TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**10040070 001**	**Seite 1 von 31** *Page 1 of 31*
Auftraggeber: *Client:*	**Lite-On Technology Corporation** 90, Chien I Road, Chung Ho, Taipei Hsien 203, Taiwan, R.O.C.	
Gegenstand der Prüfung: *Test item:*	Combo module	
Bezeichnung: *Identification:*	WCBN603MH	**Serien-Nr.:** *Serial No.:* N/A
Wareneingangs-Nr.: *Receipt No.:*	**TPE81101**	**Eingangsdatum:** *Date of receipt:* 2012-12-20
Zustand des Prüfgegenstandes bei Anlieferung: **Condition of test item at delivery:**	The sample is ok for testing and not damaged	
Prüfort: *Testing location:*	**TÜV Rheinland Taiwan Ltd.** 11F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105 Taiwan **FCC Registration No.: 365730**	
Prüfgrundlage: *Test specification:*	**FCC CFR47 Part 15: Subpart E (DFS requirement)**	
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*	
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Taiwan Ltd.** **11F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105, Taiwan, R.O.C.**	

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
2013-01-23	Neil J. N. Tsai/Project Engineer		2013-01-23	René Charton/Senior Project Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges/ *Other Aspects:*

Abkürzungen:				*Abbreviations:*			
	P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*
	F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*
	N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*
	N/T	=	*nicht getestet*		*N/T*	=	*not tested*

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1. General Remarks

1.1 Complementary Materials

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

Table 1: Applied Standard and Test Levels

Radio
FCC CFR Title 47 Part 15 Subpart E 15.407 (h): 2010 FCC 06-96

1.2 Standard Requirement

U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands employ DFS in order to avoid causing interference to Federal Government radar systems. DFS is a feature that monitors the spectrum and selects for operation a frequency that is not already in use.

1.3 DFS overview

A U-NII network will employ a DFS function to:
(1) Detect signals from radar systems and to avoid co-channel operation with these systems.
(2) Provide on aggregate a Uniform Spreading of the Operating Channels across the entire band.
This applies to the 5250-5350 MHz and/or 5470-5725 MHz bands.
Within the context of the operation of the DFS function, a U-NII device will operate in either Master Mode or Client Mode. U-NII devices operating in Client Mode can only operate in a network controlled by a U-NII device operating in Master Mode.

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.: 365730
TAF Accredited NCC Test Lab. No.:0759
TAF ISO 17025 Certification effective periods: 2010-Jul-1st to 2013-Jun-30th

Testing Laboratory
0759

2.2 List of Test and Measurement Instruments

Table 2: List of DFS Test and Measurement Equipment

Kind of Equipment	Manufacturer	Type	S/N	Calibrated until
Spectrum Analyzer	R&S	FSV 40	100921	13-Dec-13
Signal Generator	R&S	SMU200	104260	13-Aug-13

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 Test Uncertainty

Time accuracy: 1ms

3. General Product Information

3.1 Product Function and Intended Use

"The tested sample is a Combo module, which is designed to work mount on other device. The module has two antenna ports, and it is has two work functions (Bluetooth and Wireless function)."

3.2 Ratings and System Details

Table 3: Technical Specification of EUT

Technical Specification	Value
Kind of Equipment	Combo module
Brand Name	Lite-On Technology Corporation
FCC ID	PPQ-WCBN603MH
Type Designation	WBCN603MH
Operating Frequency	5150 MHz ~ 5700 MHz
Operation Voltage	3.3Vdc (Via Mini PCI-E port)
Modulation	OFDM,DSSS
Antenna gain	3.46 dBi
Antenna Type	Monopole (Chant Sincere: 341AWAE11111004)

Table 4: IUT support DFS Channel information

Band	CH	Frequency (MHz)
802.11a Band II	52~64	5260 ~ 5320
802.11a Band III	100~140	5500 ~ 5700
802.11n (HT20) Band II	52~64	5260 ~ 5320
802.11n (HT20) Band III	100~140	5500 ~ 5700
802.11n (HT40) Band II	54~62	5270 ~ 5310
802.11n (HT40) Band III	102~134	5510 ~ 5670

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured as end user normal sample.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 4.

Test was applied on below test modes.

Test Mode	802.11a
	802.11a40

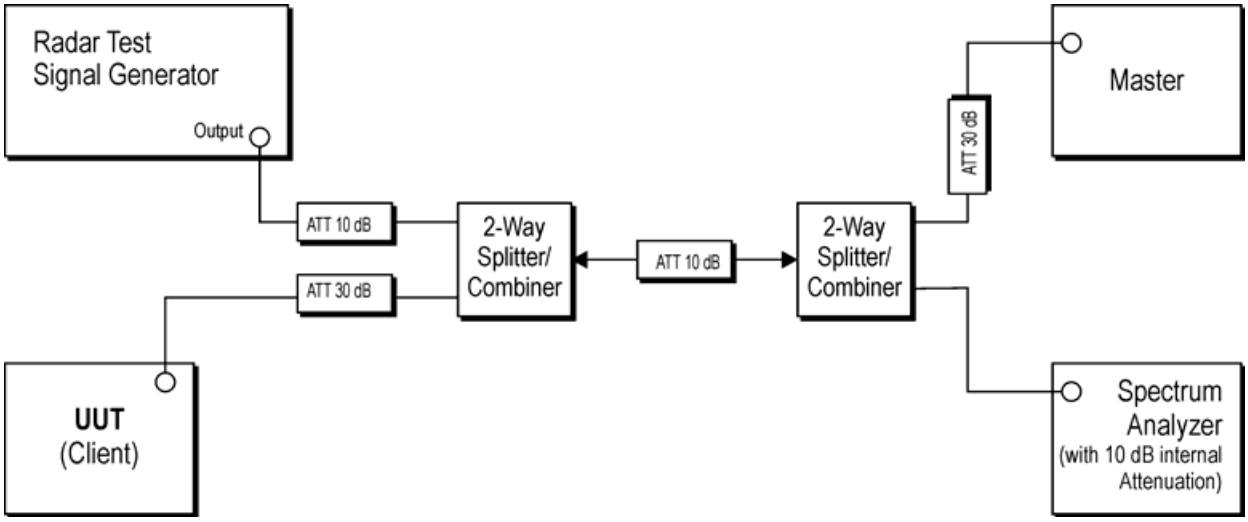
4.3 Special Accessories and Auxiliary Equipment

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

Kind of Equipment	**Manufacturer**	**Model Name**	**S/N**
Laptop	MSI	MSI4532 (CX420MX)	CX420 MX-233TWK 1008000096
Aironet IOS Access Point (Master)	Cisco	AIR-AP1252AG-A-K9	FGL1502Z03H

4.4 Test Setup Diagram

Diagram of Measurement Configuration for DFS Test



4.5 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
Uniform Spreading	Yes	Not required	Not required
U-NII Dection Bandwidth	Yes	Not required	Yes

4.6 Applicability of DFS Requirements during normal operation

Requirement	Operational Mode		
	Master	**Client without Radar Detection**	**Client with Radar Detection**
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Not required	Yes
Channel Move Time	Yes	Not required	Not required
U-NII Dection Bandwidth	Yes	Not required	Not required

4.7 DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection	
Maximum Transmit Power	**Value (See Notes 1 and 2)**
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 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.	

4.8 DFS Response Requirement Values

Paremeter	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 ms+aggregate of 60 ms over remaining 10 seconds period. See Notes 1 and 2.
U-NII Dection Bandwidth	Minimum 80% of the U-NII 99% transmission power bandwidth. See Note 3.

Note 1: The instant that the Channel Move Time and the Channel Closing Transmission Time begins is as follows:
• For the Short Pulse Radar Test Signals this instant is the end of the Burst.
• For the Frequency Hopping radar Test Signal, this instant is the end of the last radar Burst generated.
• For the Long Pulse Radar Test Signal this instant is the end of the 12 second period defining the Radar Waveform.
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 1 is used and for each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

4.9 Radar Test Waveforms

4.9.1 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum percentage of successful detection	Minimum Number of Trials
1	1	1428	18	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

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4.
For Short Pulse Radar Type 1, the same waveform is used a minimum of 30 times. 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.

4.9.2 Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per Burst	Number of Burst	Minimum percentage of successful detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms. If more than 30 waveforms are used for the Long Pulse Radar Type waveforms, then each additional waveform must also be unique and not repeated from the previous waveforms.

Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 Bursts in the 12 second period, with the number of Bursts being randomly chosen. This number is Burst_Count.
3) Each Burst consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each Burst within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a Burst will have the same pulse width. Pulses in different Bursts may have different pulse widths.
5) Each pulse has a linear frequency modulated chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a Burst will have the same chirp width. Pulses in different Bursts may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a Burst, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a Burst, the random time interval between the first and second pulses is chosen independently of the random time interval between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to Burst_Count. Each interval is of length (12,000,000 / Burst_Count) microseconds. Each interval contains one Burst. The start time for the Burst, relative to the beginning of the interval, is between 1 and [(12,000,000 / Burst_Count) – (Total Burst Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each Burst is chosen randomly.

A representative example of a Long Pulse Radar Type waveform:

1) The total test waveform length is 12 seconds.
2) Eight (8) Bursts are randomly generated for the Burst_Count.
3) Burst 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) Bursts 2 through 8 are generated using steps 3 – 5.

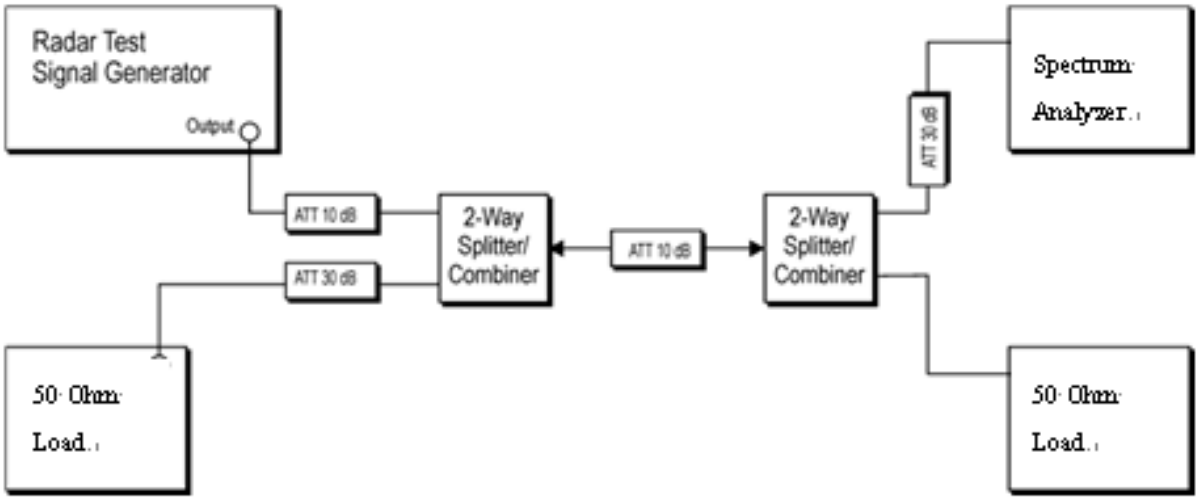
7) Each Burst is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, Burst 1 is randomly generated (1 to 1,500,000 minus the total Burst 1 length + 1 random PRI interval) at the 325,001 microsecond step. Bursts 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. Burst 2 falls in the 1,500,001 – 3,000,000 microsecond range).

4.9.3 Frequency Hopping Radar Test Waveform

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

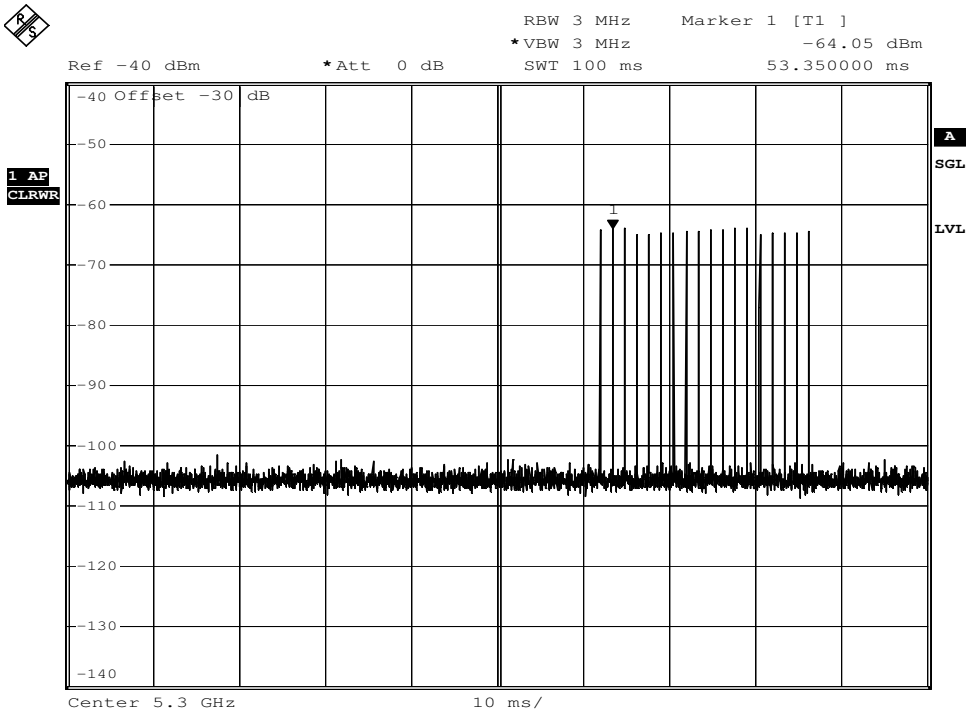
For the Frequency Hopping Radar Type, the same Burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm:
The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

4.9.4 Radar Waveform Calibration setup



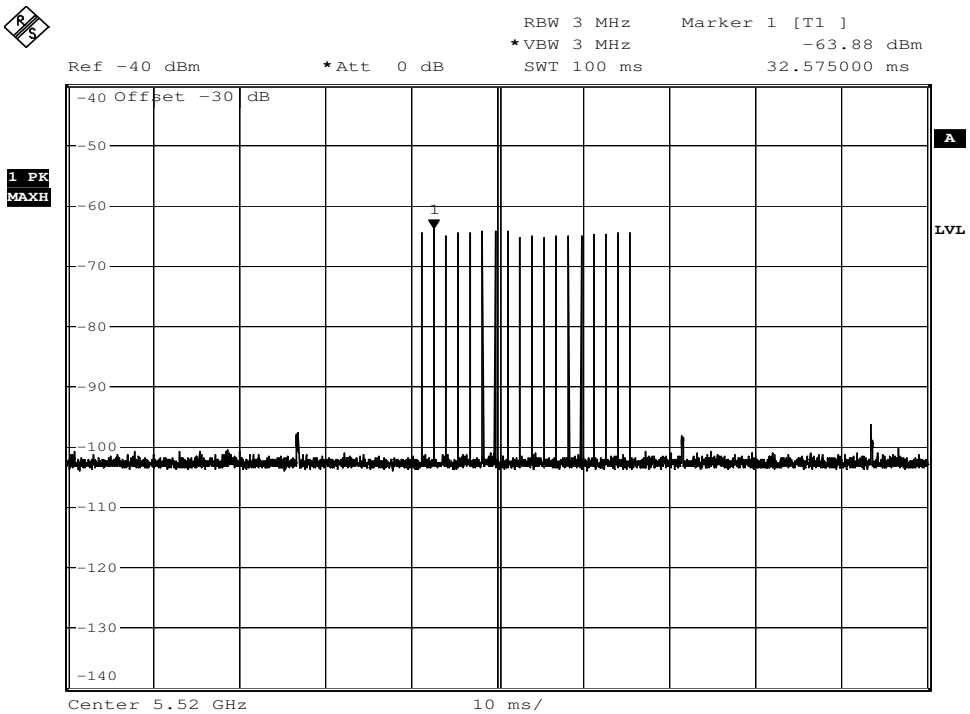
4.9.5 Radar Waveform Calibration Result

Radar Type 1 Calibration Plot (Band II)



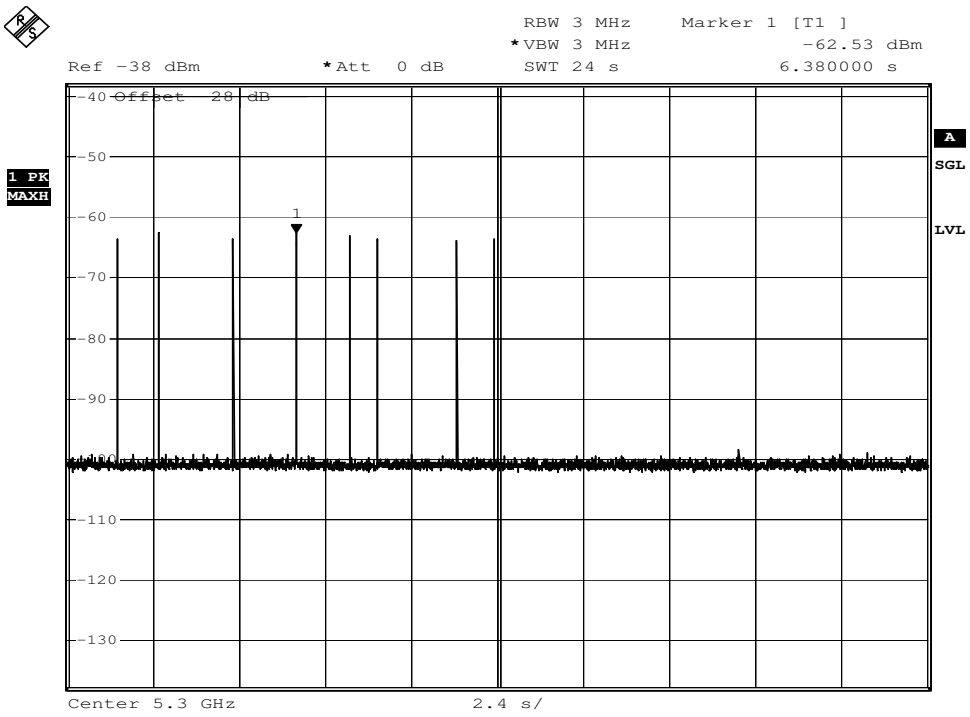
Date: 11.JAN.2013 18:14:58

Radar Type 1 Calibration Plot (Band III)



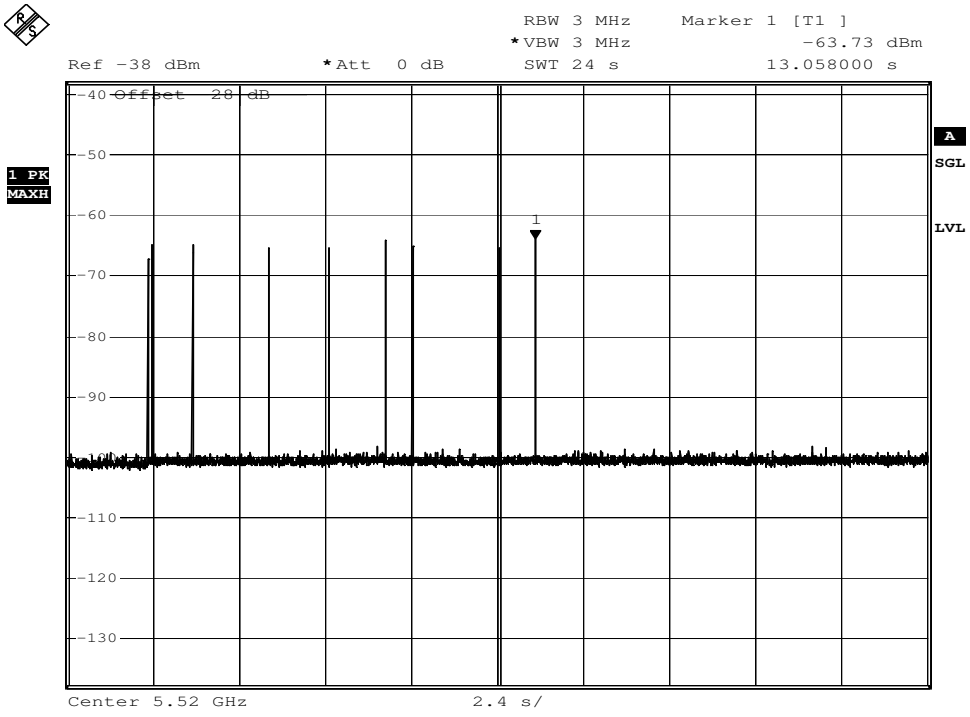
Date: 11.JAN.2013 18:13:50

Radar Type 5 Calibration Plot (Band II)



Date: 11.JAN.2013 18:20:30

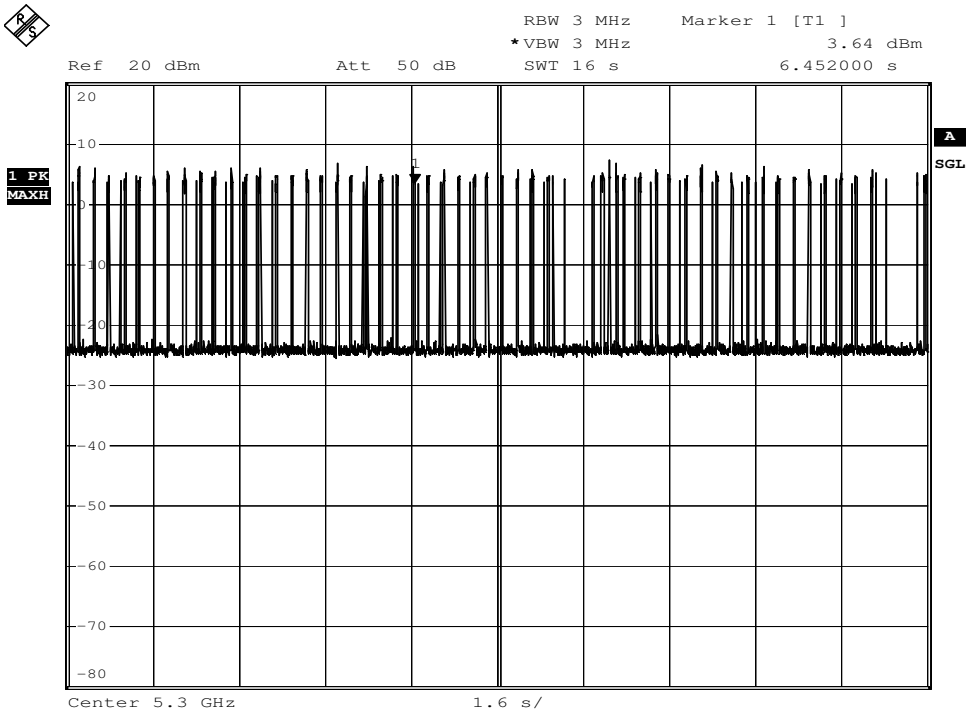
Radar Type 5 Calibration Plot (Band III)



Date: 11.JAN.2013 18:30:58

4.9.6 Slave Data Traffic Plot

Slave Data Traffic Plot (Band II)



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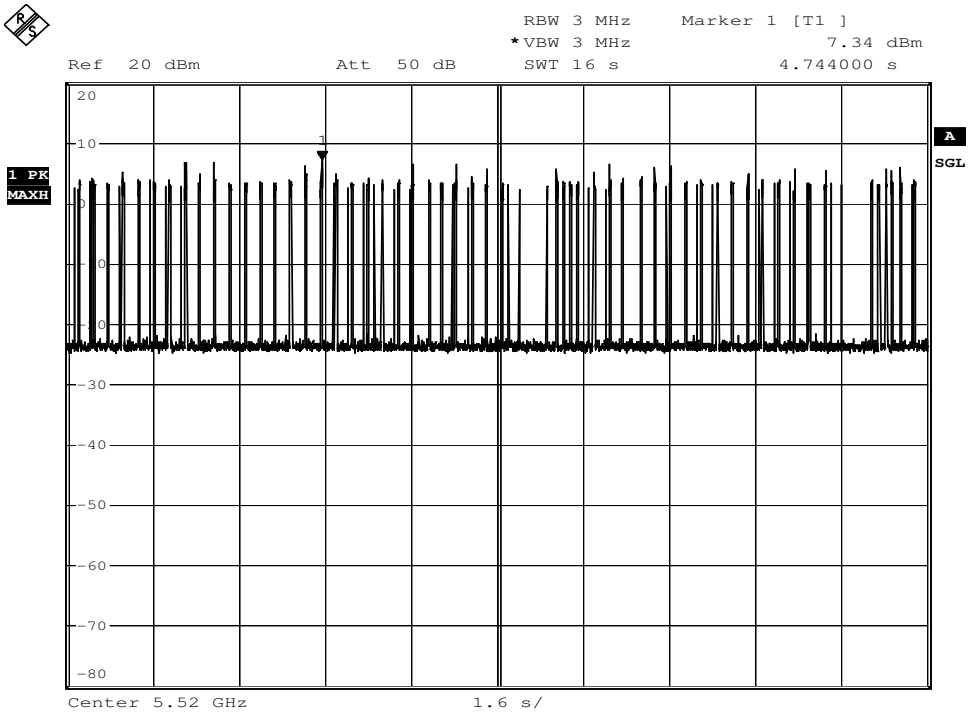
Slave Data Traffic Plot (Band III)



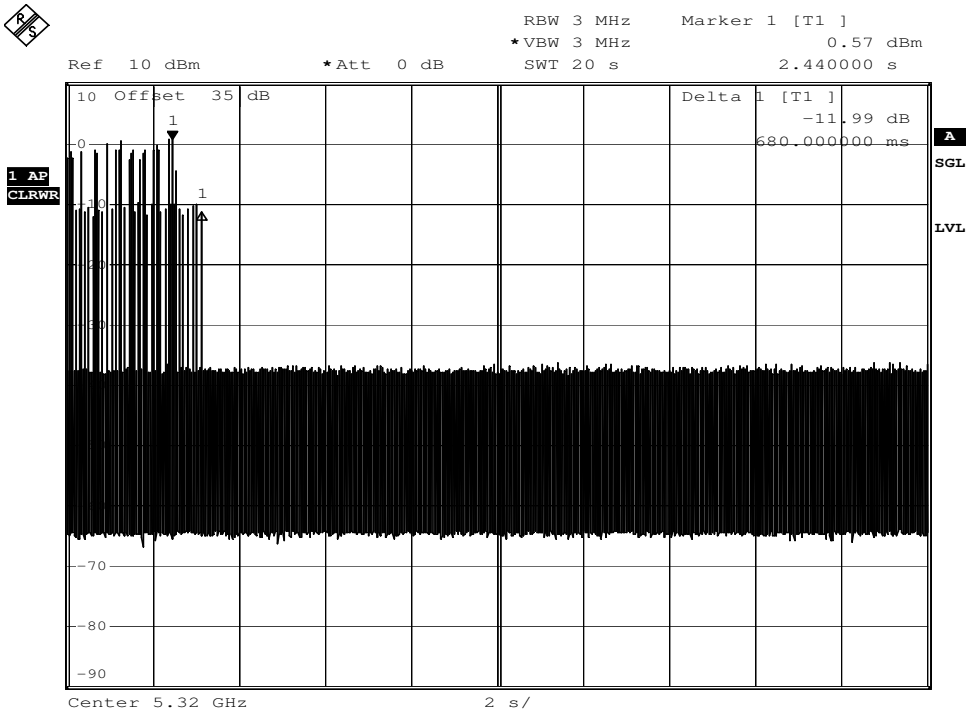
Date: 11.JAN.2013 16:54:53

5. Test Result of Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

5.1.1 Channel Move Time

Test Item : Channel Move Time
Radar Type : Type 1
Test Mode : 802.11a

Channel Move Time of Radar Test Type 1 (Band II)

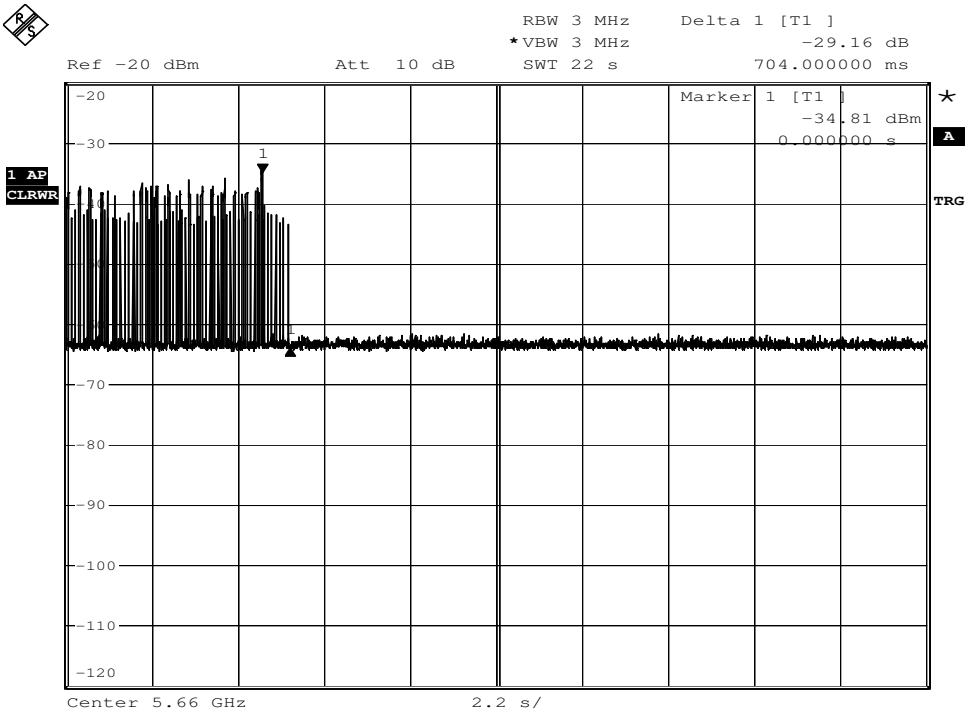


Date: 11.JAN.2013 19:44:31

Test Item	Test Result (Sec)	Limit (Sec)	Result
Channel Move Time	0.68	10	Pass

Test Item : Channel Move Time
Radar Type : Type 1
Test Mode : 802.11n40

Channel Move Time of Radar Test Type 1 (Band III)

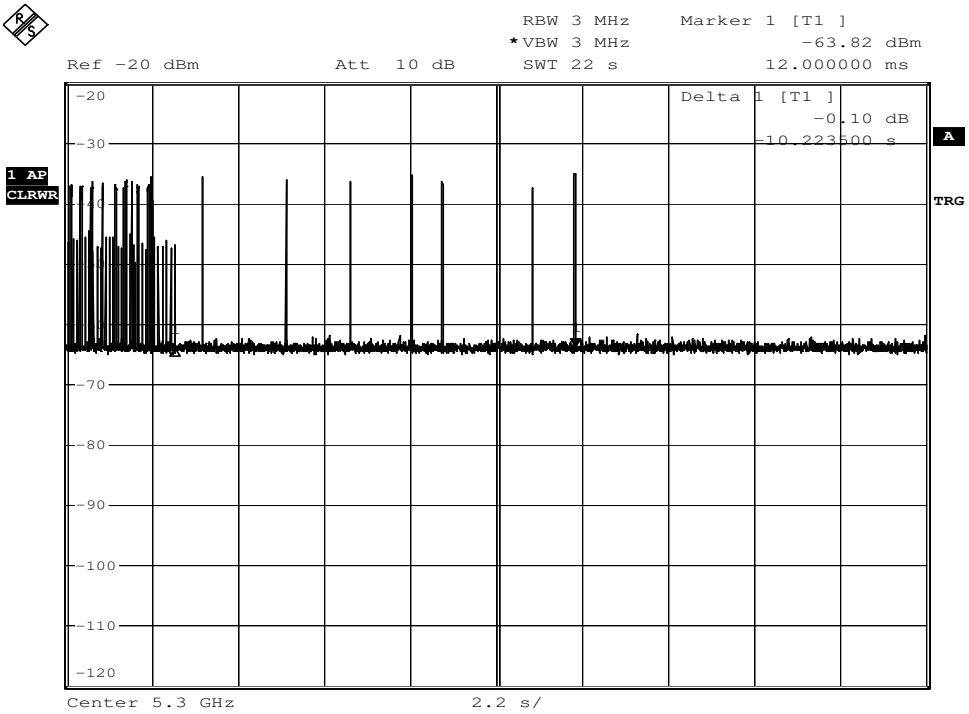


Date: 11.JAN.2013 22:11:34

Test Item	Test Result (Sec)	Limit (Sec)	Result
Channel Move Time	0.7	10	Pass

Test Item : Channel Move Time
Radar Type : Type 5
Test Mode : 802.11a

Channel Move Time of Radar Test Type 5 (Band II)

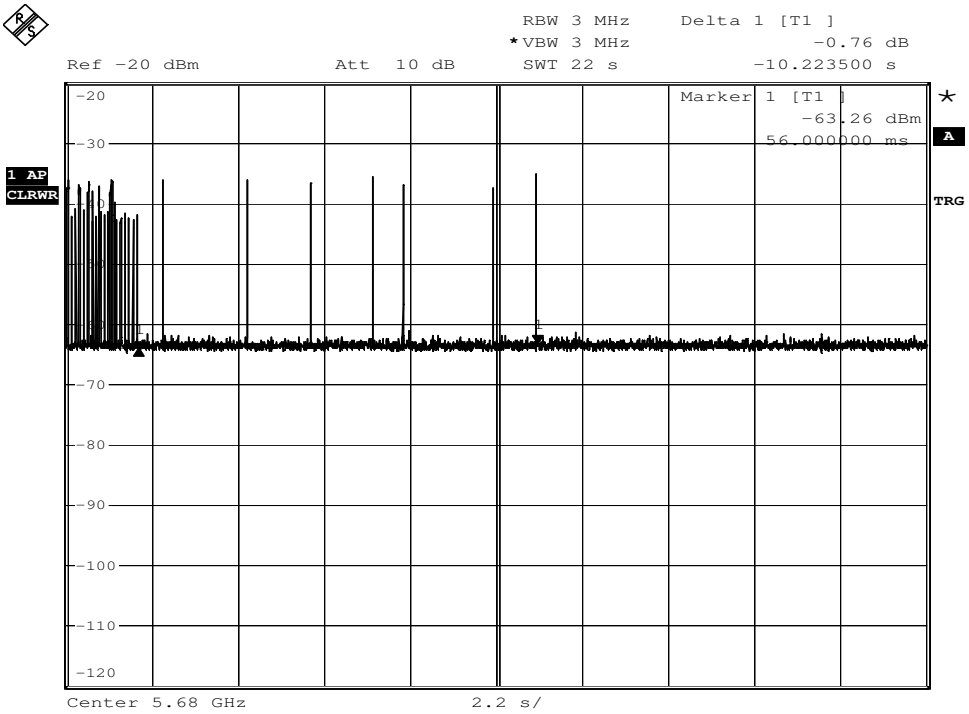


Date: 11.JAN.2013 21:51:02

Test Item	Test Result (Sec)	Limit (Sec)	Result
Channel Move Time	0	10	Pass

Test Item : Channel Move Time
Radar Type : Type 5
Test Mode : 802.11n40

Channel Move Time of Radar Test Type 5 (Band III)



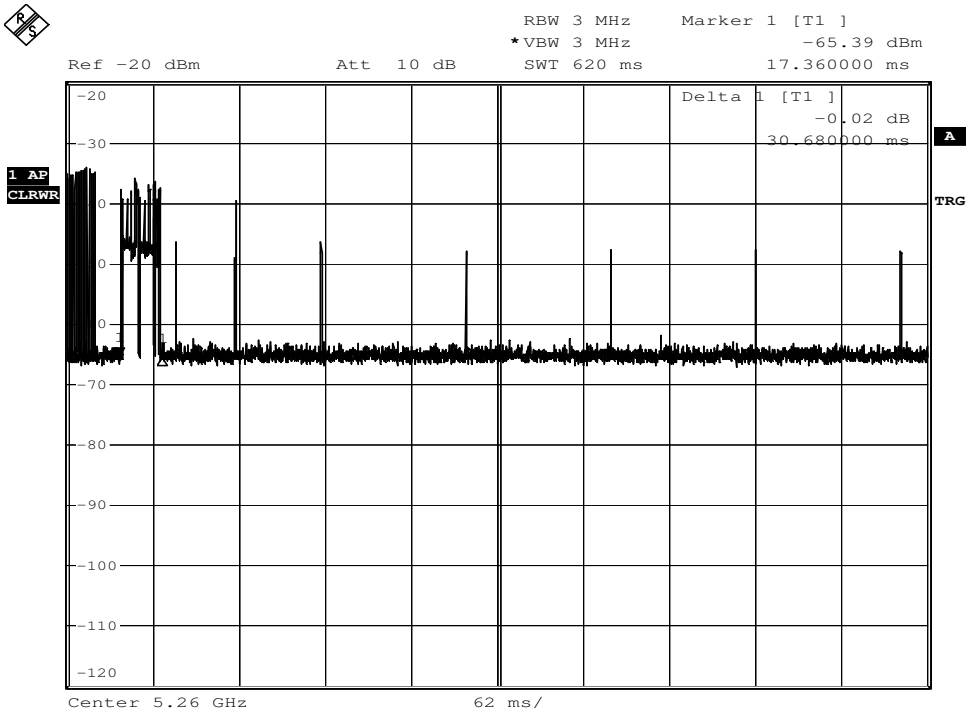
Date: 11.JAN.2013 21:59:47

Test Item	Test Result (Sec)	Limit (Sec)	Result
Channel Move Time	0	10	Pass

5.1.2 Channel Closing Transmission Time

Test Item : Channel Closing Transmission Time
Radar Type : Type 1
Test Mode : 802.11a

Channel Closing Transmission Time of Radar Test Type 1 (Band II)

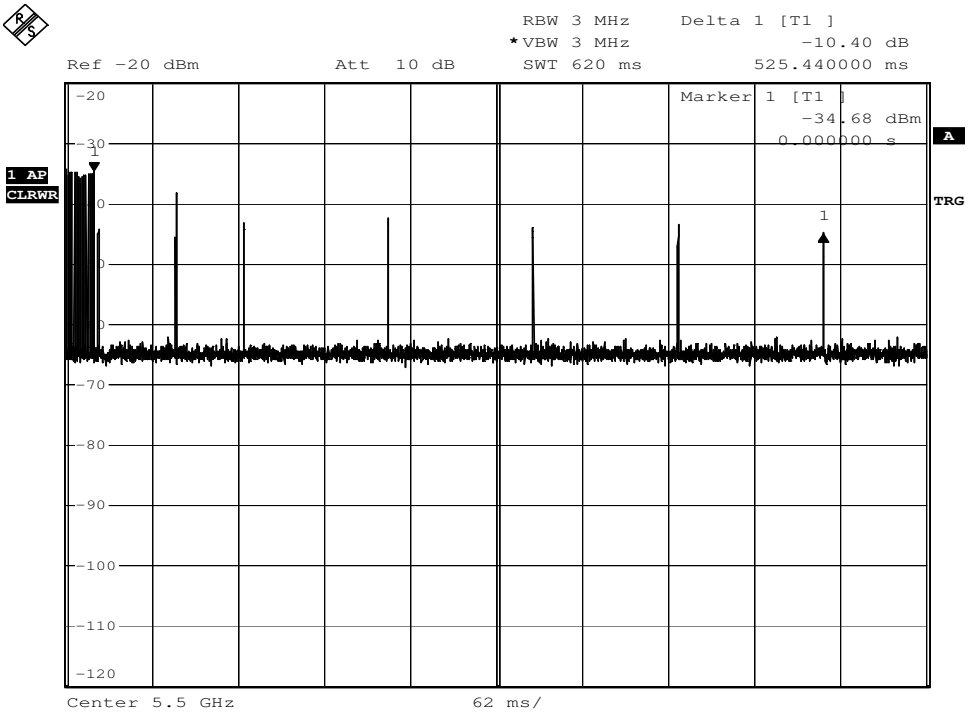


Test Item	Test Result (ms)	Limit (Sec)	Result
Channel Closing Transmission Time	0.775	200 ms + approx. 60 ms over remaining 10 seconds period	Pass

The test result is “bin number X time per bin (620ms / 4000)”
The results showed that after radar signal injected the channel transmission closing time less than 200 ms and an aggregate of no more then 60 ms.

Test Item : Channel Closing Transmission Time
Radar Type : Type 1
Test Mode : 802.11n40

Channel Closing Transmission Time of Radar Test Type 1 (Band III)



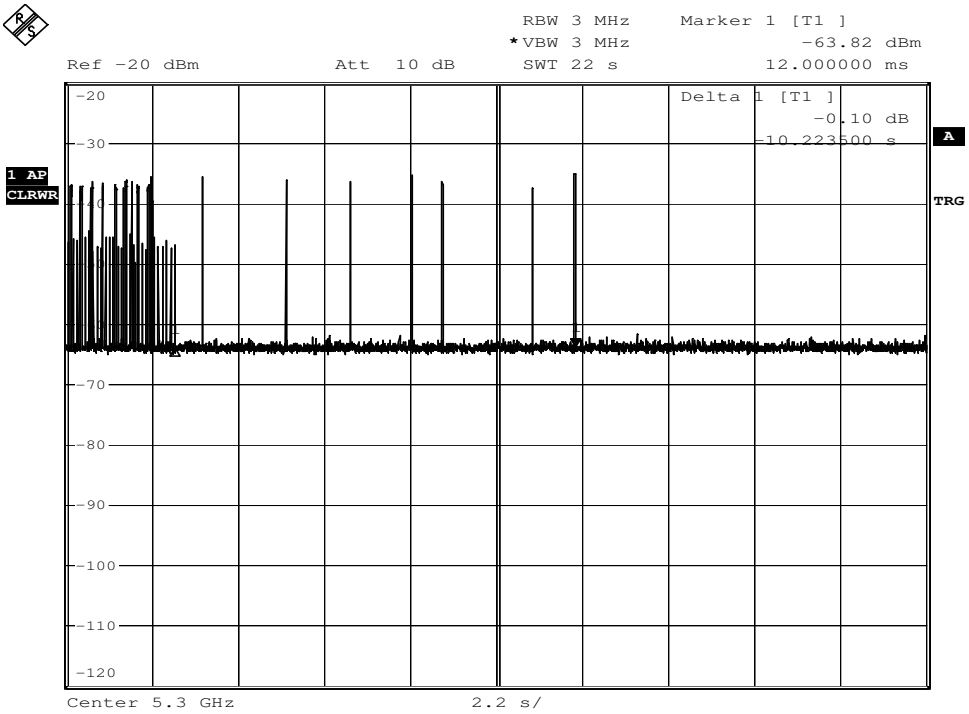
Date: 11.JAN.2013 22:30:46

Test Item	Test Result (ms)	Limit (Sec)	Result
Channel Closing Transmission Time	0.465	200 ms + approx. 60 ms over remaining 10 seconds period	Pass

The test result is “bin number X time per bin (620ms / 4000)”
The results showed that after radar signal injected the channel transmission closing time less than 200 ms and an aggregate of no more then 60 ms.

Test Item : Channel Closing Transmission Time
Radar Type : Type 5
Test Mode : 802.11a

Channel Closing Transmission Time of Radar Test Type 5 (Band II)

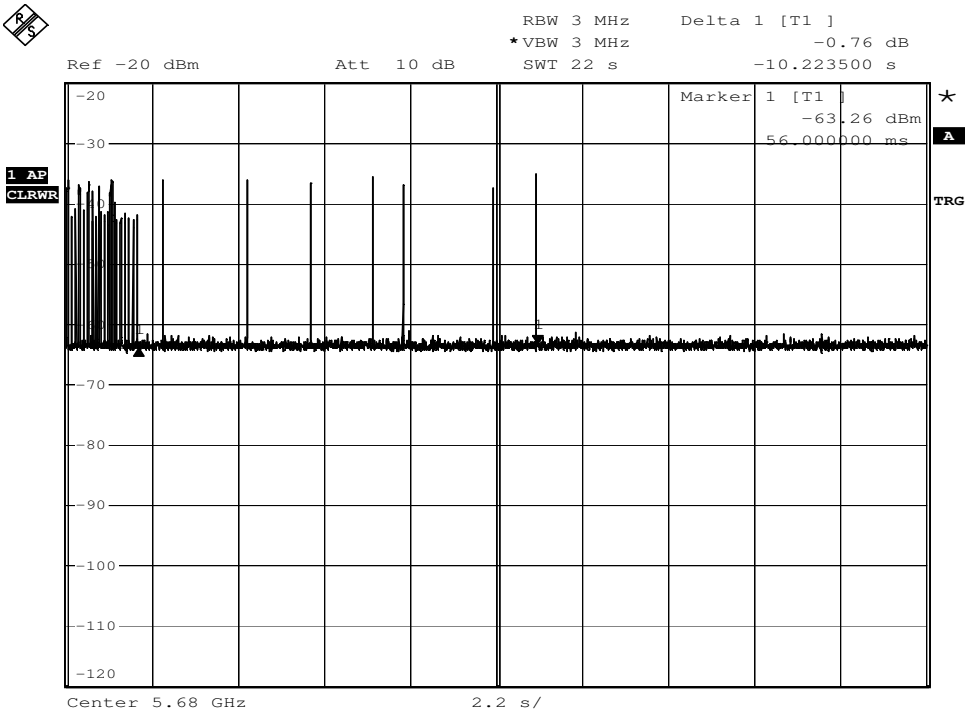


Test Item	Test Result (ms)	Limit (Sec)	Result
Channel Closing Transmission Time	0	200 ms + approx. 60 ms over remaining 10 seconds period	Pass

The test result is 0 since IUT stop transmission before end of Radar signal
The results showed that after radar signal injected the channel transmission closing time less than 200 ms and an aggregate of no more then 60 ms.

Test Item : Channel Closing Transmission Time
Radar Type : Type 5
Test Mode : 802.11n40

Channel Closing Transmission Time of Radar Test Type 5 (Band III)



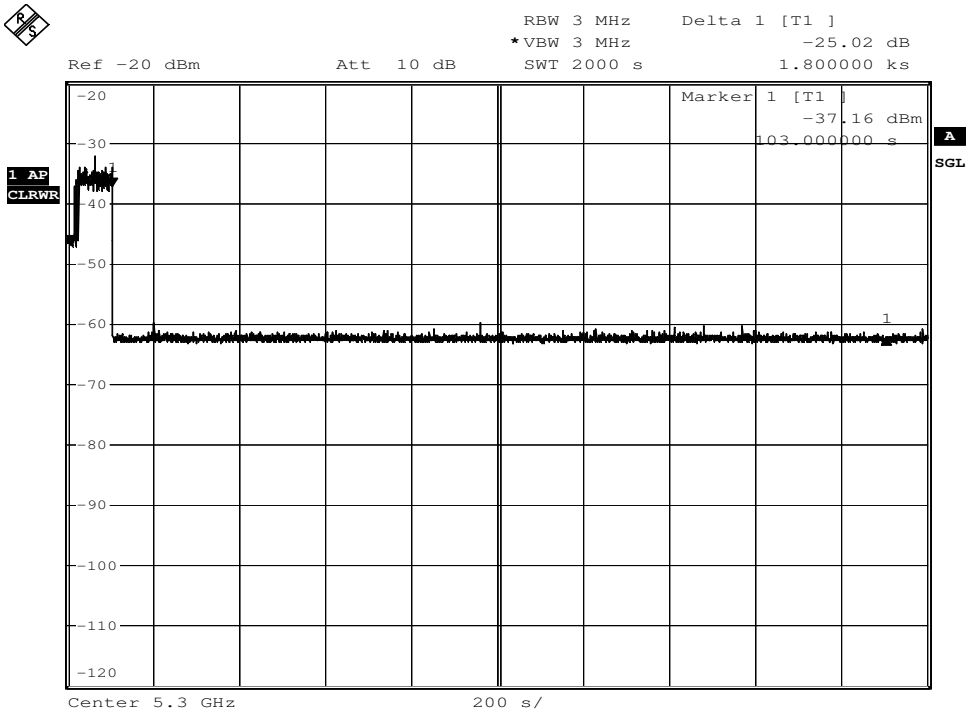
Test Item	Test Result (ms)	Limit (Sec)	Result
Channel Closing Transmission Time	0	200 ms + approx. 60 ms over remaining 10 seconds period	Pass

The test result is 0 since IUT stop transmission before end of Radar signal
The results showed that after radar signal injected the channel transmission closing time less than 200 ms and an aggregate of no more then 60 ms.

5.1.3 Non-Occupancy Period

Test Item : Non-Occupancy Period
Radar Type : Type 1
Test Mode : 802.11a

Non-Occupancy Period of Radar Test Type 1 (Band II)

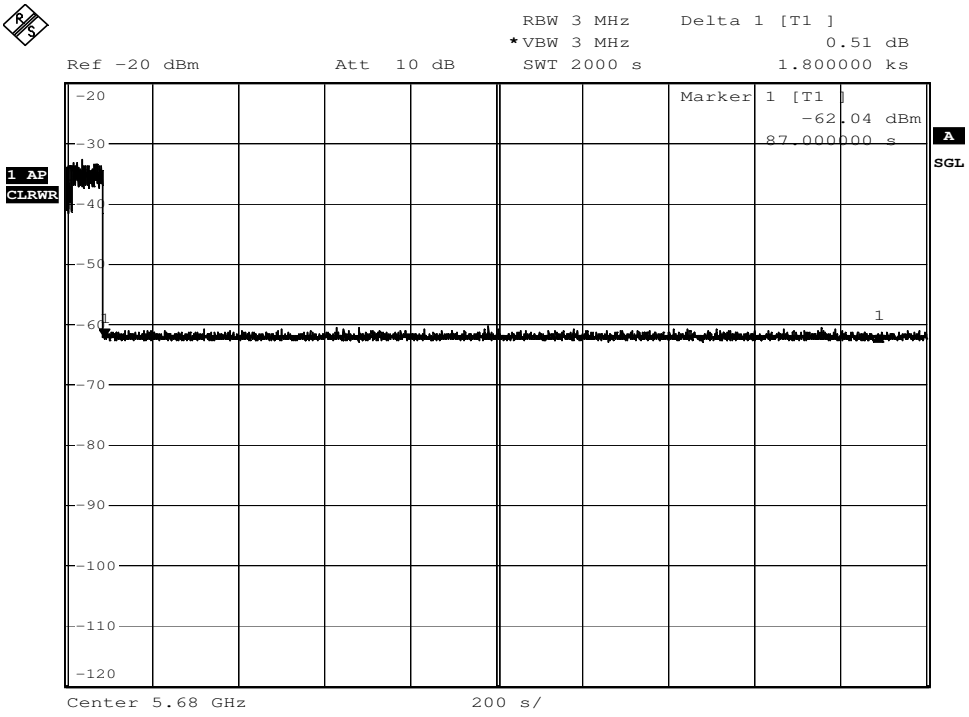


Date: 11.JAN.2013 20:37:53

Test Item	Test Result (Minutes)	Limit (Minutes)	Result
Non-Occupancy Period	> 30	>= 30	Pass

Test Item : Non-Occupancy Period
Radar Type : Type 1
Test Mode : 802.11n40

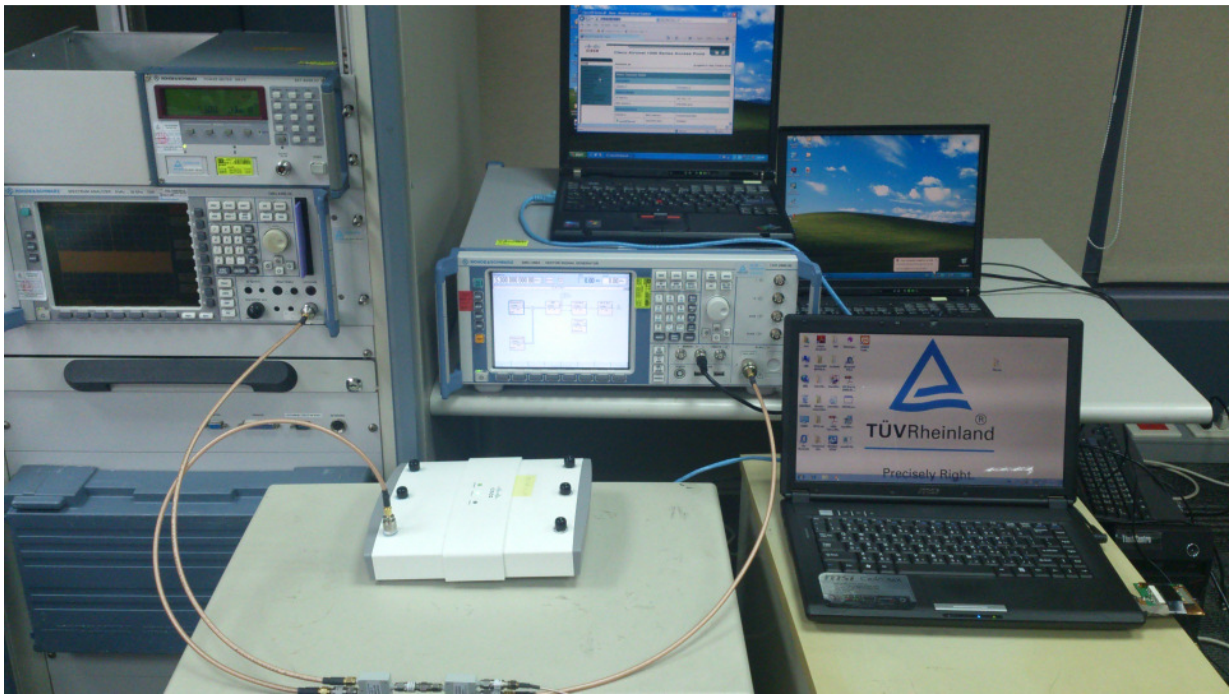
Non-Occupancy Period of Radar Test Type 1 (Band III)



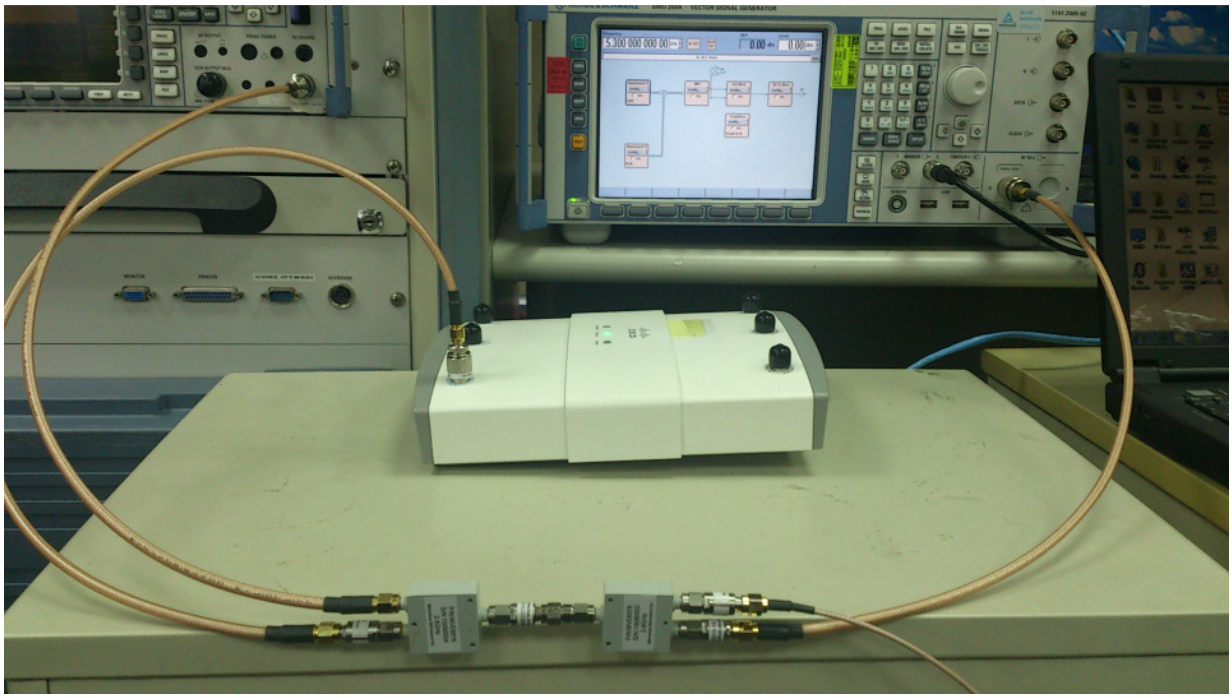
Test Item	Test Result (Minutes)	Limit (Minutes)	Result
Non-Occupancy Period	> 30	>= 30	Pass

6. Photographs of the Test Set-Up

Photograph 1: Set-up for DFS testing



Photograph 2: Set-up for DFS testing



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