

ICD-GPS-060
Revision B



GPS USER EQUIPMENT (PHASE III)
INTERFACE CONTROL DOCUMENT
FOR THE
PRECISE TIME AND TIME INTERVAL
(PTTI) INTERFACE

12 February 2002
CAGE Code 3D619

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ICD-GPS-060

Revision B

GPS USER EQUIPMENT (PHASE III)

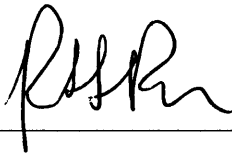
INTERFACE CONTROL DOCUMENT

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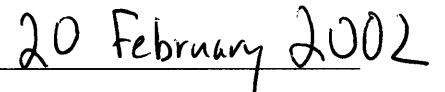
PRECISE TIME AND TIME INTERVAL

(PTTI) INTERFACE

Approved by:



RICHARD L. REASER, Colonel, USAF
Chief Engineer
NAVSTAR GPS Joint Program Office



DATE

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REVISIONS

LTR	DESCRIPTION	RECEIVER EFFECTIVITY
	BASELINE	
A	Remove proposed and developmental system sections from ICD.	
B	Remove Have Quick sections from ICD. Reformat and general clean up of ICD.	H/W CI 622-8080-040 CPCI 613-3224-031 H/W CI 622-8078-046 CPCI 613-3223-015

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PREFACE

Changes to this Interface Control Document (ICD) must be coordinated with the Global Positioning System (GPS) Joint Program Office (JPO), the Interface Control Contractor (ICC), and the GPS contractors as required.

The previous revision of this ICD is superseded. The description of the Have Quick Time of Day (TOD) interface contained therein should not be used. Organizations requiring a description of the Have Quick TOD interface applicable to a particular system must contact the activity responsible for controlling the Have Quick radio incorporated in that system.

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1. INTRODUCTION

1.1 Purpose. This document describes the Global Positioning System (GPS) production version (Phase III), Precise Time and Time Interval (PTTI) Interface port.

1.2 Scope. This document defines the fundamental electrical, functional, electromagnetic compatibility, and database requirements that must be met by the GPS UE Military Standard PTTI Interface for use in DoD applications.

1.3 GPS Time Standard. The Master Control Station monitors the SV time standards daily, with reference to GPS system time, and generates clock correction parameters for transmission to the SVs where they are retransmitted to users with the navigational signals and used to determine the precise magnitude of the clock offsets. Refer to ICD-GPS-200 for a definition of the GPS navigation signals.

GPS system time necessarily differs from Coordinated Universal Time (UTC), which must be adjusted for leap seconds at periodic intervals. The difference between GPS system time and UTC is transmitted by the space vehicles.

1.4 U.S. Naval Observatory (USNO). The mission of USNO includes maintenance and dissemination of the U.S. version of UTC and of earth orientation data. In support of this, it also monitors the GPS dissemination of UTC estimates.

1.5 Agencies and Contractors. This document is controlled in accordance with the provisions of the GPS Interface Control Working Group (ICWG) charter by the following agencies.

1.5.1 GPS Joint Program Office (JPO). The GPS JPO in the Space and Missile Systems Center (SMC) is responsible for the development, configuration control, and life-cycle support of the GPS UE. The point of contact for the GPS UE Interface Control Working Group (ICWG) is:

SMC/CZER
2420 Vela Way, Suite 1467
Los Angeles AFB
El Segundo, CA 90245-4659
Phone (310) 363-0834
DSN 833-0834
FAX (310) 363-6387

1.5.2 Interface Control Contractor (ICC). ARINC Incorporated is designated the ICC by direction of the GPS JPO and the point of contact for maintaining the technical validity of this ICD.

ARINC Incorporated
4055 Hancock Street, Suite 100
San Diego, CA 92110-5152
Phone (619) 222-7447
FAX (619) 225-1750

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2. APPLICABLE DOCUMENTS

The following documents form a part of the GPS UE standards as specified herein.

ICD-GPS-200	Navstar GPS Space Segment/Navigation
Revision C	User Interfaces
10 October 1993	
IRN001	
13 October 1995	
IRN002	
25 September 1997	
IRN003	
11 October 1999	
IRN004	
12 April 2000	

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3. DESCRIPTION

3.1 GPS User Equipment. GPS is a space-based radio navigation system which provides the user with extremely accurate three-dimensional position, three-dimensional velocity, and time of day. The GPS receiver receives and processes radio signals from satellites and provides data transfer in accordance with the interface protocol and message formats for the GPS receiver interface. Figure 3-1 illustrates the PTTI interfaces which may be implemented by the receiver. Refer to the applicable GPS receiver specification to determine the availability of these interfaces.

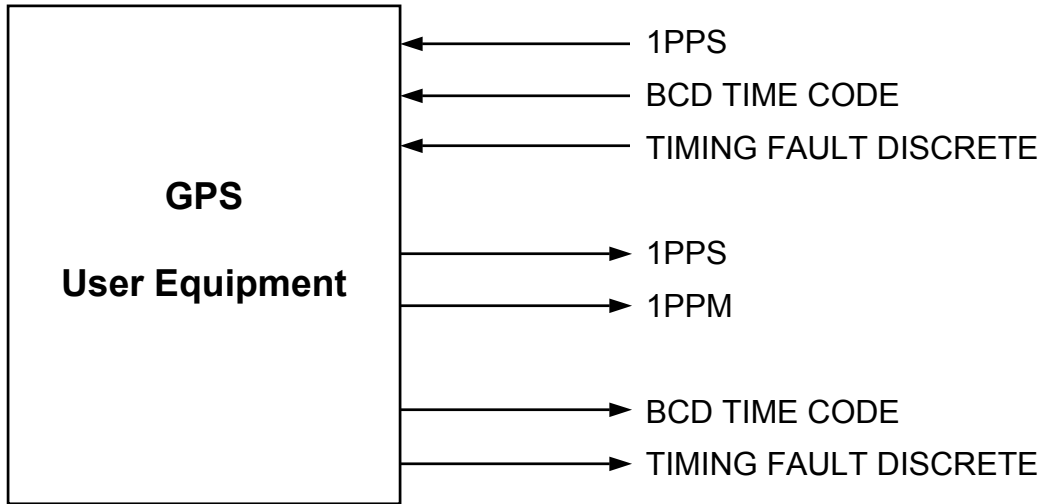


Figure 3-1. PTTI Interfaces

3.2 General Characteristics. The PTTI Input/Output port is a two-way digital interface of precise time information. The interface provides precise time synchronization between GPS users with Coordinated Universal Time (UTC). The port also receives external time aiding signals when available. This information can be used by the UE to initialize its time accurately, and therefore, aid in the acquisition of the initial satellite constellation.

The UE receives any of the following input signals: one pulse per second synchronizing signal; a Binary Coded Decimal (BCD) message consisting of time of day (UTC), day of year, and Time Figure of Merit (TFOM) signal; and a timing fault discrete.

Although the year is not part of the BCD input string, the UE must know the year in order to initialize its time correctly. Therefore, if the year is not known by the UE, it must be input via an alternate source.

The UE may provide any of the following output signals: one pulse per second synchronized with the UTC second rollover; one pulse per minute synchronized with the UTC minute rollover; a BCD time message consisting of time of day (UTC), day of year, and TFOM; and a timing fault discrete. These outputs are generated by the UE only when the Time Figure of Merit is less than or equal to 7. Refer to paragraph 3.6 for TFOM definition.

3.3 Signal Inputs to PTTI Port.

3.3.1 Time Rollover Pulse (1 PPS).

3.3.1.1 Functional Description. The leading edge of this pulse indicates the occurrence of time rollover.

3.3.1.2 Signal Characteristics. The time rollover signal is a one pulse per second (1 PPS) signal, synchronized to an external source representing the UTC second rollover.

3.3.1.3 Electrical Characteristics. The electrical characteristics are shown in Figure 3-2. If required for testing purposes, the pulse width at the 50% level may be determined by extrapolation.

3.3.2 BCD Time Code.

3.3.2.1 Functional Description. The PTTI port receives a BCD code that is used in conjunction with the 1 PPS signal to identify the time of the current one second time rollover.

3.3.2.2 Signal Characteristics. The code is a forty (40) bit serial 8421 BCD code defining UTC time of day, day of year, and Time Figure of Merit (TFOM) transmitted at a 50 bps rate. Formats of the data are outlined in Figure 3-3. Bits 41 through 50 are set at a mark (logical one). The first bit is the most significant bit of the hours. The 40th bit is the least significant bit of the TFOM. The data contained represents previous 1 PPS rollover. The TFOM is defined in paragraph 3.6.

In the event that the source of the signal cannot provide TFOM, or TFOM and day of year, the signal is modified as indicated in paragraph 3.3.2.4.

3.3.2.3 Electrical Characteristics. The BCD time code input is a two-wire balanced low level digital interface. A logical one state (mark) is denoted by 0.10 to 6.0 Vdc line A with respect to line B. A logical zero state (space) is denoted by -0.10 to -6.0 Vdc line A with respect to line B. The DC input impedance of a single BCD time code input is equal to or greater than 5000 ohms. Input reactance, if any, is capacitive. Multiple BCD time code inputs may be connected in parallel. For parallel connections the total load to the BCD time code signal must be equal to or greater than 500 ohms measured between line A and line B, including cable impedance.

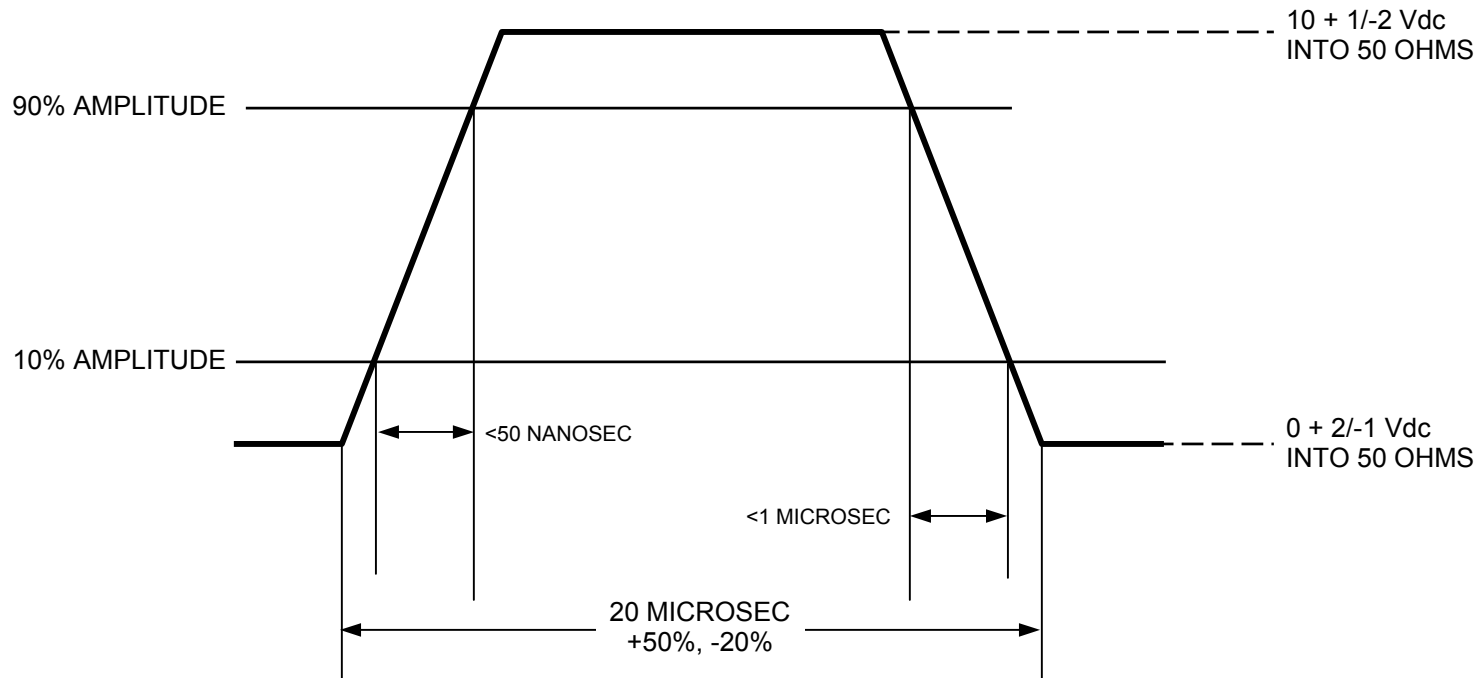
3.3.2.4 Deviation from the 40-Bit Time Code. In the event that the external BCD signal does not include TFOM, or TFOM and day of year, the 8421 BCD slots for these parameters will be set at a mark (logical one state) by the interfacing equipment. The UE recognizes these BCD data slots, when all set at a mark, to represent no data available. Under these conditions, the UE accepts an alternate source of data for the day of year.

3.3.3 Timing Fault Discrete.

3.3.3.1 Functional Description. The interfacing equipment which supplies the 1 PPS and BCD data provides a timing fault discrete which informs the UE if the transmitting equipment is functioning properly.

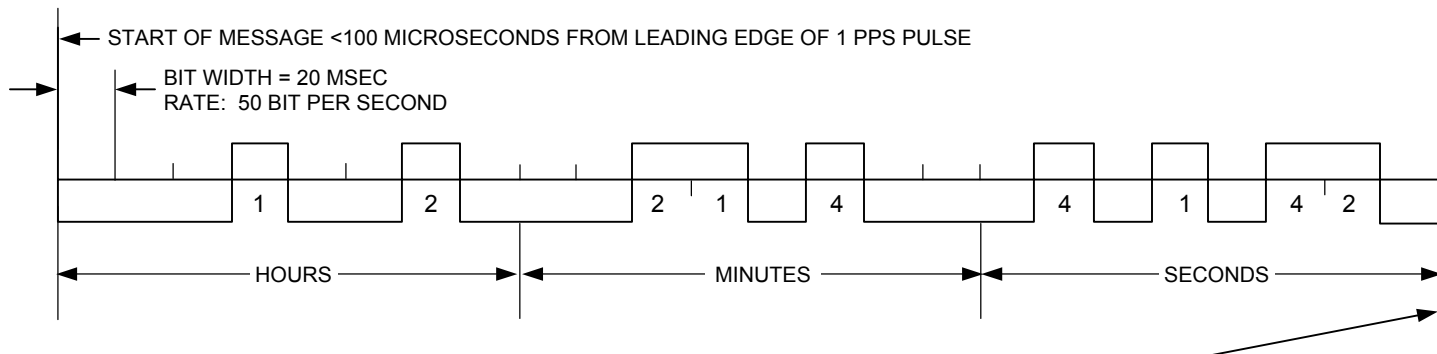
In the event that the BCD time code information is provided to the GPS UE receiver without a Timing Fault Discrete signal (hard wire), the UE receiver recognizes this condition and assumes the Timing Fault Discrete signal line to be set high, thus accepting any data that is input to the GPS receiver via the PTTI port.

3.3.3.2 Signal Characteristics. The signal is a voltage level in a logical one or zero state. A logical one state indicates normal operation and valid time information. A logical zero state indicates a fault within the external equipment and implies that the UE must not use the data.

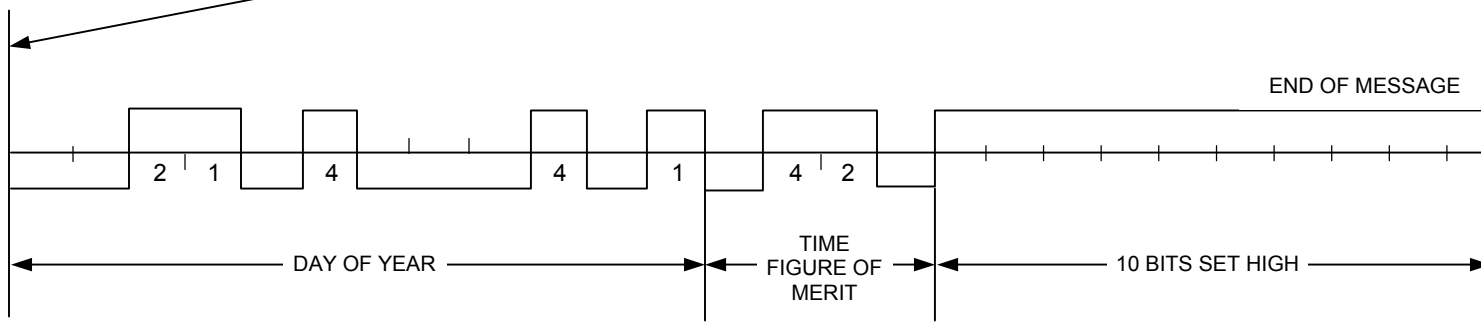


The Leading (Positive Going) Edge of this Pulse Indicates One Second Rollover

Figure 3-2. Input Time Rollover Pulse (1 PPS) Signal Characteristics



CONTINUED



EXAMPLE SHOWN IS: TIME 12:34:56
 DAY 345
 TFOM 6

3-4

Figure 3-3. Signal Characteristics of BCD Time Code

3.3.3.3 Electrical Characteristics. A logical one state is defined as +3 to +5.5 Volts dc (Vdc). A logical zero state is defined as 0 Vdc to +0.5 Vdc, when loaded with a UE input circuit of 5000 ohms connected to +5 Vdc (standard transistor logic load).

3.3.4 Configuration Inputs. The UE receiver provides configuration inputs defining Host Vehicle utilization of various PTTI interface functions. Details of these configuration inputs are defined in the applicable receiver specification.

3.4 Signal Outputs from the PTTI Port.

3.4.1 Time Rollover Pulse (1 PPS).

3.4.1.1 Functional Description. The leading edge of this pulse indicates the occurrence of time rollover.

3.4.1.2 Signal Characteristics. The Time Rollover signal is a one pulse per second (1 PPS) signal synchronized to the UTC second rollover.

3.4.1.3 Electrical Characteristics. The electrical characteristics are shown in Figure 3-4. If required for testing purposes, the pulse width at the 50% level may be determined by extrapolation.

3.4.2 Time Synchronizing Signal (1 PPM).

3.4.2.1 Functional Description. The leading edge of this pulse indicates the occurrence of time rollover.

3.4.2.2 Signal Characteristics. The Time Synchronizing Signal is a one pulse per minute (1 PPM) signal synchronized to the UTC minute rollover.

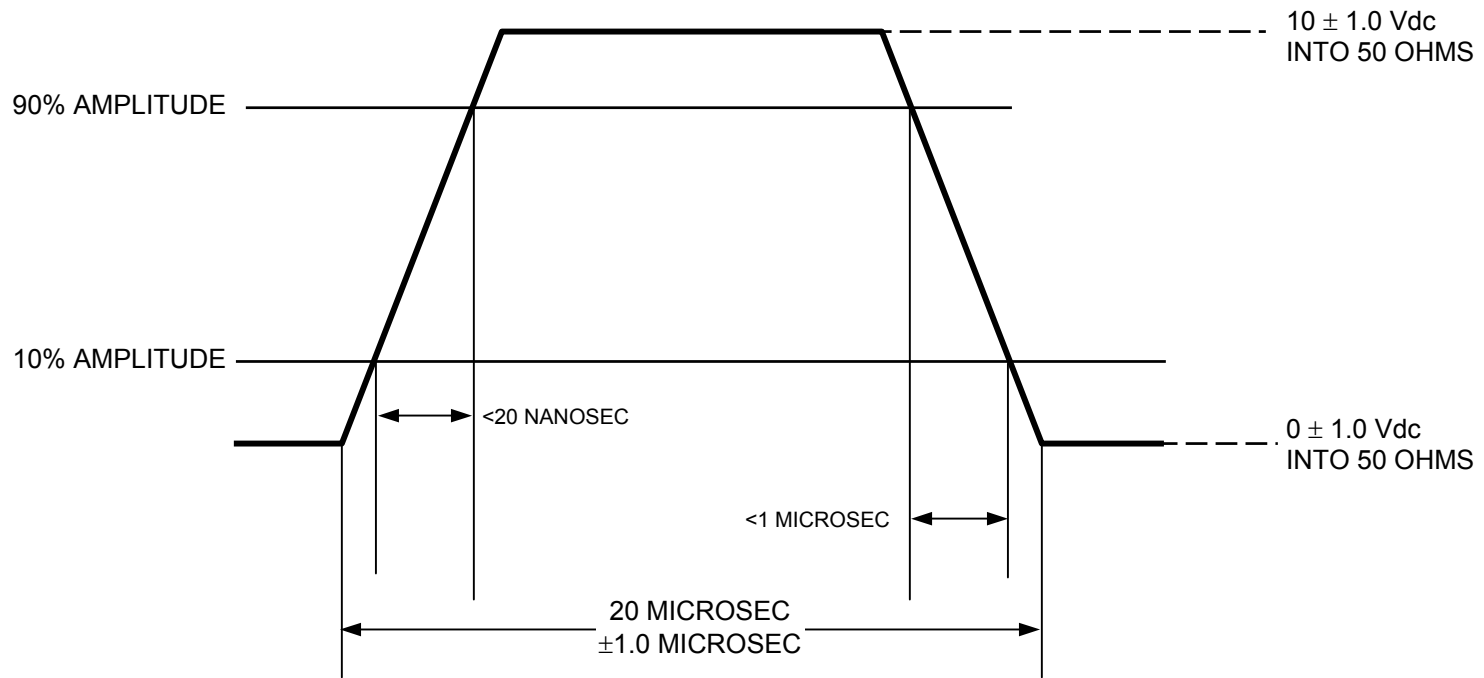
3.4.2.3 Electrical Characteristics. The electrical characteristics are shown in Figure 3-4. If required for testing purposes, the pulse width at the 50% level may be determined by extrapolation.

3.4.3 BCD Time Code.

3.4.3.1 Functional Description. The PTTI port outputs a BCD code which is used by the interfacing equipment in conjunction with the 1 PPS signal to identify current one second time rollover.

3.4.3.2 Signal Characteristics. The BCD Time Code is a 50-bit message. The first 40 bits are a serial 8421 BCD code, defining UTC time of day, day of year, and TFOM, transmitted at a 50 bps rate. The data contained represents previous 1 PPS rollover. Formats of the data are outlined in Figure 3-3. Bits 41 through 50 are set at a mark (logical one).

The first bit is the most significant bit of the hour. The 40th bit is the least significant bit of the TFOM. The TFOM is defined in paragraph 3.6.



The Leading (Positive Going) Edge of this Pulse Indicates One Second Rollover

Figure 3-4. Output Time Rollover Pulse (1 PPS) and Time Synchronizing Signal (1 PPM) Signal Characteristics

3.4.3.3 Electrical Characteristics. The BCD time code output is a two-wire balanced low level digital interface. A logical one state (mark) is denoted by 0.8 to 6.0 Vdc line A with respect to line B across a $100 \pm 10\%$ ohm load. A logical zero state (space) is denoted by -0.8 to -6.0 Vdc line A with respect to line B across a $100 \pm 10\%$ ohm load. The signaling voltage is balanced to ground within 10%, and ± 0.4 to ± 3.0 volts with respect to ground is present on either line in either the marking or spacing state. The difference in the magnitude between the marking and spacing voltages is such that the larger voltage magnitude is within 10% of the smaller voltage magnitude.

3.4.4 Timing Fault Discrete.

3.4.4.1 Functional Description. The GPS UE provides a timing fault discrete signal which informs the external equipment whether or not the UE 1 PPS, 1 PPM, and BCD data are valid. The interface output signals are considered invalid if one or more of the following conditions exist:

1. The UE internal clock has malfunctioned.
2. The UE built-in test has determined a PTTI malfunction exists in one or more of the functions being used by the host vehicle.
3. The UE is performing its power-on circuitry self testing.
4. The UE has been commanded to TEST mode and is performing the built-in-test function.

3.4.4.2 Signal Characteristics. The signal is a voltage level in logical one or zero state. A logical one state indicates no PTTI malfunctions. A logical zero state indicates one or more of the conditions described in paragraph 3.4.4.1 exists.

3.4.4.3 Electrical Characteristics. A logical one state is defined as +3 to +5.5 Volts dc (Vdc), and a logical zero state is defined as 0 Vdc to +0.5 Vdc, when loaded with 5000 ohms connected to +5 Vdc (standard transistor logic load).

3.5 Short Circuit Protection. All PTTI outputs are protected from damage due to short circuits at any of the terminals. No degradation below the specified performance limits of any pulse output occurs as a result of short circuit of any other pulse output.

3.6 TFOM. The TFOM denotes the quality of the time solution as a discrete integer from 1-9. Table 3-1 provides definition of TFOM which applies to both the GPS UE inputs and outputs.

Table 3-1. Time Figure of Merit

TFOM Number	Estimated Time Error with respect to UTC (1 sigma)
0	Not Used
1	$\leq 1\text{ns}$
2	$> 1\text{ns}$ and $\leq 10\text{ns}$
3	$> 10\text{ns}$ and $\leq 100\text{ns}$
4	$> 100\text{ns}$ and $\leq 1\mu\text{s}$
5	$> 1\mu\text{s}$ and $\leq 10\mu\text{s}$
6	$> 10\mu\text{s}$ and $\leq 100\mu\text{s}$
7	$> 100\mu\text{s}$ and $\leq 1\text{ms}$
8	$> 1\text{ms}$ and $\leq 10\text{ms}$
9	$> 10\text{ms}$
10-15	Not Used

APPENDIX A

ACRONYMS AND ABBREVIATIONS

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFI	Air Force Instruction
BCD	Binary Coded Decimal
bps	Bits Per Second
CDU	Control Display Unit
CPCI	Computer Program Configuration Item
DoD	Department of Defense
DSN	Defense Switched Network
GPS	Global Positioning System
H/W CI	Hardware Configuration Item
ICC	Interface Control Contractor
ICD	Interface Control Document
ICWG	Interface Control Working Group
IRN	Interface Revision Notice
JPO	Joint Program Office
LTR	Letter
PPM	Pulse Per Minute
PPS	Pulse Per Second
PTTI	Precise Time and Time Interval
SMC	Space and Missile Systems Center
SV	Space Vehicle
TFOM	Time Figure Of Merit
TOD	Time of Day
UE	User Equipment
UTC	Coordinated Universal Time
USAF	United States Air Force
U.S.C.	United States Code
USNO	United States Naval Observatory
Vdc	Volts Direct Current

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