

Report on the Radio Testing
For
Cambium Networks Ltd
on
PMP 450m Access Point
Report no. TRA-029590-21-45-00A
28th February 2017

RF929



Report Number: TRA-029590-21-45-00A
Issue: A

REPORT ON THE RADIO TESTING OF A
Cambium Networks Ltd
PMP 450m Access Point
WITH RESPECT TO SPECIFICATION
DFS requirements of FCC 47CFR15E

TEST DATE: 13th - 22nd February 2017

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Department Manager- Radio

Date: 28th February 2017

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
- [2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

RF929

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	28th February 2017	Original

2 Summary

TEST REPORT NUMBER:	TRA-029590-21-45-00A
WORKS ORDER NUMBER:	TRA-029590-21
PURPOSE OF TEST:	Certification
TEST SPECIFICATION:	47CFR15.407 (h) & RSS-247 Section 6.3
EQUIPMENT UNDER TEST (EUT):	PMP 450m Access Point
FCC IDENTIFIER:	QWP-50450M
ISED CERTIFICATION NUMBER:	109AO-50450M
EUT SERIAL NUMBER:	CA005223000014
MANUFACTURER/AGENT:	Cambium Networks Ltd
ADDRESS:	Unit B2 Linhay Business Park Eastern Road Ashburton Devon TQ13 7UP United Kingdom
CLIENT CONTACT:	Don Reid ☎ 01364 655667 ✉ don.reid@cambiumnetworks.com
ORDER NUMBER:	NP82690779
TEST DATE:	13th - 22nd February 2017
TESTED BY:	A Tosif Element

2.1 Test Summary

Test Method and Description	Requirement Clause		Applicable to this equipment	Result / Note
	47CFR15	RSS-247		
TPC & DFS	15.407(h)	Section 6.3	☒	Pass
U-NII detection bandwidth	15.407(h)(2)	Section 6.3	☒	Pass
CAC	15.407(h)(2)(ii)	Section 6.3 2(ii)	☒	Pass
In-service monitoring	15.407 (h)(2)(iii), (iv)	Section 6.3 2(i), (iii), (iv), (v)	☒	Pass
Statistical performance check	-	-	☒	Pass

Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set-up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

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4 Introduction

This report TRA-029590-21-45-00A presents the results of the Radio testing on a Cambium Networks Ltd, PMP 450m Access Point to specification 47CFR15.407 (h) & RSS-247 Section 6.3.

The testing was carried out for Cambium Networks Ltd by Element, at the address(es) detailed below.

☒	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	☐	Element Skelmersdale Unit 1 Pendle Place Skelmersdale West Lancashire WN8 9PN UK
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This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

FCC Site Listing:

The test laboratory is accredited for the above sites under the US-EU MRA, Designation number UK0009.

ISED Registration Number(s):

Element Hull 3483A

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- RSS-247 — Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- FCC KDB Publication 905462 D02 v02 – Compliance measurement procedures for unlicensed-national information infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection.

5.2 Deviations from Test Standards

There were no deviations from the test standard

6 Glossary of Terms

S	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CAC	Channel Availability Check
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DFS	Dynamic Frequency Selection
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada (now ISED)
ISED	Innovation, Science and Economic Development Canada
ITU	International Telecommunication Union
LBT	Listen Before Talk
LE-LAN	Licence-Exempt Local Area Network
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
PSD	Power Spectral Density
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
TPC	Transmitter Power Control
Tx	transmitter
UKAS	United Kingdom Accreditation Service
U-NII	Unlicensed-National Information Infrastructure
V	volt
W	watt
Ω	ohm

7 Equipment under Test

7.1 EUT Identification

- Name: PMP 450m Access Point
- Serial Number: CA005223000014
- Model Number: A005251
- Software Revision: CANOPY 15.0.1 AP
- Build Level / Revision Number: P5

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

- Name: PMP 450i SM Subscriber Module
- Serial Number: 0A003EBB34F7

7.3 EUT Mode of Operation

The mode of operation for tests was as follows.

The EUT was associated with the Client device during testing. Where necessary, the Master was set to indicate when a radar pulse had been successfully detected. Where channel loading was required, a channel loading of 25.9 % was used.

7.4 EUT Radio Frequency Parameters

7.4.1 General

Frequency of operation:	5150 – 5250 MHz; 5250 – 5350 MHz; 5470 – 5725 MHz; 5725 – 5850 MHz
Modulation type(s):	QPSK, 16QAM, 64QAM, 256QAM
Modulation Mode(s):	MIMO A, MIMO B
Occupied channel bandwidth(s):	5 MHz
Channel spacing:	2.5 MHz increments
Warning against use of alternative antennas in user manual (yes/no):	Not applicable
Nominal Supply Voltage:	48 Vdc (POE)
Location of notice for license exempt use:	Label / user manual / both.
Method of prevention of use on non-US frequencies:	Digitally signed software / licence key

7.4.2 Antennas

Type:	Integrated dual polarised seven-element adaptive array smart antenna
Frequency range:	5150 MHz – 5850 MHz
Impedance:	Not Applicable
SWR:	Not Applicable
Gain:	14 dBi
Polarisation:	Dual polarised
Connector type:	Integral
Length:	Not applicable
Weight:	14.2 Kg (fully assembled unit)
Environmental limits:	-40°C to +60°C
Mounting:	Pole mount

There is only one antenna assembly with 14 dBi gain. The antenna gain was verified by client during development using the antenna substitution method. The antenna is fully integrated to the PMP 450m casting and was mounted with proprietary brackets on a 1.5m mast with a 2° up tilt to compensate for the 2° electrical down tilt.

7.4.3 Product specific declarations

Multiple antenna configuration(s), e.g. MIMO:	MIMO, Beamforming, Sector, MU-MIMO *
Fixed pt-pt / pt-mtp / N/A operation (select One):	pt-mtp
Software security description:	See PMP-10088.PDF
TDWR interference information in user's manual (yes/no):	Yes

* During DFS testing, the system was using customer code, so all three modes were utilized in every 2.5ms frame

7.4.4 DFS Parameters

Antenna used for testing:	Integrated dual polarised seven-element adaptive array smart antenna
Channel loading :	25.9 %
TPC description:	N/A *
U-NII channel bandwidth(s):	5 MHz
Client/ Master (select One):	Master

*EIRP is less than 500 mW

7.5 EUT Description

The EUT is a point to multipoint access point with a seven-element dual-polarised adaptive array smart antenna and multi-user MIMO (MU-MIMO) capabilities.

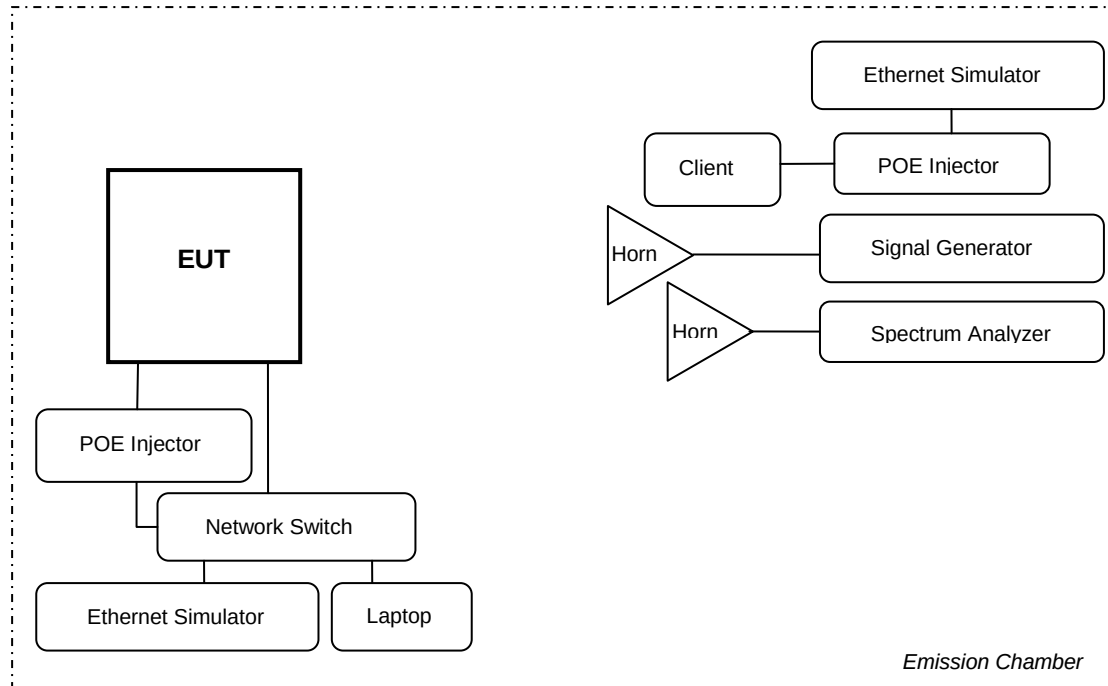
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT interconnections:



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



10 General Technical Parameters

10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was approx. 48 Vdc through POE.

10.2 Varying Test Conditions

No varying test conditions were used during these tests.

11 Dynamic Frequency Selection (DFS)

11.1 General

A U-NII network will employ a Dynamic Frequency Selection (DFS) function to detect interference from radar systems (radar detection) and to avoid co-channel operation with these systems.

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*.

11.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	REF886
Test Standard and Clause:	KDB 905462 D02, Clause 7.8
EUT Tested Channel Bandwidths:	5 MHz
EUT Test Channel Loading:	25.9 %
EUT Output Power Setting:	Max.
EUT Tested Modes:	Master
Deviations From Standard:	None

Environmental Conditions (Normal Environment)

Temperature: 23 °C	Usually: +15 °C to +35 °C
Humidity: 32 %RH	Usually: 20%RH to 75%RH

Test Limits

Refer to individual tests for applicable tables, as defined below.

Table 3: Interference threshold values

Maximum Transmit Power	Value (see notes 1, 2 and 3)
EIRP $\geq$ 200 mW	-64 dBm
EIRP $<$ 200 mW and PSD $<$ 10 dBm/MHz	-62 dBm
EIRP $<$ 200 mW that do not meet the PSD 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.
NOTE 2:	EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.

Table 4: DFS requirement values

Parameter	Value
Non-Occupancy Period	Min. 30 minutes
Channel Availability Check Time	60 s
Channel Move Time	10 s (see note 1).
Channel Closing Transmission Time	200 ms + an aggregate of 60 ms over remaining 10 s period (see notes 1 & 2).
U-NII Detection Bandwidth	Min. 100 % of the U-NII 99% transmission power bandwidth (see note 3).
Maximum Off-Channel CAC Time	4 hours (see note 2)
NOTE 1:	<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.
NOTE 2:	The <i>Channel Closing Transmission Time</i> is comprised of 200 ms starting at the beginning of the <i>Channel Move Time</i> plus any additional intermittent control signals required to facilitate a channel move (an aggregate of 60 ms) during the remainder of the 10 s period. The aggregate duration of control signals will not count quiet periods in-between transmissions.
NOTE 3:	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 %. Measurements are performed with no data traffic.

Table 5: Short pulse radar test signals

Radar type	Pulse width (μs)	PRI (μs)	Number of pulses	Min. % of successful detection	Min. number of trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μ s, with a minimum increment of 1 μ s, excluding PRI values selected in Test A	Roundup: $1/360 \times 19.10^6 / \text{PRI}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
NOTE 1: Short pulse radar type 0 should be used for detection bandwidth test, channel move time and channel closing time tests.					

Table 5a: Pulse repetition intervals for test A

<i>Pulse repetition frequency number</i>	<i>Pulse repetition frequency (pulses / s)</i>	<i>Pulse repetition interval (μs)</i>
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Table 6: Long pulse radar test signal

<i>Radar type</i>	<i>Pulse width (μs)</i>	<i>Chirp width (MHz)</i>	<i>PRI (μs)</i>	<i>Number of pulses per burst</i>	<i>Number of bursts</i>	<i>Min. % of successful detection</i>	<i>Min. number of trials</i>
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 7: Frequency hopping radar test signal

<i>Radar type</i>	<i>Pulse width (μs)</i>	<i>PRI (μs)</i>	<i>Pulses per hop</i>	<i>Hopping rate (kHz)</i>	<i>Hopping sequence length (ms)</i>	<i>Min. % of successful detection</i>	<i>Min. number of trials</i>
6	1	333	9	0.333	300	70%	30

11.3 Test Method

With the EUT setup as per section 9 of this report, the wanted signal (Gen A) was set to establish a reliable link. The interfering signal (Gen B) was then introduced at the specified Radar Detection Threshold level, plus 1dB.

[1] Conducted method

Received power was measured at the antenna port. For multiple port devices, equal splitting was employed to ensure the same level was received at each antenna port.

[2] Radiated method

Received power was measured at the centre of the EUT.

11.4 Calibration

DFS Radar Waveforms

The RF attenuator nearest the EUT was set to provide sufficient attenuation not to overload the analyser whilst the EUT was at maximum power. The RF attenuator nearest the support radio was then set by increasing to the point where the EUT could no longer receive the signal (receiver threshold), then backing off 10dB. The RF attenuator nearest the signal generator was then set to provide sufficient isolation between the generator and the support radio.

The interferer (Gen B) was set to the centre of the test channel, Ch_r , in CW mode. The EUT was replaced with the spectrum analyser, whilst the analyser was replaced with a 50 ohm load. The level of the generator was adjusted to find the appropriate DFS threshold +1dB, measured on the spectrum analyser. The analyser and EUT were then returned to position and an offset added to the analyser to read the same level as measured at the EUT.

Each radar signal required was then observed on the spectrum analyser in a 3MHz RBW with peak detector.

12 U-NII Detection Bandwidth

12.1 Definition

Emission bandwidth

The emission bandwidth is the bandwidth of the fundamental signal that contains 99% of the transmitted power of that signal, it may be determined using a spectrum analyser with an Occupied Bandwidth measurement function. Determination of the 99% power bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth between 1% and 5% of the bandwidth of the device under test.

12.2 Additional Test Parameters

EUT Test Channels, Ch_r 5597.5 MHz

EUT Operating Channels / Bandwidths: 5 MHz
(all bandwidths must be tested)

Test Limits

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.

The device must sense for radar signals at 100 percent of its emission bandwidth.

12.3 Test Method

The EUT was switched on without an associated client/master and no traffic and set to channel, Ch_r . The interferer (Gen B) was set to the same frequency, Ch_r , and radar test signal # 0, of table 5 (at the threshold level). The interferer was present for one burst only and the EUT was observed for radar detections. The test signal and observations were repeated a further 9 times as recorded in the results.

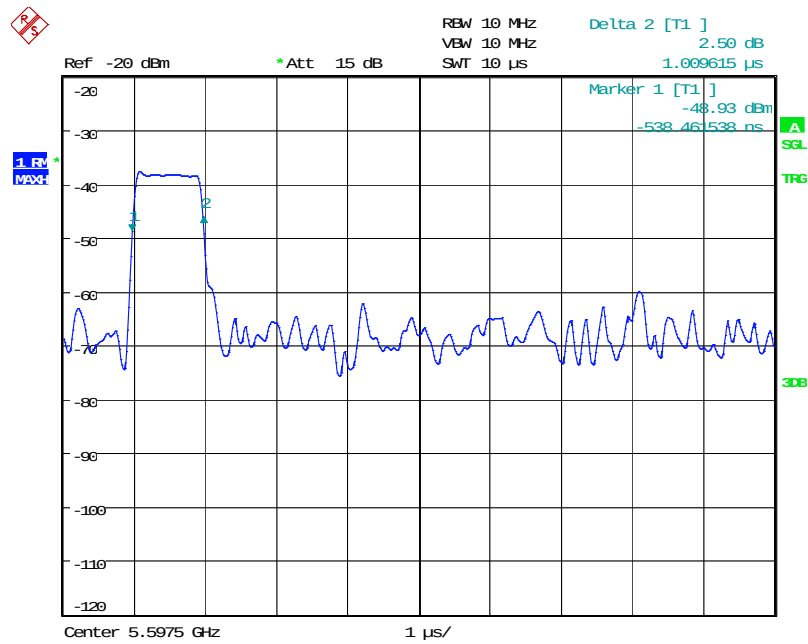
This test was repeated to find the upper and lower points where the detection rate fell below the requirement.

12.4 Test Equipment

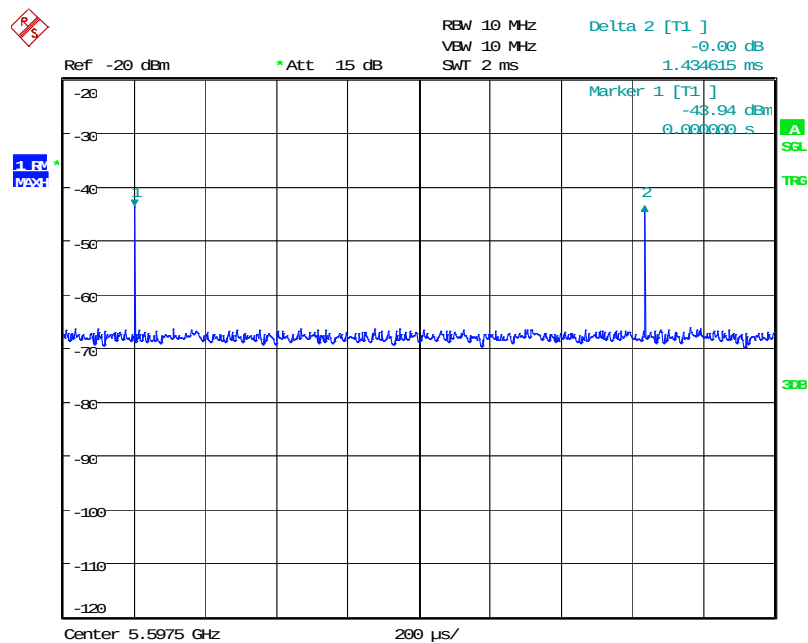
<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Last Cal Calibration</i>	<i>Calibration Period</i>	<i>Due For Calibration</i>
DFS Test System	Aeroflex	PXI-1042	REF2152	05/07/16	12	05/07/17
Spectrum Analyser	R&S	FSU26	REF909	02/05/16	12	02/05/17
Horn Antenna	EMCO	3115	RFG129	09/02/16	24	09/02/18
1-18GHz Horn	EMCO	3115	L138	13/04/16	24	13/04/18
Ferrite Lined Chamber	Rainford	ATS	REF886	21/07/14	36	21/07/17

12.5 Test Results

Type 0 Pulse



Date: 15.FEB.2017 10:35:29



Date: 15.FEB.2017 10:36:27

EUT Channel: 5597.5 MHz; Bandwidth: 5 MHz;				
Radar test signal #0; Interference level: -63 dBm *				
Test Frequency (MHz)	Number of bursts	Number detected	Percentage detected	Requirement
5597.5	10	10	100 %	90%
5595.2	10	10	100 %	90%
5599.8	10	10	100 %	90%

* Interference level = DFS Detection Thresholds (-64) +1 = -63 dBm

F_H (MHz)	F_L (MHz)	U-NII Detection Bandwidth (MHz)	Emission bandwidth (MHz)	Result
5595.2	5599.8	4.6	4.5	PASS

13 Channel Availability Check

13.1 Definition

The *Channel Availability Check (CAC)* is defined as a mechanism by which a U-NII device checks channels for the presence of radar signals. This mechanism is used for identifying *Available Channels*.

There shall be no transmissions by the U-NII device on the channels being checked during the initial CAC process.

If no radars have been detected on a channel, then that channel becomes an *Available Channel*.

13.2 Additional Test Parameters

EUT Channels At Switch On: 5597.5 MHz

EUT CAC Channel Bandwidths: 5 MHz

Test Limits

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 table 3) is detected within 60 seconds.

13.3 Test Method

[1] Length of CAC.

The EUT channel was selected, and then switched off. The spectrum analyser was set to time domain (zero span) with sufficient bandwidth to capture all intentional emissions from the EUT. The EUT was then switched on and the analyser synchronised to the moment when the power-up sequence was completed. The length of the CAC is the time difference between the completion of the power-up sequence and the initiation of transmission on the selected channel.

[2] Radar detection.

The interferer (Gen B) was set to one of the signal types of table 5 at the reference level of table 3, increased by 1dB and muted. The EUT channel was selected, then switched off. The spectrum analyser was set to time domain (zero span) with sufficient bandwidth to capture all intentional emissions from the EUT. The EUT was then switched on and upon completion of the power-up sequence; the interferer (Gen B) was unmuted for a single burst. The spectrum analyser was monitored to ensure no transmissions occurred.

The test was repeated, but with a delay of approx. 57s prior to unmuting the interferer.

During testing the CAC time measurements were manually initiated at the point in the EUT boot sequence where the CAC test was started.

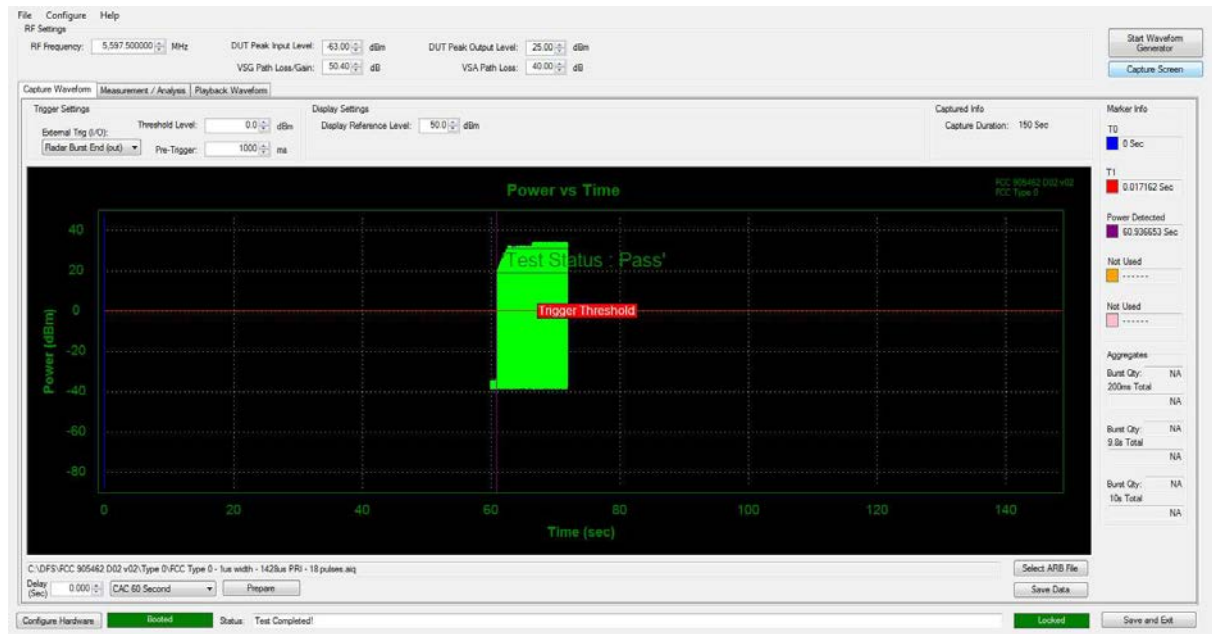
13.4 Test Equipment

<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Last Cal Calibration</i>	<i>Calibration Period</i>	<i>Due For Calibration</i>
DFS Test System	Aeroflex	PXI-1042	REF2152	05/07/16	12	05/07/17
Spectrum Analyser	R&S	FSU26	REF909	02/05/16	12	02/05/17
Horn Antenna	EMCO	3115	RFG129	09/02/16	24	09/02/18
1-18GHz Horn	EMCO	3115	L138	13/04/16	24	13/04/18
Ferrite Lined Chamber	Rainford	ATS	REF886	21/07/14	36	21/07/17

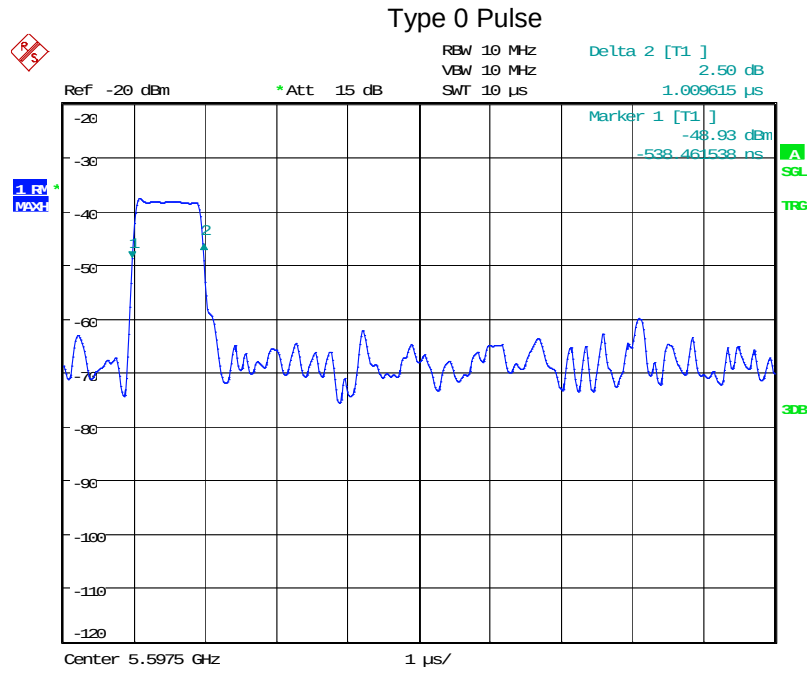
13.5 Test Results

[1] Length of CAC

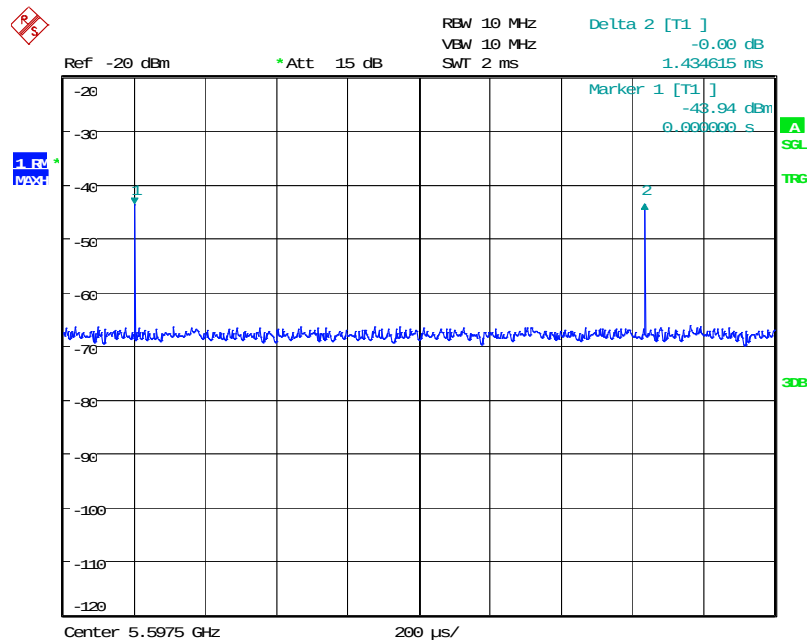
Channel Bandwidth: 5 MHz			
Channel (MHz)	CAC length (s)	EUT transmissions during CAC	Result
5597.5	60.9	None	PASS



[2] Radar detection



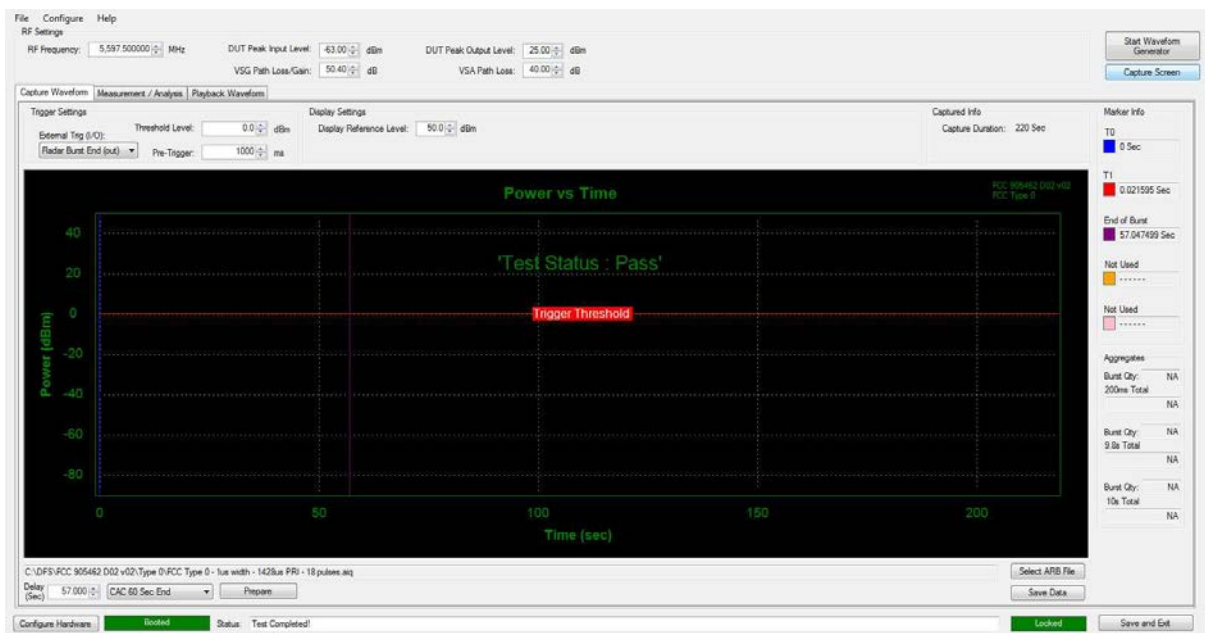
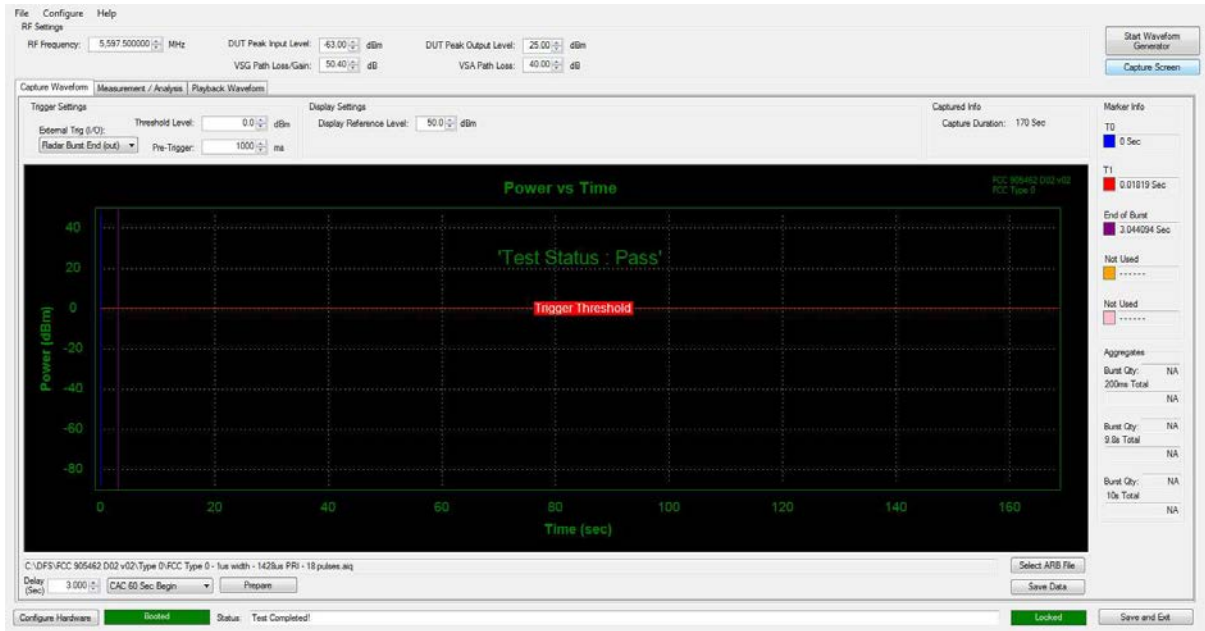
Date: 15.FEB.2017 10:35:29



Date: 15.FEB.2017 10:36:27

Channel:5597.5 MHz; Bandwidth:5 MHz; Interference level:-63 dBm*				
Time of injection (s)	Radar test signal #	Pulse width (μs)	PRI (μs)	EUT transmits (Yes/No)
T1 + 3	0	1	1429	No
T1 + 57	0	1	1429	No

* Interference level = DFS Detection Thresholds (-64) +1 = -63 dBm



14 In-Service Monitoring

14.1 Definition

The *Channel Closing* is defined as the process initiated by the U-NII device on an *Operating Channel* after a radar signal has been detected during the *In-Service Monitoring* on that channel.

The master device shall instruct all associated slave devices to stop transmitting on this channel, which they shall do within the *Channel Move Time*.

Slave devices with a Radar Interference Detection function, shall stop their own transmissions on an *Operating Channel* within the *Channel Move Time* upon detecting a radar signal within this channel.

The aggregate duration of all transmissions of the U-NII device on this channel during the *Channel Move Time* shall be limited to the *Channel Closing Transmission Time*. The aggregate duration of all transmissions shall not include quiet periods in-between transmissions.

For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, only the channel(s) containing the frequency on which radar was detected is subject to the *Channel Closing* requirement. The equipment is allowed to continue transmissions on other *Operating Channels*.

14.1.1 Non-Occupancy Period

The *Non-Occupancy Period* is defined as the time during which the U-NII device shall not make any transmissions on a channel after a radar signal was detected on that channel.

For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, only the channel(s) containing the frequency on which radar was detected is subject to the *Non-Occupancy Period* requirement. The equipment is allowed to continue transmissions on other *Operating Channels*.

After the *Non-Occupancy Period*, the channel needs to be identified again as an *Available Channel* before the U-NII device may start transmitting again on this channel.

14.2 Additional Test Parameters

EUT Test Channels, Ch _r .	5597.5 MHz
Channel Bandwidth:	5 MHz
Master Uniform Spreading:	Disabled

Test Limits

The *Channel Move Time* shall not exceed the limit defined in table 4.

The *Channel Closing Transmission Time* shall not exceed the limit defined in table 4.

The *Non-Occupancy Period* shall not be less than the value defined in table 4.

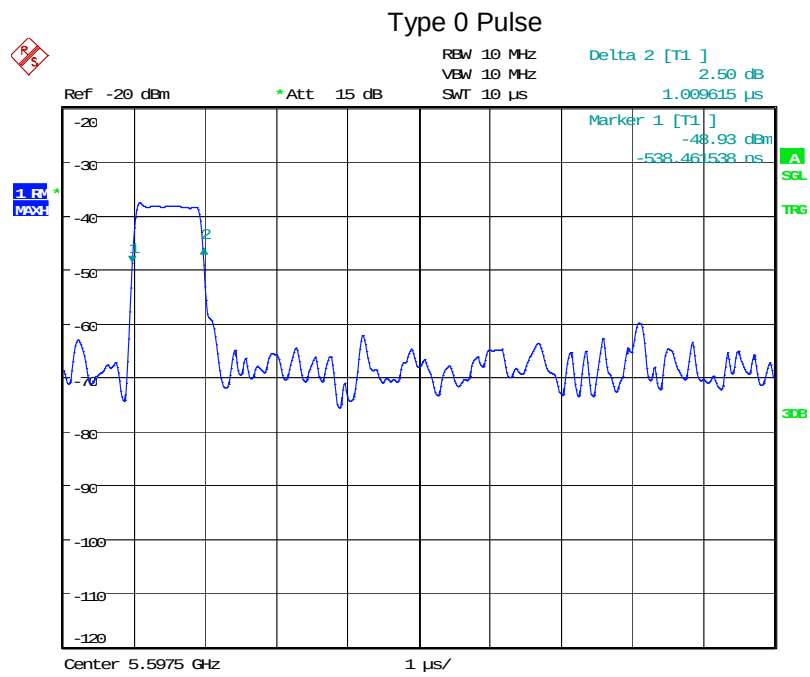
14.3 Test Method

The EUT channel for both data and control signals, Ch_r , was selected, then transmissions to the paired device commenced. The interferer (Gen B) was set to the same frequency, Ch_r , and a radar test signal of table 5 (to appear at the Master at the threshold level + 1dB) then muted. The spectrum analyser was set to time domain (zero span) with sufficient bandwidth to capture all intentional emissions from the EUT. The analyser was then synchronised to the switching of the interferer – the interferer (Gen B) level was unmuted for a single burst. Transmissions from the EUT continued to be observed for a further 30 min.

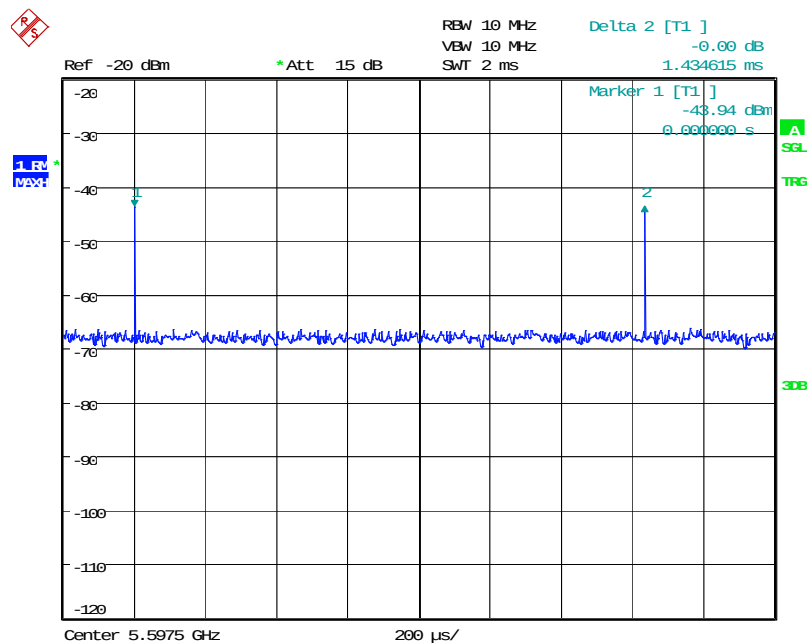
14.4 Test Equipment

<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Last Cal Calibration</i>	<i>Calibration Period</i>	<i>Due For Calibration</i>
DFS Test System	Aeroflex	PXI-1042	REF2152	05/07/16	12	05/07/17
Spectrum Analyser	R&S	FSU26	REF909	02/05/16	12	02/05/17
Horn Antenna	EMCO	3115	RFG129	09/02/16	24	09/02/18
1-18GHz Horn	EMCO	3115	L138	13/04/16	24	13/04/18
Ferrite Lined Chamber	Rainford	ATS	REF886	21/07/14	36	21/07/17

14.5 Test Results

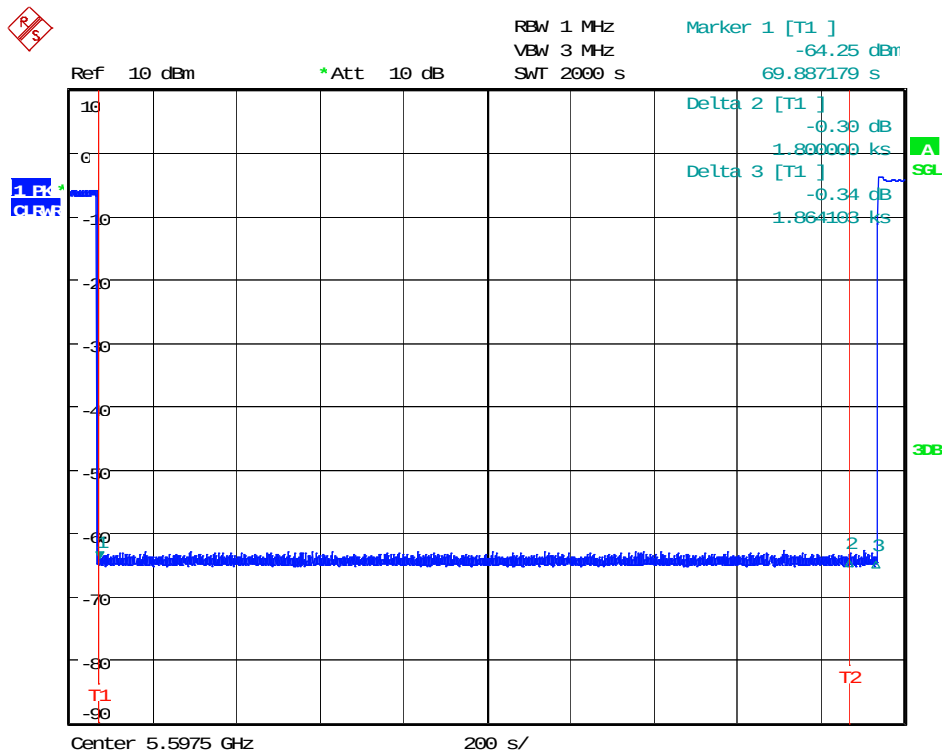
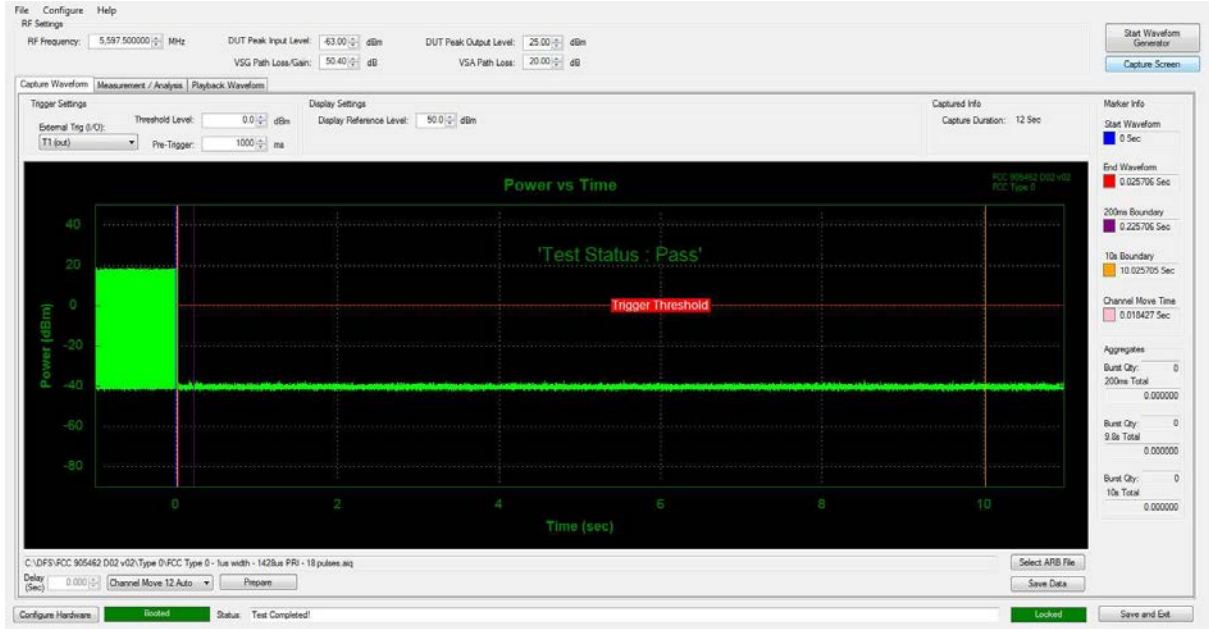


Date: 15.FEB.2017 10:35:29



Date: 15.FEB.2017 10:36:27

Bandwidth: 5 MHz					
Channel (MHz)	Interference level (dBm)	Channel move time (s)	Channel Closing Transmission Time (ms)	Transmissions during non-occupancy period	Result
5597.5	-63	0.018	0	None	PASS



Date: 14.FEB.2017 14:02:26

15 Statistical Performance Check

15.1 Definition

The *In-Service Monitoring* is defined as the process by which a U-NII device monitors each *Operating Channel* for the presence of radar signals.

15.2 Additional Test Parameters

EUT Test Channels, Ch_r : 5597.5 MHz

EUT Operating Channels / Bandwidths: 5 MHz

Test Limits

The *In-Service Monitoring* shall be used to monitor each *Operating Channel*.

The *In-Service-Monitoring* shall start immediately after the U-NII device has started transmissions on a channel.

During the *In-Service Monitoring*, the U-NII device shall be capable of detecting any of the radar test signals that fall within the ranges given by tables 5-7 with a level above the *Radar Detection Threshold* defined in table 3.

The minimum required detection probability associated with a given radar test signal is defined in tables 5-7.

15.3 Test Method

The EUT channel for both data and control signals, Ch_r , was selected, then transmissions to the paired device commenced. The interferer (Gen B) was set to the same frequency, Ch_r , and a radar test signal of table 5-7 (to appear at the Master at the threshold level + 1dB). The interferer was present for one burst only and the EUT was observed for radar detections.

15.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	Element No	Last Cal Calibration	Calibration Period	Due For Calibration
DFS Test System	Aeroflex	PXI-1042	REF2152	05/07/16	12	05/07/17
Spectrum Analyser	R&S	FSU26	REF909	02/05/16	12	02/05/17
Horn Antenna	EMCO	3115	RFG129	09/02/16	24	09/02/18
1-18GHz Horn	EMCO	3115	L138	13/04/16	24	13/04/18
Ferrite Lined Chamber	Rainford	ATS	REF886	21/07/14	36	21/07/17

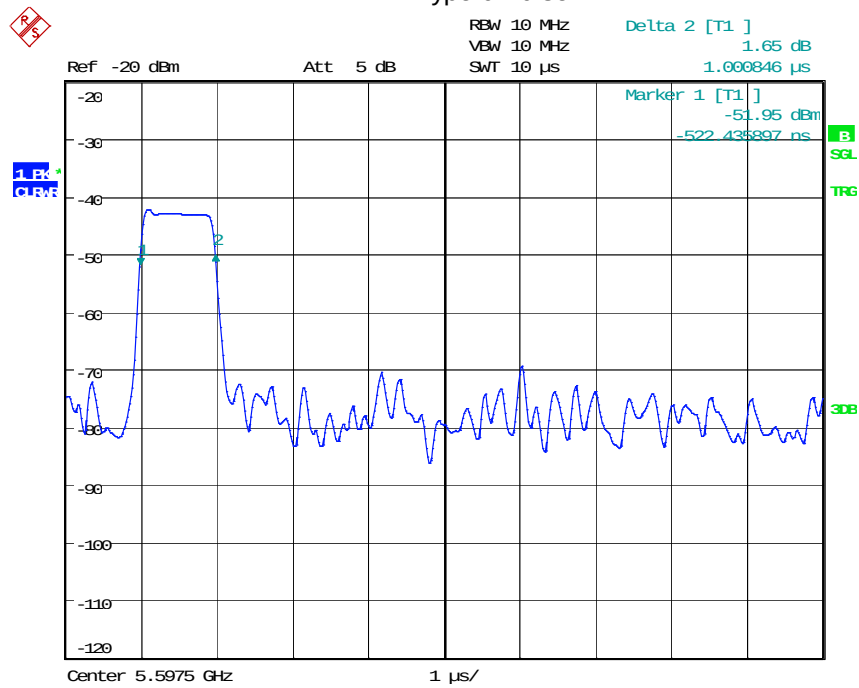
15.5 Test Results

Summary				
Radar Type	Number of trials	% successful	Limit (%)	Result
1	30	90.0	60	PASS
2	30	96.7	60	PASS
3	30	100.0	60	PASS
4	30	100.0	60	PASS
1-4	N/A	96.7	80	PASS
5	30	86.7	80	PASS
6	30	83.3	70	PASS

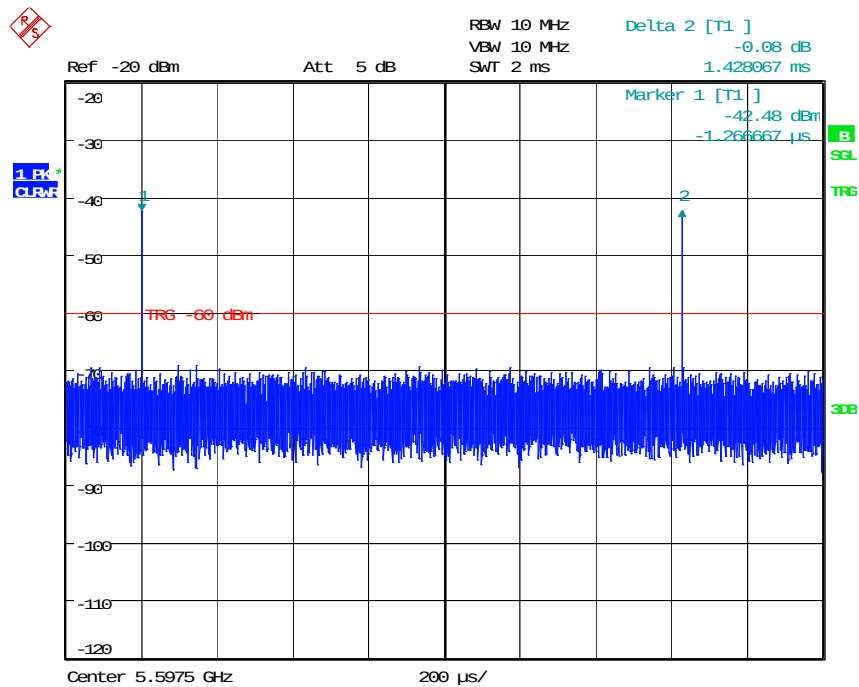
Channel: 5597.5 MHz; Bandwidth: 5 MHz; Interference level: -63 dBm						
Pulse Type	1	2	3	4	5	6
Test #	Detected (Y/N)					
1	Y	Y	Y	Y	Y	Y
2	Y	Y	Y	Y	N	Y
3	N	N	Y	Y	Y	Y
4	Y	Y	Y	Y	Y	N
5	Y	Y	Y	Y	Y	Y
6	Y	Y	Y	Y	Y	Y
7	Y	Y	Y	Y	Y	N
8	Y	Y	Y	Y	Y	Y
9	Y	Y	Y	Y	Y	Y
10	N	Y	Y	Y	Y	Y
11	N	Y	Y	Y	Y	Y
12	Y	Y	Y	Y	Y	N
13	Y	Y	Y	Y	Y	Y
14	Y	Y	Y	Y	Y	Y
15	Y	Y	Y	Y	Y	Y
16	Y	Y	Y	Y	Y	Y
17	Y	Y	Y	Y	Y	N
18	Y	Y	Y	Y	Y	Y
19	Y	Y	Y	Y	Y	Y
20	Y	Y	Y	Y	Y	Y
21	Y	Y	Y	Y	Y	Y
22	Y	Y	Y	Y	Y	Y
23	Y	Y	Y	Y	Y	Y
24	Y	Y	Y	Y	Y	Y
25	Y	Y	Y	Y	N	Y
26	Y	Y	Y	Y	Y	Y
27	Y	Y	Y	Y	N	Y
28	Y	Y	Y	Y	Y	Y
29	Y	Y	Y	Y	Y	N
30	Y	Y	Y	Y	N	Y
Successful	27	29	30	30	26	25
Successful (%)	90.0	96.7	100.0	100.0	86.7	83.3

Test Pulse Parameters

Type 0 Pulse

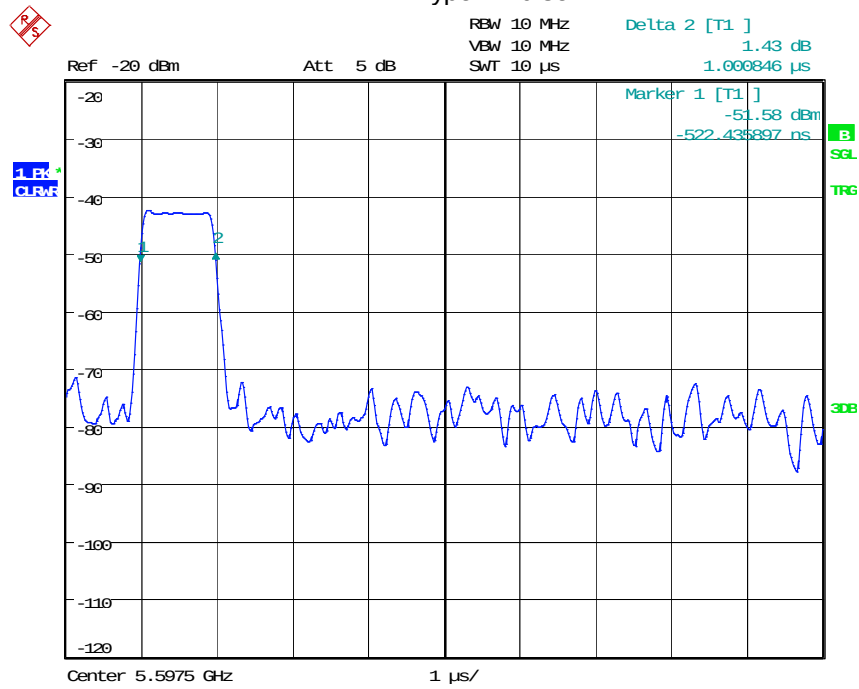


Date: 22.FEB.2017 16:52:41

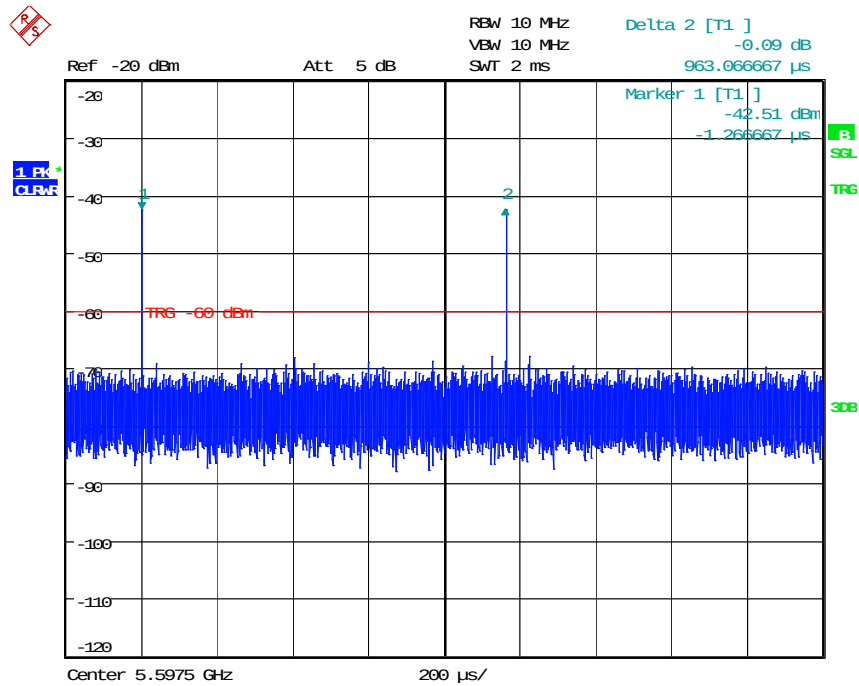


Date: 22.FEB.2017 17:11:53

Type 1 Pulse

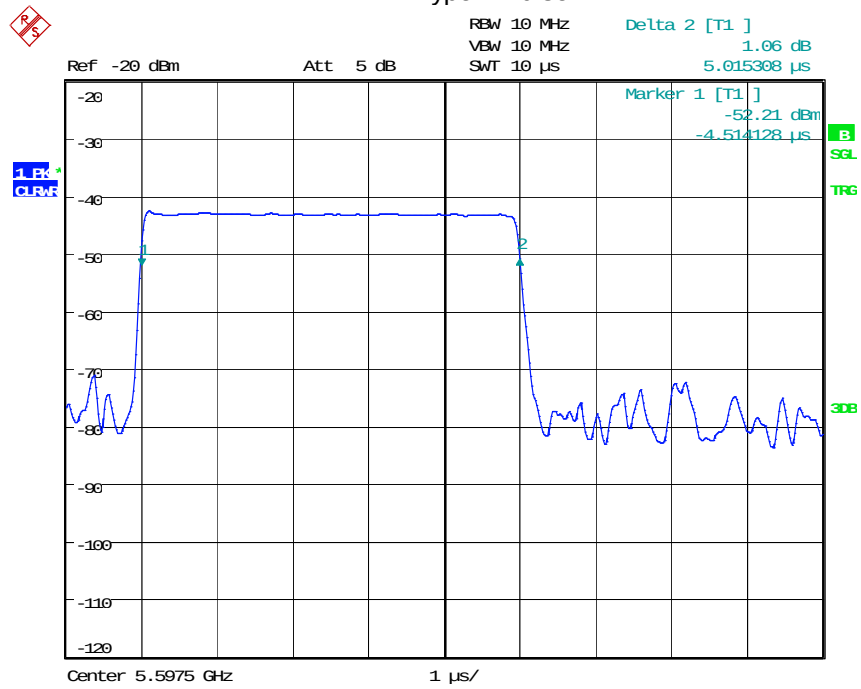


Date: 22.FEB.2017 16:53:29

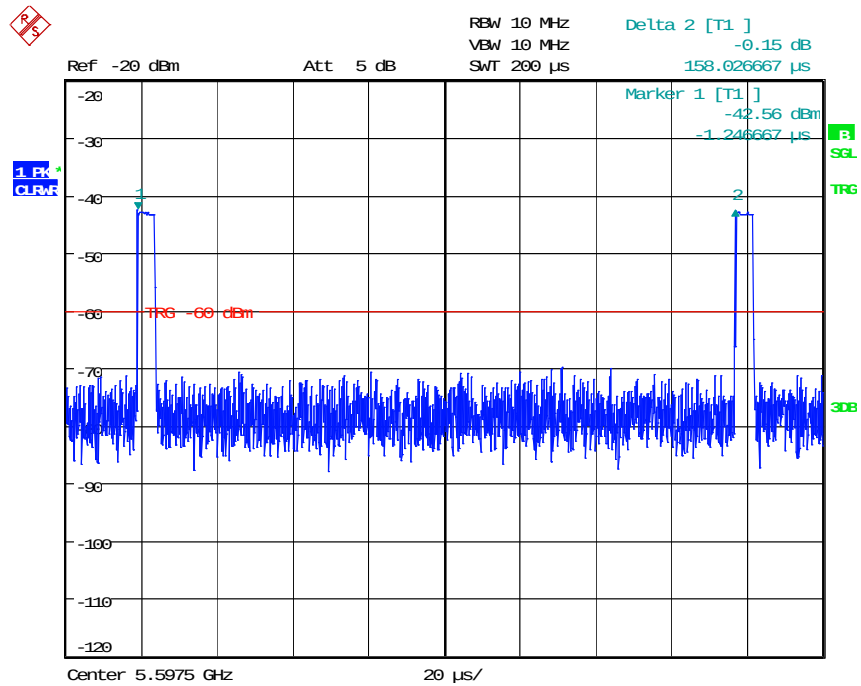


Date: 22.FEB.2017 17:13:04

Type 2 Pulse

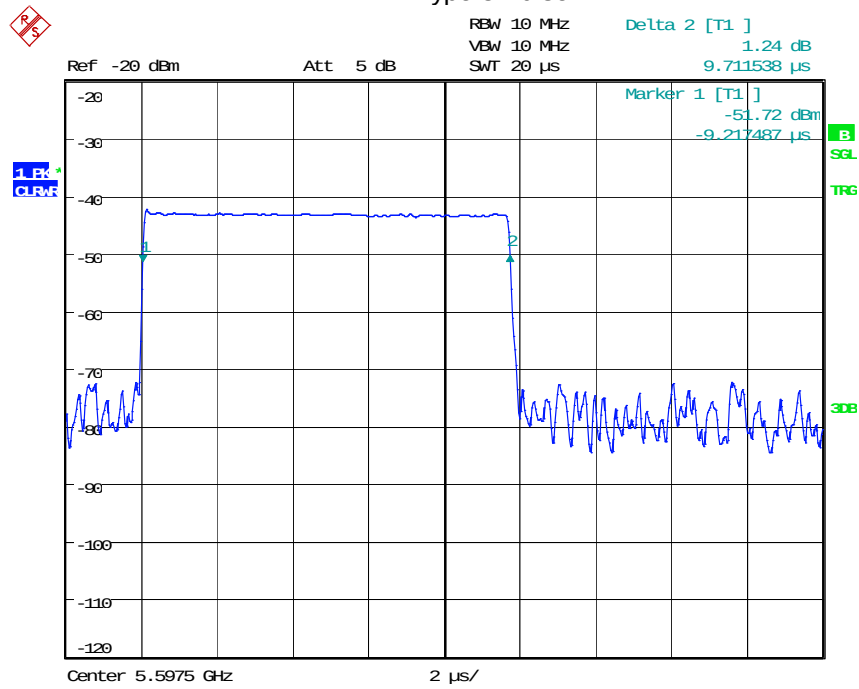


Date: 22.FEB.2017 16:57:04

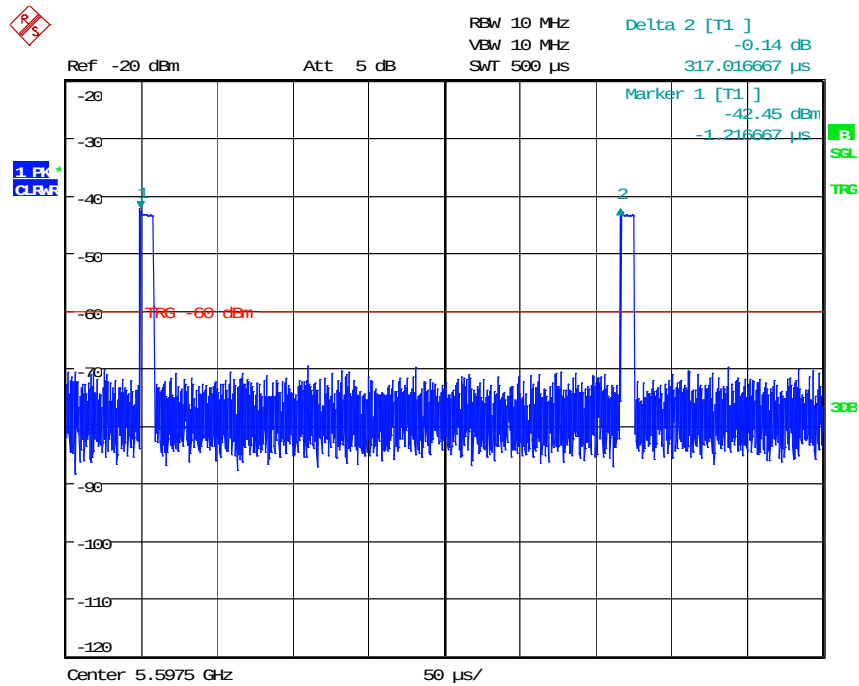


Date: 22.FEB.2017 17:14:02

Type 3 Pulse

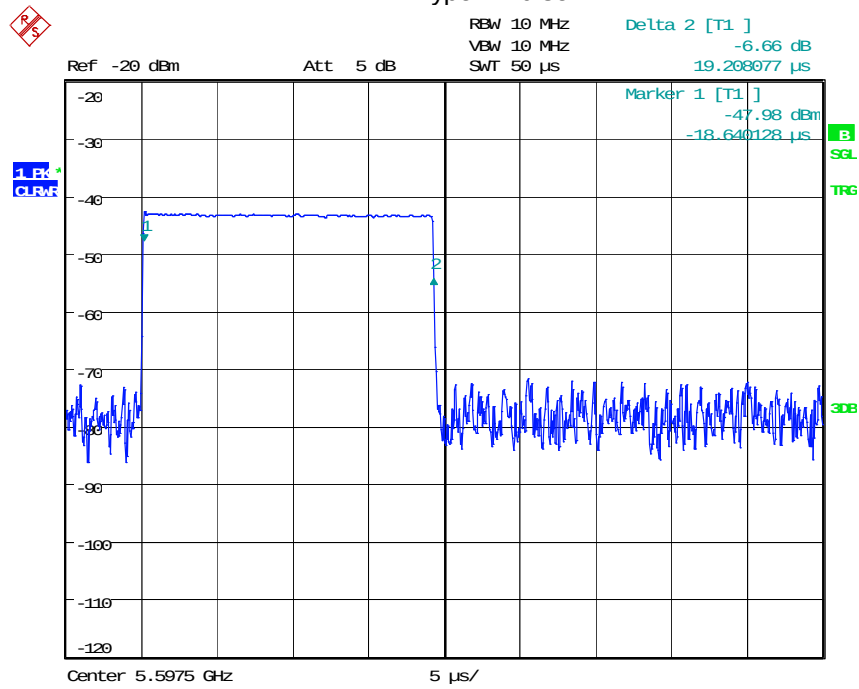


Date: 22.FEB.2017 16:59:56

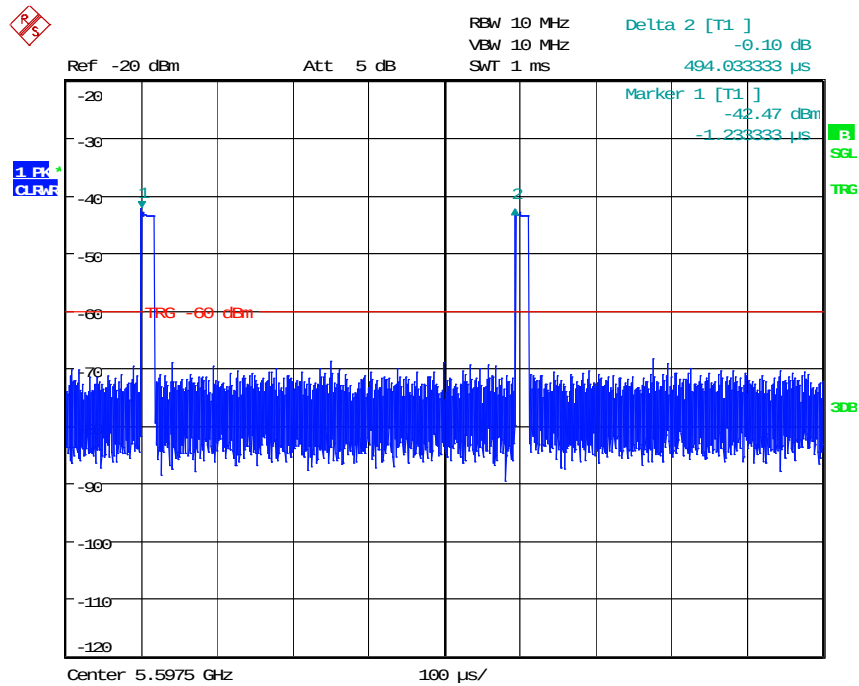


Date: 22.FEB.2017 17:14:44

Type 4 Pulse

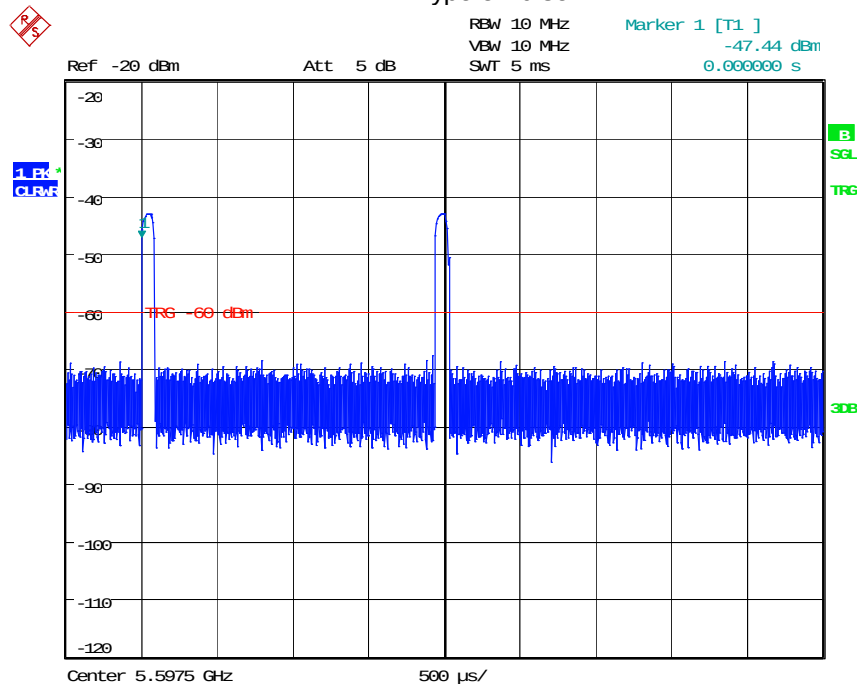


Date: 22.FEB.2017 17:02:02

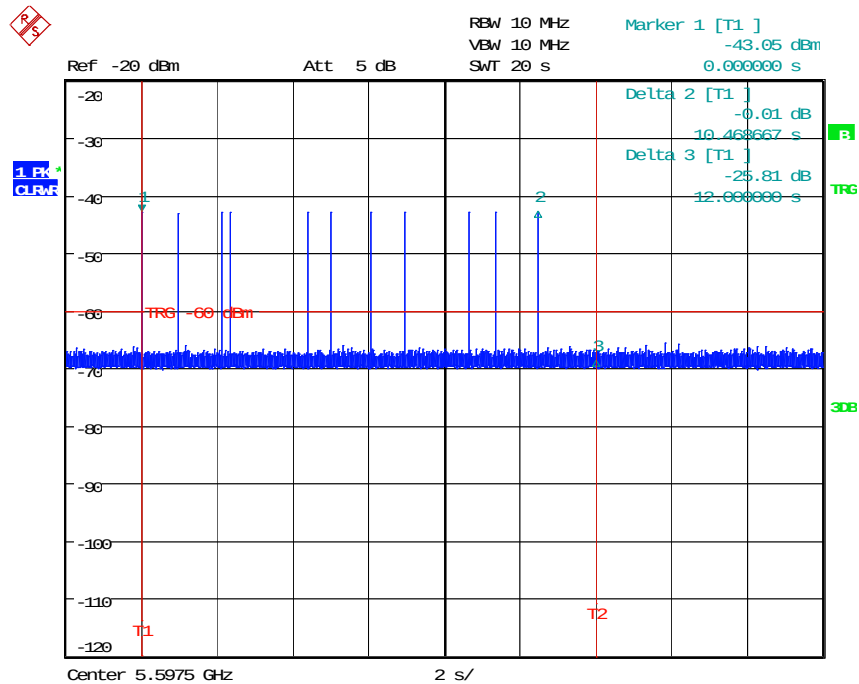


Date: 22.FEB.2017 17:15:27

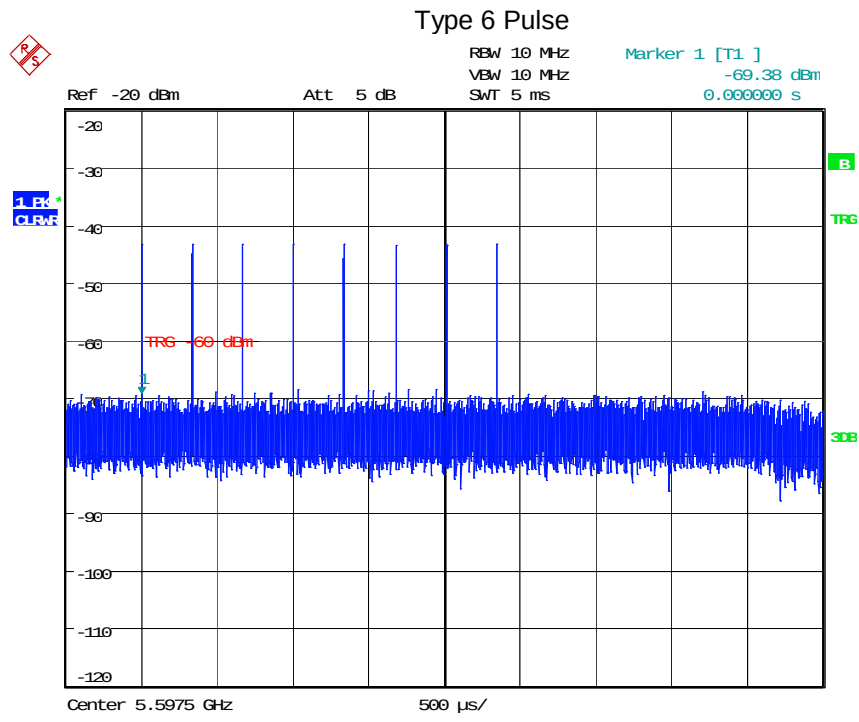
Type 5 Pulse



Date: 22.FEB.2017 17:07:36



Date: 22.FEB.2017 17:26:47



Date: 22.FEB.2017 17:21:59

DFS Parameters Types 1 to 4 and 6

Radar Type	Pulse Width (us)	PRF (Hz)	PRI	# Pulses
Type 0	1	700	1428	18
Type 1	1	1066	938	57
Type 1	1	1475	678	78
Type 1	1	1114	898	59
Type 1	1	1253	798	67
Type 1	1	1089	918	58
Type 1	1	1859	538	99
Type 1	1	1319	758	70
Type 1	1	1672	598	89
Type 1	1	326	3066	18
Type 1	1	1166	858	62
Type 1	1	1730	578	92
Type 1	1	1139	878	61
Type 1	1	1355	738	72
Type 1	1	1792	558	95
Type 1	1	1193	838	63
Type 1	1	995	1005	53
Type 1	1	485	2062	26
Type 1	1	699	1430	37
Type 1	1	411	2435	22
Type 1	1	354	2825	19
Type 1	1	1038	963	55
Type 1	1	1546	647	82
Type 1	1	396	2527	21
Type 1	1	1585	631	84
Type 1	1	554	1804	30
Type 1	1	597	1676	32
Type 1	1	438	2284	24
Type 1	1	518	1930	28
Type 1	1	427	2340	23
Type 1	1	598	1672	32
Type 2	1	4673	214	25
Type 2	4.5	4975	201	28
Type 2	1.9	4926	203	29
Type 2	4.8	4975	201	25
Type 2	2.1	5495	182	29
Type 2	1.1	4608	217	29
Type 2	3.8	5435	184	24
Type 2	3.3	4975	201	29
Type 2	4	5128	195	23
Type 2	1.1	6579	152	26
Type 2	3	6410	156	24
Type 2	2.1	6211	161	27
Type 2	3	4950	202	26
Type 2	4.5	4405	227	29
Type 2	3	4630	216	24
Type 2	4.2	4739	211	25
Type 2	1.2	5348	187	27
Type 2	4.3	4587	218	24
Type 2	1.7	5405	185	24
Type 2	2.5	6289	159	23

Type 2	4	6061	165	27
Type 2	2.5	5405	185	26
Type 2	1.4	4348	230	24
Type 2	2.6	5155	194	24
Type 2	2.7	4587	218	26
Type 2	2.2	6410	156	28
Type 2	3.6	4405	227	28
Type 2	3.8	4386	228	26
Type 2	4.5	4902	204	24
Type 2	5	6329	158	27
Type 3	7.7	4348	230	17
Type 3	7.5	4310	232	18
Type 3	7.3	4329	231	17
Type 3	8.9	2463	406	18
Type 3	6.5	2488	402	18
Type 3	7.8	3115	321	18
Type 3	9.3	2165	462	17
Type 3	7.4	2381	420	16
Type 3	7.1	4695	213	16
Type 3	6.2	2809	356	18
Type 3	7.3	4255	235	18
Type 3	8.2	2033	492	17
Type 3	8.6	4762	210	18
Type 3	8.8	2016	496	18
Type 3	7.7	2075	482	16
Type 3	6.1	2710	369	16
Type 3	8.6	3067	326	16
Type 3	6.9	3984	251	16
Type 3	7.4	4464	224	17
Type 3	7.5	4292	233	16
Type 3	8.2	3521	284	17
Type 3	8.5	3145	318	17
Type 3	9.5	2618	382	18
Type 3	7.9	2268	441	17
Type 3	7	4219	237	18
Type 3	7.5	2114	473	18
Type 3	9.6	3690	271	17
Type 3	9.7	3155	317	16
Type 3	8	4444	225	18
Type 3	8.7	3968	252	18
Type 4	11.7	3584	279	16
Type 4	17.1	4132	242	15
Type 4	14.5	2247	445	14
Type 4	17.3	4032	248	16
Type 4	16.4	3876	258	15
Type 4	19.2	2024	494	12
Type 4	14.1	2016	496	12
Type 4	16.2	2882	347	16
Type 4	16.2	2558	391	16
Type 4	15.4	4202	238	13
Type 4	16.6	3817	262	14
Type 4	18.3	3175	315	14
Type 4	15	2681	373	16

[illegible]

The highlighted rows indicate the pulses measured for the pulse parameter plots presented here. For type 5 pulses Burst 029 was recorded.

The following pages present the pulse parameters for the type 5 pulses used for testing:

Burst Number 000

Burst Number 000								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	11	62369	74	1301	0	642064	705882
2	2	11	89246	50	1056	0	615480	705882
3	3	11	93269	76	1312	1324	609749	705882
4	3	11	450205	92	1070	1104	253227	705882
5	1	11	180584	74	0	0	525224	705882
6	1	11	82682	59	0	0	623141	705882
7	3	11	44241	57	977	1295	659198	705882
8	1	11	655711	85	0	0	50086	705882
9	1	11	654590	53	0	0	51239	705882
10	2	11	475962	89	1817	0	227925	705882
11	1	11	471908	60	0	0	233914	705882
12	1	11	215829	90	0	0	489963	705882
13	2	11	632398	70	1425	0	71919	705882
14	3	11	199868	52	1397	1648	502813	705882
15	1	11	200954	72	0	0	504856	705882
16	1	11	177874	59	0	0	527949	705882
17	3	11	578787	88	975	1620	124236	705882
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 001

Burst Number 001								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	6	219380	89	0	0	703607	923076
2	2	6	802371	64	1900	0	118677	923076
3	1	6	907102	79	0	0	15895	923076
4	2	6	687966	91	1204	0	233724	923076
5	2	6	226341	73	1264	0	695325	923076
6	1	6	36484	61	0	0	886531	923076
7	3	6	658042	75	1232	1450	262127	923076
8	2	6	557408	66	1376	0	364160	923076
9	2	6	485115	99	1748	0	436015	923076
10	2	6	318698	86	1574	0	602632	923076
11	3	6	506511	74	1755	932	413656	923076
12	2	6	825289	95	1351	0	96246	923076
13	2	6	669680	72	1228	0	252024	923076
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 002

Burst Number 002								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	14	122990	51	0	0	734101	857142
2	1	14	732357	97	0	0	124688	857142
3	2	14	715209	77	1466	0	140313	857142
4	3	14	655882	82	1351	1883	197780	857142
5	2	14	847790	91	1703	0	7467	857142
6	2	14	28110	89	1311	0	827543	857142
7	2	14	67605	52	1370	0	788063	857142
8	3	14	750067	96	1791	1045	103951	857142
9	3	14	164133	70	1547	1420	689832	857142
10	2	14	150600	87	1404	0	704964	857142
11	3	14	699430	64	1106	1504	154910	857142
12	2	14	81206	74	1053	0	774735	857142
13	2	14	828569	75	1661	0	26762	857142
14	3	14	201676	92	912	1676	652602	857142
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 003

Burst Number 003								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	17	88902	81	1575	1614	764808	857142
2	3	17	186717	51	1296	1227	667749	857142
3	2	17	271865	53	1447	0	583724	857142
4	3	17	194548	55	1808	1753	658868	857142
5	3	17	228589	80	1613	1744	624956	857142
6	2	17	511292	57	1865	0	343871	857142
7	3	17	188987	74	1350	1124	665459	857142
8	3	17	406704	71	1253	1559	447413	857142
9	2	17	114933	53	1363	0	740740	857142
10	3	17	201142	94	1136	1348	653234	857142
11	2	17	121329	99	1616	0	733999	857142
12	3	17	54576	50	1487	1128	799801	857142
13	3	17	699525	69	990	1893	154527	857142
14	2	17	679549	78	1715	0	175722	857142
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 004

Burst Number 004								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	18	462010	95	1404	1390	734911	1200000
2	2	18	554757	57	1499	0	643630	1200000
3	3	18	1086954	98	939	1095	110718	1200000
4	1	18	87831	81	0	0	1112088	1200000
5	2	18	820121	73	1116	0	378617	1200000
6	2	18	288704	68	1459	0	909701	1200000
7	2	18	1172222	75	1184	0	26444	1200000
8	2	18	46718	52	1029	0	1152149	1200000
9	2	18	571124	73	1680	0	627050	1200000
10	1	18	741144	88	0	0	458768	1200000
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 005

Burst Number 005								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	20	544062	61	1789	1290	84254	631578
2	1	20	515237	77	0	0	116264	631578
3	2	20	821	72	1259	0	629354	631578
4	1	20	342278	62	0	0	289238	631578
5	3	20	558872	62	1908	1779	68833	631578
6	2	20	545034	95	1693	0	84661	631578
7	3	20	91211	80	1376	1437	537314	631578
8	3	20	441574	79	1767	1252	186748	631578
9	3	20	345961	56	1621	1835	281993	631578
10	2	20	55552	86	1076	0	574778	631578
11	2	20	276901	88	949	0	353552	631578
12	1	20	318424	60	0	0	313094	631578
13	3	20	253391	90	1687	1879	374351	631578
14	3	20	170162	72	1913	1280	458007	631578
15	2	20	404713	51	1620	0	225143	631578
16	3	20	266484	74	1596	1382	361894	631578
17	2	20	263551	65	1289	0	366608	631578
18	2	20	504185	59	1357	0	125918	631578
19	1	20	607018	55	0	0	24505	631578
20	0	0	0	0	0	0	0	0

Burst Number 006

Burst Number 006								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	9	1030857	82	0	0	169061	1200000
2	3	9	1191564	53	1310	1246	5721	1200000
3	3	9	1019527	85	1453	1195	177570	1200000
4	3	9	315961	75	1371	1672	880771	1200000
5	2	9	964152	100	1681	0	233967	1200000
6	1	9	442125	82	0	0	757793	1200000
7	2	9	32215	90	1898	0	1165707	1200000
8	1	9	468715	94	0	0	731191	1200000
9	1	9	870219	67	0	0	329714	1200000
10	1	9	71298	89	0	0	1128613	1200000
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 007

Burst Number 007								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	9	649069	71	0	0	273936	923076
2	2	9	497574	91	1047	0	424273	923076
3	2	9	400246	97	1257	0	521379	923076
4	3	9	461585	80	1093	1390	458768	923076
5	2	9	629042	61	1372	0	292540	923076
6	2	9	415483	65	1904	0	505559	923076
7	3	9	877854	57	1108	1448	42495	923076
8	2	9	779440	83	1604	0	141866	923076
9	1	9	325024	92	0	0	597960	923076
10	1	9	752123	80	0	0	170873	923076
11	1	9	265422	93	0	0	657561	923076
12	1	9	754746	84	0	0	168246	923076
13	1	9	869503	90	0	0	53483	923076
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 008

Burst Number 008								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	8	463233	78	1549	0	166640	631578
2	3	8	490008	93	1367	1159	138765	631578
3	3	8	291182	99	935	1448	337716	631578
4	3	8	218571	88	917	1445	410381	631578
5	1	8	521674	70	0	0	109834	631578
6	2	8	180818	60	1777	0	448863	631578
7	1	8	399991	65	0	0	231522	631578
8	3	8	459006	67	1156	1562	169653	631578
9	3	8	206598	55	1005	1055	422755	631578
10	3	8	92200	95	1755	1732	535606	631578
11	1	8	467698	91	0	0	163789	631578
12	2	8	7934	99	971	0	622475	631578
13	1	8	479035	80	0	0	152463	631578
14	3	8	565264	89	1052	1335	63660	631578
15	2	8	390005	80	1084	0	240329	631578
16	3	8	513245	66	1685	1340	115110	631578
17	2	8	563483	79	1608	0	66329	631578
18	1	8	142887	68	0	0	488623	631578
19	2	8	595897	100	1166	0	34315	631578
20	0	0	0	0	0	0	0	0

Burst Number 009

Burst Number 009								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	13	1188296	66	1497	0	310075	1500000
2	1	13	1305216	82	0	0	194702	1500000
3	3	13	316925	54	1912	1583	1179418	1500000
4	3	13	1276981	69	1658	1161	219993	1500000
5	3	13	1777	75	1330	1849	1494819	1500000
6	2	13	88702	69	1049	0	1410111	1500000
7	1	13	409553	77	0	0	1090370	1500000
8	3	13	1344813	94	1384	1780	151741	1500000
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 010

Burst Number 010								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	18	138258	59	0	0	461683	600000
2	1	18	546138	77	0	0	53785	600000
3	2	18	408958	81	969	0	189911	600000
4	1	18	299450	100	0	0	300450	600000
5	1	18	262241	57	0	0	337702	600000
6	2	18	386375	81	1542	0	211921	600000
7	3	18	240092	59	1616	968	357147	600000
8	2	18	54500	82	1237	0	544099	600000
9	1	18	590652	67	0	0	9281	600000
10	2	18	402608	94	1081	0	196123	600000
11	2	18	8060	69	1801	0	590001	600000
12	2	18	260393	89	1244	0	338185	600000
13	3	18	373698	62	971	1892	223253	600000
14	2	18	165179	52	1201	0	433516	600000
15	1	18	525446	97	0	0	74457	600000
16	2	18	118279	60	1660	0	479941	600000
17	1	18	317069	59	0	0	282872	600000
18	3	18	370431	67	1270	1491	226607	600000
19	1	18	502709	74	0	0	97217	600000
20	1	18	365486	88	0	0	234426	600000

Burst Number 011

Burst Number 011								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	7	405562	62	1228	1101	925256	1333333
2	3	7	112555	85	1569	1033	1217921	1333333
3	3	7	222095	56	1896	1243	1107931	1333333
4	2	7	980763	83	1589	0	350815	1333333
5	1	7	587134	62	0	0	746137	1333333
6	1	7	907639	70	0	0	425624	1333333
7	2	7	798767	91	1061	0	533323	1333333
8	3	7	1038190	75	1592	1078	292248	1333333
9	1	7	1216945	63	0	0	116325	1333333
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 012

Burst Number 012								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	19	617535	75	1800	0	180515	800000
2	1	19	347872	82	0	0	452046	800000
3	3	19	310000	93	1214	1349	487158	800000
4	1	19	676997	94	0	0	122909	800000
5	3	19	384299	70	1079	1820	412592	800000
6	3	19	105941	94	1447	959	691371	800000
7	2	19	136892	52	1918	0	661086	800000
8	1	19	386813	95	0	0	413092	800000
9	1	19	111928	89	0	0	687983	800000
10	3	19	614791	68	1599	1763	181643	800000
11	1	19	769781	87	0	0	30132	800000
12	3	19	632734	58	1539	1368	164185	800000
13	1	19	497710	94	0	0	302196	800000
14	1	19	59711	51	0	0	740238	800000
15	1	19	762284	86	0	0	37630	800000
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 013

Burst Number 013								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	15	381955	79	1386	1418	281670	666666
2	2	15	198447	98	1183	0	466840	666666
3	3	15	211726	51	1477	1689	451621	666666
4	1	15	98608	62	0	0	567996	666666
5	3	15	102307	85	1811	1451	560842	666666
6	1	15	194083	83	0	0	472500	666666
7	2	15	22253	90	1370	0	642863	666666
8	3	15	17001	71	1788	1479	646185	666666
9	1	15	520369	59	0	0	146238	666666
10	1	15	293282	69	0	0	373315	666666
11	1	15	85391	66	0	0	581209	666666
12	1	15	234610	63	0	0	431993	666666
13	3	15	565390	90	1816	1749	97441	666666
14	3	15	348394	63	1863	1041	315179	666666
15	2	15	617135	90	1116	0	48235	666666
16	2	15	345938	75	1172	0	319406	666666
17	1	15	652039	59	0	0	14568	666666
18	3	15	597436	58	1875	1398	65783	666666
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 014

Burst Number 014								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	9	333277	61	965	1125	521592	857142
2	3	9	166589	89	1901	1466	686919	857142
3	3	9	786168	80	1522	1545	67667	857142
4	2	9	35279	93	1885	0	819792	857142
5	2	9	58782	91	1612	0	796566	857142
6	2	9	319960	87	1008	0	536000	857142
7	1	9	833938	82	0	0	23122	857142
8	2	9	405	98	1193	0	855348	857142
9	1	9	427539	95	0	0	429508	857142
10	1	9	228533	71	0	0	628538	857142
11	1	9	807722	82	0	0	49338	857142
12	1	9	614024	80	0	0	243038	857142
13	2	9	463396	68	1726	0	391884	857142
14	1	9	736696	74	0	0	120372	857142
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 015

Burst Number 015								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	11	440190	57	1361	1386	1056892	1500000
2	2	11	872333	80	1281	0	626226	1500000
3	3	11	591863	99	1210	1502	905128	1500000
4	1	11	1042643	56	0	0	457301	1500000
5	2	11	286465	89	1208	0	1212149	1500000
6	3	11	780315	50	963	977	717595	1500000
7	1	11	130003	69	0	0	1369928	1500000
8	3	11	846115	96	996	1131	651470	1500000
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 016

Burst Number 016								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	16	129937	86	0	0	960886	1090909
2	3	16	260622	78	1190	1282	827581	1090909
3	2	16	1043001	70	1904	0	45864	1090909
4	3	16	92374	71	1319	1843	995160	1090909
5	3	16	440220	62	1171	1072	648260	1090909
6	2	16	244301	89	1456	0	844974	1090909
7	1	16	990729	85	0	0	100095	1090909
8	3	16	329055	54	982	1105	759605	1090909
9	1	16	485791	100	0	0	605018	1090909
10	1	16	1006435	87	0	0	84387	1090909
11	2	16	675853	89	1303	0	413575	1090909
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 017

Burst Number 017								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	6	791033	84	1413	0	7386	800000
2	1	6	256498	73	0	0	543429	800000
3	1	6	541068	80	0	0	258852	800000
4	1	6	125093	67	0	0	674840	800000
5	2	6	264422	100	1566	0	533812	800000
6	3	6	362733	66	1872	1733	433464	800000
7	2	6	9228	70	1398	0	789234	800000
8	1	6	667055	66	0	0	132879	800000
9	2	6	180259	50	1745	0	617896	800000
10	2	6	157526	81	1521	0	640791	800000
11	3	6	124889	94	1526	1622	671681	800000
12	3	6	730980	68	1625	1031	66160	800000
13	2	6	355842	97	1637	0	442327	800000
14	2	6	210848	65	1545	0	587477	800000
15	1	6	74494	65	0	0	725441	800000
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 018

Burst Number 018								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	20	206513	100	1068	0	649361	857142
2	2	20	577081	75	1045	0	278866	857142
3	3	20	741437	69	1399	1345	112754	857142
4	3	20	851910	61	1581	1691	1777	857142
5	3	20	335877	68	1026	1569	518466	857142
6	1	20	309347	96	0	0	547699	857142
7	2	20	383065	81	1137	0	472778	857142
8	1	20	338595	55	0	0	518492	857142
9	3	20	394312	59	1658	1930	459065	857142
10	3	20	567308	59	1921	1184	286552	857142
11	2	20	670557	63	969	0	185490	857142
12	2	20	349300	69	1553	0	506151	857142
13	1	20	131522	69	0	0	725551	857142
14	3	20	281512	90	1516	978	572866	857142
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 019

Burst Number 019								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	20	102184	73	1210	0	987369	1090909
2	2	20	561394	50	1942	0	527473	1090909
3	2	20	318119	83	1207	0	771417	1090909
4	2	20	1058539	69	1783	0	30449	1090909
5	3	20	990557	92	1788	1486	96802	1090909
6	1	20	42833	80	0	0	1047996	1090909
7	3	20	431350	86	1155	1890	656256	1090909
8	1	20	144606	96	0	0	946207	1090909
9	2	20	856975	59	1416	0	232400	1090909
10	2	20	14527	72	1830	0	1074408	1090909
11	3	20	128429	53	1830	1916	958575	1090909
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 020

Burst Number 020								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	18	350188	52	1770	1698	1146188	1500000
2	2	18	413631	87	1000	0	1085195	1500000
3	3	18	1163494	62	1040	1580	333700	1500000
4	1	18	591701	56	0	0	908243	1500000
5	3	18	1369222	58	1832	1263	127509	1500000
6	1	18	620208	80	0	0	879712	1500000
7	3	18	517019	94	1692	1744	979263	1500000
8	2	18	1285075	96	1882	0	212851	1500000
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 021

Burst Number 021								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	19	584072	68	1618	0	271316	857142
2	3	19	117019	55	1144	1872	736942	857142
3	2	19	664067	63	1173	0	191776	857142
4	3	19	106788	74	1160	1887	747085	857142
5	2	19	197047	93	1892	0	658017	857142
6	2	19	804150	65	1518	0	51344	857142
7	1	19	199994	97	0	0	657051	857142
8	1	19	671859	56	0	0	185227	857142
9	1	19	466059	54	0	0	391029	857142
10	1	19	406939	52	0	0	450151	857142
11	1	19	613459	60	0	0	243623	857142
12	1	19	62191	73	0	0	794878	857142
13	3	19	732363	82	927	1801	121805	857142
14	2	19	269092	98	1755	0	586099	857142
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 022

Burst Number 022								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	20	74456	51	1334	0	674108	750000
2	3	20	608085	93	1175	1600	138861	750000
3	1	20	702745	74	0	0	47181	750000
4	3	20	362998	70	1385	1116	384291	750000
5	3	20	580028	66	1067	1780	166927	750000
6	1	20	714804	81	0	0	35115	750000
7	3	20	270691	68	1005	1773	476327	750000
8	1	20	502432	73	0	0	247495	750000
9	1	20	5676	60	0	0	744264	750000
10	2	20	265186	69	1406	0	483270	750000
11	2	20	640635	72	1568	0	107653	750000
12	1	20	243380	85	0	0	506535	750000
13	2	20	355512	70	1136	0	393212	750000
14	3	20	424646	100	1396	994	322664	750000
15	3	20	366887	88	1058	1719	380072	750000
16	1	20	338758	93	0	0	411149	750000
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 023

Burst Number 023								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	5	127106	77	0	0	472817	600000
2	2	5	262376	76	1034	0	336438	600000
3	3	5	243255	84	1316	1052	354125	600000
4	2	5	535813	63	1543	0	62518	600000
5	3	5	289409	82	1806	1250	307289	600000
6	1	5	378437	52	0	0	221511	600000
7	1	5	137401	96	0	0	462503	600000
8	3	5	112306	94	1157	1500	484755	600000
9	3	5	155113	59	1367	1731	441612	600000
10	3	5	4825	84	1280	1417	592226	600000
11	3	5	197261	85	1346	1270	399868	600000
12	3	5	129965	60	1536	1465	466854	600000
13	2	5	55796	81	1440	0	542602	600000
14	2	5	369281	79	1123	0	229438	600000
15	3	5	481572	89	1024	1345	115792	600000
16	3	5	487115	75	1160	1759	109741	600000
17	2	5	312820	86	1864	0	285144	600000
18	3	5	118988	74	1290	1287	478213	600000
19	3	5	159712	79	1264	1388	437399	600000
20	3	5	400614	69	1555	1231	196393	600000

Burst Number 024

Burst Number 024								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	9	729152	88	979	1395	268210	1000000
2	3	9	856593	69	1820	1414	139966	1000000
3	1	9	384945	52	0	0	615003	1000000
4	3	9	778425	91	1177	950	219175	1000000
5	1	9	118409	87	0	0	881504	1000000
6	2	9	537964	65	976	0	460930	1000000
7	1	9	707659	93	0	0	292248	1000000
8	2	9	563965	66	1129	0	434774	1000000
9	2	9	961147	75	1882	0	36821	1000000
10	3	9	985203	52	1048	1530	12063	1000000
11	2	9	479874	86	944	0	519010	1000000
12	1	9	307367	54	0	0	692579	1000000
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 025

Burst Number 025								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	6	379935	76	1551	0	249940	631578
2	1	6	278549	65	0	0	352964	631578
3	1	6	270136	98	0	0	361344	631578
4	1	6	289485	84	0	0	342009	631578
5	1	6	334667	83	0	0	296828	631578
6	2	6	533344	94	909	0	97137	631578
7	2	6	291282	50	1630	0	338566	631578
8	3	6	352823	82	1584	1199	275726	631578
9	1	6	339845	61	0	0	291672	631578
10	3	6	589124	66	1676	1610	38970	631578
11	3	6	538115	66	1594	1456	90215	631578
12	1	6	336138	84	0	0	295356	631578
13	1	6	352422	50	0	0	279106	631578
14	2	6	127698	98	1642	0	502042	631578
15	1	6	456373	53	0	0	175152	631578
16	2	6	543052	92	1072	0	87270	631578
17	2	6	292817	82	1078	0	337519	631578
18	3	6	85782	60	1451	1818	542347	631578
19	2	6	411043	100	1492	0	218843	631578
20	0	0	0	0	0	0	0	0

Burst Number 026

Burst Number 026								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	10	724126	76	0	0	75798	800000
2	1	10	337405	97	0	0	462498	800000
3	2	10	487499	55	1860	0	310531	800000
4	2	10	573803	50	1184	0	224913	800000
5	2	10	617491	58	1778	0	180615	800000
6	1	10	22606	89	0	0	777305	800000
7	2	10	372224	69	1330	0	426308	800000
8	1	10	701901	72	0	0	98027	800000
9	1	10	286733	69	0	0	513198	800000
10	1	10	768210	82	0	0	31708	800000
11	3	10	186434	59	1618	1774	609997	800000
12	2	10	196526	96	1428	0	601854	800000
13	3	10	127247	59	1128	1218	670230	800000
14	2	10	653653	63	1090	0	145131	800000
15	2	10	768387	90	1225	0	30208	800000
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 027

Burst Number 027								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	2	13	1004443	96	1884	0	326814	1333333
2	3	13	506991	77	1175	1343	823593	1333333
3	1	13	540888	99	0	0	792346	1333333
4	2	13	794903	50	1490	0	536840	1333333
5	3	13	279826	75	1040	1463	1050779	1333333
6	1	13	376386	87	0	0	956860	1333333
7	2	13	719470	95	1130	0	612543	1333333
8	2	13	1046119	92	1553	0	285477	1333333
9	1	13	388060	58	0	0	945215	1333333
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 028

Burst Number 028								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	1	12	709952	78	0	0	289970	1000000
2	2	12	3519	89	1718	0	994585	1000000
3	1	12	773222	56	0	0	226722	1000000
4	1	12	19048	64	0	0	980888	1000000
5	3	12	294834	91	1756	1508	701629	1000000
6	1	12	697590	58	0	0	302352	1000000
7	2	12	711322	54	1257	0	287313	1000000
8	3	12	348462	77	1552	1108	648647	1000000
9	1	12	214810	86	0	0	785104	1000000
10	1	12	946140	85	0	0	53775	1000000
11	2	12	470844	97	1345	0	527617	1000000
12	3	12	75280	54	1154	1057	922347	1000000
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

Burst Number 029

Burst Number 029								
Burst Segment	Number of Pulses	Chirp Width (MHz)	t1 (μs)	Pulse Width t2 (μs)	t3 (μs)	t4 (μs)	t5 (μs)	Total Segment Length (μs)
1	3	12	951086	92	1847	1365	136335	1090909
2	1	12	831415	58	0	0	259436	1090909
3	3	12	891103	74	1325	1815	196444	1090909
4	1	12	4294	69	0	0	1086546	1090909
5	3	12	959871	73	1364	990	128465	1090909
6	1	12	481074	94	0	0	609741	1090909
7	2	12	463575	93	1699	0	625449	1090909
8	2	12	256597	60	1909	0	832283	1090909
9	2	12	865821	75	1568	0	223370	1090909
10	1	12	477886	95	0	0	612928	1090909
11	3	12	509899	52	1323	1898	577633	1090909
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0

16 Additional Information

Customer's Declaration:

[DWR] SW security requirements were complied with by 'cam-10088 - PMP 450m U-NII Security Guide KDB594280 D02 Response' and 'cam-10086 - Regulatory - PMP 450m KDB 442812 Software Defined Radio security description guide'



Element Materials Technology
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Malvern
Worcestershire
WR14 1BX
UK

Date: 14th December 2016

RE: DFS Attestation for Class III Permissive Change Request

FCC ID: QWP-50450M

To Whom It May Concern:

Subject – Attestation that DFS cannot be disabled by the End User for FCC ID: QWP-50450M.

Cambium Networks confirm that: -

The PMP 450m DFS software cannot be disabled by the End User.

Thank you for your attention to this matter.

Yours faithfully
Cambium Networks Ltd

A handwritten signature in black ink that reads 'Donald W Reid'.

Donald W Reid
CEng MIET
Principal Regulatory Engineer

17 Measurement Uncertainty

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

Test type	Quantity	Quantity frequency range	Uncertainty
DFS Parameters	Amplitude	9kHz to 26.5GHz	±0.9 dB
	Time	9kHz to 26.5GHz	0.1%
	Frequency	9kHz to 26.5GHz	3.611kHz