- PRACTICE -

GENERAL SPECIFICATIONS FOR MODEM OPERATING WITH ASYMMETRICAL TRANSMISSION (ADSL), AT THE SPEEDS OF 2048, 4096, AND 6144 KBIT/S – 2 WIRES

CONTENTS PG

1. GENERAL

1.01 The purposes of this Standard are:

a) Specify the minimum required characteristics for the modem whose main characteristic is the asymmetrical transmission technique, at one of the following speeds: 2048, 4096, and 6144 Mbit/s, by means of two wires, trough the transmission line between modems, as previously specified by the purchaser, used on the National Telecommunications Network;

b) Describe the access implemented by the modems mentioned in item 1.01.a, on the telecommunications network, the user installation characteristics in terms of its interactions, electrical characteristics, and the requirements applicable to one single line capable of handling the asymmetrical digital transmission;

c) Simultaneously provide the voice telephone service and the various lower speed two-way digital channels, in accordance with the specifications below;

d) Describe the characteristics referring to the digital interface which should be met by the modem mentioned in previous item 1.01.a.

1.02 The characteristics, configurations, and type of digital interfaces, including the modem operation modes should be defined and confirmed previously to the acquisition procedure.

1.03 Since there are different technologies available for this transmission technique, equally efficient, it is a premise established in this Practice, that the characteristics specified herein should be met by equipment furnished in pairs.

1.04 This standard is based on the document referred to in the item 2.13 hereunder.

2. REFERENCES

(A) From TELEBRÁS

2.01 Prática TELEBRÁS no. 201-100-001 (TELEBRÁS Standard no. 201-100-001) and its attachment “Glossário de Termos Técnicos de Telecomunicações” (Glossary of Telecommunications Technical Terms).

2.02 Prática TELEBRÁS no. 240-600-703 – “Condições Ambientais Aplicáveis a Equipamentos de Telecomunicações e Equipamentos Auxiliares” (TELEBRÁS Standard no. 240-600-703 - Environment Conditions Applicable to Telecommunications Equipment and Auxiliary Equipment).

2.03 Prática TELEBRÁS no 225-100-706 – “Especificações Gerais de Equipamentos Multiplex 2048 Kbit/s - MCP-30B” (TELEBRÁS Standard 225-100-706 - General Specifications for 2.048 Kbit/s Multiplex Equipment - MCP-30B).

2.04 Prática TELEBRÁS 225-001-702 – “Especificações para Documentação Técnica – Manual de Instalação” (TELEBRÁS Standard 225-001-702 Technical Documentation Specification – Installation Manual).

2.05 Prática TELEBRÁS 225-001-703 – "Especificações para Documentação Técnica – Manual de Componentes" (TELEBRÁS Standard 225-001-703 Technical Documentation Specification – Components Manual).

2.06 Prática TELEBRÁS 225-001-704 – "Especificações para Documentação Técnica – Manual de Equipamentos" (TELEBRÁS Standard 225-001-704 Technical Documentation Specification – Equipment Manual).

2.07 Prática TELEBRÁS Standard 225-540-774 – "Especificações Gerais de Compatibilidade para Modem Bi-Canal Operando à 64 kbit/s – 2 fios" (TELEBRÁS Standard 225-540-774 General Compatibility Specifications for Two-way-Channel Modem Operating at 64 kbit/s – 2 Wires).

(B) From ABNT

2.08 NBR-13414 – "Circuito de Interconexão entre Equipamento Terminal de Dados (ETD) e Equipamento de Comunicação de Dados (ECD)" (Interconnection Circuit between Data Terminal Equipment (ETD) and Data Communication Equipment (ECD)).

2.09 NBR-13416 – "Circuito de Interconexão Balanceado para Velocidades de Transmissão do Sinal de Dados de até 10 Mbit/s" (Balanced Interconnection Circuit for Data Signal Transmission Speed up to 10 Mbit/s).

2.10 NBR-13415 – "Circuito de Interconexão Desbalanceado para Velocidades de Transmissão do Sinal de Dados de até 100 Kbit/s" (Unbalanced Interconnection Circuit for Data Signal Transmission Speed up to 100 Kbit/s).

2.11 NBR-12304 – "Limites e Métodos de Medição de Radioperturbação em Equipamentos de Tecnologia da Informação (ETI)" (Radiodisturbance Measuring Limits and Methods in Information Technology Equipment (ETI)).

(C) From IEEE

2.12 Ethernet 802

(D) From ANSI

2.13 ANSI T1.413: "Network in the Customer Installation Interfaces; Asymmetric Subscriber Line (ADSL) Metallic Interface".

(E) From EIA

2.14 EIA-485: "Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems".

3. APPLICATION FIELD

3.01 This Standard is applicable to all TELEBRÁS System Companies, and for dissemination purpose it is rated as ostensive.

4. DEFINITIONS

4.01 MODEM – It is the data communication equipment for coding and/or modulating the digital signal to be transmitted, and for decoding and/or demodulating such a signal at its reception, delivering it in its original form to the associated data terminal equipment.

4.02 DATA TERMINAL EQUIPMENT (ETD) – It is the equipment which receives data signals after its transmission and/or generates these signals to be transmitted. The ETD may also produce signals for the protection against errors.

4.03 CENTRAL MODEM (ATU-C) – It is the Master modem, responsible for the generation of synchronism signal in the line interface between modems and digital access interfaces and POTS.

4.04 REMOTE MODEM (ATU-R) – It is the Slave modem, operating with a regenerated clock extracted from the signal received from the line interface between modems, and offering digital access interfaces and POTS to the user.

4.05 POTS: Access Terminal to the Public Switched Telephone Network (PSTN) (e.g., telephone, fax, modem, etc.).

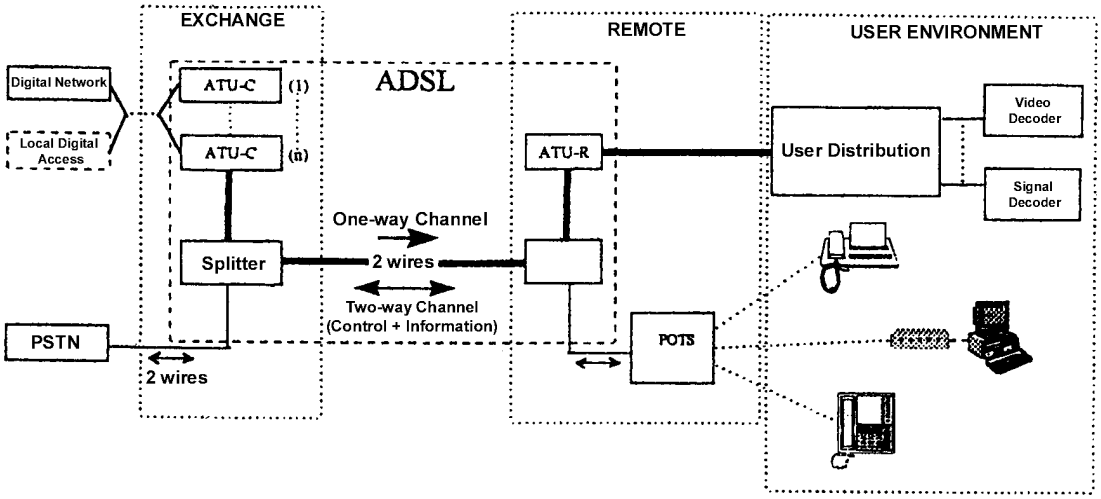
5. ENVIRONMENT CONDITIONS

5.01 The modem specified by this Standard should fully meet the requirements of Class C – Variant 1 of the document referred to in item 2.02 of this Standard.

6. DESCRIPTION OF THE FUNCTIONAL MODEL

6.01 Modems which compose this system are called ATU-C: installed on the exchange side, and ATU-R: installed either on the remote or user side.

6.02 The system reference model, as indicated in figure 1, illustrates the functional blocks required for providing the service with the modem specified by this Standard.



Notes:

- Splitter: Function used for separating/joining digital signals from the conventional telephone signal (it is optional: see item 7.04 of this Standard);
- PSTN: Public Switched Telephone Network;
- POTS: Access Terminal to the PSTN (e.g., telephone, fax, modem, etc.).

Reference Functional Model

Figure 1

7. GENERAL CHARACTERISTICS

7.02 The equipment described in the previous Part is characterized by being provided with the following:

a) An one-way transmission channel, ATU-C to ATU-R direction, which shows either of the following transmission rates: 2048 kbit/s, 4096 kbit/s or 6144 kbit/s, according to the acquisition option;

b) A two-way channel with a maximum transmission rate, depending on the Class, of up to 640 kbit/s, subdivided, formed by up to three sub-channels; one called "CONTROL SUB-CHANNEL" and the others, two at the maximum, called "INFORMATION SUB-CHANNEL":

- The control sub-channel is provided with a transmission rate of 16 kbit/s or 64 kbit/s, in accordance with the acquisition option.
- The information sub-channel, optionally supplied, is provided with a transmission rate between 160 kbit/s and 576 kbit/s, in accordance with the acquisition option;

(A) Transparence

7.02 The modem should be transparent to any code generated in its digital interfaces. It should be possible to inhibit, through programming, any function which causes interruptions in the circuit and is actuated by data signal.

(B) Voice Band Transmission Characteristics

7.03 The splitting function between digital channel voice signals in the same twisted-wire pair should be established in each of the line ends.

a) The splitting function is optional, according to the acquisition option;

b) In case the splitting function is not defined in the acquisition, its supply should be adopted as the standard, in accordance with the provisions described in this Standard.

7.04 The splitting functions are:

a) Combine the signals transmitted from the POTS and digital channels towards the subscriber line interface;

b) Split the signals received from the POTS and digital channels of the subscriber line interface;

c) Protect the POTS against the interference from the voice band of the signals generated and received by the digital channels;

d) Protect both ATU-R and ATU-C digital signals from the signals relative to the POTS, particularly to dialing, call, and call forwarding pulses.

7.05 Splitting functions between voice signals and digital signals should be processed in such a way so that if one of the ATUs is disconnected, or if power is lost, continuity along the voice band path should be kept, and the telephone service is not interrupted.

7.06 Combination and splitting of POTS and digital signals should be carried out by means of low pass and high pass filters (Splitters).

7.07 POTS signal should occupy the frequency band of 0.3 to 3.4 khz, and electrical parameters should be in accordance with the provisions described in the documents referred to in item 9.05 of this Standard.

8. TRANSPORTATION CLASSES

8.01 Based on the different configuration possibilities, as characterized in item 7.01 of this Standard, three classes are defined: 2M-3, 2M-2 and 2M-1, for the modem operating under the asymmetric transmission conditions, respectively, at speeds of 2048, 4096, and 6144, on a two-wire basis.

(A) Class 2M-1

8.02 In class 2M-1, the maximum one-way channel transmission capacity is 6144 kbit/s, on a two-wire basis, and one of the following transmission configurations should be possible:

a) One 6144 kbit/s channel; or

b) One 4096 kbit/s channel and one 2048 kbit/channel; or

c) Three 2048 kbit/s channels.

8.03 When the one-way channel configuration acquisition option is not defined, in accordance with item 8.02, the following should be adopted as the standard:

a) One 6144 kbit/s channel;

8.04 In class 2M-1 the maximum transmission capacity of the two-way channel, composed of a control sub-channel plus two information sub-channels, should be up to 640 kbit/s, enabling one of the following transmission configurations:

a) One control sub-channel of at least 64 kbit/s, of a mandatory supply; and

b) Information sub-channel, with one of the two configurations, optionally supplied, in accordance with the configuration acquisition option:

- One 160 kbit/s sub-channel and one 384 kbit/s sub-channel; or
- One 576 kbit/s sub-channel.

8.05 When the two-way channel configuration acquisition option is not defined, in accordance with item 8.04, at least the following should be adopted as the standard:

a) One control sub-channel of at least 64 kbit/s, including an electrical interface, in accordance with document referred to in item 2.10 of this Standard.

b) Without information sub-channel.

(B) Class 2M-2

8.06 In class 2M-2, the maximum one-way channel transmission capacity is 4096 kbit/s, and one of the following transmission configurations should be possible:

a) One 4096 kbit/s channel; or

b) Two 2048 kbit/s channels.

8.07 When the one-way channel configuration acquisition option is not defined, in accordance with item 8.06, the following should be adopted as the standard:

a) One 4096 kbit/s channel;

8.08 In class 2M-2 the maximum transmission capacity of the two-way channel, composed of a control sub-channel plus one information sub-channel, should be up to 640 kbit/s, on a two-wire basis, enabling one of the following transmission configurations:

a) One control sub-channel of at least 64 kbit/s, of a mandatory supply; and

b) Information sub-channel, with one of the two configurations, optionally supplied, in accordance with the configuration acquisition option:

- One 160 kbit/s sub-channel; or
- One 384 kbit/s sub-channel.

8.09 When the two-way channel configuration acquisition option is not defined, in accordance with item 8.08, at least the following should be adopted as the standard:

a) One control sub-channel of at least 64 kbit/s, including an electrical interface, in accordance with document referred to in item 2.10 of this Standard.

b) Without information sub-channel.

(C) Class 2M-3

8.10 In class 2M-3, the maximum one-way channel transmission capacity is 2048 kbit/s, on a two-wire basis, and this is the only transmission configuration.

8.11 In class 2M-3 the maximum transmission capacity of the two-way channel, composed of a control sub-channel plus one information sub-channel, should be up to 176 kbit/s, enabling one of the following transmission configurations:

a) One control sub-channel of at least 16 kbit/s, of a mandatory supply; and

b) One information sub-channel, optionally supplied, with the configurations in accordance with the following:

- One 160 kbit/s sub-channel.

8.12 When the two-way channel configuration acquisition option is not defined, in accordance with item 8.11, at least the following should be adopted as the standard:

a) One control sub-channel of at least 16 kbit/s, including an electrical interface, in accordance with document referred to in item 2.10 of this Standard.

b) Without information sub-channel.

9. ELECTRICAL INTERFACES

(A) General Characteristics

9.01 After selecting the equipment Class, as specified in the previous items of this Standard, the types of interfaces should be specified in accordance with the provisions described in the following Parts, establishing the parameter consistency.

(B) One-way Channel

9.02 The modem should have in the one-way channel at least one of the following types of interfaces, defined by the time of the acquisition,:

a) G-703, co-directional, at the speed of 2048 kbit/s, through coaxial cable - 75 ohm, and symmetric pair – 120 ohm, according to the specifications provided in Part 14 of the document referred to in item 2.03 (G-703) of this Standard;

b) V type of interface for transmission speeds up to 10 Mbit/s where pin signals should have electrical characteristics in accordance with the document referred to in item 2.09 of this Standard;

c) Ethernet 802.3 type of interface for transmission speeds up to 10 Mbit/s where pin signals should have electrical characteristics in accordance with the document referred to in item 2.12 of this Standard;

d) RS-485 type of interface as defined in the document referred to in item 2.14 of this Standard.

e) When the one-way channel interface configuration acquisition option is not defined, the letter a option of this item should be adopted as the standard for transmission speeds up to 2 Mbit/s, and letter b of this item for speeds higher than 2 Mbit/s.

(C) Two-way Channel – Control Sub-Channel

9.03 The modem should be provided with an interface of the following type in the two-way channel - control sub-channel:

a) V-type interface for transmission speeds up to 10 Mbit/s where pin signals should have electrical characteristics in accordance with the document referred to in item 2.09 of this Standard;

(D) Two-way Channel – Information Sub-Channel

9.04 The modem should be provided with an interface of the following type in the two-way channel - information sub-channel:

a) V-type interface for transmission speeds up to 10 Mbit/s where pin signals should have electrical characteristics in accordance with the document referred to in item 2.09 of this Standard;

b) U-type interface, according to Attachment I of the document referred to in item 2.07 of this Standard, except for the specifications relative to performance.

c) G-703 interface, co-directional, at the speed of 64 kbit/s for the ATU-R and ATU-C, DB-25 connector, according to the specifications provided in the document referred to in item 2.07 of this Standard;

d) When the two-way channel – information sub-channel interface configuration acquisition option is not defined, the one set forth in the letter item should be adopted as the standard.

(E) POTS (Plain Old Telephone Service) – Conventional Analog Telephone Interface

9.05 Characteristics of the interfaces, protocols and signaling contained in TELEBRÁS Standards, applicable to the Public Switched Telephone Network, should be preserved.

(F) Control and Information Sub-Channel Digital Interface

9.06 The modem should be provided with the V.24-type of digital interface, at the following synchronous speeds: 16, 64, 128, 256, 384, 512 kbit/s, and at the following asynchronous speeds: 9600,19200, 38400, 57600, and 115200 bit/s, in accordance with the specifications of document referred to in item 2.08 of this Standard, with at least the following circuits: CT-102, CT-103, CT-104, CT-105, CT-106, CT-107, CT-109, CT-113, CT-114, CT-115, CT-140, and CT-142.

9.07 The circuit electrical characteristics are the following:

a) Data and clock interconnection circuits (CT-103, CT-104, CT-113, CT-114, and CT-115) should be in accordance with the specifications of the document referred to in item 2.09 of this Standard.

b) Control circuits (CT-105, CT-106, and CT-109) should be in accordance with the specifications of the document referred to in item 2.09, or item 2.10, Receiver Category 1, of this Standard.

c) Further interconnection circuits should be in accordance with the specifications of the document referred to in item 2.10, Receiver Category 2, of this Standard.

(G) CT-109 Operation - Control and Information Sub-Channels

9.08 CT-109 should operate in accordance with the following: when there is a synchronism in the line signal, the modem sets the CT-109 under "ON" condition, and when there is a synchronism loss, CT-109 is set under "OFF" condition.

(H) CT-106 Operation - Control and Information Sub-Channels

9.09 CT-106 should be under "ON" condition when the modem is synchronous with the line signal, and CT-105 under "ON" condition.

(I) CT-104 Operation - Control and Information Sub-Channels

9.10 CT-104 should be set under the binary 1 (mark) condition, when CT-109 is under "OFF" condition.

10. PERFORMANCE

(A) Common Characteristics

10.01 The modem should operate with an error rate smaller or equal to 10^{-7} under any of the configurations provided.

10.02 Resistance/km, inductance/km, and capacitance/km characteristics of the cables which compose the lines specified in this Part, taken as reference for specification purposes, may be found in Attachment IV of this Standard.

(B) Characterization of Noise

10.03 Two types of noises are described in this Standard and should be employed to the performance tests of the modems specified by this Standard: noise model A and noise model B, described as follows, and characterized in Attachment I and II of this Standard, respectively.

10.04 The noises mentioned in the previous item are those which represent the frequency domain of the sources which model the domain of the environment permanent status, caused by crosstalk of adjacent wire pairs and due to the different transmission system coding.

a) The two noise models, model A and model B, differ from each other due to the need for complying with the systems which may either have or not subscriber access systems with information transmission based on HDB3 coding and operating at speeds of up to 2048 kbit/s.

b) Noise model A is employed to simulate environments where there are no interfering elements, as described in the previous item, but includes the radio frequency interference, observed mostly in the overhead cables.

c) Noise model B is employed to simulate environments where subscriber access systems with information transmission are based on HDB3 coding and operating at speeds of up to 2048 kbit/s in their access networks.

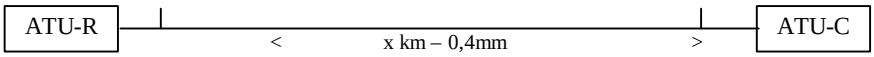
(C) Line Configurations

10.05 Table I, below, shows the X values for each of the classes and types of noise to be applied in the following lines:

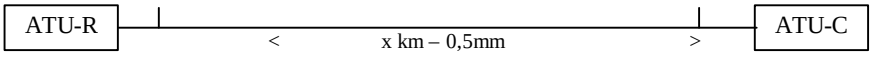
Class	2M-1		2M-2		2M-3	
Noise	A	B	A	B	A	B
Line 1	2.9	1.8	3.3	2.15	3.45	2.45
Line 2	3.85	2.35	4.3	2.8	4.55	3.2
Line 3	2.6	1.45	2.95	1.8	2.5	2.1

TABLE I

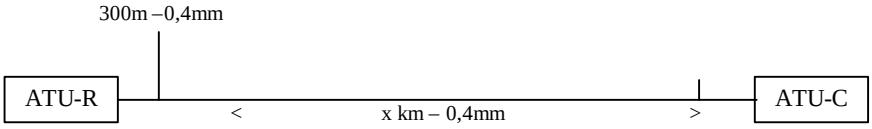
a) Line Type 1:



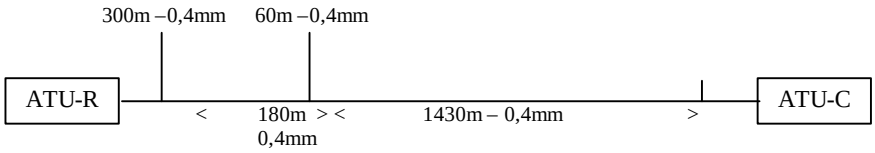
b) Line Type 2:



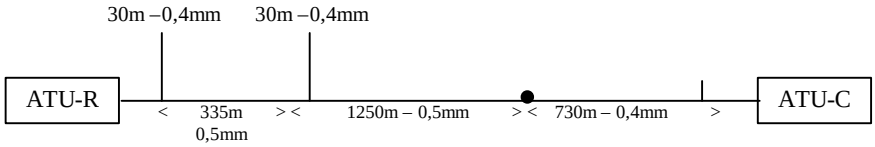
c) Line Type 3:



d) Line Type 4:



e) Line Type 5 (note: line for class 2M-3 only)



10.06 Degradation conditions: the performance of each of the channels specified for the modem should be obtained for each of the following lines shown in the previous item with the insertion of type A and type B noises as characterized in Attachment I and II of this Standard, and the interference caused by the POTS operation as described in the following Topic:

a) For class 2M-1 the specified error rate should be obtained when the modem is operating in line configurations with an insertion loss of 41 dB for noise model A at 300 kHz, and 25 dB for noise model B at 300 kHz.

b) For class 2M-2 the specified error rate should be obtained when the modem is operating in line configurations with an insertion loss of 47 dB for noise model A at 300 kHz, and 30 dB for noise model B at 300 kHz.

c) For class 2M-3 the specified error rate should be obtained when the modem is operating in line configurations with an insertion loss of 49 dB for noise model A at 300 kHz, and 35 dB for noise model B at 300 kHz.

(D) Interference Due to the Activity of the PSTN (POTS) Access Terminal Splitters

10.07 Interference caused by the operation of POTS should be considered and are not allowed for at least the following conditions:

a) Telephone call terminated at the ATU-R for at least 25 successive calling signals in the same data connection;

b) Call answering by lifting the handset in the ATU-R for at least 25 times;

c) Procedure consisting of placing the handset on and off hook in the ATU-R for at least 25 times.

d) During call routing by means of decadic and multifrequencial signaling.

(E) Signal Characteristics in the Transmission

10.08 All characteristics specified in this Part are measured, or have as reference the resistive 100-ohm termination impedance in the range of 25 kHz to 1100 kHz.

10.09 The modem should be provided with programming means so as to enable the generation and transmission of the frame alignment word and symbols of equal occurrence in further positions, for transmission signal measurement purposes.

10.10 Total Power: The signal average power is obtained with the transmission of the frame alignment word and symbols of equal occurrence in further positions. The average power value should be lower than 13.0 dBm for the ATU-R and 20.0 dBm for the ATU-C, measured in the frequency range of 4 kHz to 1100 kHz.

(F) Reception Signal Characteristics – Output Longitudinal Voltage

10.11 The modem, in the line interface, should have a longitudinal rms voltage component, measured in any 4 kHz band for an average period of 1s, smaller than –50 dBv in the frequency range of 100 Hz to 1 MHz.

10.12 In accordance with this limitation, a longitudinal termination is required with an impedance rate greater than or equal to that of the impedance of an equivalent circuit composed of a 100-ohm resistor in series with a 150nF capacitor.

(G) Reception Signal Characteristics – Degree of Unbalance

10.13 The degree of unbalance (impedance to the ground) is given by the following equation:

$$Lbal = 20 \log | ei/em | dB$$

Where:
ei – Applied longitudinal voltage (referred to the ground)
em – Resultant metallic voltage which occurs between the 100 ohm terminals

10.14 The degree of unbalance should be:

a) greater than 40 dB for frequencies in the range of 20 kHz to 1100 kHz;

(H) Clocks

10.15 The modem should have the following clock options:

a) Internal Clock: sent to the CT-114 with an accuracy of ± 50 ppm;

b) External Clock: received through the CT-113, or from an external source or extracted from the G.703 interface signal, with an accuracy of ± 50 ppm;

c) Regenerated Clock: extracted from the signal received from the line, sent to the CT-114 with an accuracy of ± 50 ppm.

d) The external and regenerated clock requirement as defined in the previous items should be compatible with the definition of the digital interface acquisition, as specified in item 9.02 of this Standard.

11. MODEM CONFIGURATION

11.01 The modem should be programmable through straps, micro-switches, ETS with characteristics compatible with the VT-100 type of terminal or similar, and may not be exclusively programmable by the ETD. When programmed by the front panel, it should be possible to inhibit the programming by means of an internal switch or password.

11.02 The modem programmed by the front panel may not change its configuration due to any variation in the power supply.

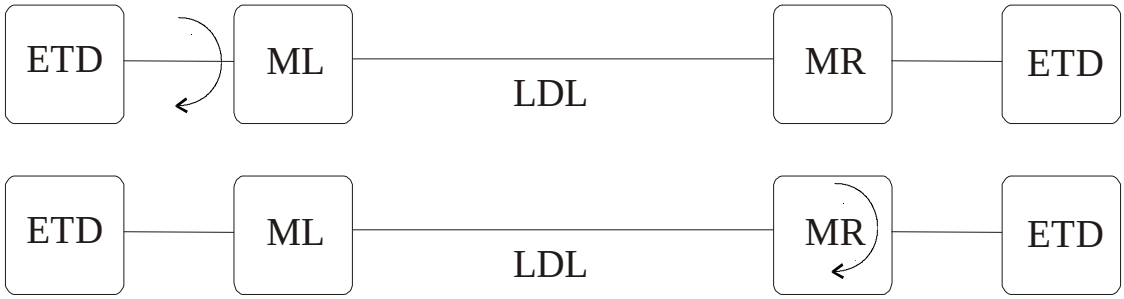
11.03 The programmable modem inhibition mentioned in item 11.01 shall not hinder the accomplishment of any test link.

12. TEST LINK – IN THE CONTROL INTERFACE

12.01 The modem should provide the following test links, in the control sub-channel, as illustrated in Figure 1 below:

a) LDL – Local Digital Loop (performed in the user interface)

b) LDR – Remote Digital Loop (performed in the remote user interface)



ML = Local Modem
MR – Remote Modem

Test Link

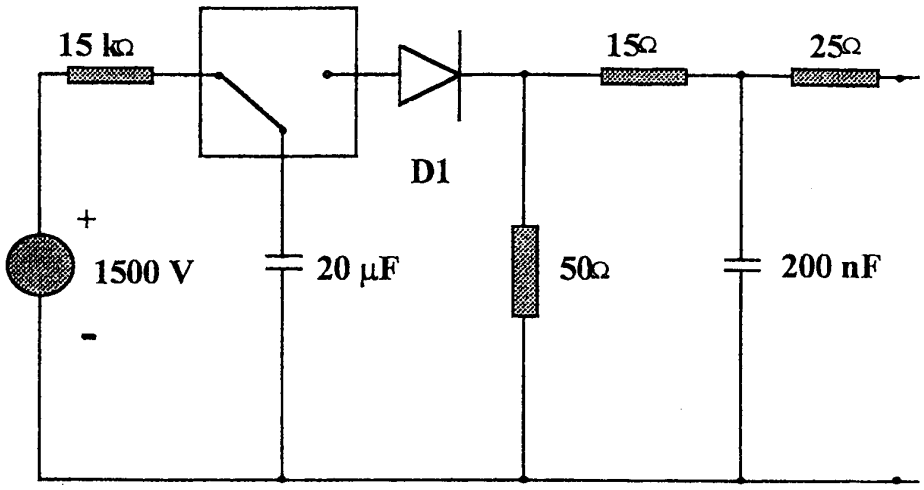
Figure 1

13. PROTECTION DEVICES

13.01 Electrical Protection – the protection devices should be incorporated into the modem so as to avoid damages caused by overvoltage:

a) Transverse Overvoltage – when at least 10 voltage surges with peaks of 1500 Volts, including a waveform of 10/700 μs are applied between the modem line terminals, through the circuit of Figure 2 or equivalent, the modem may not experience any damage;

b) Longitudinal Overvoltage – when at least 10 voltage surges with peaks of 1500 Volts, including a waveform of 10/700 μs are applied between each modem line terminal and the ground, through the circuit of Figure 2 or equivalent, the modem may not experience any damage.



DI = Quick Switching Diode

Transistorized Electronic Switch

Figure 2

13.02 Electromagnetic Compatibility – the modem should meet the provisions of the document referred to in item 2.07 of this Standard with regard to the requirements for Class B equipment.

13.03 Line and Power Supply Transformers:

a) Line and power supply transformers should support the actual 1000 volts (rms) test voltage, 60 Hz, for 30 seconds, between the primary and secondary winding, and between each of these windings and the ground. During this measurement, the leak current should be smaller than or equal to 200 µA;

b) After performing the applied voltage test, the insulation resistance should be, at least, 200 Mohms, measured with 500 VDC, between the primary and secondary winding, and between each of these windings and the ground.

14. POWER SUPPLY

14.01 Direct Current Power Supply:

a) Power supply voltage: 48 Volts, with the positive grounded;

b) Tolerance: + 20% and –15%.

14.02 Alternating Current Power Supply:

a) Power supply voltage: 110/127 VAC or 220 VAC, 60 Hz, selectable by a device or an automatic voltage switching circuit. The cabinet should be provided with a window, when applicable, so as to permit checking from the outside the selected voltage, and should be provided with a power supply switch;

b) Tolerance: ± 15% for power and ± 5% for frequency;

c) The power supply cable should have, at least, 2.5 meters in length, and its connector should be the three-pole type, with the third pin connected to the housing.

15. VISUAL INDICATIONS

15.01 The ATU-C modem should be provided, in its front panel, with at least the following visual indications:

a) Power supply – ON/OFF;

b) Line error indication;

c) Asymmetric interface signal indication;

d) Line synchronism (CT-109 status / line signal when in G.703);

e) Test indication.

15.02 The ATU-C modem should be provided, in its front panel, with at least the following visual indications:

a) Power supply – ON/OFF;

b) Line error indication;

c) Line synchronism (CT-109 status / line signal when in G.703);

d) Test indication.

16. TECHNICAL DOCUMENTATION

16.01 The modem technical documentation should meet the specifications of the documents referred to in items 2.04, 2.05, and 2.06 of this Standard.

17. NOTES

17.01 Any comments, suggestions, critiques, or other type of information related to the present document should be forwarded to the Divisão de Planejamento de Redes de Acesso do Departamento de Planejamento Técnico-Operacional da Diretoria de Engenharia e Planejamento da TELEBRÁS (Access Network Planning Division of the Technical-Operational Planning Department of TELEBRÁS Planning and Engineering Board of Directors).

18. INDUSTRIAL PROPERTY

18.01 TELEBRÁS does not take any responsibility for the occurrence of any violation of the industrial proprietary rights which may fall upon the products or processes described in this Standard.

18.02 Those interested in manufacturing the products or use the processes, object of this Standard, should check, in advance, whether there are any effective matter outstanding (patent applied for) in the Centro de Documentação e Informação Tecnológica do Instituto Nacional de Propriedade Industrial (Technological Documentation and Information Center of the National Industrial Proprietary Institute).

19. LIST OF ATTACHMENTS

19.01 ATTACHMENT I – NOISE MODEL A

19.02 ATTACHMENT II – NOISE MODEL B

19.03 ATTACHMENT III – APPLICATION CLASSES – EXAMPLES

19.04 ATTACHMENT IV – R, L and C VALUES dependent on THE FREQUENCY AND DIAMETER FOR TELEPHONE CABLES.

20. APPROVAL AND VALIDITY DATE

20.01 This document has been approved by the Technical-Operational Planning Department Manager, properly delegated by the Planning and Engineering Director on 4/28/97, and will become effective as from 4/28/97.

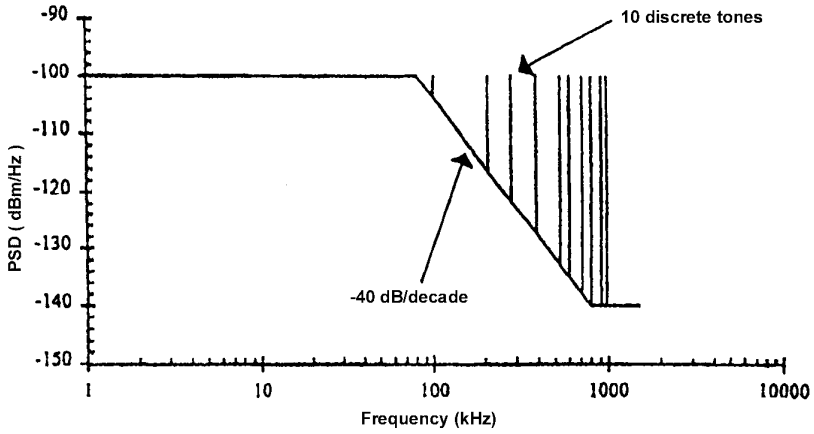
ATTACHMENT I

NOISE MODEL A

POWER SPECTRAL DENSITY OF CROSSTALK NOISE SOURCE

1.01 The radio-frequency interference normally observed is simulated by discrete tones.

1.02 The noise specifications are shown in the table below:



Unilateral band of the Power spectral density in impedance of 100 ohms

Frequency (kHz)	Power Spectral Density	
	dBm/Hz	μV/Hz
1	-100	3.16
79.5	-100	3.16
795	-140	0.03
1500	-140	0.03

Noise Coordinates

1.03 In the frequency range from 1 kHz to 1.5 MHz, the broadband noise power should be from –49.4 ± 0.5 dBm.

1.04 The noise probability density function should be approximately a Gaussian function with a crest factor greater than or equal to five.

1.05 The power spectral density accuracy should be ± 1 dB in the frequency range of 1 kHz to 1.5 MHz.

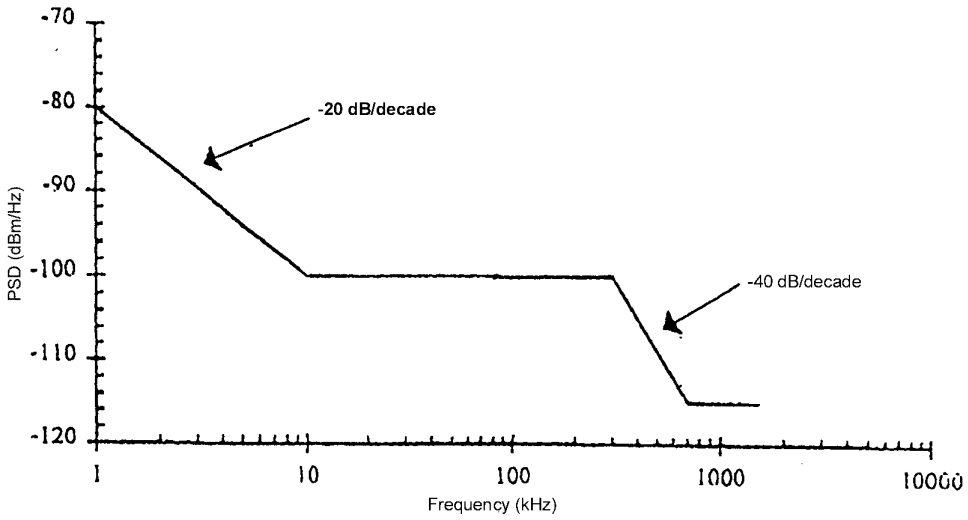
1.06 Tone frequency, with –70 dB power are: 99, 207, 333, 387, 531, 603, 711, 801, 909 and 981 Hz.

ATTACHMENT II

NOISE MODEL B

POWER SPECTRAL DENSITY OF CROSSTALK NOISE SOURCE

2.01 The noise specifications are shown in the table below:



Unilateral band of the Power spectral density in impedance of 100 ohms

Frequency (kHz)	Power Spectral Density	
	dBm/Hz	µV/Hz
1	-80	31.62
10	-100	3.16
300	-100	3.16
711	-115	0.56
1500	-115	0.56

Noise Coordinates

2.02 In the frequency range from 1 kHz to 1.5 MHz, the broadband noise power should be from –43.0 ± 0.5 dBm.

2.03 The noise probability density function should be approximately a Gaussian function with a crest factor greater than or equal to five.

2.04 The power spectral density accuracy should be ± 1 dB in the frequency range of 1 kHz to 1.5 MHz.

ATTACHMENT III

APPLICATION CLASSES – EXAMPLES

(A) Class 2M-3

1.01 ANSI Standard Example:

a) Control Sub-Channel:16 kbit/s with RS-422 interface;

b) Information Sub-Channel: 160 kbit/s with U type interface of the user basic access of narrow band ISDN.

1.02 Independent Standard Example:

a) 64 kbit/s Control Sub-Channel with interface according to document referred to in item 2.09 of this Standard;

b) Information Sub-Channel: none

(B) Class 2M-2

1.03 ANSI Standard Example:

a) Control Sub-Channel: 64 kbit/s with RS-422 interface;

b) Information Sub-Channel: 160 kbit/s with U type interface of the user basic access of narrow band ISDN.

1.04 Independent Standard Example:

a) 64 kbit/s Control Sub-Channel with interface according to document referred to in item 2.09 of this Standard;

b) Information Sub-Channel: none

(C) Class 2M-1

1.05 ANSI Standard Example:

a) Control Sub-Channel: 64 kbit/s with RS-422 interface;

b) Information Sub-Channel: 160 kbit/s with U type interface of the user basic access of narrow band ISDN.

1.06 Independent Standard Example:

a) 64 kbit/s Control Sub-Channel with interface according to document referred to in item 2.09 of this Standard;

b) Information Sub-Channel: none

ATTACHMENT IV

R, L and C values Dependent on the Frequency and Diameter for Telephone Cables

	Diameter = 0.4 mm C = 50 nF/km Ref. Temp.: 25°C Ref.: ETSI Standard		**Diameter = 0.5 mm** C = 50 nF/km Ref. Temp.: 21°C Ref.: ANSI Standard	
Freq. kHz	**R** Ω/km	**L** µH/km	**R** Ω/km	**L** µH/km
0	280.000	587.132	172.24	0.6127
2.5	280.007	587.075	172.31	0.6120
10	280.110	586.738	172.72	0.6099
20	280.440	586.099	173.58	0.6071
30	280.988	585.322	174.79	0.6042
40	281.748	584.443		
50	282.718	583.483	178.22	0.5951
100	290.433	577.878	190.39	0.5808
150	302.070	571.525	209.54	0.5719
200	316.393	564.889	241.73	0.5634
250	332.348	558.233		
300	349.167	551.714	268.15	0.5521
350	366.345	545.431		
400	383.562	539.437		
450	400.626	533.759		
500	417.427	528.409	336.59	0.5387
550	433.904	523.385		
600	450.327	518.677		
650	465.785	514.272		
700	481.180	510.153	392.76	0.5188
750	496.218	506.304		
800	510.912	502.707		
850	525.274	499.343		
900	539.320	496.197		
950	553.064	493.252		
1000	566.521	490.494	462.95	0.5062
1050	579.705	487.908		
1100	592.628	485.481		