

IEEE Standard Serial Interface for Programmable Instrumentation

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Abstract: A serial, full-duplex, asynchronous, 9-pin data terminal equipment (DTE) communications port for programmable instrumentation that follows ANSI/TIA/EIA-574-1990 and related standards is defined in this standard.

Keywords: controller, data communication equipment (DCE), data terminal equipment (DTE), device, IEEE 488.1, IEEE 488.2, interchange circuit, null modem cable, observation, permission, recommendation, rule

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

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Introduction

(This introduction is not part of IEEE Std 1174-2000, IEEE Standard Serial Interface for Programmable Instrumentation.)

The development of this standard began with an ambitious plan to layer IEEE Std 488.1-1987 and IEEE Std 488.2-1992 so that several media could take advantage of the installed base of IEEE 488 protocols. This initiative was taken in cooperation with the IEC/SC65C Working Group 3 (WG3). It appeared that this was not possible without a considerable change of the format of the IEEE 488 standards. This was considered as undesirable. Therefore, the scope was much reduced to just the support of what is popularly known as the “RS-232 serial interface” which is ubiquitous on personal computers. This standard draws from existing standards as much as possible but seeks to provide a standardization for an instrument design that chooses the slower speed serial communication because of the simplicity of the interface, the availability of most any personal computer as a controller, or other factors.

At the time of the publication of this standard, the members of the Working Group were:

Robert S. Cram, *Chair*

Stephen Greer
Steve Lomas

Joe Mueller
John Pieper

Carsten Schilling
Jochen Wolle

In the development of this standard, the Working Group was supported by many other individuals from many different organizations who contributed time, effort, and technical expertise. In particular, the Working Group wishes to acknowledge the following individuals for their contributions:

Chris Bagge
Dieter Burkhart

Gerrit de Vries
Carl Hagerling

Knud Johansen
Allen Tracht

The following members of the balloting committee voted on this standard:

David Anderson
Elaine Cooney
Roy Courtney
Robert S. Cram
Stephen Greer
Carl Hagerling

Michael G. Harrison
Ben Lee
Steve Lomas
Doug Lyons
Marlyn Miner
Robert C. Rassa

Eric Sacher
Larry C. Sollman
Joseph J. Stanco
Robin Steele
Andrew Thomson
Allen Tracht

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Akio Tojo
Hans E. Weinrich
Donald W. Zipse

*Member Emeritus

Also included is the following nonvoting IEEE-SA Standards Board liaison:

Robert E. Hebner

Andrew D. Ickowicz
IEEE Standards Project Editor

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IEEE Standard Serial Interface for Programmable Instrumentation

1. Overview

Clause 4 defines electrical, mechanical, and interchange circuit requirements suitable for controlling programmable instruments over a serial interface. Clause 5 defines techniques to emulate IEEE Std 488.1-1987¹ which are suitable for controlling programmable instruments over a serial interface as defined in Clause 4. Clause 6 defines techniques to emulate IEEE Std 488.2-1992 which are suitable for controlling programmable instruments over a serial interface as defined in Clause 4 and Clause 5. In conjunction, Clause 4 through Clause 6 form a set describing a method for ASCII-based communication over a serial link between a controller and a device using concepts found in IEEE Std 488.2-1992. Figure 1 shows the relationship among the standards. Annex A describes a state machine implementation which follows the rules of Clause 6, and Annex B summarizes the allowed Performance Classes to an IEEE 1174 interface.

1.1 Scope

This standard defines a serial, full-duplex, asynchronous, 9-pin data terminal equipment (DTE) communications port that follows ANSI/TIA/EIA-574-1990 and related standards. Portions of several standards will be referenced along with specific extensions applying to programmable instruments.

This standard applies point-to-point instrument systems composed of a measurement, stimulus, or interconnect device and an instrumentation controller. It may also apply to certain devices outside the scope of the instrument system environment.

This standard covers mechanical, electrical, and functional requirements of the interface. Intended readers include electrical, mechanical, and software engineers.

Topics covered in IEEE Std 488.2-1992 include the following:

- a) Extraction of items in IEEE Std 488.2-1992, which are independent of IEEE Std 488.1-1987.
- b) Alternatives for IEEE Std 488.2-1992 functionality that require IEEE Std 488.1-1987.

¹Information on references can be found in Clause 2.

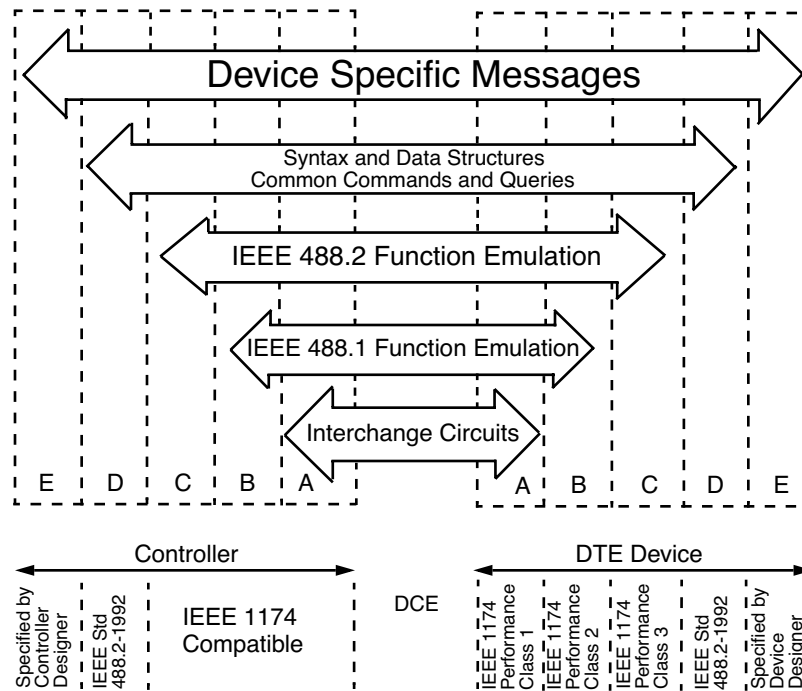


Figure 1—Relationship between IEEE Std 1174-2000 and IEEE 488 standards

2. References

This standard shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

ANSI X3.4-1986 (R1997), American National Standard Code for Information Interchange (7-bit ASCII)—Information Systems—Coded Character Sets—7-bit.²

ANSI/TIA/EIA-232-F-1997, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.³

ANSI/TIA/EIA-404-B-1995, Standard for Start-Stop Signal Quality for Non-Synchronous Data Terminal Equipment.⁴

ANSI/TIA/EIA-562-1990 (R1998), Electrical Characteristics for an Unbalanced Digital Interface.

ANSI/TIA/EIA-574-1990 (R1998), 9-Position Non-Synchronous Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

IEEE Std 488.1-1987 (Reaff. 1994), IEEE Standard Digital Interface for Programmable Instrumentation⁵

²ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

³EIA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (<http://global.ihs.com/>).

⁴TIA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (<http://global.ihs.com/>).

⁵IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

IEEE Std 488.2-1992, IEEE Standard Codes, Formats, Protocols and Common Commands for Use with IEEE Std 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation

ISO 1177:1985, Information Processing—Character Structure for Start/Stop and Synchronous Character Oriented Transmission⁶

ITU Recommendation V.14 (03/93)—Transmission of Start-Stop Characters Over Synchronous Bearer Channels⁷

ITU Recommendation V.24 (02/00)—List of Definitions for Interchange Circuits Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE)

ITU Recommendation V.28 (03/93)—Electrical Characteristics for Unbalanced Double-Current Interchange Circuits

ITU Recommendation V.32 (03/93)—A Family of 2-Wire, Duplex Modems Operating at Data Signaling Rates of up to 9600 bit/s for Use on the General Switched Telephone Network and on Leased Telephone-type Circuits

ITU Recommendation V.42 (10/96)—Error-Correcting Procedures for DCE's Using Asynchronous-To-Synchronous Conversion

3. Definitions, acronyms, abbreviations, and terminology

3.1 Definitions

3.1.1 controller: Data terminal equipment (DTE) that sends program message to and receives response messages from the device.

3.1.2 data communication equipment (DCE): In a data station, the equipment that provides the signal conversion and coding between the DTE and the line.

3.1.3 data terminal equipment (DTE): The part of a data station that serves as a data source, a data sink, or both⁷. In general, DTE may include terminals, computers, instruments, and other devices involved with the end-point generation and reception of interchange circuits. Specifically, in this document, DTE refers to instruments.

3.1.4 device: A DTE that receives a program message from and sends response messages to the controller.

3.1.5 interchange circuit: An interconnecting circuit at the interface between DTE and DCE for the transfer of binary data, control, and timing signals.⁸

3.1.6 null modem cable: A cable that allows two DTE devices to be directly connected by simulating, through cross wiring in the cable, an intermediate DCE-line-DCE circuit.

⁶ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iso.ch/>). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

⁷ITU publications are available from the International Telecommunications Union, Sales Section, Place des Nations, CH-1211, Genève 20, Switzerland/Suisse (<http://www.itu.int/>). They are also available in the United States from the U.S. Department of Commerce, Technology Administration, National Technical Information Service (NTIS), Springfield, VA 22161, USA.

⁸Refer to ITU Recommendation V.24 (02/00) and ITU Recommendation V.28 (03/93).

3.2 Acronyms and abbreviations

ANSI	American National Standards Institute
CCITT	International Telegraph and Telephone Consultative Committee
CTS	Clear To Send
DCD	Data Carrier Detected
DCE	Data Communication Equipment
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EIA	Electronic Industries Association
IEEE	Institute of Electrical and Electronics Engineers
ITU	International Telecommunications Union (formerly CCITT)
RFR	Ready For Receiving data
RI	Ring Indicator
RLSD	Receive Line Signal Detected
RXD	Received Data
TIA	Telecommunications Industries Association
TXD	Transmitted Data
XOFF	Transmit Off
XON	Transmit On

3.3 Terminology

Throughout this standard, the following headings identify the effects of the paragraphs on an implementation.

3.3.1 Rule

Rules shall be followed to ensure compatibility. A rule is characterized by the use of the words *shall* and *shall not*. These words are not used for any other purpose than stating rules.

3.3.2 Recommendation

Recommendations consist of advice to implementers which will affect the usability of the final device. These words are not used for any other purpose than stating rules.

3.3.3 Permission

Permissions are included to clarify the areas of the specification that are not specifically prohibited. Permissions reassure the reader that a certain approach is acceptable, and will cause no problems. The word *may* is reserved for indicating permissions.

3.3.4 Observation

Observations spell out the implications of the rules and bring attention to things that might otherwise be overlooked. They also give the rationale behind certain rules, so the reader understands why the rule must be followed.

4. Mechanical, electrical, and circuit requirements

4.1 Introduction

This clause defines electrical, mechanical, and interchange circuit requirements suitable for controlling programmable instruments over a serial interface. It describes a serial, full-duplex, asynchronous, 9-pin DTE communication port that follows ANSI/TIA/EIA-574-1990 and related standards. Portions of several other standards are also referenced along with specific extensions as they apply to instrument control.

This clause is one part in a set that together describe a method for ASCII-based communication over a serial link between a controller and an instrument. The other clauses in the set, Clause 5 and Clause 6, deal with emulating selected functionality of IEEE Std 488.1-1987 and IEEE Std 488.2-1992. Figure 1 shows the relationship among the standards.

This clause applies to point-to-point instrument systems composed of a measurement, stimulus, or interconnect device and an instrumentation controller. The connection may be hard-wired, by a modem interconnection, electrical to fiber optic transceivers, or other applicable means. The performance defined by this clause may also apply to certain devices outside the scope of the instrument system environment. The clause covers mechanical, electrical, and functional requirements of the interface. Intended readers include electrical, mechanical, and software engineers. This standard does not cover the interaction of multiple interfaces in a given device.

The objective of this clause is to provide a definition for the electrical, mechanical, and signalling requirements of a serial control interface suitable for use with programmable instruments. The interface defined by this standard is a serial, full-duplex, asynchronous, 9-pin DTE communication port that follows ANSI/TIA/EIA-574-1990 and related standards. Portions of several standards are referenced here along with specific extensions applying to programmable instruments.

4.2 IEEE 1174 Performance Class 1 compliance

RULE: A device claiming compliance to IEEE 1174 Performance Class 1 (Base Functionality) shall follow all rules as mentioned in Clause 4.

RULE: An IEEE 1174-compliant device shall follow all requirements of IEEE 1174 Performance Class 1.

4.3 Mechanical

Mechanical requirements follow ANSI/TIA/EIA-574-1990. This clause details the references for each mechanical requirement area and adds further rules and recommendations as needed.