TYPE OF EXHIBIT: TABLE OF CONTENTS

FCC PART: 2.1033(c)(14)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

The following are contained in this file:

TYPE OF EXHIBIT: LIST OF ATTACHED EXHIBITS

FCC PART: 2.1033(c)(14)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

TYPE OF EXHIBIT: LIST OF TEST EQUIPMENT USED

FCC PART: 2.947(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

All measurements were conducted with one or more of the following pieces of equipment:

ITEM	MANUFACTURER	MODEL NO.	SERIAL NO.
DC Power Supply	Astron	VS 20M	9205017
Multimeter	Fluke	45	6723040
Multimeter	BK Precision	2704A	234-008459
RF Test Set	Hewlett-Packard	8920AB	US39225560
Spectrum Analyzer	Advantest	R3265A	75060189
Spectrum Analyzer	Hewlett-Packard	8560E	3720A02980
Storage Scope	Fluke/Philips	PM3335	DM630034
Temp. Chamber	Delta Design	3900 CL	0-52-R
Audio Test Set	Audio Precision	SYS-322A	SYS1-33641
Thermocouple	Triplett	320-G/P	

TYPE OF EXHIBIT: DESCRIPTION OF MEASUREMENT FACILITY

FCC PART: 2.948

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

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

This site is used on a continuing basis exclusively by RITRON, Inc. and is utilized only for 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.

All other measurements were taken at RITRON's Engineering Laboratory in Carmel, IN.

Sam L. Dulaney
Chief Engineer
RITRON, Inc.

TYPE OF EXHIBIT: RADIO FREQUENCY OUTPUT POWER

FCC PART: 2.1046(a)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation at three power levels per the tune-up procedure outlined in the Maintenance manual for frequencies at the lower, middle and upper band edges.

2. Power was supplied to the RCCR-151/152 by an Astron VS 20M Power Supply. The RCCR-151/152 was connected to a HP8920B Test Set used to measure the RF carrier power. The input to the Test Set provides a resistive 50-ohm termination at the frequencies and power levels used for this test.

3. The voltage across an internal shunt in series with the power supply lead of the RF Power Module was used with a fluke 45 Digital Multimeter to measure current (Id). A Fluke 45 Digital Multimeter was used to measure the RF Power Module output stage power control voltage (Vcon) and drain voltage (Vd).

4. Measurements were taken at various power levels between 10 watts and 50 watts.

TYPE OF EXHIBIT: RADIO FREQUENCY OUTPUT POWER

FCC PART: 2.1046(a)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:

Frequency (MHz)	Po (watts)	Vcon (V)	Vd (V)	Id (A)
155.025	10	3.50	12.80	5.05
155.025	25	3.70	12.70	7.05
155.025	50	3.80	12.45	9.75
164.025	10	3.60	12.90	4.40
164.025	25	3.80	12.70	6.80
164.025	50	4.10	12.50	9.45
173.975	10	3.70	12.90	4.05
173.975	25	3.90	12.68	6.80
173.975	50	4.55	12.40	10.20

TYPE OF EXHIBIT: MODULATOR RESPONSE-VOICE INPUT

FCC PART: 2.1047(a)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

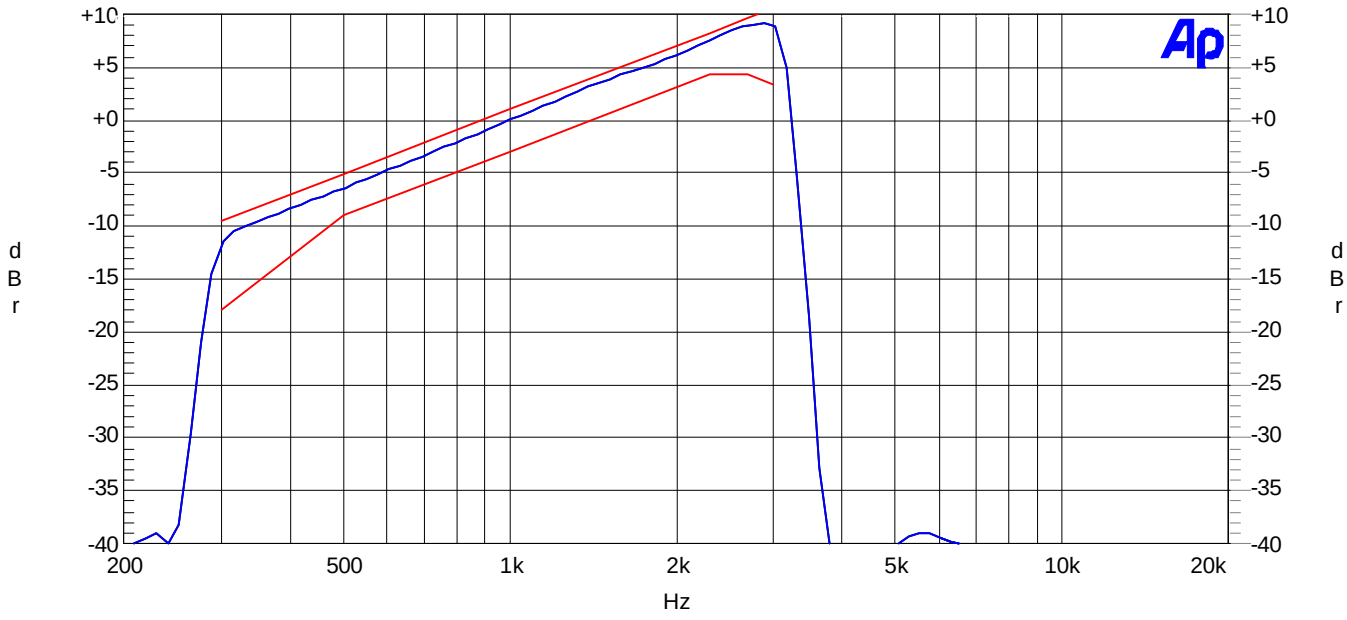
PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation at 164.025 MHz at full rated power per the tune-up procedure outlined in the Maintenance manual.

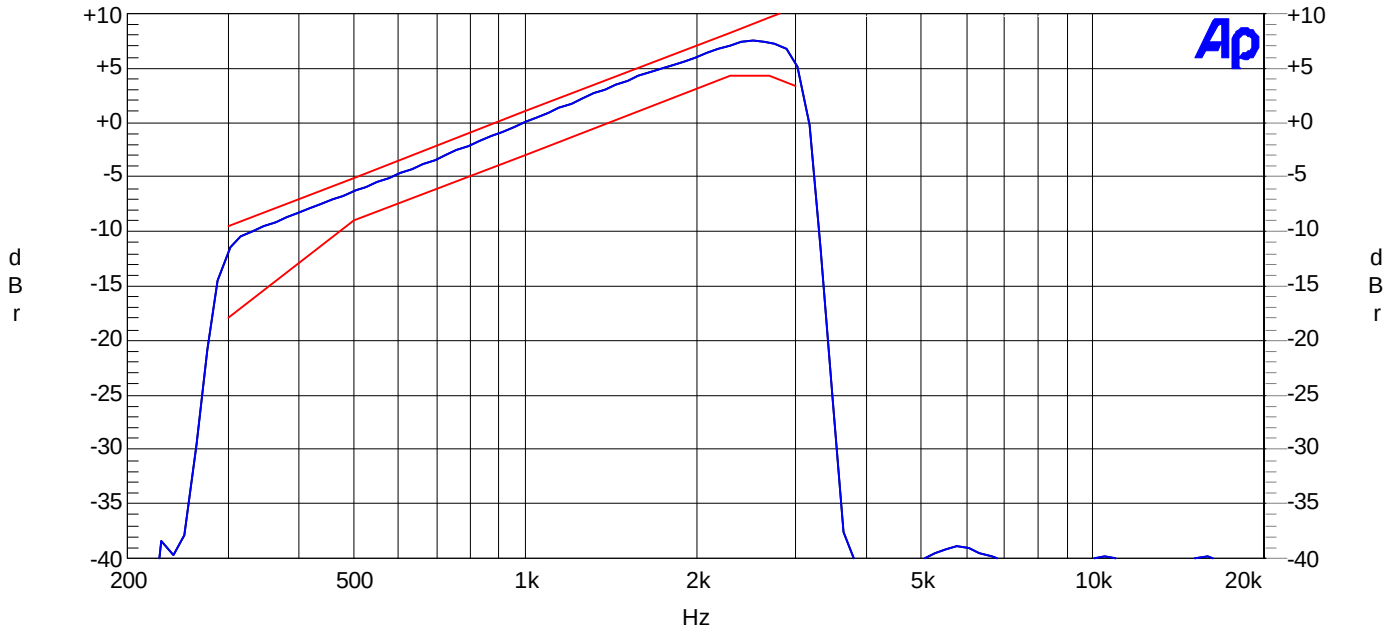
2. The response was measured from the microphone input to the output of the last audio processing op-amp where it connects to the modulator.

3. The audio test set was swept in frequency from 200 Hz to 20 kHz and the results noted. Plots are shown for both 12.5 kHz and 25 kHz channel spacing operation. The frequency response is independent of carrier frequency, therefore, only the center operating frequency is shown.

TYPE OF EXHIBIT:	MODULATOR RESPONSE-VOICE INPUT
FCC PART:	2.1047(a)
MANUFACTURER:	RITRON, Inc.
MODEL:	RCCR-151/152
TYPE OF UNIT:	VHF Locomotive Transceiver
FCC ID:	AIERIT28-150
DATE:	April 30, 2008
RESULTS:	12.5 kHz channel spacing



TYPE OF EXHIBIT:	MODULATOR RESPONSE-VOICE INPUT
FCC PART:	2.1047(a)
MANUFACTURER:	RITRON, Inc.
MODEL:	RCCR-151/152
TYPE OF UNIT:	VHF Locomotive Transceiver
FCC ID:	AIERIT28-150
DATE:	April 30, 2008
RESULTS:	25 kHz channel spacing



TYPE OF EXHIBIT: CLIPPER FILTER RESPONSE-VOICE INPUT

FCC PART: 2.1047(a)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The audio output of the audio test set was coupled into the input of the modulation limiter, which is only used for voice inputs. The audio input of the test set was connected to the output of the clipper filter.

2. The audio generator frequency was swept from 200 Hz to 20 kHz and the response noted and plotted. The same clipper filter is used for both 12.5 kHz channel operation and 25 kHz operation. Therefore, only one response is shown. The frequency response is independent of carrier frequency.

TYPE OF EXHIBIT: CLIPPER FILTER RESPONSE-VOICE INPUT

FCC PART: 2.1047(a)

MANUFACTURER: RITRON, Inc.

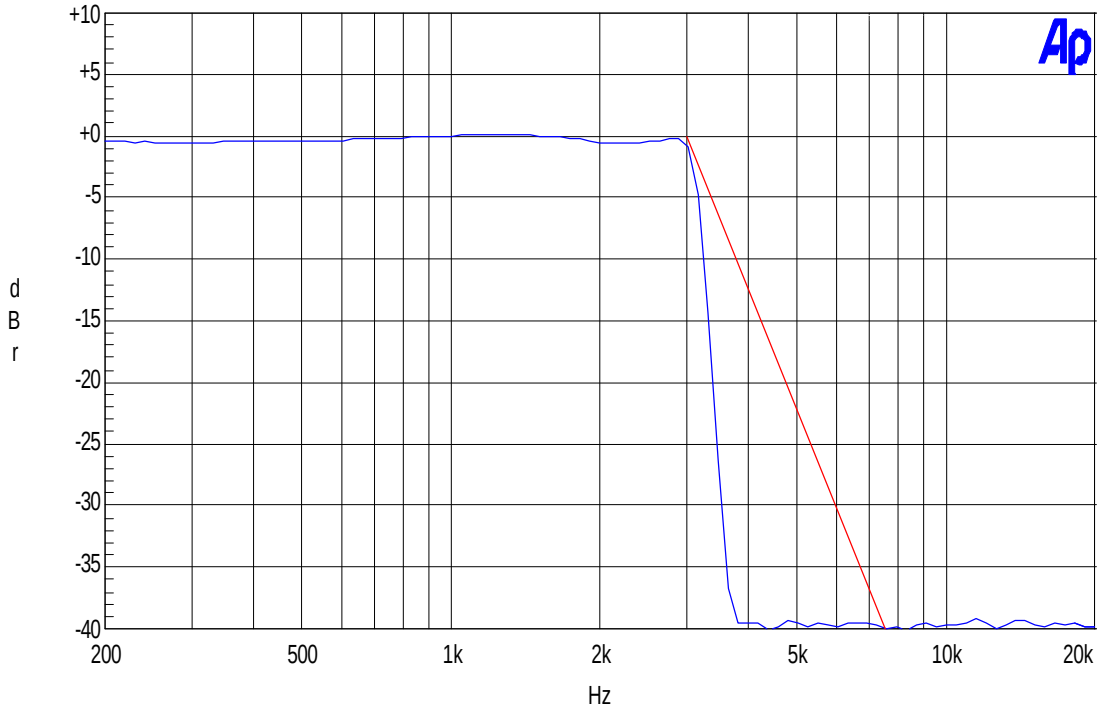
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz and 25 kHz channel spacing



TYPE OF EXHIBIT: MODULATION LIMITING CURVES-VOICE INPUT

FCC PART: 2.1047(b)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation on 164.025 MHz per the tune-up procedure outlined in the Maintenance manual.

2. The RF output was connected to the RF input of a radio Test Set configured to measure FM deviation. The audio output of the audio test set was routed to the voice input of the RCCR-151/152.

3. The frequency of the audio generator was adjusted to find the frequency of maximum response. The RCCR-151/152 transmit deviation was adjusted for 5 kHz maximum deviation as outlined in the Maintenance manual. The audio generator level was reduced to produce 50% of maximum deviation and the level noted.

4. The audio frequency was set to 300 Hz and the output level was varied from zero to a level at least 16 dB above that required to produce 50% maximum deviation noted in step 3 above.

5. Step 4 was repeated for audio frequencies of 1000 and 3000 Hz and for the transmit deviation set to 2.5 kHz maximum deviation for 12.5 kHz operation.

TYPE OF EXHIBIT: MODULATION LIMITING CURVES-VOICE INPUT

FCC PART: 2.1047(b)

MANUFACTURER: RITRON, Inc.

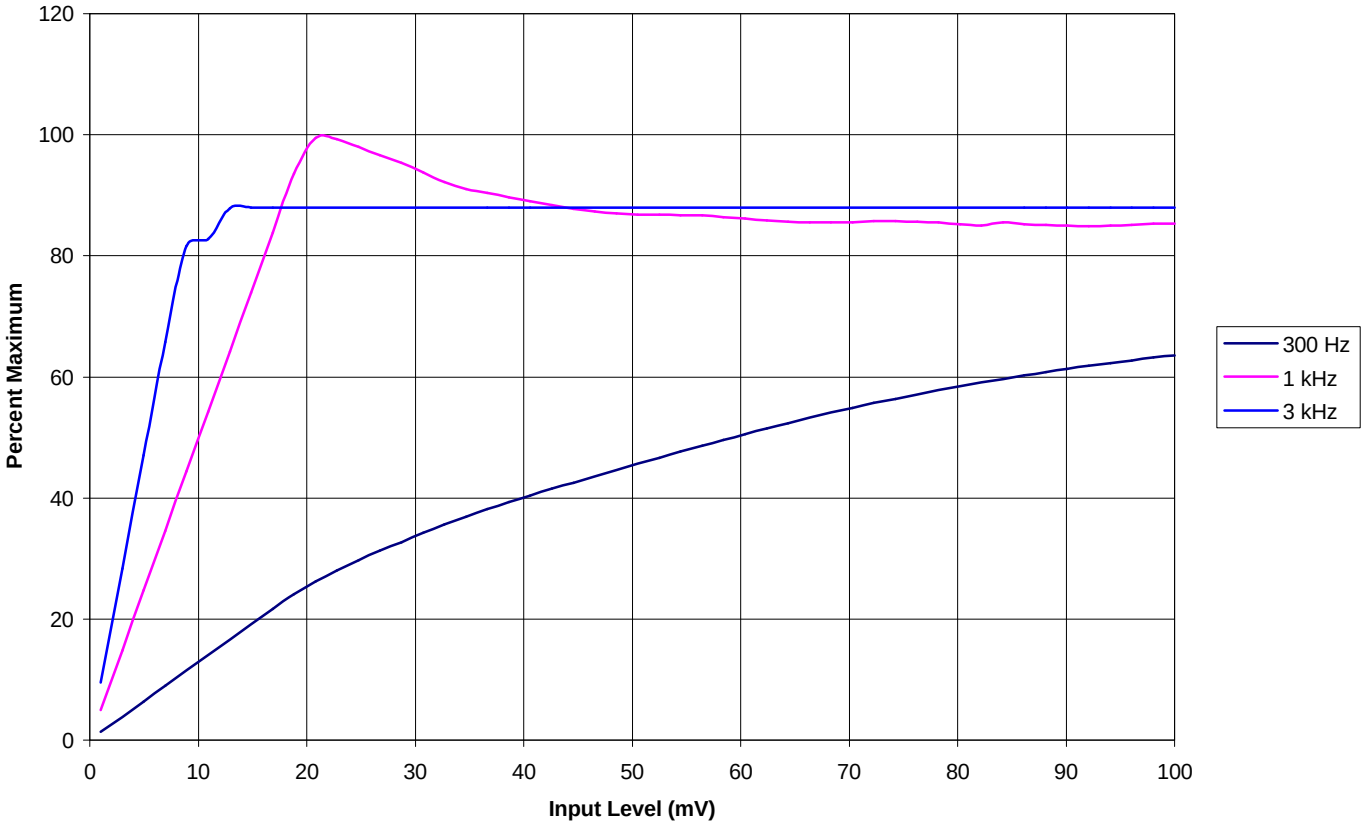
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel spacing



Note: 100% deviation represents +/-2.5 kHz deviation.

TYPE OF EXHIBIT: MODULATION LIMITING CURVES-VOICE INPUT

FCC PART: 2.1047(b)

MANUFACTURER: RITRON, Inc.

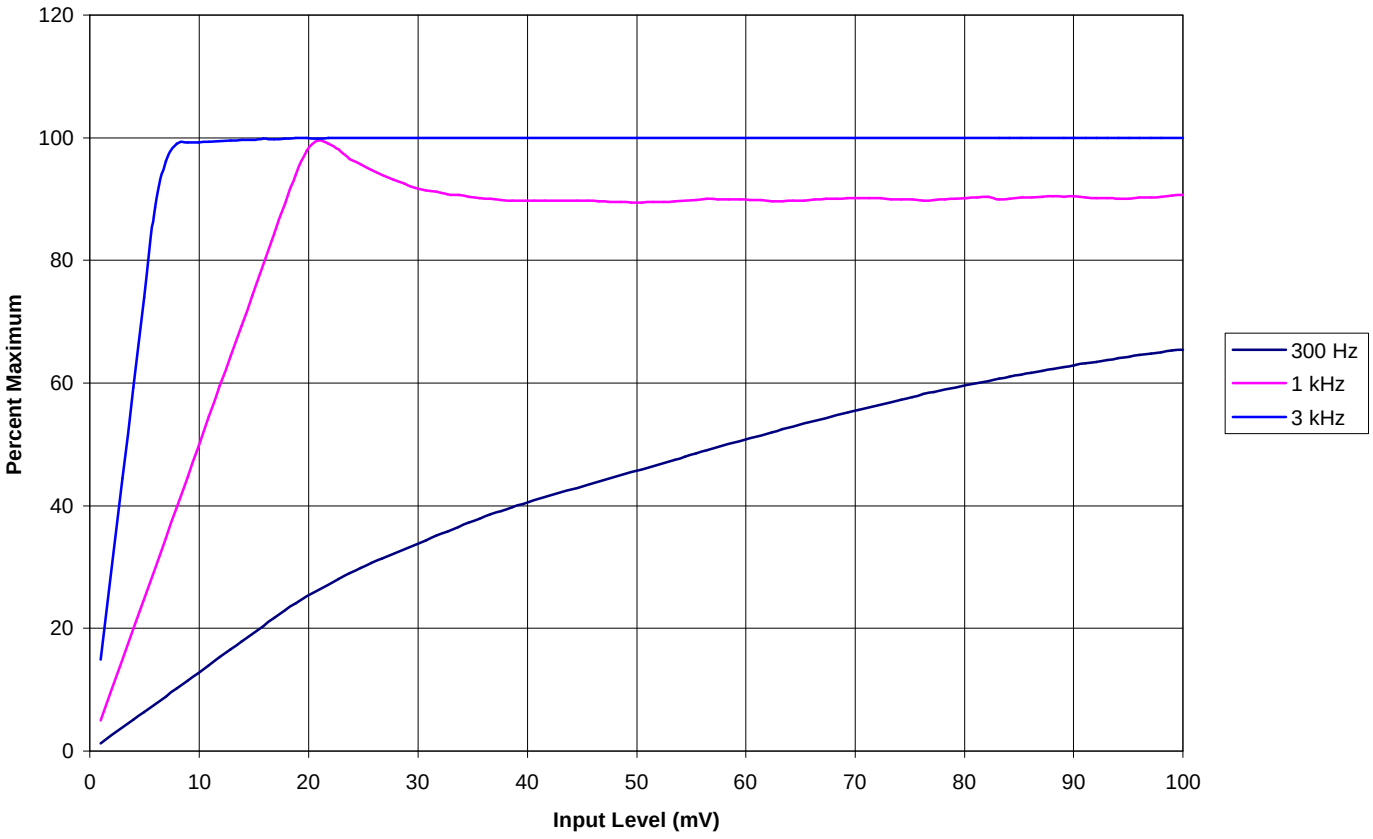
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel operation



Note: 100% deviation represents +/-5 kHz deviation.

TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-VOICE INPUT

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. A 2.5 kHz audio signal was applied to the microphone input of the unit. Its level was adjusted to be 16 dB above that required to produce 50% of peak deviation at the frequency of maximum deviation.

2. The deviation adjustment was set for 2.5 kHz maximum deviation for 12.5 kHz channel operation and a spectrum analyzer was connected to the RF output through an RF power attenuator. The analyzer was set to sweep +/-25 kHz of carrier with a reference level set to that observed when the resolution bandwidth and video bandwidth were set to 1 MHz.

3. The deviation adjustment was set for 5.0 kHz maximum deviation for 25 kHz channel operation and a spectrum analyzer was connected to the RF output through an RF power attenuator. The analyzer was set to sweep +/-50 kHz of carrier with a reference level set to that observed when the resolution bandwidth and video bandwidth were set to 1 MHz.

4. A digital voice circuit board was installed and the maximum output deviation of the C4FM signal was set to +/-1.2 kHz when a special test modulation input was applied. The analyzer was set to sweep +/- 10 kHz either side of the carrier with a reference level set to that observed when the resolution bandwidth and video bandwidth were set to 1 MHz. The deviation was increased to +/-2.4 kHz and the analyzer set to sweep +/-20 kHz either side of the carrier. Note that the digital voice circuit board is capable of imbedding low-rate data simultaneously with digital voice with no change in the specturm.

5. The occupied bandwidth plots are independent of carrier frequency, therefore, only the center channel plots are shown.

TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-VOICE INPUT

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

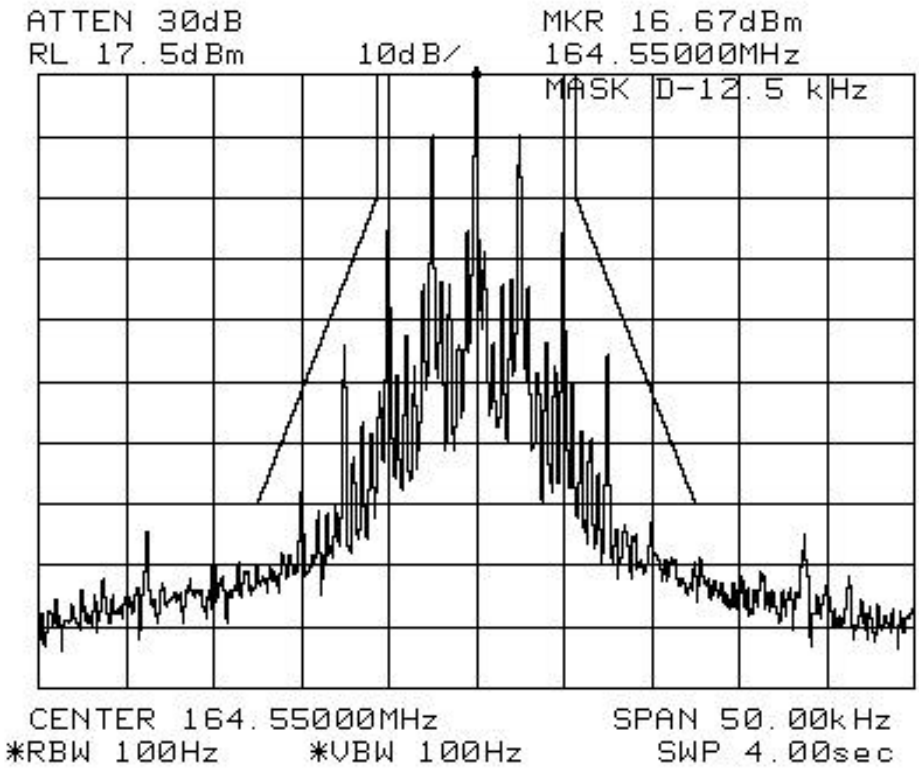
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel operation-analog modulation



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-VOICE INPUT

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

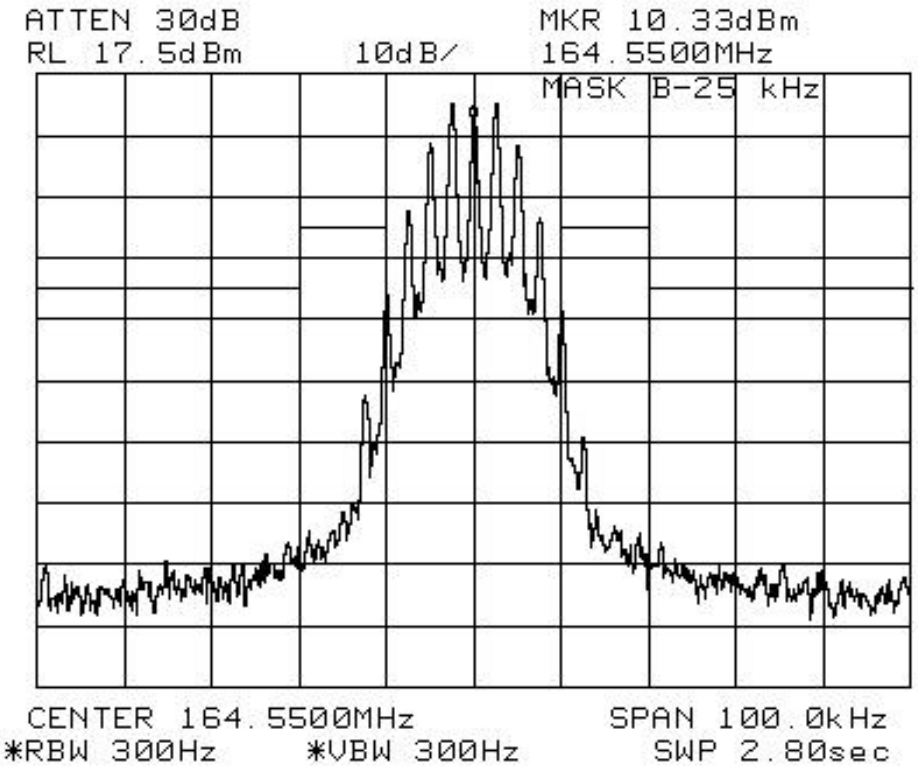
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel operation-analog modulation



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-VOICE INPUT

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

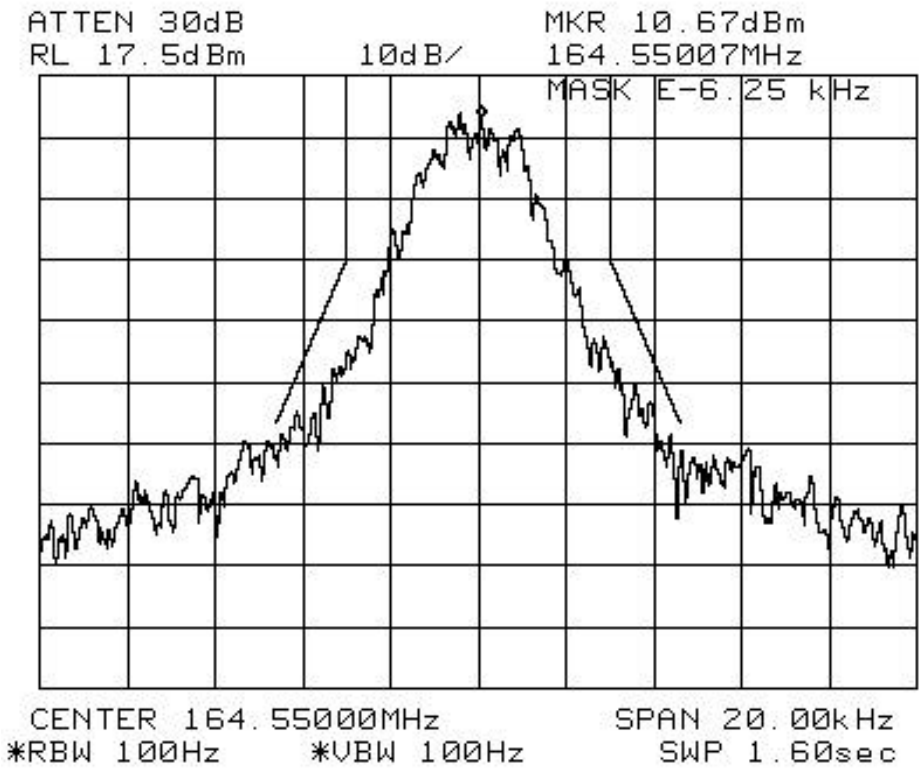
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 6.25 kHz channel operation-digital modulation



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-VOICE INPUT

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

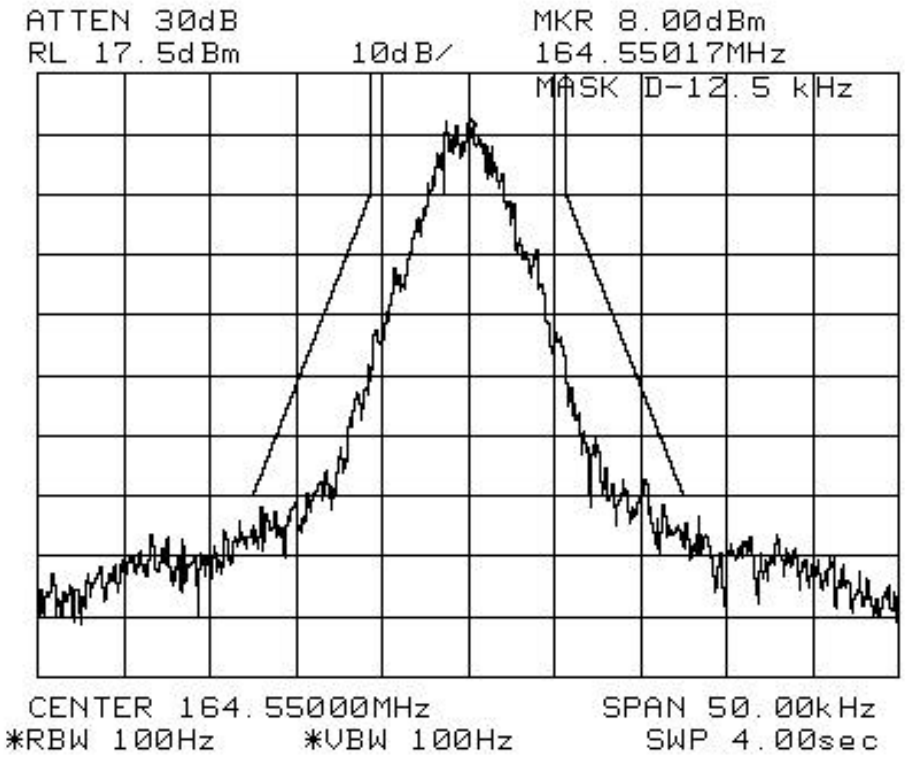
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel operation-digital modulation



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The 4FSK modem card was installed and was set to deliver a +3,+3,-3,-3 sync pattern at a level to produce 1.2 kHz deviation for 6.25 kHz channel operation, 2.4 kHz deviation for 12.5 kHz operation, and 4.8 kHz for 25 kHz channel operation. The baud rate was set to 2400 (4800 bps) for 6.25 kHz channel operation, 4800 (9600 bps) for 12.5 kHz channel operation, and 9600 (19,200 bps) for 25 kHz channel operation.

2. The RF output was connected to a spectrum analyzer through an RF power attenuator. The reference level was set with a video bandwidth of 1 MHz. The resolution and video bandwidths and frequency span were set appropriate for the channel bandwidth and emissions mask used.

3. Results are shown for a PN pattern from a 16 stage shift register set to produce a maximal length code, as well as the +3, +3, -3, -3 sync pattern, and an alternating +3, -3, +3, -3 sequence. A pre-coding circuit prevents long strings of 1's or 0's from being sent, so those patterns could be shown. The output of the 4FSK generator does not pass through the modulation limiter.

4. The occupied bandwidth plots are independent of carrier frequency, therefore, only the center channel plots are shown.

TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

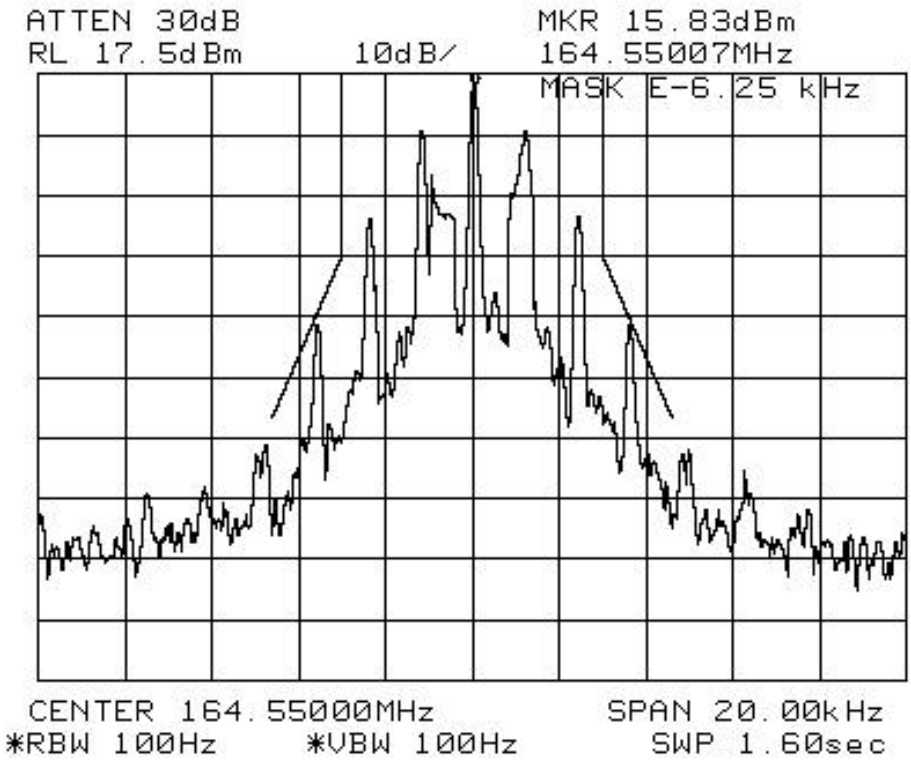
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 6.25 kHz spacing, alternating +3, -3, +3, -3 … pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

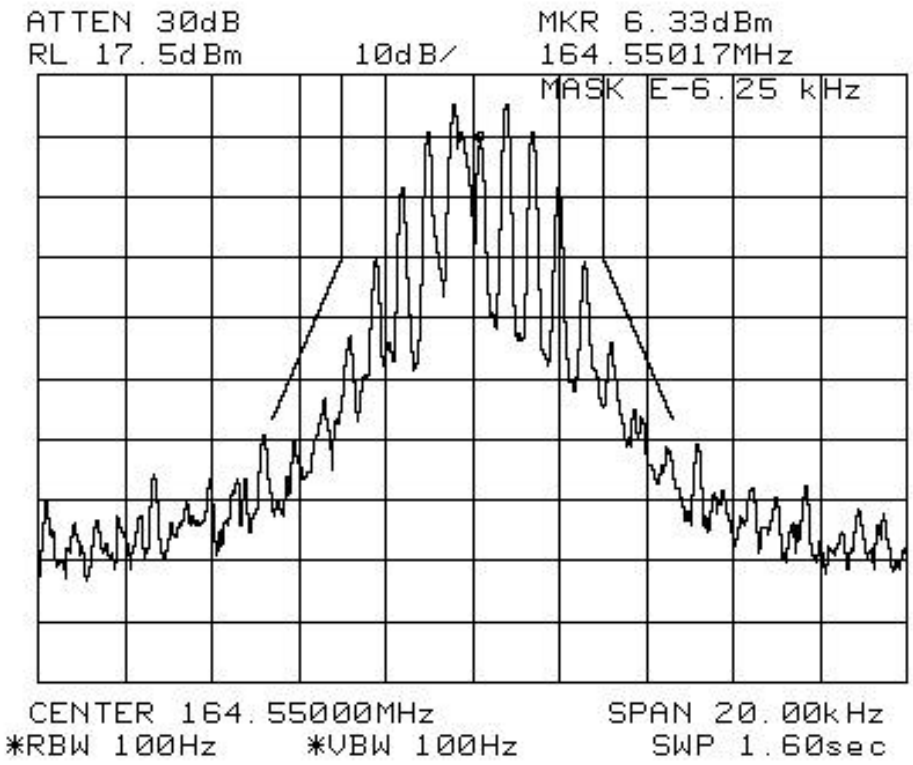
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 6.25 kHz channel, +3, +3, -3, -3 … sync pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

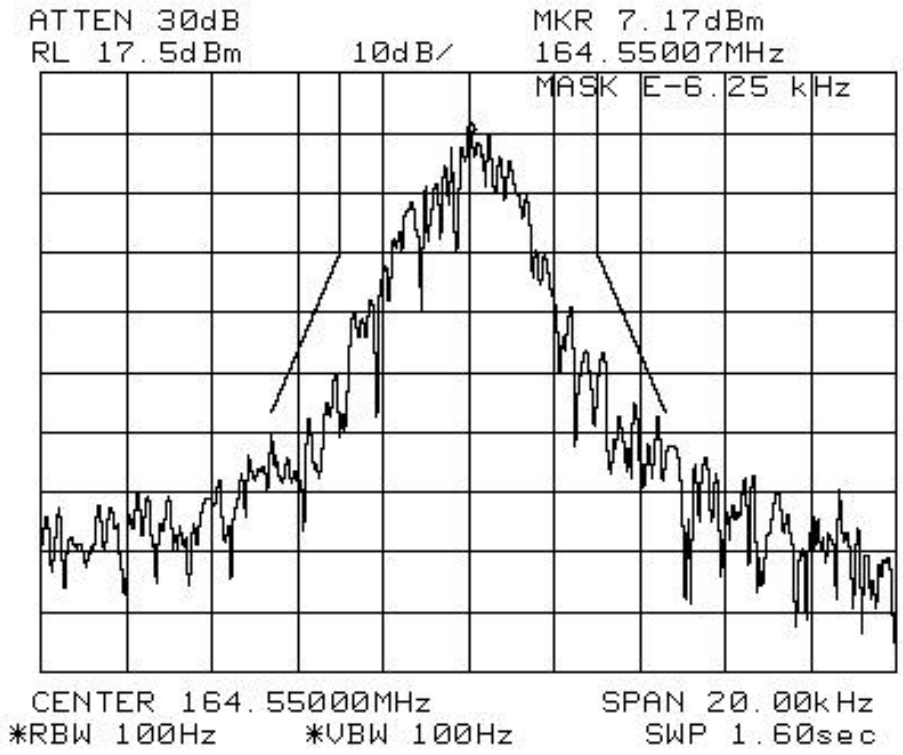
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 6.25 kHz channel, pn sequence



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

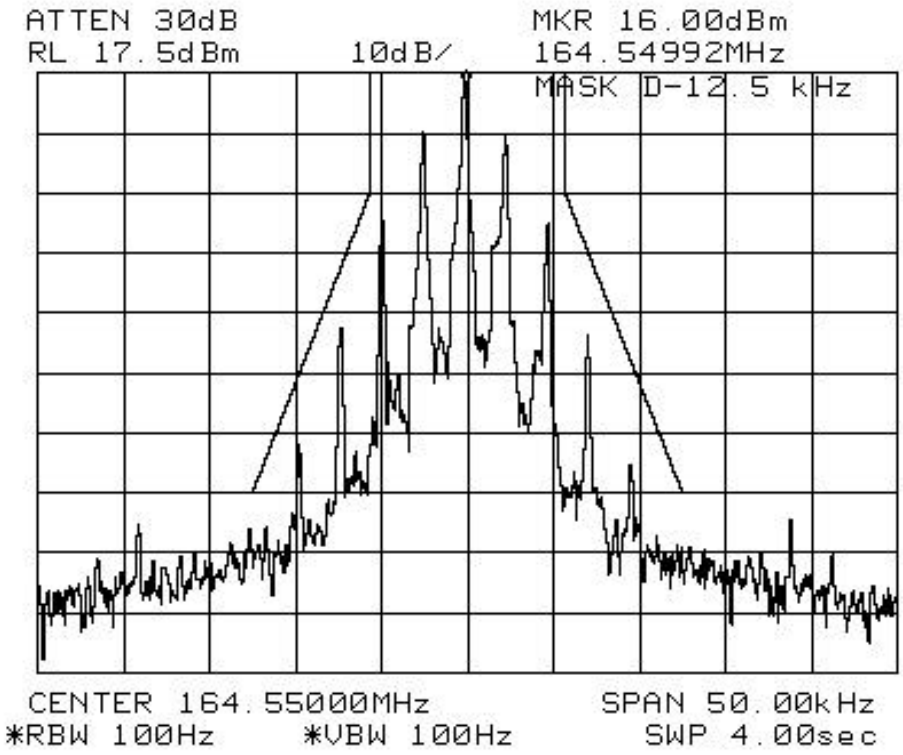
MODEL: RSS-119 Issue 9, Section 5.5

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz spacing, alternating +3, -3, +3, -3 … pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

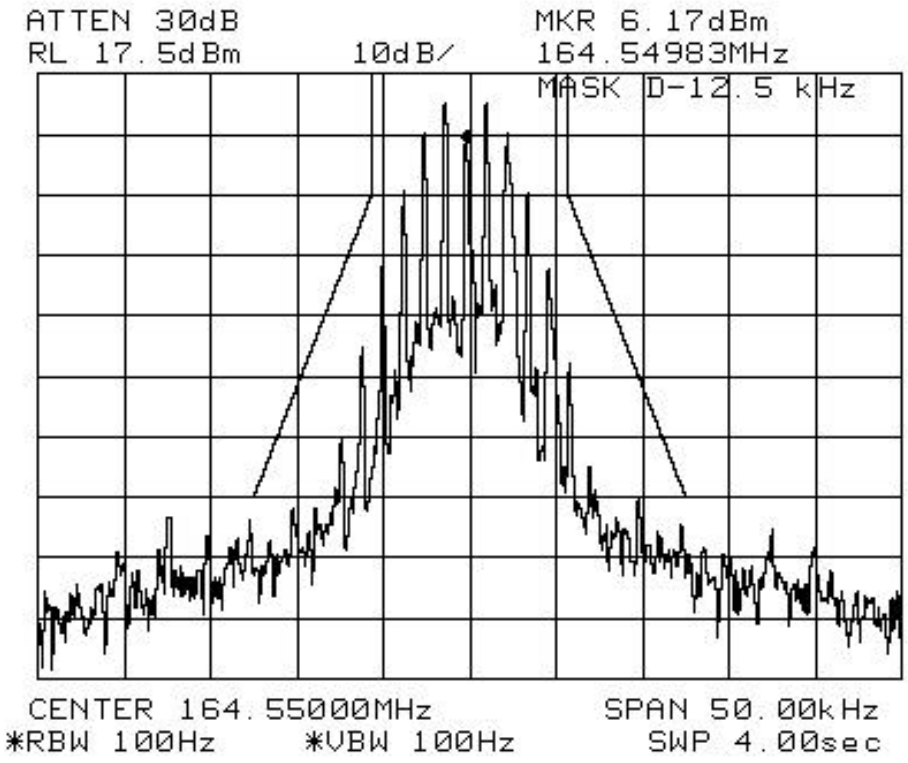
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel, +3, +3, -3, -3 … sync pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

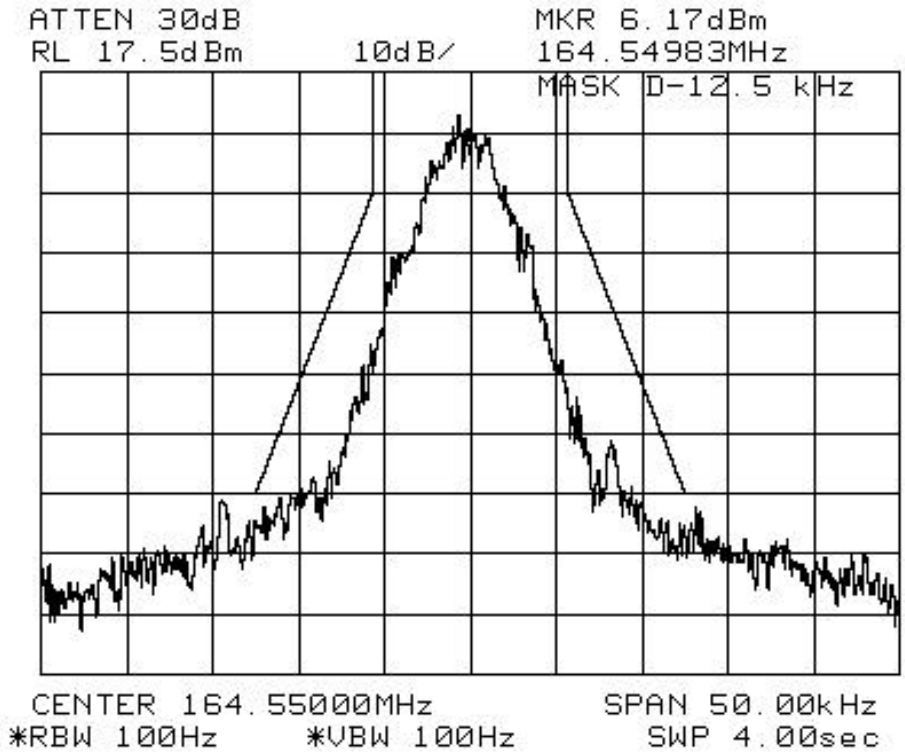
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel, pn sequence



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

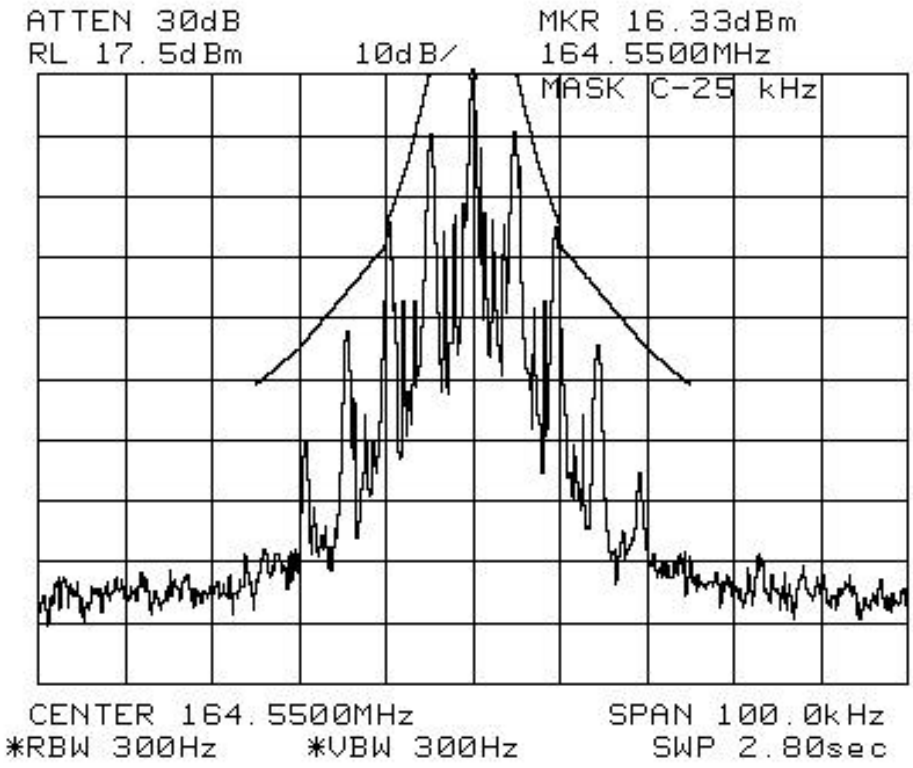
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz spacing, alternating +3, -3, +3, -3 … pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

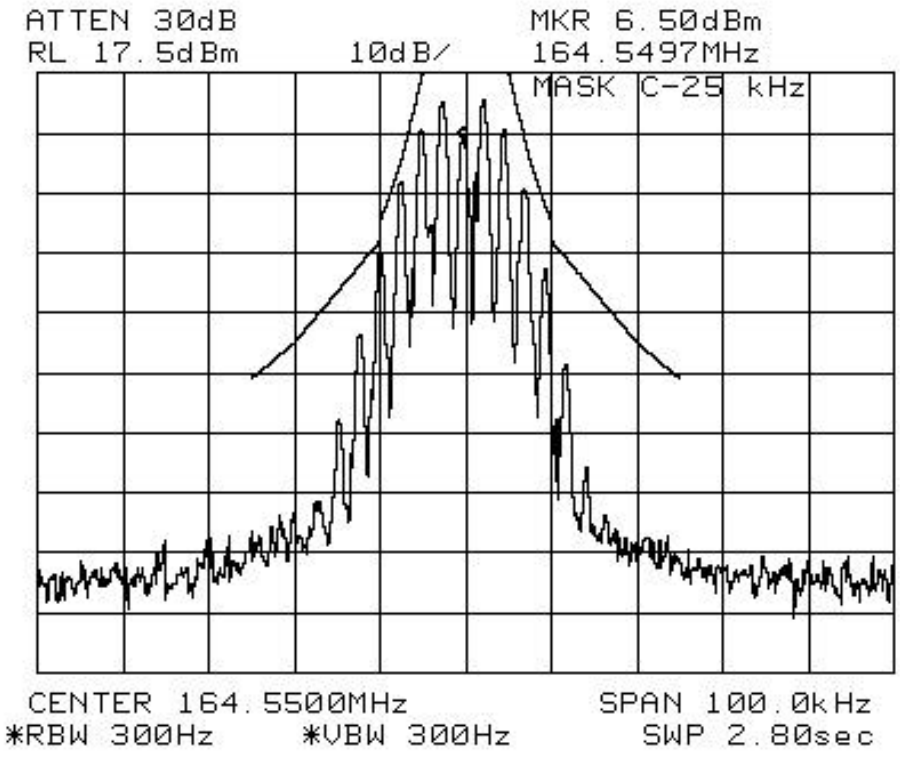
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel, +3, +3, -3, -3 … sync pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-4FSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

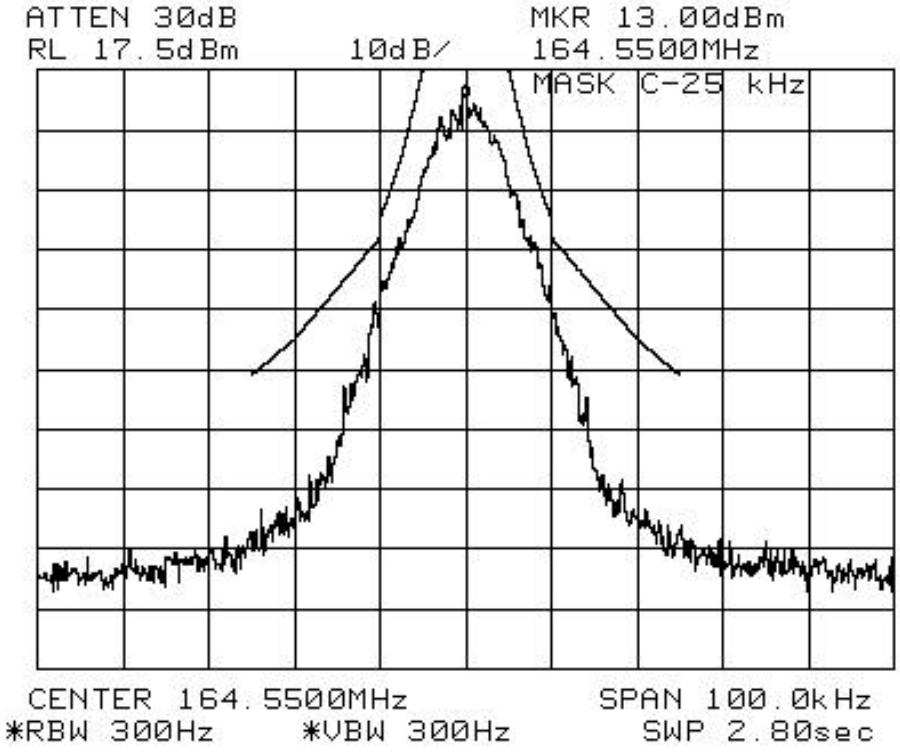
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel, pn sequence



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The AFSK card was set to produce its nominal 2400 baud frequency modulated output of an 1800 Hz tone. The pattern for setting deviation is an all zero pattern since this produced the maximum deviation. For 12.5 kHz channel operation, the maximum deviation was set to 2.5 kHz and for 25 kHz channel operation, it was set for 5 kHz deviation.

2. The RF output was connected to a spectrum analyzer through an RF power attenuator. The reference level was set with a video bandwidth of 1 MHz. The resolution and video bandwidths and frequency span were set appropriate for the channel bandwidth and emissions mask used.

3. Results are shown for a PN pattern from a 16 stage shift register set to produce a maximal length code, as well as an alternating 1,0,1,0 pattern, an all 0 pattern, and an all 1 pattern. The AFSK signal passes through the modulation limiter.

4. The occupied bandwidth plots are independent of carrier frequency, therefore, only the center channel plots are shown.

TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

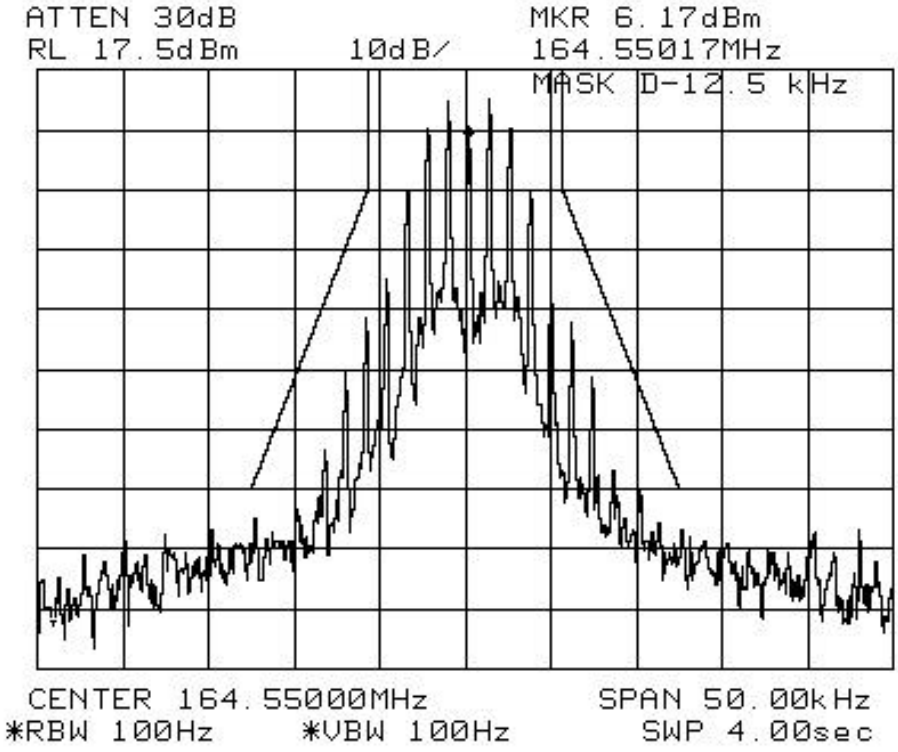
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel, all 0 pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

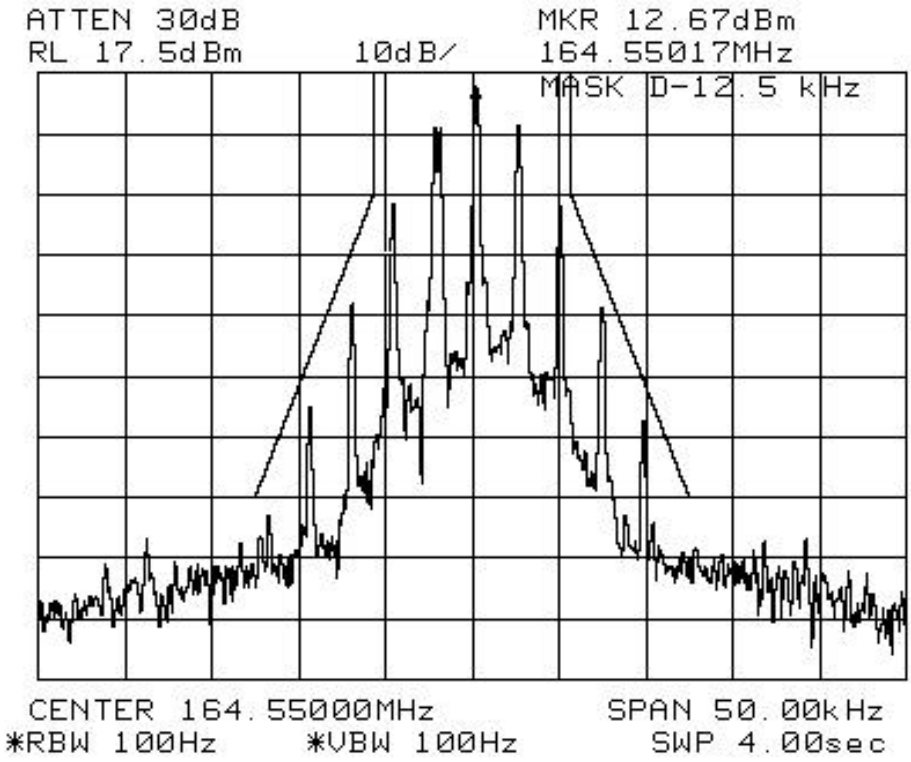
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel, all 1 pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

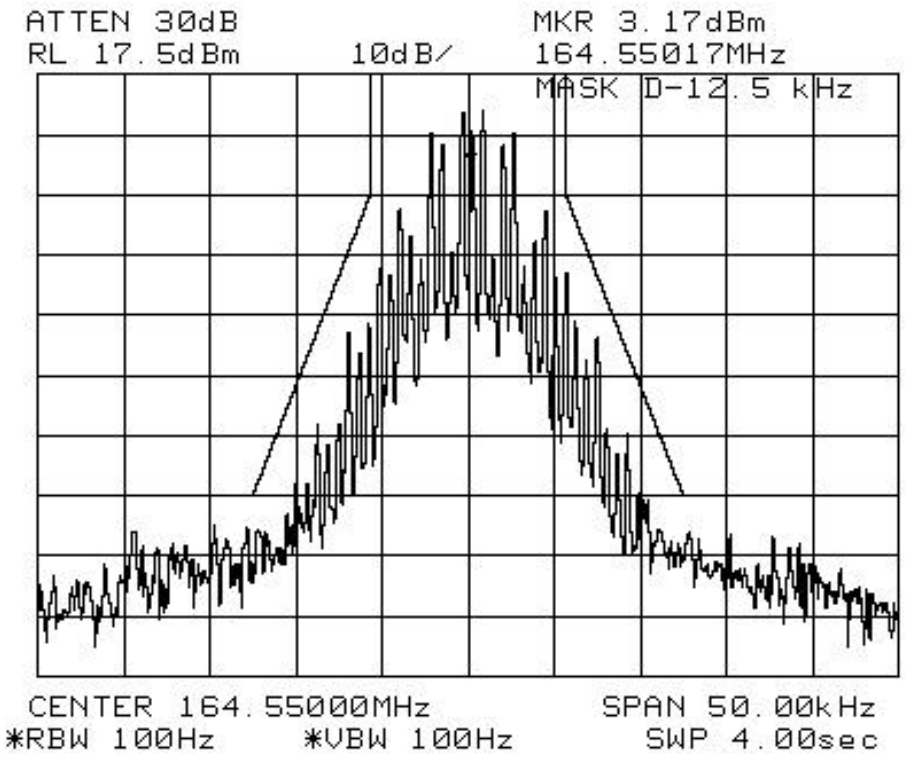
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel, alternating 0, 1 pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

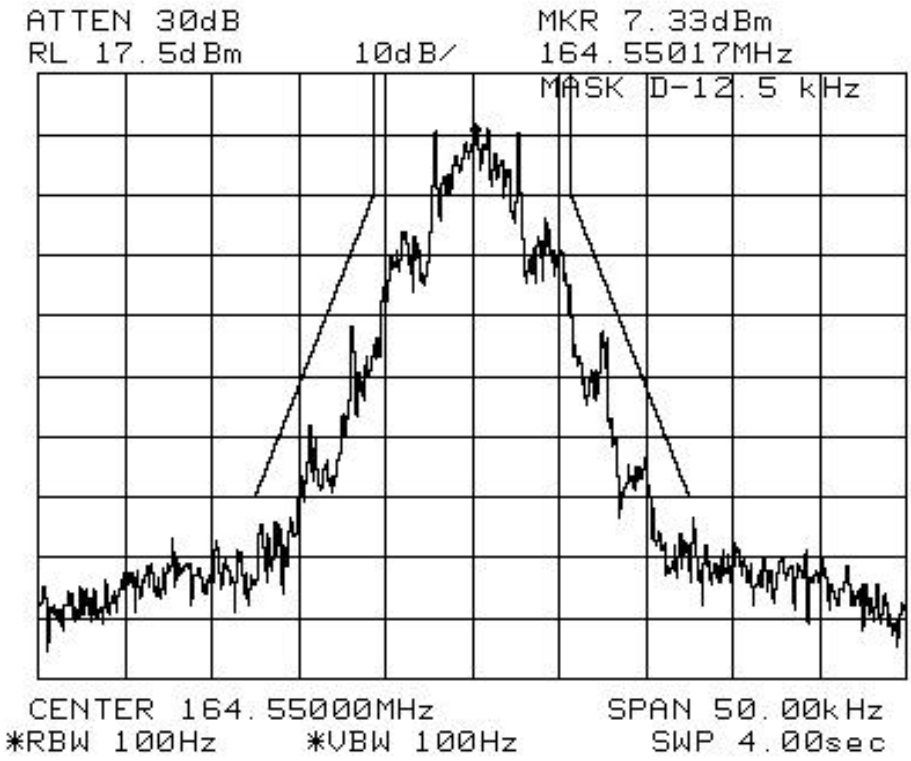
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 12.5 kHz channel, pn pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

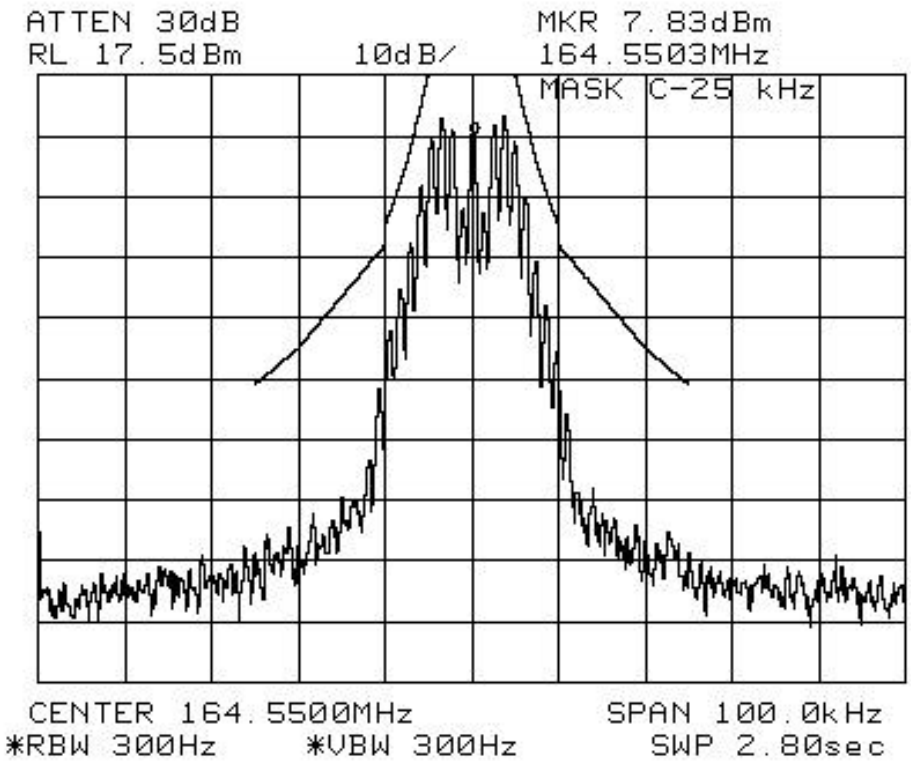
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel, all 0 pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

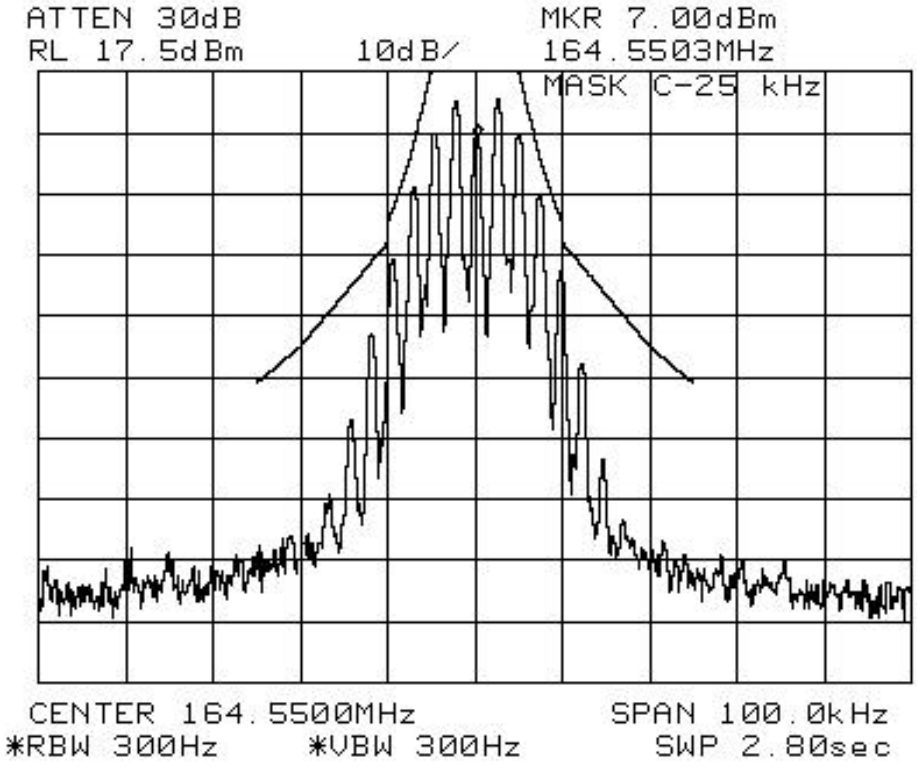
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel, all 1 pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

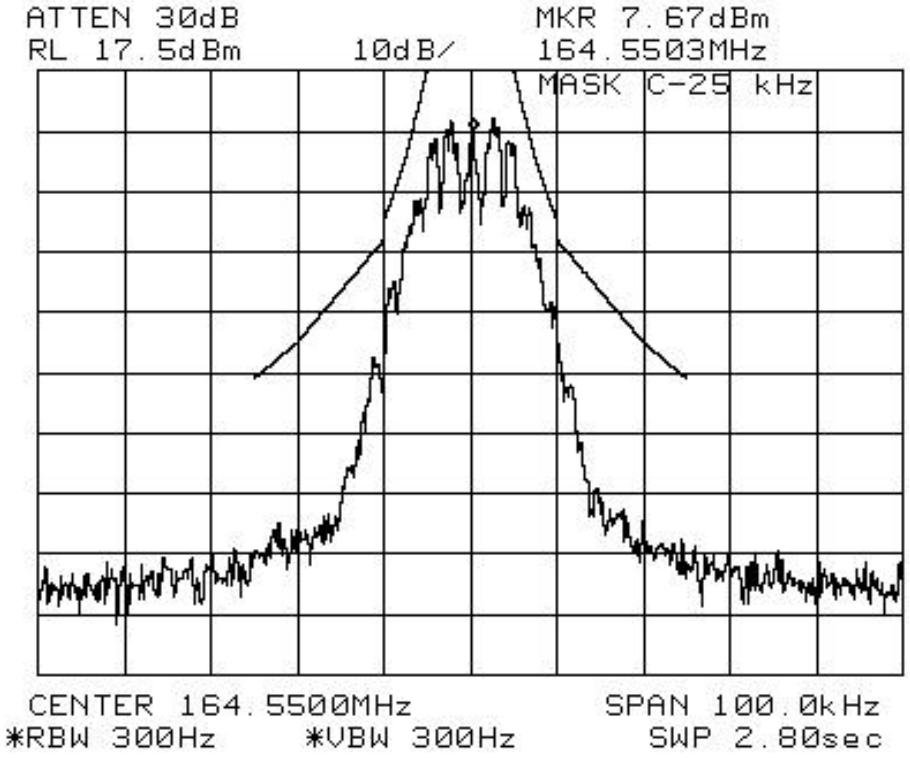
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel, alternating 0, 1 pattern



TYPE OF EXHIBIT: OCCUPIED BANDWIDTH-AFSK DATA

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

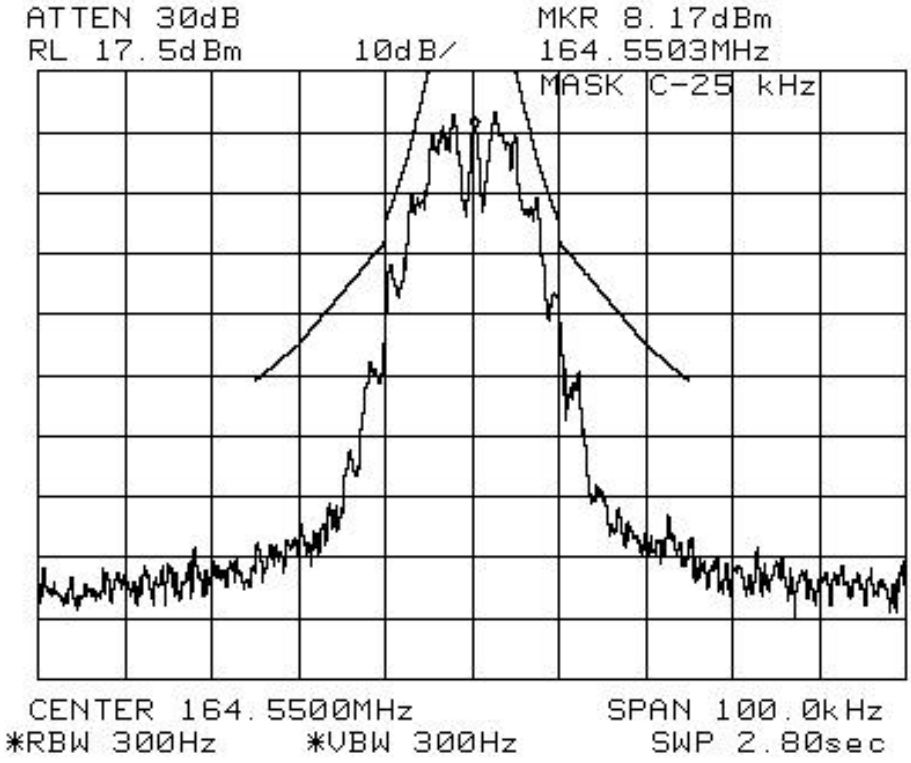
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: 25 kHz channel, pn pattern



TYPE OF EXHIBIT: BANDWIDTH CALCULATION/MODULATION TYPE

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:

Modulation:

Voice

Analog voice signals directly modulate the transmitter carrier with a maximum peak deviation which is dependant upon the channel spacing. Voice signals are pre-emphasized, limited, and filtered prior to being sent to the modulator. Digital voice signals represent the 4-level (4FSK) output of the digital voice card and directly modulate the transmitter carrier. The maximum deviation is dependant upon the channel spacing.

Data-4FSK

The 4FSK data stream is encoded into dibits at half the original data rate and used to create a 4-level audio signal which passes through a root-raised cosine filter and is then used to directly modulate the transmitter carrier. The maximum deviation is dependant upon the channel spacing.

Data-AFSK

The AFSK data stream is used to frequency an audio subcarrier at 1800 Hz. The peak audio deviation is +/-600 Hz. This signal is in turn filtered and used to directly frequency modulate the transmitter carrier with a peak deviation dependant upon the channel spacing.

TYPE OF EXHIBIT: BANDWIDTH CALCULATION/MODULATION TYPE

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:

By Carson's rule, the 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.

Modulation	f_Δ	f_m	BW	Emissions Designator
Analog Voice				
12.5 kHz	2.5	2.5	10.0	10K0F3E
25 kHz	5.0	2.5	15.0	15K0F3E
Digital Voice				
6.25 kHz	1.2	1.2	4.8	4K8F1E
12.5 kHz	2.4	2.4	9.6	9K6F1E
4FSK Data				
6.25 kHz	1.2	1.2	4.8	4K8F1D
12.5 kHz	2.4	2.4	9.6	9K6F1D
25 kHz	4.8	4.8	19.2	19K2F1D
Digital Voice/Data Combination				
6.25 kHz	1.2	1.2	4.8	4K8F7W
12.5 kHz	2.4	2.4	9.6	9K6F7W

TYPE OF EXHIBIT: BANDWIDTH CALCULATION/MODULATION TYPE

FCC PART: 2.1049(c)(1), 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: Continued

AFSK Data

12.5 kHz	2.5	1.8	8.6	8K6F2D
25 kHz	5.0	1.8	13.6	13K6F2D

TYPE OF EXHIBIT: CONDUCTED SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1051, 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation at the band edges and the band center at power levels ranging from 10 watts to 50 watts per the tune-up procedure outlined in the Maintenance manual. The transmitter was modulated in a manner consistent with the type of signal to be transmitted.

2. The RF output was connected to an HP 8560E spectrum analyzer through a 30 dB, 100 watt, 50 ohm RF attenuator. The center frequency of the spectrum analyzer was set to the transmitter frequency. The frequency span and resolution and video bandwidths were set to 100 kHz. The transmitter was keyed and the reference level on the analyzer noted.

3. An RF highpass filter was inserted into the path from the attenuator to the spectrum analyzer. The transmitter was keyed and the output spectrum was examined from 9 kHz to 10 times the operating frequency, except within 100 kHz of the operating frequency. The attenuation of the highpass filter at the transmitter spurious frequencies was measured and factored into the attenuator calculations.

TYPE OF EXHIBIT: CONDUCTED SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1051, 90.210(d)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:

Corrected Spur level(dBm) = Spur level @ analyzer(dBm) + Attenuator loss(dB)

Frequency (MHz)	Spur Frequency (MHz)	Spur level (dBm)	Atten. loss (dB)	Corr. Spur (dBm)	Limit (dBm)
155.025	465.075	-74.3	32.7	-41.6	-25.0
164.025	656.100	-77.0	33.0	-44.0	-25.0
173.975	347.950	-78.2	32.8	-45.4	-25.0

Note: Spurious levels more than 20 dB below the limit are not reported.

TYPE OF EXHIBIT: CONDUCTED SPURIOUS EMISSIONS-RECEIVER

FCC PART: 15.111

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was set for receive operation at 155.025, 164.025, and 173.975 MHz.

2. The RF output was connected directly to an HP 8560E spectrum analyzer. The center frequency of the spectrum analyzer was scanned from the lowest generated frequency to 5 GHz. The frequency span and resolution and video bandwidths were set to 100 kHz.

TYPE OF EXHIBIT: CONDUCTED SPURIOUS EMISSIONS-RECEIVER

FCC PART: 15.111

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:

Operating Frequency (MHz)	Spurious Frequency (MHz)	Spurious Level (dBm)	Limit (dBm)
155.025 MHz	198.675	<-107	-57
164.025 MHz	207.675	<-107	-57
173.975 MHz	217.625	<-107	-57

Note: Spurious levels more than 20 dB below the limit are not reported except for the strongest at each of the test frequencies and the first local oscillator frequency.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1053(a), (b)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The measurements for field strength of spurious emissions were taken at the RITRON, Inc. 3-meter test site, details of which are on file with the FCC and Industry Canada.

2. The RCCR-151/152 was aligned for transmitter operation on lower, center, and upper band edges at the 50 watt maximum output power rating for the unit per the tune-up procedure outlined in the Maintenance Manual. The unit was then terminated at the antenna port with a non-radiating 50-ohm load.

3. All field strength measurements were made with the Hewlett-Packard Model 8560E and 8559A Spectrum Analyzers and either a log periodic antenna, dipoles, or a microwave horn antenna depending upon frequency.

4. The transmitter was keyed and the spectrum searched from 9 kHz to the 10^{th} harmonic of the transmit carrier. When a spurious emission was found, the height and polarization of the field strength measurement antenna and orientation of the RCCR-151/152 were varied to provide maximum field strength.

5. A substitution antenna, a calibrated dipole, was substituted for the RCCR-151/152 at the RCCR-151/152's location. An RF signal generator was set for the frequency of the RCCR-151/152 with the level at the substitution antenna noted.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1053(a), (b)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE (continued)**:**

6. The polarization of the substitution antenna was adjusted for maximum signal strength at the field strength measuring antenna. The level at the field strength antenna was noted.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1053(a), (b)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

EQUATIONS:

The spurious level is referenced to the carrier level of the transmitter, which is 50 watts (47 dBm), maximum. The equation for spurious levels relative to carrier level is:

Pspur (dBc) = Pcarr (dBm) – Pspur (dBm)

For radiated emissions testing, Pspur (dBm) is the spurious emissions level as measured at the range receiving antenna. The reference level at the range receiving antenna for a 50-watt transmitter is:

Pcarr (dBm) = 47 dBm – Pgen (dBm) + Lcab (dB) + Pref (dBm)

Where:

Pcarr is the calculated level of a 50-watt transmitter into the substitution antenna.

Pgen is the RF signal generator level at the substitution antenna input.

Lcab is the cable loss from the substitution signal generator to the substitution antenna.

Pref is the power level of the substitution antenna emission at the receiving antenna output.

The overall equation thus becomes:

Pspur (dBc) = 47 dBm – Pgen (dBm) + Lcab (dB) + Pref (dBm) – Pspur (dBm)

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1053(a), (b)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: Horizontal Polarization

Freq (MHz)	Spur Freq. (MHz)	Pspur (dBm)	Pgen (dBm)	Lcab (dB)	Pref (dBm)	Spur Level (dBc)	Limit (dBc)
155.025	465.075	-61.2	0	2.0	–27.3	-82.9	-65.0
164.025	328.050	-63.1	0	1.6	-26.2	-85.5	-65.0
164.025	492.075	-66.0	0	2.1	-30.0	-85.1	-65.0
173.975	521.925	-63.8	0	2.2	-30.4	-82.6	-65.0

Note: Spurious levels more than 20 dB below limit are not reported.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-TRANSMITTER

FCC PART: 2.1053(a), (b)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: Vertical Polarization

Freq (MHz)	Spur Freq. (MHz)	Pspur (dBm)	Pgen (dBm)	Lcab (dB)	Pref (dBm)	Spur Level (dBc)	Limit (dBc)
164.025	492.075	-66.7	0	2.1	-30.5	-85.3	-65.0
173.975	521.925	-57.3	0	2.2	-31.0	-75.5	-65.0

Note: Spurious levels more than 20 dB below limit are not reported.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-RECEIVER

FCC PART: 15.109

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The measurements for field strength of spurious emissions were taken at the RITRON, Inc. 3-meter test site, details of which are on file with the FCC and Industry Canada.

2. The RCCR-151/152 was aligned for operation on lower, center, and upper band edges. The unit was then terminated at the antenna port with a non-radiating 50-ohm load.

3. All field strength measurements were made with the Hewlett-Packard Model 8560E and 8559A Spectrum Analyzers and either a log periodic antenna, dipoles, or a microwave horn antenna depending upon frequency.

4. The spectrum searched from 9 kHz to the 10^{th} harmonic of the local oscillator frequency. When a spurious emission was found, the height and polarization of the field strength measurement antenna and orientation of the RCCR-151/152 were varied to provide maximum field strength.

5. A substitution antenna, a calibrated dipole, was substituted for the RCCR-151/152 at the RCCR-151/152's location. An RF signal generator was set for the frequency of the RCCR-151/152 with the level at the substitution antenna noted.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-RECEIVER

FCC PART: 15.109

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE (continued)**:**

6. The polarization of the substitution antenna was adjusted for maximum signal strength at the field strength measuring antenna. The level at the field strength antenna was noted.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-RECEIVER

FCC PART: 15.109

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

EQUATIONS:

The spurious emission level is:

Spur(dBm) = Pspur(dBm) + Pgen(dBm) – Lcab – Pref(dBm)

Where:

Pspur is the power level of the radio's emission at the receiving antenna output.

Pgen is the RF signal generator level at the substitution antenna input.

Lcab is the loss of the cable from the generator to the substitution antenna.

Pref is the power level of the substitution antenna emission at the receiving antenna output.

TYPE OF EXHIBIT: FIELD STRENGTH OF SPURIOUS EMISSIONS-RECEIVER

FCC PART: 15.109

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: Horizontal Polarization

Freq. (MHz)	Spur Freq. (MHz)	Pspur (dBm)	Pgen (dBm)	Lcab (dB)	Pref (dBm)	Spur Level (dBm)	Limit (dBm)
164.025	207.675	-89.0	0	1.2	-19.7	-70.5	-57.0
173.975	217.625	-85.7	0	1.2	-20.0	-66.9	-57.0

Note: Spurious levels more than 20 dB below limit are not reported.

RESULTS: Vertical Polarization

Freq. (MHz)	Spur Freq. (MHz)	Pspur (dBm)	Pgen (dBm)	Lcab (dB)	Pref (dBm)	Spur Level (dBm)	Limit (dBm)
155.025	198.675	-84.2	0	1.2	-25.7	-59.7	-57.0
164.025	207.675	-83.7	0	1.2	-25.7	-59.2	-57.0
173.975	217.625	-88.2	0	1.2	-26.0	-63.4	-57.0

Note: Spurious levels more than 20 dB below limit are not reported.

TYPE OF EXHIBIT: FREQUENCY STABILITY VS TEMPERATURE

FCC PART: 2.1055(a)(1), 90.213

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation at 164.025 MHz at full rated power per the tune-up procedure outlined in the Maintenance manual.

2. The RCCR-151/152 was placed in a Delta Design Model 3900 CL Temperature Chamber. The RF output of the RCCR-151/152 was connected to an HP 8920 Test Set to monitor the transmitter frequency. An Astron VS 20M Power Supply was adjusted for a nominal voltage of 13.6 VDC and connected to the DC power supply input of the RCCR-151/152. A Triplett Model 320-G/P Thermocouple was used to monitor the temperature inside the chamber.

3. The chamber and the RCCR-151/152 were heated to +50 degrees C and allowed to stabilize for 30 minutes for the first measurement and 30 minutes for each 10 degree decrement in temperature until the unit reached a temperature of –30 degrees C.

4. The RF frequency at each temperature was recorded and compared with the frequency at 25 degrees C, the tune-up temperature in the Maintenance manual.

TYPE OF EXHIBIT: FREQUENCY STABILITY VS TEMPERATURE

FCC PART: 2.1055(a)(1), 90.213

MANUFACTURER: RITRON, Inc.

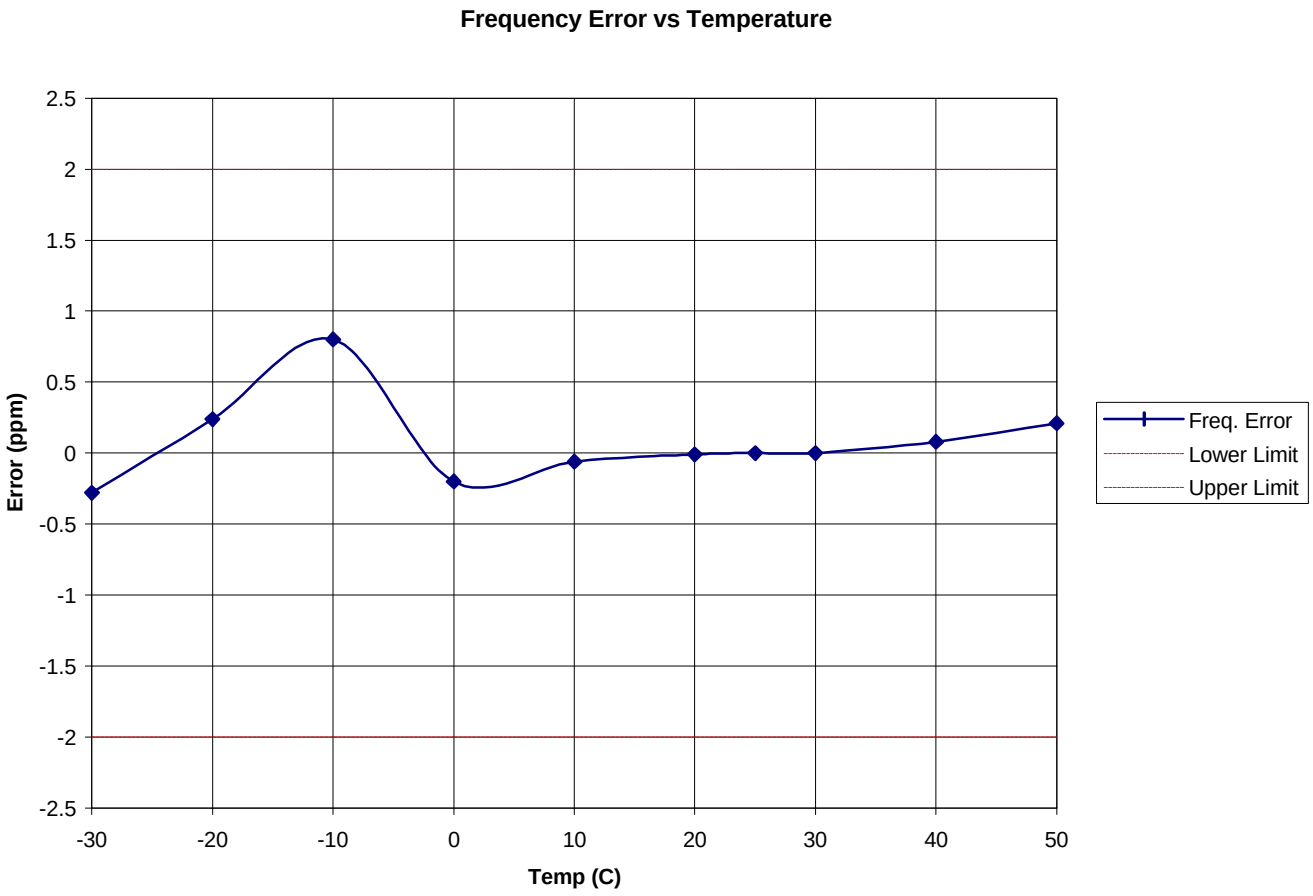
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:



TYPE OF EXHIBIT: FREQUENCY STABILITY VS SUPPLY VOLTAGE

FCC PART: 2.1055(d)(1)

MANUFACTURER: RITRON, Inc.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation at 164.025 MHz at full rated power per the tune-up procedure outlined in the Maintenance manual.

2. The RF output of the RCCR-151/152 was connected to an HP 8920B Test Set to monitor the transmitter frequency. An Astron VS 20M Power Supply was adjusted for a nominal voltage of 13.6 VDC and connected to the DC power supply input of the RCCR-151/152. The output frequency of the RCCR-151/152 was noted and used as the reference for the results in paragraph 3 below.

3. The voltage out of the DC power supply was adjusted to between 85% and 115% of nominal and the output frequency noted.

TYPE OF EXHIBIT: FREQUENCY STABILITY VS SUPPLY VOLTAGE

FCC PART: 2.1055(d)(1)

MANUFACTURER: RITRON, Inc.

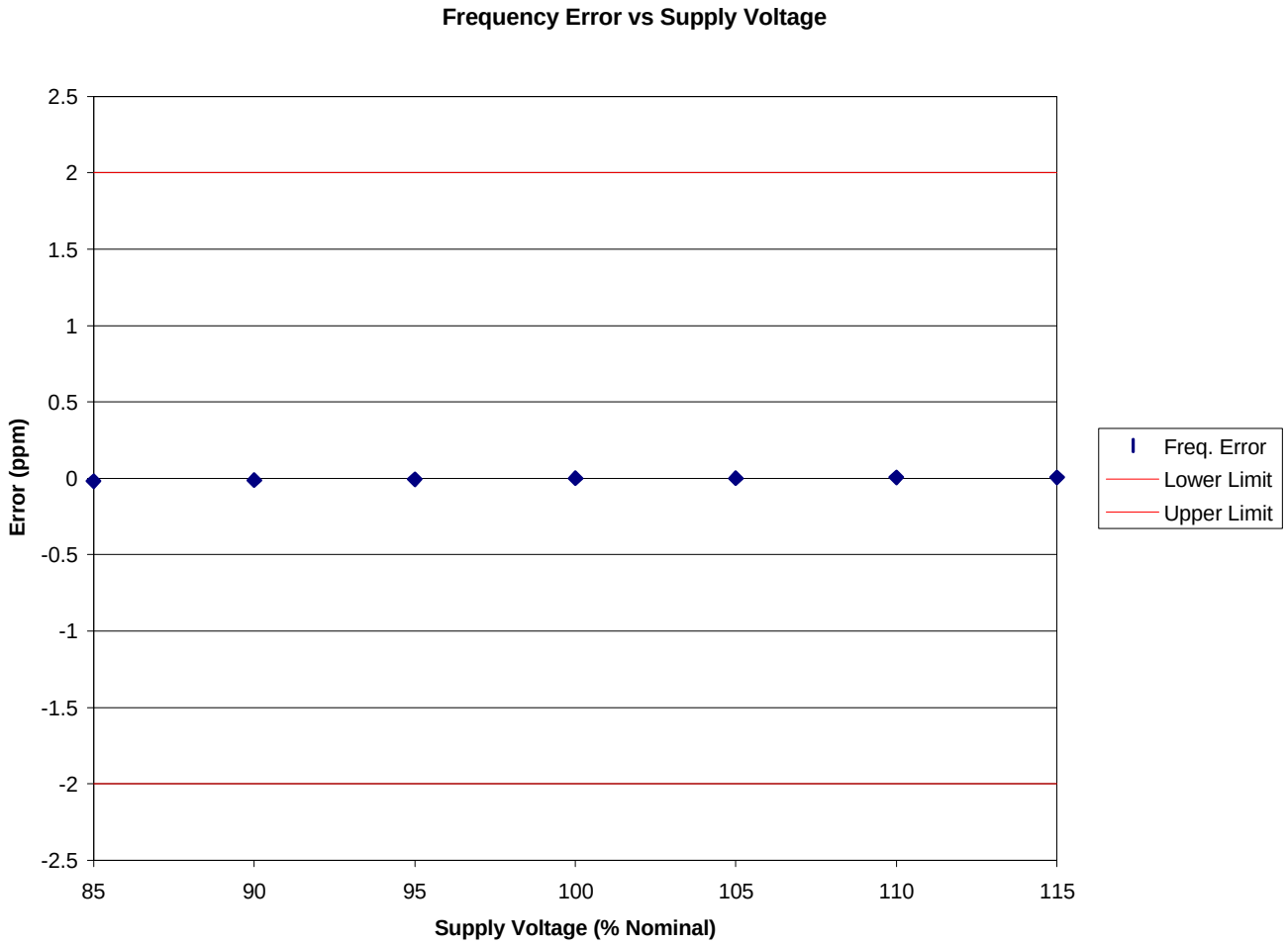
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS:



TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

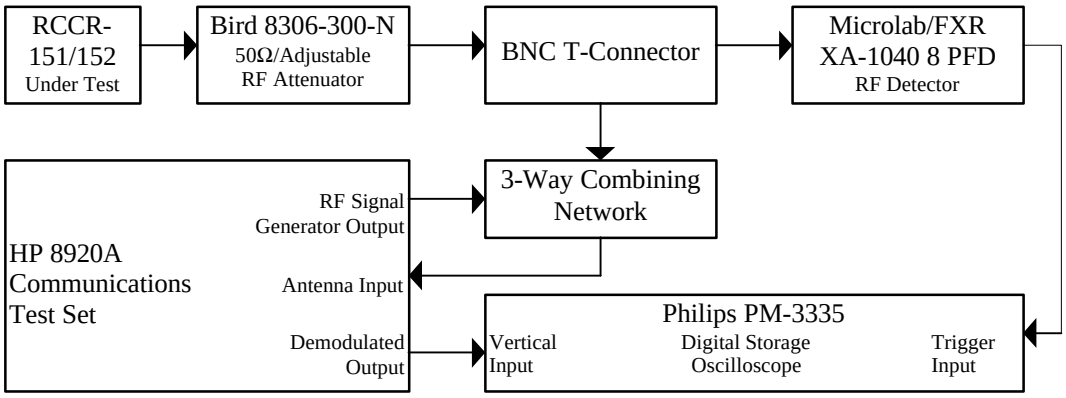
FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE:

1. The RCCR-151/152 was aligned for transmitter operation on 164.025 MHz at full rated power per the tune-up procedure outlined in the Maintenance Manual. The following steps are per TIA./EIA-603.

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



3. The HP 8920A Receiver was set to measure FM deviation with the audio bandwidth set at DC to greater than 15 kHz with the RF frequency set to 164.025 MHz. The attenuator was set for 40 dB.

4. The RCCR-151/152 transmitter under test was activated and the HP 8920A Spectrum Analyzer was used to measure the RF power level through the test network.

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE (continued):

5. The RCCR-151/152 transmitter was turned off. The HP 8920A RF Signal Generator was set to 164.025 MHz at an RF level at the HP 8920A which was 30 dB below that measured in step 3 and modulated with a 1 kHz tone at +/- 6.25 kHz deviation.

6. The Philips PM-3335 Digital Oscilloscope Horizontal Sweep Rate was set to 10 msec/div. 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 Philips PM-3335 Digital Oscilloscope was set to trigger at 1 division from the left side of the display when the RF Detector sensed RF power from the RCCR-151/152 transmitter.

8. The RCCR-151/152 transmitter was activated and the resulting waveform on the oscilloscope display was stored and plotted. The FCC limits per Part 90.214 were added to the plot. The resulting plot is labeled “Switch On Condition” and shows compliance with FCC Part 90.214/IC RSS-119, section 6.5.

9. The Philips 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 RCCR-151/152 transmitter.

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

PROCEDURE (continued):

10. The RCCR-151/152 transmitter was turned off and the resulting waveform on the oscilloscope display was stored and plotted. The limits per FCC Part 90.214/RSS-119, section 6.5 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.

11. Since this product supports 6.25 kHz, 12.5 kHz and 25 kHz channel operation, the most stringent 6.25 kHz limits are shown.

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.

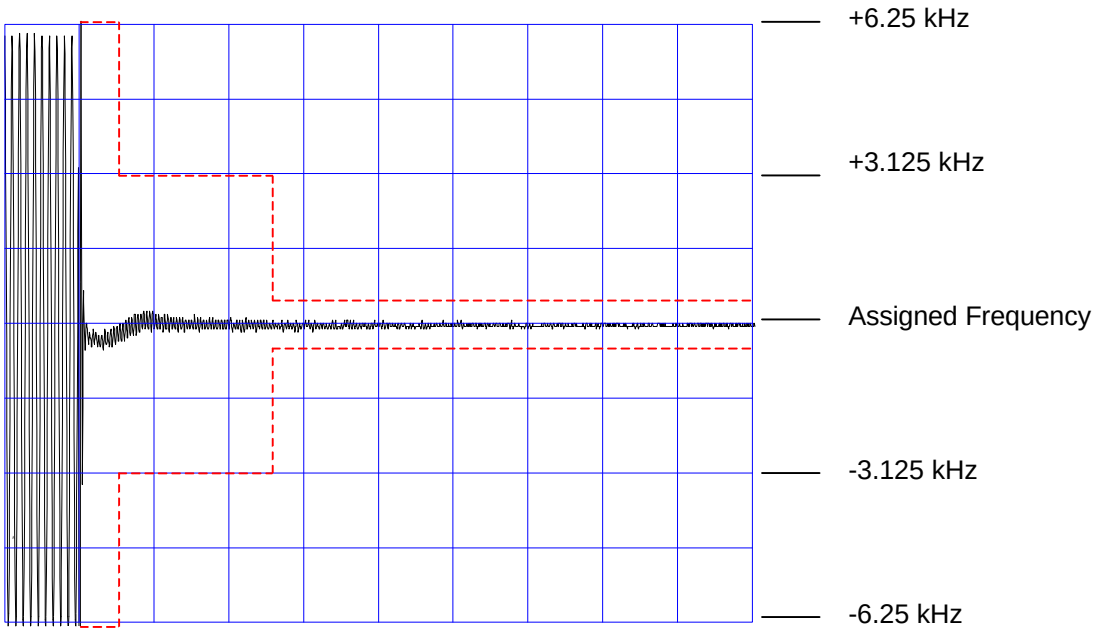
MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: Switch-On Condition



TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

MANUFACTURER: RITRON, INC.

MODEL: RCCR-151/152

TYPE OF UNIT: VHF Locomotive Transceiver

FCC ID: AIERIT28-150

DATE: April 30, 2008

RESULTS: Switch-Off Condition