



FCC CFR 47 Part 90 Test Report

APPLICANT	SHENZHEN CONSTANT ELECTRONICS CO., LTD
ADDRESS	F5, NO. 2 BLDG., EAST BRIGHT INDUSTRY REGION NO. 83 DABAO ROAD BAO'AN 33 DISTRICT SHENZHEN, GUANGDONG CHINA
FCC ID	WH2-2611D
MODEL NUMBER	MMC-2611D
PRODUCT DESCRIPTION	PAGING TRANSCEIVER
DATE SAMPLE RECEIVED	09/18/2019
FINAL TEST DATE	4/14/2020
TESTED BY	Franklin Rose
APPROVED BY	Tim Royer
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Report Version	Description	Issue Date
25080AUT19 PT90_TestReport_	Rev1	Initial Issue	4/14/2020
25080AUT19 PT90_TestReport_	Rev2	Corrected Emission Mask	08/06/2020

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

This test report and the data contained here-in relates only to the sample tested.

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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:



Sr. EMC Engineer
EMC-003838-NE



Name and Title	Tim Royer, Project Manager/Testing Engineer
Date	4/14/2020

Reviewed and Approved by:



Name and Title	Franklin Rose, Project Manager / EMC Testing Technician
Date	4/14/2020

GENERAL INFORMATION

EUT Description	PAGE TRANSCEIVER
FCC ID	WH2-2611D
Model Number	MMC-2611D
Operating Frequency	462.750, 462.775, 462.800, 462.825, 462.850, 462.875, 462.900, 462.925
Test Frequencies	462.750 MHz
Type of Emission	10K5F1D (Narrowband Digital FM)
Modulation	FM
EUT Power Source	☐ 110–120Vac/50– 60Hz
	☒ DC Power (12 V)
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☒ Pre-Production
	☐ Production
Type of Equipment	☒ Fixed
	☐ Mobile
	☐ Portable
Antenna Connector	BNC
Test Conditions	The temperature was 26°C 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	ANSI/TIA 603-E:2016, ANSI C63.26 (2015), FCC CFR 47 Part 2, Part 90
Test Facility	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA. Designation #: US1070

RESULTS SUMMARY

Rule Part No.	Test Item	Results
2.1046(a), 90.205(g),(h),(i)	RF Power Output	PASS
2.1033(c)(4), 90.209(b)(5)	Modulation Characteristics	N/A
2.1047(a)	Audio Frequency Response and Low Filter	N/A
2.1047(b)	Modulation Limiting	N/A
2.1049 (c)	Occupied Bandwidth	PASS
90.210(d)(1), (2)	Emission Masks	PASS
2.1051(a), 90.210(d)(3)	Spurious Emissions at Antenna Terminals	PASS
2.1053(a), 90.210(d)(3)	Field Strength of Spurious Emissions	PASS
2.1055(a)(2), 90.213	Frequency Stability	PASS
90.214	Transient Frequency Response	N/A

RF POWER OUTPUT

FCC Rule Parts: FCC Part 2.1046(a), 90.205 (h)

(h) 450-470 MHz. (1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2. Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 2 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 39 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 32 km (20 mi) must justify the requested service area radius, which may be authorized only in accordance with table 2, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

TABLE 2—450-470 MHz—MAXIMUM ERP/REFERENCE HAAT FOR A SPECIFIC SERVICE AREA RADIUS

	Service area radius (km)									
	3	8	13	16	24	32	40 ⁴	48 ⁴	64 ⁴	80 ⁴
Maximum ERP (w) ¹	2	100	2500	2500	2500	2500	2500	2500	2500	2500
Up to reference HAAT (m) ³	15	15	15	27	63	125	250	410	950	2700

¹Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See §73.699, Fig. 10 b).

²Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.

³When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})^2$.

⁴Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

(i) 470-512 MHz. Power and height limitations are specified in §§90.307 and 90.309.

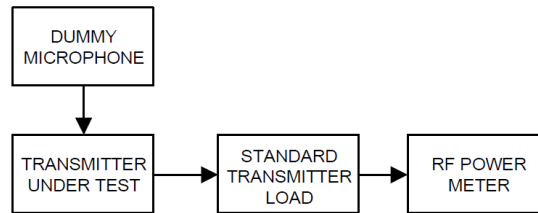
§90.307 Protection criteria.

The tables and figures listed in §90.309 shall be used to determine the effective radiated power (ERP) and antenna height of the proposed land mobile base station and the ERP for the associated control station (control station antenna height shall not exceed 31 meters (100 feet) above average terrain (AAT)).

(c) Mobile units and control stations operating on the frequencies available for land mobile use in any given urbanized area shall afford protection to co-channel and adjacent channel television stations in accordance with the values set forth in table C in §90.309 and paragraph (d) of this section except for channel 15 in New York, NY, and Cleveland, OH, and channel 16 in Detroit, MI, where protection will be in accordance with the values set forth in table D in §90.309 and paragraph (d) of this section.

RF POWER OUTPUT

Method of Measurement: TIA-603-E, 2.2.1



Test Data: Power Measurement Table

Peak Power Output		
Frequency (MHz)	dBm	Watt
462.75	27.44	0.555

Part 2.1033 (c)(8) DC Input into Final Amplifier

INPUT POWER: (12 V) (2 A) = **24 Watts**

Result: Meets Requirements

OCCUPIED BANDWIDTH

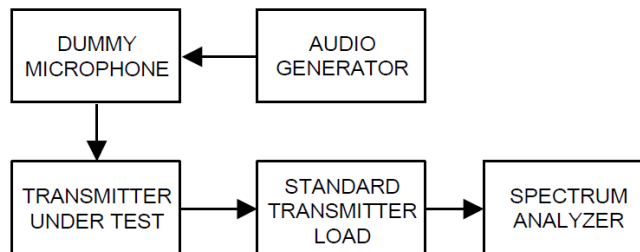
FCC Rule Parts: 2.1049 (c)

(c) Radiotelephone transmitters equipped with a device to limit modulation or peak envelope power shall be modulated as follows. For single sideband and independent sideband transmitters, the input level of the modulating signal shall be 10 dB greater than that necessary to produce rated peak envelope power.

(1) Other than single sideband or independent sideband transmitters—when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

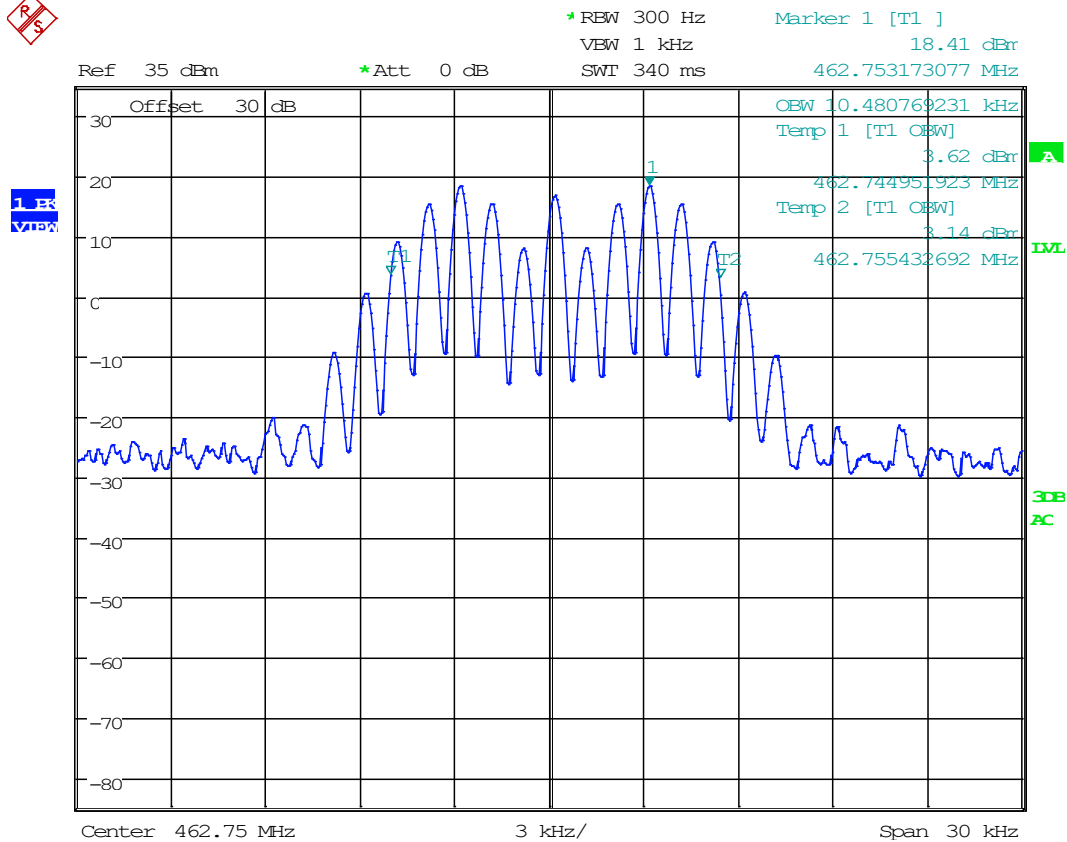
Method of Measurement: ANSI C63.26, 5.4.4 (using Test Setup from TIA 603-E 2.2.11, below)

Note: The receiver's automatic 99% Occupied Bandwidth function was used. The function is identical in operation to ANSI C63.26, 5.4.4, Step e).



OCCUPIED BANDWIDTH 99%

Test Data: 10K5F1D



Date: 8.APR.2020 17:14:28

99% OBW = 10.48 kHz

EMISSION MASKS

FCC Rule Parts: 90.210(d)(1), (2)

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
421-512 ^{2 5}	B, D, or E	C, D, or E

²Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

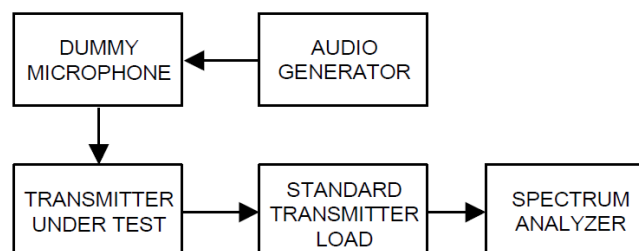
⁵Equipment may alternatively meet the Adjacent Channel Power limits of §90.221.

Requirements:

(d) *Emission Mask D—12.5 kHz channel bandwidth equipment.* For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

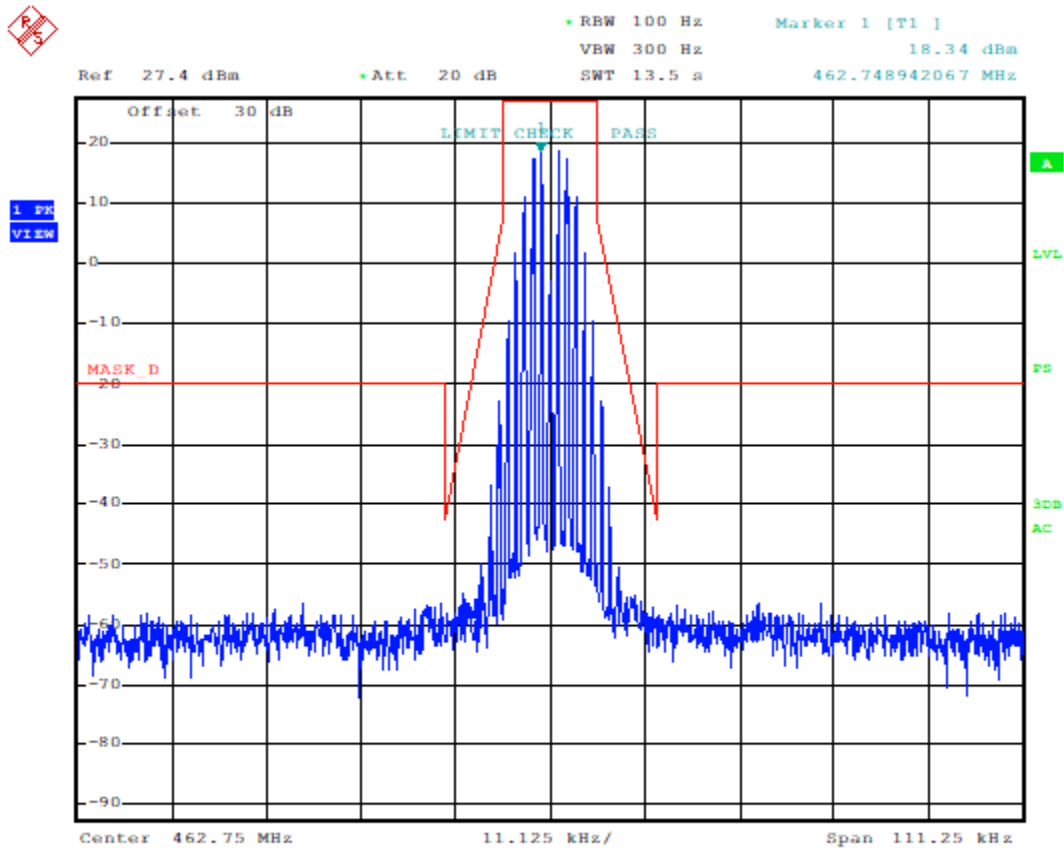
- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Method of Measurement: ANSI C63.26, 5.4.4 (using Test Setup from TIA 603-E 2.2.11, below)



EMISSION MASK B - NARROWBAND FM (12.5 kHz)

Test Data: 462.75 MHz



Date: 8.APR.2020 15:52:24

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

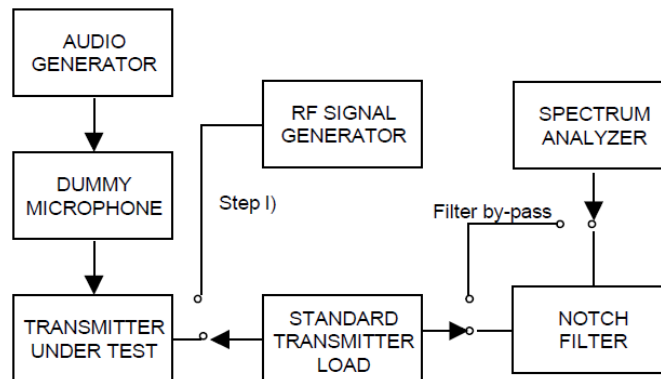
FCC Rule Parts: FCC Part 2.1051(a), 90.210(c)(3)

Requirements:

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

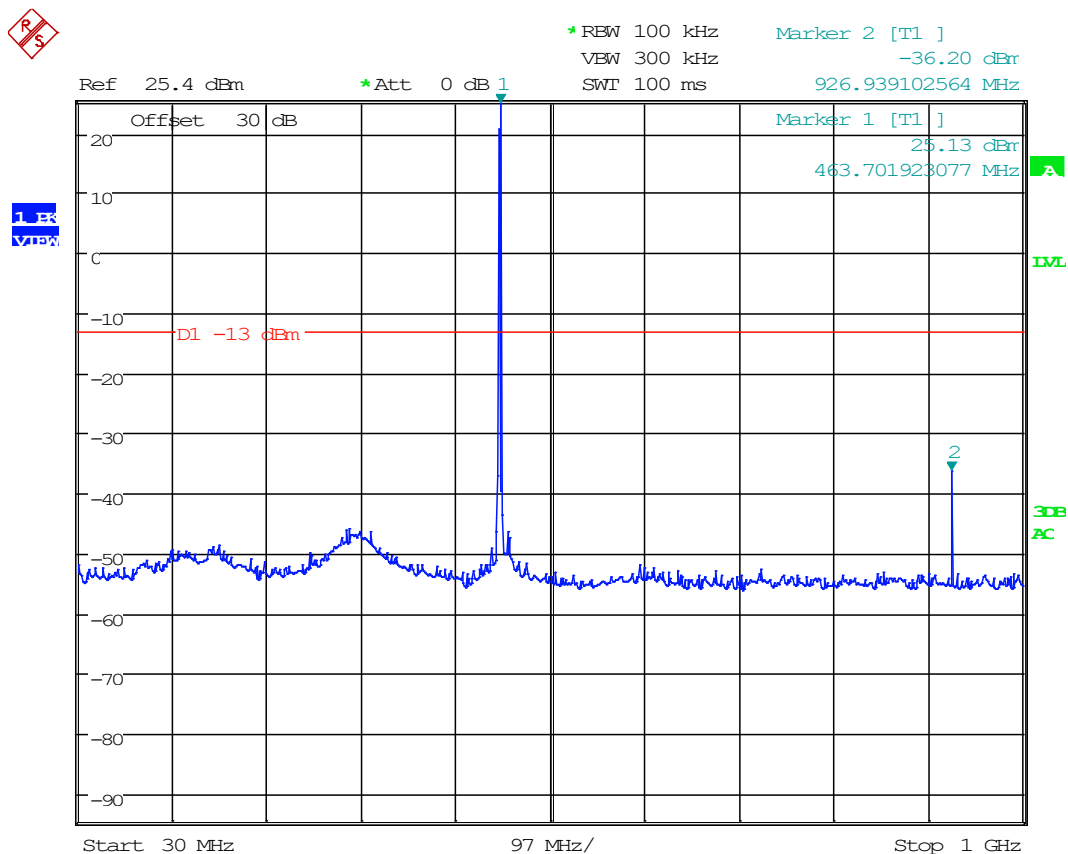
Method of Measurement: ANSI/TIA-603-E

Test Procedure: TIA 603-E, 2.2.13



SPURIOUS EMISSIONS - NARROWBAND FM

Test Data: 462.75 MHz, Below 1 GHz



Date: 8.APR.2020 17:19:32

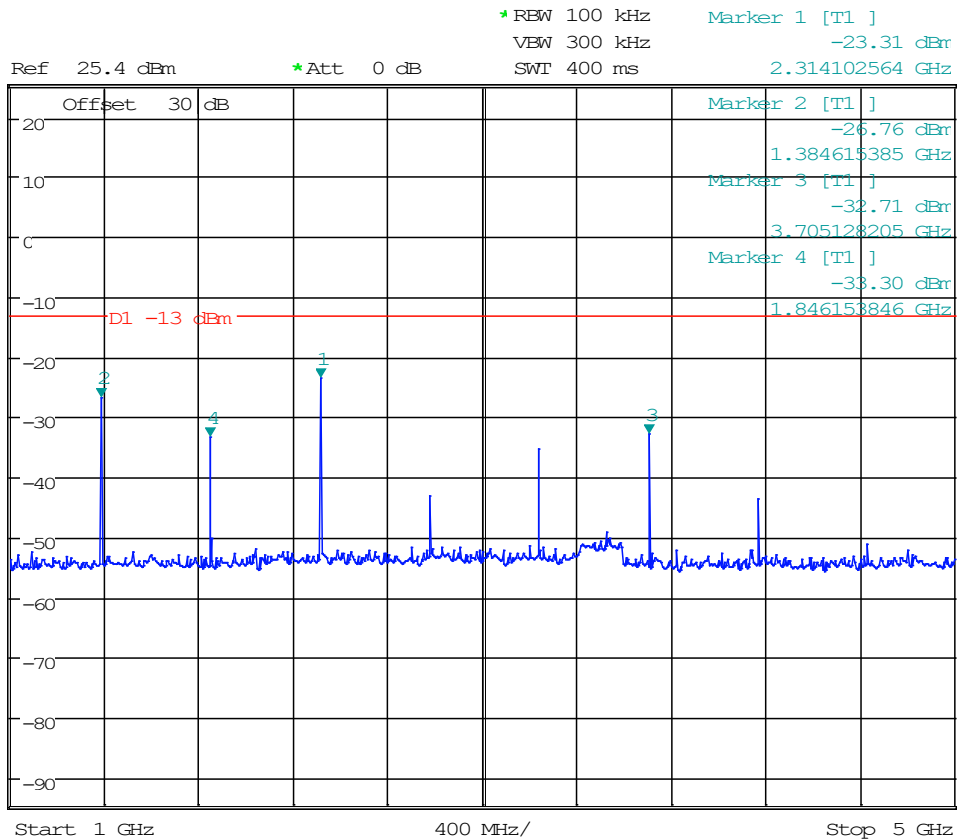
Result: Meets Requirement

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Data: 462.75 MHz, Above 1 GHz



1.384615385 GHz



Date: 8.APR.2020 17:20:35

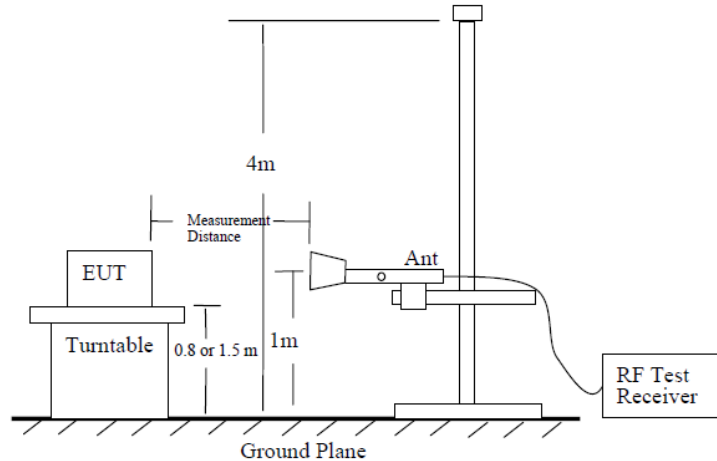
Result: Meets Requirement

FIELD STRENGTH OF SPURIOUS EMISSIONS

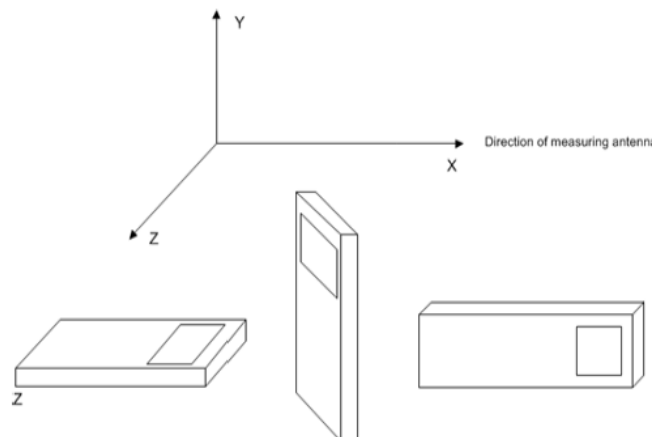
FCC Rule Parts: FCC Part 2.1053(a), 90.210(d)(3)

Method of Measurement: ANSI C63.26, 5.5.4

Test Site Setup:



EUT Orientation(s):



Note: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from the lowest frequency generated internally to at least the tenth harmonic of the fundamental. This test was conducted in accordance with the standard listed above using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669. The measurements below represent the worst case of all the frequencies tested.

Note: The six (6) highest emissions or more of each worst-case operational modes of the EUT are represented below. Emissions 20 dB below the limit are not required to be reported.

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: 462.75 MHz

Tuned Frequency (MHz)	Detector	Meter Reading (dBm)	Meter Reading (W)	Limit (dBc)	Limit (dBm)
462.75	PK	25.43	0.35	38.43	-13.00

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBm)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBμV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dBm)
462.75	176.88	PK	13.56	H	1.55	14.31	3.00	29.42	-67.96	-13.00	54.96
462.75	83.86	PK	14.08	H	1.10	9.56	3.00	24.74	-72.64	-13.00	59.64
462.75	64.54	PK	19.14	V	0.95	6.29	3.00	26.38	-71.00	-13.00	58.00
462.75	103.58	PK	18.10	V	1.17	10.64	3.00	29.92	-67.46	-13.00	54.46
462.75	925.50	PK	26.02	H	3.58	22.21	3.00	51.81	-45.57	-13.00	32.57
462.75	925.50	PK	27.76	V	3.58	22.21	3.00	53.55	-43.83	-13.00	30.83
462.75	1388.25	PK	28.39	H	4.31	28.53	3.00	61.23	-36.15	-13.00	23.15
462.75	1388.25	PK	21.61	V	4.31	28.53	3.00	54.45	-42.93	-13.00	29.93
462.75	1851.00	PK	19.05	H	4.98	30.89	3.00	54.91	-42.46	-13.00	29.46
462.75	1851.00	PK	16.24	V	4.98	30.89	3.00	52.10	-45.27	-13.00	32.27
462.75	2313.75	PK	13.41	H	5.51	31.63	3.00	50.55	-46.82	-13.00	33.82
462.75	2313.75	PK	16.74	V	5.51	31.63	3.00	53.88	-43.49	-13.00	30.49
462.75	2776.50	PK	12.57	H	6.14	32.45	3.00	51.16	-46.21	-13.00	33.21
462.75	2776.50	PK	13.06	V	6.14	32.45	3.00	51.65	-45.72	-13.00	32.72
462.75	3239.25	PK	13.06	H	6.64	32.68	3.00	52.38	-44.99	-13.00	31.99
462.75	3239.25	PK	13.45	V	6.64	32.68	3.00	52.77	-44.60	-13.00	31.60
462.75	3702.00	PK	14.41	H	6.59	33.19	3.00	54.19	-43.19	-13.00	30.19
462.75	3702.00	PK	15.06	V	6.59	33.19	3.00	54.84	-42.54	-13.00	29.54
462.75	4164.75	PK	13.39	H	6.98	33.39	3.00	53.76	-43.62	-13.00	30.62
462.75	4164.75	PK	14.63	V	6.98	33.39	3.00	55.00	-42.38	-13.00	29.38
462.75	4627.50	PK	11.43	H	7.55	33.97	3.00	52.96	-44.42	-13.00	31.42
462.75	4627.50	PK	9.96	V	7.55	33.97	3.00	51.49	-45.89	-13.00	32.89

Result: Meets Requirement

FREQUENCY STABILITY

FCC Rule Parts: FCC Part 2.1055(a)(2), 90.213

MINIMUM FREQUENCY STABILITY

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
421-512	7 11 14 _{2,5}	⁸ 5	⁸ 5

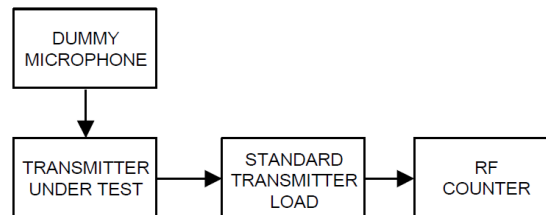
⁷In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

⁸In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

¹¹Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

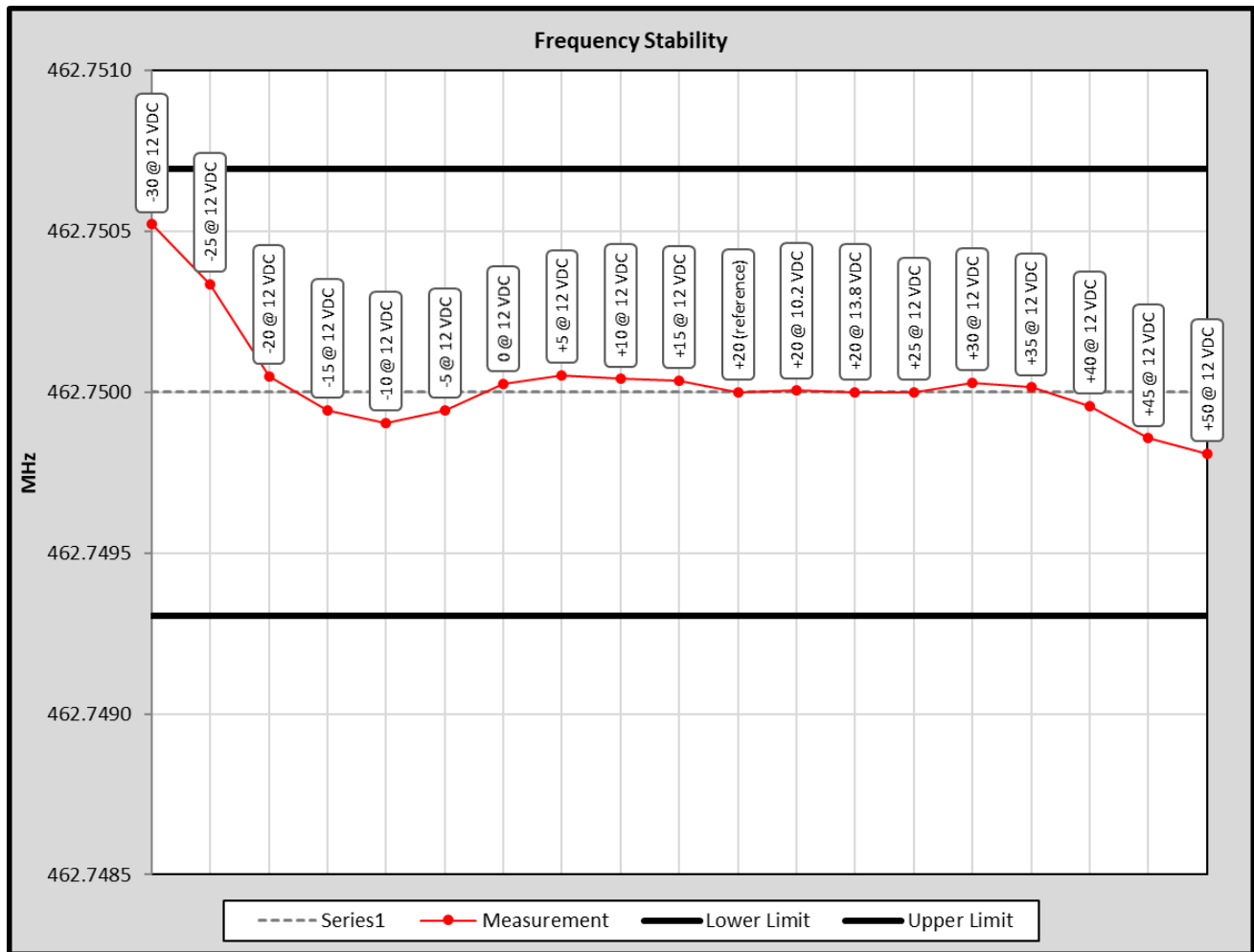
¹⁴Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

Method of Measurements: TIA 603-E, 2.2.2



FREQUENCY STABILITY

Test Data: Frequency Error Measurement Plot



FREQUENCY STABILITY

Test Data: Frequency Error Measurement Table

Limit	1.5	ppm	
Limit, in Hz	694.125	Hz	
Lower Limit	462.749306	MHz	
Upper Limit	462.750694	MHz	
Rated Supply Voltage	12.0	☐ AC ☒ DC	
Temperature / Voltage Variation			
Temperature (°C)	Supplied Voltage (V)	Frequency (MHz)	Deviation (kHz)
-30	12.0	462.750523	-0.523
-25	12.0	462.750336	-0.336
-20	12.0	462.750050	-0.050
-15	12.0	462.749945	0.055
-10	12.0	462.749905	0.095
-5	12.0	462.749945	0.055
0	12.0	462.750027	-0.027
+5	12.0	462.750053	-0.053
+10	12.0	462.750042	-0.042
+15	12.0	462.750036	-0.036
+20 (reference)	12.0	462.750000	0.000
+20	10.2	462.750005	-0.005
+20	13.8	462.750000	0.000
+25	12.0	462.750000	0.000
+30	12.0	462.750030	-0.030
+35	12.0	462.750015	-0.015
+40	12.0	462.749957	0.043
+45	12.0	462.749857	0.143
+50	12.0	462.749810	0.190

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	± 0.93 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.	$\pm 1.88\%$	
Within 6kHz and 25kHz of audio Freq.	$\pm 2.04\%$	
Rad Emissions Sub Meth up to 26.5GHz	± 2.14 dB	
Adjacent channel power	± 1.47 dB	(1)
Transient Frequency Response	$\pm 1.88\%$	
Temperature	$\pm 1.0^\circ\text{C}$	(1)
Humidity	$\pm 5.0\%$	

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	Serial Number	Cal/Char Date	Due Date
Coaxial Cable - BMBM-0065-01 Black DC-2G	Belden		BMBM-0065-01	07/18/18	07/18/20
Antenna: Biconical 1057	Eaton	94455-1	1057	12/13/17	12/13/20
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	08/26/17	08/26/20
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	N/A	N/A
Frequency Counter Small Chamber	HP	5385A	3242A07460	08/22/17	08/22/20
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 KMKM-0670-01 KFKF-0197-00	N/A	N/A
CHAMBER	Panashield	3M	N/A	03/05/19	03/05/21
Antenna: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	02/25/20	02/25/23
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Type K J Thermometer	Martel	303	080504494	11/02/17	11/02/20
EMI Test Receiver R & S ESU 40	Rohde & Schwarz	ESU 40	100320	08/28/18	08/28/20
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A
Terminator N 20W DC-18G	Narda	8205	# 14	04/06/20	04/06/22
DC Power Supply	HP	6286A	1744A03842	N/A	N/A

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT