



Measurement of RF Interference from a Model
M-2910 Blue Jay Wireless Data Transceiver Using
Digital Modulation

For : Beckwith Electric
Largo, FL

P.O. No. : 33223

Date Received : July 15, 2003

Date Tested : July 18, 2003

Test Personnel: Mark E. Longinotti, NARTE® Certified
EMC Test Engineer, ATL-0154-E

Specification : FCC "Code of Federal Regulations" Title 47 Part 15,
Subpart C, Section 15.247 for Intentional Radiators
Using Digital Modulation Operating within the 2400-
2483.5MHz band.

Test Report By : *Mark E. Longinotti*
Mark E. Longinotti
NARTE® Certified
EMC Test Engineer, ATL-0154-E

Approved By : *Raymond J. Klouda*
Raymond J. Klouda
Registered Professional Engineer of
Illinois - 44894



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Measurement of RF Emissions from a model M-2910 Blue Jay Wireless Data Transceiver Using Digital Modulation

1.0 INTRODUCTION:

1.1 Description of Test Item - This document represents the results of the series of radio interference measurements performed on a model Blue Jay Wireless Data Transceiver, Part No.M-2910, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item is a wireless data transceiver which uses digital modulation. It transmits at 2.45GHz and uses an external antenna. The test item was manufactured and submitted for testing by Beckwith Electric located in Largo, FL.

1.2 Purpose - The test series was performed to determine if the test item meets selected portions of the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.247 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2001.

1.3 Deviations, Additions and Exclusions - There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4 Applicable Documents - The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2002
- FCC-97-114, Appendix C, Federal Communications Commission, Guidance on Measurements for Direct Sequence Spread Spectrum Systems
- ANSI C63.4-2001, "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"

1.5 Subcontractor Identification - This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.6 Laboratory Conditions The temperature at the time of the test was 23°C and the relative humidity was 48%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is a Blue Jay Wireless Data Transceiver, Part No. M-2910. The test item was mounted in an Autodaptive Regulator Control, Model No. M-2601A, Serial No. Prototype. A 4.51 inch whip antenna was supplied with the test item. The whip antenna was connected to the antenna port of the test item during all tests. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The Autodaptive Regulator Control, the device in which the test item was mounted, obtained 115V 60Hz power via a 3 wire, 1.9meter long, unshielded power cord. The high and low leads were connected through a line impedance stabilization network (LISN) which was located on the ground plane. The network complies with the requirements of Paragraph 4.1.2 of ANSI C63.4-2001.

2.2 Grounding - The Autodaptive Regulator Control, the device in which the test item was mounted, was grounded only through the third wire of its input power cord.

2.3 Support Equipment - The following support equipment was submitted with the test item:

Item	Description
M-2911	Wireless Converter, FCC ID: QMCM2911
Jameco AC Adaptor	M/N: DBU120020, Product No. DC1202F12R
Laptop Computer	Sony PCG-GRX500P
M-2601A	Autodaptive Regulator Control, the device in which the test item was mounted

2.4 Interconnect Cables - The following interconnect cables were submitted with the test item:

Item	Description
Power Cable	1.9 meter long, 2 wire unshielded cable between the Jameco AC adaptor and the M-2911. The Jameco AC adaptor was used to supply 12VDC to the M-2911.
Serial Cable	1.75meter long standard serial cable used to connect the M-2911 to the laptop.

2.5 Operational Mode - The test item and all support equipment except the laptop computer were placed on a 80cm high non-conductive stand. The laptop computer was placed on the floor of the test chamber. (For radiated emissions tests, the M-2911, and the laptop computer were placed in the corner of the test chamber.) The M-2911 was connected to the laptop computer via a standard serial cable. Power was applied to the M-2911. Power was applied to the M-2601A, in which the test item was mounted. The “m2910t” program, which was provided by Beckwith Electric personnel, was executed on the laptop

computer and the communications rate was set to 115200 baud. This program causes the M-2911 to continuously poll the test item for data. This provides a constant data flow between the M-2911 and the test item.

3.0 TEST EQUIPMENT:

3.1 Test Equipment List - A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

3.2 Calibration Traceability Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Powerline Conducted Emissions

4.1.1 Requirements - All radio frequency voltages on the power lines for any frequency or frequencies of an intentional radiator shall not exceed the limits in the following table:

Frequency MHz	RFI Voltage dBuV(QP)	RFI Voltage dBuV(Average)
0.15-0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5-5	56	46
5-30	60	40

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the test item is considered to have met both requirements and measurements do not need to be performed using the Average detector.

4.1.2 Procedures - The interference on each power lead was measured by connecting the measuring equipment to the appropriate meter terminal of the LISN. The meter terminal of the LISN not under test was terminated with 50 ohm. Measurements were first made over the entire frequency range from 150kHz to 30MHz with a peak detector and the results were automatically plotted. The data thus obtained was then searched by the computer for the highest levels. Quasi-peak measurements were automatically performed at the frequencies selected from the highest peak measurements, and the results printed.

4.1.3 Results - The plots of the peak preliminary conducted voltage levels on each power line are presented on pages 13 and 14. The conducted limit for intentional radiators is shown as a

reference. The final quasi-peak results are presented on pages 15 and 16.

The emissions level closest to the limit (worst case) occurred at 14.745MHz. The emissions level at this frequency was 9.4dB within the limit. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 3.

4.2 Spurious Emissions

4.2.1 Radiated Spurious Emissions

4.2.1.1 Requirement – Per section 15.247(c), the spurious emissions in any 100 kHz BW outside the frequency band must be at least 20dB below the highest 100 kHz BW level measured within the band. In addition, the radiated emissions which fall in the restricted bands must meet the general limits of 15.209.

4.2.1.2 Test Chamber - All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2001 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

4.2.1.3 Procedures from 30MHz to 1GHz - The broadband measuring antenna was positioned at a 3 meter distance from the test item. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the test item with respect to the antenna. The maximum levels for each antenna polarization were plotted. Two separate sweeps were made. One sweep was made with the test item operating in the Constant Data Flow between the M-2910 and the M-2911 mode as described in paragraph 2.5. Another sweep was made with the Communications turned off. These two plots were then compared to determine if the transmitter circuitry of the test item was the source of any of the radiated emissions in this frequency band.

4.2.1.4 Procedures from 1GHz to 25GHz – The frequency range from 1GHz to 25 GHz was checked manually but not plotted. The harmonics of the transmitter that were not in restricted bands were measured up through the 10th harmonic. For these measurements, the measurement bandwidths were set to 100kHz RBW and 1MHz VBW.



Next, the harmonic or spurious emissions falling in the restricted bands were measured up through the 10th harmonic. For these measurements, the measurement bandwidths were set to 1 MHz RBW. The analyzer was set to **linear mode** with 10 Hz VBW in order to simulate an average detector. A pre-amplifier was used up to the ninth harmonic to increase the receiver sensitivity.

4.2.1.5 Results - The preliminary emissions levels were plotted. These plots are presented on pages 17 through 20.

All harmonics were then re-measured manually. This data is shown in the table on page 21. The field intensities levels for the harmonics in the restricted band were within the limit.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figure 4.

5.0 CONCLUSIONS:

It was determined that the Beckwith Electric Blue Jay Wireless Data Transceiver, Part No. M-2910, Serial No. None Assigned, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-2001.

6.0 CERTIFICATION:

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

7.0 ENDORSEMENT DISCLAIMER:

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.



TABLE I: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. INC.								Page: 1
Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XOB2	ADAPTER	HEWLETT PACKARD	K281C,012	09407	18-26.5GHZ		NOTE 1	
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/	001	4.8-20GHZ	07/03/03	12	07/03/04
XZG2	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2223A01751	---		N/A	
Equipment Type: AMPLIFIERS								
APK2	PREAMPLIFIER	AGILENT TECHNOL	8449B	3008A01595	1-26.5GHZ	05/09/03	12	05/09/04
Equipment Type: ANTENNAS								
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ		NOTE 1	
NWI1	RIDGED WAVE GUIDE	AEL	H1498	154	2-18GHZ	08/09/02	12	08/09/03
Equipment Type: ATTENUATORS								
T1E9	10DB, 25W ATTENUATOR	WEINSCHEL CORP.	46-10-34	BH7997	DC-18GHZ	02/06/03	12	02/06/04
TVD0	VARIABLE ATTENUATOR	HEWLETT PACKARD	K382A	1066	18-26.5GHZ	07/29/02	12	07/29/03
Equipment Type: CONTROLLERS								
CDG1	COMPUTER	HEWLETT PACKARD	D5893T	US91465296	---		N/A	
CDT1	LAPTOP COMPUTER (M. LONGIN	SONY	PCG-GRX500P	28397635-300	1.5GHZ		N/A	
Equipment Type: METERS								
MPA0	POWER METER	HEWLETT PACKARD	432A	1141A08696	0.01-40GHZ	07/01/03	12	07/01/04
Equipment Type: PROBES; CLAMP-ON & LISNS								
PLB0	FCC/LISN	CEMEC, INC.	FCC-20-2	1001	0.45-30MHZ	01/10/03	12	01/10/04
PLL9	50UH LISN 462D	ELITE	462D/70A	010	0.01-400MHZ	03/04/03	12	03/04/04
PLLA	50UH LISN 462D	ELITE	462D/70A	011	0.01-400MHZ	03/04/03	12	03/04/04
Equipment Type: PRINTERS AND PLOTTERS								
HRG1	LASERJET 2100XI	HEWLETT PACKARD	C4170A	USCD047809	---		N/A	
Equipment Type: RECEIVERS								
RAC0	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2449A01117	100HZ-22GHZ	01/30/03	12	01/30/04
RACA	RF PRESELECTOR	HEWLETT PACKARD	85685A	2926A00980	20HZ-2GHZ	01/30/03	12	01/30/04
RACE	RF PRESELECTOR W/ RECEIVER	HEWLETT PACKARD	85685A	3010A01194	20HZ-2GHZ	06/11/03	12	06/11/04
RAE7	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	2516A01685	100HZ-22GHZ	06/13/03	12	06/13/04
RAF1	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	2043A00271	0.01-1000MHZ	01/30/03	12	01/30/04
RAF6	QUASIPeAK ADAPTOR W/ RECEI	HEWLETT PACKARD	85650A	2412A00403	0.01-1000MHZ	06/13/03	12	06/13/04
RBA1	EMI TEST RECEIVER	RHODE & SCHWARZ	ESIB26	100146	20HZ-26.5GHZ	03/13/03	12	03/13/04
Equipment Type: SIGNAL GENERATORS								
GSB0	SWEEP OSCILLATOR	HEWLETT PACKARD	8350B	2309A02104	0.01-40GHZ	06/10/03	12	06/10/04
GSB8	TUNING HEAD	HEWLETT PACKARD	83570A	2412A00512	18-26.5GHZ	06/09/03	12	06/09/04

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

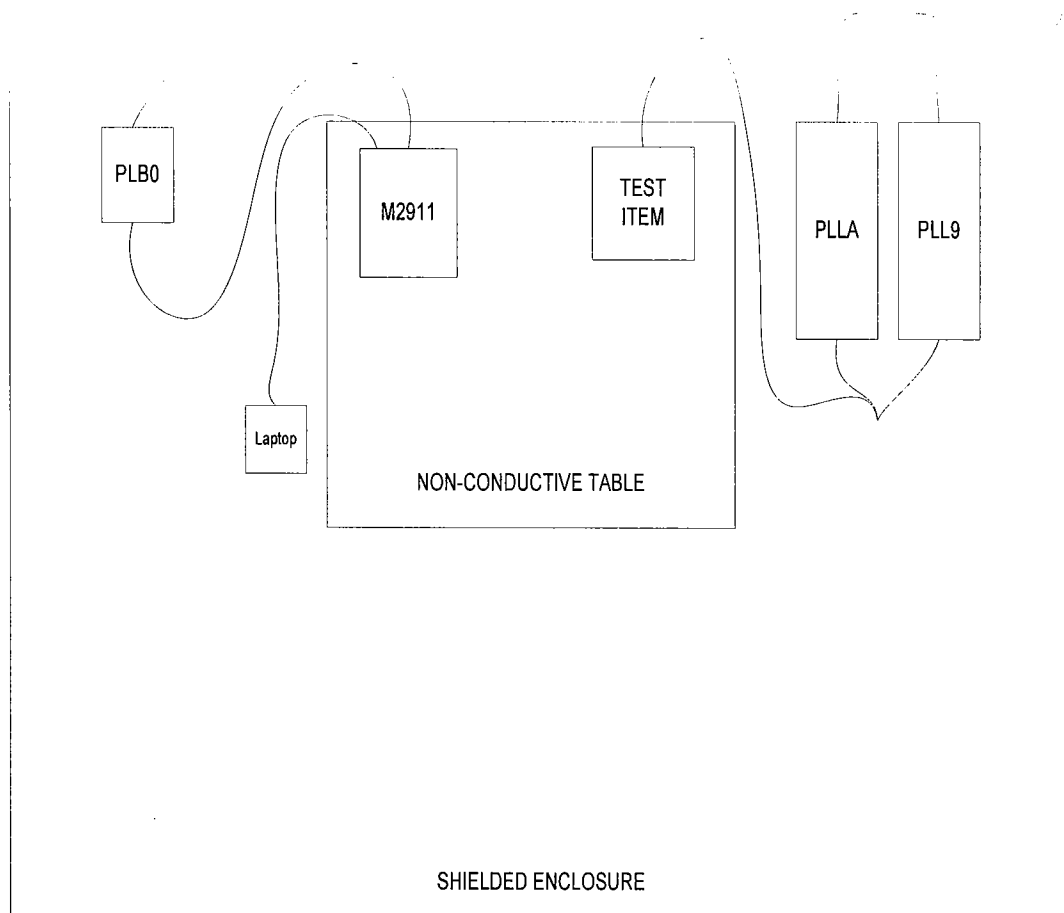


Figure 1: Test Setup for Conducted Emissions

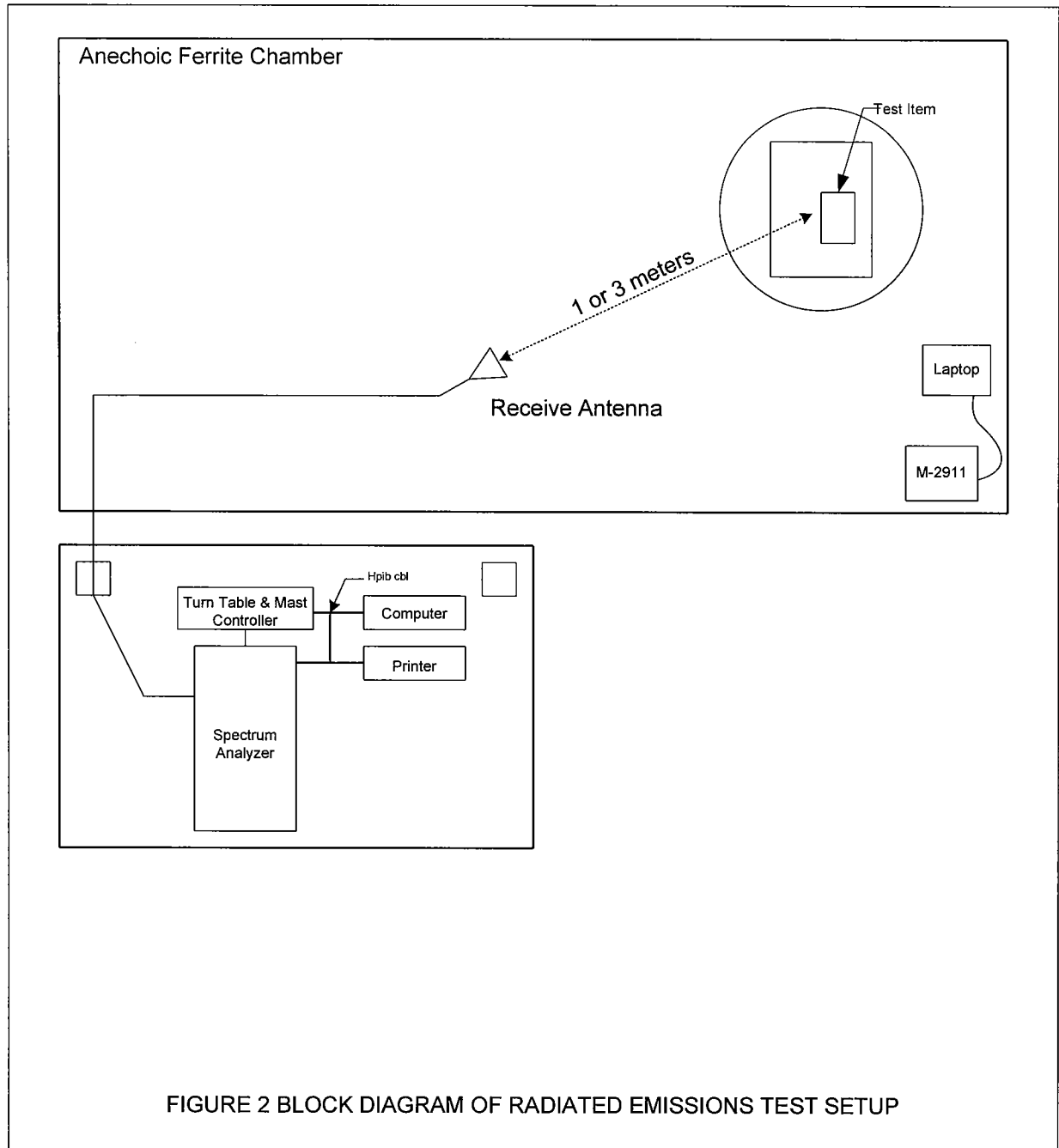


Figure 3

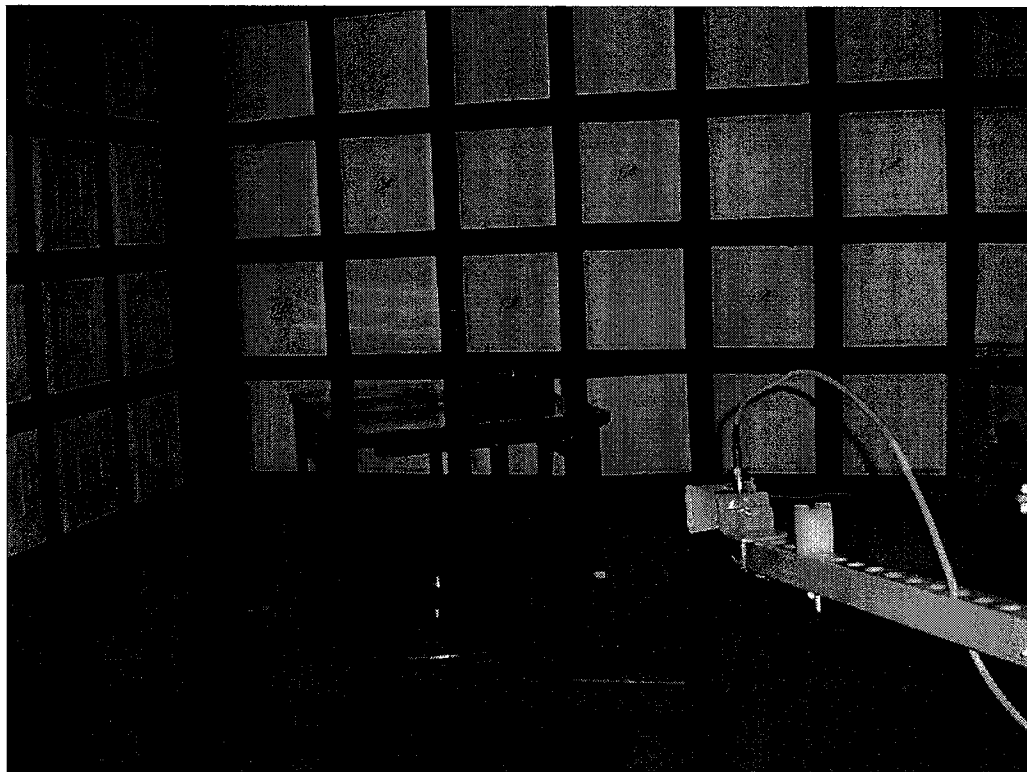


Test Setup for Conducted Emissions

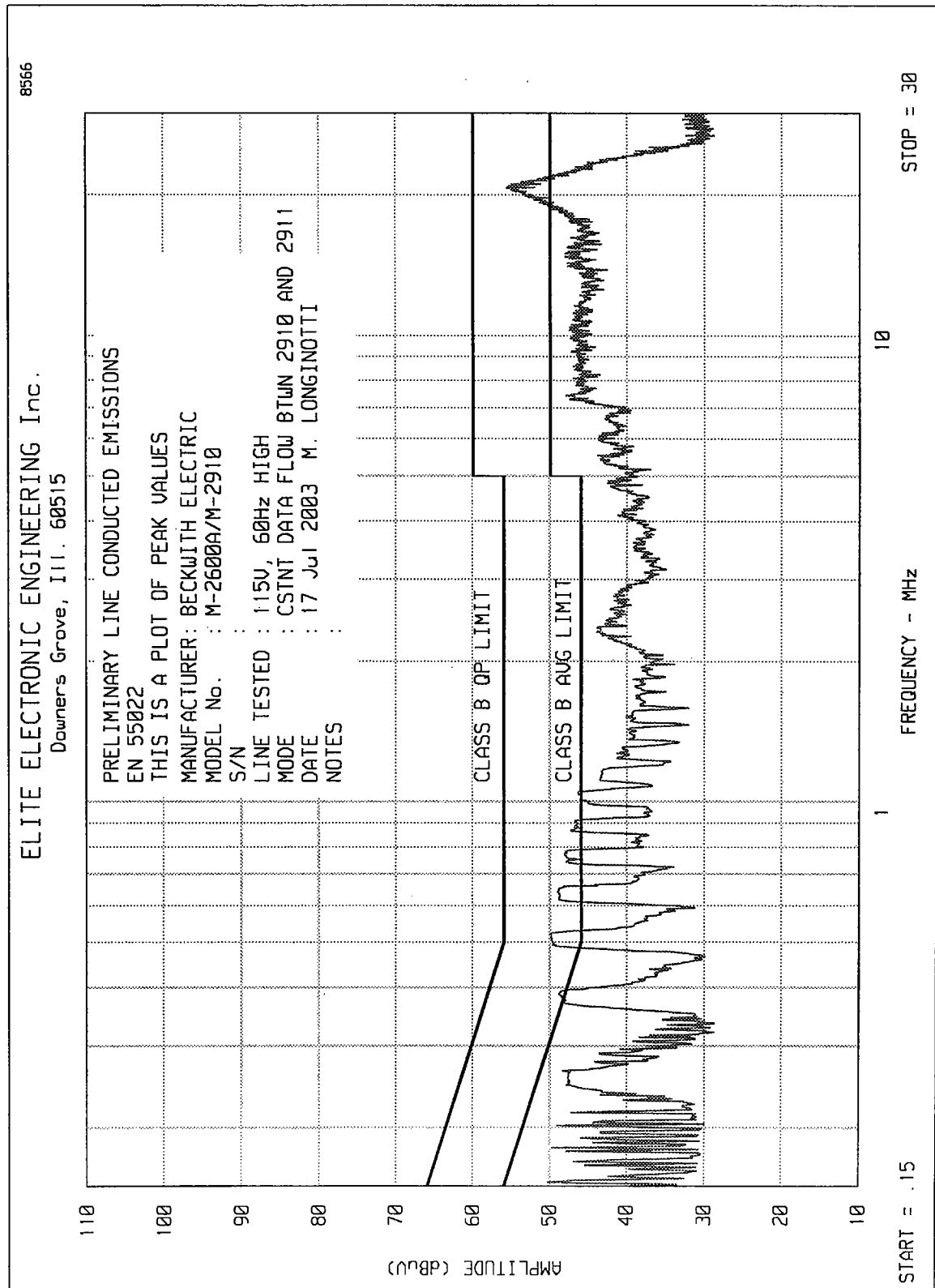
Figure 4

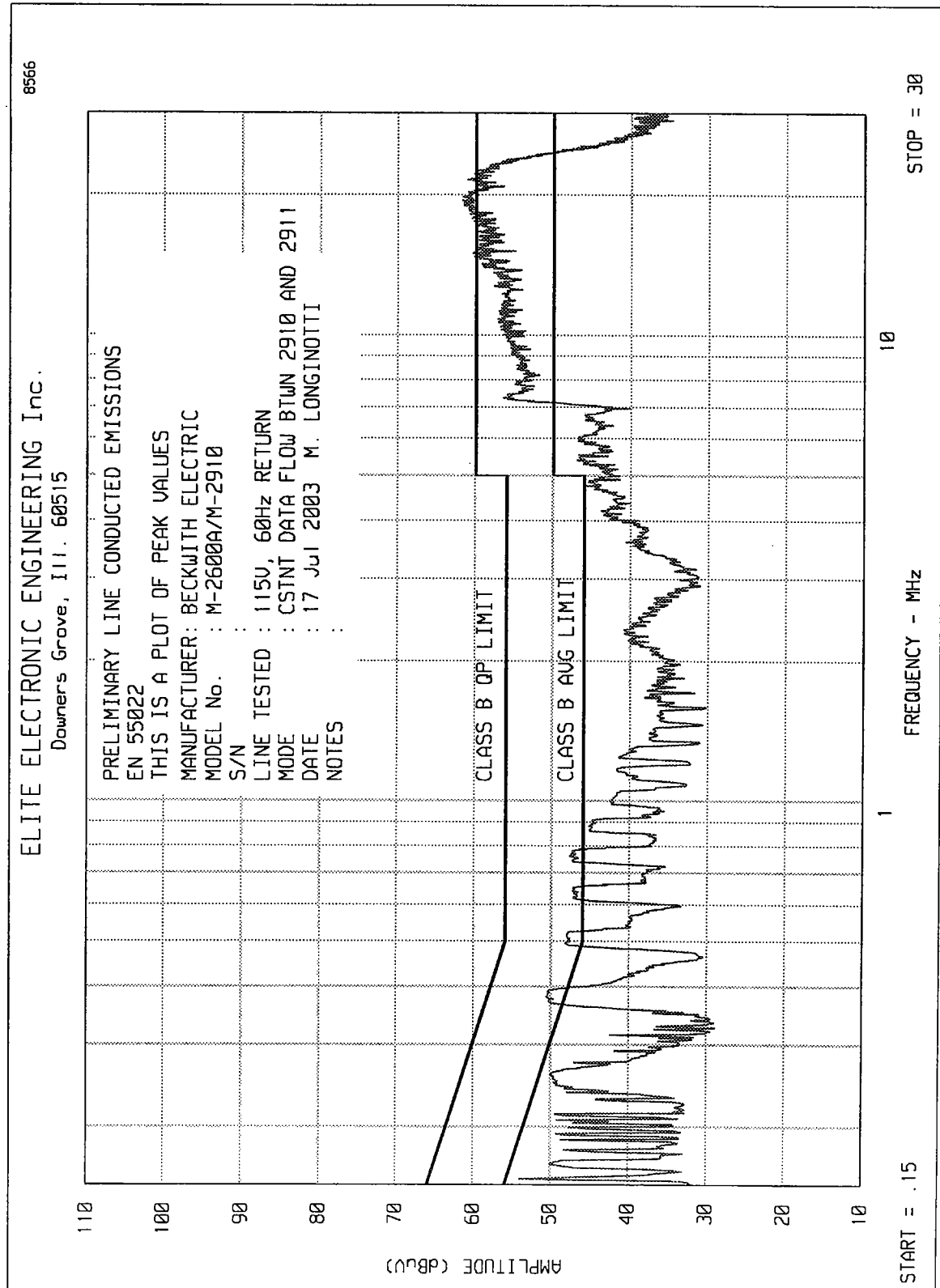


Test Setup for Radiated Emissions, 2GHz to 18GHz - Horizontal Polarization



Test Setup for Radiated Emissions, 2GHz to 18GHz - Vertical Polarization







ETR No.
ELITE ELECTRONIC ENGINEERING CO.

MANUFACTURER : BECKWITH ELECTRIC
MODEL : M-2600A/M-2910
S/N :
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : 115V, 60Hz HIGH
MODE : CSTNT DATA FLOW BTWN 2910 AND 2911
DATE : 17 Jul 2003
NOTES :
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

FREQUENCY MHz	METER RDG. dBuV	QP LIMIT dBuV	AVG RDG dBuV	AVG LIMIT dBuV	NOTES
.150	29.9	66.0		56.0	
.258	44.7	61.5		51.5	
.380	45.5	58.3		48.3	
.519	46.7	56.0	34.6	46.0	*
.620	46.5	56.0	33.3	46.0	*
.633	46.2	56.0	33.6	46.0	*
.744	44.9	56.0		46.0	
.868	43.5	56.0		46.0	
1.037	41.3	56.0		46.0	
2.309	38.7	56.0		46.0	
2.351	39.0	56.0		46.0	
3.591	34.6	56.0		46.0	
4.158	35.7	56.0		46.0	
4.829	36.3	56.0		46.0	
5.511	36.4	60.0		50.0	
5.938	37.8	60.0		50.0	
7.304	42.6	60.0		50.0	
7.434	42.5	60.0		50.0	
7.672	40.5	60.0		50.0	
9.226	40.9	60.0		50.0	
9.878	41.0	60.0		50.0	
10.009	41.1	60.0		50.0	
10.272	41.7	60.0		50.0	
11.675	39.4	60.0		50.0	
14.362	38.7	60.0		50.0	
14.733	40.8	60.0		50.0	
15.382	39.3	60.0		50.0	
15.491	39.7	60.0		50.0	
18.203	40.7	60.0		50.0	
19.891	44.7	60.0		50.0	
19.922	44.9	60.0		50.0	
20.660	47.2	60.0		50.0	
20.681	47.0	60.0		50.0	
21.659	44.2	60.0		50.0	
22.683	39.2	60.0		50.0	
23.458	36.1	60.0		50.0	
25.308	28.1	60.0		50.0	
26.840	26.8	60.0		50.0	

* QP EXCEEDS AVG LIMIT, SEE DATA

CHECKED BY:

M. Longinotti
M. LONGINOTTI



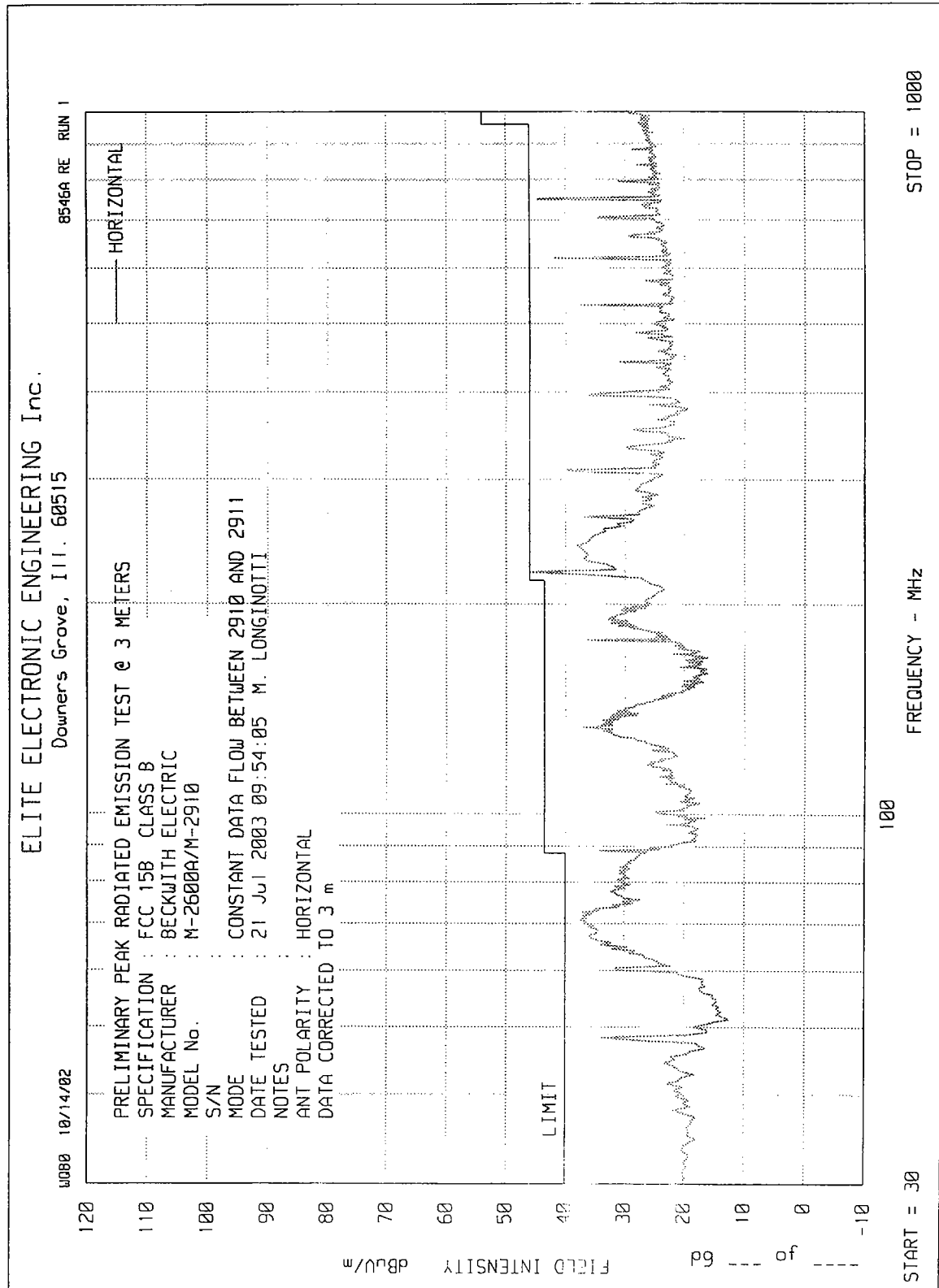
ETR No.
ELITE ELECTRONIC ENGINEERING CO.

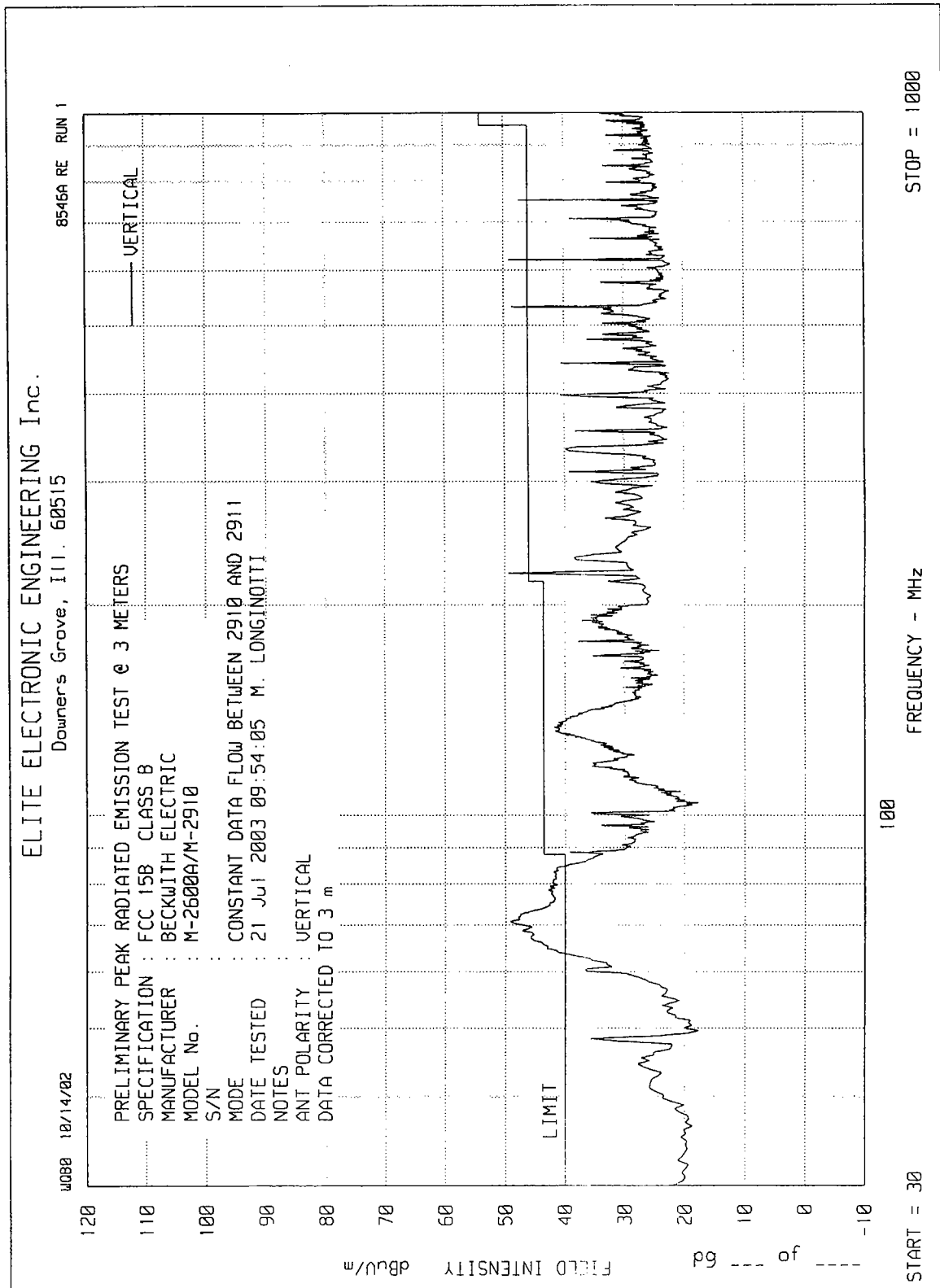
MANUFACTURER : BECKWITH ELECTRIC
MODEL : M-2600A/M-2910
S/N :
SPECIFICATION : EN 55022, CLASS B
TEST : LINE CONDUCTED EMISSIONS
LINE TESTED : 115V, 60Hz RETURN
MODE : CSTNT DATA FLOW BTWN 2910 AND 2911
DATE : 17 Jul 2003
NOTES :
RECEIVER : HP 8566 w/ HP85650A QP ADAPTOR
VALUES MEASURED WITH QP DETECTOR USING 9kHz BANDWIDTH

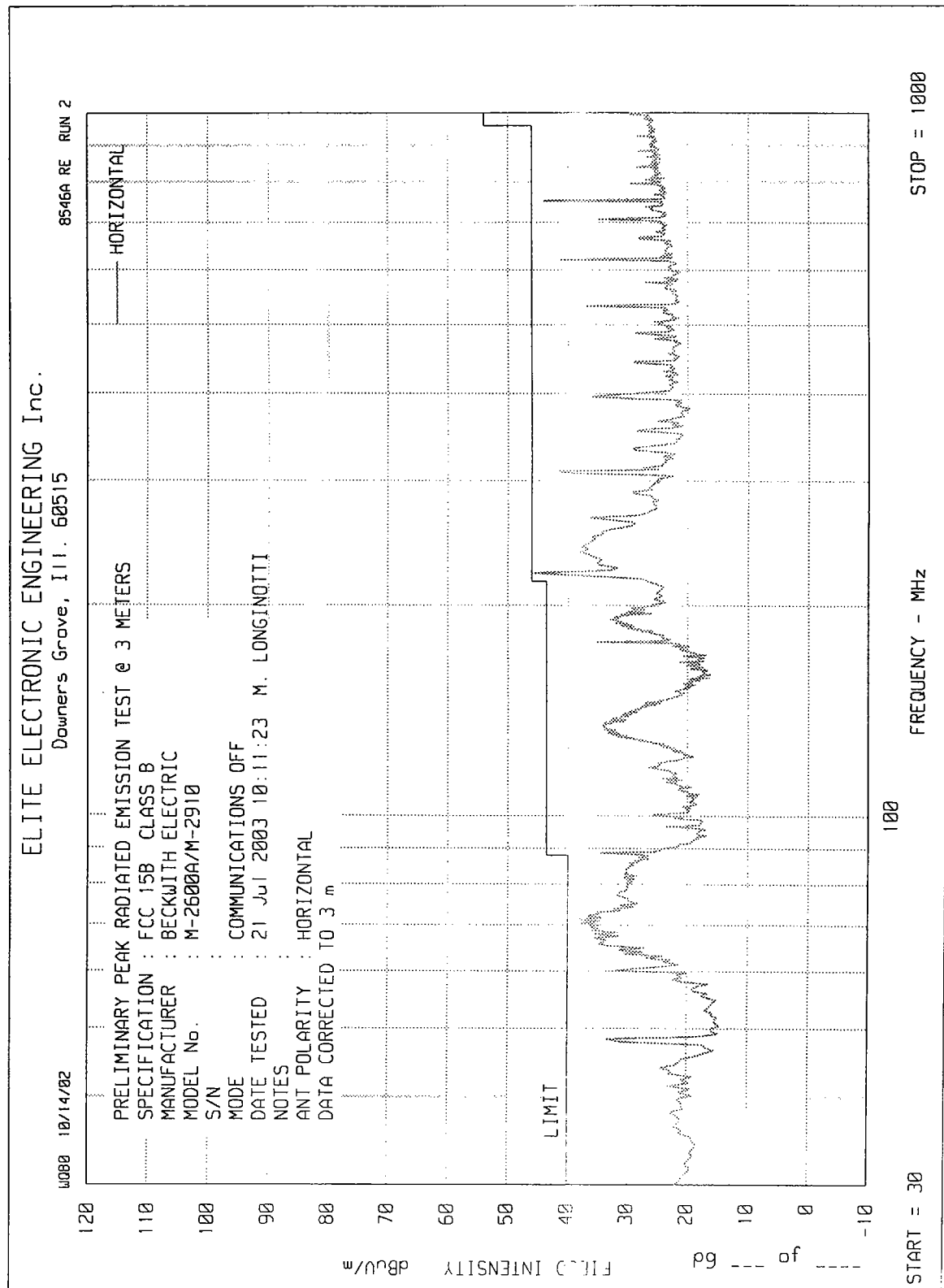
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.380	48.3	58.3	38.2	48.3	*
.506	45.9	56.0		46.0	
.744	43.7	56.0		46.0	
.759	43.9	56.0		46.0	
.884	41.9	56.0		46.0	
1.010	37.8	56.0		46.0	
1.239	36.8	56.0		46.0	
2.309	35.5	56.0		46.0	
2.336	35.1	56.0		46.0	
3.952	34.6	56.0		46.0	
4.104	37.5	56.0		46.0	
4.743	39.6	56.0		46.0	
5.421	40.6	60.0		50.0	
5.707	39.4	60.0		50.0	
7.309	51.7	60.0	38.2	50.0	*
7.305	51.6	60.0	38.0	50.0	*
9.886	49.8	60.0		50.0	
10.016	49.5	60.0		50.0	
10.637	50.1	60.0	40.0	50.0	*
11.412	48.9	60.0		50.0	
12.728	48.5	60.0		50.0	
14.745	51.9	60.0	41.6	50.0	*
15.008	51.6	60.0	41.6	50.0	*
15.396	49.9	60.0		50.0	
18.203	52.6	60.0	40.7	50.0	*
19.098	53.4	60.0	40.6	50.0	*
19.494	53.3	60.0	41.0	50.0	*
21.539	52.9	60.0	41.2	50.0	*
22.173	52.4	60.0	38.9	50.0	*
22.181	52.9	60.0	32.6	50.0	*
22.588	50.6	60.0	30.7	50.0	*
23.449	49.2	60.0		50.0	
24.984	40.4	60.0		50.0	
25.120	39.7	60.0		50.0	
26.780	32.7	60.0		50.0	
29.199	29.9	60.0		50.0	

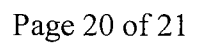
* QP EXCEEDS AVG LIMIT, SEE DATA

CHECKED BY: M. E. Longinotti
M. LONGINOTTI









**RADIATED EMISSION MEASUREMENTS IN A 3m ANECHOIC ROOM**

SPECIFICATION : FCC-15C (15.247)
MANUFACTURER : BECKWITH ELECTRIC
MODEL NO. : M-2910, BLUEJAY WIRELESS DATA TRANSCEIVER
SERIAL NO. : NONE ASSIGNED
NOTES : CONSTANT DATA FLOW BETWEEN M-2910 AND M-2911
TEST DATE : JULY 18, 2003
TEST DISTANCE : 3m

FREQ (MHz)	ANT POL	MTR RDG dBuV	BW(Hz) RES/VID	ANT FAC dB	CBL FAC dB	PRE AMP dB	TOTAL dBuV/m	TOTAL uV/m	LIMIT uV
2447.0	H	52.2	100k/1M	31.1	3.4		86.7	21627.2	
	V	66.2	100k/1M	31.1	3.4		100.7	108392.7	
4894.0	H	28.7	1M/10	35.2	4.9	34.5	34.3	51.9	500.0
	V	32.0	1M/10	35.2	4.9	34.5	37.6	75.9	500.0
7341.0	H	30.7 AMB	1M/10	38.1	6.7	34.4	41.1	113.5	500.0
	V	28.8 AMB	1M/10	38.1	6.7	34.4	39.2	91.2	500.0
9788.0	H	31.1 AMB	100k/1M	39.8	7.5	35.1	43.3	146.2	10839.3
	V	32.1 AMB	100k/1M	39.8	7.5	35.1	44.3	164.1	10839.3
12235.0	H	33.1 AMB	1M/10	41.6	8.8	35.4	48.1	254.1	500.0
	V	33.3 AMB	1M/10	41.6	8.8	35.4	48.3	260.0	500.0
14682.0	H	33.2 AMB	100k/1M	43.9	9.9	33.8	53.2	457.1	10839.3
	V	32.7 AMB	100k/1M	43.9	9.9	33.8	52.7	431.5	10839.3
17129.0	H	32.7 AMB	100k/1M	44.6	10.6	35.7	52.2	407.4	10839.3
	V	32.6 AMB	100k/1M	44.6	10.6	35.7	52.1	402.7	10839.3
19576.0	H	25.8 AMB	1M/10	40.4	3.5	33.8	35.9	62.4	500.0
	V	27.8 AMB	1M/10	40.4	3.5	33.8	37.9	78.5	500.0
22023.0	H	27.6 AMB	1M/10	40.6	3.5	33.2	38.5	84.1	500.0
	V	27.6 AMB	1M/10	40.6	3.5	33.2	38.5	84.1	500.0
24470.0	H	10.4 AMB	100k/1M	40.7	4.3		55.4	588.8	10839.3
	V	9.9 AMB	100k/1M	40.7	4.3		54.9	555.9	10839.3

CHECKED BY: Mark E Longjane