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JMX-441 Test Results

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 9, 2001

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

Semiconductors List

TYPE OF EXHIBIT: TEST EQUIPMENT LIST

FCC PART: 2.947 (d)

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 9, 2001

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.

ITEM	MANUFACTURER	MODEL NO.	SERIAL NO.
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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 9, 2001

POWER OUTPUT RANGE:

The JMX-441 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 2 watts with a battery voltage of 8.4 volts. The following data shows measured values.

PROCEDURE:

1. Power was supplied to the JMX-441 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-441 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-441 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 Q205, the final RF amplifier device.

	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)**
465.1	1.4	370	52.6	510	2.0	440	63.1	610

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Sept 20,2001

PROCEDURE:

1. A 500 mVRMS signal from the HP8920A was applied through a 220 uF cap between R235 and R234. Deviation was measured by the HP8920A from 100 to 10000 Hz. The JMX-441 is programmed to transmit in narrow band mode at 465.1 MHz.

Audio Frequency (Hz)	Peak Dev (KHz)
100	1.75
150	1.75
200	1.75
250	1.75
300	1.75
400	1.75
500	1.75
700	1.75
1000	1.75
2000	1.75
3000	1.75
4000	1.75
5000	1.75
6000	1.72
7000	1.57
8000	1.34
9000	1.00
10000	0.73

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.1047 (a)

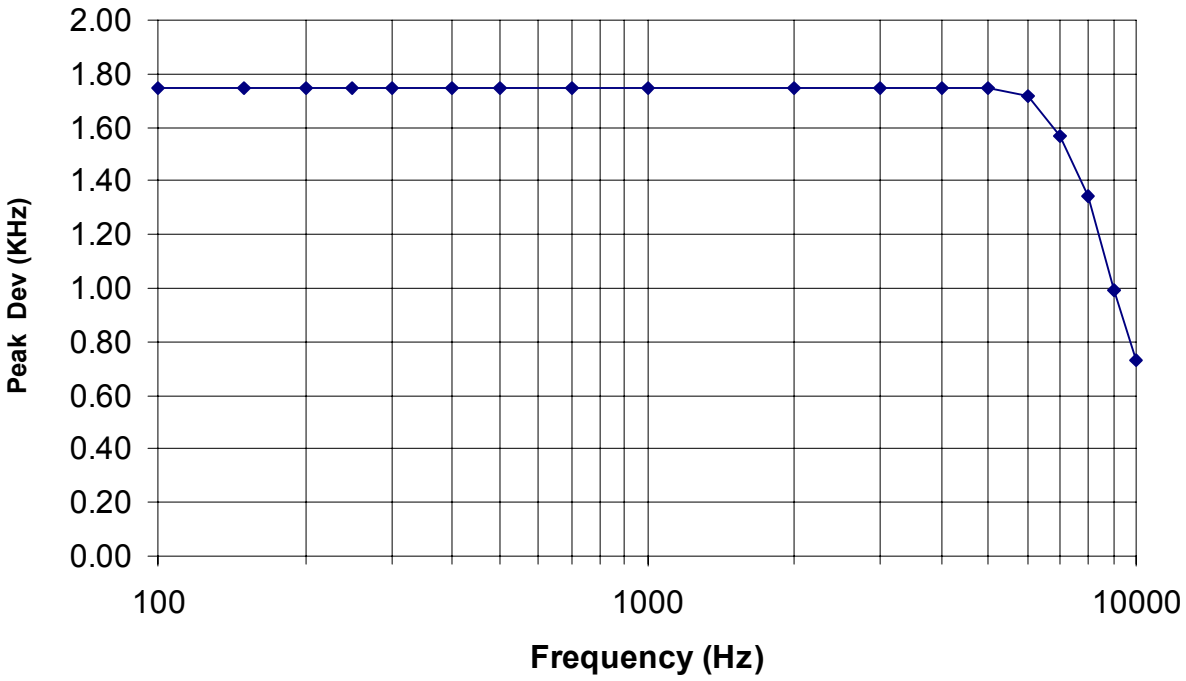
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Sept 20, 2001

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 700 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 R235.

(Hz)	LPF (mV p-p)	entire audio (mV p-p)	(Hz)	LPF(dB)	entire audio(dB)
100	1850	20	100	1.26	-33.80
200	1850	60	200	1.26	-24.26
300	1850	115	300	1.26	-18.61
400	1850	170	400	1.26	-15.22
500	1800	225	500	1.02	-12.78
700	1750	325	700	0.78	-9.59
1000	1700	480	1000	0.53	-6.20
1500	1600	740	1500	0.00	-2.44
2000	1570	980	2000	-0.16	0.00
2500	1280	980	2500	-1.94	0.00
3000	750	600	3000	-6.58	-4.26
3500	375	320	3500	-12.60	-9.72
4000	190	170	4000	-18.51	-15.22
4500	100	87	4500	-24.08	-21.03
5000	58	52	5000	-28.81	-25.50
6000	22	20	6000	-37.23	-33.80
7000	10	10	7000	-44.08	-39.82
8000	4.5	5	8000	-51.02	-45.85
9000	2.5	2.5	9000	-56.12	-51.87
10000	1.5	1.5	10000	-60.56	-56.30

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

FCC PART: 2.1047 (a)

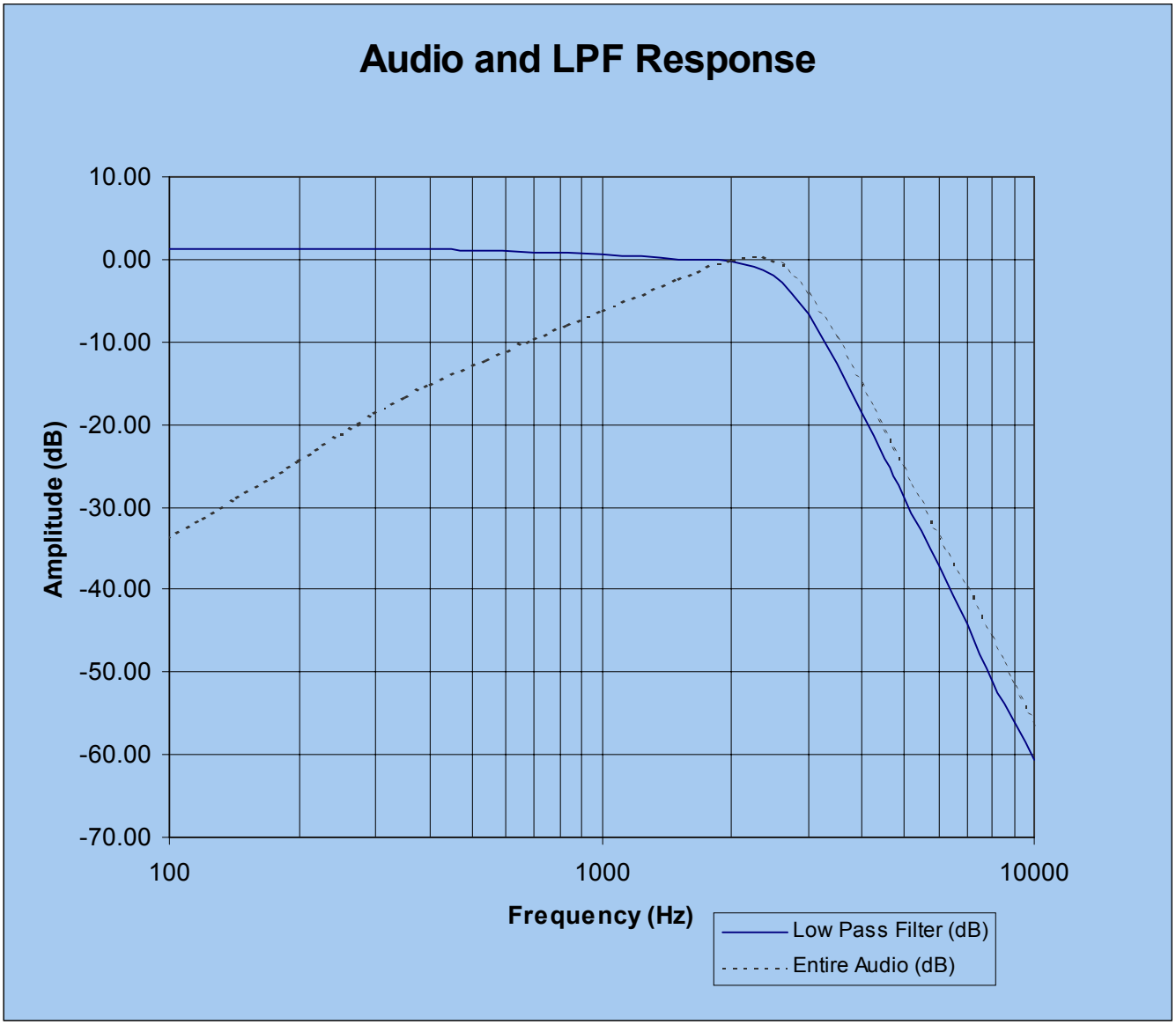
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Sept 20, 2001



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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 11, 2001

PROCEDURE:

1. The JMX-441 was programmed for narrow band transmitter operation on 465.100 MHz.

2. The output of the HP8920A audio generator was applied to the microphone input of the JMX-441 through J301. The output of the audio generator was adjusted from 3 to 100 mVrms at frequencies from 300 to 3000 Hz.

2. The HP8920A was used to read the peak deviation of the transmitter.

		Deviation (khz peak)					
frequency		**3**	**6**	**12**	**24**	**48**	**100**
	300	0.39	0.7	1.35	2.7	4.1	4.2
	500	0.66	1.25	2.5	4	4.2	4.23
	700	0.94	1.8	3.6	4.2	4.3	4.25
	1000	1.32	2.6	4.1	4.3	4.3	4.33
	1500	2	3.8	4.3	4.3	4.3	4.32
	2000	2.68	4.2	4.3	4.3	4.3	4.3
	2500	2.65	3.4	3.4	3.4	3.4	3.4
	3000	1.75	1.95	1.95	1.95	1.95	1.95

	% of max deviation					
	3	**6**	**12**	**24**	**48**	**100**
300	9	16	31	62	95	97
500	15	29	58	92	97	98
700	22	42	83	97	99	98
1000	30	60	95	99	99	100
1500	46	88	99	99	99	100
2000	62	97	99	99	99	99
2500	61	79	79	79	79	79
3000	40	45	45	45	45	45

TYPE OF TEST: PERCENT MODULATION VS. MODULATION INPUT VOLTAGE

FCC PART: 2.1047 (b)

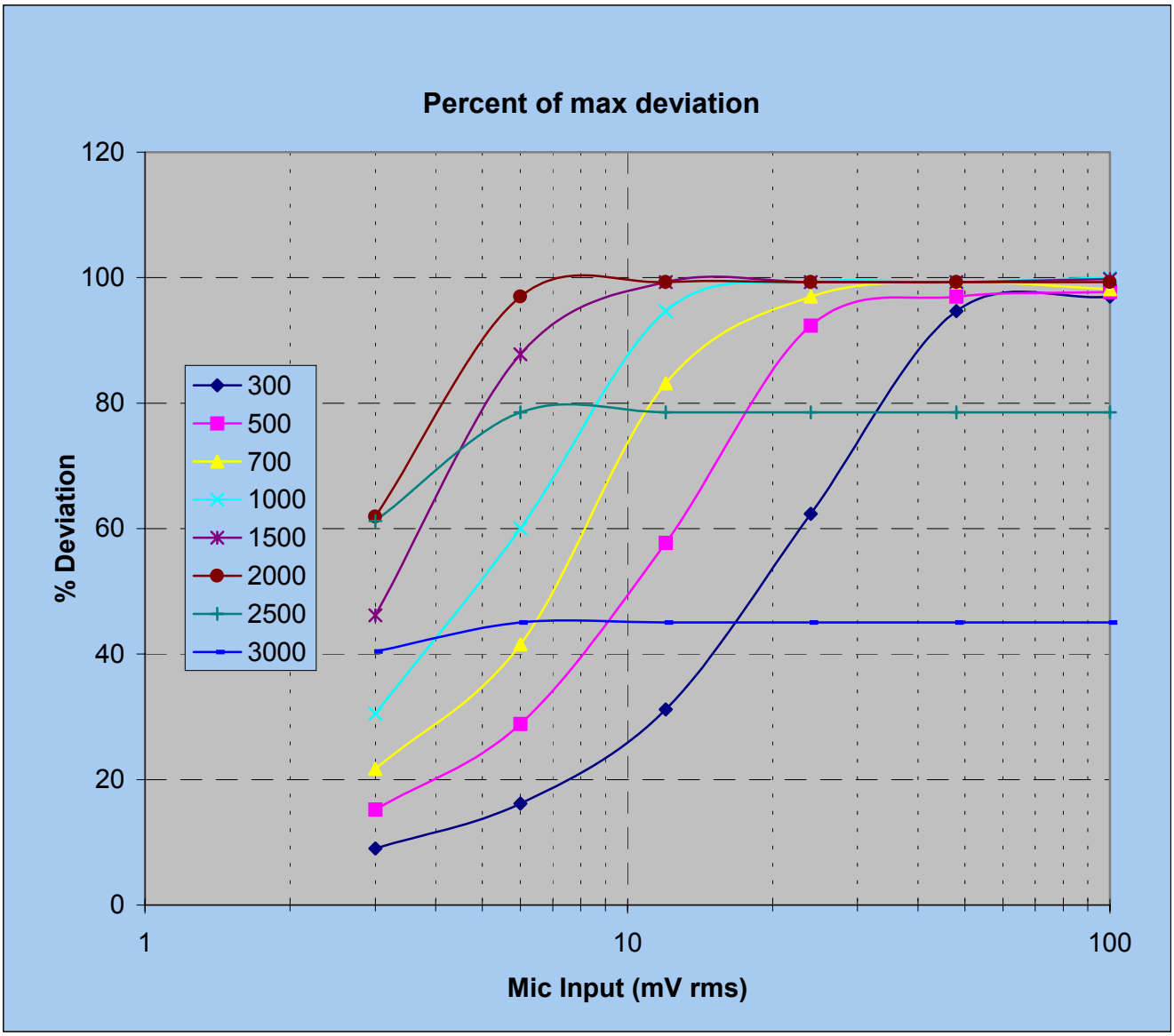
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 11, 2001



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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 11, 2001

PROCEDURE:

1. The JMX-441 was programmed for transmitter operation on 465.100 MHz , was set for 12.5 KHz bandwidth operation, and the deviation was adjusted for +/- 2.1 KHz at 1000 Hz on channel (1) as outlined in the Preliminary Maintenance Manual. Channel (2) is programmed for 465.100 MHz and 25 kHz wide band operation and yields +/- 4.2 kHz deviation at 1000 Hz..

2. The RF output of the JMX-441 was measured with a HP8920A communications test set wattmeter. This value was recorded as POWER OUTPUT. Power was supplied to the JMX-441 via a BK1730 power supply set at +7.5 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-441 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.

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: 12.5 KHZ 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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

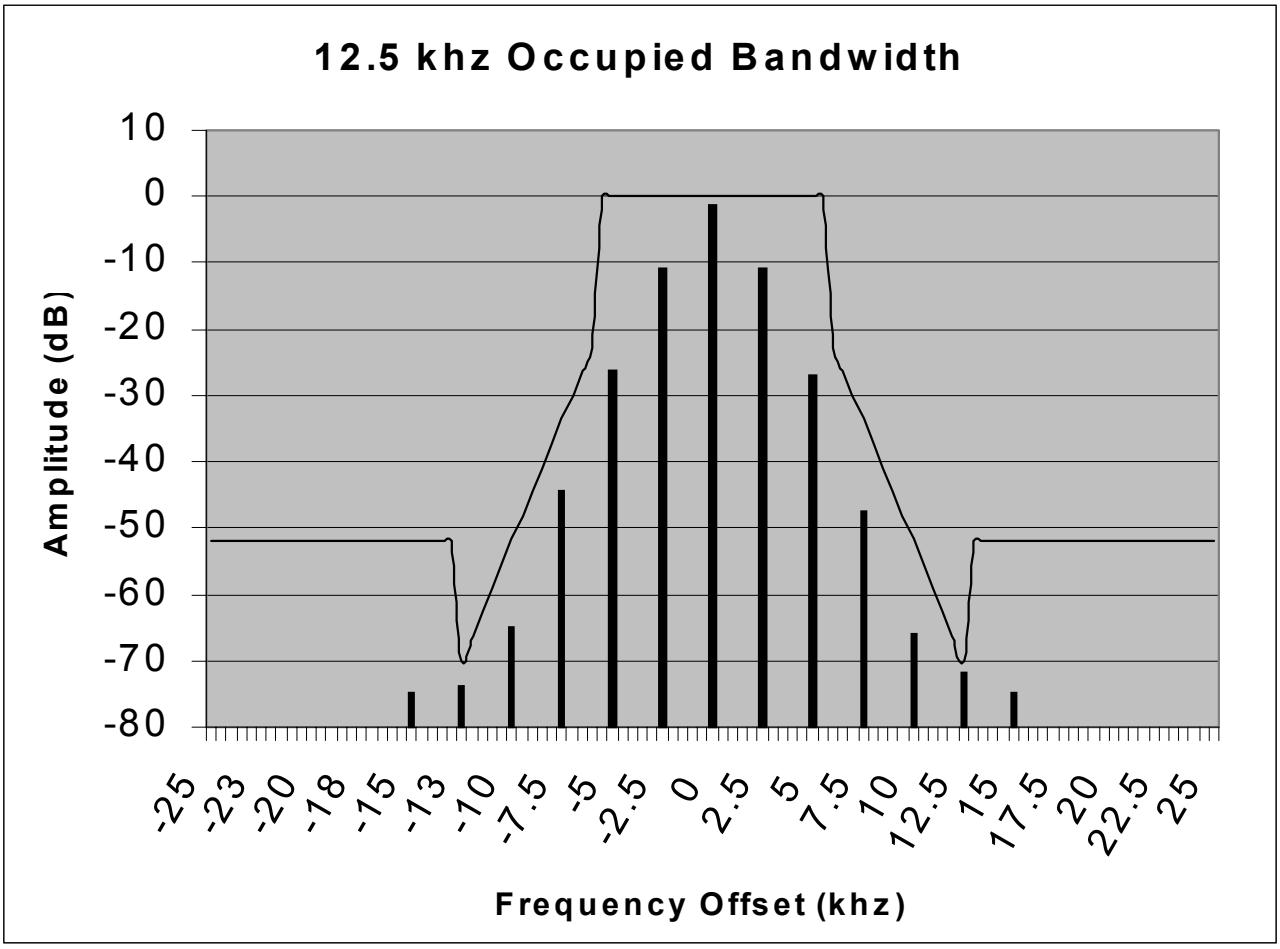
DATE: Oct 11, 2001

DATA:

Carrier Frequency:	465.1	MHz
Power Output:	1.50	Watts
Power Output:	31.76	dBm
Mean Reference Power:	31.76	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	-74.56	-42.80	-20.00	52.5E-9	0.00%	
-12.5	-73.56	-41.80	-38.18	66.1E-9	0.00%	
-10.0	-64.56	-32.80	-20.00	524.8E-9	0.00%	
-7.5	-44.06	-12.30	-1.83	58.9E-6	0.00%	
-5.0	-26.06	5.70	31.76	3.7E-3	0.25%	
-2.5	-10.56	21.20	31.76	131.8E-3	8.78%	
0.0	-0.86	30.90	31.76	1.2E+0	81.96%	99.99%
2.5	-10.56	21.20	31.76	131.8E-3	8.78%	
5.0	-26.56	5.20	31.76	3.3E-3	0.22%	
7.5	-47.06	-15.30	-1.83	29.5E-6	0.00%	
10.0	-65.56	-33.80	-20.00	416.9E-9	0.00%	
12.5	-71.56	-39.80	-38.18	104.7E-9	0.00%	
15.0	-74.56	-42.80	-20.00	52.5E-9	0.00%	
17.5			-20.00			
20.0			-20.00			
22.5			-20.00			
25.0			-20.00			

TYPE OF TEST:	12.5 KHZ 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-441
TYPE OF UNIT:	UHF-FM Handheld Transceiver
FCC ID:	AIERIT14-441
DATE:	Oct 11, 2001



TYPE OF TEST: 25 KHZ 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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

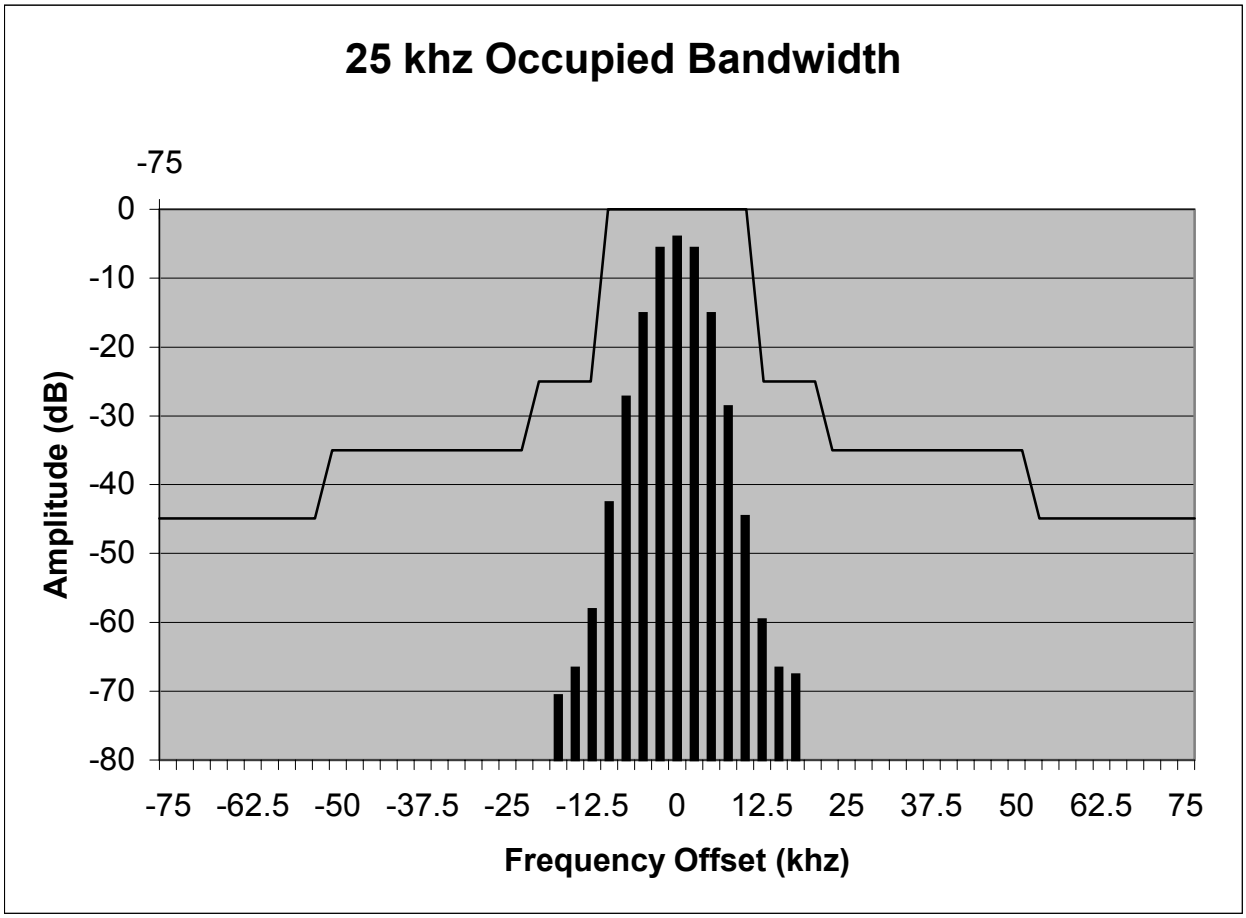
DATE: Oct 11, 2001

DATA:

Carrier Frequency:	465.1	MHz
Power Output:	1.50	Watts
Power Output:	31.76	dBm
Mean Reference Power:	31.76	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			-3.24			
-22.5			-3.24			
-20.0		-37.90	6.76			
-17.5	-70.66	-38.90	6.76	128.8E-9	0.00%	
-15.0	-66.66	-34.90	6.76	323.6E-9	0.00%	
-12.5	-58.16	-26.40	6.76	2.3E-6	0.00%	
-10.0	-42.66	-10.90	31.76	81.3E-6	0.01%	
-7.5	-27.26	4.50	31.76	2.8E-3	0.19%	
-5.0	-15.16	16.60	31.76	45.7E-3	3.05%	
-2.5	-5.66	26.10	31.76	407.4E-3	27.16%	
0.0	-4.06	27.70	31.76	588.8E-3	39.26%	100.00%
2.5	-5.66	26.10	31.76	407.4E-3	27.16%	
5.0	-15.16	16.60	31.76	45.7E-3	3.05%	
7.5	-28.66	3.10	31.76	2.0E-3	0.14%	
10.0	-44.66	-12.90	31.76	51.3E-6	0.00%	
12.5	-59.66	-27.90	6.76	1.6E-6	0.00%	
15.0	-66.66	-34.90	6.76	323.6E-9	0.00%	
17.5	-67.66	-35.90	6.76	257.0E-9	0.00%	
20.0	-72.66	-40.90	6.76	81.3E-9	0.00%	
22.5			-3.24			
25.0			-3.24			

TYPE OF TEST:	25 KHZ 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-441
TYPE OF UNIT:	UHF-FM Handheld Transceiver
FCC ID:	AIERIT14-441
DATE:	Oct 11, 2001



TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.1051

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 9, 2001

PROCEDURE:

The JMX-441 was programmed for transmitter operation 465.100 MHz. Power was supplied to the JMX-441 by a BK Precision Model 1730 Power Supply. The supply voltage was set to +7.5 VDC. 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).The JMX-441 antenna terminal P201 was connected to the input of a 20 dB power attenuator. After the attenuator and before a Hewlett-Packard Model 8559A Spectrum Analyzer a calibrated notch filter was inserted. The measured insertion loss of the external attenuator and notch filter is listed on the data sheet. The spectrum was searched from 8 MHz to the 10th harmonic of the operating frequency

Carrier Frequency: 465.100 **MHz**
Power Output: 1.50 **Watts**

Multiple of Carrier	Emmission Frequency (MHz)	Analyzer Reading (dBm)	FCC Limit (dBm)	Atten/Notch Correction Factor(dB)	dB below FCC Limit
2	930.2000	-55	-20	25	10.00
3	1395.3000	-57	-20	33	4.00
4	1860.4000	-48	-20	21	7.00
5	2325.5000	-63	-20	23	20.00

TYPE OF TEST: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.1053

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 31, 2001

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-441 was programmed to transmit on 465.100 MHz with a freshly charge battery.

2. The JMX-441 was then terminated at the antenna port with a regular (Centurion AFS-450) and stubby (Centurion AFS-450-S) antenna.

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:
   - 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-441 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).

6. Data for the fundamental and second harmonic were taken using the substitution method. Here a 0 dBm signal drove a matched dipole at the required harmonic frequency. Data for the third and fourth harmonic were taken using the calibrated range method.

Carrier Frequency: 465.100 **MHz**
Power: 1.85 **Watts**

Dipole Substitution Method

Emmission Frequency (MHz)	Mult of Carrier	Referencd Antenna at 0 dbm	Radiating Antenna	Analyzer Reading (dBm)	0 dBm Sub Reading (dBm)	Dipole Gain Correction (dB)	ERP (dBm)	FCC Spec Margin (dB)
465.10	1	Horz Dipole	Regular	4.5	-26.00	.1	30.40	None
930.20	2	Vert Dipole	Regular	-61.0	-39.00	0	-22.00	2.00
465.10	1	Horz Dipole	Stuby	3.5	-26.00	.1	29.40	None
930.20	2	Horz Dipole	Stuby	-67.0	-38.00	0	-29.00	9.00

Carrier Frequency:	465.100	**MHz**
Power Output:	1.85	**Watts**
Dipole Reference Level:	3180147	**µV / m**
FCC Limit:	52.67	**dB**

Regular Antenna (AFS-450)

Emmission Frequency (MHz)	Mult of Carrier	Receiving Antenna	Analyzer Reading (dBm)	Antenna Factor (dB)	Notch Loss (dB)	Field Strength (µV / m)	dB below Reference Level	dB below FCC Limit
1395.3000	3	Microwave	-80	28.9	12	2483.13	62.15	9.48
1860.4000	4	Microwave	-73	30.9	0.7	1905.46	64.45	11.78

Stubby Antenna (AFS-450-S)

Emmission Frequency (MHz)	Mult of Carrier	Receiving Antenna	Analyzer Reading (dBm)	Antenna Factor (dB)	Notch Loss (dB)	Field Strength (µV / m)	dB below Reference Level	dB below FCC Limit
1395.3000	3	Microwave	-73	28.9	12	5559.04	55.15	2.48
1860.4000	4	Microwave	-73	30.9	0.7	1905.46	64.45	11.78

TYPE OF TEST: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.1053

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 31, 2001

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 μV/m.

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

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

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:

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

where:
E = The amount below reference level in dB.
E_{3m} = Field strength at 3 meters in μV/m.
E_{ref} = Reference field strength at 3 meters in μV/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-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 1, 2001

PROCEDURE:

1. The JMX-441 was programmed for operation on 465.0500 MHz.

2. Power was supplied to the JMX-441 by a BK Precision Model 1730 power supply set to the nominal operating voltage of +7.5 VDC. The JMX-441 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:	465.05 MHz
Nominal Temp:	+20 °C
FCC Limit:	+/- 2.5 ppm

Temperature (°C)	Frequency (MHz)	Deviation (Hz)	Deviation (ppm)
50	465.049680	-320	-0.69
40	465.049641	-359	-0.77
30	465.049744	-256	-0.55
20	465.050040	40	0.09
10	465.050530	530	1.14
0	465.050493	493	1.06
-10	465.050373	373	0.80
-20	465.050252	252	0.54
-30	465.049880	-120	-0.26

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE

FCC PART: 2.1055 (a)(1)

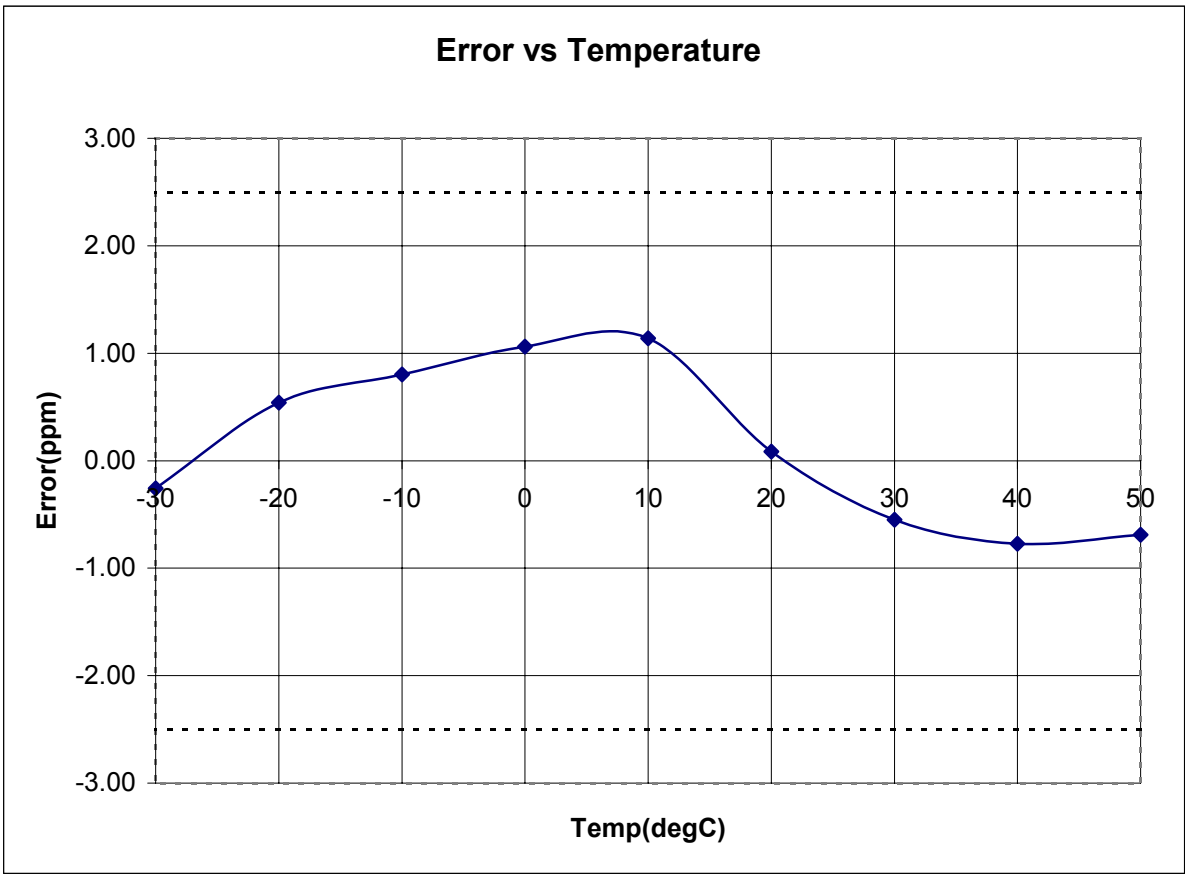
MANUFACTURER: RITRON, INC.
505 West Carmel Drive
Carmel, IN 46032

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 1, 2001



FCC PART: 2.1055 (d)(2)

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Sept 27, 2001

PROCEDURE:

1. The JMX-441 was programmed to operate at 465.100 MHz.

2. Power was supplied to the JMX-441 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-441 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 +22°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

Nominal Frequency (MHz): 465.100
FCC Limit (ppm): 2.5

Supply Voltage	Battery Condition	Transmit Frequency	Freq error (Hz)	PPM error from nominal
6.0	low	465.099984	-16.0	-0.03
7.2	nominal	465.100052	52.0	0.11
8.4	high	465.100011	11.0	0.02

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

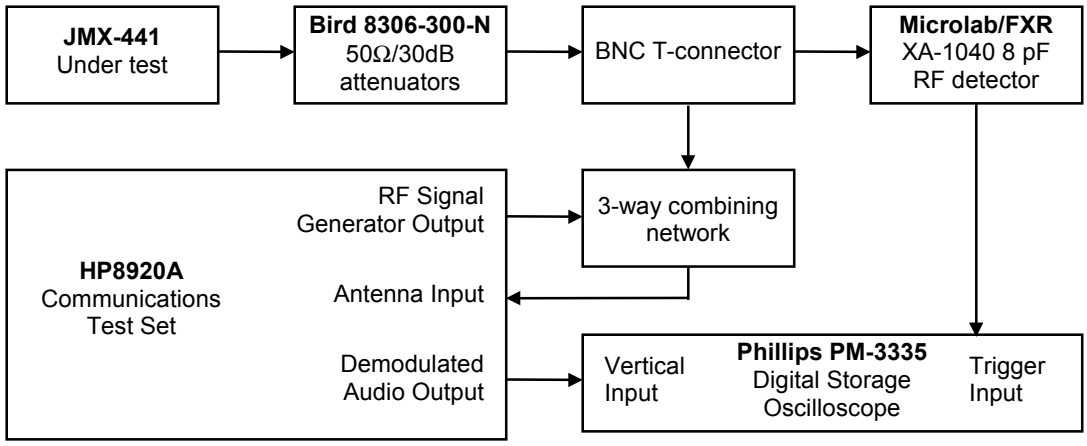
FCC ID: AIERIT14-441

DATE: Oct 17, 2001

PROCEDURE:

The JMX-441 was aligned for transmitter operation on 465.100 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 HP8920A receiver was set to measure FM deviation with the audio bandwidth set at ≤ 20 Hz to 15 KHz and the RF frequency set to 465.100 MHz.

3. The JMX-441 transmitter under test was turned on and the HP8920A Spectrum Analyzer was used to measure the RF power level through the test network.

4. The JMX-441 transmitter was turned off.

5. The HP8920A RF signal generator was set to 465.100 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 5 mS per division. The vertical amplitude control was adjusted to display the 1000 Hz demodulated audio from the signal generator at ± 25 divisions full scale (6.25 khz/div), 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-441 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-441 transmitter is turned on.

9. The JMX-441 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” 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-441 transmitter.

11. The JMX-441 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” and shows compliance with FCC Part 90.214.

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

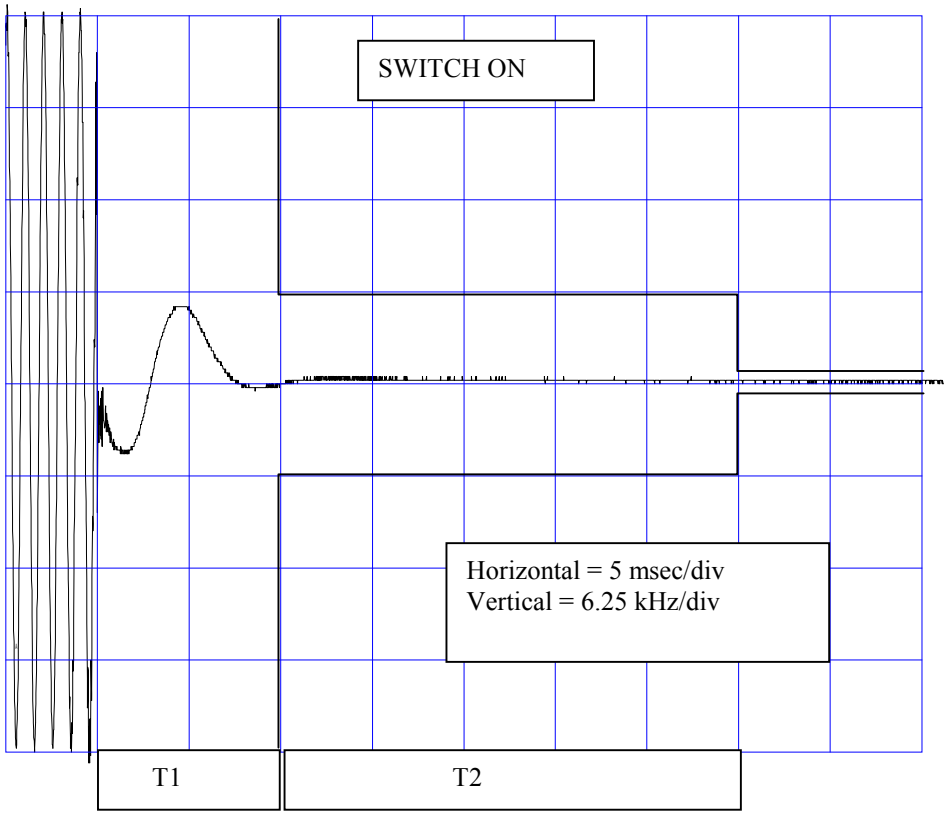
MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 17, 2001

SWITCH ON CONDITION t_{on}, t_1, t_2



TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

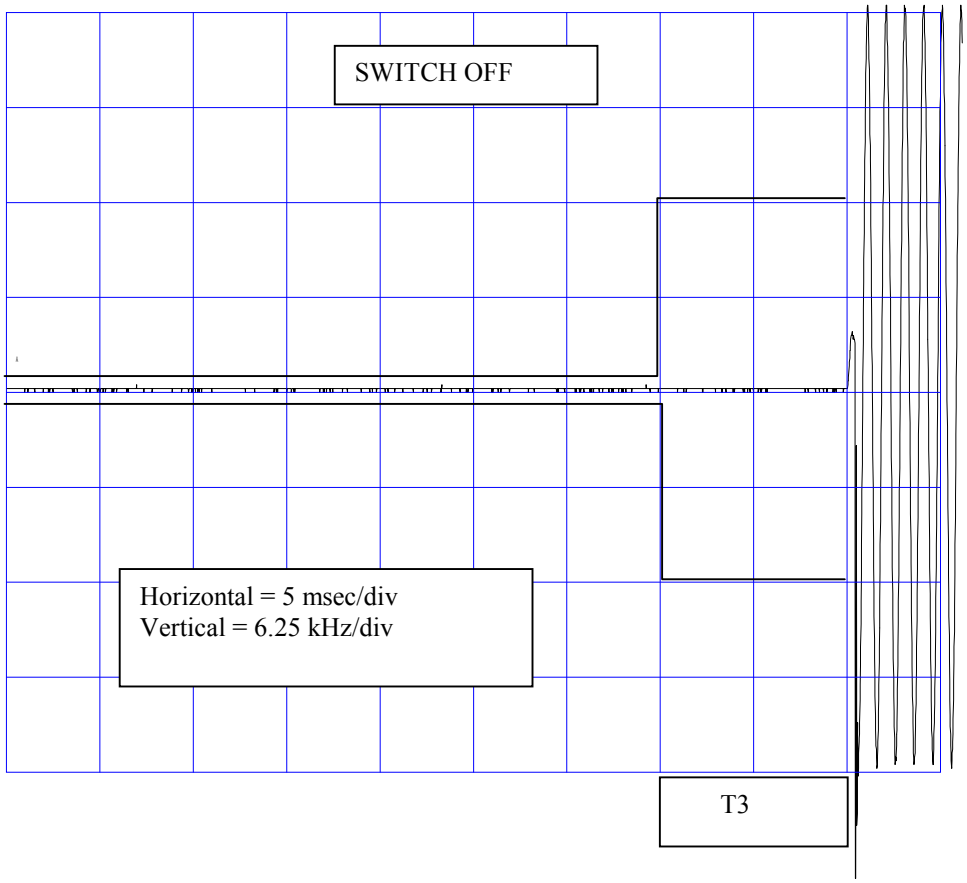
MODEL: JMX-441

TYPE OF UNIT: UHF-FM Handheld Transceiver

FCC ID: AIERIT14-441

DATE: Oct 17, 2001

SWITCH OFF CONDITION t3:



SEMICONDUCTOR LIST

Q101	482100V0	"PBR941, UHF, SOT-23 LOW NOISE"
Q102	482100V0	"PBR941, UHF, SOT-23 LOW NOISE"
Q103	4841006U	MMBFJ309T1 NFET GP SOT-23
Q104	4801002A	"MMBT3906 PNP, SOT23"
Q105	48010R02	"MUN2211T1, NPN, INT 10K/10K BIAS, ""8A"","
Q106	4821003B	MMBT918LT1 VHF SOT23 (3B)
Q107	480100DH	BCW68GLT1 .8AMP PNP SOT-23
Q108	48010R02	"MUN2211T1, NPN, INT 10K/10K BIAS, ""8A"","
Q109	4821003B	MMBT918LT1 VHF SOT23 (3B)
Q201	4801002A	"MMBT3906 PNP, SOT23"
Q202	482100V0	"PBR941, UHF, SOT-23 LOW NOISE"
Q203	482100W2	"PBR951, UHF, SOT-23 LOW NOISE"
Q204	482100W2	"PBR951, UHF, SOT-23 LOW NOISE"
Q205	4828PH59	"BLT50, UHF, SOT-223"
Q301	4801002A	"MMBT3906 PNP, SOT23"
Q302	480100DH	BCW68GLT1 .8AMP PNP SOT-23
Q303	4801001Q	"MMBT5088, NPN, SOT-23"
Q304	48010R02	"MUN2211T1, NPN, INT 10K/10K BIAS, ""8A"","
Q305	480100DH	BCW68GLT1 .8AMP PNP SOT-23
Q401	482100V0	"PBR941, UHF, SOT-23 LOW NOISE"
Q402	4801001Q	"MMBT5088, NPN, SOT-23"
Q403	4801001Q	"MMBT5088, NPN, SOT-23"
Q404	4841006T	MMBFJ310T1 NFET GP SOT-23
Q405	4801001Q	"MMBT5088, NPN, SOT-23"
Q406	4841006T	MMBFJ310T1 NFET GP SOT-23
Q407	4801001Q	"MMBT5088, NPN, SOT-23"
Q408	4801002A	"MMBT3906 PNP, SOT23"
Q409	4801002A	"MMBT3906 PNP, SOT23"
Q410	4801001Q	"MMBT5088, NPN, SOT-23"
U101	31030001	MC3361BD SO-16 IF SUBSYSTEMS
U102	310K0004	LMV324MT RAIL TO RAIL QUAD OP AMP
U103	31124066	MC14066 QUAD ANALOG SWITCH SO-14
U104	31010004	LM386MX-1 AUDIO AMP SO-8
U201	310K0004	LMV324MT RAIL TO RAIL QUAD OP AMP
U301	31040003	"REGULATOR, 50ma LDO, TPS76050DBVR *"
U302	314L0001	"MCU, AT90S4433-4AC FLASH 32 PIN TQFP"
U401	313K0005	"SYNTHESIZER, MC145193, TSSOP"