849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA

PHONE: 352.472.5500
EMAIL: INFO@TIMCOENGR.COM
WEB: HTTP://WWW.TIMCOENGR.COM

TIMCO ENGINEERING, Inc.

An IIA Company

FCC Part 15.236 Test Report

APPLICANT	AUDIO-TECHNICA CORPORATION
	2-46-1 Nishi-Naruse, Machida Tokyo 194-8666 JAPAN
FCC ID	JFZT220BI
MODEL NUMBER	ATW-T220bI
PRODUCT DESCRIPTION	HANDHELD WIRELESS MICROPHONE
DATE SAMPLE RECEIVED	1/3/2020
DATE TESTED	1/21/2020
TESTED BY	Tim Royer
APPROVED BY	Franklin Rose
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Report Version	Description	Issue Date
31BUT20_PT15_TestReport	----	Initial Issue	2/17/2020
	Rev1	Clerical updates	5/27/2020

TABLE OF CONTENTS

GENERAL REMARKS

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
Designation #: US1070

Tested by:

Name and Title	Tim Royer, Project Manager / EMC Testing Engineer
Date	2/17/2020

Reviewed and Approved by:

Name and Title	Franklin Rose, Project Manager / EMC Testing Technician
Date	2/17/2020

GENERAL INFORMATION

EUT Description	BODY-PACK WIRELESS MICROPHONE TRANSMITTER
FCC ID	JFZT220BI
Model Number	ATW-T220bI
Operating Frequency	487.125 – 506.500 MHz
Test Frequencies	487.130, 494.380, 506.500
EUT Power Source	☐ 110–120Vac/50– 60Hz
	☐ DC Power
	☒ Battery Operated Exclusively
Test Item	☐ Prototype
	☐ Pre-Production
	☒ Production
Type of Equipment	☐ Fixed
	☐ Mobile
	☒ Portable
Antenna Connector	BNC
Test Conditions	The temperature was 26ºC Relative humidity of 50%.
Modification to the EUT	No Modification to EUT.
Test Exercise	The EUT was placed in continuous transmit and was operated in "Test Mode" for digital emissions tests.
Applicable Standards	FCC CFR 47 Part 2, & 15, KDB 206256 D01 v02, ANSI C63.10-2013, ANSI C63.4 2014**,** ANSI C63.26 2015
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070

RESULTS SUMMARY

FCC Rule Part	Requirement	Test Item	Result
PART 2.1046(a), 15.236(d)(1)	Conducted Power	RF Power Output	**PASS**
PART 15.236(g), ETSI EN 300-422-1 s. 8.3.2	Unwanted Emissions	Emission Mask	**PASS**

Note: The EUT is only marketed and sold to "Professional Users" and Part 74 frequencies are also selectable in device. For more details, see companion report:

"31AUT20_PT74_TestReport_Rev1"

RF POWER OUTPUT

Rule Part No.: PART 2.1046(a), 15.236(d)(1)

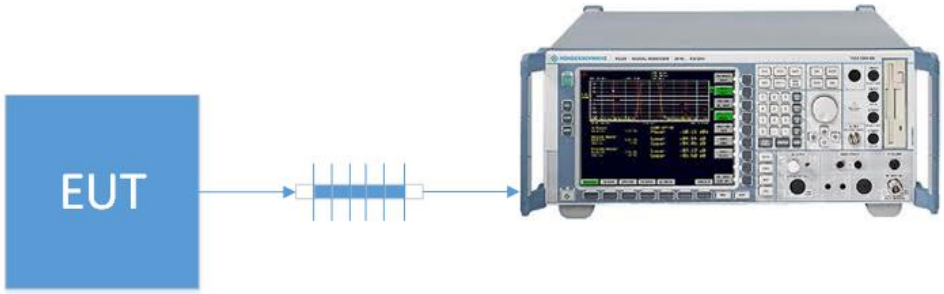
Requirement:

§15.236 Operation of wireless microphones in the bands 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz.

(d) The maximum radiated power shall not exceed the following values:

(1) In the bands allocated and assigned for broadcast television and in the 600 MHz service band: 50 mW EIRP

Setup Diagram:



Test Data: Mean Output Measurement Table, 600 MHz Guard Band & Duplex Gap

Tuned Freq. MHz	Power Output		
	EIRP (dBm)	EIRP (mW)	Margin (mW)
487.1300	16.75	47.3	2.7
494.3800	16.83	48.2	1.8
506.5000	16.71	46.9	3.1

Frequency Selection

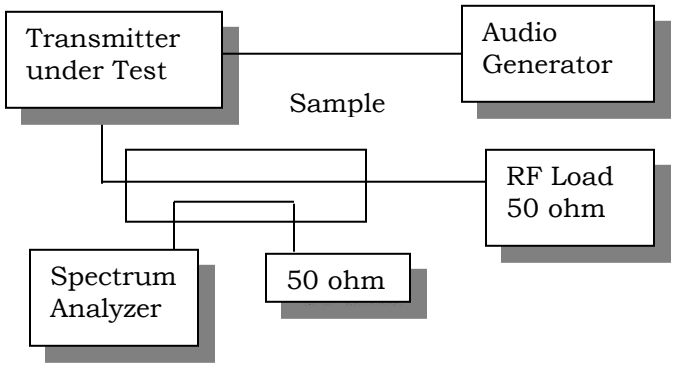
Rule Part No.: 15.236 (f) (1)

Test Requirements:

(1) The frequency selection shall be offset from the upper or lower band limits by 25 kHz or an integral multiple thereof.

Method of Measurement: For a device that has a permanently attached antenna, RF power is measured radiated. With a nominal battery voltage, and the transmitter properly adjusted, the ,RF output measures:

Test Setup Diagram:



Test Data:

Frequency Range

Low Frequency	487.13	MHz
High Frequency	506.5	MHz

Result: Meets Requirements

OCCUPIED BANDWIDTH

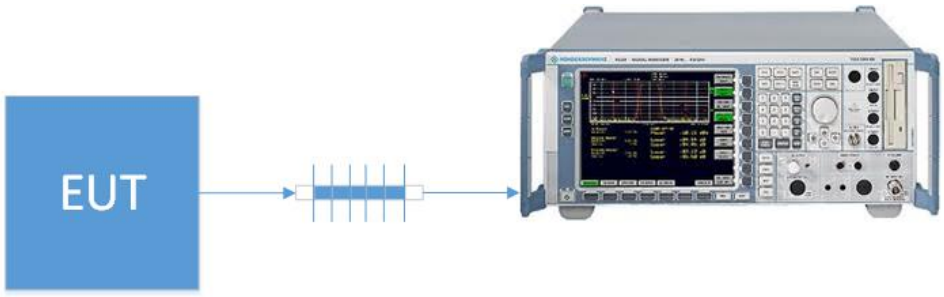
Rules Part No.: FCC Part 15.236 (f) (2)

Requirements:

(2) One or more adjacent 25 kHz segments within the assignable frequencies may be combined to form a channel whose maximum bandwidth shall not exceed 200 kHz. The operating bandwidth shall not exceed 200 kHz.

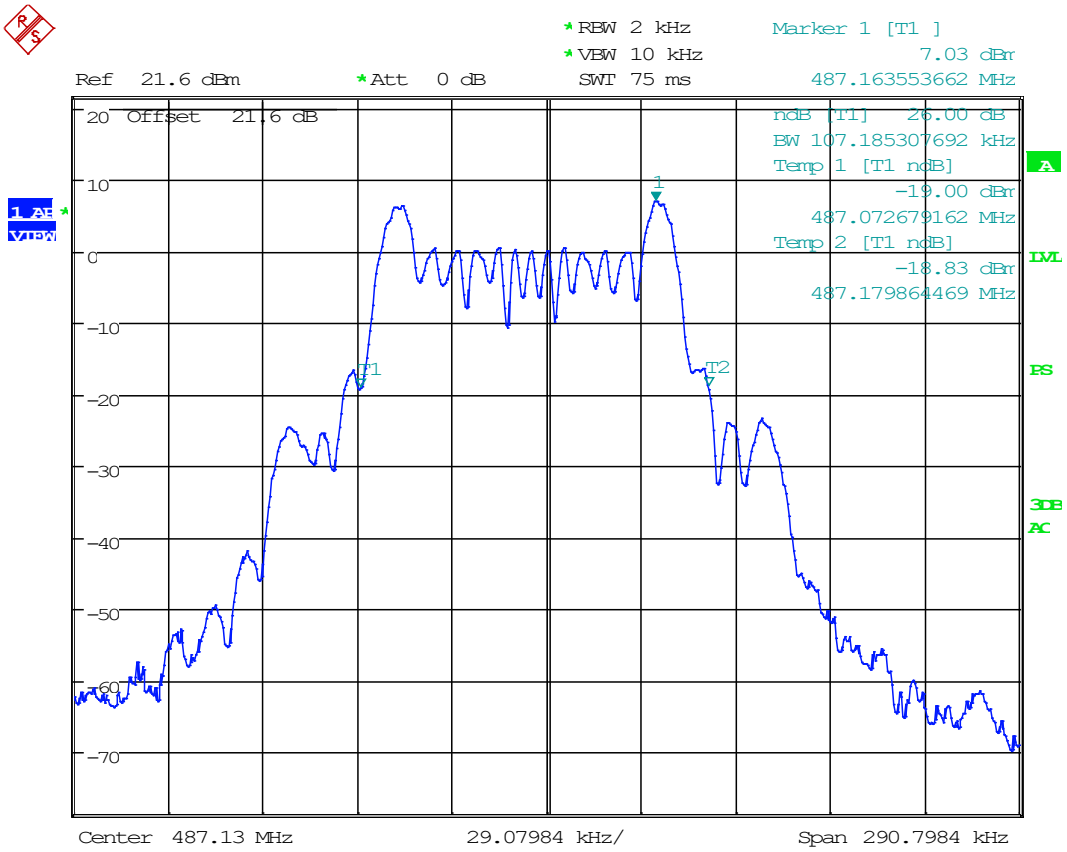
Measurement Procedure: ANSI C63.26 sec. 5.4.3

Test Setup Diagram:



OCCUPIED BANDWIDTH (26 dB)

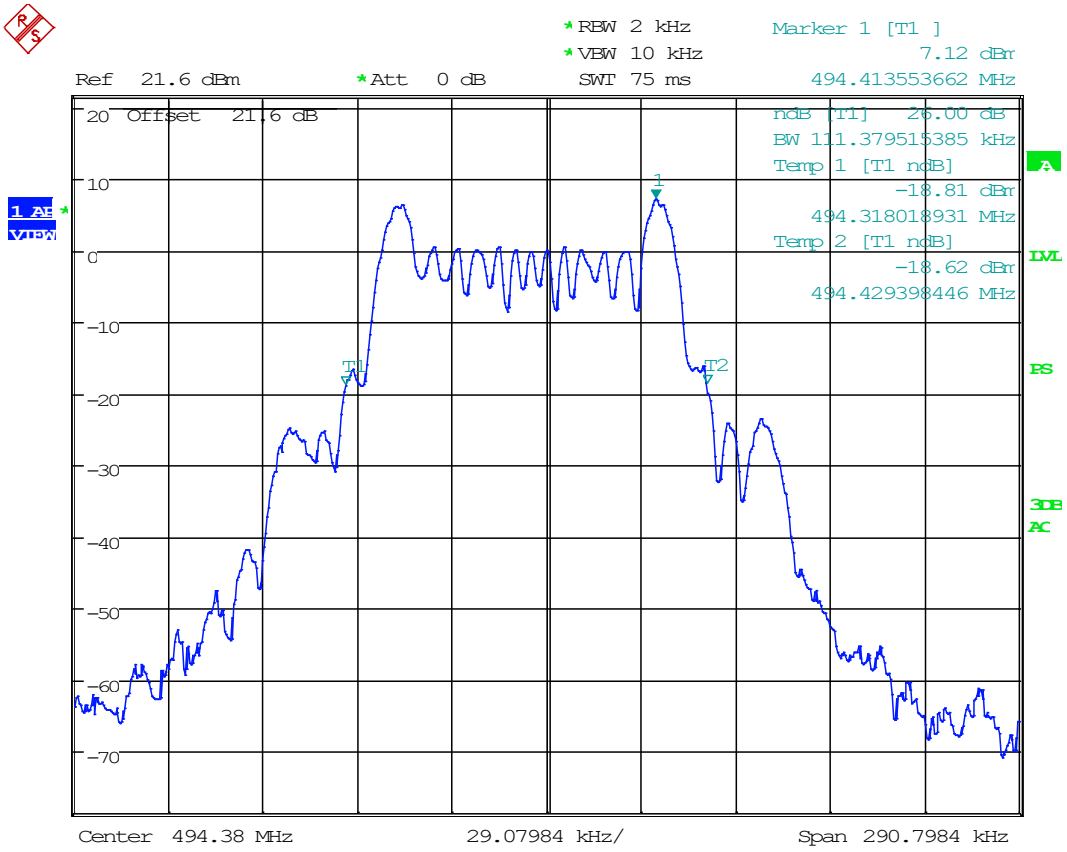
Test Data: 487.13 MHz



Date: 14.FEB.2020 11:20:03

OCCUPIED BANDWIDTH PLOT (26 dB)

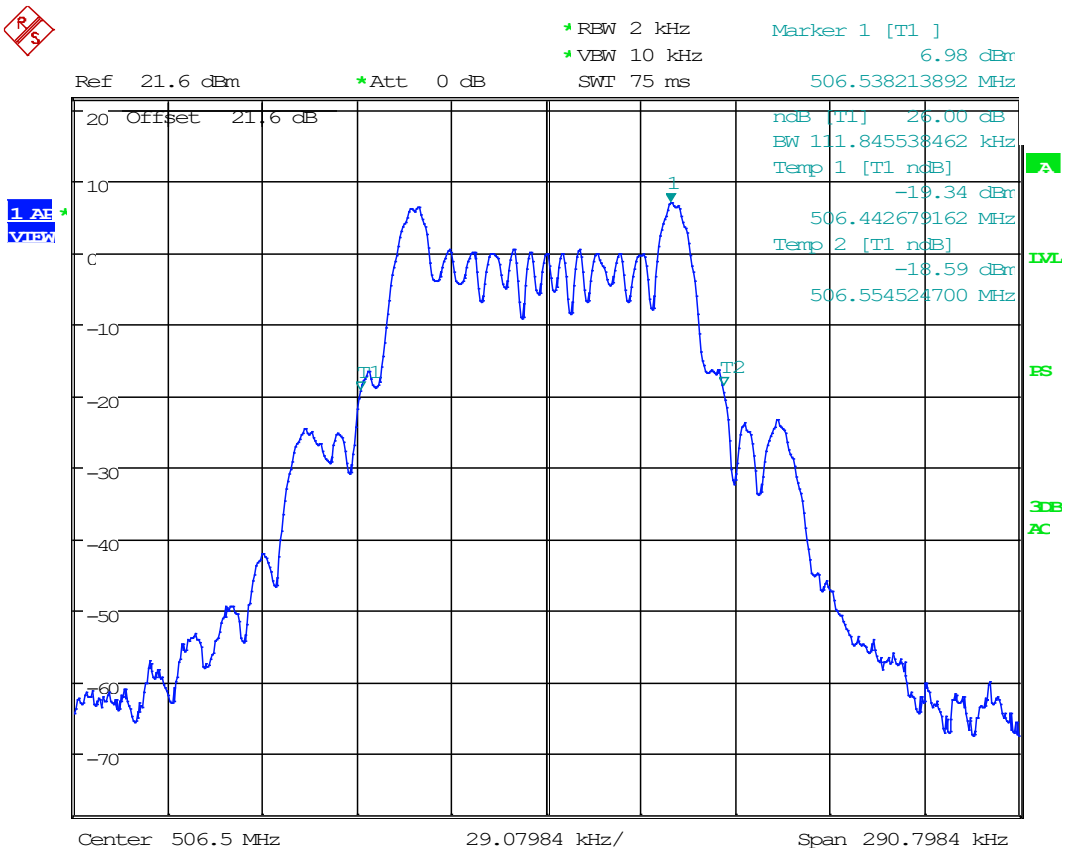
Test Data: 494.38 MHz



Date: 14.FEB.2020 11:20:38

OCCUPIED BANDWIDTH PLOT (26 dB)

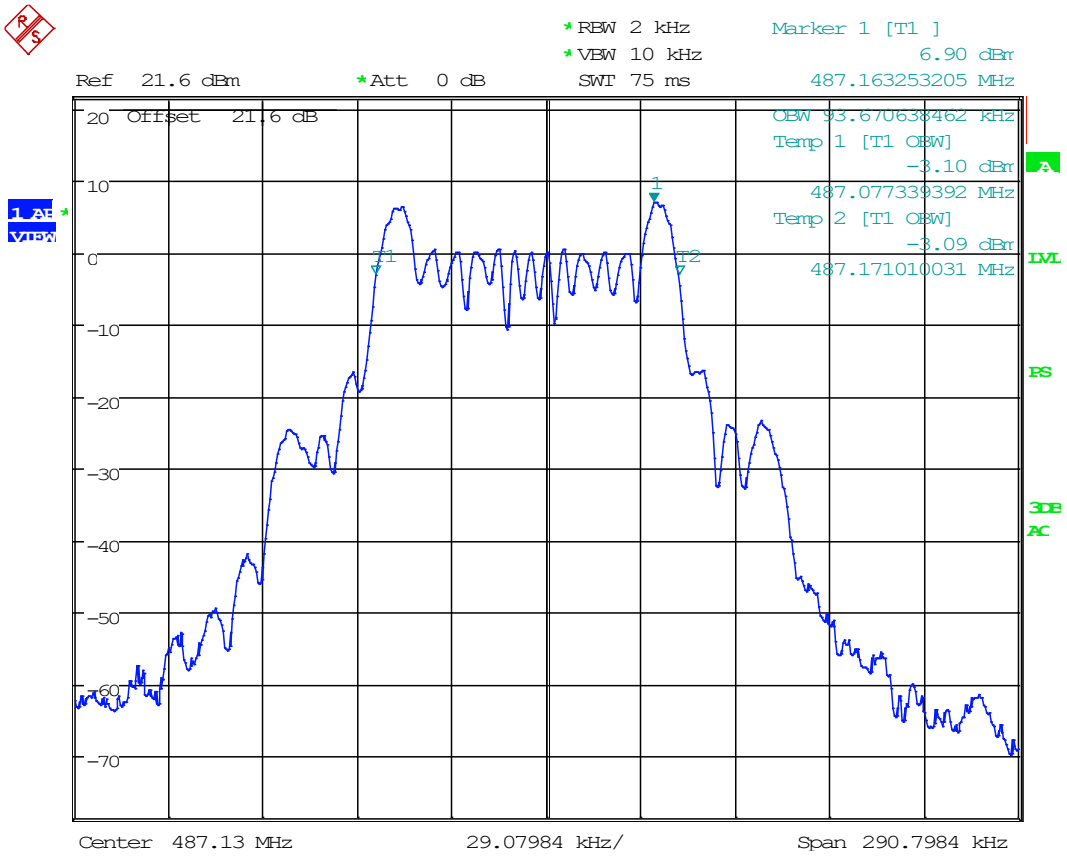
Test Data: 506.5 MHz



Date: 14.FEB.2020 11:22:15

OCCUPIED BANDWIDTH

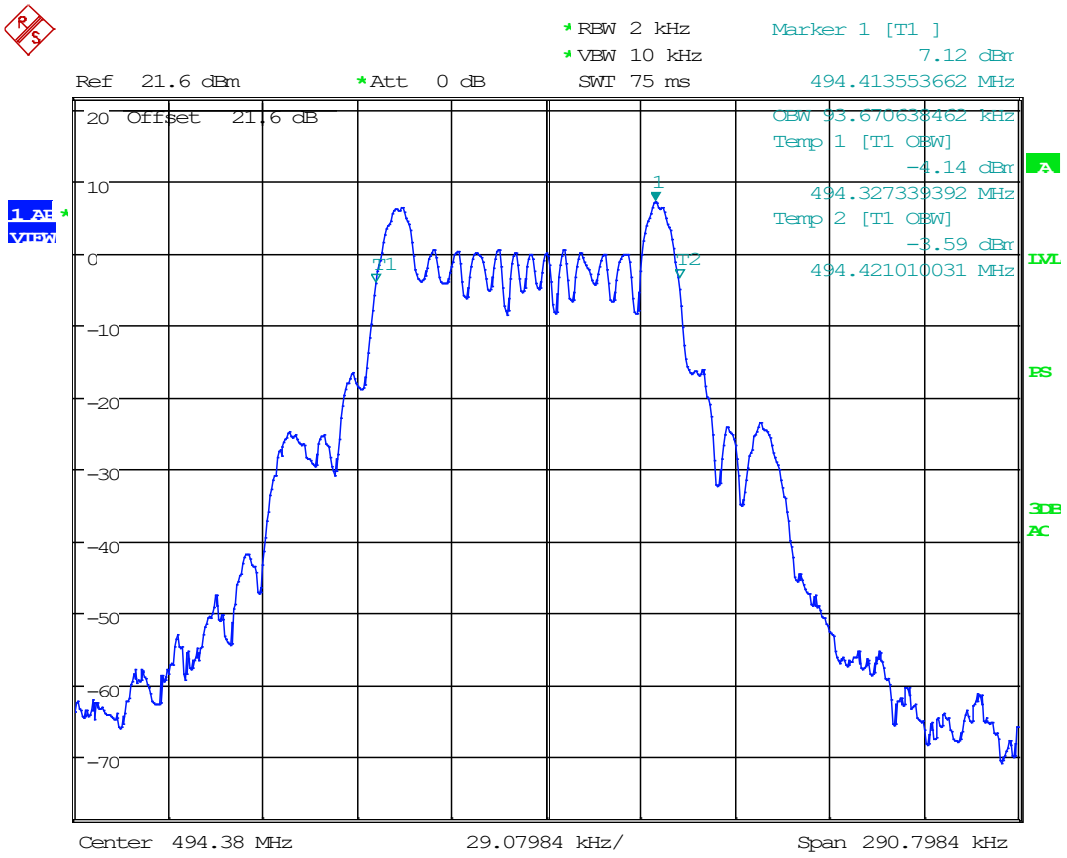
Test Data: 487.13 MHz 99% OBW Plot



Date: 14.FEB.2020 11:19:29

OCCUPIED BANDWIDTH

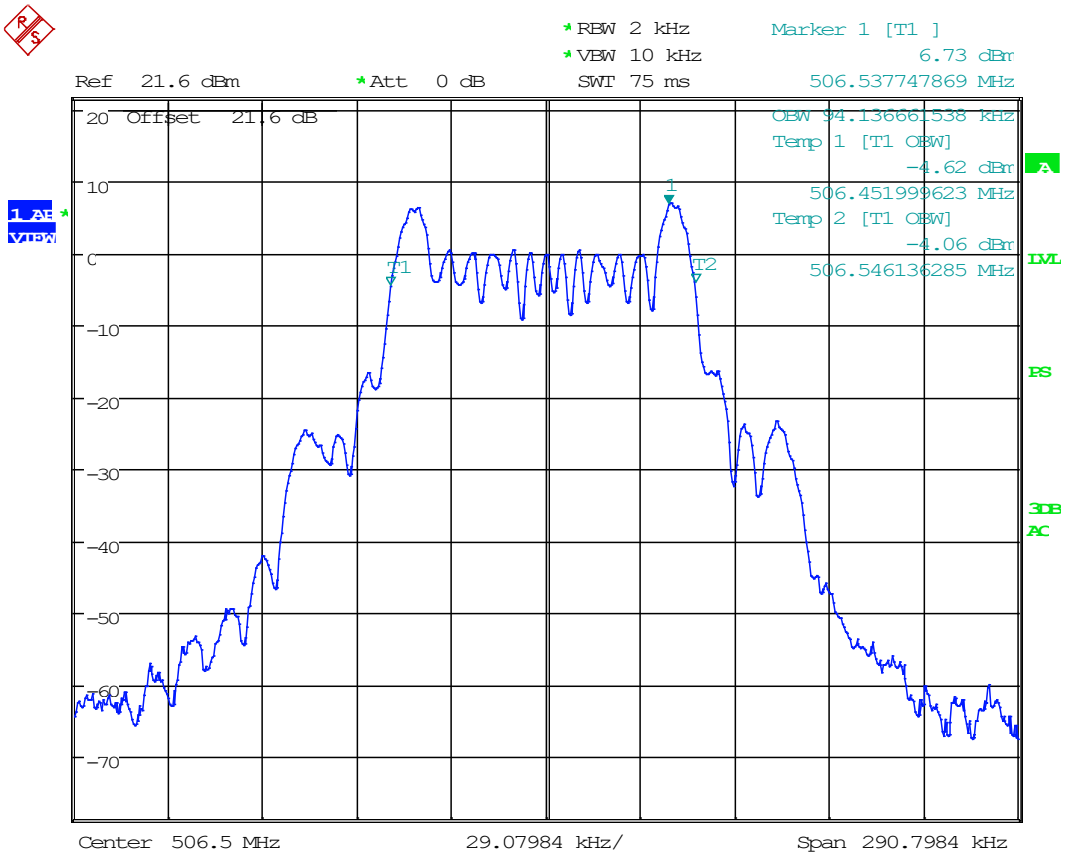
Test Data: 494.38 MHz 99% OBW Plot



Date: 14.FEB.2020 11:21:00

OCCUPIED BANDWIDTH

Test Data: 506. 5 MHz 99% OBW Plot



Date: 14.FEB.2020 11:21:56

EMISSION MASK

Rule Part No.: FCC CFR 47 PART 15.236(g)

(g) Emissions within the band from one megahertz below to one megahertz above the carrier frequency shall comply with the emission mask in §8.3 of ETSI EN 300 422-1 V1.4.2 (2011-08), *Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement.* Emissions outside of this band shall comply with the limits specified in section 8.4 of ETSI EN 300 422-1 V1.4.2 (2011-08).

Requirement: ETSI EN 300 422-1 Section 8.3.2

(c) Compliance for emission mask and spurious emission requirements shall be demonstrated using the applicable measurement procedures of ETSI EN 300 422-1. Compliance with the emission limits shall be demonstrated using a RMS Average detector. Emissions shall be investigated up to the 10th harmonic of the fundamental. All other technical requirements shall be demonstrated utilizing the procedures specified in ANSI C63.26,[4] as applicable.

EMISSION MASK

8.3.2.2 Limits

The transmitter output spectrum shall be within the mask defined in figure 4. This mask may also be used for analogue.

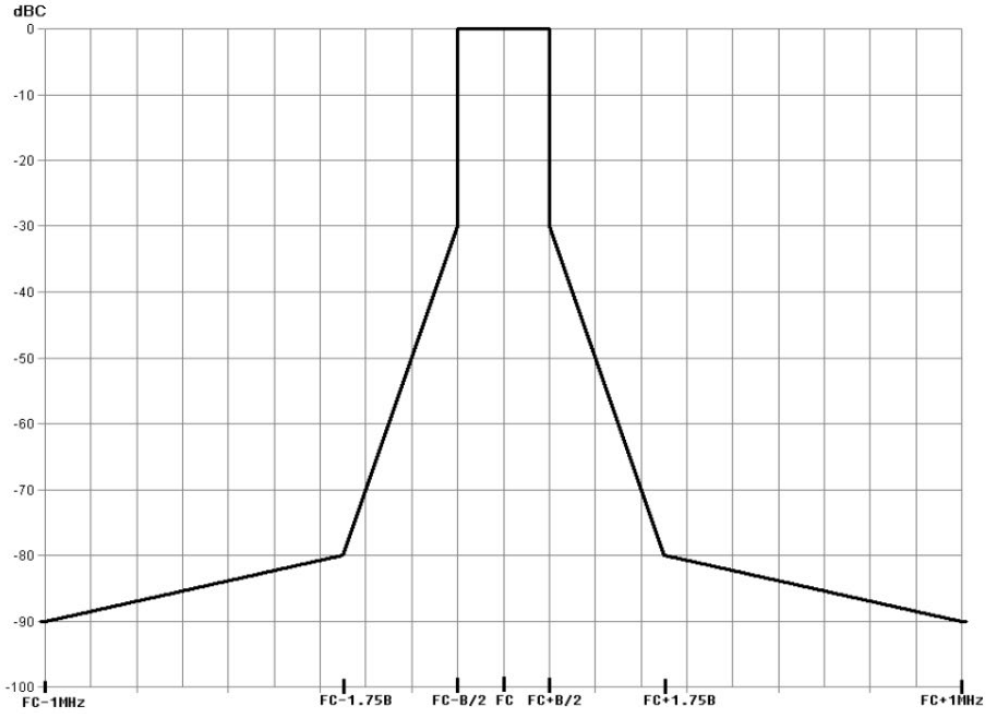
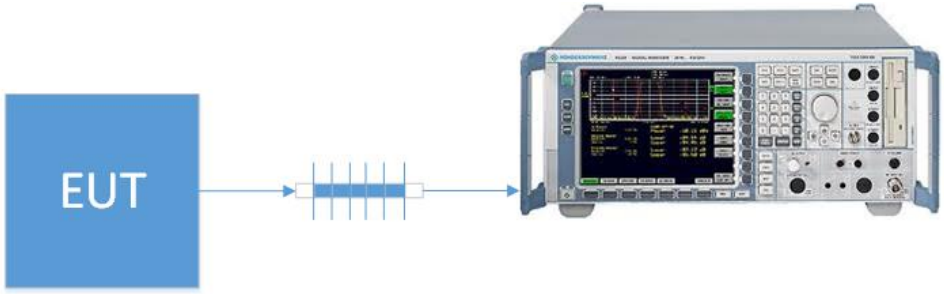


Figure 4: Spectrum mask for digital systems below 1 GHz

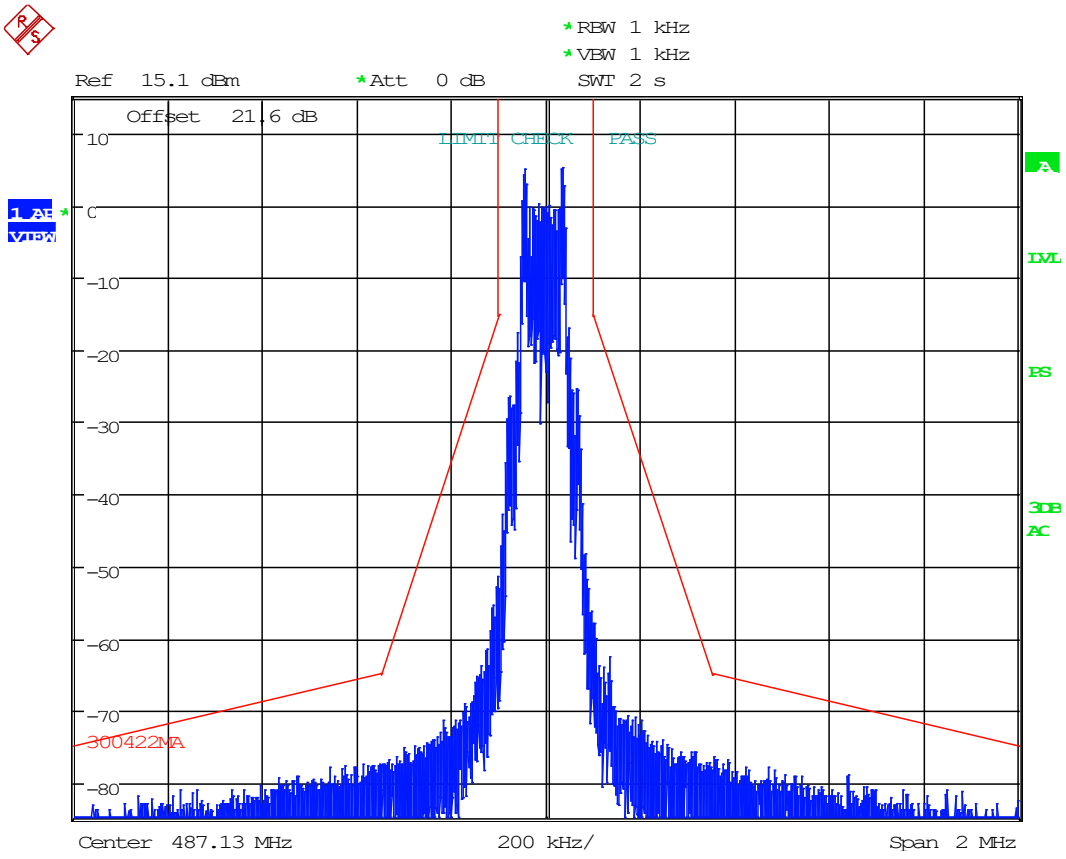
Procedure: ETSI EN 300 422-1 s. 8.3.2
ANSI C63.26, 5.4.4 (using Test Setup from TIA 603-E 2.2.11, below)

Setup Diagram:



OCCUPIED BANDWIDTH

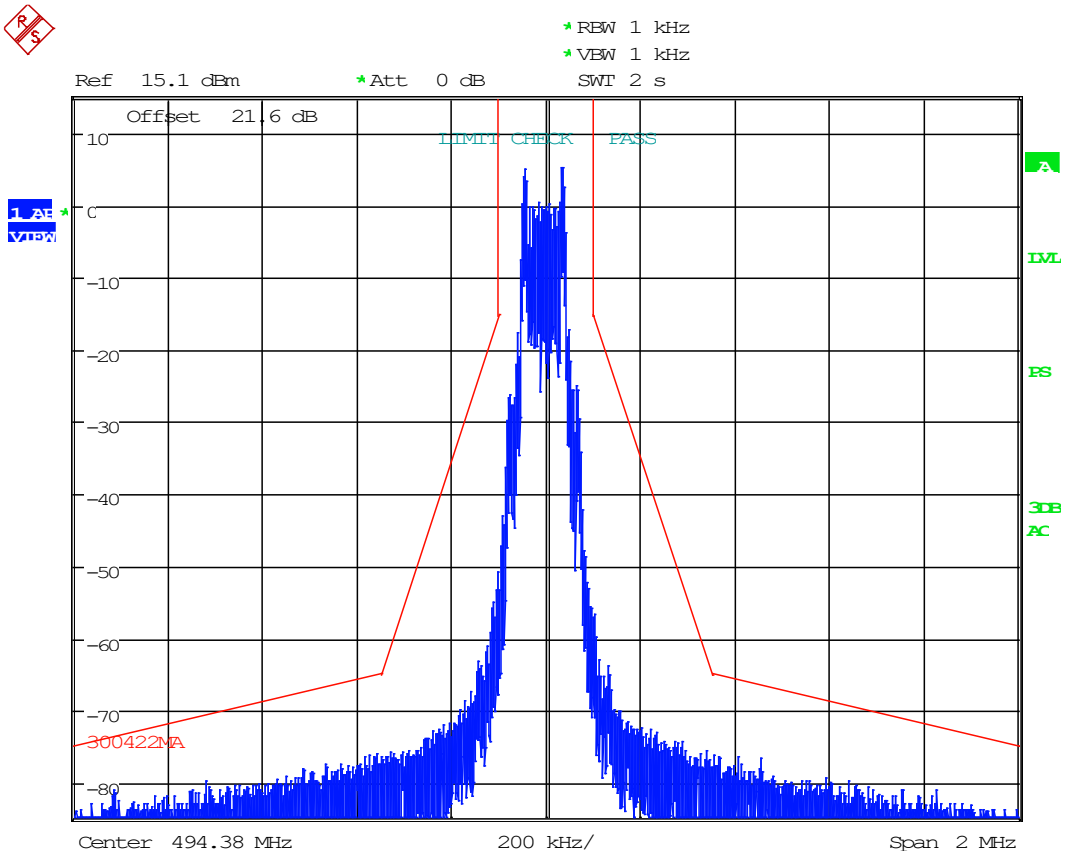
Test Data: 487.13 MHz Emission Mask Plot



Date: 14.FEB.2020 11:29:53

OCCUPIED BANDWIDTH

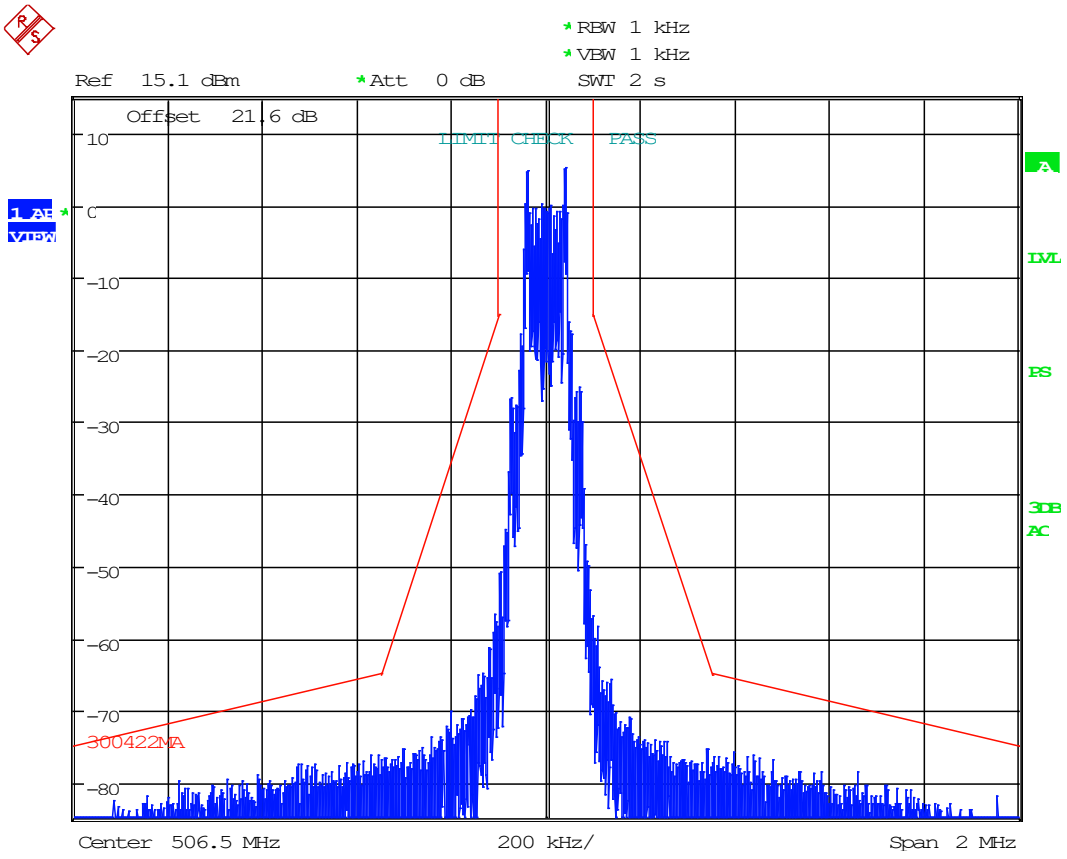
Test Data: 494.38 MHz Emission Mask Plot



Date: 14.FEB.2020 11:26:09

OCCUPIED BANDWIDTH

Test Data: 506.5 MHz Emission Mask Plot



Date: 14.FEB.2020 11:23:44

FIELD STRENGTH OF SPURIOUS EMISSIONS

Rules Part No.: FCC Part 15.236 (g)

Requirements:

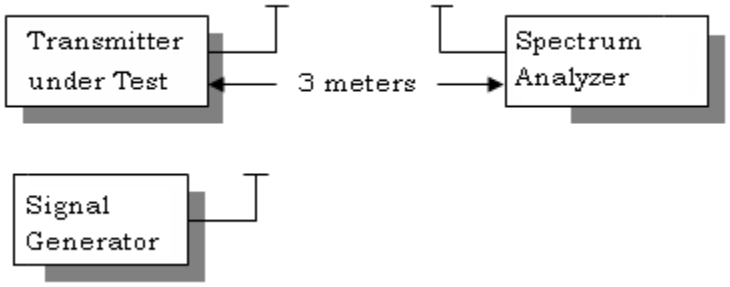
(g) Emissions within the band from one megahertz below to one megahertz above the carrier frequency shall comply with the emission mask in §8.3 of ETSI EN 300 422-1 V1.4.2 (2011-08), *Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement*. Emissions outside of this band shall comply with the limits specified in section 8.4 of ETSI EN 300 422-1 V1.4.2 (2011-08).

State	Frequency		
	47 MHz to 74 MHz 87,5 MHz to 137 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other Frequencies below 1 000 MHz	Frequencies above 1 000 MHz
Operation	4 nW	250 nW	1 µW
Standby	2 nW	2 nW	20 nW

METHOD OF MEASUREMENTS: The measuring receiver, as defined in table 4, shall be tuned over the frequency range 25 MHz to 4 GHz for equipment operating on frequencies below 1 GHz or in the frequency range of 25 MHz to 12,75 GHz for equipment operating on frequencies above 1 GHz.

Measurements were made at the test site of **Timco Engineering, Inc. located at 849 NW State Road 45, Newberry, FL 32669.**

Test Setup Diagram:



FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 487.13 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Distance (m)	Field Strength (dBµV/m)	ERP (dBm)	Margin (dB)
487.13	1461.40	10.67	V	4.43	28.41	43.51	3.000	43.511	**-53.866**	23.87
487.13	1461.40	12.31	V	4.43	28.41	45.15	3.000	45.151	**-52.226**	22.23
487.13	1948.50	14.63	V	5.11	32.25	51.99	3.000	51.988	**-45.389**	15.39
487.13	1948.50	16.08	H	5.11	32.25	53.44	3.000	53.438	**-43.939**	13.94
487.13	2435.70	11.88	H	5.62	32.43	49.93	3.000	49.930	**-47.447**	17.45
487.13	2435.70	12.91	V	5.62	32.43	50.96	3.000	50.960	**-46.417**	16.42
487.13	2922.80	17.48	V	6.25	32.79	56.52	3.000	56.516	**-40.861**	10.86
487.13	2922.80	17.98	H	6.25	32.79	57.02	3.000	57.016	**-40.361**	10.36
487.13	3409.90	16.84	V	6.78	32.92	56.54	3.000	56.540	**-40.837**	10.84
487.13	3409.90	17.82	H	6.78	32.92	57.52	3.000	57.520	**-39.857**	9.86
487.13	3897.00	13.19	H	6.82	33.48	53.49	3.000	53.493	**-43.884**	13.88
487.13	3897.00	13.48	V	6.82	33.48	53.78	3.000	53.783	**-43.594**	13.59
487.13	4384.20	10.69	V	7.31	33.72	51.72	3.000	51.721	**-45.656**	15.66
487.13	4384.20	11.29	H	7.31	33.72	52.32	3.000	52.321	**-45.056**	15.06
487.13	4871.30	15.89	H	7.27	33.98	57.14	3.000	57.140	**-40.238**	10.24
487.13	4871.30	14.80	V	7.27	33.98	56.05	3.000	56.050	**-41.328**	11.33

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 494.38 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Distance (m)	Field Strength (dBµV/m)	ERP (dBm)	Margin (dB)
494.38	1483.10	6.21	V	4.46	28.10	38.77	3.000	38.774	**-58.603**	28.60
494.38	1483.10	9.46	H	4.46	28.10	42.02	3.000	42.024	**-55.353**	25.35
494.38	1977.50	10.69	H	5.14	31.95	47.78	3.000	47.783	**-49.594**	19.59
494.38	1977.50	5.92	V	5.14	31.95	43.01	3.000	43.013	**-54.364**	24.36
494.38	2471.90	4.69	V	5.62	32.72	43.03	3.000	43.030	**-54.347**	24.35
494.38	2471.90	4.41	H	5.62	32.72	42.75	3.000	42.750	**-54.627**	24.63
494.38	2966.30	12.59	H	6.29	32.97	51.85	3.000	51.848	**-45.530**	15.53
494.38	2966.30	9.61	V	6.29	32.97	48.87	3.000	48.868	**-48.510**	18.51
494.38	3460.70	7.87	V	6.85	32.99	47.71	3.000	47.713	**-49.664**	19.66
494.38	3460.70	5.42	H	6.85	32.99	45.26	3.000	45.263	**-52.114**	22.11
494.38	3955.00	8.41	H	7.07	33.41	48.89	3.000	48.889	**-48.488**	18.49
494.38	3955.00	4.11	V	7.07	33.41	44.59	3.000	44.589	**-52.788**	22.79
494.38	4449.40	5.04	V	7.32	33.90	46.26	3.000	46.256	**-51.121**	21.12
494.38	4449.40	5.67	H	7.32	33.90	46.89	3.000	46.886	**-50.491**	20.49
494.38	4943.80	3.73	H	7.45	33.98	45.16	3.000	45.161	**-52.217**	22.22
494.38	4943.80	4.19	V	7.45	33.98	45.62	3.000	45.621	**-51.757**	21.76

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 506.5 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Meter Reading (dBµV)	Antenna Polarity	Coax Loss (dB)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Distance (m)	Field Strength (dBµV/m)	ERP (dBm)	Margin (dB)
506.50	1013.00	1.61	V	3.72	27.51	32.84	3.000	32.838	**-64.540**	34.54
506.50	1013.00	0.02	H	3.72	27.51	31.25	3.000	31.248	**-66.130**	36.13
506.50	1519.50	8.50	H	4.52	27.95	40.97	3.000	40.973	**-56.404**	26.40
506.50	1519.50	6.05	V	4.52	27.95	38.52	3.000	38.523	**-58.854**	28.85
506.50	2026.00	5.90	V	5.21	31.66	42.77	3.000	42.767	**-54.610**	24.61
506.50	2026.00	10.29	H	5.21	31.66	47.16	3.000	47.157	**-50.220**	20.22
506.50	2532.50	5.41	H	5.68	32.66	43.75	3.000	43.747	**-53.630**	23.63
506.50	2532.50	7.19	V	5.68	32.66	45.53	3.000	45.527	**-51.850**	21.85
506.50	3039.00	12.21	V	6.36	33.35	51.92	3.000	51.924	**-45.454**	15.45
506.50	3039.00	8.60	H	6.36	33.35	48.31	3.000	48.314	**-49.064**	19.06
506.50	3545.50	6.17	H	6.80	33.35	46.32	3.000	46.321	**-51.056**	21.06
506.50	3545.50	7.95	V	6.80	33.35	48.10	3.000	48.101	**-49.276**	19.28
506.50	4052.00	4.13	V	7.18	33.44	44.75	3.000	44.751	**-52.626**	22.63
506.50	4052.00	-0.23	H	7.18	33.44	40.39	3.000	40.391	**-56.986**	26.99
506.50	4558.50	8.20	H	7.43	33.97	49.60	3.000	49.602	**-47.775**	17.77
506.50	4558.50	6.99	V	7.43	33.97	48.39	3.000	48.392	**-48.985**	18.98
506.50	5065.00	4.97	V	7.68	34.10	46.75	3.000	46.748	**-50.629**	20.63
506.50	5065.00	11.34	H	7.68	34.10	53.12	3.000	53.118	**-44.259**	14.26

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 74.861

Requirements: Temperature and voltage tests were performed to verify that the frequency remains within the .0050%,(50 ppm)

Method of Measurements: ANSI/TIA 603-C: 2004.

The test was conducted as follows: The transmitter was placed in the temperature chamber at 25 ºC and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15-second intervals. The worst case number used in the table below. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -20 ºC after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15-second intervals. The worst-case number was again used in the table below. This procedure was repeated in 10-degree increments up to + 50 ºC.

Test Data:

FCC Part 90 Limit	5.0	ppm
FCC Part 90 Limit, as ppb	5000	ppb (Parts per Billion)
FCC Part 90 Limit, as %	0.00050	%
Strictest Combined Limit, as Hz	2532.500	Hz
Combined Lower Limit	506.497468	MHz
Combined Upper Limit	506.502533	MHz
Rated Supply Voltage	3.0	○ AC ◉ DC

Temperature / Voltage Variation

Temperature (°C)	Supplied Voltage (V)	Frequency (MHz)	Deviation (kHz)
-30	3.0	506.502000	-2.000
-20	3.0	506.498680	1.320
-10	3.0	506.498100	1.900
0	3.0	506.499060	0.940
+10	3.0	506.499460	0.540
+20 (reference)	3.0	506.500000	0.000
+20	2.6	506.500000	0.000
+20	3.5	506.500000	0.000
+30	3.0	506.500410	-0.410
+40	3.0	506.500554	-0.554
+50	3.0	506.500538	-0.538

Result: Meets 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	±0.93dB	(1)
Conducted spurious emission of transmitter valid up to 40GHz	±1.86dB	
Occupied Bandwidth	±2.65%	
Audio Frequency Response	±1.86dB	
Modulation limiting	±1.88%	
Radiated RF Power	±1.4dB	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. Within 6kHz and 25kHz of audio Freq.	 ±1.88% ±2.04%	
Rad Emissions Sub Meth up to 26.5GHz	±2.14dB	
Adjacent channel power	±1.47dB	(1)
Transient Frequency Response	±1.88%	
Temperature	±1.0°C	(1)
Humidity	±5.0%	

Notes: (1) 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	SN	Calibration Date	Cal Due Date
EMI Test Receiver R & S ESIB 40 firmware v 4.34.3 BIOS v3.3	Rohde & Schwarz	ESIB 40	100274	07/22/19	07/22/21
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 KMKM-0670-01 KFKF-0197-00	02/27/19	02/27/21
CHAMBER	Panashield	3M	N/A	03/15/19	03/15/21
Antenna: Active Loop	ETS-Lindgren	6502	00062529	12/11/17	12/11/20
Antenna: Biconical 1096	Eaton	94455-1	1096	08/01/17	08/01/20
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/26/17	07/26/20
Ant: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	01/30/17	01/30/20
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	N/A	N/A
Type K J Thermometer	Martel	303	080504494	11/06/17	11/06/20

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT