ENGINEERING STATEMENT

For Type Certification of

AUDIO-TECHNICA CORPORATION

Model: ATW-T602x

FCC ID: JFZT602x

I am an Electronics Engineer, a principal in the firm of Hyak Laboratories, Inc., Springfield, Virginia. My education and experience are a matter of record with the Federal Communications Commission.

Hyak Laboratories, Inc. has been retained by Audio-Technica US, Inc., to make type certification measurements on the ATW-T602x transmitter. These tests were made by me or under my supervision in our Springfield laboratory.

Test data required by the FCC for type certification are included in this report. It is submitted that the above mentioned transmitter meets FCC requirements and type certification is requested.

Rowland S. Johnson

Dated: March 21, 2001

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the ATW-T602x transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The ATW-T602x is a 5 milliwatt (ERP(d)), UHF, frequency modulated, synthesized, battery operated transmitter configured as a hand-held microphone for wireless microphone applications under Part 74.

B. GENERAL INFORMATION REQUIRED FOR TYPE CERTIFICATION (Paragraph 2.983 of the Rules)

1. Name of applicant: Audio Technica Corporation

2. Identification of equipment: FCC ID: JFZT602x

   a. The equipment identification label is included as a separate exhibit.
   b. Photographs of the equipment are included as a separate exhibit.

3. Quantity production is planned.

4. Technical description:

   a. Emission 80k0F3E
   b. Frequency range: 470 - 480 MHz.
   c. Operating power of transmitter is fixed at the factory at 5 mW (ERP(d)).
   d. Maximum power permitted under Part 74.861(e) (1)(ii) of the rules is 250 milliwatts, and the ATW-T602x complied with those power limitations.

   e. Function of each active semiconductor device: See Appendix 1.
   f. Complete circuit diagram is included as a separate exhibit.
   g. A draft instruction book is included as a separate exhibit.
   h. The transmitter tune-up procedure is included as a separate exhibit.

B. GENERAL INFORMATION REQUIRED (Continued)

   i. A description of circuits for stabilizing frequency is included in Appendix 2.
   j. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 3.
   k. Not applicable.

5. Data for 2.985 through 2.997 follow this section.

6. RF_Power_Output (Paragraph 2.987(a) of the Rules)

   The device has an integral antenna. Effective radiated power (assuming an ideal dipole) was determined, by substitution, as 5 mW.

NOTE: All audio measurements were made hard-wired.

C. MODULATION CHARACTERISTICS

1. A curve showing frequency response of the transmitter is shown in Figure 1. Reference level was a 1 kHz audio signal at 10 kHz deviation. A Boonton 8220 modulation meter was used to measure deviation. Audio output was measured from an Audio Precision System One integrated measurement system.

2. Under Section 74.861 no modulation limiting is required. Figure 2 shows deviation as a function of input does not exceed 75 kHz.

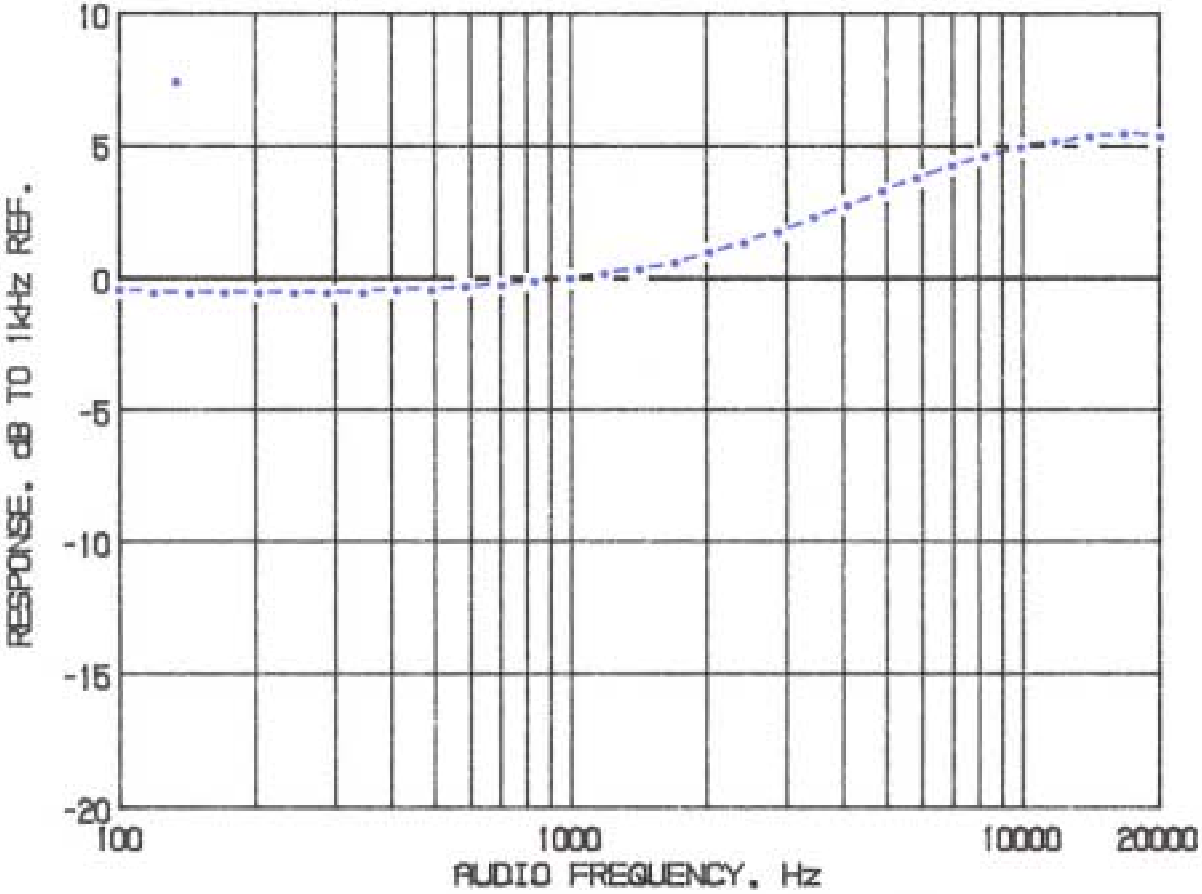
3. Occupied Bandwidth
   (Paragraphs 2.989, and 74.861(6) of the Rules)

   Figure 2 is a plot of the sideband envelope of the transmitter taken with a Tektronix 494P spectrum analyzer. Modulation consisted of a 15 kHz tone at an input level necessary to produce 85% of the rated 25 kHz deviation, per 2.989(e)(3).

   NOTE: Audio bandwidth is 15 kHz, and maximum system deviation is 25 kHz. Using 2D+2F = modulation factor. Where "D" is rated system deviation, and "F" is maximum modulation frequency, an emission designator of 80k0F3E was computed.

FIGURE 1

MODULATION FREQUENCY RESPONSE

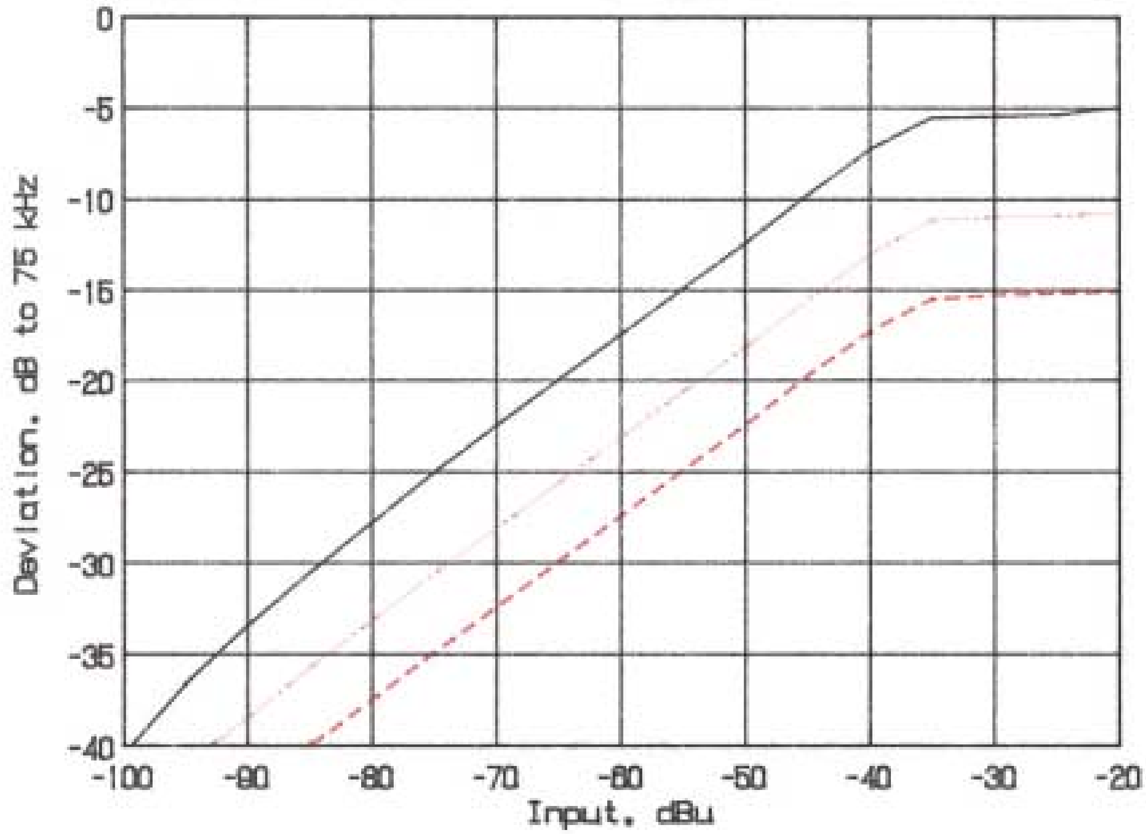


MODULATION FREQUENCY
RESPONSE
FCC ID: JFZT602x

FIGURE 1

FIGURE 2

DEVIATION VS INPUT SIGNAL



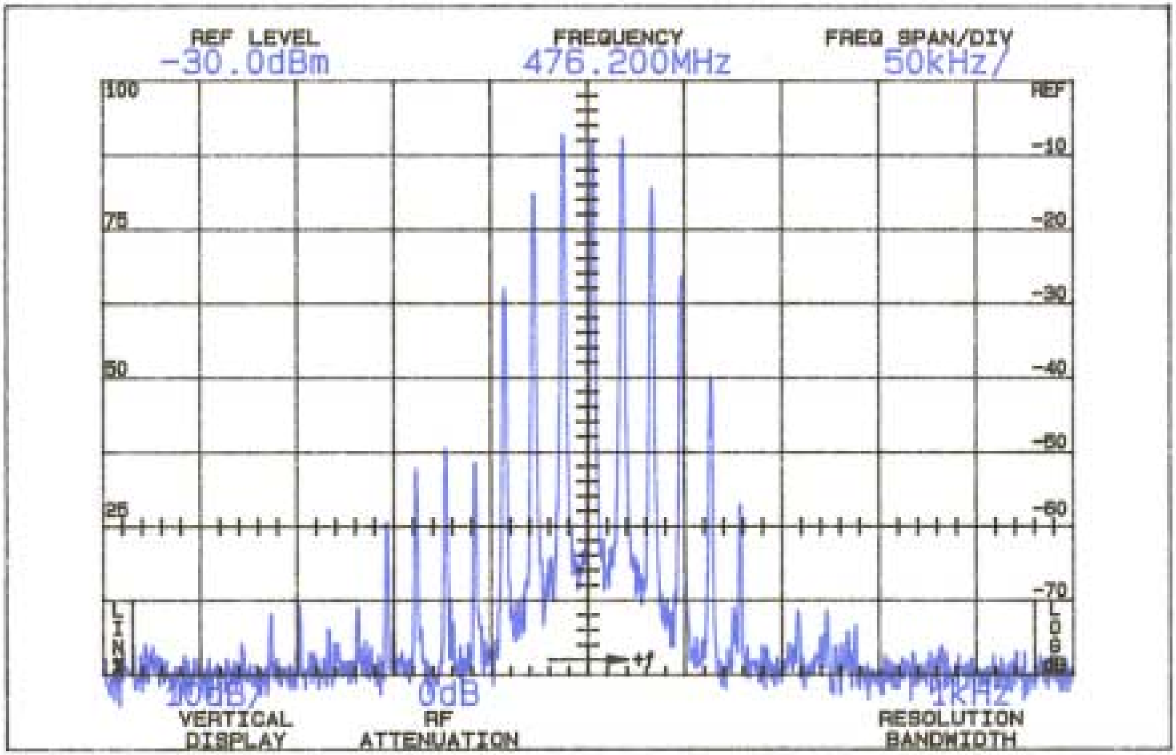
SOLID LINE: 15 kHz
LONG DASH: 7.5 kHz
SHORT DASH: 300 Hz

DEVIATION VS INPUT SIGNAL
FCC ID: JFZT602x

FIGURE 2

FIGURE 3

OCCUPIED BANDWIDTH



OCCUPIED BANDWIDTH
FCC ID: JFZT602x

FIGURE 3

C. MODULATION CHARACTERISTICS (Continued)

The plots are within the limits imposed by paragraph 74.861(6). The horizontal scale (frequency is 100 kHz per division) and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

D. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS
(Paragraph 2.991 of the Rules)

NOT APPLICABLE, INTEGRAL ANTENNA.

E. DESCRIPTION OF RADIATED SPURIOUS MEASUREMENT FACILITIES

A description of the Hyak Laboratories' radiation test facility is a matter of record with the FCC. The facility meets ANSI 63.4-1992 and was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

F. MEASUREMENTS OF SPURIOUS RADIATION

Measurements of radiated spurious emissions from the ATW-T602x were made by substitution with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated dipole antennas below 1 GHz, and Polarad CA-L, and CA-S or EMCO 3115 from 1-8.0 GHz.

The transmitter was located in an open field 3 meters from the test antenna. Supply was a fresh battery.

The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antennae polarization were employed.

Reference level for the spurious radiation was taken as the carrier level.

TABLE 1

TRANSMITTER RADIATED SPURIOUS

476.200 MHz, 9 Vdc, 5 mW

Spurious Frequency MHz	dB Below Carrier Reference[1]

476.200	0
2857.199	40V

Required: 43+10Log(P) 20

[1]Worst-case polarization, H-Horizontal, V-Vertical.

All other spurious to 4.8 GHz were 30 dB or more below FCC limit.

G. FREQUENCY STABILITY
(Paragraph 2.995(2) and 74.861 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°C to +50°C. At each temperature, the unit was exposed to test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within ±2° of the desired test temperature. Following the 1 hour soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes. Test temperature was sequenced in the order shown in Table 2, starting with -30°C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital temperature probe. Primary supply was 9 Vdc. Frequency was measured with a HP5385A digital frequency counter connected to the transmitter through a power attenuator.

TABLE 2

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE
476.200 MHz; 9 Vdc; 5 mW

Temperature, °C	Output Frequency, MHz
-29.6	476.199451
-19.9	476.198679
- 9.4	476.199028
0.3	476.199623
9.9	476.200216
19.9	476.200557
29.6	476.200259
39.8	476.200414
49.8	476.200676

Maximum frequency error: 476.198679
476.200000

- 0.001321 MHz

FCC Rule 74.861(e)(4) specifies .005% or a maximum of ±0.023810 MHz, corresponding to:

High Limit	476.223810 MHz
Low Limit	476.176190 MHz

H. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE
(Paragraph 2.995(d)(2) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with a HP 5385A digital frequency counter as supply voltage was varied ±15% from the nominal 9 Vdc rating. A Keithley 177 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 3

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE
476.200 MHz; 9 Vdc; 5 mW

Supply Voltage	Output Frequency, MHz
10.35	476.199900
9.90	476.199885
9.45	476.199869
9.00	476.199855
8.55	476.199842
8.10	476.199828
7.65	476.199817

7.20*	476.199804
Maximum frequency error:	476.199804
	476.200000
	- 0.000196

FCC Rule 74.861(e)(4) specifies .005% or a maximum of ±0.023810 MHz, corresponding to:

High Limit	476.223810
Low Limit	476.176190

*Rated mfg. battery end-point.

APPENDIX 1

ACTIVE SEMICONDUCTIOR FUNCTIONS

Reference	Type	Function
AF Circuit Board		
IC1	NJM2068M	Audio preamplifier
IC2	SA571D	Compandor IC
RF Circuit Board		
Q100	2SC4226	Final RF Amplifier
IC130	LV2102V	PLL/ 12.8MHz Ref. Oscillator

ACTIVE SEMICONDUCTORS
FCCID: JFZT602x

APPENDIX 1

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

Operating frequency is determined and stabilized by a PLL circuit using a 4MHz crystal-Controlled reference oscillator.

APPENDIX 3

CIRCUIT TO SUPPRESS SPURIOUS RADIATION AND CONTROL MODULATION

AUDIO CIRCUIT

The audio signal is injected via CP2, signal & CP4, Ground connectors into the audio circuit composed of the op amp IC1, NJM2068M, limiting voltage detector transistor Q2 & limitter/compandor IC2, SA571D. The signal is limited via the limitter circuit then compressed via the compandor circuit at a 2:1 ratio and is pre-emphasized. The level of the output signal is controlled by the pot VR2 which is injected into the VCO, VCO130.

MODULATOR CIRCUIT

The modulator circuit is a direct FM type built around the VCO, VCO130. The modulated output from the VCO is sent to the RF final amplifier which boosts the output to a nominal level of 10mW.

RF PRE-AMPLIFIER & FINAL AMPLIFIER

The 1 transistor amplifier stages, using 2SC4226 type transistors, culminating with a normal transmitter output of 10mW. The output filter comprised of L101, L102, L103, L104, C116, C117, & C123 suppresses the output harmonics and antenna matching circuit L108, C127 & C128 matches the output to the antenna.

CIRCUIT TO SUPPRESS SPURIOUS RADIATION & CONTROL MODULATION
FCC ID: JFZT602x

Appendix 3