

METRIC

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SECTION 406A
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MILITARY STANDARD
INTERFACE STANDARD FOR SHIPBOARD SYSTEMS
SECTION 406
DIGITAL COMPUTER GROUNDING
(METRIC)



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SECTION 406B

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
Arlington, VA 22242-5160

Interface Standard for Shipboard Systems,
Digital Computer Grounding

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1. This Military Standard is approved for use by all interested Commands of the Department of the Navy in the technical development plans, design, and acquisition specifications for new ship acquisitions, ship modernizations or conversions, and systems/equipment for installation therein and into active fleet ships, where applicable, 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, Naval Sea Systems Command, SEA 03R42, 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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FOREWORD

Purpose. This section establishes a standard ground system for digital computer systems and the computer equipment ground and ground interface requirements.

Nature of the interface. Equipment components of a digital computer system operate at and are interconnected with low signal level circuits that utilize direct current (d.c.) ground return currents which flow through and interface with the ship standard ground system. Differences in ground potential between equipment units directly affect circuit ability to discriminate between logical (1) and logical (0) signals and may increase error rates of transmission to unacceptable levels. A standardized grounding system will enhance the operational reliability of shipboard digital computer systems.

Structure. The technical content first delineates the characteristics in terms of digital computer system grounding requirements. Constraints on ground system design and installation, which are necessary to achieve shipboard compatibility with these characteristics, are then established.

Numerical quantities. Numerical quantities are expressed in metric (SI) units followed by U.S. customary units in parentheses. The SI equivalents of the U.S. customary units are approximated to a practical number of significant figures. The values stated in U.S. customary units are to be regarded as the current specified magnitude.

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1. SCOPE

1.1 Scope. This section establishes a standard ground system and the requirements for grounding shipboard digital computer equipment, to ensure compatibility between such grounding systems and digital computer systems/equipment which will enhance system operational reliability.

1.2 General. Policies and procedures established by MIL-STD-1399 are mandatory. This section and the basic standard are to be viewed as an integral single document.

1.3 Interface. Basic characteristic and constraint categories concerned with the computer to ground interface are shown symbolically on figure 1 (see section 3 "Definitions" of MIL-STD-1399):

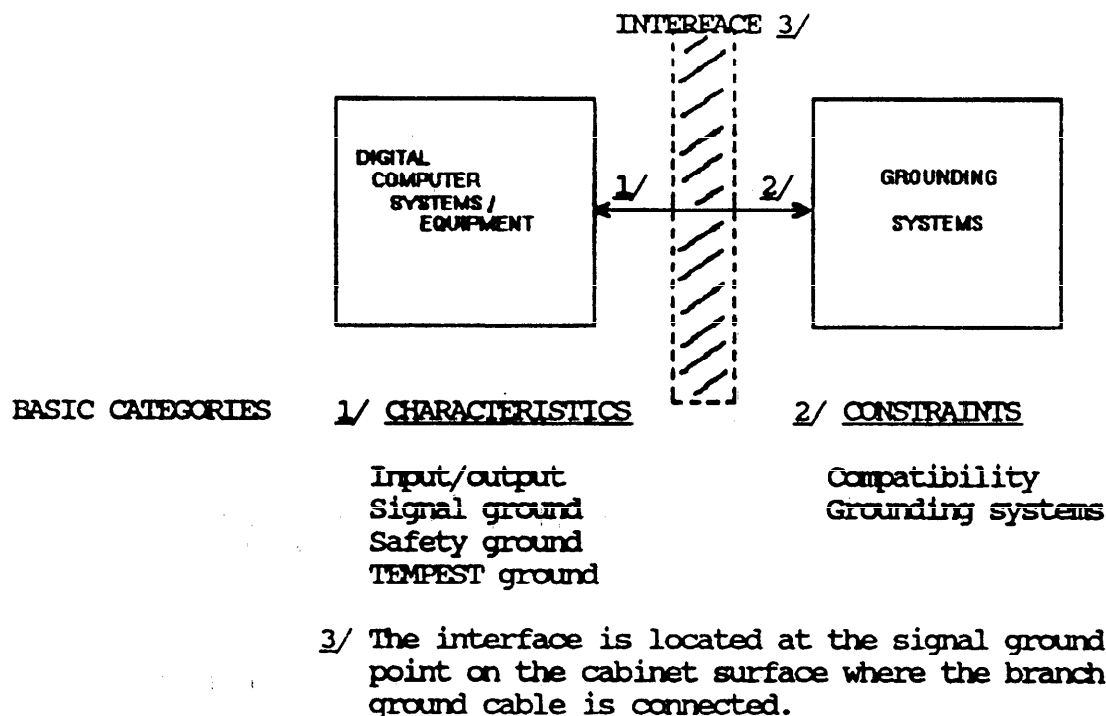


FIGURE 1. Interface.

The particular interface characteristics and constraints pertinent to this section are described in 5.2 and 5.3

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1.4 Applicability. This section applies to all shipboard digital computer systems/equipment.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

- MIL-C-915 - Cable and Cord Electrical, for Shipboard Use General Specification for.
- MIL-C-915/28 - Cable, Electrical, 1000 Volts, Type SSGU.

STANDARDS

MILITARY

- MIL-STD-454 - Standard General Requirements for Electronic Equipment.
- MIL-STD-1310 - Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety.
- MIL-STD-1397 - Input/Output Interfaces, Standard Digital Data, Navy Systems.
- MIL-STD-1399 - Interface Standard for Shipboard Systems.
- MIL-STD-1680 - Installation Criteria for Shipboard Secure Electrical Information Processing Systems (U).

(Copies of specifications and standards, required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 Signal ground. Signal ground is the low side floating signal which is grounded as shown in figure 2.

4. REQUIREMENTS

4.1 Specific interface requirements and constraints established herein are mandatory and shall be adhered to by SYSCOMs, project managers, contractors and all others engaged in any aspect of shipboard digital computer systems/equipment design to which these requirements and constraints apply including systems/equipment design, production, and installation (see section 4 "Requirements" of MIL-STD-1399).

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5. INTERFACE CHARACTERISTICS AND CONSTRAINTS

5.1 General considerations. Shipboard digital computers and their peripheral components utilize low signal level d.c. currents in the interconnecting circuits. The purpose of a ground system is to provide a low resistance current return path for the ground current components of equipment circuits, in order to minimize ground current induced circuit deterioration. Properly designed ground systems will serve to minimize ground circuit voltage drops and cross-talk and reduce destructive coupling effects, due to ground loops. Differences in ground potential between equipment units directly affect circuit ability to discriminate between logical (1) and logical (0) signals and may increase error rates of transmissions to unacceptable levels. A standardized grounding system will enhance the operational reliability of shipboard digital computer systems/equipment. Figure 3 presents the basic elements of such a standardized ground system that shall be installed exactly as specified, without exception unless deviations are fully justified (see 6.1).

5.2 Interface characteristics. Interface characteristics of the ships digital computer systems/equipment, with respect to grounding requirements, are specified in 5.2.1 through 5.2.4.

5.2.1 Input/output. Input/output signal levels of digital computer systems/equipment shall be as specified in MIL-STD-1397.

5.2.2 Equipment signal ground. An equipment signal ground shall be brought out to a connection point located on the external surface of each digital equipment cabinet (see figure 1, note 3).

5.2.2.1 Multiple cabinet equipment signal ground. Two or more adjacent equipment cabinets which have circuits requiring the same signal ground levels are to be considered as a single equipment unit. The signal ground system of such equipment shall be connected to the branch ground cable at one common point only (see figure 4). Multiple equipment common ground requirements may apply to central processors, data processing peripheral equipment and similar devices.

5.2.3 Cabinet safety ground. The design of digital equipment cabinets shall provide for grounding to chassis as specified in MIL-STD-454, requirement 1. Safety ground is for personnel safety only and shall not obviate the requirement for a signal ground connection. The safety ground shall not be isolated from the signal ground. The installation shall be as specified in 5.3.2.3. The use of a common ground point for both shall be in accordance with figure 3 and in no way degrades either ground system.

5.2.4 TEMPEST grounds. TEMPEST grounds shall be provided for all digital equipments which process plain language classified information (see 5.3.3).

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5.3 Interface constraints. Interface characteristics of the ships digital computer systems/equipment impose certain constraints on the design and installation of grounding systems. These constraints are specified in 5.3.1 through 5.3.4.

5.3.1 Compatibility. Design and installation of digital computer grounding systems shall be compatible with the interface characteristics given in 5.2.

5.3.2 Signal ground system. A signal ground system shall be installed in all major digital equipment spaces. The ground system shall connect to all units of a computer complex and shall extend to and include the first digital-to-analog peripheral equipment including remotely located high speed line printers, plotters, input/output consoles and other units which require a stiff ground reference, to properly interface with a computer complex. Ground system shall not normally extend to single remotely located ancillary equipment such as signal monitors, indicators, displays, and similar devices (electrical, mechanical, or pneumatic) which do not require a stiff reference ground for proper operation. Motor-generators and RF equipments shall not connect to this ground system. The ground system shall consist of a main ground cable and branch ground cables. The digital equipment ground system installation, cabinet grounding and signal grounding shall be in accordance with the requirements of 5.3.2.1 through 5.3.2.4 and as shown on figure 5.

5.3.2.1 Main ground cable. Main ground cable shall consist of an SSGU-1000 cable in accordance with MIL-C-915 and MIL-C-915/28, run in and between all major digital equipment spaces, and bonded to the ship's hull at one point only. Except for this one point attachment, the main ground cable shall be otherwise insulated electrically from the metallic hull or structure. The one point ground connection shall be located approximately central to all equipments included in the digital system and shall be accomplished by installing a short section of type SSGU-1000 cable (conforming to MIL-C-915/28) between the main ground cable and hull ground. This cable shall connect to the main ground cable by means of a Burndy QPX4444 "Versitap" connector, or equal, and shall connect to ground potential by means of a Burndy GB44 connector, or equal (see figure 5). Care shall be taken to ensure a tight, metal-to-metal ground connection at this point. The main ground cable shall be routed in such a manner that minimum lengths of branch ground cables are required.

5.3.2.2 Branch ground cables. Branch ground cables shall connect digital equipment signal grounds (see 5.2.2) to the main ground cable. Branch cables shall have a cross section area of 20 square millimeters (mm^2) (40,000 circular mils) or a cross section area in mm^2 determined by the cable length in meters multiplied by 0.85 (in circular mils, cable length in feet multiplied by 500), whichever is the larger. Except for attachment to the main ground cable and

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to a common signal/cabinet ground (when used), the branch cables shall be insulated electrically from the metallic hull (see figure 3). Two or more equipment units may be connected to the same branch ground cable. The connection to the branch cable shall be made to assure that the branch cable mechanical and electrical continuity is maintained throughout. Installation shall be in accordance with figure 6. Branch cable runs shall be kept as short as practicable and shall be isolated from electrical contact with ship hull (ground potential), except as required in 5.3.2.3. Branch cables shall connect to the main ground cable by means of conductor splices, Burndy QPX, or equal, see figure 5.

5.3.2.3 Signal ground common to cabinet ground. The internal signal ground shall connect to the grounding point on the equipment cabinet (see figure 3). The branch ground cable shall connect to this point using Burndy YA-L lugs, or equal, on the branch cable (see figure 5).

5.3.2.4 Input/output cables. Input/output cable armor, shields and connectors shall be bonded to the terminating equipment cabinet in accordance with MIL-STD-1310. Where manufacturers' specifications require cable armor and shields to be grounded at one or both ends of a cable run, or where requirements are to alternately ground the cable armor and shield (or shields) at alternate ends of a cable run, these requirements shall be adhered to in lieu of the preceding requirements.

5.3.3 TEMPEST ground systems. TEMPEST ground systems for digital equipments which process plain language classified information shall be installed as specified in MIL-STD-1680.

5.3.4 Installation. To enhance the quality performance level of digital systems, the installation shall comply with the following:

- (a) Digital system installations shall be contained within the smallest practical area, to minimize the extent of the ground system.
- (b) Circuits and metallic cabinet safety grounds in a digital system shall be properly connected to the ship ground system.
- (c) Ground system cables shall be as short as possible.
- (d) Primary power cables shall be installed with maximum practical separation from the main and branch ground systems cable.

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6. DEVIATIONS

6.1 Conditions. In achieving the purpose of this section, it is recognized that there must be some flexibility of application. During the early design stage of shipboard digital computer systems/equipment, it may become apparent that significant advantages in the overall design/operation of such systems/equipment can be achieved by deviating from the standard grounding characteristics specified herein. Such cases shall comply with the provisions of section 6 "Deviations" of MIL-STD-1399, with copies to the program/project manager and NAVSEA Combat Support System Engineering Branch.

Preparing activity:
Navy - SH
(Project 1990-N104)

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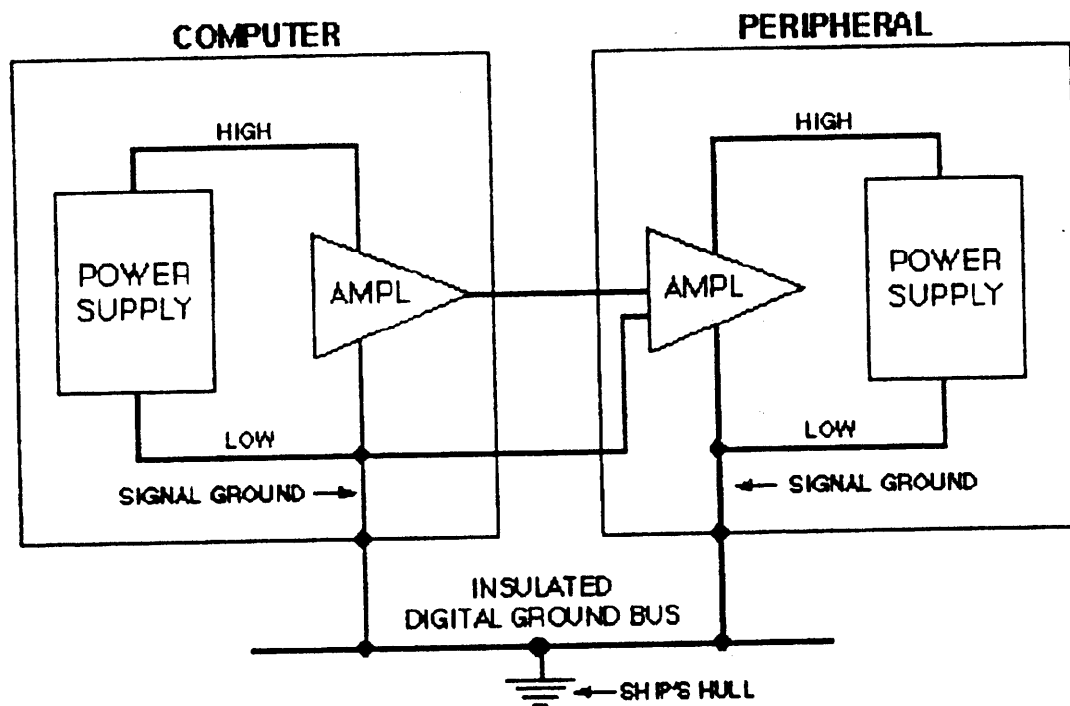


FIGURE 2. Typical signal ground application between two equipments.

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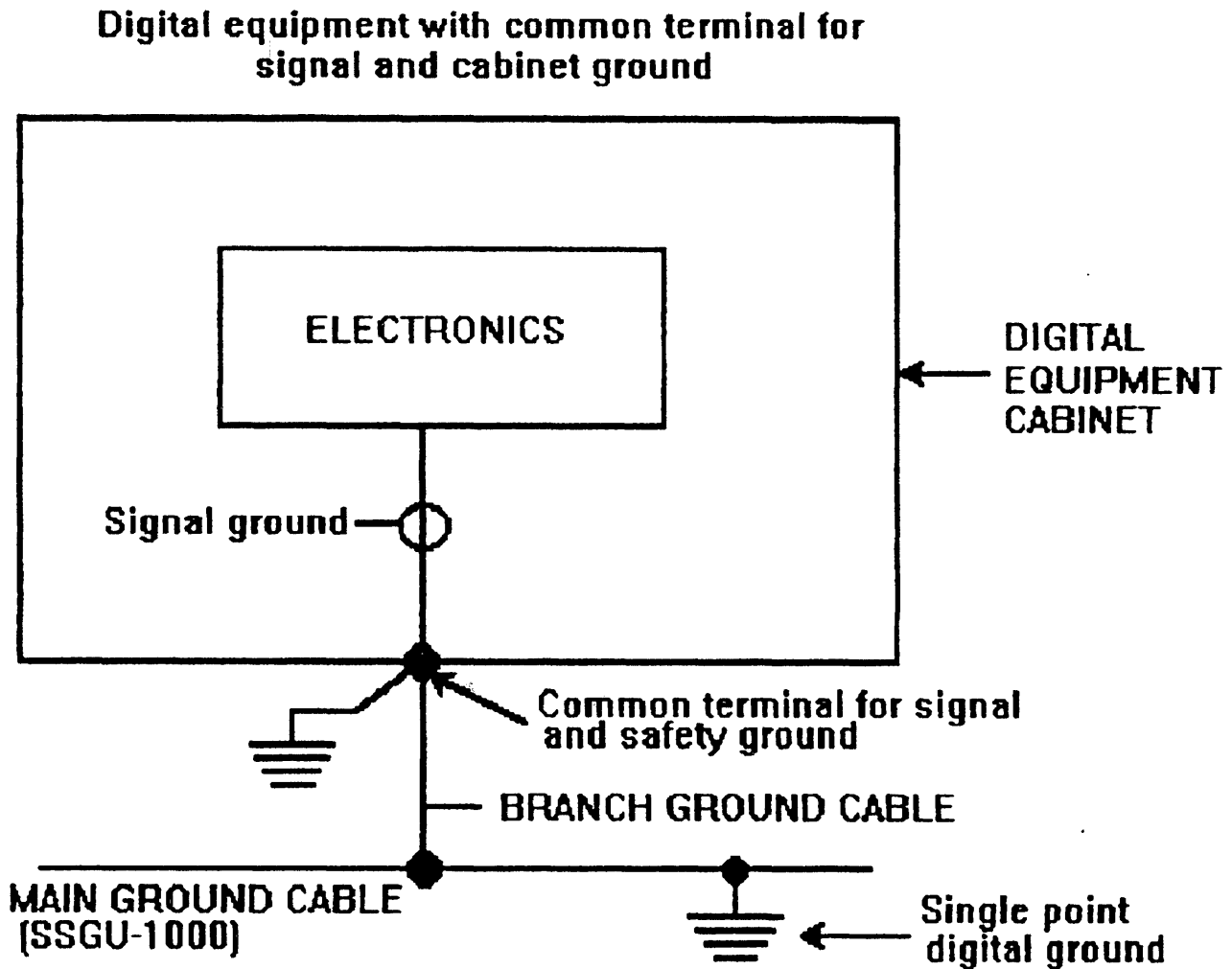
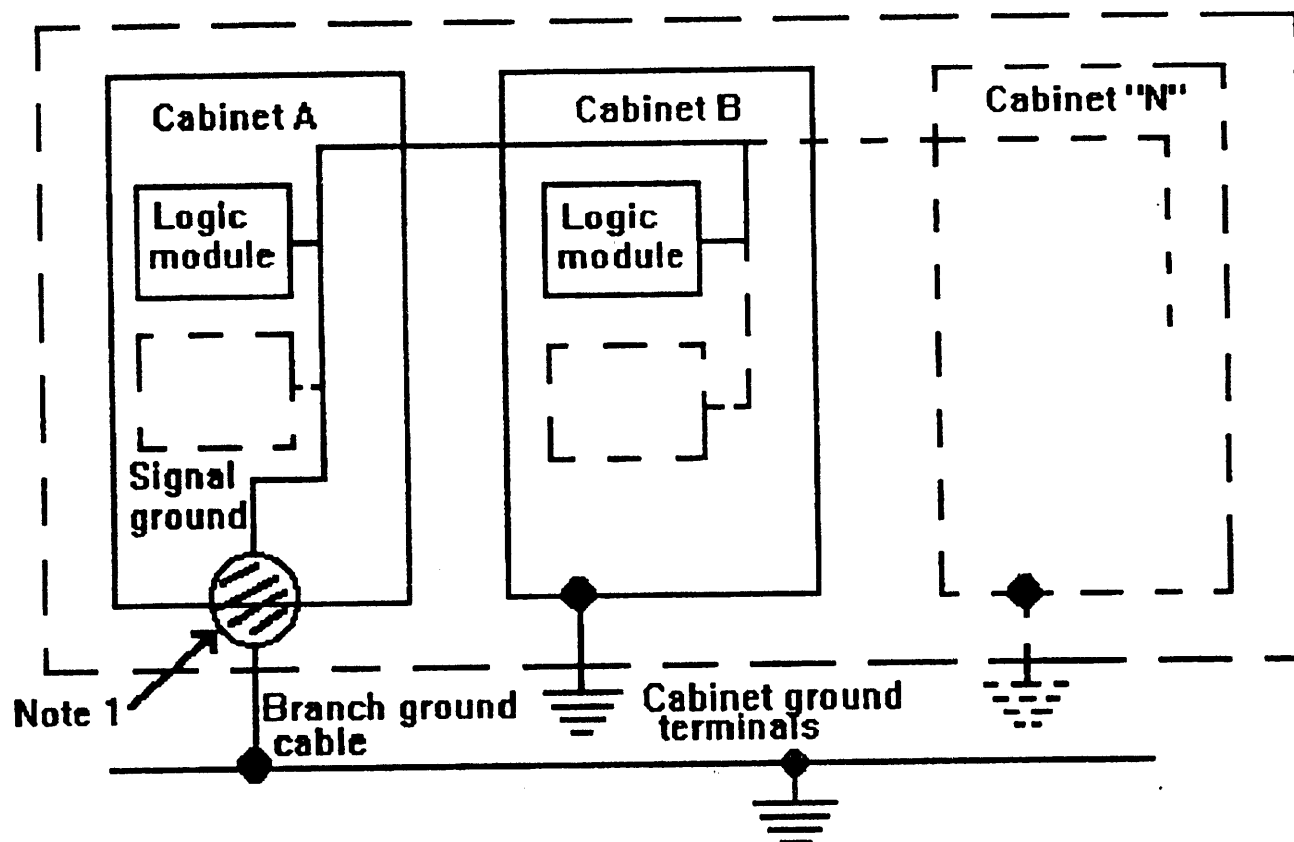


FIGURE 3. Basic elements, typical digital equipment grounding system.

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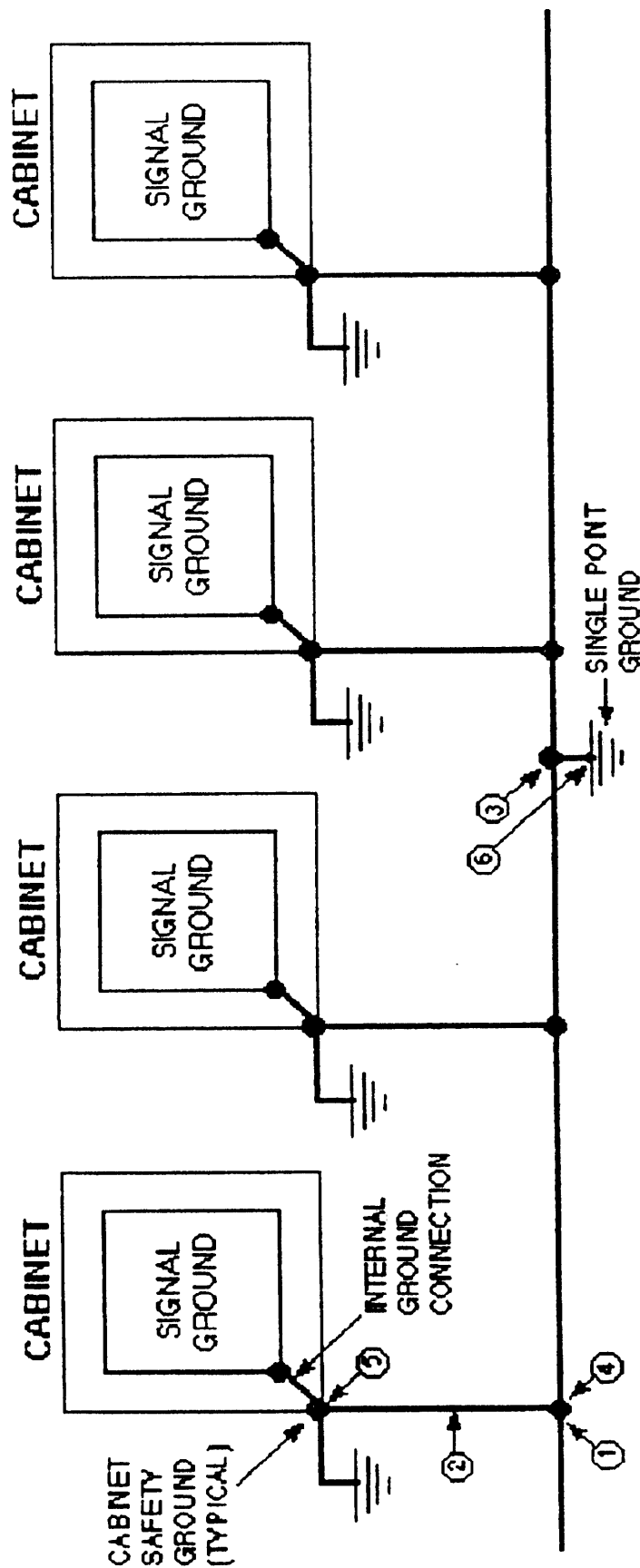
Multiple cabinet equipment



Note 1 - For signal/cabinet grounding details (see figure 3).

FIGURE 4. Signal ground, multiple cabinet equipment.

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Signal Ground Common to Cabinet Ground

LIST OF MATERIAL

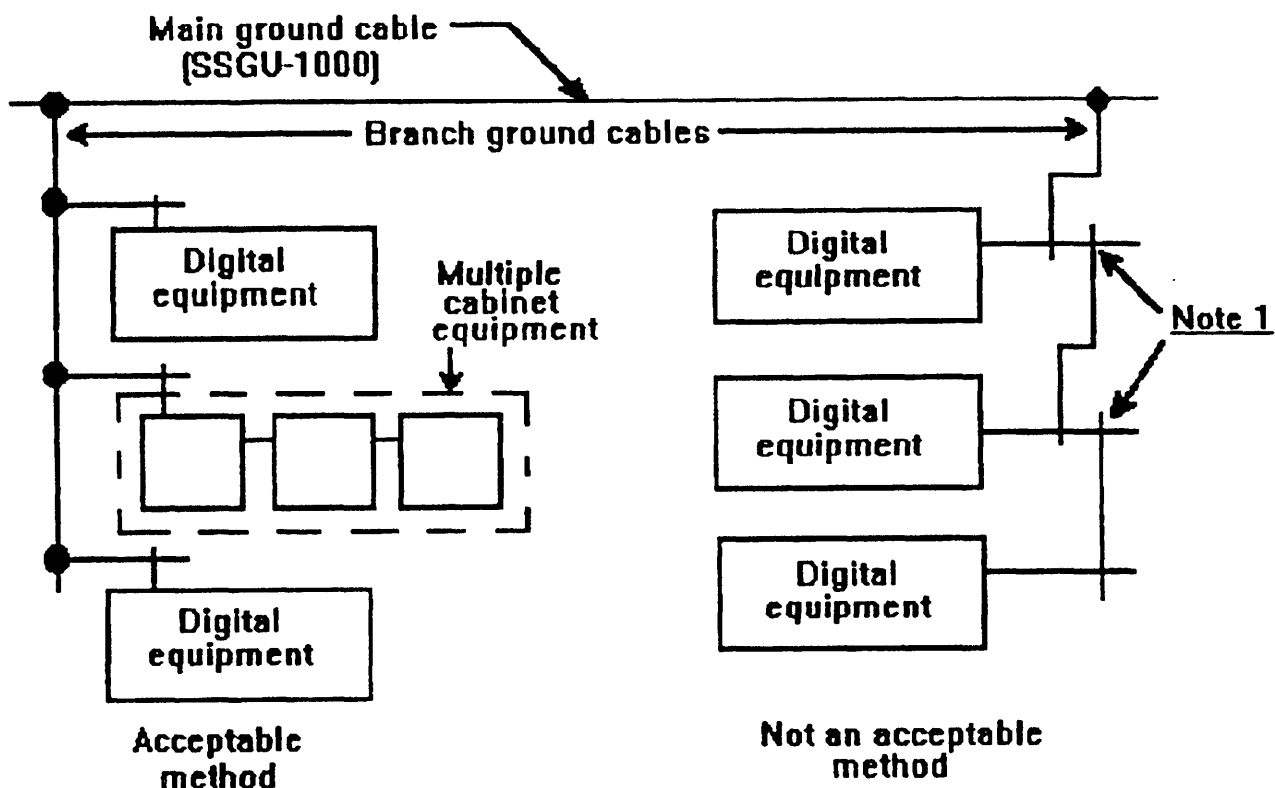
ITEM NO.	PART	SPECIFICATION	NOTE
1	CABLE, MAIN GROUND, SSGU-1000	MIL-C-915/28	1
2	CABLE, BRANCH GROUND		2
3	CONNECTOR, BURNDY QPX-4444, OR EQUAL		1
4	CONNECTOR, BURNDY QPX, OR EQUAL		2
5	CONNECTOR, BURNDY YA-L, OR EQUAL		3
6	CONNECTOR, BURNDY GB44, OR EQUAL		1

NOTE:

1. THE MAIN GROUND CABLE SHALL CONSIST OF AN UNBROKEN LENGTH OF SSGU-1000 CABLE, GROUNDED AT A SINGLE POINT. THE MAIN GROUND CABLE SHALL BE ISOLATED ELECTRICALLY FROM CONTACT WITH SHIP'S HULL AND STRUCTURES, EXCEPT FOR THE SINGLE POINT ATTACHMENT. THE MAIN GROUND CABLE SHALL BE INSTALLED AS SPECIFIED IN 5.3.2.1.
2. BRANCH CABLE SIZE AND INSTALLATION SHALL BE AS SPECIFIED IN 5.3.2.2.
3. BRANCH GROUND CABLES SHALL CONNECT TO THE CABINET GROUND POINT USING BURNDY YA-L LUGS, OR EQUAL.

FIGURE 5. Digital equipment grounding.

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Note 1 - This connection method is not acceptable for shipboard digital installations. The mechanical connection is subject to long term corrosion and physical deterioration which may result in degraded performance. Each branch cable shall be mechanically and electrically continuous during its entire run.

FIGURE 6. Grounding of digital equipments to branch ground cables.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the comment number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of this form.

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1. DOCUMENT NUMBER

MIL-STD-1399(SH)
SECTION 406B

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3. DOCUMENT TITLE

INTERFACE STANDARD FOR SHIPBOARD SYSTEMS SECTION 406 DIGITAL COMPUTER GROUNDING (METRIC)

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

5. REASON FOR RECOMMENDATION

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(1) Commercial

(2) DSN

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