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Memorandum ~~M-1831~~

Digital Computer Laboratory
Massachusetts Institute of Technology
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SUBJECT: AUXILIARY DRUM TESTING - SUMMARY #1

To: W. W. Butler, Engineering Research Associates, Division of Remington Rand Inc., St. Paul, Minnesota

From: K. E. McVicar, E. S. Rich

Date: February 9, 1953

Abstract: The various phases of work on the auxiliary drum system are proceeding satisfactorily. The voltage regulators are being studied in an attempt to improve their stability. Voltage sensors are being designed for the unsensed voltages in the drum system. Some marginal checking has been done using test equipment in place of the computer and good operating margins were observed. A system which permits rapid erase of an entire group on the drum has been assembled from test equipment. Data on the individual tracks on the drum is being gathered for the purpose of eventually separating the best heads into the same groups. The auxiliary drum has been connected to the computer on an experimental basis and early tests with simple Test-Storage programs have been very successful.

Contents:

1.0 ORIENTATION

Some time has been spent on such orientation work as measurement of pulse levels, tagging pulse lines, and checking d-c voltages and waveforms. Everyone concerned with the operation and maintenance of the drum has been involved in these procedures and has familiarized himself with the chassis layouts, switch operation, pole-line arrangement, and general circuit and system functions.

2.0 POWER SUPPLIES

We are currently studying the regulator circuits for the +5 and -15 volt supplies in an attempt to decrease the drift in the output. Although this drift is about 20 percent it is not serious in the +5 supply because the drum circuits are relatively insensitive to variations in this voltage. However, we should like to get better regulation of the -15-volt-bias supply. Current work is directed towards finding, if possible, some simple change which will make the supplies more reliable even at the expense of a sacrifice in interchangeability.

The motor-generator set for supplying the d-c to the drum system has been received and is currently being tested. Inspection of the output from the two d-c generators revealed almost 100 volts of noise on both. The noise is currently being investigated and the drum system will be connected to the generators only after the noise has been satisfactorily reduced.

3.0 VOLTAGE SENSORS

Work is under way on the design of additional sensors for the unsensed voltages in the drum system. This work is still in the preliminary stages and is involved with a close study of the present sensors to determine their operating characteristics and limitations.

The problem of providing some ind ication of which sensor tripped when the sensors operate is also being considered. In the system as it now stands, when one sensor trips all the positive voltages are removed from the chassis and all the sensor indicators light. This is unsatisfactory for the purpose of detecting transients which trip the sensors. We have had trouble with the sensors tripping on transients, and have been unable to detect on which supply the transient occurred. Much of this trouble, it is believed, is caused by the fact that we are using electronic power supplies which are operated on an a-c line which is not transient free, in place of the motor-generator set which will eventually be installed.

4.0 CIRCUIT CHANGES

Only minor circuit changes have been made to the drum system to date. It was necessary to install separate GSR and SAR clear lines for operation with the computer and these were mounted on the pole lines in the center drum bay.

In addition we are studying the relative merits of 0.5 μs and 0.1 μs readout signals to the In-Out Register and have inserted a small selection circuit and external pulse standardizer which permits switching between one type of readout and the other.

5.0 MARGINAL CHECKING

A simple marginal checking system has been installed and we have done some marginal checking of the drum circuits. The most extensive work of this type to date has been on the reading amplifiers because this also gives us some information on the drum tracks. On good tracks, that is, tracks with good readout-signal amplitude and absence of discontinuities, we found excellent operating margins (40 v. on a 90 v. line) for the reading amplifiers.

Much consideration has yet to be given to the problem of marginal checking in order to obtain a maximum of information on circuit operation.

6.0 ERASE

An external system has been built up out of test equipment which enables us to erase every register in an entire group within a period of 30 seconds. This scheme involves writing alternate ones and zeros not only in the slots around the drum but in between the slots. This process effectively establishes a d-c field of alternate polarity around the drum surface. On every field alteration the screen voltage of the writing amplifiers, and consequently the field intensity on the drum surface, is reduced until approximately zero field is reached leaving a neutral drum surface.

Initial tests on this system indicate that it is a practical and rapid way of erasing the drum. Present work is directed towards eliminating the introduction of transients in the drum system by the erase process, and the solution of some timing problems.

7.0 TESTS WITH THE COMPUTER

The drum has been connected to the computer temporarily through switch panels which enable us to operate either with the computer or test equipment.

Elementary programs were inserted in Test Storage to check the group- and storage-address selection. Once these programs were working, slightly more elaborate programs were written. We now have three Test Storage programs. The first program records then reads and checks a count in a single register on the drum. The second program records a count around the drum then reads and checks it. The third program is similar to the second except that the block transfer order is used in the reading process. More elaborate programs are in the process of being written.

Results obtained with the three programs above are just about the same. If a particular group will run satisfactorily with one program it will run satisfactorily with the others. The number of tracks which will run properly varies from day to day and seems to depend upon the drum temperature that day. We plan eventually to place all the good tracks in the same groups and isolate the poor tracks in a few groups or else not attempt to use them at all. This will be done after we have accumulated sufficient test data to provide a reliable indication of which tracks are good and which we can be reasonably sure will stay good.

8.0 TEMPERATURE AND AGING EFFECTS

We are making a careful study of the readout signal from all the tracks of the drum in an attempt to gain a clearer picture of the variations due to temperature changes and possible aging of the plastic in the heads. It is known that the readout signal amplitude varies from day to day and we are trying to correlate this phenomenon with the operating margins of the associated circuitry.

Two measurements were made of signal amplitude from the drum tracks about two weeks apart in time. The signals from the 192 tracks were arranged in order of average signal amplitude (average of the amplitude of zeros and ones) for the two different occasions. The tracks were then arranged in descending order of readout signal amplitude for the two runs and results compared. From these data it was possible to spot the tracks which had changed their relative standing by more than an arbitrary number. Of the 192 tracks, 74 changed their position by more than twenty places and 21 changed their position by more than fifty places.

An attempt was made to correlate the above change of relative readout with the low margins obtained in preliminary marginal checking of the reading amplifiers, but without success. However, there was positive correlation between low readout signal and low operating margins.

When sufficient information has been accumulated so that we can identify tracks with irreparably low output signal or which have excessive change in output signal we plan to regroup the heads so that the poor and marginal tracks are in the same groups. This should give us reliable operation in the other groups.

9.0 RELAY STICKING

We have had some trouble with spurious writing which we can only explain by the assumption that the writing relays occasionally stick causing us to write in an unselected group at the same time that we write in a selected group. The evidence is very slim on this problem and a test program is currently being written which will enable the computer to check for relay sticking.

10.0 TIMING CHANGE

We have had some trouble with the timing of the readout signal changing. When ERA's representative was here at the time of the installation of the drum, the timing was changed from the setting made at ERA. We later had to return the timing adjustment to its original setting. This phenomenon has not recurred so we have had no opportunity to trace it. However, we have made timing measurements in some detail throughout the circuits involved so that if there should be another change we can check the timing step by step and locate the source of the change.

11.0 RESULTS OF INITIAL INSPECTION

When the drum was delivered in December an inspection of the system for loose joints, wiring, or other mechanical defects which might later be a source of trouble was carried out. Such inspections are a routine matter for all equipment going into the computer whether built in our shops or purchased from a vendor. The results of this inspection are briefly summarized below.

The wiring in the drum bay was inspected for bad solder joints and obvious wiring defects. With the exception of a few solder joints which were considered below our standards, the bay wiring was satisfactory.

The system chassis were inspected for mechanical defects such as bad solder joints, broken or otherwise obviously defective parts, and other shortcomings which could be found without extensive circuit checking. Out of 40 system chassis, 27 had solder joints which inspection considered to be below our standards. Out of 12 power chassis 9 had solder joints considered inferior. In addition, 4 broken leads, 2 condensers hanging by one end, a charred resistor, and one power chassis which had 6 joints that had been crimped but not soldered, were uncovered.

SIGNED K. E. McVicar

APPROVED E. S. Rich

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