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SECTION 441
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SECTION 505
26 NOVEMBER 1974

MILITARY STANDARD

INTERFACE STANDARD FOR SHIPBOARD SYSTEMS

SECTION 441

PRECISE TIME AND TIME INTERVAL (PTTI)

FSC 1990

DEPARTMENT OF THE NAVY
WASHINGTON, DC 20301

Interface Standard for Shipboard Systems,
Precise Time and Time Interval

DoD-STD-1399(NAVY)
SECTION 441

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. Recommended corrections, additions, or deletions should be addressed to Commander, Naval Electronic Systems Command, (Code 8111) Washington, DC 20360.

FOREWORD

Purpose. This section defines the standard interface requirements for, and the constraints on, the design of shipboard equipment which will utilize the precise time and time interval (PTTI) platform distribution system (PDS).

Nature of the interface. The Navy's PTTI program is an effort to disseminate highly accurate PTTI references worldwide from the U.S. Naval Observatory (NAVOBSY) to Navy ships and other platforms and installations having a need for such references. These references are distributed within the ship via the PDS. It is essential that the interface between the PTTI PDS outputs and the various user equipments be engineered so that the stability and accuracy of the outputs are not degraded and that the user equipments may accept and process the reference outputs effectively.

Structure. The technical content of this section first delineates the interface characteristics in terms of available frequency and time parameters, impedance, voltage, capacities, and so forth. The constraints on equipment design and installation necessary to achieve shipboard compatability with these characteristics are then established.

CONTENTS

FIGURES

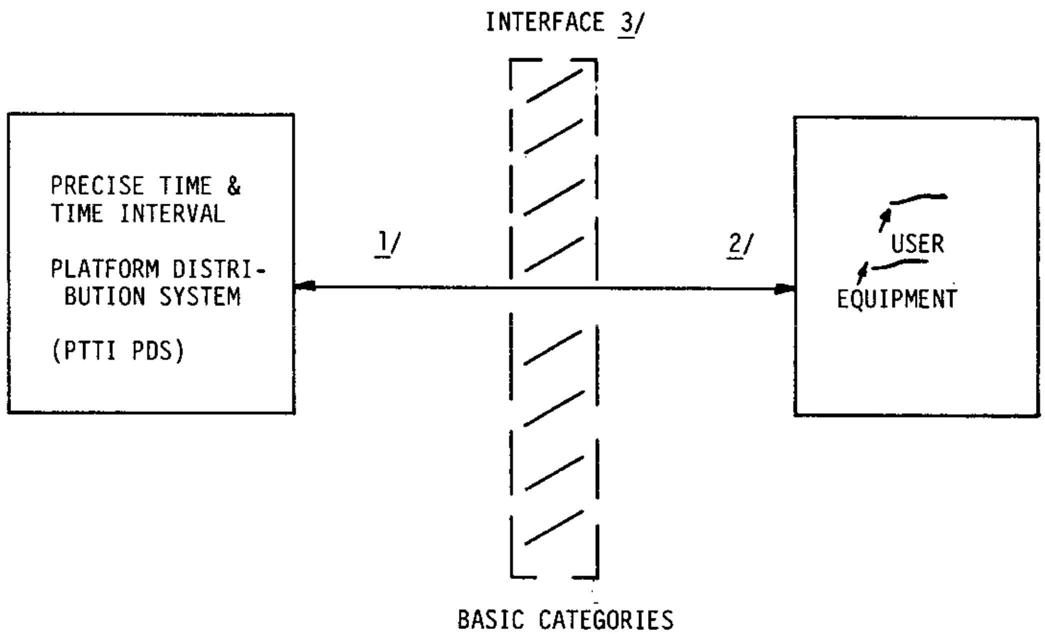
TABLES

1. GENERAL, SCOPE, INTERFACE, AND APPLICABILITY

1.1 General. Policies and procedures established by DoD-STD-1399 are mandatory. This section and the basic standard (that is, DoD-STD-1399) are to be viewed as an integral single document.

1.2 Scope. This section establishes interface requirements for shipboard equipment utilizing the Precise Time and Time Interval (PTTI) Platform Distribution System (PDS) in order to ensure compatibility between the user equipment and the PTTI PDS.

1.3 Interface. The basic characteristics and constraint categories concerned with this interface are shown symbolically in FIGURE 1 (see section 3 "Definitions" of DoD-STD-1399):



1/ CHARACTERISTICS

Precise time
Precise time interval (frequency)
Output voltage
Capacity

2/ CONSTRAINTS

Compatibility

3/ The interface is located at the input connector of the user equipment.

FIGURE 1. Interface.

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

1.4 Applicability. The criteria of this section are applicable to new ship acquisitions, ship modernizations, and ship conversions wherein a requirement exists for equipment utilizing the outputs of the PTTI PDS. They apply also to ships having equipment to be interfaced in part with the PTTI PDS to the extent indicated (for example, frequency support only).

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-A-22305	Amplifier, Distribution AM-2123/U
MIL-F-28811	Frequency Standard, Cesium Beam Tube
MIL-F-28816	Frequency-Time Standard, AN/URQ-23 Series, General Specification For

STANDARDS

MILITARY

DoD-STD-1399	Interface Standard For Shipboard Systems

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

3. DEFINITIONS

3.1 Time. Time signifies epoch, that is, the designation of an instant on a selected time scale, astronomical or atomic. It is used in the sense of time of day.

3.2 Time interval. Time interval indicates the duration of a segment of time without reference to when the time interval begins or ends. Time interval may be expressed in seconds of time.

3.3 Precise frequency. Precise frequency signifies a frequency requirement to within one part in 10^9 of an established time scale.

3.4 Precise time. Precise time signifies a time requirement within ten milliseconds (ms).

4. REQUIREMENTS

4.1 Requirements. The specific interface requirements and constraints established hereby are mandatory and shall be adhered to by the Department of the Navy and all others engaged in any aspect of shipboard equipment design, production, and installation wherein that equipment is intended to interface with the PTTI PDS for support.

5. INTERFACE CHARACTERISTICS AND CONSTRAINTS

5.1 General considerations. As weapons, navigation, command and control, communications, and other systems become increasingly sophisticated, the requirements for accurate, stable, non-interruptable time and frequency support also increase. The reference standards required to fulfill these requirements, for example, the O-1695A/U Cesium Beam Frequency Standard and the AN/URQ-23 Frequency-Time Standard are expensive, and each user system having its own built-in standard is not cost effective. The PTTI program was established to provide Navy platforms and other users with PTTI reference standards traceable to the Naval Observatory (NAVOBSY) and to forestall thereby the proliferation of built-in standards. It should be noted that the PTTI PDS concept described in 5.1.1.2 will not be fully defined and approved for Service use until fiscal year 1987 at the earliest; however, portions of the conceptual PTTI PDS have been introduced in the fleet (for example, O-1695A/U Cesium Beam Frequency Standard and AN/URQ-23 Frequency-Time Standard) and their characteristics are reflected herein, such as in 5.2.3.1 and 5.2.3.2.

5.1.1 PTTI system concept. The PTTI system consists of two major systems: The worldwide primary and backup dissemination system; and, the PDS. As used in this discussion, the term platform includes ships, submarines, aircraft, and shore installations. FIGURE 2 is a functional diagram showing the interrelationships between these major systems. The NAVOBSY has been tasked by the Department of Defense (DoD) to establish, coordinate, and maintain the standards for time and time interval for use by all DoD components, for example, Army, Navy, Air Force, National Security Agency, naval laboratories, and so forth. To provide accurate time for the DoD community, NAVOBSY maintains a master clock system which is referenced to the coordinated universal time (UTC) scale. NAVOBSY time thus referenced to UTC is identified as UTC (USNO).

Via the worldwide primary and backup dissemination system and the PDS, each equipment and system on board a Navy platform having a requirement for PTTI will be provided with time and time interval signals which will be directly traceable to the NAVOBSY, its master clock system, and UTC (USNO).

The PTTI program will establish this capability of disseminating and distributing PTTI from the NAVOBSY on a continuous worldwide basis by using not only dedicated resources such as Navigation System Using Time and Ranging Global Positioning System (NAVSTAR GPS), but also by using existing assets to the maximum extent practicable; for example, there are many communication and navigation systems presently in use within the DoD community which have an inherent capability to disseminate PTTI signals on a noninterference basis with the systems' primary missions.

While some of these systems have the capability to disseminate both time and time interval (for example, Loran-C and TV Line 10), many systems can be used to disseminate either precise time or precise frequency. The Navy navigation satellite system (NNSS), for example, has only a precise time dissemination capability; current very low frequency (VLF) broadcasts can be used only as a precise frequency reference for stationary users.

5.1.1.1 PTTI dissemination system. FIGURE 3 is a functional diagram showing an example of a PTTI dissemination system. The key point of this example is that precise time and time interval traceable to the NAVOBSY can be disseminated to various users over a variety of transmission systems. A firm ground rule of this program is that existing facilities must be used wherever practicable to meet current and planned user requirements. As future user system requirements become better defined and technological improvements in timing are realized, the dissemination system(s) will be upgraded.

5.1.1.2 PDS. FIGURE 4 is an example of a distributed PTTI PDS. A distribution system of this type will nominally employ three local reference standards. The distributed aspect of the system refers to the physical isolation of the local standards from each other for the purposes of PTTI distribution system survivability and availability; that is, the vulnerability of the distribution system to fire or battle damage is diminished by the spatial separation, and a fallback capability will generally be available. In addition, the "distributed" concept will tend to result in reference standards being powered by several platform power distribution networks, again increasing system survivability. Another important aspect of the PTTI PDS shown in FIGURE 4 is the use of a PTTI dissemination system external to the platform. As stated in 5.1.1 and 5.1.1.1, there are currently numerous systems in operation which have an inherent capability to disseminate PTTI information on a non-interference basis with the systems' primary missions. The specific external dissemination systems to be utilized by a mobile platform must be determined by analysis of its mission, its PTTI requirement, and the capabilities or assets on board. In the case of a stationary platform, the same information, as well as its geographic location will be factors in evaluating which of the external dissemination systems should be utilized. Three primary benefits can derive from utilizing a PTTI PDS such as is shown in FIGURE 4. The first will be a reduction in total cost. Nominally, three standards will serve all users aboard, thus relieving the user equipments and systems of the necessity for their own internal oscillators or stand-alone reference standards. This should also comply with Chief of Naval Operations (CNO) guidance for the PTTI program by reducing the number of reference standards per platform and thus reduce the proliferation of standards in the fleet. The second benefit is that all user systems will be provided with more accurate time and time interval information. This results from two features of the PDS. First, each standard aboard will be compared with all other standards aboard. Secondly, all standards aboard will receive regular time and time interval updates traceable to the NAVOBSY via the external dissemination systems. In the event that the external dissemination systems are lost, the platform

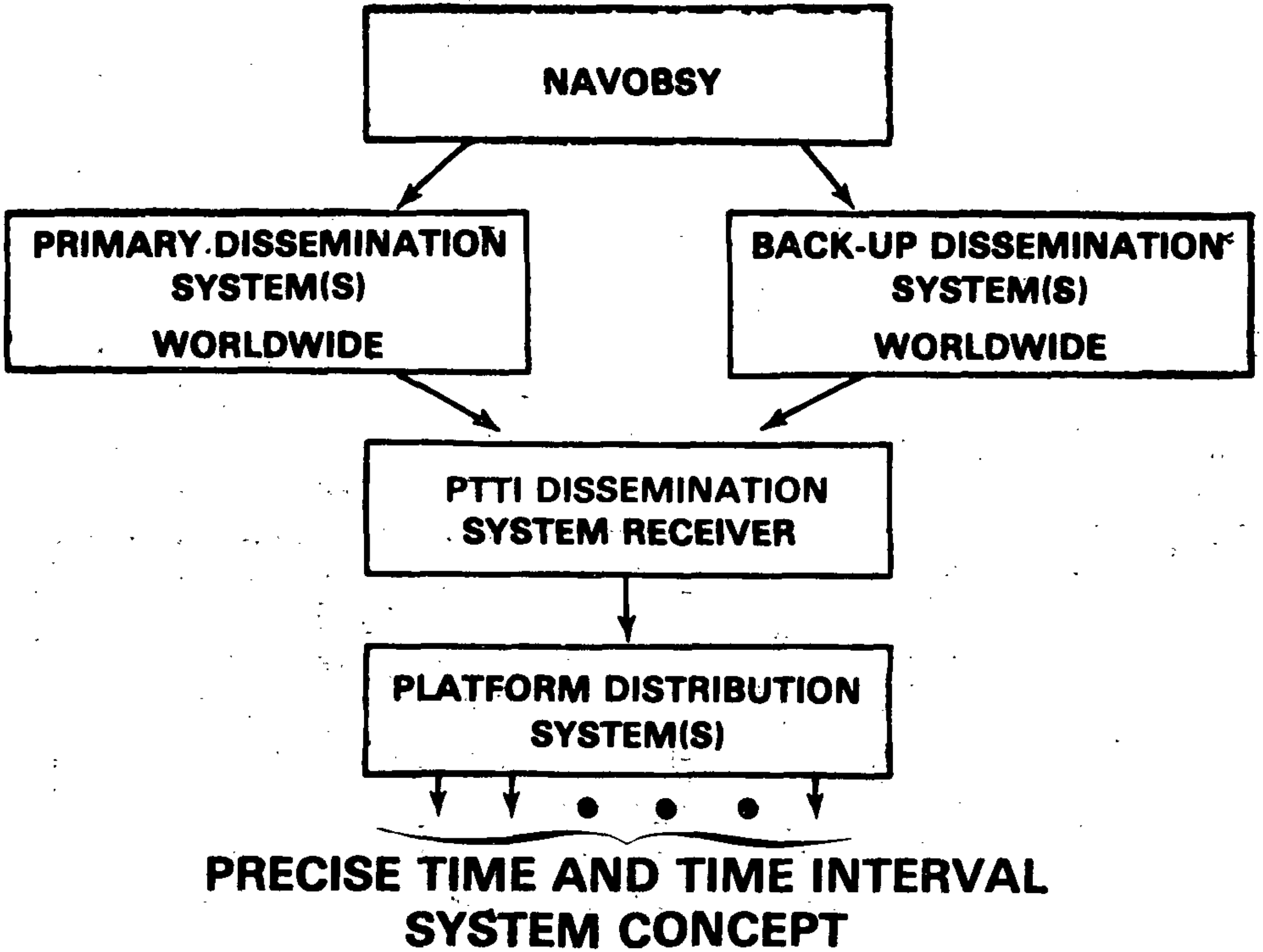


FIGURE 2. PTTI system concept.

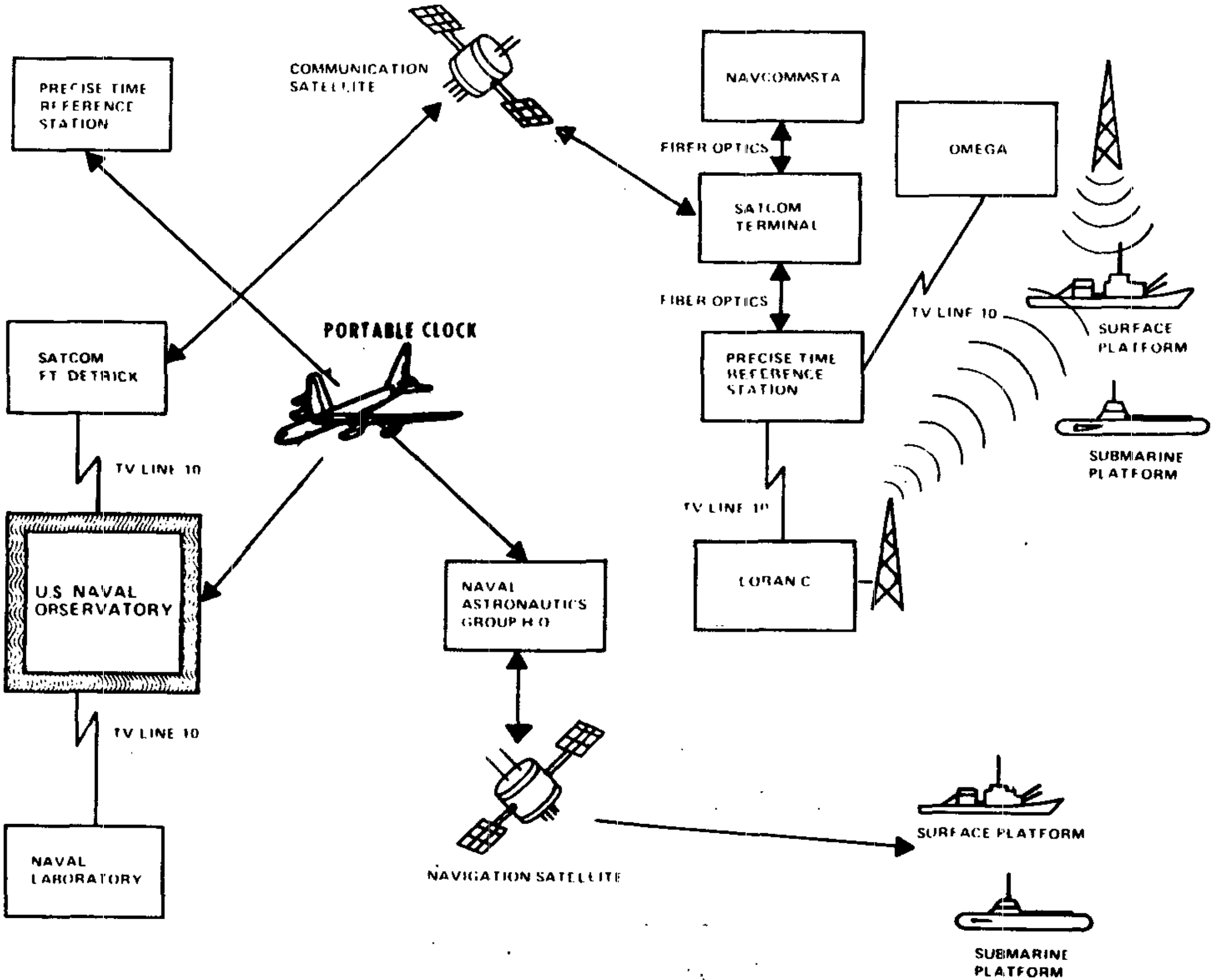


FIGURE 3. PTTI dissemination subsystem concept.

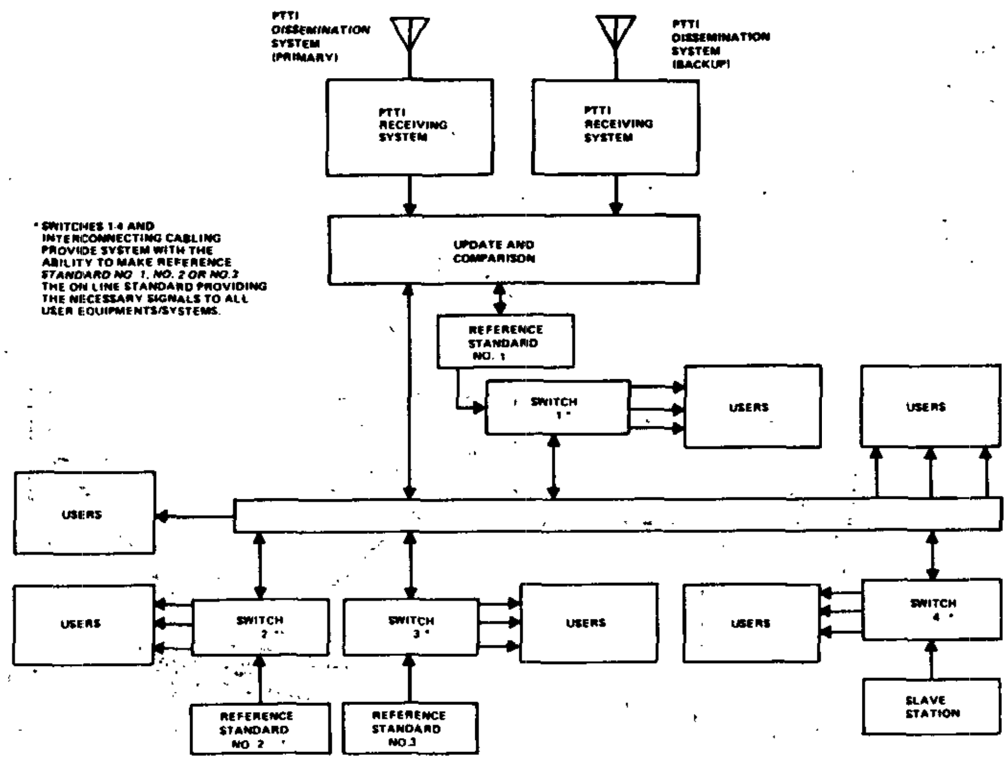


FIGURE 4. PTTI platform distribution system concept.

falls back to the inter-comparison of the standards on board. The third primary benefit will be the reduction in portable clock trips. A portable clock trip currently provides the best time of day (TOD) accuracy and traceability to the NAVOBSY; however, portable clock trips are the most expensive method of providing PTTI traceability. If a PDS is provided the capability to perform time updates on a worldwide 24-hour basis, the requirement for portable clock trips could be eliminated in almost every case.

5.2 Interface characteristics. The interface characteristics of the PTTI PDS are given below. The values for time and frequency control signals listed in 5.2.1 and TABLE I are maximums and a particular PTTI PDS may not provide all the signals listed.

5.2.1 Frequency reference. Under normal conditions, the output frequencies provided will be 100 kilohertz (kHz), 1 megahertz (MHz), and 5 MHz with a long-term stability of five parts in 10^{11} per day or better. For more exact information and details see MIL-F-28811 or MIL-F-28816.

5.2.1.1 Harmonic distortion. Harmonic distortion levels will be at least 40 decibels (dB) below the required output levels.

5.2.1.2 Nonharmonically-related output. The level of any signal component not harmonically related to the output reference will be at least 80 dB below the required output level.

5.2.1.3 Frequency reference output voltage. The voltage at the output of the PTTI PDS for the frequency references of 5.2.1 will be +1.0 (+0.5, -0.2) volts root-mean-square (V rms) into 50 ohms.

5.2.2 Time reference. Under normal conditions, the output time reference signals in TABLE I, will provide the following: The binary coded decimal (BCD), 2137, and 2137 (direct current (DC)) will provide TOD in hours, minutes, and seconds accurate to ± 1 millisecond (ms) of the on-line standard BCD time code; the one pulse per second (PPS) and one pulse per minute (PPM) signals will provide timing pulses accurate to ± 1 microsecond (s) of the on-line standard one PPS signal. The time codes may be used directly for lower accuracy requirements and in combination with 1 PPS signals for high accuracy TOD applications. Descriptions of each signal are contained in FIGURE 5 through FIGURE 7.

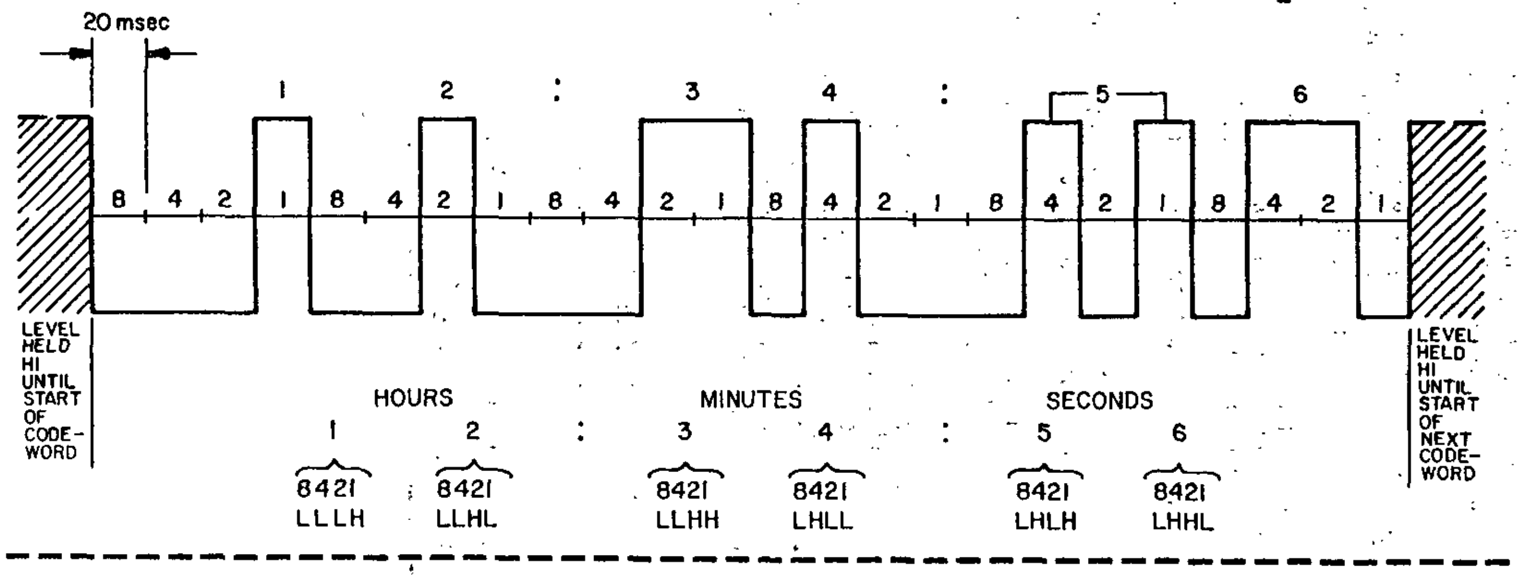
TABLE I. Time references.

BCD Time Code	1 PPS
2137 Time Code	1 PPM
2137 (DC) Time Code	

(BCD) TIME CODE
24 BIT BINARY CODED DECIMAL

EXAMPLE: SELECTED TIME IS 12:34:56

RATE: 50 BIT PER SECOND
BIT PULSE WIDTH : 20 msec
H = +6V dc ± 1V
L = -6V dc ± 1V



THIS TIME CODE IS A SERIAL BIT STREAM USING THE INTERNATIONAL ALPHABET NUMBER 2 (ITA-2) CODE. LEVELS, RISE AND FALL TIMES AND BAUD RATES ARE IN ACCORDANCE WITH MIL-STD-188-100. THE TIME CODE STARTS WITH MOST SIGNIFICANT DIGIT. [THIS TIME CODE PROVIDES TIME-OF-DAY INFORMATION, HOURS, MINUTES AND SECONDS TO WITHIN 1ms.]

FIGURE 5. BCD time code.

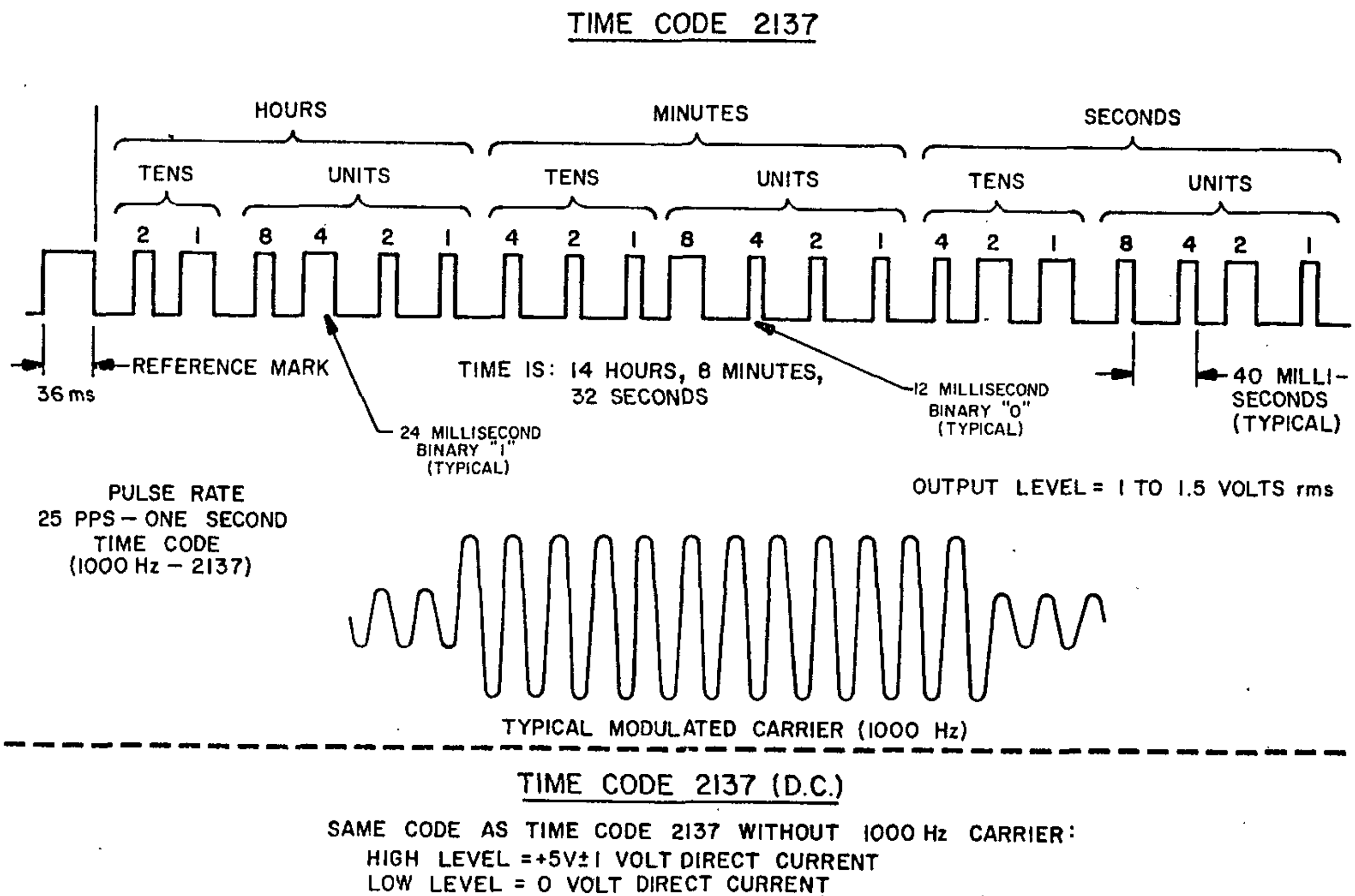
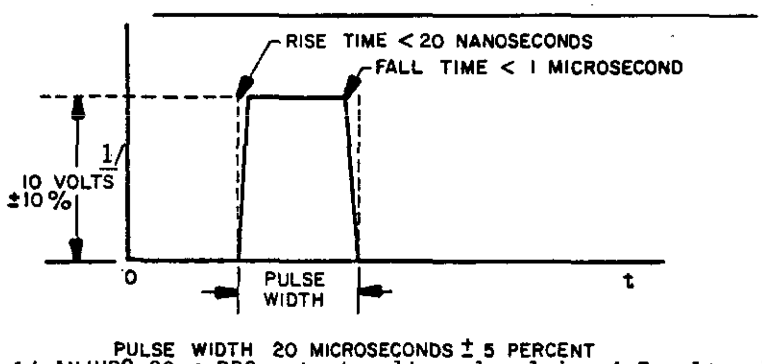


FIGURE 6. 2137/2137 (DC) time codes.



1/ AN/URQ-23 1 PPS output voltage level is +4.7 volts ±10 percent

FIGURE 7. 1 PPS and 1 PPM timing signals.

5.2.2.1 Time reference output voltage. The voltage at the output of the PTTI PDS for time reference of 5.2.2 will be as indicated in TABLE II.

TABLE II. Time reference output voltages.

Signal	Voltages		Load Impedance
	High	Low	
1 PPS	+10 (±1) VDC	0.0 (±1) VDC	50 ohms
1 PPM	+10 (±1) VDC	0.0 (±1) VDC	50 ohms
2137	1 (+0.5) V rms		50 ohms
2137 (DC)	+5 (±1) VDC	0.0 VDC	Transistor-to-transistor logic (TTL)
BCD	+6 (±1) VDC	-6 (±1) VDC	56,000 ohms

5.2.3 Interface between functional areas. The interfaces between equipment areas of the PTTI PDS will be as described in 5.2 except as specified below.

5.2.3.1 Cesium beam frequency standard (O-1695A/U). The O-1695A/U cesium beam frequency standard interfaces will be in accordance with MIL-F-28811.

5.2.3.2 Frequency-time standard (AN/URQ-23). The AN/URQ-23 frequency-time standard interfaces will be in accordance with MIL-F-28816.

5.2.4 Buffering. Each output from the PDS will be individually buffered.

5.2.5 PTTI PDS capacity. PTTI PDS output capacity is governed by the type and quantity of distribution amplifiers, for example the AM-2123A(V)/U as described in MIL-A-22305 with 12 output channels, which can be cascaded.

5.3 Interface constraints.

5.3.1 Compatibility. The design of equipment intended to utilize the PTTI PDS shall be compatible with the interface characteristics described in 5.2.

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 equipment intended to utilize the PTTI PDS it may become apparent that significant advantages in the overall design or operation of such equipment can be achieved by deviating from the standard characteristics specified herein. In such instance, the provisions must comply with the Deviations of DoD-STD-1399.

6.1.1 Deviation procedure. Requests for deviations shall be submitted to the Naval Electronic Systems Command (NAVELEX) with copies to:

a. Program or Project Manager
b. Naval Sea Systems Command
c. Naval Electronic Systems Command (PME-110-231)

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CG

Preparing activity:
NAVY - EC
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