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To: Jay W. Forrester

From: Division 6 Staff

Approved: JCP
John C. Proctor

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SAGE SYSTEM TEST AND PLANNING

(Group 61, J. F. Jacobs)

MASTER PROGRAM PREPARATION (H. D. Benington)

David Bailey has been named Assistant Section Leader and will direct work on operational programs. Some of the personnel presently working on program organization will work on operational programs; the remainder will work on program design and central programs.

A detailed schedule for preparation of coding specifications, coding, and checkout of the Master Program will be completed shortly.

Program Organization (A. R. Shoolman)

Ray Olsen and Mary Cary are drafting a memo describing status and status changes in weapons assignment.

The following studies have been assigned:

Radar data inputs	- Roy Schaub
Raid-forming	- Robert Klein
Situation and digital displays	- Mike Loviglio

Utility Programs (C. H. Gaudette)

A training program of two one-hour lectures per week for computer operators has been started. The initial sessions will be devoted to utility programs and their functions in a computing center.

A study to determine the effects of the magnetic tape peripheral equipment on magnetic tape unit requirements is underway.

Martha Sifnas has joined the subsection and will work on the read-in program.

Checkout and Duplex Standby (P. R. Vance)

Bob Carmichael has joined the section and will write the utility control program for C. Gaudette. Bob Krouss has joined the section and will work for A. Shoolman in programming. Both will ultimately work in checkout.

Initial work has begun on a proposal for table simulation. The table simulation program will be used during checkout to translate

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MASTER PROGRAM PREPARATION (continued)

alphanumeric information, read from punched cards, encode and store it in the correct table location. It will also decode tabular information and print it out in alphanumeric form.

OPERATIONAL SPECIFICATIONS FOR SAGE SYSTEM (C. A. Zraket)Air Surveillance (E. W. Wolf, J. Ishihara) CONFIDENTIAL

The following memoranda have been issued:

"Operational Specifications for Track Monitoring in the SAGE System," 6M-3826;

"Operational Specifications for SAGE System Radar Data Inputs," 6M-3774, Supplement 1;

"Operational Specifications for Track Detection and Initiation in the SAGE System," 6M-3766, Supplement 1.

A rough draft of the Mathematical Specifications for Track Monitoring has been completed.

David P. Latimer and Frona Brooks have been assigned the design and coding of a WWI program to provide an operational check on the crosstell function. Program facilities and equipment for cross-telling to the XD-1 subsector will be included. Specifications for this function are being prepared.

Weapons Direction (C. C. Grandy)

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Supplements to 6M-3744, "Operational Specification for Weapons Assignment in the SAGE System," and 6M-3786, "Operational Specification for SAGE Intercept Direction," have been issued. Final versions of these memos are in preparation and should be issued shortly. The supplement to 6M-3828, "Operational Specification for the Height-Finding Function in a SAGE Direction Center," has been approved, and the final version is in preparation. Work on the supplement to 6M-3795, "Operational Specification for Subsector Command Post in the SAGE System," should be completed shortly. The mathematical specification for AA direction is being drafted, and the first draft will be issued in the next period.

Identification, Manual Inputs and Weather
(S. J. Hauser, F. M. Garth)

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Supplements to memoranda 6M-3814 and 6M-3780, the operational specifications for the manual inputs and identification functions,

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OPERATIONAL SPECIFICATIONS FOR SAGE SYSTEM (continued)

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have been written and approved. They will be issued this week. The -1 versions of the same memos will appear soon and will include the corrections enumerated in the supplements.

We are gathering material for a proposal for equipment and other DC facilities for the weather input function in the experimental SAGE subsector.

Training and Battle Simulation

(J. Levenson)

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The first draft of the TBS ops specs is now being revised as a result of discussions with Major Chesler and Major Janek of the 4620th Wing.

Combat Center (W. Lone)

Burrows and Hager are rewriting the "Guide to Combat Center Operations" to provide more complete information.

A preliminary study of Group 61's responsibilities for the FSQ-8 has been made with estimates of manpower requirements for adequate accomplishment of each item. The extent to which XD-1 can be used to check out a combat center is being investigated. The conclusions drawn will permit a better estimate of the manpower requirements for the adaptation to XD-1.

DATA SIMULATION AND ANALYSIS (W. S. Attridge)

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Jim Slagle has joined the section and is working on ESS data analysis specifications.

Schedules have been drawn up for each of the tasks for which this section is responsible. These schedules indicate an immediate need for two more people and an additional three by 1 November.

Recording (E. Lafferty)

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Information is being gathered concerning the data required to be recorded. Nobody seems to have absolute requirements so a list of possibilities has been prepared and circulated to aid various members of Group 61 and 22 to specify them more easily.

A study is also being made of the requirements of logging and recording in the manual Air Defense System. It should be possible to extrapolate and modify those requirements for application to the SAGE System.

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CARD PREPARATION ROOM (H. Newhall)

Because the Card Room is a service facility and its responsibilities are closely related to those of documentation of the Master Program, the responsibility of the Card Room was transferred to H. K. Rising from H. D. Benington on 5 October.

On 30 September, H. Newhall, Card Room Supervisor, presented a two-hour lecture, "Basic Card Room Facilities and Capabilities," to recent graduates of the Air Defense Programmer's Course. Copies of the informal lecture notes may be obtained from H. Newhall (ext. 5410).

XD-1 (P. Guinard)

Program Checkout (Utility Assembly)	11:50
Down Time (Computer Malfunction)	3:40
Time Returned to IBM	4:30
TOTAL ASSIGNED TIME	20:00

STAFF TRAINING (A. P. Hill)

Final plans have been completed for the SAGE Familiarization Course to be held 17 to 28 October, at the Murphy Army Hospital, Waltham. To date approximately 16 applications for the course have been received and approved. There will be 30 seats held for Lincoln personnel cleared through SECRET. Application should be made to A. Hill, C-147, before 13 October.

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FSQ-7 PROTOTYPE DESIGN AND INSTALLATION

(Group 62, N. H. Taylor)

XD-1 INSTALLATION (J. A. O'Brien)

Building Modifications (H. F. Mercer)

A. Lighting Modifications - Delivery of the filter tubes is expected to start on Monday, 10 October. Completion of the changes could occur on 14 October, provided the filter tubes arrive as scheduled. We feel the outside date for completion is 21 October.

B. Command Post Modification - The general contractor should complete his work by 21 October.

Long Range Radar Input (W. J. Canty, A. Hughes, J. McCusker)

We have succeeded in displaying test patterns on the IRI Monitor by using phone line data originating at MTC. In addition, South Truro's test pattern and radar data have been displayed.

Acceptance Test (J. Crane)

Two test demonstrations on the XD-1 display system (DD, RD, and TD drum fields and the digital display generator element) were performed. The displays executed all functions listed in the test demonstration specifications.

Light Gun Modifications (R. H. Gould)

A new method of varying the Charactron selection and deflection is being devised for the test setup in the experimental lighting room. The new system should give better measurements of Charactron legibility. Thought is being given to automatic control of the variations in Charactron test pattern to speed up the testing.

Camera Systems (L. Sutro)

Lloyd Sanford is conducting tests of the SD Recording Camera to select the best film and best adjustment of the console controls for brightness of images.

It has been determined that the Manual and Automatic system for the large board display will use the same console. The manual system will photograph the 19"-tube. The automatic system will draw signals and power from the console and the operator will look at its display to monitor the display on the 5"-tube inside the Kelvin and Hughes machine.

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Camera Systems (continued)

For the manual system, the console will be located near the slide projector. The console will be placed next to the Kelvin and Hughes machine when the manual system is abandoned.

MEMORY TEST COMPUTER (W. A. Hosier)

The "data-processing brew" cooked up by Group 61 for MTC, involving magnetic tape units and drum block transfer, is still fermenting vigorously, with copious evolution of gas. It is hoped that it will settle down to an installation of three tape drive units, a tape adapter frame constructed here using MTC plug-in-units, and a new MTC central control. However, 61 has recently thrown in a new cake of yeast in their desire to have something usable by February - a requirement that can hardly be satisfied unless a prefab tape adapter frame (i.e. an IBM production unit) is available at least on a four-month loan. Furthermore, the new control idea (principal arguments for which are ability to keep within present space and power facilities) has not yet been 100% sold, so there is still the baneful possibility of instrumenting tape and drum in a gymnopygous or "stripped" fashion by adding another 19-inch rack to the present MTC control brontosaurus.

Meanwhile Herb Zielger and Earle Gates are continuing studies of how best to construct a new control. They are certain that the functions of the present control can be performed by a system consuming from a third to a half the space and power of the present system, with better reliability, ease of maintenance and facility for change or expansion. Present MTC control, unwieldy as it is, was quite well justified 2-1/2 years ago; it is simply that time and circumstance have made it obsolete, and the sooner it is changed, the less of a wrench it will be to all concerned.

SAGE Equipment Testing

Preliminary trials of Art Hughes's IRI test program indicate that it should be valuable in assessing performance of the IRI system.

Reliability

Machine performance has been good this period except for some minor intermittent difficulty in reading from drum, and a temporary total disability of the drum circuits caused by tube-tapping. The somewhat higher-than-usual figure for lost time is due in the main to troubles encountered (principally power supply relays, etc) in bringing power on Monday morning October 3.

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Reliability (continued)

Distribution of operating time this period has been as follows:

	<u>Hours</u>	<u>Per Cent</u>
Analysis and Data-Processing	96.3	37.7
Development and Testing	87.5	34.3
Installation	.9	.4
Maintenance and Marginal Checking	37.0	14.5
Interrupting Failures	9.4	3.7
Reliability Check Programs	<u>24.1</u>	<u>9.4</u>
Total	<u>255.2</u>	<u>100.0</u>

Summary of defects found in tubes and components, 26 September to 7 October:

<u>Tube or Component</u>	<u>Defect</u>	<u>Qty.</u>	<u>Hours Lost</u>
5965	Heater defect	1	0
5965	Low plate current	1	0
5965	Microphonic	1	0
6145	Tap short	1	0
Z2177	Cut-off (control grid)	1	0
Z2177	Grid emission	1	0
Z2177	Low plate current	2	0
Toggle switch	Open	1	0
Transformer	Shorted	<u>1</u>	<u>.3</u>
	Totals	<u>10</u>	<u>.3</u>

BASIC CIRCUITS (R. L. Best)

On September 29, a sense amplifier, designed by IBM at High Street, was demonstrated successfully on XD-1. Zopatti's amplifier did not perform satisfactorily in an XD-1 plug-in-unit and the trouble is now being investigated. It is hoped that a final sense amplifier will be chosen during the next period. (P. Murphy)

A meeting was held to discuss the digit-plane driver at IBM High Street on October 4, 1955. One out of six proposed circuits was chosen as the most promising one to try in machine test. (D. Shansky, R. L. Best)

A high speed power cathode follower is being developed for MTC control. (M. Flanagan, D. Shansky)

The vector intensity decoder and generator circuit has been redesigned so that it may provide a larger amplitude output swing. (R. B. Paddock, D. Shansky)

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A plane driver for the production model memory array tester is presently being designed. (D. Shansky)

Several simpler gap filler sweep circuits have been tried with some promising results. (B. W. Barrett)

Centralized Probe System (A. Hingston)

The preliminary design for the hot probe has been completed and a breadboard model is about to be constructed. Experiments were conducted to improve the square wave response of the "chopper" by shortening groundloops without much success. Experiments on types of connectors to be used on the RG114 cable were performed and preference was given to the Western Electric 477A jacks and 358A plugs.

Digital Data Receiver (E. B. Glover)

Final margins for the DDR containing the revised AGC circuit and the LMI 2000 low pass filter were obtained and were quite satisfactory for back-to-back operation of the DDT and DDR. However, later tests involving a phone line have brought to light several interesting facts.

There is agreement by all concerned that the revised AGC circuit is superior to the old. Doubt still exists, however, as to which filter will best satisfy all conditions of operation and some thought is being given to an intermediate type such as the LMI 1200 or LMI 1500. There is definitely some weakness in the timing circuit of the DDR when used with the phone line, although the exact nature of the difficulty is as yet undetermined. Further investigation into the timing difficulties will continue during the next biweekly period.

Flip-Flop Mod A (DC-2) (N. J. Ockene)

The D.C. divider networks have been redesigned so that the grids operate less positively when conducting. This necessitates the use of slightly larger resistors increasing the fall time slightly. However, the margins under conditions of full, unsymmetrically placed load have been improved considerably. The P.R.F. sensitivity of this circuit is 8 and 12 volts for 0.2 MC and 2.0 MC respectively.

DISPLAY DEVELOPMENT (C. Corderman)

A 5" tube for the Kelvin and Hughes projector, having both electrostatic deflection and focus, was evaluated during this period. Because of the requirement of writing vectors with the compensation plates, the use of electrostatic deflection appears impractical. In order to get sufficient vector length the plates must be sepa-

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DISPLAY DEVELOPMENT (continued)

rated to the extent that deflection defocusing becomes severe. A further tube having only electrostatic focus and a different matrix size is under construction.

A Typotron tube which failed on life test is being reprocessed without the flood gun and with a P14 phosphor instead of the present P1. This tube will be useful in evaluating the characteristics of post acceleration using a fine mesh near the screen.

Two reports have been completed and are waiting for final checking before being typed on masters. A short report (6M-3284) covers the theory of the display line driver and presents the input-output requirements for this driver. A detailed report on this circuit will be written later. A second report (6M-3885) covers the component circuits for the display decoders. This report treats each component circuit rather exhaustively with an especially detailed coverage of the variably terminated push-pull decoder ladder showing the advantage of this circuit over a standard terminated single-sided ladder.

Some time has been spent discussing present decoder, vector generator and line driver circuits with John Swatton of I.B.M. who will write the MRD reports on these circuits. This discussion brought to light several engineering changes which have not yet reached Poughkeepsie.

Discussions were held concerning the type of testers necessary in Building F for testing and repairing line drivers, decoders, and vector generators. Since these circuits operate in groups of three plug-in units, special testers will be necessary.

A new amplifier is being designed for studying the storage surface of a Typotron. This amplifier will require a gain of 100 db and a bandwidth of 4 megacycles. The output will be in the order of sixty volts. (Zieman and Woolf)

SAGE SYSTEMS OFFICE (H. E. Anderson)

Tape Conversion Equipment

Specifications for the modifications to commercial IBM tape conversion equipment are nearing completion. Delivery information from IBM is expected soon. Results will be contained in Memorandum 6M-3902.

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Talos Reply Back Study

Nolan Jones will go to Johns Hopkins University on 17 October to obtain background data on present plans for use of Talos in the SAGE System. As part of this study the suitability of the TSQ-7 will also be considered. It is anticipated the study will last approximately two months.

FSQ-7 Teletype Input System

The feasibility of utilizing a more direct input of teletype information is being studied. New equipment development in the teletype field will be investigated and some experimental work in XD-1 may result.

XD-1 Output For Raydist Synchronizing

A proposal is being prepared for a method of synchronizing Raydist recording with the XD-1 computer. This proposal will advocate putting out signals almost identical to those transmitted from the Barta Building. It will center around use of the operate instruction and will probably involve no circuit design.

Change Evaluation Request Summary

To date, 80 CER's have been submitted to the Systems Office. Thirteen of these are undergoing review at the present time, 13 have been submitted to IBM for concurrence, 47 have been completed and 8 have been rejected.

Memoranda Written

6M-3916, "Inactivity Alarm for XD-1 and AN/FSQ-7, AN/FSQ-8."
6M-3921, "AN/FSQ-8 Display Slot Capacity."

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ADVANCE DEVELOPMENT

(Group 63, D. R. Brown)

CHEMISTRY OF MAGNETIC MATERIALS (F. E. Vinal)Memory Core Production

During the past two weeks the facilities for evaluation and testing have been completely rearranged and almost all test equipment is now within an air-conditioned area for temperature control purposes. The rearrangements, however, have delayed and prevented memory core testing; hence the number of double-tested cores reported in the biweekly report for September 23, (1,630,000) remains essentially unchanged. During this same period, production of memory cores has progressed well, and 270,000 cores are on hand for testing. In addition, 150,000 unfired cores are on hand, making a grand total of approximately 2,050,000 cores. (R. C. Zopatti, J. J. Sacco)

Five thousand cores have been selected with extreme care for uniformity and other qualities. These cores, possessing 90 mv one-output signals at 740 ma drive, are to be used for the construction of a "standard" plane. (R. C. Zopatti)

The Colton Press continues to operate well with 12 stations tooled. It will now be put into service to supply the needs of the core production program. (L. B. Smith, J. J. Sacco)

Inorganic Chemistry

A very interesting development during the period covered by this report has been the observation for the first time of magnetic domain patterns in polycrystalline ferrites, using the approach employed by Bitter, Bozorth and others for the observation of domain patterns in magnetic metals; the technique has been refined for the present work. The domain walls appear when a dispersion of colloidal magnetite is applied to a polished ferrite surface. The walls travel when a d-c field is applied, and reversing the field reverses the direction of travel. Experiments thus far have been most successful with a ferrite whose molar composition is 15% MgO, 60% MnO and 25% Fe₂O₃, but observations on memory cores indicate a similar existence of domains. They appear, however, to be reduced in size by an order of magnitude; hence further refinement of technique is required before observation of domains in memory cores is clear-cut. (F. S. Maddocks)

Temperature control equipment for samples being studied in the X-ray diffractometer has been completed and tested. (W. J. Croft, L. B. Smith)

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CHEMISTRY OF MAGNETIC MATERIALS (continued)

While ambient temperatures fluctuated 3 to 4 degrees, the critical face of the powder sample drifted less than 0.05°C . Peak intensity losses through the Mylar windows of the constant temperature chamber are very small (3 to 5%) and no heating effect from the radiation has been detected with this setup. Absolute values of lattice parameters may be determined to 1 part in 50,000 and related measurements are accurate in proportion. (W. J. Croft)

Development work with lithium base ferrites is continuing. (D. L. Brown)
All aspects of the ferrite program are supported by analytical work. (E. Keith, P. Reimers)

PHYSICS OF MAGNETIC MATERIALS (J. B. Goodenough)

During this biweekly period Arthur L. Loeb returned from a year in Holland at the van't Hoff Laboratory, University of Utrecht, and Donald O. Smith returned from a two-month trip on the Continent.

The most pressing tasks of the physics section are the construction of a magnetometer, of a fast-rise-time current-pulse generator (rise time $\leq 0.01 \mu\text{sec}$ and $I > 5 \text{ amp}$) and a d-c fluxmeter. Although there was a month's delay getting the drawings checked for shop construction outside of Lincoln, the construction has begun and is promised for about 1 November. The shipment of the magnet has also been delayed by a month, but delivery before 1 November has been promised. It is anticipated that the vibrating-coil system will be in operation very shortly after the arrival of the magnet. The fast-rise-time current-pulse generator continues to be difficult. A new approach to the problem has been thought of and will be tried in the next few weeks. The d-c fluxmeter needs to be permanently installed with braces to both ceiling and floor as it is extremely sensitive to mechanical vibrations.

"Shmoos" of temperature vs. driving current, the upper and lower limits of which represent the current at which disturb sensitivity sets in and that for which the core switches in less than $1.0 \mu\text{sec}$, have previously been reported for the DCL and IBM memory-core materials between $+55^{\circ}\text{C}$ and $+25^{\circ}\text{C}$. The temperature range for this evaluation test has been extended to -45°C . No region for $0.5 \mu\text{sec}$ coincident-current operation has been found. Although the margins for $1.0 \mu\text{sec}$ coincident-current operation increase slightly as T decreases, the required driving current also increases; the increase in margins is too slight to justify the difficulties of operation at the lower temperatures and the higher currents.

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PHYSICS OF MAGNETIC MATERIALS (continued)

The equipment for the measurement of domain patterns of large-grain metals under tension was reactivated. A sample of 3 percent silicon-iron alloy was polished mechanically and then chemically by Group 35. A subsequent study of the domains on the surface of the sample showed the maze pattern typical of mechanically strained surfaces. This indicates that the chemical polish used was insufficient to produce a strain-free surface; electropolishing is apparently necessary.

An attempt was made to obtain initial magnetization curves of the magnetite sample discussed in the previous Biweekly reports. However, the sensitivity of the d-c fluxmeter to mechanical vibrations rendered the results meaningless. Switching-coefficient measurements are being made on the sample at high temperatures. These measurements, along with the low-temperature measurements already taken, will permit a correlation of S with the decrease in the anisotropy constant which occurs both above and below room temperature.

Since our present theories indicate that the switching time in a memory core varies with the square root of the crystalline anisotropy K and since CoFe_2O_4 is exceptional among the ferrites in that it has a positive K while the memory-core ferrites have a negative K , it has been suggested that CoFe_2O_4 be added to the present memory-core material in 1 percent steps up to 10 mol percent in the hope of reducing K , and therefore the switching time, without destroying the squareness of the hysteresis loop.

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NEW COMPONENTS AND CIRCUITS (D. Eckl for T. Meisling)Life Tests

The shielded 8-digit SBT shift-register is continuing to run without error, having now operated some 2900 hours since its last mistake. The total operating time on the unit is 4200 hours.

SBT Hole Storage

The tendency of transistors to continue conducting for a finite time after the application of a turn-off pulse to the control element is a matter of considerable importance in the design of high-speed switching circuits. This time lag, resulting from "hole" or "charge carrier" storage in the body of the transistor, has therefore been the subject of an intensive study. A memo, 6M-3888, by C. T. Kirk, has been issued which gives the initial results of this study.

Recent work on the transistor model for hole storage has succeeded in correlating the empirical figure of merit M , defined by Philco for the SBT in terms of emitter and collector currents and delay time, with the theoretical Ebers and Moll storage coefficient (Proc. I.R.E., Dec. 1954).

One of the difficulties with most theoretical approaches is that they use a one-dimensional transistor model. A modification of this model has been made to include the effect of radial diffusion of holes into the base region of the transistor. The result of this new analysis shows that the expression for storage time must be multiplied by the factor $(1 + A_e/A_b)$ where A_e is the effective area of the annular ring in which most of the "exterior" holes are concentrated and A_b is the effective area of the emitter.

The problem of obtaining a practical measurement for a hole-storage figure of merit is no simple one. The determination of M requires a Tektronix 517 scope to measure the 30-80 millimicrosecond delays encountered. A second type of measurement, which measures the voltage waveform across a capacitor to indicate magnitude of hole storage, is being studied. This measurement appears to correlate with M , and may be somewhat easier to make.

SBT Procurement

Philco is now delivering transistors at the rate of about 300 per week as scheduled. Five hundred tested transistors have been delivered to Ken Olsen's section for use in EMAR. The next 800 tested units are designated for TX-O.

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MEMORY (J. L. Mitchell)

Experimental Switch and Plane

The core switch was tested with 16 separate bias circuits and operated satisfactorily. However, this system leaves us with a problem of accurately trimming 16 separate currents, an undesirable situation. As a result we reduced the number of turns to two, and the switch operated satisfactorily with only two bias circuits. Experiments are underway to determine whether we can go back to only one bias circuit at this reduced turn.

TX-O Cooling and Supplies

The construction of the cooling system, walls, etc., is still awaiting approval of the Air Force.

The power supply framing has been designed and the detailing of the panels has started.

256 Construction

Twenty-six 64 x 64 memory planes have been accepted to date. The results of the tests on the planes wired with cores which were vibrated are inconclusive. More planes will have to be tested before any conclusions can be made.

The design of the memory is about 75 percent complete. The assembly drawings for the x-y selection circuits are being started. Another shipment of magnetic cores was received from Magnetics, Inc. Construction of the x-y selection framing is awaiting a shipment of materials.

Advanced Development

The sense amplifier being designed by Bradspies has good common-mode rejection, a difference gain of about three, and a delay of 0.2 microseconds. This circuit looks very promising.

Ralph Johnston, formerly of ERA, visited Davidson and brought us up to date on ERA's memory effort.

SYSTEM DESIGN (K. H. Olsen)

Marvin Petersen cleaned the Kennedy receptacles and etched-wire contacts in the multiplier with abrasives, and lubricated them with molybdenum disulphide in oil. After one week of operation, the average resistance of 60 contacts in series remained at approximately 0.3 ohm. Prior to cleaning, the resistance ranged from 0.5 to 35 ohms.

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Mechanical Design

We feel that we have shown due respect for the "modern way" of doing things, and now we are ready to drop etched wiring and go back to hand soldering. We think that we have solved the problems that have come up so far, but we don't want to solve any more. During the next biweekly period we expect to freeze the packaging for TX-O.

EMAR

The Experimental Memory Address Register has been completed except for the delivery of the plug-in units. The plug-in units are being delayed so that the contacts can be nickel-rodium plated but they are expected before the computer test area in the basement of Building A is completed.

Magnetic Tape Unit

A Potter magnetic tape handler that takes both NAB and IBM reels has been received. It now runs at 30 inches per second, but we are getting a special motor that will run it at 60 inches per second. The unit is simple and straightforward, and the first experiments are very encouraging. A one-transistor, experimental amplifier amplified a 17 millivolt lead signal to 10 volts.

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AN/FSQ-7 AND CAPE COD DIRECTION CENTER

(Group 64, S. H. Dodd, Jr., E. S. Rich)

CAPE COD ENGINEERING (L. L. Holmes, A. J. Roberts)WWI Computer Operation

Scheduled Computer Hours:	312.7
Interrupting Incidents:	10
Hours Lost:	2.1
Percent Good Time:	99.3
Mean Time Between Failures	31.0

The majority of computer down time was caused by two unseated tubes and a phenolic breakdown. The reliability for this biweekly period is the best experienced in the history of WWI.

Magnetic Drums

The buffer drum has been modified for the addition of a GSR index. The system should be pulse checked and ready for operational use in approximately two weeks.

L. Healy has designed a system for erasing the drums with a 70-80-cps signal instead of the present 60-cps signal which requires that the drum motor be turned off. The system has yet to be checked out.

Typewriters and Paper Tape

The manufacturer has scheduled delivery of three Flexowriters for Groups 62 and 63 for 1 November 1955. The necessary parts for modifying these machines have been ordered from the manufacturer and the Division 6 Model Shop.

Crosstell System

C. S. Lin has been working with E. Pughe and W. Arnsperger on the crosstell-input check program. A short program, which closes the loop between the input and output systems, was run successfully. The final program for marginal checking the system has been written but has not been checked out. W. Arnsperger is working on a test program to determine the number of messages lost during drum search time.

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CAPE COD ENGINEERING (continued)

F. Sturm and A. Gumbs have completed pulse checking of the cross-tell system. A. Gumbs is working on a program to display MITE information. The program uses calculated values of sine and cosine rather than a stored table in order to obtain finer resolution.

A meeting was held at Lexington to set up the tests and schedules for crossteling between WWI and XD-1. Preliminary equipment tests will not begin until November or December.

Height Tests

D. Morrison has modified the height test program to make it more comprehensive and easier to operate. The multiplexing of height, Mark X, and FGD data appears to have been accomplished successfully. Difficulties with equipment and program have prevented us from displaying Mark X and FGD data while recording height data. A successful check of this nature should be made before the present phase of the checkout is complete.

Scan-By-Scan Photographs

A camera control system has been designed for taking scan-by-scan pictures of data from the various sites. L. Norcott has been investigating the problem of displaying the same data on two mappers. The complete system should be ready for initial tests on Saturday, 22 October 1955.

Personnel Training

F. Sturm has started a trouble location program for the SDV MITES in order to acquaint himself with the SDV inputs and as an aid in servicing. R. Barlow has done some programming exercises in preparation for work on the height equipment with T. Sandy.

SYSTEM TEST PLANNING AND COORDINATION (K. E. McVicar)

Equipment Program Services Committee (R. P. Mayer)

LRI - The LRI test team is now using the DDT-DDR analysis program in which data is recorded on the Ampex tape recorder in Bldg. F, then played back and checked on MTC. (The tape recorder will ultimately be used as a signal source for the LRI equipment.)

A. Hughes has written a program which generates a pattern from MTC by which the LRI monitor can be checked. The message can be either a "South Truro" type or "FST-2" type.

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SYSTEM TEST PLANNING AND COORDINATION (continued)

S. Thompson has written a raw radar data display program. This program loads the LRI drum on "computer test" mode to simulate the radar data.

GFI - W. Marston (BTL) and B. Beatty (WE Co.) are writing a GFI pattern sorting and recognition program. The object of this program is for XD-1 to recognize errors in the reception of a test pattern generated by a GFI site.

Thompson, Rundquist and Sherrerd (BTL) are writing a data conversion to common coordinates, tracking, and data display program which will be useful for operational checking both the GFI and LRI systems.

A. Werlin and R. Mayer are writing a GFI data analysis program in which MFC-generated data is sent to the GFI equipment via a phone line. GFI sends back the data in parallel form which in turn is checked and analyzed.

Output - R. Mayberry (WE Co.) has written a program to generate a G/A output system test message. There will be no immediate need for an XT output program since the equipment has yet to be installed.

Crosstelling Test Planning (C. W. Watt)

A meeting was held on Wednesday, 5 October, to consolidate plans for the testing of the XD-1 to WWI crosstelling link. The results of this meeting which outline the expected schedule of tests is covered in memorandum 6M-3923. A test team for this crosstelling test was defined. Members of this team are Watt and Lin of Group 64, Johnson of IBM, Mayberry of Western Electric, and Paul Harris of Group 21.

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VACUUM TUBES

(Group 65, P. Youtz)

Tube Techniques (D. C. Lynch, J. S. Palermo)

Additional 5-inch Charactron projection tubes were prepared for lens characteristic studies of Groups 25 and 62.

Another series of molded cathodes have been sintered after assembly with the ceramic spacer, to supplement the QT-100 type sintered-cathode program of A. Zacharias. This revised procedure minimizes the exposure time of sintered cathodes to further oxidation and contamination during electron gun assembly and also provides an additional degassing cycle for the porous ceramic spacers during the high temperature process in both a reducing and inert atmosphere.

Initial experiments in the spray lacquer technique for aluminizing indicate the need for further study before a thorough evaluation of the procedure can be submitted.

Charactrons (A. Zacharias)

This period was devoted chiefly to the fabrication and processing of test structures containing sintered cathodes of the ZrH₂ activated variety. Results continued to be encouraging and all schedules for processing could be made final.

Time was also spent on obtaining a design for a projection Charactron using a 5-inch flat-face envelope. The last of these tubes, CHT-126, proved very successful although it was unable to write vectors of proper length. A modification of the primed lens exit aperture should eliminate this difficulty.

Charactrons (P. C. Tandy)

Six MIT 19-inch tubes and three Convair Charactrons have completed from 1618 to 5911 hours on life test. Tests are in progress to determine what changes have occurred since the last testing period.

Thirteen cathode-study tubes have completed from 2139 to 2449 hours. No significant drop in cathode current at one-half cutoff d-c was noted at the testing period.

A test position for the cathode-study tubes is in the design stage. The problem of photographing the beam uniformity as seen on the screen of the tube is being investigated. The beam-uniformity image being photographed is about 1/8-inch in diameter and several copies

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Charactrons (continued)

of each photograph are needed. Thus, a single lens reflex camera WITH a lens extension tube will probably be needed.

Receiver Tubes (S. Twicken)

The recent monthly meeting on the DT-438 showed that Tung-Sol was still progressing slowly. An anomaly in the sensitivity curve of their intermittent-short detector had not been investigated after six weeks.

A GE-IBM-MIT meeting was held at Clifton, New Jersey, relative to GE's submitting to ASESa a proposed MIL specification for a military computer twin triode of the characteristics of the AN/FSQ-7 type 0528 but with ratings for high altitude, shock, vibration, etc. The proposed specification has less rigid control on AQL's, limits, life tests, etc. It was decided that GE will also begin immediately the drafting of a proposed MIL specification for the 0528 based on the present specification and whatever changes in AQL's are mutually considered necessary.

An insulation resistance test set is under construction in the tube laboratory for general use in leakage measurements.

Commercial Tubes (T. F. Clough)

On September 29, 1955, S. Twicken, members of the Project High Tube Group, and I visited Tung-Sol in Bloomfield, New Jersey, to review the DT-438 (improved 5998) programs. At present Tung-Sol's supplier is having difficulty producing the new designed plates to specification. It is expected that this problem will be solved in a couple of weeks. At that time Tung-Sol will start pre-production runs to work out production procedures. In the meantime Tung-Sol is using 5998 parts to train personnel and check construction techniques.

Group 49 has been unable to obtain information on the variation from tube to tube of the firing point of a Schmitt trigger circuit which will be used in the automatic target alert circuit for the DEW line. At their request, we are conducting a series of tests and gathering data on groups of 5965's and 0528's to determine what this range will be.

Raytheon supplied us with a small sample of 5749's with a heater change that we requested. Inasmuch as this was the only change and these special tubes were satisfactory from the standpoint of hum output, it isolates the source of the trouble reported in the previous Biweekly. D. Allen of Group 24 has been informed of the result.

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PRODUCTION COORDINATION OFFICE

(Group 66, B. E. Morriss)

Specifications recently released have recommended use of the Kelvin & Hughes automatic projector as a part of the AN/FSQ-7 for obtaining automatically projected displays in the Command Post. Visitors from Kelvin & Hughes arrived at Lincoln on 7 October 1955 for an expected one-week visit. They will discuss with IBM, Hazeltine, and Lincoln engineers the necessary engineering modifications of their equipment. During their visit, it is also expected that they will talk with IBM and Hazeltine on production abilities, schedules, and other related items which must be resolved prior to the use of their equipment in the SAGE System.

Eight ECP's have been prepared by IBM for XD-1 changes. These are the first ECP's prepared under the procedure established by ADES Bulletin 1-2 for handling changes to SAGE equipments and they will be carefully monitored to determine the effectiveness of this procedure. Comments have been requested from IBM on master reference lists of specifications for XD-1 and for the Production AN/FSQ-7. IBM indicated at the IBM-MIT Coordination Meeting, 5 October 1955, that in approximately one week we may expect comments on the XD-1 specifications IBM does not consider to be within the present contractual scope. Also, preliminary scheduling information will be available on most of the items. At the same time, we will receive an indication of when final scheduling information will be available for all items. Similar data on the master reference list of the production AN/FSQ-7 is expected in about one month.

Representatives of Burns & Roe visited the Laboratory on 7 October and inspected the XD-1 air conditioning installation. Purpose of the visit was to determine how XD-1 experience could be reflected in production building work.

As of 4 October, usable space at Murphy General Hospital was still not available. IBM has agreed to provide facilities such as furniture and telephones. Security, janitor service, mail service, transportation, and similar items are still not provided for. The Air Force has indicated that they do not believe they can provide these facilities in sufficient time and the only proposed solutions to date have been for one of the contractors who will make use of this space to take over general building management responsibility.

At the ADES-Lincoln Engineering Meeting, 28 September 1955, results of building redesign study were presented and it was generally agreed that the study has come up with an outline and sketches of a considerably improved facility. The results of the study were then presented to ADC at Colorado on 4, 5, and 6 October for ADC approval. Comments

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PRODUCTION COORDINATION OFFICE (continued)

from ADC indicated that they also agreed the proposed building would be a significant improvement.

POWER (J. J. Gano)

Power and Equipment Cooling Loads

IBM groups are still coming up with figures which we had convinced other groups were incorrect. We are planning a meeting with IBM to avoid duplication of effort.

M-G Set Evaluation - SAGE

Coffin has been talking with systems and circuit design personnel to try to determine the effect of equipment and circuits on computer reliability when subjected to power transients.

XD-1

We are now having our technicians make any modifications that do not require any special parts from IBM. Consequently, we have started the rewiring of the ammeter leads in the PCD frame, which had a common connection across the ground bus instead of being connected directly to the respective shunts, and the relocation of the voltmeter in voltage units to prevent a repetition of grounding due to proximity to other components.

TX-0

Due to lack of time to have special thermistors made, standard thermistors have been ordered for filament cycling. As a result, many have to be used in a series to obtain the desired characteristics.

The layout drawings of the racks for the dc supplies and the relay controls have been completed.

COMMUNICATIONS (F. E. Irish)

A meeting was held at ADC Headquarters on 27 through 29 September to discuss telephone circuit schedules for the McGuire Subsector. The original plan of building the SAGE circuit requirements "on top of" the manual AD system's circuits has now been changed. The plan now is to incorporate as much as possible of the manual system's facilities into SAGE. During the period when the SAGE and manual systems are operating simultaneously, SAGE will not have its alternate circuits installed. When SAGE is declared to be operationally

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COMMUNICATIONS (continued)

capable of conducting air defense, those manual circuits which are not needed for emergency operation of the P-sites will be converted into the alternate circuits for SAGE.

TIR's AND COORDINATION (W. H. Ayer, H. J. Kirshner)

The following material has been released as engineering data for the AN/FSQ-7 and SAGE System:

<u>TIR #</u>	<u>DOCUMENT #</u>	<u>SUBJECT</u>
1-94	6M-3692	Equipment Cooling Loads for a Direction Center, dated 22 September 1955.
	6M-3790	Heat Loads in a Direction Center, dated 23 September 1955 (consisting of Francis Assoc. document A 5611-055, dated 23 September 1955).
	6M-3147-3 Supp. 1	Master Reference List, Lincoln Laboratory Requirements for Direction Center Buildings, dated 23 September 1955.
1-104	Group Report 22-6	Procedure for Orientation of AN/FST-1 Azimuth Markers for the SAGE System, dated 20 September 1955.
1-105	6M-3515-2	Proposed Site and Equipment Locations in the Experimental Subsector, dated 12 September 1955.
1-106	6M-3913	Specifications for Utilizing the Kelvin & Hughes Rapid Processing Photographic Projector System in SAGE System Command Posts, dated 30 September 1955.

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ADMINISTRATION AND SERVICES

(Group 60, J. C. Proctor)

COMPONENT ANALYSIS (H. W. Hodgdon, C. Morrione)

Hodgdon is writing an M-note on a course on Guided Missile Reliability at Redstone Arsenal, Huntsville, Alabama, 4 through 6 October.

Morrione attended the Symposium on Automation at the University of Pennsylvania. The minutes of the session have been ordered. Also visited at the same time was Eckhart-Mauchly Division of Sperry-Rand where research on ferro-magnetic cores was discussed and the testing facilities of "Univac I" were observed.

At the last technician meeting, instruction was given on the use of photography in component evaluation and failure analysis.

MATERIAL (H. B. Morley)

Because of the interest shown in the Standard Electronic Components cross-reference (DCL to LL stock numbers) mentioned in the last Bi Weekly Report, we have obtained additional copies. These are being distributed to Drafting, Production Control, Stockrooms, and WWI.

We are currently engaged in revising our Manufacturer's Index, listing electronic manufacturers alphabetically and showing the local representative for each.

ENGINEERING (A. R. Smith)

Hot Lead Test Probe - XD-1 P.U. Rack

Prototype design for a hot lead test probe to replace the present Dumont cold lead test probe is complete and ready for fabrication. Production should be delayed, however, until sufficient data has been accumulated through use of the prototype model pertaining to heat dissipation, simplification of fabrication, and operational acceptance which could seriously alter design for production.

Dos Magnetometer

The major portion of this unit is being currently fabricated by the vendor and scheduled for delivery on the latter part of November. The rotating differential head has been checked and will be ready for fabrication release next week.

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ENGINEERING (continued)

Unfortunate circumstances arising from the checking of drawings and occurring simultaneously with the absences of key personnel has postponed the delivery date forecast to approximately the middle of December.

Camera Mounts - Display Room WWI

Fabrication of a newly designed 16" display console camera mount has been requested by this office for October 18 delivery. Group 22 has issued orders for reproducing four subsequently designed Pathfinders mounts, thereby completing their requirements for test to take place on or after October 22.

Core Memory - Pluggable Units

Frequent instances have occurred over the past two weeks which point up the necessity of mechanical design consultation on projects during the drafting phase in Division 6 Drafting Room. We wish to remind project leaders that expeditious action on your projects can be expected, particularly through fabrication and operational acceptance, by requesting technical engineering through this office or drafting room supervision.

DRAFTING, DOCUMENT, AND PRINT ROOMS (A. M. Falcione)

Drawings for Laboratory Memoranda

When a drawing is to be incorporated in the text of a memorandum, the author is requested to submit the drawing to Drafting IN ADVANCE OF THE TYPING OF THE TEXT and to NOTIFY DRAFTING THAT IT IS A PART OF A MEMORANDUM. This will avoid delays and allow the Drafting Room to process drawings through whatever photographic services that may be necessary. This is the usual recommended procedure, but recent deviations have resulted in embarrassing and unnecessary delays.

Inventory of Secret Documents

In order to complete the inventory of all secret material distributed to Laboratory personnel, the Document Room will close daily from 3:30 p.m. to 5:15 p.m. for the next six weeks. This is the period allocated to the seven distributing points for the listing of all secret documents issued.

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STUDIES IN PROCESS

<u>Study</u>	<u>Responsibility of</u>	<u>Expected Completion</u>
<u>GROUP 61</u>		
Digital Data Display Program Specs	H. Briscoe	
In-Out Program Specs	A. Shoolman, A. Ginsberg	
Radar Input OPS Specs	F. Brooks	
Situation Display Program	A. Schwartz	
Switch Interpretation	R. Olsen	
Table Storage Requirements	L. B. Collins	
Track Scan	F. Ogg, Pl Straig	
XD-1 Inactivity Alarm Proposal	M. Feldstein, P. Vance	
XD-1 Startover Program OPS Specs	P. R. Vance	
Lectures, AD Programming Course	A. R. Shoolman	
OPS Specifications	A. R. Shoolman	

GROUP 62

Card and Tape Symbolic Address Assy	B. G. Farley	
Flight Test Analysis (for Grp 22)	G. Harris, C. Uskavitch	
LRI Test Programs	A. D. Hughes	
Pattern Recognition (for Grp 24, 34)	G. Dinnan, O. Selfridge et al	
Simulation (for Grp 22)	H. Neumann, B. Stahl et al	
Technician's Training Manual IV	A. Vanderburgh, Jr.	
FSQ-7 Teletype Input System	R. Gerhardt	
Talos Reply Back	N. Jones	

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DOCUMENTS ISSUED

(Frances Christopher)

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The following documents were published by Division 6 or received from IBM during the period 24 September to 7 October 1955:

<u>No. 6M-</u>	<u>Author</u>	<u>Title</u>	<u>Cls.</u>
SAGE SYSTEM TEST AND PLANNING (Group 61)			
3875	D. Israel	Group 61 Responsibilities and Personnel Requirements	S
5057	J. Uskavitch	Performance Monitoring Program	U
FSQ-7 PROTOTYPE DESIGN AND INSTALLATION (Group 62)			
3890	L. S. Sutro	Test Equip. Com. Mtg., 2 Sept 55	U
3896	R. W. Sittler	MTC Analysis Program	U
3901	H. E. Anderson	Long Range XD-1 Computer Time Allocation	C
3910	J. Giordano	Minutes, ESS Planning Approval Com. Mtg., 26 Sept 55	C
3917	J. Giordano	Minutes, IBM-SO Concurrence Mtg.#39, Held at Lincoln Lab., 29 Sept 55	U
3921	R. D. Buzzard	AN/FSQ-8 Display Slot Capacity	C
3925	J. Giordano	Minutes, ESS Planning Approval Com. Mtg., 3 Oct 55	C
ADVANCE DEVELOPMENT (Group 63)			
3888	C. T. Kirk	SBT Hole Storage-1	U
VACUUM TUBES (Group 65)			
3923	C. W. Watt	Minutes, Mtg. on XD-1-WWI Crosstelling Link, 5 Oct 55	C
PRODUCTION COORDINATION OFFICE (Group 66)			
3911	E. D. Lundberg	SAGE System Mtg., 26 Sept 55	U
3913	J. J. Carson	Specs for Utilizing Kelvin & Hughes Rapid Processing Photographic Projector System, etc.	C
3918	E. D. Lundberg	SAGE System Mtg., 3 Oct 55	U
ADMINISTRATION AND SERVICES (Group 60)			
3863	Division 6	Personnel List, 1 Sept 55	U
3905	Div. 6 Staff	Biweekly Report, 23 Sept 55	C
3912	Division 6	Personnel List, 1 Oct 55	U

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DOCUMENTS ISSUED (continued)

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OTHERS

3868	A. Chopourian	Barta Bldg. Power Distribution	U
3908	A. Wright	CCS Weekly Operations Schedule	U
3909	J. Adams & WE	List of Test Equip. for SAGE Sub-system Tests	C
3920	A. Wright	CCS Weekly Operations Schedule	U

IBM DOCUMENTS

<u>No. IBM-</u>	<u>Author</u>	<u>Title</u>	<u>Cls.</u>
822	IBM	Central Reference Room Bulletin	U
823	N. P. Edwards	Basic Electronics - Project High Engineering Report	U
824	IBM	Progress Report on Ferrite Core Research - Proj. High Engr'g Report	U
825	IBM	Progress Report AN/FSQ-7, -8 1 Jun 55	C
826	IBM	Progress Report AN/FSQ-7, -8 July 55	C
827	IBM	Progress Report AN/FSQ-7, -8 1 Aug 55	C
828	IBM	AN/FSQ-7 Engr'g Progress Report	S
829	W. Rooney	Project High Semi-Monthly Report #61	C
830	R. Palmer	Proj. High Engr'g Report Binary Loading Programs UBLMO4	U
831	A. M. Dinison	Proj. High Engr'g Report - Unit Test Procedure Proposed for XD-1 Output System	U
832	IBM	Central Reference Room Bulletins	U

LLDR DOCUMENTS

<u>No. DR-</u>	<u>Author</u>	<u>Title</u>	<u>Cls.</u>
430	H. E. Anderson	Concurrence on the Minic Panel for Maintenance and Programming Area 6M-3628	U
431	R.A. Imm	Concurrence on Change to AN/FSQ-7 Console Equip. and Label Layouts	U
432	P. A. Beeby	Concurrence on the Change to the Specs for Duplex Maintenance Console	U
433	J. Coughlin	Changes in the Output System to Make Possible Faster and More Thorough Diagnostic Programming Procedures for XD-1 and XD-2	U
434	P. A. Beeby	Change to Specs for Simplex Maintenance Console	U
435	R. A. Imm	Concurrence on 38-3	U
436	R. A. Imm	Concurrence on D-95-1	U

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GLOSSARY

AA	antiaircraft	IBM	International Business Machines
AD	Air Defense	MAR	memory address register
ADC	AD Command	MEL	minimum equipment list
ADES	AD Engr'g Service	MISP	Manned Interceptor Simula- tion Program
AEW	Airborn Early Warning	MITE	multiple input terminal equipment
AF	Air Force	MTC	Memory Test Computer
AFB	AF Base	NAS	Naval Air Station
AFCRC	AF Camb. Res. Ctr.	OPS	Operations
AFIRO	AF Installation Re- quirements Office	PIUMP	plug-in unit mounting panel
ARDC	Air Research and Dev- elopment Command	PRF	pulse repetition freq.
ATC	Air Training Command	RAFD	Rome AF Depot
ATCF	ATC Facility	RD	radar data
BTL	Bell Telephone Labs	SAGE	Semiautomatic Ground Environment
CC	combat center	SBT	surface barrier tran- sistor
CAT	category	SAR	storage address register
CCS	Cape Cod System	SD	situation display
CER	change evaluation request	SDG	SD generator
CHT	Charactron tube	SDV	slowed down video
CP	Command Post	SIF	selective identification feature
CRT	cathode ray tube	SC	Signal Corps
C&E	communications and electronics	SCEL	SC Engineering Lab
DAB	display assignment bit	SOP	standing operating pro- cedure
DC	direction center	SO	Systems Office
DD	digital display	STP	System Training Program
DDG	DD generator	TBS	training and battle simu- lation
DDR	digital data receiver	TD	track data
ECM	electronic counter measure	TIR	Technical Information Release
ECP	enr'g change procedure	WE-ADES	Western Electric-ADES
EMAR	experimental memory ad- dress register	WWI	Whirlwind I
ESS	experimental subsector		
FGD	fine grain data		
FF	flip-flop		
FORX	FGD orientation with Ray- dist and calibrated Mark X		
GFI	gap filler input		
GSR	group selection register		

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