



























10 FCC §2.1055, §90.213, RSS-111 § 5.2 - Frequency Tolerance

10.1 Applicable Standard

According to FCC Part 90.213,

§90.213 Frequency stability.

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

TABLE 1 TO §90.213(a)-MINIMUM FREQUENCY STABILITY

		Mobile stations			
Frequency range (MHz)	Fixed and base stations	Over 2 watts output power	2 watts or less output power		
Below 25	^{1 2 3} 100	100	200		
25-50	20	20	50		
72-76	5		50		
150-174	^{5 11} 5	⁶ 5	^{4 6} 50		
216-220	1.0		1.0		
220-222 ¹²	0.1	1.5	1.5		
421-512	^{7 11 14} 2.5	⁸ 5	⁸ 5		
806-809	¹⁴ 1.0	1.5	1.5		
809-824	¹⁴ 1.5	2.5	2.5		
851-854	1.0	1.5	1.5		
854-869	1.5	2.5	2.5		
896-901	¹⁴ 0.1	1.5	1.5		
902-928	2.5	2.5	2.5		
902-928 ¹³	2.5	2.5	2.5		
929-930	1.5				
935-940	0.1	1.5	1.5		
1427-1435	⁹ 300	300	300		
Above 2450 ¹⁰					

[Parts per million (ppm)]

According to RSS-111 § 5.2,

The applicant shall ensure frequency stability by showing that the occupied bandwidth is maintained within the band of operation when tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

10.2 Test Procedure

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30° to $+50^{\circ}$ centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From -20° to $+50^{\circ}$ centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and $+30^{\circ}$ centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

(4) When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c), and (d) of this section. (For example measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

10.3 Test Setup Block Diagram



10.4 **Test Equipment List and Details**

BACL No.	Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	1321.3008k39- 101203-UW	2023-06-02	13 months
1060	BACL	Temp and Humi Chamber	BTH-150- 40	30078	2023-11-22	1 year
1224	Radiall	USB COAXIAL SWITCHES	SPNT R574X11X0 1 USB	-	Each time ¹	N/A
-	-	RF Cable	-	-	Each time ¹	N/A

Note¹: Equipment was calibrated for each test.

Statement of Traceability: BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".

10.5 **Test Environmental Conditions**

Temperature:	22.4° C		
Relative Humidity:	45.4 %		
ATM Pressure:	101.8 kPa		

The testing was performed by Kevin Chau from 2024-04-16 to 2024-05-29 in the RF Site.

10.6 Test Results

4.9GHz Radio1 and Radio 1 Antenna A:

Temperature (°C)/Voltage Conditions	Radio	Reference Frequency (GHz)	Tested Frequency (GHz)	Frequency Deviation (ppm)	Result
-30°C/normal voltage (120V)	Radio 2	4.955	4.9550435	8.78	pass
-30°C /normal voltage (120V)	Radio 1	4.955	4.9550825	16.65	pass
-20°C /normal voltage (120V)	Radio 2	4.955	4.955051	10.29	pass
-20°C /normal voltage (120V)	Radio 1	4.955	4.955117	23.61	pass
-10°C /normal voltage (120V)	Radio 2	4.955	4.9550255	5.15	pass
-10°C /normal voltage (120V)	Radio 1	4.955	4.955051	10.29	pass
0°C /normal voltage (120V)	Radio 2	4.955	4.9551665	33.60	pass
0°C /normal voltage (120V)	Radio 1	4.955	4.955063	12.71	pass
10°C /normal voltage (120V)	Radio 2	4.955	4.9550945	19.07	pass
10°C /normal voltage (120V)	Radio 1	4.955	4.955129	26.03	pass
20°C /normal voltage (120V)	Radio 2	4.955	4.9550645	13.02	pass
20°C /normal voltage (120V)	Radio 1	4.955	4.955018	3.63	pass
30°C /normal voltage (120V)	Radio 2	4.955	4.9551275	25.73	pass
30°C /normal voltage (120V)	Radio 1	4.955	4.9550555	11.20	pass
40°C /normal voltage (120V)	Radio 2	4.955	4.9549805	-3.94	pass
40°C /normal voltage (120V)	Radio 1	4.955	4.9550225	4.54	pass
50°C /normal voltage (120V)	Radio 2	4.955	4.9550015	0.30	pass
50°C /normal voltage (120V)	Radio 1	4.955	4.954973	-5.45	pass
20°C /low voltage (102V)	Radio 2	4.955	4.955084	16.95	pass
20°C /low voltage (102V)	Radio 1	4.955	4.95503	6.05	pass
20°C /high voltage (138V)	Radio 2	4.955	4.9550435	8.78	pass
20°C /high voltage (138V)	Radio 1	4.955	4.955054	10.90	pass

Note: Testing done using Modulated mode

Note: ppm calculated with ((Tested Freq -Reference Freq) / Reference Freq) * 1000000

Temperature (°C)/Voltage Conditions	Radio	Antenna	Low Channel (MHz)	High Channel (MHz)	Limit (MHz)	Result
-30°C /normal voltage (120V)	Radio 2	А	4.940979	4.989129	4940 - 4990	pass
-30°C /normal voltage (120V)	Radio 1	А	4.940763	4.989345	4940 - 4990	pass
20°C /normal voltage (120V)	Radio 2	А	4.940949	4.989081	4940 - 4990	pass
20°C /normal voltage (120V)	Radio 1	А	4.940763	4.989273	4940 - 4990	pass
50°C /normal voltage (120V)	Radio 2	А	4.940895	4.989039	4940 - 4990	pass
50°C /normal voltage (120V)	Radio 1	А	4.940703	4.989249	4940 - 4990	pass
20°C /low voltage (102V)	Radio 2	А	4.940943	4.989069	4940 - 4990	pass
20°C /low voltage (102V)	Radio 1	А	4.940751	4.989291	4940 - 4990	pass
20°C /high voltage (138V)	Radio 2	А	4.940931	4.989087	4940 - 4990	pass
20°C /high voltage (138V)	Radio 1	А	4.940751	4.989279	4940 - 4990	pass

Note: Testing done using Modulated mode

Please refer to the below tables for the plots.

FCC

-30°C



-20°C



Cisco Systems, Inc.

10°C



0°C



Cisco Systems, Inc.

10°C



30°C



Cisco Systems, Inc.

40°C



50°C



20°C Voltage



IC











11 Annex A (Normative) – EUT External Photographs

Please refer to separate attachment

12 Annex B (Normative) – EUT Internal Photographs

Please refer to separate attachment

13 Annex C (Normative) – A2LA Electrical Testing Certificate



Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This laboratory also meets A2LA R222 - Specific Requirements EPA ENERGY STAR Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 21st day of December 2022.

Mr. Trace McInturff, Vice President, Accreditation Services For the Accreditation Council Certificate Number 3297.02 Valid to September 30, 2024

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---