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INTERNATIONAL TRANSMISSION SYSTEMS (ANALOGUE)

BRINGING A NEW INTERNATIONAL TRANSMISSION SYSTEM INTO SERVICE

ITU-T Recommendation M.450

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation M.450 was published in Fascicle IV.1 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation M.450

BRINGING A NEW INTERNATIONAL TRANSMISSION SYSTEM INTO SERVICE

1 Preliminary exchange of information

As soon as Administrations have decided to bring a new international transmission system into service, the necessary contacts are made between their technical services[1)] for the exchange of information. Those services jointly select the control and sub-control stations for the new system (see Recommendations M.80 and M.90).

The technical service of each Administration is responsible for the setting-up and lining-up of the line sections on its territory and for arranging that the adjustments and tests required are made by the repeater station staff concerned.

To set up a line section which crosses a frontier, Administrations should arrive at bilateral arrangements on the basis of CCITT Recommendations and, for radio-relay sections, the Recommendations of the CCIR.

2 Setting up sections crossing a frontier

2.1 *Radio-relay section*

Details of the following points will have been settled by a bilateral agreement between the technical services of Administrations:

- geographical position of the radio-relay station nearest to the frontier;
- contour of the terrain of the radio section crossing the frontier, with details of the height of the antennae above normal level;
- directivity characteristic and gain of the antennae;
- radio-frequency channel arrangement (centre frequency, polarization, intermediate frequency);
- provision of supervisory system;
- radio equipment line-regulating pilots (if any);
- continuity pilots, used for supervising the radio-relay link, in accordance with the CCIR Recommendations on the frequency and frequency deviation of this signal, each country transmitting the pilot required by the system in the receiving country;
- noise measurement channels outside the transmitted baseband;
- total noise for the radio-relay section;
- frequency deviation of the telephony channel the level of which at the centre frequency is unaffected by pre-emphasis (either of the telephony channel itself or of the radio-frequency channel of the system);
- pre-emphasis characteristics of the radio-frequency channel;
- service, supervisory and remote channel circuits;
- level, frequency and coding of the signals transmitted over these lines;
- protective switching equipment;
- interconnection points T, R, T´, R´ (see Figure 1/M.450) defined in Recommendation G.213 [1] (see also [2] and especially the return loss at points R and R´ if required (see CCIR Recommendation 380 [3] for values).

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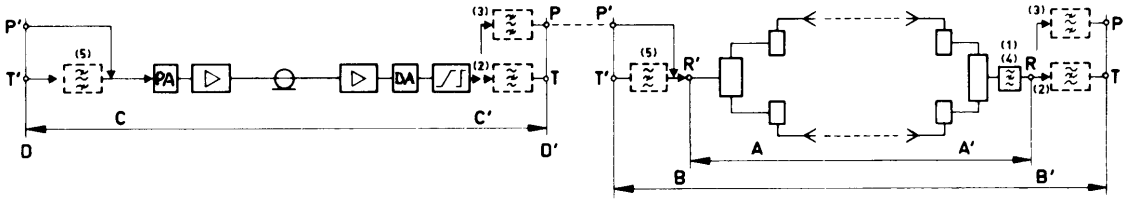
1) The *technical service* represents the appropriate authorities within the international maintenance organization of an Administration which have the responsibility for making international agreements on engineering provision and maintenance matters, specifying provision and maintenance facilities, determining engineering and maintenance policy and overseeing its implementation.



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A, A′	=	radio-relay system
B, B′	=	line link via radio-relay system
C, C′	=	line link via cable system
D, D′	=	boundary of the high-frequency line equipment
Point P′	=	provided for possible injection of regulating pilots
R	=	radio-relay system output
R′	=	radio-relay system input
Between T and T′	=	telephony translating equipment and/or direct through-connection equipment
DA	=	de-emphasis network
PA	=	pre-emphasis network
(1)	=	blocking of continuity pilots and, if necessary, of regulating pilots
(2)	=	blocking, if necessary, of line-regulating pilots, and of pilots that must not go beyond the line link.
(3)	=	through-connection filter for line-regulating pilots, if necessary. A through-connection filter for telephone groups can, if necessary, be inserted
(4)	=	blocking of unspecified pilots or supervisory signals
(5)	=	filter for blocking any unwanted frequency before injecting a pilot ensuring with (2) the requisite protection against a pilot (or other frequency) coming from another regulated line-section (system B or C, as the case may be)

FIGURE 1/M.450
Interconnection points T, R, T′, R′

2.2 *Coaxial-pair line section*

Details of the following points will have been settled by bilateral agreement between the technical services of the Administrations:

- the choice of the frequency arrangement to be adopted;
- the pilot signals to be used for regulating the line, in accordance with CCITT Recommendations on the frequency and level of such signals, each country transmitting the pilot signals required by the equipment of the other country (see the table in Recommendation M.540 indicating the pilot frequencies for various systems);
- service, supervisory and remote control circuits;
- repeater identification method and frequencies for fault location and monitoring on transistorized systems;
- provisions for remote power feeding, where a section of the supply line crosses the frontier;
- the regulation systems used by each country;
- the nominal level at various frequencies, at the output of the frontier repeater.

Concerning this last item, at the incoming point, each Administration should as far as possible accept the conditions usual for the system of the other country.

During the lining-up tests, the relative power level measured at the output of the repeater in the unburied repeater station nearest to the frontier should not differ, for any frequency, by more than ± 2 dB from the nominal value (as defined by a graph drawn up beforehand and based on the characteristics of the system in question).

The frequencies used in lining up the line are determined by agreement between the Administrations concerned. Experience shows that, provided the number of test frequencies required is not too large, it is useful to make these tests at frequencies lying very close to each other at the edges of the frequency band, or at points where irregularities have to be corrected, and at frequencies less close to each other elsewhere in the band.

If the necessary test equipment is available sweep measurements can substantially facilitate the line-up procedure. But in this case also, some test frequencies have to be agreed upon to obtain reference values for later in-service maintenance measurements.

2.3 *Symmetric-pair line section*

The following points will have been settled by bilateral agreement between the Administrations:

– frequency allocation;

– pilots (see the table in Recommendation M.540 indicating the pilot frequencies for various systems);

– service, supervisory or remote control lines, etc.;

– repeater identification method and frequencies for fault location and monitoring on transistorized systems;

– provisions for remote power feeding, where a section of the supply line crosses the frontier.

When a symmetric-pair line section crossing a frontier section is first set up, tests should be made at clearly defined frequencies to determine the insertion loss/frequency characteristics. For example, frequencies spaced at the following intervals could be used, except at the edges of the band, where more closely spaced measuring frequencies are desirable.

4 kHz between 12 kHz and 60 kHz,

8 kHz between 60 kHz and 108 kHz,

12 kHz between 108 kHz and 252 kHz,

24 kHz between 288 kHz and 552 kHz.

The conditions for making measurements at line-pilot frequencies should be agreed by the technical service concerned.

Level measurements at the frequencies chosen will be made at each line amplifier at the unburied repeater station nearest to the frontier. The relative power level measured at any of the frequencies chosen should not differ by more than ± 2.0 dB from the nominal value.

3 Overall reference measurements for the line

The section across frontiers and national sections having been set up and connected, reference measurements are made between the high-frequency line terminals of the carrier system, excluding the terminal equipment.

3.1 *Level measurements*

These are made at several frequencies, even if the regulated line section or line link has been equalized by means of sweep frequency measurements.

3.1.1 *Radio-relay line section*

When a radio-relay section is put into service, measurements and adjustments in accordance with the CCIR Recommendations for the radio-relay system concerned are first made of:

– the frequency at which the level is unchanged by pre-emphasis and the deviation of that frequency;

– the level and frequency of the baseband reference frequency;

– the *central position of the intermediate frequency* (if necessary);

– check and adjustment of input and output levels baseband/baseband (see CCIR Recommendation 380 [3] for values);

– measure of overall loss/frequency characteristics using additional measurement frequencies[2)].

3.1.2 *Coaxial line section*

The frequencies for reference measurements should be selected from the following values. (These values comprise the line pilot frequencies which, of course, cannot be sent into a system with the pilots already being transmitted.)

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2) Reference measurements should be made at several frequencies in both directions of transmission between accessible measuring points corresponding as nearly as possible to points R and R´ as defined in Recommendation G.213 [1]. These measurements should be made at the frequencies specified in § 3.1.2 for each transmitted bandwidth.

3.1.2.1 *For a 1.3-MHz system:* 60, 308, 556, 808, 1056, 1304, 1364 kHz.

3.1.2.2 *For a 2.6-MHz system:* 60, 308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2604 kHz.

3.1.2.3 *For a 4-MHz system:*

– frequency allocation with supergroups:
60, 308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2544, 2792, 3040, 3288, 3536, 3784, 4092, 4287 kHz;

– frequency allocation with mastergroups (Figure 5/M.380, scheme 2):
308, 560, 808, 1304, 1592, 2912, 4287 kHz.

3.1.2.4 *For a 6-MHz system:*

– frequency allocation with supergroups:
308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2544, 2792, 3040, 3288, 3536, 3784, 4287, (5680)[3] kHz;

– frequency allocation with mastergroups (Figure 8/M.380, scheme 3):
308, 560, 808, 1304, 1592, 2912, 4287, 5608[3] kHz.

3.1.2.5 *For a 12-MHz system:*

– at frequencies below 4 MHz:
if frequency allocation without mastergroups is used:
308, *560*, *808*, 1056, *1304*, 1552, *1800*, 2048, *2296*, 2544, *2792*, 3040, 3288, *3536* and *3784* kHz
(the frequencies in italics are those at which the measurements must always be made);
if frequency allocation with mastergroups is used:
308, 560, 808, 1304, 1592 and 2912 kHz;

– at frequencies above 4 MHz:
if frequency allocation with 15 supergroup assemblies is used:
5392, 7128, 8248, 8472, 8864, 9608 and 11 344 kHz;
if frequency allocation with mastergroups is used:
5608, 6928, 8248[4], 8472, 9792 and 11 112 kHz.

3.1.2.6 *For an 18-MHz system:*

– if frequency allocation is according to Plan 1 of Recommendation G.334 [4]:

560, 808, 1304, 1592, 2912, 5608, 6928, 8248[4], 8472, 9792, 11 112, 12 678 or 12 760, 14 408, 15 728 and 17 242 kHz;

– if frequency allocation is according to Plan 2 of Recommendation G.334 [4]:
560, *808*, 1056, *1304*, 1552, *1800*, 2048, *2296*, 2544, *2792*, 3040, 3288, *3536*, 3784, *5392*, *7128*, *8248*, *8472*, *8864*, *9608*, *11 344*, *12 678* or *12 760*, *14 408*, *15 728* and *17 242* kHz (the frequencies in italics are those at which measurements must always be made);

– if frequency allocation is according to Plan 3 of Recommendation G.334 [4]:
552, 1872, 3192, 4758, 6272, 7592, 9158, 10 672, 11 992, 1 3 558, 15 072 and 16 392 kHz[5].

3.1.2.7 *For a 60-MHz system:*

– frequencies which do not cause interference to a regulated line section and, therefore, can be sent at any time:
8472, 12 678 or 12 760[6], 17 488, 26 922, 31 322, 35 722, 40 122[6], 42 322, 46 722, 51 122, 55 522 kHz;

– frequencies which should not be sent without the agreement of the Administration at the receiving end:
4200[7] or 4287[8], 8316[7], 12 435[8], 22 302, 22 372[8], 40 920[8], 59 992 kHz.

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3) This frequency may be 5640 kHz.

4) A frequency of 8248 kHz can be used as a radio-relay link line regulating pilot. In such a case, the precautions shown in Recommendation G.423 [5] should be applied.

5) These measuring frequencies are provisional and subject to further study by Study Group XV.

6) It may be necessary to use this frequency if an adjacent auxiliary line pilot is used for regulation.

7) These frequencies may also be in use as frequency comparison pilots.

3.1.3 *Symmetric-pair line section*

Frequency of the line pilot or pilots, and frequencies showing the insertion loss/frequency characteristic of the line, for example, frequencies spaced at:

4 kHz between 12 kHz and 60 kHz,

8 kHz between 60 kHz and 108 kHz,

12 kHz between 108 kHz and 252 kHz,

24 kHz between 288 kHz and 552 kHz.

3.2 *Loss/frequency distortion*

The loss/frequency distortion of the regulated line section (symmetric pair, coaxial or radio-relay link) shall be such that the relative level at any frequency does not differ by more than ± 2 dB from the nominal level for older type-systems and ± 1 dB in case of modern transistorized systems.

Reference measurements at the frequencies chosen will be made at all attended stations at the output of each amplifier and also at the unburied station nearest the frontier.

Reference tests at unattended stations other than frontier stations are left to the discretion of each Administration.

The setting of equalizers should be noted and recorded during the reference measurements as well as the temperature of the cable, or the resistance of one of the conductors, from which the temperature could be deduced.

3.3 *Measurement of noise power*

Measurements of noise power shall be made by sending a uniform continuous spectrum signal in the transmitted frequency band in accordance with Recommendations G.228 [6] and G.371 [7] and CCIR Recommendation 399 [8][9)].

3.4 *Complementary measurements*

If the Administrations find it necessary, the following measurements could also be made:

– check of near-end crosstalk with artificial loading of radio channels;

– check of the suppression of line pilots from other regulated sections;

– check of power supply modulation, etc. (including checking of the baseband for the presence of interfering signals from radio-frequency sources outside the system);

– check of stability using a level recorder.

3.5 *Line-up record*

The results of the reference measurements made at the line terminals and at the output of frontier repeaters will be entered in a line-up record, specimens of which are included as examples in Appendices I (coaxial or radio-relay regulated line section line-up record) and II (symmetric-pair regulated line section line-up record) below.

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8) In accordance with Recommendation M.500, Administrations choosing to use these frequencies must ensure that interference is not caused to a following regulated line section which may be using these frequencies as line pilots.

9) In the case of a radio-relay line section, measurements should also be taken outside the baseband on the noise measurement channels indicated in CCIR Recommendation 398 [9]. These noise values will serve as reference values for subsequent maintenance measurements.

APPENDIX I

(to Recommendation M.450)

Line-up record for a coaxial-pair regulated line section[*)]

Control station: ..... Annemasse
Designation of link: ..... Annemasse-Courmayeur
Date of measurements: ..... 16 November 1972
Direction of transmission[4)]: ..... Courmayeur-Annemasse

Station	Courmayeur	Chamonix		Cluses			Annemasse		
Distance (km)	18.6			42.3			34.96		
Resistance of conductor used for temperature compensation (ohms)	982			2222			1846		
Frequencies (kHz)	Send[1)]	Var. eq[2)]	Rec.[3)]	Send[1)]	Var. eq[2)]	Rec.[3)]	Send[1)]	Var. eq[2)]	Rec.[3)]
380	– 65	– 8	– 53.8	– 65		– 53.7	– 64.7	– 4	– 53.8
560	– 65	– 6	– 53.9	– 65.2		– 53.7	– 64.8	–2	– 53.7
808	– 65.2	– 6	– 53.8	– 65.2		– 53.7	– 65.1	–4	– 53.8
1 056	– 65.3	– 6	– 53.8	– 65.3		– 53.7	– 65.1	–4	– 53.8
1 304	– 65.3	– 6	– 53.9	– 65.4		– 53.9	– 65	–4	– 53.9
1 800	– 65.4	– 4	– 53.8	– 65.5		– 53.8	– 65.4	–2	– 53.9
2 296	– 65.4	– 4	– 53.8	– 65.5		– 53.8	– 64.4	–2	– 53.9
2 792	– 65.4	– 6	– 53.8	– 65.4		– 53.8	– 64.4	–2	– 53.9
3 536	– 65.4	– 8	– 53.8	– 65.4		– 53.9	– 64.4	–2	– 53.9
4 032	– 65.3		– 53.6	– 65.2		– 53.7			
4 287	– 65.3	– 4	– 53.8	– 65.3		– 53.7	– 64.8	–2	– 53.8
4 648	– 65.3		– 53.8	– 65.2		– 54	– 65.1		– 53.9
5 144	– 65.2		– 53.9	– 65.3	Not used	– 54	– 65.2		– 54.1
5 640	– 65.1	– 6	– 53.8	– 65		– 53.8	– 65	–4	– 53.8
6 136	– 65		– 53.9	– 65		– 53.8	– 64.9		– 54
6 632	– 64.7	– 8	– 53.9	– 64.7		– 53.9	– 64.9	–6	– 53.8
7 128	– 64.5		– 53.9	– 64.5		– 54.1	– 64.8		– 53.8
7 624	– 64.3		– 53.9	– 64.3		– 54	– 65.1		– 53.8
8 124	– 64	– 6	– 53.8	– 64		– 53.8	– 63.9	–6	– 53.7
8 864	– 63.4		– 53.9	– 63.5		– 54.1	– 63.6		– 53.7
9 360	– 63	– 8	– 53.9	– 63		– 53.8	– 62.8	–4	– 53.7
9 856	– 62.4		– 53.9	– 62.5		– 53.8	– 62.3		– 53.6
10 352	– 61.7		– 53.8	– 61.8		– 53.8	– 61.6		– 53.6
10 848	– 61		– 53.8	– 61		– 53.9	– 60.9		– 53.6
11 344	– 60.2	– 6	– 53.8	– 60.2		– 54.1	– 60.4	–6	– 53.8
12 340	– 58.6		– 53.9	– 58.6		– 54	– 58.6		– 53.7
12 435	– 58.1	– 6	– 53.9	– 58.5		– 54.1	– 58.4	+ 4	– 53.8

[*)] Can also be used for a radio-relay regulated line section.

1) 600 ohm through-level (dB) at repeater output points

2) Variable equaliser setting.

3) 600 ohm through-level (dB) at special measuring points.

4) There will be a corresponding form for the other direction of transmission.

APPENDIX II

(to Recommendation M.450)

Line-up record for a symmetric-pair line

Control station: ..... Antwerpen
Designation of link: ..... Antwerpen-Rotterdam

Date of measurements: ..... 10 October 1959
Issue: ..... 22 March 1960

	Direction: Antwerpen-*Rotterdam*				Direction: Rotterdam-*Antwerpen*			
Distance (km)	15.8	17.7		72.4	72.4	17.7		15.8
Test frequencies kHz	Ant-werpen dB	Brasschaat dB	Zundert dB	Rotterdam dB	Rotterdam dB	Zundert dB	Brasschaat dB	Ant-werpen dB
12	+ 1.75	+ 1.75	+ 1.80	+ 1.85	+ 175	+ 1.65	+ 1.65	+ 1.65
16		1.75	1.80	1.90		1.65	1.70	1.65
20		1.75	1.80	1.90		1.70	1.70	1.70
24		1.80	1.85	1.95		1.70	1.70	1.70
28		1.85	1.85	1.90		1.70	1.65	1.75
32		1.85	1.90	1.90		1.75	1.65	1.80
36		1.85	1.90	1.85		1.75	1.70	1.80
40		1.80	1.90	1.85		1.75	1.70	1.85
44		1.80	1.85	1.85		1.80	1.75	1.90
48		1.75	1.85	1.80		1.80	1.75	1.90
52		1.75	1.85	1.75		1.75	1.70	1.90
56		1.75	1.80	1.75		1.75	1.75	1.85
60		1.80	1.80	1.75		1.70	1.65	1.85
68		1.75	1.75	1.75		1.70	1.65	1.85
76		1.70	1.75	1.80		1.70	1.60	1.80
84	Sending	1.70	1.80	1.80	Sending	1.70	1.65	1.75
92	station	1.75	1.80	1.85	station	1.65	1.65	1.75
100		1.80	1.80	1.85		1.65	1.70	1.75
108		1.80	1.85	1.85		1.65	1.70	1.70
120		1.85	1.85	1.90		1.70	1.75	1.70
132		1.85	1.85	1.95		1.70	1.80	1.70
144		1.85	1.90	1.95		1.75	1.85	1.75
156		1.80	1.90	1.95		1.80	1.85	1.80
168		1.80	1.90	1.90		1.85	1.90	1.80
180		1.85	1.85	1.90		1.85	1.95	1.85
192		1.90	1.85	1.85		1.90	1.90	1.80
204		1.85	1.80	1.80		1.90	1.85	1.80
216		1.80	1.75	1.75		1.95	1.80	1.80
228		1.75	1.75	1.70		2.00	1.80	1.75
240		1.75	1.70	1.65		2.00	1.80	1.75
252		1.70	1.70	1.65		1.85	1.80	1.70
256		1.70	1.65	1.60		1.70	1.75	1.70
60 kHz line pilot	– 13.2	– 13.1	–13.1	– 13.2	– 13.2	– 13.2	– 13.3	– 13.1
Additional measuring frequencies[1]	–	–	–	–	–	–	–	–
Equalizers.....	–	0	+ 1	0	–	+ 1	+ 1	+ 1
Temperature or resistance	–	391Ω	221Ω	+ 4.7°C	–	+ 4.5°C	226 Ω	392 Ω

1) Indicate frequencies of these pilots.

References

[1] CCITT Recommendation *Interconnection of systems in a main repeater station*, Vol. III, Rec. G.213.

[2] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380, Annex I, ITU, Geneva, 1986.

[3] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380, ITU, Geneva, 1986.

[4] CCITT Recommendation *18-MHz systems on standardized 2.6/9.5-mm coaxial cable pairs*, Vol. III, Rec. G.334.

[5] CCITT Recommendation *Interconnection at the baseband frequencies of frequency-division multiplex radio-relay systems*, Vol. III, Rec. G.423.

[6] CCITT Recommendation *Measurement of circuit noise in cable systems using a uniform-spectrum random noise loading*, Vol. III, Rec. G.228.

[7] CCITT Recommendation *FDM carrier systems for submarine cable*, Vol. III, Rec. G.371.

[8] CCIR Recommendation *Measurement of noise using a continuous uniform spectrum signal on frequency-division multiplex telephony radio-relay systems*, Vol. IX, Rec. 399, ITU, Geneva, 1986.

[9] CCIR Recommendation *Measurements of noise in actual traffic over radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 398, ITU, Geneva, 1986.