

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART E REQUIREMENT DFS TEST REPORT

OF

**Applicant:** Sharp Corporation, Mobile Communication B.U.  
2-13-1, Hachihonmatsu-lida, Higashi-hiroshima-shi,  
Hiroshima 739-0192, Japan

**Manufacturer:** Sharp Corporation  
1 Takumi-cho, Sakai-ku, Sakai-Shi, Osaka 590-8522, Japan

**Product Name:** Smart Phone

**Report Number:** ER/2018/30018

**FCC ID:** APYHRO00259

**FCC Rule Part:** §15.407, Cat: NII

**Issue Date:** Mar. 28, 2018

**Date of Test:** Mar. 05, 2018 ~ Mar. 21, 2018

**Date of EUT Received:** Mar. 05, 2018

### We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

**Tested By:**

*Marcus Tseng*  
\_\_\_\_\_  
Marcus Tseng / Sr. Engineer

**Approved By:**

*Jim Chang*  
\_\_\_\_\_  
Jim Chang / Manager



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## Revision History

| Report Number | Revision | Description                  | Effectuated Page | Issue Date    | Revised By    |
|---------------|----------|------------------------------|------------------|---------------|---------------|
| ER/2018/30018 | Rev.00   | Initial creation of document | All              | Mar. 28, 2018 | Violetta Tang |

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# 1 GENERAL INFORMATION

## 1.1 Product Description

General:

|                   |                                        |                                                                            |
|-------------------|----------------------------------------|----------------------------------------------------------------------------|
| Product Name:     | Smart Phone                            |                                                                            |
| Hardware Version: | DVT                                    |                                                                            |
| Software Version: | N/A                                    |                                                                            |
| Power Supply:     | 3.85V from Rechargeable Li-ion Battery |                                                                            |
|                   | Battery:                               | Model No.: UBATIA286AFN2,<br>Supplier: SCUD (FUJIAN) Electronics Co., Ltd. |

WLAN 5GHz:

| Wi-Fi                | Frequency Range | Channels                                                                                                                                                                                                                | Avg. Power (dBm)       | Modulation Technology |
|----------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------|
| 11a_20               | 5180~5240       | 4                                                                                                                                                                                                                       | 14.84                  | OFDM                  |
|                      | 5260~5320       | 4                                                                                                                                                                                                                       | 14.90                  |                       |
|                      | 5500~5700       | 11                                                                                                                                                                                                                      | 14.73                  |                       |
| 11n_HT / ac_VHT 20M  | 5180~5240       | 4                                                                                                                                                                                                                       | HT: 17.66 (Worst Case) | OFDM                  |
|                      | 5260~5320       | 4                                                                                                                                                                                                                       | HT: 17.54 (Worst Case) |                       |
|                      | 5500~5700       | 11                                                                                                                                                                                                                      | HT: 17.69 (Worst Case) |                       |
| 11n_HT / ac_VHT 40M  | 5190~5230       | 2                                                                                                                                                                                                                       | HT: 17.53 (Worst Case) | OFDM                  |
|                      | 5270~5310       | 2                                                                                                                                                                                                                       | HT: 17.54 (Worst Case) |                       |
|                      | 5510~5670       | 5                                                                                                                                                                                                                       | HT: 17.73 (Worst Case) |                       |
| 11ac VHT80M          | 5210            | 1                                                                                                                                                                                                                       | 14.72                  | OFDM                  |
|                      | 5290            | 1                                                                                                                                                                                                                       | 14.52                  |                       |
|                      | 5530~5610       | 2                                                                                                                                                                                                                       | 17.71                  |                       |
| Modulation Type      |                 | 64QAM, 16QAM, QPSK, BPSK for OFDM<br>256QAM for OFDM in 802.11ac only                                                                                                                                                   |                        |                       |
| Transition Rate:     |                 | 802.11 a: 6/9/12/18/24/36/48/54 Mbps<br>802.11 n_20MHz: 6.5 – 144.4Mbps<br>802.11 n_40MHz: 13.5 – 300.0Mbps<br>802.11 ac_20MHz: 6.5 –173.3Mbps<br>802.11 ac_40MHz: 13.5 –400.0Mbps<br>802.11 ac_80MHz: 29.3 – 866.7Mbps |                        |                       |
| Antenna Designation: |                 | IFA Antenna,<br>5150~5250MHz Gain: -3.6dBi (Main) / -3.9dBi(Aux)<br>5250~5350MHz Gain: -3.6dBi (Main) / -3.9dBi(Aux)<br>5470~5725MHz Gain: -1.7dBi (Main) / -3.6dBi(Aux)                                                |                        |                       |

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## 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart E §15.407

FCC KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02

FCC KDB 905462 D03 UNII Clients Without Radar Detection New Rules v01r02

All test items have been performed and record as per the above standards.

## 1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road,  
New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803  
(TAF code 0513)

FCC Registration Number and Designation are: 509634 / TW0001.

## 1.4 Special Accessories

There are no special accessories used while test was conducted.

## 1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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## 2 SUMMARY OF TEST RESULT

| FCC Rules  | Description Of Test     | Result    |
|------------|-------------------------|-----------|
| §15.407(h) | TPC and DFS Measurement | Compliant |

## 3 MEASUREMENT UNCERTAINTY

| Test Items              | Uncertainty                |
|-------------------------|----------------------------|
| TPC and DFS Measurement | +/- 123.36 Hz              |
| Temperature             | +/- 0.65 °C                |
| Humidity                | +/- 4.6 %                  |
| DC / AC Power Source    | DC= +/- 0.13%, AC=+/- 0.2% |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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## 4 TPC AND DFS MEASUREMENT

### 4.1. TPC: Standard Applicable

According to §15.407(h)(1), Transmit power control (TPC). U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

**4.1.1. Result:** N/A, The output power is less than 500mW.

### 4.2. DFS: Standard Applicable

According to §15.407(h)(2) and FCC KDB 905462 D02, Radar Detection Function of Dynamic Frequency Selection (DFS).

Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is -64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is -62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

(A) The requirement for channel availability check time applies in the master operational mode.

(B) The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

(iii) Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

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#### 4.2.1. Limit

**Table 1: 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              | Yes                             | 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                          |

**Table 2: Applicability of DFS requirements during normal operation**

| Requirement                       | Operational Mode                             |                                |
|-----------------------------------|----------------------------------------------|--------------------------------|
|                                   | Master Device or Client with Radar Detection | Client Without 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                   |

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| Additional requirements for devices with multiple bandwidth mode                                                                                                                                                                                                                                                                                             | 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                                         |
| <b>Note:</b> 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. |                                              |                                                      |

**Table 3:**  
**Interference Threshold values, Master or Client incorporating In-Service Monitoring**

| Maximum Transmit Power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Value<br>(See Notes 1, 2, and 3) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| EIRP $\geq$ 200 milliwatt                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -64 dBm                          |
| EIRP $<$ 200 milliwatt and power spectral density $<$ 10 dBm/MHz                                                                                                                                                                                                                                                                                                                                                                                                                                        | -62 dBm                          |
| EIRP $<$ 200 milliwatt 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.<br>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.<br>Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01. |                                  |

| Devices                                                                                                                       | DFS Threshold |
|-------------------------------------------------------------------------------------------------------------------------------|---------------|
| Devices with an e.i.r.p. $<$ 200 mW AND a Power Spectral Density $<$ 10 dBm/MHz                                               | -62 dBm       |
| Devices with $200 \text{ mW} \leq \text{e.i.r.p.} \leq 1 \text{ W}$                                                           | -64 dBm       |
| <b>Note:</b> The detection threshold power is the received power, averaged over a 1-microsecond reference to a 0 dBi antenna. |               |

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Table 4: DFS Response requirement values

| Parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Value                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <i>Non-occupancy period</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Minimum 30 minutes                                                                                        |
| <i>Channel Availability Check Time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 60 seconds                                                                                                |
| <i>Channel Move Time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 10 seconds<br>See Note 1.                                                                                 |
| <i>Channel Closing Transmission Time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period.<br>See Notes 1 and 2. |
| <i>U-NII Detection Bandwidth</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.                                   |
| <p><b>Note 1:</b> <i>Channel Move Time</i> and the <i>Channel Closing Transmission Time</i> should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.</p> <p><b>Note 2:</b> The <i>Channel Closing Transmission Time</i> is comprised of 200 milliseconds starting at the beginning of the <i>Channel Move Time</i> plus any additional intermittent control signals required to facilitate a <i>Channel</i> 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><b>Note 3:</b> During the <i>U-NII Detection Bandwidth</i> 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> |                                                                                                           |

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**Table 5: Radar Test Waveforms**  
**Short Pulse Radar**

| 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<br>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 $\left\lceil \frac{1}{360} \cdot \frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right\rceil$ | 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                      |
| <b>Note 1:</b> Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests. |                    |                                                                                                                                                                                                                                                            |                                                                                                         |                                            |                          |

### Long Pulse Radar

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

### Frequency Hopping Radar

| Radar Type | Pulse Width (μsec) | PRI (μsec) | Pulses per Hop | Hopping Rate (kHz) | Hopping Sequence Length (msec) | Minimum Percentage of Successful Detection | Minimum Number of Trials |
|------------|--------------------|------------|----------------|--------------------|--------------------------------|--------------------------------------------|--------------------------|
| 6          | 1                  | 333        | 9              | 0.333              | 300                            | 70%                                        | 30                       |

**The applicant of this given application confirms that information regarding the parameters of the detected Radar Waveforms is not available to the end user.**

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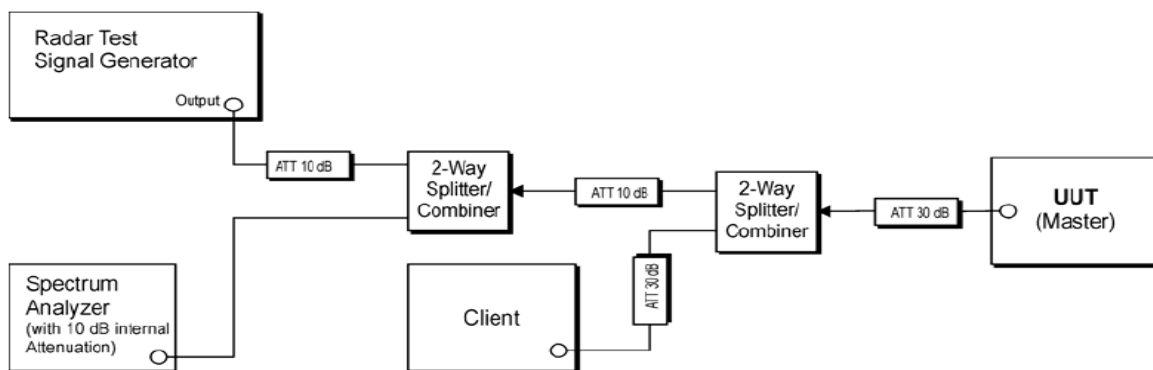
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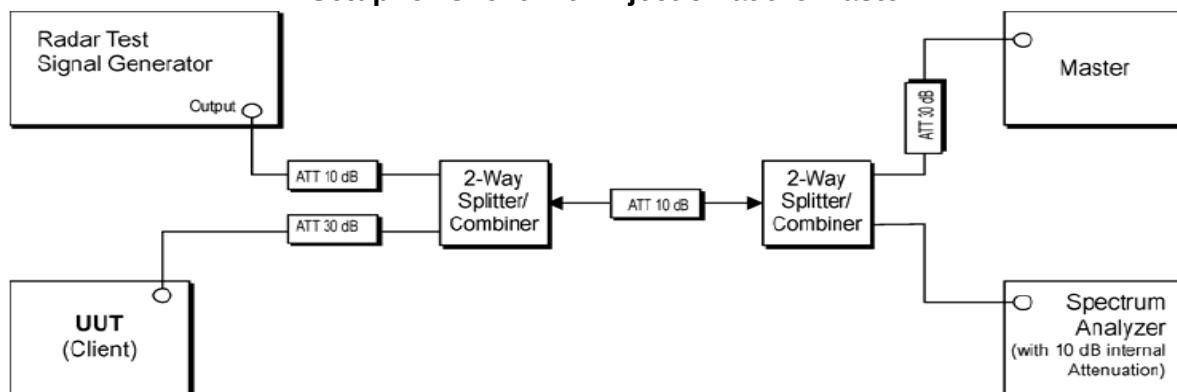
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## 4.2.2. Test Setup

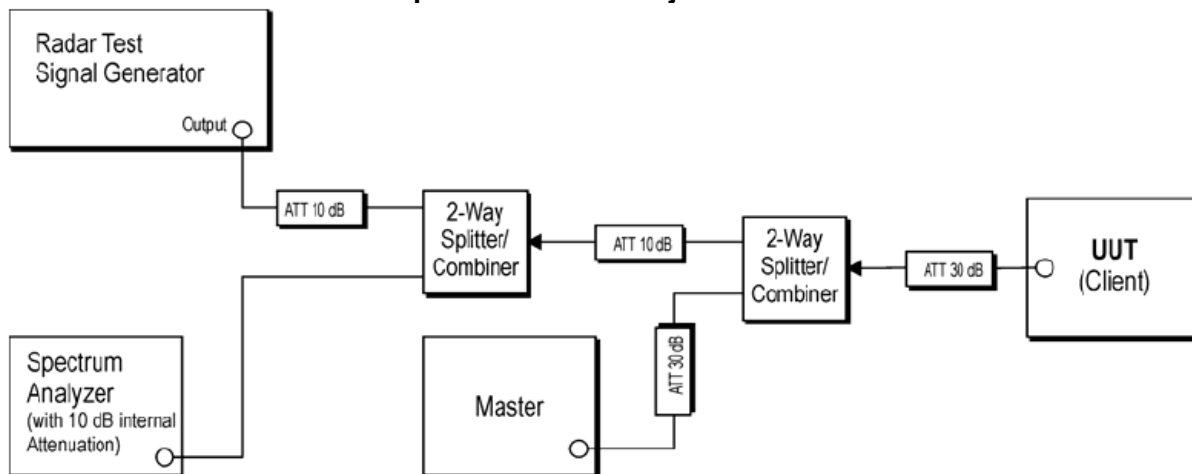
### Setup for Master with injection at the Master



### Setup for Client with injection at the Master



### Setup for Client with injection at the Client



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#### 4.2.3. Test Equipment Used:

| EQUIPMENT TYPE        | MFR          | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------|--------------|--------------|---------------|------------|------------|
| EXA Spectrum Analyzer | Agilent      | N9010A       | MY54200716    | 2017/10/16 | 2018/10/15 |
| DC Power Supply       | Anritsu      | E3640A       | MY52410006    | 2017/11/28 | 2018/11/27 |
| Attenuator            | Mini-Circuit | BW-S10W2+    | 2             | 2018/01/02 | 2019/01/01 |
| Notebook              | Lenovo       | T440         | P0000564      | N/A        | N/A        |

#### 4.2.4. Description of EUT:

EUT operates over the 5250-5350MHz and 5470-5725MHz ranges and EUT is a slave device (client equipment) w/o radar detection and DFS capability.

EUT has no TPC mechanism implemented with no adjustment of lowest, and highest power, but the level of power emission stays at fixed level.

The EUT utilizes the 802.11ac 80M architecture, with a nominal channel bandwidth of 80MHz WLAN traffic is generated by streaming the mpeg file from the master to slave in full monitor video mode using the media player.

The rated output power of the master unit is >23dBm(EIRP).therefore the required interference threshold level is -62dBm.after correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is -62dBm, and the master device as employed for the applicable DFS test is CISCO router whose FCC ID= LDK102061

While calibrate the path on antenna port of DFS test equipment (master), measurements equipments (spectrum) is ensured to be 50 Ohms, and therefore verification on antenna gain measurement can be ignored.

Conducted test was performed with appropriate adjustment, and calibration to ensure power from DFS simulator injects to antenna port of DFS test equipment (DFS) is -62dBm

#### Message or files that is used for communication between Master and Client:

IP based system:

For the required channel loading, the full motion, 30 frames per second MPEG video file from <http://ntiacsd.ntia.doc.gov/dfs/> was streamed from a network on a test bench (server of the storage to download the mandatory format of Video file), via the DFS Master device, to the UE (mobile phone).

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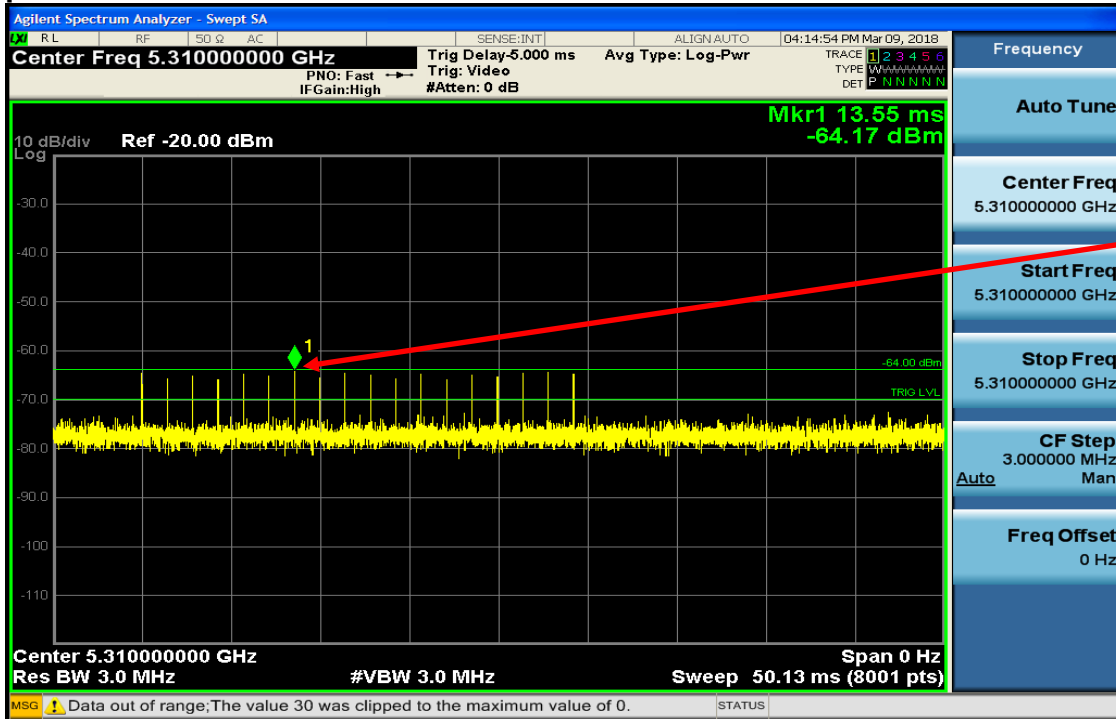
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## 4.2.5. Test results

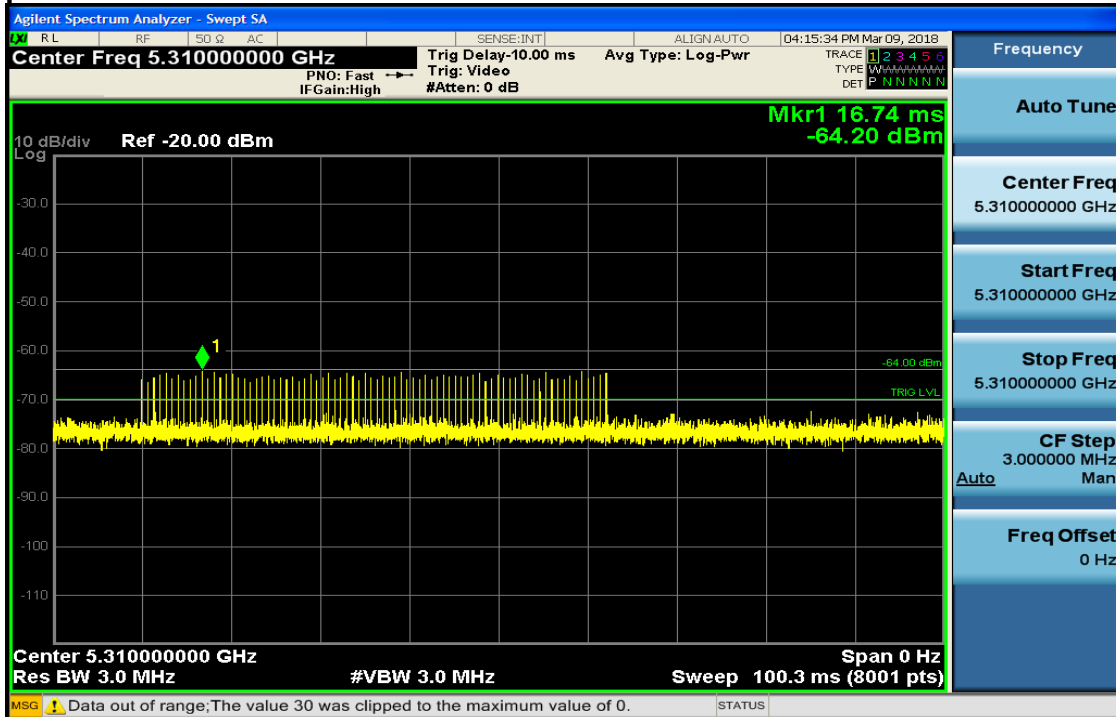
Calibration plots for each of the required radar waveforms

Radar type 0



Noise Floor

Radar type 1-A



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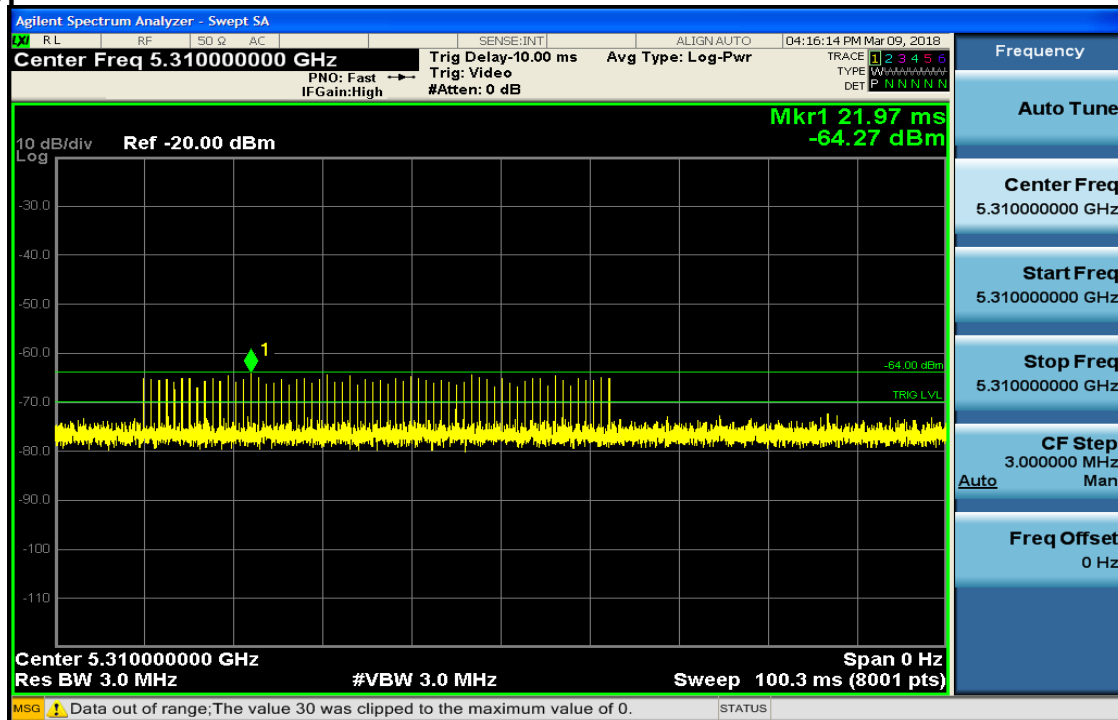
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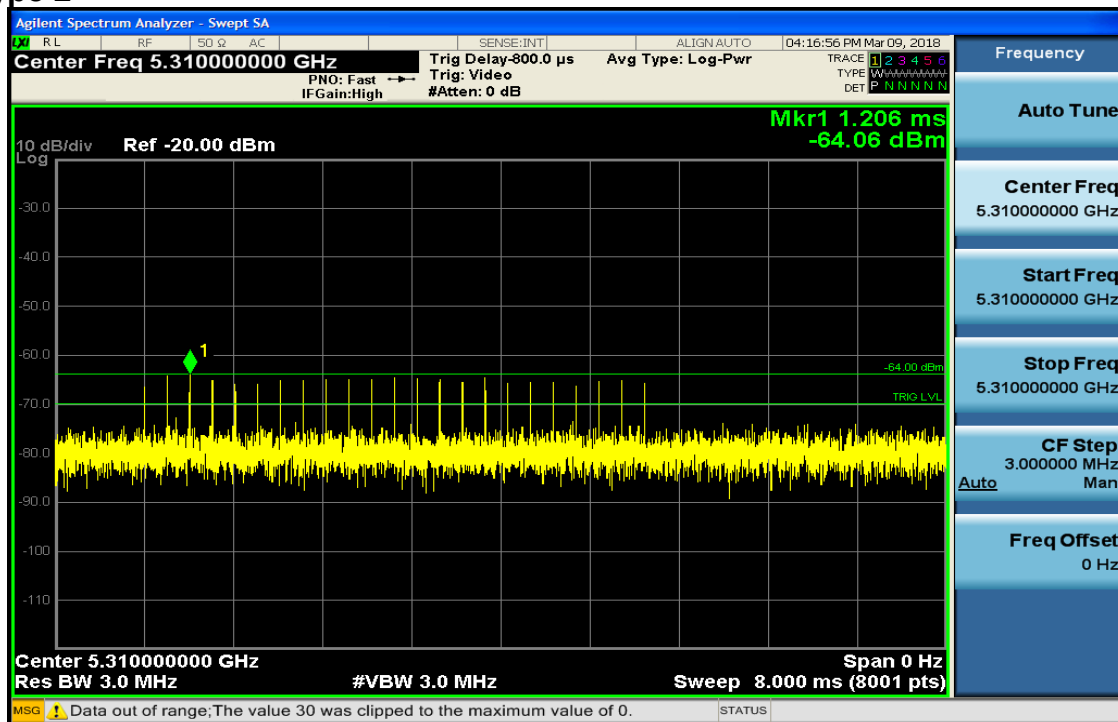
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## Radar type 1-B



## Radar type 2



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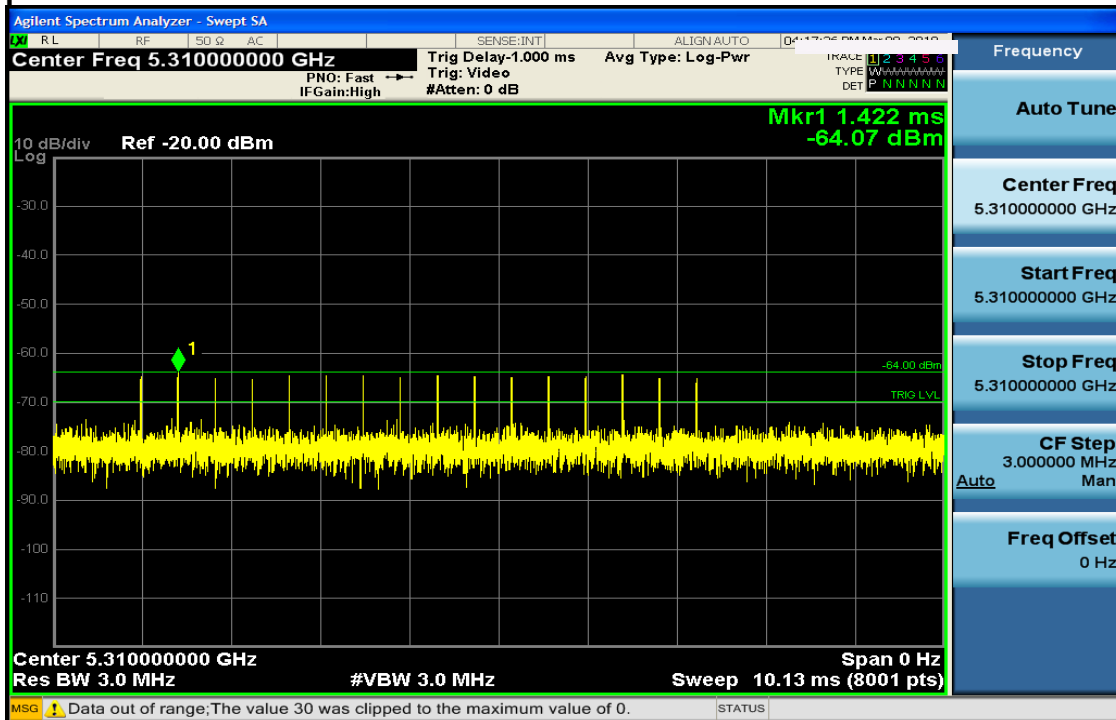
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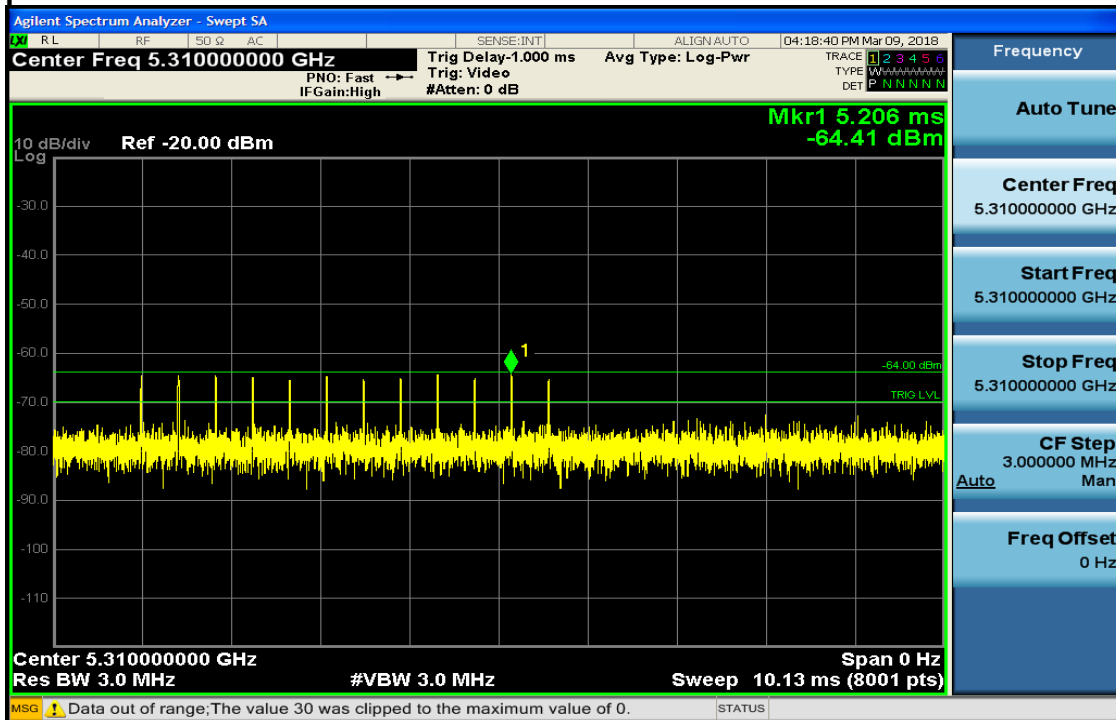
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## Radar type 3



## Radar type 4



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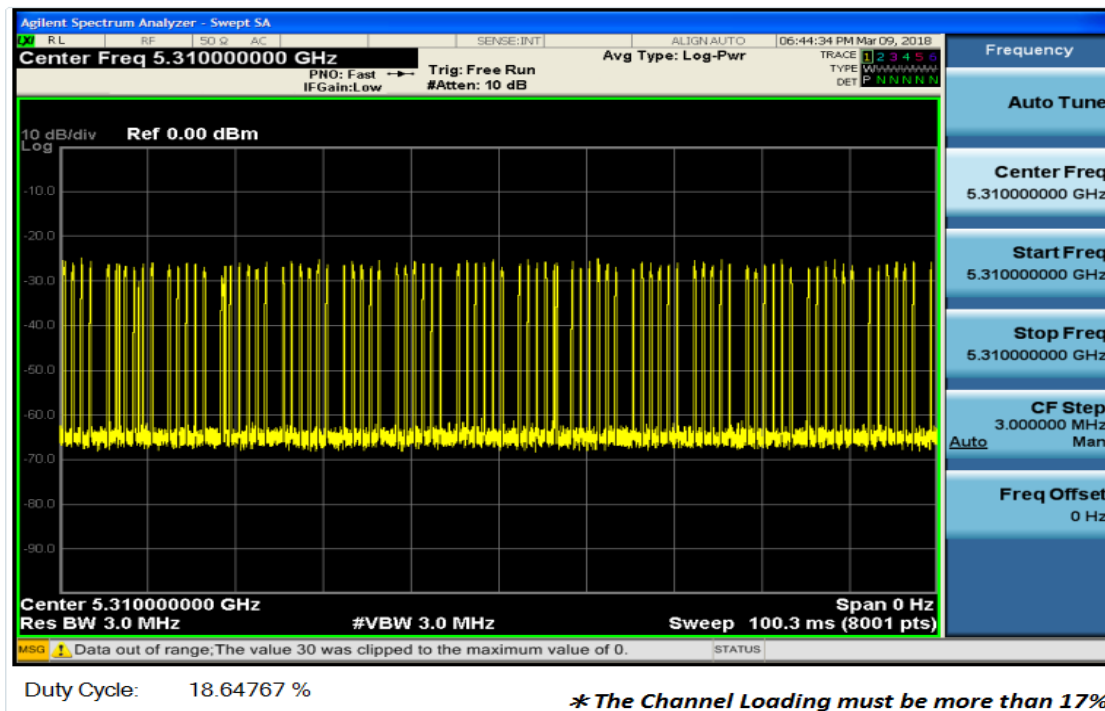
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## WLAN Payload



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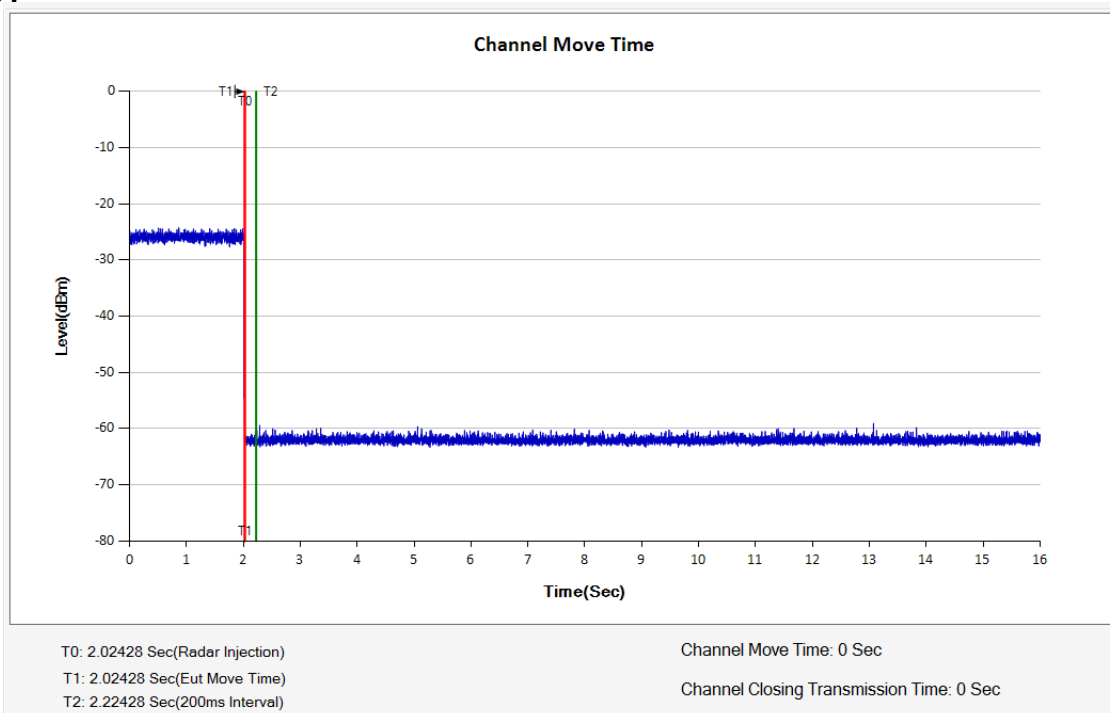
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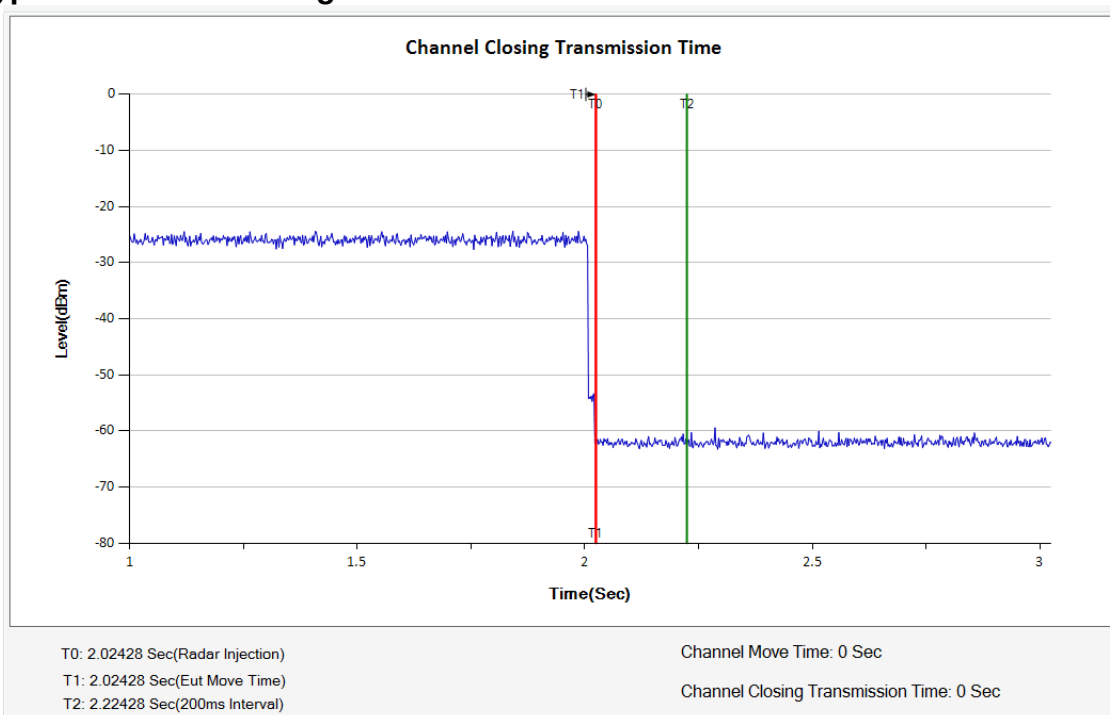
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## Radar Type 1 Channel Move Transmission Time



## Radar Type 1 Channel Closing Transmission Time



**Verdict:** Note: narrowing the sweep time as the good engineering process for the verification of transmission closing in 200ms

~ End of Report ~

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