



IEC 61158-4-19

Edition 1.0 2007-12

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 4-19: Data-link layer protocol specification – Type 19 elements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XB**

ICS 35.100.20; 25.040.40

ISBN 2-8318-9443-3

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
1.1 General.....	9
1.2 Specifications.....	9
1.3 Procedures.....	9
1.4 Applicability.....	9
1.5 Conformance.....	9
2 Normative references	10
3 Terms, definitions, symbols, abbreviations and conventions	10
3.1 Reference model terms and definitions.....	10
3.2 Additional Type 19 terms and definitions	10
3.3 Symbols	13
3.4 Abbreviations	14
3.5 Additional conventions	15
4 DL-protocol overview.....	15
5 DLPDU structure	17
5.1 Overview	17
5.2 General DLPDU identification.....	17
5.3 General DLPDU structure.....	17
5.4 DLPDU header	18
5.5 MDT DLPDU	19
5.6 AT DLPDU	28
6 DL management	38
6.1 Overview	38
6.2 Enable and disable cyclic communication.....	38
6.3 Hot-plug procedure.....	43
6.4 Status procedures	44
7 Data transmission methods	44
7.1 Overview	44
7.2 SVC	45
7.3 RTC	45
8 Telegram timing and DLPDU handling	45
8.1 Usage of real-time channel with different network topologies.....	45
8.2 Communication mechanisms	46
8.3 Device synchronization.....	52
9 Error handling and monitoring	53
9.1 Failure of telegrams	53
9.2 Response to MDT and AT telegram failure	53
9.3 Service channel error messages.....	53
Annex A (Normative) – IDN – Identification numbers.....	55
A.1 IDN specification	55
A.2 Identification numbers in numerical orders	55
A.3 Detailed specification of communication-related IDNs	56
Bibliography.....	74

Figure 1 – Valid MDT and AT telegram combinations	16
Figure 2 – Offsets within MDT payload	23
Figure 3 – Offsets within AT payload	32
Figure 4 – Communication phase transitions	39
Figure 5 – Block diagram of master and slave	46
Figure 6 – Telegram sequence	48
Figure 7 – Beginning of telegram	49
Figure 8 – Access to the medium	50
Figure 9 – Timing diagram of CP0	52
Figure 10 – Timing diagram of CP1 and CP2	52
Figure 11 – Synchronization timing	53
Figure 12 – Synchronization signal generation	53
Figure A.1 – Lengths of MDTs (example)	61
Figure A.2 – Lengths of ATs (example)	63
Figure A.3 – Structure of MAC address	67
Figure A.4 – Structure of IP address	68
Figure A.5 – Structure of subnet mask	69
Figure A.6 – Structure of gateway address	70
Table 1 – Ethernet DLPDU identification	17
Table 2 – Data structure in a DLPDU	17
Table 3 – DLPDU payload header	18
Table 4 – DLPDU type	18
Table 5 – MDT MST header	19
Table 6 – MDT MST fields to be considered by the slave	19
Table 7 – MDT phase	19
Table 8 – MDT0 in CP0	20
Table 9 – MDT0 in CP1 and CP2	22
Table 10 – MDT1 in CP1 and CP2	22
Table 11 – MDT data field	23
Table 12 – MDT hot-plug field in HP0 and HP1	24
Table 13 – MDT hot-plug field in HP2	24
Table 14 – Device address field	24
Table 15 – HP control field (in HP0 and HP1)	25
Table 16 – MDT service channel field	26
Table 17 – MDT SVC (for each slave)	26
Table 18 – SVC control word (DLL)	27
Table 19 – MDT real-time data field	28
Table 20 – MDT real-time data (for each device)	28
Table 21 – Device control field	28
Table 22 – AT MST header	29
Table 23 – AT MST fields to be considered by the slave	29
Table 24 – AT0 structure in CP0	30

Table 25 – AT0 in CP1 and CP2	30
Table 26 – AT1 in CP1 and CP2	31
Table 27 – AT data field.....	31
Table 28 – AT hot-plug field in HP0 and HP1	32
Table 29 – AT hot-plug field in HP2	32
Table 30 – HP status field (in HP0 and HP1).....	33
Table 31 – AT service channel field	34
Table 32 – AT SVC (for each slave).....	34
Table 33 – AT SVC status description (DLL)	34
Table 34 – AT real-time data field	35
Table 35 – AT MS data field.....	36
Table 36 – AT MS data (for each device)	36
Table 37 – Device status field	36
Table 38 – CC data field	37
Table 39 – CC data field producer	37
Table 40 – CC consumer control.....	37
Table 41 – Synchronization classes of master and slave.....	49
Table 42 – Telegram transmission in RT and NR channels	51
Table A.1 – List of relevant communication-related IDNs	55
Table A.2 – Attributes of IDN S-0-1001	57
Table A.3 – Attributes of IDN S-0-1002	57
Table A.4 – Attributes of IDN S-0-1005	58
Table A.5 – Attributes of IDN S-0-1006	58
Table A.6 – Attributes for IDN S-0-1007	59
Table A.7 – Attributes for IDN S-0-1008	59
Table A.8 – Attributes of IDN S-0-1009	60
Table A.9 – RTC-Offset in MDT	60
Table A.10 – Attributes of IDN S-0-1010	61
Table A.11 – Attributes of IDN S-0-1011	61
Table A.12 – RTC Offset in AT.....	62
Table A.13 – Attributes of IDN S-0-1012	62
Table A.14 – Attributes of IDN S-0-1013	63
Table A.15 – RTC Offset in MDT.....	63
Table A.16 – Attributes of IDN S-0-1014	64
Table A.17 – RTC Offset in AT.....	64
Table A.18 – Attributes of IDN S-0-1015	65
Table A.19 – Attributes of IDN S-0-1016	65
Table A.20 – Attributes of IDN S-0-1017	66
Table A.21 – Attributes of IDN S-0-1018	66
Table A.22 – Attributes of IDN S-0-1019	67
Table A.23 – Attributes of IDN S-0-1020	68
Table A.24 – Attributes of IDN S-0-1021	68
Table A.25 – Attributes of IDN S-0-1022	69

Table A.26 – Attributes of IDN S-0-1023	70
Table A.27 – Structure of IDN S-0-1023 data	70
Table A.28 – Attributes of IDN S-0-1024	71
Table A.29 – Attributes of IDN S-0-1025	71
Table A.30 – Attributes of IDN S-0-1026	72
Table A.31 – Attributes of IDN S-0-1028	72
Table A.32 – Attributes of IDN S-0-1029	73
Table A.33 – Attributes of IDN S-0-1030	73

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
 FIELDBUS SPECIFICATIONS –**
Part 4-19: Data-link layer protocol specification – Type 19 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

NOTE Use of some of the associated protocol types is restricted by their 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 particular data-link layer protocol type to be used with physical layer and application layer protocols in Type combinations as specified explicitly in the IEC 61784 series. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

IEC draws attention to the fact that it is claimed that compliance with this standard may involve the use of patents as follows, where the [xx] notation indicates the holder of the patent right:

Type 19 and possibly other Types:

DE 102 37 097	[RI]	Korrektur von Signallaufzeiten in verteilten Kommunikationssystemen
DE 102 00 405 0416.4-42	[RI]	Verfahren zur Synchronisation in einem redundanten Kommunikationssystem
DE 102 00 502 4759.8-32	[RI]	Verfahren zur Laufzeitkorrektur in einer Kommunikationsstruktur
DE 102 00 4056364.0-31	[RI]	Verfahren zum Betreiben eines Netzwerks mit Ringtopologie
DE 103 12 907.3-31	[RI]	Kommunikationssystem mit redundanter Kommunikation

IEC takes no position concerning the evidence, validity and scope of these patent rights.

The holders of these patent rights have assured IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holders of these patent rights are registered with IEC. Information may be obtained from:

[RI] Rexroth Indramat GmbH
Bgm.-Dr.-Nebel-Str. 2
D - 97816 Lohr
Germany

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61158-4-19 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition and its companion parts of the IEC 61158-4 subseries cancel and replace IEC 61158-4:2003. This edition of this part constitutes a technical addition. This part and its companion Type 19 parts also cancel and replace IEC PAS 62410, published in 2005.

This edition of IEC 61158-4 includes the following significant changes from the previous edition:

- a) deletion of the former Type 6 fieldbus, and the placeholder for a Type 5 fieldbus data link layer, for lack of market relevance;
- b) addition of new types of fieldbuses;
- c) division of this part into multiple parts numbered -4-1, -4-2, ..., -4-19.

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

FDIS	Report on voting
65C/474/FDIS	65C/485/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 ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

NOTE The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

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

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/TR 61158-1.

The data-link protocol provides the data-link service by making use of the services available from the physical 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 data-link entities (DLEs) 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:

- a) as a guide for implementors and designers;
- b) for use in the testing and procurement of equipment;
- c) as part of an agreement for the admittance of systems into the open systems environment;
- d) 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 4-19: Data-link layer protocol specification – Type 19 elements

1 Scope

1.1 General

The data-link layer provides basic time-critical messaging communications between devices in an automation environment.

This protocol provides communication opportunities to all participating data-link entities

- a) in a synchronously-starting cyclic manner, according to a pre-established schedule, and
- b) in a cyclic or acyclic asynchronous manner, as requested each cycle by each of those data-link entities.

Thus this protocol can be characterized as one which provides cyclic and acyclic access asynchronously but with a synchronous restart of each cycle.

1.2 Specifications

This standard specifies

- a) procedures for the timely transfer of data and control information from one data-link user entity to a peer user entity, and among the data-link entities forming the distributed data-link service provider;
- b) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, and their representation as physical interface data units.

1.3 Procedures

The procedures are defined in terms of

- a) the interactions between peer DL-entities (DLEs) through the exchange of fieldbus DLPDUs;
- b) the interactions between a DL-service (DLS) provider and a DLS-user in the same system through the exchange of DLS primitives;
- c) the interactions between a DLS-provider and a Ph-service provider in the same system through the exchange of Ph-service primitives.

1.4 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within the data-link layer of the OSI or fieldbus reference models, and which require the ability to interconnect in an open systems interconnection environment.

Profiles provide a simple multi-attribute means of summarizing an implementation's capabilities, and thus its applicability to various time-critical communications needs.

1.5 Conformance

This standard also specifies conformance requirements for systems implementing these procedures. This part of this standard does not contain tests to demonstrate compliance with such requirements.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158-4-16, *Industrial communications networks – Fieldbus specifications – Part 4-16: Data-link layer protocol specification – Type 16 elements*

IEC 61800-7-20x (all subparts), *Adjustable speed electrical power drive systems – Part 7-20x: Generic interface and use of profiles for power drive systems – Profile type x specification*¹

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

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Part 3: Basic Reference Model: Naming and addressing*

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and Physical Layer specifications*

¹ At present, these subparts are IEC 61800-7-201, 7-202, 7-203 and 7-204.