

RECOMMENDATION ITU-R F.398-3*

**Measurements of noise in actual traffic over radio-relay systems
for telephony using frequency-division multiplex**

(1959-1963-1966-1970-1974)

The ITU Radiocommunication Assembly,

considering

- a) that measurements by means of a generator producing white noise (according to Recommendation ITU-R F.399) are only possible when the radio-frequency channel is not carrying traffic and that channels used for these measurements can lie within the frequency range occupied by telephone channels**;
- b) that systems carrying multi-channel telephony cannot be withdrawn from service at will for measurement;
- c) that protection channels are not always available for maintenance purposes;
- d) that maintenance measurements of the total noise (thermal and intermodulation noise) are used for determining the quality of a system and must be made while the system is carrying traffic;
- e) that it is convenient to place the channels used for this kind of measurement outside the total bandwidth of the multiplex signal;
- f) that, when these measuring channels are located outside the total multiplex signal band, they should be positioned as near the limits of the total signal band as possible, to measure the intermodulation products due to the non-linearity of the system;
- g) that, on the other hand, to facilitate and to minimize the cost of filter construction, the measuring channels should not be positioned too near these limits;
- h) that measurements in channels above the multiplex signal band are generally more sensitive to changes of thermal and intermodulation noise in the radio-frequency and intermediate-frequency circuits of the equipment, whereas measurements in channels below this band are generally more sensitive to changes in the modulators and demodulators;
- j) that it is usually necessary to use band-stop filters at the input of a system, to minimize noise on the incoming circuit in the bands occupied by the measuring channels and that it will be necessary to specify the minimum performance of these filters, both in the stop band of these filters and at the edges of the total multiplex signal band;

* Radiocommunication Study Group 9 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44.

** In this Recommendation the words “frequency range occupied by telephone channels” are intended to mean the part of the baseband actually transmitted, when a system is used below its maximum capacity.

- k) that the specification of frequencies, situated about 10% above the upper limit of the total multiplex signal band for continuity pilots (Recommendation ITU-R F.401), suggests the use of the same frequencies as centre frequencies for the measuring channels. On the other hand, measuring equipment with a heterodyne receiver, which is independent of the pilot and can also be used for measurements in accordance with Recommendation ITU-R F.399, will suffer interference from a pilot transmitted during the measurement, so that a shift of the measuring channel will be necessary;
- l) that the following factors have to be taken into account when the centre frequency of noise measuring channels is shifted in accordance with § k):
- the difference in frequency between the measuring channel and the total multiplex signal band should be as small as possible (§ f),
 - intermodulation products between the pilot and the lower end of the baseband should not fall within the measuring channel,
 - in view of spurious responses which might occur with crystal band-stop filters, the measuring channel should be shifted upwards when use is made of these;
- m) that it may be of use to combine the evaluation of the power of the continuity pilot with the measurement of the noise around it;
- n) that it may be of use to employ the measuring channels outside the multiplex signal band also for measurements with white noise, according to Recommendation ITU-R F.399,

recommends

- 1** that noise occurring in radio links while actual traffic is being carried should be measured at the output of the system in relatively narrow bands situated outside (below and/or above) the total multiplex signal band;
- 2** that the centre frequencies of the noise measuring bands should be those shown in Table 1:
- the centre frequencies given in column *a*) should preferably be used in conjunction with the measuring equipment considered in § m);
 - the centre frequencies given in column *b*) are for use with measuring equipment similar to that described in Recommendation ITU-R F.399 (also considered in § n));
- 3** that the attenuation of the band-stop filters at the input of the system should exceed 50 dB over a minimum frequency band of $\pm(0.005f+2)$ kHz* (*f* being the centre frequency in kHz of the measuring channel). The additional attenuation, caused by the insertion of the band-stop filters at the lower and at the upper edges of the total multiplex signal band, shall not exceed 0.3 dB referred to the additional attenuation caused in the centre of the multiplex signal band;
- 4** that the effective bandwidth of the filters in the receiving equipment should be small enough for use with the input band-stop filter mentioned above;
- 5** that, in all cases where different frequency bands are used, or where there are differences between the measurement techniques, special agreements should be made.

NOTE 1 – In certain telephone channels and in combinations of them, harmonic distortion may be produced, which may make it necessary to leave these channels disconnected, e.g. if the second or third harmonics coincide with the centre frequencies of the noise measuring channels.

* Except when the centre frequency is 10 kHz; the minimum frequency band is then 10 ± 1 kHz.

TABLE 1

System capacity (number of channels)	Limits of band occupied by telephone channels (kHz)	Frequency limits of baseband ⁽¹⁾ (kHz)	Centre frequencies (<i>f</i>) of noise measuring channels (kHz)		
			Below	Above	
				<i>a</i>)	<i>b</i>)
24 60	12-108 12-252 60-300	12-108 12-252 60-300	10 10 50	116 or 119 304 331	(2) (2) (2)
120	12-552 60-552	12-552 60-552	10 50	607 607	600 600
300	60-1 300 64-1 296	60-1 364	50	1 499	1 549
600	60-2 540 64-2 660	60-2 792	50	3 200	3 250
960	60-4 028	60-4 287	50	4 715	4 765
900	316-4 188	60-4 287	270	4 715	4 765
1 260	60-5 564 60-5 636	60-5 680	50	6 199	6 300
1 200	316-5 564	60-5 680	270	6 199	6 300
1 800	312-8 204 316-8 204	300-8 248	270	9 023	9 073
2 700	312-12 388 316-12 388	300-12 435	270	13 627	13 677

⁽¹⁾ Including pilots or frequencies which might be transmitted to line.

⁽²⁾ These values will be indicated after more practical experience has been gained.