METRIC

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SECTION 502
28 June 1974

MILITARY STANDARD

INTERFACE STANDARD FOR SHIPBOARD SYSTEMS

SECTION 502

ELECTRONIC SYSTEMS PARAMETERS

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, SEA 03R42, Naval Sea Systems Command, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) apearing at the end of this document or by letter.

AMSC N/A FSC 1990

FOREWORD

1. This military standard is approved for use by the Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Commander, SEA 03R42, Naval Sea Systems Command, 2531 Jefferson Davis Hwy., Arlington, VA 22242-5160 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Scope. This document standardizes analog and digital interface parameter data for electronic systems and equipment.

1.2 Application. This standard addresses the lowest level of electronic systems Interfacing. Electronic systems interfaces are defined in physical, electrical, and logical terms (see 3.2).

1.3 Policy. Documentation of interface parameters during the design of electronic systems and equipment is required. This will permit the engineering assessment of future interface interoperability between different shipboard electronic systems or units.

1.3.1 Applicability. This standard applies to all Navy electronic systems and equipment. Regardless of whether, at the time of design and production, they are intended to interface with other systems and equipment or operate independently.

1.3.2 General. The policies and procedures established by MIL-STD-1399 are mandatory. This section and the basic standard should be considered as an integral single document.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

STANDARDS

FEDERAL

FED-STD-1037 - Telecommunications: Glossary of Telecommunication Terms.

FEDERAL INFORMATION PROCESSING STANDARDS

FIPS-PUB-60-2 - I/O Channel Interface.

FIPS-PUB-107 - Local Area Networks: Baseband Carrier Sense Multiple Access With Collision Detection Access Method and Physical Layer Specifications and Link Layer Protocol

FIPS-PUB-110-1 - Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Operation With Packet-Switched Data Communications Network.

FIPS-PUB-111 Storage Module Interfaces (With Extensions for Enhanced Storage Interfaces).

FIPS-PUB-130 - Intelligent Peripheral Intrface (IPI)
FIPS-PUB-131 - Small Computer System Interface (SCSI).
FIPS-PUB-146-1 - Government Open Systems Interconnection Profile (GOSIP).

MILITARY

MIL-STD-188-100 - Common Long Haul and Tactical Communications System Technical Standards.
MIL-STD-188-111 - Interoperability and Performance Standards for Fiber Optic Communications Systems
MIL-STD-970 - Standards and Specifications, Order of Preference for the selection of
MIL-STD-1343 - Glossary of Terms for Electronic and Weapons Control Interface Functions (Naval Ship Combat Systems).
MIL-STD-1399 - Interface Standard for Shipboard Systems.

(Unless otherwise indicated. copies of Federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

(Copies of Federal Information Processing Standards (FIPS) are available to Department of Defense activities from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099. Others must request copies of FIPS from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171.)

2.2 Non-Government Publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

X3.44 - Determination of the Performance of Data Communication Systems.
X3.139 - Information Systems - Fiber Distributed Data Interface (FDDI) - Token Ring Media Access Control.
X3.148 - Information Systems - Fiber Distributed Data Interface (FDDI) - Token Ring Physical Layer Protocol (PHY).
X3.166 - Information Systems - Fiber Data Distributed Interface (FDDI) - Token Ping Physical Layer Medium Dependent (PMD).
TI.504 - Telecommunications - Packet-Switched Data Communication Service - Performance Objectives (ECSA).

(Application for copies should be addressed to the American National Standards Institute, 11 W. 42nd ST., 13th Floor, New York, NY 10036.)

ELECTRONIC INDUSTRY ASSOCIATION (EIA)

CB9-F - Reference Guide for Fiber Optic Test Procedures.
334-A - Signal Quality At Interface Between Data Terminal Equipment and Synchronous Data Circuit-Terminating Equipment for Serial Data Transmission.
404-A - Standard for Start-Stop Signal Quality for Non-Synchronous Data Terminal Equipment.
408 - interface Between Numerical Control Equipment Employing Parallel Binary Data Interchange.
TIA-440-A - Fiber Optic Terminology.
TIA-455-A - Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components.
526-3 - OFSTP-3 Fiber Optic Terminal Equipment Receiver Sensitivity and Maximum Receiver Input.

(Application for copies should be addressed to the Electronic Industries Association, c/o Global Engineering, 15 Inverness Way East, Englewood, CO 80112-5704.)

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

100 - IEEE Standard Dictionary, Of Electrical and Electronics Terms.
165 - Standard Definitions of Terms for Analog Computers.
200 - Reference Designations for Electrical and Electronics Parts and Equipments (ANSI Y32.16) (DOD adopted)
610 - Computer Dictionary
812 - Standard Definitions of Terms Relating to Fiber Optics. (DOD adopted)

(Application for copies should be addressed to the Institute of Electrical and Electronic Engineers Inc., 445 Hoes Lane, P.O. Box 1331, Piscataway, NY 08855-1331.)

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS (SNAME)

3-44 - Fiber Optic Guidelines.

(Application for copies should be addressed to the Society of Naval Architects and Marine Engineers, 601 Pavonia Ave., Jersey City, NJ 07306.)

2.3 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.3.1 Documents order of Preference. Documents should be selected in the order of preference prescribed by MIL-STD-970

3 DEFINITIONS

3.1 Definitions. Unless otherwise specified, the parameters listed herein are defined by FED STD 1037, MIL-STD-1343, EIA 440-A, IEEE 165, IEEE 610, and IEEE 812.

3.2 Interface points. All signal leads and power cables entering or leaving the system should be identified as interface points.

3.2.1 Physical. Physical definitions of an interface consist of mechanical connector dimensions and pinouts.

3.2.2 Electrical. Electrical definitions of an interface consist of electrical parameters as specified herein.

3.2.3 Logical. Logical definitions of an Interface consist of well defined sequences of events, data groupings, and protocols.

4. GENERAL REQUIREMENTS

4.1 General considerations. Frequently, it is necessary to interface two or more electronic units or systems. This is done to fulfill the requirements of a new mission or to improve their capability to accomplish a given mission. To allow an engineering analysis of the interface between electronic units or systems accurate and complete parameter information shall be recorded during the design phase of such electronic units or systems.

4.2 Interface. The basic characteristic and constraint categories concerned with this interface are shown symbolically on figure 1 (see "Definitions" paragraph of MIL-STD-1399):

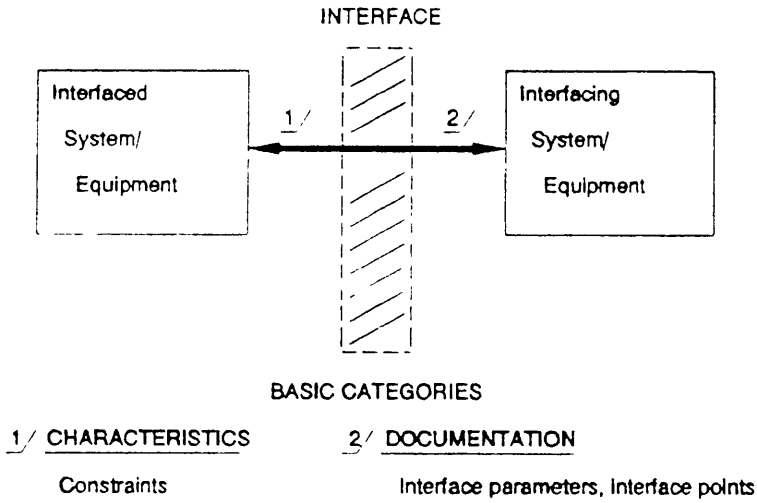


FIGURE 1 Interface.

5. DETAILED REQUIREMENTS

5.1 Identification and location.

5.1.1 Identification. The circuit and physical location of each interface point shall be identified.

5.1.1.1 Circuit location. The circuit location of the interface points associated with each set of parameters shall be identified by the equipment nomenclature , appropriate item level reference designator, manufacturer's part and code number, and schematic location.

5.1.1.2 Physical location. The physical location of the interface point associated with each set of parameters shall be identified by equipment nomenclature, assembly item level, and connection point. IEEE 200 provides definitions of item level breakdown and reference designation numbering methods for these items.

5.2 Interface parameters. Unless otherwise specified by an open systems architecture or a military specified interface, the interface parameters for an electronic system shall be identified to permit an engineering analysis.

5.2.1 Unique parameters. The analog, digital, and fiber optic parameters listed in 5.5, 5.6, and 5.7 (as applicable to a particular interface) are considered necessary to evaluate the interoperability between interfaced electronic units or systems; additional parameters unique to particular units or systems may be needed to adequately describe the interface. Weapons control functions shall be identified in accordance with MIL-STD-1343. All unique parameters shall be identified.

5.3 Parameter sheets.

5.3.1 Parameter data sheets. Technical information for each applicable parameter including unique parameters, will be recorded on an individual data sheet. In addition to the parameter data, a list of test equipment used to obtain the parameter data and a diagram of the test equipment hookup shall be provided. The test equipment diagram shall include the grounding configuration of the interconnected test equipment, grounding configuration of the test leads and shields, and alternating current (at) power isolation if used of the test equipment. When calculated parameter data is provided instead of, or with, measured parameter data, all equivalent circuits derived from the actual circuits, which were used in the calculations, shall be provided to aid in the evaluation of the data.

5.3.2 Parameter status sheets. Parameter status sheets in the general format of figure 2 shall be provided, Status sheets shell indicate the applicable parameters and identify the parameter connection points. Entries shall be associated with the interface points. Examples are filled in as shown on figure 2.

Parameter status sheet	Interface point	Interface point	Interface point
PARAMETER	4A6T6 Pins 5 and 7	3A4A1 Pins 6 and 7	
Signal (input)	X	-	
Signal (output)	-	X	
Impedance (input)	X	-	
:			
:			

FIGURE 2. Parameter status sheet.

5.4 Criteria for parameters. Performance parameters criteria for digital and fiber optic parameters (see 5.6 and 5.7), may be derived from but not limited to FIPS-PUB-60-2, 107, 110-1, 111, 130, 131, and 146-1; MIL-STD-188-100; ANSI X3.44, X3.139, X3.148, X3.166, and T1.504, EIA CB9-F, 334-A, 404-A, 408, TIA-455-A, and TIA-526-3; and SNAME 3-44.

5.5 Analog interface parameters. Detail descriptions of analog parameters applicable to electronic systems or equipment are shown in table I.

TABLE I. Analog interface parameters.

Analog parameter	Requirement
Signal type (input)	Provide the signal type, such as; analog, sine wave, noise, pulse, frequency bandwidths, and others.
Signal type (output)	Provide the signal type, such as; analog, sine wave, noise, pulse, frequency bandwiths, and others.
Interface power requirement (input)	Provide measured, calculated, or both, if available, operating interface signal power requirements for receiving interface circuits; include power factor, voltage and tolerances, current, frequency and tolerances, frequency range, grounding configuration, phase.
Interface power requirement (output)	Provide measured, calculated, or both, if available, operating interface signal power requirements for sending interface circuits; include power factor, voltage, and tolerances, current, frequency and tolerances, frequency range, grounding configuration, phase.

TABLE I. Analog interface parameters - Continued.

Analog parameter	Requirement
Impedance (input)	Provide measured, calculated, or both if available, impedance as a function of frequency at the input terminals of an information receiving device. Show real and imaginary components over the operating bandwidth and as far as practical above and below this bandwidth. Data should be a graph plot with enough frequency points to describe the impedance.
Impedance (optimum source)	If this parameter is critical, the optimum source impedance should be stipulated. Data shall be a graph plot versus frequency, if applicable.
Impedance (minimum source)	Provide the lowest value of impedance which can be connected to an information receiving device that will not affect the design performance of the receiving device. Data shall be a graph plot versus frequency, if applicable
Impedance (output)	Provide measured, calculated, or both if available, impedance as a function of frequency at the output terminals of an information sending device. Show real and imaginary components over the entire operating bandwidth and as far as practical above and below this bandwidth. Data shall be a graph plot with enough frequency points to describe the impedance.
Impedance (optimum load)	If this parameter is critical, the optimum load impedance shall be stipulated. Data shall be a graph plot versus frequency, if applicable.
Impedance (maximum load)	Provide the lowest value of impedance which can be connected to an information sending device that will not degrade the design performance of that device Data shall be a graph plot versus frequency, if applicable.
Common mode rejection (CMR)	Provide the measure of the capability of a differential or balanced input circuit to discriminate against in-phase interference signals with equal levels common to both sides of the input, while amplifying the desired signal. CMR shall be specified in decibels (dB).
Common mode rejection ratio (CMRR)	Provide the measure of the ability of a differential amplifier to produce a zero output for like inputs.

TABLE I Analog interface parameters - Continued.

Analog parameter	Requirement
Bandwidth (output)	Provide the measured, calculated, or both if available, range of frequencies over which the equipment is intended to send information in all modes of operation. Describe the bandwidth of each mode of operation, if different.
Bandwidth (input)	Provide the measured, calculated, or both if available, range of frequencies over which the equipment is intended to receive information in all modes of operation.
Sine wave gain versus frequency response (output)	Provide gain versus frequency response of information sending device from input to interface output point over entire operating bandwidth and at least two octaves above and below this band using sine wave signals. Data shall be in a table or graph plot versus frequency
Sine wave gain versus frequency response (input)	Provide gain versus frequency response of information receiving device from input to output or display over entire operating bandwidth and at least two octaves above and below this band using sine wave signals. Data shall be in a table or graph plot versus frequency.
System noise (output)	Provide a spectrum plot of noise (including tonals if present) versus frequency measured at the output of an information sending device which is loaded with the normal input and output impedances of its intended application. Plot shall extend at least two octaves above and below the normal operating bandwidth. Data shall be taken with a narrow bandwidth analyzer.
System noise (input)	Provide a spectrum plot of noise (including tonals if present) versus frequency measured at the input sending device by the gain of the device in each mode or channel, if different. The system should be loaded with the normal input and output impedances of its intended application. Plot shall extend at least two octaves above and below the normal operating bandwidth. Data shall be taken with a narrow bandwidth analyzer.

TABLE I. Analog interface parameters - Continued.

Analog parameter	Requirement
White noise gain versus frequency response (output)	Provide gain versus frequency response of information sending device over entire operating bandwidth and at least two octaves above and below this band. The white noise shall be analyzed in a narrow bandwidth at the input and also at the output. Data shall be presented in a graph plot versus frequency.
Minimum expected output (spectrum level)	Provide a graph plot of spectrum amplitude (1 hertz (Hz) basis) versus frequency of a measurement, calculation, or both if available, of the lowest spectrum level voltage or current amplitude that can be expected, which represents the output of a device operating under its normal intended operation conditions Graph plot shall extend at least two octaves above and below the normal operating bandwidth. Data shall be taken with a narrow bandwidth analyzer.
Maximum expected output (spectrum level)	Provide a graph plot of spectrum amplitude (1 Hz basis) versus frequency of a measurement, calculation, or both if available, of the highest spectrum level voltage or current amplitude that can be expected, which represents the output of a device operating under its normal intended operation conditions. Graph plot shall extend at least two octaves above and below the normal operating bandwidth. Data shall be taken with a narrow bandwidth analyzer.
Dynamic range (output) (spectrum level) (flat white noise at input)	Provide a graph plot of spectrum amplitude versus frequency at the maximum and minimum noise which can be present at the output of an information sending device without degradation of information content. Graph plot shall extend at least two octaves above and below the normal operation bandwidth of the sending device. Data shall be taken with a narrow bandwidth analyzer.
Dynamic range (output) (sine wave)	Provide a graph plot or table of amplitude versus frequency of the maximum and minimum sine wave signals which can be present at the output of an information sending device without degradation of the sine wave signal Graph or table shall extend at least two octaves above and below the normal operation bandwidth of the sending device.

TABLE I Analog interface parameters - Continued.

Analog parameter	Requirement
Dynamic range (input) (sine wave)	Provide a graph plot or table of amplitude versus frequency of the maximum and minimum sine wave signals which can be accepted at the input of an information receiving device without degradation of the sine wave signal. Graph or table shall extend at least two octaves above and below the normal operation bandwidth of the receiving device.
Phase conditions (output)	Provide the measured relative phase in degrees between two or more outputs of an information sending device over the entire operating bandwidth of the sending device.
Phase requirements (input)	Provide a tolerance in degrees, minutes, or seconds for relative phase between two or more inputs to a receiving device to allow specification performance for the receiving device.
Distortion characteristics (output) (nonlinear, frequency phase, and intermodulation)	Provide the measured, calculated, or both if available, percentage of distortion characteristics for the output of an information sending device.
Distortion characteristics (input) (nonlinear, frequency, phase, and intermodulation)	Provide the maximum percentage of allowable distortion of a signal at the input of an information receiving device which will allow the device to process the information contained in the signal without error or degradation.
Crosstalk characteristics (output)	Provide the measured crosstalk between two or more outputs of an information sending device over the entire operation bandwidth of the device.
Crosstalk characteristics (input)	Provide the maximum allowable crosstalk between two or more inputs of an information receiving device over the entire operating bandwidth of the device.
Data accuracy (output)	Provide the accuracy of the data transmitted (as opposed to synchro electrical error and static accuracy).
Data accuracy (input)	Provide the specified accuracy requirements of the received data (as opposed to synchro electrical error and static accuracy).

TABLE I. Analog interface parameters - Continued.

Analog parameter	Requirement
Synchro data scaling characteristics (output)	Provide the scale of the data transmission which is the relationship of the position of a synchro transmitter rotor to the minimum and maximum values of the transmitted variable. A graph of rotor position versus transmitted variable shall be provided
Synchro system speed characteristics (output)	Provide the speed at which data is transmitted (single-speed, dual-speed, and so forth).
Synchro data transmission rate characteristics (output)	Provide the maximum and nominal rate of change of the transmitted variable.
Synchro data scaling characteristics (input)	Provide the requirements for the scale of the data reception which are the relationship of the position of a synchro receiver rotor to the expected minimum and maximum values of the received variable. A graph of rotor position versus received variable should be provided.
Synchro system speed requirements (input)	Specify the required speeds at which data must be received (single speed, dual speed, and so forth).
Synchro data reception rate requirements (input)	Provide the maximum and nominal required rate of change of the received variable.
Synchro system loading	Provide an analysis to determine whether or not the transmitter can accommodate the connected receivers and maintain the established system tolerance.
DC on output	Stipulate whether any direct current (dc) voltages are normally present at the signal or servo output terminals, and include the maximum and minimum dc voltage levels. Identify steady state drive current logic level, logical one (1) and logical zero (0), characteristics.
DC on input	Specify if dc at the input terminals of an interfaced equipment affects performance. If it does, explain in detail. Identify steady state drive current logic level, logical one (1) and logical zero (0), requirements.

5 6 Digital interface parameters. Digital parameters applicable to electronic systems or equipment are as shown in table II:

TABLE II Digital interface parameters.

Digital parameter	Requirement
Parity	Provide the parity error detecting and feedback system used. 0 or 1 parity check.
System noise (output)	Provide a spectrum plot of noise (including tonals if present) versus frequency measured at the output of an information sending device which is loaded with the normal input and output impedances of its intended application. Plot shall extend at least two octaves above and below the normal operating bandwidth. Data shall be taken with a narrow bandwidth analyzer.
White noise gain versus frequency response (output)	Provide gain versus frequency response of information sending device over entire operating bandwidth and at least two octaves above and below this band. The white noise shall be analyzed in a narrow bandwidth at the input and also at the output Data shall be presented in a graph plot versus frequency.
Pulse characteristics	Provide a graph or plot of the pulse characteristics to include the following information: (1) Leading edge or pulse rise time, plot the transition from state 0 to state 1. (2) Pulse width or duration, plot the pulse width showing time duration. (3) Trailing edge, plot the transition from state 1 to state 0. (4) Pulse time reference points, plot the time reference points for the pulse.
Byte length	Provide the number of binary digits (bits) having significance designated as a word unit which is to be transmitted as digital data or is required to be received as digital data.
Byte organization or format	Provide the structure of parallel or serial binary bytes and words, delineating dimensions such as standard bit set locations, function codes, or any partitioning; applies to transmitted data characteristics as well as requirements for received digital data.

TABLE II. Digital interface parameters - Continued.

Digital parameter	Requirement
Baud rate	Describe the maximum transfer speed of a byte, bit, or block of data, taking into account byte length, word length, pulse characteristics, pulse repetition rate, transmission frequency, and data transfer mode; applies to transmitted data characteristics as well as requirements for received digital data.
Word rate/bit rate/block rate	Provide the maximum number of data bytes that can be transferred during a message as constrained by such factors as block rate, baud rate, and word, byte and bit dimensions, etc; applies to transmitted data characteristics as well as requirements for received digital data.
Word length	Provide the number of binary digits (bits) having significance designated as a word unit which is to be transmitted or received as digital data.
Word organization	Provide the structure of parallel or serial binary data words, delineating word dimensions such as standard bit set locations, function codes, or any word partitioning.
Error rate	Provide the error rate ratio for each communication channel.
Data block organization	Describe the grouping of data bytes into a block or bytes to form a message. This block is defined by block rate, byte order, and the number of bytes. These parameters may be fixed or variable; applies to transmitted data characteristics as well as requirements for received digital data.
Block size	Define the number of bytes which will always be transmitted or is required to be received wherever a data transmission is initiated. Block size may be specified in several different ways: (1) A fixed block size. (2) A fixed block size with, a cut-off. (3) Variable block size determined by program control.
Bit organization or structure	Provide the characteristics of the type of signals utilized to effect binary signaling. Provide the individual bits of data within a byte, e.g., RZ, NRZ, etc; applies to transmitted data characteristics as well as requirements for received digital data.

TABLE II Digital interface parameters - Continued

Digital parameter	Requirement
Data transfer mode	Define transmission method utilized or method required by receiver for information transfer, e.g., serial, parallel, hybrid, parallel by bit, serial by byte.
Control codes	Control codes should be defined. Control codes are those digital signals, which are sequential pulses in a fixed location in a byte or message (in the serial transfer mode) or which are simultaneous parallel pulses, also in a fixed location in a byte, or message (in the parallel transfer mode) that are utilized to enable the decoding circuitry to identify, locate, and route all information-bearing signal bytes. Applies to transmitted data characteristics as well as requirements for received digital data.
Restrictive codes	Define those digital codes that may not be utilized for identification in the transmission of information because their input into a subsystem element may generate unwanted responses or recognitions, e g , a transmission code which, because it is identical to an internal code of a computer utilized in the system, would effect an undesired computer response; applies to transmitted data characteristics as well as requirements for received digital data.
Error coding	Describe the transmission of inserted redundant message bits that may be decoded and recognized by the receiving/decoding circuitry as indicative of the presence of a transmission error of a known class. The type of error coding, the redundant bits, and whether error detecting or correcting is to be employed should be specified; applies to transmitted data characteristics as well as requirements for received digital data.
Timing diagram	Provide a sketch showing the sequence of operation such as request for data, acknowledgements, etc., consisting of a time base and logic levels for each line of the control cable group; applies to transmitted data characteristics as well as requirements for received digital data.

TABLE II. Digital interface parameters - Continued

Digital parameter	Requirement
Timing	Timing should be described from one of the following definitions. This will apply to transmitted data characteristics as well as requirements for received digital data. (1) Timing, synchronous - A transmission system in which the transfer of information is controlled by the timing established via a master clock, to which all sub-systems are slaved. Establishment of byte, bit, or block synchronization is performed initially. (2) Timing, asynchronous - A transmission system in which the data receiver and data transmitter timing sources are unrelated, requiring a distinctive signal or code to notify the receiver of an impending transmission sequence. (3) Timing, hybrid - A combination of asynchronous and synchronous timing utilized for data transmission; e.g., asynchronous transmission of a block of data with each individual bit and byte within the block being synchronously timed.
Data staleness	Provide information on data that has become no longer useful because of excess time delays effected by interface device delays, e.g., storage delay at a computer because of higher priority interrupt servicing of other users on its I/O channels. A maximum value must be established, as well as whether the value once established is to be fixed or variable; applies to transmitted data characteristics as well as requirements for received digital data.
Transmission mode	Transmission mode should be selected from the following: (1) Unidirectional transmission - A system that possesses the capability to transfer information in only one direction; i.e., source and load are predefined and their functions are irrevocable. (2) Bidirectional transmission - A system with the capability to transfer information in both directions; i.e., all source and load terminals possess both encoding and decoding capabilities, but the latter are not necessarily used simultaneously, applies to transmitted data characteristics as well as requirements for received digital data

TABLE II Digital interface parameters - Continued.

Digital parameter	Requirement
Idle line characteristics	Provide a description of the transmission system line characteristics during time periods when no information transfer is to be effected; applies to transmitted characteristics as well as requirements of receiver equipment.
Delay, programmed	Provide delay information on the slowing up of a pulse means of software or hardware implementation. This may be by means of storage in a memory, shift register, or delay line, and should be specified to maximum and minimum acceptable values in microseconds; applies to transmitted data characteristics as well as requirements for received digital data.
Dead spaces between messages	Provide the minimum and maximum lengths of time in which signals or messages are not transmitted. Information bearing transmission sequences are separated as required, because of data source characteristics or data receiver requirements
Multiplexing	Provide information on the sharing of a single communications channel for multiple data or multiple users. Multiplexing may be by frequency discrimination, time sharing, or separate control line response. The parameters which decide the multiplexing are multiplex frequency, bandwidth, timing diagram, etc., and are required as part of the interface description as well as the type of multiplexing; applies to transmitted data characteristics as well as requirements for received digital data.
Load driving capability characteristics (output)	Define the number of discrete data user terminals or loads or a type to which a single transmitting device may convey desired information without degrading that information or the transmission system characteristics.
Steady state drive current logical zero (0) characteristics (output)	Provide data on the amount of current capable of flowing from the output terminals of an active element or device coincident with a logic (0) state at these output terminals

TABLE II. Digital interface parameters - Continued.

Digital parameter	Requirement
Steady state drive current logical zero (0) requirements (input)	Provide data on the amount of current required at the input of an active element or device coincident with a logic (0) state at these input terminals.
Steady state drive current logical one (1) characteristics (output)	Provide data on the amount of current capable of flowing from the output terminals or an active element or device coincident with a logic (1) state at these output terminals.
Steady state drive current logical one (1) requirements (input)	Provide data on the amount of current required at the input terminals of an active element or device coincident with a logic one (1) state at the input terminals.
Input logic level zero (0)	Provide the maximum and minimum range of pulse or level amplitudes that will be recognized by the receiving digital circuitry as logic zero (0) level that will result in the desired output response. The minimum and maximum values shall be specified.
Input logic level one (1)	Provide the maximum and minimum range of pulse or level amplitudes that will be recognized by the receiving digital circuitry as a logic one (1) level that will result in the desired output response. The minimum and maximum values must be specified.
Output logic level zero (0)	Provide the range of pulse or level amplitudes that will be produced by the driving digital circuitry for a zero. The maximum and minimum values shall be specified. The variation of these levels with load shall be provided.
Output logic level one (1)	Provide the range of pulse or level amplitudes that will be produced by the driving digital circuitry for a one. The maximum and minimum values shall be specified. The variation of these levels with load shall be provided.
Rise time characteristics (output) (positive signal assumed)	Provide the time required for the positive slope transitional edge of a pulse to increase from 10 to 90 percent of its final steady state logic (1) minimum value. Give the expected time limits of the generated pulse for a transmitter.

TABLE II Digital interface parameters - Continued.

Digital parameter	Requirement
Rise time requirements (input) (positive signal assumed)	Provide the time required for the positive slope edge of a pulse to increase from 10 to 90 percent of its final steady state logic (1) minimum value. Give the required tolerance for the rise time to satisfy the receiver input requirements.
Fall time characteristics (output) (positive signal assumed)	Provide the time required for the negative slope transitional edge of a pulse to decrease from 90 percent of its minimum logic (1) value to 10 percent of its nominal zero level voltage. Give the time limits of the generated pulse for a transmitter.
Fall time requirements (input) (positive signal assumed)	Provide the time requirements for the negative slope transitional edge of a pulse to decrease from 90 percent of its minimum logic (1) value to 10 percent of its nominal zero level voltage. Give the required tolerance for the fall time to satisfy the receiver input requirements
Pulse width characteristics (output)	Provide the value in time between the percent amplitude values on the positive and negative transitional edges of a pulse whose steady state value is the minimum allowable logic (1) value.
Input pulse width sensitivity requirements	Provide the range of values of pulse widths that will be recognized as information-bearing signals by the receiving system circuitry. The minimum and maximum values shall be specified.
Maximum load capacitance	Provide the maximum value of load capacitance that a transmitting device can tolerate without degrading either the information to be transmitted or the transmission system characteristics.
Maximum source capacitance	Provide the maximum value of source capacitance that a receiving device can tolerate without degrading either the information to be received or the reception system characteristics.
Impedance	Provide measured, calculated, or both if available, impedance at the input terminals of an information-receiving device. Show real and imaginary components over the entire operating bandwidth and as far as practical above and below this bandwidth. Data should be a graph plot with enough frequency points to accurately describe the impedance

TABLE II Digital interface parameters - Continued.

Digital parameter	Requirement
Impedance (optimum source)	If this parameter is critical, the optimum source impedance should be stipulated. Data should be a graph plot versus frequency if applicable.
Impedance (minimum source)	Provide the lowest value of impedance which can be connected to an information-receiving device that will not affect the design performance of the receiving device. Data should be a graph plot versus frequency if applicable.
Output impedance	Provide measured, calculated, or both if available, impedance at the output terminals of an information-sending device. Show real and imaginary components over the entire operating bandwidth and as far as practical above and below this bandwidth Data should be a graph plot with enough frequency points to accurately describe the impedance.
Impedance (optimum load)	If this parameter is critical, the optimum load impedance should be stipulated. Data should be a graph plot versus frequency if applicable.
Impedance (maximum load)	Provide the lowest value of impedance which can be connected to an information-sending device that will not degrade the design performance of that device. Data should be a graph plot versus frequency if applicable.
Grounding system (output)	Provide a description of the type of signal ground philosophy used and what is required for the receiver load grounding configuration, if critical; e.g., common ground system, floating ground system, etc.
Grounding system (input)	Provide a description of the type of signal ground philosophy used and what is required for the source load grounding configuration, if critical; e.g., common ground system, floating ground system, etc.
Parallel data skewing characteristics (output)	Provide maximum and minimum transmitter variations in the transmittal times of bits of parallel bytes caused by variances in propagation delay among different cables and circuits.

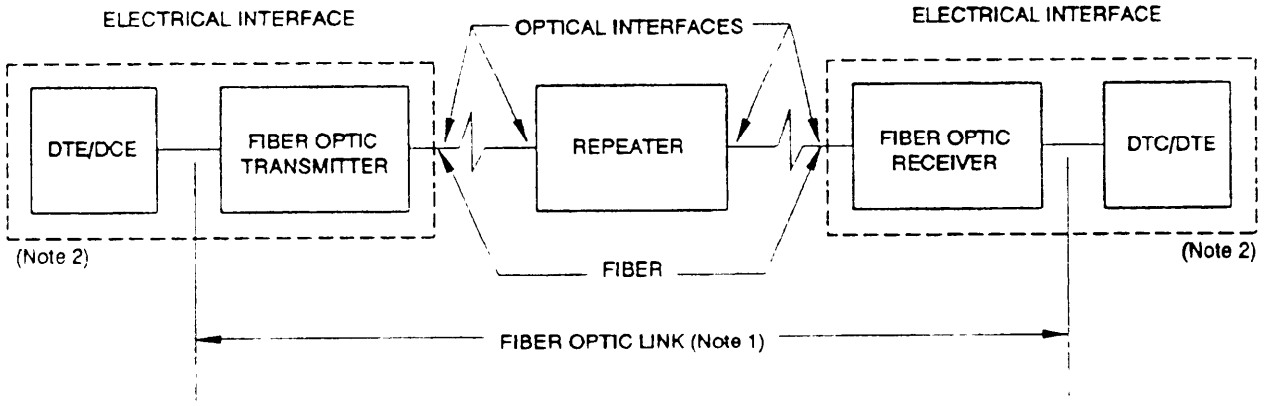
TABLE II Digital interface parameters - Continued

Digital parameter	Requirement
Parallel data skewing requirements (input)	Provide maximum receiver limits for variations in the arrival times of bits of parallel bytes caused by propagation delay among different cables and circuits.
Jitter characteristics (output)	Provide the value of time deviation that a reconstructed pulse transition may undergo without degrading the operation of the necessary system. The range of jitter expected from a source shall be specified
Jitter requirements (input)	Provide the value of time deviation that a reconstructed pulse transition may undergo without degrading the operation of the necessary system. The maximum jitter which a receiver will tolerate shall be specified.
Noise characteristics affecting error rates (output)	Provide measured data on the maximum levels and types of noise present at the output that can affect the error rate of a data receiving system.
Noise requirements affecting error rates (input)	Provide minimum levels of various types of noise that affect the inherent error rate of a receiving system.
Crosstalk characteristics (output)	Provide the measured crosstalk between two or more outputs of an information-sending device over the entire operating bandwidth of the sending device.
Crosstalk requirements (input)	Provide the maximum allowable crosstalk between two or more inputs of an information-receiving device over the entire operating bandwidth of the receiving device.
Common mode rejection (CMR)	Provide the measure of the capability of a differential or balanced input circuit to discriminate against in-phase interference signals with equal levels common to both sides of the input while amplifying the desired signal. CMR shall be specified in dB.
Propagation delay characteristics (output)	Provide the delay of a pulse through one or more elements or units of the transmission system. This may be done intentionally or unintentionally as effected by active element response characteristics of lines. The maximum and minimum delay times for a specific transmitter output shall be provided. Maximum and minimum propagation delay of a (1) to (0) transition and a (0) to (1) transition shall be provided.

TABLE II Digital interface parameters - Continued.

Digital parameter	Requirement
Propagation delay requirements (inputs)	Provide the delay requirements of a pulse through one or more elements or units of the transmission system. The maximum delay time allowable for a specific system input shall be specified Maximum propagation delay requirements of a (1) to (0) transition and a (0) to (1) transition shall be specified.

5.7 Fiber optic interface parameters. The fiber optic interface is a special case of the electrical interface; it incorporates an electrical to optical conversion process. For that reason both electrical and physical interface parameters must be specified MIL-STD-188-111 provides standards and design objectives for fiber optic system interoperability for both long haul communications and tactical systems Figure 3 illustrates the interface elements of a fiber optic data link Fiber optic parameters applicable to electronic systems or equipment are as specified in table III.



NOTES

1. The link may include connectors, splices and repeaters.
2. The data terminal equipment (DTE) and data circuit-terminating equipment (DCE) and the fiber optic transmitter or receiver may be combined into a single unit.

FIGURE 3 Fiber optic data link (one direction only).

TABLE III. Fiber optic interface parameters.

Fiber optic parameter	Requirement
Attenuation	Provide the attenuation of the cable expressed in decibels/kilometer (dB/km), assuming approximate uniformity with length.
Attenuation coefficient	Provide the attenuation coefficient expressed as the rate of change of total optical power with respect to distance.
Beam width	Provide the linear dimension of the beam irradiance
Brightness	Provide the brightness level of the source and level requirement of the receiving device, expressed in candela.
Chirping	Provide the chirping or rapid change limits of the source.
Coherence area	Provide the coherence area of the light beam
Coherence time	Provide the coherence time expressed as coherence length divided by the phase velocity.
D* (D-star)	Provide the figure of merit of detector performance, defined as the reciprocal of noise equivalent power (NEP), normalized to unit area and unit bandwidth.
Equilibrium mode distribution	Provide the distribution of power among the modes after the transmission through a requisite length of multimode optical cable.

TABLE III. Fiber optic interface parameters - Continued.

Fiber optic parameter	Requirement
Equilibrium radiation pattern	Provide the output radiation pattern of an optical cable having an equilibrium mode distribution, measured as a function of angle or distance from the wave guide axis.
Gap loss	Provide the optical power loss caused by the space between source and fiber optic cable.
Index profile	Provide the index profile, the refractive index as a function of radius.
Insertion loss	Provide the total optical power loss in a transmission system caused by the insertion of optical components such as connectors, splices, or couplers.
Intrinsic junction loss	Provide the total loss resulting from joining two identical fiber optic cables. Factors include spacing loss, alignment of the wave guides, Fresnel reflection loss, and end finish.
Irradiance	Provide the radiant power incident per unit area upon a surface expressed in watts per square meter.
Launch numerical aperture (LNA)	Provide the numerical aperture of the optical system used to couple (launch) power into the fiber optic cable.
Material dispersion	Provide the dispersion attributed to the wavelength dependence of the refractive index of material used to form the wave guide. Material dispersion is characterized by the material dispersion coefficient, $M(\lambda)$
Mode	Identify the mode characteristics of the transmission line. Mode distribution patterns include bound mode, cladding mode, degenerate wave guide modes, equilibrium mode, fundamental mode, group degenerate modes, hybrid mode, leaky modes, linearly polarized mode, multimode phase degenerate modes, single mode optical wave guide, transverse electric mode, transverse magnetic mode, and unbound mode.
Mode volume	Identify the number of propagating modes that an optical wave guide will support.
Multimode distortion	Provide the distortion level resulting from the superposition of modes that have differential modal delays.

TABLE III Fiber optic interface parameters - Continued.

Fiber optic parameter	Requirement
Pulse duration	Provide the root-mean-square (rms) pulse duration, the measure of the duration of the pulse wave form.
Radiant intensity	Provide the point source time rate of transfer of radiant energy per it solid angle, expressed in watts per steradian.
Radiant power	Provide the time rate flow of radiant energy, expressed in watts.
Radiation pattern	Identify the output radiation of an optical wave guide, specified as a function of angle or distance from the wave guide axis.
Reflectance	Provide the reflectance ratio expressed as a function of reflected power to incident power.
Reflection loss	Identify the total loss from reflections at the junction between two optical components
Responsivity	Provide the ratio of the optical detector's electrical output to it's optical input Dependant on detector type the expression may be in amps per watts or volts per watt of incident radiant power.
Source efficiency	Provide the ratio of emitted optical power of a source to the input electrical power.
Spectral irradiance	Provide the irradiance per unit wavelength interval at a given wavelength, expressed in watts per square meter per micrometer.
Spectral radiance	Provide the radiance per unit wavelength interval at a given wavelength, expressed in watts per steradian (solid angle) per square centimeter per micrometer.
Spectral responsivity	Provide the responsivity per unit wavelength interval at a given wavelength.
Spectral window	Provide the wavelength region at which relatively minimal attenuation of the optical signal is expected
Transmission loss	Provide the total loss encountered in the transmission system.
Transmittance	Provide the ratio of transmitted power to incident power.

6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. For interconnected units or systems to be interoperable, data concerning the analog or digital parameters at the connection points must be available. This section provides for the documentation of data concerning interface points during development, at the time when such data is readily available.

6.2 Issue of DODISS. When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1, and 2.2).

6.3 Tailoring. In achieving the purpose of this section, it is recognized that there must be some flexibility of application, and that advantages may accrue by deviating from the requirements specified herein. A1l deviations must comply with the provisions of the "Deviations" paragraph of MIL-STD-1399.

6.4 Documentation Documentation of system interfaces should be as specified herein.

6.4.1 DD Form 1423. When this standard is invoked, the data requirements for interface parameter documentation as prescribed herein will be specified on the Contract Data Requirements List (CDRL) DD Form 1423 attached to the contract or order.

6.4.2 System or equipment manual. The documentation specified herein should be included in the electronic system and equipment manual.

6.4.3 Drawings, All drawings and schematic wiring diagrams should be in accordance with IEEE 200, IEEE 260, IEEE 268, IEEE 280, IEEE 315, and IEEE 315A.

6.4.4 CALS. All documentation should conform to the requirements of MIL-D-28000, MIL-M-28001, MIL-R-28002, MIL-D-28003, and MIL-HDBK-59.

6.5 Subject term. (key word) listing.

Analog
Digital
Fiber optic
Logic

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Review activities
Navy - EC, OS, AS, MC, CG

Preparing activity:
Navy - SH
(Project 1990-N094)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1 The preparing activity must complete blocks 1, 2 3, and 8 In block 1, both the document number and revision letter should be given

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I RECOMMEND A CHANGE:	1 DOCUMENT NUMBER MIL-STD-1399(NAVY), Sect. 502A	2 DOCUMENT DATE (YYMMDD) 1995 February 1

3 DOCUMENT TITLE INTERFACE STANDARD FOR SHIPBOARD SYSTEMS SECTION 502 ELECTRONIC SYSTEMS PARAMETERS

4 NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible Attach extra sheets as needed)*

5 REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8 PREPARING ACTIVITY

a NAME TECHNICAL ENGINEER. Mr. Don Cebulski, NAVSEA 03K2	b TELEPHONE (Include Area Code) (1) Commercial (703) 602-7240 (2) AUTOVON 332-7240
c ADDRESS (Include Zip Code) Commander, Naval Sea Systems Command NAVSEA 03R42, 2531 Jefferson Davis Hwy., Arlington, VA 22242-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS CONTACT Defense Quality and Standardization Office 5203 Leesburg Pike Suite 1403 Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340

DD Form 1426, OCT 89 Previous editions are obsolete