

SECTION 3C: DIGITAL TRANSMISSION

3C a: Radiotelegraph circuits

RECOMMENDATION 246-3

FREQUENCY-SHIFT KEYING*

(Question 8/3)

(1951-1953-1956-1959-1966-1970-1974)

The CCIR,

CONSIDERING

- (a) that frequency-shift keying is employed in radiotelegraphy in the fixed service;
- (b) that it is desirable to adapt the frequency-shift used to the modulation rate;
- (c) that it is desirable to standardize the main operating characteristics of systems employing frequency-shift keying;
- (d) that various technical factors influence the choice of operating characteristics in such systems, in particular:
 - economy of bandwidth and the consequent need to control the shape of the transmitted signals,
 - signal distortion due to propagation conditions,
 - instability of the characteristics of certain transmitter and receiver elements (such as oscillators, filters or discriminators), this instability being one of the reasons for the relatively large shift still employed in some existing types of equipment;
- (e) that for synchronous transmissions using limiter-discriminator detection, a modulation index of about 0.8 is desirable for obtaining low bit error rates (see Recommendation 436 and Report 198, Geneva, 1963) and that for asynchronous (start-stop) transmissions, a modulation index between 1 and 2 is more appropriate;
- (f) that for synchronous transmissions using filter-assessor detection, a sufficiently high value of frequency-shift is desirable to take advantage of frequency diversity effects;
- (g) that difficulties can arise from the use of terms "mark" and "space" on teletype circuits and also that the CCIT, at its VIIth Plenary Assembly (1953), issued Recommendation I.4 introducing new terms; these terms have been published by the ITU in the "List of Definitions of Essential Telecommunication Terms", Part I, General Terms, Telephony, Telegraphy, June 1957,

UNANIMOUSLY RECOMMENDS

1. that for frequency-shift systems working on two conditions only (i.e. single channel or time division multiplex systems) and operating between about 3 MHz and 30 MHz, the value of the frequency-shift employed should be the lowest compatible with the maximum modulation rate regularly used, the propagation conditions and the equipment stability;

* For the use of frequency-shift keying in the maritime mobile service, see Appendix 38, § (c) of the Radio Regulations.

2. that for services where the transmitting equipment and the receiving equipment are of sufficient high stability* and selectivity, the following values of frequency-shift in Table I are preferred for new systems:

TABLE I

Maximum modulation rate (baud)		Frequency-shift (Hz)
Synchronous	Asynchronous	
—	50	70
100	50 and 75	85
200	100	170
—	200	340

3. that for systems using filter-assessor detection (see Report 345) or where the achievement of the necessary stability or receiver selectivity is impractical, the preferred values of frequency-shift are 200 Hz, 340 Hz, 400 Hz** and, for modulation rates above 250 baud, 500 Hz. The values of 140 Hz, 280 Hz and 560 Hz may be used provisionally, but 560 Hz should not be adopted for new systems. The value of the frequency-shift should, if possible, be maintained within $\pm 3\%$ of its nominal value and, in any case, within $\pm 10\%$;

4.*** that the following equivalence among the various terms indicating circuit condition be adopted:

(Table II is in accordance with CCITT Recommendations U.1, see Fascicle VII.1 and V.1, see Fascicle VIII.1.)

TABLE II

Frequency of emission	Circuits using teleprinter or punched tape equipment							Circuits using Morse code
	International Telegraph Alphabet No. 2				Emitted 7-unit signal (2)	Data	Telex	
Higher frequency	Space	Start	No perforation	A (1)	B	0	Free line condition	Mark
Lower frequency	Mark	Stop	Perforation	Z (1)	Y	1	Idle circuit condition	Space

(1) on a wire circuit.

(2) on a radio channel.

* In the absence of a Recommendation on the stability required for narrow-band frequency-shift keying a provisional value of 12 Hz may be used for the maximum permissible overall frequency error, including modulator, demodulator and translating stages at both ends of the circuit.

** The value 170 Hz is used in the maritime mobile service (see Appendix 38, § (c) of the Radio Regulations).

*** When modification of equipment is necessary, it is recognized that it may take some time before the recommendations of these paragraphs can be implemented on circuits between different Administrations.