MIL-STD-188-203-3
5 October 1983

MILITARY STANDARD

SUBSYSTEM DESIGN AND ENGINEERING STANDARDS FOR TACTICAL DIGITAL INFORMATION LINK (TADIL) C

NO INFORMATION REQUIREMENTS

FSA TCTS

Department of Defense
Washington, D.C. 20301

Subsystem Design and
Engineering Standards
for Tactical Digital
Information Links (TADIL-C)

MIL-STD-188-203-3
5 October 1983

1. This Military Standard is approved and mandatory for use by all Departments and Agencies of the Department of Defense in accordance with the OASD (CCCI) Memorandum, dated 10 May 1977. (See APPENDIX A).

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 Electronic Systems Command
Attn: ELEX 8111
Washington, D.C. 20363

by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

1. In the past, Military Standard 188 (MIL-STD-188), covering military communications system technical standards, has evolved from one applicable to all military communications (MIL-STD-188, MIL-STD-188A, and MIL-STD-188B) to one applicable to tactical communications only (MIL-STD-188C).

2. The Defense Communications Agency (DCA) has published DCA Circulars (DCAC) promulgating standards and criteria applicable to the Defense Communications System (DCS) and to the technical support of the National Military Command System (NMCS).

3. Standards for all military communications are now being published as part of a MIL-STD-188 series of documents. Military communications system technical standards are subdivided into common long haul and tactical standards (MIL-STD-188-100 series), tactical standards (MIL-STD-188-200 series), and long haul standards (MIL-STD-188-300 series).

4. This document is the result of a Joint Chiefs of Staff (JCS) action requiring that the technical characteristics of the TADIL-A,-B, and-C formerly contained in JCS Pub 10, Tactical Command Control and Communications Systems Standards, be updated and published in the MIL-STD-188 series. This document contains the technical requirements for TADIL C; MIL-STD-188-203-1 contains the requirements for TADIL A, and MIL-STD-188-203-2 contains the requirements for TADIL B. The MIL-STD-188-203 series of documents does not contain TADIL message formats and related information. These requirements will continue to be contained in revisions of JCS Pub 10. It is intended that technical characteristics of other TADILs currently under development, such as the Joint Tactical Information Distribution System (JTIDS), will be included as part of the MIL-STD-188-203 series.

IDENTIFICATION OF INTERNATIONAL STANDARDIZATION AGREEMENT

Certain provisions of this document are the subject of International Standardization Agreement (STANAG) 5504. When a change notice, revision or cancellation of this document is proposed which will affect or violate the international agreement concerned, the preparing activity shall take appropriate reconciliation action through international standardization channels, including departmental standardization offices, if required.

CONTENTS

CONTENTS (continued)

FIGURES

TABLES

CONTENTS (continued)

1. SCOPE

1.1 Purpose. The purpose of this document is to establish technical standards and design objectives (DO) that are necessary to ensure interoperability and to promote commonality for communications equipment and subsystems used in TADIL C. Another purpose of this document is to establish acceptable overall system performance and maximum flexibility of system layout in order to satisfy diverse user requirements without the restrictions caused by interface and incompatibility problems. Standard message formats are not included in this document. The TADIL C message formats are contained in JCS PUB 10, Tactical Command and Control and Communication System Standards.

1.2 Application. This document is applicable to the design and development of new equipment, assemblages, and subsystems used in TADIL C. This document is applicable also to the engineering and operation of existing TADIL C facilities. It is not intended that existing TADIL C facilities be immediately converted to comply with the standards contained herein. New TADIL C facilities and those undergoing major modification or rehabilitation shall comply with the standards contained herein subject to the applicable requirements of current procurement regulations. TADIL C can be used over common long haul and tactical communication circuits. In this case, both this standard and MIL-STD-188-100 shall apply.

1.3 Objectives. The main objectives of this document are to provide subsystem performance requirements that ensure interoperation of equipment and subsystems consistent with military requirements and to achieve the necessary degree of performance and interoperation in the most economical way. These objectives will be accomplished by continuing efforts in the areas specified in a through e:

a. Standardizing user-to-user performance characteristics.
b. Standardizing the type of signals at various interface points in the applicable subsystem.
c. Specifying maximum permissible degradation of a signal in the process of transmission, and allocating the permissible degradation among various parts of a system.
d. Establishing performance parameters and operating features of equipment that govern the interface characteristics with subsystems in which the TADIL-C equipment will be used.
e. Defining performance parameters without specifying the technology that should be used to obtain the required performance.

An additional objective of this document is to prevent proliferation of equipment serving the same or a similar function. The variety of equipment shall be the minimum necessary to effectively support the missions of the tactical forces in accordance with Department of Defense Directive (DoDD) 4630.5, Compatibility and Commonality of Equipment for Tactical Command and Control, and Communications.

1.4 System standards and design objectives (DOs). The parameters and other requirements specified in this document are mandatory system standards (see APPENDIX A) if the word "shall" is used in connection with the parameter value or requirement under consideration. Non-mandatory DOs are indicated as optional by the word "should" in connection with the parameter value or requirement under consideration. For a definition of the terms System Standard and Design Objective see FED-STD-1037. Information paragraphs, shown as notes, have been included to better define certain methods currently in use with TADILs.

2. REFERENCED DOCUMENTS

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

STANDARDS

FEDERAL

FED-STD-1037	Glossary of Telecommunication Terms

MILITARY

MIL-STD-188-114	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188-124	Grounding, Bonding and Shielding for Common Long Haul/Tactical Communication Systems
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurements of
MIL-STD-1553	Aircraft Internal Time Division Command/Response Multiplex Data Bus

HANDBOOKS

MILITARY

MIL-HDBK-237	Electromagnetic Compatibility Management Guide for Platforms, Systems and Equipment
MIL-HDBK-241	Design Guide for EMI Reduction in Power Supplies
MIL-HDBK-419	Grounding, Bonding and Shielding for Electronic Equipments and Facilities

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

PUBLICATIONS

Chief of Naval Operations

OP SPEC 404.1	Operational Specification for Tactical Aircraft Data Link

(Application for copies should be addressed to Chief of Naval Operations, Attn: OP-942G, Washington, D.C. 20350.)

North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG)

STANAG 5504	Tactical Data Link for the Control of Aircraft - Link 4 (U)

(Application for copies of NATO standardization documents required by contractors in connection with specific procurement functions should be made to the appropriate NATO subregistry.)

National Security Agency

NACSIM 5100	Compromising Emanation Laboratory Test Requirements Electromagnetics (U) (This document was downgraded to unclassified by Revision A)
NACSIM 5200	Compromising Emanations Design Handbook (U)
NACSIM 5203	Guidelines for Facility Design and Red/Black Installation (U)

(Application for copies of NACSIM standardization documents required by contractors in connection with specific procurement functions should be made to the Director, National Security Agency, Fort George S. Meade, MD 20755.)

2.2 Other publications. The following document forms a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Joint Chiefs of Staff Publication (JCS Pub)

JCS Pub 10	Tactical Command and Control and Communications Systems Standards (U)

(Application for copies should be addressed to the office of the Joint Chiefs of Staff, ATTN: Documents Division, Washington, D.C. 20301).

3. DEFINITIONS

3.1 Definition of terms. Definition of terms used in this document shall be as specified in FED-STD-1037.

3.2 Abbreviations and acronyms. The abbreviations and acronyms unique to this standard are listed in Appendix B.

4. GENERAL REQUIREMENTS

4.1 NATO interoperability. The interchange of information among NATO member nations using NATO LINK 4 shall comply with applicable requirements of the current edition of STANAG 5504.

4.2 Communications security equipment. Communications security equipment that may be normally employed in a TADIL C may be part of the terminal subsystem (see FIGURE 1). Communications security equipment employed in any TADIL C system shall be transparent and not change the standard TADIL C transmission frame format. Also, any function incorporated in a TADIL C system for the purpose of equipment interoperability shall be transparent to the standard TADIL C transmission frame format.

4.3 Compromising emanations (TEMPEST). All communication equipment, subsystems and systems shall comply with the applicable TEMPEST criteria of the current edition of the NACSIM 5100 series. NACSIM 5200 provides design guidance and NACSIM 5203 provides installation guidelines for compromising emanations.

4.4 Electromagnetic interference (EMI) and electromagnetic compatibility (EMC). EMI and EMC requirements shall be as specified in 4.4.1 and 4.4.2.

4.4.1 Equipment. Any item including subassemblies and parts, serving functionally in an electromagnetic environment in the broadest sense, shall comply with the applicable requirements of the current edition of MIL-STD-461. Techniques used for the measurement and determination of EMI characteristics shall comply with the applicable requirements of the current edition of MIL-STD-462.

NOTE: MIL-HDBK-241 provides guidance for EMI reductions in equipment power supplies.

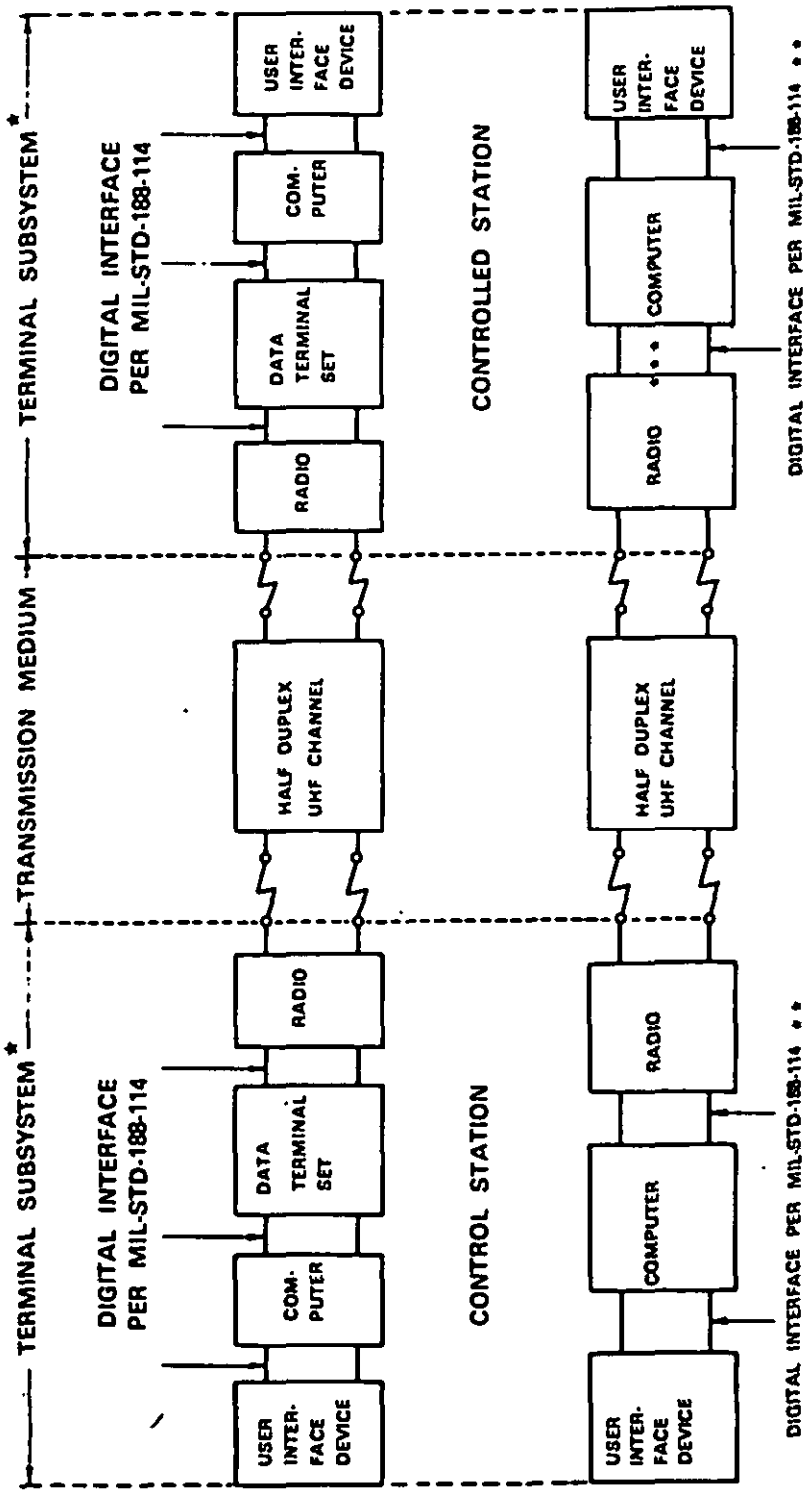
4.4.2 Subsystems and systems. Communications systems and associated subsystems shall be designed to achieve intra- and inter-system electromagnetic compatibility. There shall be neither unacceptable responses nor malfunctions of any item of the system or subsystem beyond the tolerances established by the applicable requirements of the current edition of MIL-STD-461.

NOTE: MIL-HDBK-237 provides guidance for implementing an EMC program.

4.5 Grounding, bonding and shielding. Methods and practices for grounding, bonding and shielding of ground-based telecommunications shall comply with the applicable requirements of the current edition of MIL-STD-188-124.

NOTE: MIL-HDBK-419 provides basic and application information on grounding, bonding and shielding practices recommended for electronic equipment.

4.6 Digital interfaces. All interfaces used in the TADIL C system shall comply with the applicable requirements of the current edition of MIL-STD-188-114 (see FIGURE 1) and, if required, may also comply with the applicable requirements of the current edition of MIL-STD-1553.



* ANY OR ALL FUNCTIONAL BLOCKS SHOWN IN THE TERMINAL SUBSYSTEM MAY BE INTEGRATED AND COMBINED IN A SINGLE EQUIPMENT.
** SEE 4.6
*** THE DATA TERMINAL SET FUNCTION MAY BE ACCOMPLISHED IN SOFTWARE. SEE 5.1.

FIGURE 1. Block diagram.

5. DETAILED REQUIREMENTS

5.1 General. These detailed requirements shall be met in order to establish interoperability between services. Additional information and specific application requirements are indicated and shall be used as appropriate by the implementing service. Any or all functional elements in the terminal subsystem may be integrated and combined in a single equipment (see FIGURE 1). The TADIL C system normally interconnects tactical and support aircraft to the aircraft control units. TADIL C is a 5 kilobit per second half duplex digital data transmission system used to transfer aircraft control and target information between a control station and a controlled aircraft. The TADIL C system enables control stations to transmit target data and commands to a controlled aircraft. Transmission shall be serial time division multiplex on a single radio frequency (rf) carrier with individual messages transmitted on a sequential time division basis. Messages originated and sent by a control station will be known as control messages while messages replying to control messages will be known as reply messages. The TADIL C system transmit and receive cycles shall be as specified in FIGURES 2 and 3. The two-way tactical TADIL C transmit and receive cycle shall be as specified in OP SPEC 404.1 and STANAG 5504.

The requirements for the control station radio, control station data terminal set, and the controlled airborne radio, shall be as specified in 5.2, 5.3, and 5.4 respectively. The airborne data terminal function is often accomplished in software, therefore, no hardware requirement is included herein.

The control stations shall be designed to include on-line error detection. These requirements apply to the radio and the data terminal set. The use of test messages as defined in JCS Pub 10 shall be a requirement for error detection in the control stations.

The TADIL C system shall be designed to support the range (distance between stations) as specified by the implementing service. The implementing service should coordinate with other services where multiservice control of aircraft is the intended use of the new tactical aircraft control system.

In all systems using TADIL C, the control station radio shall be required to be capable of operating full duplex. The system shall use this capability to perform on-line performance monitoring. The rf structure used for the system operation shall be half duplex.

5.2 UHF control station radio. Within the TADIL C system, the control station radio shall be functionally implemented as shown in FIGURE 1. The control station radio may be a multipurpose type, with the controls to change from one function to another, controlled by both front panel switches and by software interfaces. When the data terminal set functions are accomplished with software, the radio shall be designed to interface with the TADIL C system as specified in 4.6. The control station radio shall be capable of being operated full duplex. Technical characteristics of the UHF control station radio shall be as specified in 5.2.1 through 5.2.11.6.

5.2.1 Interoperability. The control station radio shall comply with the applicable requirements of the data terminal set standards listed in 5.3.

5.2.2 Frame rate. The control station radio shall be capable of supporting a transmit and receive frame rate of 31.25 messages per second. If the TADIL C system is being used for Carrier Aircraft Inertial Navigation System (CAINS) alignment, the control station radio shall be capable of a transmit frame rate of 62.5 messages per second, since no reply messages are required (see FIGURE 3).

5.2.3 Bit rate. The control station radio shall be capable of supporting a transmit and receive bit rate of 10,000 binary digits per second.

NOTE: Although the digital data rate is 5,000 binary digits per second, the data link synchronization requires a 10,000 binary digit per second rate.

5.2.4 Frequency coverage. The control station radio equipment shall be capable of operation, both transmit and receive on a minimum of 7000 discrete radio frequency channels. The rf channels shall be spaced at integral 25 kilohertz (kHz) increments over the frequency range of 225.000 to 399.975 megahertz (MHz).

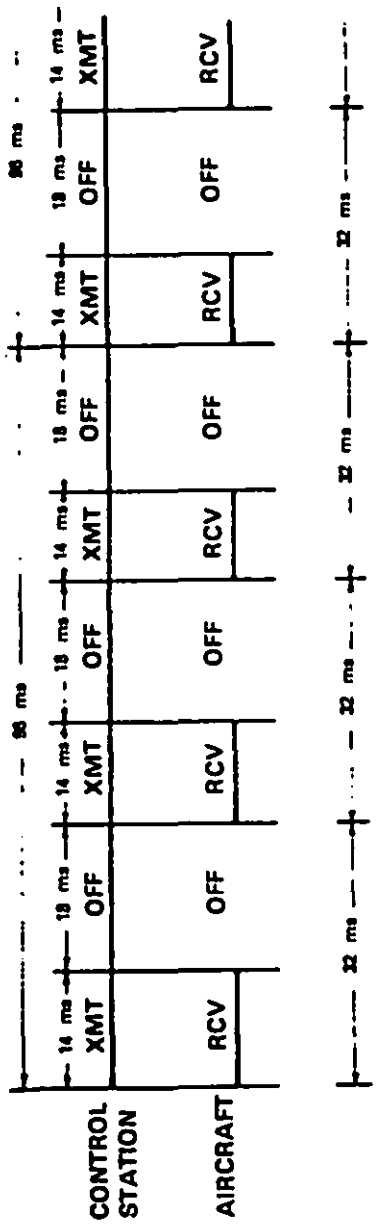
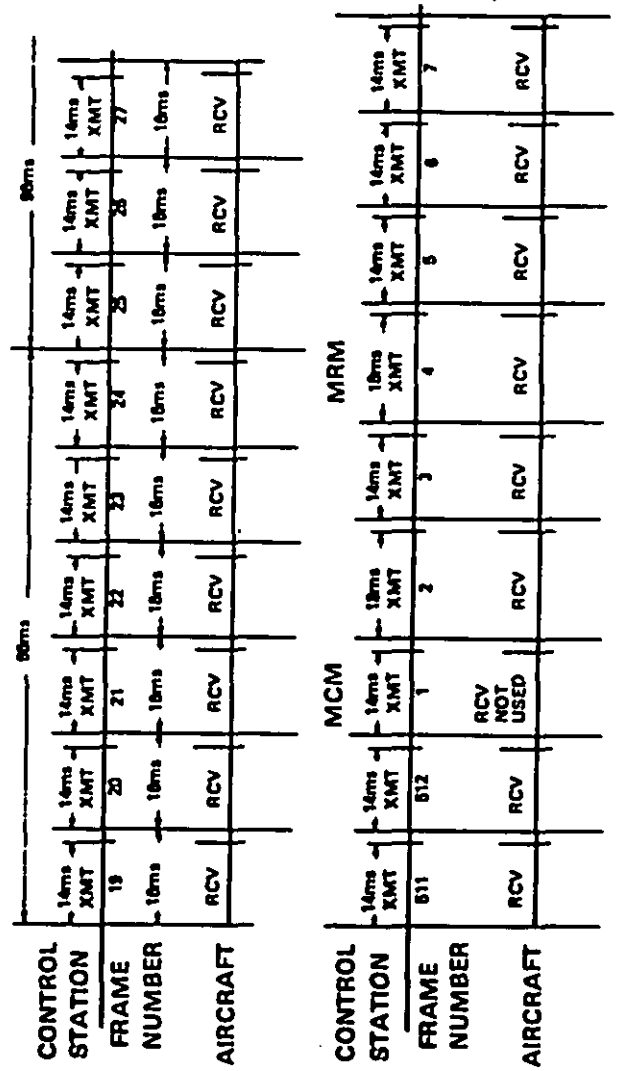


FIGURE 2. Timing relationship between control station and aircraft.



NOTES:
- IN FRAME 1 AN MCM (MONITOR CONTROL MESSAGE) IS SENT TO THE DATA TERMINAL SET FROM THE COMPUTER
- IN FRAME 4 AN MRM (MONITOR REPLY MESSAGE) IS SENT TO THE COMPUTER FROM THE DATA TERMINAL SET
- THE MCM/MRM IS REPEATED EVERY 612 FRAMES
- THE MCM IS TRANSMITTED TO THE AIRCRAFT BUT IS NOT USED ON THE AIRCRAFT

FIGURE 3. Special timing relationship between control station and aircraft for operating in the CAINS application.

5.2.5 Channel changing time. The time to change operation from one channel to another channel should be not greater than 1.5 seconds (s).

5.2.6 Frequency stability. The frequency stability of the control station radio equipment shall be within 1 part in 10^8 over 100 milliseconds (ms), 1 part in 10^7 per day, and 2 parts in 10^7 during the first 30 days after calibration. The frequency stability shall not be degraded by more than 1 part in 10^7 for each 30-day period thereafter. Available warm-up time to meet this stability requirement is a function of mission requirements.

5.2.7 Modulation mode. The rf equipment shall employ Frequency Shift Keying (FSK) modulation, (see 5.2.10.2).

5.2.8 Transmit-after-receive time delay. The time required for the control station radio to turn-around from receive to within 1 dB of its rated transmit power shall be not greater than 160 microseconds and the turn-around time from transmit to rated receiver sensitivity shall be not greater than 160 microseconds.

5.2.9 Keying. The control station radio shall be designed to provide for keying (turning transmitter on and off) from an external device by hardware or software. In any method the requirements of 5.2.8 and 5.2.10.3 shall be met.

5.2.10 Transmitter. The transmitter shall meet the requirements of 5.2.10.1 through 5.2.10.6.

5.2.10.1 Power output. The transmitter rf power output rating for each different operational application shall be identified as the average power into a resistive load of 50 ohms. When the transmitter is connected to any impedance producing a voltage standing wave ratio (VSWR) of 2.5 to 1, the rf power shall not be degraded more than 1 dB.

5.2.10.2 Modulation sensitivity. The modulation capability shall be such that a binary one applied to the data input terminals shall increase the rf carrier frequency 20 kHz (5 percent) above the nominal (center) rf carrier frequency and a binary zero applied to the data input terminals shall decrease the rf carrier frequency 20 kHz (5 percent) below the nominal (center) rf carrier frequency. The center frequency shall not be radiated.

"NOTE: The requirements of 5.2.10.2 and 5.2.11.3 do not comply with the logic and signal sense as stated in MIL-STD-188-100 and MIL-STD-188-200. These requirements apply only to TADIL C equipment and are consistent with the capabilities of existing inventory and international agreements as stated in STANAG 5504".

5.2.10.3 Transmitter attack time delay. Specified rf power shall be applied to the output load within 80 microseconds after application of each carrier-on signal. The rf power in the output load shall decrease to more than -85 dbm within 80 microseconds after cessation of the carrier-on signal.

5.2.10.4 Harmonic and spurious output. All harmonics and spurious outputs shall be at least 80 dB below carrier level except the second harmonic of the rf carrier frequency shall be no less than 60 dB below the carrier.

5.2.10.5 Transmitter noise level (FSK). Without external modulation, the peak frequency deviation of the carrier developed by internal noise shall be not greater than 1 kHz.

5.2.10.6 Antenna turn-around. The delay for switching the antenna from receive to transmit and from transmit to receive shall be not greater than 50 microseconds.

5.2.11 Receiver. The receiver shall meet the requirements of 5.2.11.1 through 5.2.11.6.

5.2.11.1 Sensitivity. The receiver sensitivity shall be such that the input signal level at the 50 ohm impedance of the antenna feed port required to produce a (S+N)/N ratio of 20 dB shall be not greater than 4 microvolts (open circuit).

5.2.11.2 Receiver attack time delay. The receiver shall meet its sensitivity characteristic within 80 microseconds after the receipt of the modulated rf carrier.

5.2.11.3 Demodulation. The demodulator shall provide an output from a frequency shift keyed signal such that a +20 kHz shift from the center rf shall provide a binary one and a -20 kHz shift from the center rf shall provide a binary zero. (See NOTE of 5.2.10.2).

5.2.11.4 Spurious response. The receiver response to spurious signals, including image response, shall be attenuated not less than 80 dB with respect to the received signal.

5.2.11.5 Selectivity. The overall selectivity, as related to peak response, of the receiver's total bandwidth shall be within the following limitation:

6 dB down	60 dB down
70 kHz minimum	140 kHz maximum

5.2.11.6 Input signal protection. A receiver protection circuit shall be activated by rf signal level. The receiver shall not be damaged by the continuous application of a +35 dBm rf signal.

5.3 Control station data terminal set (CDTS). The CDTS shall provide the necessary interface between the general purpose digital computer used by the tactical data system and the radio set which is used for TADIL C control and reply message transmission and reception (see FIGURE 1). The CDTS may provide CAINS alignment using TADIL C. When operated for this function, the data transmission method is one way, in that the digital data is transmitted from the radio control station to the controlled aircraft and no reply message is generated by the controlled aircraft. The CDTS shall be capable of operating with special timing when operating in this function (see 5.3.2). The CDTS shall perform the function of TADIL C network timing, control message generation and error detection, reply message processing, digital data exchange with the computer, test modes and radio control as specified in 5.3.1 through 5.3.12.

5.3.1 Timing. The CDTS, when operating in the computer or test modes, shall generate network frame timing intervals of 14 ms ±.07 ms transmit frame period and 18 ms ±.09 ms receive frame periods (see FIGURE 2).

5.3.2 Special timing. The CDTS, when operating in the CAINS alignment mode, shall generate network timing intervals of 14 ms ±.07 ms transmit frame periods, and 2 ms ±.01 ms receive frame periods. In the CAINS alignment mode, the CDTS shall be capable of being switched to the 14 or 18 ms frame timing for the period of time required to process test messages (TM-10 and TM-21) and monitor control messages (MCM).

5.3.3 Time slots of the transmit frame. The transmit frame period of 14 ms ±.07 ms shall be equally divided into 70 time slots, each time slot shall be 200 microseconds ±1 microsecond.

5.3.4 Time slots of the receive frame. The receive frame period of 18 ms ±.09 ms shall be equally divided into 90 time slots, each time slot shall be 200 microseconds ±1 microsecond.

5.3.5 Control message. The CDTS shall generate a control message during the transmit frame interval of 14 ms consisting of a sync burst, guard interval, start pulse, data, and transmitter un-key signal. The sync burst shall be 8 time slots, the guard interval 4 time slots, the start pulse 1 time slot, the data period 56 time slots, and the transmitter un-key signal 1 time slot (see FIGURE 4). The logic requirements, the central processing unit (CPU) bit assignment to time slots, and the overall control message profile shall be as specified in TABLES I and II.

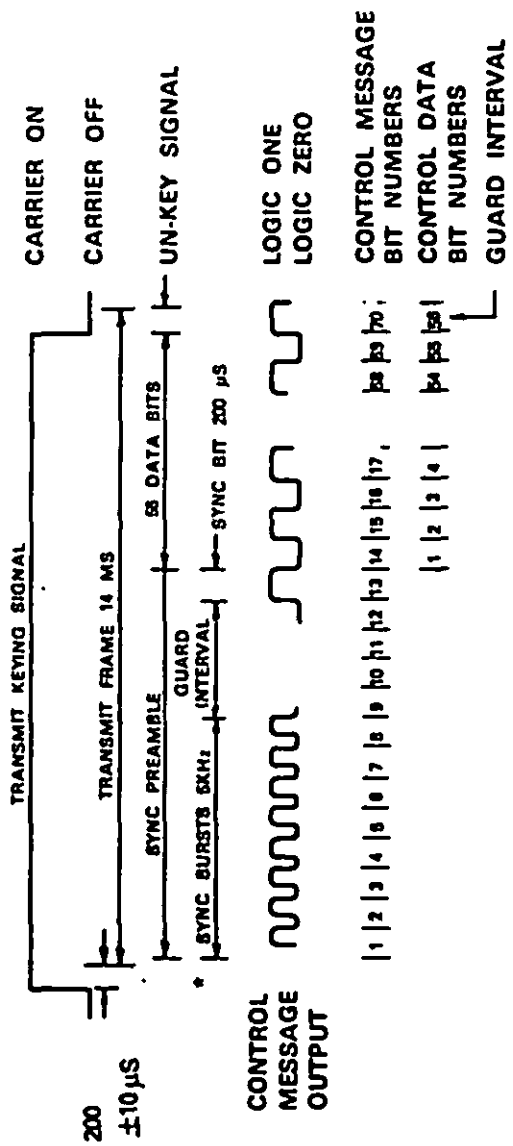


FIGURE 4. Control message output timing diagram and transmit keying signal.

TABLE I. Computer output word and control functions profile.

COMPUTER BIT POSITION		
Position	Definition	Remarks
0, 1 2-29 30-35	Used as COTS control Data Bits Not used	*Word One Only* Word One - Word Two Terminate
CONTROL LINES		
Line		Remarks
External Function Request Not Used External Function Acknowledge Output Data Acknowledge Output Data Request		Terminate Active Active Active
CONTROL FUNCTIONS		
Position 1	Ext. Funct. Ack Line	Function
0 0 1 1	0 1 0 1	No Change in previous Status Standby Not Used *Begin Two-Way Communications*
Position 0	Position 29	
0 1 0 1	0 0 1 1	Not MCM MCM TM-10 Word 1 Not MCM MCM TM-21 Word 1

TABLE II. Computer output word and control functions profile for steerable antenna.

COMPUTER BIT POSITION		
Position	Definition	Remarks
0-32 33-35	Data Bit Not Used	Word One - Word Two Terminate
CONTROL FUNCTIONS		
Word Zero is Information for Steerable Antenna		
Word Zero Octal 5 Octal 6 Octal 7	Bits 1, 2, 3 Hold Message until aircraft is in correct azimuth Wrap around test message Release immediate	

5.3.6 Reply message. The CDTS shall be capable of recognizing and processing a reply message during the 18 ms receive interval which consists of a sync burst, guard interval, start pulse, data, and transmitter key signal. The sync burst shall be 8 time slots, guard interval 4 time slots, start pulse 1 time slot, data period 42 time slots, and guard interval 1 time slot (see FIGURE 5). In addition, the CDTS shall be capable of discriminating against no signal radio receiver noise falsely being recognized as a reply message. It shall be capable of determining if the reply message being received is too late in time to allow a complete reply message to be received and processed during the received frame interval. In addition, it shall be capable of determining if the message being received, during the receive frame, is a control message from another control station. Time slot 27 shall be used for this function. The logic requirements, the CPU bit assignment, and the overall reply message profile shall be as specified in TABLES III and IV.

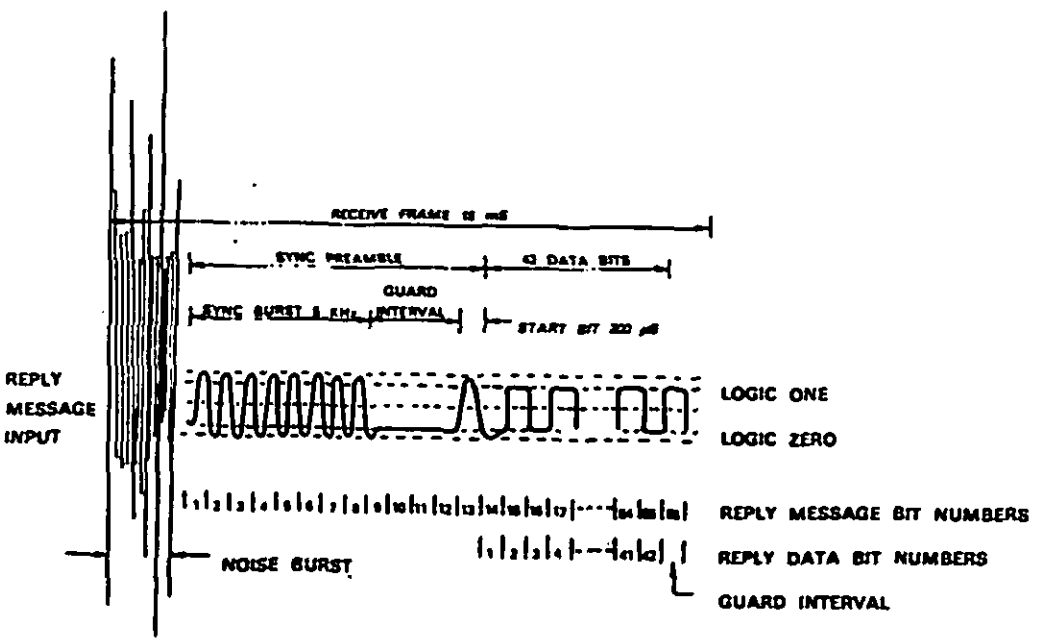


FIGURE 5. Reply message input timing diagram.

TABLE III. Computer input word and control functions profile.

COMPUTER BIT POSITION		
Position	Definition	Remarks
0-6	Not Used	Terminate
7, 8	Used as CDTS Control	Word One Only
9-29	Data Bit	Word One - Word Two
30-35	Not Used	Terminate
CONTROL LINES		
Line		Remarks
External Interrupt Request		Active
Input Data Acknowledge		Active
Input Data Request		Active
CONTROL FUNCTIONS		
CPU Bit 7	CPU Bit 8	Function
0	1	Error
1	0	OK
0	0	Not Used
1	1	Not Used

TABLE IV. Computer input word and control functions profile for steerable antenna.

COMPUTER BIT POSITION		
Position	Definition	Remarks
0-32	Data Bit	Word One - Word Two
33-35	Not Used	Terminate
CONTROL FUNCTIONS		
Aircraft address is accomplished in software		

5.3.7 Computer interface. The CDTS shall contain the necessary computer input and output (I/O) interface to provide the proper and timely exchange of digital data between the tactical data system and the controlled aircraft. The CPU electrical I/O characteristics shall comply with 4.6.

5.3.7.1 Computer output words. The CDTS shall be capable of receiving and storing a minimum of two CPU output words (three CPU output words when the TADIL C system uses steerable antennas) during each receive frame interval. Each computer word can contain up to 36 bits. Unused CPU bit lines shall be terminated at the CDTS input. The CPU output bit and control function profile shall be as specified in TABLES I and II.

5.3.7.2 Computer input words. The CDTS shall be capable of transferring to the CPU during the transmit frame interval, two computer input words. Each computer input word can contain up to 36 bits. Unused CPU bit lines shall be terminated at the CDTS. The CPU input bit and control function profile shall be as specified in TABLES III and IV.

5.3.7.3 Mode switch. When the CDTS is initially switched from the test mode to the computer mode, the CDTS shall be placed under computer control and shall automatically be switched to the STANDBY condition by the switching action. The computer program shall then send the Begin Two Way Communications (BTWC) code to the CDTS, via the computer output, utilizing the external function acknowledge and compute output bit one. When the computer output bit one is set to logic one, and the external function acknowledge set to logic one, this condition shall generate the BTWC code. When the computer output bit one is set to logic zero, and the external function acknowledge is set to logic one, the CDTS shall return to the STANDBY condition.

5.3.8 Radio interface. The CDTS radio interface shall consist of the inputs and outputs specified in 5.3.8.1 through 5.3.8.6. These interfaces shall meet the requirements of 4.6 (see FIGURE 1).

5.3.8.1 Control message. The CDTS shall generate a control message as a serial input to the radio. The input line shall be interfaced to the radio so that a binary one applied to the data input terminals of the radio shall increase the rf carrier frequency and a binary zero applied to the data input terminals of the radio shall decrease the rf carrier frequency (see 5.2.10.2). The control message signal shall be as specified in TABLE V.

TABLE V. Control message profile.

TIME SLOT	PROFILE
1-8 A Logic 0 B Logic 1	Sync Burst NOTE: Time Slots 1 through 8 100 µs Logic 0 100 µs Logic 1
9-12 Logic 0	Guard
13 Logic 1	Start Bit
14-41 Data	CPU Bit 29 - 2, Word One Respectively
42-69 Data	CPU Bit 29 - 2, Word Two Respectively
70 Logic 0	Transmitter Unkey

5.3.8.2 Transmit keying signal from the CDTS. The CDTS shall provide a transmit keying line to the radio.

5.3.8.3 Transmit keying signal timing. The CDTS shall generate a transmit keying signal which shall be on for 14 ms ±.07 ms and shall be off for 18 ms ±.09 ms.

5.3.8.4 Transmit keying signal displacement. The transmit keying signal displacement shall be 200 microseconds ±10 microseconds. The ON signal shall be generated prior to the start of the transmit frame interval (see FIGURE 4).

5.3.8.5 Transmit keying signal in standby condition. The CDTS shall be inhibited from generating the transmit keying signal when the CDTS is in STANDBY condition.

5.3.8.6 Reply message. The reply message signal shall be provided to the CDTS such that an upward shifted radio carrier frequency of the radio shall provide a binary one and a downward shifted radio carrier frequency shall provide a binary zero (see 5.2.11.3). The reply message signal shall be as specified in TABLE VI.

5.3.9 Error detection. The CDTS shall contain an error detection capability which shall process test messages received from the computer and also constantly monitor the frame timing, time slot durations, and the control message loop around signal input, via the radio receiver, during each transmission.

TABLE VI. Reply message profile.

TIME SLOT	PROFILE	
1-8 A Logic 0 B Logic 1	Sync Burst	Time slots 1 through 8 100 microseconds Logic 0 100 microseconds Logic 1
9-12 Logic 0	Guard	
13 Logic 1	Start Bit	
14-34 Data	CPU Bit 29 - 9, Word One Respectively	
34-55 Data	CPU Bit 29 - 9, Word Two Respectively	
56 Logic 0	Transmitter Key Down	

5.3.10 Test message. The CDTS shall sample each computer output word during the receive frame interval to determine if the computer output word is test data. The CDTS shall process test data words and generate a control message which is transmitted during the next transmit frame interval. The radio receiver output of the test control message transmission shall be processed to determine if the message contains an error. The sync burst, the guard interval, the start pulse, and the test data, shall be processed for error. If an error is detected, the CDTS shall notify the computer during the next transmit frame interval. If no error is detected, the computer inputs shall be set to the opposite states. The CDTS shall also contain a countdown circuit so that if test data is not transferred from the computer to the CDTS within 8.2 second time intervals, an error condition will be detected and the computer shall be notified.

5.3.11 Test reply message. The CDTS shall regenerate a test reply message of the same data structure as the test control message and then transmit the data for processing to the computer. The test reply message shall be regenerated in the proper receive frame interval corresponding to the expected reply from the test control message transmission.

5.3.12 Built-in test. The CDTS shall contain an internal testing system so that both computer I/O, the radio I/O, shall be tested at all critical paths. The CDTS shall provide a fault summary if an error or malfunction is detected. The fault summary shall localize the fault area in order that minimum additional trouble-shooting is required to isolate the error or malfunction.

5.4 UHF controlled airborne radio. The UHF controlled airborne radio shall be capable of conforming to 5.4.1 through 5.4.10. Within the TADIL C system, the UHF controlled airborne radio shall be functionally implemented as shown in FIGURE 1. The UHF controlled radio shall be designed to interface within the aircraft as required by the implementing service.

5.4.1 Interoperability. The UHF controlled airborne radio shall be compatible and interoperable with the characteristics specified in 5.1.

5.4.2 Frame rate. The UHF controlled airborne radio shall be capable of supporting a receive frame rate of 62.5 messages per second, and a transmit frame rate of 10 messages per second.

5.4.3 Bit rate. The UHF controlled airborne radio shall be capable of supporting a transmit and receive bit rate of 10,000 binary digits per second.

5.4.4 Frequency coverage. The UHF controlled airborne radio equipment (transmitter and receiver) shall be capable of operation, transmit or receive on 7000 discrete radio frequency channels. The radio frequency channels shall be spaced at integral 25 kHz increments over the frequency range of 225.000 to 399.975 MHz.

5.4.5 Channel changing time. The time to change operation from one channel to another channel should be not greater than 1.5 s.

5.4.6 Frequency stability. The frequency stability of the UHF controlled airborne radio equipment shall be within 1 part in 10^8 over 100 ms, 1 part in 10^7 per day, and 2 parts in 10^7 during the first 30 days after calibration. The frequency stability shall not be degraded by more than 1 part in 10^7 for each 30-day period thereafter. Available warm-up time to meet this stability requirement is a function of mission requirements.

5.4.7 Modulation mode. The rf equipment shall employ FSK modulation.

5.4.8 Transmitter. The transmitter shall meet the requirements of 5.4.8.1 through 5.4.8.6.

5.4.8.1 Power output. The transmitter rf power output rating for each different operational application shall be identified as the average power into a resistive load of 50 ohms. When the transmitter is connected to any impedance producing a VSWR of 2.5 to 1, the rf power shall not be degraded more than 1 dB.

5.4.8.2 Modulation sensitivity. The modulation capability shall be such that a binary one applied to the data input terminals shall increase the rf carrier frequency 20 kHz (±5 percent) (above the nominal (center) rf carrier frequency) and a binary zero applied to the data input terminals shall decrease the rf carrier frequency 20 kHz (±5 percent) (below the nominal (center) rf carrier frequency).

"NOTE: The requirements of 5.4.8.2 and 5.4.9.3 do not comply with the logic and signal sense for binary signals as stated in MIL-STD-188-100 and MIL-STD-188-200. These requirements apply only to TADIL C equipment and are consistent with the capabilities of existing inventory and international agreements as stated in STANAG 5504".

5.4.8.3 Transmitter attack time delay. Specified rf power shall be applied to the output load within 160 microseconds after application of each carrier-on signal. The rf power in the output load shall decrease to more than -85 dBm within 80 microseconds after cessation of the carrier-on signal.

5.4.8.4 Antenna turn around time. The maximum delay for switching the antenna from receive to transmit and from transmit to receive shall be 50 microseconds.

5.4.8.5 Harmonic and spurious output. All harmonics and spurious outputs shall be not less than 80 dB below carrier level except the second harmonic of the carrier frequency shall be not less than 60 dB below the carrier.

5.4.8.6 Transmitter noise level (FSK). Without external modulation, the peak frequency deviation developed by internal noise shall be not greater than 1 kHz.

5.4.9 Receiver. The receiver shall conform to the requirements specified in 5.4.9.1 through 5.4.9.6.

5.4.9.1 Sensitivity. The receiver sensitivity shall be such that the input signal level at the 50 ohm impedance of the antenna feed port required to produce a (S+N)/N ratio of 20 dB shall be not greater than 4 microvolts (open circuit).

5.4.9.3 Demodulation. The demodulator shall provide an output from a frequency shift keyed signal such that a +20 kHz shift from the center radio frequency shall provide a binary one and a -20 kHz shift from the center rf shall provide a binary zero (see 5.2.10.2 and NOTE of 5.4.8.2).

5.4.9.4 Spurious response. The receiver response to spurious signals including image response shall be attenuated not less than 80 dB with respect to the received signal.

5.4.9.5 Input signal protection. A receiver protection circuit shall be activated by rf signal level; the receiver shall not be damaged by the continuous application of a +35 dBM rf signal.

5.4.9.6 Selectivity. The overall selectivity, as related to peak response, of the receiver shall be within the following limitation:

6 dB down	60 dB down
70 kHz minimum	140 kHz maximum

5.4.10 Input and output. The electrical characteristics of the data INPUT and OUTPUT lines shall comply with 4.6.

Custodians:
Army - SC
Navy - EC
Air Force - 90

Review activities:
Army - CR
Navy - AS, OM, SH

Preparing activity:
Navy - EC
(Project TCTS-2032)

APPENDIX A

MEMORANDUM FROM THE ASSISTANT SECRETARY OF DEFENSE FOR COMMUNICATIONS, COMMAND, CONTROL AND INTELLIGENCE, 10 MAY 1977, SUBJECT: MANDATORY USE OF MILITARY STANDARDS IN THE 188 SERIES.

This APPENDIX contains information related to MIL-STD-188-203-1. APPENDIX A is a mandatory part of this standard.

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

COMMUNICATIONS, COMMAND, CONTROL, AND INTELLIGENCE

10 MAY 1977

MEMORANDUM FOR Assistant Secretary of the Army (I&L)
Assistant Secretary of the Navy (I&L)
Assistant Secretary of the Air Force (I&L)
Commandant of the Marine Corps
Director, Defense Communications Agency
Director, National Security Agency

SUBJECT: Mandatory use of military standards in the 188 Series

On January 3, 1972, the Assistant Secretary of Defense (I&L) found it necessary to make a significant change in the DoD Standardization Manual 4120.3M because of recurring misapplications of military standards in general. The essence of the change is that military standards as a general rule are now cited as "approved for use" rather than "mandatory for use" in the Department of Defense.

This deference to the judgment of the designing and procuring agencies is clearly appropriate to standards dealing with process, component ruggedness and reliability, paint finishes, and the like. It is clearly not appropriate to standards such as those in the MILSTD 188 series which address telecommunication design parameters. These influence the functional integrity of telecommunication systems and their ability to efficiently interoperate with other functionally similar Government and commercial systems. Therefore, relevant military standards in the 188 series will continue to be mandatory for use within the Department of Defense.

To minimize the probability of misapplication of these standards, it is incumbent upon the developers of the MILSTD 188 series to insure that each standard is not only essential but of uniformly high quality, clear and concise as to application, and wherever possible compatible with existing or proposed national, international and Federal telecommunication standards. It is also incumbent upon the users of these standards to cite in their procurement specifications only those standards which are clearly necessary to the proper functioning of the device or systems over its projected lifetime.

This direction is in consonance with the recommendations made by the Director, Defense Material Specifications and Standards Office, in his letter of March 4, 1977, which was addressed to the U.S. Army Electronics Command.

Gerald P. Dinneen

Gerald P. Dinneen

cc:/
OASD(MRA&L), DMSSO
Co-Chairman, JSC, ECOM (DRSEL-CE-CS)
Co-Chairman, JSC, DCEC (R110)
OJCS (J-3), Telecom Div

APPENDIX B

LIST OF ABBREVIATIONS AND ACRONYMS

10. SCOPE

10.1 Scope. This APPENDIX provides explanations of the acronyms and abbreviations unique to this standard and is not a mandatory part of this standard.

BTWC	Begin Two-way Communications
CAINS	Carrier Aircraft Inertial Navigation System
CDTS	Control Data Terminal Set
CPU	Central Processing Unit
DO	Design Objective
FDM	Frequency Division Multiplex(ing)
FSK	Frequency Shift Keying
MCM	Monitor Control Message
Modem	Modulator/Demodulator
SNR	Signal-to-Noise Ratio
(S+N)/N	Signal plus Noise to Noise Ratio
TADIL	Tactical Digital Information Link
TDM	Time Division Multiplex(ing)
TEMPEST	Unclassified short name for investigations and studies of compromising emanations
TM	Test Message

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-188-203-3	SUBSYSTEM DESIGN AND ENGINEERING STANDARDS FOR TACTICAL DIGITAL INFORMATION LINK (TADIL) C

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION (Mark one)
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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
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(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.

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