Test Report to

ITU-R M.1176

Echomax Active-XS

Dual Band Radar Target Enhancer

4th April 2011

OPERATIONAL TEST REPORT

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1. Introduction

This test report covers the requirements for Echomax Active-XS Dual Band Active Radar Target Enhancer as specified in ITU-R M.1176(1995).

The equipment was tested at the radar test range of QinetiQ Ltd., (Funtington) and data for this report has been calculated from results in the ISO8729-2 report number QINETIQ/TS/SDS/CR1002449. Supplementary testing was carried out in the facility of Ocean Signal Limited.

Testing was carried out by Ocean Signal Ltd. on behalf of the Active-XS manufacturer:-

Aquamate Products Ltd., Champers Farm, Bardfield End Green, Thaxted, Dunmow, Essex CM6 3PX

1.1. Product Description

The equipment covered by this report comprised of the Active-XS Dual Band Radar Target Enhancer (RTE) and its associated terminal connection box. The Active-XS consists of dual receiving antennas, amplifiers and transmitting antennas. The Active-XS RTE is designed to enhance the determination of position of small targets by shipborne S-band radars used in the band 2900MHz - 3100MHz and by shipborne X-band radars used in the band 9300 – 9500MHz.

The construction of the Active-XS is similar to that of the Active-X (FCC ID: XZMACTIVE-X). The S-band electronic module is mounted on the existing X-band assembly and connected to the two S-band antenna assemblies via coaxial cables.

The intended operating voltage for the EUT is 10.8V to 15.6V DC. In all applicable tests the RTE power supply was provided by a 12V DC laboratory power supply.

This report has been prepared taking into account the requirements of IMO MSC.164(78) and the terms and conditions specified in FCC waiver document DA 10-2438.

1.2. Test Locations

Testing was carried out at the following sites

QinetiQ, Common Road, Funtington, Chichester, PO18 9PD

and

Ocean Signal Ltd, Unit 4 Ocivan Way, Margate, Kent CT9 4NN

Report prepared by: ..... Date: 4/3/2011

Report checked by: ..... Date: 4/3/2011

2. Test Summary

ITU-R M.1176 Annex 1	Test Description	Result
1	Polarization	PASS
1	Beamwidth; 360° horizontal within ±3dB	PASS
1	Beamwidth; ±15° vertical to ±3dB	PASS
2	Broadband over the frequency range 2900 to 3100MHz Broadband over frequency band 9300 to 9500MHz	PASS
2	Amplification; minimum 50dB including antenna gain, subject to waiver in DA 10-2438 for S-band gain	PASS
2	Output form	PASS
2	e.i.r.p. at limiting level	PASS

Table 1: ITU-R M.1176 Test Summary

2.1. Test Result

The supplied test sample of the Echomax Active-XS Radar Target Enhancer successfully passed the series of tests outlined above. This demonstrates the operational performance of the Active-XS Radar Target Enhancer.

2.2. Test Acknowledgment

Testing in the anechoic chamber at QinetiQ Ltd (Funtington) was carried out by Steve Luke of Qinetiq in the presence of Simon Nolan from Ocean Signal on 19/03/2010.

3. Test Equipment Used

QinetiQ Funtington Calibrated RCS Anechoic Measurement Chamber and associated test equipment. See test report QINETIQ/TS/SDS/CR1002449 for details.

No.	Test Equipment	Manufacturer	Model No.	Serial No.
NAV1307	Anechoic Chamber	MPE	-	SN: C1162-D1
NAV2043	Spectrum Analyser	Rohde & Schwarz	FSP	SN: 100404
NAV2045	Horn Antenna	Rohde & Schwarz	HF906	SN: 100287
C002	N-Type Cable 10m	Teledyne	-	-
C012	N-Type Cable 3m	Teledyne	-	-
	6200 Scalar Analyser	Marconi	6200	SN
	20dB Attenuator (26GHz)	Hewlett Packard	8493C-20	n/a

Table 2: Pulse length, Power Emissions, Amplifier Gain, Test Equipment

	Excitation Signal Generation / EUT monitoring – All Tests			
No.	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**
	Pulse Generator	Lyons Instruments	PG-2E	SN: 5176
NAV2043	Spectrum Analyser	Rohde & Schwarz	FSP	SN: 100404
-	9.4 GHz Signal Source	Ocean Signal Ltd	-	-
-	6dB Attenuator	HP	8473B	SN: 04917
	Microwave Switch	HP	33144A	SN: 04284
	Switch Driver	HP	33190B	SN: 02187
-	Waveguide to Coax Transition	FMI	-	-
-	Waveguide to Coax Transition	FMI	-	-
	PSU	WEIR	460	SN: 731012
	PSU	Navico	PSU1208	SN: KF0540
	Horn Antenna X-Band	Plessey	3102	SN: 0001
	Horn Antenna X-Band	Plessey	3102	SN: 0002

Table 3: General Equipment Used for Excitation Signal and Monitoring EUT

4. Operation Test Results

Operation tests are in accordance with Annex 1.

4.1. Annex 1, Item 1: Antenna performance

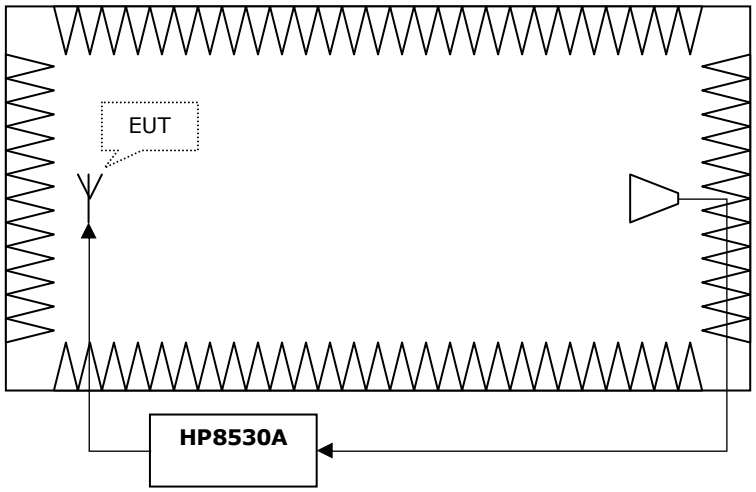
4.1.1. Test Method

Testing was carried out in the Funtington calibrated anechoic test chamber on 19/03/2010.

The Active-XS RTE assembly was mounted on the rotating test fixture and the SPL performance of measured. SPL results were converted to absolute gain for the system and then divided by two to get individual antenna gain variation required by M.1176

The antenna was fed with a test signal at 3000MHz and 9400MHz and the horizontally polarised measurement antenna in the chamber connected to a Hewlett Packard HP8530A microwave receiver. Calibration is carried out using a standard gain horn prior to measuring the antenna under test.

The test fixture is automatically rotated through ±180° and measurements of the output level taken every 0.5°.



Photographs of the test layout are shown in **Error! Reference source not found.**, page 10.

4.1.2. Equipment Used

Refer to section 3.1.

4.1.3. Results

Plots 1 and 2, page 12**,** show the measurement results are within the ±3dB of the average output in the horizontal plane for both the S and X-band antennas

Plots 3 and 4, page 13, show the measurement results are within the ±3dB limit in the vertical plane for both the S and X-band antennas

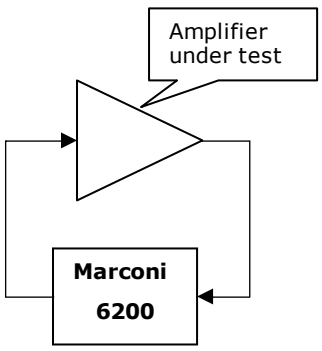
The Active-XS complies with the antenna performance requirements of ITU-R M.1176 in the both the S-band and X-Band.

4.2. Annex 1, Item 2: Broadband over the frequency range

4.2.1. Test Method

Testing was carried out in the premises of Ocean Signal Ltd.

The EUT amplifier was connected to a Marconi 6200 microwave scalar analyser and powered from a bench power supply. The gain and saturated amplifier output power of the X-band module were measured and recorded over a frequency range 9300 to 9500MHz. The test was repeated for the S-band module over the range 2900MHz to 3100MHz.



The photograph of the test layout is shown in **Error! Reference source not found.**, page 11.

4.2.2. Results

The X-band results are shown in plot 5, page 14. The lower trace shows the unsaturated amplifier gain over the frequency range 9000 – 9700MHz.

The unsaturated amplifier gain over the frequency range 9300 – 9500MHz is between 51.54dB and 53.56dB.

The S-band results are shown in plot 6, page 14. The lower trace shows the unsaturated amplifier gain over the frequency range 2000-6000MHz.

The unsaturated amplifier gain over the frequency range 2900-3100MHz is between

36.6dB and 36.99dB.

The X-band and S-band amplifiers in the Active-XS meet the requirement of ITU-R M.1176; Annex 1 to be broadband over the ranges 2900 to 3100MHz and 9300MHz to 9500MHz.

4.3. Annex 1, Item 2: Amplification

4.3.1. Test Method

The test method in 4.2 was used to determine the gain of the amplifier. The gain of the antennas used was determined in 4.1.

4.3.2. Equipment Used

Refer to section 3.1 Tables 2 and 3.

4.3.3. Results

Minimum unsaturated amplifier gain in the band 2900-3100MHz was measured at 36.60dB.

Minimum unsaturated amplifier gain in the band 9300-9500MHz was measured at 51.54dB.

The Active-XS complies with the amplifier gain requirements of ITU-R M.1176; Annex 1 at X-band. The gain at S-band is subject to the FCC waiver document DA 10-2438. The SPL requirements at both X and S-band meet the requirements of MSC.164(78). Evidence for SPL performance is provided in Qinetiq test report QINETIQ/TS/SDS/CR1002449.

4.4. Annex 1, Item 2: Output form

4.4.1. Test Method

Testing was carried out in the Funtington calibrated anechoic test chamber.

4.4.2. Equipment Used

Refer to section 3.1 Tables 2 and 3.

4.4.3. Results

Plots 7 and 8 on page 15 show the pulse waveform with the EUT switched off and on. (Giving the received and transmitted pulse shapes respectively.) The pulse length was the similar under both conditions. From test report QINETIQ/TS/SDS/CR1002449 table 2, the S-band pulse width is given as 499ns with a pulse delay of 6ns. At X-band the pulse width is 503ns and the delay is 5.5ns.

The EUT complies with the requirements of ITU-R M.1176; Annex 1

4.5. Annex 1, Item 2: e.i.r.p. at limiting level

4.5.1. Test Method

Testing was carried out as in ETSI EN 302 752 clause 5.3.3. The text of this method is given below

> *"On a test site conforming to clause B.1.1, the RTE shall be placed on a non-conductive support with a height of 1,5 m or such that it is completely within the quiet zone.*
> *"The test antenna shall be placed at a radial distance calculated according to clause B.2.5 at a height of 1,5 m above the floor absorber.*
> *"The exciting signal antenna shall be placed at a radial distance of 3 m from the RTE positioned at 90° to the line from the test antenna to the RTE and shall be connected to a suitable RF signal generator. The level of the appropriate test signal of this generator shall be increased until the maximum RF output from the RTE is obtained.*
>
> *"The RTE shall be rotated through 360° around a vertical axis in order to find the direction of the maximum signal.*
> *"The RTE shall now be removed and replaced with substitution antenna, in the same position and with the same polarization. The exciting signal RF generator shall be connected to this substitution antenna.*
> *"The input signal to the substitution antenna shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver.*
> *"The maximum carrier radiated power is equal to the power supplied by the signal generator, increased by the known relationship if necessary and after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna."*

4.5.2. Equipment Used

See Qinetiq/TS/SDS/CR1002449 Section 3, page 12.

4.5.3. Results

From test report QINETIQ/TS/SDS/CR1002449 table 2, the results given are:

S-band limit:	10W	S-band Result:	0.977W
X-band limit:	10W	X-band Result:	0.525W

The EUT complies with the requirements of ITU-R M.1176; Annex 1 for e.i.r.p. at limiting level.

5. Annex A: Photographs

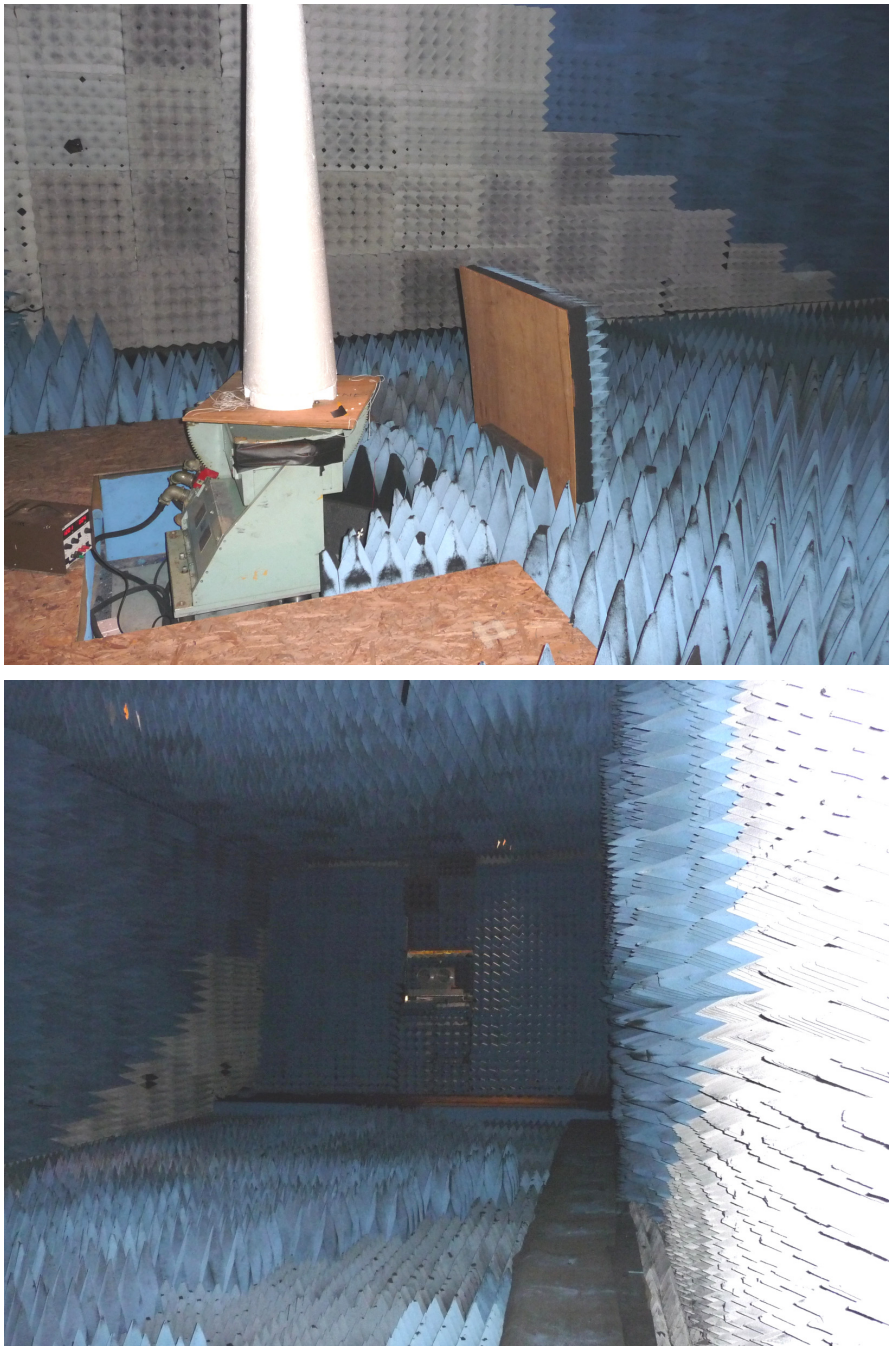


Figure 1: QinetiQ Funtington Calibrated Chamber test set up.

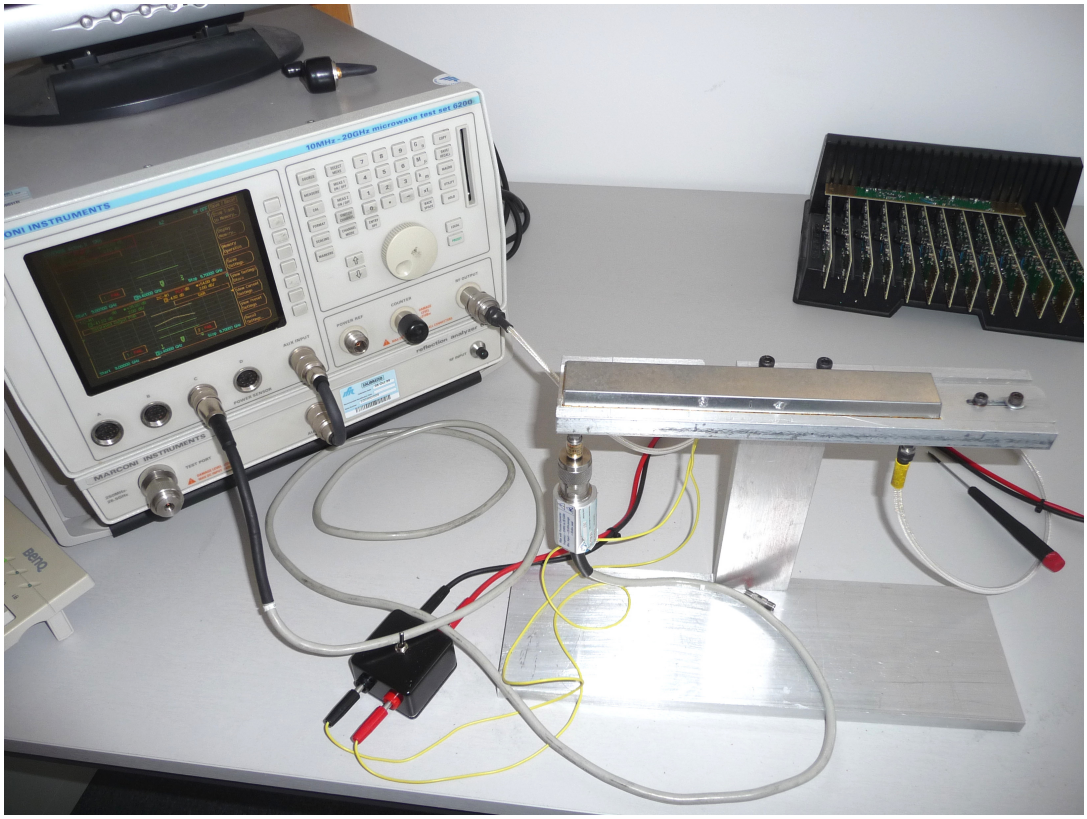
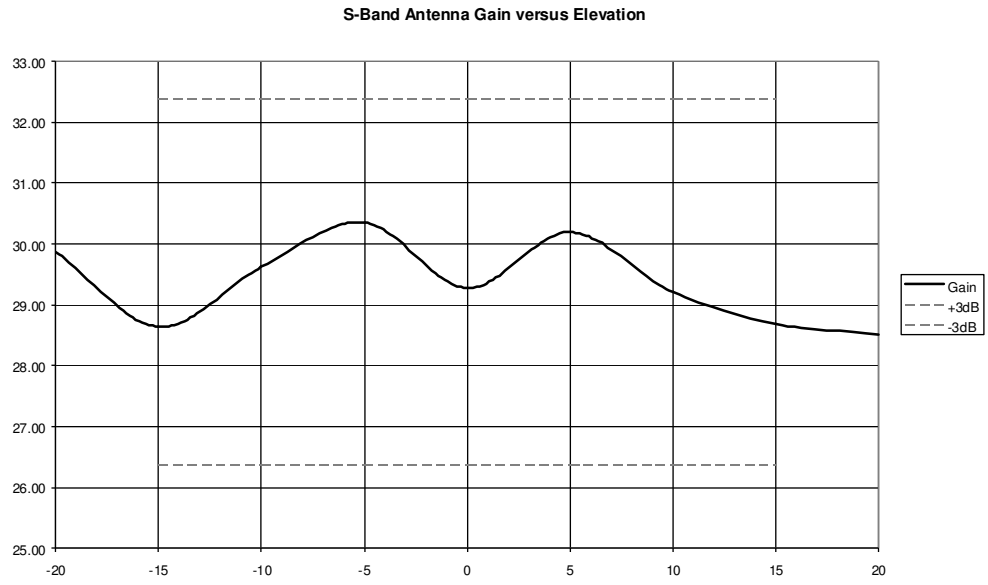


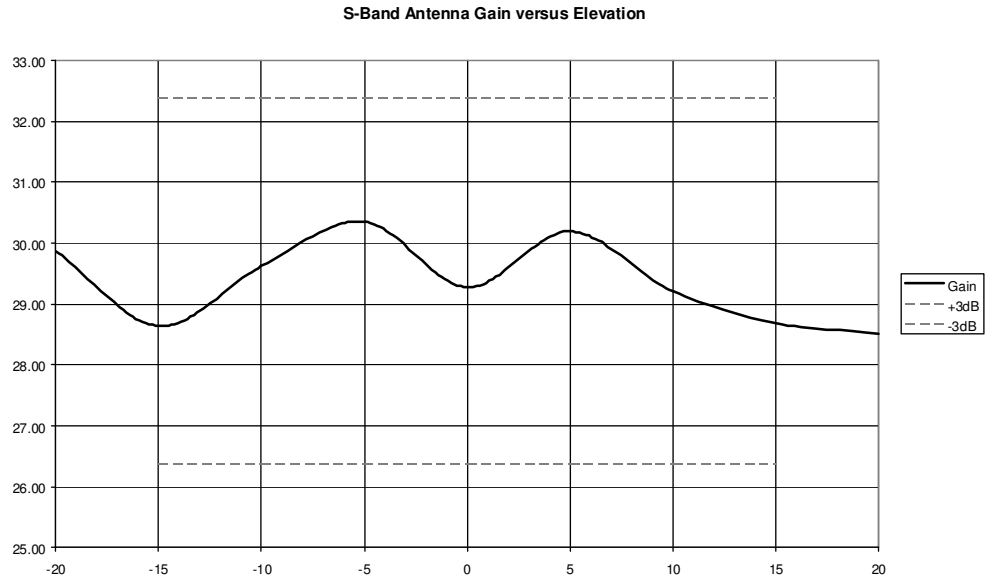
Figure 2: Gain & Saturated Power measurement system

(Shown with X band module under test)

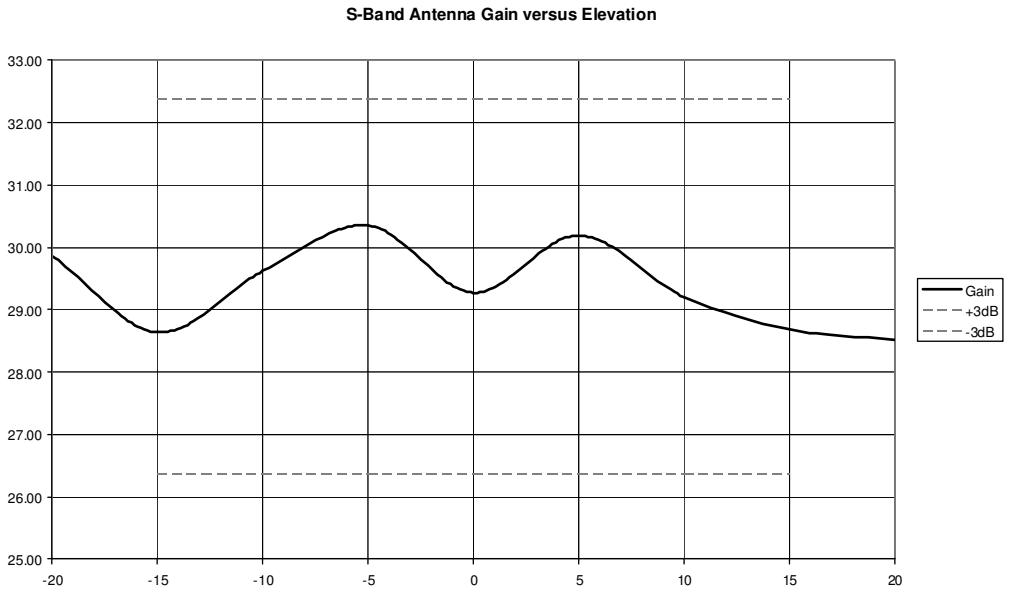
6. Annex B: Results of Performance Tests



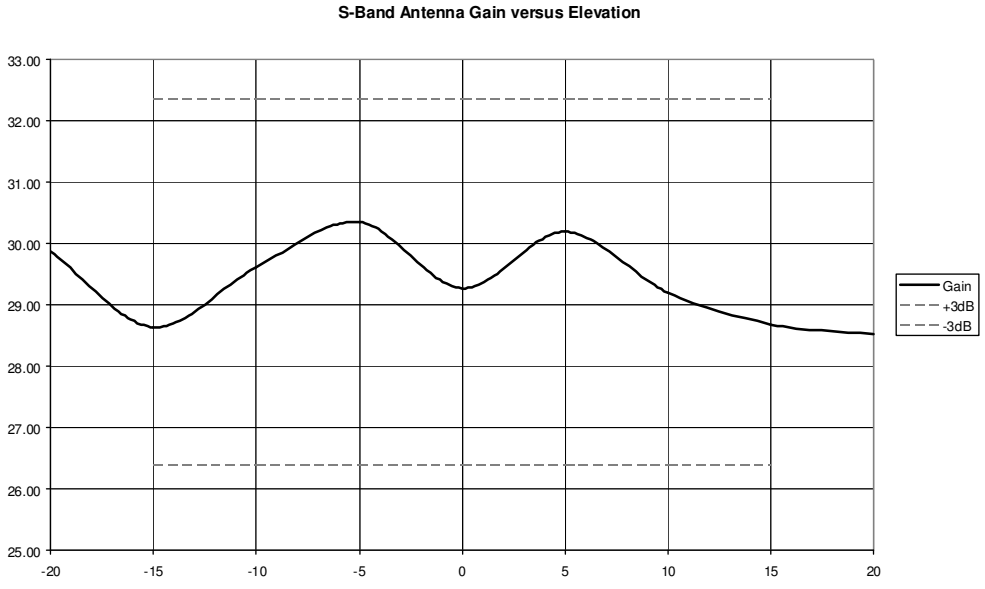
Plot 1: X-band Antenna Gain versus Azimuth



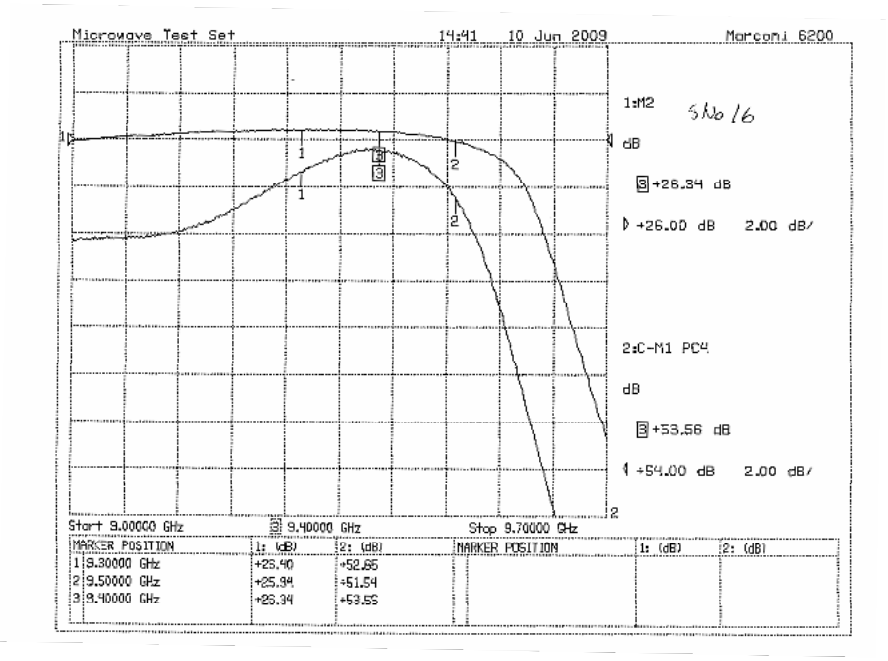
Plot 2: X-band Antenna Gain versus Elevation



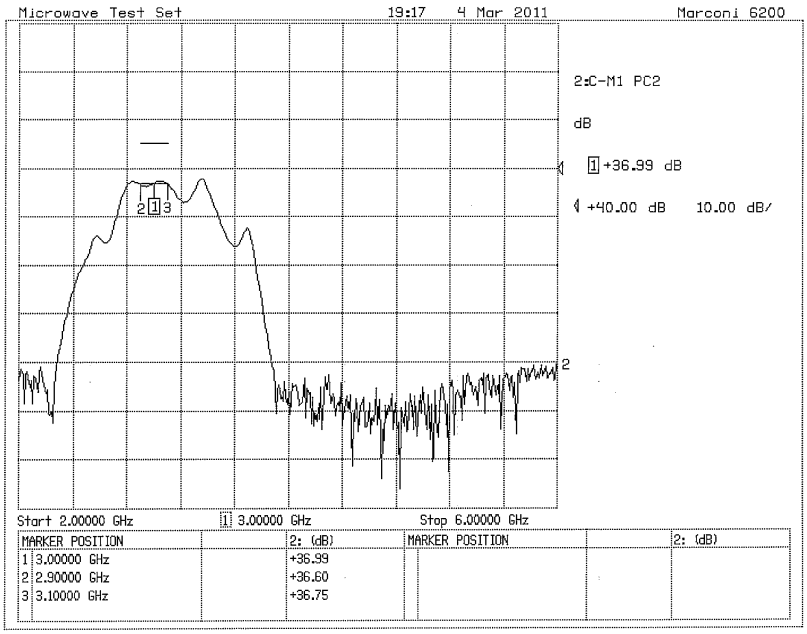
Plot 3: S-Band Antenna Gain versus Azimuth



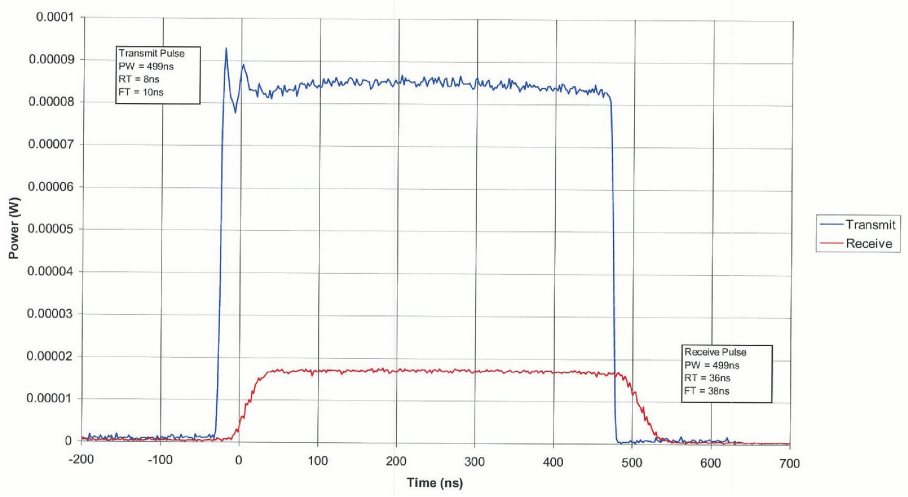
Plot 4: S-band Antenna Gain versus Elevation



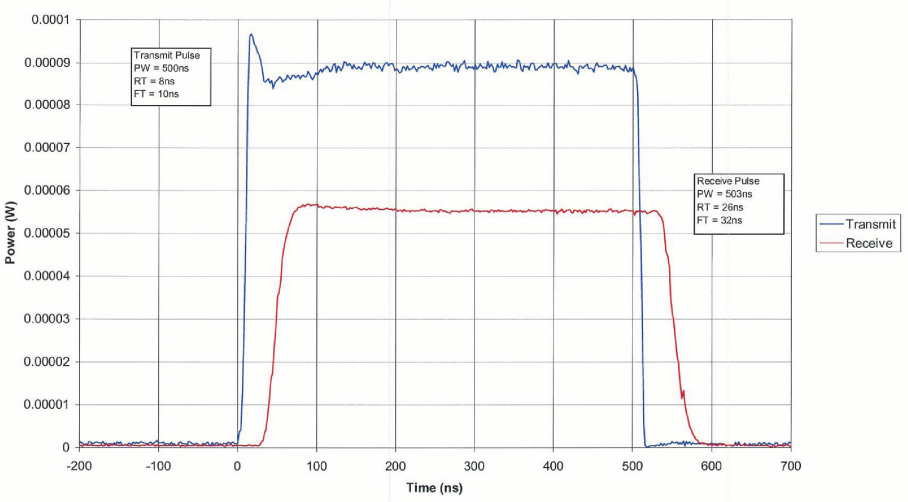
Plot 5: X-band Amplifier Gain versus Frequency



Plot 6: S-band Amplifier Gain versus frequency



Plot 7: Pulse length S-band



Plot 8: Pulse length at X-band