U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Air Traffic Organization Policy

ORDER
JO 6350.25

Formerly 6350.25

Effective Date:
12/15/2006

SUBJ: MAINTENANCE OF TARGET DATA EXTRACTOR (TDX)-2000 DIGITIZER EQUIPMENT

1. This maintenance handbook cover page is updated to:

a. Comply with Order 1700.6C, FAA Branding Policy, Use of the FAA Logo, FAA Signature, and DOT Seal.

b. Comply with Order JO 1320.1, Air Traffic Organization (ATO) Prefixes for Directives.

c. To identify new Office of Primary Responsibility (OPR) within the ATO organizational structure.

2. A hardcopy cover page will be issued when a handbook revision is performed and may be issued with the next page change if deemed appropriate by the office of primary responsibility.

James H. Pritchard

for Richard A. Thoma
Director, Safety and Operations Support

DISTRIBUTION: Web Release Only INITIATED BY: AJW-145

ORDER

6350.25

MAINTENANCE OF TARGET DATA EXTRACTOR (TDX)-2000 DIGITIZER EQUIPMENT

OCTOBER 2, 2003

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: Selected Airway Facilities Field and Regional Offices; ZAF-605

Initiated By: AOS-260

RECORD OF CHANGES

DIRECTIVE NO. 6350.25

CHANGE TO BASIC	SUPPLEMENT			OPTIONAL	CHANGE TO BASIC	SUPPLEMENT			OPTIONAL

FOREWORD

1. PURPOSE. This handbook provides guidance and prescribes technical standards, tolerances, and procedures applicable to the maintenance and inspection of the Target Data Extractor (TDX)-2000 equipment. It also provides information on special methods and techniques, which will enable maintenance personnel to achieve optimum performance from the equipment. This information augments information available in instruction books and other handbooks, and complements the latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities. A glossary of abbreviations and acronyms used throughout this directive is included in Appendix 1.

2. DISTRIBUTION. This directive is distributed to selected offices and services within Washington headquarters, regional Airway Facilities divisions, William J. Hughes FAA Technical Center, the Mike Monroney Aeronautical Center, and Airway Facilities field offices having the following facilities/equipment: TDX-2000, TDX-2000D, BDX-2000, BDX-2000D.

3. MAINTENANCE AND MODIFICATION PROCEDURE.

a. The latest edition of Order 6000.15, this handbook, and the applicable equipment instruction books shall be consulted and used together by the maintenance technician in all duties and activities for the maintenance of the TDX-2000 and related equipment. These documents shall be considered collectively as the single official source of maintenance procedure and direction authorized by the Program Engineering and Maintenance Service. References located in the chapters of this handbook entitled Standards and Tolerances, Periodic Maintenance, and Maintenance Procedures shall indicate to the user whether this handbook, the equipment instruction book, and/or Sensis System Optimization Procedures Manual shall be consulted for a particular standard, key inspection element or performance parameter, performance check, maintenance task, or maintenance procedure.

b. The latest edition of Order 1800.8, National Airspace System (NAS) Configuration Management, contains comprehensive policy and direction concerning the development, authorization, implementation, and recording of modifications to facilities, systems, and equipment in commissioned status listed in NAS-MD-001, NAS Air Traffic Control (ATC) Subsystem Baseline Configuration. It supersedes all instructions published in earlier editions of maintenance technical handbooks and related directives.

4. FORMS. The FAA Form 6000-8, Technical Performance Record-Continuation or Temporary Record/Report Form, is to be maintained for each facility. FAA Form 6000-8 is available from the FAA Depot under NSN-0052-00-686-0001.

5. RECOMMENDATIONS FOR IMPROVEMENT. This handbook is under configuration management control as defined in the latest edition of Order 1800.8, NAS Configuration Management, and NAS Configuration Management Document NAS-MD-001. Any changes to the baseline document or requests for deviation from national standards shall be processed through the National Change Proposal (NCP) process.

Richard A. Thoma
Program Director for Operational Support

TABLE OF CONTENTS

CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

CHAPTER 2. TECHNICAL CHARACTERISTICS

CHAPTER 3. STANDARDS AND TOLERANCES

TABLE OF CONTENTS (Continued)

CHAPTER 4. PERIODIC MAINTENANCE

TABLE OF CONTENTS (Continued)

Paragraph *Page*

LIST OF ILLUSTRATIONS

Figures *Page*

LIST OF TABLES

Table *Page*

CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

100. OBJECTIVE. This handbook provides the necessary guidance, to be used in conjunction with information available in instruction books and other handbooks, for the proper maintenance of the TDX-2000 and similar equipment.

Similar equipment includes the Beacon Data Extractor (BDX)-2000. Unlike the TDX, the BDX does not have the capacity to process radar or weather data. When the text refers to TDX, BDX may be substituted as applicable.

101. SAFETY. Personnel should observe all pertinent safety precautions when performing duties on the equipment. Refer to the latest edition of Order 6000.15, General Maintenance Handbook for Airway Facilities, chapter 6, for guidance.

102. MAINTENANCE CONCEPT.

a. Maintenance Activities. Scheduled maintenance activities at the radar site shall be closely coordinated with Maintenance Control at the FAA Air Traffic (AT) facility and/or with the Department of Defense (DOD) facility served. Maintenance Control and the USAF counterpart shall be advised immediately of equipment failure, restoration of service, and whenever the established tolerances are exceeded. This is especially important where standby or spare equipment is not immediately available. In any case in which equipment operation may be adversely affected, prompt notice shall be given via channels to AT operations personnel, and the proper USAF personnel of all site reported equipment problems.

b. Delegation of Authority. Maintenance Control has the delegated authority to coordinate the proposed shutdown of navigational aids with adjacent AT facilities and flight service stations. Approval or disapproval will be the decision of the AT Area Manager.

103. PERIODIC MAINTENANCE. Chapter 4, Periodic Maintenance, establishes the tasks and maintenance schedules that are required for the periodic maintenance of the TDX-2000. These tasks and scheduled maintenance are the minimum required for the TDX-2000 to meet minimum performance standards.

104. CERTIFICATION. Refer to the latest edition of Order 6000.15 for general guidance on the certification of systems, subsystems, and equipment. Refer to Appendix 2, Certification Requirements, of this handbook for specific requirements applicable to the certification of the TDX-2000.

a. Certification Statement. Upon completion of system evaluation and performance checks, the certifying technician shall make the appropriate entry in the Facilities Maintenance Log, (FAA Form 6030-1). See Appendix 2 for the required statements. If all the certification parameters cannot be met, but a required and reliable lesser service can be provided, a partial service certification statement can be made.

b. Certification Requirements. Certification shall be accomplished as follows:

(1) Periodic. In accordance with intervals specified in Appendix 2.

(2) **Following Selective Action**. After selective maintenance on an element of the TDX-2000 that will affect the certification status, check the performance in accordance with the following guidelines. The entire subsystem may not need re-certification. It's up to the certifying technician to determine the necessary certification actions. In any case, the corrective action performed should be recorded on the Facility Maintenance Log. Re-certification is based on:

(a) All subsystem parameters meeting the requirements detailed in Chapter 3, Standards and Tolerances.

(b) Subsystem demonstrating proper operations based on diagnostic tests or operational tests.

105. AIRCRAFT ACCIDENT. After receiving information that an aircraft accident has occurred within the service area of the facility for which they are responsible, the following minimum actions are required of appropriate Airway Facilities personnel: See the latest edition of order 8020.11, Aircraft Accidents and Incidents-Notification, Investigating, and Reporting.

a. Check the Facilities Maintenance Log (FAA Form 6030-1) to determine the status of the system at the time of the accident.

b. Record all Technical Performance Record data as found and any other system parameters considered necessary to establish the operational capability of the system.

c. Review the Facility Maintenance Log and the Technical Performance Record and compile all data pertinent to the accident.

d. Certify entries on FAA Form 6030-1 and the Technical Performance Record. In all cases have another electronics technician or the supervisor certify the entry, including the date and time of entry.

106. FLIGHT INSPECTION. The TDX-2000 is one element of the Radar Data Acquisition and Transfer (RDAT) subsystem, which includes the primary radar, and beacon elements at the radar site, a complete program, a computer, and traffic control displays. Flight inspection of the TDX-2000 alone will not normally take place outside of the RDAT subsystem. However, personnel who may participate in automated radar system flight inspection activities should familiarize themselves with the information contained in U.S. Standard Flight Inspection Manual, FAA Order 8200.1, in order to ensure efficient use of flight inspection time and to provide any required assistance to flight inspection personnel.

107. TECHNICAL INSPECTION. Formal inspections, objectively conducted, are an important part of the overall maintenance evaluation system. They are one of the more effective management controls for assuring the required level of maintenance work and of equipment and system performance. See latest editions of Order 6000.15 and Order 6040.6, Airway Facility Technical Inspection Program, for further details.

108. REPORTING SITE PROBLEMS. Sites experiencing difficulties in maintaining or certifying the TDX-2000 in accordance with the provisions of applicable directives and other procedural documentation, shall notify their regional Airway Facilities Divisions as soon as practicable. This will enable the responsible Airway Facilities Divisions to submit reports detailing the nature of the problem area(s) to the National Airway Systems Engineering Division, AOS-200.

109. PREREQUISITES BEFORE USE OF RADAR DATA ACQUISITION SUBSYSTEM (RDAS) FOR CONTROL OF LIVE AT. Completion of TDX-2000 System Integration Procedures, and any required re-testing shall be considered prerequisite conditions that must be met before the RDAS can be used for the control of live AT.

In addition, all certification criteria must be met as specified in the latest edition of Order 6100.1, Maintenance of NAS En Route Stage A - Air Traffic Control System, and this order.

110. ANALOG RADAR INTERFACE TO THE TDX-2000. There are certain analog radar receiver control functions that are recommended to be disabled when the radar is interfaced to the TDX-2000 digitizer. Failure to turn-off (disable) certain receiver control functions may cause a degradation in TDX-2000 performance. The analog radar receiver controls that are recommended to be turned off (disabled) are as follows:

a. Normal Log
b. Normal Enhancer
c. Enhanced Normal Log
d. MTI Log
e. MTI Enhancer
f. Enhanced MTI Log
g. MTI Weather
h. Normal Weather

The analog radar interfacing to the TDX-2000 also is recommended to be set to Linear Polarization (LP) and to the Staggered Mode in order to attain optimum performance with the TDX-2000 digitizer.

The certifying technician should refer to FAA Order 6310.9B, Change 6, Maintenance of Airport Surveillance Radar (ASR) (ASR-7, ASR-7E, ASR-7F, ASR-8, and GPN-20), for further information on the control functions that should be selected and/or disabled when the TDX-2000 digitizer is the primary interface.

111. LOGISTICS SUPPORT.

a. Background. The TDX/BDX digitizers have been installed at several ASR-7/8 radar sites. There is a logistics support contract in place through ATB-400 to ensure support of the system. Sensis Corporation will be responsible for providing depot level maintenance and supply support. Sensis Corporation will perform depot level maintenance/repair on the failed Lowest Replaceable Units (LRU) for the digitizer.

b. Contractor Support. The site technician will order the replacement part using the part numbers shown in Table 1-1, Government Furnish Equipment (GFE), of this chapter via the FAA Logistics and Inventory System (LIS) system. A replacement LRU will be shipped to the site for spare's replenishment of the TDX/BDX 2000 digitizer. The site technician will send the failed LRUs via a prepaid package to the contractor facility for repair/replacement of the failed LRU.

c. Exchange and Repair (E&R). E&R LRUs will be repaired to the extent necessary to restore it to a condition in which the item is capable of meeting all operational and functional requirements for which it was designed. Minor cosmetic defects, which do not affect the installation or operation of the item, do not require correction or repair. The contractor will reassemble, calibrate, functionally test, perform acceptance inspection, and prepare for shipment the item or component.

d. Shipment of E&R Items. The contractor will ship a serviceable E&R item to the site. The assigned Federal Aviation Administration Logistics Center (FAALC) inventory manager will furnish shipping instructions for those repaired items. The FAALC inventory manager will contact the contractor's depot repair facility and provide a Return Material Authorization (RMA) number for each forthcoming repair action.

TABLE 1-1. GOVERNMENT FURNISHED EQUIPMENT (GFE)

Chap 1
Par 109

TDX-2000 FAA GFE Inventory	
FAA Contract DTFAO1-99-C-00073 ASR-8 Digitizers	
Description	**Sensis Part Number**
SPARC-5 Monitor	190-005163-P001
DAT Tape Drive, 4mm	190-001758-P002
Sun Microsystems Workstation	190-001599-P001
Cable, AUI to Thinnet	150-001827-P001
Keyboard/Mouse, SPARC-5	190-006142-P002
Ethernet Transceiver	32G-000775-P001
Ethernet Transceiver Assembly 4-port	170-003792-P001
REPRO II - Reply Processor II	130-006630-G001
Signal Distribution Unit (SDU) Rear Fan	560-001375-P001
SDU board	130-002160-G001
TDX Internal Connector Board (MPA)	130-001071-G001
TDX Power Supply Assembly	110-003604-G001
TDX Rear Fan Assembly	560-002119-P001
TDX Status Panel	130-006133-G001
SDU Raw Power Supply	110-002093-P001
Target Extractor (TEX) Primary Search Radar (PSR) Processor *	130-003353-G001
TEX/Analog-to-Digital /(A/D)	130-003138-G002
Uninterruptible Power Supply	110-003251-P002
Universal Input/Output (UNIO)	130-000554-G001
WEPRO - Weather Processor *	130-002407-G001
TDX 68040 PETRA II board: MSC	130-009713-G001
PLEX 68040 PETRA II board	130-009714-G001
SPLEX 68040 PETRA II board *	130-009715-G001
WEX 68040 PETRA II board *	130-009716-G001
HUB, 10BT, 12 RJ-45 PORTS	170-007237-P001
Tranceiver, 10 Base – T MAU	321-004565-P00X

Items marked with an asterisk (*) are not part of the BDX configuration

112. LIST OF APPLICABLE DOCUMENTS.

a. ASTM-D 3951 Standard Practices for Commercial Packaging.

b. MIL-PRF-49506 Logistics Management Information.

113. TECHNICAL DATA REQUIREMENTS. All TDX-2000 systems include a set of operations and maintenance manuals. The manuals provide, at a minimum, guidance on TDX-2000 operations procedures, theory of operations, parts, capabilities, setup, interface, and system diagrams. Where applicable, supporting technical data will be supplied to the site to reflect the TDX-2000 installation.

114.-199. RESERVED.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 2. TECHNICAL CHARACTERISTICS

200. GENERAL DESCRIPTION. The TDX-2000 is a radar processing device that accepts analog data from both primary and secondary radars simultaneously and digitizes the data to produce track outputs. The TDX-2000D is a dual channel configuration allowing one TDX to be operational while the other is in standby. The standby TDX can be switched automatically into the operational mode via the Signal Distribution Unit (SDU) in the event of a fault in the on-line TDX. The TDX was not developed by the FAA, it is a Commercial-Off-The-Shelf (COTS) product developed and manufactured by Sensis Corporation.

The following components make up the digitizer system:

a. BDX-2000/TDX-2000.

b. SDU (Dual channel model only).

c. Control & Maintenance Console (CMC) (Sun Microsystems Workstation).

d. Uninterruptible power supply.

201. TDX-2000 CHARACTERISTICS OVERVIEW.

General. The TDX and its subsystems offer several features which are highlighted as follows:

(1) **Correlation and Track Processor (CTP).** The CTP implemented in the TDX is a key element in its false alarm control. It is based on the Multi-Scan Correlator (MSC). This algorithm based component includes the beacon false target logic to significantly reduce reflections.

(2) **Communication Processor**. The Communication Processor (CP) has the capability to receive, process, and reformat digital radar and/or beacon data. The CP currently supports Common Digitizer (CD)1, CD2, Flight Plan System (FPS)-117, ASR-9, TRACS, FPS-110, FPS-20, and TPS-63 data formats.

(3) **COTS Technologies and Industry Standards.** Digital designs employ high-density Field Programmable Gate Arrays (FPGA), Digital Signal Processing (DSP) chips, and Very Large Scale Integrated (VLSI) chips. The main data processing elements, hosted on Motorola 68040-based Single-Board Computers (SBC), are written in C programming language and run on the Versatile Large Scale Integrated (VRTX) Operating System (OS). The local maintenance console commonly known as the CMC application software is written in C, using standard X-Windows, MOTIF windowing and graphics libraries, and runs in a multi-tasking UNIX OS environment. TDX data processing code is developed on a SUN Microsystems workstation using Integrated Systems development environment for embedded applications.

(4) **Output Target Report Data.** This data represents the true position of the aircraft as detected by the radar/beacon. Track data formed by the TDX-2000 multi-scan correlation and track processing is maintained internally for false target processing only. Unless selected by the user, track-smoothed and/or coasted data is never output to the downstream tracker, as it could result in unacceptable positional biases and track initialization losses. In addition, TDX track processing is performed after the radar and beacon data has been combined, thereby eliminating additional "track initialization" losses which occur when independent tracks on the radar and beacon data are formed first and then combined. This approach maximizes the radar reinforcement of beacon targets. In applications where track output data is desired, the TDX configuration can be changed using the operator interface to provided target track outputs.

(5) **Constant False Alarm Rate (CFAR).** CFAR processing offers optimum target resolution and false alarm control in extended-range clutter conditions, such as large weather fronts.

(6) **CMC Workstation.** The CMC is a highly interactive Human-Machine Interface (HMI) from which all TDX parameters can be controlled locally, remotely via dial-up, or serial modem link over a standard telephone circuit. It provides the user with a wide variety of direct and derived real-time statistical measures of performance, and includes recording of radar and beacon data. Data can be recorded and displayed at three distinct stages within the TDX processing chain:

(a) Digital target reports,

(b) "Raw" hits from the MTI, Normal, and Beacon channels, and

(c) 12-bit or 8-bit sampled video from the Radar Data Extractor (RDX) or BDX subsystems, respectively.

202. TDX-2000 SYSTEM DESCRIPTION. The TDX-2000 is a radar signal and data processing system. It is designed to interface with analog radar and beacon systems to produce digital reports from aircraft returns within the coverage region. In general, the TDX provides the following functionality:

a. Radar digitizing and target extraction.

b. Beacon digitizing and target extraction.

c. Same-scan processing to eliminate beacon false reports due to azimuth and down-link reflections.

d. Same-scan processing to eliminate radar false reports due to clutter returns.

e. Same-scan processing to reinforce beacon reports with radar data.

f. Correlation and track processing of radar and beacon reports to further filter radar false reports attributed to clutter and slow-moving vehicles.

g. Programmable Input/Output (I/O) processor to accommodate multiple data formats and modem interfaces.

203. SYSTEM OVERVIEW.

a. **Hardware.** A complete TDX channel is contained within a rack-mountable electronics enclosure. The enclosure consists of a 16 slot 6U/Versa Modulo Europa (VME) monolithic back plane, power supply, status panel, fans and internal cabling, and measures 19"W x 15"H x 20"D. Each TDX channel consists of 12, 6U (160mm) VME Printed Wire Assemblies (PWA), of which there are six unique types. Subsystem and power supply operational status are continuously monitored and indicated on the front panel with color-coded Light Emitting Diode (LED).

The TDX data processing elements are hosted on Motorola 68040 SBC. Executable code and all user-modifiable parameters are stored in non-volatile memory, which automatically restarts the system in the event of significant power interruption.

TDX signal processing is performed on seven multi-layer PWA. The digital designs include high density FPGA, DSP, and VLSI chips. All control and setup parameters for these boards are configurable either locally or remotely through the user interface.

The user interface, known as the CMC is hosted on a Sun Microsystems Workstation. Communication between the local workstation and processing hardware enclosure is accomplished via thinwire Ethernet Local Area Network (LAN) using a combination of industry-standard Transmission Control Protocol/Internet Protocol (TCP/IP) and User Datagram Protocol (UDP)/IP. Communication between a remote workstation and the processing hardware enclosure is accomplished via standard or high-speed telephone line.

b. **Software.** The main data processing elements, hosted on the Motorola 68040 processor boards are written in C programming language. These applications run on the VRTX Real Time OS, which allows periodic execution of the on-line performance monitoring and health checks.

204. SYSTEM ARCHITECTURE.

a. **General.** The TDX-2000 can be configured to extract from several different radar configurations including analog radar, beacon or radar, and beacon simultaneously. The system can also directly interface with digital serial or parallel radar and beacon data streams to eliminate false plots, reformat data, change baud rates, and channel multiplex or demultiplex.

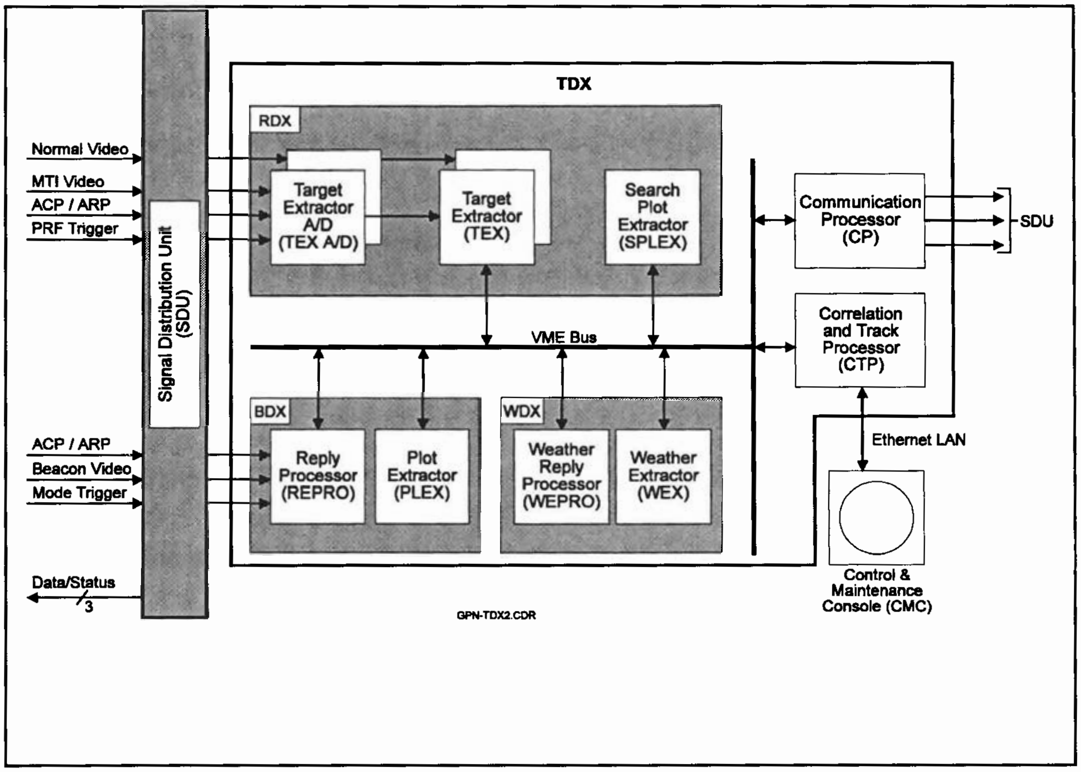
Through the use of FPGAs, the basic TDX-2000 configuration requires 12, 6U-VME Eurostandard boards. In addition, the TDX-2000 is designed with built-in test and evaluation capabilities that support the detection and isolation of faults to the LRU.

b. **System Architecture.** The System Architecture is comprised of the six modular subsystems and the user interface, as shown in Figure 2-1, Six major processing subsystems of the high level architecture system of the TDX. These subsystems are each described further in the following paragraphs.

(1) **RDX.** The RDX subsystem is a programmable radar signal and data processor which accommodates the azimuth scan rates and signal bandwidths from a variety of short- and long-range radar systems. The RDX processing is performed on a total of five circuit cards, of which three are unique board types. Radar interfacing and signal processing are the primary functions of TEX/A/D and TEX boards respectively. The radar data processing function, Search Plot Extraction (SPLEX), is hosted on a SBC.

The RDX employs two parallel channels to process independently the radar's "Normal" and "Moving Target Indicator" (MTI) video signal paths. The analog radar video passes through signal conditioning circuits that amplify the signals, dynamically remove Direct Current (DC) bias, and filter out-of-band noise. The video signals are then converted via a 12-bit A/D converter and are signal processed using threshold and clutter maps and an ordered-statistic background normalizer for CFAR processing. A peak detector is employed to eliminate range splits. Discrete timing signals are obtained from the radar's Azimuth Change Pulses (ACP), Azimuth Reference Pulse (ARP) and Pulse Repetition Frequency (PRF) triggers. The digital plot messages are passed to the CTP for further processing at the completion of the azimuth centroiding and range determination process.

FIGURE 2-1. SIX MAJOR PROCESSING SUBSYSTEMS OF THE HIGH-LEVEL ARCHITECTURE SYSTEM OF THE TDX



(2) **BDX.** The BDX is comprised of a signal processing element; the Reply Processor (REPRO), and the data processing element, Plot Extraction (PLEX). The BDX operates on either composite or separate videos and is compatible with ATC Radar Beacon System (ATCRBS) and Air Traffic Control Radar Beacon System Identification Friend or Foe Mark 12 System (AIMS)-standard beacon interrogators and receivers. Operator-selectable parameters for the BDX include: decoding and extraction logic; pulse and garble tolerances; detection thresholding; run-length/ target split criteria; and code validation criteria. These parameters are typically used during the site optimization and need not be adjusted thereafter. The BDX also has a "lossless" hardware defruiter, which accommodates dense False Replies Unsynchronized In Time (FRUIT) environments, and employs parallel processing channels to resolve simultaneous interleaved replies from up to four aircraft. The beacon digital plot messages are passed to the CTP for further processing upon determination of the range, azimuth, and mode/code information.

(3) **CTP/MSC.** The CTP data processing function is hosted on a Motorola 68040-based SBC. The CTP receives radar and beacon plot messages from the RDX and BDX and performs radar/beacon reinforcement. The operator can choose to use various combinations of radar and beacon position data in the output messages. Targets are processed on a scan-to-scan basis using a tracking algorithm to filter false radar and beacon targets. The CTP then formats and passes the radar, beacon, combined radar/beacon, and status messages to the CP for output. The TDX-2000 outputs plot messages that represent the true position of the aircraft as detected by the sensor. This is particularly relevant when the TDX-2000 feeds digital output data to a subsequent tracker. Cascading a tracker at the radar site in series with a tracker at the ATC facility creates certain problems.

The site tracker provides smoothed position data and, in some cases, actually creates data, commonly referred to as "coasting," when the sensor does not detect the aircraft. The site tracker also creates a "lag" in the aircraft position when the aircraft maneuvers. This lag is significantly amplified by subsequent trackers, which also have inherent lag in position estimation. The net result, in some cases, may result in oscillation and reduced responsiveness of the ATC tracker. Mosaicing relies on minimal registration errors injected by "true" position estimates reported by adjacent radars. Any bias errors introduced by a site tracker, especially during aircraft maneuvers, can cause "speed jumps" in the ATC tracker as the source of data changes between sort boxes. It is important to note that, depending upon the end user's system, outputting track data from the site is sometimes desirable. For that reason, the TDX-2000 is designed to allow the user to select between plot or track output.

(4) **CP/UNIO.** The UNIO board, or CP, receives data from the CTP and transmits the data at rates up to 38.4K baud on as many as three serial channels. Additional boards can be added to increase the channel output capacity and provide data to other end users. Data can be transmitted as asynchronous, synchronous, or Frequency Shift Keying (FSK) with RS-232 or RS-422 electrical interfaces. The CP interfaces directly with modems and automatically detects and switches output channels in the event of one or more failed modems. It currently supports over 17, user selectable radar message formats, including CD-2, FPS-117, and ASR-9.

(5) **SDU.** The SDU receives and distributes search and beacon triggers, beacon reply video, MTI and Normal Video, and azimuth position information (ACP, ARP). Azimuth error detection and switching is provided for single ended or differential pulses when redundant azimuth pulse generators are available. Status monitoring and reporting are provided and are used for automatic extractor output switching. Serial output protocols are user selectable for RS232 or RS422. In addition, multiple driven trigger ACP and ARP outputs are provided.

(6) **WDX.** The ability to accurately detect and report weather is dependent on both the abilities of the weather processor and the existing hardware. The basic weather processor mode, as a modular addition to the TDX, is designed to use non-coherent existing normal and MTI channel radar outputs to detect and report two or three level weather.

(7) **CMC.** The CMC is a highly interactive HMI from which all parameters of the TDX subsystems can be locally or remotely controlled. It provides the user with a wide variety of direct and derived real-time statistical measures of performance and includes the capability to display and record all user inputs. The display features a user selectable combination of Planned Position Indicator (PPI) or Range Height Indicator (RHI) presentation. Data can be recorded at three distinct stages within the TDX processing chain:

(a) Digital target report messages.

(b) "Raw" digital hits.

(c) 12-bit and 8-bit digitized video samples.

205. RDX FUNCTIONAL DESCRIPTION.

a. **General.** The RDX subsystem functional flow is responsible for interfacing with the radar analog video and discrete timing signals to create digital, target report messages. The functional flow of data through the RDX subsystem is shown in Figure 2-2, RDX Functional Block Diagram. The following paragraphs briefly describe the functional flow of data and control through the RDX subsystem.

b. **TEX A/D Functions.** The TEX A/D board receives the analog video and timing signal from the radar and creates a 12-bit digital data stream for signal processing by the TEX board.

c. **Radar Interface.** The RDX is capable of simultaneously receiving and processing two analog videos (usually the "Normal" and "MTI" channels) via the use of two simultaneous signal processing chains. The video signal termination level is selectable to minimize reflections and pulse stretching. Control signals such as digital ACPs, ARPs, and Pulse Repetition Interval (PRI) pulses can be received directly from the external sources with selectable terminations. The digital signals are received and are distributed to the other subsystems within the TDX.

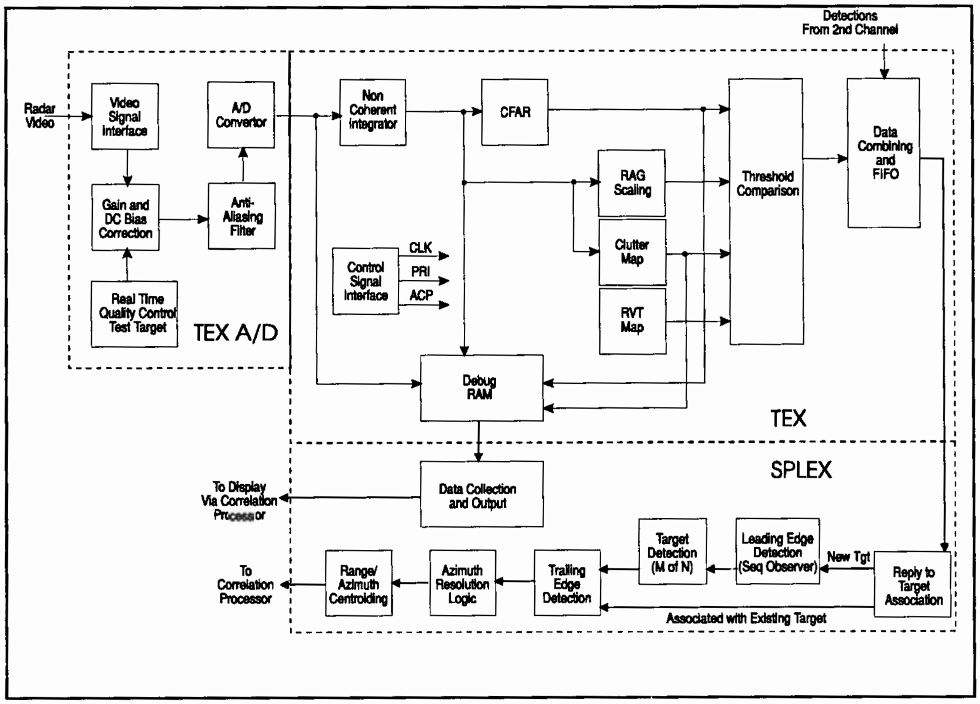
(1) **Search Real-Time Quality Control (SRTQC).** A SRTQC is generated by injecting digital and analog test targets into the front-end of the TEX and TEX A/D boards, respectively. This feature is used to ensure proper operation of the RDX subsystem.

(2) **DC Bias Correction and Gain Control.** The automatic gain control is accomplished through the use of controllable attenuators and amplifiers. The video level is automatically corrected via periodic noise sampling by the SPLEX board, which is used to calculate an adjustment factor, which is fed back to the TEX A/D for correction. The automatic gain control function can be disabled through the CMC and a manual A/D offset can be entered.

(3) **Signal Conditioning.** The incoming video signal bandwidth is matched using an analog anti-aliasing filter to reject out-of-band signal images. The filtering is accomplished using a 6^{th} order Bessel filter.

(4) **Analog-to-Digital Conversion (ADC).** The ADC process takes advantage of a 10-Megahertz (MHz), 12-bit A/D converter. Since 2-to-1 over sampling is usually employed, this sets the maximum video signal bandwidth equal to 5 MHz. Sampling rates are selectable from 250 kHz to 5 MHz.

FIGURE 2-2. RDX FUNCTIONAL BLOCK DIAGRAM



(5) Performance Monitoring. The TEX A/D performs a startup self test that injects various signal levels at the front end of the board. Output levels are checked internally to ensure that the correct performance is achieved. The SRTQC target is used as an on-line, end-to-end test of the overall performance of the board. Signal quality is measured and computed by the TEX and SPLEX boards. In the event of a failure, the status light on the front of the board, the TDX status panel, and the CMC will indicate the failure.

d. TEX Functions. The TEX board receives the 12-bit digital data stream from TEX A/D, performs signal processing, and outputs digital target "raw" replies to the SPLEX data processor.

(1) Non-Coherent Integration (NCI). The TEX board provides a single pole Infinite Impulse Response (IIR) filter to NCI the A/D output data. The NCI operates as a low-pass filter to lower the variance of the background noise over time, and it also serves to eliminate azimuth splits. The NCI feedback coefficient is adjustable through the CMC.

(2) CFAR Processing. The adaptive CFAR circuitry is implemented to provide the best compromise between false alarm control and target detection under various environmental conditions. The CFAR method used is an ordered statistics normalizer, commonly referred to as a Rank Value Filter (RVF) normalizer. It operates by constructing an estimate of the distribution statistics of the "background" clutter and noise in the vicinity of the range cell of interest. Through the CMC, the user can define the percentile level to use in the CFAR process. The resulting threshold is compared to the cell of interest to determine the presence of a target. The user also defines the number of "guard cells" around the cell of interest that will be excluded from the statistical calculation. There are a total of 64 cells that are used in the CFAR windowing process.

(3) Rank Value Threshold. The Rank Value Threshold has several advantages over the classical mean level normalizer. First, the ordered statistic normalizer is significantly better at detecting small targets in the vicinity of large targets or clutter. When a large return is in the CFAR window, the estimated background level of the mean normalizer rises significantly, and thus, so does the target decision threshold used in comparison to the small target amplitude. The net result is a loss of detectability near large targets and clutter. When the large return is in the CFAR window of the RVF, the distribution of the data is insignificantly modified, and thus, the target decision threshold remains relatively constant. Second, the mean level normalizer is subject to clutter "edge" effect. As the window of the mean normalizer slides across a change in clutter types (e.g. from sea clutter to land clutter), the mean normalizer does not respond quickly enough to the change in amplitude. This results in a target decision threshold that is lower than expected and thus, false alarms are generated. The order statistic normalizer responds rapidly driving the threshold up to minimize these false alarms.

(4) Clutter Map Processing. The adaptive hardware clutter map generates a detection threshold for a particular range/azimuth wedge based on the clutter background estimate averaged over a user-selectable number of scans. The clutter map is implemented as an IIR filter with user selectable feedback coefficient. The resultant clutter map estimate is multiplied by a user selectable threshold and compared with the cell of interest. This is particularly effective in controlling false alarms in stationary heterogeneous clutter.

(5) Range-Varying Threshold (RVT). In some environments, for example, thermal noise only, it is desirable to maintain minimum threshold levels since there is not sufficient clutter to invoke the CFAR or clutter map thresholds. This is accomplished through the use of a "fixed-level" threshold. The user can specify minimum thresholds as a function of range and azimuth. The RVT is not subject to automatic variation through environmental changes, thus, it is extremely useful as a last resort in controlling false alarms from heterogeneous clutter regions. It is also useful on systems where pre-processing prior to the video, which is input to the TDX, removes or modifies the noise characteristics preventing true CFAR processing from occurring.

e. **Peak Detection Logic.** The peak detector sorts through the possible detections in range and identifies local inflection points. This is accomplished by examining the amplitudes of a user-selectable number of adjacent cells. If the center cell is larger than the adjacent cells, this is declared a peak. Data from both channels ("normal" and "MTI") is then combined for transfer to the SPLEX processor. This feature is instrumental in eliminating split targets and establishing target resolution performance.

f. **Performance Monitoring (PM).** PM data can be collected at several points within the TEX processing string. The data collection points include: A/D Output, NCI Output, RVF Output, and Clutter Map Output. The user can define a range/azimuth wedge over which the data will be collected and transmitted to the CMC. These test points are extremely useful in the optimization, test, and debug of the system. In addition, the SRTQC generated by the TEX A/D is also processed by the TEX board. In the event of a failure, the status light on the front of the board, the TDX status panel and the CMC will indicate the failure. A second test target, injected at the TEX front-end, is used for fault isolation.

g. **SPLEX Functions.** The SPLEX board receives "raw" target detections from the TEX board, determines the range and azimuth positions, and forwards the potential target reports to the CTP.

(1) **Reply-to-Target Association Processing.** The primary function of the association process is the combining of "raw" replies into a single target report message. Take the range and azimuth position of each "raw" reply and attempting to associate it with prior replies on the same-scan. The user has control over the association process through a CMC menu window. The association gate size in both range and azimuth can be adjusted.

(2) **Sequential Observer Detection.** After a reply is associated with another reply (e.g., a potential target), a sequential observer process is initiated. Rather than require a specific number of hits in a specific interval, a count is incremented with each hit and decremented with each miss. Once the count rises above a threshold, it is passed on to the standard detection process. If the count falls to zero, the potential target is deleted. If the count remains between zero and the detection threshold, it is held over for updating on the next Pulse Repetition Time (PRT). This process allows for the M-of-N detection process to only be initiated on firm detection candidates. The initial value, increment value, and detection threshold are all user-selectable via the CMC.

(3) **M-of-N Detection.** After the sequential observer has generated detection, a standard M-of-N detection process is initiated. If within N PRTs, M hits are received, a target is declared. Otherwise the potential detection is deleted. Both M and N is user selectable via the CMC.

(4) **Trail Edge Detection.** A target is declared complete when a user-selectable number of consecutive misses is observed.

(5) **Azimuth Resolution Logic.** The user can enable an amplitude-based azimuth resolution algorithm, which compared the observed run-length to the expected run-length, given the target amplitude and the beamwidth of the antenna. The user via the CMC can set the split threshold and assumed antenna beamwidth.

(6) **Range/Azimuth Centroiding.** The range and azimuth are estimated via averaging of the range and azimuth positions of the replies that make up the target. In the case of azimuth centroiding, the averaging process can be selected to be a straight average, a power centroid, or based on the maximum amplitude raw detection. A target report is then formed with the range and azimuth estimate and is posted to a First-In-First-Out (FIFO) memory for transfer to the correlation processor.

(7) **Performance Monitoring.** The SPLEX board communicates "heart beat" messages to and from the PLEX and CTP processor. This crosschecking scheme allows each processor to monitor and report the status of the other processors. Internal watchdog timers are used to ensure that all tasks are executing properly. The single-board computer board contains built-in test and evaluation hardware and software for detecting its own failures. It has extensive power-on self-test capability that reads and writes memory locations. In the event of a fault condition, the status light on the front of the board, the TDX status panel, and the CMC will indicate the failure.

206. BDX FUNCTIONAL DESCRIPTION.

a. **General.** The BDX subsystem interfaces with the beacon analog video and discrete timing signals, digitizes the data, and extracts aircraft position, modes, and codes. The following paragraphs briefly describe the functions of the BDX subsystem, which are summarized in Figure 2-3, BDX Functional Block Diagram.

b. **REPRO Functions.** The REPRO performs the interfacing to the beacon system, the analog signal conditioning, and the detection for interrogation responses before passing the "raw" digitized replies to the PLEX data processor.

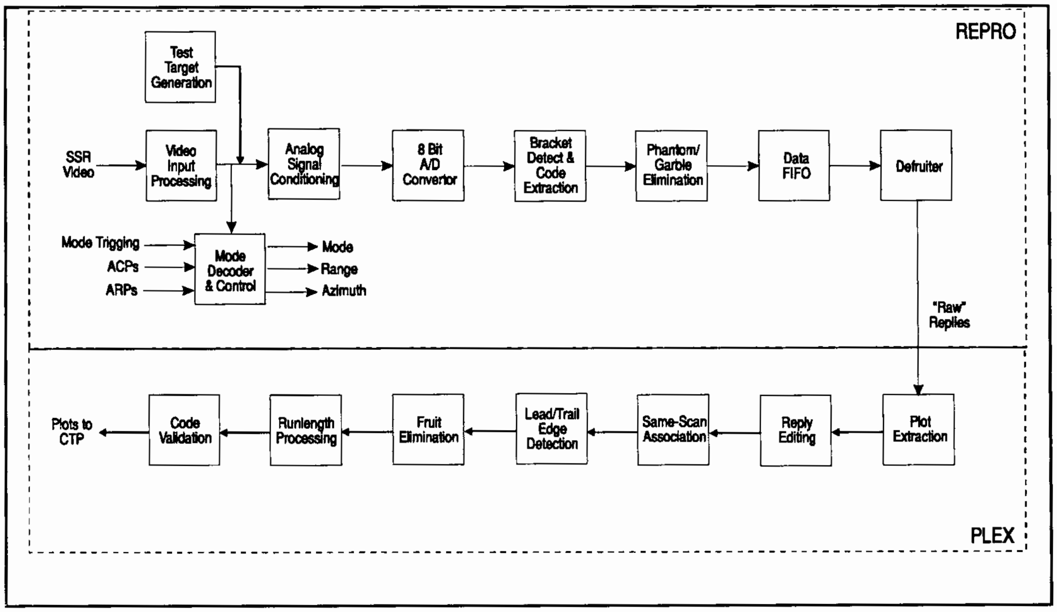
(1) **Mode Decoder.** Interrogator (challenge) pulses received by REPRO are fed into the mode decoder where the pulse spacing is interpreted into one of the five supported interrogation modes — 1, 2, 3/A, 4, and C. Many radar systems will use a pre-trigger pulse superimposed on the interrogate signal as a system trigger; this is supported as well. Nominally, only the P1-P3 interrogate pair are expected, but since some systems insert P2 as well, the mode decoder will accept all three interrogate triggers. Any interlace sequence can be accommodated since no history is kept of interrogation modes and the mode decoder resets after each PRI.

(2) **Video Input Processing.** The video signal input to REPRO is a digital or analog signal with a nominal peak voltage of 4.0 to 6.0 volts. REPRO can accept reply video and interrogator signals as separate inputs or as a composite signal on a single video line.

(3) **Analog Signal Conditioning.** Video signals input to REPRO are attenuated by a 2:1 voltage divider before being sent to a programmable gain amplifier. After amplification, the signal is low pass filtered to prevent aliasing in the A/D converter. A second gain stage with programmable gain follows the filter. The second amplifier also implements a user-selectable DC offset control to null out any bias present on input video.

(4) **A/D Conversion.** An 8-bit flash converter is used to digitize the conditioned video signal. Because a flash converter is used, no track/hold circuit is required and the final analog gain section feeds the A/D directly. Sampling occurs at 11.034 MHz.

FIGURE 2-3. BDX FUNCTIONAL BLOCK DIAGRAM



(5) **Thresholding.** The 8-bit data produced by the A/D converter is compared against a user selectable amplitude threshold and produces a 1-bit pulse train that is used in all subsequent processing. These pulses are then subjected to a width thresholding process where pulses shorter than a user selectable time are deleted and extremely long pulses are truncated.

(6) **Bracket Detect and Code Extraction.** Initial criteria for a valid reply are F1-F2 bracket pairs spaced 20.3 μsecs apart and with pulse widths that match each other within the user-selected tolerance. A digital delay line precedes the bracket detection circuit to allow for the detection of phantom and Special Position Identifier (SPI) pulses.

(7) **Phantom/Garble Elimination.** To enhance REPRO performance in the presence of multiple targets and garble conditions, the REPRO subsystem employs three independent state machines, which permit it to handle many situations of mixed replies where other detection schemes fall short. One machine alone is capable of handling an indefinite stream of closely spaced synchronous replies without assistance, leaving the other two machines free to detect any other targets that may arrive. This architecture enables REPRO to degarble three interleaved replies with one closely spaced trailing reply.

(8) **Intermediate FIFO.** Detected targets are stored in an intermediate FIFO memory as valid replies are declared. Each interrogate cycle causes the FIFO controller to write a synchronization word, azimuth data, and the code for the decoded mode. Valid replies are inserted as they occur with their range and reply code as well as SPI and garble indicators.

(9) **Defruiter.** A lossless hardware defruiter is provided as part of the extraction process. Static Random Access Memory (RAM) keeps a record of the spatial location of received replies in range and azimuth. After storing several cycles of interrogation replies, the defruiter determines whether any other replies were received near the reply in question. If no other replies are found nearby, the reply is declared FRUIT and is not written to the reply FIFO. The presence of other replies allows the reply under test to be written to the reply FIFO memory. The user by means of a control register can adjust the proximity of nearby replies for association with the reply under question.

(10) **Performance Monitoring.** On-line Built-In-Test (BIT) of REPRO is accomplished through the use of the Real Time Quality Control (RTQC). Since the test target passes through virtually all of the processing that normal targets pass through, proper operation can be ascertained with a high degree of confidence. BIT is also performed at system power-up or in a dedicated, off-line diagnostics mode. In the event of a fault condition, the status light on the front of the board, the TDX status panel and the CMC will indicate the failure.

(11) **PLEX Functions.** The PLEX data processor receives "raw" digitized beacon reply messages from the REPRO board, extracts the mode, code and validation information, determines the range and azimuth, and passes the resulting plots to the CTP.

(12) **Beacon Plot Extraction.** The Plot Extraction algorithm is the heart of the PLEX subsystem. It processes beacon raw replies received from REPRO every interrogation period. Mode 1, 2, 3/A, C, and, optionally, 4 are all processed and extracted by the PLEX processor. All the key parameters of the plot extraction algorithm are part of the PLEX subsystem configuration and can be modified upon command from the CMC.

(13) **Reply Editing.** The reply editing function handles the Mode 1 SPI replies and Military Emergency replies. A Mode 1 SPI is defined as two identical beacon replies, spaced 24.65 μsecs, F1 to F1. In Modes 1, 2, and, 3/A a Military Emergency is defined by a normal reply followed by three sets of empty framing pulses, spaced 24.65 μsecs, F1 to F1. PLEX identifies both the Mode 1 SPI and Military Emergency conditions and prevents the additional replies from entering the same scan association process.

(14) **Same Scan Association Process.** PLEX maintains a table of recently received beacon targets so that raw replies corresponding to the same target can be associated, validated, and combined into a single beacon report. Each new raw reply is compared in range to the stored targets and is associated with the first target that falls within the required range gate. If more than one target satisfies this criteria, the reply codes, azimuth and range distances are used to select the best association candidate. A beacon target cannot be associated to more than one reply in any given interrogation period. Raw replies that do not correlate to a previously stored target create new entries in the target table.

(15) **Lead Edge/Trail Edge detection.** A stored target is declared valid when a minimum number of associations have occurred within a given number of interrogation periods. Targets that do not satisfy this criterion are considered invalid and are removed from the target table. Invalid targets are reported when no associations have occurred for a given number of consecutive interrogation periods.

(16) **FRUIT Elimination.** Targets for which no associations beyond the initial reply have occurred within a given number of interrogation periods are considered FRUIT and are removed from the target table.

(17) **Run-length Discrimination.** A target report is generated only if the target azimuth run-length exceeds a minimum. If a target run-length exceeds a maximum value, it is reported immediately; i.e. before the trailing edge criteria is met.

(18) **Code Validation.** Code validation is performed when the number of associations for a given target exceeds a required minimum. Code validation is the process of matching ungarbled reply codes to the previously received codes and it is performed separately for Mode 1, 2, 3/A, and C codes. When the number of ungarbled code matches exceeds a required value, the code is declared valid. In addition, the validation process keeps track of the number of code mismatches received per target. If the number of mismatches exceeds a maximum, the target is declared as a split and a new target is entered in the target table. A validation process is also performed on the SPI pulse, X pulse, Mode 3/A Emergency, Mode 3/A Communication Failure, Mode 3/A Hijack, and Military Emergency indications. Each of these indications, with the exception of SPI, is declared valid if at least two consecutive ungarbled indications are received. Validation criteria for SPI are user selectable.

(19) **Target Report Generation.** The reported target range is the average range of all the raw replies that were combined for that target, with the addition of a range bias. Reported azimuth is obtained by calculating the center azimuth between the first and last raw replies that were used in the correlation process and applying an additional azimuth bias. The reported height is obtained by converting the Mode C Gray code into a height in increments of 100 ft. In addition to the range, azimuth, and height, the beacon plot report contains the target azimuth run-length, the Mode 1/2/3/C codes, the code validities, the X-pulse validity, SPI validity, Civil Emergency validity, Communications Failure validity, Hijack validity, and Military Emergency validity.

(20) Statistics/Status Reporting. The PLEX subsystem maintains an extensive set of statistics that are reported once per scan or upon request from the CMC. The statistics report includes various indicators accumulated by plot extraction algorithm. It also contains timing statistics such as the number of ACPs per scan, the average time between ACPs, the average time between interrogations, and so on.

(21) Hardware Test Target Processing. The PLEX subsystem supports the injection of a hardware test target by the REPRO subsystem. As part of the PLEX initialization sequence, the REPRO board is placed in a Self-Test Mode and the test target is injected in a dedicated manner. If the received replies fail to compare to the injected data, a REPRO board fault is declared. During normal system operation, the hardware test target is used as a Beacon RTQC target and is injected once per scan at a given range and azimuth. The test target raw replies undergo all stages of the Plot Extraction process and are reported as a Beacon RTQC target. A fault condition is generated if the hardware test target is not received or if its data does not match the expected values. All the test target parameters can be modified upon command from the CMC.

(22) Data Recording. In addition to the reporting of beacon targets that takes place as part of the normal system operation, the PLEX subsystem provides extensive recording capabilities that can be activated upon request from the MSC. PLEX can activate a raw video recording feature on the REPRO board, which captures video data at different stages of the reply extraction process. In addition, PLEX can record the beacon raw replies received from the REPRO board.

207. MSC FUNCTIONS.

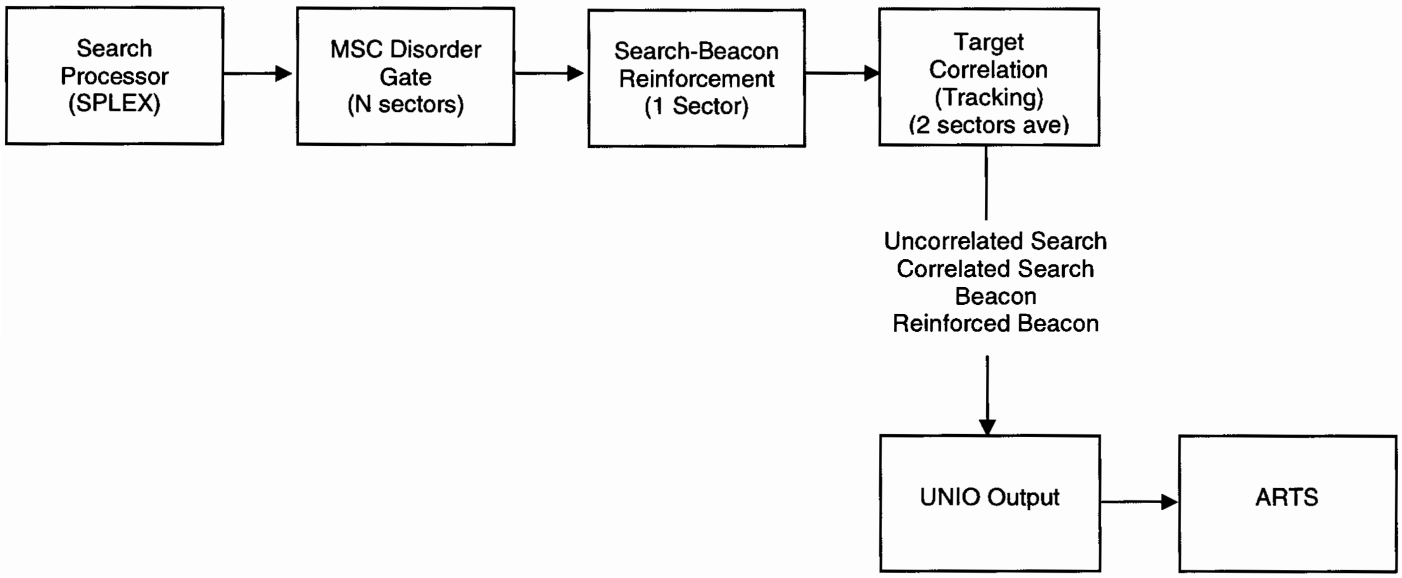
a. CTP Functions. The CTP is a data processing function that operates on the RDX and BDX digital plot messages to form an integrated data stream of radar, beacon, and reinforced radar/beacon report messages. In addition, the CTP significantly reduces false plots from both the RDX and BDX subsystems.

b. Radar/Beacon Reinforcement. The radar/beacon same-scan reinforcement process is performed at the plot level, that is, prior to tracking of the data. This is a very important distinction because performing radar/beacon correlation after tracking has several disadvantages. Creating and searching a range/azimuth region centered at the location of a beacon plot initiate the process. When a radar plot is located within the area, a reinforced radar/beacon report message is created. Through the CMC, the user can modify the range and azimuth extent of the correlation gates as well as choose to report both range and azimuth from the either radar or beacon plot data.

c. Radar False Alarm Reduction. The MSC application software accomplishes the radar false alarm reduction function. This software is based on a tracking algorithm that attempts to associate radar and beacon plots with an existing MSC system track database. The results of the tracking process are used to determine if the radar plot will be output by the TDX as a valid target report or deleted from the data stream. This process is commonly referred to as "track-filtered plots." A high-level flow diagram of the MSC processing algorithm is shown in Figure 2-4, Multi-Scan Correlation (MSC) Processing High Level Flow Diagram.

d. The MSC Tracker. The tracker uses all available information to update the tracks regardless of data type. This greatly improves the probability of correct track association and reduces the probability of dropped tracks. The MSC also takes advantage of beacon Selective Identification Feature (SIF) codes when available.

FIGURE 2-4. MULTI-SCAN CORRELATION (MSC) PROCESSING HIGH-LEVEL FLOW DIAGRAM



e. Tracker Parameters. Parameters which impact the performance of the tracking algorithm and plot-filtering function, such as radar error parameters, track initiation criteria, minimum and maximum velocity, acceleration and maneuver gate size, are selectable from the CMC. This allows the operator to optimize the algorithm performance for individual radars operational parameters and mission. Once the proper parameters are determined for a particular site, they are stored in the non-volatile memory on the processor card. If power is interrupted for any reason, the MSC will restore the saved parameters during the power-on and program load sequence.

f. Tracking Logic. The tracking logic continues to process the track throughout its lifetime once it passes the initiation process. During the life of the track, the tracker is continually calculating the expected positions of the target for each successive radar scan. This expected position and the correlation gate size determines the volume in which target plots will be tested for association. The target plot within the correlation volume, which is closest to the predicted position (priority is given to beacon and reinforced plots), will be used to update the track parameters such as heading, speed, smoothing constants, and correlation gate size for the next predicted position. Once in steady-state, the tracker will continue to predict the expected location of the radar target report for up to six consecutive scans of radar "misses" (no target plots) before being dropped from the track files. During this time, the correlation gate size will increase to maximize the potential for re-acquiring the potentially maneuvering target.

g. Correlation Gate. The correlation gate for a particular track is continually modified based upon the history of the track. The correlation gate size (volume) is computed based on track lifetime, radar coordinate estimation errors, and the performance envelope of the targets of interest. The performance envelope is determined based upon the minimum and maximum velocity parameters, the low velocity threshold, and the acceleration parameters set by the operator at the CMC. Track updating is performed using a multi-state, adaptive, alpha-beta algorithm. Smoothing constants applied to the track speed and heading are modified as a function of track quality, velocity, and reported range from the radar.

h. Track Bifurcation Logic. Track bifurcation or splitting of one track into two separate tracks occurs when a potential aircraft maneuver is detected. This is performed to reduce the possibility that a clutter return has falsely associated with an aircraft track referred to as "clutter stealing," and would otherwise significantly alter the track heading.

i. Clutter Map.

(1) General. The MSC utilizes two types of clutter map algorithms, a fixed map and an adaptive map. The clutter maps used by the MSC differ significantly from the TEX hardware clutter map. Range-azimuth cells within which the track initiation process is inhibited define the MSC clutter map. That is, radar plots which do not associate with existing system tracks are prevented from entering the track initiation process and are eliminated from the data stream. However, radar plots which lie within a clutter map cell that associate with a system track will be candidates for output. Existing tracks "pass through" clutter mapped regions without losing the possibility for association.

(2) Adaptive Clutter Map. This map is designed to react automatically to changes in the environment. It is very effective against anomalous propagation, road traffic, weather, and chaff returns since these phenomenons vary considerably over time. The map adapts only on data identified as radar false plots and includes logic to prevent densely traveled air traffic corridors and airport regions from being mapped out. Activation of the clutter map is operator selectable over several range-azimuth regions. Parameters used to control the clutter map are its adaptation time constants and range-azimuth cell size.

(3) **Fixed Clutter Map.** This map can be developed either manually or automatically. The operator at the CMC defines a manually developed map by placing the workstation in the clutter map generation mode and selecting the desired range-azimuth cells. Using the adaptive clutter map process can automatically generate a fixed map. Map cells can then be added or deleted and the edited map can then be sent to the MSC for storage.

j. **Low Velocity Tracks.** Plot data that associates with tracks that have speeds which fall below the operator defined "Low Velocity Threshold," are eliminated from the data stream.

k. **Meandering Target Logic.** Another feature of the MSC tracking algorithm is the "meandering target" logic. The meandering target logic addresses false tracks that are initiated, but exhibit heading and speed changes from scan-to-scan not normally associated with aircraft motion. These tracks are generally formed in dense clutter environments and tend to wander aimlessly from one scan to the next. By measuring their heading and speed the meandering target logic detects and removes such clutter tracks, while leaving maneuvering tracks unaffected.

l. **Multiple-Time-Around-Detection (MTAD) Processing.**

(1) **Second Time Around Detection (STAD) Processing.** This uses the known PRI length to identify STAD targets. This logic only affects targets on the current scan (i.e. prior knowledge about a target or track is not used) and there must be at least two targets for the STAD to be detected and removed.

(2) **Extended Range Beacon Processing.** This logic will try to identify the source aircraft of the STAD using the beacon returns of aircraft that are past the PRF of the primary radar. For an ASR-8, this will require setting the beacon maximum range to at least 120 nmi., but preferably 200 nmi. This logic will also attempt to detect MTAD targets based on the beacon targets and the PRF sequence (hence extending the range to 200 nmi). With this logic, a single MTAD target can be eliminated without the associated delta ranges required by STAD processing.

(3) **MTAD Tracking.** This logic uses the input of the STAD processing logic and the Extended Range Beacon Processing logic to identify MTAD tracks. Once a track is declared an MTAD track it will continue to be eliminated even if there is no associated beacon or STAD with the target so long as it remains above the MTAD track threshold.

m. **Radar Target Report Output Filter Control.** The output filter function provides the capability for the operator to select either the entire radar surveillance region or up to 32 Range-Azimuth Gated (RAG) regions. Within these regions, radar target reports, which are determined by the tracking process to be clutter and slow-moving tracks, are filtered from the data stream. The regions in which the radar target plot filtering will be performed are called "Active" regions and are user-specified through the CMC command menus. The capability to disable the filter process is also available. These disabled regions within Active regions are called "Bypass" regions, a total of 32 of which are definable through the CMC. The Bypass regions may all lie within a single Active region or one Bypass region may lie in each Active region. The Bypass regions are operator definable through the CMC in the same manner as the Active regions. The reason for Bypass regions is to permit radar target reporting of desirable fixed radar returns such as permanent echoes or parrots. In addition, a Bypass region may be desired to prevent the two-scan track initiation loss in the vicinity of airports or other priority areas.

n. **Beacon False Alarm Reduction.** The Beacon False Target Limiter (BFTL) is a function of the MSC. BFTL is used to minimize beacon reflections. False Range Azimuth Gates (FRAG) are used to set up areas beacon reflections are seen. True Range Azimuth Gates (TRAG) are used to display the areas live targets exist. When BFTL is enabled, beacon reflection processing takes place in up to four operator selected FRAGs.

o. Output Interface. The internal tracking algorithm provides the inherent capability to output smoothed track data that includes speed, heading, height, track number, quality, and beacon code data. Filtered plot or track data can be output via the interface to the control center in a custom message format, if desired. In addition, radar target reports and track information are concurrently output on the Ethernet LAN for distribution to other systems or users including the workstation.

p. Performance Monitoring. The single-board computer contains built-in test and evaluation hardware and software for detecting its own failures. Status lights on the front panel of the board provide for easy fault location. Performance monitoring statistics for up to 100 days are stored in non-volatile memory to provide a maintenance record and fault log.

208. UNIO FUNCTIONS.

a. General. The UNIO processor is responsible for interfacing and transmitting TDX digital output data to the modems used to communicate data to the control center. The UNIO is also capable of receiving digital serial data from other sensors to use in the radar/beacon reinforcement process.

b. CTP/UNIO Interface. Report and status messages are passed to the UNIO from the CTP using an internal data format. The UNIO also receives control and setup parameters from the CTP. Setup parameters are stored in non-volatile memory on the CTP board and are transmitted to the UNIO in the event of a power interruption. This allows the UNIO to return to normal operational status after such an event.

c. Message Processing. The UNIO was specifically designed to process the unique word lengths and message formats used by many radar systems for transmission of their data. Non-standard word lengths such as 7, 9, and 13 bits are handled without degradation of its processing capability. This unique capability enables the low-level input and output functions to be performed outside of the CTP, thereby maximizing system throughput.

d. Operational Statistics. Statistics are transmitted from the UNIO to the CMC on a scan-to-scan basis. These statistics indicate depth of storage FIFOs, number of parity errors, and bad messages and other communication errors if they occur.

The TDX-2000 also has the capability to receive data in various formats from other sources, process the data, and retransmit the data. For example, the TDX-2000 can be configured to receive digital data directly from radar. The data could then be processed using the CTP to remove false plots and retransmitted to a command center. Another example would be to configure the TDX-2000 to extract data from an analog radar system, receive digital beacon data, perform radar/beacon correlation processing and output a combined, digital message stream. Additionally, mode 4 interrogation messages, can be received by one channel of the UNIO while being passed on via another channel.

e. UNIO/Modem Interface. The UNIO provides three simultaneous digital serial output channels for transmission of the TDX data to remote users via modems. Each channel has full modem control logic capability and is compatible with RS-232 and RS-422 electrical protocols. Fault detection logic automatically switches data to an alternate channel in the event of a modem failure.

f. Configuration. I/O channels can be independently configured from the CMC to select among the following alternatives: serial synchronous or asynchronous, baud rates ranging from 1.2K to 38.4K, receive the clock or transmit the clock, invert clock or data signals, enable or disable channels, priority output on select messages, and a selection from 17 preprogrammed radar data formats. Data formats can easily be added to accommodate future needs. The TDX architecture supports increased output channel capacity through the addition of UNIO processor boards. Other interfaces such as Navy Tactical Data System (NTDS) (TPS-59 interface) and High Level Data Link Control (HDLC) (UK 592 and All Purpose Structured Euro Control Radar Information Exchange (ASTERIX)) are supported through the addition of COTS I/O processor cards.

209. SDU DISCUSSION. The purpose of the SDU is to route received mode triggers, radar data, and beacon reply data to both TDX in the dual configuration. The SDU also receives ACPs and ARPs from the Azimuth Pulse Generator (APG). The ACP and ARP are automatically routed to the TDX. If redundant APG are available, the SDU automatically selects optimum ACP and ARP data. In the event an APG is faulted or ACP/ARP data is absent, the SDU automatically switches to the other APG.

210. WDX DISCUSSION. The ability to accurately detect and report weather is dependent on both the abilities of the TDX and the radar feeding it. The Weather Processor (WEPRO) board processes Normal and MTI Video. After the processing is complete, the new data is sent to the Weather Extractor (WEX) where weather is extracted.

211. CMC FUNCTIONS.

a. General. The CMC provides a highly interactive HMI from which all operational parameters of the TDX can be controlled. The CMC connects locally to the TDX chassis via thinwire Ethernet LAN or optical fiber, or remotely over a standard telephone line. A wide variety of direct and derived statistical measures of performance are provided to assist in performance monitoring.

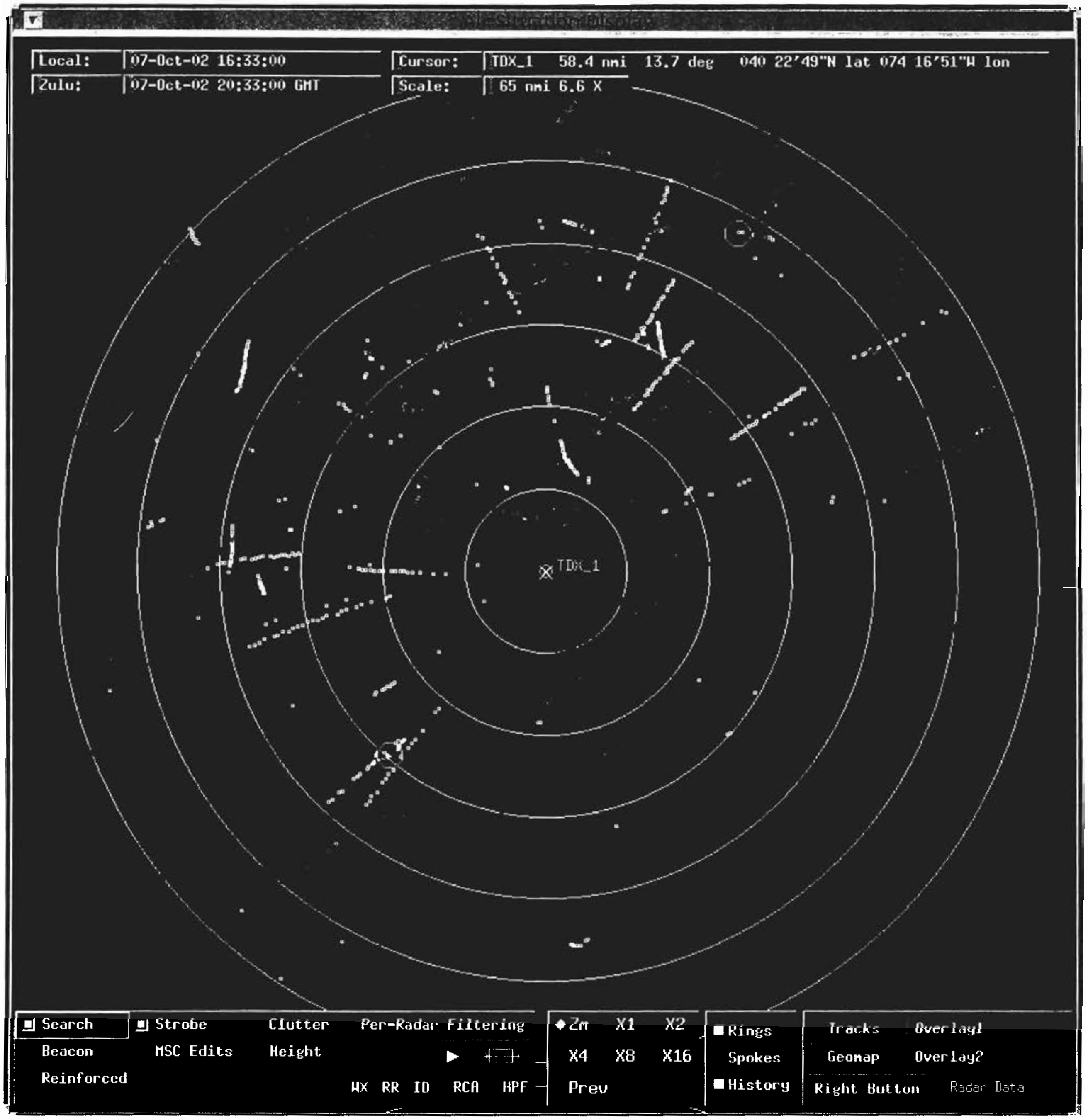
b. Display Features Overview. The CMC application software is written in C programming language, using standard MOTIF windowing and graphics libraries, and is designed to run in a UNIX operating system environment. The flexibility of the display and control software permits nearly any function, symbology, color scheme, and display layout to be implemented with minimal software changes.

c. Graphic Interface. The CMC provides graphic interface and control to the user through the use of the display monitor, keyboard, and mouse. The application software executes on a Sun Microsystems workstation, and provides the operator with a full-featured, real-time Air Situation Display (ASD), as shown in Figure 2-5, CMC Display Illustrating the Real-Time PPI in its Infinite-Scan History Mode. The CMC display provides the user with the capability to view the data in a PPI or RHI format and offers the unique capability to display detected video data from both the RDX and BDX subsystems. This enables the user to view detections from each PRI and individual aircraft transponder replies. Data is color coded so that visual distinction can be made between the Normal and MTI Video and beacon mode responses.

d. Data Recording. The CMC supports data recording at several layers within the TDX processing hardware. This unique capability allows the user to easily optimize the TDX to account for various environmental and site conditions. The following data capture points are available for both the RDX and BDX subsystems:

(1) "Raw" video amplitude data can be captured within a user-defined range/azimuth region. This permits viewing of the amplitude distribution of the radar video returns and the pulse amplitude, timing, and shape of the aircraft beacon replies.

FIGURE 2-5. CMC DISPLAY ILLUSTRATING THE REAL-TIME PPI IN ITS INFINITE-SCAN HISTORY MODE



(2) Detected "raw" video replies can be captured for the entire range and azimuth extent. This intermediate layer represents the output of the signal processing elements.

(3) Status data, plot data including data into and out of the MSC, and MSC track data can be captured. This enables viewing of all data into and output of the track filtered plot processor, thus, the user can see what the MSC has eliminated from the data stream.

(4) Final reports data transmitted to the modems can also be captured.

e. Data Playback. The playback function allows the user to view and analyze previously recorded data files using the normal display features. Once stored on the workstation hard disk, the data may be automatically transferred to an archive medium such as magnetic tape. Playback is extremely useful for viewing data files to search for specific characteristics or events and to maintain a history of flight tests or collect data for radar performance analysis. Playback speed can be set at "Real-Time" or multiplies up to the maximum processor rate. Recorded data files are immediately ready for viewing. No lengthy data reduction process is necessary to review the recorded data.

f. Data Analysis and Display (DADS) Mode. A DADS mode is provided to assist in the analysis of recorded data files. This is particularly useful in evaluating performance of the system in flight tests. The DADS function provides extensive data filtering capability. The user can selectively filter on data type, range, azimuth, height, beacon modes and codes, and track IDs. Data can then be captured in a separate data file for archive purposes.

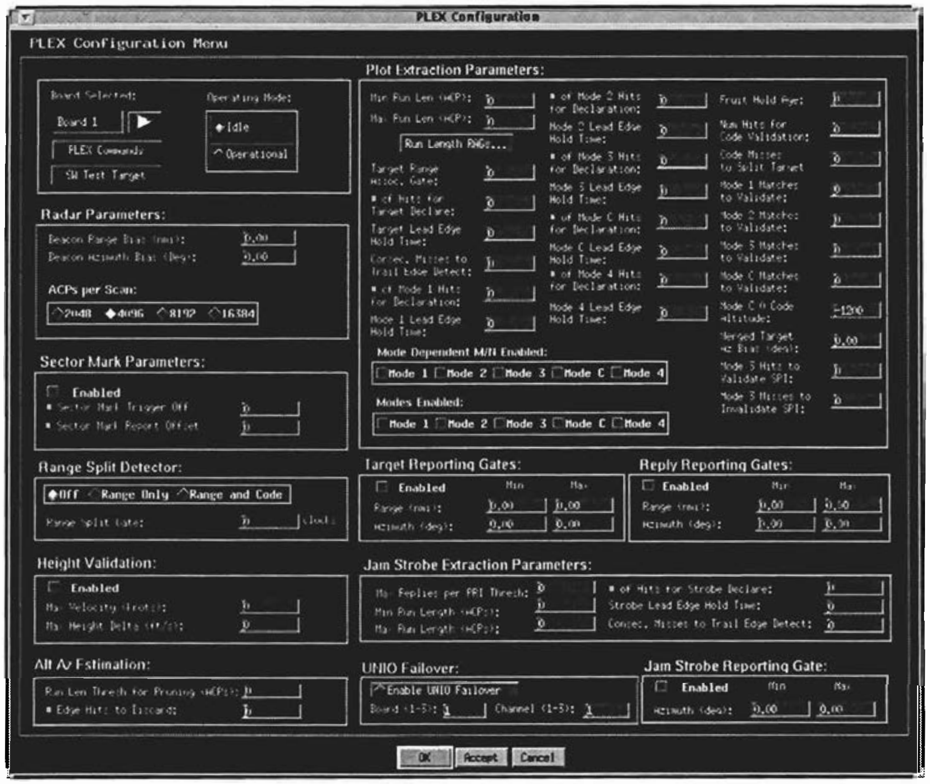
The DADS also supports extensive graphical analysis capability. Data files can be viewed in six simultaneous display modes including "variable zoom" to view tagged tracks or segments of data. DADS also provides an error analysis in which a specific track can be compared to a user-defined reference file for calculating and displaying absolute and relative errors in range, azimuth, and height.

g. TDX Control. The CMC provides an extensive interface for operator control of all parameters within each TDX subsystem. For example, through the BDX/PLEX configuration menu shown in Figure 2-6, PLEX Configuration Menu on the CMC, the user can specify various extraction criteria for each interrogate mode, including lead-edge and trail-edge detection criteria, minimum and maximum run-lengths, validation criteria, hold time and split criteria. Through the use of this level of control, the BDX accommodates a variety of on-site conditions, as well as many different beacon systems without hardware change.

(1) Subsystems. The CMC also provides for an array of RDX subsystem control, including control menus for the TEX and the SPLEX boards. Since there are two TEX boards per TDX channel, the menu has been structured to allow the user to easily configure the second board once the first board has been configured. The SPLEX control menu provides target extraction optimization control similar to that of the PLEX menu.

(2) Parameters. Parameters impacting MSC correlation gate sizes, such as maximum acceleration and velocities and minimum velocity thresholds, are contained in the CMC's Aircraft Parameters menu. These parameters allow the user to optimize the clutter rejection performance of the MSC while maintaining the desired probability of detection on aircraft of interest. Other parameters, which also impact correlation gate sizing, allow the user to adapt to a variety of radar types without hardware modifications.

FIGURE 2-6. PLEX CONFIGURATION MENU ON THE CMC



212.-299. RESERVED.

CHAPTER 3. STANDARDS AND TOLERANCES

300. GENERAL. This chapter prescribes the standards and tolerances for the TDX-2000 equipment. Where a standard value specified in this section differs from a standard value for the same parameter in an equipment manual, do not assume that a conflict exists. If the equipment that supplies the TDX-2000 with the various signals, does in fact, have signal characteristics equal to the standard values listed, then the ideal interface exists.

If it does not, the Initial Tolerance values are specified such that a wide variation of external equipment is compatible with the TDX-2000. Where the Initial Tolerance indicates a site recorded Facility Reference Data File (FRDF) value, it will be used for all subsequent checks. FRDF is determined during optimization. The maintenance handbook, Standards and Tolerances, for external equipment ensure that the external equipment is operating properly. The TDX-2000 Standards and Tolerances ensure that properly operating external equipment is not excluded by way of signal parameters from operating within the NAS system.

There are certain analog radar receiver control functions that are recommended to be disabled when the radar is interfaced to the TDX-2000 digitizer. Failure to turn-off (disable) certain receiver control functions may cause a degradation in TDX-2000 performance. The analog radar receiver controls that are recommended to be turned off (disabled) are as follows:

a. Normal Log
b. Normal Enhancer
c. Enhanced Normal Log
d. MTI Log
e. MTI Enhancer
f. Enhanced MTI Log
g. MTI Weather
h. Normal Weather

The analog radar interfacing to the TDX-2000 also are recommended to be set to the Staggered Mode in order to attain optimum performance with the TDX-2000 digitizer.

STANDARDS AND TOLERANCES

Parameter	Reference Paragraph	Standard	Tolerance/Limits	
			Initial	Operating
301. TDX INPUT VIDEOS.				
a. Normal Video.				
(1) Amplitude.......	505	+ 2V to + 8V	Commissioning Value	± 5%
(2) Noise............	505	Adjusted for 8:1 S/N	Commissioning Value	± 10%
(3) Baseline.........	505	0.0V	Commissioning Value	± 0.05V
b. MTI Video.				
(1) Amplitude......	505	+ 2V to + 8V	Commissioning Value	± 5%
(2) Noise............	505	Adjusted for 8:1 S/N	Commissioning Value	± 10%
(3) Baseline.........	505	0.0V	Commissioning Value	± 0.05V
c. Beacon Reply Video.				
(1) Amplitude.......	505	+0.5 to 20V	Commissioning Value	± 0.05V
(2) Width............	505	.45μs	± 0.15μs	Same as Initial
(3) Baseline.........	505	0.0V	Commissioning Value	± 0.05V
302. TDX AZIMUTH INPUTS (ACP/ARP).				
(1) Amplitude......	506	> 1.0V	> 1.0V	Same as Initial
(2) Width............	506	> 0.4μs	> 0.4μs	Same as Initial
(3) Noise............	506	< 0.5V	< 0.5V	Same as Initial
(4) Baseline.........	506	0.0V	± 0.5V	Same as Initial
303. TDX TRIGGER INPUTS.				
a. Radar Pretrigger.				
(1) Amplitude......	507	> 1.0V	> 1.0V	Same as Initial
(2) Width............	507	> 0.4μs	> 0.4μs	Same as Initial
(3) Noise............	507	< 0.5V	< 0.5V	Same as Initial
(4) Baseline.........	507	0.0V	± 0.5V	Same as Initial

STANDARDS AND TOLERANCES (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limits	
			Initial	*Operating*
b. Beacon Mode Pair Trigger.				
(1) Amplitude......	507	> 2.5V	> 2.5V	Same as Initial
(2) Width............	507	0.8µs	± 0.1µs	Same as Initial
(3) Baseline.........	507	0.0V	± 1.0V	Same as Initial
(4) Pulse Spacing (P1 to P3)......	507			
(a) Mode2......	507	5.0µs	± 0.1µs	Same as Initial
(b) Mode3/A...	507	8.0µs	± 0.1µs	Same as Initial
(c) ModeC......	507	21.0µs	± 0.1µs	Same as Initial
304. TDX VIDEO OUTPUTS.				
a. MTI Video. (TEX A/D #1).				
(1) Amplitude......	508	1.7V	± 0.1V	Same as Initial
(2) Noise............	508	0.2V	Commissioning Value	Same as Initial
(3) Baseline (Bottom of Noise Spikes)...	508	0.0V	Commissioning Value	Same as Initial
b. Normal Video. (TEX A/D #2).				
(1) Amplitude......	508	1.7V	± 0.1V	Same as Initial
(2) Noise............	508	0.2V	Commissioning Value	± .05V
(3) Baseline (Bottom of Noise Spikes)...	508	0.0V	Commissioning Value	± .05V
305. Range and Azimuth Accuracy.				
a. Search Radar.				
(1) Range............	511	Established PE	± 1/8 nmi.	Same as Initial
(2) Azimuth.........	511	Established PE	±4 ACPs	Same as Initial
b. Beacon Radar.				
(1) Range............	511	Established PE	± 1/16 nmi.	Same as Initial
(2) Azimuth.........	511	Established PE	± 6 ACPs	Same as Initial

STANDARDS AND TOLERANCES (Continued)

Parameter	Reference Paragraph	Standard	Tolerance/Limits	
			Initial	Operating
306. DIGITAL SENSITIVITY.				
a. Search Radar......	509	Within 6 dB of Radar MDS	Same as Standard	Same as Standard
b. Beacon...............	510	Within 3 dB of Beacon MDS	Same as Standard	Same as Standard
307. TDX DC POWER SUPPLY VOLTAGE CHECKS.				
a. + 5V...................	503	+ 5V	± 0.05V	Same as Initial
b. + 12V.................	503	+ 12V	+0.60V/-0.36V	Same as Initial
c. – 12V.................	503	– 12V	-0.60V/+0.36V	Same as Initial
d. + 24V.................	503	+ 24V	± 2.0V	Same as Initial
308. SDU POWER SUPPLY VOLTAGE CHECKS.				
a. + 5V...................	504	+ 5V	± 0.05V	Same as Initial
b. + 12V.................	504	+ 12V	+0.60V/-0.36V	Same as Initial
c. – 12V.................	504	– 12V	-0.60V/+0.36V	Same as Initial
309. ALARMS AND MESSAGES.				
a. TDX/BDX Front Panel Alarms.......	501	No Alarm LED(s)	Same as Standard	Same as Standard
b. SDU Front Panel Alarms...............	502	No Alarm LED(s)	Same as Standard	Same as Standard
c. CMC..................	501	No Error Messages	Same as Standard	Same as Standard

310.-399. RESERVED.

CHAPTER 4. PERIODIC MAINTENANCE

400. GENERAL.

a. This chapter establishes all the maintenance activities required for the TDX-2000 equipment on a periodic recurring basis and the schedules for their accomplishment. The chapter is divided into two sections. The first section identifies the performance checks (e.g., tests, measurements, and observations) of normal operating controls and functions, which are necessary to determine whether operation is within established tolerance or limits. The second section identifies other maintenance tasks that are necessary to prevent deterioration and ensure reliable operation. Refer to the latest edition of Order 6000.15 for additional guidance.

b. All reference paragraphs pertaining to standards and tolerance/limits are found in chapter 3 of this order, unless otherwise stated. All maintenance procedures are found in chapter 5.

Section 1. PERFORMANCE CHECKS

Performance Checks	*Reference Paragraph*	
	Standards & Tolerances	*Maintenance Procedures*
401. WEEKLY CHECK REQUIREMENTS.		
a. Check for TDX error indications on local or remote CMC	309c	501, 515
b. Verify error free operation of TDX (no fault lights)	309a	501
c. Verify error free operation of SDU	309b	502
d. Search digital sensitivity	306a	509
e. Search Range/azimuth accuracy	305a	511
f. Beacon Range/azimuth accuracy	305b	511
402. MONTHLY CHECK REQUIREMENTS.		
a. MTI TEX A/D video output levels	304a	508
b. NOR TEX A/D video output levels	304b	508
c. Beacon digital sensitivity	306b	510
d. Check for BDX error indications on local or remote CMC	309c	501, 515
e. Verify error free operation of BDX (no fault lights)	309a	501
f. Verify error free operation of SDU	309b	502
403. QUARTERLY CHECK REQUIREMENTS.		
a. Check TDX DC power supply voltages	307	503
b. Check SDU DC power supply voltages	308	504
c. TDX and SDU proper fan operation and air flow	N/A	519
404. SEMI-ANNUAL CHECK REQUIREMENTS.		
a. Video Input Levels		
(1) Radar	301a,b	505
(2) Beacon	301c	505
b. Trigger Input Levels		
(1) Radar	303a	507
(2) Beacon	303b	507
c. Azimuth Input		
(1) ARPs	302	506
(2) ACPs	302	506

Section 2. OTHER MAINTENANCE TASKS

Performance Checks	*Reference Paragraph*	
	Standards & Tolerances	*Maintenance Procedures*
405. ANNUAL CHECK REQUIREMENTS.		
Test Uninterruptible Power Supply (UPS) Operation		
(1) Power outage simulation	N/A	512
(2) Automatic and maintenance bypass function... (APC UPS only)	N/A	See UPS Manual
406. CMC (AS REQUIRED).		
a. Clutter Map (MTI & Normal)	N/A	514
b. Threshold Map (MTI & Normal)	N/A	514
c. RVT Map (MTI & Normal)	N/A	514
d. Weather Map	N/A	514
407. REMOTE CMC (AS REQUIRED).	N/A	515
408. EEPROM REPLACEMENT (AS REQUIRED).	N/A	517
409. ROUTER AND CMC CONFIGURATION MODIFICATION (AS REQUIRED).	N/A	518
410. DISCRETE SEARCH MINIMUM DISCERNIBLE SIGNAL (MDS) (AS REQUIRED).	N/A	513
411. SURVEILLANCE PERFORMANCE (AS REQUIRED).	N/A	516
412. CLEAN TDX AND SDU FAN AIR SCREENS (AS REQUIRED).	N/A	519

413.-499. RESERVED.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 5. MAINTENANCE PROCEDURES

500. GENERAL. This chapter establishes the procedures for accomplishing the various essential maintenance activities that are required for the TDX on either a periodic or incidental basis. Any maintenance procedures referenced in Chapter 4 or other handbooks will not be included in this chapter. Refer to the latest edition of Order 6000.15 for additional guidance.

Section 1. PERFORMANCE CHECK PROCEDURES

501. TDX OPERATIONAL CHECKS.

a. Discussion. Front panel LED can be used by the local technicians to determine the general operational state of most CCA in the TDX. In addition, there are LEDs that indicate if video, triggers, and azimuth reference information are being distributed to the TDX channel.

b. Test Equipment Required. None.

c. General Procedure. Visually check for proper operation of TDX CCA as well as the presence of input signals.

d. Detailed Procedure.

Evaluate TDX (TDX 1 & 2 if duplex system).

(1) Observe all power supply indicators are "on" green.

(2) Observe all status panel indicators are "operational", "on/green".

(3) Open front panel door of TDX chassis.

(4) Observe no "red" "fail" indicators are "on", and the dominant LED indications of the following PCB front panel LED's:

(a) Processor boards MSC, PLEX, SPLEX*, and WEX*.

1. all-run "on"
2. +12V "on"
3. VME "flashing"
4. LAN "minimal flashing" (except WEX not perceptible)
5. MSC-System Controller (SCON) "on" (System Controller)

(b) UNIO boards

1. UNIO 1
   - a. IN "flashing"
   - b. OUT "flashing"
   - c. CH1, CH2, and CH3 Tx MSG "flashing" (If configured for 3 surveillance channels)
2. UNIO 2
   - a. IN "flashing"
   - b. OUT "flashing"
   - c. CH1, CH2, or CH3 "flashing" (If weather function is enabled)

(c) REPRO II

1. Host COMM, in & out, both "on" interrogate mode
2. M3/A and C both "on" detect "flashing" (Rate dependent on traffic density).

(d) TEX* boards

TEX 1

1. Host COMM

   a. IN "flashing"
   b. OUT "flashing"

2. on line "on"

3. detect "flashing"

4. PRI "flashing"

5. ACP "flashing"

6. ARP "flash once per antennae revolution"

TEX 2

1. Host COMM

   a. IN "occasional flashing"
   b. OUT "flashing"

2. on line "off"

3. detect "flashing"

4. PRI "flashing"

5. ACP "flashing"

6. ARP "flash once per antennae revolution"

(e) WEPRO* board

1. Host COMM

   a. IN "off"
   b. OUT "flashing"

* These boards are not applicable with the BDX unit.

2. on line “on”

3. PRI “flashing”

4. ACP “flashing”

5. ARP “flash once per antennae revolution”

(f) TEX A/D* boards - online, “on”.

(g) Check TDX for proper fan operation and airflow.

* These boards are not applicable with the BDX unit.

Local CMC Operational Checks.

(1) In the upper left corner of the display screen, observe date and time are correct and time is updating.

(2) Select “CMC CONFIG” under Mode Select. Select “Password Control” under Options Select. Login at “Technician” Level.

(3) Observe “STATUS:” section of display - “Correlate” indication “on-green” and “bypass” and “fault” indicators “off”.

(4) Select “Network Control” under Options Select and check ability to command connect to TDX1 and TDX2.

(5) Observe typical site traffic displayed and updated approximately every 5 seconds.

(6) Validate TDX1 and TDX2 presentations are similar.

(7) Ensure that the following are selected in the lower left hand corner of the CMC:

(a) Search

(b) Beacon

(c) Reinforced

(d) MSC Edits

502. SDU OPERATIONAL CHECKS.

a. **Discussion.** When the TDX is configured as a dual channel unit. The SDU distributes video, triggers, and azimuth inputs to the two independent channels. It also monitors system health and provides auto channel change capability.

b. **Test Equipment Required.** None.

c. **General Procedure.** Check for alarm free operation of the SDU.

d. **Detailed Procedure.**

Evaluate SDU.

(1) Open front panel and check the SDU front panel indications.

(2) Observe the power green LED is lit indicating the unit power switch is turned on.

(3) Observe the SDU fault indicator red LED is extinguished indicating there is no fault in the unit.

(4) Observe the SDU board fail indicator red LED is extinguished indicating there is no fault in the unit.

(5) Observe BOX FAIL A and B red lights are extinguished indicating no failure in TDX 1 or TDX 2.

(6) Observe APG FAIL A and B red lights are extinguished indicating no failure in APG A or APG B. (APG B may not be available at all sites.)

(7) Observe the SDU auto-switching indicator green LED is lit indicating the manual/auto switch is in the auto position.

(8) Check SDU for proper fan operation and airflow.

503. TDX POWER SUPPLY CHECKS.

a. **Discussion.** Power supply checks are performed to ensure TDX voltages are within proper operating ranges. These voltage check points are conveniently located on the front panels of the TDX chassis.

b. **Test Equipment Required.** A properly calibrated digital voltmeter.

c. **General Procedure.** Using a properly calibrated digital voltmeter, measure the power supply voltages as indicated in the following procedure.

d. **Detailed Procedure.**

(1) Measure +5 volt DC power supply by connecting a digital voltmeter to the appropriate front panel test jacks.

(2) Measure +12 volt DC power supply by connecting a digital voltmeter to the appropriate front panel test jacks.

(3) Measure -12 volt DC power supply by connecting a digital voltmeter to the appropriate front panel test jacks.

(4) Measure +24 volt DC power supply by inserting a digital voltmeter in the appropriate front panel test jacks.

504. SDU POWER SUPPLY.

a. **Discussion.** Power supply checks are performed to ensure SDU voltages are within proper operating ranges. These voltage points are conveniently located on the front panel of the SDU.

b. **Test Equipment Required.** A properly calibrated digital voltmeter.

c. **General Procedure.** Using a properly calibrated digital voltmeter, measure the power supply volume as indicated in the following procedure.

d. **Detailed Procedure.**

(1) Measure +5 volt DC power supply by connecting a digital voltmeter to the appropriate front panel test jacks.

(2) Measure +12 volt DC power supply by connecting a digital voltmeter to the appropriate front panel test jacks.

(3) Measure -12 volt DC power supply by connecting a digital voltmeter to the appropriate front panel test jacks.

505. TDX INPUT VIDEO LEVELS.

a. **Discussion.** Primary radar video inputs to the TDX consist of normal and MTI Video. These videos are used by the TDX for target detection and weather processing (if equipped). The beacon reply video is used for beacon target detection.

b. **Test Equipment Required.** A properly calibrated oscilloscope.

c. **General Procedure.** Measure the amplitude, noise, and baseline of normal, and MTI Video as well as the amplitude and width of the beacon video at the radar interface panel on the rear of the TDX chassis. Checking the levels at this point measures the video outputs of the primary and secondary radar systems.

d. **Detailed Procedure.**

Radar input video levels.

(1) Connect a 75 Ω coax from Channel A input of the oscilloscope to J-8 (Normal Video IN) T-connector on the rear of the digitizer.

NOTE: Install T-connector if needed. Do not terminate the T-connector with 75 Ω since the TDX is internally terminated.

(2) Connect a 75 Ω coax from the external trigger input of the oscilloscope to J6 PRI input T-connector on the rear of the digitizer. Trigger scope on external.

(3) Set Channel A amplitude to 500 millivolts per centimeter and the time base to 100 microseconds per centimeter.

(4) Set Channel A input select to ground and adjust trace to align with a graticule.

(5) Set Channel A input to DC and note the amplitude of the Normal Video.

(6) Set Channel A amplitude to 200 millivolts per centimeter.

(7) Note the average noise level of the Normal Video.

(8) Set Channel A amplitude to 50 millivolts per centimeter.

(9) Set Channel A input select to ground and adjust trace to align with a graticule.

(10) Set Channel A input to DC and note the level of the DC baseline.

(11) Move coaxial cable from J8 to J7 (MTI Video IN).

(12) Repeat steps (3) through (10) to measure MTI Video input levels.

Beacon input video Levels

(13) Connect a 75 Ω coax from Channel A input of the oscilloscope to J-9 T-connector on the rear of the digitizer. (Note: Install T-connector if needed)

(14) Set Channel A amplitude to 500 millivolts per centimeter and set time base to 100 microseconds per centimeter.

(15) Trigger scope on internal (Channel A).

(16) Set Channel A input select to ground and adjust trace to align with a graticule.

(17) Set Channel A input to DC and note the amplitude of the beacon reply video.

(18) Readjust the Channel A amplitude to 200 millivolts per centimeter.

(19) Set Channel A input select to ground and adjust trace to align with a graticule.

(20) Set Channel A input to DC and note average noise level of beacon reply video.

NOTE: When quantized beacon video is used, no measurable noise will be present.

(21) Set the Channel A amplitude to 50 millivolts per centimeter.

(22) Set Channel A input select to ground and adjust trace to align with a graticule.

(23) Set Channel A input to DC and note the level of baseline.

506. TDX AZIMUTH INPUTS.

a. Discussion. Azimuth inputs are received by the TDX system from the primary radar for system synchronization.

b. Test Equipment Required. A properly calibrated oscilloscope.

c. General Procedure. Measure the amplitude, and pulse width of the Azimuth Change Pulse (ACP), and the Azimuth Reference Pulse (ARP) at the radar interface panel on the rear of the TDX chassis. Checking the levels at this point measures the azimuth inputs to the TDX system.

d. Detailed Procedure.

Measure ACP input

(1) Connect a 75 Ω coax from the Channel A input to the T-connector on J-3 for ACP-A or J5 for ACP-B on the rear of the digitizer.

NOTE: Install T-connector if needed. Do not terminate the T-connector with 75 Ω since the TDX is internally terminated.

(2) Set time base to 500 microseconds per centimeter and the amplitude to 2 Volts per centimeter.

(3) Trigger scope on internal Channel A.

(4) Set Channel A input select to ground and adjust trace to align with a graticule.

(5) Set Channel A input to DC and note the amplitude of the ACP.

(6) Set time base to 10 microseconds.

(7) Adjust the horizontal position to align lead edge of the ACP with the graticule.

(8) Measure the width of the ACP at the half amplitude point.

NOTE: May be necessary to adjust trigger level or time base to sync on ACP.

Azimuth Reference Pulse (ARP)

(9) Connect a 75 Ω coax from the Channel A input to the T-connector on J1 for ARP-A or J-2 for ARP-B on the rear of the digitizer.

NOTE: Install T-connector if needed. Do not terminate the T-connector with 75 Ω since the TDX is internally terminated.

(10) Set time base to 1 millisecond per centimeter and channel A amplitude to 2 volts per centimeter.

(11) Trigger scope on internal Channel A.

(12) Set Channel A input select to ground and adjust trace to align with a graticule.

(13) Set Channel A input to DC and note the amplitude of the ARP.

(14) Adjust the horizontal position to align lead edge of the ARP with the graticule.

(15) Set time base to 10 microseconds.

(16) Measure the width of the ARP at the half amplitude point.

NOTE: May be necessary to adjust trigger level to view pulse.

(17) Repeat steps (1) thru (16) for the second set of APG inputs as required.

507. TDX TRIGGER INPUTS.

a. **Discussion.** A trigger is received by the TDX from the primary radar for system synchronization. Mode triggers are received from the beacon system for use in beacon interrogation reply decoding.

b. **Test Equipment Required.** A properly calibrated oscilloscope.

c. **General Procedure.** Measure the amplitude, and pulse width of radar trigger and beacon mode triggers at the radar interface panel on the rear of the TDX chassis. Checking the levels at this point measures the trigger inputs to the TDX system.

d. **Detailed Procedure.**

Radar Pretrigger

(1) Connect a 75 Ω coax from the Channel A input to the T-connector on J-6 (PRI) on the rear of the digitizer.

NOTE: Install T-connector if needed. Do not terminate the T-connector with 75 Ω since the TDX is internally terminated.

(2) Set time base to 200 nanoseconds per centimeter and Channel A amplitude to 2 volts per centimeter.

(3) Trigger scope on internal.

(4) Set Channel A input select to ground and adjust trace to align with a graticule.

(5) Set Channel A input to DC and note the amplitude of the radar pretrigger.

(6) Adjust horizontal position to align lead edge of radar pretrigger with the graticule.

(7) Measure the width of the pretrigger at the half amplitude point using the delay feature on the oscilloscope.

Beacon Mode Triggers

(8) Connect a 75 Ω coax from the Channel A input to the T-connector on J-10 (INT) on the rear of the digitizer.

NOTE: Install T-connector if needed. Do not terminate the T-connector with 75 Ω since the TDX is internally terminated.

(9) Set time base to 2 microseconds per centimeter and Channel A amplitude to 2 volts per centimeter.

(10) Trigger scope on internal.

(11) Set Channel A input select to ground and adjust trace to align with a graticule.

(12) Set Channel A input to DC and note the amplitude of the beacon mode triggers.

(13) Adjust the horizontal position to align lead edge of the beacon P1 mode trigger with the graticule.

(14) Measure the width of the beacon mode triggers at the half amplitude point.

(15) Measure the spacing between the lead edge of the P1 and P3 mode triggers during the mode 3/A interval.

(16) Set time base to 5 microseconds per centimeter.

(17) Measure the spacing between the lead edge of the P1 and P3 mode triggers during the mode C interval.

508. TEX A/D VIDEO OUTPUTS.

a. Discussion. To determine that the video outputs of the TDX TEX A/D boards are within specified tolerances.

b. Test Equipment Required.

- A properly calibrated oscilloscope.
- Bayonet Connector (BNC) to Sub-Miniature B Connector (SMB) cable.

c. General Procedure. Measure the amplitude, noise, and baseline at the output of TEX A/D #1 board (MTI Video) and TEX A/D #2 board (Normal Video) at the TDX front panel test points. Perform checks on both TDX units.

d. Detailed Procedure.

(1) Connect the BNC to SMB cable (white Sensis provided cable, P/N 150-001368-P003) from Channel A input of the oscilloscope to the lower jack of the A/D board 1 (MTI).

(2) Connect a 75 Ω coax from the external trigger input of the oscilloscope to J6 PRI input on the rear of the digitizer. Trigger scope on external.

(3) Set Channel A amplitude to 500 millivolts per centimeter and the time base to 100 microseconds per centimeter.

(4) Set Channel A input select to ground and adjust trace to align with a graticule.

(5) Set Channel A input to DC and note the amplitude of the video.

(6) Set Channel A amplitude to 100 millivolts per centimeter.

(7) Note the average noise level of the video.

(8) Set Channel A amplitude to 50 millivolts per centimeter.

(9) Set Channel A input select to ground and adjust trace to align with a graticule.

(10) Set Channel A input to DC and note the level of the DC baseline.

(11) Measure Normal Video levels by moving the cable from A/D board 1 to A/D board 2.

(12) Repeat steps (3) through (10).

509. SEARCH DIGITAL SENSITIVITY.

a. **Discussion.** To determine the digital sensitivity of the TDX-2000 radar digitizer, utilize ARP, ACP's, and radar pretrigger from search radar to produce a ring of 16 to 32 test targets at a variable range to modulate an Radio Frequency (RF) signal generator, set at the frequency of the search radar transmitter.

b. **Test Equipment Required.**

(1) Test Target Generator/Signal Modulator.

Acceptable: BI-5 Beacon Test Set (FA9412, Test Target Generator section of FA9410)

UPM-155, Digital Beacon Test Set.

Video Bits (Used in ISA Slot of Generic PC)

(2) RF Signal Generator (minimum requirements).

(a) Capability to generate RF frequency of search radar transmitter.

(b) Precision calibrated (dBm) variable output signal attenuator.

Acceptable: Model 8616AHP RF Signal Generator.

Gigatronics RF Signal Generator.

Other RF Signal Generators meeting minimum requirements.

(3) Oscilloscope.

c. **General Procedure.** Digital sensitivity measurements are performed in this procedure by using the synchronized search and beacon test signals injected into the respective directional couplers.

d. **Detailed Procedure.**

(UPM-155/Digital Beacon Test Set)

(1) Load site MDS clutter maps in both the MTI and Normal TEX boards by;

(a) Log into the CMC as Technician and command connect to the standby TDX.

(b) From the Mode Select Menu choose Search.

(c) From the Options Select Menu choose Search Tech Control

(d) Under the Search Control submenu, TEX Maps, click on the arrow to the right of TEX Maps and select Board 1 (MTI).

(e) Click on the three dots located to the right side of Clutter Map (CMAP).

(f) On the File Selection submenu, select and load the MTI MDS map by clicking on the appropriate map, then click OK.

NOTE: Selecting the incorrect map could result in a loss of search Permanent Echos (PE) until the correct map is loaded. Be sure to select MTI for MTI and NOR for NOR.

(g) Load the MDS map into the normal TEX board by clicking on the arrow to the right of TEX Maps and selecting Board 2 (NOR).

(h) Click on the three dots located to the right side of CMAP.

(i) On the File Selection submenu, select and load the normal MDS map by clicking on the appropriate map, then click OK.

(j) On the bottom of the Search Control menu click OK.

(2) Radar stagger should be disabled to stabilize the target video. Trigger the UPM-155 with Radar Zero Range Trigger into the EXT IN jack.

(3) Load UPM-155 with normal site parameters used for beacon MDS certification. Append parameters as listed in Appendix 3, Maintenance Procedures, of this attachment.

NOTE: Certain parameters may be site specific and require some calculation.

(4) Connect a cable from the UPM-155 IFF VIDEO OUT FIRST REPLY to the PM input of the Gigatronics RF signal generator (or external pulse input of the RF modulator section of the HP 8616A RF signal generator).

NOTE: The Gigatronics or HP8616A should be set as if a radar MDS is to be performed. The only change should be the trigger source, which will change from pretrigger to UPM 155 FIRST REPLY OUT.

(5) Set the RF signal generator pulse width to 0.6 microseconds.

(6) Set the RF signal generator delay to approximately 650 microseconds. The test target should be positioned at a range of 50 to 53 nmi (This value is site adaptable and should be set based on site technician discretion).

(7) Inject the RF test signal from the RF signal generator into the waveguide INCIDENT port.

(8) Adjust the attenuation on the RF signal generator so that 16 to 32 digital test targets can be viewed on the CMC display.

(9) Increase the attenuation of the RF signal generator until an average of 50% of generated test targets per scan are visible on the CMC.

(10) Calculate the search digital MDS by adding the RF attenuation setting on the signal generator, cable attenuation, and the attenuation of the directional coupler.

(11) Remove MDS Maps by restoring the Operational maps.

(BI-5/Modulator Test Set)

(12) Load site MDS clutter maps in both the MTI and Normal TEX boards by;

(a) Log into the CMC as Technician and command connect to the standby TDX.

(b) From the Mode Select Menu choose Search.

(c) From the Options Select Menu choose Search Tech Control.

(d) Under the Search Control submenu, click on the arrow to the right of TEX Maps and select Board 1 (MTI).

(e) Click on the three dots located to the right of CMAP.

(f) On the File Selection submenu, select and load the MTI MDS map by clicking on the appropriate map, then click OK.

NOTE: Selecting the incorrect map could result in a loss of search Permanent Echoes (PEs) until the correct map is loaded. Be sure to select MTI for MTI and NOR for NOR.

(g) Click on the arrow to the right of TEX Maps and select Board 2 (NOR).

(h) Click on the three dots located to the right of CMAP.

(i) On the File Selection submenu, select and load the normal MDS map by clicking on the appropriate map, then click OK.

(j) On the bottom of the Search Control menu click OK.

(13) Radar stagger should be disabled to stabilize the target video. Trigger the BI-5 test set with Radar Zero Range Trigger into the CODE TN 1 EXT TRIG jack.

(14) Set the single multiple switch to multiple (this will generate 16 targets).

(15) Disable all modes except Mode 3. Disable all code train bits except F1. Remove all range delay (range will be determined by the RF test set).

(16) Connect a cable from the BI-5 test set CMPST VIDEO Output to the PM input of the Gigatronics RF signal generator (or external pulse input of the RF modulator section of the HP 8616A RF signal generator).

NOTE: The Gigatronics or 8616A should be set as if a radar MDS is to be performed. The only change should be the trigger source, which will change from pretrigger to BI-5 CMPST VIDEO Output.

(17) Set the RF signal generator pulse width to 0.6 microseconds.

(18) Set the RF signal generator delay to approximately 650 microseconds. The test target should be positioned at a range of 50 to 53 nmi. (This value is site adaptable and should be set based on site technician discretion).

(19) Inject the RF test signal from the RF signal generator into the waveguide INCIDENT port.

(20) Adjust the attenuation on the RF signal generator so that 16 digital test targets can be viewed on the CMC display.

(21) Increase the attenuation of the RF signal generator until an average of 50% of generated test targets per scan are visible on the CMC.

(22) Calculate the search digital MDS by adding the RF attenuation setting on the signal generator, cable attenuation, and the attenuation of the directional coupler.

(23) Remove MDS Maps by restoring the Operational maps.

510. BEACON DIGITAL SENSITIVITY.

a. Discussion. To determine the TDX digital sensitivity.

b. Test Equipment Required.

- RF Signal Generator (Search).
- Beacon RF Test Set.
- A properly calibrated oscilloscope.

c. **General Procedure.** Digital sensitivity measurements are performed in this procedure by using the synchronized search and beacon test signals injected into the respective directional couplers.

d. **Detailed Procedure.**

NOTE: All cable connections and setting for the beacon MDS measurement should be performed as it is for system Overall System Sensitivity (OSS) checks. The only difference is where the MDS measurement is taken.

UPM-155 Digital Beacon Test Set

(1) Trigger the UPM-155 with Beacon Sync into the EXT IN jack.

(2) Enter parameters into the UPM-155 screens as listed in Appendix 3 of this attachment.

NOTE: Certain parameters may be site specific and require some calculation.

(3) Connect a cable from the UPM-155 MAIN RF I/O to the DIR INPUT (Directional RF Input) of the ATCBI-X to inject the test targets.

(4) Adjust the attenuation of the UPM-155 until all generated test targets are displayed on the CMC display.

(5) Increase the attenuation on the UPM-155 until an average of 50% of generated test targets per scan are visible on the CMC display or maintenance terminal.

(6) Calculate the beacon digital MDS by adding the RF attenuation setting on the signal generator, cable attenuation, and the attenuation of the directional coupler.

BI-5 Modulator Test Set

(7) Trigger the BI-5 test set with Beacon Sync into the EXT MOD jack.

(8) Set single/multiple switch to multiple (this will generate 16 targets).

(9) Set Mode 3 and Mode C to values normally used at the site for OSS checks.

(10) Set range for beacon targets to range normally used for system OSS checks.

(11) Connect a cable from the BI-5 RF OUT to the DIR INPUT of the ATCBI-X to inject the test targets.

(12) Adjust the attenuation of the BI-5 test set until 16 test targets are displayed on the CMC display.

(13) Increase the attenuation on the BI-5 test set until an average of 8 test targets per scan are visible on the CMC display or maintenance terminal.

(14) Calculate the beacon digital MDS by adding the RF attenuation setting on the signal generator, cable attenuation, and the attenuation of the directional coupler.

511. RANGE AND AZIMUTH ACCURACY.

a. Discussion. Verify the range and azimuth of known search and beacon targets are within the specified tolerance.

b. Test Equipment Required. None.

c. General Procedure. Fixed beacon and search targets are measured to ensure range and azimuth accuracy of radars and their associated subsystems. Beacon parrots, search PE, and/or MTI reflectors that have known range and azimuth are typically used.

d. Detailed Procedure.

Verify Search Accuracy

(1) On the CMC, zoom in on a search PE.

(2) Under the Mode Select Menu, select ASD.

(3) Under the Options Select Menu, select History.

(4) On the History Control submenu, select 10 scans, then click OK.

(5) On the bottom of the CMC display, enable History (middle right of the display).

(6) After 10 scans using the right button of the mouse, click on the search PE.

(7) Average the 10 scans range and azimuth and ensure they are within specified tolerances.

(8) Repeat step 7 of this procedure for any other known PE's or MTI reflector(s).

Verify Beacon Accuracy

(9) Repeat steps 6 and 7 of this procedure for the beacon parrot.

512. TEST UPS OPERATION.

a. Discussion. The UPS provides continuous and consistent power to the TDX rack and its subsystems. This ensures that no loss of data will occur during short periods of commercial power outage or momentarily interruptions of power.

b. Test Equipment Required. None.

c. General Procedure. The following procedures will be performed to ensure proper operation of UPS when a loss of power is experienced.

d. Detailed Procedure. Perform the following steps to test the UPS operation:

NOTE: To mitigate risk, acquire downtime in case of UPS failure.

Simulate a power outage by using the procedures in the UPS User's Manual.

(1) Open the input power circuit breaker.

(2) Observe that the battery picks up the load.

(3) Observe no alarm conditions exist and the system operates normally, for a minimum of 10 minutes.

(4) Close the input power circuit breaker.

Section 2. OTHER MAINTENANCE TASK PROCEDURES

513. DISCRETE SEARCH MDS.

a. Objective. To determine if a possible problem exists with either MTI or NOR video, performing an MDS on the MTI and NOR channel independently, may isolate a perceived problem to one video or the other.

b. Discussion. This procedure should be performed when the system is initially installed as part of the acceptance criteria. It may also be used when a problem with either MTI or Normal Video inputs are suspected.

c. Test Equipment Required.

- RF Signal Generator (Search).
- Beacon Test Set.
- A properly calibrated oscilloscope.

d. Detailed Procedure. Determine both the MTI and Normal radar sensitivity.

(1) Load site MDS clutter maps in both the MTI and Normal TEX boards by:

(a) Log into the CMC as "Technician" and command connect to the standby TDX.

(b) From the Mode Select Menu choose Search.

(c) From the Options Select Menu choose Search Tech Control.

(d) Under the Search Control submenu, TEX Maps, click on the arrow to the right of TEX Maps and select Board 1 (MTI).

(e) Click on the three dots located to the right of CMAP.

(f) On the File Selection submenu, select and load the MTI MDS map by clicking on the appropriate map, then click OK.

Note: Selecting the incorrect map could result in a loss of search PE'(s) until the correct map is loaded. Be sure to select MTI for MTI and NOR for NOR.

(g) Load the MDS map into the normal TEX board by clicking on the arrow to the right of TEX Maps and selecting Board 2 (NOR).

(h) Click on the three dots located to the right of CMAP.

(i) On the File Selection submenu, select and load the normal MDS map by clicking on the appropriate map, then click OK.

(j) On the bottom of the Search Control menu click OK.

(2) Radar stagger should be disabled to stabilize the target video. Trigger the UPM-155 with Radar Zero Range Trigger into the EXT IN jack or the BI-5 into EXT MOD IN.

(3) Load the UPM-155 with site parameters used for beacon MDS certification. Append parameters as listed in Appendix 3 of this attachment or use BI-5 test set setup from paragraph 509, steps 13 and 14.

Note: Certain parameters may be site specific and require some calculation.

(4) Connect a cable from the UPM-155 IFF VIDEO OUT FIRST REPLY or BI-5 RF OUT to the Gigatronics PM IN or external pulse input of the RF modulator section of the 8616A RF Signal Generator.

NOTE: The 8616A or Gigatronics should be set as if radar MDS is to be performed. The only change should be the trigger source that will change from pretrigger to UPM 155 output.

(5) Set the RF signal generator pulse width to 0.6 microseconds.

(6) Set the RF signal generator delay to approximately 650 microseconds. The test target should be positioned at a range of 50 to 53 nmi. (This value is site adaptable and should be set based on discretion of the site technician.)

(7) Inject the RF test signal from the signal generator into the wave-guide INCIDENT port.

(8) Disconnect Normal Video input from the back of the **Off Line** TDX by removing the cable from “S VIDEO 2”.

(9) Adjust the attenuation of the signal generator so that 16 to 32 digital test targets can be viewed on the CMC display.

(10) Increase the attenuation on the signal generator until an average of 50% of generated test targets per scan are visible on the CMC.

(11) Calculate the MTI MDS by adding the RF attenuation setting on the signal generator, cable attenuation, and the attenuation of the directional coupler.

(12) Reconnect the Normal Video to the **Off Line** TDX to “S VIDEO 2” and disconnect the MTI Video by removing the cable from “S VIDEO 1”.

(13) Repeat steps (9) through (11) to determine the Normal MDS.

(14) Remove MDS maps by restoring the Operational TDX maps.

(15) Reconnect the MTI Video to the **Off Line** TDX to “S VIDEO 1”.

514. CMC TDX MAPS VERIFICATION.

(1) Select “CMC CONFIG” Mode.

(2) Select "Password Control" option.

(3) Login at "Technician" level.

(4) Select "Search" under Mode Select.

(5) Select "Tech Search Control" under Options Select.

(6) Select "TEX Maps" Board 1 (MTI).

(7) Verify current map files listed are the same as commissioning maps, or the latest recorded in "FRDF" data if updates were required.

(8) Select "TEX Maps" Board 2 (NOR).

(9) Repeat step 7.

(10) Cancel Menus.

(11) Select "Weather" under Mode Select.

(12) Select "WEPRO Configuration" under Options Select.

(13) Verify current map files listed are the same as commissioning maps, or the latest recorded in "FRDF" data if updates were required.

(14) Cancel Menus.

515. REMOTE CMC OPERATION VERIFICATION.

(1) In upper left corner of display screen observe date and time are correct, and time is updating.

(2) Select "CMC CONFIG" under Mode Select. Select "Password Control" under Option Select. Login at "Technician" Level. Open "Status Log" section of the screen. Scroll through "Status Log" display presentation with mouse and observe log is void of alarms or warning messages, and hourly heartbeats occurred on a regular schedule.

(3) Observe "STATUS:" section of display - "Correlate" indication "on-green" and "bypass" and "fault" indicators "off".

(4) Select "Network Control" menu and check ability to command connect to TDX1 and TDX2.

(5) Close "Status Log" section of the screen. Using mouse, select expansion and zoom selections to fill ASD portion of the display with PPI 60 nmi. Presentations of TDX1 and TDX2 concurrently. As a minimum, select "search", "beacon", "reinforced", and "MSC edits" to be displayed.

(6) Observe typical site traffic displayed and updated approximately every five seconds.

(7) Validate TDX1 and TDX2 presentations are similar.

(8) Select "TDX Stats" under Mode Select. Select "TDX Stats" under Options Select. Observe system is reporting statistics comparable with those observed at commissioning.

(9) In Particular note

(a) Beacon reports

1 Reinforcement %

2 M3 validation %

3 MC validation %

4 RL

(b) Search Reports

1 Valid %

2 Average RL

(10) Cancel Menu.

516. SURVEILLANCE PERFORMANCE.

a. Objective. To verify the range and azimuth accuracy of primary radar/beacon target reporting, beacon false target levels, and overall system performance.

b. Discussion. Using Radar and Beacon Analysis Tool (RBAT) software analysis tools, system performance can be compared to initial values recorded during installation and optimization to assure no degradation in system performance is experienced.

c. Equipment Required.

(1) Computer with a 486 processor or greater with an MX6A card (NSN 5998-01-419-9133) installed.

(2) RBAT analysis software.

d. Detailed Procedure.

(1) Use either Real Time Aircraft Display System (RTADS) or Write ASR to record a file of sufficient size (usually 1 megabyte) to allow analysis. Do this for both TDX systems.

(2) Run the RBAT program and select the Beacon False Target Summary (BFTS) Program. Record the values for "Azimuth Splits", "Ringaround", "Downlink Reflections", "Uplink Reflections", "Other", and "ATCRBS ID 0000 Percentage". Compare these values with those recorded previously for an increase in any one of the values.

(3) Run the RBAT program and select the Surveillance Analysis (SA) program. Record the values for TOTAL "Probability Detect Beacon", "Probability Detect Search", "Probability Detect Total", "Identity Rel", "Identity Val", "Altitude Rel", Altitude Val", "Radar Reinf", "Search Collimation", "Range Error", "Azimuth Error". Compare these values with those recorded previously for any degradation of performance.

(4) Identify site radar PEs and parrot(s) and run the RBAT program and select the Transponder Accuracy (TA) program. Record the values for "Range Error" and "Azimuth Error". Assure that range and azimuth errors are within the limits specified in the Standards and Tolerances.

517. ELECTRICALLY ERASABLE PROGRAMMABLE READ-ONLY MEMORY (EEPROM) REPLACEMENT.

a. **Discussion.** When power is applied to a TDX channel it initializes using configuration information stored in the EEPROM's located on the microprocessor boards (MSC, PLEX, SPLEX, WEX). EEPROM replacement may become necessary if you experience problems saving configuration information to one of these subsystems.

b. **Test Equipment Required.** None

c. **General Procedure.** Replace suspected defective EEPROM's located on the processor boards.

d. **Detailed Procedure.**

(1) On the SDU, ensure the auto/manual switch is set to manual.

(2) On the SDU, ensure the channel intended for maintenance IS NOT the on-line channel.

(3) On the back of the TDX channel under maintenance remove the beacon video from B VIDEO, the MTI Video from S.VIDEO 1, and the NOR video from S.VIDEO 2.

(4) Power the channel down and remove the suspect MSC, PLEX, SPLEX, WEX or CCA.

(5) Remove and replace the EEPROM's located in U3 and U4 of the CCA with new EEPROM's.

(6) Apply power to the channel under maintenance and wait for the channel to complete the initialization sequence.

NOTE: It may take longer than usual for the channel to initialize because there is no configuration information stored in the EEPROM's.

(7) After initialization load the latest TDX configuration file for the channel under maintenance by:

(a) Under Mode Select, select TDX Control.

(b) Under Options Select, select Load TDX configuration.

(c) In the file Selection pop up menu, select the latest configuration file for the TDX channel under maintenance and click OK.

(8) After the configuration has loaded ensure the system is operating with no unexplainable alarms.

(9) Open the Status Log (if not already opened) by clicking on the Error Warning Status button located in the lower right hand corner of the CMC screen.

(10) Save the configuration to EEPROM by;

(a) Under Mode Select, select TDX Control.

(b) Under Options Select, select TDX EEPROM Mgmt.

(c) Click on SAVE ALL at the bottom of the menu.

(d) Type "yes" or "y" in the pop up menu that is displayed when you click on Save All.

NOTE: When you see the message "(DATA BROADCAST Parameters)"displayed in the Status Log, EEPROM write is completed.

(11) Power the channel under maintenance down, wait 10 seconds and re-apply power.

(12) After the system has completed initialization ensure there are no unexplainable alarms present.

(13) Reconnect the beacon, MTI, and NOR video removed in step (3).

518. ROUTER AND CMC CONFIGURATION MODIFICATION.

a. **Discussion.** When replacing a failed CCA that has an IP address associated with it (MSC, WEX), it will be necessary to make a change in the local router Address Resolution Protocol (ARP) table configuration. The ARP table defines the hardware address associated with a particular IP address. In addition, the CMC hardware configuration will need to be updated.

b. **Test Equipment Required.**

- RJ-45 to 9 pin serial cable (supplied with router).
- Computer with HyperTerminal software (or equivalent).

c. **General Procedure.** When the MSC or WEX CCA is removed and replaced it will be necessary to change the hardware address located in the router, as well as the CMC configuration. The hardware address contained in the router allows command connection from the remote CMC.

d. **Detailed Procedure.**

ROUTER

(1) Connect the RJ-45 connector of the serial cable to the console port of the Cisco router. Connect the 9 pin connector of the serial port to COM 1 of the computer with HyperTerminal installed.

(2) Start the HyperTerminal software and configure as follows:

- Rate 9600
- Data bits 8
- Parity None
- Stop bit 1
- Flow control Hardware

NOTE: You may want to save the configuration under a unique name for use at a later date.

(3) Press the Enter key and you should see the router name followed by a > on the left side of the HyperTerminal screen.

(4) Type "enable" and the > next to the router name should become a #.

(5) Type "config t" and you should now see router name (config) #.

(6) Type the ARP line that corresponds to your system and the CCA that is being replaced. The ARP line should be typed in the following format; (ARP/IP address/hardware address/ARPA) each area of the command shown here separated with a / should be separated with a space. Also each group of numbers for both the IP and hardware address should be separated with periods. Example:

ARP 192.9.200.244 0800.3e26.f97c ARPA

(7) The IP address is located on the PROM's in slot U1 and U2 of the MSC or WEX CCA that is being replaced. The hardware address is a 12 digit number that is a combination of both numerals and letters and is located on the edge connector of the CCA.

(8) After typing the ARP command line press the Enter key. If the command was entered correctly the screen should again show; router name (config) #.

(9) Type "end" and press the Enter key. The command line will now show router name #.

(10) Type "show run" and press the Enter key. The configuration should begin scrolling across the screen. Press the space bar until you see the ARP lines appear on the screen.

(11) Ensure the ARP line associated with the IP address of the CCA being replaced has changed to the correct hardware address.

(12) Continue to press the space bar until router name # appears on the screen.

(13) Type "copy run startup". A dialog will appear; Destination filename [startup-config]?

(14) Press Return. A message will return; Building configuration...

(15) When the configuration is finished building, type "exit".

(16) Exit HyperTerminal and disconnect the cable between the router and the computer.

CMC Workstation

(17) From the Mode Select menu choose CMC CONFIG.

(18) From the Options Select menu choose Network Control.

(19) On the Network Control pop up menu, select Hardware Configuration Setup.

(20) Select the TDX that the hardware change has been made and enter the new hardware address for the MSC or WEX into the appropriate fields and click OK.

(21) Test by attempting to command connect to the TDX under maintenance.

519. TDX/BDX AND SDU FAN INSPECTION PROCEDURE.

a. Discussion. The TDX chassis is equipped with three 24 VDC muffin fans, located on the rear fold back panel of the TDX. The TDX chassis draws in air through an air inlet grill at the bottom front of the TDX chassis which is approximately two inches high and the full width of the VME card rack. The three cooling fans mounted at the top of the rear chassis, draw the air through the enclosed TDX chassis and expel the air out, cooling the electrical components of the TDX chassis.

The SDU chassis is equipped with two 12 VDC muffin fans in an enclosed chassis. The first fan is mounted on a five slot VME chassis mounted horizontally. Facing the front of the chassis, the fan is located on the left, behind an approximately 5" x 4" cooling air inlet with a screen filter. This fan cools the VME card rack. The second fan is mounted on the rear panel of the SDU chassis. Facing the rear of the cabinet, it's on the right side. The fan cools the SDU power supply. Both fans draw air in through air inlets at the front of the SDU chassis and expel the air out through the rear and card rack.

b. Test Equipment Required.

(1) Light tissue paper, such as a Kleenex tissue or equivalent.

(2) Paper towel or heavier equivalent paper.

c. General Procedure. The SDU and TDX will be checked for proper airflow and the screens cleaned.

d. Detailed Procedure.

(1) TDX Fans and Air Inlet.

Facing the front of the TDX chassis, place a small section of tissue paper at the bottom air inlet grill of the TDX. (Tissue paper should adhere to grill when released from hand). If there is not adequate suction to adhere tissue paper, schedule additional downtime to power down TDX chassis and clean air passage and/or replace defective fan(s).

Open the rear door of the TDX cabinet and observe that all three fans of the TDX chassis are rotating at normal speed and blowing air out. If not, schedule additional downtime to power down TDX chassis and replace defective fan(s).

(2) **SDU Fans and Air Inlet.**

Facing the front of the SDU chassis, place a small section of tissue paper on the air inlet grill on the left side of the chassis. Tissue paper should adhere to grill when released from hand. If there is not adequate suction, grill screen is excessively dirty. Without scheduling additional downtime, with power still "ON", remove the two screws holding the grill and screen filter to chassis and clean filter screen and replace. While grill is removed, check that VME card cage fan is rotating at a proper speed, by folding a paper towel at least six folds, and extending behind fan which should try to draw towel in. This is a safety procedure since the fans have plastic blades. However, your hands should not come closer than 6" to the rotating blades. If VME rack fan is defective, schedule additional downtime. Power "OFF" SDU and replace fan.

Open the rear door of the TDX cabinet and observe that the power supply cooling fan, located in the rear of the SDU chassis, is rotating at normal speed and blowing air out. If not, schedule additional downtime to power down SDU chassis and replace defective fan(s).

520.-599. RESERVED.

APPENDIX 1. ABBREVIATIONS AND ACRONYMS

ACRONYM	DEFINITION
A/D	Analog to Digital
ACP	Azimuth Change Pulse
ADC	Analog to Digital Conversion
AIMS	Air Traffic Control Radar Beacon System Identification Friend or Foe Mark 12 System
APG	Azimuth Pulse Generator
ARP	Azimuth Reference Pulse
ASD	Air Situation Display
ASR	Airport Surveillance Radar
ASTERIX	All Purpose Structured Euro Control Radar Information Exchange
AT	Air Traffic
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
BDX	Secondary Search Radar (Beacon) Data Extractor
BFTL	Beacon False Target Limiter
BFTS	Beacon False Target Sector
BIT	Built In Test
BNC	Bayonet Connector
CD	Common Digitizer
CD2	Common Digitizer Model -2
CFAR	Constant False Alarm Rate
CMAP	Clutter Map
CMC	Control and Maintenance Console
COTS	Commercial Off-The-Shelf
CP	Communications Processor
CTP	Correlation and Track Processor
DC	Direct Current
DADS	Data Analysis and Display System
dB	Decibel
DOD	Department Of Defense
DSP	Digital Signal Processor
EEPROM	Electrically Erasable Programmable Read-Only Memory
E&R	Exchange & Repair
FAALC	Federal Aviation Administration Logistics Center
FIFO	First-In-First-Out
FPGA	Field Programmable Gate-Array
FPS	Flight Plan System (verify)
FRAG	False Range Azimuth Gates
FRDF	Facility Reference Data File
FRUIT	False Replies Unsynchronized In Time
FSK	Frequency Shift Keying
GFE	Government Furnished Equipment
HDLC	High Level Data Link Control
HMI	Human-Machine Interface
I/O	Input/Output
IIR	Infinite Impulse Response

ACRONYM	DEFINITION
IP	Internet Protocol
LAN	Local Area Network
LED	Light Emitting Diode
LP	Linear Polarization
LRU	Lowest Replaceable Unit
MDS	Minimum Discernible Signal
MHz	Megahertz
MSC	Multi-Scan Correlator
MTI	Moving Target Indicator
NAS	National Airspace System
NCI	Non-Coherent Integrator
NCP	NAS Change Proposal
NOR	Normal
NTDS	Naval Tactical Data System
OS	Operating System
OSS	Overall System Sensitivity
PD	Probability of Detection
PE	Permanent Echoes
PLEX	Beacon Plot Extractor
PM	Performance Monitoring
PPI	Planned Position Indicator
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PRT	Pulse Repetition Time
PSR	Primary Search Radar
PWA	Printed Wire Assemblies
RAG	Range-Azimuth Gate
RAM	Random Access Memory
RBAT	RADAR and Beacon Analysis Tool
RDAS	Radar Data Acquisition Subsystem
RDAT	Radar Data Acquisition and Transfer
RDX	Primary Search Radar Data Extractor
REPRO	Reply Processor
RF	Radio Frequency
RHI	Range-Height Indicator
RL	Run Length
RMA	Return Material Authorization
RTADS	Real Time Aircraft Display System
RTQC	Real Time Quality Control
RVF	Rank Value Filter
RVT	Range Varying Threshold
SA	Surveillance Analysis
SBC	Single Board Computers
SDU	Signal Distribution Unit
SIF	Selective Identification Feature
SMB	Sub-Miniature B Connector

ACRONYM	DEFINITION
SPI	Special Position Identifier
SPLEX	Search Plot Extractor
SRTQC	Search Real Time Quality Control
STAD	Second Time Around Detection
TA	Transponder Accuracy
TCP/IP	Transmission Control Protocol/Internet Protocol
TDX	Target Data Extractor
TEX	Target Extractor
TEX A/D	Target Data Extractor/ Analog-to-Digital
TRAG	True Range Azimuth Gate
UDP	User Datagram Protocol
UNIO	Universal Input/Output
UPS	Uninterruptible Power Supply
USAF	United States Air Force
VLSI	Very Large Scale Integrated
VME	Versa Modulo Europa
VRTX	Versatile Real Time Executive
WDX	Weather Data Extractor
WEPRO	Weather Processor
WEX	Weather Extractor

Appendix 2. Certification Requirements

System and Subsystem Certification.

System and subsystem certification is event based and relies on independent judgment about the quality and scope of specific advertised services being provided to a user. Event based certification ties the certification judgment to the decision to place a system or subsystem into service.

a. ATO personnel with certification authority must perform event based system and subsystem certification. The following events define when certification is required, regardless of whether it affects a certification parameter:

(1) Prior to commissioning.

(2) Upon request following aircraft accident/incidents.

(3) Following adjustment to any certification parameter regardless of whether an interruption was required.

(4) Prior to restoration following any flight inspection requiring on-site personnel.

(5) Prior to restoration following any modification.

(6) Prior to restoration following any maintenance task that required an interruption or would have required an interruption to a facility without redundancy.

(7) Prior to restoration following any corrective maintenance activity required to restore a facility to operation.

b. System and subsystem certification is not required when a facility is restored to operation by restoration of power, initialization, or reset, and no other action was taken.

c. Some NAS systems contain user interface controls that can cause a certification parameter to be adjusted beyond its tolerance or limit. Such adjustments will not void the certification.

Appendix 2. Certification Requirements (Continued)

Table 1. Common Digitizer TDX-2000 System

Advertised Service	Certification Parameter	Reference Paragraph
Digitizing Capability	Digital Sensitivity (Search)	509, 306a
	Accuracy Range Azimuth	511, 305a
	Digital Sensitivity (Beacon)	510, 306b
	Accuracy Range Azimuth	511, 305b
	Alarm Free Operation	501, 502, 309a, b, c

CERTIFICATION BASED ON EVENTS: Events are defined in Order 6000.15 and are provided only as reference data of appendix 1, paragraph 1 of this order.

PERSON RESPONSIBLE FOR CERTIFICATION: Airway transportation system specialist (ATSS) with certification authority

CERTIFICATION ENTRY IN FACILITY MAINTENANCE LOG: Radar digitizer certified

APPENDIX 3. MAINTENANCE PROCEDURES

1. UPM-155 SETTINGS FOR BEACON DIGITAL MDS CHECK.

NOTE: These settings are approximate and may need to be adjusted slightly to achieve optimum results.

a. MENU 2: CHALLENGES

M1:	OFF	M4:	OFF
M2:	OFF		OFF
M3/A:	ON		OFF
MC:	ON		OFF
P1:	ON		OFF
P2:	OFF	S5:	OFF
P3:	ON	Mode Repeat:	4
PRF:	335 (Site Specific)	RF: -40	AUX: -60

b. MENU 3: FIRST REPLY

REPLY SIGNAL:				SIF
M1:	0000	OFF	F2:	ON
M2:	0000	OFF	SIF 2:	OFF
M/3A:	6664	ON	VAR EMG:	NOM
MC:	6664	ON (Enter any valid value)	M4 JAM: 0	
RANGE DELAY:			395 µs	
CHAL SOURCE:			INTERNAL	

c. MENU 5: TIMING, VIDEO LEVELS

M4 PRETRIGGER: DON'T CARE
P3 DELAY: 75 µs (See note)
NOTE: Set for time between BCN Sync and P3
SET ALL VIDEO LEVELS FOR +5.0V

d. MENU 8: SIGNAL GATING

GATING:OFF	= Continuous ring target (Helpful in initially locating target)	
INTERNAL	= Gated targets (Use this setting for MDS/OSS checks)	
EXTERNAL	= No targets (N/A)	
ACTIVE TARGETS	= No targets	
INT. GATE:	#PASSED	16
	#INHIBITED	82 (Palm Springs)

Total Pulse Per Revolution (PPR) = PRF x Scan Rate

Example: @ PSP: 335 x 4.7 = 1575

Pulses per target = PPR / # of targets

Example: @ PSP: 1575 / 16 = 98

Inhibited = Pulses per target - # of targets

Example: @ PSP: 98 – 16 = 82

ROUND RELIABILITY: 1.0
ALL OTHER: Don't Care

e. MENU 9: ACTIVE GATING

AZIMUTH SOURCE:	ACP EXT		
R/O WIDTH:	30 µs	ANT RATE:	4.7 S
R/O DELAY:	200 µs	AZ GATE START:	45°
		AZ GATE WIDTH:	6°

f. MENU 11: MAIN MODULATION

MODULATION:	ON	CW:	OFF
ISLS:	OFF		
CHALLENGE:	OFF		
1ST REPLY:	ON	GTC SHORT:	OFF
2ND REPLY	OFF	GTC LONG:	OFF

g. MENU 14: PRF/PRI

PRF:	PSP: 335 (Set to system PRF)
ZERO TRIGGER:	EXTERNAL +
ALL OTHERS:	(Don't Care)

2. SETTINGS FOR SEARCH MDS CHECK.

NOTE: These settings are approximate and may need to be adjusted slightly to Achieve optimum results.

a. MENU 3: FIRST REPLY

REPLY SIGNAL:			SIF	
M1:	0000	OFF	F2:	OFF
M2:	0000	OFF	SIF 2:	OFF
M/3A:	0000	OFF	VAR EMG:	NOM
MC:	0000	OFF (Enter any valid value)	M4 JAM:	0
RANGE DELAY:			N/A	

CHAL SOURCE: N/A

b. MENU 5: TIMING, VIDEO LEVELS

M4 PRETRIGGER: Don't Care
P3 DELAY N/A
SET ALL VIDEO LEVELS FOR +5.0 V

c. MENU 6: VARIABLE PULSES

VP1:	ON	VP2:	OFF
PW:	1.0 μs	PW:	1.0 μs
DELAY:	2.0 μs*	DELAY:	???
OR VP1/VP2:	NO		0
OR CHALLENGE:	NO		
OR 1ST REPLY:	YES		

NOTE: Use the Signal Generator to move the target out in range.

d. MENU 8: SIGNAL GATING

GATING:OFF	= Continuous ring target (Helpful in initially locating target)	
INTERNAL	= Gated targets (Use this setting for MDS/OSS checks)	
EXTERNAL	= No targets (N/A)	
ACTIVE TARGETS	= No targets	
INT. GATE:	#PASSED	32
	#INHIBITED	116 (Palm Springs)

Total Pulse Per Revolution (PPR) = PRF x Scan Rate

Example: @ PSP: 1005 x 4.7 = 4724

Pulses per target = PPR / # of targets

Example: @ PSP: 4724 / 32 = 148

Inhibited = Pulses per target - # of targets

Example: @ PSP: 148 – 32 = 116

ROUND RELIABILITY: 1.0
ALL OTHER: Don't Care

e. MENU 9: ACTIVE GATING

AZIMUTH SOURCE:		ACP EXT	
R/O WIDTH:	30 μs	ANT RATE:	4.7 S
R/O DELAY	200 μs	AZ GATE START:	45°
		AZ GATE WIDTH:	6°

This page is intentionally left blank.

CHANGE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Air Traffic Organization Policy

ORDER
JO 6350.25
CHG 1

Effective Date:
08/13/2008

SUBJ: Maintenance of Target Data Extractor (TDX)-2000 Digitizer Equipment

1. Purpose. This change provides page changes to Order JO 6350.25, Maintenance of Target Data Extractor (TDX)-2000 Digitizer Equipment, Appendix 2, Certification Requirements. This change is intended to allow for event based certification. Configuration Control Decision (CCD) N31846, Implementing Policy for Event Based Certification of Surveillance Systems and Sub Systems in paragraph 503 per updates to FAA Order 6000.15E, is required.

2. Who This Change Affects.

a. This document is made available to sites with this Facility, Service, and Equipment Profile (FSEP): CD.

b. For electronic copies, use the Technical Library website at http://nas.amc.faa.gov.

c. For printed copies, national offices distribute to sites with an accurate inventory record in FSEP and a mailing address in the Logistics Inventory System (LIS).

d. For help in updating inaccurate FSEP and/or DDS records, visit our website at http://nas.amc.faa.gov/technical_library/template.jsp?bodyPage=help.html&title=Help.

3. Explanation of Changes. This handbook is being updated to provide equipment certification based on events. Events are defined in the latest version of Order 6000.15, General Maintenance Handbook for National Airspace System (NAS) Facilities.

4. Disposition of Transmittal. Keep this change.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
	TOC		
v and vi	10/02/03	v and (vi blank)	08/13/2008
	Appendix 1		
1 and 2	10/02/03	1 and 2	08/13/2008

James W. Pritchard

for James N. Arrasmith
Acting Director, Safety and Operations Support

Distribution: 59AJ **Initiated By**: AJW-145