Appendix 1

List of matters concerning applications for frequency assignments in accordance with Article 56, Paragraph 1 of the Telecommunications Management Act

Frequency use	Applicant eligibility	Documents submitted	Matters for review	Frequency use period	Conditions for abolishing frequencies

For dedicated telecoms network	1. Those who apply for the establishment of public service network and use of radio frequency are limited to those confirmed by the competent authority of target business for compliance with public service purposes.
	 2. Those who apply for the establishment of private network and use of radio frequency are limited to companies, juristic persons and organizations.
		1. Radio frequency allocation application form
		 2. Radio frequency use plan:
		   2.1) Purpose of and configuration for use of radio frequency: including radio frequencies, frequency bandwidths and transmission power used in the areas of establishment and radio wave coverage. The radio wave coverage shall be provided with a topographic or electronic map that contains longitudes and latitudes;
		   2.2) Necessary configuration against interference;
		   2.3) Planning of frequency allocations for networks and radio stations: including network establishment blueprint, as well as type, frequency, frequency bandwidth, transmitting power, quantity and technical specifications of stations., etc.
		 3. Letter from competent authority of target business confirming compliance with public service purposes. (Exempted for users of private networks, government agencies, public schools, government-owned enterprises and non-departmental public bodies, etc.);
		 4. Descriptions of services provided by telecommunications enterprises, the use of a frequency that does not need distribution, or fixed telecommunications network, which cannot fulfill the need of network
			In addition to the matters stipulated in Articles 10 and 11 of the Regulations Governing the Use of Radio Frequencies (hereinafter the "Regulations"), the following matters shall also be examined:
			 1. For those who apply for use of private network, whether the services provided by the telecommunications enterprises, the use of a frequency that does not need distribution, or fixed telecommunications network cannot fulfill the need of network establisher.
			 2. Whether the application is in line with the purpose and area of establishment.
				The period of validity of the frequency use certificate:
				 1. 10 years for the establishment of public service network
				 2. 5 years for the establishment of private network.
					1. The competent authority abolishes the frequency allocation and use after the conditions specified in Article 62, Paragraph 2 of the Telecommunications Management Act (hereinafter the Act) are fulfilled.
					 2. An application has been submitted for return of radio frequency before the frequency use certificate expires, and the competent authority revokes the frequency use certificate.

Frequency use	Applicant eligibility	Documents submitted	Matters for review	Frequency use period	Conditions for abolishing frequencies
		establisher. (Exempted for users of public service network) 5. Any other documents specified by the competent authority.			
For dedicated experiments and R&D telecoms network	Those who apply shall fall under one of the following qualifications and shall not be of a China-funded investment business: 1. Corporations or public or private research institutions that have committed to related research or manufacturing of telecommunications network and radio communications. 2. Other government agencies/organizations, educational institutes, companies, legal persons or groups that have the capabilities or experimental testing needs of establishing and managing experimental research and development telecommunications networks.	1. Radio frequency allocation application form. 2. Radio frequency use plan: 2.1) Experiment items, methods and benefits; 2.2) Purpose of and configuration for use of radio frequency: including radio frequencies, frequency bandwidths and transmission power used in the areas of establishment and radio wave coverage. The radio wave coverage shall be provided with a topographic or electronic map that contains longitudes and latitudes; 2.3) Description of the measurement evaluation data, which shall include various radio frequencies of radio wave ($\geqq$-125dBm) coverage for each of the experimental areas and the range of the experiments. 2.4) Planning of frequency allocations for networks and radio stations: including network establishment proposal, as well as type, frequency, frequency bandwidth, transmitting power, quantity and technical specifications of stations., etc. 2.5) Necessary configuration against interference (Exempted in the case of technical experiments and R&D telecommunications network using specific experimental frequencies for specific experimental fields);	In addition to the matters stipulated in Articles 10 and 11 of the Regulations, the following matters shall be examined: 1. Whether it is in line with the purpose, effectiveness and necessity of the experiment; 2. Whether it conforms to the geographical range and the valid period of the establishment; 3. Whether the research, development, testing or collection of relevant data will contribute to the development of the telecommunications industry and specific industries; 4. For applications for the use of commercial experiments and R&D telecommunications networks, whether the execution planning and implementation period of business verification are feasible; 5. Whether applications for the use of commercial experiments and R&D telecommunication networks will be effective in promoting the nation's industrial development and feasibility of commercialization of future verification services; 6. Whether there is a need to continue current experiment items or to add new experiment items. For applications for the use of technical experiments and R&D telecommunications networks in the frequency band between 4.8GHz and 4.9 GHz, the following review criteria shall be considered in addition to	The validity period of the frequency use certificate: 1. For the establishment and use of technical experiments and R&D telecommunications networks: One year from the date of issuance of the network examination approval certificate; 2. For the establishment and use of commercial experiments and R&D telecommunications networks: Six months from the date of issuance of the network examination approval certificate, after the expiry of which the certificate shall be renewed only once, not subject to the provisions of Article 11, Paragraph 1 of the Regulations.	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled. 2. An application has been submitted for return of radio frequency before the frequency use certificate expires, and the competent authority revokes the frequency use certificate. 3. The competent authority revokes the frequency use certificate upon the abolition of the network establishment approval or network examination approval certificate of experiments and R&D telecommunications networks. 4. The applicant should obtain a network examination approval certificate within six months from the date of issuance of the frequency use certificate. If the applicant is unable to obtain the certificate, he/she may apply to the competent authority for an extension by stating the reasons for a

Frequency use	Applicant eligibility	Documents submitted	Matters for review	Frequency use period	Conditions for abolishing frequencies
		2.6) Available technical R&D telecommunications services or service items other than telecommunications services; 2.7) Purpose and necessity of business verification of commercial experiments and R&D telecommunications network, including the telecommunications service items for the business verification and the description of the differences from existing public telecommunications service, as well as the execution planning and implementation period (exempted for users of technical experiments and R&D telecommunication networks); 2.8) Benefits of the telecommunications of business verification for the development of domestic industries and the feasibility evaluation for future commercialization in domestic market (exempted for users of technical experiments and R&D telecommunication networks). 3. A copy of the certificate of incorporation or other establishment document (exempt for government agencies or schools). 4. Photocopies of documents relating to technology or services chartered, permitted or approved by other competent authorities of target business. 5. Any other documents specified by the competent authority. For the application for the use of the frequency band from 4.8GHz to 4.9GHz,	those mentioned in the preceding paragraph: 1. Whether the applicant is one who has the jurisdiction of the field, owner or user; 2. Whether the bandwidth applied for is reasonable; 3. Whether the necessary configuration against interference is feasible; 4. Whether the radio wave coverage exceeds the range of field applied for. For applications for the use of technical experiments and R&D telecommunications networks, where the radio frequency and geographical coverage are overlapping across multiple applicants, the one with more subjects of cooperation shall have the priority; however, the competent authority may ask the applicants to reach a mutual agreement if necessary. Applications for the establishment of commercial experiments and R&D telecommunications networks using the frequency band between 4.8GHz and 4.9 GHz will be rejected.		maximum period of six months, limited to one extension. The competent authority shall revoke the frequency use certificate upon expiry.

Frequency use	Applicant eligibility	Documents submitted	Matters for review	Frequency use period	Conditions for abolishing frequencies
		the following matters should be stated in addition to those set out in the radio frequency use plan: 1. Relationship between the applicant and the field of application (those who have the jurisdiction, owner or user), with supporting documents submitted; 2. Bandwidth to be used in 10MHz.			
For dedicated taxi telecoms network	Limited to legal entities or organizations whose taxi or taxi service business has been approved by the competent authority of highways.	1. Radio frequency allocation application form. 2. Letter from the competent authority of highways approving the establishment of telecommunications network.	Subject to the provisions of Articles 10 and 11 of the Regulations.	The validity period of the frequency use certificate: 5 years	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled. 2. An application has been submitted for return of radio frequency before the frequency use expires, and the competent authority revokes the frequency allocation and use. 3. Upon notification by the competent authority of highways regarding the revocation of the frequency use certificate of the dedicated taxi telecommunications network, the competent authority abolishes the frequency use certificate.
For terrestrial radio	Broadcasting enterprises established or operated under the Radio and Television Act.	1. Radio frequency allocation application form. 2. Photocopy of the approval letter of establishment permit or broadcast license.	Subject to the provisions of Articles 10 and 11 of the Regulations.	Frequency use is valid until the expiry date of the broadcast license.	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled. 2. An application has been submitted for return of radio frequency before

Frequency use	Applicant eligibility	Documents submitted	Matters for review	Frequency use period	Conditions for abolishing frequencies
					the frequency use expires, and the competent authority revokes the frequency allocation and use.
For terrestrial television	Television enterprises established or operated under the Radio and Television Act.	1. Radio frequency allocation application form. 2. Photocopy of the approval letter of establishment permit or television license.	Subject to the provisions of Articles 10 and 11 of the Regulations.	Frequency use is valid until the expiry date of the television license.	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled. 2. An application has been submitted for return of radio frequency before the frequency use expires, and the competent authority revokes the frequency allocation and use.
For broadcasting stations for school training	Applicants who have obtained the consent of the administrative authority of education to set up a broadcasting station for school training (television broadcasting, news, mass broadcasting, broadcasting technology or other related departments of higher education facilities for educational and practical training purposes)	1. Radio frequency allocation application form. 2. A copy of the letter of consent from the administrative authority of education. 3. Radio frequency use plan: including radio wave coverage, radio frequencies, frequency bandwidths and transmission power used. The radio wave coverage shall be provided with a topographic or electronic map that contains longitudes and latitudes.	Subject to the provisions of Articles 10 and 11 of the Regulations.	The validity period of the frequency use certificate: 10 years	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled. 2. An application has been submitted for return of radio frequency before the frequency use certificate expires, and the competent authority revokes the frequency use certificate.
For microwave links	1. Telecommunications enterprises that have established public telecommunications networks. 2. Radio and television	1. Radio frequency allocation application form. 2. Radio frequency use plan: including an analysis of the radio frequency and frequency bandwidth needs of the communication network, the	In addition to the matters provided for in Articles 10 and 11 of the Regulations, the use of microwave links shall be examined for back-up circuits or for terrain, physical obstructions or other practical applications.	The validity period of the frequency use certificate: 10 years	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled.

Frequency use	Applicant eligibility	Documents submitted	Matters for review	Frequency use period	Conditions for abolishing frequencies
	businesses established or operated under the Radio and Television Act or the Cable Radio and Television Act.	transmitting power and the radio wave coverage. The radio wave coverage shall be provided with a topographic or electronic map that contains longitudes and latitudes. 3. Radio station establishment planning data: including a list of the number of radio stations to be established, their intended locations and relative distances, antenna heights, azimuths and intervals between stations. 4. Interference analysis data: including descriptions of link analysis calculations and interference evaluation coordination. 5. Copies of relevant business operation license. 6. Other documents specified by the competent authority (New radio frequencies on existing networks should be accompanied by supporting documentation for the overall communications network).			2. An application has been submitted for return of radio frequency before the frequency use certificate expires, and the competent authority revokes the frequency use certificate.
For satellite links	1. Telecommunications enterprises that have established public telecommunications networks. 2. Radio and television businesses established or operated under the Radio and Television Act or the Satellite Broadcasting Act.	1. Radio frequency allocation application form. 2. Information on the radio wave coverage of the satellite transponder: The radio wave coverage shall be provided with a topographic or electronic map that contains longitudes and latitudes. 3. Copies of contracts or certificates of right to use satellite transponder. 4. Copies of relevant business operation license. 5. Other documents specified by the competent authority (description of the satellite transponder number and its frequency configuration, as well as the evaluation of existing frequency interference in the same/adjacent path, etc.).	Subject to the provisions of Articles 10 and 11 of the Regulations.	The validity period of the frequency use certificate: 10 years	1. The competent authority abolishes the frequency allocation and use after the conditions set out in Article 62, Paragraph 2 of the Act are fulfilled. 2. An application has been submitted for return of radio frequency before the frequency use certificate expires, and the competent authority revokes the frequency use certificate.

Appendix 2
Classification of Emission Designation and Necessary Bandwidths
I.   Designation of Emission

The basic characteristics are:

1. First symbol – type of modulation of the main carrier;

2. Second symbol – nature of signal(s) modulating the main carrier;

3. Third symbol – type of information to be transmitted.

Modulation used only for short periods and for incidental purposes (such as, in many cases, for identification or calling) may be ignored provided that the necessary bandwidth as indicated is not thereby increased.

1.   First Symbol – Type of modulation of the main carrier

1.1 Emission of an unmodulated carrier   N

1.2 Emission in which the main carrier is amplitude-modulated (including cases where sub-carriers are angle-modulated)

    1.2.1 Double-sideband   A

    1.2.2 Single-sideband, full carrier   H

    1.2.3 Single-sideband, reduced or variable level carrier   R

    1.2.4 Single-sideband, suppressed carrier   J

    1.2.5 Independent sidebands   B

    1.2.6 Vestigial sideband   C

1.3 Emission in which the main carrier is angle-modulated

    1.3.1 Frequency modulation   F

    1.3.2 Phase modulation   G

1.4 Emission in which the main carrier is amplitude-and angle-modulated either simultaneously or in a pre-established sequence   D

1.5 Emission of pulses(Emissions where the main carrier is directly modulated by a signal which has been coded into quantized form (e.g. pulse code modulation) should be designated under 1.2 or 1.3)

    1.5.1 Sequence of unmodulated pulses   P

    1.5.2 A sequence of pulses

        1.5.2.1 Modulated in amplitude   K

        1.5.2.2 Modulated in width/duration   L

        1.5.2.3 Modulated in position/phase   M

        1.5.2.4 In which the carrier is angle-modulated during the angle-period of the pulse   Q

        1.5.2.5which is a combination of the foregoing or is produced by other means   V

    1.6 Cases not covered above, in which an emission consists of the main carrier modulated, either simultaneously or in a pre-established sequence, in a combination of two or more of the following modes: amplitude, angle, pulse: W

1.7 Cases not otherwise covered   X

2.   Second Symbol –Nature of signal(s) modulating the main carrier

2.1 No modulating signal   0

2.2 A single channel containing quantized or digital information without the use of a modulating sub-carrier (except time-division multiplex)   1

2.3 A single channel containing quantized or digital information with the use of a modulating sub-carrier (except time-division multiplex)   2

3.   Third Symbol – Type of information to be transmitted

4.   In this context the word "information" does not include information of a constant, unvarying nature such as is provided by standard frequency emissions, continuous wave and pulse radars, etc.

II.   In the formulation of the table, the following terms have been employed:

B_n : Necessary bandwidth (Hz)

B: Modulation rate (Bd)

N : Maximum possible number of black plus white elements to be transmitted per second, in facsimile

M : Maximum modulation frequency (Hz)

C : Sub-carrier frequency (Hz)

D : Peak deviation, i.e. half the difference between the maximum and minimum values of the instantaneous frequency. The instantaneous frequency (Hz) is the time rate of change in phase (rad) divided by 2π

t : Pulse duration (s) at half-amplitude

tr : Pulse rise time (s) between 10% and 90% amplitude

K : An overall numerical factor which varies according to the emission and which depends upon the allowable signal distortion

N_c : Number of baseband channels in radio systems employing multi-channel multiplexing

f_p : Continuity pilot sub-carrier frequency (Hz) (continuous signal utilized to verify performance of frequency-division multiplex systems)

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
I. No modulating signal			
Continuous wave emission			None

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
II. Amplitude modulation			
1. Signal with quantized or digital information			
Continuous wave telegraphy, (Morse Code)	$B_n = BK$ K＝5 for fading circuits K＝3 for non-fading circuits	25 words per minute; B＝20, K＝5 Bandwidth: 100 Hz	100HA1AAN
Telegraph by on-off keying of a tone modulated carrier, (Morse Code)	$B_n = BK + 2M$ K＝5 for fading circuits K＝3 for non-fading circuits	25 words per minute; B＝20, M＝1000, K＝5 Bandwidth: 2100 Hz＝2.1 kHz	2K10A2AAN
Selective calling signal using sequential (single frequency code, single-sideband full carrier)	$B_n = M$	Maximum code frequency: 2110 Hz M＝2110 Bandwidth: 2100 Hz＝2.11 kHz	2K11H2BFN
Direct-printing telegraphy using a frequency shifted modulating sub-carrier, with error-correction, single-sideband, suppressed carrier (single channel)	$B_n = 2M + 2DK$ $M = \frac{B}{2}$	B＝50 D＝35 Hz (70 Hz shift) K＝1.2 Bandwidth: 134 Hz	134HJ2BCN
Telegraphy, multi-channel with voice frequency, error correction. Some channels are time-division multiplexed, (single side-band, reduced carrier)	$B_n =$ highest central frequency + M + DK $M = \frac{B}{2}$	15 channels; highest central frequency is: 2850 Hz B＝100 D＝42.5 Hz (85 Hz shift) K＝0.7 Bandwidth: 2885 Hz＝2.885 kHz	2K89R7BCW
2. Telephony (commercial quality)			
Telephony, double-sideband (single channel)	$B_n = 2M$	M＝3000 Bandwidth: 6000 Hz＝6 kHz	6K00A3EJN
Telephony, single-sideband full carrier (single channel)	$B_n = M$	M＝3000 Bandwidth: 3000 Hz＝3 kHz	3K00H3EJN

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
Telephony, single-sideband, suppressed carrier (single channel)	$B_n = M -$ lowest modulation frequency	M＝3000 lowest modulation frequency is 300 Hz Bandwidth: 2700＝2.7 kHz	2K70J3EJN
Telephony with separate frequency modulated signal to control the level of demodulated speech signal, single-sideband, reduced carrier (Lincompex) (single channel)	$B_n = M$	Maximum control frequency is 2990 Hz M＝2990 Bandwidth: 2990 Hz＝2.99 kHz	2K99R3ELN
Telephony with privacy, single sideband, suppressed carrier (two or more channels)	$B_n = N_c M -$ lowest modulation frequency in the lowest channel	$N_c = 2$ M＝3000 lowest modulation frequency is 250 Hz Bandwidth: 5750 Hz＝5.75 kHz	5K75J8EKF
Sound broadcasting, double-sideband	$B_n =$ sum of M for each sideband	2 channels M＝3000 Bandwidth: 6000 Hz＝6 kHz	6K00B8EJN
3. Sound broadcasting			
Sound broadcasting, double-sideband	$B_n = 2M$ M may vary between 4000 and 10000 depending on the quality desired	Speech and music M＝4000 Bandwidth: 8000 Hz＝8 kHz	8K00A3EGN
Sound broadcasting, single-sideband, reduced carrier (single channel)	$B_n = M$ M may vary between 4000 and 10000 depending on the quality desired	Speech and music M＝4000 Bandwidth: 4000 Hz＝4 kHz	4K00R3EGN
Sound broadcasting, single-sideband, suppressed carrier	$B_n = M -$ lowest modulation frequency	Speech and music M＝4500 lowest modulation frequency is 50 Hz Bandwidth: 4450 Hz＝4.45 kHz	4K45J3EGN
4. Television			

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
Television, vision and sound	Refer to CNS 14972	Bandwidth of radio channel: 6 MHz	6M00G7W
5. Facsimile			
Analogue facsimile by sub-carrier frequency modulation of a single-sideband emission with reduced carrier monochrome	$B_n = C + \frac{N}{2} + DK$ $K = 1.1$ (typically)	$N = 1100$ Corresponding to an index of cooperation of 352 and a cycler rotation speed of 60 rpm. Index of cooperation is the product of the drum diameter and number of lines per unit length. $C = 1900$ $D = 400$ Hz Bandwidth: 2890 Hz $=$ 2.89 kHz	2K89R3CMN
Analogue facsimile; frequency modulation of an audio frequency sub- carrier which modulates the main carrier, single-sideband suppressed carrier	$B_n = 2M + 2DK$ $M = \frac{N}{2}$ $K = 1.1$ (typically)	$N = 1100$ $D = 400$ Hz Bandwidth: 1980 Hz $=$ 1.98 kHz	1K98J3C--
6. Composite emissions			
Double-sideband, television relay	$B_n = 2C + 2M + 2D$	Video limited to 5 MHz Audio on 6.5 MHz, frequency modulated sub-carrier $=$ 50 kHz; $C = 6.5 \times 10^6$ $D = 50 \times 10^3$ Hz $M = 15000$ Bandwidth: 13.13×10^6 Hz $=$ 13.13 MHz	13M1A8W--
Double-sideband radio relay system, frequency division multiplex	$B_n = 2M$	10 voice channels occupying baseband between 1 kHz and 164 kHz; $M = 164000$ Bandwidth: 328000 Hz $=$ 328 kHz	328KA8E--

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
Double-sideband emission of VOR with voice (VOR =VHF omnidirectional radio range)	$B_n=2C_{max}+2M+2DK$ $K=1$ (typically)	The main carrier is modulated by: - A 30Hz sub-carrier - A carrier resulting from a 9960Hz tone frequency modulated by a 30 Hz tone - A telephone channel - A 1020Hz keyed tone for continual Morse identification $C_{max}=9960$ M＝30 D＝480 Hz Bandwidth: 20940 Hz＝20.94 kHz	20K9A9WWF
Independent sidebands; several telegraph channels with error-correction together with several telephone channels with privacy; frequency division multiplex	B_n = sum of M for each sideband	Normally composite systems are operated in accordance with standardized channel arrangements (e.g. Rec. ITU-R F.348). 3 telephone channels and 15 telegraphy channels require the bandwidth: 12000 Hz＝12 kHz	12K0B9WWF
III. Frequency Modulation			
1. Signal with quantized or digital information			
Telegraphy without error correction device. (single channel)	$B_n=2M+2DK$ $M=\frac{B}{2}$ $K=1.2$ (typically)	B＝100 D＝85 Hz (170 Hz shift) Bandwidth: 304 Hz	304HF1BBN
Telegraphy, narrowband direct-printing with error correction (single channel)	$B_n=2M+2DK$ $M=\frac{B}{2}$ $K=1.2$ (typically)	B＝100 D＝85 Hz (170 Hz shift) Bandwidth: 304 Hz	304HF1BCN
Selective calling signal	$B_n=2M+2DK$ $M=\frac{B}{2}$ $K=1.2$ (typically)	B＝100 D＝85 Hz (170 Hz shift) Bandwidth: 304 Hz	304HF1BCN

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
Four frequency duplex telegraphy	$B_n=2M+2DK$ B＝modulation rate (Bd) of the faster channel. If the channels are synchronized: $M=\frac{B}{2}$ (otherwise M＝2B) K＝1.1 (typically)	Spacing between adjacent frequencies ＝400 Hz, synchronized channels B＝100 M＝50 D＝600 Hz Bandwidth: 1420 Hz ＝1.42 kHz	1K42F7BDX
2. Telephony (commercial quality)			
Commercial telephony	$B_n=2M+2DK$ K＝1 (typically, but under certain conditions a higher value may be necessary)	For an average case of commercial telephony, D＝5000 Hz M＝3000 Bandwidth: 16000 Hz＝16 kHz	16K0F3EJN
3. Sound broadcasting			
Sound Broadcasting	$B_n=2M+2DK$ K＝1 (typically)	Monaural D＝75000 Hz M＝15000 Bandwidth: 180000 Hz＝180 kHz	180KF3EGN
4. Facsimile			
Facsimile by direct frequency modulation of the carrier; black and white	$B_n=2M+2DK$ $M=\frac{N}{2}$ K＝1.1 (typically)	N＝1100 elements/sec D＝400 Hz Bandwidth: 1980 Hz ＝1.98 kHz	1K98F1C--
Analogue facsimile	$B_n=2M+2DK$ $M=\frac{N}{2}$ K＝1.1 (typically)	N＝1100 elements/sec D＝400 Hz Bandwidth: 1980 Hz ＝1.98 kHz	1K98F3C--

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
5. Composite emissions (see table III-B)			
Radio-relay system, frequency division multiplex	$B_n = 2f_p + 2DK$ $K = 1$ (typically)	60 telephone channels occupying baseband between 60 kHz and 300 kHz; rms per-channel deviation: 200 kHz; continuity pilot at 331 kHz produces 100 kHz rms deviation of main carrier. $D = 200 \times 10^3$ $\times 3.76 \times 2.02 =$ 1.52×10^6 Hz， $f_p = 0.331 \times 10^6$ Hz Bandwidth: 3.702×10^6 Hz $= 3.702$ MHz	3M70F8EJF
Radio-relay system, frequency division multiplex	$B_n = 2M + 2DK$ $K = 1$ (typically)	960 telephone channels occupying baseband between 60 kHz and 4028 kHz; rms per- channel deviation: 200 kHz; continuity pilot at 4715 kHz produces 140 kHz rms deviation of main carrier. $D = 200 \times 10^3 \times 3.76 \times 5.5 = 4.13 \times 10^6$ Hz $M = 4.028 \times 10^6$; $f_p = 4.715 \times 10^6$; $(2M + 2DK) > 2f_p$ Bandwidth: 16.32×10^6 Hz $= 16.32$ MHz	16M3F8EJF
Radio relay systems, frequency division multiplex	$B_n = 2f_p$	600 telephone channels occupying baseband between 60 kHz and 2540 kHz. rms per- channel deviation: 200 kHz; continuity pilot at 8500 kHz produces with 140 kHz rms deviation of main carrier. $D = 200 \times 10^2 \times 3.76 \times 4.36 = 3.28 \times 10^6$ Hz; $M = 2.54 \times 10^6$; $K = 1$; $f_p = 8.5 \times 10^6$ Hz; $(2M + 2DK) < 2f_p$ Bandwidth: 17×10^6 Hz $= 17$ MHz	17M0F8EJF

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
Stereophonic sound broadcasting with multiplexed telephony sub-carrier	$B_n=2M+2DK$ $K=1$ (typically)	Pilot tone systems; M＝75000 D＝75000 Hz Bandwidth: 300000 Hz＝300 kHz	300KF8EHF

III-B. Multiplying factors for use in computing D, peak frequency deviation, in FM frequency division multiplex (FM-FDM) multi-channel emissions

For FM-FDM systems the necessary bandwidth is:

$$B_n=2M+2DK$$

The value of D, or peak frequency deviation, in these formulae for B_n is calculated by multiplying the rms value of per-channel deviation by the appropriate "multiplying factor" shown below.

In the case where a continuity pilot of frequency f_p exists above the maximum modulation frequency M, the general formula becomes:

$$B_n=2f_p+2DK$$

In the case where the modulation index of the main carrier produced by the pilot is less than 0.25, and the rms frequency deviation of the main carrier produced by the pilot is less than or equal to 70% of the rms value of per-channel deviation, the general formula becomes either:

$$B_n=2f_p \text{ or } B_n=2M+2DK$$

whichever is greater.

Number of telephone channels N_c	Multiplying factor[1]
	(Peak factor) x $log^1 \left\lceil \dfrac{value\ in\ dB\ above\ modulation\ reference\ level}{20} \right\rceil$
$3<N_c<12$	(Peak factor) x log^1 $\left\lceil \dfrac{a\ value\ in\ dB\ specified\ by\ the\ equipment\ manufacturer\ or\ station\ licensee, subject}{20} \right.$
$12\leqq N_c<60$	$3.76 \text{ x } log^1 \left\lceil \dfrac{2.6+2\ log\ N_c}{20} \right\rceil$

1. In the above chart, the multipliers 3.76 and 4.47 correspond to peak factors of 11.5 dB and 13.0 dB, respectively.

Number of telephone channels N_c	Multiplying factor[1]
	(Peak factor) x $log^{-1} \left\lceil \dfrac{value\ in\ dB\ above\ modulation\ reference\ level}{20} \right\rceil$
$60 \leqq N_c < 240$	3.76 x $log^{-1} \left\lceil \dfrac{-1 + 4\ log\ N_c}{20} \right\rceil$
$N_c \geqq 240$	3.76 x $log^{-1} \left\lceil \dfrac{-15 + 10\ log\ N_c}{20} \right\rceil$

1. In the above chart, the multipliers 3.76 correspond to peak factors of 11.5 dB.

Description of emission	Necessary bandwidth		Designation of emission
	Formula	Sample calculation	
IV. Pulse modulation			
1. Radar			
Unmodulated pulse emission	$B_n = \dfrac{2K}{t}$ K depends upon the ratio of pulse duration to pulse rise time. Its value usually falls between 1 and 10 and in many cases it does not need to exceed 6.	Primary radar: range resolution = 150m K = 1.5 (triangular pulse when t $\cong$ tr, only components down to 27dB from the strongest are considered) Then: t = $\dfrac{2x(range\ resolution)}{velocity\ of\ light} = \dfrac{2\ x\ 150}{3\ x\ 10^8}$ Bandwidth: 3×10^6 Hz $= 3$ MHz	3M00P0NAN
2. Composite emissions			
Radio-relay system	$B_n = \dfrac{2K}{t}$ K $= 1.6$	Pulse position modulated by 36 voice channel baseband; pulse width at half amplitude $= 0.4\mu$s Bandwidth: 8×10^6 Hz $= 8$ MHz (Bandwidth independent of the number of voice channels)	8M00M7EJT

Appendix 3
Table of Transmitter Frequency Tolerance

1. The frequency tolerance is expressed in parts in 10^6 (ppm) or in hertz (Hz).

2. The power shown for the various categories of stations is the peak envelope power for single-sideband transmitters and the mean power for all other transmitters, unless otherwise indicated.

3. For technical and operational reasons, certain categories of stations may need more stringent tolerance than those shown in the table.

Frequency bands (lower limit exclusive, upper limit inclusive) and categories of stations	Tolerance applicable to transmitters
Bandwidth: 9 kHz to 535 kHz	
1. Fixed stations:	
－9 kHz to 50 kHz	100 ppm
－50 kHz to 535 kHz	50 ppm
2. Land stations:	
a. Coast stations	100 ppm (1)(2)
b. Aeronautical stations	100 ppm
3. Mobile stations:	
a. Ship stations	200 ppm (3)(4)
b. Ship emergency transmitters	500 ppm (5)
c. Survival craft stations	500 ppm
d. Aircraft stations	100 ppm
4. Radiodetermination stations	100 ppm
5. Broadcasting Stations	10 Hz
Bandwidth: 535 kHz to 1606.5 kHz	
Broadcasting Stations	10 Hz (6)
Bandwidth: 1.6065 to 4 MHz	
1. Fixed stations:	
－power 200 W or less	100 ppm(7)(8)
－power above 200 W	50 ppm (7)(8)
2. Land stations:	
－power 200 W or less	100 ppm (1)(2)(7)(9)(10)
－power above 200 W	50 ppm(1)(2)(7)(9)(10)
3. Mobile stations:	
a. Ship stations	40 Hz (3)(4)(11)
b. Survival craft stations	100 ppm
c. Emergency position-indicating radio beacons	100 ppm
d. Aircraft stations	100 ppm(10)
e. Land mobile stations	50 ppm (12)

4. Radiodetermination stations	
−power 200 W or less	20 ppm(13)
−power above 200 W	10 ppm (13)
5. Broadcasting Stations	10 Hz (14)

Bandwidth: 4 MHz to 29.7 MHz	
1. Fixed stations:	
a. Single- sideband and independent- sideband emissions:	
−power 500 W or less	50 Hz
−power above 500 W	20 Hz
b. Class FIB emissions	10 Hz
c. Emissions of other classes	
−power 500 W or less	20 ppm
−power above 500 W	10 ppm
2. Land stations:	
a. Coast stations	20 Hz (1)(2)(15)
b. Aeronautical stations	
−power 500 W or less	100 ppm (10)
−power above 500 W	50 ppm (10)
c. Base stations:	20 ppm(7)
−power 500 W or less	
−power above 500 W	
3. Mobile stations:	
a. Ship stations:	
1) Class AIA emissions	10 ppm
2) Emissions of classes other than Class AIA	50 Hz (3)(4)(16)
b. Survival craft stations	
c. Aircraft stations	50 ppm
d. Land mobile stations	100 ppm (10)
4. Broadcasting Stations	40 ppm (17)
5. Space stations	10 Hz (14)(18)
6. Earth stations	20 ppm
	20 ppm

Bandwidth: 29.7 MHz to 100 MHz	
1. Fixed stations:	
−power 50 W or less	30 ppm
−power above 50 W	20 ppm
2. Land stations:	20 ppm
3. Mobile stations:	20 ppm (19)
4. Radiodetermination stations	50 ppm
5. Broadcasting Stations (other than television) :	2000 Hz (20)
6. Broadcasting Stations (television sound and	500 Hz (21)(22)

vision) :	
7. Space stations	20 ppm
8. Earth stations	20 ppm
Bandwidth: 100 MHz to 470 MHz	
1. Fixed stations:	
－power 50 W or less	20 ppm (23)
－power above 500 W	10 ppm
2. Land stations:	
a. Coast stations	10 ppm
b. Aeronautical stations	20 ppm (24)
c. Base stations:	
－in the band 100 MHz to 235 MHz	15 ppm (25)
－in the band 235 MHz to 401 MHz	7 ppm (25)
－in the band 401 MHz to 470 MHz	5 ppm (25)
3. Mobile stations:	
a. Ship stations and survival craft stations:	
－in the band 156 MHz to 174 MHz	10 ppm
－outside the band 156 MHz to 174 MHz	50 ppm (26)
b. Aircraft stations	30 ppm (24)
c. Land mobile stations	
－in the band 100 MHz to 235 MHz	15 ppm (25)
－in the band 235 MHz to 401 MHz	7 ppm (25)(27)
－in the band 401 MHz to 470 MHz	5 ppm (25)(27)
4. Radiodetermination stations	50 ppm (28)
5. Broadcasting Stations (other than television)	2000 Hz (20)
6. Broadcasting Stations (television sound and vision) :	500 Hz (21)(22)
7. Space stations	20 ppm
8. Earth stations	20 ppm
Bandwidth: 470 MHz to 2.45 GHz	
1. Fixed stations:	
－power 100 W or less	100 ppm
－power above 100 W	50 ppm
2. Land stations	20 ppm (29)
3. Mobile stations	20 ppm (29)
4. Radiodetermination stations	500 ppm (28)
5. Broadcasting Stations (other than television)	100 ppm
6. Broadcasting Stations (television sound and vision) :	
7. Space stations	500 Hz (21)(22)
8. Earth stations	20 ppm
	20 ppm

Bandwidth: 2.45 G Hz to 10.5 G Hz	
1. Fixed stations:	
－power 100 W or less	200 ppm
－power above 100 W	50 ppm
2. Land stations	100 ppm
3. Mobile stations	100 ppm
4. Radiodetermination stations	1250 ppm (28)
5. Space stations	50 ppm
6. Earth stations	50 ppm
Bandwidth: 10.5 G Hz to 40 G Hz	
1. Fixed stations	300 ppm
2. Radiodetermination stations	5000 ppm (28)
3. Broadcasting Stations	100 ppm
4. Space stations	100 ppm
5. Earth stations	100 ppm

Notes in the Table of Transmitter Frequency Tolerance:

(1) For coast station transmitters used for direct-printing telegraphy or for data transmission, the tolerance is
   －5 Hz for narrow-band phase shift keying;
   －15 Hz for frequency-shift keying for transmitters in use or installed before January 2, 1992;
   －10 Hz for frequency-shift keying for transmitters installed after January 1, 1992.

(2) For coast station transmitters used for digital selective calling, the tolerance is 10 Hz.

(3) For ship station transmitters used for direct-printing telegraphy or for data transmission, the tolerance is:
   －5 Hz for narrow-band phase-shift keying;

   －40 Hz for frequency-shift keying for transmitters in use or installed before January 2, 1992;
   －10 Hz for frequency-shift keying for transmitters installed after January 1, 1992

(4) For ship station transmitters used for digital selective calling, the tolerance is 10 Hz.

(5) If the emergency transmitter is used as the reserve transmitter for the main transmitter, the tolerance for ship station transmitters applies.

(6) In countries covered by the North America Regional Broadcasting Agreement (NARBA), the tolerance of 20 Hz may continue to be applied.

(7) For single- sideband radiotelephone transmitters except at coast stations, the tolerance is:
   －50 Hz in the bands 1606.5 (1605 Region 2) to 4000 kHz and 4 MHz to 29.7 MHz, for peak envelope powers of 200 W or less and 500 W or less, respectively;
   －20 Hz in the bands 1606.5 (1605 Region 2) to 4000 kHz and 4 MHz to 29.7 MHz, for peak envelope powers above 200 W and 500 W, respectively.

(8) For radiotelegraphy transmitters which frequency-shift keying, the tolerance is 10 Hz.

4

(9) For coast station single-sideband radiotelephone transmitters, the tolerance is 20 Hz.

(10) For single-sideband transmitters operating in the frequency bands 1606.5 kHz to 4000 kHz; and 4 MHz to 29.7 MHz, which are allocated exclusively to the aeronautical mobile(R) service, the tolerance on the carrier (reference) frequency is:
a. for all aeronautical stations, 10 Hz;
b. for all aircraft stations operating on international services, 20 Hz;
c. for aircraft stations operating exclusively on national services, 50 Hz.

(11) For A1A emissions, the tolerance is 50×10^{-6}.

(12) For transmitters used for single-sideband radiotelephony or for frequency-shift keying radiotelegraphy, the tolerance is 40 Hz.

(13) For radio beacon transmitters in the band 1606.5 kHz to 1800 kHz, the tolerance is 50×10^{-6}.

(14) For A3E emissions with carrier power of 10 kW or less the tolerance is 20×10^{-6}, 15×10^{-6} and 10×10^{-6} in the bands 1606.5 kHz (1605 Region 2) to 4000 kHz; 4 MHz to 5.95 MHz; and 5.95 MHz to 29.7 MHz, respectively.

(15) For A1A emissions the tolerance is 10×10^{-6}.

(16) For ship station transmitters in the band 2.6175 MHz to 2.75 MHz, on board small craft, with a carrier power not exceeding 5 W in or near coastal waters and utilizing F3E and G3E emissions, the frequency tolerance is 40×10^{-6}.

(17) The tolerance is 50 Hz for single-sideband radiotelephone transmitters, except for those transmitters operating in the band 2.6175 MHz to 2.75 MHz, and not exceeding a peak envelop power of 15 W, for which the basic tolerance of 40×10^{-6} applies.

(18) It is suggested that the competent authority shall avoid carrier frequency differences of a few hertz, which cause degradations similar to periodic fading. This could be avoided if the frequency tolerance were 0.1 Hz, a tolerance which would be suitable for single-side

(19) For non-vehicular portable equipment with a transmitter mean power not exceeding 5 W, the tolerance is 40×10^{-6}.

(20) For transmitters of a mean power of 50 W or less operating at frequencies below 108 MHz, a tolerance of 3 kHz applies.

(21) In the case of television stations of:
－50 W or less in the band 29.7 MHz to 100 MHz;
－100 W(vision peak envelope power)or less in the band 100 MHz to 960 MHz;
and which receive their input from other television stations or which serve small isolated communities, it may not, for operational reasons, be possible to maintain this tolerance. For such stations, the tolerance is 2 kHz.

For stations of 1 W (vision peak envelope power) or less, this tolerance may be relaxed further to:
－5 kHz in the band 100 MHz to 470 MHz;
－10 kHz in the band 470 MHz to 960 MHz.

(22) For transmitters for system M (NTSC), the tolerance is 1 kHz. However, for low power transmitters using this system, Note 21 applies.

(23)   For multi-hop radio-relay systems employing direct frequency conversion, the tolerance is 30×10^{-6}.

(24)   For a channel spacing of 50 kHz, the tolerance is 50×10^{-6}.

(25)   These tolerances apply to channel spacings equal to or greater than 20 kHz.

(26)   For transmitters used by on-board communication stations, a tolerance of 5×10^{-6} shall apply.

(27)   For non-vehicular mounted portable equipment with a transmitter mean power not exceeding 5 W, the tolerance is 15×10^{-6}.

(28)   Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations shall be maintained wholly within the band allocated to the service and the indicated tolerance does not apply.

(29)   In applying this tolerance competent authority should be guided by the latest relevant CCIR Recommendations.

Appendix 4
Table of Maximum Permitted Spurious Emissions Power Levels

1. This Appendix derived indicates the maximum permitted power levels of unwanted emissions in the spurious domain using the values indicated in Table 1.

2. Spurious emissions from any part of the installation, other than the antenna and its transmission line, shall not have an effect greater than would occur if this antenna system were supplied with the maximum permitted power at the frequency of that emission.

3. These levels shall not, however, apply to emergency position-indicating radio beacon, emergency locator transmitters, emergency transmitters of ship, survival craft transmitters, survival craft stations or maritime transmitters when used in emergency situations.

4. For technical or operational reasons, more stringent levels than those specified may be applied to protect specific services in certain frequency bands. The levels applied to protect these services, such as safety and passive services, shall be those agreed upon by the appropriate world radiocommunication conference. More stringent levels may also be fixed by specific agreement between the competent authority concerned. Additionally, special consideration of transmitter spurious domain emissions may be required for the protection of safety services, radio astronomy and space services using passive sensors. Information on the levels of interference detrimental to radio astronomy, Earth exploration satellites and meteorological passive sensing is given in the most recent version of Recommendation ITU-R SM.329.

5. Spurious domain emission limits for combined radiocommunication and information.

6. The frequency range of the measurement of spurious domain emissions is from 9 kHz to 110 GHz or the second harmonic if higher.

7. The spurious domain emission levels are specified in the following reference bandwidths:

   1 kHz between 9 kHz and 150 kHz

   10 kHz between 150 kHz and 30 MHz

   100 kHz between 30 MHz and 1 GHz

   1 MHz above 1 GHz

8. The reference bandwidth of all space service spurious domain emissions should be 4 kHz.

9. For radar systems, the reference bandwidths for specifying spurious domain emission levels should be calculated for each particular system. Thus, for the four general types of radar pulse modulation utilized for radio navigation, radiolocation, acquisition, tracking and other radiodetermination functions, the reference bandwidth values are determined using the following:

   For a fixed-frequency, non-pulse-coded radar, the reciprocal of the radar pulse length, in seconds (e.g. if the radar pulse length is 1μs, then the reference bandwidth is 1/(1 μs) = 1 MHz);

   For a fixed-frequency, phase-coded pulsed radar, the reciprocal of the phase chip length, in seconds (e.g. if the phase-coded chip is 2 μs long, then the reference bandwidth is 1/(2 μs)= 500 kHz).

   For a frequency modulated (FM) or chirped radar, the square root of the quantity obtained by dividing the chirp bandwidth in MHz by the pulse length, in μs (e.g. if the FM is from 1250 MHz to 1280 MHz, i.e. 30 MHz, during the pulse length of 10 μs, then the reference bandwidth is (30 MHz/10 μs)$1/2$=1.73 MHz).

   For radars operating with multiple waveforms, the reference bandwidth for specifying spurious domain emission levels is determined empirically from observations of the radar emission and is obtained following the guidance given in the most recent version of Recommendation ITU-R M.1177. In the case of radars, for which the bandwidth, as determined using the method above, is greater than 1 MHz, a reference bandwidth of 1 MHz should be used.

Table 1. Attenuation values used to calculate maximum permitted spurious domain emission power levels for use with radio equipment.

Service category, or equipment type	Attenuation (dB) below the power supplied to the antenna transmission line
All services except those services quoted below:	43 + 10 log (P), or 70 dBc, whichever is less stringent
Space services (earth stations)	43 + 10 log (P), or 60 dBc, whichever is less stringent
Space services (space stations)	43 + 10 log (P), or 60 dBc, whichever is less stringent
Radiodetermination	43 + 10 log (PEP), or 60 dB, whichever is less stringent
Broadcast television	46 + 10 log (P), or 60 dBc, whichever is less stringent, without exceeding the absolute mean power level of 1 mW for VHF stations or 12 mW for UHF stations. However, greater attenuation may be necessary on a case by case basis
Broadcasting at FM	46 + 10 log (P), or 70 dBc, whichever is less stringent; the absolute mean power level of 1 mW should not be exceeded
Broadcasting at MF/HF	50 dBc; the absolute mean power level of 50 mW should not be exceeded
SSB from mobile stations	43 dB below PEP
Amateur services operating below 30 MHz (including those using SSB)	43 + 10 log (PEP), or 50 dB, whichever is less stringent
Services operating below 30 MHz, except space, radiodetermination, broadcast, those using SSB from mobile stations, and amateur	43 + 10 log (X), or 60 dBc, whichever is less stringent, where X = PEP for SSB modulation, and X = P for other modulation
Low-power device radio equipment	56 + 10 log (P), or 40 dBc, whichever is less stringent
Emergency transmitters	No limit

Notes:

P: mean power in watts supplied to the antenna transmission line, when burst transmission is used, the mean power P and the mean power of any spurious domain emissions are measured using power averaging over the burst duration.

PEP: peak envelope power in watts supplied to the antenna transmission line.

dB$_c$:   decibels relative to the unmodulated carrier power of the emission. In the cases which do not have a carrier, for example in some digital modulation schemes where the carrier is not accessible for measurement, the reference level equivalent to dBc is decibels relative to the mean power P.

1.   Spurious domain emission limits for all space services are stated in a 4 kHz reference bandwidth.

2.   For analogue television transmissions, the mean power level is defined with a specified video signal modulation. This video signal has to be chosen in such a way that the maximum mean power level is supplied to the antenna transmission line.

3.   All classes of emission using SSB are included in the category "SSB".

4.   Low-power radio devices having a maximum output power of less than 100 mW and intended for short-range communication or control purposes; such equipment is in general exempt from individual licensing.

5.   For radiodetermination systems, spurious domain emission attenuation (dB) shall be determined for radiated emission levels, and not at the antenna transmission line. The measurement methods for determining the radiated spurious domain emission levels from radar systems should be guided by the most recent version of Recommendation ITU-R M.1177.

6.   In some cases of digital modulation (including digital broadcasting), broadband systems, pulsed modulation and narrow-band high-power transmitters for all categories of services, there may be difficulties in meeting limits close to 250% of the necessary bandwidth.

7.   Earth stations in the amateur-satellite service operating below 30 MHz are in the service category "Amateur service operating below 30 MHz (including those using SSB)".

8.   Space stations in the space research service intended for operation in deep space are exempt from spurious domain emission limits.

9.   Emergency position-indicating radio beacon, emergency locator transmitters, personal location beacons, search and rescue transponders, ship emergency, lifeboat and survival craft transmitters and emergency land, aeronautical or maritime transmitters.