



FCC TEST REPORT

Prepared for

NARCO AVIONICS

on the

AT-165 AIR TRAFFIC CONTROL TRANSPONDER

Report No. 04_0987 Rev A

May 13, 2004

R&B Laboratory

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Report No. 04_0987 Rev A

May 13, 2004

Customer:
Narco Avionics
Fort Washington, PA

P.O. Number: 024612-00

Job Number: 0987

Requirement:
FCC Part 87

Approved by: _____
Rohit Vohra, EMC Laboratory Manager

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R&B Laboratory

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DATA FOR MODULATION CHARACTERISTICS

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DATA FOR OCCUPIED BANDWIDTH

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DATA FOR SPURIOUS EMISSIONS



ADMINISTRATIVE DATA

Purpose of Test: To demonstrate completion of the Narco Avionics, Air Traffic Transponder, with FCC Part 87.

Equipment Tested: Model No: AT-165
S/N: ENG002

Manufacturer: Narco Avionics

Test Specification: FCC Rules and Regulations, Part 2 and 87

Test Personnel: Charles Landsperger
EMC Technician

Customer Representative: M. Lockner
Narco Avionics

Date of Test: April 15, 2004

Test Location: Alion Science and Technology
R&B Laboratory
20 Clipper Road
West Conshohocken, PA 19428

Disposition of Item Tested: Returned via Customer Representative



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EXECUTIVE SUMMARY

The Narco Avionics, Air Traffic Control Transponder, Model No. AT-165, Serial No. ENG002 was tested in accordance with the procedures in FCC Part 2 for compliance with the requirements of the FCC Rules and Regulations, Part 87. The Equipment Under Test (EUT) completed all requirements as summarized below. The detailed test results can be found in the appropriate sections of this report.

Test Method	Section
RF Power Output 2.1046	4
Modulation Characteristics 2.1047	5 Appendix A
Occupied Bandwidth 2.1049	6 Appendix B
Spurious Emissions 2.1051	7 Appendix C
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SECTION I GENERAL INFORMATION

I.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

The Air Traffic Control Transponder has a receiver tuned to 1030 MHz, with a coded ground interrogator which requests replies of code switch settings or altitude. Response is .45 μ s pulses at 1090 MHz. A maximum of 1200 replies per second and a maximum of 15 pulses per reply is possible.

I.2 MODE OF OPERATION

ON

OFF

StandBy

Altitude

(All Tests were performed in the Altitude Mode)



SECTION 2

APPLICABLE DOCUMENTS

ANSI C63.4-1992 17 July 1992	“American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”
ISO/IEC 17025:1999	“General Requirements for the Competence of Testing and Calibration Laboratories”
ANSI/NCSL Z54001:1994	“American National Standard for Calibration General Requirements - Calibration Laboratories and Measuring and Test Equipment”
Code of Federal Regulations Title 47 Part 2	“Telecommunications, Federal Communications Commission Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”
Code of Federal Regulations Title 47 Part 87	“Telecommunications, Federal Communications Commission Aviation Services”



SECTION 3 TEST FACILITIES

3.1 SCOPE

Field strength testing was performed on the open-area test site according to the procedures in FCC Part 2.1053. Radiated emission testing was performed at an antenna-to-EUT distance of 3 meters. All other testing was performed in a shielded enclosure.

The open-area test site (OATS) and conducted measurement facility used to collect the radiated and conducted data are located at the Alion Science and Technology R&B Laboratory, 20 Clipper Road, West Conshohocken, PA 19428. This site has been fully described in a report submitted to the FCC dated June 30, 1997.

3.2 TEST SITE

The EUT was placed on an insulated surface and arranged in a normal operating configuration. The EUT was grounded only via its power cord.

3.3 OPEN-AREA RADIATED EMISSIONS TEST SITE

The radiated emissions test was performed on the open-area test site located adjacent to R&B Laboratory's EMI facility. The test site was constructed and tested to the recommendations/requirements of ANSI C63.4-1992. The following is a description of the test site.

The conducting ground plane measures 56 feet (17 meters) wide by 70 feet (21.3 meters) long and is made up of 1/4-inch square galvanized steel mesh. Copper ground rods are connected to the ground plane at key locations.

This size ground plane allows an extension of five meters beyond the antenna tower and is sufficiently wide to that it extends at least five meters beyond the widest horizontally polarized antenna (dipole or biconical).

The receive antennas were placed on a remotely controlled motorized fiberglass antenna positioner located three or ten meters from the EUT. The positioner was capable of positioning the center of the antenna at any height in the range of one to four meters above the ground plane. The positioner was also capable of maintaining the antenna in both horizontal and vertical polarizations.

The antenna signals were fed to the EMI receiver located within the building via a shielded cable. The EMI receiver was powered from a common wall socket through an isolation transformer. The EUT was placed on a wooden table in the test site, which was located in a weather-protected structure 20 feet wide by 36 feet long and 16-1/2 feet high.



The power supplied to the EUT came from a separate power run from the main distribution box through underground PVC conduit. Receptacles were brought above ground via PVC conduit to the center of the turntable. The power was switchable remotely via a switch located at the building power-distribution panel.

3.4 TEST EQUIPMENT

3.4.1 Calibration

The calibration due date for each piece of test equipment used was specified on a sticker affixed to its case. All of the test equipment had been calibrated in accordance with the requirements of ISO/IEC 17025:1999 and ANSI/NCSL Z540-1:1994 using standards directly traceable to the National Institute of Standards and Technology.

3.4.2 Measurement-Receiver Characteristics

All emission measurements were made with the EMI analyzer in the peak detection mode. The bandwidths for the EMI analyzer were as follows:

Frequency Range	Bandwidth
10 kHz to 200 MHz	10 kHz
200 MHz to 1 GHz	100 kHz
1 GHz to 11 GHz	1 MHz



SECTION 4

RF POWER OUTPUT

4.1 SCOPE

The EUT was tested according to the procedures of FCC, Part 2.1046.

4.2 TEST PROCEDURE

The EUT was configured in a normal operating configuration. The test was performed inside a shielded room.

Measurements were taken using by placing a directional coupler in-line between the EUT and the XPDR/DME simulator, and measuring the forward power from the EUT, using a spectrum analyzer set to a 50 MHz span around the center frequency (1090 MHz), with a 3 MHz BW. The transponder front panel was set to "0 0 0 0". This reading was then recorded and corrected to account for coupler and cable loss. The process was then repeated with the transponder front panel set to "7 7 7 7", to verify that there was no difference in the reading.

The Average Power output from the EUT is determined using the following equation:

$$P_{avg} = P_{peak} \times \text{Duty Factor}$$

Where Duty Factor = (Replies per Second) x (Pulses per Reply) x (Pulse Width)

4.3 TEST RESULTS

FCC Part 87		RF Power Output		
Manufacturer:	Narco Avionics			
Model:	AT-165		S/N:	ENG002
Setting		Results (Peak)		Avg Power
"0 0 0 0"		252 W		0.121 W
"7 7 7 7"		252 W		0.121 W

4.4 LIST OF TEST EQUIPMENT

Item	Characteristics	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	9 kHz to 22 GHz	Hewlett Packard	8593EM	3639A00177	2/2/05
Directional Coupler	0.8 GHz to 4.2 GHz	Amplifier Research	DC7144	24009	4/12/05





Figure 4-1
Photograph of RF Power Output Setup



SECTION 5 MODULATION CHARACTERISTICS

5.1 SCOPE

The EUT was tested according to the procedures of FCC, Part 2.1047.

5.2 TEST PROCEDURE

The EUT was configured in a normal operating configuration. The test was performed inside a shielded room.

An oscilloscope was connected to the “Monitor - PWR” port of the XPDR/DME simulator to monitor the pulses coming from the EUT. Print-outs were obtained of the time between responses, the number of pulses per response, and a close-up of the pulse itself.

5.3 TEST RESULTS

FCC Part 87		Modulation Characteristics		
Manufacturer:	Narco Avionics			
Model:	AT-165		S/N:	ENG002
Plot		Results	Comments	
Time between responses		Completed	Appendix A	
Pulses per response		Completed	Appendix A	
Close-up of a single pulse		Completed	Appendix A	

5.4 LIST OF TEST EQUIPMENT

Item	Characteristics	Manufacturer	Model No.	Serial No.	Cal Due
Digitizing Oscilloscope	600 MHz, 4Gsa/s	Agilent	54830A	MY41000772	11/24/04





Figure 5-1
Photograph of Modulation Characteristics Setup





Figure 5-2
Photograph of Modulation Characteristics Setup



SECTION 6 OCCUPIED BANDWIDTH

6.1 SCOPE

The EUT was tested according to the procedures of FCC, Part 2.1049.

6.2 TEST PROCEDURE

The EUT was configured in a normal operating configuration. The test was performed inside a shielded room.

A directional coupler was placed in-line between the EUT and its support equipment. A spectrum analyzer was connected to the forward power port of the directional coupler to measure the bandwidth at which the mean power was 0.5 percent of the total mean power of the transponder. Print-outs were obtained of the occupied bandwidth with the EUT in the "Altitude 0 0 0 0" and "Altitude 7 7 7 7" modes.

6.3 TEST RESULTS

FCC Part 87		Occupied Bandwidth			
Manufacturer:	Narco Avionics				
Model:	AT-165		S/N:	ENG002	
Plot		Results	Comments		
Altitude 0 0 0 0		28.36 MHz	Appendix B		
Altitude 7 7 7 7		29.00 MHz	Appendix B		

6.4 LIST OF TEST EQUIPMENT

Item	Characteristics	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	100 Hz to 26.5 GHz	Advantest	R3271A	J000312	6/16/04
Directional Coupler	0.8 GHz to 4.2 GHz	Amplifier Research	DC7144	24009	4/12/05





Figure 6-1
Photograph of Occupied of Bandwidth Setup



SECTION 7 SPURIOUS EMISSIONS

7.1 SCOPE

The EUT was tested according to the procedures of FCC, Part 2.1051. The unit had to have no spurious emissions within 20 dB of the carrier signal power level within the frequency range from 9 kHz to 11 GHz.

7.2 TEST PROCEDURE

The EUT was configured in a normal operating configuration. The test was performed inside a shielded room.

Measurements were taken by placing a directional coupler in-line between the EUT and its support equipment. A spectrum analyzer was connected to the attenuated port of the coupling network to monitor the output from the transponder. Print-outs of the emissions in the frequency range from 10 kHz to 11 GHz were obtained showing the emissions.

7.3 TEST RESULTS

FCC Part 87		Spurious Emissions		
Manufacturer:	Narco Avionics			
Model:	AT-165		S/N:	ENG002
Frequency Range		Results	Comments	
10 kHz to 1 GHz		Passed	"0 0 0 0" Appendix C	
1 GHz to 11 GHz		Passed	"0 0 0 0" Appendix C	
10 kHz to 1 GHz		Passed	"7 7 7 7" Appendix C	
1 GHz to 11 GHz		Passed	"7 7 7 7" Appendix C	



7.4 LIST OF TEST EQUIPMENT

Item	Characteristics	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	9 kHz to 22 GHz	Hewlett Packard	8593EM	3639A00177	2/2/05
Directional Coupler	10 kHz to 250 MHz	Amplifier Research	DC2600	28833	2/24/05
Directional Coupler	80 MHz to 1000 MHz	Amplifier Research	DC6080	23184	2/23/05
Directional Coupler	0.95 GHz to 2 GHz	Narda	3002-30	10093	2/23/05
Directional Coupler	2 GHz to 18 GHz	Hewlett Packard	11691D	1212A01499	2/25/05





Figure 7-1
Photograph of Spurious Emissions Setup
10 kHz to 200 MHz





Figure 7-2
Photograph of Spurious Emissions Setup
200 MHz to 1 GHz





Figure 7-3
Photograph of Spurious Emissions Setup
1 GHz to 2 GHz





Figure 7-4
Photograph of Spurious Emissions Setup
2 GHz to 11 GHz



SECTION 8

FIELD STRENGTH OF SPURIOUS RADIATION

8.1 SCOPE

The EUT was tested according to the procedures of FCC, Part 2.1053.

8.2 TEST PROCEDURE

The EUT was configured in a normal operating configuration. The test was performed on the open-area test site. The measurements were taken with an EUT-to-antenna distance of three meters over the frequency range from 20 MHz to 11 GHz.

The emissions were taken in both the horizontal and vertical polarization of the receive antenna.

8.3 TEST RESULTS

FCC Part 87		Field Strength of Spurious Radiation	
Manufacturer:	Narco Avionics		
Model:	AT-165	S/N:	ENG002
Frequency Range		Results	
20 MHz to 11 GHz		Completed	

8.4 LIST OF TEST EQUIPMENT

Item	Characteristics	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	9 kHz to 22 GHz	Hewlett Packard	8593EM	3639A00177	2/2/05
Directional Coupler	0.95 GHz to 2 GHz	Narda	3002-30	10093	2/23/05
Biconical Antenna	20 MHz to 200 MHz	EMCO	3109	9403-2793	03-31-05
Log Periodic Antenna	200 MHz to 1 GHz	Amplifier Research	AT1000	16186	03-31-05
Double Ridge Guide Antenna	1 GHz to 18 GHz	Electro Metrics	RGA-60	3396	6/4/04





Figure 8-1
Photograph of Field Strength of Spurious Radiation Setup
20 MHz to 200 MHz
Vertical Polarization





Figure 8-2
Photograph of Field Strength of Spurious Radiation Setup
20 MHz to 200 MHz
Horizontal Polarization





Figure 8-3
Photograph of Field Strength of Spurious Radiation Setup
200 MHz to 1000 MHz
Vertical Polarization





Figure 8-4
Photograph of Field Strength of Spurious Radiation Setup
200 MHz to 1000 MHz
Horizontal Polarization





Figure 8-5
Photograph of Field Strength of Spurious Radiation Setup
1 GHz to 11 GHz
Vertical Polarization





Figure 8-6
Photograph of Field Strength of Spurious Radiation Setup
1 GHz to 11 GHz
Horizontal Polarization



Table 8-1 FCC Part 2.1053 Field Strength of Spurious Emissions Data Sheet			
Manufacturer:	Narco Avionics	Date:	04-16-04
Model:	AT-165	S/N:	ENG002
Tested By:	Charles Landsperger	Mode:	ALT 0000
NOTES:			
Frequency (GHz)	Reading Corrected (dBm)	Polarity	
1.090	+35.068	Vertical	
1.090	+22.341	Horizontal	
3.27	-14.93	Vertical	
3.27	-15.806	Horizontal	
5.45	-19.29	Vertical	
5.45	-22.10	Horizontal	
8.72	Not Detected	Vertical	
8.72	Not Detected	Horizontal	



Table 8-2 FCC Part 2.1053 Field Strength of Spurious Emissions Data Sheet			
Manufacturer:	Narco Avionics	Date:	04-16-04
Model:	AT-165	S/N:	ENG002
Tested By:	Charles Landsperger	Mode:	ALT 7777
NOTES:			
Frequency (GHz)	Reading Corrected (dBm)	Polarity	
1.090	+37.879	Vertical	
1.090	+22.621	Horizontal	
3.27	-9.283	Vertical	
3.27	-16.257	Horizontal	
5.45	Not Detected	Vertical	
5.45	-20.895	Horizontal	



APPENDIX A

DATA FOR TEST METHOD

FCC PART 2.1047



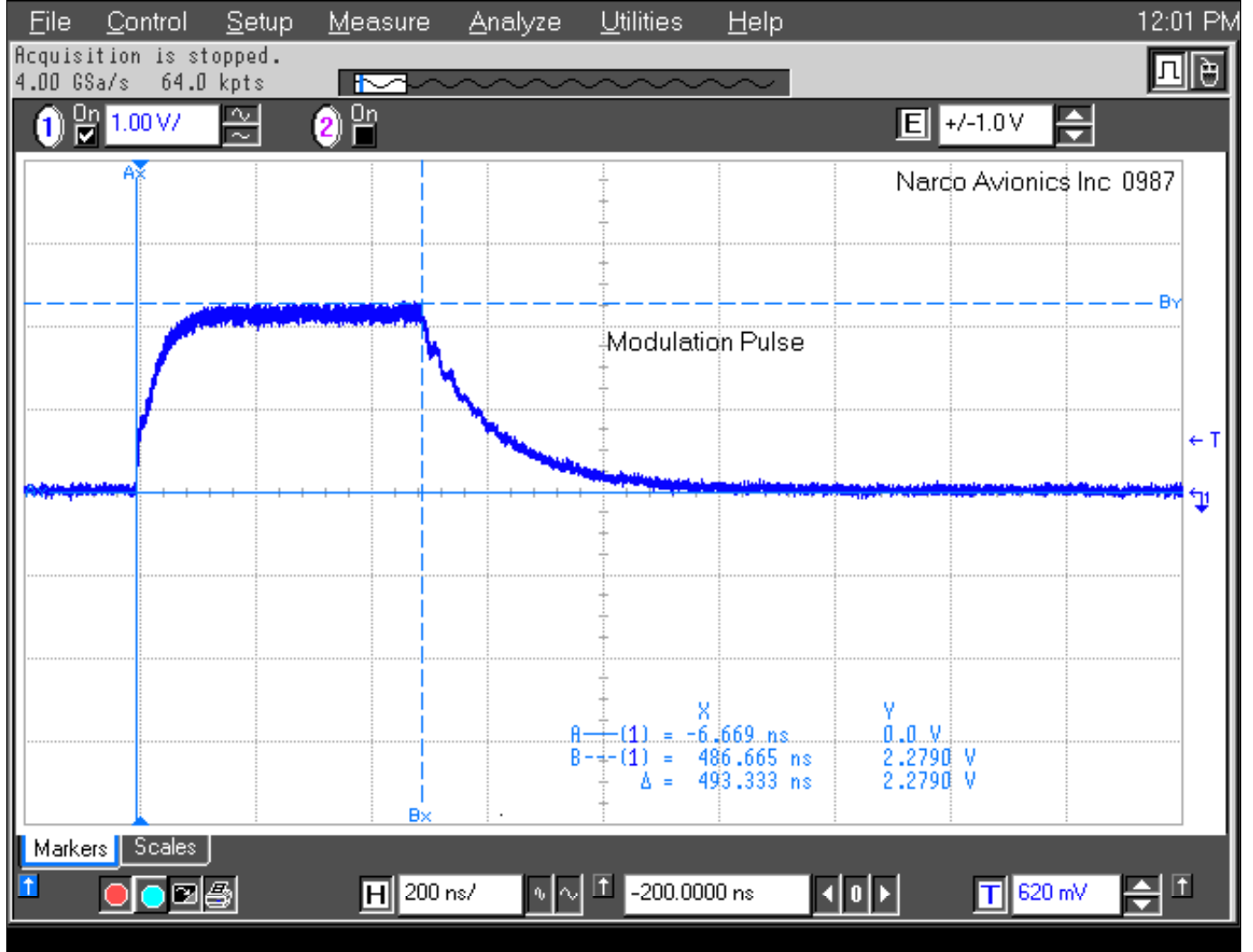
R&B Laboratory

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11:57 AM

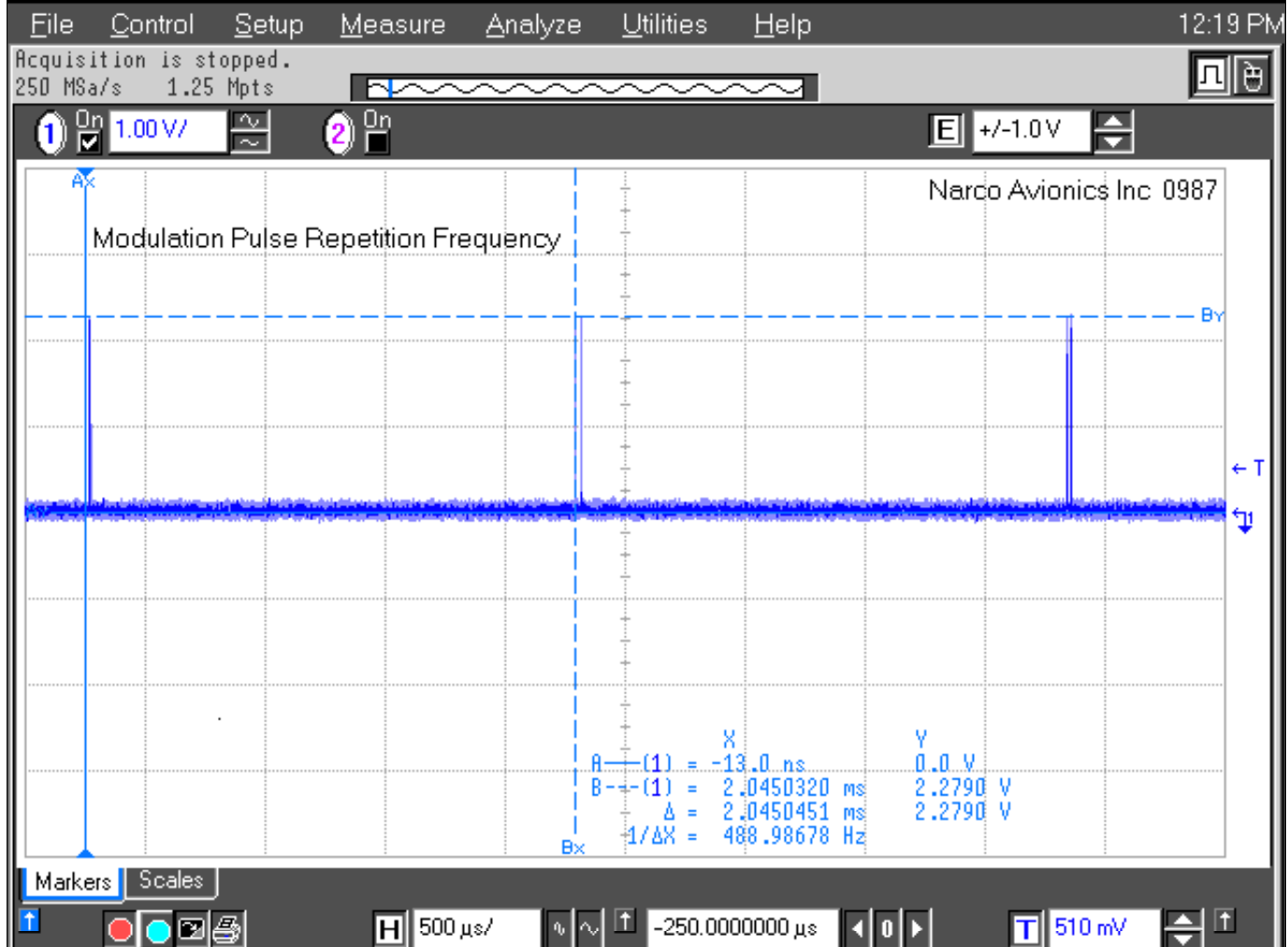
0987_001

Saved: 15 APR 2004 12:01:26



0987_002

Saved: 15 APR 2004 12:19:43



0987_003

APPENDIX B

DATA FOR TEST METHOD

FCC PART 2.1049



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REF 20.0 dBm
10 dB/

ATT 30 dB

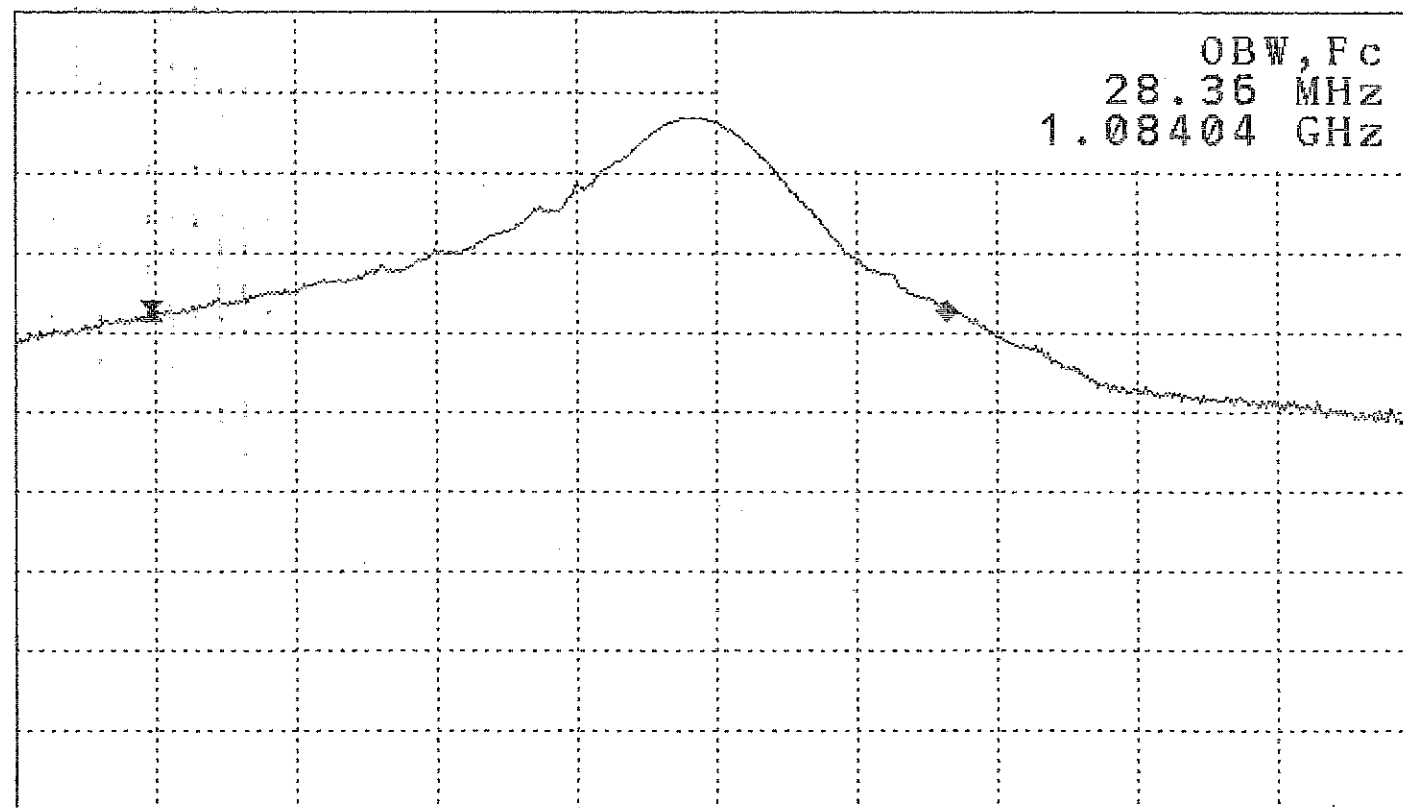
Tue May 11 03:31:58 2004

A_write&max B_blank

QBW 2
99.5 %

OBW, Fc
28.36 MHz
1.08404 GHz

RBW
3 MHz
VBW
3 MHz
SWP
490 ms



CENTER 1.09000 GHz

SPAN 50.0 MHz

Altitude "0000"

REF 20.0 dBm
10dB/

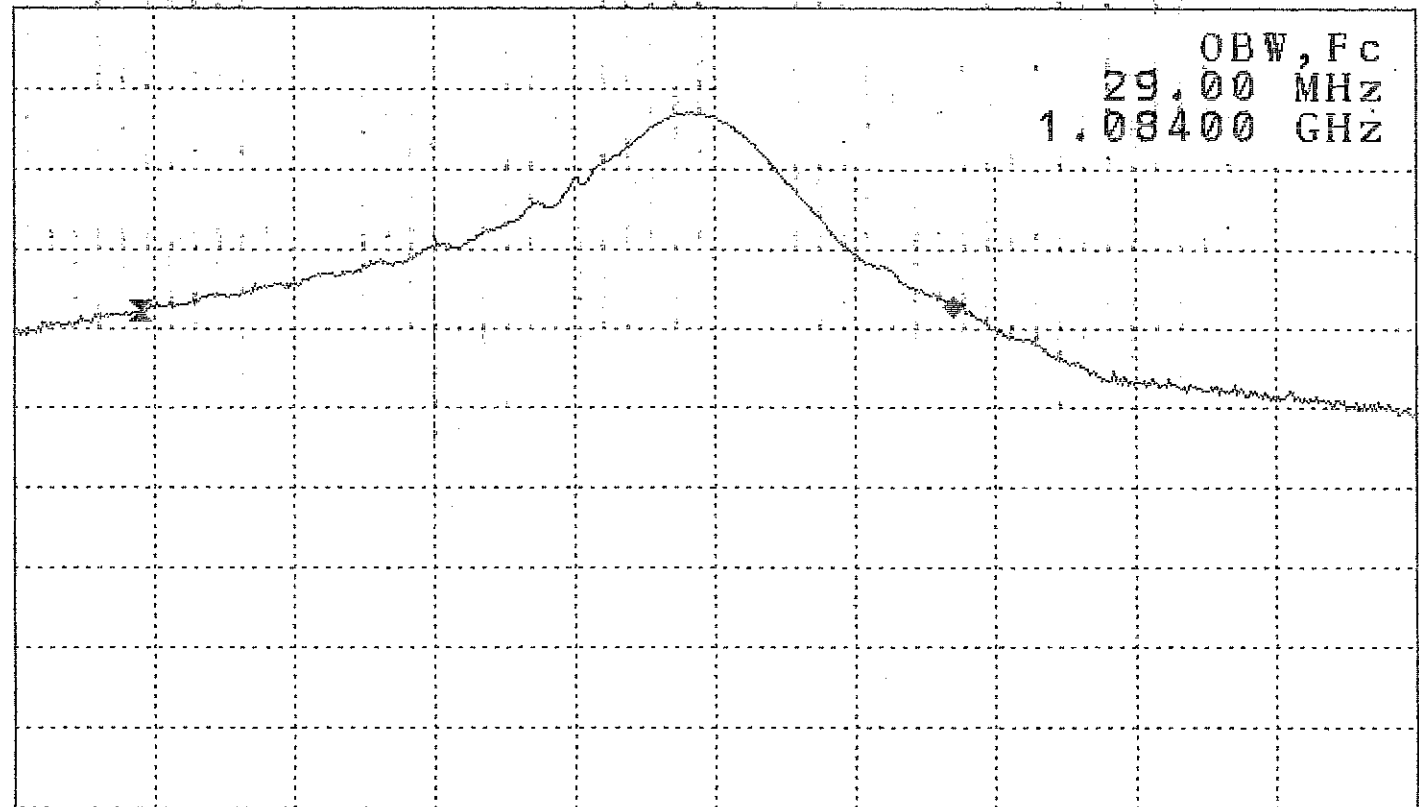
ATT 30 dB

Tue May 11 03:35:32 2004
A_writedmax B_blank

OBW %
99.5 %

OBW, Fc
29.00 MHz
1.08400 GHz

RBW
3 MHz
VBW
3 MHz
SWP
490 ms



CENTER 1.09000 GHz

SPAN 50.0 MHz

Altitude "7777"

APPENDIX C

DATA FOR TEST METHOD

FCC PART 2.1051



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FCC Part 2.1051

Spurriuos Emissions At Antenna Terminals

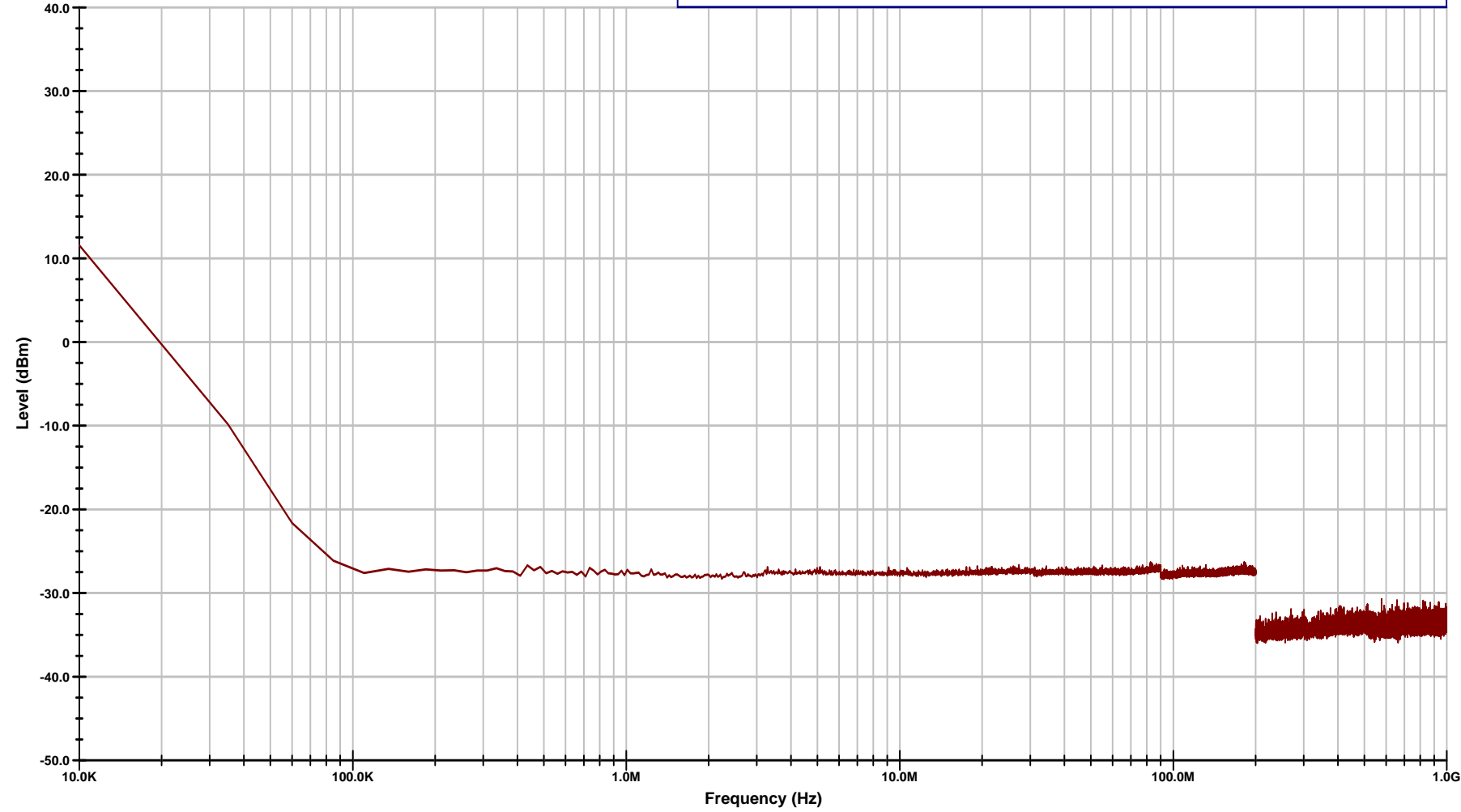
CE, 10 kHz to 1.0 GHz

Model Number - AT165 TSO

Serial # - ENG002

Mode - Altitude 0000

Notes -



Operator: cfl

EUT: AT165 TSO

H:\Test_Data\2004\JN 0987\Data\R04987TFCC003.TIL

Customer: Marty Lockner

04:43:09 PM, Thursday, April 15, 2004

Company: Narco Avionics Inc

FCC Part 2.1051

Spurious Emissions at Antenna Terminals

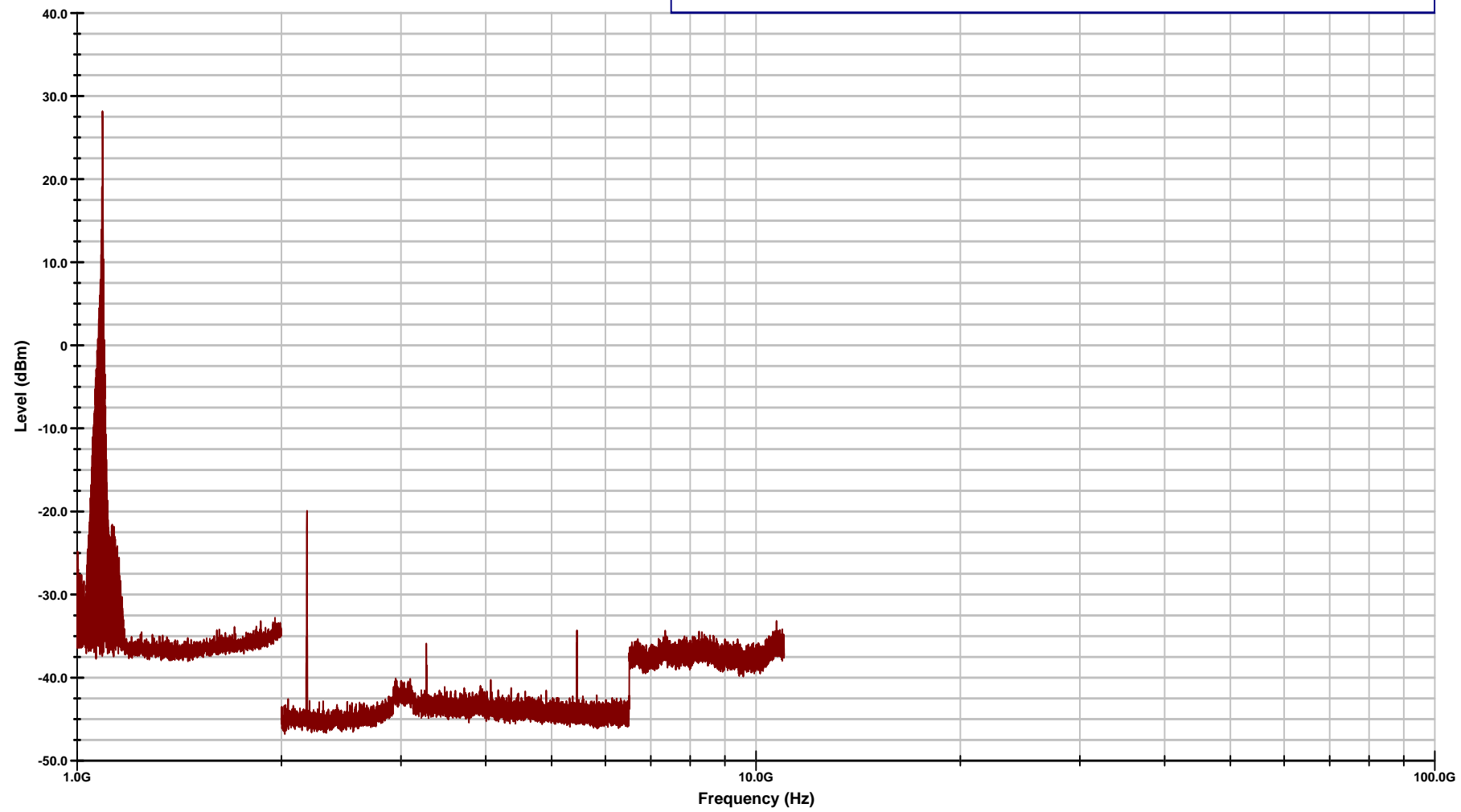
CE, 1.0 GHz to 11 GHz

Model Number - AT165 TSO

Serial # - ENG002

Mode - Altitude 0000

Notes -



Operator: cfl

EUT: AT165 TSO

H:\Test_Data\2004\JN 0987\Data\R04987TFCC003.TIL

Customer: Marty Lockner

04:41:06 PM, Thursday, April 15, 2004

Company: Narco Avionics Inc

FCC Part 2.1051

Spurriuos Emissions At Antenna Terminals

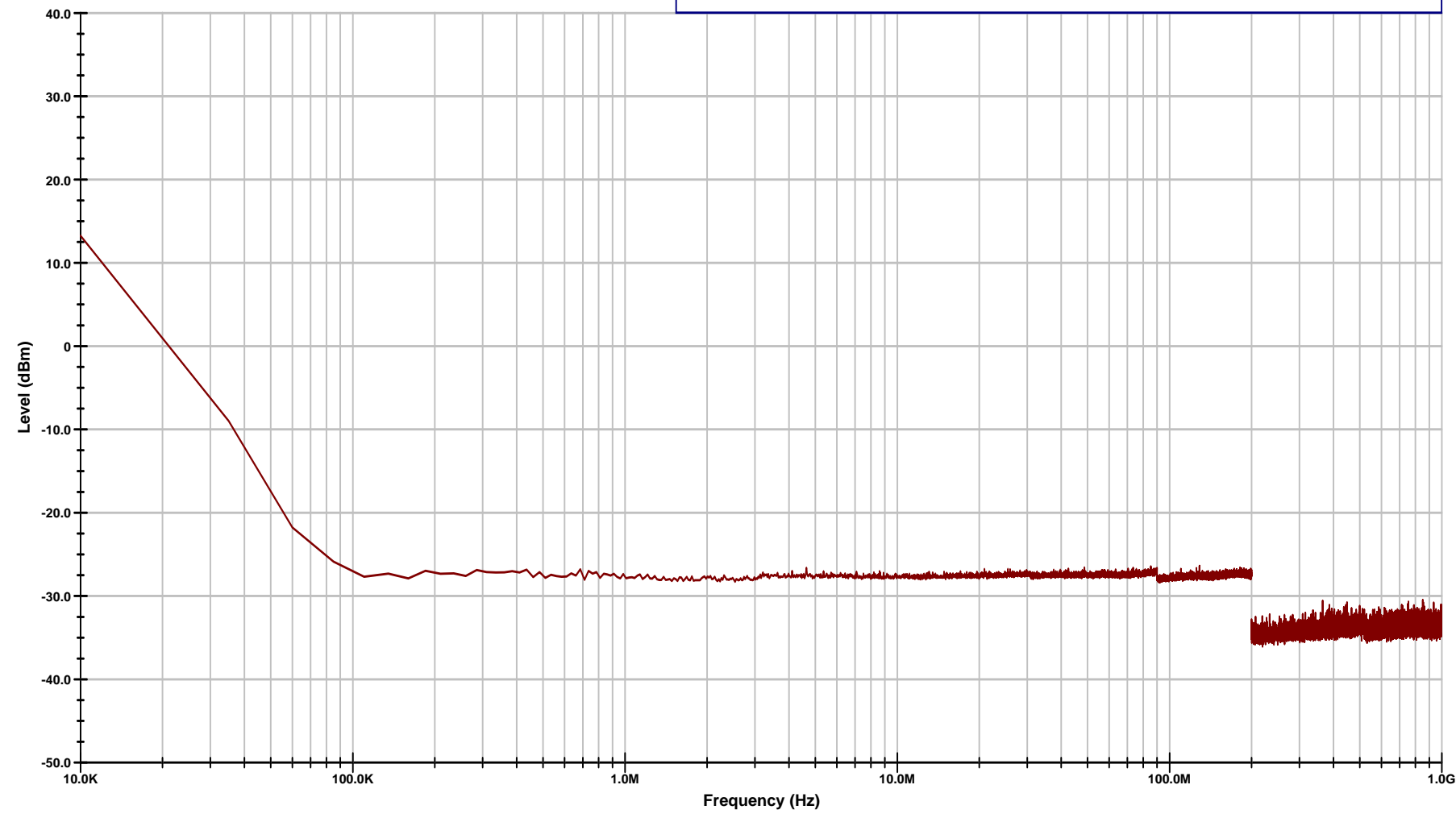
CE, 10 kHz to 1.0 GHz

Model Number - AT165 TSO

Serial # - ENG002

Mode - Altitude 7777

Notes -



Operator: cfl

EUT: AT165 TSO

H:\Test_Data\2004\JN 0987\Data\R04987TFCC004.TIL

Customer: Marty Lockner

09:13:05 AM, Friday, April 16, 2004

Company: Narco Avionics Inc

FCC Part 2.1051

Spurious Emissions at Antenna Terminals

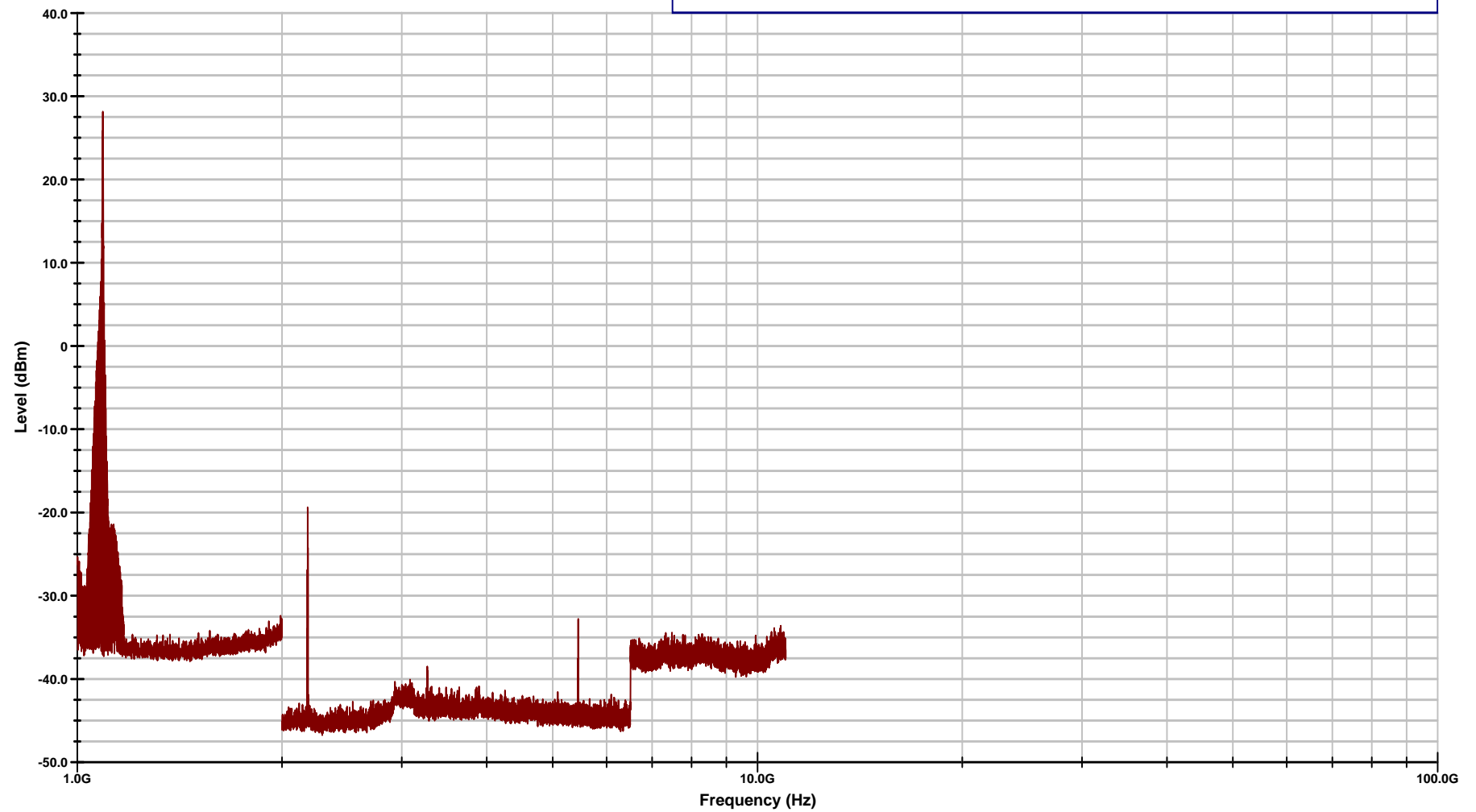
CE, 1.0 GHz to 11 GHz

Model Number - AT165 TSO

Serial # - ENG002

Mode - Altitude 7777

Notes -



Operator: cfl

EUT: AT165 TSO

H:\Test_Data\2004\JN 0987\Data\R04987TFCC004.TIL

Customer: Marty Lockner

09:13:32 AM, Friday, April 16, 2004

Company: Narco Avionics Inc