Nortel BWA Type Acceptance Radio Transceiver Test Report

Product Description:	38 GHz Base Station (BTR) and Customer Premise (CTR) Radio Transceivers
Model:	BTR3800 and CTR 3800
Nortel BWA File #	OHOBTRCTR3800

CHARLIE BISHOP PI SPECIALIST — **DATE: APRIL 28, 1999**

MICHEL HEBERT PI SPECIALIST — **DATE: APRIL 28, 1999**

WINNIPEG,

DECLARATION BY Nortel Networks BWA

The tests were performed from Feb 5 through Apr 28,1999 at the Nortel Networks BWA's EMC Laboratory in Winnipeg.

The following personnel collaborated to this project:

Mitch Hebert, PI Specialist
Charlie Bishop, PI Specialist

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:	Date
Supervised by:	Date

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Total number of pages: 79.

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 presents emissions profile of Nortel Networks BWA radios that are to operate in the 38 GHz LMDS band for the Type Acceptance of Nortel Networks BWA radios. Nortel Networks BWA radios comply to the specifications referenced in the results section below.The radios have been designed to provide mulit-carrier point-to-multipoint communication services.

Equipment Under Test Description

The Nortel Networks BWA 38 GHz radio product is of wide band design. The power amplifiers and the LNA are designed to provide gain over the entire 38.75-39.45 GHz band. The BTR and CTR are of a single conversion design. A single DRO serve both the transmit and receive path. The BTR and CTR provide a maximum power output of 1 and 0.5 watt respectively for a single tone. The following table identifies the EUT:

Model #	Description	Manufacturer	Part #
BTR3800	Base Transceiver	Nortel BWA	NTVG02AD
CTR3800	Customer Transceiver	Nortel BWA	NTVG04AD

Model #	Order Code	UW Tx (GHz)	uW Rx (GHz)	RF Tx (MHz)	RF Rx (MHz)	BW	Separation
BTR3800	NTVG02AD	39.45-39.65	38.75-38.95	450-650	50-250	200	700
CTR3800	NTVG04AD	38.75-38.95	39.45-39.65	450-650	50-250	200	700

Application Exceptions

None

General

Tests were performed on a production sample(s) of the BTR and CTR, 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.

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 section 101.111	Spectral Mask	(a)(2)(ii)	Compliant
FCC part 2, section 2.997; FCC part 101 section 101.111	Conducted Emissions	(a)(2)(iii)	Compliant
FCC part 2, Section 2.997, FCC part 101 section 101.111	Radiated Emissions	(a)(2)(iii)	Compliant
TSB10-F – June 1994	Adjacent Channel Test	4.2.1	Compliant
TSB10-F – June 1994	Co-Channel Test	ANNEX B	Complaint
FCC part 2, Section 2.995 (a) (1), (b) and FCC part 101 section 101.107	Frequency Stability Over Temperature	A(6)	Complaint

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.

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	Anritsu	ML2438A	97400074	06/99
Power Sensor	Anritsu	MA2475A		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

1. CONDUCTED EMISSIONS & MASK

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Dec 2, 1998 through Mar Apr 26,1999

Test was performed to validate the requirements specified in FCC part 2, section 2.997; FCC part 101 Section 101.111

Test Conditions

Temperature	25C
Primary Voltage	BTR -48 V and for CTR +18 V dc

Minimum Specifications

The specification for this range is 43+10*Log P which will be 43dB attenuation for the BTR and 42.7dB for the CTR.

Test Results

The EUT does comply with the specification referenced in the previous paragraph.

Measurement Data

See on Appendix A for test results and setup photographs.

Test Method

Nortel processing equipment stimulated the EUT (BTR and CTR) 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 and/or CTR. 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 and two for the CTR occupying 20MHz. The measured reference is used to determine the out of band emissions, by measuring the relative differences between the reference and the measured emission.

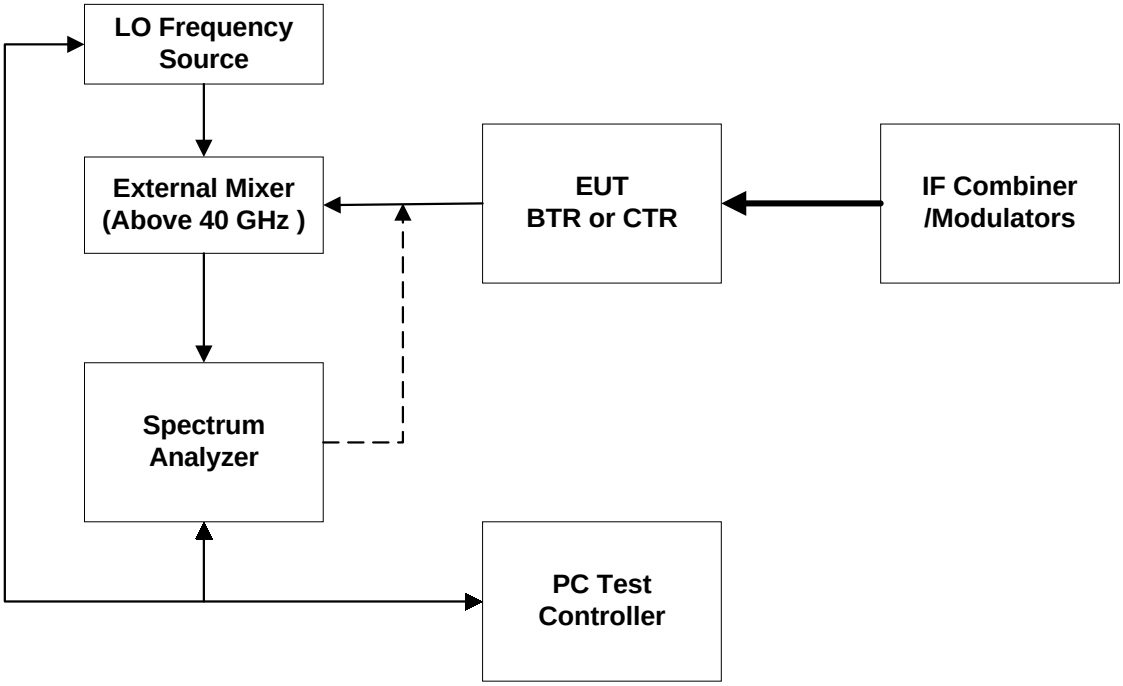


Figure 1.0: Test Setup Configuration for Conducted Emissions

2. RADIATED EMISSIONS

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Mar 18 through Apr 26, 1999

Test was performed to validate the requirements specified in FCC part 2, section 2.997; and FCC part 101 Section 101.111.

Test Conditions

Temperature	25C
Primary Voltage	BTR -48 V dc and for CTR +18 V dc

Test Results

The EUT does comply with the specification referenced in Part 101 of the FCC rulings.

Measurement Data

See on Appendix B for test results and setup photographs.

Test Method

Nortel processing equipment stimulated the EUT (BTR and CTR) 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 and/or CTR. 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 and two for the CTR occupying 20 MHz. 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.

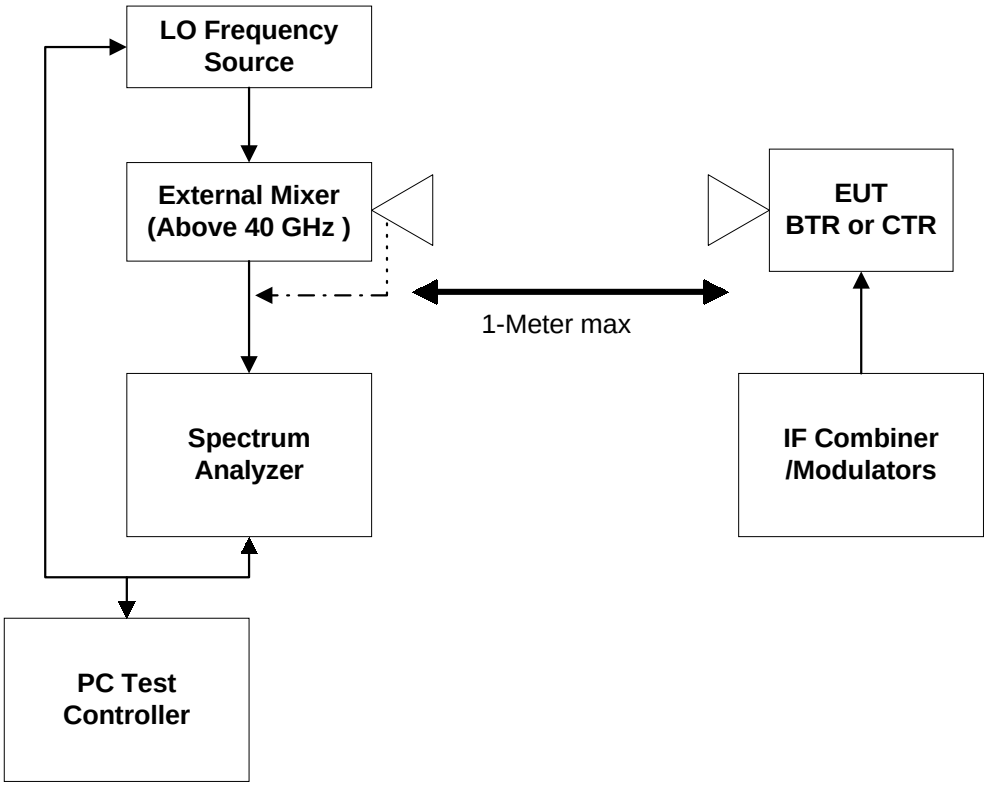


Figure 2.0: Test Setup Configuration for Radiated Emissions

3. TEMPERATURE STABILITY TESTS

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Apr 19-21, 1999

Test was performed to the validate the requirement of part 101, section

Test Conditions

Temperature	-40C to +50C,
Primary Voltage	BTR -48 V dc and for CTR +18 Vdc

Test Results

The BTR and CTR do comply with the specifications stated in specification paragraph. The limit used for the test was 0.003% as stated in the exception note 6 for point to point microwave.

Measurement Data

See on Appendix C for test setup and photographs.

Test Method

Tests were performed on a BTR and CTR, 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 (30min). The soak 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

The specified temperature profile is –40°C to +50°C.

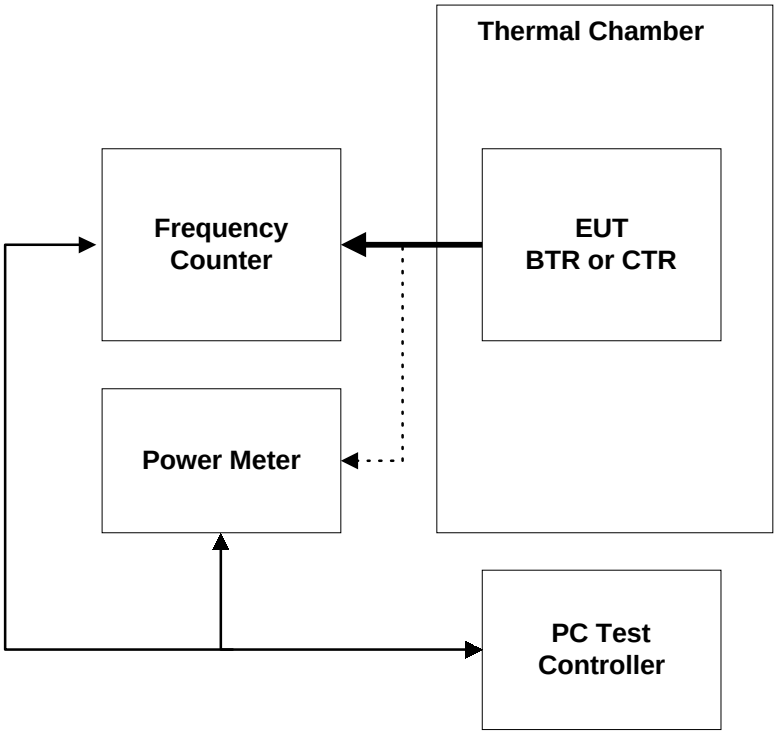


Figure 3.0: Test Setup Configuration for Temperature Stability Tests

4. CO/ADJACENT CHANNEL TEST

Tested by:	Charlie Bishop and Mitch Hebert
Date:	Apr 15,1999

Test Conditions

Temperature	25C,
Primary Voltage	BTR -48 V and for CTR +18 V dc

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.

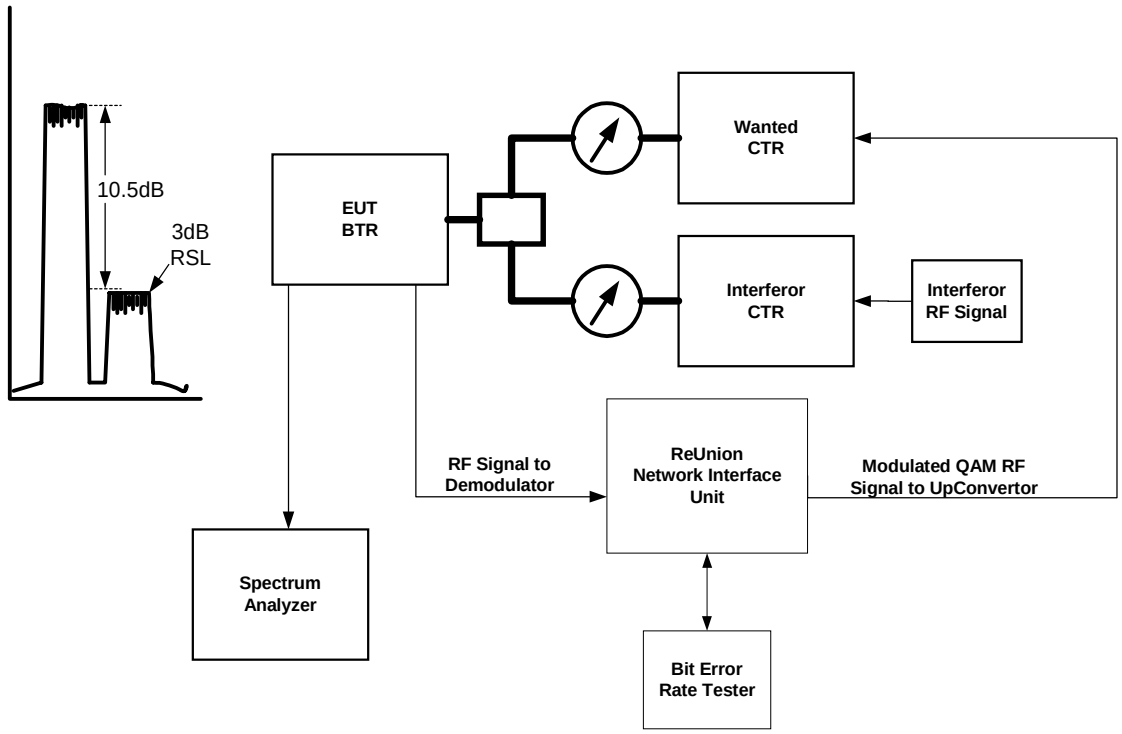
Adjacent Channel Test Method

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.

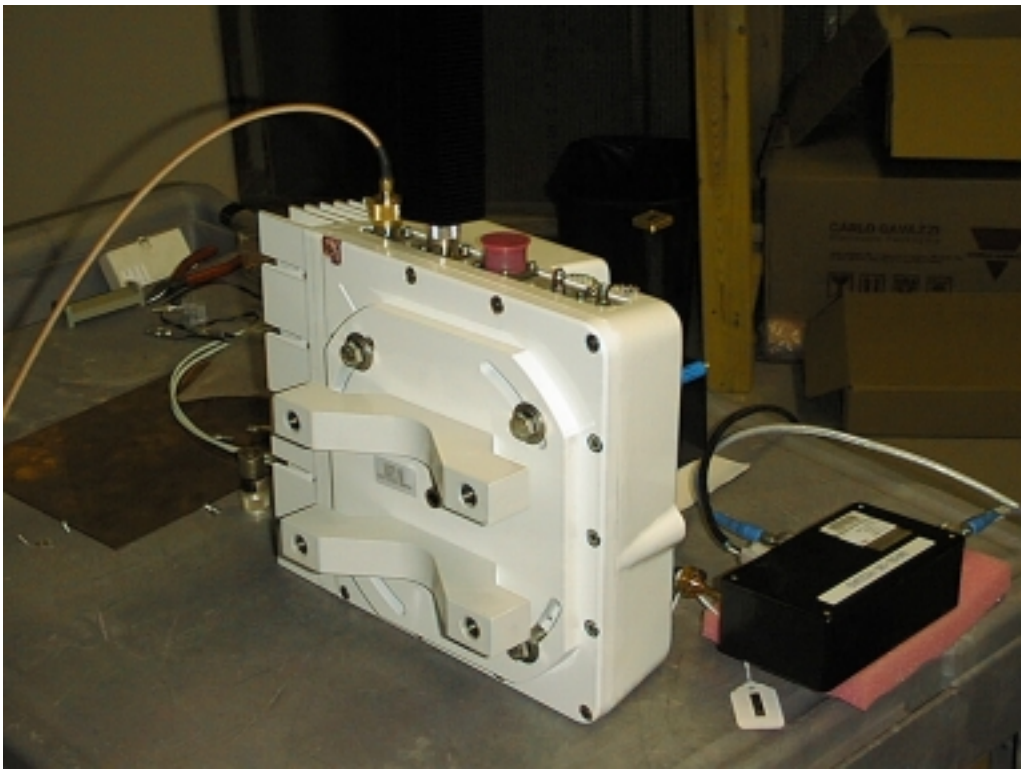
APPENDIX A

Conducted Emissions Measurement Results

5. CONDUCTED EMISSIONS MEASUREMENT RESULTS

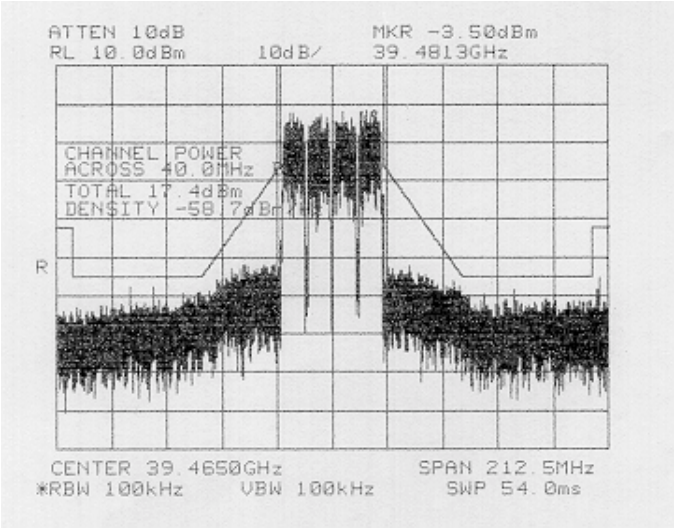
Computer setup and instrumentation in the PI laboratory

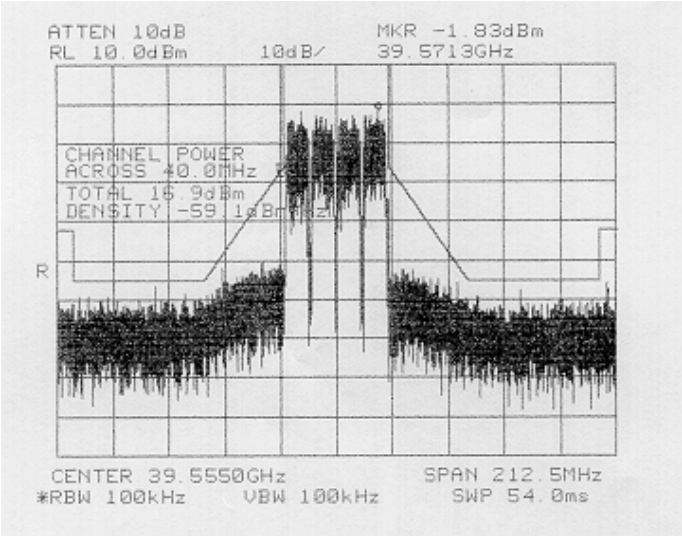
Connection to the BTR using the wave-guide connection

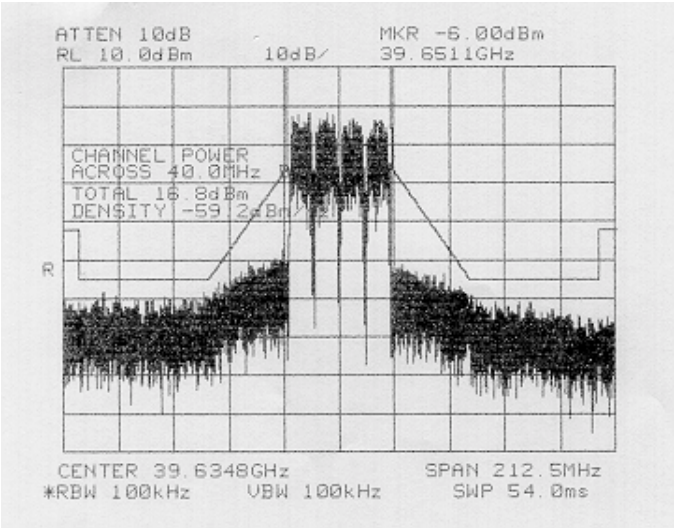


BTR Spectral Mask

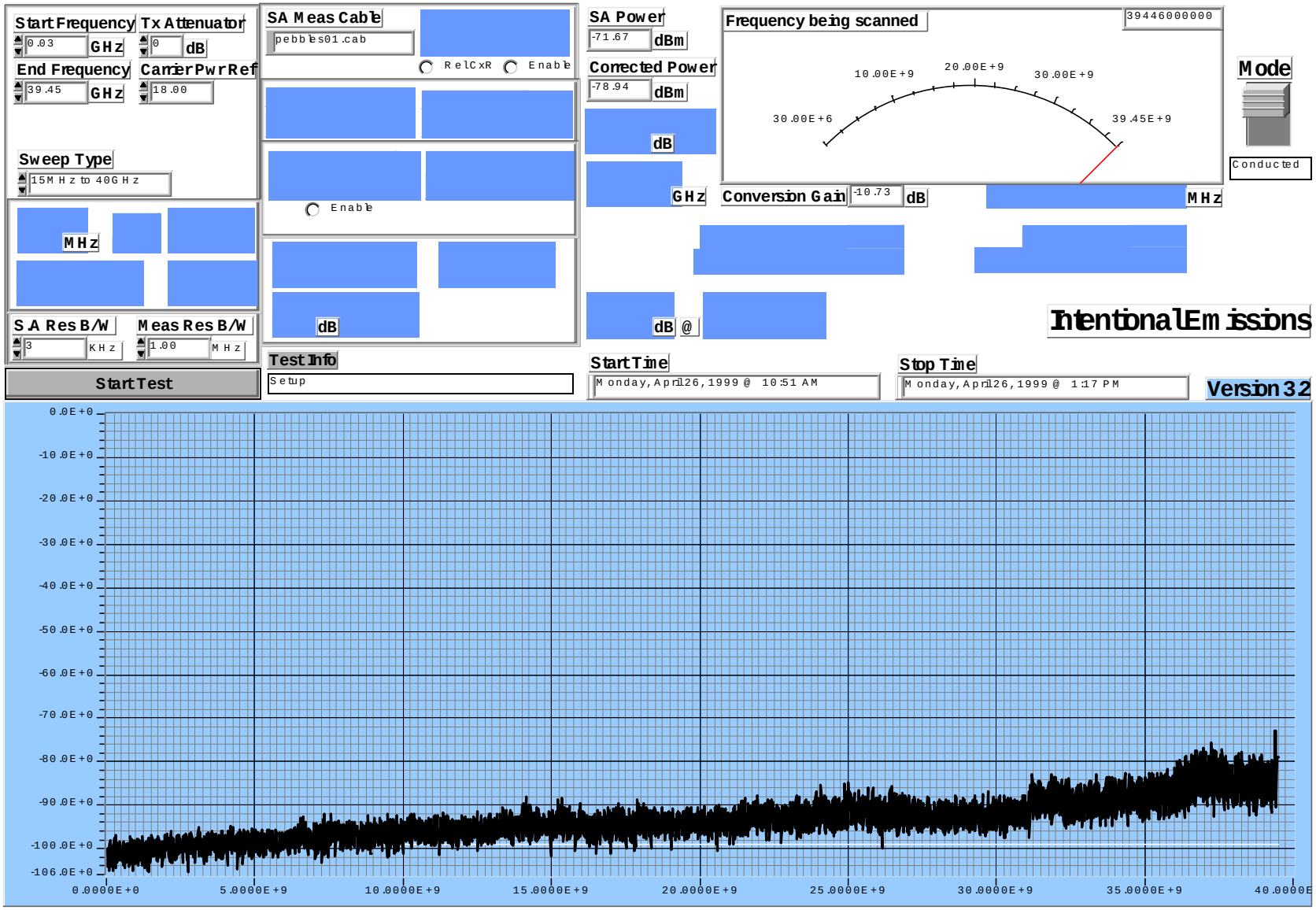
The emission showing amplitude and angle-modulated (D) with two or more channels (7) which could contain data or telephony (W). The signal has a maximum occupied bandwidth of 40MHz. (40M0). Equipment Type 40M0D7W. The following pictures show 4 – 10MHz carriers across the minimum, maximum and middle of the 200MHz band at a channel power of 17dBm. The mask calculations can be found in Appendix F.



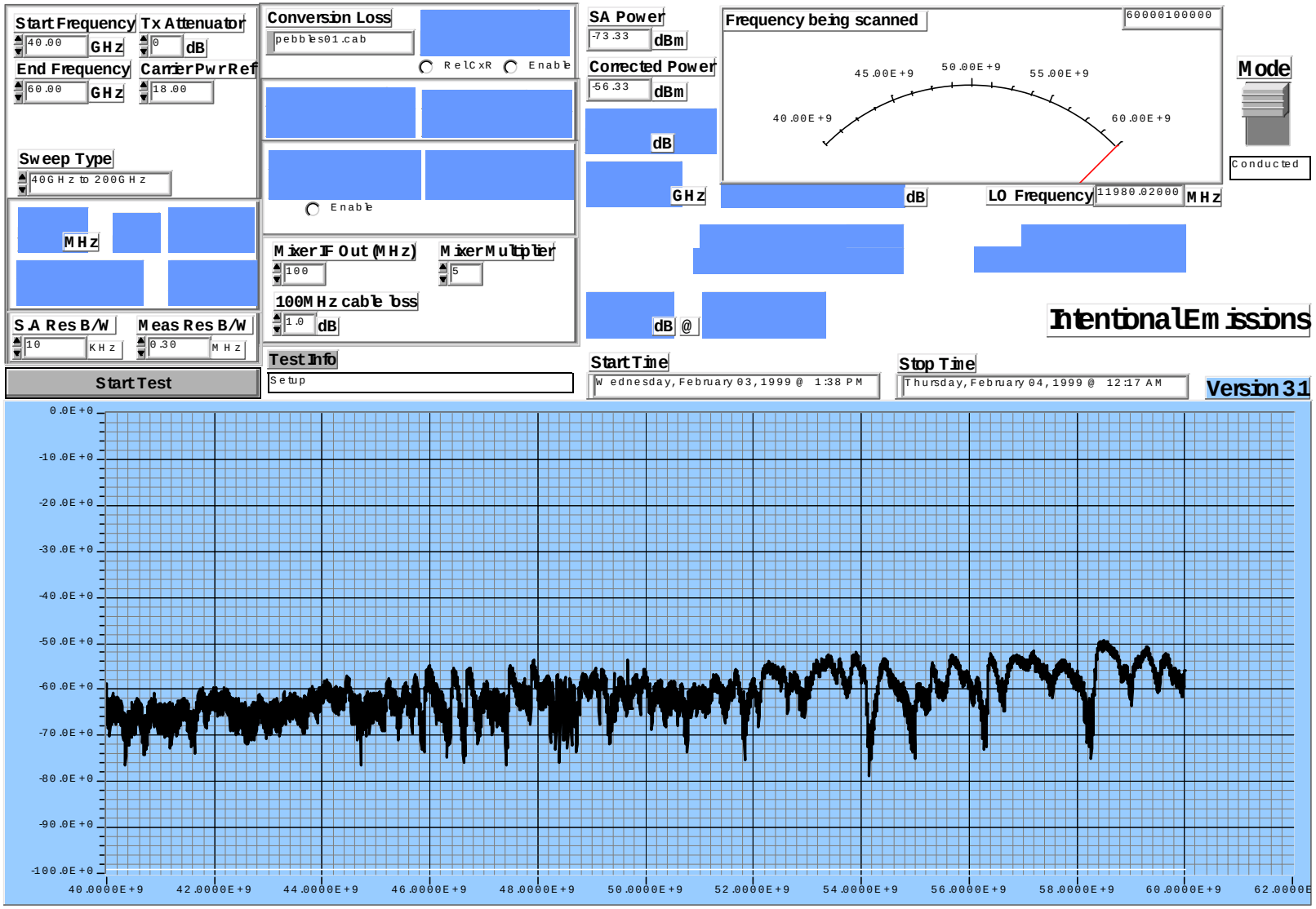




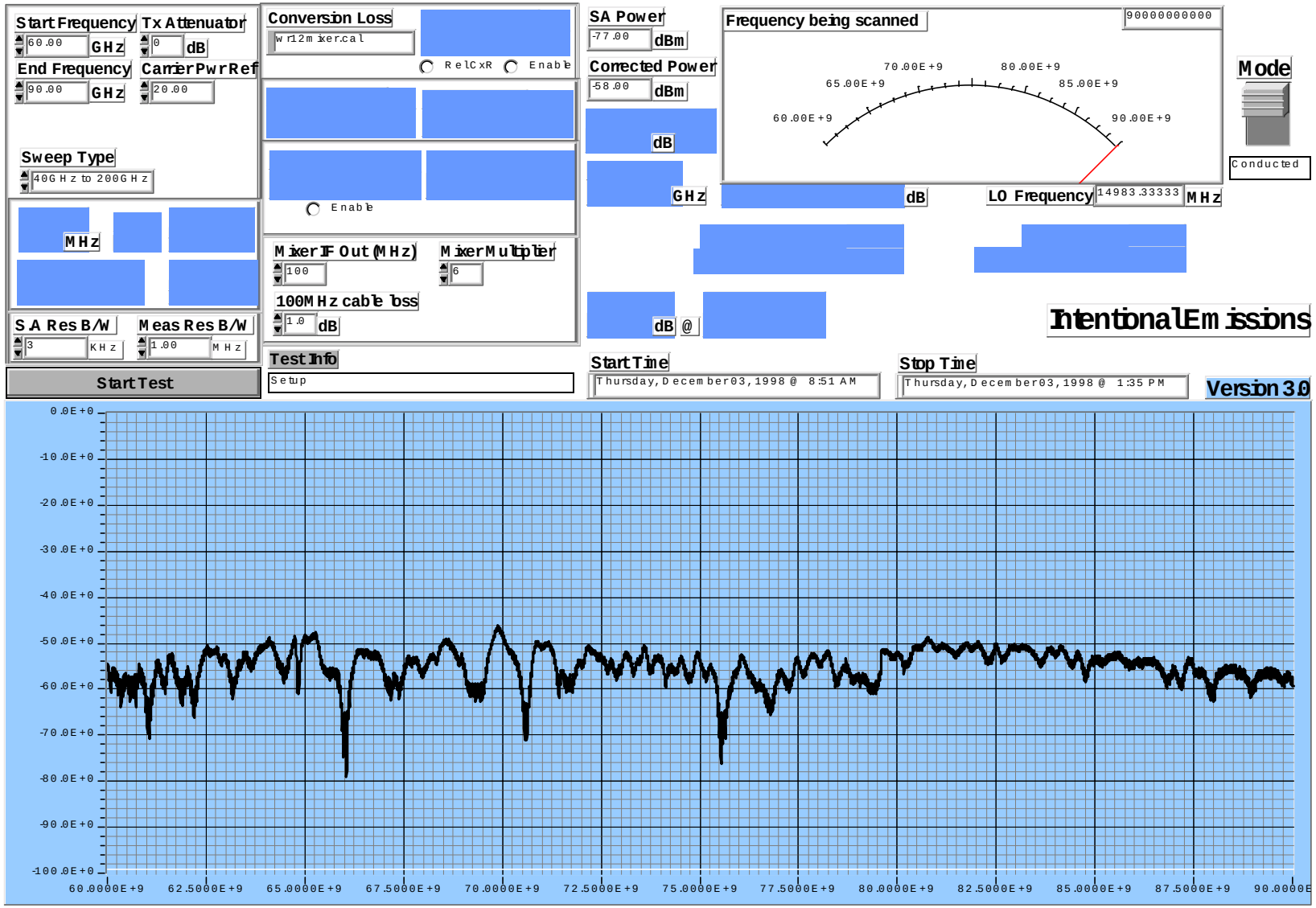
BTR 3800, 4 carrier QAM 64 modulated. – 30MHz to edge of carriers



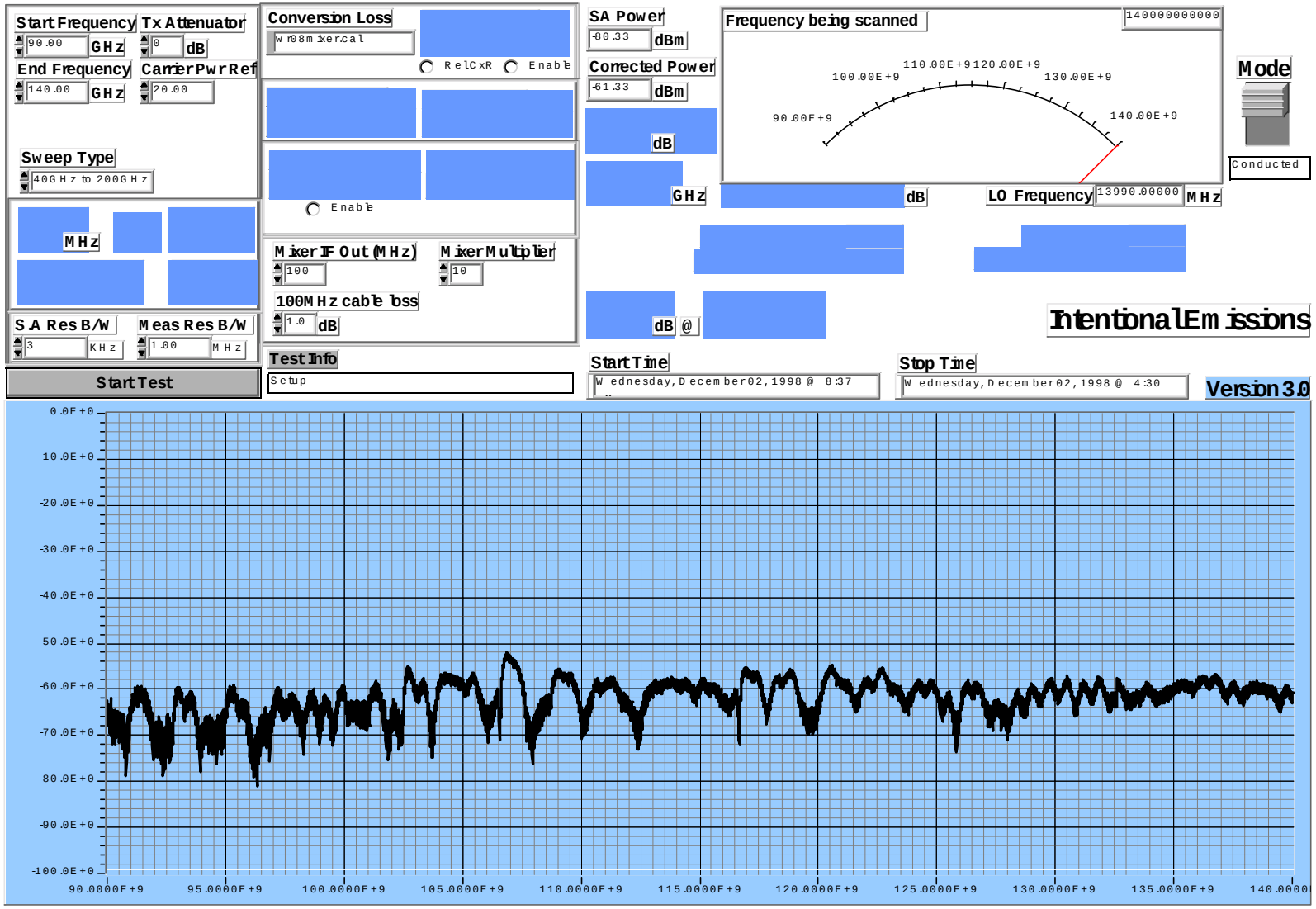
BTR 3800, 4 carrier QAM 64 modulated. – 40 to 60GHz



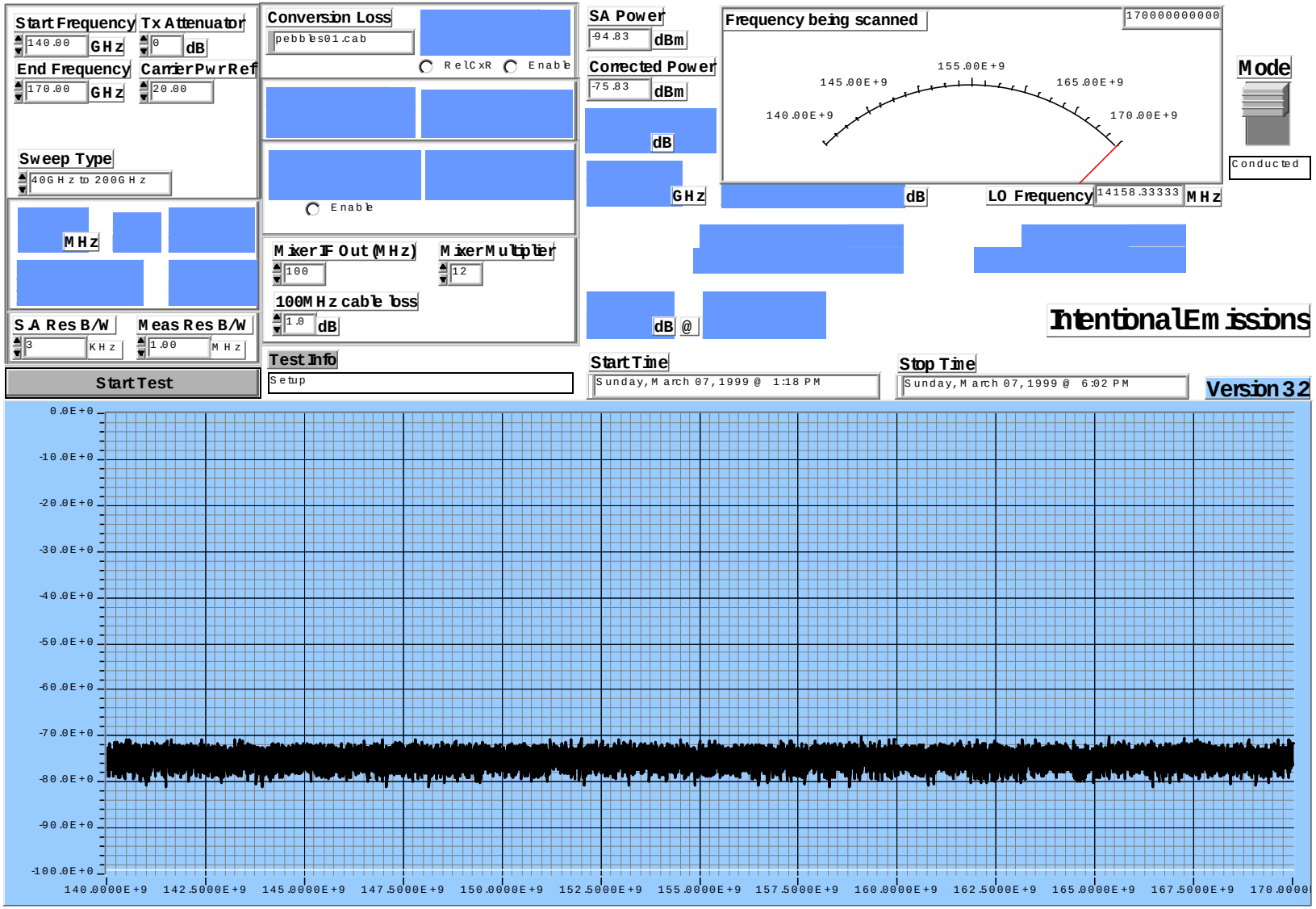
BTR 3800, 4 carrier QAM 64 modulated. – 60 to 90GHz



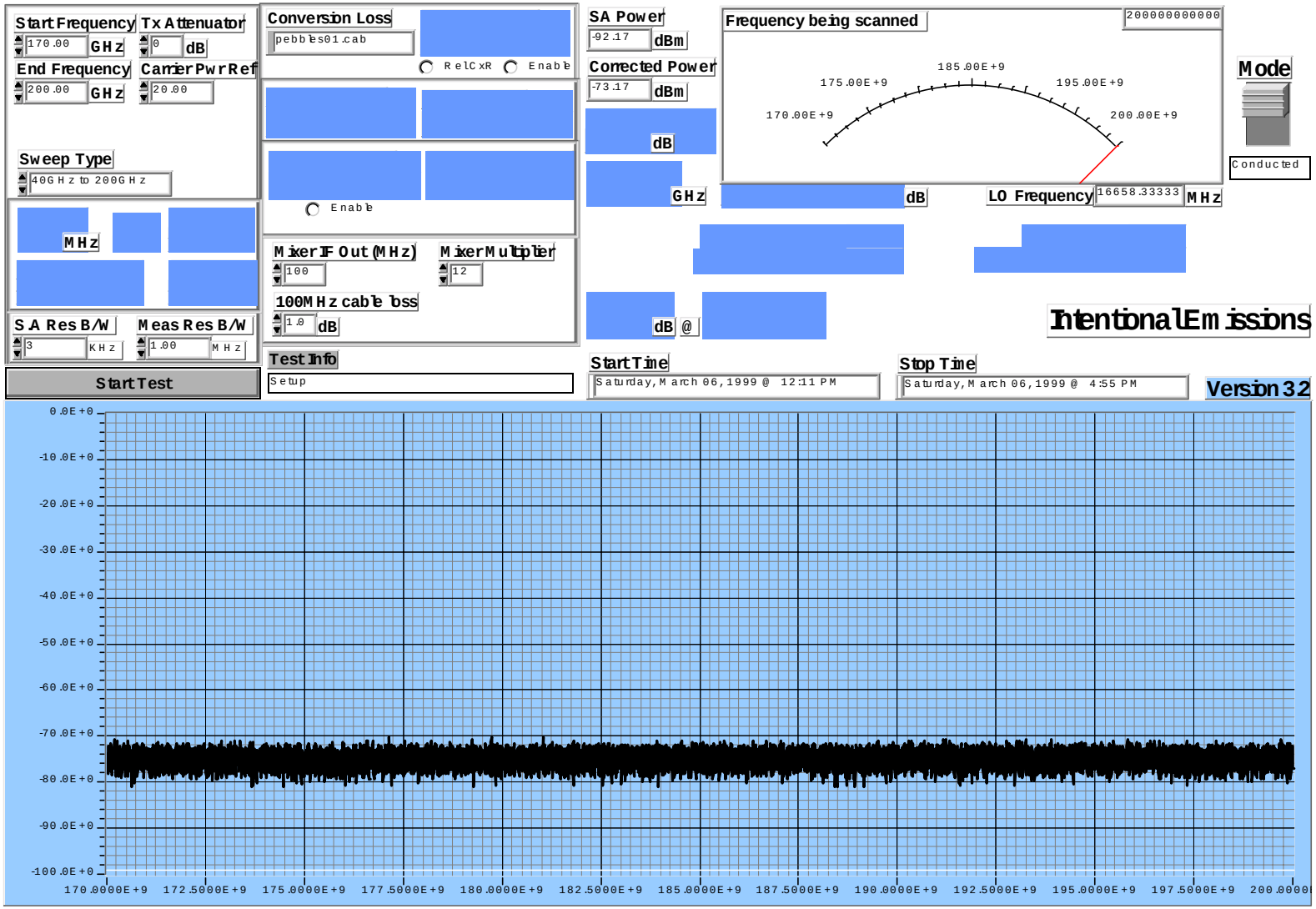
BTR 3800, 4 carrier QAM 64 modulated. – 90 to 140GHz



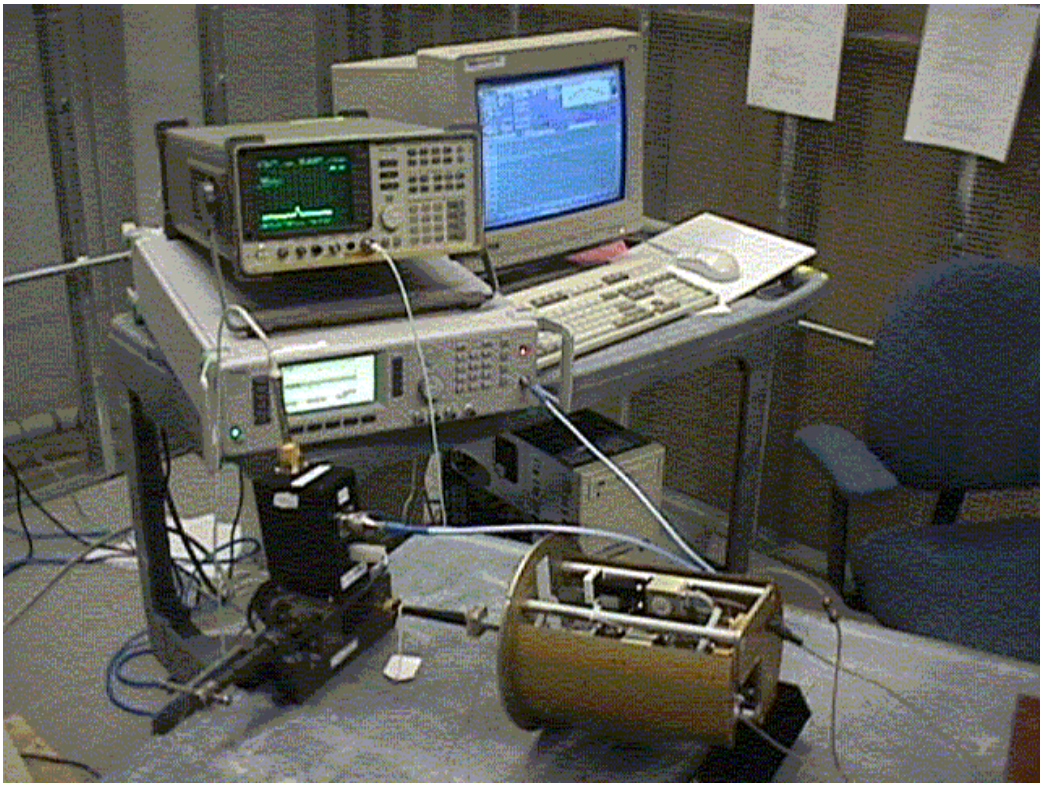
BTR 3800, 4 carrier QAM 64 modulated. – 140GHz to 170GHz

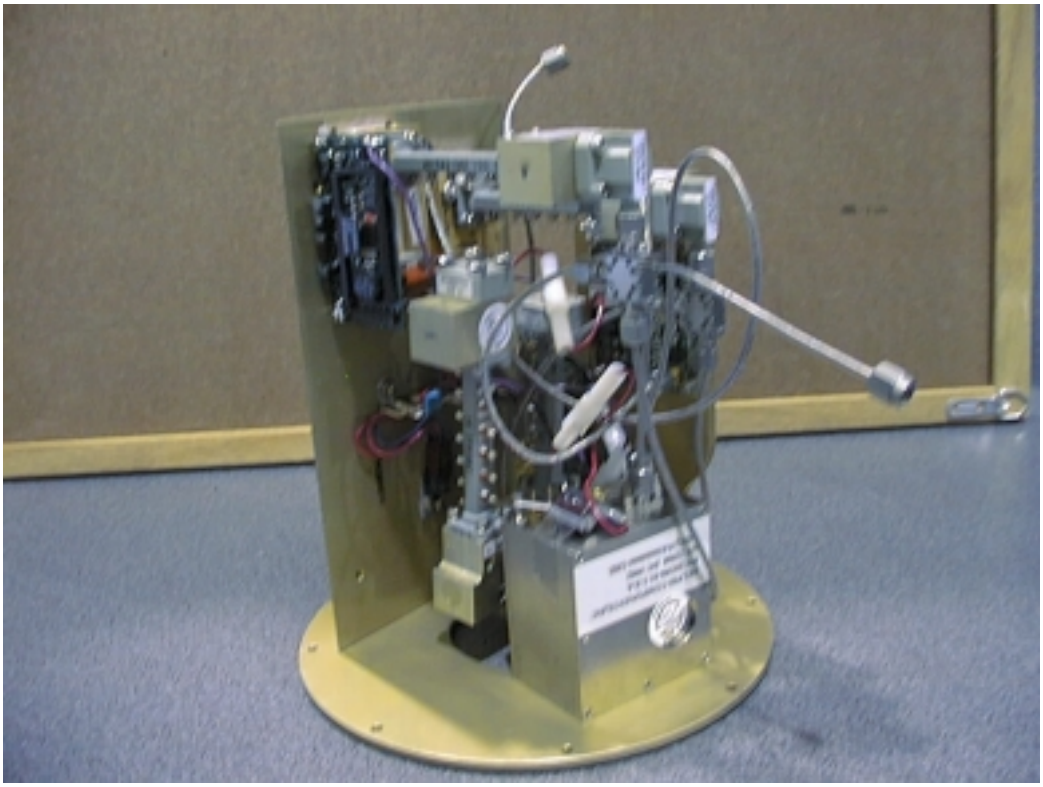


BTR 3800, 4 carrier QAM 64 modulated. – 170GHz to 200GHz



CTR connected in the laboratory for conducted measurements

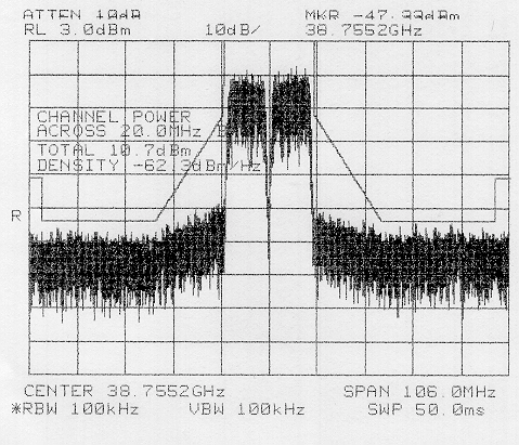


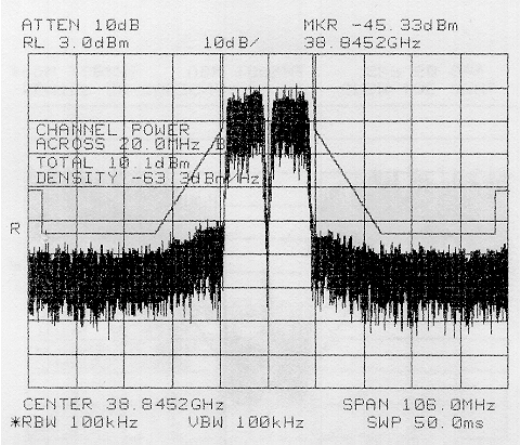


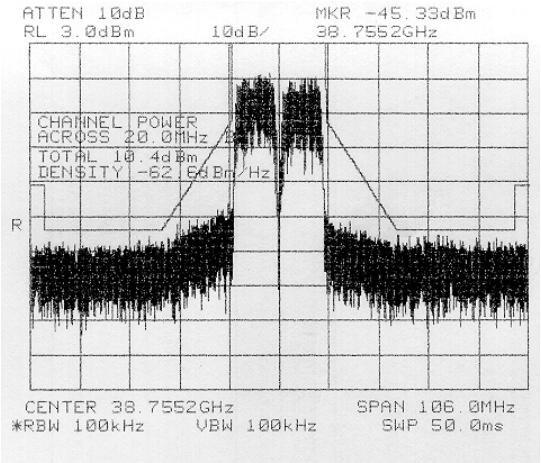
CTR with the case removed

CTR Spectral Mask

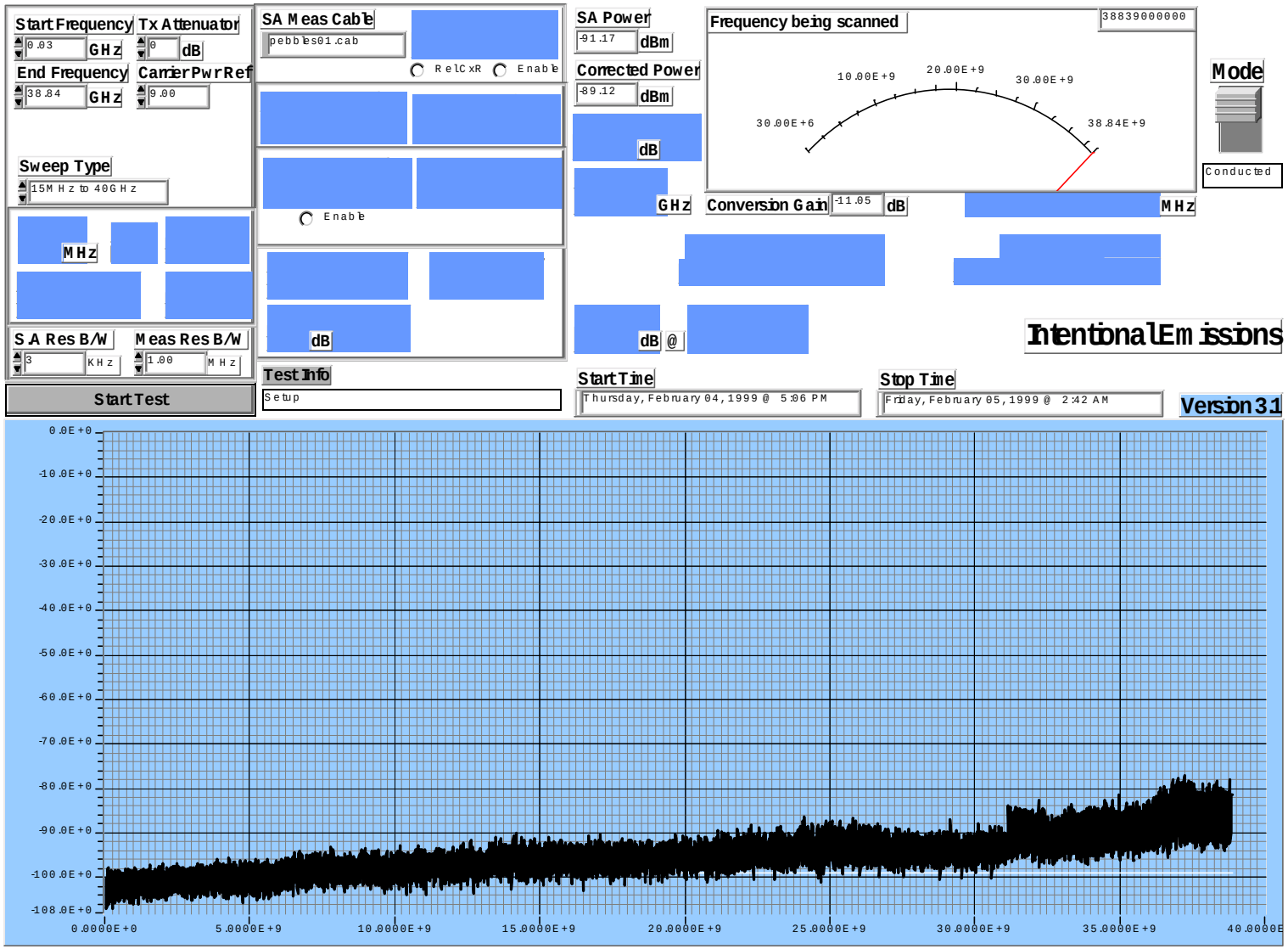
The following pictures show 2 – 10MHz carriers across the minimum, maximum and middle of the 200MHz band at a channel power of 16dBm.



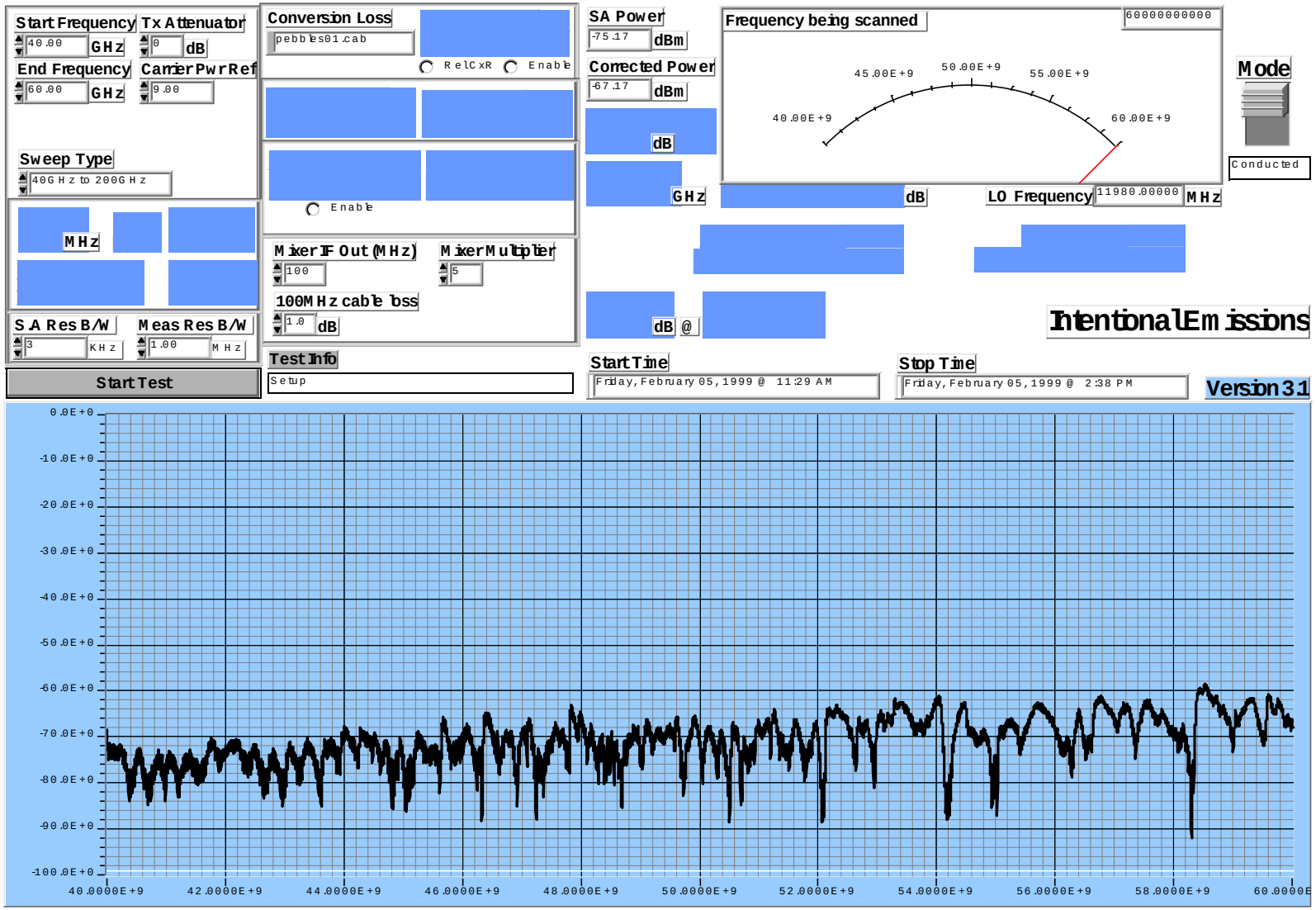




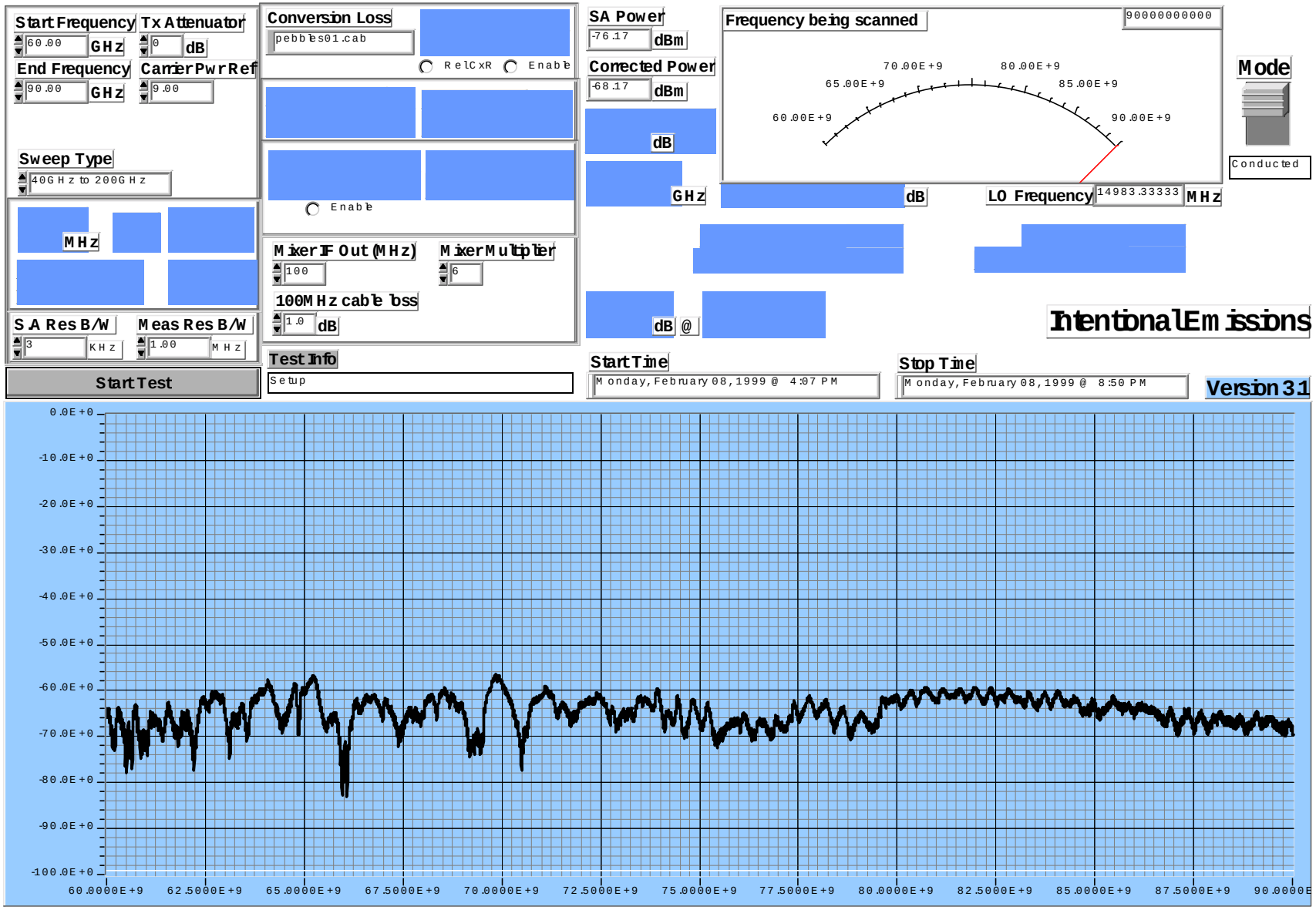
CTR 3800, 2 carrier QAM 64 modulated. – 30MHz to edge of carriers



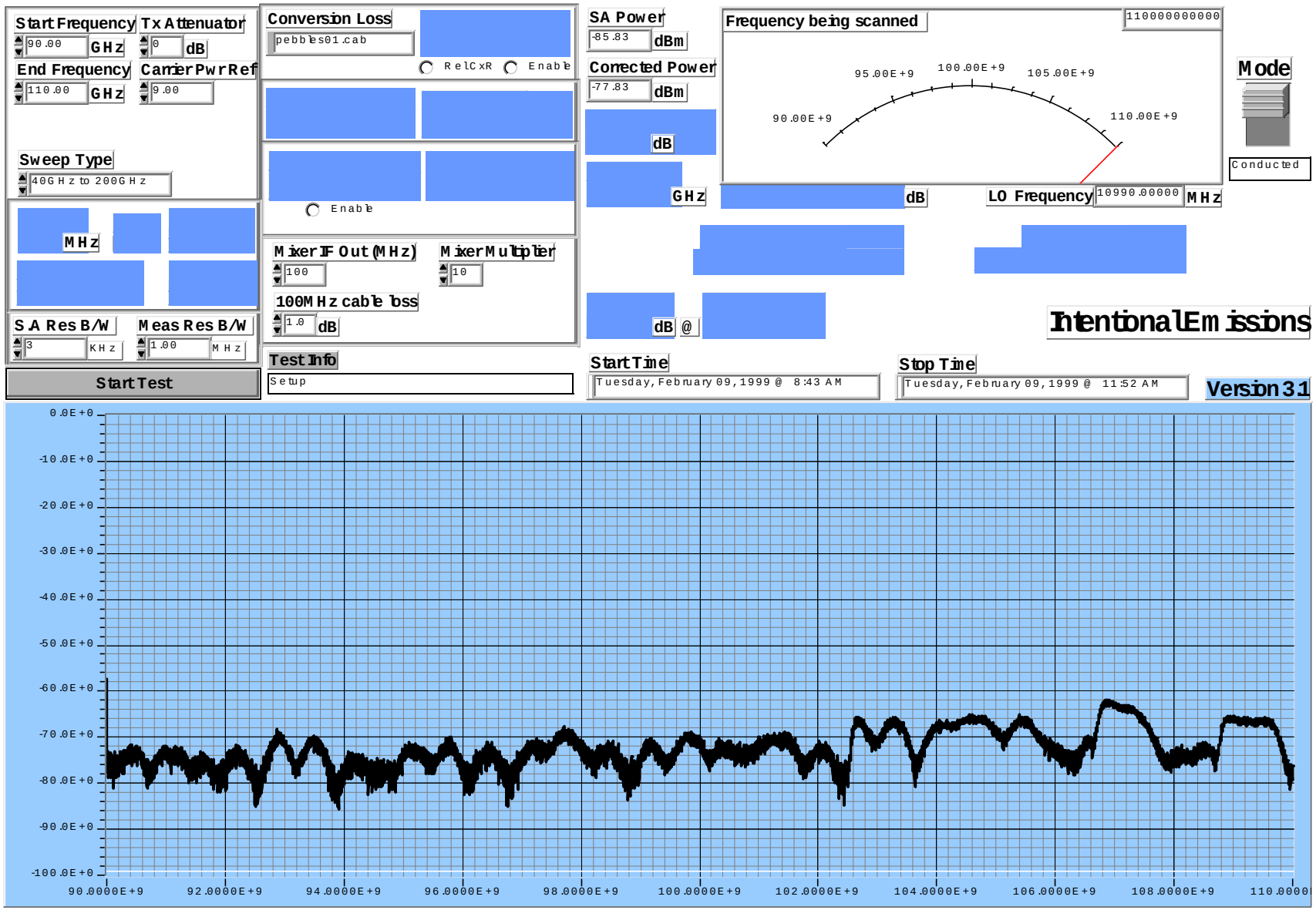
CTR 3800, 2 carrier QAM 64 modulated. – 40-60GHz



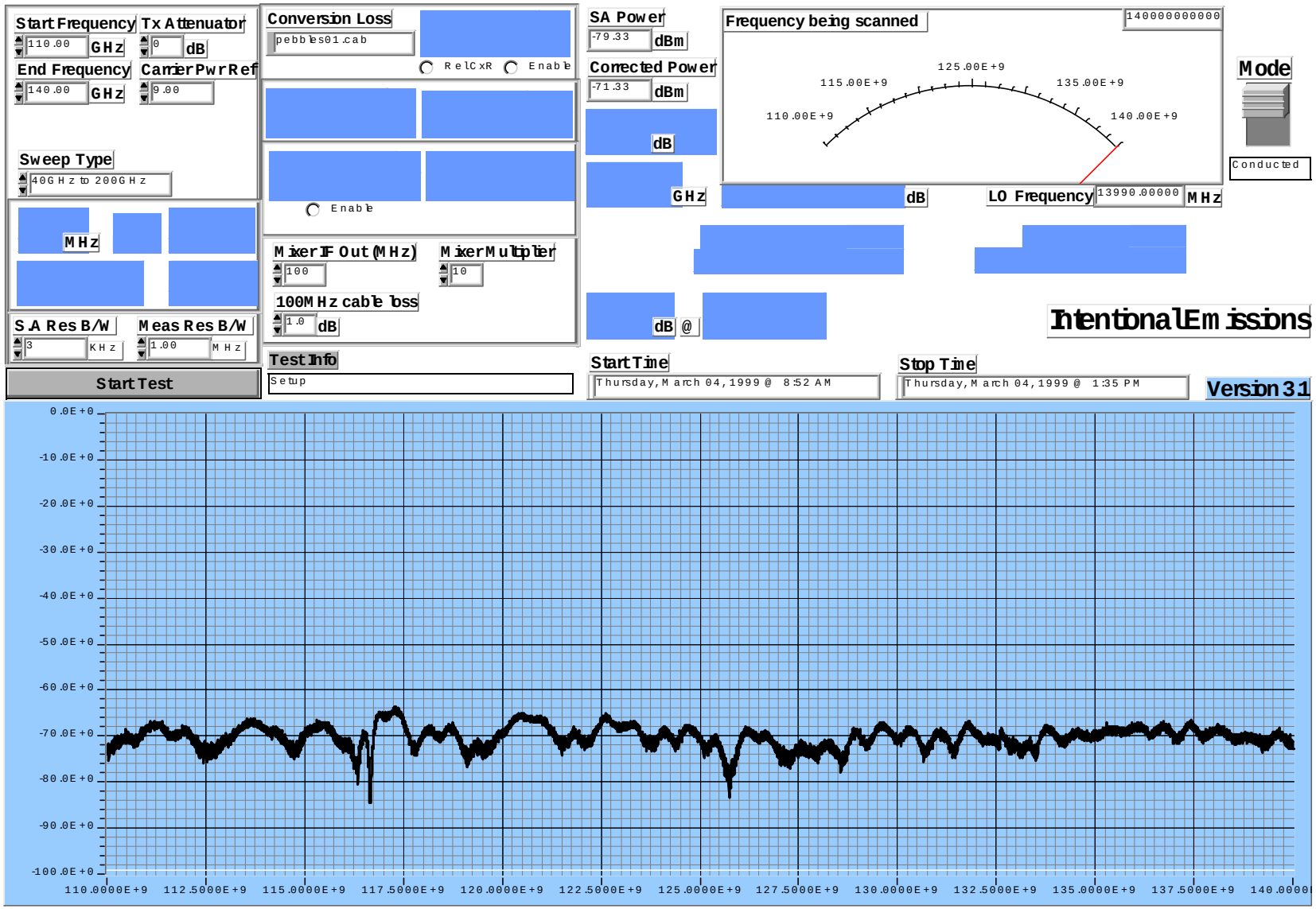
CTR 3800, 2 carrier QAM 64 modulated. –60-90GHz



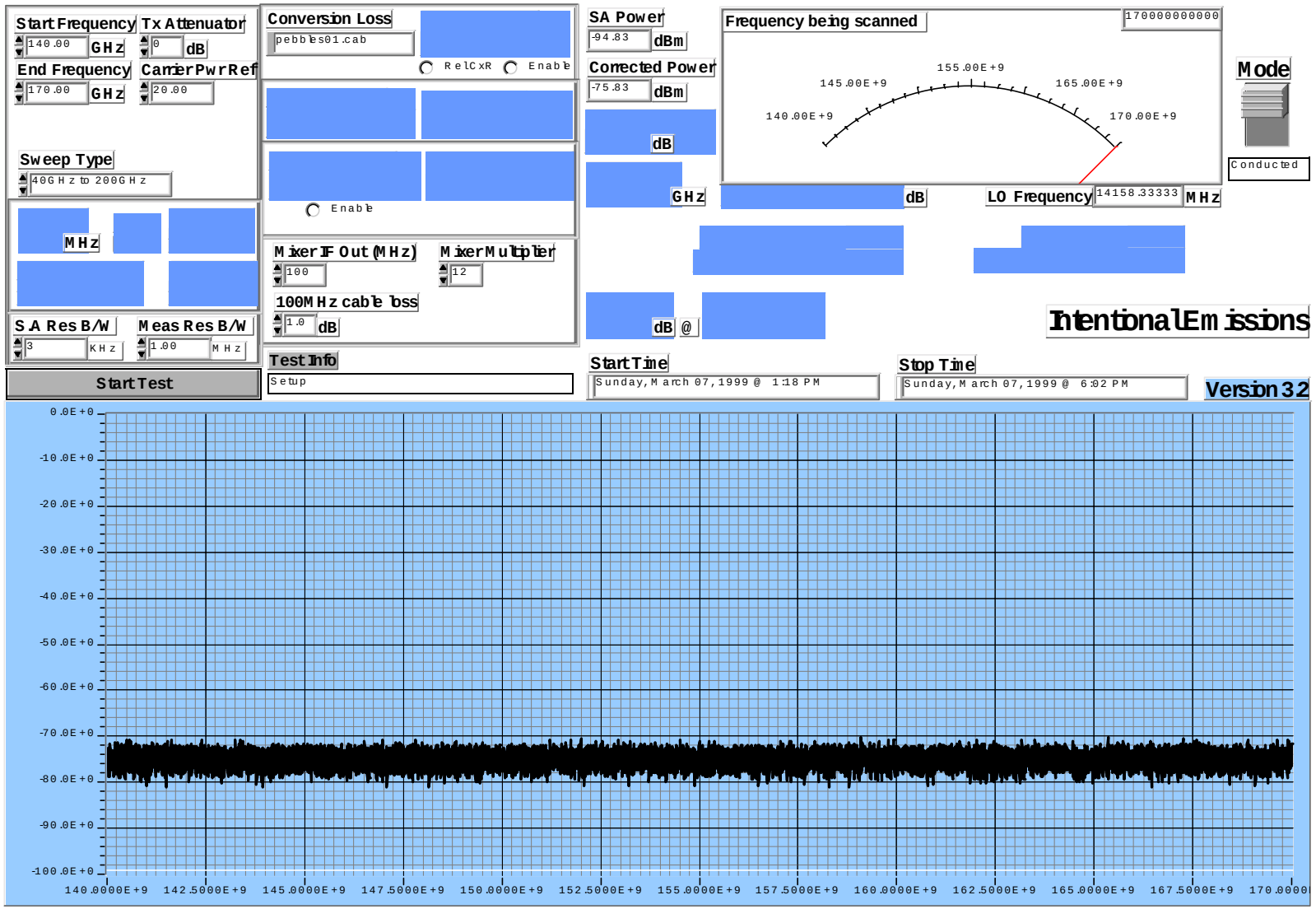
CTR 3800, 2 carrier QAM 64 modulated. –90-110GHz



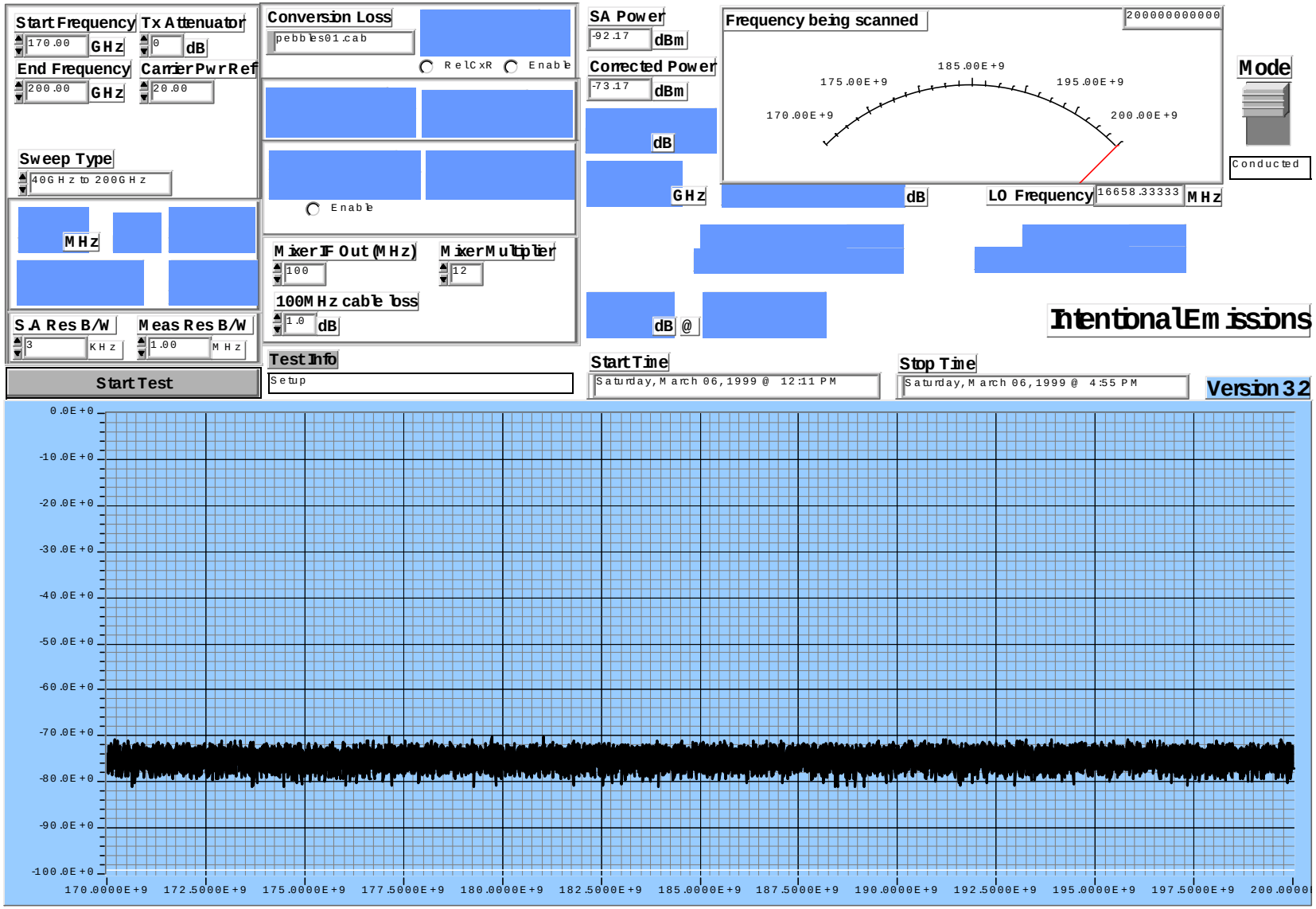
CTR 3800, 2 carrier QAM 64 modulated. –110GHz – 140GHz



CTR 3800, 2 carrier QAM 64 modulated. – 140GHz – 170GHz



CTR 3800, 2 carrier QAM 64 modulated. –170GHz – 200GHz

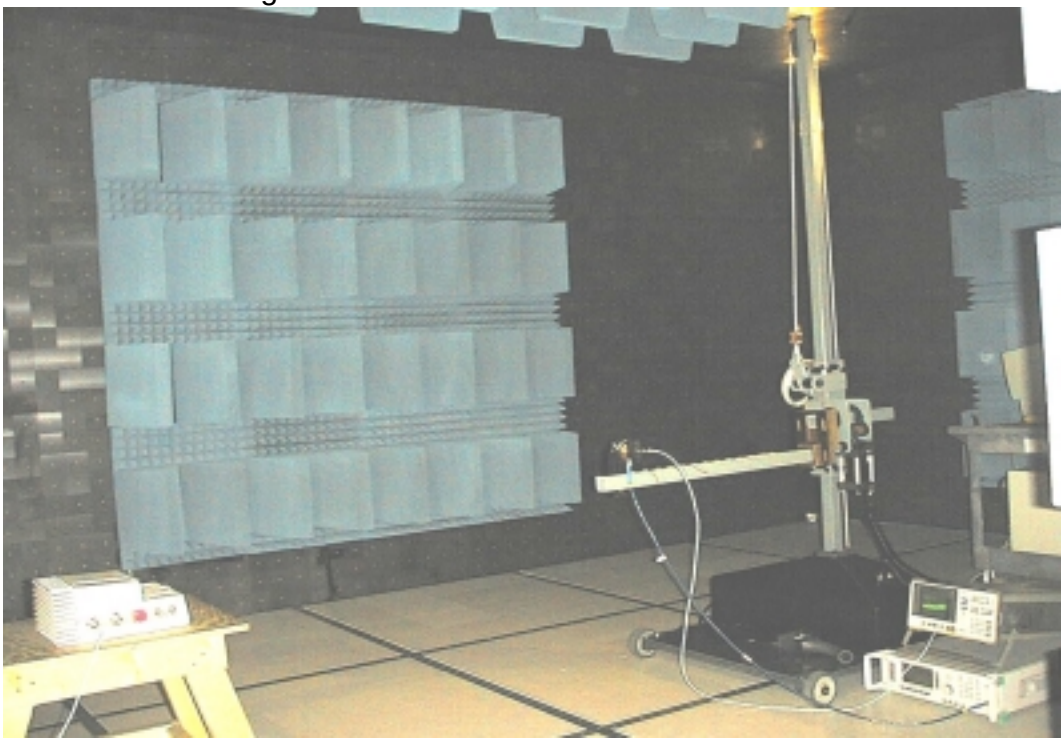


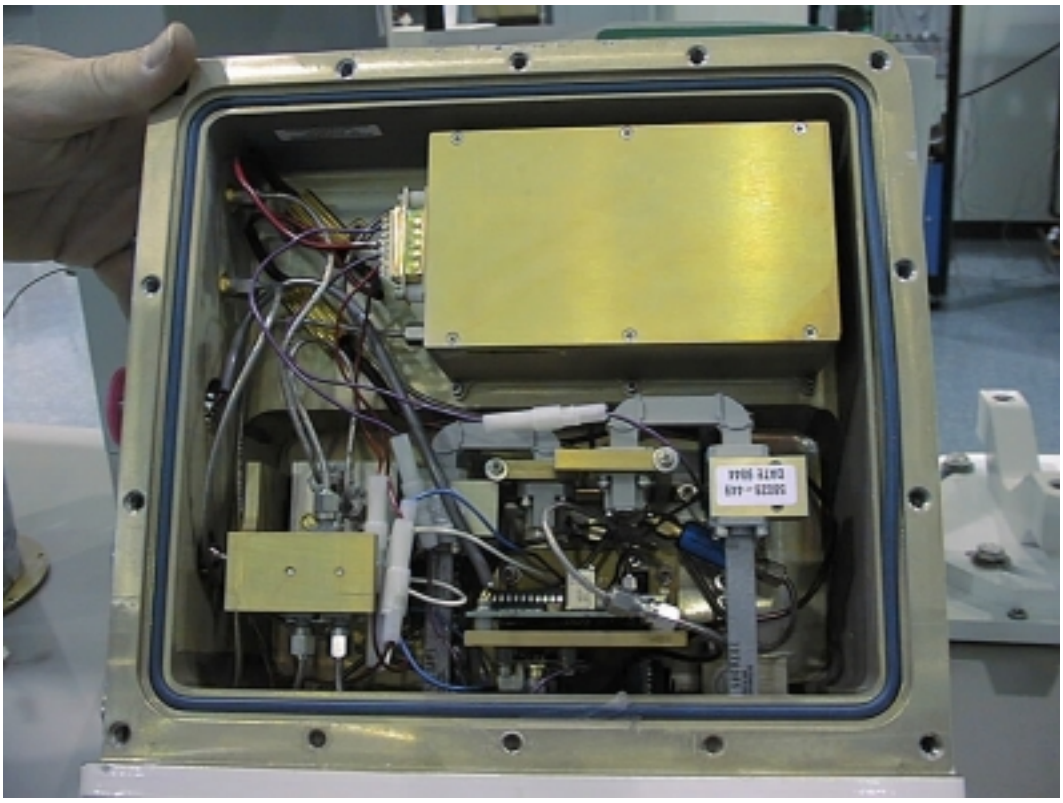
APPENDIX B

Radiated Emissions Measurement Results

6. RADIATED EMISSIONS MEASUREMENT RESULTS

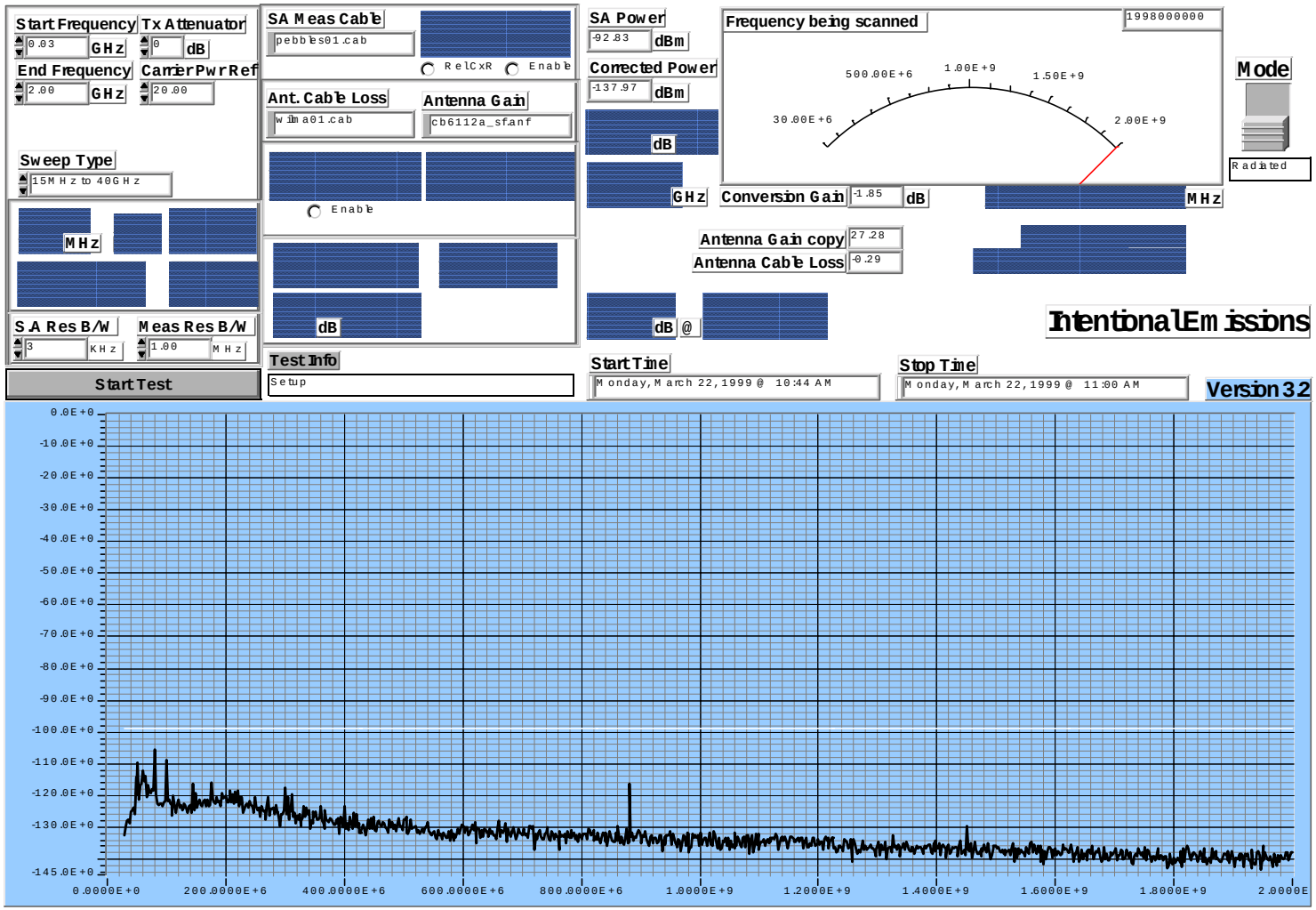
Radiated test using the 40-60GHz horn**.**



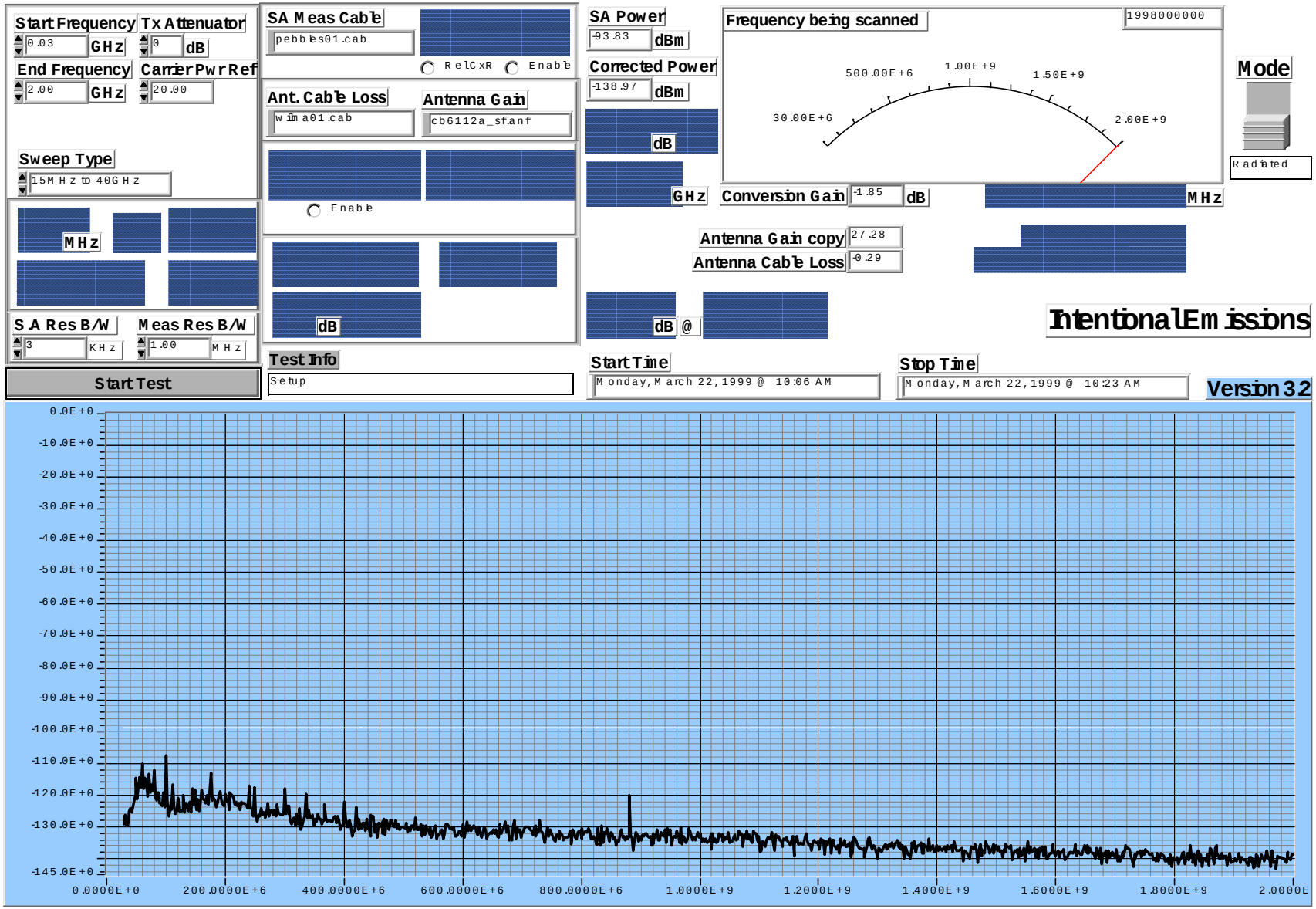


BTR with the back cover removed

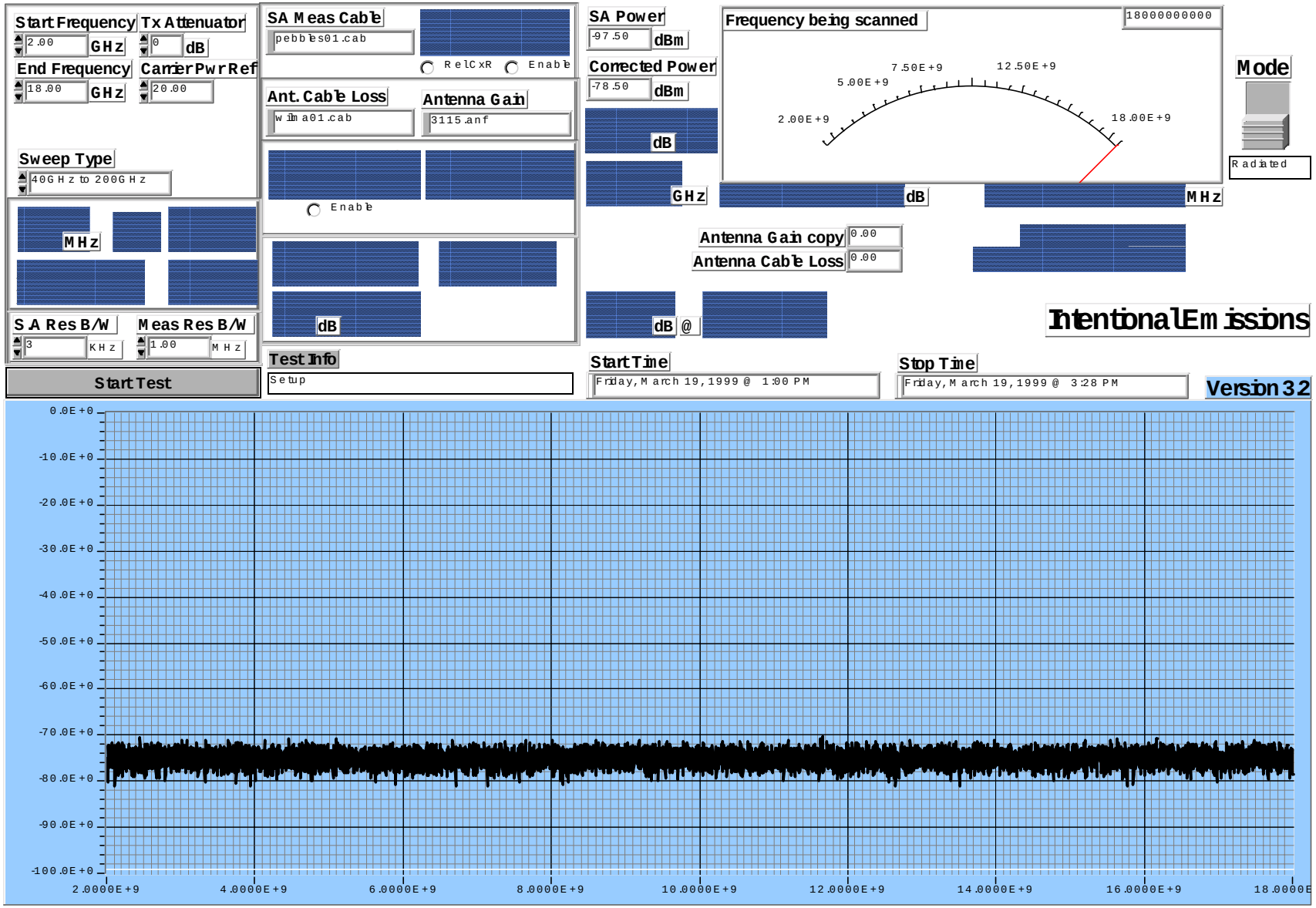
BTR 3800, 4 carrier QAM 64 modulated. – 30MHz to 2GHz - Horizontal



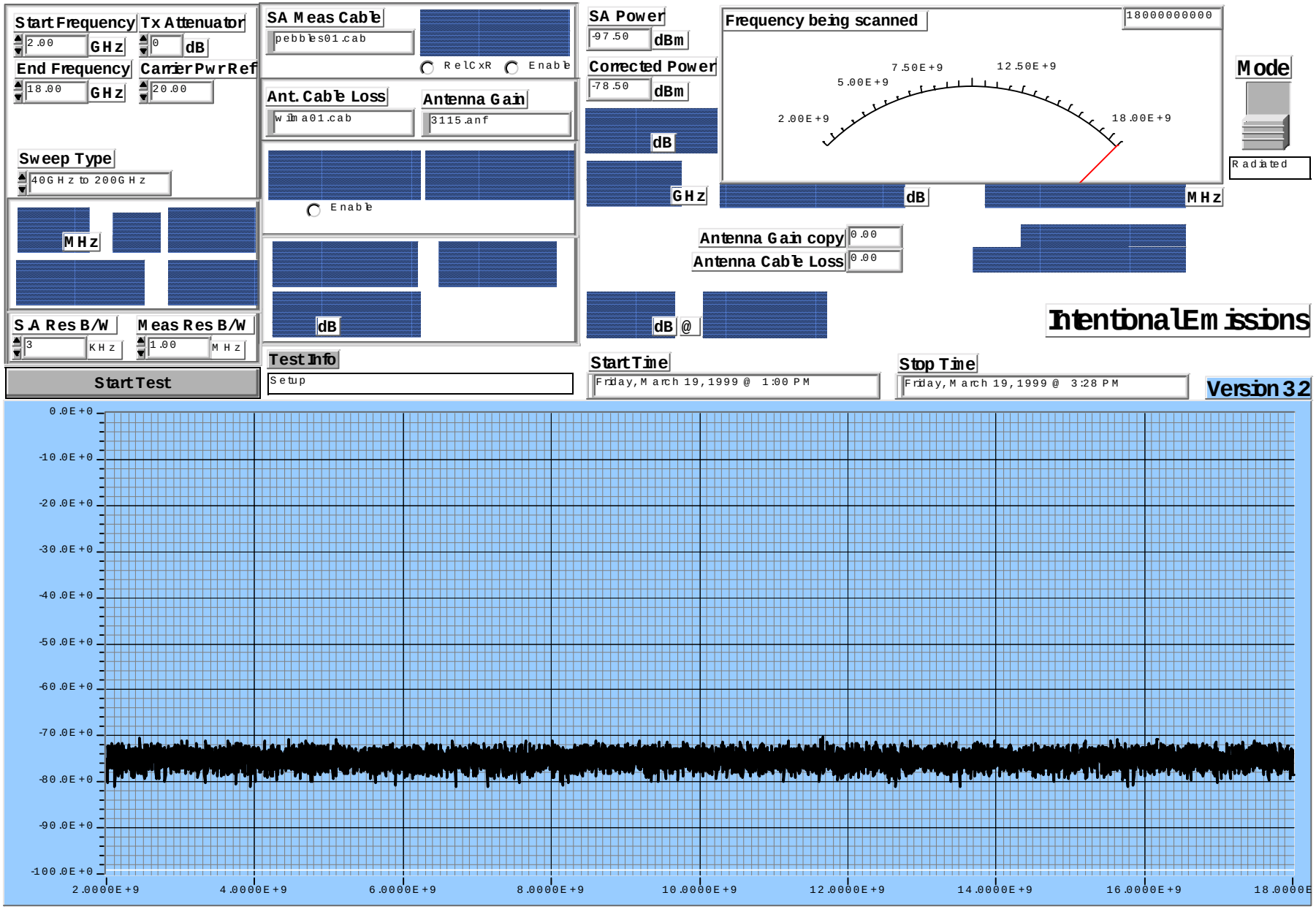
BTR 3800, 4 carrier QAM 64 modulated. – 30MHz to 2GHz - Vertical



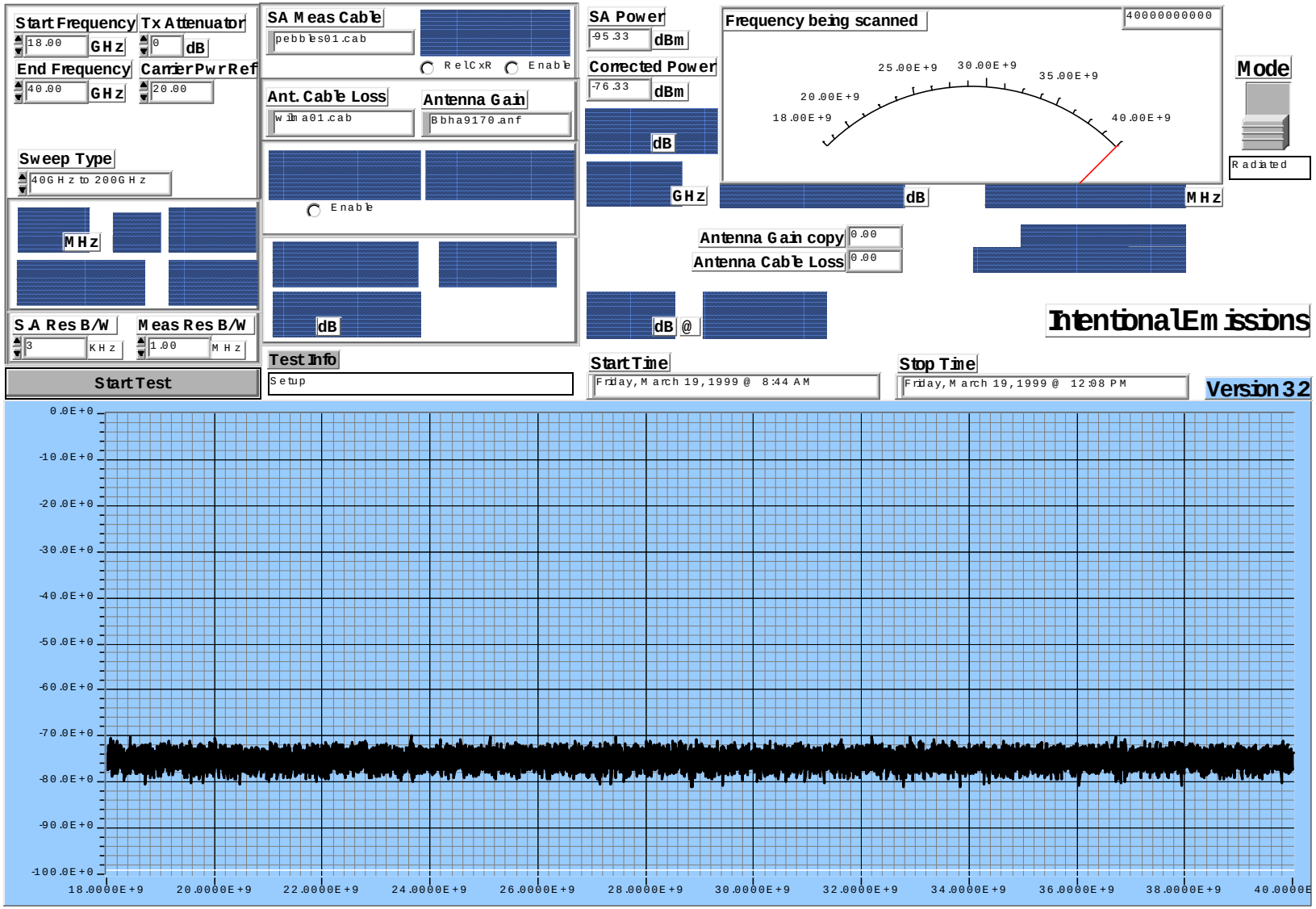
BTR 3800, 4 carrier QAM 64 modulated. – 2GHz to 18GHz – Horizontal



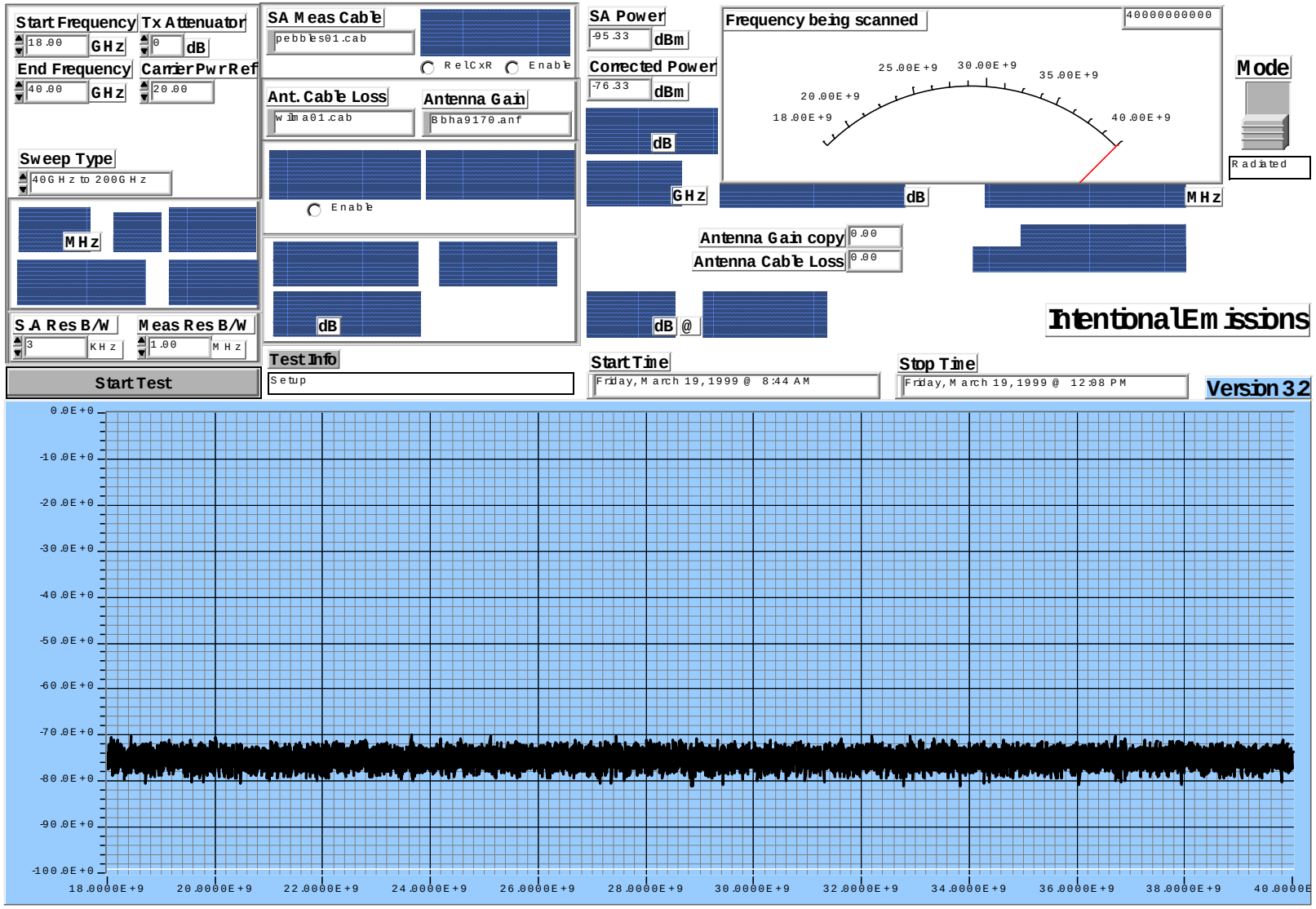
BTR 3800, 4 carrier QAM 64 modulated. – 2GHz to 18GHz – Vertical



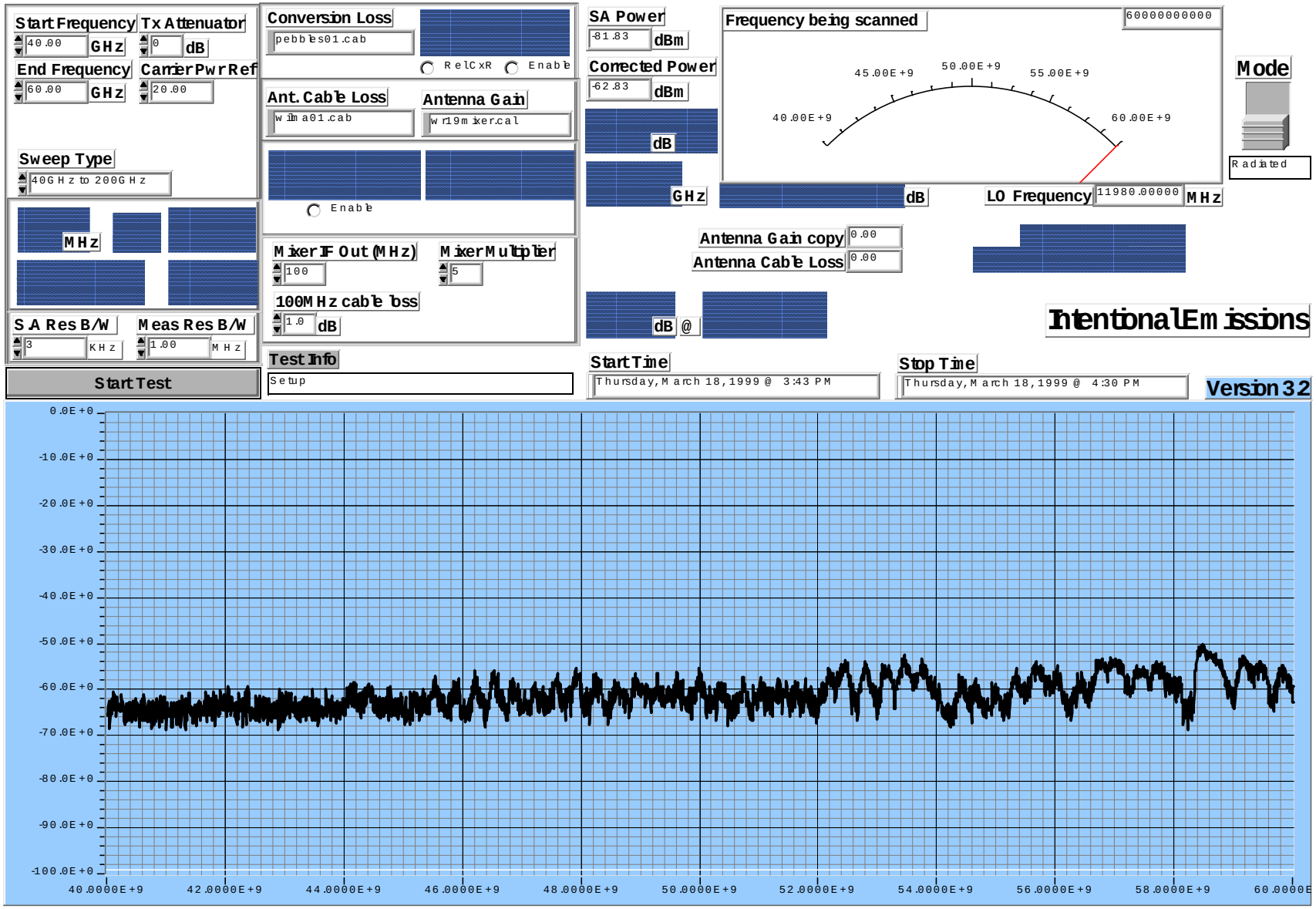
BTR 3800, 4 carrier QAM 64 modulated. – 18 to 40 GHz – Horizontal



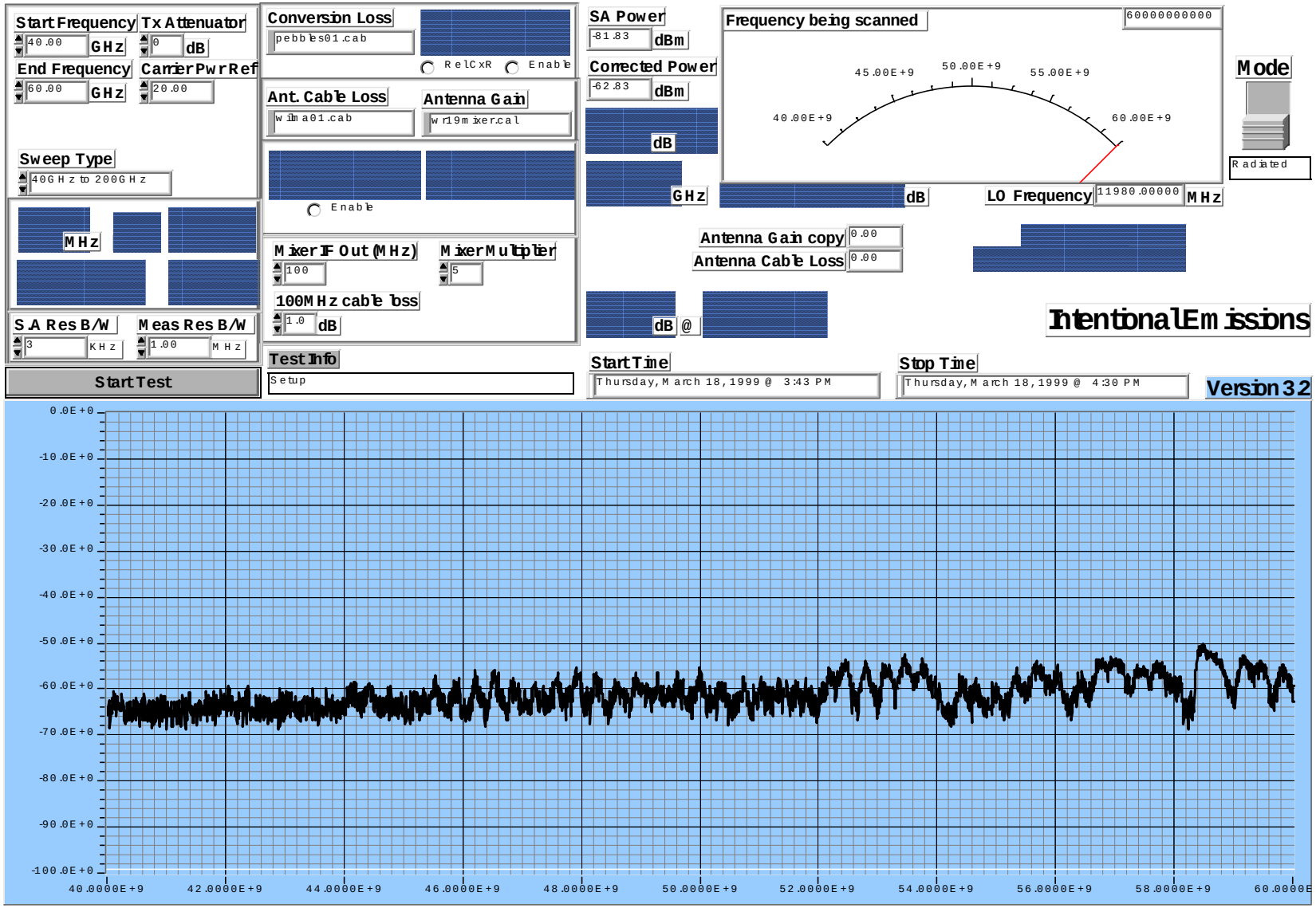
BTR 3800, 4 carrier QAM 64 modulated. – 18 to 40 GHz – Vertical



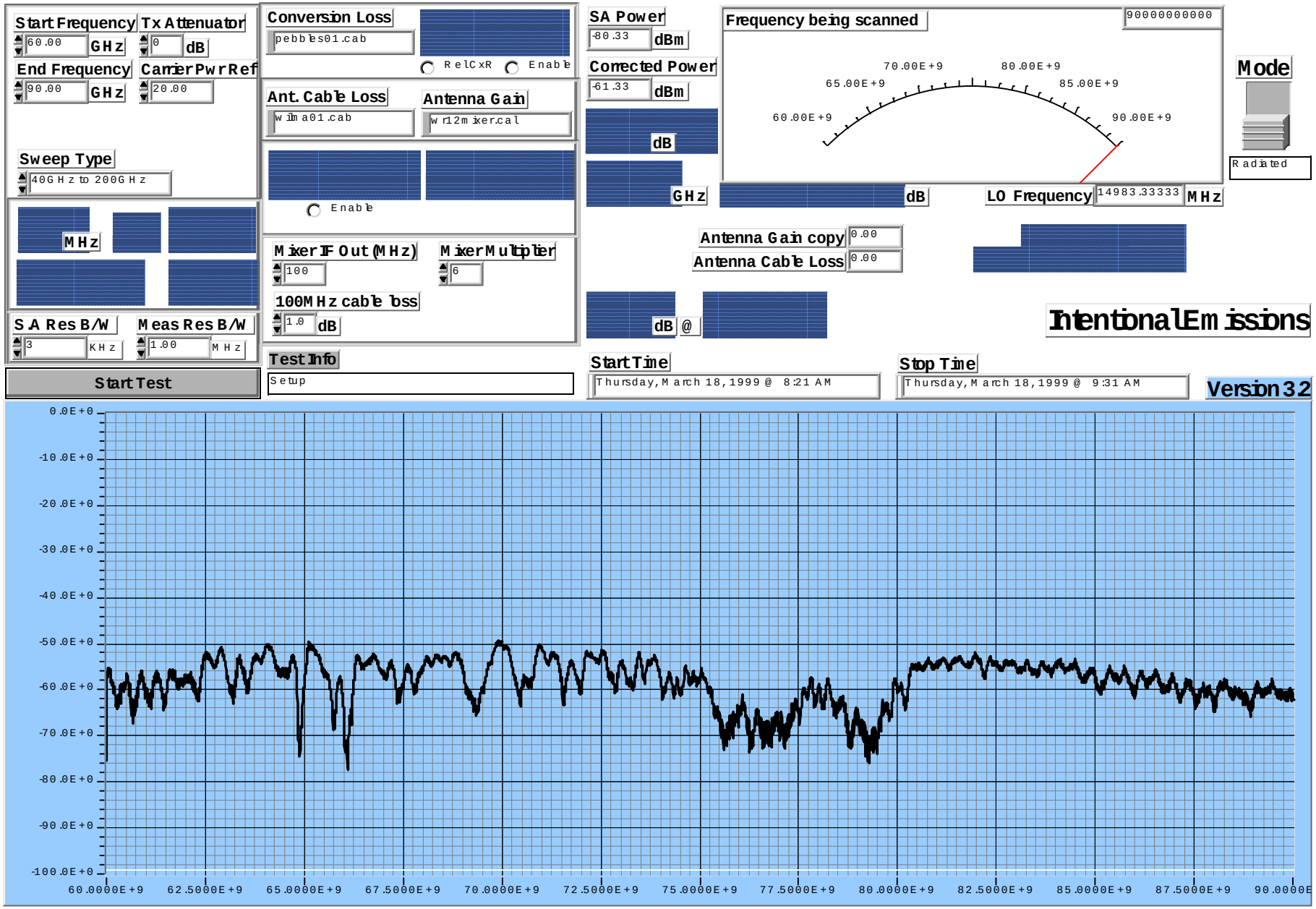
BTR 3800, 4 carrier QAM 64 modulated. – 40GHz to 60GHz - Horizontal



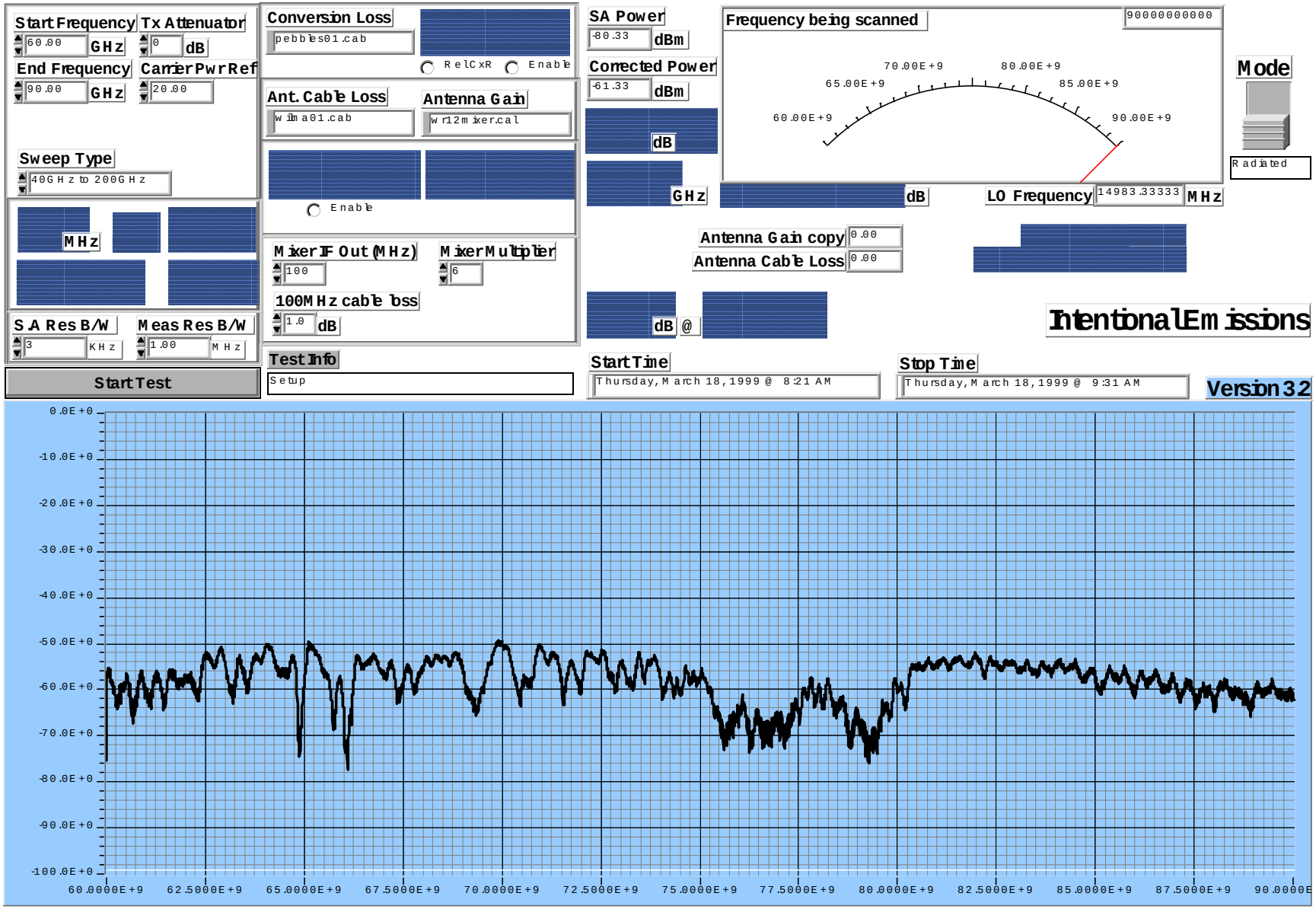
BTR 3800, 4 carrier QAM 64 modulated. –40GHz-60GHz - Vertical



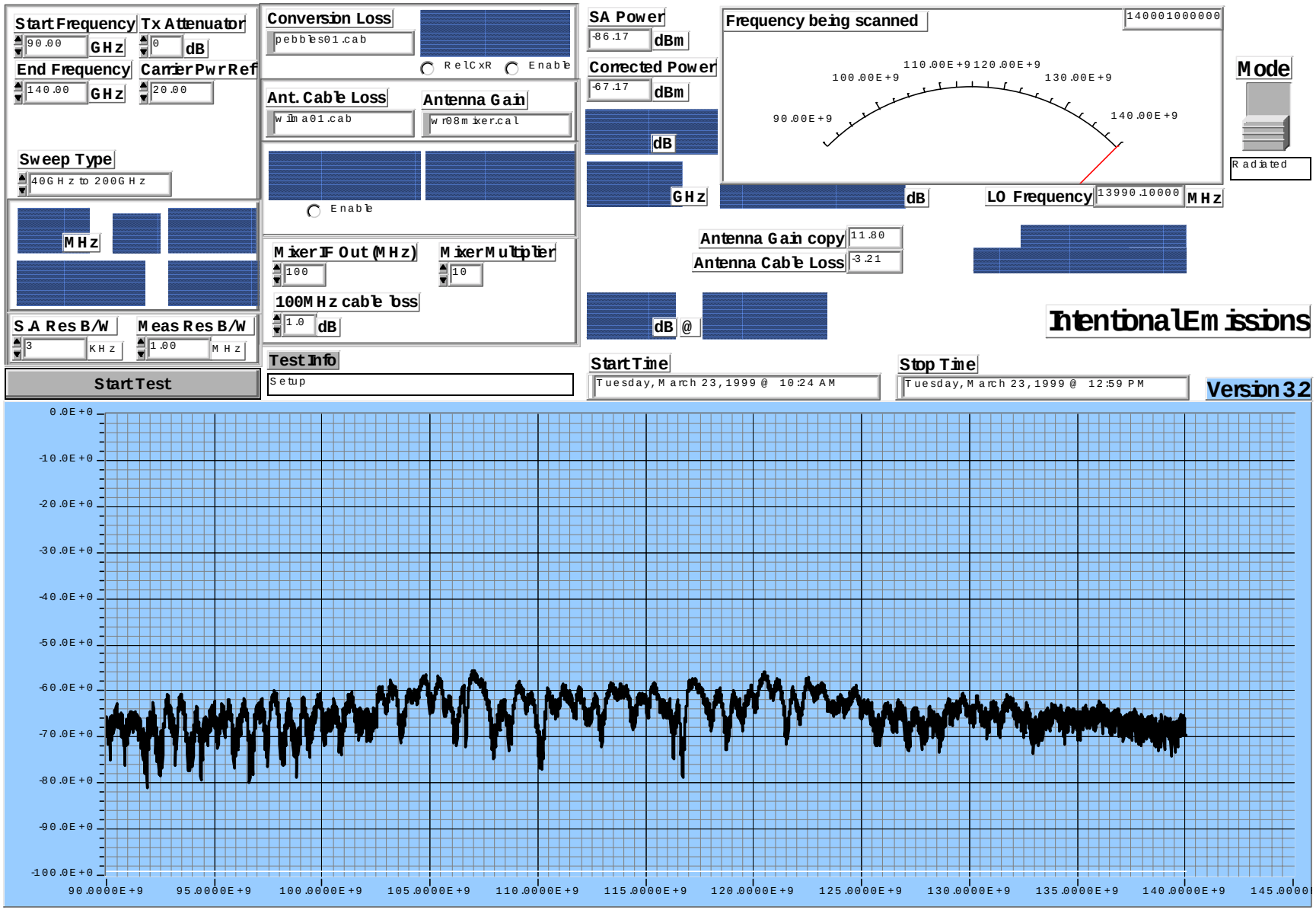
BTR 3800, 4 carrier QAM 64 modulated. –60GHz-90GHz - Horizontal



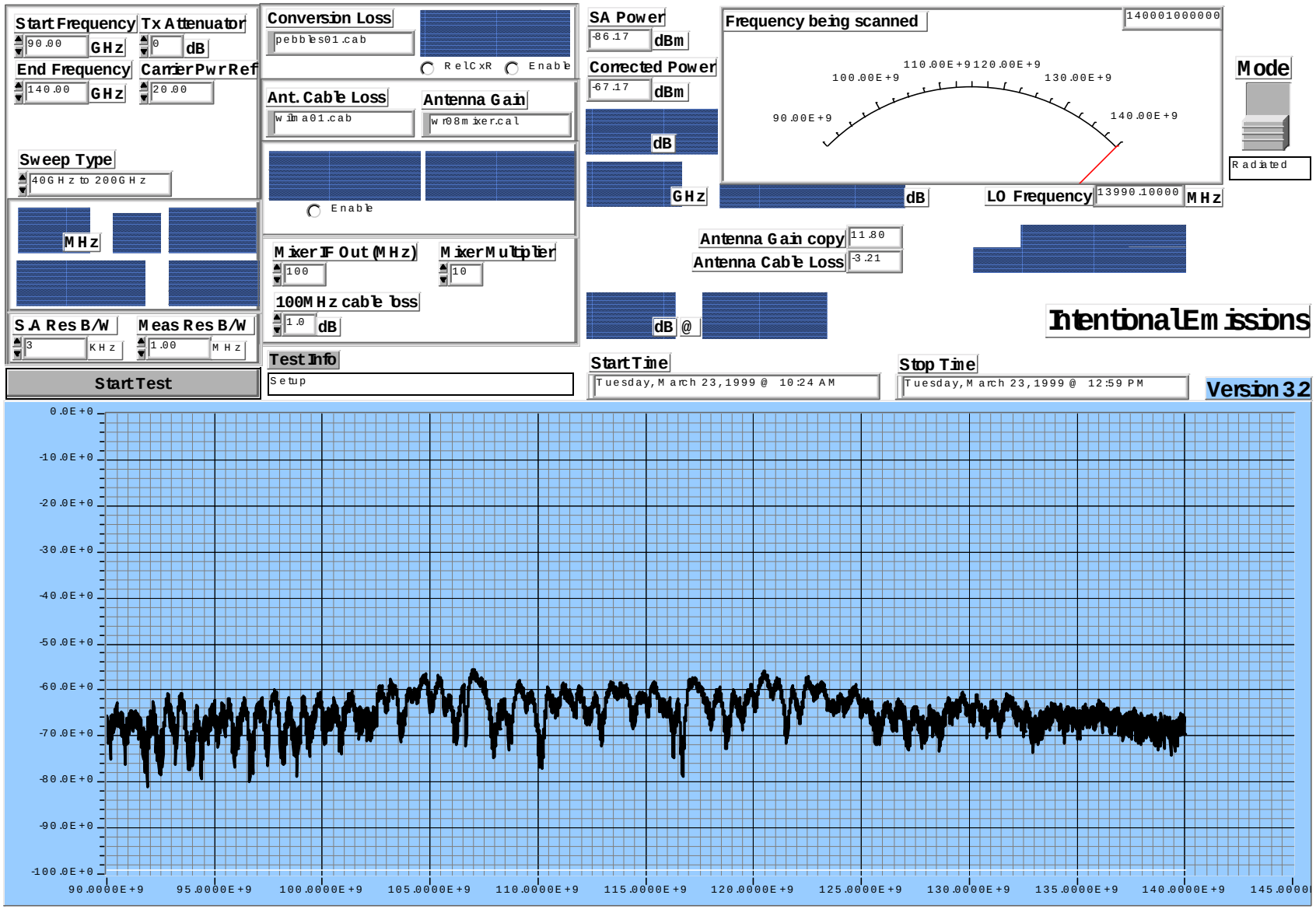
BTR 3800, 4 carrier QAM 64 modulated. –60GHz-90GHz – Vertical



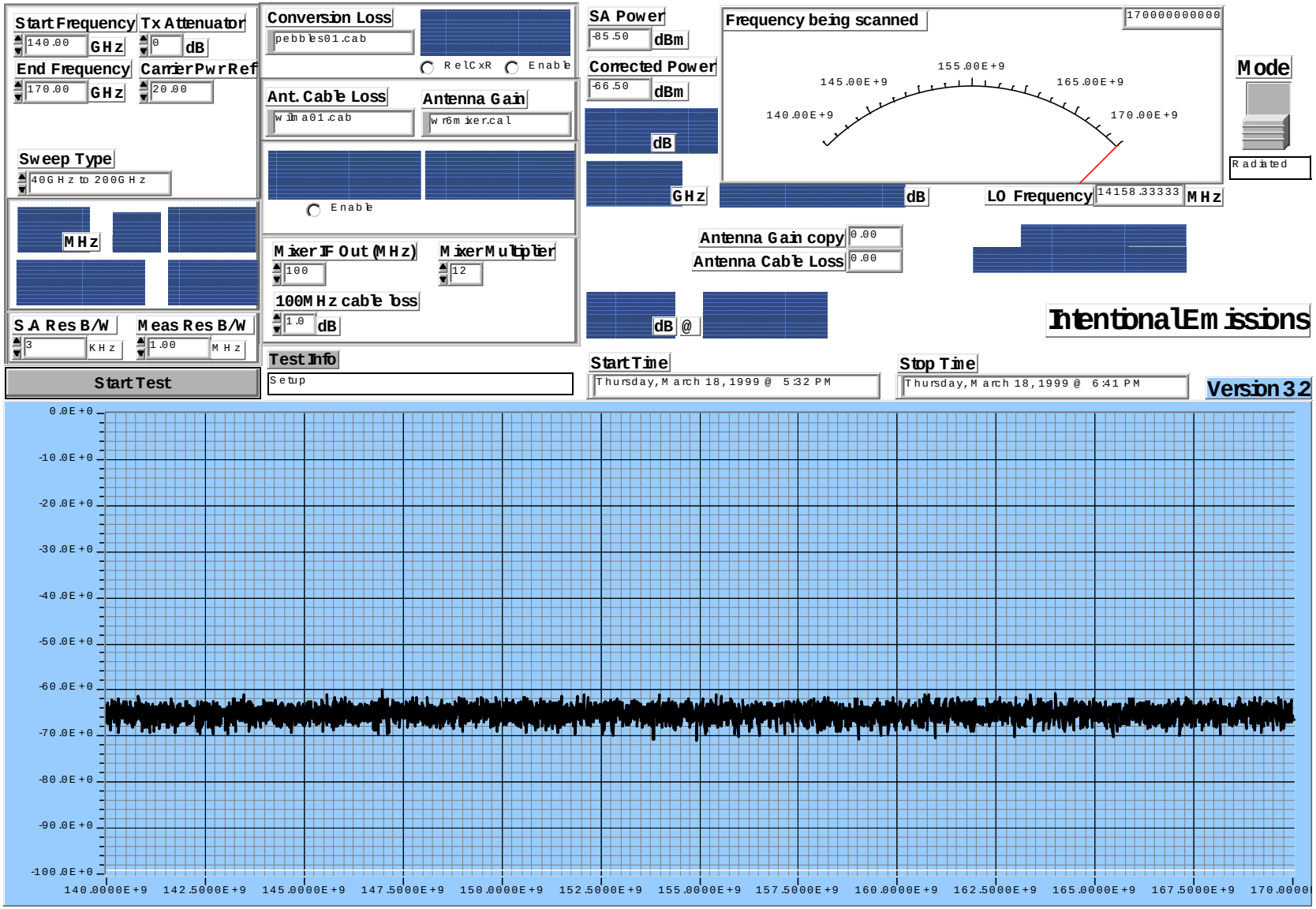
BTR 3800, 4 carrier QAM 64 modulated. –90GHz-140GHz – Horizontal



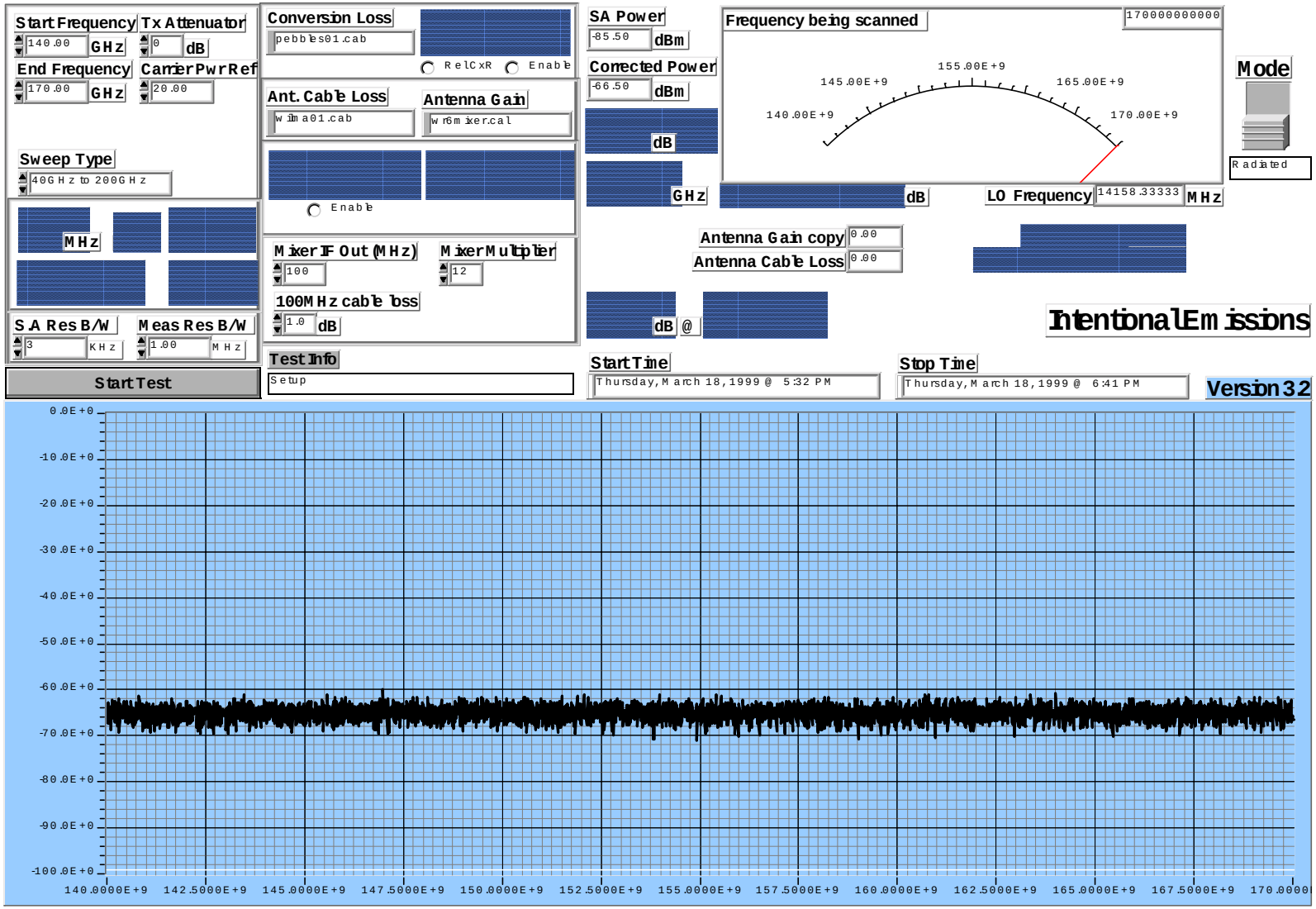
BTR 3800, 4 carrier QAM 64 modulated. –90GHz-140GHz – Vertical



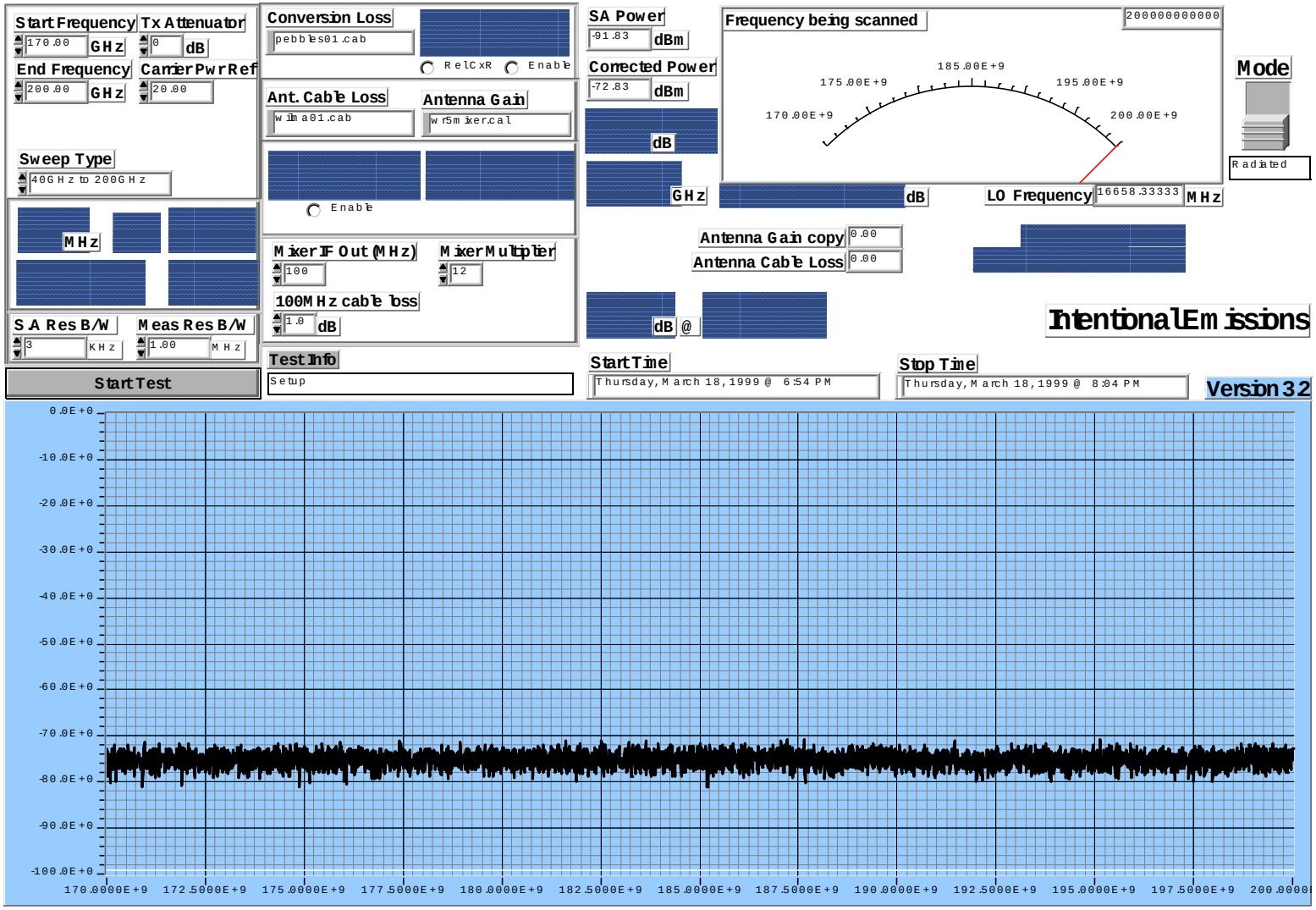
BTR 3800, 4 carrier QAM 64 modulated. –140GHz-170GHz – Horizontal



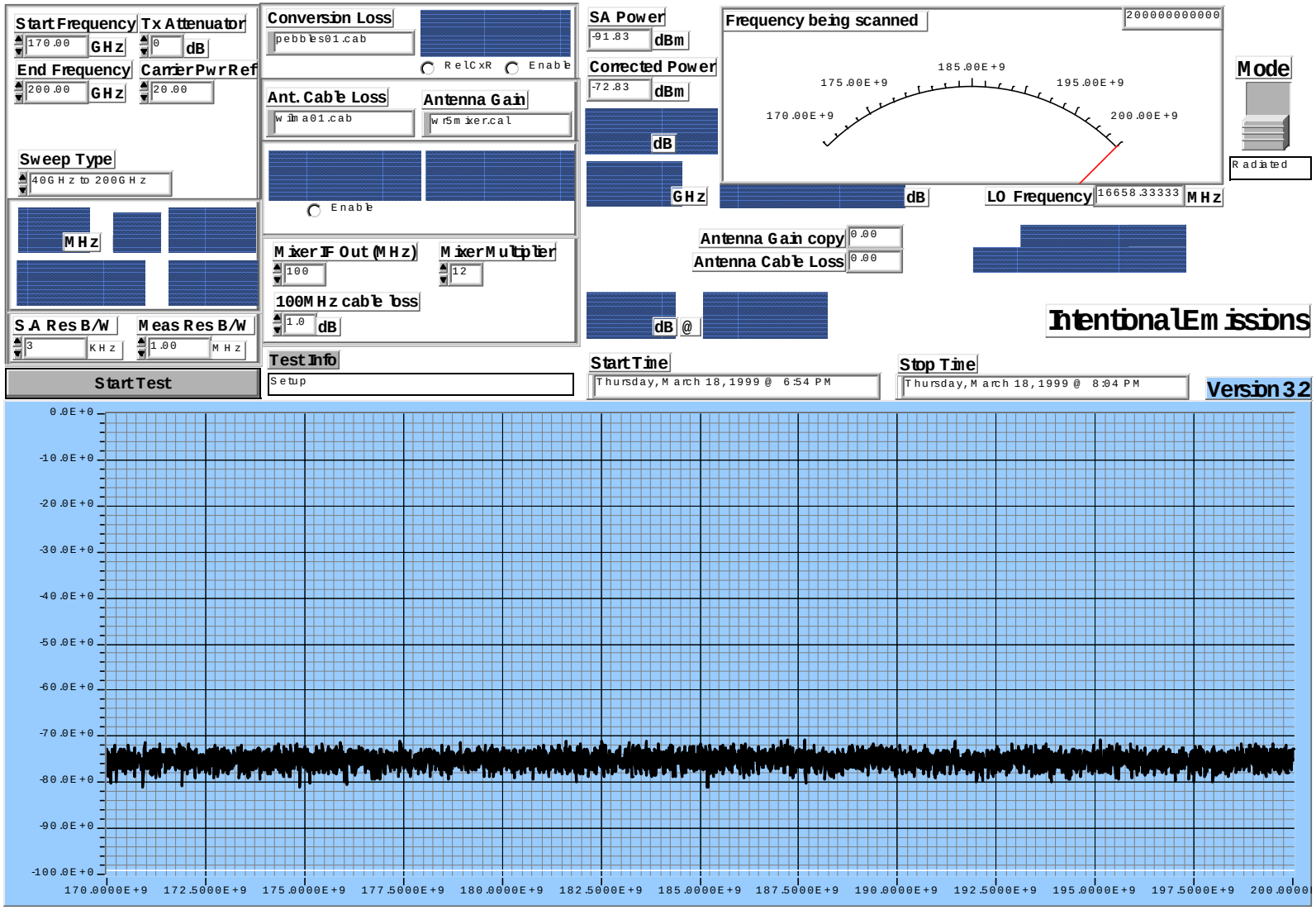
BTR 3800, 4 carrier QAM 64 modulated. –140GHz-170GHz – Vertical



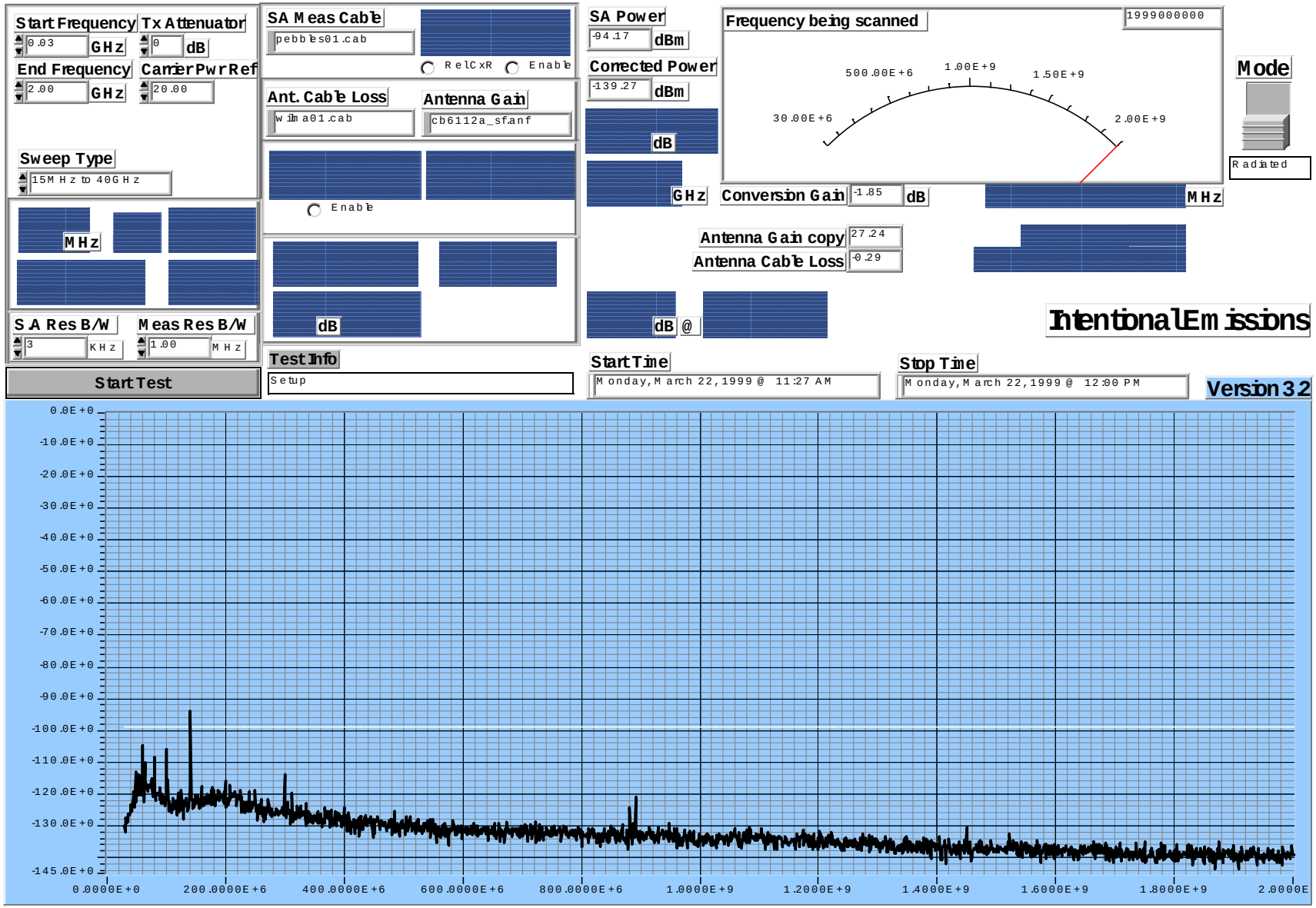
BTR 3800, 4 carrier QAM 64 modulated. –170GHz-200GHz – Horizontal



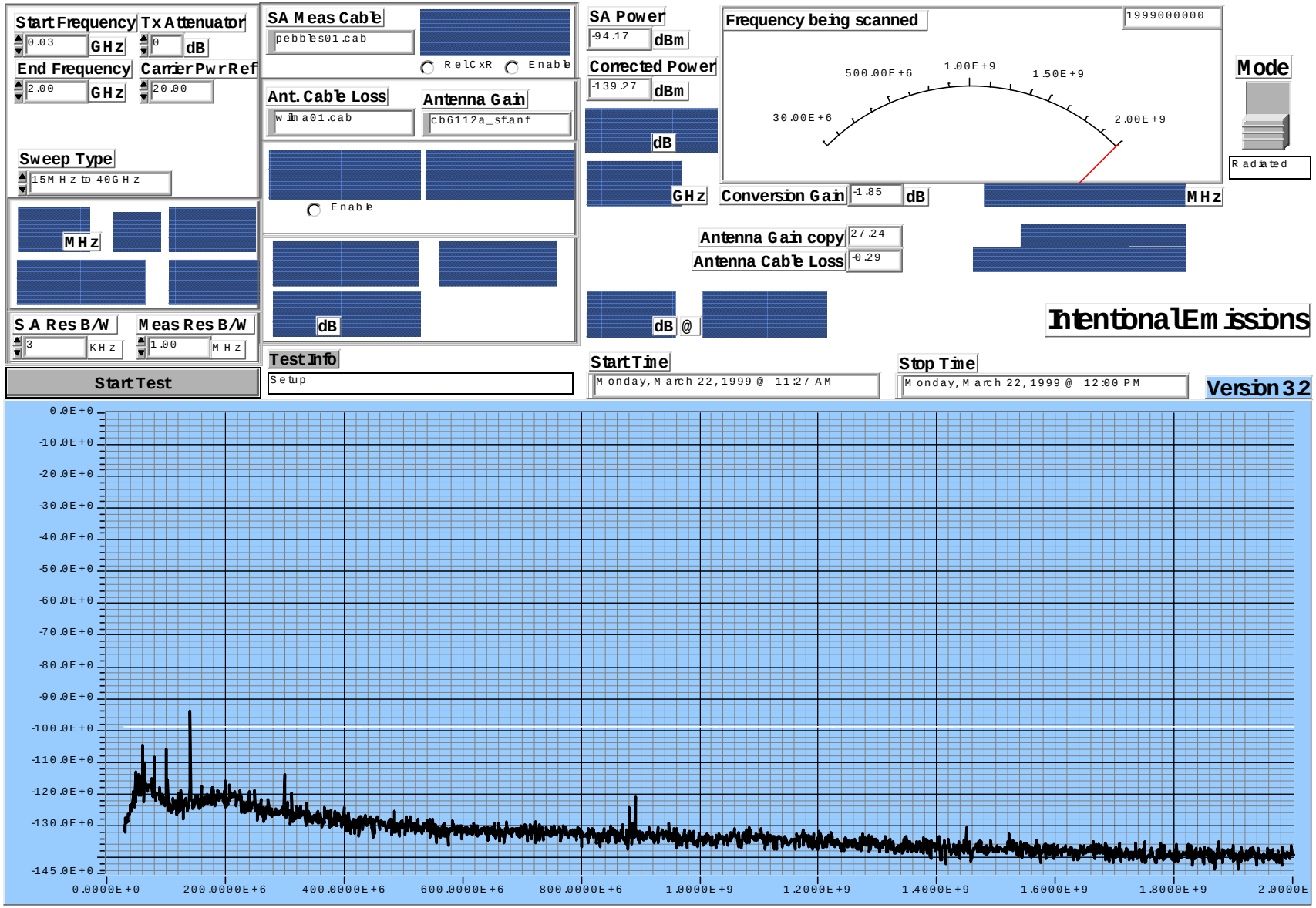
BTR 3800, 4 carrier QAM 64 modulated. –170GHz- 200GHz – Vertical



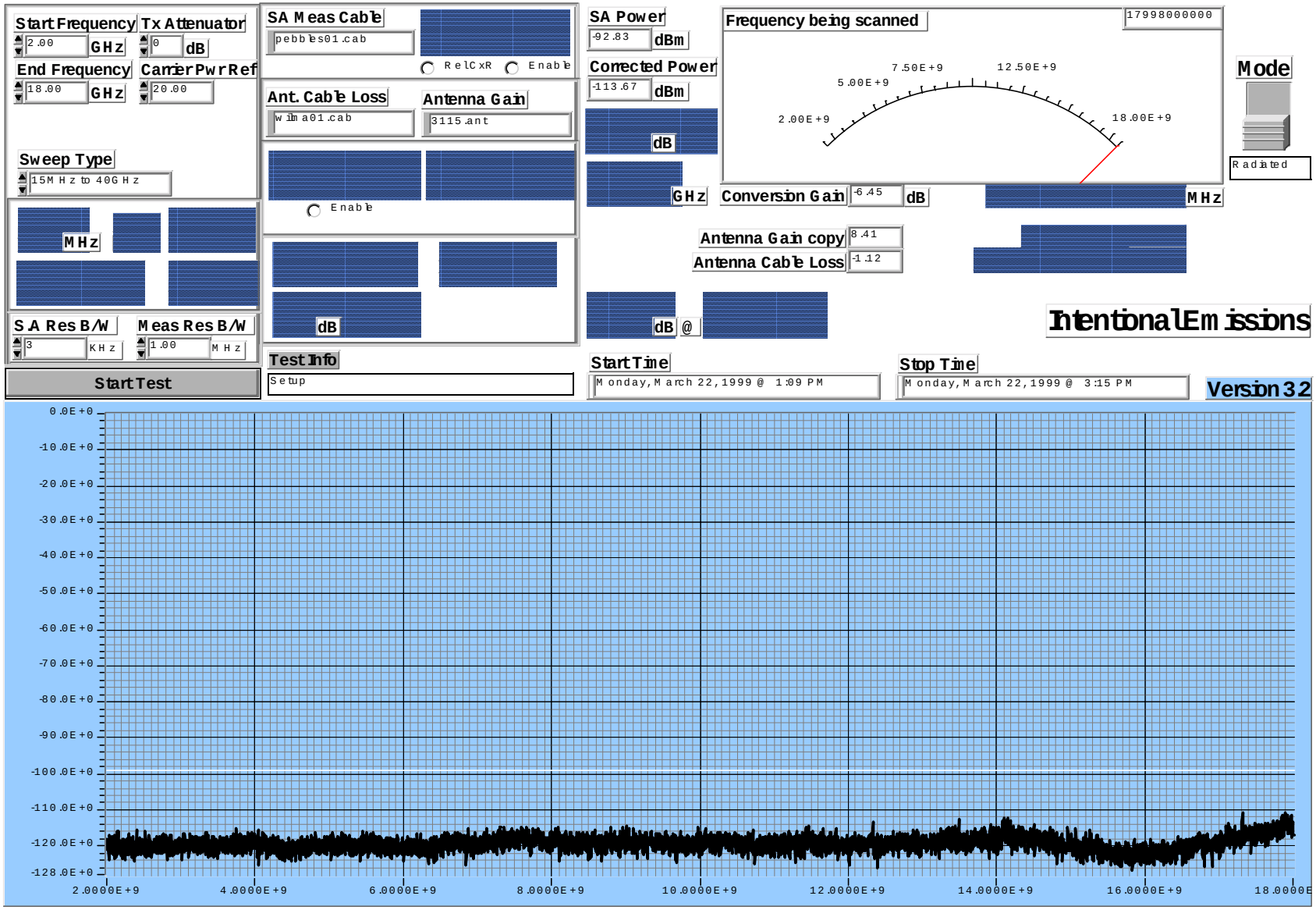
CTR 3800, 2 carrier QAM 64 modulated. – 30MHz to 2GHz – Horizontal



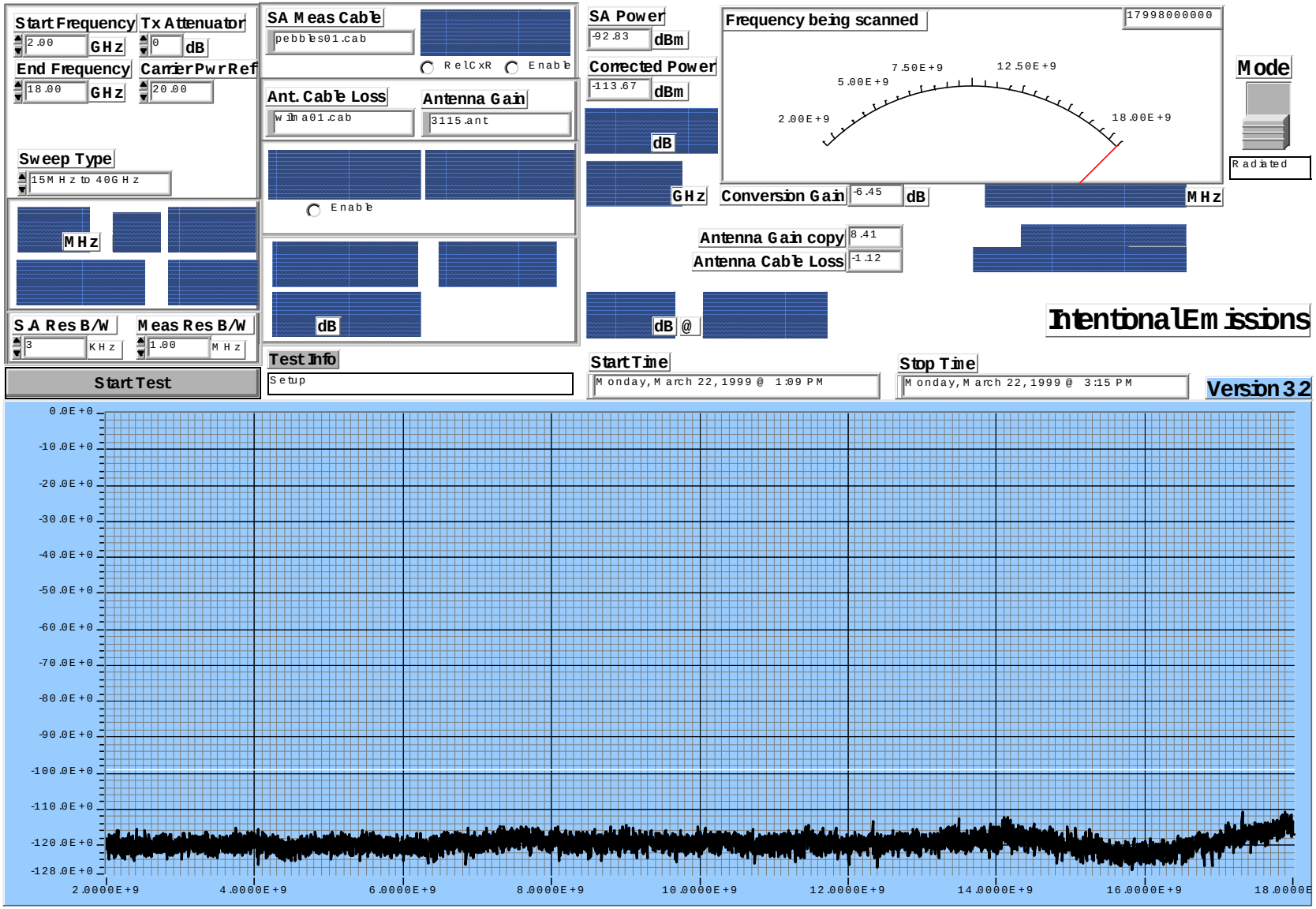
CTR 3800, 2 carrier QAM 64 modulated. – 30MHz to 2GHz – Vertical



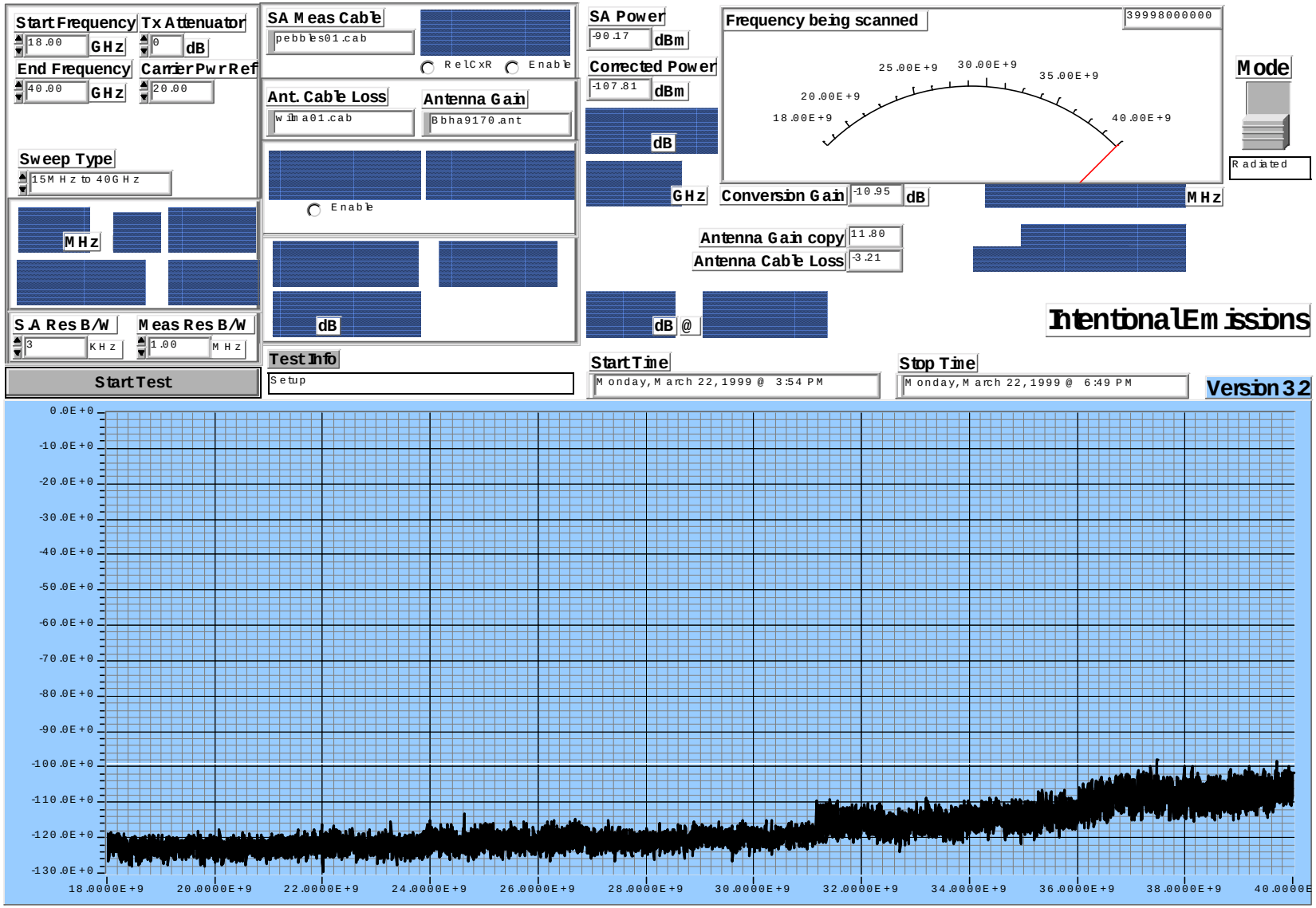
CTR 3800, 2 carrier QAM 64 modulated. – 2GHz to 18GHz - Horizontal



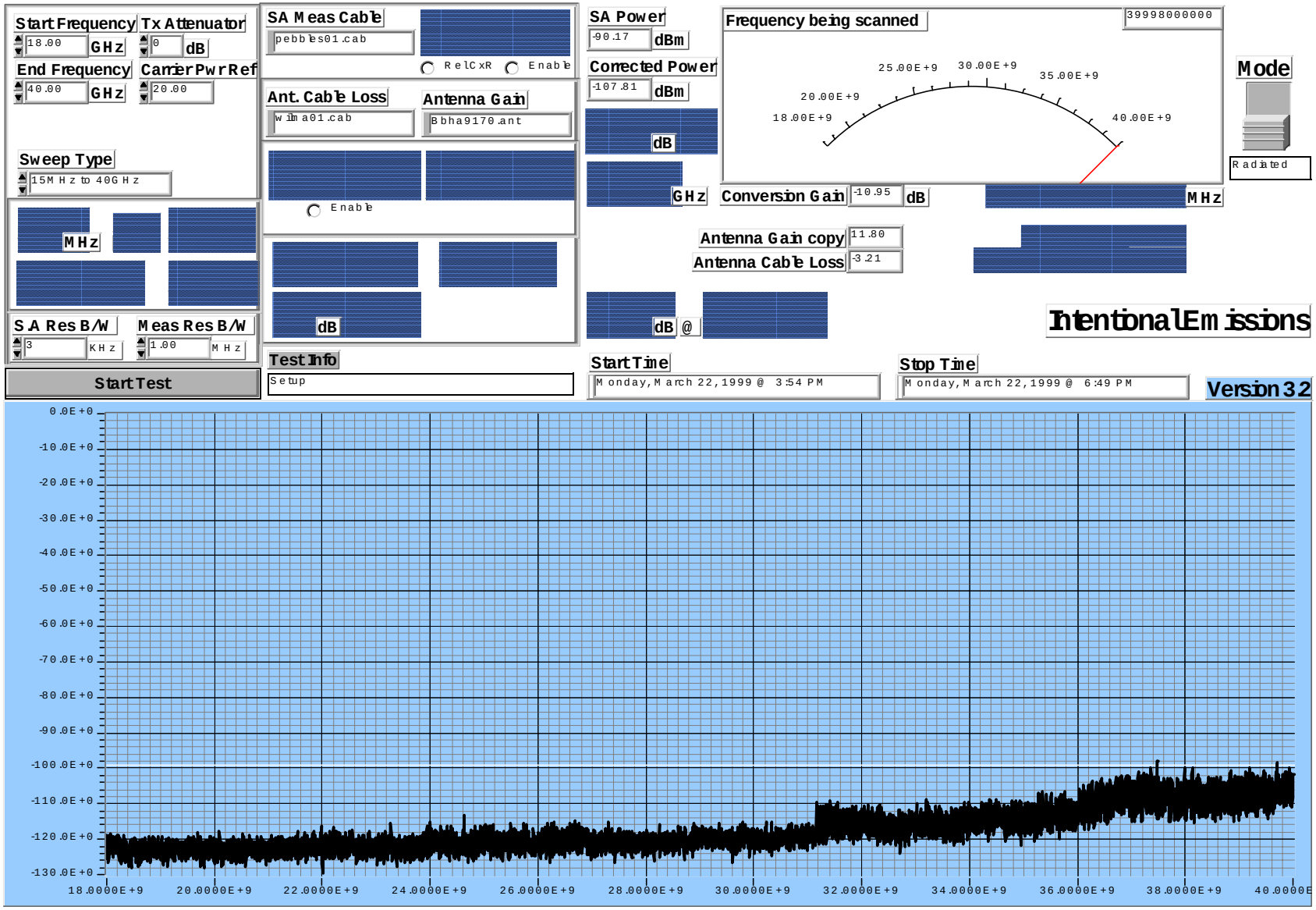
CTR 3800, 2 carrier QAM 64 modulated. – 2GHz to 18GHz - Vertical



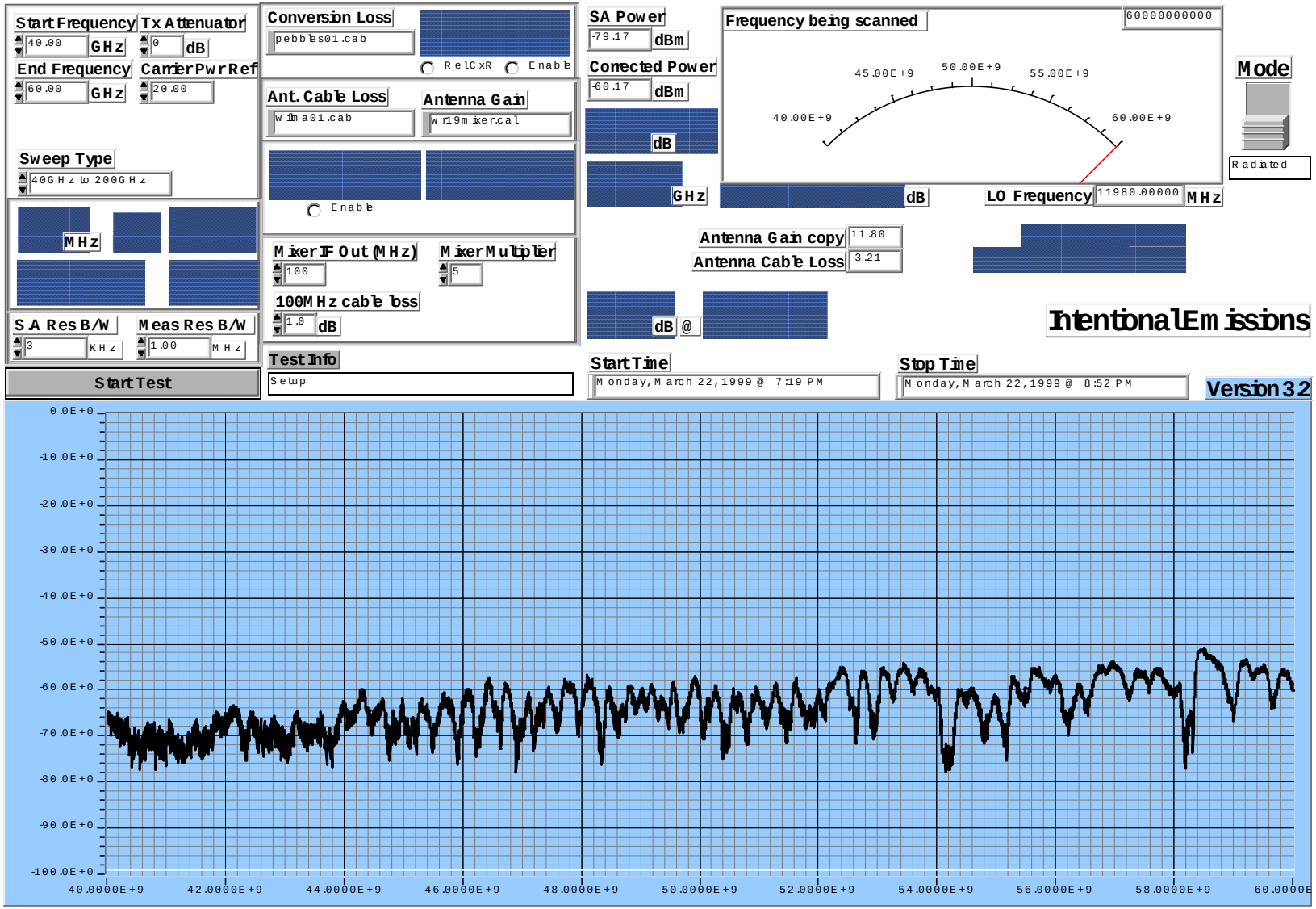
CTR 3800, 2 carrier QAM 64 modulated. –18GHz to 40GHz - Horizontal



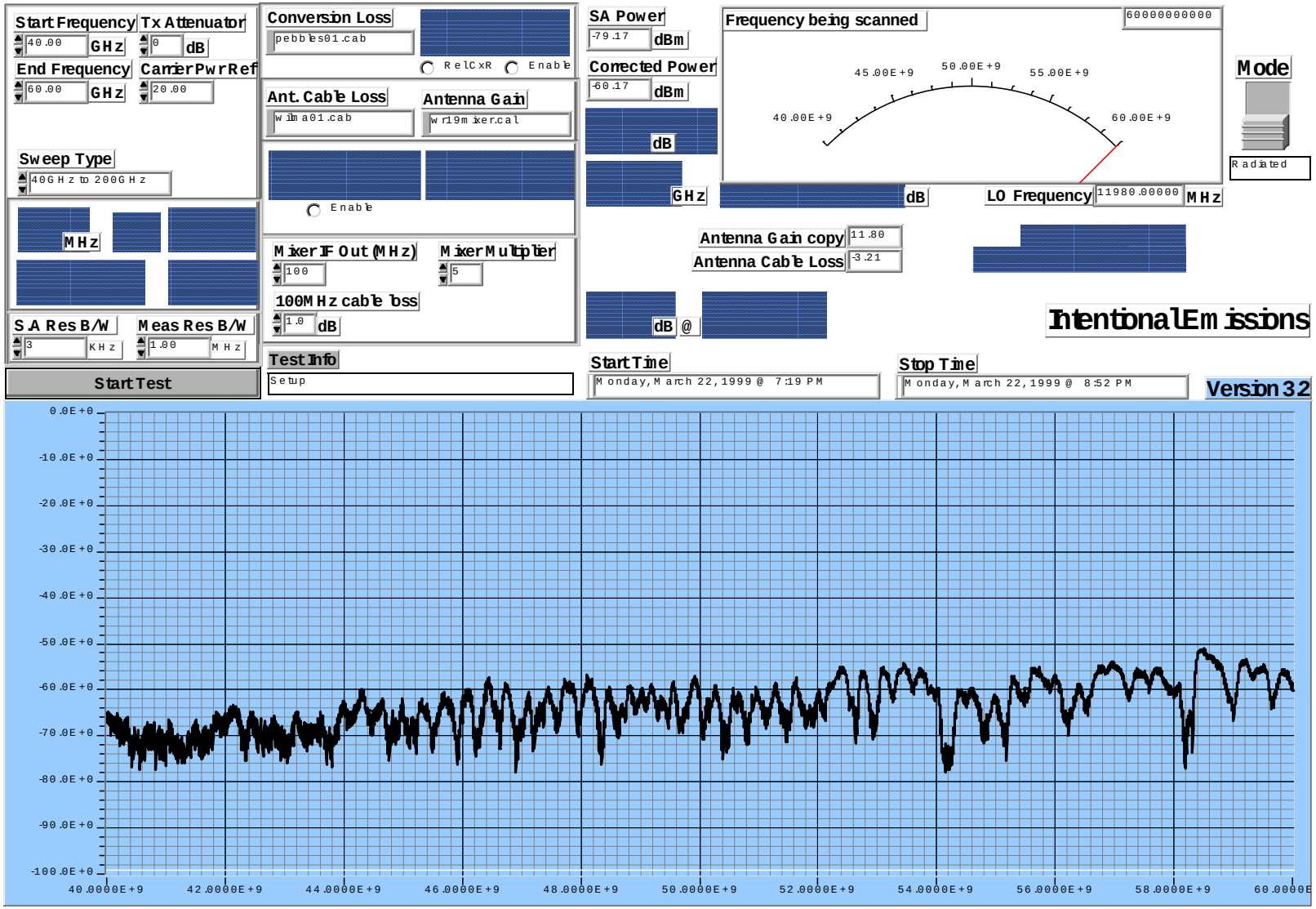
CTR 3800, 2 carrier QAM 64 modulated. –18GHz to 40GHz - Vertical



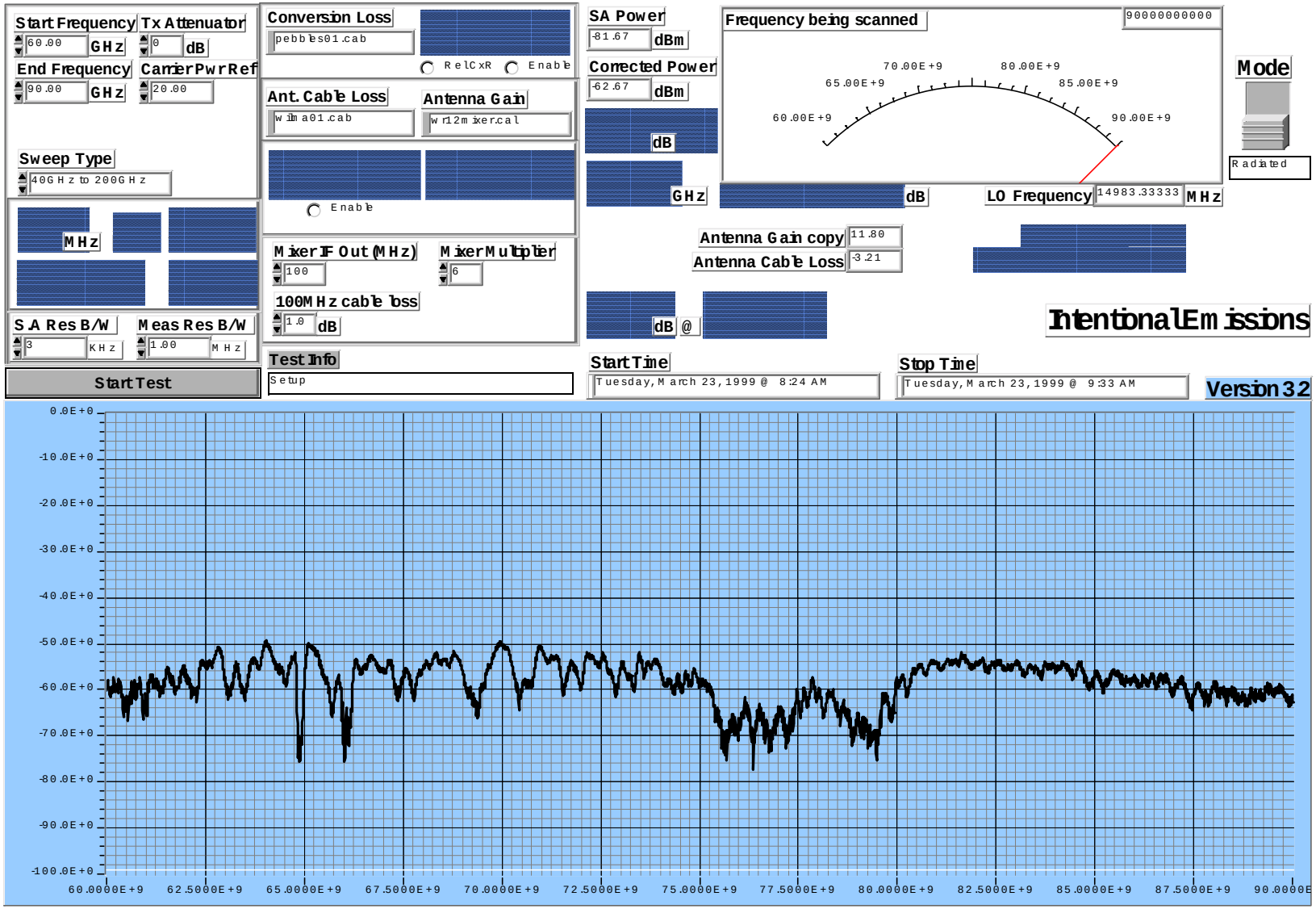
CTR 3800, 2 carrier QAM 64 modulated. –40GHz to 60GHz - Horizontal



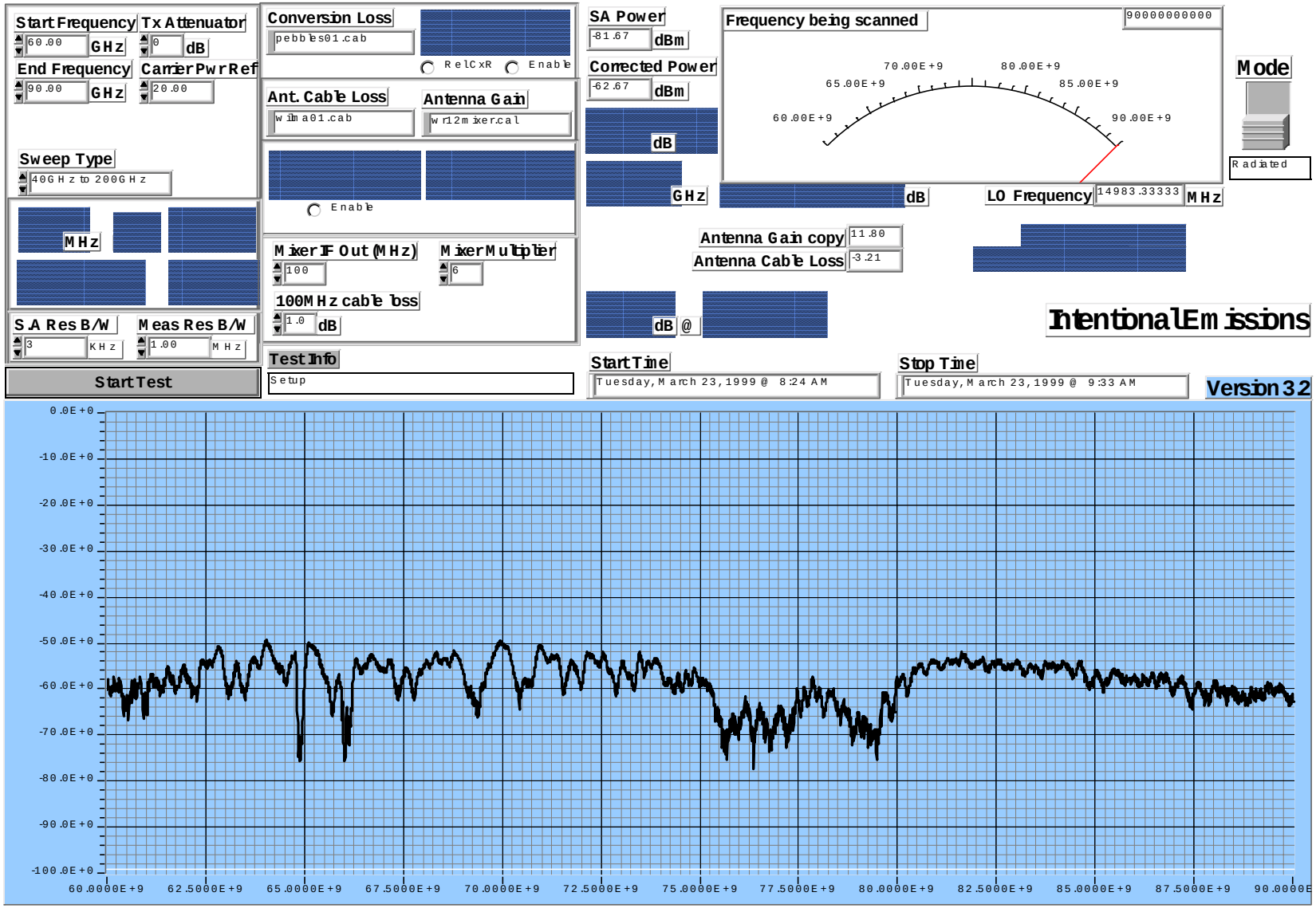
CTR 3800, 2 carrier QAM 64 modulated. –40GHz to 60GHz - Vertical



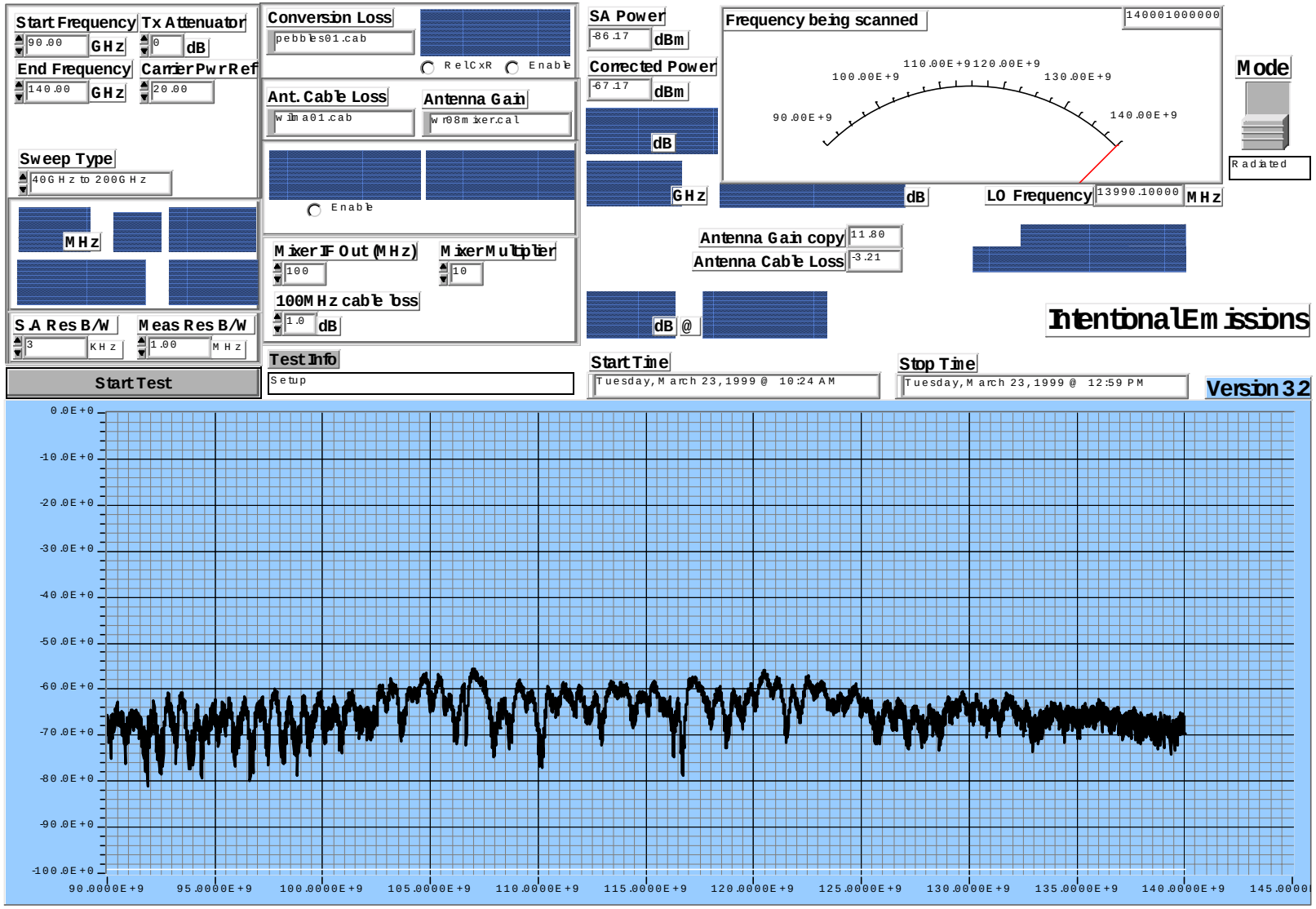
CTR 3800, 2 carrier QAM 64 modulated. –60GHz to 90GHz - Horizontal



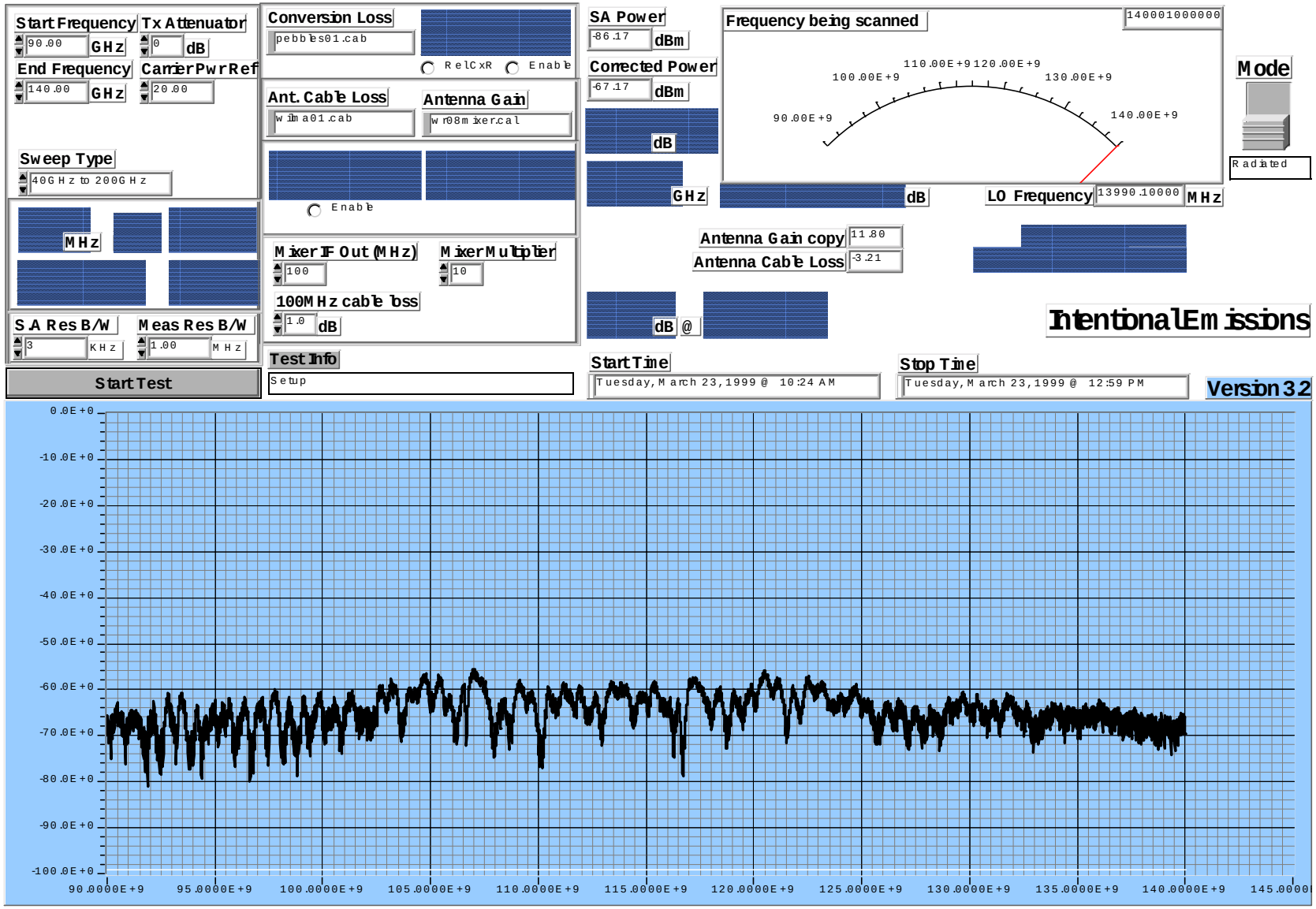
CTR 3800, 2 carrier QAM 64 modulated. –60GHz to 90GHz - Vertical



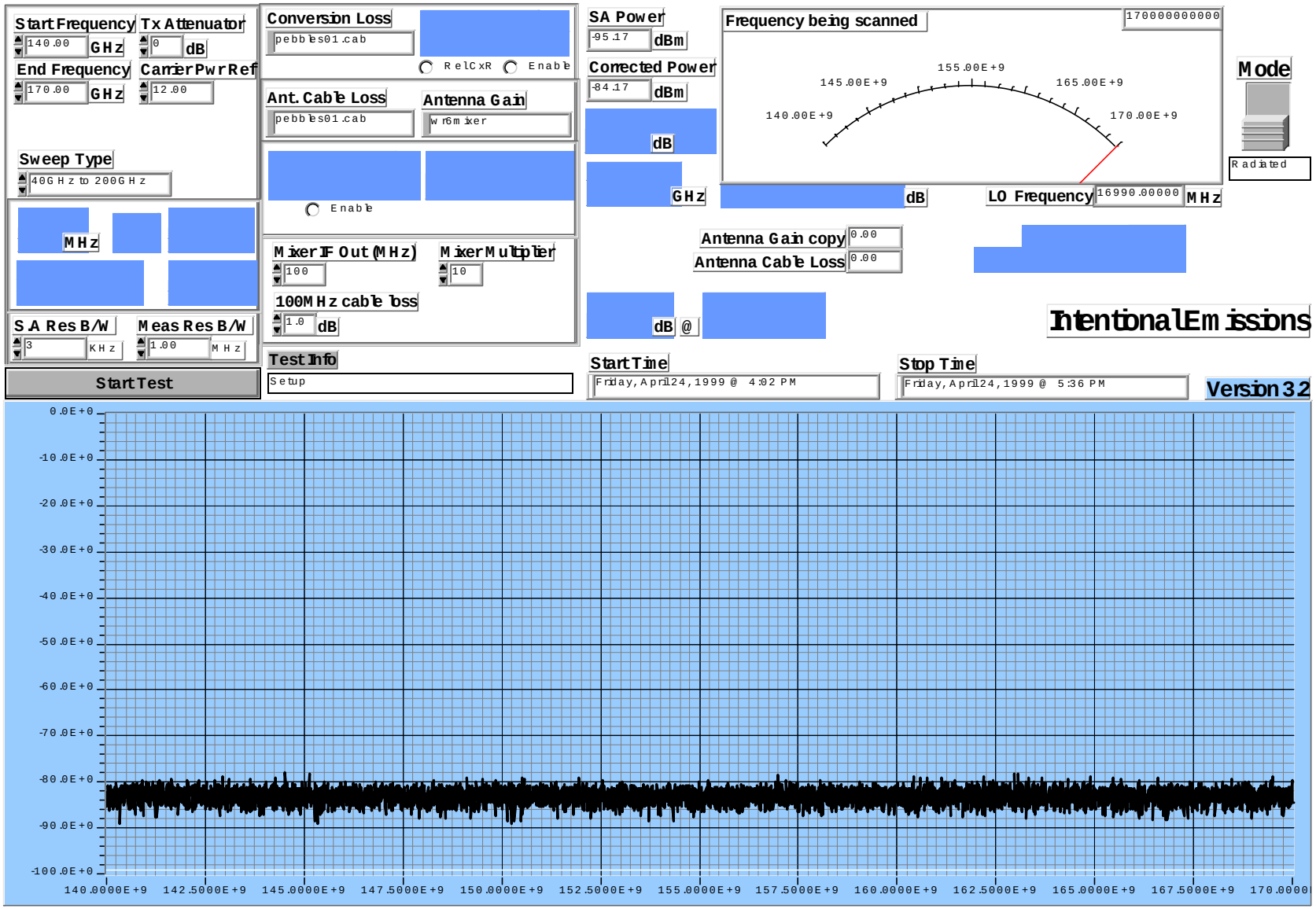
CTR 3800, 2 carrier QAM 64 modulated. –90GHz to 140GHz - Horizontal



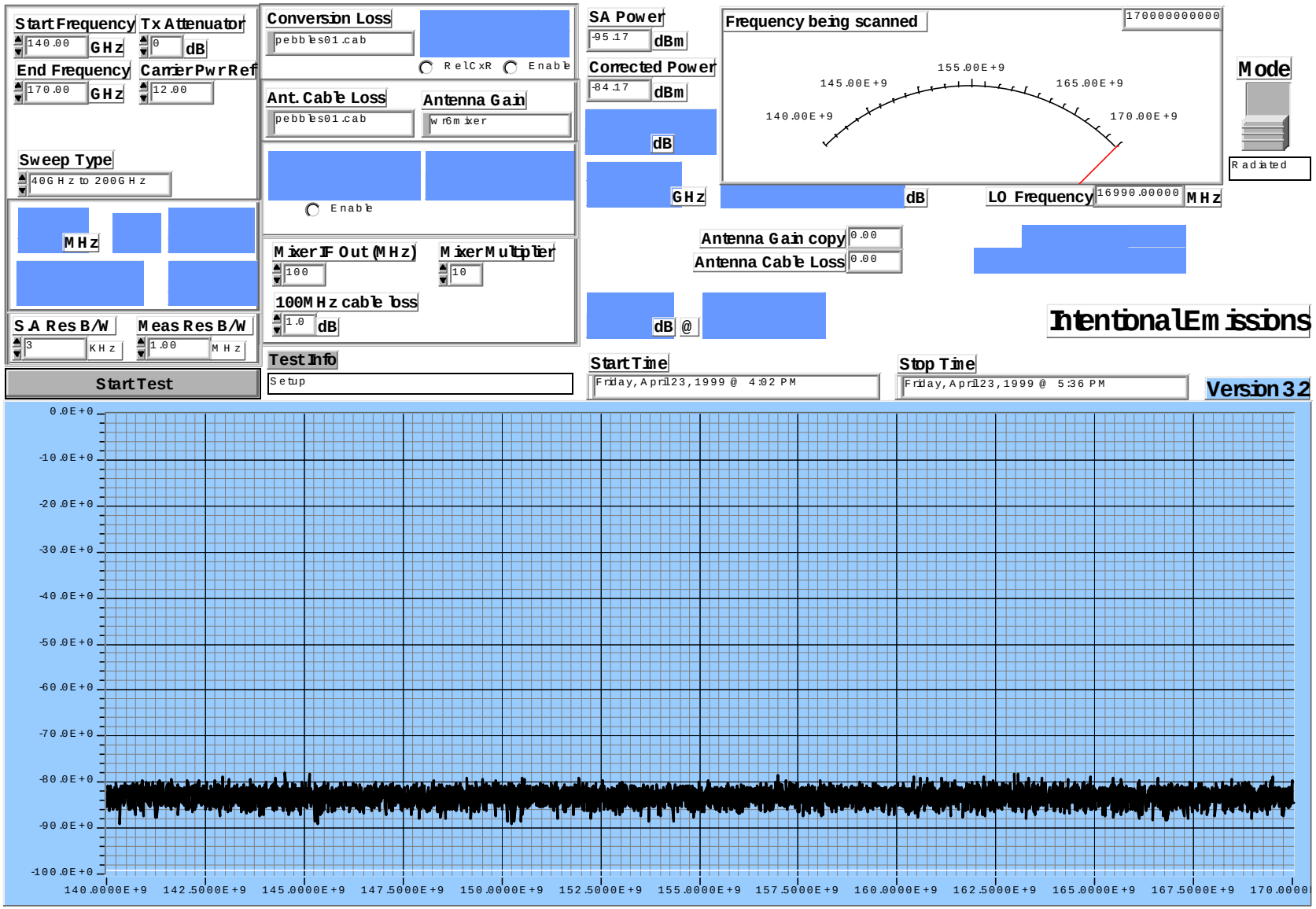
CTR 3800, 2 carrier QAM 64 modulated. –90GHz to 140GHz - Vertical



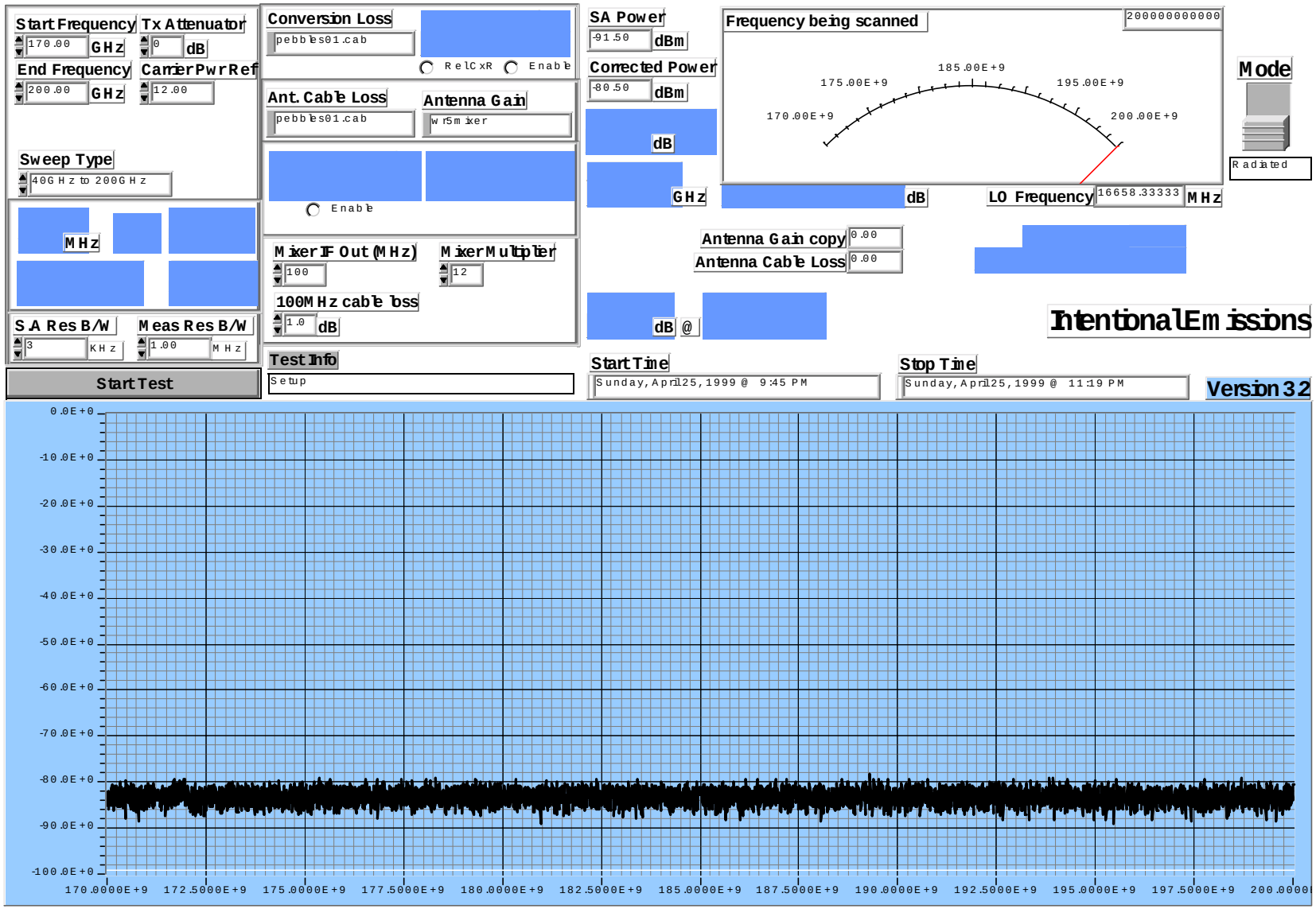
CTR 3800, 2 carrier QAM 64 modulated. –140GHz to 170GHz – Horizontal



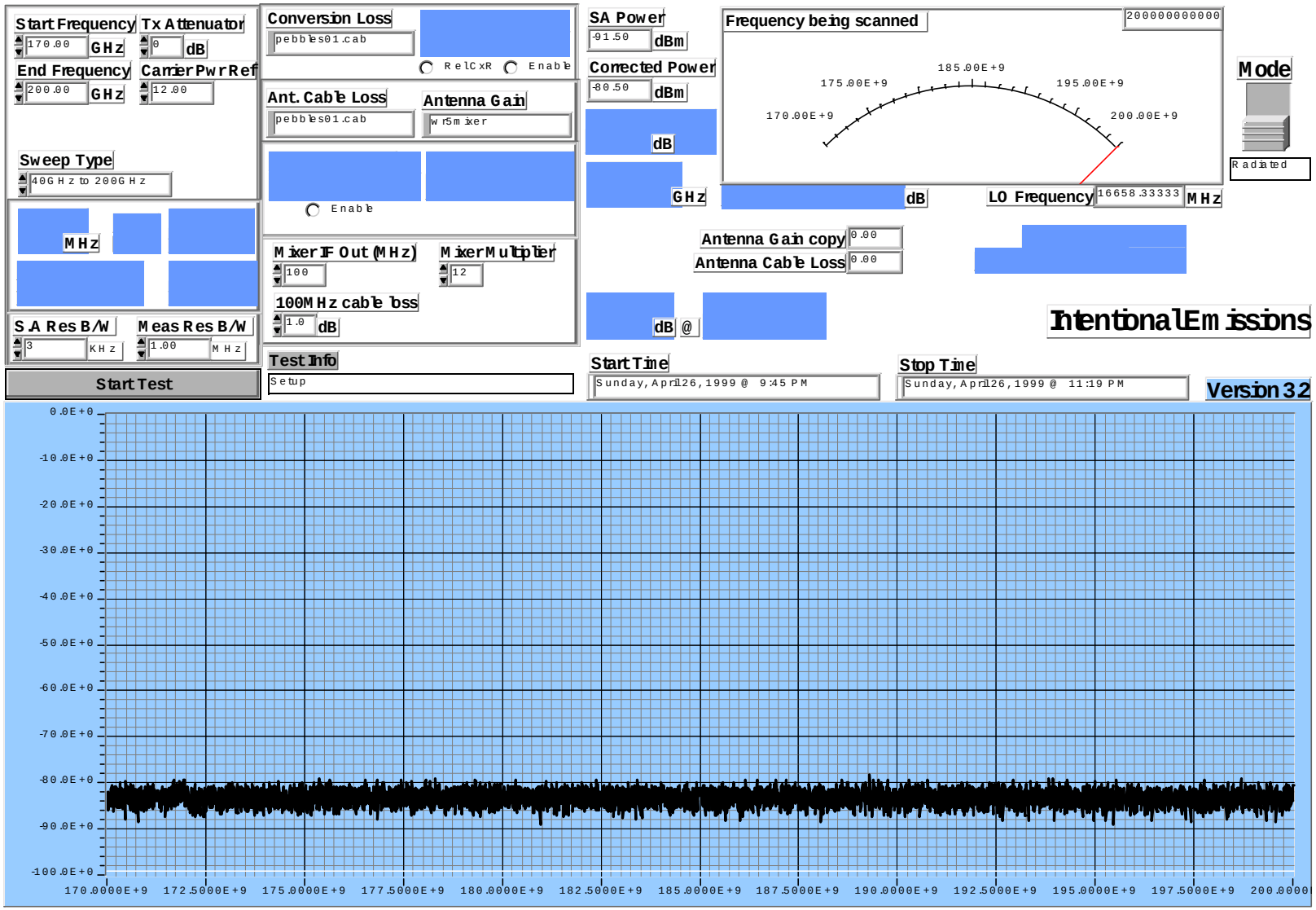
CTR 3800, 2 carrier QAM 64 modulated. –140GHz to 170GHz – Vertical



CTR 3800, 2 carrier QAM 64 modulated. –170GHz to 200GHz – Horizontal



CTR 3800, 2 carrier QAM 64 modulated. –170GHz to 200GHz – Vertical

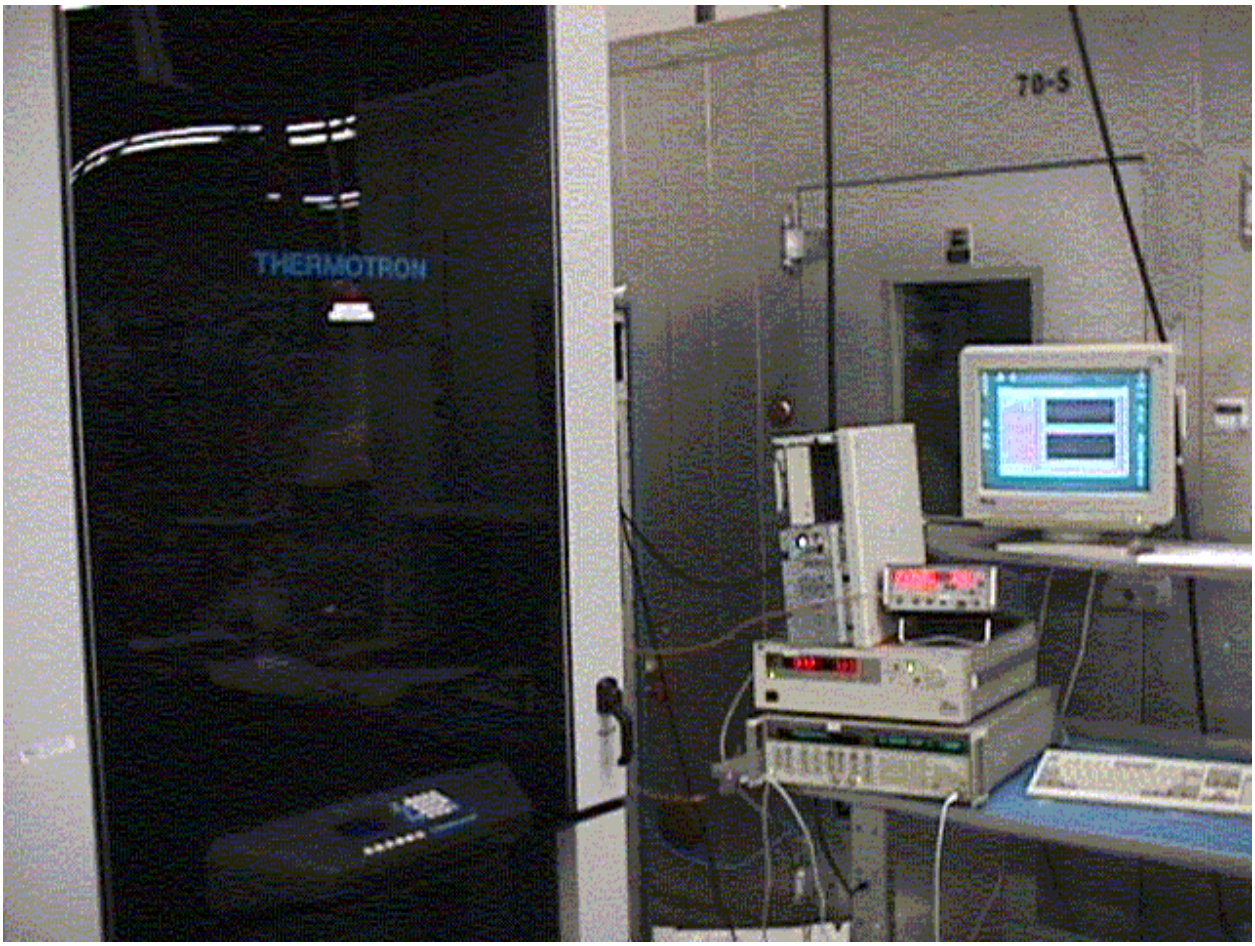


APPENDIX C

Temperature Stability Measurements Results

7. TEMPERATURE STABILITY MEASUREMENTS RESULTS

Frequency Stability Test Setup



BTR Frequency Stability

Date and Time	Frequency	Temp (C)	percent
Wed Apr 21 1999 @ 3:34 PM	39550.005655	10.0	-0.000670906
Wed Apr 21 1999 @ 4:06 PM	39550.005755	0.0	-0.000670653
Wed Apr 21 1999 @ 4:39 PM	39550.004842	-10.0	-0.000672961
Wed Apr 21 1999 @ 5:13 PM	39550.001908	-20.0	-0.00068038
Wed Apr 21 1999 @ 5:47 PM	39550.006428	-30.0	-0.000668951
Wed Apr 21 1999 @ 6:21 PM	39550.007758	-40.0	-0.000665588
Wed Apr 21 1999 @ 6:55 PM	39550.004935	-50.0	-0.000672726
Wed Apr 21 1999 @ 7:29 PM	39550.002067	-40.0	-0.000679978
Wed Apr 21 1999 @ 8:01 PM	39550.001739	-30.0	-0.000680807
Wed Apr 21 1999 @ 8:32 PM	39550.008937	-20.0	-0.000662607
Wed Apr 21 1999 @ 9:04 PM	39550.003352	-10.0	-0.000676729
Wed Apr 21 1999 @ 9:36 PM	39550.005525	0.0	-0.000671234
Wed Apr 21 1999 @ 10:08 PM	39550.005704	10.0	-0.000670782
Wed Apr 21 1999 @ 10:40 PM	39550.004081	20.0	-0.000674885
Wed Apr 21 1999 @ 11:12 PM	39550.000734	30.0	-0.000683348
Wed Apr 21 1999 @ 11:44 PM	39550.004796	40.0	-0.000673078
Thu Apr 22 1999 @ 12:16 AM	39550.006595	50.0	-0.000668529
Thu Apr 22 1999 @ 12:48 AM	39550.007104	60.0	-0.000667242
Thu Apr 22 1999 @ 1:20 AM	39550.002643	50.0	-0.000678521
Thu Apr 22 1999 @ 1:53 AM	39550.000506	40.0	-0.000683925
Thu Apr 22 1999 @ 2:25 AM	39550.007007	30.0	-0.000667487
Thu Apr 22 1999 @ 2:57 AM	39550.001665	20.0	-0.000680994
Thu Apr 22 1999 @ 3:31 AM	39550.004331	10.0	-0.000674253
Thu Apr 22 1999 @ 4:05 AM	39550.004521	0.0	-0.000673773
Thu Apr 22 1999 @ 4:37 AM	39550.004690	-10.0	-0.000673346
Thu Apr 22 1999 @ 5:11 AM	39550.001775	-20.0	-0.000680716
Thu Apr 22 1999 @ 5:45 AM	39550.006076	-30.0	-0.000669841
Thu Apr 22 1999 @ 6:19 AM	39550.007489	-40.0	-0.000666269
Thu Apr 22 1999 @ 6:53 AM	39550.004780	-50.0	-0.000673118
Thu Apr 22 1999 @ 7:27 AM	39550.002041	-40.0	-0.000680043
Thu Apr 22 1999 @ 7:59 AM	39550.001576	-30.0	-0.000681219
Thu Apr 22 1999 @ 8:30 AM	39550.008533	-20.0	-0.000663629
Thu Apr 22 1999 @ 9:02 AM	39550.002747	-10.0	-0.000678258
Thu Apr 22 1999 @ 9:34 AM	39550.004491	0.0	-0.000673849
Thu Apr 22 1999 @ 10:06 AM	39550.004207	10.0	-0.000674567
Thu Apr 22 1999 @ 10:38 AM	39550.001975	20.0	-0.00068021
Thu Apr 22 1999 @ 11:10 AM	39550.008170	30.0	-0.000664547

CTR Frequency Stability

Date and Time	Frequency	Temp (C)	ppm	percent
Mon Apr 19 1999 @ 7:04 PM	38850.002196	15.0	-0.139588	-0.00000139588
Mon Apr 19 1999 @ 7:28 PM	38850.004334	5.0	-0.084556	0.00000410734
Mon Apr 19 1999 @ 7:52 PM	38850.005069	-5.0	-0.065637	0.00000599923
Mon Apr 19 1999 @ 8:16 PM	38850.003826	-15.0	-0.097632	0.00000279974
Mon Apr 19 1999 @ 8:39 PM	38850.000340	-25.0	-0.187362	-0.00000617323
Mon Apr 19 1999 @ 9:03 PM	38850.004294	-35.0	-0.085586	0.00000400438
Mon Apr 19 1999 @ 9:27 PM	38850.003842	-45.0	-0.097220	0.00000284093
Mon Apr 19 1999 @ 9:51 PM	38850.000496	-35.0	-0.183346	-0.00000577168
Mon Apr 19 1999 @ 10:13 PM	38850.008079	-25.0	0.011840	0.00001374697
Mon Apr 19 1999 @ 10:34 PM	38850.003527	-15.0	-0.105328	0.00000203012
Mon Apr 19 1999 @ 10:56 PM	38850.006527	-5.0	-0.028108	0.00000975212
Mon Apr 19 1999 @ 11:18 PM	38850.007016	5.0	-0.015521	0.00001101081
Mon Apr 19 1999 @ 11:40 PM	38850.005261	15.0	-0.060695	0.00000649344
Tue Apr 20 1999 @ 12:02 AM	38850.001758	25.0	-0.150862	-0.00000252329
Tue Apr 20 1999 @ 12:24 AM	38850.006309	35.0	-0.033719	0.00000919099
Tue Apr 20 1999 @ 12:46 AM	38850.009202	45.0	0.040746	0.00001663758
Tue Apr 20 1999 @ 1:08 AM	38850.009881	55.0	0.058224	0.00001838533
Tue Apr 20 1999 @ 1:30 AM	38850.004355	45.0	-0.084015	0.00000416139
Tue Apr 20 1999 @ 1:52 AM	38850.000792	35.0	-0.175727	-0.00000500978
Tue Apr 20 1999 @ 2:13 AM	38850.006352	25.0	-0.032613	0.00000930167
Tue Apr 20 1999 @ 2:35 AM	38850.001153	15.0	-0.166435	-0.00000408056
Tue Apr 20 1999 @ 2:59 AM	38850.003751	5.0	-0.099562	0.00000260669
Tue Apr 20 1999 @ 3:22 AM	38850.004829	-5.0	-0.071815	0.00000538147
Tue Apr 20 1999 @ 3:46 AM	38850.003811	-15.0	-0.098018	0.00000276113
Tue Apr 20 1999 @ 4:10 AM	38850.000498	-25.0	-0.183295	-0.00000576654
Tue Apr 20 1999 @ 4:34 AM	38850.004380	-35.0	-0.083372	0.00000422574
Tue Apr 20 1999 @ 4:58 AM	38850.004314	-45.0	-0.085071	0.00000405586
Tue Apr 20 1999 @ 5:22 AM	38850.001180	-35.0	-0.165740	-0.00000401107
Tue Apr 20 1999 @ 5:44 AM	38850.008915	-25.0	0.033359	0.00001589884
Tue Apr 20 1999 @ 6:05 AM	38850.004353	-15.0	-0.084067	0.00000415624
Tue Apr 20 1999 @ 6:27 AM	38850.007242	-5.0	-0.009704	0.00001159253
Tue Apr 20 1999 @ 6:49 AM	38850.007548	5.0	-0.001828	0.00001238018
Tue Apr 20 1999 @ 7:11 AM	38850.005966	15.0	-0.042548	0.00000830811
Tue Apr 20 1999 @ 7:33 AM	38850.002192	25.0	-0.139691	-0.00000140618
Tue Apr 20 1999 @ 7:55 AM	38850.006630	35.0	-0.025457	0.00001001725
Tue Apr 20 1999 @ 8:17 AM	38850.009641	45.0	0.052046	0.00001776756
Tue Apr 20 1999 @ 8:39 AM	38850.000350	55.0	-0.187104	-0.00000614749

APPENDIX E

Channel Interference Measurements Results

8. CHANNEL INTERFERENCE MEASUREMENTS RESULTS

CTR output levels 9.5dBm/10MHz, 16 dB attenuation set on modulators.
Path Loss of wanted carrier = 45.5 dB
Path Loss of interfering carrier = 54.8 dB
Vane attenuation of up to 60dB available.

Adjacent Channel Test Results

64 QAM	Wanted	Vane Attn	Hi-Side Interferor	Vane Attn	Low-Side Interferor	Vane Attn
RSL = -75dBM/10MHz	550 MHz		560MHz		540MHz	
Channel Power	-30.5	37	-19.8	17	-19.8	17
Limit (0dB)	----		> -30.5		> -30.5	
Pass Margin	----		10.7		10.7	
16 QAM	Wanted	Vane Attn	Hi-Side Interferor	Vane Attn	Low-Side Interferor	Vane Attn
RSL = -81dBm/10MHz	550 MHz		560MHz		540MHz	
Channel Power	-36.4	44	-15.1	12	-16.1	13
Limit (0dB)	----		> -36.4		> -36.4	
Pass Margin	----		21.3		20.3	
4 QAM	Wanted	Vane Attn	Hi-Side Interferor	Vane Attn	Low-Side Interferor	Vane Attn
RSL = -90dBm/10MHz	550 MHz		560MHz		540MHz	
Channel Power	-43	52	-20	16	-22	18
Limit (0dB)	----		> -43		> -43	
Pass Margin	----		23		21	

Co-Channel Test Results

The Interferor Path Loss was adjusted to 68.9dB.

Frequency 550MHz @ 4 QAM	Wanted	Vane Attn	Interferor
Channel Power	-42.6	43	-60
Limit (19.5dB)	----		>-62.1
Pass Margin	----		2.1
Frequency 550MHz @ 16 QAM	Wanted	Vane Attn	Interferor
Channel Power	-35.9	40	-57
Limit (26.9dB)	----		>-62.8
Pass Margin	----		5.8
Frequency 550MHz @ 64 QAM	Wanted	Vane Attn	Interferor
Channel Power	-30.2	44	-61
Limit (33.1dB)	----		> -63.3
Pass Margin	----		2.3

APPENDIX F

Carrier Mask Calculations

9. BTR CARRIER MASK CALCULATIONS

The table below shows a typical example of the Part 101 limit line. The bold values are the points of inflection for the limit line.

11+0.4*(P-50)+10*Log (B)

Number of CXR	4			
Symbol rate (Msps)	8			
Authorized BW (MHz)	40			
O/P Channel Power (dBm)	20	0.1	**Watts**	
Center Frequency (MHz)	39565.7			
% Removed	**FCC Spec**	**Delta BW, Form passband edge**	**Lower Band**	**Upper Band**
0	**0**	**0**	**39565.7**	**39565.7**
50	**0**	**20**	**39545.7**	**39585.7**
50.5	**-27.22059991**	**20.2**	**39545.5**	**39585.9**
51	-27.42059991	20.4	39545.3	39586.1
55	-29.02059991	22	39543.7	39587.7
60	-31.02059991	24	39541.7	39589.7
75	-37.02059991	30	39535.7	39595.7
100	-47.02059991	40	39525.7	39605.7
101	-47.42059991	40.4	39525.3	39606.1
102	-47.82059991	40.8	39524.9	39606.5
105	-49.02059991	42	39523.7	39607.7
106	-49.42059991	42.4	39523.3	39608.1
107	-49.82059991	42.8	39522.9	39608.5
107.45	-50.00059991	42.98	39522.72	39608.68
115	-53.02059991	46	39519.7	39611.7
120	-55.02059991	48	39517.7	39613.7
125	**-56**	**50**	**39515.7**	**39615.7**
150	-56	60	39505.7	39625.7
175	-56	70	39495.7	39635.7
200	-56	80	39485.7	39645.7
250	**-56**	**100**	**39465.7**	**39665.7**
250.1	**-43**	**100.04**	**39465.66**	**39665.74**
300	-43	120	39445.7	39685.7
500	-43	200	39365.7	39765.7
1000	-43	400	39165.7	39965.7
1100	-43	440	39125.7	40005.7
1200	-43	500	39065.7	40065.7
1250	-43	500	39065.7	40065.7
1300	-43	520	39045.7	40085.7
1500	**-43**	**600**	**38965.7**	**40165.7**

10. CTR CARRIER MASK CALCULATIONS

The table below shows a typical example of the Part 101 limit line. The bold values are the points of inflection for the limit line.

Number of CXR	2		
Symbol rate (Msps)	8		
Authorized BW (MHz)	20		
O/P Channel Power (dBm)	20	0.1	**Watts**
Center Frequency (MHz)	38850		

% Removed	FCC Spec	Delta BW, Form passband edge	Lower Band	Upper Band
0	**0**	**0**	**38850**	**38850**
50	**0**	**10**	**38840**	**38860**
50.5	**-24.21029996**	**10.1**	**38839.9**	**38860.1**
51	-24.41029996	10.2	38839.8	38860.2
55	-26.01029996	11	38839	38861
60	-28.01029996	12	38838	38862
75	-34.01029996	15	38835	38865
100	-44.01029996	20	38830	38870
101	-44.41029996	20.2	38829.8	38870.2
102	-44.81029996	20.4	38829.6	38870.4
105	-46.01029996	21	38829	38871
106	-46.41029996	21.2	38828.8	38871.2
107	-46.81029996	21.4	38828.6	38871.4
107.45	-46.99029996	21.49	38828.51	38871.49
115	-50.01029996	23	38827	38873
120	-52.01029996	24	38826	38874
125	**-56**	**25**	**38825**	**38875**
150	-56	30	38820	38880
175	-56	35	38815	38885
200	-56	40	38810	38890
250	**-56**	**50**	**38800**	**38900**
250.1	**-43**	**50.02**	**38799.98**	**38900.02**
300	-43	60	38790	38910
500	-43	100	38750	38950
1000	-43	200	38650	39050
1100	-43	440	38410	39290
1200	-43	250	38600	39100
1250	-43	250	38600	39100
1300	-43	260	38590	39110
1500	**-43**	**300**	**38550**	**39150**