

Specification for

ControlNet —

Part 5: Data management

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Foreword

The DD 241 specification was developed by the Allen-Bradley Company, Inc. as “ControlNet”. Allen-Bradley has granted BSI a right to publish the specification as an open communications standard for digital communications networks in industrial control applications.

This part of DD 241 describes the General Description of the deterministic control network.

This publication consists of the following parts:

- *Part 1: General description;*
- *Part 2: Physical layer and media;*
- *Part 3: Data link layer;*
- *Part 4: Network and transport layer;*
- *Part 5: Data management;*
- *Part 6: Object model;*
- *Part 7: Device profiles;*
- *Part 8: Electronic data sheet;*
- *Part 9: Station management;*
- *Part 10: Object library.*

This Draft for Development is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because the subject matter is still under development requiring wider exposure. It should be applied on this provisional basis so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than 2 years after its publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in *Update Standards*.

According to the replies received the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

Observations which it is felt should receive attention before the official call for comments will be welcomed.

These should be sent to the Secretary of BSI Technical Committee AMT/7 at BSI, 389 Chiswick High Road, London, W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

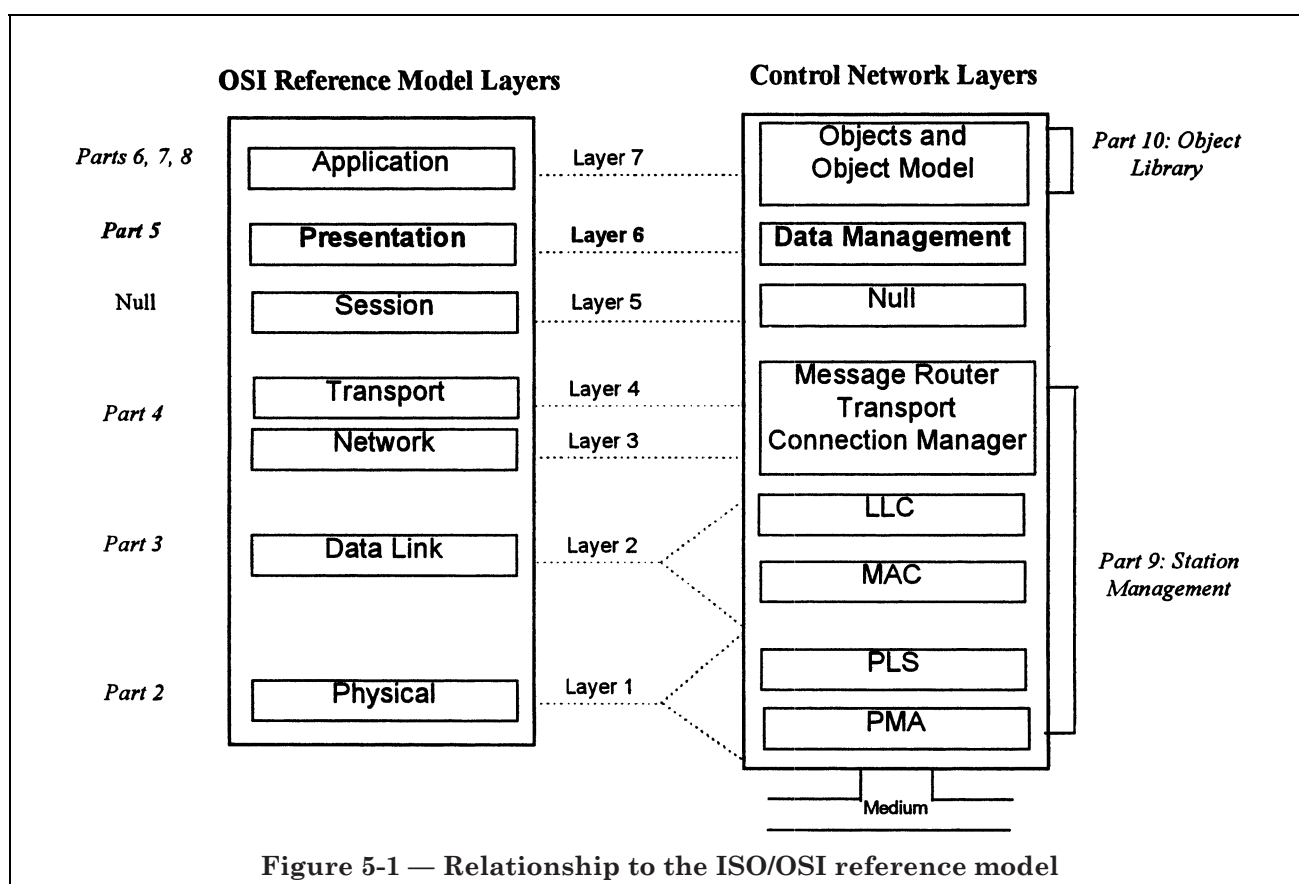
0 Introduction

This part describes the data type specification syntax, data type value ranges, and operations that can be performed on the defined data types.

1 Scope

This part of the standard defines the requirements for the Data Management standard of a device on the deterministic control network.

The Data Management part corresponds to the definition of the Presentation Layer of the seven layer OSI model in accordance with ISO 7498. It defines a common means of specifying the format of data going to and coming from the Application Layer. Figure 5-1 shows the location of the Presentation Layer within the OSI model.



2 Data type specification

The specification of a data type shall be comprised of:

- the range of *values* that variables of the type may take on;
- the *operations* performed on these variables.

NOTE This standard specifies *elementary* and *derived* data types corresponding to the notation of IEC 1131-3. In addition, since function blocks as defined in IEC 1131-3 have both an associated data structure and a set of defined standard operations, these elements are also specified as data types in this standard.

3 Data type values

3.1 Construction of data types

Data in this standard shall be made up of *elementary* (primitive) data types. These elementary data types shall be used to construct *derived* (constructed) data types.

3.2 Elementary data types

3.2.1 IEC 1131-3 data types

The elementary data types, their corresponding description and their valid values shall be as shown in Table 5-1 and its associated notes.

NOTE Table 5-1 specifies the values of certain parameters which are identified as “implementation-dependent” in Table 10.1 of subclause 2.3.1 in IEC 1131-3.

The implementation dependent parameters defined by this standard shall be as specified in clause 4.2.

Table 5-1 — Elementary data types

Keyword	Description	Range	
		Minimum	Maximum
BOOL	Boolean	See clause 3.2.2	
SINT	Short Integer	– 128	127
INT	Integer	– 32768	32767
DINT	Double Integer	– 2^{31}	$2^{31} - 1$
LINT	Long Integer	– 2^{63}	$2^{63} - 1$
USINT	Unsigned Short Integer	0	255
UINT	Unsigned Integer	0	65535
UDINT	Unsigned Double Integer	0	$2^{32} - 1$
ULINT	Unsigned Long Integer	0	$2^{64} - 1$
REAL	Floating point	See clause 3.2.3	
LREAL	Long float	See clause 3.2.3	
ITIME	Duration (short)	See clause 3.2.9	
TIME	Duration	See clause 3.2.4	
FTIME	Duration (high resolution)	See clause 3.2.4	
LTIME	Duration (long)	See clause 3.2.4	
DATE	Date only	See clause 3.2.5	
TIME_OF_DAY or TOD	Time of day	See clause 3.2.6	
DATE_AND_TIME or DT	Date and time of day	See clause 3.2.7	
STRING	character string (1 byte per character)	See clause 3.3	
STRING2	character string (2 bytes per character)	See clause 3.3	
STRINGN	character string (N-bytes per character)	See clause 3.3	
SHORT_STRING	character string (1 byte per character, 1 byte length indicator)	See clause 3.3	
BYTE	bit string — 8 bits	See clause 3.2.8	
WORD	bit string — 16 bits	See clause 3.2.8	
DWORD	bit string — 32 bits	See clause 3.2.8	
LWORD	bit string — 64 bits	See clause 3.2.8	

3.2.2 BOOL

The values of variables of type BOOL, 0 and 1, shall correspond to the keywords FALSE and TRUE, respectively.

3.2.3 REAL and LREAL

The range of values for variables of type REAL shall be as defined in IEEE 754 for the basic single floating-point format.

The range of values for variables of type LREAL shall be as defined in IEEE 754 for the basic double floating-point format

3.2.4 TIME, FTIME and LTIME

The range of values for variables of type TIME shall be the same as for variables of type DINT, representing the time duration in milliseconds, i.e. a range of T#-24d20h31m23.648s to T#24d20h31m23.647s.

The range of values for variables of type FTIME shall be same as for variables of type DINT, representing the time duration in microseconds, i.e. a range of T#-35m47.483648s to T#35m47.483547s.

The range of values for variables of type LTIME is the same as for variables of type LINT, representing the time duration in microseconds, i.e., a range of T#-106751991d4h0m54.775808s to T#106751991d4h0m54.775807s.

NOTE FTIME and LTIME are an extension to IEC 1131-3 by this standard.

3.2.5 DATE

The range of values for variables of type DATE shall be from D#1972-01-01, the start of the Co-ordinated Universal Time (UTC) era, to D#2151-06-06 (a total range of 65536 days).

3.2.6 TIME_OF_DAY

The range of values for variables of type TIME_OF_DAY shall be from TOD#00:00:00.000 to TOD#23:59:59.999 to a resolution of 1 millisecond.

3.2.7 DATE_AND_TIME

The range of values for variables of type DATE_AND_TIME shall be from DT#1972-01-01-00:00:00.000 to DT#2151-06-06-23:59:59.999.

3.2.8 BIT STRINGS

Values of bit string data types shall be in the range $2^{\#b_{N-1}b_{N-2}...b_2b_1b_0}$, where N is the number of bits in the bit string, b_{N-1} is the “most significant bit”, and b_0 shall be the “least significant bit”. The value of the j-th bit b_j is represented as 0 or 1, corresponding to the Boolean value FALSE or TRUE, respectively.

3.2.9 ITIME

The range of values for variables of type ITIME shall be the same as for variables of type INT, representing the time duration in milliseconds, i.e., a range of T#-32s768ms to T#32s767ms.

3.3 Character string data types

The declaration of a variable of type STRING, STRING2, or STRINGN shall be equivalent to declaring a structured data type for the variable which allocates a UINT variable containing the current size of the string in characters and an array of declared character size elements. STRING shall declare 1 byte per character; STRING2 shall declare 2 bytes per character. STRINGN shall declare N*bytes per character. STRINGN shall include an UINT variable which declares the character size.

The declaration of a variable of type SHORT_STRING shall be equivalent to declaring a structured data type for the variable which allocates a USINT variable containing the current size of the string in characters and an array of 1 byte characters.

NOTE SHORT_STRING, STRING2 and STRINGN are an extension to IEC 1131-3 by this standard.

NOTE Structured bit string types are an extension by this standard of the derived data type mechanisms specified in subclause 2.2.3 of IEC 1131-3. These data types are based on the IEC standard bit string types (ANY_BIT = BYTE, WORD, DWORD, or LWORD).

3.4 Derived data types

The derived data types shall be

- directly derived;
- enumerated;
- subrange;
- structured;
- array.

NOTE These data types are defined in subclauses 1.3 and 2.3.3 of IEC 1131-3. The means of specifying these data types and their default initial values is defined in subclauses 2.3.3.1 and 2.3.3.2 of IEC 1131-3. The usage of variables of these data types is defined in subclause 2.3.3.3 of IEC 1131-3.

4 IEC 1131-3 compliance

4.1 Compliance statement

NOTE 1 This clause provides information with respect to only the data types and associated operations defined in this standard.

NOTE 2 Subclause 1.5.1 of IEC 1131-3 defines the requirements which are met by programmable controller systems claiming compliance to the language standard. This provides the data type-related information to be included in the documentation of functional units which support the data types defined in this standard. Subsets or extensions of this documentation are provided as appropriate to the specific compliant functional unit.

This network shall comply with the requirements of IEC 1131-3 for language features as specified in Table 5-2, Table 5-3, and Table 5-4

Table 5-2 — Common elements

IEC 1131-3 Table/feature	Feature description
10/1	BOOL data type
10/2	SINT data type
10/3	INT data type
10/4	DINT data type
10/5	LINT data type
10/6	USINT data type
10/7	UINT data type
10/8	UDINT data type
10/9	ULINT data type
10/10	REAL data type
10/11	LREAL data type
10/12	TIME data type
10/13	DATE data type
10/14	TIME_OF_DAY or TOD data type
10/15	DATE_AND_TIME or DT data type
10/16	STRING data type
10/17	BYTE data type
10/18	WORD data type
10/19	DWORD data type
10/20	LWORD data type
12/1	Directly derived data types
12/2	Enumerated data types
12/3	Subrange data types
12/4	Array data types
12/5	Structured data types
13	Standard default initial values
Subclause 2.5.1.3	User-declared functions (no table entry)
22/1	Type conversions (see Table 5-4)
22/2	TRUNC function
22/3	BCD_TO_** functions
22/4	*_TO_BCD functions
23/1-11	Standard functions of one numeric variable: ABS, SQRT, LN, LOG, EXP, SIN, COS, TAN, ASIN, ACOS, ATAN
24/ 12n-18n	Standard named arithmetic functions: ADD, MUL, SUB, DIV, MOD, EXPT, MOVE
24/ 12s-15s, 17s, 18s	Standard symbolic arithmetic functions: +, *, -, /, **, :=