

TYPE OF EXHIBIT: TEST REPORT

FCC PART: 2.1033 (c)(14)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

Following is a list of attached exhibits required by the Federal Communications Commission for the application to and grant of FCC Certification.

Statement of Certifying Engineer	2.947
List of Test Equipment Used	2.947 (d)
Description of Measurement Facility	2.948
Required Measurements	2.1033 (c)(14)
Radio Frequency Power Output	2.1046
Modulator Response	2.1047 (a)
Speech Amplifier Low-Pass Filter Response	2.1047 (a)
Percent of Modulation vs. Modulation Input Voltage	2.1047 (b)
Occupied Bandwidth	2.1049 (c)(1)
Spurious Emissions at Antenna Terminals	2.1051
Field Strength of Spurious Emissions	2.1053
Frequency Stability vs. Temperature	2.1055 (a)(1)
Frequency Stability vs. Battery Voltage	2.1055 (d)
Transient Frequency Behavior	90.214

TYPE OF EXHIBIT: STATEMENT OF CERTIFYING ENGINEER

FCC PART: 2.947

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

I, Kevin G. Matson, have been employed by RITRON, Inc. since May 1980, working in the Engineering Department since November 1980 as a radio frequency Project Engineer.

I received an Associates Degree in Electrical Engineering Technology from Purdue University at Indianapolis in 1980. I received a Bachelor of Science Degree in Electrical Engineering Technology from Purdue University at Indianapolis in 1982.

I hereby certify that all measurements and data herein were taken by me, that they were obtained using sound and accepted engineering principles, and that they accurately reflect the performance and characteristics of the units tested.

Signed: 
Kevin G. Matson - Project Engineer

TYPE OF EXHIBIT: TEST EQUIPMENT LIST

FCC PART: 2.947 (d)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 4
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

The measured data in this report was obtained using one or more of the following pieces of equipment. The particular equipment used in any one test is detailed in the procedure for that test.

<u>ITEM</u>	<u>MANUFACTURER</u>	<u>MODEL NO.</u>	<u>SERIAL NO.</u>
Communications Test Set	IFR	COM-120B	485002391
RF Signal Generator	Marconi Instruments	2022	119019/120
Spectrum Analyzer	Hewlett-Packard	8560E	3720A02980
Audio Sweep Generator	B & K Precision	4010	275-00893
Power Supply	VIZ	WP 706A	3429D3
Digital Oscilloscope	Philips	PM-3335	DM648004
Dual Display Multimeter	Fluke	45	6723040
Digital VOM	Fluke	2704A	234-008459
RF Wattmeter	Bird	6154	8652
Dipole Antenna	Electro-Metrics	EM-6924	241
Dipole Antenna	Electro-Metrics	BDA-25	8-101
Log Periodic Antenna	Electro-Metrics	LP-25	8-102
Microwave Test Antenna	Polarad	CA-B	11-3
Temperature Chamber	Associated Laboratories	ELH-0.5-LC	N/A
Thermocouple	Omega	7035-J-225	8504
30dB Power Attenuator	Bird	8306-300-N	N/A
10dB Attenuator	ELCOM	AT-51-10	N/A
RF Detector	Microlabs/FXR	XA-1040	N/A

TYPE OF EXHIBIT:	DESCRIPTION OF MEASUREMENT FACILITY
FCC PART:	2.948
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODEL:	SPX-200
FCC ID:	AIERIT19-150
DATE:	December 21, 2004

The Field Strength measurements filed with this application were made on a site certified by RITRON, Inc. Data pertaining to this site is on file with the FCC and is current.

This site is used exclusively by RITRON, Inc. and is utilized only for the RF Field Strength Measurements of equipment designed and manufactured by RITRON, Inc. It is NOT used for measurements by or for any other party on a contract basis or otherwise.

Signed:


Kevin G. Matson - Project Engineer

TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT

FCC PART: 2.1046

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.2
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 150.050, 154.570 and 173.050 MHz (Fo) at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual. This represents frequencies at the low, middle and high end of the SPX-200 operating frequency band.
2. Power was supplied to the SPX-200 via battery input connector J301 by a VIZ Model WP 706A power supply. The power supply was set for +7.2VDC. The SPX-200 was connected at antenna terminal ANT201 to the input of a Bird 6154 Thermaline Wattmeter, used to measure RF power of the carrier.
3. A BK Model 2704A Digital Multimeter was connected in series with pin 3 of Q101 to measure the current of Q101, the RF amplifier device. A Micronta Model 22-191 Digital Multimeter was used to measure Q101 supply voltage at pin 3.
4. Measurements were taken with the SPX-200 set for low and high power operation at each frequency.

TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT

FCC PART: 2.1046

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.2

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

TEST RESULTS:

Battery Input(+7.2 VDC) : J301

Frequency (MHz)	High/Low Power	Collector Voltage (VDC)	Collector Current (Amps)	Input Power (Watts)	Output Power (Watts)	Efficiency
150.050	High	7.2	1.81	13.03	5.10	39.1%
	Low	7.2	0.72	5.18	0.81	15.6%
154.570	High	7.2	1.87	13.46	5.30	39.4%
	Low	7.2	0.76	5.47	0.95	17.4%
173.050	High	7.2	1.84	13.25	5.00	37.7%
	Low	7.2	0.72	5.18	0.76	14.7%

Certifying Engineer:

Kevin G. Matson

Kevin G. Matson - Project Engineer

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.6
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 154.570 MHz (Fo) at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual.
2. The SPX-200 speech amplifier was disconnected from the modulator at R394. The output of a BK Precision Model 4010 Function Generator was connected to R394 through a 100 μ F capacitor.
3. The SPX-200 was connected at antenna terminal ANT201 to the 50 Ω RF input of the HP 8920B, which was used to measure FM deviation.
4. The audio signal generator was set to a frequency of 1000 Hz and the output was adjusted to provide +/- 1.5 kHz deviation (60% rated system deviation) as indicated by the HP 8920B. This output level was 160mVrms.
5. With the audio generator output level fixed at 160 mVrms, the frequency was varied from 100 - 5000 Hz. Deviation was measured at various frequencies within this range and recorded on the accompanying chart.
6. A separate measurement was made for sub-audible tones. The audio signal generator was set for various sub-audible tones between 67 - 250 Hz at an output level of 42 mVrms, the level required to produce 450 Hz deviation at 100 Hz. There was no variation in resulting deviation across the sub-audible frequency range.
7. The circuit was restored to normal operation. The audio signal was injected at the microphone input. The audio frequency was adjusted to find the frequency of maximum deviation. The audio level was set to insure that clipping did not occur. The audio generator was set to 1000 Hz and the deviation noted and referenced to 0 dB.

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

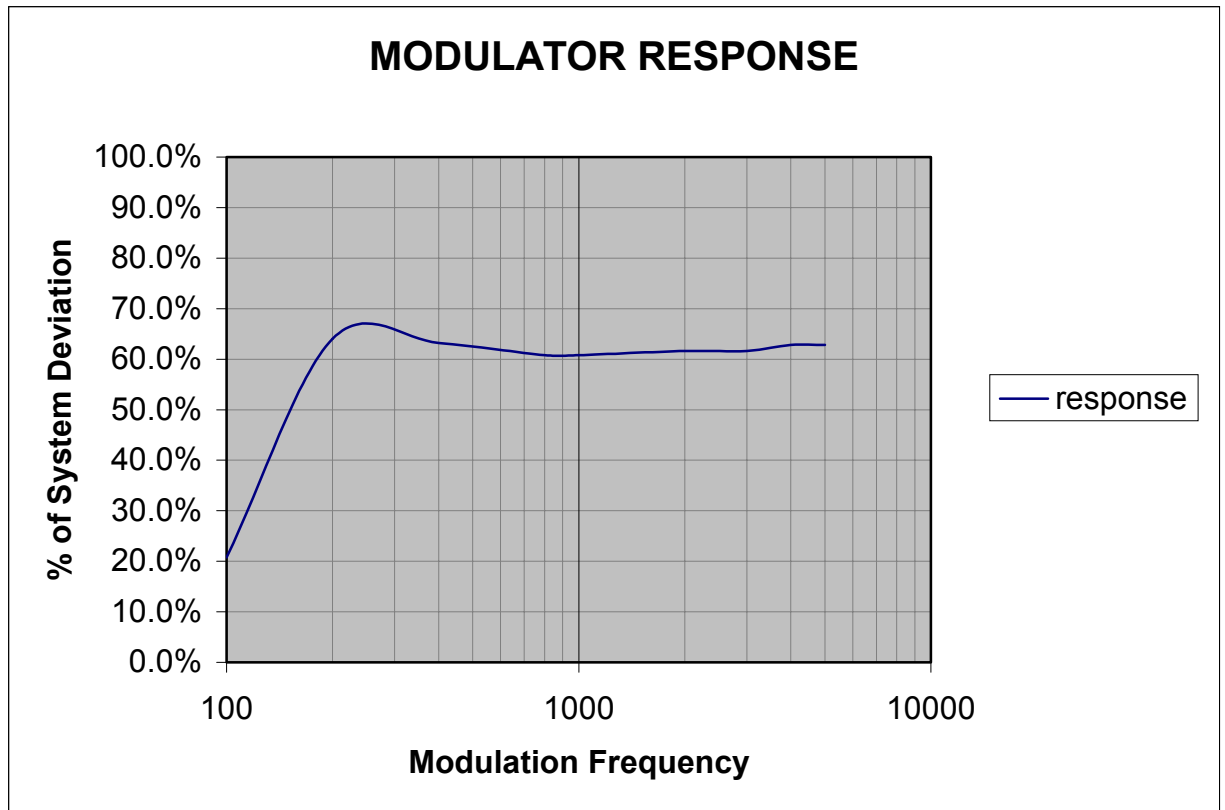
DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.6

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

CURVE:



Certifying Engineer:

Kevin G. Matson

Kevin G. Matson - Project Engineer

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

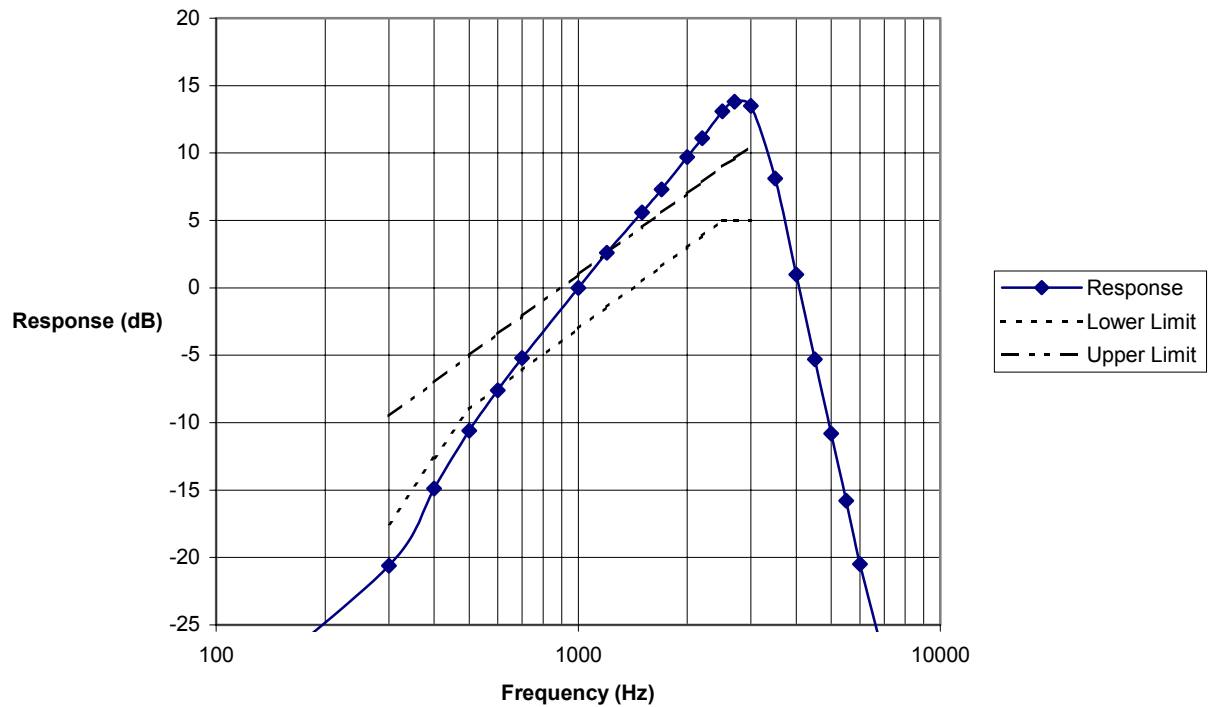
IC STANDARDS: RSS-119, Issue 6, Section 6.6

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

CURVE:

Composite Transmitter Audio Response



Certifying Engineer:

Kevin G. Matson

Kevin G. Matson - Project Engineer

TYPE OF TEST: SPEECH AMPLIFIER LOW-PASS FILTER RESPONSE

FCC PART: 2.1047 (a)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.6
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The stages of the SPX-200 speech amplifier prior to the low-pass filter were removed by disconnecting R309 from the output of limiting amplifier U8.
2. The output of a BK Precision Model 4010 Function Generator was applied to U17A pin 2.
3. A Fluke Model 45 Dual Display Multimeter was used to measure the low-pass filter output at Pin 7 of U7B.
4. The audio signal generator was set for a 1000 Hz sine wave at an output level to prevent limiting or distortion at any frequency at the output of the low-pass filter. The Fluke Model 45 Dual Display Multimeter was set to make all measurements relative to this reference level.
5. The frequency of the audio signal generator was varied from 100 to 100 kHz with the output level constant. Measurements were recorded on the accompanying chart. All measurements were +/- relative to 1000 Hz.

TYPE OF TEST: SPEECH AMPLIFIER LOW-PASS FILTER RESPONSE

FCC PART: 2.1047 (a)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

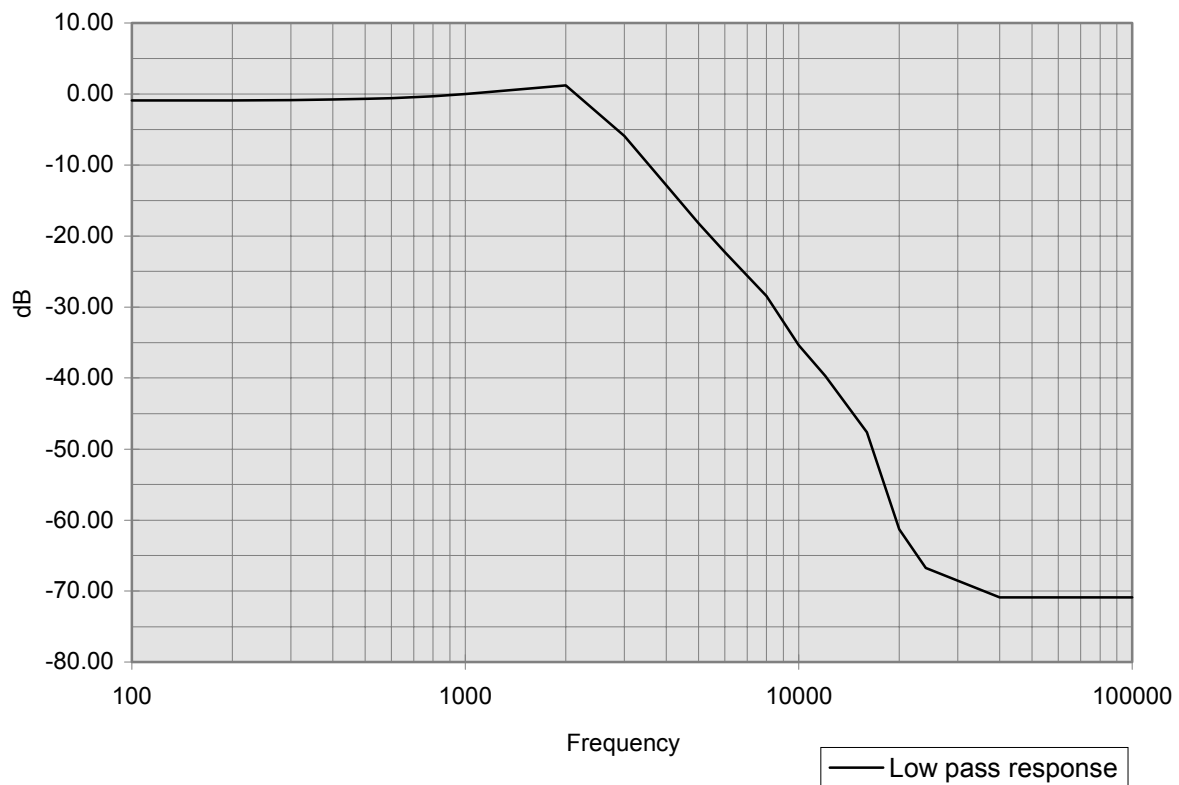
DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.6

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

CURVE:



TYPE OF TEST: PERCENT MODULATION VS. MODULATION INPUT VOLTAGE

FCC PART: 2.1047 (b)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.6
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 154.570 MHz (Fo) per the tune-up procedure outlined in the Preliminary Maintenance Manual.
2. The SPX-200 was connected at antenna terminal ANT201 to the RF input of an HP8920B Communications Test Set used to measure FM deviation.
3. The output of a BK Precision Model 4010 Function Generator was applied to the microphone input of the SPX-200 through the microphone jack. The output of the audio generator was set to an output level of 1.0 Vrms, a level sufficient to drive the audio circuit into limiting at any frequency.
4. A Fluke Model 45 Dual Display Multimeter was used to measure the amplitude of the signal applied to the microphone input.
5. The frequency of the audio generator was adjusted to find the frequency of maximum response. The SPX-200 was set for 12.5 kHz bandwidth operation and the deviation was adjusted for +/- 2.5 kHz as outlined in the Preliminary Maintenance Manual.
6. The frequency of the audio signal generator was set to 300 Hz and the output level was adjusted to produce 250 Hz deviation, which is 10% of the rated modulation. The voltage level was then adjusted for 20% of the rated modulation, and repeated for every 10% increment.
7. The input voltage was adjusted to a level 16 dB greater than required to produce 50% modulation. The maximum deviation was noted, along with the level required to achieve it, if 100% modulation was not realized.
8. Steps 6 and 7 were repeated for frequencies of 500, 750, 1000, 2000 and 3000 Hz.
9. The SPX-200 was set for 25 kHz bandwidth operation and the deviation was adjusted for +/- 5 kHz as outlined in the Preliminary Maintenance Manual.
10. Steps 6, 7 and 8 were repeated for 25 kHz bandwidth operation.
11. Results were plotted on separate graphs for 12.5 kHz and 25 kHz bandwidth operation.

TYPE OF TEST: PERCENT MODULATION VS. MODULATION INPUT VOLTAGE

FCC PART: 2.1047 (b)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

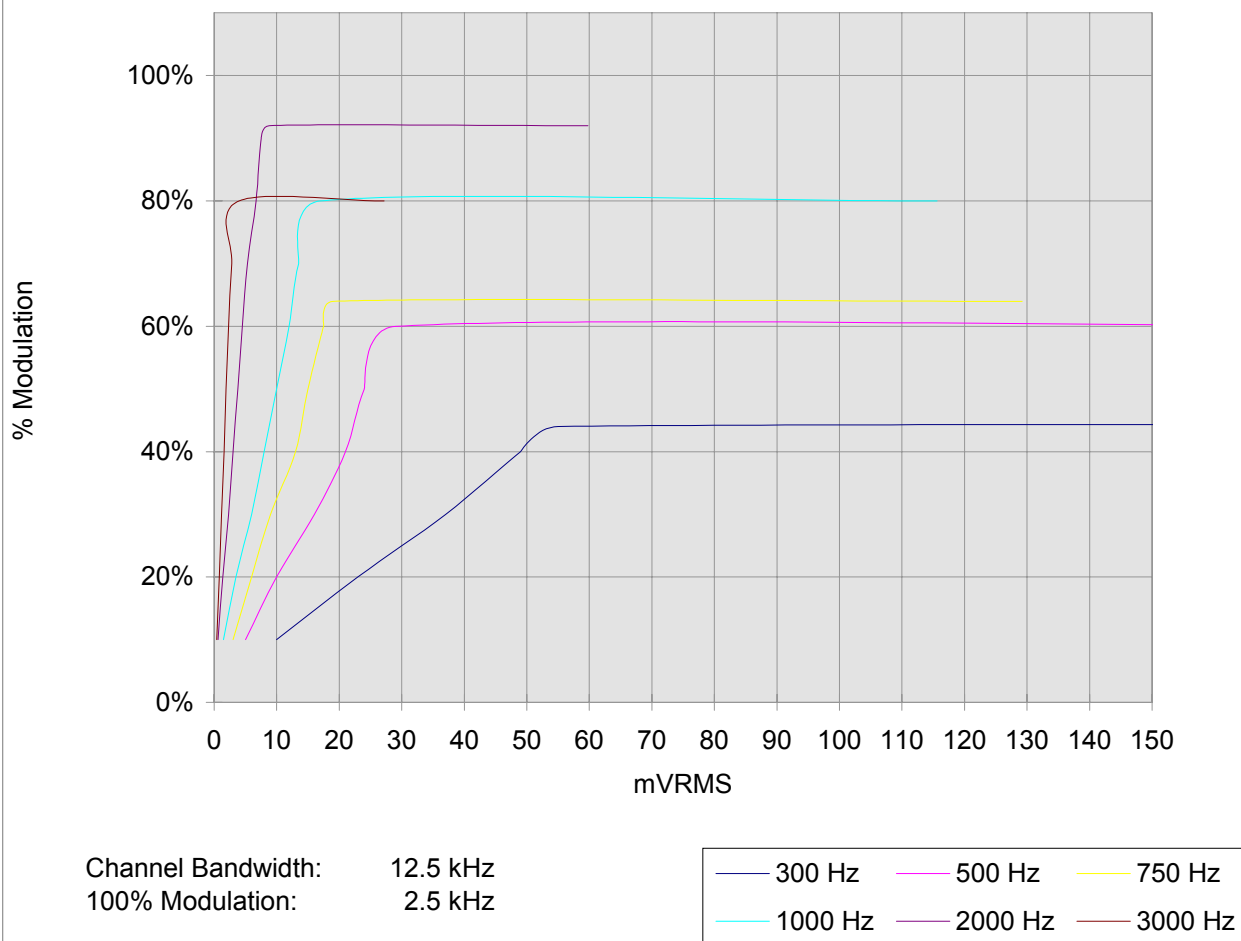
DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.6

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

CURVES:



TYPE OF TEST: PERCENT MODULATION VS. MODULATION INPUT VOLTAGE

FCC PART: 2.1047 (b)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

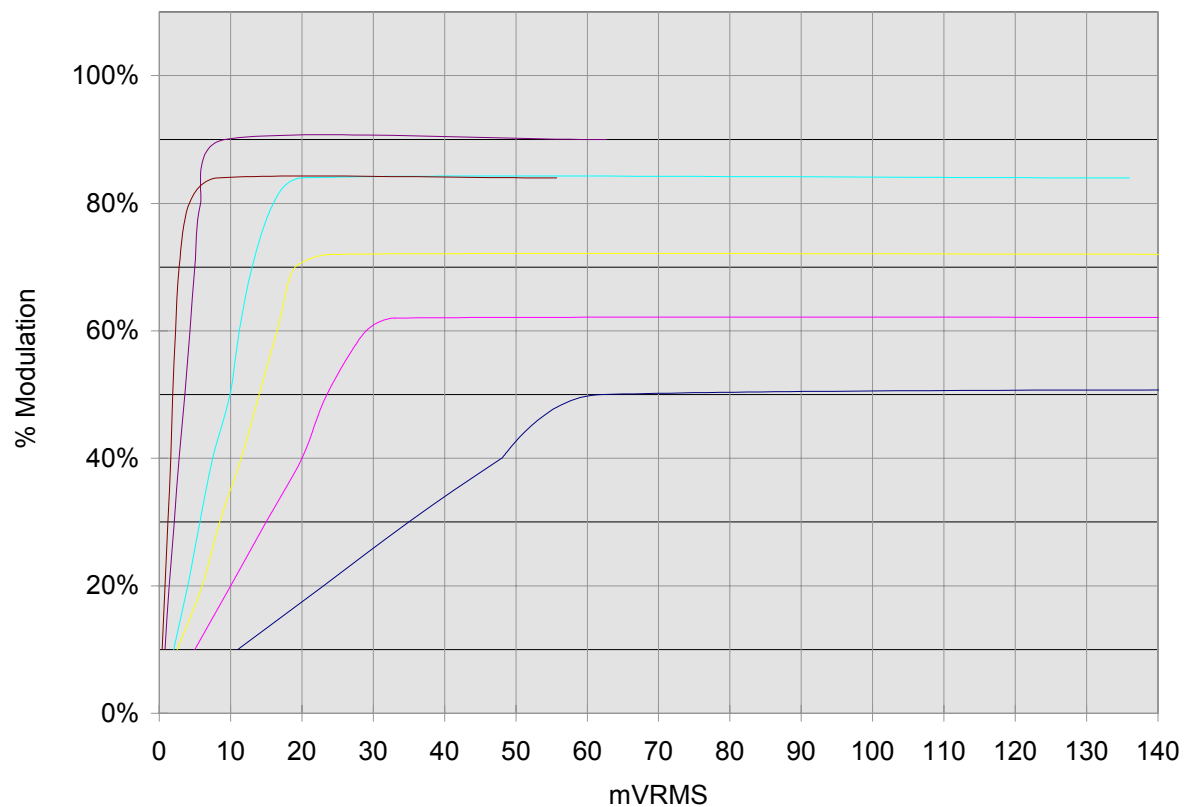
MODELS: SPX-200

FCC ID: AIERIT19-150

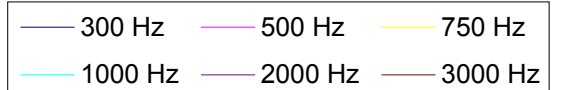
DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.6
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

CURVES:



Channel Bandwidth: 25.0 kHz
100% Modulation: 5.0 kHz



TYPE OF TEST: OCCUPIED BANDWIDTH

FCC PART: 2.1049 (c)(1) per 90.210 (b)(d)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.4
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 154.570 MHz (Fo) at full rated power, was set for 12.5 kHz bandwidth operation, and the deviation was adjusted for +/- 2.5 kHz as outlined in the Preliminary Maintenance Manual.
2. The RF output antenna terminal ANT201 was connected to the input of a Bird Model 8306-300-N 30 DB power attenuator. The output of the attenuator was connected to the input of a Hewlett Packard Model 8560E Spectrum Analyzer. The spectrum analyzer was set to:
 - 100 Hz Resolution Bandwidth
 - 100 Hz Video Bandwidth
 - 5 kHz per Horizontal Division
 - 10 dB per Vertical Division
3. The center frequency of the spectrum analyzer was set to the SPX-200 carrier frequency and the full scale reference line was set to the level of the unmodulated carrier.
4. The output of a BK Precision Model 4010 Function Generator was applied to the microphone input of the SPX-200. The frequency of the audio signal generator was set to 2500 Hz and the output adjusted to a level 16 dB greater than that necessary to produce 50% of the rated system deviation at the frequency of maximum response.
5. The spectrum analyzer output was plotted with emission mask D.
6. The SPX-200 was set for 25 kHz bandwidth operation, and the deviation was adjusted for +/- 5 kHz as outlined in the Preliminary Maintenance Manual. Steps 3 and 4 were repeated for 25 kHz bandwidth operation. The spectrum analyzer output was plotted with emission mask B.

TYPE OF TEST: OCCUPIED BANDWIDTH

FCC PART: 2.1049 (c)(1) per 90.210 (b)(d)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.4

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

RESULTS:

By Carson's rule, occupied bandwidth for an FM signal may be calculated by:

$BW = 2(f_{\Delta} + f_m)$ where f_{Δ} is the frequency deviation and f_m is the modulating frequency.

For 12.5 kHz operation, f_{Δ} is 2.50 kHz and f_m is 3 kHz, therefore

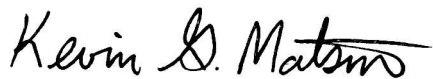
$BW = 11 \text{ kHz}$

Since this product will be transmitting voice, the emission designator for 12.5 kHz channel operation is: 11K0F3E.

For 25 kHz operation, f_{Δ} is 5.0 kHz and f_m is 3 kHz, therefore $BW = 16 \text{ kHz}$

Since this product will be transmitting voice, the emission designator for 25 kHz channel operation is: 16K0F3E.

Certifying Engineer:



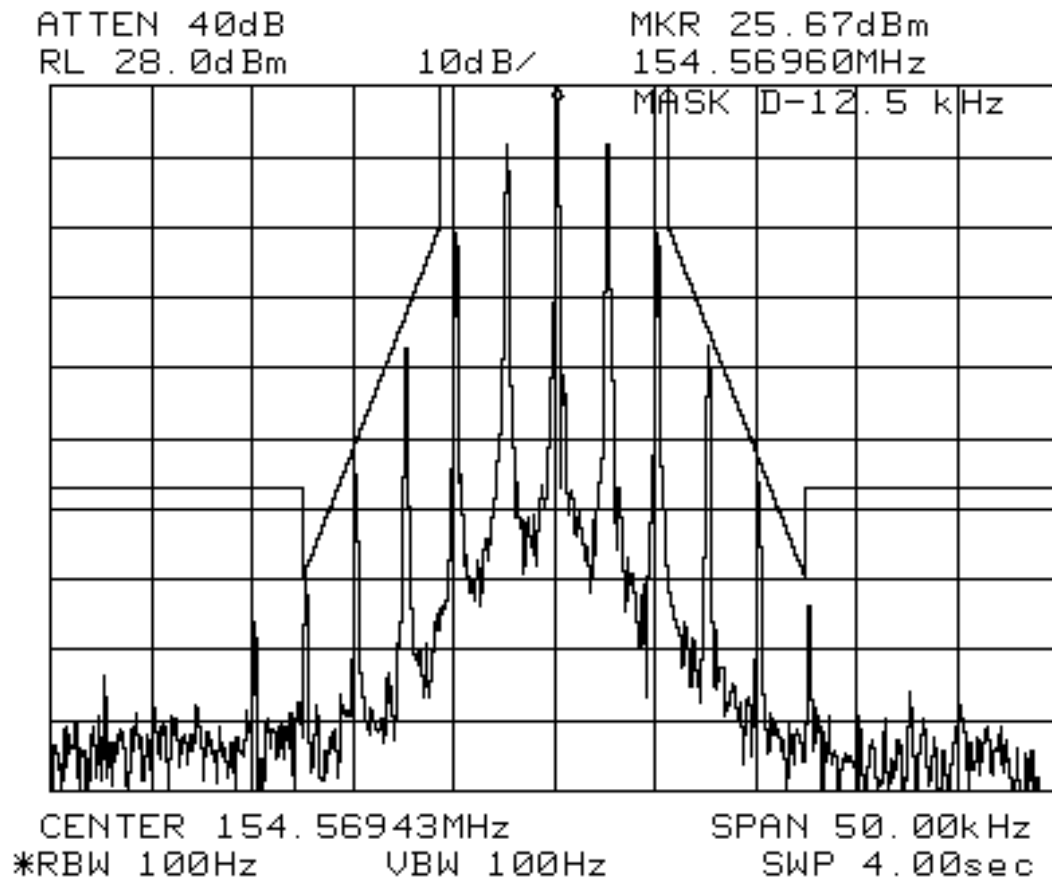
Kevin G. Matson - Project Engineer

TYPE OF TEST: OCCUPIED BANDWIDTH
FCC PART: 2.1049 (c)(1) per 90.210 (b)(d)
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032
MODELS: SPX-200
FCC ID: AIERIT19-150
DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.4
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

CURVE:

12.5 kHz Bandwidth



TYPE OF TEST: OCCUPIED BANDWIDTH

FCC PART: 2.1049 (c)(1) per 90.210 (b)(d)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

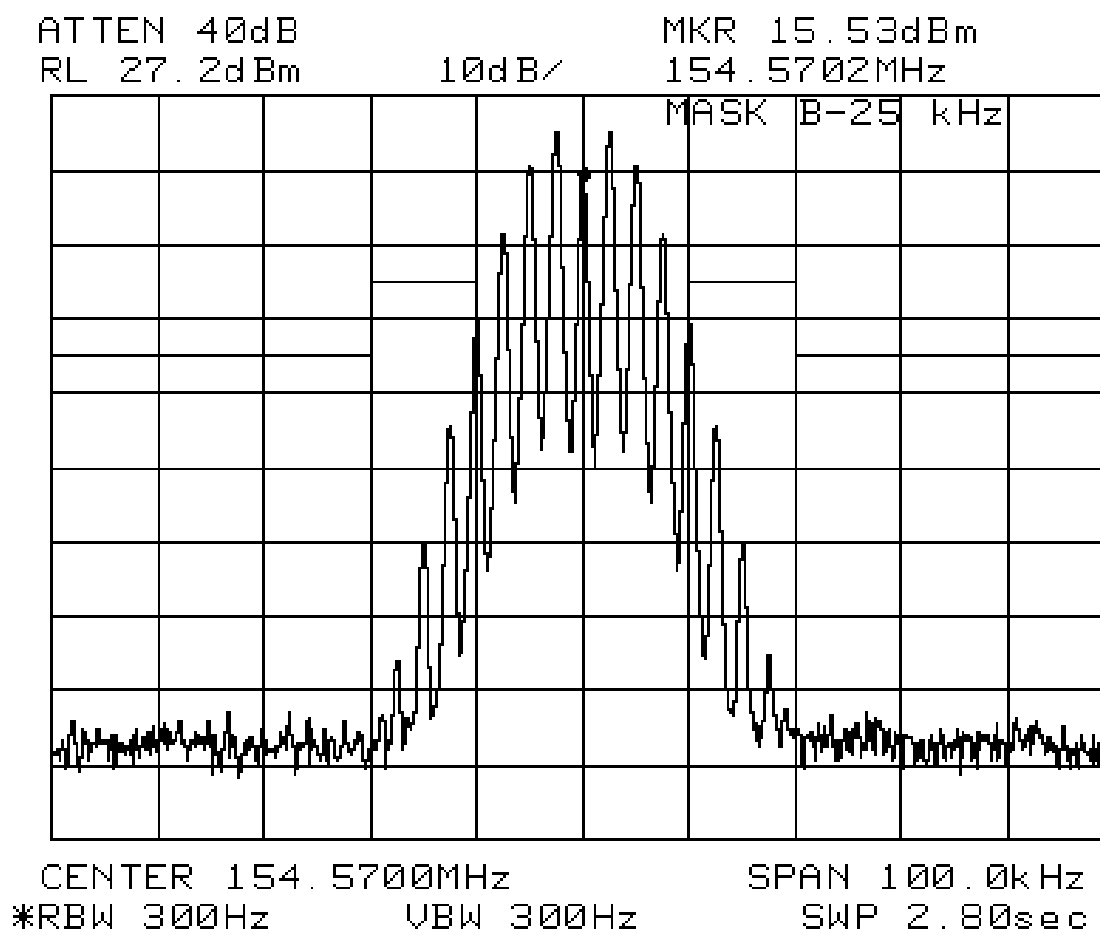
FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.4
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

CURVE:

25 kHz Bandwidth



TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.1051

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.3

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 154.570 MHz (Fo) at 5.0 Watts, the full rated power, and 1 Watt per the tune-up procedure outlined in the Preliminary Maintenance Manual.
2. Power was supplied to the SPX-200 by the VIZ Power Supply and connected to the battery input J301. The supply voltage was set at +7.2 VDC to simulate the internal battery voltage.
3. The transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation as specified in FCC Part 2.1049 (c)(1).
4. The SPX-200 antenna terminal ANT201 was connected to the input of a Bird Model 8306-300-N, 30 dB power attenuator. The output of the attenuator was connected to the input of a Hewlett-Packard Model 8560E Spectrum Analyzer.
5. The spectrum was searched from 8 MHz to the 10th harmonic of the operating frequency. All unreported emissions were more than 20 dB below the FCC limit of $50 + 10 \log P$, or -20 dBm.
6. The measured insertion loss of the attenuators and cables are listed as the "Correction Factor" on the data sheet.
7. Resultant Amplitude = Measured Amplitude + Correction Factor

TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.1051

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.3
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

TEST RESULTS:

Carrier Frequency (Fo): 154.570 MHz
Oscillator Frequency: 14.4 MHz
Output Power: 4.5 Watts
FCC Limit: -20 dBm

Emmission Frequency (MHz)	Multiple of Carrier(fo)	Measured Amplitude (dBm)	Correction Factor (dB)	Resultant Amplitude (dBm)
Battery Input P501:				
462.625	fo	+6.5	29.9	+36.4
925.250	fo * 2	-64.0	29.5	--34.5

Certifying Engineer:


Kevin G. Matson - Project Engineer

TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.1051

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.3
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

TEST RESULTS:

Carrier Frequency (Fo): 154.570 MHz
Oscillator Frequency: 14.4 MHz
Output Power: 1.0 Watts
FCC Limit: -20 dBm

Emmission Frequency (MHz)	Multiple of Carrier(fo)	Measured Amplitude (dBm)	Correction Factor (dB)	Resultant Amplitude (dBm)
Battery Input P501:				
462.625	fo	0.0	29.9	+29.9
925.250	fo * 2	-59.0	29.5	--29.5
1387.875	fo * 3	-73.0	29.7	--43.3

Certifying Engineer:

Kevin G. Matson

Kevin G. Matson - Project Engineer

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.0153

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

PROCEDURE:

- 1, The measurements for effective radiated power and field strength of spurious radiation were taken at the RITRON, Inc. 3 meter test site using the substitution method. The measurements were made in accordance with FCC Rules & Regulations Part 2.947.
2. The SPX-200 was aligned for transmitter operation on 154.570 MHz at 5.0 Watts per the tune-up procedure outlined in the Preliminary Maintenance Manual. The unit was then terminated at the antenna port with the antenna sold with this product. Power was supplied to the SPX-200 by its own installed battery pack.
3. All field strength measurements were made with the Hewlett-Packard Model 8560E Spectrum Analyzer and the appropriate antenna for the frequency being measured. The antennas used were:
 - Calibrated ½-wave dipole tuned to desired harmonic
 - Electro-Metrics LP-25 Log Periodic Antenna at 200 to 1000 MHz
4. A tuned dipole was substituted at the radio side of the range driven by a known power to produce a known ERP at each harmonic. The receiving antenna was oriented both vertically and horizontally and reference measurements were taken at each harmonic.
5. For each emission, the height and polarization of the field strength measurement antenna and orientation of the SPX-200 were varied to provide maximum field strength.
6. The spectrum was searched from 4 MHz to the 10th harmonic of the transmit frequency. All unreported emissions were more than 20 dB below the FCC limits specified in Part 90.210(d)(3).
7. ERP (dBm) = analyzer reading of emission (dBm) – 0dB substitution analyzer reading (dBm)

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS RADIATION
FCC PART: 2.1053
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032
MODELS: SPX-200
FCC ID: AIERIT19-150
DATE: December 21, 2004

RESULTS:

Emmission Frequency (MHz)	Mult of Carrier	Reference Antenna	Analyzer Reading (dBm)	0 dBm Substitution Reading (dBm)	ERP (dBm)	FCC Limit (dBm)
309.140	2	Vert Dipole	-75.4	-30.3	-45.1	-20
309.140	2	Horz. Dipole	-75.4	-31.4	-44.0	-20

All other spurious emissions were more than 20 dB below the limit.

Certifying Engineer:


Kevin G. Matson - Project Engineer

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE

FCC PART: 2.1055 (a)(1)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 7.0
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 154.570 MHz (Fo) at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual.
2. Power was supplied to the SPX-200 by the VIZ power supply. The SPX-200 antenna terminal ANT201 was connected to the input of an HP 8920B RF communications test set, used to measure frequency of the carrier.
3. Temperature was measured with an Omega Model 7035-J-225 thermocouple connected directly to the case of X101, a high stability crystal for the reference oscillator mounted on the SPX-200 printed circuit board.
4. The SPX-200 was enclosed in a plastic bag and placed into an Associated Laboratories Model ELH-0.5-LC environmental test chamber.
5. The temperature was raised to +50°C and allowed to stabilize for 30 minutes. The transmitter was activated and the frequency output recorded. The temperature was lowered in 10°C increments down to -30°C, allowing 15 minutes to stabilize at each temperature.
6. All measurements were converted to part-per-million (ppm) deviation and charted on a linear graph.

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE
FCC PART: 2.1055 (a)(1)
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MODELS: SPX-200
FCC ID: AIERIT19-150
DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 7.0
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

TEST RESULTS:

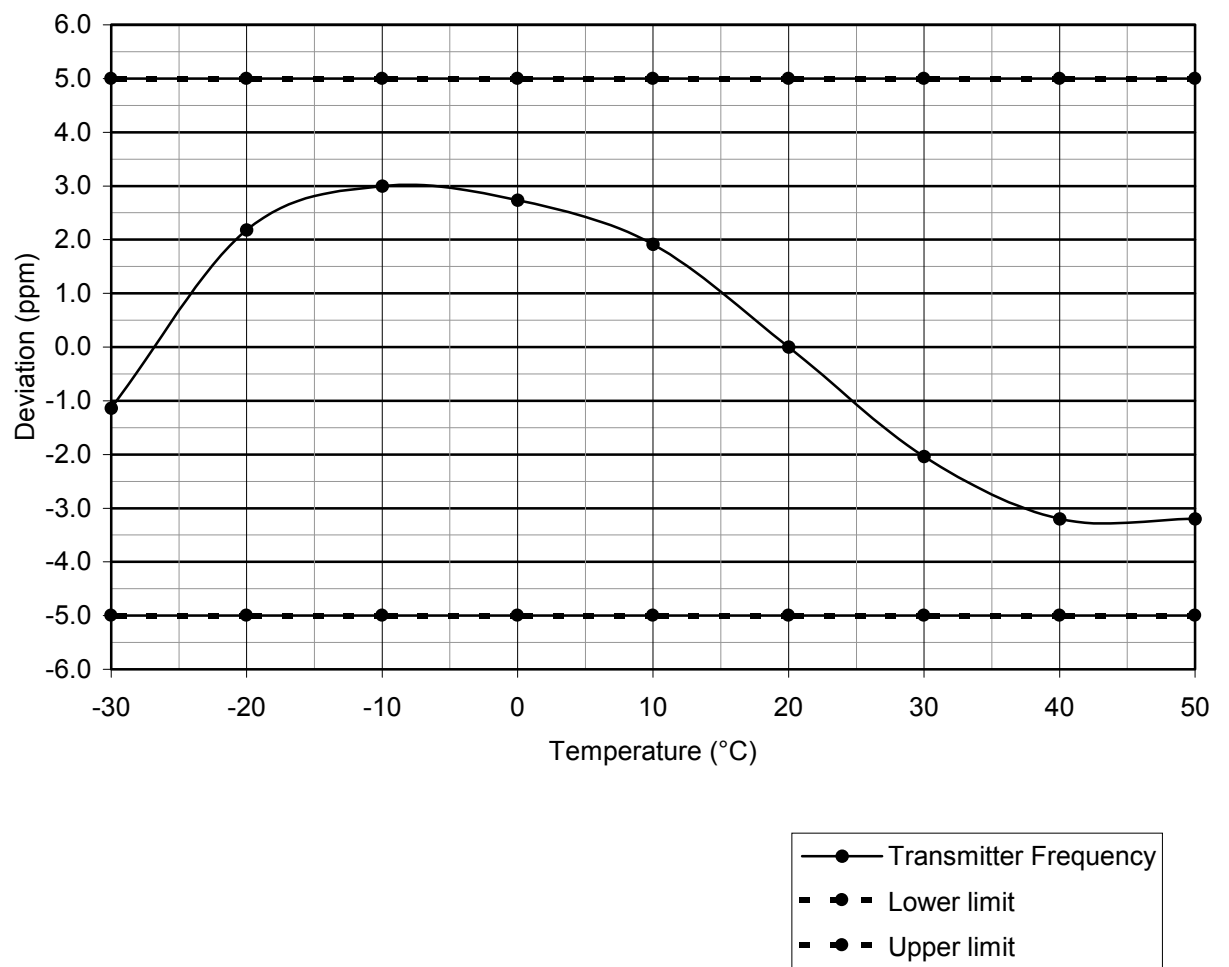
Frequency: 154.569389 MHz
Nominal Temp: +20 °C
FCC Limit: +/- 5.0 ppm

Temperature (°C)	Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
50	154.568894	-495	-3.20
40	154.568894	-495	-3.20
30	154.569074	-315	-2.04
20	154.569389	0	0.00
10	154.569685	296	1.91
0	154.569812	423	2.74
-10	154.569852	463	3.00
-20	154.569726	337	2.18
-30	154.569213	-176	-1.14

Certifying Engineer:


Kevin G. Matson - Project Engineer

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE
FCC PART: 2.1055 (a)(1)
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032



TYPE OF TEST: FREQUENCY STABILITY VS. BATTERY VOLTAGE

FCC PART: 2.1055 (d)(1)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 7.0
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

1. The SPX-200 was aligned for transmitter operation on 154.570 MHz (Fo) at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual.
2. Power was supplied to the SPX-200 by a VIZ power supply, and supply voltage was measured at J301 battery connector with a BK digital multimeter.
3. The SPX-200 antenna terminal ANT201 was connected to the input of an HP 8920B RF communications test set, used to measure frequency of the carrier.
4. Frequency measurements were made at +25°C with supply voltage set as follows for battery input:

Battery Input J301:

Minimum operating voltage

Nominal operating voltage

Maximum operating voltage

The SPX-200 is powered through J301 by a 7.2VDC battery pack with a minimum voltage of 6.0 VDC and a maximum voltage of 8.4 VDC.

5. All frequencies were referenced to the measurement made at the nominal supply voltage.

TYPE OF TEST: FREQUENCY STABILITY VS. BATTERY VOLTAGE

FCC PART: 2.1055 (d)(2)

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 7.0
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

TEST RESULTS:

Carrier Frequency: 154.570 MHz

Supply Voltage (VDC)	Supply Condition	Transmitter Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
6.0	Minimum	154.569891	-28	-0.18
7.2	Nominal	154.569919	0	0.00
8.4	Maximum	154.569885	-34	-0.22

Certifying Engineer:



Kevin G. Matson - Project Engineer

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

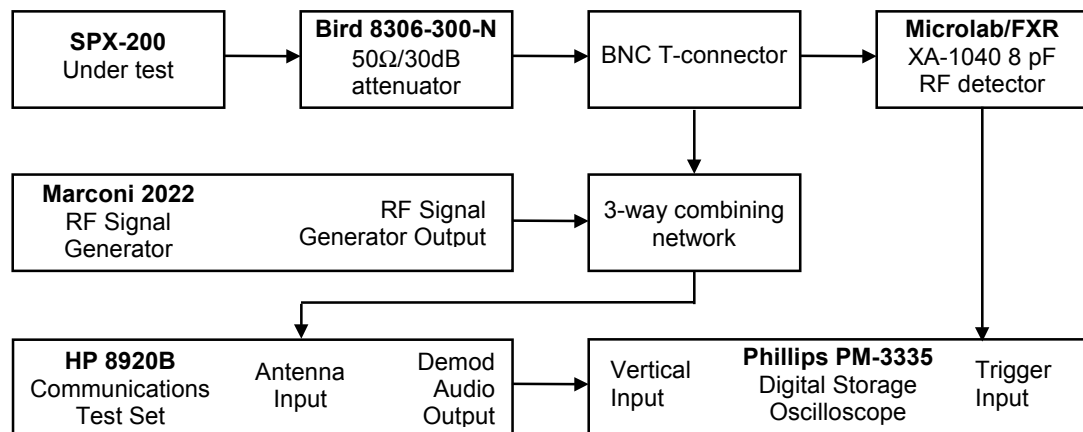
DATE: December 21, 2004

IC STANDARDS:	RSS-119, Issue 6, Section 6.5
INDUSTRY CANADA:	1084A-RIT19150
MODELS:	SPX-200-BC, SPX-200-CANADA

PROCEDURE:

The SPX-200 was aligned for transmitter operation on 154.570 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual. The tests were conducted per EIA-603 Part 2.2.19 as follows:

1. The test equipment was connected per the following diagram:



2. The HP 8920B receiver was set to measure FM deviation with the audio bandwidth set at ≤ 20 Hz to 15 kHz and the RF frequency set to 154.570 MHz.
3. The SPX-200 transmitter under test was turned on and the HP 8560E Spectrum Analyzer was used to measure the RF power level through the test network.
4. The SPX-200 transmitter was turned off.
5. The Marconi Model 2022 RF signal generator was set to 154.570 MHz at an RF level 20 dB below that measured in step 3, modulated with a 1 kHz tone at ± 12.5 kHz deviation.
6. The Phillips PM-3335 digital oscilloscope's horizontal sweep rate was set to 10 mS per division. The vertical amplitude control was adjusted to display the 1000 Hz demodulated audio from the signal generator at ± 4 divisions, vertically centered on the screen.
7. The Phillips PM-3335 digital oscilloscope was set to trigger at 1 division from the left side of the display when the RF detector senses RF power from the SPX-200 transmitter.
8. The attenuation of the RF attenuator was reduced so the input of the RF detector and the RF combiner is increased by 30 dB when the SPX-200 transmitter is turned on.

9. The SPX-200 transmitter is turned on and the resulting waveform on the oscilloscope display was stored and plotted. The FCC limits per Part 90.214 were added to the plot in the same manner illustrated in EIA-603 Part 3.2.19.2. The resulting plot is labeled "switch on condition" and shows compliance with FCC Part 90.214.
10. The Phillips PM-3335 digital oscilloscope was set to trigger at 1 division from the right side of the display when the RF detector senses loss of RF power from the SPX-200 transmitter.
11. The SPX-200 transmitter is turned off and the resulting waveform on the oscilloscope display was stored and plotted. The FCC limits per Part 90.214 were added to the plot in the same manner illustrated in EIA-603 Part 3.2.19.2. The resulting plot is labeled "switch off condition" and shows compliance with FCC Part 90.214.

Certifying Engineer:



Kevin G. Matson - Project Engineer

TYPE OF TEST:	TRANSIENT FREQUENCY BEHAVIOR
FCC PART:	90.214
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive

Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

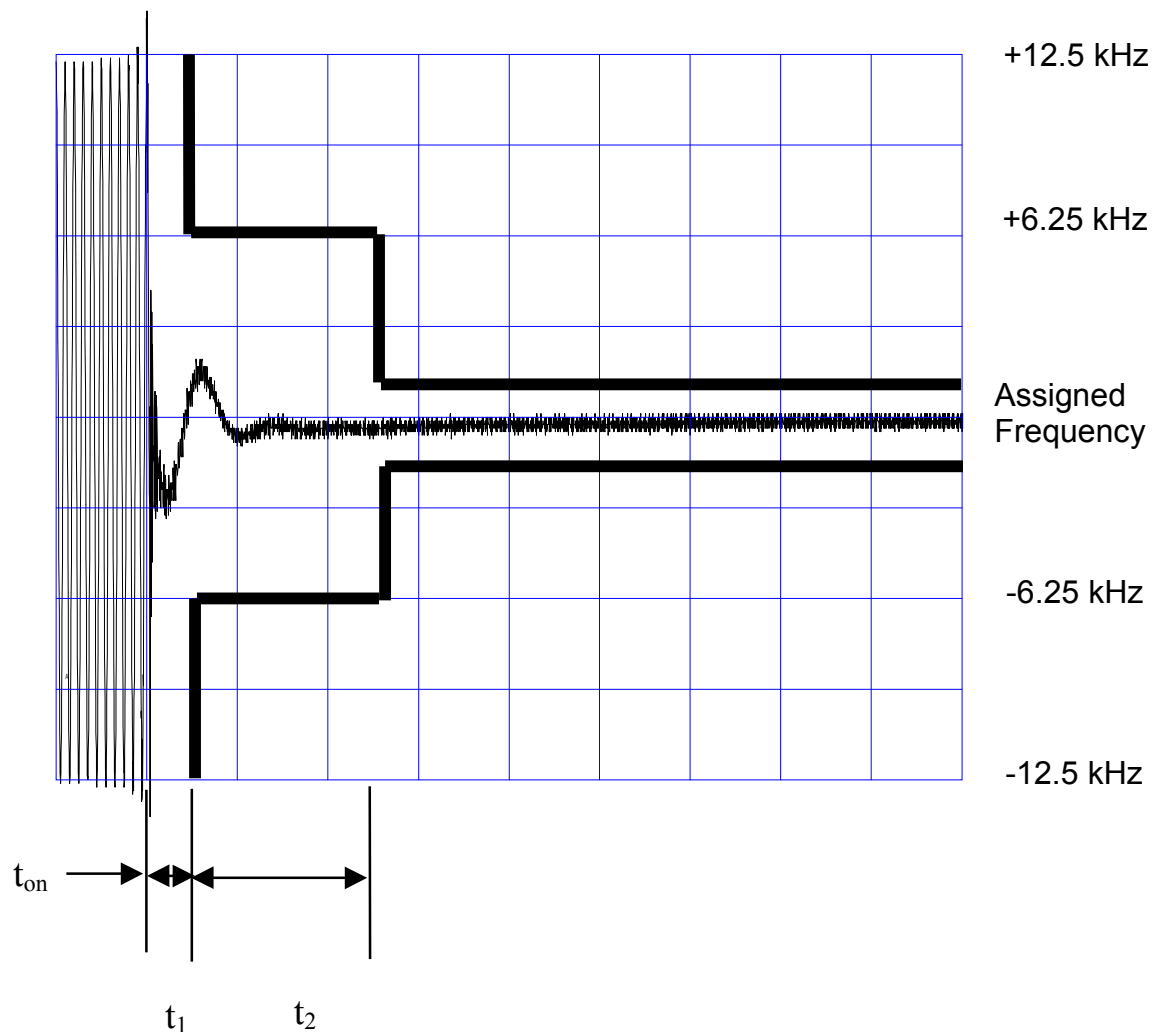
DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.5

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

SWITCH ON CONDITION t_{on} , t_1 , and t_2



TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODELS: SPX-200

FCC ID: AIERIT19-150

DATE: December 21, 2004

IC STANDARDS: RSS-119, Issue 6, Section 6.5

INDUSTRY CANADA: 1084A-RIT19150

MODELS: SPX-200-BC, SPX-200-CANADA

SWITCH OFF CONDITION t_3 and t_{OFF}

