IEC 61158-6-24

Edition 1.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications – Part 6-24: Application layer protocol specification – Type-24 Elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 6-24: Spécification du protocole de la couche application – Éléments de type 24

IEC 61158-6-24:2014-08(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX XF

ICS 25.040.40; 35.100.70; 35.110

ISBN 978-2-8322-1769-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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

International Standard IEC 61158-6-24 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/764/FDIS	65C/774/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

INTRODUCTION

This part of IEC 61158 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 protocol provides the application service by making use of the services available from the data-link or other immediately lower layer. The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer application entities (AEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

- as a guide for implementers and designers;
- for use in the testing and procurement of equipment;
- as part of an agreement for the admittance of systems into the open systems environment;
- as a refinement to the understanding of time-critical communications within OSI.

This standard is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this standard together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-24: Application layer protocol specification – Type-24 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 standard 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 24 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 standard defines in an abstract way the externally visible behavior provided by the Type 24 fieldbus application layer in terms of

a) the abstract syntax defining the application layer protocol data units conveyed between communicating application entities,
b) the transfer syntax defining the application layer protocol data units conveyed between communicating application entities,
c) the application context state machines defining the application service behavior visibly between communicating application entities, and
d) the application relationship state machines defining the communication behavior visibly between communicating application entities.

The purpose of this standard is to define the protocol provided to

a) define the representation-on-wire of the service primitives defined in IEC 61158-5-24, and
b) define the externally visible behavior associated with their transfer.

This standard specifies the protocol of the Type 24 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI Application Layer Structure (ISO/IEC 9545).

1.2 Specifications

The principal objective of this standard is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-24.

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 protocols standardized in IEC 61158-6.

1.3 Conformance

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

Conformance is achieved through implementation of this application layer protocol specification.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 IEC 61784-1 and IEC 61784-2 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 61158-5-24:2014, *Industrial communication networks – Fieldbus specifications – Part 5-24: Application layer service definition – Type 24 elements*

IEC 61158-6 (all parts), *Industrial communication networks – Fieldbus specifications – Part 6: 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 – Part 1: The Basic Model*

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

ISO/IEC 9899, *Information technology – Programming languages – C*

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

ISO/IEC 19501:2005, *Information technology – Open Distributed Processing – Unified Modeling Language (UML) Version 1.4.2*

ISO/IEC/IEEE 60559:2011, *Information technology – Microprocessor Systems – Floating-Point arithmetic*

3 Terms, definitions, abbreviations, symbols and conventions

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

3.1 Referenced terms and definitions

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

3.1.1 Terms and definitions from ISO/IEC 7498-1

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

a) abstract syntax;
b) application-entity;
c) application process;
d) application protocol data unit;
e) application-process-invocation;
f) (N)-facility;
g) (N)-function;
h) peer-(N)-entities;
i) presentation context;
j) real system;
k) transfer syntax.

3.1.2 Terms and definitions from ISO/IEC 9545

For the purposes of this document, the following terms as defined in ISO/IEC 9545 apply:

a) application-association;
b) application-context;
c) application-entity-invocation;
d) application-entity-type;
e) application-service-element.

3.1.3 Terms and definitions from ISO/IEC 8824-1

For the purposes of this document, the following terms as defined in ISO/IEC 8824-1 apply:

a) simple type;
b) component;
c) component type;
d) integer type;
e) bitstring type;
f) octetstring type;
g) null type;
h) sequence type;
i) sequence of type;
j) choice type;
k) IA5String type;
l) encoding.

3.1.4 Terms and definitions from ISO/IEC 10731

For the purposes of this document, the following terms as defined in ISO/IEC 10731 apply:

a) OSI-service-primitive; primitive;
b) OSI-service-provider; provider;
c) OSI-service-user; user.

3.1.5 Terms and definitions from ISO/IEC 19501

For the purposes of this document, the following terms as defined in ISO/IEC 19501 apply:

a) event;

b) state;

c) state machine;

d) substate;

e) submachine;

f) transition.

3.2 Additional terms and definitions

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

3.2.1
alarm
field device status to tell that the device has detected a fatal problem to be solved and cannot continue normal working, through the field device control (FDC) service of the Type 24 fieldbus

Note 1 to entry: Any alarm statuses are latched and need some operations to be cleared.

Note 2 to entry: Alarms are classified into three groups: communication alarms, illegal-command-related ones, and application specific ones. But concrete definitions are dependent on implementation of each field devices.

3.2.2
application process object
network representation of a specific aspect of an application process (AP), which is modelled as a network accessible object contained within an AP or within another APO

Note 1 to entry: Refer IEC 61158-1, 9.3.4.

3.2.3
application process context
AP context
shared knowledge or a common set of rules, governing communication of FAL application entities (AEs) and describing the permissible collective communications behavior between the AEs that are party to a specific set of application relationships (ARs)

Note 1 to entry: Data within AP context can be specified by the user in advance, by the option selected while the user uses a field bus management (FSM) service to read out the facility of peer AP, by the automatic negotiation function that the FSM system handles, and so on. The method that is to be adopted depends on the specification of each implementation.

3.2.4
application process type
AP type
description of a classification of application processes (APs) in terms of a set of capabilities for FAL of the Type 24 fieldbus

Note 1 to entry: AP types are classified into three, C1 master AP, C2 master AP and slave AP, by their application roles in the fieldbus network.

3.2.5
async command
type of a command application protocol data unit (APDU) of the FDC service of the Type 24 FAL, which can be issued any time after the previous transaction without consideration of synchronization with the communication cycle

Note 1 to entry: Definitions, which command should be async one or not, are dependent on an application. They may be provided as a registered set of commands and responses or a device profiles. See 4.4 and Annex A.

3.2.6
asynchronous communication
state or a way of communication for the FDC service of the Type 24 FAL, in which a command can be issued any time after the previous transaction without consideration of synchronization with the communication cycle

Note 1 to entry: In this state, sync commands cannot be issued, but async commands can.

3.2.7
attribute
information or parameter contained in variable portions of an object

Note 1 to entry: Typically, they provide status information or govern the operation of an object. Attributes may also affect the behavior of an object.

3.2.8
C1 master
AP type that has master facilities for the FDC service of the Type 24 FAL, or the device implementing that AP type

Note 1 to entry: Only one C1 master exists in a network of the Type 24 fieldbus

3.2.9
C2 master
AP type that has only monitor facilities for the FDC service but requester facilities for message (MSG) service of the Type 24 FAL, or the device implementing that AP type

Note 1 to entry: Less than two C2 masters can exist in a network of the Type 24 fieldbus

3.2.10
command
PDU issued by a requester or a master to make a responder or a slave execute some functions

3.2.11
communication
transfer
transmission
– communication: process to exchange information in a formal manner between two or more devices, users, APs or entities
– transfer: process to convey a PDU from a sender to a receiver
– transmission: process to send out and propagate electrical signals or encoded data

3.2.12
communication cycle
period of repetitive activities synchronized with the transmission cycle while the connection establishing for the FDC protocol of the Type 24 FAL

Note 1 to entry: Communication cycle may synchronize with the transmission cycle multiplied by a specified scaling factor.

3.2.13
connection
context or logical binding under specific conditions for the FDC protocol between a master object and a slave object for the Type 24 FAL

3.2.14
cyclic
repetitive in a regular manner

3.2.15
cyclic communication
transmission mode in which request PDUs and response PDUs are exchanged repetitively in the scheduled time slots synchronized with a transmission cycle for the lower layer protocol of the Type 24

Note 1 to entry: In the AL, the communication cycle arises from the transmission cycle in this mode.

3.2.16
cycle scale counter
counter to generate a communication cycle by means of scaling a primary cycle or a transmission cycle

3.2.17
device ID
part of “Device Information” to identify the device for a specific product type or model of the Type 24 fieldbus

3.2.18
device information
formatted and device-embedded information to characterize a device, which mainly consists of data for device model identification and device-profile specific parameters for the Type 24 fieldbus

3.2.19
device profile
collection of device-model-common information and functionality providing consistency between different device models among the same kind of devices

3.2.20
dual transfer
transfer mode for the FDC protocol of the Type 24 FAL, in which a sender sends a same PDU twice a transaction and a receiver uses them to detect and recover a communication error such as data-corruption or data-loss in cyclic communication mode

3.2.21
event driven communication
transmission mode for the lower layer protocol of the Type 24 fieldbus in which a transaction of command-response-exchanging arises as user’s demands

Note 1 to entry: Both the transmission cycle and the communication cycle don’t arise in this mode.

3.2.22
error
abnormal condition or malfunction for communication or any other activities

3.2.23
field device control
FDC service
time-critical communication service that handles a fixed length command data to control a field device and the corresponding feedback response data in a severe restriction on delay or jitter for the communication timing for the Type 24 FAL