



LCIE

TEST REPORT

N°: 137269-676311

Subject **Electromagnetic compatibility and Radio spectrum Matters
(ERM) tests according to standards:
47 CFR Part 15.407 (DFS Test Only)**

Issued to **Bittium Wireless Ltd.**
Tutkijantie 8
Oulu
Finland
90590

FCC Registration Number 166175
Industry Canada Number 6230B

Apparatus under test

↳ **Product** **Bittium Tough Mobile**
↳ **Trade mark** **Bittium**
↳ **Manufacturer** **Bittium**
↳ **Model under test** **Bittium Tough Mobile**
↳ **Serial number** **K0253000550**
↳ **FCC ID** **V27SD-41**
↳ **IC** **3282B-SD41**

Test date September 4th, 2015
Test location Fontenay Aux Roses
Test performed by Mathieu CERISIER
Composition of document 27 pages

Document issued on September 9th, 2015

Written by :
Mathieu CERISIER
Tests operator



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SUMMARY

1.	TEST PROGRAM.....	3
2.	EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)	4
3.	DFS DETECTION THRESHOLDS DETERMINATION, REFERENCE NOISE LEVEL & CHANNEL LOADING	10
4.	DYNAMIC FREQUENCY SELECTION (DFS): CHANNEL MOVE TIME & CHANNEL CLOSING TRANSMISSION TIME	16
5.	DYNAMIC FREQUENCY SELECTION (DFS): NON-OCCUPANCY PERIOD	21
6.	UNCERTAINTIES CHART	26
7.	RADAR TEST SIGNALS	27

**1. TEST PROGRAM****References**

- 47 CFR Part 15.407
- 905462 D02 UNII DFS Compliance Procedure New Rules v01r02
- 905462 D04 Test Mode New Rules v01
- 905462 D03 Client Without DFS New Rules v01r01
- 905462 D06 802.11 Channel Plans New Rules v01
- 905462 D07 Overview UNII Rules v01

Requirement:

Test Description prior to use of a channel	Test result - Comments			
Non-occupancy period	☒ PASS	☐ FAIL	☐ NA	☐ NP
DFS Detection Threshold	☐ PASS	☐ FAIL	☒ NA (1)	☐ NP
Channel Availability Check Time	☐ PASS	☐ FAIL	☒ NA(1)	☐ NP
U-NII Detection Bandwidth	☐ PASS	☐ FAIL	☒ NA (1)	☐ NP
This table is a summary of test report, see conclusion of each clause of this test report for detail.				

Test Description during normal operation	Test result - Comments			
DFS Detection Threshold	☐ PASS	☐ FAIL	☒ NA (1)	☐ NP
Channel Closing Transmission Time	☒ PASS	☐ FAIL	☐ NA	☐ NP
Channel Move Time	☒ PASS	☐ FAIL	☐ NA	☐ NP
U-NII Detection Bandwidth	☐ PASS	☐ FAIL	☒ NA	☐ NP
This table is a summary of test report, see conclusion of each clause of this test report for detail.				

(1): The EUT is a client without radar detection.

PASS: EUT complies with standard's requirement

FAIL: EUT does not comply with standard's requirement

NA: Not Applicable

NP: Test Not Performed

DP: Declaration of provider

2. EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):
Bittium Tough Mobile

Serial Number: K0253000550

Bittium

Bittium
Tough Mobile
Strong and secure
LTE smartphone



Equipment Under Test



Inputs/outputs:

Access	Type
Power & Data	Micro USB
Data	SD slot
Data	USB
Audio	Jack
Data	Docking connector

Equipment information:

Type:	WIFI			
Frequency band:	☒ 5150MHz-5250MHz	☒ 5250MHz-5350MHz	☒ 5470MHz-5725MHz	
Standard:	☒ 802.11a	☒ 802.11n HT20	☒ 802.11n HT40	
	☒ 802.11ac VHT80		☐ 802.11ac VHT160	
Spectrum Modulation:	☒ OFDM			
Channel bandwidth:	☒ 20MHz	☒ 40MHz	☒ 80MHz	☐ 160MHz
Antenna Type:	☒ Integral		☐ External	
Antenna connector:	☐ Yes		☐ No	
Transmit chains:	☒ 1		☐ 2	☐ 3
	☐ 5		☐ 6	☐ 7
	☐ 8		☐ 8	
	☐ Single antenna		☐ Symmetrical	
	☒ Asymmetrical			
	Gain 1: 2,5dBi		Gain 2: 2dBi	Gain 3: dBi
Gain 5: dBi		Gain 6: dBi	Gain 7: dBi	Gain 8: dBi
Accumulated Gain: dBi				
TPC:	☐ Yes		☒ No	
Receiver chains	☒ 1		☐ 2	☐ 3
	☐ 5		☐ 6	☐ 7
Type of equipment:	☒ Stand-alone		☐ Plug-in	
Specific mode:	☐ Ad-Hoc		☐ Bridge	
System type:	☒ IP based		☐ Frame based	
DFS operation:	☐ Master		☒ Slave with radar detection	
User access restriction:	☒ Yes		☐ No	
Equipment type:	☒ Production model		☐ Pre-production model	
Type of power source:	☒ AC power supply		☐ DC power supply	
Operating voltage range:	Vnom:		☐ 120V/60Hz	
			☒ 3.8Vdc	



CHANNEL PLAN		
802.11a / 802.11n HT20		
Channel	Frequency (MHz)	Available Channel
36	5180	☒
40	5200	☒
44	5220	☒
48	5240	☒
52	5260	☒
56	5280	☒
60	5300	☒
64	5320	☒
100	5500	☒
104	5520	☒
108	5540	☒
112	5560	☒
116	5580	☒
132	5660	☒
136	5680	☒
140	5700	☒
149	5745	☒
153	5765	☒
157	5785	☒
161	5805	☒
165	5825	☒



CHANNEL PLAN		
802.11n HT40		
Channel	Frequency (MHz)	Available Channel
36+40	5190	☒
44+48	5230	☒
52+56	5270	☒
C1=60+64	5310	☒
100+104	5510	☐
108+112	5550	☐
132+136	5670	☐
149+153	5755	☐
157+161	5795	☐

CHANNEL PLAN		
802.11ac VHT80		
Channel	Frequency (MHz)	Available Channel
C11=36+40+44+48	5210	☒
C12=52+56+60+64	5290	☒
C13=100+104+108+112	5530	☐

No DFS Channel
DFS Channel

DATA RATE		
802.11a		
Data Rate (Mbps)	Modulation Type	Modulation Worst Case
6	BPSK	☒
9	BPSK	☐
12	QPSK	☐
18	QPSK	☐
24	16-QAM	☐
36	16-QAM	☐
48	64-QAM	☐
54	64-QAM	☐



DATA RATE 802.11n HT20						
Available for EUT	MCS Index	Spatial streams	Modulation	Data Rate (Mbps)		Worst Case Modulation
				(GI = 800ns)	(GI = 400ns)	
☒	0	1	BPSK	6.5	7.2	☒
☒	1	1	QPSK	13	14.4	☐
☒	2	1	QPSK	19.5	21.7	☐
☒	3	1	16-QAM	26	28.9	☐
☒	4	1	16-QAM	39	43.3	☐
☒	5	1	64-QAM	52	57.8	☐
☒	6	1	64-QAM	58.5	65	☐
☒	7	1	64-QAM	65	72.2	☐

DATA RATE 802.11n HT40						
Available for EUT	MCS Index	Spatial streams	Modulation	Data Rate (Mbps)		Worst Case Modulation
				(GI = 800ns)	(GI = 400ns)	
☒	0	1	BPSK	13	15	☒
☒	1	1	QPSK	27	30	☐
☒	2	1	QPSK	40.5	45	☐
☒	3	1	16-QAM	54	60	☐
☒	4	1	16-QAM	81	90	☐
☒	5	1	64-QAM	108	120	☐
☒	6	1	64-QAM	121.5	135	☐
☒	7	1	64-QAM	135	150	☐

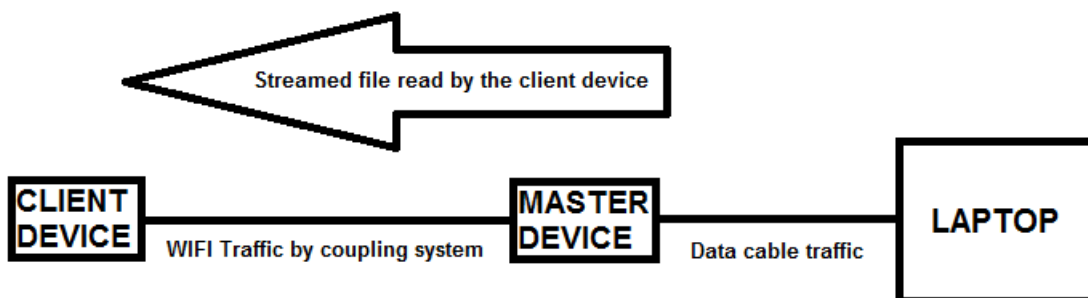
MCS Index	Nbr of spatial streams	Modulation (Stream 1/2/3/4)	Coding rate	Data Rate (in Mbps) 802.11n VHT80		Worst Case Modulation
				GI = 800ns	GI = 400ns	
0	1	BPSK	1/2	29.3	32.5	☒
1	1	QPSK	1/2	58.5	65	☐
2	1	QPSK	3/4	87.8	97.5	☐
3	1	16-QAM	1/2	117	130	☐
4	1	16-QAM	3/4	175.5	195	☐
5	1	64-QAM	2/3	234	260	☐
6	1	64-QAM	3/4	263.3	292.5	☐
7	1	64-QAM	5/6	292.5	325	☐
8	1	256-QAM	3/4	351	390	☐
9	1	256-QAM	5/6	390	433.3	☐

2.2. RUNNING MODE

The EUT is set in the following modes during tests:

- System testing is performed with the designed MPEG test file "6 ½ Magic Hour" (<http://ntiacsd.ntia.doc.gov/dfs/>) that streams video for channel loading from the Master Device to the Client Device on the test channel.

The streaming file is played as follow:



2.3. EQUIPMENT LABELLING



2.4. EQUIPMENT MODIFICATION

☒ None ☐ Modification:

3. DFS DETECTION THRESHOLDS DETERMINATION, REFERENCE NOISE LEVEL & CHANNEL LOADING

3.1. TEST CONDITIONS

Test performed by : Mathieu CERISIER
Date of test : September 7th & 8th, 2015
Ambient temperature : 25°C
Relative humidity : 35%

3.2. TEST SETUP

- The Equipment under Test is installed:

- ☒ On a table
- ☐ In an anechoic chamber

-Measurement is performed with a spectrum analyzer

- ☒ On the EUT conducted access
- ☐ With a test fixture



Photograph for DFS Detection Thresholds Determination, Reference Noise Level, Channel Loading

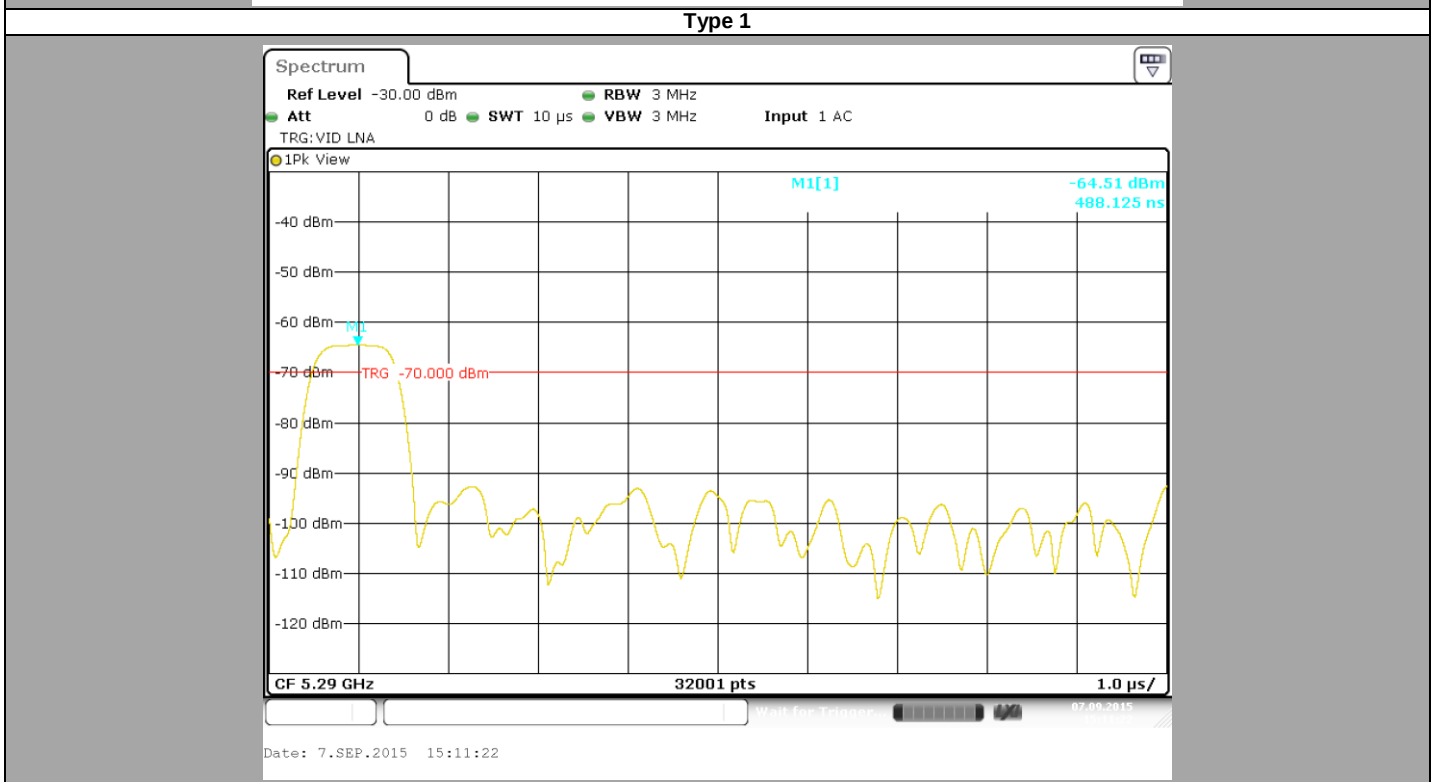
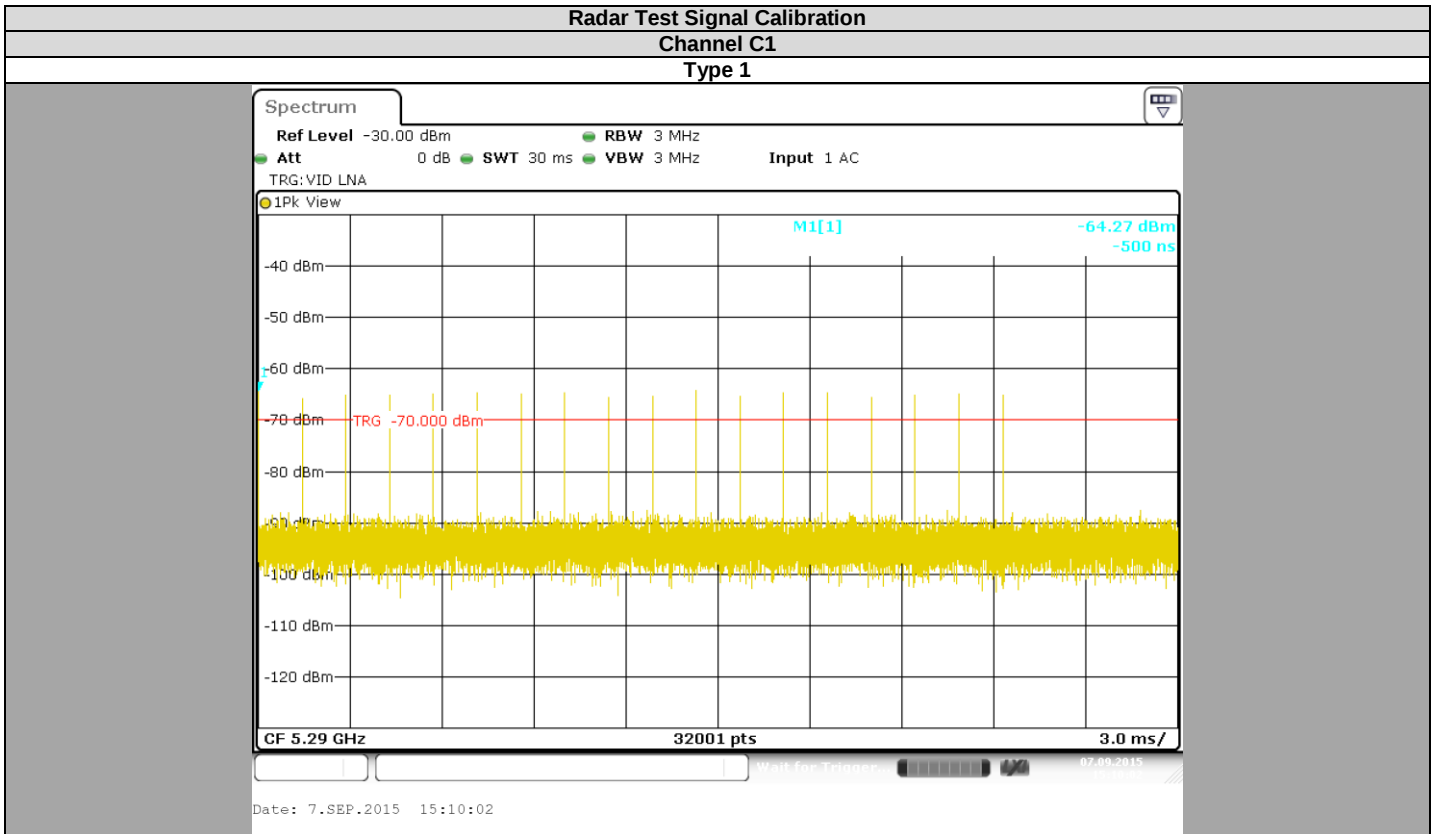


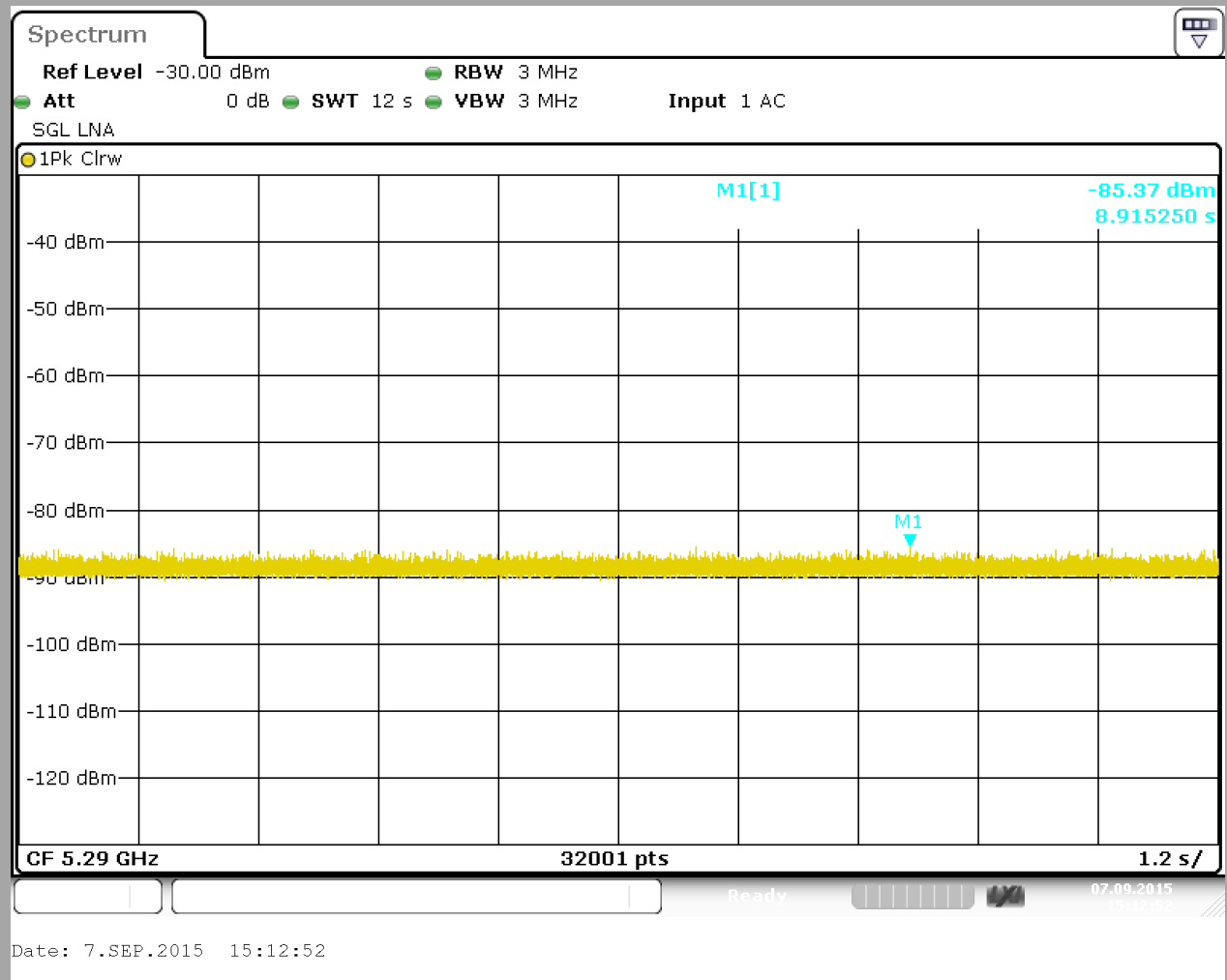
3.3. TEST EQUIPMENT LIST

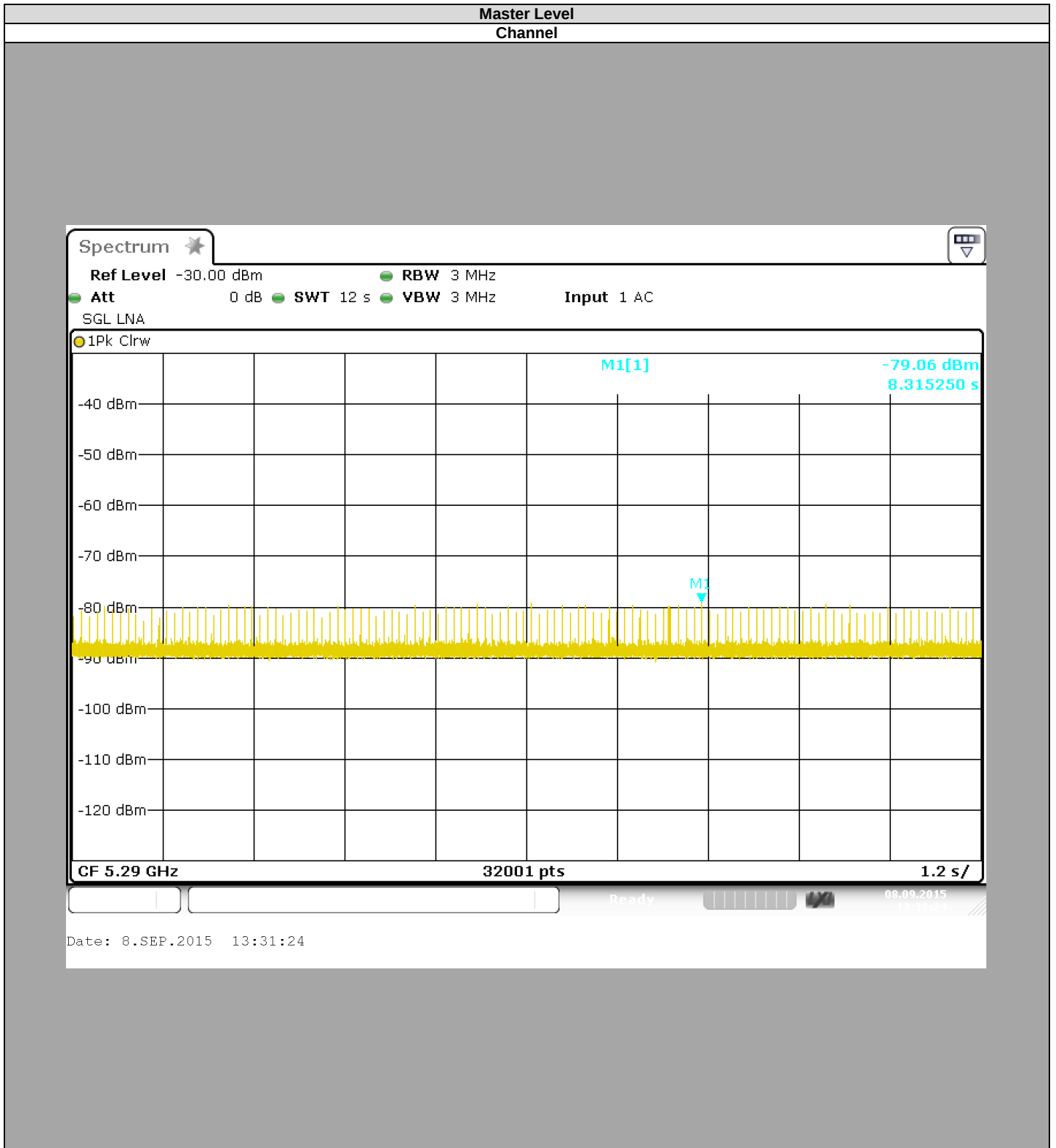
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Multi-meter	KEITHLEY	2000	A1241084	2014/02	2016/02
EMI receiver/ Spectrum analyzer	ROHDE & SCHWARZ	ESR 7	A2642023	2015/03	2016/03
RF cable	Télédyne	920-0202-024	A5329663	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329664	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329665	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329668	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329669	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329670	2014/04	2016/04
RF cable	Télédyne				
RF cable	Télédyne	920-0202-024	A5329672	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329673	2014/04	2016/04
Vector signal generator	ROHDE & SCHWARZ	SMJ100A	A5444007	Verified with calibrated EMI receiver/ Spectrum analyzer before testing	
Attenuator 10dB	MINI CIRCUITS	BW-S10W2+	A7122229	2014/04	2016/04
Attenuator 10dB	MINI CIRCUITS	BW-S10W2+	A7122230	2014/04	2016/04
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329661	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329676	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329674	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329675	2014/10	2015/10
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122238	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122239	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122240	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122241	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122242	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122243	2014/04	2016/04
Power splitter	Mini-Circuits	ZN6PD-63W-S+	A7132040	2014/04	2016/04
Power splitter	Mini-Circuits	ZN6PD-63W-S+	A7132041	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152075	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152076	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152077	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152078	2014/04	2016/04

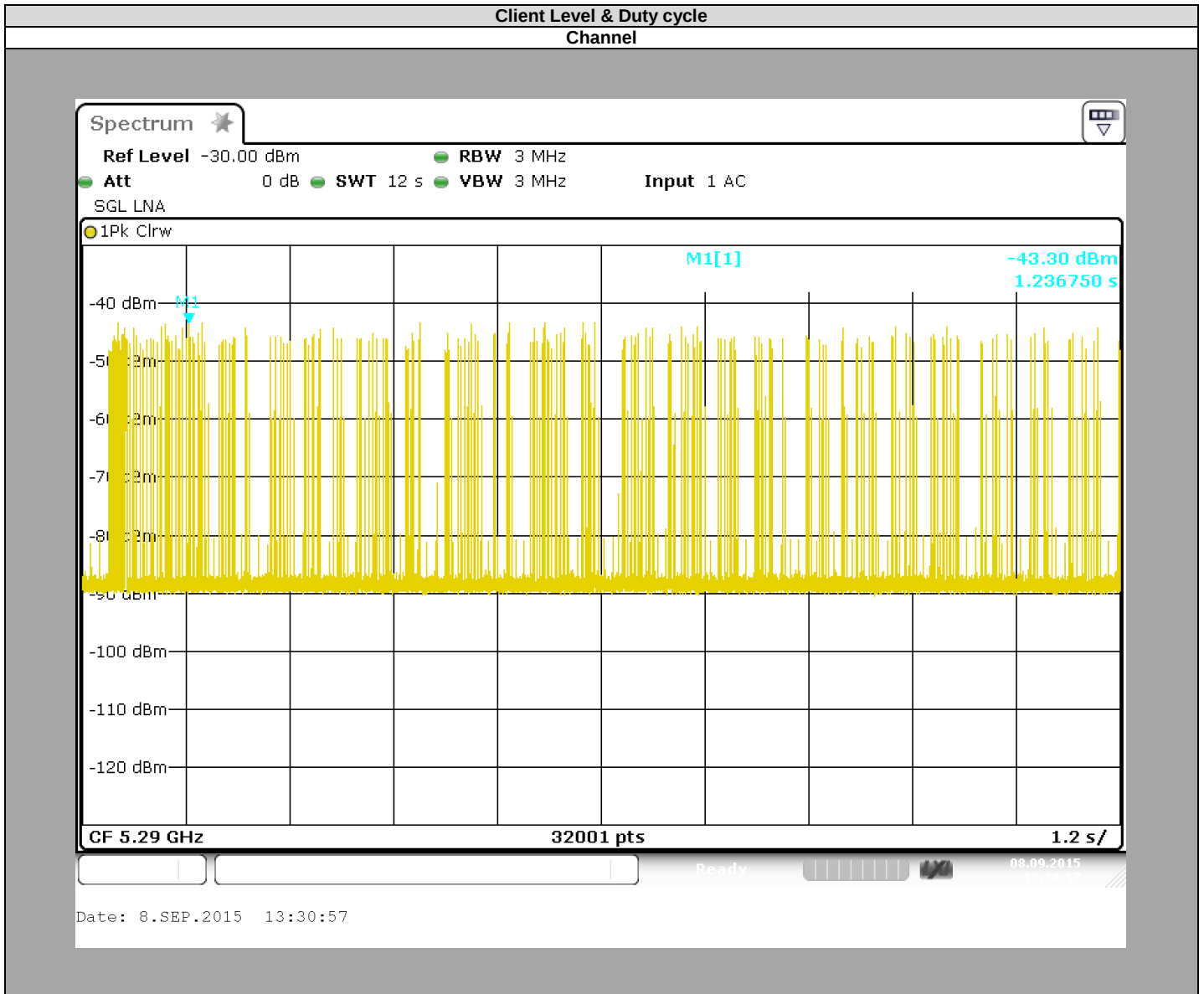


3.4. RESULTS



Reference Noise Level
Channel





Temperature	Tnom
Voltage	Vnom
Channel	C1
Duty Cycle (%)	Over 17

Temperature	Tnom
Voltage	Vnom
Channel	C1
EIRP (See test report from FCC ID: RRK2012060056-1)	338,065mW
DFS Detection thresholds applied	-64dBm

4. DYNAMIC FREQUENCY SELECTION (DFS): CHANNEL MOVE TIME & CHANNEL CLOSING TRANSMISSION TIME

4.1. TEST CONDITIONS

Test performed by : Mathieu CERISIER
Date of test : September 8th, 2015
Ambient temperature : 25°C
Relative humidity : 35%

4.2. TEST SETUP

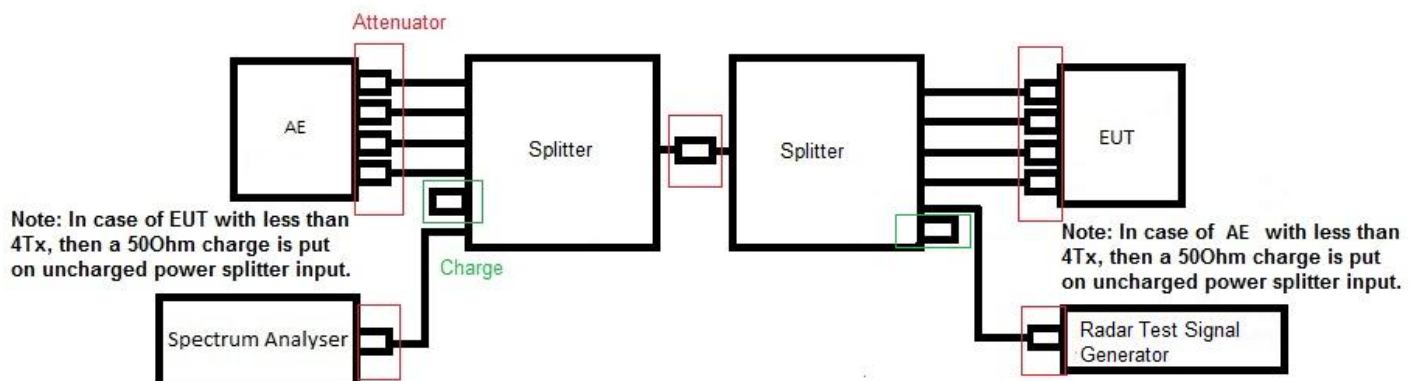
- The Equipment Under Test is:

- ☒ On a table
- ☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer:

- ☒ On the EUT conducted access
- ☐ On the EUT with a test fixture

An additional of 1dB has been added to the amplitude of DFS Detection Thresholds as specified in KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02 "5.2 Table 3"





Photograph for DFS Channel Move Time & Channel Closing Transmission Time



4.3. LIMIT

Channel Closing Transmission Time shall not exceed 200ms + an aggregate of 60ms over remaining 10s period
Channel Move Time shall not exceed 10s

4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Multi-meter	KEITHLEY	2000	A1241084	2014/02	2016/02
EMI receiver/ Spectrum analyzer	ROHDE & SCHWARZ	ESR 7	A2642023	2015/03	2016/03
RF cable	Télédyne	920-0202-024	A5329663	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329664	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329665	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329668	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329669	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329670	2014/04	2016/04
RF cable	Télédyne				
RF cable	Télédyne	920-0202-024	A5329672	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329673	2014/04	2016/04
Vector signal generator	ROHDE & SCHWARZ	SMJ100A	A5444007	Verified with calibrated EMI receiver/ Spectrum analyzer before testing	
Attenuator 10dB	MINI CIRCUITS	BW-S10W2+	A7122229	2014/04	2016/04
Attenuator 10dB	MINI CIRCUITS	BW-S10W2+	A7122230	2014/04	2016/04
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329661	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329676	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329674	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329675	2014/10	2015/10
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122238	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122239	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122240	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122241	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122242	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122243	2014/04	2016/04
Power splitter	Mini-Circuits	ZN6PD-63W-S+	A7132040	2014/04	2016/04
Power splitter	Mini-Circuits	ZN6PD-63W-S+	A7132041	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152075	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152076	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152077	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152078	2014/04	2016/04

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:

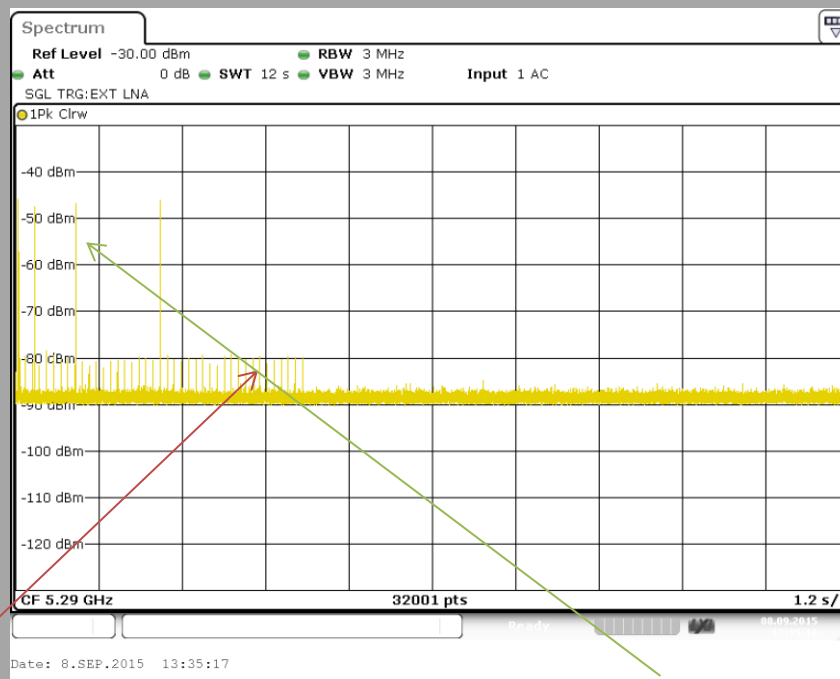
4.6. RESULTS

802.11 VHT80

C1



C1



Master Traffic. See Master Level in chapter 3

Client traffic. See Client Level in chapter 3



Temperature	Tnom
Voltage	Vnom
Channel	C1
Channel Closing Transmission Time (ms)	2,08
Channel Move Time (s)	0,202

4.7. CONCLUSION

Channel Shutdown measurement performed on the sample of the product Bittium **Tough Mobile**, SN: K0253000550, in configuration and description presented in this test report, show levels **conform to** the 47 CFR 15.407 limits.

5. DYNAMIC FREQUENCY SELECTION (DFS): NON-OCCUPANCY PERIOD

5.1. TEST CONDITIONS

Test performed by : Mathieu CERISIER
Date of test : September 8th, 2015
Ambient temperature : 26°C
Relative humidity : 35%

5.2. TEST SETUP

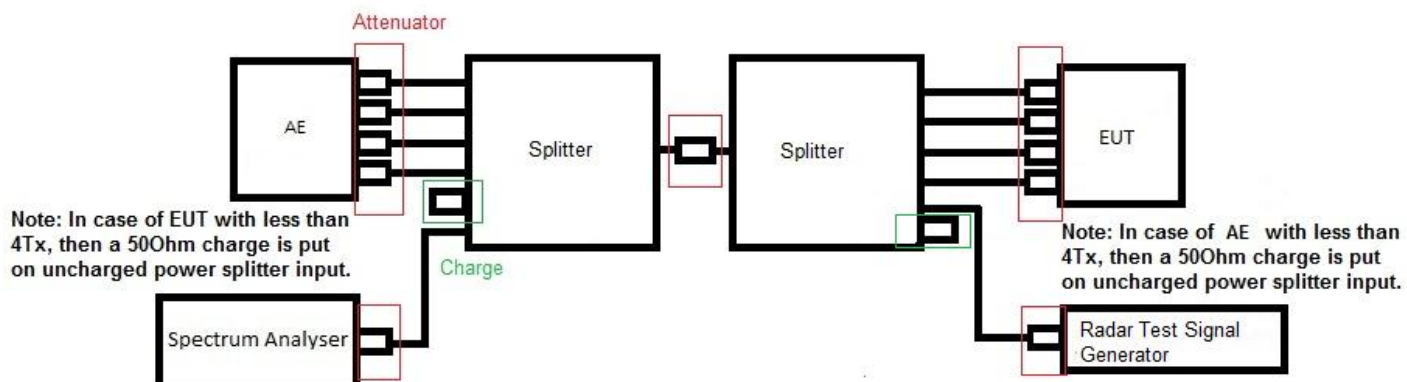
- The Equipment Under Test is:

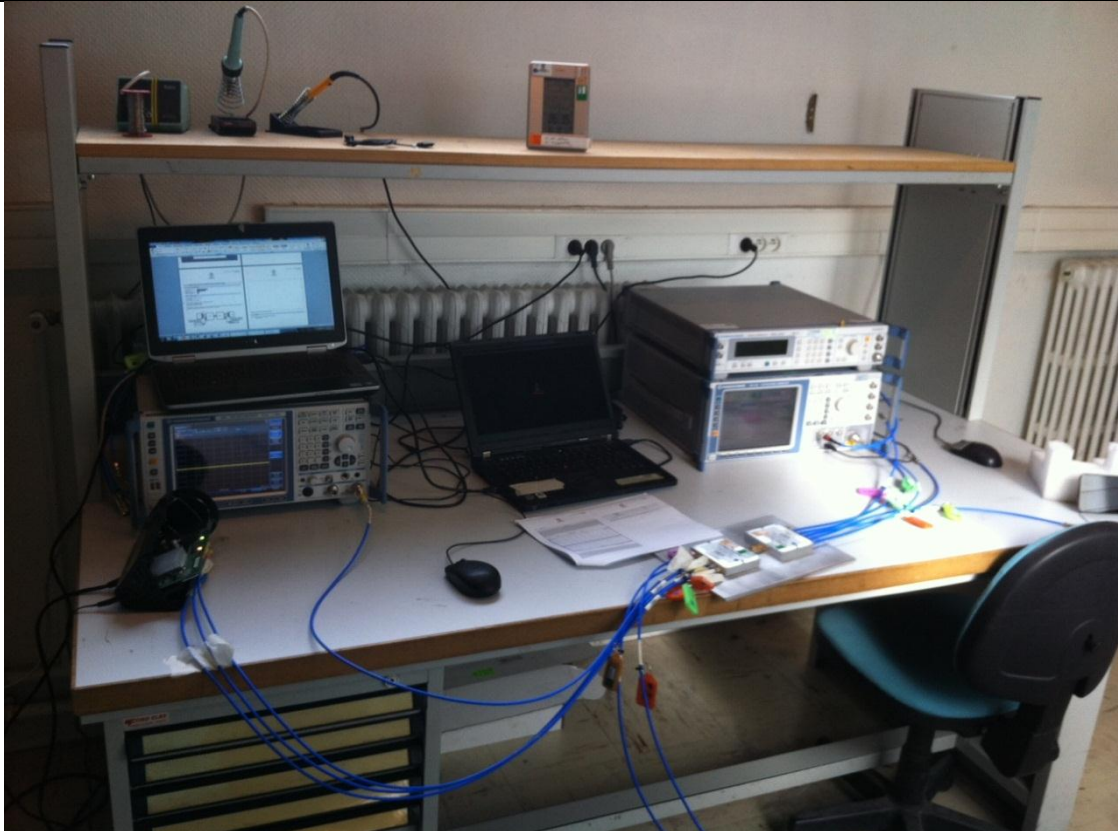
- ☒ On a table
- ☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer:

- ☒ On the EUT conducted access
- ☐ On the EUT with a test fixture

An additional of 1dB has been added to the amplitude of DFS Detection Thresholds as specified in KDB 905462 D02 UNII DFS Compliance Procedures New Rules v01r02 "5.2 Table 3"





Photograph for DFS Non-Occupancy Period

5.3. LIMIT

Non-Occupancy Period shall exceed 1800 seconds



5.4. TEST EQUIPMENT LIST

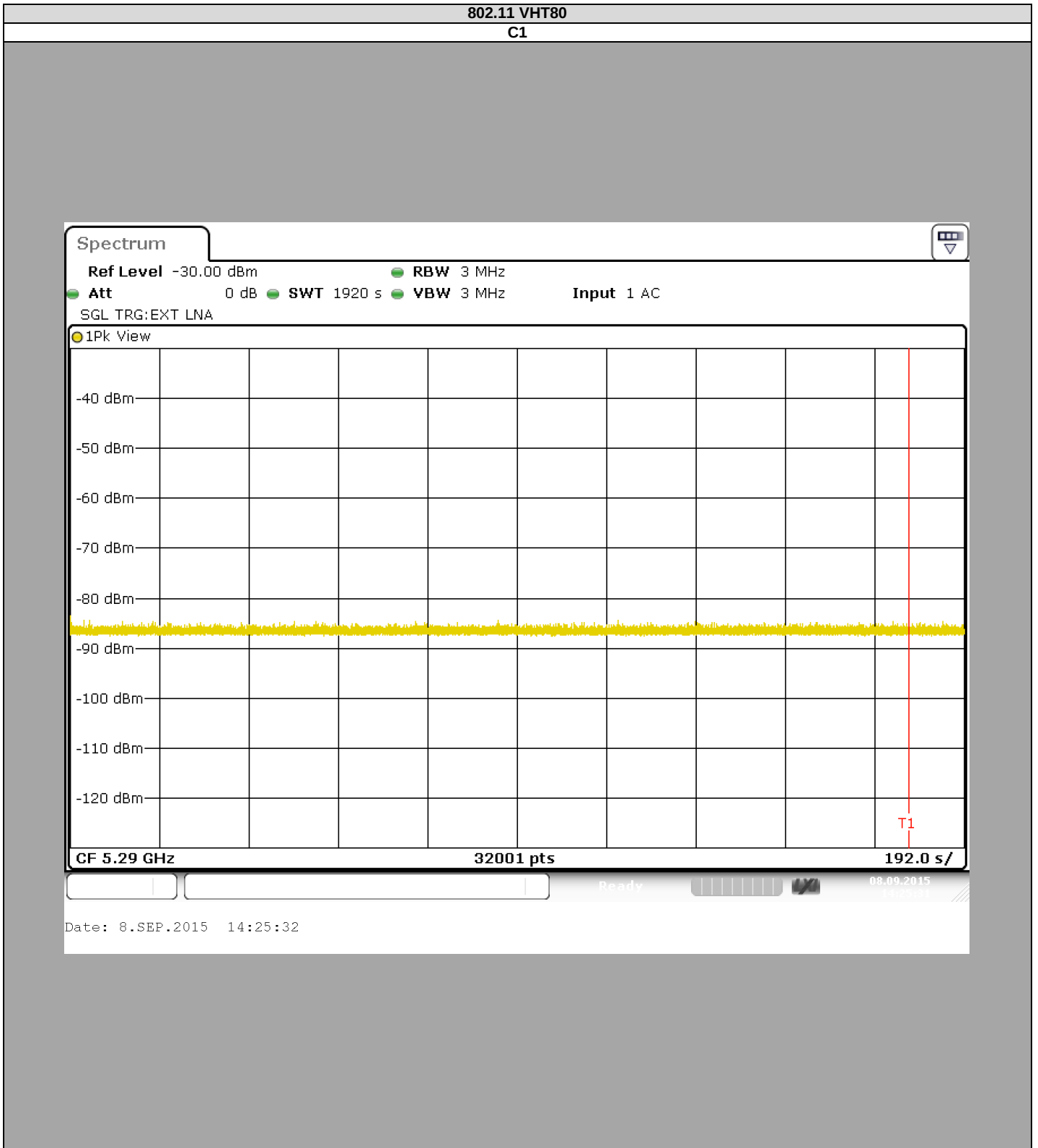
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Multi-meter	KEITHLEY	2000	A1241084	2014/02	2016/02
EMI receiver/ Spectrum analyzer	ROHDE & SCHWARZ	ESR 7	A2642023	2015/03	2016/03
RF cable	Télédyne	920-0202-024	A5329663	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329664	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329665	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329668	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329669	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329670	2014/04	2016/04
RF cable	Télédyne				
RF cable	Télédyne	920-0202-024	A5329672	2014/04	2016/04
RF cable	Télédyne	920-0202-024	A5329673	2014/04	2016/04
Vector signal generator	ROHDE & SCHWARZ	SMJ100A	A5444007	Verified with calibrated EMI receiver/ Spectrum analyzer before testing	
Attenuator 10dB	MINI CIRCUITS	BW-S10W2+	A7122229	2014/04	2016/04
Attenuator 10dB	MINI CIRCUITS	BW-S10W2+	A7122230	2014/04	2016/04
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329661	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329676	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329674	2014/10	2015/10
RF cable & Attenuator 20dB	Télédyne & MINI CIRCUITS	920-0202-024 & FW-20+	A5329675	2014/10	2015/10
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122238	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122239	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122240	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122241	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122242	2014/04	2016/04
Attenuator 3dB	MINI CIRCUITS	BW-S3W2+	A7122243	2014/04	2016/04
Power splitter	Mini-Circuits	ZN6PD-63W-S+	A7132040	2014/04	2016/04
Power splitter	Mini-Circuits	ZN6PD-63W-S+	A7132041	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152075	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152076	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152077	2014/04	2016/04
Load 50 ohms	Fairview Microwave	ST0635F	A7152078	2014/04	2016/04

5.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☒ None ☐ Divergence:



5.6. RESULTS





Temperature	Tnom
Voltage	Vnom
Channel	C1
Non-Occupancy period (s)	Over 1920

5.7. CONCLUSION

Non-Occupancy period measurement performed on the sample of the product Bittium **Tough Mobile**, SN: K0253000550, in configuration and description presented in this test report, show levels **conform to** the 47 CFR 15.407 limits.



6. UNCERTAINTIES CHART

Kind of test	Measurement uncertainties (k=2) $\pm x(\text{dB})$ / (Hz)	Limit for uncertainties $\pm y(\text{dB})$
REQUIREMENTS		
RF power conducted	$\pm 0.6\text{dB}$	$\pm 1,5\text{dB}$
Temperature	$\pm 0.5^{\circ}\text{C}$	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 2.5 \%$	$\pm 5\%$



7. RADAR TEST SIGNALS

TEST SIGNAL 1

Pulses per Burst	Pulse Width (μsec)	PRI (μs)
18	1	1428