



BSI Standards Publication

Industrial communication networks — Fieldbus specifications

Part 5-23: Application layer service definition — Type 23 elements

National foreword

This British Standard is the UK implementation of EN IEC 61158-5-23:2023. It is identical to IEC 61158-5-23:2023. It supersedes BS EN IEC 61158-5-23:2019, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/65/3, Industrial communications: process measurement and control, including fieldbus.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Date	Text affected
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English Version

Industrial communication networks - Fieldbus specifications -
Part 5-23: Application layer service definition - Type 23 elements
(IEC 61158-5-23:2023)

Réseaux de communication industriels - Spécifications des
bus de terrain - Partie 5-23 : Définition des services de la
couche application - Éléments de type 23
(IEC 61158-5-23:2023)

Industrielle Kommunikationsnetze - Feldbusse - Teil 5-23:
Dienstfestlegungen des Application Layer
(Anwendungsschicht) - Typ 23-Elemente
(IEC 61158-5-23:2023)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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European foreword

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The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2024-01-13
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-04-13

This document supersedes EN IEC 61158-5-23:2019 and all of its amendments and corrigenda (if any).

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The text of the International Standard IEC 61158-5-23:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 61158-6 (series) NOTE Approved as EN 61158-6 (series)

IEC 61784-1 (series) NOTE Approved as EN IEC 61784-1 (series)¹

IEC 61784-2 (series) NOTE Approved as EN IEC 61784-2 (series)²

¹ To be published. Stage at time of publication: FprEN IEC 61784-1-X:2023.

² To be published. Stage at time of publication: FprEN IEC 61784-2-X:2023.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61158-1	2023	Industrial communication networks - Fieldbus specifications - Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series	EN IEC 61158-1	2023
IEC 61158-6	series	Industrial communication networks - Fieldbus specifications - Part 6-X: Application layer protocol specification	EN IEC 61158-6	series
ISO/IEC 646	-	Information technology; ISO 7-bit coded character set for information interchange	-	-
ISO/IEC 7498-1	-	Information technology - Open Systems Interconnection - Basic reference model: The basic model	-	-
ISO/IEC 8822	-	Information technology - Open Systems Interconnection - Presentation service definition	-	-
ISO/IEC 8824-1	-	Information technology - Abstract Syntax Notation One (ASN.1) - Part 1: Specification of basic notation	-	-
ISO/IEC 9545	-	Information technology - Open Systems Interconnection - Application layer structure	-	-
ISO/IEC 10731	-	Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services	-	-
IEEE Std 1588	-	Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems	-	-
IEEE Std 802.1AS	-	IEEE standard for Local and metropolitan area networks - Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 5-23: Application layer service definition –
Type 23 elements****FOREWORD**

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NOTE Combinations of protocol types are specified in the IEC 61784-1 series and the IEC 61784-2 series.

IEC 61158-5-23 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) addition of Type T ASE (6.2.10 to 6.2.15).
- b) addition of Type T AR (6.5).

The text of this International Standard is based on the following documents:

Draft	Report on voting
65C/1203/FDIS	65C/1244/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all the parts of the IEC 61158 series, published under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This document is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the "three-layer" fieldbus reference model described in IEC 61158-1.

The application service is provided by the application protocol making use of the services available from the data-link or other immediately lower layer. This document defines the application service characteristics that fieldbus applications and/or system management can exploit.

Throughout the set of fieldbus standards, the term "service" refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the layer immediately above. Thus, the application layer service defined in this document is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-23: Application layer service definition – Type 23 elements

1 Scope

1.1 General

The Fieldbus Application Layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be viewed as a "window between corresponding application programs".

This part of IEC 61158 provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 23 fieldbus. The term "time-critical" is used to represent the presence of a time-window, within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant and possibly human life.

This document defines in an abstract way the externally visible service provided by the different Types of the fieldbus Application Layer in terms of

- a) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL service,
- b) the primitive actions and events of the service;
- c) the parameters associated with each primitive action and event, and the form that they take; and
- d) the interrelationship between these actions and events, and their valid sequences.

The purpose of this document is to define the services provided to

- a) the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and
- b) Systems Management at the boundary between the Application Layer and Systems Management of the Fieldbus Reference Model.

This document specifies the structure and services of the IEC Fieldbus Application Layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI Application Layer Structure (ISO/IEC 9545).

FAL services and protocols are provided by FAL application-entities (AE) contained within the application processes. The FAL AE is composed of a set of object-oriented Application Service Elements (ASEs) and a Layer Management Entity (LME) that manages the AE. The ASEs provide communication services that operate on a set of related application process object (APO) classes. One of the FAL ASEs is a management ASE that provides a common set of services for the management of the instances of FAL classes.

Although these services specify, from the perspective of applications, how request and responses are issued and delivered, they do not include a specification of what the requesting and responding applications are to do with them. That is, the behavioral aspects of the applications are not specified; only a definition of what requests and responses they can send/receive is specified. This permits greater flexibility to the FAL users in standardizing such object behavior. In addition to these services, some supporting services are also defined in this document to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this document is to specify the characteristics of conceptual application layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of application layer protocols for time-critical communications.

A secondary objective is to provide migration paths from previously existing industrial communications protocols. It is this latter objective which gives rise to the diversity of services standardized as the various Types of IEC 61158, and the corresponding protocols standardized in subparts of IEC 61158-6.

This document can be used as the basis for formal Application Programming-Interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this specification, including

- a) the sizes and octet ordering of various multi-octet service parameters, and
- b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This document does not specify individual implementations or products, nor does it constrain the implementations of application layer entities within industrial automation systems.

There is no conformance of equipment to this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfill any given Type of application layer services as defined in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE All parts of the IEC 61158 series, as well as the IEC 61784-1 series and the IEC 61784-2 series are maintained simultaneously. Cross -references to these documents within the text therefore refer to the editions as dated in this list of normative references.

IEC 61158-1:2023, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-6 (all parts), *Industrial communication networks – Fieldbus specifications – Part 6-X: Application layer protocol specification*

ISO/IEC 646, *Information technology – ISO 7-bit coded character set for information interchange*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 8824-1, *Information technology – Abstract Syntax Notation One (ASN.1) – Part 1: Specification of basic notation*

ISO/IEC 9545, *Information technology – Open Systems Interconnection – Application Layer structure*

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

IEEE Std 802.1AS, *Standard for Local and Metropolitan Area Networks – Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks*

IEEE Std 1588, *Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*

3 Terms, definitions, symbols, abbreviated terms and conventions

For the purposes of this document, the following terms, definitions, symbols, abbreviated terms and conventions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 Referenced terms and definitions

3.1.1 ISO/IEC 7498-1 terms

For the purposes of this document, the following terms given in ISO/IEC 7498-1 apply:

- a) application entity
- b) application process
- c) application protocol data unit
- d) application service element

3.1.2 ISO/IEC 8822 terms

For the purposes of this document, the following terms given in ISO/IEC 8822 apply:

- a) abstract syntax

3.1.3 IEC 61158-1 terms

For the purposes of this document, the following terms given in IEC 61158-1 apply:

- a) DLL mapping protocol machine
- b) fieldbus application layer
- c) FAL service protocol machine
- d) protocol data unit.

3.2 Additional Type 23 terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.2.1

cyclic transmission

transmission that is performed periodically used for the link device update

3.2.2

intelligent device station

node capable of performing 1:n bit data and word data cyclic transmission and transient transmission with the master station, and transient transmission with slave stations, excluding remote I/O stations and having client functions and server functions during transient transmission

3.2.3

link bit

link relay bit data that are shared by all the nodes through the cyclic transmission and is used as one bit unit shared memory of the n:n type

3.2.4

link device

link bit, link word, link x and link y or RX, RY, RWr, and RWw

3.2.5

link word

link register two octet unit data that are shared by all the nodes through the cyclic transmission and is used as two octet unit shared memory of the n:n type

3.2.6

link x

link input received bit data that are transmitted from each node through the cyclic transmission and is used as an input shared memory of the 1:n type

3.2.7

link y

link output bit data that are sent to each node through the cyclic transmission and is used as an output shared memory of the 1:n type

3.2.8

local station

node capable of performing n:n bit data and word data cyclic transmission and transient transmission with the master station and other local stations, and transient transmission with slave stations, excluding remote I/O stations and having server functions and client functions during transient transmission

3.2.9

management node

node in which parameters are set

3.2.10

master ID

ID that represents the node number of the master station

3.2.11

master station

node that has control information (parameters) and manages cyclic transmission

3.2.12**node**

element that forms a network and performs data transmission, reception, and transfer

3.2.13**node-to-node test**

physical layer test between two nodes

3.2.14**normal node**

node other than a management node

3.2.15**remote device station**

node capable of performing 1:n bit data and word data cyclic transmission and transient transmission with the master station, and transient transmission with slave stations, excluding remote I/O stations and having server functions during transient transmission

3.2.16**remote I/O station**

node capable of performing 1:n bit data cyclic transmission with the master station

3.2.17**reserve node**

node that is not yet connected, but counted in the total node number of the network not performing cyclic transmission, but always regarded as normal from applications

3.2.18**RX**

remote input as viewed from the master station with bit data that are periodically updated by cyclic transmission, slave to master, or in local station as viewed from the master station is RY of the local station

3.2.19**RY**

remote output as viewed from the master station with bit data that are periodically updated by cyclic transmission, master to slave, or in local station as viewed from the master station is RX of the local station

3.2.20**RWr**

remote register (input) as viewed from the master station with word data that are periodically updated by cyclic transmission, slave to master, or in local station as viewed from the master station is RWw of the local station

3.2.21**RWw**

remote register (output) as viewed from the master station with word data that are periodically updated by cyclic transmission, master to slave, or in local station as viewed from the master station is RWr of the local station

3.2.22**slave station**

node other than the master station

3.2.23**station**

node of a network

3.2.24

synchronization manager

single node in a master station role per network that manages synchronization, distributing synchronization timing to other nodes

3.2.25

transient transmission

transmission that is performed upon each request

3.2.26

transient transmission client function

function that issues a transient request

3.2.27

transient transmission server function

function that receives a transient request and issues a response

3.2.28

transmission control manager

single node in a master station role per network that performs token passing management

3.2.29

word

unit representing data, 16 bits in length

3.3 Symbols and abbreviated terms

AE	Application Entity
AL	Application Layer
AP	Application Process
APDU	Application Protocol Data Unit
APO	Application Process Object
AR	Application Relationship
AREP	Application Relationship Endpoint
ASE	Application Service Element
ASN.1	Abstract Syntax Notation 1
CRC	Cyclic Redundancy Check
DLL	Data-link Layer
DMPM	DLL Mapping Protocol Machine
FAL	Fieldbus Application Layer
FSPM	FAL Service Protocol Machine
LB	Link Bit
LSB	Least Significant Bit
LW	Link Word
LX	Link X
LY	Link Y
MSB	Most Significant Bit
OSI	Open Systems Interconnection
PDU	Protocol Data Unit

3.4 Conventions

3.4.1 General conventions

This document uses the descriptive conventions given in ISO/IEC 10731.

The service model, service primitives, and time-sequence diagrams used are entirely abstract descriptions; they do not represent a specification for implementation.

Service primitives, used to represent service user/service provider interactions (see ISO/IEC 10731), convey parameters that indicate information available in the user/provider interaction.

This document uses a tabular format to describe the component parameters of the service primitives. The parameters that apply to each group of service primitives are set out in tables throughout the remainder of this document. Each table consists of up to five columns, containing the name of the service parameter, and a column each for those primitives and parameter-transfer directions used by the service:

- the request primitive's input parameters;
- the indication primitive's output parameters;
- the response primitive's input parameters; and
- the confirm primitive's output parameters.

NOTE The request, indication, response and confirm primitives are also known as requestor.submit, acceptor.deliver, acceptor.submit, and requestor.deliver primitives, respectively (see ISO/IEC 10731).

One parameter (or part of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

- | | |
|---------|---|
| M | parameter is mandatory for the primitive. |
| U | parameter is a User option, and can be provided or not depending on the dynamic usage of the service-user. When not provided, a default value for the parameter is assumed. |
| C | parameter is conditional upon other parameters or upon the environment of the service-user. |
| (blank) | parameter is never present. |

Some entries are further qualified by items in brackets. These may be a parameter-specific constraint:

- | | |
|-----|---|
| (=) | indicates that the parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table. |
|-----|---|

In any particular interface, not all parameters need to be explicitly stated. Some may be implicitly associated with the primitive.

In the diagrams which illustrate these interfaces, dashed lines indicate cause-and-effect or time-sequence relationships, and wavy lines indicate that events are roughly contemporaneous.

3.4.2 Conventions for class definitions

Class definitions are defined using templates. Each template consists of a list of attributes and services for the class. The general form of the template is shown below:

FAL ASE:			ASE Name
CLASS:			Class Name
CLASS ID:			#
PARENT CLASS:			Parent Class Name
ATTRIBUTES:			
1	(o)	Key Attribute:	numeric identifier
2	(o)	Key Attribute:	name
3	(m)	Attribute:	attribute name (values)
4	(m)	Attribute:	attribute name (values)
4.1	(s)	Attribute:	attribute name (values)
4.2	(s)	Attribute:	attribute name (values)
4.3	(s)	Attribute:	attribute name (values)
5	(c)	Constraint:	constraint expression
5.1	(m)	Attribute:	attribute name (values)
5.2	(o)	Attribute:	attribute name (values)
6	(m)	Attribute:	attribute name (values)
6.1	(s)	Attribute:	attribute name (values)
6.2	(s)	Attribute:	attribute name (values)
SERVICES:			
1	(o)	OpsService:	service name
2	(c)	Constraint:	constraint expression
2.1	(o)	OpsService:	service name
3	(m)	MgtService:	service name

- a) The "FAL ASE:" entry is the name of the FAL ASE that provides the services for the class being specified.
- b) The "CLASS:" entry is the name of the class being specified. All objects defined using this template will be an instance of this class. The class may be specified by this document, or by a user of this document.
- c) The "CLASS ID:" entry is a number that identifies the class being specified. This number is unique within the FAL ASE that will provide the services for this class. When qualified by the identity of its FAL ASE, it unambiguously identifies the class within the scope of the FAL. The value "NULL" indicates that the class cannot be instantiated. Class IDs between 1 and 255 are reserved by this document to identify standardized classes. They have been assigned to maintain compatibility with existing national standards. CLASS IDs between 256 and 2048 are allocated for identifying user defined classes.
- d) The "PARENT CLASS:" entry is the name of the parent class for the class being specified. All attributes defined for the parent class and inherited by it are inherited for the class being defined, and therefore do not have to be redefined in the template for this class.

NOTE The parent-class "TOP" indicates that the class being defined is an initial class definition. The parent class TOP is used as a starting point from which all other classes are defined. The use of TOP is reserved for classes defined by this document.

- e) The "ATTRIBUTES" label indicate that the following entries are attributes defined for the class.
- 1) Each of the attribute entries contains a line number in column 1, a mandatory (m) / optional (o) / conditional (c) / selector (s) indicator in column 2, an attribute type label in column 3, a name or a conditional expression in column 4, and optionally a list of enumerated values in column 5. In the column following the list of values, the default value for the attribute may be specified.
 - 2) Objects are normally identified by a numeric identifier or by an object name, or by both. In the class templates, these key attributes are defined under the key attribute.
 - 3) The line number defines the sequence and the level of nesting of the line. Each nesting level is identified by period. Nesting is used to specify the following:
 - i) fields of a structured attribute (4.1, 4.2, 4.3),
 - ii) attributes conditional on a constraint statement (5). Attributes may be mandatory (5.1) or optional (5.2) if the constraint is true. Not all optional attributes require constraint statements as does the attribute defined in (5.2),
 - iii) the selection fields of a choice type attribute.
- f) The "SERVICES" label indicates that the following entries are services defined for the class.
- 1) An (m) in column 2 indicates that the service is mandatory for the class, while an (o) indicates that it is optional. A (c) in this column indicates that the service is conditional. When all services defined for a class are defined as optional, at least one shall be selected when an instance of the class is defined.
 - 2) The label "OpsService" designates an operational service (1).
 - 3) The label "MgtService" designates a management service (2).
 - 4) The line number defines the sequence and the level of nesting of the line. Each nesting level is identified by a period. Nesting within the list of services is used to specify services conditional on a constraint statement.

3.4.3 Conventions for service definitions

3.4.3.1 General

The service model, service primitives, and time-sequence diagrams used are entirely abstract descriptions; they do not represent a specification for implementation.

3.4.3.2 Service parameters

Service primitives are used to represent service user/service provider interactions (ISO/IEC 10731). They convey parameters which indicate information available in the user/provider interaction. In any particular interface, not all parameters need to be explicitly stated.

The service specifications of this document use a tabular format to describe the component parameters of the ASE service primitives. The parameters which apply to each group of service primitives are set out in tables. Each table consists of up to five columns for the

- a) parameter name,
- b) request primitive (transmitted from the sender),
- c) indication primitive (transmitted to the receiver),
- d) response primitive (transmitted from the receiver), and
- e) confirm primitive (transmitted to the sender).

One parameter (or component of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive specified in the column:

- M parameter is mandatory for the primitive.
- U parameter is a User option, and can be provided or not depending on dynamic usage of the service user. When not provided, a default value for the parameter is assumed.
- C parameter is conditional upon other parameters or upon the environment of the service user.
- (blank) parameter is never present.
- S parameter is a selected item.

Some entries are further qualified by items in brackets. These may be

- 1) a parameter-specific constraint:
 - "(=)" indicates that the parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.
- 2) an indication that some note applies to the entry:
 - "(n)" indicates that the following note "n" contains additional information pertaining to the parameter and its use.

3.4.3.3 Service procedures

The procedures are defined in terms of:

- the interactions between application entities through the exchange of fieldbus Application Protocol Data Units, and
- the interactions between an application layer service provider and an application layer service user in the same system through the invocation of application layer service primitives.

These procedures are applicable to instances of communication between systems which support time-constrained communications services within the fieldbus application layer.

4 Concept

The basic concept of application layer services follows IEC 61158-1, Clause 9.

The FAL defined herein has two primary deployment models. A peer-level connection based controller network is identified throughout this FAL as type C. A master/slave oriented field network is identified throughout this FAL as type F. Both support a distributed memory model as well as client/server models.

5 Data type ASE

5.1 Overview

The overview of the data type ASE follows of IEC 61158-1, Clause 10. The template is used to define the data type for the FAL.

5.2 Fixed length types

5.2.1 Bitstring types

5.2.1.1 BitString8

FAL ASE:

CLASS:

CLASS ID:

PARENT CLASS:

ATTRIBUTES:

1	Data type numeric identifier
2	Data type name
3	Format
4.1	Octet length

Data type ASE

Data type

5

Top

=	22
=	Bitstring8
=	Fixed length
=	1

5.2.1.2 BitString16

FAL ASE:

CLASS:

CLASS ID:

PARENT CLASS:

ATTRIBUTES:

1	Data type numeric identifier
2	Data type name
3	Format
4.1	Octet length

Data type ASE

Data type

5

Top

=	23
=	Bitstring16
=	Fixed length
=	2

5.2.1.3 BitString32

FAL ASE:

CLASS:

CLASS ID:

PARENT CLASS:

ATTRIBUTES:

1	Data type numeric identifier
2	Data type name
3	Format
4.1	Octet length

Data type ASE

Data type

5

Top

=	24
=	Bitstring32
=	Fixed length
=	4

5.2.2 Numeric types

5.2.2.1 Integer types

5.2.2.1.1 Integer8

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 2
2 Data type name	= Integer8
3 Format	= Fixed length
4.1 Octet length	= 1

This integer type is a two's complement binary number with a length of one octet.

5.2.2.1.2 Integer16

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 3
2 Data type name	= Integer16
3 Format	= Fixed length
4.1 Octet length	= 2

This integer type is a two's complement binary number with a length of two octets.

5.2.2.1.3 Integer32

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 4
2 Data type name	= Integer32
3 Format	= Fixed length
4.1 Octet length	= 4

This integer type is a two's complement binary number with a length of four octets.

5.2.2.2 Unsigned types

5.2.2.2.1 Unsigned8

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 5
2 Data type name	= Unsigned8
3 Format	= Fixed length
4.1 Octet length	= 1

This type is a binary number with a length of one octet. No sign bit is included. The most significant bit of the most significant octet is always used as the most significant bit of the binary number.

5.2.2.2.2 Unsigned16

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 6
2 Data type name	= Unsigned16
3 Format	= Fixed length
4.1 Octet length	= 2

This type is a binary number with a length of two octets. No sign bit is included. The most significant bit of the most significant octet is always used as the most significant bit of the binary number.

5.2.2.2.3 Unsigned32

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 7
2 Data type name	= Unsigned32
3 Format	= Fixed length
4.1 Octet length	= 4

This type is a binary number with a length of four octets. No sign bit is included. The most significant bit of the most significant octet is always used as the most significant bit of the binary number.

5.2.2.3 OctetString character types

5.2.2.3.1 OctetString1

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 30
2 Data type name	= OctetString1
3 Format	= Fixed length
4.1 Octet length	= 1

This type is an OctetString with a length of one octet.

5.2.2.3.2 OctetString2

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 31
2 Data type name	= OctetString2
3 Format	= Fixed length
4.1 Octet length	= 2

This type is an OctetString with a length of two octets.

5.2.2.3.3 OctetString4

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 32
2 Data type name	= OctetString4
3 Format	= Fixed length
4.1 Octet length	= 4

This type is an OctetString with a length of four octets.

5.2.2.3.4 OctetString8

FAL ASE:		Data type ASE
CLASS:		Data type
CLASS ID:		5
PARENT CLASS:		Top
ATTRIBUTES:		
1	Data type numeric identifier	= 33
2	Data type name	= OctetString8
3	Format	= Fixed length
4.1	Octet length	= 8

This type is an OctetString with a length of eight octets.

5.2.2.3.5 OctetString16

FAL ASE:		Data type ASE
CLASS:		Data type
CLASS ID:		5
PARENT CLASS:		Top
ATTRIBUTES:		
1	Data type numeric identifier	= 34
2	Data type name	= OctetString16
3	Format	= Fixed length
4.1	Octet length	= 16

This type is an OctetString with a length of 16 octets.

5.2.2.3.6 MACAddress

FAL ASE:		Data type ASE
CLASS:		Data type
CLASS ID:		5
PARENT CLASS:		Top
ATTRIBUTES:		
1	Data type numeric identifier	= -
2	Data type name	= MACAddress
3	Format	= Fixed length
4.1	Octet length	= 6

This type is an OctetString with a length of 6 octets and represents a MAC address.

5.2.2.4 Character String Type

5.2.2.4.1 OctetString

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 10
2 Data type name	= OctetString
3 Format	= string
4.1 Octet length	= 1 to n

This type is with a length of one to n octets. Octet 1 is referred to as the first octet.

5.2.2.4.2 VisibleString

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 9
2 Data type name	= VisibleString
3 Format	= string
4.1 Octet length	= 1 to n

This type is defined as the ISO/IEC 646 string type.

6 Communication model specification

6.1 Communication model

6.1.1 General

Two types of communication models are used in FAL Type 23: The cyclic model and the transient model.

6.1.2 Cyclic model n:n

The n:n type distributed shared memory cyclic model is shown in Figure 1 and uses an unconfirmed push model performed periodically.

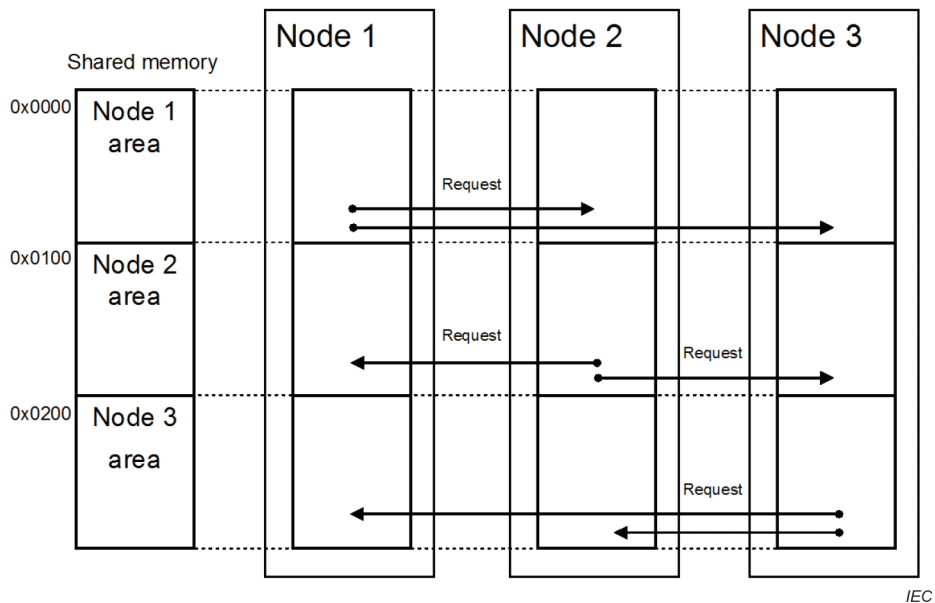


Figure 1 – Cyclic model (n:n type distributed shared memory, unconfirmed push model)

6.1.3 Cyclic model 1:n

The 1:n type distributed shared memory cyclic model is shown in Figure 2 and uses an unconfirmed push model performed periodically.

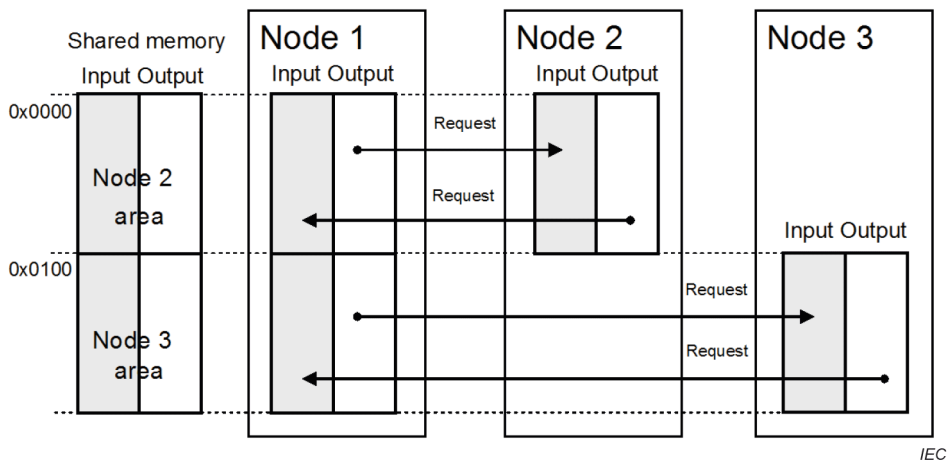


Figure 2 – Cyclic model (1:n type distributed shared memory, unconfirmed push model)

6.1.4 Transient model

The transient model is the client server model shown in Figure 3 and the push model shown in Figure 4.

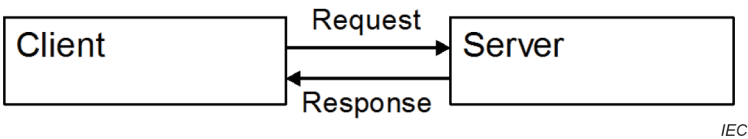


Figure 3 – Transient model (Client server model)

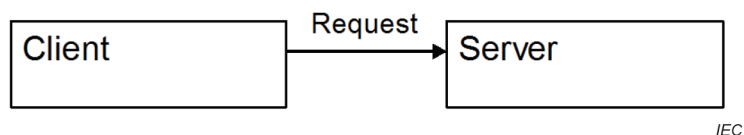


Figure 4 – Transient model (Push model)

6.2 ASE

6.2.1 Overview type C

The structure of the ASE type C for FAL Type 23 is shown in Figure 5.

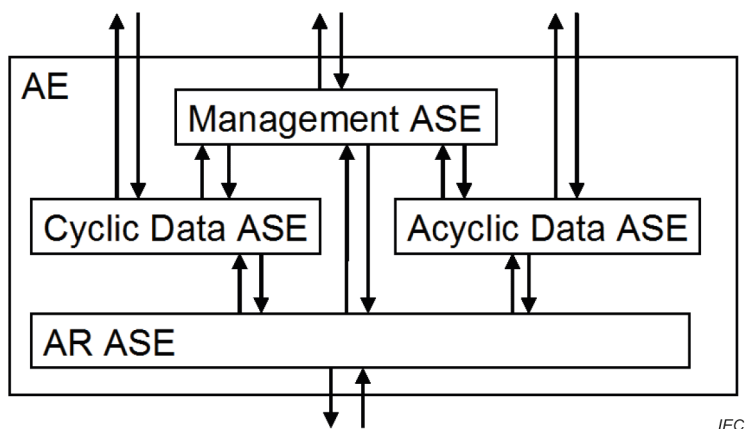


Figure 5 – Structure of ASE type C of FAL Type 23

6.2.2 Overview type F

The structure of the ASE type F for FAL Type 23 is shown in Figure 6.

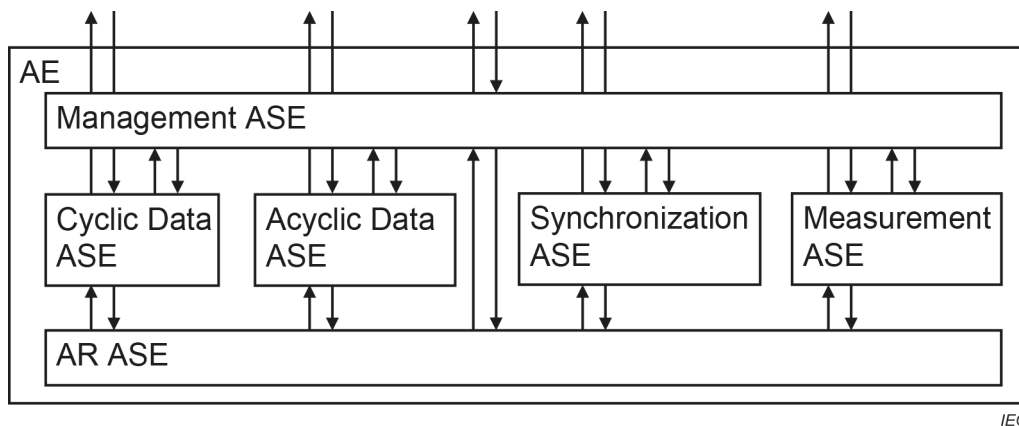


Figure 6 – Structure of ASE type F of FAL Type 23

6.2.3 Cyclic data ASE type C

6.2.3.1 Overview

The cyclic data ASE represents a distributed shared memory model which is realized using the cyclic data transmissions. The cyclic transmission is performed to read and write data periodically.

6.2.3.2 Common memory class specification

6.2.3.2.1 Overview

Common memory class is the parent class which realizes distributed shared memories.

6.2.3.2.2 Format model

FAL ASE: Cyclic data ASE type C

CLASS: Common memory C

CLASS ID: not used

PARENT CLASS: TOP

ATTRIBUTES:

- | | | | |
|---|-----|----------------|------------------|
| 1 | (m) | Key Attribute: | Node number |
| 2 | (m) | Key Attribute: | Common memory ID |

6.2.3.2.3 Attributes

Node number

Represents the node number of the node.

Common memory ID

Represents the identification of the shared memory.

6.2.3.3 LB Common memory class specification

6.2.3.3.1 Overview

LB Common memory class realizes the LB.

6.2.3.3.2 Format model

FAL ASE: Cyclic data ASE type C

CLASS: LB Common memory

CLASS ID: not used

PARENT CLASS: Common memory C

ATTRIBUTES:

- | | | | |
|---|-----|------------|-------------------------------|
| 1 | (m) | Attribute: | LB Common Memory Head Address |
| 2 | (m) | Attribute: | LB Common Memory Size |

SERVICES:

- | | | | |
|---|-----|-------------|-------|
| 1 | (m) | OpsService: | Ld |
| 2 | (m) | OpsService: | Set |
| 3 | (m) | OpsService: | Reset |
| 4 | (m) | OpsService: | Read |
| 5 | (m) | OpsService: | Write |

6.2.3.3.3 Attributes

LB Common memory head address

Represents the starting address of the LB.

LB Common memory size

Represents all the memory sizes (per bit) of the LB.

6.2.3.3.4 Service specification

6.2.3.3.4.1 Ld

This service is used to read a specified bit. Table 1 shows the parameters for this service.

Table 1 – Ld service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Result				M
Data				M

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

Result

This conveys the service specific parameters of the service response.

Data

Contains the value of the specified target memory.

6.2.3.3.4.2 Set

This service is used to set a specified bit to the value 1 (on). Table 2 shows the parameters for this service.

Table 2 – Set service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

6.2.3.3.4.3 Reset

This service is used to set a specified bit to the value 0 (off). Table 3 shows the parameters for this service.

Table 3 – Reset service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

6.2.3.3.4.4 Read

This service is used to read specified multiple bits. Table 4 shows the parameters for this service.

Table 4 – Read service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Size	M			
Result				M
Data				M

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the starting address of the target memory.

Size

Specifies the size (per bit) of the target memory.

Result

This conveys the service specific parameters of the service response.

Data

Contains the value of the specified target memory.

6.2.3.3.4.5 Write

This service is used to write data into specified multiple bits. Table 5 shows the parameters for this service.

Table 5 – Write service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Size	M			
Data	M			

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the starting address of the target memory.

Size

Specifies the size (per bit) of the target memory.

Data

Specifies the data to be written into the specified target memory.

6.2.3.4 LW Common memory class specification

6.2.3.4.1 Overview

Link work (LW) Common memory class realizes the LW.

6.2.3.4.2 Format model

FAL ASE:		Cyclic data ASE type C
CLASS:		LW Common memory
CLASS ID:		not used
PARENT CLASS:		Common memory C
ATTRIBUTES:		
1	(m)	Attribute: LW Common Memory Head Address
2	(m)	Attribute: LW Common Memory Size
SERVICES:		
1	(m)	OpsService: Ld
2	(m)	OpsService: Set
3	(m)	OpsService: Reset
4	(m)	OpsService: Read
5	(m)	OpsService: Write

6.2.3.4.3 Attributes

LW Common memory head address

Represents the starting address of the LW.

LW Common memory Size

Represents all the memory sizes (per two octets) of the LW.

6.2.3.4.4 Service specification

6.2.3.4.4.1 Ld

This service is used to read a specified bit. Table 6 shows the parameters for this service.

Table 6 – Ld service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Bit Location	M			
Result				M
Data				M

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

Bit location

Specifies the target memory bit at a location in Address. A value of 0 specifies the LSB, a value of F specifies the MSB.

Result

This conveys the service specific parameters of the service response.

Data

Contains the value of the specified target memory.

6.2.3.4.4.2 Set

This service is used to set a specified bit to the value 1 (on). Table 7 shows the parameters for this service.

Table 7 – Set service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Bit Location	M			

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

Bit location

Specifies the target memory bit at a location in Address. A value of 0 specifies the LSB, a value of F specifies the MSB.

6.2.3.4.4.3 Reset

This service is used to set a specified bit to the value 0 (off). Table 8 shows the parameters for this service.

Table 8 – Reset service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Bit Location	M			

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

Bit location

Specifies the target memory bit at a location in Address. A value of 0 specifies the LSB, a value of F specifies the MSB.

6.2.3.4.4.4 Read

This service is used to read data from a specified address. Table 9 shows the parameters for this service.

Table 9 – Read service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Size	M			
Result				M
Data				M

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

Size

Specifies the size (per two octets) of the target memory.

Result

This conveys the service specific parameters of the service response.

Data

Contains the value of the specified target memory.

6.2.3.4.4.5 Write

This service is used to write data into a specified address. Table 10 shows the parameters for this service.

Table 10 – Write service parameters

Parameter name	Req	Ind	Rsp	Cnf
Argument	M			
Address	M			
Size	M			
Data	M			

Argument

The argument conveys the service specific parameters of the service request.

Address

Specifies the address of the target memory.

Size

Specifies the size (per two octets) of the target memory.

Data

Specifies the value to be written into the target memory.

6.2.3.5 LX/LY Common memory class specification

6.2.3.5.1 Overview

Link X (LX) and link Y (LY) Common memory class realizes the LX/LY.

6.2.3.5.2 Format model

FAL ASE:	Cyclic data ASE type C
CLASS:	LX/LY Common memory
CLASS ID:	not used
PARENT CLASS:	Common memory C
ATTRIBUTES:	
1 (m) Attribute:	LX Common Memory Head Address
2 (m) Attribute:	LX Common Memory Size
3 (m) Attribute:	LY Common Memory Head Address
4 (m) Attribute:	LY Common Memory Size
SERVICES:	
1 (m) OpsService:	Ld
2 (m) OpsService:	Set
3 (m) OpsService:	Reset
4 (m) OpsService:	Read
5 (m) OpsService:	Write

6.2.3.5.3 Attributes

LX Common memory head address

Represents the starting address of the LX.

LX Common memory size

Represents the size (per two octets) of the LX.

LY Common memory head address

Represents the starting address of the LY.

LY Common memory size

Represents the size (per two octets) of the LY.

6.2.3.5.4 Service specification

Refer to 6.2.3.3.4.

6.2.4 Cyclic data ASE type F

6.2.4.1 Overview

The cyclic data ASE represents a distributed shared memory model which is realized using the cyclic data transmissions. The cyclic transmission is performed to read and write data periodically.

6.2.4.2 Common memory class specification

6.2.4.2.1 Overview

Common memory class is the parent class which realizes distributed shared memories.