

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 4-18: Data-link layer protocol specification – Type 18 elements**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2010 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

Document generated by EVS



IEC 61158-4-18

Edition 2.0 2010-08

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 4-18: Data-link layer protocol specification – Type 18 elements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

ICS 25.04.40; 35.100.20; 35.110

ISBN 978-2-88912-089-5

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
1.1 General.....	8
1.2 Specifications.....	8
1.3 Procedures.....	8
1.4 Applicability.....	9
1.5 Conformance.....	9
2 Normative references.....	9
3 Terms, definitions, symbols, abbreviations and conventions.....	9
3.1 Reference model terms and definitions.....	9
3.2 Type 18: Symbols.....	10
3.3 Type 18: Additional conventions.....	10
4 DL-protocol overview.....	10
4.1 Introduction.....	10
4.2 Polled DLE classes.....	11
4.3 Packed DLE classes.....	11
5 DLPDU encoding and transmission.....	11
5.1 DL – PhL interface.....	11
5.2 DLPDU transmission encoding.....	12
6 DLPDU – basic structure.....	14
6.1 Overview.....	14
6.2 Address field.....	14
6.3 Status field.....	15
6.4 Data field.....	17
7 DLPDU – Detailed structure, segmenting and reassembly.....	19
8 Data transmission methods.....	23
8.1 Overview.....	23
8.2 Master-polled method.....	23
8.3 Level A slave-polled method.....	24
8.4 Level B slave-polled method.....	25
8.5 Level C slave-polled method.....	25
8.6 Master-packed method.....	26
8.7 Slave-packed method.....	27
9 DL-management – procedures.....	28
9.1 Overview.....	28
9.2 Establish master-polled DLE procedure.....	28
9.3 Establish slave-polled DLE procedure.....	29
9.4 Establish master-packed DLE procedure.....	31
9.5 Establish slave-packed DLE procedure.....	32
9.6 Release connection procedure.....	33
9.7 Suspend connection procedure.....	33
9.8 Resume connection procedure.....	33
9.9 Activate standby Master procedure.....	34
Bibliography.....	35

Figure 1 – HDLC flag	12
Table 1 – HDLC convention summary	13
Table 2 – HDLC exception summary	14
Table 3 – Master-polled DLE address octet 0.....	14
Table 4 – Slave-polled DLE address octet 0.....	15
Table 5 – Master-packed DLE address octet 0	15
Table 6 – Master-polled DLE status octet 0.....	16
Table 7 – Master-polled DLE status octet 1.....	16
Table 8 – Slave-polled DLE status octet 0.....	17
Table 9 – slave-polled DLE status octet 1	17
Table 10 – Slave-packed DLE status	17
Table 11 – DLPDU – Master-polled DLE acyclic data field	18
Table 12 – DLPDU – Slave-polled DLE acyclic data field	19
Table 13 – Example master-polled DLE RY contiguous data field	20
Table 14 – Example slave-polled DLE RX contiguous data field	20
Table 15 – Example master-polled DLE RWw contiguous data field	20
Table 16 – Example slave-polled DLE RWr contiguous data field	20
Table 17 – Bit-oriented segment header	21
Table 18 – Polled DLE acyclic segment number field	22
Table 19 – Slave-polled DLE acyclic data type and sequence field	22
Table 20 – DLPDU – Polled class poll with data.....	23
Table 21 – Slave-polled DLE response timeout.....	23
Table 22 – DLPDU – Poll	24
Table 23 – DLPDU – End of cycle	24
Table 24 – slave-polled DLE request timeout.....	24
Table 25 – DLPDU – Level A poll response.....	25
Table 26 – DLPDU – Level B poll response.....	25
Table 27 – DLPDU – Level C poll response	26
Table 28 – DLPDU – Packed class poll with data	26
Table 29 – Slave-packed DLE response timeout	26
Table 30 – Slave-packed DLE request timeout.....	27
Table 31 – DLPDU – Packed class poll response.....	27
Table 32 – Slave-packed DLE time constraints	28
Table 33 – DLPDU – Poll with test data	28
Table 34 – Slave-polled DLE response timeout.....	29
Table 35 – DLPDU – Poll test	29
Table 36 – Slave-polled DLE request timeout	29
Table 37 – DLPDU – Poll test response	30
Table 38 – Slave-polled DLE configuration parameter.....	30
Table 39 – DLPDU – Baud rate synchronization.....	31
Table 40 – DLPDU – Poll test	31
Table 41 – Slave-packed DLE response timeout	31

Table 42 – Slave-packed DLE number of occupied DLE station slots	32
Table 43 – Slave-packed DLE baud rate synchronization timeout	32
Table 44 – Slave-packed DLE Master timeout.....	33
Table 45 – DLPDU – Packed poll test response	33

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELD BUS SPECIFICATIONS –****Part 4-18: Data-link layer protocol specification –
Type 18 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.

International Standard IEC 61158-4-18 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- Editorial improvements
- Addition of cyclic data segmenting

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

FDIS	Report on voting
65C/605/FDIS	65C/619/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.

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

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

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 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.

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 profile parts. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning Type 18 elements and possibly other types given in 7.1.2 as follows:

3343036/Japan	[MEC]	Network System for a Programmable Controller
5896509/USA	[MEC]	Network System for a Programmable Controller
246906/Korea	[MEC]	Network System for a Programmable Controller
19650753/Germany	[MEC]	Network System for a Programmable Controller

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

The holder of these patent rights has assured the IEC that he/she is willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of these patent rights is registered with IEC. Information may be obtained from:

[MEC] Mitsubishi Electric Corporation
 Corporate Licensing Division
 7-3, Marunouchi 2-chome, Chiyoda-ku,
 Tokyo 100-8310, Japan

Attention is drawn to the possibility that some of the elements of this document 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.

ISO (www.iso.org/patents) and IEC (http://www.iec.ch/tctools/patent_decl.htm) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-18: Data-link layer protocol specification – Type 18 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 part of IEC 61158 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) procedures for giving communications opportunities to all participating DL-entities, sequentially and in a cyclic manner for deterministic and synchronized transfer at cyclic intervals up to one millisecond;
- c) procedures for giving communication opportunities available for time-critical data transmission together with non-time-critical data transmission without prejudice to the time-critical data transmission;
- d) procedures for giving cyclic and acyclic communication opportunities for time-critical data transmission with prioritized access;
- e) procedures for giving communication opportunities based on standard ISO/ IEC 8802-3 medium access control, with provisions for nodes to be added or removed during normal operation;
- f) 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 part of IEC 61158 does not specify individual implementations or products, nor do they constrain the implementations of data-link entities within industrial automation systems.

There is no conformance of equipment to this data-link layer service definition standard. Instead, conformance is achieved through implementation of the corresponding data-link protocol that fulfills the Type 18 data-link layer services defined in this standard.

2 Normative references

The following referenced documents are indispensable for the application 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.

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

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

ISO/IEC 13239:2002, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures*

3 Terms, definitions, symbols, abbreviations and conventions

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

3.1 Reference model terms and definitions

This standard is based in part on the concepts developed in ISO/IEC 7498-1 and ISO/IEC 7498-3, and makes use of the following additional terms:

3.1.1

DLE station identifier

network address assigned to a DLE

3.1.2

DLE station slot

unit (granularity of one) of position dependent mapping (for cyclic data field) of which a DLE may occupy one or more, delineated by the range beginning at the DLE station identifier with a length equal to the configured number of occupied slots

3.1.3

Master DLE

DLE that performs the functions of network master