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UNCLASSIFIED EG/AG-1394 AFWL-TR-79-115 NL

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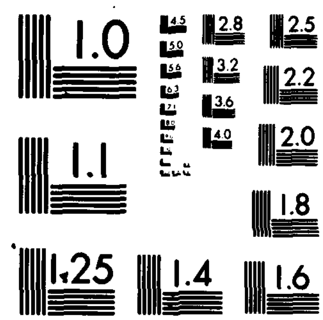


MICROCOPY RESOLUTION TEST CHART

AFWL-TR-79-115

LEVEL III

AD-E200 458

AFWL-TR-79-115

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# E-3A EMP EVALUATION PROGRAM

J. R. Anderson

EG&G, Inc.
9733 Coors Road NW
Albuquerque, NM 87114

January 1980

Final Report



Approved for public release; distribution unlimited.



AIR FORCE WEAPONS LABORATORY
Air Force System Command
Kirtland Air Force Base, NM 87117

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AFWL-TR-79-115

This final report was prepared by EG&G, Incorporated, Albuquerque, New Mexico, under Contract F29601-78-C-0013, Job Order 37630269 with the Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico. Lieutenant Daryl L. Tomczyk (NTMA) was the Laboratory Project Officer-in-Charge.

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This technical report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This document is the Final Report of the E-3A EMP Evaluation Test Program conducted for the AFWL, at Kirtland Air Force Base. The report is divided into four sections: Test Planning, Test Procedures, Data Management and Test Activities.

The Test Planning Section emphasizes the importance of pretest activities, demonstrates what can happen if critical items (such as connectors) are not identified early, and makes recommendations for future tests.

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20. ABSTRACT

The Test Procedures Section gives a step-by-step detailed explanation for performing an EMP test on a large test object. A great number of the problems the test crew encountered on this program are pointed out and solutions are recommended. A brief discussion on power-on testing and breakout box qualification tests are included at the end of the section.

The most detailed section in the report is Section IV, Data Management. Virtually every function of Data Management is covered in this section; examples of typical response data, 284 calibration data, Daset log sheets and Adset log sheets are given and explained.

The final section, Test Activities, explains to the reader the mechanics of performing a test at the HPD facility.

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# SECTION I
# INTRODUCTION

## 1. GENERAL

The E-3A Test Program was carried out from November 1977 to February 1979. EG&G performed as the Test Conduct Contractor (TCC) under Air Force Contract F29601-78-C-0013. EG&G worked closely with the Planning & Analysis (P&A) contractor, the Dikewood/Rockwell team and the HPD/VPD II Facility O&M contractor, BDM, as well as the Air Force Agencies involved in the program. During the system-level aircraft test from June through October 1978, EG&G was responsible for aircraft preparation, the screenbox instrumentation systems, internal and external test point instrumentation and test point logging. The EG&G data group provided data quality control and preparation for ADSET processing. Due to a requirement by the P&A contractor to have additional screen-box data processed into ADSET, the data group worked through December to complete the E-3A data processing.

## 2. ORGANIZATION

The purpose of this test report is to document EG&G's experience during the conduct of the E-3A test program for the benefit of future system level tests. This report is divided into four sections: TEST PLANNING, TEST PROCEDURES, DATA MANAGEMENT and TEST ACTIVITIES. Within these sections, pertinent topics are discussed with emphasis on the lessons learned, major problem areas including solutions and program impacts, and long lead time/critical coordination items. It is the intent of this report to not reiterate information that is already contained in other major E-3A documentation, except for purposes of clarity or updating of material.

## SECTION II
## TEST PLANNING

### 1. GENERAL

During the Test Planning Phase, the Test Conduct Contractor, EG&G, prepared sections of the E-3A General Test Plan, the Safety Plan, fabricated breakout boxes, cables and special fixtures, calibrated probes and sensors, and prepared data logs and forms. The TCC participated in Test Working Group (TWG) and Technical Evaluation Group (TEG) meetings, providing inputs for the test program. EG&G also provided local Technical Illustrator support for test schedules, vu-graphs, charts, etc. From EG&G's point of view, the period of time allotted to the test planning phase was adequate. However, when the P&A contractor had difficulty making timely identification of test points and The Boeing Company was unable to supply all the connector-pairs required for the breakout cables, EG&G was already behind the power-curve when brought into the connector procurement picture. Because of many long connector lead-times, some connectors were purchased but not used and some that were needed did not arrive in time or were not ordered due to unacceptable delivery dates. This problem is discussed in more detail later in this section.

### 2. TECHNICAL DATA

In any test program, the early receipt of the required technical data enhances effectual test planning. For the E-3A test, EG&G was well into the planning phase when the Technical Orders came into the Rockwell office in Albuquerque. The problems were not over, however, as they were not bound nor had the revisions been inserted. Rockwell personnel then spent several weeks getting the T.O.s into usable form.

Although EG&G was not the prime user of the T.O.s, it seemed that a number of them were not used. To make a more educated selection, perhaps test personnel should travel to a unit which has a complete T.O. library and look at the volumes to ascertain which ones will be useful to the test program.

This would eliminate the cost and clutter of ordering and storing extraneous tech orders. For T.O.s that come from an Air Force Depot, a supply of binders will be needed, and some time must be allowed to collate revisions. If, in the future, several independent contractors participate in a system level test, the test conduct contractor should have a few of the basic system tech orders he can keep at his facility.

In order for EG&G to fabricate the replacement skin panels and plan the simulated power-on connectivity more detailed data than was available in the technical orders was needed. Therefore, TCC personnel made several trips to The Boeing Company in Seattle, Washington, for consultation with Boeing engineers and technical staff. On the first trip, Dikewood engineers with EG&G assistance, selected the removable skin panels that were nearest the desired external test point locations (corresponded to E-3A scale model measurement points). Then, Boeing personnel retrieved the aircraft drawings from the E-3A microfiche file which gave the panel dimensions, and ran hard-copies for EG&G to keep. Boeing also provided schematics of the power distribution system on the aircraft and assisted EG&G engineers in determining the appropriate actions to take to accomplish simulated power-on. They also determined that the vent system adaptors used to connect the nitrogen inerting system to the EC-135G would work on the E-3A, which saved additional fabrication.

Another critical document supplied by Boeing was a computer listing of the Mil Spec or manufacturer's part numbers associated with the E-3A connector D-numbers. Since the P&A contractor specified the test points by D-number, EG&G had to translate these to part numbers that connector distributors would recognize before they could be ordered. All things considered, it was extremely valuable to have Boeing under contract to provide necessary assistance to the test participants. Without their help, the TCC's job would have been very difficult, and similar support from the test-article manufacturer should be seriously considered for future system level EMP tests.

## 3. TEST POINT IDENTIFICATION

For some reason, possibly due to the slow receipt of technical data, the P&A contractor was delayed in identifying internal current-measurement test points. In an effort to catch up and yet remain flexible, they named several large groups of D-numbers out of which a smaller set would be ultimately selected as test points. Although this was about the only course of action the P&A could take, it caused some inefficiencies in the way EG&G was able to handle the connectors. Also, EG&G got into the connector picture somewhat late, after it was determined that Boeing could not supply all the needed connectors from its on-hand stocks.

To try to support the test, EG&G was authorized to purchase the connector-pairs shown in the tentative test point lists. At the same time, Boeing received these lists and screened their stock for connector-pairs which could be released to the E-3A test program. As quickly as possible (some by TWX), EG&G issued Request for Quotes (RFQs) to seven connector manufacturers and distributors (Appendix A) asking for firm price and delivery statements. The RFQs allowed the companies to substitute equivalent form, fit and function connectors, i.e., different types of mounting (bulkhead, feedthrough, free line), different conductive finishing processes, different backshell mounting, etc. For the E-3A test, no connector backshells were procured because EG&G devised a breakout cable where the shield could be attached directly to the connector. This saved the Air Force approximately 30% of the amount of money spent on connectors, since a backshell could cost almost as much as the connector itself.

Due to the nearness of the test-start date and the long lead-times to produce connectors, EG&G was mainly constrained to buy the connectors from the company which had that particular part number in stock. Another problem EG&G had to contend with was that all the suppliers quotes did not arrive back at the same time. Therefore, a lot of the connectors were purchased from the early respondents who could promise timely delivery.

When Boeing identified connectors that they were supplying, they were deleted from EG&G's list if they had not already been ordered. Some of the connectors were never ordered because no source could promise delivery in time for the test. In addition, a few of the connectors had their delivery date slipped and did not arrive in time for their portion of the test.

Because of the delay in identifying the test points, many of the connectors could not be obtained. The manufacturers make runs of particular connectors only during specific times. This causes very long lead times on some of the more uncommon types of connectors.

Test point identification is one of the most important aspects for the daily planning of instrumentation. During the E-3A test some delays occurred from lack of test point location identification. For Experiment 5, no such delays occurred since all Experiment 5 points were tagged prior to the start of that experiment. The TCC was capable of tagging the remaining points during the test with no delay to the program, however, due to problems with the DASET system, the personnel allotted for this function were used in operating several screenbox recording systems. While this kept data collection delays to a minimum, it also precluded careful planning of main cable arteries and test point taging.

The placement of instrumentation cable arteries was also delayed as a result of the tardiness of the test point identification. More complete familiarization with the test aircraft would also have helped. For future tests of this type, more complete planning and access to the test vehicle early in the planning stages would greatly reduce the initial installation time at the start of the test.

In an effort to be absolutely complete and ready for testing, too many duplicate connectors were ordered to cover test points using the same types of connectors. Much of this duplication can be avoided with a better grasp of the situation during the period dedicated to planning. Also many of the test points were eliminated after the connectors associated with them were received and cables built. Hopefully, this situation can also be minimized in future test planning efforts.

To facilitate the procedure of test point tagging, better descriptions of the test point locations in the Detailed Test Plan would have been helpful. Often, no location was given other than a disconnect number and a station number. This required the TCC to cross reference with the T.O.s to pinpoint the location. The originator of the Detailed Test Plan had access to the T.O.s prior to the test and could have included a more complete description of the locations, thus minimizing delays during the actual test period. If this is done, and the Detailed Test Plan is made available to the TCC prior to testing, an approximate distribution of test points could be made on a floor plan of the AWACS, and Main Cable arteries could be routed graphically prior to the actual instrumentation. This method is highly successful as was demonstrated by the TCC for the power-on test.

Originally, the E-3A external test points were selected to match, as closely as possible, the points on the University of Michigan scale model. Where available, the test point was placed on a nearby, removable skin panel. In some cases, however, the aircraft had nothing but smooth skin in the vicinity of the desired test point location, e.g., top of the fuselage, rotodome strut. In other cases, the nearest skin panel was too small to accommodate the normally used B-dot and D-dot sensors. During the course of the test, the AFWL technical staff determined that any sensor which could not be bolted to a replacement panel which bolted to the aircraft had to be copper taped to bare aircraft skin. This necessitated some paint removal which was accomplished by Boeing personnel. Where small skin panels existed, EG&G used miniature sensors when there was sufficient signal, or fabricated adaptor panels to hold the larger sensor.

There is a limited amount of data concerning the use of EG&G manufactured B-dot and D-dot sensors taped to an aircraft over the paint. Of course, the electromagnetic ideal is to have the sensor in perfect electrical contact with the surface on which it is measuring the charge or current density. However, if the effect of taping the sensor to the aircraft over the painted skin is small and known, great flexibility in selecting external test points is achieved. Since this "paint scraping" issue is an important and recurring one, EG&G believes that it would be cost effective to quantify these effects under laboratory conditions to determine if and under what circumstances the B-dot and D-dot sensors could be used when taped over paint. (In all cases, the single-channel microwave transmitter is electrically bonded to the aircraft.)

## 4. SYSTEM SAFETY PROGRAM PLAN

The E-3A System Safety Program Plan was based primarily on the EC-135 and TACAMO Safety Plans prepared for the Air Force by the Autonetics Division of Rockwell International. It was modified by EG&G to cover the E-3A test article, the use of the new VPD-II simulator and the current Air Force safety directives. Inputs to the safety plan were also received from the agencies participating in the test program: AFWL/EL and SE, TAC, ESD, the Kirtland Air Base Wing, Dikewood, Rockwell, and Boeing. The safety plan was revised several times during the test program to incorporate new information and changed test plan requirements.

The Air Force is in the process of replacing its safety publication, AFR 127-101, with the Air Force Occupational Safety and Health (AFOSH) Program implemented by AFR 127-12. This creates a set of AFOSH Standards numbered 127-X and 161-X which are applicable to Air Force and Air Force contractor activities.

The Air Force Weapons Laboratory has also made a minor change in AFWL Regulation 127-1 by renumbering the Hazard Classifications. The new designations are:

Class I - CATASTROPHIC
Class II - CRITICAL

Class III - MARGINAL

Class IV - SAFE

5. GFE/GFP (BASE SUPPORT)

The list of Base Support Items to be used for the E-3A EMP test was taken from a list of support items used on other EMP tests. The result was that the TCC had items that were not needed and lacked some equipment not listed. Table 1 gives a revised list for basic equipment used for the E-3A test. This list will have to be revised on an individual basis for each particular test program.

It is suggested that the Air Force Weapons Laboratory (AFWL) purchase some current probes not presently in their inventory and increase the number of some of the high-use probes to complete its complement of sensing equipment. In the past, the missing probes were borrowed from other contractors so that important measurements could be made. From their previous experience and the E-3A test, the TCC has summarized the current-probe deficiencies it has noted in Table 2.

6. POWER-ON SIMULATION

Early in the test planning phase, TCC engineers got together with Boeing electrical power distribution personnel and explained what was desired from the Power-On simulation. Boeing then obtained some schematics from their files which showed the distribution system paths and elements, and indicated what the in-flight configuration would be. From this, the TCC developed a checklist and planned for the necessary hardware to implement the power-on simulation (see Appendix B for the checklist).

To properly simulate power-on conditions on the aircraft, it was necessary to jumper many relays. Jumpering these relays was very time consuming at the beginning of the test, since their installation required loosening of nuts, application of jumpers, and retightening of the nuts. This procedure was eventually modified so that loosening the nuts was not required which entailed using heavy duty battery clips on the ends of each jumper. This improvement cut the time necessary for this

Table 1

BASIC TEST SUPPORT EQUIPMENT

Current Probe, Atlantic Research CP-1 (1 ohm)
Current Probe, Atlantic Research CP-5 (5 ohm)

Current Probe, Singer-Stoddart 91550-2 (1 ohm)
Current Probe, Singer-Stoddart 93686-1 (2 ohms)
Current Probe, Singer-Stoddart 94430-2 (1 ohm)
Current Probe, Singer-Stoddart 93686-3 (2 ohms)
Current probe, Singer-Stoddarr 91550-1 (5 ohms)

| | |
|---|---|
| Sensor MGL-S7A(R) | Sensor HSD-S1A(R) |
| Sensor MGL-S5A(R) | Sensor HSD-3B(A) |
| Sensor MGL-S5A(A) | Sensor HSD-3B(R) |
| Sensor MGL-2D(A) | Sensor ACD-3 |
| Sensor MGL-2D(R) | |

Balun DLT-96

1.27 cm Superflex cable
RG-223 Coax cable
Type "N" connectors for Superflex cable
BNC connectors for RG-223 coax cable

| | |
|---|---|
| Between-series cable adaptors | GR 50 ohm Terminators |
| GR power dividers (TPD-874) | BNC 50 ohms Terminators |
| GR in line Attenuators 6 dB<br>14 dB<br>20 dB | BNC in line attenuators 6 dB<br>14 dB<br>20 dB |

Portable Lanterns
Copper tape - 5.08 and 7.62 cm width
Aluminum foil
400 Hz filters
Volt-ohm meter
Hickock Voltmeter 3310

TDR Unit
Impedance Bridge 4260A
Network Analyzer HP 8407A
Display Unit HP 8412A
Sweep Oscillator HP 8601
X-Y-Y Plotter HP 7045A
Walkie Talkies
Base Stations
Test Equipment Maintenance/Calibration (PMEL)
Field Reference Data
Industrial Vehicles Hi-Ranger
Fork Lift
Crane
Safety Belts
Impedance Probe Kit HP 11655A
Date Pulse 101
Tektronics 284 pulse generator

Data Acquisition System
Data acquisition Backup System

Table 2

INCREASED PROBE REQUIREMENTS

| Probe Type | Manufacturer | Transfer Impedance | Number Suggested |
|---|---|---|---|
| CP-1 | Atlantic Research | 1 ohm | 5 |
| CP-5 | Atlantic Research | 5 ohm | 10* |
| 91550-2 | Singer-Stoddart | 1 ohm | 10 |
| 91550-1 | Singer-Stoddart | 5 ohm | 10 |
| 94430-2 | Singer-Stoddart | 1 ohm | 5 |
| 93686-1 | Singer-Stoddart | 2 ohm | 1 |
| 93686-3 | Singer-Stoddart | 2 ohm | 2 |

*Assuming three are being used on screenbox trigger lines.

installation and removal by approximately 70%. Originally, these were the kind of jumpers planned by the TCC, however, to alleviate some concerns of AFWL personnel about poor conduction through the clips, they were not used at the start of the test. After the implementation of the modified jumpers, no change in data was noted, and the new jumpers were used for the duration of the test.

The checklist which was prepared by the TCC was used for every removal or installation of jumpers, and gave a permanent record of the electrical distribution system configuration.

## 7. BREAKOUT BOXES

To maintain the aircraft in a hardened configuration when making measurements on cable bundles with an overall shield it is necessary to have some type of shielding for the sensor. The method presently employed is a breakout box that is an enclosure for both the current sensor and cable bundle, which is somewhat cumbersome but effective. To maintain shielding effectiveness, tubular wire braid was used on all hardened breakout cables, and this braid was fastened to the breakout box by means of metal hose clamps. The hose clamps served two purposes: first, they kept the box securely closed, and secondly they maintained the shielding continuity throughout the breakout system.

In addition to this type of breakout cable, EG&G developed a coaxial breakout which required no hose clamps or braid utilizing a General Radio coaxial tee. These were turned into the Air Force at the end of the test.

8. BREAKOUT CABLES AND TUBULAR BRAID

A breakout cable is required when an individual wire current or voltage is desired or when the bulk current on a shielded cable is to be measured. It allows a single wire to be isolated for measurement or permits access to the cable bundle beneath an overall braid shield. The breakout cable consists of a connector-pair joined pin-to-pin with stranded hookup wire. The wires are approximately 35.56 cm long and have plastic insulation. The gauge of the wire used depended on the size of the wire-cup on the pins, with the largest gauge that would fit being used. Also, the stranded wire gave the cables maximum flexibility. Originally, it was planned to use color-coded wires to join the connector-pairs, but this proved difficult to implement. Instead, the mating wires were identified on both sides of the break with their pin numbers. An improved coupling joint for the wires on which measurements were to be made, for the most part, prevented accidental separation. (During the Power-On testing, the joints were soldered together so there was no chance of inadvertant separation.) The joint consisted of the female side of a connector pin and of a male pin fabricated by tinning a 0.64 cm tip on the other side of the cut wire. This allowed the male end to be slipped through the 0.15 cm hole in the CP-1 and CP-5 probes and plug into the continuation of the wire.

For breakout cables which were to be used on test points in an aircraft cable with an overall shield, it was necessary to provide a continuation of that shield over the section of breakout cable. EG&G used Tinned Copper Tubular Braid from Alpha Wire Company, series numbers 2176, 2178 and 2180. This braid is manufactured to Mil Spec QQ-B-575 and provides 95% shielding coverage. The tubular braid was attached to the back of the connectors, where the backshell would screw onto, using stainless steel hose clamps. These clamps were then covered with electrical tape for mechanical protection of the joint. No braid was used on breakout cables for test points in unshielded cable bundles.

To verify the shielding effectiveness of the breakout cable/breakout box combination, EG&G tested some representative cables mounted in several different boxes on a network analyzer. The ends of the cable were connected, forming a loop in the shield with the cable bundle wires forming a loop inside the shield. The shield was then inductively driven and the current in the bundle compared to the shield current. In all cases, the bundle current was greater than 40 dB down from 100 kHz to 110 MHz.

9. PANELS AND SPECIAL FIXTURES

Some of the external skin panels had to be manufactured on an individual, as needed, basis after the E-3A had arrived at Kirtland. This was the result of changing a few test point locations after the original test planning had been completed. Skin panels were built to accommodate the original test points using Boeing drawings, but several could not be used on the changed test points so new ones were fabricated at the TCC machine shop. In future programs, if specific mounting restrictions/locations are required, this information should be made available early enough to be incorporated in the test plan.

Locations for external measurements are also critical since the external skin mounted sensors are not flexible and require a nearly flat surface large enough to accommodate their bulk. This insures a smooth transition from skin to sensor. Replacement panel thickness is also important to match in maintaining the original skin continuity.

The need for wheel well boots and door and window covers was not confirmed until a very short time before they were needed. Because of the timing, most of the assembly work had to be done at the HPD site. This caused problems over security procedures and access to the area without interfering with ongoing tests. Much more of this work could have been accomplished off-site had the test plan reflected this need earlier.

The TCC built two sets of wooden steps to fit up to the lower lobe access doors of the E-3A Test Aircraft. These were used to ensure enough entry and egress paths in the case of emergencies.

The first replacement bailout-chute door containing the microwave feedthroughs and microwave control line entry point was not stiff enough to withstand the air pressure from the ground airconditioning cart. It had to be replaced by the original door which was slightly damaged upon removal. It was subsequently modified to accept these feedthroughs when it was decided the first system did not approximate the original equipment close enough. These feedthrough penetrations are difficult to locate and not alter the test article configuration, and decisions on their placement should be made early and agreed upon by the test participants.

## 10. DATA

During the test planning period, the TCC prepared to handle and QC the E-3A test data. Working with the Operations and Maintenance (O&M) contractor at the HPD/VPD-II facility, EG&G personnel became acquainted with the current DASET and ADSET procedures and application. The data forms available from past programs were reviewed for applicability on this test, and modified as required to meet the needs of the program. In some cases, a new form was generated to facilitate certain data handling or QC operations. The TCC and O&M contractor finalized the data handling and QC procedures and responsibilities, which are discussed extensively in Section IV of this report. Also during this period, the data group prepared to provide ADSET with the probe and sensor calibration curves. Because the ADSET digitizer was not available at that time, the curves from the network analyzer had to be digitized on the large Air Force Weapons Laboratory (AFWL) computer. They were then output as punch-card decks that could be read into ADSET via its card reader.

## 11. NITROGEN INERTING SYSTEM AND ATTACHMENTS

The nitrogen inerting system performed flawlessly during the E-3A test. This can probably be attributed to the major refurbishment of the system prior to the test. The only incident during the test was when the plastic feed line near the DASET van developed a leak, apparently after being stepped on. This depleted the nitrogen from the two bottles which were ON and let the supply pressure drop to zero. The leaky joint was repaired and full nitrogen bottles turned ON. The oxygen content of the aircraft fuel tanks was then checked and found to be at the normal 0-1 percent level. This indicated that the leak had developed early that morning, and the rising temperature of the nitrogen gas in the fuel tanks prevented a demand from being made on the nitrogen source.

The critical items in the inerting system are the pressure relief valves. They protect the aircraft's fuel system from an accidental over or underpressure. The fuel tanks are especially vulnerable, with bladder-lined tanks being the most sensitive. Usually, the rubber bladders are laced to the aircraft frame surrounding the fuel tank cavity. These bladders can only take a very small negative pressure (-0.34 psig for the E-3A) before there is a danger that they will collapse. If this happens, it is usually a depot-level operation to replace the damaged bladders. Therefore, it is extremely important to verify that the built-in pressure relief valves and the auxiliary climb-and-dive valves are functioning properly before the system is connected to the aircraft.

The connection of the nitrogen inerting system to the E-3A was relatively simple because of the design of the fuel vent manifold. The manifold had one dump on each wingtip, and all fuel tanks vented into one side or the other. The overboard vents were easily accessible, and the hose adaptors used on the Boeing EC-135 fit the vent pipes. The nitrogen was carried to the aircraft via 7.62 cm plastic pipe and vinyl hose. The hose was reinforced with a nylon helix for added strength and shape support.

## SECTION III
## TEST PROCEDURES

### 1. PROBE AND SENSOR CALIBRATION

The current probes used for the E-3A program were calibrated using a network analyzer, swept over a frequency range from 0.1 to 110 MHz. The test fixture used was borrowed from AFWL's Direct Drive Laboratory. The ground plane and free-field sensors were verified by running time-domain reflectometry (TDR) checks, which were compared with the manufacturers original TDR profiles. If planned early enough, the current probes could be calibrated using the automatic network analyzer (HP 8543A) in the Direct Drive Laboratory. This would allow the transfer impedance data to be placed directly on magnetic tape. Currently, this approach is not practical because the tape drives on the HP 8543A and ADSET are not compatible. It is believed that it would be possible to program the network analyzer CPU to produce a tape that ADSET could read. If this is achieved, the transfer impedance plots from a manual network analyzer would not have to be hand-digitized into ADSET. Elimination of this step would simplify the entry of data into the ADSET probe library and reduce the chance for human error.

### 2. INSTRUMENTATION

In a large test vehicle like the E-3A which had test points throughout, on two levels, efficient instrumentation becomes a serious problem. For this program, there was a 5-channel microwave transmitter forward near the bailout chute and one aft near the trap door to the lower lobe. In addition, there were three screenboxes on the aircraft, one near the front microwave, one midship and one across from the rear microwave. This necessitated a large number of coaxial cable arteries to bring the signals from the test points to the various transmitting and recording locations. For this test, the Air Force provided Andrews "Superflex", a flexible 1.27 cm diameter, 50 ohm cable with Type-N connectors. It requires a fair amount of work to lay in a cable artery, finding a suitable route, obtaining the appropriate cable lengths and grounding the shield to aircraft structure every 45.72 cm where possible. With the microwave and screenboxes competing for test points and a finite number of arteries into each "compartment" of the aircraft, TCC personnel did not always have access to the arteries that would have made the instrumentation effort most efficient. To prevent noise from leaking into the cables, aluminum foil was used to wrap connector joints. When a cable was suspected of being faulty, a TDR trace was run on it and the location of the defect isolated and repaired.

Installation of the probes and field sensors became fairly routine over the course of the test. To minimize problems, TCC personnel used some standard procedures when instrumentating various types of test points based on the probe/sensor being used. The following list is appropriate for the work done on the E-3A:

- Verify test point number and location.
- Select sensor type according to desired measurement quantity, e.g., bulk current, wire current, normal electric field, etc.
- Select sensor sensitivity appropriate for the expected signal, i.e., transfer impedance or effective area.
- If the measurement is on a single wire, obtain the breakout cable for that test point.
- If the measurement is on a cable/wire that has an overall shield, obtain the appropriate breakout box.
- Mount the probe and breakout cable in the breakout box, if required.
- Place the correct wire or bundle through/to the probe element.
- For Stoddart-Singer probes, make sure the probe is closed and the clip is snapped.
- For Atlantic Research probes, make sure the wire is securely remated.

- If using a breakout box, fasten it closed and cover the seams with copper tape.
- If using a breakout cable, insert it into the line to be measured, insuring that the connectors are fully mated.
- For field sensors:
  - mount the sensor to the replacement skin panel in the desired orientation using machine screws (insure that the contacting surfaces are free of non-conducting debries and oxide).
  - mount the skin panel on the aircraft using the original aircraft screws.

    Note: It is sometimes convenient to reverse the above two steps.
  - if there is no replacement panel, orient the sensor and copper-tape it to the aircraft where the paint has been removed for that test point.
  - copper tape the edges of the sensor back-plate to the skin panel.
  - attach the "Superflex" cable to the sensor and copper-tape the joint.
  - bond the cable to the aircraft using clamps/ screws where possible or copper-tape to the skin where paint has been stripped for that purpose.
  - mount the single-channel microwave transmitter can on the aircraft using two stainless steel hose-clamp rings screwed to existing aircraft fastening points and attach and copper-tape the cable (the transmitter's longitudinal axis should be perpendicular to the primary skin current at the mounting location to minimize noise pickup by the transmitter).
  - run the DWG from the transmitter horn to the receiver, making sure there are sufficient styrofoam donuts on the DWG to keep it away from the aircraft skin.

- Connect the probe into a nearby cable artery using another piece of "Superflex" cable of the appropriate length, and cover the joints with aluminum foil.
- Bond the connecting cable to aircraft structure approximately every 45.72 cm, making the first ground strap as close to the probe as possible.
- Verify that the cable artery is connected to the desired microwave channel or screenbox.
- Set the estimated attenuation/sensitivity into the recording system chosen and arm it.

This completes the steps required for the preparation of data collection, and the test crew is ready for a pulser shot.

During the test, some problems were encountered due to cracked/broken cables. Most often, the shielding would split behind the connectors on the cable ends from repeated bending and hookup to probes. This caused many delays as the noise source was traced and the bad cable replaced. The Andrews Company now makes a better cable that is designed to withstand repeated bending, although it won't make as tight of a radius as "Superflex". EG&G suggests that some LDF4-50 cable be procured and tried out as an EMP instrumentation cable. It has better overall properties, except turning radius, than "Superflex".

Due to DASET's slow data acquisition rate, screenbox systems were added to supplement DASET. The P&A contractor soon had the screenboxes collecting the bulk of the test data. The original cable arteries were setup for the microwave systems (fore and aft transmitters) and the screenboxes presented some new problems of location and tie in to the planned system. Some additional arteries were added where possible, but the excessive weight and bulkiness of the screenboxes made their placement on the aircraft difficult. Ideally, a screenbox requires three to four people to move it. Because of restricted space on the E-3A, two people often had to move the screenbox. This resulted in a few small dents in some cabinets and the floor. For future tests, the TCC recommends screenboxes that can be easily handled by two men. Triggering problems with the screenboxes were also encountered and it was determined that a centralized permanent trigger system should be implemented if screenboxes are to be operated more efficiently.

It was late in the test planning when the Repetitive Pulse Generator (RPG) test was added to the E-3A program. From an instrumentation standpoint, the RPG requirements were fairly straightforward. Three Tektronix 485 oscilloscopes with 1105 battery/inverter packs were used in a portable mode (without screenboxes). Each scope was used on a different test point, being placed as close as practicable to the measurement location. The scope was attached to the current probe with a short length of "Superflex" cable. P&A personnel observed the scope traces, and then had TCC technicians record the curve on film.

3. AIRCRAFT INERTING

The detailed procedures for aircraft fuel tank inerting are contained in the E-3A General Test Plan. They proved satisfactory for the test, and with appropriate modifications for test article differences, may be used for future system level tests. One Air Force requirement not specifically mentioned is the need to have a fire truck present during aircraft DEFUELING operations. Usually, defueling of the aircraft is only required once, at the time of the first inerting and involves off-loading fuel from a full load to 15% in each tank while nitrogen is supplied to the tanks. As an additional safety precaution on this test program, a fire truck was present during E-3A fueling operations also.

To facilitate ease of aircraft movement around the pad, the nitrogen supply hoses were suspended from the aircraft on yellow plastic rope. The rope was attached to lugs bolted to the E-3A or was slung over the engine pods with rubber hose sleeving to protect the aircraft paint. When the plane was moved in and out of HPD, at least two people (three was better) were required to move the nitrogen hose so that it would not be run over or stretched.

On several occassions it became necessary to remove the nitrogen hose from the aircraft completely, e.g., moving the aircraft to the other test pad. This was done during the day when the nitrogen in the fuel tanks was expanding so there was no demand on the nitrogen source. The nitrogen input and output valves on the cart were closed and the line was separated at the climb-and-dive valve next to the fuselage. The aircraft side of the line was capped, with the excess nitrogen flowing out of the positive relief vent on the climb-and-dive valve. (Note: There must be a climb-and-dive valve in the aircraft side of the circuit at all times to prevent inadvertant fuel cell failure.)

## 4. TYPICAL TEST DAY

In a large, system level test it is somewhat difficult to say what constitutes a "typical" test day. However, after conducting the E-3A test, some generalizations may be made about the activities and sequences that worked for this program. Table 3 is an updated version of the one found in the General Test Plan, and may be used as a guide for test activities.

## 5. WEATHER FACTORS

During the five month E-3A test, from June through October, the weather was very cooperative. There were about four days when testing was not even begun due to rain. However, on other days affected by the weather (about 15), some testing was accomplished. The most usual occurrence was high afternoon winds (1300 - 1500 hours, local) which forced the lowering of the HPD antenna. Sometimes, the winds were accompanied by a thunderstorm which caused all activities on the aircraft and test pad to be suspended. If there was sufficient time left in the day when the rain started, the CW impedance equipment was set up on the aircraft and data collected until quitting time. A few times, test startup in the morning was delayed after a heavy rain the night before. The

Table 3. Typical Test Day

| Time (Approximate) | Event |
|---|---|
| 0600-0630 | Weather check, raise HPD (if using facility), turn on Data Acquisition System for EMP Testing (DASET). |
| | Instrument test points. |
| | Prepare A/C for moving. |
| 0630-0730 | DASET auto-cal, pulser warm up and checkout shot, fresh batteries in microwave transmitters. |
| 0700-0730 | Daily planning and status meeting. |
| | Move A/C into position for testing if necessary. Initialize DASET, input parameters. Install dielectric waveguide and pneumatic lines, place single channel microwave transmitter. |
| 0730-0800 | Attach air conditioning to A/C if needed. Checkout microwave system. |
| | QC instrumentation setup, walk-around inspection of test area. |
| 0800-1645 | Senior analyst and data specialists on station. |
| 0800-1545 | Pulser shots to obtain test data and signal to noise ratios, microwave cal pulses. |
| | Continue to reinstrument and record data as needed. |
| | Pulser shots and reinstrumentation continue throughout the work day (lunch, reinstrumentation, etc.). |
| 1600 | Shut down pulser. |
| 1600-1630 | Shut down and secure instrumentation and other systems, prepare A/C for moving. Microwave batteries to charger. |
| 1615-1645 | Shut down DASET. |
| 1630-1645 | Lower HPD Pulser and secure. |
| 1645 | A/C Maintenance if required. |

time was needed to dry out the dielectric waveguide (DWG) and pulser components. Overall, the Albuquerque Summer-Fall period provides an excellent weather environment for system level EMP testing.

6. ELEVATED EXTERNAL TEST POINTS

A recurring problem in system level testing is access to external test points that are above the reach of ground-level personnel. In these cases, steps, ladders, stands or a Hi-Ranger must be used to allow the emplacement of sensors, cabling, microwave transmitter and DWG at these elevated locations. On the E-3A test, all of the above methods were used, some with more success than others. On the bottom rear of the fuselage and the underneath side of the wings wooden step-ladders were used effectively to reach the test point locations. When working near the top of the ladder or in gusty winds, it was necessary to have an additional person steady it. For a test shot, it was easy to fold the wooden ladder and move it a short distance from the aircraft. For access to test points on the top of the wing, personnel used the overwing hatch to get out on the wing. The walkway areas on the wing were clearly marked in the aircraft paint scheme and the test point locations were directly accessible from the walkway. There was a tripping hazard in this area due to a number of three-inch high vortex generator vanes. These just had to be worked around.

The real difficulty came in accessing test points on the vertical stabilizer, the rotodome struts and rotodome, and the top of the fuselage. For the E-3A test, four different aircraft stands were available: B-1, B-2, B-4, and B-6. The B-6 stand is an E-3A peculiar piece of AGE for rotodome access and would not be available for other aircraft tests. The B-1 stand is basically a portable stairway with a small platform on top. Its nominal extension range is from 1.5 to 3.0 meters and it was used for access to the cabin hatches and underside of the wings. The B-4 stand is a rectangular platform which elevates with a pure vertical motion and has an expanding ladder for access. It has a range of approximately 0.9 to 2.44 meters, and was used mostly for working on the underside of the wings.

The B-2 stand can be thought of as a B-1 stand on an elevated platform approximately 3.0 meters high. The stand had sufficient extension to reach the top of the fuselage and the middle of the rotodome strut. When used for access to the top of the fuselage, especially at the base of the vertical stabilizer, care had to be taken not to bang the personnel platform into the aircraft. This was because, although the stand had a rubber bumper on the front edge of the platform, there were angle-iron stiffners that protruded below the bumper which could contact the aircraft. This stand was easily movable by two people, and was comfortable to work from, even in gusty winds. From the E-3A test, the TCC found this stand very useful and recommends that it be available for future aircraft tests.

The B-6 stand was designed specifically for use with the E-3A aircraft, for accessing the rotodome compartment, and is only available at E-3A units. For this test, the 552nd AWAC Wing was able to dedicate a stand from Tinker AFB, Oklahoma. The stand was sent by truck, disassembled and packed on a pallet. It was a relatively complex job to put together and required E-3A personnel and a crane. The crane had to have a one ton capacity and a reach of approximately 6.1 meters. Nominally, the stand required three people to move it around the pad, although two TCC personnel often moved it when other assistance was not available. For long distance moves, a pickup truck or tug was used. When the aircraft first arrived at the test site, a standard, plastic-bucket Hi-Ranger was available to be used to access the test points on the top of the vertical stabilizer. However, when it was tried, it did not have sufficient reach or stability as it approached its maximum extension, so it was abandoned. Then, another "hi-ranger" (actually an alcohol de-icer truck with a hi-lift platform) was brought to the site. This unit had an adequate reach, but the lifting·hydraulics were not stable and the platform would not hold its position. This caused a danger to the aircraft skin and structure, so its use was discontinued. Since an adequate Hi-Ranger was not available, TCC personnel suggested that the B-6 stand be tried as a means to reach the stabilizer. It was found that by raising the stand to near its maximum extension, test personnel could easily reach the aircraft access panels and test points at the top of the stabilizer. It is the opinion of the TCC that this stand was more stable and easier to use than a Hi-Ranger. The stand had mechanical locks on its hydraulic piston and wheels to prevent inadvertant motions, could be rolled into the tail and positioned for use in two to three minutes, and did not involve driving a motor vehicle in the vicinity of the aircraft. The main drawbacks of using the stand were the extreme care which had to be exercised while climbing the steps (no more than two people were allowed on the stand at a time), the effort involved in climbing to the top, especially carrying a microwave transmitter, and the difficulty two people had in moving it. For other aircraft tests, this stand will not be available, and a suitable Hi-Ranger will need to be available for the test period.

7. TAC PERSONNEL

In general, TCC personnel had a good working relationship with the TAC crew that tended the E-3A at Kirtland. Occasionally, there was some friction when test personnel (not always TCC) accidently stripped a phillips screw head, put small dents in the laminated floor or a cabinet side moving a screenbox, or let a hatch tip over scratching the plexiglass window. Because of the large number of aircraft screws used as grounding points, the technicians used cordless electric drills with phillips bits for removing and inserting the screws selected as ground points. Sometimes the head of a stubborn screw would be damaged during the operation. Moving the steel screenboxes in the confines of the aircraft, especially the front end, was extremely difficult. It was all two men could do to lift the box, and trying to carry it down the narrow aisle was a real struggle. To protect the aircraft floor, rubber and plywood "booties" were made and placed on the steel legs of the screenboxes. What would have reduced the hazard associated with moving the boxes would have been units of approximately half the weight. If screenboxes are anticipated for use inside aircraft in future EMP tests, the TCC recommends that lighter weight boxes be obtained. (Note: Most of the shield boxes at the HPD/VPD II facility are in need of some refurbishment, e.g., broken fingerstock, damaged feedthroughs, etc.)

The TAC crew assisted the TCC by removing the aircraft carpets, most of the cosmetic panels, various skin panels, and generally helped with test-point access. One of their technicians worked with TCC personnel in implementing the Power-On simulation on the aircraft and verifying its removal for maintenance periods. TAC was very cooperative about working their maintenance tasks during the time allotted or during non-test hours. They often worked "overtime" at night or on weekends so that the aircraft would be ready for testing as scheduled. Both TAC and TCC personnel inserted and removed the cockpit window EMP shields as necessary. Apparently, the VELCRO fasteners on the shields were not designed for repeated handling, as some of them were showing wear from being used repeatedly in the test program.

An unforeseen event caused the loss of one of the main cockpit windows on the E-3A. During the POE Closure Experiment, thin sheet aluminum was cut-to-fit and copper-taped over all the cockpit windows. This testing was done in a period of very hot weather, and the sheet over one of the front windows got hot enough so that the window delaminated. A new window was obtained from Boeing, and installed by TAC personnel during the post-test refurbishment of the aircraft. If similar experiments are planned for future tests, the covers must be protected from extreme heat. A possible approach would be to cover the exterior of the aluminum sheets with 1.27 cm Styrofoam insulation, which will greatly reduce the heat transmitted to the glass windows.

Testing at HPD required that the aircraft be moved under the antenna in the morning and out at the end of the test day. The TAC Crew Chief instructed TCC supervisory personnel on how to be observers for aircraft moves. Then, the TCC assisted TAC with the repositioning of the aircraft when there was a shortage of TAC personnel, plus the technicians carried the nitrogen hose. Aircraft movement was one of the smoothest operations during the E-3A test. About the only problem encountered was with keeping people inside the confines of the security fence. It was sometimes necessary for personnel to leave the security area to clear obstructions from portions of the aircraft that stuck out beyond the security fence. To avoid problems, the guard was notified of this contingency before each move, and he controlled unauthorized entry into the secure area while permitting the aircraft move to be conducted in a safe manner.

8. POWER-ON TESTING

The AFWL supplied all but a few current probes used on the E-3A program. There was a shortage of current probes, especially those with a 5 ohm transfer impedance. This shortage was felt more acutely during power-on testing because a larger set of test points was instrumented at one time. It should be corrected since it may not always be practical to borrow these from a contractor, as was done for the E-3A test and there will be a continuing need for a larger inventory of probes.

New filters (400 Hz) were built for use during the power on phase of the E-3A test. They were installed in GR insertion units and clearly marked, making them applicable for future programs. Both series and "T" filters were built. If possible, these type units should be smaller and placed in Type "N" insertion units to make their use easier.

To insure efficient test point acquisition for the power-on phase, the TCC laid out the test points on the aircraft floor plan and ran new optimum cable arteries. These cables were then TDR'd to insure their integrity. This minimized the time delays due to moving instrumentation. Each stationary cable artery was grounded and then taped to the floor for its entire length to prevent a tripping hazard.

In order to insure adequate equipment cooling for the on-board systems during the power-on phase of the E-3A EMP test, two new air conditioning ducts were run to the aircraft under the left wing. Enough 30.48 cm diameter plastic pipe was purchased to extend from the aircraft to beyond the wing-tip. Rigid plastic pipe was chosen to minimize the possibility of the lines blowing around due to winds or engine jet-wash. The pipe was run under the engine nacelles to take advantage of the null there and sandbagged under restraining boxes to prevent movement. The two pipes each had a 45 degree elbow just in-board of the left in-board engine, with the front pipe running to the front air conditioning port and the rear pipe feeding the aft input.

## 9. BREAKOUT BOX QUALIFICATION TESTS

Because of the extensive use of shielded cable bundles on the E-3A aircraft, the TCC developed a first generation, universal breakout box which is described in the General Test Plan. This prevented a separate breakout box from having to be fabricated for each of the 100 or so breakout cables. In order to characterize the shielding effectiveness of the breakout box/breakout cable assembly, several typical ones were tested by the TCC on a network analyzer in the band of 0.1 - 110 MHz. The worst case occurred at low frequencies and was 48 dB, with an average range of 55-65 dB. A test report detailing the setup, procedures and results was submitted to the Air Force Project Officer for review. In addition, the TCC provided AFWL technical personnel with a typical assembly for an independent check on its shielding effectiveness.

## SECTION IV
## DATA MANAGEMENT

### 1. INTRODUCTION

The objective of Data Management during the E-3A Program was to maintain an accurately characterized, high quality data base from which data could be easily retrieved for both quick-look analysis during the testing program and for future analysis. The test data acquired and the analytic data produced during E-3A, were controlled by E-3A Data Management (DM) and were processed by and/or stored in the AFWL-ADSET System. This system also provided the means through which to access the data entered into the data base during the E-3A Program.

Within this section, the discussion is directed toward identification of the data base developed during response testing in the HPD/VPD-II Facility, and the E-3A DM procedures, techniques and records employed to ensure the accuracy and quality of the HPD-VPD II response test related data in the growing ADSET data base.

### 2. RESPONSE TEST DATA

The HPD/VPD-II Response Test related data present in the ADSET data base consist of E-3A test data. Within ADSET, segregation of common blocks of data is achieved by assignment of test/facility codes. The specific codes used during the HPD/VPD-II response testing portion of the E-3A are given below:

| Data Description | Test/Facility Code |
|---|---|
| E-3A/HPD Response Test Data | AH |
| E-3A/VPD II Response Test Data | AV |
| E-3A/Environment Reference | AM |
| E-3A/Field Mapping | AF |
| E-3A/Special Direct Drive | AD |
| E-3A/284 Microwave Calibration | AW |

For each measurement or prediction in the data base, a characterization record and a set of time and amplitude pairs are stored in ADSET. The stored (time, amplitude) data are normally the final result of time-tieing two or more traces of the same data, recorded at different sweep speeds, with corrections for attenuations and vertical sensitivites or microwave channel gains included. Occasionally, the data represents a single sweep speed trace (no time-tieing). Corrections for probes, integrators, scope loading effects, or microwave frequency response are not taken care of in the stored data. The E-3A characterization record is 128 characters long and is divided into 42 fields as shown in Table 4.

In addition to the measurement, prediction, and error analysis data, ADSET contains supporting data. There is a probe library that can be accessed and used to correct the data for sensor effects. Those probes used during E-3A are listed in Table 5.

There were several programs available on the ADSET System that could be used to access and work with the stored data. CHREDI accesses only the stored characterization records. It could be used to edit or delete records, list characterization records in selected subsets of the data base, or list a single characterization record. TAPCRF could be used to produce a tape request file. The ADSET Data Numbers (ADNs) needed dictate which program is simpler to use. The ANLn program provides the capability to access the (time, amplitude) pairs and correction functions, and perform various operations with these data. These operations include:

- Scaling and Biasing
- Fourier Transforms
- Arithmetic Operations
- Inverse Transforms
- Instrumentation Corrections in the Frequency Domain

During most of the E-3A Program, a version of the computer program was used on the CDC 6600/7600 to sort on and list selected parameters from the characterization records.

As mentioned above, CDC 6600/7600 data tapes of the ADSET stored data could be acquired. The data on such a tape consist of the ADSET characterization record followed by the (time,

Table 4
ADSET CHARACTERIZATION RECORD

| Field | Channel | Parameter Name | Description | Format |
|---|---|---|---|---|
| 1 | 1 | Test/Facility | An alphanumeric identifier assigned to a particular test in a particular facility. | A2* |
| 2 | 3 | Data Number | Sequential file number of a data set within a data block defined by a specific test/facility code. | I5* |
| 3 | 8 | Julian Date | Date. First digit is last digit of the year; next three digits indicate the number of days into the year. | I4 |
| 4 | 12 | Exp. # | Defines particular test performed. | A2 |
| 5 | 14 | Configuration | A unique set of alpha/numeric characters to define test item configuration. | A3 |
| 6 | 17 | Test Item Position X Coordinate | ±XX (nearest meter) | A3 |
| 7 | 20 | Test Item Position Y Coordinate | ±YY (nearest meter) | A3 |
| 8 | 23 | Test Item Position Z Coordinate | ±ZZ (nearest meter) | A3 |
| 9 | 26 | Shot Number | Sequential number obtained from facility pulser shot log. For special tests, this number is set by the test director. | I4 |
| 10 | 30 | Environmental | The entry is ZWY where ZW.Y is the reference field sensor level in kV/m. | I3 |
| 11 | 33 | Test Point Number | Coded numbers which represent a particular point in the test volume or on the test item. | A4 |
| 12 | 37 | Measurement | Two character code that indicates what type of measurement was made or predicted (see Table 6). | A2 |

*The combination of TEST and DATA NUMBER is used as the unique number for the data set. This number is used to access the data in the ADSET data base.

Table 4 (Continued)

| Field | Channel | Parameter Name | Description | Format |
|---|---|---|---|---|
| 13 | 39 | Instrumentation Number | Number which represents an instrumentation setup and can be used to indicate a calibration file location. | A4 |
| 14 | 43 | Signal-to-Noise Ratio | Signal peak amplitude to noise peak amplitude ratio expressed in dB. | I2 |
| 15 | 45 | Sensor Number | This number indicates the type of sensor used and indicates the sensor calibration file. The sensors used during E-3A program are listed in Table 5. | A4 |
| 16 | 49 | Calibration Pulse Number | Not used during E-3A because a calibration pulse trace accompanied each microwave data trace processed. | A3 |
| 17 | 52 | Time Domain Response | Peak response of corrected time domain data-determined after the inverse transform. | E8.3 |
| 18 | 60 | Pulse Width | Peak amplitude pulse width in nanoseconds determined after the inverse transform. | I3 |
| 19 | 63 | Dominant Frequency | Self-explanatory, format XXX.X MHz. | I4 |
| 20 | 67 | Frequency Amplitude | Format ±.XXX±XX. | E8.3 |
| 21 | 75 | Secondary Frequency | Same as Dominant Frequency. | I4 |
| 22 | 79 | Frequency Amplitude | Same as Dominant Frequency Amplitude. | E8.3 |
| 23 | 87 | Sensor Calibration | Shows if sensor calibration has been unfolded, 0 - no, 1 - yes. | A1 |
| 24 | 88 | Instrumentation Calibration | Shows if other instrumentation calibration has been unfolded, 0 - no, 1 - yes. | A1 |
| 25 | 89 | Integrator Calibration | Used for field or skin sensors, 0 - no, 1 - yes, 2 - N/A. | A1 |
| 26 | 90 | Number of photos in time-tie | Letter indicates total number of photos per data set. (A for 1, B for 2, etc.) | A1 |

Table 4 (Continued)

| Field | Channel | Parameter Name | Description | Format |
|---|---|---|---|---|
| 27 | 91 | Normalization | Has the data been normalized? 0 - no, 1 - yes. | A1 |
| 28 | 92 | Truncation | Type of truncation tail placed on corrected data. 0 - none. | A1 |
| 29 | 93 | Rise Time | Pulser risetime (10% to 90%) as measured by the facility reference sensor (ns). | A2 |
| 32 | 99 | Group Number | E-3A major data file guide. | A3 |
| 35 | 106 | Comments | Comments for this program were standardized and coded (see Table 7). The comment codes were entered in the first 8 characters of this field. The ninth character indicates the sign of the data as stored (0 positive, 1 negative). | A9 |
| 36 | 115 | NPTS | Number of data points stored. | I4 |
| 37 | 119 | Total Attenuation | Self-explanatory (units of dB). | I3 |
| 38 | 122 | Sweep Speed | Code indicating the sweep speeds used when data were recorded (see Table 8). | A1 |
| 39 | 123 | Vertical Sensitivity | Code for vertical sensitivity of fastest sweep speed trace (see Table 8). | A1 |
| 42 | 126 | Disk ID Number | ADSET disk number for the particular data set. | A3 |

TABLE 5

E-3A PROBE LIST

| Sensor No./ Library No. | Type | Transfer Impedance (Ohms) | Serial No. | Comments |
|---|---|---|---|---|
| 347 | 91550-2 | 1 | BN118 | 22 Mar 78 |
| 348 | 91550-2 | 1 | BN148 | 22 Mar 78 |
| 349 | 91550-2 | 1 | SN150 | 22 Mar 78 |
| 350 | 91550-2 | 1 | SN157 | 22 Mar 78 |
| 351 | 91550-2 | 1 | BN161 | 22 Mar 78 |
| 352 | 91550-2 | 1 | SN197 | 22 Mar 78 |
| 353 | 91550-2 | 1 | SN232 | 22 Mar 78 |
| 354 | 91550-2 | 1 | SN237 | 22 Mar 78 |
| 355 | 91550-2 | 1 | SN248 | 22 Mar 78 |
| 356 | 91550-2 | 1 | SN299 | 22 Mar 78 |
| 357 | 91550-2 | 1 | SN343 | 22 Mar 78 |
| 358 | 91550-2 | 1 | SN516 | 22 Mar 78 |
| 359 | 91550-2 | 1 | BN156 | 22 Mar 78 |
| 360 | 94430-2 | 1 | SN11 | 22 Mar 78 |
| 361 | 94430-2 | 1 | SN12 | 22 Mar 78 |
| 362 | 94430-2 | 1 | SN13 | 22 Mar 78 |
| 363 | 94430-2 | 1 | SN14 | 22 Mar 78 |
| 364 | 94430-2 | 1 | SN15 | 22 Mar 78 |
| 365 | 94430-2 | 1 | SN17 | 22 Mar 78 |
| 366 | 94430-2 | 1 | SN18 | 22 Mar 78 |
| 367 | 94430-2 | 1 | SN19 | 22 Mar 78 |
| 368 | 94430-2 | 1 | SN23 | 22 Mar 78 |
| 369 | 94430-2 | 1 | SN24 | 22 Mar 78 |
| 370 | 94430-2 | 1 | SN26 | 22 Mar 78 |
| 371 | CP-1 | 1 | NO15 | 23 Mar 78 |
| 372 | CP-2 | 1 | NO17 | 23 Mar 78 |
| 373 | CP-1 | 1 | NO21 | 23 Mar 78 |
| 374 | CP-1 | 1 | NO23 | 23 Mar 78 |
| 375 | CP-1 | 1 | NO24 | 23 Mar 78 |
| 376 | CP-5 | 5 | NO06 | 23 Mar 78 |
| 377 | CP-5 | 5 | NO26 | 23 Mar 78 |
| 378 | CP-5 | 5 | NO57(SN427) | 23 Mar 78 |
| 379 | CP-5 | 5 | NO58(SN428) | 23 Mar 78 |
| 380 | CP-5 | 5 | NO59(SN429) | 23 Mar 78 |
| 381 | CP-5 | 5 | NO60(SN430) | 23 Mar 78 |
| 382 | 93686-3 | 2 | NO43 | 03 May 78 |
| 383 | 93686-3 | 2 | NO65 | 03 May 78 |
| 384 | CP-5 | 5 | NO51 | 02 May 78 |
| 385 | 91550-2 | 1 | NO120 | 03 May 78 |
| 386 | 93686-1 | 2 | BJ35 | 02 Jun 78 |
| 387 | 91550-1 | 5 | BF384 | |
| 388 | 91550-1 | 5 | BF389 | |
| 389 | CPM-1 | | | |
| 390 | 91550-1 | 5 | 853 | |

TABLE 5 (Continued)

| Sensor No./ Library No. | Type | Transfer Impedance (Ohms) | Serial No. | Comments |
|---|---|---|---|---|
| 3 | HSD-1 | | | Volts/meter |
| 9 | HSD-2 | | | Volts/meter |
| 13 | HSD-3 | | | Volts/m/Sec |
| 25 | MGL-5 | | | Amps/M/Sec |

TABLE 6

MEASUREMENT TYPES

The measurement types will be coded by consecutive numbers as given below. This list will be augmented as necessary.

| DASET Code | Characterization Record Code | Measurement Type |
|---|---|---|
| 1 | V5 | Voltage across a 50 ohm load |
| 2 | V1 | Voltage across normal load Conditions |
| 3 | VO | Open circuit voltage measurements |
| 4 | I5 | Current through 50 ohm load |
| 5 | I1 | Current through normal load |
| 6 | IS | Short Circuit Current |
| 7 | N1 | Noise measurement with sensor foiled |
| 8 | N2 | Noise measurements with cable left open |
| 9 | N3 | Noise measurement with cable shorted |
| 10 | N4 | Background noise measurement without pulse |
| 11 | N5 | Noise measurement into cable impedance load |
| 12 | Q1 | Charge density |
| 13 | JA | Current density axial |
| 14 | JC | Current density circumferential |
| 15 | EX | Electric field in X direction |
| 16 | EY | Electric field in Y direction |
| 17 | EZ | Electric field in Z direction |
| 18 | HX | Magnetic field in X direction |
| 19 | HY | Magnetic field in Y direction |
| 20 | HZ | Magnetic field in Z direction |
| 21 | HR | Magnetic field in radial (toward pulser) direction |
| 22 | HT | Magnetic field perpendicular to radial direction |
| 23 | ER | Electric field in radial (toward pulser) direction |
| 24 | ET | Electric field perpendicular to radial direction |
| 25 | HI | Total H field of the pulser |
| 26 | HS | Total H field of the image of the pulser |
| 27 | TS | Timing shot |
| 28 | EA | Error Analysis |
| 29 | J1 | Current density axial |
| 30 | J2 | Current density circumferential |

TABLE 6 (Continued)

| DASET Code | Characterization Record Code | Measurement Type |
|---|---|---|
| 31 | J3 | Current density axial unintegrated |
| 32 | J4 | Current density circumferential unintegrated |
| 33 | J5 | Current density axial double derivative |
| 34 | J6 | Current density circumferential double derivative |
| 35 | Q2 | Charge density unintegrated |
| 36 | Q3 | Charge density double derivative |
| 37 | NC | Noise probe removed from cable and placed beside it (current probes) |
| 38 | ØØ | Unassigned |
| 39 | ND | Noise-hot probe tip grounded, ground tip shorted (diff. voltage probe) |
| 40 | SH | Shield current |
| 41 | IB | Core current |
| 42 | NT | |
| 43 | IW | Wire current (pin current) |

TABLE 7

E-3A TEST

CODED COMMENTS SUMMARY

| Comment Code Number | Comments |
|---|---|
| 01 | 284 test |
| 02 | Signal-to-Noise ratio computed using poorly resolved noise measurements. |
| 03 | Noise shot not available. |
| 04 | Noise shot not available - Used baseline line for noise. |
| 05 | Multiple shots time tied. |
| 06 | Marginal quality data |
| 07 | Single hun |
| 08 | Two wires connected |
| 09 | Hand digitized DASET data. |
| 10 | Marginally quality data processed under direction of Bill Cordova |
| 11 | No reference data or environmental risetime |
| 12 | Time-tie includes different vertical sensitivity. |
| 13 | Output on DASET B system from 5-channel A microwave. |
| 14 | Signal-to-noise is larger than 100. |
| 15 | Raceway data. |
| 16 | Reprocessed by Dikewood's request. |
| 17 | Derivative measurements. |

TABLE 8

DASET/ADSET Characterization Record Codes

I. Sweep Speed Codes

| | | |
|---|---|---|
| | | 0 |
| 0 | 1 | 5 |
| 1 | 5 | 10 |
| 2 | 5 | 20 |
| 3 | 10 | 20 |
| 4 | 10 | 50 |
| 5 | 20 | 50 |
| 6 | 20 | 100 |
| 7 | 50 | 100 |
| 8 | 50 | 200 |
| 9 | 100 | 200 |
| A | 100 | 500 |
| B | 200 | 500 |
| C | 200 | 1000 |
| D | 500 | 1000 |
| E | 500 | 2000 |
| F | 1000 | 2000 |
| G | 1000 | 5000 |
| H | 2000 | 5000 |
| Z | 100 | 1000 |

| | |
|---|---|
| J | 20, 50, 100, 200 |
| K | 50, 100, 200, 500 |
| L | 20, 50, 100, 500 |
| M | 10, 20, 50, 100 |
| N | 50, 200, 500, 1000 |
| X | Unknown/Other |

II. Vertical Sensitivity Codes

| | |
|---|---|
| 0 | 5 |
| 1 | 10 |
| 2 | 20 |
| 3 | 50 |
| 4 | 100 |
| 5 | 200 |
| 6 | 500 |
| 7 | 1000 |
| 8 | 2000 |
| 9 | 5000 |
| A | 10000 |

amplitude) pairs as stored on ADSET. Various programs exist that can read these tapes, do fourier transforms and inverse transforms, and plot the E-3A Response Test Data.

## 3. DATA MANAGEMENT OPERATION

Data Management operations for the E-3A Program were concerned with the flow and maintenance of quality of the data among the three primary program areas:

- Test Data Acquisition
- Data Processing
- Data Analysis

As a result of the use of DASET, DM was involved in the actual acquisition of the test data. The test group, assisted by DM via two data acquisition quality control (QC) analysts in DASET, conducted the test, recorded the various responses, and provided the raw test data.

In order for the data to move smoothly from acquisition through analysis and maintain a consistently high level of quality, a set of operating procedures was established. The general operation of Data Management (DM) can be represented as shown in Figure 1.

Throughout the test, DM functioned in a quality control (QC) capacity, as an interface between program areas, and as data controller. The functions performed included: resolving special problems such as turn-around requirements, schedule changes, conflicting requirements and special or priority processing requests; keeping adequate and up-to-date logs and files on the data; and insuring that data quality was maintained both throughout the test duration and throughout the various stages of processing.

The quality control (QC) function of E-3A DM was performed and provided in three major steps. One, as a control input; two, as a quick-look control; and three, as a final evaluation of the accuracy of the processing before submitting the data to the user for analysis.

As input controller, DM eliminated or minimized errors before the testing began. This was accomplished by inserting

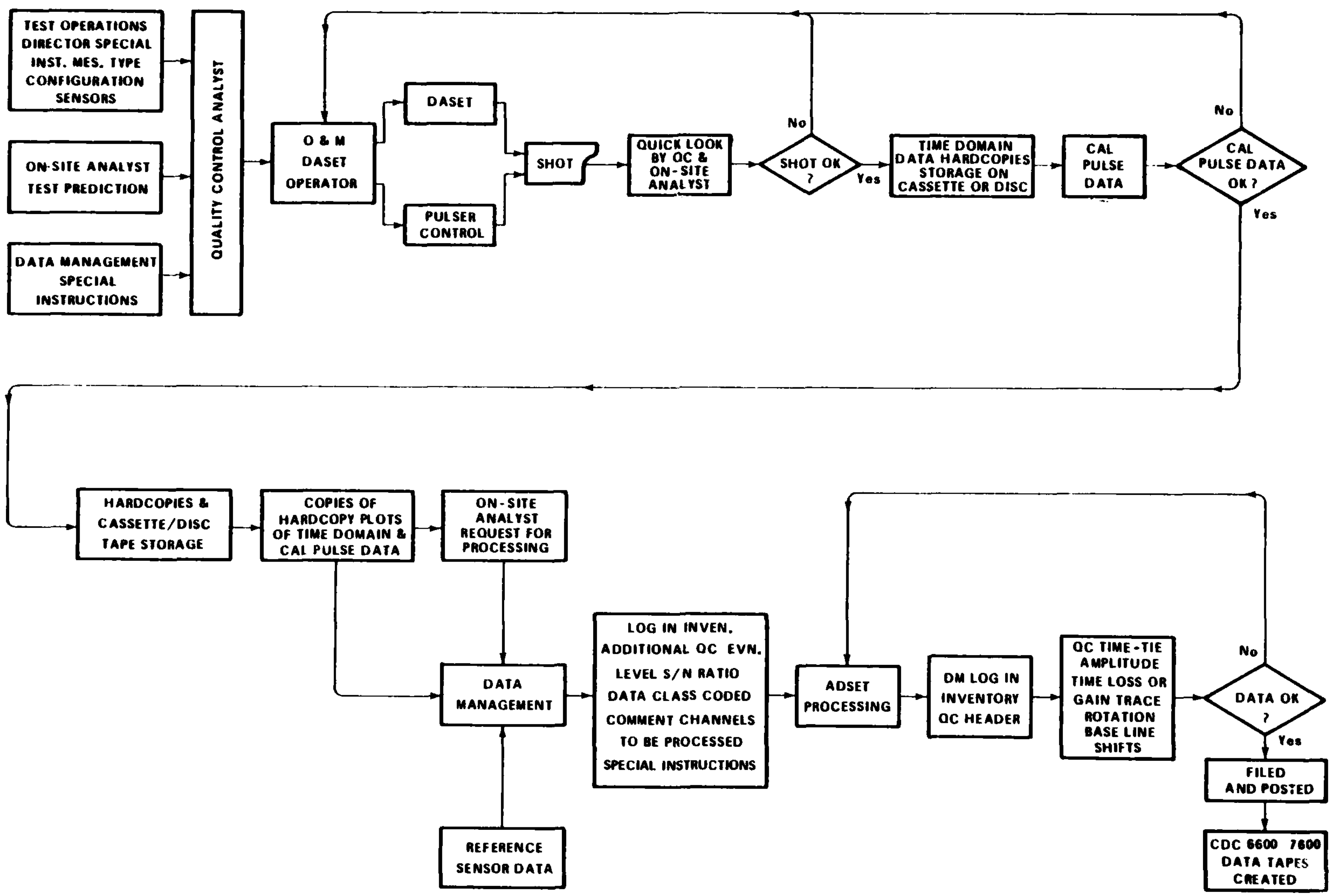



Figure 1. HPD/VPD-II Respone Test Data Flow

quality control analysts to act as central input figures and coordinators among the various program areas and the O&M contractor. This was to assure that the correct test input information was supplied to the DASET operator for input to the DASET System.

Acting in a quick-look quality control function in-testing control was provided that assured that the data was processable before the test item configuration and instrumentation were changed.

The final step of the data quality control evaluation was a two part function consisting of both pre-processing and post-processing control. In the pre-processing phase, the DASET Data Log Sheet, data cassette tapes, and hard-copy plots were delivered to data management. The data cassette tapes were checked to see if the shot numbers were recorded on the tape. The hard-copy header information was checked against the DASET data log sheet for validity. If special instructions were required, these were indicated before submission to ADSET for processing. Photographic data from the reference sensor or other sources received similar attention. In the post-processing phase, the data was logged back into data management and a thorough verification of the data was made before it was furnished for use in analysis.

4. DATA MANAGEMENT RECORDS AND FILES

DM maintained several records and files during the E-3A Program Response Testing. Descriptions of these are presented in the following paragraphs. Some of the records and files will be stored for subsequent use or reference, while some were only tools for use in accomplishing DM's various tasks. The retention status for each record or file is identified in the following discussion.

a. Polaroid Photograph Data Sets

A data set consists of those oscilloscope traces recorded on Polaroid photographs for one or more pulser shots on one instrumentation system. This may be either one or more photographs. These photograph data sets are stored in individual envelopes and filed. Each data set is identified and filed by E-3A group number and each photo is identified by test-shot-channel number. The back of each photograph is marked with "E-3A" and stamped with a header information stamp (refer to Figure 2). Header information was entered on the back of each photograph at the time of the shot. Reference data photographs for each test shot are included among the raw test data sets. These shots are identified as Channel 6. All recorded data sets were retained and filed regardless of quality or validity. All these will be retained for future reference.

b. DASET Data Sets

A DASET data set consists of copies of the R7912 digitized traces for one pulser shot for all active channels which recorded good data. These include data traces and calibration pulse traces for each hardware unit which are stored in file folders. Each set is identified and filed by group number and test-shot number. Header information is given on each plot. Each set is accompanied by a summary sheet indicating the data channels included in the set. A sample of the summary sheet is given in Figure 3 and samples of microwave calibration pulse and data traces are furnished in Figures 4 and 5 respectively. All recorded data sets were filed regardless of whether or not they were entered into the data base. All are to be retained for future reference.

c. Data Log Sheets

Test information known at test time was recorded on the data log sheets which were initiated in duplicate with one copy filed as the raw data input back-up master file. The other copy served as a working copy for processing data through ADSET. Both copies are filed in binders according to group number. During E-3A, there were two different types of data log sheets: one for photographic data, and one for DASET data. These log sheets record the same basic characterization and other supporting information. Samples of the two forms are given in Figures 6 and 7. Table 9 gives short descriptions of the entry items common to all sheets.

E-3A SYSTEM TEST

Date 7-18-78 Test Facil Code AH

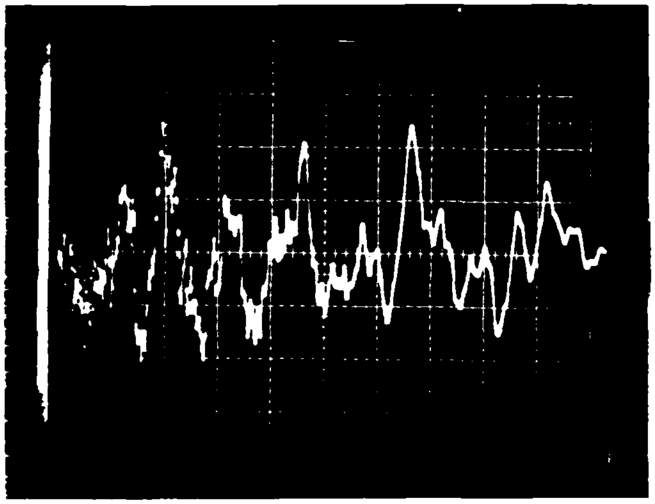
Shot No. 550 Channel A

Vert 10 mV Horiz 100 ns

Atten 6 dB Location 2554

Sensor 388 Component IB

Instrumentation No. S301



E-3A SYSTEM TEST

Date 7-18-78 Test Facil Code AH

Shot No. 550 Channel B

Vert 10 mV Horiz 500 ns

Atten 6 dB Location 2554

Sensor 388 Component IB

Instrumentation No. S301

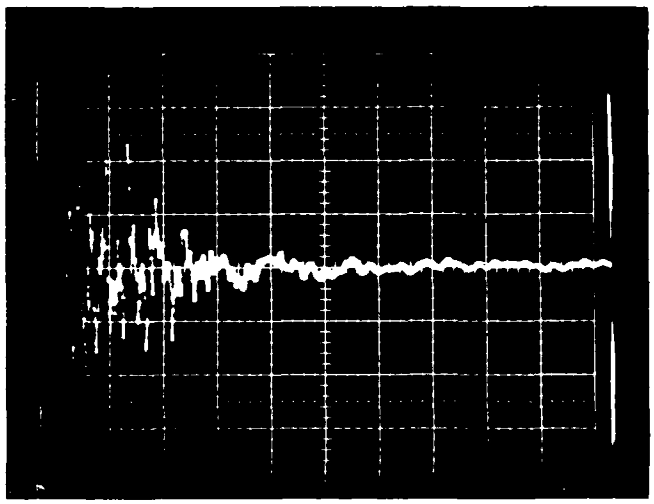


Figure 2. E-3A Oscilloscope Stamp

```
THE FOLLOWING CAL PULSE DATA
WERE SAVED ON A DISK OUTPUT FILE FOR SHOT 1463

                DISK ID = DASET 26

CHANNEL 1    TEST PT 109    R7912 HUN 0

CHANNEL 1    TEST PT 109    R7912 HUN 1

CHANNEL 1    TEST PT 109    R7912 HUN 2

CHANNEL 1    TEST PT 901    R7912 HUN 3

CHANNEL 5    TEST PT 104    R7912 HUN 8

CHANNEL 5    TEST PT 104    R7912 HUN 9

CHANNEL 5    TEST PT 104    R7912 HUN 10

CHANNEL 5    TEST PT 104    R7912 HUN 11

DO YOU WANT TO REVIEW DATA AGAIN AND SAVE MORE? (Y,N)
 ?N
```

```
THE FOLLOWING TIME DOMAIN DATA
WERE SAVED ON A DISK OUTPUT FILE FOR SHOT 1463

                DISK ID = DASET 26

CHANNEL 1    TEST PT 109    R7912 HUN 0

CHANNEL 1    TEST PT 109    R7912 HUN 1

CHANNEL 1    TEST PT 109    R7912 HUN 2

CHANNEL 1    TEST PT 901    R7912 HUN 3

CHANNEL 5    TEST PT 104    R7912 HUN 8

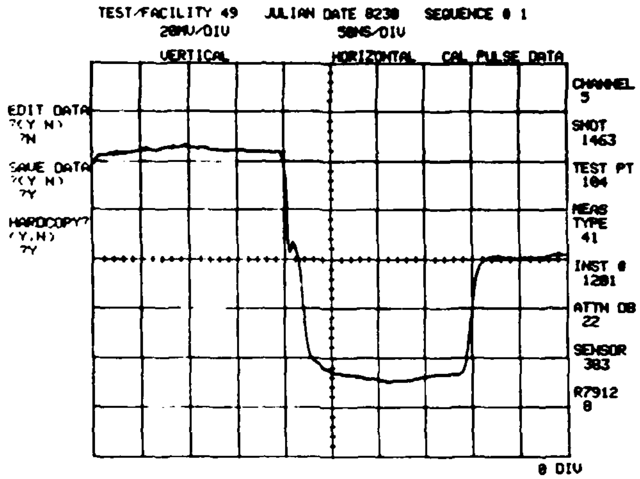
CHANNEL 5    TEST PT 104    R7912 HUN 9

CHANNEL 5    TEST PT 104    R7912 HUN 10

CHANNEL 5    TEST PT 104    R7912 HUN 11

DO YOU WANT TO REVIEW DATA AGAIN AND SAVE MORE? (Y,N)
 ?N
```

Figure 3. DASET Cal Pulse and Time Domain Summary Sheets



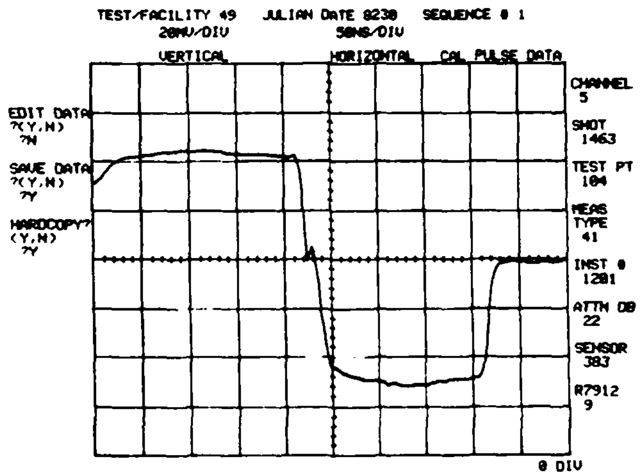
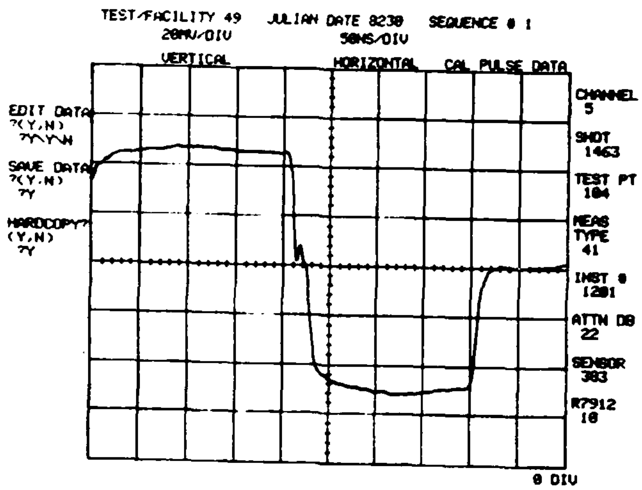




Figure 4. DASET Calibration Pulse Data Set



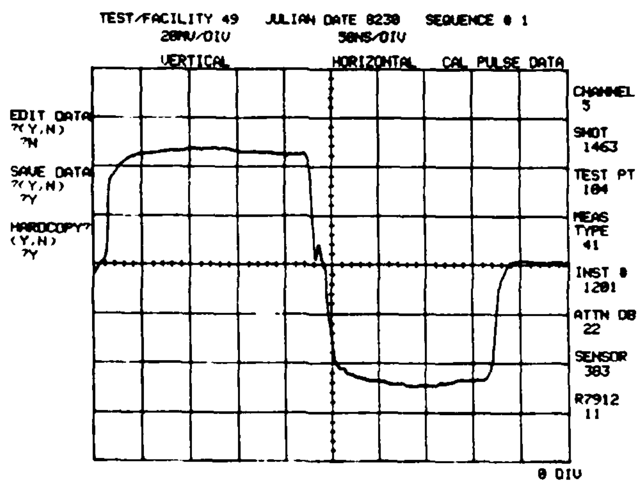
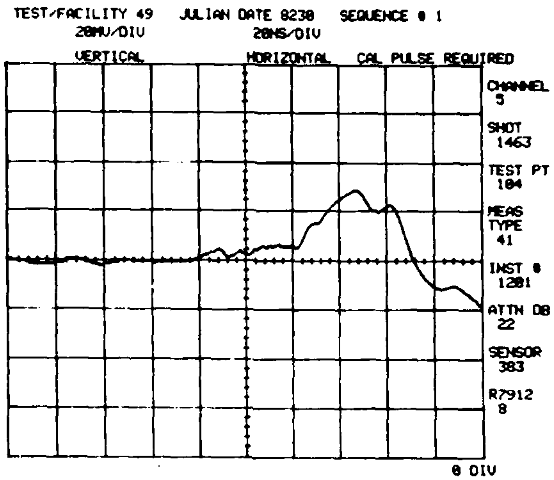




Figure 4. (Continued)



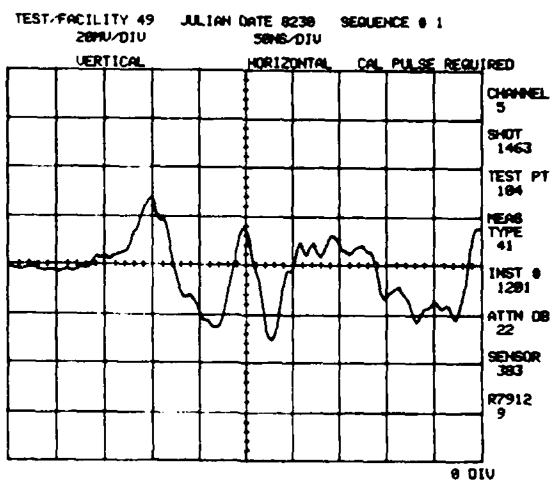
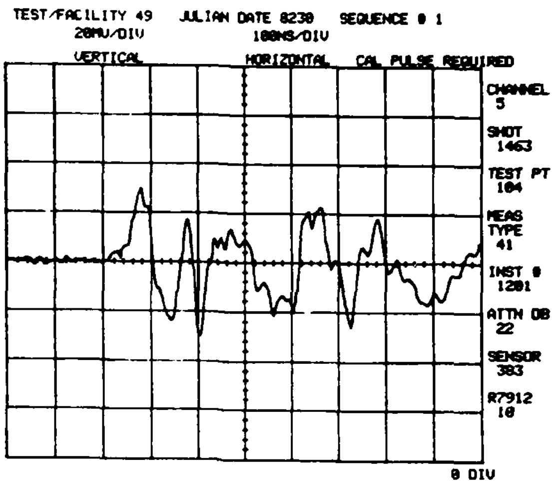




Figure 5. DASET Time Domain Data Set



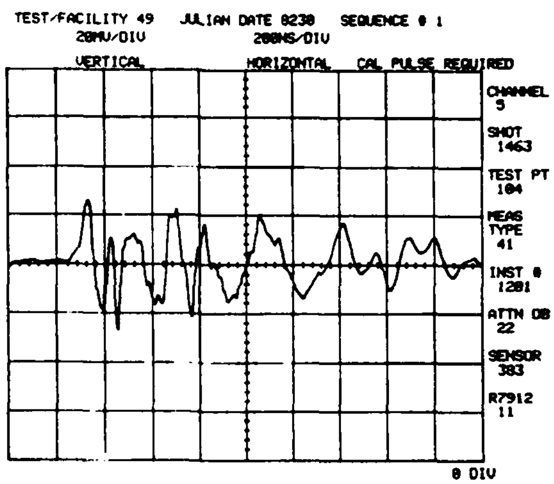




Figure 5. (Continued)

# OSCILLOSCOPE DATA LOG SHEET
## E-3A PROGRAM

JULIAN DATE [ ][ ][ ]
TEST/FACILITY [ ][ ]
SYSTEM NO [ ]

◆ = PRE TEST
▼ = TEST
● = POST TEST

GROUP NUMBER [ ][ ][ ]

| ◆ TEST ITEM DESCRIPTION | Azimuth Orientation | Configuration | Position (nearest meter) X | Y | Z |
|---|---|---|---|---|---|
| | | | | | |

| TEST IDENTIFICATION | | | | | | | | | | | OSCILLOSCOPES | | | | | | | | | ADDITIONAL INFORMATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Scope A | | | | Scope B | | | | | | |
| SPECIAL INSTRUCTIONS | PEAK PICKER (Y or N) | SHOT NUMBER | TIME | ENVIRONMENTAL LEVEL | RISE TIME | TEST POINT NUMBER | MEASUREMENT TYPE | INSTRUMENTATION NO. | SIGNAL-TO-NOISE RATIO | SENSOR NUMBER | SWEEP SPEED CODE | SWEEP SPEED (ns/div) | VERTICAL SENSITIVITY (mV/div) | SENSITIVITY CODE | ATTENUATION (dB) | SWEEP SPEED (ns/div) | VERTICAL SENSITIVITY (mV/div) | SENSITIVITY CODE | ATTENUATION (dB) | CODED COMMENTS | ADSET DATA NUMBER | COMMENTS |
| ● | ● | ▼ | ▼ | ▼ | ▼ | ◆ | ◆ | ◆ | ● | ◆ | ● | ◆ | ◆ | ● | | ◆ | ◆ | ● | ◆ | ● | ● | |
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Figure 6. Oscilloscope Data Log Sheet

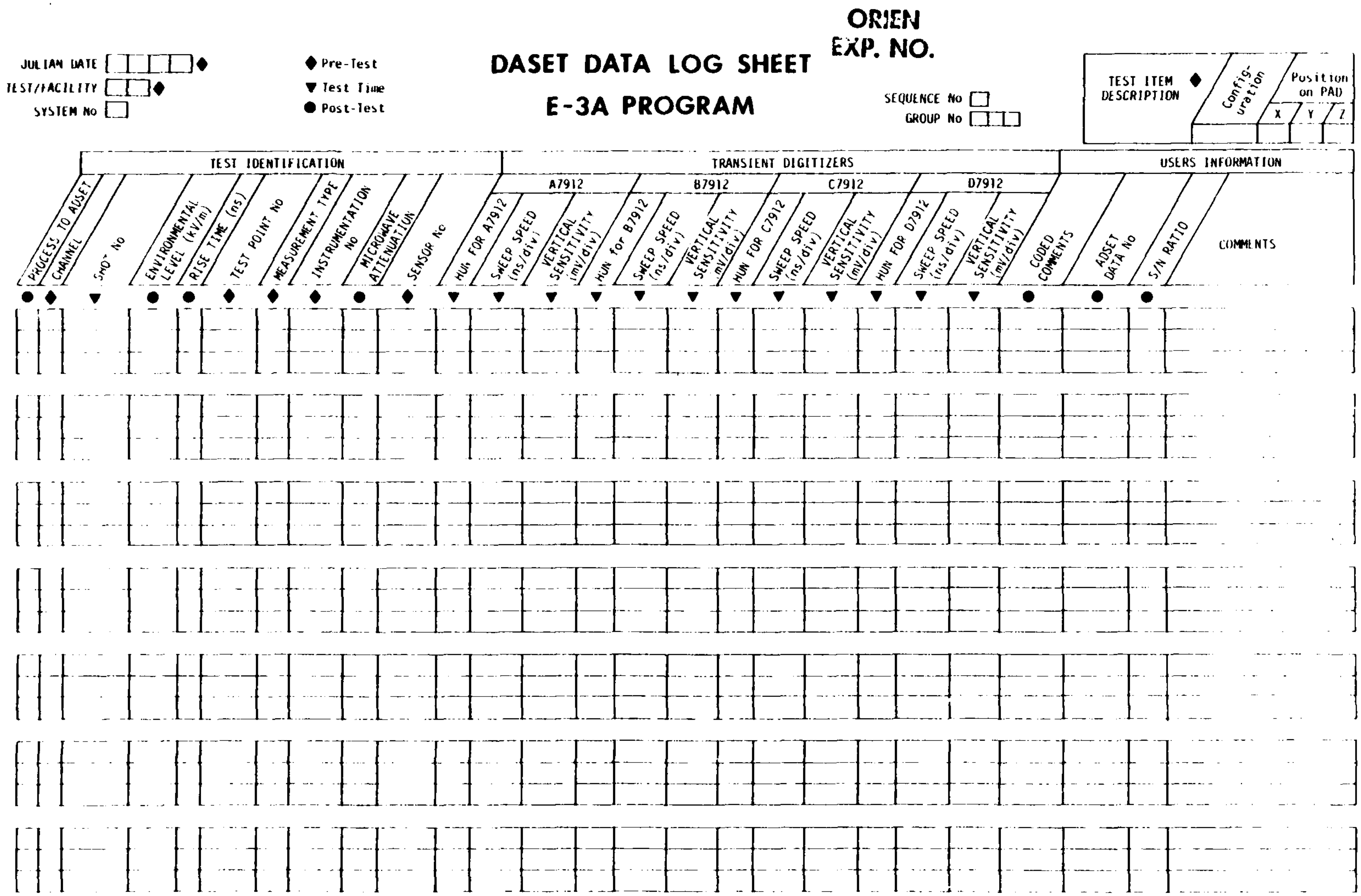


Figure 7. DASET Data Log Sheet

Table 9

DATA LOG SHEET PARAMETERS

| Parameter | Description | Number of Characters |
|---|---|---|
| Date | Julian date; the first digit is the last digit in the year, the next three digits are the number of days into the year. | 4 |
| Test/Facility | Code indicating the test and the facility for the test. | 2 |
| System Number | Denotes either A or B system the data were recorded on in DASET. | |
| Orientation Experiment Number | Refers to particular experiment under which data were taken. | |
| Sequence Number | Not used on E-3A Program. | |
| Group Number | Denotes a particular set of data. This number was assigned by Data Management and used as reference by which data could be retrieved for analysis. | |
| Channel Number | Channel number on DASET system (1-5) reference sensor was channel 6. Single channel 6 referred to as Channel 7. | 2 |
| <u>Test Item Description</u> | | |
| Configuration | Refer to Table for configuration used in response testing. | 3 |
| Position on Pad | XYZ coordinate position of test point on the pad ($\pm$XX$\pm$YY$\pm$ZZ) nearest meter. | 9 |
| Digitize or Process to ADSET | Indication as to whether the particular data set is to be digitized and/or processed at ADSET. | 1 |
| Shot Number | Sequential number obtained from the facility pulser shot log. | 4 |
| Environmental Level | The reference field sensor level in kV/m accurate to tenths. (A decimal is understood between the last two digits.) | 3 |

Table 9 (Continued)

| Test Item Description | Description | Number of Characters |
|---|---|---|
| Test Point Number | Coded number which represents a particular point in the test or on the test item. | 4 |
| Measurement Type | Two digit number indicating the type of measurement. Table 6 gives a list of the measurement types. | 2 |
| Instrumentation | A number which represents an instrumentation setup and identifies an end-to end transfer function for the instrumentation. | 3 |
| **Parameter** | | |
| Signal-to-Noise Ratio | Signal peak amplitude to noise peak amplitude in db. | 2 |
| Microwave Attenuation | Self-explanatory, units of dB. | 2 |
| Cal Pulse Number | A number which indicates the microwave calibration pulse data to be used for photo set. This was not used during response testing because all photographic data were recorded with the screenbox and calibration pulse data accompanied all DASET data. | 2 |
| Sensor Number | A number that indicates the type of sensor used and indicates the calibration file (see Table 4). | 4 |
| HUN for 7912 | Refers to a particular Hardware Unit Number for each assigned R7912 utilized. | |
| Scope Information (Repeated for each Scope/7912) | | |
| Vertical Sensitivity | Vertical Sensitivity of the oscilloscope/7912 mv/div. | 3 |
| Sweep Speed | Oscilloscope/7912, sweep speed in ns/div. | 5 |
| Attenuation | Attenuation in dB (screenbox only). | 2 |

Table 9 (Continued)

| Test Item Description | Description | Number of Characters |
|---|---|---|
| Coded Comments | The comments for this program were standardized and coded for entry into the user's area of the ADSET characterization record. The comments used are given in Table 7. | 9 |
| ADSET Data Number | The sequential file number of the data (filled in by ADSET digitizer). | 5 |
| Comments | General Comments Area. | |

The coded comment entry requires a more detailed explanation than can be given in the table. Comments regarding data taken during the E-3A Testing were given comment code numbers which appear as needed in the coded comments field of the characterization record. Any of the comment codes may appear in any one of these five fields. These comments point up non-normal conditions. For example, normally, data were time-tied from only one shot. Any condition different from this is given a comment code and the code put in the characterization record. The coded comment summary was given in Table 7 presented earlier in this section.

Data log sheets and their associated data sets were delivered to ADSET-Remote, as requested by the data analyst, after being logged in and after the addition of supporting information and a quality check for completeness, accuracy, and validity. The environmental level in kV/m was obtained by using the Reference Sensor (Channel 6) Data Log Sheet for the corresponding shot number. (A decimal point is understood to be between the last two digits.) Signal-to-noise ratio, and coded comments were added to each data set sent to ADSET-Remote for entry into the Test Data Base. The DASET data number, entered by the digitizer at ADSET-Remote, is used as the basic control number for test data set stored in ADSET-Data Base (AD). The Data Log Sheets served as the basic documents for processing of test data by ADSET and will be stored with the raw data sets.

d. Data Control Logs

These logs were used to control the flow of test data into ADSET as well as to indicate the status of all data being processed. Data Status Log Sheets are filed according to group number. Data sets are identified in the Data Status Log by shot-channel number. Other information entered includes the date the data was recorded and the date the data was turned over to ADSET. After processing at ADSET-Remote, data sets and Data Log Sheets were returned to DM. The date these data arrived, in addition to the date that time-domain plots and header records were QC'ed, were entered in the Data Control Log. The ADSET-Remote assigned Data Number (ADN) was entered in the Data Control Log for each test data set processed. Each time-domain plot and header record received from ADSET-Remote was quality controlled. Rejection of a data set's plots resulted in resubmission of the data set to ADSET Remote. A discussion indicating standards for acceptance is given later in this section. Minor header errors were noted on the header record and comments section of the data control log sheet. These were corrected using the edit program (CHREDI) available on the Analyst Terminal. The date that characterization records were received for any data set from ADSET Main was also logged in the Data Control Log. This data also received a quality control check. A sample Data Control Log Sheet is given in Figure 8. This log will be retained for future reference.

e. Time-Domain Plots

These plots show the results of digitizing and/or time-tieing test data at ADSET-Remote. Two or more plots were normally included in each data set and were used to determine the acceptance of the processing. For example, an "A" suffix on the ADSET data number indicates the "A" trace of the data set. A "BB" suffix denotes a time-tie plot of the raw data. A hard-copy of the "B" trace was not required when only two photos or plots were to be time-tied. Those plots not passing the quality control technical evaluation were returned to ADSET-Remote, with appropriate comments, for reprocessing. New ADNS were assigned to reprocessed data sets. Rejected ADSET data was identified for deletion. The deletion was accomplished using the ADSET-Remote Analyst Terminal and the characterization edit program. This program allowed for deletion of a particular data set using the ADN. See Figure 9 for a sample of the time-domain plots as received from ADSET-Remote.

f. Header Record

Two different types of header records (test photograph data or DASET data) were returned from ADSET-Remote

E-3A TEST DATA CONTROL LOG

TEST/FACILITY ☐☐

TEST DATE ☐☐☐☐

GROUP NUMBER ____________

| Shot No. | Channel No. | Test Point | To ADSET | From ADSET | ADSET Data No. | Header Edit | Purge | Comments | Adsort Edit |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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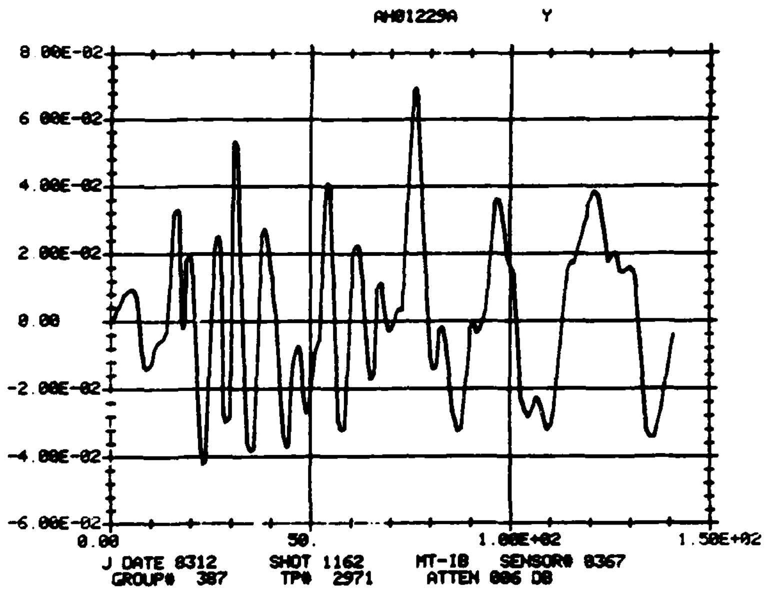
Figure 8. Data Control Log



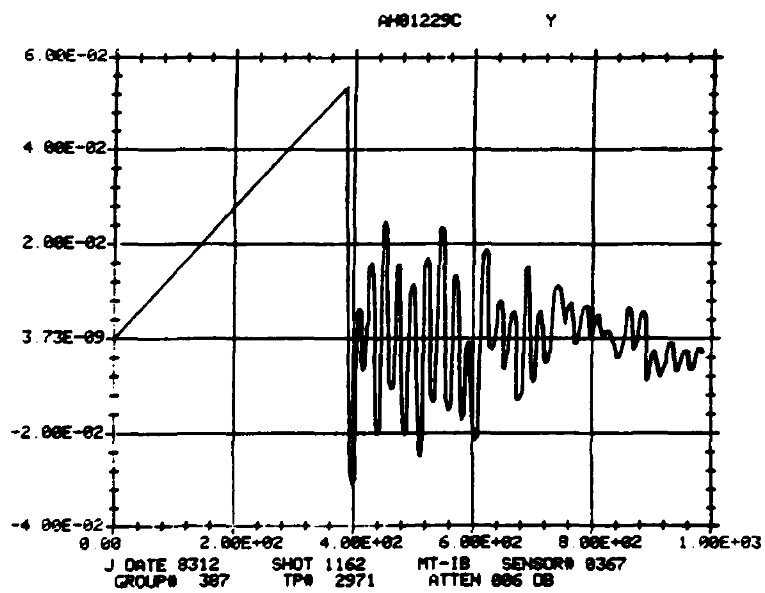
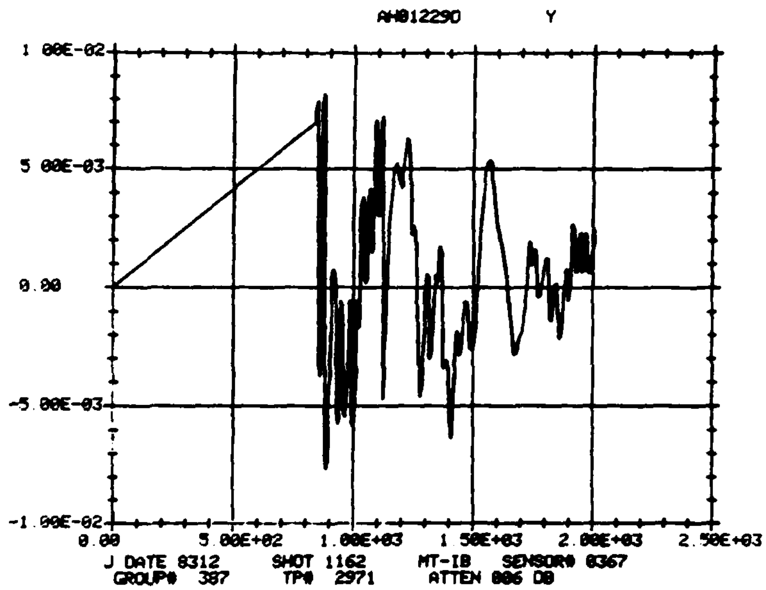




Figure 9. ADSET Time-Domain Plots



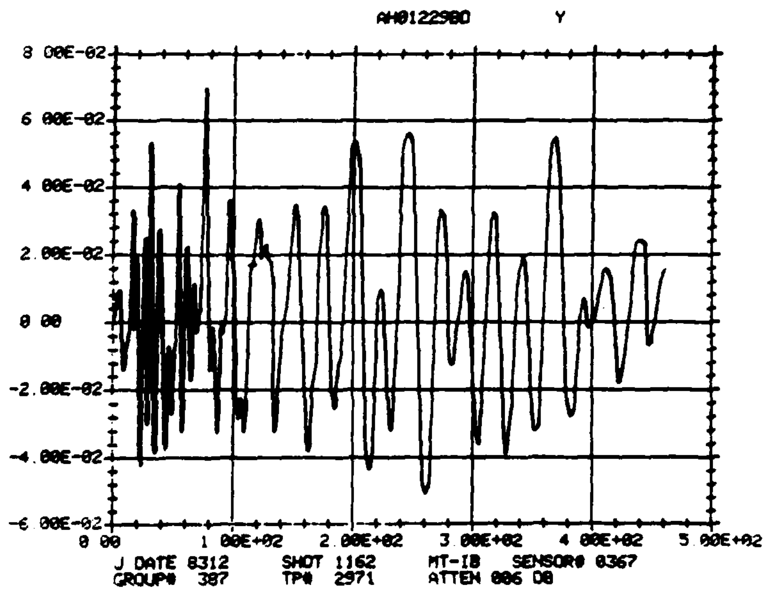






Figure 9. (Continued)

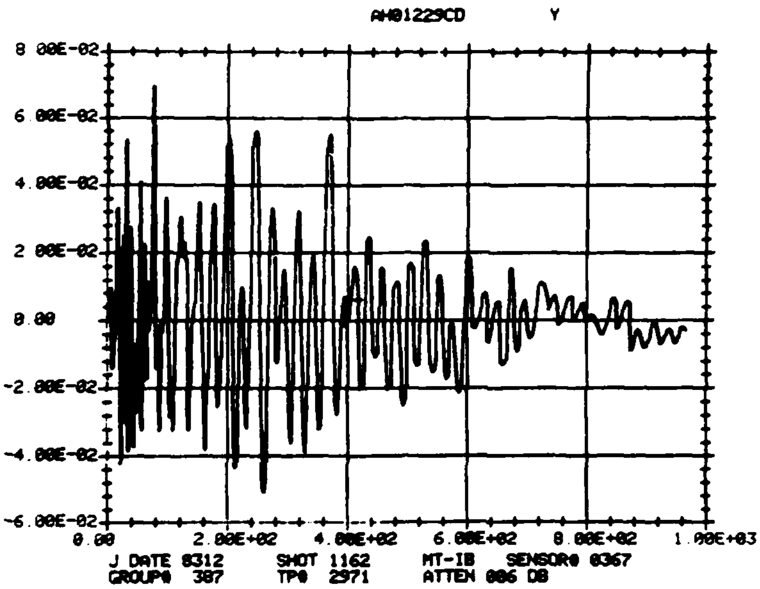



Figure 9. (Continued)

with their associated data log sheets and time-domain plots. A sample for photographic data is given in Figure 10; one for DASET data is shown in Figure 11.

The header record for photograph data has the ADSET characterization information, ordered just as it will be stored, that had been entered by the ADSET operator. This information is listed for each photograph of the data set following the characterization information concerning the particular photograph. Sequence indicates how many photographs are in the time-tie (second character) and which one is being processed (first character). AB would indicate that the photograph processed was the first of two traces to be time-tied. Sweep speed (SWP SPD) is given in ns/div,; vertical sensitivity, in volts/div,; attenuation (ATTEN), in db. The information, as printed on the header list for DASET, is self-explanatory.

Characterization record data was compared against the Data Log Sheet for accuracy. Some errors found in the characterization record required reprocessing of the data set; others required only editing of the characterization record stored in the ADSET-Main Data Base. All errors found were annotated on both the header record and the data status log. Characterization records are filed by date of receipt from ADSET-Remote and will be available for future reference.

g. ADSET Data Number Logs

All ADSET-Remote data numbers assigned to Test Data Sets submitted for processing are recorded in these logs. Each ADN has an associated group number, set number, sequence number, measurement type and comments. ADNs which were identified for deletion from the ADSET-Main Data Base are marked by an "X" beside the Data Number. Appropriate remarks are entered in the comments section. This log may be used to verify acceptable data sets stored in the Data Base. There is an ADSET Data Number Log for each type of response testing in the HPD/VPD-II. For example, there is one for the data identified by test/facility code AH and another for AV. A

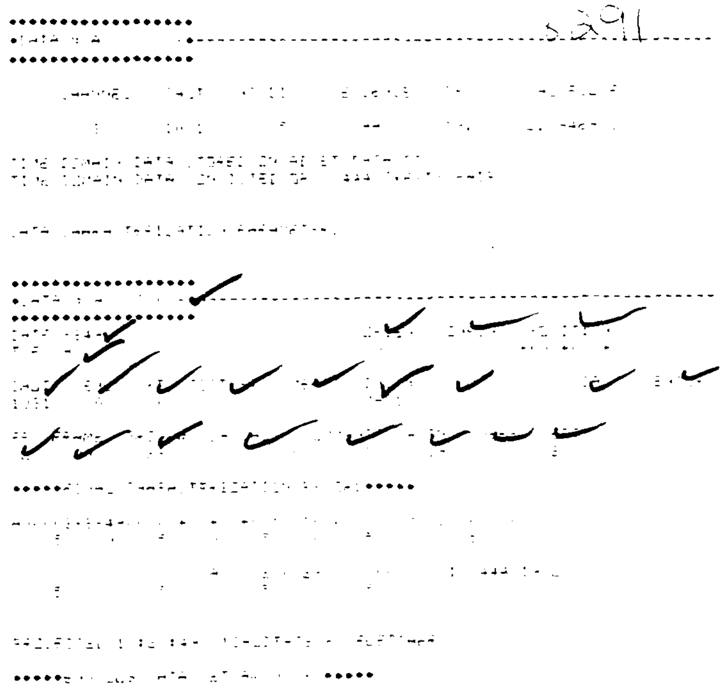


Figure 10. ADSET-Remote Header Record (Photgraphic Lata)

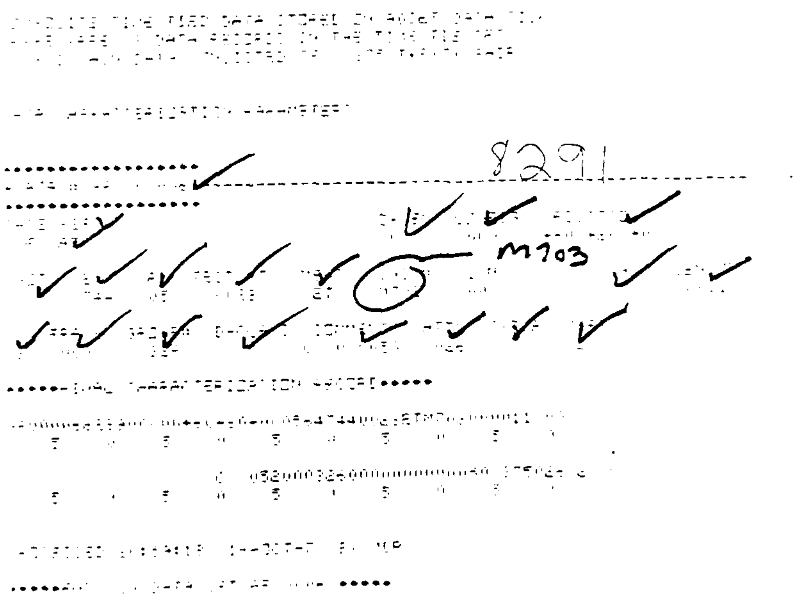


Figure 11. ADSET-Remote Header Record (DASET Data)

sample page from the AH ADSET data number log is given in Figure 12. These logs will be retained by the Air Force for future reference.

h. Test Status Logs

All HPD/VPD-II test data sets entered into ADSET-Main Test Data Base are listed in these logs which are organized by group number. Additional critical data relating to tests/shots for each sequence are also recorded. These logs were used to verify complete testing for each designated sequence. Data sets entered into the Test Data Base may also be inventoried by this log.

i. Probe Library

Probe types used in the E-3A Test Program and catalogued in ADSET-Data Base computers are included in this library list. The corresponding probe ID numbers were entered on the Data Log Sheets by test personnel for each data set. Descriptive information on each probe type is given in this library list. A list of the probes used during the E-3A program was given in Table 5. A complete list of all probes in the library can be obtained using the analyst terminal.

j. Characterization Records

Characterization information was furnished by ADSET-Main for each data set processed. This information includes a duplication of header information created by ADSET-Remote during processing and also data obtained during frequency domain computations performed at ADSET-Main. The date of receipt of this characterization information was recorded in the data status log. For a sample characterization record, see Figure 13. The final line on the characterization printout is the characterization record for that data set. These listings are stored in the computer listing folders and will be retained. The entries in the characterization record described in Table 4.

k. ADSORT Listings

Use of a modified version of the computer program ADSORT furnished a computer listing of all test data sets

E-3A ADSET DATA NUMBER LOG

| ADSET Data No. | Group No. | Data Set No. | Test Point No. | Measurement Type | Comments |
|---|---|---|---|---|---|
| | | | | | |
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Figure 12. E-3A ADSET Data Number Log

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$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
CHARACTERIZATION RECORD.
AF00018825  900000+00+  00+2005237  200010EZM7  030001100  0-.217+061
550000+.19  4+000037+.  302-017010  0105300032  2000000000  0050 40403
5X2  601
CHARACTERIZATION RECORD.
AF00020825  300000+00+  00+2005237  320013HYM7  0300002100  0+.139+040
300031+.70  3-140459+.  376-057018  0105300032  2000000000  0000 31402
6b2  601
CHARACTERIZATION RECORD.
AF00021825  300000+00+  00+2005367  200013EZM7  0300001100  0-.138+061
560001+.19  0+000030+.  283-017010  0105300032  2000000000  0050 42503
5X2  601
CHARACTERIZATION RECORD.
AF00022828  900000+80+  20+0005627  440005ETM7  0300001100  0+.231+061
570000+.38  1+000102P+.  354-017010  0105300032  5000000000  0050 31503
7X2  601
CHARACTERIZATION RECORD.
AF00023828  300000+60+  20+0005647  440023ETM7  0300001100  0+.316+061
600000+.81  9+000032+.  474-017010  0105300032  6000000000  0050 27303
9X2  601
CHARACTERIZATION RECORD.
AF00024825  300000+00+  00+2005176  340010HYM7  0300002100  0+.157+040
190031+.72  1-040420+.  344-357018  0105400032  2000000000  0000 33202
662  601
CHARACTERIZATION RECORD.
AF00025831  700000+001  00+0504167  550010EZM7  0300001900  0+.577+110
100000+.12  1+040417+.  319+037008  0106300039  6000000000  0170 34807
2X3  601
CHARACTERIZATION RECORD.
AF00026831  700000+001  00+0504167  300010ETM7  0300000700  0-.232+140
070337+.25  2+360438+.  232+067003  0106300039  6000000000  0170 33008
6X3  601
```

Figure 13. ADSET-Main Characterization Record

stored in the ADSET Data Base for a particular test/facility code. During the E-3A Program, this listing was sorted by DATANUM (ADN). Characterization information associated with each ADN number was included on this listing. The listing served as a major basis for editing or deleting the characterization records in the Test Data Base. Errors found during QC were annotated directly on the ADSORT listing. Correction of errors and deletion requests were done at ADSET-Remote using the characterization edit program on the analyst terminal. The listing that has been retained for future reference was obtained using ADSORT. It has proved to be an excellent source of characterization information. Refer to Figure 14 for a sample output page from ADSORT.

## 5. HPD/VPD-II TEST DATA FLOW

A summary of the flow for HPD/VPD-II testing data is given in the following paragraphs. The files, logs, records, and lists mentioned in the discussion were described in detail in Section 4 above. Figure 15 furnishes a flow diagram for reference.

The data acquisition quality control analyst received information for input to DASET from three sources: the test operations director, the on-site analyst, and data management. This information was recorded on the DASET data log sheet. When all required information was entered, the DASET data log sheet was given to the O&M DASET operator for entry. When all information was entered, the DASET operator notified pulser control that DASET was prepared to receive the data shot. After the shot, it was determined if the environmental levels and rise times were satisfactory. If the shot was acceptable, the data were then reviewed for processibility and checked to determine if the time-tie area on the traces agreed within specifications. If these criteria were met the time-domain data and cal-pulse data were stored on cassette tapes or disc and hard copies were made of the data for each accepted channel. If, for any reason, the data was not accepted, another shot was requested.

FACILITY CODE AM   SORTED BY DATA NUMBER   PAGE 1   THE DATE IS 08/29/78

| RECORD NO. | TEST FAC | DATANUMBER | JULN DATE | CONFIG | ITEMPOSIT | SHOTNUMBER | ENVIRONLEV KV/M | TSTPTNUMBR | MEASURTYPE | S/N DB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AM | 00007 | 8173 | 000 | +00+06-63 | 0100 | 5.3 | 0044 | HS | 00 |
| 2 | AM | 00008 | 8173 | 000 | +00+06-63 | 0101 | 5.2 | 0044 | HS | 00 |
| 3 | AM | 00009 | 8173 | 000 | +00+06-63 | 0102 | 5.3 | 0044 | HS | 00 |
| 4 | AM | 00013 | 8173 | 000 | +00+06-63 | 0110 | 5.3 | 0044 | HS | 00 |
| 5 | AM | 00014 | 8173 | 000 | +00+06-63 | 0117 | 5.3 | 0044 | HS | 00 |
| 6 | AM | 00016 | 8173 | 000 | +00+06-63 | 0122 | 5.2 | 0044 | HS | 00 |
| 7 | AM | 00017 | 8173 | 000 | +00+06-63 | 0125 | 5.2 | 0044 | HS | 00 |
| 8 | AM | 00019 | 8173 | 000 | +00+06-63 | 0130 | 5.3 | 0044 | HS | 00 |
| 9 | AM | 00021 | 8174 | 000 | +00+06-63 | 0139 | 5.4 | 0044 | HS | 00 |
| 10 | AM | 00046 | 8179 | 000 | +00+06-63 | 0153 | 5.4 | 0044 | HS | 00 |
| 11 | AM | 00047 | 8179 | 000 | +00+06-63 | 0154 | 5.4 | 0044 | HS | 00 |
| 12 | AM | 00048 | 8185 | 000 | +00+06-63 | 0190 | 5.5 | 0044 | HS | 00 |

| RECORD NO. | DATANUMBER | INSTRNUMBR | SENSRNUMBER | ATTEN DB | RISE TIME NANO SEC. | GROUPNUMBR | COMMENTS | SWEEPSPEED A (NS) B | VERT SEN MV | ORIENTATN |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00007 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 10 | 00 |
| 2 | 00008 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 10 | 00 |
| 3 | 00009 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 10 | 00 |
| 4 | 00013 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 10 | 00 |
| 5 | 00014 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 20 | 00 |
| 6 | 00016 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 20 | 00 |
| 7 | 00017 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 20 | 00 |
| 8 | 00019 | S601 | 0020 | 006 | 04 | 014 | 0000000000 | 5 20 | 20 | 00 |
| 9 | 00021 | S601 | 0020 | 006 | 04 | 018 | 0000000000 | 5 20 | 20 | 00 |
| 10 | 00046 | S601 | 0020 | 006 | 04 | 023 | 0000000000 | 5 20 | 20 | 00 |
| 11 | 00047 | S601 | 0020 | 006 | 04 | 023 | 0000000000 | 5 20 | 20 | 00 |
| 12 | 00048 | S601 | 0023 | 006 | 04 | 034 | 0000000000 | 5 20 | 20 | 00 |

| RECORD NO. | DATANUMBER | INTYNUMPID | TDRESPONSE | PULSEWIDTH NANO SEC. | DOMFREQ MEGA HZ. | DFREQAMPL | SECFREQ MEGA HZ. | SFREQAMPL | SENSORCAL | INSTRCALIB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00007 | B | +.656+01 | 009 | 17.3 | +.115-06 | 75.1 | +.246-07 | 7 | 0 |
| 2 | 00008 | B | +.673+01 | 009 | 17.5 | +.110-06 | 75.8 | +.218-07 | 7 | 0 |
| 3 | 00009 | B | +.674+01 | 010 | 17.6 | +.117-06 | 76.4 | +.251-07 | 7 | 0 |
| 4 | 00013 | A | +.717+01 | 008 | 17.1 | +.114-06 | 34.2 | +.539-07 | 7 | 0 |
| 5 | 00014 | A | +.124+02 | 009 | 0.0 | +.164-06 | 143.8 | +.478-08 | 7 | 0 |
| 6 | 00016 | A | +.137+02 | 010 | 0.0 | +.271-06 | 17.3 | +.204-06 | 7 | 0 |
| 7 | 00017 | A | +.143+02 | 009 | 0.0 | +.267-06 | 17.1 | +.228-06 | 7 | 0 |
| 8 | 00019 | B | +.128+02 | 010 | 0.0 | +.252-06 | 17.7 | +.193-06 | 7 | 0 |
| 9 | 00021 | B | +.129+02 | 010 | 0.0 | +.243-06 | 18.1 | +.203-06 | 7 | 0 |
| 10 | 00046 | A | +.146+02 | 007 | 0.0 | +.253-06 | 18.5 | +.187-06 | 7 | 0 |
| 11 | 00047 | A | +.147+02 | 009 | 0.0 | +.227-06 | 75.2 | +.626-07 | 7 | 0 |
| 12 | 00048 | B | +.120+02 | 010 | 18.5 | +.184-06 | 33.8 | +.938-07 | 7 | 0 |

| RECORD NO. | DATANUMBER | INTEGCALIB | NORMALZ | TRUNCATION | NUMTDOPTS | DISK ID | MICROFICHE | FRAME NO. | BOOK NO. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 00007 | 1 | 0 | 1 | 231 | 601 | 00 | 000 | 00 |
| 2 | 00008 | 1 | 0 | 1 | 182 | 601 | 00 | 000 | 00 |
| 3 | 00009 | 1 | 0 | 1 | 188 | 601 | 00 | 000 | 00 |
| 4 | 00013 | 1 | 0 | 1 | 190 | 601 | 00 | 000 | 00 |
| 5 | 00014 | 1 | 0 | 1 | 43 | 601 | 00 | 000 | 00 |
| 6 | 00016 | 1 | 0 | 1 | 127 | 601 | 00 | 000 | 00 |
| 7 | 00017 | 1 | 0 | 1 | 78 | 601 | 00 | 000 | 00 |
| 8 | 00019 | 1 | 0 | 1 | 98 | 601 | 00 | 000 | 00 |
| 9 | 00021 | 1 | 0 | 1 | 223 | 601 | 00 | 000 | 00 |
| 10 | 00046 | 1 | 0 | 1 | 88 | 601 | 00 | 000 | 00 |
| 11 | 00047 | 1 | 0 | 1 | 95 | 601 | 00 | 000 | 00 |
| 12 | 00048 | 1 | 0 | 1 | 84 | 601 | 00 | 000 | 00 |

Figure 14. ADSET ADSORT Listing

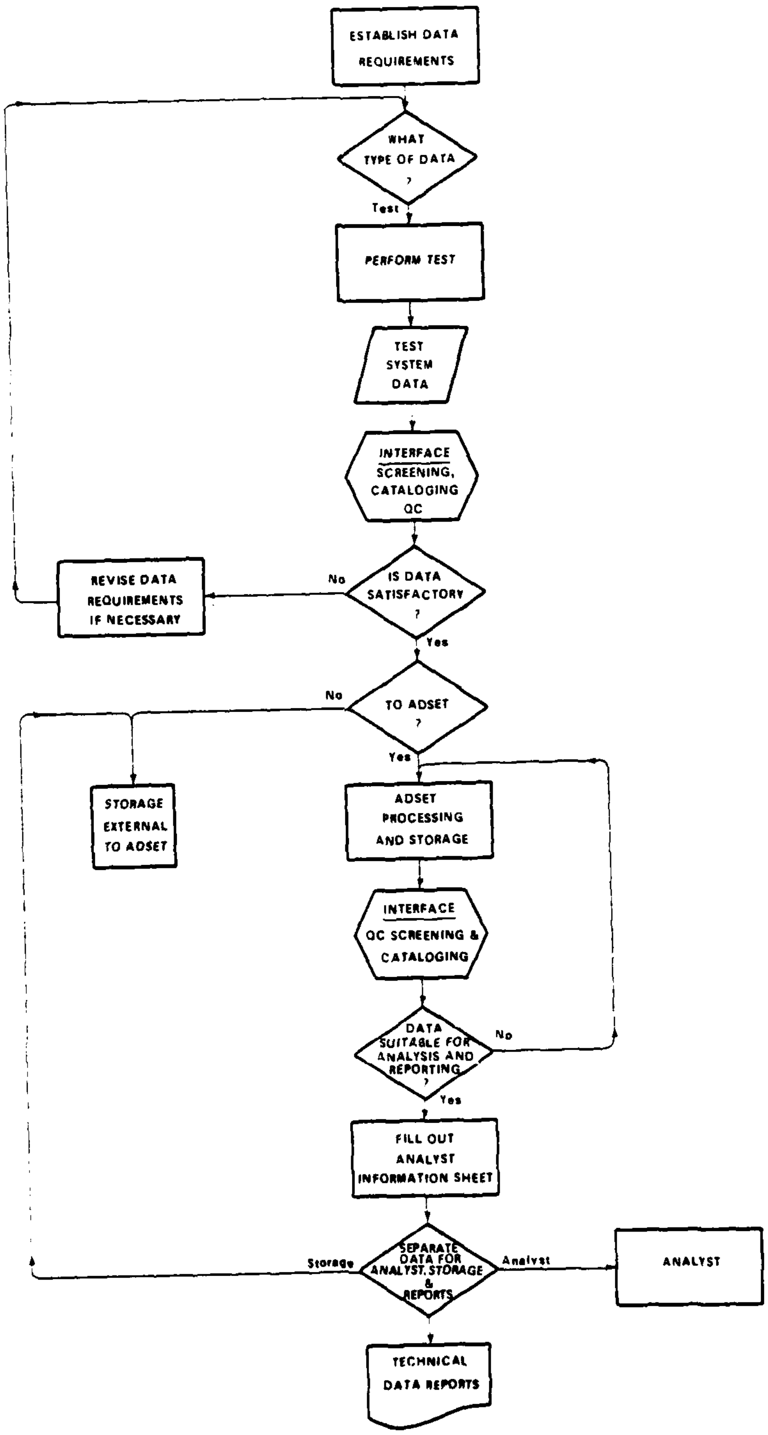



Figure 15. E-3A Data Management Operation

The hard copies and the associated data log sheets were then submitted to DM for preprocessing QC and subsequent processing. The first step was the assignment of a group number and recording of the data description in the group number log. The Polaroid photograph data sets and the hard copy plots from DASET were made available to a data analyst for evaluation. After this evaluation, Data Management submitted a request for data sets tentatively identified for entry into ADSET-Remote for processing.

DM then performed a more thorough QC of the requested data sets. This included a check of all the pertinent header information and identification of baseline and time starts where these were not obvious. Occasionally, it was necessary to request an override on the use of the automatic time-tie and revert to the manual time-tie feature on ADSET. Those data sets, both photographs and DASET data, found acceptable for entry into the system required the addition of information to the data log sheets. The reference sensor data log sheet and coded comments summary were consulted to determine what information was to be added. The signal-to-noise ratio (S/N) was computed and entered for that data whose characteristics made this possible. The data to be processed was marked and submitted to ADSET-Remote. The date of submission of the data sets and their associated data log sheet were noted in the data status log.

After processing at ADSET-Remote, the photographs and copies of DASET traces, data log sheets, ADSET created time-domain plots and header records were returned to DM. The receipt of this data was logged in the data status log. A quality control check of the data received was performed. This QC revealed only data that required either reprocessing by ADSET-Remote or header information changes via the characterization edit program (CHREDI) on the ADSET analyst terminal. Total rejection of a data set required the deletion of the ADSET assigned data number (ADN) from the directory of the ADSET Data Base. Data sets that had been accepted were entered in the data status log and ADSET data number log for control and accounting purposes.

Concurrent with the above procedures was the processing at ADSET-Main. This processing resulted in listings of characterization information for each processed data set.

In order to review and edit the ADSET E-3A data base at periodic intervals, ADSORT computer listings were produced. The test status log, ADSET data number log, data status log, and data log sheets were used in checking the accuracy and completeness of the characterization records as given on this listing. An annotated listing was sent to ADSET-Remote for characterization record editing.

## 6. QUALITY CONTROL PROCEDURE ANALYSIS

The primary purpose of data quality control during E-3A testing was to add to and maintain the high quality data base in the ADSET data storage/retrieval system for use in subsequent analysis. Data control, as explained in previous paragraphs, was a two-part function consisting of both preprocessing and post-processing control. In the pre-processing phase when the data was recorded, logged in, and checked for potential processing problems and additional characterization information was furnished, certain types of errors were detected that would have degraded either the quality of or the capability to retrieve the data and use it properly. In the post-processing phase, when the data was logged back into DM and thorough evaluation of the processing was made, other errors were detected that would have detracted from the quality and usefulness of the data. The errors can be separated into two major areas: 1) log information and characterization errors - data record control, and 2) digitizing and time-tieing errors - data validity control.

### a. Data Record Control

When the DASET data log sheet data cassette tapes, and the hard copy plots were received from the quality control analyst, the cassette tapes were checked to determine if the shot numbers were recorded on the cassettes. Approximately mid-way through the E-3A program, the recording of the data on cassette tapes was abandoned in favor of recording the data on computer disc. This proved to be more effective and efficient than cassette tapes. Less data was lost due to bad tapes, and more data could be stored on disc so storage problems, to some extent, could be eliminated. The entries were cross-checked between the DASET data log sheets and the information printed on the DASET hard copy plots. These included microwave attenuations, sweep speeds, and vertical sensitivities, which are the most critical to the ADSET processing. The instrumentation numbers, test/facility, test item description, julian date, sequence number, shot number, and measurement types were also checked for accuracy. Any discrepancies were noted to ADSET for correction during processing. In addition, any target defects that may have occurred in the R7912s that were transmitted to the data and were not or could not be removed by the DASET edit routine were also noted, and additional special instructions made on copies of the plots.

Quality control inspection of the DASET data log sheets and DASET hard copy plots revealed only an occasional incorrect entry. The parameters that were most likely to be in error on these are listed below:

DASET Data Log Sheet

- Configuration
- Measurement Type
- Attenuation
- Instrumentation Number

DASET Plots

- Attenuation
- Measurement Type
- Instrumentation Number

Miscellaneous problems that occasionally were discovered included:

- Incorrect risetime/environmental level
- Calibration pulse trace missing
- Shot unable to be retrieved from cassette due to hardware/software failure in DASET.

As testing progressed and more effective communications were established, the errors associated with DASET data as it arrived at DM were minimal.

During log-in and check of the photographs, DM occasionally had to fill in missing or incomplete entries on the data log sheet. There were also some inconsistent and actually incorrect entries. Any inaccuracies or inconsistencies between the photographs and the log sheets were brought to the attention of the test director or the data analysts, and were corrected when possible. The data log entries had to be accurate because the personnel at ADSET-Remote used the data log sheet to determine entries made during data processing. In contrast to the processing of DASET data, the operators at ADSET-Remote had to make all data entries at the time of processing. The most critical entries that were occasionally in error or missing were the sweep speeds, vertical sensitivities, attenuation, and sensor number. An error in any one of these parameters that was allowed to get through for ADSET processing invalidated the entire data set.

Data record control during the post-processing phase consisted of a QC inspection of the header records received from ADSET-Remote against the data log sheets, and an accuracy inspection of characterization record entries as given on an ADSORT printout. The errors found during post-processing record control fall into two categories: those that can be corrected using the edit capability of the analyst terminal and those that require reprocessing of the data set and purging of the data that was processed incorrectly. Those errors found that required reprocessing are listed below:

- Wrong attenuation, sweep speed, or vertical sensitivity.
- Duplicate data records at ADSET-Main.
- Duplicate data numbers assigned to different data sets at ADSET-Remote.
- Data record lost at ADSET-Main.
- Wrong set of data numbers assigned to a particular test/facility code

- Plots not received from ADSET-Remote.

Those errors that could be corrected by editing of the characterization record include incorrect entries in fields other than ADN. Characterization record errors were numerous and ADSORT listings proved to be quite useful in detecting and correcting these errors.

b. Data Validity Control

The types of errors most common to the data during the real-time digitization (DASET) that can be corrected before processing by ADSET are, for the most part, detected by the data acquisition quality control analyst. The quality control analysts were present within the DASET Van during the testing and coordinated the information supplied by the user and the test director. This eliminated the possibility of conflicting information being supplied to the DASET operator. By assuring that the pre-test information recorded on the DASET data log sheet (see Figure 7) was correct and complete, the possibility of incorrect test point numbers, instrumentation numbers, attenuations, sensor numbers, sweep speeds, and vertical sensitivities was minimized. This pre-test information was again verified during the timing shot for each channel and for each R7912 transient digitizer in use.

The quality control analyst also assured that there was a true and adequate baseline for both the fast and slow sweeps; that the R7912 intensities were correct; and that the test conductor was notified when more than approximately two cycles per division occurred or the peak amplitude of data trace exceeded two times the calibration pulse amplitude.

The area of the time-tie between the hardware units (HUNS) of each channel was closely monitored to assure that the data was time-tieable. In addition, erroneous points, peak clipping, and target defects were detected. These were eliminated either by adjusting the HUN intensities, sweep speeds or attenuations, or by the edit routine in DASET. If these errors could not be remedied in DASET, they were noted on the DASET data log sheet and recommendations were made to DM and ADSET to correct these problems. The calibration pulse data was taken separately, after the time-domain data had been stored on cassette tapes or disc and hard copies made by DASET. Again, all the header information for each channel and HUN in use was checked as previously described. The cal-pulse for each channel was checked for symmetry and for stability of the gain factor between hardware units and between shots. If excessive ringing occurred due to possible reflections or movement of the dielectric waveguide, the cal-pulse was retaken.

When it was determined that the time-domain and cal-pulse data were satisfactory, the DASET data log sheet and the hard copies of the data trace were turned in at appropriate intervals to DM. The data was then scrutinized thoroughly before being turned over for processing. Occasionally, it was determined that a particular measurement could not be processed because of lack of agreement between the traces in the time-tie area. This information was transmitted immediately to the test director so that additional measurements could be made or the hardware units in DASET could be checked. This feature of DM allowed a sufficient amount of accurate, processible data to be recorded before movement or removal of the test point setup.

A technical QC step was implemented in the DM area when the time-tie plots were returned from ADSET. Particular attention was paid to the time-tie area to determine possible time loss or gain. The peak amplitudes were calculated to determine possible variances which may have been caused by incorrect attenuations, trace rotation, baseline shift, scaling error or incorrect measurement of the cal-pulse. When corrections were required, additional special instructions were submitted to ADSET pertaining to the problem involved. The ADSET data numbers (ADNs) and plots for the erroneous data were purged from the system and the corrected ADNs and plots were inserted. This deletion of the incorrect data was accomplished utilizing the ADSET-Remote Analyst Terminal and the characterization edit program, CHREDI.

DM rejected processed data sets when any one or more of the following were found:

- A discrepancy between a peak amplitude on the ADSET plot and the amplitude as determined by the DM analyst as great or greater than one-tenth of a division on the photograph or DASET plot.
- A time loss or gain as great or greater than one-fifth of a division.
- Loss of structure due to an inaccurate time-tie on DASET data.
- Visibly inaccurate structure in digitized photograph data.
- Baseline rotation that results in an error at the late time as great or greater than one-tenth of a division on the photograph or DASET plot.
- Baseline shift as great or greater than one-tenth of a division on the photograph or DASET plot.
- Inaccurate selection of time zero.

c. Data Management Manning

The single most important factor in assuring the best quality control of data is to have well trained, experienced personnel performing each task. The E-3A tests were fortunate to have these levels of personnel doing the QC.

There were 6 data management types working on various aspects of the data as it made its way through the data mill. As was noted earlier in this section, the quick quality controller (QQC) is the first step in QC, these people must be able to make quick decisions on data which is coming at them at a very fast pace. On E-3A the personnel we had performing this task were able to make all the decisions necessary on raw data at the rate of one hard copy photo (this relates to one HUN) per minute. Obviously, one person cannot keep a rate such as this up for long periods of time, however, when all other factors associated with a test are taken into consideration, one person can manage 10 to 12 HUNS for a period of 6 hours of testing. The next QC function is data tracking. This job requires someone who is capable of staying on top of all the many logs required. Ms. Anita Bookless of EG&G was able to do the job for us on E-3A, however, it was a 50 hour week effort for her and she was experienced. This job was made more difficult than it should have been due to the P&A Contractor constantly wanting to see the data while it was being worked on.

There were three other data management people involved in the data mill. These people had the task of performing the pre and post QC on the data. Their jobs were made most difficult by the P&A Contractor analysis. It seems there was always a disagreement on the separation of good data from bad data. The difficulty with the P&A people plus the amount of Polaroid film data required these three individuals to work 50 to 60 hours each week to stay up with the data accumulation.

d. Conclusions and Recommendations

In conclusion, complete quality control of the data produced has proved to be the most practical method of supplying the user with accurate data containing the most usable information. The amount of test time lost due to the quality control function is minor in contrast to the time involved when a test has produced unusable data or if the test item instrumentation and configuration must be reset to acquire the data, or the test item has been removed entirely.

With the advent of the data acquisition quality control analyst, induced error in the data was reduced substantially. In addition, there was less confusion with the DASET operator as to the correct input information and as to the source. The error in characterization information was reduced by approximately a factor of three. If corrections were required, the quality control analyst was immediately available to supply or obtain this information, and all program areas were appraised of any abnormal situations pertaining to the data or problems of operations within DASET.

An even better communication between the various program areas and more control by the quality control analyst on the final acceptance of the data would greatly reduce the type of random errors that occurred during the E-3A Testing. When any changes occur with the test item that affects the input to DASET, an immediate notification should be made to alert the DASET operator to these changes to assure that DASET is operating optimally. This would expedite the entire system, resulting in less cost and a better quality of data to the user.

## SECTION V
## TEST ACTIVITIES

### 1. PRE-PULSE

Each day, before data acquisition could actually begin, a series of preliminary activities had to be accomplished. Usually, they were fairly routine and carried out in a timely manner by TCC personnel. From time to time, changed requirements or a breakdown in communications delayed the morning test preparation. During the morning status meeting for supervisory personnel, which began at 0700 hours daily, the TAC crew and TCC technicians moved the aircraft under the HPD antenna (if testing at that facility). This normally took about half an hour. If the wheel-well boots were used, they were emplaced as part of the aircraft movement exercise. When the E-3A was in position under the pulser, it was backed up enough to allow the wheel-well boots to be placed on the landing gear footprints. Then, the back walls of the boots were removed and the aircraft pulled forward into them. After replacement of the backwalls, the screen on the tops of the boots was attached to the aircraft with copper tape. The paint had been stripped in a band above the walls for this purpose. Once the aircraft was in position, the other setup activities could begin. TAC and TCC personnel hooked up the air-conditioning duct and pushed up and held the in-board leading-edge flaps closed with 2 x 4 props. This was required because without hydraulic power on the aircraft all the leading-edge flaps were free to droop. Because of check-valves in this flap system, the hydraulic line in each wing had to be opened at a joint to bleed the pressure and allow closure. The outboard flaps were held up by plastic tabs bolted to the wings. The flood lights on the perimeter of the security area were laid over on their sides and the extension cords feeding them were pulled back to the edge of the test pad. If external measurements were to be made, the sensor(s) and single-channel microwave transmitter were positioned at this time.

The majority of equipment on-board the aircraft was contained in the screenbox setups. A typical screenbox contained two oscilloscopes, two 1105 power supplies, one nickel-cadmium (NiCd) 28 volt battery with an EG&G inverter, two polaroid scope cameras, two to four matched BNC cables and two GR power splitters. In addition to this equipment, an effective trigger system and trigger signal point were necessary. Typically, this system consisted of a superflex coaxial cable connected to the external trigger feedthrough on the screenbox with the other end connected to a five ohm probe coupled to a trigger point. The trigger system used was effective, but often cumbersome. A centralized trigger system for all screenbox setups should be used. This would help eliminate the many trigger cables, and ease the congestion on-board the aircraft. Other equipment on-board the aircraft consisted of two five-channel microwave transmitter systems with their associated test point probes, cable arteries and waveguides. This type of system is much more appealing since it doesn't require a lot of operators or space on the aircraft.

During the course of the E-3A test, delays were encountered due to non-tagged test points. As a result, an effective test point layout/acquisition plan for more than a few days ahead was not possible. Prior to any implementation of a test phase, all test points involved in that phase should be tagged. If this is done, an ordered test point layout/acquisition plan can be made for the entire phase. Of course, if test points are added or deleted during the phase, this impacts the efficiency with which the TCC can instrument.

For most of the E-3A test, screenboxes were used. These systems were setup every morning and allowed to warm up for 30 minutes. Setup was begun by installing fresh batteries in the system which typically included two 485 scopes, one 28 volt NiCd battery with an EG&G inverter and two 1105 Tektronix battery packs with inverters. One scope was connected to the NiCd/inverter, the other to an 1105, with the other 1105 being held in reserve. Once the scopes had warmed up, the calibration procedure was begun. The cameras were verified to be in focus by use of a focusplate, then new film was placed in the cameras. The scopes were put in the calibration mode and calibration via the square wave source (internal to the scope) was done. The calibration was then documented by means of the scope camera using the sweep speeds typical of the data sweep speeds. The calibration photographs were stamped and the scope setting recorded on their backs.

Once this procedure was completed, electrically matched coaxial cables were used to connect each scope input (single-channel) to a power splitter. The input of the power splitter was connected to the screenbox input. Similar connections were made for the external trigger input of the scopes to the trigger feedthrough of the screenbox. Instrumentation test points were then connected to the screenboxes along with a suitable trigger source.

Keeping the microwave transmitters hooked into the appropriate test points became somewhat of a problem since the primary data acquisition system evolved into screenboxes. This resulted in many non-tagged arteries in the proximity of the microwave transmitters, and occasionally an incorrect cable was attached to the transmitters. It should be noted that all instrumentation setups were checked before disconnection occurred, which resulted in the discovery of all nonprogrammed test points. In addition to this problem, non-TCC personnel occasionally and inadvertently disconnected test points and hooked up their own without notifying the TCC engineer. All of these errors were also discovered in the same manner.

Having to use breakout boxes added a cumbersome dimension to instrumentation on the E-3A. Sometimes the boxes were too large to fit in the desired location easily, or would not go at all. This would necessitate that the access to the test point be moved. Another drawback of the present design is the weight. This often made it difficult to support the boxes once they had been put into position. EG&G has considered several alternatives such as aluminum enclosures and a compact version especially for the 91550-series of probes. Occasionally, the braid shielding on the breakout cable was a little short which required that the breakout cable wires be somewhat compacted in the breakout box.

When using the breakout boxes, they were isolated from the metal structure of the aircraft, which often put strain on the cable portion. This additional restriction seems unnecessary since the instrumentation cables were grounded as close to the boxes as possible. Now the instrumentation cable would seem to supply the grounding which was trying to be avoided.

The screenbox setup using a single channel microwave system was the same as described earlier except that a single-channel microwave receiver was used between the screenbox input and the scopes. The microwave signal was fed through the screenbox by means of waveguide. This waveguide was terminated outside the box in a horn transition to Dielectric Waveguide (DWG). The spare battery in the screenbox was used as a power supply for the microwave receiver (see Figure 16).

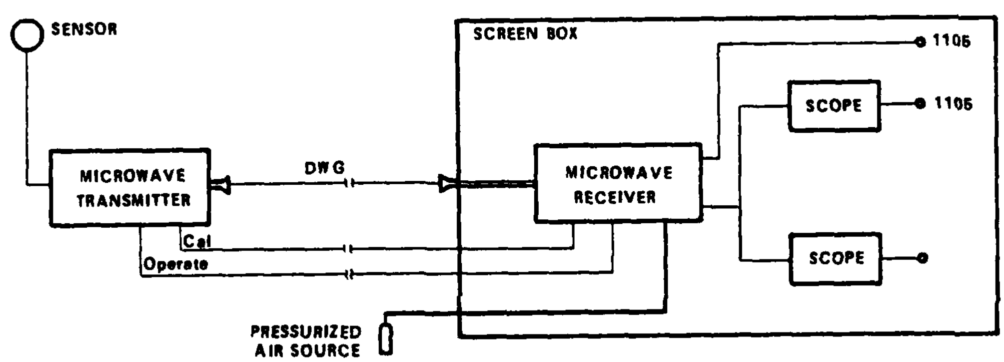



Figure 16. Screenbox with Single-Channel Microwave

For controlling the receiver, air lines were fed through the screenbox wall and connected to the appropriate terminals of the microwave. The scopes were calibrated in the same manner as previously described. The microwave system was calibrated using a cal pulse from the transmitter that goes through the receiver and is recorded by the oscilloscopes.

2. DATA COLLECTION

Log keeping for the microwave transmitters was done on-board the aircraft and inside the DASET Van. This method provided constant checks on possible instrumentation system errors. These errors could be due to non-recorded changes, inaudible radio communications and erroneous information. After each data save, test point location, sensor attenuation and channel were checked. This control produced good confidence in the instrumentation system parameters.

The quality control of the data taken with the screenbox/ oscilloscope systems could be improved by employing only those TCC people assigned specifically for that purpose. However, due to personnel shortages and pressure to take data as rapidly as possible, the TCC did not always have a final say on data that was saved. In addition, better lighting conditions on the aircraft would have made the photograph QC job easier.

In any test environment, monitoring is necessary. On-board the AWACS it was imperative due to the continuous traffic encountered. People were constantly stepping on setups and/or moving them. This problem was reduced by education and securely placed instrumentation, however, decreasing the number of persons on-board will minimize this type of occurrence.

After a pulser shot, the screenbox operators advanced the oscilloscope film. This made the back of the Polaroids just exposed accessible and started the 15 second development period. During this wait, they used a stamp to imprint a form on the backs and filled out the instrumentation data requested. This stamp has been shown previously in Figure 2.

Quite often, noise-type signals would appear for a data point. This was frequently caused by a faulty microwave transmitter. Other sources of noise also manifested themselves during the test. They were usually broken cables and loose connectros. While there is no a priori place to look for noise, there is a systematic method of determining its source. Beginning with the probe/sensor, each element of the instrumentation chain is checked for proper hookup or settings. By elimination, the probable cause is isolated and changed. If this does not correct the situation, the process is continued until the faulty element is located and fixed.

The CW impedance measurements were an important part of the E-3A test. These measurements were scheduled to be taken during hours when pulse testing was impossible due to weather conditions or other pulser "holds". This technique was quite successful in spite of the two major drawbacks of warm-up time and lightning danger. The warm-up time can be shortened by keeping the system on when it is probable that weather conditions will halt pulse testing. This was done for the E-3A test successfully, however, it does not work for unanticipated "no-pulsing" periods. During a lightning storm there is danger to personnel entering or leaving the aircraft, if it is not grounded. When grounded, the lightning danger is minimized. The other danger due to lightning is that from the AC power cord required for operation of the CW system. The power cord can act as an antenna and conduct the lightning pulse (if struck) to the CW system or personnel on-board the aircraft. If, in future system level tests CW measurements are permitted while there is a thunder storm in the vicinity, do not connect the network analyzer to an antenna or it could be destroyed if lightning were to strike the aircraft.

3. SHUTDOWN

At the end of the test day, all of the used battery packs, rechargable lights and Polaroid data shots/logs were removed from the aircraft. This equipment and data was returned to its appropriate station, and readied for the next day of testing. At this time some aircraft clean-up was done. It should be noted that, while clean-up is an on-going process, some specific time should be allotted for this purpose to prevent pile-up of debris on the aircraft. Test point instrumentation was done at this time for the first few weeks of the test. Then, it was determined that morning instrumentation increased the efficiency of the test activities/data acquisition.

Much of the equipment used for the E-3A test program ran on rechargable batteries. Because there are restrictions for maximum charging times, some batteries had to be charged beginning on the weekend in order to be ready for use at the beginning of the week. This was no problem as long as someone had to come in to check the nitrogen inerting system. If an alarm system for the nitrogen supply were implemented which eliminated the weekend checks, the battery charging would still present a problem. The incorporation of a timer to control the battery charging system would then eliminate the need for personnel to initiate this operation on the weekend.

4. PERIODIC ACTIVITIES

Periodic checks for oxygen content in the aircraft fuel tanks were performed throughout the system level test. During the first several weeks, the checks were made more often to determine the stability of the system. A check consisted of drawing a sample of the fuel tank's atmosphere into an oxygen content analyzer and recording the reading on the analyzer's scale. Because of the reliability of the nitrogen inerting system, the oxygen level always remained well below the maximum allowable level of 9%. Usually, all the tanks were between 0% and 1%.

Checks of the nitrogen supply trailer were completed on a daily basis. All pressure gauges were set initially and were monitored throughout the duration of the test. Once the system was stabilized, no adjustments of pressure gauges were necessary. As the gas bottles were used, old bottles were turned off and then new ones turned on in groups of three. Refilling of the nitrogen trailer was accomplished during the day without any upset in the system because the heat from the sun caused the vapors in the tanks to expand so that there was no demand on the nitrogen source.

Cooling water was required for the E-3A surveillance radar system checkout. The nearest source was the HPD's fire hydrant, some 150 meters away. The TCC purchased 6.35 cm diameter high pressure PVC pipe and couplings, plus several adaptors, and ran pipe from the hydrant to the edge of the HPD pad. From this point, 3.8 cm fire hose was used to attach directly to the aircraft input adaptor. At the VPD-II site, a fire hose was routed from the underground trailer shelter area up to the ground level where it was coupled to several lengths of the PVC pipe. The PVC was run part way onto the VPD-II pad and, once again, a fire hose was used to joint the PVC to the input adaptor at the aircraft.

For the engines-off test phase (the major portion of the program), the E-3A was in a "Simulated Power-On" configuration. This meant that the connectivity paths of the aircraft's electrical distribution system were completed as if the vehicle was in flight. This was accomplished with hard-wire jumpers and switch actions by TCC and TAC personnel. However, when maintenance or checkout activities became necessary which required the application of ground power and/or engines on, the aircraft had to be restored to its normal ground configuration. In order to facilitate this repetitive implementation and removal of power-on simulation, Mr. Jim Bridge of EG&G prepared a Guide/ Checklist to assist personnel in accomplishing this task. It is included as Appendix B of this report for easy reference.

Prior to the first pulse of each day, the aircraft configuration should be verified by the measurement's engineer. The window EMP barriers, hatches, and microwave feed through panels should be in their correct positions, and all circuit breakers checked for the required positions and any discrepancies corrected and noted. Also, any jumpers necessary for proper aircraft configuration should be checked.

E-3A TEST DAYS LOST

| BAD WEATHER | | AIRCRAFT MAINTENANCE | | TEST EQUIPMENT FAILURE | | HOLIDAYS | | AIRCRAFT AND/OR EQUIPMENT SETUP | | OVERTIME | | DAYS BEHIND SCHEDULE* | | OTHER | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Hours | Date | Hours | Date | Hours | Date | Hours | Date | Hours | Date | Hours | Date | Hours | Date | Hours |
| 6/29/78 | 4 | 6/26/78 | 8 | 6/28/78 | 5 | 7/4/78 | 8 | 6/28/78 | 4 | 7/5/78 | | 6/21/78 | 12 | 6/22/78 | 1-1/2 |
| 8/2/78 | 2 | 7/10/78 | 8 | 7/5/78 | 8 | | | 7/11/78 | 3-1/2 | 7/14/78 | | 6/22/78 | 16 | 7/21/78 | 1 |
| 8/3/78 | 5 | 7/24/78 | 8 | 7/12/78 | 2-1/2 | | | 8/28/78 | 8 | 7/17/78 | | 6/26/78 | 20 | 7/27/78 | 1-1/4 |
| 8/4/78 | 5 | 8/7/78 | 8 | | | | | 10/6/78 | 8 | 7/18/78 | | 6/28/78 | 24 | 10/3/78 | 4 |
| 10/3/78 | 4 | 9/5/78 | 8 | | | | | 10/9/78 | 8 | 8/7/78 | 1 to 2 | | | 10/7/78 | 8 |
| 10/23/78 | 8 | 9/6/78 | 8 | | | | | | | | | | | | |
| | | 9/18/78 | 8 | | | | | | | | | | | | |
| | | 10/5/78 | 8 | | | | | | | | | | | | |
| 6 | 28 | 8 | 64 | 3 | 15-1/2 | 1 | 8 | 5 | 31-1/2 | 5 | 3 plus | 4 | 24 | 5 | 15-3/4 |

TEST DAYS AVAILABLE = 96
APPROXIMATE DAYS LOST - 20

* For Reference Only

# APPENDIX A

## CONNECTOR VENDORS

1. Rhimco Industries, Inc.
   Route 2, Box 18
   Mansfield, Texas 76063
   Attn: Don Macey (817) 477-3176

2. Bendix Corporation
   Electrical Components Div/Microwave Sales
   Sidney, New York 13838
   Attn: Janet Sheils (607) 563-5385

3. Deutsch Company
   Electronic Component Div.
   Municipal Airport
   Banning, CA 92220
   Attn: Ken Linson (714) 849-7844

4. Spacecraft Components
   14183 Chadron Avenue
   Hawthorne, CA 90250
   Attn: Clay Campbell (213) 772-6411

5. AMPHENOL Sales Division (Bunker Ramo Corp.)
   8939 S. Sepulveda Blvd.
   Suite 400
   Westchester, CA 90045
   Attn: Richard F. d'Entremont (213) 649-5015

6. Cramer Electronics
   2460 Alamo Avenue SE
   Albuquerque, NM 87106
   (505) 243-4566

7. Powell Electronics
   411 Fairchild Drive
   P.O. Box 997
   Mt. View, CA 94040
   Attn: Vicki Estow

APPENDIX B

# CHECK LIST

## E-3A POWER-ON CONNECTIVITY SIMULATION

This Check List augments Appendix D (Power-On Connectivity Simulation) of the General Test Plan/Procedures for the E-3A System Level EMP Test Program Part I. It is a result of experience gained in accomplishing the tasks of Appendix D while relying heavily on experienced TAC Maintenance Crew Members and on information contained in the Electrical Systems T.O. 1E-3A-2-24-1.

The Check List shall be used by the EG&G Test Team and the TAC Maintenance Crew to insure that the requirements and objectives of Appendix D of the General Test Plan are accomplished in a safe and timely manner. The check list is divided into two major parts. Part I deals with those activities required to place the aircraft in simulated power-on configuration prior to power-off testing. Part II covers the tasks required to restore the aircraft to its original electrical configuration prior to (a) connection and application of external auxiliary ground power or, (b) connection and use of aircraft emergency batteries or, (c) power up of aircraft APU or (d) power up of aircraft engines.

The EG&G Test Instrumentation Engineer or his appointed alternate and the TAC Electrical Maintenance Technician or his appointed alternate will be responsible for insuring that the check list tasks are performed safely and thoroughly. Each party will personally inspect the electrical configuration pertaining to a particular step in the check list before initialing the step as completed. After all steps of Part I or Part II of the check list are completed, the responsible EG&G and TAC representatives shall sign and date the applicable portion of the check list before further EMP tests or aircraft maintenance commence. The EG&G Test Instrumentation Engineer shall maintain a file of the original completed check lists.

CHECK LIST

PART I

Configuration of E-3A Aircraft Electrical System for Simulated Power-On Tests

Approved by: ________________EG&G

________________TAC

Date: ________________

CAUTION: Steps 1 thru 3 must be performed in sequence before proceeding. Steps 4 thru 7 may then be performed in any sequence or simultaneously, as desired.

STEP 1 Checked by:_______ EG&G; ___________TAC

Remove external ground power from the aircraft and detach power cables from EXT PWR receptacles EP1 and EP2. Secure warning tags to receptacle access doors.

STEP 2 Checked by: _________EG&G; __________ TAC

(a) Set the BATTERY switch on Panel P11 (Flight Engineer's Panel) to OFF position with gaurd open.

(b) Set the following circuit breakers to the OFF position by pulling the circuit breaker knob outward:

C104 Hot Battery Bus - Batt Chgr located on Panel P61-6

C3061 115 VAC Bus 6 - Batt Chgr located on Panel P61-6

C3071 Lighting - Bat - 115V AC Chgt located on Panel P67-1

C305 Battery Charger (Emergency Lighting) located at Station 370)

C326 Battery located at Station 370

C3108 Battery located at Station 370

STEP 3 Checked by: _____________EG&G: ___________TAC

(a) Disconnect plug D1545 from left Upper Battery (M5) and short the two pins of the plug together using a suitable jumper. Place warning tag on battery jack (J1). Refer to Figure 1-3; T. O. 1E-3A-2-24-1.

STEP 3 (Continued)

(b) Disconnect plug D1537 from left Lower Battery (M6) and short the two pins of the plug together using a suitable jumper. Place warning tag on battery jack (J1).

(c) Disconnect plug D597 from right Upper Battery (M689) and short the two pins of the plug together using a suitable jumper. Place warning tag on battery jack (J1).

(d) Disconnect plug D578 from right Lower Battery (M686) and short the two pins of the plug together using a suitable short. Place warning tag on battery jack (J1).

(e) Close the circuit breakers (6) that were previously opened in Step 2b above.

(f) Set the BATTERY switch on Panel P11 to the ON position.

(g) Set the EMERGENCY POWER switch on Panel P11 to NORMAL position.

STEP 4 Checked by: ____________ EG&G; ________________ TAC

(a) On Panels P61-5 and P61-6 located below and right of the flight engineer's station, install jumpers on relays R914, R991, R992, R993 and R994 as indicated below. Place warning tags on all jumpers or groups of jumpers and tape ends of disconnected wires.

On R994 located in P61-5 jumper: A1-A2

On R914 located in P61-6 jumper: A1-A2, B1-B2, C1-C2

On R991 located in P61-6 jumper: A1-A2, B1-B2, C1-C2

On R992 located in P61-6 jumper: B1-B2

On R993 located in P61-6 disconnect: Wires 036-16, 034-20 and jumper: C1-C2

(b) On Panel P61-6, open circuit breaker C107 HOT BATTERY BUS CONTROL and place warning tag on breaker.

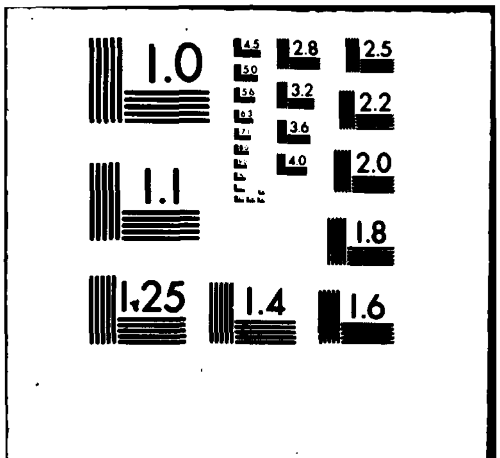
STEP 5 Checked by: ________________ EG&G: ______________ TAC

Install jumpers on the following ELCU's located in Racks E15 and E16 in the forward lower lobe. Secure a warning tag on each group of three jumpers on a particular ELCU. Refer to Figure 1-3, in T. O. 1E-3A-2-24-1.

AD-A081 725 EG AND G INC ALBUQUERQUE N MEX F/G 20/14
E-3A EMP EVALUATION PROGRAM.(U)
JAN 80 J R ANDERSON F29601-78-C-0013
UNCLASSIFIED EG/AG-1394 AFWL-TR-79-115 NL

2 of 2

END
DATE FILMED
4-80
DTIC




MICROCOPY RESOLUTION TEST CHART

| | | | | | |
|---|---|---|---|---|---|
| On M1007 in E15 | jumper: | A1-L1, | A2-L2, | A3-L3 | |
| M1009 in E15 | " | " | " | " | |
| M1113 in E15 | " | " | " | " | |
| M1034 in E15 | " | " | " | " | |
| M1029 in E15-P25 | " | " | " | " | |
| On M1053 in E16 | jumpers: | A1-L1, | A2-L2, | A3-L3 | |
| M1013 in E16 | " | " | " | " | |
| M1011 " " | " | " | " | " | |
| M1052 " " | " | " | " | " | |
| M1014 " " | " | " | " | " | |
| M1012 " " | " | " | " | " | |
| M1108 " " | " | " | " | " | |
| M1010 " " | " | " | " | " | |
| M1018 " " | " | " | " | " | |
| R933 " " | " | L1-T1, | L2-T2, | L3-T3 | |

STEP 6 *Checked by:* ______________ EG&G; ________________ TAC

(a) Latch the eight Generator Circuit Breakers (GCB) located in Racks E15 and E16 to the closed position. To latch a GCB, first disconnect its 55 pin control connector; then apply +28 VDC to pin 53 with respect to pin 54 (28 VDC common) on the GCB connector. Reconnect the control connector.

In rack E15 on Panel P23 latch GCB4-C3004
" " E15 " " P23 " GCB3-C3003
" " E15 " " P25 " GCB2-C3002
" " E15 " " P25 " GCB1-C3001
" " E16 " " P26 " GCB5-C3005
" " E16 " " P26 " GCB6-C3006
" " E16 " " P28 " GCB7-C3007
" " E16 " " P28 " GCB8-C3008

(b) Verify that the eight generator Bus Tie Breakers (BTB) located in Racks E15 and E16 are closed. If any of the BTB's are open, latch them to the closed position as described above in Step 6a.

In rack E15 on Panel P23 verify that BTB 3 - C3011 is closed
" " E15 " " P23 " " BTB 4 - C3012 " "
" " E15 " " P25 " " BTB 1 - C3009 " "
" " E15 " " P25 " " BTB 2 - C3010 " "
" " E16 " " P26 " " BTB 5 - C3013 " "
" " E16 " " P26 " " BTB 6 - C3014 " "
In rack E16 on Panel P28 verify that BTB 7 - C3015 is closed
" " E16 " " P28 " " BTB 8 - C3016 " "

STEP 7 Checked by: ______________ EG&G; ______________ TAC

Verify that all of the circuit breakers listed below are in the closed position. If the listed circuit breakers are found open, close them.

(a) P5 Pilot's Overhead Panel located in Cockpit, Forward Flight Deck

C318 28V DC Bus Power - Emerg Bus
C533 Emergency Communications - UHF Xcvr

(b) P61-5 Main Power Circuit Breakers Panel in Cockpit, Aft Flight Deck

C94 28V DC Tie Bus - DC Bus 8
C96 28V DC Tie Bus - DC Bus 4
C97 28V DC Tie Bus - DC Bus 2
C121 28V DC Bus 2 - Inv.
C122 28V DC Bus 2 - Emerg. DC Bus
C136 28V DC Bus 4 - Voltmeter
C137 28V DC Bus 2 - Voltmeter
C138 28V DC Bus 8 - Voltmeter
C176 28V DC Bus 2 - Batt Bus
C178 28V DC Tie Bus - DC Bus 3, 5 & 6
C190 28V DC Bus 2 - Freq. Ref. Unit
C192 28V DC Bus 2 - Intgr Dr Gen Disc 1 & 2
C194 28V DC Bus 4 - Intgr Dr Gen Disc 3 & 4
C196 28V DC Bus 6 - Intgr Dr Gen Disc 5 & 6

C198 28V DC Bus 8 - Intgr Dr Gen Disc 7 & 8
C214 28V DC Bus 2 - Flt Avionic Bus No 1
C215 28V DC Bus 8 - Flt Avionic Bus No. 2
C216 28V DC Bus 6 - Main Bus Distr
C278 28V DC Bus 2 - Main Bus Distr
C279 28V DC Bus 4 - Main Bus Distr
C280 28V DC Bus 8 - Main Bus Distr
C1050 115V AC Bus 2 - Emerg AC Bus
C1097 115V AC Bus 2 - 28V AC XFMR
C3021 115V AC Bus 2 - Distr Bus No. 2
C3022 115V AC Bus 4 - Distr Bus No. 4
C3046 115V AC Bus 2 - XFMR Rect Unit No. 2
C3047 115V AC Bus 4 - XFMR Rect Unit No. 4
C3062 115V AC Bus 2 - Flt Avionic Bus No. 1

(c) P61-6 Main Power Circuit Breaker Panel in Cockpit, Aft Flight Deck:

C103 Hot Battery Bus - Main Bus Distr.
C104 Hot Battery Bus - Batt Chgr
C105 Hot Battery Bus - Inv.
C106 Hot Battery Bus - Emerg DC Bus
C107 Hot Battery Bus - Batt Bus Cont.
C134 Hot Battery Bus - Voltmeter
C177 Hot Battery Bus - Batt Bus Pwr
C200 Hot Battery Bus - Bus Pwr Cont Unit Prot
C1098 115V AC Bus 8 - 28V AC XFMR
C3023 115V AC Bus 6 - Distr Bus No. 6
C3027 115V AC Bus 8 - Distr Bus No. 8
C3049 115V AC Bus 8 - XFMR Rect Unit No. 8
C3061 115V AC Bus 6 - Batt Chgr
C3063 115V AC Bus 8 - Flt Avionic Bus No. 2

(d) P66-1 Circuit Breaker Panel located forward of Station 500 on the right in the main cabin:

C95 Mission Power Distribution DC Dist - DC Tie Bus - Bus 6

C135 " " " " " - 28V DC Bus 6 - VM

C282 " " " " " " " " 3-Dist 1

C284 " " " " " " " " 6-Dist 1

C507 " " " " " " " " 6-WBSV-ZERO

C536 " " " " " " " " 6-Dist 2

C546 " " " " " " " " 3-Dist 2

C547 " " " " " " " " 6-Dist 3

C548 " " " " " " " Bus-Bus 3

C554 " " " " " " " Bus-Mission

C610 " " " " " - 28V DC Bus 3-Mission Lts

C2541 Mission Power Distr. AC Dist - 28V AC XFMR

C2559 " " " " " - Mission Lts

C3501 - 115V AC Bus 1 - Dist 1

C3502 " " " " " - Dist 2

C3510 " " " " " - 115V AC Bus 2 - Dist 1

(e) P67-1 Circuit Breaker Panel located forward of the right wing escape door.

C2001 Lighting Power Distribution - 28V AC - Bus 5 ØB

C3071 Lighting - Bat - 115V AC Chgr

C3558 Surveillance Radar - Rotodome

(f) P67-2

C608 Contactor Power

(g) P67-3

C67 Liquid Cooling System - Liquid Pump Contr 1

C321 Mission Power Dist. DC Tie Bus - Mission

C322 " " " " " " - Bus 3

C323 " " " " " " - Bus 6

C534 Mission Power Dist. - 28V DC - Bus 3 Dist 3
C535 " " " - 28V DC - Bus 5 Dist 1
C597 " " " - DC Tie Bus - Bus 5
C599 " " " - Voltmeter - DC Bus 5
C3045 " " " - Equip & Furn - Galley
C3503 " " " - 115V AC Bus 3 - Dist 1
C3507 " " " - 115V AC Bus 7 - Dist 1
C3509 " " " - 115V AC Bus 8 - Dist 1
C3511 " " " - 115V AC Bus 4 - Dist 1
C3512 " " " - 115V AC Bus 6 - Dist 1
C3516 " " " - TRU - 5
C3517 " " " - TRU - 3
C3560 " " " - TRU - 6

(h) At Station 370 in the Lower Forward Battery Compartment:

C305 Battery Charger (Emergency Lighting)
C226 Battery
C108 Battery

## CHECK LIST

## PART II

### Restoration of E-3A Aircraft Electrical System to Original Configuration After Simulated Power-On Tests

Approved by: ______________ EG&G

______________ TAC

Date: ______________

**CAUTION:** Steps 1 thru 4 must be completed before proceeding to Steps 5 and 6.

**STEP 1:** Checked by: ______________ EG&G; ______________ TAC

Open the following circuit breakers:

C108 Battery Charger (Emergency Lighting) located at Station 370

C305 Battery located at Station 370

C326 Battery located at Station 370

C104 Hot Battery Bus - Batt Chgr located on Panel 61-6

C3061 115V AC Bus 6 - Batt Chgr located on Panel 61-6

C507 Mission Power Distribution DC Dist - 28V
DC Bus 6 located on Panel 66-1

C2001 Lighting Power Distribution - 28V AC -
Bus 5 ØB located on Panel 67-1

C3071 Lighting - Bat - 115V AC Chgr located on Panel 67-1

**STEP 2:** Checked by: ______________ EG&G; ______________ TAC

(a) Set the BATTERY switch on Panel P11 to OFF position (gaurd open)

(b) Set the EMERGENCY POWER switch on Panel P11 to OFF position

STEP 3: Checked by: ________________ EG&G; ___________ TAC

Remove all jumpers installed on 15 each ELCU's located in Racks E15 and E16 in the forward lower lobe. These jumpers were installed per Step 5, Part I of this checklist. Remove jumpers from:

M1007 in E15
M1009 in E15
M1113 in E15
M1034 in E15
M1029 in E15 - P25
M1053 in E16
M1013 in E16
M1011 in E16
M1052 in E16
M1014 in E16
M1012 in E16
M1108 in E16
M1010 in E16
M1018 in E16
R993 in E16

STEP 4: Checked by: ________________ EG&G; ___________ TAC

(a) Remove all jumpers installed on 5 each relays located in Panels P61-5 and P61-6. These jumpers were installed per Step 4, Part I of this checklist.

Remove jumpers from:
R994 in P61-5
R914 in P61-6
R991 in P61-6
R992 in P61-6
R993 in P61-6

(b) Reconnect wire 036-16 to terminal C3 of R993 and wire 034-20 to terminal A2 of R993

(c) On Panel P61-6, close circuit breaker C107 HOT BATTERY BUS CONTROL

<u>STEP 5:</u> Checked by: _______________ EG&G; ___________TAC

(a) Remove each of the four jumpers installed in the four battery plugs. These jumpers were installed per Step 3, Part I of this check-list.

(b) Reconnect each of the four battery power plugs to its appropriate battery.

(c) Close the following circuit breakers:

C305 Battery Charger (Emergency Lighting) located at Station 370

C108 Battery located at Station 370

C326 Battery located at Station 370

C104 Hot Batter Bus - Bat Chgr located on Panel P61-6

C3061 115V AC Bus 6 - Batt Chgr located on Panel P61-6

C3071 Lighting - Bat- 115V AC Chgr located on Panel P61-7

<u>STEP 6:</u> Checked by: _______________ EG&G; ___________TAC

Remove warning tags from EXT PWR receptacle access doors.