
JMX-141 Test Results

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 29, 2000

The following is a list of attached exhibits required by the Federal Communications Commission for the application to and grant of FCC Type Acceptance.

List of Test Equipment Used	2.947 (d)
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 (b)
Frequency Stability vs. Temperature	2.1055 (a)
Frequency Stability vs. Battery Voltage	2.1055 (d)
Transient Frequency Behavior	90.214

TYPE OF EXHIBIT: TEST EQUIPMENT LIST

FCC PART: 2.947 (d)

MANUFACTURER: RITRON, INC.
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Carmel, IN 46032

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 29, 2000

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	Hewlett-Packard	HP8920A	3352A03633
Communications Test Set	IFR	COM120B	500008863
Spectrum Analyzer	Hewlett-Packard	8559A	2010A 06979
Power Supply	BK/Precision	1730	263-023610
Digital Oscilloscope	Philips	PM-3335	DM630034
Dual Display Multimeter	Protek	506	
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
10dB Attenuator		50F-010	N/A
20dB Attenuator	Tenuline	8340-200	1544
30dB Attenuator	Bird	8306-N	N/A
RF Detector	Microlabs/FXR	XA-1040	N/A

TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT

FCC PART: 2.1046

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 10, 2000

POWER OUTPUT RANGE:

The JMX-141 is designed to operate over two frequency sub-bands with output power ranging from about 1 Watt with a battery voltage of 6.0 volts to just under 2 watts with a battery voltage of 8.4 volts. The following data shows measured values over the sub-bands.

PROCEDURE:

1. Power was supplied to the JMX-141 via P301 by a BK Precision Model 1730 power supply. The supply is first set to 7.2 VDC and later 8.4 VDC. The JMX-141 is equipped with a 6-cell AA NiCd battery pack that has a nominal voltage of 7.2 VDC and a maximum voltage of 8.4 VDC.
2. The JMX-141 was connected at antenna terminal P201 to the input of the HP8920A Wattmeter, used to measure RF power of the carrier.
3. A Protek Model 506 Digital Multimeter was connected in series with L205 to measure the Drain current of Q203, the final RF amplifier device.

Low Split:

7.2 volt operation:

8.4 volt operation

Frequency (MHz)	Power (Watts)	I of Q203 (mA)	Q203 Eff (%)	I of radio (mA)	Power (Watts)	I of Q203 (mA)	Q203 Eff (%)	I of radio (mA)
148	1.36	410	46.1	510	1.85	490	52.4	610
153	1.41	440	44.5	550	1.89	520	50.5	630
157	1.38	440	43.6	540	1.81	525	47.9	625
161	1.32	460	39.9	550	1.69	540	43.5	670

High Split:

Frequency (MHz)	Power (Watts)	I of Q203 (mA)	Q203 Eff (%)	I of radio (mA)	Power (Watts)	I of Q203 (mA)	Q203 Eff (%)	I of radio (mA)
161	1.43	470	42.3	600	1.95	600	45.1	700
167	1.44	480	41.7	590	1.91	550	48.2	680
170	1.31	440	41.4	560	1.82	510	49.6	630
174	1.22	390	43.4	500	1.61	450	49.7	600

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 29, 2000

PROCEDURE:

1. A 250 mVRMS signal from the HP8920A was applied through a 220 uF cap between R235 and R236. Deviation was measured by the HP8920A from 100 to 10000 Hz. The JMX-141 is programmed to transmit in narrow band mode at 153.500 MHz.

Audio Frequency (Hz)	Peak Dev (KHz)
100	1.69
150	1.68
200	1.65
250	1.60
300	1.57
400	1.55
500	1.52
700	1.50
1000	1.50
2000	1.50
3000	1.50
4000	1.50
5000	1.50
6000	1.50
7000	1.37
8000	1.10
9000	0.82
10000	0.57

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

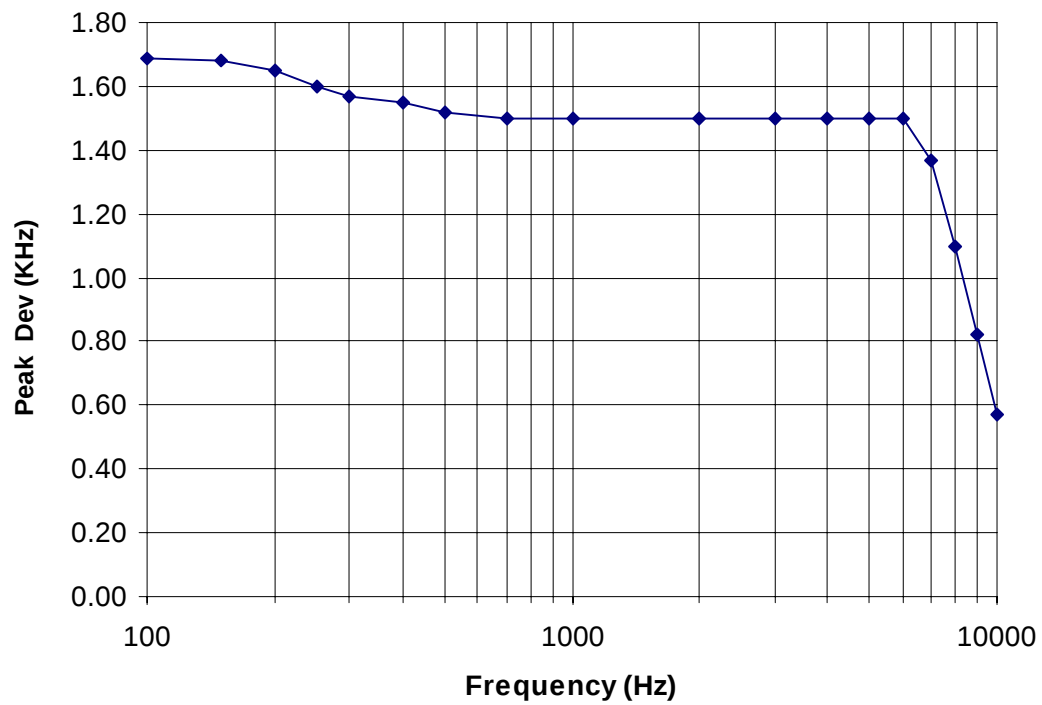
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

Modulation Response



TYPE OF TEST: Speech Low Pass and Pre-emphasized Filter Response

FCC PART: 2.1047 (a)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 21, 2000

PROCEDURE:

- 1) Two responses of the audio modulation circuit are taken. The first is the fifth order low pass (LPF) filter response from R229 through R238. This filter follows the clipper circuit. The second is the entire pre-emphasised response from the mic input jack J301 through R238.
- 2) For the LPF curve an 800 mV signal was generated by the HP8920A and applied via a 220 uF cap to the R228 and R229 junction. For the entire audio curve a 3 mV signal was applied to J301. In both cases a Phillips PM3335 oscilloscope measured the signal at the output of R238.

<u>(Hz)</u>	<u>LPF</u> <u>(volts p-p)</u>	<u>entire</u> <u>audio</u> <u>(volts p-p)</u>	<u>(Hz)</u>	<u>LPF(dB)</u>	<u>entire</u> <u>audio(dB)</u>
100	200	4	100	0.45	-34.81
200	210	14	200	0.87	-23.93
300	220	28	300	1.27	-17.91
400	220	44	400	1.27	-13.98
500	220	62	500	1.27	-11.00
700	220	95	700	1.27	-7.29
1000	230	150	1000	1.66	-3.33
1500	230	227	1500	1.66	0.27
2000	190	250	2000	0.00	1.11
2500	140	220	2500	-2.65	0.00
3000	84	132	3000	-7.09	-4.44
3500	48	80	3500	-11.95	-8.79
4000	28	45	4000	-16.63	-13.78
4500	17	27	4500	-20.97	-18.22
5000	10	16	5000	-25.58	-21.49
6000	4.2	6	6000	-33.11	-30.01
7000	2.1	2.8	7000	-39.13	-36.63
8000	1.2	1.8	8000	-43.99	-40.47
9000	0.7	1	9000	-48.67	-45.58
1000	0.4	0.6	10000	-53.53	-50.01

TYPE OF TEST: Speech Low Pass and Pre-emphasized Filter Response

FCC PART: 2.1047 (a)

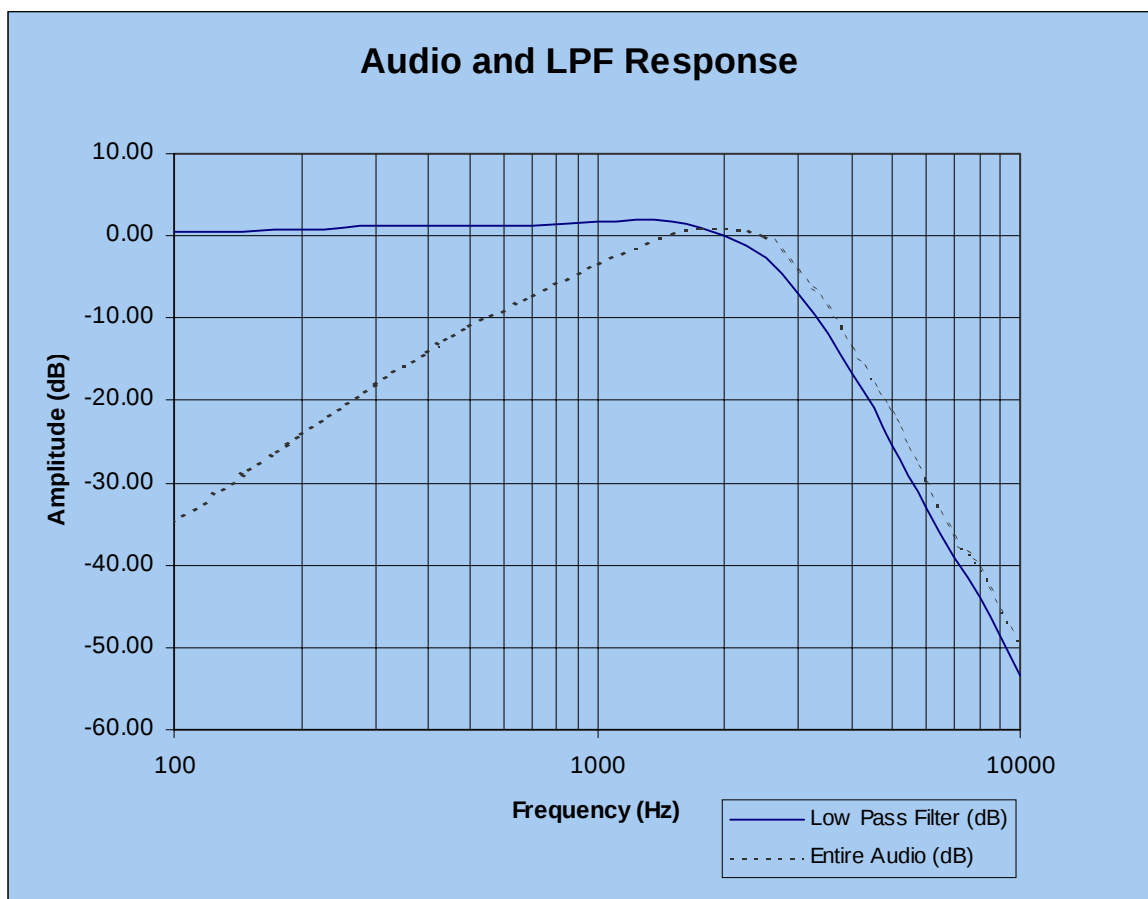
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 21, 2000



TYPE OF TEST: PERCENT MODULATION VS. MODULATION INPUT VOLTAGE

FCC PART: 2.1047 (b)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 21, 2000

PROCEDURE:

1. The JMX-141 was programmed for narrow band transmitter operation on 153.500 MHz.
2. The output of the HP8920A audio generator was applied to the microphone input of the JMX-141 through J301. The output of the audio generator was adjusted from 3 to 100 mVrms at frequencies from 300 to 3000 Hz.
3. A Protek 506 multimeter was used to measure the amplitude of the signal at the low pass filter output at R238.

frequency	mvRMS in	mvRMS					
		3	6	12	24	48	100
300		28	58	116	230	360	430
500		62	124	250	360	430	430
700		95	190	360	420	430	430
1000		150	300	420	430	430	430
2000		250	360	380	380	380	380
3000		132	160	160	160	160	160

mvRMS in	% of max deviation					
	3	6	12	24	48	100
300	7	13	27	53	84	100
500	14	29	58	84	100	100
700	22	44	84	98	100	100
1000	35	70	98	100	100	100
2000	58	84	88	88	88	88
3000	31	37	37	37	37	37

TYPE OF TEST: PERCENT MODULATION VS. MODULATION INPUT VOLTAGE

FCC PART: 2.1047 (b)

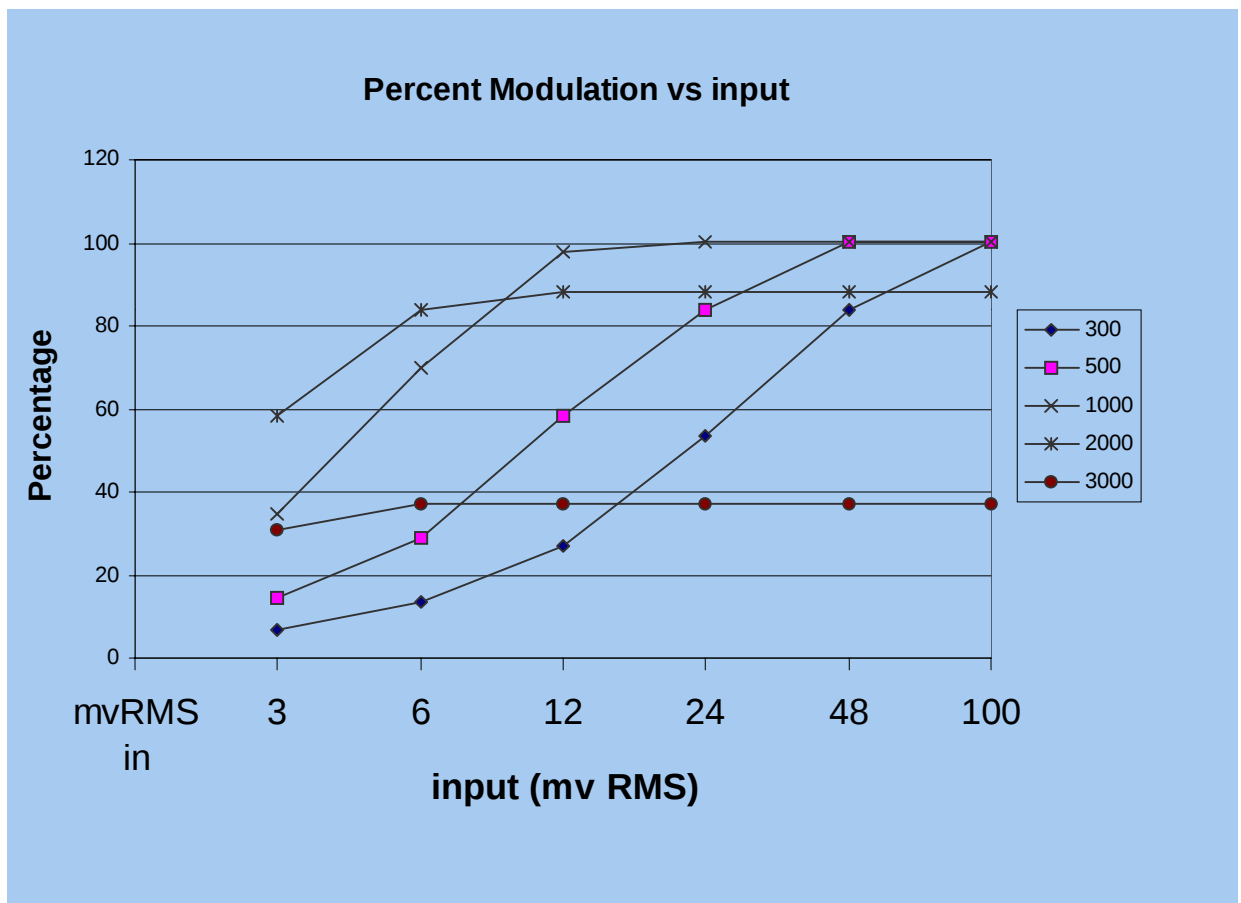
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 21, 2000



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: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 19, 2000

PROCEDURE:

1. The JMX-141 was programmed for transmitter operation on 153.500 MHz , was set for 12.5 KHz bandwidth operation, and the deviation was adjusted for +/- 2.0 KHz at 1000 Hz on channel (1) as outlined in the Preliminary Maintenance Manual. Channel (2) is programmed for 153.500 MHz and 25 kHz wide band operation and yields +/- 4.35 kHz deviation at 1000 Hz. Channel (3) is programmed for 153.500 MHz narrow bandwidth operation with a random data stream of 64 symbols. These are 4 level (2 bit) symbols which will FM modulate the transmitted carrier. They are generated within the microcontroller for demonstration purposes and output through pins 13 and 16. In a real application data would be received from the programming connector J302 and the microcontroller would act as a modem. Channel (4) is similar to channel (3) except the symbols alternate between 0 and 3 to demonstrate worst case or broadest spectral occupation.
2. The RF output of the JMX-141 was measured with a HP8920A communications test set wattmeter. This value was recorded as POWER OUTPUT. Power was supplied to the JMX-141 via a BK1730 power supply set at +7.2 VDC.
3. The antenna terminal P201 was connected to the HP8920A communications test set. The spectrum analyzer was set up for:
 - 300 Hz Resolution
 - 25 kHz span
 - 32 dBm Reference
 - 10 dB per Vertical Division
4. The output of the HP8920A audio function generator was applied to the microphone input of the JMX-141 through J301. 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 was centered on the sideband being read. Readings of the sideband levels in dBm were recorded and a graph of the spectrum analyzer output was plotted. All readings were rounded up to the nearest dB.
6. The JMX-141 was set for 25 KHz bandwidth operation, and the deviation was adjusted for +/- 4 KHz as outlined in the Preliminary Maintenance Manual. Steps 3 - 5 were repeated for 25 KHz bandwidth operation.

TABLE DATA

The sideband powers on each side of the carrier were reduced to a percentage of the MEAN REFERENCE POWER OUTPUT. The percentages were added together starting with the carrier and expanding out equally in +/- 2.5 KHz increments until greater than 99.5% of the total MEAN REFERENCE POWER was reached. The occupied bandwidth is defined as having 99.5% of the total MEAN REFERENCE POWER existing within its limits.

TYPE OF TEST: OCCUPIED BANDWIDTH FOR WIDE BAND VOICE

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

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 26, 2000

DATA: Carrier 153.5 MHz
Frequency:
Power 1.40 Watts
Output:
Power 31.46 dBm
Output:
Mean Reference Power: 31.38 dBm
Channel Bandwidth: 25.0 KHz
Occupied Bandwidth: 20.0 KHz

Emission Frequency Offset (KHz)	Measured Relative Amplitude (dBm)	Actual Amplitude (dBm)	FCC Limit (dBm)	Power (Watts)	Percent MRP (%)	Occupied Bandwidth (%)
-25.0			-3.54			
-22.5			-3.54			
-20.0			6.46			
-17.5	-70.50	-39.04	6.46	124.8E-9	0.00%	
-15.0	-62.50	-31.04	6.46	787.3E-9	0.00%	
-12.5	-51.60	-20.14	6.46	9.7E-6	0.00%	
-10.0	-39.00	-7.54	31.46	176.2E-6	0.01%	
-7.5	-25.00	6.46	31.46	4.4E-3	0.32%	
-5.0	-13.00	18.46	31.46	70.2E-3	5.10%	
-2.5	-5.35	26.11	31.46	408.4E-3	29.71%	
0.0	-5.35	26.11	31.46	408.4E-3	29.71%	100.00%
2.5	-5.35	26.11	31.46	408.4E-3	29.71%	
5.0	-13.00	18.46	31.46	70.2E-3	5.10%	
7.5	-25.00	6.46	31.46	4.4E-3	0.32%	
10.0	-40.00	-8.54	31.46	140.0E-6	0.01%	
12.5	-52.00	-20.54	6.46	8.8E-6	0.00%	
15.0	-63.50	-32.04	6.46	625.4E-9	0.00%	
17.5	-71.50	-40.04	6.46	99.1E-9	0.00%	
20.0			6.46			
22.5			-3.54			
25.0			-3.54			

TYPE OF TEST: OCCUPIED BANDWIDTH for WIDE BAND VOICE

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

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

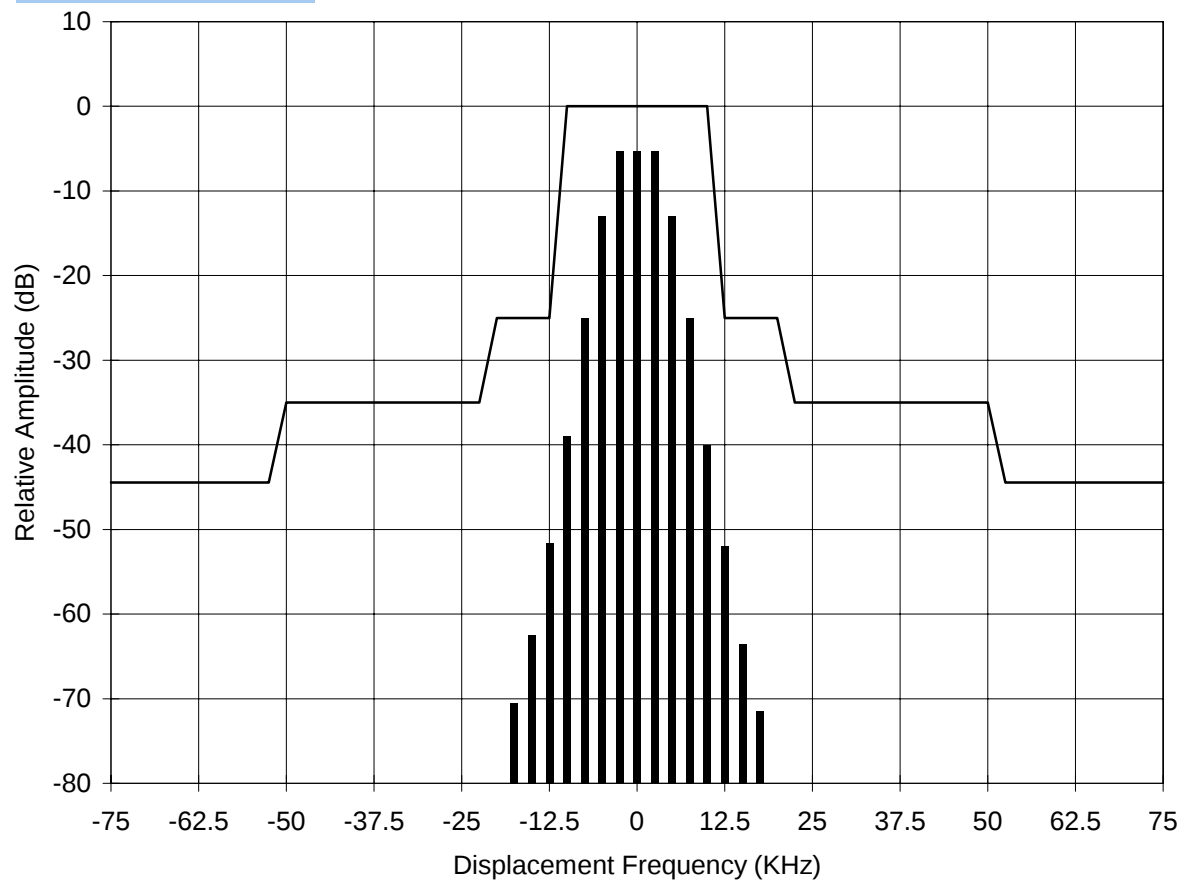
MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 26, 2000

CURVE:



Channel Bandwidth: 25 KHz
Power Output: 1.4 Watts

■ 2500 Hz Sidebands
— Emission Mask B

TYPE OF TEST: OCCUPIED BANDWIDTH for NARROW BAND VOICE

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

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

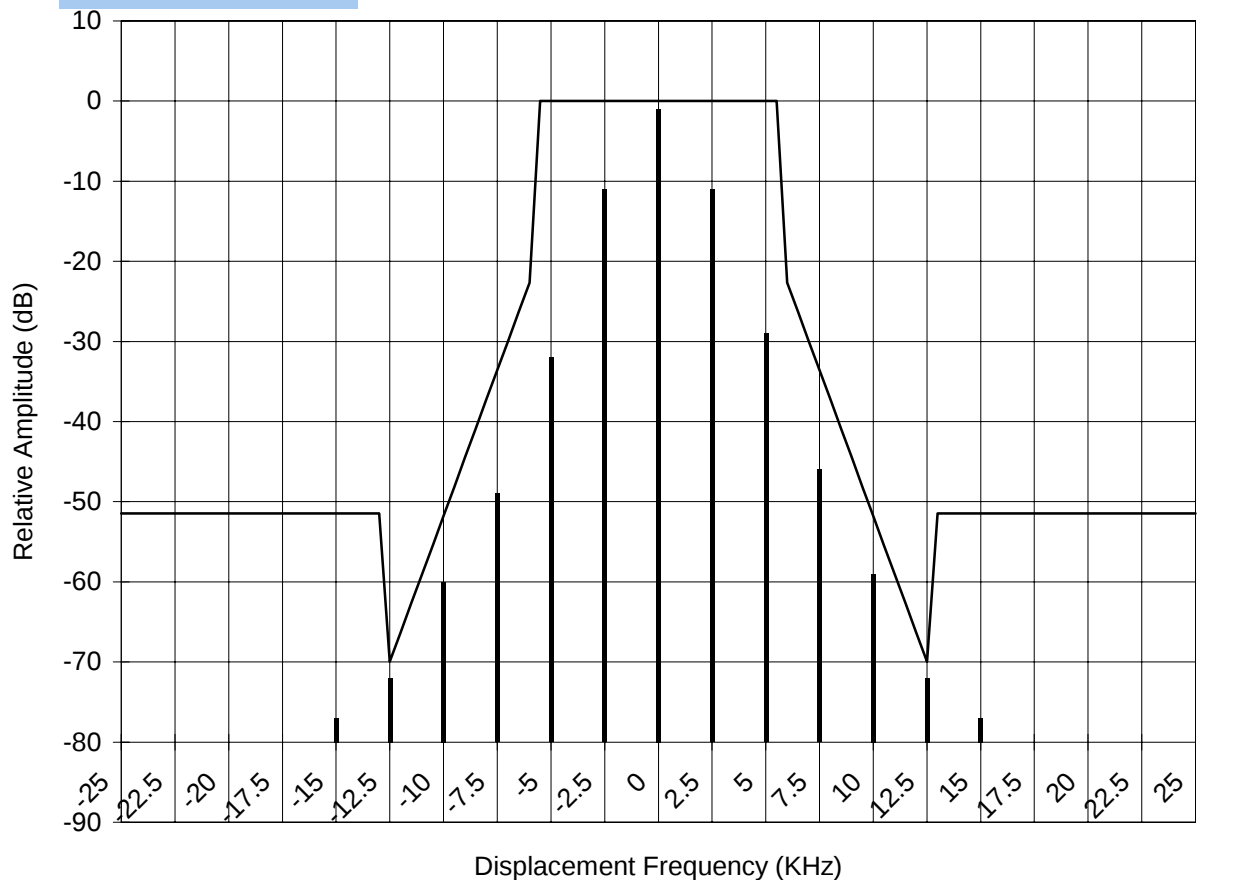
FCC ID: AIERIT14-141

DATE: July 26, 2000

DATA: Carrier 153.5 MHz
Frequency:
Power 1.40 Watts
Output:
Power 31.46 dBm
Output:
Mean Reference Power: 31.26 dBm
Channel Bandwidth: 12.5 KHz
Occupied Bandwidth: 10.0 KHz

Emission Frequency Offset (KHz)	Measured Relative Amplitude (dBm)	Actual Amplitude (dBm)	FCC Limit (dBm)	Power (Watts)	Percent MRP (%)	Occupied Bandwidth (%)
-25.0			-20.00			
-22.5			-20.00			
-20.0			-20.00			
-17.5			-20.00			
-15.0	-77.00	-45.54	-20.00	27.9E-9	0.00%	
-12.5	-72.00	-40.54	-38.48	88.3E-9	0.00%	
-10.0	-60.00	-28.54	-20.30	1.4E-6	0.00%	
-7.5	-49.00	-17.54	-2.13	17.6E-6	0.00%	
-5.0	-32.00	-0.54	31.46	883.3E-6	0.07%	
-2.5	-11.00	20.46	31.46	111.2E-3	8.32%	
0.0	-1.00	30.46	31.46	1.1E+0	83.16%	100.00%
2.5	-11.00	20.46	31.46	111.2E-3	8.32%	
5.0	-29.00	2.46	31.46	1.8E-3	0.13%	
7.5	-46.00	-14.54	-2.13	35.2E-6	0.00%	
10.0	-59.00	-27.54	-20.30	1.8E-6	0.00%	
12.5	-72.00	-40.54	-38.48	88.3E-9	0.00%	
15.0	-77.00	-45.54	-20.00	27.9E-9	0.00%	
17.5			-20.00			
20.0			-20.00			
22.5			-20.00			
25.0			-20.00			

TYPE OF TEST:	OCCUPIED BANDWIDTH FOR NARROW BAND VOICE
FCC PART:	2.1049 (c) (1) per 90.210 (d)
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODEL:	JMX-141
TYPE OF UNIT:	VHF-FM Handheld Transceiver
FCC ID:	AIERIT14-141
DATE:	July 26, 2000
CURVE:	



Channel Bandwidth: 12.5 KHz
Power Output: 1.4 Watts

2500 Hz Sidebands
Emission Mask D

TYPE OF TEST: OCCUPIED BANDWIDTH for NARROW BAND (12.5 kHz) DATA

FCC PART: 2.1049 (c)(1) per 90.210 (d) and 90.203 (j)(3)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 26, 2000

PROCEDURE:

1. The JMX-141 was programmed on channel (1) for transmitter operation on 153.500 MHz, was set for 12.5 kHz bandwidth operation, and the deviation was adjusted for +/- 2.0 kHz at 1000 Hz as above. Two plots are shown. The first is a typical spectrum generated from random data on channel (3). The second is the worst case spectrum from channel (4) (see (4) below).
2. The RF output of the JMX-141 was measured with a HP8920A communications test set wattmeter. This value was recorded as POWER OUTPUT. Power was supplied to the JMX-141 via a BK1730 power supply set at +7.2 VDC.
3. The antenna terminal P201 was connected to the HP8920A communications test set. The spectrum analyzer was set up for:
 - 300 Hz Resolution
 - 25 kHz span
 - 32 dBm Reference
 - 10 dB per Vertical Division
4. The JMX-141 microcontroller was flashed programmed for the modem mode of operation. The first spectrum results from a random 4 level FM modulated carrier. A random symbol rate of 4800 symbols per second with two bits per symbol yielding 9600 bits per second was generated by the microcontroller. The second spectrum is the worst case spectrum resulting where data alternates form 0 to 3. That is, no 1's and 2's are present only the maximum FM deviations for the 9600 bps rate. The equivalent modulation is a 2400 Hz square wave.
5. The spectrum analyzer was centered on the sideband being read. Readings of the sideband levels in dBm were recorded and a graph of the spectrum analyzer output was plotted.

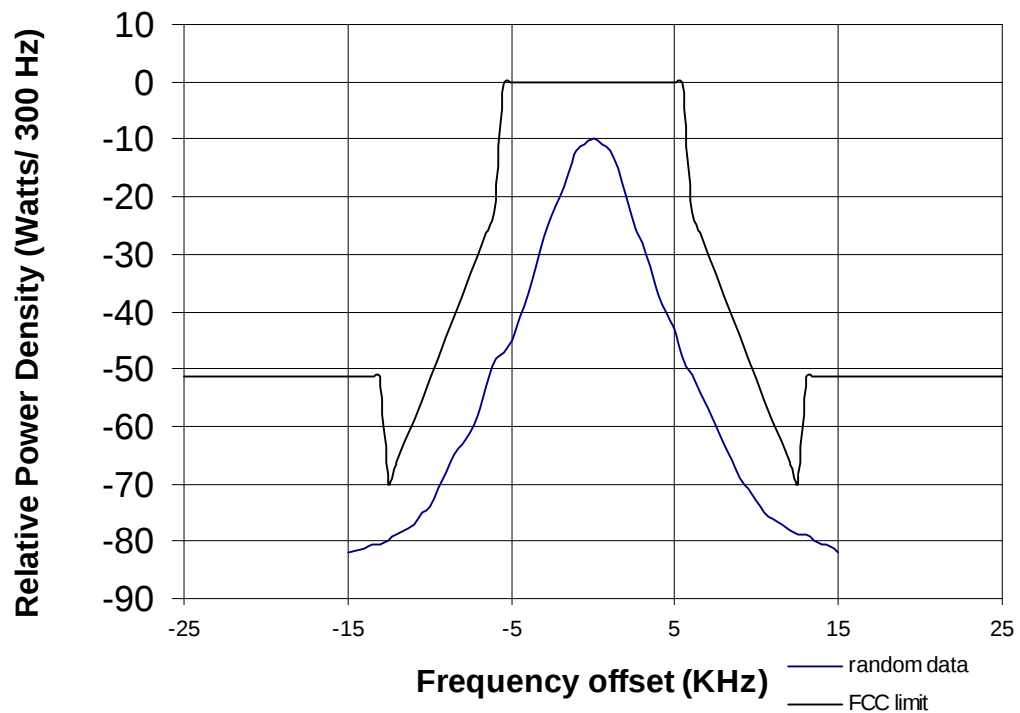
TABLE DATA

The sideband powers on each side of the carrier were reduced to a percentage of the MEAN REFERENCE POWER OUTPUT. The percentages were added together starting with the carrier and expanding out equally in +/- 2.4 KHz increments until greater than 99.5% of the total MEAN REFERENCE POWER was reached.

The occupied bandwidth is defined as having 99.5% of the total MEAN REFERENCE POWER existing within its limits.

TYPE OF TEST:	OCCUPIED BANDWIDTH for NARROW BAND DATA
FCC PART:	2.1049 (c)(1) per 90.210 (d) and 90.203 (j)(3)
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODEL:	JMX-141
TYPE OF UNIT:	VHF-FM Handheld Transceiver
FCC ID:	AIERIT14-141
DATE:	July 26, 2000

Typical 9600 bps Occupied BW



TYPE OF TEST: OCCUPIED BANDWIDTH for NARROW BAND DATA (WORST)

FCC PART: 2.1049 (c)(1) per 90.210 (d) and 90.203 (j)(3)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 26, 2000

DATA: Carrier 153.5 MHz
Frequency:
Power 1.40 Watts
Output:
Power 31.46 dBm
Output:
Mean Reference Power: 31.46 dBm
Channel Bandwidth: 12.5 KHz
Occupied Bandwidth: 10.0 KHz

Emission Frequency Offset (KHz)	Measured Relative Amplitude (dBm)	Actual Amplitude (dBm)	FCC Limit (dBm)	Power (Watts)	Percent MRP (%)	Occupied Bandwidth (%)
-24.0			-20.00			
-21.6			-20.00			
-19.2			-20.00			
-16.8			-20.00			
-14.4	-77.00	-45.54	-20.00	27.9E-9	0.00%	
-12.0	-68.00	-36.54	-34.84	221.9E-9	0.00%	
-9.6	-57.00	-25.54	-17.39	2.8E-6	0.00%	
-7.2	-44.00	-12.54	0.05	55.7E-6	0.00%	
-4.8	-26.00	5.46	31.46	3.5E-3	0.25%	
-2.4	-10.00	21.46	31.46	140.0E-3	10.01%	
0.0	-1.00	30.46	31.46	1.1E+0	79.48%	99.99%
2.4	-10.00	21.46	31.46	140.0E-3	10.01%	
4.8	-26.00	5.46	31.46	3.5E-3	0.25%	
7.2	-44.00	-12.54	0.05	55.7E-6	0.00%	
9.6	-57.00	-25.54	-17.39	2.8E-6	0.00%	
12.0	-68.00	-36.54	-34.84	221.9E-9	0.00%	
14.4	-77.00	-45.54	-20.00	27.9E-9	0.00%	
16.8			-20.00			
19.2			-20.00			
21.6			-20.00			
24.0			-20.00			

TYPE OF TEST:

FCC PART:

MANUFACTURER:

MODEL:

TYPE OF UNIT:

FCC ID:

DATE:

CURVE:

OCCUPIED BANDWIDTH FOR NARROW BAND DATA

2.1049 (c) (1) per 90.210 (d)and 90.210 (j)(3)

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

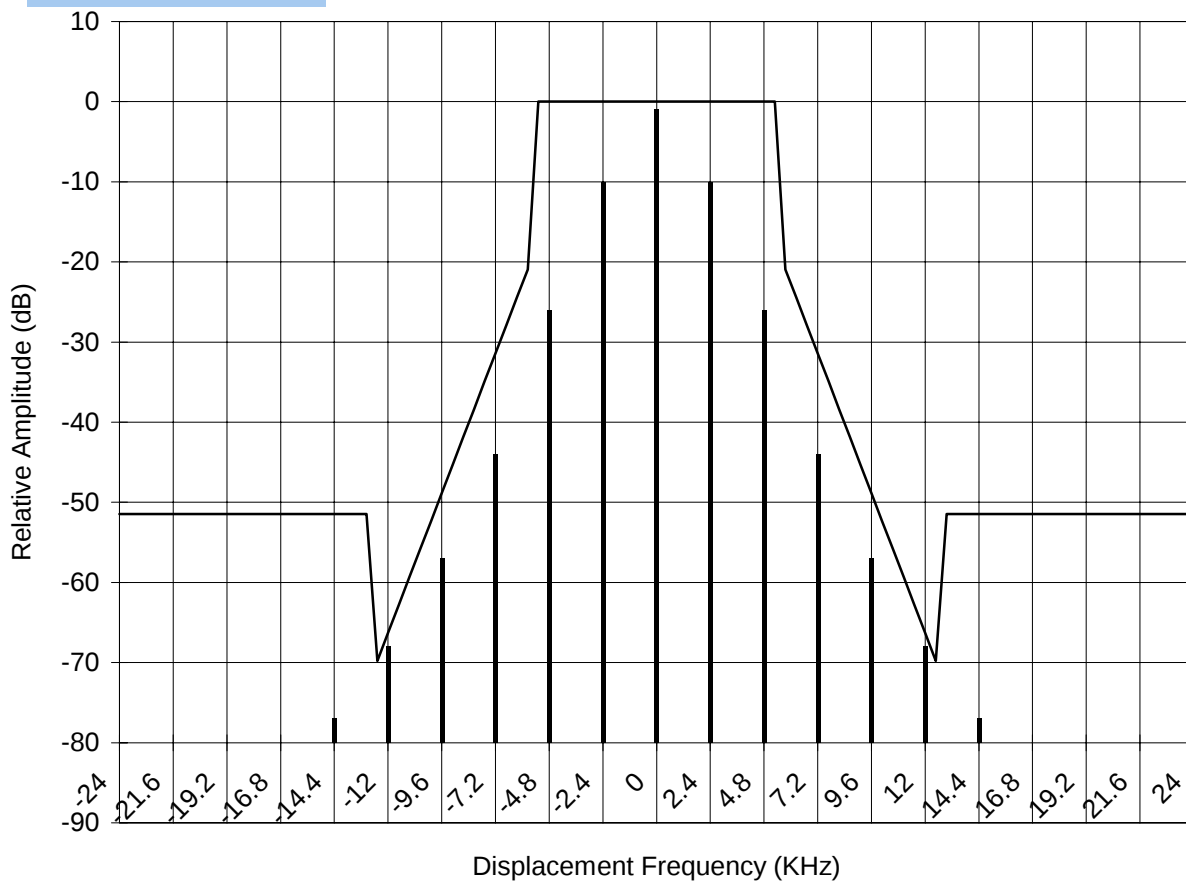
JMX-141

VHF-FM Handheld Transceiver

AIERIT14-141

July 26, 2000

Worst Case Spectrum For 9600 BPS Transmission



Channel Bandwidth: 12.5 KHz
Power Output: 1.4 Watts

■ 2400 Hz Sidebands
— Emission Mask D

TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.1051

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 27, 2000

PROCEDURE:

1. The JMX-141 was programmed for transmitter operation on 153.500 MHz.
2. Power was supplied to the JMX-141 by a BK Precision Model 1730 Power Supply. The supply voltage was set to +7.2 VDC.
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 JMX-141 antenna terminal P201 was connected to the input of a 20 dB power attenuator,. The output of the attenuator was connected to the input of a Hewlett-Packard Model 8559A Spectrum Analyzer.
5. The spectrum was searched from 8 MHz to the 10th harmonic of the operating frequency. All unreported emissions were more than 30 dB below the FCC limit of $50 + 10 \log P$, or -20 dBm.
6. The spectrum analyzer's internal attenuator was increased until no internal harmonics were produced by the analyzer. This was set to 40 dB.
7. The measured insertion loss of the external attenuator is listed as the "Correction Factor" on the data sheet.

Carrier Frequency: 153.500 **MHz**
Power Output: 1.40 **Watts**

Multiple of Carrier	Emmission Frequency (MHz)	Analyzer Reading (dBm)	FCC Limit (dBm)	Attenuator Correction Factor(dB)	dB below FCC Limit
2	307.0000	-52	-20	19	13.00
3	460.5000	-52	-20	19	13.00
4	614.0000	-62	-20	19	23.00
5	767.5000	-65	-20	18.5	26.50
6	921.0000	-66	-20	19	27.00

TYPE OF TEST: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.1053

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 22, 2000

PROCEDURE:

The following measurements were taken at the RITRON, Inc. 3 meter test site. Measurements were made in accordance with FCC Rules & Regulations Part 2.947, using the procedures of IEC Publication 106.

1. The JMX-141 was aligned for transmitter operation on 153.500 MHz.
2. The JMX-141 was then terminated at the antenna port with a non-radiating 50Ω terminating load.
3. All field strength measurements were made with the Hewlett-Packard Model 8559A Spectrum Analyzer and the appropriate antenna for the frequency being measured. The antennas used were:
 - Electro-Metrics BDA-25 Dipole Antenna at 0 to 200 MHz
 - Electro-Metrics LP-25 Log Periodic Antenna at 200 to 1000 MHz
 - Polarad CA-BB Microwave Antenna at 1000 to 10,000 MHz
4. For each emission, the height and polarization of the field strength measuring antenna and orientation of the JMX-141 were varied to provide maximum field strength.
5. 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).

Carrier Frequency: 153.500 **MHz**
Power 1.40 **Watts**
Output:
Dipole Reference Level: 2766466 **μV / m**
FCC 51.46 **dB**
Limit:

Emmission Frequency (MHz)	Multiple of Carrier	Antenna	Analyzer Reading (dBm)	Antenna Factor (dB)	Field Strength (μV / m)	dB below Reference Level	dB below FCC Limit
307.0000	2	Log Periodic	-50	17.15	5100.35	54.69	3.23
460.5000	3	Log Periodic	-57	21.49	3754.05	57.35	5.89
614.0000	4	Log Periodic	-75	24.48	666.81	72.36	20.90
767.5000	5	Log Periodic	-59	26.48	5296.63	54.36	2.90
921.0000	6	Log Periodic	-62	28.35	4650.50	55.49	4.03

TYPE OF TEST: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.1053

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 22, 2000

EQUATIONS:

Analyzer readings in dBm and the calibrated antenna factor were converted to field strength as follows:

$$P_{3m} = R + 107 + K$$

$$E_{3m} = \text{Log}^{-1} (P_{3m} / 20)$$

where:

- P_{3m} = Power output at 3 meters in dBm.
- R = Direct reading from spectrum analyzer in dBm.
- K = Antenna factor in dB at 3 meters.
- E_{3m} = Field strength at 3 meters in $\mu\text{V/m}$.

The reference level for a half wave dipole was computed as follows:

$$E_{\text{ref}} = 1000000 * \sqrt{(49.2 * P) / D}$$

where:

- P = Transmitter power in Watts.
- D = Distance in meters.

The amount, in dB, that the measured field strength is below the reference field strength was computed as follows:

$$E = 20 \text{ Log } (E_{3m} / E_{\text{ref}})$$

where:

- E = The amount below reference level in dB.
- E_{3m} = Field strength at 3 meters in $\mu\text{V/m}$.
- E_{ref} = Reference field strength at 3 meters in $\mu\text{V/m}$.

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE

FCC PART: 2.1055 (a)(1)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 27, 2000

PROCEDURE:

1. The JMX-141 was programmed for operation on 153.500 MHz.
2. Power was supplied to the JMX-141 by a BK Precision Model 1730 power supply set to the nominal operating voltage of +7.2 VDC. The JMX-141 antenna terminal P201 was connected to the input of an HP8920A RF communications test set used to measure frequency of the carrier.
2. Temperature was measured with an Omega Model 7035-J-225 thermocouple.
5. The temperature was raised to +50°C and allowed to stabilize for 45 minutes. The transmitter was activated and the frequency output recorded. The temperature was lowered in 10°C increments down to -30°C, allowing 30 minutes to stabilize at each temperature.

Frequency: 153.500 MHz
Nominal Temp: +20 °C
FCC Limit: +/- 2.5 ppm

Temperature (°C)	Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
50	153.499870	-130	-0.85
40	153.499912	-88	-0.57
30	153.499983	-17	-0.11
20	153.500109	109	0.71
10	153.500130	130	0.85
0	153.500165	165	1.07
-10	153.500162	162	1.06
-20	153.500151	151	0.98
-30	153.500138	138	0.90

TYPE OF TEST:**FREQUENCY STABILITY VS. TEMPERATURE****FCC PART:**

2.1055 (a)(b)

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

JMX-141

TYPE OF UNIT:

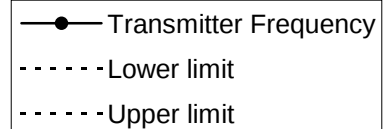
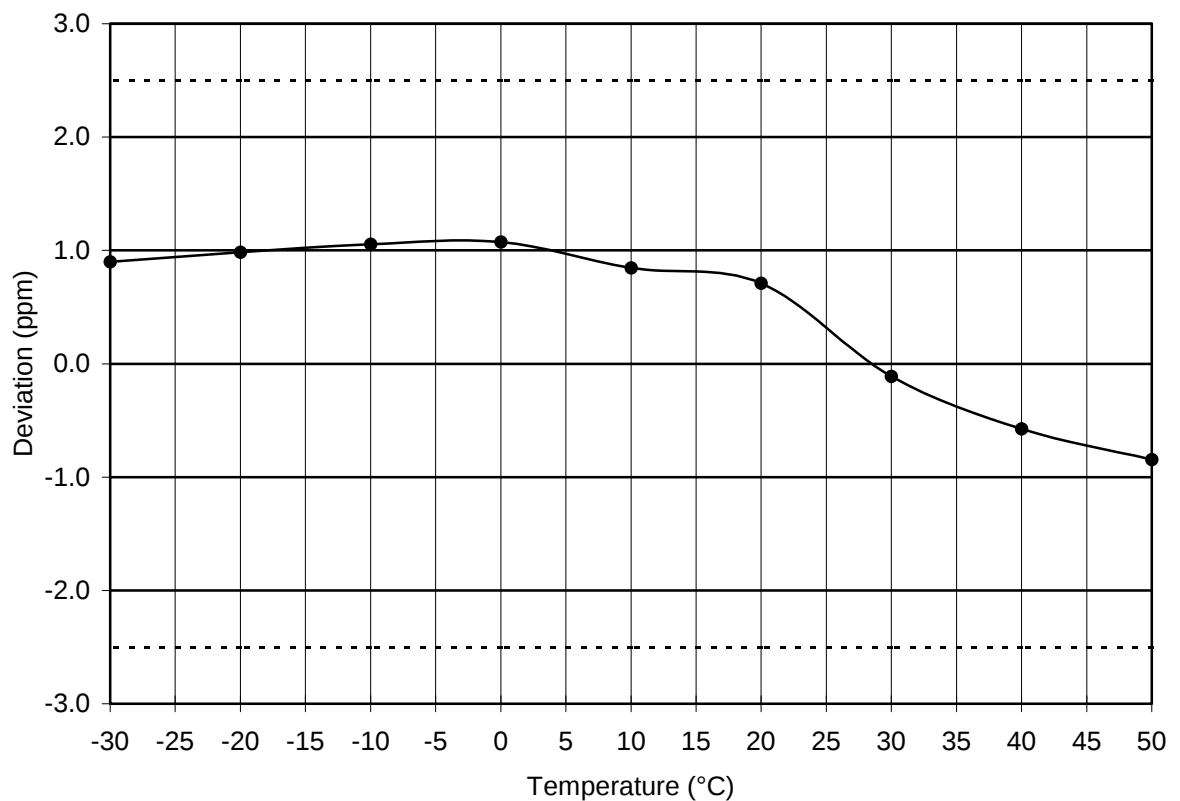
VHF-FM Handheld Transceiver

FCC ID:

AIERIT14-141

DATE:

June 27, 2000

CURVE:

TYPE OF TEST: FREQUENCY STABILITY VS. BATTERY VOLTAGE

FCC PART: 2.1055 (d)(2)

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: June 27, 2000

PROCEDURE:

1. The JMX-141 was programmed to operate at 153.500 MHz.
2. Power was supplied to the JMX-141 by a BK Precision Model 1730 power supply, and supply voltage was measured at P301 battery connector with a Protek 506 DVM.
3. The JMX-141 antenna terminal P201 was connected to the input of an HP8920A communications test set, used to measure frequency of the carrier.
4. Frequency measurements were made at +25°C with supply voltage set to 6.0, 7.2 and 8.4 VDC.
5. The lowest operating voltage is determined by battery end of life voltage for each cell multiplied by the number of individual cells. The maximum cell voltage multiplied by the number of cells determines the highest operating voltage. For AA NiCd and NiMH cells the lowest operating voltage is 1 VDC and the highest operating voltage is 1.4 VDC.

Lowest operating voltage	1.0 VDC X 6 cells	6.0 VDC
Nominal operating voltage	1.2 VDC X 6 cells	7.2 VDC
Lowest operating voltage	1.4 VDC X 6 cells	8.4 VDC

6. All frequencies were referenced to the measurement made at +7.2 VDC, the nominal supply voltage for a 6-cell AA NiCd battery pack.

Nominal Frequency (MHz): 153.500

FCC Limit (ppm): 2.5

Supply Voltage	Battery Condition	Transmit Frequency	Freq error (Hz)	PPM error from nominal
6.0	low	153.500055	55.0	0.36
7.2	nominal	153.500068	68.0	0.44
8.4	high	153.500066	66.0	0.43

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

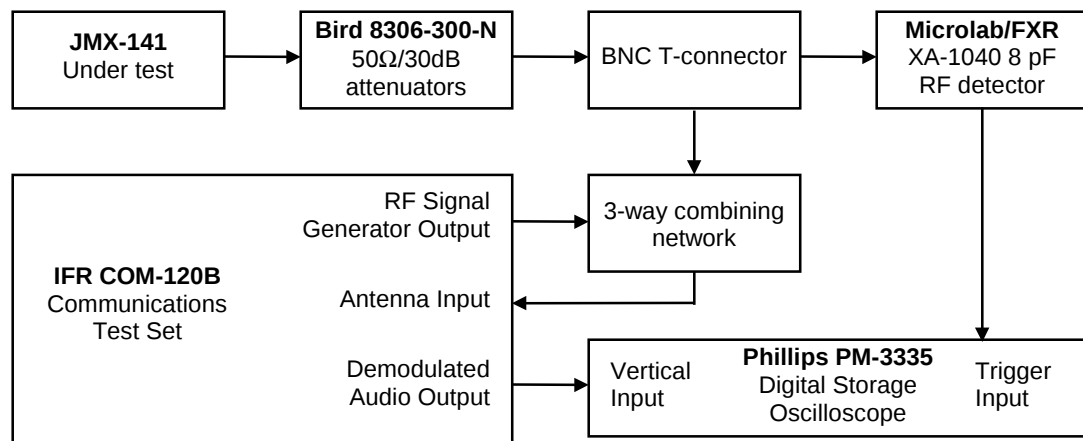
FCC ID: AIERIT14-141

DATE: July 10, 2000

PROCEDURE:

The JMX-141 was aligned for transmitter operation on 153.500 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:

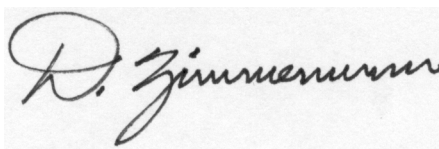
1. The test equipment was connected per the following diagram:



2. The IFR COM-120B receiver was set to measure FM deviation with the audio bandwidth set at ≤ 20 Hz to 15 KHz and the RF frequency set to 153.500 MHz.
3. The JMX-141 transmitter under test was turned on and the IFR COM-120B Spectrum Analyzer was used to measure the RF power level through the test network.
4. The JMX-141 transmitter was turned off.
5. The IFR COM-120B RF signal generator was set to 153.500 MHz at an RF level 20 dB below that measured in step 3, modulated with a 1 KHz tone at ± 25 KHz deviation.
6. The Phillips PM-3335 digital oscilloscope 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 JMX-141 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 JMX-141 transmitter is turned on.
9. The JMX-141 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 JMX-141 transmitter.
11. The JMX-141 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:

A handwritten signature in black ink, reading "D. Zimmerman", is written over a horizontal line.

Dennis Zimmerman - Project Engineer

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

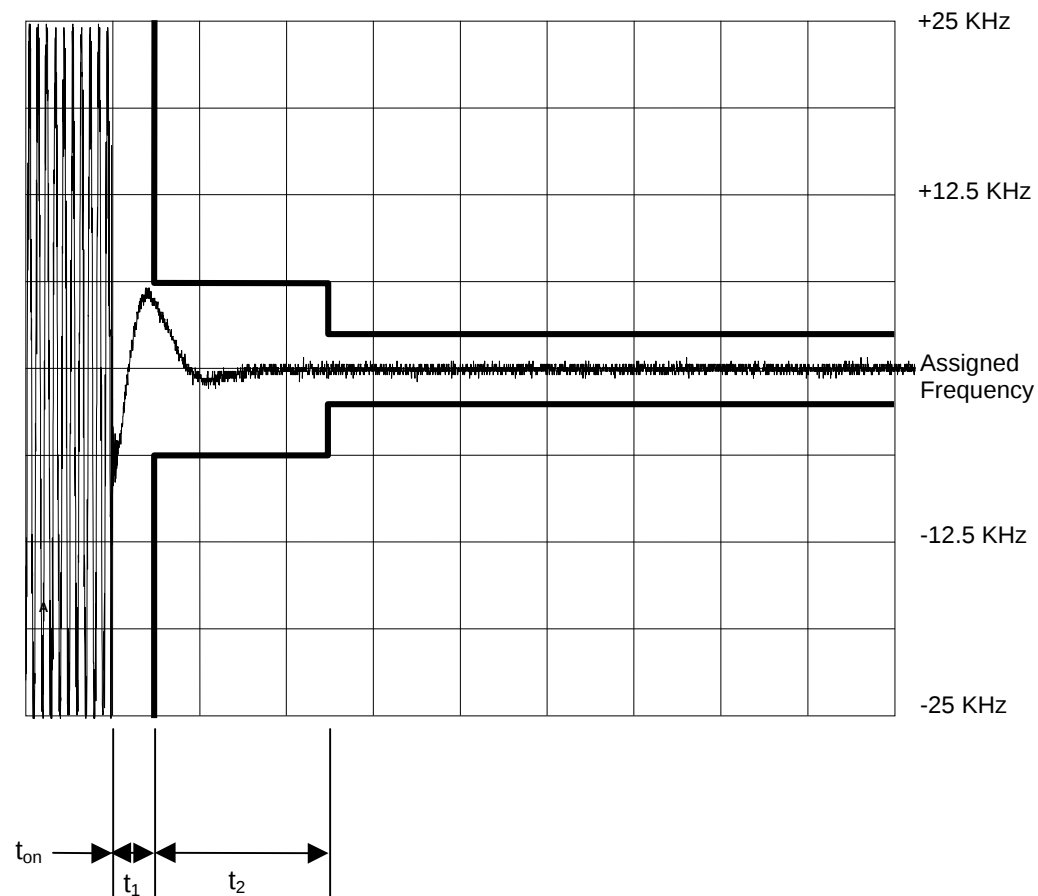
MODEL: JMX-141

TYPE OF UNIT: VHF-FM Handheld Transceiver

FCC ID: AIERIT14-141

DATE: July 10, 2000

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



TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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MODEL: JMX-141

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SWITCH ON CONDITION t_3 and t_{OFF}

