BRITISH STANDARD

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Measuring relays and protection equipment — Protection communication interfacing

Part 1. General

The European Standard EN 61733-1 : 1996 has the status of a British Standard

ICS 29.120.70; 35.200

BSi
British Standards

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PEL/95, Measuring relays and protection equipment, upon which the following bodies were represented:

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Electricity Association
Federation of the Electronics Industry
Transmission and Distribution Association (BEAMA Ltd.)

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Contents

National foreword

This British Standard has been prepared by Technical Committee PEL/95 and is the English language version of EN 61733-1 : 1996 *Measuring relays and protection equipment – Protection communication interfacing Part 1: General*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1733-1 : 1995 published by the International Electrotechnical Commission (IEC).

This standard was intended to be the first of a series from TC 95. However, as TC 57, Telecontrol, protection and associated telecommunications for electric power systems, also has an interest in this field the work will be continued on a joint basis between the two technical committees. Administration and publication, however, will be undertaken by TC 57.

Cross-references

Publication referred to	Corresponding British Standard
IEC 255-1 : 1975	BS 5992 *Electrical relays* Part 2 : 1980 *Specification for all-or-nothing electrical relays*
ISO 7498 : 1984	BS 6568 *Reference model of open systems inteconnection* Part 1 : 1988 *Basic reference model (incorporating connectionless-mode transmission)*

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EUROPEAN STANDARD
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Measuring relays and protection equipment Protection communication interfacing Part 1: General

(IEC 1733-1 : 1995)

Relais de mesure et dispositifs de protection
Interface de communication des protections
Partie 1: Généralités
(CEI 1733-1 : 1995)

Meßrelais und Schutzeinrichtungen
Schutz-Kommunikations-Schnittstelle
Teil 1: Allgemeines
(IEC 1733-1 : 1995)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 95/17/FDIS, future edition 1 of IEC 1733-1, prepared by IEC TC 95, Measuring relays and protection equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61733-1 on 1995-11-28.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-09-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-09-01

Annexes designated 'normative' are part of the body of the standard. In this standard, annex ZA is normative. Annex ZA has been added by CENELEC.

Contents

INTRODUCTION

This International Standard is Part 1 of a series of standards covering protection communication interfacing.

This standard presents the general overview of the structure of communication-based, hierarchical control and monitoring systems in electrical installations. The overview outlines the architectures, protocol profiles, and other design features presented in prospective additional parts.

Today the availability of low-cost microprocessors, with increased capability, supports the concept of electrical installations in which distributed devices, built by different manufacturers, can be used in an open system. In an open system the microprocessor provides the base element of distributed functional units that allows the exchange of information inside the system via communication links.

The above concept will only be achieved in practice after an IEC standard is made available that clearly defines the communication criteria among distributed and centralised devices, the interoperability rules and the responsibility of different digital devices (protection, monitoring and control) that operate together in the same open system.

The following subjects have been included in this part of IEC 1733:

a) typical hierarchical structure of an electrical installation;

b) typical information interchange in an electrical installation;

c) needs for communication between digital protection equipment and related monitoring and control devices;

d) the transmission media.

The main links between other IEC committees and TC 95 are shown in the following block diagram.

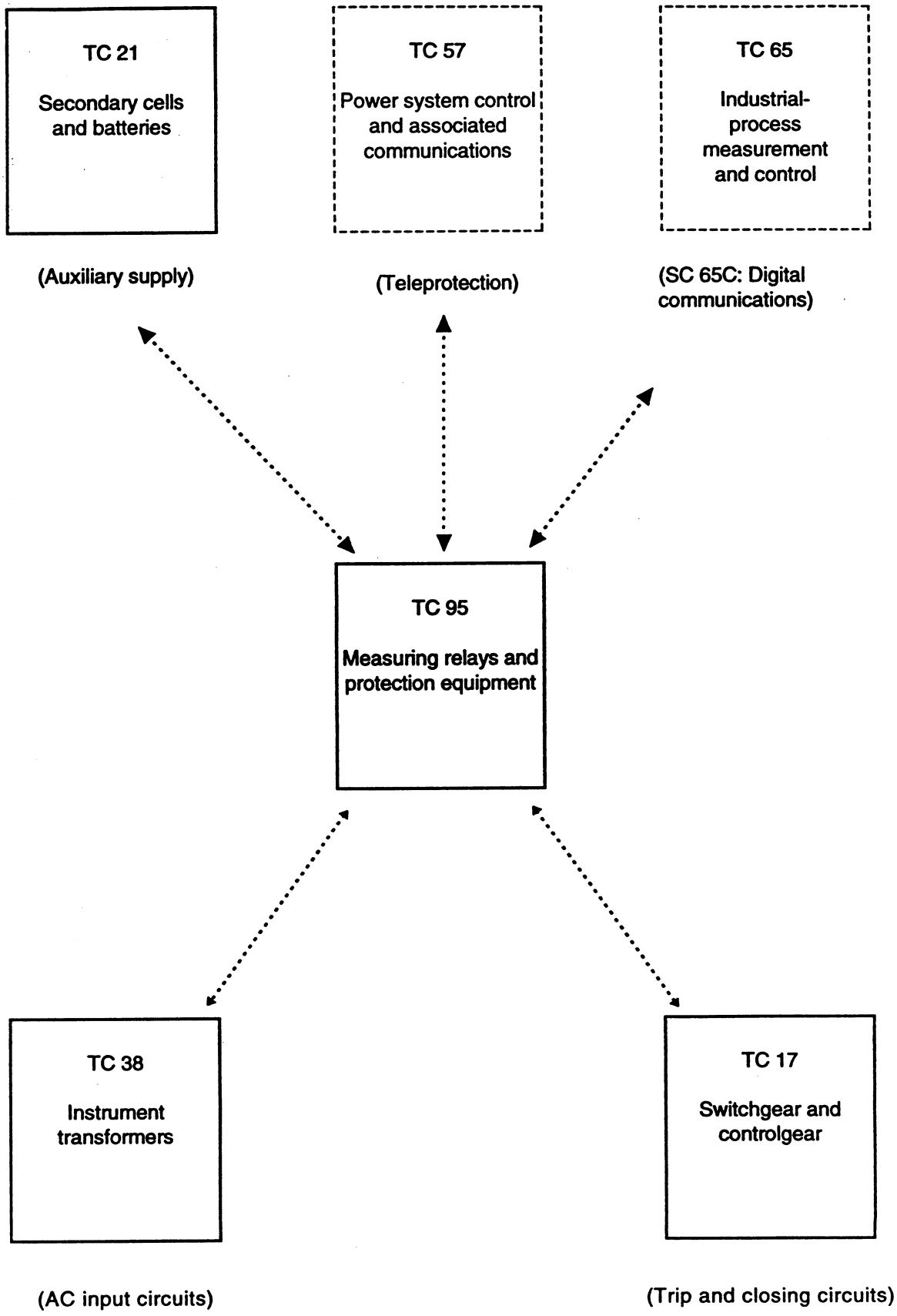


Figure 1 - Block diagram of main links of TC 95 with other IEC committees

MEASURING RELAYS AND PROTECTION EQUIPMENT – PROTECTION COMMUNICATION INTERFACING –

Part 1: General

1 Scope and object

This part of IEC 1733 applies to standardisation of protection communication interfacing for digital protection equipment and related control and monitoring devices to be used in the same electrical installation.

This standard gives general information about the functional levels in a hierarchical structure and about the typical organisation of devices communicating in an open system.

In this standard, an electrical installation refers to substations for voltage levels above 1 kV and power stations.

Communication outside a particular electrical installation (for example communication between a substation and a remote control centre or another substation) is outside the scope of this standard.

Communication between dedicated devices provided by the same manufacturer, for example differential protection schemes, is outside the scope of this series of standards.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 1733. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1733 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 255, *Electrical relays*

ISO 7498: 1984, *Information processing systems – Open Systems Interconnection – Basic Reference Model*

3 Definitions

For the purpose of this part of IEC 1733 the following definitions apply:

3.1 **protection communication interfacing:** Interfacing that allows the interconnectivity and interoperability between protection, monitoring and control devices, built by different manufacturers installed in the same electrical installation.

3.2 **hierarchical system:** System organised in different hierarchical functional levels with communication between them.

3.3 **interconnectivity:** Capability of devices to exchange data (see figure 5).

3.4 **interoperability:** Capability of different devices to exchange commonly understandable information (see figure 5).

3.5 **interchangeability:** Capability of different devices, built by different manufacturers, to be interchanged with one another without modifying the system operating characteristics (see figure 5).

3.6 **communication element:** Part of a connected device which communicates with other elements via the communication network.

3.7 **communication interface (physical and logical):** Interface of a device, operating in an open system, that allows exchange of information between devices of the same or different functional levels in a hierarchical system (for example between distributed unit devices and a centralized equipment).

3.8 **connector:** Coupling device employed to connect the medium of one circuit or communication element with that of another circuit or communication element.

3.9 **device:** Physical entity connected to the communication network which may have a control element and/or a final element (transducer, actuator, etc.).

4 Types of information identifiable in an electrical installation

Figure 2 shows a typical information flow within a feeder unit.

The typical information flow in an electrical installation can be grouped into the following six categories:

a) position information (for example, position of disconnectors and circuit-breakers);

b) commands (for example closing and opening commands of disconnectors and circuit-breakers);

c) anomalies and status information (of the different devices of the electrical installation);

d) measurands;

e) fault information, for example from protection devices;

f) parameter information (settings, etc.).

5 Typical structure of a hierarchical system

5.1 Structure of a hierarchical system

Figure 3 shows a typical functional structure of an electrical installation (for example an EHV/HV substation) organised in a hierarchical system. There are three functional levels:

a) level 0: process level

this level includes the primary equipment (instrument transformers, circuit breakers, disconnectors, etc.).

b) level 1: unit level

this level includes functions directly related to primary equipment, for example:

- monitoring and metering;
- protection;
- automatic reclosing;
- control.

c) level 2: substation level

this level includes common substation functions, for example:

- monitoring and metering;
- control;
- telemetry and telecontrol.

5.2 *Information exchange*

Figure 3 shows a block diagram of a typical EHV/HV substation. The information (analog and/or digital) can be exchanged between devices operating at the same functional level or between devices operating at different functional levels.

The communication between devices may be achieved by either conventional point-to-point connections (medium: multicore cable) and/or a communication network.

6 Communication system arrangement of an electrical installation

6.1 *Device communication*

The secondary equipment of an electrical installation includes a number of functions.

Each device includes at least two important parts, as shown in figure 4:

- communication machine;
- application machine.

The communication machines connect two or more application machines, via an interface and medium, to allow the exchange of information.

In order to allow the above-mentioned exchange of information, the transmission protocol(s) shall be compatible, in all cases where communication between devices of different manufacturers is required.

The communication machine as shown in figure 4 usually includes both hardware (communication chips, controller, transceivers) and software and is designed by the device manufacturer.

The communication sub-system includes the physical medium and the communication machine of communicating devices: this is shown by the dashed zone in figure 4.

6.2 *Model of an intelligent device*

Figures 5 and 6 show a more detailed representation of intelligent distributed communicating devices.

Referring to figure 5 the lower connecting terminals represent the physical connection between the device and the process, for example in the case of a protection equipment the connecting terminals needed to connect the CT's, VT's and circuit-breaker, etc., via a point-to-point conventional link (cable).

In the communicating device (D) the block "application machine" can be sub-divided into three parts:

a) **process interface,** whose task is the acquisition of analog signals and the analog to digital signal conversion. The process interface also sends commands to and receives status from the process (for example circuit breaker). The process interface is dependent on the physical connections to the process and on the electrical signal characteristics. The technology used is usually proprietary to the manufacturer;

b) **application algorithms,** which provide the device function. The application algorithms include the application functions relative to the system concerned. The application algorithms and the processing techniques used are particular characteristics of any device. The method used to implement the application algorithms and the technology used are usually proprietary to the manufacturer;

c) **system interface,** which enables the application machine to communicate with the communication machine through its application layer. The format of the data transmitted shall be compatible with those of the other devices of an open system in order to guarantee interoperability, for example the meaning of a "0" value shall be clearly attributed to the position "open" or "closed" of a contact.

The system interface is directly connected to the communication machine (ISO layer 7: Application).

For the communicating device (D) three different compatibility levels exist as follows:

1) **interconnectivity:** represents the capability of devices to exchange data. The interconnectivity is provided by the communication sub-system;

2) **interoperability:** represents the capability of devices to co-operate in an application exchanging significant information. This means that each device can associate the same meaning to each of the received and transmitted data.

To ensure interoperability, interconnectivity and common definitions of items exchanged are required.

3) **interchangeability:** enables the exchange of a device by another without modifying the system functional characteristics. Interchangeability can be ensured if the same functional characteristics required by the specific application are present in devices of different manufacturers.

Figure 6 shows a model of an intelligent distributed communicating device which is not directly connected to the process. It exchanges data and commands with lower and higher level devices through two different communication machines. In this model the task assigned to the layer "process interface" is the same as that assigned to the layer "system interface".

The two communication machines (A) and (B) may be different; for this reason in figure 6 two distinct domains of interconnectivity and interoperability relevant to the two communication sub-systems are shown.

6.3 *Standard compatibility levels*

Three standard compatibility levels are envisaged for the future application of communication between protection, monitoring and control devices to be used in an open system of an electrical installation:

a) interconnectivity;

b) interoperability;

c) interchangeability.

7 Standard parameters

The following subclauses identify parameters for which standards will be specified in subsequent parts of this standard.

7.1 *Communication levels*

Other parts of this standard consider the following communications between protection equipment and related monitoring and control devices of an electrical installation operating:

a) in level 1 and level 2 (level 1 ⇔ level 2 devices);

b) inside level 1 (level 1 ⇔ level 1 devices).

The communication between level 0 and level 1 may also be considered in other parts of this standard in conjunction with the relevant IEC committees.

NOTE – The communication between level 2 and level 3 (remote control centre) is outside the scope of TC 95.

7.2 *Communication network characteristics*

The following communication network characteristics will be considered:

a) typical number of communicating devices: 50 – 200
   - typical number of units (bays) per installation: 5 – 60
   - typical number of communicating devices per unit: 3 – 10

b) typical distance among communicating devices: less than 1 km

c) transmission media to be considered:
   - optical fibre;
   - shielded cable.

In addition standardisation of connectors will be considered:

d) redundancy requirements;

e) availability.

7.3 *Environmental conditions*

The environmental conditions specified in the relevant parts of IEC 255 shall apply to communicating devices.

7.4 *Test requirements*

The tests to be considered are:

a) tests on a single communicating device;

b) tests on a system including several communicating devices (commissioning tests).

7.5 *Message characteristics*

The message characteristics to be considered include the following:

a) transmission of status and measurands;

b) time delay requirements;

c) data integrity requirements;

d) synchronization;

e) maximum number of data for a single message.

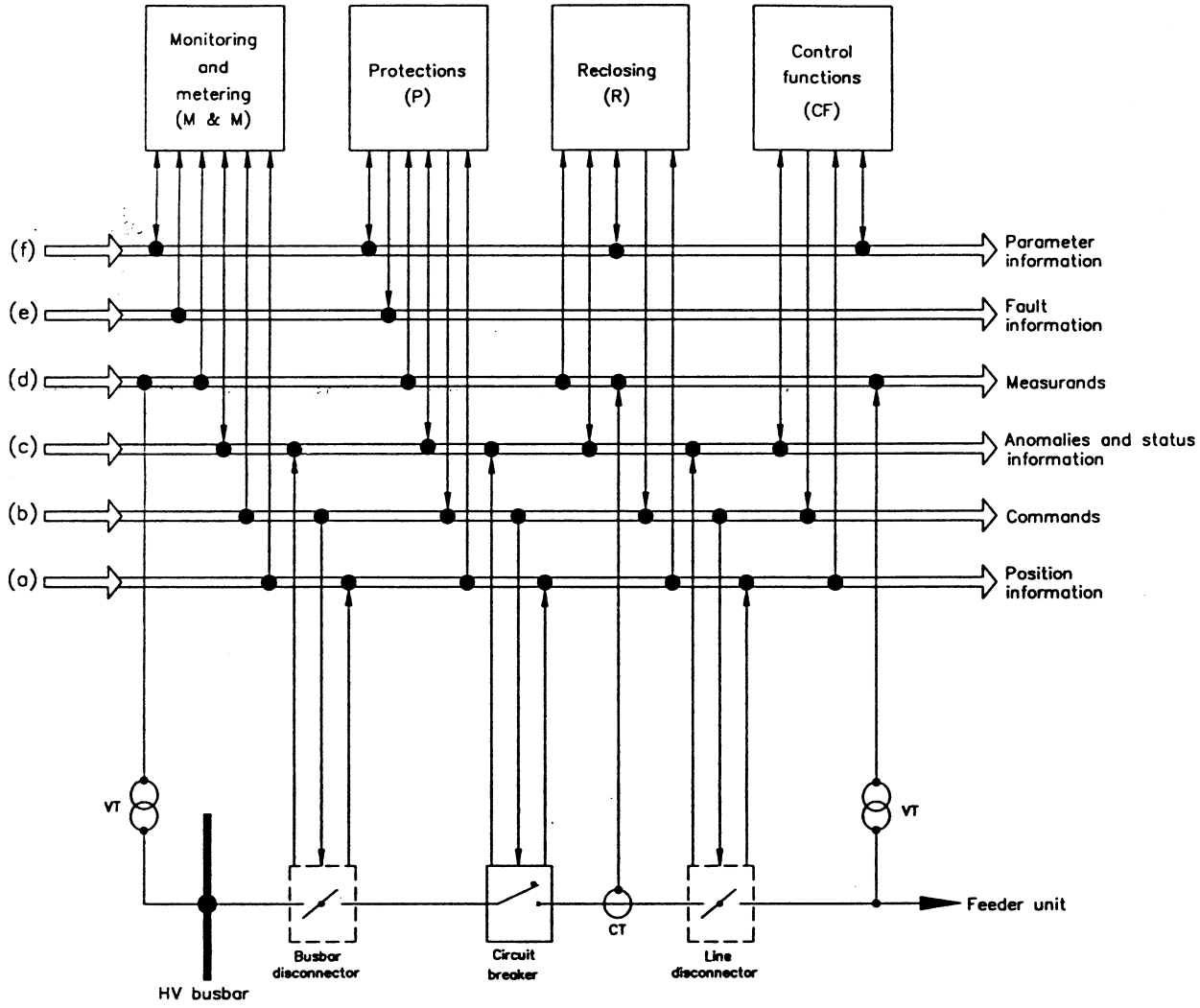


Figure 2 – Example of a typical information flow involving a feeder unit

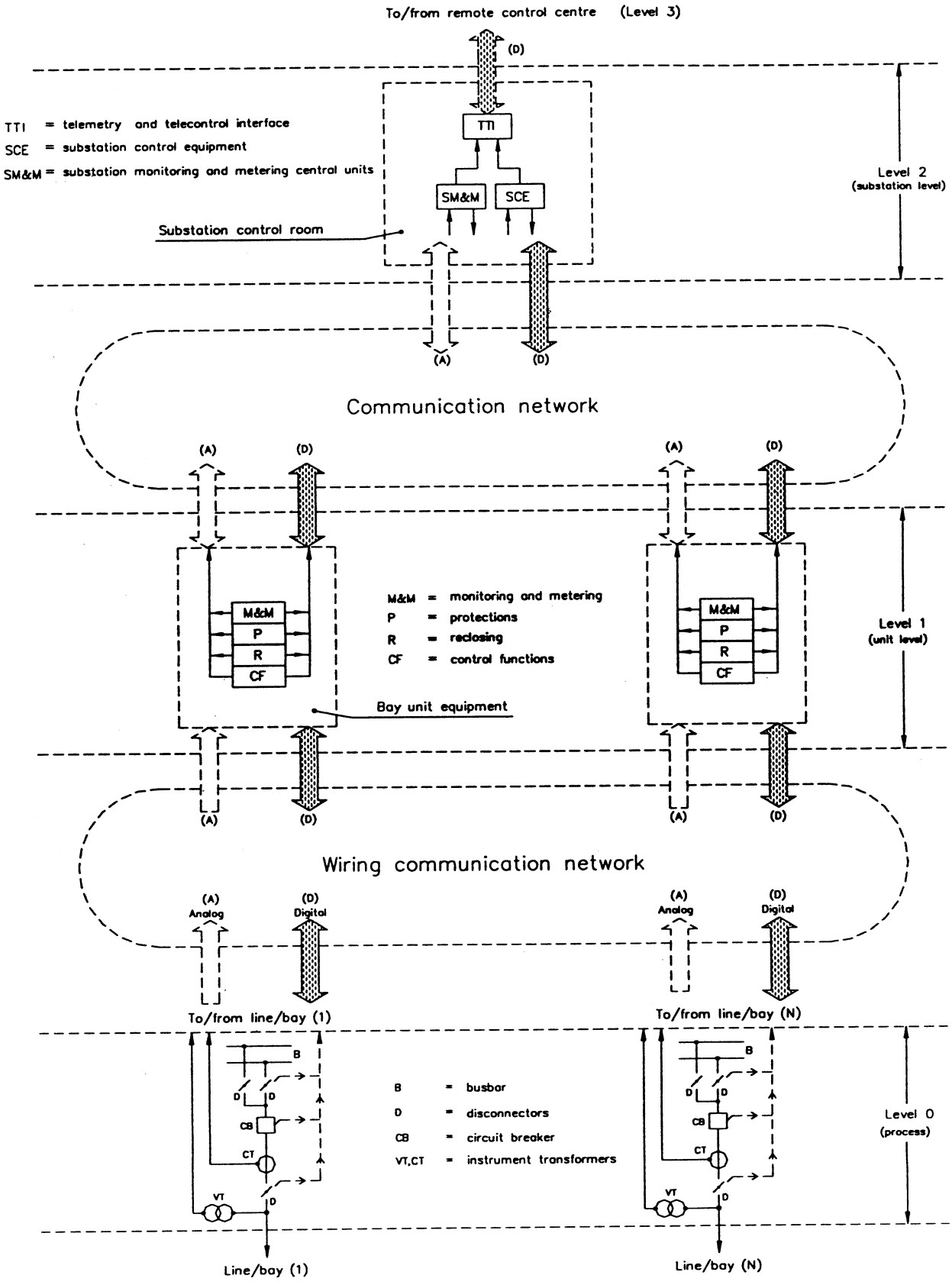


Figure 3 – Typical functional structure and information flow in a hierarchical system (e.g. EHV/HV substation)

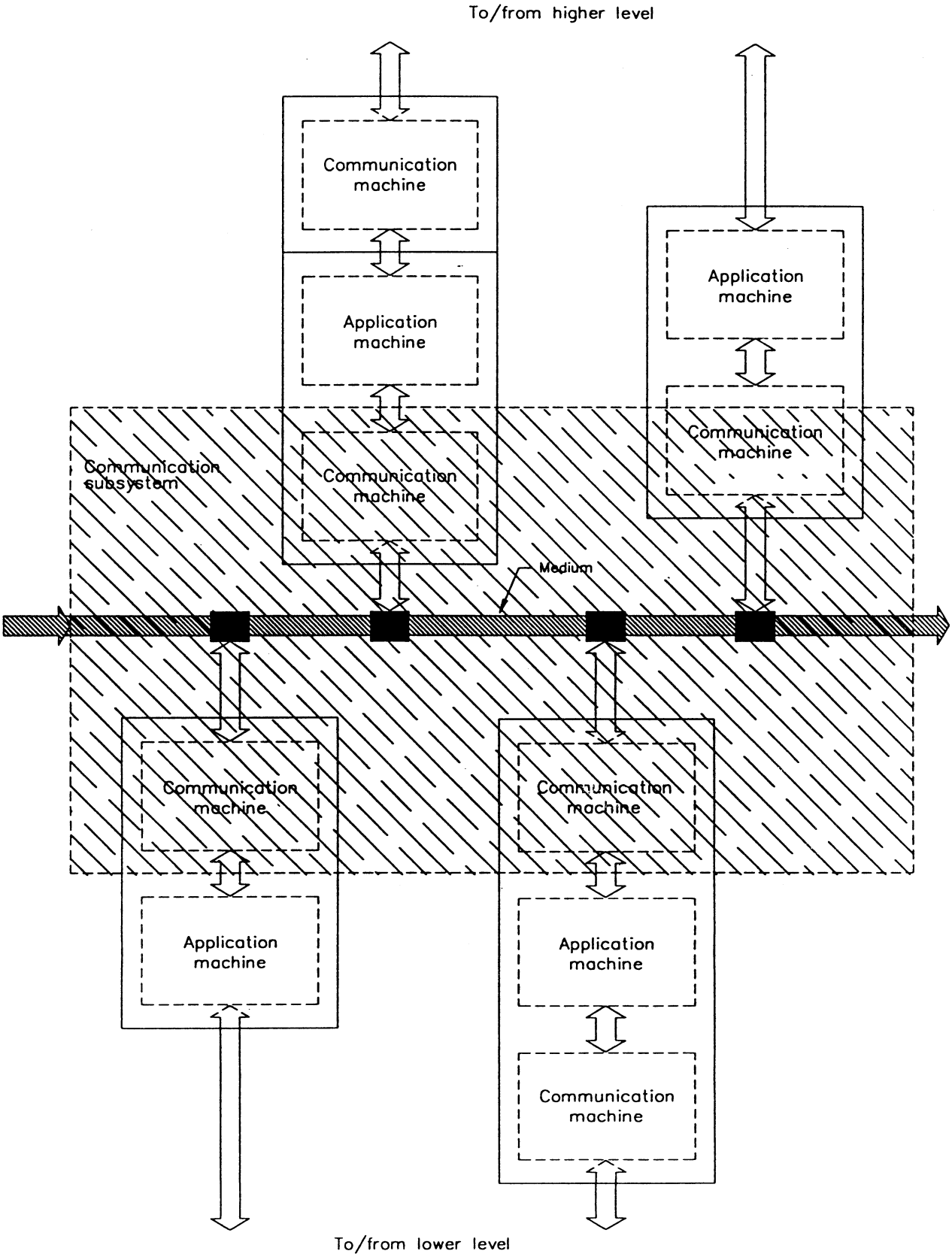


Figure 4 – Example of intelligent distributed communicating devices in an open system

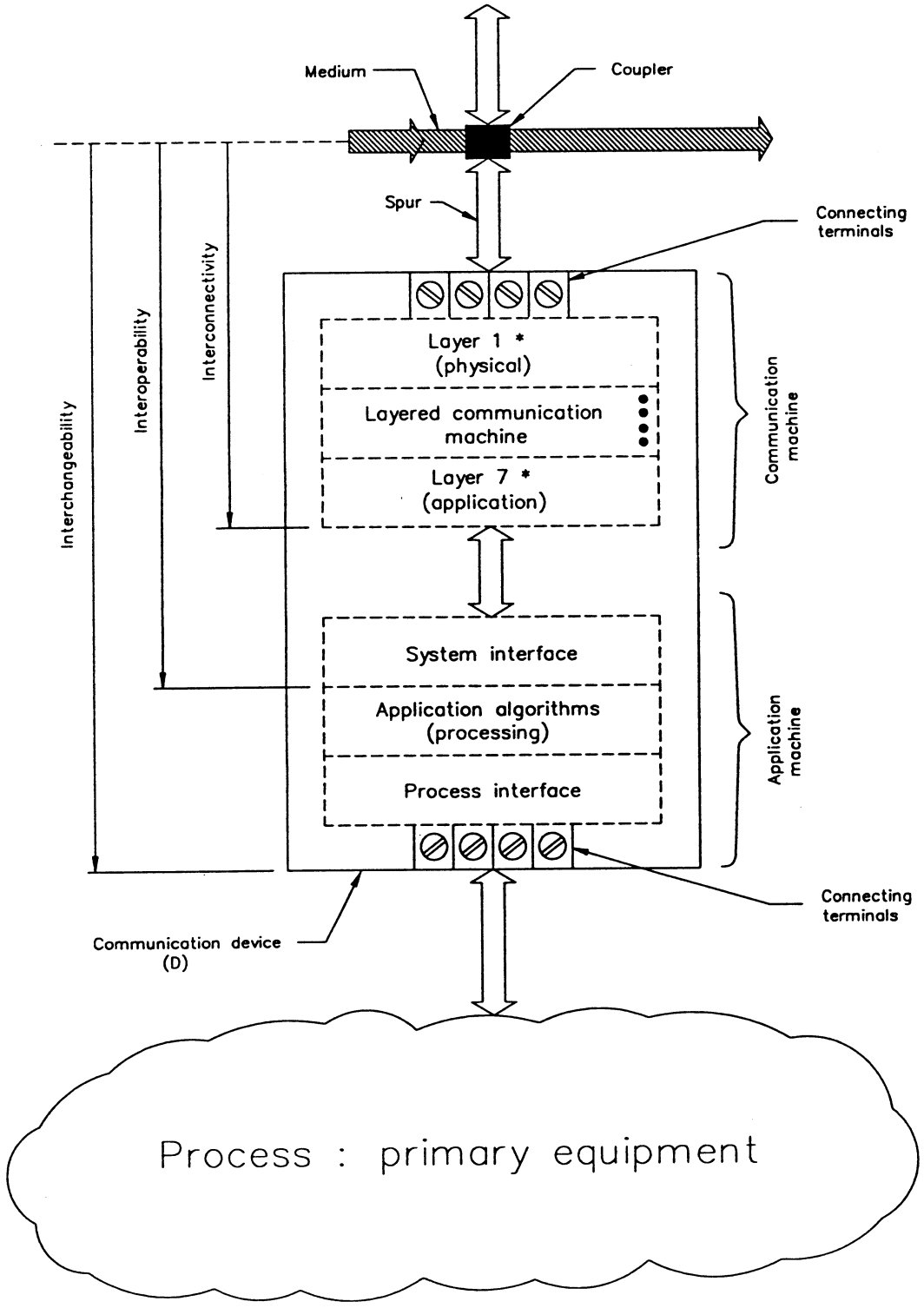
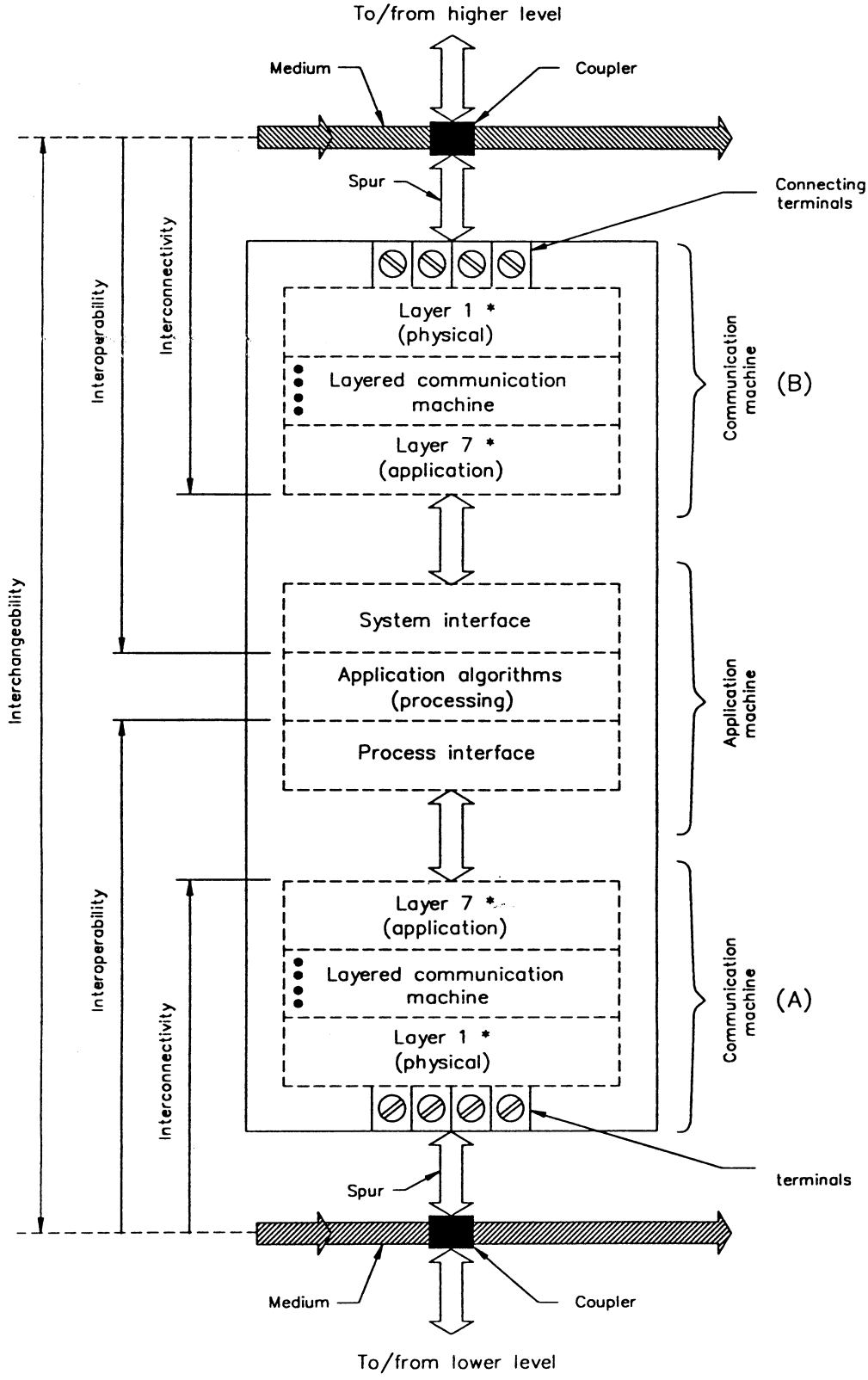


Figure 5 – Detailed block diagram of a device communicating to the process and to the centralized control equipment



* See ISO 7498

Figure 6 – Detailed block diagram of a device communicating to higher and lower levels of automation system

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE. When an international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 255-1	1975	*Electrical relays*	—	—
ISO 7498	1984	*Information processing systems* *Open systems interconnection* *Basic reference model*	—	—

List of references

See national foreword.

BS EN 61733-1 : 1996 IEC 1733-1 : 1995

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