[3] CCITT Recommendation – Electrical characteristics for unbal-
ances double-
current interchange circuits, Recommendation V.28,
[4] CCITT Recommendation – Resistibility of subscribers' termi-
nals to over- voltages and over-currents, Recommendation K.y.

The equipment shall withstand residual lightning surges, high voltage line faults, and high level telegraph keying. The protection required is considered a national matter, though in some cases Recommendation K.y could be applied [3].

8.Line wetting

8.1Line wetting, where required by the type of line plant used, will normally be sourced by the in-station equipment and looped by the subscriber's equipment.

8.2The current has a maximum value of 15 mA with the line short-circuited. The wetting current shall be a minimum of 5 mA on 4000 ohms lines. The open circuit voltage shall be under 80 V.

Note - In some countries, other values may apply.

Where a modem may be required to work in the presence of line wetting, then the modem performance (§ 4) and the modem line impedance (§ 5) requirements must apply with line wetting current flowing.

The noise applied to the line from the wetting power supply shall be under -80 dBm (600 ohms) over a range 300 to 3 400 Hz (flat).

9.Permitted out-of band energy

9.1The out-of-band energy is a national matter; however, the following information is provided to assist equipment manufacturers.

9.2The transmitted signal level (with an output level at -13 dBm) at any one frequency shall not exceed the following limits (with the forward and reverse channel keyed at 300 bit/s with a QKS code):

200 Hz to 3 200 Hz	-13 dBm
100 Hz to 200 Hz and 3 200 Hz to 3 400 Hz	-23 dBm
Below 100 Hz	-33 dBm
Above 3 400 Hz	-33 dBm and decreasing by 12 dB/octave to -67 dBm.

REFERENCES

[1] CCITT Recommendation - 300 bit/s per second duplex modem standardized for use in the general switched telephone network, Recommendation V.21.

[2] CCITT Recommendation - List of definitions for interchange circuits between data terminal equipment adn data circuit terminating equipment, Recommendation V.24.

-13 dBm

Note - In certain applications, in particular if carrier circuits for voice channel frequency division multiplex or pulse code modulation systems are used (where the input level should be limited to -13 dBmO) it may be necessary to have a setting range of output level which could give up to 0 dBm.

5.1.2The difference in output levels between the Binary 1 (condition Z) and Binary 0 (condition A) signals shall not be greater than 1 dB for either of the channels.

5.2Receive signal level

5.2.1When the received signal level is -43 dBm or greater, the equipment should correctly interpret the line condition as either Fa or Fz.

5.2.2When the received signal level remains below a threshold between
-45 dBm and -48 dBm, the equipment shall ignore incoming information within 300 ms of the signal level dropping below the threshold. During this delay the receiving equipment may interpret (correctly or incorrectly) characters received after the drop in received signal level below the threshold. Thereafter, the equipment should not interpret characters received until the received signal level has restored to at least 2 dB above the threshold. If the signal level drops below the threshold for less than 10 ms, the equipment should take no action.

5.2.3Once the received signal level has fallen below the threshold value, the equipment shall ignore any subsequent increases in the signal level which are either less than 2 dB above the threshold or of more than 2 dB above the threshold but less than 10 ms in duration.

Note 1- The requirements of 5.2.3 need not apply during the first 20 ms from the fall in received signal level below the threshold.

Note 2 - The signal level detector shall respond to the total power contained within the nominal spectrum of the received line signal.

6.Maintenance facilities

Maintenance facilities, e.g. test loops, are a national matter.

7.Protection against high voltages

1 This is considered optional, particularly at the subscriber's location.

4.3Test signals to Recommendation R.51bis (QKS) shall be sent at a –13 dBm transmit level in both directions simultaneously. (To ensure incoherence, the rate of the test signals for the direction not under test shall be slightly lower.) The test period shall be 15 seconds.

The performance shall be in accordance with Table 1/R.20.

TABLE 1/R.20

4.4In certain configurations, it is not possible to check the modem distortion, e.g. telegraph terminals, multiplex and switching equipment with integral telegraph modems on which the d.c. signal output of the telegraph modem is inaccessible for any reason. The performance will normally be in the form of a test for distortion margin before errors are output from the equipment.

Note – The modem need only be tested at the maximum modulation rate of the equipment into which it is to be incorporated.

4.5The design of the telegraph modem shall be such that the transmissionperformance is guaranteed without adjustment on installation or subsequently.

5.Line signal levels and terminating impedance

The line interface of the modem shall be balanced and shall present an impedance of 600 ohms with a return loss (reference 600 ohms resistive) of not less than 14 dB (reflection coefficient no greater than 20%) over the range
300 – 3 400 Hz.

5.1Output signal level

5.1.1When terminated in 600 ohms the output level should be set to

The characteristic frequencies as measured at the telegraph modem line output should not differ by more than ± 3 Hz from the nominal figures.

The modem shall continue to operate with a ± 6 Hz change in receive frequency.

It should be noted that there is equipment in use that applies alternative frequencies to those shown in this Recommendation.

2. Interface

Where the modem is a separate, self-contained unit, the following interchange circuits shall be used:

Common return (e.g. circuit 102 in Recommendation V.24 [2])

Transmitted data (e.g. circuit 103 in Recommendation V.24 [2])

Received data (e.g. circuit 104 in Recommendation V.24 [2])

Carrier detect (e.g. circuit 109 in Recommendation V.24 [2]).[1]

3. Electrical characteristics

The electrical characteristics (for stand alone telegraph modems) of the interchange circuits, should be in accordance with CCITT Recommendation V.28 [3].

4. Performance

4.1 The modem under test shall be connected to another modem (according to this Recommendation or to Recommendation V.21) via an attenuator having a return loss of 4 dB and an insertion loss of 30 dB. The relative group-delay characteristics of the transmit filters are subject to further study.

4.2 Uniform spectrum Gaussian noise (band limited to 10 kHz) shall be added to give a normalized signal-to-noise ratio of 32 dB.

This is defined as:

$$\frac{\text{SIGNAL ENERGY PER BIT}}{\text{NOISE POWER PER HERTZ}} = \frac{\text{SIGNAL POWER}}{\text{NOISE POWER}} \times \frac{\text{NOISE BANDWIDTH}}{\text{SIGNAL BIT RATE}} = 32 \text{ dB}$$

Recommendation R.20

Replace by the following:

TELEGRAPH MODEM FOR SUBSCRIBER LINES

(Geneva, 1980; amended at Malaga-Torremolinos, 1984
and at Melbourne, 1988)

The CCITT,

considering

(a) that the use of high-level telegraph transmission with single or double current may cause disturbing impulse noise in adjacent cable pairs that may be eliminated by applying low-level transmission with telegraph modems;

(b) that telegraph modems would substantially reduce the power consumption in the central office;

(c) that where connection to a subscriber has to be achieved over a non-metallic pair (e.g., a voice-channel frequency-division multiplex or pulse code modulation system) a telegraph modem has to be utilized;

(d) that the frequencies given below are already standardized in Recommendation V.21 [1];

(e) that suitable inexpensive telegraph modems can be used for full duplex transmission on 2-wire circuits at modulation rates up to 300 bauds;

unanimously declares the view

that where low-level telegraph transmission is used, the following method of transmission should be recommended for all modulation rates up to 300 bauds.

1. Channel allocation

The method of transmission is based on Recommendation V.21 [1] with the following frequency designations:

Central office to subscriber (channel 1) F_A = 1 180 Hz,
F_Z = 980 Hz;

Subscriber to central office (channel 2) F_A = 1 850 Hz,
F_Z = 1 650 Hz.