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Certification Test Report

CFR 47 FCC Part 2 and Part 90, Subpart I

Model: CRU/HEA Assembly

FCC ID # MCV-CRU101

Project Code W6306-1

Revision: 3

Prepared for:	**Input/Output Inc**.
Author:	**Tom Tidwell, Manager of Wireless Services**
Issued:	11 October, 2006

Report Summary

NTS Plano

Accreditation Numbers: FCC: 101741
IC: 46405-4319 File # IC-4319

Applicant: Input/Output, Inc.
12300 Parc Crest Drive
Stafford, Texas

Customer Representative: Herb Blair

EUT Description:

EUT Description	Manufacturer	Model	Revision	Serial Number
The EUT is a data radio system consisting of the CRU (Central Radio Unit) and HEA (Head End Amplifier)	Input/Output Land Imaging Systems Division	CRU/HEA Assembly	None	None

Test Summary

Appendix	Test/Requirement Description	Deviations from:			Pass / Fail	Applicable Rule Parts
		Base Standard	Test Basis	NTS Procedure		
A	RF Power Output	No	No	No	PASS	CFR 47, Part 2, Para. 2.1046 CFR 47, Part 90, Para. 90.205
B	Modulation Characteristics	No	No	No	PASS	CFR 47, Part 2, Para. 2.1047 CFR 47, Part 90, Para. 90.207
C	Occupied Bandwidth	No	No	No	PASS	CFR 47, Part 2, Para. 2.1049 CFR 47, Part 90, Para. 90.210
D	Spurious Emissions at Antenna Terminals	No	No	No	PASS	CFR 47, Part 2, Para. 2.1051 CFR 47, Part 90, Para. 90.210
E	Field Strength of Spurious Radiation	No	No	No	PASS	CFR 47, Part 2, Para. 2.1053 CFR 47, Part 90, Para. 90.210
F	Frequency Stability	No	No	No	PASS	CFR 47, Part 2, Para. 2.1055 CFR 47, Part 90, Para. 90.213

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	8 Sept., 2006
1	Inserted additional information on modulation supplied by client (page 6)	13 Sept., 2006
2	Changed FCC ID # to MCV-CRU101 per client email request	27 Sept., 2006
3	Corrected typographical error on page 40 of 42. Changed "8/8/06" to "8/8/07". Ref. Liberty Labs Cert. of Cal. No. 2006080411	11 Oct., 2006

INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the tests applied by NTS Plano to demonstrate compliance of the CRU/HEA assembly from Input/Output, Inc. to FCC Part 90 Subpart I for Public Mobile Radio in accordance with the certification requirements of CFR 47, Part 2.

2.0 EUT DESCRIPTION

2.1 CONFIGURATION

Description of EUT

	Name	Model	Revision	Serial Number
EUT	CRU/HEA assembly	CRU/HEA assembly	None	None
RF Exposure Classification	Outdoor Fixed (mounted on a fixed outdoor tower structure)			
Channels/Frequency Range	217.0125 MHz – 219.9875 MHz			
Power	+31 dBm (1.3 watts) at antenna terminals. Maximum 2 watts erp			
Emission Designator:	Emission Designator: 11K0F1D BW_N = 2 x Pk. Dev. + (2 x max. data rate)/2 BW_N = 2 x 3100 Hz + (2 x 4800 bps)/2 BW_N = 6200 + 4800 = 1102 Hz or 11.02 kHz			
TX antenna details	No specific antenna was supplied. The system will be licensed with a specific antenna or antenna(s). The minimum antenna gain is anticipated to be 2 dB, thus the maximum rf power at the antenna terminals would be +31 dBm. The system was, therefore, tested in this configuration.			
Functional Description	The system is intended for the gathering of geological field data. The CRU would typically be mounted in a truck with the HEA and antenna mounted on a tower on the back of the truck. The truck would be parked for some period of time and the antenna tower would be erected for the duration of data collection activities.			

2.1.1 EUT POWER

Voltage	120 VAC supplied to a power adapter
Number of Feeds	2 (L1, N)

2.2 EUT CABLES

Quantity	Model/Type	Routing		Shielded / Unshielded	Description	Cable Length (m)
		From	To			
1	Unknown	CRU	Laptop computer	Shielded	LAN cable	2.5
1	Unknown	CRU	GPS Antenna	Shielded	Coaxial	50
1	Unknown	CRU	HEA	Shielded	Coaxial	30

2.3 MODE OF OPERATION DURING TESTS

The CRU/HEA assembly was tested while in a continuous transmit mode. The EUT was tuned to a low, middle, and high channel to perform rf power output, occupied bandwidth, and spurious/harmonic tests. The EUT was setup to operate at the intended maximum power output available to the end user.

3.0 SUPPORT EQUIPMENT

3.1 CONFIGURATION

The radio was activated using customer-supplied test software. The software allowed the test engineer to change modulation modes and data rates as well as transmit channel.

3.2 TEST BED/PERIPHERAL CABLES

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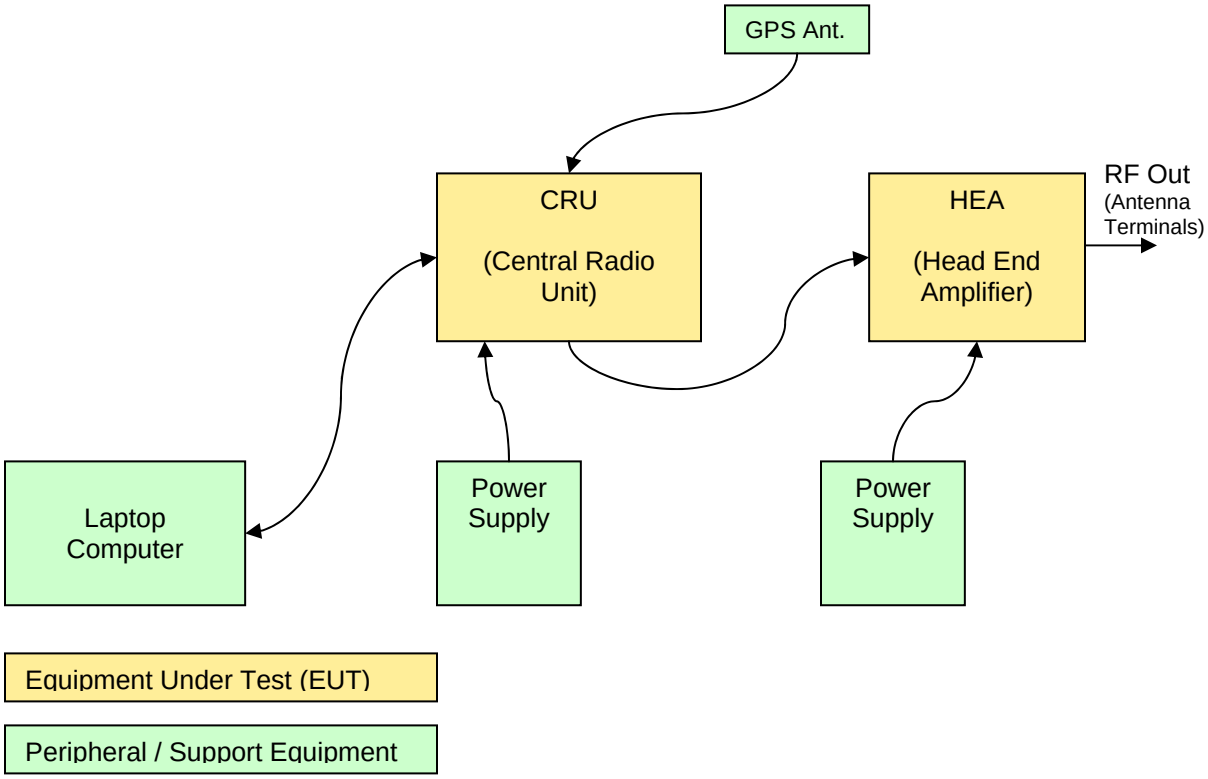


APPENDICES

APPENDIX A: 2.1046 RF POWER OUTPUT

A.1. Base Standard & Test Basis

Base Standard	FCC PART 2.1046
Test Basis	TIA 603-C, 2004
Test Method	TIA 603-C, 2004

A.2. Specifications

90.205 Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized to applicants whose license applications for new stations are filed after August 18, 1995 is as follows:

(a) *Below 25 MHz.* For single sideband operations (J3E emission), the maximum transmitter peak envelope power is 1000 watts.
(b) *25–50 MHz.* The maximum transmitter output power is 300 watts.
(c) *72–76 MHz.* The maximum effective radiated power (ERP) for stations operating on fixed frequencies is 300 watts. Stations operating on mobile-only frequencies are limited to one watt transmitter output power.
(d) *150–174 MHz.* (1) The maximum allowable station ERP is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 1. Applicants requesting an ERP in excess of that listed in table 1 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.
(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 1 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 37 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.
(3) An applicant for a station with a service area radius greater than 40 km (25 mi) must justify the requested service area radius, which will be authorized only in accordance with table 1, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

Table 1_150-174 MHz_Maximum ERP/Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	8	13	16	24	32	40	48[4]	64[4]	80[4]
Max. EIRP (w) [1]	1	28	178	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]
Up to ref. HAAT (m) [3]	15	15	15	15	33	65	110	160	380	670

(1) Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 19 (See § 73.699, Fig.10).
(2) Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.
(3) When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation:
$ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})$ [2]
(4) Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

(e) *217–220 MHz.* Limitations on power and antenna heights are specified in §90.259.

(f) *220–222 MHz.* Limitations on power and antenna heights are specified in §90.729.

(g) *421–430 MHz.* Limitations on power and antenna heights are specified in §90.279.

(h) *450–470 MHz.* (1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2. Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 2 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 39 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 32 km (20 mi) must justify the requested service area radius, which may be authorized only in accordance with table 2, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

Table 2_450-470 MHz_Maximum ERP/Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	8	13	16	24	32	40	48[4]	64[4]	80[4]
Max. EIRP (w) [1]	2	100	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]
Up to ref. HAAT (m) [3]	15	15	15	27	63	125	250	410	950	2700

(1) Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 19 (See § 73.699, Fig.10).
(2) Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.
(3) When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation:
$ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})$ [2]
(4) Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

(i) *470–512 MHz.* Power and height limitations are specified in §§90.307 and 90.309.

(j) *764–776 MHz, 794–824 MHz, 851–869 MHz, 896–901 MHz and 935–940 MHz.* Power and height limitations are specified in §90.635.

(k) *902–928 MHz.* LMS systems operating pursuant to subpart M of this part in the 902–927.25 MHz band will be authorized a maximum of 30 watts ERP. LMS equipment operating in the 927.25–928 MHz band will be authorized a maximum of 300 watts ERP. ERP must be measured as peak envelope power. Antenna heights will be as specified in §90.353(h).

(l) *929–930 MHz.* Limitations on power and antenna heights are specified in §90.494.

(m) *1427–1429.5 MHz and 1429.5–1432 MHz.* Limitations on power are specified in §90.259.

(n) *2450–2483.5 MHz.* The maximum transmitter power is 5 watts.

(o) *4940–4990 MHz.* Limitations on power are specified in §90.1215.

(p) *5850–5925 MHz.* Power and height limitations are specified in subpart M of this part.

(q) *All other frequency bands.* Requested transmitter power will be considered and authorized on a case by case basis.

(r) The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with §90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

Applicable RF Power Limit from Above: 90.259(a)(4) applies: *"In the 217–220 MHz band, the maximum transmitter output power is 2 watts. The maximum antenna height above average terrain (HAAT) is 152 m (500 feet)."*

A.3. Deviations

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

A.4. Test Procedure

TIA 603-C, 2004

A.5. Test Results

The EUT is in compliance with the limits as specified above. The maximum rf output power at the antenna terminals is 1.32 watts.

A.6. Operating Mode During Test

The transmitter was tested while in a continuous transmit mode. The EUT was tuned to a low, middle, and high channel..

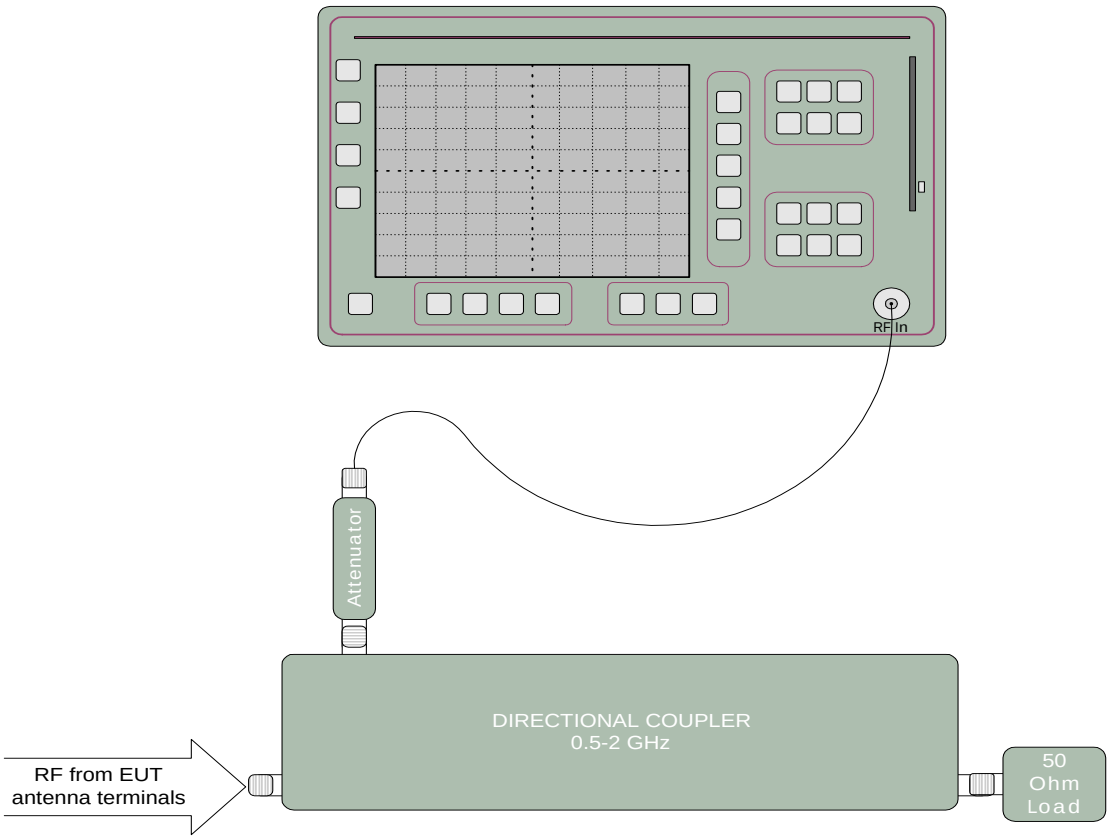
A.7. Sample Calculation

Rf power(watts) = $10^{(\text{rf power(dBm)}/10)}$ x 1000

A.8. Test Data

Channel	Modulation Mode	RF Power Output at Antenna Terminals
217.0125 MHz	CW	+31.2 dBm (1.32 w)
218.4125 MHz	CW	+31.1 dBm (1.29 w)
219.9875 MHz	CW	+31.2 dBm (1.32 w)

A.9. Test Diagram



A.10. Tested By

Name: Tom Tidwell,
Function: Manager of Wireless Services

APPENDIX B: 2.1047 MODULATION CHARACTERISTICS

B.1. Base Standard & Test Basis

Base Standard	FCC 2.1047
Test Basis	FCC 2.1047 Modulation Characteristics
Test Method	TIA 603-C, 2004

B.2. Specifications

2.1047 – Modulation Characteristics

(a) *Voice modulated communication equipment.* A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.
(b) *Equipment which employs modulation limiting.* A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.
(c) *Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power.* A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.
(d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

90.209 - Bandwidth limitations

(a) Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant. In those cases where §2.202 of this chapter does not provide a formula for the computation of necessary bandwidth, the occupied bandwidth, as defined in part 2 of this chapter, may be used in lieu of the necessary bandwidth.
(b) The maximum authorized single channel bandwidth of emission corresponding to the type of emission specified in §90.207 is as follows:
(1) For A1A or A1B emissions, the maximum authorized bandwidth is 0.25 kHz. The maximum authorized bandwidth for type A3E emission is 8 kHz.
(2) For operations below 25 MHz utilizing J3E emission, the bandwidth occupied by the emission shall not exceed 3000 Hz. The assigned frequency will be specified in the authorization. The authorized carrier frequency will be 1400 Hz lower in frequency than the assigned frequency. Only upper sideband emission may be used. In the case of regularly available double sideband radiotelephone channels, an assigned frequency for J3E emissions is available either 1600 Hz below or 1400 Hz above the double sideband radiotelephone assigned frequency.
(3) For all other types of emissions, the maximum authorized bandwidth shall not be more than that normally authorized for voice operations.
(4) Where a frequency is assigned exclusively to a single licensee, more than a single emission may be used within the authorized bandwidth. In such cases, the frequency stability requirements of §90.213 must be met for each emission.
(5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table.

Standard Channel Spacing / Authorized Bandwidth		
Frequency (MHz)	Channel Spacing (kHz)	Authorized Bandwidth (kHz)
Below 25[(2)]		
25 – 50	20	20

72 – 76	20	20
150 – 174	7.5(1)	20/11.25/6(1), (3)
216 – 220(5)	6.25	20/11.25/6(5)
220 – 222	5	4
406 – 512(2)	6.25(1)	20/11.25/6(1), (3)
806 – 809 / 851 - 854	12.5	20
809 – 824 / 854 – 869	25	20
896 – 901 / 935 – 940	12.5	13.6
902 – 928(4)		
929 – 930	25	20
1427 – 1432(5)	12.5	12.5
2450 – 2483.52(2)		
Above 2500(2)		

(1) For stations authorized on or after August 18, 1995.
(2) Bandwidths for radiolocation stations in the 420-450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.
(3) Operations using equipment using a 25 kHz bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized an 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013, unless the operations meet the efficiency standard of §90.203(j)(3) unless specified elsewhere.
(4) The maximum authorized bandwidth shall be 12 MHz for non-multilateration LMS operations in the band 909.75-921.75 MHz and 2 MHz in the band 902.00-904.00 MHz. The maximum authorized bandwidth for multilateration LMS operations shall be 5.75 MHz in the 904.00-909.75 MHz band; 2 MHz in the 919.75-921.75 MHz band; 5.75 MHz in the 921.75-927.25 MHz band and its associated 927.25-927.50 MHz narrowband forward link; and 8.00 MHz if the 919.75-921.75 MHz and 921.75-927.25 MHz bands and their associated 927.25-927.50 MHz and 927.50-927.75 MHz narrowband forward links are aggregated.

Authorized Bandwidth from above table: 11.25 kHz
Rated peak deviation: +/-3.1 kHz
Measured peak deviation: +3.11 kHz

B.3. Deviations

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

B.4. Test Method

TIA 603-C, 2004

B.5. Test Results

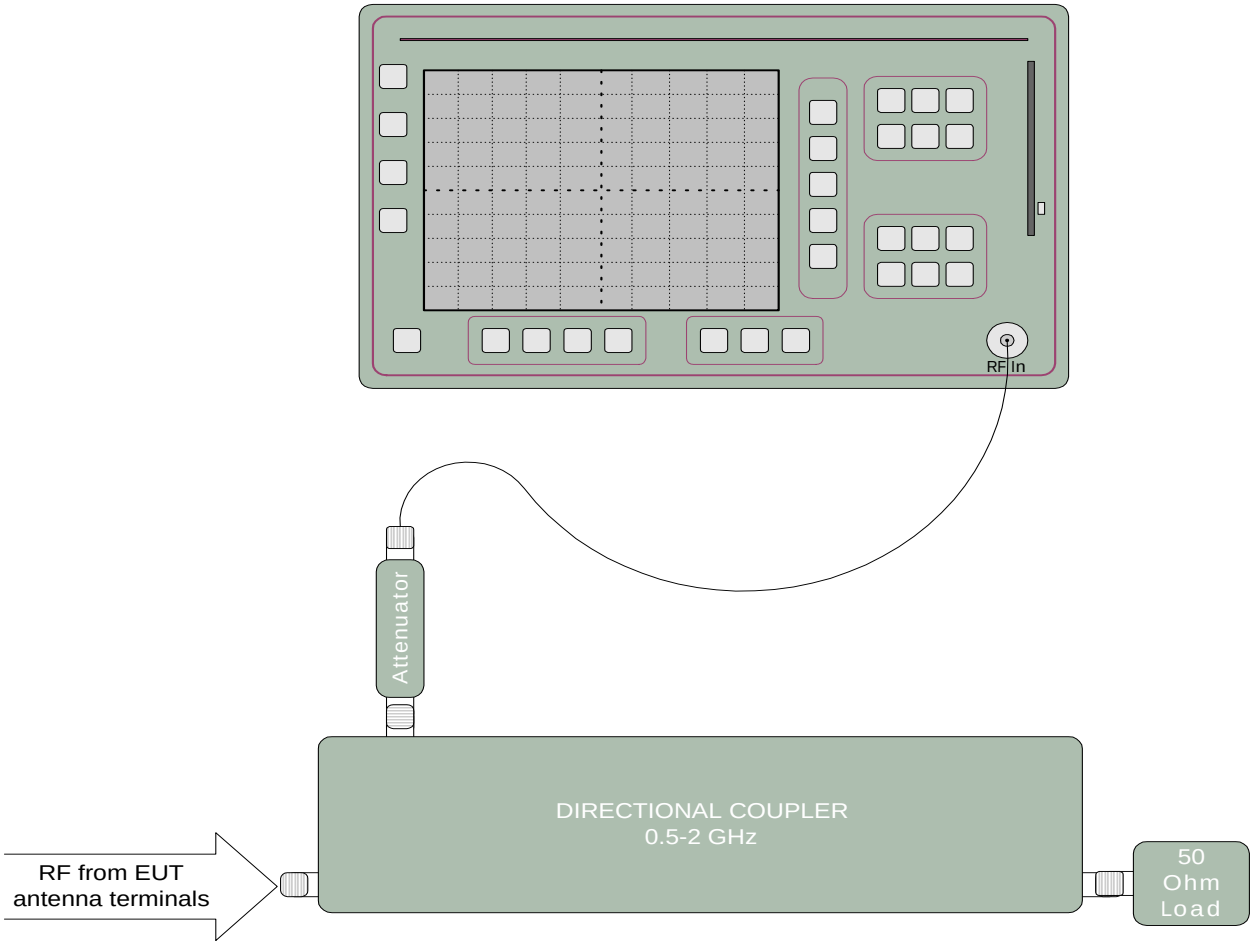
Compliant – The modulation characteristic meet the requirements of 2.1047 and 90.209

Test Data Summary

EUT Transmit Channel	Modulation Mode	Authorized Bandwidth (kHz))	Maximum Modulation Deviation (kHz) - FM	Maximum Modulation Depth (%) - AM
217.0125 MHz	F1D	11.25	3.11	-
218.4125 MHz	F1D	11.25	3.11	-
219.9875 MHz	F1D	11.25	3.11	-

Emission Designator: 11K0F1D
BW_N = 2 x Pk. Dev. + (2 x max. data rate)/2
BW_N = 2 x 3100 Hz + (2 x 4800 bps)/2
BW_N = 6200 + 4800 = 1102 Hz or 11.02 kHz

B.6. Test Diagram



B.7. Tested By

Quality Manual.
Name: Tom Tidwell
Function: Manager of Wireless Services

APPENDIX C: 2.10.49 OCCUPIED BANDWIDTH

C.1. Base Standard & Test Basis

Base Standard	FCC 2.1049
Test Basis	FCC 2.1049 Occupied Bandwidth
Test Method	TIA 603-C, 2004

C.2. Specifications

90.210 Emission masks.
Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks		
Frequency (MHz)	Mask for equipment with audio low-pass filter	Mask for equipment without audio low-pass filter
Below 25(1)	A or B	A or C
25 – 50	B	C
72 – 76	B	C
150 – 174(2)	B, D, or E	C, D, or E
150 paging only	B	C
220 – 222	F	F
421 – 512(2)	B, D, or E	C, D, or E
450 paging only	B	G
806 – 809 / 851 - 854	B	H
809 – 824 / 854 – 869(3)	B	G
896 – 901 / 935 – 940	I	J
902 – 928(4)	K	K
929 – 930	B	G
4940 – 4990	L or M	L or M
5850 - 5925(4)	-	-
All other bands	B	C

(1) Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
(2) Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.
(3) Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.
(4) DSRCS Roadside Units equipment in the 5850-5925 MHz band is governed under subpart M of this part.

C.3. Deviations

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

C.4. Test Method

TIA 603-C, 2004

The transmitted carrier was modulated at maximum modulation deviation with a pseudorandom data bit stream.

Peak Deviation: +/-3.1 kHz of carrier during tests.

C.5. Test Results

Compliant. The device complies with the emission mask C.

C.6. Deviations from Normal Operating Mode During Test

None.

C.7. Sample Calculation

None.

C.8. Test Data

Appropriate emission mask from table: C

See plots following.

Figure 1 Occupied Bandwidth – Low Channel

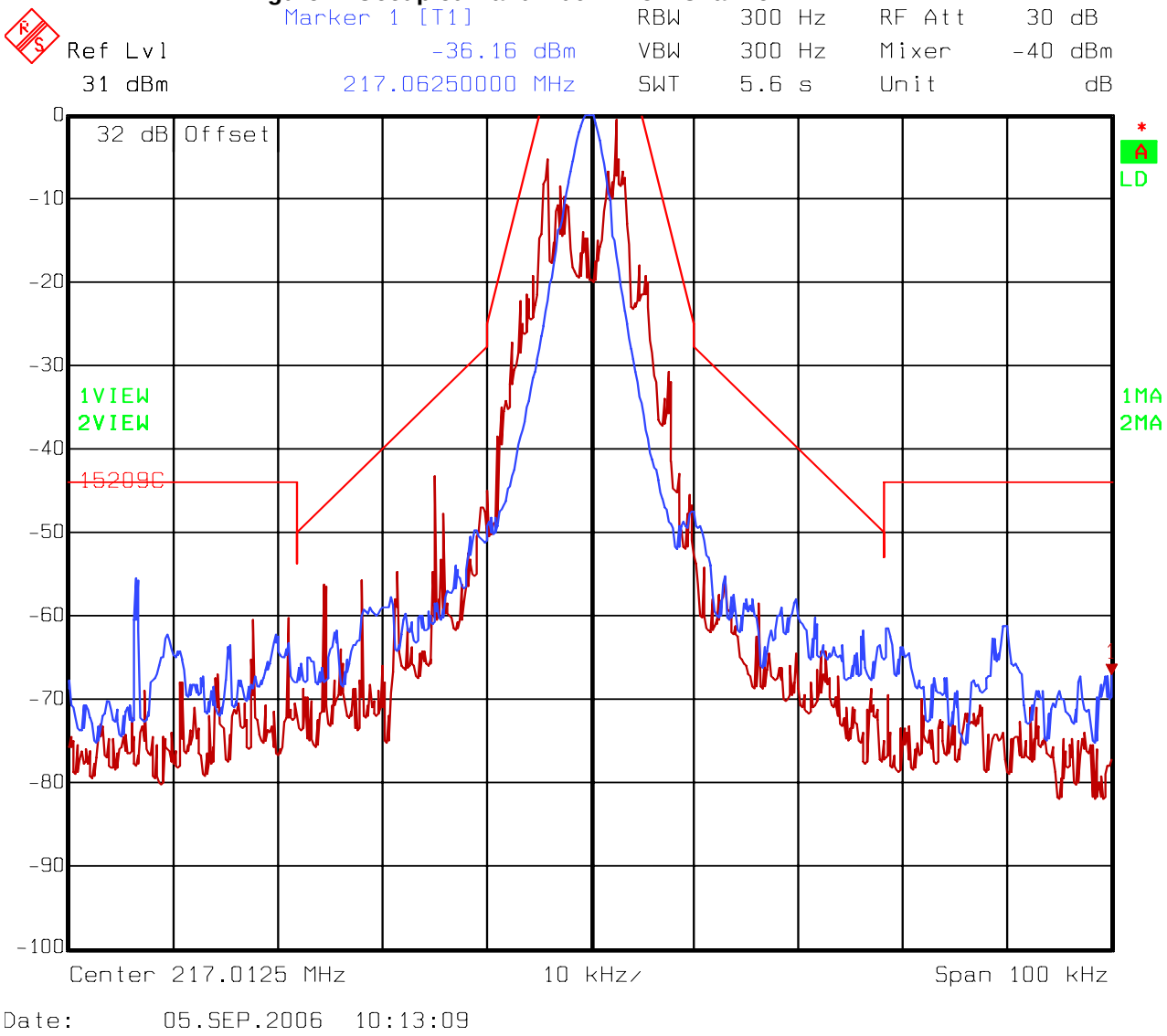


Figure 2 Occupied Bandwidth – Mid Channel

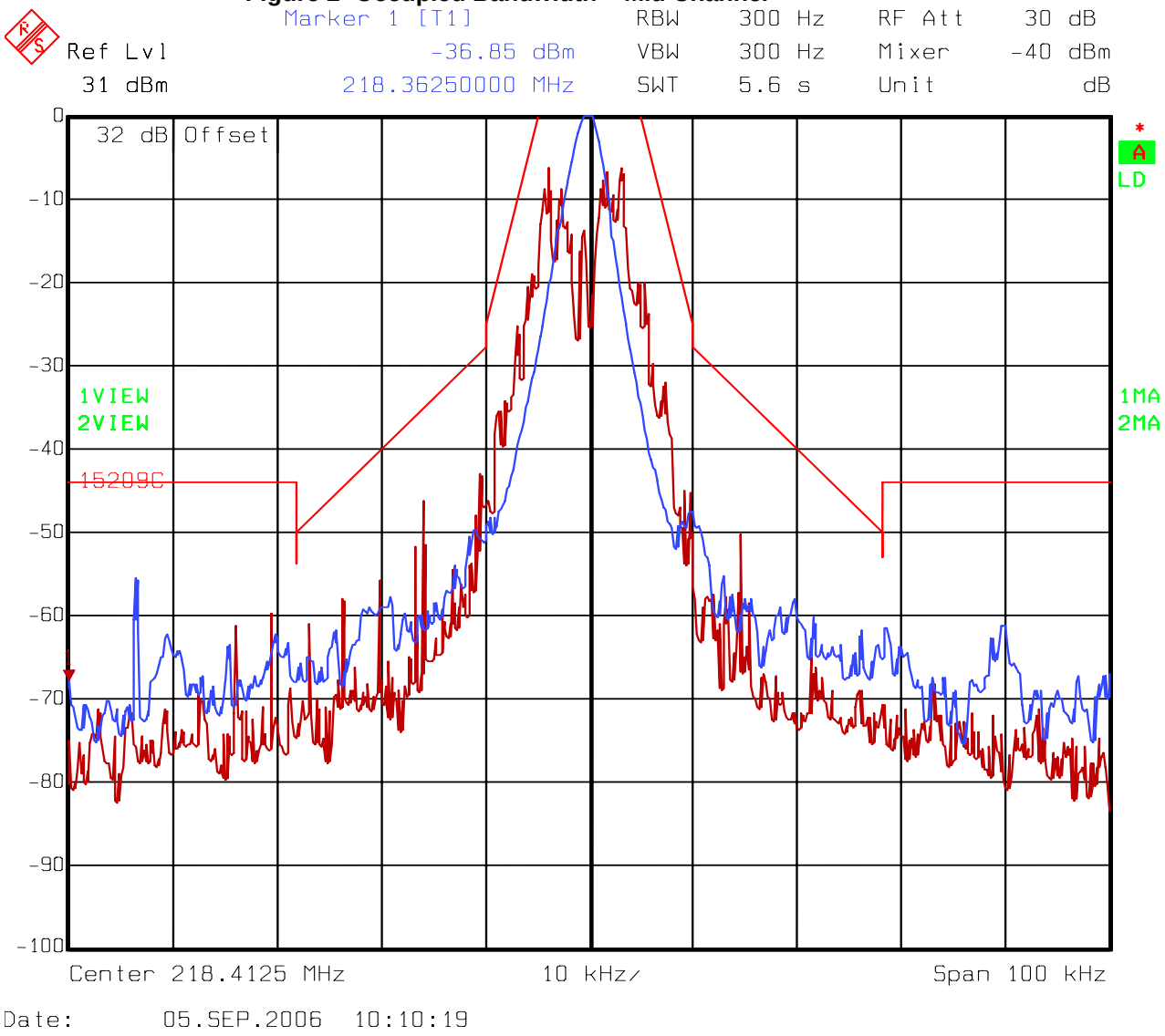
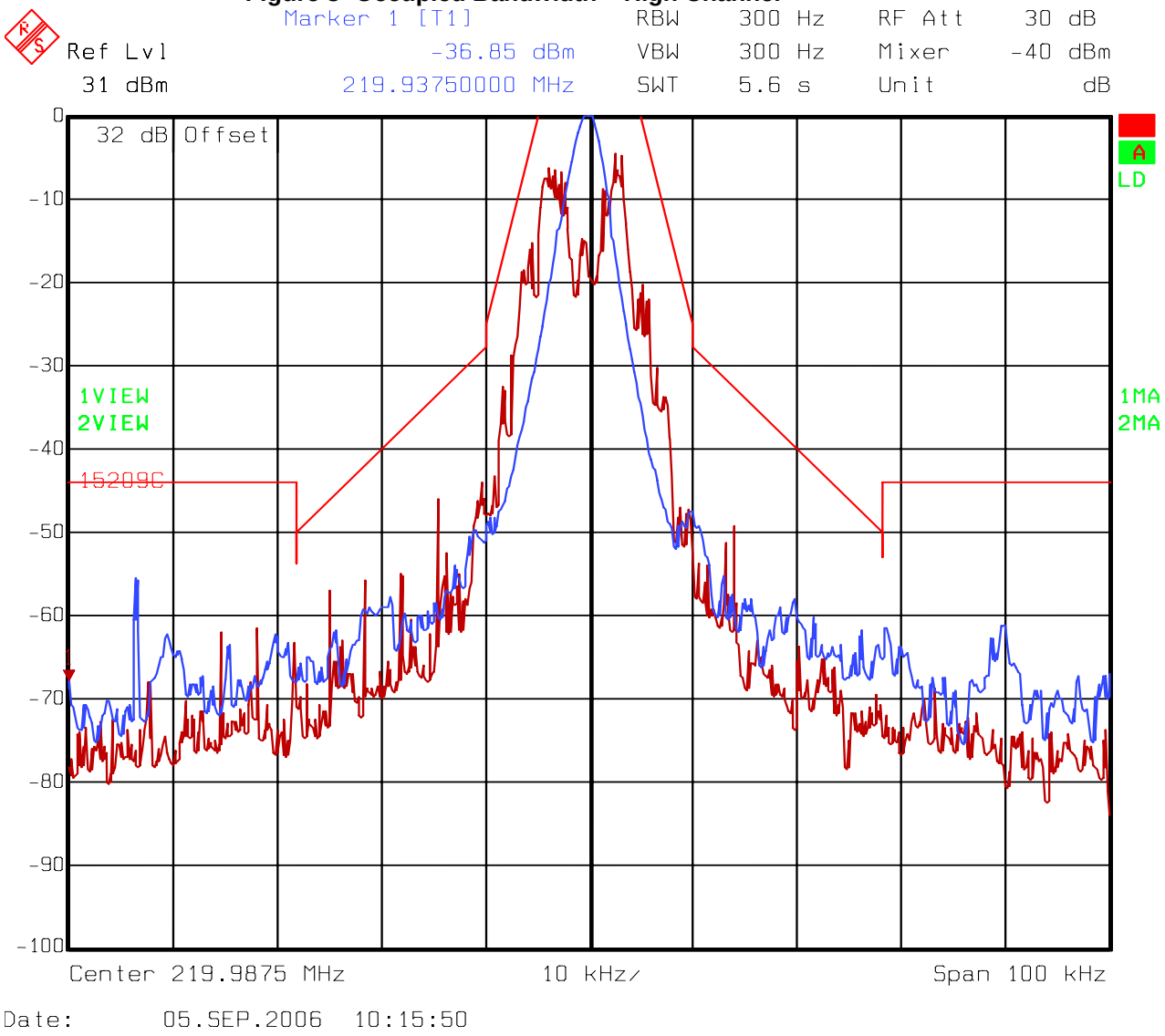
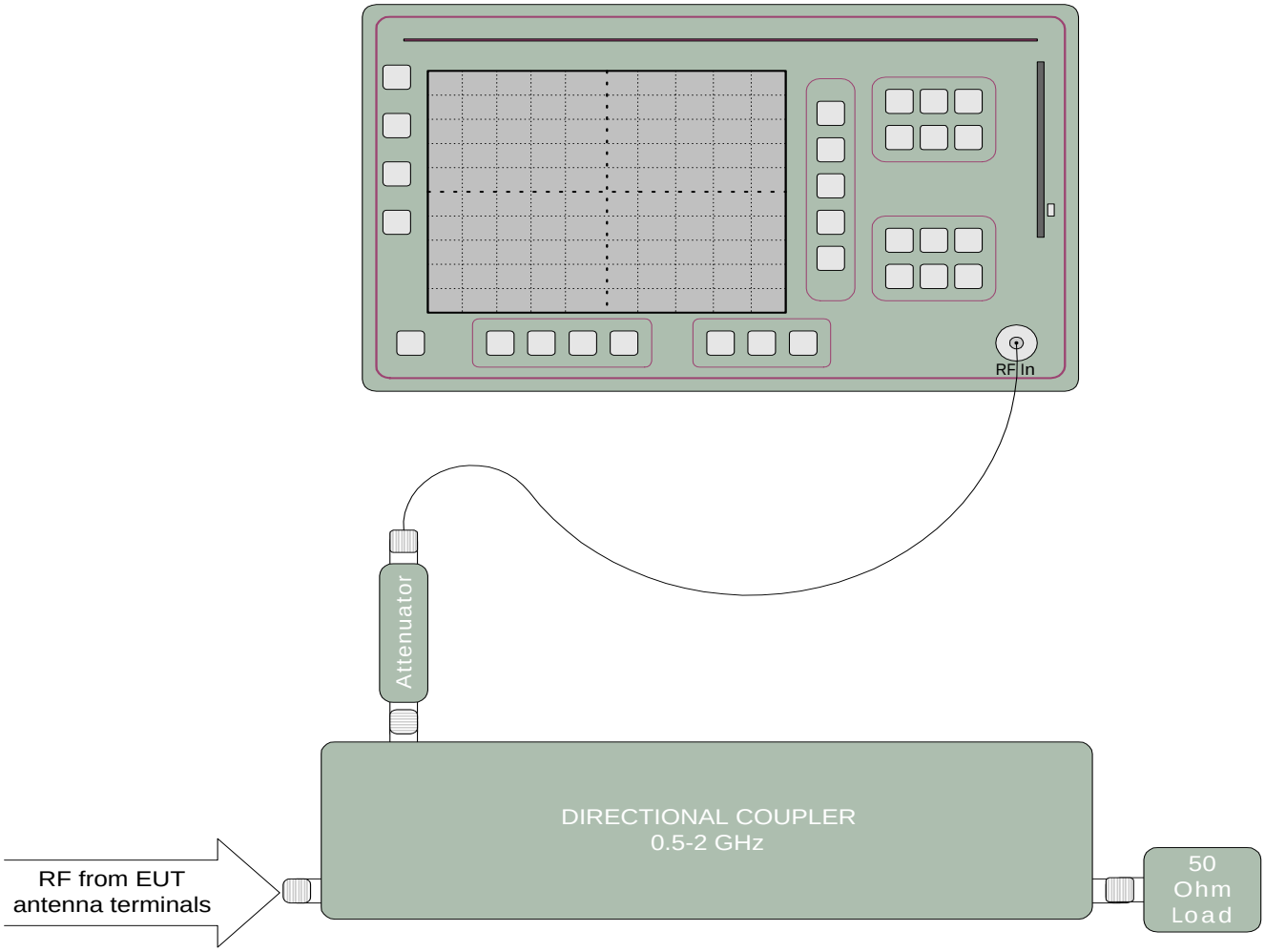


Figure 3 Occupied Bandwidth – High Channel



C.9. Test Diagram



C.10. Tested By

Name: Tom Tidwell,
Function: Manager of Wireless Services

APPENDIX D: 2.1051 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

D.1. Base Standard & Test Basis

Base Standard	FCC 2.1051
Test Basis	FCC 2.1051 Spurious Emissions at Antenna Terminals
Test Method	TIA 603-C, 2004

D.2. Specifications

90.210 Emission masks.
Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks		
Frequency (MHz)	Mask for equipment with audio low-pass filter	Mask for equipment without audio low-pass filter
Below 25(1)	A or B	A or C
25 – 50	B	C
72 – 76	B	C
150 – 174(2)	B, D, or E	C, D, or E
150 paging only	B	C
220 – 222	F	F
421 – 512(2)	B, D, or E	C, D, or E
450 paging only	B	G
806 – 809 / 851 - 854	B	H
809 – 824 / 854 – 869(3)	B	G
896 – 901 / 935 – 940	I	J
902 – 928(4)	K	K
929 – 930	B	G
4940 – 4990	L or M	L or M
5850 - 5925(4)	-	-
All other bands	B	C

(1) Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
(2) Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.
(3) Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.
(4) DSRCS Roadside Units equipment in the 5850-5925 MHz band is governed under subpart M of this part.

D.3. Measurement Uncertainty

Expanded Uncertainty (K=2)
+1.11/-1.22

D.4. Deviations

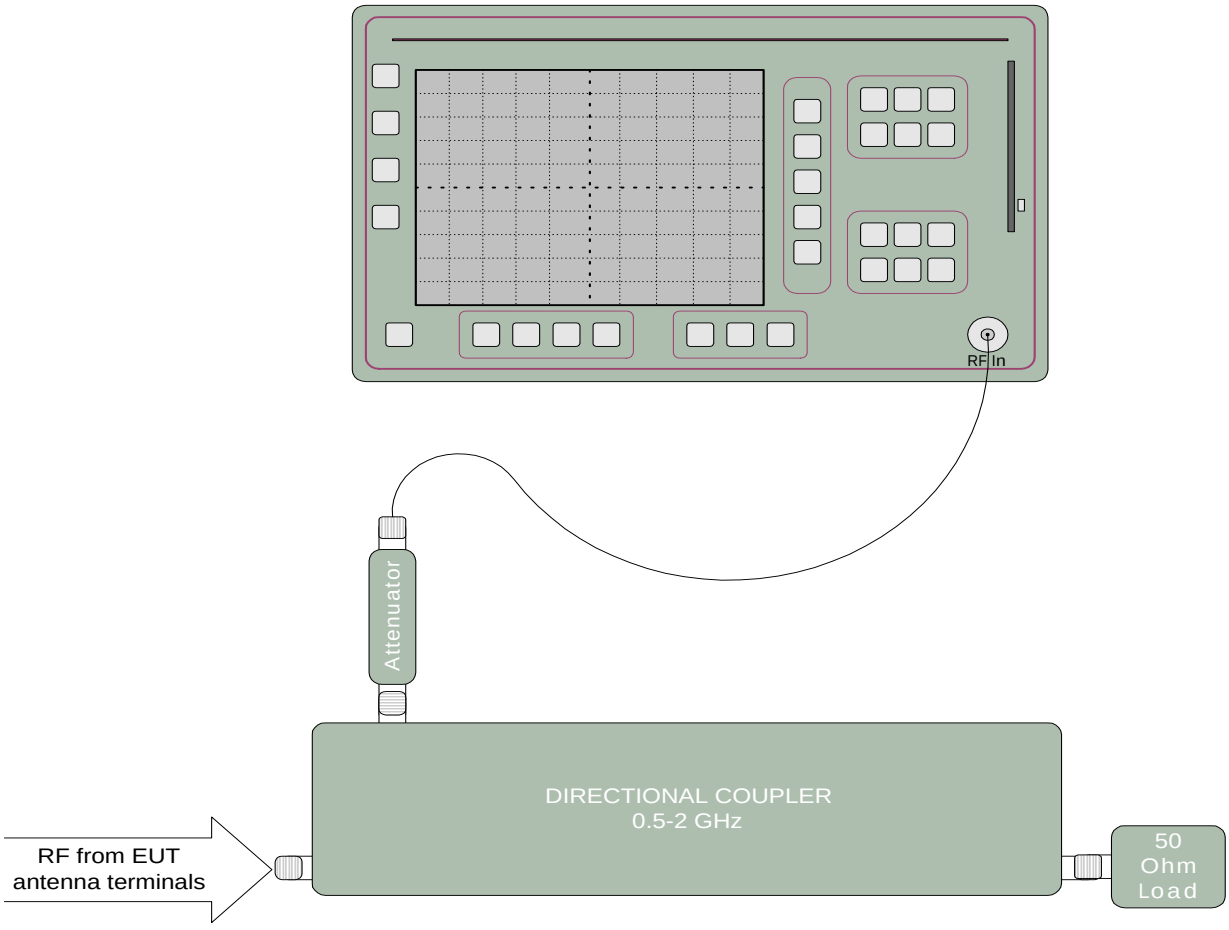
Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

D.5. Test Results

Compliant. All emissions meet the limits of mask C.

Out-of-Band Emissions (>250% of authorized bandwidth) limit is 43 + 10 log(P) which relates to -13 dBm absolute power.

D.6. Test Diagram



D.7. Test Data

See following pages.

Figure 4 Antenna Conducted Spurious – Low Channel - 10 MHz – 1 GHz

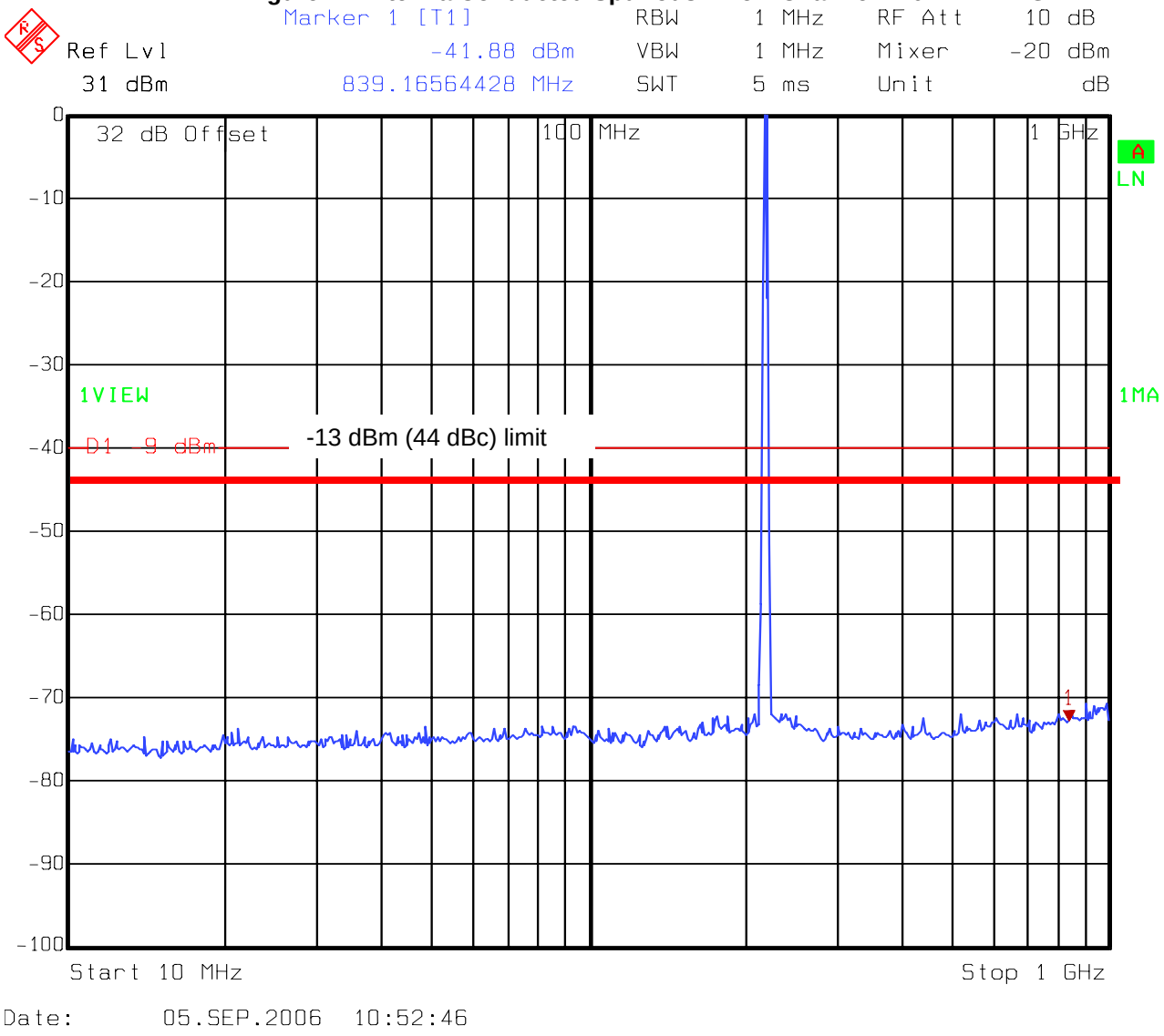


Figure 5 Antenna Conducted Spurious - Low Channel – 1 GHz – 3 GHz

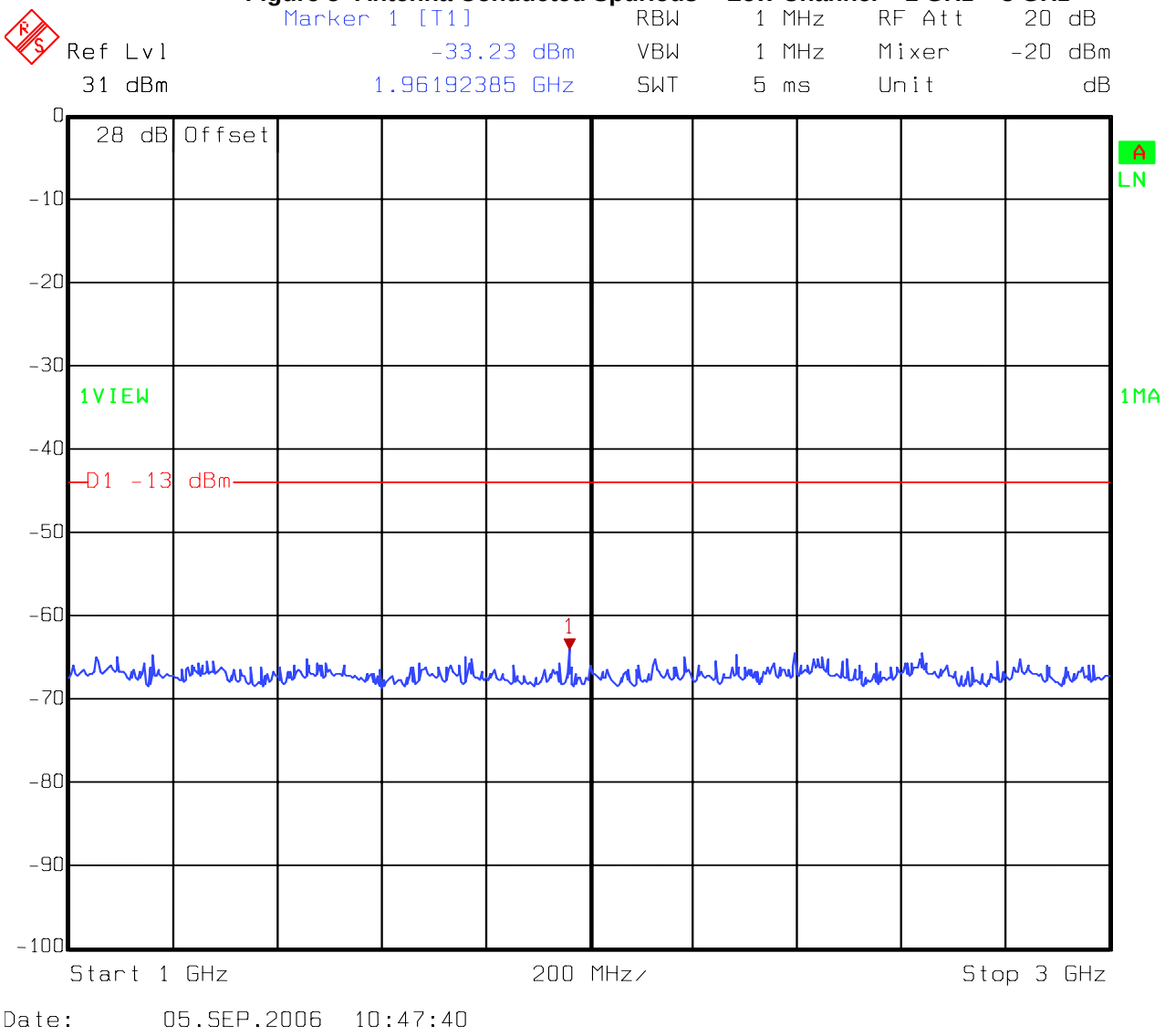


Figure 6 Antenna Conducted Spurious - Mid Channel – 10 MHz – 1 GHz

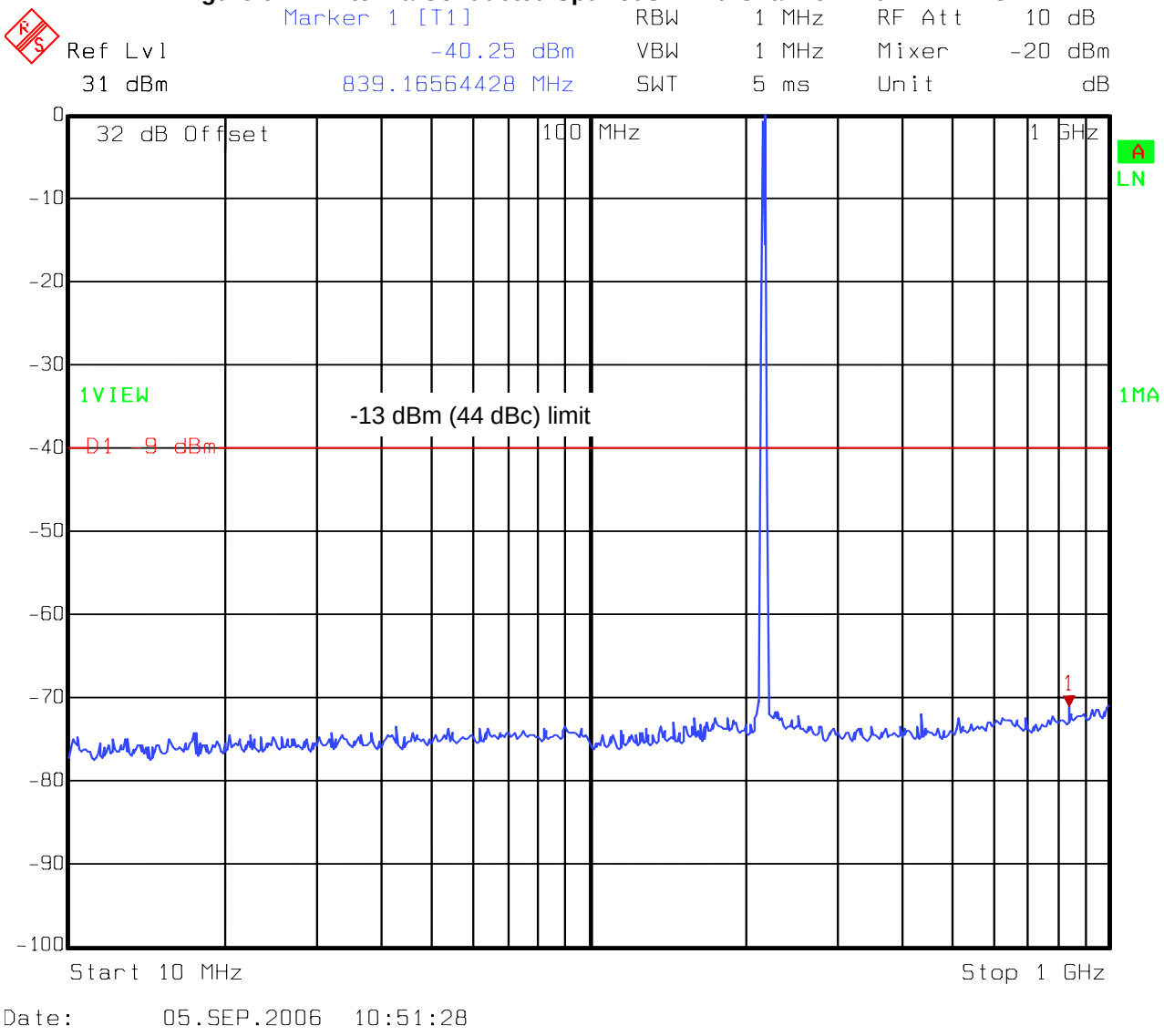


Figure 7 Antenna Conducted Spurious - Mid Channel – 1 GHz – 3 GHz

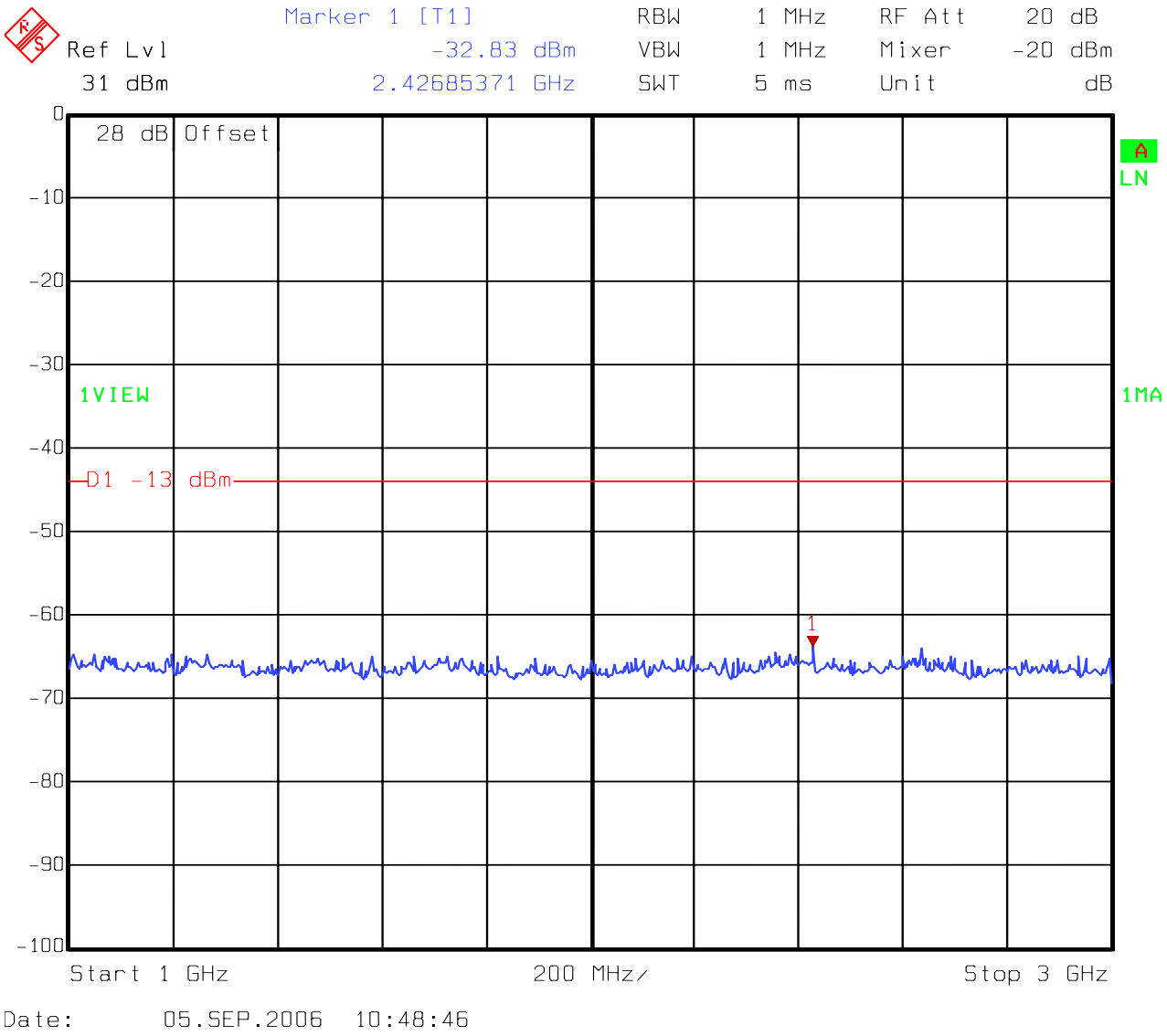


Figure 8 Antenna Conducted Spurious - High Channel – 10 MHz – 1 GHz

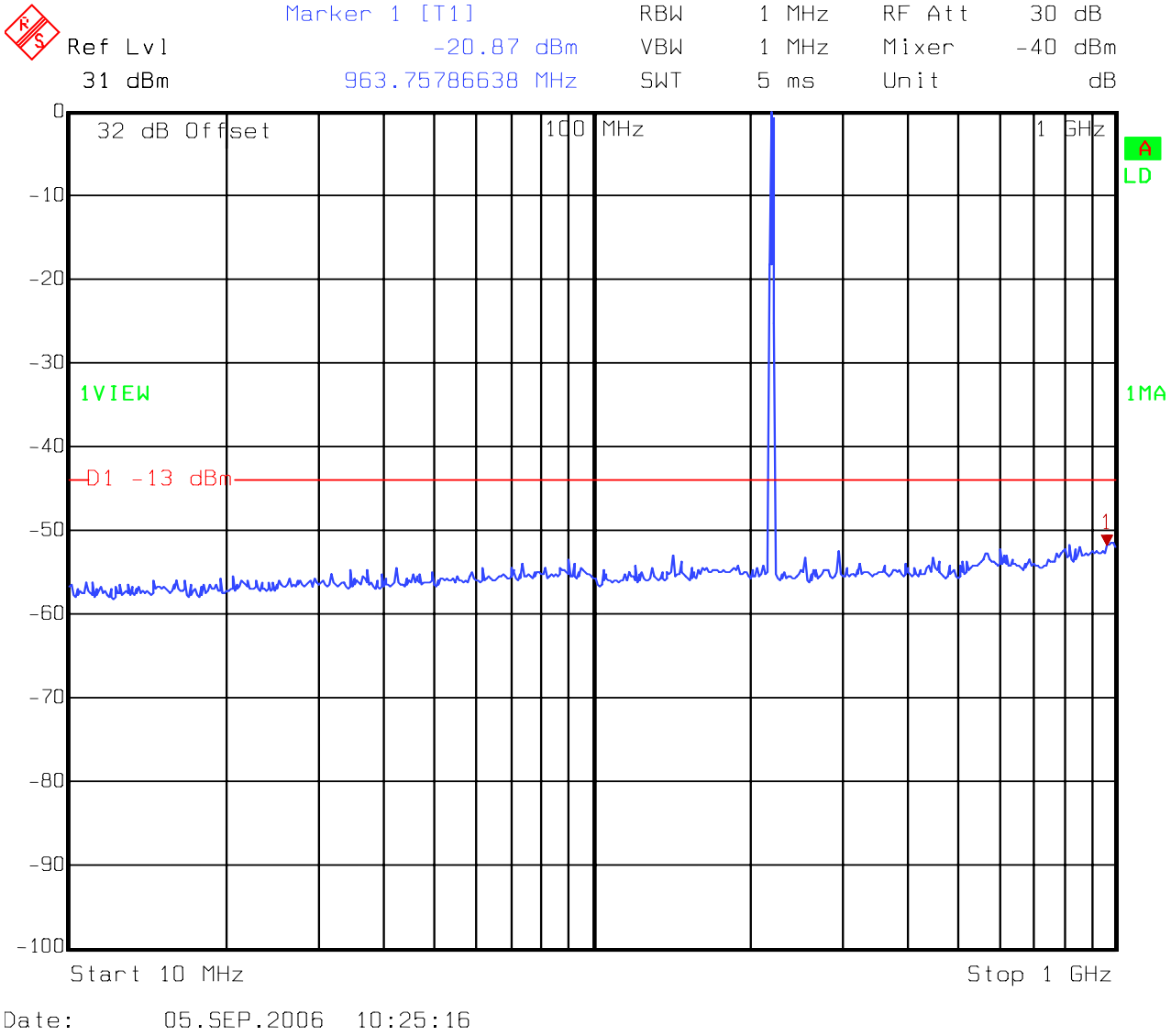
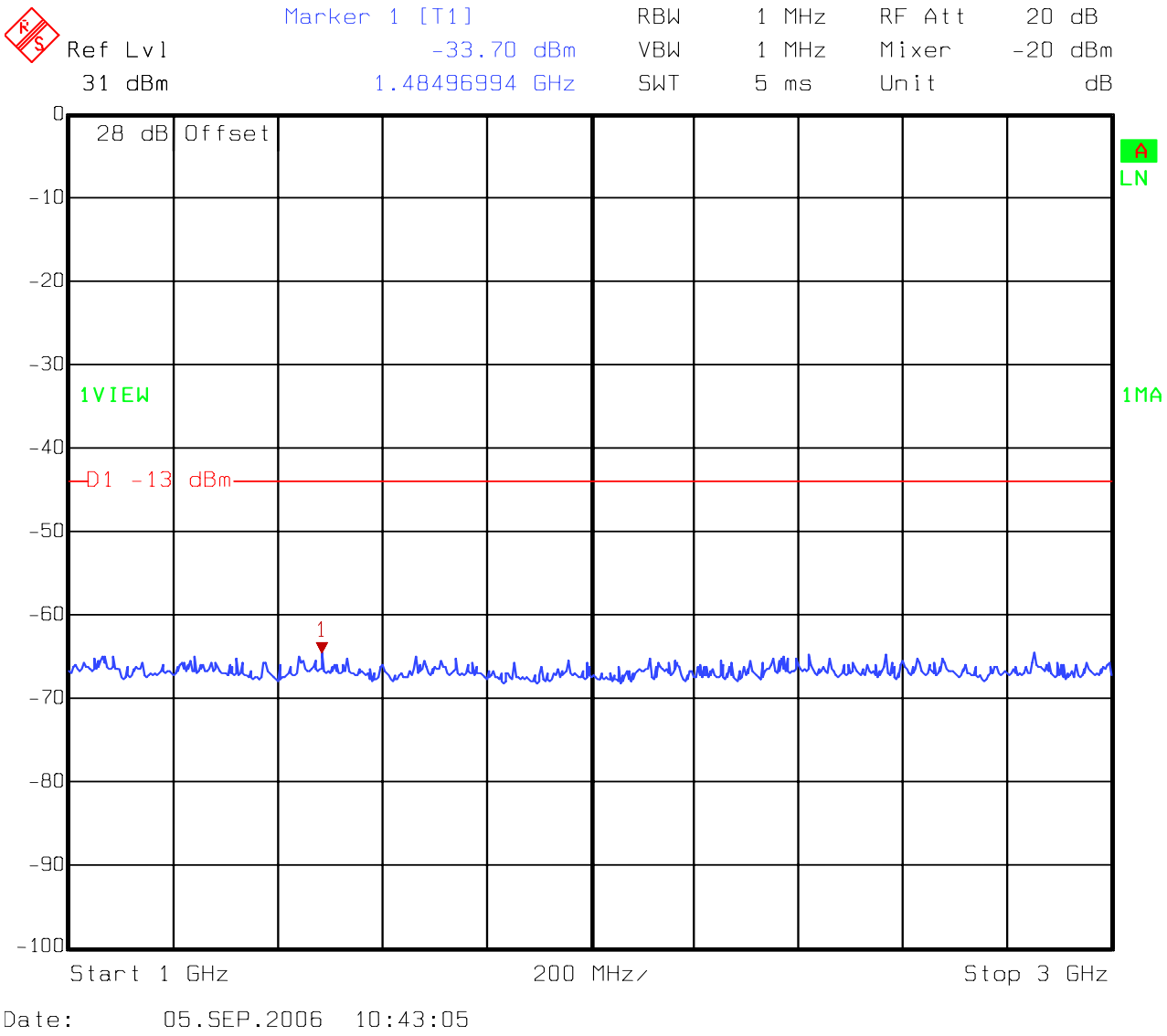


Figure 9 Antenna Conducted Spurious - High Channel – 1 GHz – 3 GHz



D.8. Tested By

Name: Tom Tidwell,
Function: Manager of Wireless Services

APPENDIX E: 2.1053 FIELD STRENGTH OF SPURIOUS RADIATION

E.1. Base Standard & Test Basis

Base Standard	FCC 2.1053
Test Basis	FCC 2.1053 Field Strength of Spurious Radiation
Test Method	TIA 603-C, 2004 Substitution Antenna Method

E.2. Limits

90.210 Emission masks.
Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks		
Frequency (MHz)	Mask for equipment with audio low-pass filter	Mask for equipment without audio low-pass filter
Below 25(1)	A or B	A or C
25 – 50	B	C
72 – 76	B	C
150 – 174(2)	B, D, or E	C, D, or E
150 paging only	B	C
220 – 222	F	F
421 – 512(2)	B, D, or E	C, D, or E
450 paging only	B	G
806 – 809 / 851 - 854	B	H
809 – 824 / 854 – 869(3)	B	G
896 – 901 / 935 – 940	I	J
902 – 928(4)	K	K
929 – 930	B	G
4940 – 4990	L or M	L or M
5850 - 5925(4)	-	-
All other bands	B	C

(1) Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
(2) Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.
(3) Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.
(4) DSRCS Roadside Units equipment in the 5850-5925 MHz band is governed under subpart M of this part.

E.3. Test Results

Compliant. All emissions are below the limits of mask C specified in 90.210 (-13 dBm erp).

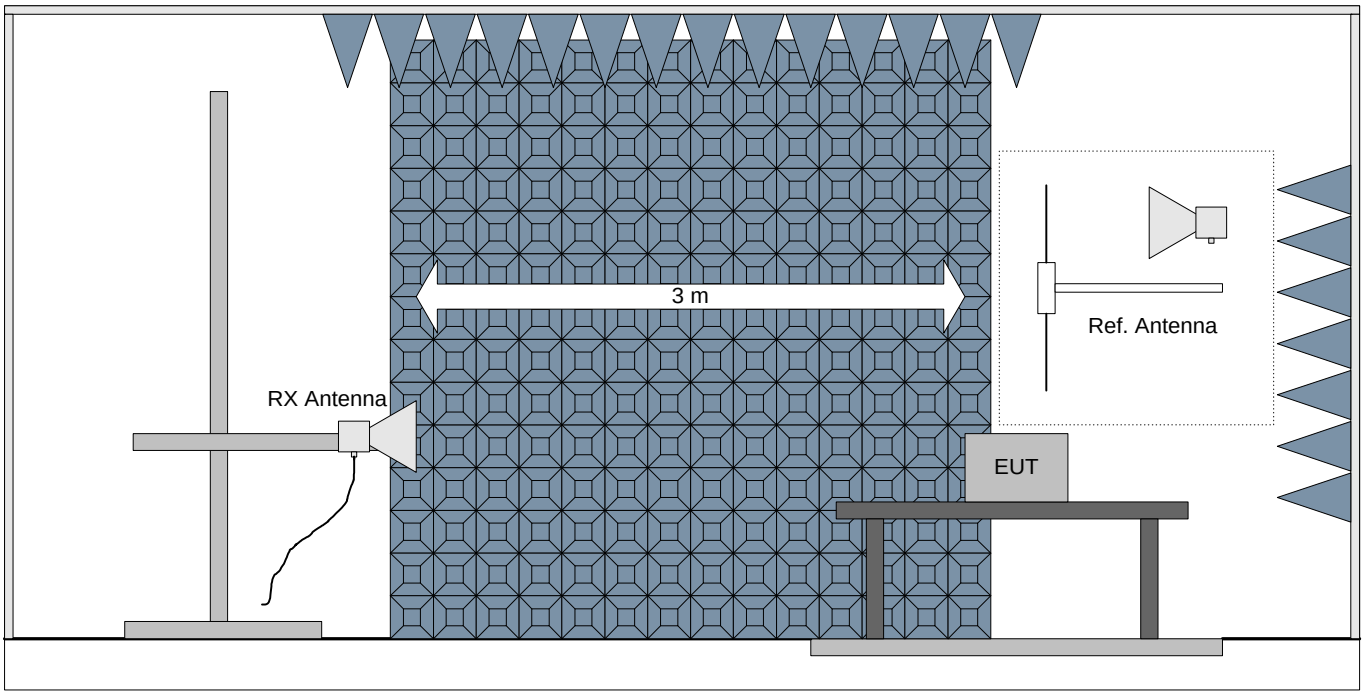
E.4. Deviations from Normal Operating Mode During Test

None.

E.5. Sample Calculation

NA.

E.6. Test Diagram



E.7. Test Data

Project No:	W6306
Model:	CRU/HEA assembly
Comments:	Transmit at full rf output power (1.3 watts)

Distance:	3 m	Standard:	CFR 47, Part 2.1043	RBW: (unless noted)	< 1 GHz = 120 kHz	> 1 GHz = 1 MHz	VBW: (unless noted) Peak = RBW Avg. = RBW

Antenna	Polarization	Frequency	Measured	Substitution Level	Substitution Antenna Gain	Final Measured Value		Peak Carrier Power		Minimum Attenuation Limit	Margin
	(V/H)	(MHz)	(dBm)	(dBm)	(dBd)	(dBm)	(watts)	(dBm)	(watts)	(dBc)	(dB)
Ref. E1019	V	436.82	-35.4	-31	0	-31	7.94328E-07	43	20	56	18
Ref. E1019	H	436.82	-39.9	-37	0	-37	1.99526E-07	43	20	56	24
Ref. E1019	V	655.23	-35.8	-25	0	-25	3.16228E-06	43	20	56	12
Ref. E1019	H	655.23	-36.9	-28	0	-28	1.58489E-06	43	20	56	15
Ref. E1019	V	873.65	-61.5	-47	0	-47	1.99526E-08	43	20	56	34
Ref. E1019	H	873.65	-58.9	-46.3	0	-46.3	2.34423E-08	43	20	56	33.3
Ref. E1019	V	1092.06	-58.3	-47.5	5.9	-41.6	6.91831E-08	43	20	56	28.6
Ref. E1019	H	1092.06	-60.8	-50	5.9	-44.1	3.89045E-08	43	20	56	31.1
Ref. E1019	V	1310.47	-56.2	-44.4	8.5	-35.9	2.5704E-07	43	20	56	22.9
Ref. E1019	H	1310.47	-58.6	-46.9	8.5	-38.4	1.44544E-07	43	20	56	25.4

Notes: *(1) A positive margin indicates a passing result*
(2) If duty cycle correction is indicated, plots are included in the test report to validate the factor used.

E.8. Test Photo

E.9. Tested By

Name: Tom Tidwell,
Function: Manager of Wireless Services

APPENDIX F: 2.1055 FREQUENCY STABILITY

F.1. Base Standard & Test Basis

Base Standard	FCC 2.1055
Test Method	TIA 603-C, 2004

Specifications

90.213 Frequency stability.
(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Minimum Frequency Stability (parts per million)			
Frequency (MHz)	Fixed & Base Stations	Mobile Stations	
		Over 2 watts	2 watts or less
Below 25	100(1)(2)(3)	100	200
25 – 50	20	20	50
72 – 76	5	-	50
150 – 174	5(5)(11)	5(6)	50(4)(6)
216 – 220	1.0	-	1.0
220 – 222(12)	0.1	1.5	1.5
421 – 512	2.5(7)(11)(14)	5(8)	5(8)
806 – 809	1.0(14)	1.5	1.5
809 – 824	1.5(14)	2.5	2.5
851 – 854	1.0	1.5	1.5
854 - 869	1.5	2.5	2.5
896 - 901	0.1(14)	1.5	1.5
902 – 928	2.5	2.5	2.5
902 - 928(13)	2.5	2.5	2.5
929 – 930	1.5	-	-
935 – 940 MHz	0.1	1.5	1.5
1427 – 1435	300(9)	300	300
Above 2450(10)	-	-	-

(1) Fixed and base stations with over 200 watts transmitter power must have a frequency stability of 50 ppm except for equipment used in the Public Safety Pool where the frequency stability is 100 ppm.
(2) For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.
(3) Travelers information station transmitters operating from 530-1700 kHz and transmitters exceeding 200 watts peak envelope power used for disaster communications and long distance circuit operations pursuant to §§ 90.242 and 90.264 must maintain the carrier frequency to within 20 Hz of the authorized frequency.
(4) Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
(5) In the 150-174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
(6) In the 150-174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.
(7) In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have

a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.
(8) In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
(9) Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 kHz must operate with a frequency stability of 100 ppm. Fixed stations with output powers less than 120 watts and using time-division multiplex, must operate with a frequency stability of 500 ppm.
(10) Except for DSRCS equipment in the 5850-5925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5850-5925 MHz band is specified in subpart M of this part.
(11) Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.
(12) Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.
(13) Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.
(14) Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

F.2. Deviations

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

F.3. Test Results

Compliant. The maximum frequency drift was 0.7 ppm. This is less than the permitted 1.0 ppm.

F.4. Observations

F.5. Deviations from Normal Operating Mode During Test

None.

F.6. Sample Calculation

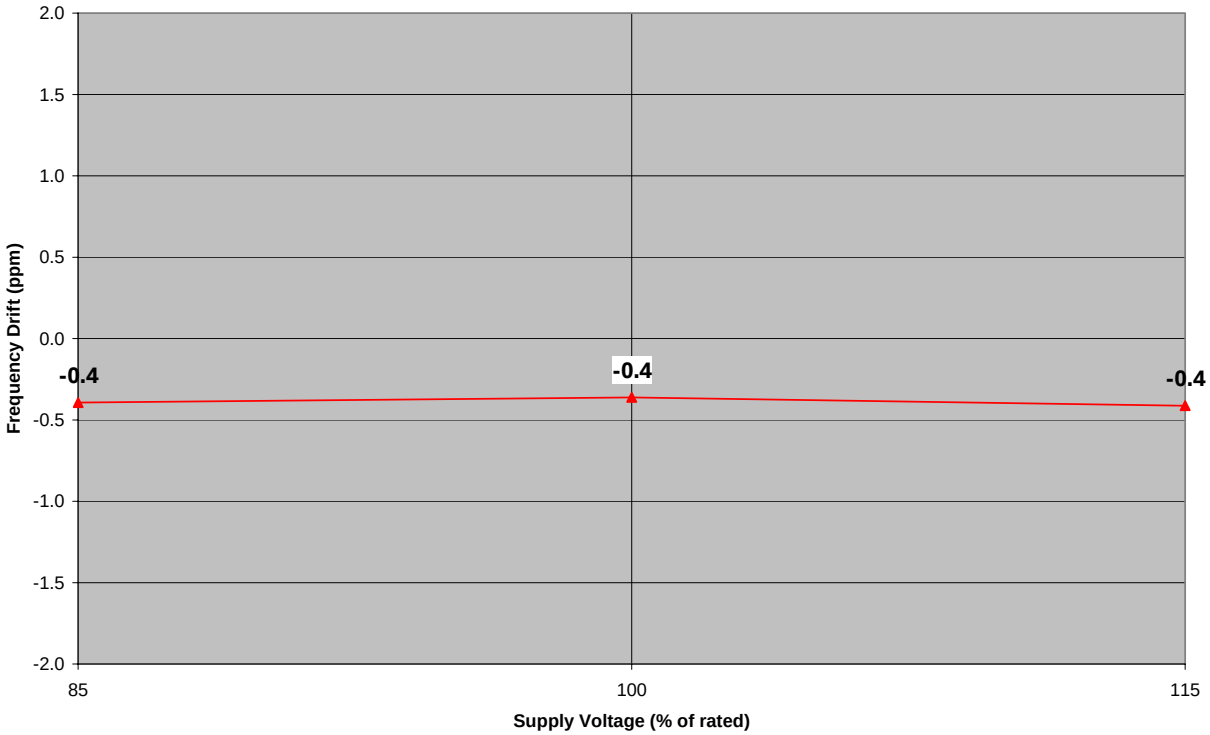
Frequency drift (ppm) = Frequency Drift (Hz)/Authorized frequency (MHz)

F.7. Test Data

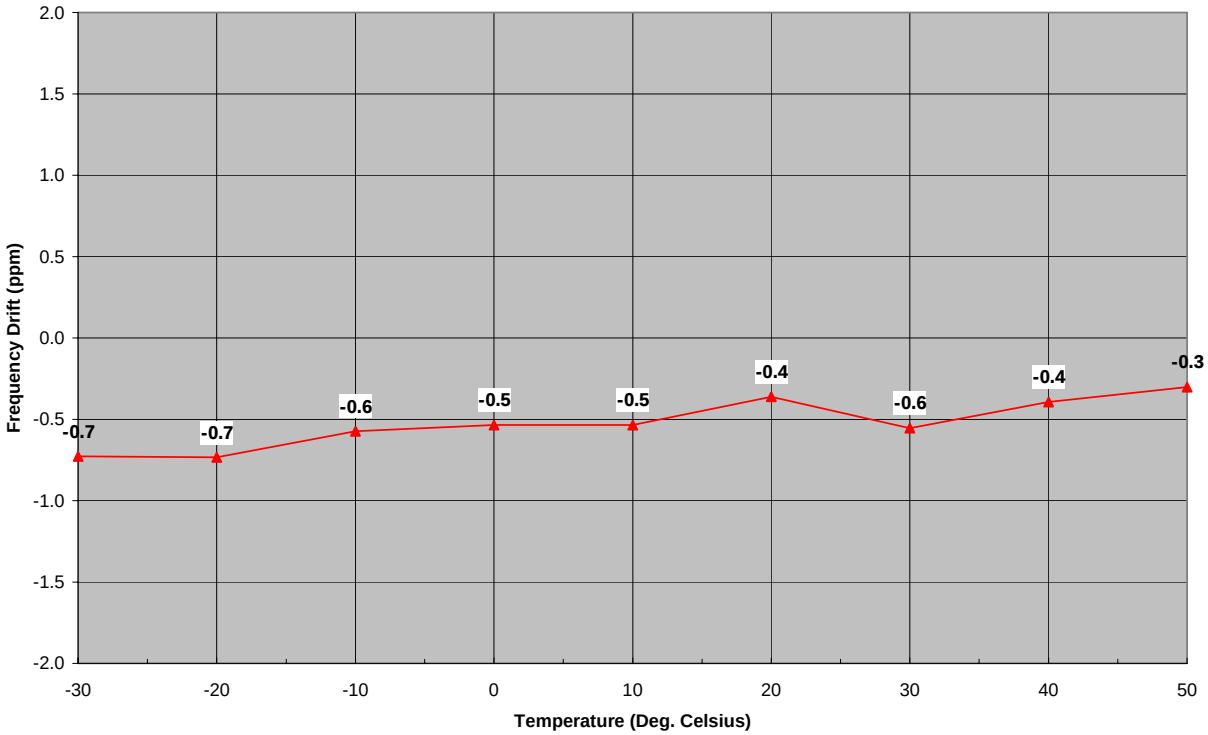
Plots follow.
Rated Supply Voltage: 120 VAC
85% Supply Voltage: 102 VAC
115% Supply Voltage: 138 VAC

Supply Voltage % of rated	Ambient temperature Deg. Celsius	Assigned Transmit Frequency MHz	Measured Frequency MHz	Frequency Drift (Hz)	Frequency Drift (ppm)
85	20	218.412500	218.412414	-86	-0.4
100	20	218.412500	218.412421	-79	-0.4
115	20	218.412500	218.412410	-90	-0.4
100	-30	218.412500	218.412341	-159	-0.7
100	-20	218.412500	218.412340	-160	-0.7
100	-10	218.412500	218.412375	-125	-0.6
100	0	218.412500	218.412383	-117	-0.5
100	10	218.412500	218.412383	-117	-0.5
100	20	218.412500	218.412421	-79	-0.4
100	30	218.412500	218.412379	-121	-0.6
100	40	218.412500	218.412414	-86	-0.4
100	50	218.412500	218.412434	-66	-0.3

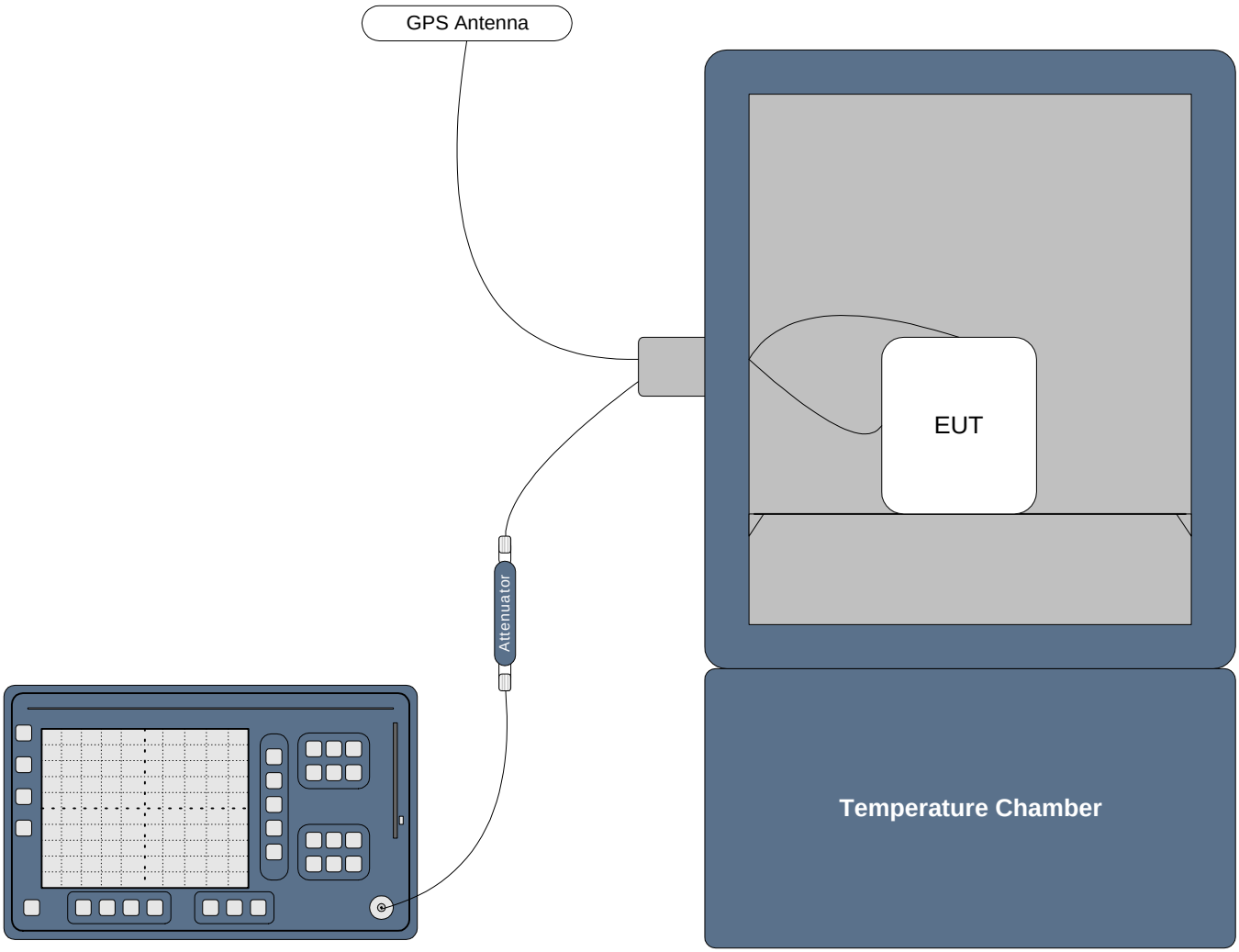
Frequency Drift with Supply Voltage Variation



Frequency Drift with Temperature Variation



F.8. Test Diagram



F.9. Tested By

.

Name: Tom Tidwell,
Function: Manager of Wireless Services

APPENDIX G: TEST EQUIPMENT LIST

G.1. Field Strength of Spurious Emissions 30 MHz – 26.5 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Calibration Frequency	Cal Due	NTS Control No.
3m ANECHOIC CHAMBER					
RX Bilog Antenna	ETS	3142C	12 Months	8/17/07	E1288P
Ref. Horn Antenna	ETS	3115	12 Months	11/1/07	E1019P
RX Horn Antenna	ETS	3115	12 Months		E1022P
High Frequency - Cable 1	MegaPhase	TM26-3135-144	12 Months	8/23/07	6070401001
Reference Antenna	ETS	3121 Dipole Set	12 months	8/8/07	S/N. 274
CONTROL ROOM					
Test Receiver	Rohde & Schwarz	FSEM30Y	12 Months	5/4/07	Rental
High Frequency - Cable 2	MegaPhase	NA	12 Months	8/23/07	6070401002
Amplifier	HP	8449B	12 Months	5/4/07	E1010P

G.2. Antenna Conducted Emissions Measurement Equipment

Instrument	Manufacturer	Model	Calibration Frequency	Calibration Due
ANTENNA CONDUCTED EMISSIONS				
Spectrum Analyzer	Rohde & Schwarz	FSEM30Y	12 Months	4 May, 2007
High Frequency - Cable 1	MegaPhase	TM26-3135-144	12 Months	8/23/07
Directional Coupler	Narda	3020A	12 Months	8/28/07
Directional Coupler	Narda	4242-10	12 Months	8/28/07
50 ohm loads	Amphenol	50R	12 Months	8/28/07

G.3. Modulation Characteristics Measurement Equipment

Instrument	Manufacturer	Model	Calibration Frequency	Calibration Due
MODULATION CHARACTERISTICS				
Spectrum Analyzer	Rohde & Schwarz	FSEM30Y	12 Months	4 May, 2007
High Frequency - Cable 1	MegaPhase	TM26-3135-144	12 Months	8/23/07
Directional Coupler	Narda	3020A	12 Months	8/28/07
50 ohm loads	Amphenol	50R	12 Months	8/28/07

G.4. Frequency Stability Measurement Equipment

Instrument	Manufacturer	Model	Calibration Frequency	Calibration Due
MODULATION CHARACTERISTICS				
Spectrum Analyzer	Rohde & Schwarz	FSEM30Y	12 Months	5/4/07
High Frequency - Cable 1	MegaPhase	TM26-3135-144	12 Months	8/23/07
Directional Coupler	Narda	3020A	12 Months	8/28/07
50 ohm loads	Amphenol	50R	12 Months	8/28/07
Variable Transformer	Variac	W20G2M	Not Calibrated	-
Multimeter	Fluke	87 III/E1061P	12 Months	3/3/07

END OF DOCUMENT