

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 |
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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 x 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 x 1, USB Port x 2, Power Port x 1, SD Card Port x 1, Audio Port x 1, RS232 Port x 1, Single Port x 5, Control Port x 1(For Docking) Docking : USB Port x 4, HDMI Port x 1, Power Port x 1, VGA Port x 1, Control Port x 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 |
|---------------|-----|

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 |
| <p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p>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.</p> <p>Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p> | |

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. |
| <p>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.</p> <p>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.</p> <p>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.</p> | |

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 1 μsec, 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

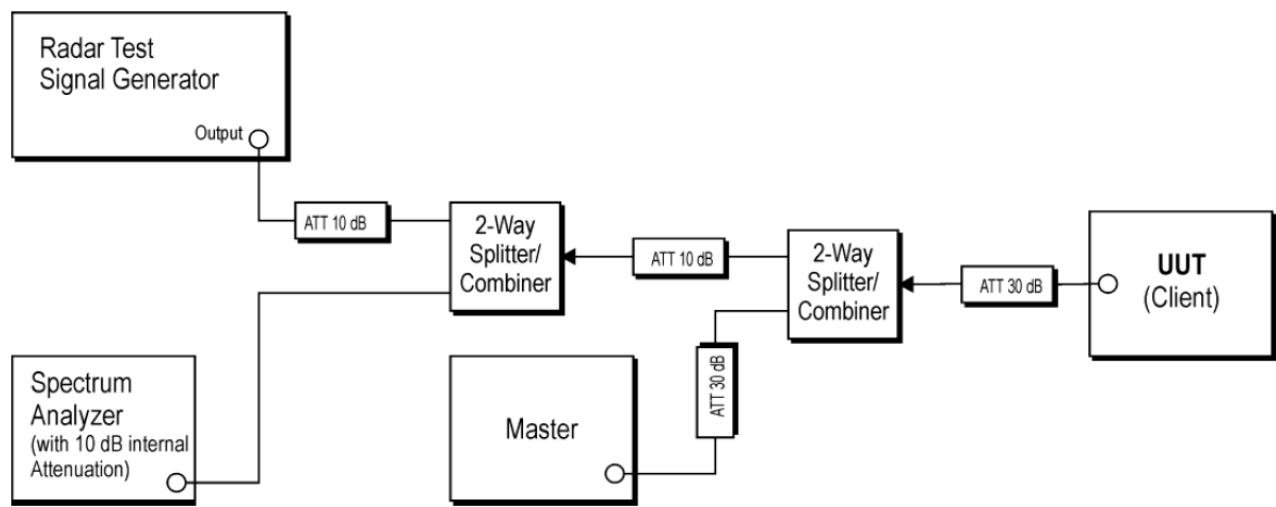
| Requirement | Operational Mode | | |
|---------------------------------|------------------|--------------------------------|-----------------------------|
| | Master | Client Without Radar Detection | Client With Radar Detection |
| Non-Occupancy Period | Yes | Not Required | Yes |
| DFS Detection 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.

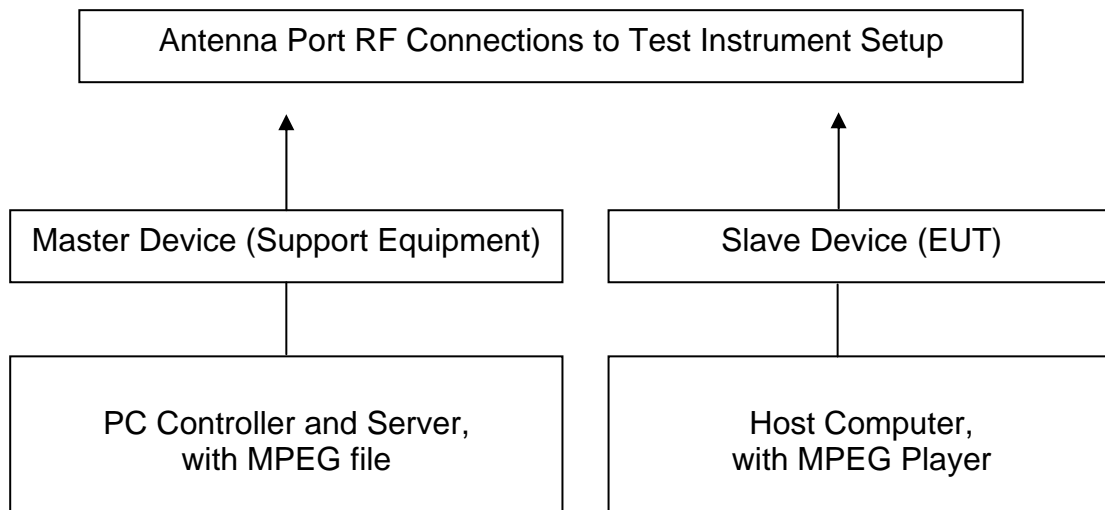
The EUT is a Client without radar detection.

Two antennas are utilized to meet the system operational requirements.

TEST CHANNELS AND METHOD

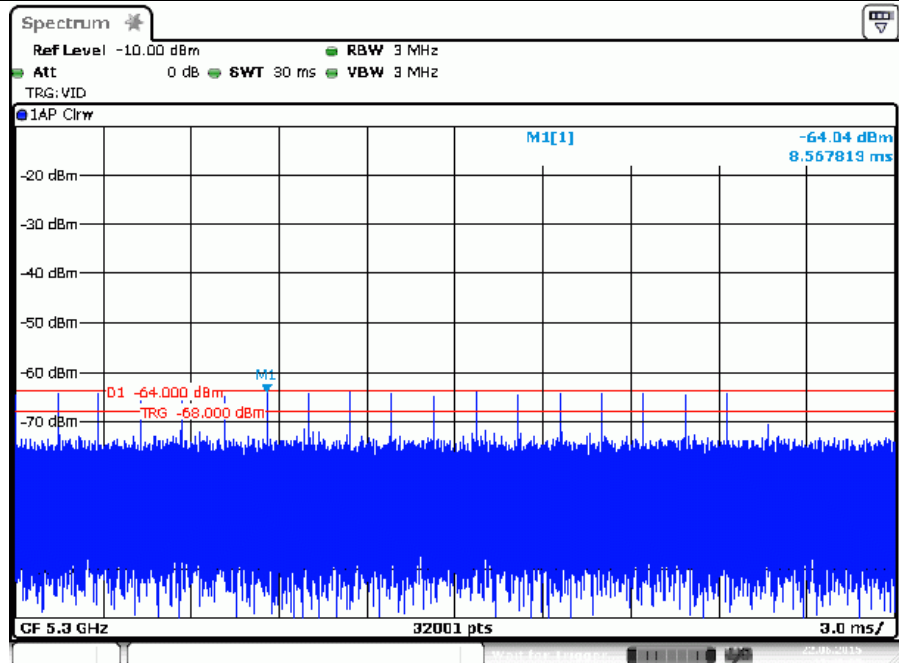
All tests were performed at a channel center frequency of 5300 MHz / 5310 MHz.
Measurements were performed using conducted test methods.

TEST SETUP



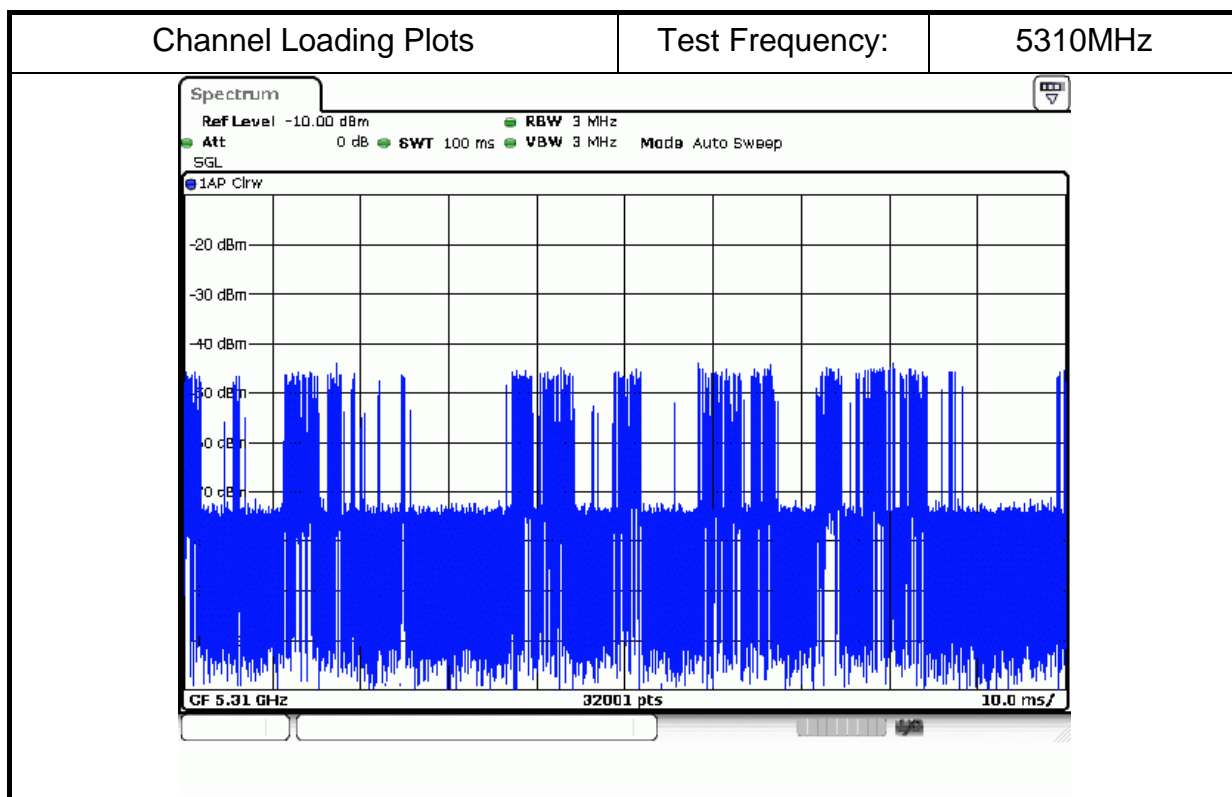
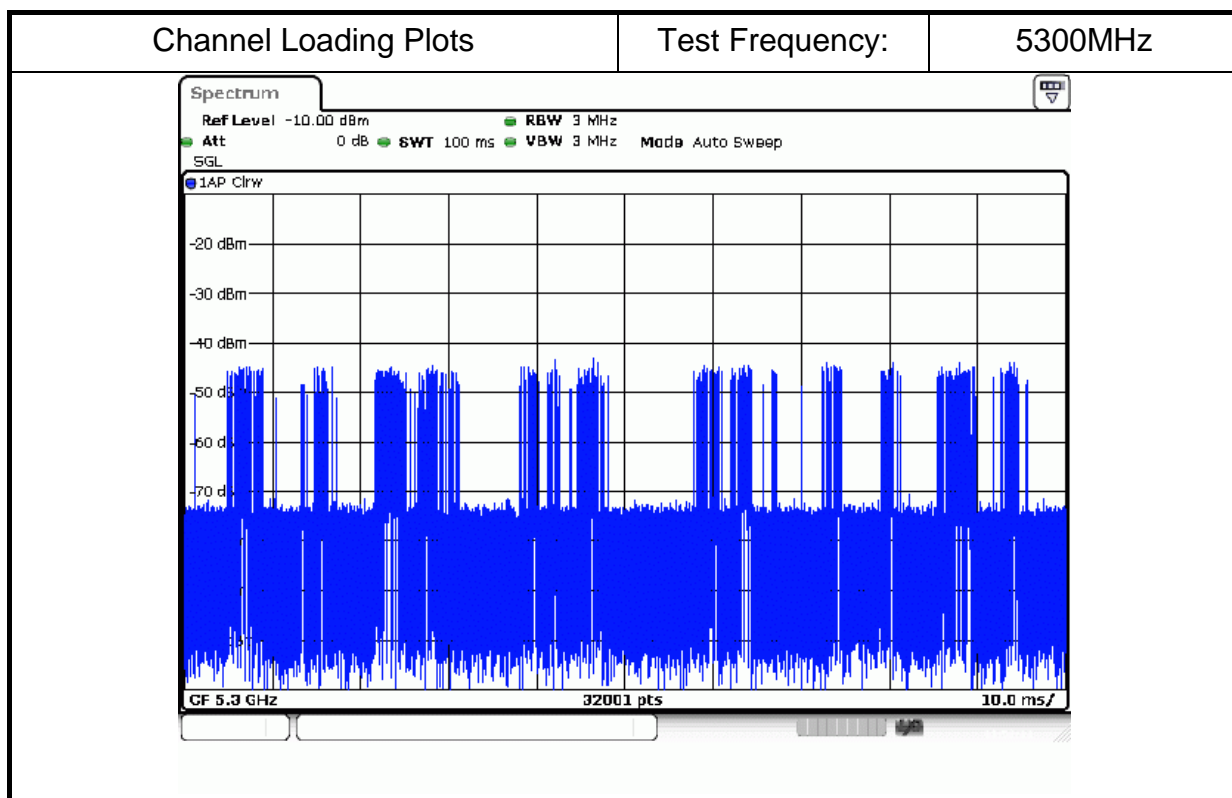
Radar Waveform calibration Plot

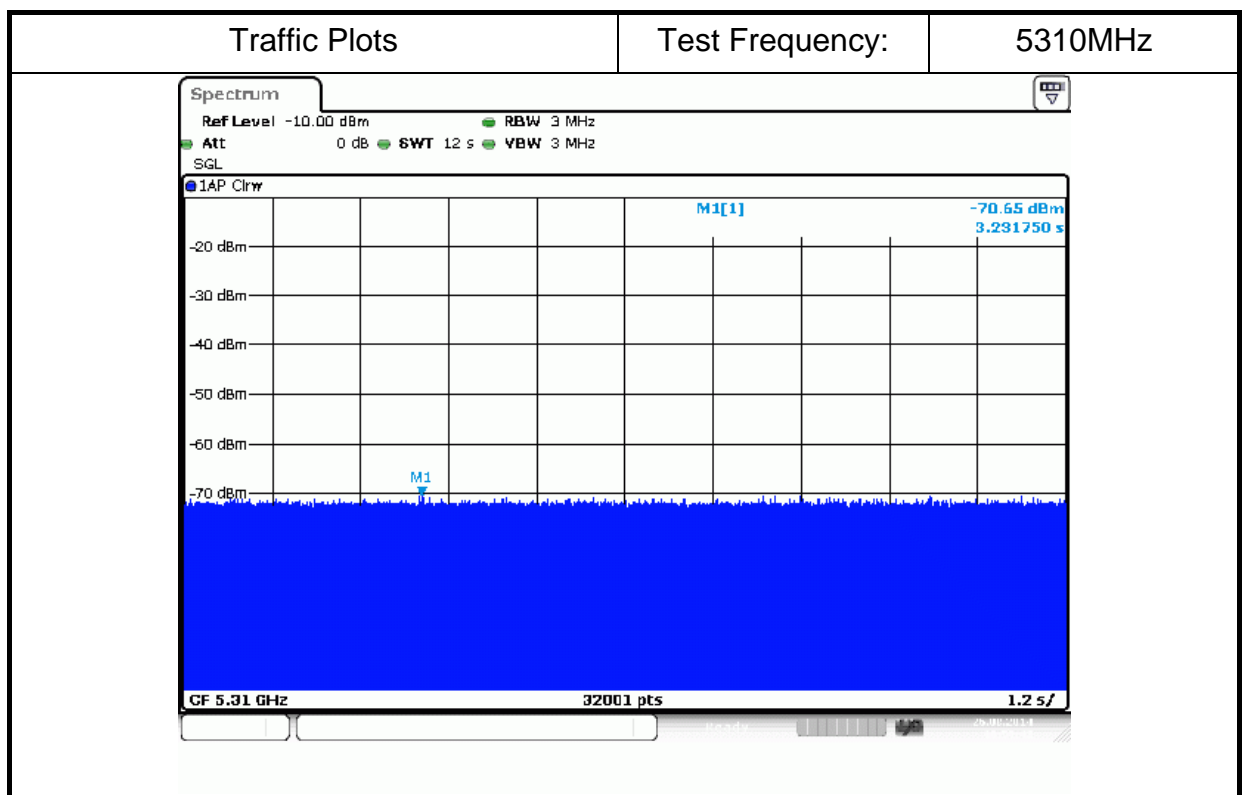
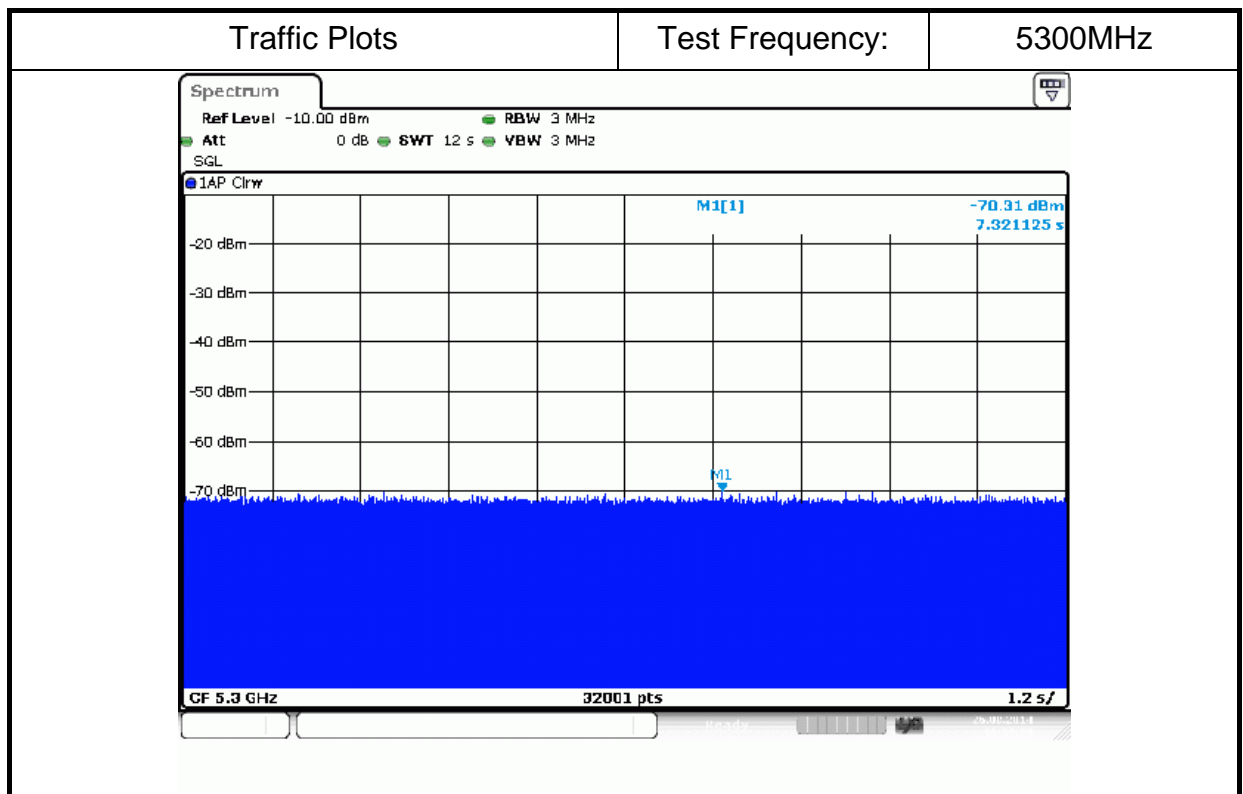
Radar test signal type 1 / 5300 MHz

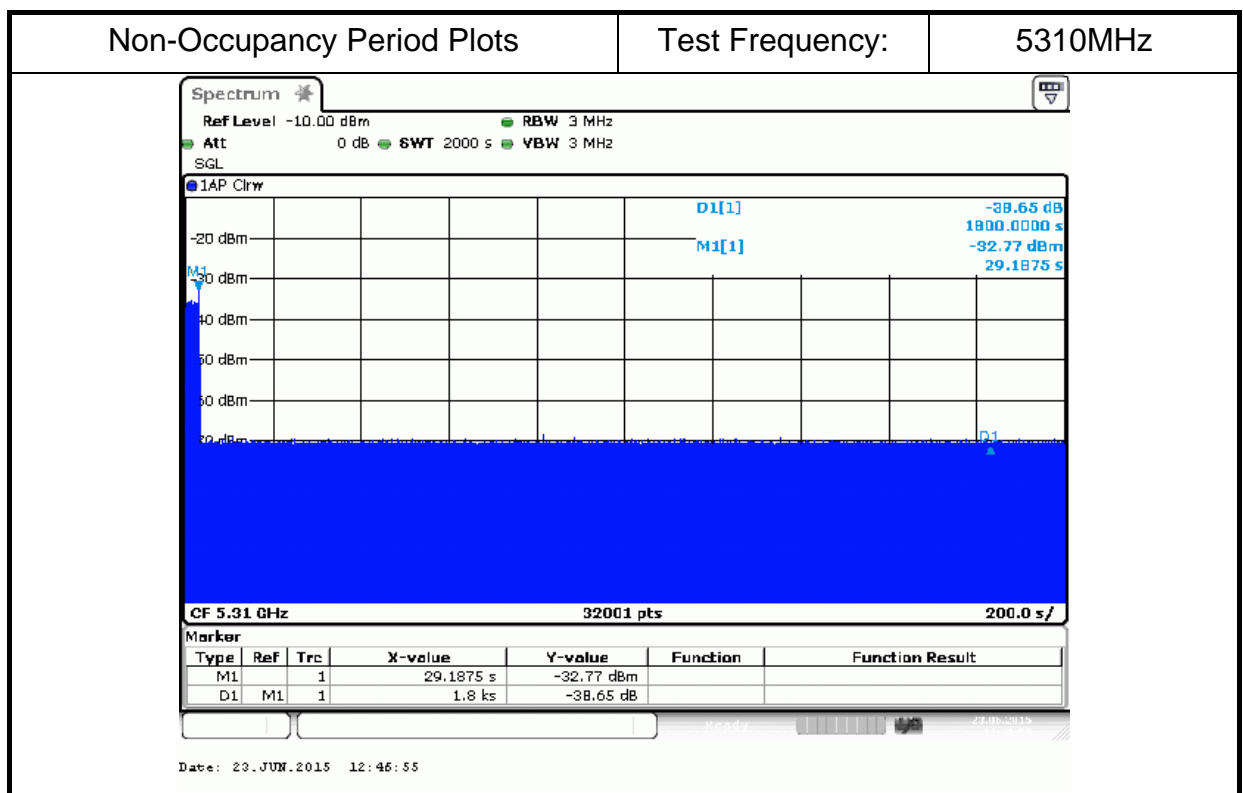
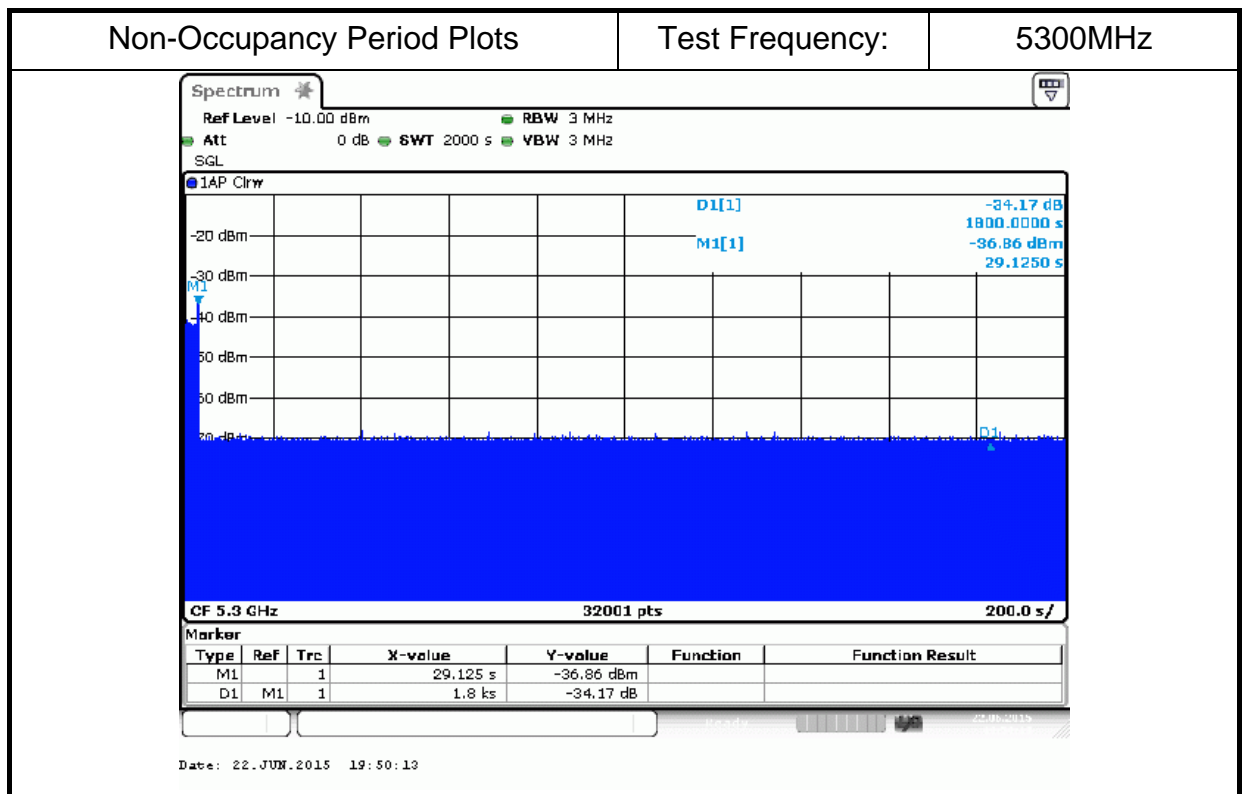


Date: 22.JUN.2015 17:46:06

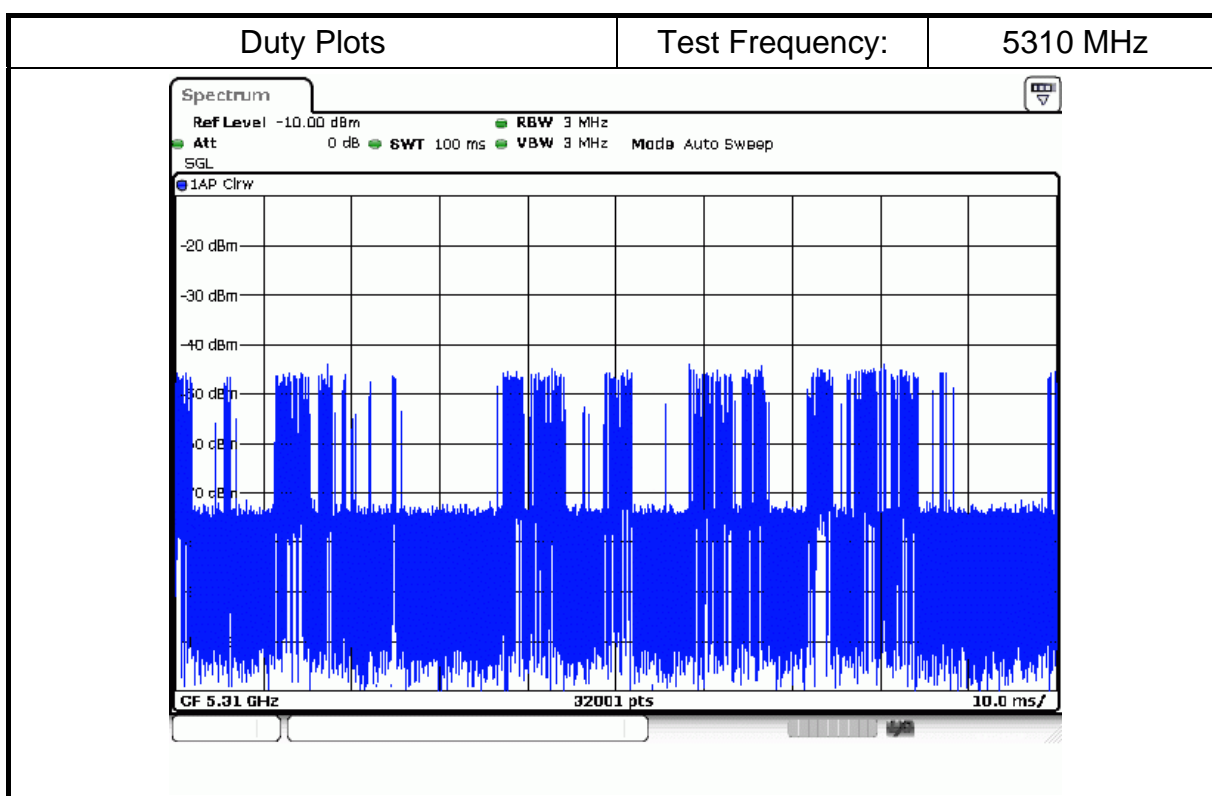
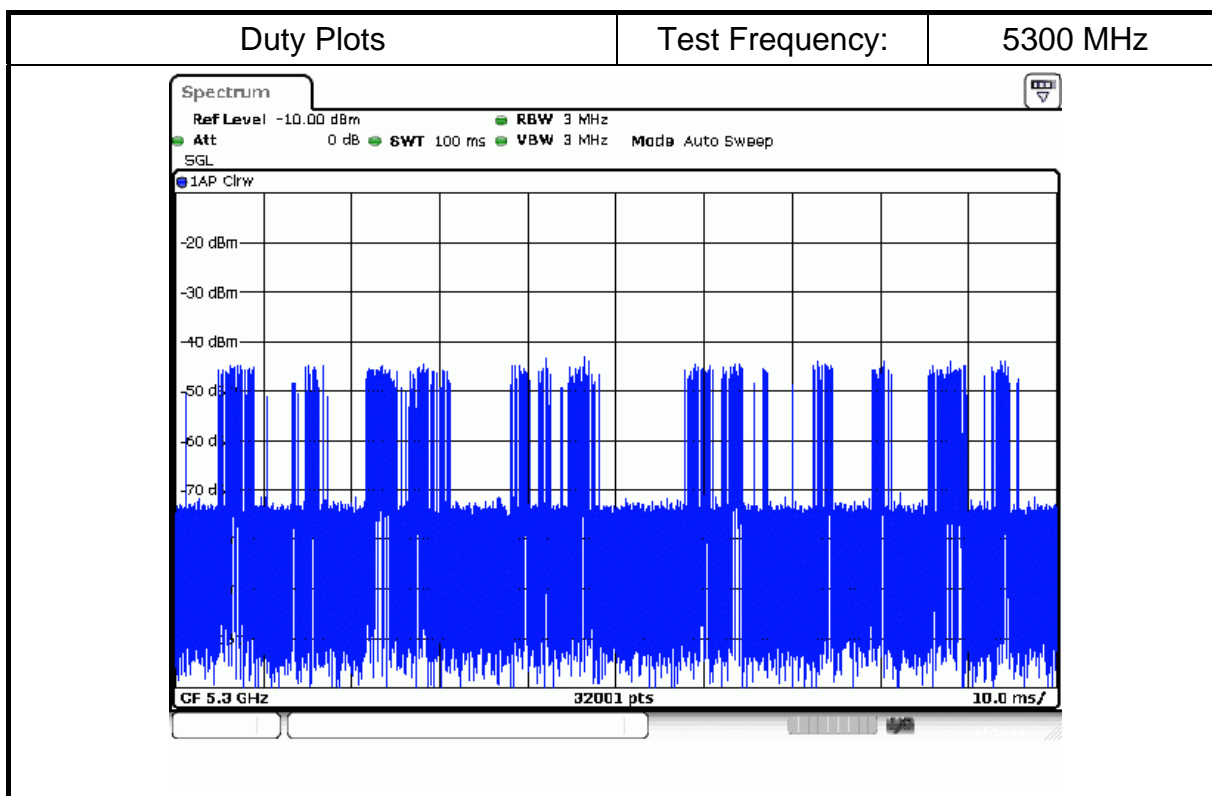
Test Result of Channel Loading Plots



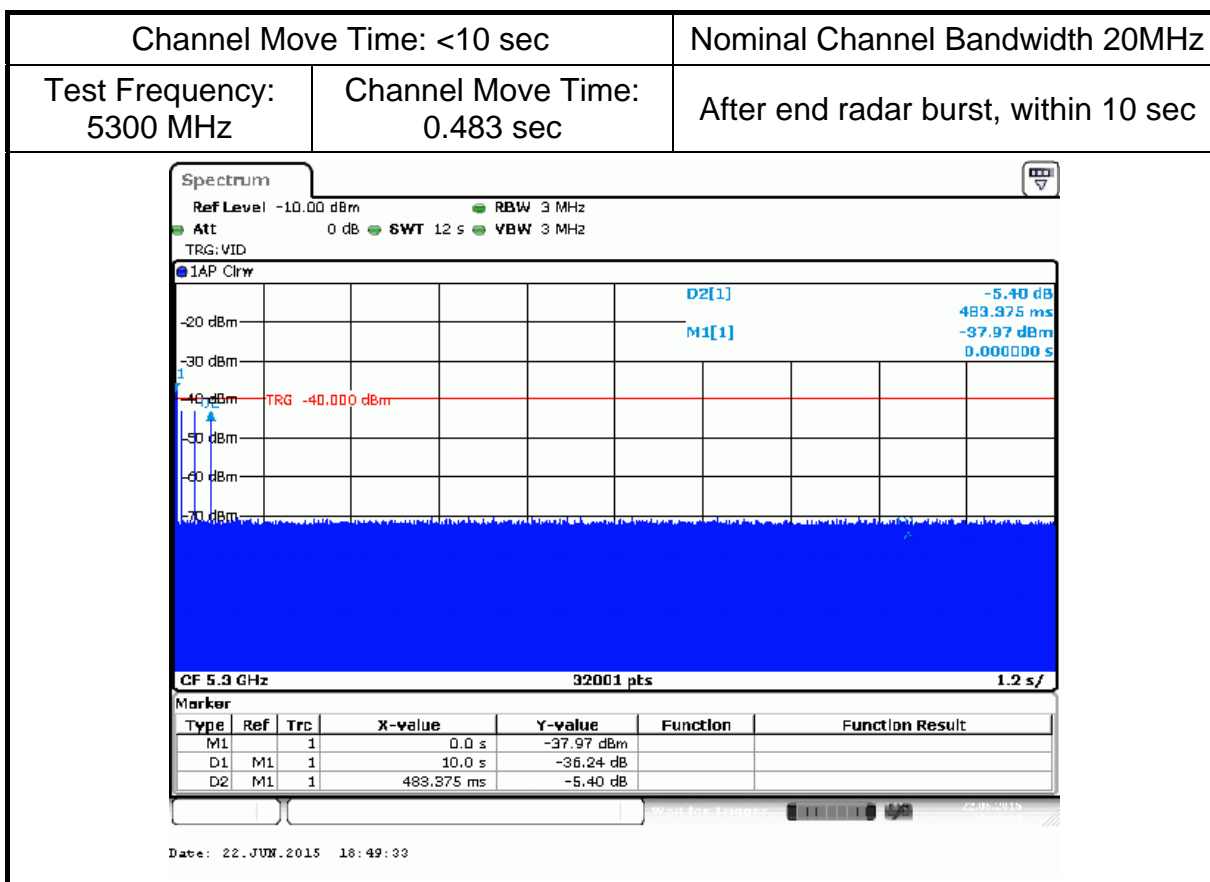
Data Traffic Plots (Noise Plots)

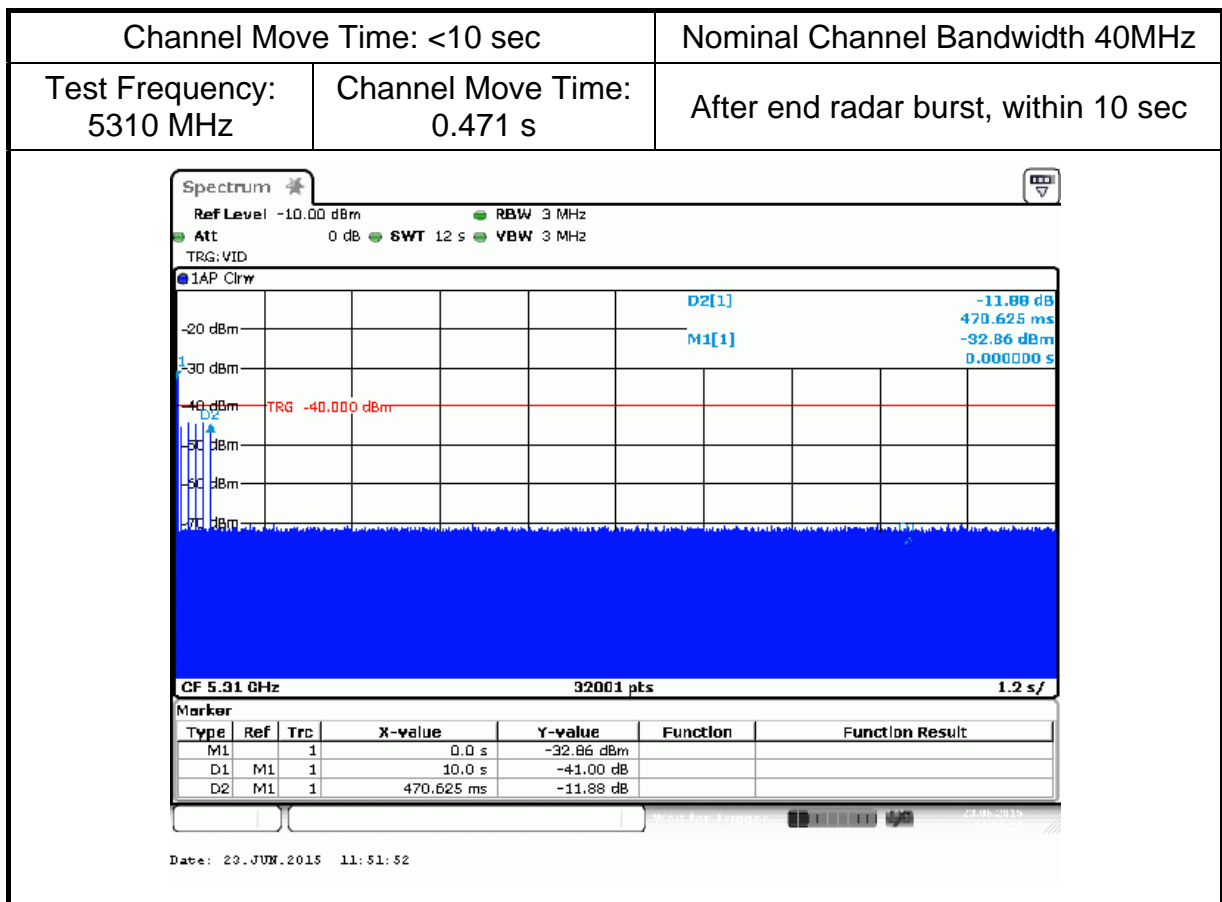
Test Result of Non-Occupancy Period Plots

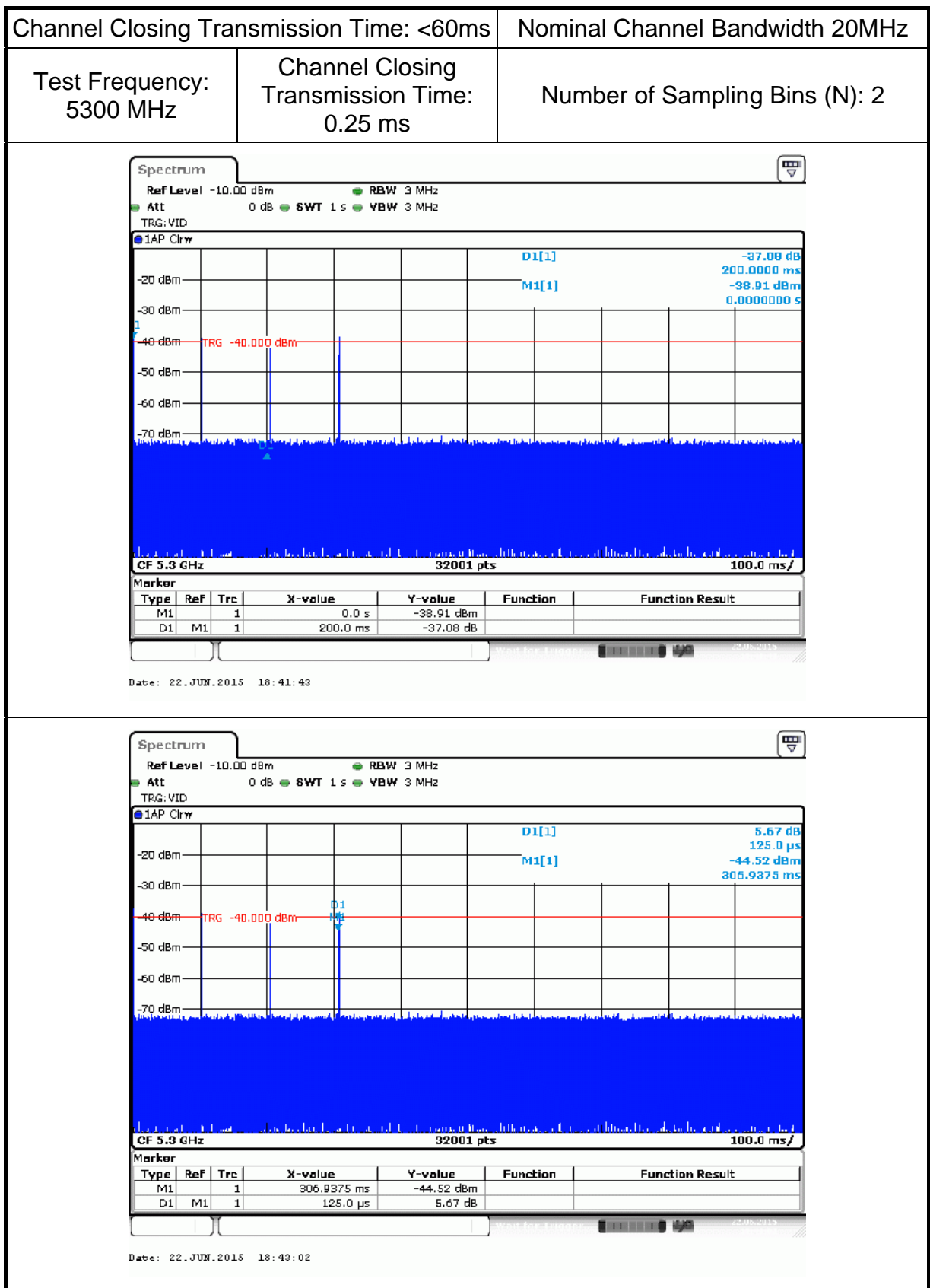
Test Result of Duty Plots



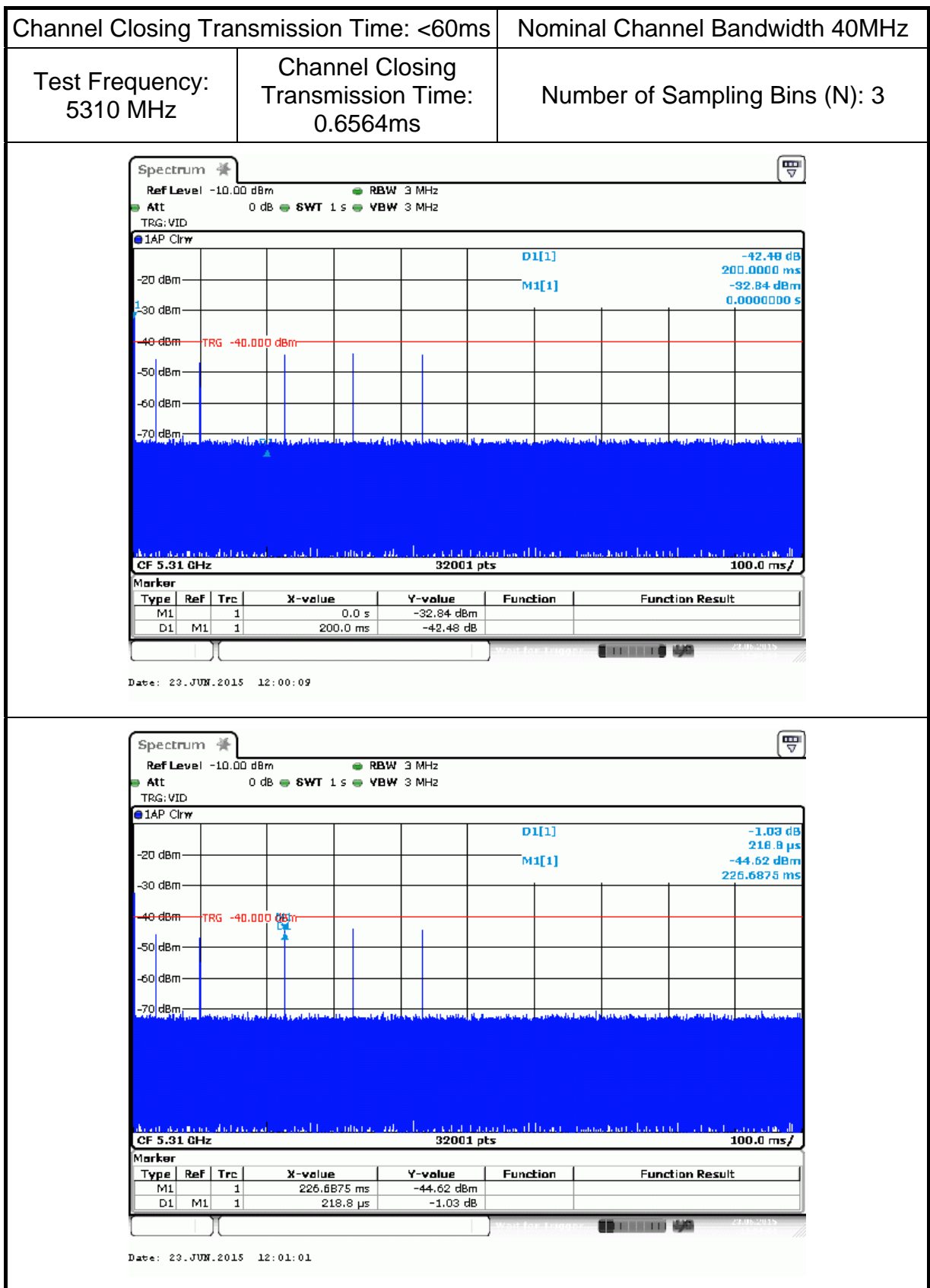
Test Result of Channel Shutdown Time Plots







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



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