

**Interactive Technologies, Inc.
System Sensor 2100 ARFT Smoke Alarm
B4Z-764A-SMOKE
Certification**

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Interactive Technologies Inc

**System Sensor 2100 ARFT Smoke Alarm
B4Z-764A-SMOKE**

8/19/1999

**Interactive Technologies, Inc.
2266 North Second Street
North Saint Paul, MN 55109
(651) 777-2690**

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1. Introduction

This device is a wireless fire alarm transmitter for use in a wireless security system. The unit is self-contained and powered by two 3.0 Volt Lithium batteries. The transmitter's frequency is crystal controlled and is not adjustable by the user. The device measures approximately 5" in diameter and 2" in height. The unit weighs approximately 6.5 ounces without batteries.

We are requesting Certification under FCC Rules, Part 15, Subpart C, Paragraph 15.231.

Please send comments/suggestions on the report format to jbergman@securitypro.com.

2. Statement of Compliance

§2.907

Certification

This is an application for certification

§2.911

Application

- a) This is an application and has been filed electronically with form 731.
- b) All information required has been supplied.
- c) The applicant has signed the application (electronically).
- d) The technical data has been signed.
(See Radiated Emissions)
- e) Applicant signature block on electronic form 731 completed by officer of the company or authorized company personnel.
- f) The appropriate fee has been paid electronically with VISA on 8/19/99.

§2.915

Grant

This application demonstrates that all applicable technical standards have been met and a grant of this application will serve the public interest.

§2.925

Label

Each piece of equipment for which authorization will be granted will be uniquely identified with "FCC ID: B4Z-764A-SMOKE." The required statement will appear with the FCC ID on the product and, although not required, in the installation instructions. See Exhibit A, PDF file *id_label.pdf*

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§2.947 Measurement Procedure

- a) The measurement procedure follows ANSI C63.4 procedure. Procedural notes are contained in the laboratory report.
- d) A list of test equipment used is contained in the laboratory report.

§2.948 Description of Measurement Facilities

Measurements were performed at TUV Testing Services Open Test Site. The FCC keeps a full description of the measurement facilities on file. TUV's acceptance and approval is dated as December 5, 1993 in a letter received from the FCC.

The address of the test facility is:

TUV Product Service
19035 Wild Mountain Road
Taylors Falls, MN 55084-1758

Phone: 651-638-0297
Contact: Joel Schneider
Test Engineer in Charge

See Exhibit F, PDF file *test_pho.pdf* for sketch of measurement setup

§2.1033 Application for Certification

- a) Form 731 has been electronically filed on 8/19/99. Items that did not apply were left blank.
- b) This technical report contains the following information where applicable.
 - 1) Full name and mailing address of manufacturer and applicant for certification:
Interactive Technologies Inc
2266 North Second Street
North Saint Paul, MN 55109
 - 2) FCC Identifier:
B4Z-764A-SMOKE
 - 3) Copy of installation instructions:
See Exhibit G, PDF file: *user_man.pdf*
 - 4) Brief Description of circuit functions and device operation:
See Exhibit I, PDF file *op_desc.pdf*
See Exhibit D, PDF file *schemat.pdf* for schematics (page 1) and parts placement (page 2) diagrams.

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- 5) Block Diagram
See Exhibit C, PDF file *block.pdf*.
- 6) Report of the measurements of radiation and conducted emissions:
This document.
- 7) Photographs
External:
See Exhibit B, PDF file *extern.pdf*
Internal:
See Exhibit H, PDF file *intern.pdf*
- 8) Peripheral or Accessory devices:
This is not applicable since this device is stand-alone product.
- 9) Transition Rules
This application is not pursuant to the transition rules of §15.37
- 10) Emergency Broadcast decoding:
This is not applicable to device in this application.
- 11) Application for direct sequence spread spectrum devices...
This is not applicable to device in this application.
- 12) Application for scanning receivers...
This is not applicable to device in this application.
- c) Composite Systems
This is not applicable to device in this application.

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3. Lab Measurements Discussion / Test Notes

3.1 Test Notes

3.1.1 Transmissions shall cease within 5 seconds of activation [**§15.231(a)(2)**]

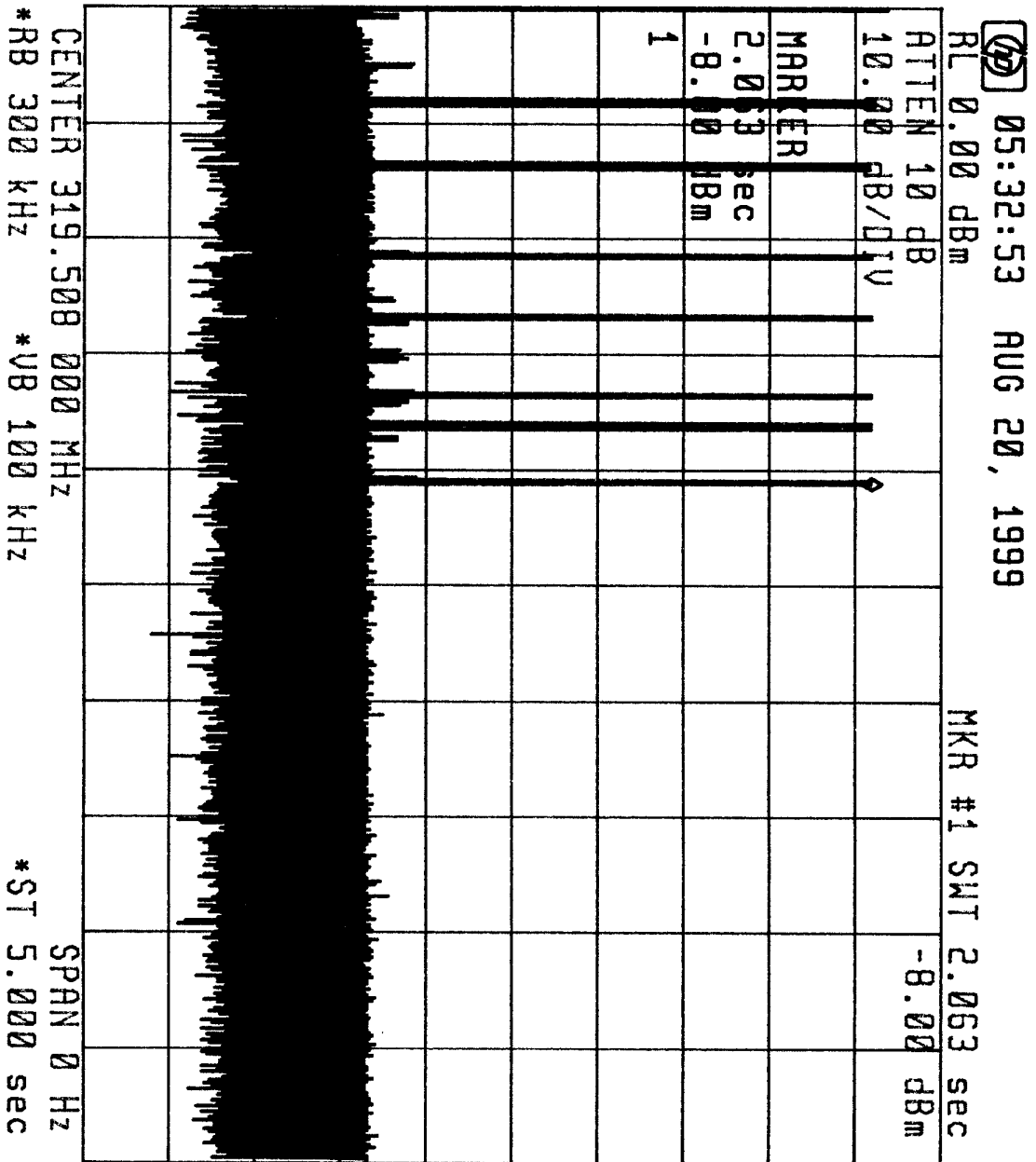
In the event of a smoke alarm, 8 packets are sent in the transmission. The packet duration is, at most, 30 mS, see **Duty Cycle Correction Factor** [§15.231(b)(2) and §15.35(c)]. The time between packets random between 100 mS and 450 mS so the length of the longest transmission is:

$$8*30\text{mS} + 7*450\text{mS} = 3.39 \text{ seconds.}$$

So long as the fire alarm condition is present, the device will re-transmit every minute as allowed in §15.231(a)(4).

The following plot shows an 8-packet transmission that concludes in less than 5 seconds.

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3.1.2 Supervisory Calculation [§15.231(a)(3)]

As permitted, this device will transmit three packets for supervision purposes. The inter-packet delay is a random time between 100 mS and 450 mS. The packet itself may be as long as 30 ms depending on the data sent. The longest time to conclude a supervisory transmission is then:

$$3 * 30 \text{ mS} + 2 * 450 \text{ mS} = 990 \text{ mS}$$

3.1.3 Duty Cycle Correction Factor [§15.231(b)(2) and §15.35(c)]

The transmitter employs amplitude modulation and transmits 64 bits. Each bit, except for one, has an “ON” time of 122 μ S. One bit has an on time of 366 μ S. The total on time of a single packet is:

$$64 * 122 \mu\text{S} + 366 \mu\text{S} = 8.174 \text{ mS}.$$

Only one packet is sent in any given 100 mS window for a duty cycle correction factor of:

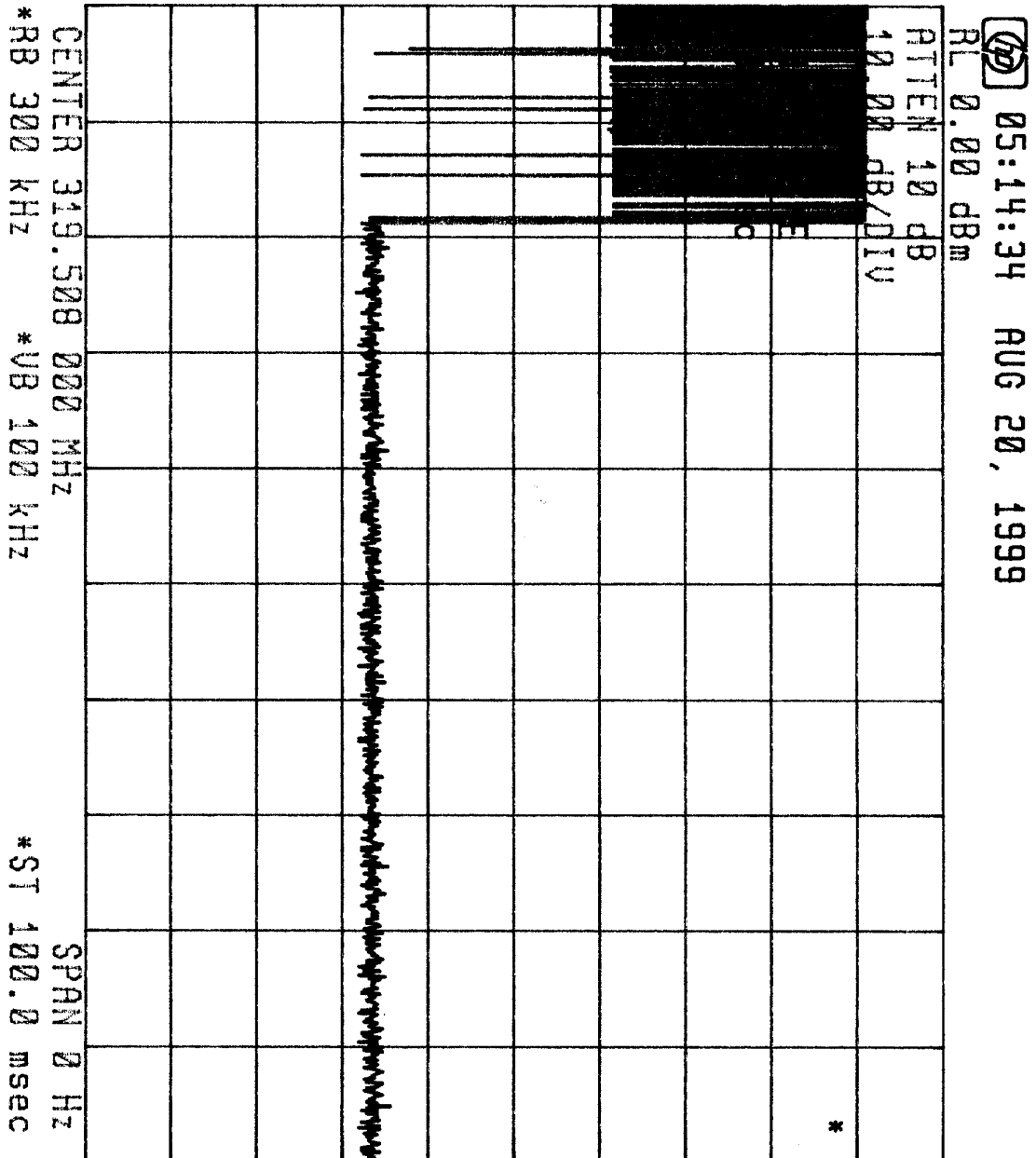
$$20 * \text{LOG}(8.174/100) = -21.75 \text{ dB}$$

The maximum allowed correction factor is 20 dB.

The following plots show:

1. Single packet in 100 mS window.
2. Expanded view of a packet with a duration of 18.62mS

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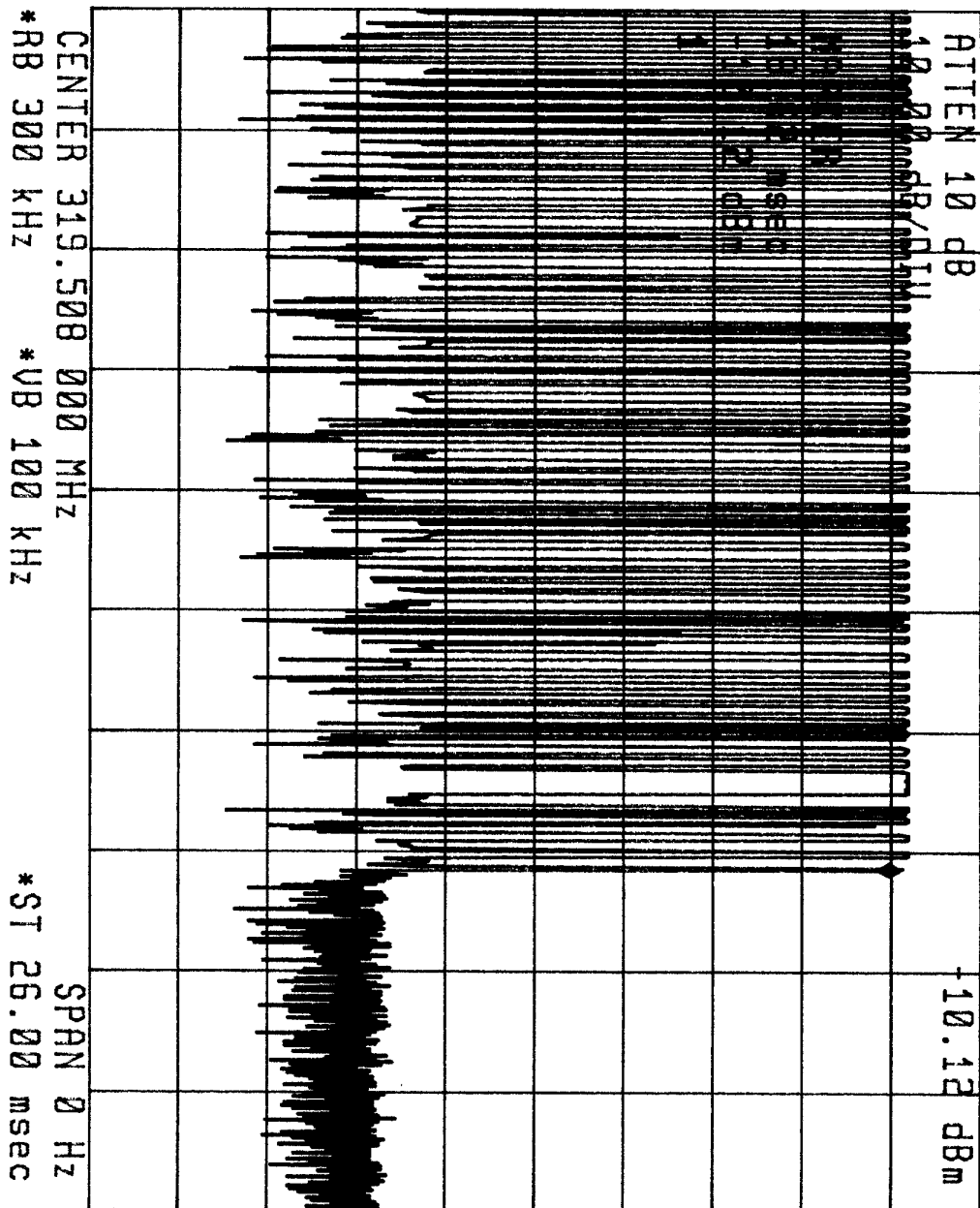
05:25:10 AUG 20, 1999

RL 0.00 dBm

MKR #1 SWT 18.62 msec

ATTEN 10 dB

-10.12 dBm



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3.1.4 Bandwidth Measurement [§15.231(c)]

Bandwidth Measurements were made in peak mode, using a Hewlett Packard Spectrum Analyzer, model number 70000.

The spectrum analyzer 20 dB skirt bandwidth is 7.3 KHz.

The allowed 20 dB bandwidth is 0.25% of center frequency.

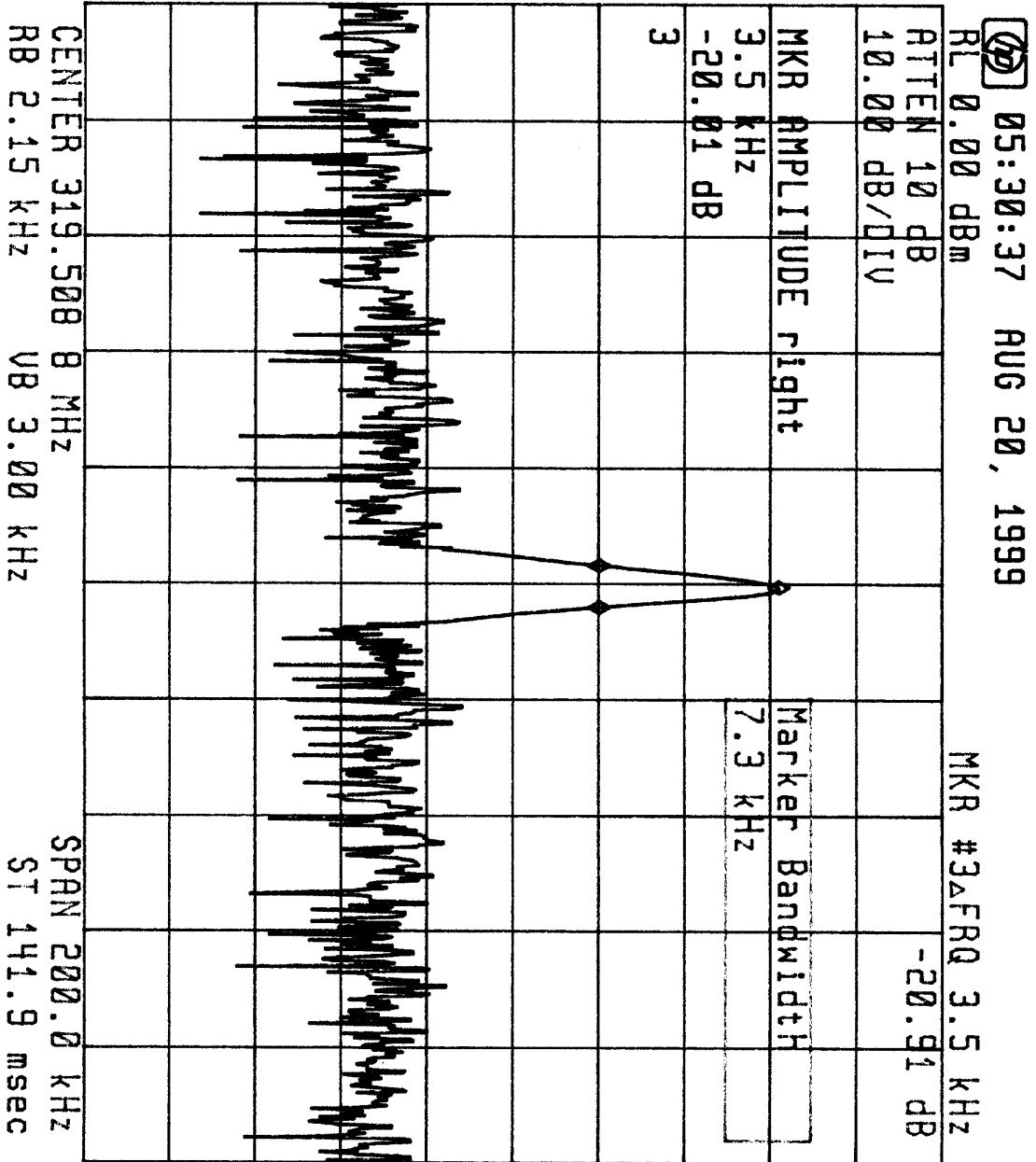
Estimated signal bandwidth = Measured signal bandwidth - analyzer bandwidth.

Center Frequency MHz	Measured 20 dB Bandwidth in KHz	Estimated 20 dB signal Bandwidth in KHz	FCC allowed 20 dB Bandwidth in KHz
319.5	124.8	117.5	799

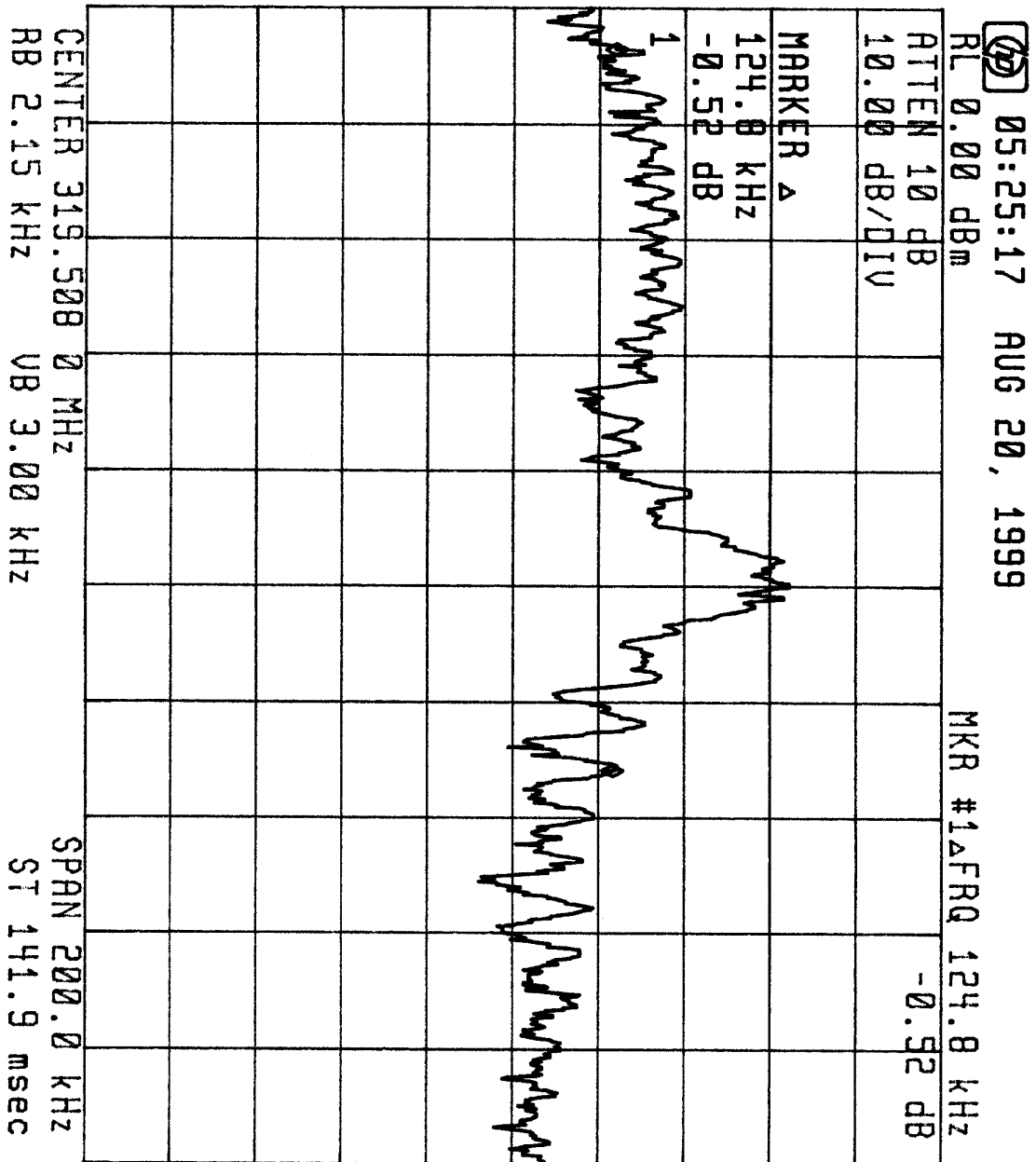
The following three plots show:

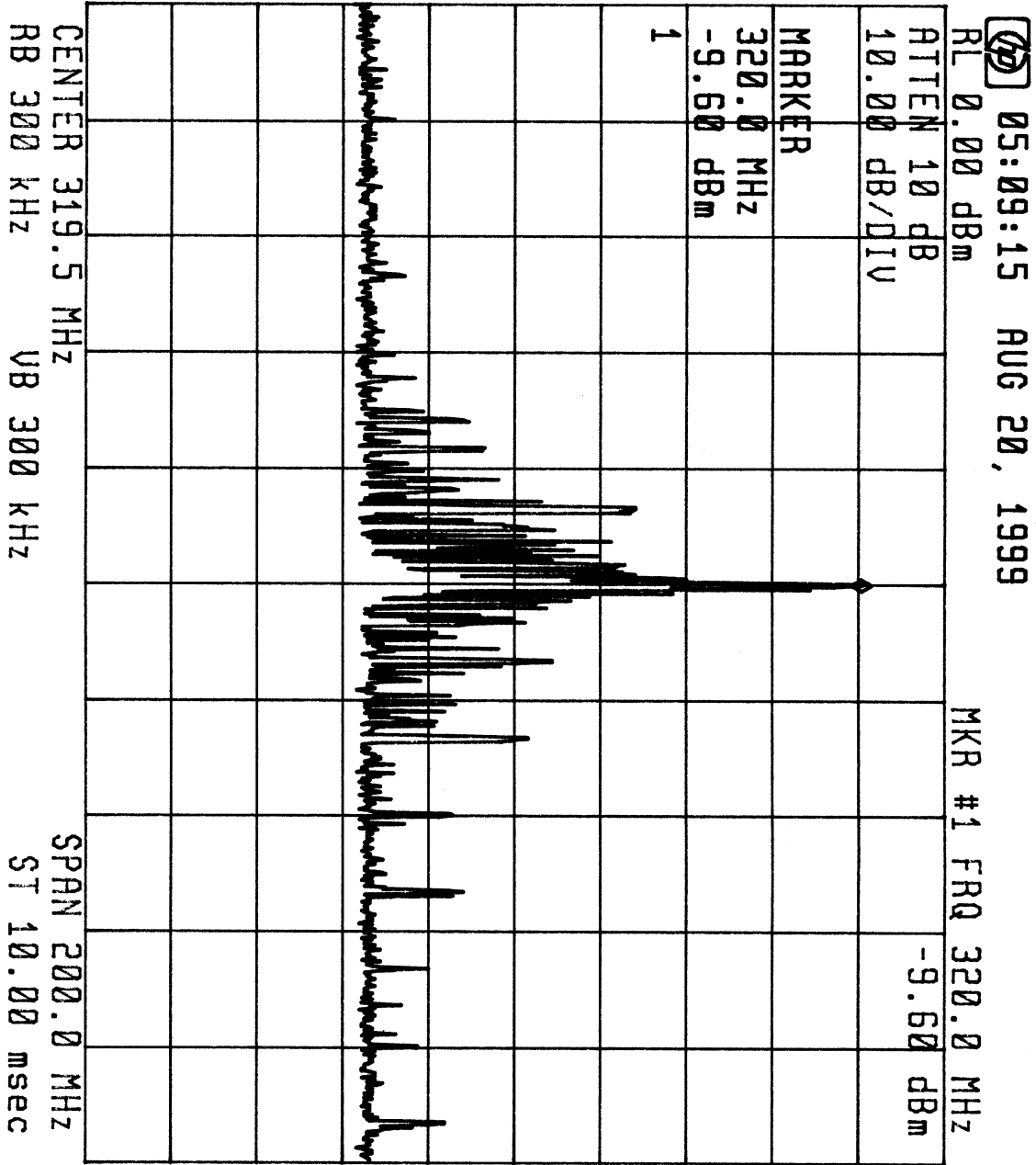
1. Bandwidth of carrier without modulation
2. Bandwidth of signal with modulation, 200 KHz span
3. Bandwidth of signal with modulation, 200 MHz span

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3.1.5 Emissions Measurements

3.1.5.1 Radiated Emissions Summary

The System Sensor 2100 ARFT passes FCC Rules Part 15, Subpart C, Paragraph 15.231. The highest fundamental radiated emission was 1.4 dB below the FCC limit at 319.5 MHz. The highest spurious emission measurement was 3.2 dB below the FCC limit at 532.46 MHz. The highest forbidden band emission was 6.3 dB below the FCC limit at 1065 MHz.

3.1.5.2 FCC Emissions Calculation

3.1.5.2.1 Terms

Term	Abbreviation	Units	Description
Analyzer Reading	AR	dB μ V	The power reading read directly from the analyzer without any correction for cabling or receive antenna.
Duty Cycle Correction	DC	dB	Correction for averaging measurement, see Duty Cycle Correction Factor [§15.231(b)(2) and §15.35(c)]
Antenna Factor	AF	dB	Calibration factor for measurement antenna which converts from dB μ V measured with antenna to the field strength received by the antenna in dB μ V/M.
Cable Loss	CL	dB	Amount of power lost in cable (and connectors, if any) between antenna and analyzer

3.1.5.2.2 Example Calculation

AR = 70 dB μ V

AF = 18.4 dB

CL = 4.1 dB

DC = 20 dB

The field strength for comparison to FCC limits is found to be:

$$AR + AF + CL - DC = 70 + 18.4 + 4.1 - 20 = 72.5 \text{ dB}\mu\text{V/M}$$

Alternatively, the AR + AF + CL is compared to the FCC limit + DC. This number is often written to the right of measurement data on the test results. For example, the FCC

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limit for ITI transmitters at 319.5 MHz is approximately 95.8 dB μ V/M. The limit from §15.231(b) with linear interpolation yields a limit, without consideration for duty cycle, of approximately 75.8 dB μ V/M.

To convert to μ V/M the following equation is used:

$$\mu\text{V/M} = \text{INVLOG}(\text{dB}\mu\text{V/M} / 20)$$

For the above example, 72.5 dB μ V/M is 4,216.965 μ V/M

3.1.5.3 Radiated Emissions

The highest fundamental emission along with the three highest spurious and restricted band emissions are listed below as per ANSI C63.4 paragraph 10.1.8.2. Emissions from 0.009 MHz to the tenth harmonic were measured as per FCC Rules Part 15, Subpart C, Paragraph 15.33(a). Emission limits were derived from §15.231(b).

Frequency	Analyzer Reading	Duty Cycle Correction	Antenna Factor	Cable Loss	Field Strength	Field Strength	FCC Limit
MHz	dB μ V	dB	dB	dB	dB μ V/M	μ V/M	μ V/M
319.46	77.30	20	15.5	1.6	74.40	5,248	6,229
532.46	51.25	20	18.9	2.2	52.35	414	623
638.96	49.10	20	20.5	2.4	52.00	398	623
425.96	52.15	20	17.0	1.9	51.05	357	623

3.1.5.4 Forbidden Bands

Noise floor of spectrum analyzer with antenna factors and duty cycle correction converted to μ V/M at approximately one meter.

All measurements were taken with an HP 8566B Spectrum Analyzer. The bandwidth was 100 KHz for measurements below 1000 MHz. The bandwidth was 1 MHz for measurements above 1000 MHz. The video filter was off.

The noise floor measurements are summarized in the table below. See also the test data included in this report.

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Frequency Range									
Low Limit	High Limit	Noise Floor Reading	Duty Cycle Corr	Ant Factor	Cable Loss	Field Strength	Field Strength	FCC Limit @ 3M	FCC Limit @ 1M
MHz	MHz	dBuV	dB	dB	dB	dBuV/M	uV/M	uV/M	uV/M
0.09000	0.11000	N/A	20	N/A	N/A	N/A	N/A	2400/F	
0.49500	0.50500	N/A	20	N/A	N/A	N/A	N/A	2400/F	
2.13750	2.19050	N/A	20	N/A	N/A	N/A	N/A	30	90
4.12500	4.12800	N/A	20	N/A	N/A	N/A	N/A	30	90
4.17725	4.17775	N/A	20	N/A	N/A	N/A	N/A	30	90
4.20725	4.20775	N/A	20	N/A	N/A	N/A	N/A	30	90
6.21500	6.21800	N/A	20	N/A	N/A	N/A	N/A	30	90
6.26775	6.26825	N/A	20	N/A	N/A	N/A	N/A	30	90
6.31175	6.31225	N/A	20	N/A	N/A	N/A	N/A	30	90
8.29100	8.29400	N/A	20	N/A	N/A	N/A	N/A	30	90
8.36200	8.36600	N/A	20	N/A	N/A	N/A	N/A	30	90
8.37625	8.38675	N/A	20	N/A	N/A	N/A	N/A	30	90
8.41425	8.41475	N/A	20	N/A	N/A	N/A	N/A	30	90
12.29000	12.29300	N/A	20	N/A	N/A	N/A	N/A	30	90
12.51975	12.52025	N/A	20	N/A	N/A	N/A	N/A	30	90
12.57675	12.57725	N/A	20	N/A	N/A	N/A	N/A	30	90
13.36000	13.41000	N/A	20	N/A	N/A	N/A	N/A	30	90
16.42000	16.42300	N/A	20	N/A	N/A	N/A	N/A	30	90
16.69475	16.69525	N/A	20	N/A	N/A	N/A	N/A	30	90
16.80425	16.80475	N/A	20	N/A	N/A	N/A	N/A	30	90
25.50000	25.67000	N/A	20	N/A	N/A	N/A	N/A	30	90
37.50000	38.25000	2.85	20	9.5	0.9	-6.8	0.5	100	300
73.00000	74.60000	2.85	20	9.5	0.9	-6.8	0.5	100	300
74.80000	75.20000	2.85	20	9.5	0.9	-6.8	0.5	100	300
108.00000	121.94000	2.85	20	9.5	0.9	-6.8	0.5	150	450
123.00000	138.00000	2.85	20	9.5	0.9	-6.8	0.5	150	450
149.90000	150.05000	2.85	20	9.5	0.9	-6.8	0.5	150	450
156.52475	156.52525	2.85	20	9.5	0.9	-6.8	0.5	150	450
156.70000	156.90000	2.85	20	9.5	0.9	-6.8	0.5	150	450
162.01250	167.17000	2.85	20	9.5	0.9	-6.8	0.5	150	450
167.72000	173.20000	2.85	20	9.5	0.9	-6.8	0.5	150	450
240.0	285.0	2.55	20	12.9	1.4	-3.2	0.7	200	600
322.0	335.4	19.20	20	12.9	1.4	13.5	4.7	200	600
399.9	410.0	19.20	20	21.7	2.7	23.6	15.1	200	600
608.0	614.0	19.20	20	21.7	2.7	23.6	15.1	200	600
960.0	1240.0	17.44	20	25.1	3.1	25.6	19.2	500	1500
1300.0	1427.0	17.44	20	25.1	3.1	25.6	19.2	500	1500
1435.0	1626.5	17.44	20	25.1	3.1	25.6	19.2	500	1500
1645.5	1646.5	17.44	20	25.1	3.1	25.6	19.2	500	1500
1660.0	1710.0	17.44	20	25.1	3.1	25.6	19.2	500	1500
1718.8	1722.2	17.44	20	25.1	3.1	25.6	19.2	500	1500
2200.0	2300.0	-1.15	20	29.4	4.7	13.0	4.4	500	1500
2310.0	2390.0	-1.15	20	29.4	4.7	13.0	4.4	500	1500
2483.5	2500.0	-1.15	20	29.4	4.7	13.0	4.4	500	1500
2655.0	2900.0	-1.15	20	30.1	5.3	14.3	5.2	500	1500
3260.0	3267.0	-2.15	20	31.2	5.9	15.0	5.6	500	1500
3332.0	3339.0	-2.15	20	31.2	5.9	15.0	5.6	500	1500
3345.8	3358.0	-2.15	20	31.2	5.9	15.0	5.6	500	1500
3600.0	4400.0	-2.15	20	31.2	5.9	15.0	5.6	500	1500

The test data follows on the next 3 pages:

Interactive Technologies Inc

TUV PRODUCT SERVICE

RADIATED EMISSIONS

Large Test Site
 3 Meter Antenna Distance
 Equipment Under Test:
 ITI
 SYSTEM SENSOR WIRELESS SMOKE DETECTOR
 Notes: 60-838-95

Report W9394 Run 1
 Date 08/18/99 Page 1
 Engineer
 Tech: RMJ
 Requester: *YJ*

Frequency MHz	Level dBuV	Factor dB	Cable dB	Final dBuV/m	Az deg	Polar\ Height	Delta	Delta
ALL READINGS MAXED IN PEAK.								
106.45	25.9	9.2	.9	36	--	H --		
180	2.55	12.5	1.2	16.2	--	H --		
NOISE FLOOR MEASUREMENT.								
212.95	52.5	12	1.3	65.8	--	H --		
319.46	77.3	15.5	1.6	94.4	--	H --		
319.46	62.8	15.5	1.6	79.9	--	V --		
425.96	52.15	17	1.9	71.1	--	H --		
532.46	51.25	18.9	2.2	72.3	--	H --		
638.96	49.1	20.5	2.4	72	--	H --		
745.46	43.4	21.7	2.7	67.7	--	H --		
851.97	42.55	22.9	2.9	68.3	--	H --		
958.47	40.55	24.5	3.1	68.1	--	H --		
300	19.2	15	1.6	35.8	--	H --		
NOISE FLOOR MEASUREMENT.								
700	17.45	21.8	2.6	41.8	--	H --		
NOISE FLOOR MEASUREMENT.								
1065.0	39.7	24.7	3.3	67.7	--	H --		
1171.5	29.8	25.2	3.4	58.4	--	H --		
1278.0	22	25.7	3.6	51.3	--	H --		
1384.5	28.5	26.2	3.8	58.4	--	V --		

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T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

Large Test Site
3 Meter Antenna Distance
Equipment Under Test:
ITI
SYSTEM SENSOR WIRELESS SMOKE DETECTOR
Notes: 60-838-95

Report W9394 Run 1
Date 08/16/99 Page 2
Engineer
Tech: RMJ
Requester *HH*

Frequency MHz	Level dBuV	Factor dB	Cable dB	Final dBuV/m	Az deg	Polar Height	Delta	Delta
1491.0	27.75	26.7	3.9	58.4	--	V --		
1597.5	28.1	27.2	4.1	59.4	--	V --		
1704.0	23.25	27.8	4.3	55.3	--	V --		
1810.5	17.8	28.4	4.4	50.6	--	V --		
1917.0	11.65	29	4.5	45.1	--	V --		
2023.5	13.25	29.4	4.7	47.5	--	V --		
2130.0	14.8	29.6	4.8	49.2	--	V --		
2236.5	21	29.7	5	55.7	--	V --		
2343.0	12.65	29.9	5.1	47.6	--	V --		
2449.5	4.15	30	5.2	39.4	--	V --		
2556.0	18.75	30.2	5.3	54.3	--	V --		
2662.5	15.25	30.5	5.5	51.2	--	V --		
2769.0	7.1	30.7	5.6	43.4	--	V --		
2875.5	12.95	30.9	5.7	49.6	--	V --		
2982.0	9.75	31.2	5.8	46.7	--	V --		
3088.5	7	31.7	5.9	44.6	--	V --		
3195.0	.95	32.2	6.1	39.2	--	V --		

2000 -1.15 29.4 4.7 32.9 -- V --

3000 -2.15 31.2 5.9 34.9 -- V --

THE LAST 2 READINGS WERE NOISE FLOOR MEASUREMENTS.
END OF SCAN.

Interactive Technologies Inc

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

Large Test Site
3 Meter Antenna Distance
Equipment Under Test:
ITI
SYSTEM SENSOR WIRELESS SMOKE DETECTOR
Notes: 60-838-95

Figure

Report W9394 Run 1
Date 08/16/99 Page 3
Engineer
Tech: RMJ
Requester *HL*

Measurement Summary

Frequency MHz	Final dBuV/m	Final uV/m	Azimuth deg	Polar Height	Delta	Delta
106.45	36	63.095	--	H --		
180	16.2	6.4565	--	H --		
212.95	65.8	1949.8	--	H --		
300	35.8	61.659	--	H --		
319.46	94.4	58480.	--	H --		
425.96	71.1	3589.2	--	H --		
532.46	72.3	4180.9	--	H --		
638.96	72	3981.0	--	H --		
700	41.8	123.02	--	H --		
745.46	67.7	2426.6	--	H --		
851.97	68.3	2600.1	--	H --		
958.47	68.1	2540.9	--	H --		
1065.0	67.7	2426.6	--	H --		
1171.5	58.4	831.76	--	H --		
1278.0	51.3	367.28	--	H --		
1384.5	58.4	831.76	--	V --		
1491.0	58.4	831.76	--	V --		
1597.5	59.4	933.25	--	V --		
1704.0	55.3	582.10	--	V --		
1810.5	50.6	338.84	--	V --		
1917.0	45.1	179.88	--	V --		
2000	32.9	44.157	--	V --		
2023.5	47.5	237.13	--	V --		
2130.0	49.2	288.40	--	V --		
2236.5	55.7	609.53	--	V --		
2343.0	47.6	239.88	--	V --		
2449.5	39.4	93.325	--	V --		
2556.0	54.3	518.8	--	V --		
2662.5	51.2	363.07	--	V --		
2769.0	43.4	147.91	--	V --		
2875.5	49.6	301.99	--	V --		
2982.0	46.7	216.27	--	V --		
3000	34.9	55.590	--	V --		
3088.5	44.6	169.82	--	V --		
3195.0	39.2	91.201	--	V --		

File W9394 Run 1