



BS 6146 : Part 2 : 1981
IEC 625-2 : 1980

UDC 621.317.7 : 621.38 : 681.326.3.04 : 681.513.2

An interface system for programmable measuring instruments (byte serial, bit parallel)

Part 2. Guide for code and format conventions

Un système d'interface pour instruments de mesure
programmables (bits parallèles, octets série)
Partie 2. Guide pour les conventions de code et de format

Ein Schnittstellensystem für programmierbare Meßgeräte (byteseriell, bitparallel)
Teil 2. Anleitung zu den Vereinbarungen über Codes und Datenformate

National foreword

This Part of this British Standard, published under the direction of the Electronic Equipment Standards Committee, is identical with IEC Publication 625-2 'An interface system for programmable measuring instruments (byte serial, bit parallel)' Part 2 'Code and format conventions' published in 1980 by the International Electrotechnical Commission (IEC).

Part 1 of this British Standard, which is published simultaneously with this Part, deals with functional specifications, electrical specifications, mechanical specifications, system applications and requirements for the designer and user.

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards.

References to page numbers in the text refer to IEC page numbers, which are given in brackets at the bottom of each page.

Cross-references

International standard	Corresponding British Standard
IEC 625-1 : 1979	BS 6146 An interface system for programmable measuring instruments (byte serial, bit parallel) Part 1 : 1981 Specification for functional, electrical and mechanical requirements, system applications and requirements for designer and user (Identical)
ISO 646-1973	BS 4730 : 1974 Specification for the United Kingdom 7-bit data code (ISO-7-UK) (Technically equivalent)
ISO 1000-1973	BS 5555 : 1976 SI units and recommendations for the use of their multiples and of certain other units (Identical)
ISO 1001-1979	BS 4732 Specification for magnetic tape labelling and file structure for data interchange Part 2 : 1979 Label standard version 3 (Identical)
ISO 3309-1979	BS 5397 Specification for high-level data link control procedures for data communication Part 1 : 1976 Frame structure (Identical)

Related British Standards for ISO 1155-1978 and ISO 2955-1974, referred to for information purposes only, are, respectively, BS 4505 'Digital data transmission' Part 3 : 1969 'The use of longitudinal parity to detect errors in information messages', and DD 8 : 1971 'Unit symbols for use in systems with limited sets'.

IEC 27-1 : 1971 and IEC 27-2 : 1972, referred to for information purposes only, are related to BS 1991 'Letter symbols, signs and abbreviations' Part 6 : 1975 'Electrical science and engineering'. Attention is also drawn to BS 5775 'Specification for quantities, units and symbols' Part 5 : 1980 'Electricity and magnetism', which is identical with ISO 31/V-1979. ISO 31/V-1979 is related to IEC 27, but does not contain so many detailed recommendations.

Additional information. The 'bel', which is referred to in C1.2, is not a recognized SI unit. BS 1991, BS 5555 and DD 8 give the 'decibel' as the unit for sound power level, with the symbol 'dB' (common usage) or 'DB'.

CONTENTS

	Page
National foreword	Inside front cover
Cooperating organizations	Back cover
Introduction	2
Clause	
1. Scope	2
2. Object	3
3. System considerations	3
4. Message concepts	4
5. Measurement data	5
6. Program (programme) data	7
7. Status data	8
8. Display data	9
9. Data shift techniques	9
10. Data representation	9
11. Message unit separation	14
12. Code elements related to signal-lines	18
13. Error detection	19
APPENDIX A – Illustrative message formats	20
APPENDIX B – Syntactical description for device-dependent message formats	21
APPENDIX C – Preferred SI units and multipliers	22
APPENDIX D – Reference literature on error detection techniques	24

British Standard

An interface system for programmable measuring instruments (byte serial, bit parallel)

Part 2. Guide for code and format conventions

INTRODUCTION

IEC Publication 625-1, An Interface System for Programmable Measuring Instruments (Byte Serial, Bit Parallel), Part 1: Functional Specifications, Electrical Specifications, Mechanical Specifications, System Applications and Requirements for the Designer and User, sets forth the device-independent mechanical, electrical, and functional specifications necessary to permit the configuration of programmable instruments using a byte-serial, bit-parallel means to transfer digital data among the interconnected instruments and apparatus. A fourth category of specifications dealing with the more operational aspects of an interface system is necessary to bring about a full and complete operating system. These operational specifications and parameters of systems and devices tend to be more device and system dependent. Program codes and formats, application software, diagnostic routines, and application dependent operational sequences unique to specific devices or systems are examples of items considered to be operational in nature. No single code set and message format appears to be feasible for use with IEC Publication 625-1 and still support the overall objective of permitting a wide range of products and product capabilities to be interfaced. It is feasible, however, to define a limited set of guidelines and alternatives setting forth a number of different codes and formats generally applicable to products implemented with IEC Publication 625-1 capability.

It is assumed the reader of this standard is familiar with the general content and descriptive means of IEC Publication 625-1.

1. Scope

- 1.1 This standard elaborates a family of codes and formats to be generated, processed, and interpreted by the device functions of apparatus operating in concert with interface functions.
- 1.2 This standard is intended to apply to both those devices with limited ability to generate, process or interpret a variety of codes and formats as well as those devices that have extensive ability to generate, process and interpret unique and very specialized codes and formats.
- 1.3 This standard applies to the organization and content of messages at the machine-to-machine information interchange level, however, the guidelines set forth herein may have critical impact on both the related man-to-machine and machine-to-man information interchange.
- 1.4 This standard applies to device-dependent messages, and Figure 1, page 9, shows the major relationships between this part and the other parts of the standard.

2. Object

This standard is intended:

- to enable the highest possible degree of compatibility among different manufacturers' products;
- to enable the interconnection of measurement apparatus and equipment with both limited and extensive capability to generate, process and interpret a variety of different message types;
- to define codes and formats that will minimize the generation of application software and system configuration costs;
- to permit direct communication among apparatus and equipment without extraordinary translation and conversion of special codes and formats;
- to define a limited family of preferred message codes and formats in a relatively device-independent manner.

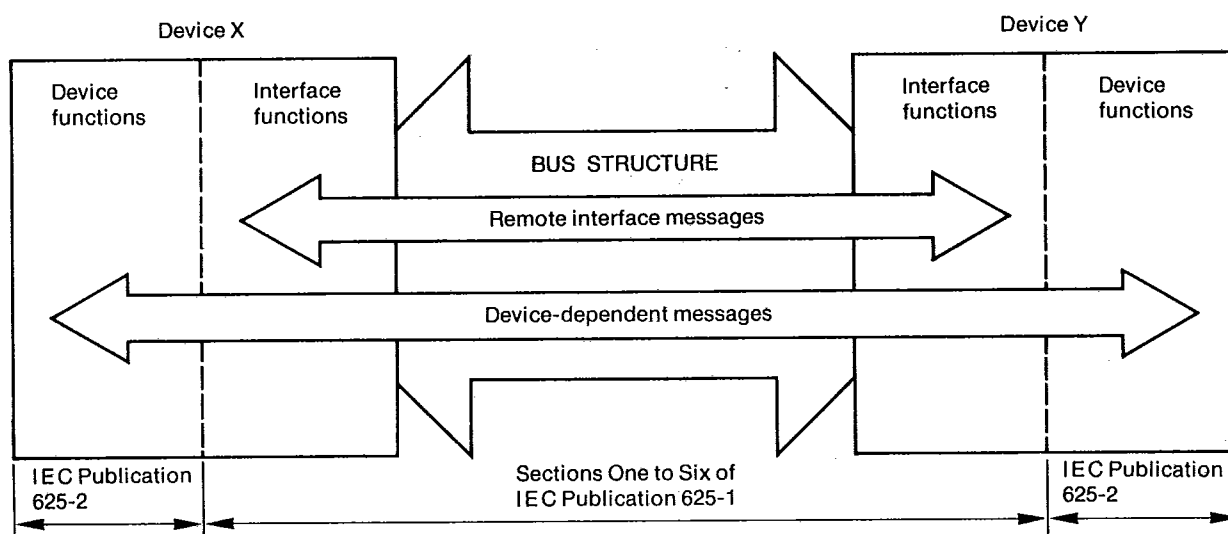


FIG. 1. – Functions and messages of the interface system.

3. System considerations

The purpose of an interface system is to carry device-dependent messages between devices, via interface functions, to and from device functions as shown in Figure 1. Device functions may differ from one another in several respects, and thus impact the nature of device-dependent messages that may be interchanged. The type and complexity of messages interchanged is, in part, determined by these factors:

- 1) ability of devices to generate, process or interpret only a limited or single set of codes and formats versus an extensive or complex set of data codes and formats;
- 2) data sourced or sunk completely at a machine level versus data initiated or consumed via human contact.

Systems may be configured that require support of only the lowest level of messages interchanged, only the highest level of messages interchanged, or a mixture of high and low-level messages interchanged. The type of system or systems a given product is to be placed in (i.e., other products it must communicate with and at what levels) has a significant impact on the

nature of device-dependent messages the product may be capable of generating, processing or interpreting. The codes and formats used by a given product determine, to a large extent, the scope of systems the product will operate effectively in. Therefore, careful consideration should be given to the matter of code and format capability of a device to ensure satisfactory system performance.

4. Message concepts

4.1 *Message type*

Devices interconnected through the interface send and receive different types of device-dependent messages at different times and for different purposes during an operational sequence. The major purpose for which messages may be carried across the interface are identified as follows:

- measurement data (e.g., parameter(s) measured by an instrument, output) (see Clause 5);
- program or control data (e.g., set-up of information determining the measurement function(s) of an instrument, input) (see Clause 6);
- status data (e.g., internal condition(s) of an instrument, output) (see Clause 7);
- display data (e.g., text or other data previously generated and then displayed for operator convenience, input or output) (see Clause 8).

The formats for these different message (data) types tend to be different from each other and furthermore the format within each data type may not necessarily be the same for different products as used in different applications. Therefore, a selection of formats are contained in the following clauses to best satisfy these different needs.

4.2 *Message unit*

4.2.1 Any given device-dependent message, of the type listed in Sub-clause 4.1, represents an amount of information whose beginning and end are defined or implied and are generated, carried and interpreted as a unit. In general, device-dependent messages contain a header (alpha), body (numeral) and ending (delimiter). Either or both the header or ending may be implicit. Further, messages may be either isolated or grouped to form a continuous flow of messages, as a function of the given application requirements.

4.2.2 A message unit contains one or more data bytes (identified throughout Section Two of IEC Publication 625-1 as DAB) and may in addition contain an EOS byte(s). In general, a string of data bytes generated, processed or interpreted as a unit constitute a message unit. Specialized messages that tend to be more device-dependent, such as the status byte (STB) and the end message (END), are examples of a message contained within a single byte or single bit respectively.

4.3 *Data fields*

4.3.1 The message unit contents are considered to be further partitioned into data fields to reflect specific and identifiable portions of data within the message unit. An individual data field is considered to be either essential or optional as identified in subsequent clauses.

Not all message units need contain all possible data fields. Each of the several message types identified in Sub-clause 4.1 may contain a different set of data fields for different applications to which the instrument or device is applied.

4.3.2 In this standard the individual data fields are identified by letters as follows:

T	Type and/or quality of data	Header (alpha)
U	Sign or polarity of data	Body (numeric)
V	Numeric value of data	
W	Exponent notation	
X	String delimiter	Ending (delimiter)
Y	Block delimiter	
Z	Record delimiter	

5. Measurement data

Instrumentation devices typically output data (e.g., frequency, voltage, current) as a result of performing a measurement function. These device-dependent data are output while the device's talk interface function is in TACS state. To accommodate the wide variety of measurement devices, the general format for measurement output data may be variable in length and may contain alpha information, in addition to the numeric values, to adequately describe and identify the numeric portion of the output data string.

5.1 Message unit format and structure

5.1.1 The basic message unit representation of measurement data may use as many as five different data fields, each to serve a specific purpose. Each field, identified by an arbitrary letter for descriptive purposes, is output in the sequence below from left to right:

T U V W X Y Z

Within each field, the most significant digit (or character) is output first. Only one of the fields X, Y and Z is allowed in any one message unit.

5.1.2 All data fields are optional except the V field containing the numeric value.

5.1.3 The T, V and W fields may be of variable length to best fit the specific device application.

5.2 Data field content (see Table I)

5.2.1 The **T** field is used to describe the type and quality of the data present in the V field. The preferred data in the T field is limited to alpha information and should be as short in length as possible. Interpretation of the data is simplified if the T field is fixed in length for each unique product.

If the **T** field refers to units, the use of unscaled units (e.g., F, V, A, m) is preferred. Scaled units are permitted as long as the prefixes are in accordance with IEC Publication 27: Letter Symbols to be Used in Electrical Technology (see Appendix C). Multiples of 10^3 or 10^{-3} (e.g., μF , mV, kA, mm) are preferred.

Examples for contents of the T field referring to the quality of the data that follow in the V field are overload, overflow, over-range, calibration value, etc.

5.2.2 The **U** field is limited to a single character. It may be used:

- to indicate the sign (polarity) of the data present in the following V field which then together is termed "Signed representation" in Sub-clause 5.2.3;
- where the sign is positive the U-field may contain Δ^* in its place, or the U-field may be omitted, and the term is "Unsigned representation".

TABLE I

Code set for the representation of measurement or program data by the ISO 7-bit Code

Field	Interpretation	Use ¹⁾		Number of bytes when used	Characters or columns of the ISO 7-bit Code (columns 0 and 1 are disallowed)		Remarks
					Preferred	Allowed	
T	Unit or quality	O	M	As small as possible	Any alpha characters from columns 4 and 5	Any alpha characters from columns 6 and 7, and Δ (space)	- Use "E" (in respect of W) with caution - Use non-alpha characters from columns 2 to 5 with caution for program data^{2) 3)}
U	Sign	O	O	1	+ - ¹⁾	Δ (space)	No spaces at beginning of V field if U field is + or -
V	Numerals	M	O	≥ 1	Any numerals from column 3	Δ (space)	No embedded nor trailing spaces
	Decimal point	O	O	1	. (period)	No others	
W	Identifier	M only if NR 3 used		1	E	No others	The W field is either to be used completely or not to be used at all
	Sign			1	+ - ¹⁾	No others	
	Numerals			≤ 2	Any numerals from column 3	No others	Preferred: two digits Allowed: one digit For further preferences see NR 3 (Sub-clause 10.3.5)

Notes 1. - The "|" sign is used in this table and throughout this standard to separate two specified characters.

2. - The use of |+|-|.|. and digits 0 to 9 not allowed.

3. - Use of O and I are sometimes construed to be 0 and 1.

4. - M = mandatory; O = optional; MD = measurement data; PD = program data.

* In this and further paragraphs, Δ means "space", <SP>

- 5.2.3 The **V** field is used to present the numeric value of the measurement data and may be of variable length to fit the particular product requirements.

V field data is sent (and received) most significant digit first.

The V field is the only mandatory one for measurement data.

- 5.2.4 The **W** field is used together with, and to present the exponent of the numeric value expressed in, the V field when exponential (NR 3) representation is used (see Sub-clause 10.3.5).

The W field consists of three mandatory parts in the sequence as follows:

- 5.2.4.1 The single character E designates that the subsequent numerals, including their sign, are to be interpreted as an exponent to the base 10.
- 5.2.4.2 The single character + or - indicates the sign of the exponent. If the exponent is equal to zero the + sign shall be used.
- 5.2.4.3 One or more characters indicate the exponent. A two-digit exponent is preferred. A one-digit exponent is allowed.
- 5.2.5 The **X**, **Y** and **Z** fields are used to delimit either single message units, multiple message units each one of which contains a different data type, or multiple message units containing the same data type. Clause 11 defines specific alternatives for the several different delimiter requirements common in instrumentation systems.

6. Program (programme) data

Instrumentation devices typically receive program data (e.g., measurement range, operating mode, output mode) in preparation for performing a measurement function. This device-dependent data is input while the device's listen interface function is in the LACS state. A wide variety of device-dependent requirements and capabilities must be accommodated and therefore a rigid format for program data is not feasible. A few guidelines, however, will serve to minimize potential ambiguities.

- 6.1 A program data input string usually consists of a series of message units each of which is constructed, in general, from the data fields described as T and V in Sub-Clause 5.2.
- 6.2 Each functional message unit (considered in some implementations to be accessed by "sub-addresses") should contain at least one leading alpha character in the T field to identify the functional use of that message unit. Use of the V field is optional.
- 6.3 Suitable choice of T and V field characters minimizes or eliminates the need for delimiters between each functional message unit. A V field may be followed with one or more alpha characters to identify the V field unit provided these alpha characters are then delimited explicitly or implicitly in an unambiguous manner.
- 6.4 If V field data is represented in exponential form (NR 3), then E must be used with caution to avoid ambiguity.