TEST REPORT FOR

FCC PART 90 COMPLIANCE

FOR KNOWLES ELECTRONICS, INC.

Prepared by
Daniel C. Swann
August 25, 1998

Knowles Electronics, Inc.
Model Number RF-3296

Wireless Headset Microphone

FCC Part 90.265

FCC ID N29RF100

GEL Report File PE9805

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

MEASUREMENT/TECHNICAL REPORT

KNOWLES ELECTRONICS, INC.

FCC ID N29RF100

This report concerns:	An Original Grant
Equipment type:	FCC Part 90.265, Wireless Microphone
Deferred grant requested:	no
Transition rules per 15.37:	no

Report prepared by:

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Report Certified By: Daniel C. Swann

Date August 25, 1998

GEL Report File: PE9805

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1 GENERAL INFORMATION

1.1 Product Description

The Knowles Electronics, Inc. High Performance Radio Frequency Wireless Headset Model Number RF-3296 is 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). Signals are received by the headset at either 200 or 400 kHz, from a base station unit, Model Number RF-3296.

The headset is powered by re-chargeable batteries.

All plastic parts are un-plated.

1.2 Related Submittal or Grant

There are no related submittals or grants.

1.3 Tested System Details

EUT

Knowles Electronics, Inc. Model Number RF-3296.

Made by:

Knowles Electronics, Inc.
2800 West Golf Road
Rolling Meadows, IL 60143

See the Block Diagram/Operational Description for more information.

1.4 Test Methodology

The 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.

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: This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesirable operation.

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 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 transmitter frequencies were changed by changing the crystal in the unit.

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.

3.5 Configuration of Tested System

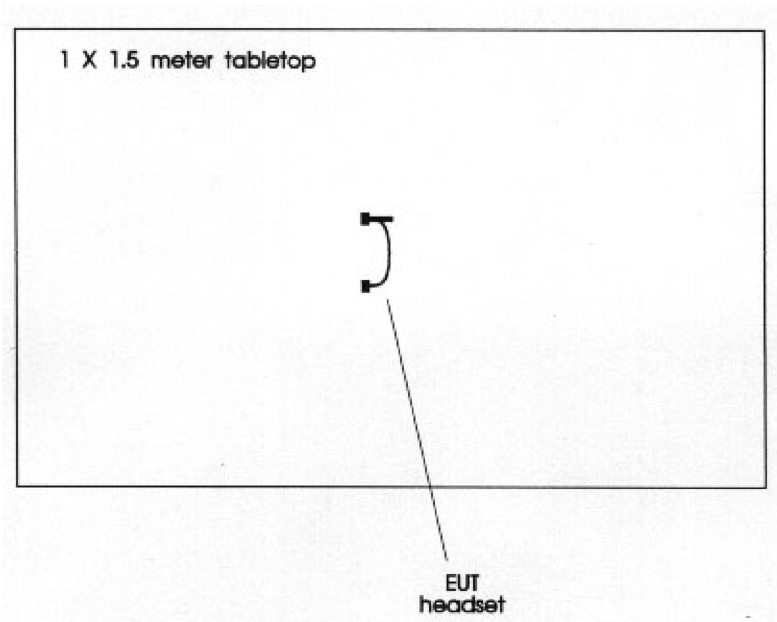
The headset was tested by placing it in the center of the tabletop, with the headset held vertically by a nonconductive foam block.

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.

This condition put the EUT in the highest emissions state.

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

Figure 3.1



4 CONDUCTED EMISSIONS DATA

No conducted emissions measurements were made since the product is powered by batteries.

Test Personnel:

Tester Name Daniel C. Swann

5 RADIATED EMISSIONS DATA

5.1 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 to the 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

5.2 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.

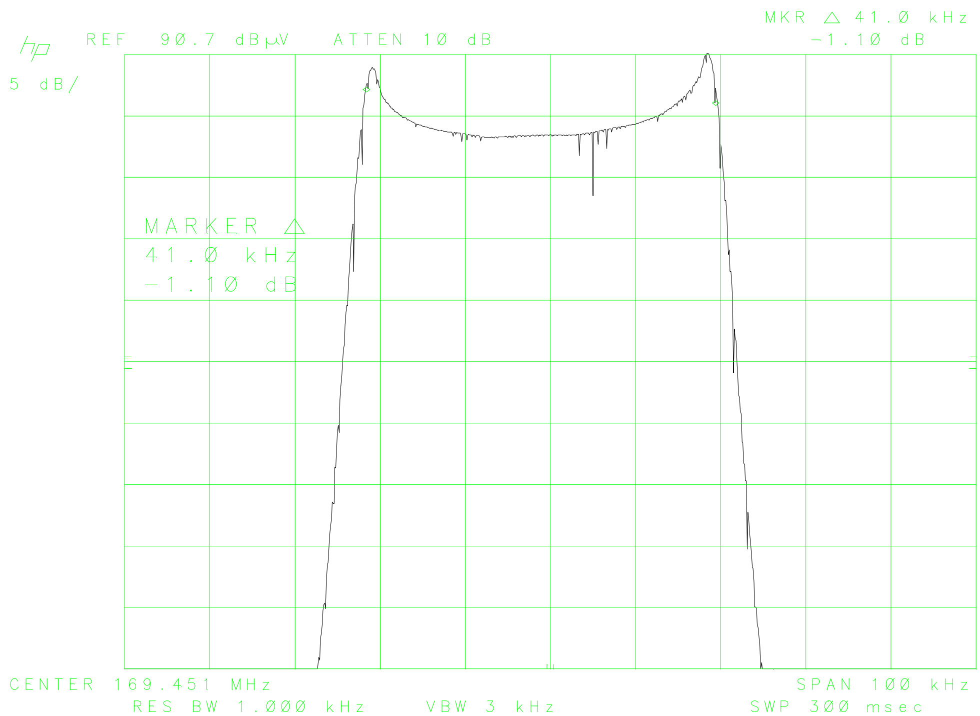
Daniel C. Swann

Test Personnel:

Tester Name Daniel C. Swann

5.2 Headset Emission Bandwidths (continued)

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

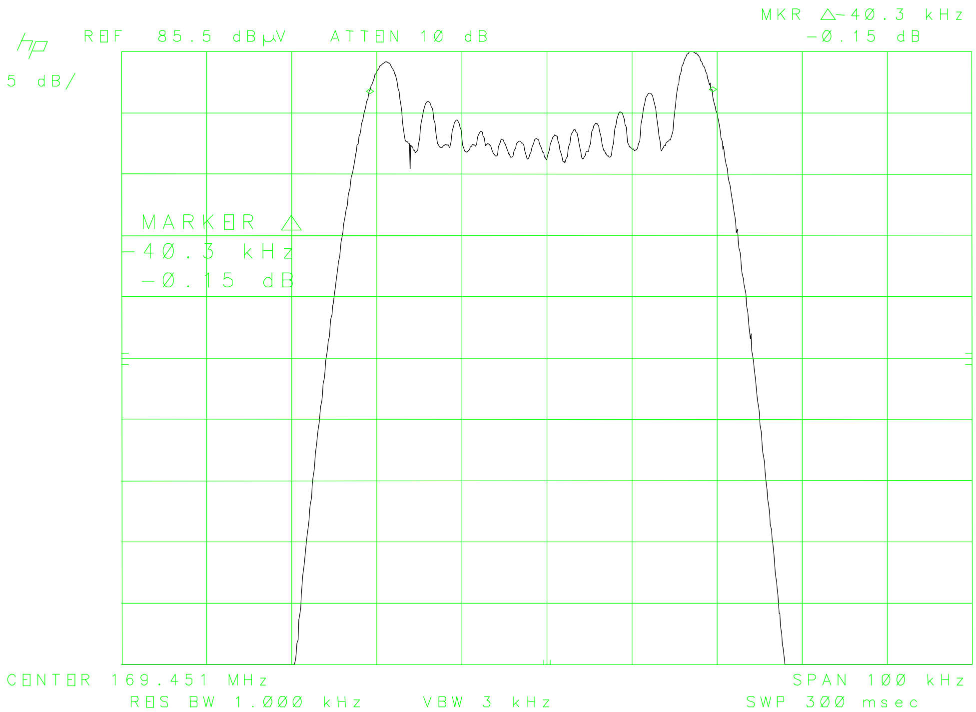


Test Personnel:

Tester Name Daniel C. Swann

5.2 Headset Emission Bandwidths (continued)

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

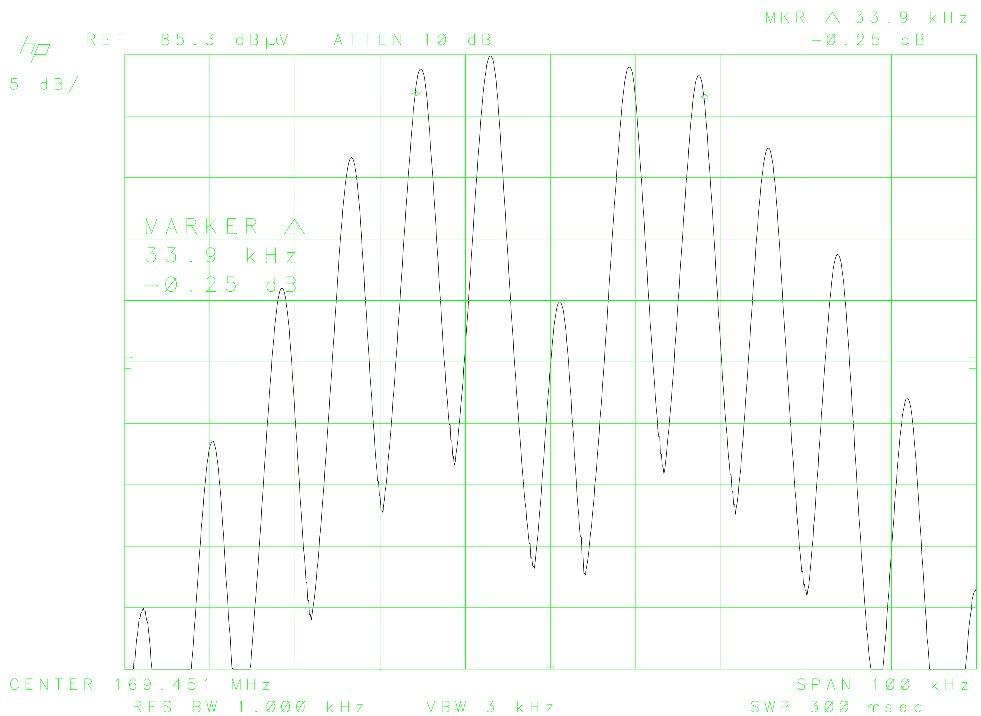


Test Personnel:

Tester Name Daniel C. Swann

5.2 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)

5.3 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:

Tester Name Daniel C. Swann

5.3 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)

5.4 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