

FCC 47 CFR PART 15 SUBPART E TEST REPORT

For

Display Unit

Model: EEMS330xxxxxxx ; EEMSyy330xxxxxxx
(where “x” or “y” may be any alphanumeric character
or blank and where “y” is a country code)

Trade Name: Snap-on

Issued for

Snap-on Diagnostics

420 Barclay Blvd, Lincolnshire, Illinois, USA

Issued by

**Compliance Certification Services Inc.
Hsinchu Lab.**

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Issued Date: March 28, 2017



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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	03/28/2017	Initial Issue	All Page 27	Dola Hsieh



TABLE OF CONTENTS

TITLE	PAGE NO.
1. TEST REPORT CERTIFICATION	4
2. EUT DESCRIPTION	5
3. DESCRIPTION OF TEST MODES.....	8
4. TEST METHODOLOGY	8
5. FACILITIES AND ACCREDITATION	9
5.1 FACILITIES	9
5.2 ACCREDITATIONS	9
5.3 MEASUREMENT UNCERTAINTY	10
6. SETUP OF EQUIPMENT UNDER TEST	11
7. DYNAMIC FREQUENCY SELECTION (DFS)	12
8. APPENDIX SETUP PHOTOS	27

1. TEST REPORT CERTIFICATION

Applicant : Snap-on Diagnostics
Address : 420 Barclay Blvd, Lincolnshire, Illinois, USA
Equipment Under Test : Display Unit
Model : EEMS330xxxxxxx ; EEMSyy330xxxxxxx
(where "x" or "y" may be any alphanumeric character
or blank and where "y" is a country code)
Trade Name : Snap-on
Tested Date : April 28 ~ June 25, 2015 ;
December 23, 2016 ~ March 15, 2017

APPLICABLE STANDARD	
Standard	Test Result
FCC Part 15 Subpart E	PASS

WE HEREBY CERTIFY THAT: The above equipment has been tested by Compliance Certification Services Inc., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:



Sb. Lu
Sr. Engineer

Reviewed by:



Gunden Lin
Sr. Engineer

2. EUT DESCRIPTION

Product Name	Display Unit
Model Number	EEMS330xxxxxxx ; EEMSyy330xxxxxxx (where "x" or "y" may be any alphanumeric character or blank and where "y" is a country code)
Identify Number	T161223D11
Received Date	April 28, 2015
Frequency Range	UNII Band 1: IEEE 802.11a, 802.11an HT20 : 5180MHz ~ 5240MHz IEEE 802.11an HT40 : 5190MHz ~ 5230MH UNII Band 2A: IEEE 802.11a, 802.11an HT20 : 5260MHz ~ 5320MHz IEEE 802.11an HT40 : 5270MHz ~ 5310MHz UNII Band 3: IEEE 802.11a, 802.11an HT20 : 5745MHz ~ 5825MHz IEEE 802.11an HT40 : 5755MHz ~ 5795MHz
Transmit Power	UNII Band 1: IEEE 802.11a Mode: 18.24 dBm (0.0677 W) IEEE 802.11an HT20 NSS1/MCS0 Mode: 21.23 dBm (0.1327 W) IEEE 802.11an HT40 NSS1/MCS0 Mode: 17.39 dBm (0.0548 W) UNII Band 2A: IEEE 802.11a Mode: 18.15 dBm (0.0653W) IEEE 802.11an HT20 NSS1/MCS0 Mode: 21.25 dBm (0.1334 W) IEEE 802.11an HT40 NSS1/MCS0 Mode: 17.65 dBm (0.0582 W) UNII Band 3: IEEE 802.11a Mode: 15.78 dBm (0.0378 W) IEEE 802.11an HT20 NSS1/MCS0 Mode: 17.30 dBm (0.0537 W) IEEE 802.11an HT40 NSS1/MCS0 Mode: 17.03 dBm (0.0505 W)
Channel Spacing	IEEE 802.11a, 802.11an HT20 Mode: 20MHz IEEE 802.11an HT40 Mode: 40MHz

Channel Number	IEEE 802.11a, 802.11an HT20 Mode: 5150MHz ~ 5250MHz: 4 Channels 5250MHz ~ 5350MHz: 4 Channels 5725MHz ~ 5850MHz: 5 Channels IEEE 802.11an HT40 Mode: 5150MHz ~ 5250MHz: 2 Channels 5250MHz ~ 5350MHz: 2 Channels 5725MHz ~ 5850MHz: 2 Channels
Transmit Data Rate	IEEE 802.11a Mode: up to 54 Mbps IEEE 802.11an HT20 Mode (800ns GI): up to 130.00 Mbps IEEE 802.11an HT20 Mode (400ns GI): up to 144.40 Mbps IEEE 802.11an HT40 Mode (800ns GI): up to 270.00 Mbps IEEE 802.11an HT40 Mode (400ns GI): up to 300.00 Mbps
Type of Modulation	IEEE 802.11a Mode: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11an VHT20/40 Mode: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)
Antenna Type	PIFA Antenna × 2 Ant. 0/Main (Chain 0), Antenna Gain: 3.02 dBi Ant. 1/Aux (Chain 1), Antenna Gain: 3.47 dBi
Power Rating	11.1Vdc, 5200mAh/58Wh (For Battery) 19Vdc (For Charging)
Test Voltage	120Vac, 60Hz
Test Firmware Version	1.0.2
I/O Port	EUT : RJ-45 Port × 1, USB Port × 2, Power Port × 1, SD Card Port × 1, Audio Port × 1, RS232 Port × 1, Single Port × 5, Control Port × 1(For Docking) Docking : USB Port × 4, HDMI Port × 1, Power Port × 1, VGA Port × 1, Control Port × 1

The difference of the series model

Model Number	Difference
EEMS330xxxxxxx	1. For marketing purpose only. 2. where "x" or "y" may be any alphanumeric character or blank and where "y" is a country code
EEMSyy330xxxxxxx	

Remark:

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. For more details, please refer to the User's manual of the EUT.
3. This submittal(s) (test report) is intended for FCC ID: STO-EEMS330E filing to comply with Section 15.207, 15.209 and 15.407 of the FCC Part 15, Subpart E Rules.
4. The model EEMS330 was considered the main model for testing.
5. This report is modified from T150428L12-RP1-3.

3. DESCRIPTION OF TEST MODES

The EUT (Display Unit) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed.

IEEE 802.11an HT20 Mode

The EUT had been tested under operating condition.

There are three channels have been tested as following:

Channel	Frequency (MHz)
60	5300

IEEE 802.11an HT20 NSS1/MCS0 Mode: 6.5Mbps data rate (worst case) was chosen for full testing.

IEEE 802.11an HT40 Mode

The EUT had been tested under operating condition.

There are three channels have been tested as following:

Channel	Frequency (MHz)
62	5310

IEEE 802.11an HT40 NSS1/MCS0 Mode: 13.5Mbps data rate was chosen for full testing.

4. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 905462 D02v02 and the DFS portions of FCC CFR 47 Part 15.

5. FACILITIES AND ACCREDITATION

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

No.989-1, Wenshan Rd., Shangshan Village,
Qionglin Township, Hsinchu County 30741, Taiwan (R.O.C.)

The sites are constructed in conformance with the requirements of ANSI C63.10:2013 and CISPR 22. All receiving equipment conforms to CISPR 16-1-1, CISPR 16-1-2, CISPR 16-1-3, CISPR 16-1-4, CISPR 16-1-5.

5.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Taiwan	TAF
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The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	INDUSTRY CANADA
Japan	VCCI
Taiwan	BSMI
USA	FCC MRA

Copies of granted accreditation certificates are available for downloading from our web site, <http://www.ccsrf.com>

Remark: FCC Designation Number TW1027.

5.3 MEASUREMENT UNCERTAINTY

The interpretation of the results for the measurements described in the present document shall be as follows:

- (1) The measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document.
- (2) The measurement uncertainty value for the measurement of each parameter shall be recorded.
- (3) The recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures under the table.

PARAMETER	UNCERTAINTY
RF frequency	$\pm 1 \times 10^{-5}$
RF power conducted	$\pm 1,5$ dB
RF power radiated	± 6 dB
Spurious emissions, conducted	± 3 dB
Spurious emissions, radiated	± 6 dB
Humidity	± 5 %
Temperature	$\pm 1^{\circ}\text{C}$
Time	± 10 %

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and shall correspond to an expansion factor (coverage factor) $k = 1.96$ or $k = 2$ (which provide confidence levels of respectively 95 % and 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

No.	Product	Manufacturer	Model No.	Serial No.
1	Notebook PC	DELL	PP19L	CN-0MG532-70166-7 1G-03EC
2	Notebook PC	TOSHIBA	M840	9C104267C
3	Wireless AC1750 Dual Band Gigabit Cloud Router	D-Link	DIR-868L	R3WE1E1001943

No.	Product	Manufacturer	Model No.	Power Input	Power Output
1	Power Adapter	FSP GROUP INC.	FSP065-REBN2	100-240Vac, 1.5A, 50-60Hz	19Vdc, 3.42A

SETUP DIAGRAM FOR TESTS

EUT & peripherals setup diagram is shown in appendix setup photos.

EUT OPERATING CONDITION

1. EUT & peripherals setup diagram is shown in appendix setup photos.
2. Enter the web configuration:
 - ⇒ **TX Data Rate:**
 - 6.5Mbps Bandwidth 20 (IEEE 802.11an HT20 NSS1/MCS0 Mode)
 - 13.5Mbps Bandwidth 80 (IEEE 802.11an HT40 NSS1/MCS0 Mode)
 - ⇒ **Select channel:**
 - IEEE 802.11an HT20 Mode Channel (5300 MHz)
 - IEEE 802.11an HT40 Mode Channel (5310 MHz)
3. All of the functions are under run.
4. Start testing

7. DYNAMIC FREQUENCY SELECTION (DFS)

Interference Threshold values, Master or Client incorporating In-Service

Maximum Transmit Power	Value (see note 1, 2, 3)
EIRP $\geq$ 200 mW	-64 dBm
EIRP < 200 mW and Power Spectral Density < 10 dBm/MHz	-62 dBm
EIRP < 200 mW that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

DFS Response requirement values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1μsec, excluding PRI values selected in Test A	Roundup $\left\{ \left(\frac{1}{360} \right) \times \left(\frac{19 \times 10^6}{PRI_{\mu sec}} \right) \right\} \left\{ \left(\frac{1}{360} \right) \times \left(\frac{19 \times 10^6}{PRI_{\mu sec}} \right) \right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing tests.					

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Test A & B.

Table 5a – Pulse Repetition Intervals Values for Test A

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (μsec)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Long Pulse Radar Test Waveform

Radar Waveform	Pulse Width (μsec)	Chirp Width (μsec)	PRI (μsec)	Pulses per Burst	Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Frequency Hopping Radar Test Signal

Radar Waveform	Pulse Width (μsec)	PRI (μsec)	Pulses Per Hop	Hopping Rate (kHz)	Burst Length (ms)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	0.33	300	70%	30

Applicability of DFS Requirements Prior to Use of a Channel

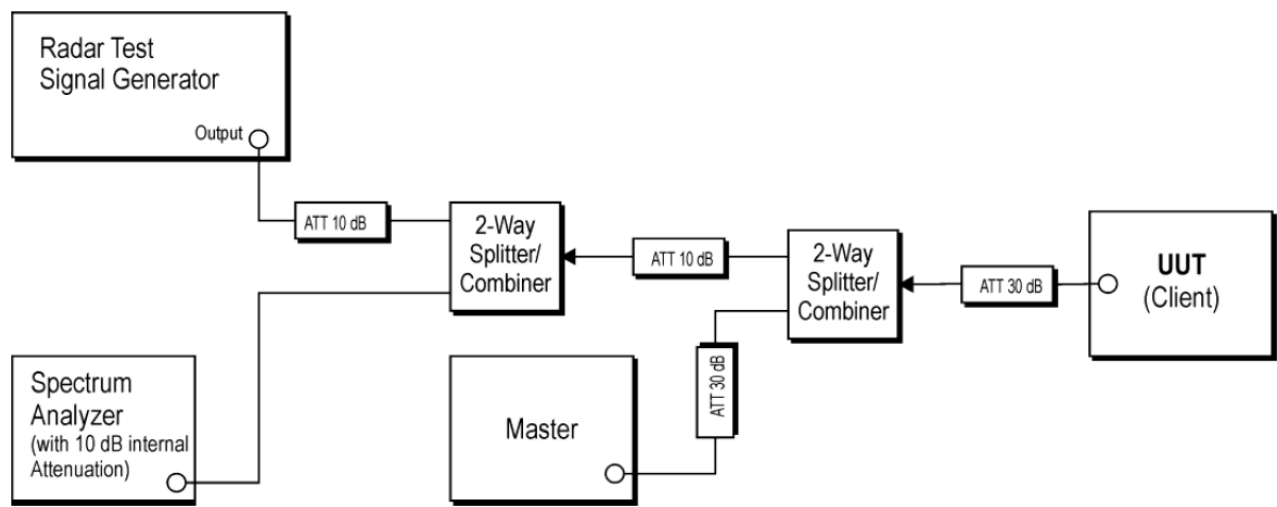
Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
Non-Occupancy Period	Yes	Not Required	Yes
DFS Detection Threshold	Yes	Not Required	Yes
Channel Availability Check Time	Yes	Not Required	Not Required
U-NII Detection Bandwidth	Yes	Not Required	Yes

Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Client Without Radar Detection	Client With Radar Detection
DFS Detection Threshold	Yes	Not Required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not Required

Additional Requirements for Devices with Multiple Bandwidth Modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not Required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not Required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

CONDUCTED METHOD SYSTEM BLOCK DIAGRAM



DESCRIPTION OF EUT

Overview Of EUT With Requirements

The firmware installed in the EUT during testing was:

Firmware Rev: 1.0.2

The EUT operates over the 5250-5350 MHz ranges.

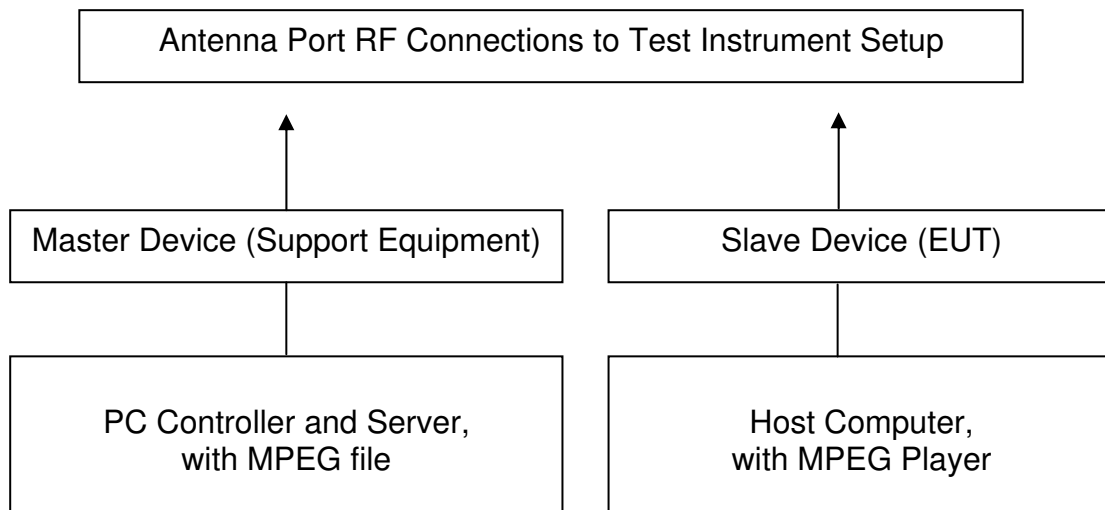
The EUT is a Client without radar detection.

Two antennas are utilized to meet the system operational requirements.

TEST CHANNELS AND METHOD

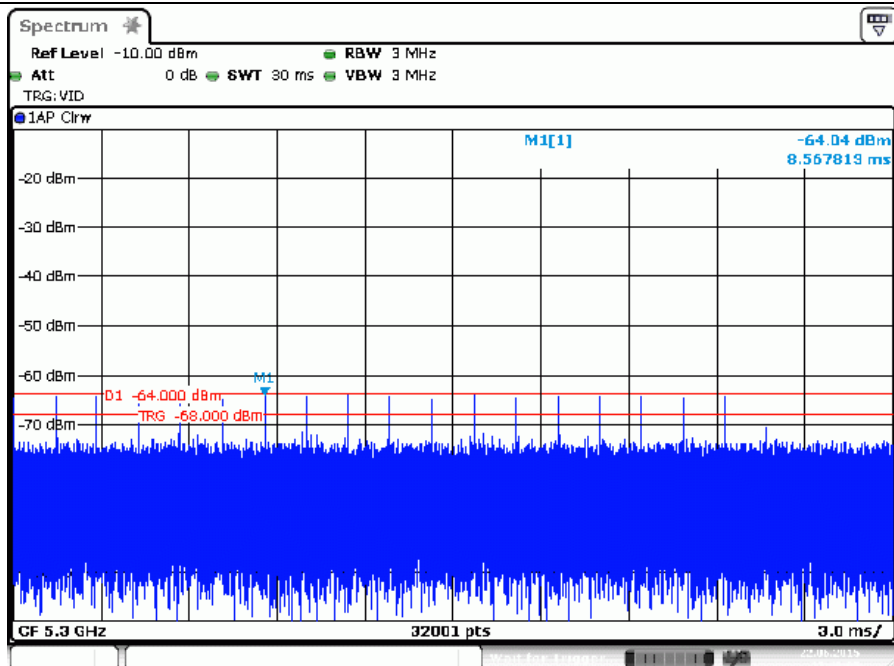
All tests were performed at a channel center frequency of 5300 MHz / 5310 MHz.
Measurements were performed using conducted test methods.

TEST SETUP



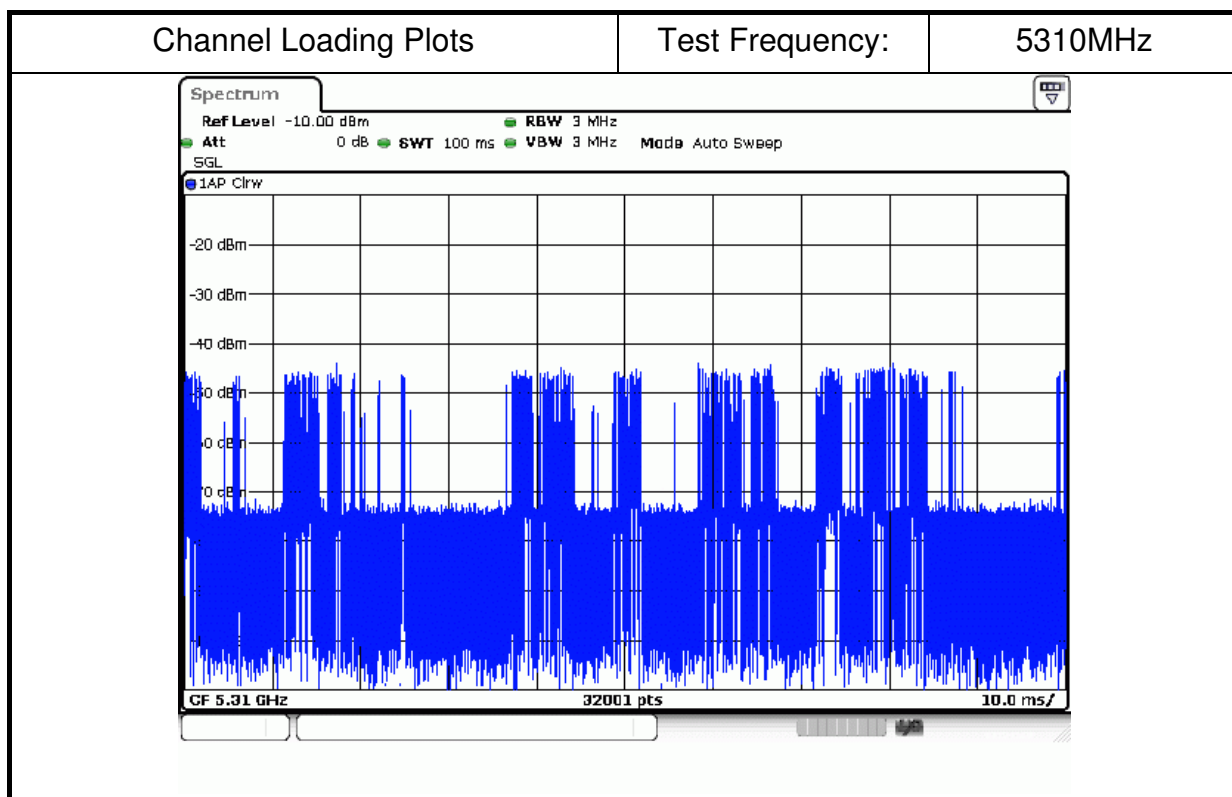
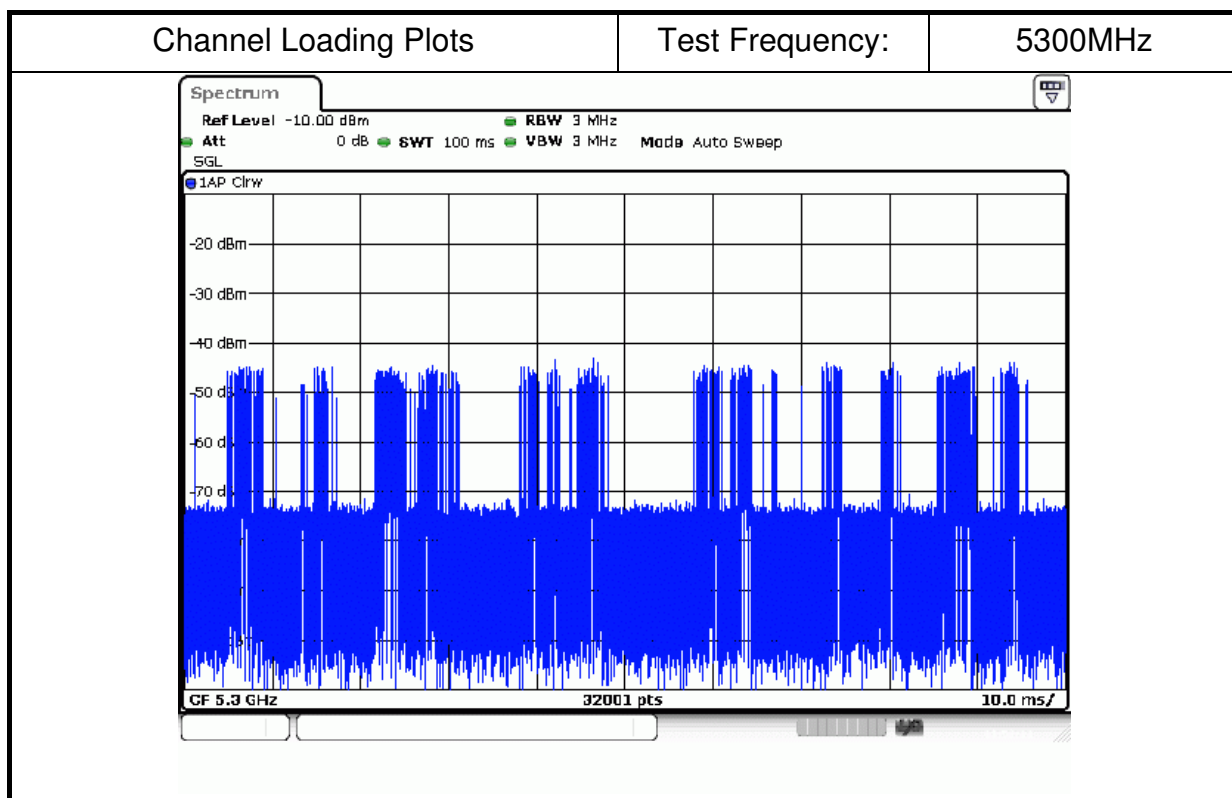
Radar Waveform calibration Plot

Radar test signal type 1 / 5300 MHz

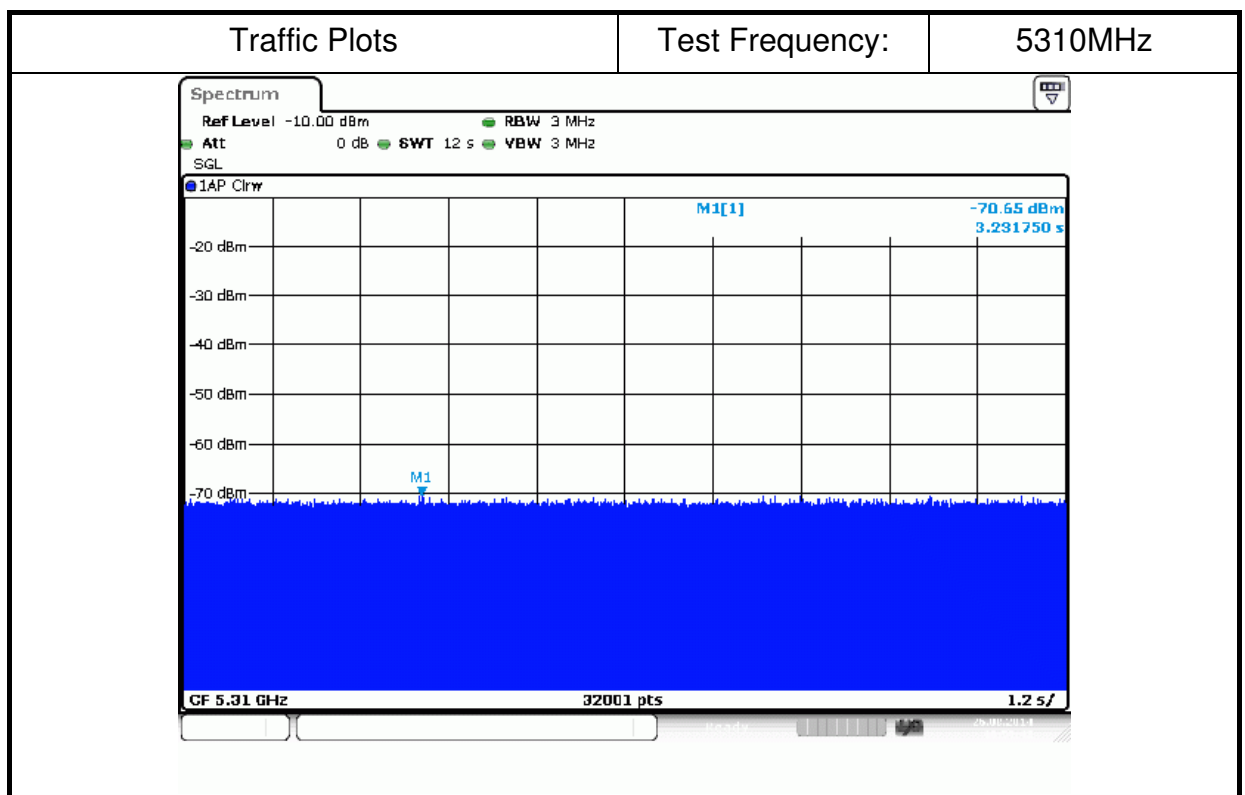
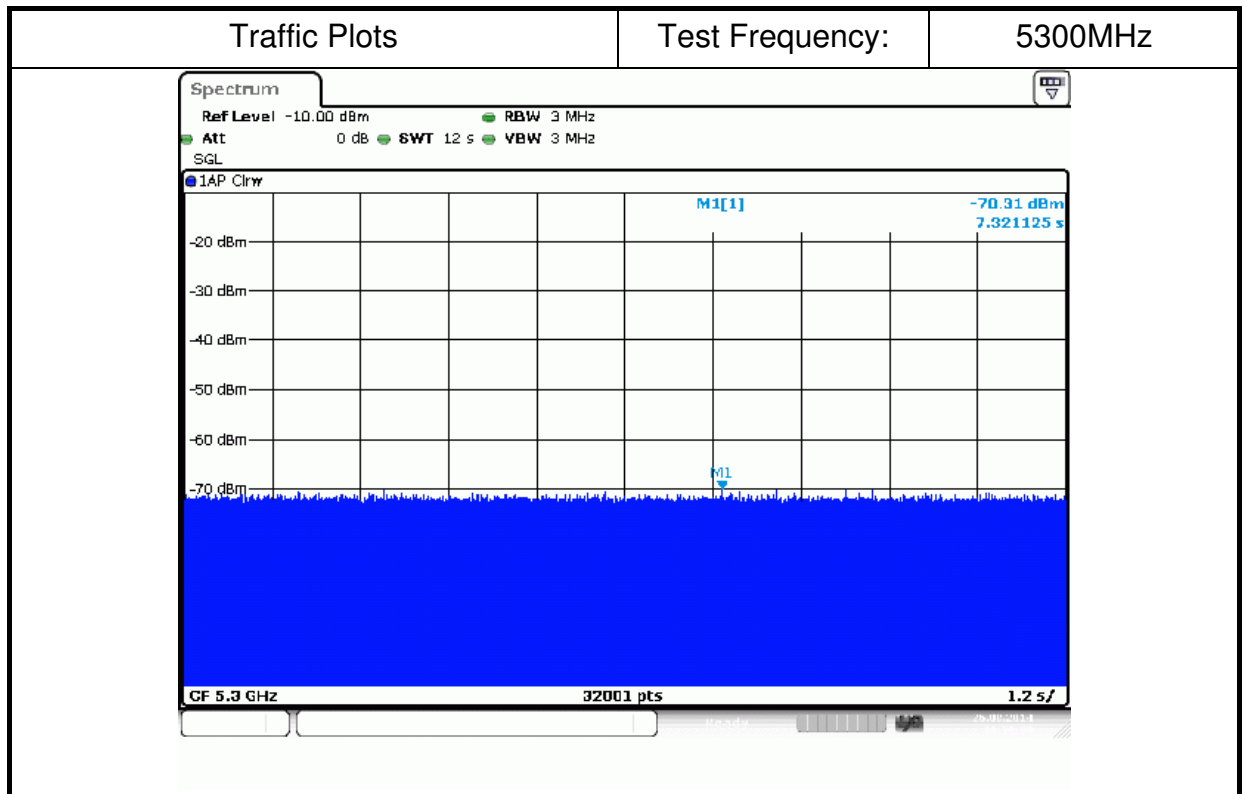


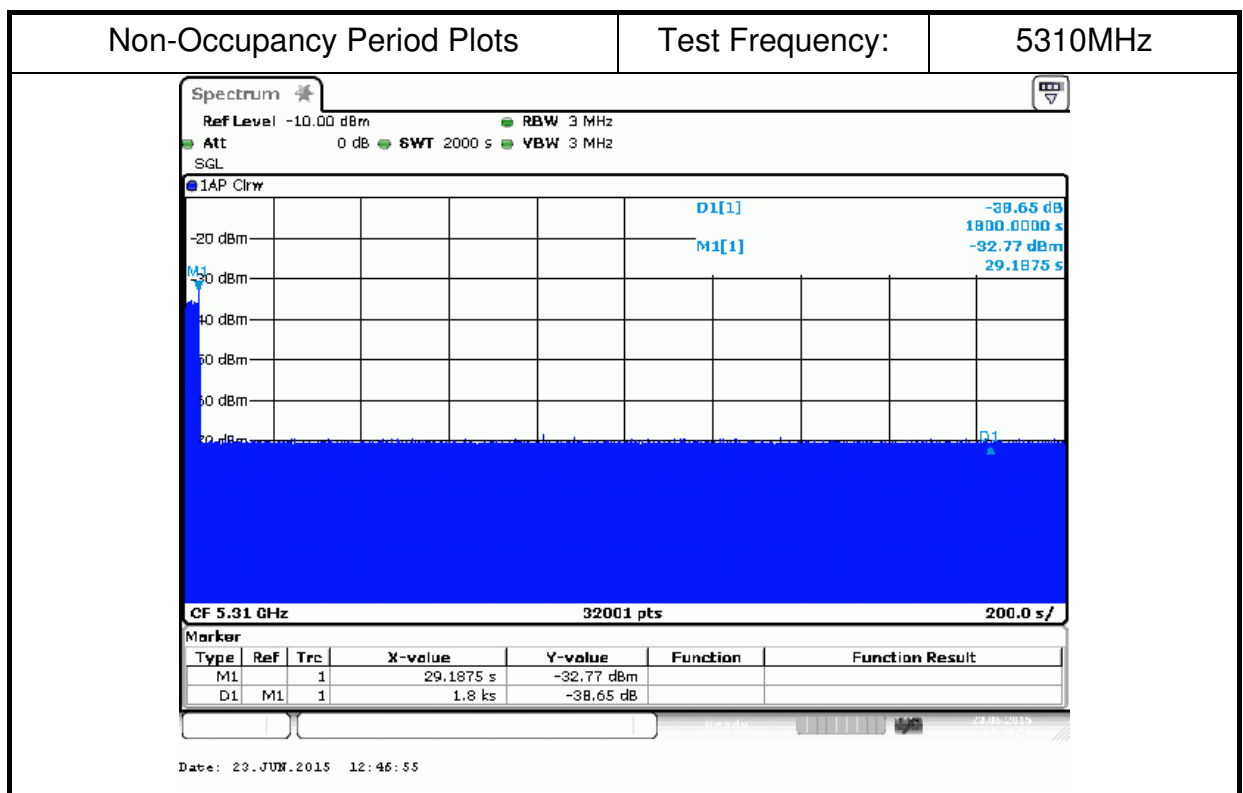
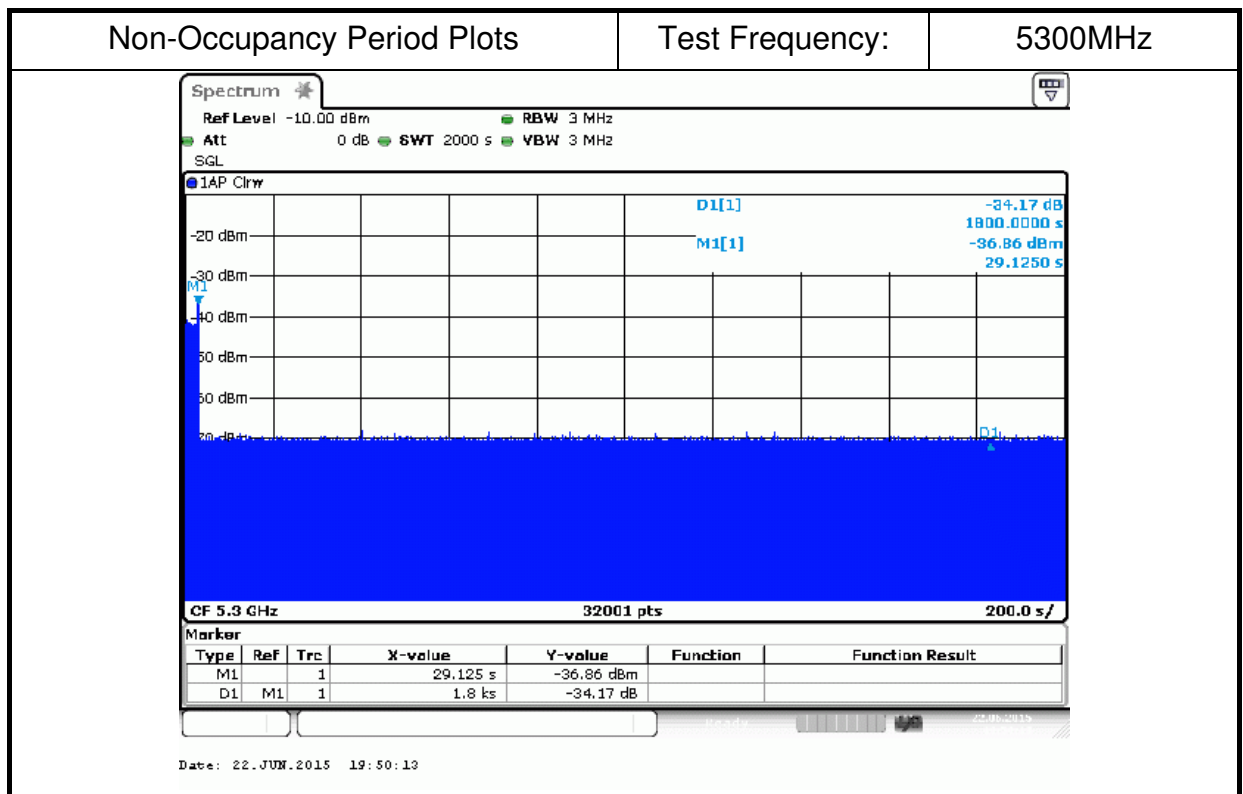
Date: 22.JUN.2015 17:46:06

Test Result of Channel Loading Plots

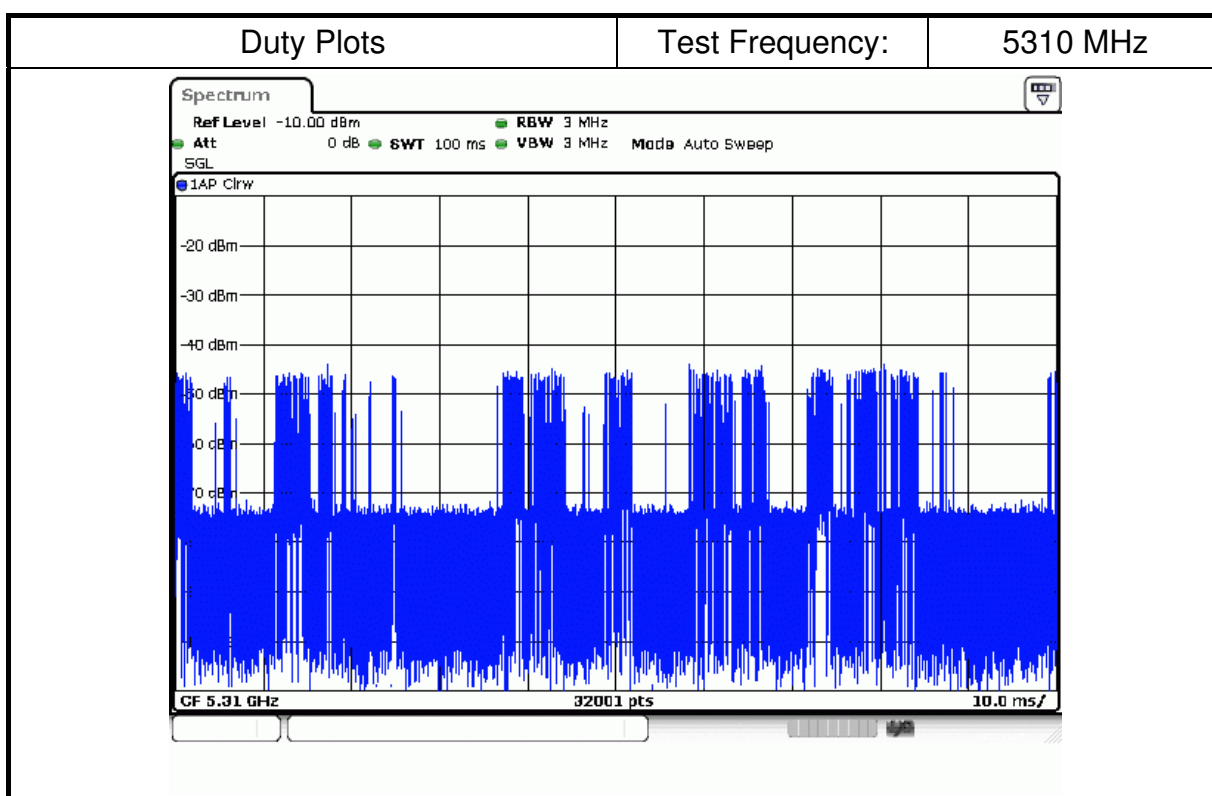
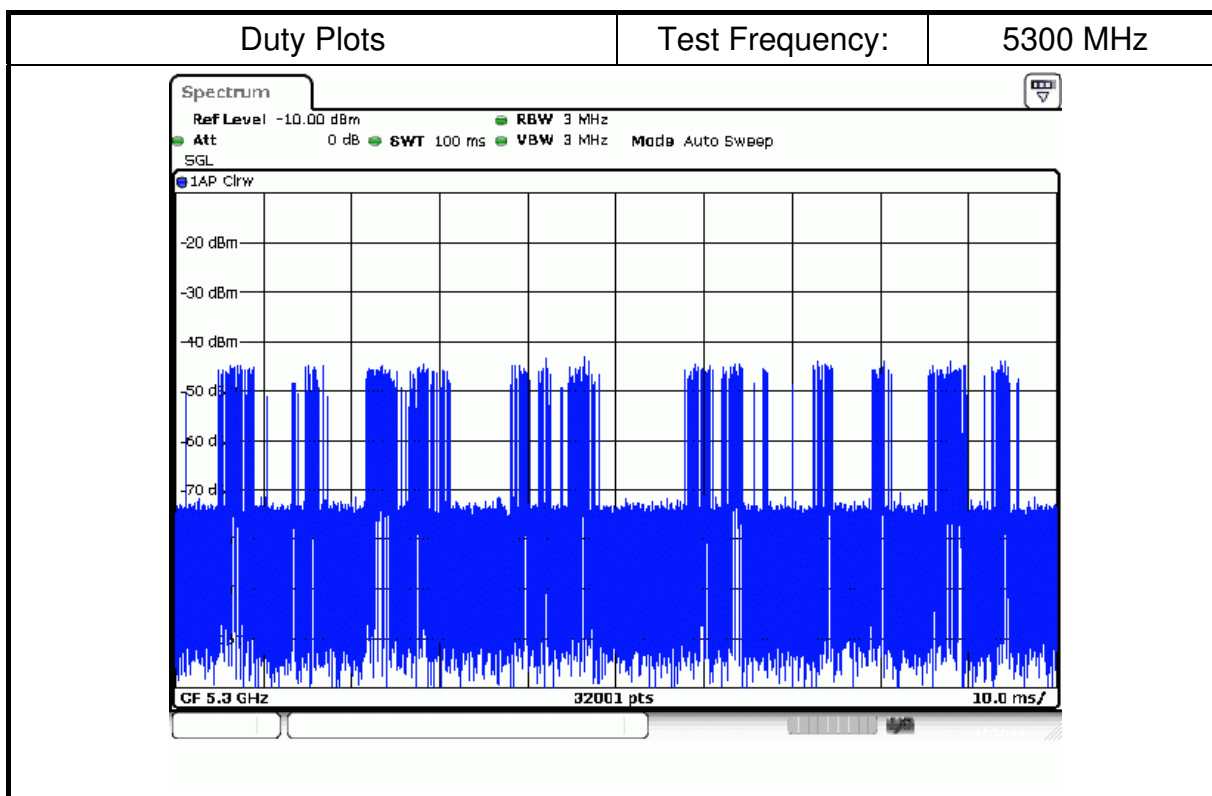


Data Traffic Plots (Noise Plots)

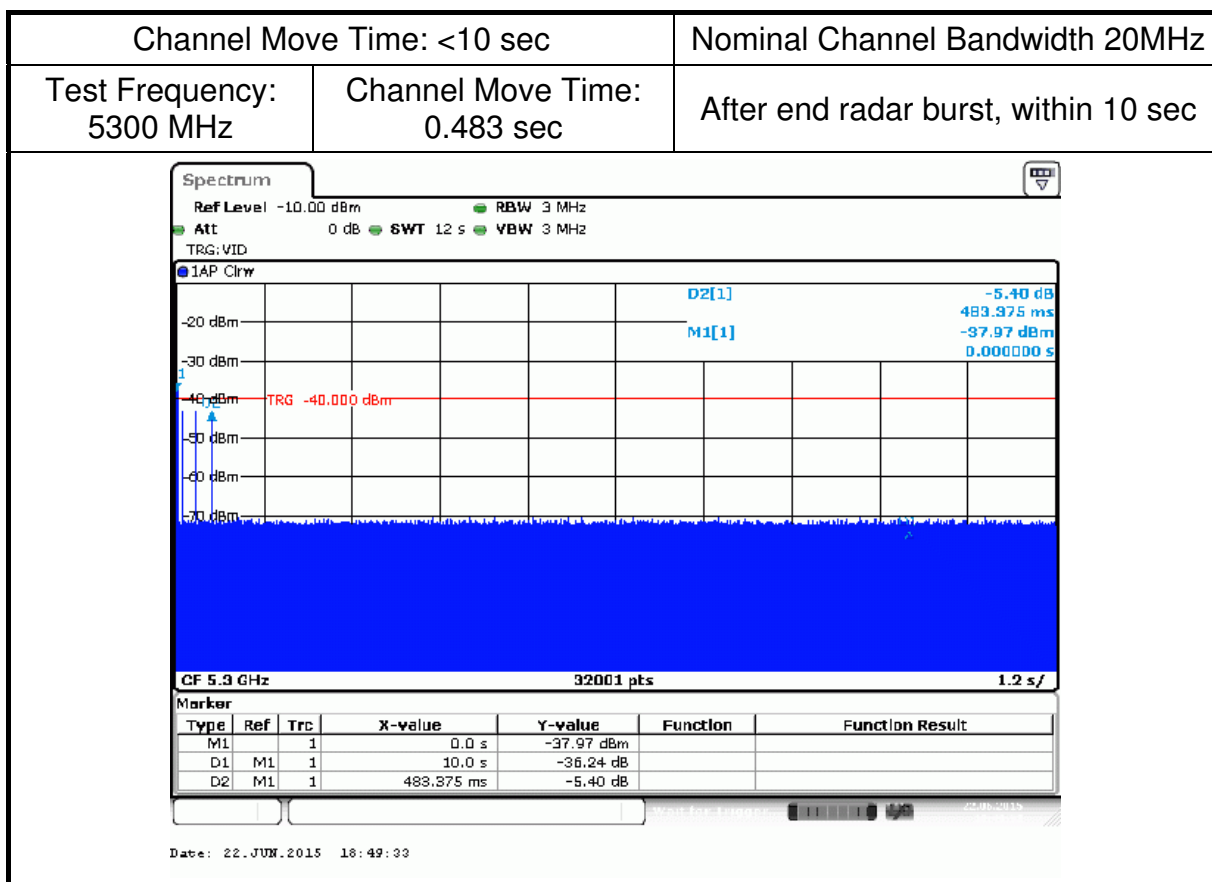


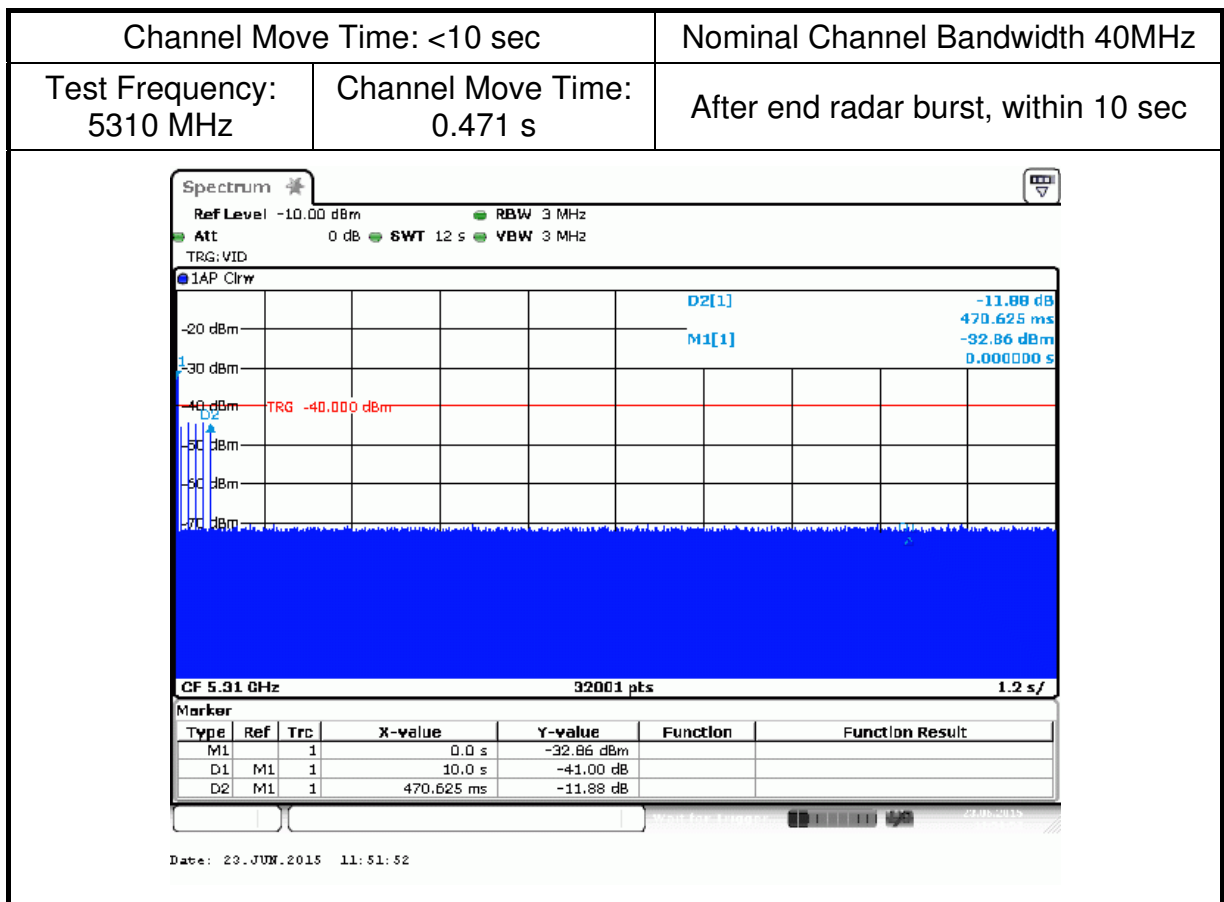
Test Result of Non-Occupancy Period Plots

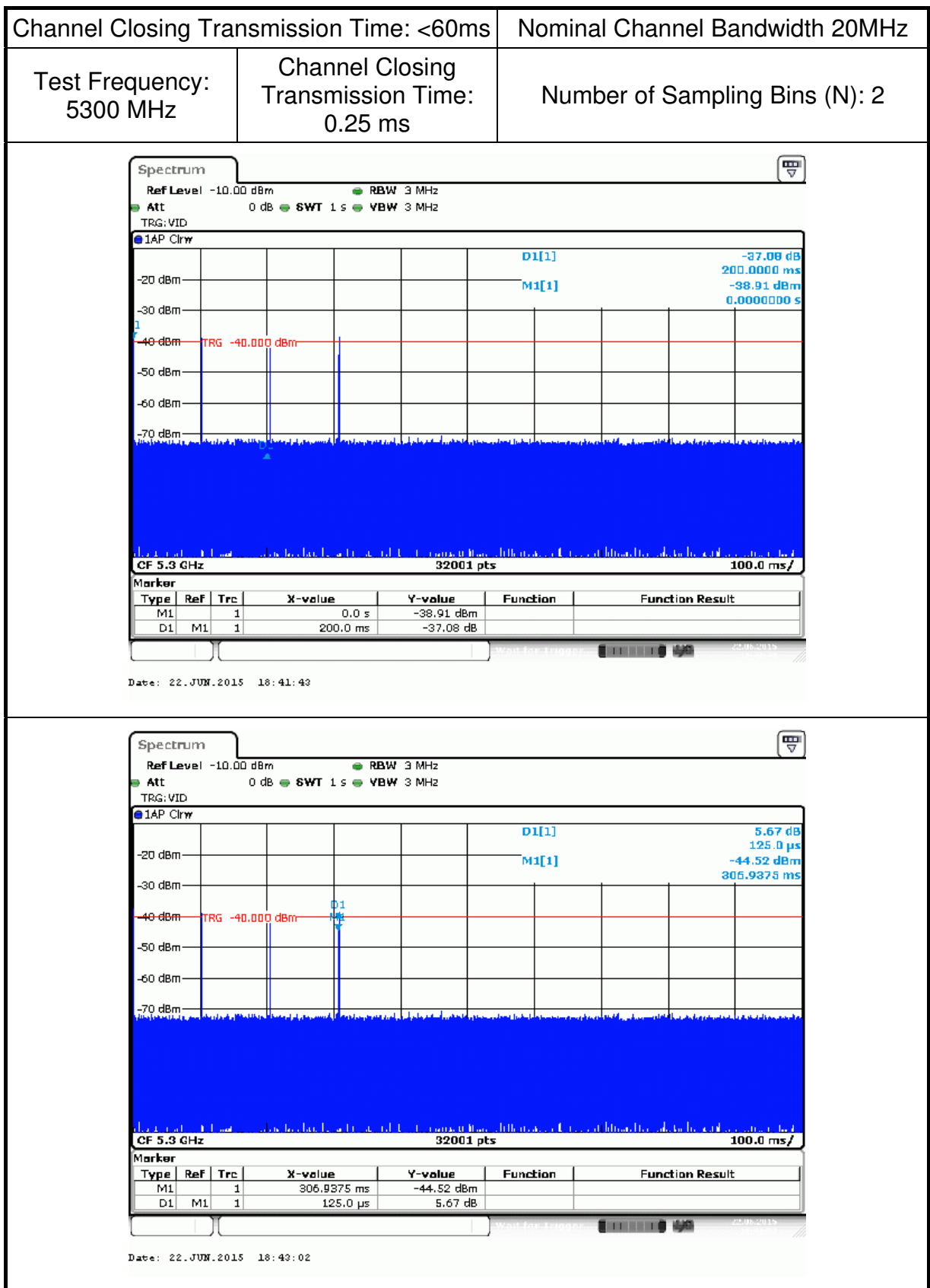
Test Result of Duty Plots



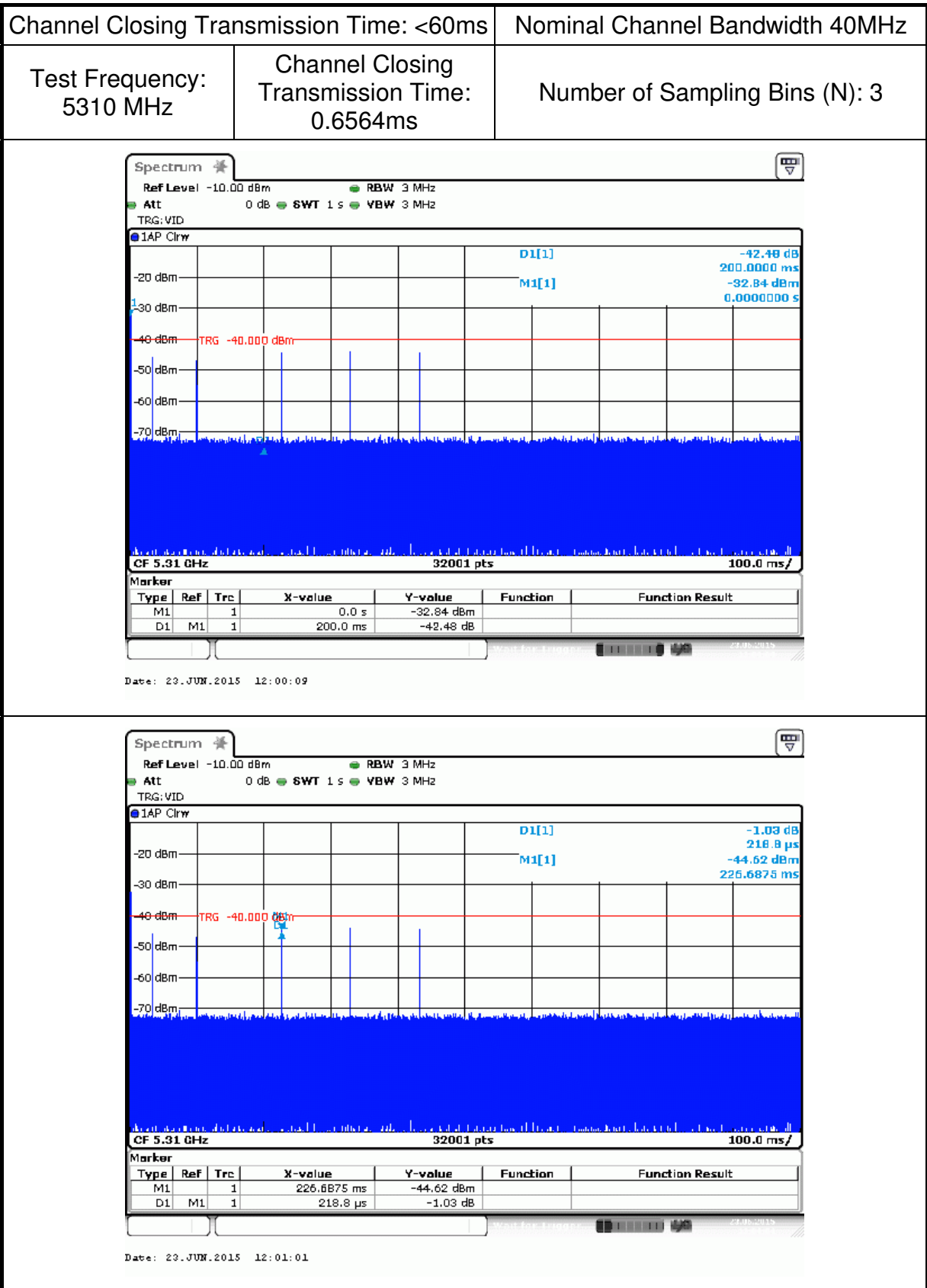
Test Result of Channel Shutdown Time Plots







Note: $5300 \text{ MHz} = \text{Dwell} \times N = 125 \text{ us} \times 1 = 0.25 \text{ ms}$



Note: 5310 MHz = Dwell × N = 218.8us × 3 = 0.6564ms