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Class of station	Frequency band/ frequency	Authorized emission(s)[9]	Maximum power[1]
Aeronautical utility mobile	VHF	A3E	10 watts.
	1090 MHz	M1D	20 watts.
Aircraft data link land test	131.450 MHz, 131.550 MHz, 131.725 MHz, 131.825 MHz, 136.850 MHz.	A2D	100 microwatts.
	136.900 MHz, 136.925 MHz, 136.950 MHz, 136.975 MHz.	G1D	100 microwatts.
Radionavigation land test	108.150 MHz	A9W	1 milliwatt.
	334.550 MHz	A1N	1 milliwatt.
	Other VHF	M1A, XXA, A1A, A1N, A2A, A2D, A9W	1 watt.
	Other UHF	M1A, XXA, A1A, A1N, A2A, A2D, A9W	1 watt.
	5031.0 MHz	F7D	1 watt.
Radionavigation land	Various[4]	Various[4]	Various.[4]
	Aeronautical Frequencies		
Aircraft (Communication)	UHF	F2D, F9D, F7D	25 watts.
	VHF	A3E, A9W, G1D, G7D, A2D	55 watts.
	HF	R3E, H3E, J3E, J7B, H2B, J7D, J9W	400 watts.
	HF	A1A, F1B, J2A, J2B	100 watts.
	Marine Frequencies[5]		
	156.300 MHz	G3E	5 watts.
	156.375 MHz	G3E	5 watts.
	156.400 MHz	G3E	5 watts.
	156.425 MHz	G3E	5 watts.
	156.450 MHz	G3E	5 watts.
	156.625 MHz	G3E	5 watts.
	156.800 MHz	G3E	5 watts.
	156.900 MHz	G3E	5 watts.
	157.425 MHz	G3E	5 watts.
	HF[6]	R3E, H3E, J3E, J2B, F1B, A3E	1000 watts. 250 watts.
	MF[6]	R3E, H3E, J3E, J2B, F1B	1000 watts.
	HF[6]	A3E	250 watts.
(Radionavigation)	Various[7]	Various[7]	Various.[7]
Aircraft earth	UHF	G1D, G1E, G1W	60 watts.[8]
Differential GPS	VHF	G7D	Various.[2]

[1] The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:
(i) Mean power (pY) for amplitude modulated emissions and transmitting both sidebands using unmodulated full carrier.
(ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (i) of this note.
[2] Power and antenna height are restricted to the minimum necessary to achieve the required service.
[3] Transmitter power may be increased to overcome line and duplexer losses but must not exceed 25 watts delivered to the antenna.
[4] Frequency, emission, and maximum power will be determined after coordination with appropriate Government agencies.
[5] To be used with airborne marine equipment certificated for part 80 (ship) and used in accordance with part 87.
[6] Applicable only to marine frequencies used for public correspondence.
[7] Frequency, emission, and maximum power will be determined by appropriate standards during the certification process.
[8] Power may not exceed 60 watts per carrier, as measured at the input of the antenna subsystem, including any installed diplexer. The maximum EIRP may not exceed 2000 watts per carrier.
[9] Excludes automatic link establishment.
[10] Power is limited to 0.5 watt, but may not exceed 2 watts when station is used in an automatic unattended mode.

[54 FR 11720, Mar. 22, 1989, as amended at 57 FR 45749, Oct. 5, 1992; 62 FR 40308, July 28, 1997; 63 FR 36607, July 7, 1998; 64 FR 27474, May 20, 1999; 66 FR 26798, May 15, 2001; 69 FR 32880, June 14, 2004; 78 FR 61205, Oct. 3, 2013]

§ 87.133 Frequency stability.

(a) Except as provided in paragraphs (c), (d), (f), and (g) of this section, the carrier frequency of each station must be maintained within these tolerances:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance[1]	Tolerance[2]
(1) Band-9 to 535 kHz:		
Aeronautical stations	100	100
Aircraft stations	200	100
Survival craft stations on 500 kHz.	5,000	20 Hz[3]

Frequency band (lower limit exclusive, upper limit inclusive), and categories of stations	Tolerance [1]	Tolerance [2]
Radionavigation stations	100	100
(2) Band-1605 to 4000 kHz:		
Aeronautical fixed stations:		
Power 200 W or less	100	100 [8]
Power above 200 W	50	50 [8]
Aeronautical stations:		
Power 200 W or less	100 [7]	100 [7 8]
Power above 200 W	50 [7]	50 [7 8]
Aircraft stations	100 [7]	100 [7]
Survival craft stations on 2182 kHz.	200	20 Hz [3]
(3) Band-4 to 29.7 MHz:		
Aeronautical fixed stations:		
Power 500 W or less	50	
Power above 500 W	15	
Single-sideband and Independent-sideband emission:		
Power 500 W or less		50 Hz
Power above 500 W		20 Hz
Class F1B emissions		10 Hz
Other classes of emission:		
Power 500 W or less		20
Power above 500 W		10
Aeronautical stations:		
Power 500 W or less	[7] 100	100 [7]
Power above 500 W	[7] 50	50 [7]
Aircraft stations	[7] 100	100 [7]
Survival craft stations on 8364 kHz.	200	50 Hz [3]
(4) Band-29.7 to 100 MHz:		
Aeronautical fixed stations:		
Power 200 W or less	50	
Power above 200 W	30	
Power 50 W or less		30
Power above 50 W		20
Operational fixed stations:		
73–74.6 MHz (Power 50 W or less).	50	30
73–74.6 MHz (Power above 50 W).	20	20
72–73.0 MHz and 75.4–76.0 MHz.	5	5
Radionavigation stations	100	50
(5) Band-108 to 137 MHz:		
Aeronautical stations	[4] 50	[12] 20
Emergency locator transmitter test stations.	50	50
Survival craft stations on 121.5 MHz.	50	50
Emergency locator stations	50	50
Aircraft and other mobile stations in the Aviation Services.	[5] 50	[13] 30
Radionavigation stations	20	20
Differential GPS		2
(6) Band-137 to 470MHz:		
Aeronautical stations	50	20
Survival craft stations on 243 MHz.	50	50
Aircraft stations	50 [5]	30 [10]
Radionavigation stations	50	50
Emergency locator transmitters on 406 MHz.	N/A	5
(7) Band-470 to 2450 MHz:		
Aeronautical stations	100	20
Aircraft stations	100	20
Aircraft earth station		320 Hz [11]
Aeronautical utility mobile stations on 1090 MHz.	1000	1000
Radionavigation stations:		
470–960 MHz	500	500
960–1215 MHz	20	20
1215–2450 MHz	500	500
(8) Band-2450 to 10500 MHz:		
Radionavigation stations	[6 9] 1250	1250 [6 9]
(9) Band-10.5 GHz to 40 GHz:		
Radionavigation stations	5000	5000

[1] This tolerance is the maximum permitted until January 1, 1990, for transmitters installed before January 2, 1985, and used at the same installation. Tolerance is indicated in parts in 10^6 unless shown as Hertz (Hz).

[2] This tolerance is the maximum permitted after January 1, 1985 for new and replacement transmitters and to all transmitters after January 1, 1990. Tolerance is indicated in parts in 10^6 unless shown as Hertz (Hz).

[3] For transmitters first approved after November 30, 1977.

[4] The tolerance for transmitters approved between January 1, 1966, and January 1, 1974, is 30 parts in 10^6. The tolerance for transmitters approved after January 1, 1974, and stations using offset carrier techniques is 20 parts in 10^6.

[5] The tolerance for transmitters approved after January 1, 1974, is 30 parts in 10^6.

[6] In the 5000 to 5250 MHz band, the FAA requires a tolerance of ±10 kHz for Microwave Landing System stations which are to be a part of the National Airspace System (FAR 171).

[7] For single-sideband transmitters operating in the frequency bands 1605–4000 kHz and 4–29.7 MHz which are allocated exclusively to the Aeronautical Mobile (R) Service, the tolerance is: Aeronautical stations, 10 Hz; aircraft stations, 20 Hz.

[8] For single-sideband radiotelephone transmitters the tolerance is: In the bands 1605–4000 kHz and 4–29.7 MHz for peak envelope powers of 200 W or less and 500 W or less, respectively, 50 Hz; in the bands 1605–4000 kHz and 4–29.7 MHz for peak envelope powers above 200 W and 500 W, respectively, 20 Hz.

[9] Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations must be maintained within the band allocated to the service and the indicated tolerance does not apply.

[10] Until January 1, 1997, the maximum frequency tolerance for transmitters with 50 kHz channel spacing installed before January 2, 1985, is 50 parts in 10^6.

[11] For purposes of certification, a tolerance of 160 Hz applies to the reference oscillator of the AES transmitter. This is a bench test.

[12] For emissions G1D and G7D, the tolerance is 2 parts per 10^6.

[13] For emissions G1D and G7D, the tolerance is 5 parts per 10^6.

(b) The power shown in paragraph (a) of this section is the peak envelope power for single-sideband transmitters and the mean power for all other transmitters.

(c) For single-sideband transmitters, the tolerance is:

(1) All aeronautical stations on land—10 Hz.

(2) All aircraft stations—20 Hz.

(d) For radar transmitters, except non-pulse signal radio altimeters, the frequency at which maximum emission occurs must be within the authorized frequency band and must not be closer than 1.5/T MHz to the upper and lower limits of the authorized bandwidth, where T is the pulse duration in microseconds.

(e) The Commission may authorize tolerances other than those specified in

this section upon a satisfactory showing of need.

(f) The carrier frequency tolerance of all transmitters that operate in the 1435–1525 MHz or 2345–2395 MHz band is 0.002 percent. The carrier frequency tolerance of all transmitters that operate in the 5091–5150 MHz band is 0.005 percent.

(g) Any aeronautical enroute service transmitter operating in U.S. controlled airspace with 8.33 kHz channel spacing (except equipment being tested by avionics equipment manufacturers and flight test stations prior to delivery to their customers for use outside U.S. controlled airspace) must achieve 0.0005% frequency stability when operating in that mode.

[53 FR 28940, Aug. 1, 1988, as amended at 56 FR 38084, Aug. 12, 1991; 57 FR 45749, Oct. 5, 1992; 58 FR 31027, May 26, 1993; 63 FR 36607, July 7, 1998; 64 FR 27474, May 20, 1999; 66 FR 26799, May 15, 2001; 69 FR 32880, June 14, 2004; 76 FR 17350, Mar. 29, 2011; 78 FR 61205, Oct. 3, 2013; 80 FR 38909, July 7, 2015]

§ 87.135 Bandwidth of emission.

(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.

(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.

(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

§ 87.137 Types of emission.

(a) The assignable emissions, corresponding emission designators and authorized bandwidths are as follows:

Class of emission	Emission designator	Authorized bandwidth (kilohertz)		
		Below 50 MHz	Above 50 MHz	Frequency deviation
A1A[1]	100HA1A	0.25		
A1N	300HA1N		0.75	
A2A	2K04A2A	2.74	50	
A2D	6K0A2D		50	
A2D[5]	13K0A2D		50	
A3E[2]	6K00A3E		50[3]	
A3E kHz[17]	5K6A3E		8.33	
A3X[4]	3K20A3X		25	
A9W[5]	13K0A9W		25	
F1B[1]	1K70F1B	1.7		
F1B[1]	2K40F1B	2.5		
F1D[18]	1M30F1D		1300 kHz	312.5 kHz
F2D	5M0F2D		([9])	
F3E[6]	16K0F3E		20	5
F3E[7]	36K0F3E		40	15
F7D[8]	5M0F7D		[9]	
F9D	5M0F9D		[9]	
G1D	16K0G1D		20 kHz	
G1D[16]	21K0G1D		25	
G1D	14K0G1D		25	
F9D	5M0F9D		[9]	
G1D	16K0G1D		20 kHz	
G3E[6]	16K0G3E		20	5
G7D	14K0G7D		25	
H2B[10 11]	2K80H2B	3.0		
H3E[11 12]	2K80H3E	3.0		
J2A[1]	100HJ2A	0.25		
J2B[1]	1K70J2B	1.7		
	2K40J2B	2.5		
J3E[11 12]	2K80J3E	3.0		
J7B[11]	2K80J7B	3.0		
J7D	5M0J7D		[9]	
J9W[11]	2K80J9W	3.0		
M1A	620HM1A			
M1D	14M0M1D	14.0		
NON	NON		None[15]	
PON[13]	[9]		[9]	
R3E[11 12]	2K80R3E	3.0		
XXA[14]	1K12XXA	2.74		

NOTES:

[1] A1A, F1B, J2A and J2B are permitted provided they do not cause harmful interference to H2B, J3E, J7B and J9W.

[2] For use with an authorized bandwidth of 8.0 kilohertz at radiobeacon stations. A3E will not be authorized:

(i) At existing radiobeacon stations that are not authorized to use A3 and at new radiobeacon stations unless specifically recommended by the FAA for safety purposes.

(ii) At existing radiobeacon stations currently authorized to use A3, subsequent to January 1, 1990, unless specifically recommended by the FAA for safety purposes.

[3] In the band 117.975–136 MHz, the authorized bandwidth is 25 kHz for transmitters approved after January 1, 1974.

[4] Applicable only to Survival Craft Stations and to the emergency locator transmitters and emergency locator transmitter test stations employing modulation in accordance with that specified in § 87.141 of the Rules. The specified bandwidth and modulation requirements shall apply to emergency locator transmitters for which approval is granted after October 21, 1973.

[5] This emission may be authorized for audio frequency shift keying and phase shift keying for digital data links on any frequency listed in § 87.263(a)(1), § 87.263(a)(3) or § 87.263(a)(5). 13K0A2D emission may be authorized on frequencies not used for voice communications. If the channel is used for voice communications, 13K0A9W emission may be authorized, provided the data is multiplexed on the voice carrier without derogating voice communications.

[6] Applicable to operational fixed stations in the bands 72.0–73.0 MHz and 75.4–76.0 MHz and to CAP stations using F3 on 143.900 MHz and 148.150 MHz.

[7] Applicable to operational fixed stations presently authorized in the band 73.0–74.6 MHz.