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Memorandum M-1605

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Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: MTC MEETING OF AUGUST 4, 1952

To: MTC Planning Group

From: W. A. Hosier

Date: August 20, 1952

Abstract: Decisions and progress relevant to the proposed Memory Test Computer (MTC) are summarized for distribution to those interested, and to trace development of the computer.

Present:	D. R. Brown	R. G. Farmer	W. N. Papian
	J. D. Crane	W. A. Hosier	H. Smead
	R. R. Everett	R. Hughes	N. H. Taylor
	J. W. Forrester	W. Ogden	R. von Buelow
		K. H. Olsen	

This meeting opened with a review of the metallic core situation by D. R. Brown. On the basis of some 60 samples from Magnetics, Inc. tested by W. Ogden, it was decided about June 1st that a satisfactory core ought to result from interpolation among these sample designs, and that after inspection of a preliminary batch of 300 such cores, the full order of 20,000 would be placed for September delivery. The first batch, which according to Magnetics, Inc. had phenomenally low switching times like 4 microseconds, turned out on delivery here to average 17 microseconds switching time, with a dispersion all the way from $9\frac{1}{2}$ to 24 microseconds. Switching time showed a marked variation inverse to the current.

Why these cores were less satisfactory than the earlier ones, and why the company thought they were better, are questions that will have to be answered before 20,000 satisfactory cores can be turned out.

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It is thought, with regard to the first question, that either the company does not keep sufficient processing data, or has been varying its processing hoping to effect an improvement. With regard to the second, since they have the necessary core-testing equipment, it would seem that better testing is primarily a matter of interpretation - i. e., of experienced personnel. It may be that the quickest solution for us lies in having one of our own men (say, R. Jenney) on the spot to test samples from each new lot of cores as soon as it comes out of the furnace.

We have ordered 3,000 ceramic bobbins. D. Brown estimates that once specifications are frozen, assuming they can be met, it will take from 4 to 6 weeks to manufacture 20,000 cores, and another month to test them.

The other company, Magnetic Metals, is also a possibility, but they apparently have difficulty in obtaining bobbins and would be even slower to produce an order than Magnetics, Inc. D. Brown estimates that it would take them at least three months to turn out 20,000.

Some anxiety was expressed over possible variations due to the alloy strip out of which metallic cores are wound if the manufacturer does not have enough of one homogeneous roll to supply both experimental samples and final order. Financial considerations would probably prevent the manufacturer from buying enough metal for 20,000 cores before he has an order. Therefore, to assure uniformity and avoid delay, we might do well either to place the order before seeing satisfactory samples or to purchase sufficient Mo-Permalloy strip ourselves and supply it to the manufacturer.

Magnetic Metals is now engaged on an order from us for 100 cores of 1/4-mil strip and 100 of 1/8 mil strip, and has more bobbins on order.

Present facilities and techniques for core testing require at least 45 minutes per core, and 3 or 4 days for satisfactory appraisal of samples from a trial batch. This assumes two men working with one test set-up.

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Pending receipt of sufficient Burroughs test equipment (consisting, for one test set-up, of 5 flip-flops, 2 gates, 2 G&D's, 1 LFPG, and power supply), this testing is being done on the "Model IV Core Tester" designed by R. Best's group. They can probably help speed up core testing by putting more effort into reducing difficulties experienced with this device.

Other possibilities are to get Burroughs equipment from Harrington's group, to put more people (for example, Mitchell and Di Nolfo, who are working with ceramic array II), or to put more experienced people (for example, K. Olsen) on the testing job.

For the longer-range problem, R. Hunt and P. Baltzer are working on designs for automatic high-speed core testers. H. Smead agreed to keep abreast of their progress, along with that of R. Best's group, and to do whatever coordination seems desirable.

One rather urgent need in this connection, Ogden pointed out, is for technicians skilled in construction and maintenance of pulse circuits.

K. Olsen offered for use in core testing such plug-in units and Burroughs items as he had assembled for tentative MTC layouts; H. Smead agreed to see how nearly this meets the needs of Brown's group and to find out how available equipment is to fill out the needs of Brown's group beyond what Olsen can supply.

With regard to power supplies for MTC, K. Olsen proposed to build regulated high-voltage d-c supplies like those of WWI ES. This would take some 5 months (quicker than ordering them built outside); meanwhile, laboratory supplies can be used. Burroughs power supplies could be used, he thought, if they had an independent a-c supply from their own motor-generator set. This last alternative was preferred by J. Forrester and N. Taylor, particularly since the motor-generator set can be big enough to allow extra capacity for future expansion of equipment.

ERA, according to W. Ogden, has successfully used d-c generators, without brush noise; however, it was generally agreed that brushes are not dependable enough to warrant our relying on rotating d-c sources.

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Plug-in circuits, Olsen said, need further work before they can be incorporated into MTC. A pulse standardizer needs to be designed, also a flip-flop buffer; the dual gate unit can be simplified by omitting pulse transformers. He is working with R. Best on this. He suggested further that the flip-flops be altered to omit the cathode complement input, using negative pulses on both grids instead; also perhaps that the .06-micro-second delay element be put into the plate circuits instead of the cathode. N. Taylor warned against this last change, saying that trouble with plate-circuit transients might necessitate more engineering effort in redesign than is expedient.

W. Ogden outlined the schedule for memory construction as follows:

Breadboard circuits operating satisfactorily - probably not before -	Oct. 15th
Circuit and array design frozen - (assuming satisfactory cores are available Nov. 1st) -	Nov. 15th
Circuits and array constructed -	Jan. 1st
Circuits and array debugging and testing -	Feb. 1st

In view of the uncertain characteristics obtainable in cores, Ogden proposed going ahead with a design that would accommodate a switching time of 15 microseconds, currents of 150 ma. with 50% duty factor. Switching time and current could then be lessened if the cores permit. H. B. Frost has recommended for driver tubes the 6BL7, a twin triode used for television sweep driving.

N. Taylor suggested that the 6L46 would give greater current capacity without excessive size; he recommended that, if the driver circuits were designed with, say, 6BL7's, a tabulation be made of whatever circuit changes should be necessary to change to another tube type. Of course a change in ferrite cores (unlikely) would demand more thoroughgoing changes in the driver circuits.

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R. R. Everett recommended to Ogden that he try to use a 3:1 selection ratio for reading (this would mean that read drivers would put out relative currents of $2/3$, possibly also + and - $1/3$, or an over-all bias of - $1/3$, instead of the write currents of $1/2$, - $1/2$). (Later work on the metallic array by B. Widrowitz has established that the 3:1 system is virtually unworkable due to cumulative second-order "delta" effects).

Buffer amplifiers should not be needed between storage switch and drivers, since the 6BL7's can be driven directly by the 30-volt output of the switch's crystal matrix. However, rise time of the matrix may necessitate allowing $1/2$ microsecond for it to settle down before applying driving gates.

The sensing amplifier is being worked on by C. Iaspina of Best's group. Its main problem is that it must respond both to positive and negative signals, whose average value over short intervals is not necessarily zero; this seems to demand a restoration of d-c level. The tentative MTC block diagram proposes a minimum of 2 microseconds between memory cycles, which may not be enough to restore the sensing amplifier.

Work on drivers (principally carried on by D. Shansky of Best's group) has been facilitated by an equivalent impedance for metallic cores which has been derived from work on the 16 x 16 metallic array.

Physical packaging of the array is still very much of a problem, though it seems fairly likely that each layer of 1024 cores will be embedded in some sort of plastic sheet. (J. Forrester was concerned over the heat-dissipating ability of such an arrangement.) Six months would seem to be an absolute minimum for assembly of the magnetic array. If it is all built outside, requiring standard drawings, drafting-room delay will augment this time; hence it is desirable to make as much of it as possible in our own shops, from sketches. Procurement should not be much of a problem for the array exclusive of cores.

In connection with the automatic core-testing problem, J. Forrester and N. Taylor described a device used by Raytheon to make easy and rapid contact closing a multiple-turn winding on cores to be tested: a pool of mercury divided by insulating partitions into sectors. The mercury completes turns of wire "hairpins" which are lowered into it over the toroidal core.

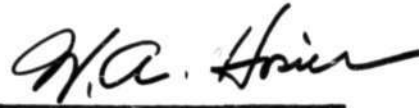
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Procurement of certain other components for MTC - viz., plug-in units, germanium diodes, chassis, pulse transformers, precision resistors - could be sticky. J. Ferrester urged everyone concerned to give scrupulous attention to specifications and to the formalities of procurement procedure, lest time be wasted needlessly because of confusion, procrastination, or neglect in this regard.

The situation on plug-in units, in particular, was thought to demand immediate looking into, since some 150 of these are needed for MTC, and since it is not certain how many, if any, will be available out of the 1700 for which parts are presumably on hand, in view of large requirements of the new WWI in-out system.

Signed



W. A. Hosier

Approved



R. R. Everett

WAH/bs