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IMPROVED POSITION AND AZIMUTH DETERMINING SYSTEM

INTERFACE CONTROL DOCUMENT

FOR THE

FORWARD OBSERVER SYSTEMS

Prepared for:

Department of the Army
U.S. Army Material Command
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OPERATIONS SECURITY

All Department of Defense (DOD), Government, and civilian contract personnel associated with the Communications-Electronics Command (CECOM) Software Engineering Center, Fire Support Software Engineering (SEC, FSSE), have the inherent responsibility to ensure all prescribed security regulations and measures are implemented and strictly enforced. The test director will manage, plan, schedule, and conduct the test program so as to minimize Operations Security (OPSEC) vulnerabilities. Specific countermeasures are contained in the SEC, FSSE OPSEC plan. The test director should review the OPSEC plan and conduct an OPSEC briefing for appropriate test facility personnel prior to initiating this test.

RECORD OF REVISIONS

REVISION	DATE	REVISION DESCRIPTION	APPROVED BY
N/C	30 SEP 02	Original submittal	J.W. Chapman, II

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TABLES

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1. INTRODUCTION

1.1 Scope. This document defines the physical and data interface requirements necessary to pass location data, survey point data, and time data between the Improved Position and Azimuth Determining System (IPADS) and the Forward Observer Systems (FOS). Adherence to this interface will establish compatibility between the various hardware devices needed for the IPADS and FOS to pass data.

1.2 Overview. The U.S. Army Tank-Automotive and Armament Command (TACOM), Rock Island Arsenal, Rock Island, Illinois is interested in a contract for the development of an IPADS device. The U.S. Army Field Artillery (FA) and Air Defense Artillery (ADA) have an urgent need for a replacement capability for the older PADS device. The IPADS will provide a more reliable inertial survey system that is not dependent on Global Positioning System (GPS) to provide primary and backup, precise location, elevation and direction for FA and ADA platforms. FA and ADA systems require precise location, elevation, and direction information to effectively employ their systems on the battlefield. The IPADS will provide accurate location, elevation and direction for FA and ADA units use while being more reliable, easy to use, cost effective, and require less maintenance than PADS.

1.3 Item Description. The Handheld Terminal Unit (HTU) or Ruggedized Handheld Computer (RHC) operating with the FOS software (hereafter referred to as FOS) in conjunction with the IPADS device forms the basic hardware configuration for this interface. The FOS provides the capability to operate as a node on the Fire Support (FS) Command and Control (C2) network via tactical communications. The FOS and IPADS will communicate via the Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)-232 (TIA/EIA-232) serial interface to send and receive data.

1.4 Purpose. This Interface Control Document (ICD) shall be the record of agreement for interface requirements that will dictate system-processing requirements. Any subsequent changes will be controlled via normal configuration control procedures and will require approval/ concurrence from the controlling agencies.

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2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact date and revision shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS: None

STANDARDS: None

DRAWINGS: None

OTHER PUBLICATIONS:

NIMA TR 8350.2	Department of Defense World Geodetic System 1984, Its Definition and Relationships with Local Geodetic Systems (Third Edition, Amendment 1, January 2000)

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the contracting agency or as directed by the contracting offices.

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

SPECIFICATIONS: None

STANDARDS:

TIA/EIA-232	Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Exchange (ANSI/TIA/EIA-232, Revision F, October 1997)

DRAWINGS: None

OTHER PUBLICATIONS:

RFC #791, Appendix B	Data Transmission Order – Internet Protocol, DARPA Internet Program, Protocol Specification – Request For Comment (RFC), Internet Protocol Standards, September 1981 http://www.faqs.org/rfcs/rfc791.html.

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

3. INTERFACE REQUIREMENTS

3.1 Interface Definition. The interface between the FOS and IPADS shall be a data interface via a TIA/EIA-232, full duplex, serial connection. Data on this interface shall be byte-oriented digital data. Each node on this interface shall be capable of sending and receiving data as described within this document.

3.2 Interface Characteristics. The interface characteristics are defined in the following paragraphs.

3.2.1 Signals. The interface shall implement the TIA/EIA-232 signals defined in Table I. For this interface, the FOS hardware shall be considered the Data Terminal Equipment (DTE) and the IPADS hardware shall be considered the Data Circuit-Terminating Equipment (CDE).

3.2.2 Data Transmission Byte. A data transmission byte shall consist of 1 start bit ("spacing" or logic "0" level), 8 data bits, no parity, and 1 stop bit ("marking" or logic "1" level). An idle line is in a "Marking" or logic "1" level condition.

3.2.3 Baud Rate. The baud rate for this interface shall be a fixed rate of 19,200 baud. Baud rate is defined as the serial data transmission rate of one signal element per second, or more commonly, bits per second.

3.2.4 Network Byte Order Scheme. The data shall be transmitted on the serial interface following a network byte-ordering scheme – most significant byte first (see RFC #791). This is also referred to as "Big Endian". The intrinsic "C" routines htonl (host to network - long integer), htons (host to network - short integer), ntohl (network to host - long integer), and ntohs (network to host - short integer) should be used (if possible) to convert the data from host to network order prior to transmission and from network to host order after reception.

3.2.5 Acknowledgment Requirements. There are no requirements for Acknowledgment (ACK) or Negative Acknowledgment (NAK) of data sent on this interface.

3.2.6 Basic Message Format. The basic message format shall consist of a start of message flag, a message identifier, the number of bytes of data, a data validity indicator, message data, and a 2-byte checksum value. The start of message flag shall be a 2-byte value used for synchronization and shall consist of the value 1 decimal ("SOH") as the first byte and value 2 decimal ("STX") as the last byte. The 2-byte checksum shall be computed by simply summing the unsigned 16-bit values (ignoring overflow) of all transmitted data from the start of message flag through the last byte of the Message data (if included in the message) or stopping at the Number of bytes of data field. The basic message format without message data contains 6 bytes of data. If the number of bytes of data indicates 0, the message data portion of the message shall be omitted. Table II provides a definition of the basic message format.

Table I. Interface Signals

SIGNAL NAME	ABBREVIATION	TIA/EIA-232 Circuit Ref.	Signal Function/Direction
Receive Data	RD	BB	Data, from DCE
Transmitted Data	TD	BA	Data, to DCE
Signal Ground	SGND	AB	Ground/Common

Table II. Basic Message Format

COMPONENT	DATA TYPE	UNITS	RANGE	DEFAULT	DESCRIPTION	SOURCE
START OF MESSAGE	UNS16	Integer	N/A	0x0102	Start of message flag	IPADS or FOS
MESSAGE ID	INT8	Integer	1 - 4	1	Message id. 1 = Heartbeat 2 = Location Data 3 = Survey Data 4 = Time Data	IPADS or FOS
NUMBER OF BYTES OF DATA (N)	INT8	Integer	0 - 127	0	Number of bytes of data present in the message data portion of the message.	IPADS or FOS
MESSAGE DATA (1..N)	See message definitions	See message definitions	See message definitions	N/A	Actual message data as described for each message.	IPADS or FOS
CHECKSUM	UNS16	Integer	0 - 65535	0	Checksum from the start of message through the message data.	IPADS or FOS

3.3 Connectors and Pin Assignments. The following tables provide the connector and pin assignments for the various hardware devices on this interface.

3.3.1 HTU/RHC. The HTU and RHC have a standard male DB-9 connector. The pin assignments for the HTU/RHC connector are shown in Table III.

Table III. HTU/RHC Connector Pin Assignments

Pin Number	Signal
2	RD
3	TD
5	SGND

3.3.2 IPADS. This document will be updated to reflect the IPADS serial port connector and pin assignments after an IPADS vendor has been selected. The IPADS has a **TBD** connector. The pin assignments for the IPADS connector are shown in table IV.

Table IV. IPADS Connector Pin Assignments

Pin Number	Signal
TBD	RD
TBD	TD
TBD	SGND

3.4 Interface Data. Data for this interface is defined as either "signed" or "unsigned" data with 8, 16, or 32 bits (e.g. UNS16 = unsigned 16-bit integer; INT16 = signed 16-bit integer). The data exchanged on this interface shall consist of the following data messages.

3.4.1 Heartbeat Message. The connectivity requirement between the FOS and IPADS will be a heartbeat message. IPADS shall transmit this message every 2 seconds, incrementing the counter with each transmission. FOS shall return this message without modification within 1 second to indicate connectivity. Other functionality for the interface will only be enabled after establishment of connectivity between the interfacing devices. The Heartbeat Message contains 1 byte of data. Table V provides a definition of the message data for the heartbeat message.

Table V. Heartbeat Message Data

COMPONENT	DATA TYPE	UNITS	RANGE	DEFAULT	DESCRIPTION	SOURCE
COUNTER	UNS8	Integer	0 - 255	0	Heartbeat counter	IPADS

3.4.2 Location Message. The Location Message serves two functions: 1) to request location data and 2) to send location data. FOS shall initiate requests for location data and IPADS shall respond to requests for location data. A Location Message with no data (Number of bytes of data = 0) shall be used as a request for current location data. The Location Message contains 11 bytes of data. Horizontal position (latitude and longitude) is referenced to the World Geodetic System 1984 (WGS 84). The National Imagery and Mapping Agency (NIMA) Technical Report (TR) 8350.2 defines WGS 84. Altitude is references to Mean Sea Level (MSL). Table VI provides a definition of the message data for the Location Message.

Table VI. Location Message Data

COMPONENT	DATA TYPE	UNITS	RANGE	DEFAULT	DESCRIPTION	SOURCE
Latitude Degrees Minutes Seconds	 INT8 UNS8 UNS16	 Integer Integer Integer	 -80 – 84 0 – 59 0 – 59999	 0 0 0	Latitude (WGS 84) of the current location to the nearest thousandths of a second.	IPADS
Longitude Degrees Minutes Seconds	 INT16 UNS8 UNS16	 Integer Integer Integer	 -180 – 180 0 – 59 0 – 59999	 0 0 0	Longitude (WGS 84) of the current location to the nearest thousandths of a second.	IPADS
Altitude	INT16	Integer	-400 – 9999	0	Altitude (MSL) of the current location in meters	IPADS

3.4.3 Time Message. The Time Message serves two functions: 1) to request time data and 2) to send time data. After the first Heartbeat Message (Table II) is received by FOS and returned to establish connectivity, FOS shall format and send a Time Message to IPADS to synchronize the time for each device. IPADS shall initiate requests for current system time and FOS shall respond to requests for system time. A Time Message with no data (Number of bytes of data = 0) shall be used to request the current system time from FOS. FOS shall respond to requests for time from IPADS by formatting the Time Message data elements with the current system time and returning the message. Time zone information is referenced to Greenwich Mean Time (GMT). The Time Message contains 9 bytes of data. Table VII provides a definition of the message data for the Time Message.

Table VII. Time Message Data

COMPONENT	DATA TYPE	UNITS	RANGE	DEFAULT	DESCRIPTION	SOURCE
Date Year Month Day	 INT16 INT8 INT8	 Integer Integer Integer	 1995 – 2094 1 – 12 1 – 31	 2002 1 1	Current system date.	FOS
Time Hour Minutes Seconds	 INT8 INT8 INT8	 Integer Integer Integer	 0 – 23 0 – 59 0 – 59	 0 0 0	Current system time referenced to the time zone and daylight savings indicator of this message	FOS
Time Zone	UNS8	ASCII	A-Z (excluding 'J')	Z	Time zone indicator Z = GMT A = GMT + 1 hr … M = GMT + 12 hrs N = GMT – 1 hr … Y = GMT – 12 hrs	FOS
Daylight Savings Time Indicator	UNS8	Integer	0 – 1	0	Indicates if time is adjusted by daylight savings time 0 = No 1 = Yes	FOS

3.4.4 Survey Message. The Survey Message is used to transfer Survey Control Point (SCP) data between IPADS and FOS. Operator action is required at the IPADS device to initiate the transfer of survey data to the FOS device. FOS shall receive the SCP data and update the appropriate database file within FOS. Operator action is required at the FOS device to initiate the transfer of survey data to the IPADS device. IPADS shall receive SCP data to aid in the setup of the IPADS device. The Survey Message contains 53 bytes of data. Horizontal position (latitude and longitude) is referenced to WGS 84. Altitude is referenced to MSL. Azimuth is referenced to geodetic (true) north. IPADS will use an order of survey value of 4 (1:3000) to indicate a high accuracy mode and a value of 5 (1:1000) to indicate a lower accuracy mode. Table VIII provides a definition of the message data for the Survey Message.

Table VIII. Survey Message Data

COMPONENT	DATA TYPE	UNITS	RANGE	DEFAULT	DESCRIPTION	SOURCE
Latitude Degrees Minutes Seconds	 INT8 UNS8 UNS16	 Integer Integer Integer	 -80 – 84 0 – 59 0 – 59999	 0 0 0	Latitude (WGS 84) of the SCP; thousandths of a second.	IPADS or FOS
Longitude Degrees Minutes Seconds	 INT16 UNS8 UNS16	 Integer Integer Integer	 -180 – 180 0 – 59 0 – 59999	 0 0 0	Longitude (WGS 84) of the SCP; thousandths of a second.	IPADS or FOS
Altitude	INT32	Integer	-4000 – 99999	0	Altitude (MSL) of the SCP; tenths of a meter.	IPADS or FOS
SCP Id (1..15)	UNS8	ASCII	A-Z; 0-9; space	Space	SCP identification; all spaces is not allowed	IPADS or FOS
Order of survey	INT8	Integer	1 – 6	6	Order of survey 1 = 1:25,000 2 = 1:10,000 3 = 1:5,000 4 = 1:3,000 5 = 1:1,000 6 = Coordinates specified are assumed	IPADS or FOS
Mark 1 Id (1..8)	UNS8	ASCII	A-Z; 0-9; space	Space	Marker 1 identifier	IPADS or FOS
Azimuth 1	UNS32	Integer	0 – 6400000; 6400000 = Not Given (N/G)	6400000	Azimuth of marker 1; thousandths of a mil.	IPADS or FOS
Mark 2 Id (1..8)	UNS8	ASCII	A-Z; 0-9; space	Space	Marker 2 identifier	IPADS or FOS
Azimuth 2	UNS32	Integer	0 – 6400000; 6400000 = N/G	6400000	Azimuth of marker 2; Thousandths of a mil.	IPADS or FOS

4. ACRONYMS

ACK	Acknowledgment
ADA	Air Defense Artillery
C2	Command and Control
CECOM	Communications-Electronics Command
DoD	Department of Defense
EIA	Electronic Industries Alliance
FA	Field Artillery
FOS	Forward Observer Systems
FS	Fire Support
FSSE	Fire Support Software Engineering
GMT	Greenwich Mean Time
GPS	Global Positioning System
HTU	Handheld Terminal Unit
ICD	Interface Control Document
INT	Signed integer
IPADS	Improved Position and Azimuth Determining System
MSL	Mean Sea Level
NAK	Negative Acknowledgment
NIMA	National Imagery and Mapping Agency
N/G	Not Given
OPSEC	Operations Security
PADS	Position and Azimuth Determining System
RFC	Request for Comments
RHC	Ruggedized Handheld Computer
SCP	Survey Control Point
SEC	Software Engineering Center
TACOM	U.S. Army Tank-Automotive and Armament Command
TIA	Telecommunications Industry Association
TR	Technical Report
UNS	Unsigned integer

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