A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the ATW-T102 transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The ATW-T102 is a 4 milliwatt, UHF, frequency modulated battery operated transmitter configured as an adjunct to hand-held microphones 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

2. Identification of equipment: FCC ID: JFZT102

   a. The equipment identification label is shown in Appendix 1.
   b. Photographs of the equipment are included in Appendix 2.

3. Quantity production is planned.

4. Technical description:

   a. Emission 80k0F3E
   b. Frequency range: 728 - 741 MHz.
   c. Operating power of transmitter is fixed at the factory at 4 mW.
   d. Maximum power permitted under Part 74.861(e)(1)(ii) of the rules is 250 milliwatts, and the ATW-T102 complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 8.7 Vdc
      Collector current: 0.7 mA

   f. Function of each active semiconductor device: See Appendix 3.
   g. Complete circuit diagram is included in Appendix 4.
   h. A draft instruction book is submitted as Appendix 5.
   i. The transmitter tune-up procedure is included in Appendix 6.
   j. A description of circuits for stabilizing frequency is included in Appendix 7.
   k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 8.
   l. Not applicable.

B. GENERAL INFORMATION REQUIRED FOR TYPE CERTIFICATION (cont'd)

5. Data for 2.985 through 2.997 follow this section.

6. RF Power Output (Paragraph 2.987(a) of the Rules)

Output power was calculated (see Table 1) from measured field intensity as 4 mW.

C. MODULATION CHARACTERISTICS

NOTE: All audio measurements were made hard-wired using the XLR connector.

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

2. Under Section 74.861 no modulation limiting is required.

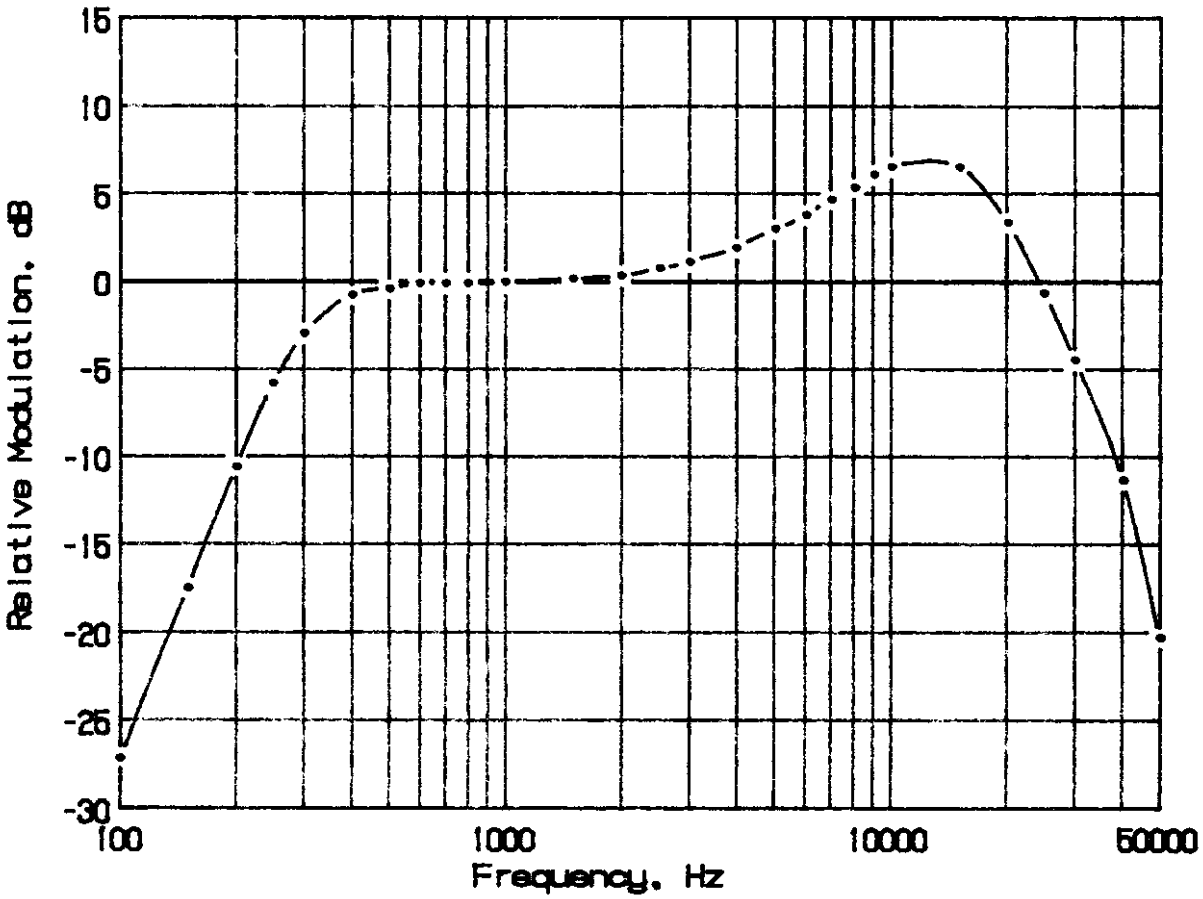
3. Occupied Bandwidth
(Paragraphs 2.989(c), and 74.861(6) of the Rules)

Figure 2 is a plot of the sideband envelope of the transmitter taken with a Tektronix 494P spectrum analyzer. Modulation consisted of a 12.5 kHz tone, the frequency of maximum response, at an input level 16 dB greater than that necessary to produce 50% modulation.

NOTE: As a wireless microphone, 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

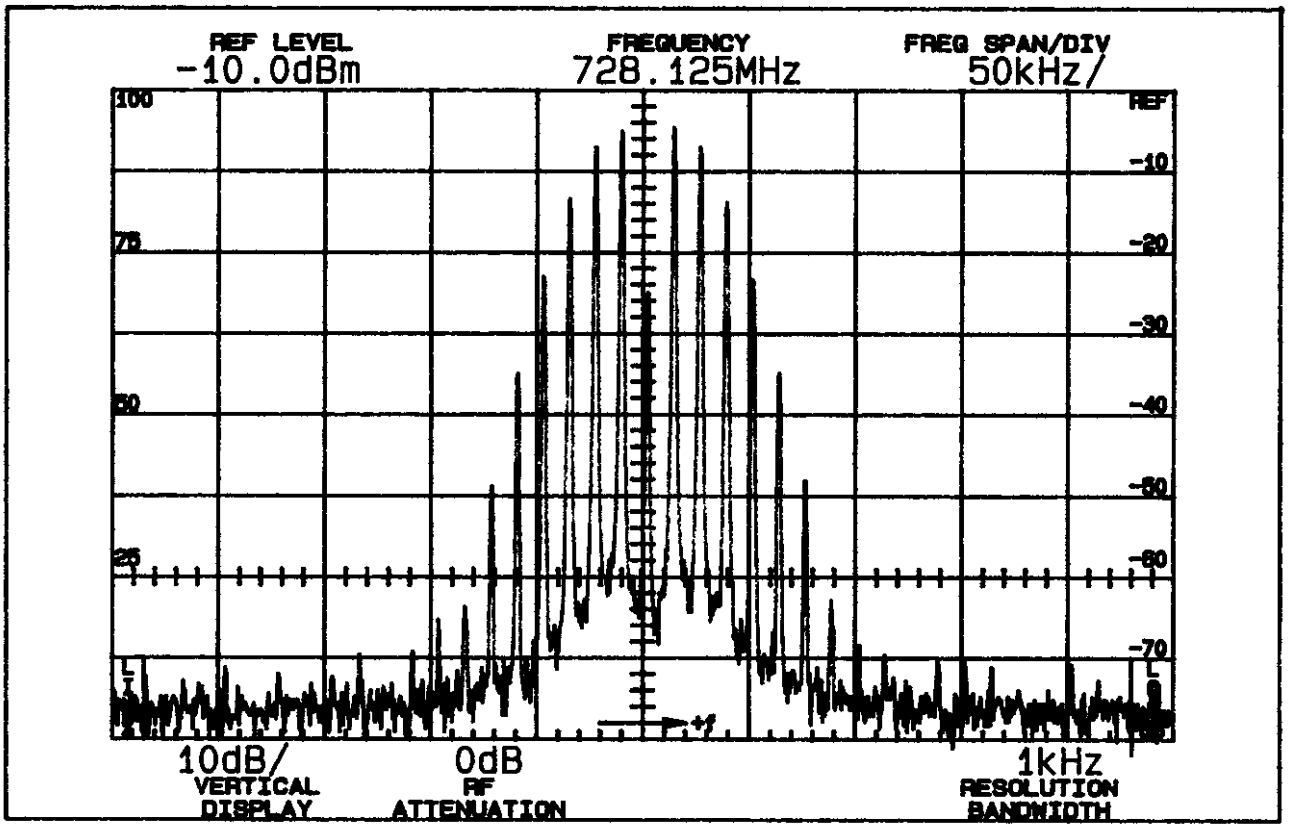


MODULATION FREQUENCY RESPONSE
FCC ID: JFZT102

FIGURE 1

FIGURE 2

OCCUPIED BANDWIDTH



OCCUPIED BANDWIDTH
FCC ID: JFZT102

FIGURE 2

C. MODULATION CHARACTERISTICS (Continued)

The plot is within the limits imposed by paragraph 74.861(6). The horizontal scale (frequency is 50 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)

The ATW-T102 transmitter has no provisions for external antenna connections. Accordingly, only radiated emissions were measured.

E. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION
(Paragraph 2.993(a) (b) (2) of the Rules)

Field intensity measurements of radiated spurious emissions from the ATW-T102 were made with a Tektronix 494P spectrum analyzer using Singer DM-105A dipoles or Polarad CA-L, CA-S and EMCO 3115 horn antennas. The transmitter was located in an open field 3 meters from the test antenna. Supply voltage was a fresh battery with a terminal voltage under load of 9.0 Vdc. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed. (The radiation test range is currently listed as an accepted site.)

Since the transmitter is used only with an integral antenna and has no provisions for connection of an external antenna, reference level for spurious emissions was taken as maximum measured emission at the operational frequency.

The measurement system was capable of detecting signals 80 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit, or 4 MHz, to 10 times operating frequency. Data after application of antenna factors and line loss corrections are shown in Table 1.

TABLE 1

TRANSMITTER RADIATED SPURIOUS
728.125 MHz; 9 Vdc; 4 mW

Emission Frequency MHz	Field Intensity uV/m@3m	dB Below Carrier Reference[1]
728.124 (Carrier)	147911	0.0
1456.248	1122	42.4
2184.372	617	47.6
2912.496	159	59.4
3640.622	221	56.5
4368.744	174	58.6
5096.868	118	62.0
5824.992	102	63.2
6553.116	100	63.4
7281.240	151	59.8
Required: 43+10Log(P) =		19.0

1. Worst-case polarization.

All other spurious from 4 MHz to the tenth harmonic were 20 dB or more below limit.

Power Computation:

$$E = \frac{(49.2P_t)^{1/2}}{3} \quad (1)$$

$$P = \frac{(3E)^2}{49.2}$$

where P = Power in watts

E = electric-field intensity in volts/meter

$0.004 = (3*147911E^{-6})^2/49.2$

(1)

*Reference Data for Radio Engineers, Fourth Edition, International Telephone and Telegraph Corp., p. 676.

F. FREQUENCY STABILITY
(Paragraph 2.995(2) and 90.213 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. The transmitter output stage was terminated in a 50 ohm dummy load. Primary supply was 9 volts. Frequency was measured with a HP5385A digital frequency counter connected to the transmitter through a power attenuator. Measurements were made at 728.125 MHz.

TABLE 2

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE

728.125 MHz; 9 Vdc; 4 mW

Temperature, °C	Output Frequency, MHz
-29.0	728.124138
-19.9	728.125350
- 9.4	728.127070
- 0.5	728.127875
10.5	728.127698
20.0	728.126359
30.4	728.124240
39.9	728.122062
49.8	728.120071
Maximum frequency error:	728.120071
	728.125000
	- 0.004929 MHz

FCC Rule 74.861(e)(4) specifies .005% or a maximum of ±0.036406 MHz, corresponding to:

High Limit	728.161406 MHz
Low Limit	728.088594 MHz

G. 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 provided by a HP 6264B variable dc power supply was varied ±15% from the nominal 9 volt 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

728.125 MHz; 9 Volt Nominal; 4 mW

Supply Voltage	Output Frequency, MHz
10.35	728.126511
9.90	728.126455
9.45	728.126405
9.00	728.126359
8.55	728.126314
8.10	728.126275
7.65	728.126238
6.50* rated battery end-point	728.126204
Maximum frequency error:	728.126511
	728.125000
	+ 0.001511

FCC Rule 74.861(e)(4) specified .005% or a maximum of ±0.036406 MHz, corresponding to:

High Limit	728.161406
Low Limit	728.088594

APPENDIX 1

EQUIPMENT IDENTIFICATION LABEL

LABEL SKETCH AND LABEL LOCATION FOLLOWS THIS SHEET

APPENDIX 3

ACTIVE SEMICONDUCTOR FUNCTIONS

Reference	Type	Function
AF Circuit Board		
IC1	NJM20680	Audio preamplifier
IC7	NE5720	Audio processor
RF Circuit Board		
Q7	2SC4226	Driver
Q8	2SC4226	Final RF Amplifier
IC4	PIC16062A	PLL/4 MHz Ref. Oscillator

APPENDIX 6

TRANSMITTER ALIGNMENT

ONE (1) PAGE ALIGNMENT PROCEDURE FOLLOWS THIS SHEET

Alignment Procedure

1. RF Alignment

1) Connect AF ,RF and Microprocessor PCB by connector
2) Apply DC 9V in between connector, CNP6 and CNP7
3) Using special cable, connect CNP4 output to Spectrum Analyzer
4) Turn power switch to ST.BY position and observe power LED blinking once
5) Set Spectrum Analyzer's center frequency to transmitter frequency, select span adequate enough to observe up to third harmonics and check that carrier is on and no sign of unusual oscillation appeared
6) Adjust VR4 and set output power with in 10dBm +-3db, by keeping current consumption with in area of not exceeded 50mA.
7) Adjust VC2 and set it at the balancing point that output power maximum and spurious minimum
8) Adjust span to 100kHz, adjust VC1 to set carrier frequency to intended frequency
9) Reduce power supply voltage slowly until 6.5V and as at same time, verify that carrier frequency stay within adequate range and no sign of unusual oscillation appeared. Also, check that, with in 6.5+-0.3 volts range, LED light on.

2. AF Alignment

1) Disconnect CNP3 output from Spectrum Analyzer and connect to FM Liner Detector
2) Apply 1kHz,-13.2dBV of audio signal in to Mic Input
3) Turn T76 Power Switch to ON position, adjust VR3 and set FM Liner Detector reading to +-30kHz deviation
4) Reduce audio signal level 20dB, set 1kHz level as 0dB and measure 100Hz and 10kHz frequency response

   100Hz: -2.0dB +-1.5dB

   10kHz: +8.0dB+-1.5dB

APPENDIX 7

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

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

APPENDIX 8

CIRCUITS TO SUPPRESS SPURIOUS RADIATION, ETC.

A low-pass filter consisting of network F1L2 (5C4LW) and C062, C70, L6, VC2, L7, C71, C79 and L9 suppress spurious emissions.