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FCC PART 90.265 and RSS-123(i3)
LOW POWER LICENSED
WIRELESS MICROPHONE TRANSMITTER

APPLICANT	AUDIO-TECHNICA CORPORATION
ADDRESS	2-46-1 Nishi-Naruse Machida Tokyo 194-8666 JAPAN
FCC ID	JFZT901A
IC	1752B-T901A
MODEL NUMBER	ATW-T901a
PRODUCT DESCRIPTION	BELTPACK WIRELESS MICROPHONE
DATE SAMPLE RECEIVED	8/23/2017
DATE TESTED	08/29/2017
TESTED BY	FRANKLIN ROSE
APPROVED BY	Sid Sanders
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

Report Number	Version Number	Description	Issue Date
1543AUT17TestReport	Rev1	Initial Issue	8/31/2017
1543AUT17TestReport	Rev2	Clerical Updates. Test result added to Audio Response section.	9/12/2017

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- ☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Tested by:



Name and Title: Franklin Rose, Project Manager/Testing Technician

Date: 08/30/2017

Reviewed and approved by:

Name and Title: Sid Sanders



Date: 5 Sept. 2017

Applicant: AUDIO-TECHNICA CORPORATION
FCC ID: JFZT901A
IC: 1752B-T901A
REPORT: 1543AUT17TestReport_Rev1

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GENERAL INFORMATION

EUT Description	BELTPACK WIRELESS MICROPHONE
FCC ID	JFZT901A
IC	1752B-T901A
Model Number	ATW-T901a
Operating Frequency	169.505 – 171.905 MHz
Test Frequencies	169.505 MHz, 171.905 MHz
Modulation	FM
EUT Power Source	<input type="checkbox"/> 110–120Vac/50– 60Hz
	<input type="checkbox"/> DC Power 12V
	<input checked="" type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input checked="" type="checkbox"/> Pre-Production
	<input type="checkbox"/> Production
Type of Equipment	<input type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input checked="" type="checkbox"/> Portable
Test Conditions	The temperature was 26°C with a relative humidity of 50%. Atmospheric pressure 1010 mb.
Revision History to the EUT	None
Test Exercise	The EUT was powered on and modulated with the appropriate signal.
Applicable Standards	FCC CFR 47 Part 2, & 90, IC RSS-123(i3), RSS-GEN ANSI/TIA 603-E: 2016 ANSI C63.4 2014
Test Facility	Timco Engineering Inc. 849 NW State Road 45 Newberry, FL 32669 USA.

RESULTS SUMMARY

FCC Rule Part	IC Standard	Requirement	Test Item	Result
2.1046(a), 90.265(b)(2)	RSS-GEN, RSS-123 4.1, 4.6.2	Conducted Power	RF Power Output	PASS
2.1047(a)	RSS-123 4.6.2	Modulation Characteristics	Audio Frequency Response	PASS
2.1047(b)	n/a	Modulation Characteristics	Modulation Limiting	PASS
2.1049(c), 90.265(b)(1)	RSS-GEN, RSS-123 4.1, 4.2	Operating Bandwidth	Occupied Bandwidth	PASS
2.1051, 90.210(b)(3)	RSS-123, 4.4	Unwanted Emissions	Spurious Emissions at Antenna Terminals	PASS
2.1053(a), 90.265(b)(1)	RSS-123, 4.4	Unwanted Emissions	Field Strength of Spurious Emissions	PASS
90.214	n/a	Transient Frequency Behavior	Transient Frequency Behavior	n/a ¹
2.1055(a),(b), 90.265(b)(3)	RSS-GEN, RSS-123 4.1, 4.3	Frequency Tolerance	Frequency Stability	PASS

NOTES:

1. Transient Frequency Behavior does not pertain to this device for the following reason(s):
The EUT exhibits transmissions immediately when powered-on, continuously without interruption at 100% duty cycle until powered-off. In addition the EUT has no "push-to-talk" feature.

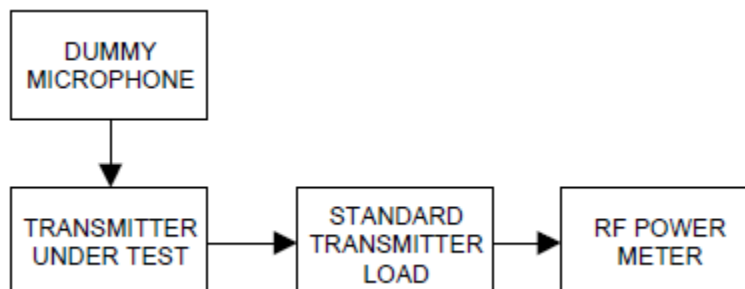
RF POWER OUTPUT

Rule Part No.: Part 2.1046(a), Part 90.265(b)(2), RSS-123 Issue 3

Method of Measurement: TIA 603 E, Section 2.2.1

Requirement: The output power shall not exceed 50 milliwatts.

Test Setup Diagram:



Test Data:

RF Output Power –Peak Conducted		
Channel	Power (dBm)	Power (mW)
Channel 1: 169.505	9.84	9.6 mW
Channel 2: 171.905	9.25	8.4 mW

Part 2.1033 (C)(8) - DC Input into the final amplifier

INPUT POWER: $(3.0\text{ V})(0.16\text{ A}) = 480\text{ mW}$

MODULATION CHARACTERISTICS

Rule Part No.: Part 2.1049, 90.265(b)(1), RSS 123(4.1)

Requirement: Per FCC 90.265(b)(1): On center frequencies 169.475 MHz, 170.275 MHz, 171.075 MHz, and 171.875 MHz, the emission bandwidth shall not exceed 200 kHz. On the other center frequencies listed in this paragraph (b), the emission bandwidth shall not exceed 54 kHz.

Additionally, Per RSS 123(4.1), Table 1: Frequency Band 150-174 MHz Authorized Bandwidth is 54 kHz.

Test data:

$$B_n = 2M + 2DK$$

$$M = 3000$$

$$D = 9.0 \text{ kHz (Peak Deviation)}$$

$$K = 1$$

$$B_n = 2(3000) + 2(9000) (1) = \mathbf{24.0 \text{ K}}$$

Please refer to the following plots.

AUDIO FREQUENCY RESPONSE

Rule Part No.: Part 2.1047(a), RSS-123(4.6.2)

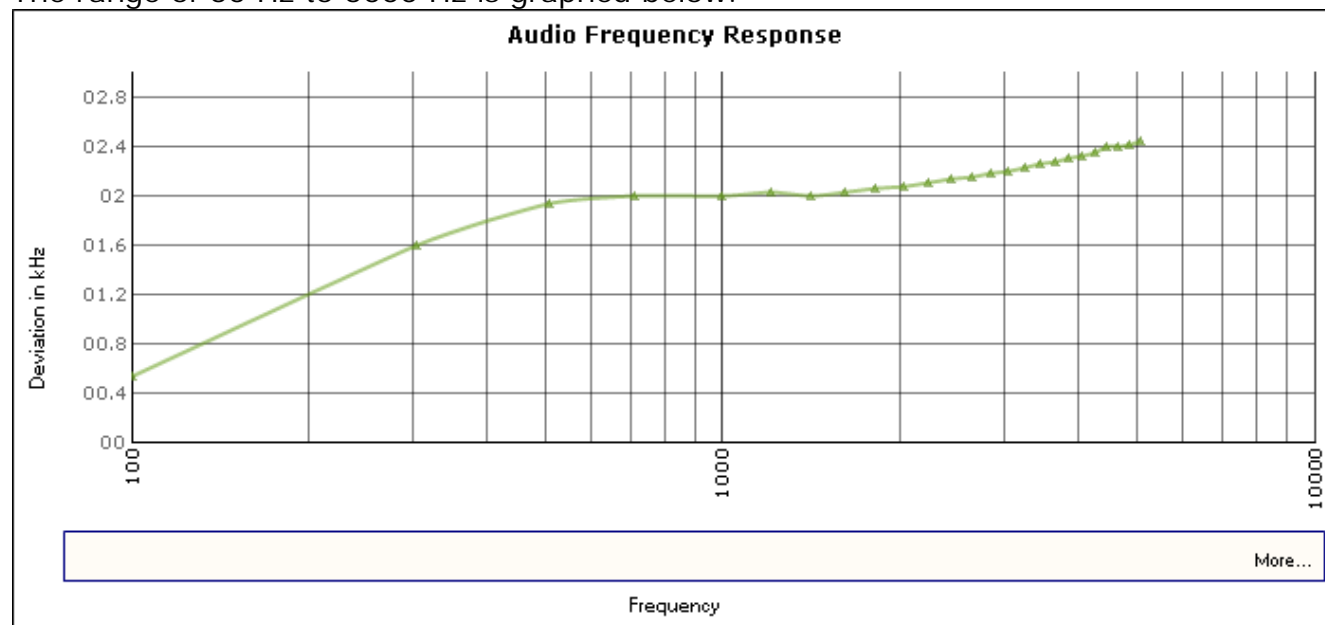
Method of Measurement: TIA 603-E, Section 2.2.6

Test data:

The following plots show both the Audio Frequency Response and Low Pass Filter Response of the EUT. Due to software limitation, compliance below 100 Hz is stated numerically.

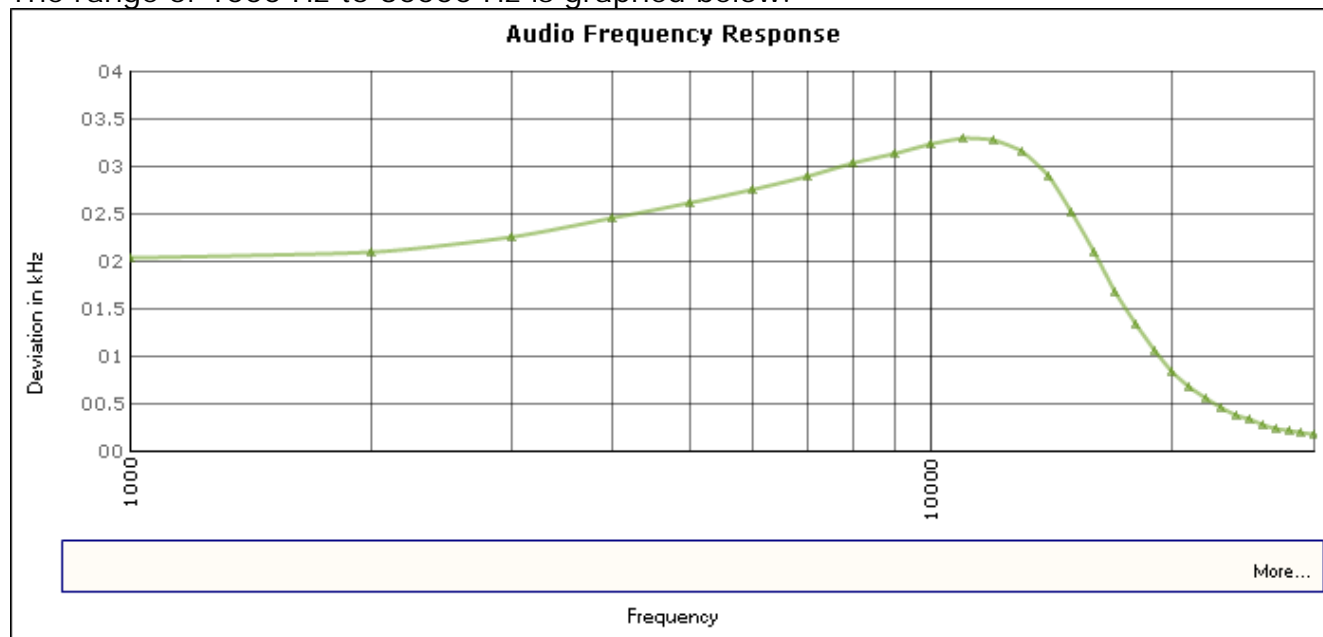
At **50 Hz**, response was **0.48 kHz**.

The range of 50 Hz to 5000 Hz is graphed below:



AUDIO FREQUENCY RESPONSE, Con't

The range of 1000 Hz to 30000 Hz is graphed below:



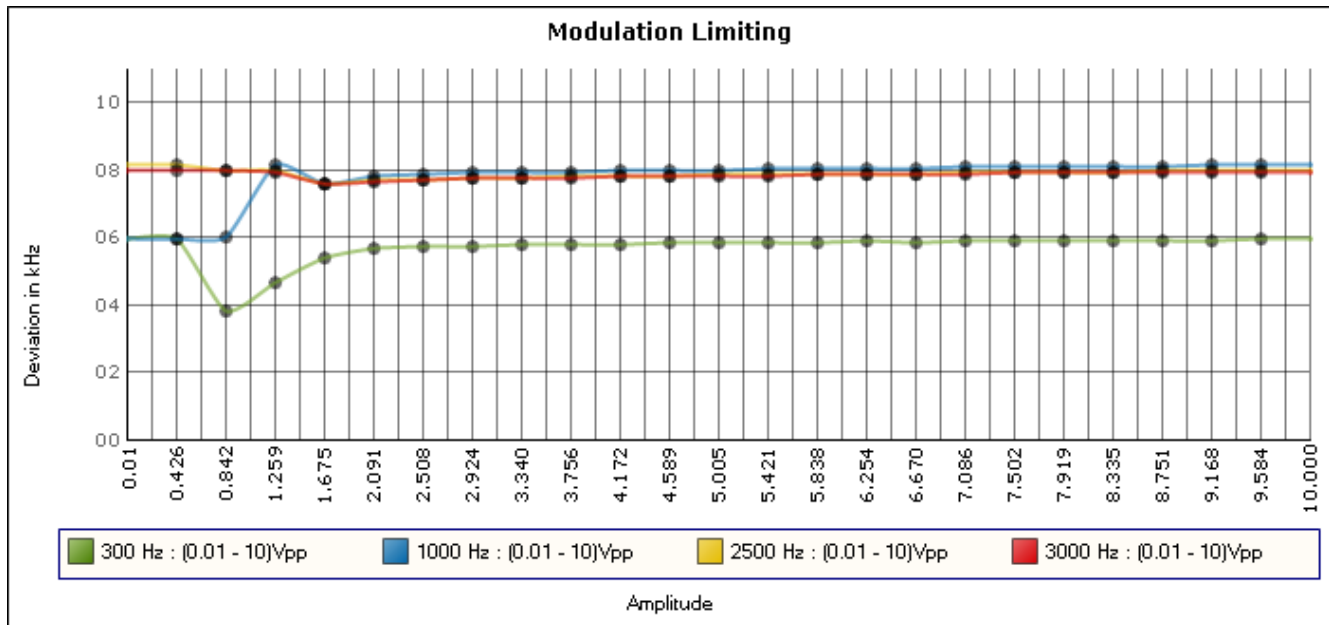
Result: Meets all Requirements

MODULATION LIMITING

Rule Part No.: Part 2.1047(b), RSS-123

Method of Measurement: TIA 603-E, Section 2.2.3

Test data:



Applicant: AUDIO-TECHNICA CORPORATION
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OCCUPIED BANDWIDTH

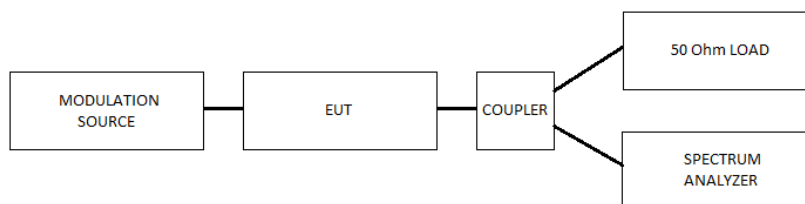
Rule Part No.: Part 2.1049, 90.210(b), 90.265(b)(1), RSS-123(4.1), RSS-123(4.4)

Test Requirements: Per FCC 90.265(b)(1): On center frequencies 169.475 MHz, 170.275 MHz, 171.075 MHz, and 171.875 MHz, the emission bandwidth shall not exceed 200 kHz. On the other center frequencies listed in this paragraph (b), the emission bandwidth shall not exceed 54 kHz.

Additionally, Per RSS 123(4.1), Table 1: Frequency Band 150-174 MHz Authorized Bandwidth is 54 kHz.

Method of Measurement: TIA 603-E, Section 2.2.12

Test Setup:

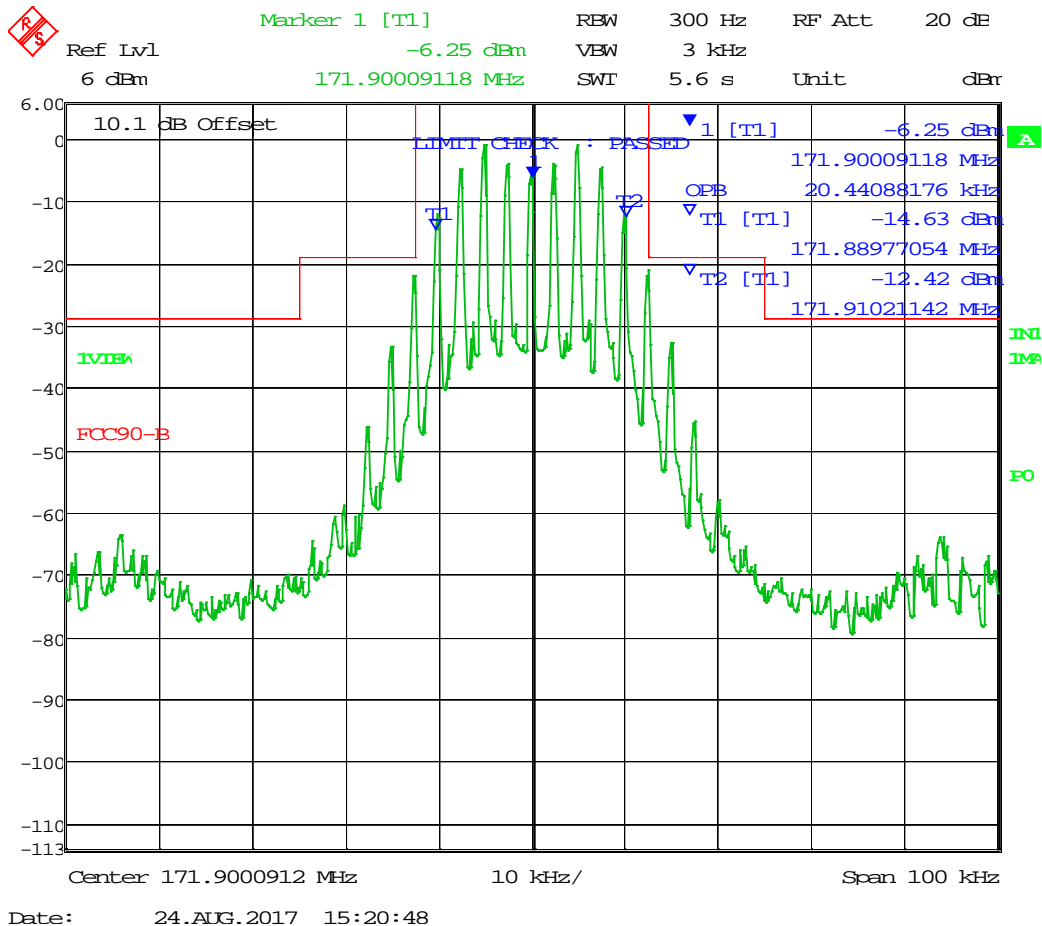


OCCUPIED BANDWIDTH

Test data:

MASK B

99% OCCUPIED BANDWIDTH = 20.44 kHz



Result: Meets all Requirements

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SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051, 90.210(b)(3), RSS-123(4.4)

Test Requirements: Per FCC 90.210(b)(3): On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log(P)$ dB, where P = Power, in Watts.

Per RSS 123(4.4): At least $55 + 10 \log_{10}(p_{\text{MEAN}}$ in watts) dB: on any frequency removed from the operating frequency by more than 250% of the authorized bandwidth.

For this test, compliance was demonstrated using the more strict of the two limits: $55 + 10\log(P)$.

Method of Measurement: TIA 603-E, Section 2.2.13

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Test Data: CH 1, 169.505 MHz

Power Output	dBm	Watts	Limit (dBc)
	9.25	0.01	22.25
Frequency	dBc	Margin	
169.505	0.00	0.00	
339.010	56.21	43.21	
508.515	84.41	71.41	
678.020	89.88	76.88	
847.525	90.18	77.18	
1017.030	86.25	73.25	
1186.535	91.40	78.40	
1356.040	91.73	78.73	
1525.545	87.12	74.12	
1695.050	83.41	70.41	

Test Data: CH 4, 171.905 MHz

Power Output	dBm	Watts	Limit (dBc)
	9.84	0.01	22.84
Frequency	dBc	Margin	
171.905	0.00	0.00	
343.810	55.34	42.34	
515.715	68.90	55.90	
687.620	70.27	57.27	
859.525	78.98	65.98	
1031.430	78.77	65.77	
1203.335	87.89	74.89	
1375.240	88.74	75.74	
1547.145	85.61	72.61	
1719.050	88.84	75.84	

Result: Meets all Requirements

Applicant: AUDIO-TECHNICA CORPORATION
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FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Part No.: Part 2.1053, 90.210(b), RSS-123(4.4)

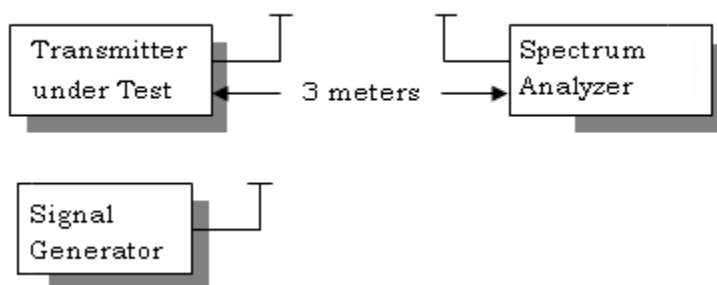
Test Requirements: Per FCC 90.210(b)(3): On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log(P)$ dB, where P = Power, in Watts.

Per RSS 123(4.4): At least $55 + 10 \log_{10}(p_{\text{MEAN}}$ in watts) dB: on any frequency removed from the operating frequency by more than 250% of the authorized bandwidth.

For this test, compliance was demonstrated using the more strict of the two limits: $55 + 10\log(P)$.

Method of Measurement: TIA 603-E, Section 2.2.12

Test Setup:



FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 169.505 MHz

Tuned Freq		169.505 MHz	
Output Power (dBm)		9.84	
Output Power (W)		0.01	
Limit (dBm)		34.82	
Emission Frequency MHz	Antenna Polarity	Field Strength ERP (dBm)	Margin
1695.05	H	-36.40	71.23
1695.05	V	-36.64	71.47
1356.04	H	-36.67	71.50
1356.04	V	-37.35	72.18
1525.55	V	-38.40	73.22
1525.55	H	-38.43	73.25
1186.54	V	-38.48	73.30
1186.54	H	-39.27	74.09
1017.03	V	-40.24	75.07
339.01	H	-40.42	75.24
1017.03	H	-41.45	76.28
847.53	H	-43.14	77.96
847.53	V	-44.67	79.49
678.02	H	-45.51	80.33
678.02	V	-46.91	81.73
339.01	V	-47.88	82.70
508.52	H	-50.12	84.94
508.52	V	-50.85	85.67
184.74	H	-55.23	90.06
184.20	V	-55.39	90.22
64.87	H	-63.91	98.73

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 171.905 MHz

Tuned Freq	171.905 MHz		
Output Power (dBm)	9.25		
Output Power (W)	0.01		
Limit (dBm)	34.66		
Emission Frequency MHz	Antenna Polarity	Field Strength ERP (dBm)	Margin
1719.05	H	-36.23	70.89
1719.05	V	-36.61	71.27
1375.24	V	-37.75	72.41
1375.24	H	-37.84	72.50
1547.15	V	-38.28	72.95
1203.33	H	-38.69	73.35
1547.15	H	-38.77	73.44
1203.33	V	-39.07	73.73
1031.43	H	-41.24	75.90
1031.43	V	-41.34	76.00
343.79	H	-43.43	78.09
859.53	H	-43.79	78.45
859.53	V	-45.32	79.98
687.62	H	-47.32	81.98
687.62	V	-47.92	82.58
343.81	V	-49.25	83.91
515.72	H	-50.86	85.52
515.72	V	-50.89	85.55
160.22	H	-51.82	86.48
140.61	V	-53.84	88.50
124.26	H	-57.43	92.09
79.86	V	-61.38	96.04

Result: Meets all Requirements

TRANSIENT FREQUENCY BEHAVIOR

Rule Part No.: Part 90.214

Test Requirements: Transmitters must maintain transient frequencies within the maximum frequency difference limits during the time intervals below:

Time intervals ^{1 2}	Maximum frequency difference ³	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t ₁ ⁴	±25.0 kHz	5.0 ms	10.0 ms
t ₂	±12.5 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t ₁ ⁴	±12.5 kHz	5.0 ms	10.0 ms
t ₂	±6.25 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t ₁ ⁴	±6.25 kHz	5.0 ms	10.0 ms
t ₂	±3.125 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±6.25 kHz	5.0 ms	10.0 ms

¹ t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t_1 is the time period immediately following t_{on} .

t_2 is the time period immediately following t_1 .

t_3 is the time period from the instant when the transmitter is turned off until t_{off} .

t_{off} is the instant when the 1 kHz test signal starts to rise.

² During the time from the end of t_2 to the beginning of t_3 , the frequency difference must not exceed the limits specified in §90.213.

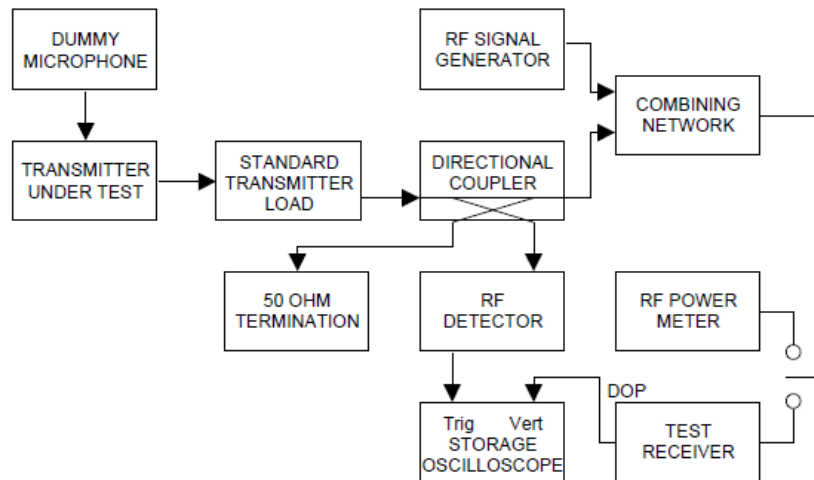
³ Difference between the actual transmitter frequency and the assigned transmitter frequency.

⁴ If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

Method of Measurement: TIA 603-E, Section 2.2.19

TRANSIENT FREQUENCY BEHAVIOR

Test Setup:



Test Data:

The EUT begins transmitting when powered-on, and continues to transmit at 100% duty cycle until powered-off. The EUT does not have a “push-to-talk” feature and is not able to be assessed for Transient Frequency Behavior.

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 90.265(b)(3), RSS-123(4.3)

Requirements: Temperature and voltage tests were performed to verify that the total emissions stay within ± 32.5 kHz of the assigned frequency. For RSS 123, Table 1 specifies the emissions shall stay within ± 50 ppm.

Method of Measurements: ANSI C63.10, Section 6.8

Test Data:

Reference Frequency (Hz)	169500010
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Temperature (°C)	Frequency (MHz)	Deviation (kHz)	PPM
-30°C	169496410	3.60	21.239
-20°C	169498810	1.20	7.080
-10°C	169500300	-0.29	-1.711
0°C	169500830	-0.82	-4.838
10°C	169500740	-0.73	-4.307
20°C	169500340	-0.33	-1.947
30°C	169499770	0.24	1.416
40°C	169499160	0.85	5.015
50°C	169498870	1.14	6.726

Voltage	Frequency (MHz)	Deviation (kHz)	PPM
2.55	169499930	0.08	0.472
3.00	169500010	0.00	0.000
3.45	169499940	0.07	0.413

Result: Meets all Requirements

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4 or ENTR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: “Uncertainty in EMC Measurements” and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	Notes
RF Frequency Accuracy	± 49.5 Hz	(1)
RF Conducted Power	± 0.93 dB	(1)
Conducted spurious emission of transmitter valid up to 40GHz	± 1.86 dB	
Occupied Bandwidth	$\pm 2.65\%$	
Audio Frequency Response	± 1.86 dB	
Modulation limiting	$\pm 1.88\%$	
Radiated RF Power	± 1.4 dB	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. Within 6kHz and 25kHz of audio Freq.	$\pm 1.88\%$ $\pm 2.04\%$	
Rad Emissions Sub. Method up to 26.5GHz	± 2.14 dB	
Temperature	$\pm 1.0^{\circ}\text{C}$	(1)
Humidity	$\pm 5.0\%$	

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
Digital Multimeter	Fluke	FLUKE-77-3	79510405	10/21/15	10/21/17
Frequency Counter	HP	5385A	2730A03025	10/21/15	10/21/17
CHAMBER	Panashield	3M	N/A	04/25/16	12/31/17
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/16/16	08/16/18
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Type KJ Thermometer	Martel	303	08054494	10/26/15	10/26/17
Modulation Analyzer	HP	8901A	3050A05856	04/13/17	04/13/19
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax	Chamber 3 cable set (Primary)	KMKM-0244-01; KMKM-0670-00; KFKF-0198-01	08/09/16	08/09/18
Function Generator	Standford	DS340	25200	02/02/16	02/02/18
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Tunable Notch Filter 54-210 MHz	Eagle	210BFBF	54-210MHz (#42)	09/17/15	09/17/17
Signal Generator HP 8648C	HP	8648C	3847A04696	04/05/17	04/05/19
Coaxial Cable – BMBM-0060-00 Black	Alpha Wire		BMBM-0060-00	06/08/16	06/08/18
Coaxial Cable – BMBM-0031-00 Black	Pasternack		BMBM-0031-00	02/17/17	02/17/19
DC Power Supply	Sky TPOWER	STP6005	n/a	n/a	n/a

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT

Applicant: AUDIO-TECHNICA CORPORATION
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