

Industrial communication networks - Fieldbus
specifications - Part 6-3: Application layer protocol
specification - Type 3 elements

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 61158-6-3:2019 sisaldab Euroopa standardi EN IEC 61158-6-3:2019 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 61158-6-3:2019 consists of the English text of the European standard EN IEC 61158-6-3:2019.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 23.08.2019.	Date of Availability of the European standard is 23.08.2019.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 25.040.40, 35.100.20, 35.110

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

**Industrial communication networks - Fieldbus specifications -
Part 6-3: Application layer protocol specification - Type 3
elements
(IEC 61158-6-3:2019)**

Réseaux de communication industriels - Spécifications des
bus de terrain - Partie 6-3: Spécification du protocole de la
couche application - Éléments de type 3
(IEC 61158-6-3:2019)

Industrielle Kommunikationsnetze - Feldbusse - Teil 6-3:
Protokollspezifikation des Application Layer
(Anwendungsschicht) - Typ 3-Elemente
(IEC 61158-6-3:2019)

This European Standard was approved by CENELEC on 2019-07-25. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 65C/948/FDIS, future edition 4 of IEC 61158-6-3, prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61158-6-3:2019.

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) 2020-04-25
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-07-25

This document supersedes EN 61158-6-3:2014 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61158-6-3:2019 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 standards indicated:

IEC 61158-1:2019	NOTE Harmonized as EN IEC 61158-1:2019 (not modified)
IEC 61784-1	NOTE Harmonized as EN IEC 61784-1
IEC 61784-2	NOTE Harmonized as EN IEC 61784-2

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.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61158-3-3	2014	Industrial communication networks Fieldbus specifications - Part 3-3: Data-link layer service definition - Type 3 elements	-EN 61158-3-3	2014
IEC 61158-4-3	2019	Industrial communication networks Fieldbus specifications - Part 4-3: Data-link layer protocol specification - Type 3 elements	-EN IEC 61158-4-3	2019
IEC 61158-5-3	2014	Industrial communication networks Fieldbus specifications - Part 5-3: Application layer service definition - Type 3 elements	-EN 61158-5-3	2014
IEC 61158-5-10	2019	Industrial communication networks Fieldbus specifications - Part 5-10: Application layer service definition - Type 10 elements	-EN IEC 61158-5-10	2019
IEC 61158-6-10	2019	Industrial communication networks -- Fieldbus specifications - Part 6-10: Application layer protocol specification - Type 10 elements	--	-
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): 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 754	-	IEEE Standard for Binary Floating-Point- Arithmetic		-

CONTENTS

FOREWORD.....	14
INTRODUCTION.....	16
1 Scope.....	17
1.1 General.....	17
1.2 Specifications	18
1.3 Conformance	18
2 Normative references	18
3 Terms, definitions, abbreviations, symbols and conventions	19
3.1 Referenced terms and definitions.....	19
3.1.1 ISO/IEC 7498-1 terms.....	19
3.1.2 ISO/IEC 8822 terms.....	19
3.1.3 ISO/IEC 9545 terms.....	19
3.1.4 ISO/IEC 8824-1 terms.....	20
3.1.5 Fieldbus Data Link Layer terms	20
3.2 Additional definitions.....	20
3.3 Abbreviations and symbols	23
3.4 Conventions.....	25
3.4.1 General concept	25
3.4.2 Abstract syntax conventions	25
3.4.3 Convention for the encoding of reserved bits and octets	26
3.4.4 Conventions for the common coding s of specific field octets	26
3.5 Conventions used in state machines	27
3.5.1 State machine conventions	27
4 FAL syntax description	29
4.1 APDU abstract syntax	29
4.2 Data types	34
4.2.1 Notation for the Boolean type	34
4.2.2 Notation for the Integer type	34
4.2.3 Notation for the Unsigned type	34
4.2.4 Notation for the Floating Point type.....	35
4.2.5 Notation for the OctetString type.....	35
4.2.6 Notation for VisibleString type	35
4.2.7 Notation for BinaryDate type.....	35
4.2.8 Notation for TimeOfDay type.....	35
4.2.9 Notation for TimeDifference type	35
4.2.10 Notation for Network Time type.....	35
4.2.11 Notation for Network Time Difference type.....	35
5 Transfer syntax.....	35
5.1 Coding of basic data types.....	35
5.1.1 Encoding of a Boolean value	35
5.1.2 Encoding of an Integer value	36
5.1.3 Encoding of an Unsigned value.....	36
5.1.4 Encoding of a Floating-Point value	36
5.1.5 Encoding of a Visible String value.....	36
5.1.6 Encoding of an Octet String value.....	36
5.1.7 Encoding of a BinaryDate value	36

5.1.8	Encoding of a TimeOfDay with and without date indication value	36
5.1.9	Encoding of a Time Difference with and without date indication value	37
5.1.10	Encoding of a Network Time value	37
5.1.11	Encoding of a Network Time Difference value	37
5.1.12	Encoding of a Null value	37
5.2	Coding section related to data exchange PDUs	37
5.2.1	General	37
5.2.2	Coding of the field Outp_Data	37
5.2.3	Coding of the field Inp_Data	37
5.3	Coding section related to slave diagnosis PDUs	37
5.3.1	Coding of the field Station_status_1	37
5.3.2	Coding of the field Station_status_2	38
5.3.3	Coding of the field Station_status_3	39
5.3.4	Coding of the field Diag_Master_Add	39
5.3.5	Coding of the field Ident_Number	39
5.3.6	Coding of the field Header_Octet	39
5.3.7	Coding of the field Alarm_Type	40
5.3.8	Coding of the field Status_Type	41
5.3.9	Coding of the field Slot_Number	41
5.3.10	Coding of the field Alarm_Specifier	41
5.3.11	Coding of the field Status_Specifier	42
5.3.12	Coding of the field Diagnosis_User_Data	43
5.3.13	Coding of the field Modul_Status_Array	43
5.3.14	Coding of the field Identifier_Diagnosis_Data_Array	44
5.3.15	Coding of the field Identifier_Number	45
5.3.16	Coding of the field Channel_Number	45
5.3.17	Coding of the field Type_of_Diagnosis	46
5.3.18	Coding of the field Revision_Number	46
5.3.19	Coding of the field Publisher_Address	47
5.3.20	Coding of the field Publisher_Status	47
5.3.21	Coding of the field RedSpecifier	47
5.3.22	Coding of the field Function	47
5.3.23	Coding of the field Red_Status1	48
5.3.24	Coding of the field Red_Status2	48
5.3.25	Coding of the field Red_Status3	49
5.4	Coding section related to parameterization PDU	49
5.4.1	Coding of the field Station_status	49
5.4.2	Coding of the field WD_Fact_1	50
5.4.3	Coding of the field WD_Fact_2	50
5.4.4	Coding of the field min_TSDR	50
5.4.5	Coding of the field Group_Ident	50
5.4.6	Coding of the field User_Prm_Data_Element	51
5.4.7	Coding of the field DPV1_Status_1	51
5.4.8	Coding of the field DPV1_Status_2	52
5.4.9	Coding of the field DPV1_Status_3	52
5.4.10	Coding of the field Structure_Length	53
5.4.11	Coding of the field Structure_Type	53
5.4.12	Coding of the field Version	53
5.4.13	Coding of the field Publisher_Addr	54

5.4.14	Coding of the field Publisher_Length	54
5.4.15	Coding of the field Sample_Offset	54
5.4.16	Coding of the field Sample_Length	54
5.4.17	Coding of the field Dest_Slot_Number	54
5.4.18	Coding of the field Offset_Data_Area	54
5.4.19	Coding of the field T _{BASE_DP}	54
5.4.20	Coding of the field T _{DP}	55
5.4.21	Coding of the field T _{MAPC}	55
5.4.22	Coding of the field T _{BASE_IO}	55
5.4.23	Coding of the field T _I	55
5.4.24	Coding of the field T _O	55
5.4.25	Coding of the field T _{DX}	55
5.4.26	Coding of the field T _{PLL_W}	55
5.4.27	Coding of the field T _{PLL_D}	55
5.4.28	Coding of the field Specifier	55
5.4.29	Coding of the field Function	55
5.4.30	Coding of the field Properties	56
5.4.31	Coding of the field Output Hold Time	56
5.4.32	Coding of the field Clock Sync Interval	56
5.4.33	Coding of the field CS Delay Time	56
5.5	Coding section related to configuration PDUs	57
5.5.1	Coding of the field Cfg_Identifier	57
5.5.2	Coding of the field Special_Cfg_Identifier	57
5.5.3	Coding of the fields Length_Octet	58
5.5.4	Coding of the field Manufacturer_Specific_Data	58
5.5.5	Coding of the field Extended_Length_Octet	58
5.5.6	Coding of the field Data_Type	59
5.6	Coding section related to global control PDUs	59
5.6.1	Coding of the field Control_Command	59
5.6.2	Coding of the field Group_Select	60
5.7	Coding section related to clock-value-PDUs	61
5.7.1	Coding of the field Clock_value_time_event	61
5.7.2	Clock_value_previous_TE	61
5.7.3	Coding of the field Clock_value_status1	61
5.7.4	Coding of the field Clock_value_status2	61
5.8	Coding section related to function identification and errors	62
5.8.1	Coding of the field Function_Num	62
5.8.2	Coding of the field Error Decode	64
5.8.3	Coding of the field Error_Code_1	64
5.8.4	Coding of the field Error_Code_2	65
5.9	Coding section related to master diagnosis PDU	65
5.9.1	Coding of the field MDiag_Identifier	65
5.9.2	Coding of the field System_Diagnosis	66
5.9.3	Coding of the field USIF_State	66
5.9.4	Coding of the field Hardware_Release_DP	67
5.9.5	Coding of the field Firmware_Release_DP	67
5.9.6	Coding of the field Hardware_Release_User	67
5.9.7	Coding of the field Firmware_Release_User	67
5.9.8	Coding of the field Data_Transfer_List	67

5.10	Coding section related to upload/download/act para PDUs.....	68
5.10.1	Coding of the field Area_Code_UpDownload	68
5.10.2	Coding of the field Timeout.....	68
5.10.3	Coding of the field Max_Len_Data_Unit.....	68
5.10.4	Coding of the field Add_Offset.....	68
5.10.5	Coding of the field Data	68
5.10.6	Coding of the field Data_Len	68
5.10.7	Coding of the field Area_CodeActBrct.....	69
5.10.8	Coding of the field Area_CodeAct.....	69
5.10.9	Coding of the field Activate	69
5.11	Coding section related to the bus parameter set	70
5.11.1	Coding of the field Bus_Para_Len.....	70
5.11.2	Coding of the field DL_Add	70
5.11.3	Coding of the field Data_rate	70
5.11.4	Coding of the fields T _{SL} , min T _{SDR} , max T _{SDR}	70
5.11.5	Coding of the fields T _{QUI} , T _{SET} , G, HSA, max_retry_limit	71
5.11.6	Coding of the field T _{TR} (Target Token Rotation time)	71
5.11.7	Coding of the field Bp_Flag (Busparameter flag).....	71
5.11.8	Coding of the field Min_Slave_Interval.....	71
5.11.9	Coding of the field Poll_Timeout	71
5.11.10	Coding of the field Data_Control_Time	71
5.11.11	Coding of the field Alarm_Max	71
5.11.12	Coding of the field Max_User_Global_Control.....	72
5.11.13	Coding of the field Master_User_Data_Len.....	72
5.11.14	Coding of the field Master_Class2_Name	72
5.11.15	Coding of the field Master_User_Data	72
5.11.16	Coding of the field T _{CT}	72
5.11.17	Coding of the field maxT _{SH}	72
5.12	Coding section related to the slave parameter set.....	72
5.12.1	Coding of the field Slave_Para_Len.....	72
5.12.2	Coding of the field SI_Flag (slave flag)	72
5.12.3	Coding of the field Slave_Type	73
5.12.4	Coding of the field Max_Diag_Data_Len	73
5.12.5	Coding of the field Max_Alarm_Len	73
5.12.6	Coding of the field Max_Channel_Data_Length	73
5.12.7	Coding of the field Diag_Upd_Delay	74
5.12.8	Coding of the field Alarm_Mode	74
5.12.9	Coding of the field Add_SI_Flag.....	74
5.12.10	Coding of the field MS1_Timeout	74
5.12.11	Coding of the field Prm_Data_Len	74
5.12.12	Coding of the field Prm_Data	74
5.12.13	Coding of the field Cfg_Data_Len	75
5.12.14	Coding of the field Cfg_Data.....	75
5.12.15	Coding of the field Add_Tab_Len.....	75
5.12.16	Coding of the field Number_of_Entries.....	75
5.12.17	Coding of the field Add_Tab_Entry_Header	75
5.12.18	Coding of the field I/O_Data_Length	75
5.12.19	Coding of the field I/O_Config_Address	75
5.12.20	Coding of the field Host_Address.....	75

5.12.21	Coding of the field Slave_User_Data_Len.....	76
5.12.22	Coding of the field Slave_User_Data	76
5.12.23	Coding of the field Ext_Prm_Data_Len	76
5.12.24	Coding of the field Ext_Prm_Data	76
5.13	Coding section related to statistic counters	76
5.13.1	Coding of the field DLPDU_sent_count and SD_count	76
5.13.2	Coding of the field Error_count and SD_error_count	76
5.14	Coding section related to set slave address PDU	76
5.14.1	Coding of the field New_Slave_Add	76
5.14.2	Coding of the field No_Add_Change	76
5.14.3	Coding of the field Rem_Slave_Data	76
5.15	Coding section related to initiate/abort PDUs	77
5.15.1	Coding of the field Features_Supported_1	77
5.15.2	Coding of the field Features_Supported_2	77
5.15.3	Coding of the field Profile_Features_Supported_1	77
5.15.4	Coding of the field Profile_Features_Supported_2	77
5.15.5	Coding of the field Profile_Ident_Number.....	77
5.15.6	Coding of the field S_Type (source type)	77
5.15.7	Coding of the field D_Type (destination type)	77
5.15.8	Coding of the field S_Len (source length)	78
5.15.9	Coding of the field D_Len (destination length)	78
5.15.10	Coding of the field S_API (source application identifier).....	78
5.15.11	Coding of the field D_API (destination application identifier)	78
5.15.12	Coding of the field S_SCL (source security level)	78
5.15.13	Coding of the field D_SCL (destination security level).....	78
5.15.14	Coding of the field S_Network_Address.....	78
5.15.15	Coding of the field D_Network_Address.....	78
5.15.16	Coding of the field S_MAC_Address	78
5.15.17	Coding of the field D_MAC_Address	78
5.15.18	Coding of the field Send_Timeout	78
5.15.19	Coding of the field Server_SAP	78
5.15.20	Coding of the field Subnet	79
5.15.21	Coding of the field Instance_Reason_Code	79
5.16	Coding section related to read/write/data transport PDUs	80
5.16.1	Coding of the field Index	80
5.16.2	Coding of the field Length.....	80
5.17	Coding section related to load region and function invocation PDUs	80
5.17.1	Coding of the field Extended_Function_Num	80
5.17.2	Coding of the field Options	80
5.17.3	Coding of the field Sequence_Number	81
5.17.4	Coding of the field LR_Data.....	81
5.17.5	Coding of the field Max_Segment_Length.....	81
5.17.6	Coding of the field LR_Index.....	81
5.17.7	Coding of the field LR_Length.....	81
5.17.8	Coding of the field Max_Response_Delay.....	81
5.17.9	Coding of the field Intersegment_Request_Timeout	81
5.17.10	Coding of the field User_Specific	81
5.17.11	Coding of the field FI_Index.....	81
5.17.12	Coding of the field Entity Number	82

5.17.13	Coding of the field Execution_Argument	82
5.17.14	Coding of the field Result_Argument.....	82
5.17.15	Coding of the field FI_State	82
5.17.16	Coding of the field IMData_Execution_Argument	83
5.17.17	Coding of the field IMData_Result_Argument.....	83
5.18	Examples of Diagnosis-RES-PDUs	84
5.19	Example of Chk_Cfg-REQ-PDU	86
5.20	Examples of Chk_Cfg-REQ-PDUs with DPV1 data types.....	86
5.21	Example structure of the Data_Unit for Data_Exchange	88
6	FAL protocol state machines	90
6.1	Overall structure	90
6.1.1	Fieldbus Service Protocol Machines (FSPM).....	90
6.1.2	Master to Slave cyclic (MS0)	90
6.1.3	Master (class 1) to Slave acyclic (MS1)	90
6.1.4	Master (class 2) to Slave acyclic (MS2)	90
6.1.5	Master to Slave clock synchronisation (MS3)	90
6.1.6	Master Master acyclic (MM1/MM2).....	91
6.1.7	DLL Mapping Protocol Machines (DMPM).....	91
6.2	Assignment of state machines to devices	91
6.3	Overview DP-slave	92
6.4	Overview DP-master (class 1).....	93
6.5	Overview DP-master (class 2).....	94
6.6	Cyclic communication between DP-master (class 1) and DP-slave.....	95
6.7	Acyclic communication between DP-master (class 2) and DP-master (class 1).....	97
6.8	Acyclic communication between DP-master (class 1) and DP-slave	99
6.9	Application relationship monitoring.....	101
6.9.1	Monitoring of the MS0 – AR	101
6.9.2	Monitoring of the MS2 – AR	102
7	AP-context state machine	106
8	FAL service protocol machines (FSPMs)	107
8.1	FSPMS	107
8.1.1	Primitive definitions	107
8.1.2	State machine description.....	112
8.1.3	FSPMS state table	115
8.1.4	Functions.....	141
8.2	FSPMM1	142
8.2.1	Primitive definitions	142
8.2.2	State machine description.....	148
8.2.3	FSPMM1 state table	151
8.2.4	Functions.....	177
8.3	FSPMM2.....	177
8.3.1	Primitive definitions	177
8.3.2	State machine description.....	182
8.3.3	FSPMM2 state table	182
8.3.4	Functions.....	194
9	Application relationship protocol machines (ARPMs)	195
9.1	MSCY1S	195
9.1.1	Primitive definitions	195

9.1.2	State machine description.....	196
9.1.3	MSCY1S state table	202
9.1.4	Functions.....	222
9.2	MSAC1S	225
9.2.1	Primitive definitions	225
9.2.2	State machine description.....	227
9.2.3	MSAC1S state table	228
9.2.4	Functions.....	237
9.3	SSCY1S	238
9.3.1	Primitive definitions	238
9.3.2	State machine description.....	239
9.3.3	SSCY1S state table	239
9.3.4	Functions.....	241
9.4	MSRM2S	241
9.4.1	Primitive definitions	241
9.4.2	State machine description.....	242
9.4.3	MSRM2S state table	245
9.5	MSAC2S	247
9.5.1	Primitive definitions	247
9.5.2	State machine description.....	250
9.5.3	MSAC2S state table	252
9.6	MSCS1S	264
9.6.1	Primitive definitions	264
9.6.2	State machine description.....	264
9.6.3	MSCS1S state table	265
9.7	MSCY1M	266
9.7.1	Primitive definitions	266
9.7.2	State machine description.....	268
9.7.3	MSCY1M state table	270
9.8	MSAL1M	284
9.8.1	Primitive definitions	284
9.8.2	State machine description.....	286
9.8.3	MSAL1M state table	289
9.9	MSAC1M	294
9.9.1	Primitive definitions	294
9.9.2	State machine description.....	295
9.9.3	MSAC1M state table	301
9.10	MMAC1.....	306
9.10.1	Primitive definitions	306
9.10.2	State machine description.....	308
9.10.3	MMAC1 state table	308
9.11	MSCS1M	313
9.11.1	Primitive definitions	313
9.11.2	State machine description.....	314
9.11.3	MSCS1M state table	315
9.12	MSAC2M	318
9.12.1	Primitive definitions	318
9.12.2	State machine description.....	320
9.12.3	MSAC2M state table	323

9.13	MMAC2.....	333
9.13.1	Primitive definitions	333
9.13.2	State machine description.....	334
9.13.3	MMAC2 state table	335
10	DLL mapping protocol machines (DMPMs)	340
10.1	DMPMS	340
10.1.1	Primitive definitions	340
10.1.2	State machine description.....	346
10.1.3	DMPMS state table	346
10.1.4	Functions.....	352
10.2	DMPMM1	353
10.2.1	Primitive definitions	353
10.2.2	State machine description.....	360
10.2.3	DMPMM1 state table	361
10.2.4	Functions.....	368
10.3	DMPMM2	369
10.3.1	Primitive definitions	369
10.3.2	State machine description.....	373
10.3.3	DMPMM2 state table	373
10.3.4	Functions.....	376
11	Parameters for a DP-slave.....	377
	Bibliography.....	378
	Figure 1 – Common structure of specific fields.....	26
	Figure 2 – Example Modul_Status_Array	44
	Figure 3 – Example of Ext_Diag_Data in case of DPV1 diagnosis format with alarm and status PDU.....	84
	Figure 4 – Example of Ext_Diag_Data in case of the basic diagnosis format	86
	Figure 5 – Example of a special identifier format.....	86
	Figure 6 – Example of a special identifier format with data types	87
	Figure 7 – Example of a special identifier format with data types	87
	Figure 8 – Example of an empty slot with data types.....	88
	Figure 9 – Example for multi-variable device with AI and DO function blocks	88
	Figure 10 – Identifiers (ID)	89
	Figure 11 – Identifier list	89
	Figure 12 – Structure of the Data_Unit for the request- and response-DLPDU	89
	Figure 13 – Structuring of the protocol machines and adjacent layers in a DP-slave	93
	Figure 14 – Structuring of the protocol machines and adjacent layers in a DP-master (class 1).....	94
	Figure 15 – Structuring of the protocol machines and adjacent layers in a DP-master (class 2).....	95
	Figure 16 – Sequence of the communication between DP-master and DP-slave	97
	Figure 17 – Sequence of communication between DP-master (class 2) and DP-master (class 1).....	99
	Figure 18 – Sequence of acyclic communication between DP-master (class 1) and DP-slave.....	101
	Figure 19 – Example for connection establishment on MS2.....	104

Figure 20 – Idle at master-side on MS2.....	105
Figure 21 – Idle at slave-side on MS2	106
Figure 22 – Example for connection establishment on MS2(server-side).....	243
Figure 23 – Structure of RM entries in the RM_Registry.....	244
Table 1 – State machine description elements	27
Table 2 – Description of state machine elements	27
Table 3 – Conventions used in state machines	28
Table 4 – APDU syntax.....	30
Table 5 – Substitutions	32
Table 6 – Block_Length for Selection:= 0	39
Table 7 – Block_Length for Selection:= 1	40
Table 8 – Block_Length for Selection:= 2	40
Table 9 – Block_Length for Selection:= 3	40
Table 10 – Selection range	40
Table 11 – Alarm_Type range	41
Table 12 – Status_Type value range.....	41
Table 13 – Alarm_Specifier	42
Table 14 – Additional_Acknowledge.....	42
Table 15 – Status_Specifier	42
Table 16 – Range of Modul_Status_Entry (1-4).....	44
Table 17 – Input_Output_Selection	46
Table 18 – Error type	46
Table 19 – Channel_Type	46
Table 20 – Specification of the bits Lock_Req and Unlock_Req	50
Table 21 – Range of Length_of_Manufacturer_Specific_Data if used in Chk_Cfg-REQ-PDU.....	57
Table 22 – Range of Length_of_Manufacturer_Specific_Data if used in Get_Cfg-RES-PDU	58
Table 23 – Input_Output_Selection	58
Table 24 – Data types	59
Table 25 – Specification of the bits for Un-/Freeze.....	60
Table 26 – Specification of the bits for Un-/Sync.....	60
Table 27 – Coding of the Function_Code/ Function_Num.....	62
Table 28 – Coding of the Error_Code / Function_Num	63
Table 29 – Values of Error_Decode	64
Table 30 – Coding of Error_Code_1 at DPV1	65
Table 31 – Values of MDiag_Identifier	66
Table 32 – Values for Area_Code_UpDownload.....	68
Table 33 – Values for Area_CodeActBrct.....	69
Table 34 – Values for Area_CodeAct	69
Table 35 – Values for Activate	70
Table 36 – Values for Data_rate	70
Table 37 – DPV1_Data_Types	73

Table 38 – Values for Slave_Type	73
Table 39 – Values for Alarm_Mode	74
Table 40 – Values for Subnet.....	79
Table 41 – Values of reason code if instance is DLL	79
Table 42 – Values of reason code if instance is MS2	79
Table 43 – Values of Extended_Function_Num	80
Table 44 – Values of FI_Index	82
Table 45 – Values of FI_State.....	82
Table 46 – IMData_Execution_Argument	83
Table 47 – IMData_Result_Argument.....	83
Table 48 – Assignment of state machines	92
Table 49 – Primitives issued by AP-Context to FSPMS	107
Table 50 – Primitives issued by FSPMS to AP-Context	109
Table 51 – FSPMS state table	116
Table 52 – Functions used by the FSPMS.....	141
Table 53 – Primitives issued by AP-Context to FSPMM1.....	142
Table 54 – Primitives issued by FSPMM1 to AP-Context.....	145
Table 55 – FSPMM1 state table	151
Table 56 – Functions used by the FSPMM1	177
Table 57 – Primitives issued by AP-Context to FSPMM2.....	177
Table 58 – Primitives issued by FSPMM2 to AP-Context.....	179
Table 59 – FSPMM2 state table	182
Table 60 – Functions used by the FSPMM2	194
Table 61 – Primitives issued by FSPMS to MSCY1S.....	195
Table 62 – Primitives issued by MSCY1S to FSPMS	195
Table 63 – Rules for DPV1_Status_1, DPV1_Status_2 and DPV1_Status_3 check	197
Table 64 – MSCY1S state table	202
Table 65 – Functions used by the MSCY1S	223
Table 66 – Primitives issued by FSPMS to MSAC1S	225
Table 67 – Primitives issued by MSAC1S to FSPMS	226
Table 68 – Primitives issued by MSCY1S to MSAC1S.....	226
Table 69 – Primitives issued by MSAC1S to MSCY1S.....	226
Table 70 – Parameter used with primitives exchanged between MSAC1S and MSCY1S	227
Table 71 – MSAC1S state table	228
Table 72 – Functions used by the MSAC1S	238
Table 73 – Primitives issued by FSPMS to SSCY1S	238
Table 74 – Primitives issued by SSCY1S to FSPMS	238
Table 75 – SSCY1S state table.....	240
Table 76 – Functions used by the SSCY1S.....	241
Table 77 – Primitives issued by FSPMS to MSRM2S	241
Table 78 – Primitives issued by MSRM2S to FSPMS	242
Table 79 – MSRM2S state table.....	245
Table 80 – Primitives issued by FSPMS to MSAC2S	248

Table 81 – Primitives issued by MSAC2S to FSPMS	249
Table 82 – Primitives issued by MSRM2S to MSAC2S	249
Table 83 – Primitives issued by MSAC2S to MSRM2S	250
Table 84 – Parameter used with primitives exchanged with MSAC2S.....	250
Table 85 – MSAC2S state table	253
Table 86 – Primitives issued by MSCS1S to FSPMS	264
Table 87 – MSCS1S state table	265
Table 88 – Primitives issued by FSPMM1 to MSCY1M	266
Table 89 – Primitives issued by MSCY1M to FSPMM1	267
Table 90 – Parameters used with primitives exchanged between FSPMM1 and MSCY1M	267
Table 91 – MSCY1M state table.....	270
Table 92 – Primitives issued by FSPMM1 to MSAL1M	285
Table 93 – Primitives issued by MSAL1M to FSPMM1	285
Table 94 – Primitives issued by MSCY1M to MSAL1M	285
Table 95 – Primitives issued by MSAL1M to MSCY1M	285
Table 96 – Parameter used with primitives exchanged between MSAL1M and MSCY1M.....	286
Table 97 – Possible values in the Alarm_State_Table	287
Table 98 – MSAL1M state table	289
Table 99 – Primitives issued by FSPMM1 to MSAC1M	294
Table 100 – Primitives issued by MSAC1M to FSPMM1	294
Table 101 – Primitives issued by MSAL1M to MSAC1M	295
Table 102 – Primitives issued by MSAC1M to MSAL1M	295
Table 103 – Parameter used with primitives exchanged between MSAL1M and MSCY1M	295
Table 104 – MSAC1M state table.....	301
Table 105 – Primitives issued by FSPMM1 to MMAC1	307
Table 106 – Primitives issued by MMAC1 to FSPMM1	307
Table 107 – MMAC1 state table	309
Table 108 – Primitives issued by FSPMM1 to MSCS1M	314
Table 109 – Primitives issued by MSCS1M to FSPMM1	314
Table 110 – MSCS1M state table.....	316
Table 111 – Primitives issued by FSPMM2 to MSAC2M	318
Table 112 – Primitives issued by MSAC2M to FSPMM2	319
Table 113 – Parameters used with primitives exchanged with MSAC2M	319
Table 114 – MSAC2M state table.....	323
Table 115 – Primitives issued by FSPMM2 to MMAC2	333
Table 116 – Primitives issued by MMAC2 to FSPMM2	334
Table 117 – Parameters used with primitives exchanged with MMAC2.....	334
Table 118 – MMAC2 state table	336
Table 119 – Primitives issued by FSPMS to DMPMS	341
Table 120 – Primitives issued by DMPMS to FSPMS	341
Table 121 – Primitives issued by MSCY1S to DMPMS	341
Table 122 – Primitives issued by DMPMS to MSCY1S	342

Table 123 – Primitives issued by DMPMS to SSCY1S	342
Table 124 – Primitives issued by MSAC1S, MSRM2S, MSAC2S to DMPMS	343
Table 125 – Primitives issued by DMPMS to MSAC1S, MSRM2S, MSAC2S	343
Table 126 – Primitives issued by DMPMS to MSCS1S	343
Table 127 – Primitives issued by DMPMS to DL	344
Table 128 – Primitives issued by DL to DMPMS	344
Table 129 – Parameters used with primitives exchanged with DMPMS	345
Table 130 – DMPMS state table	347
Table 131 – Functions used by the DMPMS	352
Table 132 – Primitives issued by FSPMM1 to DMPMM1	354
Table 133 – Primitives issued by DMPMM1 to FSPMM1	354
Table 134 – Primitives issued by MSCY1M to DMPMM1	355
Table 135 – Primitives issued by DMPMM1 to MSCY1M	355
Table 136 – Primitives issued by MSAL1M, MSAC1M to DMPMM1	356
Table 137 – Primitives issued by DMPMM1 to MSAL1M, MSAC1M	356
Table 138 – Primitives issued by MMAC1 to DMPMM1	356
Table 139 – Primitives issued by DMPMM1 to MMAC1	356
Table 140 – Primitives issued by MSCS1M to DMPMM1	357
Table 141 – Primitives issued by DMPMM1 to MSCS1M	357
Table 142 – Primitives issued by DMPMM1 to DL	357
Table 143 – Primitives issued by DL to DMPMM1	358
Table 144 – Parameters used with primitives exchanged with DMPMM1	359
Table 145 – Possible values of status	360
Table 146 – DMPMM1 state table	361
Table 147 – Functions used by the DMPMM1	369
Table 148 – Primitives issued by FSPMM2 to DMPMM2	370
Table 149 – Primitives issued by DMPMM2 to FSPMM2	370
Table 150 – Primitives issued by MSAC2M to DMPMM2	371
Table 151 – Primitives issued by DMPMM2 to MSAC2M	371
Table 152 – Primitives issued by MMAC2 to DMPMM2	371
Table 153 – Primitives issued by DMPMM2 to MMAC2	371
Table 154 – Primitives issued by DMPMM2 to DL	372
Table 155 – Primitives issued by DL to DMPMM2	372
Table 156 – Parameters used with primitives exchanged with DMPMM2	373
Table 157 – DMPMM2 state Table	373
Table 158 – Functions used by DMPMM2	377
Table 159 – Bus parameter/reaction times for a DP-slave	377

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-3: Application layer protocol specification – Type 3 elements

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

Attention is drawn to the fact that the use of the associated protocol type is restricted by its intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by its intellectual-property-right holders.

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

International Standard IEC 61158-6-3 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

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

- corrected substitutions in Table 4;
- corrections in 5.3.14;
- corrections in 5.5.6;
- corrections in 5.17.15;
- corrections in 5.17.16.2;
- spelling and grammar.

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

FDIS	Report on voting
65C/948/FDIS	65C/956/RVD

Full information on the voting for the approval of this International 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.

A bilingual version of this publication may be issued at a later date.

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 document 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 implementors 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 document is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this document 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 6-3: Application layer protocol specification – Type 3 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 3 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 International Standard defines in an abstract way the externally visible behavior provided by the Type 3 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 machine defining the application service behavior visible between communicating application entities; and
- d) the application relationship state machines defining the communication behavior visible between communicating application entities.

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

- a) define the wire-representation of the service primitives specified in IEC 61158-5-3, and
- b) define the externally visible behavior associated with their transfer.

This document specifies the protocol of the Type 3 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 syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-3.

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 parts of the IEC 61158-6 subparts.

1.3 Conformance

This 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 the application layer service definition standard. Instead, conformance is achieved through implementation of this application layer protocol specification.

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 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 61158-3-3:2014, *Industrial communication networks – Fieldbus specifications – Part 3-3: Data-link layer service definition – Type 3 elements*

IEC 61158-4-3:2019, *Industrial communication networks – Fieldbus specifications – Part 4-3: Data-link layer protocol specification – Type 3 elements*

IEC 61158-5-3:2014, *Industrial communication networks – Fieldbus specifications – Part 5-3: Application layer service definition – Type 3 elements*

IEC 61158-5-10:2019, *Industrial communication networks – Fieldbus specifications – Part 5-10: Application layer service definition – Type 10 elements*

IEC 61158-6-10:2019, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements*

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): Specification of basic notation*