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TEST REPORT

Covering the DYNAMIC FREQUENCY SELECTION (DFS) REQUIREMENTS OF

FCC Part 15 Subpart E (UNII), RSS-210 Annex 9

Aruba Networks
Model(s): APINH205 2x2:2 MIMO 802.11a/b/g/n/ac Wireless Access Point

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REPORT DATE:	April 29, 2016
FINAL TEST DATE:	November 13, 2015
TEST ENGINEER:	Mark Hill
TOTAL NUMBER OF PAGES:	50

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Testing Cert #0214.26

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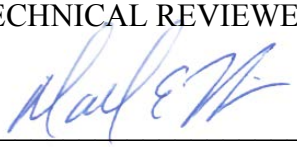

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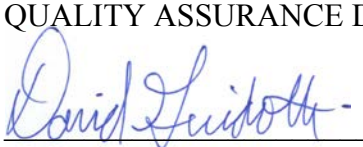

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REVISION HISTORY

Rev #	Date	Comments	Modified By
-	April 29, 2016	Initial Release	-

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SCOPE

Test data has been taken pursuant to the relevant DFS requirements of the following standard(s):

- FCC Part 15 Subpart E Unlicensed National Information Infrastructure (U-NII) Devices.
- RSS-247 Issue 1 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Tests were performed in accordance with these standards together with the current published versions of the basic standards referenced therein including FCC KDB 905462 D02 and FCC KDB 905462 D03 as outlined in NTS Silicon Valley test procedures. The test results recorded herein are based on a single type test of the Aruba Networks model APIN205 2x2:2 MIMO 802.11a/b/g/n/ac Wireless Access Point and therefore apply only to the tested sample. The sample was selected and prepared by Phillip Carranco of Aruba Networks.

Note – the testing was limited to the in-service monitoring requirements using the Type 5 radar. This was due to a change in the Bin 5 detection algorithm.

OBJECTIVE

The objective of the manufacturer is to comply with the standards identified in the previous section. In order to demonstrate compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards. Compliance with some DFS features is covered through a manufacturer statement or through observation of the device.

STATEMENT OF COMPLIANCE

The tested sample of the Aruba Networks model APIN205 2x2:2 MIMO 802.11a/b/g/n/ac Wireless Access Point complied with the DFS requirements of FCC Part 15.407(h)(2), RSS-247 Issue 1 Section 6.3.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARD

The following deviations were made from the test methods and requirements covered by the scope of this report:

1. Testing was limited to in-service monitoring using the Type 5 radar in the 20MHz bandwidth mode

TEST RESULTS

TEST RESULTS SUMMARY – FCC Part 15, MASTER DEVICE

Table 1 - FCC Part 15 Subpart E Master Device Test Result Summary (20MHz)						
Description	Radar Type	EUT Frequency	Measured Value	Requirement	Test Data	Status
In-Service Monitoring Detection Threshold	Type 5	5500MHz	-63dBm	-64dBm (See note 2)	Appendix B	Pass

1) Tests were performed using the radiated test method.
2) The measured detection threshold is based on testing the master device using the radiated test method when connected to an antenna with a nominal gain of 6dBi, plus 1dB per FCC test procedure. The limit is based on an EIRP of more than 23dBm.
3) The in-service monitoring detection threshold and detection probability measurements were made with the device operating in the 5250-5350 5500-5700 MHz band.

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level, with a coverage factor (k=2) and were calculated in accordance with UKAS document LAB 34.

Measurement	Measurement Unit	Expanded Uncertainty
Timing (Channel move time, aggregate transmission time)	ms	Timing resolution ± 0.24%
Timing (non occupancy period)	seconds	5 seconds
DFS Threshold (radiated)	dBm	1.6
DFS Threshold (conducted)	dBm	1.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Aruba Networks model APIN205 2x2:2 MIMO 802.11a/b/g/n/ac Wireless Access Point is a high-performance dual radio wireless access point for hospitality and branch deployments.

The sample was received on November 13, 2015 and tested on November 13, 2015. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Aruba	APINH202-2x2:2	2.4GHz/5GHz AP	DN0010195

The manufacturer declared values for the EUT operational characteristics that affect DFS are as follows:

Operating Modes (5250 – 5350 MHz, 5470 – 5725 MHz)

☒ Master Device 5250-5350 MHz

☒ Master Device 5470-5725 MHz (excluding 5600-5650 MHz for Canada)

Antenna Gains / EIRP (5250 – 5350 MHz, 5470 – 5725 MHz)

	5250 – 5350 MHz	5470 – 5725 MHz
Lowest Antenna Gain (dBi)	6	6
Highest Antenna Gain (dBi)	6	6
EIRP Output Power (dBm)	26.6	29.0

☒ Power can exceed 200mW eirp

Channel Protocol

☒ IP Based

ENCLOSURE

The EUT enclosure measures approximately 15.5 by 9 by 4.3 centimeters. It is primarily constructed of uncoated coated plastic.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the requirements of the standard(s) referenced in this test report.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for testing:

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	*Latitude E5440*	*Intel Dual Band Wireless AC 7260 802.11ac/a/b/g/n 2x2 Half Mini Card*	*38cnp12*	*PD97260HU*
Lenovo	Thinkpad T420	Intel i5-2520M CPU @ 2.50 GHz	R9LC5GV	QDS-BRCM1046

The italicized device was the client device.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length (m)
E0	Aruba 7010 Controller	Ethernet	Shielded	15m

EUT OPERATION

The EUT was operating with the following software listed below. The software is secured by Aruba OS to prevent the user from disabling the DFS function.

Master Device: Aruba OS version: 6.4.4.0 #51667

The manufacturer provided special software that over-rode the non-occupancy mechanism (allowing return to the same channel) for the purposes of determining the probability of detection. This test feature was disabled and the normal operating software enabled for verifying the 30-minute non-occupancy period and channel move time.

The start of the Channel Availability Check was 0.1ms after the instant the command to change channel was sent.

During the in-service monitoring detection probability and channel moving tests the system was configured with a streaming video file from the master device (sourced by the PC connected to the master device via an Ethernet interface) to the client device.

The streamed file was FCC movie and the client device was using media player to view the file. The channel loading was evaluated to be 17.7% (refer to figure 9) meeting the approximately 17% loading as required by FCC KDB 905462 D02.

RADAR WAVEFORMS

Table 2 - FCC Short Pulse Radar Test Waveforms

Radar Type		Pulse Width (μsec)	PRI (μsec)	Pulses / burst	Minimum Detection Percentage	Minimum Number of Trials
0		1	1428	18	See **Note 1**	
1	1a	1	15 unique PRI values randomly selected from the list of 23 PRI values in **Note 2** below	Round Up $1/360 * 19*10^6 / PRI_{\mu sec}$	60%	15
	1b		518-3066 with minimum increment of 1 μsec, excluding PRI values selected in 1a			15
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 is used for the detection bandwidth test, channel move time, and channel closing time tests.

Note 2: Pulse repetition intervals values for Test 1a above

Pulse Repetition Frequency Number	**Pulse Repetition Frequency (Pulses Per Second)**	**Pulse Repetition Interval (Microseconds)**
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 3 - FCC Long Pulse Radar Test Waveforms							
Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Pulses / burst	Number of *Bursts*	Minimum Detection Percentage	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 4 - FCC Frequency Hopping Radar Test Waveforms							
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses / hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Detection Percentage	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

DFS TEST METHODS

RADIATED TEST METHOD

The combination of master and slave devices is located in an anechoic chamber. The simulated radar waveform is transmitted from a directional horn antenna (typically an EMCO 3115) toward the unit performing the radar detection (radar detection device, RDD). Every effort is made to ensure that the main beam of the EUT's antenna is aligned with the radar-generating antenna which is oriented in vertical polarization.

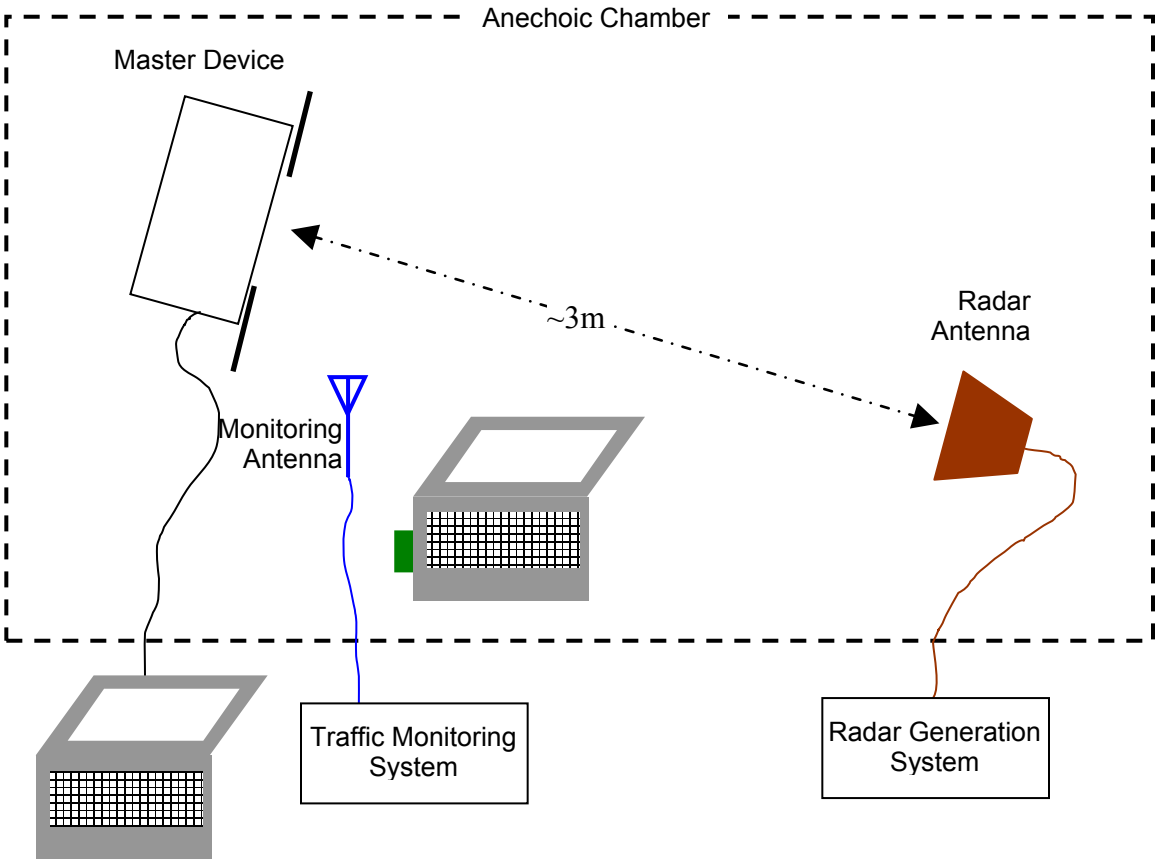


Figure 1 Test Configuration for radiated Measurement Method

The signal level of the simulated waveform is set to a reference level equal to the threshold level (plus 1dB if testing against FCC requirements). Lower levels may also be applied on request of the manufacturer. The level reported is the level at the RDD antenna and so it is not corrected for the RDD's antenna gain. The RDD is configured with the lowest gain antenna assembly intended for use with the device.

The signal level is verified by measuring the CW signal level from the radar generation system using a reference antenna of gain G_{REF} (dBi). The radar signal level is calculated from the measured level, R (dBm), and any cable loss, L (dB), between the reference antenna and the measuring instrument:

$$\text{Applied level (dBm)} = R - G_{REF} + L$$

If both master and client devices have radar detection capability then the device not under test is positioned with absorbing material between its antenna and the radar generating antenna, and the radar level at the non RDD is verified to be at least 20dB below the threshold level to ensure that any responses are due to the RDD detecting radar.

The antenna connected to the channel monitoring subsystem is positioned to allow both master and client transmissions to be observed, with the level of the EUT's transmissions between 6 and 10dB higher than those from the other device.

DFS MEASUREMENT INSTRUMENTATION

RADAR GENERATION SYSTEM

An Agilent PSG is used as the radar-generating source. The integral arbitrary waveform generators are programmed using Agilent's "Pulse Building" software and NTS Silicon Valley custom software to produce the required waveforms, with the capability to produce both un-modulated and modulated (FM Chirp) pulses. Where there are multiple values for a specific radar parameter then the software selects a value at random and, for FCC tests, the software verifies that the resulting waveform is truly unique.

With the exception of the hopping waveforms required by the FCC's rules (see below), the radar generator is set to a single frequency within the radar detection bandwidth of the EUT. The frequency is varied from trial to trial by stepping in 5MHz steps. For radar types with variable parameters, each detection probability trial is performed using a unique set of parameters obtained by a random selection with uniform distribution for each of the variable parameters.

Frequency hopping radar waveforms are simulated using a time domain model. A randomly hopping sequence algorithm (which uses each channel in the hopping radar's range once in a hopping sequence) generates a hop sequence. A segment of the first 100 elements of the hop sequence are then examined to determine if it contains one or more frequencies within the radar detection bandwidth of the EUT. If it does not then the first element of the segment is discarded and the next frequency in the sequence is added. The process repeats until a valid segment is produced. The radar system is then programmed to produce bursts at time slots coincident with the frequencies within the segment that fall in the detection bandwidth. The frequency of the generator is stepped in 1 MHz increments across the EUT's detection range.

The radar signal level is verified during testing using a long duration pulse waveform generated in the same manner as the normal radar generated signals.

The generator output is connected to the coupling port of the conducted set-up or to the radar-generating antenna. The radar generating antenna (when used) is oriented for vertical polarization.

CHANNEL MONITORING SYSTEM

Channel monitoring is achieved using a spectrum analyzer and digital storage oscilloscope. The analyzer is configured in a zero-span mode, center frequency set to the radar waveform's frequency or the center frequency of the EUT's operating channel. The IF output of the analyzer is connected to one input of the oscilloscope.

A signal generator output is set to send either the modulating signal directly or a pulse gate with an output pulse co-incident with each radar pulse. This output is connected to a second input on the oscilloscope and the oscilloscope displays both the channel traffic (via the if input) and the radar pulses on its display.

For in service monitoring tests the analyzer sweep time is set to > 20 seconds and the oscilloscope is configured with a data record length of 10 seconds for the short duration and frequency hopping waveforms, 20 seconds for the long duration waveforms. Both instruments are set for a single acquisition sequence. The analyzer is triggered 500ms before the start of the waveform and the oscilloscope is triggered directly by the modulating pulse train. Timing measurements for aggregate channel transmission time and channel move time are made from the oscilloscope data, with the end of the waveform clearly identified by the pulse train on one trace. The analyzer trace data is used to confirm that the last transmission occurred within the 10-second record of the oscilloscope. If necessary the record length of the oscilloscope is expanded to capture the last transmission on the channel prior to the channel move.

Channel availability check time timing plots are made using the analyzer. The analyzer is triggered at start of the EUT's channel availability check and used to verify that the EUT does not transmit when radar is applied during the check time.

The analyzer detector and oscilloscope sampling mode is set to peak detect for all plots.

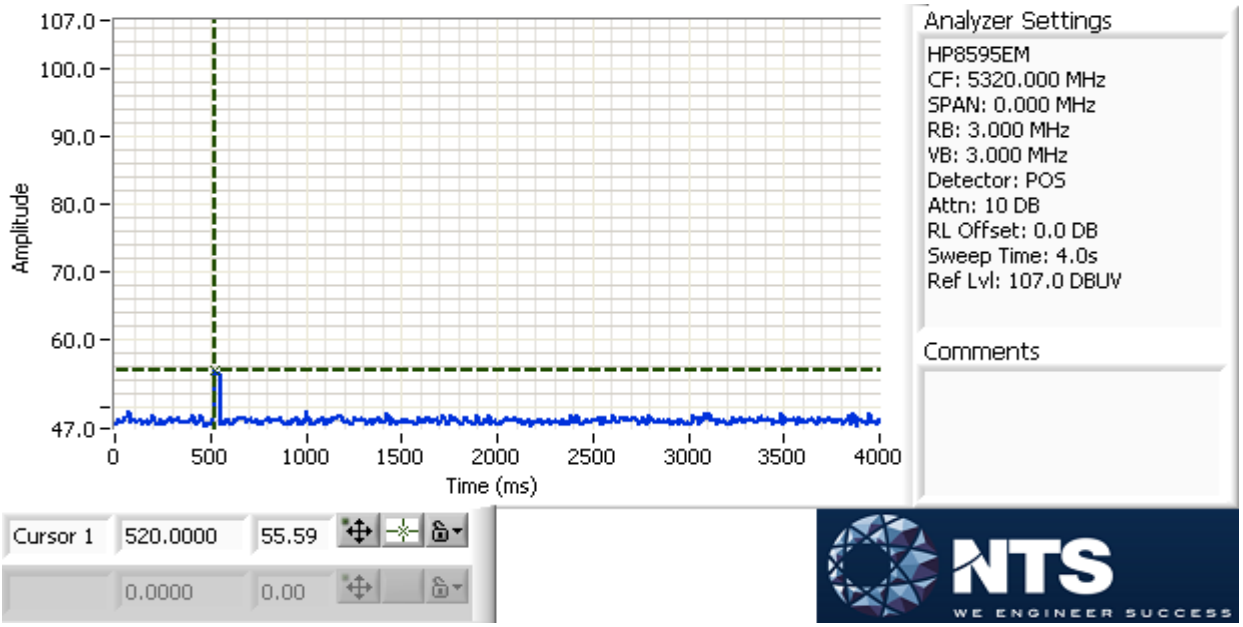


Figure 2 SA Noise Floor During Testing (radar shown at 520 ms)

RADAR GENERATOR PLOTS

The radar generator was connected to Spectrum Analyzer (SA) input, with the SA set to zero span, 3 MHz RBW, 3 MHz VBW. The SA IF output was connected to an oscilloscope to provide timing plots.

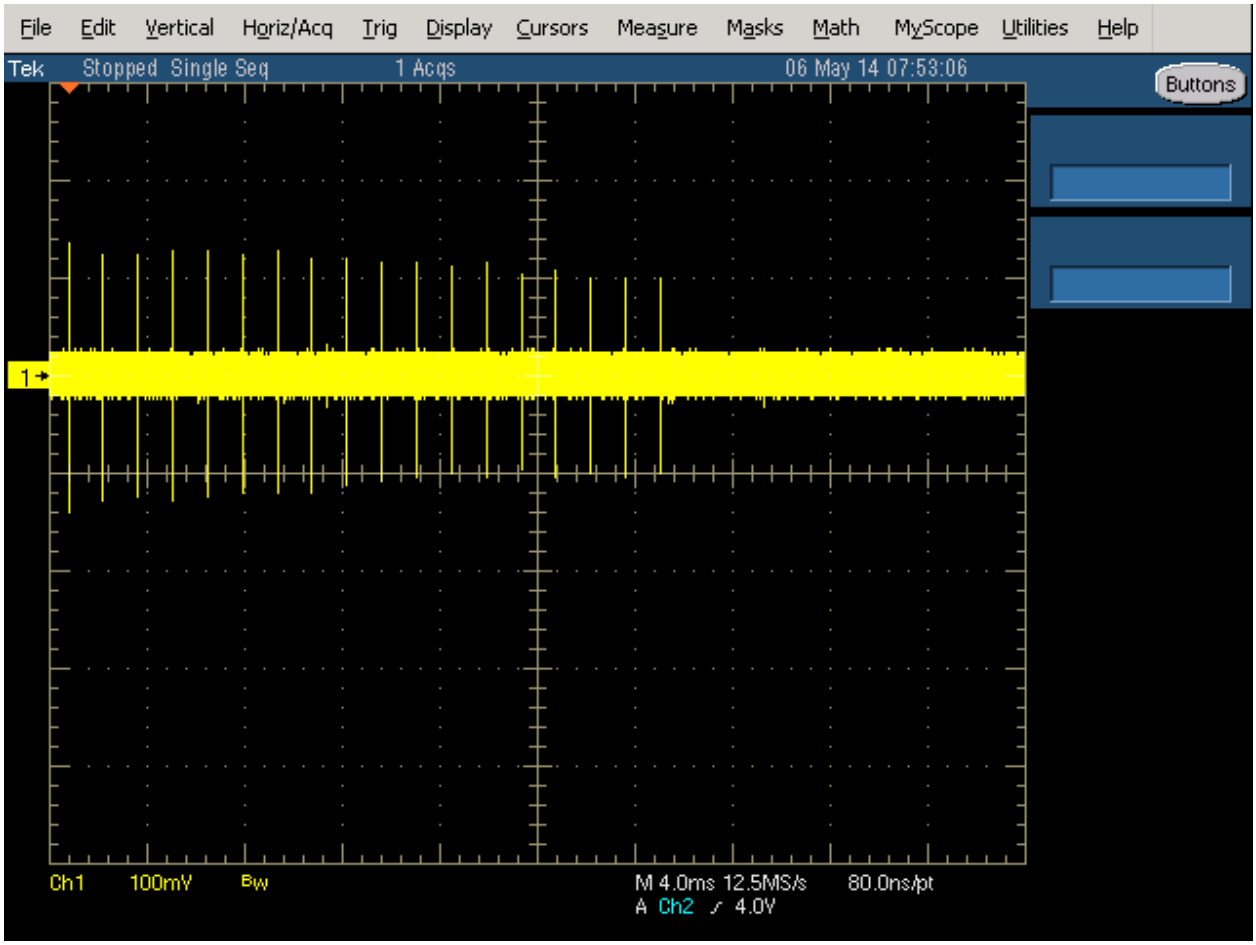


Figure 3 FCC Type 1 Radar (18 pulses)

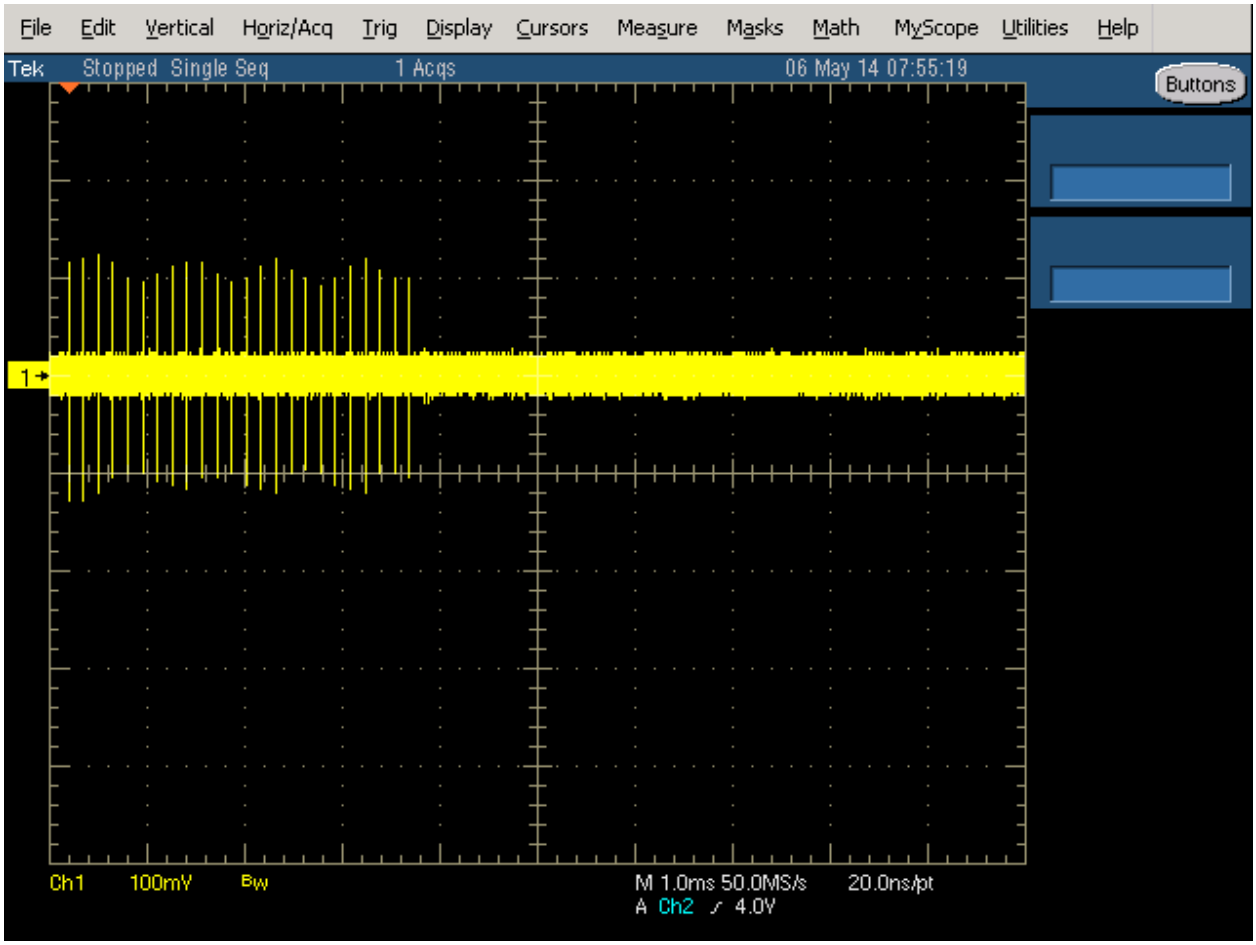


Figure 4 FCC Type 2 Radar (24 pulses)

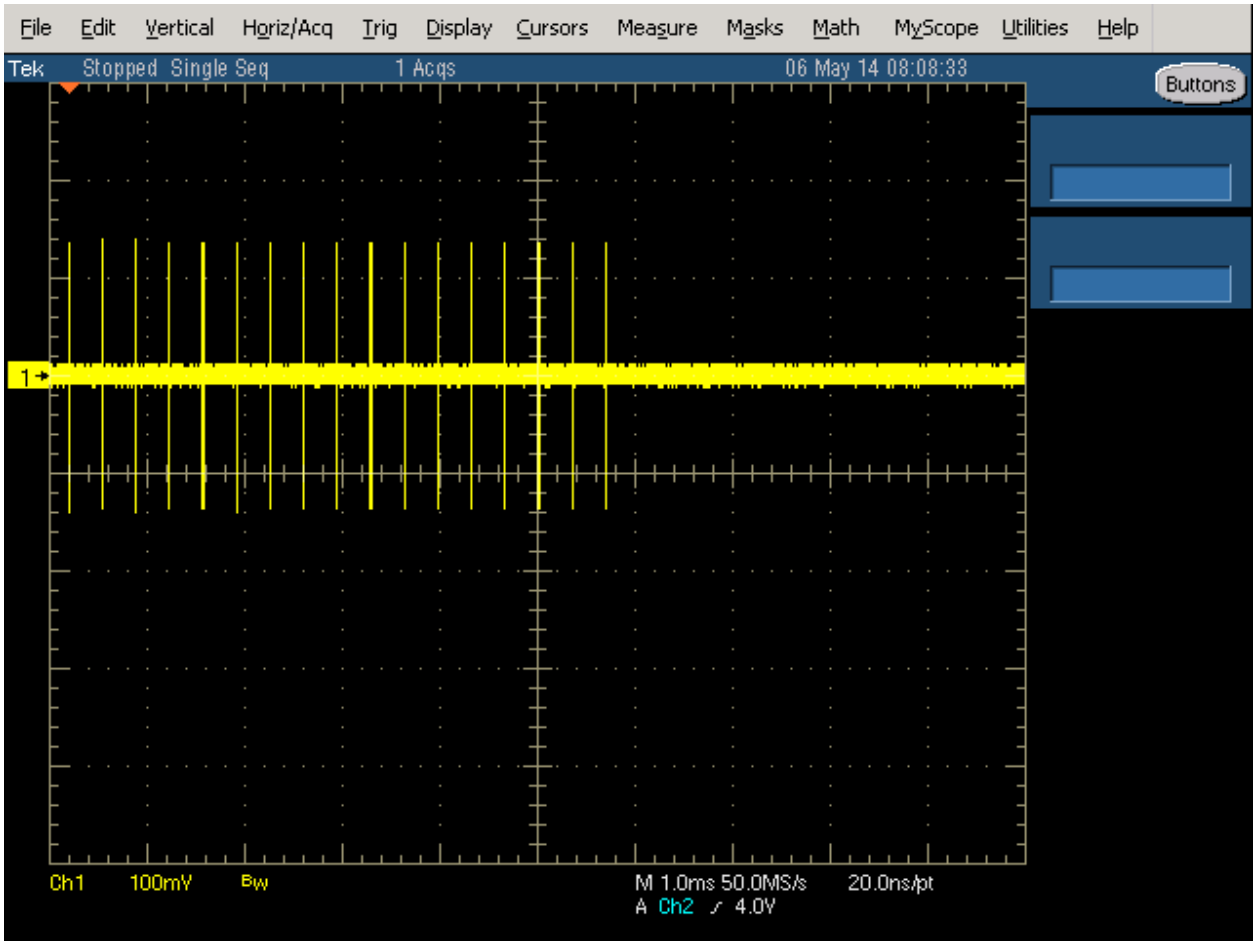


Figure 5 FCC Type 3 Radar (17 pulses)

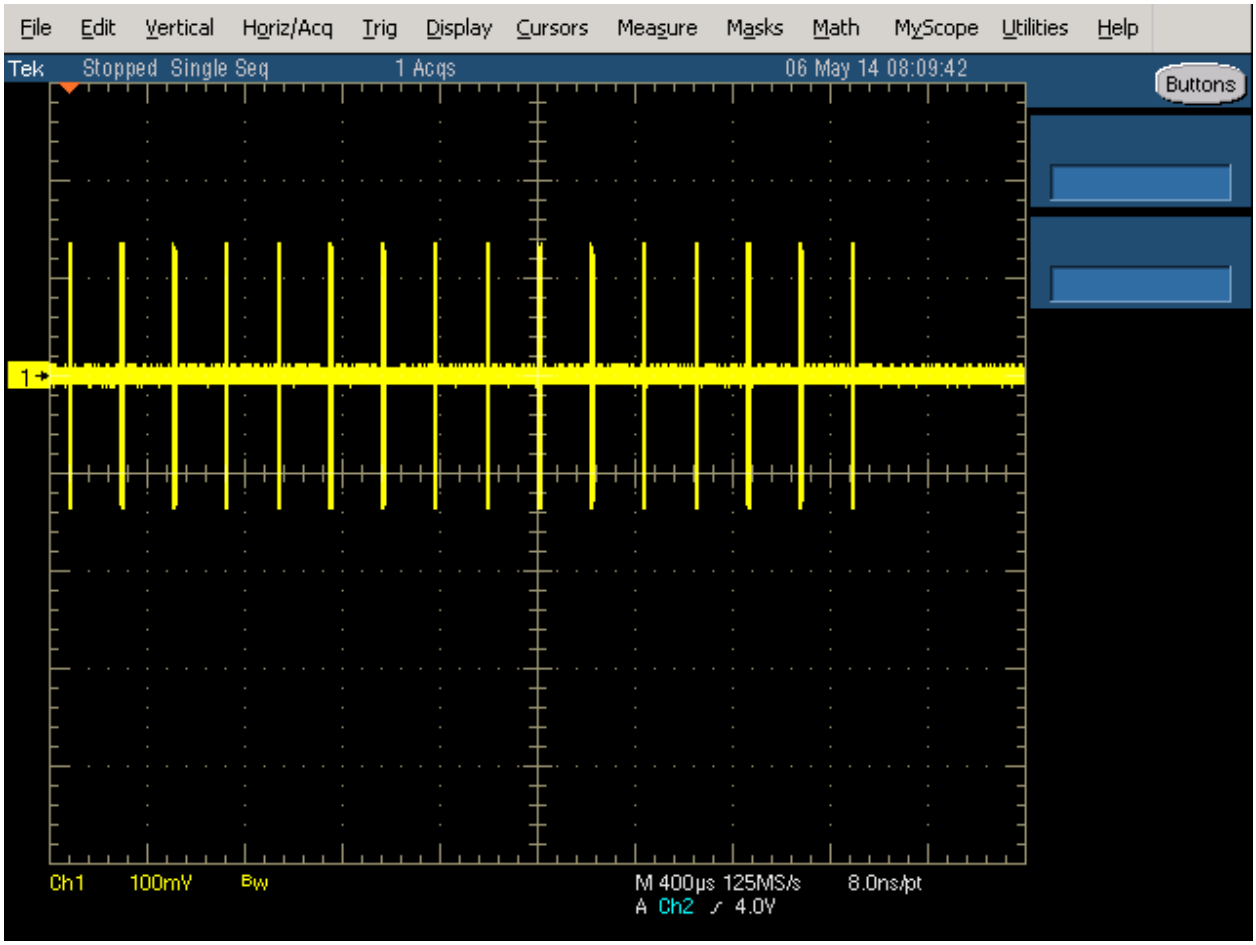


Figure 6 FCC Type 4 Radar (16 pulses)

Figure 7 FCC Type 5 Radar (burst with three pulses, 1650 µs first period)

The shape is round due to chirped frequency during pulse as the SA is in zero span with 3 MHz BW.

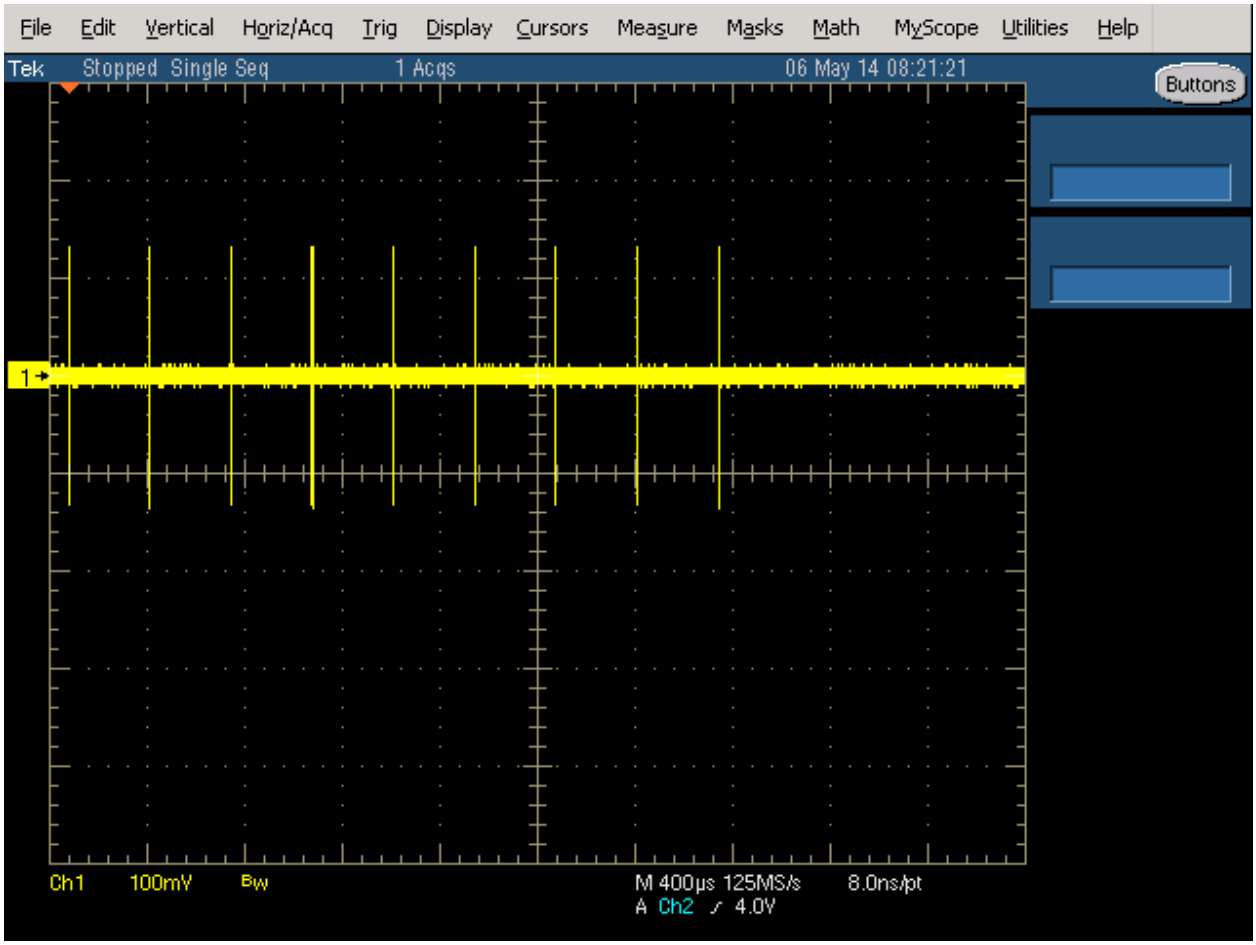


Figure 8 FCC Type 6 Radar (9 pulses in each burst)

DFS MEASUREMENT METHODS

DFS RADAR DETECTION BANDWIDTH

The radar detection bandwidth is determined by using FCC radar waveform 1 and applying radar pulses at offsets from the center channel frequency by multiples of 1MHz. These bursts are applied with no traffic on the channel. The first frequencies above and below the center channel frequency that have a detection rate below 90% define the radar bandwidth, the actual range being 1MHz below the upper frequency and 1MHz above the lower frequency.

DFS – CHANNEL CLOSING TRANSMISSION TIME AND CHANNEL MOVE TIME

Channel clearing and closing times are measured by applying a burst of radar with the device configured to change channel and by observing the channel for transmissions. The time between the end of the applied radar waveform and the final transmission on the channel is the channel move time.

The aggregate transmission closing time is measured using

FCC/KCC Notice No. 2010-48 – the total time of all individual transmissions from the EUT that are observed starting 200ms at the end of the last radar pulse in the waveform. This value is required to be less than 60ms.

DFS – CHANNEL NON-OCCUPANCY AND VERIFICATION OF PASSIVE SCANNING

The channel that was in use prior to radar detection by the master is additionally monitored for 30 minutes to ensure no transmissions on the vacated channel over the required non-occupancy period. This is achieved by tuning the spectrum analyzer to the vacated channel in zero-span mode and connecting the IF output to an oscilloscope. The oscilloscope is triggered by the radar pulse and set to provide a single sweep (in peak detect mode) that lasts for at least 30 minutes after the end of the channel move time.

DFS CHANNEL AVAILABILITY CHECK TIME

It is preferred that the EUT report when it starts the radar channel availability check. If the EUT does not report the start of the check time, then the time to start transmitting on a channel after switching the device on is measured to approximate the time from power-on to the end of the channel availability check. The start of the channel availability check is assumed to be 60 seconds prior to the first transmission on the channel.

To evaluate the channel availability check, a single burst of one radar type is applied within the first 2 seconds of the start of the channel availability check and it is verified that the device does not use the channel by continuing to monitor the channel for a period of at least 60 seconds. The test is repeated by applying a burst of radar in the last 2 seconds (i.e. between 58 and 60 seconds after the start of CAC when evaluating a 60-second CAC) of the channel availability check.

UNIFORM LOADING

Compliance with the FCC's channel loading requirement is demonstrated through the manufacturer's operational description for the device under test.

TRANSMIT POWER CONTROL (TPC)

Compliance with the transmit power control requirements for devices is demonstrated through measurements showing multiple power levels and manufacturer statements explaining how the power control is implemented.

SAMPLE CALCULATIONS

DETECTION PROBABILITY / SUCCESS RATE

The detection probability, or success rate, for any one radar waveform equals the number of successful trials divided by the total number of trials for that waveform.

In the case of the FCC requirements, for radar waveform types 1 through 4 an additional calculation is made to determine the average detection probability over all four radar waveform types. This calculation is the arithmetic mean of the four individual probabilities.

THRESHOLD LEVEL

The threshold level is the level of the simulated radar waveform at the EUT's antenna. If the test is performed in a conducted fashion then the level at the rf input equals the level at the antenna plus the gain of the antenna assembly, in dBi. The gain of the antenna assembly equals the gain of the antenna minus the loss of the cabling between the rf input and the antenna. The lowest gain value for all antenna assemblies intended for use with the device is used when making this calculation.

If the test is performed using the radiated method then the threshold level is the level at the antenna.

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer, 9 kHz - 6.5 GHz	8595EM	787	18-Aug-16
ETS Lindgren	Antenna, Horn, 1-18 GHz	3117	1662	04-Jun-16
Agilent Technologies	PSG, Vector Signal Generator, (250kHz - 20GHz)	E8267C	1877	19-Jun-16
Tektronix	500MHz, 2CH, 5GS/s Scope	TDS5052B	2118	30-Oct-16

Appendix B Test Data Tables for Radar Detection Probability

The plot below shows the channel loading during testing as evaluated over a 2 second period. The traffic was generated by FCC movie.

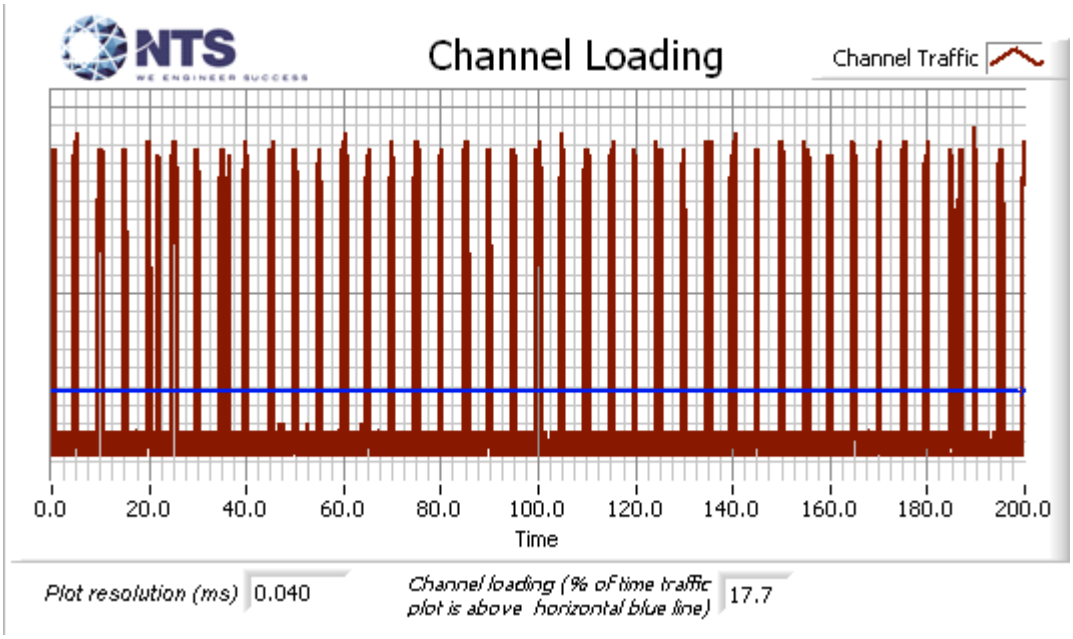


Figure 9 Channel Utilization During In-Service Detection Measurements (n20 mode)

Table 5 - Summary of All Results 20MHz				
Waveform Name	Pd (%)	Pd Required (%)	Number of Trials	Status
Long Sequence	93.3 %	80.0 %	30	PASSED

Table 6 - Long Sequence Waveform Summary 20MHz		
Long Sequence Trial	Result	Radar Frequency / Amplitude
Trial #1	Detected	5300.0MHz, -63.0dBm
Trial #2	Detected	5301.6MHz, -63.0dBm
Trial #3	Detected	5304.9MHz, -63.0dBm
Trial #4	Detected	5306.6MHz, -63.0dBm
Trial #5	Detected	5307.2MHz, -63.0dBm
Trial #6	Detected	5292.8MHz, -63.0dBm
Trial #7	Detected	5294.2MHz, -63.0dBm
Trial #8	Detected	5295.5MHz, -63.0dBm
Trial #9	Detected	5296.7MHz, -63.0dBm
Trial #10	Detected	5300.3MHz, -63.0dBm
Trial #11	Detected	5302.0MHz, -63.0dBm
Trial #12	Detected	5304.1MHz, -63.0dBm
Trial #13	Detected	5307.0MHz, -63.0dBm
Trial #14	Detected	5307.2MHz, -63.0dBm
Trial #15	Detected	5292.8MHz, -63.0dBm
Trial #16	Detected	5293.1MHz, -63.0dBm
Trial #17	Detected	5295.2MHz, -63.0dBm
Trial #18	Detected	5297.9MHz, -63.0dBm
Trial #19	NOT Detected	5299.4MHz, -63.0dBm
Trial #20	Detected	5299.4MHz, -63.0dBm
Trial #21	Detected	5300.9MHz, -63.0dBm
Trial #22	Detected	5303.3MHz, -63.0dBm
Trial #23	Detected	5305.9MHz, -63.0dBm

Table 6 - Long Sequence Waveform Summary 20MHz		
Long Sequence Trial	Result	Radar Frequency / Amplitude
Trial #24	Detected	5307.2MHz, -63.0dBm
Trial #25	Detected	5292.8MHz, -63.0dBm
Trial #26	Detected	5292.9MHz, -63.0dBm
Trial #27	Detected	5296.6MHz, -63.0dBm
Trial #28	NOT Detected	5298.3MHz, -63.0dBm
Trial #29	Detected	5298.3MHz, -63.0dBm
Trial #30	Detected	5300.8MHz, -63.0dBm

Table 7 - Long Sequence Waveform Trial#1 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	53.5	18	1668.0	-	0.585932
2	2	57.6	16	1790.0	-	1.138763
3	2	74.1	6	1833.0	-	1.560809
4	1	84.9	14	-	-	2.342259
5	1	64.0	18	-	-	3.341448
6	2	92.0	18	1351.0	-	3.633452
7	1	59.5	20	-	-	4.323844
8	2	97.8	15	1144.0	-	5.630607
9	3	83.5	10	1034.0	1614.0	6.177173
10	2	81.6	12	1029.0	-	6.874771
11	2	81.5	12	1490.0	-	7.286363
12	1	58.3	18	-	-	8.370207
13	1	52.9	7	-	-	9.006948
14	2	62.9	10	1903.0	-	9.497666
15	2	50.6	6	1769.0	-	10.000281
16	2	58.6	14	1573.0	-	10.808433
17	3	97.2	8	1499.0	1305.0	11.720552

Table 8 - Long Sequence Waveform Trial#2 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	90.9	8	1723.0	-	0.160519
2	3	69.8	20	1462.0	1142.0	1.601043
3	2	61.1	19	1298.0	-	2.088854
4	2	68.2	15	1446.0	-	3.387533
5	2	66.2	6	1526.0	-	3.444460
6	2	95.2	20	1136.0	-	4.374097
7	1	98.5	18	-	-	5.603473
8	3	88.7	14	1430.0	1183.0	6.245449
9	2	60.4	7	1349.0	-	7.680796
10	3	71.4	6	1285.0	1931.0	8.364218
11	2	76.8	7	1384.0	-	8.587362
12	2	69.2	7	1068.0	-	9.678404
13	1	60.1	17	-	-	10.817531

Table 8 - Long Sequence Waveform Trial#2 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
14	1	96.5	16	-	-	11.291468

Table 9 - Long Sequence Waveform Trial#3 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	80.1	11	1161.0	-	0.244365
2	3	94.8	9	1237.0	1696.0	0.897698
3	2	83.0	18	1960.0	-	2.248546
4	2	98.5	18	1651.0	-	3.014204
5	2	85.3	10	1176.0	-	3.405760
6	2	99.7	19	1988.0	-	4.744179
7	2	58.8	16	1614.0	-	4.947596
8	2	68.4	13	1948.0	-	6.273811
9	2	92.0	18	1921.0	-	7.197788
10	2	91.9	19	1643.0	-	7.987797
11	2	69.3	5	1850.0	-	8.471866
12	2	98.8	12	1053.0	-	9.221311
13	2	89.6	7	1861.0	-	10.353426
14	2	93.3	15	1086.0	-	11.004133
15	1	57.3	6	-	-	11.797956

Table 10 - Long Sequence Waveform Trial#4 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	59.0	12	1857.0	-	0.154222
2	2	55.8	8	1257.0	-	1.358106
3	2	83.7	18	1709.0	-	1.790471
4	3	77.4	17	1120.0	1437.0	2.876431
5	3	77.1	13	1460.0	1853.0	3.871719
6	3	97.4	15	1949.0	1258.0	4.051682
7	1	55.1	8	-	-	4.877467
8	2	62.4	8	1556.0	-	5.925230
9	1	63.5	18	-	-	7.179386
10	3	50.8	19	1016.0	1865.0	7.957803
11	1	85.5	16	-	-	8.041595
12	2	65.0	5	1647.0	-	9.188794
13	1	93.8	14	-	-	10.013954
14	2	76.6	8	1259.0	-	11.130656
15	2	73.0	12	1046.0	-	11.878616

Table 11 - Long Sequence Waveform Trial#5 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	3	60.8	14	1859.0	1872.0	0.603531
2	3	52.0	17	1022.0	1619.0	0.802395
3	2	81.6	6	1079.0	-	1.320035
4	3	81.8	10	1512.0	1632.0	2.430336
5	2	78.9	7	1023.0	-	2.938009
6	2	99.1	18	1066.0	-	3.648383

Table 11 - Long Sequence Waveform Trial#5 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
7	1	84.8	15	-	-	4.177175
8	1	73.5	15	-	-	4.425391
9	2	67.5	8	1529.0	-	5.531062
10	3	69.3	14	1211.0	1871.0	6.079037
11	1	89.6	12	-	-	6.559518
12	1	55.0	12	-	-	7.366603
13	3	50.7	12	1603.0	1394.0	7.611957
14	2	74.7	20	1726.0	-	8.395350
15	1	92.8	9	-	-	9.310801
16	2	52.4	16	1696.0	-	9.916718
17	2	54.6	11	1915.0	-	10.296082
18	1	81.3	17	-	-	11.131541
19	2	62.2	5	1966.0	-	11.972886

Table 12 - Long Sequence Waveform Trial#6 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	65.9	8	1028.0	-	0.743878
2	3	64.7	17	1247.0	1418.0	1.442526
3	1	51.8	17	-	-	1.854388
4	2	62.0	11	1006.0	-	3.155239
5	3	82.4	5	1741.0	1267.0	4.279093
6	3	65.8	8	1567.0	1325.0	4.622253
7	1	74.7	5	-	-	6.373845
8	2	85.4	7	1906.0	-	7.342755
9	3	56.0	7	1067.0	1660.0	7.688736
10	1	55.6	16	-	-	9.164499
11	3	65.6	7	1160.0	1433.0	9.553805
12	3	93.1	17	1066.0	1614.0	10.471723
13	2	59.3	8	1950.0	-	11.497756

Table 13 - Long Sequence Waveform Trial#7 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	3	73.0	19	1710.0	1913.0	0.158830
2	1	59.0	7	-	-	1.205391
3	3	86.1	16	1806.0	1053.0	1.455554
4	3	94.2	6	1935.0	1561.0	1.956593
5	3	70.2	20	1215.0	1016.0	3.078248
6	3	98.2	11	1329.0	1902.0	3.299874
7	3	89.0	7	1538.0	1842.0	4.143539
8	2	58.8	13	1687.0	-	4.787362
9	3	52.8	16	1943.0	1431.0	5.104985
10	2	69.1	13	1695.0	-	6.051152
11	3	86.1	6	1779.0	1675.0	6.759217
12	2	84.4	6	1547.0	-	6.955743
13	3	65.6	6	1626.0	1643.0	7.741768
14	2	80.2	6	1015.0	-	8.744401
15	2	86.8	8	1699.0	-	8.881970
16	2	84.0	10	1406.0	-	9.833338

Table 13 - Long Sequence Waveform Trial#7 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
17	2	67.7	13	1933.0	-	10.262760
18	2	51.1	17	1356.0	-	11.125875
19	2	84.7	10	1980.0	-	11.711150

Table 14 - Long Sequence Waveform Trial#8 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	71.9	20	1372.0	-	0.437990
2	2	88.6	7	1932.0	-	1.369416
3	1	75.6	16	-	-	2.367378
4	1	50.6	15	-	-	3.681706
5	3	91.7	17	1974.0	1036.0	4.363773
6	3	94.2	15	1476.0	1635.0	4.620596
7	2	53.7	8	1322.0	-	5.578359
8	2	69.6	17	1155.0	-	7.373760
9	1	92.7	20	-	-	8.232365
10	1	97.6	7	-	-	8.793125
11	1	72.7	20	-	-	9.612380
12	3	94.8	18	1039.0	1104.0	11.062401
13	2	66.6	11	1861.0	-	11.348272

Table 15 - Long Sequence Waveform Trial#9 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	77.0	15	1913.0	-	0.186090
2	2	75.1	17	1452.0	-	0.762527
3	1	86.5	9	-	-	1.839130
4	1	51.2	18	-	-	2.966737
5	2	74.8	11	1473.0	-	3.214356
6	2	64.4	15	1814.0	-	4.387045
7	2	92.6	8	1322.0	-	5.093200
8	1	87.5	9	-	-	5.292659
9	2	69.2	7	1192.0	-	6.317467
10	3	72.1	6	1657.0	1893.0	6.817053
11	2	52.3	12	1555.0	-	8.177503
12	2	74.2	17	1965.0	-	8.403539
13	1	63.4	8	-	-	9.347794
14	2	54.2	13	1811.0	-	9.881698
15	2	56.9	10	1805.0	-	10.623180
16	2	60.1	6	1353.0	-	11.917275

Table 16 - Long Sequence Waveform Trial#10 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	59.1	18	1671.0	-	0.481583
2	1	81.3	9	-	-	1.055530
3	2	64.0	10	1853.0	-	2.052408
4	1	61.6	13	-	-	3.180613
5	2	63.0	17	1756.0	-	4.082366

Table 16 - Long Sequence Waveform Trial#10 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
6	1	58.8	20	-	-	4.952151
7	3	70.7	14	1360.0	1696.0	5.599943
8	1	74.2	5	-	-	6.685389
9	2	87.1	5	1878.0	-	6.932394
10	3	72.7	16	1545.0	1417.0	8.278479
11	2	69.7	9	1810.0	-	9.238044
12	2	72.3	8	1589.0	-	10.053909
13	2	92.5	12	1360.0	-	10.724679
14	1	72.1	8	-	-	11.626761

Table 17 - Long Sequence Waveform Trial#11 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	63.3	18	1392.0	-	0.616370
2	1	64.6	13	-	-	0.818969
3	1	52.8	13	-	-	1.634208
4	1	97.2	6	-	-	2.212672
5	2	84.3	18	1580.0	-	2.923349
6	3	92.1	6	1864.0	1277.0	3.346770
7	3	72.5	17	1163.0	1557.0	4.234703
8	2	87.4	8	1680.0	-	5.029071
9	2	92.5	19	1802.0	-	5.898592
10	1	53.9	12	-	-	6.467437
11	1	77.2	14	-	-	7.157342
12	2	62.4	14	1867.0	-	7.749502
13	2	83.3	13	1616.0	-	8.024946
14	2	87.5	13	1992.0	-	9.108063
15	3	62.1	8	1004.0	1262.0	9.486781
16	3	90.3	13	1276.0	1236.0	10.350803
17	3	73.7	19	1424.0	1223.0	11.187902
18	2	57.4	9	1808.0	-	11.739678

Table 18 - Long Sequence Waveform Trial#12 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	53.5	6	1022.0	-	0.026478
2	2	88.2	10	1246.0	-	0.982546
3	2	84.7	7	1731.0	-	1.817075
4	2	83.1	6	1389.0	-	2.270157
5	2	85.8	6	1001.0	-	3.721661
6	1	88.1	12	-	-	4.207833
7	2	67.7	9	1312.0	-	4.626318
8	3	86.1	18	1795.0	1821.0	5.538596
9	3	82.0	14	1727.0	1336.0	6.312035
10	2	73.5	6	1720.0	-	7.313852
11	1	84.9	18	-	-	7.512306
12	1	67.2	9	-	-	8.825264
13	3	95.6	13	1369.0	1809.0	9.384583
14	1	82.9	16	-	-	9.816303
15	3	71.5	17	1362.0	1894.0	10.835342

Table 18 - Long Sequence Waveform Trial#12 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
16	2	57.9	16	1839.0	-	11.611452

Table 19 - Long Sequence Waveform Trial#13 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	68.6	7	1173.0	-	0.517173
2	2	68.9	19	1769.0	-	1.002513
3	3	99.7	13	1918.0	1395.0	1.665058
4	2	78.0	8	1322.0	-	2.028563
5	2	62.9	18	1190.0	-	2.892885
6	3	99.8	15	1782.0	1961.0	3.487125
7	3	54.1	13	1030.0	1182.0	4.362009
8	3	73.3	18	1360.0	1136.0	4.575362
9	1	67.4	18	-	-	5.175612
10	2	97.9	11	1554.0	-	6.088462
11	2	51.7	9	1455.0	-	6.550223
12	3	57.6	17	1231.0	1162.0	7.088281
13	2	58.0	19	1740.0	-	7.864094
14	2	71.5	18	1050.0	-	8.381833
15	2	98.9	17	1428.0	-	9.048070
16	2	98.6	7	1632.0	-	9.496725
17	2	65.6	11	1010.0	-	10.530831
18	2	63.2	11	1735.0	-	10.986921
19	1	86.4	17	-	-	11.998280

Table 20 - Long Sequence Waveform Trial#14 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	78.9	17	1021.0	-	0.142997
2	1	52.9	12	-	-	1.512429
3	3	72.5	18	1378.0	1012.0	2.040007
4	1	84.2	14	-	-	3.346656
5	2	71.2	15	1246.0	-	4.046891
6	2	75.9	10	1752.0	-	5.337444
7	2	54.8	8	1619.0	-	6.169150
8	1	100.0	18	-	-	6.909054
9	2	73.8	9	1942.0	-	8.111815
10	3	85.5	6	1434.0	1989.0	8.383143
11	2	91.7	9	1965.0	-	9.833204
12	3	95.2	18	1102.0	1474.0	10.502994
13	1	59.2	7	-	-	11.773986

Table 21 - Long Sequence Waveform Trial#15 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	1	83.8	18	-	-	0.774536
2	2	72.9	11	1685.0	-	1.340872
3	2	77.5	6	1111.0	-	2.728383
4	2	73.1	20	1123.0	-	3.608810

Table 21 - Long Sequence Waveform Trial#15 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
5	3	73.3	9	1453.0	1674.0	4.072426
6	3	67.5	7	1925.0	1674.0	4.625565
7	2	94.5	6	1809.0	-	6.150797
8	2	65.2	5	1310.0	-	6.978705
9	1	70.1	15	-	-	8.049397
10	2	51.1	14	1300.0	-	8.975565
11	2	92.7	13	1756.0	-	9.484408
12	2	62.7	10	1222.0	-	10.282141
13	2	62.1	17	1959.0	-	11.814668

Table 22 - Long Sequence Waveform Trial#16 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	1	94.8	12	-	-	0.498335
2	2	54.6	7	1692.0	-	0.999223
3	3	96.9	16	1095.0	1909.0	2.188474
4	1	61.4	6	-	-	2.886213
5	3	98.1	16	1038.0	1900.0	3.003890
6	3	84.0	8	1209.0	1277.0	4.042393
7	1	94.1	11	-	-	4.999580
8	2	78.1	7	1615.0	-	5.665735
9	3	68.0	14	1893.0	1130.0	6.447767
10	1	68.2	19	-	-	6.896492
11	2	64.0	15	1359.0	-	7.710427
12	2	81.8	13	1316.0	-	8.888176
13	3	72.9	15	1125.0	1192.0	9.033405
14	2	85.7	6	1668.0	-	10.132229
15	1	82.2	16	-	-	10.795896
16	2	57.0	8	1312.0	-	11.298415

Table 23 - Long Sequence Waveform Trial#17 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	96.7	13	1253.0	-	0.116494
2	1	64.7	10	-	-	1.259816
3	2	78.6	5	1668.0	-	1.714269
4	2	78.9	7	1347.0	-	2.125807
5	2	69.7	16	1325.0	-	2.792697
6	3	96.1	17	1850.0	1337.0	3.417045
7	2	90.1	10	1503.0	-	4.251656
8	2	55.4	14	1344.0	-	4.921199
9	2	71.1	9	1175.0	-	5.211202
10	3	69.2	13	1974.0	1462.0	6.002403
11	2	100.0	18	1884.0	-	6.403721
12	2	71.4	9	1461.0	-	7.310655
13	2	69.6	5	1062.0	-	7.666617
14	2	79.7	17	1537.0	-	8.290633
15	2	59.8	10	1116.0	-	8.907487
16	2	84.4	7	1025.0	-	9.759106
17	3	60.1	13	1721.0	1591.0	10.140799

Table 23 - Long Sequence Waveform Trial#17 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
18	2	88.5	12	1310.0	-	10.817139
19	1	73.6	18	-	-	11.712167

Table 24 - Long Sequence Waveform Trial#18 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	3	72.5	19	1507.0	1221.0	0.589389
2	2	72.2	8	1909.0	-	1.025317
3	1	58.7	20	-	-	1.398034
4	3	66.0	13	1417.0	1878.0	2.256671
5	2	80.9	7	1780.0	-	2.985855
6	1	54.7	11	-	-	3.367457
7	1	77.4	7	-	-	4.098651
8	2	93.1	9	1238.0	-	4.640117
9	2	86.3	17	1683.0	-	5.680419
10	2	62.4	7	1366.0	-	5.887968
11	3	53.9	9	1662.0	1155.0	6.645005
12	1	74.1	14	-	-	7.184422
13	3	65.5	12	1645.0	1206.0	7.654453
14	2	79.9	14	1971.0	-	8.741762
15	1	92.5	16	-	-	9.167486
16	2	56.7	16	1984.0	-	10.100307
17	2	86.2	11	1116.0	-	10.309504
18	1	72.9	6	-	-	11.307566
19	2	92.0	8	1042.0	-	11.823284

Table 25 - Long Sequence Waveform Trial#19 (NOT Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	3	70.8	7	1951.0	1944.0	0.474143
2	2	58.8	11	1472.0	-	0.984186
3	1	57.4	17	-	-	1.760952
4	1	86.2	14	-	-	3.307440
5	2	92.0	10	1068.0	-	3.764048
6	2	87.8	19	1813.0	-	4.422707
7	2	57.1	8	1286.0	-	5.426901
8	2	52.9	16	1276.0	-	6.168546
9	2	91.3	7	1254.0	-	7.338151
10	2	58.6	15	1266.0	-	8.179411
11	2	72.8	6	1783.0	-	9.240648
12	2	56.2	6	1355.0	-	10.237727
13	1	53.2	19	-	-	10.835998
14	2	61.4	10	1458.0	-	11.653841

Table 26 - Long Sequence Waveform Trial#20 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	1	72.7	16	-	-	0.172972
2	2	71.7	9	1209.0	-	1.532456

Table 26 - Long Sequence Waveform Trial#20 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
3	2	93.2	15	1341.0	-	2.039164
4	2	74.6	15	1107.0	-	2.868047
5	2	83.0	14	1296.0	-	3.665301
6	1	80.2	15	-	-	4.332164
7	1	92.2	11	-	-	4.976239
8	2	73.4	16	1690.0	-	6.005058
9	1	98.8	14	-	-	7.181869
10	3	83.1	13	1375.0	1101.0	7.520767
11	2	92.0	15	1956.0	-	8.470567
12	2	93.6	7	1543.0	-	9.028268
13	2	65.9	10	1860.0	-	10.171265
14	1	89.9	6	-	-	10.972077
15	2	55.7	10	1658.0	-	11.730548

Table 27 - Long Sequence Waveform Trial#21 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	1	51.8	7	-	-	0.229911
2	3	76.5	5	1622.0	1389.0	1.428342
3	2	63.1	8	1085.0	-	2.474459
4	2	80.1	6	1671.0	-	2.975726
5	2	83.9	15	1699.0	-	3.880069
6	2	51.1	18	1381.0	-	4.759860
7	2	60.0	19	1720.0	-	5.143642
8	2	79.2	13	1200.0	-	6.369328
9	2	70.1	11	1209.0	-	7.360284
10	1	93.7	18	-	-	8.524329
11	1	81.3	6	-	-	9.276282
12	2	58.3	11	1199.0	-	9.516014
13	3	94.8	17	1371.0	1937.0	10.426519
14	3	77.9	20	1826.0	1846.0	11.752223

Table 28 - Long Sequence Waveform Trial#22 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	3	57.2	16	1863.0	1368.0	0.228160
2	2	63.6	7	1932.0	-	1.100053
3	1	59.0	19	-	-	1.775197
4	2	79.4	13	1753.0	-	2.024277
5	2	85.8	18	1713.0	-	2.881328
6	1	65.5	9	-	-	3.619753
7	2	78.9	7	1541.0	-	4.499654
8	2	75.4	13	1674.0	-	5.110238
9	2	85.6	17	1253.0	-	5.424252
10	2	82.5	14	1809.0	-	6.140861
11	2	73.7	13	1710.0	-	7.194391
12	2	63.7	6	1099.0	-	7.587847
13	2	72.5	17	1152.0	-	8.214488
14	2	77.4	9	1700.0	-	8.940943
15	3	74.7	6	1467.0	1958.0	9.491266

Table 28 - Long Sequence Waveform Trial#22 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
16	3	77.7	9	1761.0	1689.0	10.164161
17	3	99.6	10	1955.0	1113.0	11.323608
18	3	71.6	14	1707.0	1053.0	11.753642

Table 29 - Long Sequence Waveform Trial#23 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	1	93.4	19	-	-	0.392441
2	1	79.6	16	-	-	1.510524
3	2	55.9	7	1820.0	-	2.408842
4	3	70.3	18	1854.0	1514.0	3.451578
5	3	53.2	7	1929.0	1422.0	4.882681
6	2	94.4	15	1750.0	-	5.822707
7	2	72.1	8	1594.0	-	6.995494
8	3	53.7	11	1517.0	1546.0	7.939134
9	3	70.7	11	1623.0	1208.0	8.385697
10	2	68.0	7	1243.0	-	9.899571
11	3	85.6	12	1241.0	1708.0	10.073189
12	2	89.8	6	1712.0	-	11.112557

Table 30 - Long Sequence Waveform Trial#24 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	79.8	8	1468.0	-	0.599285
2	3	55.6	15	1772.0	1105.0	1.488639
3	2	70.1	16	1736.0	-	1.938098
4	2	50.2	14	1787.0	-	3.171473
5	2	64.9	16	1155.0	-	4.060786
6	3	73.9	16	1407.0	1278.0	4.999565
7	2	73.4	19	1467.0	-	5.464484
8	2	99.3	14	1576.0	-	6.014516
9	3	74.2	10	1620.0	1674.0	6.998354
10	2	90.8	14	1816.0	-	8.278881
11	3	58.2	7	1991.0	1767.0	9.114630
12	2	57.8	12	1924.0	-	9.870221
13	2	93.3	11	1045.0	-	10.391349
14	2	51.5	16	1872.0	-	11.486668

Table 31 - Long Sequence Waveform Trial#25 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	96.1	8	1530.0	-	0.095780
2	2	88.8	14	1899.0	-	1.556974
3	3	55.2	6	1552.0	1458.0	2.871318
4	2	56.1	7	1799.0	-	3.941848
5	2	66.5	18	1623.0	-	4.936737
6	2	70.4	16	1349.0	-	6.510042
7	2	88.4	8	1325.0	-	8.309767
8	3	65.6	9	1697.0	1777.0	9.159253

Table 31 - Long Sequence Waveform Trial#25 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
9	3	72.5	15	1910.0	1387.0	10.365662
10	2	57.4	16	1616.0	-	11.254105

Table 32 - Long Sequence Waveform Trial#26 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	78.1	18	1224.0	-	0.341282
2	2	53.6	13	1771.0	-	1.134327
3	2	84.0	8	1142.0	-	2.073005
4	1	50.5	7	-	-	2.721070
5	1	62.9	17	-	-	3.507234
6	2	79.3	8	1924.0	-	4.471041
7	2	90.7	12	1017.0	-	5.492237
8	2	60.5	20	1123.0	-	6.816387
9	3	90.7	9	1886.0	1743.0	7.696095
10	1	87.1	14	-	-	7.854125
11	2	51.8	6	1816.0	-	8.841923
12	3	54.6	8	1626.0	1733.0	9.844737
13	1	52.5	6	-	-	10.437730
14	2	64.7	14	1412.0	-	11.295455

Table 33 - Long Sequence Waveform Trial#27 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	55.7	9	1543.0	-	0.043542
2	2	97.4	8	1263.0	-	0.853518
3	2	91.3	17	1884.0	-	2.380157
4	2	75.1	16	1488.0	-	2.581309
5	2	85.6	6	1111.0	-	3.992950
6	1	68.5	7	-	-	4.027363
7	3	52.3	12	1204.0	1317.0	5.423330
8	3	65.2	16	1632.0	1470.0	5.924747
9	2	94.7	8	1395.0	-	6.802298
10	2	92.4	13	1522.0	-	7.446970
11	2	85.9	13	1946.0	-	8.111137
12	1	63.7	17	-	-	9.587631
13	3	69.7	11	1823.0	1998.0	9.761305
14	2	60.9	19	1983.0	-	10.883031
15	3	78.7	6	1741.0	1121.0	11.983489

Table 34 - Long Sequence Waveform Trial#28 (NOT Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	86.5	9	1912.0	-	0.113828
2	1	76.5	20	-	-	1.165635
3	1	98.5	8	-	-	2.474775
4	2	57.9	19	1223.0	-	3.327489
5	2	52.6	8	1665.0	-	4.246365
6	2	77.2	10	1566.0	-	4.749017

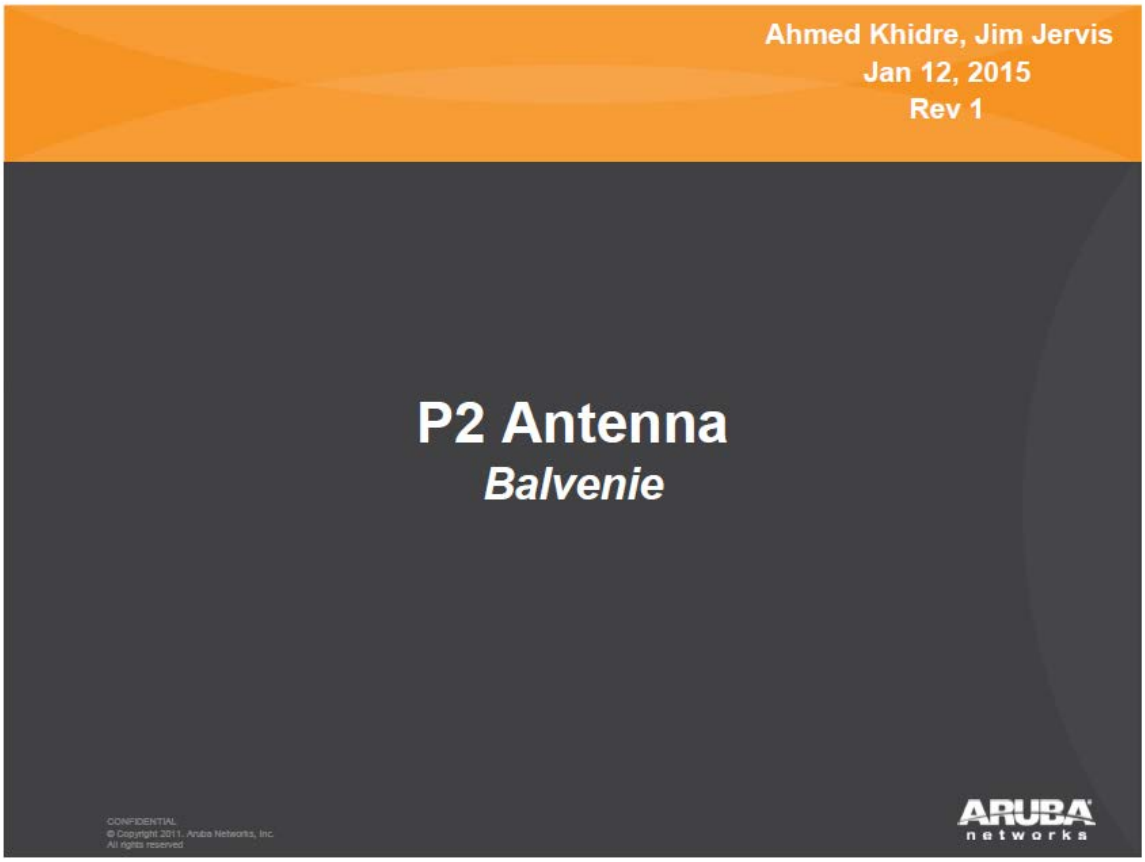
Table 34 - Long Sequence Waveform Trial#28 (NOT Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
7	1	91.9	15	-	-	5.684215
8	1	72.4	10	-	-	7.048864
9	1	82.1	14	-	-	7.449009
10	1	70.4	16	-	-	9.216186
11	2	99.5	10	1537.0	-	9.869638
12	2	63.6	19	1376.0	-	11.037220
13	3	73.3	17	1269.0	1857.0	11.184097

Table 35 - Long Sequence Waveform Trial#29 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	3	81.0	7	1881.0	1738.0	0.025561
2	1	88.1	14	-	-	0.695528
3	2	68.4	15	1488.0	-	1.339053
4	2	68.5	6	1763.0	-	2.217356
5	1	95.5	7	-	-	2.567095
6	1	73.5	12	-	-	3.204665
7	3	95.8	6	1012.0	1738.0	4.379766
8	1	69.4	15	-	-	4.963649
9	2	75.4	5	1545.0	-	5.304209
10	2	55.9	12	1309.0	-	5.926099
11	3	90.5	14	1308.0	1357.0	6.609663
12	3	81.8	17	1721.0	1158.0	7.493288
13	2	78.0	6	1020.0	-	7.825943
14	2	64.6	8	1380.0	-	8.633241
15	1	62.4	6	-	-	9.384350
16	3	99.5	10	1963.0	1288.0	9.664402
17	1	95.1	17	-	-	10.156941
18	1	98.9	13	-	-	11.168568
19	2	94.8	18	1784.0	-	11.518602

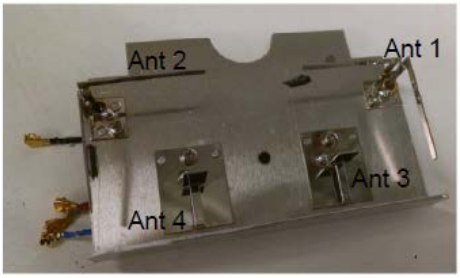
Table 36 - Long Sequence Waveform Trial#30 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
1	2	74.6	9	1776.0	-	0.159417
2	2	79.9	7	1981.0	-	0.841565
3	3	77.3	12	1048.0	1029.0	1.649290
4	2	66.6	15	1666.0	-	1.869776
5	2	75.6	5	1962.0	-	2.611172
6	2	87.5	19	1972.0	-	3.377188
7	1	74.2	12	-	-	4.133077
8	3	81.4	9	1037.0	1775.0	4.717314
9	3	55.4	19	1219.0	1257.0	5.385817
10	3	81.7	16	1081.0	1524.0	5.498954
11	1	53.2	12	-	-	6.373391
12	2	69.6	8	1341.0	-	6.613422
13	2	95.8	12	1409.0	-	7.470504
14	1	91.8	19	-	-	8.191899
15	1	60.1	17	-	-	8.665446
16	3	68.3	11	1729.0	1865.0	9.341394

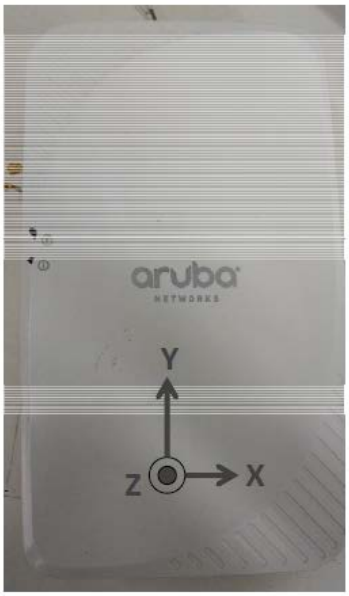
Table 36 - Long Sequence Waveform Trial#30 (Detected) 20MHz						
Burst #	# Pulses	Pulse Width (us)	Chirp (MHz)	Interval 1 to 2 (us)	Interval 2 to 3 (us)	Start time (s)
17	2	72.5	7	1153.0	-	9.846325
18	1	95.8	9	-	-	10.309284
19	2	68.6	12	1133.0	-	11.119054
20	1	91.9	10	-	-	11.978314

Appendix C Antenna Specification



P2-Antennas





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S-parameters

Figure 5

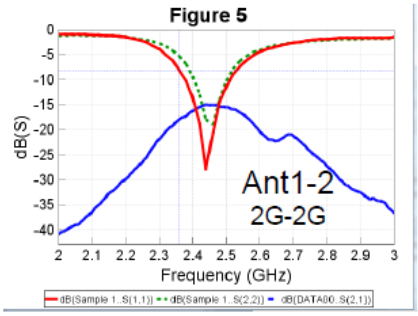


Figure 4

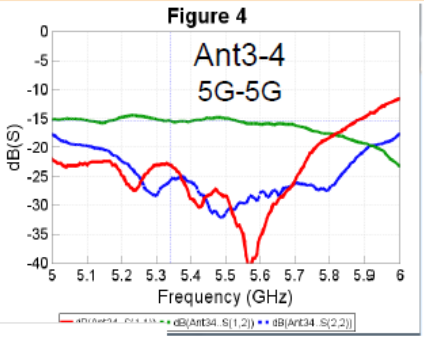
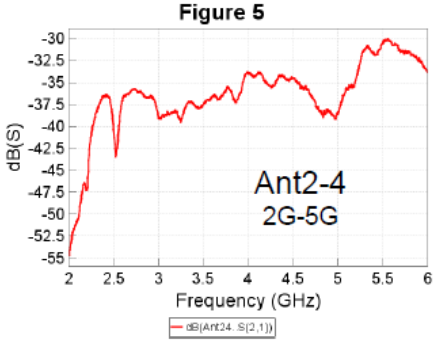


Figure 5



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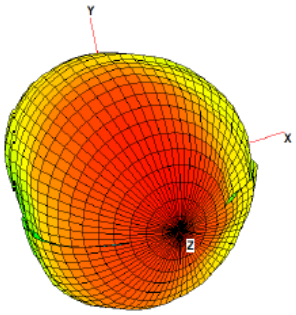
3

2G Patterns

2.45 GHz



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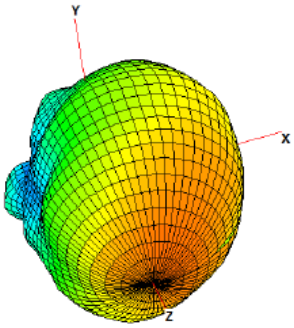

Ant2

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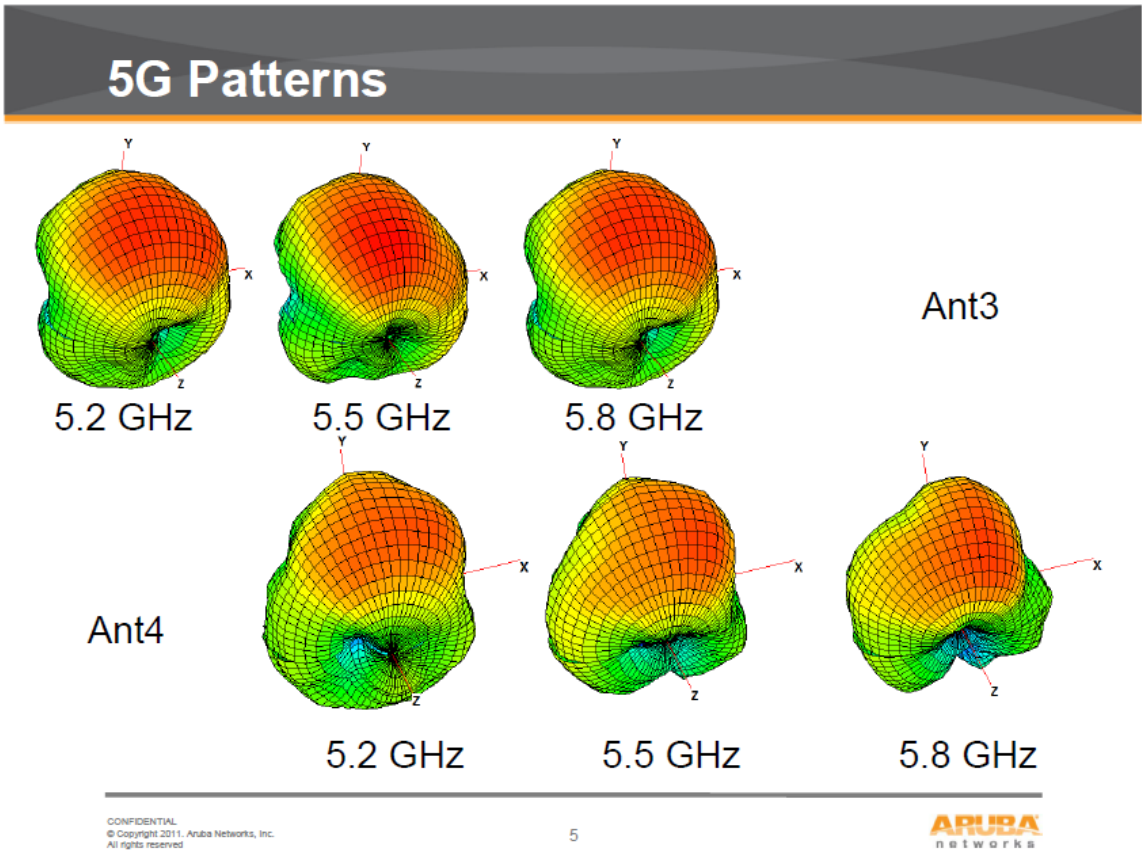
5G Patterns
Ant3
5.2 GHz
5.5 GHz
5.8 GHz
Ant4
5.2 GHz
5.5 GHz
5.8 GHz
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5
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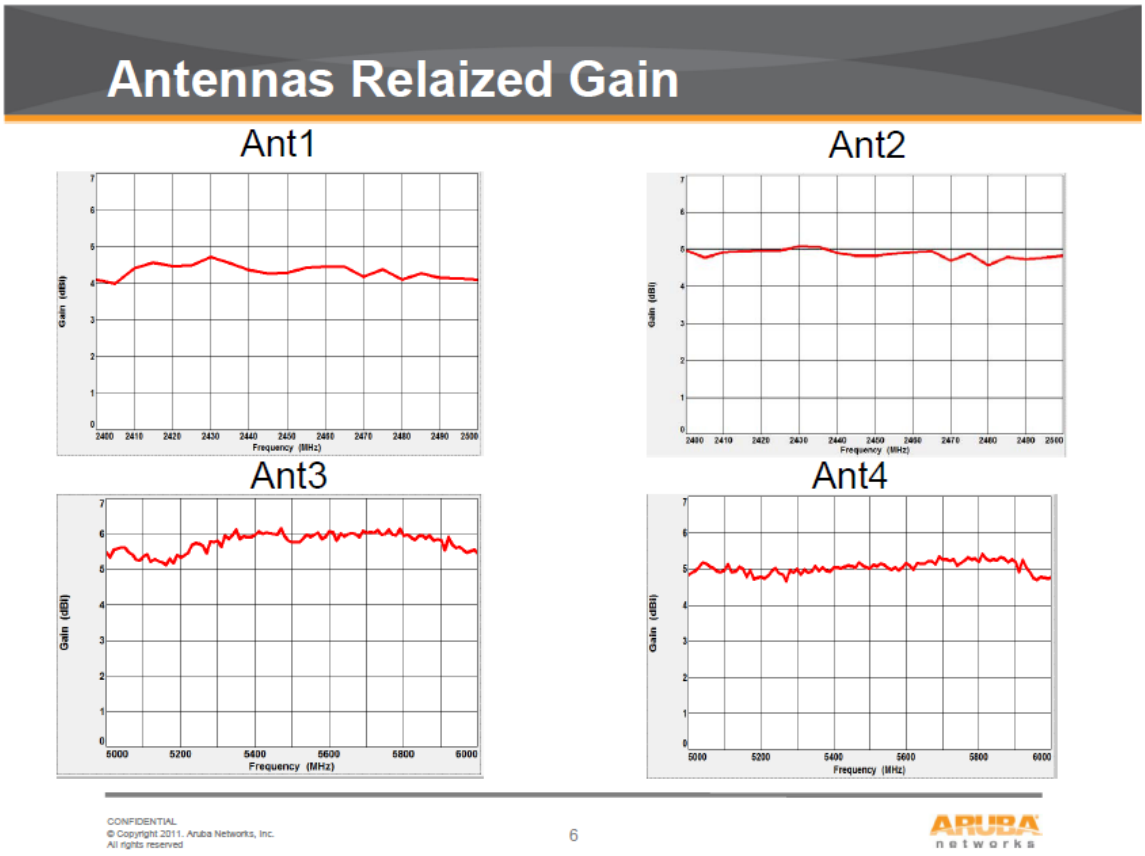
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Ant3
Ant4
Gain (dBi)
Frequency (MHz)
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5000 5200 5400 5600 5800 6000
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6
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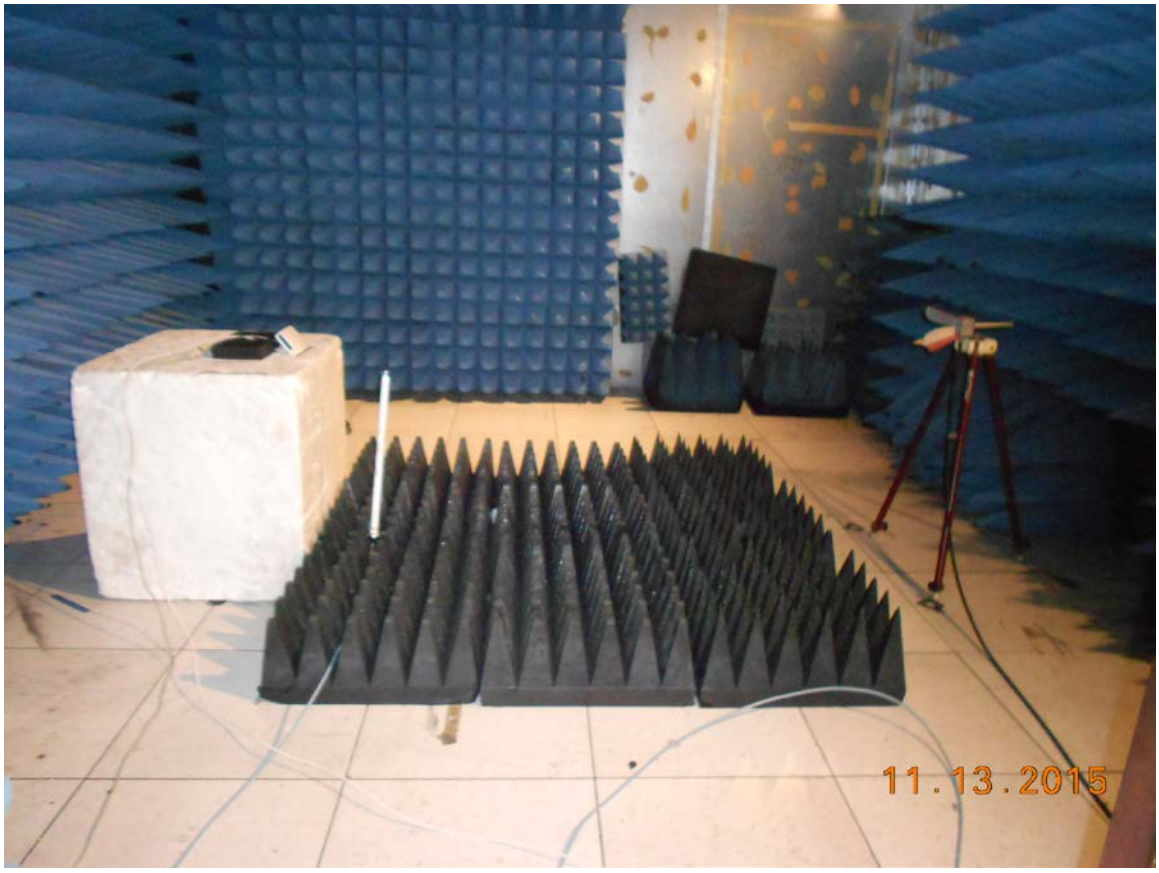
Appendix D Test Configuration Photograph(s)



End of Report

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marks the last page of this test report.