National Technical Systems

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Certification Test Report

CFR 47 FCC Part 15, Subpart C Section 15.247
Industry Canada RSS 210, Issue 6
FHSS Transmitters

Model: 195Es
FCC ID No.: ENPESTEEM195ES
IC No.: 2163A-195ES

Project Code W7052-1

Revision: 2

Prepared for:	Electronic Systems Technology 415 North Quay St. Building B-1 Kennewick, WA 99336
Author:	Tom Tidwell
Issued:	31 May, 2007

Report Summary
NTS Plano

Accreditation Numbers: FCC: 101741
IC: IC 4319A-1

Applicant: Electronic Systems Technology
415 North Quay St.
Building B-1
Kennewick, WA 99336

Customer Representative: Brent Strecker

EUT Description:

EUT Description	Manufacturer	Model	Revision	Serial Number
The EUT is a data modem that uses FHSS technology	Electronic Systems Technology	195Es	1	E-15757

Test Summary

Appendix	Test/Requirement Description	Deviations from:			Pass / Fail	Applicable Rule Parts
		Base Standard	Test Basis	NTS Procedure		
A	Antenna Information	No	No	No	PASS	15.203/15.204 RSS-Gen, 7.1.4
B	AC Power line Conducted Emissions	No	No	No	PASS	15.207 RSS-Gen, 7.2.2
C	Frequency Hopping System Information	No	No	No	PASS	15.247(a) RSS 210, Issue 5 A8.1
D	Carrier Frequency Separation	No	No	No	PASS	15.247(a) RSS 210, Issue 5 A8.1
E	No. of Hopping Frequencies	No	No	No	PASS	15.247(a) RSS 210, Issue 5 A8.1
F	Time of Occupancy	No	No	No	PASS	15.247(a) RSS 210, Issue 5 A8.1
G	20 dB Bandwidth	No	No	No	PASS	15.247, 15.205 RSS 210, Issue 5 A8.1
H	Peak Power Output	No	No	No	PASS	15.247(b) RSS 210, Issue 5 A8.4
I	Conducted Spurious Emissions	No	No	No	PASS	15.247(c) RSS 210, Issue 5 A8.5
J	Restricted Band Field Strength and Receiver Emissions	No	No	No	PASS	15.209 RSS 210, Issue 5 2.7,Table 2 and 3 RSS-Gen 7.2.3.2
K	Test Equipment List					

Test Result: The product presented for testing complied with test requirements as shown above.

This is to certify that the preceding report is true and correct to the best of my knowledge.

Robert Stevens,
Quality Assurance Manager

Tom Tidwell,
Wireless Test Engineer

Table of Contents

Register of revisions

Revision	Reason for Revision	Revision Date
0	Original	3 April, 2007
1	Changed Title to read "…15.247" instead of "…5.247" Added a comment to pages 12 and 35 to clarify that the operating mode for testing was transmit and receive.	24 May, 2007
2	Corrected references to the frequency hopping sequence algorithm.	31 May, 2007

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the tests applied by NTS Plano to demonstrate compliance of the 195Es to FCC Part 15 Subpart C section 15.247 for FHSS transmitters and the equivalent sections of Industry Canada's RSS 210, Issue 6

2.0 EUT DESCRIPTION

2.1 CONFIGURATION

Description of EUT

	Name	Model	Revision	Serial Number
EUT	Wireless Modem	195Es	0	E-15757
Classification	Mobile			
Channels/Frequency Range	902.3 – 927.6 MHz (Channels 1 – 52), Channel Spacing is 460 kHz			
Power	1 watt max. available from antenna port. Power is reduced for antenna gains > 6 dBi.			
Functional Description	The EUT uses pseudorandom frequency hopping spread spectrum technology to a achieve data transmission rate of 200 kbps			

2.1.1 EUT POWER

Voltage	48 Vdc (power over Ethernet)

2.2 EUT CABLES

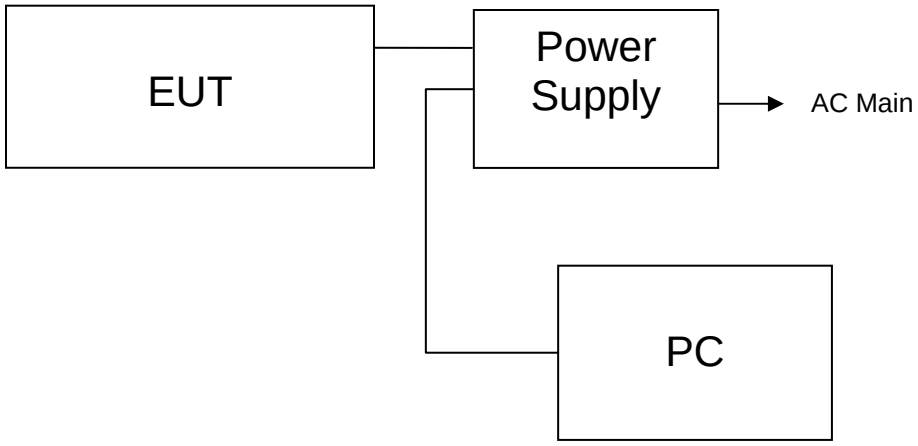
Quantity	Model/Type	Routing		Shielded / Unshielded	Description	Cable Length (m)
		From	To			
1	CAT5	Power Supply	Support Equipment (PC)	Shielded	CAT5 Ethernet cable	2
1	CAT5	Power Supply	EUT	Shielded	CAT5 Ethernet cable	2

2.3 MODE OF OPERATION DURING TESTS

The 195Es was tested while in a continuous transmit mode. The EUT was tuned to a low, middle, and high channel to perform power, occupied bandwidth, and spurious/harmonic tests. For conducted emissions the device was tuned to its center frequency. The EUT continuously transmitted a modulated packet with payload. While transmitting the EUT was setup to operate at the intended maximum power output available to the end user. For all test cases pre-scans were completed in all modes to determine worst case levels.

3.0 SUPPORT EQUIPMENT

3.1 CONFIGURATION



Power Supply: I.T.E. model PW130
Input: 100 – 250 VAC, 50 – 60 Hz, 500 mA
Output: 48 Vdc, 350 mA

APPENDICES

APPENDIX A: ANTENNA INFORMATION

A.1. Base Standard & Test Basis

Base Standard	FCC PART 15.203/15.204
Test Basis	FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

A.2. Specifications

15.203
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.204
(c) An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator. An intentional radiator may be authorized with multiple antenna types.

(1) The antenna type, as used in this paragraph, refers to antennas that have similar inband and out-of-band radiation patterns.
(2) Compliance testing shall be performed using the highest gain antenna for each type of antenna to be certified with the intentional radiator. During this testing, the intentional radiator shall be operated at its maximum available output power level.
(3) Manufacturers shall supply a list of acceptable antenna types with the application for equipment authorization of the intentional radiator.
(4) Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator. No retesting of this system configuration is required. The marketing or use of a system configuration that employs an antenna of a different type, or that operates at a higher gain, than the antenna authorized with the intentional radiator is not permitted unless the procedures specified in §2.1043 of this chapter are followed.

A.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

A.4. Results

Complies. The EUT uses a connector that is considered to be non-standard at this time (Reverse polarity TNC).

A.5. Sample Calculation

EIRP (dBm) = P + G
Where,
P = Peak rf power at antenna port expressed in dBm
G = Directional gain of the transmit antenna expressed in dBi

dBi = dBd + 2.15
Where,
dBi is gain referenced to an isotropic radiation source
dBd is gain referenced to a standard ½ wave dipole

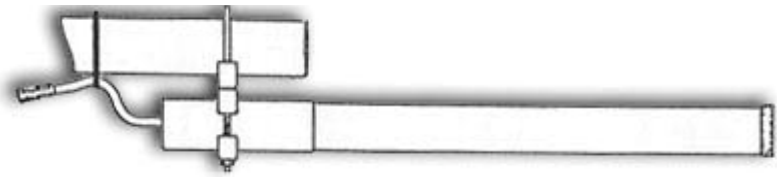
A.6. Antenna Data

Antenna Type	Supplier	Model	Gain (dBi)	Connector Type
Omni-Directional	EST	AA20DMEs	2	TNC-R Male
Omni-Directional "Mag" Mount	EST	AA191Es	5	TNC-mrp with 17 ft. of LMR-195 permanently attached to antenna
Omni-Directional, DC grounded	EST	AA20Es900	7	TNC-R Male
Yagi	EST	AA203Es900	7	TNC-R Male with permanently attached pigtail

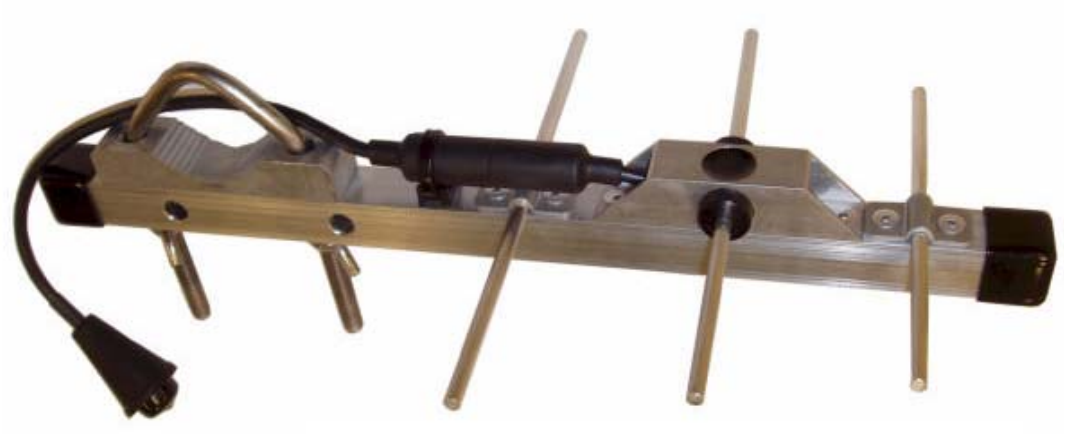
A.7. Antenna Photos

AA20DMEs

AA191Es



AA20Es900



AA203Es900

A.8. Evaluated By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX B: AC POWERLINE CONDUCTED EMISSIONS

B.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.107/15.207 – Radio Frequency Devices
Test Basis	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Test Method	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

B.2. Specifications

Frequency	☐ **Class A**		☒ **Class B**	
Limit	**Quasi-Peak**	**Average**	**Quasi-Peak**	**Average**
MHz	**dBµV**	**dBµV**	**dBµV**	**dBµV**
0.150 – 0.500	79.00	66.00	66 to 56[1]	56 to 46[1]
0.500 – 5.00	73.00	60.00	56	46
5.00 – 30.00	73.00	60.00	60	50

Note 1: decrease with the logarithm of the frequency.

B.3. Measurement Uncertainty

Conducted Current Emissions 150 kHz – 30 MHz	**Expanded Uncertainty (K=2)**
(dB)	+/-1.7

B.4. Deviations

Deviation Number	**Time & Date**	**Description and Justification of Deviation**	**Deviation Reference**			**Approval**
			Base Standard	**Test Basis**	**NTS Procedure**	
none						

B.5. Test Method

RF conducted as per ANSI C63.4-2003
The radio was set in normal operating mode (Transmit and Receive) for this testing.

B.6. Test Results

Compliant. The worst-case emission is 42.5 dBuV at 0.464 MHz measured with a Quasi-Peak detector. This is 4.5 dB below the average limit of 47 dBuV.

B.7. Sample Calculation

Correction Factor = LISN Correction Factor + Cable Loss
Corrected Value = Measurement + Correction Factor
Margin = Limit – Corrected Emission Level

B.8. Test Data

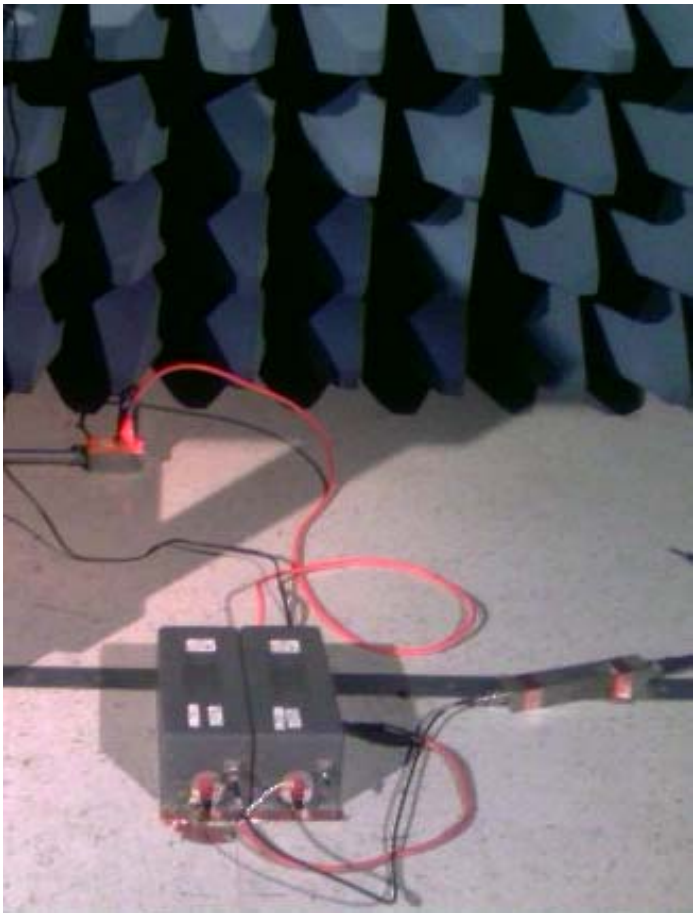
Project No:	W7052 - EST
Model:	195Es, S/N. E-15754
Comments:	The QPk measurements met the average limit.

Standard: CFR 47, 15.207

Conductor	Impulse BW (kHz)	Frequency	LISN Factor	Cable Loss	Total Correction	Measured	Corrected	Detector	Avg. Limit	Margin
		(MHz)	(dB)	(dB)	(dB)	(dBuV)	(dBuV)		(dBuV)	(dBuV)
1	9	0.397	0.5	0	0.5	39.6	40.1	QPk	48.9	8.8
1	9	0.464	0.5	0	0.4	42.1	42.5	QPk	47	4.5
1	9	0.597	0.5	0	0.3	37.9	38.2	QPk	46	7.8
1	9	12.792	0.5	0.1	0.6	42.4	43	QPk	50	7
1	9	13.943	0.5	0.1	0.6	34.4	35	QPk	50	15
1	9	19.86	0.6	0.1	0.7	35.6	36.3	QPk	50	13.7
2	9	0.397	0.5	0	0.5	35.7	36.2	QPk	48.9	12.7
2	9	0.464	0.5	0	0.5	38.6	39.1	QPk	47	7.9
2	9	0.597	0.5	0	0.5	31.7	32.2	QPk	46	13.8
2	9	12.792	0.5	0.1	0.6	34.8	35.4	QPk	50	14.6
2	9	13.943	0.5	0.1	0.6	23.6	24.2	QPk	50	25.8
2	9	19.86	0.6	0.1	0.7	15.4	16.1	QPk	50	33.9

Notes:

B.9. Photographs



B.10. Tested By

Name: Tom Tidwell
Function: 18 March, 2007

APPENDIX C: FREQUENCY HOPPING SYSTEM INFORMATION

C.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.247
Test Basis	FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

C.2. Specifications

15.247
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725–5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

C.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

C.4. Results

(A) 15.247(a) Requirement: Describe how the EUT meets the definition of a frequency hopping spread spectrum system found in CFR 47, Part 2, Clause 1.

(1) Pseudorandom Frequency Hopping Sequence
   a. Describe how the hopping sequence is generated.
   The hopping sequence is generated from a hop table. The hop channel table is shuffled after selection. The table is shuffled using a Fischer-Yates shuffle with pseudo-random indexes generated using RC4 and then modulo-[setsize]. The RC4 algorithm is keyed (seeded) using a unique 'system identifier' allowing collocated systems to operate on distinct hop sequences.

(2) Equal Hopping Frequency Use
   a. Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average.
   The absolute maximum time of occupancy per channel in any 10s period is 192ms. Due to the nature of packet delivery in this system, the likelihood of full occupancy of any given hop is quite low. The average occupancy is demonstrably uniform due to the uniform distribution of “packet ready for transmit” times.

(3) System Receiver Input Bandwidth
   a. Describe how the receiver complies with the requirement that its input bandwidth (IF or RF) matches the bandwidth of the transmitted signal.
   The RF bandwidth of the receiver is 460 kHz.

(4) System Receiver Hopping Capability
   a. Describe how the receiver has the ability to shift frequencies in synchronization with the transmitted signals.
   A transmission is sent on one of the hop channels. This is an identification transmission that identifies the transmitter and announces “data packet ready”. The receiver then synchronizes its hopping sequence with the transmitter for the data hop sequence in order to receive the transmitted data packet(s).

C.5. Evaluated By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX D: CARRIER FREQUENCY SEPARATION

D.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.247
Test Basis	FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

D.2. Specifications

15.247
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

D.3. Measurement Uncertainty

Expanded Uncertainty (K=2)
+/-10 Hz

D.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

D.5. Test Method

RF conducted as per ANSI C63.4-2003

D.6. Test Results

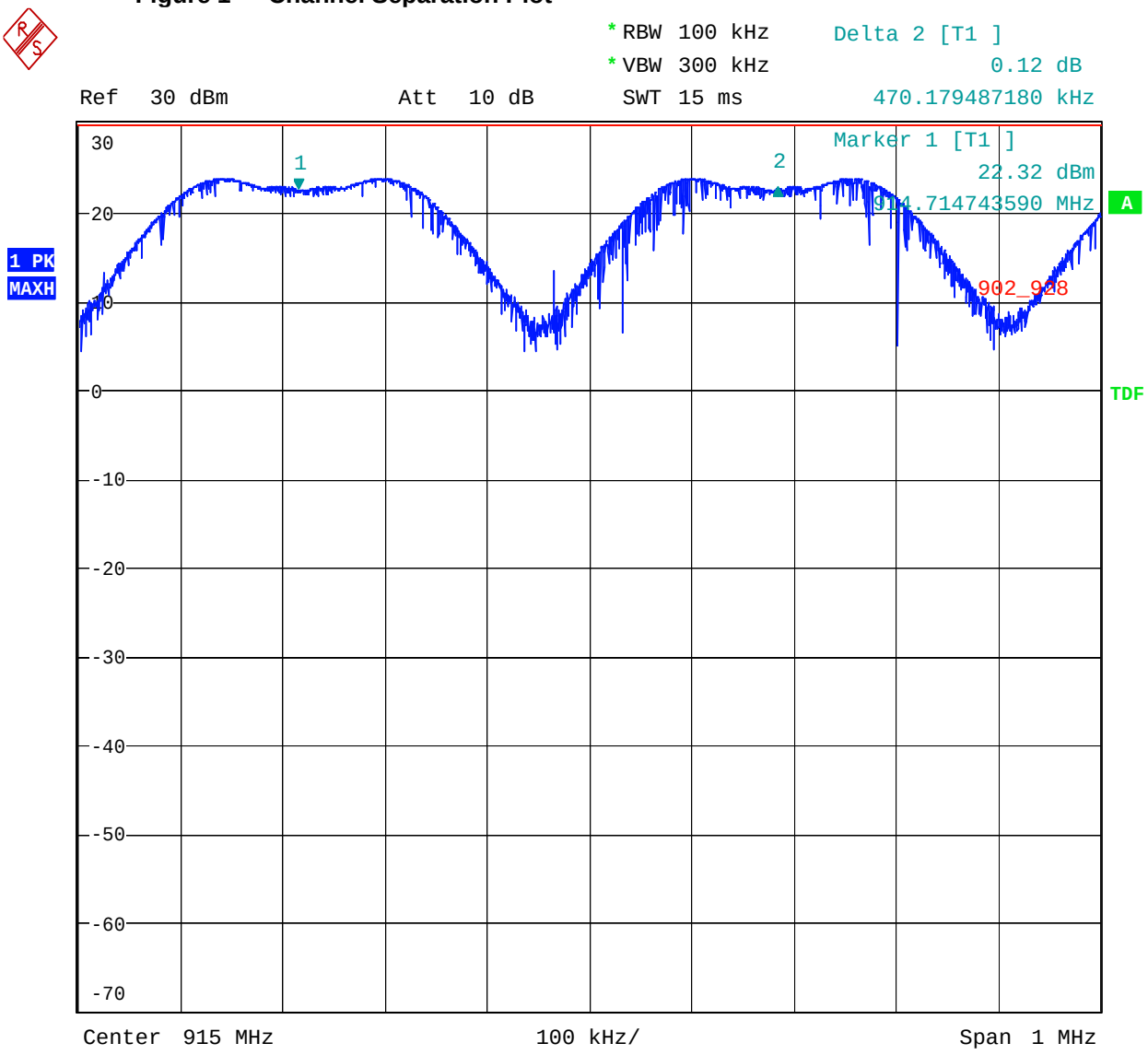
Compliant. The channel separation was measured to be 470 kHz.

D.7. Sample Calculation

N/A

D.8. Test Data

Figure 1 Channel Separation Plot



D.9. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX E: NUMBER OF HOPPING CHANNELS

E.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.247
Test Basis	FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

E.2. Specifications

15.247
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1)(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(1)(ii) Frequency hopping systems operating in the 5725–5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(1)(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

E.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

E.4. Test Method

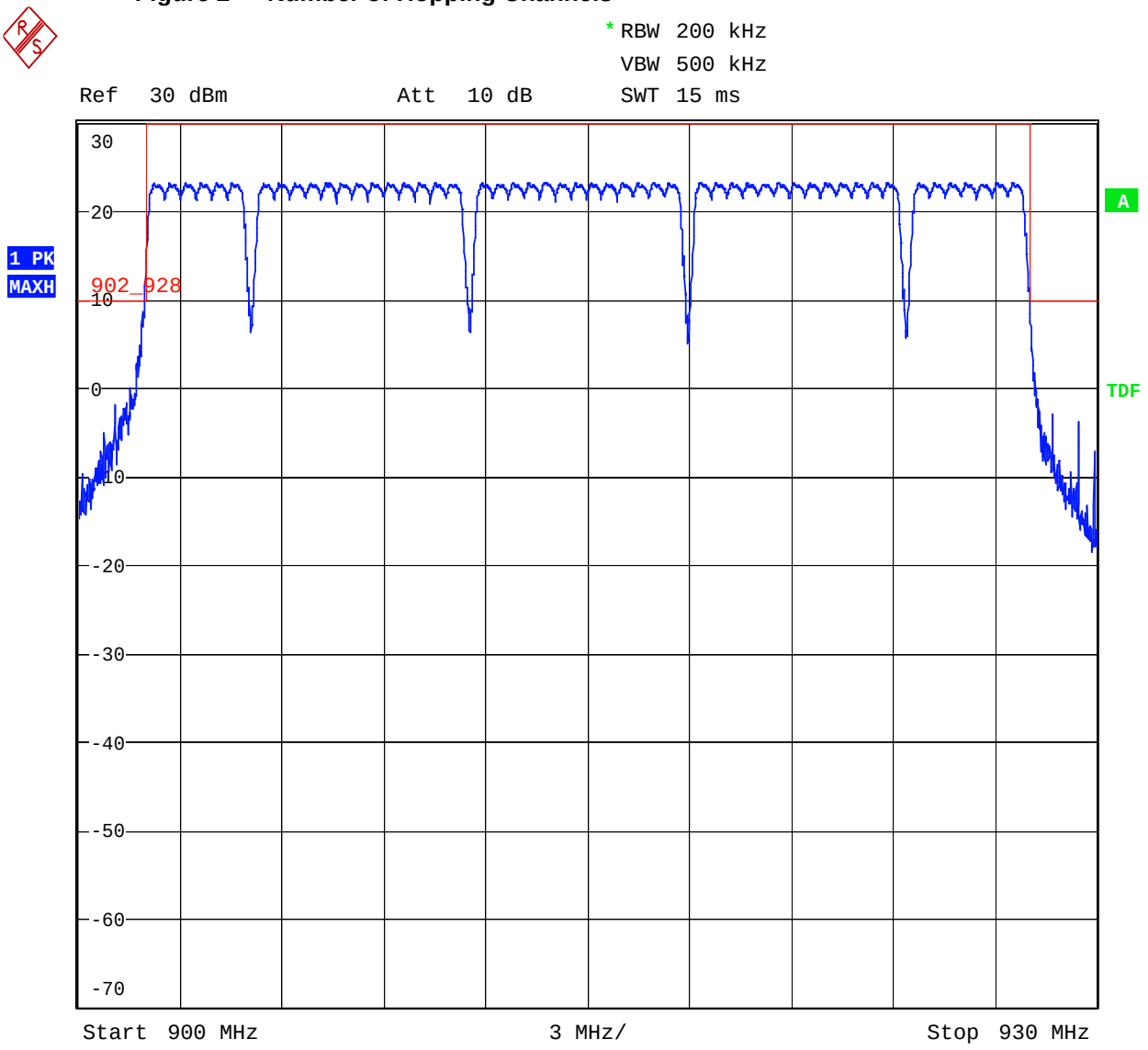
RF conducted as per ANSI C63.4-2003

E.5. Test Results

Compliant. There were 52 channels plotted with the device in data transmit hopping mode.

E.6. Test Data

Figure 2 Number of Hopping Channels



E.7. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX F: TIME OF OCCUPANCY

F.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.247
Test Basis	FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

F.2. Specifications

15.247
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1)(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency **shall not be greater than 0.4 seconds within a 20 second period**; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency **shall not be greater than 0.4 seconds within a 10 second period**. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(1)(ii) Frequency hopping systems operating in the 5725–5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. **The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.**

(1)(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. **The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.** Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

F.3. Measurement Uncertainty

Expanded Uncertainty (K=2)
+/- 0.12 msec.

F.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

F.5. Test Method

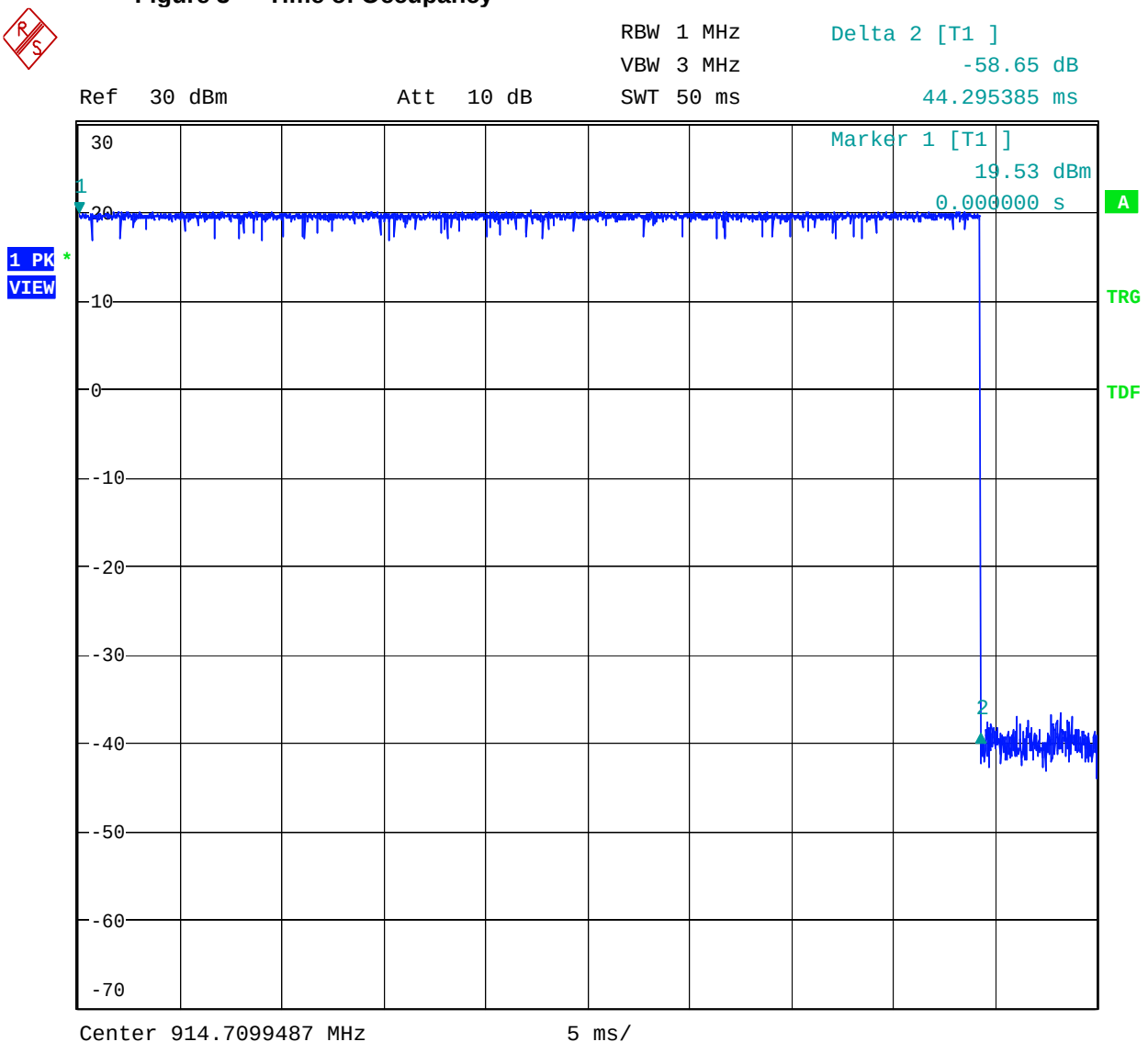
RF conducted as per ANSI C63.4-2003

F.6. Test Results

Compliant. The measured maximum time of occupancy during normal data transmission was 44.3 ms.

F.7. Test Data

Figure 3 Time of Occupancy



F.8. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX G: 20 DB BANDWIDTH

G.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.247
Test Basis	FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

G.2. Specifications

15.247
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1)(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. **The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz**.

(1)(ii) Frequency hopping systems operating in the 5725–5850 MHz band shall use at least 75 hopping frequencies. **The maximum 20 dB bandwidth of the hopping channel is 1 MHz**. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(1)(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

G.3. Measurement Uncertainty

Expanded Uncertainty (K=2)
+/- 10 Hz

G.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

G.5. Test Method

RF conducted as per ANSI C63.4-2003

G.6. Test Results

Compliant. The maximum 20 dB bandwidth is 429.7 kHz.

G.7. Test Data

Figure 4 20 dB BW – Lowest Channel

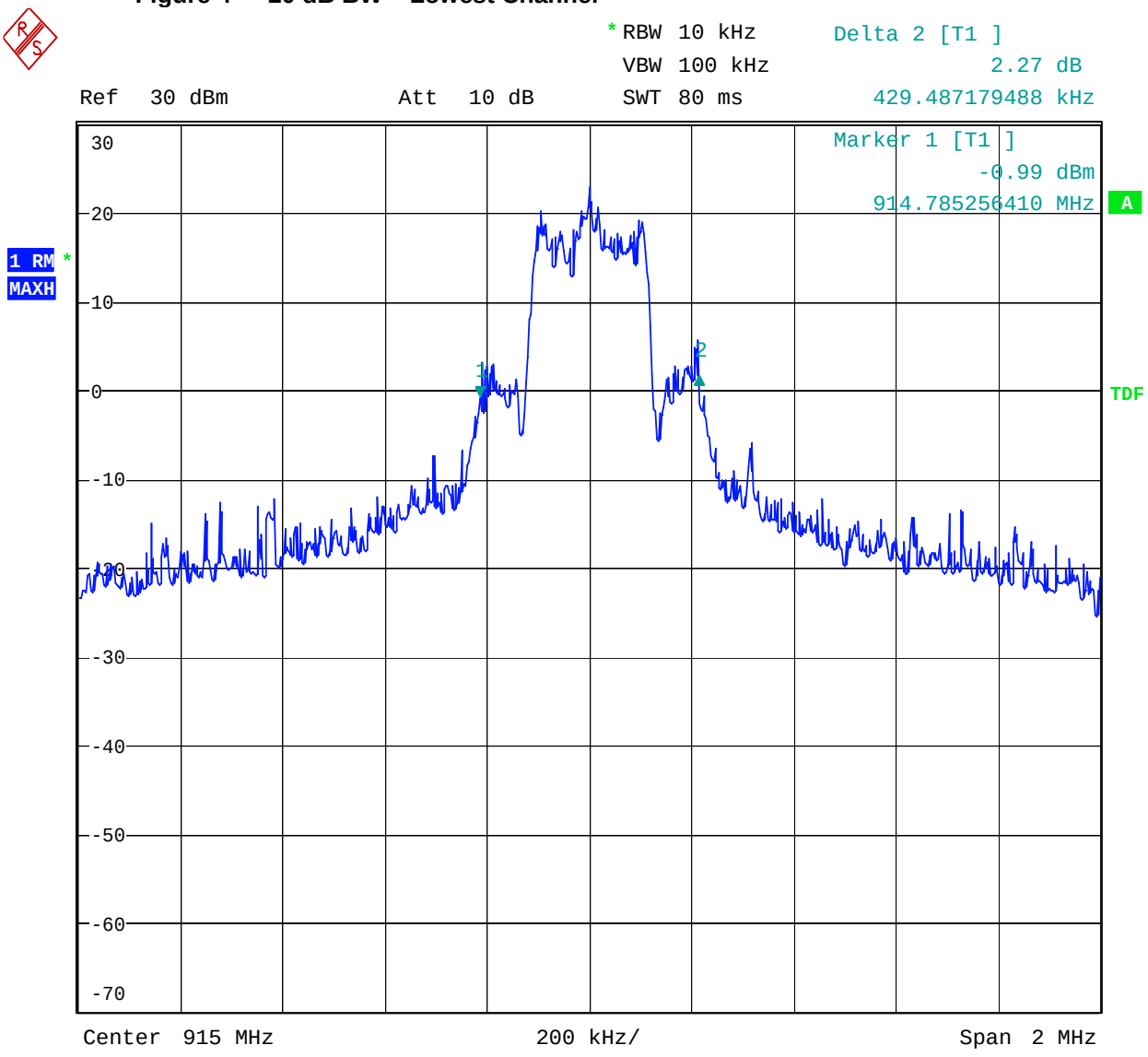


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Figure 5 20 dB BW – Mid Channel

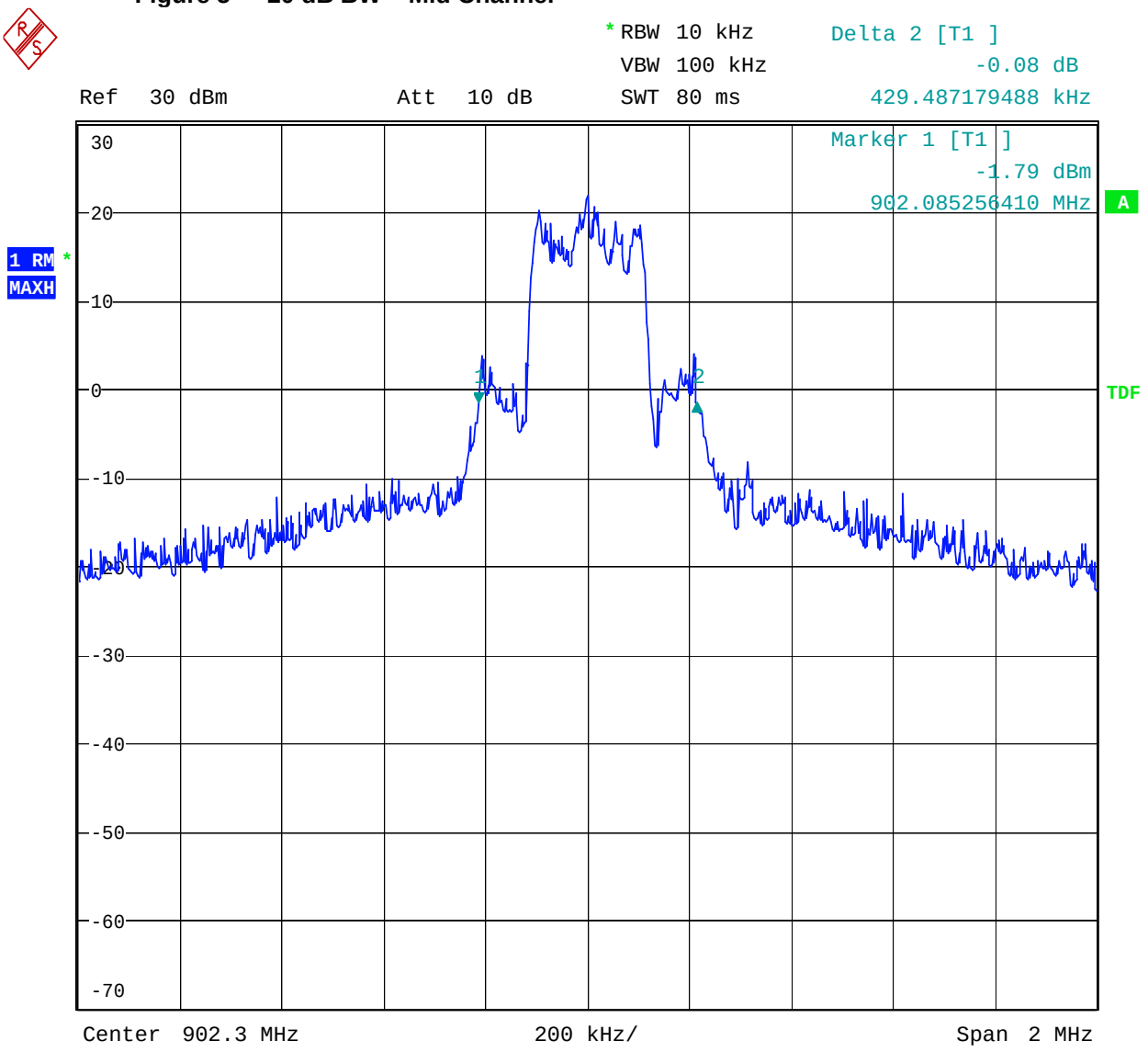

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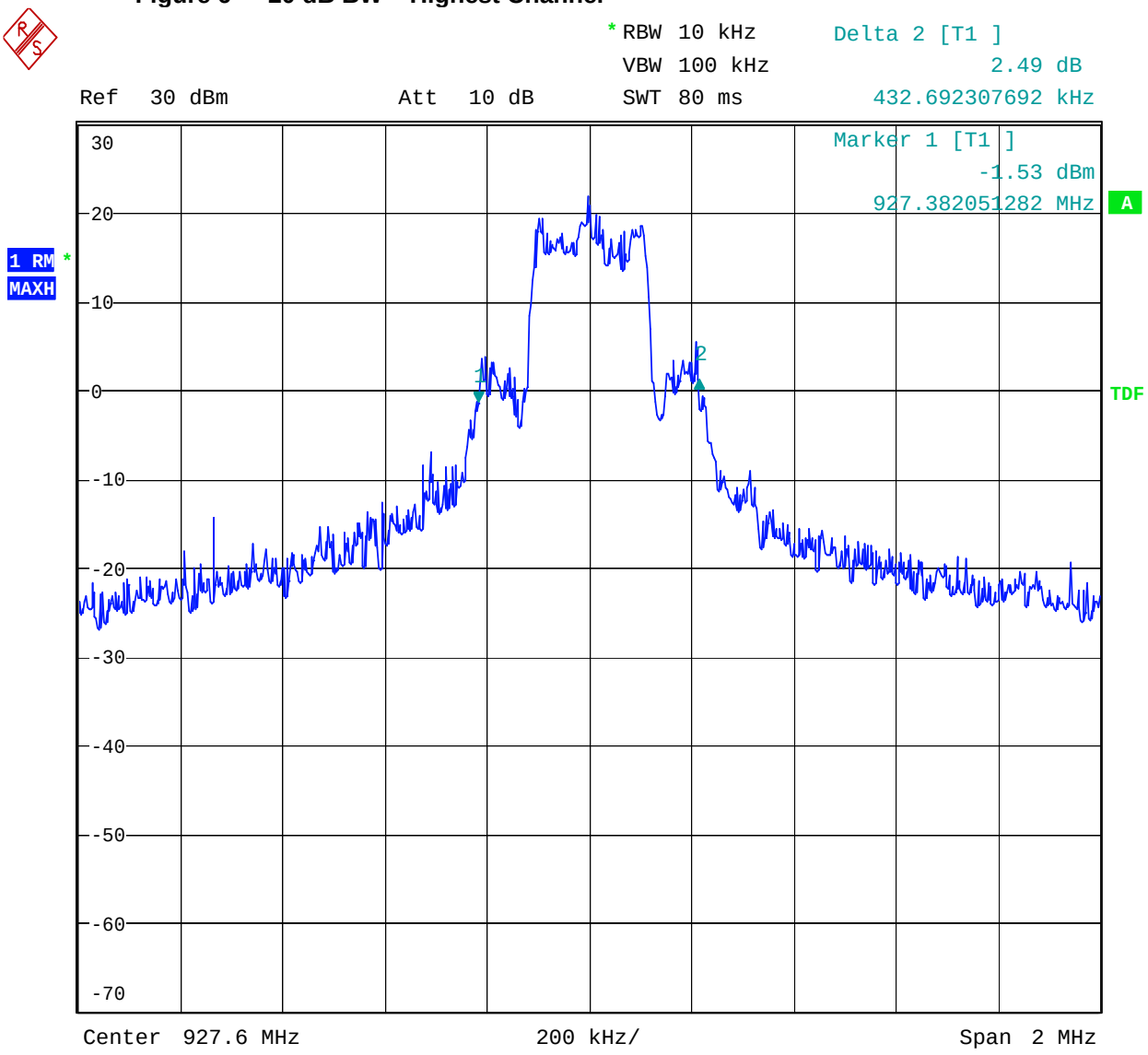
Figure 6 20 dB BW – Highest Channel



G.8. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX H: PEAK POWER OUTPUT

H.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.247 – Radio Frequency Devices - Subpart C– intentional Radiators
Test Basis	RF conducted as per FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

H.2. Specifications

15.247

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.
(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.
(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g.,
alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

H.3. Measurement Uncertainty

Expanded Uncertainty (K=2)
+/-0.76

H.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

H.5. Test Method

RF conducted as per FCC Publication DA 00-75

H.6. Test Results

Compliant. The maximum measured Peak Power was +35.9 dBm EIRP.

H.7. Deviations from Normal Operating Mode During Test

None.

H.8. Sample Calculation

None.

H.9. Test Data

The EUT is in compliance with the limits as specified above

Channel (MHz)	Data Rate (kbps)	Measured Peak RF Power at antenna terminals (dBm)	Antenna	Antenna Gain (dBi)	EIRP (dBm)
902.30	384	29.78	AA20DMEs	2	31.78
902.30	384	29.78	AA191Es	5	34.78
902.30	384	28.93	AA20Es900	7	35.93
902.30	384	28.93	AA203Es900	7	35.93
915.00	384	29.68	AA20DMEs	2	31.68
915.00	384	29.68	AA191Es	5	34.68
915.00	384	28.93	AA20Es900	7	35.93
915.00	384	28.93	AA203Es900	7	35.93
927.60	384	29.56	AA20DMEs	2	31.56
927.60	384	29.56	AA191Es	5	34.56
927.60	384	28.93	AA20Es900	7	35.93
927.60	384	28.93	AA203Es900	7	35.93

H.10. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX I: 15.247 CONDUCTED SPURIOUS EMISSIONS

I.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I – FCC Part 15.247 – Radio Frequency Devices - Subpart C– intentional Radiators FCC Part 15.205 Restricted Bands of Operation
Test Basis	RF conducted as per FCC Publication DA 00-75
Test Method	RF conducted as per FCC Publication DA 00-75

I.2. Specifications

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

I.3. Measurement Uncertainty

Expanded Uncertainty (K=2)

I.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

I.5. Test Results

Compliant. All peak emissions were more than 20 dB below the in-band power.

I.6. Test Data & Photographs

Figure 7 Antenna Conducted Spurious Emissions – Lowest Channel

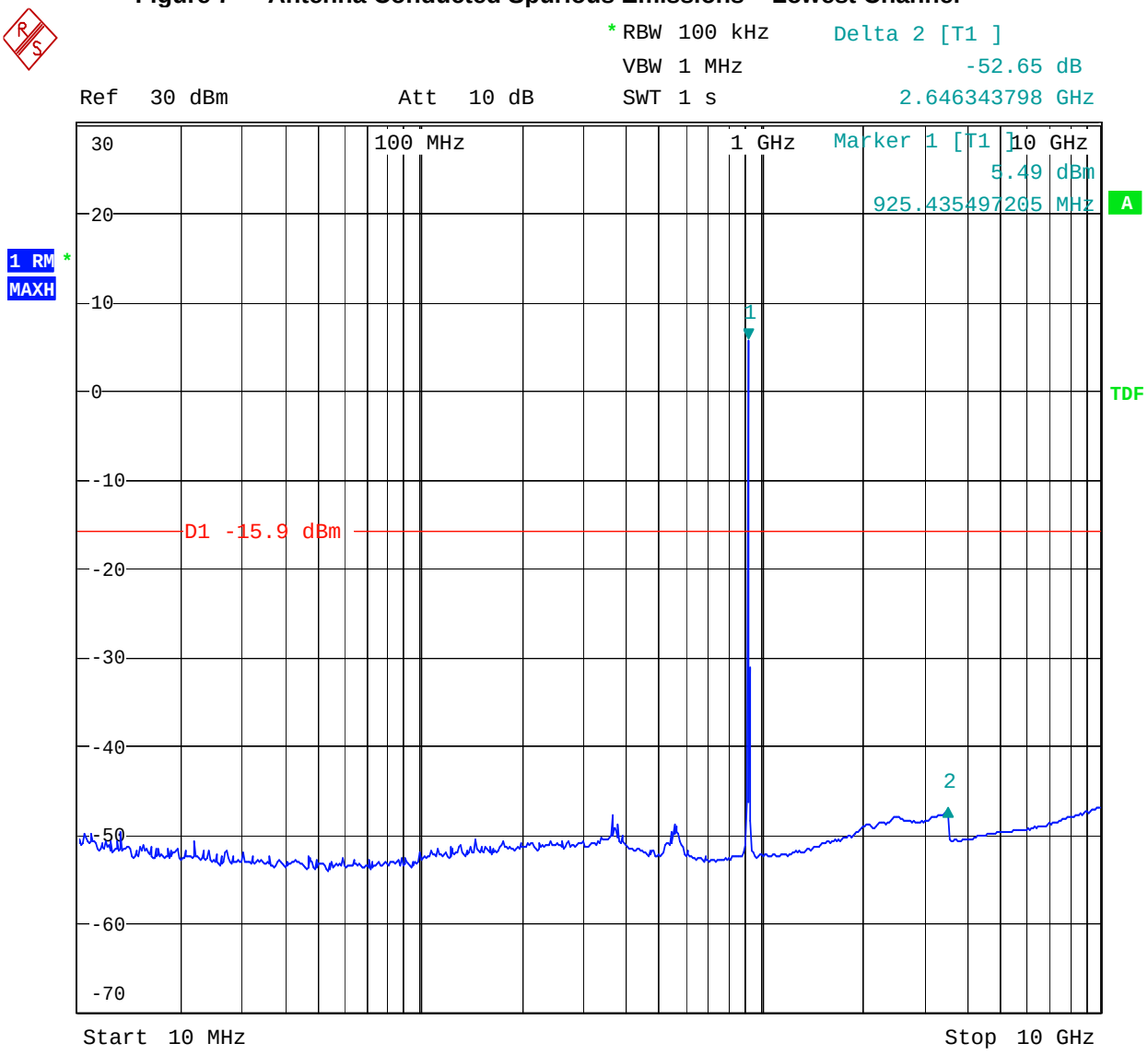
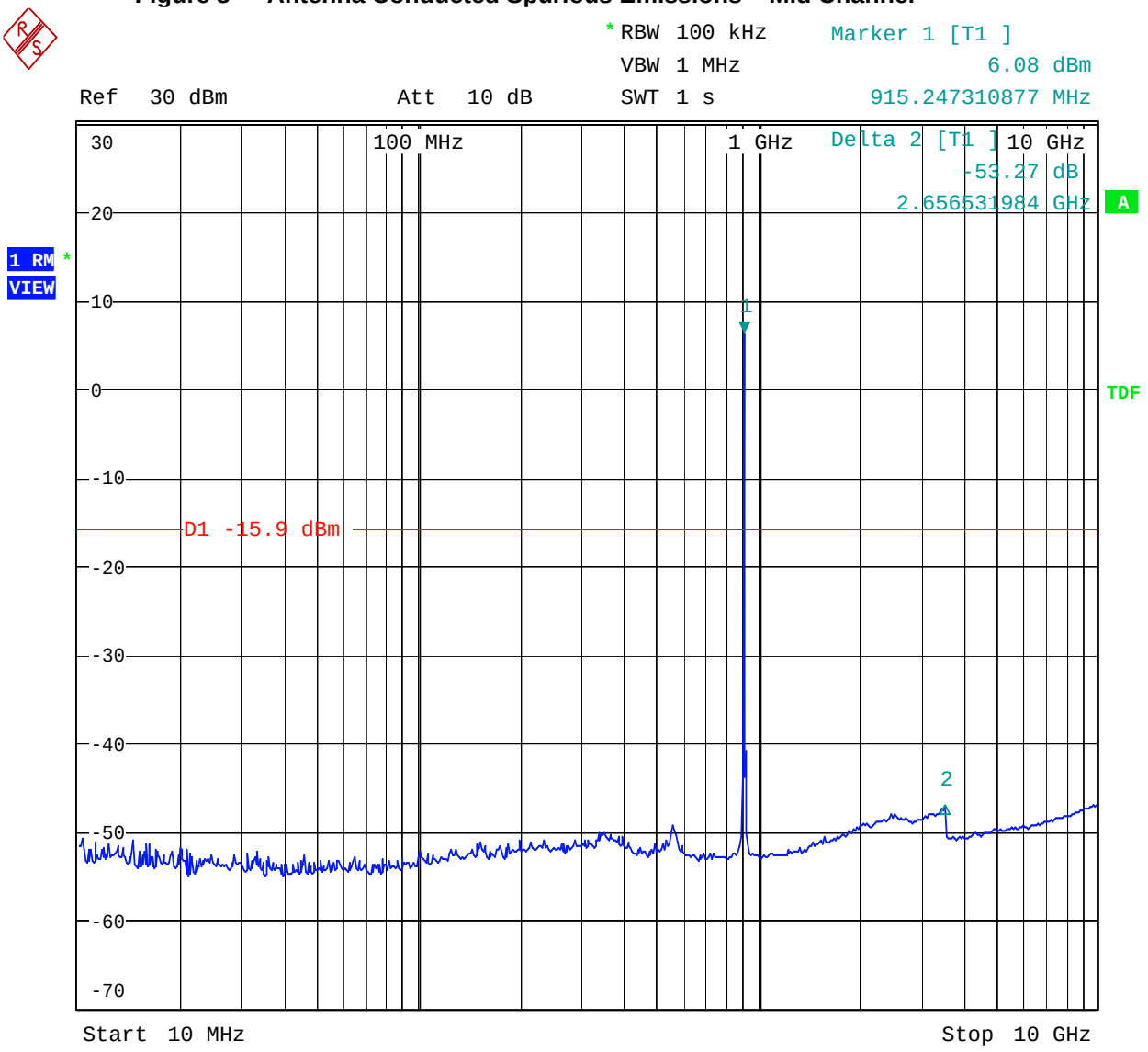
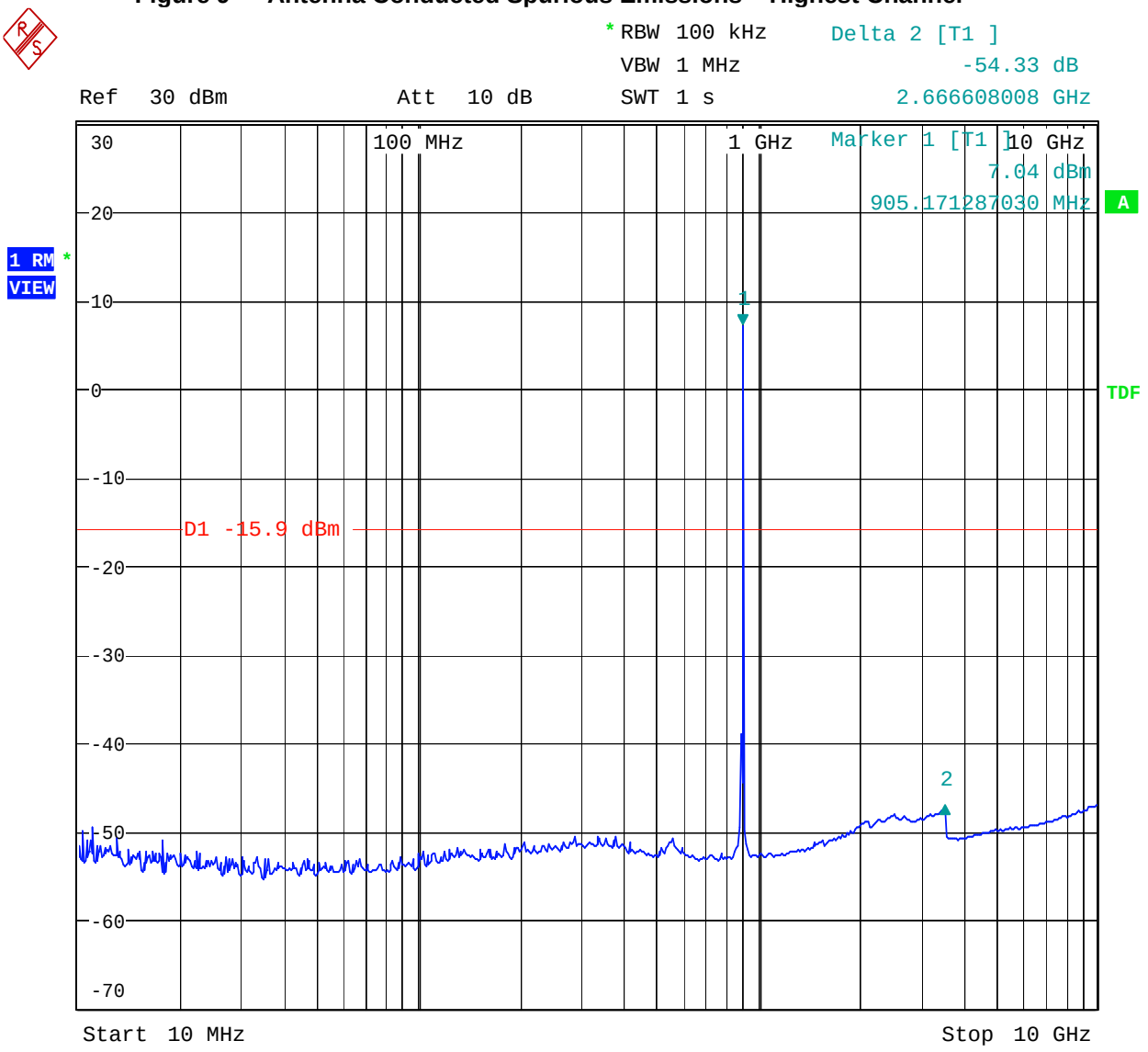


Figure 8 Antenna Conducted Spurious Emissions – Mid Channel



Date: 13.MAR.2007 12:22:02

Figure 9 Antenna Conducted Spurious Emissions – Highest Channel



Date: 13.MAR.2007 12:23:21

I.7. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX J: RADIATED EMISSIONS IN RESTRICTED BANDS 30 MHz – 25 GHz (TX AND RX)

J.1. Base Standard & Test Basis

Base Standard	CFR Title 47 – Telecommunications, Chapter I - FCC Part 15.209 – Radio Frequency Devices
Test Basis	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Test Method	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Specifications

（b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

J.2. Measurement Uncertainty

Radiated Emissions 30 MHz – 1 GHz	Measurement Uncertainty	Expanded Uncertainty (K=2)
(dB)	+/- 3.7	+/- 4.1

J.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

J.4. Test Results

The EUT is in compliance with radiated emission limits. The worst case emission was 38 dBμV/m @ 3 meters @ 124.94 MHz, a pass margin of 5.5 dB. The EUT was operating in TX and RX mode during this test. Testing was performed on three channels with each antenna.

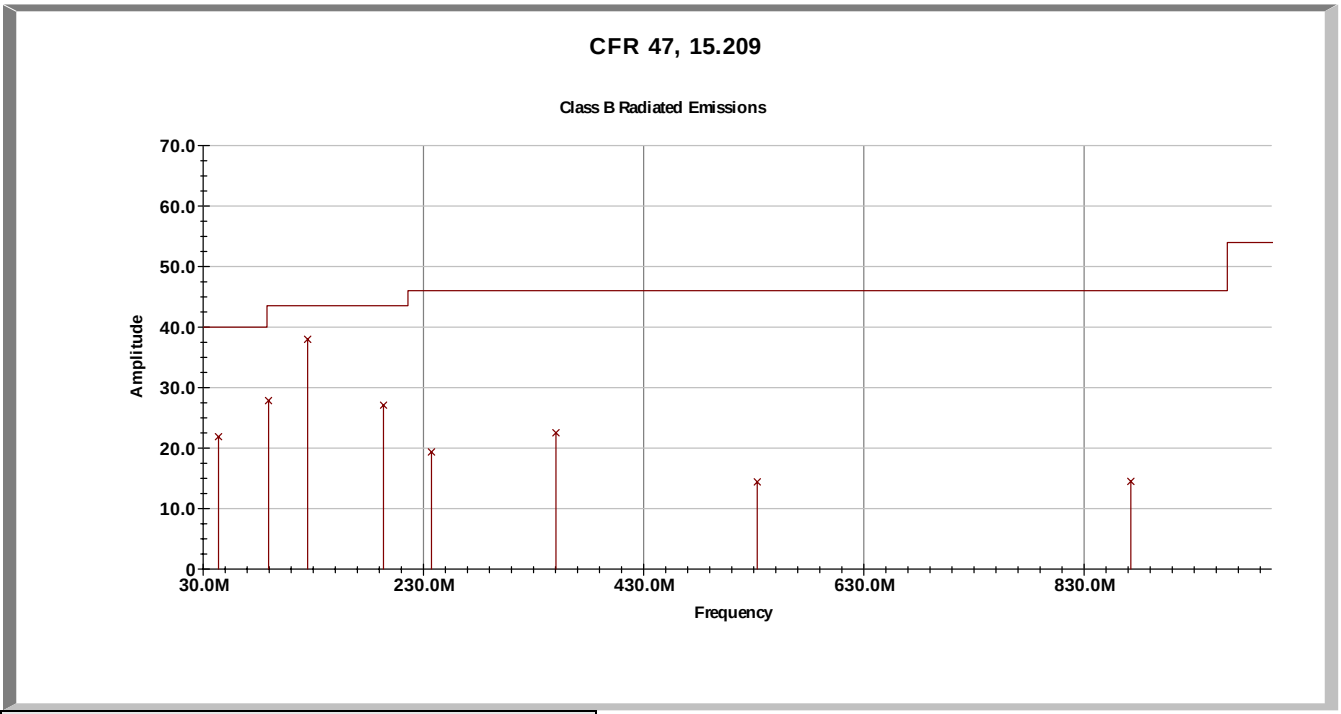
J.5. Deviations from Normal Operating Mode During Test

None. The device was tested in normal operating mode (Transmit and Receive).

J.6. Sample Calculation

Emission Level = Measured Level + Correction Factors.
Margin = Limit – Emission Level. A positive margin indicates a passing result.

J.7. Test Data



Operator: T. Tidwell
Model: 195Es
Company: EST
Contact: Brent Strecker
Worst-case data

Frequency MHz	FCC B Limits	Corrected QPk (dBuV/m@3m)	Margin (dB)
43.96	40.0	21.9	-18.1
88.00	40.0	27.7	-12.3
89.36	43.5	27.8	-15.7
124.94	43.5	38.0	-5.5
193.83	43.5	27.1	-16.4
216.00	43.5	23.1	-20.4
216.00	46.0	23.1	-22.9
237.32	46.0	19.4	-26.7
350.47	46.0	22.5	-23.5
533.25	46.0	14.4	-31.6
872.45	46.0	14.5	-31.5

OmniDirectional Antenna AA20DMEs

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA20DMEs Channel 902.3 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz GHz = 1 MHz	> 1
					VBW: (unless noted)	Peak = RBW Avg. = 10 Hz	

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2706.9	28.6	-29.1	0.0	-0.5	Pk	27.4	26.9	54.0	27.1
	H	2706.9	28.6	-29.1	0.0	-0.5	Pk	26.8	26.3	54.0	27.7
	V	3609.2	31.2	-27.1	0.0	4.1	Pk	24.3	28.4	54.0	25.6
	H	3609.2	31.2	-27.1	0.0	4.1	Pk	23.7	27.8	54.0	26.2
	V	4511.5	32.3	-26.8	0.0	5.5	Pk	25.1	30.6	54.0	23.4
	H	4511.5	32.3	-26.8	0.0	5.5	Pk	25.0	30.5	54.0	23.5
	V	5413.8	33.4	-26.0	0.0	7.4	Pk	24.0	31.4	54.0	22.6
	H	5413.8	33.4	-26.0	0.0	7.4	Pk	23.4	30.8	54.0	23.2
	V	8120.7	36.8	-24.4	0.0	12.4	Pk	30.8	43.2	54.0	10.8
	H	8120.7	36.8	-24.4	0.0	12.4	Pk	29.7	42.1	54.0	11.9
	V	9023.0	37.7	-23.5	0.0	14.2	Pk	30.8	45.0	54.0	9.0
	H	9023.0	37.7	-23.5	0.0	14.2	Pk	30.5	44.7	54.0	9.3

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA20DMEs Channel 915.0 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz GHz = 1 MHz	> 1
					VBW: (unless noted)	Peak = RBW Avg. = 10 Hz	

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2745.0	28.6	-28.7	0.0	-0.1	Pk	27.4	27.3	54.0	26.7
	H	2745.0	28.6	-28.7	0.0	-0.1	Pk	26.8	26.7	54.0	27.3
	V	3660.0	31.2	-27.4	0.0	3.8	Pk	24.3	28.1	54.0	25.9
	H	3660.0	31.2	-27.4	0.0	3.8	Pk	23.7	27.5	54.0	26.5
	V	4575.0	32.3	-27.1	0.0	5.2	Pk	25.0	30.2	54.0	23.8
	H	4575.0	32.3	-27.1	0.0	5.2	Pk	24.7	29.9	54.0	24.1
	V	7320.0	35.2	-25.2	0.0	10.0	Pk	23.5	33.5	54.0	20.5
	H	7320.0	35.2	-25.2	0.0	10.0	Pk	23.5	33.5	54.0	20.5
	V	8235.0	36.8	-24.4	0.0	12.4	Pk	30.3	42.7	54.0	11.3
	H	8235.0	36.8	-24.4	0.0	12.4	Pk	29.1	41.5	54.0	12.5
	V	9150.0	37.7	-23.5	0.0	14.2	Pk	30.7	44.9	54.0	9.1
	H	9150.0	37.7	-23.5	0.0	14.2	Pk	30.6	44.8	54.0	9.2

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA20DMEs Channel 927.6 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz > 1 GHz = 1 MHz	VBW: (unless noted) Peak = RBW Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2782.8	28.6	-28.7	0.0	-0.1	Pk	28.2	28.1	54.0	25.9
	H	2782.8	28.6	-28.7	0.0	-0.1	Pk	27.6	27.5	54.0	26.5
	V	3710.4	31.2	-26.9	0.0	4.3	Pk	25.1	29.4	54.0	24.6
	H	3710.4	31.2	-26.9	0.0	4.3	Pk	24.4	28.7	54.0	25.3
	V	4638.0	32.3	-27.0	0.0	5.3	Pk	25.2	30.5	54.0	23.5
	H	4638.0	32.3	-27.0	0.0	5.3	Pk	25.1	30.4	54.0	23.6
	V	7420.8	35.2	-25.3	0.0	9.9	Pk	24.0	33.9	54.0	20.1
	H	7420.8	35.2	-25.3	0.0	9.9	Pk	24.1	34.0	54.0	20.0
	V	8348.4	36.8	-23.7	0.0	13.1	Pk	30.3	43.4	54.0	10.6
	H	8348.4	36.8	-23.7	0.0	13.1	Pk	30.0	43.1	54.0	10.9
	V	9276.0	37.7	-23.6	0.0	14.1	Pk	30.3	44.4	54.0	9.6
	H	9276.0	37.7	-23.6	0.0	14.1	Pk	30.2	44.3	54.0	9.7

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

OmniDirectional "Mag-Mount Antenna AA191Es

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA191Es
	Channel 902.3 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz > 1 GHz = 1 MHz	VBW: (unless noted) Peak = RBW Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2706.9	28.6	-29.1	0.0	-0.5	Pk	26.7	26.2	54.0	27.8
	H	2706.9	28.6	-29.1	0.0	-0.5	Pk	27.6	27.1	54.0	26.9
	V	3609.2	31.2	-27.1	0.0	4.1	Pk	24.6	28.7	54.0	25.3
	H	3609.2	31.2	-27.1	0.0	4.1	Pk	24.4	28.5	54.0	25.5
	V	4511.5	32.3	-26.8	0.0	5.5	Pk	24.9	30.4	54.0	23.6
	H	4511.5	32.3	-26.8	0.0	5.5	Pk	24.6	30.1	54.0	23.9
	V	5413.8	33.4	-26.0	0.0	7.4	Pk	23.1	30.5	54.0	23.5
	H	5413.8	33.4	-26.0	0.0	7.4	Pk	24.3	31.7	54.0	22.3
	V	8120.7	36.8	-24.4	0.0	12.4	Pk	29.5	41.9	54.0	12.1
	H	8120.7	36.8	-24.4	0.0	12.4	Pk	29.6	42.0	54.0	12.0
	V	9023.0	37.7	-23.5	0.0	14.2	Pk	29.5	43.7	54.0	10.3
	H	9023.0	37.7	-23.5	0.0	14.2	Pk	29.6	43.8	54.0	10.2

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA191Es
	Channel 915.0 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz > 1 GHz = 1 MHz	VBW: (unless noted) Peak = RBW Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2745.0	28.6	-28.7	0.0	-0.1	Pk	26.1	26.0	54.0	28.0
	H	2745.0	28.6	-28.7	0.0	-0.1	Pk	26.6	26.5	54.0	27.5
	V	3660.0	31.2	-27.4	0.0	3.8	Pk	24.1	27.9	54.0	26.1
	H	3660.0	31.2	-27.4	0.0	3.8	Pk	25.6	29.4	54.0	24.6
	V	4575.0	32.3	-27.1	0.0	5.2	Pk	23.7	28.9	54.0	25.1
	H	4575.0	32.3	-27.1	0.0	5.2	Pk	24.5	29.7	54.0	24.3
	V	7320.0	35.2	-25.2	0.0	10.0	Pk	29.8	39.8	54.0	14.2
	H	7320.0	35.2	-25.2	0.0	10.0	Pk	29.4	39.4	54.0	14.6
	V	8235.0	36.8	-24.4	0.0	12.4	Pk	31.4	43.8	54.0	10.2
	H	8235.0	36.8	-24.4	0.0	12.4	Pk	29.7	42.1	54.0	11.9
	V	9150.0	37.7	-23.5	0.0	14.2	Pk	29.4	43.6	54.0	10.4
	H	9150.0	37.7	-23.5	0.0	14.2	Pk	29.6	43.8	54.0	10.2

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA191Es Channel 927.6 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz GHz = 1 MHz	> 1
					VBW: (unless noted)	Peak = RBW Avg. = 10 Hz	

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2782.8	28.6	-28.7	0.0	-0.1	Pk	26.1	26.0	54.0	28.0
	H	2782.8	28.6	-28.7	0.0	-0.1	Pk	26.6	26.5	54.0	27.5
	V	3710.4	31.2	-26.9	0.0	4.3	Pk	24.1	28.4	54.0	25.6
	H	3710.4	31.2	-26.9	0.0	4.3	Pk	25.6	29.9	54.0	24.1
	V	4638.0	32.3	-27.0	0.0	5.3	Pk	23.7	29.0	54.0	25.0
	H	4638.0	32.3	-27.0	0.0	5.3	Pk	24.5	29.8	54.0	24.2
	V	7420.8	35.2	-25.3	0.0	9.9	Pk	29.8	39.7	54.0	14.3
	H	7420.8	35.2	-25.3	0.0	9.9	Pk	29.4	39.3	54.0	14.7
	V	8348.4	36.8	-23.7	0.0	13.1	Pk	31.4	44.5	54.0	9.5
	H	8348.4	36.8	-23.7	0.0	13.1	Pk	29.7	42.8	54.0	11.2
	V	9276.0	37.7	-23.6	0.0	14.1	Pk	29.4	43.5	54.0	10.5
	H	9276.0	37.7	-23.6	0.0	14.1	Pk	29.6	43.7	54.0	10.3

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

OmniDirectional DC-Grounded Antenna AA20Es900

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA20Es900
	Channel 902.3 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz > 1 GHz = 1 MHz	VBW: (unless noted) Peak = RBW Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2706.9	28.6	-29.1	0.0	-0.5	Pk	27.7	27.2	54.0	26.8
	H	2706.9	28.6	-29.1	0.0	-0.5	Pk	27.2	26.7	54.0	27.3
	V	3609.2	31.2	-27.1	0.0	4.1	Pk	24.4	28.5	54.0	25.5
	H	3609.2	31.2	-27.1	0.0	4.1	Pk	24.1	28.2	54.0	25.8
	V	4511.5	32.3	-26.8	0.0	5.5	Pk	25.9	31.4	54.0	22.6
	H	4511.5	32.3	-26.8	0.0	5.5	Pk	26.1	31.6	54.0	22.4
	V	5413.8	33.4	-26.0	0.0	7.4	Pk	23.6	31.0	54.0	23.0
	H	5413.8	33.4	-26.0	0.0	7.4	Pk	23.8	31.2	54.0	22.8
	V	8120.7	36.8	-24.4	0.0	12.4	Pk	28.2	40.6	54.0	13.4
	H	8120.7	36.8	-24.4	0.0	12.4	Pk	28.3	40.7	54.0	13.3
	V	9023.0	37.7	-23.5	0.0	14.2	Pk	28.5	42.7	54.0	11.3
	H	9023.0	37.7	-23.5	0.0	14.2	Pk	29.1	43.3	54.0	10.7

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA20Es900
	Channel 915.0 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz > 1 GHz = 1 MHz	VBW: (unless noted) Peak = RBW Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2745.0	28.6	-28.7	0.0	-0.1	Pk	27.7	27.6	54.0	26.4
	H	2745.0	28.6	-28.7	0.0	-0.1	Pk	27.2	27.1	54.0	26.9
	V	3660.0	31.2	-27.4	0.0	3.8	Pk	24.4	28.2	54.0	25.8
	H	3660.0	31.2	-27.4	0.0	3.8	Pk	24.1	27.9	54.0	26.1
	V	4575.0	32.3	-27.1	0.0	5.2	Pk	25.9	31.1	54.0	22.9
	H	4575.0	32.3	-27.1	0.0	5.2	Pk	26.1	31.3	54.0	22.7
	V	7320.0	35.2	-25.2	0.0	10.0	Pk	23.6	33.6	54.0	20.4
	H	7320.0	35.2	-25.2	0.0	10.0	Pk	23.8	33.8	54.0	20.2
	V	8235.0	36.8	-24.4	0.0	12.4	Pk	28.2	40.6	54.0	13.4
	H	8235.0	36.8	-24.4	0.0	12.4	Pk	28.3	40.7	54.0	13.3
	V	9150.0	37.7	-23.5	0.0	14.2	Pk	28.5	42.7	54.0	11.3
	H	9150.0	37.7	-23.5	0.0	14.2	Pk	29.1	43.3	54.0	10.7

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA20Es900 Channel 927.6 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW:	(unless noted) < 1 GHz = 120 kHz GHz = 1 MHz	> 1	VBW: (unless noted) Peak = RBW Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2782.8	28.6	-28.7	0.0	-0.1	Pk	29.4	29.3	54.0	24.7
	H	2782.8	28.6	-28.7	0.0	-0.1	Pk	27.6	27.5	54.0	26.5
	V	3710.4	31.2	-26.9	0.0	4.3	Pk	25.2	29.5	54.0	24.5
	H	3710.4	31.2	-26.9	0.0	4.3	Pk	24.4	28.7	54.0	25.3
	V	4638.0	32.3	-27.0	0.0	5.3	Pk	25.2	30.5	54.0	23.5
	H	4638.0	32.3	-27.0	0.0	5.3	Pk	25.1	30.4	54.0	23.6
	V	7420.8	35.2	-25.3	0.0	9.9	Pk	24.0	33.9	54.0	20.1
	H	7420.8	35.2	-25.3	0.0	9.9	Pk	24.1	34.0	54.0	20.0
	V	8348.4	36.8	-23.7	0.0	13.1	Pk	30.3	43.4	54.0	10.6
	H	8348.4	36.8	-23.7	0.0	13.1	Pk	31.3	44.4	54.0	9.6
	V	9276.0	37.7	-23.6	0.0	14.1	Pk	30.0	44.1	54.0	9.9
	H	9276.0	37.7	-23.6	0.0	14.1	Pk	30.1	44.2	54.0	9.8

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Yagi Antenna AA203Es900

Project No: W7052
Model: 195Es
Comments: Tested at full power with omni-directional antenna p/n. AA203Es900
Channel 902.3 MHz

Distance: 3 m

Standard: CFR 47, 15.247 and 210, Issue 6 RSS

RBW: (unless noted) < 1 GHz = 120 kHz, > 1 GHz = 1 MHz

VBW: (unless noted) Peak = RBW, Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2706.9	28.6	-29.1	0.0	-0.5	Pk	29.2	28.7	54.0	25.3
	H	2706.9	28.6	-29.1	0.0	-0.5	Pk	30.2	29.7	54.0	24.3
	V	3609.2	31.2	-27.1	0.0	4.1	Pk	27.0	31.1	54.0	22.9
	H	3609.2	31.2	-27.1	0.0	4.1	Pk	26.7	30.8	54.0	23.2
	V	4511.5	32.3	-26.8	0.0	5.5	Pk	30.5	36.0	54.0	18.0
	H	4511.5	32.3	-26.8	0.0	5.5	Pk	27.4	32.9	54.0	21.1
	V	5413.8	33.4	-26.0	0.0	7.4	Pk	26.3	33.7	54.0	20.3
	H	5413.8	33.4	-26.0	0.0	7.4	Pk	26.5	33.9	54.0	20.1
	V	8120.7	36.8	-24.4	0.0	12.4	Pk	31.0	43.4	54.0	10.6
	H	8120.7	36.8	-24.4	0.0	12.4	Pk	30.7	43.1	54.0	10.9
	V	9023.0	37.7	-23.5	0.0	14.2	Pk	30.1	44.3	54.0	9.7
	H	9023.0	37.7	-23.5	0.0	14.2	Pk	29.7	43.9	54.0	10.1

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

Project No: W7052
Model: 195Es
Comments: Tested at full power with omni-directional antenna p/n. AA203Es900
Channel 915.0 MHz

Distance: 3 m

Standard: CFR 47, 15.247 and 210, Issue 6 RSS

RBW: (unless noted) < 1 GHz = 120 kHz, > 1 GHz = 1 MHz

VBW: (unless noted) Peak = RBW, Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2745.0	28.6	-28.7	0.0	-0.1	Pk	29.2	29.1	54.0	24.9
	H	2745.0	28.6	-28.7	0.0	-0.1	Pk	30.2	30.1	54.0	23.9
	V	3660.0	31.2	-27.4	0.0	3.8	Pk	27.0	30.8	54.0	23.2
	H	3660.0	31.2	-27.4	0.0	3.8	Pk	26.7	30.5	54.0	23.5
	V	4575.0	32.3	-27.1	0.0	5.2	Pk	30.5	35.7	54.0	18.3
	H	4575.0	32.3	-27.1	0.0	5.2	Pk	27.4	32.6	54.0	21.4
	V	7320.0	35.2	-25.2	0.0	10.0	Pk	26.3	36.3	54.0	17.7
	H	7320.0	35.2	-25.2	0.0	10.0	Pk	26.5	36.5	54.0	17.5
	V	8235.0	36.8	-24.4	0.0	12.4	Pk	31.0	43.4	54.0	10.6
	H	8235.0	36.8	-24.4	0.0	12.4	Pk	30.7	43.1	54.0	10.9
	V	9150.0	37.7	-23.5	0.0	14.2	Pk	30.1	44.3	54.0	9.7
	H	9150.0	37.7	-23.5	0.0	14.2	Pk	29.7	43.9	54.0	10.1

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

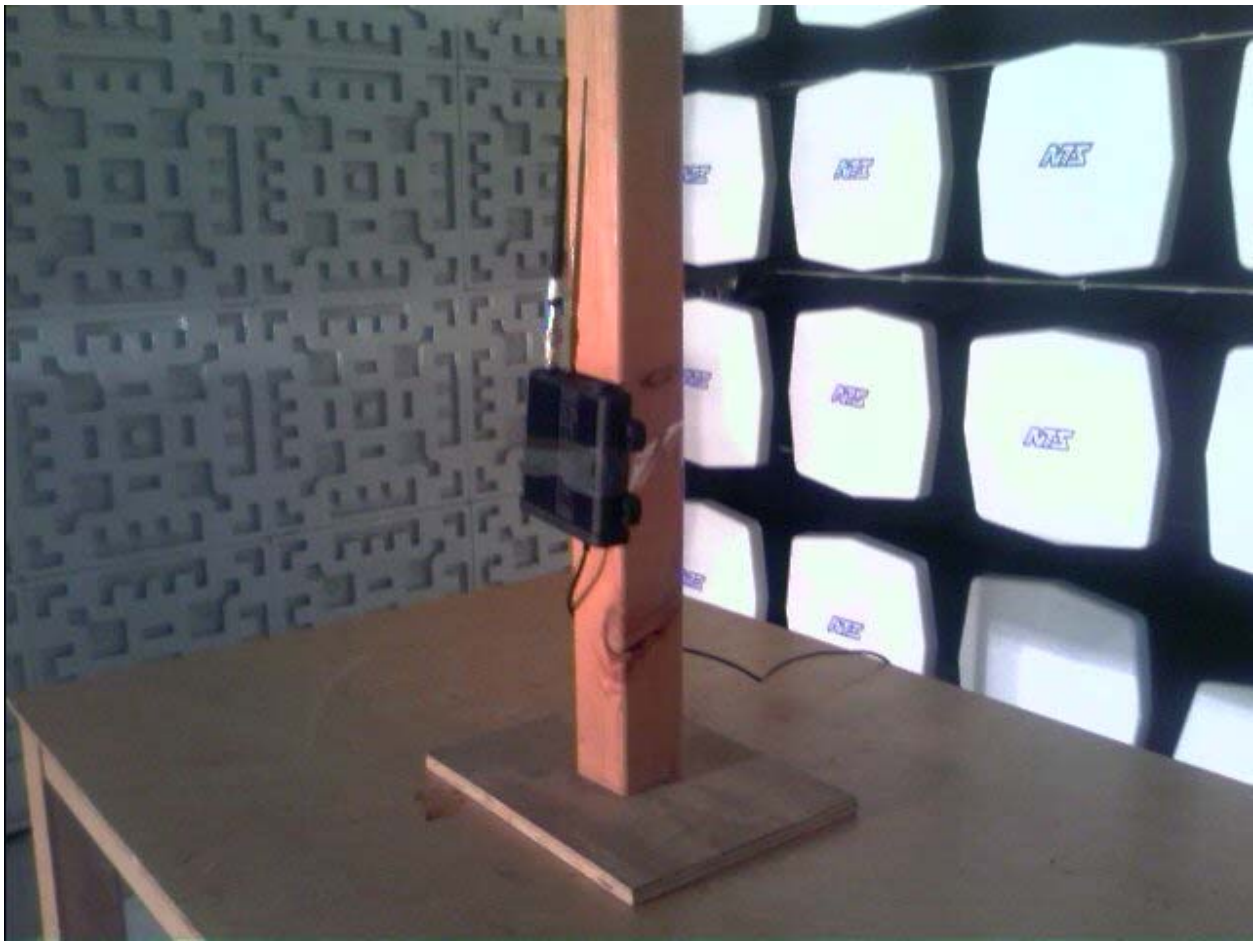
Project No:	W7052
Model:	195Es
Comments:	Tested at full power with omni-directional antenna p/n. AA203Es900 Channel 927.6 MHz

Distance:	3 m	Standard:	CFR 47, 15.247 and 210, Issue 6	RSS	RBW: (unless noted)	< 1 GHz = 120 kHz; GHz = 1 MHz	> 1 VBW: (unless noted) Peak = RBW; Avg. = 10 Hz

	Polarization	Frequency	Antenna Factor	Cable Loss + LNA	Duty Cycle Correction	Total Correction	Detector	Measured	Corrected	Limit	Margin
	(V/H)	(MHz)	(dB/m)	(dB)	(dB)	(dB/m)	(Pk/Avg)	(dBuV)	dBuV/m)	(dBuV/m)	(dB)
	V	2782.8	28.6	-28.7	0.0	-0.1	Pk	29.4	29.3	54.0	24.7
	H	2782.8	28.6	-28.7	0.0	-0.1	Pk	31.1	31.0	54.0	23.0
	V	3710.4	31.2	-26.9	0.0	4.3	Pk	26.7	31.0	54.0	23.0
	H	3710.4	31.2	-26.9	0.0	4.3	Pk	27.0	31.3	54.0	22.7
	V	4638.0	32.3	-27.0	0.0	5.3	Pk	30.1	35.4	54.0	18.6
	H	4638.0	32.3	-27.0	0.0	5.3	Pk	27.5	32.8	54.0	21.2
	V	7420.8	35.2	-25.3	0.0	9.9	Pk	26.4	36.3	54.0	17.7
	H	7420.8	35.2	-25.3	0.0	9.9	Pk	26.6	36.5	54.0	17.5
	V	8348.4	36.8	-23.7	0.0	13.1	Pk	30.7	43.8	54.0	10.2
	H	8348.4	36.8	-23.7	0.0	13.1	Pk	30.6	43.7	54.0	10.3
	V	9276.0	37.7	-23.6	0.0	14.1	Pk	30.0	44.1	54.0	9.9
	H	9276.0	37.7	-23.6	0.0	14.1	Pk	30.0	44.1	54.0	9.9

Notes:
(1) A positive margin indicates a passing result
(2) For 15.247 emissions Peak detector indicates 1 MHz RBW/ 1 MHz VBW and Average indicates 1 MHz RBW / 10 Hz VBW
(3) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

J.8. Photographs



J.9. Tested By

Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX K: TEST EQUIPMENT LIST

K.1. Conducted Emissions 150 kHz – 30 MHz Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due
Test Receiver	Polarad	ESH3	E1281P	9/7/2007
LISN	Solar	8028-50	E1110P	6/26/2007
LISN	Solar	8028-50	E1226P	6/26/2007

K.2. Radiated Emissions 30 MHz – 18 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due
Bilog Antenna	ETS	3142C	E1289P	8/21/07
RF Cable	Gore	FJN	EMI8	9/1/07
Spectrum Analyzer	HP	8566B	E1007P	8/29/07
Quasi-Peak Adapter	HP		E1007P	8/29/07
Low Noise Amplifier	Miteq	AM-1431	E1279P	12/4/07
Multi Device Controller (Turntable and Mast)	ETS	2090	00058930	-
Horn Antenna 1 GHz – 18 GHz	EMCO	3115	E1149P	8/24/07
High pass filter	K&L	11SH10-2000	W1024P	9/29/07
Low Noise Amplifier	HP	8449B	E1010P	5/4/07
Spectrum Analyzer	HP	8566B	E1007P	8/29/07

K.3. Antenna Conducted Emissions Measurement Equipment

Description	Manufacturer	Type/Model	Asset #	Cal Due
20 dB coaxial attenuator	Inmet	36AH-20	W1019P	9/29/07
10 dB coaxial attenuator	Inmet	36AH-10	W1018P	9/29/07
3 dB coaxial attenuator	Inmet	36AH-03	W1016P	9/29/07
3 dB coaxial attenuator	Inmet	36AH-03	W1017P	9/29/07
Coaxial Cable	MegaPhase	TM26	W1010P	9/29/07
Spectrum Analyzer 20 Hz -26.5 GHz	Rohde & Schwarz	FSQ26	W1020P	10/16/07
Peak Power Meter	Boonton	4532	W1001P	9/1/07
Peak Power Sensor	Boonton	57340	W1002P	9/1/07

END OF DOCUMENT