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Supplement 5
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SERIES G: INTERNATIONAL ANALOGUE CARRIER SYSTEMS

Transmission media – Characteristics

Measurement of the load of telephone circuits under field conditions

ITU-T G-series Recommendations – Supplement 5

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NOTES

1 Supplement 5 to the G-series Recommendations was approved in Málaga-Torremolinos (1984) and published in Fascicle III.2 of the *Red Book*. This file is an extract from the *Red Book*. While the presentation and layout of the text might be slightly different from the *Red Book* version, the contents of the file are identical to the *Red Book* version and copyright conditions remain unchanged (see below).

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

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Supplement No. 5

MEASUREMENT OF THE LOAD OF TELEPHONE CIRCUITS UNDER FIELD CONDITIONS

(Mar del Plata, 1968; further amended)
(referred to in Recommendations G.223 and H.51 [1])

In the Study Periods 1968-1972 and 1973-1976 several Administrations carried out speech power measurements under field conditions. These measurements were carried out in accordance with rules and definitions as given in § 1. The results of the measurements are contained in § 2.

1 Rules and definitions for the measurement of the loading of telephone channels and transmission systems

1.1 *Rules and definitions for the measurement of speech power from the public switched telephone network in field conditions*

1.1.1 *List of definitions* (see also Figure 1)

Z_s (mW0) is the speech power, while talker is active

y_s (dBm0) is the level of speech power, while active $= 10 \log_{10} Z_s$

Z_c (mW0) is the speech power on a channel averaged over a conversation (a distinction may be made between auxiliary and main conversations)

y_c (dBm0) is the level of speech power on a channel averaged over a conversation $= 10 \log_{10} Z_c$

σ_{y_c} (dB) is the standard deviation of y_c

$\bar{y}_c$ (dBm0) is the mean of the levels of speech power y_c

y_p (dBm0) is the level of the long-term mean speech power averaged over a population of talkers participating in customer conversations,

$y_p = \bar{y}_c + 0.115\ \sigma_{y_c}^2$ (assuming y_c is Gaussian)

$\bar{\tau}_c$ is the long-term mean of the activity factor within a conversation

$$\tau_c = \frac{ab + cd + ef + gh}{XY} \text{ in } c) \text{ of Figure 1}$$

$\bar{\tau}_o$ is the long-term mean of the "channel busy" customer occupancy factor

$$\tau_o = \frac{XY}{WZ}$$

$\bar{\tau}_B$ is the long-term mean of the "channel engaged" factor defined as the fraction of "busy hour" during which "channel busy" conditions occur

$$\tau_B = \frac{\Sigma WZ}{\text{observation period}}$$

$\bar{\tau}_u$ $= \overline{\tau_o \times \tau_B}$; on the assumption that τ_o and τ_B are statistically independent, it follows that

$$\overline{\tau_o \times \tau_B} = \bar{\tau}_o \times \bar{\tau}_B$$

This is the long-term mean of the proportion of time of the "busy-hour" in which conversation occurs.

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$\overline{Z}_{sig}$ (mW0) is the signalling power averaged over the signalling time intervals (WT + YZ)

$\overline{Z}_t$ (mW0) is the power of supervisory tones averaged over time interval UV

$\overline{Z}_{st} = \overline{Z}_{sig} + \overline{Z}_t$

$y_{st} = 10 \log_{10} \overline{Z}_{st}$

$\overline{\tau}_{st}$ is the long-term mean of the occupancy factor for signalling and tones within a "channel busy" period

$$\tau_{st} = \frac{WT + UV + YZ}{WZ}$$

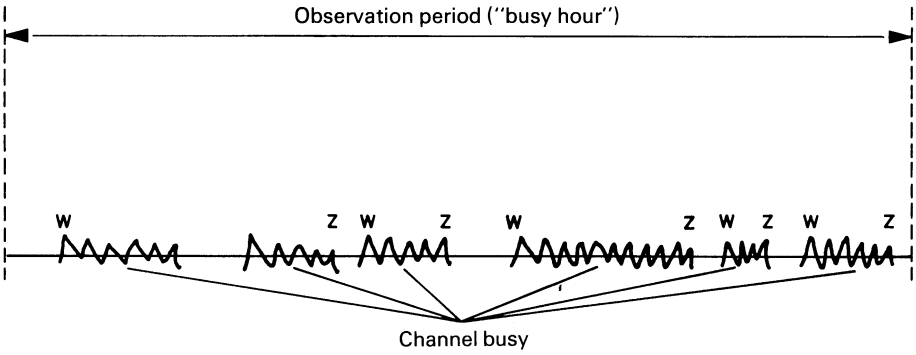
The following relationships apply:
level of mean power due to customer conversation averaged over the "busy hour"

$y_m = y_p + 10 \log_{10} \overline{\tau}_u$

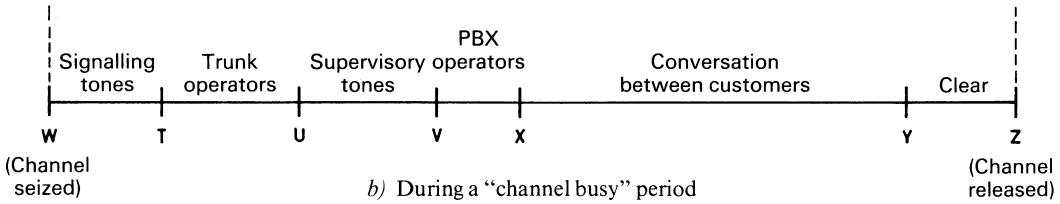
$y_c = y_s + 10 \log_{10} \tau_c$

$y_p = \overline{y}_c + 0.115\ \sigma_{y_c}^2$ (assuming a Gaussian distribution)

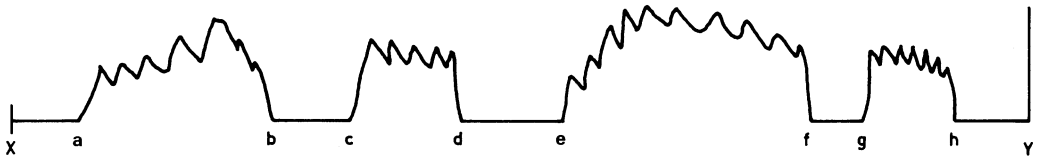
All the mean values $\overline{\tau}$ of the various activity and occupancy factors τ_{ij} are mean values averaged over calls and channels.



a) During a "busy hour"



b) During a "channel busy" period



c) During a conversation

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FIGURE 1
Load of a telephony channel

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1.1.2 *Measurements made on one channel*

1.1.2.1 *Mean power level* during conversations of the subscribers, y_c dBm0. The results are presented in the form of $\bar{y}_c$ and σ_{y_c} from which y_p may be derived.

1.1.2.2 The point of measurement is chosen so that only unidirectional signals are incorporated in the results. The relative level of this point is indicated as well as its situation in the connection in some cases.

1.1.2.3 The *circuit occupancy factors* τ_o, τ_B and their product τ_u are given in the form of their long-term mean value.

1.1.2.4 The level of the signalling and supervisory tone power y_{sl} are in the form of mean level in dBm0 and the standard deviation.

1.1.2.5 The *signalling occupancy* τ_{sl} is indicated as long-term mean value.

1.2 *Rules and definitions for the measurement of the power of a multiplex system, averaged over a given time*

1.2.1 This measurement expresses, in dBm0, the level of the mean power of all signals in a particular multiplex system, averaged over a time interval determined by the measuring equipment.

The measurement is usually conducted during a number of busy periods and gives directly, after division by N (number of channels in the system), the mean power per telephone channel. If channels are used to carry signals other than telephony, suitable corrections have to be applied. The mean power per channel obtained in this way can be compared with the conventional load.

1.2.2 *List of definitions*

y_l (dBm0) level of the multiplex signal power averaged over a specified time interval (e.g. 1 minute)

σ_{y_l} (dB) standard deviation of y_l

$\bar{y}_l$ (dBm0) mean level (mean of y_l)

y_N (dBm0) level of the mean power

($y_N = \bar{y}_l + 0.115\ \sigma_{y_l}^2$ assuming a Gaussian distribution)

P (mW0) mean power, whereby

$y_N = 10 \log_{10} P$.

1.2.3 *Measurements made on assemblies of channels*

1.2.3.1 The *mean power* on assemblies of channels (basic groups, supergroups, etc., and multichannel systems) is measured. Information about the constitution of the groups (numbers of channels used for telephony, telegraph bearers, programme circuits, data, etc.) is also provided.

1.2.3.2 Statistical information on the multiplex signal, averaged over several busy hours (probability distribution of the instantaneous signal level in dBm0) is of interest, particularly for estimating the probability of overload. (Distribution curves are contained in this Supplement.)

2 Results of speech power measurements under field conditions

The results of the measurements of the power on one channel are contained in Table 1.

The results of measurements on groups of channels and systems are shown in Table 2.

Figures 2 and 3 indicate distribution curves for the instantaneous signal levels on basic groups and supergroups. Measurement results obtained during Study Period 1973-1976 as shown in Figures 4 to 8 are also given.

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