

Apparatus for connection to public telecommunications systems using signalling systems over a 2048 kbit/s G.703 interface —

Part 1: Requirements for apparatus for connection to Digital Access Signalling System No. 2 (DASS 2)

ICS 33.040.60

Committees responsible for this British Standard

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- British Approvals Board for Telecommunications
- British Telecommunications plc
- Department of Trade and Industry (Communications Information Industries Directorate)
- Electricity Association
- Federation of the Electronics Industry
- Mercury Communications Limited
- National Computing Centre Ltd.
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Foreword

This Part of BS 7378 has been prepared by Technical Committee TCT/6. It supersedes BS 7378 : Part 1 : 1991 which is withdrawn. It forms one of a series of British Standards that was produced following the commencement of liberalization in October 1981 of the supply of certain telecommunications apparatus within the United Kingdom.

The series of standards includes 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).

This edition introduces technical changes but it does not reflect a full review or revision of the standard. The changes have been made in order to maintain alignment of the standard with the changing and developing aspects of the UK liberalized telecommunications environment, to rectify errors and remedy deficiencies discovered during application of the standard. In particular, this edition has been re-aligned with the network service presentation which is defined in the industry specification BTNR 190. BTNR 190 has been amended, since the publication of BS 7378 : Part 1 : 1991, to allow effective inter-working with UK ISDN 2 and ISDN 30 (I.421) services and the corresponding equivalent international facilities.

In January 1994, the DTI asked BSI to assist with the introduction of a revised approvals regime in the United Kingdom that reduced the approvals requirements to the minimum essential requirements identified in the TTE Directive 91/263/EC. The essential requirements necessary for approval of equipment that fall within the scope of BS 7378 : Part 1 : 1991 are specified in National Technical Regulation NTR 11, which refers to PD 7004 (published by BSI). An informative appendix is included in this edition of BS 7378 : Part 1 to show the relationship between clauses in BS 7378 : Part 1 and PD 7004.

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 and is not intended to ensure full compatibility with DASS 2 as defined in BTNR 190, Issue 2, (June 1992) and SIN 206 (November 1994).

DASS 2 is a set of layered protocols that provides for up to thirty 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 (now ITU-T) 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.

A British Standard does not purport to include the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

1 Scope

This Part of BS 7378 specifies requirements for apparatus for connection to public telecommunications systems using the Digital Access Signalling System No 2 (DASS 2) defined fully in BTNR 190 Issue 2 (June 1992).

NOTE 1. 'Connection to public telecommunications systems' means both direct connection to an NTP and indirect connection where interworking occurs by means of the applicable NTP via one or more items of intervening apparatus.

Requirements are specified in terms of apparatus performance at the interface at the apparatus terminations (see 3.9). The requirements are general design requirements intended to prevent interference with the PTOs networks and other users, but compliance is not intended to ensure full compatibility with DASS 2 and will not necessarily ensure that the apparatus is satisfactory for the user's purpose. In addition to the design requirements specified in this standard, the requirements of other product standards may apply depending on the function of the apparatus.

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

If the apparatus is to be connected to, or to interwork with, any service run by public telecommunications operators, it will have to meet the approval requirements applicable to that service.

NOTE 3. The requirements for the safety of the public telecommunications systems from electrical conditions originating in the connected apparatus are not specified in this standard.

NOTE 4. 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 with 2.1.1 of BS EN 122120 : 1996.

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:

- signalling;
- over-voltage surge suppression;
- voltage referencing with respect to earth;
- noise suppression;
- 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:

- too short (i.e. less than 40 bits between flags);
- does not contain an integral number of octets;
- does not contain a valid LAP address;
- 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:

- SABMR;
- UA;
- 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.

2.1.34 type test

Test or series of tests directed towards approval of a design, conducted to determine whether an item is capable of meeting the requirements of the product specification.

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	TA	Terminal Adaptor
ET	Exchange Termination	TLI	Terminating Line Identity
FCS	Frame Check Sequence	TS	Time-slot
HDB3	High Density Bipolar 3	TS0	Time-slot 0
Hz	Hertz	TS16	Time-slot 16: common channel signalling
IA5	International Alphabet No.5 of CCITT Recommendation V.3	UA	Unnumbered Acknowledgement
ICI(C)	Incoming Call Indication message (Complete)	UDC	User Data Control message
ICI(I)	Incoming Call Indication message (Incomplete)	UI	Unit Interval (in context of bit interval timing)
ISRM	Initial Service Request Message	UI	Unnumbered Information (in context of call control message signalling)
ISRM(C)	Initial Service Request Message (Complete)	UI(C)	Unnumbered Information (Command)
ISRM(I)	Initial Service Request Message (Incomplete)	UI(R)	Unnumbered Information (Response)
LAP	Link Access Protocol	UUD(C)	User to User Data message (Complete)
MIM(C)	Maintenance Information Message (Complete)	UUD(I)	User to User Data message (Incomplete)
NAE	Network Address Extension	WSR	Withhold Service Request
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		

3 General

3.1 Text deleted

3.2 General test requirements

Tests for compliance with the requirements of this standard shall be type tests (see 2.1.34).

3.3 Environment for tests

All tests shall be performed at:

- an ambient temperature in the range 15 °C to 25 °C;
- a relative humidity in the range 45 % to 75 %;
- 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 **2.1.1** of BS EN 122120 : 1996.

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 kbit/s ± 50 ppm.

Compliance shall be checked by the test of **4.3**

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 kbit/s $\pm$ 50 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 1a).

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

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 ± 0.237 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.	

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

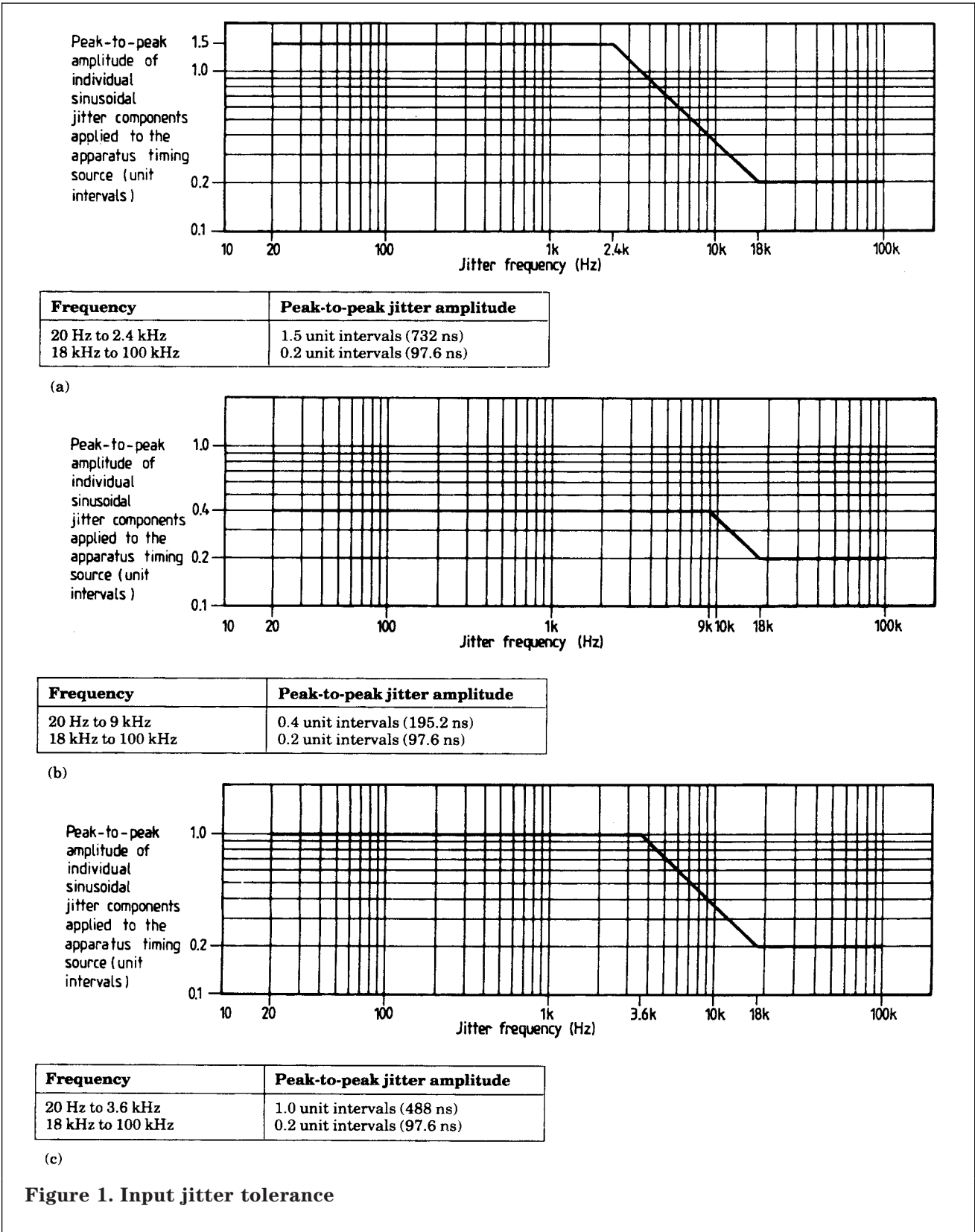
Primary multiplex frames shall be aligned by the use of the frame alignment signal of 0011011 which shall occur in the same relative position in every 512 bits. This signal shall be interpreted as bits 2 to 8 of TS0 in alternate 256 bit frames. Bit 2 of TS0 in all other frames shall be set to 1. The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

6.2.1.4 Network initiated information transfer

NOTE. The first error free UI command frame received after a reset will have the N-bit set to 0. This bit will be used subsequently as a sequence number (modulo 2) and enables the apparatus to determine the expected sequence number of the next UI command frame to be received.

On receipt of a UI command frame (see note) the apparatus shall check the value of the N-bit and if different from the expected value the frame shall be discarded. If it is the same as the expected value the frame shall be accepted and a UI response frame transmitted with the N-bit set to that value.

6.2.1.5 Invalid LAP frames

The apparatus shall disregard invalid LAP frames received.

6.2.1.6 Abort sequence

The apparatus shall detect a sequence of seven or more contiguous 1s and shall discard the current frame.

6.2.1.7 Transparency

Subclause 4.5.1 of BS ISO/IEC 3309 : 1993 shall apply.

6.2.1.8 Frame check sequence (FCS)

Subclause 4.6.2 (for synchronous transmission) and subclause 4.7.1 of BS ISO/IEC 3309 : 1993 shall apply.

6.2.1.9 Error handling

Any frame received with an incorrect FCS shall be discarded.

6.2.2 Call control procedures

6.2.2.1 General

The apparatus shall perform, as described in this subclause, those call control procedures declared by the supplier to be supported by the apparatus (see 8.2.2) for those call categories and supplementary services declared by the supplier (see 8.2.1) to be supported by the apparatus. Each message specified in accordance with the declarations of 8.2.1 and 8.2.2 shall be conveyed as the information field of a UI frame that carries the address coding of the traffic channel assigned to that call. The formats and encodings of the message types used shall be as defined in B.2 to B.8 inclusive.

The procedures applicable to the three phases of a call; call set-up, call in progress, and call clearance, shall be as shown in figure 2. Apparatus that is capable of setting up a call shall support at least one of the apparatus initiated call set-up procedures (see 6.2.2.2, 6.2.2.3, 6.2.2.4 and 6.2.2.5), call collision (see 6.2.2.6), completion of call establishment (see 6.2.2.7), and both call clearance procedures (see 6.2.2.16 and 6.2.2.17). All call in progress procedures are optional but if implemented shall comply with this subclause. All apparatus shall respond to Network Indication Messages (NIMs) in accordance with 6.2.2.13, to CIM messages in accordance with 6.2.2.17, to unrecognized and invalid messages as described in 6.2.2.20, and to MIM(C) messages as described in 6.2.2.21.1.

NOTE 1. The procedures within boxes in the vertical columns of figure 2 indicate the options available in each of the three phases of a complete call sequence from establishment to clearance. The figure can also be read from left to right so that any of the four call set-up options, when completed, can be followed by any call in progress procedure followed by either call clearance procedure. Call control messages are followed by a reference to the clause or subclause specifying the requirements for the procedure.

NOTE 2. The overall call protocol is illustrated in figures 3 and 4. There are three basic call types which are known as category 1 calls, category 2 calls, and telephony calls.

Category 1 calls are those that require an end-to-end digital path, for example, as required for data use. If such a path is not available at the time of call set-up, the network will clear the call attempt. The swap facility can be fully used. No in-band tones or announcements are given by the network.

Category 2 calls are those for which an end-to-end digital path is not essential, such as for voice services. If a non-digital path is encountered a 'not suitable for data' indication is given in the CCM. The swap facility may be used on category 2 calls subject to the capability of the end-to-end path and the terminal facilities. In-band tones and announcements are given by the network.

Telephony calls also do not require a fully digital path. However, they differ from category 2 calls in that the 'not suitable for data' indication is not given in CCMs, the swap facility cannot be used, and the user to user data supplementary service cannot be used. SM and UUD messages are treated as invalid messages by the network for telephony calls. Incoming calls to an apparatus from a non-digital connection subscribed are offered as telephony calls.

Compliance shall be checked by the tests described in A.7.

6.2.2.2 *Call set-up request by the apparatus without supplementary service request: option 1*

To set up a call on a traffic channel which is idle at that time, the apparatus shall transmit an ISRM(C), containing a SIC indicating the call category and a selection field containing a destination address.

Subclause 6.2.2.6 shall apply.

NOTE. Call establishment then proceeds subject to the recommendations described in 6.2.2.7.

6.2.2.3 *Call set-up request by the apparatus without supplementary service request: option 2*

To set up a call on a traffic channel which is idle at that time, the apparatus shall transmit an ISRM(I), containing the SIC indicating the call category. Any SSRM(I) or SSRM(C) shall follow the ISRM(I). The numerical character sequence of the destination address shall be contained within the selection fields of the ISRM(I) and SSRM(I)/SSRM(C) messages.

Subclause 6.2.2.6 shall apply.

NOTE 1. Call establishment then proceeds subject to the recommendations described in 6.2.2.7.

NOTE 2. An SSRM(C) received by the network will be treated in the same manner as an SSRM(I). The end of selection information will be determined by inspection or by timer expiry. It is recommended that, if transmitted, an SSRM(C) is the final message of that ISRM/SSRM sequence.

6.2.2.4 *Call set-up request by the apparatus with supplementary service request: option 1*

To set up a call on a traffic channel that is idle at that time, and request one or more supplementary services, the apparatus shall transmit an ISRM(C), containing a SIC indicating the call category and a selection field containing supplementary service request(s) and a destination address. The format of the supplementary service request and other procedures related to the specific supplementary service shall be as specified in the relevant subclause of 6.2.2.22.

Subclauses 6.2.2.6 and 6.2.2.11 shall apply.

NOTE. Call establishment then proceeds subject to the recommendations described in 6.2.2.7.

6.2.2.5 *Call set-up request by the apparatus with supplementary service request: option 2*

To set up a call on a traffic channel that is idle at that time, and request one or more supplementary services, the apparatus shall transmit an ISRM(I), containing the SIC indicating the call category. Any SSRM(I) or SSRM(C) shall follow the ISRM(I). The numerical character sequence of the destination address shall be contained within the selection fields of the ISRM(I) and SSRM(I)/SSRM(C) messages. The format of the supplementary service request and other procedures related to the specific supplementary services shall be as specified in the relevant subclause of 6.2.2.22.

Subclause 6.2.2.6 and 6.2.2.11 shall apply.

NOTE 1. It is recommended that the procedures of 6.2.2.10 should apply.

NOTE 2. Call establishment then proceeds subject to the recommendations described in 6.2.2.7.

NOTE 3. A SSRM(C) received by the network will be treated in the same manner as a SSRM(I). The end of selection information will be determined by inspection or by timer expiry. It is recommended that, if transmitted, a SSRM(C) is the final message of that ISRM/SSRM sequence.

Call set-up		Call in progress		Call clearance	
Apparatus	Network	Apparatus	Network	Apparatus	Network
ISRM(C) 6.2.2.2 or 6.2.2.4	→ ← NAM ← CCM	SM → ← SM 6.2.2.14		CRM 6.2.2.16 → ← NIM(CCI) (see note 4) ← CIM	
6.2.2.7 (see note 1)		SM ← SM → 6.2.2.15			
ISRM(I) SSRM(I) SSRM(I) SSRM(C) 6.2.2.3 or 6.2.2.5	→ → → → ← NAM ← CCM	RM(C) 6.2.2.8 → ← NAM (see note 3)		CCF 6.2.2.17 (see note 5) ← NIM(CCI) (see note 4) ← CIM →	
6.2.2.7 (see notes 1 and 2)		RM(I) SSRM(I) SSRM(I) SSRM(C) 6.2.2.9 ← NAM (see note 2) (see note 3)			
CAM CCM 6.2.2.19	← CS ← ICI(C) → ← CA →	RM(I) 6.2.2.9 → ← NAM (see note 3)			
CAM CCM 6.2.2.19	← CS ← ICI(I) ← SCI(I) ← SCI(I) ← SCI(C) → ← CA →				

NOTE 1. The procedures specified in **6.2.2.6** in the event of call collision apply.

NOTE 2. The apparatus shall respond in accordance with **6.2.2.10** if WSR messages are received from the network.

NOTE 3. The network may respond to a supplementary service request contained within a RM by transmitting a RRM as described in **6.2.2.12**.

NOTE 4. A NIM(CCI) message will be sent only if the CCI facility has been requested.

NOTE 5. This procedure applies regardless of the call control signalling state.

Figure 2. Generalized DASS 2 call control procedures