

# 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



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IEC 61158-6-24

Edition 1.0 2014-08

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(standards.iteh.ai)

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56f5c8812808/iec-61158-6-24-2014

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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## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
1.1 General.....	8
1.2 Specifications.....	8
1.3 Conformance.....	9
2 Normative references.....	9
3 Terms, definitions, abbreviations, symbols and conventions.....	9
3.1 Referenced terms and definitions.....	9
3.2 Additional terms and definitions.....	11
3.3 Abbreviations and symbols.....	16
3.4 Conventions.....	17
4 Abstract syntax.....	19
4.1 Basic Data types.....	19
4.2 FAL PDU types.....	21
4.3 Detailed definitions of _FDCService-PDUs.....	33
4.4 Device profile.....	52
5 Transfer syntax.....	52
5.1 Concepts.....	52
5.2 Encode rules.....	53
6 Structure of FAL protocol state machine.....	58
7 AP-context state machine (APCISM).....	61
7.1 Overview.....	61
7.2 State descriptions.....	62
7.3 Triggering events.....	63
7.4 Action descriptions at state transitions.....	63
8 FAL service protocol machines (FSPM).....	64
8.1 Overview.....	64
8.2 Field Deice Control Protocol Machine (FDC PM).....	64
8.3 Message Protocol Machine (MSGPM).....	89
9 Application relationship protocol machine (ARPM).....	95
9.1 General.....	95
9.2 ARPM for FDC ASE.....	95
9.3 ARPM for MSG ASE (ARPM-MSG).....	109
10 DLL mapping protocol machine (DMPM).....	111
Annex A (informative) Device profile and FDC command sets.....	112
Annex B (normative) Virtual memory space and Device Information.....	113
B.1 Overview.....	113
B.2 Device Information.....	114
B.2.1 Device identifier area structure.....	114
B.2.2 Detail specifications of device IDs.....	114
Annex C (informative) Basic message function.....	120
Bibliography.....	121

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Figure 1 – Tree structure of APDU types.....	22
Figure 2 – Encode of Integer subtypes.....	53
Figure 3 – Example of transfer of INTEGER value .....	54
Figure 4 – Encode of Unsigned subtypes .....	54
Figure 5 – Float32 type encode.....	55
Figure 6 – Float64 type encode.....	55
Figure 7 – Bit field definition example with named bits .....	56
Figure 8 – Bit field definition example with field size .....	57
Figure 9 – SEQUENCE type encode .....	58
Figure 10 – Structure of FAL protocol state machines .....	60
Figure 11 – Statechart diagram of APCSM.....	62
Figure 12 – Example communication cycle of FDC master AP.....	66
Figure 13 – Example communication cycle of FDC slave AP .....	67
Figure 14 – Synchronous command communication in sync state .....	68
Figure 15 – Asynchronous command communication in sync state.....	69
Figure 16 – Asynchronous command communication in async state.....	70
Figure 17 – Event-driven communication .....	71
Figure 18 – Statechart diagram of FDCPM-M.....	72
Figure 19 – Statechart diagram of FDCPM-S.....	78
Figure 20 – Statechart diagram of FDCPM-MN.....	85
Figure 21 – PDU transmission flow for user message .....	89
Figure 22 – PDU transmission flow for one-way message .....	90
Figure 23 – Statechart diagram of MSGPM-RQ.....	91
Figure 24 – Statechart diagram of MSGPM-RS .....	93
Figure 25 – Example of single transfer process.....	95
Figure 26 – Example of dual transfer process .....	96
Figure 27 – Statechart diagram of ARPM-FDCM .....	97
Figure 28 – Statechart diagram of ARPM-FDCS.....	102
Figure 29 – Statechart diagram of ARPM-FDCMN.....	107
Figure 30 – Statechart diagram of ARPM-MSG .....	110
Figure B.1 – Memory map of virtual memory space.....	113
Figure B.2 – Memory map of device ID area .....	114
Table 1 – State transition descriptions .....	18
Table 2 – Description of state machine elements .....	18
Table 3 – Conventions used in state machines .....	19
Table 4 – Mapping for Protocol State Machines .....	60
Table 5 – State descriptions of APC SM .....	62
Table 6 – Trigger event descriptions of APC SM .....	63
Table 7 – Transitions of APC SM .....	63
Table 8 – FDC protocol mode .....	65
Table 9 – State descriptions of FDCPM-M .....	72
Table 10 – Trigger event descriptions of FDCPM-M .....	73

Table 11 – Transitions of main SM of FDCPM-M.....	74
Table 12 – Transitions of submachine of FDCPM-M.....	75
Table 13 – State descriptions of FDCPM-S .....	78
Table 14 – Trigger event descriptions of FDCPM-S.....	79
Table 15 – Transitions of main SM of FDCPM-S .....	80
Table 16 – Transitions of submachine of FDCPM-S .....	82
Table 17 – State descriptions of FDCPM-MN .....	85
Table 18 – Trigger event descriptions of FDCPM-MN.....	86
Table 19 – Transitions of main SM of FDCPM-MN .....	86
Table 20 – Transitions of submachine of FDCPM-MN .....	86
Table 21 – State descriptions of MSGPM-RQ.....	91
Table 22 – Trigger event descriptions of MSGPM-RQ .....	92
Table 23 – Transitions of MSGPM-RQ .....	92
Table 24 – State descriptions of MSGPM-RS .....	93
Table 25 – Trigger event descriptions of MSGPM-RS.....	94
Table 26 – Transitions of MSGPM-RS.....	94
Table 27 – State descriptions of ARPM-FDCM.....	97
Table 28 – Trigger event descriptions of ARPM-FDCM.....	99
Table 29 – Transitions of main SM of ARPM-FDCM.....	100
Table 30 – Transitions of submachine of ARPM-FDCM.....	100
Table 31 – State descriptions of ARPM-FDCS .....	102
Table 32 – Trigger event descriptions of ARPM-FDCS.....	104
Table 33 – Transitions of main SM of ARPM-FDCS.....	105
Table 34 – Transitions of submachine of ARPM-FDCS.....	106
Table 35 – State descriptions of ARPM-FDCMN .....	108
Table 36 – Trigger event descriptions of ARPM-FDCMN .....	108
Table 37 – Transitions of main SM of ARPM-FDCMN.....	108
Table 38 – Transitions of submachine of ARPM-FDCMN.....	109
Table 39 – State descriptions of ARPM-MSG .....	110
Table 40 – Trigger event descriptions of ARPM-MSG.....	110
Table 41 – Transitions of ARPM-MSG.....	111
Table A.1 – Example of registered device profiles.....	112
Table A.2 – Example command list of the profile '00'H.....	112
Table B.1 – Specifications of device IDs .....	115
Table C.1 – Example of message command set.....	120

IEC 61158-6-24:2014  
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**INDUSTRIAL COMMUNICATION NETWORKS –  
FIELD BUS SPECIFICATIONS –****Part 6-24: Application layer protocol specification –  
Type-24 Elements**

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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.

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## 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.

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## 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.

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### 3.1.3 Terms and definitions from ISO/IEC 8824-1

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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