



CERTIFICATION TEST REPORT

Report Number. : 12524644-E3V1

Applicant : GOOGLE LLC
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW, CA 94043, U.S.A.

Model : H1A

EUT Description : INTERACTIVE VIDEO STREAMING DEVICE

Test Standard(s) : NCC LP0002:2018

Date Of Issue:
October 16, 2018

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	10/16/2018	Initial Issue	---

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: GOOGLE LLC
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW, CA 94043, U.S.A.

EUT DESCRIPTION: INTERACTIVE VIDEO STREAMING DEVICE

MODEL: H1A

SERIAL NUMBER: G1424638 (CONDUCTED)
G1421457 (RADIATED)

DATE TESTED: July 18, 2018 –July 31, 2018; October 11, 2018

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
NCC LP0002:2018	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with NCC LP0002:2018, ANSI C63.10-2009 for FCC and ANSI C63.10-2013 for IC, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd
☐ Chamber A (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☒ Chamber K (ISED:2324A-1)
☒ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☐ Chamber L (ISED:2324A-3)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	
	☐ Chamber G (ISED:22541-4)	
	☐ Chamber H (ISED:22541-5)	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned}\text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m}\end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an Internet Video Streaming Device

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum average conducted output power as follows:

2.4GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
1Tx			
2412 - 2472	802.11b	19.06	80.54
2412 - 2472	802.11g	19.40	87.10
2412 - 2472	802.11n HT20	19.25	84.14
2422 - 2462	802.11n HT40	14.47	27.99

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of 4dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware and utility software during testing was version 127694.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

EUT can only be set up in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

Simultaneous transmission for BT/BLE radios and 2.4GHz WLAN radios was investigated, no additional noticeable emissions were found.

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps

802.11g mode: 6 Mbps

802.11n HT20mode: MCS0

802.11n HT40mode: MCS0

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

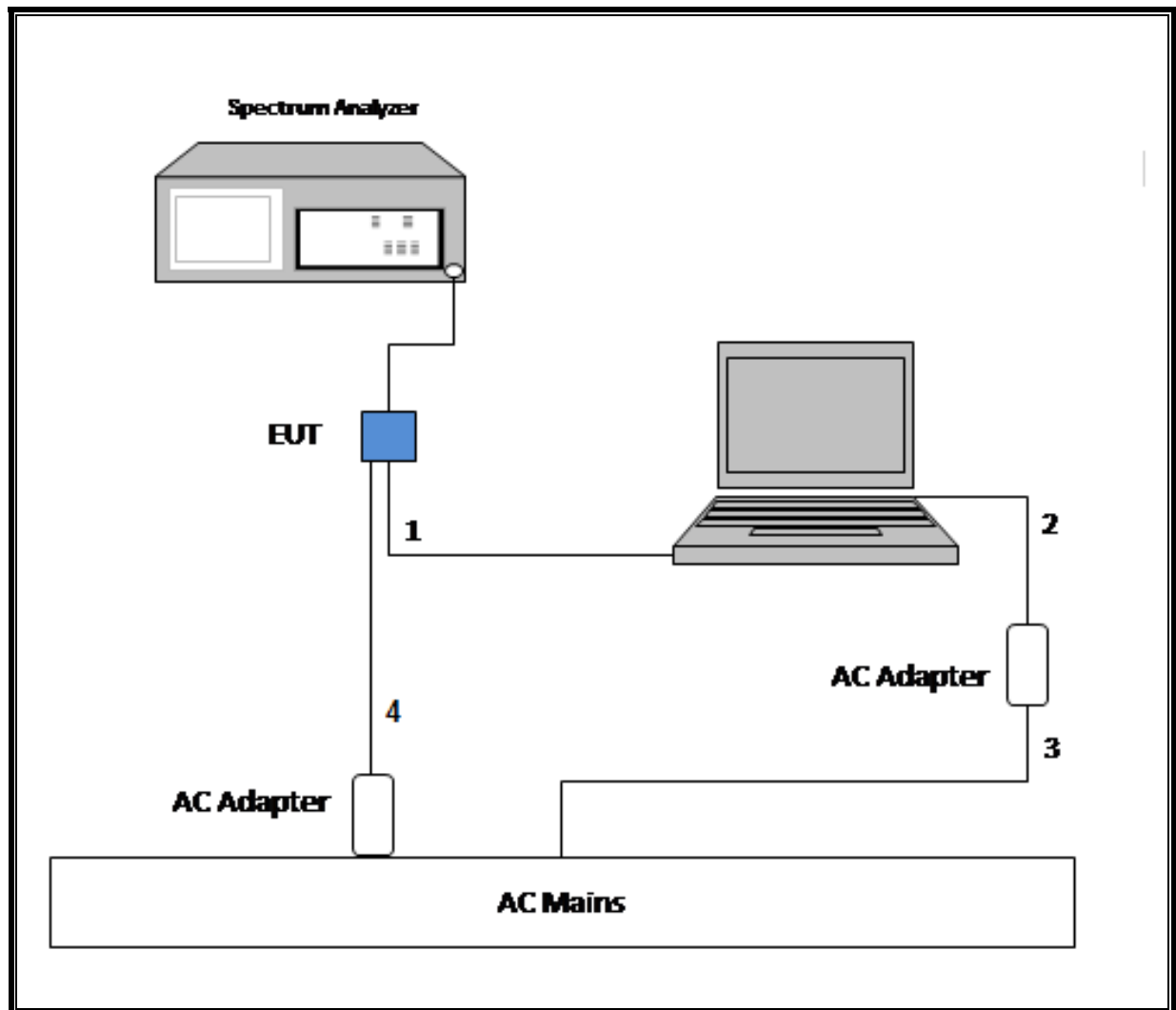
Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop AC/DC adapter	Lenovo	ADLX65NCT2A	11S36200293ZZ10049556E	NA
Laptop	Lenovo	X220	R9-P89W3	NA
AC adapter	Google	NA	W015R007q	NA

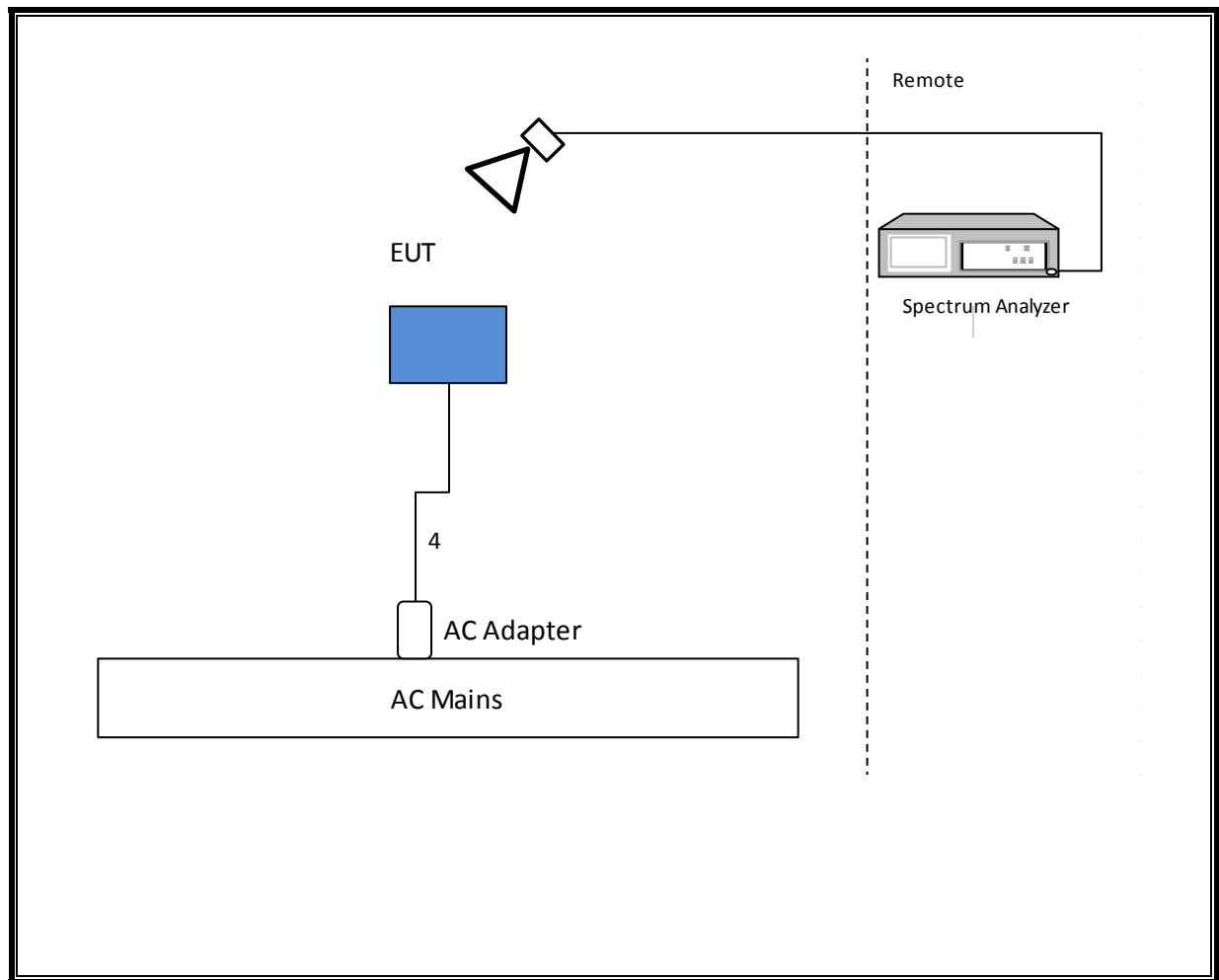
I/O CABLES

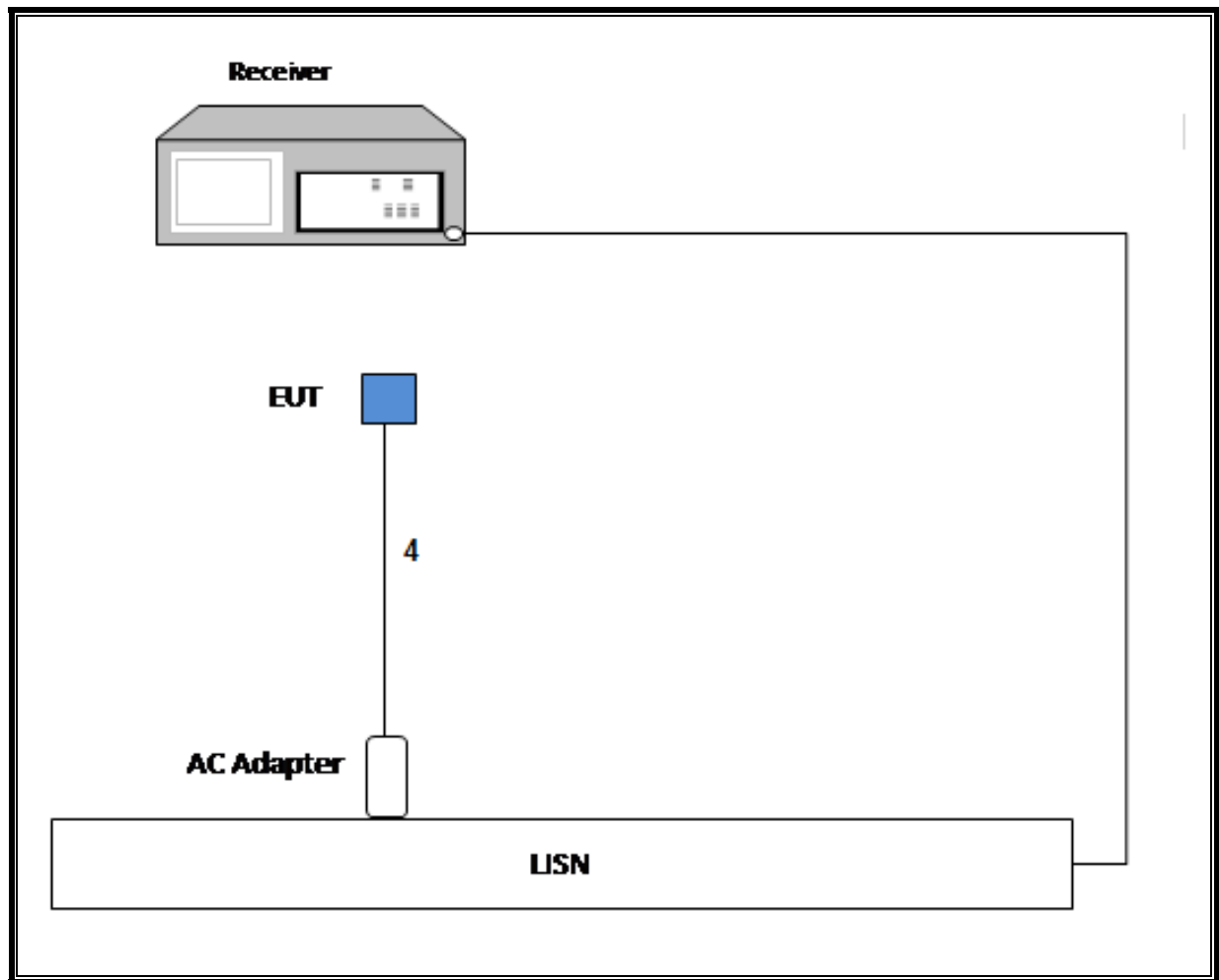
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	micro USB	Shielded	1	
2	DC	1	DC connector	Unshielded	1.75	
3	AC	1	2-Prong	Unshielded	1	
4	DC	1	DC connector	Unshielded	1.75	

TEST SETUP

The EUT was connected to a host Laptop via USB cable. Test software exercised the EUT.

SETUP DIAGRAM FOR ANTENNA PORT CONDUCTED TESTS

SETUP DIAGRAM FOR RADIATED TESTS

SETUP DIAGRAM FOR AC LINE CONDUCTED TESTS

6. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v04, Section 6.

6 dB BW: KDB 558074 D01 v04, Section 8.1.

99% BW: ANSI C63.10-2013, Section 6.9.3.

Output Power: KDB 558074 D01 v04, Section 9.2.3.2.

Power Spectral Density: KDB 558074 D01 v04, Section 10.3.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.1 (b).

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Amplifier	Hewlet Packard	8447D	T64	02/14/2019
Amplifier, 1 - 18GHz	MITEQ	AFS42-00101800-25-S-42	T931	09/20/2018
Amplifier, 1 - 18GHz	Amplicial	AMP1G18-35	T1569	06/03/2019
RF Preamplifier, 1 - 26GHz	Agilent	8449B	T404	03/09/2019
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T407	05/10/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T863	06/21/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T344	04/30/2019
Antenna Horn, 18 to 26GHz	ARA	MWH-1826/B	T488	10/04/2018
Power Meter, P-series single channel	Keysight	N1912A	T1271	07/26/2019
Power Sensor	Keysight	N1921A	T1225	04/10/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1466	04/16/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1454	01/08/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1113	12/21/2018
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	04/28/2019
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESC17	T1124	11/07/2018
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2	EMC4385	01/31/2019
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2018
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, Dec 01, 2016	
Antenna Port Software	UL	UL EMC	Ver 7.9, Jan 24, 2018	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing was completed before equipment expiration date.

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

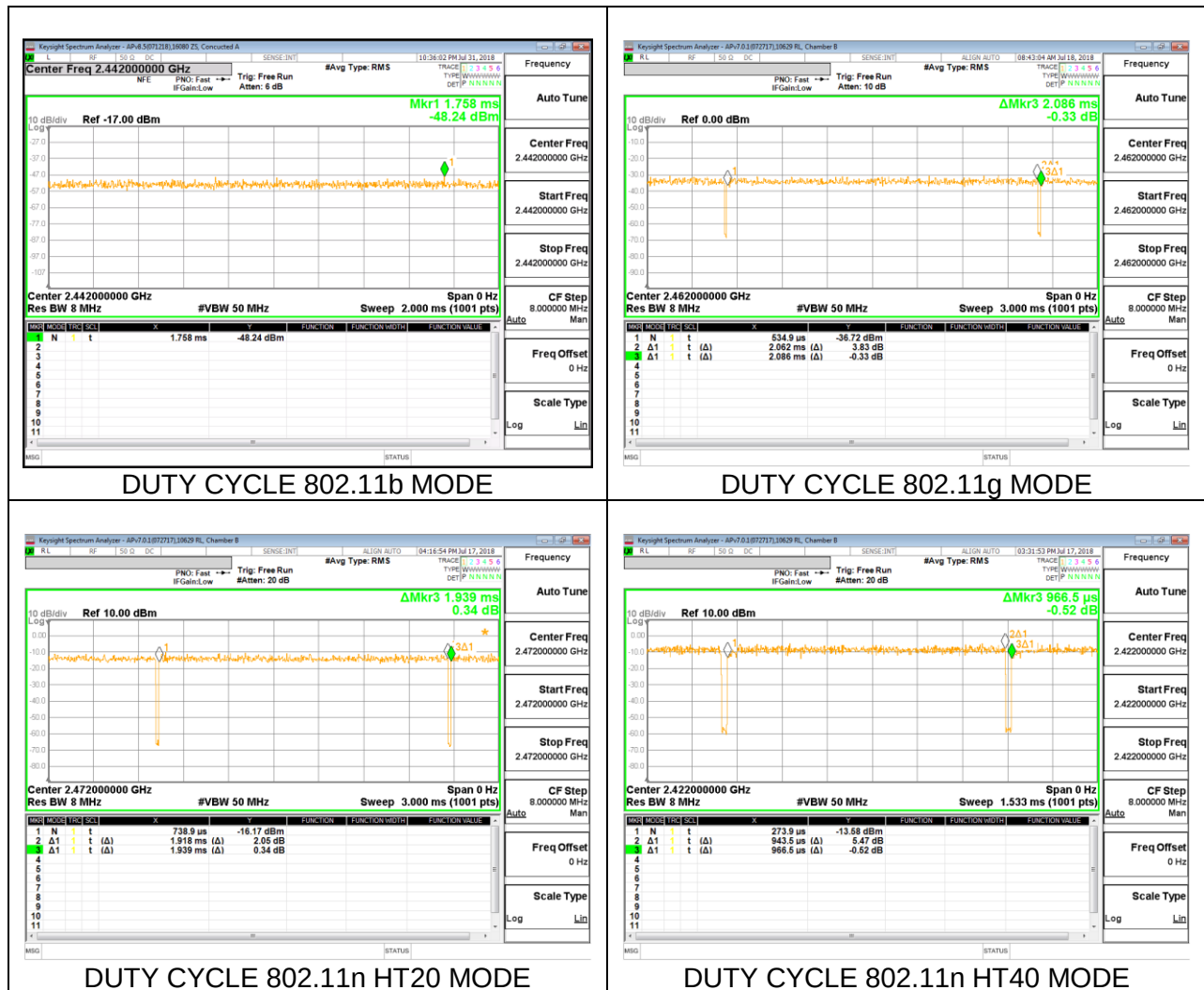
PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
802.11b 1TX	2.000	2.000	1.000	100.00%	0.00	0.010
802.11g 1TX	2.062	2.086	0.988	98.85%	0.00	0.010
802.11n HT20 1TX	1.918	1.939	0.989	98.92%	0.00	0.010
802.11n HT40 1TX	0.944	0.967	0.976	97.62%	0.10	1.060

DUTY CYCLE PLOTS



8.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

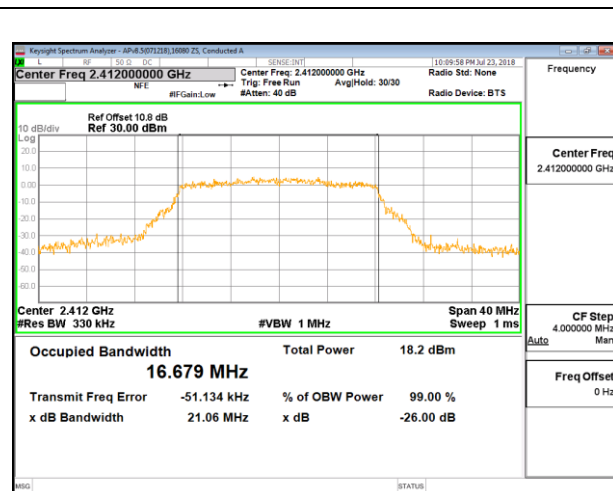
8.2.1. 802.11b MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	12.1210
Mid 6	2437	12.1110
High 11	2462	12.1030
High 12	2467	11.9700
High 13	2472	11.5970

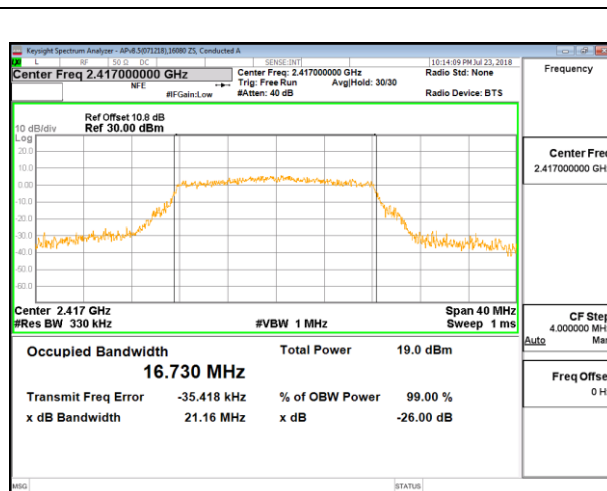


8.2.2. 802.11g MODE

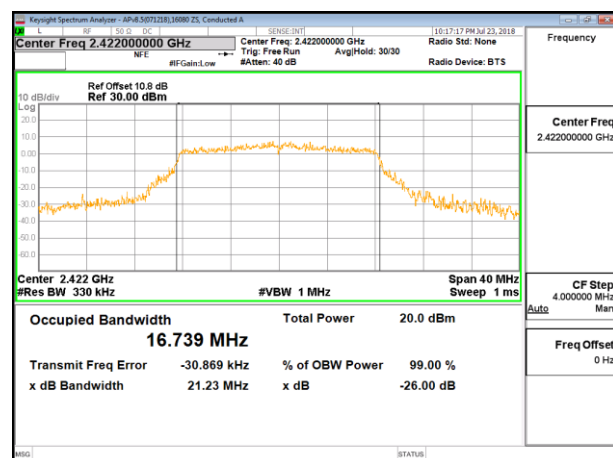
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	16.6790
Low 2	2417	16.7300
Low 3	2422	16.7390
Low 4	2427	16.6980
Low 5	2432	16.9180
Mid 6	2437	17.3810
High 8	2447	16.9480
High 9	2452	16.7550
High 10	2457	16.7330
High 11	2462	16.5600
High 12	2467	16.7270
High 13	2472	16.7050



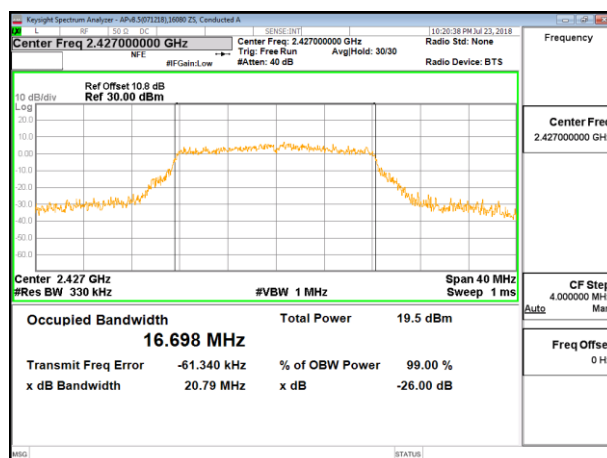
LOW CHANNEL 1



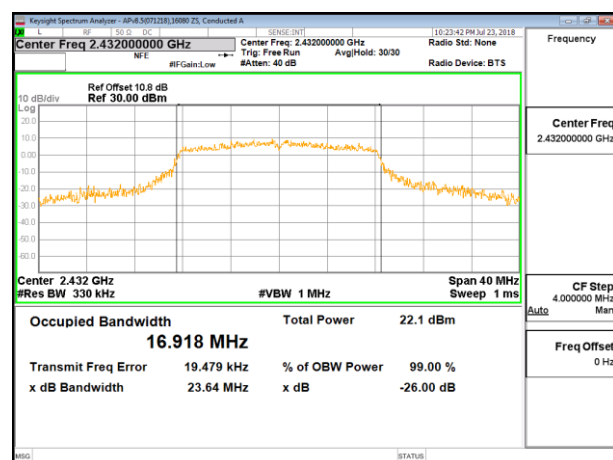
LOW CHANNEL 2



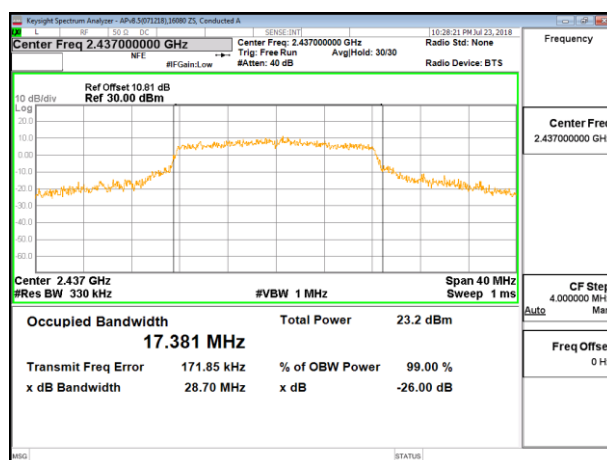
LOW CHANNEL 3



LOW CHANNEL 4



LOW CHANNEL 5

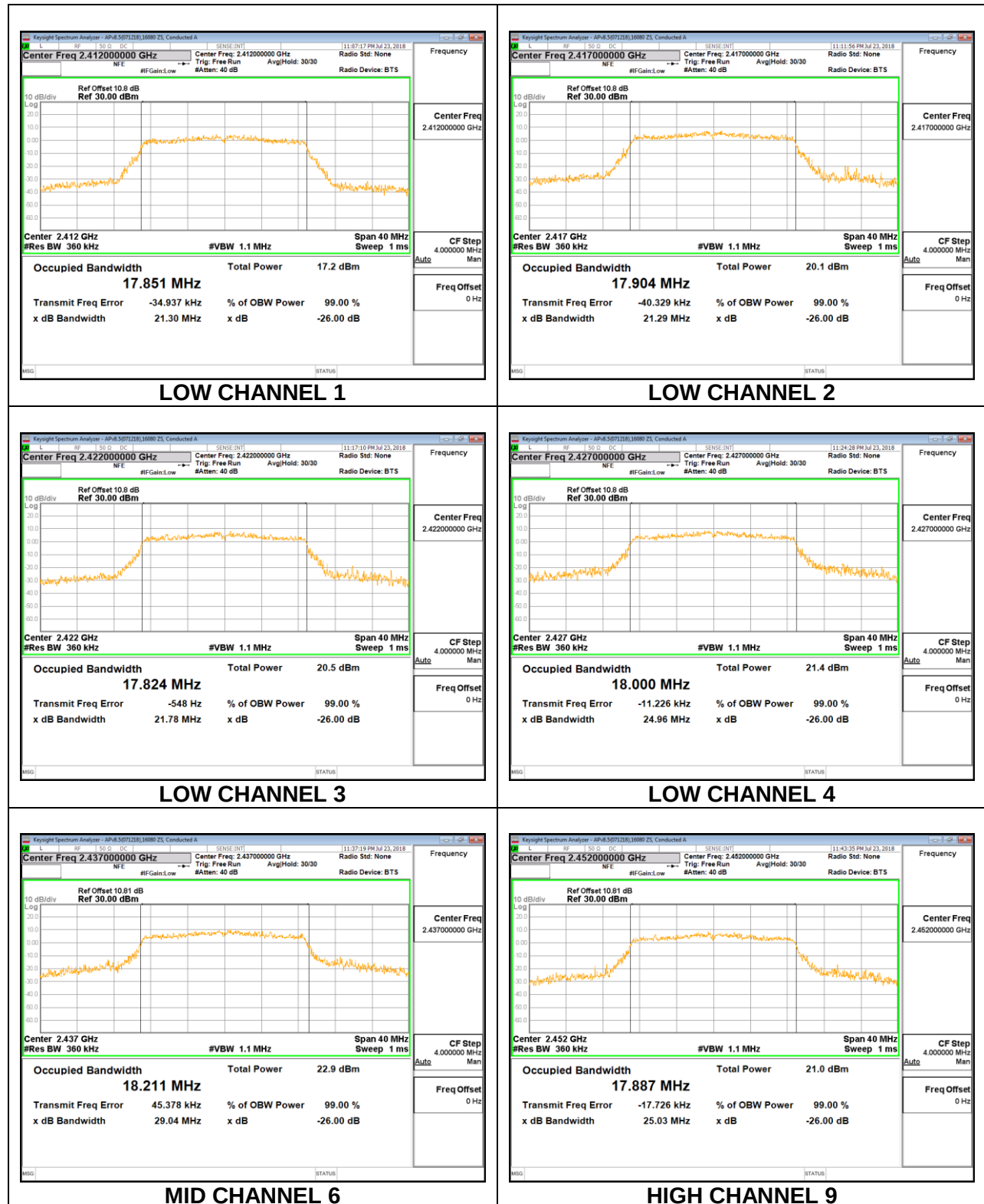


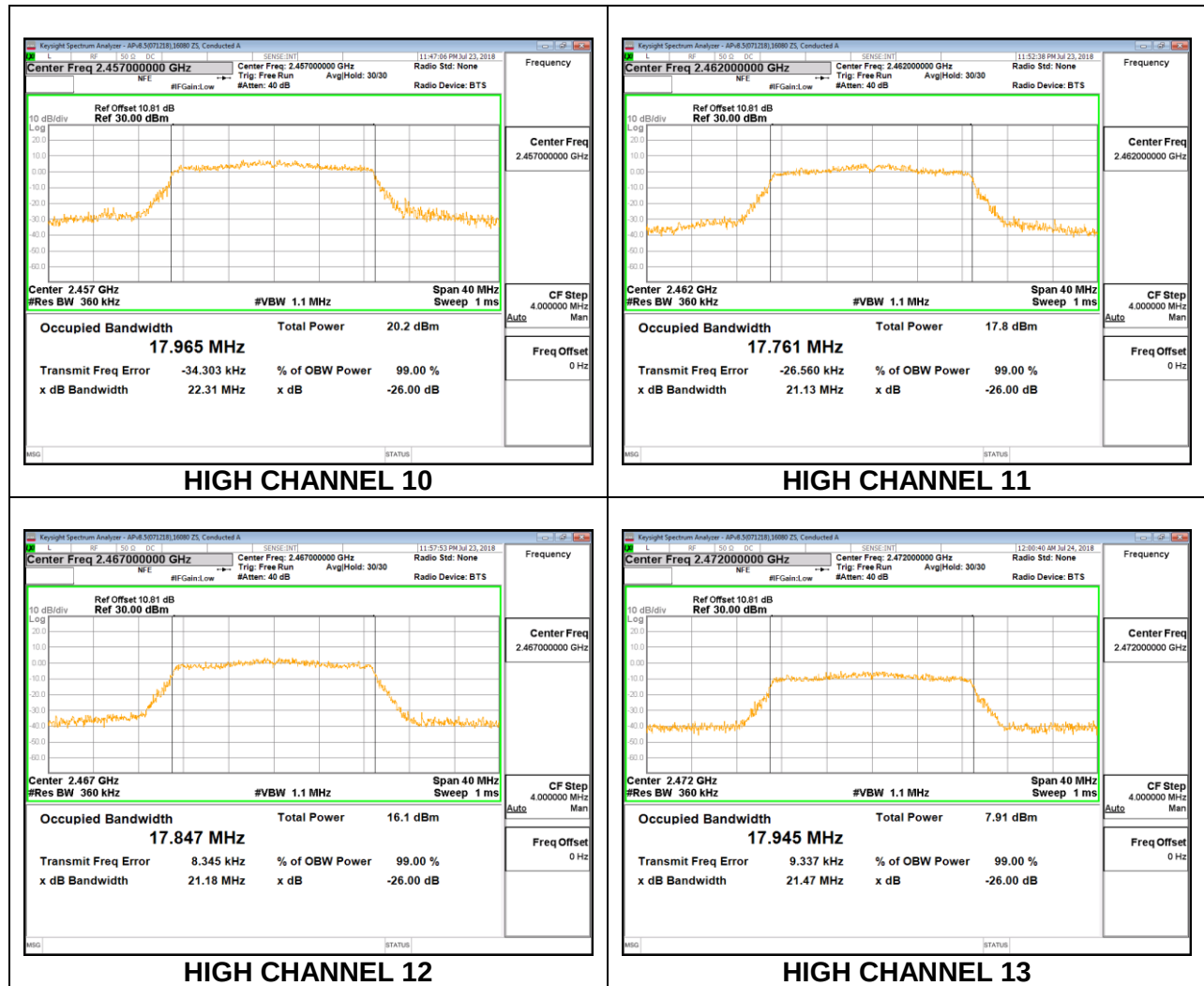
MID CHANNEL 6



8.2.3. 802.11n HT20 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	17.8510
Low 2	2417	17.9040
Low 3	2422	17.8240
Low 4	2427	18.0000
Mid 6	2437	18.2110
High 9	2452	17.8870
High 10	2457	17.9650
High 11	2462	17.7610
High 12	2467	17.8470
High 13	2472	17.9450

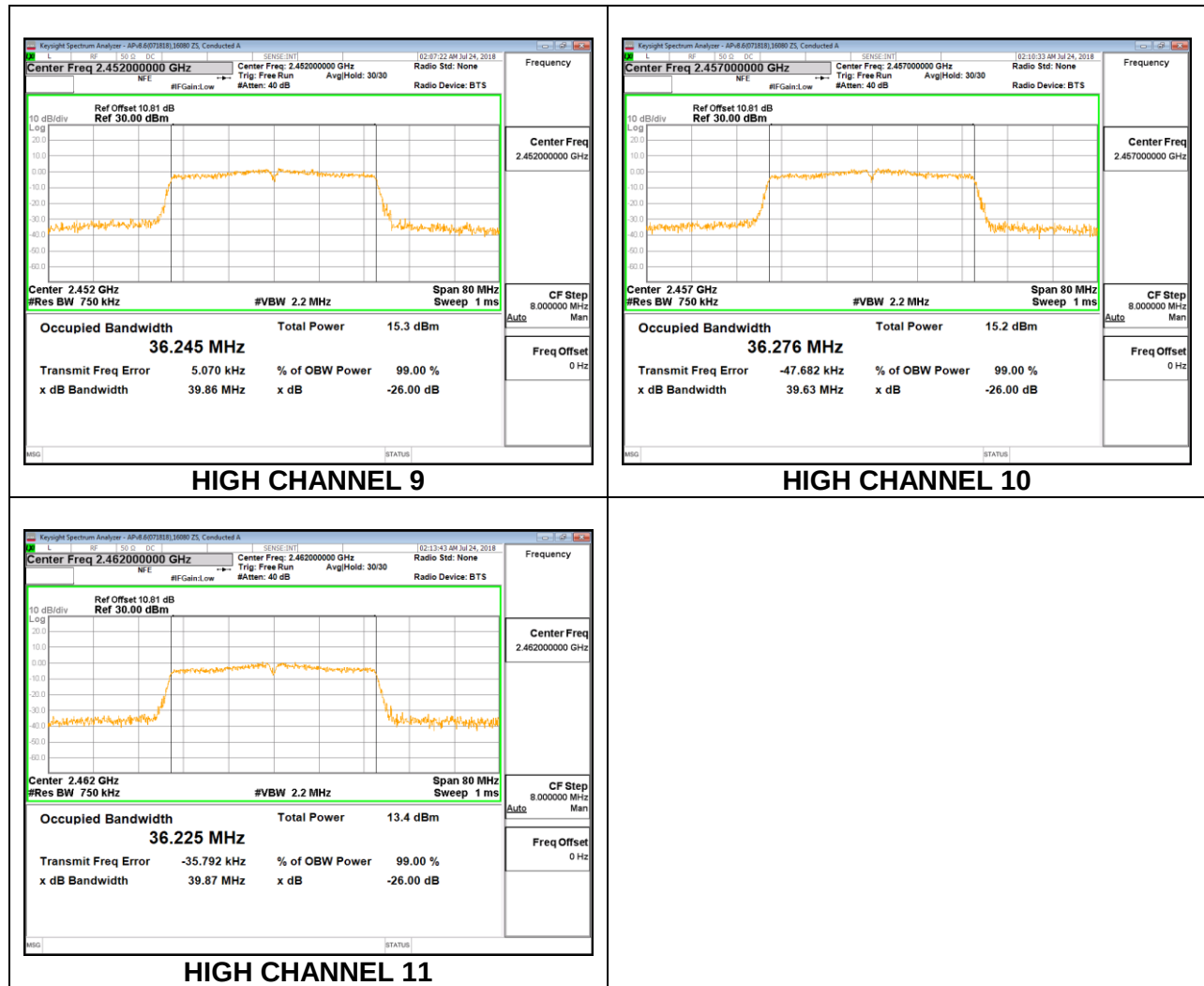




8.2.4. 802.11n HT40 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 3	2422	36.2740
Low 4	2427	36.2010
Low 5	2432	36.2310
Mid 6	2437	36.2920
High 7	2442	36.2310
High 8	2447	36.2930
High 9	2452	36.2450
High 10	2457	36.2760
High 11	2462	36.2250





8.3. 6 dB BANDWIDTH

LIMITS

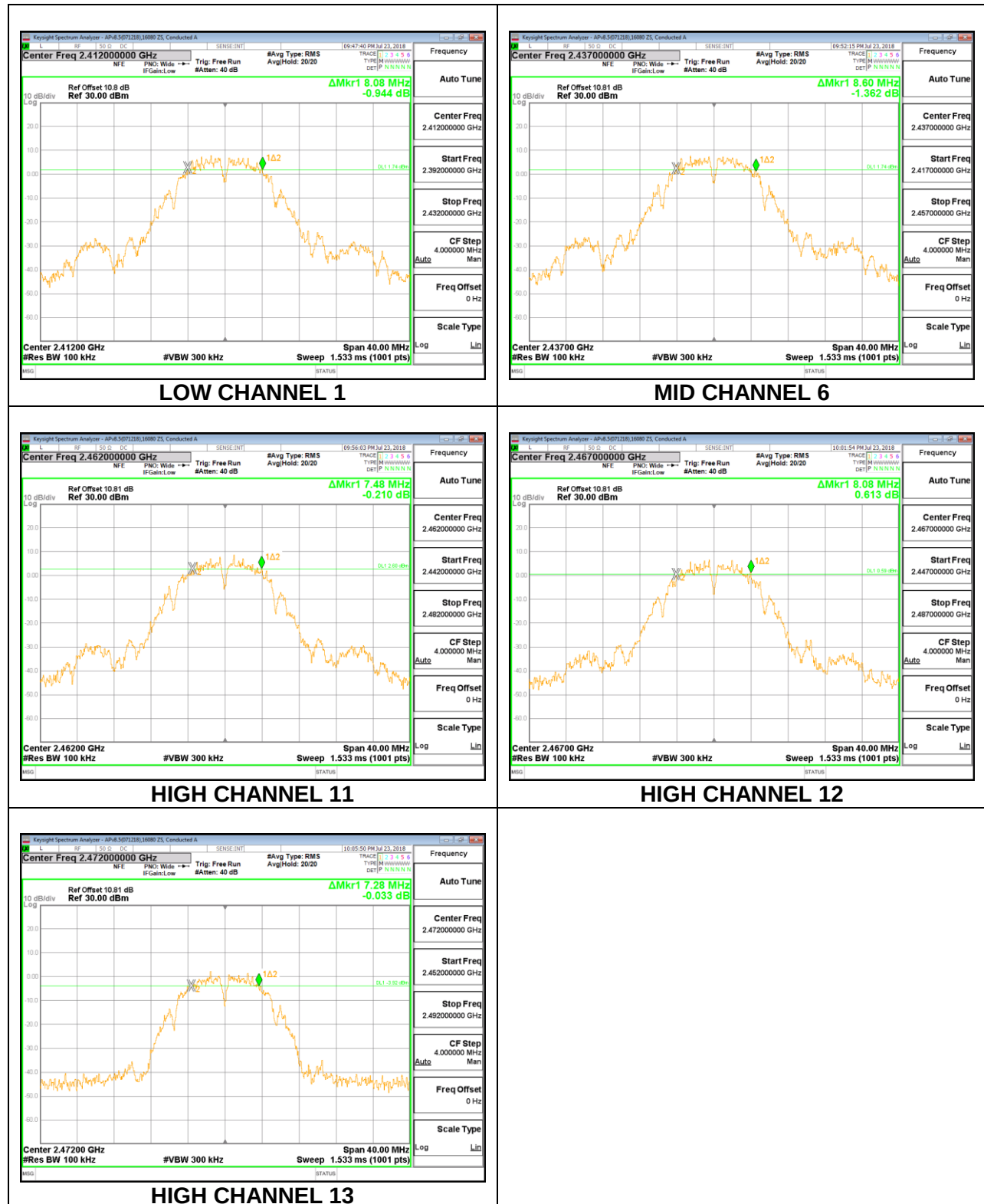
NCC LP0002 §3.10.1.6 (2)(A)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

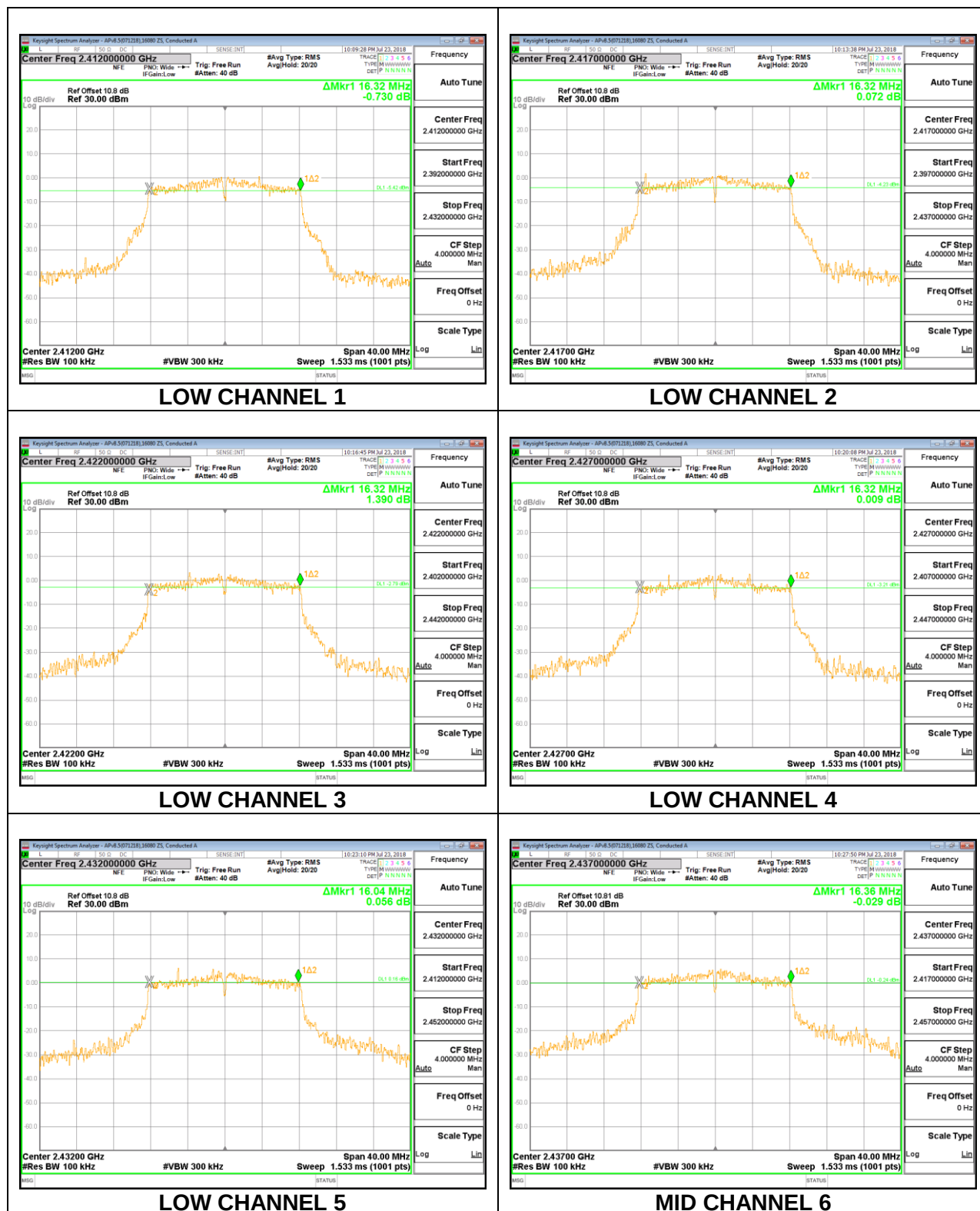
8.3.1. 802.11b MODE

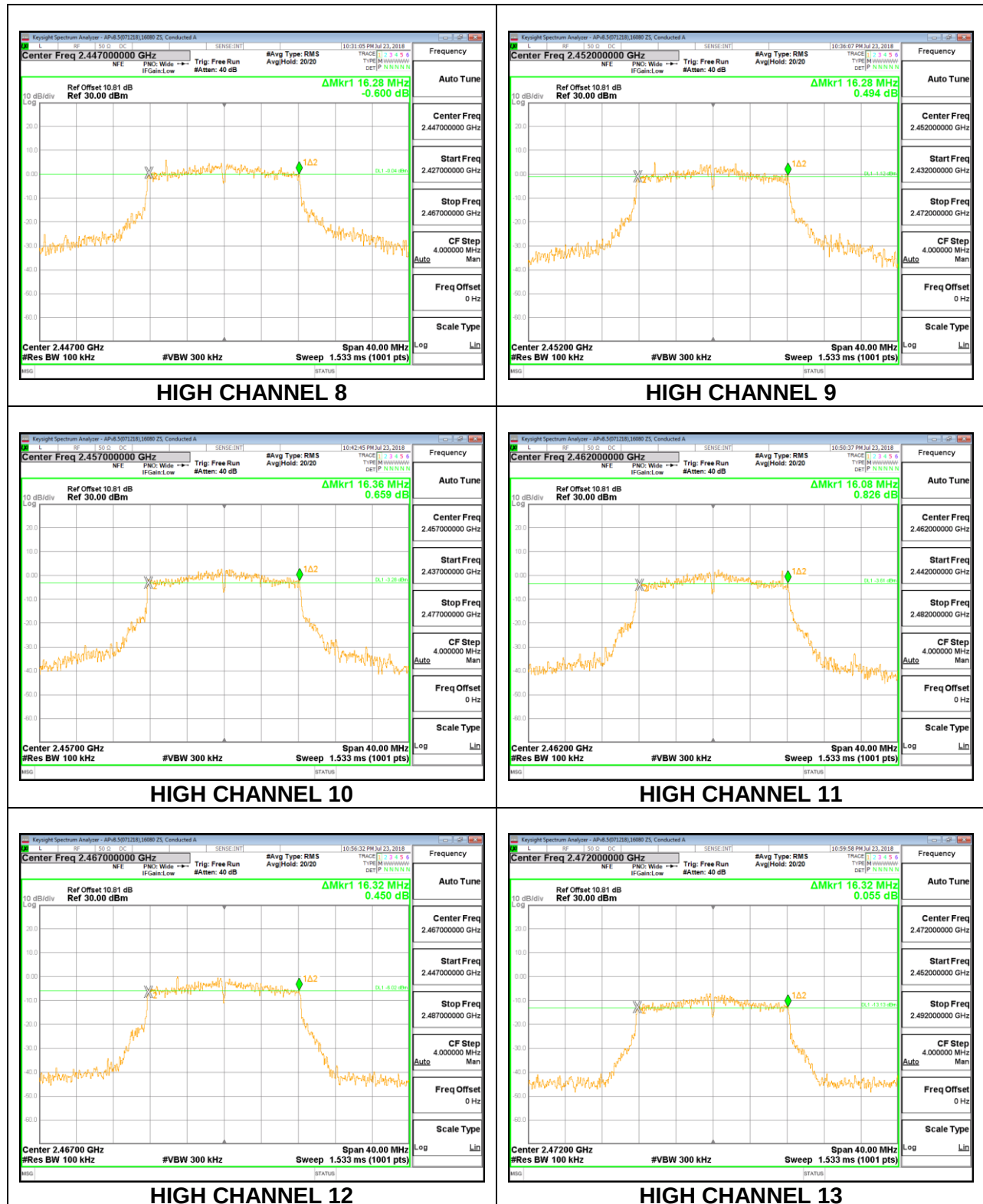
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	8.0800	0.5
Mid 6	2437	8.6000	0.5
High 11	2462	7.4800	0.5
High 12	2467	8.0800	0.5
High 13	2472	7.2800	0.5



8.3.2. 802.11g MODE

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	16.3200	0.5
Low 2	2417	16.3200	0.5
Low 3	2422	16.3200	0.5
Low 4	2427	16.3200	0.5
Low 5	2432	16.0400	0.5
Mid 6	2437	16.3600	0.5
High 8	2447	16.2800	0.5
High 9	2452	16.2800	0.5
High 10	2457	16.3600	0.5
High 11	2462	16.0800	0.5
High 12	2467	16.3200	0.5
High 13	2472	16.3200	0.5





8.3.3. 802.11n HT20 MODE

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	17.5600	0.5
Low 2	2417	17.6400	0.5
Low 3	2422	17.6000	0.5
Low 4	2427	17.5600	0.5
Mid 6	2437	17.6000	0.5
High 9	2452	17.5600	0.5
High 10	2457	17.6400	0.5
High 11	2462	17.3200	0.5
High 12	2467	17.0400	0.5
High 13	2472	17.6000	0.5

