Remind me to check & see if Ken called

dec

# INTEROFFICE MEMORANDUM

DATE 12-24-63

SUBJECT PDP-5 SALES (POSSIBLE)

TO K. H. Olsen

FROM Dave Denniston
NYO

Ken - call Bob Hughes stopped in today and among other things gave us a letter of commitment for five (5) PDP-5's. This is pretty much speculation, but with a fair amount of confidence on two of the machines.

Bob mentioned an upcoming Request For Quotation from the State Department on a switching center to replace existing Phillips equipment in Washington, D.C., (Not connected with the Paris system) and wondered if we would be interested in bidding as prime contractor at this time. I think he would appreciate a 'phone call.

DBD:BMP

CC: H. Anderson
S. Olsen ✓
N. Mazzerese

DATA TRENDS INC

R. W. HUGHES
PRESIDENT

# DATA TRENDS, INC.

1259 RT. 46, PARSIPPANY, N. J. TEL 201-334-1515

24 December 1963

Mr. David Denniston
Digital Equipment Corporation
1259 Route 46
Parsippany, New Jersey

Dear Dave:

Data Trends, Inc. intends to order five (5) PDP-5 machines during the next 12 months.

As discussed, we request delivery of the first PDP-5 on or before February 24, 1964. Basically, the configuration is the standard machine but with the 4,096 word core storage. Final details on the configuration will be forwarded separately.

For the remaining four machines the requested delivery schedule is:

April 1, 1964
June 1, 1964
August 1, 1964
October 1, 1964

This order is based on our understanding that we may cancel any or all deliveries up to thirty (30) days before the specified delivery date.

With best regards,

R. W. Hughes

RWH:jag

# INTEROFFICE MEMORANDUM

DATE December 11, 1963

SUBJECT Digital's Art Exhibit - 1964

TO DEC Managers

FROM Elsa Newman

After several inconclusive attempts, a committee of art-minded employees has been nominated to work on one or more art projects. Henry Crouse's objective to focus attention on the cafeteria was discussed with Elsa Newman and after some further thought, others were brought in on the old art festival idea (prior to the cafeteria focus). The ON LINE article, somewhat elaborated on by Don Watson, has put the Committee on record. This memo requests the assistance and blessing of management.

I should like to know what limitations, if any, you may wish to place on the purpose of the Committee and its scope. Its present tentative goals are:

1. To stimulate employee interest in expression and appreciation of art.

2. To encourage the expression of cooperative, creative processes for either direct or indirect communal good. Places that will be improved: The cafeteria, the lobbies, etc.

Paintings by J. Lozouski, T. Bertz and others could be placed in Bldg. 5 Reception Hall before December 15.

Elsa
Elsa Newman

EN:ajc

# INTEROFFICE MEMORANDUM

dec

DATE December 9, 1963.

SUBJECT

TO Ken Olsen

FROM Denny Doyle

1. I thought it would be a nice gesture for you to send a Christmas card to a couple of the people you met up here last summer:

   1. Dave Coll - Defence Research Telecommunications Establishment,
      Shirley Bay,
      Ottawa, Ontario.

      (He showed us around and had lunch with us)

   2. Mr. D. Patterson - Same address

      (He was doing radar work)

   3. Mr. E. Ducharme )
   4. Mr. G. Lockwood ) - Same address

      (The film reading people)

   Sent 12/20 ek

   I don't know about the Chalk River people - I presume you met the following people:

   1. Dr. L. G. Elliott
      Physics Division Head
      Atomic Energy of Canada Ltd.
      Chalk River, Ontario.

   2. Mr. Clayton

   3. Mr. P. Tunnicliffe

2. I spoke to the Central Dynamics people when I was in Montreal the other day. Their engineer told me they bid on the Chalk River job in three different ways, with a PDP-4, an SDS 910, and a DDP-24. Boland lobbied quite vigorously to people like the Minister of Industry, Mr. C. M. Drury, and the president of AECL, and as the engineer said, they waved the Canadian flag quite hard.

Their impression is that Foxboro is getting the job although we seem to think it is Honeywell. In any event, Central Dynamics never was in the running even though the SDS rep. here in Canada actually wrote their quote for them. As you recall, I refused to do this for them as we were bidding against them and in the event we got the job, we would have been in real trouble with them; I now am more convinced that we did the right thing since SDS was in the same bed with us all the time.

Denny

Denny.

DJD:LMM

# INTEROFFICE MEMORANDUM

DATE December 6, 1963

SUBJECT Meetings Scheduled for Week of December 15-20, 1963.

TO K. Olsen ✓
H. Anderson
N. Mazzarese
S. Olsen
D. Best
A. Kotok
B. Savell
B. Long
D. Morse

FROM R. Lane

The following meetings with customers have been scheduled for the week of December 15-20, 1963:

Monday, 2:00 p.m. - Raytheon Company
Discussion on PDP-6

Attendance: A. Kotok
R. Lane

Tuesday, 10:30 a.m. - MIT Project MAC
PDP-1 and 340

Attendance:

| DEC | MIT |
|---|---|
| R. Lane | J. Ward |
| R. Savell | Mr. Ross |
| B. Long | Mr. Minskey |
| A. Kotok | |

Wednesday, 10:30 a.m. - ITT
Discussion on PDP-6

Attendance:

| DEC | ITT |
|---|---|
| A. Kotok | H. Mills |
| R. Lane | D. Cronin |
| D. Best | E. Wolf |
| D. Morse | |

Purpose - Technical Discussion on PDP-6 and associated software and peripheral devices.

Friday, 10:30 a.m. - ITT
Purpose - Management Visit.

Attendance:

| DEC | ITT |
| --- | --- |
| R. Lane | T. Dmochowski |
| H. Anderson | G. Mauksch |
| K. Olsen | |

If you cannot attend these meetings, please contact me.

DATE December 3, 1963

SUBJECT Europe trip November 10 - 21, 1963

TO Ken Olsen
Harlan Anderson
Stan Olsen

FROM Jon Fadiman

On Monday, November 11, I visited the Philips plant in Eindhoven, Netherlands. I spent the time with Mr. Béla Csonth who is at present in charge of memory test equipment at Philips. Our system is working well except that the 5Ω General Radio potentiometers need to be replaced by 5Ω Claristat potentiometers. In addition, the switches on the units and tenths position of the level discriminators are weak. In general however, they have had very little maintenance on this machine. Mr. Csonth has since designed a memory tester of his own, which he calls the Philidec, of which he is installing the first at the Philips plant in Evreux near Paris. He is also suggesting that he would like to install a similar machine at the Philips plant in England which is Mullard. This is an almost direct copy of our machine except that he has designed new circuits, uses silicon control rectifier switches for the X and Y axes and reed relays for the Z axis and sense switches. All of the ideas of the memory tester are taken from our 1516. I saw the prototype machine in operation and it does look very good. Mr. Csonth seems to have done an excellent job. Philips is going to go into the computer business and make small computers in the future, which might be competition for our PDP-5 and PDP-4. However, Mr. Csonth does not seem to think that Philips will do very well since they are such a slow moving conservative outfit, and that by the time they bring out a computer it will be very outdated.

I spent all of Sunday evening with Béla Csonth at his home. He is definitely interested in coming to work for us as the Manager of a European office. I think that he is an excellent man and that we should consider hiring him. Both Win Hindle and I have his resumé on file. His background is in Mechanical Engineering and the Machine Tool Industry in Hungary. Since then he has worked as an Electrical Engineer at Philips, designing first variacs and then responsible for memory test equipment. He has done a considerable amount of circuit design and systems design. He is an extremely adaptable person, learns fast, and speaks French, English and German fluently as well as Dutch, Hungarian and some Italian. Ted Johnson will be seeing him again in the near future.

I do not think that there is much chance of selling very much additional equipment to Philips, in as much as they seem to wish to make everything themselves. Of course it is Béla Csonth who has done all the making, and therefore hiring him might change the situation slightly.

The rest of my visit was spent in Paris. On November 14, Guenter Huewe and I visited M. Llop at the Societié d'Optique et Mechanique, 125 Boulevard Davout, Paris 20, France. These people have the job of making an entire SMP ( Scanning Measuring Projector) for CERN and other customers. They are mechanical people and are doing the mechanical job of the actual measuring table and optics. Since they have the entire systems responsibility they must purchase the rest of the system, i.e., the electronics from someone else. CERN has suggested us as the logical supplier for the electronics. This job has already been done by Lawrence Radiation Laboratory at the University of California and I have all of the block schematics of the LRL system here in my office. Guenter and I decided to make a bid on the entire system which we submitted on November 15. The price for the first system is $23,000. not including some additional power supplies which we would have to buy and add on. The company asked for a bid of up to twenty systems. Most of the system consists of reversable counters and other logic which we can very easily realize with our system plug-in units. They would want the first of these systems delivered by about the end of May, 1964. I think the chances of our getting at least one of these systems is very good, probably about 80%.

I spent a considerable amount of time at Cofelec installing the Memory Tester 1516. I worked mostly with M. Eusbio who works for M. Dufour. The Memory Tester was installed without any difficulty whatsoever and everything worked perfectly. Cofelec was extremely well impressed with this machine. Indeed, I talked with them about buying a Semi-Automatic Core Tester, Model 2108 and they asked me to write a quotation immediately. I did so and the next day they gave us a purchase order for this machine. No one in this company speaks any English so it is a bit difficult for Guenter to work there. However he did spend some time there doing some very thorough checkout work of the Memory Tester to make sure that everything was operating properly. M. Eusbio seems to understand the operation of the machine very well.

On Tuesday, November 19, John Leng and I visited Saclay which is outside Paris. This is the Atomic Energy Commission of France. We were supposed to have an appointment with Dr. Y. Amram. However, he was sick that day so we spoke with M. Mugel. He explained to us how the Pulse Height Analyzers at Saclay work and we explained to him how the PDP-5 worked as a Pulse Height Analyzer. He was considerably impressed. He spoke no English so I had to translate everything between John Leng and him, which made things a bit difficult. John Leng and I then gave a talk to about 20 physicists on the general structure of the PDP-5 Computer, the PDP-5 used as a Pulse Height Analyzer, and some major details on the PDP-1 and PDP-4 Computers. The talk was very well received. There were a lot of very intelligent questions, which showed that the physicists did understand the use of the PDP-5 as a Pulse Height Analyzer and appreciated it. The talk was given completely in French and no one understood any English. After the talk, many of the physicists came to our booth at the Mesucora show to see the equipment in use. Many other people at Saclay had already heard about it and came to the booth; thus I felt that this was an extremely valuable visit.

The first few days of the Mesucora show were very slow but after that, the booth was crowded most of the time. There was very great interest from Saclay who would probably be our best customer in France, other customers associated with Saclay such as College de France, and Ecole Polytechique. People from the Eléctricité de France and Gaz de France were also very interested in the PDP-5 as a control system. I feel that the French market is expanding rapidly and we should definitely take advantage of it at this time.

At the show I spent a considerable amount of time with M. P. Lantieri from Le Materiel Electrique, S.W. This company was introduced to me by Mr. Arnaud de Vitry and he was with me at some of the conversations. Actually they are a group who are interested in doing process control work with full system responsibility. They have their own computer, the PSP77, which they are developing for a price somewhere between $20,000. and $40,000. This would compete with either our PDP-5 or PDP-4. So far, although they say they have sold some, there are none in operation, and the computer on display at the show was not operating. This company says they are interested in working with us to represent us but what they really want is for us to license them to build our computer. This would not be very attractive for us. I suggested that we could sell computers to them which they could use in their control system. However, this did not interest M. Lantieri very much. I feel that they are primarily a competitor and not a customer. There address is 36 Quai National, Puteaux ( Seine) France. Telephone number LON2235.

I also visited Jean Lebel at the Centre Lebel d'Études Scientifiques ( CLES). He has already bought some of our system plug-in units and is about to purchase a considerable amount more of our A-D equipment and possibly sample and hold circuitry. He is using this in systems which he is designing for seismographic work. M. Lebel has indicated that he would try to be of help to us if we wish to establish a Paris office. He feels very strongly that we should establish a Paris office as soon as possible to take advantage of the French market. It is essential to have a European in Paris who speaks French. It is not possible to do business in France in either English or German. Possibly Jean Lebel himself would be interested in working for us but if so, he did not give any hint to me of this. He would of course be an excellent man. At least he will help us to find an office in Paris. His Engineer, M. Gouyet will visit DEC on December 17 to talk with myself, Barbera Stephenson, Dick Best and others concerning the use of DEC equipment in his work.

Ted Johnson has been doing a fine job in Europe and has made many important contacts with customers in France, England, Germany and Sweden. Guenter Huewe is becoming more sales oriented, has learned a little French so that he is at least able to understand without translation, and is in general a bit more adapted to the ways of a sales office than he was in the beginning. He will never of course be a really first rate salesman and I don't think we should expect him to be. However, he is a top technical man and systems designer and extremely thorough. Although he and Ted Johnson sometimes clash, the net result is beginning to show results in Europe.

My feelings on the French market in general are as follows: It is certainly more difficult to do business in France than in either England, Germany or Holland. This is due mostly to the greater amount of paper work involved and the red tape in importing the equipment into France. The French custom officials are notoriously slow ( for example it took sixteen days to get the Memory Tester through customs in France while it took one day to do the same job in Germany). French engineers in general speak only French which makes it very difficult for Ted Johnson or Guenter Huewe to do a large amount of business in France. However, the business is certainly there. Saclay has money to spend and is willing to spend it for foreign equipment. Utility companies are interested in automation in a big way and are certainly in the market for control computers. There is much system design work to be done. In order to do this business we must open a French office with a French speaking person in charge somewhere in Paris. I spent some time with M. de Vitry discussing this subject, and he is also of the opinion that we must do this now.

# # # # #

bbn

# INTEROFFICE MEMORANDUM

DATE November 26, 1963

SUBJECT New Test Equipment

TO R L Best

FROM R Doane

"Usage on our present Boonton 95A is so high that the production area is in constant conflict about it."

Bob Hughes

The 95A measures 10μV to 1000V and 1 picoamp to 1 ampere, dc, full-scale (center zero) to ±3% voltage and ±4% on current.

RCD/dhw

# PURCHASE REQUISITION

digital EQUIPMENT CORPORATION
MAYNARD·MASSACHUSETTS

PURCHASE ORDER NO.

| | |
|---|---|
| SUPPLIER Boonton Electronics | DATE Nov. 23 '63 |
| ADDRESS | REQUESTED BY R. Doane |
| | ROOM Deliver to Test Equipment |
| ATTENTION | CONFIRMATION YES ☐ NO ☐ |
| REQ'D DELIVERY DATE / SHIP VIA / TERMS / F.O.B. | ITEMS ARE TO BE USED FOR Test Equipment |

| ITEM | QUANTITY | STOCK NO./DESCRIPTION | UNIT PRICE | AMOUNT |
|---|---|---|---|---|
| 1 | 1 | Model 95A sensitive DC Meter | $ 495 | |

FOR ALL COST CENTER EXPENSES

| GENERAL LEDGER ACCOUNT | GENERAL LEDGER AMOUNT | COST CENTER | EXPENSE ELEMENTS ACCT. | EXPENSE ELEMENTS AMOUNT | JOB ORDER NUMBER ACCT. | JOB ORDER NUMBER AMOUNT | EMPLOYEE NUMBER |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

CHECKED BY

APPROVED BY [signature]

# SENSITIVE DC METER

**MODEL 95 A**
**SENSITIVE DC METER**



- **Extremely Wide Range**
  **Voltage: 1 µv to 1000 V**
  **Currents: 0.1 µµa to 1 amp.**
- **Simplicity of Range Switching and Meter Reading**
- **Constant Input Resistance of 10 Megohms on all Voltage Ranges.**
- **Floating Input**
- **Fast Response**
- **Low Drift**
- **Amplifier Output at Front Panel**




**Price $495**

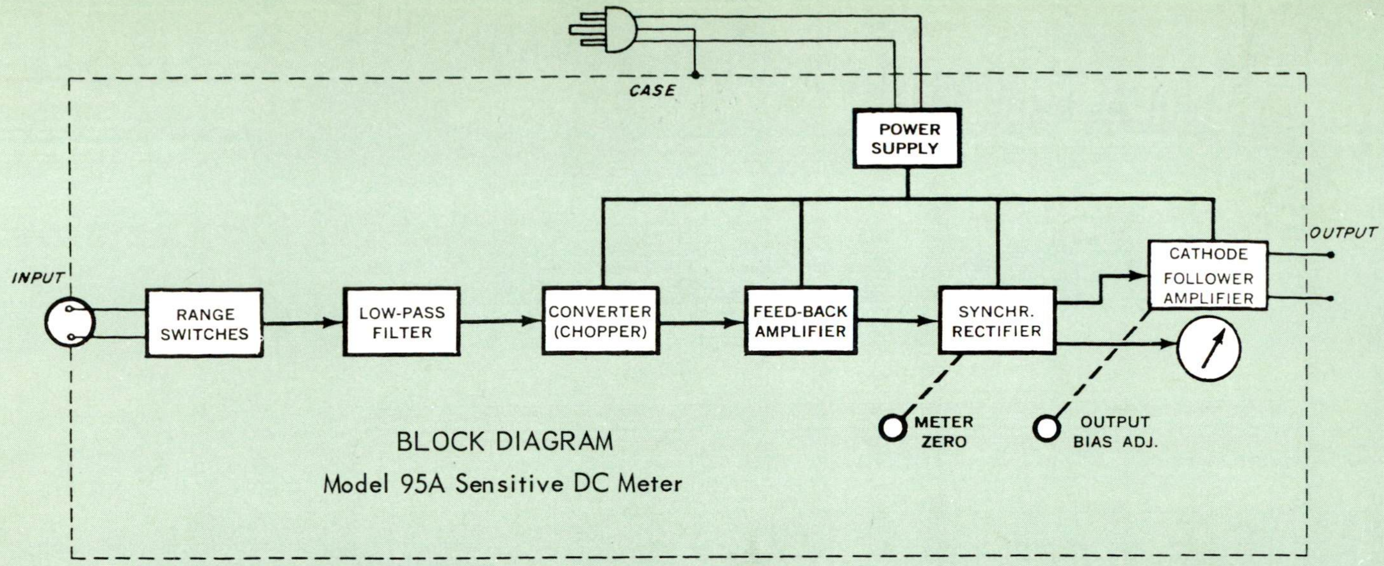


BEC

**Boonton *ELECTRONICS* Corporation**

MORRIS PLAINS, NEW JERSEY Telephone: JEfferson 9-4210

Printed in U.S.A. 20M 12-60




BLOCK DIAGRAM

Model 95A Sensitive DC Meter

## GENERAL DESCRIPTION

The Model 95A Sensitive DC Meter is a sensitive wide range combination voltmeter, ammeter and amplifier. A unique multiplex range switching system permits rapid selection of any of the 42 voltage or current ranges and displays in large lighted windows the full scale value and unit of measure of the range in operation. This range switching system makes for easy operation and instant recognition of the scale in use thereby reducing the incidence of errors of interpretation. The range of measurements, 1 $\mu$volt to 1000 volts and 0.1 $\mu\mu$a to 1 ampere, it is believed, is the greatest of any commercially available instrument.

### CIRCUIT

The instrument is a stable, high gain, feedback, ac amplifier operating from the output of a low noise chopper. A synchronous output rectifier consisting of a transistor switching circuit driven in phase with the input chopper produces a dc output current proportional in amplitude and identical in polarity to the input voltage. A zero center meter indicates positive to the right and negative to the left. The input voltage is applied to the chopper through a switching system which either attenuates the input voltage or varies the gain of the amplifier. Current ranges are provided by internally shunting the input with an appropriate resistance and then reading the voltage drop across this resistance in terms of current calibration. A meter ZERO ADJ control is provided; however, after a 30 minute warm-up normally there is no need to reset the zero when changing sensitivity ranges. An exception to this is the most sensitive range where some correction may be needed, particularly when thermals or residual voltages are present in the test circuit.

### FLOATING INPUT

The input circuit may be operated either grounded or floating. A jumper across the terminal posts at the bottom left of the front panel connects the input circuit to the panel for grounded operation. When the jumper is removed the input circuit floats a minimum of 500 megohms above ground.

### CONSTANT INPUT RESISTANCE

The input resistance of the Model 95A is held to a constant 10 megohms on all voltage ranges. This frees the Model 95A of a range switching error which is inherent in all meters that have their input resistance varying with range. By presenting a constant load to a high resistance source the Model 95A can be switched from range to range without changing the voltage at the source.

### AMPLIFIER OUTPUT

The output of the synchronous rectifier is also applied to a cathode follower where separate gain and bias controls give complete flexibility in the control of the output gain and reference level without interacting with the internal meter. This feature allows the high sensitivity of the Model 95A to be used in conjunction with a variety of recording or control devices.

## SPECIFICATIONS

| | |
|---|---|
| **VOLTAGE RANGE:** | $\pm$1.0 microvolt to 1,000 volts dc |
| **CURRENT RANGE:** | $\pm$0.1 $\mu\mu$a ($10^{-13}$) to 1.0 ampere dc |
| **INPUT RESISTANCE:** | |
| Voltmeter: | 10 megohms all ranges |
| Ammeter: | 1.0 $\mu\mu$a to 100 $\mu\mu$a Range: 10 megohms |
| 300 $\mu\mu$a: 3.33 megohms | 1 $\mu$a: 1K ohms |
| 1 m$\mu$a: 1.0 megohms | 3 $\mu$a: 333 ohms |
| 3 m$\mu$a: .333 megohms | 10 $\mu$a: 100 ohms |
| 10 m$\mu$a: 100K ohms | 30 $\mu$a: 33.3 ohms |
| 30 m$\mu$a: 33.3K ohms | 100 $\mu$a: 10 ohms |
| 100 m$\mu$a: 10K ohms | 300 $\mu$a: 3.33 ohms |
| 300 m$\mu$a: 3.33K ohms | 1 ma to 1a: 1.0 ohm |
| **FULL SCALE SENSITIVITIES:** | |
| Voltage: | $\pm$10 microvolts to 1,000 volts dc |
| Current: | $\pm$1.0 micromicroampere to 1 ampere |
| **ACCURACY:** | |
| Voltmeter: | $\pm$3% of Full Scale |
| Ammeter: | $\pm$4% of Full Scale |
| **RANGES:** | |
| Voltmeter: | 17 Ranges 1,3,10,30 etc. sequence |
| Ammeter: | 25 Ranges 1,3,10,30 etc. sequence |
| **NOISE:** | 1 $\mu$v PP (approx.) referred to input |
| **DRIFT:** | less than $\pm$2 $\mu$v after 30 minute warm up referred to input. |
| **BANDWIDTH:** | 1 cycle at 3 DB |
| **RESPONSE TIME:** | Approx. 1 Sec. to 90% of Full Scale |
| **60 CYCLE REJECTION:** | greater than 60 DB |
| **METER:** | Zero center with mirror scale |
| **RESISTANCE FROM INPUT CIRCUIT TO CASE:** | Approx. 500 megohms |
| **AMPLIFIER:** | Gain 100,000 maximum |
| **OUTPUT:** | 0 to $\pm$1.0 volt into 1,000 ohm load polarity same as applied Input. Output is continuously adjustable. |
| **OUTPUT IMPEDANCE:** | Approximately 400 ohms. |
| **RACK MOUNTING:** | Also available, the 95A-R on a 5¼ x 19' rack panel. Extends 8¾' behind panel. Price $520. |
| **POWER REQUIREMENTS:** | 105 to 125V, 50-60 cycles, 40 watts. 210 to 250V, 50-60 cycles (Special) |
| **SIZE:** | 7½W x 9½D x 11H excluding handle |
| **WEIGHT:** | 17 lbs. packed. Approx. 22 lbs. packed (rack mounted) |
| **SUPPLIED WITH:** | 4 ft. shielded test leads terminated in insulated cups. |


Model 95A-R

REPRESENTED BY

dec INTEROFFICE MEMORANDUM

DATE November 14, 1963

SUBJECT Annual Review of Salaried Employees

TO

FROM Win Hindle

Enclosed are evaluation forms on salaried employees under your supervision and in some cases on others whose work you are in a good position to evaluate. If you feel you cannot evaluate any of these people, please feel free to leave the form blank. We are planning to review only people hired up to October 1st.

In addition to the numerical rating, it is particularly helpful to receive any remarks you may want to make in the "Comment" section of the form.

We want to start the review very soon, so I would appreciate your getting the forms back to me in a confidential envelope by Friday, November 22.

digital **MEMO**

DATE October 18, 1963

TO Mr. K. Olsen FROM Accounting Department

So that we may be sure the company's records agree with yours, this statement is to show you that your account has a balance of $ 200.00 due the company as of September 27, 1963.

October 3, 1963, charge for three posters $ 3.00 and October 15, 1963, a Petty Cash Advance for $ 30.00. Total balance due company as to date $ 233.00.

If the above does not agree with your records, please advise the accounting department promptly.

# INTEROFFICE MEMORANDUM

DATE October 11, 1963

SUBJECT Comments about my meeting with Dick Mills at Project MAC on Friday October 11, 1963.

TO H. Anderson
G. Bell
N. Mazzarese
S. Olsen
K. Olsen ✓

FROM R. L. Lane

1. The first topic which we discussed was Project MAC as a customer. Dick's feelings are that Project MAC refuses to be just a customer for the sale of a computer but they should function with the computer manufacturer in the design of the long range computer which Project MAC is looking for.

2. They feel that PDP-6 would be a replacement for the 7094 rather than a satellite such as PDP-1, yet they feel it is not quite as powerful as a 7094 and that a 1 to 1 replacement would cost them programming and additional expenses. Yet they are favorably impressed with the multiple processor capability and the ability to address a quarter of a million words of core memory. They want more than just a quarter of a million words on the memory bus even though a single processor could address only $2^{18}$ words.

3. Dick further commented that a quarter of a million words isn't enough. A million is more what they are looking for or roughly $2^{20}$ addressable words.

4. Dick requested technical publications on the PDP-6 for Project MAC evaluation and review. I pointed out how difficult that this was at this early stage and that we would like to talk to as many of Project MAC people individually or collectively as possible. He suggested formally rather than informally since all the MAC people would have equal knowledgeability about PDP-6.

5. This leads to the next point we discussed; a proposal to Project MAC. Dick suggested that a rather short but formal proposal be prepared for MAC by DEC. I pointed out that we had tentatively scheduled this for November 1, 1963.

   He immediately recommended that we either make it before then or after November 8th since they are spending 2 days at Remington Rand and 2 days at CDC the week of November 4th through 8th.

6. What I would like to see is our inviting the Project MAC group to DEC for a briefing on PDP-6 and do this before they leave for St. Paul. This way, subconsciously, they would be comparing PDP-6 concepts to the Univac and CDC equipment, but on PDP-6 terms.

7. Dick Mills emphasized that IBM gave them an educational discount and recommended that we consider them for an educational discount since 28 full professors are partially employed by Project MAC as well as 24 associate professors, and that numerous students will be trained for Project MAC activities.

dec **INTEROFFICE MEMORANDUM**

DATE October 1, 1963

SUBJECT Connectors

TO Ken Olsen

FROM Frank Kalwell

cc: Henry Crouse

Confirming our earlier discussion on the sample Cinch Jones "Twin-ConEdge Connector", the prices are as follows:

Part #254-15-70-113 Connector

| 1 | 25 | 50 | 100 | 250 | 500 | 1000 | 2000 | 5000 & up |
|---|---|---|---|---|---|---|---|---|
| 8.90 | 7.12 | 5.94 | 4.75 | 4.51 | 4.27 | 3.83 | 3.56 | 3.48 |

Part #462-94-11-130 Contact for #20 Wire - $38.00/M bulk
Part #462-94-11-131 Contact for #22-24 Wire - $38.00/M bulk

Part #318-02-00-242 Black-Insul. Jumper Pins
Part #318-02-00-244 Red-Insul. Jumper Pins

| 1 | 25 | 50 | 100 | 250 | 500 | 1000 | 2500 & up |
|---|---|---|---|---|---|---|---|
| .51 | .41 | .34 | .27 | .26 | .25 | .22 | .20 |

Part #599-11-11-102 Comb. Insertion & Removal Tool - $15.09/each.

As soon as the Burndy unit and prices are received, I'll forward them to your attention. Burndy's connector has .100 spacing, but within the next few weeks .156 spacing will be available in the 15, 22, 30 and 43 contacts.

Prices have also been obtained on Cinch Jones bifurcated Contact Edge Connectors as follows:

| 1-24 | 25-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000-1999 | 2000-24999 |
|---|---|---|---|---|---|---|---|
| 1.97 | 1.57 | 1.31 | 1.05 | .999 | .947 | .85 | .79 |

# INTEROFFICE MEMORANDUM

DATE September 19, 1963

SUBJECT Australian Observations

TO Kenneth Olsen

FROM Harlan Anderson

cc: S. Olsen
G. Bell
R. Mills

This memo is the result of a trip to Australia during the week of 26 August 1963.

## General Impression

The simplest way to think of Australia as far as size, economy and market potential is to regard it as similar to Canada. The physical sizes are similar. The populations are comparable and their relationships to the U.K. are similar. They each have similar numbers of universities. The majority of the populations of each country are concentrated in a very small area. In Australia, this is the Southeastern part of the country. The climate of Australia is quite moderate with very few homes having central heat. The cities of Melbourne and Sydney each have over 2 million people and have all the characteristics of large American cities.

The area, however, has been neglected by electronic firms due to its extreme distance from the U.S. The market looks excellent for import of computers since there are none manufactured there. I met with quite a number of potential customers who are very similar to the ones we sell to in the U.S. The universities are quite actively involved in training students in digital computer techniques. DEC should as soon as possible become involved in marketing its products in Australia.

## Sales Potential

These are the following principal potential customers who are likely to be a computer or module customer in the next 12 months.

### Aeronautical Research Laboratory (Melbourne)

They are likely to be a customer for a PDP-1 or perhaps even a PDP-6 for use in a hybrid analog to digital computation facility in the immediate future. Mr. Merfield of ARL saw our computer at a trade show in New York and is a solid booster of ours. The main competition is an Elliott 503 for which I have a specification. He is an older man (very active) who is fearful that the government won't let him order from us unless we are represented by a subsidiary or agent in Australia. The government business people are frightened by the distance to the point where they will sometimes appoint an agent for a company if they want to buy badly enough. Mr. Merfield therefore was the instigator in urging J. J. Masur Company to push us for an agency appointment. He is a senior research officer and became acquainted with Masur when they were the representative for Electronic Associates.

In addition to this computer, the same laboratory is interested in improving their war gaming simulation system, which has been very limited, consisting of a large geographical board having hundreds of lights representing position of raiding or defending forces. I believe they might go for a small computer with a CRT display. I suggested this and they seemed very interested.* Mr. Shaeffer is also a Senior Research Officer and is more reserved than Mr. Merfield but I believe on our side.

He is interested still in a third possible computer application consisting of wind tunnel instrumentation and I gave him the name of Tom Miller at J.P.L. who can direct him to the group doing wind tunnel work with the PDP-1. There are a number of module applications associated with each of these computer prospects.

Government Aircraft Factory (Port Melbourne)

Here I spoke with Mr. David Fien who should be addressed as follows:

Manager, Government Aircraft Factory

Attention: Mr. David Fien
Private Bag #4
Post Office
Port Melbourne, Victoria, Australia.

He has an Analog to Digital application of a special type where maybe our modules could be useful. He wants to find the maximum amplitude of a 10 KC sine wave modulation. It seemed like an up down counter which would stop counting when it reached the peak of the second sine wave would be adequate. He does not need great accuracy.

He also is interested in a film reader for use in studying some sort of simulated flight data recorded on 20 inch film. He would be willing to read it in two pieces, does not need automatic film advancing and would build those things necessary to go on to our CRT. This is a very important project for them and he plans to visit the U.S. near the first of the year to look into these matters further. I feel sure we can get him to visit DEC and perhaps arrange for him to visit United Aircraft in Hartford.

*Spacewar fascinated them.

University of New South Wales (Sydney)

Here I visited Prof. Vowles, who is head of the Electrical Engineering Department and Prof. Speedy who is interested in computer control techniques. Prof. Vowles has funds just approved to buy a computer. He has been thinking in terms of the IBM 7040. This has been a long standing plan with him and he almost bought the machine 18 months ago but his funding fell through. He has a beautiful new building just being finished and it has a large computer room built with subflooring, air conditioning but no computer. He is very interested in the PDP-6 and would be quite interested in helping us into a joint venture with the University by establishing a computation center. He has over $400,000 available and the timing is perfect right now.

Prof. Vowles was acquainted with Gordon Bell when he was in Australia. He is a very senior person and very nice. They are now using the DEUCE computer but expect to retire it in the next two years. A Mr. Hill is in charge of it.

University of Sydney (Sydney)

Here I met with Prof. Nelson (Mechanical Engineering) and Mr. B. R. Goddard (Electrical Engineering). A Mr. Wong who was in the U.S. at the time is building a general purpose computer at the moment. His assistant is Kenny Roslin. They are potential module customers, but on a small scale. The concept of large government funding to university is not prevalent. Instead the money usually goes directly to government organizations who buy this type of equipment.

I did not meet with the people who are associated with the "home-made" SILLIAC (copy of the University of Illinois ILLIAC), but they would probably be a better potential customer.

The above groups comprise those customers whom I visited. In addition there are others who maybe have greater potential. They are as follows:

Weapons Research Laboratories (Canberra)

They now have an IBM 7090 and are quite big.

University of Adelaide (Adelaide)

Woomera Missile Test Range (near Adelaide)

CSIRO (Commonwealth Scientific Industrial Research Organization)

They are everywhere it seems and are involved in very broad areas of research including agriculture as well as electronics. They are quite big and have just ordered a CDC 3600 with satellites at remote sites. (CDC has approximately

8 million dollars worth of business with 2 orders from Australia).

Melbourne Institute of Technology

The above list has been limited to those types of customers that we now sell to in the U. S. No business or process control applications have been included although they, of course, abound.

## Government Influence

As in the U. S., the government is behind the financing of most of these customers. In some cases, the British are subsidizing the defense work of Australia. Whenever possible, they make their contribution in the form of equipment made in U.K.

Most things that the government buys end up being duty free. However, the customs has an interesting philosophy. If an equivalent item to what you are trying to import is made in Australia, you must pay a 45% duty. Fortunately, there are no computers now being made in Australia nor does it appear likely there will be in the near future. If an equivalent item to what you are trying to import is made in some part of the U.K. or other Commonwealth countries you must pay a 7 ½% duty. The customs department would seek an opinion from University experts in determining equivalency. For partial assembly and special cases, I believe specific deals can be made ahead of time. Local manufacturers apply for a "by-law control" against incoming imports which bring to bear the 45% duty which shuts off importing for all practical purposes.

There are no monetary controls or Australian ownership requirements. We have a fine book for considering these types of questions from the Bank of New South Wales. It is called "Establishing a Business in Australia".

When the government buys, they have similar requirements for advertised bid as we do in the U.S. They normally write the specification fairly closely around the unit they want to buy so that as a practical matter, the decision is made long before the formal invitation to tender.

They are quite annoyed by extra charges for ex port packing etc. suddenly appearing on invoices. They don't mind paying them but they prefer to know about them from the beginning. They shutter at the thought of air freight and refuse to pay it.

They do expect to pay up to 10% above American prices to cover freight, insurance, etc. They feel they must have the contract with an Australian company so they have recourse to someone in Australia if anything goes wrong. They would hate to have to deal through consulates to get action.

Incidentally, one must pay import duty on technical literature. It is not obvious to me who should pay this, us or the sales agent.

## Role of Sales Agency

Electronic instruments and components are all sold through sales agents who normally are paid 15% or perhaps 10%. Typically, they handle 30 lines of products or more, I visited three agencies although there are others. They are described below.

## Jacoby-Mitchell (Sydney and branches)

Their main office is in Sydney and they are the largest sales agency. They claim to have imported 60% of all instruments into Australia. Mr. Jacoby contacted us by telephone when he was in Boston, after seeing DEC listed in a Greater Boston Chamber of Commerce directory. They represent Raytheon, Consolidated Electro Dynamics, Superior Electric and many others. They also sell electrical supplies like light fixtures, electric heaters, etc. They seem competent and well organized. I don't think they are right for us however. They are too big and have too many things going on. They have 5 manufacturing subsidiaries (having an employment of about 60 people). They have this in the expectation that competition might start manufacturing and they must be ready. Their total employment is about 120 people. They also have a small plastics business of some kind. I met with Mr. Hibbert and Mr. Jacoby.

## Ronald J. T. Payne Co. PTY, Ltd.

Ronald Payne has been more narrow in selecting his line of products. He has a very capable engineer named Peter Wingett who does the work. Payne travels in the right circles and probably has many good contacts. They represent Schlumberger companies and just recently took on EMR and ASI. Because of this I believe there is no point to pursuing them further. Mr. Payne is very pleasant and has been in the business a long time (over 20 years). He has just returned from a four month trip around the world. Mr. Wingett arranged an introduction for me to a Mr. Kegele of the Amalgamated Wireless (Australasia) Ltd. discussed below. I don't believe that this group nor EMR or ASI will be willing to invest in computers in Australia and thus will not be serious competition.

Amalgamated Wireless (Australasia) Ltd.

This company is not basically a sales agency. They are very large having 3,000 to 5,000 employees I would guess. They are licensee for RCA, English Electric and others. Basically, they are manufacturers of consumer electronics. They also held the sales agency for Bendix Computers before they folded. They were not very successful with it in my opinion however. They had two G-15's installed (Melbourne and Sydney). They are now casting about for a new affiliation. They are potential manufacturer, but unless they become more aggressive I doubt if they will be a threat. They are too big for us to get involved with. They claimed to have assembled a staff of programmers, maintenance people, etc. Most of these have dispersed and Mr. Kegele with whom I met is marking time until the man in charge (Sir Lional Hook) in Sydney decides what to do. They claim to make some peripheral equipment and also some analog equipment. We may hear from Mr. Kegele.

J. J. Masur and Co. PTY, Ltd.

Mr. Masur started his business over 20 years ago after arriving in Australia from Germany. He has sold many things including analog computers, process control instrumentation, supplies for machinery, and meter movements. He represented Electronic Associates in selling the analog computer for a period of time. I have no idea how he got involved with EA in the beginning. He had in my opinion only medium success on their behalf. This was probably due to the time lag for developing the market and for support from EAI. (He reported to their London subsidiary). A sizeable order is just over the horizon for EAI ($200,000) and they decided to terminate him recently. Basically, I think it was a poor match. They paid 15% commission which was too high for what he could do for them.

However in the process of representing them his organization came in contact with a whole new market area for them - the government sponsored research market using electronics. They also became known to these people and apparently respected as business men. For example, they arranged my lecture while I was in Australia and I was amazed at the quantity and quality of people they had. They had approximately 60 people representing almost all the Melbourne area. Outside Prof. Vowles, they arranged all the customer appointments.

Mr. Heinz Kirschner is the sales manager. He is a very pleasant, competent older man whom I would describe as a professional salesman. He is tactful and understands selling very well.

On a long range basis, I doubt if J. J. Masur Co. can play a role for us. They realize this and admitted it. However, I think they can plan an exceedingly important role for a shorter period of time.

(1) They can provide initial sales contacts for DEC. They demonstrated their ability to do this very satisfactorily to me.

(2) They can provide us detail assistance in weaving our way through Australian government red tape.

(3) They can provide a base of operations immediately in Melbourne. (Literature distribution, office space, etc. )

We would be a very important principal for them and they will knock themselves out on our behalf. I have discussed a tentative arrangement with them which would last a minimum of one year and provide our domestic commission arrangement for modules and a 3% "finders fee" for computer systems. They are agreeable to this. Their motivations are threefold in being willing to enter into something that is not expected to last forever. They want a commission on the ARL sale where they have taken the initiative. They want to make whatever money they can while they can. They want to have the prestige of being associated with DEC.

Recommended Action

The immediate and long range potential in Australia is sufficiently good that I think we should immediately set up operations as outlined below.

1. Appoint J. J. Masur and Co. PTY, Ltd. our sales agent with the terms mentioned above.

2. Organize a subsidiary to have headquarters in Sydney. Mr. Jeffs of the Bank of New South Wales with whom I met in Sydney could suggest a lawyer, real estate agent, etc. I think maybe this could all be done by mail.

3. Hire an Australian to come to DEC immediately for training. Mr. Robin Frith approached me and I believe is an excellent candidate. He could leave his present employer in about 6 to 8 weeks. He has digital circuit design experience and has a patent on a small digital system for recording wind velocity on punched paper tape. He also has taken programming classes on the IBM 1620 and on an English Electric machine. He is single and is very interested in working for us and then returning to Australia. Pay levels I believe are about half U.S.

   If he doesn't work out, we can approach any of the University professors that I met for suggestions. In addition Prof. John Bennett in Sydney is regarded as a leader and could provide recommendations perhaps.

4. Send a present DEC employee to Australia to live for six months or as long as is practical. This should be someone who is familiar with programming and the interface of the computer. He should be in Sydney but visit Melbourne frequently.

5. Send Gordon Bell to Australia for 2 weeks to follow up with Prof. Vowles, to look for senior potential employees, to follow up with other customers.

6. Consider and perhaps arrange a PDP-1 and scope tour of Japan and Australia. This may not be economically justified on one sale, but would give us a tremendous boost in getting started. The people of both Japan and Australia are eager to see this type of equipment. Masur has a fine place to set it up.

7. Consider and perhaps arrange a deal with the University of New South Wales for a PDP-6 joint venture.

8. Gradually increase the staff to have three or four professional people including maintenance in Sydney.

I believe we will have a firm order for a computer within a year if we do this and that we will have a good indication if our first order is coming through within 6 months. After the first year, I think we can sell at least three computers per year!

Harlan Anderson

HEA:ncs

dec INTEROFFICE MEMORANDUM

DATE September 19, 1963

SUBJECT Turnover Ratio, Major Components

TO ✓K. Olsen
H. Anderson
S. Olsen
M. Sandler
G. O'Dea

FROM J. Smith

The attached figures denote a rather healthy turnover of major component inventory for the past fiscal year. A turnover rate of five is considered good for our application of this type of equipment.

Memory stacks show an unusually high turnover rate for our type of business. This was mostly due to increasing construction rates throughout the year and the large number of unexpected additional memory orders. A turnover rate as large as this is usually not a very healthy situation. It usually leads to increased manufacturing costs, brought about by the use of overtime to meet slipping schedules caused by delivery delays from component manufacturers. Secondly, increased acquisition costs caused by expanded expediting, air express shipments, etc. Most important of all, increased work-in-process inventories and delivery delays to our customers. We were rather fortunate that Ferroxcube was capable of reacting rapidly to our increased requirements which held delays to a minimum. Arrangements have now been made with Ferroxcube to have a number of stacks on the shelf available for immediate delivery. This will enable fast delivery to our customers while maintaining a desirable turnover rate.

28KSR have the lowest turnover rate due to a decreasing construction schedule for PDP-4. Orders for these printers have been reduced and delivery lengthened out which will result in a more desirable turnover rate.

An overall turnover rate of 15 was maintained over the past fiscal year for all major components with a very minimum of delivery delay. This, I feel, is an extremely healthy situation that I hope can be maintained through our next fiscal year.

| Major Components | Average Inventory | Cost of Goods Sold | Turnover Rate |
|---|---|---|---|
| 28KSR Printer | $5,434.25 | $ 14,518.45 | 3 |
| 2500 Reader | 769.80 | 12,372.40 | 13 |
| 3500 Reader | 5,825.00 | 60,580.00 | 10 |
| BPRE 11 Punch | 2,218.40 | 17,755.20 | 8 |
| Type 16" | 5,755.75 | 50,938.10 | 8 |
| Memory Stacks | 9,562.05 | 298,938.03 | 24 |
| | $29,565.25 | $455,102.68 | 15 |

Ken

hopefully we're in the surplus cash position to stay.

the attached AMA Seminar is right up that alley

If you have no objection I'd like to attend the session (Oct 21-23)

George O'Dea
9/16

## IS YOUR CORPORATE CASH EARNING ITS KEEP?

No company can afford idle cash. In fact, you will probably find — as more and more growing companies are discovering every day — that making money work *hard*, through scientifically planned money management, can add to your profit margin and make possible a continuing, sound growth pattern for your company.

A vital area too often overlooked in otherwise sound corporate cash management programs is the short-term investment portfolio. Here is a profitable "by-product" source of income that your company can capitalize on through up-to-date financial know-how.

To help you get this highly specialized "savvy" in short-term investment, AMA has scheduled two seminars, each called —

### CORPORATE SHORT-TERM PORTFOLIO MANAGEMENT

The first meeting of this program is an instructional orientation seminar. The second meeting is a discussion workshop, and they have been scheduled in sequence so that you can attend *both meetings* during one week.

At the first meeting, the guest speakers will be financial executives who have successfully applied effective short-term investment techniques in their own companies. There will also be specialists from the professional financial community, who will show you how improved management of your short-term portfolio can help you make your company's cash pay its way. They will focus attention on all aspects of these financial concepts . . . share with you their views, ideas and individual operating experiences. Ample time will be set aside for question-and-answer periods and for project sessions — to give you a chance to adapt the information you've received to problems you are facing in your own company.

At the second meeting, attendance is limited to just fifteen seasoned executives — only one man from a single company. The intensive discussion will give you a chance to analyze the various methods recommended for their usefulness in operations like your own. You'll get to exchange insights gained from years of experience solving corporate financial problems, and you'll be able to weigh the new techniques against proven ones for enhancing your investment income and at the same time assuring the financial liquidity necessary to your company's efficient operation.

Because companies frequently send teams to orientation seminars . . . and because attendance at workshops is so limited . . . we expect both of these meetings to be oversubscribed. You and other men in your company who plan to attend can ensure your places by registering promptly with the clip-out card. Or, for immediate confirmation of your reservations, just wire or phone AMA's Seminar Registrar in New York.

# CORPORATE SHORT-TERM PORTFOLIO MANAGEMENT

IN NEW YORK

2

AMA FINANCE SEMINARS

AMA HEADQUARTERS

OCTOBER, 1963

AMERICAN MANAGEMENT ASSOCIATION

FORTIETH YEAR

AMERICAN MANAGEMENT ASSOCIATION, INC.
1515 Broadway, New York 36, N. Y. Telephone: JUdson 6-8100

Please register the following executives for the meetings indicated.

■ NAME
POSITION
COMPANY
STREET
CITY ZONE STATE
MEETING NO.
DATES:
TITLE:

■ NAME
POSITION
COMPANY
STREET
CITY ZONE STATE
MEETING NO.
DATES:
TITLE:

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**To Register** — fill out and return the card. Or, you may wire or phone the Registrar at the address given. Registrations must be made in advance, and may be made up to the time of the meeting, subject to confirmation by the Registrar. Applicants are requested not to come to the meeting unless they have received advance confirmation. Confirmed registrations cancelled later than two weeks before the meeting are subject to a $25 service charge. Registrants whose applications have been confirmed and who fail to attend a meeting are liable for the entire fee unless they contact the Registrar *prior to the meeting* to cancel their reservations.

**Hotel Accommodations** — AMA does not arrange hotel accommodations. Registrants should contact the hotel of their choice for reservations.

**Registration Fees** — The full fee is payable in advance and includes the cost of all [illegible] eons and meeting materials.

| | AMA Members | Nonmembers* |
|---|---|---|
| Three-day meeting | $150 | $175 |

*Nonmembers: Difference between member and nonmember registration fee can be applied to AMA membership. Check box on card for full information.

# CORPORATE SHORT-TERM PORTFOLIO MANAGEMENT

**Orientation Seminar #1245-04 October 21-23, 1963 AMA Headquarters, 135 W. 50th St., New York City**

Primarily instructional in nature, this meeting is designed to give men new to the field a solid background in principles and practices. To more experienced men it offers a thorough review of latest techniques. At the meeting, speakers who are authorities in the field will focus on all aspects of short-term portfolio management — from the first step of determining the cash available for investment to the measurement of investment efficiency. Investment policies and management . . . the various types of short-term investments . . . appraisal of short-term markets . . . and operating procedures will be explained. And small group project sessions will be held on a short-term investment problem.

***Chairman:*** **WILLIAM G. McGAGH**
*Manager — Banking & Investment*
Chrysler Corp.
Detroit, Mich.

***Co-Chairman:*** **HOWARD WILLIAMS**
*Investment Officer & Assistant to Financial Vice-President*
New England Mutual Life Insurance Co.
Boston, Mass.

***Speakers Include:***

**THOMAS F. CREAMER**
*Vice-President*
First National Bank of New York
New York, N. Y.

**JOHN J. CAHILL**
*Partner*
C. J. Devine & Co.
New York, N. Y.

**ROBERT F. LEWIS**
*Manager — Municipal Bond Department*
Chemical Bank of New York
New York, N. Y.

**ALFRED DE SALVO**
*Vice-President & Assistant Treasurer*
C.I.T. Financial Corp.
New York, N. Y.

**ROBERT G. WILSON**
*Commercial Paper Representative*
Goldman Sachs & Co.
New York, N. Y.

**GEORGE D. EWINS**
*Investment Representative*
Socony Mobil Oil Co., Inc.
New York, N. Y.

**EDWARD D. TOLAND, JR.**
*Treasurer*
United Fruit Co.
Boston, Mass.

**CHARLES W. POTTER**
*Assistant Treasurer*
American Telephone & Telegraph Co.
New York, N. Y.

## SEMINAR OUTLINE

I. DETERMINATION OF CASH AVAILABLE FOR INVESTMENT
- A. Cash Investments vs. Bank Balances
- B. Cash Forecasting and Cash Flow

II. INVESTMENT POLICIES AND MANAGEMENT
- A. Objectives, Policies and Authorizations
- B. Organization and Staff
- C. Investment Programing

III. TYPES OF SHORT-TERM INVESTMENTS
- A. U.S. Government's — Treasury Bills; U.S. Certificates, Notes and Bonds
- B. U.S. Government Agencies
  General appraisal of agencies; secondary markets and market liquidity; obtaining size on original bids
- C. Tax Exempts
  PHA Notes — bidding; state and municipals — ratings vs. maturities; tax aspects — yields in excess of coupons; comparison of yields; secondary markets and dealers
- D. Finance Paper (Directly Placed)
  Use of repurchase privilege; analysis of finance company condition; comparison to repurchase rates
- E. Other Investments
  Repurchases; bankers' acceptances; bank time deposit; assignable certificates of deposit; commercial paper; railroad equipment issues; Canadian securities with futures; called bonds and preferred stock

IV. APPRAISING SHORT-TERM MARKETS
- A. Forecasting Interest Rate Trends and Their Effect on Investment Decisions
- B. Relationships to Capital Markets

V. OPERATING PROCEDURES
- A. Dealer Relationships
- B. Reference Material
- C. Reports to Management, Records, etc.

VI. MEASURING INVESTMENT EFFICIENCY
- A. Current Portfolio Yield
- B. Pre-Tax vs. After-Tax Earnings
- C. Average Maturity
- D. Return on Average Investment
- E. Methods of Appraisal

VII. PROJECT SESSION
Small group project session on a short-term investment problem

**If you are a corporate financial executive with experience in this area, you can attend BOTH MEETINGS. The first meeting will end at noon on Wednesday. The second will begin on Wednesday immediately after lunch.**

# CORPORATE SHORT-TERM PORTFOLIO MANAGEMENT

**Workshop Seminar #1145-05 October 23-25, 1963 AMA Headquarters, 135 W. 50th St., New York City**

Registration in this workshop seminar is open only to executives with substantial experience in the subject area. The meeting provides an opportunity to join a small group of operating executives and explore your on-the-job problems through intensive, guided discussion. You'll outline your problems . . . hear suggested solutions . . . learn of successful systems and methods used in other companies. You will be expected to join the others in contributing personal business experience. The discussion is carefully guided by the seminar leaders to assure that each participant's problems and suggestions are fully covered . . . so that valuable information brought out can be measured, evaluated and applied to your own operations. The workshop is strictly limited to 15 participants, and only one executive from a company may attend the meeting.

***Discussion Leaders:***

**GENE A. RADFORD**
*Assistant to the Treasurer*
Eastman Kodak Co.
Rochester, N. Y.

**S. G. WILSON**
*Assistant Treasurer*
Burlington Industries, Inc.
Greensboro, N. C.

## SEMINAR OUTLINE

I. DETERMINATION OF CASH AVAILABLE FOR INVESTMENT
- A. Cash Investments vs. Bank Balances
- B. Cash Forecasting and Cash Flow

II. INVESTMENT POLICIES AND MANAGEMENT
- A. Objectives, Policies and Authorizations
- B. Organization and Staff
- C. Investment Programing

III. TYPES OF SHORT-TERM INVESTMENTS
- A. U.S. Government — Treasury Bills; U.S. Certificates, Notes and Bonds
- B. U.S. Government Agencies
- C. Tax Exempts
- D. Finance Paper (Directly Placed)
- E. Other Investments:
  1. Repurchases; bankers' acceptances; bank time deposit; assignable certificates of deposit; commercial paper; railroad equipment issues; Canadian securities with futures; called bonds and preferred stock

IV. APPRAISING SHORT-TERM MARKETS
- A. Forecasting Interest Rate Trends and Their Effect on Investment Decisions

V. OPERATING PROCEDURES

VI. MEASURING INVESTMENT EFFICIENCY
- A. Current Portfolio Yield
- B. Pre-Tax vs. After-Tax Earnings
- C. Average Maturity
- D. Return on Average Investment
- E. Methods of Appraisal

## *WE'RE MOVING*

**During the week of September 16, AMA will move to its new Headquarters in the American Management Association Building, 135 W. 50th Street, New York City. All AMA New York meetings scheduled to begin on September 23 or thereafter will be held at this new location. Registrants for such meetings should report to the 7th floor at the above address.**

File

# INTEROFFICE MEMORANDUM

**COMPANY CONFIDENTIAL**

DATE September 4, 1963

SUBJECT Gruntal and Company
DEC Stock Report

TO Ken Olsen

FROM Dick Mills


Summary

1) Let's dispose of Gutman first — I believe his $50,000,000 figure would have to be $25,000,000 at the present time for DEC. DEC has had no public exposure as a company and to assume such a market value on his CDC basis is not realistic.

2) The study for 1) above led quite naturally to thinking about a public issue for DEC and what might be sold, number of shares, equity of owners, price per share, underwriter, time required, DEC story to public, use of money obtained, new products, mergers, new markets acquisitions, plant facilities, etc. I believe we exceed CDC in capability and except for the lack of telling our story to the public investor we could command a higher P/E ratio on issue of stock today.


The following is an attempt to arrive at the basis of the $50 million valuation placed on DEC by Gutman.

First

He adjusts our Fiscal '63 net earnings to put us on an "all equal" basis with CDC, which gives us an earnings per share for FYE 6/30/63 of $10.80. CDC's high proportion of rentals is Gutman's basis for the revision.

Second

With a stated value of approximately eight (8) times the AR&D value, DEC would have a market value of $1,120 per share or a 104 to 1 P/E ratio (price to earnings).

Third

Using the 104 to 1 P/E ratio we have CDC with the following for the Fiscal Year End '63 —

| | |
|---|---|
| Shares of Capital Stock | 5,600,000 (shares) |
| Earnings | $3,600,000 (per Gutman) |
| Earnings per Share | $ .64 |
| Market Value per Share Aug. 1, 1963 | $66.75 |
| P/E Ratio | 104 to 1 |

COMPANY CONFIDENTIAL



There appears a gross inconsistency in Gutman's figures — for example with a $300 million market value for CDC divided by the August 1st MV per share of $66.75 the capital stock would be 4,500,000 shares, versus a required 104 to 1 P/E ratio of 5,600,000 shares to arrive at the DEC share price of $1,120. I believe he has erred on his multiplier in converting the AR&D value per share for DEC to the CDC basis — a figure of four (4) instead of eight (8) would be a more reasonable value, with a P/E ratio of 52 to 1 (on a CDC basis), which would still be high for the average electronics company today. However, I believe DEC with its past exceptional record of products, sales and earnings and future possibilities could sustain a higher than average market value for its stock in relation to earnings.

I believe that the company with a net income of 5% on sales such as CDC, highly touted as one of only two computer companies showing a profit (IBM), merger minded, and with a good press gives the investor the impression that here is another IBM and I want to be in on the ground floor. As a result of heavy demand for shares, price rises out of proportion to real value of company. In due course of time, more shares will be made available and price stability of sorts will arrive. It is interesting to note that CDC has not changed its profit % on sales noticeably since 1959.

Computer Control on 2/7/63 tried to stock issue at a 38 to 1 P/E ratio and had to change to a more conservative 25 to 1, more nearly the market average but near the top. CCC has not had the benefit of the public relations, Newsweek, Time and Business Week that CDC has enjoyed. This effort, expended properly, over a period of time, can still create this atmosphere for DEC thus greatly strengthening the after market for the shares.

DEC Picture

If the public relations for DEC were handled in such a way as to show our record and capabilities in terms of people, products, installations, service, ROI, earnings, market penetration, and with emphasis on some of the more basic company philosophies, I believe we could sell the initial offering at a P/E ratio of 25 to 35, depending on the state of the market. The importance of the evaluation in establishing a P/E ratio is seen clearly in the following example of a sample DEC issue:

COMPANY CONFIDENTIAL



Current Shares 6/30/'63

50,560

New Offering

| | | |
|---|---|---|
| From DEC | 10,000 | (Treasury) |
| From AR&D (50%) | 17,500 | |

Current Earnings FYE 6/30/63

Per Share $22.80

| P/E Ratios | Value per Share |
|---|---|
| 25 | $570.00 |
| 30 | $684.00 |
| 35 | $798.00 |

Ownership after Issue

| | Shares | % |
|---|---|---|
| Officers | 10,000 | 16.5 |
| Employees and Directors | 5,650 | 9.3 |
| AR&D | 17,500 | 28.8 |
| Outsiders | 27,500 | 45.4 |
| | 60,650 | 100.0 |

Assume a desired selling price at issue of $25.00 and a 30 to 1 P/E ratio or a stock split of 27 to 1.

Note that the money available to the company is materially effected by a small change in the P/E ratio.

DIGITAL EQUIPMENT CORPORATION • MAYNARD, MASSACHUSETTS

KHO.

August 29, 1963

# INVENTORY ANALYSIS

## JANUARY 1962 - JUNE 1963

| Month | | Raw Materials | W.I.P. Manufacturing | W.I.P. Engineering | Finished Goods Maynard | Finished Goods Branches | Total Inventory |
|---|---|---|---|---|---|---|---|
| June | 1963 | $ 462,061.40 | $ 580,792.29 | $ 587 987.63 | $ 242,424.46 | $ 15,624.46 | $ 1,888,890.24 |
| May | 1963 | 390,712.11 | 831,503.94 | 474,719.24 | 182,518.76 | 15,624.46 | 1 895,078.51 |
| April | 1963 | 411,696.80 | 835,066.27 | 434,460.70 | 193,610.32 | 15,438.72 | 1,890 272.81 |
| March | 1963 | 387,696.31 | 800,193.99 | 433,326.00 | 184,336.72 | 13,146.34 | 1,818,699.36 |
| February | 1963 | 336,372.67 | 825,540.57 | 333,626.30 | 186,677.38 | 13,616.02 | 1,695,832.94 |
| January | 1963 | 410,524.33 | 858,269.85 | 303,006.42 | 188,951.64 | 13,640.65 | 1,774,392.89 |
| December | 1962 | 433,588.59 | 759,905.26 | 392,514.51 | 216,032.72 | 12,758.98 | 1,814,800.06 |
| November | 1962 | 535,092.44 | 807,866.90 | 413,933.72 | 273,149.35 | 6,329.18 | 2,036,371.59 |
| October | 1962 | 569,687.92 | 803,390.94 | 608,062.03 | 255,248.55 | | 2,236,389.44 |
| September | 1962 | 654,636.65 | 654,166.01 | 731,367.77 | 243,414.36 | | 2,283,584.79 |
| August | 1962 | 563,557.31 | 583,330.00 | 763,657.93 | 240,154.29 | | 2,150,699.53 |
| July | 1962 | 530,084.41 | 550,932.98 | 681,081.82 | 236,839.64 | | 1 998,938.85 |
| June | 1962 | 567,217.10 | 560,257.17 | 708,330.13 | 271,313.37 | | 2,107,117.77 |
| May | 1962 | 773,198.15 | 580,607.98 | 729,608.23 | 285,877.82 | | 2,369,292.18 |
| April | 1962 | 698,612.35 | 506,623.79 | 868,255.14 | 163,693.42 | | 2,237,184.70 |
| March | 1962 | 727,368.01 | 364,552.18 | 637,392.31 | 149,154.58 | | 1,878,467.08 |
| February | 1962 | 819,331.85 | 262,752.87 | 388,862.44 | 156,024.62 | | 1,626,971.78 |
| January | 1962 | 763,741.60 | 182,861.19 | 202,433.53 | 191,661.48 | | 1,340,697.80 |
| Avg. for last 12 Months | | 472,975.00 | 740,912.00 | 513,745.00 | 220,279.00 | *13,271.00 | 1,956,995.00 |
| Avg. for last 18 Months | | 557,509.00 | 630,478.00 | 538,478.00 | 214,504.00 | | 1,946,870.00 |

*Avg. for 8 Months only

Combined ave. 12 Months 229,127.00

Combined ave. 18 Months 220,402.00

# INTEROFFICE MEMORANDUM

DATE August 26, 1963

SUBJECT One Coat Durez Dipped Mica Capacitors

TO K. Olsen

FROM Frank Kalwell

cc: H. Crouse
K. Doering
R. Best
M. Sandler
R. Hughes
D. White
T. Whalen
J. Cudmore
G. Gerelds
R. Melanson

In reply to your memo dated July 23, 1963, and a confirmation from Dick Best to proceed and purchase single dip mica capacitors, I have recently cancelled two outstanding blanket purchase orders with Electro-Motive and Cornell-Dubilier on the present triple dip mica capacitors on a no cancellation basis. In turn, I have placed an order for one coat Durez dipped mica capacitors with special lead treatment. The order consists of the more commonly used capacitors, in which the two suppliers have agreed to stock ten per cent of the initial purchase order, so delivery on one coat should be no problem. The values recently placed are as follows: DM-15, ±5%: 47 μμf, 56 μμf, 82 μμf, 100 μμf, 120 μμf, 150 μμf, 220 μμf, 330 μμf, 470 μμf, 680 μμf, 820 μμf and 1000 μμf. Electro-Motive's national distributor now stocks one coat Durez without the lead treatment, so I can not foresee any delivery problems.

The first shipment of the single dip will be made the second week in September. We will continue using triple dip until Production's inventory is depleted.

Engineering and Quality Control have requested that these capacitors be supplied with a special lead treatment, removing the excess clear epoxy rundown on the leads. This will be controlled to 3/64" maximum on rundown, eliminating any possibility of the capacitor not making a proper connection once inserted into the printed circuit board. Only capacitors supplied to us by the manufacturer will have the treatment included at an additional cost of $3.00/M for this treatment. An excellent manner in inspecting the controlled rundown is to use an ultra-violet or 120 watt mercury lamp.

Enclosed is a photostat copy of a memo from Klaus Doering, which covers the physical size of the new single coat Durez capacitors.

Frank A. Kalwell

# dec INTEROFFICE MEMORANDUM

DATE 31 July 1963

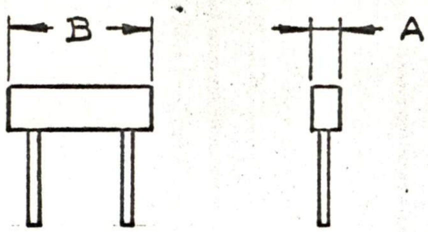
SUBJECT Physical Size of Dip Mica Capacitors

TO Dick Best, G. Gerelds, R. Melanson, M. Perryman

FROM K. Doering

The three dip mica capacitors we have been buying are of the size type "15". From Elmenco "DM-15", from Cornell Dubilier "CD-15".

In order to get some idea about how one dip compares with three dip mica capacitors in physical size, we measured 10 pieces of each kind.




| ONE DIP | | | |
|---|---|---|---|
| Dimension | | | |
| A | Freq. | B | Freq. |
| .099 | 1 | .378 | 1 |
| .100 | | .379 | |
| .101 | | .380 | 111 |
| .102 | 1 | .381 | 11 |
| .103 | 1 | .382 | |
| .104 | 11 | .383 | 1 |
| .105 | 11 | .384 | |
| .106 | | .385 | 1 |
| .107 | 11 | .386 | 11 |
| .108 | 1 | | |

| THREE DIP | | | |
|---|---|---|---|
| Dimension | | | |
| A | Freq. | B | Freq. |
| .153 | 11 | .442 | 1 |
| .156 | 1 | .443 | 1 |
| .159 | 111 | .444 | |
| .162 | | .445 | |
| .165 | 1 | .446 | 1 |
| .168 | | .447 | 1 |
| .171 | 1 | .448 | 1 |
| .174 | 11 | .449 | |
| | | .450 | 111 |
| | | .451 | 1 |
| | | .452 | |
| | | .453 | 1 |

Dimension "A" (thickness is approximately .057" smaller than 3 dip and dimension "B" (width) is approximately .067" smaller. We should find out from our circuits whether this reduction in size is significant enough to switch to one dip mica capacitors.

# INTEROFFICE MEMORANDUM

DATE 31 July 1963

SUBJECT Physical Size of Dip Mica Capacitors

TO Dick Best, G. Gevelds, R. Melanson, M. Perryman FROM K. Doering

The three dip mica capacitors we have been buying are of the size type "15". From Elmenco "DM-15", from Cornell Dubilier "CD-15".

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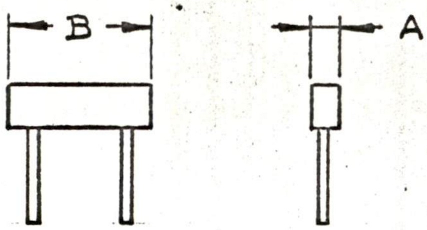


**ONE DIP**

| Dimension A | Freq. | Dimension B | Freq. |
|---|---|---|---|
| .099 | 1 | .378 | 1 |
| .100 | | .379 | |
| .101 | | .380 | 111 |
| .102 | 1 | .381 | 11 |
| .103 | 1 | .382 | |
| .104 | 11 | .383 | 1 |
| .105 | 11 | .384 | |
| .106 | | .385 | 1 |
| .107 | 11 | .386 | 11 |
| .108 | 1 | | |

**THREE DIP**

| Dimension A | Freq. | Dimension B | Freq. |
|---|---|---|---|
| .153 | 11 | .442 | 1 |
| .156 | 1 | .443 | 1 |
| .159 | 111 | .444 | |
| .162 | | .445 | |
| .165 | 1 | .446 | 1 |
| .168 | | .447 | 1 |
| .171 | 1 | .448 | 1 |
| .174 | 11 | .449 | |
| | | .450 | 111 |
| | | .451 | 1 |
| | | .452 | |
| | | .453 | 1 |

Dimension "A" (thickness is approximately .057" smaller than 3 dip and dimension "B" (width) is approximately .067" smaller. We should find out from our circuits whether this reduction in size is significant enough to switch to one dip mica capacitors.

# INTEROFFICE MEMORANDUM

COMPANY CONFIDENTIAL

DATE August 15, 1963

SUBJECT Product Line Profitability - Fiscal 1963

TO Ken Olsen
Harlan Anderson

cc: R. Mills
W. Hindle

FROM George O'Dea

The financial statements for Fiscal 1963 express net profit in terms of total DEC activities as: ($000's Omitted)

| | |
|---|---|
| Net Sales | $9,903 |
| Net Profit | $1,158 |
| % to Net Sales | 11.7% |

The first cut in obtaining more refined data appears on page 2 of the June 1963 Progress Report wherein Gross margin is spelled out in considerable detail and Co. Sponsored Engineering is itemized in even greater detail; but SG&A is carried in total only.

For fiscal 1964 work order systems are being instituted whereby the selling and the technical publication activities of the company can be charged to specific products. For Fiscal 1963 however, the best we can hope to accomplish is an estimate of the extent to which these costs are attributable to individual products.

Before undertaking such a process it is significant to note that $1,949 of the Company's $8,745 total costs, expenses, and taxes are being estimated. This represents 22% of the total. The remaining 78% is reasonably definitive.

For a first approximation we take the classical Modules - Systems - Computers segregation of activity and ask Stan to estimate a percentage distribution of selling expense over these broad categories; then, ask Atwood to do the same thing for Technical Publications; they say

| | Sales Effort per Stan | Technical Publications Effort per Atwood |
|---|---|---|
| Modules | 60% | 45% |
| Systems | - | 15% |
| Computers | 40% | 40% |
| Total Effort | 100% | 100% |
| Cost to be Allocated | $765 | $300 |

For G&A we follow the time honored, blind, but arithmetically accurate method of allocating the total over the total manufacturing cost, sales expense, and technical publications expense of each of the three principal classes of business.

Thus, our first approximation of Product Line Profitability yields:

| | Modules | Systems | Computers | Total |
|---|---|---|---|---|
| Net Sales | $3,482 | $1,073 | $5,348 | $9,903 |
| Less Mfg. Cost | 1,124 | 676 | 2,407 | 4,207 |
| Gross Margin | $2,358 | $ 397 | $2,941 | $5,696 |
| % Gross Margin | 67.7% | 37.0% | 55.0% | 57.5% |
| Deduct Engineering Expense | 254 | 91 | 845 | 1,190 |
| Margin after Measured Costs | $2,104 | $ 306 | $2,096 | $4,506 |
| Less Unmeasured Costs* | | | | |
| Selling | 459 | - | 306 | 765 |
| Technical Publications | 135 | 45 | 120 | 300 |
| G&A | 270 | 111 | 503 | 884 |
| Total Unmeasured Costs | $ 864 | $ 156 | $ 929 | $1,949 |
| Profit Before Taxes | $1,240 | $ 150 | $1,167 | $2,557 |
| Less Taxes | $ 678 | $ 82 | $ 639 | $1,399 |
| Net Profit | $ 562 | $ 68 | $ 528 | $1,158 |
| % Profit to Net Sales | 16.1% | 6.3% | 9.9% | 11.7% |

* The term "unmeasured" refers to the product line applicability.

The accuracy of the allocation of costs is probably great enough to draw the simple conclusion that modules sold direct to customers are much more rewarding than modules incorporated in system and computer sales.

As regards the Systems branch of the business, the analysis issued June 17 still pretty much tells the story. Jon suffers from "first time" costs - not to be thought of as "one of a kind" costs - from the marketing disadvantage of distributing Ramsey Handlers in Japan - and now from allocation of a share of his profits to DEGmbH. The final Fiscal '63 Systems Summary as regards gross margin reads

| | Sales | Cost | Gross | % Gross |
|---|---|---|---|---|
| First time units | $ 120 | $106 | $14 | 12% |
| Ramsey Handlers to Japan | 24 | 22 | 2 | 7% |
| DEGmbH discount | -3 | - | 3 Loss | - |
| Sub Total "Special" Situations | $ 141 | $128 | $ 13 | 9% |
| Regular Business | 932 | 548 | 384 | 41% |
| Total Systems Gross Margin | $1,073 | $676 | $397 | 37% |

Included in Jon's Engineering expense is a charge of $9 for the time of his people working on the PDP-5, a unit which produced no income during Fiscal '63. It seems appropriate to assume the majority of his remaining engineering fall on specials with the minority on regular business. For these purposes we will use a 60-40 split. These results are summarized on the attached Product Line Profitability Worksheet.

Tuming next to Computers we move into probably the stickiest area of all. Here the inter-dependence of one product on another is so great as to limit the conclusions one might draw from any allocated segregation.

Probably the only meaningful analysis is to attempt to tie accessory billings to the two basic central processors and see where that leads us . Page 2 of the Progress Report shows that the billing total breaks down -

| | | |
|---|---|---|
| PDP-1 (incl ADX) | $2,035 | (16 2/3rds machine) |
| PDP-1 as rentals | 108 | (1 machine) |
| Sub total PDP-1's | $2,143 | |
| PDP-4's | 315 | (7 machines) |
| Total, Central Processors | $2,458 | |
| Accessories | 2,881 | |
| Field Service | 9 | |
| Total Computers | $5,348 | |

The Cost data on these transactions is only segregated to the extent of rentals ($48), Field Service ($128), gross up of Warranties ($80 cr.) and "all other" of $2,311.

The problem is thus one of allocating Accessory, Field Service, and the gross up of Warranties between Central Processor Sales. For this purpose we will use the billing split as the base and cast the overall computer activity as follows:

| | Sales | Cost of Sales | Gross | % |
|---|---|---|---|---|
| PDP-1 Sales | $2,035 | $ 899 | | |
| Share of Accessory Sales | 2,506 | 1,108 | | |
| Share of Field Service Billings | 8 | 111 | | |
| Share of Warranty Reserve Gross-up | - | 70 cr. | | |
| Rentals | 108 | 48 | | |
| Total PDP-1 | $4,657 | $2,096 | $2,561 | 55.0% |
| PDP-4 Sales | 315 | 139 | | |
| Share of Accessory Sales | 375 | 165 | | |
| Share of Field Service Billings | 1 | 17 | | |
| Share of Warranty Gross-up | - | 10 cr. | | |
| Total PDP-4 | $ 691 | $ 311 | $ 380 | 55.0% |
| Total Computers | $5,348 | $2,407 | $2,941 | 55.0% |

Segregation on this basis may give a slight preference to the PDP-4 (Beckman discount refund of $26K involved no cost: ITT cancellation of $83 only incurred cost of $14: one is hard pressed to identify $375 of accessory billings with PDP-4 customers), but the difference is not believed to be of sufficient magnitude to distort the conclusions.

Engineering expense as stated on the progress report shows $166 on new products, $223 on PDP-1's, $161 on PDP-4's and $295 on accessories. If we split the accessory total on the sales base we can approximate the product line applicability. The attached Worksheet treats it thus.

For Selling and Publications effort, the assumption is some of this money is for new products - say 10% - the rest is split evenly between PDP-1's and PDP-4's.

So much for the guess work. If all of our assumptions were perfect, we can say the attached Product Line Profitability Worksheet gives the true results by category.

Probably the most disturbing thing is the fact that the PDP-4 after two years of life is still a loser. Very roughly, at a 55% gross margin it needs \$486 ÷ 55 or about \$900K per year volume to break even.

Your comments on the propriety of the allocation bases are invited.

George O'Dea

GO'D:ncs
Attachment

# DIGITAL EQUIPMENT CORPORATION

## Product Line Profitability Worksheet - Fiscal 1963

($000's Omitted)

| | | | | Deduct Operating Expenses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Net Sales | Less Cost of Goods Sold | Gross Margin | Engineer-ing | Sell-ing | Tech Pubs. | G&A | Total | Pre-Tax Profit | Less Taxes on Profits | Net Profit | % Net Profit to Sales |
| Modules | $3,482 | $1,124 | $2,358 | $ 254 | $459 | $135 | $270 | $1,118 | $1,240 | $ 678 | $ 562 | 16.1% |
| Systems: | | | | | | | | | | | | |
| Special Situations | 141 | 128 | 13 | 48 | - | - | 19 | 67 | 54 loss | 29 cr | 25 loss | 17.7% loss |
| Regular Business | 932 | 548 | 384 | 34 | - | 45 | 91 | 170 | 214 | 117 | 97 | 10.4% gain |
| Future Products | - | - | - | 9 | - | - | 1 | 10 | 10 loss | 6 cr | 4 loss | - |
| | $1,073 | $ 676 | $ 397 | $ 91 | $ - | $ 45 | $111 | $ 247 | $ 150 | $ 82 | $ 68 | 6.3% |
| Computers: | | | | | | | | | | | | |
| PDP-1 | 4,657 | 2,096 | 2,561 | 480 | 138 | 54 | 377 | 1,049 | 1,512 | 830 | 682 | 14.7% gain |
| PDP-4 | 691 | 311 | 380 | 199 | 137 | 54 | 96 | 486 | 106 loss | 58 cr | 48 loss | 7.0% loss |
| Future Products | - | - | - | 166 | 31 | 12 | 30 | 239 | 239 loss | 133 cr | 106 loss | - |
| | $5,348 | $2,407 | $2,941 | $ 845 | $306 | $120 | $503 | $1,774 | $1,167 | $ 639 | $ 528 | 9.9% |
| Grand Total | $9,903 | $4,207 | $5,696 | $1,190 | $765 | $300 | $884 | $3,139 | $2,557 | $1,399 | $1,158 | 11.7% |

Allocated Expenses (Selling, Tech Pubs., G&A)

# NEWS RELEASE

CONTROL DATA CORPORATION
CONTROL DATA CORPORATION
8100 34th AVENUE SOUTH, MINNEAPOLIS 20, MINNESOTA

FROM: James G. Miles, Vice President

FOR IMMEDIATE RELEASE: For Immediate Release
June 19, 1963

Ken, after the ARDC turndown (via Hubbard) this looked like the best direction! Ed F.

CONTROL DATA ACQUIRES RIGHTS TO ITEK DIGIGRAPHIC SYSTEM

William C. Norris, President of Control Data Corporation, Minneapolis, Minnesota, and Franklin A. Lindsay, President of Itek Corporation, Lexington, Massachusetts, announced today, June 19, 1963, that Control Data has acquired, for an undisclosed amount of cash and other considerations, rights to Itek's Digigraphic System and certain of the assets relating to development and manufacture of these systems. Control Data has assumed responsibility for completing existing orders for Digigraphic components.

The Digigraphic System, developed by Itek over the past two and one half years, is a unique method for direct "real-time" communication between man and computer. Through the medium of a cathode-ray tube display and a photoelectric pen, a human operator is able to communicate directly with a pre-programmed, high-speed digital computer. The System, when fully developed, is expected to have widespread applications in such areas as machine-tool control, management of large technical projects such as weapons systems, and automatic or semi-automatic conversion of existing graphic documents (including mechanical drawings and schematic diagrams) into digital form.

Further development and production of the principal digital electronics elements of the system will now be carried on by Control Data. Itek will retain

-more-responsibility for development and production of key non-digital components, including precision cathode-ray tubes. The complete system will be marketed by Control Data.

Norris said that this acquisition is a part of Control Data's over-all plan to broaden its market areas and product lines. He pointed out that the Digigraphic products represent an extremely sophisticated extension of computer usage and technology, particularly in scientific and engineering fields.

Norris also noted that his company has been looking for some time for a qualified digital systems development group in the Boston area and that the Digigraphic staff and operation ideally meets this need. He said that the Digigraphic staff is "unusually experienced and talented in digital computer and display technology and will be encouraged both to elaborate the Digigraphic development, and also to extend its talents into other fields compatible with Control Data's overall objectives." He said that Control Data definitely plans to build up this facility in the Boston area. Pending the acquisition soon of Control Data facilities near Boston's Route 128, the Digigraphic operation will continue at the Itek location.

Itek President Franklin A. Lindsay said that the Control Data arrangement would provide the substantial electronics capabilities and marketing required to put the Digigraphic System to commercial use. He added that Itek is looking forward to a continuing relationship with Control Data Corporation in the full exploitation of the Digigraphic System. As a part of the basic agreement, Control Data has agreed to supply Itek with Digital Display equipment for use in Itek's Graphic Data Handling Systems.

# # # # # #

1-30

# INTEROFFICE MEMORANDUM

DATE August 19, 1963

SUBJECT

TO K H Olsen

cc: R L Best

FROM R Doane


SUMMARY

This memo shows the reasoning that gives the VHF project the direction it has. I also list the principal direct results achieved with the $40,000 (approximately) spent on the project so far, and the principal engineering still to be done.

I expect this will give you more confidence in the worth of the effort. In any case, you'll have a more detailed picture of it.


RD/dhw

## HIGHER SPEEDS ARE NECESSARY:

It seems clear that the electronic industry is still moving ahead on all fronts, including speed. As other electronic equipment at increased speed becomes available, the appetite for faster digital equipment is bound to come. The questions of how soon and from whom (re-negotiable or not?) are difficult, but I believe that even if the initial demand is weak and mainly military, we would be wrongheaded to omit preparation. As I believe you once remarked, it is easier to retain leadership than to reclaim it.

## FASTER SATURATION IS INADVISABLE:

If you agree to some kind of preparation for speeds faster than the 10 Mc line offers, then arises the technical question of how to proceed. The most direct approach would certainly be to extend the speed of saturation circuits, with which we are already very familiar. Faster transistors designed for saturated switching are still being introduced and published reports of saturated switching circuits operating to 240 Mc (1961 Solid State Circuits Conference) seem to offer unlimited potential.

However, our present circuits have a characteristic that is onerous even at 10 Mc, and promises to worsen at higher frequencies: leads must be kept short. At 5Mc, our wiring recommendations state that a level can be transmitted three feet without a series damping resistor. At 10 Mc, the distance is still shorter (I recommend one foot max., but this is not based on any thorough comparison). As the lead length increases, susceptive and inductive reactances increase together, so transmission of risetimes can worsen more than linearly with increased lead length. For a 20 Mc saturated logic system an undamped 6" lead length would probably be tops. Pulsed emitters would have to be within about 3" of ground (12" is allowable at 5Mc). While such a system would be workable, its flexibility would be distinctly limited. Level fan-out would be impaired because few inputs can be reached with 6" of wire, and beyond that distance the required damping resistor severely reduces the drive available.

In addition to lead length limitations in systems use, there would be testing problems. We have failed on many occasions to build testers at 10 Mc that have fidelity enough to give repeatable test data. At 20 Mc extending similar techniques would provide only a sketchy indication of performance. Possibly by moving the scope probe instead of switching,acceptable results could be obtained, but hot and cold tests would be very cumbersome, and testing of any sort would be slow. Certainly considerable effort would be expended, with no bright prospects for futher increases.

None of these arguments show that faster saturated circuits are impossible or even impractical. What they do show is fast diminishing returns and the prospect of proliferating module speed lines with only moderate speed distinctions, and with increasingly limited flexibility.

In view of such observations, my objectives in exploring fast circuits increased from the original one of simply making a faster flip flop. What seemed required was a circuit geometry that allowed connection to a transmission line, without requiring separate cable and reactive compensating termination for every input driven (as the saturating circuits of the Lincoln Lab FX-1 do). Such circuitry would allow ultimate extension to much higher speeds, though the initial development is harder.

DESIGN GOALS:

1. To use transmission line for long runs:

There are three major aspects of this problem: driven circuitry, driving circuitry, and mechanical geometry. To allow good fan-out driven circuitry should present an impedance higher than Zo during the entire switching process, making it possible for several inputs to be driven at widely separated points on the same transmission line. Driving circuitry must supply enough power to drive the Zo selected. Mechanical design must keep stray shunt capacitive reactance high compared to Zo, and keep stray series inductive reactance low compared to Zo.

2. To allow compatibility with other DEC modules: Electrical compatibility demands easy two-way communication between module speed lines. Mechanically, the new circuits should use standard packaging and standard production methods.

SOLUTION:

Since the most demanding requirement is high input impedance during switching, available geometries can be screened on this characteristic. Obviously, circuits whose input is an emitter must be eliminated*, and both saturating and grounded-emitter circuits have too low input impedance for practical Zo even though they have base input. Only emitter-followers and current switches remain, as far as I know.

Emitter-followers by themselves have too many disadvantages: low voltage gain, oscillatory tendencies, and non-inversion. The use of NPN emitter-followers in a high-current version of the 1111 as input buffers could offer fair transmission-line matching and excellent compatibility with present circuits (PNP emitter-followers in an 1110-type circuit would be slower and would load the driving cable during turnon).

But performance would be limited by the low gain of the saturated stage. This objection hinges on the recognition that signal power efficiency is basically antagonistic to controlled impedance; input-to-output power gain (at the highest frequency of interest) divided by fanout must be of the order of five to allow impedance matching of the order of $\pm$ 20%. The power gain of this type of circuit at the point of desaturation is not easy to predict, but it is certainly lower than the worst gain of a current-switching circuit.

Had I been able to state things this clearly at the outset, no doubt I would have explored the possibilities of the follower-driven saturated switch. However, a lot of experience with the present VHF current-switching circuits has already proven their utility and has brought us close to a marketable product.

*I know of one suitable circuit with emitter input, but the input "transistor" is used as though it were two diodes. My recollection is that this geometry was invented for the special requirements of microcircuitry.

PROGRESS:

I want to list for you the successful events, since as critical and impatient engineers it is commoner for both of us to concentrate on the hurdles still uncleared. These accomplishments are each small ones, but taken together I think they show a considerable progress. Not listed are some other steps that had limited useful life, such as an interim resonant-cable burst generator with alternating and non-alternating outputs at several frequencies, and the VHF Test System that exposed the tendency of the 8201 to allow a splintered input pulse to propagate.

1. Finding a basic geometry that can be driven from transmission line with high fan-out at high speeds.

2. Finding a way to make it communicate with standard circuits without using special interface circuits, but without sacrificing its basic advantages.

3. Finding a convenient way to get flip flop outputs both with and without logical delay, to maximize logic time for application where the outputs may condition the inputs.

4. Putting two complementary current-switching circuits in series in the modules, so their voltage translations cancel, and so the combined power gain allows high speed with high fanout.

5. Using transmission line delay instead of transformer inductance to define pulse widths, so that pulse transformers could be eliminated, thereby avoiding the difficult production of critically wound transformers on low mu materials.

6. Taking advantage of pulse transformer absence by DC coupling all circuits and making both pulses and levels permitted in all circuits.

7. Printing high quality delay lines on double-sided etched boards without demanding excessively tight registration tolerances.

8. Making a remotely controllable clock multivibrator capable of operation toabove 40 Mc.

9. Finding means to measure thermal resistances in transistors and heat sinks.

10. Finding method and materials for making thermal connections from output transistor cases to connector pins without making manufacture unduly difficult or spoiling appearance.

11. Making printed board layouts for circuits that make full use of all available connector pins, but with leads tolerably short.

12. Making testers that provide signal fidelity comparable with that obtainable in 5Mc testers.

13. Providing for oven-controlled hot and cold tests without distorted signals or loss of full tester control.

14. Building a burst generator like the ones we use at 5 Mc, giving a 63 pulse 30 Mc burst, and operable to 40 Mc.

The schedule sheet shows that the 10 logic modules and 15 flip-flops made in Production have finally been completed. As I write this, we have taken enough data sheets on the 8103s to know what revisions are needed on the data sheet and test procedure, and we are now trying various transistors in an 8201 to find out what $F_t$ is required and whether a new silicon PNP will work (it costs about what the germanium 2N994 did). As you can see from the sheet, all steps along the way took about twice as long as the people responsible told me they expected, but I think it's important to realize that these results were obtained without much pressure from me; I have seldom asked anyone to give priority to VHF, since our first obligations are to waiting customers.

PLANS:

These are the major tasks ahead:

1. Revising test data sheets and procedures.

2. Taking the remaining test data on production modules, including hot and cold checks.

3. Testing a scheme for preventing split pulse carry propagation suggested by Don White (in a jig already designed and wired).

4. Testing fan-out characteristics and open wire $Z_o$ for various loads (in a mounting panel already wired for it).

5. Testing the prototype 8401 in a tester already built for it (the successful breadboard is now running the burst generator).

This is not the kind of project the company has invested in before, being years instead of months in development, and it is not surprising if you wonder whether anything will ever come out of it. I am well aware that companies have often sponsored boondoggles that have gone on for years without a useful output. I am just as anxious to prevent this project from being made a boondoggle through lack of management confidence as you are to know it hasn't been made a boondoggle through bad engineering judgment. I still hope to present my results to the Works Committee when they are at the stage predicted for June 17, which should be in about two months (in spite of my vacation). Meanwhile, we could discuss the future of VHF when you return from your vacation, or at any other time.

# PROJECT SCHEDULE SHEET

PROJECT TITLE VHF Modules [redacted]

March: 4, 11, 18, 25 — April: 31, 7, 14, 21, 28 — May: 6, 13, 20, 27 — June: 3, 10, 17

| | |
|---|---|
| Prepare Board Layouts | 3/18 |
| Get Back Photos | 3/27 |
| Build Etched-Board Models | 4/4 and 4/9 |
| Build Models | 5/2 and 5/3 |
| Test Models | 5/13 |
| Manufacture Etched Boards | 6/11 to 6/13 |
| Manufacture Modules | 7/24 and 7/30 |
| Production Test Modules | |
| Tests of counter, shift register, burst generator, transmission line loading, long-term reliability; write paper | |

Report to Works Comittee: Aim to have sufficient experience and data for marketing the product.

NAME - R. Doane

DEPT. -

DATE -

DF100-26

500-9/62

R Olsen

# INTEROFFICE MEMORANDUM

DATE July 29, 1963

SUBJECT Germanium Diodes

TO M Sandler

FROM R L Best
R Hughes
H Crouse
D White

In less than one month our supply of D001 diodes will be depleted. The latest quotes on 003 diodes indicate that the difference in price between 001 and 003 will be too small to justify two diode types.

When the present supply of D001's is exhausted, we will use D003 in its place . Circuit schematics will be changed gradually in conjunction with other engineering changes.

ASJ
CC
Distribution List D

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G Porazzo
R Reed
M Sandler
B Scudney
J Shields
J Smith
B Stephenson
T Stockebrand
R Tringale
K Wakeen
D Wardimon
L White

Ken Olsen

Velma Grasseler
Sales Department
7/29/63

RL Best
R. L. Best

## INDEX OF ITEMS NOT IN THE CATALOG

CATALOG ITEMS will appear in future editions of the module catalog, or on Supplementary Pages to be included in the present catalog. (See Page 13 for a list of Supplementary Pages now available.)

Those that are NOT catalog items are available to customers on a replacement basis or special order only.

Delivery dates on all items included in this list should not be quoted without first checking with Cy Kendrick, Production Department.



| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 42 | ALARM PANEL | Used in Memory Tester | | no |
| 43 | ALARM PANEL | Used in Memory Tester | | no |
| 44 | ALARM PANEL | Same as 43, but has both a light and a buzzer. | | no |
| 75 | BIAS PANEL | Resistive network used to introduce a small and variable amount of current into current driver. | $82 | yes |
| 76 + | BIAS PANEL | Electrically the same as the 75, but has only 4 circuits. Same size as a current driver. | | no |
| 722A | POWER SUPPLY | This is a 50 cps 722 Power Supply. | | yes |
| 728A | POWER SUPPLY | A 50 cps 728 Power Supply. | | yes |
| 734A | POWER SUPPLY | A 50 cps 734. | | yes |
| 735 | POWER SUPPLY | For computer memories. Temperature compensated. | $455 | no |
| 735A | POWER SUPPLY | A 50 cps 735. | | no |
| 735B | POWER SUPPLY | A 735 modified for memories. | | no |
| 735C | POWER SUPPLY | A 50 cps 735B. | | no |
| 743A | POWER SUPPLY | A 50 cps 743. | | yes |
| 764 | POWER SUPPLY | 0 to 250 volts for test equipment. 60 milliamp. | | no |
| 769A | POWER SUPPLY | A 50 cps 769. | | yes |
| 770 | POWER SUPPLY | Used in CRT Display unit. (+10K v., +250 v., -150 v.) | $410 | no |
| 770A | POWER SUPPLY | A 50 cps 770. | | no |

+Advertising Dept. has issued preliminary information.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 772A | POWER SUPPLY | A 50 cps 772. | | yes |
| 776A | POWER SUPPLY | A 50 cps 776. | | yes |
| 778 + | POWER SUPPLY | Dual -15 volt. For mounting on a plenum door. | $350 | yes |
| 778A | POWER SUPPLY | A 50 cps 778. | | yes |
| 779 | POWER SUPPLY | +10, -15 and -30 volts. | $374 | yes |
| 779A | POWER SUPPLY | A 50 cps 779. | | yes |
| 780 | POWER SUPPLY | Floating 12 volt, 250 milliamp. Zener regulated PS which provides the holding voltage for Type 4704 R/W Hold and Deselect module. For Memory Testers. | | no |
| 811 | POWER CONTROL | Single step with power interlock. | $241 | no |
| 811A | POWER CONTROL | Modified for duplex tape. | | no |
| 811B | POWER CONTROL | Modified for Holly printer. | | no |
| 812 | POWER CONTROL | Fast ON, Slow OFF for teletype punch. | $335 | no |
| 813 | POWER CONTROL | 2-step, 3 wire. Used in PDP-1 &-4 | $675 | no |
| 814 | POWER CONTROL | 2-step. Used for Anelex Printer. | $555 | no |
| 814A | POWER CONTROL | Used for extra memories on PDP-1. | | no |
| 815 | POWER CONTROL | Special systems only. Used to turn on AC power in machines and protect against overload. 5-1/4"x 19". | | no |
| 816 | POWER CONTROL | Same as 815. 3-1/2" x 19". | | no |
| 817 | POWER CONTROL | Same as 815. To be mounted on top of computer cabinet. 5-7/8" x 19-1/2 | | no |
| 818 | POWER CONTROL | Same as 817, only mounted on bottom of computer cabinet. | | no |
| 820 | POWER CONTROL | Single step, remote ON-OFF, filters, circuit breaker. | | no |
| 821-5A | MARGINAL CHECK CONTROL PANEL | 5-channel marginal check panel. | | no |
| 822 | POWER CONTROL | For Tape Unit 50. Designed to allow insertion of isolation transformer or other device. Similar to 811, but with noise filters. | | no |

+ Advertising Department has issued preliminary information.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 823 | SCR CONTROL | 3-amp. Turns punch motor on and off | | no |
| 824 | POWER CONTROL | Similar to 815, 816 and 817. Has an additional switch and outlet. 3-1/2" x 19" panel. | | no |
| 825 | POWER CONTROL | 2-step. Similar to 813 except it is designed to continue to operate with power off up to 100 millisecs. | | no |
| 825A | POWER CONTROL | An 825 with delayed output controlling -15 v. only. | | no |
| 826 | POWER CONTROL | Used with Displays. | | no |
| 828 + | POWER CONTROL | Standard equipment on all PDP-1's and PDP-4's. Located below typewriter logic. Provides AC outlet panel for scopes, soldering iron, etc. Contains a circuit breaker and has 8 outlets. 5-1/4" x 19". | | no |
| 850 | RELAY PANEL | | | no |
| 851 | RELAY PANEL | | | no |
| 852 | RELAY PANEL | | | no |
| 930 | TERMINATOR BOX | Plugs into current drivers. | | no |
| 931 | TERMINATOR BOX | Two 930's on 3 pins. | | no |
| 960 | INDICATOR PANEL | 3-1/2" x 19" panel with 18 indicato lights. Has 18 banana jacks on one side of the front panel for inputs to lights from lab modules. | $175 | yes |
| 1010 | DIODE MATRIX | For high speed adder and incremental scope. | | no |
| 1011 * +(numbered 1101) | DIODE | Negative AND gate with load and biasing circuitry. | $41 | no |
| 1020 | MEMORY DIODE UNIT | 12-pin matrix. | | no |
| 1030 | TERMINATOR | Terminator for memory bus in PDP-6 | | no |
| 1031 | RIGHT ANGLE CONNECTOR | Right angle 18 coax 22-pin connector. | | no |
| 1032 | STRAIGHT CONNECTOR | Straight 18 coax 22-pin connector. | | no |
| 1103A | INVERTER | Interface for DCTL to DEC. | | no |

* Sales Dept. has issued an information sheet.

+ Advertising Dept. has issued an information sheet.

| Model Name | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 1141 | NEGATIVE AND-NOR GATE | General description same as 4141. Output loading same as 1105. | $61 | no |
| 1260 | SUB-ROUTINE CARD | Contains 3 flip-flops and 3 pulse amplifiers. | | no |
| 1316 | DELAY LINE | Contains 6 delay lines; each produces delays in steps of 50 nanosecs to a maximum of 200 nanosecs. | $117 | yes |
| 1534 + | VARIABLE SLICING RECTIFIER | Each channel clips and rectifies signal supplied from one read bus line of a digital mag tape system. Input comes directly from output of a 4550. Output drives input of a 1535. | $169 | yes |
| 1535 + | PEAK DETECTOR | Generates a 2.5-volt, 0.4 μsec Standard DEC pulse each time input signal passes through a positive amplitude peak. Is driven by the 1534. | $83 | yes |
| 1536 + | MAG TAPE SENSE AMPLIFIER | Replaces the 1549. Output drives input to a 1542. | $164 | yes |
| 1537 + | DRUM SENSE AMPLIFIER | Amplifies drum head playback, slices at predetermined threshold, strobes (time samples) and provides standard pulse amplifier output. | $132 | yes |
| 1539 | PEAK DETECTOR AND SLICER | Used in tape systems to provide a logic pulse at the peak of an analog input signal. Driven from the output of a 1542. | $112 | no |
| 1542 | GATABLE RECTIFIER AND SLICER | Used in NRZ tape systems to rectify amplified read head signals and slice away a variable amount for noise rejection. Is driven by output of a 1536. Drives the 1539. | $122 | no |
| 1559 | LIGHT PEN AMPLIFIER | (Being redesigned) | $145 | no |
| 15591 | LIGHT PEN AMPLIFIER | | | no |
| 1567 | DISPLAY PREAMPLIFIER | | $480 | no |
| 1571 | DUAL SENSE AMPLIFIER | 70 nanosec strobe, 400 nanosec output. | $203 | yes |

+ Advertising Dept. has issued an information sheet.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 1572 + | DIFFERENCE AMPLIFIER | DC comparator like the 1547, but lower drift and higher speed. | $180 | yes |
| 1574 + | D-A CONVERTER | 12-bit D-A Converter employing a binary weighted resistor ladder network. | | yes |
| 1575 | SAMPLE AND HOLD | Used in Display. | | no |
| 1576 | STAR | For use in Type 140 high speed ADC. Contains combination star-ladder type DAC. Intended to convert binary code which has overlapping bits into analog. (Limited production - to be made as requested) | | no |
| 1577 | DEFLECTION CORRECTION GAIN CONTROL | | | no |
| 1578 | MULTIPLEXER SWITCH | | $425 | yes |
| 15781 | MULTIPLEXER SWITCH | Similar to 1578; designed for low level operation. | | yes |
| 1609 | 70 NANOSECOND PULSE AMPLIFIER | Six pulse amplifiers, 2-1/2 megacycle, 70 nanosecond pulse standardizers. | | yes |
| 1664 | MEMORY BUS CONTROL | Quadruple size module for PDP-6. | | no |
| 1665 | PULSED BUS TRANSCEIVER | Quadruple size module for PDP-6. | | no |
| 1666 | ANALOG EMITTER FOLLOWER | Drives display monitors. | | no |
| 1692 + | BUS DRIVER | Similar in driving capability to the 1682. | $140 | yes |
| 1701 | POWER SUPPLY CONTROL | Contains two identical circuits: one controls inhibit supply, and the other controls R/W supply. | $105 | no |
| 1704 | POWER SUPPLY | -10 volt precision. | $242 | yes |
| 1705 | CRT BIAS & FOCUS | Supplies voltages for the #1 and #2 grids of the 16" CRT used in DEC Type 30 Displays. | $185 | no |
| 1706 | DC POWER AMPLIFIER | Unity gain amplifier used for focus correction. Will soon be replaced by the 1750. | $220 | no |

+ Advertising Dept. has issued an information sheet.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 1707 + | MULTIPLIER BIAS SUPPLY | Used with the 1706. Level shifter, places 5 volts across resistors in both directions in a 4677 single-ended bridge. | $172 | no |
| 1708 | CATHODE CURRENT LIMITER | Used in Type 31 Display. | | no |
| 1710 | DC VOLTAGE MONITOR | Detects reduced +10 or -15 volts before system fails. | | no |
| 1711 | POWER SUPPLY CONTROL | Control for 781 Power Supply. Similar to 1701 Power Supply Control. | | no |
| 1750 | OPERATIONAL AMPLIFIER | Will replace the 1706. | | no |
| 1772 | CURRENT/VOLTAGE CALIBRATOR | See 72 C/V Calibrator. | | no |
| 1802 * + | RELAY | Consists of 10 Form A relay contacts energized from a single coil. | $45 | no |
| 1803 * + | RELAY | Consists of 4 Form A Dunco Reed relays, each with optional protecting circuit. | $108 | yes |
| 1804 * + | RELAY | Consists of 4 Form A Dunco Reed relays with pulse forming network in each contact circuit. | $108 | yes |
| 1924 | MOUNTING PANEL | Like a 1901 except there are 4" between front panel and logic. | $150 | yes |
| 1928 | SYSTEM MOUNTING PANEL | 19". 25-unit taper pin mounting panel; unpainted, with marginal check switches. Like a 1914 with taper pins. | $220 | yes |
| 1929 | LOUVERED MOUNTING PANEL COVER | | $15 | yes |
| 1930 | MOUNTING PANEL | Wire wrap; 24" wide, painted. | $250 | yes |
| 1931 | MOUNTING PANEL | 25-unit, quadruple size module mounting panel; unpainted. Has marginal check switches. | | no |
| 1932 | MOUNTING PANEL | For 16 quadruple size modules mounted horizontally. Used in PDP-6 Memory. 10-1/2" high. | | no |

*Sales Dept. has issued an information sheet.

+ Advertising Dept. has issued an information sheet.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 1956 | 10-PIN PLUG ADAPTER | Provides connections from logic to rear plug of 4203 flip-flop. | $43 | no |
| 1957 | BLANK SYSTEM MODULE | Double length, assembled; plain board. | $13.50 | yes |
| 1958 | BLANK SYSTEM MODULE | Double length, unassembled; copper clad board. | $13.50 | yes |
| 1959 | 22-PIN PLUG ADAPTER | 1-1/2 size module. Used in PDP-5. | $22 | no |
| 1964 | BLANK SYSTEM MODULE | 1-1/2 length, assembled, plain board. | | yes |
| 1965 | BLANK SYSTEM MODULE | 1-1/2 length, unassembled, copper clad board. | | yes |
| 1972 | READ/WRITE SWITCH | Contains 4 identical switch circuits each with an AND gate input used to control the application of drive current to a memory core winding. | $153 | no |
| 1973 | MEMORY DRIVER | Read and Write drivers. Provide R/W drive currents to the windings of the core array. | $130 | no |
| 1976 | RESISTOR BOARD | Contains eight 50-ohm, 3-watt resistors with 1/2% tolerance. | $55 | no |
| 1978 | RESISTOR BOARD | Contains eight 50-ohm, 3-watt resistors with 1/2% tolerance. | $55 | no |
| 1981 | SENSE SWITCH | 4 per card, designed to accept input signals of one volt amplitude. Stands back voltage of 50 volts. | $160 | no |
| 1982 + | INHIBIT DRIVER | Used to drive the inhibit windings of magnetic core memory planes. Contains 4 circuits. | $146 | no |
| 1987 + | READ/WRITE SWITCH | Used as a bipolar selection switch for address lines of a magnetic core memory. Each circuit has a 4-input diode AND circuit to decode the address register. Output lines for read and write currents are separate and can be paralleled where independence is not necessary. | $153 | no |
| 1990 | READ/WRITE SWITCH | Used in drive system of Memory Testers 1516 and 1521. Switching device is low impedance silicon control rectifier. 4 switches and 4 switching circuits per module. | $200 | yes |

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 4111A | DIODE | Used as a sense switch in core testers. | $58 | no |
| 4116 * +Ω6/3/63 | DIODE | Three 5-input negative OR gates. Connections same as 4117. | $47 | yes |
| 4123 * +Ω6/3/63 | NEG.CAPACITOR DIODE GATE | Similar to 4129. Useful as input gates for a 1 megacycle accumulator. | $59 | yes |
| 4130 | POS.CAPACITOR/ DIODE GATE | Similar to 4129 except positive C/D gates with positive output. | $44 | no |
| 4143 * | DIODE | A 4141 with 2 transistors. | $56 | yes |
| 4161 * +Ω6/25/63 | BCD DECODER | Same as 1161 except for transistors. Used for decoding 8421 or excess 3 to decimal. | $105 | yes |
| 4202A | FLIP-FLOP | Half of a 4202. Flip-flop B only. | $96 | no |
| 4202B | DUAL FLIP-FLOP | Same as 4202 but with shift paths bypassing flip-flop A. | $96 | no |
| 4206 | TRIPLE FLIP-FLOP | For PDP-5. 1-1/2 size module with plugs on both ends. Contains one bit of the MA, MB, and AC. | $212 | no |
| 4207 | FLIP-FLOP | Replaces 4203 in the newer PDP-4's. | $122 | no |
| 4219 * | QUINTUPLE FLIP-FLOP | Five flip-flops; common clear, set and jam transfer requiring two level inputs per bit. | $110 | yes |
| 4220 + | 8-BIT BUFFER REGISTER | See Adv. Bulletin C-4001. 8 flip-flops with common clear and common read-in determined by conditioning of gates. | $107 | yes |
| 4221 + | 6-BIT SHIFT REGISTER WITH PARALLEL READ-IN | See Adv. bulletin C-4001. 6 flip-flops. 5 have common clear, 1 has connections for either clear or set. | $109 | yes |
| 4222 + | 7-BIT COUNTER WITH READ-IN GATES | See Adv. Bulletin C-4001. 7 flip-flops with a common clear and common read-in determined by conditioning of read-in gates. | $119 | yes |
| 4223 * + | 10-BIT SHIFT REGISTER | 10 flip-flops. 9 have common clear, 1 has either clear or set depending on jumpers on board. All flip-flops have shift gates. | $143 | yes |

*Sales Dept. has issued an information sheet.
+Advertising Dept. has issued an information sheet. Ω Revised (date)

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 4224 + | 9 SET-RESET FLIP-FLOP | See Adv. Bulletin C-4001. | $86 | yes |
| 4225 + | 8-BIT PRESET BCD OR BINARY COUNTER | See Adv. Bulletin C-4001. There are 8 flip-flops which can either be cleared or set, depending on usage of available jumpers on the board. | $112 | yes |
| 4226 | SERIAL TO PARALLEL ASSEMBLER | Used in Analog to Digital Converters. | | yes |
| 4228 | 3-BIT SHIFT REGISTER WITH BUFFER REGISTER | 1-1/2 length board. | | yes |
| 4260 | MARK TRACK DECODER | Used for microtape. 1-1/2 length. | | no |
| 4261 | BLOCK FORMAT DECODER | Used for micro tape. 1-1/2 length. | | no |
| 4304 + | DELAY CONTROL | Connects to 4303 Integrating Single Shot and is used to program 6 external potentiometers for up to three 4303's. Contains 6 negative NORs similar to 4112 for logical gating. | | yes |
| 4305 + | DELAY CONTROL | Same as 4304, except no gates provided | | yes |
| 4505 + | IBM 7090(P) TO DEC CONVERTER | Handles one set of current levels; has 6 channels. | $79 | yes |
| 4514 | NRZ WRITER | Used in tape systems to supply 70 ma. of current into a center tapped load. | $65 | yes |
| 4517 + | MAG TAPE READ/WRITE SWITCH | Used with 4514 and 1536 to permit reading and writing on mag tape with one head. | $77 | no |
| 4518 +∩6/3/63 | DRUM NRZ WRITER | Used for recording on a magnetic drum surface. | $72 | yes |
| 4519 +∩6/25/63 | DRUM FIELD SELECT | A 3-state device functioning to connect a group of drum magnetic heads to either read or write busses, or to bias the group to a non-selected state | $106 | yes |

+ Advertising Dept. has issued an information sheet ∩ revised (date).

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 4521 + | DRUM X SELECT | Used with 4522 circuits to form a two coordinate X-Y selection for drum heads operating in serial mode. The matrix may be up to 16 x 16 = 256 heads. | $84 | yes |
| 4522 + | DRUM Y SELECT | Used with 4521 circuits to form a two coordinate X-Y selection for drum heads operating in serial mode. Matrix may be up to 16 x 16 = 256 heads. | $69 | yes |
| 4524 | MASTER SLICE CONTROL | Used in Core Memories with 4551. | | no |
| 4550 | 2-CHANNEL AMPLFEIER | Mag tape 2-channel amplifier. Output drives input to 1534. | | yes |
| 4551 | DUAL DC SENSE AMPLIFIER | For Core Memories. | | no |
| 4552 | 4-INPUT DC SENSE AMPLIFIER | For 16K Memories. | | no |
| 4605 * + | PULSE AMPLIFIER | Contains 3 pulse amplifiers which share a 6-input diode AND gate. | $76 | no |
| 4659 + | DEC TO IBM 7090(N) TRANS-MISSION LINE | Used to drive IBM 7090(N) transmission lines which are terminated with the IBM Terminating Shoe. | $42 | yes |
| 4660 + | DEC TO IBM 7090(P) TRANS-MISSION LINE | Same as 4659, except that it drives Type P lines. | $44 | yes |
| 4670 * +Ω6/3/63 | DEC TO IBM 7090(P) CONVERTER | Similar to 4669 except that it drives Type P lines. | $97 | yes |
| 4671 * + | BCD INCANDESCENT LIGHT DRIVER | Same as 1671 except it will decode 8421 and excess 3 codes. | $96 | yes |
| 4673 * +Ω6/3/63 | BCD NEON DRIVER | Used to provide visual indication of the contents of a decimal counter. Decodes 8421 as well as excess 3 code. | $85 | yes |
| 4678 + | LEVEL AMPLIFIER | Contains 5 level amplifiers to drive D to A ladder network. | $78 | yes |

* Sales Dept. has issued an information sheet.
\+ Advertising Dept. has issued information. Ω (revision date)

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 4679 | LEVEL AMPLIFIER | Contains 4 level amplifiers to drive D to A ladder network. | $77 | yes |
| 4700 + | PRINTER BUFFER DRIVER | Double length board. Used to drive Anelex printer hammer. Contains 6 flip-flops with individual complement inputs and a common clear input. | $168 | no |
| 4702 * + | TELETYPE RECEIVER | A serial to parallel converter. (See also Adv. Brochure C-4001.) | $200 | yes |
| 4703 + | TELETYPE TRANSMITTER | A parallel to serial converter. (See also Adv. Brochure C-4001.) | $250 | yes |
| 4704 | HOLD AND DESELECT | Used in Memory Testers in conjunction with the 1990 R/W switch. | | no |
| 4705 | DESELECT CURRENT DRIVERS | Used in Memory Testers in conjunction with the 1990 R/W switch. | | no |
| 4706 * | TELETYPE RECEIVER | A serial to parallel converter. Data consisting of 10 elements is received in serial form. | $270 | yes |
| 4707 * | TELETYPE TRANSMITTER | A parallel to serial converter. Data consisting of 10 elements is transmitted in serial form. | $310 | yes |
| 4900 | BUTTON PUSHER | | $45 | no |
| 6102 * + | 9 INVERTERS | For general use. Logic diagram is same as 4102. Output fall and rise times same as 6105. | $77 | yes |
| 61020 | 9 INVERTERS | Same as 6102 except overdrive capacitor is 27 pf instead of 56 pf. | $77 | yes |
| 6104 * + | INVERTERS | General purpose. 10 mc.; contains 4 inverters and 4 clamped loads. | $48 | yes |
| 61040 | INVERTERS | Same as 6104 except overdrive capacitor is 27 pf instead of 56 pf. | $48 | yes |
| 61050 | INVERTERS | Same as 6105 except overdrive capacitor is 27 pf instead of 56 pf. | $52 | yes |
| 61060 | INVERTERS | Same as 6106 except overdrive capacitor is 27 pf instead of 56 pf. | $67 | yes |
| 61090 | INVERTERS | Contains 10 inverters. | | yes |

* Sales Dept. has issued an information sheet.
+ Advertising Dept. has issued an information sheet.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 6110 | DIODE | Similar to 4110 (board). | | yes |
| 6111 * + | DIODE | Same as 1111 and 4111, but will operate to 10 mc. Do Not use for 10 mc pulses. | $52 | yes |
| 6113 * + | DIODE | Same as 1113 and 4113, but will operate to 10 mc. Do Not use for 10 mc pulses. | $80 | yes |
| 6115 * + | DIODE | Same as 1115 and 4115, but will operate to 10 mc. Do Not use for 10 mc pulses. | $69 | yes |
| 6116 | DIODE | Similar to 4116. | | yes |
| 6117 * | DIODE | Same as 1117 and 4117, but will operate to 10 mc. Do Not use for 10 mc pulses. | $64 | yes |
| 6118 | DIODE GATE | Similar to 4116. Two 8-input negative NORs. | | yes |
| 6119 | DIODE | Two 8-input positive NORs. | | yes |
| 61220 | INVERTERS | Contains 12 inverters and is the logical equivalent of the 4112. | | yes |
| 61230 | INVERTERS | Contains 12 inverters and is the logical equivalent of the 6113. | | yes |
| 61240 | INVERTERS | Contains 14 inverters and is the logical equivalent of the 4114. | | yes |
| 6141 | DIODE | High speed equivalent of the 4141. | | yes |
| 6143 | DIODE | High speed equivalent of the 4143. | | yes |
| 6155 | TWO 2-BIT DECODERS | Selected lines are ground. Each decoder has an extra enable input. | | yes |
| 6227 | 8 UNBUFFERED FLIP-FLOPS | Two clear inputs which may be jumpered. | $150 | yes |
| 6684 | BUS DRIVER | Similar to 1684 except faster and non-inverting. | | yes |
| 8103 | VHF LOGIC MODULE | See Adv. Brochure C-8000P. | | no |
| 8110 | VHF TWO 6-INPUT NOR | | | no |
| 8201 | VHF FLIP-FLOP | See Adv. Brochure C-8000P. | | no |

* Sales Dept. has issued an information sheet.

+ Advertising Dept. has issued an information sheet.

INDEX OF ITEMS NOT IN THE CATALOG

SUPPLEMENTARY PAGES in Catalog form are available on the following. These pages are now included in an envelope inside the back cover of all Catalogs being distributed by the Advertising Department.

The first ten items below appear on the latest price list dated April 1, 1963.

| Model Number | Model Name | Description | Price | Catalog Item |
|---|---|---|---|---|
| 53 | CURRENT DRIVER | | $760 | yes |
| 63 | CURRENT DRIVER | | $760 | yes |
| 72 | CURRENT VOLTAGE CALIBRATOR | | $950 | yes |
| 1161 | BCD-TO-DECIMAL DECODER | | $160 | yes |
| 1538 | SENSE AMPLIFIER | | $203 | yes |
| 4205 | DUAL FLIP-FLOP | | $100 | yes |
| 4217 | FOUR-BIT COUNTER | | $96 | yes |
| 4506 | 7090 (N)-TO-DEC CONVERTER | | $62 | yes |
| 4606 | PULSE AMPLIFIER | | $122 | yes |
| 4669 | DEC-TO-7090 (N) CONVERTER | | $114 | yes |

| | | | |
|---|---|---|---|
| 31 | ULTRA PRECISION CRT DISPLAY | | yes |
| 40-523 | CARD PUNCH CONTROL | | yes |
| 41 | CARD READER AND CONTROL | | yes |

Ken Olsen

# INTEROFFICE MEMORANDUM

DATE July 18, 1963

SUBJECT PDP-5 Software

TO Computer Guidance Committee

FROM Dit Morse

Enclosed is a rough specification of a PDP-5 Programming System.

The decision should be made very soon (Friday, if possible) whether to do it in house or not. Some of the arguments are as follows:

<u>OUT-HOUSE</u>

Advantages:

1) There are numerous competent consultants available and anxious to do the work.

2) The price will probably compare to what it would cost DEC to do it internally.

3) We might encoutage a consultant to "favor" our machine by offering a trade, loan of a computer in house, etc.

4) Documentation will probably be more satisfactory.

Disadvantages:

1) We would lose some level of control over the design of the system.

2) No-one at DEC is closely acquainted with the inner workings of the system.

<u>IN-HOUSE</u>

Advantages:

1) We can design the system exactly as we want.

2) We will have in house knowledge of the system.

Disadvantages:

1) We have no-one at DEC both competent enough and available presently.

The same person (or group) should do ALL the software, to insure the system is both integrated and optional.

If we decide to do it in-house, then we should immediately hire someone capable of handling the job.

This will probably take a month. Otherwise we should hire a consultant and get a final specification, delivery date and cost basis. This will probably take two weeks to a month.

In either case, a definite schedule consisting of the following should be established.

1) final system specification
2) Assembler and tape editor completed
3) Arithmetic Package
4) FORTRAN
5) Rough draft documentation
6) final documentation

If done internally,two people should work on the programming, with some technical writing help for documentation.

The time estimates in-house, assuming two people, 1 excellent, 1 capable are,

| FOR | EFFORT |
|---|---|
| specification and design | 4mm |
| programming | 1my |
| documentation | 3mm |

HRM/nbh

# SPECIFICATION OF THE PDP-5 PROGRAMMING SYSTEM

This document describes the proposed programming system for PDP-5 Computer.

The minimum configuration will be:

PDP-5 with 4K memory

1 dual micro-tape transport and control

1 teletype Model 33 ASR

## NORMAL OPERATING PROCEDURE:

The PDP-5 Computer is intended to be a self-contained device not requiring support from off-line equipment. Consequently, the system will use micro-tape as primary I/O device, with the keyboard-printer used for control and secondary I/O.

The normal procedure will be to use the computer on-line for program preparation, keeping symbolic programs stored on micro-tape.

The assembler and compiler will perform their processing from micro-tape to micro-tape leaving the resulting binary program to be loaded from micro-tape and executed.

The following programs constitute the minimal generally useful programming system:

1. Tape editor: micro-tape to micro-tape for program preparation and editing.
2. Assembler of the PDP-4 flavor, which should include features to ease the addressing problem.
3. Compiler: A subset of FORTRAN for PDP-4. Output will be in symbolic machine language or an interpretive language, which ever is more feasible (probably the latter).

4. Arithmetic Package:
   a) fixed point multiply and divide
   b) floating point add, subtract, multiply and divide.
   c) functions - sin, cos, $e^x$, $x^y$, $\log_{2,10,e}$, arctan, sgrt.
   d) floating point interpreter.
   e) floating point I/O.
   f) fixed point I/O.
5. Debugging routine: Probably a simple debugger including octal I/O, break points, searching features, the ability to dump core on micro-tape, and make corrections to the program while on micro-tape is sufficient.
6. Utility routines:
   a) micro-tape read-write-search package.
   b) micro-tape to punch dump.
   c) reader to micro-tape loader.

COMMENTS:

1. Micro-tape should be an integral part of the system.
2. The possibility of FORTRAN programs too large to fit into core with the subroutines necessary to support them should be provided for.
3. The debugging routine should work on a program which overlays it.
4. All system programs should inter-communicate - in the same format. (For example, the symbols defined during assembly should be directly accessible to the debugging routine.)
5. The programs must be modular enough so that changes to the system can be safely made a non-author of the system. In particular, adapting the system for different I/O configuration should be easily accomplished.
6. The system should take advantage of larger equipment configurations.

GENERAL AIMS:

The Assembler should have features which allow subroutines to be assembled with main programs without symbol conflicts. This merely means a feature which allows the subroutine writer to indicate to the assembler which symbols are to be saved after assembly of the subroutine, and which are to be discarded. (PDP-4 FORTRAN does this automatically). This eliminates the general problem of linking and relocating binary programs. In addition there are many advantages to keeping library programs in symbolic rather than binary form, such as the ability to look at a subroutine and easily modify it. The assembly process should be efficient enough so that there is normally no reason to keep binary versions of programs other than the system programs.

Since every PDP-5 Computer sold will have micro-tape, we should go to some lengths to take advantage of it in our system programs. There should always be available (in core) a set of micro-tape read-write-search routines, which will used by the Assembler, Compiler, editor, debugging routines, and user's programs, if desired.

It is advantageous to dump some of core on tape and overlay that core with the debugging routine when interrogating a program. This means only enough of the debugging program to handle traps and dump core necessarily be in core when the program is running.

Since program are almost relocatable now (on page basis), it appears fairly trivial to make them completely so. This possibility may make it very feasible for the subroutines needed by compiled programs to be quite elaborate yet occupy a small portion of core, with sections of program being brought into core as needed. For example, only one or two pages need be allocated for all function generators. The desired one is brought in when needed, overlaying the previous one.

The preceding paragraph points out one predominate problem in constructing a satisfactory programming system for the PDP-5. That is the problem of limited memory capacity. It is desired that this problem be alleviated by the use of micro-tape as a large backing store. To this end, the programming system should be designed to expect programs which will exceed the memory capacity of the machine, and to properly handle such programs.

This does not mean that the general storage allocation problem (choke!) need be solved on PDP-5. However, the programs which make the system up must be designed to operate in a small amount of core if necessary. In particular, the subroutines necessary to support a FORTRAN program are large in number, and may leave only a very small portion of core for user's programs if all subroutines are in core at once. However, only a few subroutines need be in core at any one time. Certain subroutines may be able to perform their functions in two or more passes, with a new section of program being loaded at each stage ot minimize the storage used by the subroutine.

Features to permit such storage overlay should be included in the system.

H. R. Morse III
July 18, 1963

P.S. The main purpose of the preceding discussion is to explain our general aims, rather than precisely specify the system.

Ken Olsen

# INTEROFFICE MEMORANDUM

**DATE** July 3, 1963

**SUBJECT**

**TO** Ken Olsen ✓
Harlan Anderson
Stan Olsen
Nick Mazzarese
Ted Johnson
Ken Larsen
Gerry Moore

**FROM** Mort Ruderman

The MIT order for the 20 LINC's is approximately 95% complete as of July 1, 1963. The order for the remaining 6 LINC computers that Wes Clarke is going to build, exclusive of the 4102 units will be placed sometime within the next couple of weeks. The present status of the LINC computer is that 1) 99% of the unit has been debugged and checked out and 2) the overall design is complete and firm.

The significance of the overall design of the LINC being complete is that now all information concerning the LINC is public information. This allows any individual or concern to obtain all specifications and prints. Thus, logic prints, circuit schematics, wiring diagrams, mechanical prints and overall system drawings are available to anybody for simply the cost of reproducing the drawings. I feel it is extremely important that DEC should be fully aware of this situation for a number of reasons. 1) the present LINC is designed with 90% of the plug-in modules being DEC units and the other 10% being special circuits that were designed by the LINC staff but built and tested by Electro-Pac. Now this places DEC at a distinct advantage when any subsequent users of the LINC computer decide to build (or have built) a unit identical to the present one. This would mean just ordering off-the-shelf units both DEC Modules and all other units that make up a complete LINC. However, reason no. 2) Electro-Pac, a fully owned subsidiary of Computer Control Corporation, is presently in the process of procuring all prints, layouts and literature concerning the LINC system. Their plans, from what I am told by the people at MIT, are to try and market the LINC computer and to have the capability of building a complete LINC computer for any future user.

They are underwriting the cost of redesigning the LINC system using their logic and modules. This means conversion of DEC logic to their logic, new power requirements, new logic levels, new wiring and new system layout. They are, as MIT puts it, getting their foot in the door and really persuing the issue.

DEC's decision to either market the LINC computer as a unit or to supply future builders of LINC's with the plug-in modules is one that should be made in the very near future. The position of supplying future users of LINC's with the modules would be an enviable position. The cost of DEC Modules per system (approximately 300 units) is $23,000 before discount. MIT has approximately $650,000 for 19 LINC units. This, therefore, estimates the cost of materials and assembly to be $34,000 per system.

If the decision to market the LINC computer were to be made by DEC, here are some of the pertinent facts to date. MIT received approximately 75 proposals for the LINC's. Of these, approximately 16 are to go to various installations and MIT themselves will keep 10 at their computer complex. There are also four independent groups building LINC's: NIH, CID, AFCRL and Lincoln Lab. Therefore, there are presently 60 initial requests for LINC's unfulfilled plus many requests after the initial proposals: CID is now planning to build two more LINC's after January 1, 1964 and RLE is hopeful of maybe building one next year. In general there appears to be a growing market.