

Apparatus for connection to public telecommunications systems using the Digital Access Signalling System No. 2 (DASS 2) via a 2048 kbit/s CCITT Recommendation G.703 interface

Part 1. General requirements

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Telecommunications Standards Policy Committee (TCT/-) to Technical Committee TCT/6, upon which the following bodies were represented:

- British Approvals Board for Telecommunications
- British Facsimile Industry Consultative Committee
- British Gas plc
- British Telecommunications plc
- Department of Trade and Industry (Telecommunications and Posts Division)
- EEA (Electronics and Business Equipment Association)
- Electricity Supply Industry in England and Wales
- GAMBICA (BEAMA Ltd.)
- HM Treasury (Central Computer and Telecommunications Agency)
- Independent Broadcasting Authority
- Institution of Electrical Engineers
- Mercury Communications Ltd.
- National Communications Union
- National Computing Centre Ltd.
- OFTEL (Office of Telecommunications)
- Telecommunication Engineering and Manufacturing Association
- Telecommunications Managers' Association
- Telecommunications Users' Association (TUA)

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Foreword

This British Standard has been prepared under the direction of the Telecommunications Standards Policy Committee. It forms one of a series of British Standards that is being produced following the commencement of liberalization in October 1981 of the supply of certain telecommunications apparatus within the United Kingdom.

These standards will include product specifications giving particular requirements for individual items of apparatus, together with standards covering general requirements for connection of apparatus to various public telecommunication systems (i.e. any telecommunication system designated as a public telecommunication system by an order made under Section 9 of the Telecommunications Act 1984). At the present time, these systems include the public switched telephone networks, the telex networks, the packet switching network, and leased private circuits run by British Telecommunications plc, Kingston Communications (Hull) plc and Mercury Communications Limited.

The requirements specified in the standards are intended to ensure that apparatus complying with them, when connected directly or indirectly to public or branch telecommunication systems, will neither adversely affect any public system nor interfere with the service available to other users of public telecommunication systems. The standards include safety requirements only for the protection of personnel operating the public telecommunication system.

This British Standard specifies the requirements for an apparatus to be approved for connection to a public telecommunication system using the Digital Access Signalling System No. 2 (DASS 2). A full description of the protocol operation is not given in this standard. The operation of the network is only described in so far as it is necessary to clearly state the requirements to be met by apparatus for connection to the network. The purpose of this standard is to state the requirements for the approval of apparatus and the associated tests to be performed, not to ensure full compatibility with DASS 2 as defined in BTNR 190, Issue 1, (April 1985) Part 1, Volumes 1 and 2 (as amended by Addendum to BTNR 190, Issue 1 (April 1985) Part 1, Volumes 1 and 2 (June 1987)).

DASS 2 is a set of layered protocols that provides for up to 30 simultaneous calls, each using a 64 kbit/s channel, over a single access link.

The electrical interface is a 2048 kbit/s interface in accordance with CCITT Recommendation G.703 using the co-axial option. The bit stream is structured into 32 8-bit time-slots. A specific signal in time-slot 0 is used to align this multiplex structure and time-slot 16 is used to convey signalling information. The signalling information consists of messages that are transferred within a separate link access protocol (LAP) for each of the time-slots 1 to 31 inclusive. The LAP provides for the identification of the time-slot to which the message applies and for the message to be given a high degree of protection from the effect of transmission errors. Specific messages achieve call control and supplementary service functions.

This British Standard is published in Parts. This Part specifies general requirements. Part 2 specifies additional requirements for automatic-repeat call attempt facilities on apparatus. A third Part covering requirements for telephony may be added.

This Part is presented for designation under the Telecommunications Act 1984.

It is stipulated in the Telecommunications Act 1984 that apparatus within the scope of a designated standard may only be approved for connection to a telecommunication system if it complies with that standard. Exceptions may be determined by or under the designation, which may stipulate variations of, or additions to, the requirements of the standard and may also set conditions that have to be complied with as regards the apparatus, or its connection, or its use.

A copy of any designation when available will be included with all copies of this standard. Any further information on, or details of, the designation may be obtained from the Office of Telecommunications (OFTEL), Export House, 50 Ludgate Hill, London EC4M 7JJ.

Some apparatus may incorporate facilities for which a mandatory standard is necessary, but for which no standard has yet been designated under the Telecommunications Act 1984. Other apparatus may incorporate innovative features not foreseen when the relevant standard was written and designated and for which that standard is not fully appropriate. The British Approvals Board for Telecommunications (BABT) can sometimes deal with these cases by writing a 'Special investigation test schedule' (SITS), which has the effect of stating requirements where there is no designated standard or of supplementing or varying the requirements in the application of the designated standard. Information on any relevant SITS may be obtained from the Director, British Approvals Board for Telecommunications, Claremont House, 34 Molesey Road, Hersham, Walton-on-Thames, Surrey KT12 4RQ.

During the preparation of this standard, work commenced in the European Conference of Postal and Telecommunication Administrations (CEPT) at the instigation of the Commission of the European Communities, on the preparation of European Telecommunications Standards (NETs).

In any country whose telecommunications administration has signed the CEPT Memorandum of Understanding on European Telecommunications Standards, compliance of apparatus with a NET, verified by an accredited laboratory in any of those countries, will be recognized for the purpose of approval of the apparatus for connection to that country's appropriate telecommunication network. National standards or requirements that are covered by the scope of a NET will not apply after a transition period. This standard does not yet come within the scope of any NET.

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular attention is drawn to the Telecommunications Act 1984.

Specification

1 Scope

This Part of BS 7378 specifies requirements for apparatus for connection to public telecommunication systems using the Digital Access Signalling System No. 2 (DASS 2) defined fully in BTNR 190 Issue 1 (April 1985), Part 1, Volumes 1 and 2 (as amended by Addendum to BTNR 190 Issue 1 (April 1985), Part 1, Volumes 1 and 2, (June 1987)).

Requirements are specified in terms of apparatus performance at the interface at the apparatus terminations (see 3.9).

NOTE 1. The connection of the interface to the public telecommunication system is not covered by this standard. The interface of apparatus other than a private branch exchange (PBX) may be connected directly to the public telecommunication system, or indirectly if the apparatus is to form part of a branch system. Connection of a PBX is specified in the relevant product standard.

Under the Class Licence for the Running of Branch Telecommunication Systems granted by the Secretary of State for Trade and Industry under Section 7 of the Telecommunications Act 1984, all branch systems have to be comprised entirely of apparatus approved for the purpose. A general approval under Section 22 of the Telecommunications Act 1984 of cable, wire and wiring accessories connected to digital services has been published by the Office of Telecommunications (OFTEL). OFTEL will publish guidelines for the wiring used in digital services as Wiring Code Part 2. This standard includes recommendations for the characteristics of cable used for the indirect connection of the specified interface of the public telecommunications system, which may be superseded by the OFTEL Wiring Code.

Part 2 of this standard specifies the additional requirements that apply if automatic-repeat call attempt facilities are supported by the apparatus.

NOTE 2. Other requirements may apply. A British Standard for 3.1 kHz bandwidth, 64 kbit/s, A-law encoded digital telephony is in preparation.

In addition to the connection requirements specified in this standard, the requirements of other product standards may apply depending on the function of the apparatus.

If the apparatus is also to be connected, either directly or indirectly, to any other service run by certain public telecommunication operators (PTOs), for the purpose of approval for connection it will have to meet the requirements in the standard covering attachments to that other service.

If the apparatus is to be used to access any other service via the service connection covered by this standard, additional requirements for connection to that other service may apply.

The requirements are intended to minimize the risk of interference with other users and to ensure the integrity of the public telecommunications networks. The requirements provide for the safety of the public telecommunication system from electrical conditions originating in the connected apparatus.

NOTE 3. Compliance with this British Standard is intended to provide safety and the prevention of interference with the PTO's networks and other users, but compliance will not necessarily ensure that the apparatus is satisfactory for the user's purpose. Recommendations are made in this standard for jitter control procedures.

NOTE 4. Compliance with clause 6 (call control signalling) does not imply that an apparatus fully supports DASS 2.

This British Standard does not apply to apparatus approved under Section 16(2) of the British Telecommunications Act 1981 or Section 22 of the Telecommunications Act 1984 before this standard comes into effect. Neither does it apply to apparatus connected to any telecommunication system for development purposes or when under test.

NOTE 5. The titles of the publications referred to in this British Standard are listed on the inside back cover.

2 Definitions and abbreviations

2.1 Definitions

For the purposes of this Part of BS 7378 the following definitions apply.

2.1.1 active channel

Traffic channel that is switched through to a terminal device.

2.1.2 alarm indication signal (AIS)

Signal received at the apparatus input port or generated by the apparatus output port, comprising a continuous stream of high density bipolar 3 (HDB3) encoded binary 1s.

2.1.3 apparatus terminations

Means associated with the apparatus port for making an electrical connection directly or indirectly to a particular service.

2.1.4 BNC plug/socket

Type of coaxial connective system complying with the physical dimensions required for compatibility in figure 2 of BS 9210 : N0001 : Part 2 : 1982.

2.1.5 flag

Octet of bit sequence 01111110 used to delimit LAP frames.

2.1.6 frame alignment

Process by which the receive equipment is enabled to identify each bit in the received frame.

2.1.7 frame alignment signal

Distinctive signal in alternate primary multiplex frames, in the same relative position within the frame, used for frame alignment.

2.1.8 functional earth

Earth used for telecommunications to provide for one or more of the following:

- (a) signalling;
- (b) over-voltage surge suppression;
- (c) voltage referencing with respect to earth;
- (d) noise suppression;
- (e) disconnection of d.c. power supplies under fault conditions.

2.1.9 idle channel

Traffic channel that is available to be assigned to a call.

2.1.10 input port

Terminations through which an electrical signal from the network termination point (NTP) passes to the apparatus.

2.1.11 invalid LAP frame

Frame that is one or more of the following:

- (a) too short (i.e. less than 40 bits between flags);
- (b) does not contain an integral number of octets;
- (c) does not contain a valid LAP address;
- (d) contains one or more errors as indicated by means of the FCS process.

2.1.12 invalid message

Signalling message that is recognizable but is not appropriate at that time in the call.

2.1.13 jitter

Short term non-cumulative variations of the significant instants of a digital signal from their ideal positions in time.

2.1.14 LAP frame

One of three types of frame:

- (a) SABMR;
- (b) UA;
- (c) UI;

bounded by a flag octet of 01111110.

NOTE. It is permissible for a single flag to act as an end and start of frame indicator for consecutive frames. Contiguous flags are transmitted between frames.

2.1.15 Link Access Protocol (LAP)

Procedure for controlling the conveyance of signalling messages through a transmission link by the use of LAP frame structures that enable the operational status of the link to be supervised, the traffic channel to which a message applies to be identified, and the messages to be given a high level of protection from the effect of transmission errors.

2.1.16 loss of primary multiplex frame alignment

Receipt of three or four consecutive errored frame alignment signals.

2.1.17 loss of signal

Break in the HDB3 transmission path to the input port equivalent to an insertion loss at the signal source of at least 40 dB.

NOTE. An actual insertion loss in excess of 6 dB may be interpreted as loss of signal.

2.1.18 mask

Boundaries of the waveform.

2.1.19 N-bit

Bit 5 of the control octet of Unnumbered Information (UI) frames.

NOTE. See B.1.2.

2.1.20 'No signal' condition

Break in the HDB3 transmission path from the output port equivalent to an insertion loss at the signal source of at least 40 dB.

2.1.21 octet

Sequence of eight contiguous bits.

NOTE. In this standard octets are numbered such that bit 1 is the low order bit (transmitted first) and bit 8 is the high order bit.

2.1.22 output port

Terminations through which an electrical signal originating in the apparatus passes to the NTP.

2.1.23 particular service

Service for which apparatus complying with this standard may receive approval to connect.

2.1.24 primary multiplex frame

32 8-bit time-slots, numbered TS0 to TS31, giving 256 bits per frame.

2.1.25 remote alarm bit

Bit 3 of time-slot 0 in those frames that do not contain a frame alignment signal.

2.1.26 return loss

Ratio of the power level of the incident signal to the power level of the reflected signal expressed in decibels.

NOTE. Return loss is an indication of the impedance matching of the apparatus to the circuit. A large value of return loss represents a good impedance match.

2.1.27 signalling channel

Time-slot 16 of the primary multiplex frame used solely for transmission of signalling information.

2.1.28 slip

Loss or gain of a digit position or a set of consecutive digit positions in a digital signal resulting from an aberration of the timing processes associated with transmission or switching of a digital signal.

2.1.29 timing reference source

Source of output port signal timing.

2.1.30 traffic channel

Channel usable for switched voice/data/telephony call occupying one of time-slots 1 to 15 or 17 to 31.

NOTE. Traffic channels 1 to 15 are represented by time-slots 1 to 15 and traffic channels 16 to 30 are represented by time-slots 17 to 31.

2.1.31 unit interval

Time required for one element of data.

2.1.32 unrecognized message

Signalling message that does not comply with any defined in this standard.

2.1.33 wander

Long term non-cumulative variations of the significant instants of a digital signal from their ideal positions in time.

2.2 Abbreviations

For the purposes of this British Standard the following abbreviations apply.

AIS	Alarm Indication Signal
BTNR	British Telecommunications Network Requirement
CA	Call Arrival message
CAM	Call Accepted Message
CCF	Clear ConFirmation message
CCI	Call Charge Indication
CCITT	International Telegraph and Telephone Consultative Committee
CCM	Call Connected Message
CIM	Clear Information Message
CLI	Calling and Called Line Identification
CRM	Clear Request Message
CS	Channel Seized message
CUG	Closed User Group
DA	Destination Address
DASS 2	Digital Access Signalling System No. 2
dB	decibel
DDI	Direct Dial-In
DTE	Data Terminal Equipment
ESRA	ECMA (European Computer Manufacturers Association) Standard Rate Adaptation
ET	Exchange Termination
FCS	Frame Check Sequence
HDB3	High Density Bipolar 3
Hz	Hertz

IA5	International Alphabet No. 5 of CCITT Recommendation V.3
ICI(C)	Incoming Call Indication message (Complete)
ICI(I)	Incoming Call Indication message (Incomplete)
ISRM	Initial Service Request Message
ISRM(C)	Initial Service Request Message (Complete)
ISRM(I)	Initial Service Request Message (Incomplete)
LAP	Link Access Protocol
MIM(C)	Maintenance Information Message (Complete)
NAE	Network Address Extension
NAM	Number Acknowledge Message
NCOP	Network Code of Practice
NIM	Network Indication Message
NIM(CCI)	Network Indication Message (Call Charge Indication)
NTP	network termination point NOTE. NTP is defined in the PTO's licence.
OFTEL	Office of Telecommunications
OLI	Originating Line Identity
PBX	private branch exchange
PSN	public switched network
PTN	private telecommunication network
PTO	public telecommunication operator
RM	Recall Message
RM(C)	Recall Message (Complete)
RM(I)	Recall Message (Incomplete)
RRM	Recall Rejection Message
SABMR	Set Asynchronous Balanced Mode Restricted
SCI(C)	Subsequent Call Indication message (Complete)
SCI(I)	Subsequent Call Indication message (Incomplete)
SCT	Subscriber Call Termination
SeSR	Send Service Request message
SIC	Service Indicator Code
SITS	Special Investigation Test Schedule
SM	Swap Message
SRW	Service Request Withheld
SSRM	Subsequent Service Request Message
SSRM(C)	Subsequent Service Request Message (Complete)
SSRM(I)	Subsequent Service Request Message (Incomplete)
SSTV	Slow Scan TeleVision
TA	Terminal Adaptor
TLI	Terminating Line Identity
TS	Time-slot
TS0	Time-slot 0
TS16	Time-slot 16: common channel signalling
UA	Unnumbered Acknowledgement

UDC	User Data Control message
UI	Unit Interval (in context of bit interval timing)
UI	Unnumbered Information (in context of call control message signalling)
UI(C)	Unnumbered Information (Command)
UI(R)	Unnumbered Information (Response)
UUD(C)	User to User Data message (Complete)
UUD(I)	User to User Data message (Incomplete)
WSR	Withhold Service Request

3 General

3.1 Safety requirements for connection to a digital interface

Apparatus shall comply with BS 6301 : 1987, except as follows.

NOTE 1. Foreword, paragraph 2. The text 'for the protection of users from electrical hazards that may arise from the connection of the apparatus to the network' is not applicable to the following alterations.

NOTE 2. Foreword, paragraph 4. In line 2 'all' is not applicable to the following alterations.

(a) Clause 1, paragraph 2, lines 4 to 6. The text 'and to reduce adequately the risk of conditions on the telecommunication networks creating electrical hazards for persons using the apparatus.' does not apply.

(b) Note 1 to clause 1 does not apply.

(c) Clause 4 does not apply.

(d) Subclause 5.3.3 does not apply.

(e) Subclause 6.1 does not apply.

(f) Subclause 9.2. Delete the two warnings:

'for a single port: **WARNING. CONNECT ONLY APPARATUS COMPLYING WITH BS 6301 TO THIS PORT.**'

for a group of ports: **WARNING. CONNECT ONLY APPARATUS COMPLYING WITH BS 6301 TO THESE PORTS.**'

Substitute: 'SAFETY WARNING. See instructions for use.'

(g) Subclause 10.11 does not apply; subclause 10.12 does not apply; subclause 10.13 the references to 4.2(a) and A.3.1.1 do not apply; subclause 10.21 does not apply.

(h) Subclause 11.2 item (b) does not apply; subclause 11.2 item (c) does not apply, instead the following text applies.

'(c) If the apparatus has ports marked in accordance with 5.2, where the option of providing, within the instructions for use, an indication of ports requiring special attention has

been selected, the supplier shall indicate unambiguously the port(s) to which the warning applies.

A warning shall be given that:

'The port(s) indicated by (supplier inserts means by which he has identified to port(s)) does (do) not provide isolation sufficient to satisfy the requirements of BS 6301. Apparatus connected to this (these) port(s) must have either been evaluated against relevant parts of BS 6301 or have previously been evaluated against British Telecom (Post Office) Technical Guides 2 or 26 and given permission to attach. Other usage will invalidate any approval given to this apparatus.'

Subclause 11.2 item (f) does not apply.

(i) Subclause B.0 does not apply;

subclause B.1 item (b) and subsequent references to it in appendix B do not apply;

subclause B.2 paragraph 3 commencing 'In, for example, ...' does not apply.

NOTE 3. BS 6301 : 1987 was written primarily for apparatus for connection to analogue networks, and the above amendments are considered necessary to adapt it for apparatus for connection to digital interfaces.

Requirements for the safety of apparatus for connection to digital interfaces remain under consideration.

3.2 General test requirements

Tests for compliance with this standard shall be type tests as defined in BS 4778.

3.3 Environment for tests

All tests shall be performed at:

(a) an ambient temperature in the range 15 °C to 25 °C;

(b) a relative humidity in the range 45 % to 75 %;

(c) an air pressure in the range 86 kPa to 106 kPa.

3.4 Power supply limitations

For apparatus that is directly powered from the mains supply all tests shall be carried out within $\pm 5\%$ of the normal operating voltage.

If apparatus is powered by other means and those means are not supplied as part of the apparatus, e.g. batteries, stabilized a.c. supplies and d.c., all tests shall be carried out within the power supply limits declared by the supplier.

If the power supply is a.c. the tests shall be conducted within $\pm 4\%$ of the frequency declared by the supplier.

3.5 Test equipment

Unless otherwise specified in this standard test equipment used to measure voltage shall have a minimum resistance of 5 M Ω . Current measurements shall be made using a current measuring device of resistance no greater than 1 Ω .

3.6 Tolerances on test measurements

Unless otherwise specified in this standard all voltage, current and resistance measurements specified in the tests shall be made with an accuracy of $\pm 1\%$. Unless otherwise specified in this standard all timed periods specified in clause 6 have a tolerance of $\pm 10\%$ of the stated figure.

3.7 Tolerances on test components

Unless otherwise specified in this standard test components assigned values shall be within $\pm 1\%$ of nominal value.

All resistors specified shall be non-reactive, having an impedance whose reactive component is a negligible fraction of its resistive component at every frequency within its required operational range. Unless otherwise specified, a negligible fraction shall be taken to mean not exceeding one hundredth.

3.8 Test connections

Apparatus shall be submitted for approval with apparatus terminations as supplied to the user.

3.9 Compliance testing

Compliance testing shall be applied at the apparatus terminations, i.e. for apparatus complying with:

- (a) 4.1, at the connectors that mate with BNC sockets;
- (b) 4.2(a), at the means of connection to the apparatus;
- (c) 4.2(b), at the means of connection to the apparatus.

3.10 Connection to multiple interfaces of a particular service

If an apparatus is capable of being connected to more than one interface concurrently, this standard shall apply to each individual connection.

NOTE. It is recommended that apparatus submitted for approval is designed to comply with the appropriate specification of the PTO to ensure a usable connection.

4 Connection

4.1 Integral connection arrangement

If apparatus is provided with cables for connection to the particular service that cannot be detached without the use of tools, the cables shall terminate

on connectors capable of being properly mated with BNC sockets.

NOTE. The two connectors at the NTP to which the apparatus has to connect will be BNC sockets. Physical dimensions required for compatibility are given in figure 2 of BS 9210 : N0001 : Part 2 : 1982.

Each cable or associated connection shall carry means of identification such that:

- (a) the apparatus transmit cable or termination shall be identified for the forward direction of transmission associated with the PTO's network input port socket;
- (b) the apparatus receive cable or termination shall be identified for the reverse direction of transmission associated with the PTO's network output port socket.

Compliance shall be checked by inspection.

4.2 Non-integral connection arrangement

If the apparatus is either:

- (a) not provided with connecting cables; or
- (b) provided with connecting cables that are detachable by the user without the use of tools;

no requirement is specified for the means of connection to the apparatus (i.e. the point of connection between the apparatus and the cables that will have to be provided or the detachable cables), except that the input and output connections at the apparatus shall have means of identification in accordance with 4.1(a) and 4.1(b).

Compliance shall be checked by inspection.

4.3 Earthing of coaxial cables

4.3.1 Connection to apparatus transmit cable

A facility shall be provided at the apparatus to enable the functional earth of the apparatus to be either isolated from, or connected to, the conductor at the output port that is to be connected to the outer conductor of the coaxial cable that is to be connected to the NTP.

Compliance shall be checked by inspection.

4.3.2 Connection to apparatus receive cable

A facility shall be provided at the apparatus to enable the functional earth of the apparatus to be either isolated from, or connected to, the conductor at the input port that is to be connected to the outer conductor of the coaxial cable that is to be connected to the NTP.

Compliance shall be checked by inspection.

NOTE. Contact between the non-insulated outer body of cable connectors of adjacent coaxial cables may cause intermittent earth loops.

5 Physical interface

5.1 Apparatus output port

5.1.1 Current and voltage limit

The output current measured over any period of 10 s with a resistance of not more than $1\ \Omega$ applied across the output port, shall not at any time exceed 50 mA.

Compliance shall be checked by measurement.

The peak output voltage shall not exceed 2.85 V in any operating state of the apparatus.

Compliance shall be checked by measurement with an instrument having a rise time not exceeding 10 % of the unit interval.

5.1.2 Output port signal timing

5.1.2.1 In normal operation the timing of the output port signal shall be synchronized to the timing source or sources as declared by the supplier in accordance with **8.1.7** and this shall be effective over the bit rate range $2048\text{ kbit/s} \pm 50\text{ ppm}$.

Compliance shall be checked by the test of **A.9**.

5.1.2.2 In the absence of an external timing source the apparatus output port signal, if maintained, shall be within the range $2048\text{ kbit/s} \pm 50\text{ ppm}$.

Compliance shall be checked by measurement of the frequency of the HDB3 encoded signal at the output port with the external timing source removed.

NOTE. Under the conditions specified in **5.1.2.2**, the maximum level of jitter present on the digital signal at the apparatus output port, if maintained, should not exceed the limits given in table 1.

5.1.3 Maximum levels of jitter

NOTE. The jitter requirements are dependent on the timing configuration of the apparatus and apply when the apparatus is in normal operation as specified in **5.1.2.1**.

5.1.3.1 Apparatus that derives the output port timing from the signal on the corresponding input port of the port pair

The maximum levels of jitter present on the digital signal at the apparatus output port shall not exceed either of the limits given in table 1 for the two frequency bands indicated when the timing source

has jitter applied at a level anywhere within the amplitude/frequency limits given in figure 1(a).

Compliance shall be tested by measurement using instrumentation in accordance with CCITT Recommendation O.171 and the appropriate test configuration indicated in **A.10** for the particular supplier-declared output signal timing as required by **8.1.7(a)**.

5.1.3.2 Apparatus that derives the output port timing by reference to a specified external timing source

The maximum levels of jitter present on the digital signal at the apparatus output port shall not exceed either of the limits given in table 1 for the two frequency bands indicated when the timing source has jitter applied at a level anywhere within the amplitude/frequency limits given in one of the following:

- (a) figure 1(b);
- (b) figure 1(c);
- (c) figure 1(a);

Compliance shall be tested by measurement using instrumentation in accordance with CCITT Recommendation O.171 and the appropriate test configuration indicated in **A.10** for the particular supplier-declared output signal timing as required by **8.1.7(b)**.

5.1.4 Signal waveform

The signal waveform at the output port of the apparatus shall have the following characteristics and shall comply with the waveform defined in **A.3.1**:

- (a) nominal peak voltage of mark (pulse): 2.37 V;
- (b) peak voltage of space (no pulse): $0 \pm 0.237\text{ V}$;
- (c) nominal pulse width: 244 ns;
- (d) ratio of positive to negative pulse amplitudes at the mid-points of pulse width: 0.95 to 1.05;
- (e) ratio of positive to negative pulse widths at the nominal half amplitudes: 0.95 to 1.05.

Compliance shall be tested in accordance with **A.3.2**.

Table 1. Limits for maximum peak-to-peak jitter

Measurements	Limits
Measured with a jitter measuring instrument which, prior to measurement, filters the jitter with a band pass filter having:	
(a) a lower cut-off frequency of 20 Hz, an upper cut-off frequency of 100 kHz and a filter roll-off of 20 dB/decade;	0.4 unit intervals (195.2 ns)
(b) a lower cut-off frequency of 18 kHz, an upper cut-off frequency of 100 kHz and a filter roll-off of 20 dB/decade.	0.2 unit intervals (97.6 ns)
NOTE. Unit interval is equivalent to 488 ns.	

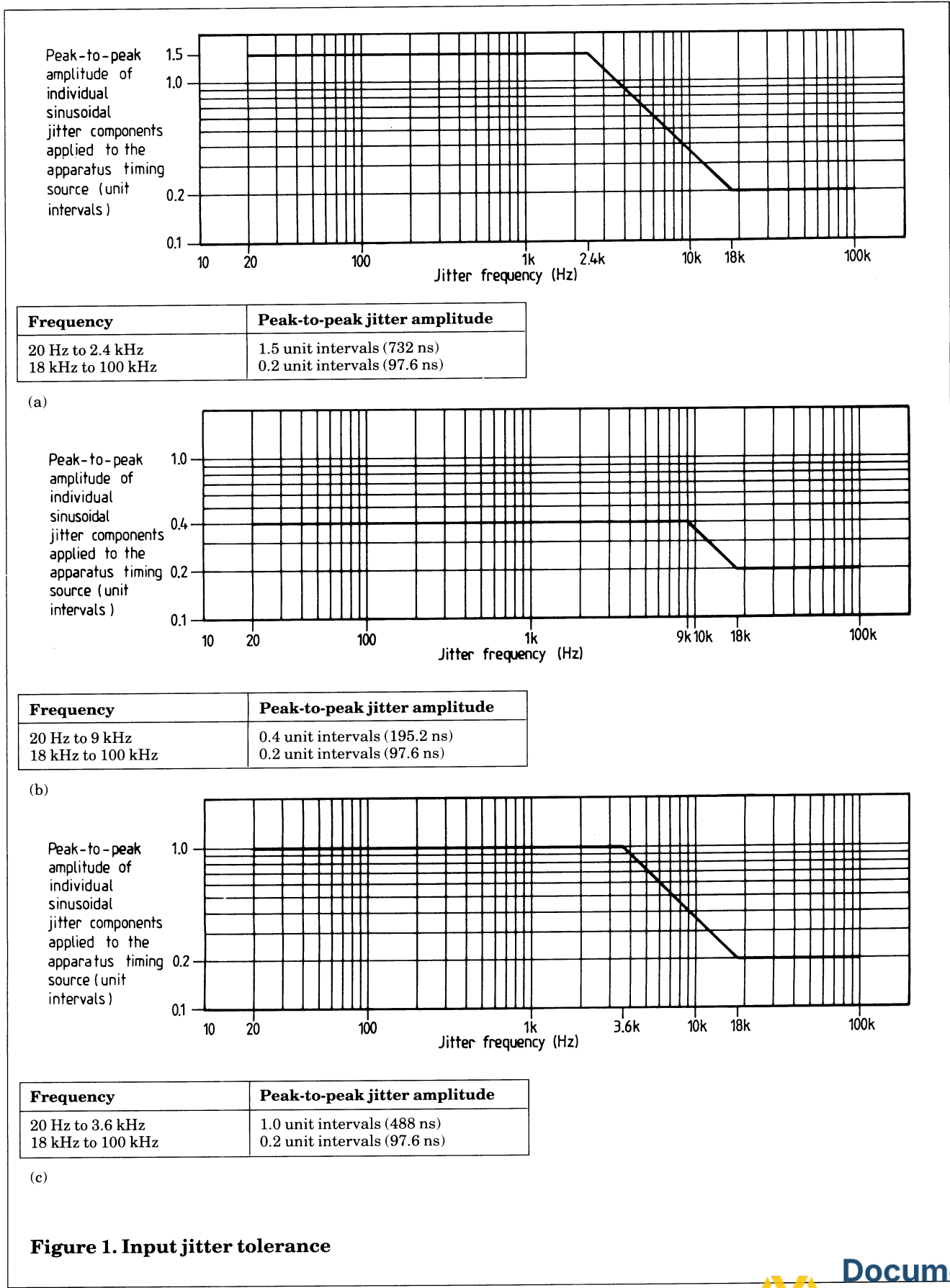


Figure 1. Input jitter tolerance

5.1.5 Signal coding

Coding of the digital signal appearing at the output port of the apparatus shall be in accordance with HDB3 encoding rules as defined in CCITT Recommendation G.703.

Compliance shall be tested in accordance with **A.2.1**.

5.1.6 Alignment of the primary multiplex frame structure

Primary multiplex frames shall be aligned by the use of the frame alignment signal of 0011011 which shall occur in the same relative position in every 512 bits. This signal shall be interpreted as bits 2 to 8 of TS0 in alternate 256 bit frames. Bit 2 of TS0 in all other frames shall be set to 1. The use of bit 1 of TS0 is reserved and shall be set to 1.

Compliance shall be tested using a frame alignment signal monitor conforming to CCITT Recommendation O.162 and with the appropriate test configuration given in **A.9**.

5.1.7 Alarm indications at the apparatus output port

The apparatus shall inform the network after detection of one or more of the following conditions at the apparatus input port:

- (a) an error of 1 in 10^3 bits or a worse error, detected in the frame alignment signal;
- (b) AIS;
- (c) loss of primary multiplex frame alignment;
- (d) loss of signal.

The apparatus shall inform the network by applying one of the following signals at the apparatus output port:

- (1) bit 3 of TS0 (i.e. the remote alarm bit) in those frames which do not contain a frame alignment signal shall be set to 1;
- (2) AIS.

The signals listed in items (1) and (2) shall only be applied after detection of one or more of the conditions listed in items (a) to (d).

NOTE 1. The use of the remote alarm bit is preferred.

The signal at the output port shall be applied within 10 s of the onset of the relevant condition at the input port.

Compliance shall be checked by the test of **A.4**.

NOTE 2. The coding of bits 4 to 8 of TS0 in those frames not containing the frame alignment word is not currently defined, but it is recommended that they be set to 1.

NOTE 3. Because the setting of an alarm condition may cause all calls in progress to be cleared, sufficient time within the specified period should be allowed.

5.1.8 No signal condition

The supplier shall declare any appropriate conditions that cause the no signal condition to be generated.

Compliance shall be checked by measurement.

NOTE. The conditions under which the no signal condition is generated, are defined in the product standard.

5.2 Apparatus input port

5.2.1 Minimum return loss

The return loss as measured at the apparatus input port shall be not less than the limits specified in table 2 when referred to 75 Ω . Return loss values for both frequency ranges shall apply.

Table 2. Minimum return loss	
Frequency range	Minimum return loss
kHz	dB
100 to 3000	20
50 to 100	15

Compliance shall be checked by the test described in **A.1**.

5.2.2 Immunity to interference

The apparatus shall be immune to interference such that a signal with a signal to interference ratio of 18 dB, attenuated by up to the maximum specified interconnecting cable loss, shall produce no error when applied to the apparatus input port.

Compliance shall be checked by the test of **A.5**.

5.2.3 Tolerance to jitter

The apparatus shall function without error when a digital signal, having electrical characteristics in accordance with CCITT Recommendation G.703 but modulated by sinusoidal jitter having an amplitude-frequency relationship as defined in figure 1(a) is applied to the apparatus input port.

Compliance shall be checked by the test of **A.8**.

5.2.4 Tolerance to wander

NOTE. This subclause applies to all apparatus with more than one port pair (associated input and output ports) and to apparatus with a single port pair if the output port timing is derived from a source other than the signal at the input port. It does not apply to apparatus with a single port pair which derives its timing from the input port signal.

If the timing source of the apparatus is not wholly derived from the specific port pair under test, the port pair under test shall function without error, errors being indicated by the occurrence of slips at any output port, when a digital signal having electrical characteristics in accordance with CCITT Recommendation G.703 but modulated by wander whose peak-to-peak value does not exceed 18 μ s

relative to the external timing source, is applied to the apparatus input port.

For compliance, the supplier shall declare how this requirement is met.

Provision of buffering to accommodate 18 μ s of wander shall be sufficient to comply.

5.2.5 Signal coding

NOTE. The signal presented to the apparatus input port will be encoded in accordance with HDB3 encoding rules as defined in CCITT Recommendation G.703.

The apparatus shall decode an HDB3 encoded signal without error.

Compliance shall be checked by the test of **A.2.2**.

5.2.6 Primary multiplex frame alignment

In accordance with the following procedure the apparatus shall:

- (a) establish primary multiplex frame alignment;
- (b) recover primary multiplex frame alignment after loss of primary multiplex frame alignment.

The signal 0011011 shall be interpreted as bits 2 to 8 of TS0 if in the following frame bit 2 of TS0 is set to 1 and in the next frame bits 2 to 8 of TS0 also contain the frame alignment signal of 0011011.

NOTE. Primary multiplex frame alignment is lost when three or four consecutive errored frame alignment signals have been received.

Compliance shall be checked implicitly by the higher layer signalling tests which will be failed if this subclause is not complied with.

6 Call control signalling

6.1 General

TS16 of the primary multiplex frame shall be used for signalling in accordance with DASS 2 and for no other purpose.

Compliance shall be checked by the tests of LAP and call control procedures.

NOTE. Signalling information relating to a call on a traffic channel is transmitted within TS16 of the primary multiplex frame in the form of messages which are carried within a LAP. A LAP is uniquely associated with each of TS1 to TS31. Traffic channels 1 to 15 are represented by TS1 to TS15 and traffic channels 16 to 30 are represented by TS17 to TS31. It is possible to freely interleave LAP frames associated with different time-slots as the need for transmitting and receiving messages relating to different traffic channels arises. Traffic channels may be circuit switched or registered as tie-lines. The requirements for the LAP and call control procedures for circuit switched and tie-line connections are specified in **6.2** and **6.3** respectively. See also paragraph 6 of the foreword.

6.2 Call control signalling relating to circuit switched connections

6.2.1 Link access protocol (LAP)

6.2.1.1 General

A LAP shall operate for each of TS1 to TS31 and shall utilize SABMR, UA, and UI frame formats as defined in **B.1**. All frames shall have bits 6 to 8 of the first octet of the address field set to 000 to indicate circuit switched signalling. The LAP and therefore time-slot to which a frame applies shall be identified by the binary coding of bits 2 to 6 of the second address octet in each frame. Subclauses **6.2.1.2** to **6.2.1.9** shall apply separately and independently to each LAP.

Compliance shall be checked by the tests described in **A.6**.

6.2.1.2 LAP initialization and/or reset

LAP initialization and/or reset is achieved by the completion of either of the sequences described in items (a) and (b). During LAP initialization or reset, the apparatus shall transmit no frame types other than those described.

- (a) *Network invoked*. The apparatus shall respond to a SABMR frame by transmitting a UA frame.
- (b) *Apparatus invoked*. If the apparatus is capable of invoking the initialization and/or reset of a LAP(s) it shall do so by transmitting a SABMR frame(s).

The supplier shall declare whether the apparatus is capable of invoking initialization and/or reset of a LAP(s).

6.2.1.3 Apparatus initiated information transfer

To send information the apparatus shall transmit a UI command frame. The N-bit shall be used as a sequence number (modulo 2). The first UI command frame to be transmitted after reset shall have the N-bit set to 0. A UI command frame is acknowledged by return of a UI response frame with the N-bit set to the same value as the N-bit of the frame to which it is referring and on receipt of a UI response frame, the apparatus shall check the value of the N-bit and if different from the expected value the frame shall be discarded. The apparatus shall retransmit the UI command frame until a valid response is received or the minimum elapsed retransmission period of 500 ms has been exceeded. The apparatus can continue to retransmit a frame until the retransmission limit (N_L) has been reached if this condition has not been met within the 500 ms retransmission period.

NOTE. N_L is recommended to be 64.