A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the ATW-T310 transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The ATW-T310 is a 28 milliwatt (ERP(d), UHF, frequency modulated, synthesized, transmitter configured as a portable belt-pack for wireless microphone applications under Part 74. Power supply consists of two 1.5 volt batteries.

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: JFZT310D

   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 130k0F3E
   b. Frequency range: 655 - 680 MHz.
   c. Operating power of transmitter is fixed at the factory at 28 mW.
   d. Maximum power permitted under Part 74.861(e)(1)(ii) of the rules is 250 milliwatts, and the ATW-T310 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 28 mW.

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

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)

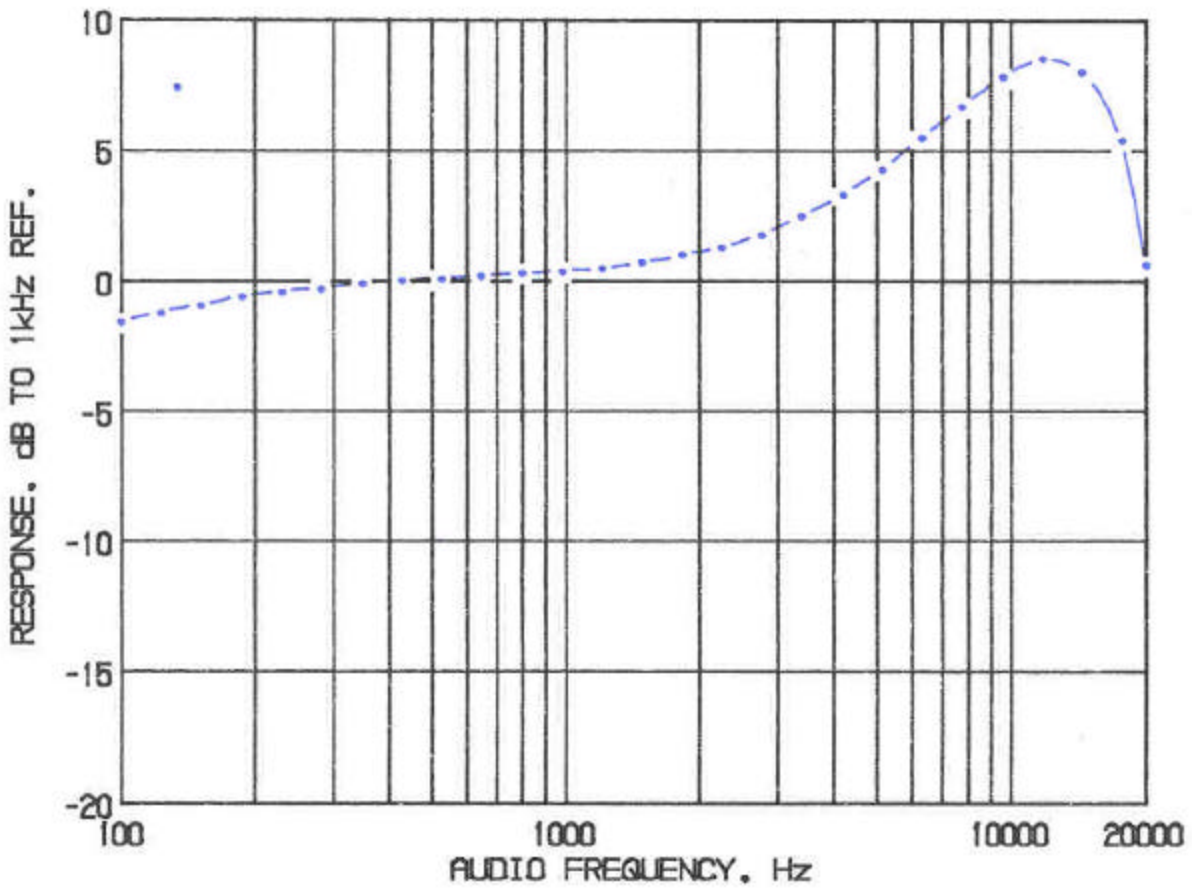
Figure 2 is a plot of the sideband envelope of the transmitter taken with a Tektronix 494P spectrum analyzer. Modulation consisted of a 15 kHz tone at an input level necessary to produce 85% of the rated 50 kHz deviation, per 2.989(e)(3).

NOTE: Audio bandwidth is 15 kHz, and maximum system

deviation is 50 kHz. Using 2D+2F = modulation factor. Where "D" is rated system deviation, and "F" is maximum modulation frequency, an emission designator of 130k0F3E was computed.

FIGURE 1

MODULATION FREQUENCY RESPONSE

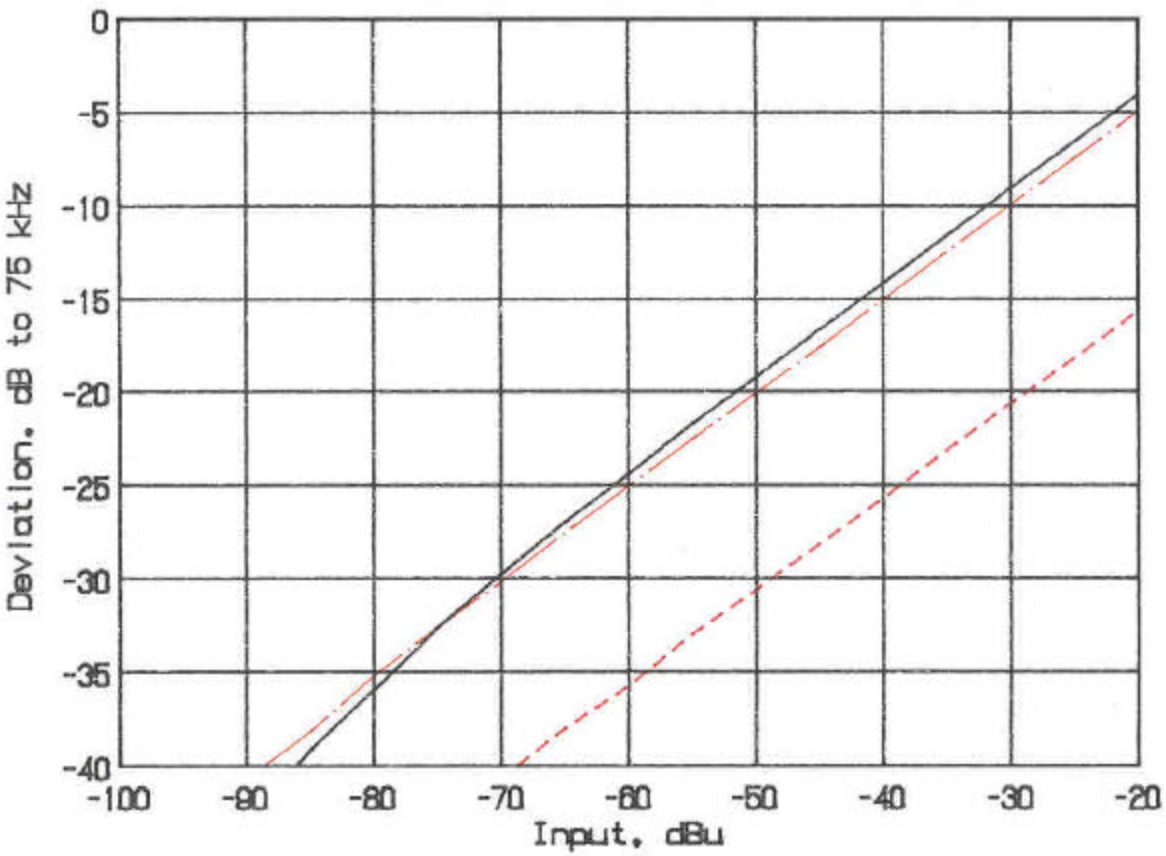


MODULATION FREQUENCY
RESPONSE
FCC ID: JFZT310D

FIGURE 1

FIGURE 2

DEVIATION VS INPUT SIGNAL



SOLID LINE: 15 kHz

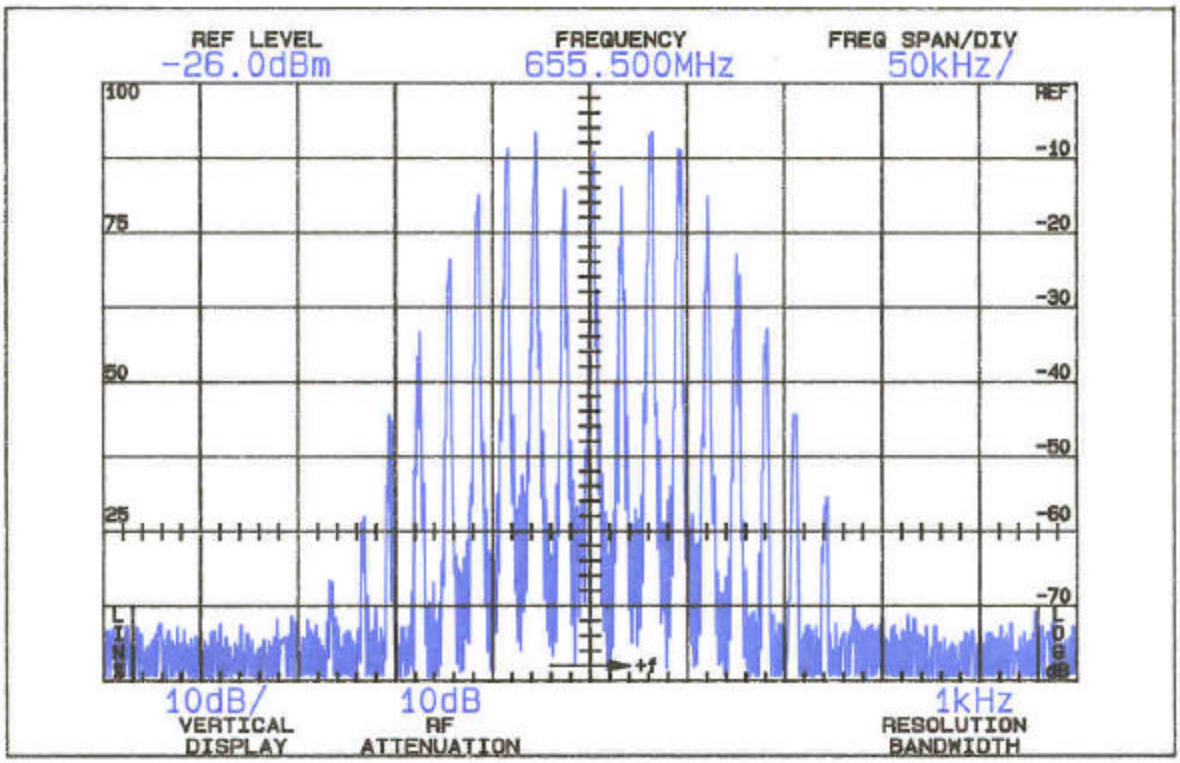
LONG DASH: 7.5 kHz
SHORT DASH: 300 Hz

DEVIATION VS INPUT SIGNAL
FCC ID: JFZT310D

FIGURE 2

FIGURE 3

OCCUPIED BANDWIDTH



OCCUPIED BANDWIDTH
FCC ID: JFZT310D

FIGURE 3

C. MODULATION CHARACTERISTICS (Continued)

The plots are 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)

NOT APPLICABLE, INTEGRAL ANTENNA.

E. MEASUREMENTS OF SPURIOUS RADIATION

Measurements of radiated spurious emissions from the ATW-T310 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 Horns from 1-8.0 GHz.

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

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

655.500 MHz, 3 Vdc, 28 mW

Spurious Frequency MHz	dB Below Carrier Reference[1]
655.504	0
1311.004	60V
Required: 43+10Log(P)	28

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

All other spurious to 6.6 GHz were 30 dB or more below FCC limit.

F. 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 3 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
655.500 MHz; 3 Vdc; 28 mW

Temperature, °C	Output Frequency, MHz	p.p.m.
-28.8	655.514870	22.7
-19.5	655.514721	22.5
- 9.6	655.514455	22.1
0.7	655.513711	20.9
10.1	655.512289	18.7
20.7	655.508989	13.7
30.6	655.502913	4.4
40.4	655.496077	- 6.0
50.6	655.488992	-16.8

Maximum frequency error: 655.514870
655.500000

+ 0.014870 MHz

FCC Rule 74.861(e)(4) specifies .005% (50 ppm) or a maximum of ±0.032775 MHz, corresponding to:

High Limit	655.532775 MHz
Low Limit	655.467225 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 was varied ±15% from the nominal 3 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
655.500 MHz; 3 Vdc; 28 mW

Supply Voltage	Output Frequency, MHz	p.p.m.
3.45	655.509592	14.6
3.30	655.509386	14.3
3.15	655.509178	14.0
3.00	655.508989	13.7
2.85	655.508797	13.4
2.70	655.508613	13.1
2.55	655.508450	12.9
2.40*	655.508291	12.6

Maximum frequency error: 655.509592
655.500000

\+ 0.009592

FCC Rule 74.861(e)(4) specifies .005% (50 ppm) or a maximum of ±0.032775 MHz, corresponding to:

High Limit	655.532775
Low Limit	655.467225

*Rated mfg. battery end-point.

APPENDIX 1

ACTIVE SEMICONDUCTIOR FUNCTIONS

Reference	Type	Function
AF Circuit		
IC200	Dream T1	AF-amplifier and tone-Generator IC
IC250	NJM2068MD	OP amplifier
IC251	SA572D	Compander IC
RF Circuit		
Q101	2SC4226	RF-Buffer
Q102-103	2SC5226	RF Amplifier
Q104	2SC4738	RF-Power Controller
Q106	DTA114YKA	RF-Switch
IC5	MB1511PFV	PLL IC
IC8	NJU6366	PLL/ 9MHz Ref. Oscillator

APPENDIX 1

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

Operating frequency is determined and stabilized by a PLL circuit using a 9MHz crystal-Controlled reference oscillator.

APPENDIX 3

CIRCUIT TO SUPPRESS SPURIOUS RADIATION AND CONTROL MODULATION

AUDIO CIRCUIT

The audio signal is injected via the HRS connector into the audio circuit composed of the op amp in IC200, Dream T1, then compressed via the compandor circuit composed of the op amp IC250,and compander IC251 at a 2:1 ratio and is pre-emphasized by AF amp in IC200. The level of the output signal is controlled by the pot VR201 which is injected into the VCO, VCO100.

Output level of the 32.15kHz tone signal that produced by IC200 is controlled by the pot VR200 which is mixed with the audio output signal and injected into the VCO, VCO100

MODULATOR CIRCUIT

The modulator circuit is a direct FM type built around the VCO, VCO100. The modulated output from the VCO is sent to the RF final amplifier which boosts the output to a nominal level of 10mW at RF output low setting or 30mW at RF output Hi setting.

RF PRE-AMPLIFIER & FINAL AMPLIFIER

The 3 transistor amplifier stages, using 2SC4226 and 2SC5225 type transistors, culminating with a normal transmitter output of 10mW at RF output low setting and 30mW at RF output Hi setting. The output filter comprised of L104, L L105, L106 L107, C132, C133, C134 & C135suppresses the output harmonics and the output to the antenna.

APPENDIX 3