

Prüfbericht-Nr.: Test Report No.:	50056940 001	Auftrags-Nr.: Order No.:	114054306	Seite 1 von 28 Page 1 of 28
Kunden-Referenz-Nr.: Client Reference No.:	N/A	Auftragsdatum: Order date:	25-Jul-2016	
Auftraggeber: Client:	Lenovo (Beijing) Limited, No.6 Chuang Ye Road, Shangdi Information Industry Haidian District, Beijing			
Prüfgegenstand: Test item:	ThinkPad Stack Mobile Projector			
Bezeichnung / Typ-Nr.: Identification / Type No.:	M123			
Auftrags-Inhalt: Order content:	FCC Part 15E / IC RSS-247 Test report (DFS)			
Prüfgrundlage: Test specification:	FCC 47CFR Part 15: Subpart C Section 15.407 RSS-247 (05-2015)			
Wareneingangsdatum: Date of receipt:	9-Aug-2016			
Prüfmuster-Nr.: Test sample No.:	A000406107-002 A000406107-001			
Prüfzeitraum: Testing period:	19-Sep-2016 - 20-Sep-2016			
Ort der Prüfung: Place of testing:	EMC Laboratory Taipei			
Prüflaboratorium: Testing laboratory:	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von / tested by:		kontrolliert von / reviewed by:		
2016-11-04 Ryan W. T. Chen / Project Manager Datum Name / Stellung Unterschrift Date Name / Position Signature		2016-11-04 Rene Charton / Senior Project Manager Datum Name / Stellung Unterschrift Date Name / Position Signature		
Sonstiges / Other: Please refer to 50058588 001 report for other test requirement.				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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Test Report No.

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TEST SUMMARY

6.2.1 CHANNEL CLOSING TRANSMISSION AND CHANNEL MOVE TIME

RESULT: Passed

6.2.2 NON-OCCUPANCY PERIOD

RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation
(File Name: 50056940APPENDIX P)
Appendix D: Test Result of Radiated Emissions
(File Name: 50056940APPENDIX D)

Test Specifications

The following standards were applied (in bold: product standards, otherwise: basic standards).

Table 1: Applied Standard and Test Levels

Radio
FCC CFR47 Part 15 Subpart E RSS-Gen, Issue 4, November 2014 RSS-247 Issue 1 May 2015 FCC KDB 905462

2. Test Sites

2.1 Test Facilities

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

FCC Registration No.: 799772
IC Canada Registration No.: 9465A-1
TAF Accredited NCC Test Lab. No.:0759

TAF ISO17025 Certification effective periods: 2016-Jul-1st to 2019-Jun-30th



Testing Laboratory
0759

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manu-facturer	Type	S/N	Last Calibration	Next Calibration
Spectrum Analyzer	R&S	FSV 40	100921	2016/04/21	2017/04/21
Spectrum Analyzer	Agilent	N9010A	MY53470241	2016/04/25	2017/04/24
Power sensor	Agilent	U2021XA	MY53480013	2016/03/11	2017/03/10
EXG-B RF Analog Signal Generator	Agilent	N5171B	MY53050377	2016/03/04	2017/03/03
MXG-B RF Vector Signal Generator	Agilent	N5182B	MY53050524	2016/03/04	2017/03/03

2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements are $\pm 3\text{dB}$.

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	$\pm 1.5 \text{ dB}$
Temperature	$\pm 2 \text{ }^{\circ}\text{C}$
Humidity	$\pm 10 \%$

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Mobile Projector. It contains a WiFi and Bluetooth compatible module enabling the user to communicate data through a Wireless interface.
For details refer to the User Guide, Data Sheet and Circuit Diagram.

The device is a Slave Device with DFS function.

For further details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Technical Specification of EUT

Technical Specification	Value
Kind of Equipment	ThinkPad Stack Mobile Projector
Type Designation	M123
Brand Name	Lenovo
FCC ID	A5MM123
Canada ID	5903G-M123
Canada HVIN	M123
Operating Frequency	5150-5250MHz,5250 ~5350 MHz,5470-5725MHz,5725-5850MHz
Operation Voltage	20Vdc
Modulation	OFDM with BPSK, QPSK, QAM
Antenna gain	5.7 dBi
Antenna Type	PCB antennas (2*2 MIMO)
Software/Firmware version	Kernel version:3.14.55-x86_64 www@c55-Lenovo-Product#1 Thu Jul 28 15:50:14 CST 2016 Build number:r2.cht_rvp-user debug 6.0.1 PIC060KMDNG1.0.8 eng.www.20160728.153509 test-keys

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

System testing will be performed with channel-loading using means appropriate to the data types that are used by the unlicensed device.

The following requirements apply:

Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater.

The EUT operates over the 5250-5350 MHz and 5470-5725MHz range as a Client Device that does not have radar detection capability.

The samples were used as follows:
Conducted: A0COND22757-001

The device under test is 802.11 WiFi compliant.

The rated output power of the Master unit is > 23dBm (EIRP 200mW). Therefore the required interference threshold level is -64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is $-64 + 5.89 = -58.11$ dBm.

The calibrated conducted DFS Detection Threshold level is set to -58.11 dBm. The tested level is lower than the required level hence it provides margin to the limit.

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

NO.	PRODUCT	BRAND	MODEL NO.	FCC ID	GAIN
1	Access Point	Dell	SonicPoint ACe	E2K-APL260AE	5G Ant gain : 5.89 dBi Maximum EIRP : 27.28dBm

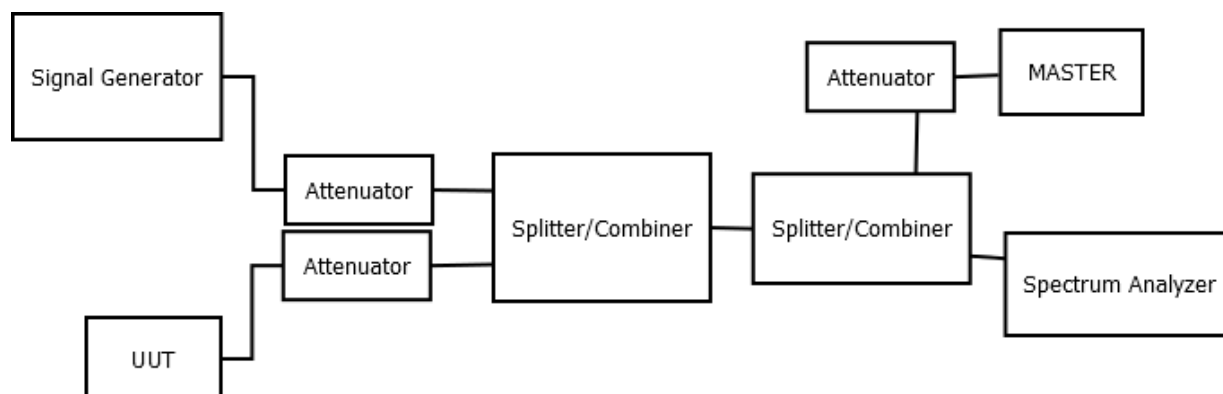
NOTE: This device was functioned as a ☒ Master ☐ Slave device during the DFS test.

NO.	PRODUCT	MODEL NO.	SOFTWARE/FIRMWARE VERSION
1.	Access Point	SonicPoint ACe	SonicOS 9.0.0.0-1o

Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-06)	Lenovo	TP00048A	PB-0F8B2

4.4 Test Setup Diagram

Diagram of Measurement Equipment Configuration for Conducted DFS Measurement



5. UNII DFS Rule Requirement

5.1 Working Modes And Required Test Items

The manufacturer shall state whether the UUT is capable of operating as a Master and/or a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately. See tables 5 and 6 for the applicability of DFS requirements for each of the operational modes.

Table 5: Applicability of DFS requirements prior to use a channel

Requirement	Operational Mode		
	Master	Client without radar detection	Client with radar detection
Non-Occupancy Period	✓	Not required	✓
DFS Detection Threshold	✓	Not required	✓
Channel Availability Check Time	✓	Not required	Not required
U-NII Detection Bandwidth	✓	Not required	✓

Table 6: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master or Client with radar detection	Client without radar detection
DFS Detection Threshold	✓	Not required
Channel Closing Transmission Time	✓	✓
Channel Move Time	✓	✓
U-NII Detection Bandwidth	✓	Not required

Additional requirements for devices with multiple bandwidth modes	Master 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
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 all 20 MHz channel blocks and a null frequencies between the bonded 20 MHz channel blocks.		

5.2 Test Limits And Radar Signal Parameters

Table 7: DFS detection thresholds for Master devices and Client devices with Radar detection

Maximum Transmit Power	Value (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. 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. Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 8: 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.

6. Test Results

6.1 DFS Detection Threshold levels

Test standard : FCC Part 15.407(i), RSS-247 6.3,LP0002(4.7.7.2)
Kind of test site : Shielded room

Test setup

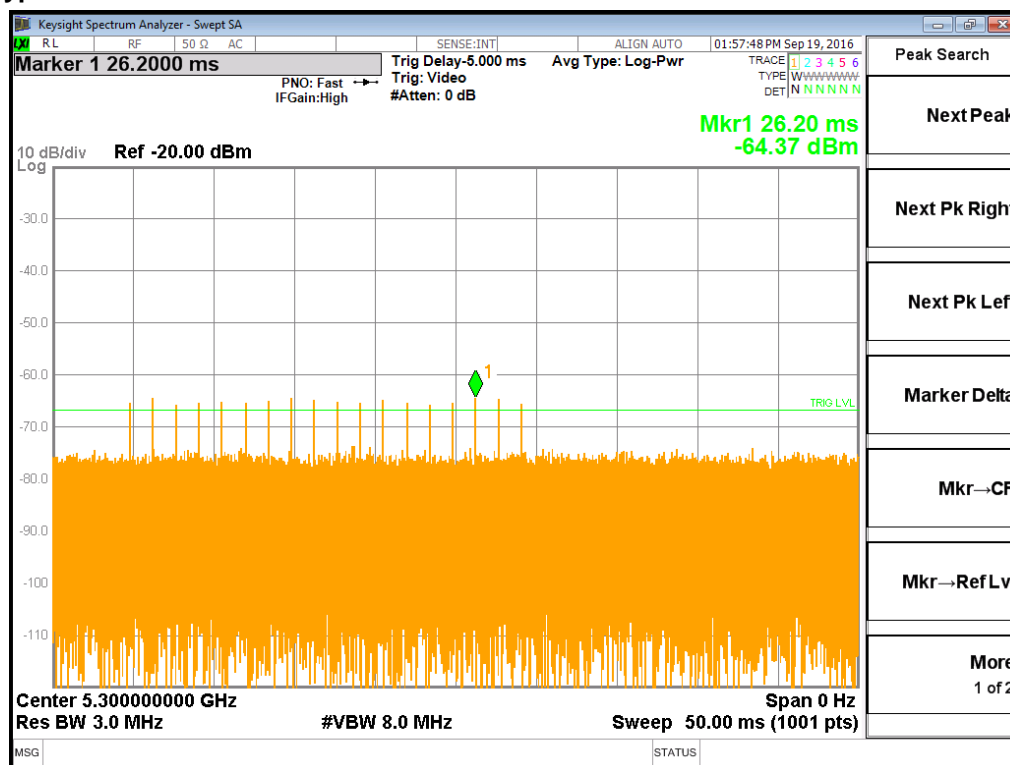
Test Channel : 5530MHz,5500MHz
Operation Mode : A

Ambient temperature : 22-26 °C
Relative humidity : 50-65 %
Atmospheric pressure : 100-103 kPa

For a detection threshold level of -64dBm, the required signal strength at EUT antenna location is -64 dBm. The tested level is lower than required level hence it provides margin to the limit.

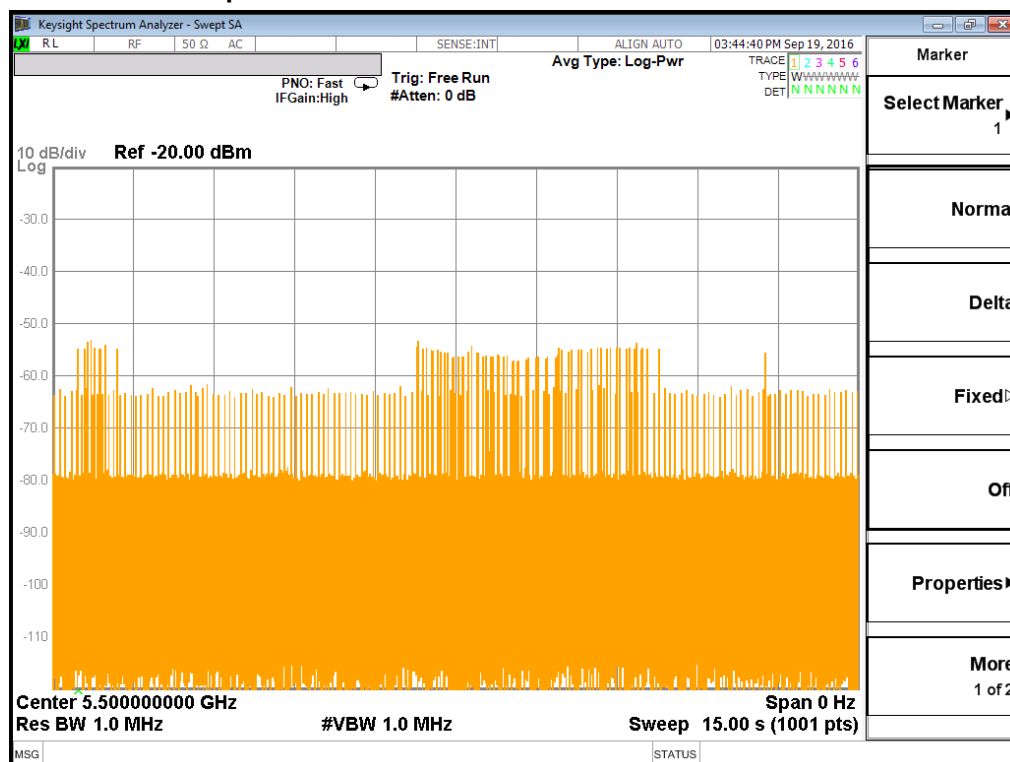
Test Plot of Radar Waveform calibration

Radar Type 0 DFS detection threshold level



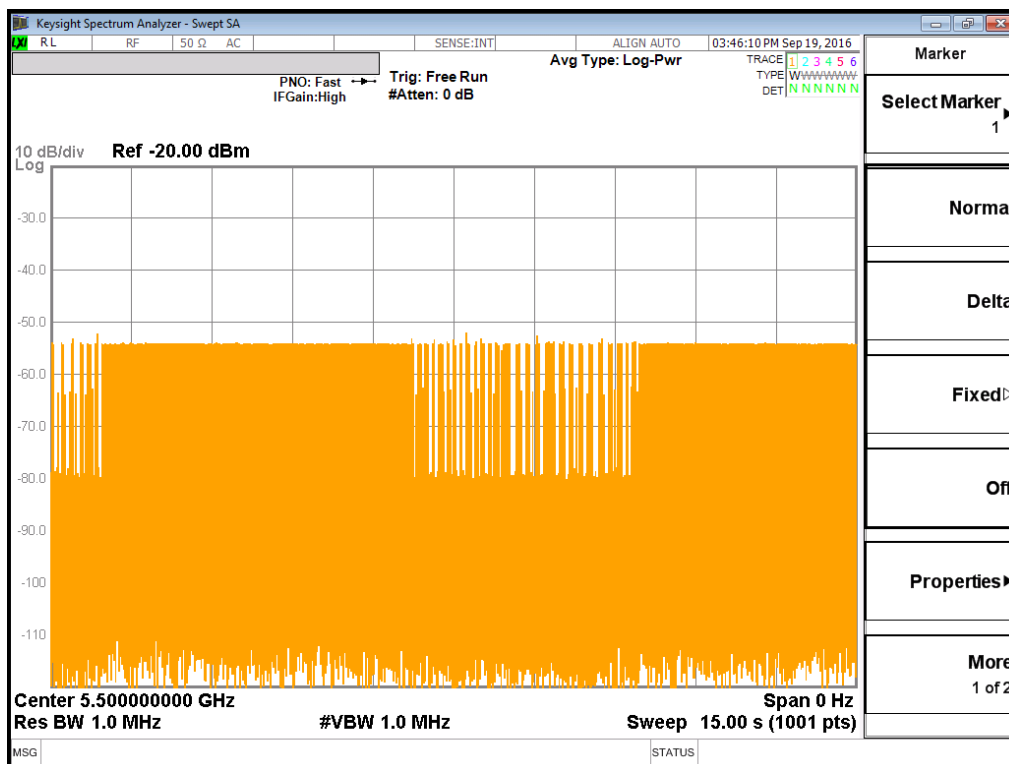
Test Plot Plot of WLAN Traffic

Waveform of EUT links up with Master



Test Plot Plot of WLAN Traffic

Waveform of transmission



6.2 DFS Requirement & Test Suites

6.2.1 Channel Closing Transmission And Channel Move Time

RESULT:**Passed**

Test standard : FCC Part 15.407(i), RSS-247 6.3, LP0002(4.7.7.2)
Kind of test site : Shielded room

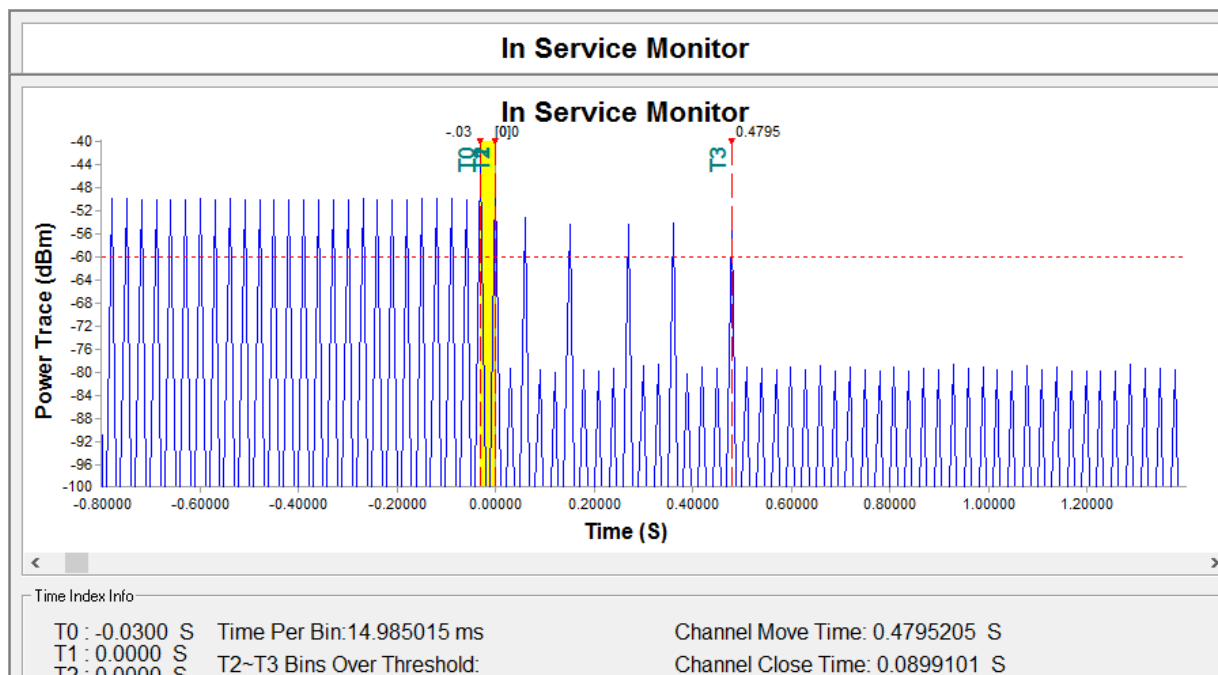
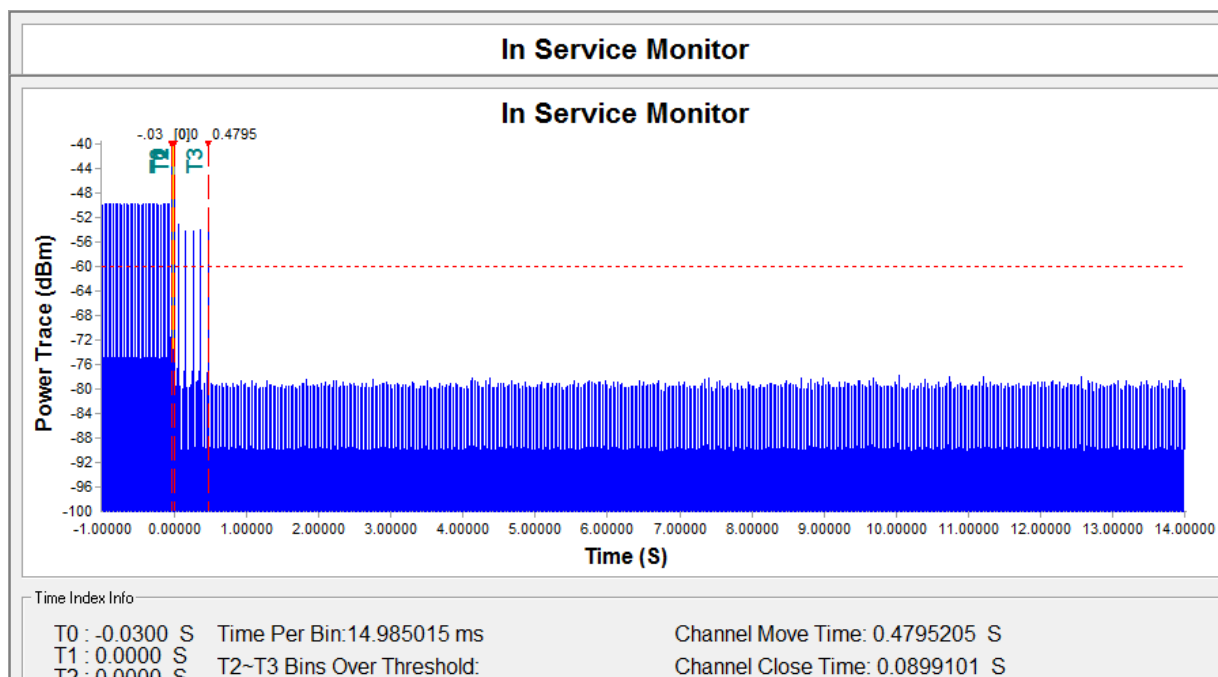
Test setup

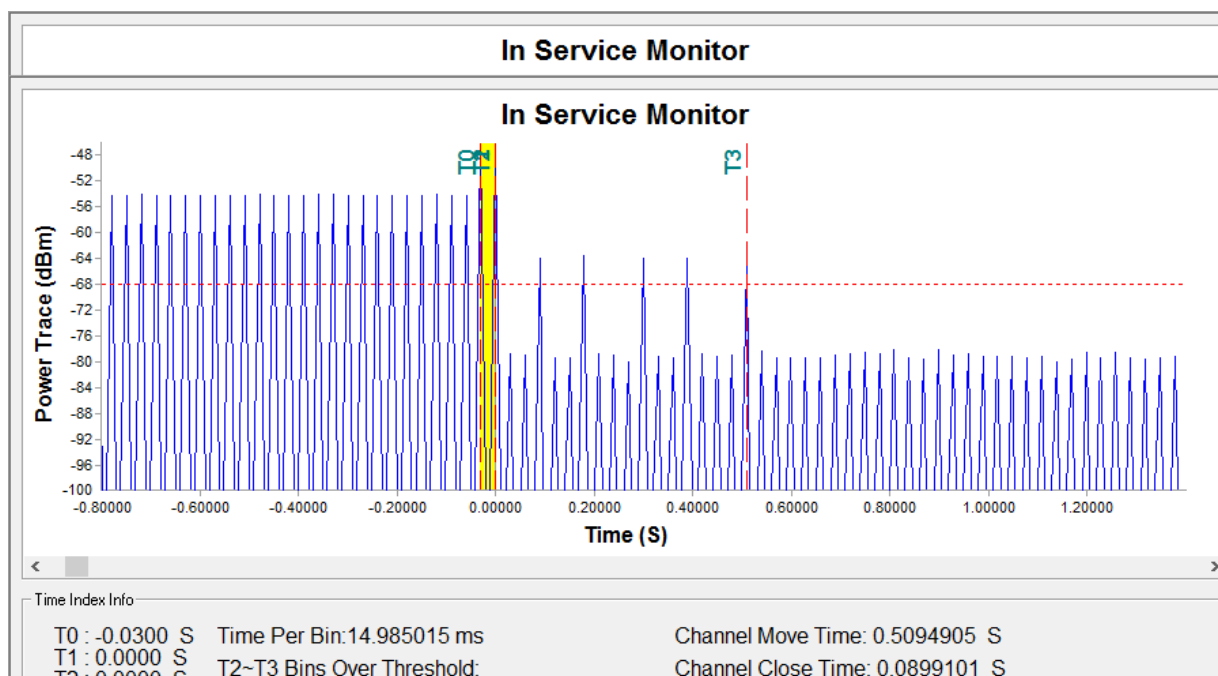
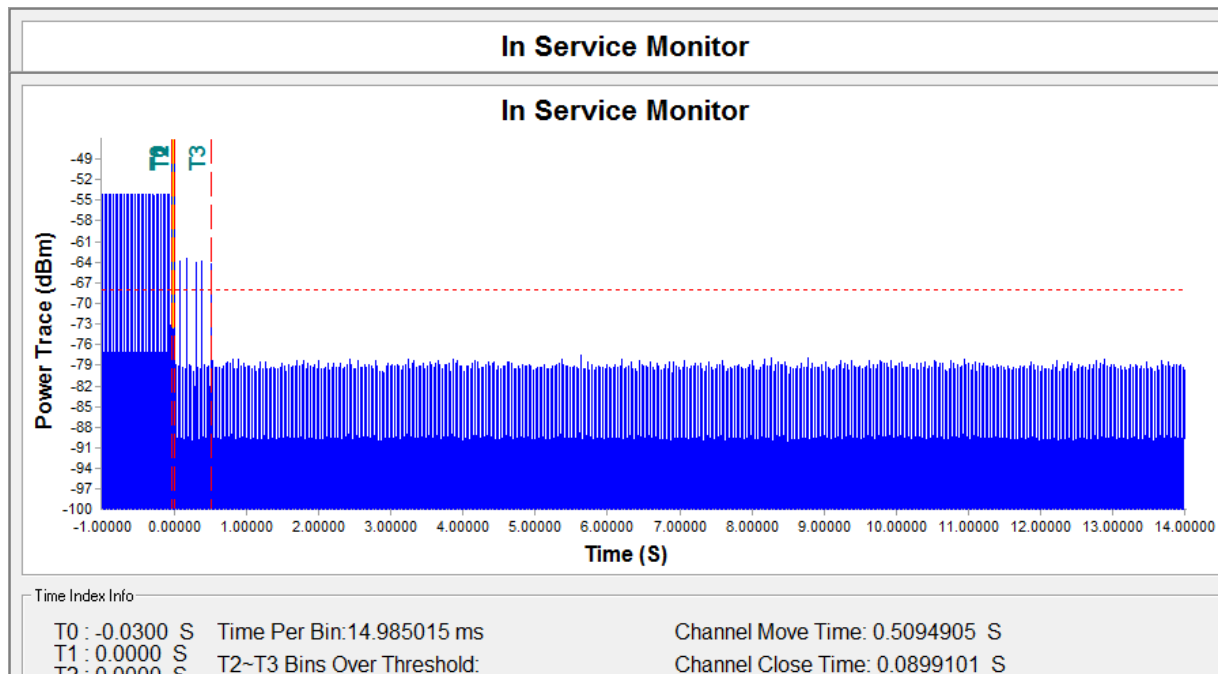
Test Channel : 5300MHz ,5500MHz
Operation Mode : Normal

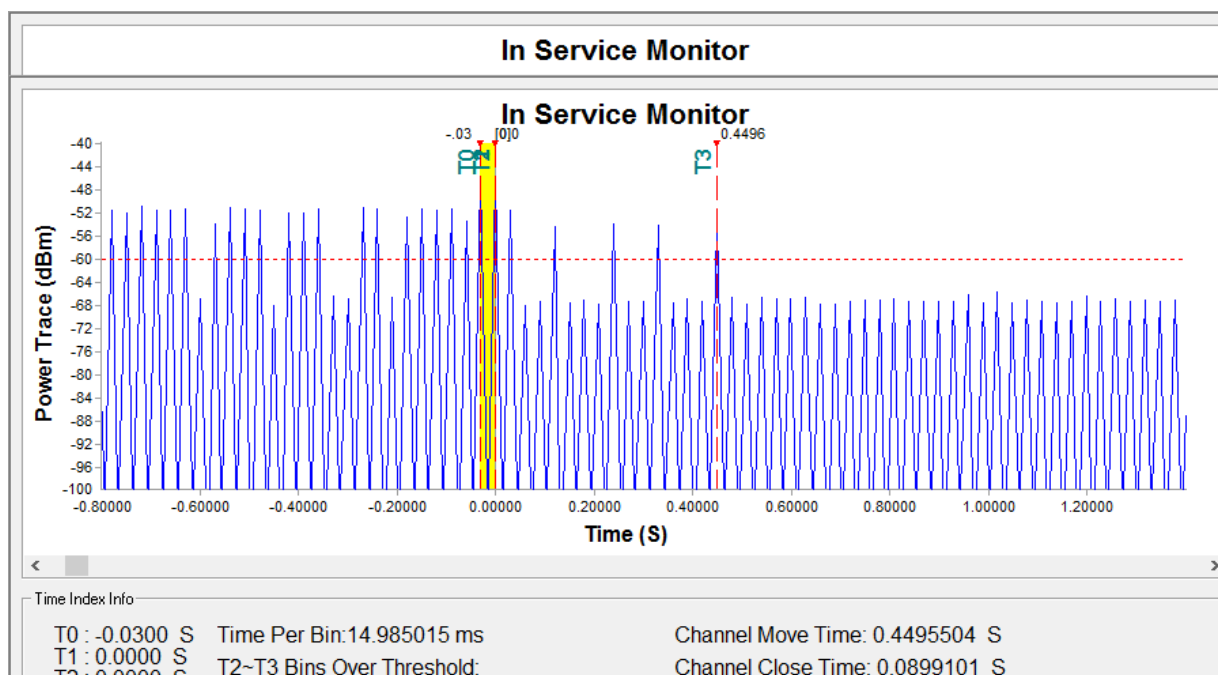
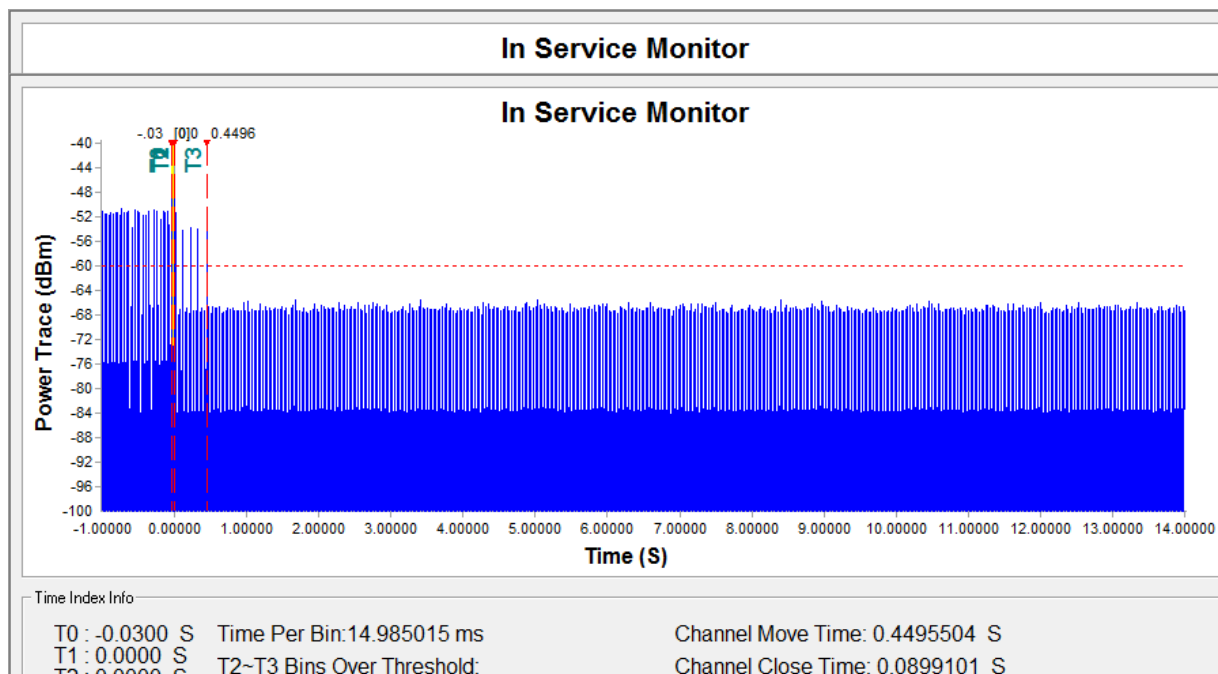
Ambient temperature : 22-26 °C
Relative humidity : 50-65 **Error! Reference source not found.**%
Atmospheric pressure : 100-103 kPa

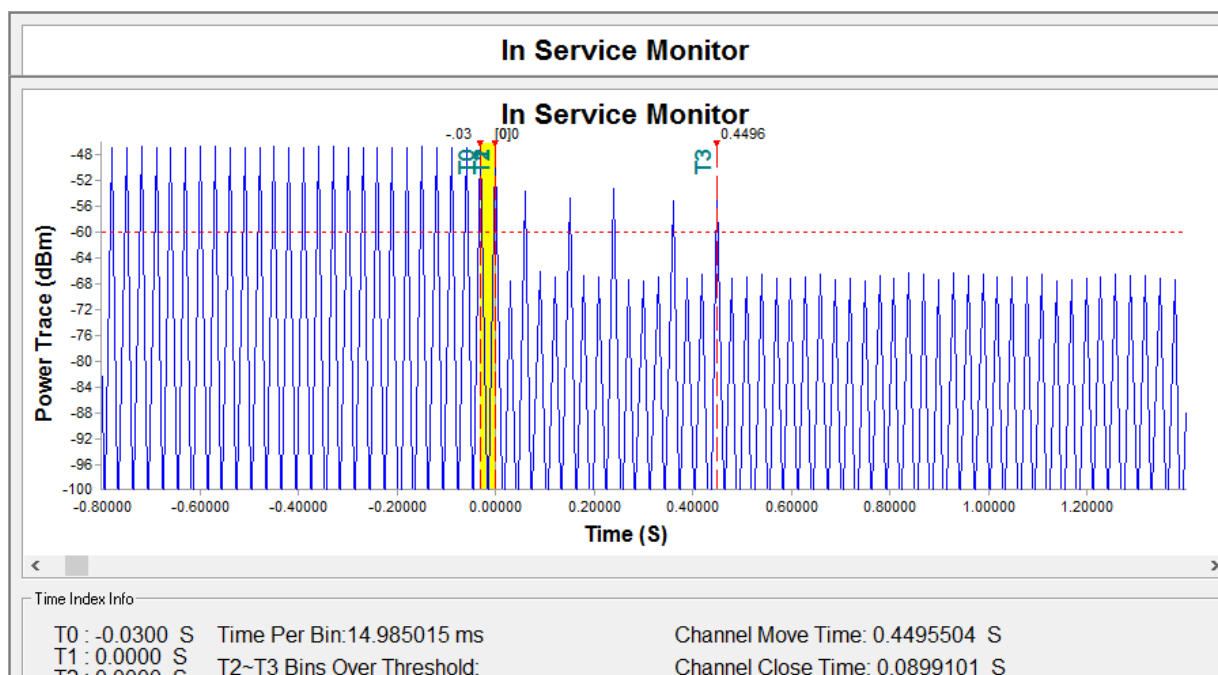
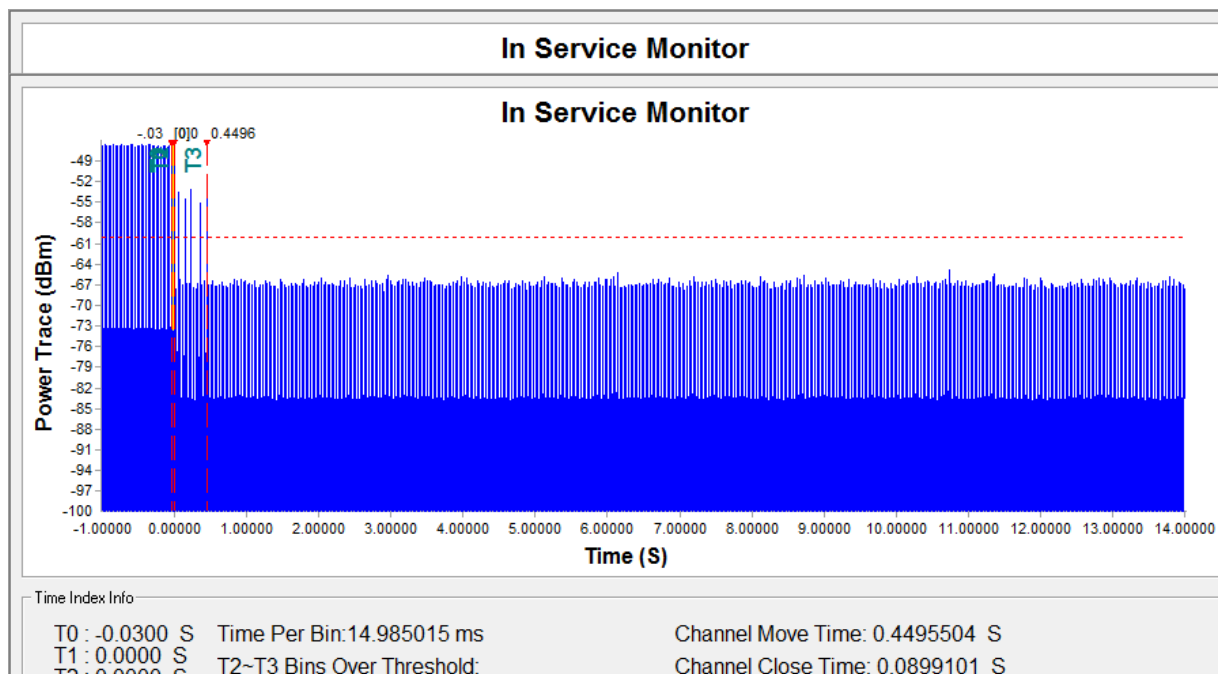
NOTE: T1 denotes the start of Channel Move Time upon the end of the last Radar burst.
T2 denotes the end of channel closing time.

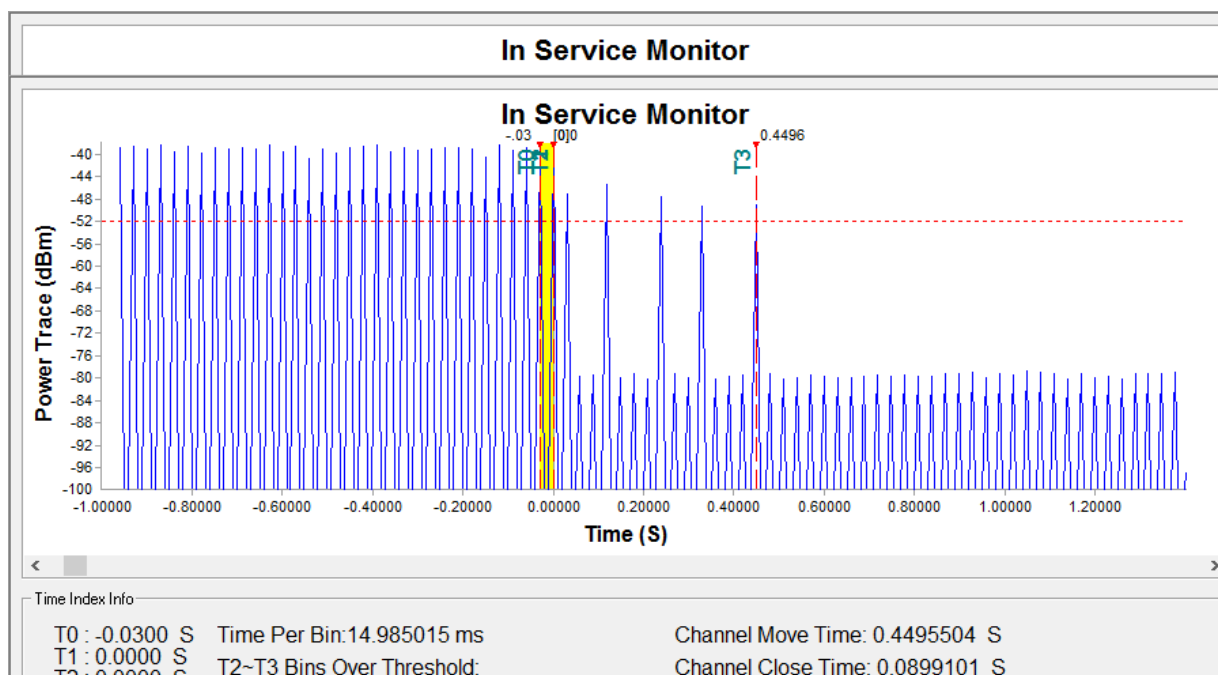
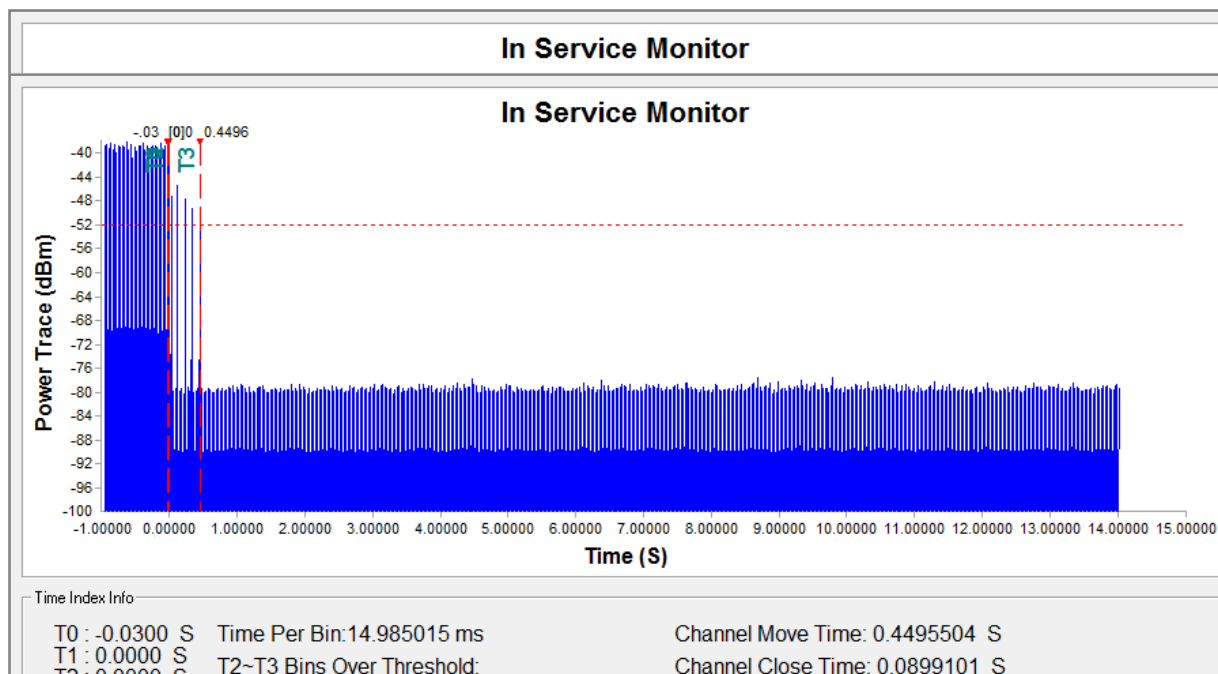
Test Plot of Channel closing transmission and channel move time

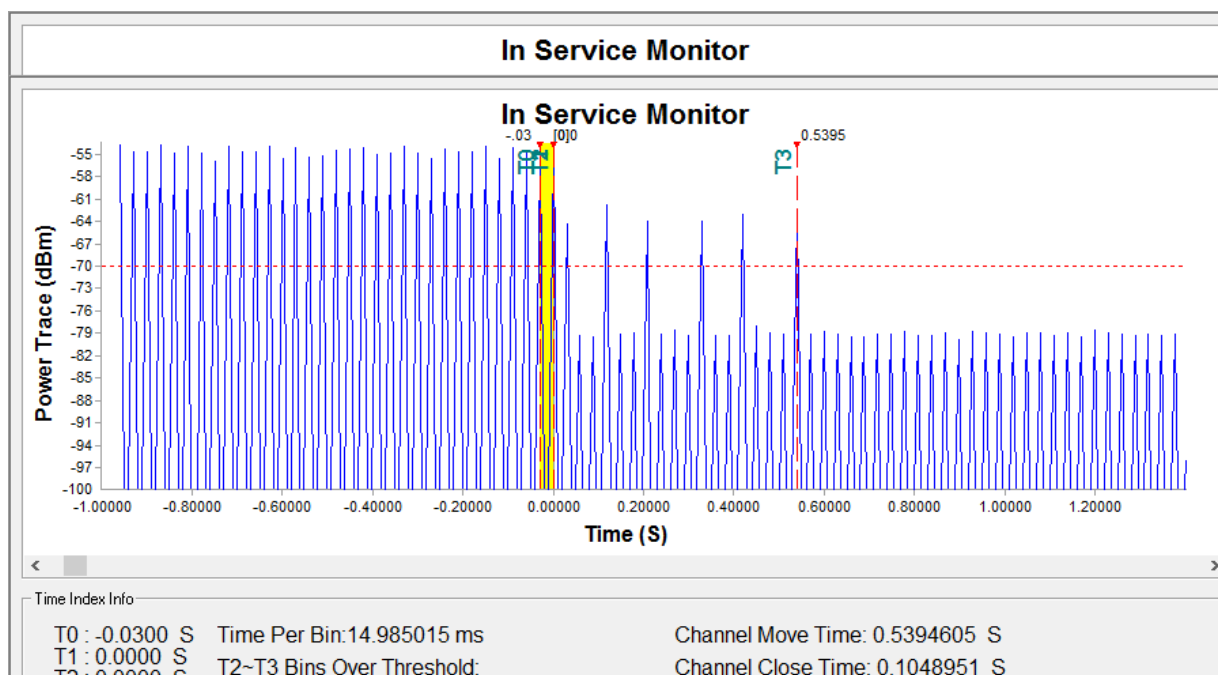
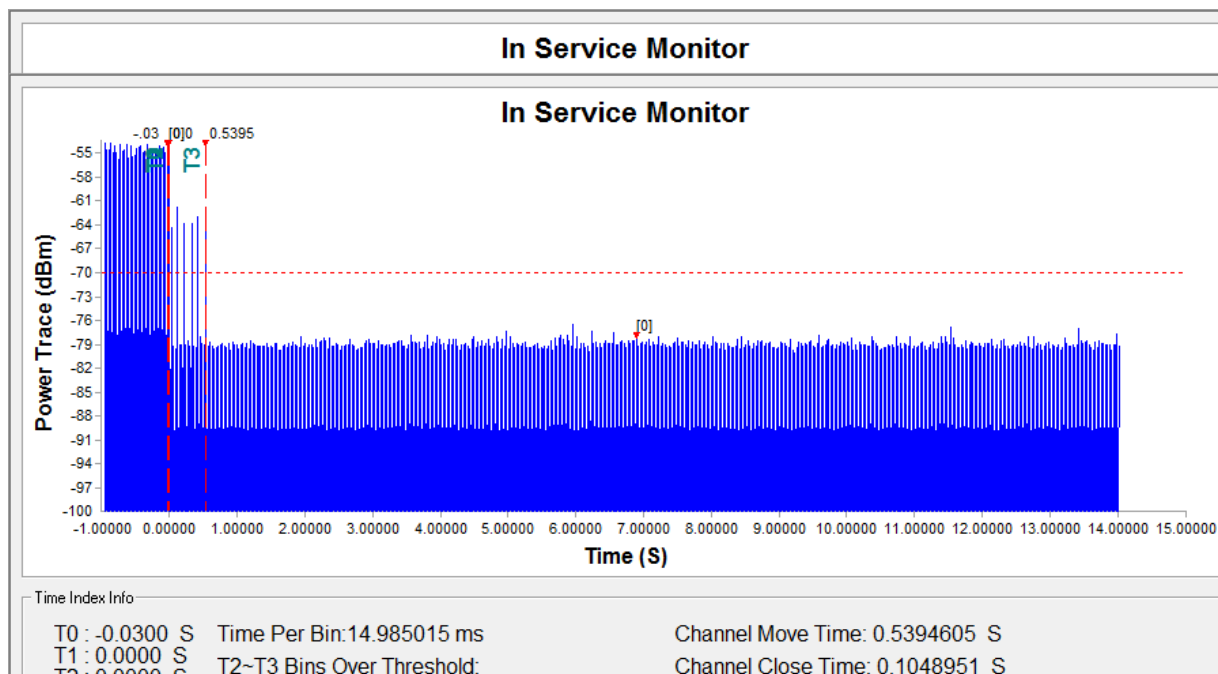
802.11a 5300MHz


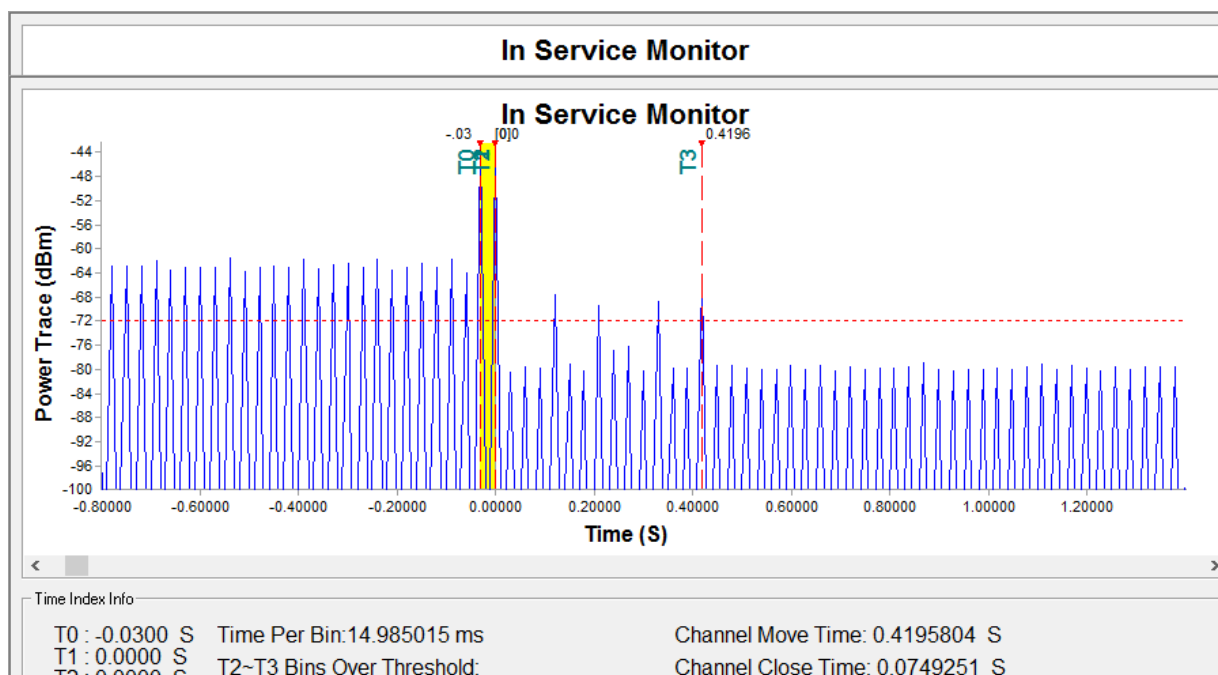
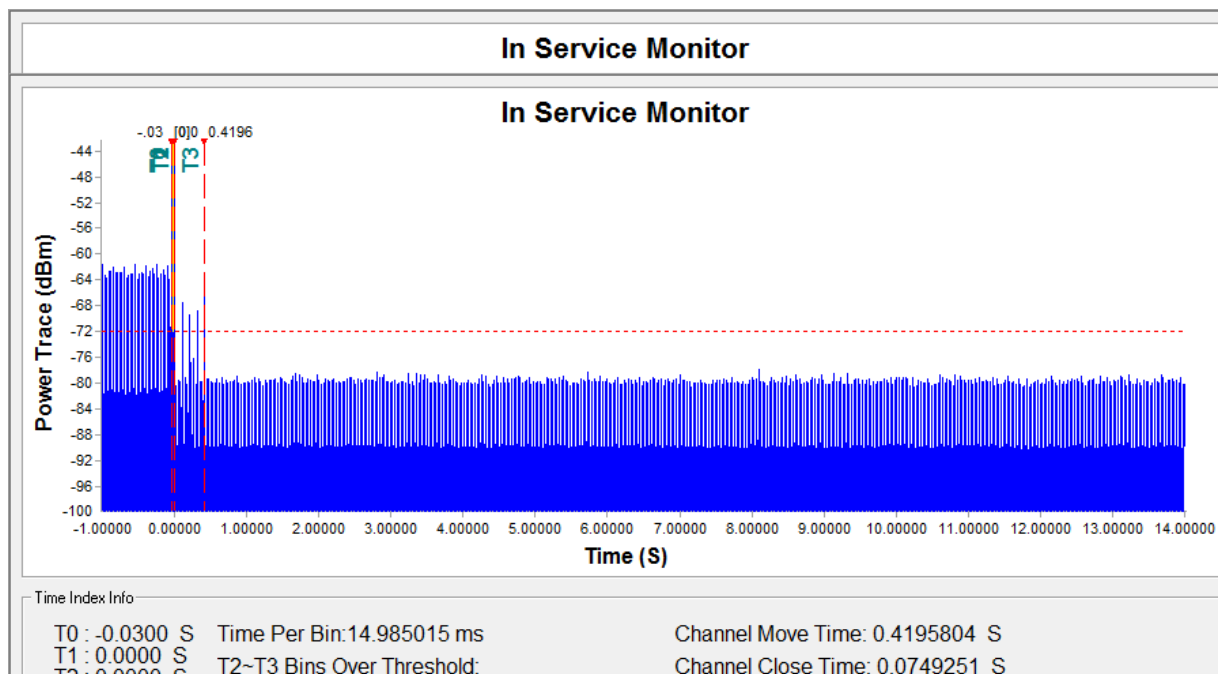
802.11a 5500MHz


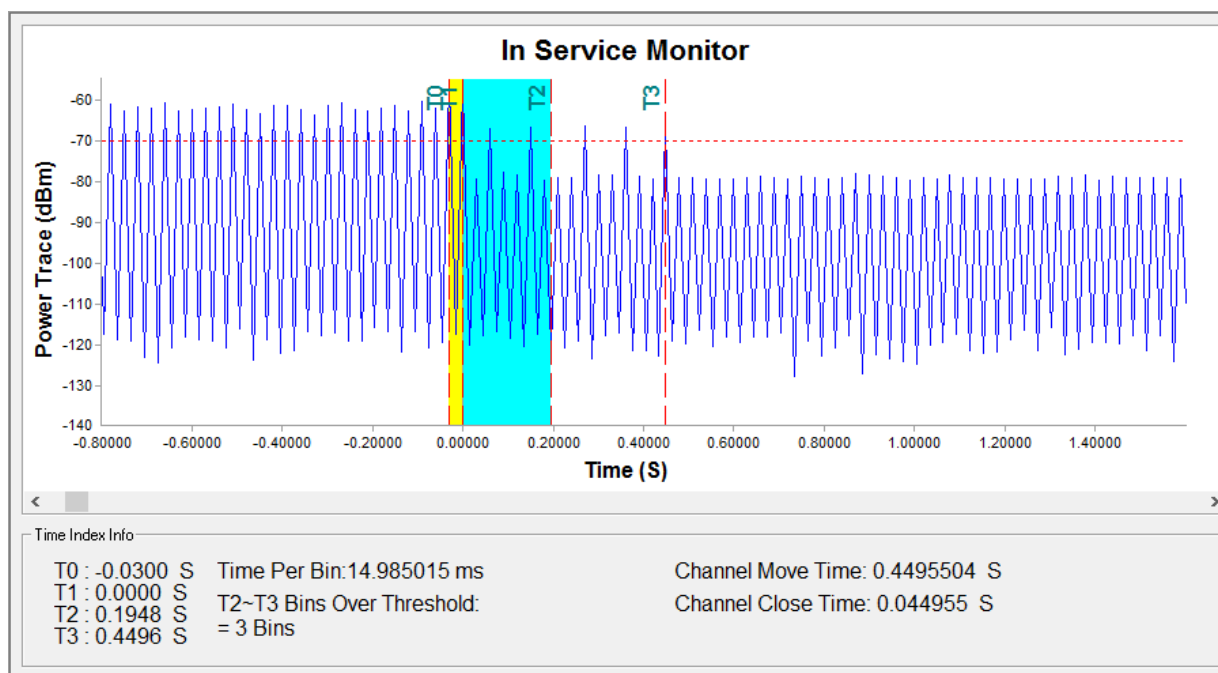
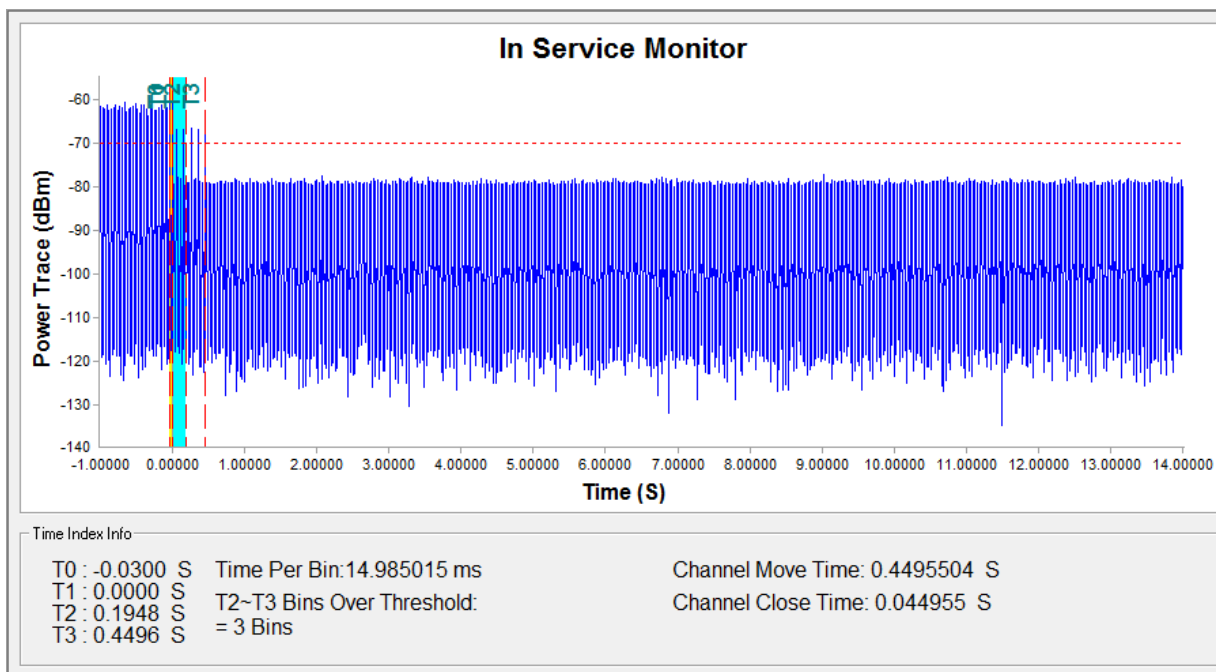
802.11a HT20 5300MHz


802.11a HT20 5500MHz


802.11a HT40 5310MHz


802.11a HT40 5510MHz


802.11AC 5290MHz


802.11AC 5530MHz


6.2.2 Non-Occupancy Period

RESULT:

Passed

Test standard : FCC Part 15.407(i), RSS-247 6.3, LP0002(4.7.7.2)
 Kind of test site : Shielded room

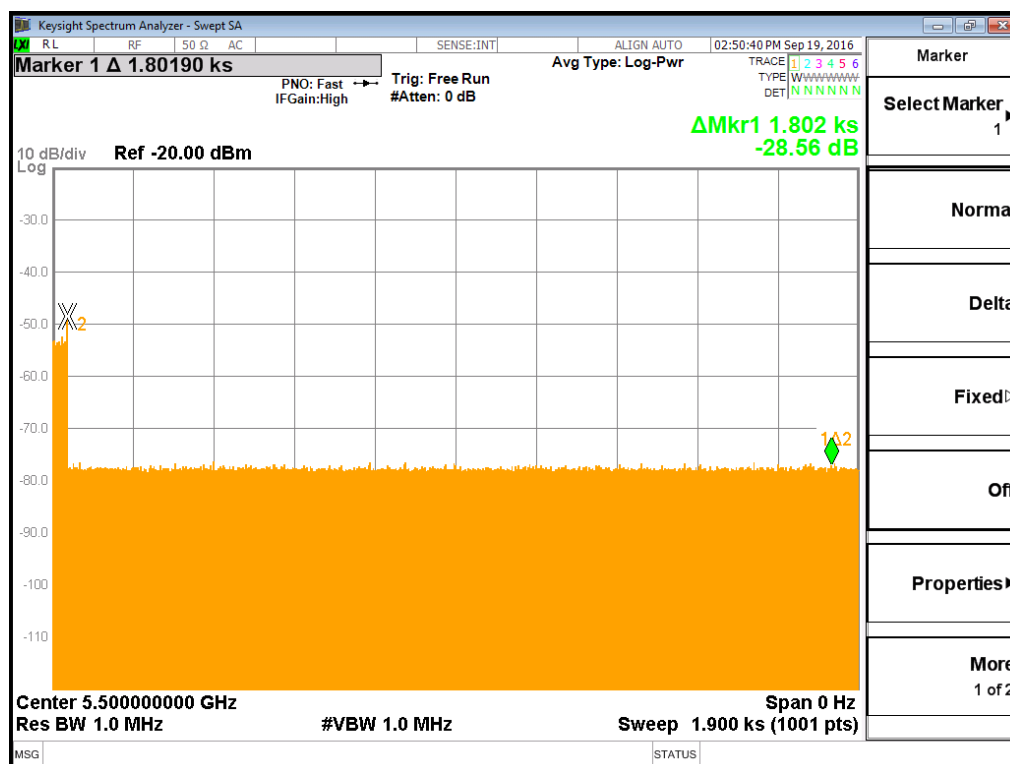
Test setup

Test Channel : 5300MHz ,5500MHz
 Operation Mode : Normal

Ambient temperature : 22-26 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

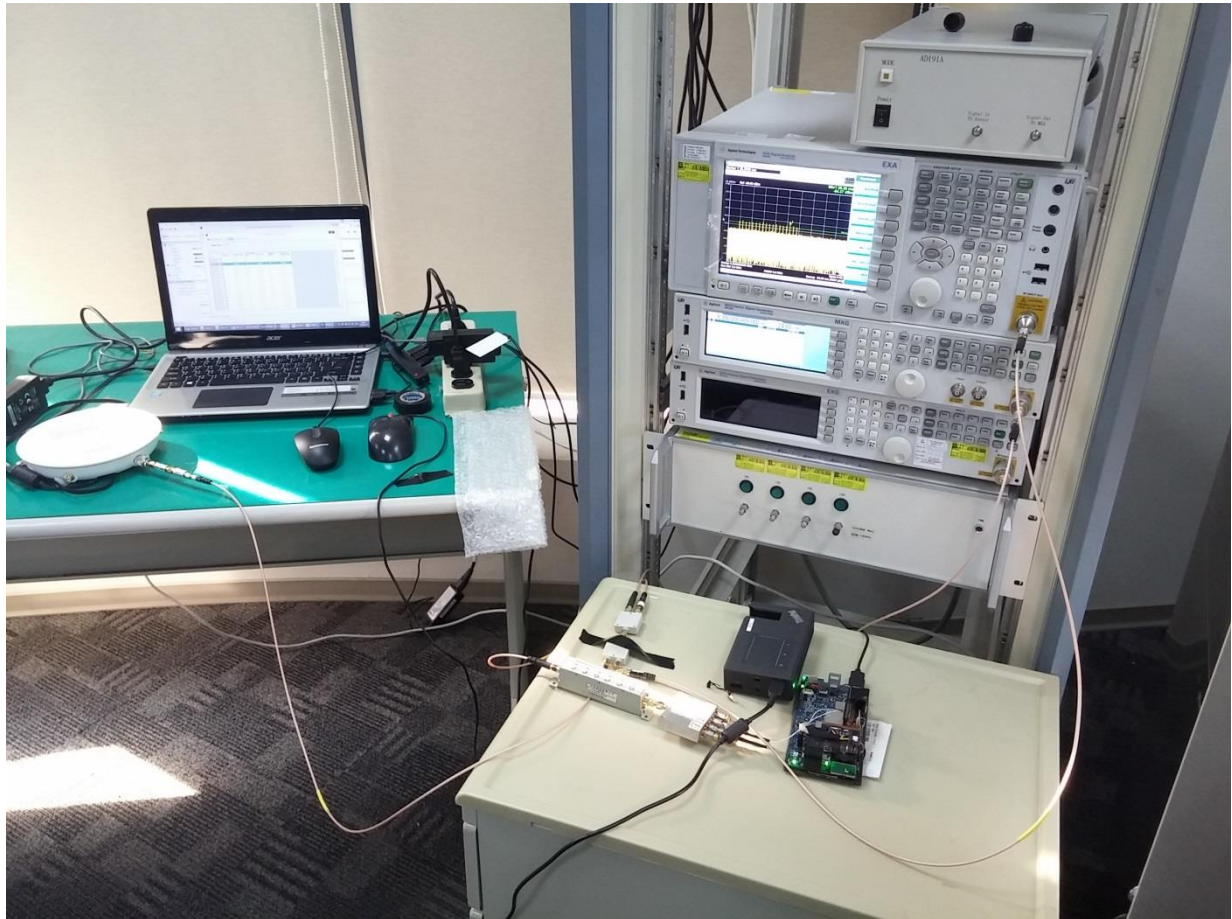
Test Plot of Non-Occupancy Period

802.11n HT20



7. Photographs of the Test Set-Up

Photograph 1: Set-up for Conducted testing



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