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ENGINEERING STATEMENT

For Type Acceptance of

AUDIO-TECHNICA

Model No: ATW-T52
FCC ID: JFZT52B

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 authorized by Audio-Technica to make type acceptance measurements on the ATW-T52 transmitter. These tests made by me or under my supervision in our Springfield laboratory.

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

89428

Rowland S. Johnson

Dated: April 28, 1998

A. INTRODUCTION

The following data are submitted in connection with this request for type acceptance of the ATW-T52 transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The ATW-T52 is a 10 milliwatt, UHF, frequency modulated battery operated transmitter configured as a hand-held microphone for wireless microphone applications under Part 74.

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

1. Name of applicant: Audio-Technica

2. Identification of equipment: FCC ID: JFZT52B

   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. 80k0F3E
   b. Frequency range: 732 - 746 MHz.
   c. Operating power of transmitter is fixed at the factory at 10 mW and can be reduced by 3 dB.
   d. Maximum power permitted under Part 74.861(e)(1)(ii) of the rules is 250 milliwatts, and the ATW-T52 complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 8.7 Vdc
      Collector current: 10 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 ACCEPTANCE (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 from Table 1 as 8.2 mW. A switch permits a nominal 3 dB reduction.

C. MODULATION CHARACTERISTICS

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 one 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)

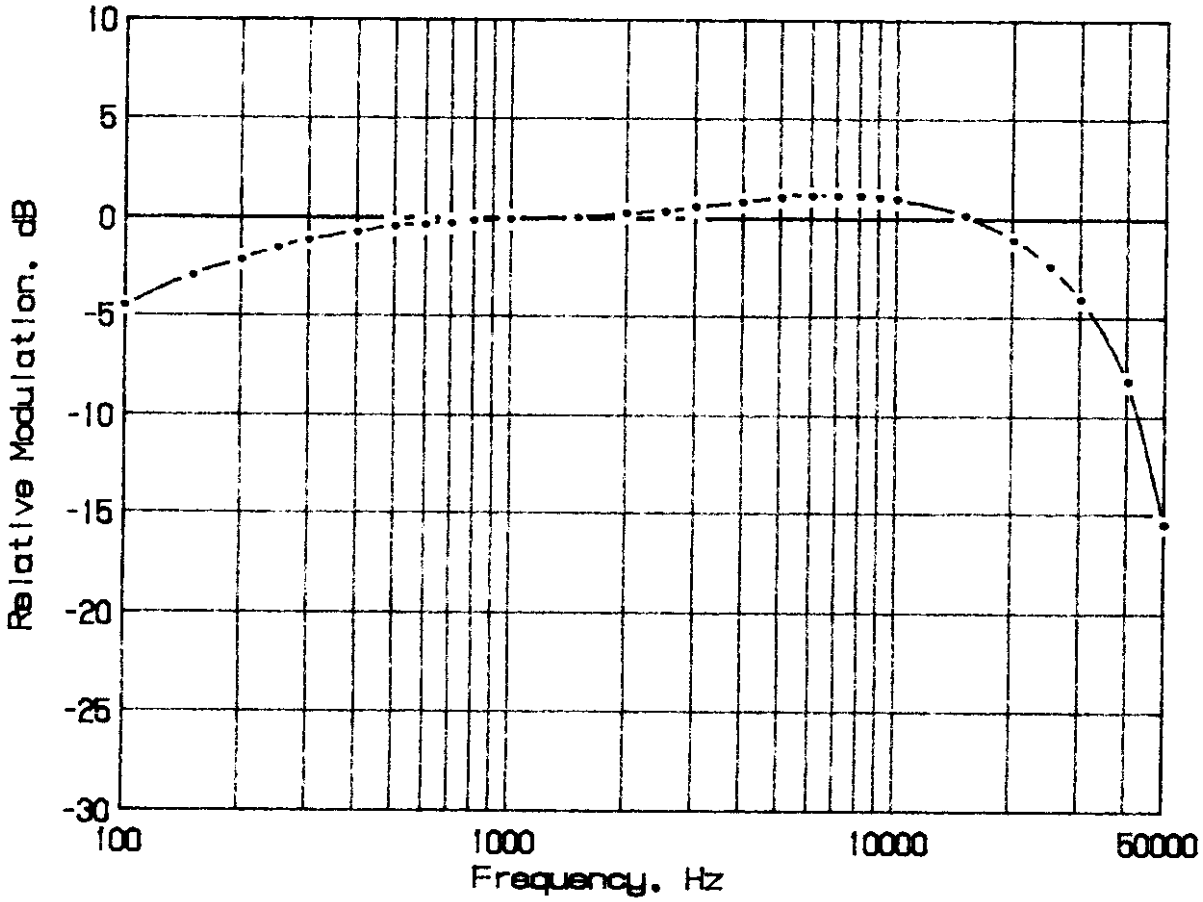
Figure 2 is a plot of the sideband envelope of the transmitter taken with a Tektronix 494P spectrum analyzer. Modulation consisted of a 7569 Hz tone, the frequency of maximum response, at an input level 16 dB greater than that necessary to produce 50% modulation.

Maximum measured modulation was 20 kHz.

NOTE: As a wireless microphone, audio bandwidth is 20 kHz, and maximum system deviation is 20 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

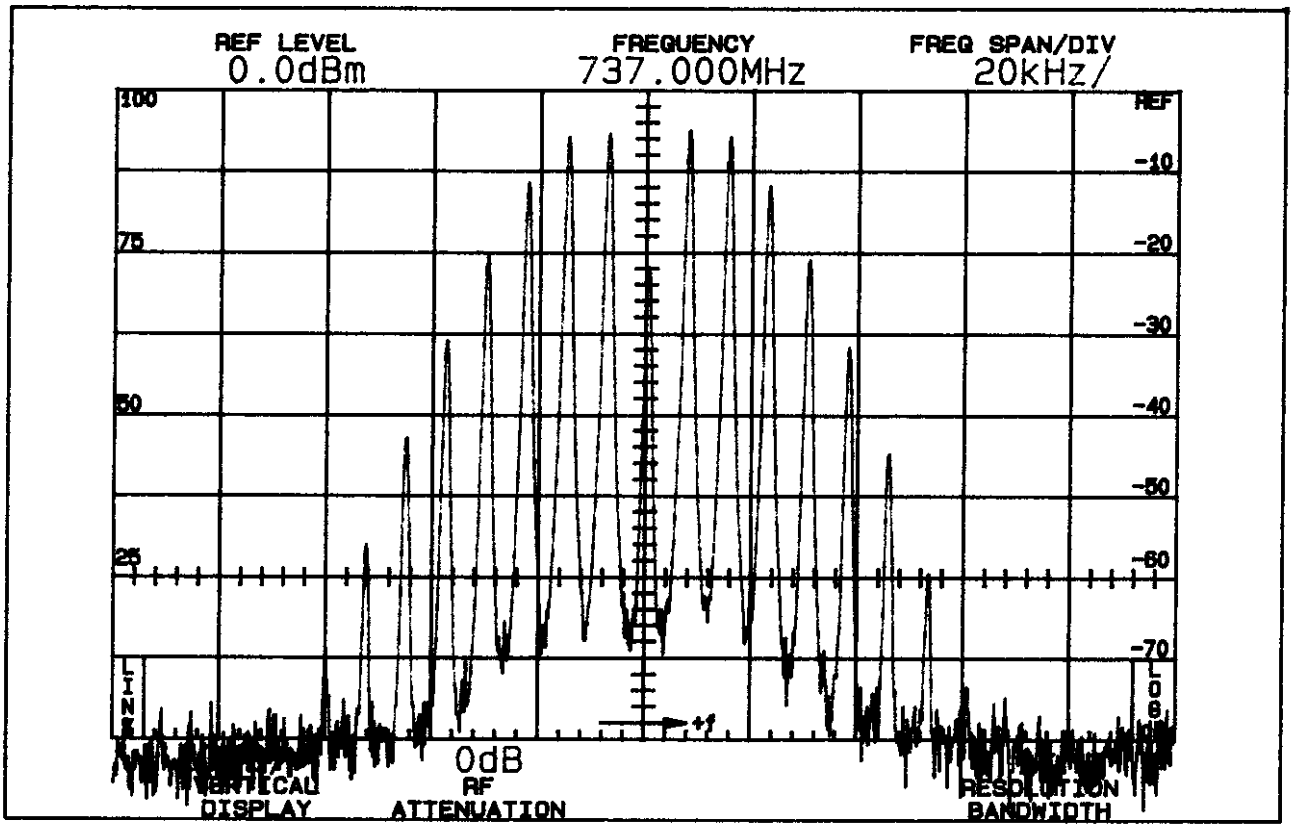


MODULATION FREQUENCY RESPONSE
FCC ID: JFZT52B

FIGURE 1

FIGURE 2

OCCUPIED BANDWIDTH



OCCUPIED BANDWIDTH
FCC ID: JFZT52B

FIGURE 2

C. MODULATION CHARACTERISTICS (Continued)

The plots are within the limits imposed by paragraph 74.861(6). The horizontal scale (frequency is 20 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-T52 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-T52 were made with a Tektronix 494P spectrum analyzer using Singer DM-105A, Palard CA-L, CA-S and EMCO 3115 calibrated test 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 9.1 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 100 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit, or (F_C/16) 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
737.000 MHz; 9 Vdc; 8.2 mW

Emission Frequency, MHz	Field Intensity uV/m @ 3m	dB Below Carrier Reference[1]
737.000 (Carrier)	211,723	0.0 Ref.
1474.000		36
2210.998		49
2947.996		51
3684.996		56
4421.994		49
5158.994		52
5896.000		64
6633.000		65
7370.000		61
Required: 43+10Log(P) =		20

1. Worst-case polarization.

All other spurious from (F_C/16) MHz to the tenth harmonic were 20 dB or more below limit.

$P = (F.I. \times 3)^2/49.2$

$= 8.2$ mW

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 737.000 MHz.

TABLE 2

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE

737.000 MHz; 9 Vdc; 8.2 mW

Temperature, °C	Output Frequency, MHz	p.p.m.
-29.2	736.998361	-2.2
-19.5	737.002350	3.2
-10.1	737.004271	5.8
0.5	737.004516	6.1
10.6	737.003622	4.9
19.9	737.001867	2.5
30.5	736.999756	-0.3
39.7	736.998038	-2.7
50.6	736.996426	-4.8

Maximum frequency error: 737.004516
737.000000

\+ .004516 MHz

FCC Rule 74.861(e)(4) specifies .005% (50 p.p.m.) or a maximum of ±0.036850 MHz, corresponding to:

High Limit	737.036850 MHz
Low Limit	736.963150 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 ^{o}C ambient.

TABLE 3

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE

737.000 MHz; 9 Volt Nominal; 8.2 mW

Supply Voltage	Output Frequency, MHz	p.p.m.
10.35	737.001903	2.6
9.90	737.001807	2.5
9.45	737.001858	2.5
9.00	737.001867	2.5
8.55	737.001844	2.5
8.10	737.001919	2.6
7.65	737.001888	2.6
7.20* rated battery end-point	737.001905	2.6

Maximum frequency error: 737.001919
737.000000

\+ 0.001919 MHz

FCC Rule 74.861(e)(4) specified .005% (50 p.p.m.) or a maximum of ±0.036850 MHz, corresponding to:

High Limit	737.036850 MHz
Low Limit	736.963150 MHz

APPENDIX 3

ACTIVE SEMICONDUCTOR FUNCTIONS

Reference	Type	Function
Q7	2SC3606	Final RF Amplifier
Q6	2SC3606 (Type H)	Driver
Q5	2SC3606 (Type H)	Quadrupler
Q4	2SC3606 (Type H)	Quadrupler
Q3	2SC2714	XTAL Oscillator
IC1	NJM2068	Audio Amplifier/Processor
IC2	NE571D	Compandor/Pre-emphasis