Nortel BWA Type Acceptance Radio Transceiver Test Report

Product Description:	28 GHz Base Station (BTR) Radio Transceiver
Model:	BTR2800
Nortel BWA File #	OHOBTR2807NT

CHARLIE BISHOP PI ENGINEER **DATE MAY 11, 1999**

WINNIPEG,

DECLARATION BY Nortel Networks BWA

The tests were performed from Feb 5 through Mar 26,1999 at the Nortel Networks BWA's EMC Laboratory in Winnipeg.

The following personnel collaborated to this project:

Mitch Hebert, Tech.
Charlie Bishop, PI Engineer

Testing was performed and supervised by the undersigned. The test supervisor attests to the accuracy of the test data recorded in this report.

Performed by: Mitch Hebert	Date March 26, 1999
Supervised by: Charlie Bishop	Date March 26, 1999

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Total number of pages: 69.

The results presented in this report refer only to the product(s) described in section 1.

All equipment and instrumentation used during this test have been verified and/or calibrated. All calibration certificates are traceable to the National Research Council of Canada (CNRC) and/or to the American National Institute of Standards and Technology (NIST) standards and can be provided on request.

Nortel BWA is registered ISO 9002:1998, certificate # 766.2.

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1. INTRODUCTION

Object

This test report is being submitted for type acceptance of the Nortel Networks BWA Reunion Radios operating in the LMDS Bands 29.1 to 29.25GHz. The Reunion radios are designed to provide wide-band multi-carrier point-to-multi-point subscriber services in an efficient and cost effective manner. The adherence to the rules for LMDS radios in these bands are demonstrated in the following pages. Nortel Networks BWA is currently seeking type approval on this product.

Equipment Under Test Description

The Nortel Networks BWA 28GHz radio product is of wide band design. The power amplifiers and the LNA are designed to provide gain over the entire 27.5 to 29.25 GHz band. The BTR is of a single conversion design and a single DRO serve both the transmit and receive path. The BTR provide a maximum power output of 1 watt respectively for a single un-modulated tone. Thus the power limitation requirement of FCC part 101 section 101.113 is satisfied. The following tables identify the EUTs:

Model #	Description	Manufacturer	Part #
BTR2800	Base Transceiver	Nortel BWA	NTVG14AG

Model #	Order Code	uW Tx (GHz)	uW Rx (GHz)	RF Rx (MHz)	RF Tx (MHz)	BW	Separation
BTR2800	NTVG14AG	29.1-29.25	28.2-28.35	250-400	500-650	150	900

Antennae

The antenna used by the Base Station transceiver can be identified by the marking 2800-07 on the side of the wave-guide housing. Please note that the below table indicates the horizontal/vertical polarization by the part numbers.

Nortel Part Number	Spread (degrees)	Isotropic Gain (dBi)
NTVG13AB/ED	90 +/- 9	15 min
NTVG13AD/EF	45 +/- 4.5	18 min
NTVG13EG/EH	15 +/- 1.5	23 min

General

Tests were performed on a production sample(s) of the BTR, according to standards and directives indicated on the table in paragraph 1.1. All measurements were performed in accordance to the measurement procedures outlined in these standards or detailed in this report. The BTR is intended to fall under the 29100 to 29250MHz section of the Part 101.109 table. The complimenting customer transceiver (CTR) is intended to fall under the 27500 to 28350MHz section and will be documented under CTVG16AG and FCC ID OHOCTR2807NT.

Results

The following table summarizes the EUT test results of the testing described in this report:

Standard	Test Description	Para. No.	Results
FCC part 101.111(a)	Spectral Mask	(2)(ii)	Compliant
FCC part 101.111(a)	Conducted Emissions except mask region	(2)(iii)	Compliant
FCC part 101.111(a)	Radiated Emissions except mask region	(2)(iii)	Compliant
FCC part 101, sec 101.113	Transmit Power Limitation	C2	Compliant
FCC part 101, sec 101.113	Antenna azimuth limitation	C3	Compliant
FCC part 2, Section 2.995 (a) (1), (b) and FCC part 101 section 101.107	Frequency Stability Over Temperature	4	Compliant

Test Facilities Description

The Nortel Network BWA EMC facility is a shielded 3m room The room is provided with input voltage of 120 and 240 V ac, which is filtered through Corcom filters before entry. Due to lab construction, the radiated measurements were performed in an open lab environment. A reference sweep was taken to demonstrate the ambient conditions.

Test Equipment

The following is a list of test equipment used to perform all tests described in this report.

Equipment	Manufacturer	Model	Serial or Asset #	Cal due (Y/M/D)
Spectrum Analyzer	Hewlett Packard	HP 8665E	02940	09/99
Spectrum Analyzer	Hewlett Packard	HP 8663E	3611A05001	08/99
Synthesized Sig. Gen.	Anritsu	69369A	981807	06/99
Power Meter Power Sensor	Anritsu Anritsu	ML2438A MA2475A	97400074	06/99 06/99
Mixer Assembly 40 to 60 GHz	Millitech/Nortel BWA	MHB-19-RD3A0	MS-118086	7/99

Equipment	Manufacturer	Model	Serial or Asset #	Cal due (Y/M/D)
Mixer Assembly 60 to 90 GHZ	Millitech/Nortel BWA	MHB-12-RD3A0	MS-118101	7/99
Mixer Assembly 90 to 140 GHz	Millitech/Nortel BWA	MHB-08-RD3A0	MS-118090	7/99
Power Supply	Hewlett Packard	6544A	US36390168	-----
Power Supply	Hewlett Packard	6554A	US36340233	-----
Frequency Counter	XL microwave	3460	980338143	03/99
Antenna Bilog 30 to 1000 MHz	Shaffner-Chase	CBL6111B	2261	08/99
Horn Antenna 1 to 18 GHz	EMCO	3115	9711-5345	11/99
Horn Antenna 14 to 40 GHz	Shaffner-Chase	BBHA 9170	9046	3/99

2. CONDUCTED EMISSIONS

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Mar 9 through Mar 15,1998

Test was performed to validate the requirements specified in FCC part 101.111(a)(2)(iii)

Test Conditions

Temperature	22 to 25C,
Primary Voltage	BTR -48 Vdc

Test Results

The EUT does comply with the specification referenced in the Part 101.111 requirement.

Measurement Data

See on Appendix A for test results and setup photographs.

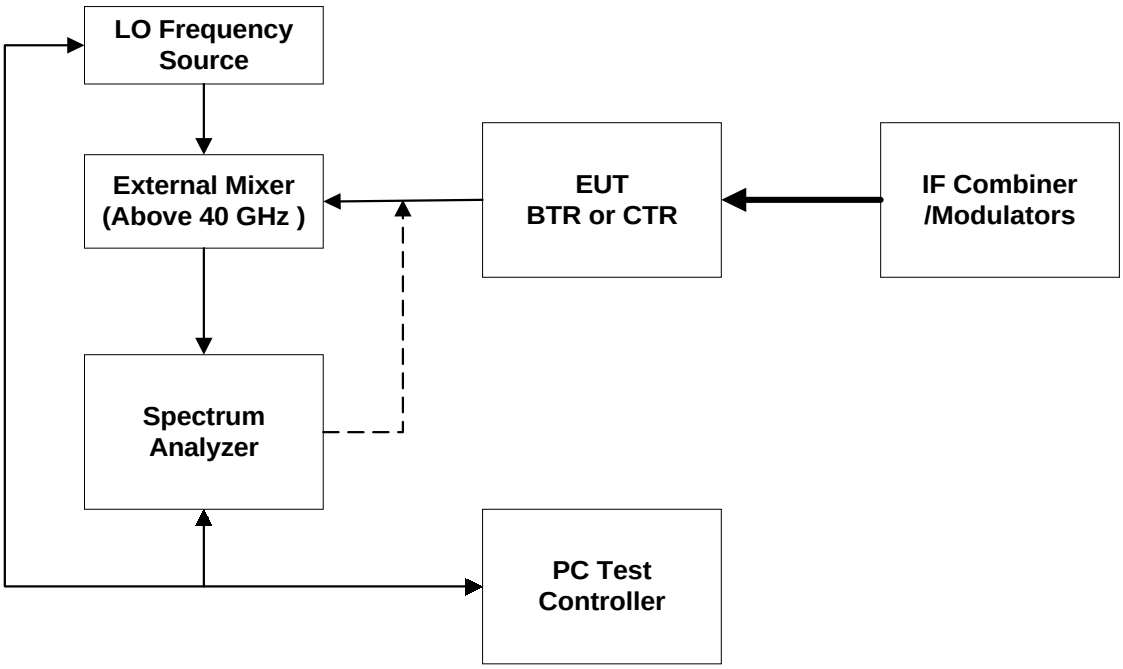
Test Method

Nortel processing equipment stimulated the BTR with digitally modulated 16 QAM signal. The modulator output signals are then combined, through a passive combiner, and fed into the input to the BTR. The output is examined directly by a spectrum analyzer for up to frequencies of 40GHz. External mixers are used for frequencies greater than 40GHz. A synthesized frequency generator stimulates the external mixer's local oscillator input. The spectrum analyzer, synthesized generator and all calculations are administered by a Labview software application on a PC.

Test System Test Configuration

Figure 1.0 presents a simplified block diagram of the conducted emissions test set-up. For measurements above 40GHz, a PC controlled a synthesized generator programming the LO frequency input to the external mixer, so that the difference frequency between what is measured and the LO frequency is 100MHz. Below 40GHz, the output of the EUT was directly connected to the input of the spectrum analyzer.

A reference passband response is recorded, of four 16 QAM modulated carriers, occupied bandwidth of 40MHz for the BTR. The measured reference is used to determine the out of band emissions, by measuring the relative differences between the reference and the measured emission.


LO Frequency Source
External Mixer (Above 40 GHz)
EUT BTR or CTR
IF Combiner /Modulators
Spectrum Analyzer
PC Test Controller

3. RADIATED EMISSIONS

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Mar 9 through Mar 15, 1998

Test was performed to validate the requirements specified in FCC part 101.111(a)(2)(iii)

Test Conditions

Temperature	20-25C,
Primary Voltage	BTR -48 Vdc

Test Results

The EUT does comply with the specification referenced in the Part 101.111 requirement.

Measurement Data

See on Appendix B for test results and setup photographs.

Test Method

Nortel processing equipment stimulated the BTR with digitally modulated 16 QAM signal. The modulator output signals are then combined, through a passive combiner, and fed into the input to the BTR. The output is examined directly by a spectrum analyzer for up to frequencies of 40GHz. External mixers are used for frequencies greater than 40GHz. A synthesized frequency generator stimulates the external mixer's local oscillator input. The spectrum analyzer, synthesized generator and all calculations are administered by a Labview software application on a PC.

Test System Configuration

Figure 2.0 presents a simplified block diagram of the radiated emissions test set-up. For measurements above 40GHz, the antennae is positioned 30cm from the EUT; a PC controlled a synthesized generator programming the LO frequency input to the external mixer, so that the difference frequency between what is measured and the LO frequency is 100 MHz. External mixers are connected to Millitech horn antennae, covering the band 40 to 60GHz, 60 to 90GHz and 90 to 140GHz. Below 40 GHz, the antennae is positioned 1m from the EUT; the input to the spectrum analyzer was connected to various antenna a Chase 30 to 1000MHz bilog, EMCO 1 to 18GHz horn, and Chase 14 to 40GHz horn.

A reference passband response is recorded, of four 64 QAM modulated carriers, occupied bandwidth of 40 MHz for the BTR. The test antennae and the EUT antenna are positioned at a given distance, to produce a maximum amplitude response of the passband. The antennae are held in this position during the entire testing of up to 110 GHz. The measured reference is used to determine the out of band emissions, by measuring the relative differences between it and the measured emission.

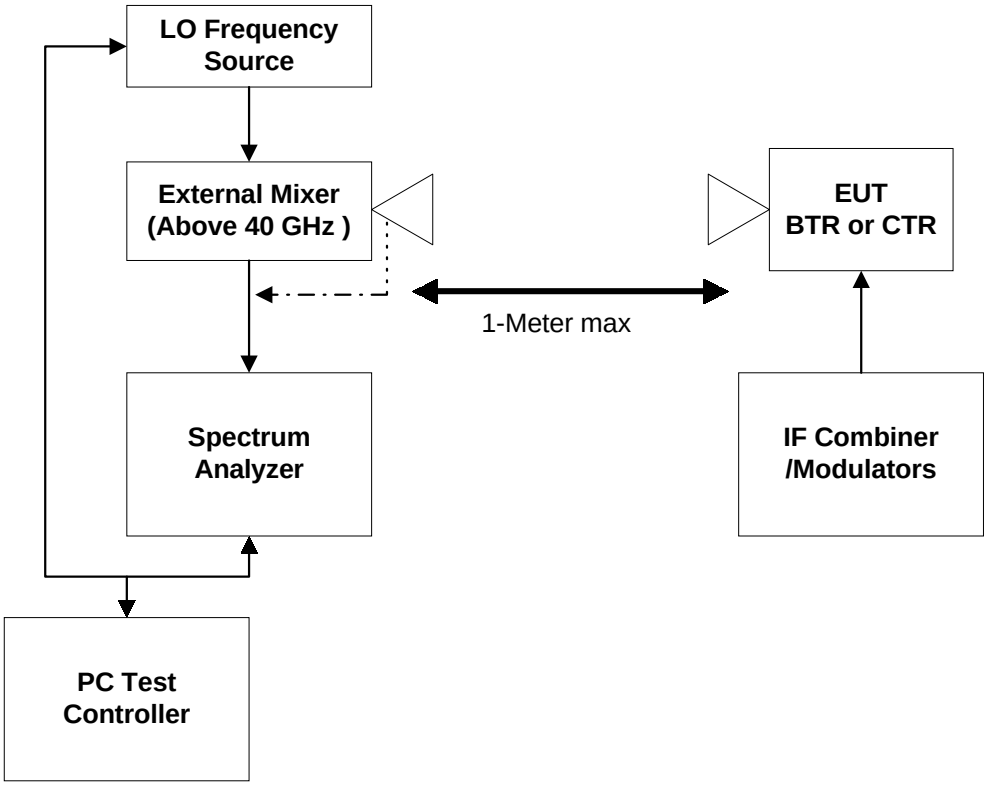


Figure 2.0: Test Setup Configuration for Radiated Emissions

4. TEMPERATURE STABILITY TESTS

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Mar 8, 1998

Test was performed to the validate the requirement of part 101.

Test Conditions

Temperature	-40C to +50C,
Primary Voltage	BTR -48 Vdc

Specifications

Requirement specified in FCC part 101, section 101.107, frequency tolerance of ±0.03%

Test Results

The BTR and CTR complies with the specifications stated in specification paragraph

Measurement Data

See on Appendix C for test setup and photographs.

Test Method

Tests were performed on a BTR, these units were placed into a temperature chamber, and the temperature profile used for temperature is referenced in FCC part 2, section. A base line frequency measurement is made at first ambient temperature. With the power not applied to the EUT, the temperature is then decreased by the programmed interval (10C) and allowed to “soak” for a period time specified by the user.(20min) This time allows the internal component temperature to stabilize. Once the plateau has been achieved, the power is applied to the EUT and the frequency is measured to 6 significant digits.

Test System Configuration

Figure 3.0 presents a simplified block diagram of the temperature stability test set-up. The PC controls the temperature profile of the temperature chamber. The specified temperature profile is –40°C to +50°C.

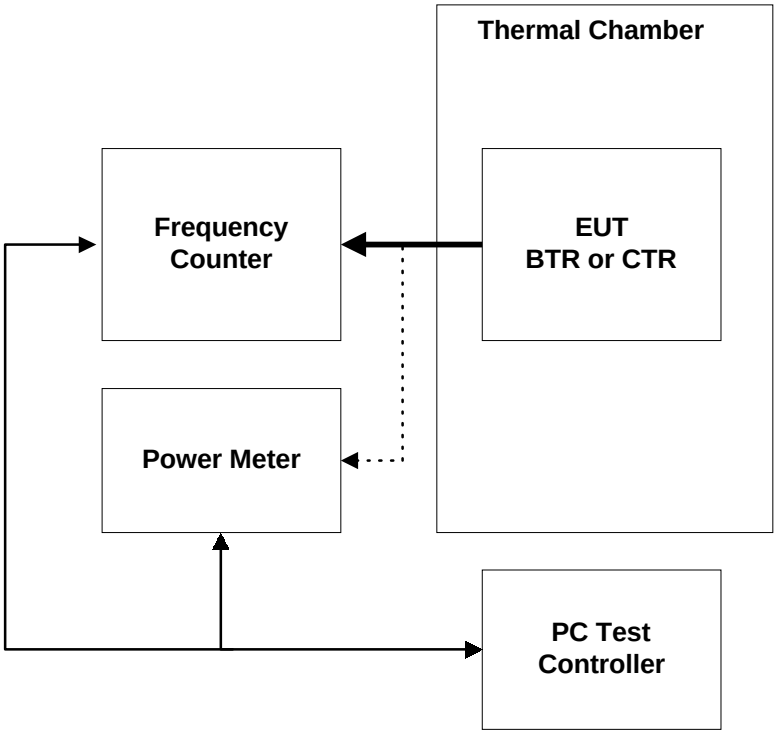


Figure 3.0: Test Setup Configuration for Temperature Stability Tests

5. CO/ADJACENT CHANNEL TEST

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Apr 13,1999

Test Conditions

Temperature	25C,
Primary Voltage	BTR -48 Vdc

Minimum Specifications

As specified in Part 101.105(c)(6), the protection criteria shall be at least 0dB for adjacent channel and as found in TIA Bulletin TSB-10 Table B-1, the limits for 4, 16 and 64 QAM are 19.5, 26.9 and 33.1 dB respectively for co-channel.

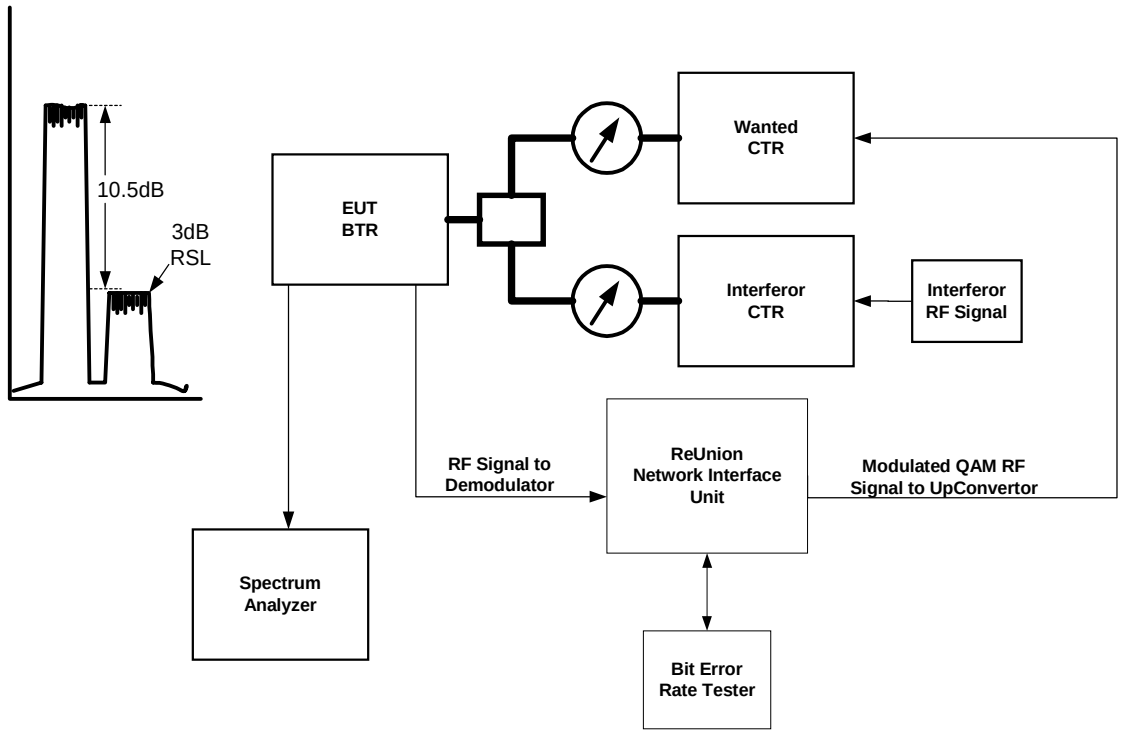
Adjacent Channel Test Method

Nortel translation equipment (CTR) is stimulated with digitally modulated 16 QAM RF signals. The two signals (wanted and interferor) are combined, up-converted and fed into the microwave receive of the EUT (BTR). The wanted CTR output is adjusted such that a quality QAM signal is present. An inline vane attenuator is adjusted until a payload BER of 10^{-6} is achieved. The level is then increased by 3dB. The interfering signal is applied and adjusted such that the BER of 10^{-6} is achieved. The power density of the wanted and interfering carrier are recorded. It should be noted that the vane attenuation reading is noted and it is removed so that accurate measurements are easily made at the microwave flange of the receiver.

Co-Channel Test Method

Nortel translation equipment (CTR) is stimulated with digitally modulated 16 QAM signals. The two signals (wanted and interferor) are combined and fed into the microwave receiver of the EUT (BTR). The wanted CTR output is adjusted such that a quality QAM signal is present. An inline vane attenuator is adjusted until a payload BER of 10^{-6} is achieved. The wanted output is then increased by 3dB and the level is recorded. The interfering signal is then applied at maximum in-line attenuation. The interfering signal is adjusted until the payload BER reaches $10^{-6.}$ The interfering signal is removed. The power density of the wanted carrier is measured and recorded. The wanted carrier is then removed and the interfering signal is measured and recorded. The two measurements should be at least 20.9 dB. It should be noted that the vane attenuation reading is noted and it is removed so that accurate measurements are easily made at the microwave flange of the receiver.

Test System Test Configuration



The figure below represents a simplified block diagram of the adjacent and co-channel interference test set-up. 8.0Msps carriers were used giving a bandwidth of 10MHz. Measurements at 4, 16 and 64 QAM were performed using a BER trigger metric of 3dB RSL. For ease of measurement, the relative levels were measured at the RF output of the receiver.

Adjacent Channel Test Results

4 QAM	Wanted	Hi-Side Interferor	Low-Side Interferor
	550 MHz	560MHz	540MHz
Channel Power	-.41.3	-15	-18.4
Limit (0dB)	----	> -41.3	> -41.3
Pass Margin	----	26.3	22.9

16 QAM	Wanted	Hi-Side Interferor	Low-Side Interferor
	550 MHz	560MHz	540MHz
Channel Power	--34.5	-14.5	-17
Limit (0dB)	----	> -34.5	> -34.5
Pass Margin	----	20	17.5

64 QAM	Wanted	Hi-Side Interferor	Low-Side Interferor
	550 MHz	560MHz	540MHz
Channel Power	-28.9	-14.5	-17.4
Limit (0dB)	----	> -28.9	> -28.9
Pass Margin	----	14.4	11.5

Co-Channel Test Results

Frequency 550MHz @ 4 QAM	Wanted	Interferor
Channel Power	-43.5	-54.5
Limit (19.5dB)	----	> -63
Pass Margin	----	8.5

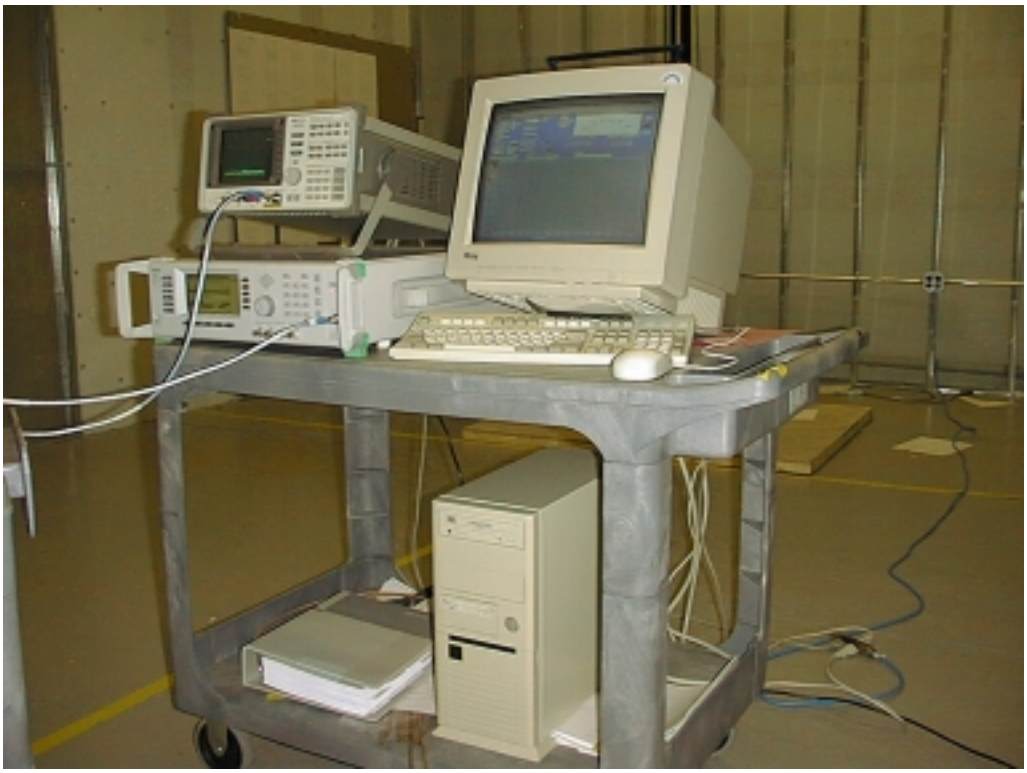
Frequency 550MHz @ 16 QAM	Wanted	Interferor
Channel Power	-45	-60.5
Limit (26.9dB)	----	> -71.9
Pass Margin	----	11.4

Frequency 550MHz @ 64 QAM	Wanted	Interferor
Channel Power	-47.5	-65.5
Limit (33.1dB)	----	> -80.6
Pass Margin	----	15.1

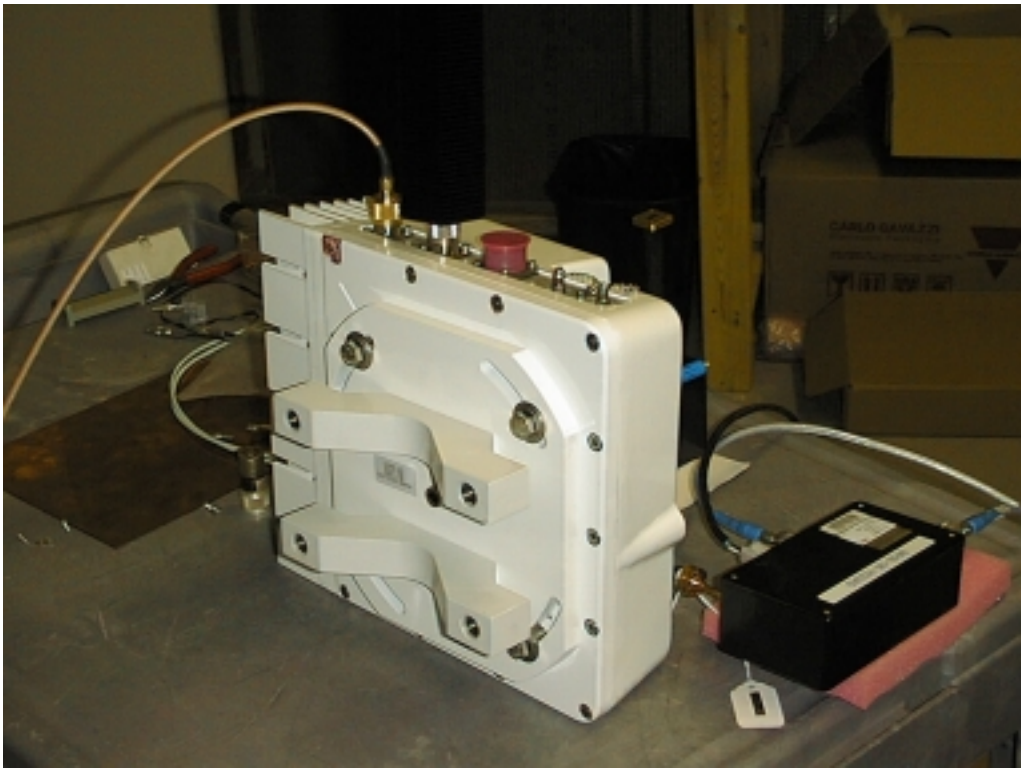
APPENDIX A

Conducted Emissions Measurement Results

6. CONDUCTED EMISSIONS MEASUREMENT RESULTS



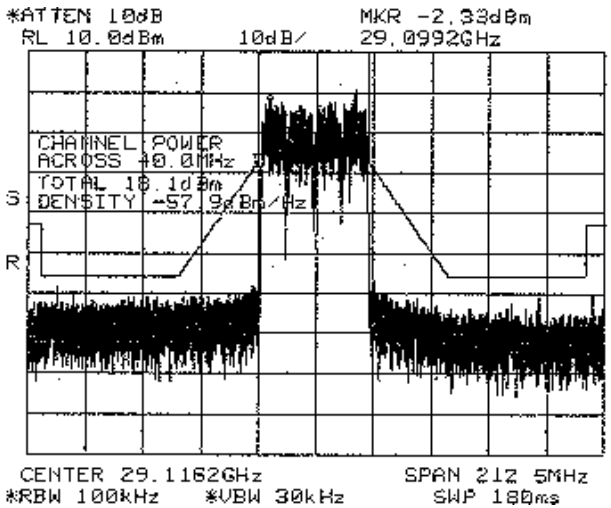
Computer setup and instrumentation in the PI laboratory

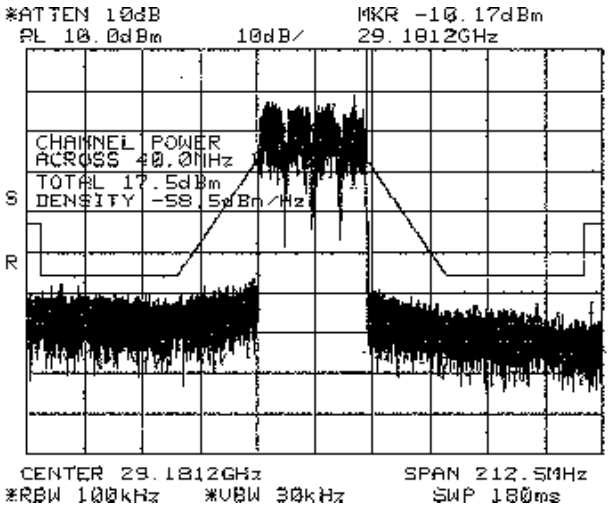


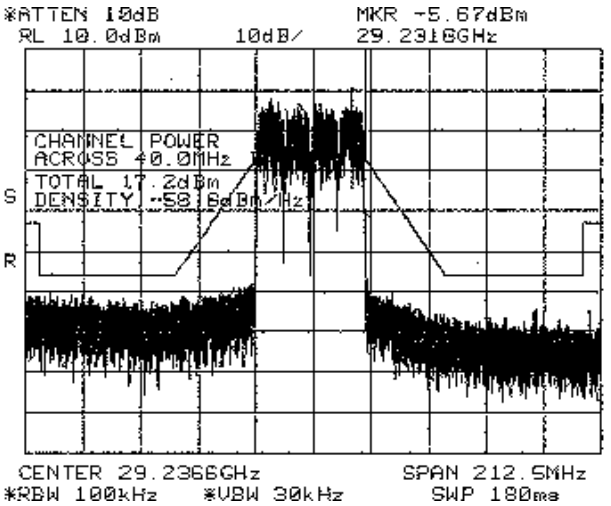
Connection to the BTR using the wave-guide connection

BTR 2800, 4 carrier QAM 64 modulated - In-band carriers

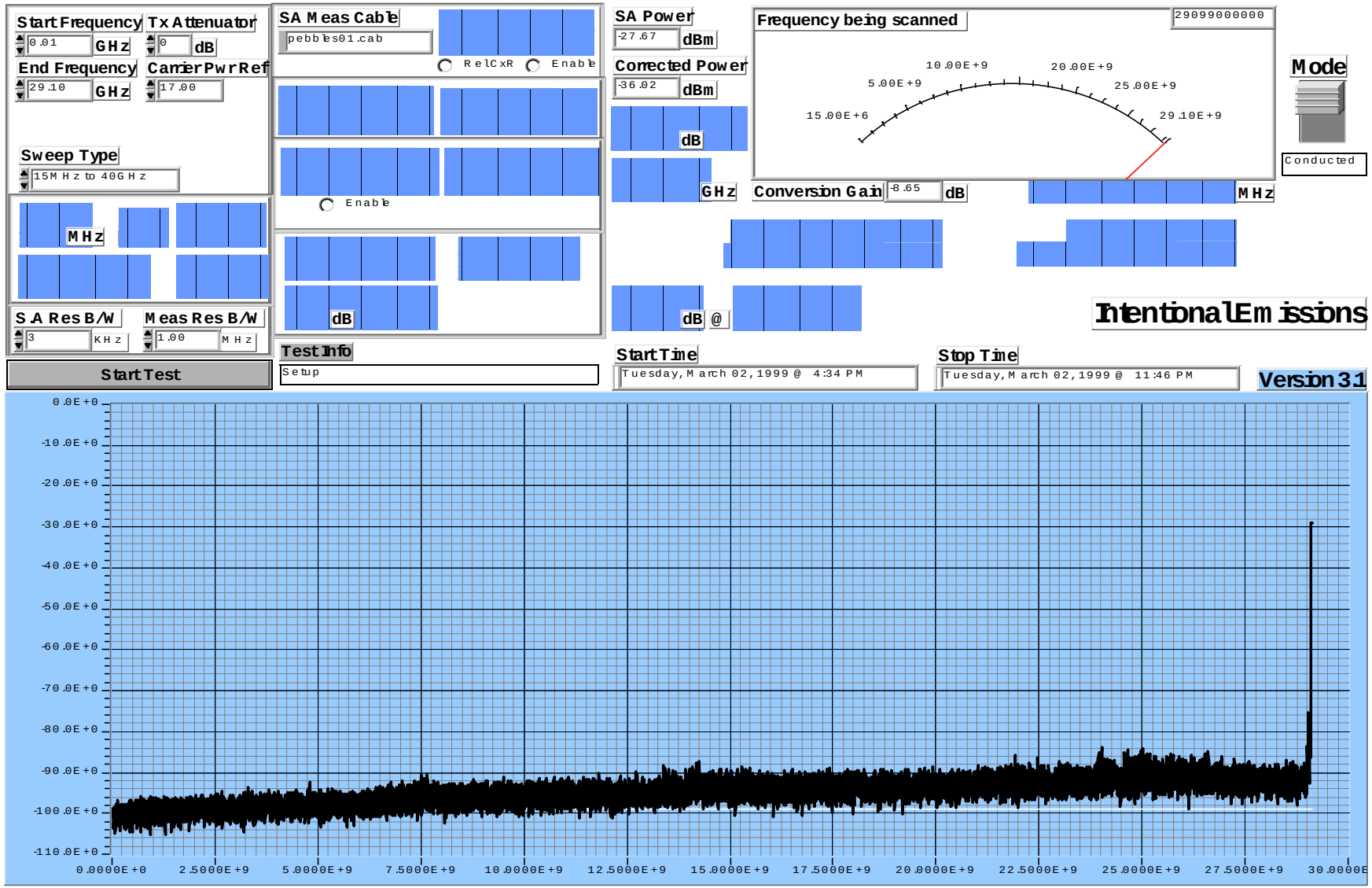
The emission showing amplitude and angle-modulated (D) with two or more channels (7) which could contain data or telephony (W). The signal has a maximum occupied bandwidth of 40MHz. (40M0). Equipment Type 40M0D7W The following pictures show 4 – 10MHz carriers across the minimum, maximum and middle of the 150MHz band at a channel power of 20dBm Limit calculations can be found in Appendix D.



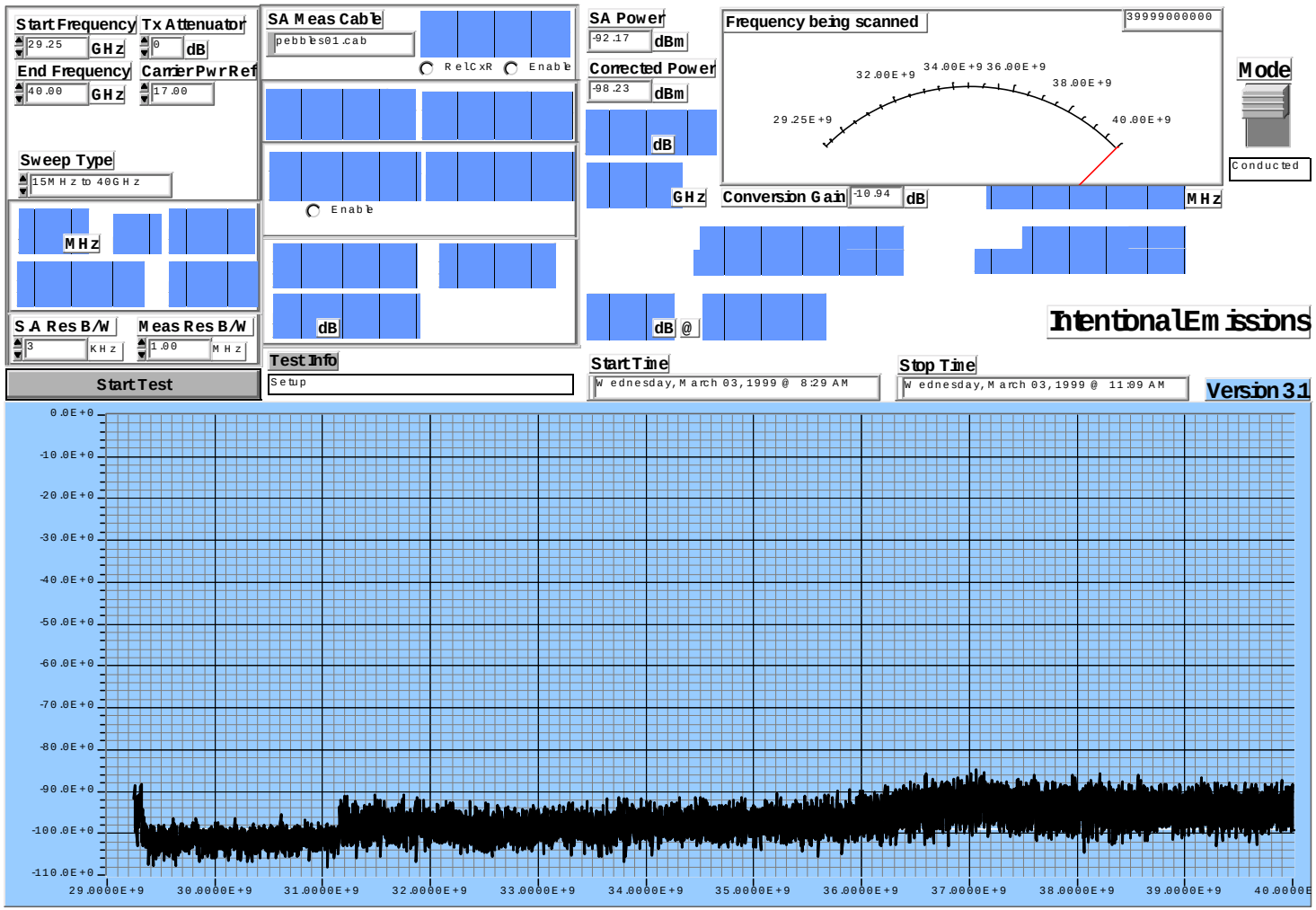




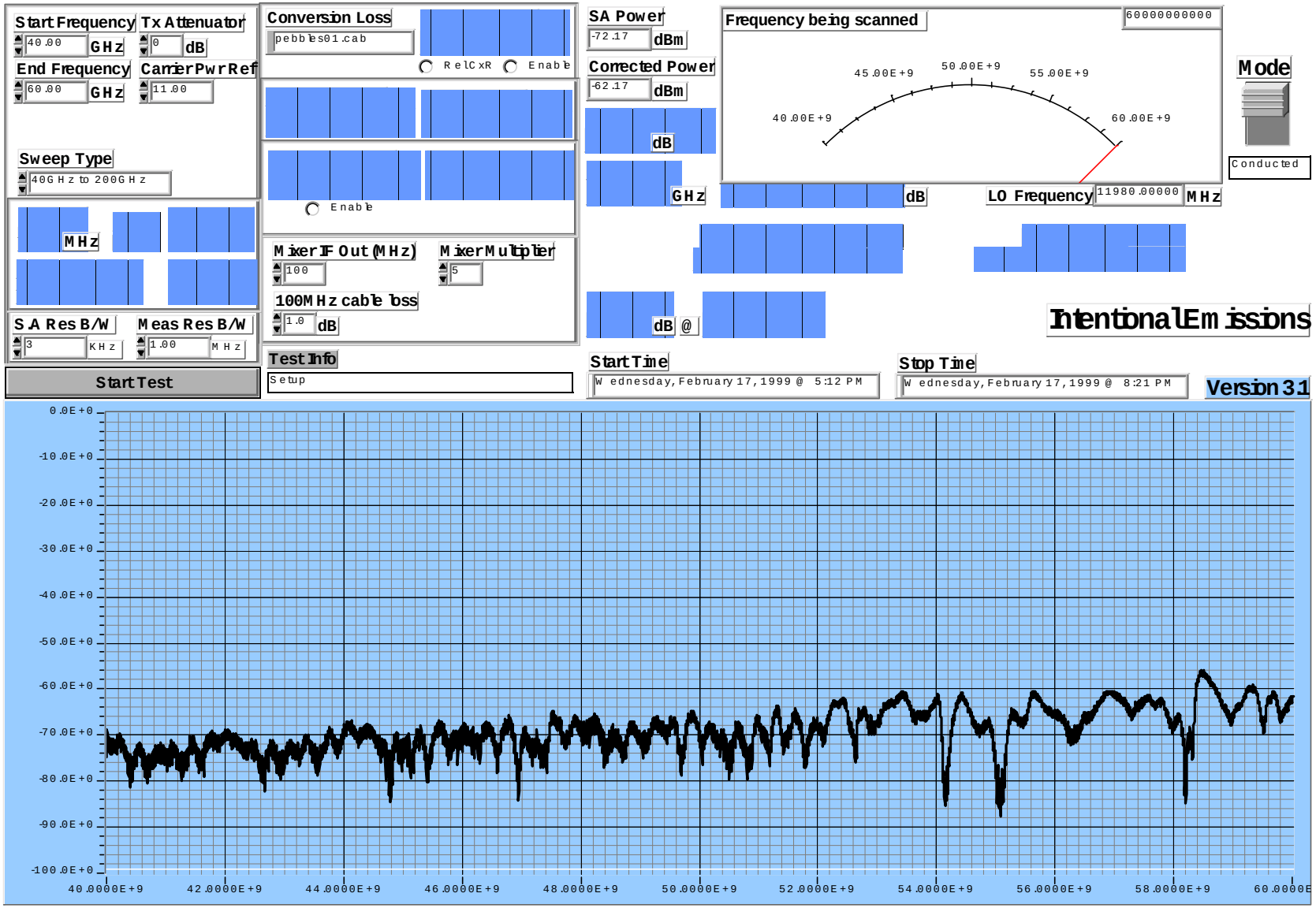
BTR 2800, 4 carrier QAM 64 modulated. – 30MHz to edge of carriers



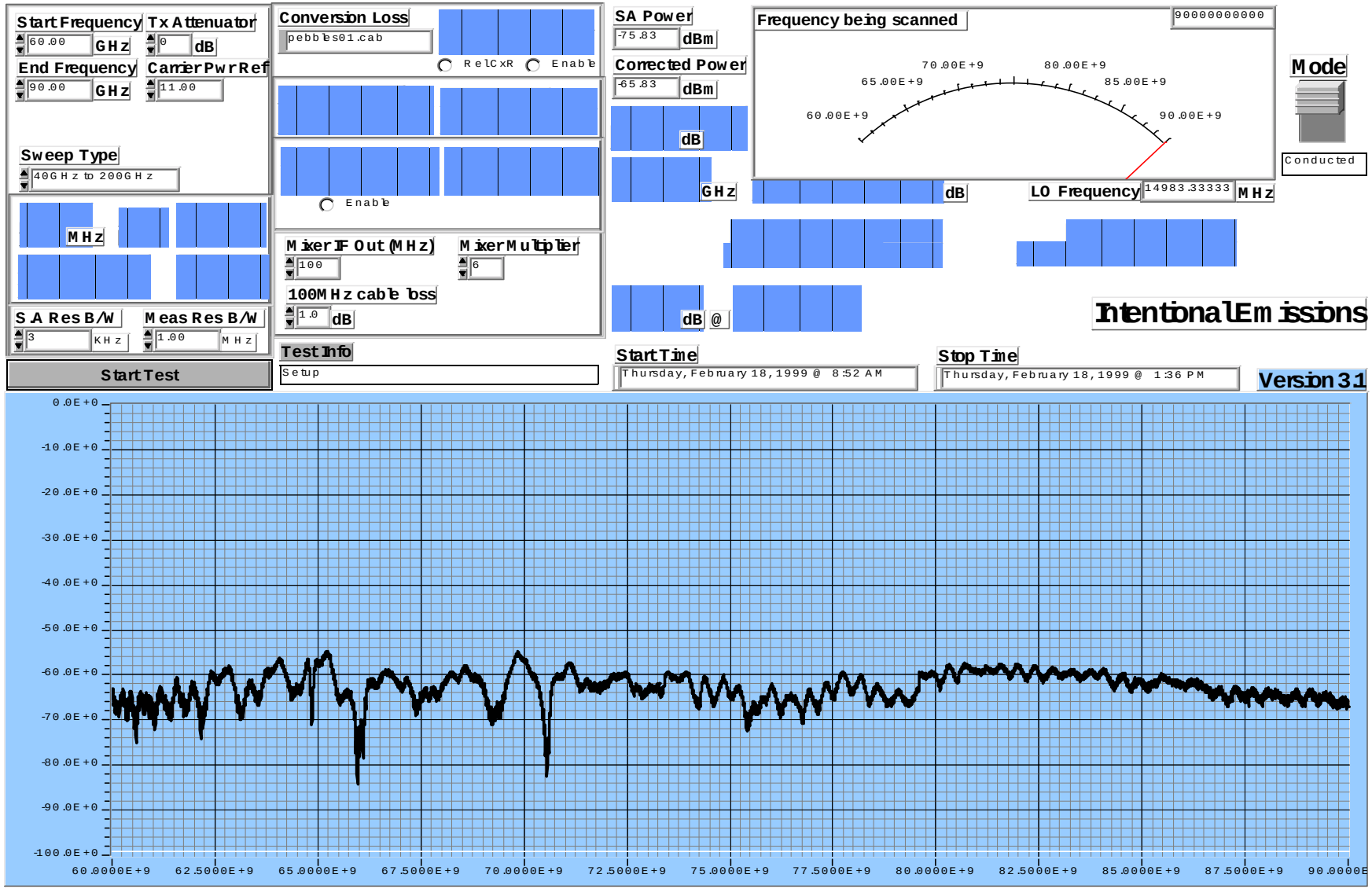
BTR 2800, 4 carrier QAM 64 modulated. – edge of carriers to 40GHz



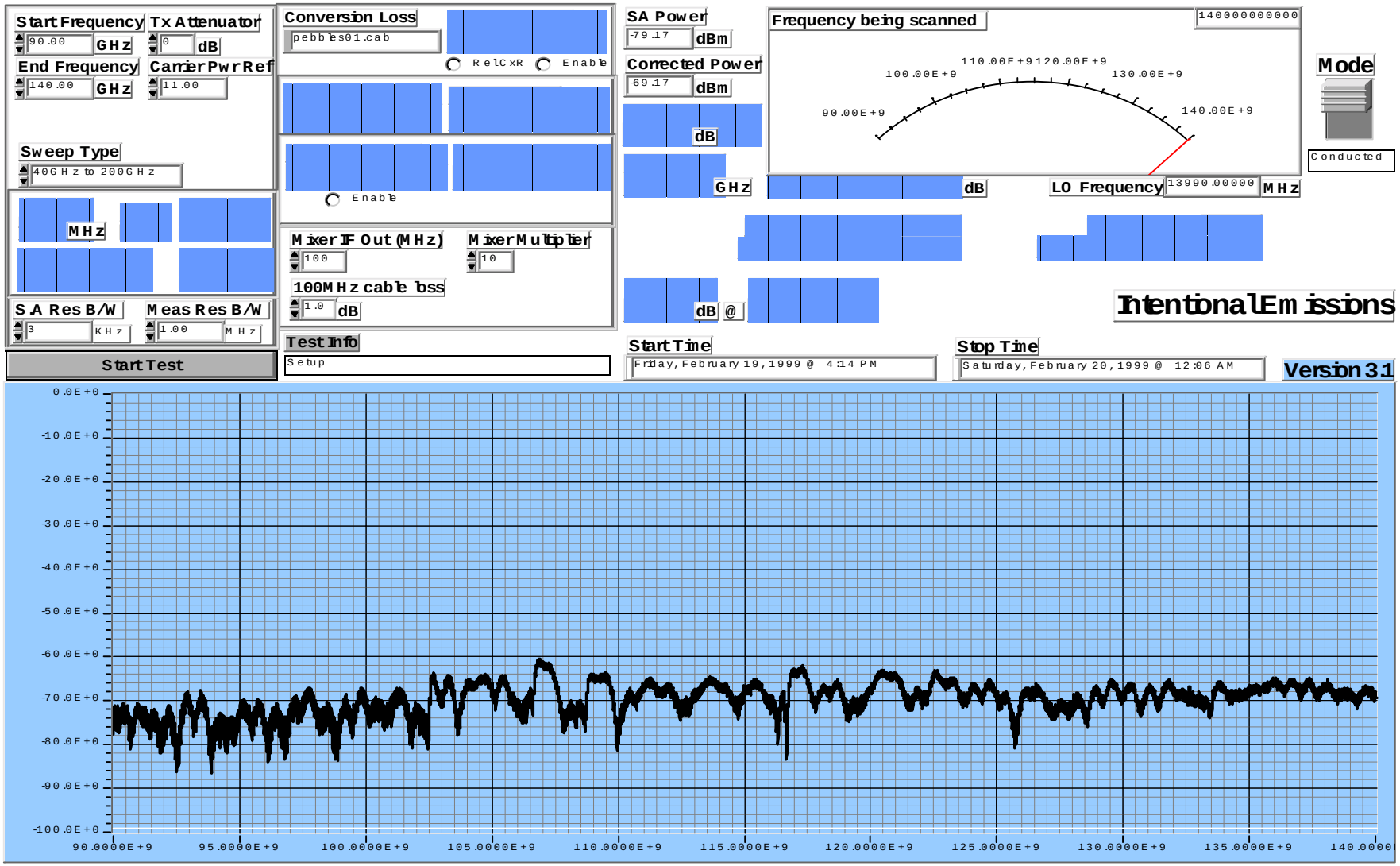
BTR 2800, 4 carrier QAM 64 modulated. – 40 to 60GHz



BTR 2800, 4 carrier QAM 64 modulated. – 60 to 90GHz



BTR 2800, 4 carrier QAM 64 modulated. – 90 to 140GHz

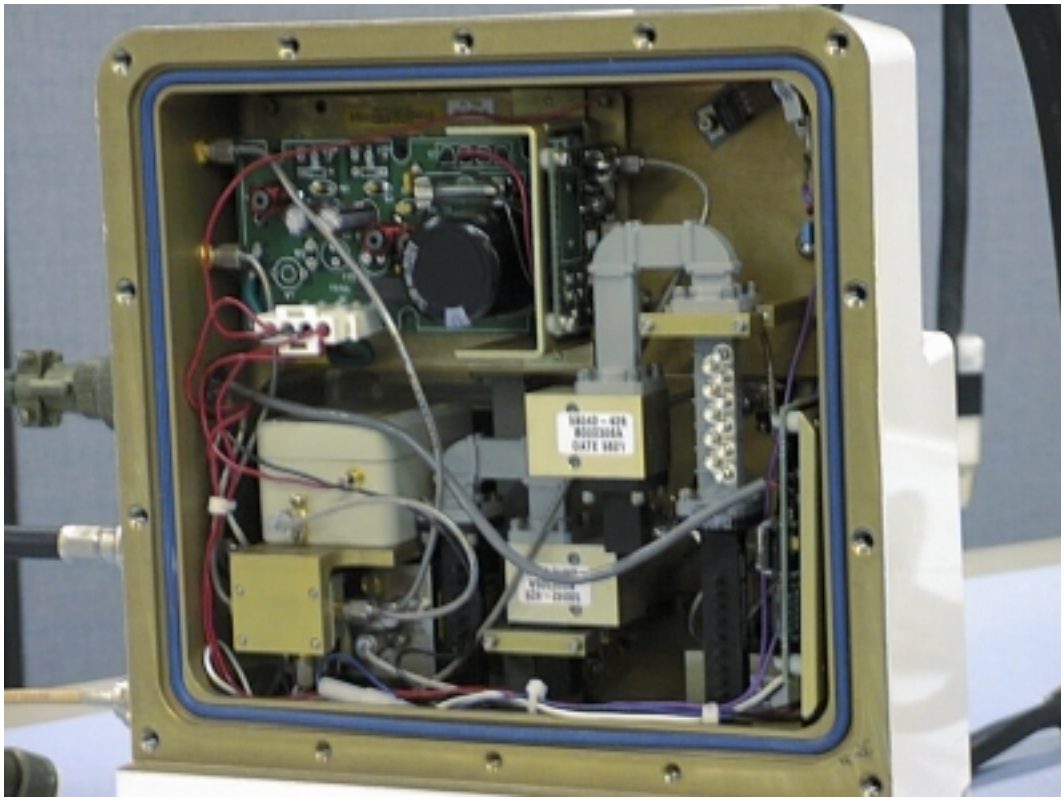


APPENDIX B

Radiated Emissions Measurement Results

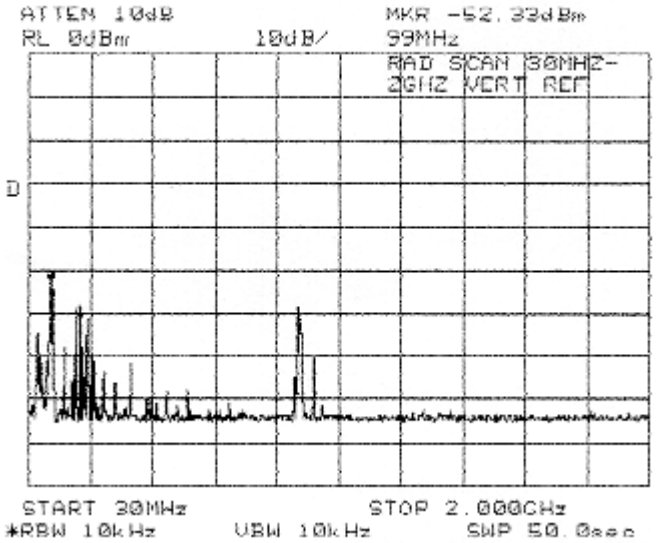
7. RADIATED EMISSIONS MEASUREMENT RESULTS

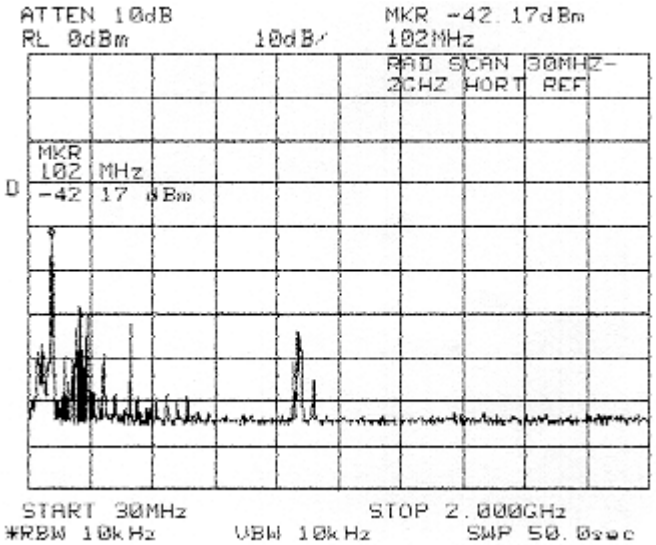
Radiated test using the 40-60GHz horn**.**



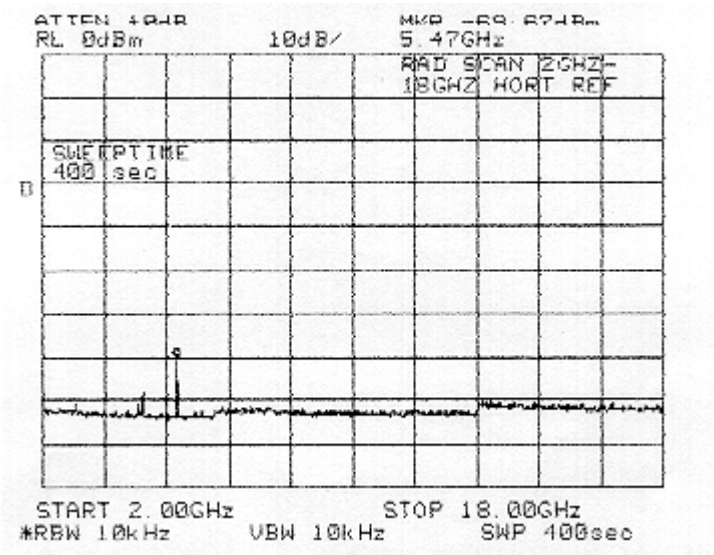
BTR with the back cover removed

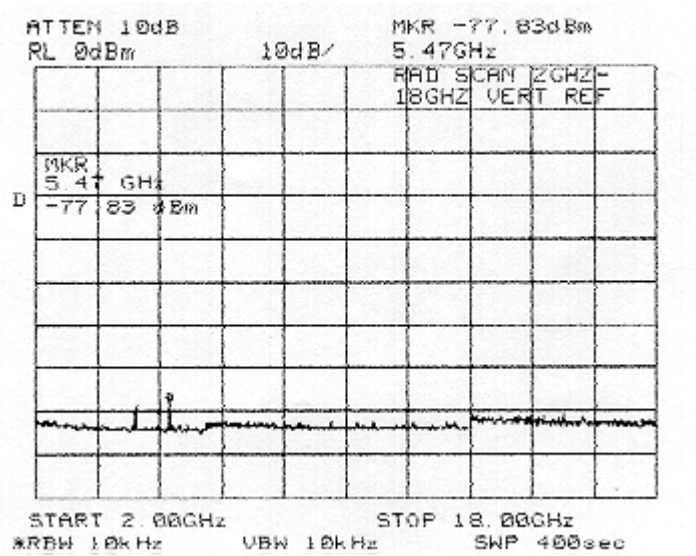
BTR 2800, 4 carrier QAM 64 modulated. – 30MHz to 2GHz



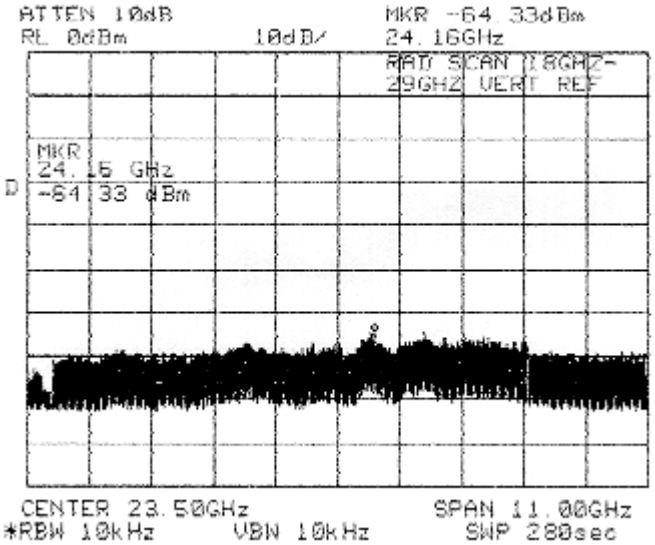


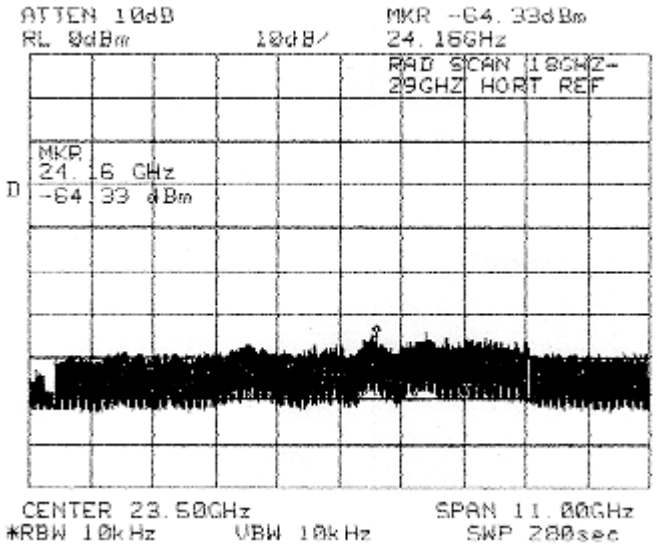
BTR 2800, 4 carrier QAM 64 modulated. – 2GHz to 18GHz



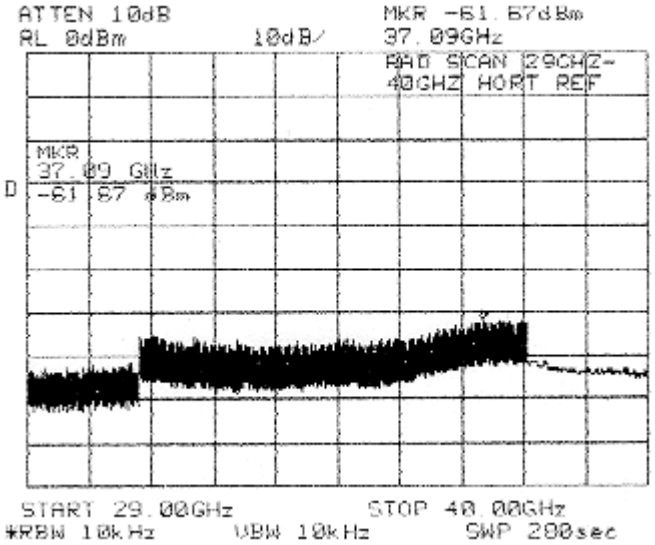


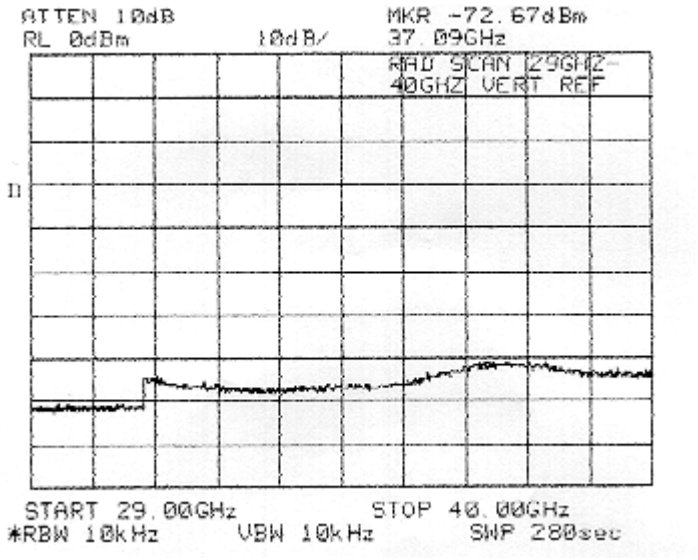
BTR 2800, 4 carrier QAM 64 modulated. – 18 to 29 GHz



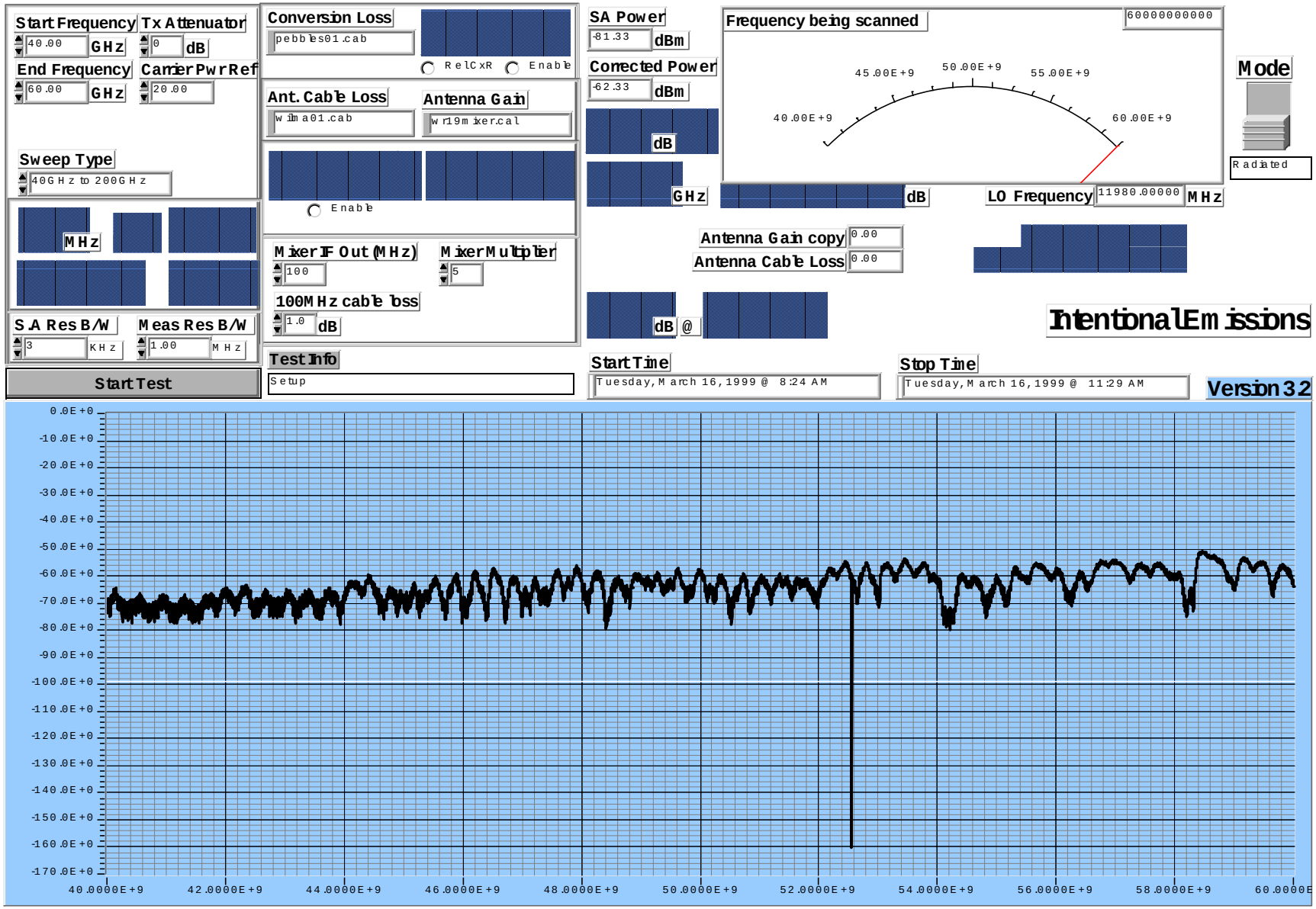


BTR 2800, 4 carrier QAM 64 modulated. – 29.5GHz to 40GHz

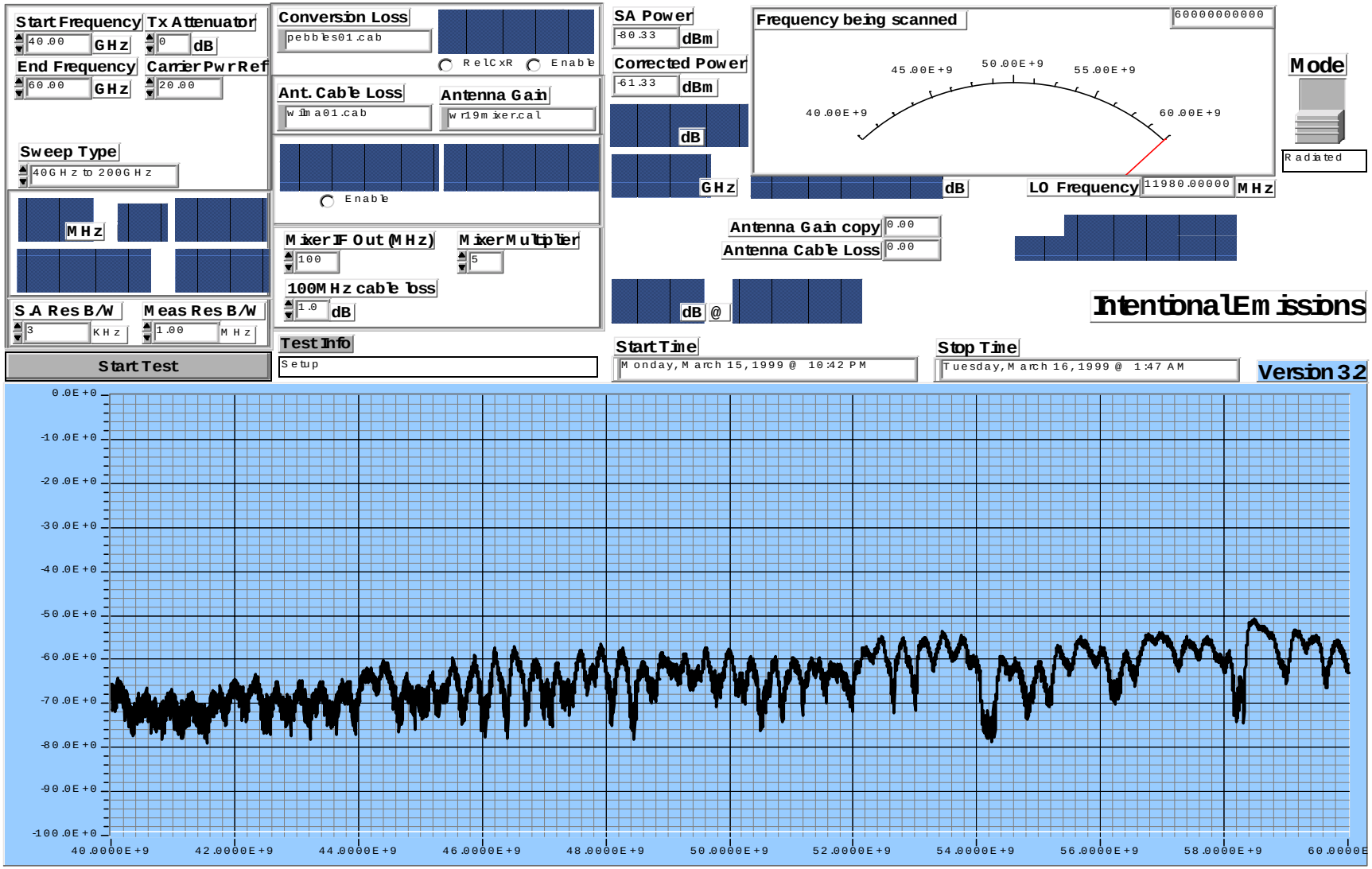




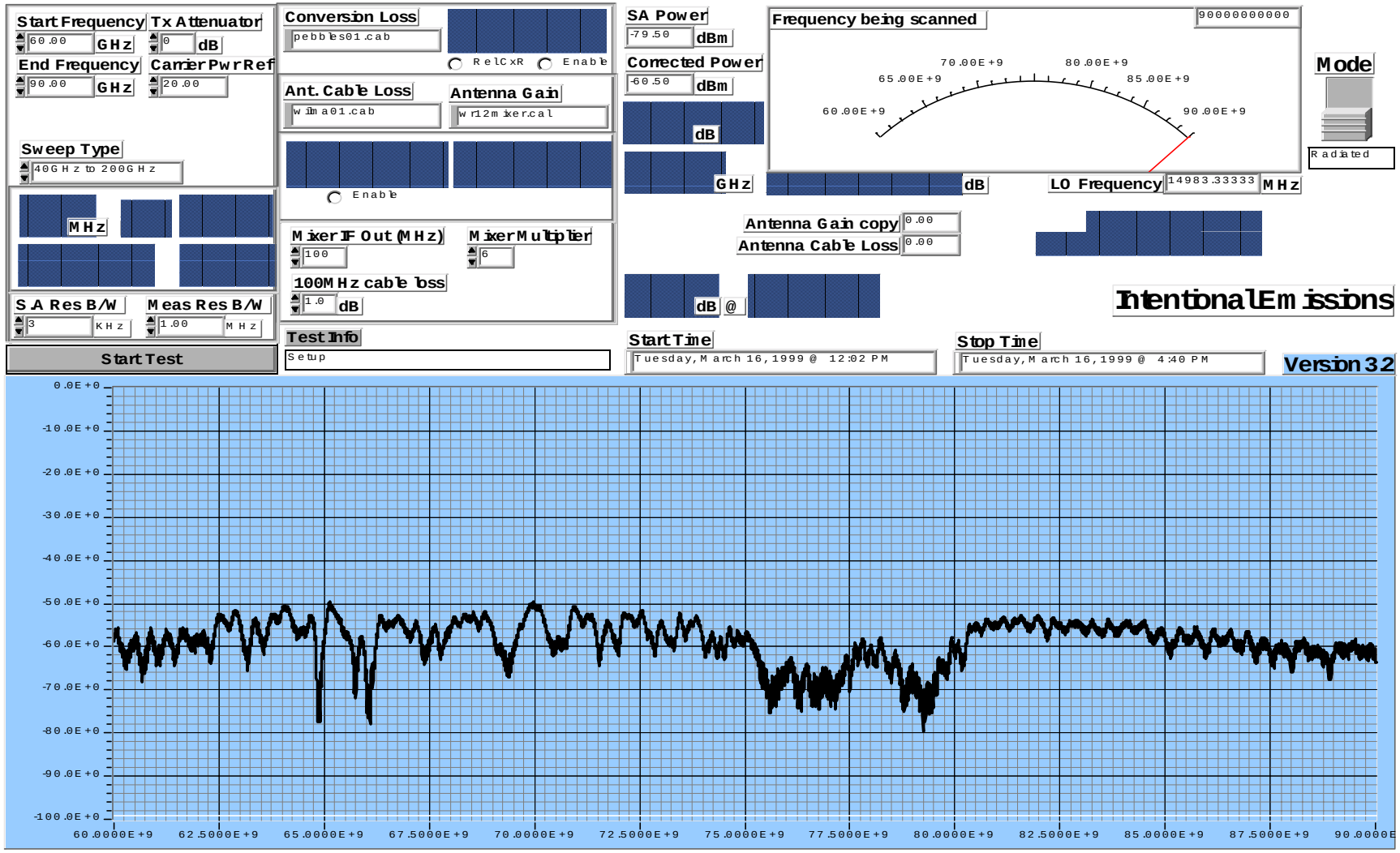
BTR 2800, 4 carrier QAM 64 modulated. –40GHz-60GHz - Horizontal



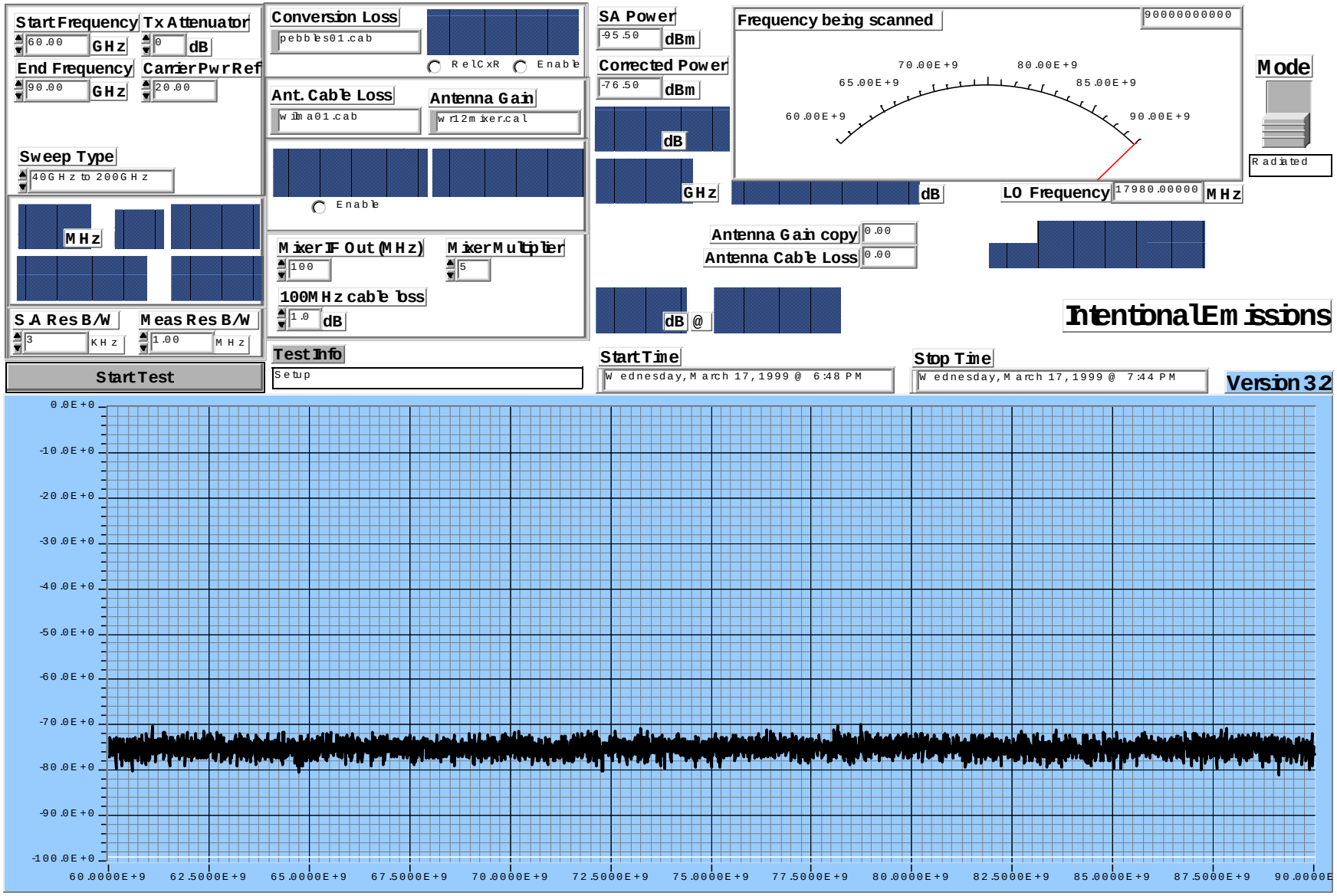
BTR 2800, 4 carrier QAM 64 modulated. –40GHz-60GHz - Vertical



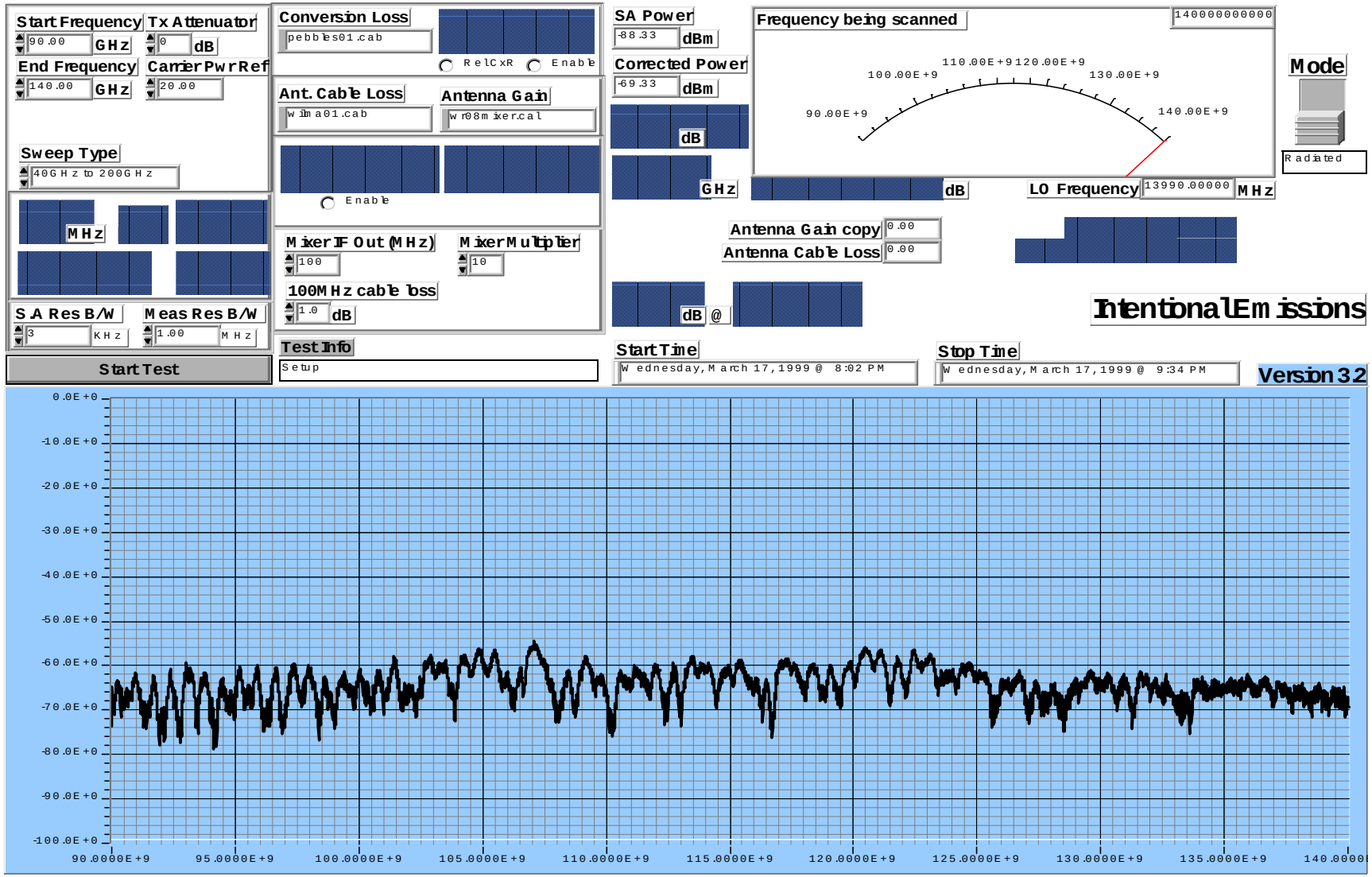
BTR 2800, 4 carrier QAM 64 modulated. –60GHz-90GHz - Horizontal



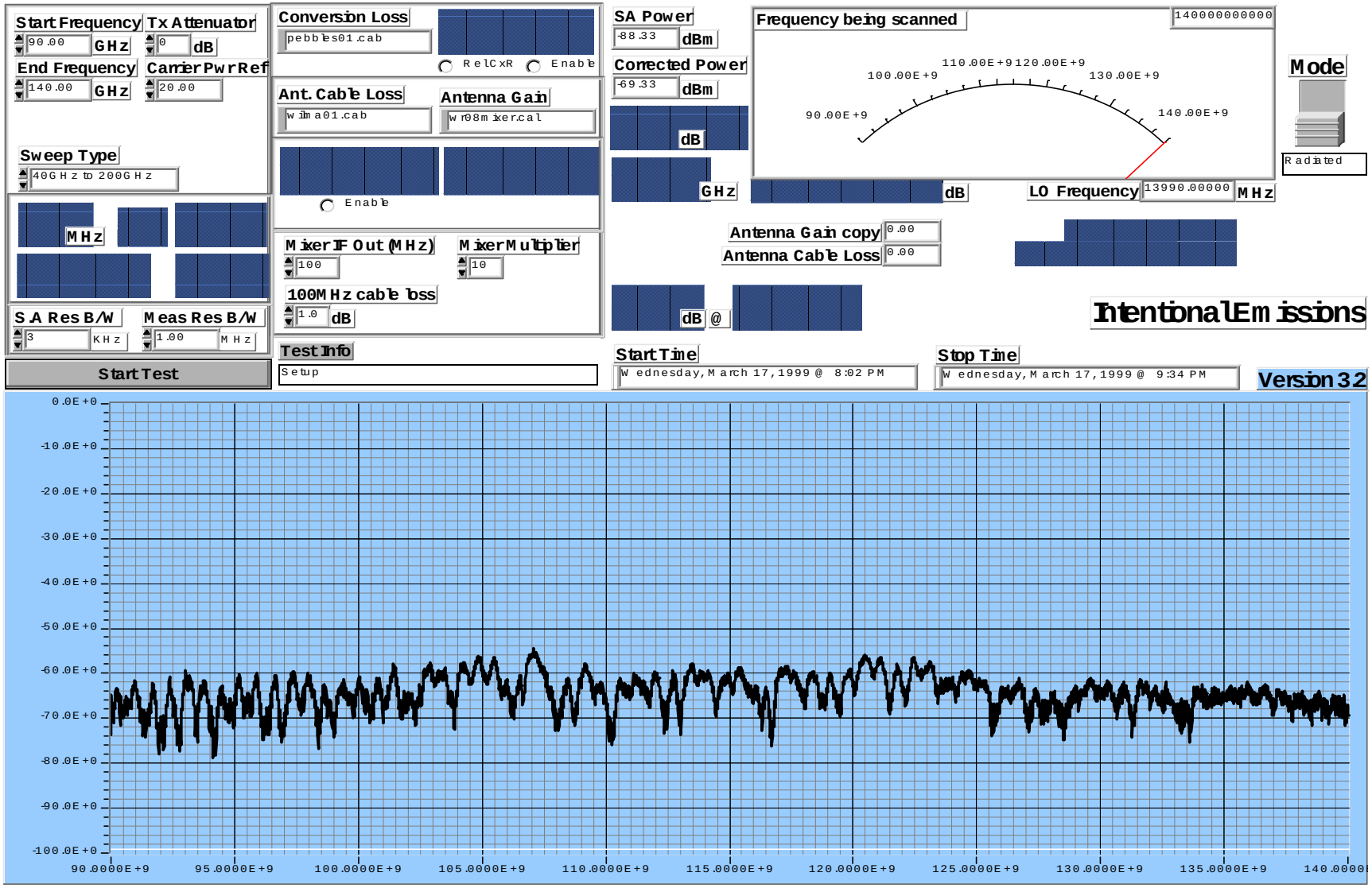
BTR 2800, 4 carrier QAM 64 modulated. –60GHz-90GHz – Vertical



BTR 2800, 4 carrier QAM 64 modulated. –90GHz-140GHz – Horizontal



BTR 2800, 4 carrier QAM 64 modulated. –90GHz-140GHz – Vertical

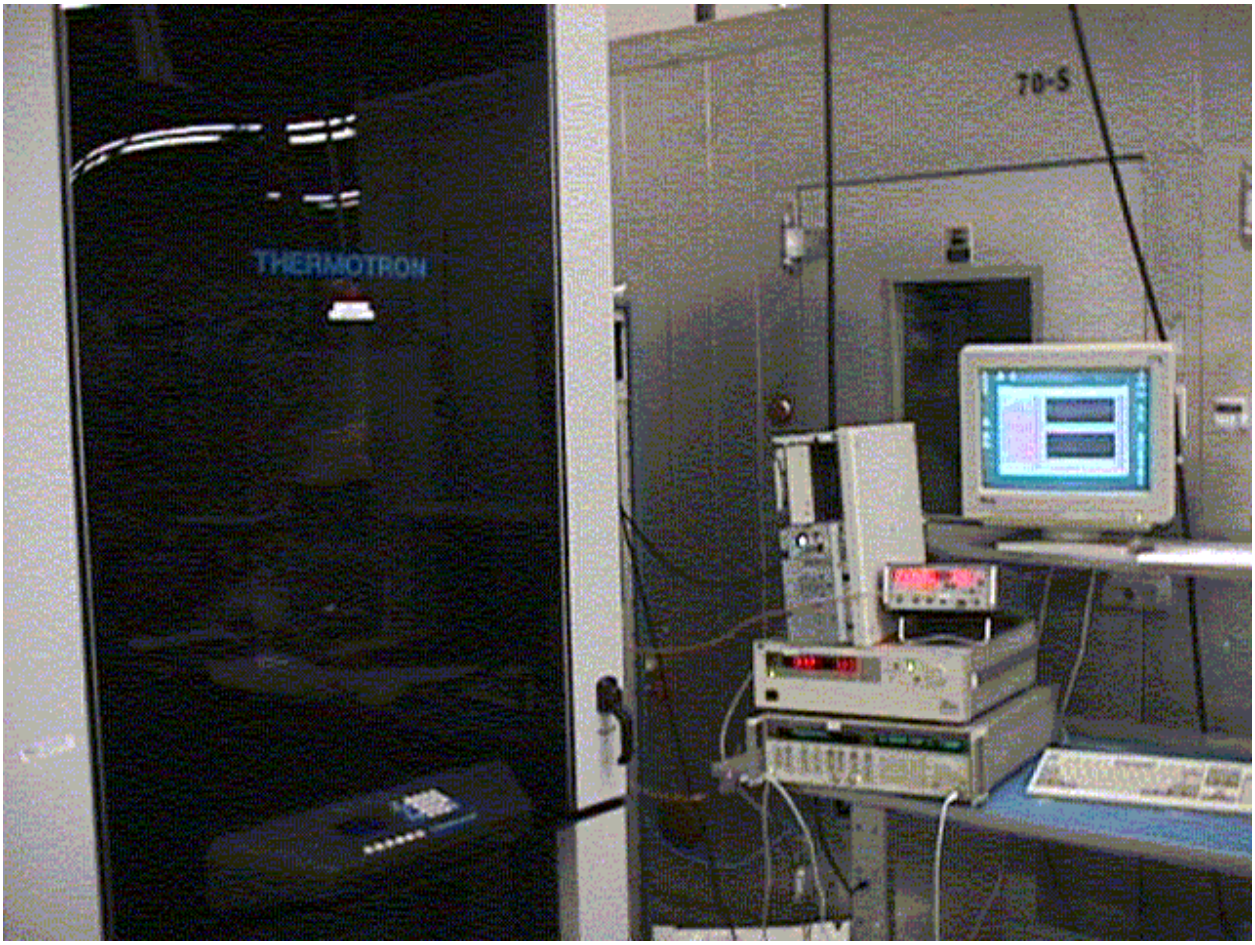


APPENDIX C

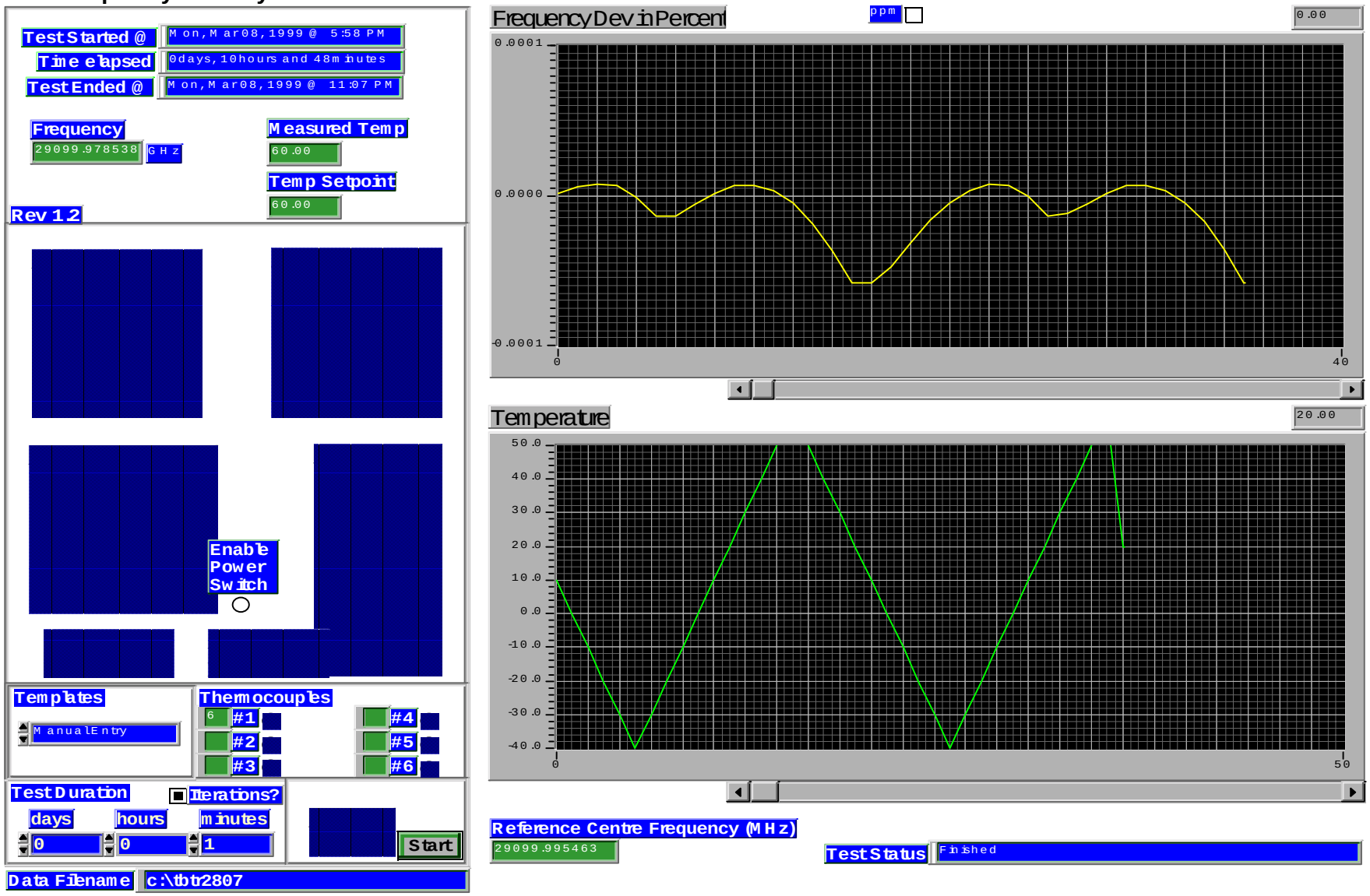
Temperature Stability Measurements Results

8. TEMPERATURE STABILITY MEASUREMENTS RESULTS

Frequency Stability Test Setup



BTR Frequency Stability



Date and Time			Frequency	Temp	Deviation
Mon	Mar08	1999 @ 6:16PM	29099.995747	10.0	0.000001
Mon	Mar08	1999 @ 6:36PM	29099.997153	0.0	0.000006
Mon	Mar08	1999 @ 6:54PM	29099.997590	-10.0	0.000007
Mon	Mar08	1999 @ 7:13PM	29099.997346	-20.0	0.000006
Mon	Mar08	1999 @ 7:32PM	29099.995199	-30.0	-0.000001
Mon	Mar08	1999 @ 7:51PM	29099.991453	-40.0	-0.000014
Mon	Mar08	1999 @ 8:10PM	29099.991398	-30.0	-0.000014
Mon	Mar08	1999 @ 8:27PM	29099.993856	-20.0	-0.000006
Mon	Mar08	1999 @ 8:44PM	29099.995924	-10.0	0.000002
Mon	Mar08	1999 @ 9:00PM	29099.997276	0.0	0.000006
Mon	Mar08	1999 @ 9:17PM	29099.997357	10.0	0.000007
Mon	Mar08	1999 @ 9:34PM	29099.996241	20.0	0.000003
Mon	Mar08	1999 @ 9:51PM	29099.993925	30.0	-0.000005
Mon	Mar08	1999 @ 10:09PM	29099.989839	40.0	-0.000019
Mon	Mar08	1999 @ 10:28PM	29099.984737	50.0	-0.000037
Mon	Mar08	1999 @ 10:48PM	29099.978462	60.0	-0.000058
Mon	Mar08	1999 @ 11:07PM	29099.978409	50.0	-0.000059
Mon	Mar08	1999 @ 11:24PM	29099.981585	40.0	-0.000048
Mon	Mar08	1999 @ 11:41PM	29099.986225	30.0	-0.000032
Tue	Mar09	1999 @ 12:00AM	29099.990573	20.0	-0.000017
Tue	Mar09	1999 @ 12:19AM	29099.993987	10.0	-0.000005
Tue	Mar09	1999 @ 12:38AM	29099.996469	0.0	0.000003
Tue	Mar09	1999 @ 12:55AM	29099.997603	-10.0	0.000007
Tue	Mar09	1999 @ 1:16AM	29099.997368	-20.0	0.000007
Tue	Mar09	1999 @ 1:34AM	29099.995438	-30.0	0.000000
Tue	Mar09	1999 @ 1:53AM	29099.991581	-40.0	-0.000013
Tue	Mar09	1999 @ 2:11AM	29099.992010	-30.0	-0.000012
Tue	Mar09	1999 @ 2:28AM	29099.993853	-20.0	-0.000006
Tue	Mar09	1999 @ 2:45AM	29099.995944	-10.0	0.000002
Tue	Mar09	1999 @ 3:01AM	29099.997295	0.0	0.000006
Tue	Mar09	1999 @ 3:18AM	29099.997420	10.0	0.000007
Tue	Mar09	1999 @ 3:35AM	29099.996299	20.0	0.000003
Tue	Mar09	1999 @ 3:52AM	29099.994005	30.0	-0.000005
Tue	Mar09	1999 @ 4:10AM	29099.990394	40.0	-0.000017
Tue	Mar09	1999 @ 4:27AM	29099.985010	50.0	-0.000036
Tue	Mar09	1999 @ 4:46AM	29099.978538	60.0	-0.000058

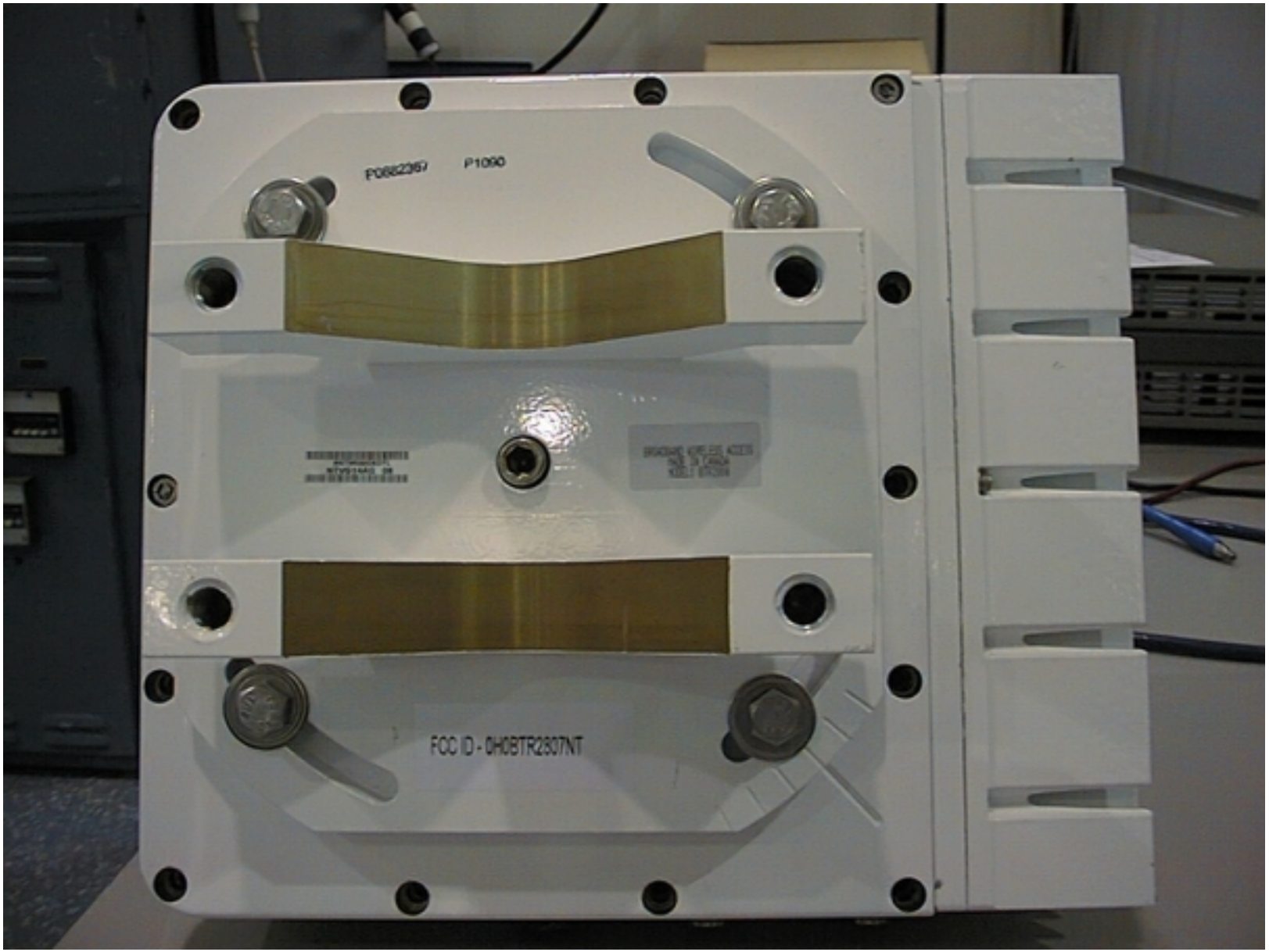
APPENDIX D

SPECTRAL MASK LIMIT CALCULATIONS

9. SPECTRAL MASK LIMIT CALCULATIONS

Symbol rate (Msps)	8	**Center Freq. (MHz)**	29116.2	BTR - low side mask
Authorized BW (MHz)	40			
O/P Channel Power (dBm)	20	0.1	**Watts**	
% Removed	**FCC Spec**	**Delta BW**	**Lwr Band**	**Upr Band**
0	**0**	**0**	**29116.2**	**29116.2**
50	**0**	**20**	**29096.2**	**29136.2**
50.5	**-27.2205999**	**20.2**	**29096**	**29136.4**
51	-27.4205999	20.4	29095.8	29136.6
55	-29.0205999	22	29094.2	29138.2
60	-31.0205999	24	29092.2	29140.2
75	-37.0205999	30	29086.2	29146.2
100	-47.0205999	40	29076.2	29156.2
101	-47.4205999	40.4	29075.8	29156.6
102	-47.8205999	40.8	29075.4	29157
105	-49.0205999	42	29074.2	29158.2
106	-49.4205999	42.4	29073.8	29158.6
107	-49.8205999	42.8	29073.4	29159
107.45	-50.0005999	42.98	29073.22	29159.18
115	-53.0205999	46	29070.2	29162.2
120	-55.0205999	48	29068.2	29164.2
125	**-56**	**50**	**29066.2**	**29166.2**
150	-56	60	29056.2	29176.2
175	-56	70	29046.2	29186.2
200	-56	80	29036.2	29196.2
250	**-56**	**100**	**29016.2**	**29216.2**
250.1	**-43**	**100.04**	**29016.16**	**29216.24**
300	-43	120	28996.2	29236.2
500	-43	200	28916.2	29316.2
1000	-43	400	28716.2	29516.2
1100	-43	440	28676.2	29556.2
1200	-43	500	28616.2	29616.2
1250	-43	500	28616.2	29616.2
1300	-43	520	28596.2	29636.2
1500	**-43**	**600**	**28516.2**	**29716.2**
Number of CXR	4	**Center Freq (MHz)**	29181.2	BTR - mid-band mask

Symbol rate (Msps)	8			
Authorized BW (MHz)	40			
O/P Channel Power (dBm)	20	0.1	**Watts**	
% Removed	**FCC Spec**	**Delta BW**	**Lower Band**	**Upper Band**
0	**0**	**0**	**29181.2**	**29181.2**
50	**0**	**20**	**29161.2**	**29201.2**
50.5	**-27.2205999**	**20.2**	**29161**	**29201.4**
51	-27.4205999	20.4	29160.8	29201.6
55	-29.0205999	22	29159.2	29203.2
60	-31.0205999	24	29157.2	29205.2
75	-37.0205999	30	29151.2	29211.2
100	-47.0205999	40	29141.2	29221.2
101	-47.4205999	40.4	29140.8	29221.6
102	-47.8205999	40.8	29140.4	29222
105	-49.0205999	42	29139.2	29223.2
106	-49.4205999	42.4	29138.8	29223.6
107	-49.8205999	42.8	29138.4	29224
107.45	-50.0005999	42.98	29138.22	29224.18
115	-53.0205999	46	29135.2	29227.2
120	-55.0205999	48	29133.2	29229.2
125	**-56**	**50**	**29131.2**	**29231.2**
150	-56	60	29121.2	29241.2
175	-56	70	29111.2	29251.2
200	-56	80	29101.2	29261.2
250	**-56**	**100**	**29081.2**	**29281.2**
250.1	**-43**	**100.04**	**29081.16**	**29281.24**
300	-43	120	29061.2	29301.2
500	-43	200	28981.2	29381.2
1000	-43	400	28781.2	29581.2
1100	-43	440	28741.2	29621.2
1200	-43	500	28681.2	29681.2
1250	-43	500	28681.2	29681.2
1300	-43	520	28661.2	29701.2
1500	**-43**	**600**	**28581.2**	**29781.2**
Number of CXR	4	**Center Freq. (MHz)**	29236.6	BTR - high-band mask
Symbol rate (Msps)	8			

Authorized BW (MHz)	40			
O/P Channel Power (dBm)	20	0.1	**Watts**	
% Removed	**FCC Spec**	**Delta BW**	**Lower Band**	**Upper Band**
0	**0**	**0**	**29236.6**	**29236.6**
50	**0**	**20**	**29216.6**	**29256.6**
50.5	**-27.2205999**	**20.2**	**29216.4**	**29256.8**
51	-27.4205999	20.4	29216.2	29257
55	-29.0205999	22	29214.6	29258.6
60	-31.0205999	24	29212.6	29260.6
75	-37.0205999	30	29206.6	29266.6
100	-47.0205999	40	29196.6	29276.6
101	-47.4205999	40.4	29196.2	29277
102	-47.8205999	40.8	29195.8	29277.4
105	-49.0205999	42	29194.6	29278.6
106	-49.4205999	42.4	29194.2	29279
107	-49.8205999	42.8	29193.8	29279.4
107.45	-50.0005999	42.98	29193.62	29279.58
115	-53.0205999	46	29190.6	29282.6
120	-55.0205999	48	29188.6	29284.6
125	**-56**	**50**	**29186.6**	**29286.6**
150	-56	60	29176.6	29296.6
175	-56	70	29166.6	29306.6
200	-56	80	29156.6	29316.6
250	**-56**	**100**	**29136.6**	**29336.6**
250.1	**-43**	**100.04**	**29136.56**	**29336.64**
300	-43	120	29116.6	29356.6
500	-43	200	29036.6	29436.6
1000	-43	400	28836.6	29636.6
1100	-43	440	28796.6	29676.6
1200	-43	500	28736.6	29736.6
1250	-43	500	28736.6	29736.6
1300	-43	520	28716.6	29756.6
1500	**-43**	**600**	**28636.6**	**29836.6**

FCC ID Label Positioning