

Test Report

Report Number: 3098380MPK-001

Project Number: 3098380

May 31, 2006

Testing performed on the

Repeater

Model Numbers: RE-S1

FCC ID: LCB-060501

to

FCC Part 15 Subpart C

RSS-210 Annex 8

for

Topcon Positioning Systems, Inc.



A2LA Certificate Number: 1755-01

Test Performed by:

Intertek Testing Services NA Inc.
1365 Adams Court
Menlo Park, CA 94025

Test Authorized by:

Topcon Positioning Systems
7400 National Drive
Livermore CA 94551

Prepared by:

Handwritten signature of Krishna K Vemuri in blue ink.

Krishna K Vemuri

Date: May 31, 2006

Reviewed by:

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David Chernomordik, EMC Technical Manager

Date: May 31, 2006

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1.0 Introduction

This report is intended to show compliance of the Topcon Repeater, model RE-S1 to the requirements of FCC Part 15.247 Specification.

As declared by the Applicant, the transmitter module, used in Repeater, is identical (unmodified) to the module used in the other device: Hiper Lite, Model: 01-840802-03, which has been certified (FCC ID: LCB-840802). Therefore, the following test results from the original Application are applicable to the Repeater (see test report #30394451, issued July 30, 2003):

TEST	REFERENCE FCC 15.247	REFERENCE RSS-210 (A8)	RESULTS
Output Power, EIRP	15.247(b)(1)	A8.4	Complies, verified*
20 dB Bandwidth	15.247(a)(1)	A8.1	Complies
Min. Channel Separation	15.247(a)(1)	A8.1	Complies
Min. Hopping Channels	15.247(a)(1)	A8.1	Complies
Average Channel Occupancy Time	15.247(a)(1)	A8.1	Complies
Out-of-band Antenna Conducted Emission	15.247(c)	A8.5	Complies

* See test results in Appendix 1.

Since the Transmitter module is installed in a new host, the only required tests are:

- Radiated emissions in the restricted bands,
- AC line-conducted emissions.

2.0 Summary of Tests

TEST	REFERENCE	RESULTS
Radiated Emission in Restricted Bands	15.247(c), 15.205	Complies
AC Conducted Emission	15.207	Complies

3.0 General Description

3.1 Product Description

Overview of the Transmitter module

Applicant	Topcon Positioning Systems 7400 National Drive Livermore CA 94551
Manufacturer name & address	Topcon Positioning Systems 7400 National Drive Livermore CA 94551
Trade Name & Model No.	Topcon, RE-S1
FCC Identifier	LCB-840802
Use of Product	GPS Survey Receiver
Type of Transmission	Spread Spectrum, Frequency Hopping
Rated RF Output	1 W
Frequency Range	902.2 – 927.6 MHz
Number of Channel(s)	128
Baude Rate/Link Rate	Up to 57600 bps
Antenna(s) type & Gain	Model: DEXRN902RTN from Antenex, swivel, 1/2 wave, 2.5 dBi
Antenna Requirement	The antenna is affixed to the EUT using a reverse polarity TNC connector.
LO Frequencies	LO1: 1172.2 – 1197.6 MHz; LO2: 280.7 MHz

3.2 Related Submittal(s) Grants

None.

3.3 Test Methodology

Radiated and AC Line conducted emissions measurements were performed according to the procedures in ANSI C63.4 (2003). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Data Sheet**" of this Application. All other measurements were made in accordance with the procedures described in DA 00-705.

3.4 Test Facility

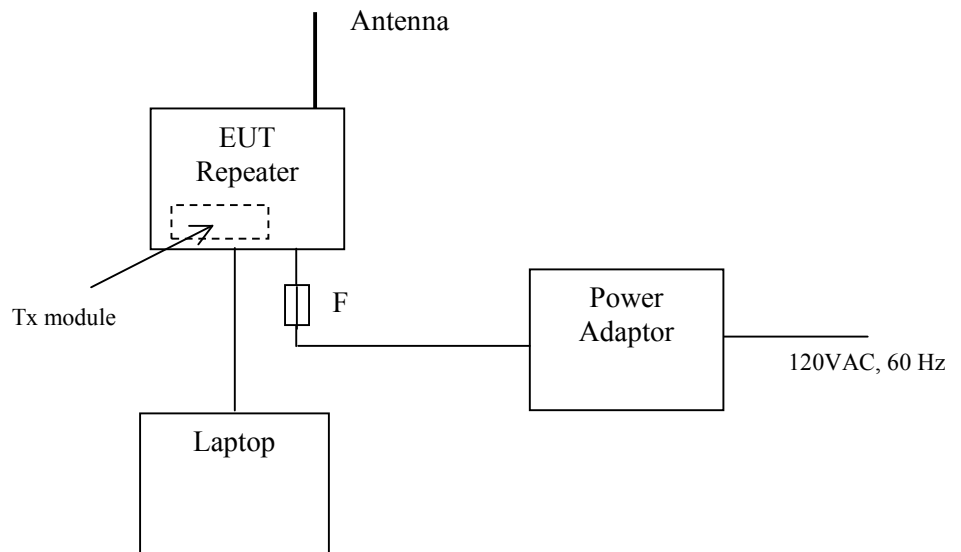
Then radiated emission test site and conducted measurement facility used to collect the data is site 1 located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC.

4.0 System Test Configuration

4.1 Support Equipment

Item #	Description	Model No.	Serial No.
1	Compaq Laptop	Armada	7933CY570157

4.2 Block Diagram of Test Setup



S = Shielded	F = With Ferrite
U = Unshielded	m = Length in Meters

4.3 Justification

For radiated emission measurements the EUT is placed on a plastic table. The EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power. During testing, all cables are manipulated to produce worst-case emissions.

4.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was “Survey-Pro for Ranger” which exercised the various system components in a manner similar to a typical use.

4.5 Mode of Operation During Test

The EUT was setup in test mode. With hopping disabled, the EUT was setup to transmit continuously at the lowest, middle, and highest channels (frequencies).

4.6 Modifications Required for Compliance

No modifications were installed by Intertek Testing Services during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by Topcon prior to compliance testing).

5.0 Transmitter Radiated Emissions in Restricted Bands

FCC 15.247 (c), 15.205

5.1 Procedure

Radiated emission measurements were performed from 30 MHz to 25,000 MHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz - for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

5.2 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:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength in dB(μ V/m)

RA = Receiver Amplitude (including preamplifier) in dB(μ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB

AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB(μ V) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB(μ V/m). This value in dB(μ V/m) was converted to its corresponding level in μ V/m.

$$RA = 52.0 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(1/\text{m})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 52.0 + 7.4 + 1.6 - 29.0 = 32 \text{ dB}(\mu\text{V}/\text{m})$$

$$\text{Level in } \mu\text{V}/\text{m} = \text{Common Antilogarithm } [(32 \text{ dB}\mu\text{V}/\text{m})/20] = 39.8 \mu\text{V}/\text{m}$$

5.3 Test Result

Tested By:	Krishna K Vemuri
Test Date:	May 16, 2006

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

The EUT passed the test by 7.3 dB.

Test Result									
FCC Part 15.247 Radiated Emission in restricted bands									
Temperature: 21.0 C					Topcon Positioning Systems				
Humidity: 44 %					Model: RE-S1				
Test distance = 3 m					Engineer: Krishna K Vemuri				
Test date: May 16, 2006									
Frequency MHz	Polarity	Detector	SA reading dB(μ V)	Cable loss dB	Pre-amp gain dB	Ant. factor dB(1/m)	Field Strength dB(μ V /m)	Limit dB(μ V /m)	Margin dB
Tx, @ 902.2 MHz									
2706.6	V	Average	30.7	4.0	28.0	29.6	36.3	54.0	-17.7
3608.8	V	Average	26.9	5.2	28.5	31.6	35.2	54.0	-18.9
4511.0	V	Average	35.2	7.7	29.0	32.8	46.7	54.0	-7.3
5413.2	V	Average	23.3	8.1	29.5	34.4	36.3	54.0	-17.7
8119.8	V/H	Average	17.8*	8.3	28.1	38.5	36.5	54.0	-17.5
9022.0	V/H	Average	17.5*	8.3	28.0	38.5	36.3	54.0	-17.7
Tx, @ 915.6 MHz									
2746.8	V	Average	25.8	4.0	28.0	29.7	31.5	54.0	-22.5
3662.4	V	Average	25.4	5.3	28.5	31.7	33.9	54.0	-20.3
4578.0	V	Average	31.0	7.9	29.0	33.0	42.9	54.0	-11.1
7324.8	V/H	Average	17.0*	7.6	29.5	36.6	31.7	54.0	-22.3
8240.4	V/H	Average	17.8*	8.3	28.1	38.3	36.3	54.0	-17.7
9156.0	V/H	Average	17.3*	8.3	27.9	38.5	36.2	54.0	-17.8
Tx, @ 927.6 MHz									
2782.8	V	Average	25.2	4.1	28.1	29.7	30.9	54.0	-23.1
3710.4	V	Average	17.9	5.4	28.6	31.8	26.5	54.0	-27.5
4638.0	V	Average	29.0	8.1	29.1	33.2	41.2	54.0	-12.9
7420.8	V/H	Average	17.2*	7.7	29.3	36.6	32.2	54.0	-21.8
8348.4	V/H	Average	17.6*	8.3	28.1	38.1	35.9	54.0	-18.1

* Noise floor

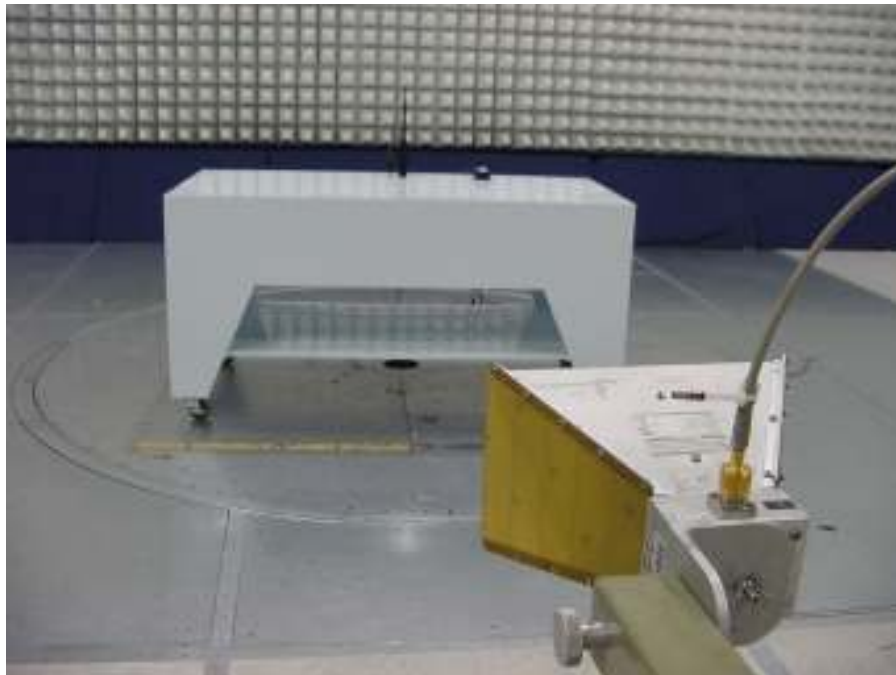
All other emissions not reported are noise floor which is at least 10 dB below the limit.

Notes: Average value was measured with RBW = 1MHz, VBW = 1 KHz

Peak reading exceeds the average reading by no more than 10 dB. Therefore, the EUT is in compliance with the peak field strength limit of 74 dB(μ V /m).

5.4 Configuration Photographs

Radiated Emission Test Setup



6.0 AC Line Conducted Emission
FCC 15.207:

6.1 AC Line Conducted Emission Limits

FCC 15.207/CISPR 22 Class B AC Line-Conducted Emissions		
Frequency (MHz)	Limits (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56 decreases linearly with the logarithm of the frequency	56 to 46 decreases linearly with the logarithm of the frequency
0.50 to 5.0	56	46
5 to 30.0	60	50

Note: The lower limit shall apply at the transition frequency.

6.2 Procedure

AC line conducted emission test was performed according the ANSI C63.4 (2003) standard. The EUT was connected to AC Line through the LISNs.

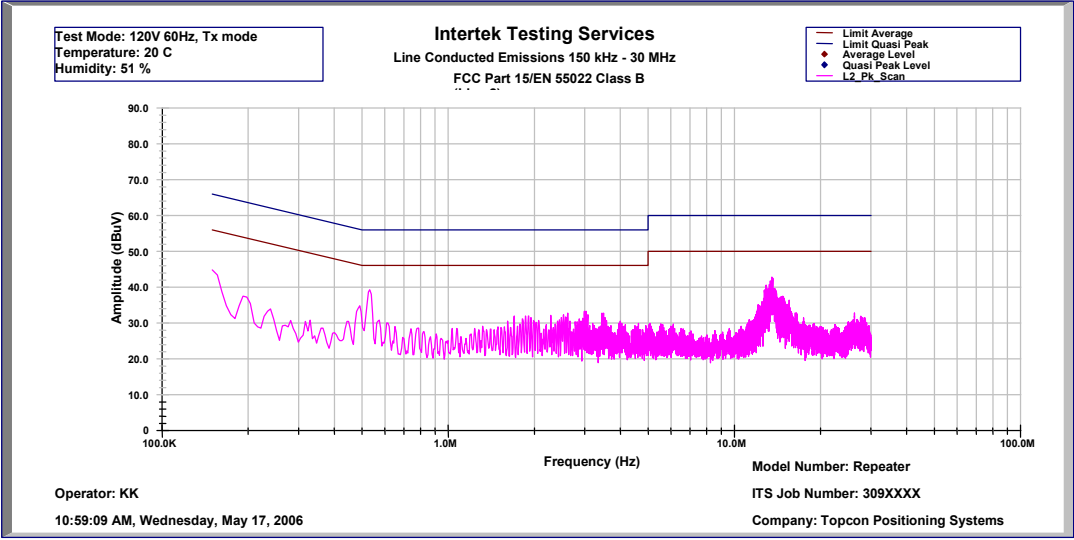
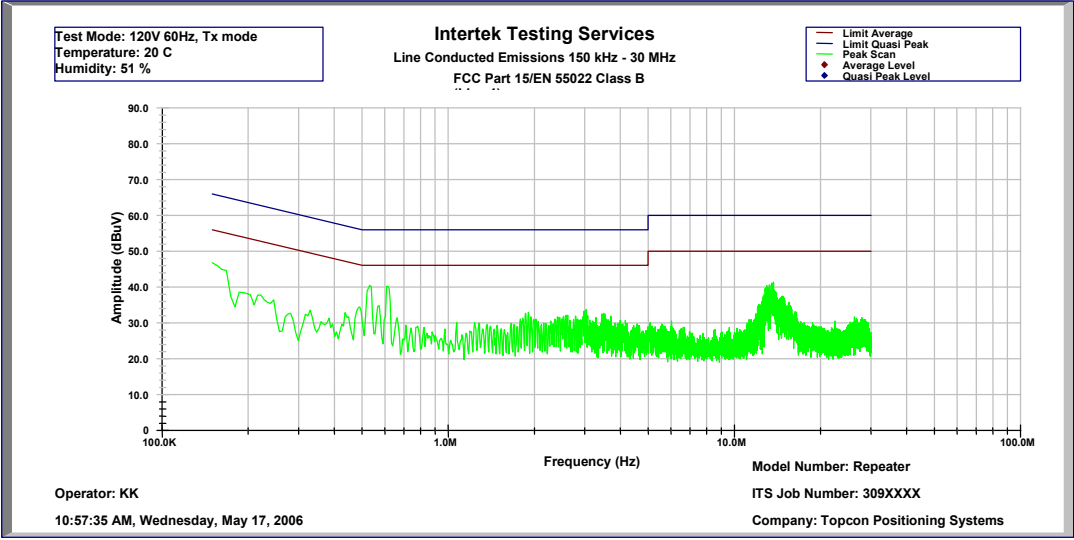
6.3 Test Result

Tested By:	Krishna K Vemuri
Test Date:	May 17, 2006

The EUT met the conducted disturbance requirements of FCC 15.207/CISPR 22 Class B. The test results are located on the following page(s).

A complete scan was made from 0.15 MHz to 30 MHz.

Results:	Complies by 5.6 dB at 532.0 kHz
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Intertek Ttesting Services	
Line Conducted Emissions 150 kHz - 30 MHz	
FCC 15.207/EN 55022 Class B (Line 1)	
Operator: KK	Model Number: RE-S1
	ITS Job Number: 3098380
10:57:35 AM, Wednesday, May 17, 2006	Company: Topcon Positioning Systems

Frequency MHz	Pk Level (dBuV)	Av Limit (dBuV)	QP Limit (dBuV)	Worst-case Margin (dB)
0.150	46.8	56	66	-9.2
0.185	38.6	55	65	-16.4
0.532	40.4	46	56	-5.6
0.609	40.2	46	56	-5.8
12.729	37.9	50	60	-12.1
12.812	39.5	50	60	-10.5
12.902	39.9	50	60	-10.1
12.985	40.3	50	60	-9.7
13.087	39.9	50	60	-10.1
13.158	39.1	50	60	-10.9
13.260	40.5	50	60	-9.5
13.367	38.9	50	60	-11.1
13.439	40.5	50	60	-9.5
13.529	41.1	50	60	-8.9
13.612	38.3	50	60	-11.7
13.708	41.3	50	60	-8.7
13.773	39.1	50	60	-10.9
13.863	38.7	50	60	-11.3
13.947	38.5	50	60	-11.5
14.735	37.5	50	60	-12.5

Temperature: 20 C

Humidity: 51 %

Intertek Ttesting Services	
Line Conducted Emissions 150 kHz - 30 MHz	
FCC 15.207/EN 55022 Class B (Line 2)	
Operator: KK	Model Number: RE-S1
	ITS Job Number: 3098380
10:59:09 AM, Wednesday, May 17, 2006	Company: Topcon Positioning Systems

Frequency MHz	Pk Level (dBuV)	Av Limit (dBuV)	QP Limit (dBuV)	Worst-case Margin (dB)
0.150	44.8	56	66	-11.2
0.532	39.2	46	56	-6.8
12.728	39.1	50	60	-10.9
12.812	39.3	50	60	-10.7
12.914	40.5	50	60	-9.5
12.985	39.7	50	60	-10.3
13.075	39.1	50	60	-10.9
13.099	38.5	50	60	-11.5
13.176	39.5	50	60	-10.5
13.260	40.7	50	60	-9.3
13.350	41.7	50	60	-8.3
13.367	38.7	50	60	-11.3
13.445	41.3	50	60	-8.7
13.529	42.7	50	60	-7.3
13.612	42.5	50	60	-7.5
13.684	38.9	50	60	-11.1
13.780	39.5	50	60	-10.5
13.863	39.5	50	60	-10.5
13.952	39.1	50	60	-10.9
14.036	38.5	50	60	-11.5

Temperature: 20 C

Humidity: 51 %

6.4 Test Configuration Photographs



7.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
BI-Log Antenna	EMCO	3143	9509-1160	12	11/29/06
Horn Antenna	EMCO	3115	9107-3712	12	6/8/06
Pre-Amplifier	Sonoma Inst.	310	185634	12	7/05/06
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	7/05/06
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	9/12/06
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	9/12/06
Spectrum Analyzer 8566B w/85650A QP Adapter	Hewlett Packard	8566B	2416A00317 2043A00251	12	8/25/06
Spectrum Analyzer	R & S	FSP40	036612004	12	10/3/06
LISN	FCC	FCC-LISN-50-50-M-H	2012	12	6/6/06

No Calibration required

8.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / 3098380	KK	May 31, 2006	Original document

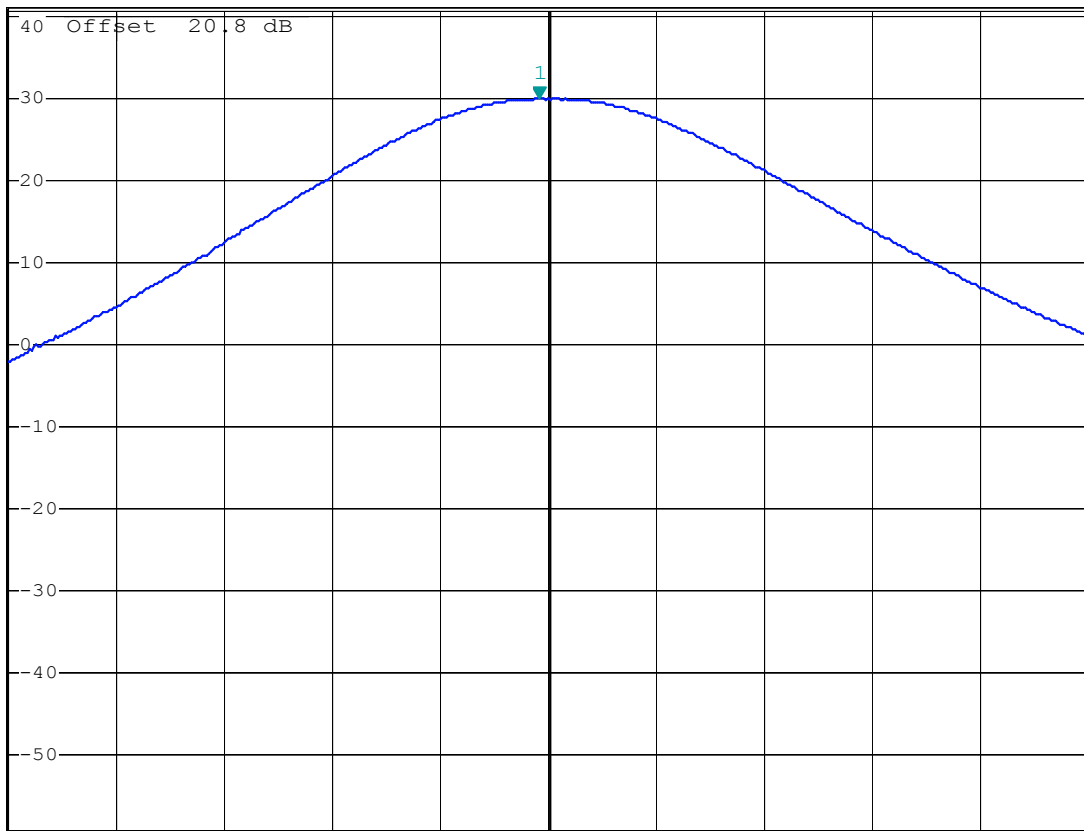
9.0 Appendix 1 - Output Power graphs



*RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 29.79 dBm
 SWT 2.5 ms 902.16000000 MHz

Ref 40.8 dBm Att 50 dB

1 PK
 MAXH

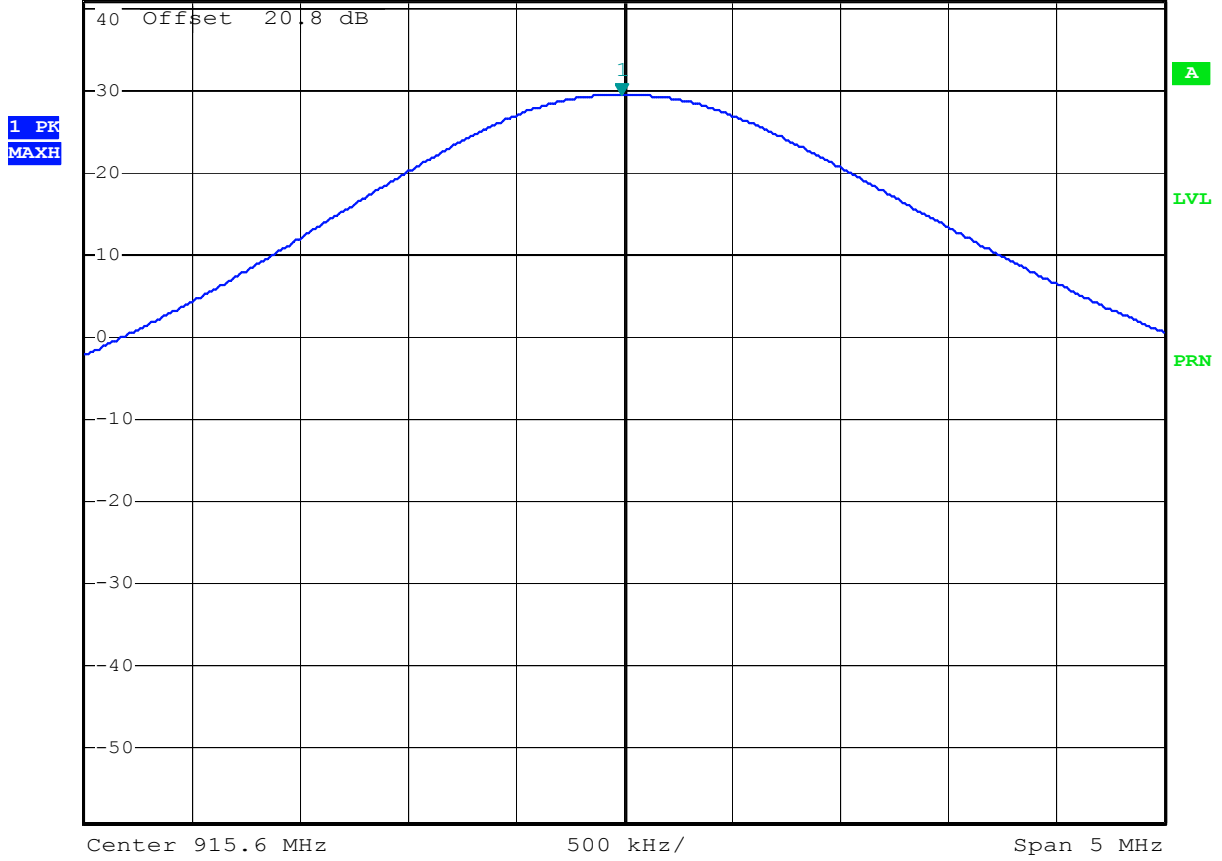


Center 902.2 MHz 500 kHz/ Span 5 MHz

Comment: Repeater, Output Power, 902.2 MHz
 Date: 16.MAY.2006 10:10:18



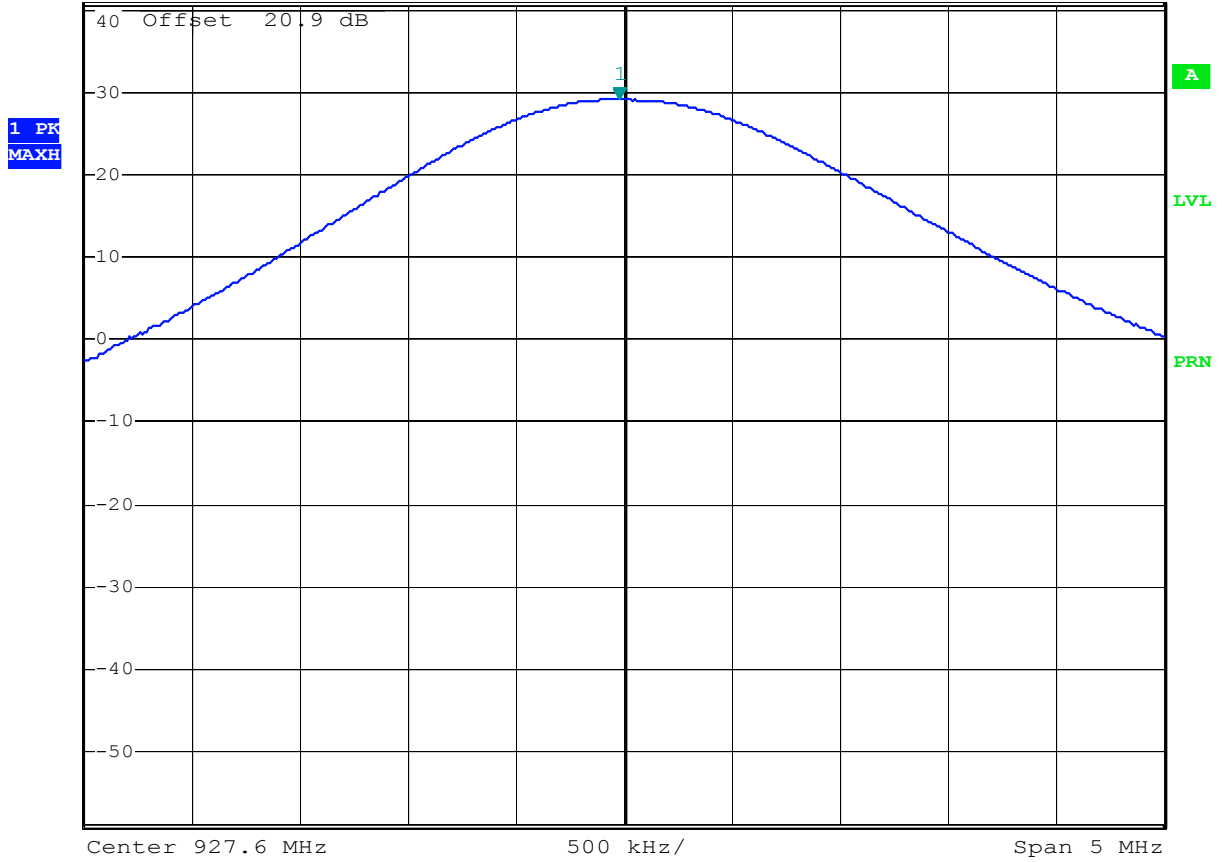
*RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 29.35 dBm
 Ref 40.8 dBm Att 50 dB SWT 2.5 ms 915.59000000 MHz



Comment: Repeater, Output Power, 915.6 MHz
 Date: 16.MAY.2006 10:27:46



*RBW 1 MHz Marker 1 [T1]
 VBW 3 MHz 29.19 dBm
 Ref 40.9 dBm Att 50 dB SWT 2.5 ms 927.58000000 MHz



Comment: Repeater, Output Power, 927.6 MHz
 Date: 16.MAY.2006 10:36:33