

Aviation Maintenance Automated Tracking System (AMATS) Demonstration Program Plan

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1.0 Introduction

1.1. Purpose

The purpose of this program is to evaluate the Contact Memory Button's (CMB) ability to reduce manual component tracking within The Army's Maintenance Management System Aviation Component Tracking System. CMB will be evaluated to determine its ability to replace the current DA Form 2410 (Component Removal and Repair/Overhaul Record), paper method, reduce tracking errors and determine possible cost savings associated with a paperless tracking system.

CMB technology will be evaluated as an improved data feed to the Global Combat Support System – Army (GCSS-Army) when that system is fielded, reducing workload and improving data quality and information transmission. In the near term, CMB technology will be evaluated as an improved data feed to the Enhanced Logbook Automation System (ELAS) and then to the current Army Aviation and Missile Command (AMCOM) 2410 database located in the Field Data Division of the Integrated Materiel Management Center (IMMC).

1.2. Background

The current component tracking system depends on completion of the DA Form 2410 and updating the DA Form 2408-16 (Aircraft Historical Record) and DA Form 2408-16-1 (History Recorder, Component, Module Record) historical forms either manually or through keystroke input into an automated system (either the Unit Level Logistics System-Aviation (ULLS-A) or Enhanced Logbook Automation System (ELAS)). Inherent to this process is calculation and data entry errors. Additionally, due to the cumbersome nature of the process, entries may not be made, forms may be lost, and components may fail to be reported.

Technological advances, such as those associated with CMB, offer the ability to move from a redundant paper environment to a paperless, error reduced one.

1.3. Scope

Memory buttons will be attached to selected components (see Appendix A) on UH-60 and AH-64 helicopters. The memory buttons will be loaded with DA Form 2410 data. Memory buttons will contain historical data for its associated component and will be updated when the component is removed, repaired, installed, or overhauled. Although other information such as DD 250 and DA Form 2408 Series (logbook and historical) data could be stored on the buttons, the scope of this evaluation is focused solely on DA Form 2410 data.

This evaluation program will be executed in two phases with each phase composed of two parts. Phase I will be a ground evaluation which will consist of airworthiness qualification (Phase IA) and a proof of concept (Phase IB). The Phase I program will be performed at Redstone Arsenal, AL. Phase II will include an operational demonstration with a beta evaluation conducted at the Aviation Technical Test Center (ATTC) Ft. Rucker, AL (Phase IIA) and an operational evaluation to follow at the 2nd Battalion of the 101st Airborne Division (Air Assault), hereafter referred to as 2-101st, at Fort Campbell, KY (Phase IIB).

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2.0 Description of Evaluation Aircraft and Equipment

2.1. Evaluation Aircraft

The United States Army UH-60A/ L configured helicopter will be used for the Phase IIA evaluation effort. This helicopter was selected because it provides a cross section of complexity from a fleet size record keeping standpoint and also because the U.S. Navy tested CMBs on the SH-60, which should make the airworthiness qualification a simpler process.

The United States Army AH-64D configured helicopter will be used for the Phase IIB evaluation effort. This helicopter was chosen because of the future re-capitalization efforts that are a part the of Army Reduction in Total Ownership Cost effort. The AMATS program is being investigated within this phase as a method for tracking historical information for the re-capitalized components.

2.2. Description of Evaluation Equipment

The following paragraphs provide a brief description of the various types of equipment that will be used during the evaluation. The demonstration program will include an evaluation of the usability of these devices. Recommendations will be provided in the final report as to types and numbers of read/write devices and downloaders for Aviation and support units.

2.2.1. Memory Button

The memory button selected for evaluation under the pilot program is a MacSema 32K mini-button. The rugged touch button memory device contains: a completely encapsulated electronically erasable programmable read/write only memory (EEPROM) microcircuit with virtually unlimited (100,000 cycles) read and write capability. The microcircuit is housed in a strong brass container that is gold plated to enhance corrosion resistance. Additional strength is derived from the glass filled epoxy-potting material that is capable of withstanding extreme pressures and caustic environments. The memory buttons are inert, containing no internal power source or measurable electrical charge. No energy source is required for evaluation (except the internal power source in the reader/writer) nor is any energy transmitted as a result of the buttons being attached to the host aircraft. The memory button can be written to or read from using the reader/writers described below.

2.2.2. Reader/Writer Devices

There are several read/write devices that are compatible with the memory button selected for this evaluation. Power for the memory button is drawn directly from the devices described below. These devices will be evaluated during Phase IB and IIA to determine which device or combination of devices best fit the needs of the Army supply and maintenance system.

ButtonReader®: The ButtonReader® is a rugged data collector that features 12 programmable keys and a variety of display options. It is hand-held, making it simple to update data stored on the memory buttons while on site. The unit contains an IBM compatible processor capable of executing 4 million instructions per second (MIPS). The ButtonReader® is equipped with 128K of memory as standard or 512K available as an option. Data readout provides 2 lines by 16 characters supertwist technology with a beeper and superbright LED. The unit is housed in a rugged, machined, aircraft grade aluminum that is black powder coated with a gold plated read

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tip. A rechargeable Nickel Cadmium battery powers the ButtonReader®. The unit is programmable in C and other standard IBM languages.

ButtonWand®: The ButtonWand® is a commercial rugged memory button reader that is easy to use. It, too, is hand-held and contains an IBM compatible processor capable of executing 4 million instructions per second (MIPS). The ButtonWand® is equipped with 128K of memory as standard or 512K available as an option. Data readout provides a beeper and superbright LED to signal events to the user. The unit is housed in a rugged, machined, aircraft grade aluminum with black anodized color and a gold plated read tip. A rechargeable Nickel Cadmium battery powers the ButtonWand®. The unit is programmable in C and other standard IBM languages.

ButtonLink™: The ButtonLink™ is a low-cost device which enables the user to read from and write to MacSema's memory buttons with any device via the serial port, such as a PC or notebook computer. The unit is encased in black anodized aluminum. It is capable of interfacing with any device with a serial port. A standard 4.5-foot serial cable with DB9 connector is provided. The ButtonLink™ requires a standard RS232 serial power port and uses 6 volts (V) at 10 milliAmps (mA) of power that is provided by the device that is connected.

Symbol PPT 2740. The Symbol PPT 2740 is a hand held device that allows the user to communicate via a wireless LAN. This device uses the Pocket PC operating system that is Microsoft Windows based. This device has an optional CMB reader that attaches to the bottom of the device for easy reading writing of CMBs. The device can also communicate with a PC through a custom cradle connected to the PC through a serial port connection.

2.2.3. Downloaders

Several variants of downloaders are available for interfacing the host computer to the ButtonWand® or the ButtonReader®. The host computer for this demonstration program is the computer on which the 2410 data resides at those locations that will write to or read from the CMB (e.g. at the unit, at depot, at the Proof of Concept phase). An assessment will be conducted prior to Phase IB to determine which downloader(s) best fit the needs, both technical and fiscal, of the evaluation. Common features of the downloaders include Nickel Cadmium recharge capability with a red and green charge status LED, fast/trickle charge with no overcharging, and a protected reader reset controlled by the host computer.

2.3. Description of Software

The ultimate focus of the AMATS effort is to feed data through the unit's automated aircraft logbook system software to the Aviation and Missile Command (AMCOM). The objective maintenance management system for the Army will be the Global Combat Support System-Army (GCSS-A). GCSS-Army is still under development and will not be available prior to the execution of this demonstration effort. The software systems used will be existing systems at the unit.

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2.3.1. Electronic Logbook Automation System (ELAS)

The Logbook Automation System (LAS) was developed by AMCOM to automate logbook functions before the ULLS-A modules were finalized. ELAS is an enhanced, Windows based version of the LAS. Some activities have continued to use LAS and ELAS systems.

The ELAS automates the Army's aircraft logbook system. It is a software tool that allows for the collection of flight hours and maintenance information on and at each aircraft using a laptop computer. It provides for one-time data entry and a paperless record-keeping environment. Transfer of data between logbook forms is also possible. The ELAS, also, automates standard readiness reports and provides the capability for recording and reporting monthly flight hours. In order to enter memory button data into the ELAS, a software interface between ELAS and the ButtonLink™ or other downloader(s), will have to be developed. As ELAS is utilized in the maintenance process at Ft. Rucker, these software modifications must be in place prior to execution of Phase IIA. In order to minimize cost and schedule the tactical operational unit that participates in Phase IIB must use ELAS as well.

2.3.2. Maintenance Consolidated Database System (MCDS)

MCDS is a sub-system within The Army Maintenance Management System – Aviation (TAMMS-A) put in place for tracking and managing the life cycle of logistically significant maintenance requirements. These requirements include finite life, Time Between Overhauls (TBO), and command interest (high dollar or safety/performance) components installed on U S Army aircraft. The MCDS data is stored in a database at the Aviation and Missile Command AMCOM at Redstone Arsenal, Alabama. The purpose of MCDS is to assure that components are not operated past their designated retirement life or TBO and conversely that the components are fully utilized and not overhauled or discarded before all of their useful life is consumed. The system also has provisions to measure repair value-operating hours obtained between repairs. Components removed from Army service through Foreign Military Sales (FMS), Defense Reutilization Management Office (DRMO) or crash damage are also tracked to ensure they do not find their way back into the Army's inventory. The current input mechanism for the TACTS database is the DA 2410 form. This multi-part paper form consists of three parts, Copy 1 (removal), Copy 2 (repair and inventory loss/gain) and Copy 3 (installation).

Copy 1 is filled out whenever a 2410 component is removed from an aircraft. This removal may occur when the component fails, is removed for controlled substitution on another aircraft, has reached its TBO or has reached its retirement life. Copy 1 is filled out by maintenance personnel in the unit that owns the aircraft by transcribing data from the DA 2408-16 series forms that are part of the aircraft logbook. This process of transcription may result in improper data being entered on the form or not all data being completed on the form. Once Copy 1 is completed, it is mailed to AMCOM for processing. When the 2410 form arrives at AMCOM, it is given a visual inspection to assure that it was filled out properly. Next, a data entry clerk reviews Copy 1 and the data is entered into the MCDS database with any missing data verified. This data entry process is error prone due the fact that the handwriting must be read and interpreted by the data entry clerk and then correctly entered into the database. This manual process may result in errors getting into the database. Additionally, significant man-hour resources are expended in performing the automated edit and correction of 2410 data.

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The other two parts of the 2410 form (i.e. Copy 2 and Copy 3) accompany the part when it is shipped to the repair facility or to another location for installation on another aircraft. This facility may be a higher echelon Army maintenance unit or an Army Depot. When the component is repaired, detailed information about time and materials used in the repair is recorded on Copy 2 of the 2410. When the repair is completed, Copy 2 is torn off and mailed to AMCOM, where it is entered into the MCDS database. This data is then correlated/reconciled with the previous data from the Copy 1. If the component is to be repaired or overhauled at depot, it may be stored along with other like components until there is a sufficient quantity of parts accumulated to economically justify setting up a repair/overhaul line for the component. These conditions create a perfect environment for loss/mix-up of hard copies of 2410 forms. This can result in loss of the asset (records are unable to be reconstructed) or reduction of remaining useful life (lowest estimate must be based on highest life consumption for safety). Asset visibility is lost during the time this component is in the supply system.

Additionally, Copy 2 is used on newly manufactured components to initialize them into the MCDS database. In this case the Copy 2 is filled out by the manufacturer and mailed to AMCOM.

Copy 3 of the 2410 stays with the repaired component until it is installed on another aircraft. However, if there is significant elapsed time or if the component is physically relocated one or more times, then the likelihood increases of it being detached and lost. A case in point is when a component in the Authorized Stockage List (ASL) or Prescribed Load List (PLL) stock of a support unit has to relocate due to mission requirements. When the component is installed on the aircraft, that information is entered on the Copy 3 and the form is mailed to AMCOM where it is entered into the MCDS database.

3.0 Evaluation Objectives

3.1. Phase I – Ground Evaluation

Phase I will be conducted in two parts: flight qualification and proof of concept. These efforts will be conducted in conjunction with each other; however, successful completion of Phase I is required before Phase II can begin execution. This will be accomplished through successfully meeting requirements of pre-established exit criteria. The definition, coordination and execution of Phase I will be the responsibility of the Multi-purpose Aviation Integration Laboratory (MPAIL) manager. Functions to be performed during Phase I, for the most part, will take place at Redstone Arsenal, AL.

3.1.1. Phase IA - Flight Qualification

The purpose of Phase IA Flight Qualification is to obtain an Airworthiness Release (AWR) from the Aviation and Missile Research Development and Engineering Center (AMRDEC) Aviation Engineering Directorate (AED). Successful completion of this phase will result in an AWR for placing memory buttons on the 2410 tracked components selected for this demonstration program (see Appendix A).

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3.1.2. Phase IB - Proof of Concept

The purpose of Phase IB Proof of Concept is to demonstrate the utility and viability of using contact memory button technology to improve the effectiveness and efficiency of Army Aviation's supply and maintenance processes, through automation. Specific objectives of Phase IB will be to:

- review components identified in Appendix A for applicability to demonstration
- develop the memory management plan for use of the 32K space on the button
- identify requirements for and develop the software that will read and write the appropriate 2410 data to the button
- develop process framework for button's initialization of component data with new procurements, with maintenance and overhaul, and field applications. This will include Contract Data Requirements Lists (CDRL) and Data Item Descriptions (DID)
- collect data to develop button maintenance and supply concept, to include buttons, read/write devices, adhesives, and others
- develop draft installation procedures and Technical Data Package (TDP)/drawing modification
- conduct evaluation of Depot Maintenance Work Requirement (DMWR) procedures for button utility and survivability
- conduct an evaluation of the data survivability considering the vendor information and operating temperature surveys conducted at Army Technical Test Center (ATTC) in Fort Rucker, Alabama
- modify Army Aviation unit, depot and AMCOM software as necessary to accept inputs from memory button read/write results
- develop and operator and maintainer training materials that include clear operating instructions for the hardware and software
- create a test plan that simulates a part's movement through the maintenance documentation process to govern the ground test mock up
- ground test the mock-up to ensure the memory buttons and associated hardware and software are functioning as desired prior to executing on an actual aircraft which is to be accomplished during Phase II Operational Demonstration

Successful completion of this phase will result in correctly functioning hardware and software for the component, the unit, the depot, and the AMCOM supply and maintenance processes.

3.2. Phase II – Operational Demonstration

The definition, coordination and execution of Phase II will be the responsibility of the MPAIL manager. The MPAIL manager will work with those organizations necessary to support conduct of the evaluation. Phase II will be conducted in two parts: a Beta Evaluation and an Operational Evaluation. The Beta Evaluation will be conducted at Ft. Rucker. The operational demonstration will be conducted at the 2-101st at Fort Campbell, KY, an Apache Longbow Battalion. Completion of both the beta and operational flight evaluation portion will be measured through successful performance measured against pre-established exit criteria. Successful completion of the beta evaluation must precede initiation of the operational demonstration. The success of the beta evaluation, and the key elements that lead thereto, will be drivers in the selection of the operational evaluation location.

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3.2.1. Phase IIA - Beta Evaluation

The Beta Evaluation will be conducted at the ATTC at Ft. Rucker, AL. ATTC has contractor maintenance, an extensive information flow network, and extensive repair capability. This phase will be to evaluate/modify the functionality of the procedures, software, data transmission, and hardware prior to an operational unit's participation. This phase will run a minimum of six months. If there is a successful conclusion of this phase, and the maintenance contractor agrees, the CMB system (i.e. the memory buttons, read/write devices, and associated software) may remain in effect at Ft. Rucker as a no cost value engineering improvement to the maintenance contractor's operation.

3.2.2. Phase IIB - Operational Evaluation

The Phase IIB demonstration will be conducted at the 2-101st, Fort Campbell, KY. This phase is intended to operationally validate the hardware, software, procedures, and data transmission in a mission driven environment with a tactical unit. An evaluation of the impact on labor hours, both at and above the unit level, will also be conducted.

3.3. Data Collection and Transmittal

The MPAIL Manager will be responsible for planning, coordinating, data collection and reduction, data evaluation/analysis and preparation of the evaluation report. To accomplish the foregoing, the MPAIL manager will identify a project lead and the skills and manpower requirements needed to execute this element of the evaluation. A team will be assembled and instructed as to evaluation expectations and the respective responsibilities of each team member.

3.3.1 Phase I – Data Collection

Data collection and evaluation during Phase I will have the following objectives:

- Determine the most reliable process to transfer data incorporating procedures for components and assembly events.
- Determine any foreseeable safety issues associated with using CMBs on the UH-60 and AH-64 airframes in the specified locations.
- Determine a reliable and efficient button memory management plan.
- Determine any foreseeable limitations in the CMB's survivability through maintenance procedures including depot level maintenance.
- Determine any foreseeable limitations in the button data survivability through the component's life span.
- Determine the adherence to the economic analysis.

3.3.2 Phase II – Data Collection

The data collection, reduction, and evaluation team will be responsible for evaluating each aspect of Phase II performance against its exit criteria. The Field Data Division will assist in the data evaluation process. The objectives of the evaluation will be to:

- Determine the technical and economic impact of using CMB technology, and associated hardware, software and process infrastructure to support GCSS-A information systems as a replacement for the current paper based system in use on all Army aircraft.

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- Determine if the Memory Management Plan will provide the unit and higher maintenance echelons with sufficient historical data on each of the evaluated components.
- Determine if data can be reliably electronically transmitted in usable format between the field units and AMCOM, and to determine which data link (media) is best suited to accomplish this task.
- Determine the manpower burden/savings this system poses for the Army at each level of activity.
- Determine the accuracy improvements in the TACTS process resulting from AMATS versus the present paper system.
- Determine button maintenance and supply concept, to include buttons, read/write devices, adhesives, and others.
- Determine processes for button's initialization of component data with new procurements, with maintenance and overhaul, and field applications. This will include Contract Data Requirements Lists (CDRL) and Data Item Descriptions (DID).

4.0 Method of Evaluation

4.1. Phase I – Ground Evaluation

4.1.1. Phase IA - Flight Qualification

A list of potential candidate parts will be presented to the AMRDEC AED. Issues such as the following as a minimum will be considered:

- Foreign Object Damage (FOD) resulting from a loose or lost button.
- Balance/vibration risks.
- Secondary maintenance damage from reading/accessing the button..

THE AED WILL PROVIDE AN AWR PRIOR TO ANY INSTALLATION ON A FLYABLE COMPONENT.

4.1.2. Phase IB - Proof of Concept

Exit criteria for this phase is:

- Error/deficiency free demonstration of button installation/population
- Error/deficiency free demonstration of data transfer and procedures for component and assembly events (i.e. gain, installation, removal, controlled substitution, and loss)
- Acceptability of button memory management
- Acceptability of maintenance/supportability concept,
- Continued adherence to the economic analysis.

4.1.2.1. Selected Components

Benchtop (non-airmobile) testing will evaluate sample or simulated components to induce events which CMBs could experience during flight. It is anticipated that a minimum of 20 components will be evaluated and/or simulated. They will cover the following types

- Field removable
- Field repairable
- Field scrappable
- Depot removable

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- Depot repairable
- Depot scrappable
- Assemblies containing tracked components
- Single tracked components.

4.1.2.2. Button Installation

CMBs will be installed on the components being evaluated using the recommended attachment procedures in accordance with the AWR. The process/procedures will be documented and corrected as necessary and identified in the evaluation report.

4.1.2.3. Button Data Population/Installation

The historical data for the selected components will be downloaded, corrected/modified if required, and installed on the buttons. The process will be documented and modified as necessary and will be included in the evaluation report.

4.1.2.4. DMWR Evaluation/Simulation

Before button technology can be adopted Army wide, several depot related issues must be addressed. A major issue of concern is the survivability of the button during the process of depot overhaul. Some of the process environments, such as cleaning and stripping, may be quite hazardous to the button. The DMWR for each component will be reviewed to determine the survivability of the button and its data during the overhaul processes and procedures. Each case will be evaluated individually and the decision made at that time to remove the button and install a new one later or to modify the process or procedure. Processes that have the potential to damage the button or it's data will be simulated at Corpus Christi Army Depot (CCAD) and the effects evaluated. DMWR warning/modification procedures will be documented for inclusion in the DMWR if the evaluation is successful.

4.1.2.5. Component Event Simulation

Each component or simulated component will be processed through a number of maintenance events that they are expected to encounter. These events will include as a minimum:

- Removal/Replacement
- Cannibalization or transfer within the operational unit.
- Gain to the inventory.
- Loss to the inventory.
- Repair at each authorized level.
- Modification Work Order (MWO)
- Safety of Flight (SOF) or Aviation Safety Advisory Message (ASAM) compliance.

4.1.2.6. Button Maintenance Data Capacity

The CMB's capacity for recording maintenance event data will be continually evaluated throughout the demonstration program. The data will be categorized into three areas:

1. Component Identification Data, Manufacturing Certification – This data will be permanently stored on the button and never overwritten.
2. Component Configuration/Compliance Data. This data will be permanently stored, but additional information can be appended/written to it.

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3. Component Maintenance Status data. This data can be written/updated/and deleted if deemed appropriate and capacity becomes an issue.

4.1.2.7. Software Development/Interfaces

Several software systems must be evaluated and the systems affected must be documented and software written to ensure effective integration. The systems and anticipated work efforts are defined below.

4.1.2.7.1. Enhanced Logbook Automation System (ELAS)

Modifications will be made to the existing ELAS to integrate memory button technology. Software will be written to interface the button reader or downloader devices to the ELAS Quality Control (QC) and unit computers.

The ELAS software will be enhanced to allow the electronic extraction of data from the button when a component is removed from the aircraft. When a component is removed from the aircraft, a button reader electronically identifies the component and provides this information to whatever device it interfaces with (an ELAS system or a MacSema downloader). If the reader interfaces to a downloader this device in turn will interface with an ELAS computer. ELAS will match up the component identification data with the appropriate 2408-16 series record in the ELAS database. The 2408-16 series record will be removed from the database and an electronic 2410 form Copy 1 will be created. A paper copy of the 2410 form Copy 2 and 3 will be printed out for shipment with the removed component. A paper copy of the 2410 data and all component historical data that is stored on the button is still required in the event the component is shipped to a location that is not participating in the demonstration program. The electronic version of the Copy 1 will be transmitted to AMCOM. Additional paper copies can be printed and maintained wherever desired.

When a 2410 component is installed (2410 Copy 3) on an aircraft, the button reader will be used to extract component identification and history data from its button. ELAS will use this data to initialize the component into the ELAS database by automatically creating the data required to generate a new 2408-16 series record or update the next higher assembly 2408-16 series record in the ELAS database with the appropriate data from the button. An electronic version of the form will be created and sent to AMCOM.

4.1.2.7.2. Data Transfer

Software and procedures will be developed to assure correct and timely transfer of the information from the site to the National Maintenance Point (NMP) at AMCOM. Software and procedures will be developed or modified to provide positive assurance of receipt of electronic CMB data. AMATS software procedures will be developed for updating the IMMC 2410 database via electronic means.

4.1.2.7.3. Depot Aspects

One aspect of the 2410 data in Depot is receipt and shipping. Parts can be stored at Depot for long periods of time before rework, reuse, or disposal. In the mean time no information is flowing about the component. This aspect used to be covered by the 2410 system when it was a

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six part form. It was anticipated that computer databases would handle this and thus the form was simplified to a three part form. The database indication of shipping receiving has not occurred accurately to date, and could be re-addressed with the CMB process. This software will not be developed under this Demonstration Program Plan. However, the processes will be in place for this to occur using AMATS processes.

4.2. Phase II – Operational Demonstration

4.2.1. Phase IIA - Beta Evaluation

The Beta Evaluation will be conducted at Ft. Rucker, AL. The memory buttons will be installed on the UH-60 aircraft at ATTC. The ATTC will assure that the installation procedures, software integration with the ELAS, and data processing procedures are complete and accurate. The ATTC will operate both the paper and the AMATS system until they are assured that the AMATS system integrity is maintained. Any deficiencies will be noted and corrected. The Phase IIA aircraft will be operated and monitored for a total of six months. Any deficiencies noted will be corrected and sufficiently demonstrated before entering the next demonstration phase. Additionally, the economic analysis will be assessed prior to entering the next phase.

4.2.2. Phase IIB - Operational Evaluation

The operational demonstration is intended to show that the concept is sound, that the benefits and burdens are understood and acceptable to the field Army, and that the benefits and economic impacts for the NMP are understood and quantifiable. The operational demonstration will run a minimum of six months. Any software and procedural deficiencies will be noted, corrected, and demonstrated prior to successful completion of this phase.

4.3. Evaluation Metrics

- Process and software deficiencies noted, corrected, demonstrated
- Time to complete form
- Time to transfer button info
- Accuracy of form
- Accuracy of button info
- Loss rate of form
- Loss rate of button
- Time to input form in NMP database
- Time to process electronic info into NMP database
- Time, resources to install buttons
- Time, resources to populate buttons
- Flight Hours, calendar time
- Activity of monitored components. (Remove, install, repair, transfer).

5.0 Evaluation Reports and Meetings

Weekly Status Report – provides a short summary of key events that occurred during the week.

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Deficiency Reports – Documents any deficiencies found with recommendations for corrective action and follow-up of corrective actions taken. Deficiencies may be in the form of hardware, software, procedures, etc.

Status Meeting – Review board convened, as necessary, to monitor the progress of efforts to date and to direct future program activities as needed.

In-progress Review (IPR) – Conducted at the conclusion of every phase to ensure exit criteria are met and the demonstration program can proceed to the next phase.

Final Report – Comprehensive discussion of the entire demonstration program and results thereof. Report at a minimum will include: CMB attachment procedures, hardware recommendations for read/write/download devices, software for implementing approach from the unit to AMCOM to Depot, and implementation procedures.

6.0 Program Cost.

Summary of cost is provided below.

Cost Summary			
Labor	Contractor	Government	Total
Phase I	\$203,949.90	\$133,966.40	\$337,916.30
Phase IIA	\$309,320.80	\$54,331.20	\$425,652.00
Phase IIB	\$172,254.60	\$44,452.80	\$216,707.40
Total	\$685,525.30	\$232,750.40	\$980,275.70
Travel	\$78,000.00	\$9,777.00	\$25,777.00
Hardware	\$212,510.20		\$212,510.20
Total			\$1,218,562.90

Appendix A –AMATS Components

Nomenclature	WUC
ENGINE HISTORY RECORDER	04A06B
SWASHPLATE ASSY	05A03A
DRIVESHAFT SECT VI	06H11
T700 ENGINE ASSY TURBINE	04A
POWER TURBINE MODULE	04A03
COLD SECTION MODULE	04A01
ACCESSORY SECTION MODULE	04A04
MAIN ROTOR HUB	05A01A
MAIN ROTOR SHAFT EXTENDER	05A01L
MAIN ROTOR BLADE ASSY	05A02
MAIN TRANSMISSION MODULE	06A
INPUT MODULE	06E
INTERMEDIATE GEARBOX	06F
DRIVESHAFT SECT I	06H06
DRIVESHAFT SECT II	06H08
DRIVESHAFT SECT III, IV, V	06H09
DRIVESHAFT SECT VII	06H12
T/R OUTBOARD RETENTION PLATE	06G01B
TAIL ROTOR GEARBOX	06G01
AFT TIE ROD SUPPORT FITTING	11D05
RIGHT TIE ROD	11D14
LEFT TIE ROD	11D13
MAIN ROTOR SPINDLE	05A01I
ACCESSORY MODULE	06A11
LATERAL SERVO BELLCRANK	11D09
ELECTRICAL CONTROL UNIT	04A06A
AUXILARY POWER UNIT	15B

Table A-1. The AMATS Components for the UH-60A/L

Appendix A –AMATS Components

Nomenclature	WUC
TAIL ROTOR FORK ASSEMBLY	05B01N
TAIL ROTOR HEAD	05B01
TAIL ROTOR BLADE	05B02
TAIL ROTOR SWASHPLATE	05B03A
TAIL ROTOR GEARBOX	06G01
DIRECTIONAL SERVO	11C25
INTERMEDIATE GEARBOX	06F
AFT HANGER BEARING	06H18D
FWD HANGER BEARING	06H18C
APU	15B
APU PTO CLUTCH	15B05
COLLECTIVE SERVO	11D01C
LONGITUDINAL SERVO	11D01D
LATERAL SERVO	11D01E
FWD INBOARD ENGINE MOUNT	02B10N
M/R SUPPORT MASK	02B27
MAST SUPPORT BASE ASSEMBLY	02B28
COUNTERMEASURE TRANSMITTER	76F01
DEROTATION UNIT	37A11
FWD CENTER STRUT LH	02B29
FWD CENTER STRUT RH	02B29
AFT CENTER STRUT LH	02B31
AFT CENTER STRUT RH	02B31
COLLECTOR SERVO SUPPORT	11D01C01
LONGITUDE SERVO SUPPORT	11D01D01
LATERAL SERVO SUPPORT	11D01E01
MAIN ROTOR HEAD	05A01
PITCH HOUSING	05A01I
LEAD LAG LINKS	05A01I01
LOWER SHOE ASSEMBLY	05A01V

Appendix A –AMATS Components

TRUNNION DAMPER	05A01W
LEAD LAG DAMPER	05A01Z
MAIN ROTOR BLADE	05A02
MAIN ROTOR SWASHPLATE	05A03A
PITCH LINK ASSEMBLY	05A03C
MAIN TRANSMISSION	06A
HYDRAULIC PUMP PRIMARY	07A01
HYDRAULIC PUMP UTILITY	07B01
GENERATOR	09A01
MAIN ROTOR DRIVE PLATE	06A08
ENGINE GEARBOX	06E
FWD LONGITUDE BELLCRANK	11D15
LONGITUDE TORQUE LINK	11D18
LONGITUDINAL LINK	11D20
AFT LONGITUDINAL BELLCRANK	11D21
COLLECTIVE BELLCRANK	11D24
MIXER SUPPORT ASSY	11D27
T-701 ENGINE	04A
HISTORY RECORDER	04A06B
ELECTRICAL CONTROL UNIT	04A06A
ENGINE STARTER	07D01
WING ASSEMBLY LH/RH	02B18A
SIGNAL DATA CONVERTER	19E04B
INERTIAL NAVIGATION SYSTEM	19E04E
IMPROVED DATA MODEM	19V01
COMPARATOR/PROCESSOR	76A03
LASER SENSOR UNIT	76E01
COMPARATOR	76E02
IHADSS DISPLAY ELECTRONIC UNIT	39C
IHADSS SIGHT ELECTRONIC UNIT	39B

Table A-2. The AMATS Components for the AH-64A/D

Appendix A –AMATS Components

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Appendix B - Equipment Specification Sheets

Button Memories



ButtonMemory®



MiniButton™

ButtonMemories come in a variety of memory capacities; From 32k bytes down to 16 bytes, all ButtonMemories are able to survive [extreme conditions](#). ButtonMemories use EEPROM technology rather than battery-powered memory. Each time a ButtonMemory is read, it is given a charge which extends data retention for another 100 years.

Because of their small size, large storage capacity and the ability to operate in extreme environments, ButtonMemories can be used in almost any data recording and collection application.

Technical Specifications

MacSema, Inc. ButtonMemory® and MiniButton™
 U.S. Patent Nos. 5,506,757 and 5,539,252

Memory Sizes	16 read-only bytes; 128, 256, 2k, 4k, 8k and 32k bytes read/write	Power	EEPROM technology - no batteries required
Casing	Hermetically sealed to withstand water, oil, dust, grease, salt, radiation, weather extremes, electromagnetic fields and mechanical stress	Dimensions	ButtonMemory: 16.2 mm diameter x 6 mm high MiniButton: 10.7 mm diameter x 3 mm high
Read Time	13 - 165 milliseconds	Operating Temperature	-85° to 257° F (-60° to 125° C)
Security & Encryption	MacSema's software routine provides for password protecting data stored on buttons. Data may also be encrypted using any commercial file encryption system.	Storage Temperature	-85° to 302° F (-60° to 150° C)
Life expectancy	One million read/write cycles. Data retention is extended to 100 years each time a button is touched by a reader. Reusable. No hazardous compounds.	Weight	ButtonMemory: 0.14 oz (4.0 gm) MiniButton: 0.027 oz (0.77 gm)
		Shock	Internal components are encapsulated in epoxy to withstand terminal velocity to hard surfaces such as concrete.

Appendix B - Equipment Specification Sheets

PPT 2700 Series Specification Highlights



Physical Characteristics	
Dimensions:	1D: 7 in. L x 3.625 in. W x 1 in. H/177.8 mm x 92 mm x 25.4 mm 2D: 7.625 in. L x 3.625 in. W x 1 in. D (grip area) x 1.5 in. D (scanner bay)/193.7 mm x 92 mm x 25.4 mm x 38.1 mm
Weight (including battery):	1D: 10.3 oz./288 gm (batch version); 11.8 oz./330 gm (wireless version) 2D: 13.8 oz./391 gm (batch version); 15.3 oz./434 gm (wireless version)
Drop Specification:	4 ft / 1.2 m to concrete
Battery:	3.7 V, 1400 mAh rechargeable Lithium ion
Environmental Sealing:	IP54 (windblown dust and rain)
Operating Temperature:	-20° to 50° C (-4° to 122° F)
Storage Temperature:	-25° to 50° C (-13° to 122° F)
Humidity:	5% to 90% RH non-condensing
Electrostatic Discharge (ESD):	8 kVdc air; 4 kVdc contact
Scan Engine:	1D: SE 900 2D: SE 2200
Performance Characteristics	
CPU:	NEC Vr4181 (MIPS)
Operating System:	Pocket PC
Memory (RAM/ROM):	16 MB/12 MB (ROM is all flash ROM)
Application Development:	Fully compatible with Microsoft SDK for Pocket PC's; Symbol SDK available to support bar code scanning
Display:	High contrast, anti-reflective monochrome LCD display; 1/4 VGA resolution (240 x 320 pixels)

Appendix B - Equipment Specification Sheets

Peripherals and Accessories	
Cradles:	Vehicle, modem, serial, four-slot Ethernet
Communication and Charging Cable:	Serial/charges battery in terminal
Magnetic Stripe Reader (MSR):	Serial connection/swipe reader attachment
4-Slot Universal Battery Charger (UBC):	Simultaneous charge of 1-4 batteries; Requires adapters for PPT 2700 batteries
RF Data Communications	
Network:	Spectrum24 [®] IEEE 802.11 airwaves standard-based 1 Mbps, 2Mbps; 802.11b for 11 Mbps
Output Power:	500 mW U.S.; 100 mW international
Data Rate:	1 Mbps, 2 Mbps and 11 Mbps
Spreading Technique:	Frequency hopping 1 Mbps, 2Mbps; Direct Sequence 11 Mbps
Antenna:	Internal
Range:	Open space: up to 1,000 ft./303 m; Typical: 180 ft. to 250 ft./54.5 to 76 m
Frequency Range:	Country dependent, typically 2.4 to 2.5 GHz
Regulatory	
Electrical Safety:	Certified to pending to UL 1950, CSA C22.2 No. 950, EN60950/IEC950
EMI/RFI:	FCC Part 15 Class B, ICES-003 Class B, European Union EMC Directive, Australian SMA
Laser Safety:	CDRH Class II, IEC Class 2

Appendix B - Equipment Specification Sheets

ButtonLink™

The ButtonLink is currently available in three styles (miniButtonLink is not pictured):



ButtonLink



FingerTip ButtonLink

The ButtonLink™ is a low-cost tool which enables the user to read from and write to MacSema's ButtonMemories with any device via the serial port, such as a PC or notebook. For Windows developers, MacSema provides a DLL (for both 16 and 32-bit Intel platforms). The DLL allows developers to quickly integrate the powerful ButtonMemory technology into their applications. MacSema provides example code and developer support for developers using Microsoft Visual C++, Microsoft Visual Basic (and VBA), Borland Delphi, and Borland C++.

Technical Specifications

MacSema, Inc. ButtonLink™

Reads

128, 256, 2k, 4k, 8k and 32k byte ButtonMemories. Finger Tip and Mini ButtonLinks read MiniButtons

Power

Standard RS232 serial port power; uses RTS and DTR (6 volts at 10 mA).

Note: Some laptops and portables do not supply sufficient power. Modified ButtonLinks are available for these cases.

Casing

Black anodized aluminum

Software

Dos and Windows software provided for file transfers; Windows DLL provided for development and application integration
4 in. x 3/4 in. diameter
(105mm x 19mm)

Download Rate

9600, 19200, and 38400 baud

Dimensions

Interfaces

Works with any device with a serial port. Standard 4.5 foot serial cable with DB9 connector. Custom cables available for use with hand-held systems.

Weight

3.5 ounces (98 grams)

Other Features

Gold contacts. Surface mount technology provides for shock resistance. Pen shaped for ease of use. Dust and oil resistant.

Appendix B - Equipment Specification Sheets

ButtonReader™

The ButtonReader™ is a rugged data collector. Easy to use, it features 12 programmable keys and a variety of display options, making it simple to update data stored on ButtonMemories while on site.

Available software includes MacSema's comprehensive Developer's Kit for the ButtonReader, in addition to [Hierarchy](#) and the [Security Plus System](#).



Button Reader



FingerTip Extension



Graphical Display

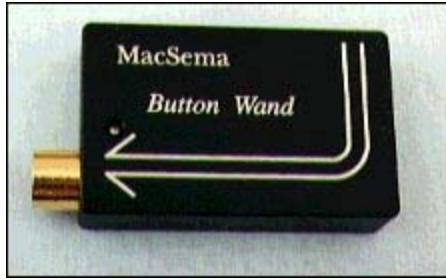
Technical Specifications

MacSema, Inc. ButtonReader™

Processor	IBM Compatible, executes 4 million instructions per second	Display	2 lines x 16 characters supertwist technology (other displays, including backlit, are available).
Memory Size	128K (standard) or 512K (optional)	Software	Unit is programmable in C and other standard IBM languages. (IBM PC host software available)
Download Rate	9600-38400 baud, 4-50 seconds for a full wand	Clock	Crystal controlled, real-time clock reports accuracy to 1/100th of a second
Read feedback	Beeper and Superbright LED	Weight	210 grams (7.5 oz.)
Temperature range	Operational: 32 ° to 140 ° F (0 ° to 60 ° C) Storage: -4 ° to 158 ° F (-20 ° to 70 ° C)	Dimensions	104mm x 61mm x 22.8mm (4.1" x 2.4" x 0.9")
Case material and color	Rugged, machined, aircraft-grade aluminum. Black powder coated. Gold-plated read tip.	Downloader	Serial port, charge status indicator, daisy chainable. IBM connection, reset by software, no keys or switches
Battery requirements	NiCd rechargeable. Low battery detection.	Other features	Gold contacts Usable by either left or right handed persons. All keys are programmable.
Warranty	MacSema products are backed by a one-year limited warranty against defects in materials or workmanship.		

Appendix B - Equipment Specification Sheets

ButtonWand™



ButtonWand

The ButtonWand™ is an economical yet rugged ButtonMemory reader which measures a scant 4.1 x 2.4 x 0.9 inches and weighs only 6.5 ounces. It is extremely easy to use - simply touch a ButtonMemory and the button serial number, along with the current data and time, is automatically recorded in the reader. The unit, which comes standard with 128kb RAM (optional 512kb RAM available) has a beeper and a superbright LED to signal events to the user. Available software includes MacSema's comprehensive Developer's Kit for the ButtonWand, in addition to [Hierarchy](#) and the [Security Plus System](#).

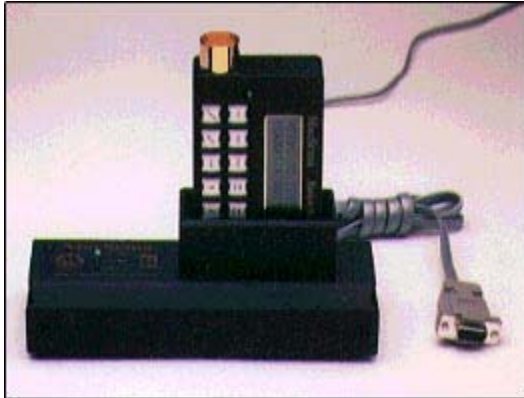
Technical Specifications

MacSema, Inc. ButtonWand™

Processor	IBM Compatible, executes 4 million instructions per second	Software	Unit is programmable in C and other standard IBM languages. (IBM PC host software available)
Memory Size	128K (standard) or 512K (optional)	Clock	Crystal controlled, real-time clock reports accuracy to 1/100th of a second
Download Rate	9600-38400 baud, 4-50 seconds for a full wand	Weight	168 grams (6.0 oz.)
Read feedback	Beeper and Superbright LED	Dimensions	104mm x 61mm x 22.8mm (4.1" x 2.4" x 0.9")
Temperature range	Operational: 32 ° to 140 ° F (0 ° to 60 ° C) Storage: -4 ° to 158 ° F (-20 ° to 70 ° C)	Downloader	daisy chainable. IBM connection, reset by software, no keys or switches
Case material and color	Rugged, machined, aircraft-grade aluminum. Black anodized color. Gold-plated read tip.	Other features	Gold contacts. Usable by either left or right handed persons.
Battery requirements	NiCd rechargeable. Low battery detection.		
Warranty	MacSema products are backed by a one-year limited warranty against defects in materials or workmanship.		

Appendix B - Equipment Specification Sheets

Single-Station Downloader/Recharger



MacSema's Single-Station Downloader/Recharger is a docking station which provides the necessary link between the host computer and MacSema units for sending and receiving information.

- Red and green charge status LED
- Fast/trickle charge - no overcharging
- Reader reset protected - controlled by host computer
- Communication active status lights
- Rugged die-cast metal casing
- Stereo jack connection designed for unlimited connections
- Uses RJ11 serial cable connection to host computer
- Modem-to-modem compatible

The Single-Station also recharges a unit's NiCad batteries. In about six hours, a reader is charged to approximately 90% to 95% of power, at which time the charge status LED on the Single-Station turns green. As long as the reader is in the downloader, the battery will continue to "trickle-charge" - batteries cannot be overcharged

Appendix C - Acronym List

AED	Aviation Engineering Directorate
AMCOM	Aviation and Missile Command
AMD	Average Monthly Demand
ASAM	Aviation Safety Advisory Message
ASL	Authorized Stockage List
ATTC	Army Technical Test Center
AMRDEC	Aviation Research Development and Engineering Center
AWR	Airworthiness Release
CDRL	Contract Data Requirements Lists
CMB	Contact Memory Button
DID	Data Item Descriptions
DLITS	Depot Level Information Technology System
DMWR	Depot Maintenance Work Requirement
DRMO	Defense Reutilization Management Office
EEPROM	electronically erasable programmable read/write only memory
ELAS	Electronic Logbook Automation System
FMS	Foreign Military Sales
FOD	Foreign Object Damage
GCSS-A	Global Combat Support System – Army
IPR	In-progress Review
LAS	Logbook Automation System
mA	milliAmps
MIPS	million instructions per second
MPAIL	Multi-purpose Aviation Integration Laboratory
MWO	Modification Work Order
NMP	National Maintenance Point
PLL	Prescribed Load List
Qty/NHA	Quantity of Components per Next Higher Assembly
RTTC	Redstone Technical Test Center
SOF	Safety of Flight

Appendix C - Acronym List

STAMIS	Standard Army Management Information System
TACTS	The Army's Maintenance Management System Aviation Component Tracking System
TAMMS-A	The Army Maintenance Management System – Aviation
TBO	Time Between Overhauls
TDP	Technical Data Package
TRADOC	Training & Doctrine Command
ULLS	Unit Level Logistics System
ULLS-A	Unit Level Logistics System-Aviation
V	volts