31st December, 1965.

Sales to Eastern Bloc.

Ted Johnson. John Leng

cc Nick Mazzarese
Win Hindle
Harlan Anderson
Ken Olsen
Stan Olsen
Gerry Moore
Tim McInery

Enclosed are two cuttings relating to computer sales to the Eastern Bloc.

There has been considerable activity by British computer manufacturers in the last year to sell to Eastern Bloc countries. Quite a few systems have been delivered by Elliott-NCR and by English Electric Leo Marconi. From time to time we have also noted press announcements on the increasing activity of American companies in this regard.

For ourselves there have been several contacts. One of these could result in an order, e.g. a Linc to Czeckoslovakia and a further enquiry came from Poland during the Basle show to purchase a PDP-8.

Several weeks ago when I was in Paris I met Mr. Vladimir Vetrov from the Russian trade delegation at the Embassy. He stated his interest was primarily in modules but was also keen to have us exhibit at the international computer exhibition to be held in Moscow between 1st September and 16th September. We pointed out that it would not make sense for us to exhibit unless we knew we could make sales from it, and in order to test Russia's new policy of increasing trade with the West we invited him to make a trial purchase order on a few thousand dollars' worth of modules.

Perhaps the Prague exhibit from 12th May to 8th June would be worthwhile a view of the prominence given to it?

One advantage at present in selling to these people is that there is usually just one customer and if one could negotiate a sale for 20 PDP-8's say, then it could prove quite profitable.

# Iron Curtain computer sales may be lost

BRITISH computer makers may lose their foothold in the Iron Curtain countries if moves by US firms to penetrate the market come off.

As forecast in Electronics Weekly, April 14, there was evidence of a relaxing in the rules of COCOM, the organisation of NATO countries that formulates the strategic embargo list for goods with military or security applications.

Indications in this direction have been confirmed with the arrangements under way for the International Computer Exhibition to be held in Prague from May 12 to June 8.

British manufacturers are expected to occupy at least 75 per cent of the 20,000 square feet of exhibition. But IBM is also expected to be present with a 1410 computer system. Other American companies and a West German firm, Eurocomp, are reported to have approached the Czechoslovak State Commission for Technology for permission to participate.

The State Commission takes over responsibility for all computer purchases from the beginning of 1966.

During the next 12 months substantial purchases of machinery are expected from the Czechoslovak government for commercial data processing and process computers, the estimated value of these is £15 to £20 million.

The Czechs wish to cover the whole range of computing science and technology at the ten day meeting, but with particular emphasis on applications and software.

Companies participating in the exhibition will be allowed to nominate experts to take part in the symposium lectures and discussions.

It is also intended to send invitations to all Iron Curtain countries to attend the meeting.

In America there is growing pressure from computer makers to persuade the government to relax its embargo of selling to the east.

At last week's Fall Joint Computer Conference, Las Vegas, Control Data's vice-president, James Miles, complained that the industry had lost substantial business and his firm had large orders from the Communists that they could not meet because of embargo.

# £3M. ORDERS FOR ENG. ELECTRIC COMPUTER

By Our Scientific Editor

A single recently ordered computer of the English Electric-Leo-Marconi System 4 series will be replacing five U.S. computers. This is stated by Sir Gordon Radley, chairman of English Electric-Leo-Marconi in an end-of-year message to staff. Altogether orders worth £3m had been placed for System 4 since it was announced in September.

"We have completed a most satisfactory year's work," Sir Gordon said. Deliveries had averaged over £1m. each month.

Twenty-nine computers were delivered in 1965, including those to the P.O., the Meteorological Office, the Admiralty Research Laboratory, the U.K. Atomic Energy Authority and customers in Australia. The software system developed for the U.K. A.E.A. has been described by the Authority as a signal success.

"Export orders during the year included major contracts worth £1m. for computers from our current range for Czechoslovakia. Next year we shall be showing our machines in Eastern Europe generally," Sir Gordon added.

INTEROFFICE MEMORANDUM

DATE 30th December, 1965

SUBJECT

TO John Jones

FROM Geoff Shingles

John, I was very concerned to read the third of your "Three Items" mentioned in Sales Newsletter No. 171 of December 15th, 1965.

In the U.K. we have found that our A-D equipment, both as A-series modules and as packages such as 138E/139E, which is one of the items covered in your third note, are products which really excite interest. At present, I have really hot interest in the 138E in at least 3 areas and recently sold $14,500 (F.O.B.) worth of A-D equipment including a 138E/139E system to English-Electric against competition from within their own company. We were 3 times as fast and half the price that they could do it themselves and this includes the fact that we have a 27% mark up on these items on top of F.O.B. Maynard price as a burden to sell against.

I have always felt that this was one of our best lines and with a bit more engineering and literature could be made really solid. As you know, due to treasury fund problems and the "Buy British" attitude of the Ministry of Technology we have a tough time selling computers to establishments which rely on government controlled finance. We have, however, the A-D equipment which is not affected by these problems to anywhere near the same extent and in the present climate it provides us (in company with modules) with an excellant entry to a financially difficult area. Once in with our equipment people apply much stronger arguments to obtain the computer they want, and if they are using our A-D equipment on basis of compatibility alone we stand a much healthier chance with the PDP range.

We have been promoting this line as much as we can and must fulfil our present commitments where we have been raising interest if we are to maintain a good company image in the U.K., and I urge strongly that we continue to sell our A-D equipment separately as it can be an effective wedge into areas where a computer can come along later.

Cont'd/...

I have canvassed opinion in the U.K. office and find that we are all of the same mind. I would really appreciate your comments on this topic, and your reasons why we will not sell separately and why it has not worked out well? I feel if they work well on our machines, then in the hands of a customer who has received the correct technical information (which should after all be available if they are to work on the PDP's, or anywhere for that matter) they should be reliable and we should continue to sell them. The fact that they've not gone well may be due to our failings in the field office, in which case we should be told. Anyway, it would be nice to know why?

Sincerely,

Geoff Shingles

c.c. Ken Olsen
Stan Olsen
Nick Mazzarese
Brad Vachon
John Leng
Jon Fadiman
Bernard Haus
Klaus Kyris

dec INTEROFFICE MEMORANDUM

SUBJECT: PROPOSAL OF THE TOTAL QUALITY ASSURANCE SYSTEM FOR DIGITAL

DATE: December 30, 1965

TO: K. Olsen

FROM: K. Doring

Introduction:

We have designed this system to fit our product line organization. Its primary objective is to assure that our customers receive products of competitive quality and reliability at competitive prices.

Our proposed Quality Assurance System is new and unique in that it deemphasizes the conventional practices of vetoing, policing and controlling: It puts primary weight on coordinating the quality efforts of the various departments such as Design and Production engineering, Marketing, Purchasing and Manufacturing. In addition, it provides the urgently needed channels of communications for product quality information among all groups and employees concerned. The Total Quality Assurance System is the answer to our present quality problems.

We recommend adopting it because it helps to achieve management's objectives: satisfied customers, profits, and growth.

AREAS OF RESPONSIBILITY:

OUR RESPONSIBILITIES ARE VERY MUCH INTERRELATED WITH THOSE OF SEVERAL OTHER DEPARTMENTS. THE ACOMPANYING CHART WILL ILLUSTRATE THESE INTERRELATIONSHIPS.

| | DEPARTMENT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RESPONSIBILITY | PROD. LINE MANAGER | FINANCE | MARKETING, SALES | DEVELOP. ENGINEERING | PRODUCT ENGINEERING | MANUFACTURING | MATERIALS, PURCHASING | QUALITY ASSURANCE |
| DETERMINE CUSTOMER NEEDS | | | RESPONS. | | | | | |
| ORGANIZE QUALITY SYSTEM | CONTRIB. | | CONTRIB. | | CONTRIB. | CONTRIB. | CONTRIB. | RESPONS |
| ESTABLISH QUALITY LEVEL FOR PROD. LINE | RESPONS. | | CONTRIB. | CONTRIB | | | | CONTRIB |
| SET ENGINEERING SPECIFICATIONS | | | | RESPONS | | | | |
| DESIGN TEST AND INSP. PROCEDURES | | | | | CONTRIB. | CONTRIB. | CONTRIB. | RESPONS |
| DESIGN AND MAINT. TEST AND INSP. EQUIP. | | | | | CONTRIB. | MAY CONTRIB. | | RESPONS |
| REVIEW NEW AND MODIFIED DESIGNS | | | | | CONTRIB. | CONTRIB | | RESPONS |
| SPECIFY PROCESSES AND METHODS | | | MAY CONTRIB. | | RESPONS. | CONTRIB | | MAY CONTRIB |
| PRODUCE TO SPECIFICATIONS | | | | | CONTRIB. | RESPONS | CONTRIB. | CONTRIB |
| EVALUATE VENDOR QUALITY | | | | | | | RESPONS. | CONTRIB |
| QUALITY REPORTING; GATHERING AND ANALYZING OF CUSTOMER COMPLAINTS | | | CONTRIB. | | MAY CONTRIB. | CONTRIB | | RESPONS |
| PERFORMING CORRECTIVE ACTION | | | | MAY CONTRIB | RESPONS | CONTRIB | | CONTRIB |
| COMPILE AND ANALYZE QUALITY COSTS | | RESPONS | CONTRIB. | | | CONTRIB | | CONTRIB |
| IN PROCESS TEST AND AUDIT | | | | | | CONTRIB | | RESPONS |
| FINAL TEST AND INSPECTION | | | | | CONTRIB | RESPONS | | CONTRIB |

Job Descriptions for Quality Assurance Engineering Functions:

These functions serve the purpose of prevention. They are also the major factor in quality cost control.

1) WORK WITH MARKETING AND ENGINEERING IN ESTABLISHING REALISTIC QUALITY REQUIREMENTS ON COMPANY PRODUCTS ON THE BASIS OF CUSTOMER NEEDS, PRODUCT FUNCTION, VALUE AND RELIABILITY.

   Plan: Start immediately. Utilize existing staff. First results can be reported in 3 months.

2) ORGANIZE A QUALITY ASSURANCE SYSTEM TO MEET THE ABOVE REQUIREMENTS.

   Plan: 1. Modules: Visual and mechanical quality system existing (formal). Electrical quality system informally existing. Formalize over next 6 months for high production modules. Will take one year for special modules since it involves designing and building of special test equipment.
   Required: 1 electrical engineer, 1 technician.
   2. Systems: Line Managers will provide written documentation of existing quality system in existance under their direction.

3) DESIGN AND MAINTAIN TEST AND INSPECTION EQUIPMENT LIKE MODULE TESTER, COMPONENT TESTER, WRITING OF TEST PROGRAMS, PROVIDING SPECIAL TOOLS AND GAUGES. MANAGE TEST EQUIPMENT SERVICE DEPARTMENT.

   Plan: Perform over next one year with present staff plus personnel required under 2.

4) TOGETHER WITH PRODUCTION ENGINEERING REVIEW SPECIFICATIONS OF PRODUCTS WITH HIGH DEFECT RATES.

   Plan: Quality system in existence. Needs to be presented through formal channels. Can be done with present staff.

5) ESTABLISH METHODS FOR MEASURING QUALITY: TEST AND INSPECTION PROCEDURES, TEST DATA SHEETS, POINTS OF INSPECTION, STATISTICAL TECHNIQUES, DISPOSITION OF DEFECTIVE MATERIAL, PROCEDURES FOR QUALITY CHECKS BY OPERATORS, INSPECTORS, TESTERS.

Plan: Mostly existing. Can be completed within the next 4 months, present staff.

6) ASSIST PURCHASING IN SETTING QUALITY LEVELS FOR PURCHASED MATERIAL. ENSURE COMMUNICATION OF COMPANY QUALITY AND RELIABILITY REQUIREMENTS TO VENDORS. DETERMINE VENDOR CAPABILITIES, SURVEILLANCE.

Plan: Continuous job. Add 1 technician to present staff.

7) REVIEW NEW AND MODIFIED DESIGNS AS A RESULT OF PROTOTYPE (MODEL) OR PILOT RUN PERFORMANCE. RECOMMEND IMPROVEMENTS TO PRODUCT ENGINEERING TO INCREASE PRODUCT UNIFORMITY, RELIABILITY AND STANDARDIZATION.

Plan: System in existence. Will take 4 months to formalize and gain experience. We would like to present an outline of this function within the next 2 weeks.

8) USE 7, AS A BASIS FOR ENVIRONMENTAL AND LIFE TESTS AND FOR RELIABILITY STUDIES AND DATA.

Plan: Start has been made. Continuous job. Enlarge. Add 1 technician.

9) PROVIDE TIMELY INTERNAL QUALITY REPORTS.

Plan: In existence. Establish formal channels with product lines. Continuous job.

10) COLLECT AND ANALYZE CUSTOMER COMPLAINTS AS A BASIS FOR CORRECTIVE ACTION.

Plan: Will provide formal procedure for use by Product Engineering. Will be started immediately.

11) ANALYZE CHRONIC MANUFACTURING PROBLEMS AND PROVIDE TECHNICAL ASSISTANCE AS REQUESTED.

Plan: In existence. Performed through roving inspection.

12) DETERMINE QUALITY COSTS OF PREVENTION, APPRAISAL, REWORK AND SCRAP.

Plan: Start immediately. System available in 6 months.

13) PROVIDE FORMAL TECHNICAL TRAINING IN THE USE OF TEST AND INSPECTION EQUIPMENT.

Plan: Add 1/2 competent technician to staff. Start program in 2 months.

14) TOGETHER WITH ENGINEERING, MARKETING AND TECHNICAL PUBLICATIONS WRITE AND FURNISH QUALITY SYSTEMS MANUALS TO SHOW THE CUSTOMER THE ADVANTAGES OF BUYING QUALITY ASSURED PRODUCTS.

Plan: We can do utilizing our Technical Writers. Start in 6 months after quality system has settled. Will then take 4 more months to complete.

These quality engineering functions will be tailored to the needs of the individual product lines.

15) CONTRIBUTE TO ZERO DEFECTS PROGRAM PENDING ITS ACCEPTANCE.

## The Quality Appraisal or Test and Inspection Functions

The following portions of the Total Quality Assurance System have basically been approved by the Product Line Managers.

Incoming Semiconductor Test and Mechanical Inspection:

These departments will continue to provide production Lines A, B, C, and D with tested components and hardware. Ken Olsen will encourage Engineering and Purchasing to provide Quality Assurance with timely test specifications.

Incoming Peripheral Equipment and Major Components (memories) will be tested by the individual product lines. They in turn will provide the necessary written test procedures for this equipment with the Line Manager approving them.

In Process Test and Inspection:

This function will mainly be performed by the product lines. Quality Assurance will perform first piece, tool and die inspection, roving inspection, provide technical assistance where requested, interpret quality standards to production inspection, and inspect models. Our job will mainly be one of service to help assure continuous flow of production.

Final Test and Inspection:

This function for modules as well as systems is with the product lines. Quality Assurance may audit finished modules. On systems we will continue to perform the mechanical assembly inspection and make sure that test outlined in the procedures have been performed. Assuring soundness of design and performance will be done by quality engineering in the new design control function as outlined on Page 4.

Special Processes:

These will fall under new design control as outlined under the quality engineering functions upon release for production.

## SUMMARY

There might be the objection that this program requires additional personnel which means new expenditures.

This is true. In order to approach quality on an organized and coordinated scientific basis, we have to provide the tools for this job. I believe that we at this stage of our growth are willing and ready for it.

We cannot afford to let our competitors get ahead of us any further. This is the right time to make the decision to lead them. Our Quality Assurance System will enable the company to achieve this goal. We have in our department the skill and experience and a basic staff to do this job.

Therefore, we are asking for your permission to go ahead.

dec INTEROFFICE MEMORANDUM

DATE December 29, 1965

SUBJECT Product Development for Biomedical Market

TO Ken Olsen

FROM Mort Ruderman

I have indicated the areas of hardware development that I think are important to our continued expansion in the biomedical market. No mention is made of software development or promotional efforts that are also important and necessary for continued expansion in this market.

1. Larger, inexpensive display scope.
   (a) Selling price should be $6000. or less.
   (b) Presently available is a Fairchild and ITT 16-inch scope that would be slave to either 340 types or more commonly to 34B displays. Extremely desirable in small laboratories.

2. The "programmable console".
   (a) This is what has been developed as a remote processor at Washington University. The next smaller step in laboratory processing.
   (b) Direct access to larger computer.
   (c) Very short and simple instruction set, mainly for sending and receiving information over communication lines. Input and output equipment should consist of display scope and A to D converter.
   (d) Be made small and simple, a selling price of $10,000.
   (e) Extremely large market with existing PDP-8's, PDP-7's and PDP-6's.

3. The development of functional blocks for expansion of computers.
   (a) A to D converters non-expandable. (Fixed length 8, 10, 12 bits.)
   (b) Relay buffers for multiple lines both input and output.
   (c) DA functional blocks. The big market is operative conditioning.
   (d) Develop others as the need dictates.

4. I see a great need for a system to read slides and film. This should be a complete system and it should not be a

central processor such as a 7 and 8 with an optical scanner or reader attached. The problem area here obviously is software support; however, a large market exists in hospitals and laboratories. Applications areas would be to do work that presently is done by lab technicians with microscopes. This system should sell for under $100,000.

I would like to discuss this in further detail at your convenience. I have just given some thoughts to four areas that I think would appear to be extremely profitable to the existing markets that we are now servicing.

MER:dc

cc: N. Mazzarese

# INTEROFFICE MEMORANDUM

DATE December 28, 1965

SUBJECT National Security Module Application

TO Harry Doyle - Washington Office
cc: Stan Olsen
Russ Doane
Saul Dinman
Dick Best
Ken Olsen

FROM Harlan Anderson

On a recent check on corporate quality at NSA, I happened to meet a man who had had some mysterious problems in trying to use our modules. He was using our Lab Modules first and then our System Modules. He was attempting to make a count of 5 units following exactly the descriptions contained in our module handbooks. In particular, he was using first the 201 flip-flop and then the 1201 flip-flop. He was running a 5 kilocycle counter and claimed that the only way he could make it work was to re-shape the pulses between the flip-flops by placing a diode and a 300-to-900 ohm resistor network in the circuit. The effect of this was to clip off the positive overshoot on positive pulses. He claimed that when the overshoot was there he got spurious results. This overshoot, of course, is a necessary part of the waveform in order to insure recovery of the trouble transformer. I suspect there was some other phenomena going on but cannot imagine the overshoot really having anything to do with the subject. At any rate, the customer's impression is that our modules are mysterious and he doesn't understand them.

I did not have ample time to investigate this any further than what I have indicated above but I would suggest that you look into it further and after getting more details ask for help from someone such as Saul Dinman, Russ Doane, etc. to clear up the matter.

Andy

HEA:ncs

dec INTEROFFICE MEMORANDUM

DATE December 28, 1965

SUBJECT GPS Instrument Module Usage

TO Ron Eisenhauer

FROM Harlan Anderson

cc: Stan Olsen
Ken Olsen
Saul Dinman
Dick Best

Recently I spent a day at the National Security Agency in Fort Meade, Maryland and by chance met a man who has a GPS analog computing system which includes some of our modules. The man's name was L. A. O'Neill and apparently GPS has used some of our 4225 modules to make several DECADE counters with the output of one feeding the input of the next one. The people at NSA say that the 4225 frequently counts to 11 instead of counting to 10 as it is wired. They do not understand this but they found that by swapping 4225 around they are able to find others which will count to 10. This is true of the first DECADE which is driven by a clock. This characteristic does not exist for the subsequent DECADES they are suspicious that the input pulse, which must do a lot of other logical functions, may be overloaded. This sounds like it may be a misapplication of our modules or it may be a malfunction but I would suggest that if possible you contact GPS and discuss the matter with them since the fact that this does not work is presently reflecting on DEC. I believe the name of the man at GPS is Y. T. Lee. Let me know what happens on this matter.

Andy

HEA:ncs

INTEROFFICE MEMORANDUM

DATE December 28, 1965

SUBJECT Job Description - Process Engineer

TO K. Olsen ✓ FROM C. Kendrick

1. Develop manufacturing methods on new products, or new methods suggested by new equipment.

2. Determine tools, jigs and fixtures required to facilitate production.

3. Investigate alternate methods.

4. Determine manufacturing specifications.

5. Work with Manufacturing on any problems that arise requiring the services of an engineer.

# INTEROFFICE MEMORANDUM

DATE December 27, 1965

SUBJECT PDP-8 Quality Check at National Security Agency

TO Kenneth Olsen

cc: Nick Mazzarese

FROM Harlan Anderson

On Monday, December 20th, I visited with Major James Webster at the National Security Agency. His mail address is R424, Fort Meade, Maryland. His group took delivery of PDP-8-43. The installation began on October 7th and was completed October 15th. The configuration includes:

| | |
|---|---|
| 2 | Type 580 Tape Transports |
| 1 | Extended Arithmetic Element |
| 1 | Analog to Digital Converter with a Multiplexer. |

His first comment related to delivery delays on his PDP-8 and he felt strongly that this was our biggest problem area. He said that NSA came within one week of cancelling the order due to delays in delivery. He also said in considering the ordering of equipment the principal competitive machine they considered was the SDS-92. Our basic machine had a $10,000 price advantage over the 92 but by the time the optional equipment was added on, this price advantage had eroded to be not more than $3,000 or $4,000.

When the machine was delivered, it was discovered that the Analog to Digital Converter had been wired in our standard fashion even though our quotation to them and their purchase order to us clearly specified that the data was to be right justified when it was read into the accumulator. Our Field Service people borrowed some parts from the customer and rewired the Analog to Digital Converter on site to make it correspond to the purchase order. Some shipping damage had occurred because the lower doors on the tape transport had come off and were bouncing against the logic wiring and terminals. In addition, a transistor had burned out in one of the R210 modules. Neither of these latter things were significant enough to cause the customer any great concern.

They claim they did not use much of our customer training and what they did use left something to be desired. In particular, they did not send anyone to the maintenance course but they have a graduate engineer who has worked on computers before doing the maintenance work. They sent one man to our programmer training course and he is no longer available to them since he was a service man who has been discharged or transferred recently. However, he was unable to obtain any instructional help on how to program the 580 Tape Transports since this was not covered in the course. They tried programming mag tape following our literature and manuals on the subject and ran into troubles in reading the first word on tape. They suspected these were timing troubles and finally solved their difficulties, without much assistance from us, in the following way. They took our maintenance diagnostic programs for magnetic tape and used the exact sequence of instructions that were there. This sequence works

although they don't understand why it works but feel it must be related to some strange timing characteristic of the tape drive that is not specified.

Concerning spare parts, they thought our handling of it was inadequate. This was particularly true of spare parts for the tape drive. They assumed they could buy the spare parts from us that were described in the Datamec manual. When they tried to obtain quotes from DEC for these parts they were told that those parts were not available from DEC and that we didn't recognize the parts numbers at all. They also had troubles with teletype spare parts.

Their intended use of the PDP-8 is in a van-mounted environment with a radar connected to it. They will be using it as a data collection device with the data being recorded on magnetic tape to be analyzed later on an IBM computer. Reliability and tape interchangeability with IBM computers therefore are very important to them. Their reason for selecting the PDP-8 in addition to price, was that the IO Bus made it easy to connect special equipment.

Programming-wise, they did their early assemblies of PDP-8 programs prior to delivery by using an assembler program prepared by the University of California to run on an IBM 7090 computer. They have not used the Fortran to any extent and do not plan any use of it. They have used our assembler for some interim applications of the PDP-8 connected to an analog computer. The programs here have been under 100 instructions and have not used magnetic tapes. They report the assembler works satisfactorily. In general, they say the PDP-8 is easy to comprehend and program.

There were several minor problems that they were concerned with. One of these was that the power control for the tape drives was never connected into the central power switch of the computer as it was designed to be. This meant that in an emergency they would have to go to several locations to turn off power completely. All the equipment and relays are there to have centralized power shut down but the unit was not wired up that way. Along the same line, they did not like having a key to turn the power on and off and had removed that feature of the machine replacing it with an ordinary switch. They felt that the PDP-8 had a very bad cable design in the cabinet mounted version. The weight of the vertical cables was sufficiently large that it would severely bend the printed circuit boards that were used as a connector if there were no support for the cable. They have made their own mod to this area of the equipment by providing a special clamp to support the cable weight. I understand that we have considered shortening those printed circuit boards which are used for cable connectors to alleviate this problem. They also felt that lock down bars for the boards were highly desirable.

By far the largest complaint they had was that the electronics associated with the tape drive represented a lousy design in his words. What he meant was that there was no electronic deskew in the DEC part of the tape system and in his opinion the question of interchangeability of tapes between our 580 and IBM transports was questionable. This, of course, is a very complex question. They have had a preliminary interchangeability experiment run which they feel is inconclusive but gives them some cause for concern. They had the Datamec Field Service man located

somewhere in Pennsylvania come in and look at the transports and his statement was that they were both within Datamec tolerances. They thought that Datamec used electronic deskewing with their electronics. One of these is near the edge of Datamec acceptable tolerance according to Webster. The skew that they thought they had remembered measuring was 7 microseconds on unit 1 and 12 microseconds on unit 2. If these are the correct numbers, according to Roland Boisvert these are within limits of acceptability on an IBM transport. Nevertheless, in the minds of the customers, he is still concerned on this point.

They felt the tape control for the 580 transports would not allow enough simultaneous computing to occur while transfers of data were taking place. As a result, they have designed their own data break interface so that data can be placed directly in the memory without having to be handled by the program. The only use that has been made of the tape system to date has been for the purpose of testing out this data break that they designed and constructed out of our modules.

Some general comments that Major Webster made was that they were pleased that the machine had run 400 hours since delivery without a transistor failure. This, of course, does not count the one transistor that was replaced during the installation process. Another comment was that he couldn't see how we could live with the amount of electrical noise that existed with our system. During the last month, they have used the computer about five hours per day with programs that did not use magnetic tape but did use a connection to an analog computer. He felt that Al Kimmel our Washington Field Service man was very thorough and very sharp. He felt he was better than the factory people who have been there occasionally. He further thought that an automatic loading feature for initially getting a paper tape into the computer would be highly desirable for their work. This would be something like the read-in mode that was on the PDP-1. I asked him if this would have been worth any additional money to him and he indicated that he would be willing to pay more money to get a feature such as this. Another minor problem that left some bad feeling in his mind was that we changed our plans for how many tape drives could be run from one control during the negotiating process.

Overall, I would say Major Webster is quite pleased with the equipment and is a representative of a well-qualified group to give us constructive criticism. The tape transports, I believe, are the largest potential problem and have not been used enough for them to feel confident that there is or is not a compatibility problem.

Andy

HEA:ncs

Elsa - Save

# INTEROFFICE MEMORANDUM

DATE December 27, 1965

SUBJECT Corporate type engineering projects.

TO Ken Olsen

FROM Harry S. Mann

Corporate type engineering projects can be charged off simply by having the people working on such jobs fill in the first field of their time reports with:

D - 99

They can leave the rest of the fields blank unless there is some large project you plan to undertake where you would like a special project number which can be obtained from Ed Simeone.

I would suggest you not advertise the use of D - 99 because we don't want this to become a "dumping-ground."

We are planning some revisions to our reporting which may require a new number later.

Harry S. Mann

HSM/clw

# INTEROFFICE MEMORANDUM

DATE December 22, 1965

SUBJECT SHIPPING AREA

TO Ken Olsen
CC: Stan Olsen
L. Prentice
R. Michel
J. Woodman

FROM Frank Kalwell

In order to operate our module shipping department economically and efficiently, additional space is required. At the present time, we have 88'x16', a total of 1408 square feet vs. 2500 square feet required. The following is a specification of our requirement and the reasons for it.

Square Footage: 2500' - concentrated in 50x50 area.

Location: Near dock, if possible. Convenient to Production A & B.

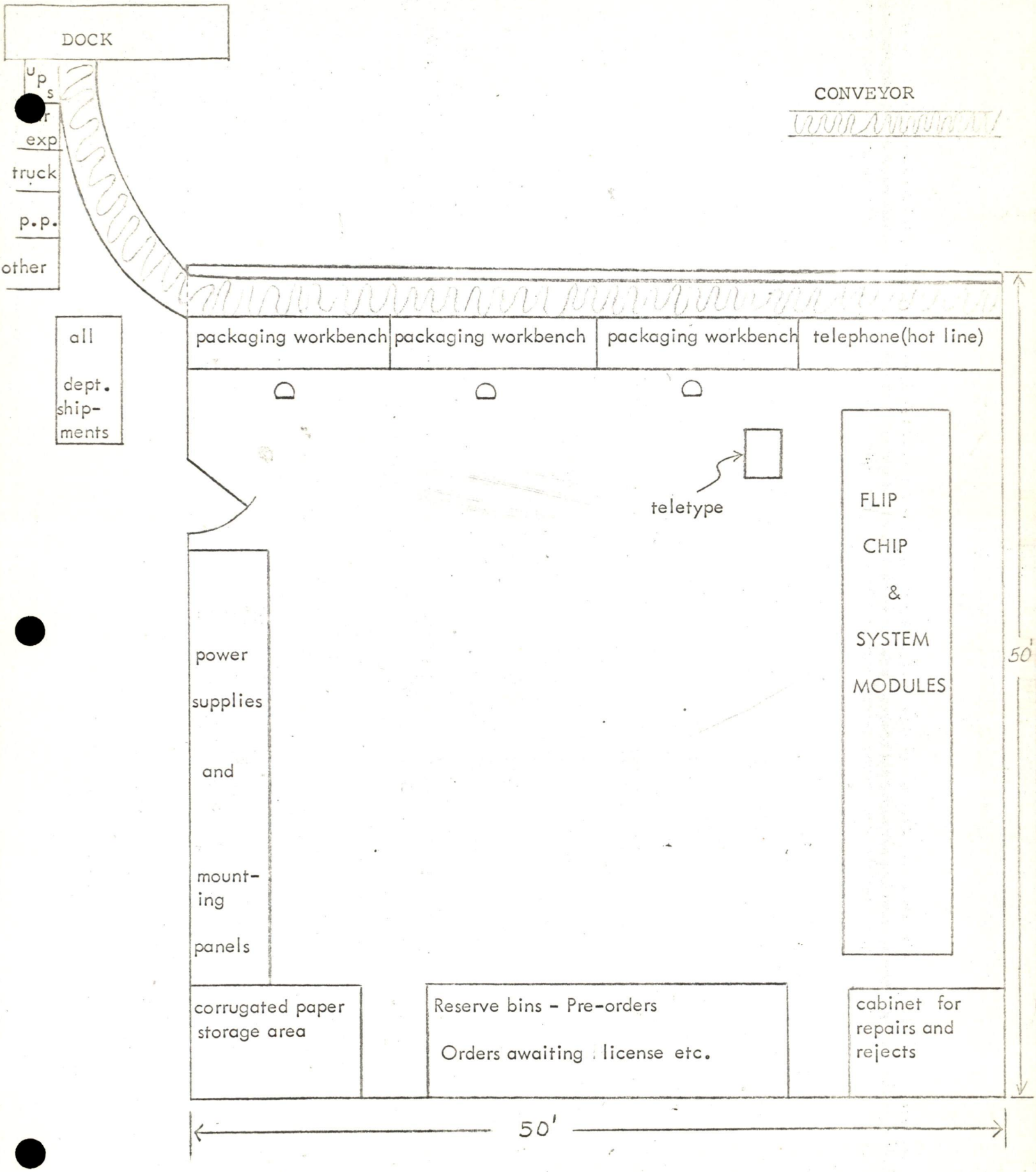
Reasons:

1. Necessity to store corrugated supplies for all departments for shipments.
2. Presently, we are supplying Field Service, Small Computers, and Special Systems a packaging area, plus packaging supplies.
3. Maintaining larger "Flip Chip" inventories.
4. Customer orders and pre-orders which are packaged awaiting licenses, and orders which require storage prior to shipment.
5. A centralized shipping area is necessary for DEC in order to handle shipments economically, plus centralization enables us to screen all shipments leaving and authorizing such shipments in the most practical way.

The enclosed rough draft will give you an indication of the proposed set-up. I have the Purchasing Department working with our material handling people in a possible new method of storage of the "Flip Chip" modules which I will present to you once available.

I would appreciate any further comments on whether such space will be available in the near future. Thank you.

Frank Kalwell




PROPOSED SHIPPING AREA

INTEROFFICE MEMORANDUM

DATE December 20, 1965

SUBJECT Material Ordering Responsibility

TO Ad Hoc Production
Planning Committee

FROM Henry J. Crouse

Recommendations:

1. Ordering responsibility be transferred to the Purchasing Department January 1, 1966.

2. Total material requisitions be submitted to the Purchasing Department on the third Tuesday of each month for a period of three months. (Re: Memo dated November 29, 1965)

3. Two clerical transfers from Production Control to the Purchasing Department on or about January 1, 1966.

4. The format for requisitioning material be standardized and be used as a control tool for internal expediting and scheduling.

Henry J. Crouse

# INTEROFFICE MEMORANDUM

DATE December 16, 1965

SUBJECT SERVICE ANNIVERSARY LUNCHEON

TO Ken Olsen
Bob Lassen

FROM Jack Atwood

I have two suggestions in regard to this year's luncheon for five-year employees:

1. That it be postponed from the end of December to the end of January, and

2. That it become the responsibility of the Personnel Department.

The postponement is necessary because we do not have enough hardware. Our initial order for pins and tie clips was supposed to have been adequate for three years. However, we find ourselves with only half enough of each for this year's qualifiers. We cannot get delivery on the balance until January 20.

The transfer of responsibility is recommended not only because we have fouled up the deal but also because this activity seems to fall well within the province of the Personnel Department. The awards started as a public relations project, but Bob's accomplishments in the area of employee relations indicate that his group has the interest and the capability to handle this particular job with no problem.

J. L. A.

cal

# INTEROFFICE MEMORANDUM

DATE December 15, 1965

SUBJECT My Performance during 1965

TO Ken Olsen

FROM Jim Hastings

1. Personnel

a) Recruiting -

Employees for whom I was instrumental in hiring:

| | |
|---|---|
| Ron Eisenhauer | N.E. Sales Engineer |
| Don Killebrew | PDP-6 (terminated) |
| Pres Behn | PDP-6 (terminated) |
| Stan Booth | Small Computer Engineer |
| Charlie Braunhardt | Tech. Pub. Writer |
| Evelyn Dow | PDP-6 Programmer |
| Marv Horovitz | Small Computer Diagnostic Programmer |
| Bill Karavatos | Home Office (Chicago) Sales Engineer |
| Ron Klausewitz | PDP-6 Engineer |
| Dick Sogge | Small Computer Engineer |
| Ilsa Peter | Small Computer Programming |
| Martha Sifnas | Small Computer Programmer |
| Keith Nelson | Small Computer Diagnostic Programmer |
| Brad Vachon | Small Computer Engineer |
| Dave Dodge | New York Sales Engineer |
| Wayne Dengel | New York Sales Engineer |
| Skip Hickman | Denver Office Sales Engineer |
| Charles Kilgore | Huntsville Programmer (terminated) |
| Joseph Miller | Los Angeles Programmer (terminated) |
| Les Abrams | Palo Alto Programmer |
| John Burroughs | Washington Sales Engineer |
| Irwin Jacobs | Module Sales Engineer |

I coordinated the efforts to hire Harry Mann and spent the better part of 2 weeks prior to that time organizing the work for Andy in the search for a Treasurer.

b) Salary Survey

Enrolled DEC in the Los Alamos (professional engineers) and Systems Development Corporation (professional programmers) Salary Surveys.

Also conducted a detailed survey of DEC's salaries (including visits to Honeywell, Hankins, Baldwin Lima Hamilton) to compare our salary structure with engineering and programming based companies in this area.

c) Salary Review

Conducted the semi-annual reviews, including a recommendation for handling performance reviews in the future (some suggestions - adding H. Mann to Committee, avoid distributing salary notices at beginning of Christmas holiday).

d) Summer Program - Handled the professional summer program.

II. Engineering Department

A very unfortunate effort from all concerned to support an organization that did not exist at any time during the 15 months I was assigned to the area.

III. Patent, Trademark Efforts

Was Cesari consulted to see if I am providing him with satisfactory support? I have taken the initiative to have new developments reviewed, words trademarked in addition to handling the routine processing of patent applications. You are familiar with the MIT negotiations, I know, through Harry Mann's comments. Also, negotiated with Technitrol and IBM.

IV. Small Computer Administration

Nick commented on my work at the Salary Review meeting.

# INTEROFFICE MEMORANDUM

**DATE** December 14, 1965

**SUBJECT** Some thoughts on how to substantially increase module sales

**TO** K. Olsen
S. Olsen
T. Johnson

**FROM** D. J. Doyle

1. There is no reason why DEC's module sales per year could not reach $12 million during 1966-67.

2. Some of the techniques which have worked so effectively to increase module sales in Canada can be applied on a company-wide scale.

3. The fundamental problem which we must face is customer ignorance. (I am, of course, assuming that our delivery problems are now behind us.) This customer ignorance is chronic in Canada and is probably the same in the U.S. and worse elsewhere. Our reliance on technical sophistication amongst customers must end if we are to open up OEM and industrial markets.

4. The module seminars in Canada have been very effective in two ways:

   a) They have removed some of the ignorance, and

   b) They have convinced customers and competitors that we are serious.

   If we can achieve these two aims everywhere, then we can have all of the market.

5. I am suggesting that DEC take on a massive training program and charge for this service. A two-day logic school is recommended. The first day would be a lecture period, and the second day would be a laboratory period. I am suggesting schools of fifteen to twenty people and a charge of $20 per person - or merely enough to cover our costs,whichever is less. This school would rotate (or operate simultaneously) at such centers as Maynard, Los Angeles, New York, Ottawa and London and would last for about two weeks at a time.

6. Our approach to module literature must be completely modified. We must change the hodge-podge of pseudo-theory which we dish out in the front of our catalogues and in our applications notes so as to make them more "design-oriented." The whole purpose in writing any applications note should be to get a module list before the customer; he doesn't want to educate himself before he buys.

7. We must produce at least an applications note per week and mail them to selected customers about once a month. The following customer grouping is the one we use in Canada:

   a) Communications
   b) Physics
   c) Chemistry
   d) PDP-8 "Interfacees"
   e) Process Control
   f) Oceanography

   A little more thought would allow us to improve the module mailing system so that our customers do not forget about us.

8. We must automate our applications engineering so as to be able to run off preliminary drawings quickly. We might exploit the use of our CRT equipment for this purpose. An applications note "clearing house" must also be established. Drawings of repeatable units like counters, D-A's, A-D's, clocks, etc., should be available for "blocking into" field engineers applications drawings.

9. We must havea statement from management of our intention to reach a certain goal during 1966-67, and the module manager (and the module sales manager) must be given whatever authority he needs to meet it.

10. Our shipping and sales administration procedures must be streamlined to cope with the increased volume.

11. A module customer relations man must be appointed to police overdue shipments and remove the apathy towards customers which presently exists within our company.

12. Three month's inventory must be available at all times.

The above procedures could be in operation by July 1, 1966, on a budget of about $100,000 to be spent in the next six months. This is a small investment for the position that it could gain for us. What's more, it will ease the problem of design help for the PDP-8 customers who will (if we are clever) deluge us with special module applications. With our PDP-8 work, we should be ashamed to admit doing less than $12 million a year in modules even if they were the worst on the market.

Can I have some comments on these ideas. I have expressed most of them before, but unless someone believes me then I will stop preaching.

INTEROFFICE MEMORANDUM

DATE December 14, 1965

SUBJECT GENERAL MODULE STATUS

TO K. H. Olsen FROM S. C. Olsen

Strate and Semiconductor Programs, (as revised September, '65 i.e. DD 2 diodes produced first).

Program on schedule.
November production approximately 3,000 -3V strates approximately 50,000 diodes.
Until January production will show as development costs.
In January they will be charged to end product.
The second strate, (DGL), has been designed and the prototypes undergoing tests. They will be in production January.

First Phase: (DD 2's) looking very encouraging.

Second Phase: (DD 1's) scheduled for June production.
Procurement of special equipment single largest factor in timing.
Presently looking into ways of advancing date.

At this point we should proceed along the lines of completely packaging a complete module on a strate.

The groundwork has to be laid out in considerable detail as the full module rules tend to be quite different. We will then be working on much closer tolerance production so that production machinery and techniques need to be different. We will also give up totally the opportunity to modify modules after they have been built. We presently have given up some of this flexibility with our present substrates.

The other factors that have changed in the past year or so are that transistors, whether discrete or in chip form, are closely approaching the prices of diodes. Therefore, our circuit considerations must change also.

# INTEROFFICE MEMORANDUM

DATE December 13, 1965

SUBJECT

TO Bob Lassen
Ken Olsen
Jack Atwood
Nick Mazzarese
Win Hindle
Loren Prentice

FROM Jim Jordan

It has come to my attention that there is no definite place for the display of the various awards which have been bestowed upon the company for the activities within the community and the activities of the corporation in the computer industry. I would deem it highly advisable that an area be set up for the display of these award certificates and trophies. Two devices could be used.

1. A wall for flat matter such as certificates and awards.

2. A well designed display case for the trophies.

The most appropriate place for this display would probably be in the employee/purchasing lobby. As it is now, the recognition that we have received has been dispersed to such a degree that there is little evidence of our active participation in both community and industrial affairs.

# INTEROFFICE MEMORANDUM

DATE December 13, 1965

SUBJECT COLORS FOR ALL NEW DIGITAL EQUIPMENT

TO ✓Ken Olsen
Nick Mazzarese
Win Hindle
John Jones
Mort Ruderman
Ed Harwood
Dick Richardson
Harlan Anderson
Loren Prentice

FROM Jim Jordan

At a meeting on Monday, December 6, with Ken Olsen, Win Hindle, Nick Mazzarese, John Jones and myself, it was decided that all new computers and special systems will have a new color layout which is as follows: Frames will be black. Panels on front, top and back will be black, including the doors. End panels will be light gray. Accent colors will be introduced by product as they are designed with the approval of the appropriate managers. In addition, all the peripherals which are to be used with the new systems (the PDP-7X, the PDP-6X and PDP-8/Linc) must be reviewed and coordinated.

INTEROFFICE MEMORANDUM

CONFIDENTIAL

DATE December 10, 1965

SUBJECT Design Goals for the PDP-7X Memory

TO Attendees
CC K. Olsen
J. Jones
D. Cotton

FROM Nick Mazzarese

A meeting was held with the following attendees:

R. Best
E. DeCastro
D. Sogge
T. Hughes
L. Seligman

The following design goals were established for the PDP-7X memory:

1) The memory speed would be 1 microsecond or less.
2) The selling price would be less than $2 per word.
3) The memory should be field expandable with no return of memory stacks to DEC.
4) The memory would be expandable in 8K increments.
5) A basic 4K configuration would be made available but this would be done as a pricing trick rather than an engineering technique.

To accomplish these goals, it was decided to cancel the presently existing order for a 20 mil 16K stack and place an order for a 30 mil 8K stack (this should not effect its delivery).

CONFIDENTIAL

dec INTEROFFICE MEMORANDUM

DATE December 9, 1965

SUBJECT Notes on Module Sales, Competition, FJCC

TO S. Olsen
K. Olsen ✓
H. Anderson

FROM T. Johnson

1. There was little module activity at FJCC. 3C didn't seem to stress their modules. I don't know of anything new there. The monolithic cards were somewhat useful and effective in our booth, basically in opening up the discussion to find out what the basic attitude was that was held by the prospect. One showed polite interest and then was pleased to see we stressed discrete components.

2. Sid Halligan is going to open an office in Paris. It appears that he plans for 3C to go direct. I expect he'll let his present reps go shortly (Germany, France, U.K. - one company). There are certainly two side to this. I'm sure our combined effort on selling modules will have some beneficial results for both of us (education of the market). But it emphasizes the need to push hard now. I expect their enthrallment with our success on PDP-8's is pushing them along. Also suspect R. Mills is playing expert and getting them in on our approach to these markets.

3. I learned a good deal about 3C during my trip, much of which needs careful evaluation and should be helpful in steering us in the future:

   A. When they see a good procurement possibility, they work hard at the outset to put DEC out of the picture.

   B. Their main emphasis in doing so is to "scare" the prospect. They take advantage of our minimal "engineering" (circuits) information to pull out fears of noise sensitivity, etc., and they play down our off-beat symbology. In turn, they set in front of the customer their extensive (at least voluminous) circuit diagrams, etc. (We need to go back to re-emphasizing certain basics, in my opinion, namely: waveforms, circuit philosophy on loading and noise temperature specs, marginal checking, full compatibility throughout, etc.) I imagine they are being quite successful at combating some integrated circuits on this basis as well.

   C. They currently have 12 week delivery on micropaks and a few weeks on S paks. They are not pushing the micropaks any harder, if as hard, as S paks right now. With delivery we could have and can still drive them hard (the next few months are critical).

D. Their salesmen attend a mainplant course in modules (that is, their modules salesmen). It lasts 6 weeks (lab, lectures, and evening dinner discussions). Len Eisner set the courses up originally.

E. They are apparently quite pleased with their micropak decision within the 3C sales force, but I don't know how much is brainwashing and how much this is based on customer response.

F. They are going to add MOL circuits to their line. This is especially for DELTICs and similar logic systems. Basically, there are long serial shift registers (up to 2000 bits) which have feedback loops, used for pseudo-random noise generation, phase measurement I believe, and other applications. If we had been able to knock this application years ago, we would have severely knocked 3C at JPL, NEL and possibly Boeing, not to mention all sonar people. I told Ken Larsen's office to study this further and prepare a report and proposal.

G. They feel they are particularly effective in the use of the afore-mentioned sales techniques, with the new module customer, and that they can knock us out of the picture this way in 30% of the cases.

4. Al Vagge brought some Decisional Controls logic and a small core memory. He is still pressing us for the PDP-5 gift. I told Skip Hickman to find out more about the memory. Did the idea for adding memory modules die?

5. Oliver Judd sees the handwriting on the wall for modules and is holding out on module prospects. I will call him and find out what is going on. Ken Larsen is going to discuss the idea of being a distributor. He now is thinking of going into the "black box" business, so he could be a customer and stocking middleman. I'd like to discuss this. Datronics and Si Sterling are both interested in this possibility.

6. The Termi-Point situation has been confused for our salesmen. Apparently, we are now in favor of this again. Most salesmen took Dick Best's past statement in the Sales Newsletter to heart. The SF Amp salesman is really doing everything he can to knock our connector for Termi-Point. I think he needs a blast from their management, if possible. We need a consistent policy on this and more information. Basically, Amp is saying our connector can't take the force. Actually, there are several very contented Termi-Point customers out there, although Berkeley was suffering with improper mandrils and clips in their guns, causing a great deal of trouble until it was discovered.

7. Despite a bad 1st quarter for SF, they got in a good month in SF in November. They are almost on budget and going to pull it up. L.A. is above budget. Their first quarter was up from last year and feel they can get a big business with added effort. Denver needs emphasis and I made sure Skip got that message on a brief visit to that office.

8. Saul Dinman is apparently doing a good (described as first-rate) job of getting help and answers for the SF office at least. Modules has been the best in responses of all product groups over the last two months, but hasn't built the automatic information flow system yet.

9. We need to get some ads and announcements out on production successes and delivery as soon as possible.

   Couldn't we get in Electronic News and Computer Design right away? The competition is saying we can't produce. I'd stress the following:

   1. Compatibility and breadth (systems, FC discrete, strates, monolithic).
   2. Solid circuits.
   3. Delivery (and security!!)
   4. Ease of use.
   5. Price.

10. On my trip I urged certain people to see trips back East as an opportunity to make formal presentations and raise discussion at guidance meetings. In particular, Dave Denniston has some questions about the status of systems and some other modules. I think we should evaluate the delivery and inventory situation on each type of module very carefully indeed.

11. Ken Weir suggested that we do a better job of enclosing or protecting our power supplies.

# dec INTEROFFICE MEMORANDUM

DATE December 9, 1965

SUBJECT Corporate Quality Check at Teradyne

TO Kenneth Olsen ✓

cc: N. Mazzarese

FROM Harlan Anderson

On Wednesday, December 8, I spent about two hours with Nick de Wolf and Alex d'Arbeloff of Teradyne in Boston. Their company is now about five years old and they have approximately 100 people and appear from all outward signs to be quite successful. Our business relationship with them has developed over the last year with the purchase of PDP-8's on a blanket contract with the first delivery last June.

OEM Plan

They had some question in their mind as to whether they were well advised to take the OEM plan. They felt that a little more guidance from DEC would have been helpful to them. In particular, they feel that the services that are not available with the purchase under OEM are ones that they probably will need anyway and will have to repurchase them on an individual basis. In particular, they are very concerned about the warranty and are now struggling with how they can provide a warranty to their customer with any degree of assurance. They had some mistaken ideas about the OEM warranty and thought that they would not even be able to get a module repaired.

They also had the feeling that when they called for maintenance service even though they were paying for it that they received a lower priority treatment from our Field Service Department. Apparently, part of our field service procedure is to ask whether the equipment is under warranty or whether it is a maintenance contract or something of that kind which leaves a bad impression in the minds of the customer.

Another pricing problem to which I see no solution is that the PDP-8 has a very wide spread image of being the $18,000 computer. This brings psychological pressure from their customers to include it without any markup as part of the system. Their system price has been about $58,000 and they normally are required to break this down as to how much is computer, how much is instrumentation, how much is systems engineering, programming and etc. They also mentioned that the peripheral equipment and memory extensions were quite expensive. Here they had a mistaken impression in at least one area. They thought the paper tape reader was $8,000 and our price is actually $3,500 without spooler. Concerning DECtape, they did not yet know of the solid state transport at $2,300 shown in our August 1st price list. There was a substantial number of areas where they had wrong impressions and had not been kept well informed by DEC.

## Manuals and Training

Nick deWolf felt quite strongly that our instructions books which he personally had read several times are poorly self-explanatory. I asked him how they compared with those provided by other computer manufacturers and he said he did not have experience with others so he really couldn't comment on that. There was a misunderstanding of our intent for programmer training courses. It has always been my understanding that the entrants to these courses were expected to be programmers before they came here and we would merely orient them for our particular computer. I believe DEC may have done a poor job in making this concept clear. A simple way to do it would be to state entrants' requirements for the course which amounted to having a one semester college course in programming or equivalent experience. Their man, Milt Collins, was an experienced programmer and apparently caught on to using the PDP-8 quite quickly but some of their other people whom they sent to the course did not get much out of it.

## Reliability

In general, their feeling is that it has been much more difficult than they had imagined to start using a PDP-8 in their systems. They feel that some of this is due to their naiveness but they are overcoming that aspect and still are very concerned about all the trouble there has been to get going. They are hopeful that this will, indeed, be startup difficulties and that once the system is placed in operation and left alone that it will run very well. When they purchased the equipment they had anticipated the Model Type 33 teletypewriter would be a weak link but they feel they have found other areas that have caused them trouble. Concerning the teletypewriter, Nick deWolf did not know that it was possible to substitute a Model 35 on the PDP-8. Their impression of the computer is that the program frequently appears to deteriorate. By this they mean that the program continues to run but it starts doing strange things. This they feel is a very dangerous state of affairs since it might go undetected when the system is in operation sorting transistors and the cost of such an error could be very very high since many thousands of dollars of transistors would have been handled by the machine in the space of a few hours.

The evening before I met with them, they pointed out one example of reliability problems when the paper tape punch started punching without cause and they had some difficulties in getting it stopped. They feel that one defense against program deterioration and the seriousness of this kind of a malfunction is merely to reload the program frequently. During their test phase they reload very very often. Many times they have the feeling that this is for mysterious reasons. They, of course, are trying to strive for ten years of trouble-free operation of their own equipment. This makes them very conscious of troubles with the computer. They have no experience with other computers but are willing to consider that this is the state of reliability of all computer manufacturers. If this is true, they made the statement that four years from now they will not be using computers in their systems. They have not run any of their systems using the PDP-8 in place at their customer location as yet so they have no good operating experience. The first of these is being shipped to

Motorola right now and I would expect that their concern about reliability will be intensified or they will feel their troubles were merely startup difficulties.

Their competitors for this kind of business are Fairchild Instruments and Texas Instruments neither of whom believe in the use of general purpose computers for this work. Fairchild has sold some sixty special purpose systems for this type of work at a price of about $100,000 apiece. The big challenge of the future is to make a integrated circuit tester which would be similar to our PDP-4 module tester. The competitors thus far are doing this using disc units for memory and in general a continuation of the special purpose approach.

Summary

In general, they are quite pleased with the cooperation we have given them and are enthusiastic about the concept of using a computer as part of their system. They are, however, concerned with the reliability of the equipment and have had more difficulties than they had anticipated in becoming familiar with the computer and getting a smoothly operating system.

Andy

HEA:ncs

dec INTEROFFICE MEMORANDUM

DATE December 9, 1965

SUBJECT Cramer Electronics, Inc.

TO Kenneth H. Olsen FROM Henry J. Crouse

Mr. Tim Cronin, President of Cramer, sent us a copy of their recent annual report.

Our purchases over the same period of their report, total $130,299.43. We do use several other distributors, however, Cramer Electronics is the most helpful to us, ie. willing to stock material until we call for it and overnite service via Woody and Paul Green.

Henry J. Crouse

# INTEROFFICE MEMORANDUM

DATE December 9, 1965

SUBJECT

TO K. Olsen✓
H. Anderson
H. Mann
N. Mazzarese
W. Hindle
S. Olsen

FROM Bill Farnham

A recent suggestion received from the field is to have a personnel telephone directory, laminated in wallet size, This directory would list the home telephone numbers of field salesmen and key Maynard personnel.

Since this is an invasion of privacy, Ted has asked me to poll your views on the above.

WHF:kge

# INTEROFFICE MEMORANDUM

DATE December 9, 1965

SUBJECT Estimated Manufacturing Cost of PDP-6 FC

TO W. Hindle/K. Olsen

FROM G. Bell

cc: N. Mazzarese
H. Anderson
A. Kotok
H. Mann

The following is an estimate of the present FC 6 selling price, based on current selling prices of DEC modules, parts, etc.

## TOTAL SYSTEM SELLING PRICE

| | | |
|---|---|---|
| Processor (Parity, checking, Fast Memory) | $ 74,800 | |
| I/O (Reader, Punch, Teletype, Card Reader (Logic Only)) | 12,190 | |
| 1 - DECtapes, Control, Data Control | 19,000 | |
| 65,536 Word Memory | 66,000 | |
| | 171,990 | |

## PROCESSOR

| | | | |
|---|---|---|---|
| 880 - Modules | at 44 | 39,000 | |
| Parity Buffer Modules | | 1,760 | |
| Fast Memory Control | | 1,320 | |
| 36 Adder Components | (3x 130) | 6,400 | |
| 72 Fast Memory Components | 3 x 10 | 2,160 | |
| | | 50,640 | 50,640 |
| Indicator Drivers | (300/7 x 43) | 730 | |
| Indicator Cables | (300 x 18 x 18) | 320 | |
| Indicator Brackets | (300/18 x 96) | 1,680 | |
| Console Cables | | 68 | |
| Co-ax Memory/IO Bus Cables | (16 x 80) | 1,280 | |
| | | 4,078 | 4,078 |

| | | |
|---|---|---|
| 8 - Power Supplies 240 | 1,920 | |
| 1 - Marginal Check | 280 | |
| 1 - Power Control | 300 | |
| 2 - Misc Panel 150 | 300 | |
| | 2,800 | 2,800 |
| 16 - Mounting Panels 200 | 3,200 | |
| 7,000 Wires 30 | 2,100 | |
| | 5,300 | 5,300 |
| 2 Cabinets (small) 500 | 1,000 | |
| 2 Cabinets (large) 650 | 1,300 | |
| Console Hardware | 3,000 | |
| Indicator Panels | 1,000 | |
| | 6,300 | 6,300 |
| 240 hrs. Checkout (3 x 8) | 5,760 | 5,760 |
| Total | | 74,878 |

I/O PACKAGE (Reader, Punch, Teletype, Card Reader)

| | | |
|---|---|---|
| Modules | 5,200 | |
| 2 Power Supplies at 240 | 480 | |
| Cables | 500 | |
| 4 Mounting Panels at 200 | 800 | |
| 3000 Wires at (3 x 10) | 900 | |
| | 7,880 | 7,880 |
| Cabinet | 650 | 650 |
| Teletype 3 x 500 | 1,500 | |
| Reader-Punch (3 x 400) | 1,200 | |
| | 2,700 | 2,700 |
| 40 hrs. Checkout (3 x 8) | 960 | 960 |
| | | 12,190 |

DECtape - DATA CONTROL

| | | |
|---|---|---|
| Modules | 5,500 | |
| Power Supplies | 240 | |
| Cables | 1,000 | |
| 4 DECtapes at 2,400 | 9,600 | |
| 4 Mounting Panels at 200 | 800 | |
| 3000 Wires at (3 x 10) | 900 | |
| 40 hrs. checkout (3 x 8) | 960 | |
| | 19,000 | 19,000 |

Memory (at Mfg. Cost)

| | | |
|---|---|---|
| Modules | 6,321 | |
| Power Supplies | 980 | |
| Cabinet | 303 | |
| Wire Wrapping | 450 | |
| Inhibit Resistors | 85 | |
| Stack | 13,300 | |
| Assembly | 318 | |
| Checkout | 240 | |
| | 22,000 | 22,000 |

Selling Price ..... $66,000.

Savings on a Small Configuration:

| | | |
|---|---|---|
| DECtape | | 19. |
| 8K Memory (3 x 6.7) | | 20.0 |
| Fast Memory and Control | | 3.4 |
| Card Reader Modules | | 1.0 |
| Parity Buffer | 40 | |
| Protect/Relocate Modules | 20 | |
| MQ " | 61 | |
| Byte " | 50 | |
| BLT " | 15 | |
| Floating Point " | 100 | |
| FE Register " | 15 | |
| MI Register " | 45 | |
| PI Register " | 15 | |
| | 361 x 4.4 | 15.4 |
| 80 hrs. Checkout (3 x 8) | | 1.9 |
| Total Savings | | $60,700 |

A price for the comparable IBM 360/44 is:

| | |
|---|---|
| 16,384 - 32 bit word processor with $8 \times 10^6$ bit | |
| DISC | $ 179,700 |
| Floating Point | 11,000 |
| Fast AC's | 28,000 |
| | $ 218,700 |

GB/bwf

K H Olsen

dec INTEROFFICE MEMORANDUM

DATE December 3, 1965

SUBJECT Tape Problems at DECtape Transport

TO D Nevala
D Kuyamjian
L Prentice
K Doering
J Smith
T Stockebrand
D Vonada
D Bevins

FROM D Wardimon

The purposes of this memo are:

A. To describe problem encountered recently in connection with driving tape over out DECtape transports.

B. To run short analysis of the problem source.

C. To outline steps needed to cure the problem.

The problem: Lately we received reports (in house and field) that a tape occasionally sticks over the guide and would either stop or slow down and render writing and reading impossible. The reason was simply a question of accumulated tolerances and both tape width and guide width manufacturing tolerances were the suspects.

Therefore the problem was attacked from both ends: On one hand the prints, manufacturing procedure both at the plant and at the parts vendor's plant, and quality control inspection process were thoroughly revised. Secondly tape tolerances were (and still are at this moment) being investigated in cooperation with the supplier, the 3M Company.

This memo will deal only with the tape tolerance problems and how to avoid shipping tapes that might stick. The manufacturing problems of the transport itself will be dealt with in the future in another memo and both memos should refer to each other.

Analysis: The fact that all of a sudden new tape shipments were causing the above mentioned trouble on transports that were existing for some time suggests immediately that the tape manufacturing tolerances were shifted to the higher side. The tape width tolerance being bought is +0 -.004 inches. (The guide tolerance is -0 +.001 inch). The first step was to get hold of some of these tapes and measure them and see if the width was within specs to begin with. Unfortunately we don't have any instrument in the house that will do the job. We have measured the tape width at a vendor's plant shadow graph but did not feel that the results were accurate or reliable. (None though have been found to exceed the maximum tolerance). The only alternative at the moment is to rely on the 3M Company. Samples from the stock currently at Digital plus a few of the tapes that caused trouble were sent back to them. Part of the samples have been checked to their entire length and

although a written word has not yet been received as per this date their salesman told us that none of the tapes have been found to exceed the 3M specification but a few were just on the upper edge. Further measurements will be run on the entire sample lot (28 pieces) and we are promised documented results. Based on the evidence we have received so far we have come to conclusions and therefore recommend steps to be taken. Problems of this sort are liable to occur even when the tape is within tolerance. That means a few of our guides are narrower than specified and somehow came through Quality Control inspection. Moreover the same problems could very well occur when both tape and guide are within tolerance. For example, a tape and guide which are both exactly .75 inches wide. We feel that a situation like this will tend to slow the tape. It could be therefore that some of our problems stem from the fact that the tolerance specification is wrong and should be changed. Here are the steps that are being taken and that will be taken to correct the situation.

1. To prove the last point we have asked the vendor to supply us with tapes of known width, that is: 5 tapes with width stepped one thousandth of an inch apart: 1) .7500 2) .749 3) .748 4) .747 5) .746 inch. We could run .75" tape on a .75" guide and see what happens. As a result we would probably specify the width as .75 - .001 - .004 inch. (This is better than changing our guide specs since we have to ship future tapes to existing transports.)

2. Every tape that we sell should be checked for width. This is automatically being done when certifying the tape. However, Dave Nevala will see to it that all transports on which we certify tapes are on the narrow tolerance limit, that is .750 inch wide and not over (or under). This will assure that all the tapes that pass through the certified transports will also move unobstructedly in the field transport.

We do occasionally sell uncertified tape. That means that we ship them out of the stockroom without knowing the quality of the tapes either mechanically or electrically. Therefore the least we can do is run these uncertified tapes through a certifying transport two passes (the second pass is rewind) to assure tape width acceptance. Since this almost amounts to the time taken to certify a tape (and also since bad oxide coated tape may escape any notice and be shipped) I strongly suggest that our policy will be not to sell any uncertified tape and I suggest that Tom Whalen will see to it that this rule is being practiced.

3. Those transports that somehow got into the field with narrow guides, that is under 0.750 inch will have to be modified when found to give trouble. The technique will be shimming as has been practiced already in the house and as I understand, on the Australian PDP-6.

4. In the future Quality Control will take the extra precautions to avoid shipping narrow guides into Production. The whole procedure of assembly and other technical matters will be discussed in a memo written by Dave Nevala. (Like a go no go gauge to test guide width for acceptance).

5. Purchasing and 3M Company will come to an agreement and steps to be taken pending a final report on the findings of the 28 tape reels that have been sent to them for measuring.

6. 3M Company has been notified as to the exact nature of the problem and they might come up with suggestions based on their experience and know how as to what are the best tolerances to specify.

7. Measuring Instrumentation. From an engineering point of view some measuring devices are necessary and we do not have them. They are among the rest, a shadow graph to accurately measure tape width. At the moment we sell about 500 reels a month and the number is expected to grow. This represents a volume of close to $100,000 a year. Will this figure help to make a decision as to whether to invest in that instrument that cost about $4,000 and could be used for other purposes as well. Another optical device is highly needed to measure critical dimensions on the read write heads. In the past as well as in the present there have been mechanical problems with more than 15% of heads that came to the house. When we reject them we have to prove that the dimension is not according to the print. This is something which we cannot do at the present beyond indicating that the heads are not operating. This leads to a sticky problem with the vendor plus the fact that the heads are not inspected mechanically for correct dimensions when received. This last matter has been dragging for some time now and should be solved in the very near future. There are orders for 250 heads now which represent a volume of 60 to 70 thousand dollars and we have to control the situation immediately. The instrument needed for this inspection costs around $750 which is less than the value of 3 heads and it will pay for itself in no time at all.

DW:ASJ
CC
K H Olsen
R L Best
E DeCastro

# INTEROFFICE MEMORANDUM

DATE December 1, 1965

SUBJECT Items to be produced in Production D.

TO AD HOC Production Planning Meeting

FROM Robert Maxcy

It is proposed that:

A. Production D begin immediately on the production of the Logic Laboratory. Equipment and space is available and the situation is presently being phased from a vendor to full time - in house operation.

B. Production D phase into the manufacture of standard power supplies. The high-speed line in Production B would be phased in first, as it is highly mobile and could adapt easily once the Production D stockroom is ready. The people and equipment in P. Greene's area would constitute step two of the phase-in.

C. Production D phase-in to the manufacture of standard mounting panels. This phase-in would be more gradual than item "B", as new people have to be hired and trained.

The words "phase-in" mean just that. The entire process will be geared to transferring existing production capabilities, stock, people, and equipment, so that no interruption in manufacturing capabilities will occur. In the case of power supplies, the intent is to eventually produce all standard power supplies in house, thus eliminating vendor operations.

dec INTEROFFICE MEMORANDUM

DATE December 1, 1965

SUBJECT Proposal for setting up and operation of stockroom for cabinet parts

TO Ad Hoc Production Planning Committee

FROM R. W. Richardson

1. Set up stock room to store and dispense all metal parts and related hardware that go into the assembly of our cabinets and accessories. Location of Stockroom to be adjacent to Carpenter Shop, Ground Floor, Bldg. 3.

2. Secure a clerk for operation of stockroom. (Male if possible)

3. Maintain card file on parts that are in inventory and keep accurate records on material, transfers and recharges to stock.

4. Max - Mins and level of inventory to be established based on the firm monthly orders plus the projected use for the three month period.

5. Quantities ordered for inventory should be based on:

   a. economical lot size whenever possible.
   b. projected usage as well as past usages that can be obtained from our records.

6. Ultimate goal will be to:

   a. build and meet the firm requirements of the Product Line Managers from parts already in stock or in process.
   b. fabricate parts based on the three month projection as received from the Product Line Managers.
   c. build standard parts that are used in various products on a three times a year basis.

7. Subcontract and Make or Buy Decision should be based on workload, facilities and price.

8. Engineering Change Orders and new designs should take into consideration what is available from stock. This could eliminate obsoleting expensive parts or in some cases creating a new part where an existing part could have been used.

# INTEROFFICE MEMORANDUM

DATE November 30, 1965

SUBJECT Proposed Reporting System for Foreign Subsidiaries

TO Harry Mann
Denny Doyle
John Leng
Ken Olsen

FROM Ted Johnson

Please read the proposed reporting system memo. I would like to proceed on the quarterly (and out of phase) financial reporting. The job ticketing allows us to run the product line allocation by direct labor, treating foreign offices as regular sales offices. I would like to get more and better information, but will consider any suggestions for making the system more efficient and less of a load on the foreign offices. Some of the advantages will not be apparent to the foreign managers but will, I believe, be necessary to bring the foreign offices the same marketing and management support and cooperation that domestic offices receive, and in the same objective way.

TJ/mr

Attachment

By...Ted Johnson

# REPORTING SYSTEM FOR FOREIGN SUBSIDIARIES

## 1. Job Tickets

Job tickets must be filled out first on standard DEC cards and must follow the same rules. These rules, activity codes, etc. are available in DEC memoranda which will be furnished to each office manager.

If the subsidiary requires allocating other charge numbers than the DEC required numbers for their own purposes, an unused field on the card (job ticket) may be used. Then, after copying the job tickets at the end of each week and sending the original in to the Sales Manager, Maynard, the copy can be used to prepare the job charge sheets required for subsidiary accounting. Office managers will be responsible for seeing that all job tickets are sent each Friday, air mail, to Maynard (Sales Mgr.).

## 2. Monthly tabulation of expenses

The job tickets will be fed into our present accounting system which yields a tab run each month, by cost center. It will be necessary to get wage and salary rates from each office to perform the translation from job tickets to dollars by activity code and product line. This will be checked and updated for personnel changes on a quarterly basis.

The office managers will provide a forecast of monthly expenses (or quarterly, or determined) which will be added to the cost center tab run to provide total expenses for the month and, after approval, represent a budget for that period.

The tab run will then be returned to the office managers or area supervisors as determined to show the monthly results (with comments by the

Sales Manager). This gives all of the basic data, provided we can easily generate product line information, that we need for overall operating control. This is accomplished without adding to the present bookkeeper's load in each office.

3. Financial statements

It is the objective of our accounting system that we produce complete financial statements consistent with our management needs and local subsidiary and government requirements. At the same time, it is our objective to reduce unnessary administrative and non-productive overhead.

Therefore, a plan for reporting on a quarterly basis will be worked out replacing present monthly reporting. The quarters will run as follows (accounting months used therein) Dec - Feb, Mar - May, June - August, Sept - Nov. In this way, subsidiary information will lag one month on our consolidated statements allowing sufficient time so as not to delay our quarterly closing of accounts.

This saving should far outweigh any extra work involved in job ticket transfers to subsidiary job sheets, if that is required at all.

4. Forecasting Expenses

As indicated in Section 2, office managers will be responsible for providing a forecast of expenses each quarter. This forecast will cover the normal DEC quarters, Jan - Mar, etc. and be due into Maynard with the financial statements one month before the quarter.

5. Additional Operating Reports

In addition, the designated office manager or personnel in each office or subsidiary will send in the following information every month.

A. List of customers, with associated amounts, due dates and expected receipt of payment making up the subsidiaries Accounts Receivable (including duty rebates, etc.).

B. List of Accounts Payable payees with invoice date.

C. Amounts in subsidiary bank account.

D. Amounts on hand in petty cash or undeposited receivables.

E. List of expected disbursements for the next two months, other than listed.

F. Details on forecasted expenses and expenditures required for complete understanding of the report.

G. Any other information as deemed appropriate by sub or DEC management.

6. Customer Order Information

Every order for equipment for Maynard must be accompanied by the end customers name, purchase order number, and information if part of the order is being filled by the subsidiaries stock. This information is to appear on any and all Telex messages or other written communication.

The subsidiary will send in a copy of the customer order (key parts translated if appropriate) and a copy of the subsidiary order form, if there is one. This form will also note if any portion of the order is filled from any place other than Maynard.

Other information on duty, delivery, etc. will be required as per other memoranda and continuing instructions.

Copies of all invoices will also be sent to Maynard.

7. Expense vouchers

Copies of expense vouchers will be sent to Maynard following approval by the Regional manager. Payment will be made within the subsidiary. These copies are to be used for record keeping and planning purposes only.

In general, however, all DEC money must be properly accounted for, including purchases, payments of fees, etc. within our international organization.

8. Weekly sales summaries and call reports.

A list of customers contacted each week, with required information on weekly summary sheet, must be sent in weekly to Regional Manager and then DEC Sales Manager.

These summaries will be supported by call reports detailing important and significant applications and customer information. A copy of call reports

goes to the DEC Sales Manager.

9. Forecasting

A monthly forecast is required on standard supplied DEC format. This is basically a list of expected orders with type, date, and probability of closing. It should be also used as the sales office follow-up list.

10. Other reports and information as required from time to time.

# INTEROFFICE MEMORANDUM

DATE November 30, 1965

SUBJECT Revised Product Line Statement Reference

TO Ken Olsen ✓
Harlan Anderson
Harry Mann
Stan Olsen
Win Hindle
Nick Mazzarese

FROM Ed Simeone

Attached is the revised "Product Line Statement Reference" which will properly describe the content of the Financial Statements for the period ending November 27, 1965 and for subsequent periods.

ES/clw
Attachment

DIGITAL EQUIPMENT CORPORATION

Product Line Statement Reference

Effective Date : 10/30/65
Release # : 2
Revision # : 1

Line 1 Sale of New Equipment: Total of domestic and foreign billings of new equipment at gross prices. In consolidation inter-company billings are eliminated.

Line 2 Contributions: The value of equipment donated included in new equipment billings, line 1.

Line 3 Trade in and Returns Allowances: The value allowed for equipment being traded in or returned.

Line 4 Quantity Discounts: Deductions from gross sales due to quantity, OEM and distributors purchases. Inter-company discounts are eliminated in consolidation.

Line 5 Sub-Total: Line 1 less lines 2, 3, and 4.

Line 6 Sale of Leased Equipment: Total of domestic and foreign billings of equipment that was previously on rental. The amount billed is net of credits given for rental payments received but is before any other discounts, allowances or credits. In consolidation, inter-company billings are eliminated.

Line 7 Rental Income: Total of domestic and foreign billings for equipment on rental. Rental billings are credited to product lines per the lease.

Line 8 Maintenance and Service Income: Total of domestic and foreign billings for maintenance and service contracts plus billings for customer training courses, credited to product lines as designated by the order processed.

Line 9 Net Operating Revenue: The sum of lines 5, 6, 7, and 8.

Line 10 Job and Standard Costs: Actual material, labor and budgeted overhead job costs applicable to domestic and foreign billings of computers and special products. In addition, the standard material, labor and overhead applicable to domestic and foreign billings of modules. In consolidation, inter-company billings are eliminated.

Line 11 Other Job Costs: Actual material, labor, and budgeted overhead applicable to manufacturing and customer jobs which were billed in prior months, costs charged to invalid job numbers, and cancelled jobs. Also included are costs of trade-in and returns allowances (credits) and charges for contributions of inventory items, inter-company profit determined to be in inventories through consolidations, inventory write-offs, and any other miscellaneous charges or credits for which no line item is designated on the statement.

Line 12 Manufacturing Overhead Variance: The sum of overhead center variances from all Manufacturing Overhead Centers. This variance is allocated to product lines on the basis of budgeted cost of sales for the current quarter. Budgets dated July 2, 1965 will be used for fiscal 1966.

Line 13 Variances from Standards: The difference between purchase price and standard price due to raw material purchases during the month. Also, material, labor, and overhead variances (from standard) from the prior month production. This variance is allocated to product lines on the basis of module content, i.e., cost of modules used in product lines based on budget for fiscal 1966.

Line 14 Warranty Costs: Actual material, labor, and budgeted overhead expended on equipment covered by warranty. This cost is accumulated by product lines on the basis of charges from Field Service operations.

Line 15 Royalty Expense: Expense incurred for the sale of core memories in lines 1 and 6 of non-renegotiable nature. This expense is accumulated by product lines on the basis of equipment designation.

Line 16 Sub-Total: The sum of lines 10 through 15.

Line 17 Book Value of Leased Equipment Sold: Actual material, labor, and budgeted overhead, less depreciation, of equipment sold that was previously on rental.

Line 18 Depreciation of Rented Goods: Depreciation expense for equipment leased to customers based upon the total cost of the equipment and depreciated over a four year period. The double declining balance method of depreciation is used to arrive at the depreciation expense. This expense is accumulated by product lines on the basis of equipment designation per the lease.

Line 19 Maintenance and Service Costs: Actual material, labor, and budgeted overhead applicable to maintenance and service contracts and charged to product lines by job designation.

Line 20 Costs Directed to Operating Revenue: The sum of lines 16 through 19.

Note: For financial analysis purposes, the following line items are equatable from a revenue-cost aspect:

1) lines 5 and 16
2) lines 6 and 17
3) lines 7 and 18
4) lines 8 and 19

Line 30 Gross Profit: Line 9 less line 20.

Line 40 Product Line Marketing: Total actual material, labor and budgeted overhead applicable to sales job numbers for marketing purposes. This cost is accumulated by product lines on the basis of job number designation.

Line 41 Domestic Selling: Total actual material, labor, and budgeted overhead to domestic sales overhead centers. This cost is accumulated by product lines on the basis of job number designation.

Line 42 Trade Shows: Total actual material, labor, and budgeted overhead applicable to sales job numbers in series P4000. This cost is accumulated by product lines on the basis of job number designation.

Line 43 Foreign Selling: Selling costs from foreign subsidiaries in consolidation plus actual labor and materials in foreign overhead centers.

Line 44 Advertising: Total actual material, labor, and budgeted overhead applicable to sales job numbers in series P1000 and P2000. This cost is accumulated by product lines on the basis of job number designation.

Line 45 Promotion Literature: Total actual material, labor, and budgeted overhead applicable to sales job numbers in series P3000, P5000, and P6000. This cost is accumulated by product lines on the basis of job number designation.

Line 46 Selling Overhead Variances: The sum of overhead center variances from all marketing and selling overhead centers and the costs charged to invalid sales job numbers. This amount is allocated to product lines on the basis of total actual selling costs (lines 40-45) by product line for the current month.

Line 47 Total Selling Expense: The sum of lines 40 through 46.

Line 50 Product Line: Total actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "hardware" (except modules which are designated as Flip Chip). This cost is accumulated by product lines on the basis of job number designation.

Line 51 Product Line: The actual material, labor, and budgeted overhead charged to company sponsored development jobs designated as "software" (except modules which are designated as "Systems & Lab Plug-In Units" and Digital Test Systems designated as "Current Drivers"). This cost is accumulated by product lines on the basis of job number designation.

Line 52 Central Storage Devices: The actual material, labor, and budgeted overhead charged to company sponsored development jobs designated as "storage devices" and allocated to product lines on the basis of 50% to the Large Computer Line, 25% to Product Lines 4 & 7, and 25% to Product Lines 5 & 8. The allocation percentages are subject to change by product managers only.

Line 53 Central Semiconductor Development: The actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "semi-conductor development" and allocated to product lines on the following basis:

| | | | | | |
|---|---|---|---|---|---|
| Large Computers | | 10% | Modules | | 50% |
| PDP-6 | 10% | | Special Products | | 5% |
| Small Computers | | 35% | Digital Test Equip. | | 5% |
| PDP-7 | 15% | | | | |
| PDP-8 | 15% | | | | |
| Linc | 4% | | | | |
| Comp. Aid. Design | 1% | | | | |

Line 54 Central Strate Development: The actual material, labor, and budgeted overhead charged to company sponsored development jobs designated as "strate development" and allocated to product lines on the following basis:

| | | | | | |
|---|---|---|---|---|---|
| Large Computers | | 10% | Modules | | 50% |
| PDP-6 | 10% | | Special Products | | 5% |
| Small Computers | | 35% | Digital Test Equip. | | 5% |
| PDP-7 | 15% | | | | |
| PDP-8 | 15% | | | | |
| Linc | 4% | | | | |
| Comp. Aid. Design | 1% | | | | |

Line 55 Manuals: Total actual material, labor, and budgeted overhead applicable to job numbers in series P9000. This cost is accumulated by product line on the basis of job number designation.

Line 56 Engineering Overhead Variances: The sum of overhead center variances from all engineering overhead centers and the cost charged to invalid engineering job numbers. This amount is allocated to product lines on the basis of total actual engineering costs (lines 50-55) for the current month.

Line 57 Total Engineering Expense: The sum of lines 50 through 56.

Line 60 Administrative Expense: The sum of actual Accounting, Administration, Personnel, Training and Purchasing Overhead Center expense. Also includes corporate interest charges net of credits for interest income and earned discounts. These charges are allocated to product lines on the

basis of the sum of actual selling, cost of sales, and company sponsored engineering by product line for the current month.

Line 70 Profit Before Taxes: ; Line 30 less lines 47, 57, and 60.

# INTEROFFICE MEMORANDUM

DATE November 29, 1965

SUBJECT Recommended Changes in Procedures

TO Ad Hoc Production Planning Committee

FROM M. Sandler
R. Belden
H. Crouse
D. Packer

A meeting of the subgroup above resulted in the following recommendations:

1. That module requirements and forecasts be changed to the following:

   a. Every month: Firm order for the following month (month 1), plus projections for months 2 and 3.

   b. Every quarter: Firm order for the following month (month 1), plus projections for months 2–6. Due in December, March, June, and September.

   c. Every half: Firm order for the following month plus projections for months 2–12. Due in December and June.

   (It was also noted that orders and projections must be in on time -- by the 15th of the month -- for the planning process to be effective. A suggestion was made to make requirements due in the first week of each month, to increase lead time for scheduling and planning.)

2. That responsibility for requisitioning, ordering, and procuring module materials be placed entirely with Purchasing. The following steps would be followed:

   a. Each month, Production Managers will give Purchasing the latest set of material needs for each component for each month in the future. (The number of months will be a minimum of 6 and a maximum of 12, depending on the time period of the latest requirements).

   b. Purchasing will match delivery requirements against open purchase orders and place necessary purchase orders. Purchasing will notify Production if material requirements cannot be met.

   This change means that:

   a. Purchasing must set up a record system for open orders and material requirements.

   b. Production control can drop open order record keeping now being maintained.

Henry Crouse will examine required record keeping, and based on his evaluation will recommend a date for implementing the revised procedure.

3. It was noted that a gap exists between Purchasing and Production due to incoming inspection. It appears desirable to integrate this function with that of Purchasing so that one organizational unit controls materials from order through delivery to stock.

DWP:ncs

dec INTEROFFICE MEMORANDUM

DATE November 29, 1965

SUBJECT Policy & Procedures for the Sales Department

TO Ken Olsen
Harry Mann
Bob Lassen

FROM Bill Farnham

We are presently putting together a Policy and Procedure Manual for the Sales Department. Attached are proposed drafts on certain subjects to be contained in this manual.

I would appreciate any comments that you might have in respect to the contents of these drafts.

WHF:kge

dec INTEROFFICE MEMORANDUM

DATE November 19, 1965

SUBJECT DEC Automobile Allowance Policy for U. S. and Canadian Offices

TO FROM

It is the policy of the Company to reimburse an individual for use of their personal automobile on company business. It is also felt that field office personnel fall in a special catagory in that they are constantly required to use their cars both in self transportation and in customer transportation; and for this reason should receive an additional allowance in order to keep these cars in a safe, clean, and up-dated condition. In order to qualify for the allowance, an automobile must be two years or less rated on January 15th of each year. In addition, the car must comfortably seat 5 passengers and preferably be a four door model.

It is recommended that an application for approval be submitted before the purchase of the car so as to ensure qualification.

The fixed-fee allowance of $30 per month will be automatically forwarded to each person who has qualified. This will be in the form of a separate check and need not be reported as income; however, it is recommended that recipients make a statement on their tax forms that conforms to the following:

> "all amounts which I have received from my employer as reimbursement or other allowance for travel and entertainment expenses did not exceed my ordinary and necessary business expenses."

In addition to the fixed-monthly fee, an individual may receive nine (9) cents per mile while on company business. Mileage is collected on the standard-daily travel voucher.

All other personnel, who have not qualified for the fixed fee, will only receive nine (9) cents per mile.

The above-fixed allowance may be terminated if a person's primary responsibility changes from customer work requiring constant use of his automobile.

Attached is a guide for generally acceptable models for the major U. S. Manufacturers.

WHF:kge
ATTACHMENT

GUIDE FOR DETERMINING QUALIFICATIONS FOR DEC AUTOMOBILE ALLOWANCE*

BUICK
- Special
- Le Sabre
- Wildcat
- Electra 225
- Riviera

CADILLAC
- Calais
- DeVille
- Fleetwood 60 SPL.

CHECKER
- Marathon

CHEVROLET
- Corvair
- Chevy II
- Chevelle
- Chevrolet

CHRYSLER
- Newport
- New Yorker
- Chrysler 300
- Imperial

DODGE
- Dart
- Coronet
- Polara
- Monaco

FORD
- Falcon
- Fairlane
- Galaxie
- Mustang (Coupe)
- Thunderbird

KAISER
- Jeep Wagoneer

LINCOLN
- Continental

MERCURY
- Comet
- Mercury

OLDSMOBILE
- F-85
- Jetstar 88
- Dynamic 88
- Delta 88
- Torondao
- Starfire (Coupe)
- Oldsmobile 98

PLYMOUTH
- Valiant
- Barracuda (Coupe)
- Belvedere
- Fury

PONTIAC
- Tempest
- Catalina
- Star Chief
- Bonneville
- Grand Prix & 2+2

RAMBLER
- American
- Marlin
- Classic
- Ambassador

STUDEBAKER
- Commander
- Daytona
- Cruiser

*This is a guide only and does not constitute qualification until final approval has been given by the Sales Manager.

dec INTEROFFICE MEMORANDUM

DATE November 19, 1965

SUBJECT Policy & Procedure for Expense Control in the Domestic Field Offices

TO

FROM

It is the general policy of DEC to control expenses in the field offices in the same manner as they are in Maynard. It is realized that there are certain limitations in the field offices in respect to local circumstances.

The following types of expenditures must be processed as indicated.

CAPITAL EQUIPMENT - This item is defined as material of permanent nature that becomes an asset of the company's. It would include items such as desks, furniture, test equipment, and office equipment. The purchase of capital equipment must receive approval of the Sales Manager via the Regional Manager. This may be accomplished normally thru a material requisition and in an urgent case via the TWX.

OPERATING SUPPLIES - These items are defined as material of a reoccuring nature such as office supplies, maintenance supplies, inexpensive hand tools, coffee, small donations, postage, etc. These items may be purchased by the sales office with only the approval of the District Sales Manager required. Expenses such as printing and advertising that exceed $100 should be approved by the Sales Manager in writing.

TRAVEL & ENTERTAINMENT - Travel in ones own sales territory is at the discretion of the District Manager. Travel to Maynard should be approved by the Sales Manager. Entertainment should be conservative in nature and at the judgment of the individual salesman. Salesmen who are not entertaining customers and who are leaving and returning to their houses each day are expected to take care of their own personal expenses such as lunch and snacks. Unusual circumstances such as dinner due to working late with a customer may be reimbursable at the discretion of the Sales Manager.

Reimbursement for travel and entertainment is obtained by submission of the Daily-Travel Voucher in conjunction with the Travel Voucher Summary. The summary must be approved by the Office Manager before forwarding to the Sales Manager.

Travel advances may be obtained from the local petty cash funds. These advances should be kept at minimum amounts wherever possible. Travel and telephone expenses should be paid for by credit cards.

CREDIT CARDS - Credit cards are obtained by submission of a request to the Sales Manager via the Regional Manager. The Company will issue credit cards for air travel, telephone and automobile rental.

PERSONNEL - There will be on "hiring" or "firing" without the approval of the Sales Manager via the Regional Manager. All applications for employment should be properly documented. DEC will not recognize any commitments made without the proper approval.

Contract help may be obtained by the Office Manager up to two weeks; any extension of this time must have the approval of the Sales Manager.

PROCEDURE FOR PAYMENT OF INVOICES - It is the general practice, wherever possible, to charge expenses. Vendors should send their invoices to the local office where they should be approved by the Office Manager and forwarded to the Sales Manager for payment.

PETTY CASH - It is the general practice to keep petty cash at a minimum with fast replenishment. Its use is for payment of those items that are not chargeable such as postage, coffee, and travel advances. Every withdrawal from this account must be accompanied with an Office Manager approved petty cash slip with all supporting evidence attached to the petty cash slip. Replenishment is achieved by submission of the petty cash summary sheet to the source who supplies the district office with petty cash.

BANK ACCOUNTS - Certain larger offices, generally the regional office, will have a bank account in the company's name. This account will be authorized for a certain amount and the only depositer would be DEC, Maynard. Replenishment by Maynard will be made weekly based on a summary sheet of expenses.

Is this immediate enough?

WHF:KGE

dec INTEROFFICE MEMORANDUM

DATE November 29, 1965

SUBJECT My Future at DEC

TO Ken Olsen

FROM Patrick Greene

The purpose of this memorandum is to describe to you some of the past, present and future problems here at DEC and my goals as a member of the staff in solving these problems. There are three major areas described below and some general comments in the summary. This is in response to your request for me to describe what I would like to accomplish at DEC.

I Memory Test Business

Our major competitor at the moment is Computer Test Corporation of Cherry Hill, N. J., who at the present time is capturing approximately 60% of the market with a staff of over 120 people. The only reason I mention this is to emphasize another reason as to why we need the Computerized Memory Tester. Special Engineering on a per-machine basis is making our life very unpleasant, but the competition is forcing us to do it.

I intend to reduce the Product Line to the following:

1) PDP-8 Memory Tester

2) 2119 Core Tester

3) 2120 Pulse Generator

4) 1527 Production Plane Tester

Item No. 1 is approximately 50% done and has a deadline for the magnetics show in April. In the meantime, we will just have to get along with what we have. All other items are about 95% complete. Of course, the related components such as current drivers, sense amplifiers, etc. will need continuous development to meet the increasing analog demands.

The business will continue to expand and prosper in the next 3 or 4 years, but it is hard to say what the requirements will be at that time; another reason why we have to learn how to make a computer work for us as a test instrument. It will give us a basis for future expansion in general testing applications.

Module testing is only one example of this. With a system such as this, we should be able to expand the Memory Test business to 2 million dollars in the next fiscal year.

Fairchild is now in the core business and I suspect they will be building and marketing their own test equipment after initial purchases of existing equipment. E. H. is making strong overtones of providing equipment also.

A list of the vendors of Memory Test equipment in the order the strongest competition is as follows:

1) CTC serious competitors

2) Fairchild " "

3) E. H. " "

4) Honeywell

5) CCC

6) ADAR

7) R.F.S.

8) Data Pulse Inc.

NOTE: None of the serious competitors are computer companies.

My major responsibility at the moment is to get a strong technical man displaying leadership ability to take over and operate the Memory Test Business with a minimum of guidance. This would release me to plan the new areas of business and products that must materialize in the proper growth that is necessary in the success of our company. I am actively looking for this man at the present time. Perhaps he could best be described as a "Small Company President".

II Memory Systems for Computers

It makes a lot of sense to me to have one control point for all "magnetics" here at DEC. I have already won the support of some of the Product Line Managers in my proposal to manage the memory system design with a first line supervisor reporting directly to me.

I am deeply concerned with the future of our memory systems for our PDP line and I shudder when I think of it going on unmanaged. The success or failure of all our computers depends to a large extent (technically), on competitive designs here. Technical specifications of the memory are the key selling point in any computer. I hope you agree with the importance of this group and with my opinion that we should not "skimp" when looking for a group supervisor. I have interviewed several people and have other contacts to call for this position.

I realize that each product line is responsible for it's own components, but there is too much common ground here and duplication of efforts would be redundant and costly. Maybe all our future computers should use a standard "state of the art" memory that could be of variable word length by modular construction? There are many questions that need to be answered in the general memory area. I would like the opportunity to pull this effort together for the best interest of all product lines.

III Core Stringing

If and when we decide to produce our own memory stacks, they ought to be managed by the test and systems people. An intimate marriage exists between testing stacks and designing systems that would lend itself to the fabrication of the memories. I have seen some of the economical studies that were made in this area and although they look good, I would want to examine the whole picture in detail and come up with a firm proposal before embarking on a venture such as this. Perhaps my experience in memory testing is flashing a warning signal to be cautious. There are many problems involved in this phase of the business. I do not mean to reflect pessimism on the project but only caution. In fact, I am enthusiastic about it.

IV Summary

As you can see Ken, the above presentation puts the major portion of the magnetics responsibility into one "ball of wax" to be controlled by what I eventually think will be a Product Line Managers job.

The transition need not be abrupt but it should be done by April or May of next year, the approximate time at which we should have the Memory Test Business well under control. Meanwhile, we should be hiring the kind of people we need to realize the plan.

A capsule summary of my goals at DEC for the next few years is as follows:

1) Finish memory test problems and hire first line supervisor for group. (This includes natural growth into other test areas).

2) Organize Memory Systems Group and hire first line supervisor.

3) Study and decide on the "Core Stringing" Project and make plans to carry out if affirmative.

My last and final plan is to study the common problems of all product lines. This of course, is very long range and hence must be quite general in it's presentation.

There are many pieces of equipment manufactured by DEC that are made specifically for a product line. I think it would be advantageous to examine each from an overall product line view and make everything as standard as possible to reduce production costs. We do not use the expression "cost reduction" enough at DEC. We should be answering questions like, "Should we limit our designers to a standard high volume series of modules to reduce production costs?" "Should we separate development and production groups for more efficient operation?" Many similar questions could be asked but whose responsibility is it to evaluate them? Many loose ends like this need to be tied down.

I appreciate very much the opportunity that was given to me in the past to gain experience in the management of a small part of our company. It is my responsibility to learn more about the company's problems and that is why I am especially grateful for being made a member of the Works Committee. In the future I will take time to get as much formal training as I can in managerial techniques to prepare me more adequately in carrying out the plans I have outlined.

Sincerely

Pat

PJG/ds

*équipement* digital

65, RUE DU FAUBOURG SAINT-HONORÉ
PARIS 8e - *Tél. 256 13 28 - 256 11 37*
*TÉLEX : 26.705 DIGITAL PARIS*

Paris the 29th November 1965

Mister Ken OLSEN
DIGITAL EQUIPMENT CORPORATION
146, Main street
MAYNARD
Massachussets

Dear Ken,

Arnaud de VITRY informed me about the possible relation you may start with C.S.F. through M. HAASE, DUBOSC, Presidant of American Radio.

If DEC purchases components from C.S.F. we should take full advantage of possible, trade relationship and therefore I would like to be advised of any deal you may find with C.S.F.

If you want Equipement Digital to do some local investigations for you we would be delighted to do so.

Sincerely yours,

Bernard HAUS

K. Olsen

Save

# COMPARISON OF SOFTWARE REQUIREMENTS

# BETWEEN CURRENT

# DEC HARDWARE AND POSSIBLE COMPATIBLE COMPUTER LINE

From: L. Portner
H. Burkhardt

| | Assembler/ Loader | Fortran Compiler | Monitor | Debugging System | Editor | I/o Pkge. | lity |
|---|---|---|---|---|---|---|---|
| PDP-8 4K | 1 | 1 | | 1 | 1 | | 1 |
| PDP-7X 4K | 1 | | | 1 | 1 | 1 | 1 |
| PDP-7X 8K - Hi-Speed I/O | | 1 | 1 | | 1 | 1 | |
| PDP-6A 8K Paper Tape or Cards | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| PDP-6A 16K TIME SHARING | | | 1 | | 1 | Included in T.S. Monitor | |
| OTALS PARATE SOFTWARE ITEMS) | 3 | 3 | 3 | 3 | 5 | 3 | 3 |

| COMPATABLE COMPUTER FAMILY | Assembler/ Loader | Fortran Compiler | Monitor | Debugging System | Editor | I/O Package | Utility |
|---|---|---|---|---|---|---|---|
| Small | 1 (BASIC ASSEM., ABSOLUTE LOADER) | — | — | 1 | 1 (PAPER TAPE) | — | 1 |
| Medium | BASIC ASSEMBLER PLUS FEATURES RELOCATABLE LOADER. | 1 | 1 | AS ABOVE + FEATURES | AS ABOVE + FEATURES (LIKE TECO) | 1 | — |
| Large TIME SHARING) | SAME AS MEDIUM SIZE, + FEATURES | SAME AS MEDIUM SIZE, + FEATURES + OPTIMIZATION | T.S. | AS ABOVE + FEATURES | 1 (DECTAPE) | INCLUDED IN T.S. | — |
| TOTALS | 1 BASIC, + FEATURES | 1 BASIC + FEATURES | 2 | 1 BASIC + FEATURES | 2 | 1 | 1 |

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K. OLSEN

Some thoughts on a new line of computers

L. SELIGMAN

The family concept of a computer line has been made very popular by the major manufacturers. Since each machine is upward program compatible with others in the series, it is possible to transfer machine language programs from one computer to a larger one when it comes time to upgrade system performance. This program compatibility does the computer manufacturer little good since his systems programming requirements are basically related to the breadth of the line he offers, rather than a function of the order codes of the machines. If a user is able to swap machines, he can take advantage of the compatibility. For the majority of our customers who buy, not rent, the process of upgrading performance remains difficult. A distinct advantage that the manufacturer of a line of computers does have is in the area of hardware-software packages. Examples are PDP-8 typesetting and the 680 communications system. The computer in the system can be choosen to suit the job but unfortunately, it can then only be expanded at large cost.

I suggest we shun the vertically organized family concept described above in favor of a horizontally organized family. This machine has the property that it can be expanded from a very basic machine which is hardly a computer to a system configuration far more complex than PDP-6.

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The idea behind this organization is not really new. We have, for years, been selling more memory, central processor options, extra i/o equipment, etc. for field expansion of machines. It is a stable and reliable business, enabling customers to spend their money on our equipment without entirely replacing the main frame.

Thus we should offer a very basic central processor with inexpensive memory ~~xnxk~~ (small) which can be expanded easily. The processor is so organized that it has few internal instructions and relies on the use of multiple accumulators and index registers for ~~xxxx~~ speed. By expanding memory size, making the accumulators hardware instead of core, and adding an optional arithmetic unit, the basic processor/memory grows from below PDP-8 in capability/speed through PDP-7 class to small PDP-6 size. The addition of extra processors and clever I/O results in the configuration larger than PDP-6. For the sake of a good sales pitch, we can define several specific machine configurations as "members of a family".

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Thus, model T might be the basic machine, model A would be model T with hardware active registers and more core, model LTD would be two model T's with fancy interrupt and lots of core and extra arithmetic/iterative instructions. A software package would be defined for each model level. Thus model T would come with a basic assembler and little more, model A would run a relocatable macro assembler, fortran, etc., and model LTD with all the bells and whistles . It is important that we define a minimum hardware configuration for each system program and stick to it!!!

In order to have the above argument realizeable today, I must define the basic processor and options alluded to above. Further, I must show that several processors may be interconnected in a meaningfull fashion.

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A list of advantages of this system not immediately clear follows:

1. We supposedly will be able to stamp out basic processors @ several thousand per year - this means that a good part of the large machine is separately produceable and testable.

2. A multiple processor system is inherently more reliable than a single large processor - we should be able to program the large machine such that it just runs slower when a basic processor goes down. Foxboro seems to be able to sell multiple 8 systems now.

3. The whole system is extremely modular, both from the purchasing viewpoint and from production's standpoint.

4. If we are reasonably clever, it should be possible to work our way up from the basic processor tothe larger machine both in hardware and software development. Thus, assuming no gross errors, we can have the small machine on the market quickly with options to follow.

The whole project is large - but is perhaps one step ahead of current computer organization and gives us a product that we can market for a number of years.

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BASIC PROCESSOR

The basic processor contains 2 registers, called B (data) and MA (memory address) and an adder. The sense amps of the memory put out wide pulses, wide enough that their output can be used to load the MA with an operand address. All active registers are contained in core corresponding to

locations
0 PC
1 AC
2 MQ
3 I/O bus
4 operand, $X_1$
5
6
7 operand, $X_2$

The instruction format is as follows

OPcode - 2 bits : load, store, augmented, optional
R - 3 bits : specifies the register to be loaded, stored
X - 3 bits : specifies the register used as index
M - 2 bits : specifies the addressing mode
A - 6 bits : specifies the "relative address"

Note: augmented instructions use the R bitd to further specify the operation code.

theiTx is a full addressing mode which uses the 16 bit word following the instruction as the address

While the above description is far from complete, I claim that it is possible to (easily) include all PDP-8 instructions, the rest of the details will be chosen to make multiprocessor systems more efficient

Since the entire processor state is stored in memory, one can easily multiprogram by periodically changing a relocation register and, perhaps, a protection register. Similarly, for interrupts only the relocation register need be changed.

To facilitate program efficiency I propose option 1

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OPTION 1

Hardware locations 0-7, FF memory, these wouldonly work for the main program, interrupt programs would still use only core locations.

OPTION 2

Associative memery, 16 registers, with wide memory interface. These registers hold the most often used 16 memory locations, hence, usually the 8 above active registers, and an interface to permit a 32 bit wide memory to be used with data and instruction lookahead facilities. On interrupt the registersxxxxxxxx used inthe main program would be stored as they became inactive and new ones automatically picked up .

OPTION 3

Arithmetic/iterative processor implements the optional class instruction of the basic processor as the xxxxxxx current EAE does but has the fur further property that it has its own registers and hence can be time shared between many basic processors.

OPTION 4

I/O multiplexor- allocates and assigns I/O devices to multiple processors - insures that 2 processors do not give conflicting instructions to a common device.

OPTION 5

Priority interrupt system - switches basic processor(s) between jobs on a priority basis in response to I/o device service requests. Similar to API today except less channels and contains one relocation register per channel.

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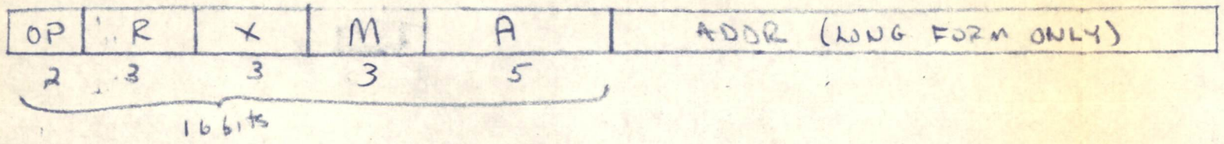
THE PRODUCTION VIEWPOINT

I cannot stress sufficiently the need to make the computers manufactureable. Central processor checkout seems exponential in the complexity of the machine; system checkout on PDP-7 seems to take forever usually because of hard to detect CP problems. If we simplify the central processor to the point that makes the PDP-8 look complex, we should be able to literally stamp the things out as we do modules. The same can be made true for memories - we define a memory size and make all machine memories out of it. Economies of scale hopefully override the higher electronics cost. Large systems are then just assemblies of small systems, which hopefully simplifies the checkout and delivery problems. The number of module types required is greatly reduced and the volume used per type goes up tremendously.

WORD FORMAT

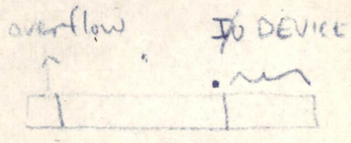



OP= OPCODES – 2bits

0 LOAD
1 STORE
2 OPTIONAL
3 Augmented (uses R)
- 0 } incrementby 1 and skip on pos
- 1 } " " 2 "
- 2 } " " 4 "
- 3 skip on minus
- 4 cmpl
- 5 mask
- 6 SHR
- 7 SHL

R, X = index (relative) / accumulator selection

0 PC
1 AC
2 MQ
3 PROCESSOR STATUS WORD
4 I/O BUS
5 $X_1$
6 $X_2$
7 $X_3$




M = ADDRESS MODE [$M_1$ | $M_2$ | $M_3$]

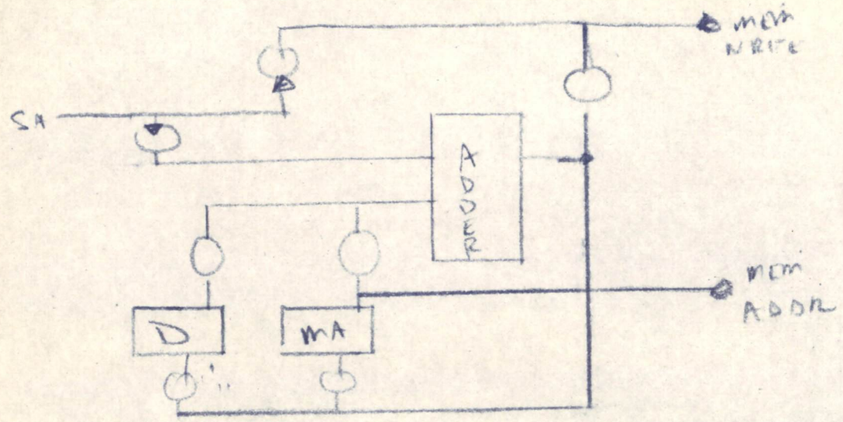
$M_1$ = immediate / indirect (depends on $M_3$)

$M_2$ = use ADDR not A (two word format)

$M_3$ = ignore PC as index

| | | |
|---|---|---|
| 000 | addr | C(X) + A |
| 001 | | " except c(0) = 0 |
| 010 | | C(X) + ADDR |
| 011 | | " except c(0) = 0 |
| 100 | ~~data~~ = | C(X) + C(A) |
| 101 | addr = | C(X) + C(A) ; c(0) = 0 |
| 110 | data = | C(X) + C(ADDR) |
| 111 | addr = | C(X) + C(ADDR) c(0) = 0 |

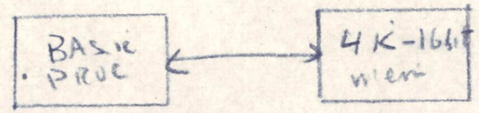
BASIC PROCESSOR



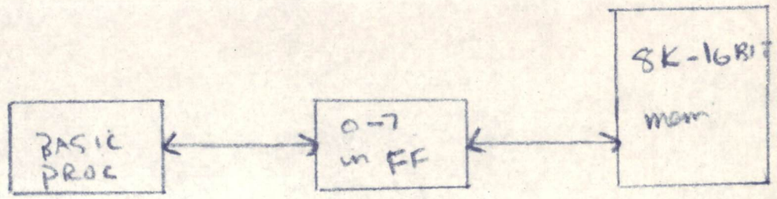

IR

all registers + adder
16 bit
all registers RS not SK

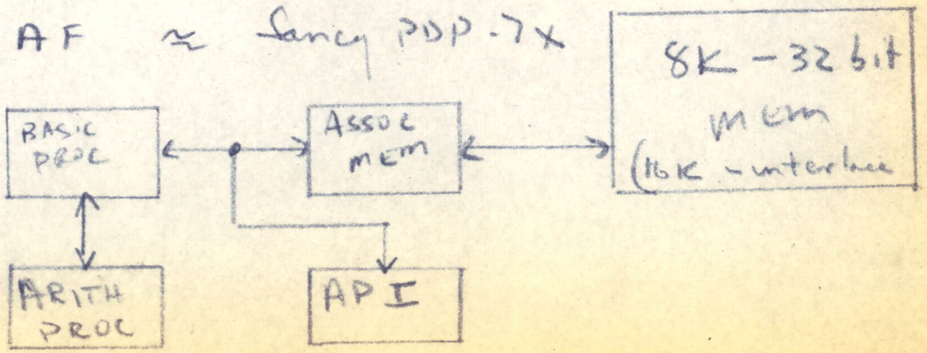
model T ≈ PDP-8 class
but cheaper

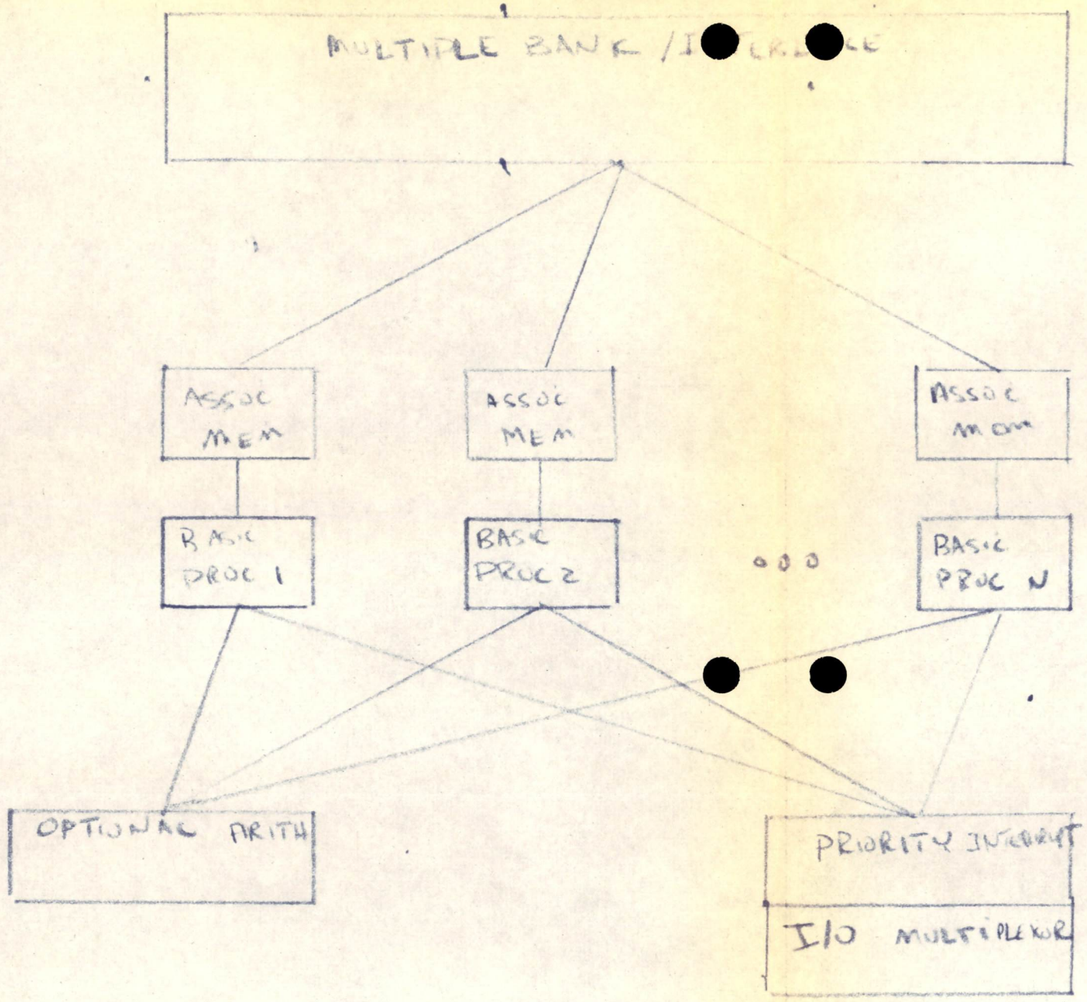



model A ≈ PDP-7 x class




model AF ≈ fancy PDP-7x






LTD - Bells & Whistles

# INTEROFFICE MEMORANDUM

DATE November 30, 1965

SUBJECT Memory Disc

TO K H Olsen

FROM D Wardimon

Referring to your request, I have investigated the aspects of a memory disc (drum) as mentioned in your memo.

A disc exactly as you described is available as a ready product from General Precision and has existed on the market for several years and was used as the memory for their LGP 21 computer (other users names are recorded in my files).

Since we also have this disc price it is worthwhile to make some estimate to see if we could beat their tag should we contemplate making this disc ourselves.

General Precision disc features:

The disc carries the L-300 designation. A 10 inch disc, 45 fixed heads (5 groups of 9) with a total capacity of about 0.27 million bits, which is twice as much as you have specified, so this leaves us with optional capacity expansion. Should we require only 130k bits, half the heads could be knocked out with a "saving" of about $20 per head. There are also four read/write heads for the purpose of circulating registers (one more could be accommodated). Further bit expansion could be accommodated by adding additional discs to the same shaft. Speed could be any of the RPM standards: 1200, 1800, or 3600. Again this is also meeting your request.

Price

| | | |
|---|---|---|
| Quantity | 1-10 | about $2500 |
| Quantity | 10-50 | about $2000 |
| Quantity | Above 50 | about $1800 |

Following is price breakdown should we try to assemble it in plant:

| | | | |
|---|---|---|---|
| Heads and mountings (45 heads) | $1100 | 25 heads | $600 |
| Disc | 100 | | 100 |
| Jig bore plates | 300 | | 300 |
| Motor | 100 | | 100 |
| Assembly and testing | 100 | | 100 |
| Development charge* (assumed 100 discs) | 1000 | | 1000 |
| Total | $2700 | | $2200 |

*Note: Developing costs are estimated at $100,000 minimum and are written off for the first 100 discs.

Summary:

The General Precision L-300 disc is a time proven device and readily available. In contemplating manufacturing it ourselves we should bear in mind the above facts plus the fact that GP has integrated facilities in house to produce heads discs plates etc, we don't. The rather simple price analysis shows that their price is hard to beat. It is quite clear that GP can offer their discs at the rather moderate prices because they produce most of the items themselves and developing charges probably have been written off years ago. While these very charges will reflect heavily through the price of the first 100 discs that we will build.

Therefore unless we intend to make a big quantity of this kind of disc and unless we have it at least a year to develop the item, I suggest we buy a ready made L-300.

DW:ASJ
Encl

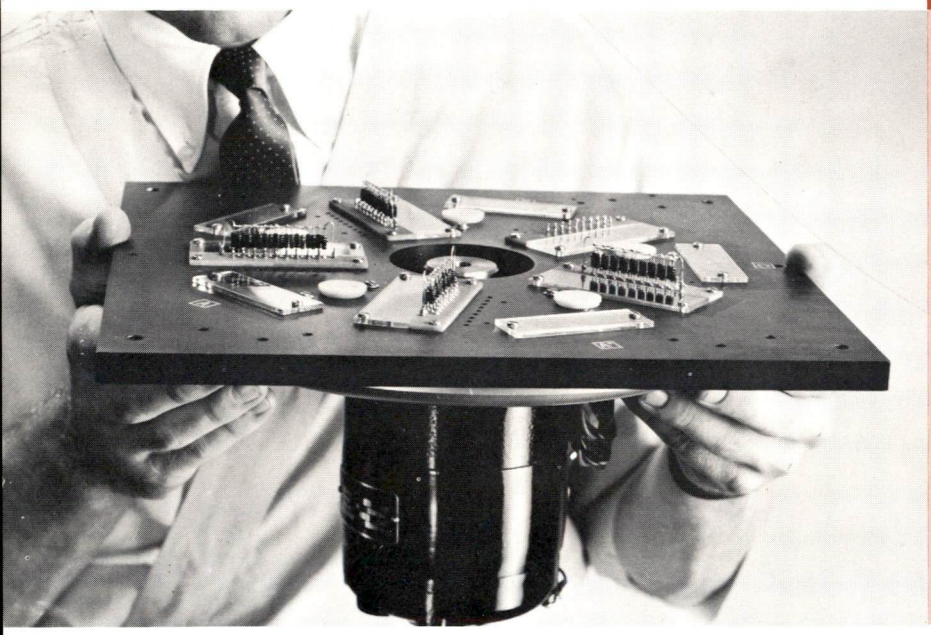
Encl. 1

$15

10 = 50

$2000

LIBRASCOPE engineering data



SERIES L-300

# random-access disc memory

**DESCRIPTION**—Librascope random-access disc memories can be used to provide data storage and transfer in a wide variety of computer systems and peripheral equipment or wherever rapid-access memory is a system requirement. They feature a flying head per track and a nonwearing, plated cobalt recording surface, providing superlative magnetic performance under all conditions of operation. The Series L-300 magnetic storage discs have a maximum capacity of 275,000 bits and are available with an average access time of either 17 or 25 milliseconds. could be done on 2 sides

**SPECIAL FEATURES**—The superior but simplified disc and head design results in more efficient packaging than has previously been available and in a lower-cost product.

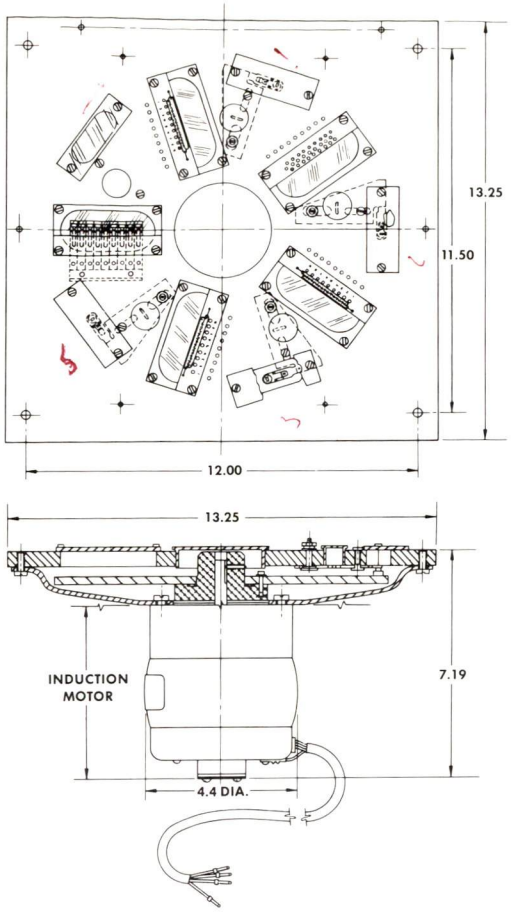
The recording disc surface, plated with a cobalt coating, is smooth and long-wearing, unaffected by multiple start-and-stop operations. The flying head is in contact with the metallic recording surface when the disc is not rotating. The inherent hardness of the cobalt plating provides high resistance to abrasive wear and relative insensitivity to accidental damage.

All materials, fits, and design proportions of the basic structure are selected to compensate for the temperature differentials the disc assemblies may encounter in storage and in operation. For strength, rigidity, and lightness of weight, all discs and supporting structures are made of aluminum.

**APPLICATIONS**—Random-access disc memories are used in computer systems and peripheral equipment as the main storage or buffer storage or they supplement other memory. In a typical computer system, the magnetic disc memory provides an inexpensive, rapid-access, reliable storage with sufficient capacity for many programs. In peripheral equipment such as visual computer displays, they make possible a constant (no-flicker) variable-size display.

SERIES L-300

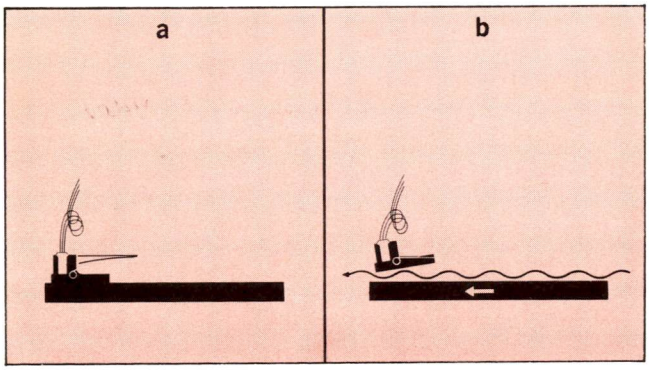
# random-access disc memory




MEMORY UNIT ASSEMBLY

## GENERAL CHARACTERISTICS

| | |
|---|---|
| Power requirements | 115-volt, 60-cycle, single-phase AC |
| Disc diameter | 10 in. |
| Weight | 25 lb. |
| Axis of rotation | Vert., horiz., or any combination |
| Recording diameters | 4.7 in. to 9.2 in. |
| Number of tracks | 45 (5 groups of 9) |
| Number of registers | 4 |
| Register length | 0.25 or 0.5 in. |
| Register adjustment | ±0.018 in. |
| Bits per track (max.) | 6144 pm recording |
| Track width | 0.034 in. |
| Tracks per inch | 20 |
| Capacity (total) | 276,480 bits |
| Packing density (max.) | 400 bits/in. at 4.7 in. dia. |
| Rotational speed | 1200 or 1800 rpm |
| Frequency (repetition rate) | 184kc (max.) |
| Recording surface | Proprietary plated cobalt |
| Head spacing | Flying head |
| Head inductance (typical) | 1 mh/half coil |
| Write current (typical) | 28 ma |
| Readback voltage (typical) | |
| 1200 rpm | 180 mv (min.), inner track<br>340 mv (max.), outer track |
| Bearing life (average) | 10 years |




## OPERATION

When a disc is not rotating (a), the heads are held in contact with the metallic recording surface by a reed of bifurcated leaf springs whose tension, for each individual head, can be adjusted by clamping/adjusting screws. In the contact position, the low-friction surface prevents the heads from damaging the disc tracks.

When the disc rotates (b), the heads "fly" over the track, riding on an air cushion approximately 0.0001-inch thick. The design of the heads and their adjustable mountings is such that the head-to-disc gap remains constant during operation; the flying action of the heads automatically compensates for inherent variations in the run-out of the disc and for any unbalanced temperature differentials between the head mounting plate and recording surface of the disc.

Track access is controlled by addressing from electronic switching circuits, control logic circuits, and buffers that are wired to the heads.


COMMERCIAL COMPUTER DIVISION

GENERAL PRECISION INC.

LIBRASCOPE GROUP

**COMPONENTS SALES** / 610 RODIER DRIVE
**GLENDALE, CALIFORNIA** 91201 • 245-8711

# INTEROFFICE MEMORANDUM

DATE November 29, 1965

SUBJECT Technical Publications Expense Summary

TO Jack Atwood FROM Harry S. Mann

Attached is an expense summary for the October Accounting Period and for the fiscal year 1965 through October 30.

There are four sets of figures reported as follows:

1. For the four weeks ended October 30 we have shown the distribution of the actual expenses incurred in this activity and how these expenses were distributed by product line. Except for the Overhead Center Variances the expenses include not only those current charges in your cost center but also the expenses incurred for these activities by other cost centers and charged to these activities via project numbers. In the case of the overhead center variance, which was a very nominal amount, the figures report the variance between charge-out rates and actual cost for your cost center numbers 49, 50, 51, and 52.

2. The second section reports the current budget for the items outlined in section 1. The figures represent 4/13 of the revised budget prepared on October 5.

3. This section covers the 4 month period with the figures prepared in the same manner as discussed under section 1.

4. The fourth section shows the anticipated expenses in these categories on the basis of the original budget prepared in June.

It can be seen from the figures that, in the month of October, our expenditures for Technical Pulbications were approximately $20,000 over the revised budget and for the year-to-date they were $39,000 above the original budget. All categories are over-expended as compared to the budget for the month of October except preparation of manuals. For year-to-date figures, the greatest variation occurs in Promotion Literature. Overhead Center Variances are small in comparison to the total expenditures.

Harry S. Mann

Harry S. Mann

HSM/clw
CC: K. Olsen
W. Hindle
S. Olsen
N. Mazzarese
P. Greene

# Technical Publications
## Expense Summary

| Item | Total | Modules | Total | Small Computers PDP 5+8 | PDP 4+7 | PDP 1 | Large Computers | Total | Special Digital Test | Products - Line | Computer Audio Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 4 Weeks Ended 10/30/65 | | | | | | | |
| Advertising | 10932 - | 3929 - | 3228 - | 2364 - | 864 - | — | 3246 - | 529 - | 483 - | 31 - | 15 - |
| Trade Shows | 8159 - | 2810 - | 3137 - | 2721 - | 418 - | — | 1701 - | 508 - | 103 - | 405 - | . - |
| Promotion Literature | 44999 - | 15508 - | 12374 - | 6349 - | 6025 - | — | 15102 - | 2016 - | 924 - | 130 - | 962 - |
| Manuals | 9451 - | 345 - | 7340 - | 2791 - | 4549 - | - | 1623 - | 143 - | 141 - | 2 - | — |
| Cost Center Variance | 443 - | 148 - | 169 - | 97 - | 70 - | 133 | 109 - | 17 - | 7 - | 7 - | 3 - |
| Total | 73984 - | 22740 - | 26250 - | 14325 - | 11726 - | 133 | 21781 - | 3213 - | 1658 - | 575 - | 980 - |
| | | | | Current Budget | | | | | | | |
| Advertising | 18155 - | 4615 - | 2155 - | 1540 - | 615 - | — | 1075 - | 310 - | — | 310 - | — |
| Trade Shows | 10315 - | 3075 - | 3080 - | 1540 - | 1540 - | — | 2310 - | 1850 - | 925 - | 615 - | 310 - |
| Promotion Literature | 21545 - | 4615 - | 7690 - | 4000 - | 3690 - | — | 4615 - | 4625 - | 1540 - | 2155 - | 930 - |
| Manuals | 13855 - | — | 6155 - | 1540 - | 4615 - | - | 4615 - | 3085 - | — | 2155 - | 930 - |
| Total | 53870 - | 12305 - | 19080 - | 8620 - | 10460 - | — | 12615 - | 9870 - | 2465 - | 5235 - | 2170 - |
| | | | | Year - To Date | | | | | | | |
| Advertising | 39395 - | 11780 - | 11257 - | 8423 - | 2834 - | — | 15082 - | 1335 - | 1121 - | 99 - | 15 - |
| Trade Shows | 18566 - | 5731 - | 8543 - | 7620 - | 923 - | — | 3014 - | 1277 - | 688 - | 584 - | — |
| Promotion Literature | 159292 - | 38853 - | 70178 - | 53860 - | 16295 - | 23 - | 44914 - | 5948 - | 2246 - | 264 - | 962 - |
| Manuals | 37635 - | 1856 - | 24187 - | 9439 - | 14748 - | — | 11055 - | 537 - | 531 - | 2 - | 14 - |
| Cost Center Variance | 13144 - | 3519 - | 6524 - | 4167 - | 2335 - | 122 - | 2472 - | 431 - | 110 - | 318 - | 3 - |
| Total | 269373 - | 61739 - | 120687 - | 83509 - | 37035 - | 145 - | 77537 - | 9428 - | 4788 - | 1146 - | 994 - |
| | | | | Original Budget | | | | Year To Date | | | |
| Advertising | 47520 - | 19950 - | 9310 - | 6650 - | 2660 - | — | 16730 - | 1330 - | — | 1330 - | — |
| Trade Shows | 28530 - | 8300 - | 13300 - | 6650 - | 6650 - | — | 4950 - | 1980 - | 990 - | 660 - | 330 - |
| Promotion Literature | 78460 - | 34950 - | 23630 - | 16780 - | 6850 - | — | 25270 - | 14610 - | 7980 - | 5310 - | 1320 - |
| Manuals | 55830 - | — | 26600 - | 6650 - | 19950 - | — | 25270 - | 3960 - | — | 2310 - | 1650 - |
| Total | 230340 - | 63200 - | 72540 - | 36230 - | 34310 - | — | 72420 - | 21880 - | 8970 - | 9610 - | 3300 - |

# digital MEMO

DATE 11/24/65

TO K. H. Olsen FROM Bob Lassen

Attached is a copy of a monthly blurb that we send out to all direct line supervisors.

This one is particularly good and reflects the type of thinking we should instill in all of our managers and supervisors.

RTL/jfr
Enclosure

New Management Training Aids

# THE FRONT LINE MANAGER

NEW MANAGEMENT TRAINING AIDS FOR SUPERVISION

AMERICAN ASSOCIATION OF INDUSTRIAL MANAGEMENT

THE BENSON MANOR • TOWNSHIP LINE & WASHINGTON LANE • JENKINTOWN, PA 19046

No. 49

November, 1965

## HOW TO UPGRADE EMPLOYEE PERFORMANCE THROUGH MORE EFFECTIVE SUPERVISION



Suppose you were a professional football coach faced with a heavy schedule. The opposition is hard and tough and loaded for bear. You know the one thing that keeps the fans happy, and your paycheck regular, is to win your share of games. In such a situation you wouldn't tell your players, "Let's take it easy. No use getting excited. The season doesn't open for a few weeks, so why worry?" No, you would lay it on the line with, "Get down to business. The games coming up are not going to be easy. We have to go all out if we're to beat the competition and keep earning our salaries."

Professional athletes know the minute they get so they can't win for losing, they stop being professionals - paid professionals, that is. There's no player's union to keep a below-par ball player on the job simply because he has seniority. No coach is so kindhearted that he allows a "take-it-easy" halfback to fill out his backfield just because the halfback needs the money. In professional athletics competition is raw, face-to-face, and it's the results that count. There is no room for a featherbed. Everybody knows that the names and numbers of each and every player won't stay the same if the box score gets too heavy on the minus side.

### What Top Executives Say about the Future

The same hard facts are true in industry. If a company can't stand up to competition, sooner or later it goes out of business. What's more, the competitive ability of a company depends on the know-how, energy and will-to-win of every employee on the payroll. If wages outrun productivity, or if a company is forced to pay more for jobs than they are worth, employees

quickly find that they (or their union) have priced their jobs out of the market. To see the future, look at what is happening in many basic industries. Unskilled and semi-skilled jobs, and the people who fill them, are being mechanized out because management can't pay the cost and stay economically healthy. Furthermore, this fast competitive pace won't slacken.

Here is what industry's coaches, the top executives of America's leading companies, have to say about present trends.

"You are going to be competing literally with yourself to hit par on each hole in your company," Paul B. Wishart of the Minneapolis-Honeywell Regulator Company told his managers. "Failure to adapt to this type of realistic philosophy will result in your losing your position through subjecting yourself to repeated blows on your soft spots."

"I sometimes visualize business in terms of a track meet," observed Ralph Lazarus, President of Federal Stores. "Some of us have been running in the Big Ten, some in the Ivy League or in the Pacific Coast Conference. A few of us are big enough to run in the Nationals. But tomorrow we're going to compete in the Olympics. Only the Olympics for industry won't be staged every four years. It will be held daily in the market place. To win we will need to do everything better than we do now."

Finally, Henry Ford II of the Ford Motor Car Company has remarked, "I believe we are in a permanent buyers' market. Competitors will get steadily tougher. We will face more competition within domestic industries and more competition among industries."

## The Supervisor: Key Man

Competition puts all members of management on the spot, for no group is any better than its leaders. But the supervisor is the key man. He has to take the story of competition to the rank and file employee, and to do so in a way that makes the competitive challenge a personal one to every member of his work group. To do this he must have a keen understanding of his full management assignment.

Among the most important of his responsibilities is to get the best from each employee by convincing him that he helps himself when he gets the most out of his own skills. Brains, know-how and motivation are the prime ingredients of competitiveness. High motivation is usually found when know-how is solidly based on know-why. The approach of "togetherness" or "we're all one big happy family" won't do the trick. The famous infield which featured the "Tinker-to-Evers-to-Chance" double-play combination made

baseball history. Off the field Tinker, Evers and Chance seldom spoke. They disliked each other intensely, but understood that they had to work together to win ball games.

The fact that the competitive attitude is founded on personal pride and team pride has been documented time and time again. Not long ago the Norden-Ketay Company of Stamford, Connecticut, made a series of motivational studies covering 3,000 skilled workers involved in the production of high-precision electrochemical instruments. Here are some of the key findings.

1. There is a close relationship between production and the practice of good human relations by supervision.

2. There is a close relationship between productivity and group loyalty. Group loyalty and pride depend on a supervisor's attitude and his ability to stimulate a strong feeling of team spirit, initiative, enthusiasm and individual responsibility.

3. "Making people happy" has little to do with getting the job done. There is little relationship between participation in the company's recreational program and increased productivity.

4. Close supervision is usually associated with low productivity and general supervision with high productivity. In referring to "general supervision," Leslie M. Slote, who conducted the study, makes it clear that he does not mean loose or careless foremanship, but the kind of direction that encourages well trained employees to use initiative.

## A Matter of Motivation

The upgrading of employee job performance is essentially a matter of training plus motivation. The supervisor must first present the challenge to the worker, and then sell him on the idea that it is in his personal self-interest to help reach a team goal. To bring his work group up to a sharp competitive edge the experienced supervisor never falls into the trap of soft-thinking. The competitive employee does not wish to be mollycoddled. This kind of worker is thoroughly trained to do his job and is proud that he does it well. He expects his boss to set high standards, and he accepts his responsibility for living up to them. He cooperates with fellow workers because he realizes that getting the job done right takes team effort, that if the team fails to click the ball goes to the competitor.

Thomas A. Edison once said the reason a lot of people do not recognize opportunity is that it usually goes around wearing overalls and looking like

hard work. The years ahead will be years of hard competition. If you can meet the competition, they will also be years of opportunity. Nobody ever won anything worth winning with an "easy-come, easy-go" attitude. Sound training and competitive motivation are your tools of leadership. The training job you know how to do. Here are some suggestions on how to build competitive employee attitudes.

## A Supervisor's Guide to Upgrading Employee Performance

1. Encourage the will to win. Communications is the key to competitiveness. You encourage the competitive instinct by laying the facts on the line, so never break the news easy and make a hard job sound soft. Tell employees what the job is, what the problems are, why it's important to them and to the company to come through with a quality effort. Keep everybody informed on progress. A worker gets the incentive to be a winner by knowing how he is stacking up against competitors.

2. Offer opportunity. A supervisor can't have the attitude that opportunity knocks but once. Always prop open the door to opportunity by encouraging the employees who show ability and the desire to get ahead.

3. Give responsibility. It is one thing a supervisor can give away and still keep. Giving responsibility to workers develops their self-reliance. Responsible employees make your job easier. They take pride in doing a good job, and this is reflected in the spirit of cooperation of your work group.

4. Appraise honestly. Your people know when they are doing a good job, when they are not. If you let them get away with slip-shod work practices you lose their respect - and worse, they lose their self-respect. When team pride and individual pride are gone, so is the ball game. If employees have weaknesses or shortcomings discuss them frankly - but with an eye to improvement. Be just as quick to recognize and credit their abilities.

5. Train thoroughly. Positive discipline is the foundation on which to build competitive success. The well trained employee is sure of himself, sure of his supervisor, sure of the ability of his group to take on a tough assignment and push it through to a successful finish.

dec INTEROFFICE MEMORANDUM

CONFIDENTIAL

DATE November 23, 1965

SUBJECT

TO Ken Olsen
Bob Lassen

FROM Ted Johnson

Some time ago, I suggested a possible candidate for a mag tape engineer. His name is Jim Crosby. He works at CEC (Consolidated Electrodynamics). Caltech about 1953. Well thought of. He is supposed to be an excellent analog circuit man.

Other possibilities would be Ampex (Telemeter Magnetics) engineers.

Crosby can be reached through Al Peachey Associates. Also, I know him personally, but not very well.

What with current DECtape problems (PDP-6) and the history of responsibility-transfer on it and other tape and tape control problems we have, it seems to me that we might assure better performance by fixing tape responsibility on someone who can handle pulling this together and stick with it, not to mention future tape transport design.

TJ/mr

11/23/65

# PRODUCTION D

It is proposed that Production D be set up in building 6B for the assembly of Logic Laboratories and power supplies.

As it stands, the present building needs little work. We propose that it not be painted. Lights and power are already in and need only to be modified. Compressed air must be supplied, but the main feed line is already present. Any night operations will require no additional heating expense as long as Production B is running a night shift. Heating is on the same lines. All benches will be moveable to allow for floor plan adjustment and, or expansion.

A screened Raw Stock room will be set up in Building 8, with easy access, alleviating travel time to building 5 for material.

Space has been provided for temporary storage of completed stock. QC inspections will be done in this area and then finished items can be wheeled to the building 4 elevator.

## SCHEDULE TO BEGIN OPERATIONS

Within 3 weeks from approval, the area can be completely set up, including tools and stock to begin production. The logic lab assembly should begin within 2 weeks as operations are presently being done at night and tools for this operation are scattered throughout the building. The high speed line in Production B can be easily moved within 3 weeks as operations are presently being performed and are not dependent on the other facilities in Production B.

Within 5 weeks the power supply people from Production A should be completely integrated in Production D.

## PRODUCTION QUANTITIES

Within the next 5 months 3371 power supplies are forecasted for production. Of this 2769 have been somewhat "standardized" for high speed production. About ½ of those are normally slated to go to vendors for assembly. Production D could produce 400 of the standardized supplies per month on the high speed line using 2-3 people full time. This figure could be realized within 8 weeks. The specialized supplies present average rate of 100/mo would be increased because of more space, less rework from vendors, less "catch all" work, and more of production atmosphere. The present "special line" has about 5 men. Facilities exist for the expansion of both "high speed" and "special" lines so that vendor assembly can be eliminated.

The logic laboratory production rate will be 25 per month which will require 2-3 people full time.

BUDGET
COST OF SETUP OF BUILDING 6B

| | |
|---|---|
| Lighting | 1200 |
| Compressed Air (2 lines 4 taps each) | 300 |
| Lavatory fix-up & office construction | 300 |
| Benches (see plan) | 450 |
| Fire extinguishers | 50 |
| Remove cage show booth area | 300 |
| Stock Room construction | 200 |
| TOTAL | 2800 |

COST OF SUPPLIES FOR PRODUCTION D

| | | |
|---|---|---|
| 1 Variable speed drill press | | 140 |
| 1 Eyeletter | available | NC |
| 1 Amp of matic | " | NC |
| 2 Air Mites | | 140 |
| 4 Steel cabinets @$33 EA. | | 132 |
| 1 Na: wide drill | " | NC |
| 2 B & D Scruguns | " | NC |
| 15 4* x 4' steel shelves for stockroom | | 500 |
| 2 Push cart @ 27.50ea. | | 55 |
| TOTAL | | 967 |
| Grand total | | $ 3767 |

LABOR 1 MONTH

| | | | | | |
|---|---|---|---|---|---|
| 6 men avg. $85 = 510 | x 4 | 2040 | double for overhead | | 4080 |
| 5 women avg. $65 = 325 | x 4 | 1300 | " | " | 2600 |
| Labor & overhead/mo. | | | | | 6680 |

Out of $6680, new people comprise the following:

| | | | | |
|---|---|---|---|---|
| 1 man 85 = 85x4 = 340 | double for overhead | | | 680 |
| 4 women 65=260x4 = 1040 | " | " | " | 2080 |
| Net increase in labor & overhead/mo. | | | | 2760 |

Ken Olsen

dec INTEROFFICE MEMORANDUM

DATE November 23, 1965

SUBJECT

TO Jack Atwood

FROM Jim Hastings

Because of the apparent leaning toward the name Digital rather than DEC, I thought you might be interested in the attached copy of Cesari's letter regarding Digital Electronics. I have pushed for eventually calling the firm DEC, Inc., but have so far persuaded no one but myself that this is something to aim for.

BLAIR BUCKLES & CESARI
PATENT AND TRADE MARK COUNSEL
89 STATE STREET
BOSTON, MASSACHUSETTS 02109

(617) 742-3340
CABLE: "PATENTS"

COPY

November 22, 1965

Mr. Stanley Olsen
Digital Equipment Corporation
146 Main Street
Maynard, Massachusetts

Re: Digital Electronics
File 83T-02

Dear Stan:

This will acknowledge receipt of your memo from Don Henderson and the enclosed Digital Electronics flyer. The problem we have with Digital Electronics is that nothing can be done unless we can prove confusion in the marketplace, and by this I mean more than a negligible amount of confusion. You may recall that some time ago we got them to change their name from Digital Electronics Corporation to Digital Electronics Inc. so that they would stop using DEC. It is difficult, however, to go beyond that because of the descriptiveness of DEC's name.

More specifically, it is extremely difficult to obtain broad protection for a name which is largely descriptive of the goods with which it is used. This is the case with "Digital Equipment" and since Digital Electronics is similarly descriptive of their goods, there is little we can do about their name unless confusion actually results and, furthermore, the public has come to associate the otherwise descriptive terminology exclusively with DEC.

This means that you have an uphill battle in trying to convert a descriptive term to a term having a "secondary meaning" denoting your company. In my opinion, the best way in

 COPY

the long run is to shift gradually to a designation which is not so descriptive. It can be in the form of a group of letters such as DEC or a word which does not necessarily denote the type of goods which you market.

There is a greater likelihood that we can do something about the possible conflict between DEC and DE. However, again we shall need concrete evidence of confusion in the marketplace resulting from the use of these symbols. Therefore, I urge you to have your marketing group document all instances of confusion and forward the same to us.

Sincerely,

Robert A. Cesari

D/jpl

cc: Mr. James P. Hastings, Jr.

INTEROFFICE MEMORANDUM

DATE November 18, 1965

SUBJECT IMPROVING OUR IMAGE AS A PROSPECTIVE EMPLOYER

TO K. H. Olsen

FROM Bob Lassen

cc: H. Anderson
J. Atwood
J. Nangle
H. Mann

Per your request, I have outlined the types of activities which I feel would help to improve our image as a prospective employer. Please bear in mind that these thoughts are the result of personnel recruiting experience and are slanted in that direction.

1. Meetings with local merchants--plant tours and luncheon.

2. Informal discussions with local guidance counsellors. I have met in the past with small groups of these people to discuss their problems and to explain the areas of opportunity for graduates who may be employed at DEC.

3. Occasional plant tours and discussion meetings with local vocational school teachers. Limit to groups of 12. We are currently doing this.

4. Meetings with local town officials--plant tours and luncheons. Limit to small groups.

5. Periodic "open house" for students (local high school, vocational and technical schools). We are currently doing this.

6. Yearly visits to local schools by members of the Personnel Office. We are currently doing this.

7. Publicity (people)--Technical Publications is conducting an active publicity release program with respect to new hires, promotions, and training class graduates. I feel this will help greatly because the publicity is widespread, continuous and gets to the right sources.

8. Publicity (company)--Periodic articles in major newspapers or magazines with respect to the activities of the company.

9. Periodic speaking engagements by top company officials. This would require additional study.

10. Send "On Line" to local officials and officers of local business and civic groups.

11. Occasionally, we may find it necessary to conduct an "open house" for the general local public. This is a larger undertaking and should be reserved for a major recruiting effort. The open house we held several years ago was extremely effective.

12. Contribution of equipment to worthwhile schools. This must be backed up by technical instruction from the company.

RTL/jfr

K H Olsen

# INTEROFFICE MEMORANDUM

DATE November 17, 1965

SUBJECT

TO K H Olsen FROM D Wardimon

I have given some thought, at your request, about the two disc files arrangements mentioned in your memo.

I have some definite ideas about the display disc which are sketched in this memo. I reserve to myself additional time to investigate the problems of the other memory disc the results of which will appear in another memo.

## Disc System Organization

In organizing the display disc the major specified parameters which will be adhered to are bit rate at 7.5 mc and storage capacity of 250,000 bits. (That as you have mentioned will give the desired display quality and there is no necessity for compromise). Following are the other disc parameters which evolve from the above mentioned ones:

Bit rate of 7.5 mc from one head is impossible at the present state of art, (even half that much is very high). Therefore I suggest recording in parallel in four channels at the rate of $\frac{7.5}{4} = 1.88$ mc. (This is also a high frequency but we can just manage it.)

This gives us the advantage of using existing modules of our Red Line (2 mc). Reading will be in parallel to 4 bit register at the rate of 1.88 mc. This information will be jammed to another 4 bit register which will be sampled or shifted at the rate of 7.5 mc. This second register will consist of available modules from the 10 mc line (Blue Line).

## The Disc Itself

If we were to record 250,000 on 4 track only (that is 63,000 bits to a track) a very simple electronic scheme will result: No switching electronics from one head to another will be necessary and smaller number of heads will be required (only 4).

Every track will consist of 500 sectors of 500 bits each for the 500 lines on the screen. Although logic could be constructed to change the content of one bit, I think that for reasons of simplicity and economy we should change the whole line. No error check will be incorporated but as you have mentioned we can afford some rate of errors due to the nature of the application. Furthermore error checking means considerable additional electronics and in case an error will be detected, rereading of the sector at a revolution later will be necessary delaying the data rate and causing flicker.

If the information is to be repeated every 30th of a second that means a disc rotation rate of 1800 RPM (which is standard of course). Now all the above information coupled with reasonable bit density will dictate the disc diameter. If we will assume a range of 1500 to 1600 bits per inch a 12.5 to 13.5 inch diameter is necessary.

If we use the above disc for only 4 tracks it will be a gross waste of recording area. But on the other hand if we think on a use where many different picture displays are connected at the same time to a computer and are to be kept alive, the same disc could be easily adopted to such application by addition of quadruplet sets of heads on to the same surface since we can easily pack 50 channels to the inch. Naturally this expansion implies multiple reading electronics to allow multiple displays running at the same time.

## Implementation

Disc as outlined above is certainly not available on the market therefore we might as well try to do it ourselves. Fortunately we already have a 14 inch disc in the house (and are committed to a quantity of ten from the time we investigated a source for discs). As much as the dependency on one source is going I would say that there is another outfit that will plate the discs in Palo Alto and given time Vermont Research, Bryant and others would tackle similar jobs. I am definitely thinking of nickel cobalt surfaces since I do not know of any source which would supply us with oxide discs that will be capable of the outlined densities. (I am wondering as to the outcome of Steve Lambert"s experiments to apply special oxide coated tape material to a disc and by this solving the coating problem, since the smallest bump would interfere with the flying head operation. However if his tries are successful we might try it on our 14 inch disc and by this cut the dependency on extenal sources for the disc coating).

## Heads

The heads will be flying and could be secured from Ferroxcube (unfortunately most people who make discs and drums are making their own heads and independent sources for flying heads are quite limited).

## Electronics

This subject will be treated very briefly. A 7.5 mc clock will be incorporated in the logic with a set of ff's to divide this figure by 4 for the purpose of the recording process. When reading, the clock pulses should be used for the data transfer gating. However, and this is a very important point, this clock rate should be synchronized with the read out pulses. The pulses read out of the disc should lock in the clock at every fourth pulse of the master clock. Thus synchronization between the two clock rates will be achieved when the disc will slow down or speed up due to voltage or frequency fluctuation. Furthermore at higher densities a self clocking is mandatory. So far we have not done it at DEC and we should learn this technique. (This will help us also in future disc projects). The recording technique will be such that will enable self clocking like the double frequency or the phase modulation codes.

The whole project at least mechanically is less complicated than the one we have discussed

in the past since no head moving mechanization is needed and I am quite confident that we can undertake a job of this magnitude and finish it successfully. However as a condition a mechanical engineer will be needed who will devote unimpeded efforts of his time for solution of the problems as well as investment in mechanical measuring devices which are unique to this kind of a job and are not existing in the house at the moment. The mechanical disc arrangement should not cost us more than $500-$600.

DW:ASJ
CC
S Olsen

END
DIGITAL MAYN

Else file

DIGITAL EQPA
MSG. NO. SFO-2470 11-16-65 5.00 PM

MSG. NO. SFO-2470-1 11-16-65

ATTN ..... KEN OLSEN

THE PEOPLE WORKING ON THE MEMORIES USING "ELECTRATES" HAVE FORMED A COMPANY TO RESEARCH AND DEVELOP THE MEMORY TECHNIQUES.

THE COMPANY NAME IS:

ELECTRETIC SYSTEMS, INC.
941 CHARLESTON ROAD
PALO ALTO, CALIFORNIA

DON RICHARDSON VISITED YOU. ARTHUR NEARON IS THE PRESIDENT. LARRY TESLER IS ALSO A COMPANY OFFICER.

THEY WILL CONTACT YOU SOMETIME NEXT WEEK BY PHONE.

KEN LARSEN

# INTEROFFICE MEMORANDUM

DATE November 16, 1965

SUBJECT

TO Ken Olsen

FROM Lee D. Butterworth

Dollar Value of Goods Shipped or Due For Month Ending Nov. 26th 1965

| | | |
|---|---|---|
| 1. | EMI Memory Tester 1525-3 | $74,600. |
| 2. | EMI Core Tester 2119-6 | 20,780. |
| 3. | Ft. Monmouth Buffer 2007 | 21,150. |
| 4. | Western Electric Memory Tester 1516-13 | 53,000. |
| 5. | High Current Pulse Equipment (Estimated) | 15,000. |
| | | $184,530. Total |

above telephoned to Bob Hill 11/18/65 mss.

LDB/ds

# INTEROFFICE MEMORANDUM

DATE November 12, 1965

SUBJECT Bank Account Signatures

TO Ken Olsen

FROM Harry Mann

I would like to clear up the signatory powers on the bank accounts the company has with National Shawmut Bank, Morgan Guaranty Trust Company, and Middlesex County National Bank.

I would suggest that you, Andy, Win, and I have signatory powers for each of these banks.

I would further recommend that I have a signature plate that could be used for any checks up to $5,000 on a single signature basis and that any checks up to $10,000 could be signed by hand, individually, by you, Andy, or myself. Any checks above $10,000 would require two hand signatures, one of which would be either yours or mine with the other being either Andy's or Win Hindle's.

Harry S. Mann

HSM/clw

# INTEROFFICE MEMORANDUM

DATE November 12, 1965

SUBJECT PDP-6 Commitments

TO Ken Olsen
Harry Mann

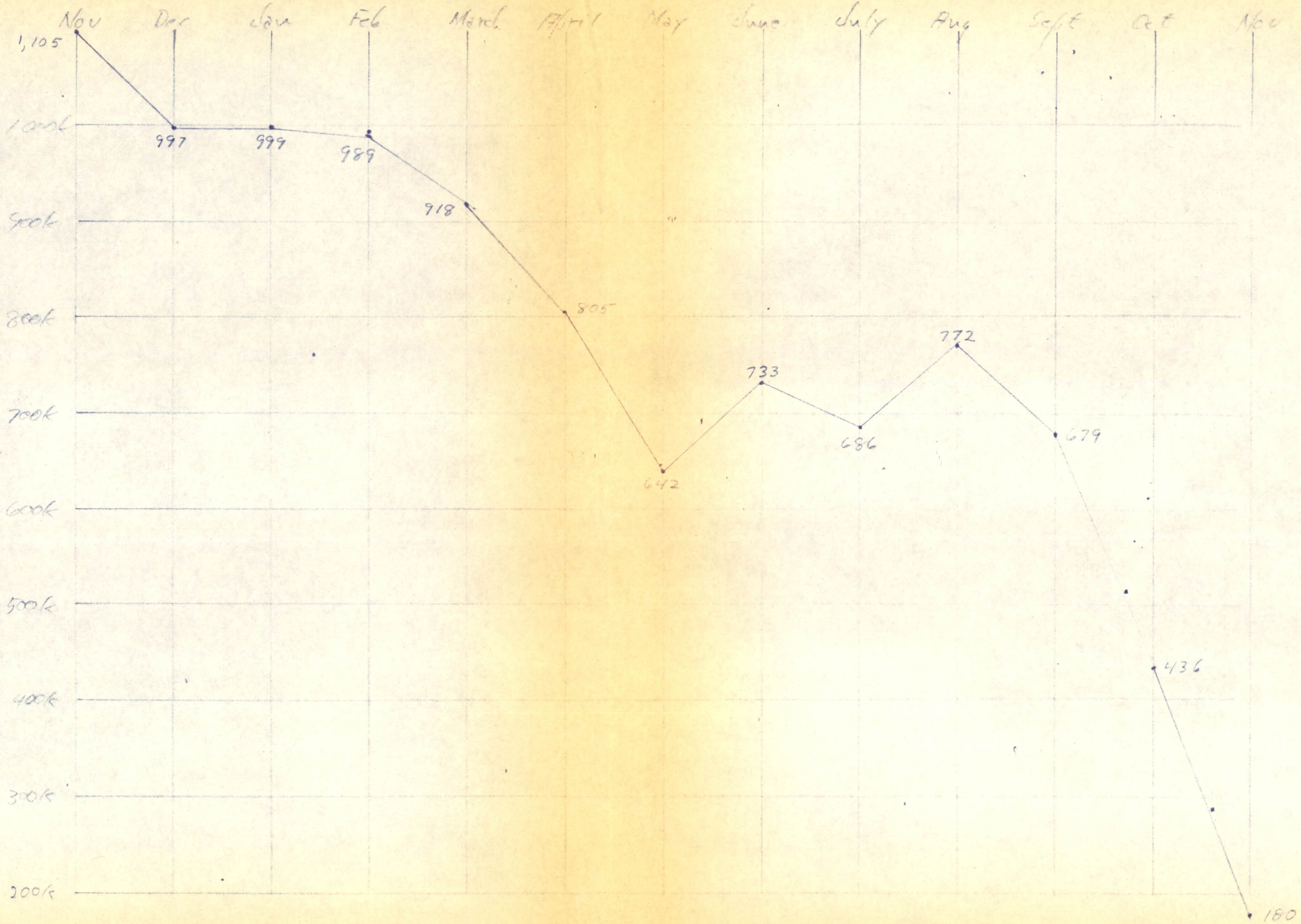
FROM Win Hindle

| PDP-6 Customers | | Proposed Action |
|---|---|---|
| 1. United Aircraft<br>2. Colgate<br>3. Rochester<br>4. Stanford<br>5. MIT - LNS | Group I. | P. O. Received |
| 6. Yale<br>7. Oxford<br>8. Imperial | Group II. | P. O. Imminent |
| 9. Weizmann<br>10. LRL #2<br>11. New Mexico<br>12. BBN<br>13. U. of Penn | Group III. | Follow up and accept P.O. if it is placed. Withdrawal would have very negative effect on an important customer or important market. |
| 14. Berkeley #2<br>15. Witwatersrand<br>16. Martin - Denver<br>17. Cerci - Orly<br>18. CERCI - Own | Group IV. | Withdraw proposal nicely. Some loss of good will inevitable. |

We have six machines in progress. I propose we start one more now to keep one ahead of the actual orders. This will be an engineering and checkout machine and will be the next to last machine shipped. The programming machine will be shipped last. As new orders are received on numbers 9-13, we will start a new central processor until we reach the engineering machine as the next to last shipment. Deliveries will be 6 months from date of P.O. but no closer than 1 month apart.

Under this plan we have a potential of starting 5 more processors in addition to the 8 now in-house (including the Engineering and Programming machines.) However, I believe the likelihood is that only 5 of the 7 potential orders will be placed. To take a conservative look at the inventory effects of this plan, the attached chart on PDP-6 inventory assumes that we build 5 more processors and ship the last one (Oxford) in November, 1966.

I believe this plan will hurt us least in our customer's eyes. In several withdrawal situations, we may be able to keep the proposal alive enough to propose a FC-6 when and if it is available. Another significant advantage to the plan is that it provides a bridge between current PDP-6 production and potential FC-6 production.




Estimated PDP-6 inventory at end of each month.

FC-6 not included

P/B
11/17/65

# INTEROFFICE MEMORANDUM

DATE November 11, 1965

SUBJECT

TO Ken Olsen
cc: Elsa Carlson

FROM Dave Packer

We should have a meeting to discuss two items that you had requested from Maynard.

1. An analysis of all items in raw materials inventory, showing the number of months of projected usage in stock for each raw material item.

2. An analysis of work in process, showing each module lot in process and the date it was started. Suggest list be arranged by starting date (oldest lots first).

Elsa will set up a meeting early next week and inform Maynard of the information required. Suggest that normal production meeting people be there, plus Harry Mann.

Dave

DWP:ncs

# INTEROFFICE MEMORANDUM

DATE November 10, 1965

SUBJECT

TO K. Olsen
J. Jones
D. Cotton
R. Boisvert
R. Savell
H. Crouse
cc: R. Best

FROM D. Kuyamjian

Burroughs will be announcing a new Magnetic Tape Transport System shortly.

Briefly, the system is a bank of four tape transports sharing common electronics and vacuum systems, priced at $15,000.00 including all electronics except registers. Each transport, consequently, is $3,750.00.

Speed: 75 ips
Density: 800 bpi (3 - selectable)

Reading and writing may be performed on only one set of reels ("transport") at a time. Each of the other "transports" is on-line and ready should it be selected. Although the vacuum systems are inter-connected, one may block off one transport for purposes of maintenance or switching reels without interfering with simultaneous operation of another.

The system will be offered as seven or nine channel.

K H Olsen

INTEROFFICE MEMORANDUM

DATE October 28, 1965

SUBJECT Diode Considerations Part Three

TO
K H Olsen
R Brown
R L Best
D A White
R Sogge
R Hughes
G Wood
T Stockebrand

FROM Walter Bonin

SUBJECT: DIODE DESIGN CONSIDERATIONS PART THREE

3.0 Magnitude of minority carrier stored charge.

3.1 Fundamental considerations:

In determining the amount of stored charge one inserts into a forward biased diode it is necessary to consider the concentration gradient of the injected minority carriers. The DD2 diode current is primarily a hole current and therefore the injected carriers are holes. Fig. 3.1 shows the concentration of carriers in a diode as a function of distance (x).

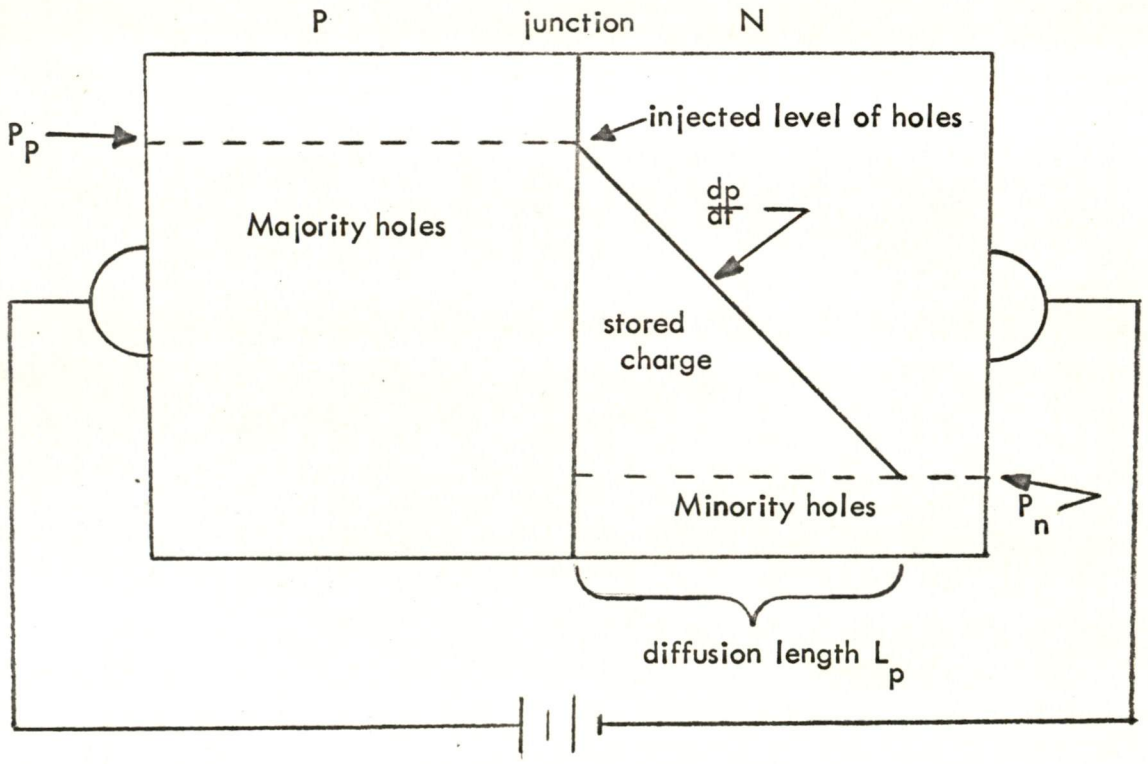



Fig. 3.1

The holes injected into the n type material are a function of applied voltage $V_o$ and equilibrium concentration of minority holes in the n type material. The slope of the carrier concentration arises because some carriers recombine with electrons while traversing the n type region and after one diffusion length they have "decayed" to the equilibrium value $P_n$. The diffusion length $L_p$ is related to the diffusion constant and lifetime; both being functions of n type impurity concentration; by the equation:

$$L_p = \sqrt{D_p t} \qquad \text{eq. 3.1}$$

where: $D_p$ = diffusion constant of holes in n type material in $cm^2\ sec^{-1}$

$t$ = lifetime of holes in n type material in sec

both $D_p$ and $t$ decrease with increasing impurity doping ($N_d$).

The minority hole concentration $P_n$ is related to doping level by the equation:

$$P_n = \frac{ni^2}{n_n} \qquad \text{eq. 3.2}$$

where: $ni^2$ = intrinsic conductors = $1.5 \times 10^{10}\ cm^{-3}$

$n_n = N_d$ = impurity doping in n type material

From Fig. 3-1 it is shown that the stored charge $Q_s$ is the area under the dp/dt curve and above the line $P_n$. Therefore to realize maximum stored charge it is essential that the injected level and diffusion length be maximized.

In order to increase the injection level we must increase the forward bias $V_o$ which results in higher currents. Injection level is related to $V_o$ mathematically by:

$$I.L. = P_n e^{\frac{V_o q}{kT}} \qquad \text{eq. 3.3}$$

where: $P_n$ = minority hole concentration

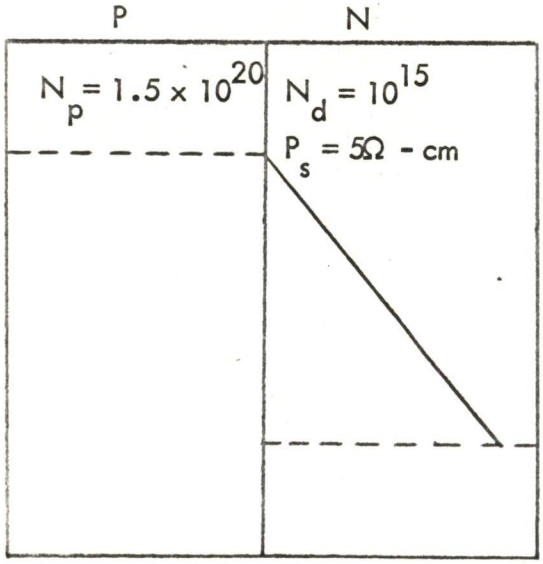
$V_o$ = applied forward bias

$\frac{q}{kT}$ = a constant = .26 at 300° K

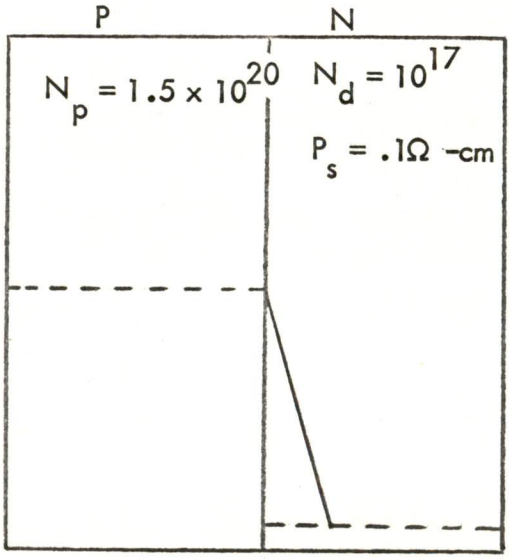
To increase the diffusion length $L_p$ we must increase the diffusion constant and lifetime. This is obtained by using the lowest doped (highest resistivity) n type material. We are limited in how far we may go in this direction because we are then introducing a large series resistance which is undesirable (see diode design considerations part one). It now remains for us to mathematically relate the previous given relationships to the stored charge and we will be assisted by appropriate examples.

3.2 Stored Charge Calculations

We will first relate the stored charge to impurity doping $N_d$, giving two examples to aid in the analysis.




(A)




(B)

Fig. 3.2

The first analysis will be of Fig. 3.2 (A) and follows:

To calculate the value of $P_n$ we use equation 3.2

$$P_n = \frac{ni^2}{n_n} = \frac{2.25 \times 10^{20}}{10^{15}} = 2.25 \times 10^5$$

Having established this value we are in a position to determine the injected level given by eq. 3.3.

Letting $V_o = .6$ volts

$$I.L. = P_n e^{\frac{V_o q}{kT}} = 2.25 \times 10^5 e^{\frac{.6}{.026}}$$

$$= 2.25 \times 10^5 e^{.6 \times 38}$$

$$= 2.25 \times 10^5 e^{22.0}$$

since $e^{22} = x$

then $22 = \ln x$

from math tables

$\ln x = 2.3 \times \text{Log}_{10} x$

substituting for $\ln x$

$22 = 2.3 \times \text{Log}_{10} x$

$\text{Log}_{10} x = \frac{22}{2.3} = 9.6$

since the mantissa of 6 is approximately 4

$\text{Log}^{-1} 9.6 = 4 \times 10^9$

$x = 4 \times 10^9$

therefore:

$I.L. = 2.25 \times 10^5 \times 4 \times 10^9$

$I.L. = 9 \times 10^{14}$

Knowing the injected and equilibrium levels it now remains for us to calculate the diffusion length $L_p$ which allows us to determine dp/dt. At this point it will be worthwhile to mention the fact that the steeper (higher) dp/dt is the greater the forward current is. The slope of the injected carriers dp/dt at low current levels is the sole factor which makes the carriers flow. This is a diffusion current caused by the concentration gradient. Returning now to diffusion length calculations we can determine $L_p$ by using eq. 3-1.

$$L_p = \sqrt{D_n t}$$

where

$D_n$ = diffusion constant = 13 $cm^2/v_{-sec}$

t = lifetime = 8 msec

Substituting

$$L_p = \sqrt{13 \times 8 \times 10^{-6}}$$

$$L_p = \sqrt{10^{-3} \times 104}$$

$$= 10^{-2} \text{ cm}$$

Converting to inches yields

$\frac{10^{-2}}{2.54}$ approximately equal to .004"

We have thus far determined the injected level, the diffusion length and the equilibrium level. These values are presented in Fig. 3-2, to aid in the analysis of storage charge.

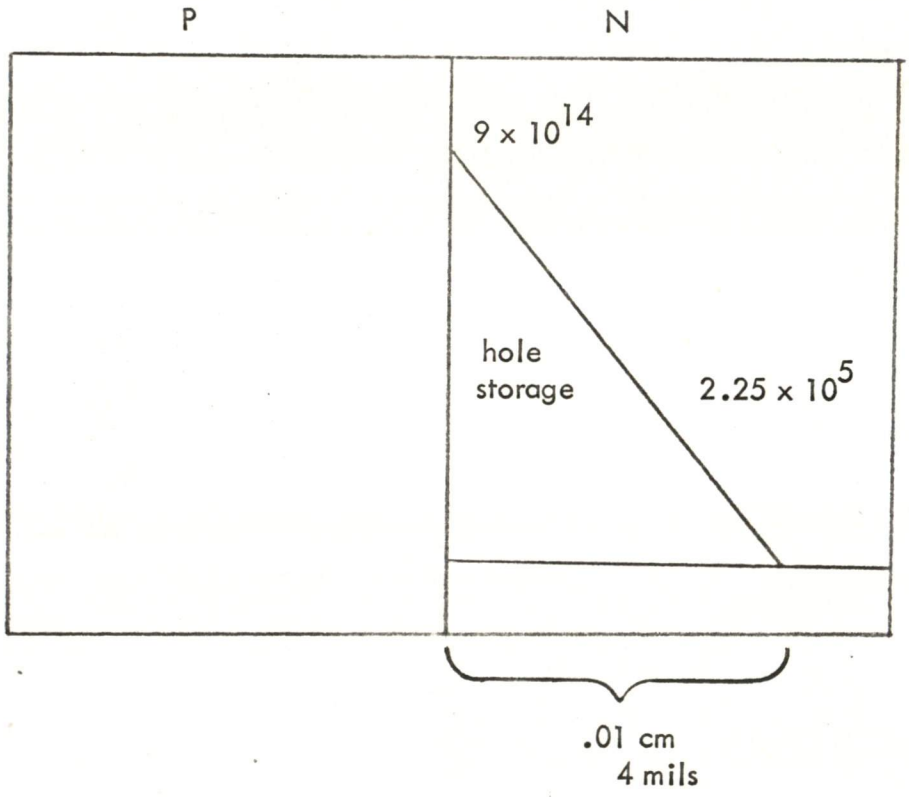
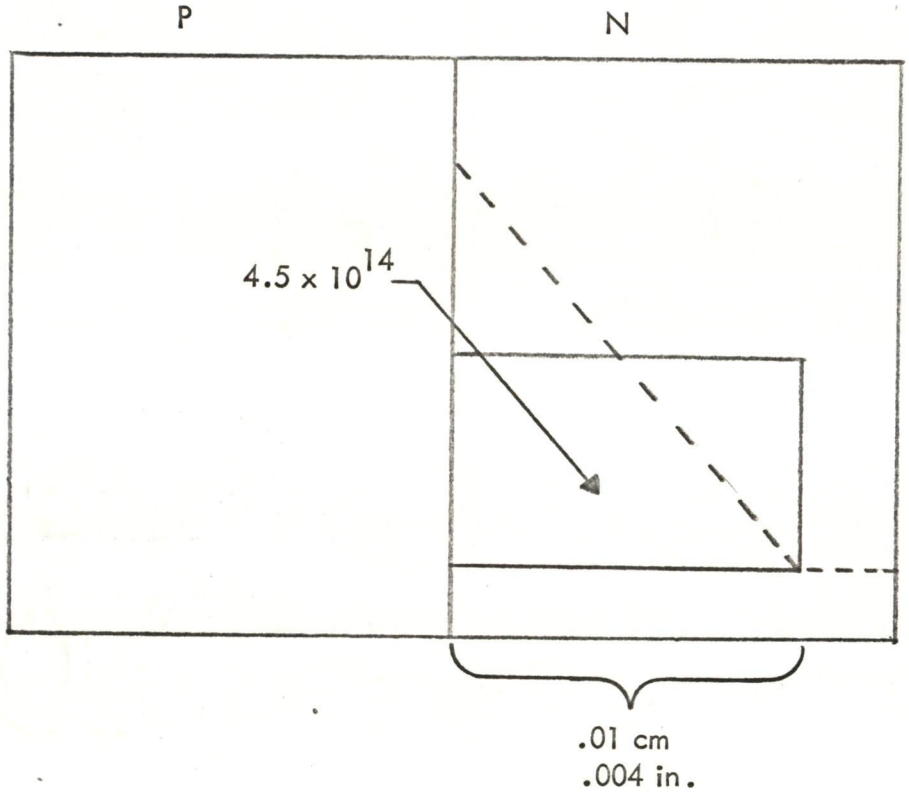



Fig. 3-2

The mean density of charges in the storage area is $4.5 \times 10^{14}$ $cm^{-3}$ and the total storage charge can be as shown in Fig. 3-3.




3.3 Equivalent Stored Charge.

Since there are $4.5 \times 10^{14}$ charges per cubic centimeter it remains for us to calculate the volume of the diode storage region and multiply this number by the mean density of charges in this region. Since the diode is made on 40 mils square (.1 cm) and the diffusion length is .01 cm then the volume is -

$$V = .1 \times .1 \times .01 = 10^{-4} \ cm^3$$

Therefore the total number of charges equals -

$q_n$ = mean density x volume

$= 4.5 \times 10^{14} \times 10^{-4}$

$= 4.5 \times 10^{10}$

Since one coulomb = $6.25 \times 10^{18}$ charges, our total charge may be found by the ratio of the total charge in the diode to this figure.

$$\frac{4.5 \times 10^{10}}{6.75 \times 10^{18}} = .72 \times 10^{-8} \text{ coulombs}$$

in

in pico coulombs this value becomes -

7200 pico coulombs.

This total represents the stored charge that is injected into the diode with a forward bias of .6 volts. Due to recombination effects up to 50% of this charge is available upon application of a reverse bias, which yields a figure closer to 3000 pico coulombs.

Returning to Fig. 3-2B, and using the same method of analysis we can determine the general relationship between impurity doping and stored charge. Note that the only difference between 3-2A and B is the n type substrate doping level, being $10^{15}$ $cm^{-3}$ in A and $10^{17}$ $cm^{-3}$ in B, first solving for $P_n$ using eq. 3-2.

$$P_n = \frac{ni^2}{n_n}$$

$$= \frac{2.25 \times 10^{20}}{10^{17}} = 2.25 \times 10^{3}$$

The injected level is then

$$I.L. = p_n e^{\frac{V_o q}{kT}}$$

$$= 2.25 \times 10^3 \, e^{.6 \times 38}$$

$$= 2.25 \times 10^3 \times 4 \times 10^9$$

$$I.L. = 9 \times 10^{12}$$

Using eq. 3-1 to solve for the diffusion length,

$$L_p = \sqrt{D_n t}$$

where,

$$D_n = 7.3$$

$$t = 10^{-6}$$

$$L_p = \sqrt{7.3 \times 10^{-6}} = 2.7 \times 10^{-3} \text{ cm}$$

or approximately .001"

Comparing this value for the diffusion length with the value in the first example shows that the length is now approximately 1/4 the amount for .1 ohm cm material in comparison to 5 ohm -cm material.

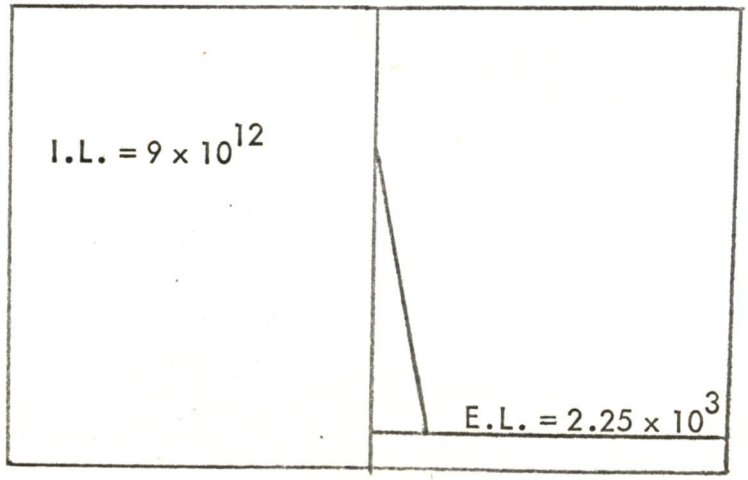



Fig. 3-4

The mean density of charges in this case is therefore $4.5 \times 10^{12}$ $cm^{-3}$. Multiplying this figure times the stored charge volume of the diode gives us the total number of carriers in this region.

No. of carriers = mean density x volume

$= 4.5 \times 10^{12} \times .27 \times 10^{-4}$

$= 1.22 \times 10^{8}$

The charge in coulombs is obtained by the ratio of carriers to the number in one coulomb.

Therefore -

$\frac{1.22 \times 10^{8}}{6.25 \times 10^{18}}$ is approximately $.20 \times 10^{-10}$ = 20 pico coulombs

## SUMMARY

The previous discussion has demonstrated the relative relationship between minority carrier storage charge (as opposed to capacitive storage charge) and impurity doping. We have demonstrated by a simplified analysis that the stored charge increases considerably with resistivity. It must be borne in mind that the results given in the example are not exact due to the simple nature of the analysis which has neglected drift velocity effects on the carriers which alters the diffusion constant and the actual non linear carrier concentration but has served to give the interdependence of minority carrier charge and impurity doping.

# INTEROFFICE MEMORANDUM

DATE 21 October 1965

SUBJECT Minutes of Training Requirements Meeting

TO Ken Olsen
Harlan Anderson
Nick Mazzarese
Win Hindle
Stan Olsen
Ted Johnson
Jack Shields
Bob Lassen
Harry Mann

FROM Bob Pate

The meeting was held in Conference Room A, Building 12 at 3:00 p.m., 15 October 1965. Those present were:

Ken Olsen Bob Lassen Bob Pate Harlan Anderson Ted Johnson

Jack Shields Win Hindle John Jones Jim Hastings.

1. Bob Pate presented the Training Plan for January 1966 to June 1966. The plan was based on requirements established by the Product Line Managers.

   The plan agreed to is as follows:

| | |
|---|---|
| PDP-6 Maintenance | 2 courses |
| PDP-6 Programming | 2 courses |
| PDP-7 Maintenance | 4 courses |
| PDP-7 Programming | 4 courses |
| PDP-8 Maintenance | 24 courses |
| PDP-8 Programming | 24 courses |
| LINC-8 Maintenance | 2 courses |
| LINC-8 Programming | 2 courses |

   Inhouse Training:
   2 twenty-one week cycles consisting of:

   7 weeks Basic Tech
   2 weeks Standard I/O
   2 weeks PDP-7
   2 weeks Memories
   2 weeks Magnetic Tapes
   1 week respectively of Punch, DEC Tape, Displays, A to D, Line Printer, Card Reader

To implement this plan will require the addition of the following:

1 Programming Instructor
2 Inhouse Instructors
2 PDP-8's in addition to the PDP-5 presently with training.

These additions were approved.

The budget (187K) needed to implement this plan was part of the presentation and was broken down according to the percentages agreed to in the previous meeting. Ken Olsen felt that this method of percentages was still inequitable. His will contact Harry Mann and the Product Line Managers to work out a more suitable allocation of the expenses.

# INTEROFFICE MEMORANDUM

DATE October 21, 1965

SUBJECT RAND - Unhappiness and Risk

TO Ken Olsen FROM Ted Johnson

Following our meeting with Rand this week, Dick Musson reports that the Rand people are openly unhappy with us. As I get it, the problem is more in their loss of rapport based on what they consider our attitude toward our commitments to be and based more on what we say than what we do. In particular, that our justification of the delay on the Joss consoles because of the gear box mod doesn't completely hold water, since they were told they were ready except for that and, in fact, we apparently are still working on the electronics.

Dick points out that we have a severe default clause in our contract (Article 16) and an unused opportunity to protect ourselves on the Joss console commitment before October 31st. I am having Dick Testa look into this.

Without looking over our commitments, the problems are:

1. Delivery of modified Joss consoles.

2. Refusal to put in memory "percolator" word.

3. Controller for the disc (they've had a $66,000 disc since June, no clear statements of final delivery from us).

4. Delayed 630 system.

5. Delayed drum, no clear commitment.

They are talking about getting a drum from another source. The default clause (Art. 16) could make us liable for any difference in their cost and our quoted price.

Dick urges us to take their dissatifaction very seriously. They know they could be tough on us.

# INTEROFFICE MEMORANDUM

DATE October 20, 1965

SUBJECT

TO KEN OLSEN

FROM RAY LINDSAY

CC: JOHN JONES
TOM WHALEN

I have just received a Letter of Intent for a PDP-7 Computer from the Graduate School of Public Health at the University of Pittsburgh. I have been discussing their application with them, and they have also made a trip to the Plant which I think you are aware of. I feel certain they will receive their money as Dr. Wald seems to have a great deal of influence both at the University of Pittsburgh and NASA.

The reason for this letter being directed to you is the additional CRT 31 they would like to purchase from us as stated in their enclosed letter.

As there is a discount involved from the original price, I thought the letter to you directly would better the chances of me getting an answer in a fairly short time.

A brief description of the application is also enclosed which is a very interesting one. I think it would be the first time this is accomplished if their project is successful.

If there are any questions that arise relating to the application and future purchasing plans, I would be glad to clarify them for you.

Enclosures: (3)

UNIVERSITY OF PITTSBURGH
GRADUATE SCHOOL OF PUBLIC HEALTH
PITTSBURGH, PENNSYLVANIA 15213

DEPARTMENT OF OCCUPATIONAL HEALTH

October 15, 1965

Mr. Ray Lindsay
Digital Equipment Corp.
300 Seco Road
Monroeville, Pennsylvania

Dear Mr. Lindsay;

During a recent visit to your plant, two of my engineers, Mr. Ranshaw and Mr. Feagin, expressed interest in a model 31 Ultra-Precision Display Unit. They were informed by Mr. Robert Lane, Mr. Allen Titcombe and Mr. George Rice, that a slightly used version of this unit is presently available. Mr. Lane has indicated that it might be possible to obtain this unit in an "as is condition" for about $22,000. I understand that this would relieve Digital Equipment Corporation of all obligations and warranties. The condition would be acceptable if the unit could be purchased by us for $22,000.

A brief description of the system of which the Model 31 will be an integral part is enclosed.

Sincerely yours,

Niel Wald, M.D.
Professor of Radiation Health

NW:bm
enclosure

OCT 20 REC'D

UNIVERSITY OF PITTSBURGH
GRADUATE SCHOOL OF PUBLIC HEALTH
PITTSBURGH, PENNSYLVANIA 15213

DEPARTMENT OF OCCUPATIONAL HEALTH

October 15, 1965

Mr. Ray Lindsay
Digital Equipment Corporation
300 Seco Road
Monroeville, Pennsylvania

Dear Mr. Lindsay;

This letter is to inform Digital Equipment Corporation of our intention to purchase a PDP-7 computer system through the University of Pittsburgh, contingent upon the granting of sufficient funds by the National Aeronautics and Space Administration. This system will consist of the following equipment:

| | | |
|---|---|---|
| BASIC PDP-7 CONFIGURATION | $45,000 | List Price |
| TYPE 147 MEMORY EXPANSION | 12,000 | List Price |
| TYPE 177 EXTENDED ARITHMETIC | 6,300 | List Price |
| | $63,300 | |

This letter is in no way binding upon the University of Pittsburgh, and will be considered void if not followed by a written purchase order within 90 days prior to DEC's comitted delivery date or 90 days following the date of this letter, whichever is sooner.

Sincerely yours,

Niel Wald

Niel Wald, M.D.
Professor of Radiation Health

NW:bm

# 9 – 3 AUTOMATION OF HUMAN CYTOGENETIC STUDY METHODOLOGY

N. WALD, F. FEAGIN, R. RANSHAW

Department of Occupational Health and
Computation and Data Processing Center
The University of Pittsburgh
Pittsburgh, Pennsylvania 15213, U.S.A.

The science of cytogenetics involves the study of chromosomes, the paired units composed of DNA (deoxyribonucleic acid) by which genetic information is carried in the body's cells. This methodology is being applied increasingly to the investigation of unsolved health problems including the etiology of congenital abnormalities and cancer, and the effects of environmental agents such as radiation and chemicals.

The first step, sample preparation, can be done with circulating blood or bone marrow cells. One can trigger cell division (or mitosis) with phytohemagglutinin, stop the process with colchicine at metaphase when the chromosomes are most visible, swell the cells with hypotonic saline to minimize overlapping, and air-dry them on a slide to flatten them for microscopy. In the second step, data collection and recording, one searches the slides for usable dividing cells, photographs them, enlarges the pictures, cuts out the chromosomes and matches up the pairs in a "karyotype." A normal male cell and its karyotype are shown in Fig. 1

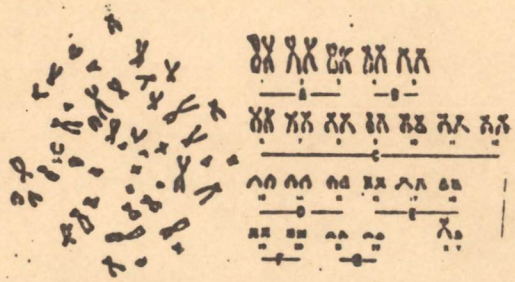


Fig. 1. Mitotic blood cell and its karyotype

To prepare 20 cells this way takes about 3 man-days from blood drawing to the end of karyotyping. The third step, data analysis, requires decision-making about the presence and significance of variations in chromosome number and appearance revealed in the karyotypes of a number of cells in any given sample.

We are attempting full automation of the second and third steps to facilitate the two major problems, i.e. locating mitotic cells and karyotyping. A complete solution to the problem of chromosome analysis would be one in which the mitotic cell was located on the microscope slide and then karyotyped directly from the microscope image without human intervention, as shown in Fig. 2. This is our eventual goal.

The problem of locating the mitotic cell requires an automatic microscope with pattern recognition capabilities. A further complication due to the relatively small size of a chromosome (about 10 μ), is the high magnification requirement (1000 x). With this magnification, the depth of focus is about 0.3 μ (micron) for monochromatic light of 5400 angstroms. The actual focus requirements are not known at this time.

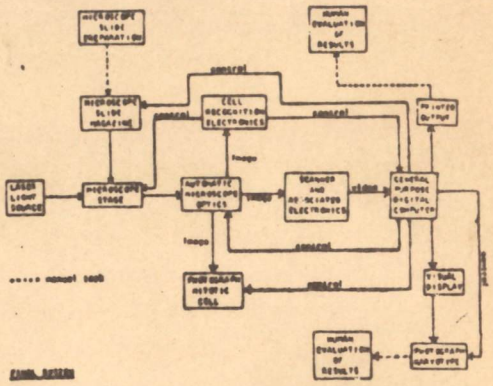


Fig. 2. Final automatic system

Our current approach to the problem of cell recognition is to use a coherent light microscope and evaluate the Fourier transform of the resulting image. This bypasses the need of focus for cell recognition but not for karyotyping. A study program is presently being conducted by the Perkin-Elmer Corporation to determine the specifications of the coherent light microscope. Some preliminary experimental work by Perkin-Elmer Corporation indicates that a mitotic cell can be distinguished from other objects on the microscope slide.

The next phase of the problem is to convert the microscope image into a form suitable for processing by a digital computer. A preliminary investigation is being carried out using two types of film scanners. The first scanner is an electronic flying spot scanner (Fig. 3). This scanner accepts 35 mm film and has a 150 μ diameter spot size at the film plane. It produces a maximum of 65,536 resolution elements and has 256 linear gray levels. This system can, in theory, generate over $1 \times 10^7$ bits of information. However, electronic noise and instability, as well as photographic film and processing limitations cut the actual information output to about $1 \times 10^6$ bits of information.

The second scanner is a mechanical flying spot scanner (Fig. 4) that accepts 35 mm film, has a 34 μ diameter spot size at the film plane,

produces a maximum of 1,048,576 resolution elements, and has a linear 256 level gray scale. The total theoretical information output is over $2.68 \times 10^8$ bits. Again practical considerations limit the useful output to about $1 \times 10^7$ bits.

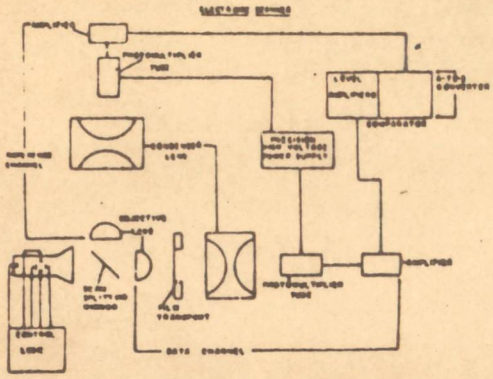


Fig. 3. Electronic film scanner

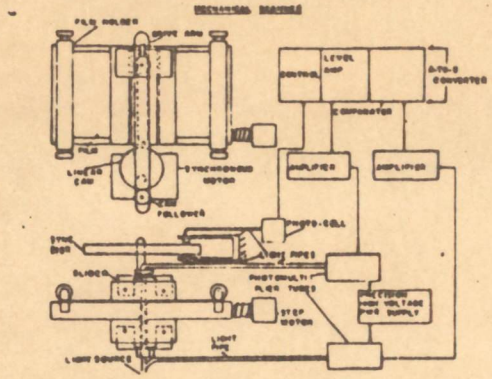


Fig. 4. Mechanical film scanner

The interim system (Fig. 5) can accept input from either scanner. The present system allows us to choose what area of the film is to be scanned and if the scanner output is to be recorded on magnetic tape, or to be displayed on a storage oscilloscope. There is also a mode of operation that allows us to measure the density distribution of the scanned area. From this the total DNA content of the cell can be determined. The system also allows us to read magnetic tape and display this information on the storage oscilloscope. This feature allows the human observer to see how the computer has matched the chromosomes. The system was designed such that, when the parameters for cell identification and karyotyping are known, and if an on-line computer is economically feasible, a computer can be added to the existing system with no major modifications.

Preliminary work on the third phase, computer programming, has been centered on two problems: determination of the factors contributing to accurate comparisons of chromosomes, and manipulation of the vast quantity of data represented by photomicrographs of mitotic cells.

The initial program was based upon the work of George A. Moore of the National Bureau of Standards, which utilizes a mapping of $(\text{perimeter})^2/\text{area}$ vs. area, and considers the closest entries on this mapping as matches. The $P^2/A$ factor is a shape dependent measure and is independent of size. One difficulty is that $P^2/A$ is not necessarily unique for a given shape; other shapes may have the same value. In our future programming effort it is planned to utilize other measurements, such as arm-length ratio and volume.

Further research is required into the resolving of the overlap problem. It is felt that the wide range of densities provided by the scanner system will give an indication of overlapping by showing a rapid rise in density values at the points of superimposition.

Current work is directed toward the development of subroutines for manipulating the picture data. Since one 1024 x 1024 point picture would require 175,104 words of computer memory to be retained in its entirety, it is necessary to condense the data into a more reasonable format.. The technique being developed is to use a list-structure which records only density charge information. By this means, about half of the picture may be retained within the computer. Those portions of the picture not actually in the computer's memory will be stored on a disc storage unit providing high speed access to any of the data.

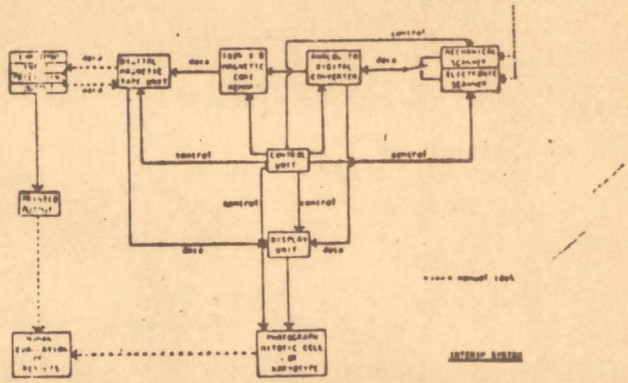


Fig. 5. Interim system

In summary, we have set as our final goal the automation of cytogenetic methodology from the completion of microscope slide preparation through the analysis of mitotic cell karyotypes. Preliminary results suggest the feasibility of automatically locating the mitotic cells on the microscope slide. An electronic and a mechanical film scanner have been developed to provide alternative cytogenetic data input from 35 mm photomicrographs while the automatic microscope is being constructed. A system has been built to convert cytogenetic information from any of these sources to computer input. Research is in progress on a computer program for the chromosome karyotyping operation. Cytogenetic material has been collected and analyzed manually from a large unselected human population to provide study material for this project and a means of evaluating the results produced by the automatic system.

This work is supported by funds provided under National Aeronautics and Space Administration Contract NASr-169. Computer work has been partially supported by National Science Foundation grant G-11039.

INTEROFFICE MEMO

October 20, 1965

SUBJECT: PRESENT RAW MATERIAL PROBLEM AREAS

TO: K. Olsen FROM: J. Smith

In the past, our suppliers of raw materials have been capable to react quite rapidly to our increased demands. A large percentage increase in our demand of his production capability did not require radical changes to his production capability. I believe we have now reached a volume where a large percentage increase in our demand on a supplier's capabilities requires some far reaching decisions on his part. A situation such as this has a definite negative effect on his reaction time.

Our volume requirements in the past have allowed us to operate on a small-lot production flow. This type of flow in practice requires a minimum of raw material and finished goods inventories.

This past quarter, we not only attempted to increase our module output radically (double), but we introduced a new process - "monthly batch" (Production B). This process in itself demands larger raw material and finished goods inventories. The effect of these large changes in our demands could have forced our suppliers to the saturation point in his production capability; thus, extending his reaction time to our demand.

PROPOSAL:

1. Determine what our raw material suppliers current reaction time is to our current demand. This should be the first factor considered on all future increased volume proposals.

2. Until such time as our suppliers can react to a demand that will allow a "monthly batch" operation, with its associated buffer inventories, the "Production B" concept should be revised. A new operating philosophy, more sensitive to the needs of the module user, should be put into effect, such as a weekly output of module types of a smaller lot size - between 300 and 500.

3. When the reaction time is known and we have built up our inventories; we could develop a new line, "Production C", based on the original "Production B" concept of larger monthly-batch processing. The end result would be the three (3) production areas we are currently planning - low (Production A), medium (Production B) and high (Production C) lines.

If the above, or some variation of the above, could be put into effect, I believe we can come fairly close to reaching our accelerated production goals with our present supply of raw materials. We would, in effect, be making maximum use of our limited supply of raw material.

# dec INTEROFFICE MEMORANDUM

**DATE** October 18, 1965

**SUBJECT** Quotations to Foreign Customers

**TO** Product Managers
Ted Johnson
Ken Olsen ✓

**FROM** Harry Mann

When we or our foreign affiliates quote prices to customers, the quotation should make it clear that the price is in U. S. dollars at time of payment. This position protects the company from possible devaluation of foreign currency between the date of the quotation and the time of payment. The longer the time interval between these events, the greater is the risk.

It is recognized that some foreign nationals may be sensitive to this approach and, therefore, for sales reasons, it may be occasionally desireable to deviate from this practice. Such situations should be considered an exception and be handled by joint agreement on a case by case basis between the Product Line Manager, Ted Johnson, and me.

Harry S. Mann

HSM/clw

INTEROFFICE
MEMORANDUM

DATE: October 18, 1965

TO: Ken Olsen
Dick King
Loren Prentice
All Engineers

FROM: Jim Jordan

If the possibility were to exist that we could mold our own knobs, what functions do you feel would be best served by an optimum group of knobs. That is, what various diameters in the fewest number of knobs would serve our purposes. At the present time, there are four knobs under consideration. One is a 2" knob for use on the variac in the marginal check panel; a 1" knob for general purpose tuning, infinitely variable potentiometers; a 1/2" knob for tuning and/or cramped panel situations; and a bar knob for incrimenal switching functions. If any more possibilities occur to you such as other possible functions or better diameters, please contact me.

# INTEROFFICE MEMORANDUM

**DATE** 10-13-65

**SUBJECT** MODULES AWAITING TEST IN PRODUCTION "A" AREA

**TO** K. OLSEN **FROM** ROBERT HUGHES

A COUNT WAS MADE OF THE MODULES AND IT WAS DETERMINED THAT 8541 WERE AWAITING TEST. OF THESE 5289 ARE FLIP-CHIP AND 3252 ARE SYSTEM MODULES. THE MODULES ARE LISTED NUMERICALLY ALONG WITH THEIR QUANTITIES AND THE DATE THE LOT WAS ISSUED. MANY MISSING DATES OF ISSUE INDICATE THAT NONE COULD BE FOUND. INFORMAL DISPOSITION COMMENTS HAVE BEEN ADDED.

CC: H. MANN
M. SANDLER
R. LANE

# MODULES TO BE TESTED

Quantity

SYSTEM MODULES - 3252
FLIP CHIP - 5289
Total 8541

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| 103 | 7 | 7-12-65 | |
| 201 | 20 | 6-21-65 | |
| 1103 | 50 | | 180 Auto — To AMT for Testing |
| 1103 | 40 | | |
| 1103 | 40 | 10-4-65 | |
| 1103 | 50 | 10-4-65 | |
| 1201 | 30 | 9-11-65 | |
| 1209 | 30 | 2-25-65 | |
| 1250 | 5 | 2-9-65 | PDP-6 |
| 1304 | 30 | 6-10-65 | |
| 1304 | 30 | 8-20-65 | 120 Hand to Test |
| 1304 | 30 | 8-20-65 | |
| 1304 | 30 | 8-31-65 | |
| 1311 | 10 | 8-31-65 | |
| 1316 | 60 | 8-20-65 | |
| 1317 | 30 | 9-17-64 | 60 old but good — sell them |
| 1317 | 30 | 10-5-64 | |
| 1404 | 20 | | |
| 1503 | 10 | 8-18-65 | 20 new module now considered obsolete |
| 1503 | 10 | 8-18-65 | |
| 1536 | 40 | 9-11-65 | old style tape Amp |
| 1537 | 10 | 9-15-65 | drum sense Amp |
| 1539 | 10 | 8-31-65 | old style tape peak picker |
| 1559-1 | 20 | 12-12-64 | light pen amp — obsolete |

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| 1566 | 5 | 9-13-65 | |
| 1578-0 | 20 | 2-16-65 | expensive multiplexer |
| 1579 | 10 | 9-14-65 | Feed Fwd for 130 display |
| 1579 | 10 | 9-14-65 | (20) |
| 1582 | 10 | 9-13-65 | linc |
| 1583 | 4 | 8-17-65 | |
| 1606 | 10 | 7-26-65 | obsolete |
| 1665 | 10 | 8-26-65 | PDP-6 |
| 1672 | 10 | 9-15-65 | - really obsolete |
| 1677 | 20 | 9-5-65 | |
| 1681 | 20 | 9-15-65 | |
| 1689 | 10 | 9-11-65 | |
| 1704 | 20 | 8-19-65 | expensive power supply module |
| 1987 | 93 | | PDP-4 selection sw. — give to small comput |
| 1987 | 30 | 10-5-65 | (123) stock room, for test in a PDP-4 |
| 1996 | 50 | | |
| 1996 | 50 | 5-26-65 | (150) |
| 1996 | 50 | 6-2-65 | |
| 1997 | 46 | | |
| 1997 | 30 | 6-1-65 | (76) |
| 1997 | 30 | 3-16-65 | (60) |
| 1997 | 30 | 3-16-65 | |
| 1998 | 43 | | |
| 1998 | 49 | 6-2-65 | |
| 1998 | 30 | 7-27-65 | (182) |
| 1998 | 30 | 8-24-65 | |
| 1998 | 30 | 8-24-65 | |

PDP-6 Memory

check in operating memory

about enough modules for six Type 163 (16K 36 Bit) PDP-6 memories

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| 3201 | 20 | 3-17-65 | |
| 3201 | 20 | 9-1-65 | 40 |
| 3203 | 20 | 6-10-65 | Lab Modules |
| 3203-C | 5 | 3-15-65 | |
| 3602 | 10 | 5-27-65 | |
| 4201 | 50 | 8-17-65 | |
| 4202 | 50 | 8-9-65 | special Systems only |
| 4204 | 44 | 3-1-65 | PDP-4 only |
| 4205 | 30 | 2-24-65 | Linc |
| 4209 | 50 | 9-3-65 | |
| 4209 | 30 | 9-4-65 | 80 |
| 4215 | 50 | 8-16-65 | |
| 4216 | 30 | 9-30-65 | |
| 4220 | 30 | 9-24-65 | |
| 4223 | 30 | 8-26-65 | |
| 4225 | 30 | 9-1-65 | |
| 4226 | 20 | 9-11-65 | |
| 4226 | 30 | 9-11-65 | 50 Only used in A-D's |
| 4230 | 20 | 8-31-65 | |
| 4231 | 10 | 8-16-65 | |
| 4290 | 10 | 9-2-65 | — No customers |
| 4410 | 30 | 7-23-65 | |
| 4410 | 40 | 8-12-65 | 120 Large Number of pulse generators |
| 4410 | 50 | 9-24-65 | |
| 4514 | 10 | | |
| 4514 | 10 | | 30 Tape writer used in old style transport 4 per transport — Testin transport |
| 4514 | 10 | 10-7-65 | |

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| 4526 | 50 | 9-2-65 | New style mag tape writer |
| 4552 | 30 | 5-7-65 | Low Speed PDP-6 memory Sense Amp (5μs) |
| 4552-1 | 25 | 5-12-65 | 49 PDP-6 Sense Amp (2μs) |
| 4552-1 | 24 | 5-12-65 | |
| 4604 | 1 | Retest | |
| 4605 | 50 | 6-16-65 | 150 Only Used in PDP-4's |
| 4605 | 50 | 8-12-65 | |
| 4605 | 50 | 8-16-65 | |
| 4606 | 10 | | 125 Very Popular |
| 4606 | 15 | Retest | |
| 4606 | 50 | 5-25-65 | |
| 4606 | 50 | 6-8-65 | |
| 4657 | 50 | 6-16-65 | 100 PDP-6 IO Bus Driver |
| 4657 | 50 | 7-7-65 | |
| 4671 | 30 | 9-27-65 | |
| 4702 | 10 | 2-23-65 | 20 |
| 4702 | 10 | 4-9-65 | |
| 6131 | 20 | 9-21-65 | PDP-6 |
| 6132 | 18 | 7-26-65 | PDP-6 |
| 6203 | 20 | 9-27-65 | PDP-6 |
| 6206 | 10 | 9-7-64 | 30 PDP-6 |
| 6206 | 10 | 8-20-65 | |
| 6206 | 10 | 9-25-65 | |
| 6207 | 50 | 3-3-65 | Low volume sales |
| 6227 | 50 | 7-28-65 | PDP-6 |
| 6310 | 30 | 5-28-65 | |
| 6603 | 50 | 4-23-65 | |

| TYPE | QUANTITY | DATE OF ISSUE | | DISPOSITION |
|---|---|---|---|---|
| 6684 | 35 | 3-1-65 | | |
| 6684 | 36 | 3-1-65 | 169 | Probably for PDP-6 and peripheral equip. |
| 6684 | 48 | 4-29-65 | | |
| 6684 | 50 | 7-13-65 | | |

# MODULES TO BE TESTED

Quantity

SYSTEM MODULES - 3252
FLIP CHIP - 5289
Total 8541

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| A101 | 24 | 9-21-65 | Multiplexer switchs |
| A102 | 24 | 9-21-65 | |
| A702 | 48 | 8-20-65 | cheap -10v reference supply |
| B130 | 48 | 8-26-65 | Test in comptor |
| B130 | 48 | 8-28-65 — 144 | PDP-6 |
| B130 | 48 | 9-29-65 | |
| B201 | 40 | | To be tested by simpler go-no-go tester being built. |
| B201 | 100 | 6-9-65 1/2 tested | |
| B201 | 100 | 8-24-65 1/2 tested — 300 | |
| B201 | 100 | 8-25-65 1/2 tested | |
| B204 | 48 | 7-29-65 | Test in comptor |
| B204 | 48 | 8-25-65 — 96 | |
| B210 | 48 | 9-17-65 1/2 tested | Test in comptor |
| B211 | 24 | 6-12-65 | |
| B211 | 24 | 8-24-65 | New PDP-6 memory only. |
| B211 | 24 | 8-26-65 — 168 | large number |
| B211 | 48 | 9-2-65 | |
| B211 | 48 | 9-17-65 | |
| B301 | 48 | 9-21-65 | Hard to test |
| B301 | 48 | 9-21-65 — 144 | |
| B301 | 48 | 9-22-65 | |
| B360 | 48 | | |
| B360 | 78 | 8-17-65 | |

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| B360 | 87 | 9-15-65 | 313 hard to Test |
| B360 | 100 | 9-24-65 | |
| B401 | 48 | 8-25-65 | 96 hard to Test |
| B401 | 48 | 9-4-65 | |
| B602 | 96 | | |
| B602 | 48 | 9-17-65 | |
| B602 | 48 | 9-17-65 | |
| B602 | 48 | 9-18-65 | 384 Test in computor |
| B602 | 48 | 9-23-65 | |
| B602 | 48 | 9-23-65 | |
| B602 | 48 | 9-29-65 | |
| B620 | 48 | 7-7-65 | |
| B620 | 100 | 9-20-65 1/2 tested | 932 Test in computor |
| B620 | 84 | 9-20-65 1/2 tested | |
| B681 | 48 | 9-4-65 | 96 |
| B681 | 48 | 9-17-65 | |
| B682 | 24 | 10-1-65 | Special Systems Only |
| G001 | 100 | 9-17-65 | PDP-7 sense Amp |
| G002 | 24 | 8-25-65 | 72 Test in operating PDP-7 memory |
| G002 | 24 | 8-25-65 | |
| G002 | 24 | 8-27-65 | |
| G006 | 24 | 8-23-65 | |
| G006 | 48 | 8-23-65 | 120 Test in operating PDP-8 memory |
| G006 | 48 | 8-28-65 | |
| G007 | 48 | 9-3-65 | |
| G081 | 24 | 10-1-65 | New mag tape amp |
| G201 | 48 | 9-21-65 | Test in PDP-7 memory |

| TYPE | QUANTITY | DATE OF ISSUE | DISPOSITION |
|---|---|---|---|
| G202 | 48 | 9-23-65 | Test in PDP-7 memory |
| G209 | 48 | 8-28-65 | Test in PDP-8 memory |
| G270 | 12 | 8-28-65 | Digital Test Group Only user — Test in system |
| G270 | 24 | 8-28-65 | |
| G272 | 48 | 9-7-65 | Only used in 2500, 2600 current drivers — extremely hard to test and manufacture. |
| G275 | 48 | 9-8-65 | |
| G276 | 48 | 9-8-65 | |
| G281 | 48 | 8-25-65 | Drum Circuit PDP-6 Test in Drum System |
| G281 | 48 | 8-25-65 | (96) |
| G282 | 48 | 7-18-65 | Drum Circuit PDP-6 |
| G282 | 48 | 8-25-65 | (96) |
| G808 | 48 | 9-3-65 | PDP-8 power supply control — Do not test in power supply — tends to be destroyed if at all bad. |
| G809 | 48 | 8-25-65 | " " " " |
| G850 | 42 | ——— | New DEC TAPE module Very easy to Test |
| G880 | 24 | 8-28-65 | Mag Tape —— Test in system |
| G981 | 32 | 10-6-65 | Joss Audio Osc Test in system |
| R131 | 24 | 8-31-65 | XOR —low usage |
| R151 | 100 | 9-30-65 | Auto Send to AMT |
| R211 | 12 | | Check in PDP-8 |
| R303 | 48 | 8-26-65 | Hard to test |
| R401 | 48 | 8-28-65 | Hard to test — seem like a large number of units. |
| R401 | 48 | 9-3-65 | (244) |
| R401 | 48 | 9-3-65 | |
| R401 | 100 | 9-25-65 | |
| R602 | 48 | 9-29-65 | Auto send to AMT |
| R602 | 48 | 9-29-65 | (96) |

| TYPE | QUANTITY | DATE OF ISSUE | | DISPOSITION |
|---|---|---|---|---|
| W040 | 100 | 9-3-65 | 200 | ½ amp driven low volume |
| W040 | 100 | 9-3-65 | | |
| W052 | 24 | 9-22-65 | 72 | .1 amp driven low volume |
| W052 | 48 | 10-2-65 | | |
| W061 | 48 | 9-11-65 | | Tends to make W040 obsolete. |
| W101 | 48 | 8-10-65 | 96 | PDP-6 IO Check in System |
| W101 | 48 | 9-3-65 | | |
| W102 | 100 | 9-17-65 | | PDP-6 IO Check in system |
| W300 | 48 | 9-9-65 | | equivalent to 1310 system module - low volume |
| W500 | 48 | 8-19-65 | | |
| W505 | 24 | 9-10-65 | 48 | low voltage detector where used? |
| W505 | 24 | 9-10-65 | | |
| W511 | 24 | 8-18-65 | | low volume |
| W590 | 24 | 8-31-65 | | Auto Test To AMT |
| W601 | 48 | 9-2-65 | 148 | Positive Level Amp where Used? |
| W601 | 100 | 9-25-65 | | |
| W602 | 48 | 9-11-65 | 196 | Bipolar Level amp where used? |
| W602 | 48 | 9-15-65 | | |
| W602 | 100 | 9-18-65 | | |
| W690 | 24 | 9-11-65 | | Auto Test To AMT |
| W700 | 100 | 10-6-65 | 200 | Should be Tested Automatically But no program now. |
| W700 | 100 | 10-6-65 | | |
| W750 | 32 | 9-9-65 | | check in PDP-8 system |
| W800 | 48 | 8-13-65 | 132 | Relay module where used? |
| W800 | 84 | 9-18-65 | | |

K Halsey

INTEROFFICE MEMORANDUM

DATE October 14, 1965

SUBJECT PRELIMINARY THOUGHTS ON A NEW COMPUTER LINE

TO N Mazzarese FROM E De Castro

I believe that we should start fairly soon to develop both hardware and software for a completely new line of small computers. Our current machines, because of their limited organization, have made it impossible for us to add features which cost very little and yet are standard equipment on most competitive machines. The following are some of the most predominant deficiencies in our line:

1. We are unable to offer our customers the ability to replace a small machine with a larger one as his requirements grow without asking him to undertake a complete reprogramming job.

2. We do not have a full line and therefore are precluded from a fair segment of the market.

3. We have yet to build a computer small enough and inexpensive enough to fully satisfy the OEM, educational and small laboratory markets.

4. We do not have compatible interfaces and therefore must develop and maintain different peripherals for each computer.

5. We do not have program compatibility and as new programming concepts evolve or new applications areas become interesting we must either duplicate our efforts or forego the competitive advantage on one machine or the other.

Completely replacing a computer line is certainly a large undertaking but we now have several advantages which we have not enjoyed during the recent past. These are as follows:

1. A large order backlog for standard products which can be produced with a minimum of engineering assistance.

2. A competitive line which with only minor modifications can probably be sold successfully for another year.

3. An adequate programming system which, although not fully competitive is complete enough so as not to detract seriously from sales in the short run.

4. Sufficient personnel in the small computer group capable in circuit design, system design and programming.

If we are going to avoid serious fluctuations in our production rate and still allow development to be done in a thorough and orderly manner we must start now to plan the products which will take over as PDP-7 and 8 phase out.

## DESIGN OBJECTIVES

For a new computer line to be successful in the market it must meet several objectives some of which are in conflict and therefore compromises must be made. We must have a low cost basic configuration yet it must not be so inept that peripherals are prohibitively expensive or extremely unwieldy to attach. We must have machines that closely approach the accepted standards yet not so complex in organization that we are unable to sell at a price slightly below that of competition for a computer of equal memory speed and word length. We must do everything possible to get the most mileage out of our engineering and programming effort. To further this objective central processors must all have an identical interface so that one line of peripherals may be designed to connect to any processor. C.P. organization should be such that software may be transferred without change from one machine to another. In achieving this degree of compatibility we must not make it impossible for efficient programs to be written for each machine in the series although this does not mean that the most efficient program for one machine is necessarily optimum for another.

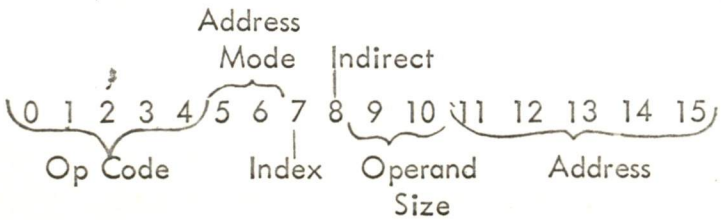
## GENERAL CHARACTERISTICS

The line should consist of three computers having word lengths of 8, 16 and 32 bits respectively. Each machine will have a parallel memory and be capable of performing arithmetic and logical functions in parallel on operands equal to or smaller than the basic word length. In addition the two smaller machines will be able to perform 16 and 32 bit operations by processing operands in serial. For example, if the small machine were programmed to add two 32 bit numbers it would make 4 calls on memory to obtain operands and would add each 8 bit segment individually to the appropriate section of the accumulator using the same adding circuitry for each step. The 16 bit machine would require only two such steps. To achieve compatibility in the other direction the larger machines will be capable of dealing with words consisting of 1, 2 or 4 - 8 bit bytes. Thus the op code which causes the small machine to add a single word will be interpreted by the large machine as a command to add a single byte.

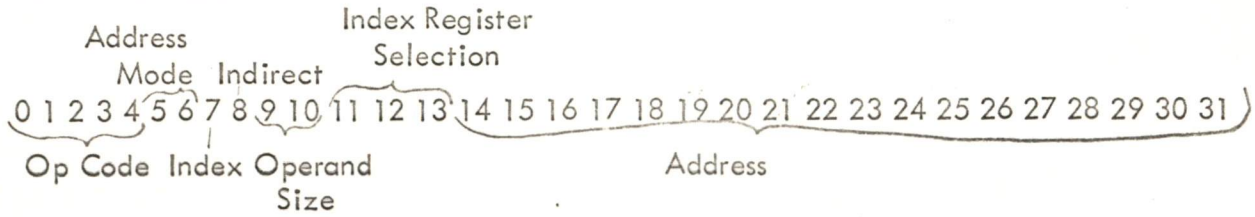
It is desirable to make the 32 bit machine capable of performing some instruction which will not be included in the repertoire of the smaller ones. To maintain compatibility all unused op codes will trap, i.e., cause the program to branch to a fixed location where a subroutine to simulate the non-existant instruction may be located. Some additional storage is thus required in the smaller machines to simulate these instructions.

## INSTRUCTION FORMAT

All instructions are either 16 or 32 bits in length and are fetched from memory in 1, 2 or 4 cycles as required. The small machine must make at least 2 references to memory for each instruction while the large machine may have 2 instructions in a single word. The 16 bit memory reference instruction word format is as follows:



The 32 bit word format is:




"The OP Code portion" is used in the traditional sense and merely selects the instruction to be performed.

"The Address Mode" is decoded as follows:

0 = Immediate i.e. operand is contained in the next 2 bytes immediately following the instruction or in the same word on the 32 bit machine.

1 = Relative forward. Add the contents of the address portion to the current P.C. to obtain the address of the operand.

2 = Relative reverse. Subtract the contents of the address portion from the current P.C. to obtain the address of the operand.

3 = Full address. Fetch the next two bytes to obtain the address of the operand.

Modes 0, 1 and 2 specify 16 bit instructions whereas mode 3 specifies a 32 bit instruction.

"The Index bit" if a one indicates that the contents of the index register will be added to the address after any relative address calculation has been made.

"The Indirect bit" specifies deferred addressing in the usual sense. Multi level indirect addressing is possible. During a defer cycle the address mode, index and indirect bits of each word are obeyed.

"The Operand Size portion" indicates that the operand will be 8, 16 or 32 bits long.

"The Index Register selection bits" allow any one of 8 index registers to be specified in the full address mode. In any other address mode only index register 0 may be used.

"The Address portion" is used to select the first of the 1, 2 or 4 bytes which will be used as the operand. Thus in the 8 bit machine the address portion is equivalent to the memory address. In the 32 bit machine the least significant 2 bits are not used to address memory but rather are used as a byte pointer to select the desired portion of the word.

## INSTRUCTION REPERTOIRE

The instruction set is designed to be complete but straightforward. Many of the instructions can be implemented at very small cost over and above the most basic useful set because they use existing gating and transfer paths. The following list represents a starting point and probably can be improved upon. Instructions are grouped by major function.

1. Memory Reference

   Arithmetic

   - Add to accumulator
   - Add to memory
   - Subtract from accumulator
   - Multiply (optional)
   - Divide (optional)

   Logical

   - AND
   - Inclusive OR
   - Exclusive OR

   Store and Load

   - Load Accumulator
   - Store Accumulator
   - Store Zero in memory
   - Load MQ (optional)
   - Store MQ (optional)

   Index

   - Increment Memory and skip if 0
   - Decrement Memory and skip if 0

   Compare

   - Skip if same
   - Skip if different

Branching

Jump conditional #1

Jump conditional #2

Jump to subroutine

Jump and save P C in index register

In-Out

Transmit memory on IO bus

Transmit IO bus to memory

Test and jump

Miscellaneous

Execute

2. Augmented Instructions

Shifts and Rotates

Logical Shift right (1 or 8 places)

Logical Shift left (1 or 8 places)

Arithmetic Shift right (1 or 8 places)

Rotate left (1 or 8 places)

Rotate right (1 or 8 places)

Long Shift right (optional)

Long Shift left (optional)

Normalize (optional)

Clears and Complements

Clear accumulator

Complement accumulator

Clear overflow

Complement overflow

Coun ting

Increment accumulator

Decrement accumulator

Miscellaneous

Halt

Read switches into accumulator

In-Out

Select device

Transmit AC on IO bus

Transmit IO bus to AC

Most of the instructions listed above are quite conventional. However the jump instructions require further explanation. Since the operand size portion has no meaning for these instructions it will be used to specify the condition for jumping. Conditions are decoded as follows:

Jump #1

0 = unconditional

1 = if AC = 0

2 = if AC = 0

3 = if overflow = 1

Jump #2

0 = if AC is positive

1 = if AC is negative

2 = if overflow = 0

4 = not used

Test and Jump

0 = if device flag 0 is a 1

1 = if device flag 1 is a 1

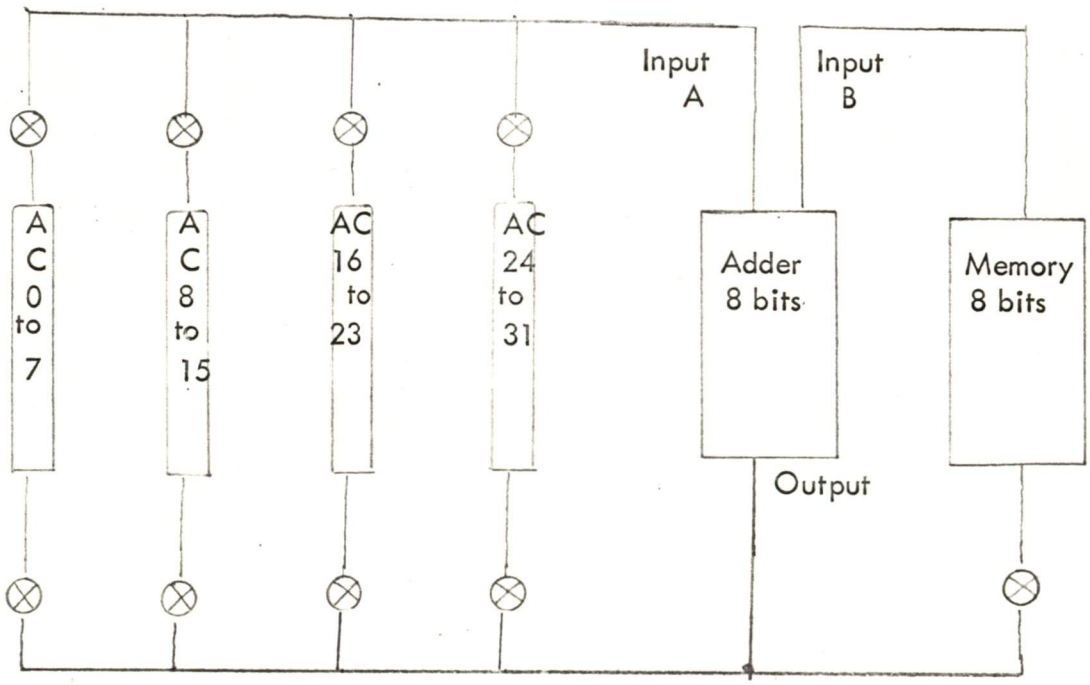
2 = if device flag 2 is a 1

3 = if device flag 3 is a 1

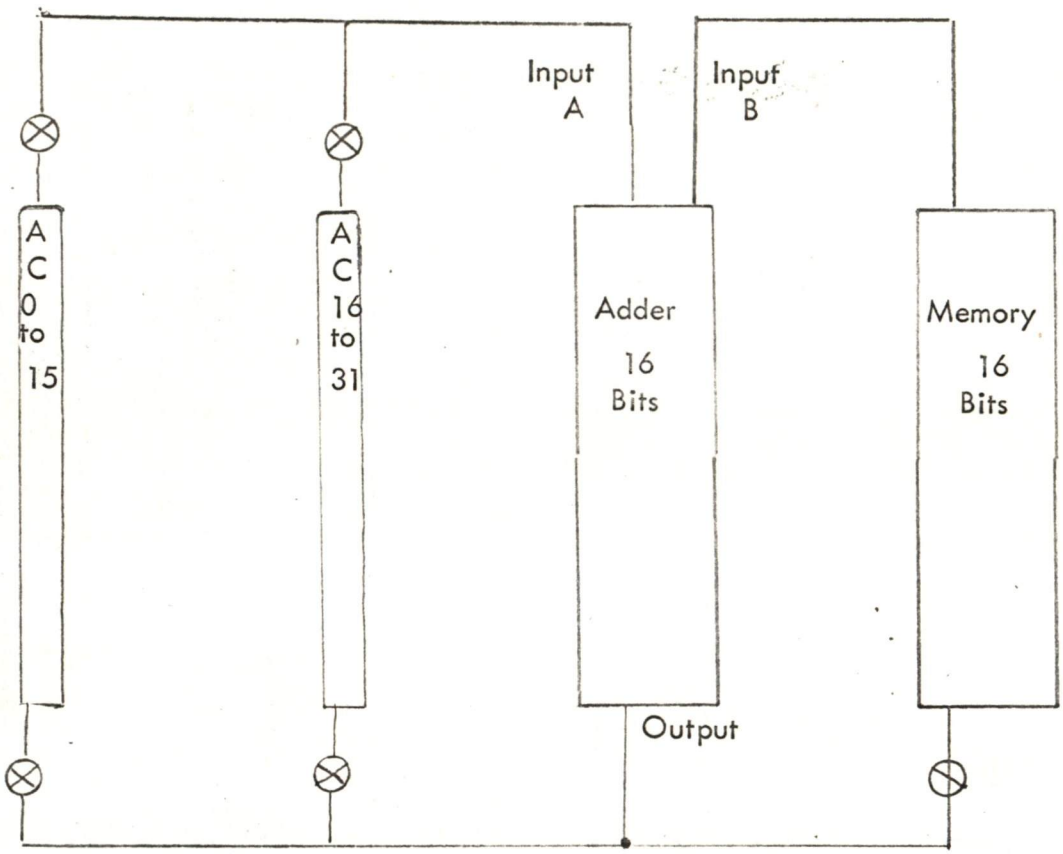
## DATA HANDLING

Internal data is normally handled by moving it from memory to the accumulator where it is processed and then returned to memory. In all machines the accumulator is a full 32 bit register. However its organization and transfer paths differ. The block diagrams below illustrate the organization of each member of the family.

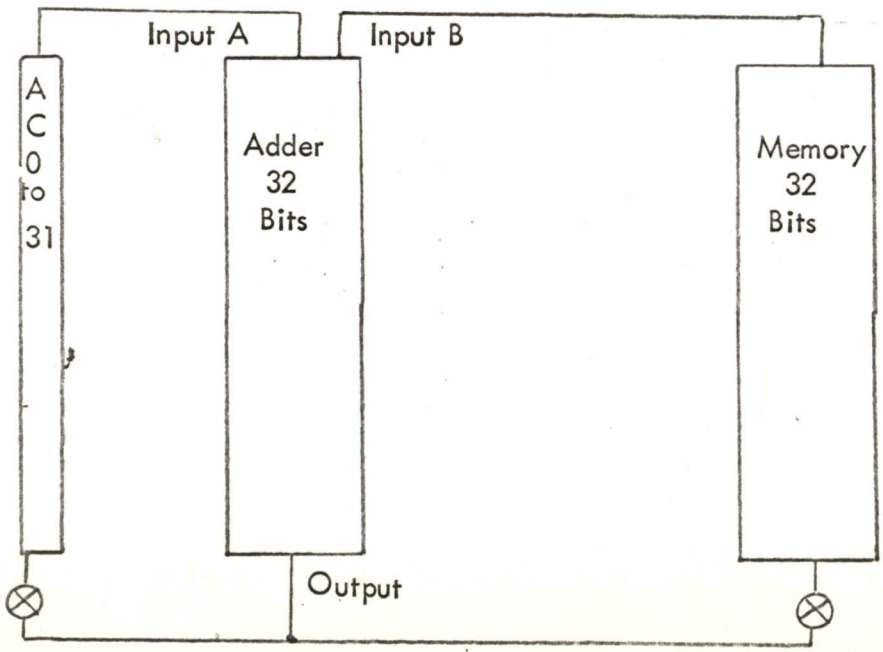
### 8 Bit Organization



## 16 Bit Organization




## 32 Bit Organization



It can be seen that in order to process a 32 bit number with an 8 bit machine, 4 passes must be made through the adder in serial. This of course takes 4 times as long but also substantially reduces the cost since all of the complex operations are done in the adder. The accumulator flip flops themselves are really quite simple and inexpensive. Carries out of any of the lower order portions of the accumulator will propagate into the next higher order part. Carries from the most significant bit will set the overflow flip flop.

## INDEX REGISTERS

Eight index registers are provided and are normally located in core memory. They may however be replaced by flip flop registers as an option. Each index register is 16 bits long including a sign bit. During an index cycle the sign bit will be obeyed, i.e., if it is negative the index register will be subtracted from the address. If it is positive it will be added. In addition if subtraction is specified and the index register is equal to 0 the next instruction will be skipped.

## INPUT OUTPUT

All IO operations will be done on a bus system. Data transmission is normally accomplished as a 2 step operation. The first step is to load the selection register and the second is to transmit the data. The selection register is 8 bits long and its contents are transmitted to each device. Whenever a device recognizes its own code on the selection lines it will make a DC connection to the bus. Actual data transfers may be made with the accumulator using an augmented instruction or with memory using a memory reference instruction. If the transfer is with memory the instruction may be indexed and thus blocks of data may be conveniently transmitted or received. Either 1, 2 or 4 bytes will be transferred depending on the operand size portion of the instruction.

Device status may be tested by use of the test and jump instruction. This instruction will sample any one of 4 status lines on the IO bus. Since the selected device will have previously connected its status information to the bus the program may be branched in accordance with any of 4 different conditions from any of 256 devices.

## ADVANTAGES

An organization along these lines gives us many advantages in return for a small amount of added complexity to maintain compatibility. The most important of these are as follows:

1. A 32 bit arithmetic capability. This will drastically reduce the amount of double and triple precision computations required and thus speed processing and reduce storage requirements.
2. A fairly powerful order code structure which will allow us to write programs to operate in smaller memories.
3. A more efficient method of handling data which allows easy character packing and does not require use of more memory than necessary for data of a given length.
4. A full line with the possibilityof replacing a small machine with a larger one as requirements change.
5. A fully compatible line of peripherals which may be transferred from one machine to the next if the processor is replaced. This will also reduce the engineering cost of peripheral equipment.
6. A fully compatible programming system. This will allow us to invest all of our programming effort in a single language and thus we will be able to develop better software at lower cost.
7. Reduced module costs since all machines will use the same circuits and thus volume will be much higher.

EDEC:ASJ

CC
K H Olsen, J Jones, R L Best,
G Bell, L Hantman

# INTEROFFICE MEMORANDUM

DATE October 12, 1965

SUBJECT

TO Ken Olsen

FROM Jim Jordan

cc: Loren Prentice
John Culkins

In response to your request of September 30, I have chosen five colors to be used with white at the discretion of the individual office holder. One wall will be painted one of the colors, the remaining three walls would be painted white. This gives the color touch which I think you are after while increasing the amount of light within the office. Enclosed are samples of these colors and white for your approval. The color names as indicated on the back are Squash Yellow, Sky Blue, Mustard Tan, Sage Green, Light Vermilion, and white.

# INTEROFFICE MEMORANDUM

DATE October 11, 1965

SUBJECT

TO Ken Olsen
Jack Atwood

FROM Jim Jordan

Congratulations on the new logo as introduced in the Sunday Boston Globe. Now that the die has been cast, I want to coordinate the use of this logo, as it is applied to packaging, stationery, signage, product, labels and trucks, throughout the entire corporation. It's our mark, it's clean and direct - a vast improvement over the old one. I would like to see it used to the best advantage for the corporation.

# INTEROFFICE MEMORANDUM

DATE October 8, 1965

SUBJECT Switchless Circuit Breaker

TO Ken Olsen FROM Irwin Jacobs

George Gerelds and I have talked over the feasibility of using the Wood Electric Company's Model 375 Circuit Breaker in conjunction with a DPST Toggle Switch to replace the Circuit Breaker Model XAM33-20 now in use on the PDP-8 Power Supply and on various Power Control Panels.

The Switchless Circuit Breaker and Toggle Switch have been installed in the experimental PDP-8 on the Engineering Floor and the operation of this circuit has been monitored for the past week. At this writing, no failures have been reported and it appears to be a good electrical substitute for the more expensive circuit breaker.

The cost of modifying existing equipment to accept the Switchless Circuit Breaker follows:

| | | |
|---|---|---|
| New Mounting Bracket | - | $1.00 |
| Switchless Circuit Breaker | - | $1.20 |
| DPST Toggle Switch | - | $1.50 |
| | | $3.70 |

This cost of $3.70 is compared with $9.55 for the Circuit Breaker now in use.

I have checked with Production Control and found that we have enough material on hand and on order to build the next 125 PDP-8 supplies. It is for this reason that I feel we cannot make use of the cheaper circuit on the PDP-8 supplies until our present stock is exhausted. However, we can incorporate this new circuit on some Power Control Panels and there is a good possibility that the PDP-7X can make use of this item.

CC:George Gerelds

# INTEROFFICE MEMORANDUM

DATE October 7, 1965

SUBJECT COST OF MOVING CABINET SHOP AND CARPENTER SHOP FROM BUILDING #5, 5th FLOOR TO BUILDING #3, 1st (BASEMENT) FLOOR

TO Ken Olsen
Nick Mazzarese

FROM Loren Prentice

| | |
|---|---|
| CABINET SHOP | |
| Lighting & Power | $1,200.00 |
| Heating | 300.00 |
| Carpentry | 300.00 |
| Materials | 100.00 |
| | $1,900.00 |
| Painting if done in this area | $1,014.00 |
| CARPENTRY SHOP | |
| Lighting & Power | $1,200.00 |
| Carpentry | 460.00 |
| Material | 200.00 |
| | $1,860.00 |
| Painting if done in this area | $ 594.00 |
| TOTAL OF BOTH AREAS WITHOUT PAINTING. . . . . | $3,760.00 |
| Total of painting. . . . . | $1,608.00 |
| TOTAL OF BOTH AREAS INCLUDING PAINTING. . . . . | $5,368.00 |

One further item which must be done in the future is, the replacement of the wooden door in the foot of the elevator shaft. Payne elevator has given me an estimate of $630.00 for a single blade gate to be installed, giving a grand total estimate of $5,998.00.

If the scheduled work is tight enough in these shops, the moves could be made over a weekend and the only added cost could be the overtime paid to the people in these shops to do their own moving for probably 1-1/2 days (a full Saturday and 1/2 of Sunday). It is possible that these moves could be accomplished in one day each. It is not necessary that they both be moved in the same weekend. This could be started on two weekends as the areas are ready for accupancy in building #3.

Attached is a zerox copy of Frank L. Adams' estimates on painting as you requested.

CONTRACTING
AND
CONSULTING
ENGINEERS
INDUSTRIAL
PAINTING

FRANK L. ADAMS CO., INC.

MEMBER

TWO BROOKS STREET
WORCESTER 6, MASS.
AREA CODE 617 756-8331

FRANK L. ADAMS
DAVID H. ADAMS

May 20, 1965

Digital Equipment Corp.
Maynard
Massachusetts

Attn: Mr. Loren Prentice,
Plant Engineer

Dear Mr. Prentice:

INTERIOR PAINTING

1 In accordance with your request and under your direction, we have inspected and measured various areas of Buildings 7, 7A and 3 for interior maintenance painting.

2 As discussed with you, we are submitting budget prices which are based on areas being more or less free of equipment and materials.

3 Based on the above and our high standard of workmanship and service, we are pleased to submit the following quotation:

Labor (all bonded employees), tools, equipment, transportation, insurance (workmen's compensation - statutory limits, public liability - $100/300,000 limits, property damage - $10/50,000 limits, unemployment compensation and social security) - and all materials -

220V, 60C, AC, fused 30 amps to be supplied by you at convenient outlets without charge -

to furnish clean cover protection for fixtures, floors and working areas;

to scrape and sand to remove loose and deteriorated paint; to spot prime these areas as necessary as well as new work;

to apply one finish coat of paint, in your standard colors, to ceilings, ceiling beams, walls, windows, doors, columns and miscellaneous trim -

the budget prices of:

1) - Building 7 - - - - - - - - - - - - $1,971.00

2) - Building 7A - - - - - - - - - - - 1,634.00

| | | |
|---|---|---|
| 3) - Building 3 - Gardner-Denver area - - | $ | 189.00 |
| (4) - Building 3 - high area - - - - - - - - | | 1,014.00 |
| 5) - Building 3 - area 2- - - - - - - - - | | 231.00 |
| 6) - Building 3 - area 3- - - - - - - - - | | 594.00 |
| 7) - Building 3 - area 4- - - - - - - - - | | 462.00 |
| 8) - Office area - - - - - - - - - - - - - - | | 397.00 |

We believe that you are familiar with the quality of our workmanship, complete insurance coverage and extensive rigging equipment.

Very truly yours,

FRANK L. ADAMS CO., INC.

Herbert E. Chase
Sales Engineer

hec/j

dec INTEROFFICE MEMORANDUM

DATE October 7, 1965

SUBJECT SPECIAL REPORT ON NUMERICAL CONTROL

TO Ken Olsen
Nick Mazzarese

FROM Loren Prentice

I talked with literally hundreds of people concerning their numerical control at the Machine Tool Show. By far, the greatest number are using Mark IV Century control by GE. The second competitor in this field is Bendix, then Hughes and then Pace in that order. Warner Swazy has their own name on it, but it may be made by RCA. Cincinnati Milling Machine is the only company, I believe, making their own electronic control.

Five years ago, all the tool builders thought that GE Mark IV Century was the best control available and some of them went so far as to get a grant for the exclusive use of Mark Century control on their particular type of machine tool. For instance, LeBlond got a lisence so that no one else could use Mark Century control for a period of years for lathe operation. At present, there seems to be a great deal less confidence in GE Mark IV Century control and several companies who are using it, are offering alternates to their customers and no one seems to be completely satisfied with any numerical type control at the present time; nor is any particular format used with paper tape readers. Some are using line at a time reading, some are using 8 blocks and other blocks up to 20 in block readers. Some are using 7 lines, some are using 4, some are using 8 lines of holes.

The Bendix unit is the only one I saw using magnetic tape at the show. Magnetic tape has some advantages where the number of addresses is high; that is, for machine tool operations that take a long time to be performed. Almost all the companies with the exception of Pratt & Whitney, seem to be willing to sell their machine tools without controls and allow the customer to put on their own or specify which electronics company controls that they wish to have. I believe Weiderman has sold theirs with Mark IV Century, Vickers and with one by either Allen Bradley or Cutler Hammer.

In talking with various customers who are viewing these tools and considering their use, most of them are still frightened at the programming and the machine tool companies themselves feel that the greatest resistance to numerical control lies in the

customers fear of the cost and time involved in programming the machine tools. In most cases, the answer from the machine tool builder is that the flexowriter is sufficient to do the programming and several attempts have been made to overcome this.

Several machine tool builders are generating tape on the first pass, allowing the operator to make the tape. At least two others are making optical generators by scanning a drawing to generate the tape, or scanning a drawing to generate the piece directly from the drawing without numerical control. Optical read-in of this method is much less popular then it was five years ago. Fewer companies are offering it as an option and many more are suggesting the use of flexowriters as the easiest programming method for their machine tool.

Several companies are offering semi-automatic control by patch board. This is a patch board directly on the machine. A few years ago this was only evident on machine tools that were foreign built, but this year several small lathes and other machine tools of the small nature could be patch board programmed.

INTEROFFICE MEMORANDUM

DATE October 7, 1965

SUBJECT

TO Nick Mazzarese
Dave Brown
Bill Long
Loren Prentice
✔ Ken Olsen

FROM Jim Jordan

There are several things which I would like to include in any displays which we design for the future. Among them is a rectangular tube; next is a tube with as short a neck as possible; and third is to provide the largest diagonal scope size that we can possibly obtain for ease of use.

Some weeks ago, I had some pictures in the office which showed rectangular display screens. Ken Olsen saw them and became interested but indicated that round tubes were better for spot size, better resolution and the minimizing of pin cushioning. With improved technology in the C.R.T. area, I would at least like to question these opinions. At the suggestion of Ken Olsen I had purchasing write as many manufacturers of tubes, suitable for displays, as they could find. I have received some information on this matter and today, October 6, a representative from Westinghouse came in wanting to know more specifically what our requirements for a C.R.T. would be. Initially, in the letter that was written over my name, we indicated a 27" round tube would be desirable. However, it is more desirable from a marketing viewpoint and aesthetically if we can purchase a 27" diagonal rectangular tube with the same properties that are obtained from the 16" display we are currently using.

In talking over this request and visiting with the Westinghouse representative, Bill Long and Dave Brown requested that we have a project number against which to charge time spent investigating this project. They currently have a lead on a tube which they would like to evaluate. Additionally, there is substantial information which I have collected for which they will need time. The time that I will spend on this project will be minimal in as much as I am primarily interested in just using a rectangular tube. The technical aspects of which are not particularly pertinent to my function except as the neck affects the cabinetry and I would therfore like to see

it minimized. It is not fruitful for me to propose rectangular tubes if we can not use them. What I need then, is more information from which I can make informed proposals. At the earliest opportunity, I would like to discuss this matter with you and determine the feasibility of this project.

INTEROFFICE MEMORANDUM

DATE October 6, 1965

SUBJECT TRIP REPORT - 1965 PRODUCTION ENGINEERING SHOW AND MACHINE TOOL SHOW, CHICAGO, ILLINOIS - SEPTEMBER 29th & 30th

TO Mechanical Engineers
Dick Richardson
Dick Hebden
Dan Varno
Ken Olsen

FROM Loren Prentice

I arrived early at McCormick Place and waited for the show to open Wednesday morning with approximately 1,200 other people. This was the best attended and most enthusiastic show that I have ever attended. The local press, probably with some exaggeration, reported that 75,000 people attended the first three days of the show. I would estimate that 7,000 to 8,000 attended the day I was there.

I had several objectives in visiting the show and the foremost and most urgent was the looking for production handling equipment, especially that which could be used in the production of flip chip modules in the flip chip strates. I had marked on the plan, 32 booths which I planned to visit; that is, make an extra effort to check what they had to offer.

My second objective was to look into the use of tape controlled equipment and to make some inquiry as to the satisfaction of the people with the control equipment they are now using.

My third objective was to check on several different specific items which I deemed necessary for our production in the future. One of the most important of these is finishing equipment and I visited Binks, DeVilbiss and other companies offering items of this nature along with companies offering coating and degreasing equipment. Several companies are offering dip coating equipment and electrostatic painting equipment with hand guns as well as semi-automated equipment. There is not a great deal of new equipment in this field. Some new companies have entered it, but they are not offering equipment with any innovations that haven't been offered before.

In the rather heavier production equipment, I was looking for two things: 1) A sheet metal fabricator of some type that could be tape controlled as a demonstrater of our use of our own equipment; 2) A milling machine of approximately 20 x 30" working surface which could be offered as a demonstrater and

also as a production unit in our own shops.

I visited the Moog exhibit which has the new hydraulically controlled down-feed which is programmable and it also has lead screw tapping and will tap down to 0-80 directly on the machine. They were also offering a cheaper machine with a programmed down-feed operating against stops on a turret and controlled the turret by tape.

Superior Electric is offering a conversion pack to go on a standard Bridgeport milling machine for approximately $4,000 which does very well for this item.

I did not find any other companies offering tape controlled Bridgeports at the show. This is in contrast with five years ago, where from five to ten companies were offering tape controlled Bridgeports of one kind or another.

Several companies have, at least by rumor, broken the rules of exhibits and were either banned from the show or were too late to get in. Noteably among these companies who had sneaked in under somebody elses name were Pratt & Whitney and noteably lacking were Zaggar and the Weiderman Machine Company which is now a subsidiary of Warner Swazy Company.

On the second day, I visited the Machine Tool Show at International Amphitheatre down in the stockyards. This is considerably further from the loop in Chicago then the McCormick Place and takes longer to get there. We had very hard showers in Chicago that morning and many people had dampened enthusiasm before they arrived at the show.

My primary interest here was to visit and look at the heavier machine tools that we expect we may need for our shops in the future. I had marked approximately 20 exhibits for special attention.

Two companies are offering circuit drilling machines; the Leland-Gifford Company and the Edlund Company, a subsidiary of Monarch Machine Tool Company. Leland-Gifford also makes a coordinator which produces tape for their machine optically directed without any further programming. Leland-Gifford makes a turret head type machine similar to the one made by Edlund sometime ago and as far as I now know from the industry, it has never had a successful application. The turret arrangement is fine. Their unit is exceptionally large and heavily made and does not have sufficient speed for small hole drilling. Edlund

was offering two machines; a two station drilling unit and a four station drilling unit. Each of these have mounted as close as possible together, Buck-Eye air drill units. These are used similar to a turret in that a different size drill is placed in each one and the machine is programmed to progress from drill to drill. The machine works very well. Tape operation seems to be fine. There is one problem, and this problems is the amount of air used which is 13 cubic feet of air per minute per drill head. This, coupled with the price of the machine tool, plus the cost of furnishing sufficient air, probably prices it beyond the range of reasonableness. The table movement is smooth and well controlled and the table will accommodate four rather large circuit boards somewhat larger then we require. To make efficient use of this particular tool, we would have to change the number of small flip chip boards that we place on a given size blank. This would be expensive because we would have to generate new dies for cutting up the boards.

Several small tape controlled machines were exhibited with single drill heads. I had visited the previous day, the Nashoba Drill exhibit in the Production Engineering Show. The machine is equiped with precise drill heads and Gilman slides and was very well received at the show. With these slides and a dove-tailed cross slide, very precise drilling can be accomplished. They were using paper base material and obtaining extremely accurate hole locations and very small round holes. These were very carefully measured on the Farrand measuring instrument that was in an adjoining booth and no error was found greater then approximately .0002" over a reasonably large pattern. Edlund is also producing several types of milling machines that are tape controlled and as far as I could see, they are producing the cheapest tool changing vertical milling machine at the show with guaranteed accuracy of $\pm$.001" and repeat accuracy of $\pm$.4". This has approximately a 20" x 30" table with approximately 20 tool stations which can be selected in any sequence. I believe the control was Pace. The only fault I could find with the machine was the quill and spindle were too light for very heavy work. However, I believe it is the cheapest machine tool with the versatility in this size. 20 tools could be selected and, in a very short time, placed in operation and brought to the work in any sequence.

Another machine tool in this category was Van Norman. It is a heavy bridge type machine with a table 20" x 28", tape controlled, very well made and doing very nice and precise work.

The Hillyer Company is making a machine tool of a similar type. Others offered in this field are Cincinnati, Heald and Pratt & Whitney (which has an exhibit under True-Trace Corp. in the first show).

I visited two companies who are building high speed tape controlled or tracer controlled routers. These will handle aluminum in thicknesses up to approximately 1", very rapid material removal, particularly for the removal of inside surfaces and contouring. Both units that I witnessed did extremely good work and extremely fast.

I visited all the companies exhibiting press brakes & shears. Among these are Niagra, Famco, Dreis & Krump, Lodge & Shipley, and Di-Arco.

No turret fabricators were exhibited with the exception of Di-Arco. There is a rumor that Wales Strippit, which is owned by the same parent company as Di-Arco, will shortely bring out a turret operated machine. They have a new small fabri-matic with the gaging on the right side of the machine as well as the duplicator being on the right hand machine so that gage made templates do not have to be flipped both ways in order to be used on the duplicator. The machine capacity has been increased with a deeper throat and the tonage remains the same. This was their newest tool and the first time publicily shown at the show.

Most companies that are offering hydraulically controlled press brakes are offering two or multiple speed press brakes, a rapid approach of the ram with a slow speed through the stroke.

Lodge & Shipley is offering the most precise shear I have ever seen with very well and easy to use read-out dials. This is specifically aimed at people who use it for electronics and have a tape controlled punch and punch up a large sheet of multiple sections for electronic gear and then precisely cut these into small sections.

Two other innovations were an 8 or 10 position tool, rotary, motor driven, lower die block presented by Niagra. With a long bred press, with this rotary die in position, several different operations can be completed like a progressive die.

One of the mostinteresting exhibits for us, I believe, is put on by the Minster Machine Company who has a permanently built-in die set with quick change arrangement for die plates

located to very precise manner. These can be used for piercing or shallow drawing on the 35 ton press; die plates of approximately 7" x 7" or 9" x 9" could be used; time to change from 1 die set to another die set is 30 seconds; motor driven; down-feed to the ram and lock. The two main advantages are; a small amount of storage space required for the die plates, and the quick change from die to die allowing very short runs. This system might be very well used in producing flip chip modules, even in small quantities with a minimum expense for perforation dies. Very possibly competing very successfully with any drilling operation.

I visited every company exhibiting multiple drill heads. Some of these, particularly the National Company, make extremely large units of this nature and a noteable exception was that Zaggar was not exhibiting at either show.

I visited practically all the companies making lathes in the sizes that we are interested in. Most of the larger lathe companies have gone to either tracer or tape control in their exhibits. The most noteable improvement was by the LeBlond Company who was making the only American made gap lathes and sliding bed lathes. They have taken corrective measures to stiffen the bed which has been one of the reasons people have shied away from using gap lathes or sliding bed lathes. They have also made considerable improvement in their toolroom lathes; increasing the versatility of the feeds; the threading that is available; and the number of feeds and speeds. This toolroom lathe is extremely precise and should have a life of 10 to 15 years without any loss of precision.

Other people exhibiting extremely precise and expensive lathes are Lodge & Shipley, Sheffield & Monarch.

I believe, literally hundreds of brochures will be mailed to me from the show. These will be distributed to all you people during the following weeks. I wish everyone might have attended as it was very informative and inspiring.

# INTEROFFICE MEMORANDUM

DATE October 6, 1965

SUBJECT Advances to Equipement Digital S.A.R.L.

TO Ted Johnson
cc: Ken Olsen ✓

FROM H. Mann

We have advanced an additional $10,000 to France in accordance with your instructions. Attached is a copy of the letter of transmittal which also includes a summary of the current status.

It is my understanding that you will prepare recommendations in the next 30 - 60 days in respect to the continuation of the French office and its management.

Harry S. Mann

d g t a l equipment corporation
MAYNARD, MASSACHUSETTS
TWinoaks 7-8822 TWX MAYN 816

October 6, 1965

Mr. Arnaud De Vitry
C/O Alfred Davidson
12 Rue de la Paix
Paris 2, France

Dear Arnaud:

Monday, D.E.C. transferred the equivalent of $10,000.00 U. S. dollars to the account of Equipement Digital S.A.R.L. This transfer brings our total outstanding loans to $45,300.00 which is $5,300.00 in excess of our agreement of July 6, 1965, to loan your company the equivalent of 200,000 French Francs, therefore, would you please have a note prepared to cover this transaction, bearing interest at the rate of 4% and which shall be payable within two years from 10/4/65. Please find attached a summary of total loans outstanding with the appropriate interest charges to the end of September. The interest has been calculated on the basis of a 30 day month. This interest should be recorded on the books as interest expense payable to D.E.C.

Thank you for your co-operation.

Sincerely yours,

Harry S. Mann
Treasurer

HSM/tr

Enclosure

cc: T. Johnson
G. MacDonnell
B. Haus

| Date | Amount | Daily Interest | Number of Days | Interest to 9/30/65 |
|---|---|---|---|---|
| 4/12/65 | $ 5,000.00* | $ .56 | 168 | $ 94.08 |
| 5/12/65 | 1,000.00* | .11 | 138 | 15.18 |
| 5/19/65 | 2,000.00* | .22 | 131 | 28.82 |
| 5/28/65 | 2,000.00* | .22 | 122 | 26.84 |
| 6/16/65 | 4,000.00 | .44 | 104 | 45.76 |
| 6/28/65 | 1,000.00 | .11 | 92 | 10.12 |
| 7/19/65 | 4,500.00 | .50 | 71 | 35.50 |
| 7/28/65 | 5,000.00 | .56 | 62 | 34.72 |
| 8/4/65 | 800.00 | .09 | 56 | 5.04 |
| 8/17/65 | 5,000.00 | .56 | 43 | 24.08 |
| 9/17/65 | 5,000.00 | .56 | 13 | 7.28 |
| 10/4/65 | 10,000.00 | 1.11 | | |
| Total | $45,300.00 | | | $327.42 |

*Initial deposits in D.E.C. Acct. in Paris, but used by Equipement Digital, therefore, considered loans.

END
+
DIGITAL MAYN

DIGITAL PARIS+
DIGITAL MAYN

26 OP PARIS+
DIGITAL MAYN

DIGITAL PARIS
MSG PAR Ø92
TO KEN OLSEN
FROM BERNARD HAUS
THANK YOU FOR YOUR MSG 1681.
WE ARE WORKING VERY HARD SATURDAYS, SUNDAYS AND NIGHTS INCLUDED TO SELL SOME PDP 6 S. WE WANT AND WE CAN MAKE THOSE SALES. IF MAYNARD FEELS THIS IS NOT ABSOLUTELY NECESSARY, PLS TELL ME
END OR GA PLS

OK



END
DIGITAL PARISD+
DIGITAL MAYN

# INTEROFFICE MEMORANDUM

DATE October 5, 1965

SUBJECT Product Line Statement Reference

TO Ken Olsen
Harlan Anderson
Harry Mann
Stan Olsen
Win Hindle
Nick Mazzarese

FROM Ed Simeone

Attached is the "Product Line Statement Reference" which is a detailed line by line description of the content of the monthly product line statement.

The September 1965 statements are being prepared on the basis as described in this reference.

If, in the future, it becomes necessary to make changes in the preparation of the statements, amendments will be issued to the Product Line Statement Reference.

Product Line

Statement Reference

Line 1 — Sale of New Equipment: Total of domestic and foreign billings of new equipment at gross prices. In consolidation inter company billings are eliminated.

Line 2 — Sale of Leased Equipment: Total of domestic and foreign billings of equipment previously on rental. The amount billed is net of credits given for rental payments received but is before any other discounts, allowances or credits. In consolidation inter company billings are eliminated.

Line 3 — Rental and Maintenance Service Income: Total of domestic and foreign billings of equipment on rental. Also includes domestic and foreign billings for maintenance contracts and service. Rental billings are credited to product lines per the lease. Maintenance and service contracts are credited to field service. In consolidation inter company billings are eliminated.

Line 4 — Gross Revenue: The sum of lines 1, 2 and 3.

Line 5 — Contributions: The value of equipment donated included in new equipment billings, line 1.

Line 6 — Trade in and Returns Allowances: The value allowed for equipment being traded in or returned.

Line 7 — Quantity Discounts: Deductions from gross sales due to quantity, OEM and distributors purchases. Inter company discounts are eliminated in consolidation.

Line 8 — Net Operating Revenue: Line 4 less lines 5, 6 and 7.

Line 10 — Job and Standard Costs: Actual material, labor and budgeted overhead job costs applicable to domestic and foreign billings of computers and special products. In addition, the standard material, labor and overhead applicable to domestic and foreign billings of modules. In consolidation inter company billings are eliminated. Also includes the actual material, labor and budgeted overhead applicable to maintenance contracts and service, charged to field

service product line.

Line 11 — Other Job Costs: Actual material, labor and budgeted overhead applicable to Manufacturing and Customer jobs which were billed in prior months. Also, costs to invalid job numbers, cancelled jobs and other miscellaneous charges and credits to cost of sales.

Line 12 — Manufacturing Overhead Variance: The sum of overhead center variances from all Manufacturing Overhead Centers. This variance is allocated to product lines on the basis of budgeted cost of sales (Lines 10 through 17) for the current quarter. Budgets dated July 2, 1965, will be used for fiscal 1966. Also, includes the overhead center variances from the Field Service Overhead Center, charged primarily to field service product line.

Line 13 — Variances from Standards: The difference between purchase price and standard price due to raw material purchases during the month. Also, material, labor and overhead variances (from standard) from the prior month production. This variance is allocated to product lines on the basis of module content, i.e. cost of modules used in product lines based on budget for fiscal 1966.

Line 14 — Book Value of Leased Equipment Sold: Actual material, labor and budgeted overhead, less depreciation, of equipment sold previously on rental.

Line 15 — Warranty Costs: Actual material, labor and budgeted overhead expended on equipment covered by warranty. This cost is accumulated by product lines on the basis of charges from field service operations.

Line 16 — Royalty Expense: Expense incurred for the sale of core memories in lines 1 and 2 of a non-renegotiable nature. This expense is accumulated by product lines on the basis of equipment designation.

Line 17 — Depreciation of Rented Goods: Depreciation expense for equipment leased to customers based upon the total cost of the equipment and depreciated over a four year period. The double declining balance method of depreciation is used to arrive at the depreciation expense. This expense is accumulated by product lines on the basis of equipment per the lease.

Line 18 — Costs Directed to Operating Revenue: The sum of lines 10 through 17.

Line 20 — Gross Profit: Line 8 less line 18.

Line 30 — Product Line Marketing: Total actual material, labor and budgeted overhead applicable to sales job numbers for marketing purposes. This cost is accumulated by product lines on the basis of job number charges.

Line 31 — Domestic Selling: Total actual material, labor and budgeted overhead to domestic sales overhead centers. This cost is accumulated by product lines on the basis of job number charges.

Line 32 — Foreign Selling: Selling costs from foreign sudsidaries plus actual labor and materials in foreign overhead centers.

Line 33 — Advertising: Total actual material, labor and budgeted overhead applicable to sales job numbers in series P1000 and P2000. This cost is accumulated by product lines on the basis of job number charges.

Line 34 — Trade Shows: Total actual material, labor and budgeted overhead applicable to sales job numbers in series P4000. This cost is accumulated by product lines on the basis of job number charges.

Line 35 — Promotion Literature: Total actual material, labor and budgeted overhead applicable to sales job numbers in series P3000, P5000, P6000, P7000 and P8000. This cost is accumulated by product lines on the basis of job number charges.

Line 36 — Selling Overhead Variances: The sum of overhead center variances from all marketing and selling overhead centers and the costs charged to invalid sales job numbers. This amount is allocated to product lines on the basis of total actual selling costs (lines 30-35) by product line for the current month.

Line 37 — Total Selling Expense: The sum of lines 30 through 36.

Line 40 — Product Line: Total actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "hardware" (except modules which are designated as Flip Chip). This cost is accululated by product lines on the basis of job number charges.

Line 41 — Product Line: The actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "software" (except modules which are designated as "Systems & Lab Plug-in Units" and Digital test systems designated as "Current Drivers"). This cost is accumulated by product lines on the basis of job number charges.

Line 42 — Central Storage Devices: The actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "storage devices" and allocated to product lines on the basis of 50% to the Large Computer Line, 25% to Product Lines 4 & 7 and 25% to Product Lines 5 and 8. The allocation percentages are subject to change by product managers only.

Line 43 — Central Semiconductor Development: The actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "semiconductor development" and allocated to product lines on the following basis:

| | | | |
|---|---|---|---|
| Large Computers | 10% | Modules | 50% |
| PDP-6 10% | | Special Products | 10% |
| Small Computers | 30% | Digital Test Equipment | 5% |
| PDP-7 15% | | Linc | 4% |
| PDP-8 15% | | Computer Aided Design | 1% |

Line 44 — Central Strate Development: The actual material, labor and budgeted overhead charged to company sponsored development jobs designated as "strate development" and allocated to product lines on the following basis:

| | | | |
|---|---|---|---|
| Large Computers | 10% | Modules | 50% |
| PDP-6 10% | | Special Products | 10% |
| Small Computers | 30% | Digital Test Equipment | 5% |
| PDP-7 15% | | Linc | 4% |
| PDP-8 15% | | Computer Aided Design | 1% |

Line 45 — Manuals: Total actual material, labor and budgeted overhead applicable to sales job numbers in series P9000. This cost is accumulated by product line on the basis of job number charges.

Line 46 — Engineering Overhead Variances: The sum of overhead center variances from

all engineering overhead centers and the cost charged to invalid engineering job numbers. This amount is allocated to product lines on the basis of total actual engineering costs (lines 40-45) for the current month.

Line 47 Total Engineering Expense: The sum of lines 40 through 46.

Line 50 Administrative Expense: The sum of actual Accounting, Administration, Personnel, Training and Purchasing Overhead Center expenses. These charges are allocated to product lines on the basis of the sum of actual selling, cost of sales and company sponsored engineering by product line for the current month.

Line 60 Profit Before Taxes: Line 20 less lines 37, 47 and 50.

October 5, 1965

dec INTEROFFICE MEMORANDUM

COMPANY CONFIDENTIAL

DATE October 5, 1965

SUBJECT MODULE SALES INVENTORY

TO Ken Olsen

FROM Frank Kalwell

Module Sales Inventory as of September 13, 1965 was $197,565.00. As of today - October 5, 1965 - with the increase of flip chip modules into Module Sales Inventory, an estimated Module Sales Inventory is $250,000.00.

Based on Stan's forecast for '65-'66, the following is the goal of Module Sales in respect to inventories.

| | MODULE BOOKING FORECAST | MODULE SALES INVENTORY FORECAST |
|---|---|---|
| 1st Quarter | $1,100,000 | $ 400,000 |
| 2nd Quarter | 1,100,000 | 400,000 |
| 3rd Quarter | 1,400,000 | 500,000 |
| 4th Quarter | 1,900,000 | 700,000 |

# INTEROFFICE MEMORANDUM

DATE October 4, 1965

SUBJECT Product Line Reports
Production vs. Requirements

TO Kenneth H. Olsen ✓

FROM Dave Packer

This is to remind you to have both module production areas report to the product lines on production vs. requirements at the end of each month.

This report is necessary feedback in the module ordering system. It assures each product line has the same idea of what they have on backorder as the manufacturing people do.

A good format for the report is:

Modules Production Report
Prod. Area :
Product Line:
Month :

| Type | (1) Backorders at Begin. | (2) Ordered this Mo. | (3) = (1) + (2) Total Req. This Mo. | (4) Total Produced | (5) = (3) - (4) Backorders at End |
|---|---|---|---|---|---|

Dave

DP:ncs

INTEROFFICE MEMORANDUM

COMPANY CONFIDENTIAL

DATE September 28, 1965

SUBJECT Status of Potential Patent Licenses and DEC Portfolio

TO K H Olsen
H Mann

FROM J P Hastings

1. Western Electric

Subject - Data processing system patent licensing program that includes the Bell System patents on computers.

Initial Contact - Donald C Mead to Kenneth Olsen - 6/18/65

Current Status - Western Electric notified KHO this month that they want to discuss possible patent license agreement. Cesari acknowledging last communication.

2. IBM

Subject - Data processing portfolio.

Initial Contact - T E Birchfield to Kenneth Olsen 3/15/62.

Current Status - DEC waiting for L W Miles ot IBM to contact us. When IBM does approach us we are going to suggest IBM is possibly infringing the Olsen-Best patent on high-speed magnetic core memory; also DEC has a number of new applications which they may review.

3. Technitrol Engineering Co (Thomas K Sharpless)

Subject - Moving magnetic storage system of the magnetic disc and tape type.

Current Status - Technitrol suing government; DEC waiting for outcome of suit; hopefully we will hear nothing for two years.

4. Cleeton

Subject - Generating pulses which employ monostable multivibrators in the delay and pulse width circuits.

Initial Contact - Paul T O'Neil (Shanley and O'Neil) to DEC 10/12/64.

Current Status - 8/2/65 DEC agreed with Cesari to offer Cleeton $250 for a paid up license; no reply to date from Cleeton.

5. Illinois Scientific Development Inc (Sperry Rand subsidiary)

Subject - Eckert and Manchly's electronic numerical integrator and computer patent number 3,120,606; issued 2/4/64.

Current Status - ISD experienced internal reorganization; after they contacted DEC we asked ISD to point out the parts of the patent they think we are infringing; no reply to date.

6. MIT

Subject - Three dimensional magnetic core storage.

Initial Contact - MIT contacted us approximately 6/64.

Current Status - DEC committed to meet with MIT within a month in an attempt to resolve DEC's patent liability, if any.

DEC Portfolio

Serial #2,977,485, Filed 11/28/58, Inventor, K H Olsen, Title - Diode-Transformer Gating Circuit (Flip-Flop), File 83-001. Issued 3/28/61.

Serial #3,161,861, Filed 11/12/59, Inventor, K H Olsen, R L Best, Title - High Speed Magnetic Core Memory, File 83-004. Issued 12/15/64

Serial #199,837, Filed 6/4/62, Inventor, H Anderson, K H Olsen, B Gurley R L Best, Title - Improved Line Printer Buffer, File #83-005. This application is about to be issued as a patent.

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In addition to the above, there are approximately ten applications pending in the Patent Office.

JPH:ASJ