TEST REPORT FOR ZAXCOM INC.
MODEL MB-1
WIRELESS MICROPHONE

For

Zaxcom Inc.
140 Greenwood Ave
Midland Park NJ 07432

Glenn Sanders President
Model: MB1

Name: Digital Wireless Microphone Transmitter
Frequency 470-802 MHz
FCC ID: PR6MB1

Test Date October 16 2001

EXHIBIT 1:

Forward:

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 1999, Part 2 Subpart J, Paragraphs 2.907, 2.911 to 2.913, 2.925, 2.926, 2.1031 through 2.1057 and; Part 74 Subpart H; Paragraphs 74.801 through 74.861 the following is submitted:

2.1033 Application for certification:

According to section 2.1033 the following exhibits are required:

(1) Name and Address:

Zaxcom Inc.
140 Greenwood Ave, BLDG. #2
Midland Park, NJ
07432

(2) FCC Identifier: PR6MB1

(3) Manual/instructions:

See the Operating manual in a separate exhibit.

(4) Type of Emissions: 180K V2E

(5) Frequency range:

470 MHz to 802 MHz with lockout provisions on restricted frequency bands

(6) Range of operating power values or specific operating power levels and description of any means provided for varying the output power:

The output power is fixed at 50 mW nominal. The transmitter has no provision for operator variation of the output power.

(7) The maximum power rating as defined in the applicable part(s) of the rules.

As stated in CRF 47, 74.861 (e) (ii), the maximum permissible output power is 250 mW

(8) The DC voltages applied to and DC currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

The final amplification stage operates at 3.8 Volts and draws 100 mA for a power requirement of 380 mW.

(9) Tune-up procedure over the power range, or at specific operating power levels.

See tune-up procedure in the Appendix of this document.

(10) A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.
See schematics supplied with in a separate exhibit.

(11) A photograph or drawing of the equipment identification plate or label showing the information to be placed thereon.

See FCC ID label supplied in the photo exhibit supplied with this application.

(12) Photographs (8"x10") of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Insofar as these requirements are met by photographs or drawings contained in instruction manuals supplied with the certification request, additional photographs are necessary only to complete the required showing.

See the photo section in photo exhibit supplied with this application.

(13) For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (frequency, phase and amplitude) of any filters provided, and a description of the modulating wave train, shall be submitted for the maximum rated conditions under which the equipment will be operated.

See the appendix at the end of this document for details.

(14) The data required by §§ 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in § 2.1041.

List Of Test Instrumentation

The following instrumentation is used in the measurement of emissions. All test equipment calibration is N.I.S.T. traceable.

Manufacturer/Description	Model	Serial
ADVANTEST Spectrum Analyzer	R3361A	91730394
AILTECH Log Periodic Antenna	90005/3146	1095
EMCO Horn Antenna	3115	2498
FLUKE Digital Multimeter	76	6540398
GLOBAL Laboratories 3, 10 & 30 meter O.A.T.S.	N/A	N/A
RAYPROOF Shielded Room		4536
Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer	FSEA 3	843263/003
SCHWARZBECK Biconical Antenna	VHA-9103	"A"
SCHWARZBECK RF Receiver 30 to 1000 MHz	VUME 1520	1520427
Hewlett Packard Spectrum Analyzer	8569B	37974

2.1046 RF Power Output

Measurements Required:

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun except as noted below: If the power output is adjustable measurements shall be made for the highest and lowest power levels.

Test Arrangement:

Transmitter --> Spectrum Analyzer

The RF output power of the transmitter was measured at the antenna output directly with a Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer. The input to the spectrum analyzer had an impedance of 50 ohms, which matched the transmitter's antenna terminal. The power data was read in dBm and converted to watts as shown below. See Table 1 and Figure 1, which show the output power measurements. Data was accumulated as per 2.1046(a) and applicable paragraphs of Part 74.

P dBm = Power in dBm = Power in dB above 1 milliwatt
milliwatts = 10 ^ (PdBm/10)

16.7dBm = 10 (16.5/10) = 46.8mW
46.8mW * (1 Watt / 1000mW)
= 0.0468 Watts

Measurement Results:

Frequency (MHz)	Power (dBm)	Power (mW)	Power (Watts)
638.88 Mhz	15.35 dBm	34.2 mW	0.0342 W
640.80 Mhz	15.38 dBm	34.5 mW	0.0345 W
642.72 Mhz	15.82 dBm	38.1 mW	0.0381 W
644.64 Mhz	16.07 dBm	40.4 mW	0.0404 W
646.56 Mhz	16.26 dBm	42.2 mW	0.0422 W
648.48 Mhz	16.51 dBm	44.7 mW	0.0447 W
650.40 Mhz	16.64 dBm	46.1 mW	0.0461 W
652.32 Mhz	16.70 dBm	46.8 mW	0.0468 W
654.24 Mhz	16.60 dBm	45.7 mW	0.0457 W
656.16 Mhz	16.49 dBm	44.5 mW	0.0445 W
658.08 Mhz	16.46 dBm	44.2 mW	0.0442 W
660.00 Mhz	15.87 dBm	38.6 mW	0.0386 W
661.92 Mhz	15.72 dBm	37.3 mW	0.0373 W
663.84 Mhz	15.12 dBm	32.5 mW	0.0325 W
665.76 Mhz	14.74 dBm	29.7 mW	0.0297 W

Table 1: Output power vs. Channel Frequency

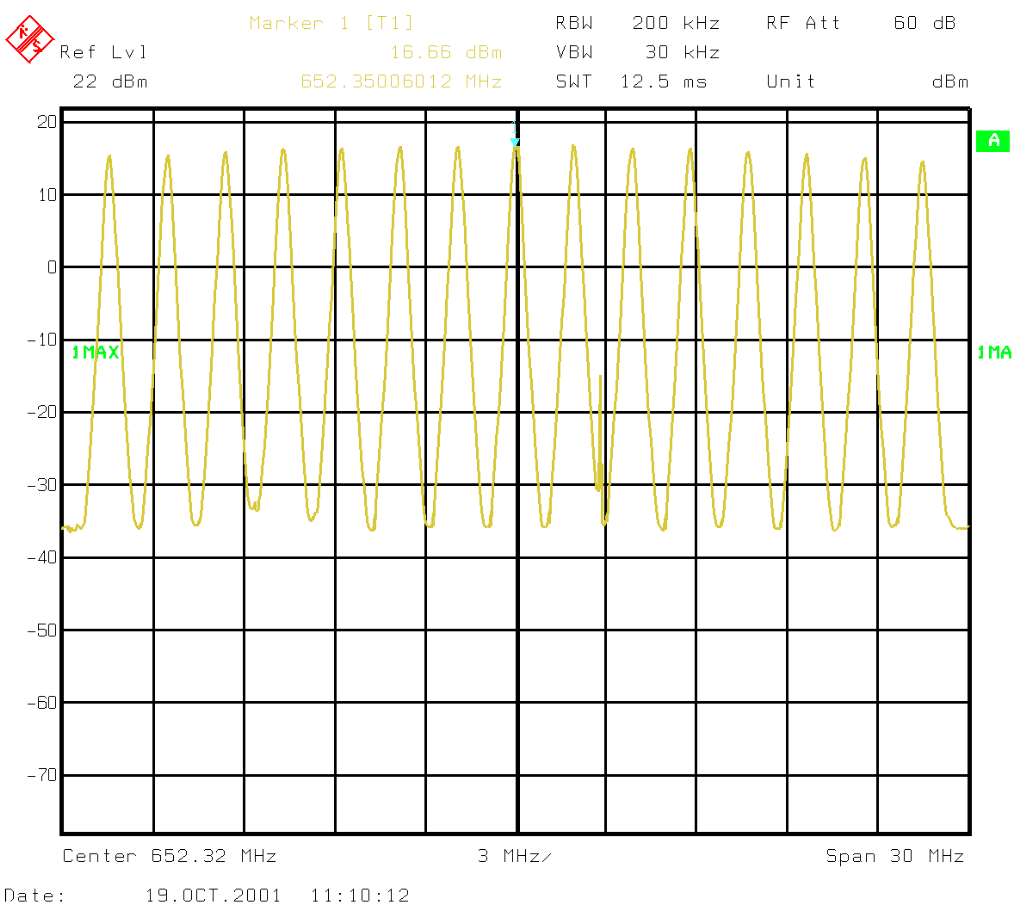

Figure 1: Output Power vs. channel Frequency

2.1047 Modulation Characteristics

Measurements Required:

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test Arrangement:

Audio Waveform Generator --> Transmitter --> Spectrum Analyzer

The RF output of the transmitter was coupled to a Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer. The spectrum analyzer was used to measure the transmitter's RF spectrum characteristics under various conditions.

The transmitter converts the audio microphone input from an analog to a digital data stream using an Analog to Digital Converter. The data is randomized and formatted into a serial bit stream at a rate of 640,000 bits per second. The bit stream is grouped into symbol clusters of 4 bits each. These 4 bit symbols, operating at a rate of 160,000 symbols per second, are mapped into a 16-QAM signal constellation. The I and Q samples are sent to a high speed Digital to Analog converter which converts the waveform into an analog I and Q waveform. The analog waveform is filtered by two RC filters and a PI filter with a combined 3 dB cut-off frequency of 90 kHz to remove images produced by the IQ DAC. The filtered IQ analog waveform is applied to a quadrature modulator for direct conversion to the final RF carrier frequency before being amplified by the final linear power amplifier.

The nature of the digital encoding process produces a constant symbol rate of 160,000 symbols per second regardless of the nature or amplitude of the microphone audio signal. Thus the RF spectrum does not change its appearance or occupied bandwidth based on the audio data being transmitted.

Results:
The output RF spectrum was observed while applying a 20 Hz to 20,000 Hz sine wave to the audio input. There was no apparent change in the shape of the spectrum while varying the frequency and amplitude of the audio input. In addition to the audio sweep, worst-case constellation sub-patterns including maximum and minimum amplitude constellation sub-sets were forced and observed to ensure that no spreading of the RF spectrum occurred. Since the modulation is digital, there was no audio frequency response characterization made of the device.

2.1049 Occupied Bandwidth

Measurements Required:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

Test Arrangement:

Transmitter --> 3 dB Attenuator --> Spectrum analyzer

A spectrum analyzer was used to measure the RF spectrum of the transmitter while modulated by a frequency of 2,500 Hz and again at 15,000 Hz. The power ratio representing 99.5% of the total mean power was measured by the spectrum analyzer. Figure 2 indicates the results of the occupied bandwidth and spectral mask measurements.

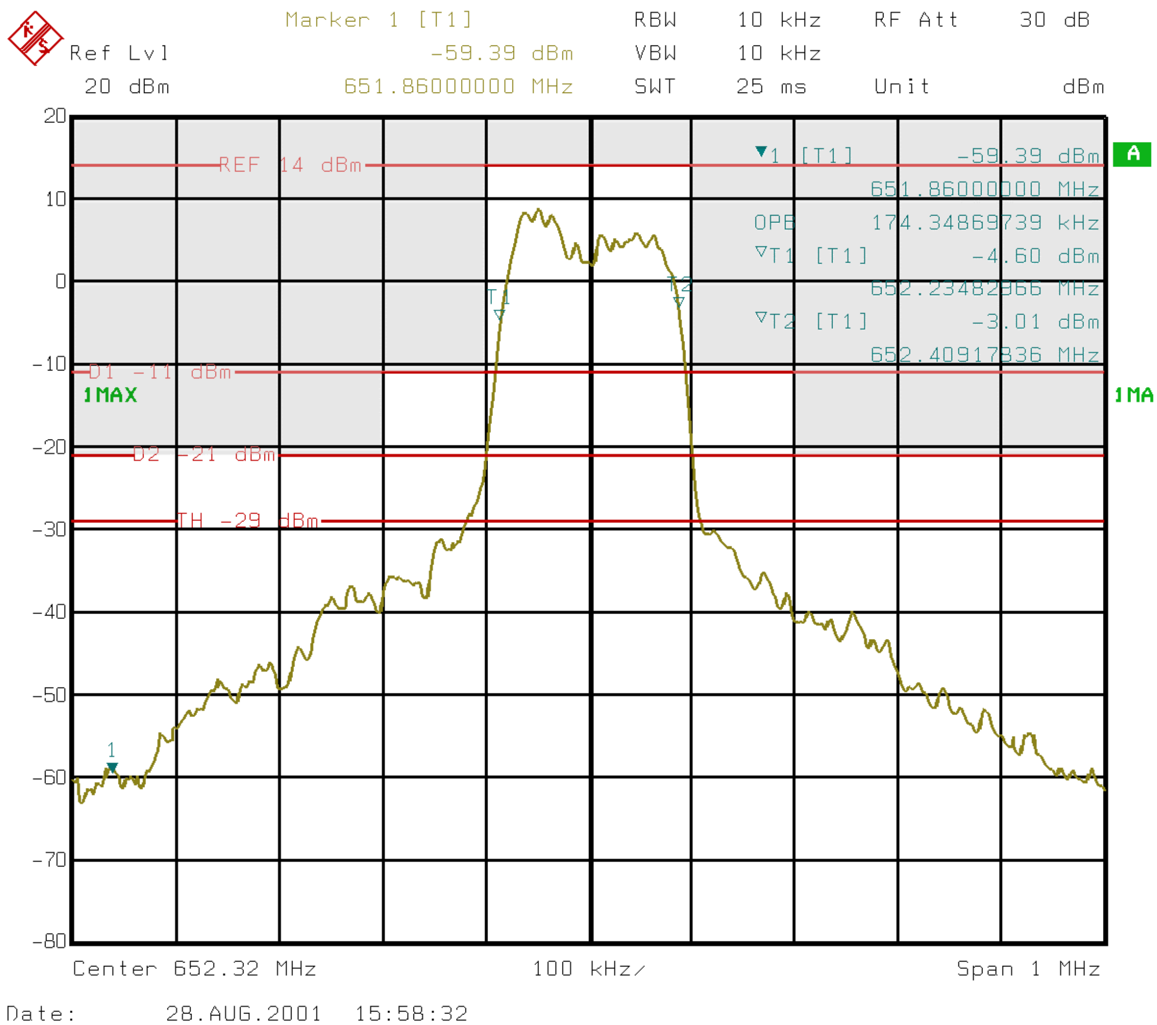

Figure 2: Occupied bandwidth spectral plot with shaded mask

<u>Results:</u>

Center Frequency (MHz)	Occupied Bandwidth (kHz)
652.320	174

2.1051 Spurious Emissions at Antenna Terminals

Measurements required:
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

Test Arrangement:

Transmitter - -> Spectrum Analyzer

The RF output of the transmitter was coupled to a Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer. The spectrum analyzer was used to measure the spurious emissions of the transmitter while operating in normal mode. The RF frequency spectrum from 30 MHz to 10.0 GHz was observed. Figure 3 shows the results of these measurements. The data was taken as per 2.1057, and the applicable paragraphs of Part 74.

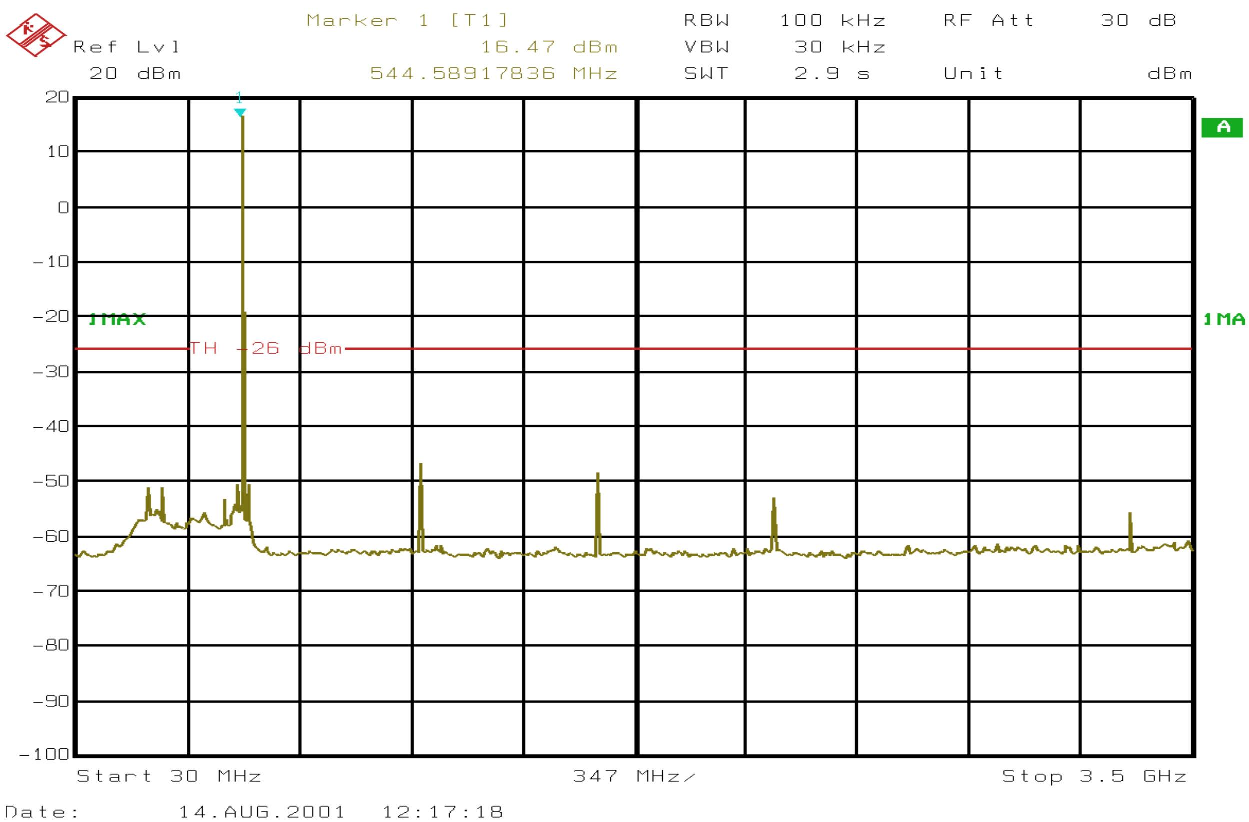

Figure 3: Spurious emissions plot

Results:
The RF output of the transmitter was coupled to a Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer and the RF emissions were measured. The data was taken as per 2.1057, and the applicable paragraphs of Part 74. The specifications of Paragraphs 2.1051,2.1057 and the applicable paragraphs of Part 74 are met. There are no deviations to the specifications.

The spurious emissions must be attenuated at least 43+10log(Po) be low the level of the carrier frequency. All Spurious emissions above 3.5 GHz measure less than –80 dB below the main carrier level.

Channel frequency (MHz)	Spurious Frequency (MHz)	Level Below Carrier (dB)
544.590	272.295	-68.1
	1089.18	-64.3
	1633.77	-66.2
	2178.36	-70.3
	2722.95	-78.0
	3667.54	-72.3

Table 2: Spurious emissions at antenna terminal

2.1053 Field Strength of Spurious Radiation

Measurements Required:
Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Test Arrangement:
Transmitter w/Antenna --------3m---------> Antenna ---> Spectrum Analyzer

Specific Measurement Procedure:
The field strength of spurious emissions for 30 to 1000 MHz were measured on the Global Certification 3-meter Open Area Test Site.

The charts that are included are maximized by antenna height and azimuth scans. Measurements with vertical and horizontal antenna polarities were performed.

A display line is drawn on the plots, which is 43+10log(P), dB down from the measured power of the fundamental transmitter signal. From the RF power section, 0.0468 Watts was used. Plugging this power into 43 + 10log(P) yields 29.7 dB. All plots have a display line that is 30dB down from the maximized peak of the fundamental frequency. All spurious signals are more that 20dB below this line. All plots have been translated to table form.

Specifications of Paragraph 2.1053, 2.1057, and applicable paragraphs of Part 74 are met. There are no deviations to the specifications.

Results:

Global Certification Laboratories, Ltd.
4 Matthews Drive East Haddam CT 06423 ♦ 860 873-1451 voice 860 873-1947 fax
Model MB1 transceiver File: ZAX0101 10/18/01 FCC Parts 15, 74 & 2

THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL QUASI-P dB(μV)	AZIMUTH DEGREES	CABLE LOSS dB(μV)	ANTENNA FACTORS dB	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.								

THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL QUASI-P (dBμV)	AZIMUTH DEGREES	CABLE LOSS	ANTENNA FACTORS	TOTAL FIELD dBμV/m	LIMIT QUASI-P (dBμV)	PASS?	MARGIN (dBμV)
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.								

THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL QUASI-P (dBμV)	AZIMUTH DEGREES	CABLE LOSS	ANTENNA FACTORS	TOTAL FIELD dBμV/m	LIMIT QUASI-P (dBμV)	PASS?	MARGIN (dBμV)
306.340	4	0	5.14	16.28	25.42	84	YES	58.6
307.740	2	0	5.14	16.22	23.36	84	YES	60.6
344.660	5	0	5.14	14.00	24.14	84	YES	59.9
346.160	7	0	5.14	13.88	26.02	84	YES	58.0
365.360	2	0	5.14	12.74	19.88	84	YES	64.1
384.500	3	0	5.31	11.60	19.92	84	YES	64.1
393.770	4	0	5.31	11.06	20.38	84	YES	63.6
403.700	5	0	5.31	10.94	21.25	84	YES	62.7
421.990	3	0	5.31	12.73	21.04	84	YES	63.0
422.800	5	0	5.31	12.83	23.14	84	YES	60.9
441.160	7	0	6.19	14.72	27.90	84	YES	56.1
442.100	10	0	6.19	14.82	31.00	84	YES	53.0
471.190	9	0	6.19	17.70	32.89	84	YES	51.1
479.570	7	0	6.19	18.49	31.68	84	YES	52.3
480.510	5	0	6.19	18.59	29.78	84	YES	54.2
491.810	16	0	6.19	19.69	41.87	46	YES	4.1
505.260	1	0	6.19	20.56	27.75	84	YES	56.3
517.970	9	0	7.31	20.51	36.82	84	YES	47.2
537.140	8	0	7.31	20.42	35.74	84	YES	48.3
539.140	5	0	7.31	20.42	32.73	84	YES	51.3
545.470	7	0	7.31	20.39	34.70	84	YES	49.3
576.110	17	0	7.31	20.26	44.57	84	YES	39.4
586.630	20	0	7.78	20.22	47.50	84	YES	36.5
590.000	18	0	7.78	20.20	45.98	84	YES	38.0
615.700	19	0	7.78	19.46	46.25	84	YES	37.8

Continued on the following page.

THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL QUASI-P (dBμV)	AZIMUTH DEGREES	CABLE LOSS	ANTENNA FACTORS	TOTAL FIELD dBμV/m	LIMIT QUASI-P (dBμV)	PASS?	MARGIN (dBμV)
629.670	14	0	7.78	18.81	40.59	84	YES	43.4
630.840	30	0	7.78	18.77	56.25	84	YES	27.8
634.600	34	0	7.78	18.58	60.01	84	YES	24.0
636.670	28	0	7.78	18.49	53.87	84	YES	30.1
Fundamental frequency:								
652.314	83	0	8.17	17.74	108.91	N/A	N/A	N/A
653.989	20	0	8.17	17.69	45.94	84	YES	38.1
664.530	15	0	8.17	17.18	40.35	84	YES	43.6
668.030	27	0	8.17	16.99	52.17	84	YES	31.8
670.110	33	0	8.17	16.90	58.07	84	YES	25.9
673.870	29	0	8.17	16.76	53.93	84	YES	30.1
687.900	17	0	8.17	16.11	41.28	84	YES	42.7
688.590	23	0	8.17	16.06	47.23	84	YES	36.8
713.570	17	0	8.17	16.43	41.60	84	YES	42.4
718.110	21	0	8.17	16.79	46.26	84	YES	37.7
732.910	16	0	9.03	17.79	42.82	84	YES	41.2
737.440	30	0	9.03	18.15	57.18	84	YES	26.8
748.130	9	0	9.03	18.94	36.97	84	YES	47.0
758.290	11	0	9.03	19.65	39.69	84	YES	44.3
761.370	22	0	9.03	19.87	50.50	84	YES	33.5
833.600	8	0	9.84	25.47	43.32	84	YES	40.7
838.110	11	0	9.84	25.90	46.74	84	YES	37.3
902.240	15	0	11.31	31.02	57.34	84	YES	26.7
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.								

THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL QUASI-P dB(μV)	AZIMUTH DEGREES	CABLE LOSS dB(μV)	ANTENNA FACTORS dB	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
355.000	15	0	5.14	13.34	33.48	84	YES	50.5
364.000	6	0	5.14	12.80	23.94	84	YES	60.1
460.000	17	0	6.19	16.61	39.79	84	YES	44.2
479.000	16	0	6.19	18.49	40.68	84	YES	43.3
492.300	23	0	6.19	19.79	48.97	84	YES	35.0
501.000	17	0	6.19	20.58	43.76	84	YES	40.2
590.000	14	0	7.78	20.20	41.98	84	YES	42.0
616.400	23	0	7.78	19.42	50.20	84	YES	33.8
Fundamental frequency:								
652.320	84	0	8.17	17.74	109.91	N/A	N/A	N/A
691.000	33	0	8.17	15.92	57.09	84	YES	26.9
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.								

Continued on the following page.

For frequencies above 1 GHz, the transmitter was measured with a 1 meter antenna distance.
A 1/2 meter solid shield SMA cable is used to connect the horn antenna to the HP 8569B spectrum analyzer. Peak detection with a 1 MHz bandwidth is used for the following frequencies.

The 3 meter limit is changed what it should be at 1 meter by using the formula on the first page.
That formula produces a limit of 93.96 dBuV/m.

The amplitudes are read off the spectrum analyzer plots.

THE 1 TO 18 GHz ANTENNA IS VERTICAL AND AT 1 METER.							
FREQ. (MHz)	**AMPL QUASI-P dBmW**	**CABLE LOSS, dB**	**ANTENNA FACTORS dB/m**	**TOTAL FIELD dB(μV/m)**	**FCC LIMIT QUASI-P dB(μV/m)**	**PASS?**	**MARGIN dB**
1304	-66	13.39	24.80	-27.81	94	YES	121.8
3264	-63	21.86	31.10	-10.04	94	YES	104.0
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

THE 1 TO 18 GHz ANTENNA IS HORIZONTAL AND AT 1 METER.							
FREQ. (MHz)	**AMPL QUASI-P dBmW**	**CABLE LOSS, dB**	**ANTENNA FACTORS dB/m**	**TOTAL FIELD dB(μV/m)**	**FCC LIMIT QUASI-P dB(μV/m)**	**PASS?**	**MARGIN dB**
1304	-66	13.39	24.80	-27.81	94	YES	121.8
3264	-64	21.86	31.10	-11.04	94	YES	105.0
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

2.1055 Frequency Stability

Test Arrangement for Power Voltage Stability:

Variable Power supply ---> Transmitter ---> Frequency Counter

Measurements required:
The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade.

Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement.

In addition to temperature stability the frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, batteries powered equipment, reduce primary supply voltage to the battery operating end point, which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Specific Measurement Procedure:
For this test, the battery was replaced with a variable voltage power supply. The voltage was stepped by 0.1 voltage steps. After the near instant frequency stabilization, the transmitter frequency was measured by the frequency counter function of the spectrum analyzer.

The Advantest R3361A spectrum analyzer was set to the following settings:
ATT = 50dB, REF = 20 dBm, RBW = 100 kHz, VBW = 100 kHz, Span = 10MHz,
SWP = 50ms, 10dB/ for the battery voltage variation tests. As with the temperature tests, an adapter cable supported the transmitter and connected it to the spectrum analyzer.
The analyzer was operating in the frequency counter mode.

Section 74.861(4) requires the frequency stability to be within 0.005% from nominal for battery voltage variations.

Measurement Results:

652MHz transmitter:

Battery Voltage	MHz	Deviation From nominal	%
3.6	652.319845	.010034	.00154
3.7	652.319878	.010001	.00153
3.8	652.329879	0	0
3.9	652.330000	.000121	.000019
4.0	652.329895	.000016	.000002
4.1	652.329893	.000014	.000002
4.2	652.329891	.000012	.000002

Test Arrangement for Temperature Stability:

Transmitter → ***Frequency Counter***

Temperature chamber

The measurement procedure outlined below shall be followed:

Steps 1: The transmitter shall be installed in an environmental test chamber whose temperature is controllable. Provision shall be made to measure the frequency of the transmitter.

Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a temperature stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.

Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated unmodulated at full radio frequency power output at the duty cycle, for which it is rated, for a duration of at least 5 minutes. The radio frequency carrier frequency shall be monitored and measurements shall be recorded.

Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to 50°C in 10 degree increments.

Specific Measurement Procedure:
The temperature tests were performed in a Delta Design Model 7600 CDT environmental test chamber. The transmitter antenna was replaced with an adapter cable setup. The cable passed through a porthole in the chamber to the ADVANTEST R3361A spectrum analyzer operating in the frequency counting mode. The cable also physically supported the transmitter when it was being cooled, and when it was transmitting.

For temperatures less than 20°C, a block of dry ice was used to produce the cooling. The transmitter minus battery power was suspended between the block of dry ice and its paper bag in order to achieve the 10°C step temperatures required by 2.1055.

In order to monitor the transmitter's temperature, a thermocouple was black-taped on the side of the transmitter opposite the dry ice. Typically, it would take approximately 1 minute to reach each Two 2-inch foam insulation was used to provide some insulation from the chamber door.

After the transmitter temperature dropped 10°C step, the battery was connected to the transmitter to cause it to begin transmitting and the chamber door quickly closed.

For all practical purposes, the transmitter frequency would stabilize immediately. The frequency stabilization time was extremely short compared to the time it took the transmitter and battery to return to the target temperature after the door was closed.

The Advantest R3361A spectrum analyzer used the following settings:
ATT = 50dB, REF = 20 dBm, RBW = 100 kHz, VBW = 100 kHz, Span = 10MHz, SWP = 50ms, 10dB/.
The measurement results are stated in the table below.

Section 74.861(4) requires the frequency stability to be within 0.005% from nominal for temperature variation.

Measurement Results:

652MHz transmitter:

°C	MHz	Deviation from nominal	%
-30	652.329000	.000885	.000135668
-20	652.336000	.006115	.000009374
-10	652.329000	.000885	.000001357
0	652.329769	.0000116	.0000178
10	652.305298	.0245871	.0037691
20	652.329885	0	0
30	652.329902	.000017	.000002606
40	652.329886	.000001	.000000153
50	652.329983	.000098	.000015023

EXHIBIT II

Appendix

MB1 Transmitter Tune-up Procedure

Equipment Required
RF spectrum analyzer with sensitivity of –100 dBm or better, frequency range of 10 MHz to 3 GHz or wider, capable of non-distorted +20 dBm input. Capable of measuring occupied bandwidth and power output. Device used in development: Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer

Current limiting power supply capable of supplying 400 mA at 4 Volts with an accuracy of 3% or better. Device used in development: HP 6112A

Test Accessories
2 feet of 50 Ohm flexible coaxial cable. The cable should be terminated with a mating connector for the spectrum analyzer and with an SSMA male connector for mating to the transmitter under test. The cable should have its loss characteristics measured (about 1 dB) and all power measurements should compensate for this loss.

50 Ohm, 10 dB Attenuator pad.

Non-ferrous tuning tool appropriate for tuning surface-mount variable capacitors.

Battery eliminator module for applying power to the unit under test.

Electrically conductive tweezers for entering calibration mode. Note that this procedure is performed on the PCBs when they are removed from their enclosure and is accessible only to Zaxcom employees.

RF Tuning
All RF tuning adjustments are made on the TX-RF PCB board.

Apply power to the transmitter using the battery eliminator module. Set the external power supply to 3.8 Volts current limited at 400 mA. Observe that the transmitter passes its self-diagnostic tests.

Setup the Rohde & Schwarz FSEA 3.5 GHz spectrum analyzer to the following settings:

Start Frequency = 1 MHz
Stop Frequency = 3.5 GHz
Resolution bandwidth = 300 kHz

Using the front panel user interface of the transmitter under test, tune the transmitter to the center of its tuning range. Connect the antenna output of the device under test to the spectrum analyzer through a 50 ohm 10 dB attenuator. Tune C207 to produce maximum amplitude carrier. Tune C300 to produce maximum power output. Alternately tune C73 and C120 to produce maximum power output at the fundamental frequency. Tune C399 such that the 2nd harmonic is minimized. Observe the output of the transmitter to ensure power output is close to 50 mW (+/- 1 dB). Repeat entire procedure. Set the spectrum analyzer to 99.5% occupied bandwidth mode and ensure that the occupied bandwidth is less than 180 kHz. Adjust transmitter to its lowest and highest operating frequencies. Ensure that all harmonics are suppressed at least 45 dB with respect to the fundamental output frequency at both minimum and maximum possible operating frequencies.

IQ Calibration

Using the metallic tweezers, short the resistor (R113) on the TX-DSP board to enable IQ calibration mode. On the front panel interface, choose the "Cal I" menu. Repeatedly press INC or DEC to minimize the carrier output. Choose the "CAL Q" menu and repeat. Repeat procedure for both Q and I until minimum possible carrier is obtained. Hold the FNCT key for 3 seconds until display flashes to indicate settings have been stored in FLASH ROM.

MB1 Frequency stabilizing, spurious suppression, limiting modulation and power limiting:

(10) A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.

The MB1 is a frequency synthesized transmitter. The RF frequency is referenced to a 19.2 MHz Temperature Compensated Crystal Oscillator module (U9) (PCB# TX-AUDIO). The synthesizer chip, U4 (PCB# TX-AUDIO) uses this signal to generate a carrier. This carrier is buffered by (U31) (PCB# TX-RF) to generate the final drive to the digital modulator. The Digital Signal Processor U7 (PCB# TX-DSP) monitors the LOCKED status output of U4 to determine if the synthesizer is properly phase locked. If U4 is not locked, the Digital Signal Processor can disable the entire RF modulator and power amplification output stage (U14, U15) (PCB# TX-RF) via the DACEN and TX-ENABLE signal.

The final RF power amplifier (U15) (PCB# TX-RF) generates harmonics at multiples of the carrier frequency. The power amplifier IC is operated at 4 dB below its 1 dB compression point. The components L6, C73 and C120 provide a match to the antenna impedance of 50 ohms as well as filtering higher harmonics. The components L19, L18 and C122 form a trap for the second harmonic.