

Telecontrol equipment and systems —

Part 5-103: Transmission protocols — Companion standard for the informative interface of protection equipment

The European Standard EN 60870-5-103:1998 has the status of a
British Standard

ICS 33.200

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 92 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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Descriptors: Telecontrol, transmission protocol, protection equipment, companion standard, informative interface

English version

Telecontrol equipment and systems
Part 5-103: Transmission protocols
Companion standard for the informative interface
of protection equipment

(IEC 60870-5-103:1997)

Matériels et systèmes de téléconduite
Partie 5-103: Protocoles de transmission
Norme d'accompagnement pour
l'interface de communication d'information des
équipements de protection
(CEI 60870-5-103:1997)

Fernwirkleinrichtungen und -systeme
Teil 5-103: Übertragungsprotokolle
Anwendungsbezogene Norm für die
Informationsschnittstelle von
Schutzeinrichtungen
(IEC 60870-5-103:1997)

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Foreword

The text of document 57/327/FDIS, future edition 2 of IEC 60870-5-103, prepared by IEC TC 57, Power system control and associated communications, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60870-5-103 on 1998-01-01.

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) 1998-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-10-01

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex ZA is normative and Annex A and Annex B are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60870-5-103:1997 was approved by CENELEC as a European Standard without any modification.

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1 Scope and object

This section of IEC 60870-5 applies to protection equipment with coded bit serial data transmission for exchanging information with control systems. It defines a companion standard that enables interoperability between protection equipment and devices of a control system in a substation. The defined companion standard utilizes standards of the IEC 60870-5 series.

This section of IEC 60870-5 presents specifications for the informative interface of protection equipment. This standard does not necessarily apply to equipment that combines protection and control functions in the same device sharing a single communication port.

This section of IEC 60870-5 describes two methods of information exchange: the first is based on explicitly specified APPLICATION SERVICE DATA UNITS (ASDUs) and application procedures for transmission of “standardized” messages, and the second uses generic services for transmission of nearly all possible information. The “standardized” messages do not cover all possible protection functions, and furthermore a protection device may support only a subset of the messages specified in this standard. For interoperability purposes, in specific applications, this subset has to be specified in clause 8.

The use of predefined messages and application procedures is mandatory, if applicable. In other cases generic services shall be used. The “private ranges” defined in this standard are maintained for compatibility reasons; however, their use is not recommended for future applications.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 60870-5. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 60870-5 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 60050(371):1984, *International Electrotechnical Vocabulary — Chapter 371: Telecontrol*.

IEC 60794-1:1996, *Optical fibre cables — Part 1: Generic specification*.

IEC 60794-2:1989, *Optical fibre cables — Part 2: Product specifications*.

IEC 60870-5-1:1990, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 1: Transmission frame formats*.

IEC 60870-5-2:1992, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 2: Link transmission procedures*.

IEC 60870-5-3:1992, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 3: General structure of application data*.

IEC 60870-5-4:1993, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 4: Definition and coding of application information elements*.

IEC 60870-5-5:1995, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 5: Basic application functions*.

IEC 60874-2:1993, *Connectors for optical fibres and cables — Part 2: Sectional specification for fibre optic connector — Type F-SMA*.

IEC 60874-10:1992, *Connectors for optical fibres and cables — Part 10: Sectional specification — Fibre optic connector type BFOC/2,5*.

ISO/IEC 7498-1:1994, *Information technology — Open System Interconnection — Basic Reference Model: The Basic Model*.

EIA RS-485, *Standard for electrical characteristics of generators and receivers for use in balanced digital multipoint systems*.

R 32, — IEEE Standard 754.

R 64, — IEEE Standard 754.

3 Definitions

For the purpose of this section of IEC 60870-5, the following definitions apply.

3.1

companion standard

a companion standard adds semantics to the definitions of the basic standard or a functional profile. This may be expressed by defining particular uses for information objects or by defining additional information objects, service procedures and parameters of the basic standard

NOTE Companion standards do not alter the standards to which they refer, but make explicit the relationship between those used together for a specific domain of activity.

3.2

enhanced performance architecture (EPA)

a protocol reference model that provides, compared with the full seven layer architecture according to the basic reference model of ISO/IEC 7498-1, a three layer architecture for obtaining faster response times for the critical information but with service limitations

3.3

control direction

direction of transmission from the control system to the protection equipment

3.4

monitor direction

direction of transmission from the protection equipment to the control system

3.5

control system

used for the master of the communication link, i.e. the primary station according to IEC 60870-5-2

3.6

informative interface

interface of a protection equipment used to exchange data with control systems without having an impact on the protection function

3.7

tag

binary signal which is recorded and transmitted within the transmission of disturbance data

3.8

compatible range

standard range to be used by all manufacturers

3.9

private range

range that may be used by manufacturers for their own private use

3.10

Abbreviations

ΔI_L	Line differential protection
ΔI_T	Transformer differential protection
ACC	Actual channel
AR	Auto-recloser
ASC	ASCII character
ASDU	APPLICATION SERVICE DATA UNIT
APCI	APPLICATION PROTOCOL CONTROL INFORMATION
BFOC/2,5	Bayonet fibre optic connector
BS	Bitstring

CB	Circuit breaker
COL	Compatibility level
COM	Command
CONT	Continued
COT	CAUSE OF TRANSMISSION
COUNT	One bit counter of ASDUs
CP	Compound
CU	Communication unit
CP32Time2a	FOUR OCTET BINARY TIME
CP56Time2a	SEVEN OCTET BINARY TIME
dB	Decibel
DCE	Data circuit-terminating equipment
DCO	Double command
DFC	Data flow control
DPI	Double-point information
DTE	Data terminal equipment
EIA	Electronic Industries Association
EPA	Enhanced Performance Architecture
ER	Error
f	Frequency
F	Fixed point number
FAN	Fault number
F-Code	Function code
FCB	Frame count bit
FCV	Frame count bit valid
F-SMA	Type of an optical fibre connector
FT	Frame transmission format
FUN	FUNCTION TYPE
GDD	Generic data description
GEN	Generic function type
GGI	General interrogation of generic data
GI	General interrogation
GID	Generic identification data
GIN	Generic identification number
GLB	Global function type
GRC	GENERIC REPLY CODE
I	Integer
I>>	Overcurrent protection
IEC	International Electrotechnical Commission
IEV	International Electrotechnical Vocabulary
INF	INFORMATION NUMBER
INT	Interval between information elements
ISO	International Organization for Standardization
IV	Invalid
KOD	Kind of description
L	Line
LED	Light emitting diode
LPCI	LINK PROTOCOL CONTROL INFORMATION

LPDU	LINK PROTOCOL DATA UNIT
MEA	Measurand with quality descriptor
MVAL	Value of measurand
NDE	Number of descriptive elements
NDV	Number of relevant disturbance values per ASDU
NFE	Number of the ASDU first information element
NGD	Number of generic data sets
NO	Number
NOC	Number of channels
NOE	Number of information elements of a channel
NOF	Number of grid faults
NOG	Number of generic identification
NOT	Number of tags
OTEV	Other event (disturbance data recording initiated by)
OV	Overflow
P	Active power
PRM	Primary message
Q	Reactive power
RES	Reserved
RET	Relative time
RFA	Reference factor
RII	RETURN INFORMATION IDENTIFIER
RPV	Rated primary value
RSV	Rated secondary value
S	Sign
SCL	Short-circuit location
SCN	SCAN NUMBER
SDV	Single disturbance value
SIN	SUPPLEMENTARY INFORMATION
SOF	Status of fault
SU	Summer bit
SQ	Sequence of equal information elements
t(z)	Distance protection
TAP	Tag position
TM	Transmit (disturbance data)
TOO	Type of order
TOV	Type of disturbance values
TP	Trip (recorded fault)
T _{LD}	Loop delay
t _{wz}	Cycle repeat time
TYP	TYPE IDENTIFICATION
UF	Unsigned fixed point number
UI	Unsigned integer
V	Voltage
V _{EN}	Neutral voltage
VT	Voltage transformer

4 General rules

This clause provides general rules for constructing companion standards for the transmission protocol of specific control systems and protection equipment, using the IEC 60870-5 protocol.

These general rules are applied in the following subclauses.

4.1 Protocol structure

The IEC 60870-5 protocol is based on the three layer reference model “Enhanced Performance Architecture” (EPA), as specified in clause 4 of IEC 60870-5-3.

The physical layer uses a fibre optic or a copper-wire based system that provides binary symmetric and memoryless transmission.

The link layer consists of a number of link transmission procedures, using explicit LINK PROTOCOL CONTROL INFORMATION (LPCI), that are capable of carrying APPLICATION SERVICE DATA UNITS (ASDUs) as link user data. The link layer uses a selection of frame formats to provide the required integrity, efficiency, and convenience of transmission.

The application layer contains a number of application functions that involve the transmission of APPLICATION SERVICE DATA UNITS (ASDUs) between source and destination.

The application layer of this companion standard does not use explicit APPLICATION PROTOCOL CONTROL INFORMATION (APCI). This is implicit in the contents of the ASDU DATA UNIT IDENTIFIER and in the type of link service used.

Table 1 shows the Enhanced Performance Architecture (EPA) model and the selected standard definitions of this companion standard.

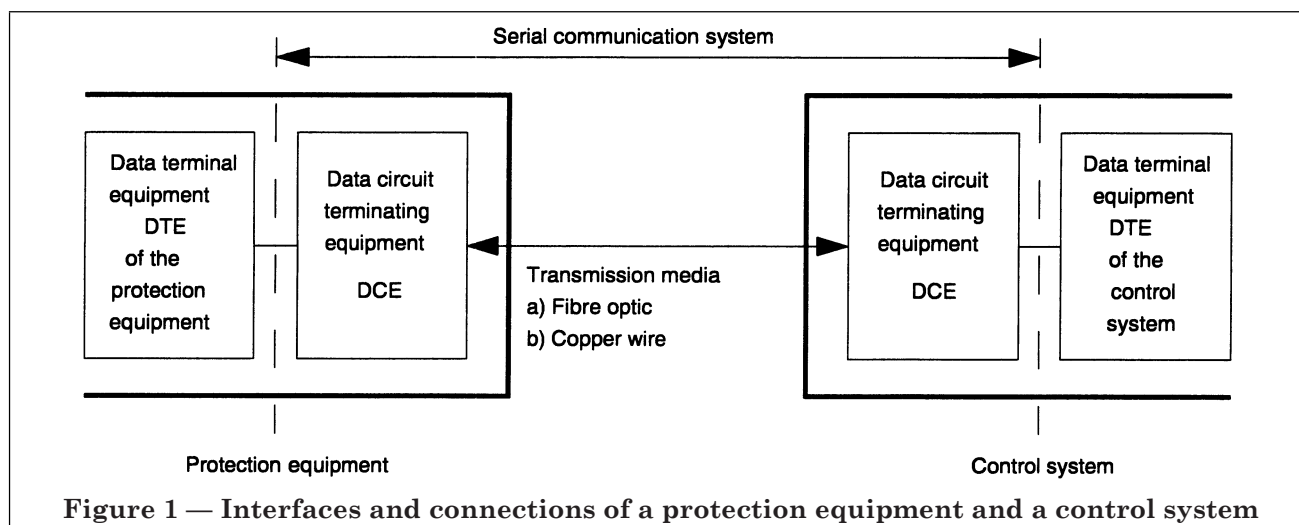
Table 1 — Selected standard provisions of this companion standard

Selected application functions of IEC 60870-5-5	User process
Selected APPLICATION SERVICE DATA UNITS of IEC 60870-5-3	Application layer (Layer 7)
Selected application information elements of IEC 60870-5-4	
Selected link transmission procedures of IEC 60870-5-2	Link layer (Layer 2)
Selected transmission frame formats of IEC 60870-5-1	
Fibre optic system based on IEC 60874-2 or IEC 60874-10 and IEC 60794-1 and IEC 60794-2 or copper-wire based system according to EIA RS-485	Physical layer (Layer 1)

4.2 Physical layer

Either a fibre optic system or a copper-wire based transmission system is used in this companion standard between the protection equipment and the control system. The interface between the data circuit-terminating equipment (DCE) and data terminal equipment (DTE) of the protection equipment, according to Figure 1, is not defined within this companion standard.

NOTE Data transmission methods which increase the exploitation of the bandwidth of a given transmission channel should be avoided, unless it can be proven that the method, that usually violates the required memoryless channel encoding principle, does not reduce the Hamming distance of the data block encoding method of the selected frame format in the link layer.



4.3 Link layer

IEC 60870-5-2 offers a selection of link transmission procedures using a control field and an optional address field. Links between stations may be operated in either an unbalanced or a balanced transmission mode. Appropriate function codes for the control field are specified for both modes of operation.

If the links from a control system to several protection equipments share a common physical channel, then these links shall be operated in an unbalanced mode to avoid the possibility that more than one protection equipment attempts to transmit on the channel at the same time. The sequence in which the various protection equipments are granted access to transmit on the channel is then determined by an application layer procedure in the control system, see 6.2 of IEC 60870-5-5.

The companion standard specifies whether an unbalanced or a balanced transmission mode is used, together with which link procedures (and corresponding link function codes) are to be used.

The companion standard specifies an unambiguous address (number) for each link. Each address may be unique within a specific system, or it may be unique within a group of links sharing a common channel. The latter needs a smaller address field but requires the control system to map addresses by channel number.

A companion standard shall specify one frame format chosen from those offered in IEC 60870-5-1. The format chosen shall provide the required data integrity together with the maximum efficiency available for an acceptable level of convenience of implementation.

4.4 Application layer

A companion standard shall define appropriate ASDUs from a given general structure in IEC 60870-5-3. These ASDUs are constructed using the definition and coding specifications for application information elements given in IEC 60870-5-4.

A companion standard shall specify one chosen order of transport for application data fields according to 4.10 of IEC 60870-5-4. The order, i.e. mode 1 or mode 2, may be chosen to provide the maximum overall convenience of programming, for the various computers in the specific system.

4.5 User process

IEC 60870-5-5 offers a selection of basic application functions. A companion standard contains one or more instances of these functions chosen to provide the required set of input and of output application procedures to suit the specific system.

4.6 Compatibility with companion standards of the IEC 60870-5 series

Certain parts of this standard are not fully compatible with other companion standards of the IEC 60870-5 series. This is due to the need to maintain compatibility with existing equipment already in use.

5 Physical layer

The data circuit terminating equipment (DCE) of the protection equipment may either be realized as a fibre optic transmission system or as a copper-wire-based transmission system. In the following sub-clauses, descriptions are given for both alternatives.

5.1 Fibre optic transmission

If a fibre optic transmission system is used, the compatible interface is a fibre optic connector at the protection equipment. Separate optical fibres are used in the monitor direction and in the control direction. The DCE may be mechanically and/or electrically integrated into the data terminal equipment (DTE).

For connecting the fibre optic cables to the DCE, a fibre optic connector of the BFOC/2,5 type as specified in IEC 60874-10 shall be used. The fibre optic connector of F-SMA type, as specified in IEC 60874-2, is included for compatibility with existing equipment. All the other mechanical specifications, for example mounting position and cable layout, are manufacturer specific.

The connectors are suitable for use with glass and plastic fibres, as indicated in Table 2.

The line-idle state is defined as “light on”.

Table 2 — The compatible fibre optic transmission system

Characteristics	Plastic fibre	Glass fibre
Connector	BFOC/2,5 (or F-SMA)	BFOC/2,5 (or F-SMA)
Cable type	Step-index 980/1 000 µm	Graded-index 62,5/125 µm ^a
Typical distance	Up to 40 m	Up to 1 000 m
Optical wavelength	660 nm	820 nm – 860 nm
Temperature range	– 5 °C... + 55 °C	– 5 °C... + 55 °C
Transmission power	Min. – 7 dBm	Min. – 16 dBm
Minimum receiving power	Min. – 20 dBm	Min. – 24 dBm
System reserve	Min. + 3 dB	Min. + 3 dB

^a Both connectors may also be used with 50/125 µm optical fibres. If this type of fibre is used, the transmitting power that can be input is reduced and therefore the distance, the receiving power, and the system reserve shall be specified separately.

5.2 EIA RS-485 interface

As an alternative to the fibre optic transmission described above a copper-wire based transmission system may be used between the protection equipment and the control system. This transmission system shall comply with the EIA RS-485 standard.

Due to the characteristic of the EIA RS-485 standard a maximum number of 32 units of load can be connected to one physical line. The location and the values of the termination resistances used are not specified, neither in the base standard nor in this companion standard. For compatibility purposes, the manufacturer shall state the units of load for each specific device (refer to clause 8).

The type of the cable used is not defined in the EIA RS-485 standard. However, guidance on the choice of the cable is given in Annex A.2.2 of the EIA RS-485 standard.

All other mechanical specifications are manufacturer specific.

NOTE Copper-wire based transmission systems are more susceptible to electromagnetic interference than fibre optic based systems. The inclusion of a copper-wire based system shall not degrade the performance of the protection equipment with respect to the relevant EMC standards.

6 Link layer

The following International Standards are applicable:

IEC 60870-5-1;

IEC 60870-5-2.

6.1 Selections from IEC 60870-5-1 (transmission frame formats)

This companion standard admits exclusively frame format FT1.2 that is defined in 6.2.4.2 of IEC 60870-5-1. Formats with fixed and with variable block lengths are admitted. Also the single control character E5H transmission is admitted.

NOTE 1 The rules defined in clause 6.2.4.2 of IEC 60870-5-1 have to be observed completely.

NOTE 2 The maximum number of user data is limited to 255 octets. However, as the frame length has an impact on the polling cycle time, especially when transmission errors occur, it may be considered to limit further the number of user data octets.

6.2 Selections from IEC 60870-5-2 (link transmission procedures)

The statements in the “introduction” and “scope” of IEC 60870-5-2 regarding utilization in geographically widespread telecontrol networks are not relevant.

The following selections from IEC 60870-5-2 shall be applied:

6.2.1 Format FT 1.2 (see 3.2 of IEC 60870-5-2)

The frame with fixed length has no link user data. It is referred to below as a short message. The single character A2H is not used.

6.2.2 Service primitives and elements of transmission procedures (see clause 4 of IEC 60870-5-2)

All three transmission procedures (S1 to S3) are used. The interface between the link control level and the user service is not specified.

6.2.3 Unbalanced transmission (see clause 5 of IEC 60870-5-2)

The control system constitutes the master, the protection equipment the slave; i.e. the control system is always primary station, the protection equipment always secondary station. The RES bit is not used.

The following function codes are used:

PRM = 1 0, 3, 4, 9, 10, 11

PRM = 0 0, 1, 8, 9, 11

Address field A always consists of one octet only. For broadcast (send/no reply) the address is defined as 255.

6.2.4 Time out interval for repeated frame transmission (see Annex A.1 of IEC 60870-5-2)

The loop delay T_{LD} shall be 50 ms.

The standard transmission speeds are 9,6 kbit/s or 19,2 kbit/s (adjustable).

6.3 Additional specifications to IEC 60870-5-2

The following additional function code is defined in the reserved range:

PRM = 1 F-Code 7 := reset FCB FCB and FCV = 0

This SEND function code is used to set the internal FCB bit to the value 0, i.e. the next successive primary message with FCV = 1 is expected with the setting FCB = 1 by the protection equipment. No other reset function such as those associated with function code 0 (reset communication unit) are triggered.

The following function codes are already specified in the standard. They are used here as follows:

PRM = 0 F-Code 14 := link service not functioning

Primary messages that cannot be passed on due to a malfunction are answered with an F-Code 14. The FCB bit is processed alternately.

PRM = 0 F-Code 15 := link service not implemented

Primary messages containing not implemented function codes are acknowledged with short messages and will not be processed. Non-plausible primary messages involving function codes 0-15 will be answered by means of function code 15 in a short message. The FCB bit will be processed alternately.

As long as the protection equipment is not able to process a further command, the DFC bit is set to “1” to prevent loss of information in the control direction. This state may only be maintained for a maximum of 15 s. During this time, no further command shall be transmitted by the control system. Such messages are answered by the protection equipment by means of a short message with function code 1 and are not processed. This leads to a loss of information. The exception to this is the broadcast command.

7 Application layer

The following International Standards are applicable:

- IEC 60870-5-3;
- IEC 60870-5-4;
- IEC 60870-5-5.

7.1 Selections from IEC 60870-5-3 (general structure of application data)

IEC 60870-5-3 describes the basic application data units in transmission frames. This subclause selects specific field elements out of this basic standard and defines APPLICATION SERVICE DATA UNITS used in this companion standard.

A LINK PROTOCOL DATA UNIT (LPDU) of this companion standard contains not more than one APPLICATION SERVICE DATA UNIT (ASDU).

The ASDU according to Figure 2 is composed of a DATA UNIT IDENTIFIER and only one INFORMATION OBJECT. The DATA UNIT IDENTIFIER has always the same structure for all ASDUs and consists of four octets. Its structure is as follows:

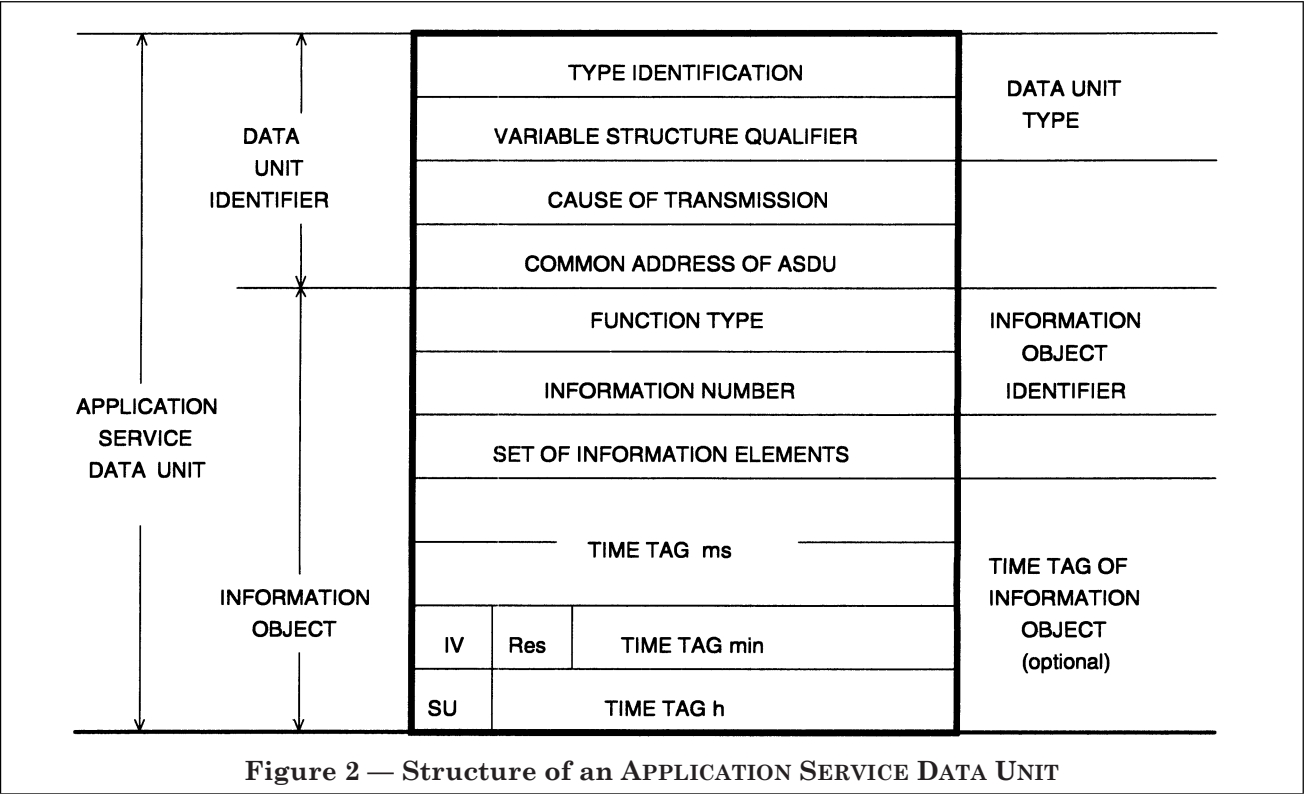
- TYPE IDENTIFICATION
- VARIABLE STRUCTURE QUALIFIER
- CAUSE OF TRANSMISSION
- COMMON ADDRESS OF ASDU

The COMMON ADDRESS OF ASDU shall normally be identical to the address used in the link layer.

The INFORMATION OBJECT consists; of an INFORMATION OBJECT IDENTIFIER, a SET OF INFORMATION ELEMENTS and, if present, a TIME TAG.

The INFORMATION OBJECT IDENTIFIER consists of two octets. Its structure is as follows:

- FUNCTION TYPE
- INFORMATION NUMBER



The SET OF INFORMATION ELEMENTS consists of a SINGLE INFORMATION ELEMENT, a COMBINATION OF INFORMATION ELEMENTS, or a SEQUENCE OF INFORMATION ELEMENTS.

APPLICATION SERVICE DATA UNIT	:=	CP48+8i+8j {DATA UNIT IDENTIFIER, INFORMATION OBJECT}
DATA UNIT IDENTIFIER	:=	CP32{TYPE IDENTIFICATION, VARIABLE STRUCTURE QUALIFIER, CAUSE OF TRANSMISSION, COMMON ADDRESS OF ASDU}
INFORMATION OBJECT	:=	CP16+8i+8j{FUNCTION TYPE, INFORMATION NUMBER, SET OF INFORMATION ELEMENTS, TIME TAG}
with parameter i	:=	number of octets of SET OF INFORMATION ELEMENTS
parameter j	:=	0 : TIME TAG not present, 4 : TIME TAG present

7.2 Selections from IEC 60870-5-4 (definition and coding of application information elements)

The sizes and the contents of individual information fields of the ASDUs are specified according to the declaration rules for information elements defined in IEC 60870-5-4.

NOTE The definitions concerning the TYPE IDENTIFICATION, the CAUSE OF TRANSMISSION and the FUNCTION TYPE are used for the compatible range. Combinations going beyond these may be used for the private range.
Example: TYPE IDENTIFICATION 7 (general interrogation) in combination with a CAUSE OF TRANSMISSION > 63 may be used for a private initiation of a general interrogation, which is specific to a given manufacturer.

7.2.1 Type identification

The first octet of the DATA UNIT IDENTIFIER of the ASDU defines the TYPE IDENTIFICATION. For compatible data exchange, 31 TYPE IDENTIFICATIONS are used. Their definition is as follows:

TYPE IDENTIFICATION	:=	UI8[1..8] <1..255>
<1..31>	:=	definitions of this companion standard (compatible range)
<32..255>	:=	for special use (private range)

Table 3 — Semantics of TYPE IDENTIFICATION; Information in monitor direction

<1>	:=	time-tagged message
<2>	:=	time-tagged message with relative time
<3>	:=	measurands I
<4>	:=	time-tagged measurands with relative time
<5>	:=	identification
<6>	:=	time synchronization
<8>	:=	general interrogation termination
<9>	:=	measurands II
<10>	:=	generic data
<11>	:=	generic identification
<23>	:=	list of recorded disturbances
<26>	:=	ready for transmission of disturbance data
<27>	:=	ready for transmission of a channel
<28>	:=	ready for transmission of tags
<29>	:=	transmission of tags
<30>	:=	transmission of disturbance values
<31>	:=	end of transmission

Table 4 — Semantics of TYPE IDENTIFICATION; Information in control direction

<6>	:=	time synchronization
<7>	:=	general interrogation
<10>	:=	generic data
<20>	:=	general command
<21>	:=	generic command
<24>	:=	order for disturbance data transmission
<25>	:=	acknowledgement for disturbance data transmission

All values in the range <0..31> not listed above are reserved for future compatible use.

7.2.2 Variable structure qualifier

The second octet of the DATA UNIT IDENTIFIER of the ASDU defines the VARIABLE STRUCTURE QUALIFIER, which is specified as follows:

VARIABLE STRUCTURE QUALIFIER := CP8 {number, SQ}

with	number	:=	UI7 [1..7] <0..127>
	<0..9>	:=	number of information elements
	<10..127>	:=	not used
	SQ	:=	BS1 [8] <0..1>
	<0>	:=	addressing of a sequence of information elements in one object
	<1>	:=	addressing of single information element or a combination of elements

The SQ bit specifies the method of addressing the following INFORMATION OBJECT or information elements.

SQ = 0: A sequence of equal information elements is addressed (see 5.1.5 of IEC 60870-5-3) by the INFORMATION OBJECT address. The INFORMATION OBJECT address specifies the associated address of the first information element of the sequence. The following information elements are identified by numbers increasing by 1 from this address. This mode is used for measurands and for the list of recorded disturbances.

SQ = 1: Each single element or combination of elements is addressed by the INFORMATION OBJECT address.

7.2.3 Cause of transmission

In the third octet of the DATA UNIT IDENTIFIER of the ASDU the CAUSE OF TRANSMISSION is identified. This octet is specified as follows:

CAUSE OF TRANSMISSION	:=	UI8 [1..8] <0..255>
with	<0>	:= not used
	<1..63>	:= compatible range
	<64..255>	:= private range

Table 5 — Semantics of CAUSE OF TRANSMISSION; Information in monitor direction

<1>	:=	spontaneous
<2>	:=	cyclic
<3>	:=	reset frame count bit (FCB)
<4>	:=	reset communication unit (CU)
<5>	:=	start/restart
<6>	:=	power on
<7>	:=	test mode
<8>	:=	time synchronization
<9>	:=	general interrogation
<10>	:=	termination of general interrogation
<11>	:=	local operation
<12>	:=	remote operation
<20>	:=	positive acknowledgement of command
<21>	:=	negative acknowledgement of command
<31>	:=	transmission of disturbance data
<40>	:=	positive acknowledgement of generic write command
<41>	:=	negative acknowledgement of generic write command
<42>	:=	valid data response to generic read command
<43>	:=	invalid data response to generic read command
<44>	:=	generic write confirmation

NOTE For further explanation, see 7.4.

Table 6 — Semantics of CAUSE OF TRANSMISSION; Information in control direction

<8>	:=	time synchronization
<9>	:=	initiation of general interrogation
<20>	:=	general command
<31>	:=	transmission of disturbance data
<40>	:=	generic write command
<42>	:=	generic read command

All values in the range <0..63> not listed in Table 5 and Table 6 are reserved for future compatible use.

7.2.4 Common address of ASDU

The fourth octet of the DATA UNIT IDENTIFIER of the ASDU defines the COMMON ADDRESS OF ASDU. This octet shall normally be identical to the station address used at the link level. Exceptions are only permitted where additional COMMON ADDRESSES OF ASDUs are required on the same physical link because of duplicated functions, for example two overcurrent protection functions within a transformer differential protection.

COMMON ADDRESS OF ASDU := UI8 [1 ..8] <0..255>

with <0..254> := station address
 <255> := global address

System co-ordination functions (see Table 8 and Table 16) need only use the COMMON ADDRESS OF ASDU which is identical to the link layer address.

7.2.5 Information object identifier

7.2.5.1 Function type

The first octet of the INFORMATION OBJECT IDENTIFIER defines the FUNCTION TYPE of the protection equipment used. It is defined as follows:

FUNCTION TYPE	:=	UI8 [1 ..8] <0..255>
with		
<0..127>	:=	private range
<128..129>	:=	compatible range
<130..143>	:=	private range
<144..145>	:=	compatible range
<146..159>	:=	private range
<160..161>	:=	compatible range
<162..175>	:=	private range
<176..177>	:=	compatible range
<178..191>	:=	private range
<192..193>	:=	compatible range
<194..207>	:=	private range
<208..209>	:=	compatible range
<210..223>	:=	private range
<224..225>	:=	compatible range
<226..239>	:=	private range
<240..241>	:=	compatible range
<242..253>	:=	private range
<254..255>	:=	compatible range

Table 7 — Semantics of FUNCTION TYPE

<128>	:=	distance protection	$t(z)$
<129>	:=	not used	
<144>	:=	not used	
<145>	:=	not used	
<160>	:=	overcurrent protection	$I >>$
<161>	:=	not used	
<176>	:=	transformer differential protection	ΔI_T
<177>	:=	not used	
<192>	:=	line differential protection	ΔI_L
<193>	:=	not used	
<208>	:=	not used	
<209>	:=	not used	
<224>	:=	not used	
<225>	:=	not used	
<240>	:=	not used	
<241>	:=	not used	
<254>	:=	generic function type	GEN
<255>	:=	global function type	GLB

7.2.5.2 Information number

The second octet of the INFORMATION OBJECT IDENTIFIER defines the INFORMATION NUMBER within a given FUNCTION TYPE. The full range <0..255> is used independently in the control direction as well as in the monitor direction. The second octet is defined as follows:

INFORMATION NUMBER	:=	UI8 [1..8] <0..255>
with monitor direction	:=	<0..255>
<0..15>	:=	system functions
<16..31>	:=	status
<32..47>	:=	supervision
<48..63>	:=	earth fault
<64..127>	:=	short circuit
<128..143>	:=	auto-reclosure
<144..159>	:=	measurands
<160..239>	:=	not used
<240..255>	:=	generic functions
control direction	:=	<0..255>
<0..15>	:=	system functions
<16..31>	:=	general commands
<32..239>	:=	not used
<240..255>	:=	generic functions

The semantics of the octet INFORMATION NUMBER (INF) is given in the following tables. INFORMATION NUMBERS not listed are not used according to the above list.

A distinction is not only made between monitor direction and control direction but also for the different modes mentioned above. Additionally, the TYPE IDENTIFICATIONS (TYP) and possible CAUSES OF TRANSMISSION (COT) are listed.

For each INFORMATION NUMBER typical FUNCTION TYPES (FUN) are given. GLB and GEN are mandatory, where specified.

The field GI indicates whether the information is included in the general interrogation. For these INFORMATION NUMBERS both status changes ("OFF" to "ON" and "ON" to "OFF") are also transmitted spontaneously. For the other INFORMATION NUMBERS only the status changes "OFF" to "ON" are transmitted.

Table 8 — Semantics of INFORMATION NUMBER; System functions in monitor direction

INF	Description	GI	TYP	COT	FUN
<0>	:= end of general interrogation	—	8	10	GLB
<0>	:= time synchronization	—	6	8	GLB
<1>	:= not used	—			
<2>	:= reset FCB	—	5	3	according to main FUN
<3>	:= reset CU	—	5	4	according to main FUN
<4>	:= start/restart	—	5	5	according to main FUN
<5>	:= power on	—	5	6	according to main FUN

NOTE 1 INFORMATION NUMBER 0 refers to the GLOBAL FUNCTION TYPE and is identical for all system services.

NOTE 2 INFORMATION NUMBERS 2 to 5 are used with a FUN according to the main function of the protection device.

Table 9 — Semantics of INFORMATION NUMBER; Status indications in monitor direction

INF	Description	GI	TYP	COT	FUN (typical)
<16>	:= auto-recloser active	×	1	1,7,9,11,12,20,21	t(z), I>>, ΔI _L
<17>	:= teleprotection active	×	1	1,7,9,11,12,20,21	t(z), I>>
<18>	:= protection active	×	1	1,7,9,11,12,20,21	t(z), I>>, ΔI _T , ΔI _L
<19>	:= LED reset	—	1	1,7,11,12,20,21	t(z), I>>, ΔI _T , ΔI _L
<20>	:= monitor direction blocked	×	1	9,11	t(z), I>>, ΔI _T , ΔI _L
<21>	:= test mode	×	1	9,11	t(z), I>>, ΔI _T , ΔI _L
<22>	:= local parameter setting	×	1	9,11	t(z), I>>, ΔI _T , ΔI _L
<23>	:= characteristic 1	×	1	1,7,9,11,12,20,21	t(z)
<24>	:= characteristic 2	×	1	1,7,9,11,12,20,21	t(z)
<25>	:= characteristic 3	×	1	1,7,9,11,12,20,21	t(z)
<26>	:= characteristic 4	×	1	1,7,9,11,12,20,21	t(z)
<27>	:= auxiliary input 1	×	1	1,7,9,11	t(z), I>>, ΔI _T , ΔI _L
<28>	:= auxiliary input 2	×	1	1,7,9,11	t(z), I>>, ΔI _T , ΔI _L
<29>	:= auxiliary input 3	×	1	1,7,9,11	t(z), I>>, ΔI _T , ΔI _L
<30>	:= auxiliary input 4	×	1	1,7,9,11	t(z), I>>, ΔI _T , ΔI _L

Table 10 — Semantics of INFORMATION NUMBER; Supervision indications in monitor direction

INF	Description	GI	TYP	COT	FUN (typical)
<32>	:= measurand supervision I	×	1	1,7,9	t(z), I>>
<33>	:= measurand supervision V	×	1	1,7,9	t(z), I>>
<35>	:= phase sequence supervision	×	1	1,7,9	t(z), I>>
<36>	:= trip circuit supervision	×	1	1,7,9	t(z), I>>, ΔI _T , ΔI _L
<37>	:= I>> back-up operation	×	1	1,7,9	t(z)
<38>	:= VT fuse failure ^a	×	1	1,7,9	t(z), I>>
<39>	:= teleprotection disturbed	×	1	1,7,9	t(z), I>>, ΔI _L
<46>	:= group warning	×	1	1,7,9	t(z), I>>, ΔI _T , ΔI _L
<47>	:= group alarm	×	1	1,7,9	t(z), I>>, ΔI _T , ΔI _L

^a VT := voltage transformer**Table 11 — Semantics of INFORMATION NUMBER; Earth fault indications in monitor direction**

INF	Description	GI	TYP	COT	FUN (typical)
<48>	:= earth fault L ₁	×	1	1,7,9	t(z), I>>
<49>	:= earth fault L ₂	×	1	1,7,9	t(z), I>>
<50>	:= earth fault L ₃	×	1	1,7,9	t(z), I>>
<51>	:= earth fault forward, i.e. line	×	1	1,7,9	t(z), I>>
<52>	:= earth fault reverse, i.e. busbar	×	1	1,7,9	t(z), I>>

Table 12 — Semantics of INFORMATION NUMBER; Fault indications in monitor direction

INF	Description	GI	TYP	COT	FUN (typical)
<64>	:= start/pick-up L_1	×	2	1,7,9	$t(z), I>>, \Delta I_L$
<65>	:= start/pick-up L_2	×	2	1,7,9	$t(z), I>>, \Delta I_L$
<66>	:= start/pick-up L_3	×	2	1,7,9	$t(z), I>>, \Delta I_L$
<67>	:= start/pick-up N	×	2	1,7,9	$t(z), I>>, \Delta I_L$
<68>	:= general trip	—	2	1,7	$t(z), I>>, \Delta I_T, \Delta I_L$
<69>	:= trip L_1	—	2	1,7	$t(z), I>>, \Delta I_T, \Delta I_L$
<70>	:= trip L_2	—	2	1,7	$t(z), I>>, \Delta I_T, \Delta I_L$
<71>	:= trip L_3	—	2	1,7	$t(z), I>>, \Delta I_T, \Delta I_L$
<72>	:= trip I >> (back-up operation)	—	2	1,7	$t(z)$
<73>	:= fault location X in ohms	—	4	1,7	$t(z), I>>$
<74>	:= fault forward/line	—	2	1,7	$t(z), I>>$
<75>	:= fault reverse/busbar	—	2	1,7	$t(z), I>>$
<76>	:= teleprotection signal transmitted	—	2	1,7	$t(z), I>>$
<77>	:= teleprotection signal received	—	2	1,7	$t(z), I>>$
<78>	:= zone 1	—	2	1,7	$t(z)$
<79>	:= zone 2	—	2	1,7	$t(z)$
<80>	:= zone 3	—	2	1,7	$t(z)$
<81>	:= zone 4	—	2	1,7	$t(z)$
<82>	:= zone 5	—	2	1,7	$t(z)$
<83>	:= zone 6	—	2	1,7	$t(z)$
<84>	:= general start/pick-up	×	2	1,7,9	$t(z), I>>, \Delta I_T, \Delta I_L$
<85>	:= breaker failure	—	2	1,7	$t(z), I>>$
<86>	:= trip measuring system L_1	—	2	1,7	ΔI_T
<87>	:= trip measuring system L_2	—	2	1,7	ΔI_T
<88>	:= trip measuring system L_3	—	2	1,7	ΔI_T
<89>	:= trip measuring system E	—	2	1,7	ΔI_T
<90>	:= trip I>	—	2	1,7	$I>>$
<91>	:= trip I>>	—	2	1,7	$I>>$
<92>	:= trip IN>	—	2	1,7	$I>>$
<93>	:= trip IN>>	—	2	1,7	$I>>$

Table 13 — Semantics of INFORMATION NUMBER; Auto-reclosure indications in monitor direction

INF	Description	GI	TYP	COT	FUN (typical)
<128>	:= CB “on” by AR ^a	—	1	1,7	$t(z), I>>, \Delta I_L$
<129>	:= CB “on” by long-time AR ^a	—	1	1,7	$t(z), I>>, \Delta I_L$
<130>	:= AR blocked ^a	×	1	1,7,9	$t(z), I>>, \Delta I_L$

^a CB := circuit breaker; AR := auto-recloser**Table 14 — Semantics of INFORMATION NUMBER; Measurands in monitor direction**

INF	Description	GI	TYP	COT	FUN (typical)
<144>	:= measurand I	—	3.1	2,7	$t(z), I>>$
<145>	:= measurands I, V	—	3.2	2,7	$t(z), I>>$
<146>	:= measurands I, V, P, Q	—	3.3	2,7	$t(z)$
<147>	:= measurands I_N, V_{EN}	—	3.4	2,7	$t(z), I>>$
<148>	:= measurands $I_{L1,2,3}, V_{L1,2,3}, P, Q, f$	—	9	2,7	$t(z)$

Table 15 — Semantics of INFORMATION NUMBER; Generic functions in monitor direction

INF	Description	GI	TYP	COT	FUN
<240>	:= read headings of all defined groups	—	10	42,43	GEN
<241>	:= read values or attributes of all entries of one group	—	10	42,43	GEN
<242>	:= not used	—	—	—	—
<243>	:= read directory of a single entry	—	11	42,43	GEN
<244>	:= read value or attribute of a single entry	(×)	10	1,2,7,9,11,12,42,43	GEN
<245>	:= end of general interrogation of generic data	—	10	10	GEN
<249>	:= write entry with confirmation	—	10	41,44	GEN
<250>	:= write entry with execution	—	10	40,41	GEN
<251>	:= write entry aborted	—	10	40	GEN

The INFORMATION NUMBER <245> uses ASDU 10 with NGD = 0.

NOTE Some generic data may be included in the general interrogation of generic data.

Table 16 — Semantics of INFORMATION NUMBER; System functions in control direction

INF	Description	TYP	COT	FUN
<0>	:= initiation of general interrogation	7	9	GLB
<0>	:= time synchronization	6	8	GLB

NOTE INFORMATION NUMBER <0> refers to the global function type and is identical for all system services.

Table 17 — Semantics of INFORMATION NUMBER; General commands in control direction

INF	Description	COM ^a	TYP	COT	FUN (typical)
<16>	:= auto-recloser on/off	ON/OFF	20	20	t(z), I>>, ΔI _L
<17>	:= teleprotection on/off	ON/OFF	20	20	t(z), I>>
<18>	:= protection on/off	ON/OFF	20	20	t(z), I>>, ΔI _T , ΔI _L
<19>	:= LED reset	ON	20	20	t(z), I>, ΔI _T , ΔI _L
<23>	:= activate characteristic 1	ON	20	20	t(z)
<24>	:= activate characteristic 2	ON	20	20	t(z)
<25>	:= activate characteristic 3	ON	20	20	t(z)
<26>	:= activate characteristic 4	ON	20	20	t(z)

^a Permissible selections of DCO values are specified in the COM column (see 7.2.6.4).

Table 18 — Semantics of INFORMATION NUMBER; Generic functions in control direction

INF	Description	TYP	COT	FUN
<240>	:= read headings of all defined groups	21	42	GEN
<241>	:= read values or attributes of all entries of one group	21	42	GEN
<242>	:= not used	—	—	—
<243>	:= read directory of a single entry	21	42	GEN
<244>	:= read value or attribute of a single entry	21	42	GEN
<245>	:= general interrogation of generic data	21	9	GEN
<248>	:= write entry	10	40	GEN
<249>	:= write entry with confirmation	10	40	GEN
<250>	:= write entry with execution	10	40	GEN
<251>	:= write entry abort	10	40	GEN

7.2.6 Information elements

The following information elements are used in the ASDUs defined in this standard. They are structured according to the definitions of IEC 60870-5-4.

7.2.6.1 Actual channel

ACC	:=	UI8[1..8] <1..255>
with		
	<0>	:= global ^a
	<1>	:= I _{L1}
	<2>	:= I _{L2}
	<3>	:= I _{L3}
	<4>	:= I _N
	<5>	:= V _{L1E}
	<6>	:= V _{L2E}
	<7>	:= V _{L3E}
	<8>	:= V _{EN}
	<9..63>	:= reserved for future compatible use
	<64...255>	:= reserved for private use

^a The value 0 is used with ASDU 24, 25, and 31 in the octet ACC only, if no transmission of a channel is to be processed.

This octet indicates the actual channel to be processed within the transmission of disturbance data.

7.2.6.2 ASCII character

ASC := UI8 [1..8] <ASCII 8-bit code>

7.2.6.3 Compatibility level

COL := UI8 [1..8] <0..255>

The compatibility level of protection equipment based on this companion standard is “2” without use of generic services, and “3” with use of generic services.

7.2.6.4 Double command (see IEV 371-03-03)

DCO	:=	UI2 [1..2] <0..3>
with		
	<0>	:= not used
	<1>	:= OFF
	<2>	:= ON
	<3>	:= not used

7.2.6.5 Double-point information (see IEV 371-02-08)

DPI	:=	UI2 [1..2] <0..3>
with		
	<0>	:= not used
	<1>	:= OFF
	<2>	:= ON
	<3>	:= not used

7.2.6.6 Fault number

FAN := UI16 [1..16] <0..65535>

The fault number is used to identify an event associated with a protection function, for example, a start/pick-up from a protection equipment will increment a fault number. This means that a sequence with an unsuccessful auto-reclosure will be recorded as two separate fault numbers. The fault number need not be reset nor preset.

7.2.6.7 Interval between information elements

INT := UI16[1..16] <1..65535>

The interval for acquisition of the single information elements is the same for all disturbance data. It is listed in microseconds.

7.2.6.8 Measurand with quality descriptor

MEA := CP16 {OV, ER, RES, MVAL}
 with
 OV := BS1[1]
 <0> := no overflow
 <1> := overflow
 ER := BS1 [2] <0..1>
 <0> := MVAL valid
 <1> := MVAL invalid
 RES := BS1 [3] not used (always <0>)
 MVAL := F13 [4..16] <-1..+1-2⁻¹²>

In the case of overflow of MVAL it is set to its maximum positive or maximum negative value respectively, in addition to OV :=1. The maximum MVAL can either be $\pm 1,2$ or $\pm 2,4 \times$ the rated value.

Other formats and ranges can be used with generic services.

7.2.6.9 Number of the ASDU first information element

NFE := UI16[1..16] <0..65535>

All single disturbance values of a channel (file) have consecutive numbers and are transmitted in uniform portions. Within an ASDU they are transmitted with consecutive increasing numbers. To be able to correctly reassemble the file, the number of the first disturbance value (first information element) of the ASDU is shown.

7.2.6.10 Number of channels

NOC := UI8[1..8] <0..255>

This octet indicates the number of analogue channels of a set of transmission data being ready for transmission.

7.2.6.11 Number of information elements of a channel

NOE := UI16[1..16] <1..65535>

All channels contain the same number of information elements. This number is transmitted in ASDU 26 “ready for transmission of disturbance data”, being valid for all channels.

7.2.6.12 Number of grid faults

NOF := UI16[1..16] <0..65535>

NOTE A grid fault, for example a short circuit, might cause several faults with trip and auto-reclosing, each fault being identified by an increased fault number. In this case, the grid fault number remains the same. The grid fault number need not be reset nor preset.

7.2.6.13 Number of tags

NOT := UI8[1..8] <1..255>

This octet indicates the number of tags to be transmitted per ASDU.

7.2.6.14 Number of relevant disturbance values per ASDU

NDV := UI8[1..8] <1..255>
 with
 <1 .. 25> := used
 <26 .. 255> := not used

7.2.6.15 Relative time

RET := UI16 [1..16] <0..65535>

The relative time is reset at the beginning of a short circuit. It indicates the time in milliseconds from the start/pick-up of the protection equipment up to the present time.

7.2.6.16 Reference factor

RFA := R32.23{Fraction, Exponent, Sign}

The disturbance values are transmitted as raw values. The reference factor shows the relationship between raw value and secondary value.

$$\text{Reference factor } F = \frac{\text{raw value}}{\text{secondary value}}$$

The primary value is the secondary value multiplied with the ratio “rated primary value” and “rated secondary value”.

$$\begin{aligned} \text{Primary value} &= \text{secondary value} \times \frac{\text{rated primary value}}{\text{rated secondary value}} = \\ &= \frac{\text{raw value}}{\text{reference factor}} \times \frac{\text{rated primary value}}{\text{rated secondary value}} \end{aligned}$$

7.2.6.17 Rated primary value

RPV := R32.23{Fraction, Exponent, Sign}

7.2.6.18 Rated secondary value

RSV := R32.23{Fraction, Exponent, Sign}

7.2.6.19 Return information identifier

RII := UI8 [1..8] <0..255>

7.2.6.20 Short-circuit location

SCL := R32.23 {Fraction, Exponent, Sign}

The short-circuit location represents the location as fault reactance related to primary values. It is given in ohms.

7.2.6.21 Scan number

SCN := UI8 [1 ..8] <0..255>

7.2.6.22 Single disturbance value

SDV := F16[1..16] <-1..+1-2⁻¹⁵>

7.2.6.23 Supplementary information

SIN := UI8 [1 ..8] <0..255>

SUPPLEMENTARY INFORMATION is used as follows:

CAUSE OF TRANSMISSION	=	general interrogation
SIN	:=	SCAN NUMBER of the GI initiating ASDU
CAUSE OF TRANSMISSION	=	positive or negative acknowledgement of command
SIN	:=	RETURN INFORMATION IDENTIFIER of the command message
CAUSES OF TRANSMISSION	=	other
SIN	:=	not relevant

7.2.6.24 Status of fault

SOF	:=	BS8{TP, TM, TEST, OTEV, RES}
with	TP	:= BS1[1]
	<0>	:= recorded fault without trip
	<1>	:= recorded fault with trip
	TM	:= BS1[2]
	<0>	:= disturbance data waiting for transmission
	<1>	:= disturbance data currently being transmitted
	TEST	:= BS1[3]
	<0>	:= disturbance data recorded during normal operation
	<1>	:= disturbance data recorded during test mode
	OTEV	:= BS1[4]
	<0>	:= disturbance data recording initiated by start/pick-up
	<1>	:= disturbance data recording initiated by other events
	RES	:= BS4[5...8] not used

NOTE SOF indicates whether the protection equipment has tripped during the fault (bit TP), whether the disturbance data are currently being transmitted (bit TM), whether the disturbance data have been recorded during normal operation or test mode (bit TEST), and whether disturbance data recording has been initiated by another event than start/pick-up (bit OTEV).

7.2.6.25 Tag position

TAP := UI16[1..16] <0..65535>

These two octets show the position of the tag within the disturbance data set. The number is the “distance” of the tag from the first element of the disturbance data set, coded as number of information elements modulo 65536. The position of the first tag is zero.

7.2.6.26 Type of order

TOO	:=	UI8[1..8] <1..255>
with	<1>	:= selection of fault
	<2>	:= request for disturbance data
	<3>	:= abortion of disturbance data
	<4..7>	:= reserved
	<8>	:= request for channel
	<9>	:= abortion of channel
	<10..15>	:= reserved
	<16>	:= request for tags
	<17>	:= abortion of tags
	<18..23>	:= reserved
	<24>	:= request for list of recorded disturbances
	<25..31>	:= reserved
	<32>	:= end of disturbance data transmission without abortion
	<33>	:= end of disturbance data transmission with abortion by control system
	<34>	:= end of disturbance data transmission with abortion by the protection equipment
	<35>	:= end of channel transmission without abortion
	<36>	:= end of channel transmission with abortion by control system
	<37>	:= end of channel transmission with abortion by the protection equipment
	<38>	:= end of tag transmission without abortion
	<39>	:= end of tag transmission with abortion by control system
	<40>	:= end of tag transmission with abortion by the protection equipment
	<41..63>	:= reserved
	<64>	:= disturbance data transmitted successfully (positive)
	<65>	:= disturbance data transmitted not successfully (negative)
	<66>	:= channel transmitted successfully (positive)

<67>	:=	channel transmitted not successfully (negative)
<68>	:=	tags transmitted successfully (positive)
<69>	:=	tags transmitted not successfully (negative)
<70..255>	:=	reserved

TOO specifies the type of order, for example selection, request, abort of transmission of disturbance data, channels, tags, and list of recorded disturbances. The following ranges of TOO are used with the different ASDUs:

TOO <1..31>	used with ASDU 24: order for disturbance data transmission
TOO <32..63>	used with ASDU 31: end of disturbance data transmission
TOO <64..95>	used with ASDU 25: acknowledgement for disturbance data transmission

7.2.6.27 Type of disturbance values

TOV	:=	UI8[1..8] <0..255>
with	<0>	:= not used
	<1>	:= instantaneous values
	<2..255>	:= not used

7.2.6.28 Four octet binary time

CP32Time2a := CP32 {Milliseconds, Minutes, RES1, Invalid, Hours, RES2, Summer time}

This binary time is defined in 6.8 of IEC 60870-5-4. It is used for the TIME TAG of an INFORMATION OBJECT.

7.2.6.29 Seven octet binary time

CP56Time2a := CP56 {Milliseconds, Minutes, RES1, Invalid, Hours, RES2, Summer time, Day of month, Day of week, Months, RES3, Years, RES4}

This binary time is defined in 6.8 of IEC 60870-5-4. It is used for time synchronization and within the list of recorded disturbances.

Day of week is set between 1 and 7 if used, where 1 equals Monday, otherwise it is set to zero.

When used with generic services, shortened time information is transmitted by discarding high order octets. The DATASIZE determines the actual number of octets.

7.2.6.30 Number of generic data sets

NGD	:=	CP8 {NO, COUNT, CONT}
with	NO	:= UI6[1..6] <0..63>
	COUNT	:= BS1[7] <0..1>
	<0..1>	:= one bit counter of ASDUs with same RII
	CONT	:= BS1[8] <0..1>
	<0>	:= no further ASDU with same RII will follow
	<1>	:= further ASDUs with same RII following

The initial value of COUNT is zero.

7.2.6.31 Generic identification number

GIN	:=	CP16{GROUP, ENTRY}
with	GROUP	:= UI8[1..8] <0..255>
	ENTRY	:= UI8[9..16] <0..255>
	<0>	:= GROUP identifier
	<1..255>	:= ENTRY identifier