INTERNATIONAL STANDARD

ISO/IEC 8482

Second edition
1993-12-15

Information technology — Telecommunications and information exchange between systems — Twisted pair multipoint interconnections

Technologies de l'information — Télécommunications et échange d'informations entre systèmes — Interconnexions multipoints par paire torsadée

Reference number
ISO/IEC 8482:1993(E)

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 8482 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

This second edition cancels and replaces the first edition (ISO 8482:1987), which has been technically revised.

Annexes A and B of this International Standard are for information only.

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Information technology — Telecommunications and information exchange between systems — Twisted pair multipoint interconnections

1 Scope

1.1 This International Standard specifies the physical medium characteristics for

- twisted pair multipoint interconnections in either 2-wire or 4-wire network topology in order to provide for half duplex or duplex data transmission capability, respectively;

- a binary and bi-directional signal transfer of the interconnected endpoint systems;

- the electrical and mechanical design of the endpoint system branch cables and the common trunk cable, which may be up to 1 200 m in length;

- the component measurements of the integrated circuit type generators and receivers within the endpoint systems;

- the applicable data signalling rate up to 12,5 Mbit/s.

1.2 The defined electrical component characteristics and measurements are in close conformance with the twisted pair point-to-point characteristics given in ITU-T Recommendation V.11.

1.3 This International Standard does not describe a complete physical interface and has no functional interface characteristics, such as

- number of interchange data and control circuits;

- type, size and pin allocation of the endpoint system and branch trunk cable connectors;

- data and control signal encoding;

- time relations between signals on the interchange circuits;

- mode of synchronous or asynchronous transmission;

- signal quality for transmission and reception.

1.4 This International Standard does not specify special environmental conditions, such as galvanic isolation, electromagnetic interference (EMI), radio frequency interference (RFI), and human safety. This may form the subject of a future amendment.

1.5 This International Standard is primarily a component specification. It is not sufficiently specified for satisfactory interoperation in all possible configurations. It is the responsibility of implementors to ensure that their intended configuration will allow satisfactory interoperation.

1.6 This International Standard may be combined with any appropriate set of functional and additional environmental characteristics so as to meet the practical data transmission requirements in the field of local or wide area networks.

2 Normative reference

The following ITU-T Recommendation contains certain provisions which, through reference in this text, constitutes provisions of this International Standard. At the time of publication, the edition indicated was valid. All CCITT Recommendations and International Standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the recommendation indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The ITU-T Secretariat maintains a list of currently valid ITU-T Recommendations.

ITU-T Recommendation V.11:1988, *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.*

3 Definitions

For the purposes of this International Standard the following definitions apply:

3.1 balanced interchange circuit: An interchange circuit which uses two conductors and the differential mode voltage for transmitting signals.

3.2 common mode ejection ratio (CMRR): For balanced interchange circuits, the ratio of an applied common mode voltage, V_{cm} to the resulting transverse voltage V_{tr} (same as the differential mode voltage).

The ratio is normally expressed in decibels as

$$CM\,RR = 20 \log \frac{V_{cm}}{V_{tr}}$$

NOTE - The rejection ratio depends upon the circuit termination and should be measured while terminated in normal use.

3.3 common mode voltage: One half the vector sum of the voltages between each conductor of a balanced interchange circuit and ground or other stated voltage reference.

NOTE This voltage may be a transmitted (or received) signal or noise intereference. In the latter case, this voltage is generally not the same as the voltage, which is sometimes referred to as common mode voltage, that may exist (in a common mode) between the ends of an interchange circuit pair as a result of induction or ground-reference potential difference.

3.4 cross-talk loss (near end): For two interchange circuits used for transmission in opposite directions, the ratio, expressed in decibels, of the voltage transmitted on one interchange circuit to the resulting voltage (cross-talk) at the receive end of the other interchange circuit.

3.5 cross-talk loss (far end): For two interchange circuits used for transmission in the same direction, the ratio, expressed in decibels, of the voltage transmitted on one interchange circuit to the resulting voltage (cross-talk) at the receive end on the other interchange circuit.

3.6 differential mode voltage: The vector difference of the voltages between each conductor of a balanced interchange circuit and ground or other stated voltage reference.

NOTE - The differential mode voltage is commonly referred to as the transverse mode voltage.

3.7 environmental conditions: Those characteristics of the electrical or physical environment, for example EMI, ground potential difference magnetic fields, altitude, temperature, etc., which may affect the operation, with respect to interchange circuits, of a DTE or DCE.

3.8 galvanic isolation: The existence of a element that is non-conductive with respect to the conductivity of common mode voltage, between the equipment containing a generator and the equipment containing a receiver of an interchange circuit.

3.9 generator: The component of an interchange circuit that is the source of the transmitted signal.

NOTE - The term generator is used interchangeably with the term driver.

3.10 generator offset voltage: The d.c. component of half the vector sum of the voltages between each conductor of a balanced interchange circuit generator and its signal ground reference

NOTE - The d.c. component of half the vector sum of the voltages is the same as the arithmetic mean of the d.c. voltages in the above.

3.11 ground signal: The generator/receiver signal voltage reference.

3.12 ground earth: The voltage reference established by conductive components having a conductive path to earth in the vicinity of the equipment including the generator/receiver.

NOTE - Earth ground is generally synonymous with, and the same as, frame or building ground or protective ground.

3.13 ground potential difference: The difference between the signal ground potentials of the generator and the receiver of an interchange circuit.

The potential is the same as the difference in the earth ground potential difference only if the signal ground is connected to earth ground at both the generator and the receiver.

3.14 induced noise: An interfering voltage that is introduced into an interchange circuit by electromagnetic induction from currents in other conductors.

For balanced interchange circuits induced voltages generally appear in the common mode.

3.15 interchange circuit: The circuit, including a generator, a receiver and interconnecting media, that provides for the interchange of signals across an interface, for example DTE/DTE, DTE/DCE, DCE/DCE.

3.16 interchange point: The point in an interchange circuit at which the specified electrical characteristics of the circuit apply and should be measured.

NOTE - The interchange point usually defines the line of demarcation between equipment and is usually the location of an interface connector.

3.17 receiver: The component of an interchange circuit that provides for the detection of interchange circuit signals at the receiving equipment.

3.18 rise time: The time required for a generator output signal voltage to change from a value characteristic of one state to a value characteristic of a second state.

It is most often specified as the time for the signal voltage to pass between the 10 % and 90 % points of the wave form.

NOTES

1 Rise time is normally dependent on the load and is usually specified for a specific test termination.

2 For unbalanced generators, the time for the change from an ON or active state to an OFF or inactive state is sometimes referred to as the "fall time".

3.19 site conditions: The environmental conditions for a given site.

3.20 surge voltage resistance: The ability of an interchange circuit to function normally after being subjected to surges having peak voltages up to some specified value.

NOTE - Surge voltage resistance is sometimes referred to as surge immunity.

3.21 surge voltage: A transient voltage wave appearing on an interchange circuit as a result of induction or other phenomenon and having a relatively high value and short duration.

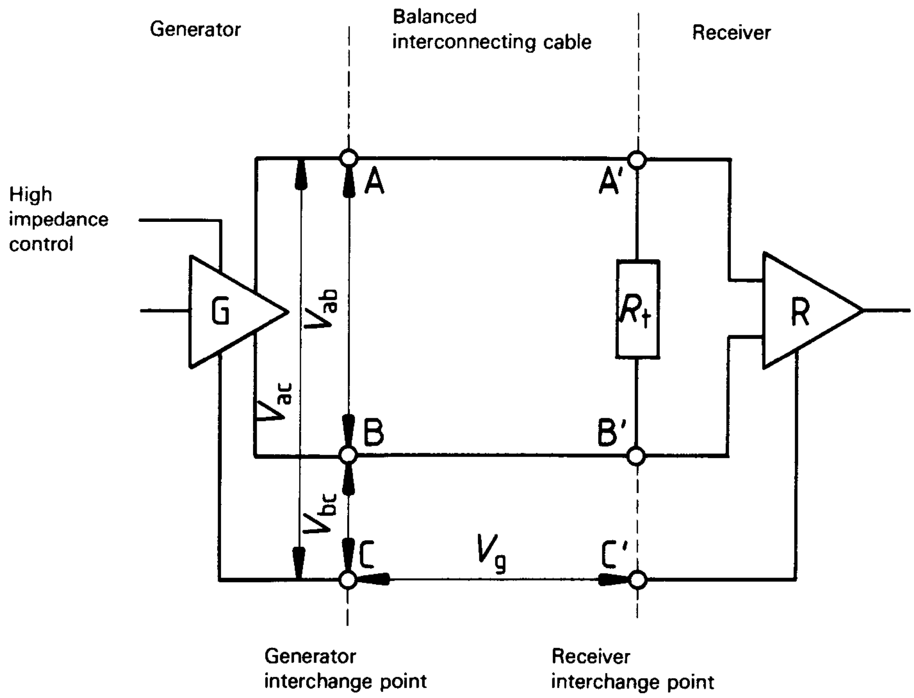
It is normally acceptable for such surges to cause errors or malfunctions.

NOTE - Surges are normally specified with the intent of assuring that equipment will not be damaged by such unusual conditions.

3.22 unbalanced interchange circuit: An interchange circuit that uses one conductor together with a second return conductor, normally signal ground, which is used in common by several circuits.

4 Symbolic representation of an interchange circuit (see figure 1)

The symbolic representation of an interchange circuit is in principle as given in ITU-T Recommendation V.11. However, the generator specified in this International Standard includes an additional control to place the device into the active state or the inactive, high impedance zero voltage state. This addition is shown in the symbolic representation reproduced in figure 1.



V_{ab}	=	Generator output voltage between points A and B
V_{ac}	=	Generator voltage between points A and C
V_{bc}	=	Generator voltage between points B and C
V_g	=	Ground potential difference
R_t	=	Cable termination resistor
A, B and A', B'	=	Interchange points
C, C'	=	Zero volt reference interchange points (Signal ground)

NOTES

1 Two interchange points are shown. The output characteristics of the generator, excluding any interconnecting cable, are defined at the "generator interchange point". The electrical characteristics to which the receiver must respond are defined without the cable termination resistor at the "receiver interchange point".

2 Points C and C' may be interconnected and further connected to protective ground if required by national regulations.

Figure 1 — Symbolic representation of interchange circuit

5 Interconnection configurations (see figures 2 and 3)

In general, the interconnection configuration consists of one balanced trunk cable, which may be up to 1 200 m in length, and several balanced branch cables, each connecting an individual endpoint system to the common trunk cable. The branch cable connection points may be spaced as appropriate. A branch cable should be kept as short as possible and in any case not exceed 1 m in length.

The balanced trunk cable shall be terminated by a termination resistor at each end. This facilitates the generator/receiver load measurements defined in 6.1.2. For connection of the endpoint systems to the trunk cable, a branch/trunk cable connector should be used. The connector(s) at each end of the trunk cable shall accommodate the termination resistor(s).

Balanced cables may be shielded if required by local regulations. It may also be necessary to extend shielding across the branch/trunk cable connectors.

Depending on the type of multipoint operation, either a two wire or a four wire interconnection configuration may be used. For example, figure 2 shows a two wire multipoint configuration for half duplex data transmission, while figure 3 shows a four wire multipoint configuration for either half duplex or duplex data transmission.

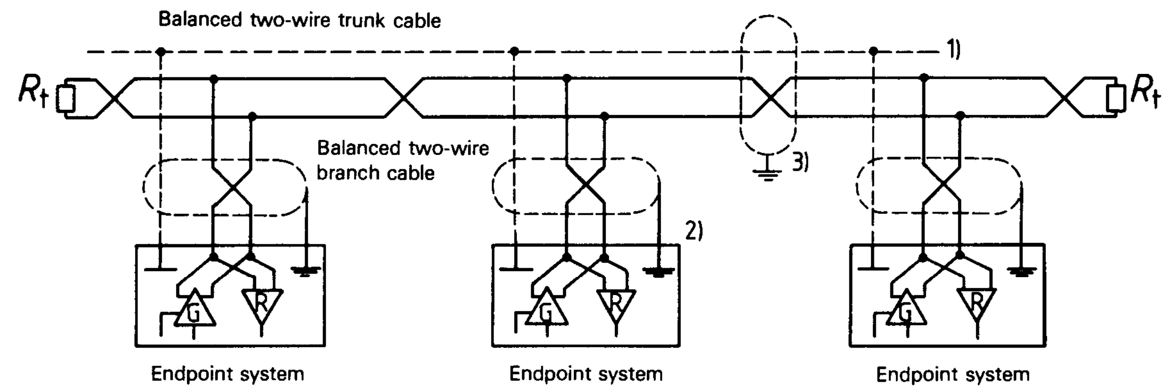
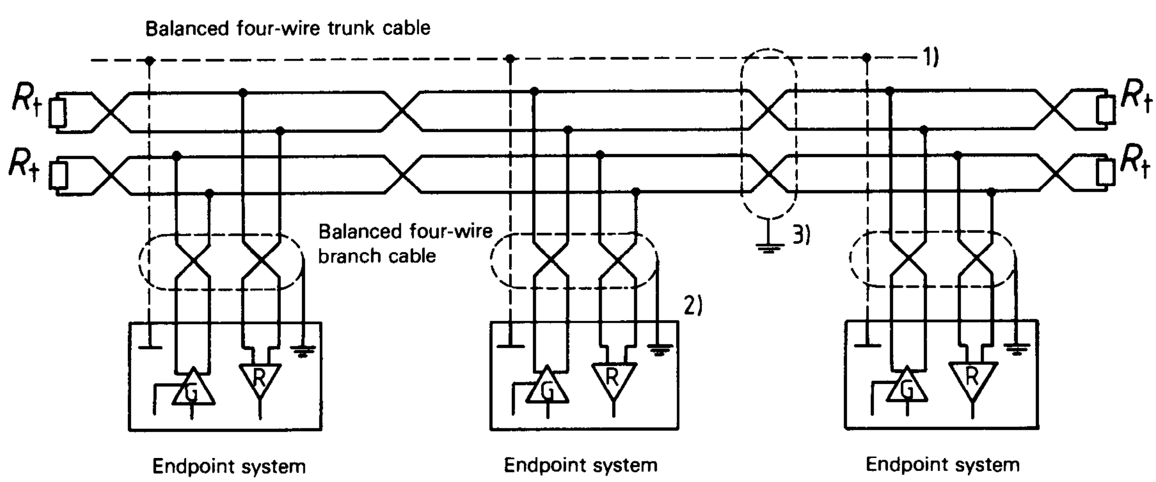


Figure 2 — Two-wire multipoint configuration



Legend: ⊥ Signal ground ⏚ Protective ground

NOTES

1) Interconnection of the endpoint system signal ground is optional and depends on local regulations.

2) Branch cable shield is optional and, when provided, it connects to the endpoint system protective ground, which may be further connected to the signal ground.

3) Trunk cable shield is optional and, when provided, it connects to a protective ground at one place. Interconnection of shield to branch cable shields may be necessary.

Figure 3 — Four-wire multipoint configuration

6 Load on the multipoint medium

Each endpoint system represents a load to the multipoint medium. The load consists of a passive generator and/or a receiver with associated internal wiring and a balanced branch cable as shown in figures 2 and 3. In accordance with the multipoint half duplex data transmission principle, only one generator is in the active state at a given time.

Successful operation requires specification of the load in terms of d.c. loading and a.c. loading. For d.c. loading, the component specification in clauses 8 and 9 are selected such that an active generator can drive the interconnecting trunk cable, terminated at each end with not less than 120 Ω, and 32 so-called Unit Loads (ULs), representing the total load of all endpoint systems. The value of 1,0 UL is defined in 6.1.1.

6.1 Specification of d.c. loading

The d.c. loading specification limits the current of an active generator to a practical value. For this reason, a hypothetical Unit Load (UL) is defined for a current/voltage measurement.

6.1.1 UL definition (see figure 4)

The value of 1,0 UL is defined by a current ranging between - 0,8 mA and + 1,0 mA when varying the voltage between - 7 V and + 12 V. The correspondent current/voltage diagram is shown in figure 4.

The voltage range takes into account the output and offset voltage of the generator, the common mode and internal voltage of the receiver and the power supply voltage.

6.1.2 UL determination of the endpoint systems (see figures 5 and 6)

When measuring the current/voltage characteristics at the disconnected branch/trunk cable connector of one endpoint system, the measured generator shall be in the inactive state. The measurement configuration is shown in figure 5. The current/voltage measurement corresponds to that of the V.11 receiver input in ITU-T Recommendation V.11, i.e. with the voltage V_{ia} (or V_{ib}) ranging between - 7 V and + 12 V, while V_{ib} (or V_{ia}) is held at zero volts, the resulting input current I_{ia} (or I_{ib}) should remain within the shaded range shown in figure 4. These measurements apply with the power supply of the generator and/or receiver in both the power-on and power-off conditions.

To determine UL from the measurements, the slope of the bounds of the current limit of one UL, see figure 4, shall be modified to the minimum slope required to fully contain the current/voltage characteristics, while the - 3 V and + 5 V intercept points are maintained. The actual value of UL is then equal to the larger of the two ratios of the actual current to the one UL current at the - 7 V and + 12 V points (see the two examples of UL value determinations in figure 6).

The slopes of the currents should be positive to lower the possibility of oscillations from negative resistance.

When adding all measured UL values, the sum shall not exceed 32,0.

6.2 a.c. loading

The a.c. loading on the multipoint medium affects the received signal quality. The determining factors, such as cable characteristics, type of encoding, etc., are

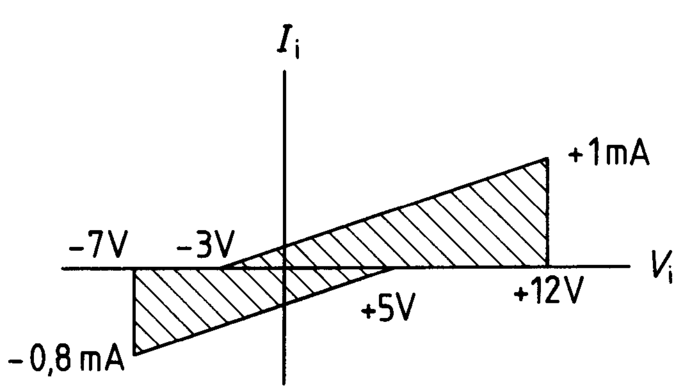


Figure 4 — Current limit of 1,0 UL

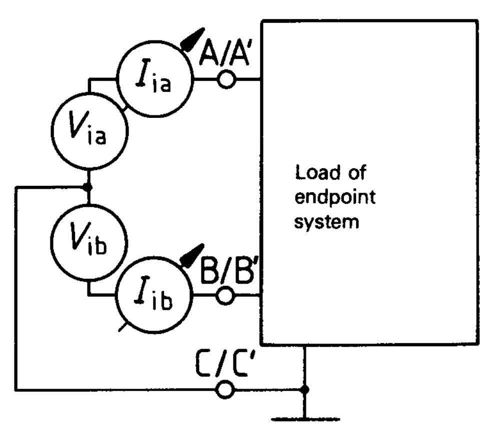
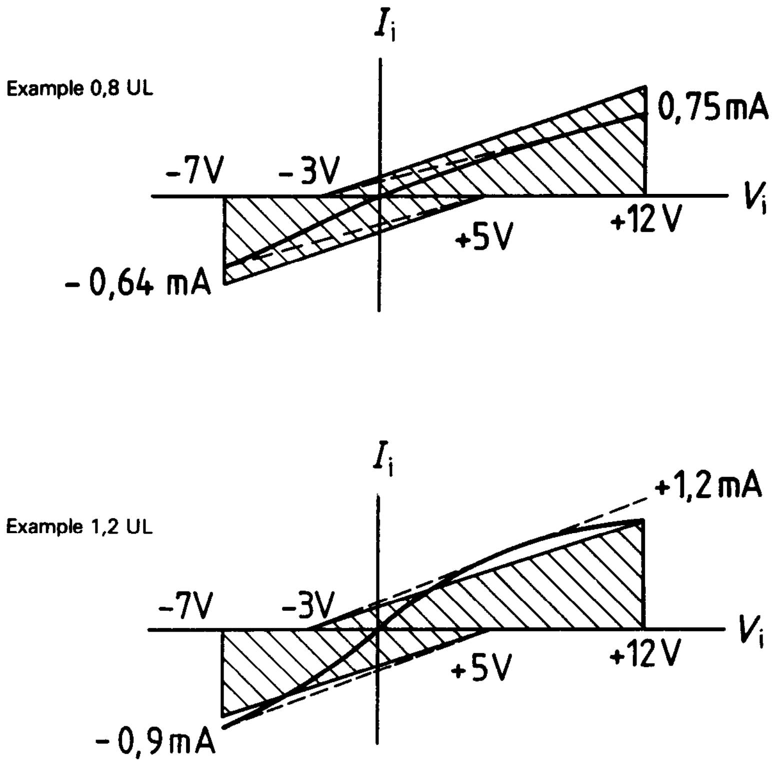


Figure 5 — Input current/voltage measurement



$$\frac{+0{,}75\ \text{mA}}{+1{,}0\ \text{mA}} = 0{,}75$$

$$\frac{-0{,}64\ \text{mA}}{-0{,}8\ \text{mA}} = 0{,}8$$

$$\frac{+1{,}2\ \text{mA}}{+1{,}0\ \text{mA}} = 1{,}2$$

$$\frac{-0{,}9\ \text{mA}}{-0{,}8\ \text{mA}} = 1{,}125$$

Figure 6 — UL value determination

application dependent and therefore beyond the scope of this International Standard. Some guidance, however may be obtained form annex B.

7 Polarities and significant levels

The generator polarities and receiver significant levels have closer tolerances than those specified in ITU-T Recommendation V.11.

Table 1 - Receiver differential significant levels

	$V_{A'} - V_{B'} \leq -0{,}2V$	$V_{A'} - V_{B'} \leq +0{,}2V$
Data circuits	MARK, 1	SPACE, 0
Control and timing circuits	OFF	ON

8 Generator characteristics

The generator component is measured in the active, low impedance state by the following tests using the measurement configurations shown in figures 7 to 10. The component may be operated from a single-rail positive power supply.

The tests are made for either binary state, whereby for the magnitude of the voltage specifications both symbols $|V|$ and $|\overline{V}|$ are used, respectively.

8.1 Open circuit voltage, V_o

The voltage, when measured in accordance with figure 7, shall be, between the

— output terminals A, B: $1{,}5V \leq |V_o|$ or $|\overline{V_o}| \leq 6{,}0V$

— terminals A, C and B, C:

$$|V_{oa}| \text{ or } |V_{ob}| \text{ or } |\overline{V_{oa}}| \text{ or } |\overline{V_{ob}}| \leq 6{,}0\ V$$

8.2 Offset voltage, V_{os}

The voltage, when measured in accordance with figure 8, shall be, between the

- load centre and terminal C: $0V \leq V_{os}$ or $\overline{V_{os}} \leq 3{,}0V$
- binary states, the difference: $|V_{os} - \overline{V_{os}}| \leq 0{,}2V$

8.3 Terminated output voltage, V_t

The voltage, when measured in accordance with figure 9 by varying the testing voltage V in the range from - 7 V to + 12 V shall be, between the

— output terminals A, B: $1{,}5V \leq |V_t|$ or $|\overline{V_t}| \leq 5{,}0V$

— binary states, the difference: $|V_t| - |\overline{V_t}| \leq 0{,}2V$

8.4 Rise time, t_r

When testing the mark/space reversals voltage V_{ss} in accordance with figure 10, the rise and fall time between 0,1 and 0,9 of V_{ss} on the output terminals A, B shall be

$$t_r \leq 0{,}3 t_b$$

where

t_b = time of UI (unit interval); and

$V_{ss} = |V_t - \overline{V_t}|$

— the resultant voltage due to imbalance between load centre and terminal C shall be

$V_e \leq 0{,}4V$ peak-to-peak.

9 Receiver characteristics

The receiver component is measured in accordance with the measurement configurations shown in figures 11 and 12.

A component meeting these requirements results in a differential receiver having a high input impedance, a small input threshold transition region between - 0,2 V and + 0,2 V differential, and allowance for an internal bias voltage not exceeding 5 V in magnitude.

9.1 Input sensitivity (see figure 11)

The permitted range of input voltages $V_{A'}$ and $V_{B'}$ appearing at the receiver input terminals A' and B' measured with respect to receiver terminal C' shall be between - 7 V and + 12 V. For any combination of receiver input voltages within this permitted range, the receiver shall assume the intended binary state with an applied differential input voltage V_i of ± 0,2 V or more.

9.2 Input balance (see figure 12)

The balance of the receiver input voltage/current characteristics and internal bias voltages shall be such that the receiver will remain in the intended binary state when a differential voltage V_{R3} of ± 0,4 V is applied through matched resistors equal to 1 500 Ω to each input terminal, as shown in figure 12, with the input voltages V_{R1} and V_{R2} ranging between - 7 V and + 12 V. When the polarity of V_{R3} reverses, the opposite binary state shall be maintained under the same conditions.

10 Fault condition tests

In order to ensure no damage occurs due to a single fault condition the components shall be tested in accordance with the measurement configurations shown in figures 13 to 14.

10.1 Generator short circuit (see figure 13)

A generator shall not sustain any damage as a result of short-circuiting its output terminals A and B to each other.

10.2 Generator current limitation (see figure 14)

The peak current in any lead to the generator shall not exceed 250 mA when testing in accordance with figure 14 by varying the testing voltage V in the range from - 7 V to + 12 V.

This criterion should not be interpreted as a requirement that a generator be capable of sourcing 250 mA. The sinking generator shall not permit a composite current in excess of 250 mA, if multiple (sourcing) generators are providing that current. (See annex A clause A.4 for additional information on generator contention.)

11 Environmental constraints

In order to operate a balanced interchange circuit at data signalling rates up to 12,5 Mbit/s, the following conditions apply:

The total common-mode voltage at any point of the interchange circuit shall be within - 7 V to + 12 V.

The common mode voltage at the receiver is the worst case combination of

a) generator-receiver ground potential difference ($V_{g'}$, see figure 1);

b) longitudinally induced random noise voltage measured between the receiver terminals A' or B' and C' with the generator ends of the cable A, B, and C joined together;

c) generator offset voltage $V_{os'}$.

12 Component compatibility

Generators and receivers meeting the requirements of this International Standard will meet the requirements of ITU-T Recommendation V.11.

Table 2 - Compatibility with ITU-T Recommendation V.11

Characteristics	ISO/IEC 8482	ITU-T Recommendation V.11
Generator and receiver		
Power supply	positive	positive and/or negative
Common mode	- 7V to + 12 V	- 7 V to + 7 V
Generator		
Open circuit	≤ 6,0 V	≤ 6,0 V
Output terminated	1,5 V to 5,0 V/54 Ω	2,0 V to 6,0 V/100 Ω
Offset	≤ 3,0 V	≤ 3,0 V
Mark/Space difference	≤ 0,2 V	≤ 0,4 V
Rise/Fall time	≤ 0,3 UI	≤ 0,1 UI
Imbalance	not specified	≤ 0,4 V p/p
Short circuit	not specified	≤ 150 mA
Current limitation	≤ 250 mA	not specified
Receiver		
Sensitivity min.	± 200 mV	± 300 mV
Sensitivity range	- 7 V to + 12 V	- 10 V to + 10 V
Imbalance	± 400 mV	± 720 mV
Internal bias	≤ 5,0 V	≤ 3,0 V
Failure detection	not specified	3 types

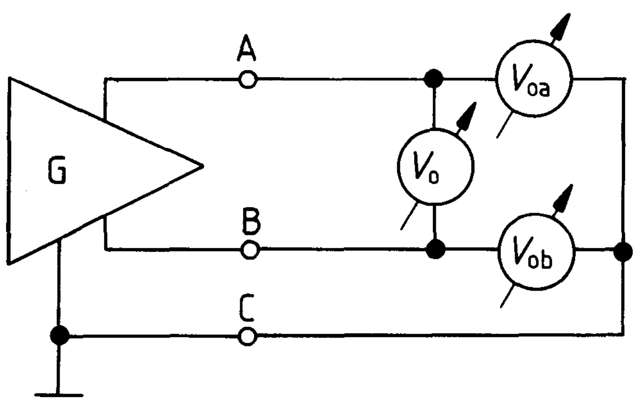


Figure 7 — Open circuit voltage measurement

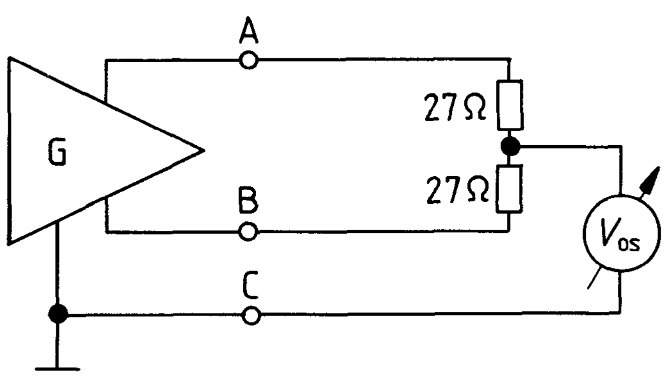


Figure 8 — Offset voltage measurement

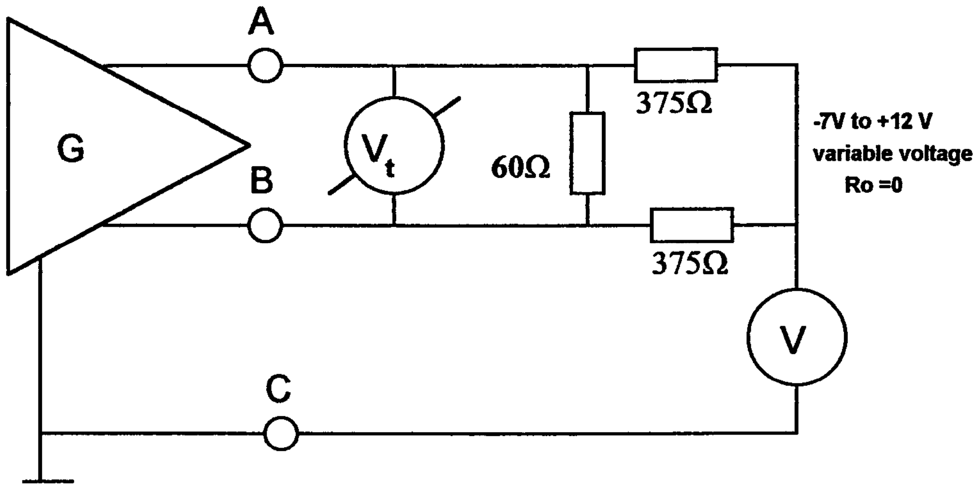
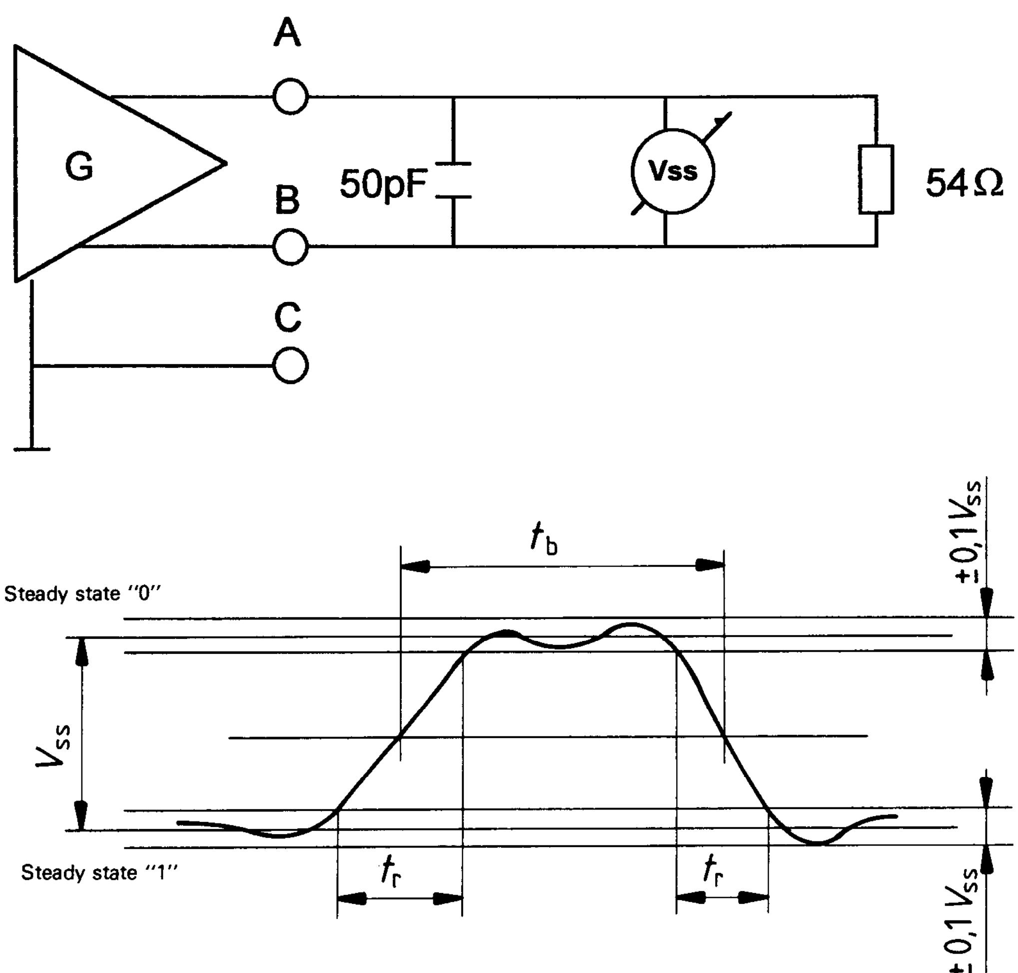


Figure 9 — Terminated output voltage measurement



t_r = Rise time

t_b = Time duration of the unit interval at the applicable data signalling rate

$t_r < 0,3\, t_b$

V_{ss} = Difference in steady state voltages

$V_{ss} = | V_t - \overline{V}_t |$

Figure 10 — Rise time measurement

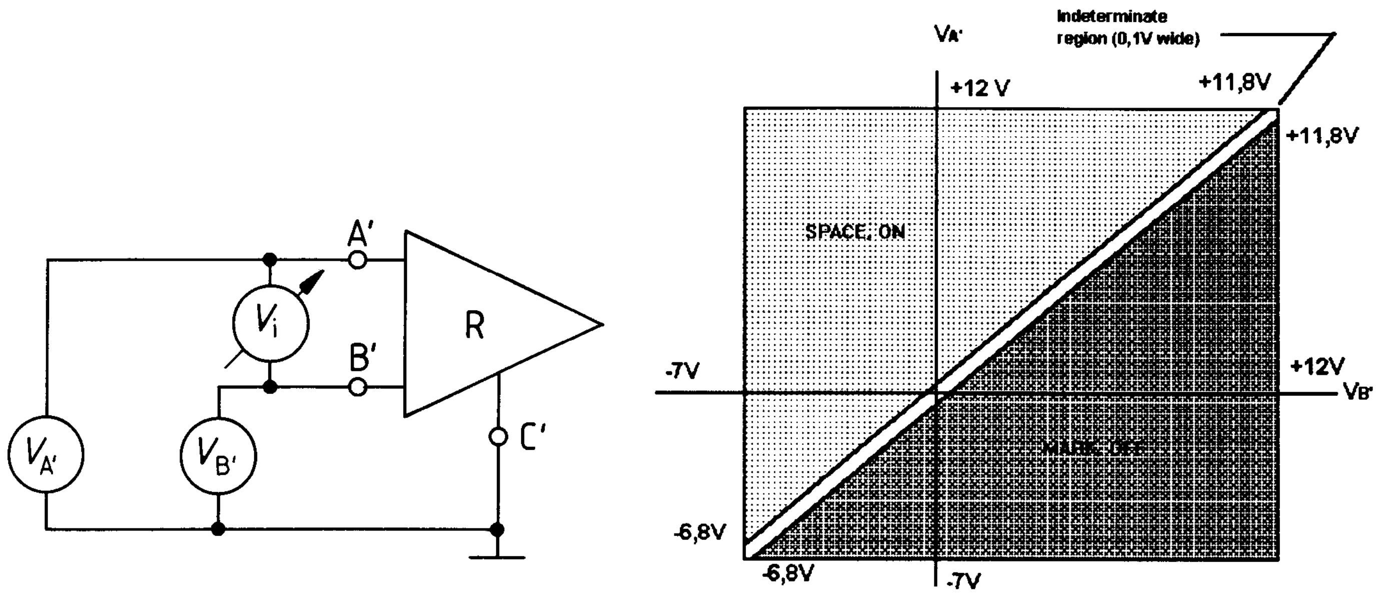


Figure 11 — Input voltage range

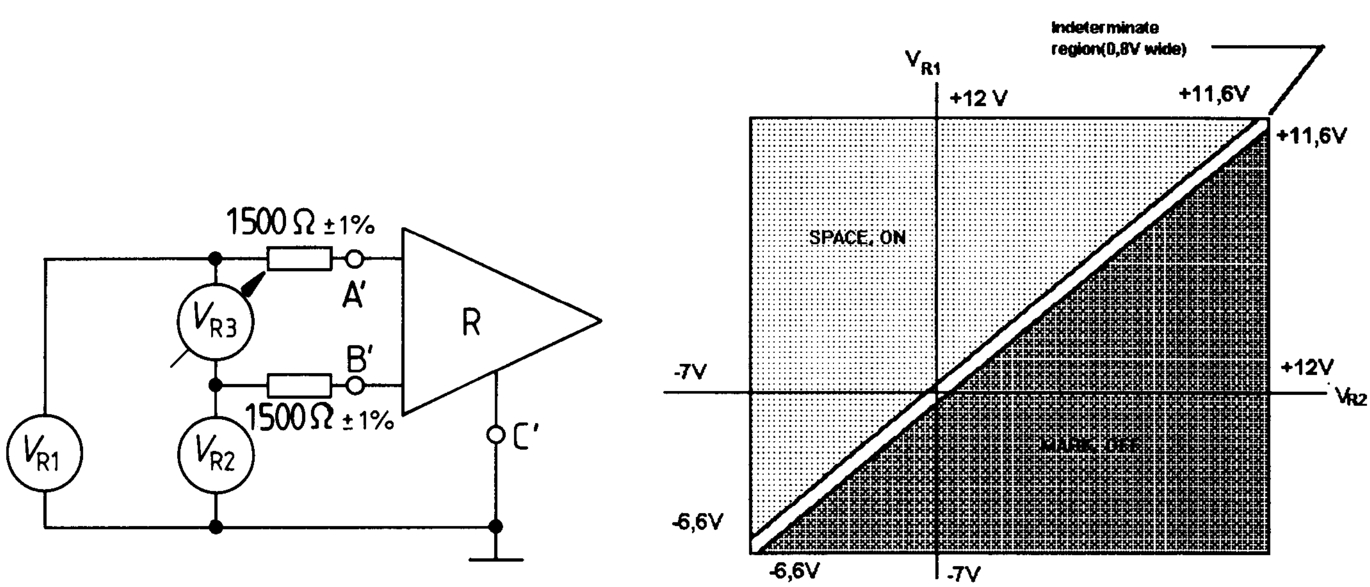


Figure 12 — Input balance measurement

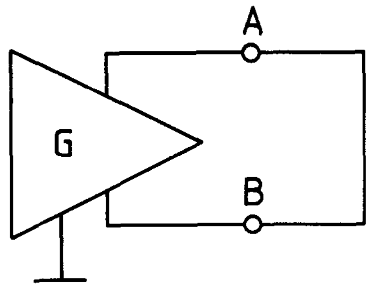


Figure 13 — Generator short-circuit test

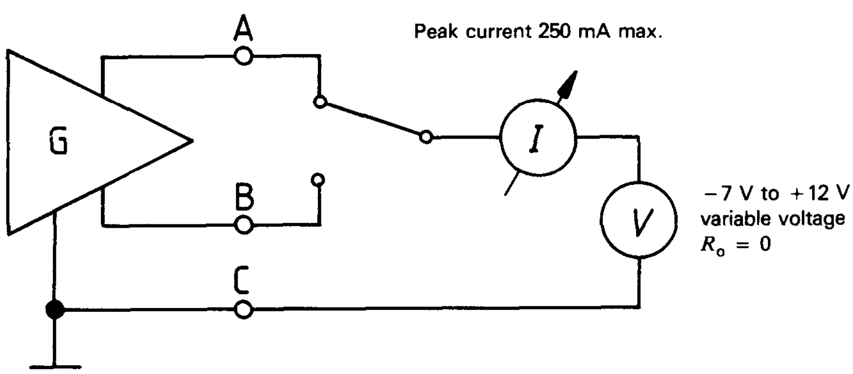


Figure 14 — Generator contention test

Annex A
(informative)

Guidelines and explanatory notes

In applying the generators and receivers defined in this International Standard, considerations should be given to the following:

A.1 Fail safe operation

The designer, of a system using these generators and receivers should consider, the possible situation in which all generators may be in the passive state. Under, this condition, no specific state can be assumed for any receiver. The designer, should provide for this condition with protocol or other fail safe considerations which are beyond the scope of this International Standard,

A.2 Interconnecting means

The cable is not standardized; however, the following guidance for the selection of cable for some specific application may be useful. The important parameters that influence cable selection are

a) Data signalling rate, and hence the unit interval (UI);
b) Minimum signal voltage to be present at the receiver;
c) Maximum acceptable signal distortion;
d) Cable length required (see clause 5).

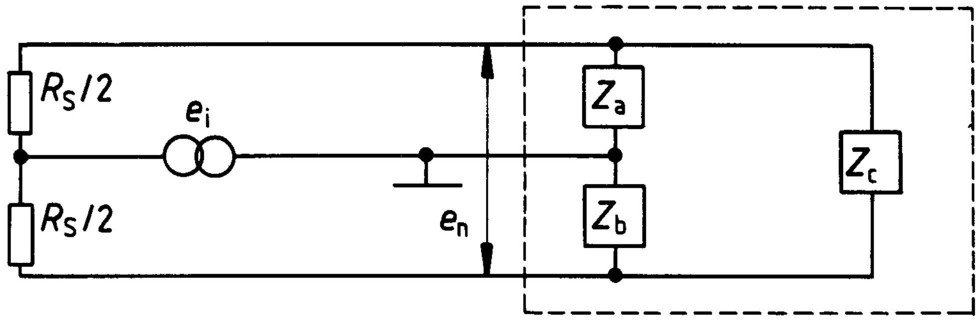
The UI of the signal determines the minimum time between transmitted signal transitions and thus the time available for the signal to achieve its final steady state. If the signal does not achieve its final steady state before the next transition occurs, the transition will appear to the receiver to be displaced in time and the signal will suffer from "inter symbol distortion". In choosing the cable, the relationship between UI and the rise time of the signal at the distant endpoint system shall be considered.

The minimum signal voltage presented to the receiver shall be equal to or larger than the worst permitted receiver threshold. Any receiver input voltage in excess of this value is margin. The amount of margin needed in a system will depend upon noise consideration, permitted error rate, and amount of permitted signal distortion. To determine the cable characteristics, the designer should first decide on the amount of receiver voltage desired to be presented to the worst case receiver.

Signal distortion is a measurement of the displacement in time from the ideal instant that a significant event, such as a transition, occurs. Some equipment is more tolerant of distortion than others. Knowing the maximum permitted distortion for a given application will provide an additional necessary input to determine the interconnecting cable.

A.3 Interference and balance

The susceptibility of a network to interference, whether the result of electromagnetic inductive or capacitive coupling to the medium, is determined in part by the imbalance of its impedance to ground. Assuming the coupling of interference to each of the two conductors is equal, the magnitude of the component of the interference which appears between conductors will generally be determined by the imbalance of the impedance to ground. Consider an active generator at one end of a cable (pair) and several passive generators and receivers bridged at the other end. Neglecting the generator output signal, the configuration can be approximated by



where

R_S, is, at high frequencies, the characteristic impedance of cable, and at low frequencies, the loop resistance of cable; Z_a Z_b Z_c are the corresponding impedance's of the combination of the bridged receivers;

e_i is the magnitude of the interfering signal, as would appear to ground at one end of the cable with the other end shorted to ground;

e_n is the conductor to conductor, component of the interference resulting from impedance imbalance.

It should be noted that an active generator provides a low impedance to ground from both conductors of the cable, and therefore, at low frequencies, a common mode voltage will appear at the bridged receiver end of the cable as a voltage to ground with a source impedance of $R_S/4$.($R_S/2$ for each conductor).

For the equivalent circuit shown, the balance of concern is the ratio of the voltage of the common mode interference to the resultant conductor noise voltage, e_n or

Bal = 20 log $\frac{e_j}{e_n}$ -and, for $G_S = 1/R_S$ and $Y_X = 1/Z_X$,

$$\frac{e_j}{e_n} = \frac{(2G_s+Y_a)(2G_s+Y_b)+Y_c(4G_s+Y_a+Y_b)}{2G_s(Y_b-Y_a)}$$

Let: Y_b-Y_a = Y_d, and assuming: $Y_a \leq G_S$, $Y_b \leq G_S$, and $Y_c \leq G_S$

as may be typical for the configuration, the following approximation is obtained:

$$\frac{e_j}{e_n} = \frac{2G_s}{Y_d}$$

This suggests that the balance of the configuration is inversely proportional to the resulting difference in the admittance to ground (Y_d) for the two input terminals of the bridged receivers and that it is essentially independent of common mode admittance to ground ($Y_a + Y_b$) of the receivers.

Balance is of concern up to at least the maximum frequency of a signal to which receivers will respond. Differences in the capacitance to ground from the two receiver input terminals of only a few picofarads can cause significant imbalance if the response of the receivers extends to signals in the MHz range. For example, 10 receivers, each having a capacitance difference (to ground) of 10 pF bridged on a 120 Ω cable, would result in a balance, at 10 MHz, of about 10 dB. At higher frequencies (for example 50 MHz) the configuration would appear to have one conductor grounded.

A.4 Generator contention

When two or more generators are connected to the same interchange circuit, a potential condition exists whereby both generators are simultaneously in the active state. If one generator (or more) is sourcing current while another generator is sinking current, excessive power dissipation may occur within either the sourcing or sinking element. This condition is defined as generator contention, since multiple generators are competing for transmission on one circuit.

Since system requirements may dictate that more than one generator, is active simultaneously, the parameters in the generator contention tests (10.2) were selected so that a practical limitation could be put on the dissipation within a generator.

Generator contention will occur under any or all of the following three conditions:

— System power-up: When a system is powered or regains power, multiple generators may be active simultaneously, during the interval of initialization.

— System fault: A failure may occur in either hardware or software which may result in generator contention.

— System protocol: certain system protocols may intentionally cause multiple generators to be active for brief periods while switching from one transmission to another. Also, other, protocols may allow stations that are sharing one circuit to compete for a transmission, resulting in multiple generators being active simultaneously. However, one station will eventually succeed in acquiring the circuit, thereby ending the contention.

The generator failure mechanisms may be best described with the aid of figures A.1 and A.2.

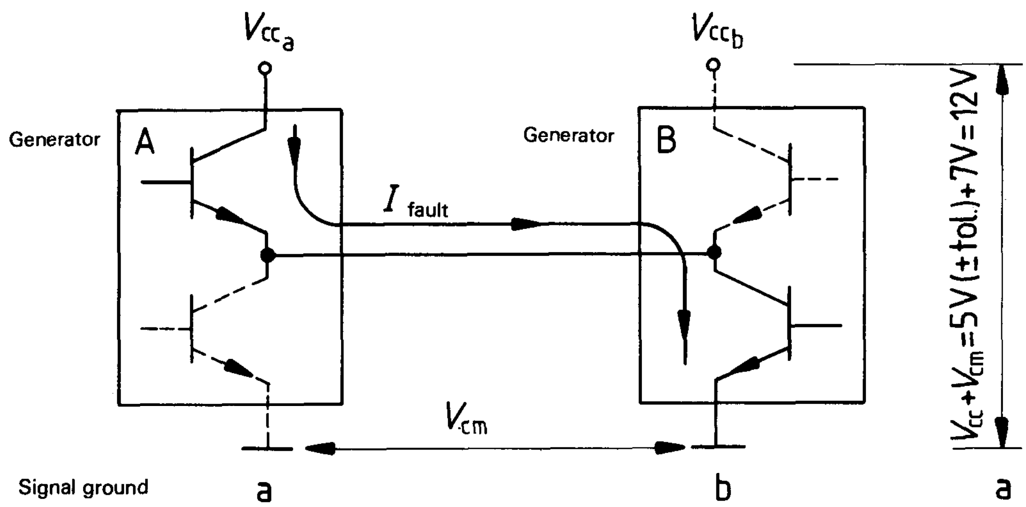


Figure A.1 – Generator contention with single sourcing generator

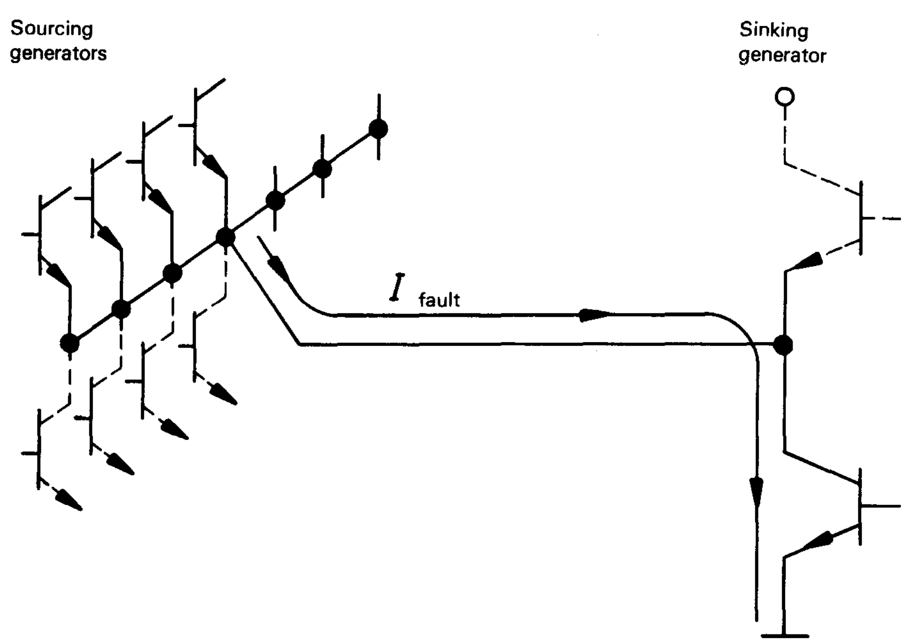


Figure A.2 – Generator contention with multiple sourcing generators

The case shown in figure A.1 illustrates two generators on a transmission circuit. Generator A will be delivering its short circuit current to the sinking generator B. This situation, worsened by the possible presence of a common mode voltage (- 7 V to + 7 V) between two generators, can cause generator A to dissipate potentially excessive power for the generator design. As an example, if the generator's short circuit current is 250 mA and the combination of supply voltage and common mode potential difference equals 12 V, generator A will dissipate approximately 3 W.

The case shown in figure A.2 illustrates the condition where multiple generators are driving their short circuit current into one sinking generator. As the sinking generator comes out of saturation, the combination of collector to emitter voltage in conjunction with the large current that is being supplied may cause excessive power within generator, B. This may lead to the second type of failure, that of the sinking element.

Both cases show that a means of protection has to be designed within the generator to prevent either type of failure. The two most obvious solutions fall into the categories of current limiting and thermal shutdown. Although the solution to the generator contention problem may be either, current limiting, thermal shutdown, or some combination of both, these means do not preclude some other means of protection as long as that protection is built into the generator.

Current limiting simply does not allow excessive dissipation within the generator, by restricting the amount of current under the contention condition. This means of protection has the advantage that it can recover quickly to deal with contention protocols. Thermal shutdown exhibits the opposite properties of current limiting in its slow recovery time from the contention situation and its inherent ability to sense power overload versus only high current levels.

When contention exists, the high currents cause energy to be stored in the circuit. When the current is abruptly interrupted, a voltage will be developed across the transmission circuit of

$$V = \frac{I_s Z_o}{2}$$

where

V is the developed voltage, in volts;

I_s is the short circuit current, in amperes;

Z_o is the cable characteristics impedance, in ohms.

With a 250 mA peak current limit, this voltage will equal about 15 V. If four, or more receivers are ON (circuit current up to 500 mA) and the unlikely event occurs where two generators are turned OFF such that the current interruptions concur on the circuit, the differential voltage could rise to a larger value. The designer is cautioned to consider this possibility in the system design. The requirements specified in clause 10 are designed to protect when only one such event occurs.

Annex B
(informative)

Guidance on a.c. loading measurement

The a.c. loading on the multipoint medium caused by the connection of the endpoint systems determines the transmission performance. This loading is the most part is dependent on the parameters of the application such as, type of encoding, signalling rate and the characteristics of the branch cable. Therefore the following measurements are provided for general guidance only and may have to be modified to be appropriate for measurement in accordance with the complete interface and signal quality standards (see also clause A.1 of annex A).

B.1 Reflection attenuation (see figure B.1)

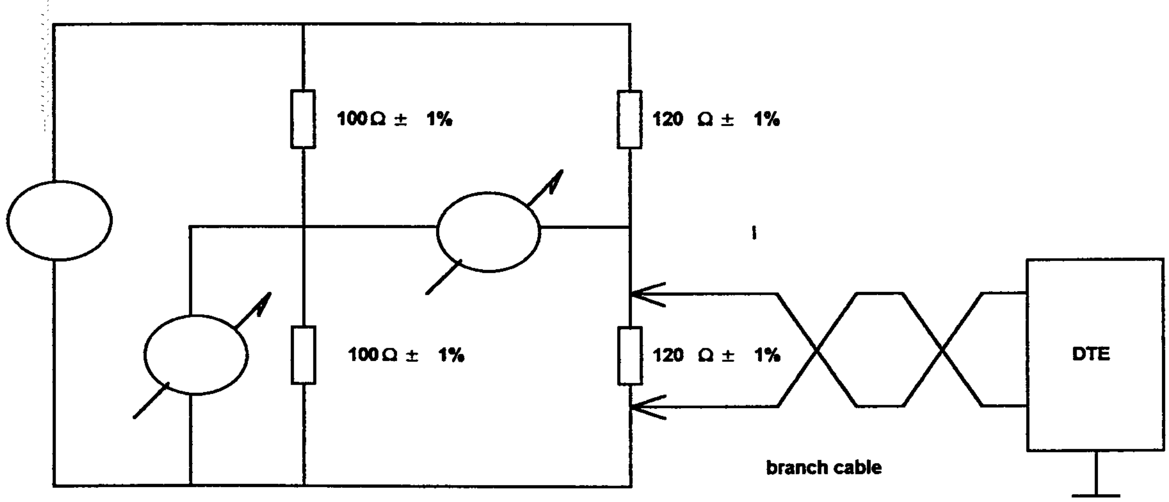
The reflection attenuation of a connected endpoint system should not be less than 20 dB for frequency range corresponding to the main transmission spectrum.

The measurement is made at the disconnected branch/trunk cable connector of an endpoint system using a parallel test resistor of 120 Ω. The recommended measurement configuration is shown in figure B.1. During the test, any generator involved is in an inactive state.

B.2 Receiving signal distortion

The receiving signal distortion measured at the interconnected branch/trunk cable connector of an endpoint system should not exceed 25 % for mark/space reversals at the application signalling rate.

NOTE - In the case of twisted pair transmission medium it is assumed that the pattern dependent distortion is not very far outside the range of the mark/space reversals measurement.



$$a_R = 20 \log \frac{U_1}{U_2} \text{ (in dB)}$$

Figure B.1 – Reflection attenuation measurement

UDC 681.327.8:621.316.5

Descriptors: data processing, information interchange, telecommunications, data transmission, network interconnection, data communication equipment.

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