TEST REPORT FOR

FCC PART 15 COMPLIANCE

FOR EMKAY INNOVATIVE PRODUCTS

Prepared by
Daniel C. Swann
July 21, 1998

Emkay Innovative Products
Model Number RF-3296

Analog Inductive Intentional Radiator
And Wireless Microphone

FCC Part 15.209
FCC Part 90.265

FCC ID N293296

GEL Report File PE9804

GLEN ELLEN LABORATORIES
1876 London Ranch Road
Glen Ellen, CA 95442

MEASUREMENT/TECHNICAL REPORT

EMKAY INNOVATIVE PRODUCTS

FCC ID N293296

This report concerns:	An Original Grant
Equipment type:	FCC Part 15, Subpart C, Paragraph 15.209(a) Analog Inductive Intentional Radiator, and FCC Part 90.265, Wireless Microphone
Deferred grant requested:	no
Transition rules per 15.37:	no
Report prepared by:	Daniel C. Swann Glen Ellen Laboratories 1876 London Ranch Road Glen Ellen, CA 95442 (707) 996-8533 (707) 996-2803 fax
Report Certified By:	Daniel C. Swann
	Date <u>July 28, 1998</u>
GEL Report File:	PE9804

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1 GENERAL INFORMATION

1.1 Product Description

The Emkay Innovative Products High Performance Radio Frequency Wireless Headset Model Number RF-3296 is a headset/base station combination utilizing a pulse modulated magnetic induction loop operating at 200 kHz or 400 kHz to transmit from the base station to the headset (FCC Part 15, Subpart C, Paragraph 15.209(a), intentional radiator), and a wireless microphone headset transmitter to transmit microphone signals to the base station, operating at 169.445 / 171.905 MHz (FCC Part 90.265(b), intentional radiator).

The product consists of a headset, a base station, a magnetic transmit antenna, a computer monitor sensor (to sense nearby computer display frequencies to reduce interference,) an audio cable, and a wall mount power supply to power the base station.

The headset is powered by re-chargeable batteries. The base station provides a 7 mA charger position for the headset when the EUT is not in use.

All plastic parts are un-plated, for both the base station and the headset.

1.2 Related Submittal or Grant

There are no related submittals or grants.

1.3 Tested System Details

EUT

Emkay Innovative Products Model Number RF-3296.

Made by:

Emkay Innovative Products
2800 West Golf Road
Rolling Meadows, IL 60143

See the Block Diagram/Operational Description for more information.

1.4 Test Methodology

The conducted and radiated tests were performed in accordance with the ANSI C63.4-1992 standard. See Figure 3.1 and the photographs for details of the test setup.

1.5 Test Facility

The Glen Ellen Laboratories open area test site and conducted measurement facility is located in Glen Ellen, California, at the street address of 1876 London Ranch Road. This site has been fully described in a report dated September 16, 1996, submitted to the FCC, and accepted in a letter dated December 4, 1996 (31040/SIT/1300F2.)

Test equipment used was:

1. Hewlett Packard 8560A opt 002 spectrum analyzer, cal due 6-06-99.

2. Sonoma Instruments 330 opt 38 preamplifier, 10 kHz to 2.5 GHz, cal due 3-06-99.

3. GEL BIC9414 biconical antenna, 30 MHz to 300 MHz, cal due 6-13-99.

4. GEL LPA-3 log periodic antenna, 275 MHz to 2 GHz, cal due 6-13-99.

5. GEL ML9411 passive magnetic loop antenna, 10 kHz to 30 MHz, cal due 2-22-99.

6. EMCO LISN, model number 3825/2, cal due 4-25-99.

7. Two Solar LISN's model number 8028-50-TS-24-BNC, cal due 4-25-99.

2 PRODUCT LABELING AND MANUAL STATEMENTS

2.1 Product Labeling

For the headset, the text of the FCC warning normally placed on the label appears in a prominent location in the manual, as the product is too small to accommodate the text.

2.2 FCC Statement in User Manual

The following statements appear in a prominent location in the text of the user manual:

This wireless microphone complies with Part 90 of FCC Rules. There are a total of eight frequencies available for this microphone, and the microphone you plan to use operates on one of these frequencies. You must get a license for the frequency you plan to use before you use the microphone. Whether this license is applicable depends on how you will use the microphone.

Look in your local phone book for the nearest FCC office and contact them to get the necessary application.

Note: FCC Rules. Part 15, Subpart A, 15.19(a)(1). This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

3 SYSTEM TEST CONFIGURATION

3.1 Justification

The EUT was tested in accordance with the standard ANSI C63.4-1992, 47 CFR Part 15, Subpart C, and 47 CFR Part 90.265. The base station magnetic transmitter was tested at the two available transmit frequencies, 200 kHz and 400 kHz, changed by moving a jumper on the magnetic transmitter board.

The headset transmitter was tested at the lowest frequency available for Part 90.265 wireless microphones, 169.445 MHz, and the highest frequency available, 171.905 MHz. The base station receiver was tested at both of these available frequencies, corresponding to a LO frequency of 158.745 MHz, and of 161.205 MHz, respectively. Both the transmitter and receiver frequencies were changed by changing the crystals in the units.

3.2 EUT Exercise Equipment and Software

The product was tested in the powered up condition, with the addition of external modulation for the occupied bandwidth test of the headset, as described in the occupied bandwidth test results.

3.3 Special Accessories

No special accessories were used.

3.4 Equipment Modifications

The inductor L7 in the headset was changed to 150 nH. Two 22 pF capacitors were added on the base station receiver PC board to bypass the ground plane cutout at high frequencies. Two Fair-Rite bead-on-lead ferrites were loaded on the base station magnetic transmitter board at the power input connector, in existing plated through holes.

3.5 Configuration of Tested System

The base station was configured with the back of the base station at the rear of the tabletop, the induction loop laid out on the right side of the tabletop, the monitor sense cable laid out on the left side of the tabletop and the audio cable and the power cable draped over the rear of the tabletop to the turntable surface.

AC line conducted measurements were made by placing additional LISN's on, and grounding them to, the turntable surface.

The headset was tested by placing it in the center of the tabletop, with the headset held vertically by a nonconductive foam block.

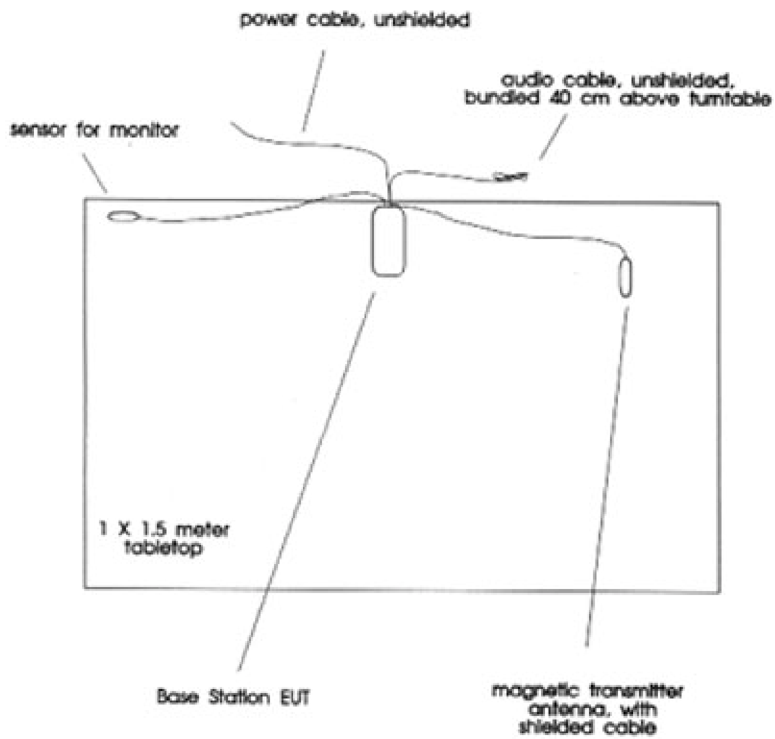
The tabletop was rotated 360 degrees, and the antenna height was scanned from 1 meter to 4 meters height, in both vertical and horizontal polarization. The magnetic loop tests were performed with the loop rotated between 0 and 180 degrees, at 1 meter height, and the tabletop rotated 360 degrees.

This condition put the EUT in the highest emissions state.

See Figure 3.1 and 3.2 and the photographs for the configuration of the tested system.

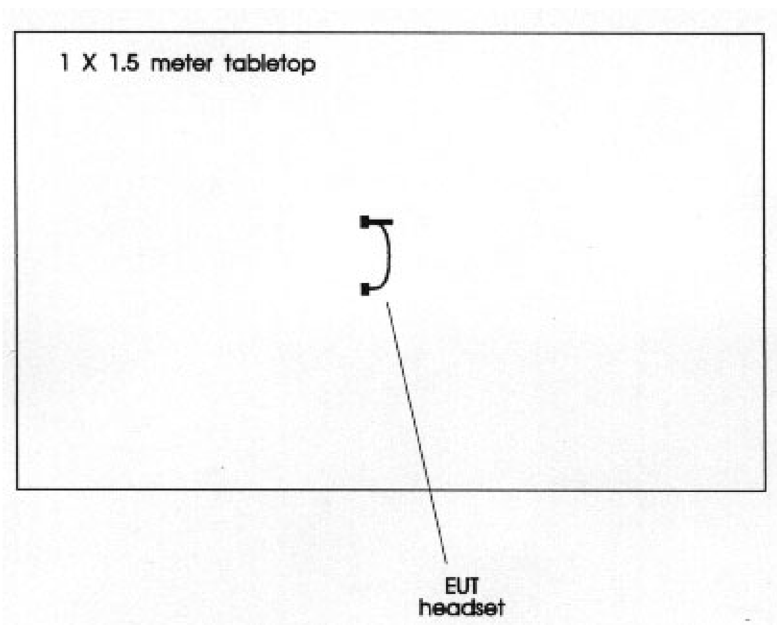
3 SYSTEM TEST CONFIGURATION (continued)

Figure 3.1 Configuration of Tested System, Base Station



3 SYSTEM TEST CONFIGURATION (continued)

Figure 3.2 Configuration of Tested System, Headset



4 CONDUCTED EMISSIONS DATA

The following data lists the significant emissions frequencies, measured quasi-peak levels and FCC Class B margins, of the base station using 9 KHz RBW at 6 dB. These measurements were made on July 6, 1998, by Daniel Swann and Roger Davis.

Frequency MHz	Measured Amplitude dBuV	Corrected Measured Amplitude dBuV	FCC B Limit dBuV	FCC B Margin dB
Line				
0.600	34.7	45.4	48.0	-2.6
1.000	33.2	44.2	48.0	-3.8
1.400	31.7	42.8	48.0	-5.2
1.800	30.8	42.1	48.0	-5.9
2.200	29.6	41.1	48.0	-6.9
2.600	28.5	40.1	48.0	-7.9
7.600	25.2	38.0	48.0	-10.0
8.400	23.7	36.6	48.0	-11.4
8.800	24.1	37.1	48.0	-10.9
Neutral				
0.600	33.1	43.8	48.0	-4.2
1.000	32.5	43.5	48.0	-4.5
1.400	31.7	42.9	48.0	-5.1
1.800	31.3	42.6	48.0	-5.4
2.200	30.8	42.3	48.0	-5.7
2.600	29.9	41.5	48.0	-6.5
5.600	28.1	40.5	48.0	-7.5
6.800	25.8	38.4	48.0	-9.6
8.800	23.9	36.8	48.0	-11.2

Test Personnel:

Daniel C. Swann

Tester Name Daniel C. Swann

5 RADIATED EMISSIONS DATA

5.1 Intentional Radiated Emissions, Base Station

The following data lists the intentional emissions frequencies, measured levels and FCC Part 15.209 limits for measurements made on July 6, 1998, by Daniel Swann and Roger Davis.

The FCC Part 15.209 limit is calculated from the formulas:

Limit (.009 to 490 kHz) = 2400/F(kHz) microVolts/meter, at 300 meters distance.
Limit (490 to 1705 kHz) = 24000/F(kHz) microVolts/meter, at 30 meters distance.
Limit (1.705 to 30 MHz) = 30 microVolts/meter, at 30 meters distance.

Converting the Limit to dBuV/meter yields:

Limit (.009 to 490 kHz) = 20*LOG(2400/F(kHz)) dBuV/m, at 300 meters distance.
Limit (490 to 1705 kHz) = 20*LOG(24000/F(kHz)) dBuV/m, at 30 meters distance.
Limit (1.705 to 30 MHz) = 20*LOG(30) dBuV/m, at 30 meters distance.

At other measurement distances, , in accordance with 47CFR15.31(f), item 2, below 30 MHz, the limit can be scaled by using the square of an inverse linear distance extrapolation factor (40 dB/decade)

Limit (distance d meters) = Limit (specified distance) + 40*LOG(specified distance) /d meters).

5.1 Intentional Radiated Emissions, Base Station (continued)

The following data was taken using an average detector below 490 kHz, and quasi-peak detector above 490 kHz. The EUT to antenna spacing was 10 meters. The turntable was rotated 360 degrees, and the magnetic loop receive antenna was rotated 180 degrees to maximize the signal for each measurement. These measurements were made on July 6, 1998, by Daniel Swann and Roger Davis.

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	15.209 10m Average Limit dBuV/m	15.209 10m Margin dB
400 kHZ transmit frequency							
0.4000	51.0	55.6	0.1	38.5	68.1	74.6	-6.5
0.8000	24.8	49.9	0.1	38.5	36.3	48.6	-12.3
1.2002	35.1	46.6	0.1	38.5	43.3	45.1	-1.8
1.6002	31.4	44.2	0.2	38.5	37.2	42.6	-5.4
2.0002	35.8	42.3	0.2	38.5	39.8	48.6	-8.8
2.4002	22.9	40.8	0.2	38.5	25.5	48.6	-23.2
2.8002	29.7	39.6	0.3	38.5	31.0	48.6	-17.6
3.2002	23.4	38.5	0.3	38.5	23.7	48.6	-25.0
3.6002	26.6	37.5	0.4	38.5	25.9	48.6	-22.7
4.0002	21.8	36.6	0.4	38.5	20.3	48.6	-28.4
200 kHZ transmit frequency							
0.2000	52.0	61.3	0.1	38.5	74.9	80.7	-5.8
0.4000	32.1	55.6	0.1	38.5	49.3	74.6	-25.4
0.6000	34.5	52.3	0.1	38.5	48.4	51.1	-2.7
0.8000	34.1	49.9	0.1	38.5	45.6	48.6	-3.0
1.0000	33.2	48.1	0.1	38.5	42.9	46.7	-3.8
1.2000	29.3	46.6	0.1	38.5	37.5	45.1	-7.6
1.4000	32.9	45.3	0.1	38.5	39.8	43.8	-3.9
1.8000	31.7	43.2	0.2	38.5	36.6	48.6	-12.0
2.0000	20.4	42.3	0.2	38.5	24.5	48.6	-24.2
2.2000	30.8	41.6	0.2	38.5	34.1	48.6	-14.5

Test Personnel:

Tester Name Daniel C. Swann

5 RADIATED EMISSIONS DATA (continued)

5.2 Unintentional Radiated Emissions, Base Station

The following data lists the significant emissions frequencies, measured quasi-peak averaged levels and FCC Class B margins. The spectrum analyzer RBW was 120 KHz at 6 dB. These measurements were made on July 6, 1998, and July 21, 1998. by Daniel Swann and Roger Davis. The emissions were measured with the receiver LO for the lowest available frequency for Part 90.265 wireless microphones, 169.445 MHz, and the highest frequency available, 171.905 MHz, corresponding to a LO frequency of 158.745 MHz, and of 161.205 MHz, respectively.

LO frequency of 158.745 MHz

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	FCC B 3 m Limit dBuV/m	FCC B 3 m Margin dB
Vertical Polarization							
30.100	49.7	17.5	1.4	38.5	30.0	40.0	-10.0
30.300	42.5	17.5	1.4	38.5	22.9	40.0	-17.1
51.001	44.6	10.5	1.8	38.5	18.5	40.0	-21.5
158.745	49.9	15.1	3.0	38.5	29.5	43.5	-14.0
317.496	46.0	15.0	4.3	38.4	26.8	46.0	-19.2
476.235	42.9	18.3	5.2	38.3	28.1	46.0	-17.9
634.980	42.3	20.8	6.1	38.4	30.8	46.0	-15.2
793.725	46.2	22.7	6.9	38.4	37.4	46.0	-8.6
Horizontal Polarization							
30.100	40.2	17.5	1.4	38.5	20.6	40.0	-19.4
49.700	45.1	11.3	1.8	38.5	19.7	40.0	-20.3
158.748	38.8	15.1	3.0	38.5	18.4	43.5	-25.1
317.490	50.5	15.0	4.3	38.4	31.3	46.0	-14.7
476.235	43.0	18.3	5.2	38.3	28.2	46.0	-17.8
634.980	37.5	20.8	6.1	38.4	26.0	46.0	-20.0
793.725	45.7	22.7	6.9	38.4	36.8	46.0	-9.2

Test Personnel:

Daniel C. Swann

Tester Name Daniel C. Swann

5.2 Unintentional Radiated Emissions, Base Station (continued)

LO frequency of 161.205 MHz

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	FCC B 3 m Limit dBuV/m	FCC B 3 m Margin dB
Vertical Polarization							
30.894	52.3	17.5	1.4	38.5	32.6	40.0	-7.4
49.299	52.2	11.3	1.8	38.5	26.8	40.0	-13.2
49.812	53.4	11.3	1.8	38.5	28.0	40.0	-12.0
161.212	52.1	15.4	3.0	38.5	32.0	43.5	-11.5
322.422	59.5	15.2	4.3	38.4	40.6	46.0	-5.4
483.638	49.5	18.5	5.3	38.3	34.9	46.0	-11.1
644.854	48.7	21.0	6.1	38.4	37.3	46.0	-8.7
806.044	50.9	23.1	6.9	38.5	42.5	46.0	-3.5
967.254	47.8	25.1	7.6	38.6	41.9	54.0	-12.1
Horizontal Polarization							
30.110	35.7	17.5	1.4	38.5	16.1	40.0	-23.9
49.388	46.0	11.3	1.8	38.5	20.6	40.0	-19.4
161.216	54.6	15.4	3.0	38.5	34.5	43.5	-9.0
322.396	56.4	15.2	4.3	38.4	37.5	46.0	-8.5
483.626	52.4	18.5	5.3	38.3	37.9	46.0	-8.1
644.826	50.8	21.0	6.1	38.4	39.5	46.0	-6.5
806.034	48.1	23.1	6.9	38.5	39.8	46.0	-6.2
967.250	44.0	25.1	7.6	38.6	38.1	54.0	-15.9

Test Personnel:

Daniel C. Swann

Tester Name Daniel C. Swann

5 RADIATED EMISSIONS DATA (continued)

5.3 Headset Effective Radiated Power and Frequency Stability

The transmit frequency of the headset is set by a crystal with 50 ppm frequency stability. This controls the transmit frequency to within 10 kHz, within the allowable frequency deviation of Part 90.265 of +/- 32.5 kHz.

The output power of the headset transmitter at the fundamental frequency of 169.445 was calculated by substituting a second biconical antenna on the site turntable with the same 3 meter spacing to the receive biconical antenna, and applying power antenna with a signal source until the received field strength at the receive biconical antenna/spectrum analyzer was the same as the signal received with the headset transmitting, 98.4 dBuV analyzer amplitude. The effective radiated power was then calculated using the signal generator power output, the cable loss in the transmit cable and the antenna factor of the substituted antenna. These measurements were made on July 6, 1998, by Daniel Swann and Roger Davis

Frequency MHz	Signal Generator Amplitude dBuV	Biconical Antenna Factor dB/m	Cable Loss dB	Power Input to Antenna dBm	Effective Radiated Power dBm	Effective Radiated Power mW	Part 90.265(b)2 Radiated Power Limit
169.445	93.0	15.6	0.1	-14.0	1.7	1.5 mW	50 mW

7.4 Headset Emission Bandwidths

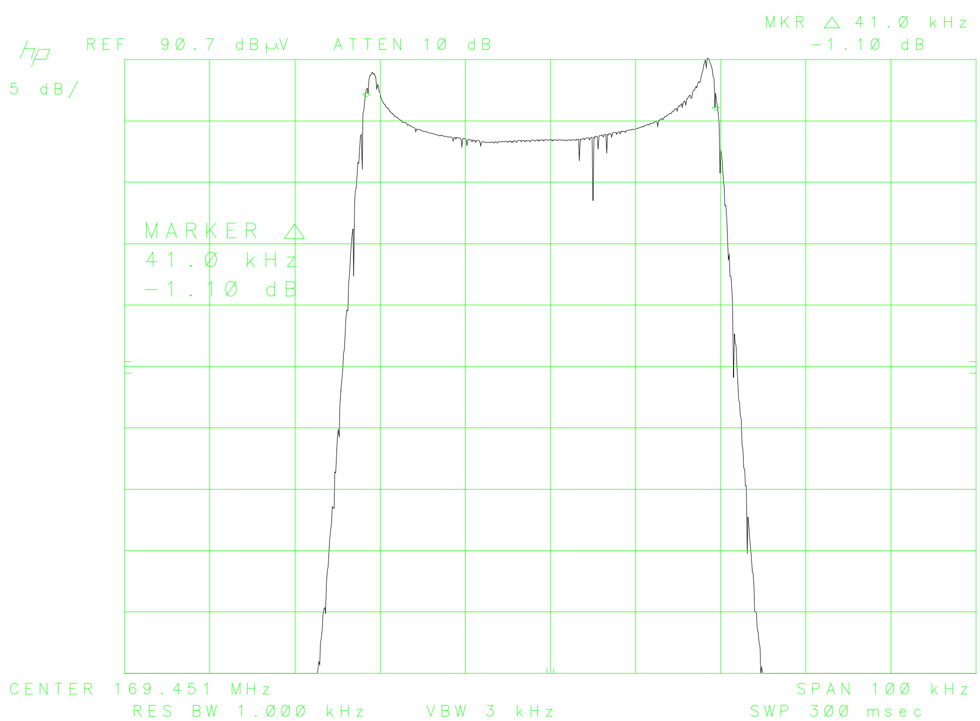
Emission bandwidths were measured first at 1 kHz using modulation levels of 10 mV to 100 mV. The compression point for modulation was 45.7 mV. Therefore, all occupied bandwidth measurements were made with 50 mV modulation levels. Antenna to EUT spacing was 3 meters.

Test Personnel:

Tester Name Daniel C. Swann

5.4 Headset Emission Bandwidths (continued)

Emission Bandwidth, 200 Hz tone modulation to microphone input on headset, marker at 3 dB bandwidth points:

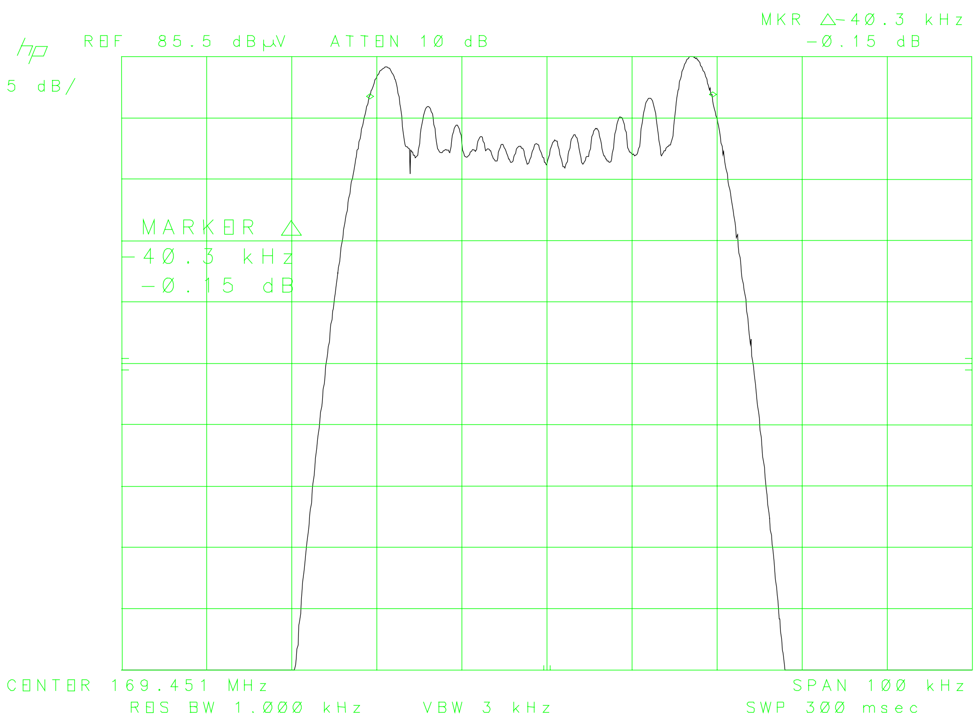


Test Personnel:

Tester Name Daniel C. Swann

5.4 Headset Emission Bandwidths (continued)

Emission Bandwidth, 1 kHz tone modulation to microphone input on headset, marker at 3 dB bandwidth points:

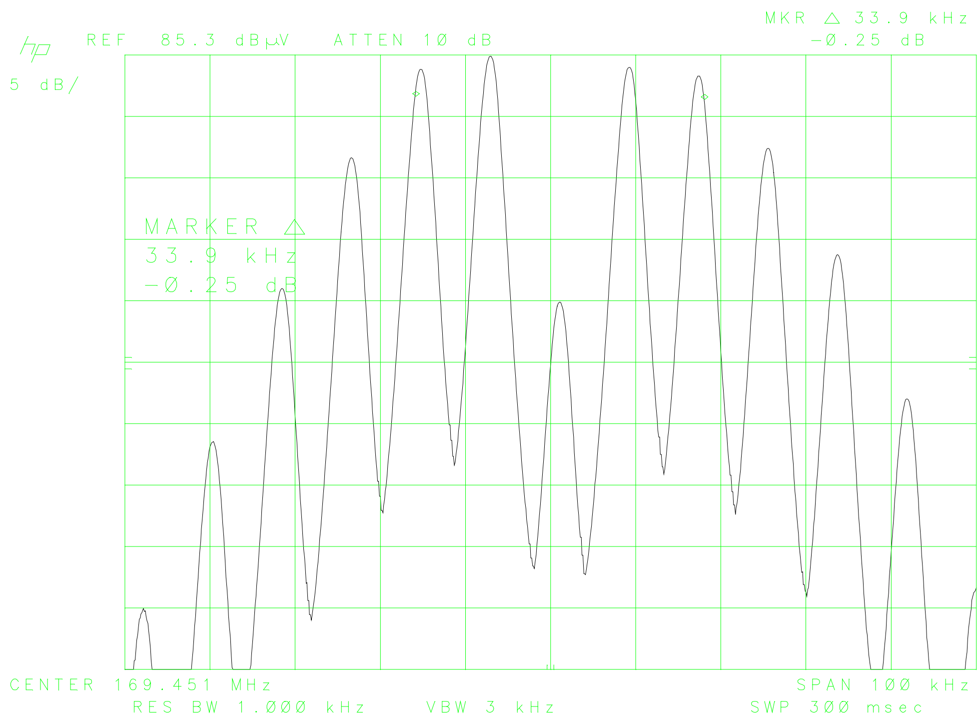


Test Personnel:

Tester Name Daniel C. Swann

5.4 Headset Emission Bandwidths (continued)

Emission Bandwidth, 8 kHz tone modulation to microphone input on headset, marker at 3 dB bandwidth points:



Test Personnel:

Tester Name Daniel C. Swann

5 RADIATED EMISSIONS DATA (continued)

5.5 Unintentional Radiated Emissions, Headset

Radiated measurements were made using an IF bandwidth of 120 kHz for the frequency range of 30 to 1000 MHz, in quasi-peak detection mode. These measurements were made on July 6, 1998, by Daniel Swann and Roger Davis. The emissions were measured with the receiver crystal for the lowest available frequency for Part 90.265 wireless microphones, 169.445 MHz, and the highest frequency available, 171.905.

169.445 transmit frequency

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	FCC B 3 m Limit dBuV/m	FCC B 3 m Margin dB
Vertical Polarization							
33.911	35.0	16.6	1.4	38.5	14.6	40.0	-25.4
67.796	41.0	7.1	2.1	38.5	11.7	40.0	-28.3
135.566	42.1	13.9	2.8	38.5	20.3	43.5	-23.2
169.451	101.8						
203.343	57.2	17.2	3.4	38.4	39.4	43.5	-4.1
237.221	38.0	16.9	3.6	38.5	20.1	46.0	-25.9
271.106	33.2	17.9	3.9	38.5	16.5	46.0	-29.5
Horizontal Polarization							
33.911	34.3	16.6	1.4	38.5	13.9	40.0	-26.1
67.796	45.4	7.1	2.1	38.5	16.1	40.0	-23.9
135.566	35.4	13.9	2.8	38.5	13.6	43.5	-29.9
169.451	82.8						
203.336	41.0	17.2	3.4	38.4	23.2	43.5	-20.3
237.221	33.5	16.9	3.6	38.5	15.5	46.0	-30.5
271.106	31.8	17.9	3.9	38.5	15.1	46.0	-30.9
305.013	34.7	14.7	4.2	38.4	15.2	46.0	-30.8
338.900	57.1	15.8	4.4	38.4	38.9	46.0	-7.1

Test Personnel:

Daniel C. Swann

Tester Name Daniel C. Swann

5.5 Unintentional Radiated Emissions, Headset (continued)

171.905 transmit frequency

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	FCC B 3 m Limit dBuV/m	FCC B 3 m Margin dB
Vertical Polarization							
34.351	25.1	16.3	1.5	38.5	4.4	40.0	-35.6
68.732	37.9	6.9	2.1	38.5	8.4	40.0	-31.6
103.113	49.1	10.6	2.5	38.5	23.9	43.5	-19.6
137.494	30.9	14.1	2.8	38.5	9.3	43.5	-34.2
171.905	91.9						
206.286	55.7	17.2	3.4	38.4	37.8	43.5	-5.7
240.667	29.7	17.0	3.6	38.5	12.0	46.0	-34.0
275.048	28.7	18.3	3.9	38.5	12.5	46.0	-33.5
309.428	32.7	14.8	4.2	38.4	13.3	46.0	-32.7
859.524	35.2	23.3	7.2	38.5	27.2	46.0	-18.8
Horizontal Polarization							
34.380	30.0	16.3	1.5	38.5	9.3	40.0	-30.7
68.761	42.7	6.9	2.1	38.5	13.2	40.0	-26.8
103.142	43.6	10.6	2.5	38.5	18.3	43.5	-25.2
137.523	32.1	14.1	2.8	38.5	10.5	43.5	-33.0
171.904	85.1						
206.285	53.0	17.2	3.4	38.4	35.1	43.5	-8.4
240.666	27.5	17.0	3.6	38.5	9.7	46.0	-36.3
275.047	23.5	18.3	3.9	38.5	7.3	46.0	-38.7
309.429	28.0	14.8	4.2	38.4	8.5	46.0	-37.5
343.810	48.0	15.9	4.5	38.4	29.9	46.0	-16.1
859.525	37.0	23.3	7.2	38.5	29.0	46.0	-17.0

Test Personnel:

Tester Name Daniel C. Swann

5 RADIATED EMISSIONS DATA (continued)

5.6 Field Strength Calculations

The field strength was calculated from the following formula:

FIELD STRENGTH = MEASURED SIGNAL + CORRECTION FACTOR

Where MEASURED SIGNAL = Spectrum Analyzer amplitude, in dBuV

CORRECTION FACTOR = AF + CF - GAIN, in dB/m

AF = antenna factor, in dB/m

CF = cable attenuation factor, in dB

GAIN = pre-amplifier gain, in dB

For example, for the headset, with the transmit frequency of 169.445, at 203.343 MHz, in vertical polarization, an quasi-peak reading of 57.2 dBuV was measured, and the antenna factor is 17.2 dB/m, the cable loss is 3.4 dB, and the pre-amplifier gain is 38.4 dB.

FS (dBuV/m) = 57.2 + 17.2 + 3.4 – 38.4

FS (dBuV/m) = 39.4 dBuV/m

FCC Class B 3 meter Radiated Emissions Limit = 43.5 dBuV/m