TYPE OF EXHIBIT: LIST OF ATTACHED EXIBITS

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 2, 1999

The following exhibits are contained in this file. Other exhibits required were electronically filed as separate exhibits. This file may make reference to information contained in these separate exhibits. This includes, but is not limited to, schematics, drawings, and photographs.

Description of Exhibit	FCC Rule(s)
Statement of Certifying Engineer	2.947
Manufacturer's Statement	2.983 (a), (b), (c)
List of Test Equipment Used	2.947 (d)
Description of Measurement Facility	2.948
Statement Certifying Spectrum Efficiency	90.203 (j) (3)
Radio Frequency Power Output	2.985
Modulator Response	2.987 (a), (b)
Clipper Filter Response	2.987 (a)
Modulation Limiting Curves	2.987 (b)
Occupied Bandwidth	2.989 (c), 90.210 (b), 90.210 (d), 90.211 (a)
Spurious Emissions at Antenna Terminal	2.991
Field Strength of Spurious Radiation	2.993 (b)
Frequency Stability vs. Temperature	2.995 (a), 90.213 (a)
Frequency Stability vs. Supply Voltage	2.995 (d)
Transient Frequency Behavior	90.214

TYPE OF EXHIBIT: STATEMENT OF CERTIFYING ENGINEER

FCC PART: 2.947

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

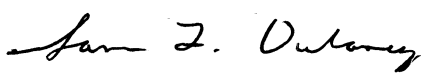
FCC ID: AIERIT11-450

DATE: February 2, 1999

I, Sam L. Dulaney, am now, and have been for the past year, employed as an Engineering Group Manager with RITRON, Inc. I have been employed in the two-way radio industry for the last 15 years. I received a BSEE degree from West Virginia University in 1978 and an MSEE degree from West Virginia University in 1980.

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

Further, I attest that manufacturing controls exist such that this data is representative of units which will be manufactured by RITRON.

Certifying Engineer: 

Sam L. Dulaney – Group Manager

Date: 8 February, 1999

TYPE OF EXHIBIT: MANUFACTURER'S STATEMENT

FCC PART: 2.983 (a) (b) (c)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 2, 1999

The Ritron model DTX-454 is a voice/data two-way radio designed for operation on either 12.5 kHz or 25 kHz channels in the 450-470 MHz frequency band. Its output power is variable from 1 watt to either 6 watts or 10 watts, depending upon model.

This unit will be manufactured and marketed on a continuing basis in the United States of America by the applicant, RITRON, Inc. of Carmel, Indiana.

EXIHIBIT: TEST EQUIPMENT LIST

FCC PART: 2.947

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 3, 1999

The measurements taken for this application were obtained using one or more of the following pieces of equipment.

ITEM	MANUFACTURER	MODEL NO.	SERIAL NO.
DC Power Supply	Astron	VS 12M	90071655
Multimeter	Fluke	45	6967029
Multimeter	BK Precision	2704A	234-008455
Wattmeter	Telewave	612	15081
RF Test Set	Hewlett-Packard	8920A	R# 01498
Spectrum Analyzer	Tektronix	7L12	R# 01334
Spectrum Analyzer	Hewlett-Packard	8559A	2010A06979
Spectrum Analyzer	Hewlett-Packard	8560E	R# 01540
Digital Storage Scope	Fluke/Philips	PM3335	DM630034
Plotter	Hewlett-Packard	7585B	2503A05509
Temperature Chamber	Delta Design	3900 CL	0-52-R
Frequency Counter	Hewlett-Packard	5383A	1716A01417
Function Generator	BK Precision	4010	275-00280
Modulation Analyzer	Hewlett-Packard	8901A	2426A03311
Network Analyzer	Hewlett-Packard	8753E	US37390503

TYPE OF TEST: DESCRIPTION OF MEASUREMENT FACILITY

FCC PART: 2.948

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

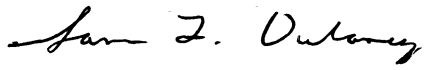
FCC ID: AIERIT-11-450

DATE: February 3, 1999

The Field Strength measurements filed with this application were made on a site certified by RITRON, INC. Data pertaining to this site are on file with the FCC 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, Indiana.



TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT

FCC PART: 2.985

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 3, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 450.0125, 461.750 and 469.9875 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual. This represents frequencies at the low, middle and high end of the DTX-454 operating frequency band. To cover the power range of 1 to 10 watts, two versions exists, one with a maximum output power of 6 watts and one with a maximum output power of 10 watts. These two versions are identical except for the RF output module device. Two different modules are used to cover the two power ranges.

2. Power was supplied to the DTX-454 by an Astron VS 12M Power Supply. The DTX-454 was connected at the RF Test Jack J401 to the input of a Bird 6154 Thermaline Wattmeter used to measure RF power of the carrier. The Wattmeter provides a resistive 50 ohm termination at the frequencies and power levels used for this test.

3. A B&K Digital Multimeter was connected in series with pin 3 of IC104 to measure the PA module final stage current. A Fluke 45 Digital Multimeter was used to measure the final stage voltage as well as the module power control voltage.

4. Measurements were taken with the power supply set as indicated in the table of results. The DTX-454 transmitter was then set to operate at various power levels from 1 watt to the maximum for the version tested by varying the module control voltage.

TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT
6 Watt Maximum Output Power Version

FCC PART: 2.985

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

TEST RESULTS:

Nominal Power Supply Voltage = 7.5 VDC

Frequency (MHz)	Output Power (W)	Final Stage Voltage (VDC)	Final Stage Current (IDC)	Control Voltage (VDC)
450.0125	1.0	7.4	0.78	1.46
	2.0	7.3	1.13	1.71
	3.0	7.3	1.44	2.00
	4.0	7.3	1.72	2.30
	5.0	7.2	1.99	2.63
	6.0	7.2	2.28	3.01
461.7500	1.0	7.4	0.73	1.35
	2.0	7.3	1.06	1.63
	3.0	7.3	1.35	1.90
	4.0	7.3	1.62	2.20
	5.0	7.2	1.86	2.52
	6.0	7.2	2.15	3.03
469.9875	1.0	7.4	0.72	1.33
	2.0	7.3	1.03	1.60
	3.0	7.3	1.29	1.87
	4.0	7.3	1.56	2.21
	5.0	7.2	1.86	2.68
	6.0	7.2	2.14	3.25

TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT
10 Watt Maximum Output Power Version

FCC PART: 2.985

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

TEST RESULTS:

Nominal Supply Voltage = 13.7 VDC

Frequency (MHz)	Output Power (W)	Final Stage Voltage (VDC)	Final Stage Current (IDC)	Control Voltage (VDC)
450.0125	1.0	13.6	0.59	1.64
	2.0	13.6	0.85	1.90
	3.0	13.6	1.06	2.11
	4.0	13.5	1.19	2.25
	5.0	13.5	1.35	2.40
	6.0	13.5	1.53	2.60
	7.0	13.4	1.73	2.77
	8.0	13.4	1.88	2.93
	9.0	13.4	2.05	3.16
	10.0	13.4	2.16	3.38
461.7500	1	13.6	0.51	1.39
	2.0	13.6	0.72	1.61
	3.0	13.6	0.91	1.80
	4.0	13.5	1.10	1.97
	5.0	13.5	1.26	2.23
	6.0	13.5	1.47	2.49
	7.0	13.4	1.69	2.72
	8.0	13.4	1.82	2.95
	9.0	13.4	2.04	3.30
	10.0	13.4	2.20	3.45

Note: Results at 469.9875 MHz shown on following page.

TYPE OF TEST: RADIO FREQUENCY POWER OUTPUT
10 Watt Maximum Output Power Version

FCC PART: 2.985

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

TEST RESULTS:

Nominal Supply Voltage = 13.7 VDC

Frequency (MHz)	Output Power (W)	Final Stage Voltage (VDC)	Final Stage Current (IDC)	Control Voltage (VDC)
469.9875	1	13.6	0.54	1.38
	2.0	13.6	0.74	1.64
	3.0	13.6	0.94	1.86
	4.0	13.5	1.09	2.02
	5.0	13.5	1.25	2.22
	6.0	13.5	1.43	2.44
	7.0	13.4	1.55	2.63
	8.0	13.4	1.73	2.79
	9.0	13.4	1.91	2.97
	10.0	13.4	2.06	3.30

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.987 (a)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual.

2. The DTX-454's clipper filter was bypassed by setting analog switch IC303C to the bypass position. The output of a BK Precision Model 4010 Function Generator was connected to the Auxiliary input of the unit. The Auxiliary input has a frequency response which is flat well beyond 5000 Hz. The radio was connected to an HP8901 Modulation analyzer for measuring deviation.

3. The audio signal generator was set to a frequency of 1000 Hz and the output was adjusted to provide +/- 1.5 kHz deviation (60% rated system deviation for 12.5 kHz operation) as indicated by the HP8901.

4. With the audio generator output level fixed at the value in step 3 above, the frequency was varied from 100 – 10,000 Hz. Deviation was measured at various frequencies within this range and recorded on the accompanying chart.

5. The audio level was increased to produce 3 kHz deviation (60% rated system deviation for 25 kHz operation) at an audio frequency of 1000 Hz and steps 1 through 4 above were repeated. Since the results did not change with the change in deviation, only one plot is shown.

TYPE OF TEST: MODULATOR RESPONSE

FCC PART: 2.987 (a)

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

MODEL: DTX-454

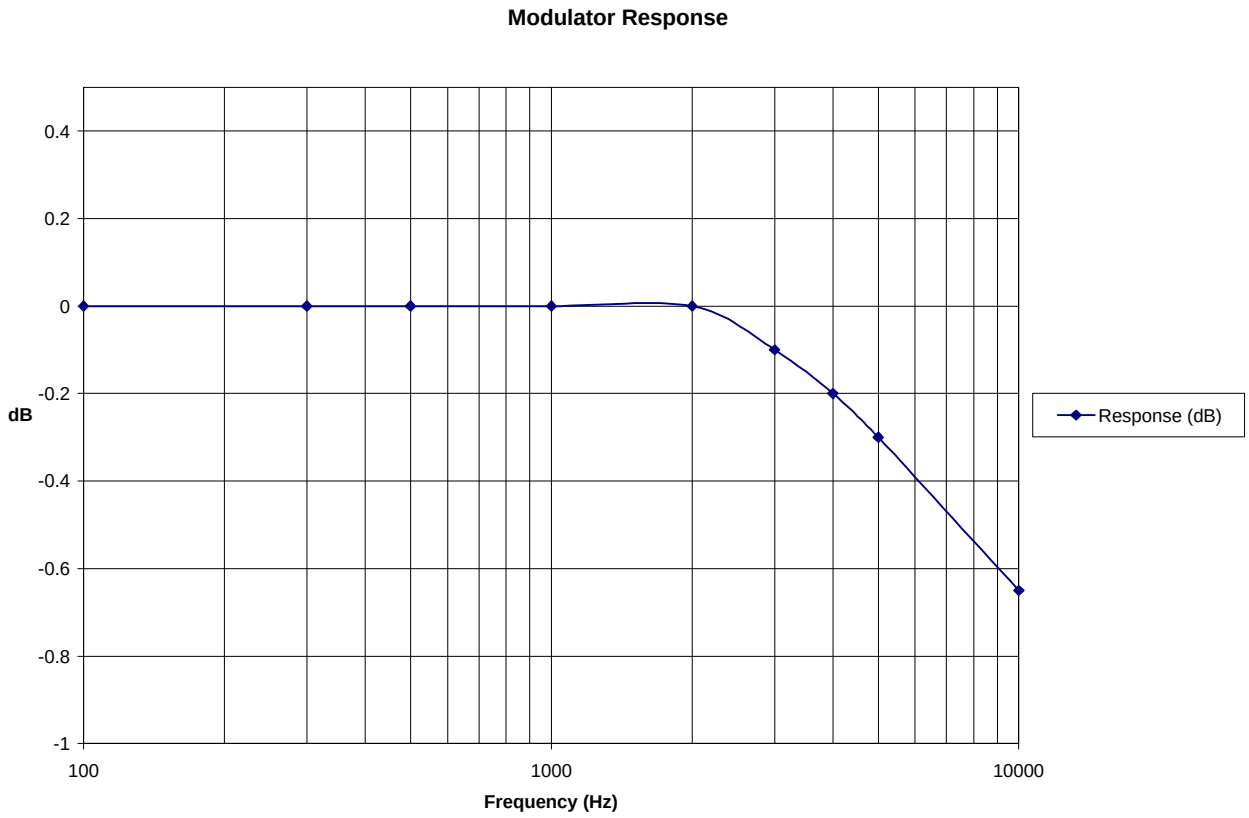
TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

TEST RESULTS:

Frequency (Hz)	Response (dB)
100	0
300	0
500	0
1000	0
2000	0
3000	-0.1
4000	-0.2
5000	-0.3
10000	-0.65


Modulator Response
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
dB
100
1000
10000
Frequency (Hz)
Response (dB)

TYPE OF TEST: CLIPPER FILTER RESPONSE

FCC PART: 2.987 (a)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

PROCEDURE:

1. The stages of the DTX-454 speech amplifier prior to the low-pass filter were removed by disconnecting R346 from the output of TX mute switch IC303A. The output of a BK Precision Model 4010 Function Generator was applied to R346.

2. A Fluke Model 45 Dual Display Multimeter was used to measure the low-pass filter output at Pin 8 of IC310C. A DC offset of 2.5 volts was used to insure that the clipper filter operational amplifiers were biased properly.

3. The audio signal generator was set for a level of 1.6 VRMS to produce 0 dB at the output of the low-pass filter. This level was selected to prevent limiting or distortion at any frequency. The Fluke Model 45 Dual Display Multimeter was set to make all measurements relative to this reference level.

4. The frequency of the audio signal generator was varied from 100 Hz to 100 kHz with the output level constant. Measurements were recorded on the accompanying chart. All measurements were relative to the input signal level.

TYPE OF TEST: CLIPPER FILTER RESPONSE

FCC PART: 2.987 (a)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

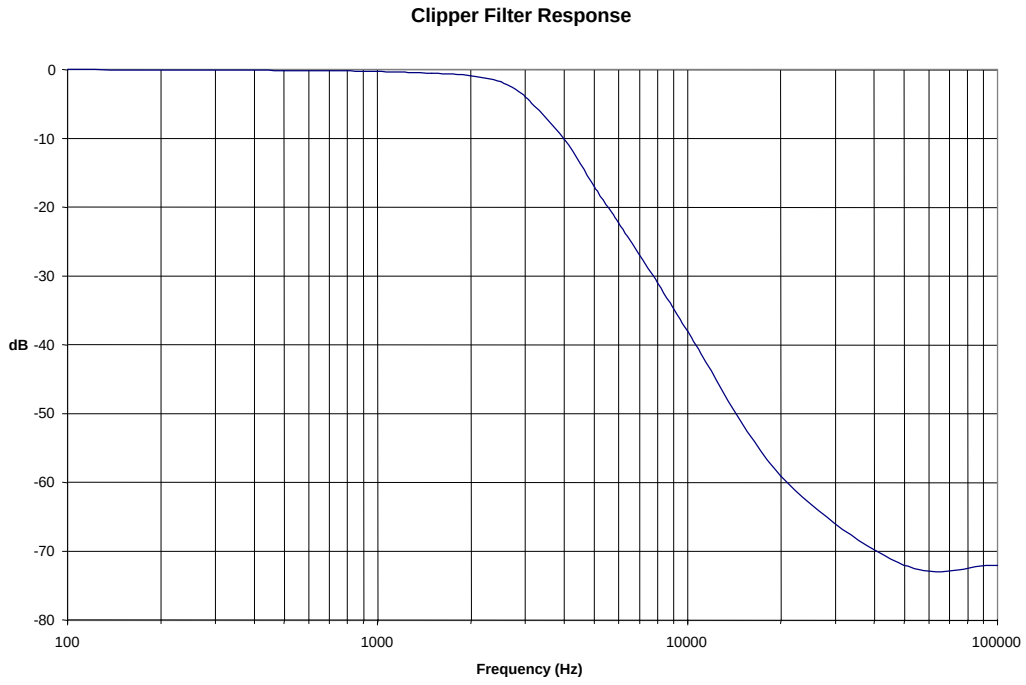
FCC ID: AIERIT11-450

DATE: January 26, 1999

TEST RESULTS:

Frequency (Hz)	Response (dB)
100	0
500	-0.1
1000	-0.3
1500	-0.5
2000	-0.9
2500	-1.8
3000	-4
4000	-10.1
5000	-17
6000	-22.3
8000	-31
10000	-38
20000	-59
50000	-72
100000	-72

Response relative to input level.


Clipper Filter Response
0
-10
-20
-30
dB -40
-50
-60
-70
-80
100
1000
10000
100000
Frequency (Hz)

TYPE OF TEST: MODULATION LIMITING CURVES
Microphone Input

FCC PART: 2.987 (b)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz per the tune-up procedure outlined in the Preliminary Maintenance Manual.

2. The DTX-454 was connected to the RF input of an HP 8901 Modulation Analyzer set up to measure FM deviation.

3. The output of a BK Precision Model 4010 Function Generator was applied to the microphone input of the DTX-454 through pin 4 of J301. The output of the audio generator was set to an output level sufficient to drive the modulation limiter into limiting at any audio frequency.

4. A Fluke Model 45 Dual Display Multimeter was used to measure the amplitude of the signal applied to the microphone input.

5. The frequency of the audio generator was adjusted to find the frequency of maximum response. The DTX-454 deviation was adjusted for +/- 2.5 kHz for 12.5 kHz channel operation as outlined in the Preliminary Maintenance Manual.

6. The frequency of the audio signal generator was set to 300 Hz and the output level was adjusted to produce less than 500 Hz deviation, which is 20% of the rated modulation. The voltage level was then adjusted in amplitude from zero through a value at least 16 dB above that required to produce maximum deviation. Deviation was recorded at a number of increments of audio input amplitude and converted to percent deviation.

7. The input voltage was adjusted to a level 16 dB greater than that required to produce 50% maximum deviation. The maximum deviation was noted.

8. Steps 6 and 7 were repeated for frequencies of 1000 and 3000 Hz.

TYPE OF TEST: MODULATION LIMITING CURVES
Microphone Input

FCC PART: 2.987 (b)

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

MODEL: DTX-454

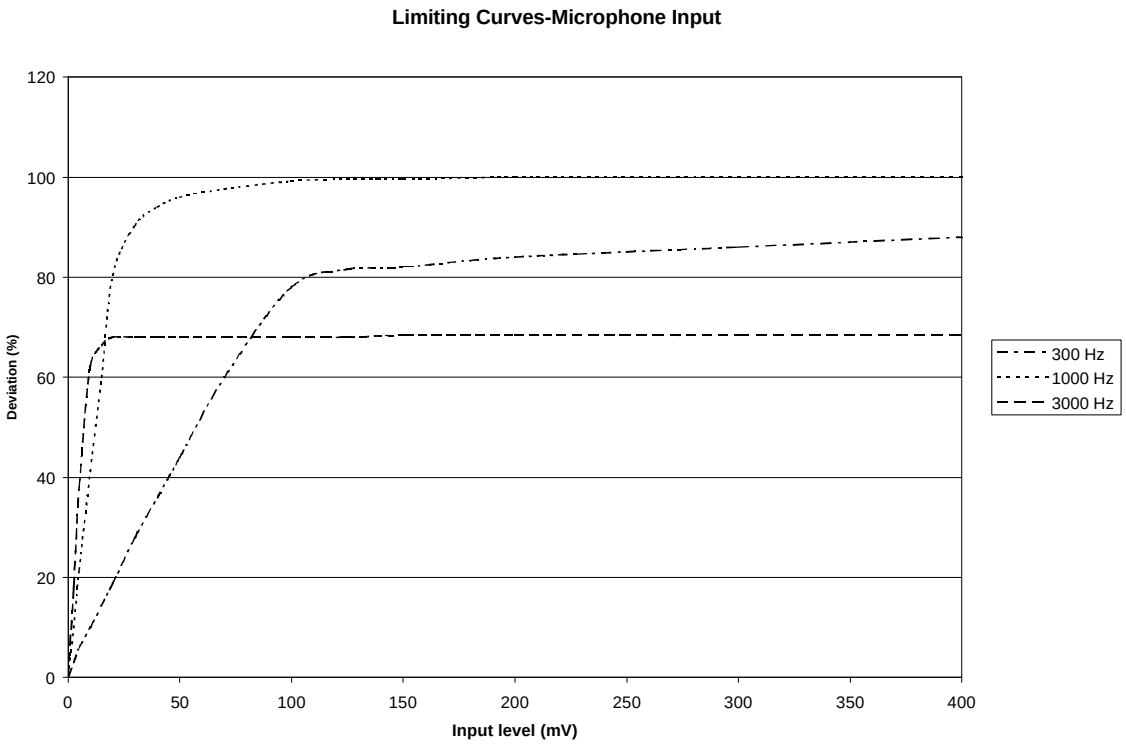
TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

TEST RESULTS:

	Deviation (%)		
Input Level (mV)	300 Hz	1000 Hz	3000 Hz
0	0	0	0
2.5	3	10	18
5	6	21.6	38
10	10	41.2	62.4
15	14.4	60	66.4
20	18.8	80.4	68
30	28	90.4	68
40	36	94	68
50	44	96	68
70	60	97.6	68
100	78	99.2	68
125	81.6	99.6	68
150	82	99.6	68.4
200	84	100	68.4
300	86	100	68.4
400	88	100	68.4
16 dB above 50 % Deviation	90	100	68


Limiting Curves-Microphone Input
120
100
80
60
40
20
0
Deviation (%)
0
50
100
150
200
250
300
350
400
Input level (mV)
300 Hz
1000 Hz
3000 Hz

TYPE OF TEST: MODULATION LIMITING CURVES
Auxiliary Input

FCC PART: 2.987 (b)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz per the tune-up procedure outlined in the Preliminary Maintenance Manual.

2. The DTX-454 was connected to the RF input of an HP 8901 Modulation Analyzer set up to measure FM deviation.

3. The output of a BK Precision Model 4010 Function Generator was applied to the microphone input of the DTX-454 through pin 7 of J301. The output of the audio generator was set to an output level sufficient to drive the modulation limiter into limiting at any audio frequency.

4. A Fluke Model 45 Dual Display Multimeter was used to measure the amplitude of the signal applied to the microphone input.

5. The frequency of the audio generator was adjusted to find the frequency of maximum response. The DTX-454 deviation was adjusted for +/- 2.5 kHz for 12.5 kHz operation as outlined in the Preliminary Maintenance Manual.

6. The frequency of the audio signal generator was set to 300 Hz and the output level was adjusted to produce less than 500 Hz deviation, which is 20% of the rated modulation. The voltage level was then adjusted in amplitude from zero through a value at least 16 dB above that required to produce 50 % maximum deviation. Deviation was recorded at a number of increments of audio input amplitude and converted to percent deviation.

7. The input voltage was adjusted to a level 16 dB greater than that required to produce 50% modulation. The maximum deviation was noted.

8. Steps 6 and 7 were repeated for frequencies of 1000 and 3000 Hz.

TYPE OF TEST: MODULATION LIMITING CURVES
Auxiliary Input

FCC PART: 2.987 (b)

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

MODEL: DTX-454

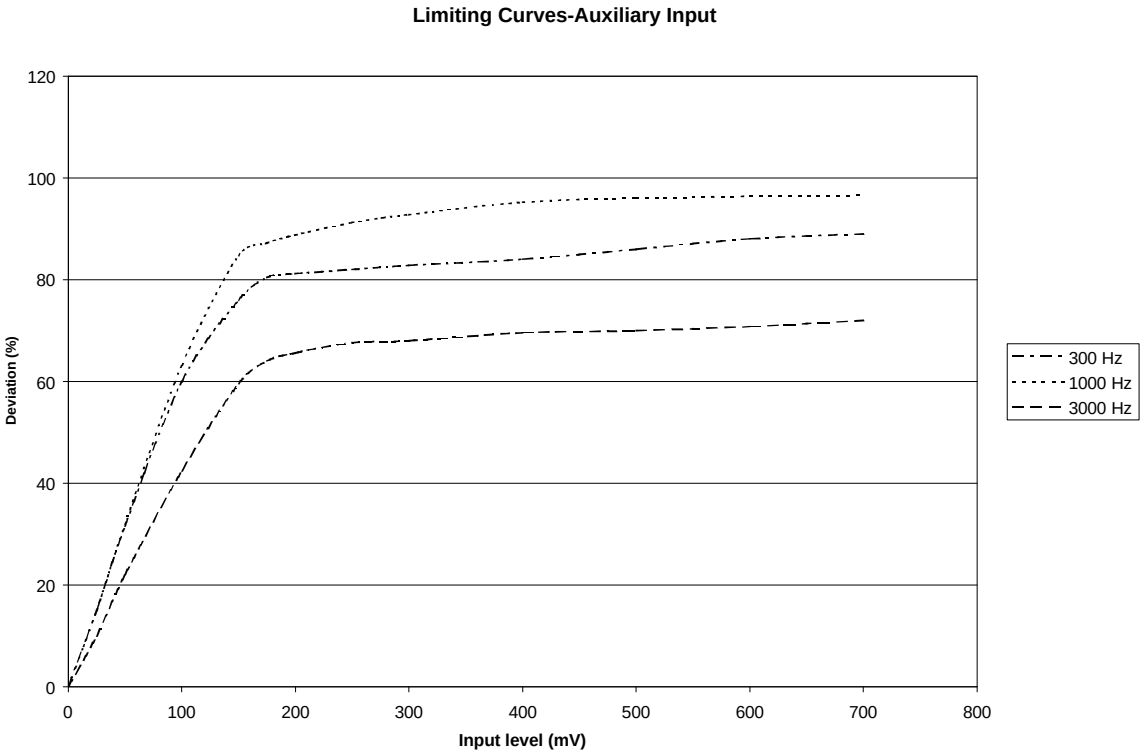
TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

TEST RESULTS:

	Deviation (%)		
Input Level (mV)	300 Hz	1000 Hz	3000 Hz
0	0	0	0
25	15	15	10
50	31.6	32	22
100	60	63.2	42.4
150	76	84.8	59.6
175	80.4	87.2	64
200	81.2	88.8	65.6
250	82	91.2	67.6
300	82.8	92.8	68
400	84	95.2	69.6
500	86	96	70
600	88	96.4	70.8
700	89	96.6	72
16 dB above 50 % Deviation	88	96.5	71.5


Limiting Curves-Auxiliary Input
Deviation (%)
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800
Input level (mV)
300 Hz
1000 Hz
3000 Hz

TYPE OF TEST:	OCCUPIED BANDWIDTH Microphone Input
FCC PART:	2.989 (c) (1) per 90.210 (b) (d)
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODEL:	DTX-454
TYPE OF UNIT:	UHF-FM Transceiver
FCC ID:	AIERIT11-450
DATE:	January 26, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power and the deviation was adjusted for +/- 2.5 kHz for 12.5 kHz operation as outlined in the Preliminary Maintenance Manual.

2. The RF Output Jack J101 was connected to the input of a Bird Model 8306-300-N 30 dB power attenuator. The output of the attenuator was connected to the input of a Tektronix 7L12 Spectrum Analyzer in a 7613 storage frame. The spectrum analyzer was set to:

   - 300 Hz Resolution
   - 5 kHz per Horizontal Division
   - 3 kHz video bandwidth
   - 10 dB per Vertical Division

3. The center frequency of the spectrum analyzer was set to the DTX-454 carrier frequency and the full scale reference line was set to the level of the unmodulated carrier.

4. The output of a BK Precision Model 4010 Function Generator was applied to the microphone input of the DTX-454 through pin 4 of 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 audio frequency which produced the greatest deviation.

5. The spectrum analyzer readings of the emission levels in dBc were recorded and a graph of the spectrum analyzer output was plotted. All readings were rounded to the nearest dB.

6. Steps 3 – 5 were repeated at the lowest power setting of the radio.

7. The DTX-454 deviation was adjusted for +/- 5 kHz for 25 kHz operation as outlined in the Preliminary Maintenance Manual and steps 3 - 6 were repeated. The spectrum analyzer center frequency was then shifted +/-40 kHz and the spectrum was examined for emissions.

TYPE OF TEST: OCCUPIED BANDWIDTH
Microphone Input

FCC PART: 2.989 (c) (1) per 90.210 (b) (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

TEST RESULTS:

12.5 kHz Operation

Frequency Offset (kHz)	Emission Level (dBc)	FCC Limit (dBc)
-12.5	-71	-70
-10	-58	-52
-7.5	-40	-34
-5	-22	0
-2.5	-8	0
0	-2	0
2.5	-8	0
5	22	0
7.5	-40	-34
10	-58	-52
12.5	71	-70

Note: Emission levels did not change as a function of power level.

TYPE OF TEST: OCCUPIED BANDWIDTH
Microphone Input

FCC PART: 2.989 (c) (1) per 90.210 (b) (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

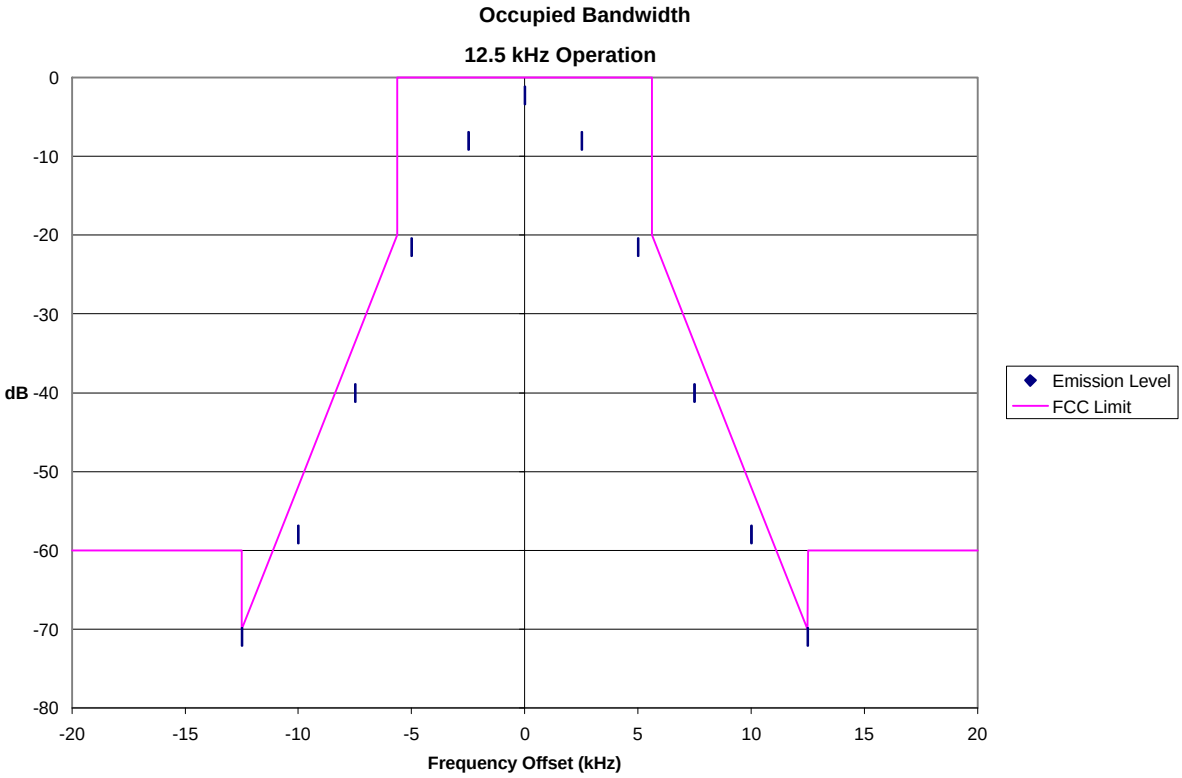
DATE: January 26, 1999

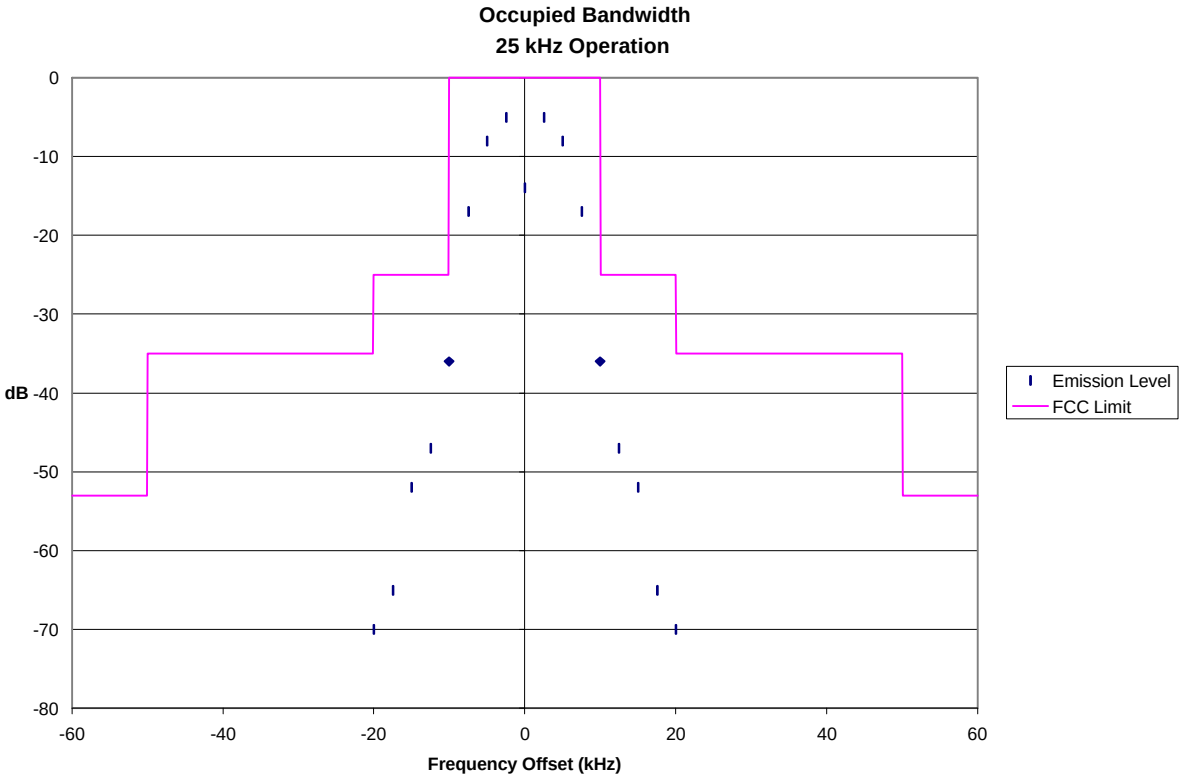
TEST RESULTS:

25 kHz Operation

Frequency Offset (kHz)	Emission Level (dBc)	FCC Limit (dBc)
-20	-70	-25
-17.5	-65	-25
-15	-52	-25
-12.5	-47	-25
-10	-36	0
-7.5	-17	0
-5	-8	0
-2.5	-5	0
0	-14	0
2.5	-5	0
5	-8	0
7.5	-17	0
10	-36	0
12.5	-47	-25
15	-52	-25
17.5	-65	-25
20	-70	-25

Note: Emission levels did not change as a function of power level.


Occupied Bandwidth
12.5 kHz Operation
0
-10
-20
-30
dB -40
-50
-60
-70
-80
-20
-15
-10
-5
0
5
10
15
20
Frequency Offset (kHz)
Emission Level
FCC Limit


Occupied Bandwidth
25 kHz Operation
0
-10
-20
-30
dB -40
-50
-60
-70
-80
-60
-40
-20
0
20
40
60
Frequency Offset (kHz)
Emission Level
FCC Limit

TYPE OF TEST:	OCCUPIED BANDWIDTH Auxiliary Input-Squarewave Input Signal
FCC PART:	2.989 (c) (1) per 90.210 (b) (d)
MANUFACTURER:	RITRON, INC. 505 West Carmel Drive Carmel, IN 46032
MODEL:	DTX-454
TYPE OF UNIT:	UHF-FM Transceiver
FCC ID:	AIERIT11-450
DATE:	January 26, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power and the deviation was adjusted for +/- 2.5 kHz for 12.5 kHz operation as outlined in the Preliminary Maintenance Manual.

2. The RF Output Jack J101 was connected to the input of a Bird Model 8306-300-N 30 dB power attenuator. The output of the attenuator was connected to the input of a Tektronix 7L12 Spectrum Analyzer in a 7613 storage frame. The spectrum analyzer was set to:

   - 300 Hz Resolution
   - 5 kHz per Horizontal Division
   - 3 kHz video bandwidth
   - 10 dB per Vertical Division

3. The center frequency of the spectrum analyzer was set to the DTX-454 carrier frequency and the full scale reference line was set to the level of the unmodulated carrier.

4. The output of a BK Precision Model 4010 Function Generator was applied to the auxiliary input of the DTX-454 through pin 7 of J301. The frequency of the audio signal generator was set to 2400 Hz (representing 4800 baud), the waveform set for square, and the output adjusted to a level such that the square wave was just reaching clipping in the DTX-454 clipper.

5. The spectrum analyzer readings of the emission levels in dBc were recorded and a graph of the spectrum analyzer output was plotted. All readings were rounded to the nearest dB.

6. Steps 3 – 5 were repeated at the lowest power setting of the radio.

TYPE OF TEST: OCCUPIED BANDWIDTH
Auxiliary Input-Squarewave Input Signal

FCC PART: 2.989 (c) (1) per 90.210 (b) (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

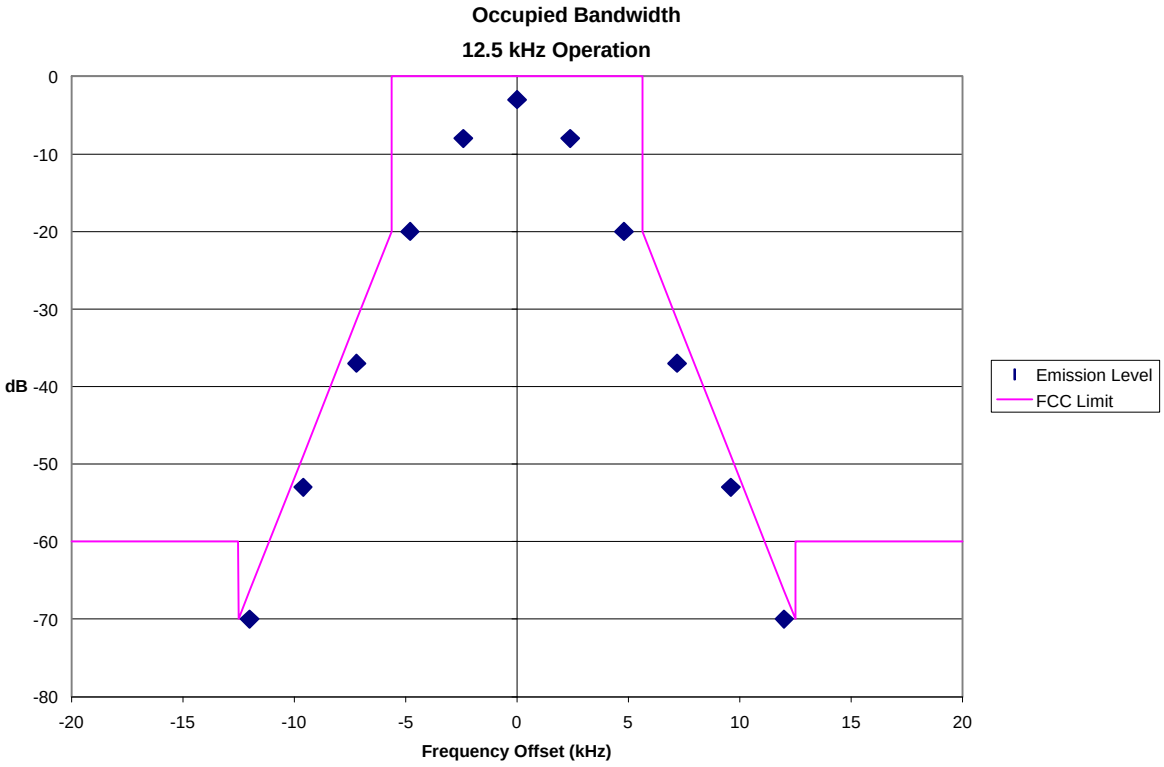
DATE: January 26, 1999

TEST RESULTS:

12.5 kHz Operation

Frequency Offset (kHz)	Emission Level (dBc)	FCC Limit
-12	-70	-66.3
-9.6	-53	-48.9
-7.2	-37	-31.4
-4.8	-20	0
-2.4	-8	0
0	-3	0
2.4	-8	0
4.8	-20	0
7.2	-37	-31.4
9.6	-53	-48.9
12	-70	-66.3

Note: Emission levels did not change as a function of power level.


Occupied Bandwidth
12.5 kHz Operation
0
-10
-20
-30
dB -40
-50
-60
-70
-80
-20
-15
-10
-5
0
5
10
15
20
Frequency Offset (kHz)
Emission Level
FCC Limit

TYPE OF TEST: OCCUPIED BANDWIDTH

FCC PART: 2.989 (c) (1) per 90.210 (b) (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 1, 1999

PROCEDURE:

1. The analyzer readings in dBm were converted to power readings and then were summed to provide a MEAN REFERENCE POWER. The powers of the carrier and each sideband were calculated as a percentage of the reference power level. The percentages were added together starting with the carrier and expanding outward pair by sideband pair until greater than 99.0% of the total MEAN REFERENCE POWER was reached.

2. The occupied bandwidth is defined as having 99.0% of the total MEAN REFERENCE POWER existing within its limits.

RESULTS:

Microphone Input-2500 Hz tone:

12.5 kHz operation	10 kHz
25 kHz operation	15 kHz

Auxiliary Input-squarewave input:

12.5 kHz operation	9.6 kHz

TYPE OF TEST: OCCUPIED BANDWIDTH
Auxiliary Input-Pseudorandom Data Stream Input

FCC PART: 2.989 (c) (1) per 90.210 (b) (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 26, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power and the deviation was adjusted for +/- 2.5 kHz for 12.5 kHz operation as outlined in the Preliminary Maintenance Manual.

2. The RF Output Jack J101 was connected to the input of a Bird Model 8306-300-N 30 dB power attenuator. The output of the attenuator was connected to the input of a Tektronix 7L12 Spectrum Analyzer in a 7613 storage frame. The spectrum analyzer was set to:

   - 300 Hz Resolution
   - 5 kHz per Horizontal Division
   - 3 kHz video bandwidth
   - 10 dB per Vertical Division

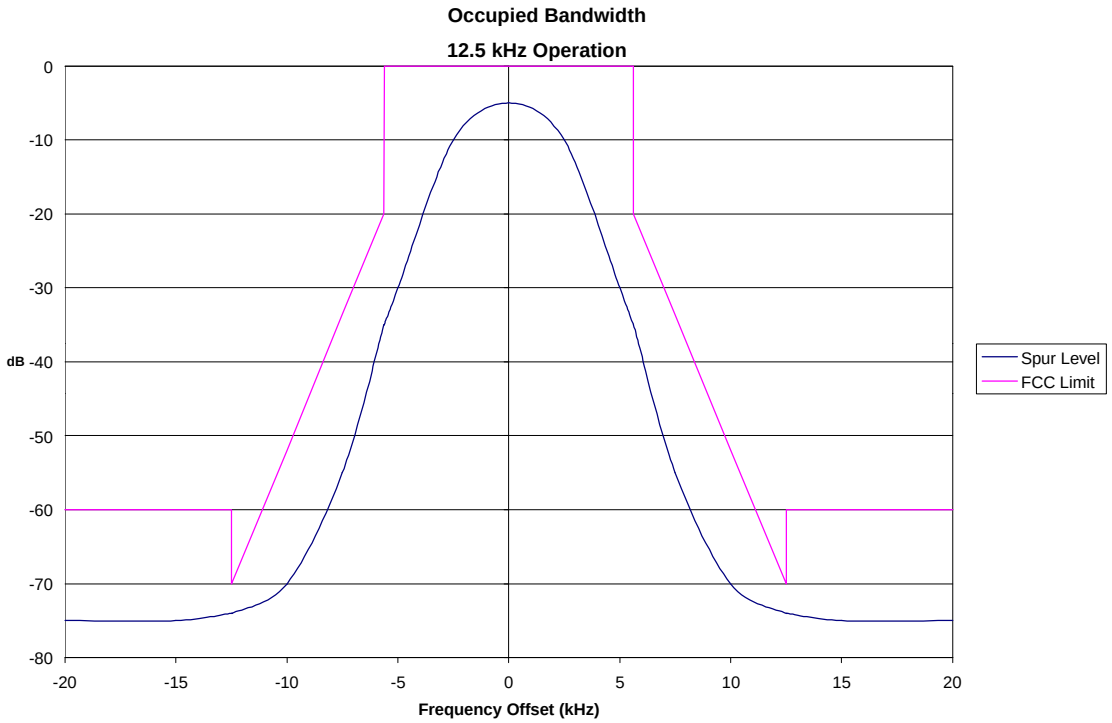
3. The center frequency of the spectrum analyzer was set to the DTX-454 carrier frequency and the full scale reference line was set to the level of the unmodulated carrier.

4. The output of a Pseudorandom data stream generator was applied to the auxiliary input of the DTX-454 through pin 7 of J301. The output of the pseudorandom generator was a four level pattern at 4800 baud (9600 bps). The output level was adjusted such that the outside two levels (0 and 3) were just at the edge of clipping in the DTX-454 clipper.

5. The spectrum analyzer result was recorded and a graph of the spectrum analyzer output was plotted.

6. Steps 3 – 5 were repeated for the lowest power setting of the radio.

7. The results are plotted on the following sheet.


Occupied Bandwidth
12.5 kHz Operation
0
-10
-20
-30
dB -40
-50
-60
-70
-80
-20
-15
-10
-5
0
5
10
15
20
Frequency Offset (kHz)
Spur Level
FCC Limit

TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.991

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual.

2. This test was conducted as specified in 2.991 “under the conditions specified in 2.989 as appropriate”, i.e. “when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation” “... at the frequency of maximum response of the audio modulating circuit.”

3. The RF Output of the DTX-454 was connected to a 100 Watt, 50 Ohm, 30 dB attenuator, a UHF Notch Filter tuned to 461.750 MHz, and then to the input an Tektronix 7L12 Spectrum Analyzer. An Astron VS 12M power supply was connected to the power supply input. The voltage was set to the nominal voltage for the version tested.

4. The measured insertion loss of the attenuators and cables are listed as the “Correction Factor” in the Results Table. For each emission frequency, the insertion loss was measured using an HP 8753E Network Analyzer.

5. The spectrum was searched from 8 MHz to the 10th harmonic of the operating frequency. All unreported emissions were more than 20 dB below the FCC limit of 50 + 10 log P, or -20 dBm absolute.

6. Since the PA modules differ in the two output power versions, 6 watt maximum and 10 watt maximum, test were conducted at the minimum and maximum power settings for each.

TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.991

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 3, 1999

TEST RESULTS:

6 Watt version:

Supply Voltage = 7.5 VDC
Output Power = 1 Watt

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Absolute Spur Level (dBm)

All emissions more than 20 dB below FCC limit.

Supply Voltage = 7.5 VDC
Output Power = 6 Watts

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Absolute Spur Level (dBm)
2308.750	-68	34	-34

Note: Results for 10 watt version shown on following page.

TYPE OF TEST: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC PART: 2.991

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: February 3, 1999

TEST RESULTS:

10 Watt version:
Supply Voltage = 13.7 VDC
Output Power = 1 Watt

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Absolute Spur Level (dBm)
923.500	-67	31	-36
1385.250	-70	33	-37
2308.750	-62	34	-28
4155.750	-66	36	-30
4617.500	-66	36	-30

Supply Voltage = 13.7 VDC
Output Power = 10 Watts

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Absolute Spur Level (dBm)
923.500	-65	31	-34
1385.250	-70	33	-37
2308.750	-62	34	-28
4155.750	-66	36	-30
4617.50	-66	36	-30

TYPE OF TEST: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.993 (b)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

PROCEDURE:

1. 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.

2. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual. The unit 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 DTX-454 were varied to provide maximum field strength. 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).

5. The DTX-454 was tested in its two output power versions, 6 watt and 10 watt at 1 watt and maximum output power levels.

TYPE OF TEST: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.993 (b)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

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: FIELD STRENGTH OF SPURIOUS RADIATION

FCC PART: 2.993 (b)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

TEST RESULTS:

Supply Voltage = 7.5 VDC

Po (W)	Emission Frequency (MHz)	Measurement dBm	Antenna	Antenna Factor (dB)	Field Strength (uV/m)	FCC Limit (uV/m)	Margin dB
1	923.50	-62	Log-Periodic	28.4	4668	7394	4
1	1385.25	-70	Discone	28.9	1963	7394	11.5
6	923.50	-60	Log-Periodic	28.4	5876	7394	2
6	1385.25	-65	Discone	28.9	3490	7394	6.5
6	1847.00	-82	Discone	30.8	620	7394	21.5

Supply Voltage = 13.7 VDC

	Emission Frequency (MHz)	Measurement dBm	Antenna	Antenna Factor (dB)	Field Strength (uV/m)	FCC Limit (uV/m)	Margin dB
1	923.50	-65	Log-Periodic	28.4	3304	7394	7
1	1385.25	-72	Discone	28.9	1559	7394	13.5
10	923.50	-68	Log-Periodic	28.4	2339	7394	10
10	1385.25	-68	Discone	28.9	2471	7394	9.5

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE

FCC PART: 2.995 (a)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 27, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual.

2. The DTX-454 was placed in a Delta Design Model 3900 CL Temperature Chamber. The RF Output of the DTX-454 was connected through a 30 dB power attenuator to an HP 8353A Frequency Counter to monitor the transmitter frequency. An Astron VS 12M Power Supply was adjusted for a nominal voltage of 13.7 VDC and connected to the power supply input of the DTX-454. A Triplett Model 320-G/P Thermocouple was used to monitor the temperature inside the chamber.

3. The DTX-454 was heated to +50 degrees C and allowed to stabilize for 30 minutes for the 1st measurement and 30 minutes for each 5 degree decrement until the DTX-454 reached a temperature of -30 degrees C.

4. The frequency reading at each temperature was recorded and compared with the frequency at the nominal tune-up temperature.

TYPE OF TEST: FREQUENCY STABILITY VS. TEMPERATURE

FCC PART: 2.995 (a)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

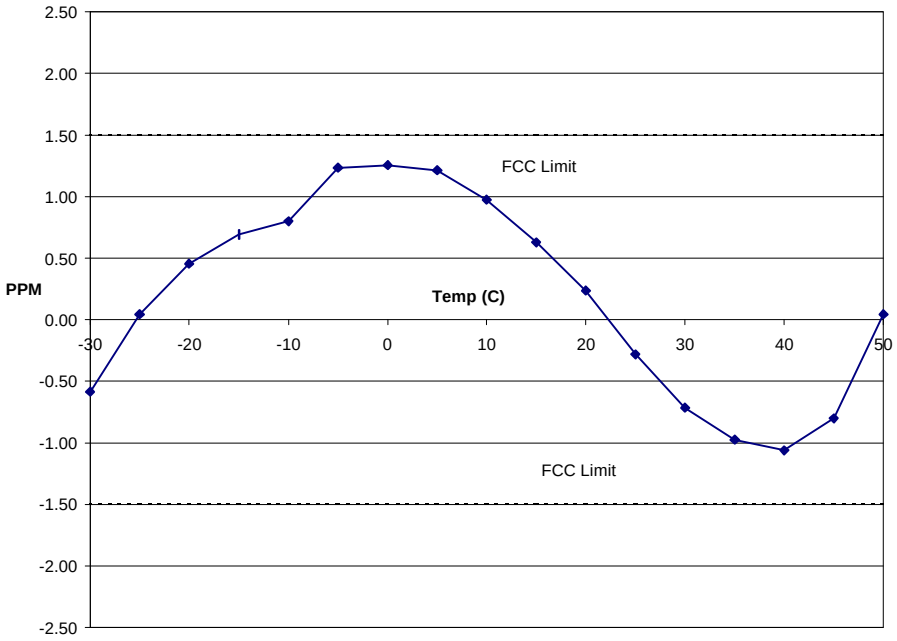
DATE: January 27, 1999

TEST RESULTS:

Temp C	Frequency MHz	Freq. Error ppm	FCC Limit ppm	FCC Limit ppm
50	461.74982	0.04	-1.5	1.5
45	461.74943	-0.80	-1.5	1.5
40	461.74931	-1.06	-1.5	1.5
35	461.74935	-0.97	-1.5	1.5
30	461.74947	-0.71	-1.5	1.5
25	461.74967	-0.28	-1.5	1.5
20	461.74991	0.24	-1.5	1.5
15	461.75009	0.63	-1.5	1.5
10	461.75025	0.97	-1.5	1.5
5	461.75036	1.21	-1.5	1.5
0	461.75038	1.26	-1.5	1.5
-5	461.75037	1.23	-1.5	1.5
-10	461.75017	0.80	-1.5	1.5
-15	461.75012	0.69	-1.5	1.5
-20	461.75001	0.45	-1.5	1.5
-25	461.74982	0.04	-1.5	1.5
-30	461.74953	-0.58	-1.5	1.5

Ref Temp 461.7498
22 C

Frequency Stability vs Temperature



TYPE OF TEST: FREQUENCY STABILITY VS. SUPPLY VOLTAGE

FCC PART: 2.995 (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power per the tune-up procedure outlined in the Preliminary Maintenance Manual. Because the two power output versions use different supply voltages, test were conducted at the full power limit of each version.

2. The RF Output Jack J101 of the DTX-454 was connected to the input of an HP 5383A Frequency Counter through a 30 dB power attenuator.

3. An Astron VS 12M Power Supply was connected to the power supply input of the DTX-454. The output of the power supply was adjusted between 85 % and 115 % of the nominal voltage for the two versions and the carrier frequency was recorded.

TYPE OF TEST: FREQUENCY STABILITY VS. SUPPLY VOLTAGE

FCC PART: 2.995 (d)

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

TEST RESULTS:

Output Power = 6 W

Supply Voltage-%Nominal	Actual Voltage	Frequency (MHz)	Frequency Error (ppm)
85	6.375	461.75006	0.11
100	7.5	461.75001	0
115	8.625	461.74992	-0.17

Output Power = 10 W

85	11.65	461.74993	0.11
100	13.7	461.74988	0
115	15.76	461.74983	-0.11

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

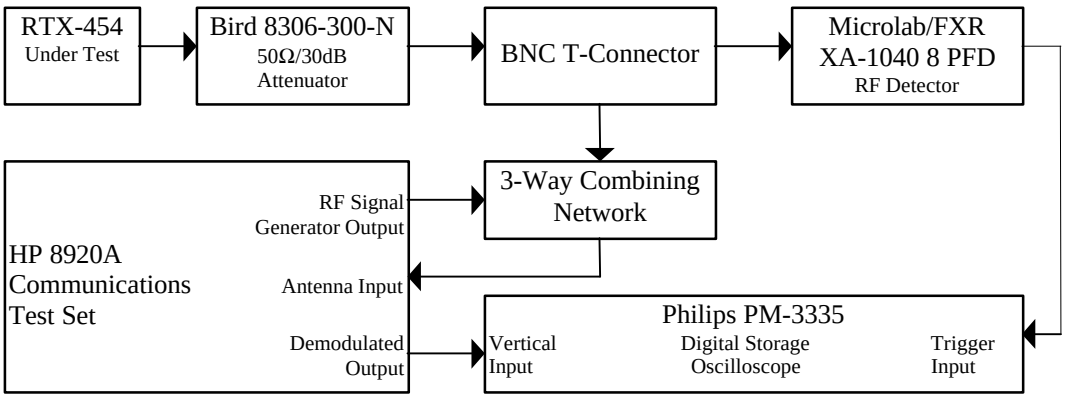
FCC ID: AIERIT11-450

DATE: January 28, 1999

PROCEDURE:

1. The DTX-454 was aligned for transmitter operation on 461.750 MHz at full rated power per the tune-up procedure outlined in the Preliminary 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 461.750 MHz.

4. The DTX-454 transmitter under test was activated and the HP 8920A Spectrum Analyzer was used to measure the RF power level through the test network.

5. The DTX-454 transmitter was turned off. The HP 8920A RF Signal Generator was set to 461.750 MHz at an RF level 20 dB below that measured in step 3, modulated with a 1 kHz tone at +/-12.5 kHz deviation.

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 28, 1999

PROCEDURE (continued):

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 DTX-454 transmitter.

8. The DTX-454 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 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.

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 DTX-454 transmitter.

10. The DTX-454 transmitter was 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.

11. Since the limits are more stringent above 6 watts, results of the 10 watt version are shown.

TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

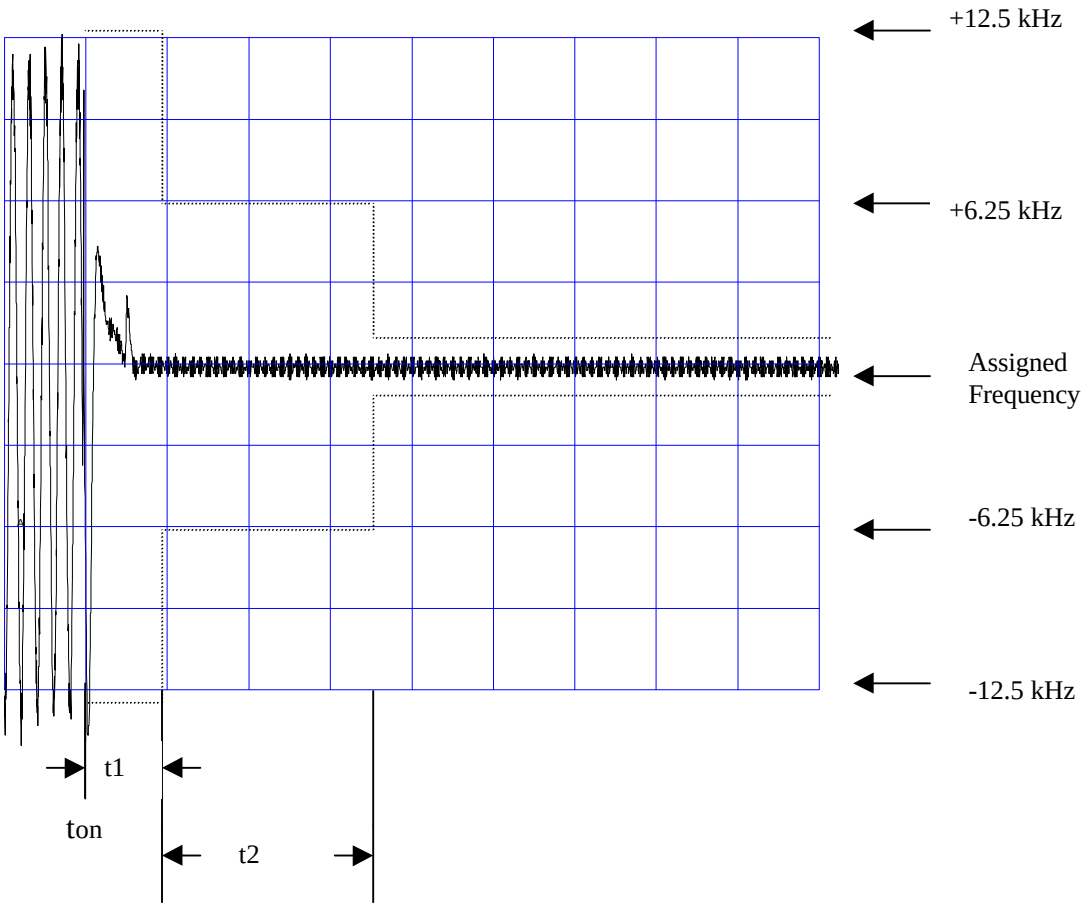
MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 29, 1999

Switch On Condition:



TYPE OF TEST: TRANSIENT FREQUENCY BEHAVIOR

FCC PART: 90.214

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

MODEL: DTX-454

TYPE OF UNIT: UHF-FM Transceiver

FCC ID: AIERIT11-450

DATE: January 29, 1999

Switch Off Condition: