METRIC
MIL-C-24733(NAVY)
31 August 1989

MILITARY SPECIFICATION

CONTROLLER INTERFACE UNIT, FIBER OPTIC (METRIC), GENERAL SPECIFICATION FOR

This specification 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.

1. SCOPE

1.1 Scope. This specification covers the requirements for a fiber optic controller interface (see 6.5.5) for use in Naval shipboard applications. The controller interface, hereinafter referred to as the unit, shall provide fiber optic transmission of command, interlock, safety, and indication signals (see 6.5.9) between existing remote control panels and existing controllers.

1.2 Classification. Units covered by this specification are classified as specified in 1.2.1 through 1.2.4 (see 3.1).

1.2.1 Fiber style. The fiber style designation defines the optical fiber used in the unit.

SM - Single-mode
MM - Multimode

1.2.2 Fiber quantity. The fiber quantity defines the number of independent fiber channels (see 6.5.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6030

1.2.3 Optical wavelength class. The optical wavelength class designation defines the nominal center wavelength of operation of the fiber optic transmission.

Class A - 1.31 micrometers (μm)
Class B - 1.55 μm

1.2.4 Electrical signal type. The electrical signal type designation defines the type of electrical signal.

Type 1 - Analog (see 6.5.1)
Type 2 - Digital (see 6.5.4)

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).

SPECIFICATIONS

FEDERAL

TT-I-735	- Isopropyl Alcohol.

MILITARY

MIL-I-631	- Insulation, Electrical, Synthetic-Resin Composition, Nonrigid.
MIL-S-901	- Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for.
MIL-H-5606	- Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance.
MIL-T-5624	- Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8 ST.
MIL-P-11268	- Parts, Materials, and Processes Used in Electronic Equipment.
MIL-P-15024	- Plates, Tags and Bands for Identification of Equipment.
MIL-P-15024/5	- Plates, Identification.
MIL-E-16400	- Electronic, Interior Communication and Navigation Equipment, Naval Ship and Shore: General Specification for.
MIL-F-16884	- Fuel, Naval Distillate.
MIL-L-17331	- Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-E-17555	- Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts): Packaging of.

MILITARY (Continued)

MIL-E-21981	- Electronics Equipment, Nomenclature, Serial Numbers and Identification Plates: Requirements for.
MIL-I-23053	- Insulation Sleeving, Electrical, Heat Shrinkable, General Specification for.
MIL-L-23699	- Lubricating Oil, Aircraft Turbine Engine, Synthetic Base.
MIL-C-24621	- Couplers, Passive, Fiber Optic, General Specification for.
MIL-R-24720	- Receivers, Digital, Fiber Optic, Shipboard, General Specification for.
MIL-T-24721	- Transmitters, Digital, Fiber Optic, Shipboard, General Specification for.
MIL-C-24733/1	- Controller Interface Unit, Fiber Optic, 2 Fiber Channels, Multimode Fiber (Metric).
MIL-C-28754	- Connectors, Electrical, Modular, and Component Parts General Specification for.
MIL-C-28859	- Connector Component Parts, Electrical Backplane, Printed Wiring, General Specification for.
MIL-T-55164	- Terminal Boards, Molded, Barrier Screw and Stud Types, and Associated Accessories, General Specification for.
MIL-C-85045	- Cable, Fiber Optic, Shipboard (Metric) General Specification for.
MIL-C-85045/14	- Cable, Fiber Optic, Fiber Optic Cable Configuration Type B (Pigtail), Optical Fiber Type MM (Graded Index, Glass Core and Glass Cladding, Multimode) (Metric).

STANDARDS

MILITARY

MIL-STD-104	- Limits for Electrical Insulation Color.
MIL-STD-129	- Marking for Shipment and Storage.
MIL-STD-167-1	- Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
MIL-STD-202	- Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454	- Standard General Requirements for Electronic Equipment.
MIL-STD-461	- Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
MIL-STD-462	- Electromagnetic Interference Characteristics, Measurement of.
MIL-STD-690	- Failure Rate Sampling Plans and Procedures.
MIL-STD-790	- Reliability Assurance Program for Electronic Parts Specifications.
MIL-STD-810	- Environmental Test Methods and Engineering Guidelines.
MIL-STD-965	- Parts Control Program.

MILITARY (Continued)

MIL-STD-1344 - Test Methods for Electrical Connectors.
MIL-STD-1378 - Requirements for Employing Standard Electronic Modules.
MIL-STD-1399, Section 300 - Interface Standard for Shipboard Systems Electric Power, Alternating Current. (Metric)
MIL-STD-1399, Section 070 Part 1 - Interface Standard for Shipboard Systems, D.C. Magnetic Field Environment (Metric).
DOD-STD-2167 - Defense System Software Development.

HANDBOOKS

MILITARY

MIL-HDBK-217 - Reliability Prediction of Electronic Equipment.
MIL-HDBK-472 - Maintainability Prediction.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following document(s) 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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

F 1166 - Standard Practice for Human Engineering Designs for Marine Systems, Equipment and Facilities.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

455-6 - Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices. (DoD adopted)
455-36 - Twist Test for Fiber Optic Connecting Devices. (DoD adopted)

(Application for copies should be addressed to the Electronic Industries Association, 2001 Eye Street, NW, Washington, DC 20006.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

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

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.4.

3.3 Reliability. Reliability of items furnished under this specification shall be established and maintained in accordance with the procedures and requirements specified in MIL-STD-790 and MIL-STD-690.

3.3.1 Reliability requirement. The quantitative reliability requirements expressed in mean time between failures (MTBF) (see 6.5.7), mean-cycle-between-failures (MCBF), or others, shall be as specified (see 3.1).

3.3.2 Reliability prediction. A qualitative reliability prediction in the form of an MTBF calculation shall be performed in accordance with MIL-HDBK-217. Failure rates shall be derived based on an application environment assuming "Naval sheltered" usage and an ambient thermal environment range as specified herein (see 3.9).

3.4 Materials. The units shall be constructed of materials that will not produce toxic, corrosive, or explosive by-products. Materials shall not have adverse effects upon operational or maintenance personnel under all operational and environmental conditions, nor cause degradation of equipment performance.

3.4.1 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new. Products may be fabricated using raw materials produced from recovered bulk materials to the extent practicable if the intended use of the product is not jeopardized. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become part of a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of partially processed, assembled, used or rebuilt products are allowed under this specification.

3.4.2 Fibrous material, organic. Organic fibrous material shall be in accordance with MIL-STD-454, requirement 44.

3.4.3 Flammable materials. Flammable materials shall be in accordance with MIL-STD-454, requirement 3.

3.4.4 Fragile or brittle materials. Cast iron, ebonite (hard vulcanized rubber), asbestos, porcelain, and other similar materials shall not be used.

3.4.5 Fungus resistance (see 4.6.5.1). The unit shall be in accordance with MIL-STD-454, requirement 4, for fungus-inert materials. Units that are not in accordance with MIL-STD-454, requirement 4, shall meet grade 1 classification of MIL-STD-810, method 508.

3.4.6 Hazardous material marking. When a unit is produced with hazardous materials, only as required (see 3.1), it shall be marked in accordance with the requirements of public laws and regulations. The marking shall include as applicable: name of product; quantity; warning symbol; signal word designating degree of hazard; affirmative statement of hazards; precautionary measures covering actions to be followed or avoided; instructions in case of contact or exposure; antidotes and notes to physicians; instructions in case of fire, spill, or leak; instructions for handling and storage; and disposal instructions. Marking of hazardous materials shall be in conformance with Federal Hazardous Substance Labeling Act.

3.5 Design. The unit shall provide fiber optic transmission of command, interlock, safety, and indication signals between existing remote control panels and existing controllers via optical fiber transmission medium (cable). The unit shall consist of two basic parts: fiber optic remote control panel interface and fiber optic controller interface (see figure 1). The unit circuits shall be designed such that a failure does not cause a change in state.

3.5.1 Fiber optic remote control panel interface. The fiber optic remote control panel interface shall accept various types and numbers of input electrical signals from the existing remote control panel and provide a composite time-division or frequency-division multiplexed electrical signal output compatible with the specified fiber optic transmitter. The fiber optic remote control panel interface shall also accept a time-division or frequency-division multiplexed electrical signal from the specified fiber optic receiver and provide various types and numbers of electrical signals compatible with the existing remote control panel. Where applicable, the functions of this part of the unit may be incorporated into control consoles on special purpose electronic cards. These boards shall meet the performance requirements of this specification.

3.5.2 Fiber optic local controller interface. The fiber optic controller interface shall accept a time-division or frequency-division multiplexed electrical signal from the specified fiber optic receiver and provide the electrical command signals compatible with the existing controller. The fiber optic controller interface shall also accept types and numbers of electrical indication signals from the existing controller and provide a time-division or frequency-division multiplexed signal compatible with the specified fiber optic transmitter.

3.5.3 Firmware. If the design of the unit includes firmware, then the firmware specifications shall conform to the requirements of DOD-STD-2167. No software shall be included in the unit design and operation.

3.6 Construction. The unit shall be of the construction and physical dimensions as specified herein. Unless otherwise specified (see 3.1), all units shall use modular construction. The equipment modular construction shall conform to the standard hardware program module requirements specified in MIL-STD-1378. The selection of specific assembly design and packaging techniques shall reflect the reliability and maintainability requirements of the individual unit specification sheet.

3.6.1 Degree of enclosure. The type of enclosure shall be drip-proof or watertight as specified (see 3.1).

3.6.2 Fiber optic pigtail. Units shall be supplied with fiber or cable pigtails as specified (see 3.1). One end of the pigtail shall be permanently mounted in the unit housing, and the mounting construction shall provide strain relief for the pigtail. The pigtail length shall be not less than 1 meter. Metal components shall not be used within the pigtail, except for mounting to the unit housing or termination connector.

3.6.3 Terminals. The electrical connections and terminals, and the optical connections shall be in accordance with MIL-STD-454, requirement 19, and as specified herein.

3.6.3.1 Terminal strength (see 4.6.2.1). The electrical terminals and the optical interconnections shall show no evidence of breakage, loosening, or relative motion between the electrical terminals or connectors and the body of the unit.

3.6.3.2 Solderability (see 4.6.2.2). Terminal solderability shall be in accordance with MIL-STD-454, requirement 5.

3.6.4 System modularization and accessibility. The modular construction of the items shall provide for replacement at the organizational level. Modular construction of the units shall be used to facilitate the removal and replacement of components and assemblies while minimizing the removal of other system components or assemblies. The unit shall be in accordance with MIL-STD-454, requirement 36.

3.6.5 Standardization and interchangeability. The units shall be constructed to minimize the quantity of special tools required for all levels of maintenance. Special tools are defined as those tools not listed in the Federal Supply Catalog. Copies of this catalog may be consulted in the office of the Defense Contract Administration Services Management Area (DCASMA). Standardized piece parts shall be used wherever possible. Circuit card assemblies shall be constructed to be interchangeable between the appropriate units. The construction of the units shall enable the units to be functionally and physically interchangeable between different units of the same part number and shall be in accordance with MIL-STD-454, requirement 7.

3.6.6 Dimensions (see 4.6.1). The unit dimensions shall be as specified (see 3.1).

3.6.7 Weight (see 4.6.1). Weight shall be within the limits specified (see 3.1).

3.6.8 Interconnect wire color (see 4.6.1). Interconnect wire color shall be in accordance with MIL-STD-104, or as specified (see 3.1).

3.6.9 Finish (see 4.6.1). The unit housing finish shall not affect the legibility of the unit part number and required markings over the life of the unit. The finish on all units shall be in accordance with MIL-E-16400.

3.6.10 Hardware. Unit hardware and unit mounting hardware shall conform to MIL-E-16400 and shall be selected to support unit requirements for electromagnetic interference (EMI) and electromagnetic compatibility (EMC) and durability.

3.6.10.1 Printed-wiring and printed-wiring assemblies. Printed wiring and printed wiring assemblies used in the construction of the unit shall be in accordance with MIL-STD-454, requirement 17.

3.6.10.2 Circuit card edge connectors. Circuit card edge connectors shall be in accordance with MIL-C-28754 or MIL-C-28859.

3.6.10.3 Encapsulation and embedment. Unless otherwise specified (see 3.1), the unit shall be in accordance with MIL-STD-454, requirement 47.

3.6.10.4 Internal wiring practices. Internal wiring practices shall be in accordance with MIL-STD-454, requirement 20.

3.6.10.5 Microcircuit devices. Integrated circuits and hybrid devices used in the unit shall be in accordance with MIL-STD-454, requirement 64.

3.6.10.6 Semiconductor devices. Semiconductor devices used in the unit shall be in accordance with MIL-STD-454, requirement 30.

3.6.10.7 Fiber optic transmitters. Fiber optic transmitters used in the unit shall be as specified (see 3.1).

3.6.10.8 Fiber optic receivers. Fiber optic receivers used in the unit shall be as specified (see 3.1).

3.6.10.9 Fiber optic couplers. Fiber optic couplers used in the unit shall be in accordance with MIL-C-24621.

3.6.10.10 Fiber optic connectors. Fiber optic connectors used in the unit shall be as specified (see 3.1).

3.6.10.11 Fiber optic splices. Fiber optic splices used in the unit shall be as specified (see 3.1).

3.6.10.12 Multiplexers and demultiplexers. Multiplexers and demultiplexers used in the unit shall be as specified (see 3.1).

3.6.10.13 Switches and indication lights. Switches and indication lights shall be as specified (see 3.1).

3.6.11 Electrical grounding. Exposed metal or other conducting parts shall be at ground (ship's hull) potential at all times.

3.6.12 Bonds and grounds for integral EMI suppression. Units shall be constructed with adequate provisions for bonding the unit to a subsystem ground plane. Bonding shall not be accomplished through screws connecting the equipment to mounting racks. Shock mounted units or those employing vibration isolators shall utilize bonding straps to bypass the shock mount or isolator to achieve a low impedance bond, 2.5 milliohms or less, between the equipment and subsystem ground plane. Bonding jumpers shall be of the solid metal type and be as short as possible. However, in no case shall the length to width ratio of the jumper be in excess of 5 to 1. Bonding techniques employed shall not impede maintainability nor adversely affect interchangeability. Surfaces being bonded together shall be prepared by removing all anodic film, grease, paint, lacquer, dirt, or other

foreign and high resistance materials or agents from the immediate area to ensure negligible radio frequency (RF) impedance between the adjacent metal parts. Upon completion of the bonding assembly and ascertainment of the specified 2.5 milliohm or less bonding impedance, the completed assembly shall be refinished in accordance with the finish removed.

3.6.13 Conductor identification. Conductor identification shall be in accordance with MIL-STD-454, requirement 20. Noninsulated wire leads in excess of 10 centimeters (cm) in length shall be color coded by means of colored lacquer located near terminals, except when the leads terminate at marked terminals or when the terminal designations and the placement of the leads provide easy lead identification.

3.6.14 Terminal end identification. The ends of all conductors that terminate in lugs shall be clearly and permanently marked with the conductor identification. Markings shall be made on white synthetic resin tubing conforming to MIL-I-631, type F, grade A, from U, class I, or polyvinyl chloride pressure-sensitive adhesive marking tape. Wire markings shall be clearly visible in the assembled units. The tape markers shall be tightly wrapped with at least two turns around the wire.

3.6.15 Human factors engineering. The units shall be designed and constructed in accordance with ASTM F 1166, sections 33 through 40.

3.6.16 Selection of alternative materials, constructions, and parts. All of the materials, processes, or parts required for the fabrication of the units shall be selected in accordance with MIL-P-11268. Any item not in accordance with MIL-P-11268 shall be defined as a nonstandard part and shall be tested in accordance with nonstandard parts requirements as specified in MIL-STD-965. Procedures for obtaining approval for use of nonstandard items shall be in accordance with MIL-STD-454, requirement 22.

3.7 Performance. The following defines the prime power, interface characteristics, and optical performance parameters for the unit.

3.7.1 Prime power (see 4.6.3.1). The unit shall operate from prime power sources as specified (see 3.1).

3.7.1.1 Prime power variation - alternating current (ac) (see 4.6.3.1). The unit shall operate within specified parameters defined in MIL-STD-1399, section 300.

3.7.1.2 Prime power variation - direct current (dc) (see 4.6.3.1). The dc prime power variation requirements shall be as specified (see 3.1).

3.7.1.3 Current load (see 4.6.3.1). The unit shall not exceed worst-case current load requirements as defined in the applicable specification sheet (see 3.1).

3.7.1.4 Reverse polarity protection. The unit shall provide reverse polarity protection for dc power inputs.

3.7.2 Interface characteristics (see 4.6.3.2).

3.7.2.1 Remote control panel interface.

3.7.2.1.1 Analog channels (from existing remote control panel) (see 4.6.3.2). Analog channels interface parameters such as impedance, signal levels, and equalization shall be as specified (see 3.1).

3.7.2.1.2 Digital channels (from existing remote control panel) (see 4.6.3.2). Digital signal interface parameters such as signal format, signal voltage levels, rise and fall times, short circuit protection, and data rate (see 6.5.3) shall be as specified (see 3.1).

3.7.2.1.3 Transmitter and receiver signals (see 4.6.3.2). The transmitter and receiver signals interface parameters shall interface directly with the fiber optic receiver or the fiber optic transmitter specified (see 3.6.10.8 and 3.6.10.7).

3.7.2.2 Local control interface.

3.7.2.2.1 Analog channels (to existing controller) (see 4.6.3.2). Analog channels interface parameters such as impedance, signal levels, and equalization shall be as specified (see 3.1).

3.7.2.2.2 Digital channels (to existing controller) (see 4.6.3.2). Digital signal interface parameters such as signal format, signal voltage levels, rise and fall times, short circuit protection, and data rate shall be as specified (see 3.1).

3.7.2.2.3 Transmitter and receiver signals (see 4.6.3.2). The transmitter and receiver signal interface parameters shall enable them to directly interface with the fiber optic receiver or the fiber optic transmitter specified (see 3.6.10.8 and 3.6.10.7).

3.7.3 Optical performance parameters.

3.7.3.1 Power margin (see 4.6.3.3.1). The power margin shall be as specified (see 3.1).

3.7.3.2 Dynamic range (see 4.6.3.3.2). The unit shall exhibit sufficient dynamic range to support operation under worst-case conditions established for both minimum and maximum path length configurations, including connectors and repair splices, as specified (see 3.1). The unit shall function without degradation in performance and without operator interference.

3.7.3.3 Data rate (see 4.6.3.3.3). The maximum data rate shall be as specified (see 3.1).

3.8 Electrical breakdown prevention.

3.8.1 Dielectric withstanding voltage and insulation resistance (see 4.6.4.1 and 4.6.4.2). The remote and local units shall pass the specified insulation resistance and dielectric voltage withstanding tests. The insulation resistance of the circuits shall be not less than 10 megohms when measured with the units at

ambient temperature of 25 degrees Celsius (°C). This requirement shall be met without resorting to either disassembly or disconnection of circuits, the shorting together of terminals, or the short-circuiting, by-passing, or grounding of parts or circuit elements during the test to prevent the test voltage from being applied to parts. Such measures, however, may be used when specifically authorized in the accepted test procedure for convenience and effectiveness in testing the units, provided such measures do not prevent the test from being effective on portions of the units. The remote and local units shall enable the required insulation resistance and dielectric withstanding voltage tests on the insulation system to be performed without causing either incipient or catastrophic damage or significant (within acceptable product variability tolerance) degradation of any material part, including the electrical insulation. Furthermore, a defect in the insulation system shall not cause performance of either of the tests, when properly conducted, to result in damage or degradation to any other material or part except that which may possibly be inflicted to the immediately adjacent parts separated by the defective insulation.

3.8.2 Electrical creepage and clearance distances (see 4.6.4.1 and 4.6.4.2). Clearances between any two electrical circuits or between any electrical circuit and ground (metal enclosures or chassis) shall meet the specified test conditions for insulation resistance and dielectric withstanding voltage. The minimum creepage and clearance distances between electric circuits or between any electric circuit and ground specified in MIL-STD-454, requirement 69, shall be met. The values shown in MIL-STD-454, requirement 69, represent the desired minimum acceptable limits for nonarcing rigid construction in that they take into consideration only the average degree of enclosure and service exposure. To ensure equipment reliability, minimum creepage and clearance distance shall be increased as necessary, consistent with the minimum space and weight requirements for any of the following: where noninsulated parts are arc-rupturing; when an item is not rigidly mounted; when an item is connected to higher voltage equipment; and when an item is subjected to exceptionally severe exposure.

3.8.3 Self-protection from input voltage spikes (see 4.6.4.3). The unit shall continue proper operation with no degradation in performance.

3.9 Environmental requirements. The unit shall meet all requirements specified herein, during the specified operating environments and after the specified storage environment. The operating temperature range and storage temperature range shall be as specified (see 3.1), as shown in table I.

TABLE I. Temperature ranges (ambient).

Range	Operating (°C)	Storage (°C)
1	-54 to +65	-62 to +71
2	-28 to +65	-62 to +71
3	-0 to +50	-62 to +71

3.9.1 Temperature-humidity cycling (see 4.6.5.2). The unit shall meet the performance requirements over the operating temperature range. There shall be no evidence of physical damage.

3.9.2 Salt fog (spray) (see 4.6.5.3). The units shall withstand the effects of salt fog without sustaining any damage or degradation in performance. In addition, after completion of the tests and cleaning, the base metal of the unit shall not be visible through the finish or coating, nor shall there be any evidence of blistering, softening, separation from the base metal, corrosion products, or other coating failure.

3.9.3 Fluid immersion (see 4.6.5.4). The unit shall reveal no swelling or softening of materials and no loss of sealing capability or other effects detrimental to the operation of the unit.

3.9.4 Shock (see 4.6.5.5). The units shall withstand the effects of shock without sustaining any damage or degradation in performance.

3.9.5 Vibration (see 4.6.5.6). The units shall withstand the effects of vibration without sustaining any damage or degradation in performance.

3.9.6 Inclination (see 4.6.5.7). The units shall withstand the effects of the inclination test without sustaining any damage or degradation in performance.

3.9.7 Magnetic field environment (see 4.6.5.8). The units shall be compatible with the magnetic field environment interface constraints of MIL-STD-1399, section 070, Part 1.

3.9.8 Explosive atmosphere (see 4.6.5.9). The unit shall safely operate in flammable atmospheres without causing an explosion.

3.9.9 Water drip (for drip-proof enclosures only) (see 4.6.5.10). The unit shall not reveal any water penetration into the sealed region of the unit.

3.9.10 Water pressure (for watertight enclosures only) (see 4.6.5.11). The unit shall reveal no penetration of indicator dye into the sealed region of the unit.

3.9.11 Nuclear radiation resistance (see 4.6.5.12). The units, including electronics and interconnecting wires and optical pigtails, shall withstand the effects of nuclear radiation without sustaining any damage or degradation in performance.

3.10 Mechanical requirements.

3.10.1 Compression resistance (see 4.6.6.1). The unit shall not deform more than 1 percent from its largest cross-sectional dimension.

3.10.2 Impact resistance (see 4.6.6.2). The unit shall not reveal any physical damage.

3.10.3 Cable seal flexing (see 4.6.6.3). Each strain relief mechanism shall prevent loss of environmental sealing or other damage that may impair the unit operation.

3.10.4 Cable pull-out force (see 4.6.6.4). The minimum cable pull-out strength shall be 50 percent of the specified tensile strength of the attached cable or 100 newtons, whichever is less. There shall be no evidence of cable jacket damage, cable clamp failure, seal damage, distortion or bending of metallic parts, or cable disengagement from the clamp.

3.10.5 Cable twist (see 4.6.6.5). The cable assembly shall reveal no damage or loss of environmental sealing.

3.11 Electromagnetic interference suppression.

3.11.1 Electromagnetic (see 4.6.7). The units shall meet the emission and susceptibility requirements specified in MIL-STD-461, part 5 as specified (see 3.1). Above deck or below deck application shall be as specified (see 3.1).

3.11.2 Lightning (see 4.6.7). Input suppression and transient suppression shall be incorporated into the unit to provide protection against lightning strikes and current and voltage spikes.

3.11.2.1 Inputs - ac (see 4.6.7). The units shall sustain no damage or degradation in performance when subjected to voltage variations.

3.11.2.2 Power leads - dc (see 4.6.7). The units shall sustain no damage or degradation in performance when subjected to voltage variations.

3.12 Maintainability (see 6.5.6). Maintainability shall be in accordance with MIL-STD-454, requirement 54 and as specified herein.

3.12.1 Quantitative maintainability requirements. The maintainability requirement, expressed as the mean-time-to-repair (MTTR) (see 6.5.8), shall be as specified (see 3.1).

3.12.1.1 MTTR. The MTTR time figure includes localization (troubleshooting to modular level), isolation, disassembly, modular replacement, reassembly, and checkout of all corrective maintenance for restoration of system operation.

3.12.2 Maintainability prediction. Unless otherwise specified (see 3.1), a maintainability prediction shall be performed in accordance with MIL-HDBK-472, procedure II, part A.

3.12.3 Maintainability design criteria. Unless otherwise specified (see 3.1), maintainability design criteria shall be as follows:

(a) Minimize the number and frequency of required preventive maintenance actions.
(b) Provide adequate access to all components and minimize the requirements for special tools and test equipment. Ensure that each shipboard replaceable unit (SRU) shall be easily removable from its chassis or cabinet without the use of special tools.
(c) Ensure that it shall be possible to perform maintenance diagnostics with power applied, equipment open and operating for intervals not exceeding 15 minutes at ambient temperatures.

(d) Ensure that preventive maintenance at the organizational level be limited to visual equipment inspections, lubricating mechanical parts, cleaning surfaces and interiors, changing or cleaning filters, and similar tasks necessary to ensure that the equipment does not deteriorate with age and use. Preventive maintenance, involving removal and replacement of components (except filters), shall not be required at any level.
(e) Ensure that no intermediate level maintenance is required.
(f) Incorporate Built-In-Tests.

3.13 Maintenance.

3.13.1 Maintenance levels. Three levels of maintenance exist for the equipment described in this specification: organizational, intermediate, and depot.

3.13.1.1 Organizational level. The units shall be designed to minimize the preventive and corrective maintenance workload at the organizational level. All required maintenance actions shall be compatible with the Third Class Interior Communications Technician (IC3) skill level or as specified (see 3.1).

3.13.1.1.1 Corrective maintenance. Corrective maintenance actions shall consist of SRU replacement at this level (see 3.12.1.1).

3.13.1.1.2 Preventive maintenance. Preventive maintenance at the organizational level shall be limited to visual equipment inspections, lubricating mechanical parts, cleaning surfaces and interiors, changing filters and similar tasks necessary to ensure minimum equipment deterioration with age and use. Preventive maintenance shall not require the removal and replacement of components (except filters). Preventive maintenance requirements shall be grouped into periodic maintenance packages with the schedule interval maximized; the minimum allowable interval shall be greater than 90 days. Preventive maintenance shall be performed by one person. Whenever preventive maintenance is in progress, it shall be possible to restore the equipment to operational condition within 5 minutes. Requirements for preventive maintenance shall be such that a 1-month delay in performing the task will not adversely affect the operational performance of, or cause irrepairable damage to, the unit.

3.13.1.2 Depot level. The repair procedures, processes, materials, tools, and special purpose electronic test equipment, required for corrective maintenance of the unit at the depot level, shall be determined by the Logistic Support Analysis (LSA). The units shall be designed to preclude the need for preventive maintenance at the depot level.

3.14 Safety. The handling, installation, and operation of the items shall not endanger personnel by direct contact or by long-term effects due to deterioration of any component within the unit construction. The unit design and operation requirements for safety shall implement and conform to the safety standards issued by the Occupational Safety and Health Administration (OSHA) under the Secretary of Labor.

3.14.1 Safety engineering. Safety design criteria shall be in accordance with MIL-STD-454, requirement 1, and MIL-STD-129 for labeling of safety hazards.

3.14.2 Terminals. Wire connections (bare terminals) shall use red polyolefin sleeving in accordance with the requirements specified in MIL-I-23053 with nominal voltage and current type imprinted on sleeving.

3.14.3 Terminal strips. Terminal strips shall be covered by red, transparent, nonconductive barriers in accordance with MIL-T-55164 with nominal voltage and current type identified. Small openings shall be provided (where needed) for maintenance.

3.14.4 Laser safety. When laser transmitters are used (see 3.6.10.7), laser safety requirements shall be as specified (see 3.1).

3.14.5 Connector alignment. All electrical connectors shall be provided with aligning pins or equivalent devices to aid in alignment, to preclude inserting in other than the desired position, and to preclude electrical shock.

3.15 Security. When specified (see 3.1), the unit shall provide full data security. The transmission security shall conform to the TEMPEST requirements as specified (see 3.1).

3.16 Identification and marking (see 4.6.1).

3.16.1 Nomenclature (item name and type designation). Item name and type designation shall be established in accordance with the part numbering system specified in 6.8 and 6.9.

3.16.2 Serial numbers. Unless otherwise specified (see 3.1), serial numbers are required for each item level of the equipment to which an identification plate is to be applied and shall comply with the requirements of MIL-E-21981.

3.16.3 Marking. Marking of the equipment and items thereof shall be in accordance with MIL-STD-454, requirement 67 and as specified herein. Unless otherwise specified (see 3.1), marking shall conform to the normal service requirements of MIL-P-15024 and MIL-P-15024/5.

3.16.4 Identification plates (mounting and location). Identification plates and information plates shall be in accordance with MIL-P-15024 and MIL-P-15024/5, except that type G (adhesive backed plates) of MIL-P-15024 shall not be used. Plates shall be mounted in conspicuous space, generally on the front panel of the item to which it applies. When space does not permit mounting on the front or front panel, they may be mounted externally or internally in locations easily accessible. The Government assigned identification and serial numbers shall be permanently marked on the units.

3.16.4.1 Material compatibility. The material selected for identification plates and their fastening devices shall be compatible with the materials on which the plate is mounted.

3.17 Workmanship (see 4.6.1). Workmanship shall be in accordance with MIL-STD-454, requirement 9.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspections set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.4).
(b) Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Inspection conditions shall be met as specified in the applicable test method for each inspection parameter.

4.4 First article inspection. First article inspection shall consist of all the tests listed in table II. The units submitted shall be representative of the production process.

TABLE II. First article inspection.

Inspection	Requirement	Test method	Sample size
Group I			
Dimensions	3.6.6	4.6.1	4
Weight	3.6.7	4.6.1	1/
Finish	3.6.9	4.6.1	1/
Conductor identification	3.6.13	4.6.1	1/
Identification and marking	3.16	4.6.1	1/
Workmanship	3.17	4.6.1	1/
Prime power	3.7.1	4.6.3.1	1/
Interface characteristics	3.7.2	4.6.3.2	1/
Power margin	3.7.3.1	4.6.3.3.1	1/
Dynamic range	3.7.3.2	4.6.3.3.2	1/
Data rate	3.7.3.3	4.6.3.3.3	1/
Group II			
Terminal strength	3.6.3.1	4.6.2.1	1
Solderability	3.6.3.2	4.6.2.2	2/
Shock	3.9.4	4.6.5.5	1
Compression resistance	3.10.1	4.6.6.1	3/
Impact resistance	3.10.2	4.6.6.2	3/

See footnotes at end of table.

TABLE II. First article inspection - Continued.

Inspection	Requirement	Test method	Sample size
Cable seal flexing	3.10.3	4.6.6.3	3/
Cable pull-out force	3.10.4	4.6.6.4	3/
Cable twist	3.10.5	4.6.6.5	3/
Fungus resistance	3.4.5	4.6.5.1	3/
Group III			
Temperature-humidity cycling	3.9.1	4.6.5.2	1
Salt fog	3.9.2	4.6.5.3	4/
Fluid immersion	3.9.3	4.6.5.4	4/
Vibration	3.9.5	4.6.5.6	4/
Inclination	3.9.6	4.6.5.7	4/
Magnetic field environment	3.9.7	4.6.5.8	4/
Explosive atmosphere	3.9.8	4.6.5.9	4/
Water-drip	3.9.9	4.6.5.10	4/
Water pressure	3.9.10	4.6.5.11	4/
Group IV			
Dielectric withstanding voltage and insulation resistance	3.8.1	4.6.4.1 4.6.4.2	1
Electrical creepage and clearance distances	3.8.2	4.6.4.1 4.6.4.2	5/
Self-protection from input voltage spikes	3.8.3	4.6.4.3	5/

See footnotes at end of table.

TABLE II. First article inspection - Continued.

Inspection	Requirement	Test method	Sample size
Electromagnetic interference suppression	3.11	4.6.7	5/
Nuclear radiation resistance	3.9.11	4.6.5.12	5/

1/ All samples shall be submitted to group I inspection.
2/ The same sample shall be used as in the terminal strength inspection.
3/ The same sample shall be used as in the shock inspection.
4/ The same sample shall be used as in the temperature-humidity inspection.
5/ The same sample shall be used as in the dielectric withstanding voltage inspection.

4.4.1 Sample. A unit sample shall be submitted for each unit construction for which first article approval is desired. The sample submitted shall be four units of the same part number.

4.4.2 Inspection routine. The sample shall be subjected to the inspections specified in table II in the order shown. All sample units shall be subjected to the inspection of group I. The sample shall then be divided for testing in the remaining three groups. The sample units shall then be subjected to the inspection for their particular group. After completion of sample testing, all units shall be resubjected to group I testing. Any unit failing any inspection shall not be subjected to further inspection.

4.4.3 Failures. One or more failures shall be sufficient cause for refusal to grant first article approval. When first article test units are taken from a larger lot, and the first article is disapproved, none of the units from that lot shall be delivered.

4.5 Quality conformance inspection. Quality conformance inspection shall consist of the inspections and tests specified for group A inspection (table III), group B inspection (table IV), and group C inspection (table V), as specified (see 6.4).

4.5.1 Group A inspection. Group A inspections shall follow the order shown in table III.

TABLE III. Group A inspection.

Inspection	Requirement	Test method
Dimensions	3.6.6	4.6.1
Weight	3.6.7	4.6.1
Finish	3.6.9	4.6.1
Conductor identification	3.6.13	4.6.1
Identification and marking	3.16	4.6.1
Workmanship	3.17	4.6.1
Prime power	3.7.1	4.6.3.1
Interface characteristics	3.7.2	4.6.3.2
Power margin	3.7.3.1	4.6.3.3.1
Dynamic range	3.7.3.2	4.6.3.3.2
Data rate	3.7.3.3	4.6.3.3.3

4.5.2 Group B inspection. Group B inspection shall consist of the inspections specified in table IV. Group B inspections shall be made on units that have passed the group A inspection.

TABLE IV. Group B inspection.

Inspection	Requirement	Test method
Terminal strength	3.6.3.1	4.6.2.1
Solderability	3.6.3.2	4.6.2.2
Shock	3.9.4	4.6.5.5
Compression resistance	3.10.1	4.6.6.1
Impact resistance	3.10.2	4.6.6.2
Cable seal flexing	3.10.3	4.6.6.3
Cable pull-out force	3.10.4	4.6.6.4
Cable twist	3.10.5	4.6.6.5

4.5.3 Group C inspections. Group C inspections shall consist of the inspections in table V. Group C samples shall have satisfactorily completed all group A and group B inspections. After completion of group C inspections, the samples shall be re-subjected to group A inspection.

TABLE V. Group C inspection.

Inspection	Requirement	Test
Fungus resistance	3.4.5	4.6.5.1
Temperature-humidity cycling	3.9.1	4.6.5.2
Salt fog	3.9.2	4.6.5.3
Fluid immersion	3.9.3	4.6.5.4
Vibration	3.9.5	4.6.5.6
Inclination	3.9.6	4.6.5.7
Magnetic field environment	3.9.7	4.6.5.8
Explosive atmosphere	3.9.8	4.6.5.9
Water-drip	3.9.9	4.6.5.10
Water pressure	3.9.10	4.6.5.11
Nuclear radiation resistance	3.9.11	4.6.5.12
Dielectric withstanding voltage and insulation resistance	3.8.1	4.6.4.1 4.6.4.2
Electrical creepage and clearance distances	3.8.2	4.6.4.1 4.6.4.2
Self-protection from input voltage spikes	3.8.3	4.6.4.3
Electromagnetic interference suppression	3.11	4.6.7

4.5.3.1 Disposition of sample units. Sample units that have failed shall not be delivered.

4.6 Methods of inspection.

4.6.1 Visual and mechanical. Units shall be examined to verify that the material, dimensions, weight, color, finish, markings, and workmanship are in accordance with the applicable requirements. Examinations shall be limited to those that may be performed without disassembling the unit in such a manner that its performance, durability, or appearance will be affected.

4.6.2 Design and construction.

4.6.2.1 Terminal strength (see 3.6.3.1). The terminals shall be tested in accordance with MIL-STD-202, method 211. Test condition A shall be used for tension, test condition D shall be used for twist, and test condition E shall be used for torque. The load for test condition A shall be 4.5 kilograms (kg).

4.6.2.2 Solderability (see 3.6.3.2). The terminals shall be tested in accordance with MIL-STD-202, method 208.

4.6.3 Performance.

4.6.3.1 Prime power. The unit shall be supplied with prime power and tested for proper operation with prime power sources as specified (see 3.7.1). The ac power variation shall be in accordance with MIL-STD-1399, section 300.

4.6.3.2 Interface characteristics (see 3.7.2). The interface parameters such as signal levels and rise and fall times shall be measured for the fiber optic remote control panel interface and the fiber optic control interface. The parameters measured and the test setup shall be as specified (see 3.1).

4.6.3.3 Optical performance parameters.

4.6.3.3.1 Power margin (see 3.7.3.1). The power margin shall be tested by inserting an attenuator equal to the required power margin into the fiber optic transmission path during the maximum path configuration of the system range test.

4.6.3.3.2 Dynamic range (see 3.7.3.2). The dynamic range shall be verified by proper operation at the specified maximum and minimum optical path configurations.

4.6.3.3.3 Data rate (see 3.7.3.3). The maximum data rate shall be verified by proper operation at the specified maximum data rate.

4.6.4 Electrical breakdown prevention.

4.6.4.1 Insulation resistance (see 3.8.1 and 3.8.2). The insulation resistance of each electrically isolated circuit (see (b) (1), (2) below) within the unit shall be measured in accordance with MIL-STD-202, method 302. The following test conditions shall apply:

(a) Test potential: test condition B (high internal impedance).
(b) Points of measurement: Between each electrically isolated circuit (see (1) and (2) below) and another electrically isolated circuit, and between each electrically isolated circuit and ground.

(1) Electrically isolated circuits are those which have a mutual connection only by means of electromagnetic coupling.
(2) Circuits whose only mutual connection is by means of a capacitor shall not be considered electrically isolated. Such circuits may be temporarily interconnected with a jumper wire only when circuits are tested internally within the equipment.

(c) Electrification time: Not less than 60 seconds.
(d) The unit should be operating during the test.

4.6.4.2 Dielectric withstanding voltage (see 3.8.1 and 3.8.2). Dielectric withstanding voltages shall be measured in accordance with MIL-STD-202, method 301. These measurements shall be made after all other tests have been completed. The following test conditions shall apply:

(a) Magnitude of test voltage.

(1) For circuits rated 60 volts or less, the root mean square (rms) test voltage shall be 900 volts.
(2) For circuits rated more than 60 volts but not greater than 600 volts, the rms test voltage shall be twice rated circuit voltage plus 1000 volts.
(3) For circuits rated above 600 volts, the rms test voltage shall be 2½ times rated circuit voltage plus 2000 volts.
(4) For circuits containing parts that are applied within their specified ratings and are in accordance with part specifications that specify a lower dielectric test voltage than specified in (1), (2), or (3), the dielectric test voltage for the circuit shall correspond to that specified for the part having the lowest specified dielectric test voltage, but in no case less than:

a. 900 volts for circuits connected to the power supply terminals.
b. 500 volts for circuits electrically isolated from the power supply terminals.

(b) Nature of test voltage: The test voltage shall approximate a true sine wave of a frequency not less than the rated frequency of the circuit under test.
(c) Points of measurement: Between each electrically isolated circuit of the remote and local units (see 4.6.4.1, (b) (1), (2)), and between each such electrically isolated circuit and ground.
(d) Duration of test voltage application: Either of the following:

(1) Not less than 60 seconds. The test voltage shall not be abruptly applied to or removed from any circuit. The applied voltage shall be raised from 0 volts to the test voltage in a sufficiently gradual manner to ensure the absence of voltage spikes and overvoltages. Following test voltage application, the applied voltage shall be reduced to 0 volts in the same gradual manner.

(2) Not less than 1 second (as by means of a probe). This duration shall be used only if it is determined that the surges resulting from sudden application and removal of the test voltage will not damage circuit components, and only under the condition that the test voltage used is 20 percent greater than that specified in (a) above.

(e) Definition of failure. Any evidence of arcing, corona (visible, audible, or odorous), flashover, or punctured insulation shall be interpreted as a failure of the test.

(f) Dielectric withstanding voltage tests shall be conducted after all other tests have been completed.

4.6.4.3 Self-protection from input voltage spikes (see 3.8.3). It shall be assumed that input voltage spikes up to 2500 volts are superimposed on the supply voltage (line-to-line or line-to-ground or both) having a basic impulse level (BIL) wave shape as shown on figure 2. The unit shall be subjected to the input voltage spike as shown on figure 2. After the test, the unit performance shall be verified.

4.6.5 Environmental tests.

4.6.5.1 Fungus resistance (see 3.4.5). Units that do not meet the requirements of fungus-inert materials in accordance with MIL-STD-454, requirement 4, shall be tested by exposure to fungus in accordance with MIL-STD-810, method 508.

4.6.5.2 Temperature-humidity cycling (see 3.9.1). The unit shall be tested in accordance with MIL-STD-810, procedure III, method 507. The temperature range shall be the specified operating range, and the relative humidity shall be 95 percent.

4.6.5.3 Salt fog (spray) (see 3.9.2). The unit shall be tested in accordance with MIL-STD-810, procedure I, method 509, for 96 hours.

4.6.5.4 Fluid immersion (see 3.9.3). The unit shall be tested in accordance with MIL-STD-202, method 215, except that the immersion fluids specified in table VI shall be used for a period of 24 hours. Each unit shall be immersed in each fluid and shall be completely dried before further testing.

TABLE VI. Immersion test fluids.

Fluids	Specification	Test temperature (°C)
Fuel oil	MIL-F-16884	33 - 37
Turbine fuel (JP-5)	MIL-T-5624	20 - 25
Isopropyl alcohol	TT-I-735	20 - 25
Hydraulic fluids	MIL-H-5606	48 - 50
Lubricating oils	MIL-L-17331 MIL-L-23699	73 - 77
Coolant 1/	-	20 - 25
Seawater	-	20 - 25

1/ Monsanto Coolanol 25 or equivalent.

4.6.5.5 Shock (see 3.9.4). The unit shall be tested in accordance with MIL-S-901, grade A, type A, class I.

4.6.5.6 Vibration (see 3.9.5). The unit shall be tested in accordance with type I vibration test of MIL-STD-167-1.

4.6.5.7 Inclination (see 3.9.6). The unit shall be tested for verification of inclination requirements by demonstration of operation under various inclination angles up to and including a 60-degree angle.

4.6.5.8 Magnetic field environment (see 3.9.7). The unit shall be tested in accordance with the applicable test procedures in MIL-STD-462.

4.6.5.9 Explosive atmosphere (see 3.9.8). The unit shall be tested in accordance with MIL-STD-202, method 109, under conditions as specified (see 3.1).

4.6.5.10 Water-drip (see 3.9.9). The unit shall be placed beneath a drip pan and subjected to continuously dripping water for 30 minutes. The drip pan shall extend beyond all exposed sides of the unit and contain uniformly distributed spouts which produce both splashing and dripping. Each 129 square centimeters of the pan surface shall contain one spout. Each spout shall have a drip rate of 20 drops per minute.

4.6.5.11 Water pressure (see 3.9.10). The unit shall be immersed in an aqueous dye penetrant solution at an applied pressure of 0.1 megapascal (equivalent to a depth of 10.4 meters). The units shall be maintained at a temperature of 10 to 35°C for 1 hour.

4.6.5.12 Nuclear radiation resistance (see 3.9.11). The unit performance shall be verified as specified (see 3.1). The dose rates and exposure times shall be as specified (see 6.2).

4.6.6 Mechanical requirements inspection.

4.6.6.1 Compression resistance (see 3.10.1). The unit shall be tested as follows. A force of 890 newtons shall be applied uniformly over each of its sides and shall be maintained for 10 minutes. The test shall be performed at the maximum and minimum operating temperatures.

4.6.6.2 Impact resistance (see 3.10.2). The unit shall be fully operating during and after an impact test of 13.6 newton-meters at the specified maximum and minimum operating temperatures. The impact mass shall have a maximum radius of 10 cm at the impact point.

4.6.6.3 Cable seal flexing (see 3.10.3). The unit shall be tested in accordance with MIL-STD-1344, method 2017, with the exception that the test sample shall be a unit or unit component.

4.6.6.4 Cable pull-out force (see 3.10.4). The unit shall be tested in accordance with EIA 455-6. The axial tensile load shall be applied and maintained for 10 minutes.

4.6.6.5 Cable twist (see 3.10.5). The unit shall be tested in accordance with EIA 455-36, with the exception that the test sample shall be a properly pigtailed unit. The tensile load shall be 5 newtons and the number of loads to be applied shall be one.

4.6.7 Electromagnetic interference suppression (see 3.11). The unit shall be tested for effects of electromagnetic emissions in accordance with MIL-STD-462 as specified (see 3.1).

4.8 Inspection of packaging (see 5.1). Sample packages and packs, and the inspection of the preservation, packing, and marking for shipment shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.7.)

5.1 Specific requirements. The requirements for preservation, packing, and marking shall be in accordance with MIL-E-17555 or as specified (see 6.2).

5.1.1 Marking.

5.1.1.1 Standard marking. In addition to any special or other identification marking required (see 6.2), each unit supplementary, intermediate, and exterior container shall be marked in accordance with MIL-STD-129. The complete

military or contractor's type or part number, as applicable (including the CAGE), shall be marked on all units, supplementary and intermediate packs in accordance with the identification marking provisions specified in MIL-STD-129.

5.1.1.2 Special marking. All units, supplementary, intermediate and exterior containers, shall be marked as specified for sensitive electronic devices in MIL-STD-129.

6. NOTES

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

6.1 Intended use. The unit is intended for use as a retrofit on existing equipment or as part of original design in new control applications. The unit is intended to be used to provide communication over optical fibers between a remote control panel and a local controller.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of the specification.
(b) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(c) Applicable specification sheet number, title, and date.
(d) When first article is required (see 3.2).
(e) Nuclear radiation dose rate and exposure times, when test is required (see 4.6.5.12).
(f) Level of preservation and packing required (see 5.1).
(g) Special marking if required (see 5.1.1.1).
(h) Applicable part number (see 6.8).
(i) Quantity of units required.

6.3 First article. When first article inspection is required, the items should be a first article sample. The first article should consist of 4 units. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.3.1 Lot size. The lot size may be specified contractually, if desired.

6.4 Quality conformance inspections. Quality conformance inspections require contractual definition of the overall test program, including sample sizes and lot sizes, if appropriate (see 4.5).

6.5 Definitions.

6.5.1 Analog signal. An analog signal is a nominally continuous signal that varies in a direct correlation to the instantaneous value of a physical variable.

6.5.2 Channel. A channel is a path along which signals can be sent.

6.5.3 Data rate. Data rate is the aggregate signaling rate in the transmission path of a data transmission system, usually expressed in bits per second.

6.5.4 Digital signal. A digital signal is a nominally discontinuous electrical signal that changes from one state to another in discrete steps.

6.5.5 Interface. Interface is a concept involving the interconnection between two devices or systems.

6.5.6 Maintainability. Maintainability is a characteristic of design and installation of an item expressed as the probability that an item will be retained in or restored to a specific condition within a given period of time, when the maintenance is performed in accordance with prescribed procedures and resources.

6.5.7 Mean-time-between-failures (MTBF). MTBF, for a particular measurement interval, is the total functioning life of a population of an item divided by the total number of failures within the population during the measurement interval.

6.5.8 Mean-time-to-repair (MTTR). MTTR is the total corrective maintenance time, that is, the total time devoted to maintenance, divided by the total number of corrective maintenance actions during a given period of time.

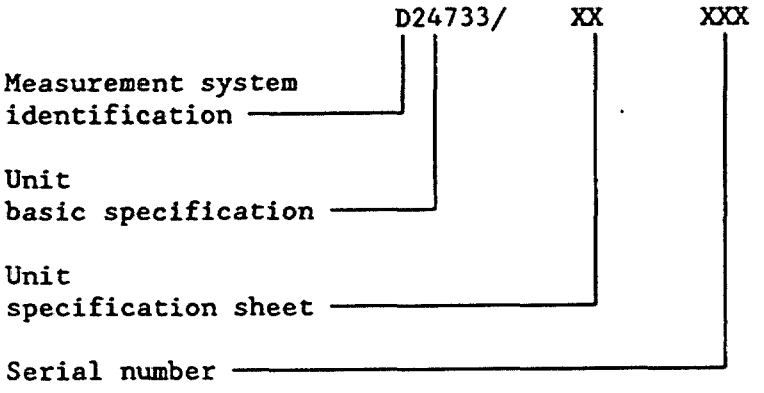
6.5.9 Signal. A signal is the code or pulse that represents intelligence, message, or control function conveyed over a communication system.

6.6 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.6.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.7 Subcontracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.8 Part or Identifying Number (PIN). Units should contain only the following:



Examples:

D24733/01-001
D24733/01-002

6.9 Part designator. A part designator, if specified (see 3.1), should include classifications (see 1.2) as follows:

(a) Fiber style (see 1.2.1).
(b) Fiber quantity (see 1.2.2).
(c) Optical wavelength class (see 1.2.3).
(d) Electrical signal type (see 1.2.4).

Example: SM1A2.

6.10 Specification use. Where MIL-C-24621 and MIL-C-85045 are referenced, the Navy versions, MIL-C-0024621 and MIL-C-0085045, should be used until canceled.

6.11 Subject term (key word) listing.

Fiber optic cable
Fiber optic communications
Fiber optic component
Fiber optic receiver
Fiber optic transmitter
Power margin
Remote control panel

Review activities:
Navy - EC, YD

Preparing activity:
Navy - SH
(Project 6030-N005)

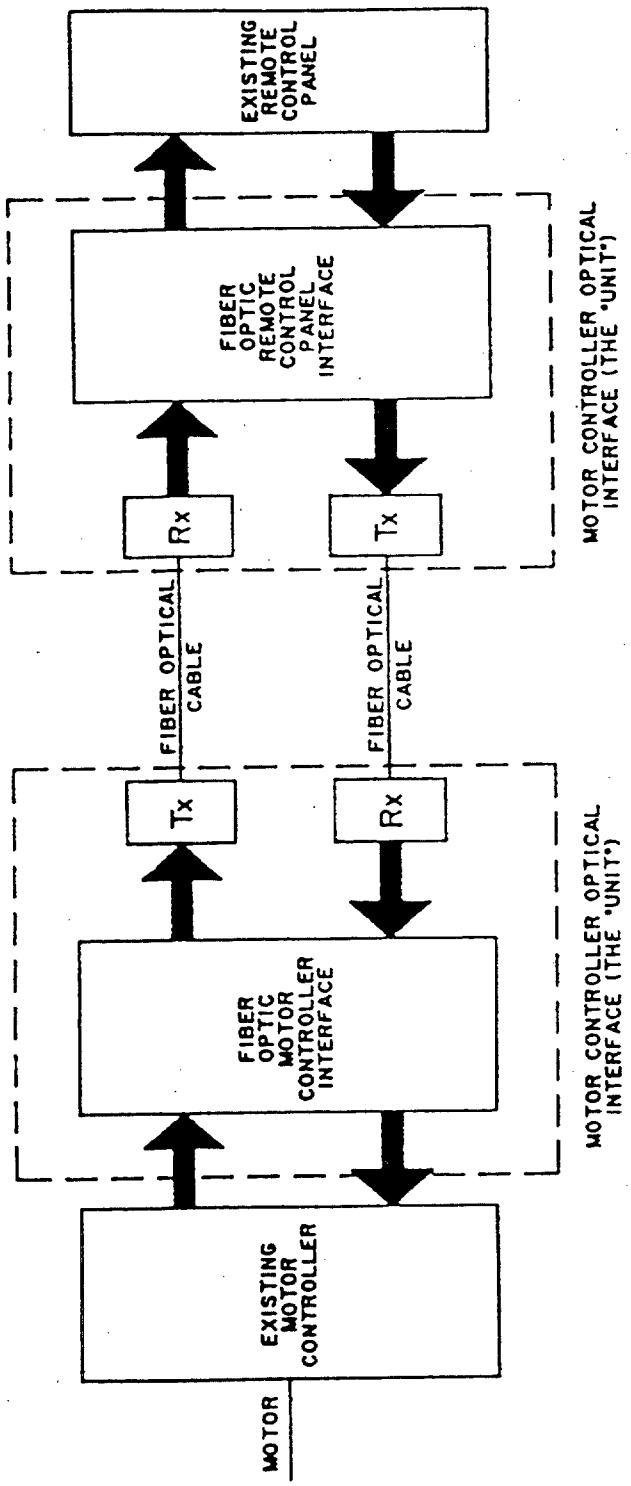


FIGURE 1. Unit conceptual block diagram for motor control (example).

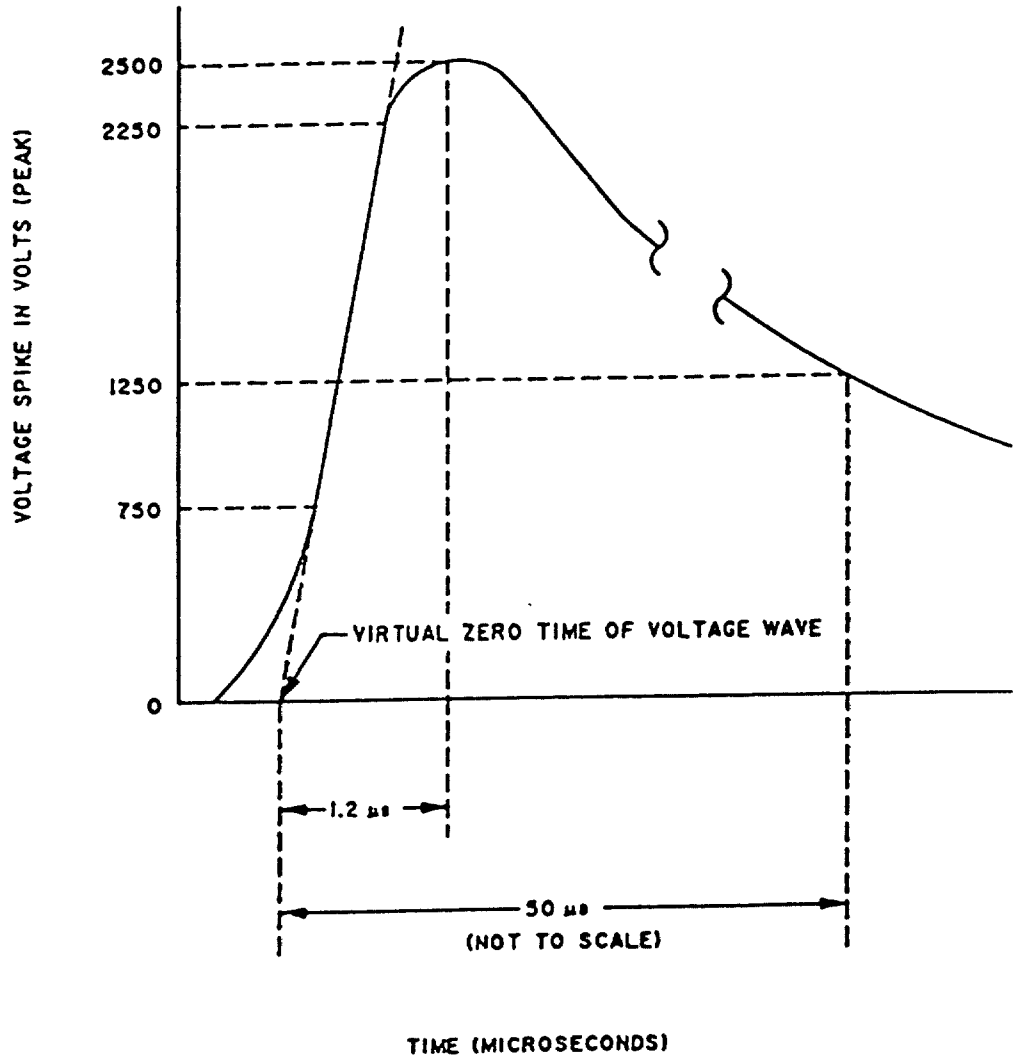


FIGURE 2. Voltage spike impulse wave shape.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-C-24733(NAVY)	CONTROLLER INTERFACE UNIT, FIBER OPTIC (METRIC), GENERAL SPECIFICATION FOR

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*:
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 55Z3)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362-5101

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12503 WASHINGTON D. C.
POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 55Z3)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362-5101

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES