
FCC ID: L82-228869

Prepared for:

SIEMENS BUSINESS COMMUNICATIONS

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Submitted to:

**Federal Communications Commission
Equipment Authorization Division,
Application Processing Branch**

7435 Oakland Mills Road
Columbia, MD 21048

August 1998

**FCC Type Certification Test Report
of an Intentional Radiator**

**SIEMENS BUSINESS COMMUNICATION SYSTEMS
GigaSet 2400HS Spread Spectrum
Cordless Phone System Handset
(Transmitter Portion)**

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Certificate of Compliance

Manufacturer: Siemens Business Communications

Model: Gigaset 2400HS Handset

Serial #: 6-070

FCC ID: L82-228869

Test Dates: June through August 1998

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measurement data and this report. I believe them to be true and accurate. The **Siemens Gigaset 2400HS Handset** was tested and found to be in compliance with FCC Part 15 for Intentional Radiators.

Jeffrey A. Lenk
President

1.0 Equipment Under Test (EUT) Description

The **Siemens Gigaset 2400HS Handset** is a two way mobile unit used as part of the Siemens Gigaset 2420 Small Office/Home Office (SOHO) Cordless Phone System. The system is intended for use in a home or small office environment. The system is comprised of a base unit (**Siemens Gigaset 2420DS Desk Station**) and up to eight cordless handsets. The system can use some of the standard higher end telephone features (speed dial, station ID, hold, etc.)

Unlike most other cordless phone systems, this system is a frequency hopping spread spectrum technique for the wireless link. For this reason, the system is being qualified under spread spectrum (frequency hopping methods) of Section 15.247 rather than the standard cordless telephone parts. Since the system is comprised of two types of transmitters, the system is being qualified under two FCC ID numbers. The identifiers for the system are:

<u>System Component</u>	<u>FCC ID Number</u>
Gigaset 2400HS Handset	L82-228869
Gigaset 2420DS Desk Station	L82-228870

In addition to the frequency hopping portions of §15.247, The document FCC 97-111 was used for guidance in the procedures used for testing of the **Siemens Gigaset 2400HS Handset**. Specific test requirements include the following:

47 CFR 15.247(a)(1)(ii)	Occupied Bandwidth
47 CFR 15.247(a)(1)(ii)	Number of Hop Frequencies
47 CFR 15.247(a)(1)(ii)	Average Time of Occupancy
47 CFR 15.247(b)	Peak Output Power
47 CFR 15.247(c)	Out-of-Band Emissions
& 47CFR 15.205	Restricted Bands of Operation
47 CFR 15.207	Conducted Emissions
47 CFR 15.203	Antenna Requirement
47 CFR 15.31(e) and 15.215(c).	Frequency Stability

The system tested consisted of the following components:

EUT

<u>Manufacturer & Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Siemens Business Communications, Inc., Gigaset 2400HS	6-057	N/P	Mobile Phone
Siemens Business Communications, Inc., Gigaset 2400HS	6-070	N/P	Mobile Phone

Support Equipment

<u>Manufacturer & Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Siemens Business Communications, Inc., Gigaset 2420DS	505	N/P	Desk Station
Ault Inc. P41120400A010G	N/P	N/P	Desk Station Power Supply
<u>System Peripherals:</u>			
Radio Shack 43-858	047766	AAOCHIN-22523-TE-E	Standard Phone
Siemens Business Communications, Inc., Headset Load Cable	N/P	N/P	Headset Load Emulator

Cables and Cords:

8 Wire Phone Patch Cable (6 Ft.) (1 ea.)
Radio Shack Clear 4 Wire Phone Cable (6 Ft.) (1 ea.)

The equipment within this report was tested to verify its compliance with FCC Rule Part 15, for Intentional Radiators.

1.1 Equipment Under Test (EUT) Operation

For all tests except those involving §15.247(c), §15.205 and §15.247(a)(1)(ii), the **Siemens Gigaset 2400HS Handset** was put into an intercom mode with the Desk Station unit. This mode exercised the transmit functions of the EUT in a normal fashion. For the remainder of the tests, the EUT was placed in a special mode which transmitted the signal on a single channel. For tests using this mode, either three channels were used for testing or the channel producing the worst case emissions was tested.

2.0 Occupied Bandwidth Measurements

Measurements were made on the **Siemens Gigaset 2400HS Handset** to verify compliance with the bandwidth requirements of § 15.247(a)(1)(ii).

2.1 Test Procedure

Radiated Emissions measurements were made at the Professional Testing "Open Field" Site 3, located in Marble Falls, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

2.2 Test Criteria

Section 15.247(a)(1)(ii) states that each channel of a frequency hopping spread spectrum system shall have a maximum bandwidth of 1 MHz. In accordance with this section, this is based on a 20 db criteria.

2.3 Test Results

The **Siemens Gigaset 2400HS Handset** operates over the frequency range 2401.056 to 2483.136 MHz. The frequency hopping algorithm was disabled, resulting in emission at discrete channels. Testing was performed on three separate channels, centered at 2401.056 (Channel 00), 2440.800 MHz (Channel 46) and 2483.136 MHz (Channel 95). Measurements were performed utilizing a spectrum analyzer IF/video bandwidth of 100 kHz/300 kHz.

The measured bandwidths were as follows:

MAXIMUM BANDWIDTH (kHz)			
	<u>Measured</u>	<u>Specified</u>	<u>Margin</u>
Channel 1	821	1000	-179
Channel 3	896	1000	-104
Channel 7	827	1000	-173

Plots for occupied bandwidth are contained in Appendix A of this report. The **Siemens Gigaset 2400HS Handset** met the §15.247(a)(1)(ii) maximum bandwidth requirements.

3.0 Hop Frequency Quantity

An analysis of the **Siemens Gigaset 2400HS Handset** was performed to verify compliance with the hop frequency quantity requirement of §15.247(a)(1)(ii).

3.1 Evaluation Procedure

The channel listing provided by the Siemens Business Communication Systems was studied to determine the number of channels assigned for the **Siemens Gigaset 2400HS Handset**. The number of the channels used was determined based on spectral analysis of the EUT in normal operating mode. The basic evaluation procedure was to determine that the number of hopping channels was equal to or greater than 75 (based on the list comparison) and that all channels in available band were used by the device. The second part of the evaluation involved plotting the spectral response of the EUT over the transmit band over time in a peak hold mode. If all channels are used, the transmit band should be filled with little or no dropouts.

3.2 Evaluation Criteria

Section 15.247(a)(1)(ii) requires that frequency hopping spread spectrum systems shall utilize a minimum of 75 frequencies (Channels). Data for the channel assignments for the system was obtained from the manufacturer and the number of channels compared to the limit.

3.3 Evaluation Results

The **Siemens Gigaset 2400HS Handset** operates over the 96 channels over the frequency range of 2401.056 to 2483.136 MHz. The spectral response of the EUT showed no significant omissions in the transmit channel band.

Data for this evaluation is contained in Appendix B. The **Siemens Gigaset 2400HS Handset** met the §15.247(a)(1)(ii) hop frequency quantity requirement.

4.0 Average Time of Occupancy

Measurements were made on the **Siemens Gigaset 2400HS Handset** to verify compliance with the average time of occupancy requirements of §15.247(a)(1)(ii).

4.1 Test Procedure

Testing was performed in a controlled laboratory environment. The EUT was placed into a standard operating mode (intercom with the desk station). A spectrum analyzer was set with a center frequency of 2440.7 MHz (Channel 46) and the bandwidth set to view only the primary emissions of this channel. The individual transmission period and worst case duty cycle of the transmission on this channel was measured. The total period of occupancy of the channel over a 30 second period was then calculated and compared to the limit. This criteria is more stringent than that quoted by the rule.

4.2 Test Criteria

Section 15.247(a)(1)(ii) states that the average time of occupancy on a single frequency shall not be greater than 0.4 seconds over a 30 second period.

4.3 Test Results

Data plots for these measurements are contained in Appendix C of this document. The maximum signal duration on the channel was 0.68 ms. The worst case period (shortest) for repetition of signals on this channel was 790 ms. This period equates to approximately 38 pulses over a 30 second period. Based on this rate and a signal duration of 0.68 ms, the highest signal duration for this channel would be $30 \times 0.68 \text{ ms} = 25.84 \text{ ms}$. Based on this criteria, the **Siemens Gigaset 2400HS Handset** meets the average time of occupancy requirement of §15.247(a)(1)(ii).

5.0 Peak Output Power

Measurement of the peak output power for the **Siemens Gigaset 2400HS Handset** to verify compliance with requirements of §15.247(b).

5.1 Measurement Procedure

The tests were performed in a 12' X 16' RayProof anechoic lined modular shielded room. A Hewlett Packard 8566B Spectrum Analyzer was used to record the output profile of the transmitter. The EUT was operated in a normal intercom mode with the spread spectrum transmitter in standard communication with a remote unit.

The orientation of the EUT and the measurement antenna were varied to find the worst case (highest emission level) for this test. The final orientation was with the EUT vertical and the measurement antenna vertical. The spectrum of the transmit signal from the EUT was recorded on an HP 8566 Spectrum Analyzer with an EMCO 3115 horn as the measurement antenna. The plot of this spectrum is shown in Appendix D. The peak of this plot was measured and compared to the limit. Final measurement of the peak was made with a 1 MHz/1 MHz bandwidth combination.

5.2 Evaluation Criteria

Section 15.247(b) states that the maximum peak output power from the transmitter shall not exceed 1 watt.

5.3 Evaluation Results

Datasheets containing this information is contained in Appendix D. The highest ERP for the **Siemens Gigaset 2400HS Handset** occurred at a frequency of 2440.1 MHz with a maximum recorded level of 0.469 watts. The **Siemens Gigaset 2400HS Handset** meets the §15.247(b) maximum transmitted power criteria.

6.0 Out-of-Band Emission Measurements

Measurements were made on the **Siemens Gigaset 2400HS Handset** to verify compliance with the out-of-band emission requirements of §15.247(c). Measurements were performed for the radiated out-of-band emissions. The antenna of the **Siemens Gigaset 2400HS Handset** is internal to the handset and no add-on port is available, so conducted out of band emissions were not performed for the antenna.

6.1 Test Procedure

Radiated Emissions measurements were made at the Professional Testing "Open Field" Site 3, located in Marble Falls, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

The EUT was placed in single channel transmit mode at Channel 95 (Center Frequency = 2483 MHz). This method (single channel operation) provided the most effective method for detecting emissions from the EUT by disabling the hopping function. Prior to formal testing, the spectrum of the intended emissions from the EUT in this mode were compared to those for normal operation mode. The emissions in single channel mode were higher, thereby making this a worst case configuration for this test.

6.2 Test Criteria

Section 15.247(c) requires that all out-of-band emissions from the EUT be 20 dB below the intended signal level. In addition, the emissions from the EUT must meet the restricted band criteria of 15.205.

6.3 Test Results

A Hewlett Packard 8566B Spectrum Analyzer utilizing an IF/video bandwidth of 100 kHz/300 kHz was used to record the output signals. Testing was performed over the frequency range 30 MHz to 18 GHz. While this test range covers emissions through the seventh harmonic, analysis of the emissions from the EUT was made to determine if the detected signals were from the EUT. If a significant number of the signals were emissions from the EUT, additional testing would be performed.

The data sheets for out-of-band emissions is contained in Appendix E of this report. All measured emissions outside the 2401 to 2483 MHz band were greater than 20 dB below the carrier; therefore, the **Siemens Gigaset 2400HS Handset** met the §15.247(c) radiated emission requirements. In addition, in the restricted bands defined by §15.205, the emissions detected during this test were also below this limit.

7.0 Frequency Stability Analysis

AN analysis of the **Siemens Gigaset 2400HS Handset** to verify compliance with the frequency stability requirements of §15.31(e) and 15.215(c). Under these specifications, the EUT is tested to verify satisfactory frequency stability versus changes in the amplitude of the primary power for operation from the AC mains. For the battery powered option, the EUT shall be tested with the battery assembly fully charged.

7.1 Evaluation Procedure

For all tests described in this report, the EUT was operated with fresh batteries. The EUT has no provision for an external power input. The transmit frequencies were observed during testing to determine if the units were exhibiting drift due to power fluctuations (battery decay).

7.2 Evaluation Results

No drift of the transmit frequencies of the EUT were detected between the tests. The **Siemens Gigaset 2400HS Handset** meets the frequency stability requirements for frequency stability for battery powered devices.

8.0 Antenna Requirement

An analysis of the **Siemens Gigaset 2400HS Handset** was performed to determine compliance with Section 15.203 of the Rules. This section requires specific handling and control of antennas used for devices subject to regulation under the Intentional Radiator portions of Part 15.

8.1 Evaluation Procedure

The structure and application of the **Siemens Gigaset 2400HS Handset** were analyzed with respect to the rules. The antenna for this unit is permanently attached internally to the circuit board of the EUT. No user accessible antenna ports are available.

8.2 Evaluation Criteria

Section 15.203 of the rules states that the subject device must meet at least one of the following criteria:

- (a) Antenna be permanently attached to the unit.
- (b) Antenna must use a unique type of connector to attach to the EUT.
- (c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

8.3 Test Results

The **Siemens Gigaset 2400HS Handset** meets the criteria of this rule by virtue of having an antenna permanently attached to the unit. The EUT is therefore compliant with §15.203.

9.0 List of Test Equipment

A list of the test equipment utilized to perform the conducted and radiated emission measurements is given below. The date of calibration is given for each.

<u>Device</u>	<u>Description</u>	<u>Date Last Calibrated</u>	<u>Calibration Due</u>
HP 8566B	Spectrum Analyzer	09/22/97	09/22/98
HP 85650A	Quasi Peak Adapter	09/22/97	09/22/98
MITEQ AFS4-00101800-40-10P-N	Preamplifier	05/22/98	05/22/99
EMCO 3115	Double Ridged Horn Antenna	05/22/98	05/22/99

Appendix A

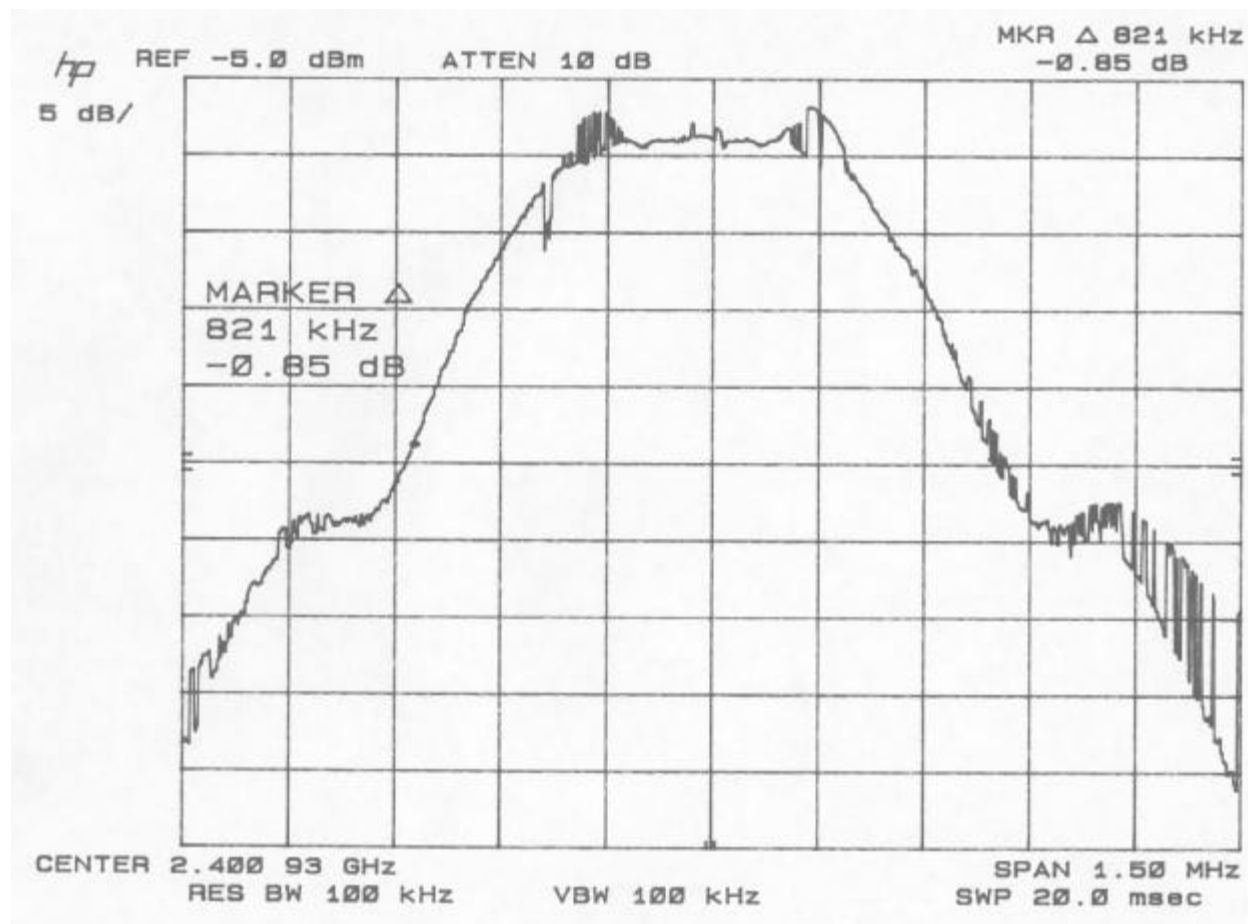
Occupied Bandwidth Test Data

Occupied Bandwidth Data Sheet

Siemens Business Communication Systems Gigaset 2420HS Handset

SERIAL #: 6-070
DATE: August 8, 1998

PROJECT #: 99-016



COMMENT #1: Channel Setting = 00 (Center Frequency = 2400.93 MHz)

COMMENT #2: 20dB Bandwidth = 821 kHz

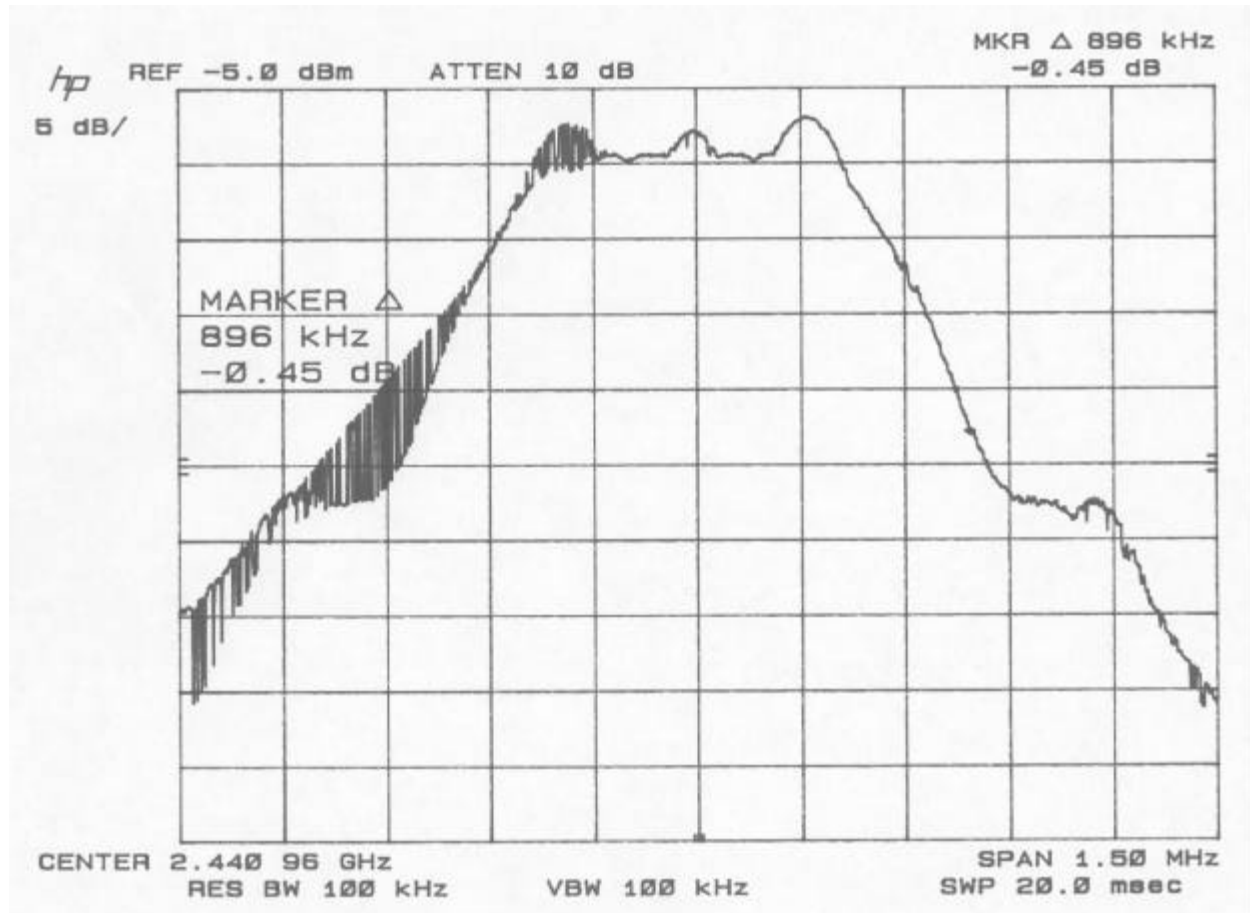
TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Occupied Bandwidth Data Sheet

Siemens Business Communication Systems Gigaset 2420HS Handset

SERIAL #: 6-070
DATE: August 8, 1998

PROJECT #: 99-016



COMMENT #1: Channel Setting = 46 (Center Frequency = 2440.96 MHz)

COMMENT #2: 20dB Bandwidth = 896 kHz

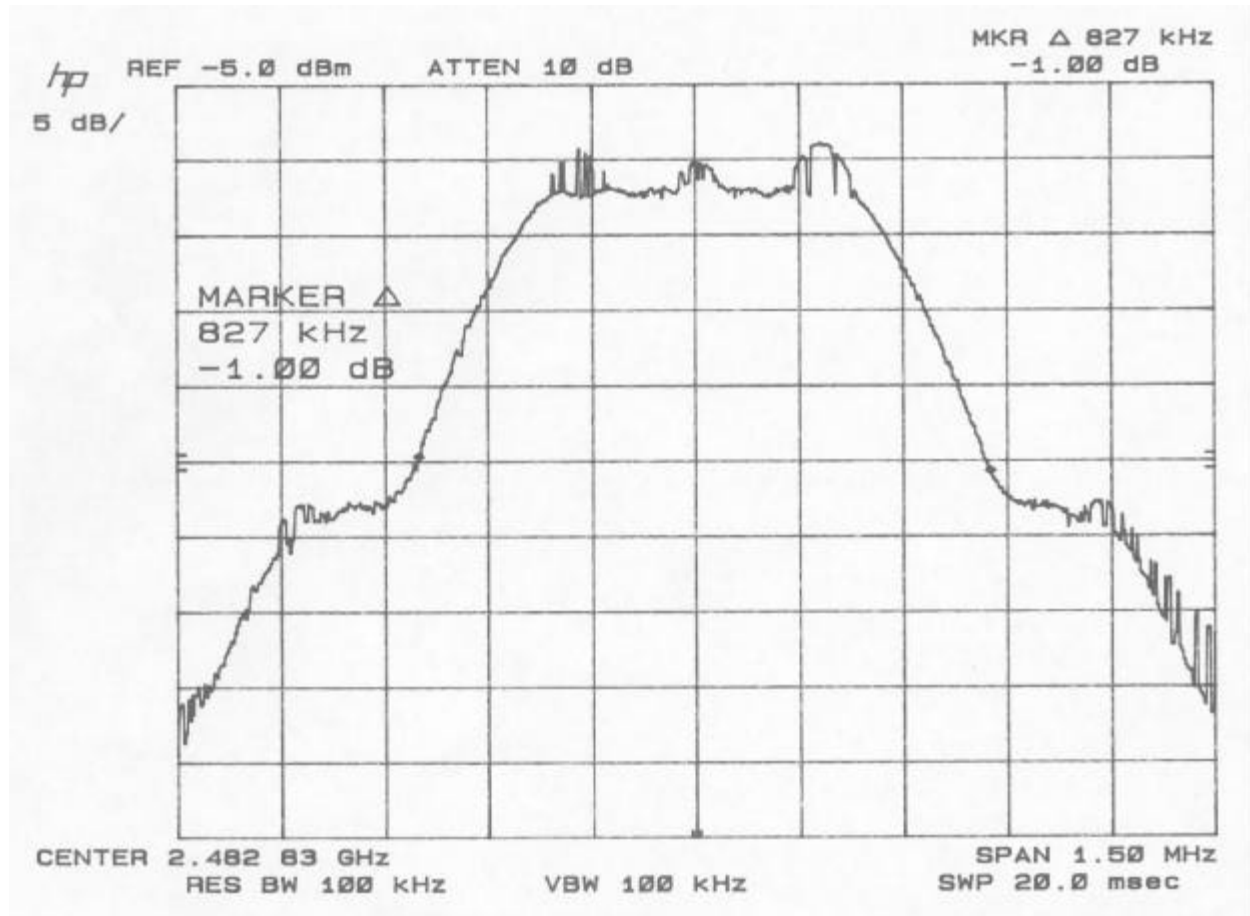
TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Occupied Bandwidth Data Sheet

Siemens Business Communication Systems Gigaset 2420HS Handset

SERIAL #: 6-070
DATE: August 8, 1998

PROJECT #: 99-016



COMMENT #1: Channel Setting = 95 (Center Frequency = 2482.83 MHz)

COMMENT #2: 20dB Bandwidth = 827 kHz

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Appendix B

Hop Frequency Quantity Evaluation Data

Hop Frequency Quantity Data Sheet #1**Siemens Business Communication Systems
Gigaset 2420HS Handset**

SERIAL #: 6-070
DATE: August 3, 1998

PROJECT #: 99-016

Table 3.2.3. SOHOC Hopping Channels

Channel ##	Freq. MHz	Channel ##	Freq. MHz	Channel ##	Freq. MHz	Channel ##	Freq. MHz
00	2401.056	24	2421.792	48	2442.528	72	2463.264
01	2401.920	25	2422.656	49	2443.392	73	2464.128
02	2402.784	26	2423.520	50	2444.256	74	2464.992
03	2403.648	27	2424.384	51	2445.120	75	2465.856
04	2404.512	28	2425.248	52	2445.984	76	2466.720
05	2405.376	29	2426.112	53	2446.848	77	2467.548
06	2406.240	30	2426.976	54	2447.712	78	2468.448
07	2407.104	31	2427.840	55	2448.576	79	2469.312
08	2407.968	32	2428.704	56	2449.440	80	2470.176
09	2408.832	33	2429.568	57	2450.304	81	2471.040
10	2409.696	34	2430.432	58	2451.168	82	2471.904
11	2410.560	35	2431.296	59	2452.032	83	2472.768
12	2411.424	36	2432.160	60	2452.896	84	2473.632
13	2412.288	37	2433.024	61	2453.760	85	2474.496
14	2413.152	38	2433.888	62	2454.624	86	2475.360
15	2414.016	39	2434.752	63	2455.488	87	2476.224
16	2414.880	40	2435.616	64	2456.352	88	2477.088
17	2415.744	41	2436.480	65	2457.216	89	2477.952
18	2416.608	42	2437.344	66	2458.080	90	2478.816
19	2417.472	43	2438.208	67	2458.944	91	2479.680
20	2418.336	44	2439.072	68	2459.808	92	2480.544
21	2419.200	45	2439.936	69	2460.672	93	2481.408
22	2420.064	46	2440.800	70	2461.536	94	2482.272
23	2420.928	47	2441.664	71	2462.400	95	2483.136

COMMENT #1: Number of Hop Channels = 96

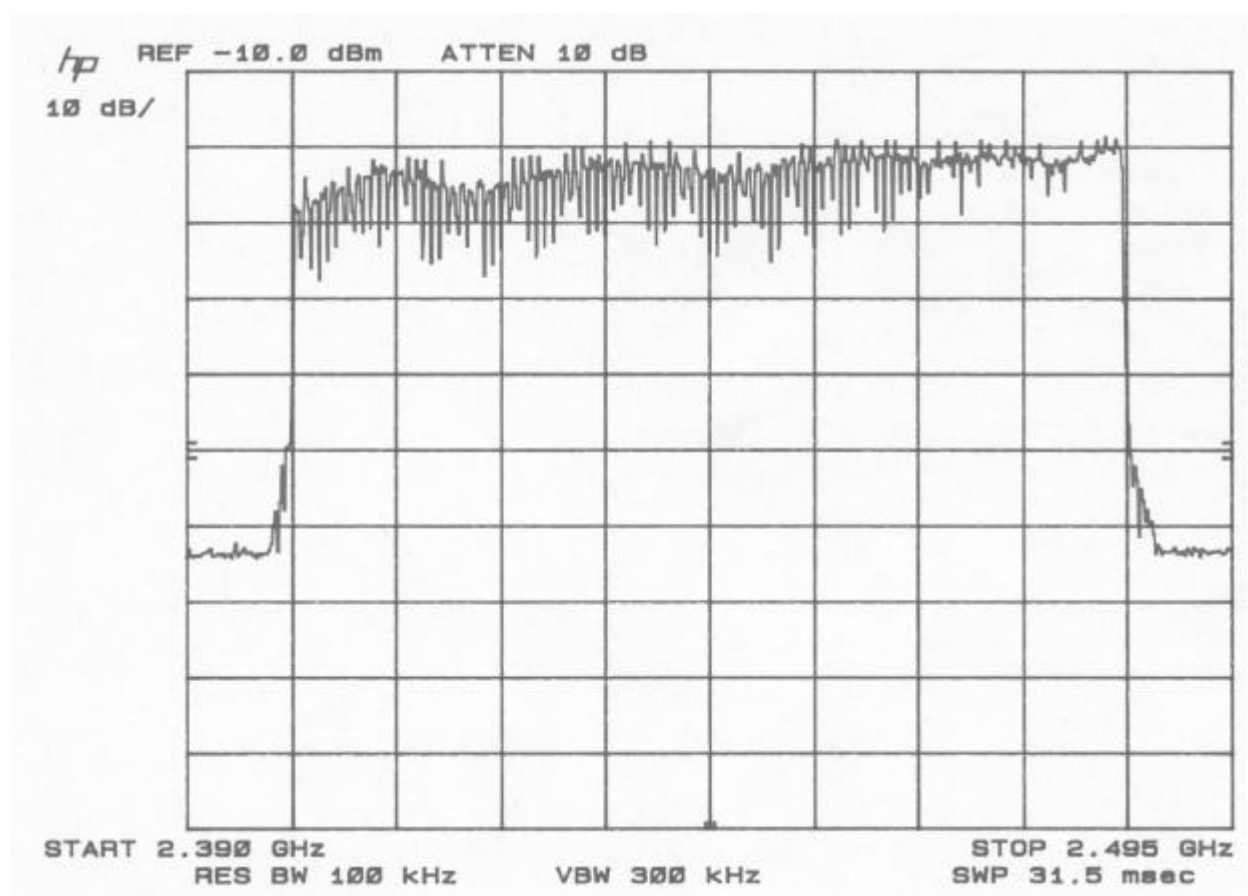
COMMENT #2:

TEST ENGINEER: _____ **APPROVED BY:** _____
 John O'Brien Jeffery Lenk

Hop Frequency Quantity Data Sheet #2**Siemens Business Communication Systems
Gigaset 2420HS Handset**

SERIAL #: 6-070
DATE: August 3, 1998

PROJECT #: 99-016



COMMENT #1: No significant channel omissions detected

COMMENT #2:

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Appendix C

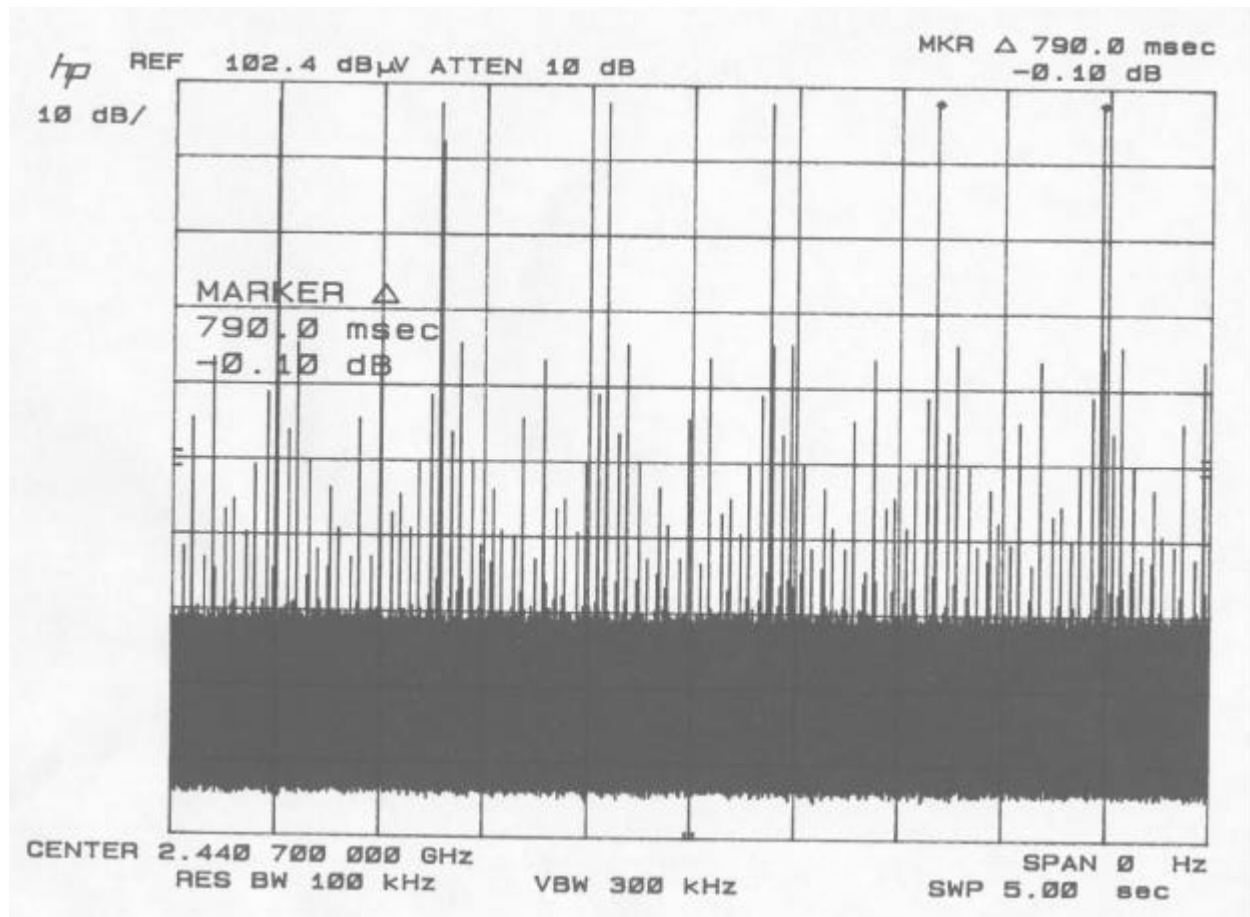
Average Time of Occupancy Test Data

Average Time of Occupancy Sheet #1

Siemens Business Communication Systems
Gigaset 2420HS Handset

SERIAL #: 6-070
DATE: August 3, 1998

PROJECT #: 99-016



COMMENT #1: Pulse Interval = 790 mS

COMMENT #2:

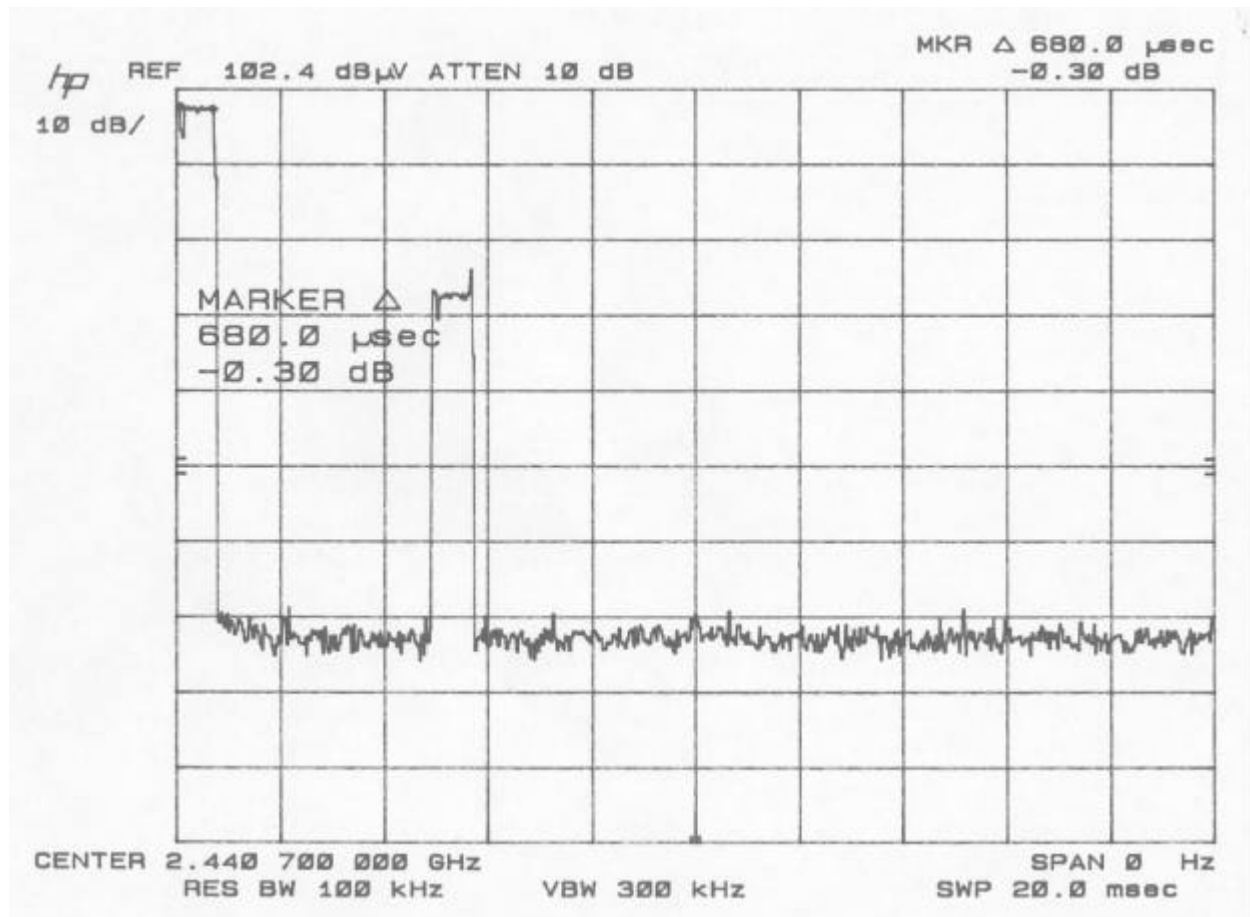
TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Average Time of Occupancy Sheet #2

Siemens Business Communication Systems
Gigaset 2420HS Handset

SERIAL #: 6-070
DATE: August 3, 1998

PROJECT #: 99-016



COMMENT #1: Pulse Interval = 0.680 mS

COMMENT #2:

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

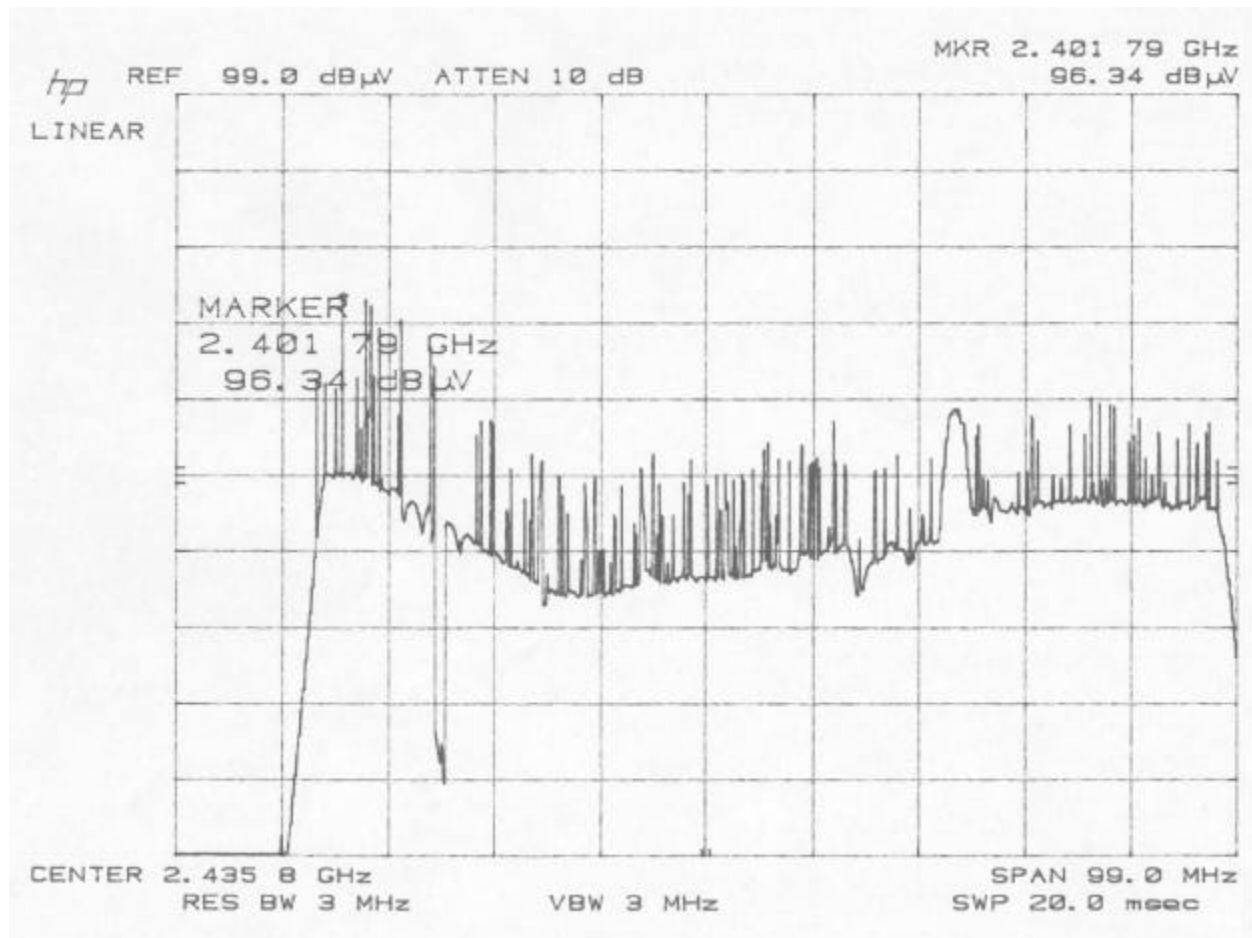
Appendix D

Peak Output Power Test Data

Peak Output Power (Section 15.247)**Siemens Business Communication Systems
Gigaset 2420HS Handset**

SERIAL #: 6-070
DATE: July 26, 1998

PROJECT #: 99-016



COMMENT #1: Peak Radiated Signal Level = Signal + Cable Loss + Antenna Factor
= 96.3 dBuV + 1.6 dB + 26.2 = 1 dBuV/m

COMMENT #2: 124.1 dBuV/m = 0.372 watts

TEST ENGINEER: _____ APPROVED BY: _____
John O'Brien Jeffery Lenk

Appendix E

Out-of-Band Emissions Test Data

Radiated Out-of-Band Emissions Data Sheet**Siemens Business Communication Systems
Gigaset 2420HS Handset**

SERIAL #: 6-070
 DATE: July 8, 1998
 PROJECT #: 99-016

MEASUREMENT DISTANCE (m): 1
 ANTENNA POLARIZATION: Vertical
 DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Elevation Meters	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.0	321.0	1.0	92.4	26.9	3.6	122.9	Ref	Ref
4966.0	321.0	1.0	12.4	36.5	5.8	54.7	63.5	-8.8
7449.0	321.0	1.0	11.2	36.0	6.0	53.2	63.5	-10.3
9932.0	321.0	1.0	32.3	38.0	5.8	76.1	102.9	-26.8
12415.0	321.0	1.0	11.1	38.4	8.5	58.0	63.5	-5.5
14897.0	321.0	1.0	34.6	41.0	10.0	85.6	102.9	-17.3
17381.0	321.0	1.0	37.9	43.2	11.3	92.4	102.9	-10.5

$$\text{Corrected Level} = \text{Recorded Level} + \text{Antenna Factor} + \text{Cable Loss}$$

COMMENT #1: All measurements above the fundamental are detection system noise floor

COMMENT #2:

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffery Lenk

Radiated Out-of-Band Emissions Data Sheet**Siemens Business Communication Systems
Gigaset 2420HS Handset**

SERIAL #: 6-070
 DATE: July 8, 1998
 PROJECT #: 99-016

MEASUREMENT DISTANCE (m): 1
 ANTENNA POLARIZATION: Horizontal
 DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Elevation Meters	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.0	290.0	1.0	94.7	26.9	3.6	125.2	Ref	Ref
4966.0	290.0	1.0	18.5	36.5	5.8	60.8	63.5	-2.7
7449.0	290.0	1.0	12.5	36.0	6.0	54.5	63.5	-9.0
9932.0	290.0	1.0	14.1	38.0	5.8	57.9	105.2	-47.3
12415.0	290.0	1.0	11.2	38.4	8.5	58.1	63.5	-5.4
14897.0	290.0	1.0	38.3	41.0	10.0	89.3	105.2	-15.9
17381.0	290.0	1.0	35.5	43.2	11.3	90.0	105.2	-15.2

Corrected Level = Recorded Level + Antenna Factor + Cable Loss

COMMENT #1: All measurements above the fundamental are detection system noise floor

COMMENT #2:

TEST ENGINEER: _____ APPROVED BY: _____
 John O'Brien Jeffery Lenk