

## Ritron JMX-441 Test Report Update

This test report update contains responses to questions in a January 7<sup>th</sup>, 2002 e-mail from Stan Lyles of the FCC processing branch. The following outlines the questions or responses.

- 1) SAR data
- 2) Calculations for emissions designators – page 2
- 3) The 100% level on modulation limiting on page 9 of the original report was 4.33 khz for wideband voice. Data is redone here for wide and narrowband voice.  
Page 4
- 4) Conducted spurious at 2 watts output. – page 7
- 5, 6 and 7) Antenna range data via the substitution method. – page 9
- 8) Narrow as well as wideband transient frequency response – page 10

**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:** Jan 22, 2002  
**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:	16.0 kHz

Emission Frequency Offset (kHz)	Measured		FCC Limit	Power (Watts)	Percent MRP (%)	Occupied Bandwidth (%)
	Relative Amplitude (dBm)	Actual Amplitude (dBm)	(dBm)	(Watts)		
-25.0			-3.24			
-22.5			-3.24			
-20.0	-69.66	-37.90	6.76	162.2E-9	0.00%	
-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%	99.99%
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			

The previous chart shows that 99.99% of the power is contained within +/- 8 kHz of the carrier. The occupied bandwidth is therefore 16 kHz. The necessary bandwidth as determined by Carson's rule is:

Maximum modulation frequency (M) in kHz	= 3
Maximum deviation (D) in kHz	= 5
Constant K	= 1
Necessary bandwidth for <b>wideband</b> in kHz	= $(2 \times M) + (2 \times D \times K) = 16$

The necessary bandwidth for the narrowband channel is as follows:

Maximum modulation frequency (M) in kHz	= 3
Maximum deviation (D) in kHz	= 2.5
Constant K	= 1
Necessary bandwidth for <b>narrowband</b> in kHz	= $(2 \times M) + (2 \times D \times K) = 11$

**TYPE OF TEST:** PERCENT MODULATION VS. 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:** Jan 21, 2002

**PROCEDURE:**

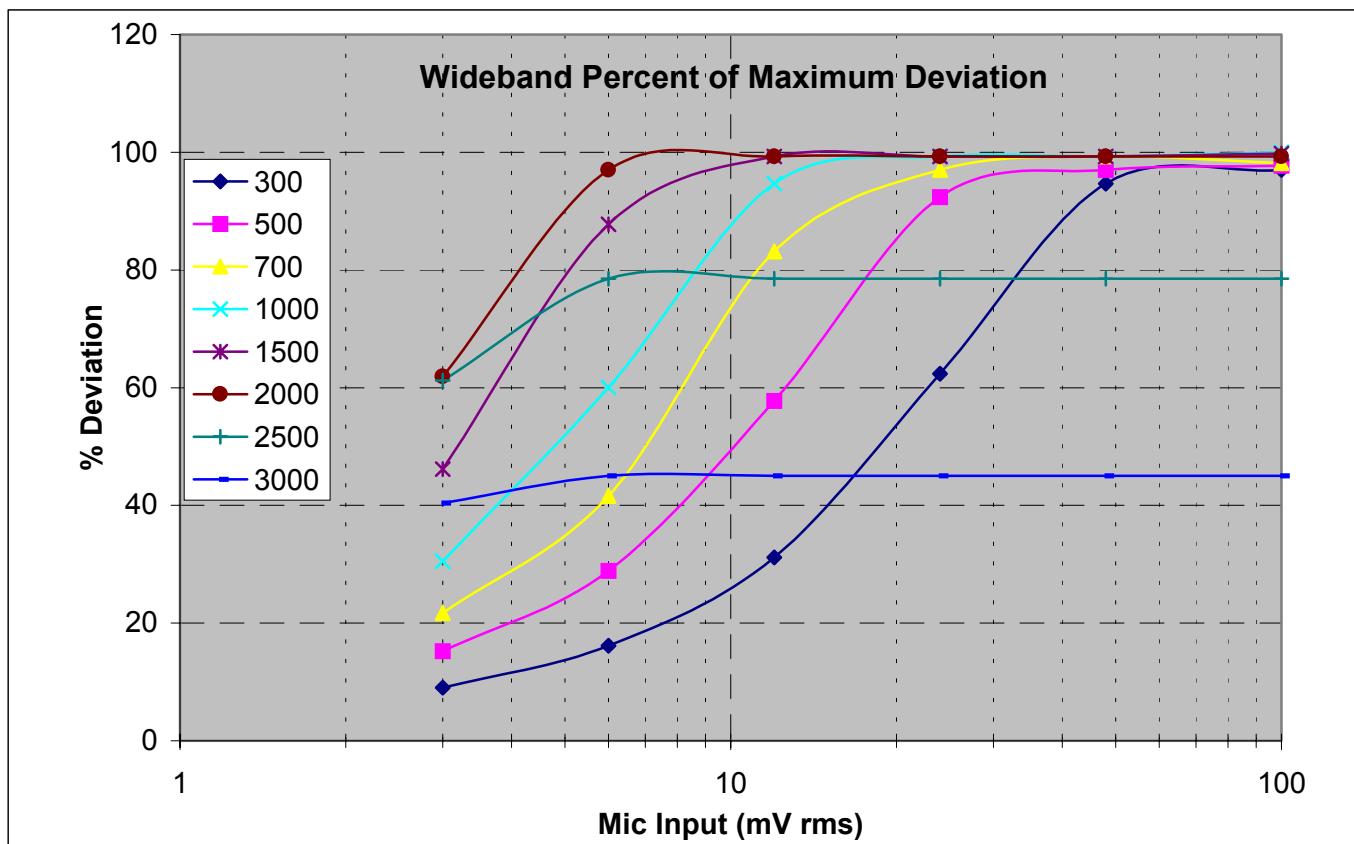
1. The JMX-441 was programmed for wide band transmitter operation on 465.100 MHz.
2. The output of the HP8920A audio generator was applied to the microphone input of the JMX-441 through J301. The output of the audio generator was adjusted from 3 to 100 mVrms at frequencies from 300 to 3000 Hz. The HP8920A was used to read the peak deviation of the transmitter. Both wide and narrowband deviation data are shown
3. Maximum or 100% deviation occurred at 1kHz and 100mV input. Both wide and narrowband modulation tables and plots are shown. Maximum wideband deviation is 4.33 kHz and the maximum narrowband deviation is 2.27 kHz. The percentage plots are based on these as 100%.

### Wideband Deviation (kHz peak)

input(mVrms) frequency(Hz)	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

### Wideband % of Max Deviation

input(mVrms) frequency(Hz)	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



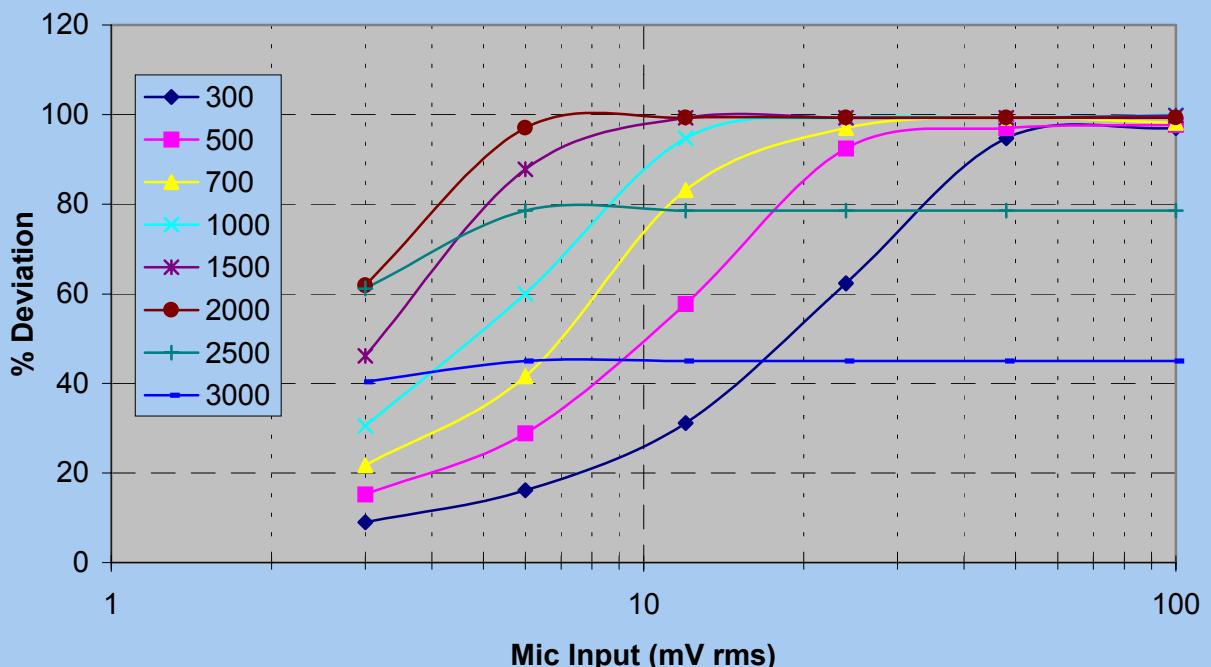
### Narrowband Deviation (kHz)

input(mVrms) frequency(Hz)	3	6	12	24	48	100
300	0.201	0.362	0.69	1.36	2.2	2.27
500	0.361	0.7	1.37	2.07	2.12	2.17
700	0.532	1.023	1.9	2.15	2.17	2.18
1000	0.755	1.49	2.19	2.25	2.23	2.27
1500	1.123	2.02	2.16	2.17	2.17	2.18
2000	1.506	2.177	2.2	2.2	2.2	2.2
2500	1.595	1.9	1.9	1.92	1.9	1.9
3000	1.001	1.122	1.12	1.12	1.12	1.11

### Narrowband % of max deviation

input(mVrms) frequency(Hz)	3	6	12	24	48	100
300	9	16	30	60	97	100
500	16	31	60	91	93	96
700	23	45	84	95	96	96
1000	33	66	96	99	98	100
1500	49	89	95	96	96	96
2000	66	96	97	97	97	97
2500	70	84	84	85	84	84
3000	44	49	49	49	49	49

### Narrowband percent of max deviation



**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:** Feb 1, 2002

**PROCEDURE:**

The JMX-441 was programmed for transmitter operation on 465.100 MHz. Power was supplied to the JMX-441 by a BK Precision Model 1730 Power Supply. The supply voltage was set to +8.4 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 high pass filter was inserted. The measured insertion loss of the external attenuator and notch filter is listed on the data sheet. Results within 20 dB of the FCC limits were recorded. The harmonic power was calculated as follows:

$$\text{Spur power(dBm)} = \text{Analyzer reading(dBm)} + \text{Correction factor(dB)}$$

**Carrier Frequency:** 465.100 MHz  
**Power Output:** 2.00 Watts

Multiple of Carrier	Emmission Frequency (MHz)	Analyzer Reading (dBm)	Atten/HPF Correction Factor(dB)	Spurious Power (dBm)	FCC Limit (dBm)	dB below FCC Limit
2	930.2000	-46	20.6	-25.4	-20	5.40
3	1395.3000	-49	20.5	-28.5	-20	8.50
4	1860.4000	-56	20.3	-35.7	-20	15.70

**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:** Feb 20, 2002

**PROCEDURE:**

Field strength of spurious radiation of the JMX-441 was taken on a 3 meter test range using the substitution method. The following procedure was used.

1. The JMX-441 was programmed to transmit on 465.100 MHz with a freshly charged battery.
2. The JMX-441 was then terminated at the antenna port with a regular (Centurion AFS-450) or stubby (Centurion AFS-450-S) antenna.
3. All field strength measurements were made with the Hewlett-Packard Model 8559A Spectrum Analyzer connected to the appropriate antenna for the frequency being measured. The receive antennas used:
  - Dipole tuned to desired harmonic
  - Electro-Metrics LP-25 Log Periodic Antenna at 200 to 1000 MHz
4. A tuned dipole was substituted at the radio side of the range driven by a known power to produce a known ERP at each harmonic. The receiving antenna was oriented both vertically and horizontally and reference measurements were taken at each harmonic.
5. For each emission, the height and polarization of the field strength measuring antenna and orientation of the JMX-441 were varied to provide maximum field strength.
6. The spectrum was searched up to the 10th harmonic of the transmit frequency.

**TYPE OF TEST:** FIELD STRENGTH OF SPURIOUS RADIATION  
AFS-450 Regular Antenna

**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:** Feb 20, 2002

Test Frequency: 465.1 MHz  
Test Power: 1.85 watts

**JMX-441 with AFS-450 (regular-horizontal)**

freq(Ghz)	Substitution power(dBm)	Sub horz reading(dBm)	Max Horz (dBm)	Max Spur ERP(dBm)	FCC limit(dBm)	FCC margin(dB)
1 0.4651	0	-28	3	31		
2 0.9302	-10	-46	-68	-32	-20	12
3 1.3953	-10	-52	-75	-33	-20	13
4 1.8604	-10	-55	-72	-27	-20	7
5 2.3255	-13	-58	-78	-33	-20	13
6 2.7906	-20	-68	-72	-24	-20	4
7 3.2557	-30	-80	-80	-30	-20	10
8 3.7208	-28	-82	-90	-36	-20	16
9 4.1859	-33	-85	-88	-36	-20	16
10 4.651	-30	-81	-93	-42	-20	22

**JMX-441 with AFS-450 (regular-vertical)**

freq(Ghz)	Substitution power(dBm)	Sub Vert reading(dBm)	Max Vert (dBm)	Max Spur ERP(dBm)	FCC limit(dBm)	FCC margin(dB)
1 0.4651	0	-28	3	31.0		
2 0.9302	-10	-46	-63	-27	-20	7
3 1.3953	-10	-53	-67	-24	-20	4
4 1.8604	-10	-57	-75	-28	-20	8
5 2.3255	-13	-60	-78	-31	-20	11
6 2.7906	-20	-74	-78	-24	-20	4
7 3.2557	-30	-80	-77	-27	-20	7
8 3.7208	-28	-80	-89	-37	-20	17
9 4.1859	-33	-88	-88	-33	-20	13
10 4.651	-30	-81	-93	-42	-20	22

**TYPE OF TEST:** FIELD STRENGTH OF SPURIOUS RADIATION  
AFS-450S Stubby Antenna

**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:** Feb 20, 2002

Test Frequency: 465.1 MHz  
Test Power: 1.85 watts

**JMX-441 with AFS-450s (stubby-horizontal)**

	freq(Ghz)	Substitution power(dBm)	Sub horz reading(dBm)	Max Horz (dBm)	Max Spur ERP(dBm)	FCC limit(dBm)	FCC margin(dB)
1	0.4651	0	-28	1	29.0		
2	0.9302	-10	-46	-68	-32.0	-20	12
3	1.3953	-10	-52	-77	-35.0	-20	15
4	1.8604	-10	-55	-72	-27.0	-20	7
5	2.3255	-13	-58	-68	-23.0	-20	3
6	2.7906	-20	-68	-77	-29.0	-20	9
7	3.2557	-30	-80	-77	-27.0	-20	7
8	3.7208	-28	-82	-85	-31.0	-20	11
9	4.1859	-33	-85	-85	-33.0	-20	13
10	4.651	-30	-81	-88	-37.0	-20	17

**JMX-441 with AFS-450s (stubby-vertical)**

	freq(Ghz)	Substitution power(dBm)	Sub Vert reading(dBm)	Max Vert (dBm)	Max Spur ERP(dBm)	FCC limit(dBm)	FCC margin(dB)
1	0.4651	0	-28	1.5	29.5		
2	0.9302	-10	-46	-58	-22.0	-20	2
3	1.3953	-10	-53	-67	-24.0	-20	4
4	1.8604	-10	-57	-76	-29.0	-20	9
5	2.3255	-13	-60	-72	-25.0	-20	5
6	2.7906	-20	-74	-85	-31.0	-20	11
7	3.2557	-30	-80	-75	-25.0	-20	5
8	3.7208	-28	-80	-82	-30.0	-20	10
9	4.1859	-33	-88	-89	-34.0	-20	14
10	4.651	-30	-81	-93	-42.0	-20	22

**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

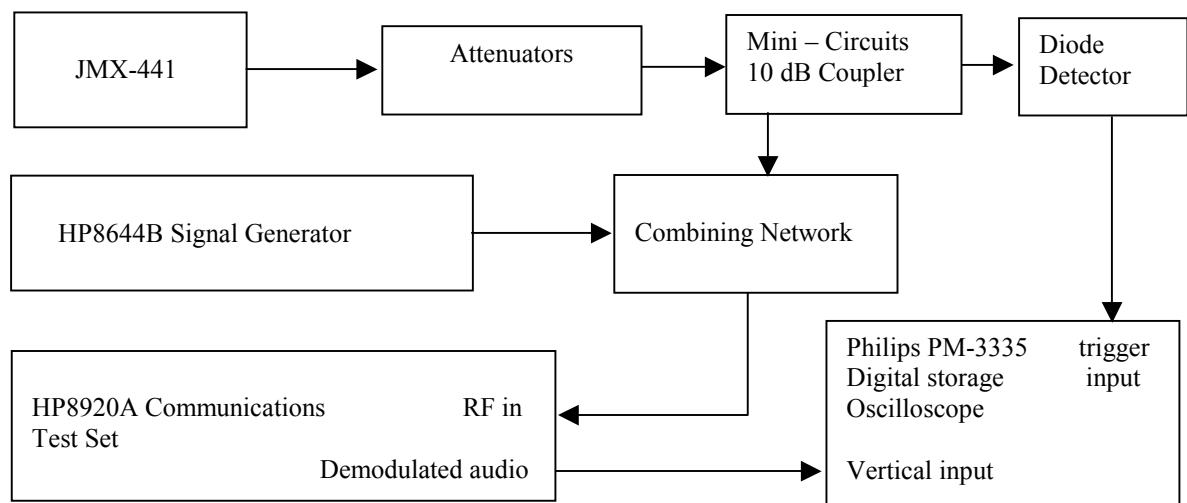
**FCC ID:** AIERIT14-441

**DATE:** Jan 23, 2002

**PROCEDURE:**

The JMX-441 was aligned for transmitter operation on 465.100 MHz.

1. The transient frequency behavior test is performed according to TIA/EIA-603. 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  $\leq 20$  Hz to 15 kHz, IF filter at 230 kHz and the RF frequency set to 465.1 MHz.
3. With the HP8644B generator off and the JMX-441 transmitting the signal level was read by the HP8920A Test Set. The JMX-441 was then shut off and the HP8644B set 20 dB below the level just read from the JMX-441 at 465.1 MHz modulated with a 1 kHz tone at  $\pm 12.5$  kHz deviation.
4. The Phillips PM-3335 digital oscilloscope horizontal sweep rate was set to 10 msec per division. The vertical amplitude control was adjusted to display the 1000 Hz demodulated audio from the signal generator at  $\pm 12.5$  divisions full scale ( 3.125 kHz/div), vertically centered on the screen.
5. 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.
6. 30 dB of attenuation is removed from after the JMX-441.

7. The JMX-441 transmitter is turned on and the resulting waveform on the oscilloscope display was stored and plotted. The resulting plot is labeled "Narrowband 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 resulting plot is labeled "Narrowband Switch OFF" and shows compliance with FCC Part 90.214.
12. The above process was repeated for the wideband channel with the incoming 1 kHz tone set to +/- 25 kHz deviation. These plots have 6.25 kHz per vertical division and 10 msec per horizontal division.

**TYPE OF TEST:** NARROWBAND TRANSIENT FREQUENCY BEHAVIOR

**FCC PART:** 90.214

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

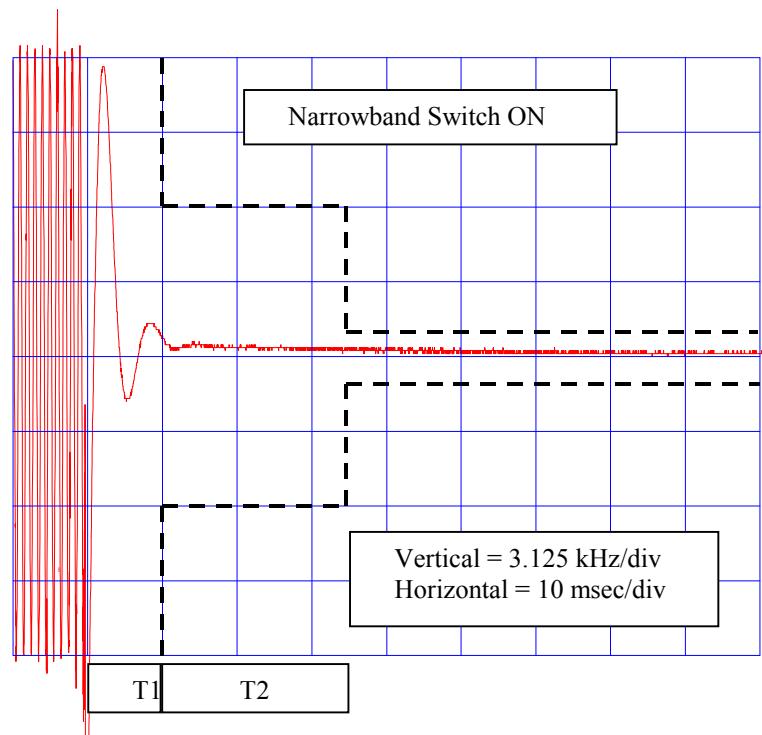
**MODEL:** JMX-441

**TYPE OF UNIT:** UHF-FM Handheld Transceiver

**FCC ID:** AIERIT14-441

**DATE:** Jan 23, 2002

**SWITCH ON CONDITION  $t_{on}$ ,  $t_1$ ,  $t_2$**



**TYPE OF TEST:** NARROWBAND TRANSIENT FREQUENCY BEHAVIOR

**FCC PART:** 90.214

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

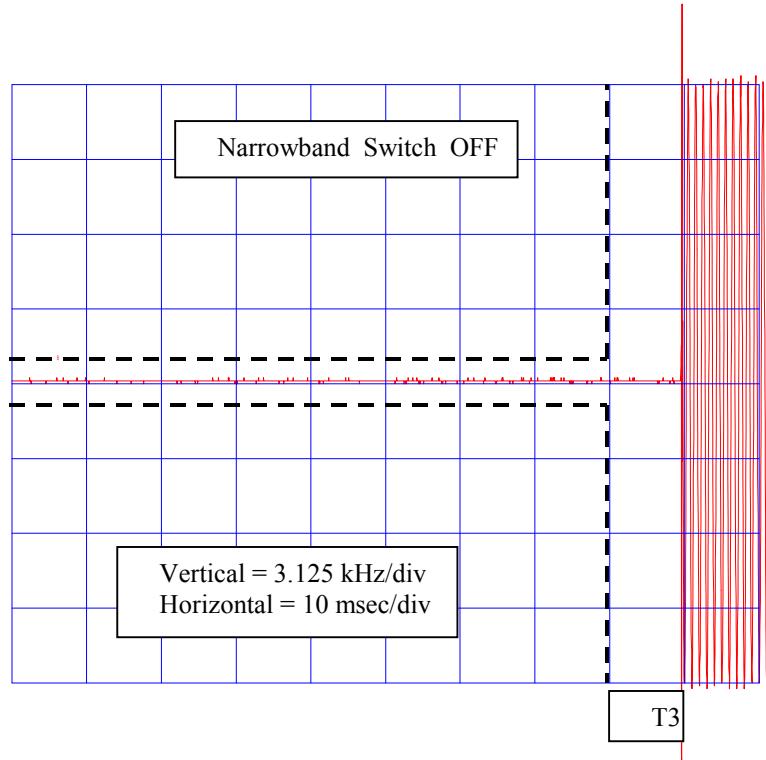
**MODEL:** JMX-441

**TYPE OF UNIT:** UHF-FM Handheld Transceiver

**FCC ID:** AIERIT14-441

**DATE:** Jan 23, 2002

**SWITCH OFF CONDITION**



**TYPE OF TEST:** WIDEBAND TRANSIENT FREQUENCY BEHAVIOR

**FCC PART:** 90.214

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

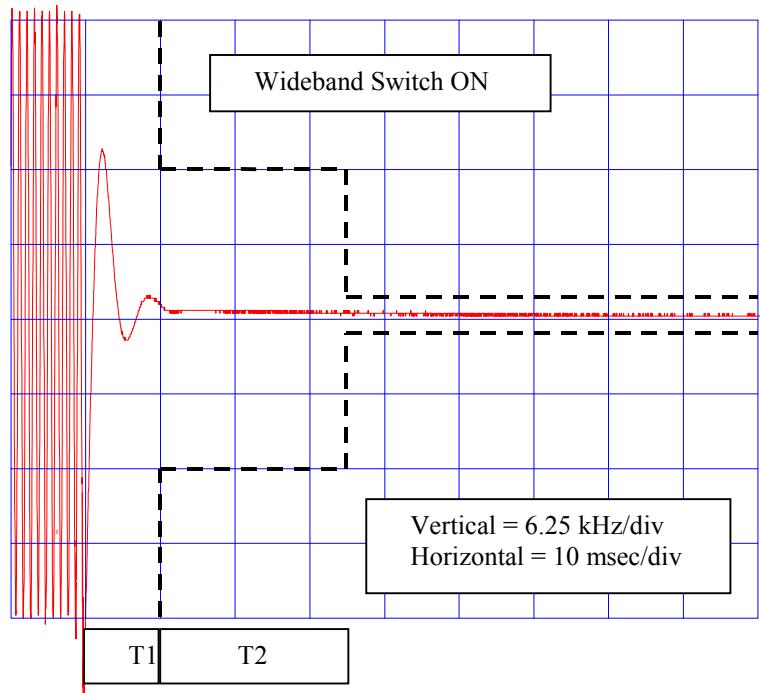
**MODEL:** JMX-441

**TYPE OF UNIT:** UHF-FM Handheld Transceiver

**FCC ID:** AIERIT14-441

**DATE:** Jan 23, 2002

**SWITCH ON CONDITION  $t_{on}$ ,  $t_1$ ,  $t_2$**



**TYPE OF TEST:** WIDEBAND 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:** Jan 23, 2002

**SWITCH OFF CONDITION**

