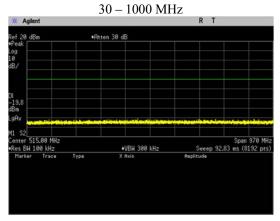


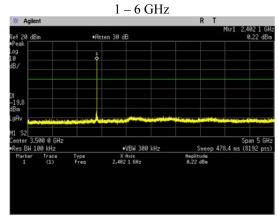


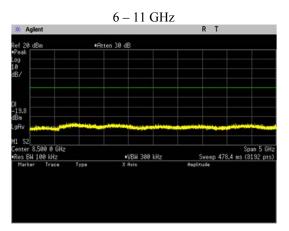


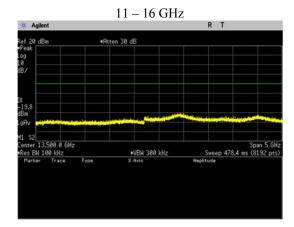
[Chart]

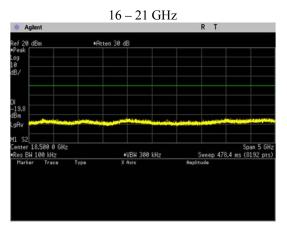


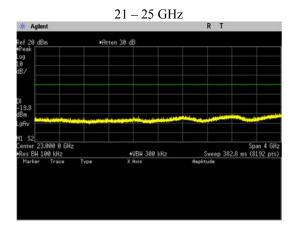


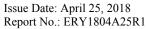








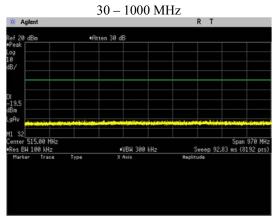


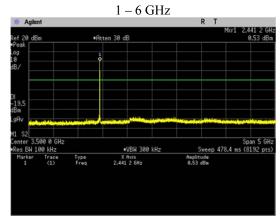


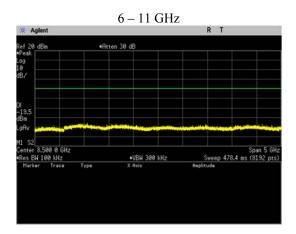


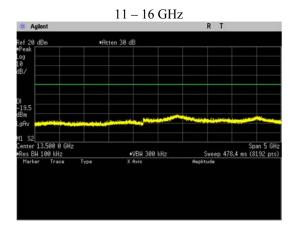


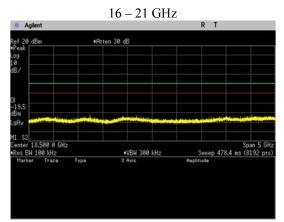
DH5, 2441 MHz

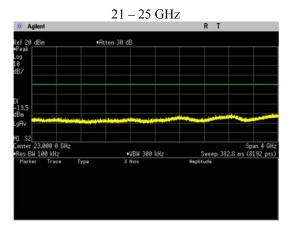


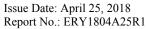








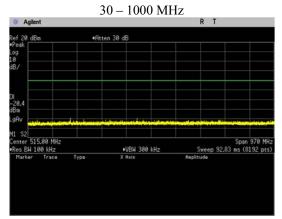


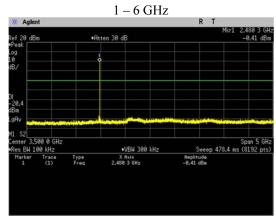


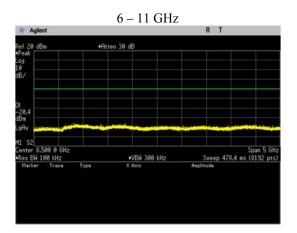


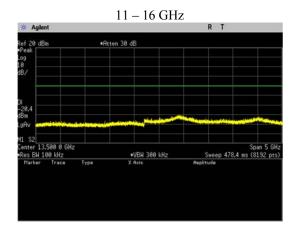


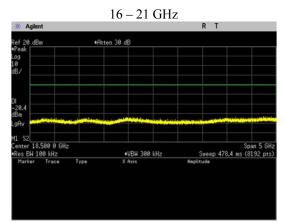
DH5, 2480 MHz

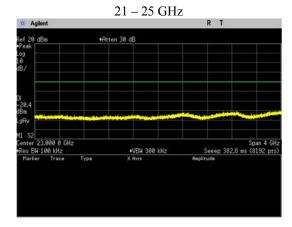


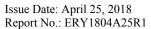








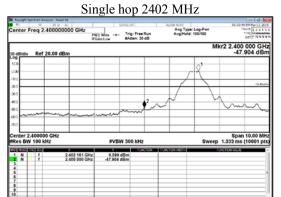


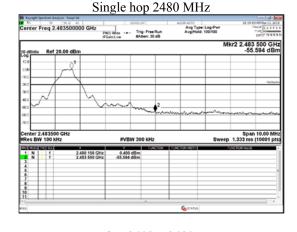


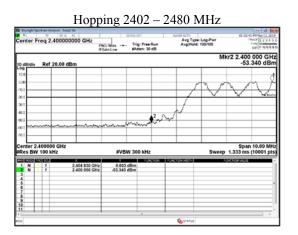


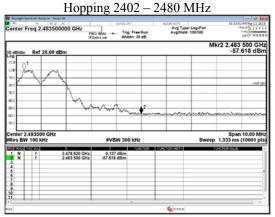


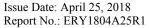
DH5 Bandedge







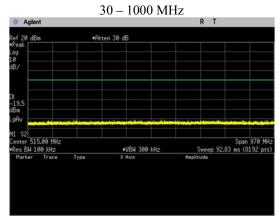


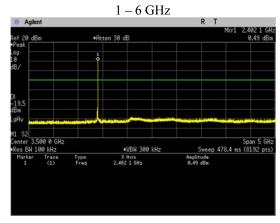


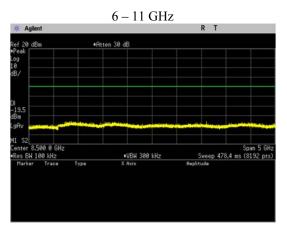


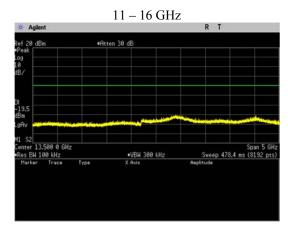


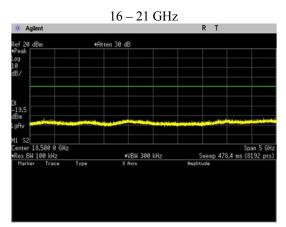
2DH5, 2402 MHz

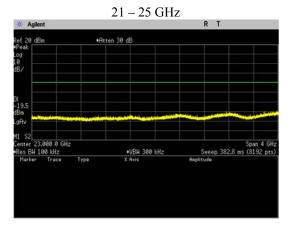


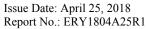








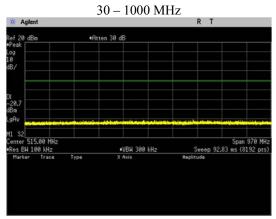


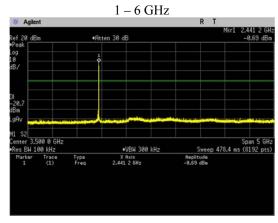


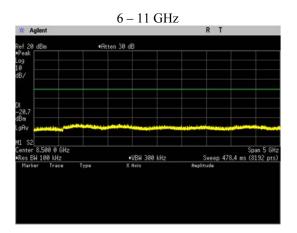


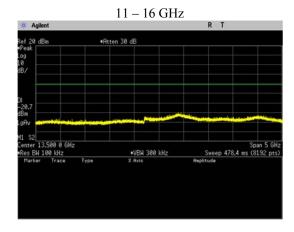


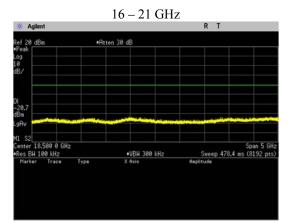
2DH5, 2441 MHz

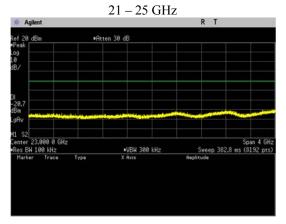


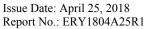








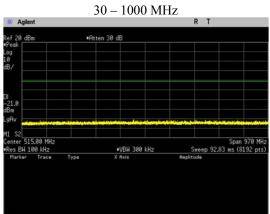


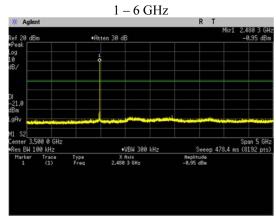


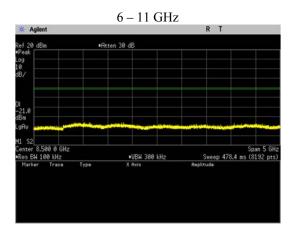


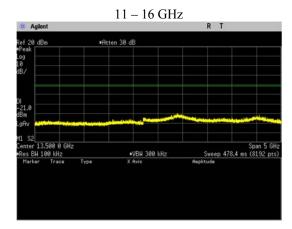


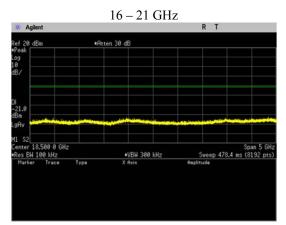
2DH5, 2480 MHz

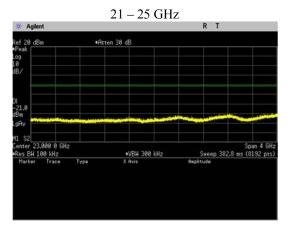


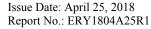








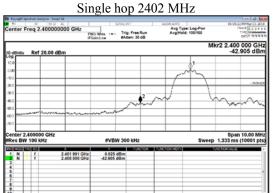








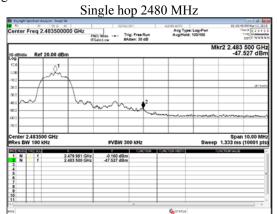
2DH5 Bandedge

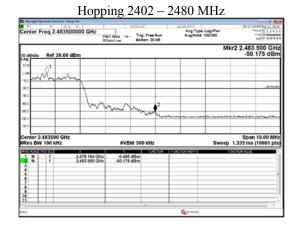


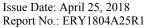
Hopping 2402 – 2480 MHz

PNO: Wide --- Trig: Free Run IFGain Low #Atten: 30 dB





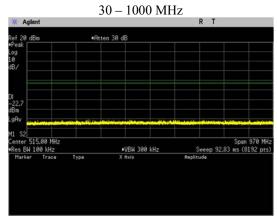


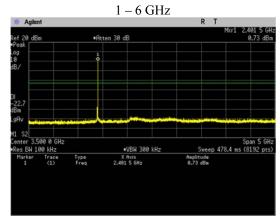


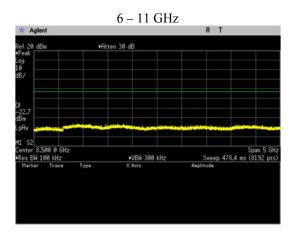


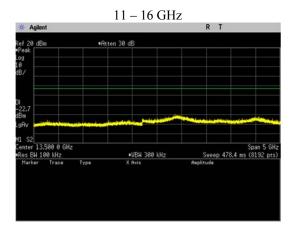


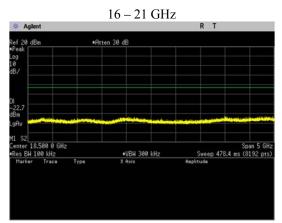
3DH5, 2402 MHz

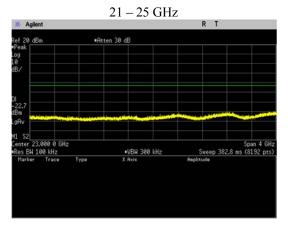


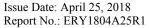








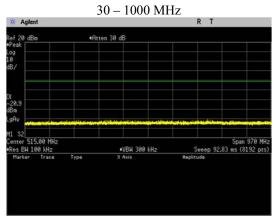


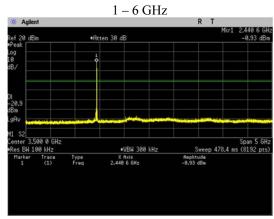


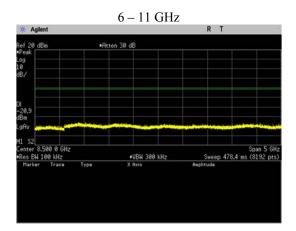


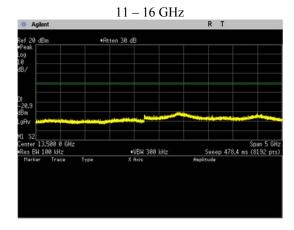


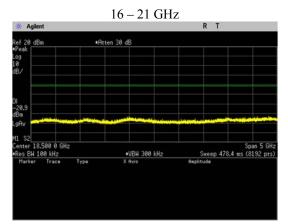
3DH5, 2441 MHz

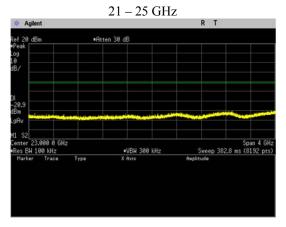


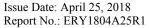








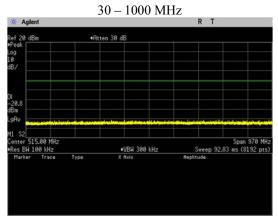


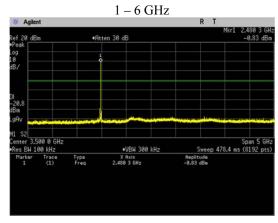


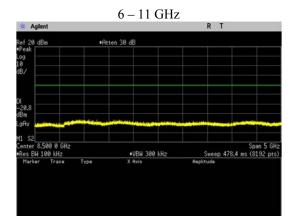


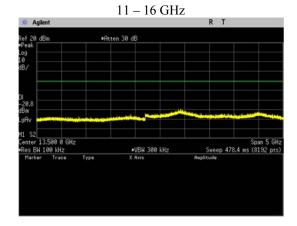


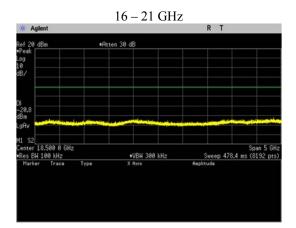
3DH5, 2480 MHz

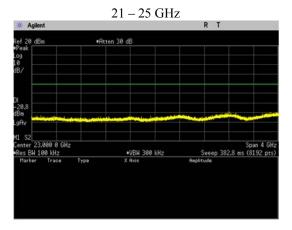


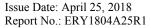
















3DH5 Bandedge

