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INTERNATIONAL ANALOGUE CARRIER SYSTEMS

GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS

PROTECTION OF PILOTS AND ADDITIONAL MEASURING FREQUENCIES AT POINTS WHERE THERE IS A THROUGH - CONNECTION

ITU-T Recommendation G.243

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.243 was published in Fascicle III.2 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 G.243

PROTECTION OF PILOTS AND ADDITIONAL MEASURING FREQUENCIES AT POINTS WHERE THERE IS A THROUGH-CONNECTION

(amended at Geneva, 1964; further amended)

1 Interconnection of telephone circuits at audio frequency

It is necessary that the interconnection of telephone circuits at audio frequency may be made without restriction and without causing interference between the sent and received group and supergroup pilots. It is therefore recommended that Recommendations G.232, § 13 and G.234 [1] be met, which specify an attenuation of at least 20 dB in both modulating and demodulating equipments for the leaks of group pilots (channels 6 and 7 or 1 and 2) and supergroup pilots (channels 1 and 2 or 11 and 12).

2 Through-group connection

2.1 *Group routed on a supergroup equipped with pilots 411.860 and 411.920 kHz*

To permit unrestricted through-group connection without causing interference between the sent and received supergroup pilots Recommendation G.233, § 9.1.2, has to be followed. Otherwise, it is necessary at least to follow Recommendation G.233, § 9.1.1 and, moreover, to avoid routing a through group in position 3 in two successive supergroup links.

2.2 *Group routed on a supergroup equipped with pilot 547.920 kHz*

The same provisions as in § 2.1 apply, but to the group in position 5 and not in position 3 (in accordance with Recommendation G.233, § 9.1.2.

3 Through-supergroup connection

3.1 *Protection of a line-regulating pilot against additional measuring frequencies*

To prevent interference with a line-regulating pilot lying adjacent to a through-connected supergroup, arising from an additional measuring frequency on an adjacent line link, it is recommended that the combined through-supergroup equipment, plus any additional blocking filter (e.g. associated with the through-supergroup equipment or provided as a pilot suppression filter immediately preceding the point on the line at which the line-regulating pilot is injected) should provide the following discrimination (relative to 412 kHz):

- over the range 308 kHz ± 8 Hz, not less than 40 dB;
- over the range 308 kHz ± 40 Hz and **t**he range 556 kHz ± 40 Hz, not less than 20 dB.

Note 1 - In making this recommendation, it has been assumed that the addition of the various frequency components within pilot-operated line regulators will follow a square or average law of addition.

Note 2 - If, by mutual agreement, Administrations use an auxiliary line-regulating pilot, an additional attenuation giving a discrimination of at least 40 dB relative to the attenuation at 412 kHz should be provided over a suitable frequency range around 556 kHz and in particular in the range 556 kHz ± 10 Hz in the case of a 2792-kHz pilot, for which the CCITT has recommended that the frequency variations should not exceed ± 5 Hz.

Note 3 - When the synchronizing or frequency-checking pilot is also a line-regulating pilot (multipurpose pilot), then where it passes from one regulated-line section to another, the pilot should be blocked and reintroduced (after filtration) on the following regulated-line section after its amplitude has been corrected.

3.2 *Protection of additional measuring frequencies*

To minimize interference between additional measuring frequencies on adjacent line sections and to prevent interference between additional measuring frequencies on non-adjacent line sections, it is recommended that through-supergroup equipment should provide the following discrimination (relative to 412 kHz):

- over the range 308 kHz ± 50 kHz and the range 556 kHz 50 Hz, not less than 15 dB;
- over the range 308 kHz ± 20 Hz and the range 556 kHz 20 Hz, not less than 20 dB;
- at frequencies of 308 kHz and 556 kHz, not less than 40 dB.

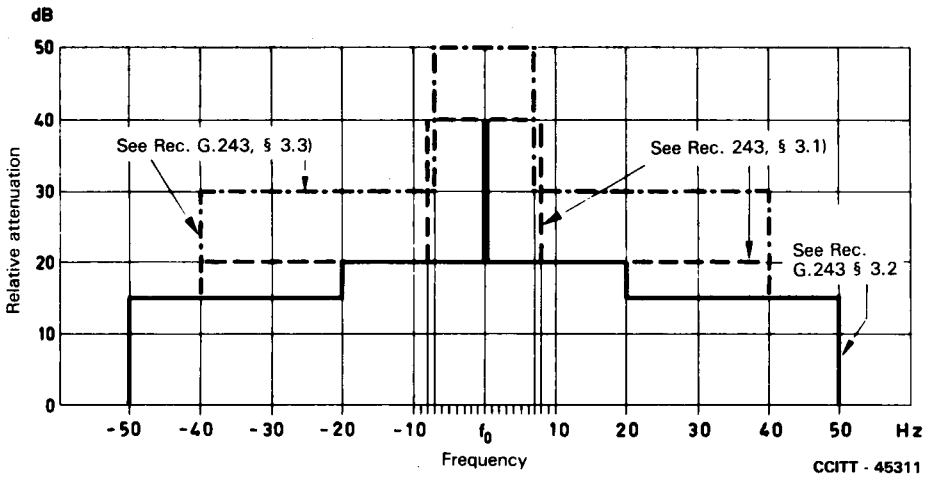
3.3 *Protection of the mastergroup or 15-supergroup pilot against additional measuring frequencies*

To prevent interference with the mastergroup or 15-supergroup pilot arising from additional measuring frequencies, it is recommended that the through-supergroup equipment, plus any necessary additional blocking filter, should provide the following discrimination relative to 412 kHz:

- over the range 308 kHz ± 7 Hz and the range 556 kHz ± 7 Hz, 50 dB;
- over the range 308 kHz ± 40 Hz and the range 556 kHz ± 40 Hz, 30 dB.

Any necessary additional blocking filter should be provided in association with the equipment where the 1552 kHz pilot is injected, that is, in the supergroup translating equipment on the sending side where the mastergroup or 15-supergroup assembly is formed.

Figure 1/G.243 recapitulates all the attenuations recommended over the range 308 kHz and 556 kHz.



Note 1 — The ordinates of this graph give the minimum recommended relative attenuation (referred to the attenuation at 412 kHz):
— for through-connection equipment alone in all cases ——————
— for through-connection equipment (filters and translating equipment, together with any supplementary filters) when it is necessary to safeguard:
a line-regulating pilot – – – – –
a mastergroup pilot —•—•—•—

Note 2 — This graph applies both to f_0 = 308 kHz and to f_0 = 556 kHz.

FIGURE 1/G.243

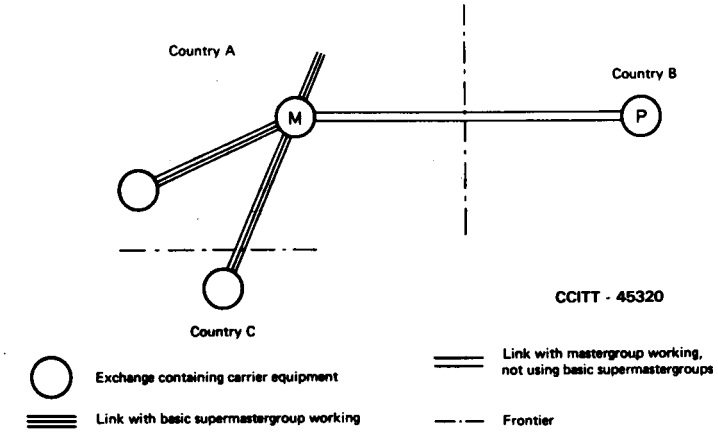
Minimum recommended relative attenuation around 308 kHz and 556 kHz for various cases of through-supergroup connection

4 End of a supermastergroup link

The supermastergroup pilot should be blocked at the end of a supermastergroup link, unless otherwise agreed between Administrations. The end of a supermastergroup link shall be considered as any point where basic supermastergroup working is no longer used, even though the supermastergroup may not be broken up into mastergroups at that point.

For example, in the case described in Figure 2/G.243, point M is the end of a supermastergroup link, at which point the supermastergroup pilot should not be transmitted to country B (even though the supermastergroups continue to be transmitted to line without demodulation), unless country B agrees to depart from this rule. Moreover, country B, which does not use the basic supermastergroup, is not required to transmit this supermastergroup pilot over the link PM.

In any case, the supermastergroup pilot is considered as blocked when it undergoes an additional attenuation of 40 dB.



Note - It is assumed that countries A and C use the basic supermastergroup and that country B does not.

FIGURE 2/G.243

Definition of a supermastergroup link

5 Direct through-connection

Let B be a repeater station where one or several supergroups, mastergroups, supermastergroups or 15-supergroup assemblies are through-connected by direct filtering[1)] from a line section AB on to another line section BC (see Figure 3/G.243). At point B special precautions should be taken with respect to pilots and additional measuring frequencies, so that these signals are transmitted to certain line sections where it is desired to route them but, on the other hand, do not interfere with pilots of the same type transmitted on other sections.

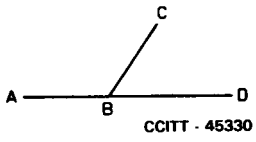


FIGURE 3/G.243

1) If the supergroups are in the basic supergroup frequency band, this becomes the case dealt with in § 3.

5.1 *Precautions to be taken in the use of pilot signals and additional measuring frequencies where there is direct through-connection within a regulated line section*

5.1.1 *Line-regulating pilots*

When the regulation of line section BD is to be performed together with the regulation of line section AB (and with that section only), the regulated line section extends from A to D and point B is not the end of the regulated line section AB. If one or two line-regulating pilots are outside the frequency band of the supergroups, mastergroups or supermastergroups diverted over BD, or lie at the edge of this frequency band, special arrangements must be made at point B for these pilots to be extended beyond B on to section BD (see Recommendation G.213, § 1 General Remarks, 2).

In the direction of C, however, the line-regulating pilots of section AB should be stopped, in the same conditions as at the end of the regulated-line section, so as not to be transmitted on section BC.

5.1.2 *Additional measuring frequencies*

At a station where there is direct through-connection and which is within a regulated-line section (station B of section AD in the preceding example) the additional measuring frequencies within the frequency bands of the supergroups, mastergroups or supermastergroups are diverted as a whole.

It may not be possible to use additional measuring frequencies at the edges of a through-connected frequency band because the amplitudes of these frequencies are affected by the direct through-connection filters. It might therefore be desirable in certain cases to specify "measuring sections" over which these additional measuring frequencies would be used. The choice of such measuring sections is left to the discretion of the Administrations concerned.

5.1.3 *Other pilot frequencies*

In each particular case, the Administrations concerned should decide on the points where the synchronizing or frequency-checking pilot and any switching pilot should be blocked so as not to interfere with other parts of the link. However, should one of these pilots also be a line-regulating pilot (multipurpose pilot) the rules defined above for line-regulating pilots should be applied.

5.2 *Precautions to be taken at a direct through-connection point at the end of a regulated-line section*

5.2.1 *Line-regulating pilots*

If it is not desired to associate the line regulation of section AB with that of the other sections, point B is, by definition, the end of a regulated line in section AB and the line-regulating pilots of this section AB should be stopped in such a way that, on all the interconnected sections (in this case, BC and BD), they are at least 40 dB below the pilots used on these sections.

When some (or all) of the pilots used on line-regulating section AB are not on the same frequency as those used on a line-regulating section connected to it, suppression of these pilots by 20 dB only (which implies a residue of not more than -30 dBm0 on the connected line-regulating section) may be tolerated at direct through-connection point B, if this residue is further suppressed by 20 dB before reaching the injection point of a line-regulating pilot with the same frequency on another line-regulating section connected at a distant point (for example, at D). However, the line-regulating pilot should be suppressed by 40 dB whenever it is applied to an international line-regulated section crossing at least one frontier. It therefore follows that the line-regulating pilot should be suppressed by 40 dB if the following section is an international section, even with a line-pilot at a different frequency. Similarly, if a line-regulating pilot is suppressed by 20 dB only, a supplementary attenuation of 20 dB must be introduced on the line frequency at the end of the corresponding line-regulating section before this pilot residue reaches a distant international section.

With reference to the example in Figure 1/G.213, the sum of the suppression of (2) and (5) (see legend of Figure 1/G.213) at the frequency of any received line-regulating pilot should therefore be at least 40 dB when the frequencies of these pilots are the same on both interconnected regulated-line sections. Division of this suppression between filters (2) and (5) may be made in different ways. As the two filters are in the same station this is not an

international interconnection problem, but one of industrial standardization for countries which order systems from several manufacturers.

If it is considered necessary always to have a filter (5) before the point of injection of an outgoing line-regulating pilot, for the suppression of unwanted signals from other equipments, and if the line-regulating pilots of the two interconnected regulated-line sections are on the same frequency, the division may be made in the following way:

filter (2) = 20 dB filter (5) = 20 dB.

Thus, if the frequencies of the pilots do not coincide and there is no interconnection with an international section, the 20 dB suppression recommended above will remain. Nevertheless, this provision may necessitate the addition of a further suppression at the adequate frequency at some point before reaching an international section.

To avoid the latter difficulty, it may be considered preferable, in order to facilitate network arrangements, to adopt the value of 40 dB for (2). If the frequencies of the pilots are the same on both interconnected regulated-line sections and if it has been considered desirable always to have a filter (5) before the point of injection of an outgoing line-regulating pilot, the suppression of the received line-regulating pilot will be very much greater than the recommended value of 40 dB. There is no technical objection to this.

5.2.2 *Additional measuring frequencies*

The additional measuring frequencies within the frequency band occupied by all the through-connected supergroups, etc., are normally transmitted without special blocking[2]. The level of the additional measuring frequencies at the edges of this band may be affected by the sections of the through-connection filters.

There is no need in such cases for equipments to include methodical provision of blocking filters for protecting line-regulating pilots against additional measuring frequencies sent over a preceding section. The arrangements to be made by the maintenance staff when such blocking filters are not provided are shown in Recommendation M.500 [2].

References

[1] CCITT Recommendation *8-channel terminal equipments*, Orange Book, Vol. III-1, Rec. G.234, ITU, Geneva, 1977.

[2] CCITT Recommendation *Routine maintenance measurements to be made on regulated line sections*, Vol. IV, Rec. M.500.

2) Such special blocking attenuation would in any case be both expensive and technically difficult to achieve.