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ACCREDITED
Certificate Number 1953-01

Test Report

Company: Radiotronix, Inc.
905 Messenger Lane
Moore, OK 73160

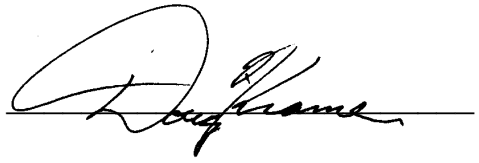
Contact: Tom Marks

Product: FCC-Wi232DTS
FCC ID: Q7V-3F090003X

Test Report No: R062205-05D

APPROVED BY:

Doug Kramer
Test Engineer



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Total Pages: 77

Table of Contents

1.0 Summary of test results
- 1.1 Test Results
- 1.2 Test Methods
  - 1.2.1 Conducted Emissions
  - 1.2.2 Radiated Emissions
- 1.3 Reason for amendment

2.0 Description
- 2.1 Equipment under test
  - 2.1.1 Identification
  - 2.1.2 EUT received date
  - 2.1.3 EUT tested dates
  - 2.1.4 Manufacturer
  - 2.1.5 Serial number
- 2.2 Laboratory description
- 2.3 Special equipment or setup

3.0 Test equipment used

4.0 Detailed Results
- 4.1 FCC Part 15.203 Antenna Requirement
- 4.2 FCC Part 15.207 Conducted Emissions
- 4.3 FCC Part 15.109 Radiated Emissions, Receive only
- 4.4 FCC Parts 15.209, 15.247 and 15.249 Radiated Emissions, Transmit only
- 4.5 Band edge and Conducted Power Measurements

Appendix A – Photos
Appendix B – Conducted Emissions from RF port of module
Appendix C – Radiated Emissions Results Receiver
Appendix D – Radiated Emissions Results Transmitter
Appendix E – Sample Calculation
Appendix F – Bandwidth and Conducted Power Measurements
Appendix G – Duty cycle measurements
Appendix H – SAR evaluation
Appendix I – Index of Figures
Appendix J – Part 15.107/207 data
Appendix K– Frequency Table

1.0 Summary of test results

1.1 Test Results

Test	Test Specification	Results
CFR 47, FCC Part 15.203	Part 15.203	Complies
CFR 47, FCC Part 15.207	Part 15.207, Class B	Complies
CFR 47, FCC Part 15.1/209	Part 15.1/209, Class B	Complies
CFR 47, FCC Part 15.24x	Parts 15.247 and 15.249	Complies

DTS-mode complies with Part 15.247
LP-mode complies with Part 15.249

1.2 Test Methods

1.2.1 Conducted Emissions

Measurements of conducted emissions to the limits set in CFR 47 Part 15.207 were performed using the methods shown in ANSI/IEEE C63.4: 2003. Measurements of the EUT can be found in Appendix J.

1.2.2 Radiated Emissions

Compliance to CFR 47 Parts 15.109/209 and 15.247 was tested in accordance with the methods of ANSI/IEEE C63.4: 2003. Several configurations were examined the results presented represent a worst-case scenario. The EUT was mounted on a wooden table 80 centimeters high and centered on a 4-meter diameter turntable. The table was rotated 360° and the antenna height was varied from 1 to 4 meters to maximize emissions. All measurements were taken at a distance of 3 meters from the EUT.

1.3 Reason for amendment

This report has been amended to provide additional information on the results of LP-mode RF bandwidth measurements and duty cycle.

2.0 Description

2.1 Equipment under test

The FFC-Wi232DTS is a digital transmission system module that operates in one of two distinct modes. LP (low power) mode has a rated maximum output power of -2dBm and 83 frequencies of operation. DTS mode operates at a rated maximum of 14dBm and over 32 channels.

2.1.1 Identification: FCC-Wi232DTS module

2.1.2 EUT received date: 24 June 2005

2.1.3 EUT tested dates: June 30, July 13,
Aug 2, 3, 4, October 2005

2.1.4 Manufacturer: Radiotronix, Inc.

2.1.5 Serial number: NCEETest1

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility, which is a FCC registered lab. This site has been fully described in a report submitted to the FCC office, and accepted in a letter dated May 4, 2001. This site has been fully described in a report submitted to Industry Canada with filing number 4294 and expiry date of May 9, 2008.

2.3 Special equipment or setup

The EUT was evaluated while attached to an evaluation board. Conducted AC mains emissions measurements were made using a RadioShack AC adapter Cat. No. 273-1662A. The EUT was set to transmit continuously with the maximum output power for each mode (DTS and LP) of operation. For DTS-mode that setting was 15dBm, for LP-mode the setting was 0dBm.
The firmware was modified such that selecting Channel 0 tunes the transmitter to Channel 1 frequency; the table in Appendix K provides more details.

3.0 Test equipment used

Serial #	*Manufacturer*	*Model*	*Description*	*Last cal.*
1647	EMCO	3142B	Biconilog antenna	10-May-05
6415	EMCO	3115	DRG Horn	08-Mar-05
100037	Rohde & Schwarz	ESIB26	EMI Test Receiver	08-Jul-04*
836679/010	Rohde & Schwarz	ESH3-Z5	Art. mains	27-May-05
082001/003	Rohde & Schwarz	TS-PR18	Preamplifier	N/A
2575	Rohde & Schwarz	ES-K1	Software v1.60	N/A

**Sent and returned from calibration 10-Aug-05 without adjustment*

4.0 Detailed Results

Radiated emissions measurements were made by first using a spectrum analyzer getting a rough signal spectrum, any points were then measured using a CISPR 16 compliant receiver with the following bandwidth setting:

30MHz - 1GHz: 120kHz IF bandwidth, 60kHz steps
Above 1GHz: 1MHz IF bandwidth, 500kHz steps

Conducted measurements were made using a CISPR 16 compliant receiver with the IF bandwidth set to 9kHz taking 5kHz steps through the range 150kHz to 30MHz.
All results shown are corrected to incorporate cables losses, antenna factors, and any amplification.

4.1 FCC Part 15.203 Antenna Requirement

The RF connector is an RP-SMA jack connector integrated into the module. Figure 1 shows the EUT with 1 of the 3 antennas tested.

4.2 FCC Part 15.207 Conducted Emissions

Measurements of the EUT can be found in Appendix J. The EUT was found to be compliant.

4.3 FCC Part 15.109 Radiated Emissions, Receive only

The EUT was found to not produce any emissions in excess of the Class 'B' limits. The test setup can be seen in Figures 3 and 4. More information on the radiated emissions can be found in Section 4.4. The transmitter was not active for these measurements. Appendix C shows the measured values denoted by a red '+' in Figure 13. The red '+' is the quasi-peak measurement. No values were found to be in excess of the limits. No emissions above 1GHz were found to be within 10dB of the FCC limit as shown in Figure 14 where the blue '+' is a peak measurement. All measurements were made at a distance of 3 meters.

4.4 FCC Parts 15.209, 15.247 and 15.249 Radiated Emissions, Transmit only

The EUT was tested with the transmitter operating with a continuous RF signal at three frequencies in the lower, middle and upper portions of the band. The frequencies chosen were Channel 0 (902.971MHz), Channel 16 (915MHz), and Channel 31 (926.277MHz) in DTS-mode and Channel 0 (902.271MHz**), Channel 42 (914.9MHz) and Channel 83 (927.228MHz) in LP-mode. Initial testing in LP-mode was performed with the lowest frequency of operation set to 902.271MHz, this frequency did not meet the 50dB reduction from the fundamental at the band edge required per 15.249, the corrected channel table can be found in Appendix K. Original data can be found remaining in this report. Appendix D shows the worst-case emissions for each channel in the ranges of 30MHz – 1GHz and 1GHz – 10GHz while the EUT was transmitting. Figures 8 through 17 show the emissions. The peak and quasi-peak measurements below 1GHz were found not to exceed the limits outside of the transmission band. The peak and average measurements between 1GHz and 10GHz did not exceed limits.

The representative test setup can be seen in Figures 3 and 4; all of the different antenna combinations were attached directly to the module for testing. The EUT was mounted on a table 80 centimeters above a ground plane. Appendix D contains the results of testing the 6 transmitter frequencies (3 channels/mode) and 3 antennas. Data is presented in tables and labeled with the detector used in collecting the data.

4.5 Bandwidth and Conducted Power Measurements

The EUT was tested with the transmitter operating with a continuous RF signal at three frequencies in the lower, middle and upper portions of the band. The frequencies chosen were Channel 0 (902.971MHz), Channel 16 (915MHz), and Channel 31 (926.277MHz) in DTS mode and Channel 0 (902.271MHz**), Channel 42 (914.9MHz) and Channel 83 (927.228MHz) in LP-mode. A continuous transmission baud rate of 19200 was found to produce the greatest bandwidth and a baud rate of 2400 was found to produce the greatest power spectral density (PSD). Appendix F shows the results and the plots of bandwidth and conducted power measurements. Appendix B shows the conducted RF energy found outside of the transmission bands (902MHz-928MHz) as measured from the antenna port.

The following table shows the values measured in Figures 29 through 37.

	Channel DTS/LP		
	0/0	16/42	31/83
6dB Bandwidth, DTS/LP (kHz)	629/297	617/295	629/297
20dB Bandwidth, DTS/LP (kHz)	850/483	829/463	869/495
Maximum Power (dBm)*	13.74/- 2.05	12.34/-2.85	13.2/-2.25
Maximum PSD (dBm)*	7.73/na	5.53/na	6.76/na

*1dB added to measurements shown in Appendix F to correct for cable losses

TABLE OF ANTENNA CONFIGURATIONS (from user's manual)

Radiotronix Part number	Antenna type	Nominal Antenna gain	DTS-mode	LP-mode
ANT-915-06A	RP ½ Wave Dipole	3dBi	Approved	NOT APPROVED
ANT-915-02A	RP ¼ Wave Whip	3dBi	Approved	Approved
ANT-915-04A	RP ¼ Wave Helical	2dBi	Approved	Approved

**Channel 0 was found to be non-compliant with the band requirements of 15.249; the firmware of the EUT was modified so that Channel 0 is now set to equal Channel 1 (902.572MHz)

Appendix A: Photos

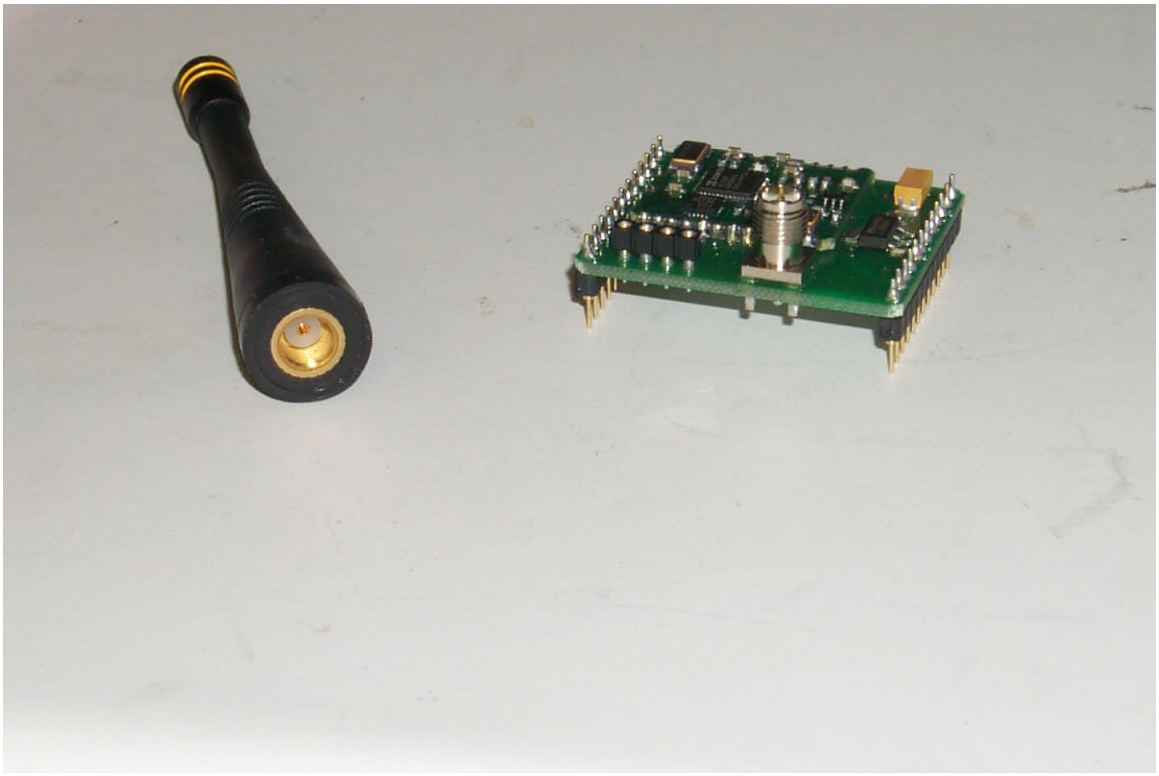

Figure 1 Module and antenna (RP-SMA), shield removed, ANT-915-02A antenna

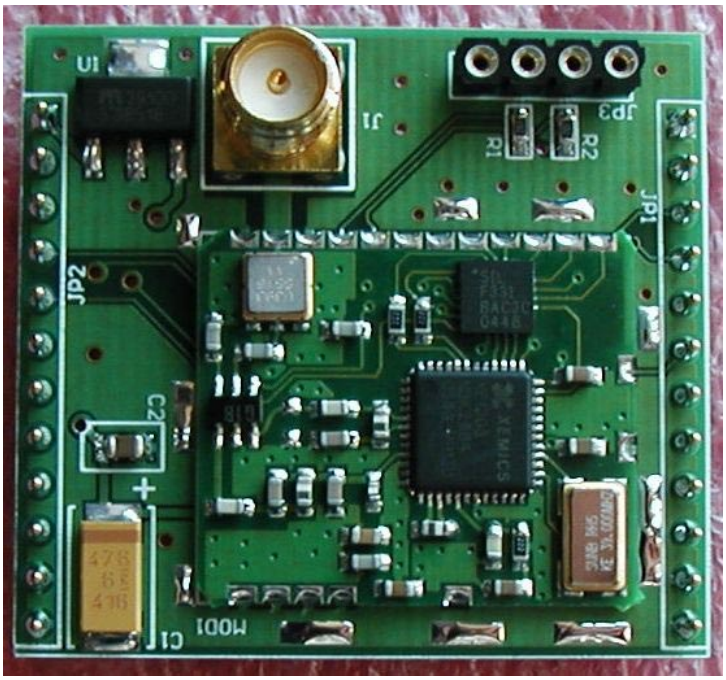

Figure 2 Top of FCC-Wi232 module, with shield removed

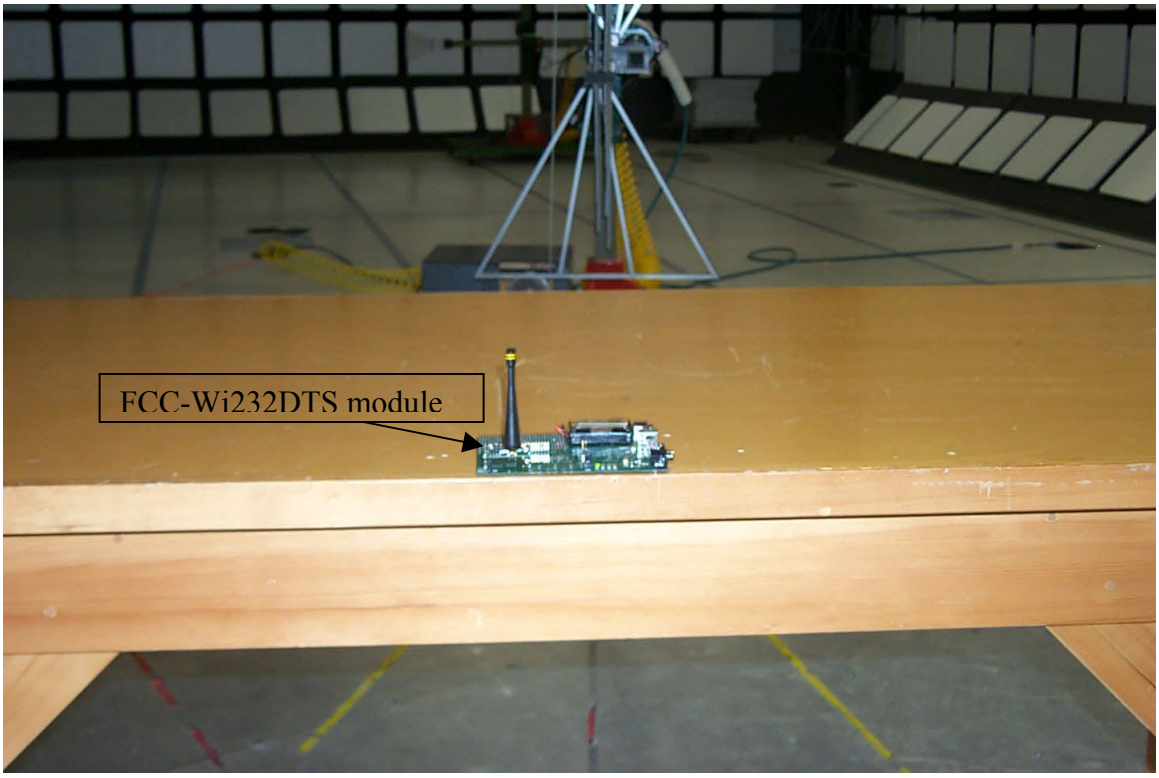

Figure 3 Test configuration, module on evaluation board

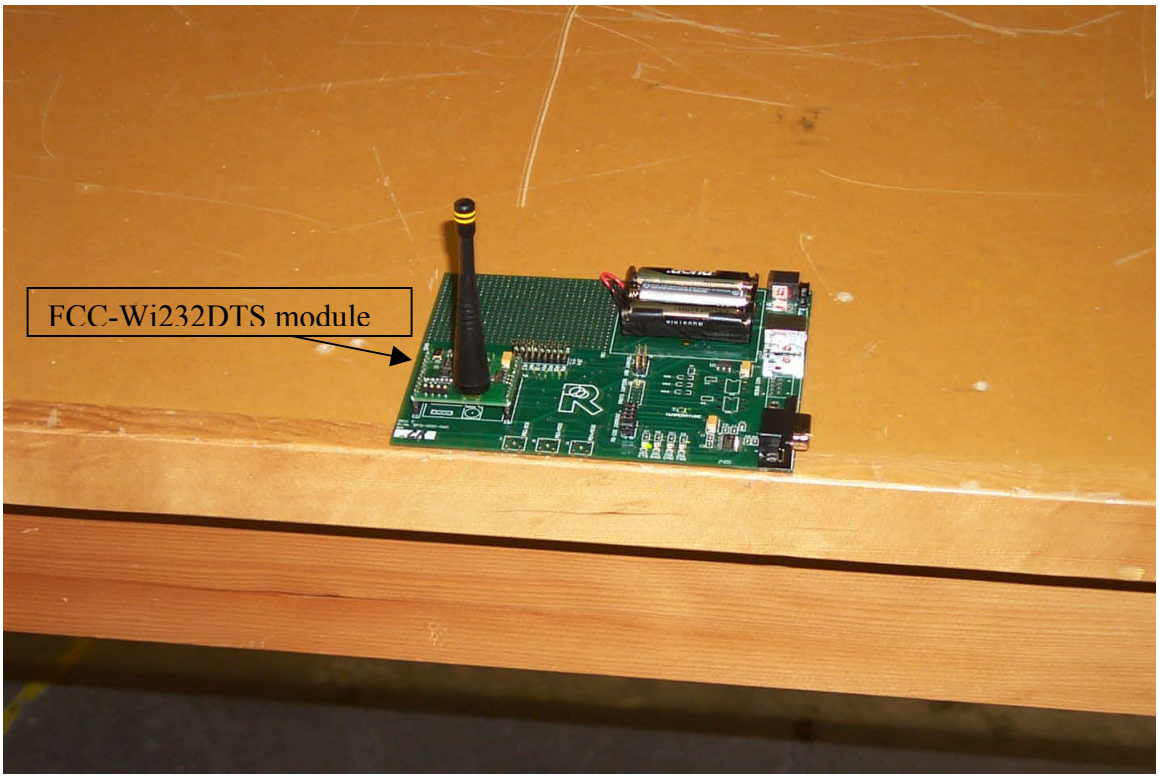

Figure 4 FCC-Wi232DTS as tested, module on evaluation board

Appendix B: Conducted Emissions from RF port of module

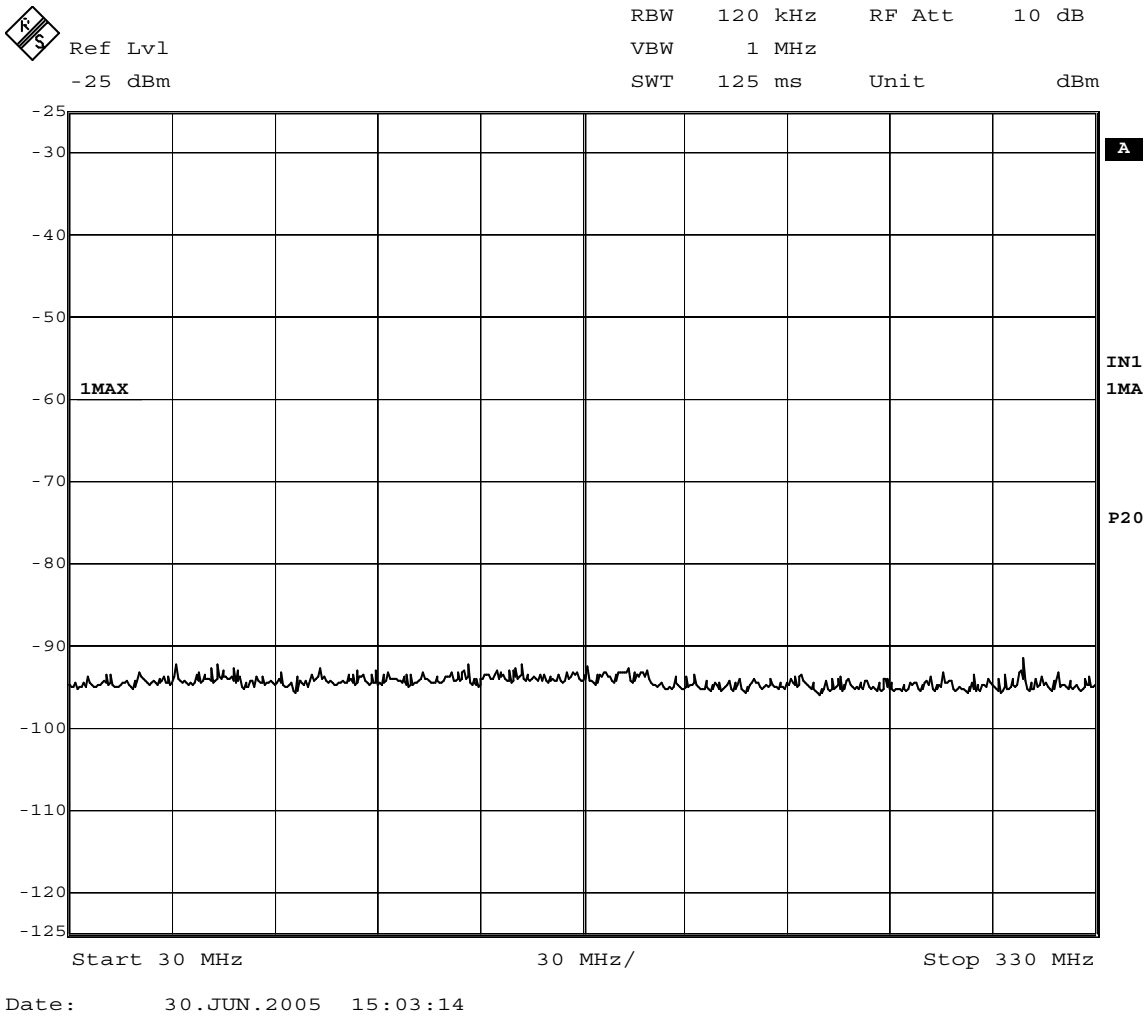

Figure 5 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, measured from RP-SMA connector

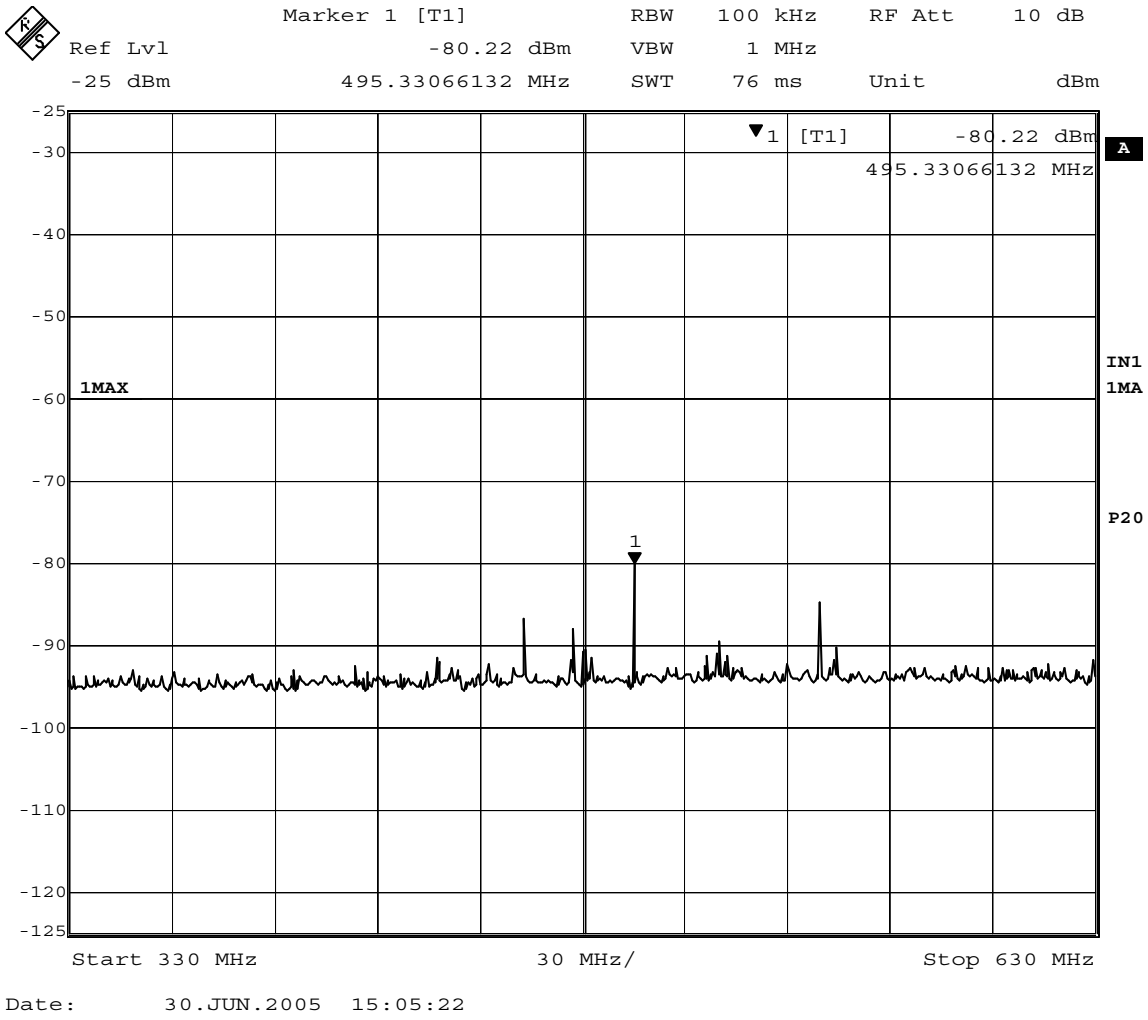

Figure 6 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, measured from RP-SMA connector

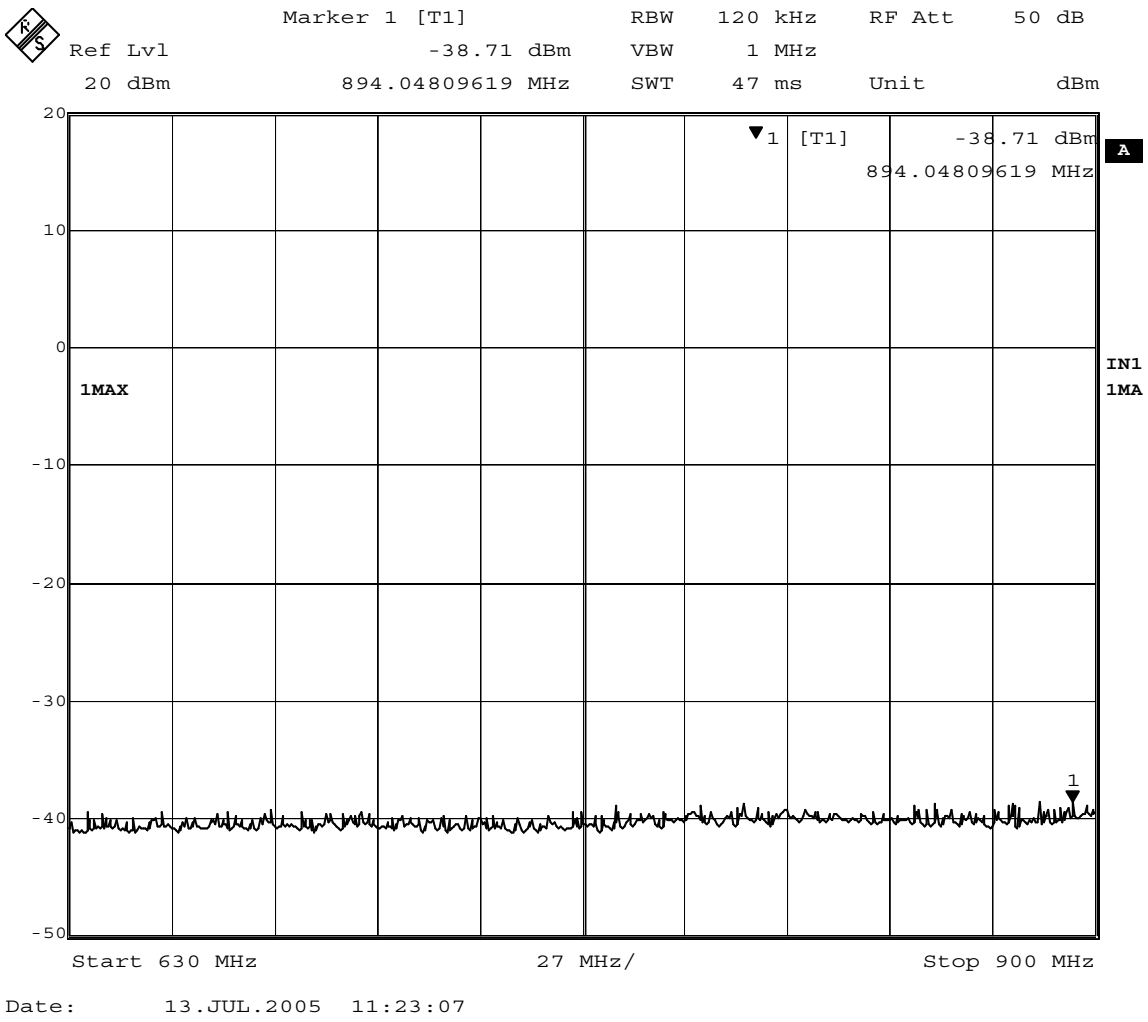

Figure 7 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, 630MHz-900MHz, measured from RP-SMA connector

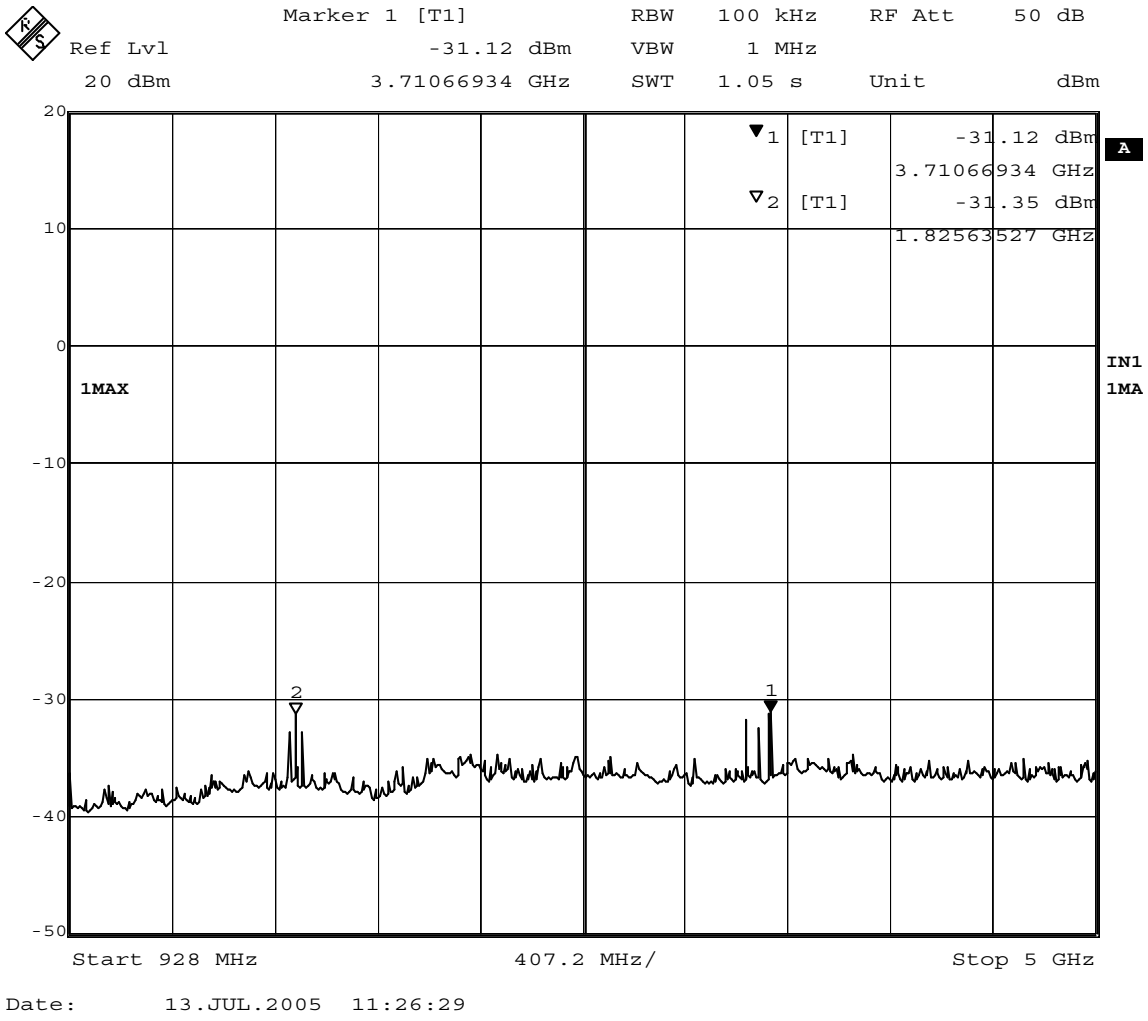

Figure 8 DTS-mode (15dBm setting), LMH channels, all bauds, measured from RP-SMA connector

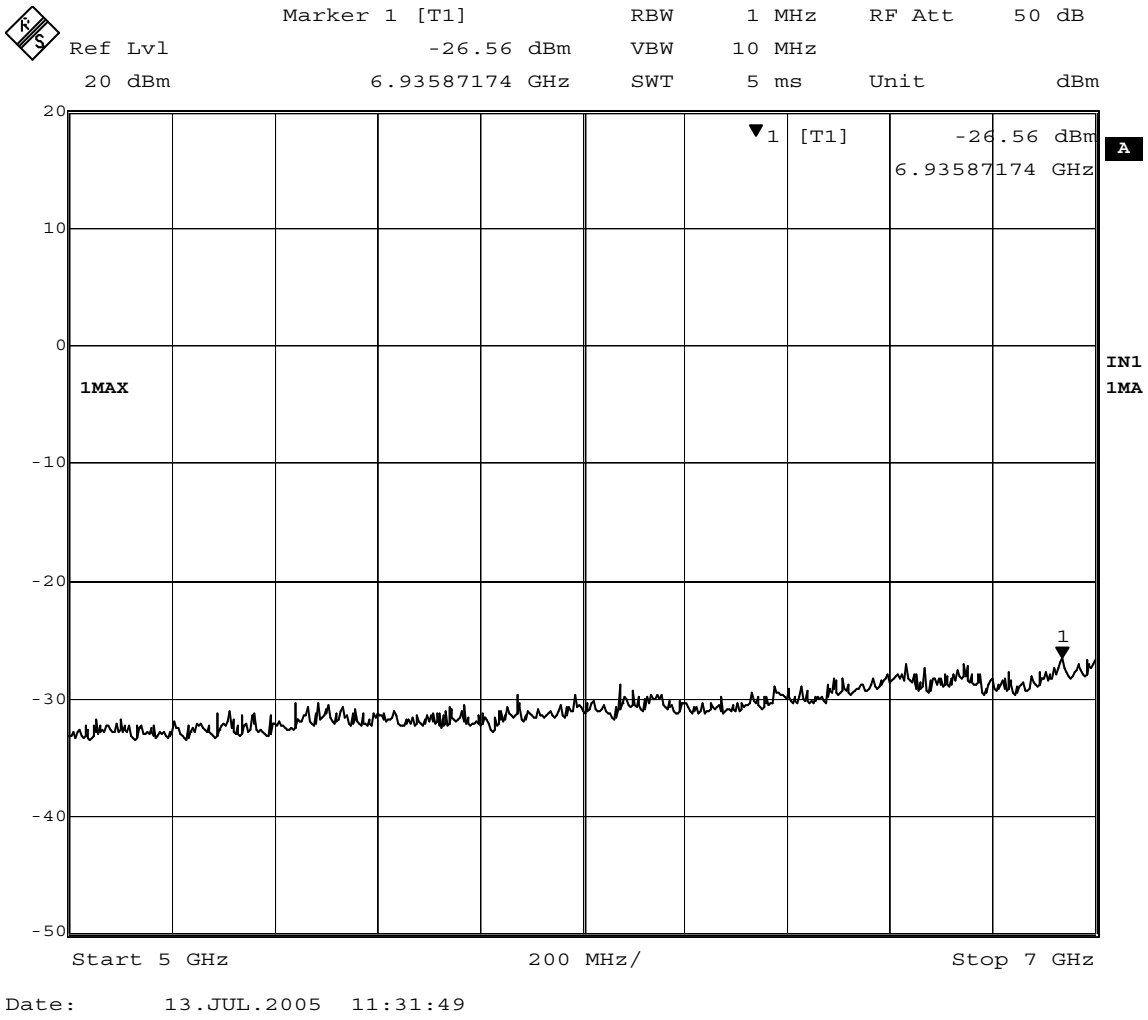

Figure 9 DTS-mode (15dBm setting), LMH channels, all bauds, measured from RP-SMA connector

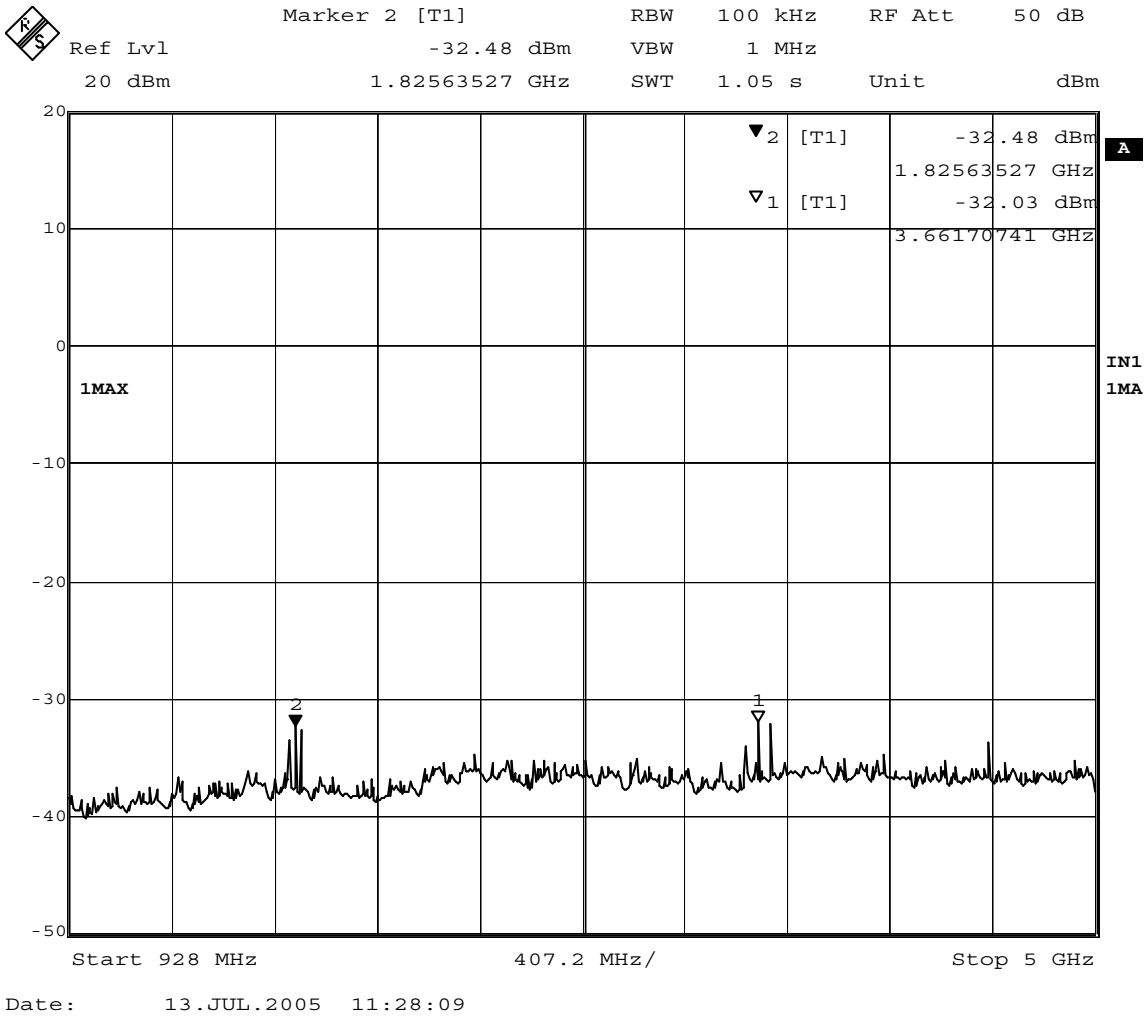

Figure 10 LP-mode (0dBm setting), LHM channels, all bauds, measured from RP-SMA connector

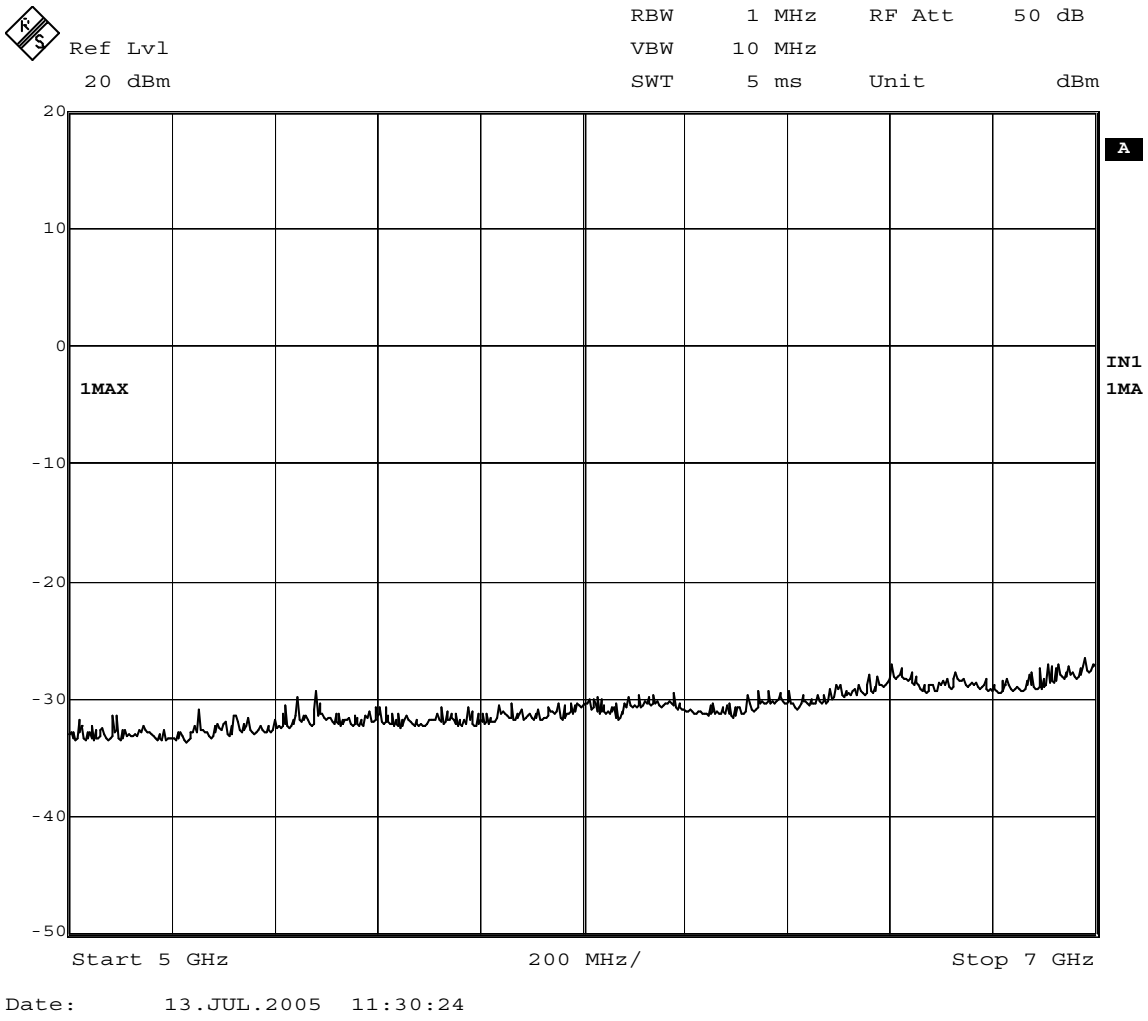

Figure 11 LP-mode (0dBm setting), LMH channels, all bauds, measured from RP-SMA connector

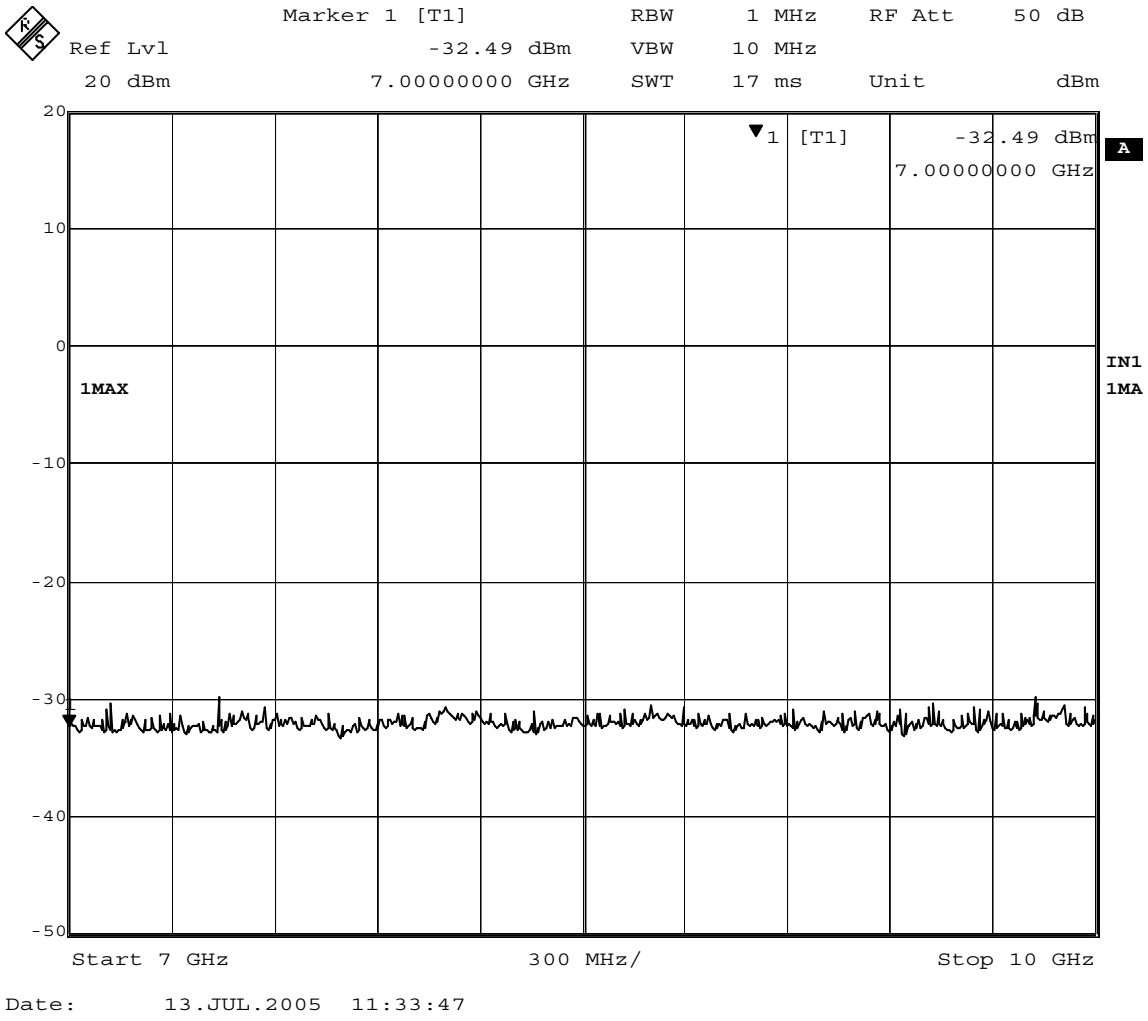

Figure 12 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, LMH channels, measured from RP-SMA connector

Appendix C: Radiated Emissions Results, Receiver, 3-Meter Measurement Distance

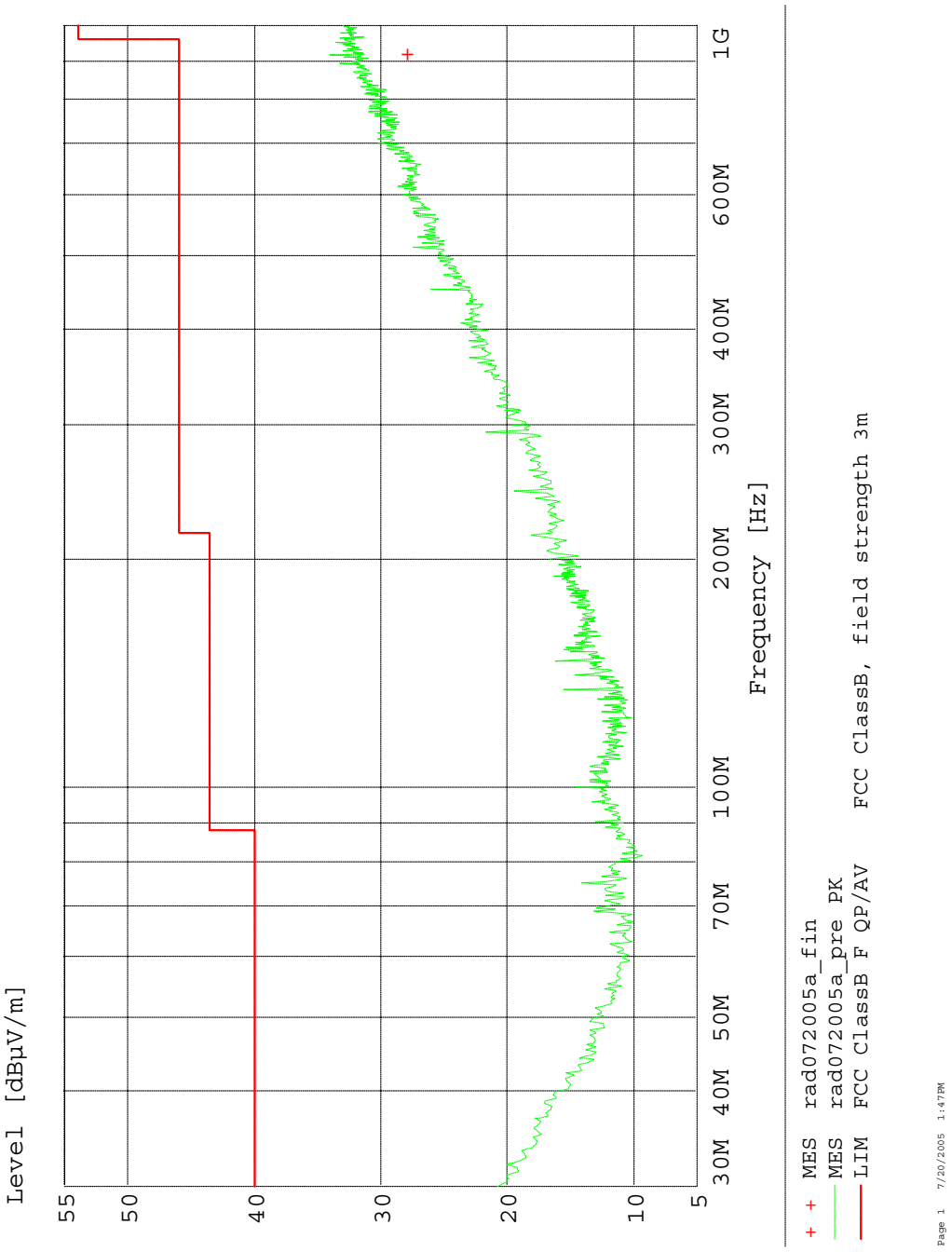

Figure 13 Rx, radiated emissions

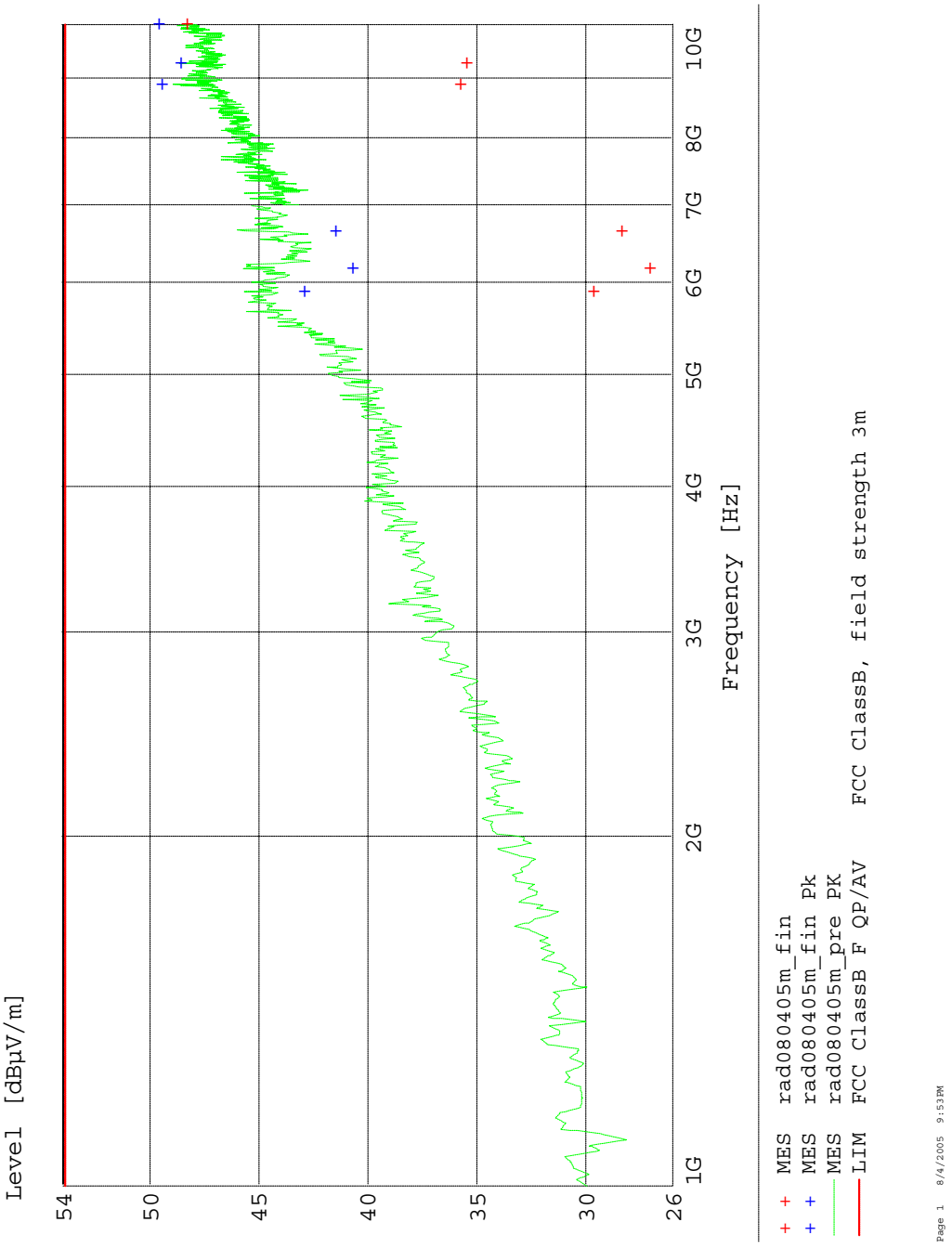

Figure 14 Rx, radiated emissions

Appendix D: Radiated Emissions Results, Transmitter, 3-Meter Measurement Distance

ANT-915-06A antenna (½ Wave Dipole), 30MHz-1GHz, DTS-mode.

ANT-915-06A antenna, DTS-mode, Ch0, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
	dBµV/m	dBµV/m	dB	cm.	Deg.		
902.72	110.26	---	---	106	196	VERT	Peak Tx, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1805.44	53.14	73.9	20.76	100	301	VERT	PK, 1MHz RBW, 3MHz VBW
1805.44	44.16	53.9	9.74	100	301	VERT	AV, 1MHz RBW, 3MHz VBW
2708.16	53.75	53.9	7.15	100	80	VERT	PK, 1MHz RBW, 3MHz VBW
3610.88	53.93	73.9	20.06	141	177	VERT	PK, 1MHz RBW, 3MHz VBW
3610.88	43.66	53.9	10.24	141	177	VERT	AV, 1MHz RBW, 3MHz VBW
4513.6	49.24	53.9	10.66	100	339	VERT	PK, 1MHz RBW, 3MHz VBW
5416.32	52.39	53.9	7.51	129	295	VERT	PK, 1MHz RBW, 3MHz VBW

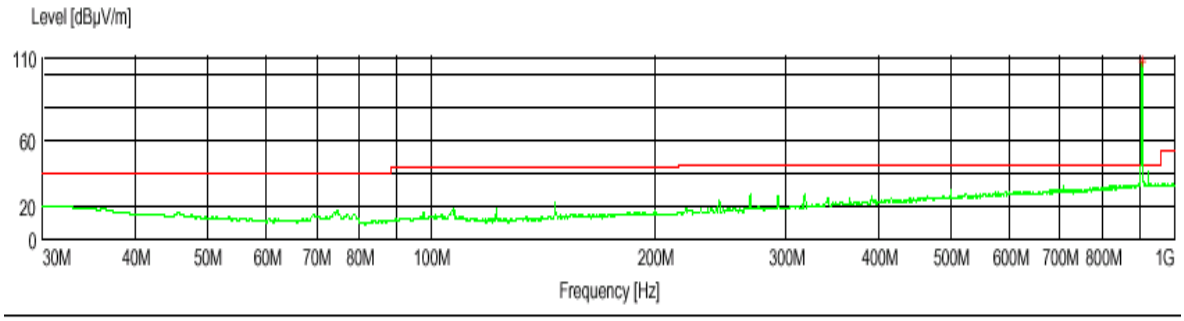

Figure 15 DTS-mode, Channel 0, 15dBm setting

ANT-915-06A antenna (½ Wave Dipole), 30MHz-1GHz, DTS-mode.

ANT-915-06A antenna, DTS-mode, Ch16, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Note
MHz	dBµV/m	dBµV/m	dB	cm	deg		
146.7	22.44	43.5	21.1	150.0	244	HORI	QP
317.88	26.62	46.0	19.4	100.0	239	HORI	QP
914.64	94.93	---	---	191.0	17	VERT	QP
914.76	111.6	---	---	109.0	265	VERT	PK, 120kHz RBW, 3MHz VBW
916.62	56.67	---	---	100.0	250	VERT	QP

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1829.5	49.35	53.9	4.55	156	9	VERT	PK, 1MHz RBW, 3MHz VBW
2744.2	51.51	53.9	2.39	99	66	VERT	PK, 1MHz RBW, 3MHz VBW
3659	56.69	73.9	17.21	101	250	VERT	PK, 1MHz RBW, 3MHz VBW
3659	47.23	53.9	6.67	101	250	VERT	AV, 1MHz RBW, 3MHz VBW
4576	46.37	53.9	7.53	119	334	VERT	PK, 1MHz RBW, 3MHz VBW
5491.5	54.22	73.9	19.68	100	309	VERT	PK, 1MHz RBW, 3MHz VBW
5491.5	41.52	53.9	12.38	100	309	VERT	AV, 1MHz RBW, 3MHz VBW

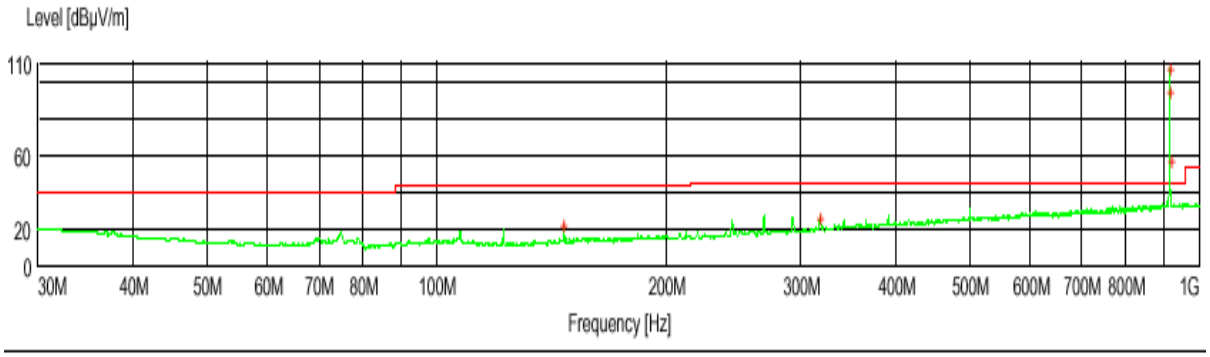

Figure 16 DTS-mode, Channel 16, 15dBm setting

ANT-915-06A antenna (½ Wave Dipole), DTS-mode.

ANT-915-06A antenna, DTS-mode, Ch31, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Note
MHz	dBµV/m	dBµV/m	dB	cm	deg		
75	18.87	40	21.13	239	71	VERT	QP
122.28	20.02	43.5	23.48	178	212	HORI	QP
146.7	23.53	43.5	19.97	150	230	HORI	QP
268.98	28.43	46	17.57	100	230	HORI	QP
293.4	27.04	46	18.96	99	245	HORI	QP
317.88	26.94	46	19.06	100	245	HORI	QP
924.78	59.47	---	---	115	88	VERT	PK
926.04	111.8	---	---	112	259	VERT	PK, 120kHz RBW, 3MHz VBW
927.3	51.77	---	---	106	261	VERT	PK

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1852	49.59	53.9	4.31	114	339	VERT	PK, 1MHz RBW, 3MHz VBW
2778.1	47.55	53.9	6.35	114	339	VERT	PK, 1MHz RBW, 3MHz VBW
3704	60.59	73.9	13.31	100	28	VERT	PK, 1MHz RBW, 3MHz VBW
3704	49.87	53.9	4.03	100	28	VERT	AV, 1MHz RBW, 3MHz VBW
4630.2	50.0	53.9	9.9	214	355	HORI	PK, 1MHz RBW, 3MHz VBW
6482.2	53.42	53.9	0.48	214	355	HORI	PK, 1MHz RBW, 3MHz VBW

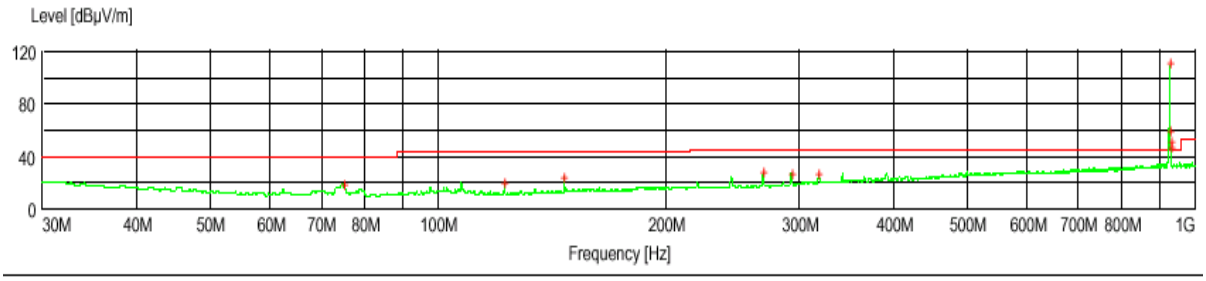

Figure 17 DTS-mode, Channel 31, 15dBm setting

ANT-915-02A antenna (¼ Wave Whip), DTS-mode.

ANT-915-02A antenna, DTS-mode, Ch0, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
902.72	110.5	---	---	113	265	VERT	Peak Tx, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1805.4	49.23	53.9	4.67	150	311	VERT	PK, 1MHz RBW, 3MHz VBW
2708.2	49.03	53.9	4.87	201	92	VERT	PK, 1MHz RBW, 3MHz VBW
3610.8	52.14	53.9	1.76	194	282	VERT	PK, 1MHz RBW, 3MHz VBW
4513.6	48.97	53.9	4.93	208	86	VERT	PK, 1MHz RBW, 3MHz VBW
5416.3	52.78	53.9	1.12	204	85	VERT	PK, 1MHz RBW, 3MHz VBW
6319	54.53	73.9	19.37	204	91	VERT	PK, 1MHz RBW, 3MHz VBW
6319	45.12	53.9	8.78	204	91	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-02A antenna (¼ Wave Whip), DTS-mode.

ANT-915-02A antenna, DTS-mode, Ch16, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
914.75	107.84	---	---	112	265	VERT	PK, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1829.5	45.76	53.9	8.14	227	188	VERT	PK, 1MHz RBW, 3MHz VBW
2744.5	51.39	53.9	2.51	309	12	HORI	PK, 1MHz RBW, 3MHz VBW
3659	50.63	53.9	3.27	208	70	VERT	PK, 1MHz RBW, 3MHz VBW
4573	47.8	53.9	6.1	150	159	VERT	PK, 1MHz RBW, 3MHz VBW
5488	54.13	73.9	19.77	209	60	VERT	PK, 1MHz RBW, 3MHz VBW
5488	45.91	53.9	7.99	209	60	VERT	AV, 1MHz RBW, 3MHz VBW
6403.3	55.03	73.9	18.87	399	237	VERT	PK, 1MHz RBW, 3MHz VBW
6403.3	46.02	53.9	7.88	399	237	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-02A antenna (¼ Wave Whip), DTS-mode.

ANT-915-02A antenna, DTS-mode, Ch31, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
926.03	110.15	---	---	104	261	VERT	PK, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1852	46.59	53.9	7.31	119	65	VERT	PK, 1MHz RBW, 3MHz VBW
2778.1	47.21	53.9	6.69	214	160	VERT	PK, 1MHz RBW, 3MHz VBW
3704.16	52.74	53.9	1.16	201	278	VERT	PK, 1MHz RBW, 3MHz VBW
4630	47.87	53.9	6.03	220	159	VERT	PK, 1MHz RBW, 3MHz VBW
5556.2	53.42	53.9	0.48	162	95	VERT	PK, 1MHz RBW, 3MHz VBW
6482.3	54.25	73.9	19.65	208	160	VERT	PK, 1MHz RBW, 3MHz VBW
6482.3	47.36	53.9	6.54	208	160	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-02A antenna (¼ Wave Whip), LP-mode.

ANT-915-02A antenna, LP-mode, Ch0**, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
146.94	23.61	43.5	19.89	148	221	HORI	QP
318.42	25.54	46	20.46	101	251	HORI	QP
900.48	39.76	46	6.24	191	329	VERT	QP
902.34	92.54	93.9	1.4	108	261	VERT	PK, 120kHz RBW, 3MHz VBW
903.84	34.94	46	11.06	100	261	VERT	QP
906.72	27.19	46	18.81	99	323	VERT	QP

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1804.4	43.57	53.9	10.33	169	298	VERT	PK, 1MHz RBW, 3MHz VBW
2706.6	38.13	53.9	15.77	169	298	VERT	PK, 1MHz RBW, 3MHz VBW
3609	47.62	53.9	6.28	179	148	VERT	PK, 1MHz RBW, 3MHz VBW
4511	42.19	53.9	11.71	179	148	VERT	PK, 1MHz RBW, 3MHz VBW
5413.2	42.46	53.9	11.44	165	179	VERT	PK, 1MHz RBW, 3MHz VBW
6315.4	44.83	53.9	9.07	165	179	VERT	PK, 1MHz RBW, 3MHz VBW

**Data shown with Channel 0=902.271MHz

ANT-915-02A antenna (¼ Wave Whip), LP-mode.

ANT-915-02A antenna, LP-mode, Ch42, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
146.82	21.73	43.5	21.77	149	244	HORI	QP
318	28.39	46	17.61	99	246	HORI	QP
913.14	41.64	93.9	52.26	101	258	VERT	QP
914.82	90.14	93.9	3.76	99	256	VERT	PK, 120kHz RBW, 3MHz VBW
915.18	62.08	93.9	31.82	115	331	VERT	Peak, Tx
916.38	34.78	46	11.22	191	89	VERT	Peak, Tx

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
3659.4	47.55	53.9	6.35	182	175	VERT	PK, 1MHz RBW, 3MHz VBW
5489	44.54	53.9	9.36	112	18	VERT	PK, 1MHz RBW, 3MHz VBW

ANT-915-02A antenna (¼ Wave Whip), LP-mode.

ANT-915-02A antenna, LP-mode, Ch83, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
925.74	33.41	46	12.59	265	168	HORI	QP
927.3	91.77	93.9	2.13	99	259	VERT	PK, 120kHz RBW, 3MHz VBW
928.74	37.06	46	8.94	100	304	VERT	QP
929.58	29.72	46	16.28	107	320	VERT	QP

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1854.5	43.97	53.9	9.93	150	236	VERT	PK, 1MHz RBW, 3MHz VBW
2782	44.26	53.9	9.64	107	48	VERT	PK, 1MHz RBW, 3MHz VBW
3708.6	51.79	53.9	2.11	178	3	VERT	PK, 1MHz RBW, 3MHz VBW
4635	48.89	53.9	5.01	294	306	VERT	PK, 1MHz RBW, 3MHz VBW
5562.5	53.11	53.9	0.79	99	0	VERT	PK, 1MHz RBW, 3MHz VBW
6490	60.90	73.9	19.0	227	121	VERT	PK, 1MHz RBW, 3MHz VBW
6490	49.79	53.9	3.21	227	121	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-04A antenna (¼ Wave Helical), DTS-mode.

ANT-915-04A antenna, DTS-mode, Ch0, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
75	26.24	40	13.76	188	85	VERT	QP
902.7	111.16	---	---	99	257	VERT	PK, 120kHz RBW, 3MHz VBW
903.18	107.74	---	---	194	229	VERT	Peak Tx

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1805.5	48.63	53.9	5.27	100	300	VERT	PK, 1MHz RBW, 3MHz VBW
2708	48.52	53.9	5.38	107	61	VERT	PK, 1MHz RBW, 3MHz VBW
3611	53.83	53.9	0.07	99	338	VERT	PK, 1MHz RBW, 3MHz VBW
4513.5	48.03	53.9	5.87	99	338	VERT	PK, 1MHz RBW, 3MHz VBW
5416.3	52.11	53.9	1.79	149	146	VERT	PK, 1MHz RBW, 3MHz VBW
6319	54.72	73.9	19.18	149	146	VERT	PK, 1MHz RBW, 3MHz VBW
6319	46.27	53.9	7.63	149	146	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-04A antenna (¼ Wave Helical), DTS-mode. Shield in place.

ANT-915-04A antenna, DTS-mode, Ch16, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
914.75	108.35	---	---	103	265	VERT	PK, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1830	45.47	53.9	8.43	214	248	VERT	PK, 1MHz RBW, 3MHz VBW
2745.5	49.93	53.9	6.03	141	172	VERT	PK, 1MHz RBW, 3MHz VBW
3659	52.63	53.9	1.27	142	4	VERT	PK, 1MHz RBW, 3MHz VBW
4573.8	48.45	53.9	5.45	150	223	VERT	PK, 1MHz RBW, 3MHz VBW
5488.56	53.91	73.9	19.99	100	25	VERT	PK, 1MHz RBW, 3MHz VBW
5488.56	44.94	53.9	8.96	100	25	VERT	AV, 1MHz RBW, 3MHz VBW
6403.5	54.94	73.9	18.86	258	64	VERT	PK, 1MHz RBW, 3MHz VBW
6403.5	43.93	53.9	9.97	258	64	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-04A antenna (¼ Wave Helical), DTS-mode.

ANT-915-04A antenna, DTS-mode, Ch31, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
75	16.77	40	23.23	191	353	VERT	QP
926.04	110.34	---	---	109	264	VERT	PK, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1853	44.82	53.9	9.08	119	280	VERT	PK, 1MHz RBW, 3MHz VBW
2779	47.53	53.9	6.37	214	160	VERT	PK, 1MHz RBW, 3MHz VBW
3705	54.9	73.9	19	201	278	VERT	PK, 1MHz RBW, 3MHz VBW
3705	44.2	53.9	9.7	201	278	VERT	AV, 1MHz RBW, 3MHz VBW
4630	47.94	53.9	5.96	220	159	VERT	PK, 1MHz RBW, 3MHz VBW
5556	52.7	53.9	1.2	250	61	VERT	PK, 1MHz RBW, 3MHz VBW
6482.2	54.0	73.9	19.9	208	165	VERT	PK, 1MHz RBW, 3MHz VBW
6482.2	43.87	53.9	10.03	208	165	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-04A antenna (¼ Wave Helical), LP-mode.

ANT-915-04A antenna, LP-mode, Ch0**, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
75	25.82	40	14.18	194	356	VERT	QP
902.2	92.49	93.9	1.41	100	260	VERT	PK, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1804.5	41.85	53.9	12.05	107	127	VERT	PK, 1MHz RBW, 3MHz VBW
2706.5	37.56	53.9	16.34	199	42	VERT	PK, 1MHz RBW, 3MHz VBW
3608.5	50.43	53.9	3.47	100	125	VERT	PK, 1MHz RBW, 3MHz VBW
4511	40.96	53.9	12.94	100	165	VERT	PK, 1MHz RBW, 3MHz VBW
5413.2	42.52	53.9	11.38	150	160	VERT	PK, 1MHz RBW, 3MHz VBW
6136	43.96	53.9	9.94	99	110	VERT	PK, 1MHz RBW, 3MHz VBW

**Data shown with Channel 0=902.271MHz

ANT-915-04A antenna (¼ Wave Helical), LP-mode.

ANT-915-04A antenna, LP-mode, Ch42, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
75	21.46	40	18.54	198	210	VERT	QP
146.76	23.79	43.5	19.71	150	220	HORI	QP
293.52	25.24	46	20.76	100	269	HORI	QP
391.38	20.32	46	25.68	144	293	HORI	QP
914.82	89.74	93.9	4.2	107	255	VERT	PK, 120kHz RBW, 3MHz VBW
916.68	44.39	46	1.61	99	257	VERT	QP

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
2744.52	44.6	53.9	9.3	150	59	VERT	PK, 1MHz RBW, 3MHz VBW
3660	52.45	53.9	1.45	178	182	VERT	PK, 1MHz RBW, 3MHz VBW
4574	47.56	53.9	6.34	250	166	VERT	PK, 1MHz RBW, 3MHz VBW
5489	53.04	53.9	0.86	200	188	VERT	PK, 1MHz RBW, 3MHz VBW
6969	55.29	73.9	18.61	235	108	VERT	PK, 1MHz RBW, 3MHz VBW
6969	46.44	53.9	26.23	235	108	VERT	AV, 1MHz RBW, 3MHz VBW

ANT-915-04A antenna (¼ Wave Helical), LP-mode.

ANT-915-04A antenna, LP-mode, Ch83, 19200 baud

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
75	19.93	40	20.07	198	67	VERT	QP
927.3	92.91	93.9	0.99	108	264	VERT	PK, 120kHz RBW, 3MHz VBW

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Notes
MHz	dBµV/m	dBµV/m	dB	cm	deg		
2781.5	43.96	53.9	9.94	167	0	VERT	PK, 1MHz RBW, 3MHz VBW
3708.64	53.54	53.9	0.36	106	15	VERT	PK, 1MHz RBW, 3MHz VBW
4635.8	48.41	53.9	5.49	105	239	VERT	PK, 1MHz RBW, 3MHz VBW
5563	53.38	53.9	0.52	15	309	VERT	PK, 1MHz RBW, 3MHz VBW
6490	55.28	73.9	18.62	154	0	VERT	PK, 1MHz RBW, 3MHz VBW
6490	45.00	53.9	25.69	154	0	VERT	AV, 1MHz RBW, 3MHz VBW

Appendix E: Sample Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:
FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBµV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBµV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBµV/m

The 48.1 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm [(48.1 dBµV/m)/20]= 254.1 µV/m

AV is calculated by the taking the 20*log(T_{on}/100) where T_{on} is the maximum transmission time in any 100ms window.

Is this case, T_{on} is less than 50mSec for a 100mSec window. An average correction factor of 6dB was applied where noted.

Appendix F: Bandwidth and Conducted Power Measurements

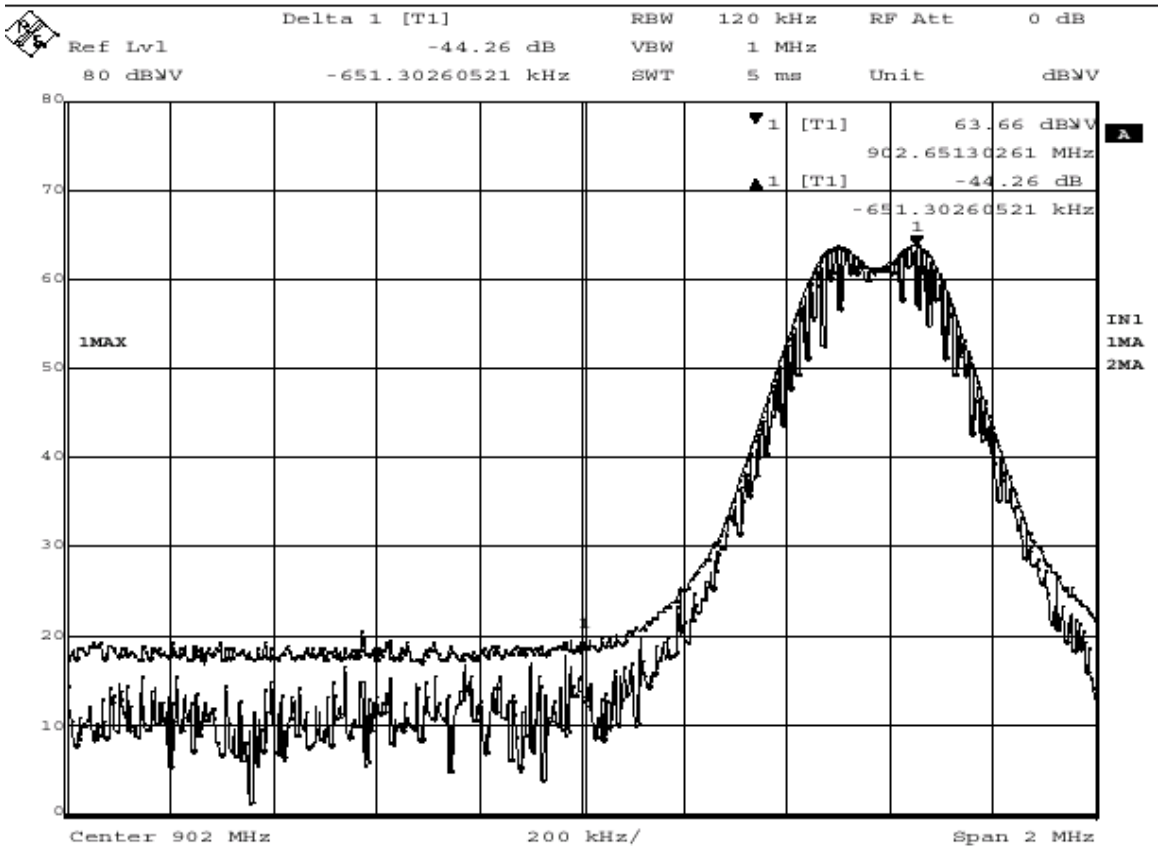

Figure 18 Channel 1(902.572MHz), 902 band edge, Peak measurements, LP-mode (Channel 1 replaces Channel 0)

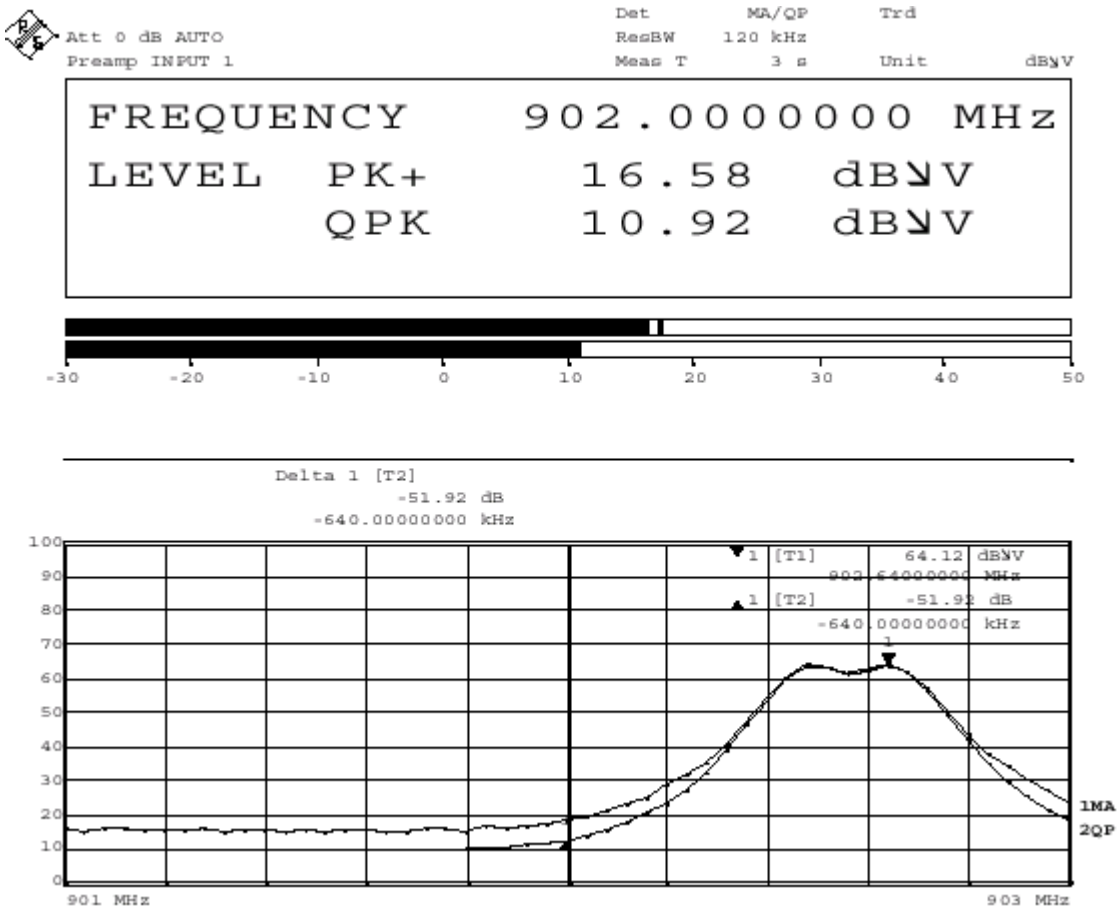

Figure 19 Tx set to Channel 1 (902.572), 902 MHz QP measurement, 52dB below fundamental of 63dB.

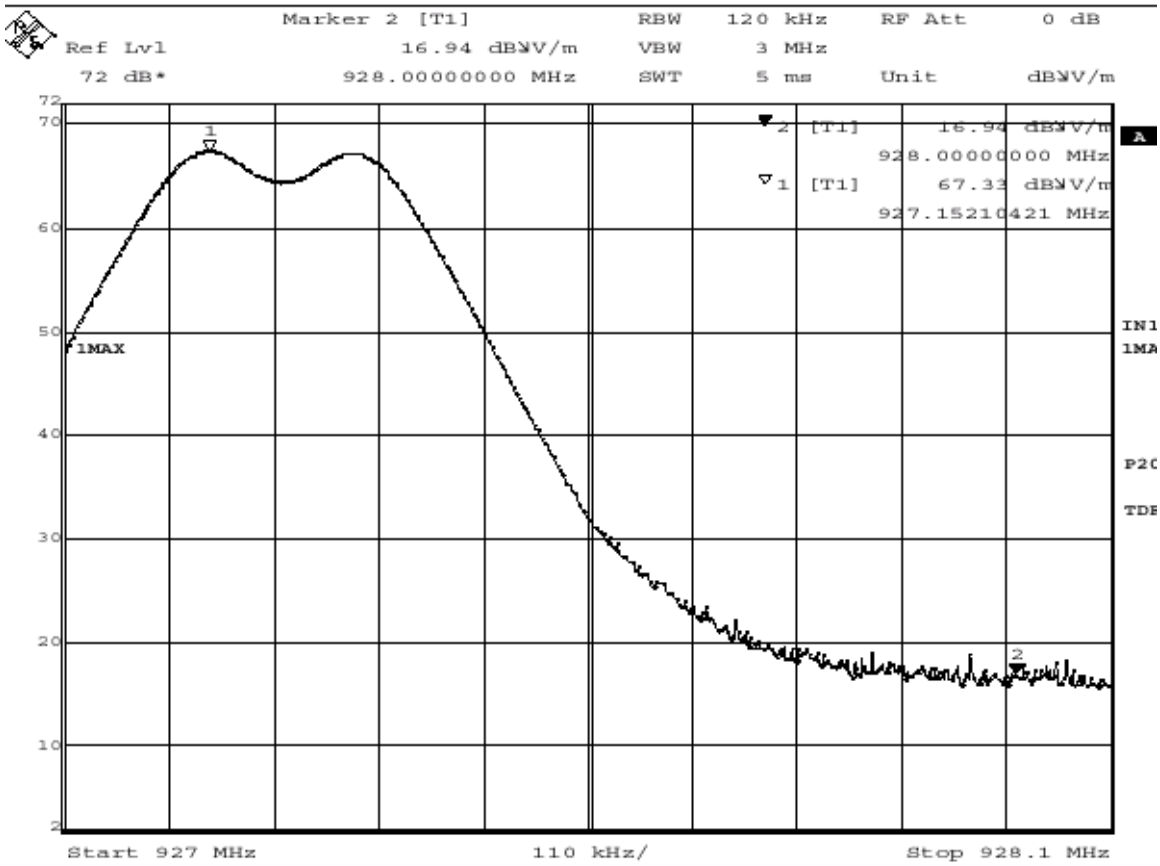

Figure 20 LP-mode, Channel 83, 928MHz band edge, Delta=50.38dB, radiated emissions measurement uncorrected

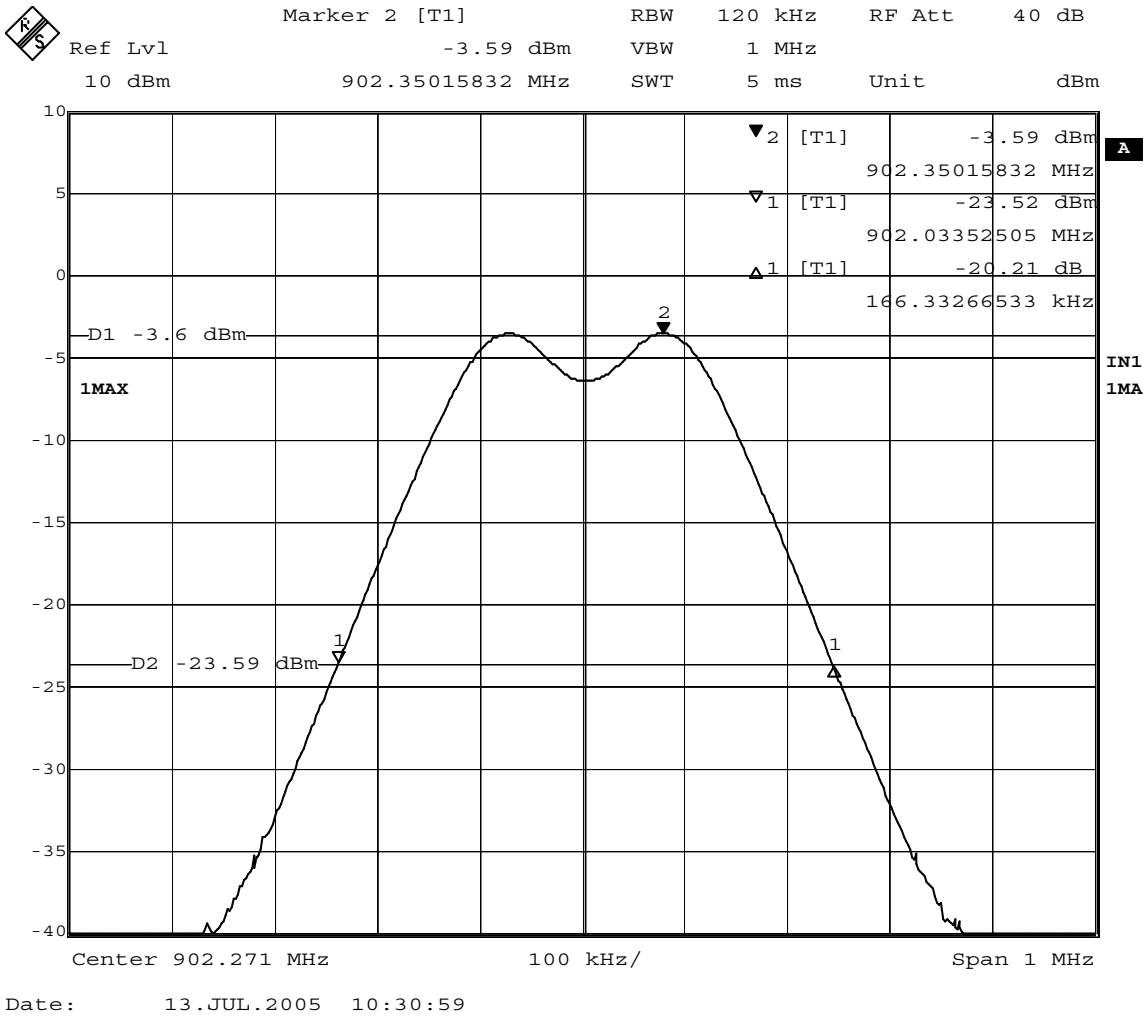

Figure 21 LP-mode, Channel 0, 20dB BW, 19200 baud, 483kHz

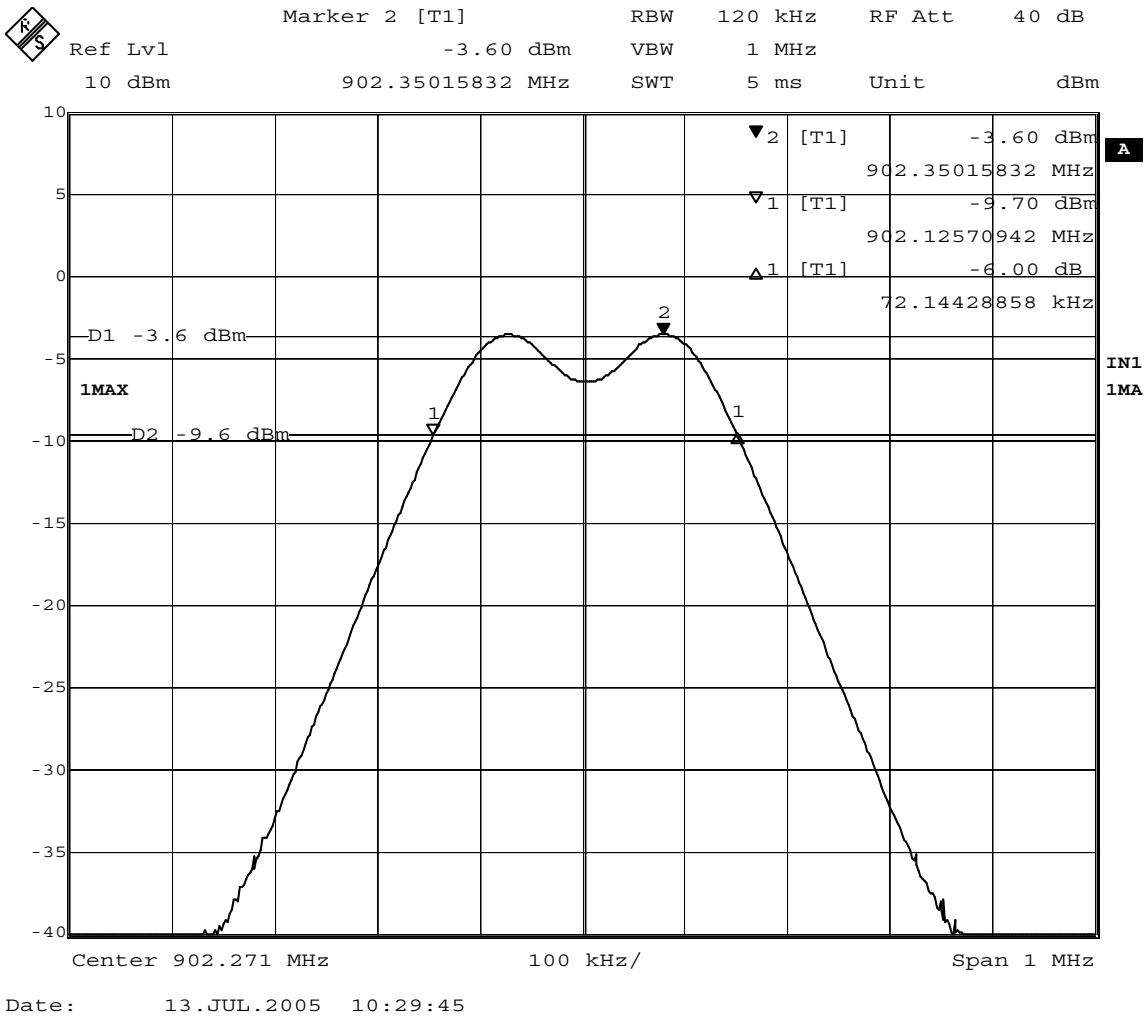

Figure 22 LP-mode, Channel 0, 6dB BW, 19200 baud, 297kHz

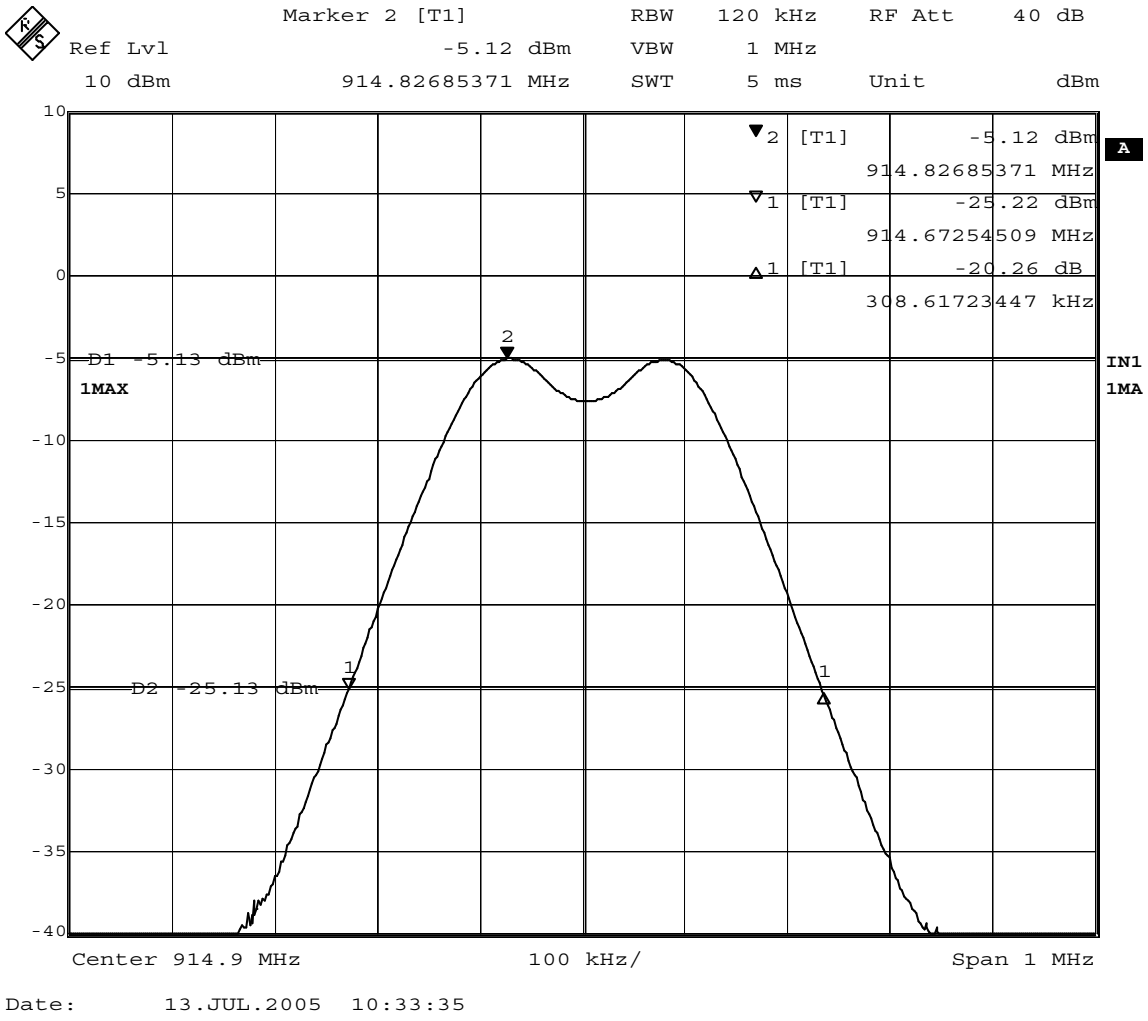

Figure 23 LP-mode, Channel 42, 20dB BW, 19200 baud, 463kHz

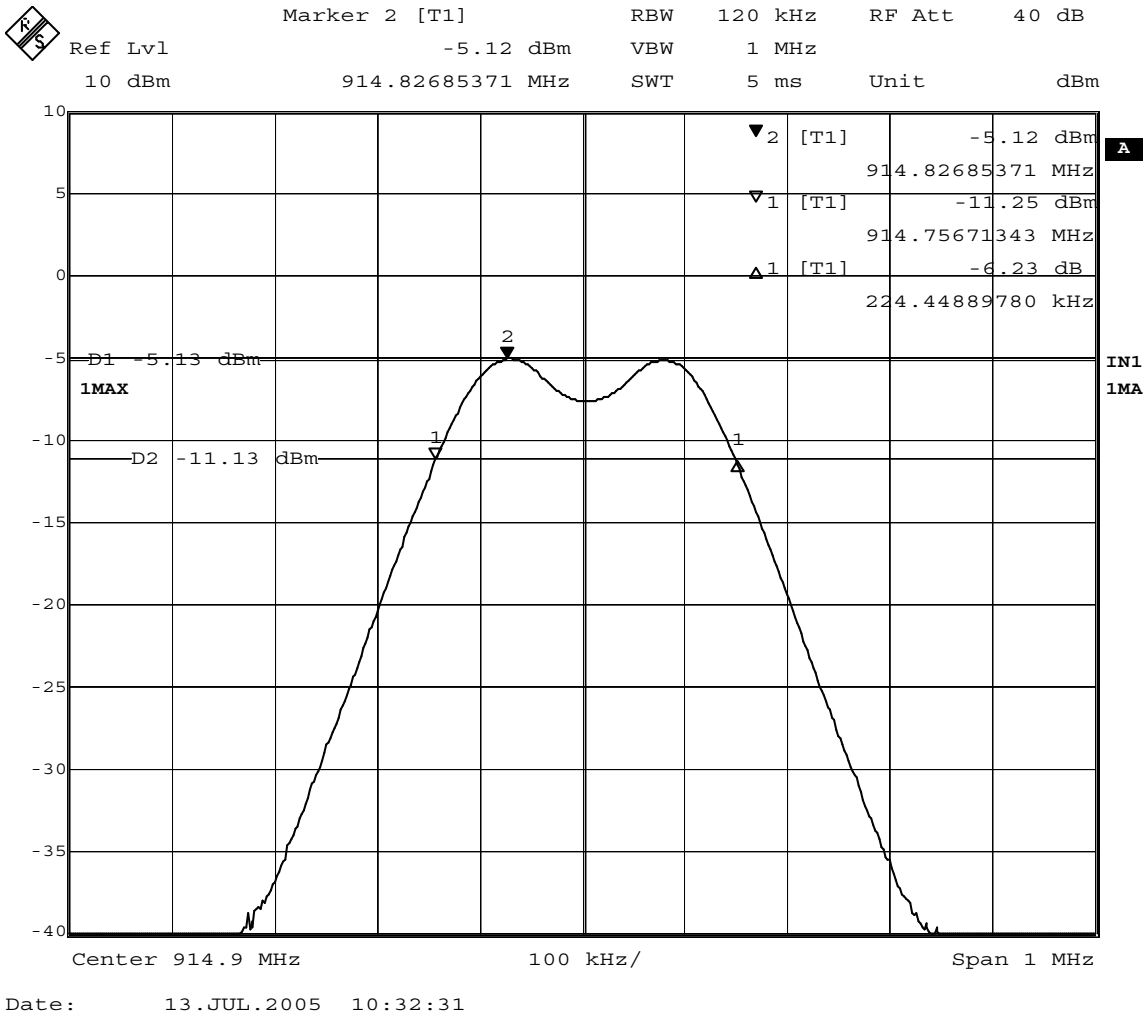

Figure 24 LP-mode, Channel 42, 6dB BW, 19200 baud, 295kHz

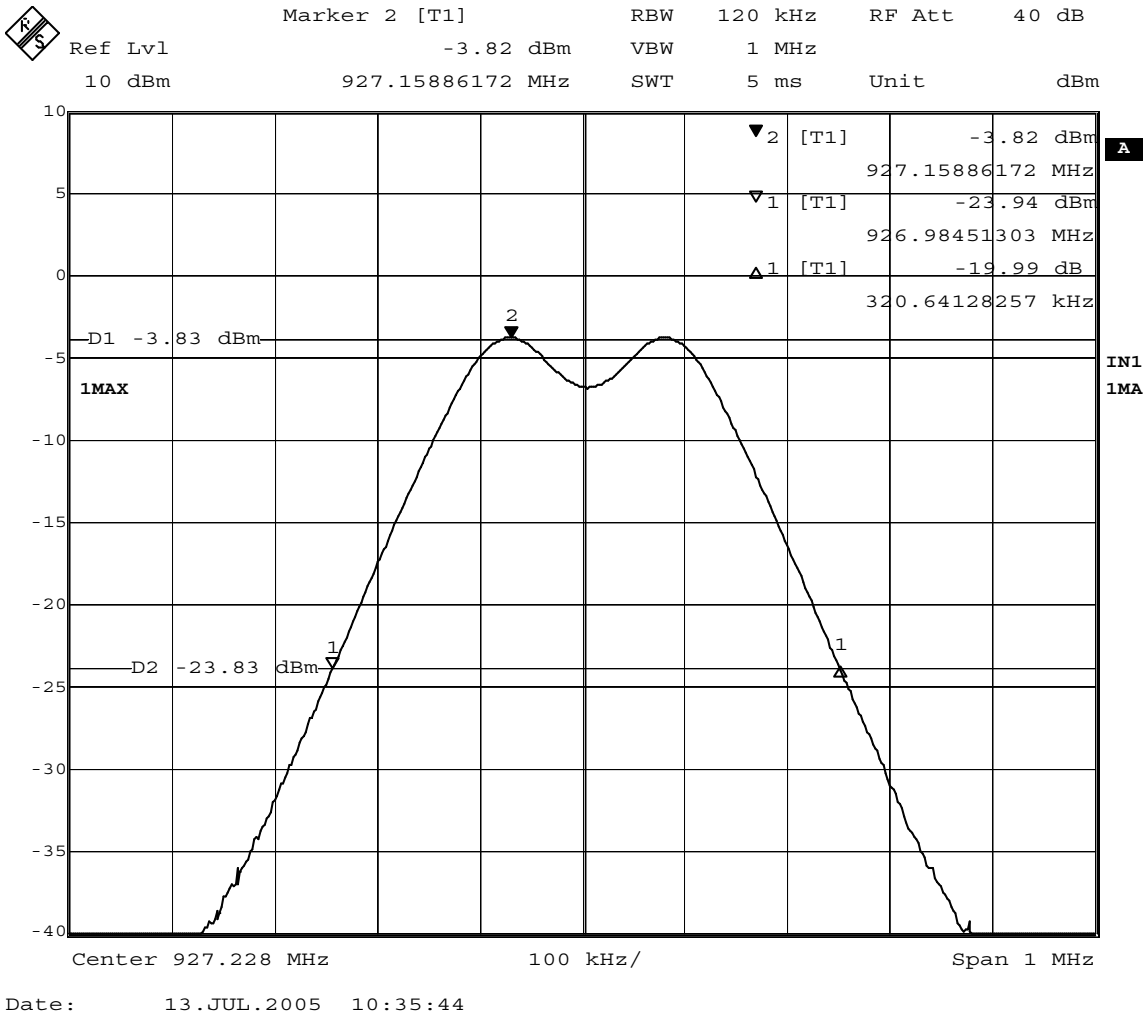

Figure 25 LP-mode, Channel 83, 20dB BW, 19200 baud, 495kHz

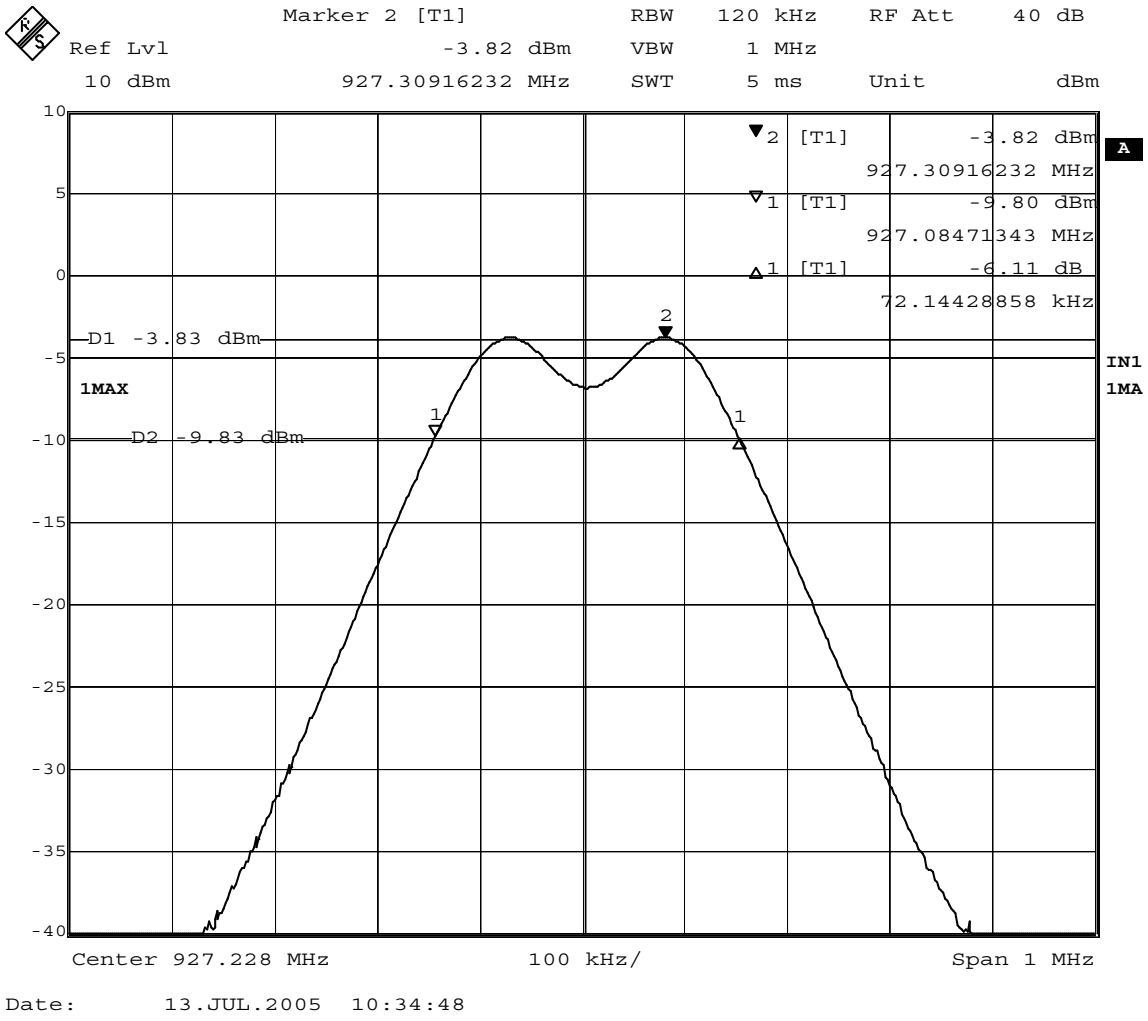

Figure 26 LP-mode, Channel 83, 6dB BW, 19200 baud, 297kHz

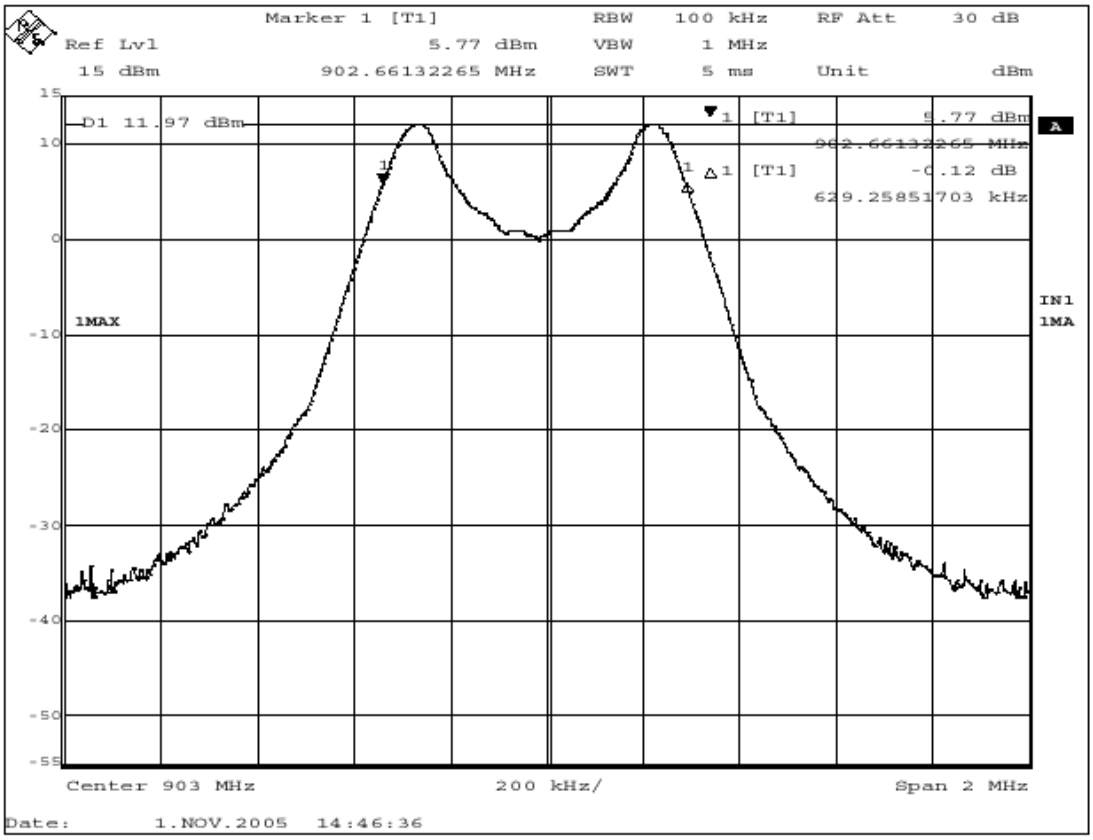

Figure 27 DTS-mode, Channel 0, 6dB BW, 19200 baud, 629kHz

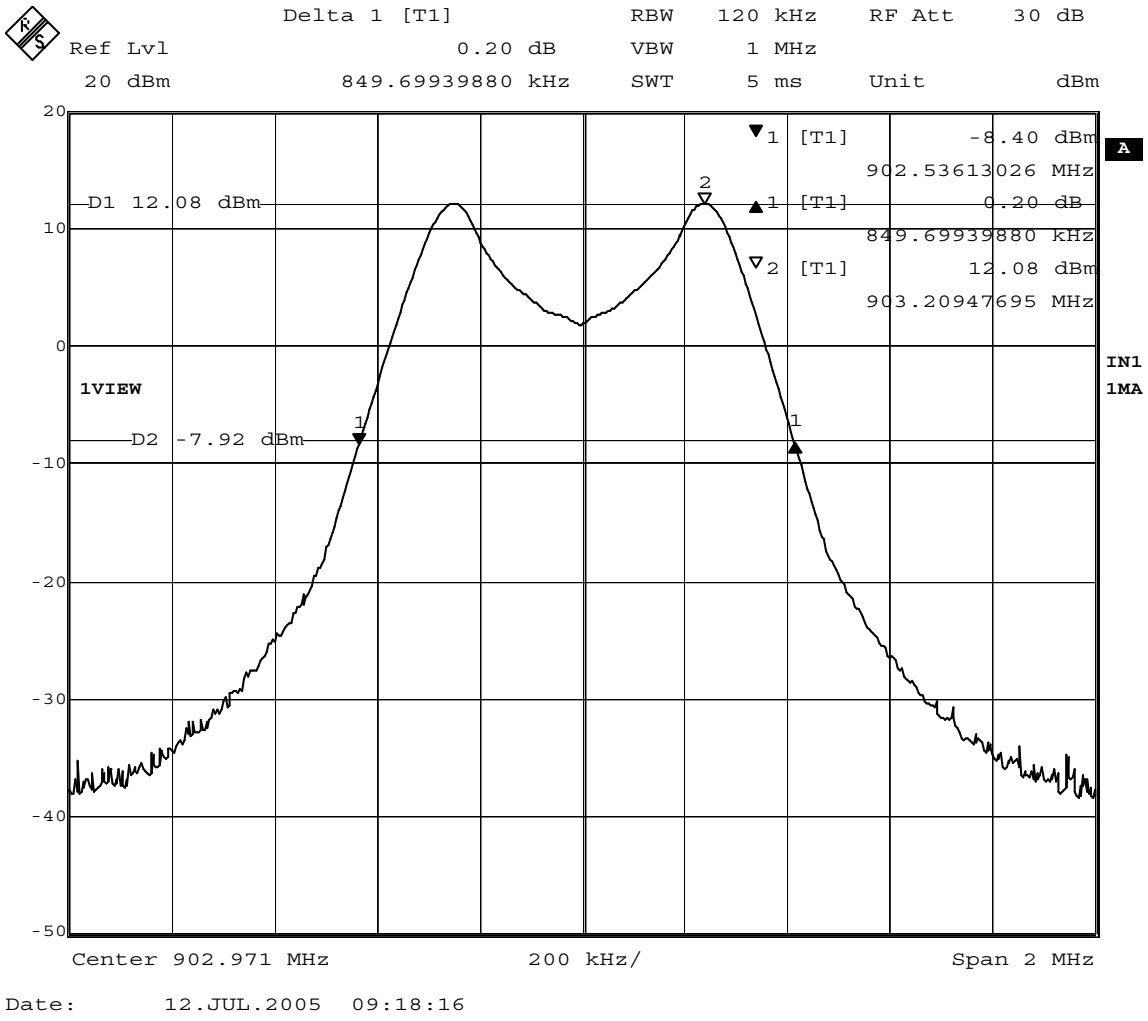

Figure 28 DTS-mode, Channel 0, 20dB BW, 19200 baud, 850kHz

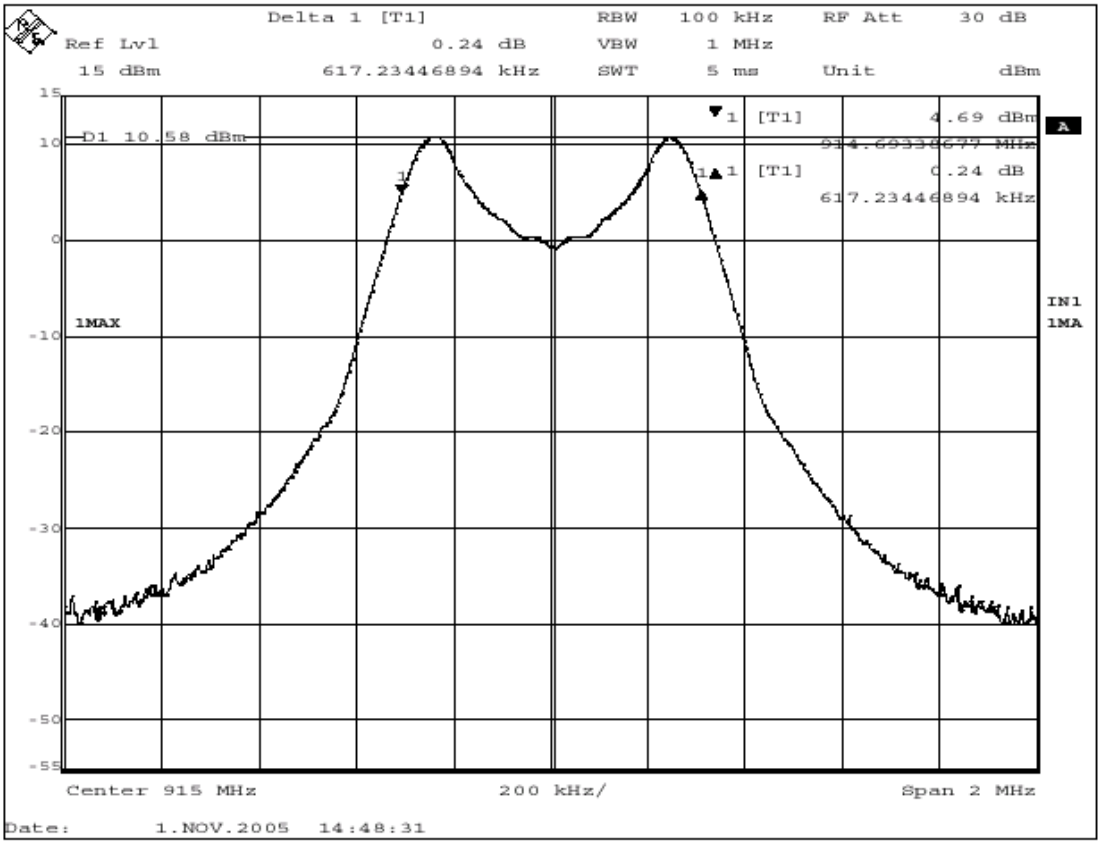

Figure 29 DTS-mode, Channel 16, 6dB BW, 19200 baud, 617kHz

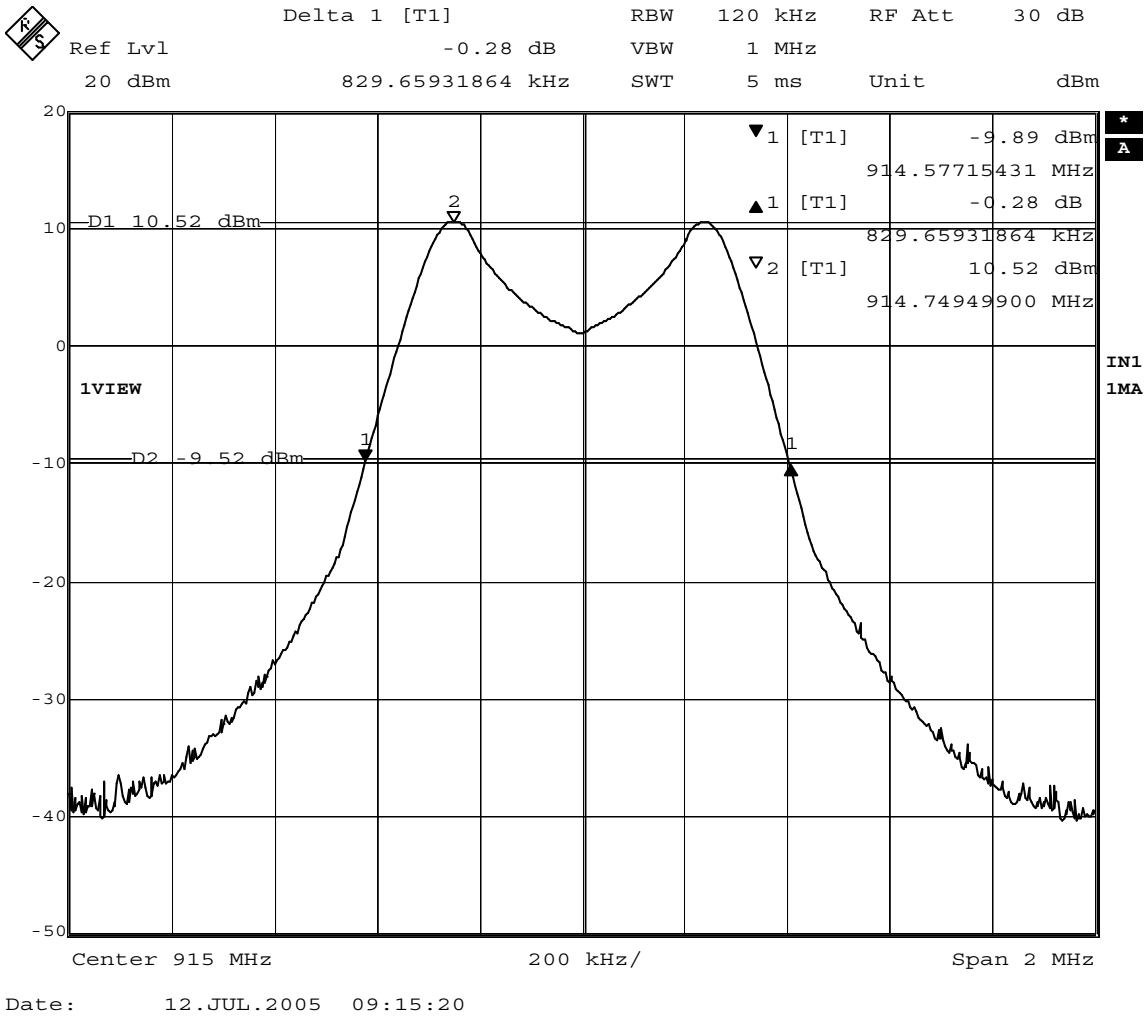

Figure 30 DTS-mode, Channel 16, 20dB BW, 19200 baud, 829kHz

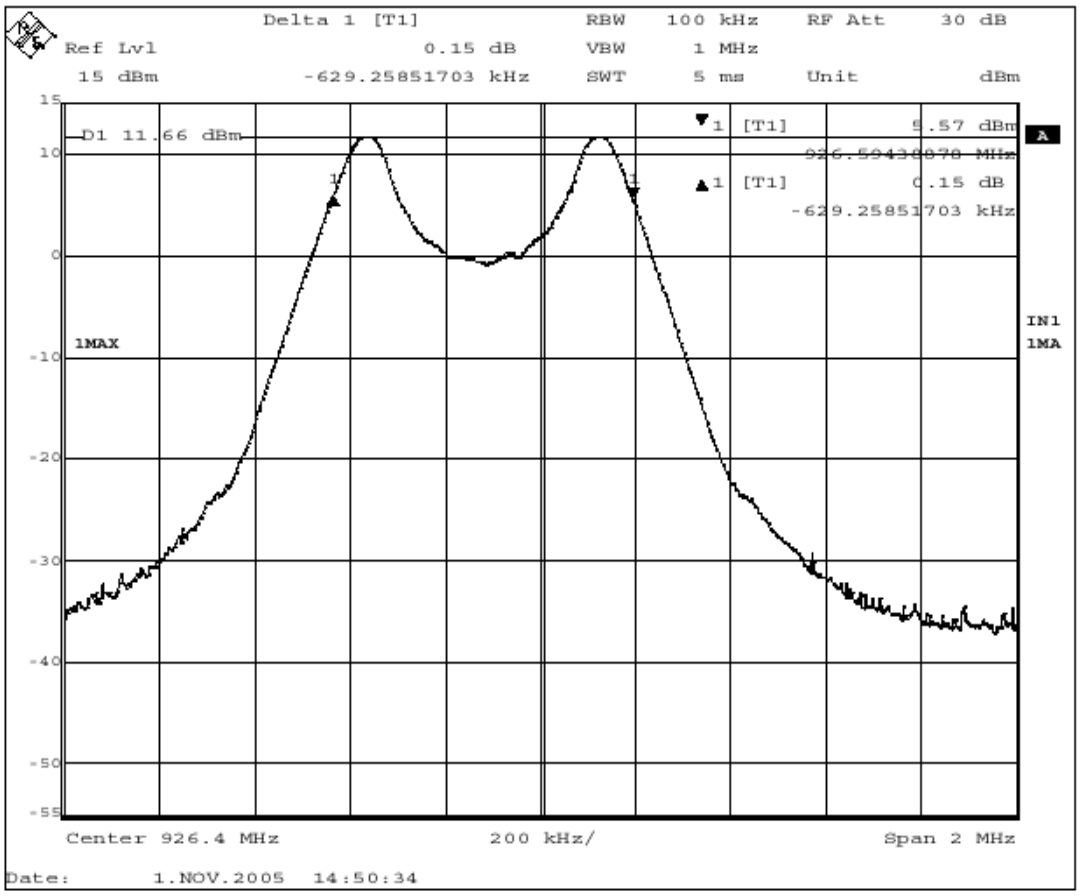

Figure 31 DTS-mode, Channel 31, 6dB BW, 19200 baud, 629kHz

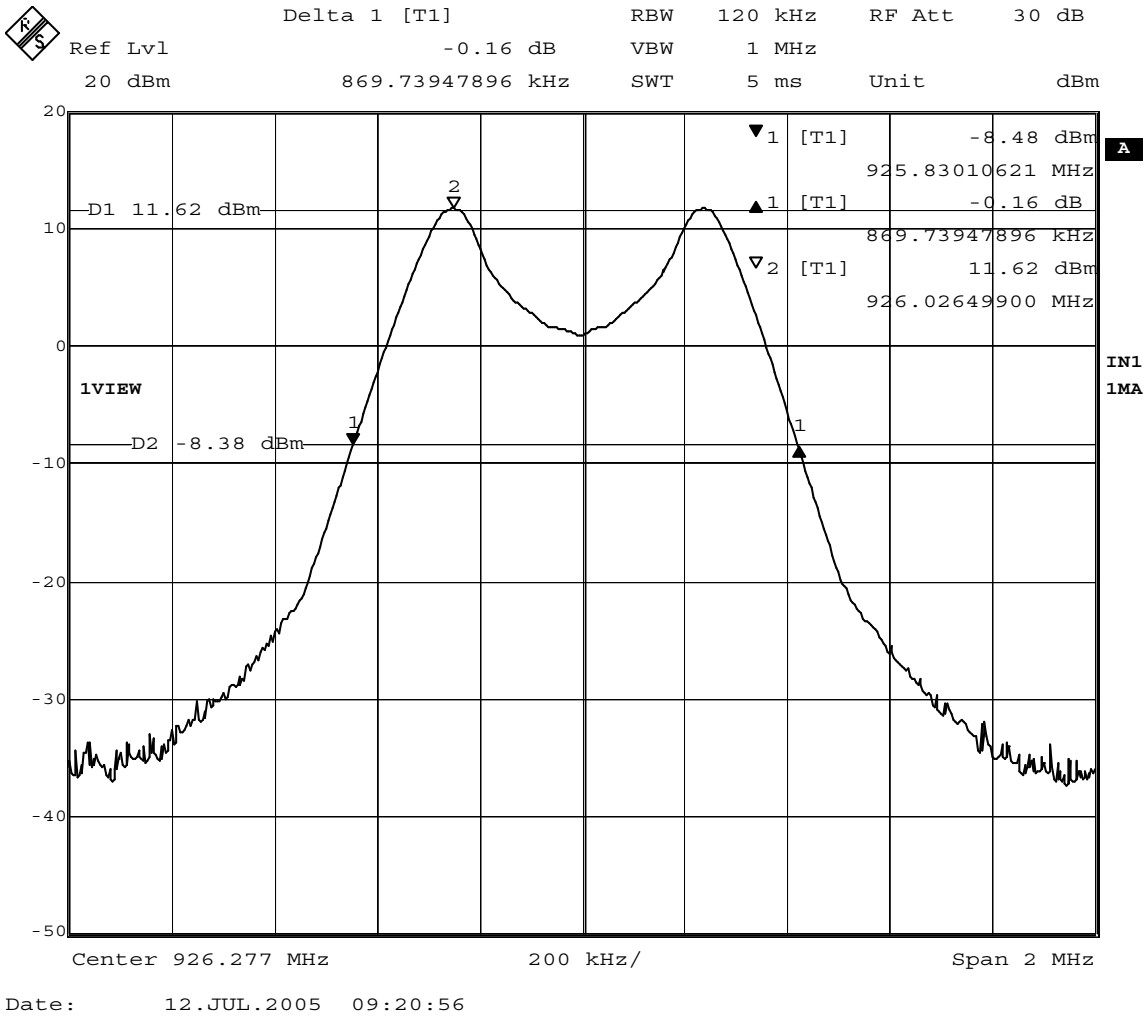

Figure 32 DTS-mode, Channel 31, 20dB BW, 19200 baud, 869kHz

A baud rate of 2400 produced the greatest power spectral density (PSD) in a 3kHz RBW.

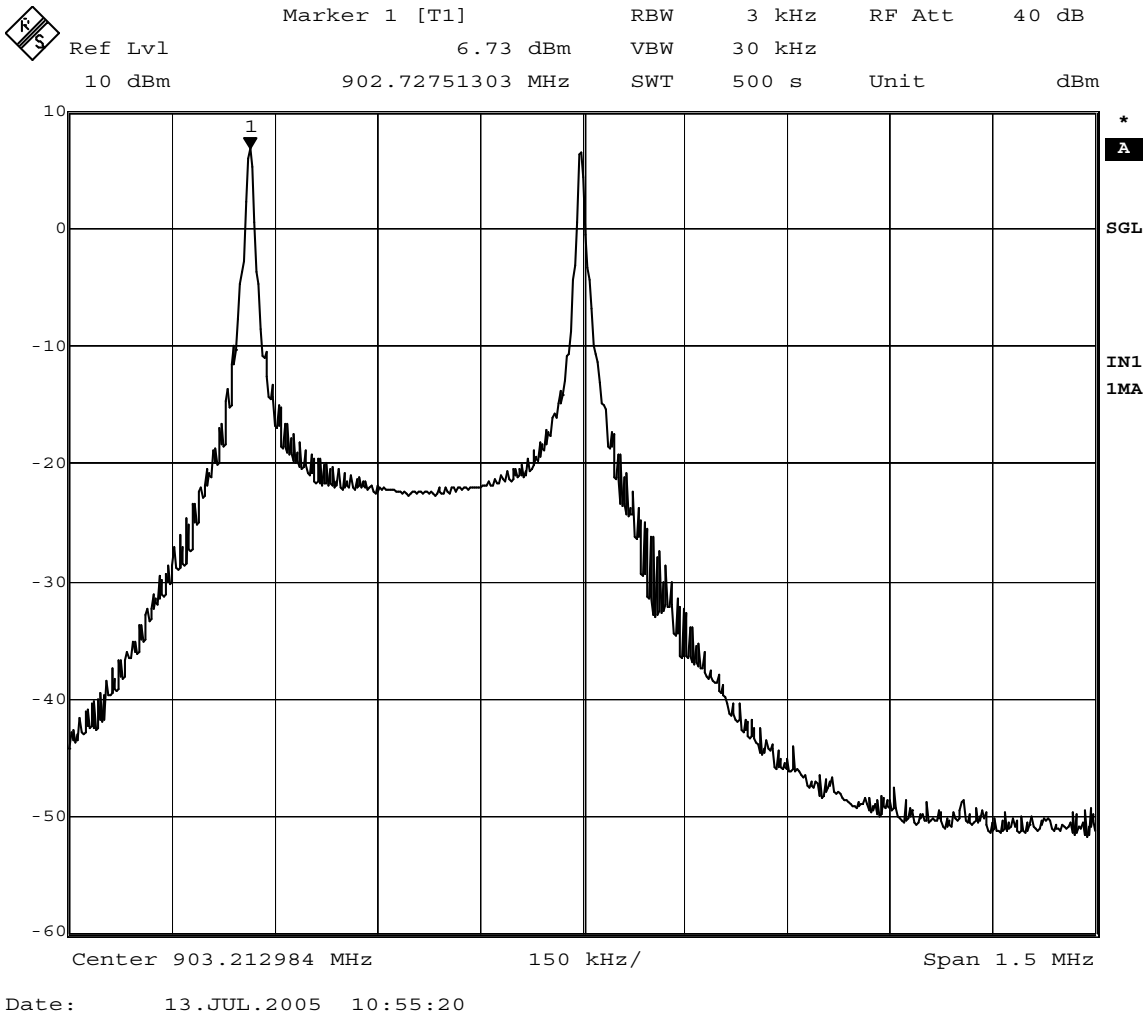

Figure 33 DTS-mode, Channel 0 PSD, 2400 baud

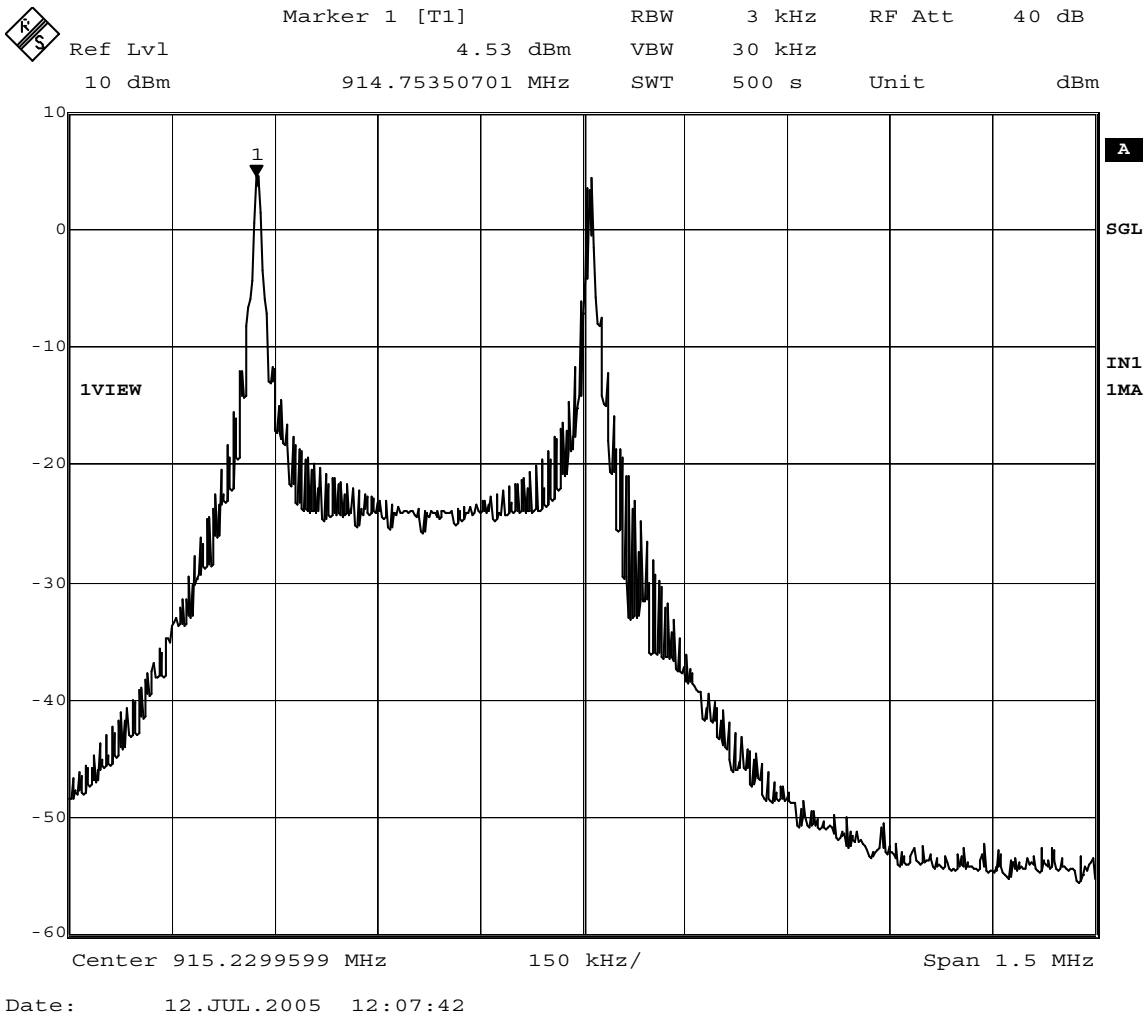

Figure 34 DTS-mode, Channel 16 PSD, 2400 baud

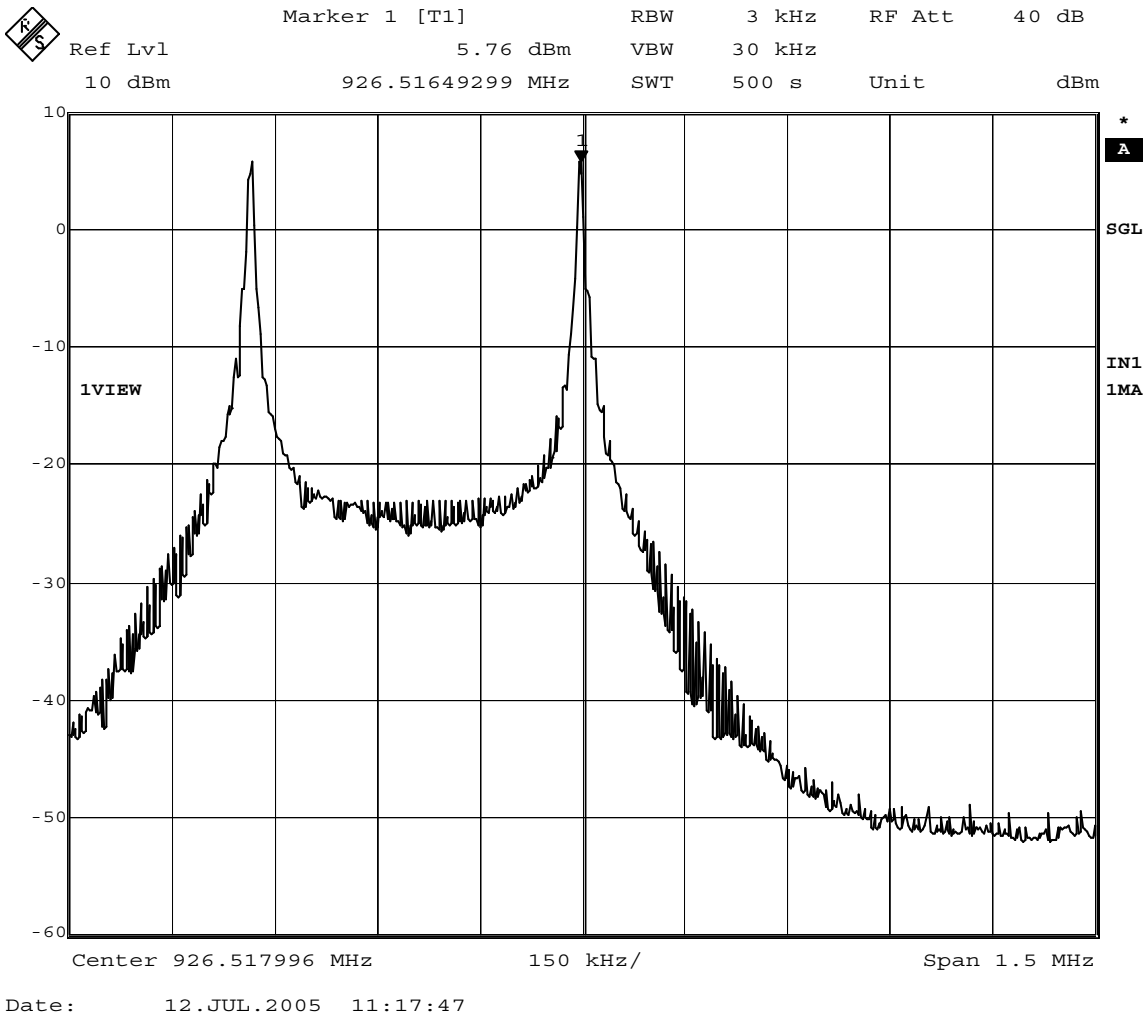

Figure 35 DTS-mode, Channel 31 PSD, 2400 baud

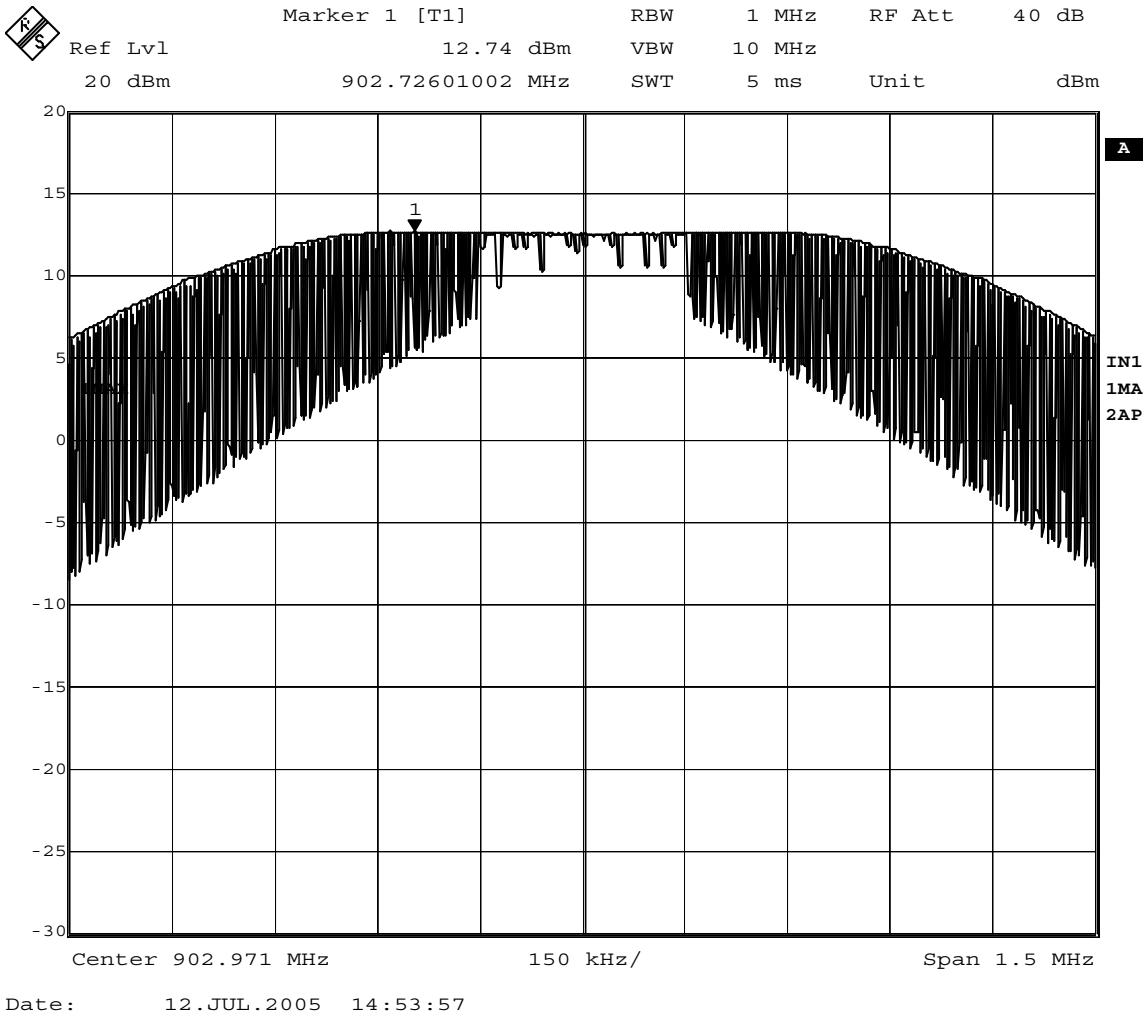

Figure 36 Maximum Power setting, DTS-mode, Ch 0, 19200 baud

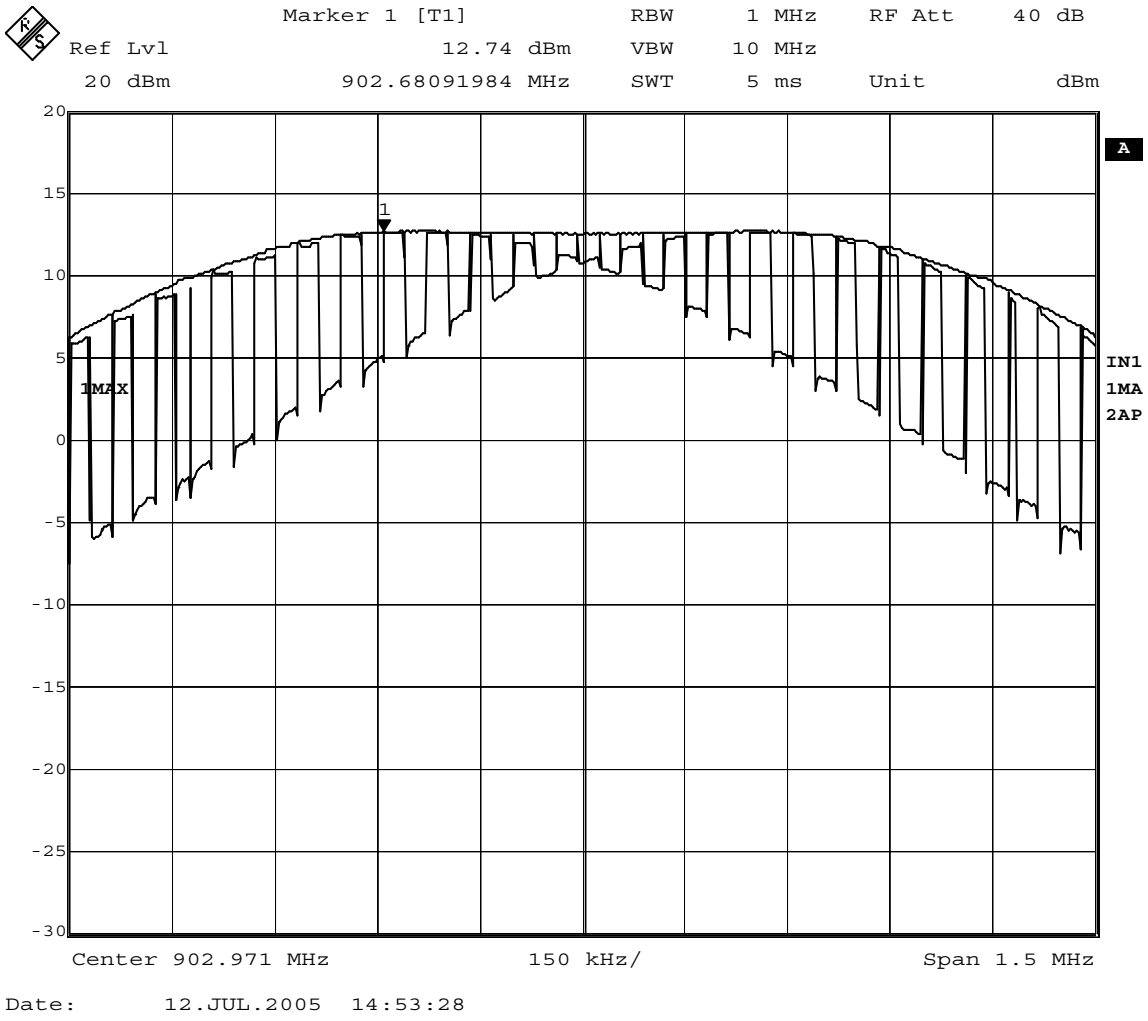

Figure 37 Maximum Power setting, DTS-mode, Ch 0, 2400 baud

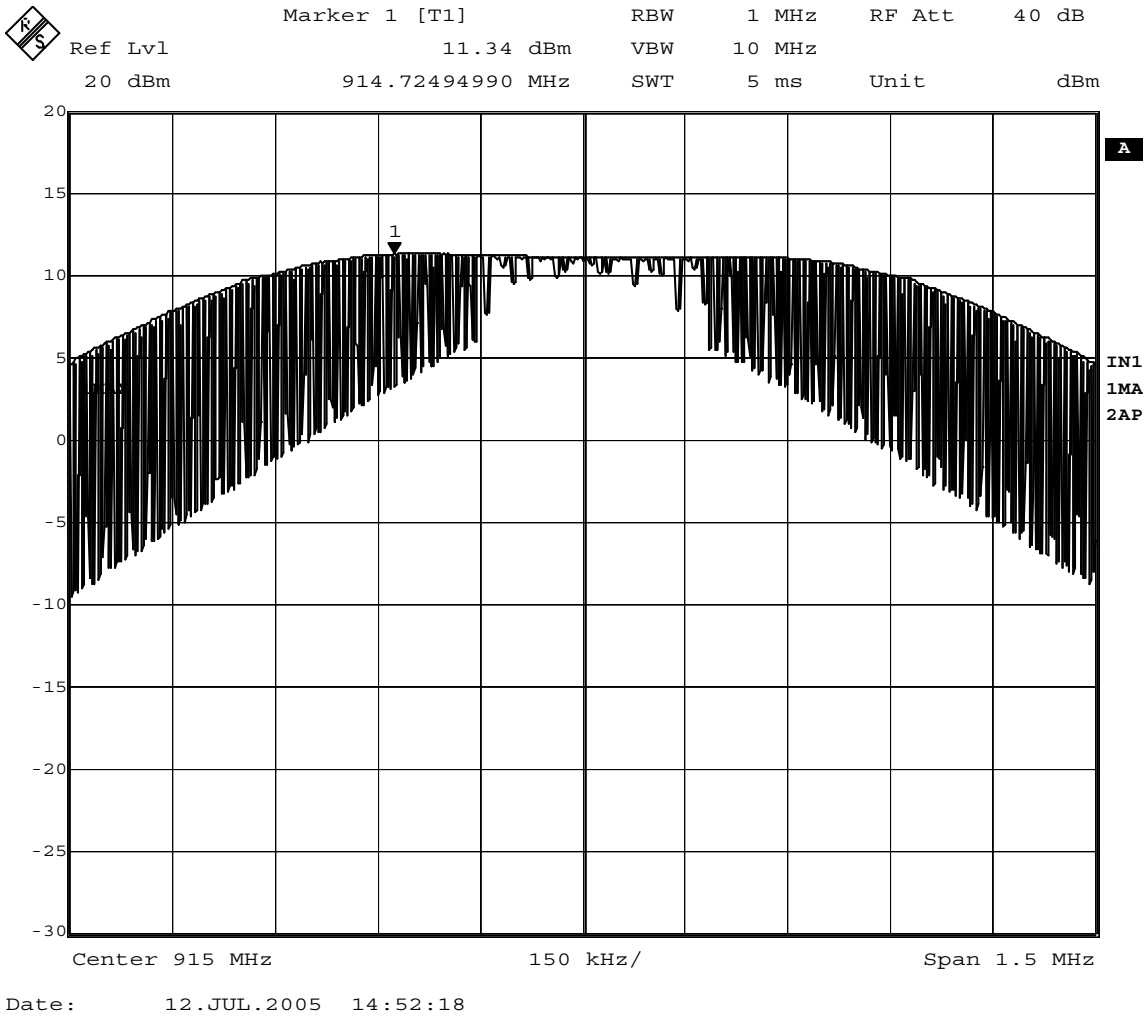

Figure 38 Maximum Power setting, DTS-mode, Ch 16, 19200 baud

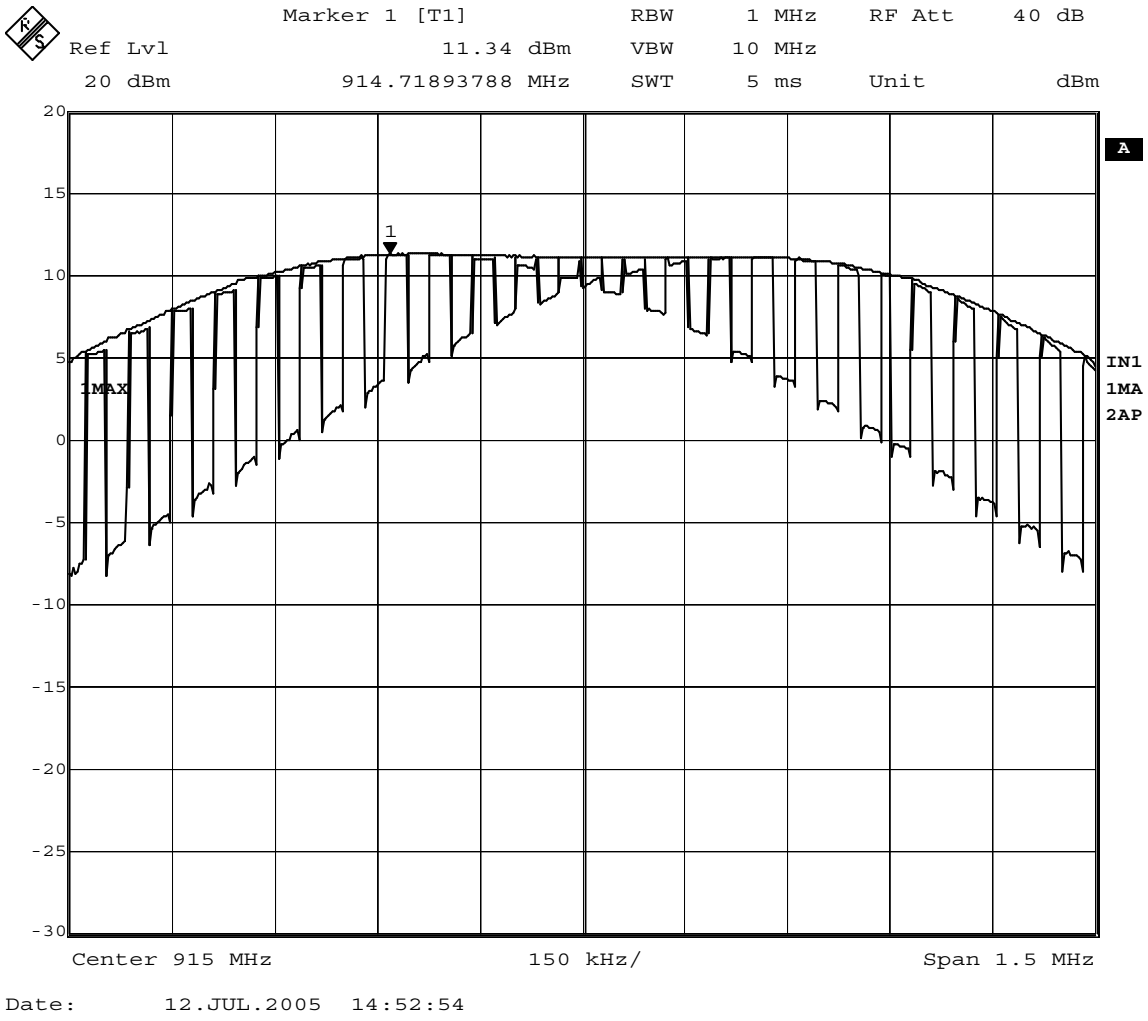

Figure 39 Maximum Power setting, DTS-mode, Ch 16, 2400 baud

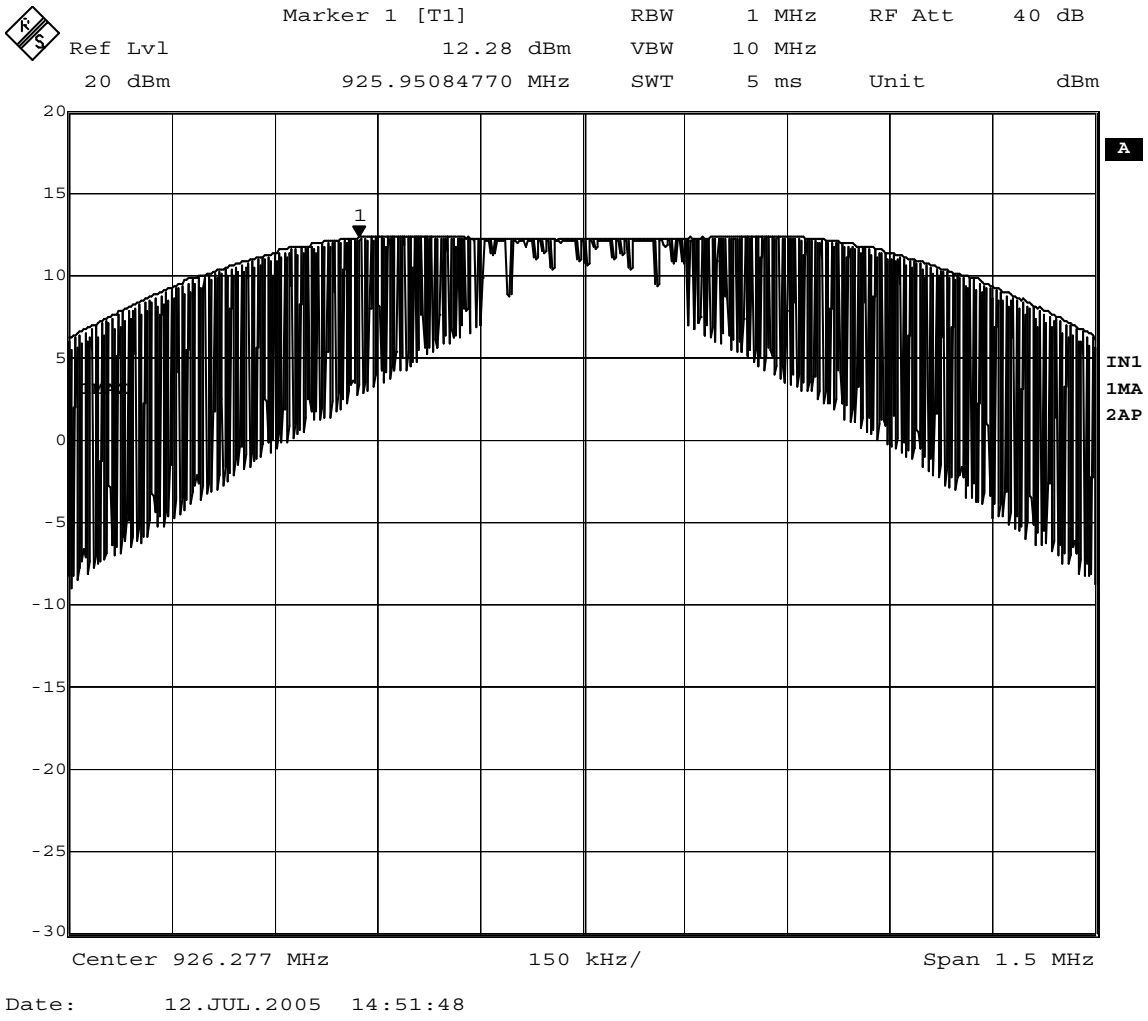

Figure 40 Maximum Power setting, DTS-mode, Ch 31, 19200 baud

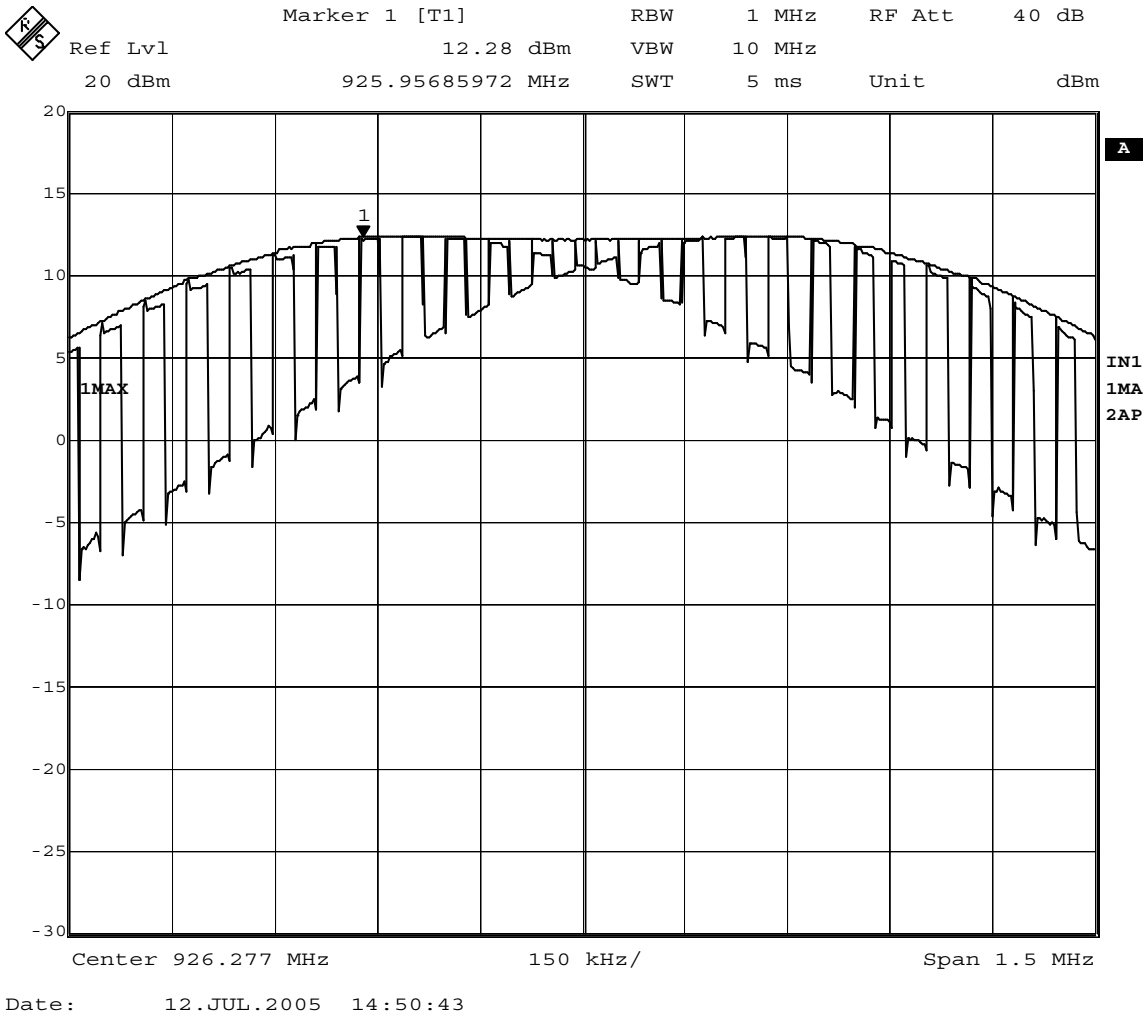

Figure 41 Maximum Power setting, DTS-mode, Ch 31, 19200 baud

Appendix G: Duty cycle measurements

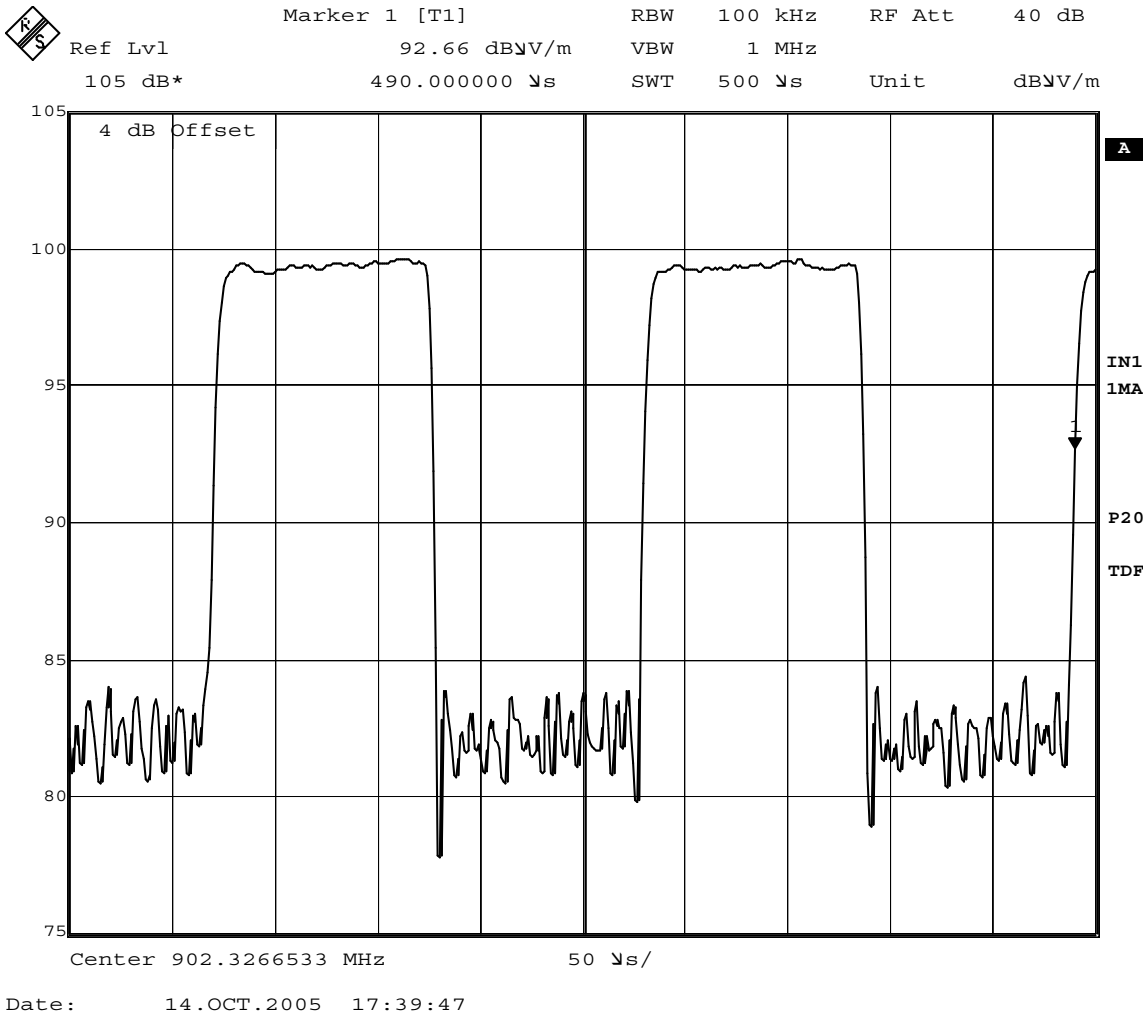

Figure 42 DTS-mode, 2400 baud, 40% duty cycle

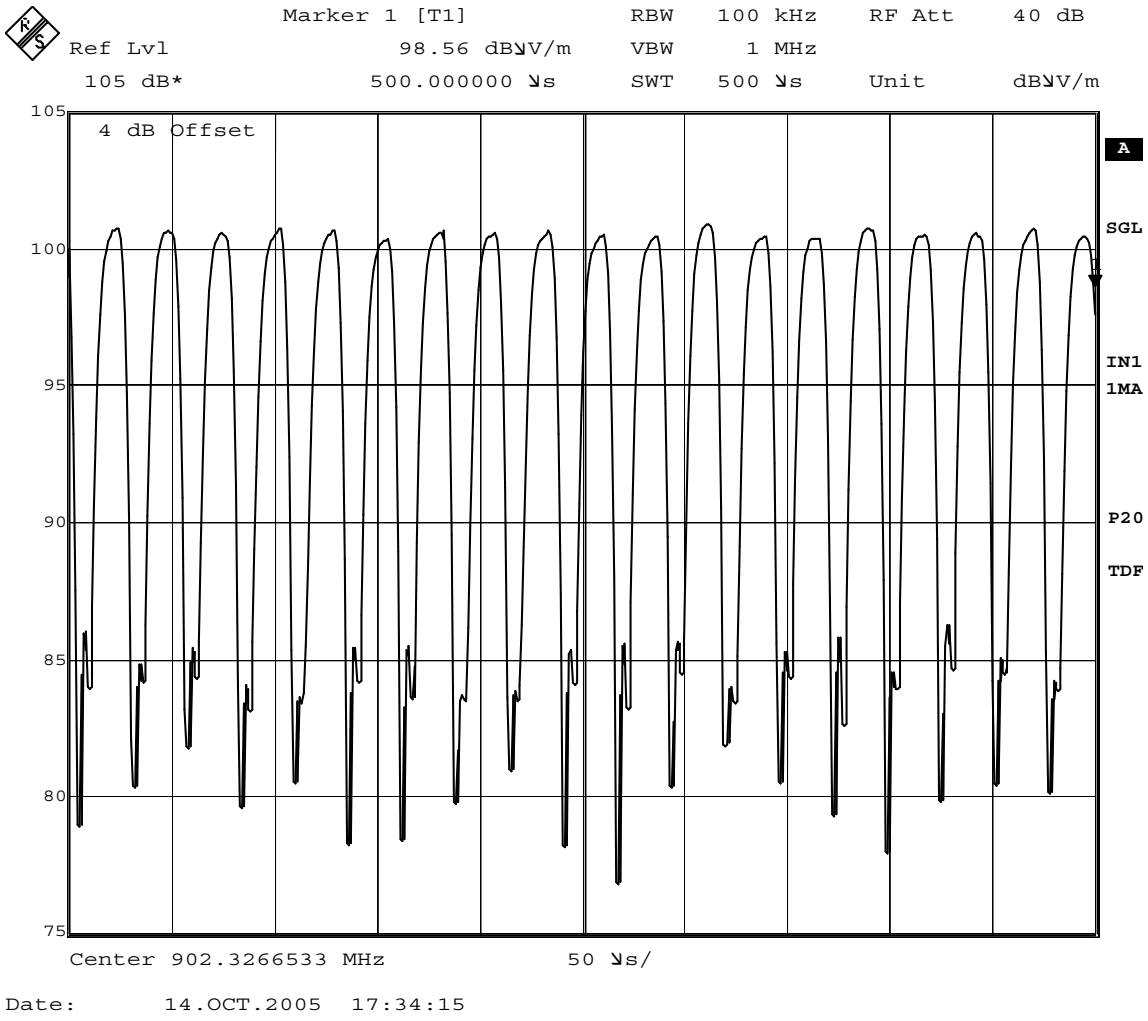

Figure 43 DTS-mode, 19200 baud, 39% duty cycle

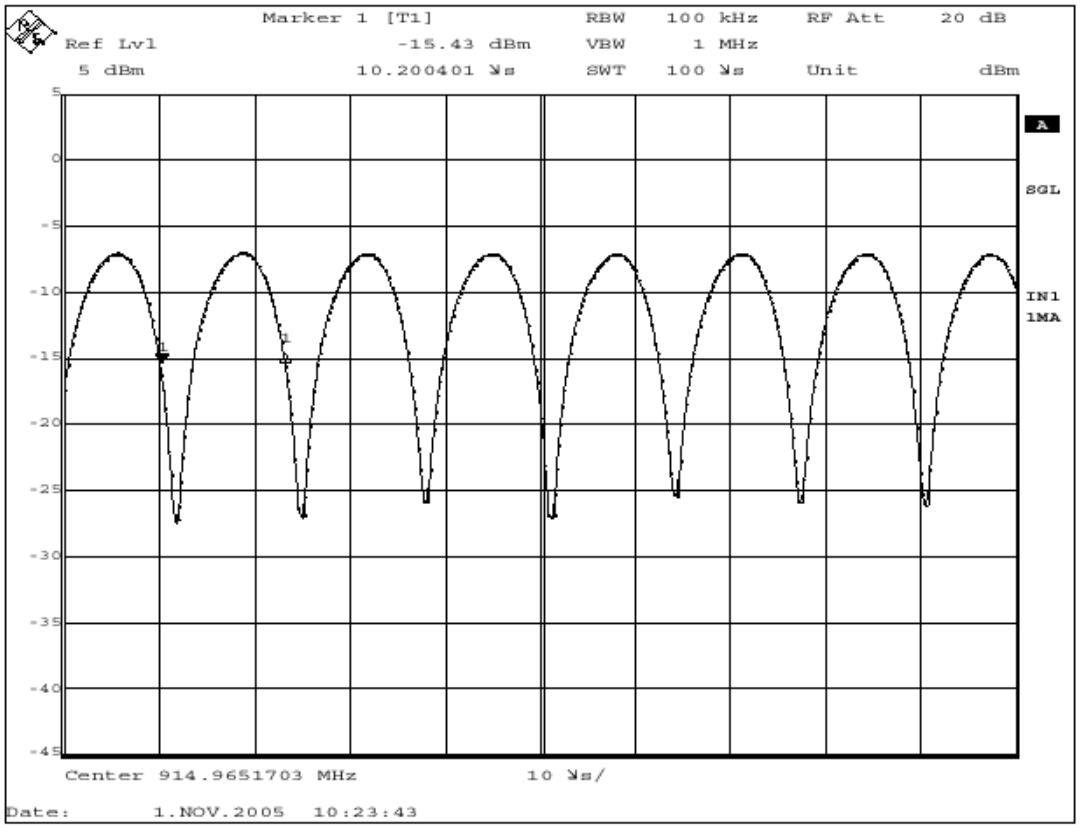

Figure 44 15200 baud LP-mode

Appendix H: SAR Evaluation

No SAR Evaluation Required if power is below the following threshold:

Tunable Range(GHz)			
F(low)	F(high)	Band center (GHz)	60/f SAR limitation (mW)
0.902	0.928	0.915	65.57377

Maximum Tx output (mW)	Max Antenna Gain (dBi)	Pout EIRP (mW)
23.7	3	47.288

Threshold for no SAR evaluation is 65.57 mW
Maximum TX Power is 23.7 mW Conducted and 47.288 mW EIRP

Conclusion: No SAR evaluation is required since maximum Transmitter output power, Pout (both conducted and EIRP) is below FCC threshold.

Appendix I: Index of Figures

Figure 1 Module and antenna (RP-SMA), shield removed, ANT-915-02A antenna 8
Figure 2 Top of FCC-Wi232 module, with shield removed 8
Figure 3 Test configuration, module on evaluation board 9
Figure 4 FCC-Wi232DTS as tested, module on evaluation board 9
Figure 5 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, measured from RP-SMA connector 11
Figure 6 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, measured from RP-SMA connector 12
Figure 7 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, 630MHz-900MHz, measured from RP-SMA connector 13
Figure 8 DTS-mode (15dBm setting), LMH channels, all bauds, measured from RP-SMA connector 14
Figure 9 DTS-mode (15dBm setting), LMH channels, all bauds, measured from RP-SMA connector 15
Figure 10 LP-mode (0dBm setting), LHM channels, all bauds, measured from RP-SMA connector 16
Figure 11 LP-mode (0dBm setting), LMH channels, all bauds, measured from RP-SMA connector 17
Figure 12 DTS and LP modes (15dBm and 0dBm settings) and all possible bauds, LMH channels, measured from RP-SMA connector 18
Figure 13 Rx, radiated emissions 20
Figure 14 Rx, radiated emissions 21
Figure 15 DTS-mode, Channel 0, 15dBm setting 23
Figure 16 DTS-mode, Channel 16, 15dBm setting 24
Figure 17 DTS-mode, Channel 31, 15dBm setting 25
Figure 18 Channel 1(902.572MHz), 902 band edge, Peak measurements, LP-mode (Channel 1 replaces Channel 0) 41
Figure 19 Tx set to Channel 1 (902.572), 902 MHz QP measurement, 52dB below fundamental of 63dB. 42
Figure 20 LP-mode, Channel 83, 928MHz band edge, Delta=50.38dB, radiated emissions measurement uncorrected 43
Figure 21 LP-mode, Channel 0, 20dB BW, 19200 baud, 483kHz 44
Figure 22 LP-mode, Channel 0, 6dB BW, 19200 baud, 297kHz 45
Figure 23 LP-mode, Channel 42, 20dB BW, 19200 baud, 463kHz 46
Figure 24 LP-mode, Channel 42, 6dB BW, 19200 baud, 295kHz 47
Figure 25 LP-mode, Channel 83, 20dB BW, 19200 baud, 495kHz 48
Figure 26 LP-mode, Channel 83, 6dB BW, 19200 baud, 297kHz 49
Figure 27 DTS-mode, Channel 0, 6dB BW, 19200 baud, 629kHz 50
Figure 28 DTS-mode, Channel 0, 20dB BW, 19200 baud, 850kHz 51
Figure 29 DTS-mode, Channel 16, 6dB BW, 19200 baud, 617kHz 52
Figure 30 DTS-mode, Channel 16, 20dB BW, 19200 baud, 829kHz 53
Figure 31 DTS-mode, Channel 31, 6dB BW, 19200 baud, 629kHz 54
Figure 32 DTS-mode, Channel 31, 20dB BW, 19200 baud, 869kHz 55
Figure 33 DTS-mode, Channel 0 PSD, 2400 baud 56
Figure 34 DTS-mode, Channel 16 PSD, 2400 baud 57

Figure 35 DTS-mode, Channel 31 PSD, 2400 baud....58
Figure 36 Maximum Power setting, DTS-mode, Ch 0, 19200 baud....59
Figure 37 Maximum Power setting, DTS-mode, Ch 0, 2400 baud....60
Figure 38 Maximum Power setting, DTS-mode, Ch 16, 19200 baud....61
Figure 39 Maximum Power setting, DTS-mode, Ch 16, 2400 baud....62
Figure 40 Maximum Power setting, DTS-mode, Ch 31, 19200 baud....63
Figure 41 Maximum Power setting, DTS-mode, Ch 31, 19200 baud....64
Figure 42 DTS-mode, 2400 baud, 40% duty cycle....66
Figure 43 DTS-mode, 19200 baud, 39% duty cycle....67
Figure 44 15200 baud LP-mode....68
Figure 45 Plot of results of testing with EUT set to 15dBm output power....75
Figure 46 Test setup of EUT, 40cm from vertical ground plane....75

Appendix J: Part 15.107/207 data

The EUT was tested for compliance to Part 15.107/207 using a RadioShack Cat. No. 273-1662A. wall adapter, as provided by NCEE set to 4.5VDC output. The EUT was shown to be in compliance with 15.107/207. Results and photos can be seen below.

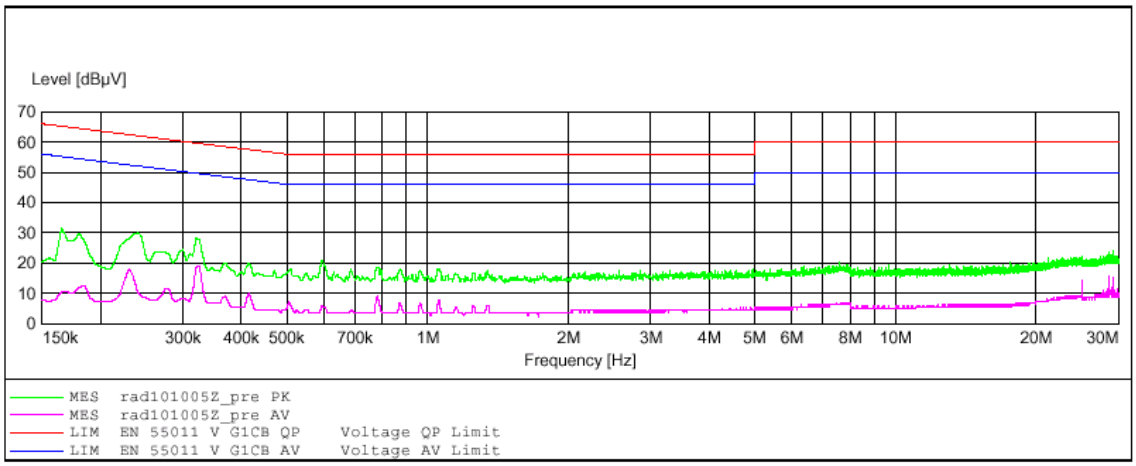

Figure 45 Plot of results of testing with EUT set to 15dBm output power

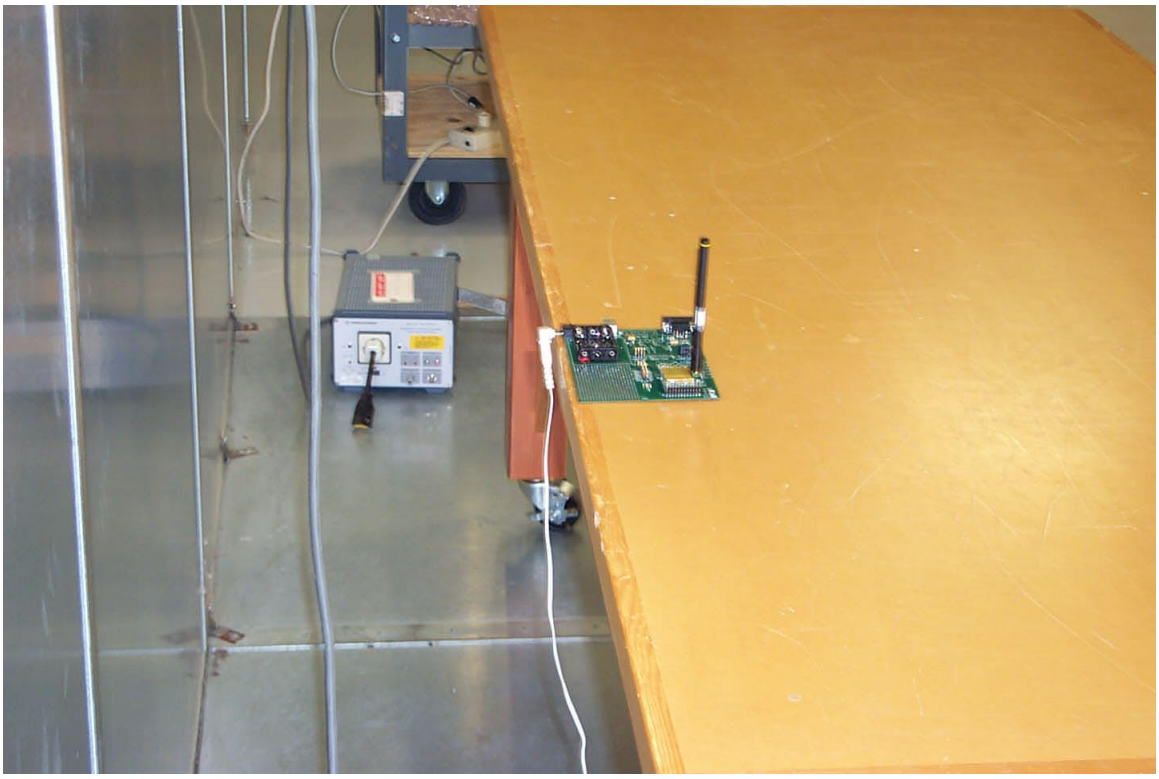

Figure 46 Test setup of EUT, 40cm from vertical ground plane

Appendix K: Frequency Table

Channel	LP Mode f, MHz	DTS Mode f, MHz
0	902.572	902.971
1	902.572	903.723
2	902.872	904.475
3	903.173	905.226
4	903.474	905.978
5	903.774	906.730
6	904.075	907.482
7	904.376	908.234
8	904.677	908.986
9	904.977	909.737
10	905.278	910.489
11	905.579	911.241
12	905.879	911.993
13	906.180	912.745
14	906.481	913.496
15	906.781	914.248
16	907.082	915.000
17	907.383	915.752
18	907.683	916.504
19	907.984	917.255
20	908.285	918.007
21	908.586	918.759
22	908.886	919.511
23	909.187	920.263
24	909.488	921.015
25	909.788	921.766
26	910.089	922.518
27	910.390	923.270
28	910.690	924.022
29	910.991	924.774
30	911.292	925.525
31	911.592	926.277
32	911.893	N/A
33	912.194	N/A
34	912.494	N/A
35	912.795	N/A
36	913.096	N/A
37	913.397	N/A
38	913.697	N/A
39	913.998	N/A
40	914.299	N/A
41	914.599	N/A

Channel	LP Mode f, MHz	DTS Mode f, MHz
42	914.900	N/A
43	915.201	N/A
44	915.501	N/A
45	915.802	N/A
46	916.103	N/A
47	916.403	N/A
48	916.704	N/A
49	917.005	N/A
50	917.306	N/A
51	917.606	N/A
52	917.907	N/A
53	918.208	N/A
54	918.508	N/A
55	918.809	N/A
56	919.110	N/A
57	919.410	N/A
58	919.711	N/A
59	920.012	N/A
60	920.312	N/A
61	920.613	N/A
62	920.914	N/A
63	921.215	N/A
64	921.515	N/A
65	921.816	N/A
66	922.117	N/A
67	922.417	N/A
68	922.718	N/A
69	923.019	N/A
70	923.319	N/A
71	923.620	N/A
72	923.921	N/A
73	924.221	N/A
74	924.522	N/A
75	924.823	N/A
76	925.123	N/A
77	925.424	N/A
78	925.725	N/A
79	926.026	N/A
80	926.326	N/A
81	926.627	N/A
82	926.928	N/A
83	927.228	N/A