INTEROFFICE MEMORANDUM

DATE October 30, 1963

SUBJECT Formation of Engineering Programming Group

TO Harlan Anderson
Winston Hindle
George O'Dea
Richard Mills
All Engineers
All Programmers
Maynard Sandler
Ken Wakeen
Ed Harwood
Robert Beckman
Jack Shields
Stan Olsen
Nick Mazzarese
Bob Lassen

FROM Kenneth H. Olsen

We have been doing programming in many parts of the company. The individuals doing this programming have done a very good job but we now feel there is a lot to be gained if we combine them into one group. Therefore, we are forming an Engineering Programming Group to be headed up by Len Hantman who will report to Gordon Bell.

In forming this group, we hope to eliminate the possibility of doing the same programming jobs several times; first in Engineering, then in Check-Out, and finally in Field Service. In addition, by putting the programmers together in one group we hope that they will help each other in solving particular jobs but even more in developing the capability of each other.

At the present time, the individual programmers are doing a very effective job because they are very closely tied to their individual projects. We feel that we can keep this efficiency and enthusiasm and still gain the advantages of centralization.

Kenneth H. Olsen

KHO:ncs

INTEROFFICE MEMORANDUM

DATE October 30, 1963

SUBJECT Technical News Release – Light Pen

TO Jack Atwood
Derrick Chin
Stan Olsen
Harlan Anderson

FROM Kenneth Olsen

I think we should get a technical news release out on our new light pen. This is one of the few practical applications of light pipe principle. A good place for this might be Machine Design magazine because it has a section of new products which are large pictures and a very short amount of text. I think we should, in a single paragraph, explain the use of the light pen and how we are doing it.

In addition, of course, we should send out new product releases to the general market.

K. H. Olsen

KHO:ncs

INTEROFFICE MEMORANDUM

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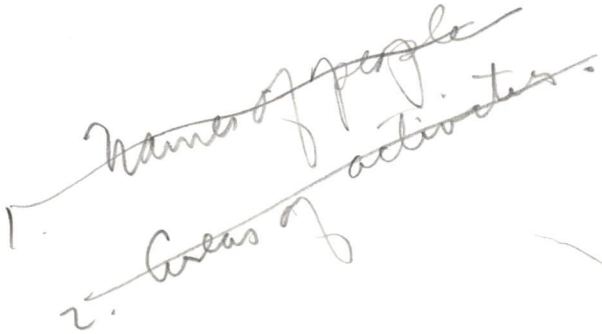
KHO:ncs



October 24, 1963

PROPOSED ENGINEERING PROGRAMMING GROUP

TO: K H OLSEN

FROM: L M HANTMAN

1. The purpose of this memorandum is to define the Engineering Programming Group and discuss its proposed immediate makeup, its future requirements and methods for fulfilling those requirements.

2. The Engineering Programming Group shall be defined as that group of programmers which will work directly with the engineers, production group, checkout group, and field service personnel during the design, testing, debugging, demonstration and checkout of newly designed and current computer hardware and special systems. The group will produce programs which will be incorporated into checkout, diagnostic, maintenance, and acceptance tests. It will also produce programs for such in house functions as module testing, wiring lists, information retrieval, inventory and production control, and machine-aided design problems.

The group can be distinguished from Harrison Morse's group which will produce systems programs, compilers and utility programs for use of the customer himself.

3. There are at present four main areas of programming which the group should eventually handle. These can be outlined as follows:

A. Production of the backlog of maintenance,checkout, diagnostic and acceptance tests and their writeups for equipment currently in production.

B. The production of maintenance, checkout, diagnostic and acceptance tests and their writeups for newly designed equipment including central processors, peripheral equipment, and special systems. The individual programmer

would be required to do the following:

1. Write any programs necessary to initially test the equipment on line.

2. When the hardware is ready, to work directly with engineer in designing and running simple programs for immediate use in getting the equipment on the air, and working out any design or programming bugs in the larger tests.

3. Write all immediate demonstration programs for various shows and possible customer demonstrations.

4. Upon completion of on-line testing, write the programs necessary for use by the checkout section and the engineering group.

5. Write a complete description of the equipment from a programming standpoint (i.e., an enlargement of the original specifications) including technical information, IOT commands, timing problems and possible examples of simple instruction sequences, or basic subroutines. These writeups should be made available to the checkout section and the Systems Programming Group through an up-to-date program library.

C. In house programming including module testing, wiring lists, automated milling machine, accounting, and production and inventory control.

D. Advanced techniques including graphical input to the computer, printed circuit design, information retrieval and other machine aided design problems.

4. To implement the four programming areas, I feel that the following allocation of personnel should be made. It is assumed that all those mentioned would be available to the group.

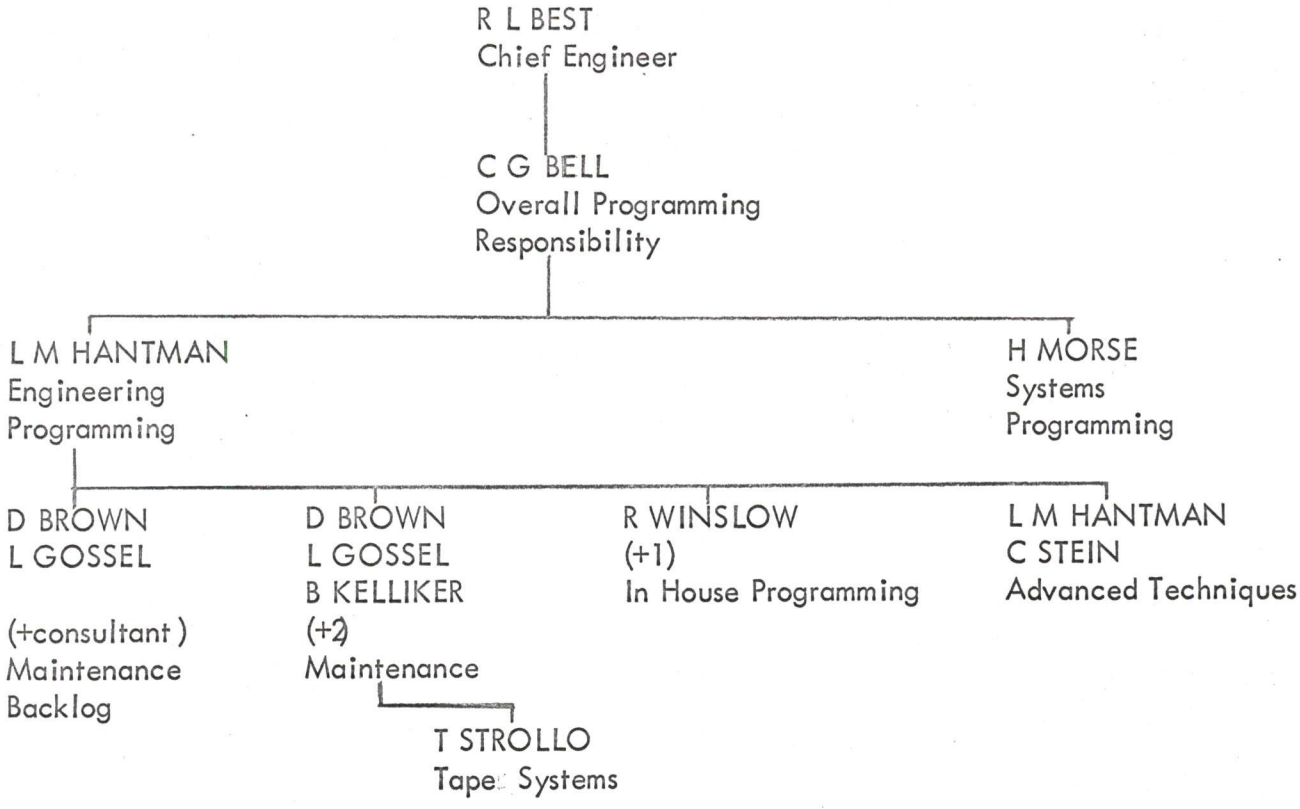
A. To catch up on the backlog of required maintenance type programs with the available manpower would be virtually impossible. I, therefore, feel that this backlog would be cleared away by some outside consulting organization with the specifications for the programs closely controlled by Dave Brown and Leo Gossel. At the present time Leo is the only one with PDP-1 experience, for example.

B. The programming for equipment currently being designed would be done by Dave Brown and Leo Gossel with an assist from myself and an eventual assist from Bill Kelliker. Note that although Bill has had some field experience he has had no programming experience. One separate area within this group should be devoted to magnetic tape systems. At present Ted Strollo, a part time employee, is helping in this area. It is suggested that he continue his work.

C. The in house programming is currently being done by Russ Winslow. Russ is currently spending most of his time with the Module Tester. However, I think that he can start broadening his horizons. Russ has had only a few months programming experience, but is familiar with some of the problems in the production area. With help from others, he might profitably work on problems of inventory and production control. Persons in the Company have already expressed an interest in this type of work.

D. Some progress in graphical techniques and information retrieval etc., can probably be made by myself and Charles Stein. Charles is presently working on techniques for the incremental scope and has shown a great deal of interest and ability in this type of work.

E. An overall chart of the proposed group is shown on the following page. Because of the lack of sufficient personnel in any of the four areas, I think it would be unfair and unwise to delegate individual responsibility for any of the particular areas at this time.


R L BEST
Chief Engineer
C G BELL
Overall Programming
Responsibility
L M HANTMAN
Engineering
Programming
H MORSE
Systems
Programming
D BROWN
L GOSSEL
(+consultant)
Maintenance
Backlog
D BROWN
L GOSSEL
B KELLIKER
(+2)
Maintenance
T STROLLO
Tape Systems
R WINSLOW
(+1)
In House Programming
L M HANTMAN
C STEIN
Advanced Techniques

5. It should be obvious from a casual glance that the mission of the group, as herein defined, cannot be attained with the group as shown. Though the formal creation of the group is a needed first step in producing greater control, efficiency, and responsibility, I think we should be extremely careful about setting up a "paper" group with lofty ideals. The following points should be considered, for example:

A. Leo Gossel is presently working for Ed Harwood in the Checkout Section. No matter where he is formally assigned, Leo would have to continue giving Ed some support simply because there is nobody else available to do it. This much of Leo's effort, at least for the time being, would be lost to the service pool which the group is attempting to establish.

B. Russ Winslow is currently working for Ken Wakeen, attempting to add more and more production modules to the Automatic Tester. This is an important production job and therefore much of his time will be spent in continuing that type of work. Here again, at least for the present, some of his effort will be lost to the group.

C. Ted Strollo is a part time employee, hired by and for Roland Boisvert. He will, of necessity, have to continue his present work, and therefore his effort is, in effect, lost to the group. Therefore, with the exception of the addition of Dave Brown, the group will remain almost exactly as it is; one which at present is totally incapable of meeting the obligations set forth in Paragraph 2.

6. For the above reasons I recommend that a concerted effort be made to hire at least three (3) additional programmers immediately. Two of these would be assigned to the maintenance area, and one would be assigned to in house programming. Additional programmers would probably be needed in the near future in all three of the permanent programming areas I have outlined previously.

7. Almost immediately the amount of key punching and paper work generated by the group will require additional punching and secretarial help. Some thought should be given to the possibility of providing such help as soon as practically possible.

LHM:ASJ

D. Kicilinski
October 29, 1963

STATUS OF OPEN CONSTRUCTION REQUISITIONS

AEC Harvard

Complete with 4K Memory, Const. Req. calls for Mem. Mod. 170D (EN 2655)

AEC Yale University

Complete with 4K Memory, Const. Req. calls for Mem. Mod. 170D.(EN 2551)

AECL

1	Memory Module 170B	EN 2735	1/20/64
1	Memory Ext. Control 121C	EN 2736	1/20/64

BBN Cambridge

1	Memory Module 170D	EN 2650	12/1/63
2	Memory Module 170A	EN 2651	12/1/63
3	Memory Ext. Control 121C	EN 2666	12/1/63

Bell Tel. Labs

1	PDP-5-#8	EN 2761	12/15/63
1	Photo Multiplier Light Pen 370	EN 2762	12/15/63
1	A/D Converter Module 137	EN 2771	

Columbia PDP-4

1	Mag. Tape Control 57A	EN 2758	12/15/63
1	Interface Logic 520	EN 2759	12/15/63

Customer Relations

1	Data Control 131	EN 2586	7/1/63
1	Tape Control 510	EN 2587	7/1/63

Foxboro Co. PDP-4

1	Extended Arithmetic Element	EN 2768	11/13/63

ITT

2	Memory Module Type 12	EN 2753	11/1/63

DEC Los Angeles Office

1	Portable Display Tester	EN 2583	5/20/63

LRL

1	PDP-5-#7 4K	EN 2757	

University of Michigan PDP-4C-#17

1	Printer Keyboard and Control Type 65	EN 2772	12/10/63
1	Tape Punch & Control Type 75		
3	D/A Converters WD 2311	EN 2773	12/10/63
1	Two Channel Input Multip for Type 138	EN 2775	12/10/63
1	A/D Converters 138	EN 2774	12/10/63

MIT - Mac

1	Memory Module 170D	EN 2540	11/1/63
1	High Speed Channel 19	EN 2727	11/1/63
1	30H Display	EN 2474	11/1/63
1	Light Pen Type 32	EN 2728	11/1/63
1	Data Control 131	EN 2730	11/1/63
1	Micro Tape Control 550	EN 2731	11/1/63
1	Micro Tape Transport 555	EN 2732	11/1/63

DEC Production PDP-4B-#9

1	Micro Tape Transport 555	EN 2755	12/10/63
1	Micro Tape Control 550	EN 2756	12/10/63

PDP-4 Prototype

1	Micro Tape Control 550	EN 2719	10/14/63
3	Micro Tape Transports 555	EN 2720	10/14/63

DEC PDP-6 Prototype

3	Micro Tape Transports 555	EN 1178	9/1/63

Raytheon Wayland PDP-1C-#38

1	A/D Converter 138	EN 2662	8/28/63
1	Multiplexer & Control 139	EN 2663	8/28/63

DEC Sales

1	Micro Tape Control 550	EN 2641	6/20/63
1	Micro Tape Unit 555	EN 2642	6/20/63

DEC Sales PDP-4B-#6

1	A/D Converter 138	EN 2637	9/1/63
1	Micro Tape Control 550	EN 2638	9/1/63
1	Micro Tape Unit 555	EN 2639	

DEC Sales Foreign PDP-5#6

1	PDP-5-#6 4K Memory	EN 2746	11/3/63
1	Display 34 with Tekt and yellow filter 503 for 50 cycle operation	EN 2747	11/3/63
1	Nuclear Data 160F A/D	EN 2748	11/3/63
1	Interface for 160F A/D	EN 2749	11/3/63

DEC Sales for Loan to AECL

1	Memory Module Type 12 Mount in Cabinet	EN 2750	10/25/63

Stanford University

1	PDP-1C-#48	EN 2692	12/30/63
1	Memory Module 170D	EN 2764	12/30/63
1	32 Field Drum Sys. with Interface for Memory Control Type 121	EN 2695	12/30/63
2	Data Control 131	EN 2694	
1	Memory Control 121B	EN 2766	
1	Memory Control 121C	EN 2767	

dec INTEROFFICE MEMORANDUM

DATE October 29, 1963

SUBJECT SUGGESTED NEW MODULES

TO K. Olsen
H. Anderson
S. Olsen
R. Best
D. White

FROM Dave Denniston

The following ideas for new modules have resulted mainly from talking to some of our customers in the New York area.

A. Suggested Pulse Amplifiers

CONCEPT: Provide a module with more Pulse Amplifiers per package with less output driving ability (4 or 5 pulse loads) and at a slightly reduced cost.

This would be helpful for clearing, shifting, and reading into our hi-density flip-flops. Such a "reduced output" Pulse Amplifier would probably be psychologically helpful too, since people feel they are wasting the capability of a 4603 Pulse Amplifier when they are only driving a few loads.

I have shown two of the different suggestions people have submitted. (attached)

B. Suggested Delay

CONCEPT: Provide more than one delay per card with only one basic range. Longer periods through use of external capacitors. Flip-Flop outputs--no pulse output.

Bell Labs has been building and using such a module for almost 2 years now using blank cards.

With Flip-Flop type outputs, one delay could trigger the next providing, I am sure, much more economical one-shot timing chains.

DATE October 29, 1963

TO K. Olsen
H. Anderson
S. Olsen
R. Best
D. White

c. Suggested Flip-Flop

CONCEPT: Provide a general purpose RST Flip-Flop compatible with quadruple and hi-density packages for use in control and adding that one extra bit to 4215/4225 counters while using the other Flip-Flops elsewhere. Unbuffered outputs. R and S inputs tied together to form trigger input.

Again, I have shown two different ideas. The first is merely a rework of the 4214 to allow it to be used with a wider variety of gates or with Pulse Amplifiers. The second is about the same except that it adds direct set inputs and separates the clear inputs.

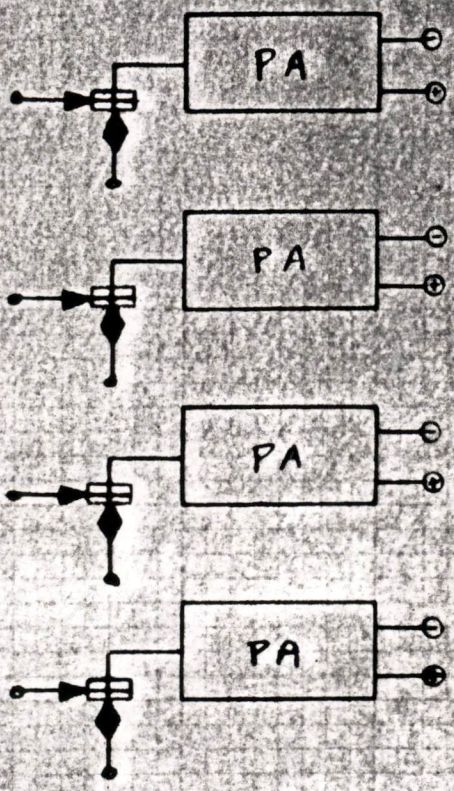
DBD:BMP
Attach.

SUGGESTED PA'S - 1 MC

(A)

INPUT:

PULSE OR LEVEL CHANGE



OUTPUT:

DUAL POLARITY

DRIVES 4 OR 5 PULSE LOADS

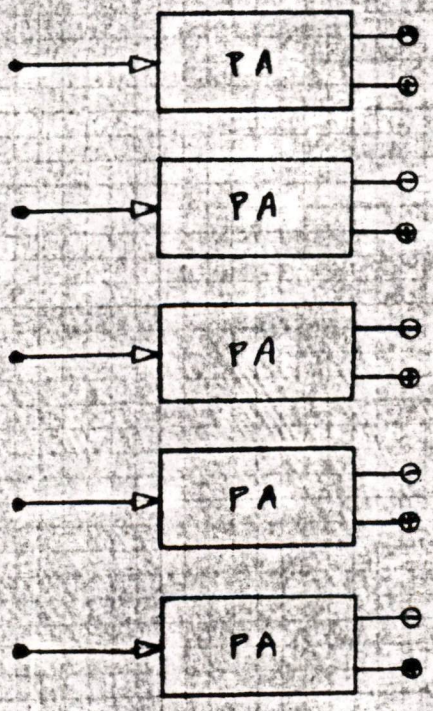
STANDARD 0.4 μs PULSE

(B)

INPUT:

PULSE OR LEVEL CHANGE

DRIVEN FROM INVERTER OR CD GATE WITH CLAMPED LOAD



OUTPUT:

DUAL POLARITY

DRIVES 4 OR 5 PULSE LOADS

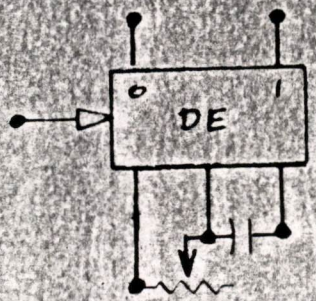
STANDARD 0.4 MS PULSE

DBD 10/28/63

SUGGESTED DELAY - 4000 SERIES

INPUT:

+ PULSE OR LEVEL CHANGE



OUTPUT:

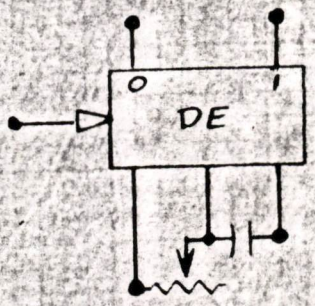
FLIP-FLOP TYPE

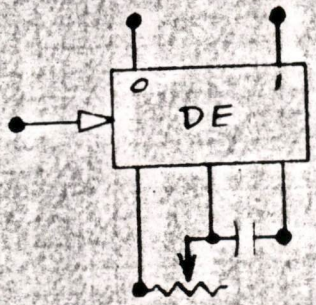
PERIOD CONTROL:

INTERNAL POT. & CAP. FOR VARIATION BETWEEN 1 TO 10 μS

EXTERNAL R & C TERM. AVAILABLE FOR LONGER PERIOD OR PANEL ADJUSTMENT.

BOARD JUMPER TO BE REMOVED WHEN USING EXTERNAL POT.

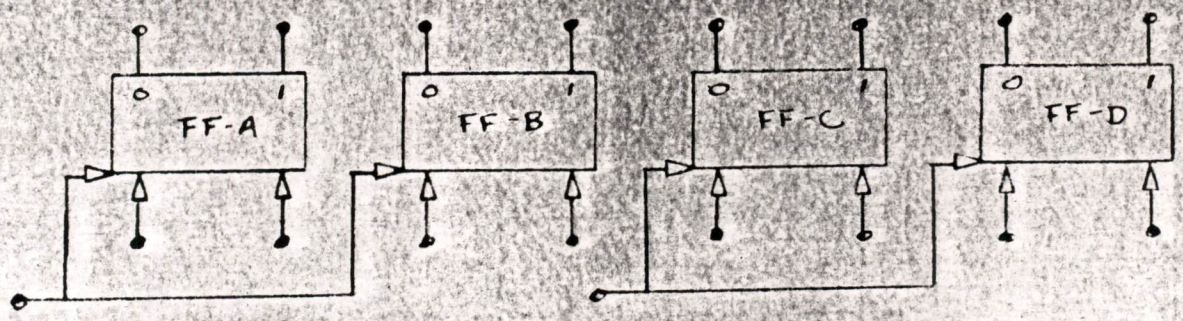




DBD 10/28/63

SUGGESTED FF'S - 1MC

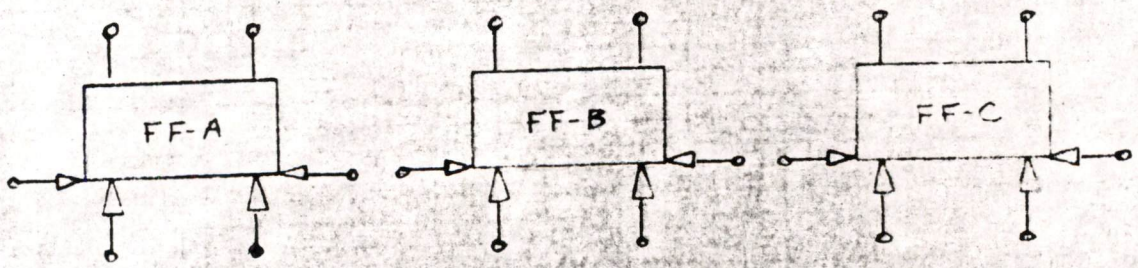
(A)



LIKE 4214 EXCEPT:

1) INPUTS AC COUPLED TO ALLOW TRIGGERING FROM LEVELS OR PULSES
2) TIE SET & RESET INPUTS TOGETHER TO PROVIDE COMPLEMENT

(B)



INPUTS:

A-C COUPLED FOR TRIGGERING FROM LEVELS OR PULSES

TIE SET & RESET INPUTS TOGETHER TO COMPLEMENT

OUTPUTS:

LIKE STANDARD QUAD. FF'S

DRD 10/28/63

H. Anderson

INTEROFFICE MEMORANDUM

DATE October 29, 1963

SUBJECT PRIOR NOTIFICATION OF LATE DELIVERIES

TO Works Committee FROM Jim Myers

After discussion with Maynard Sandler and Bill Farnham the following outline of procedures to be followed was drawn up:

1. Open orders are checked daily to make up shipping orders.

2. Orders, which are not available in stock one week prior to the scheduled shipping date, will be pulled.

   Production will be consulted on the units involved. If the units are likely to be late, the decision to notify the customer will be made.

3. The customer is to be notified by telephone, TWX or letter.

INTEROFFICE MEMORANDUM

DATE 28 October 1963

SUBJECT PDP-5 Course Convening 28 October 1963

TO K. Olsen
H. Anderson
S. Olsen
N. Mazzarese
R. Beckman
R. Wilson
All Sales Personnel
District Offices

FROM R. Bernier

The following individuals are scheduled to attend a one week course on the PDP-5 convening 28 October 1963:

NAME	COMPANY
L. Gefert	Westinghouse; R & D Center, Pittsburg
F. A. Shallo	Westinghouse; R & D Center, Pittsburg
S. D. Silliman	Westinghouse; R & D Center, Pittsburg
D. A. Stackpole	Westinghouse; R & D Center, Pittsburg
J. F. Sutherland	Westinghouse; R & D Center, Pittsburg
J. M. Martin	Digital Equipment Corp; San Francisco
R. F. Maxcy	Digital Equipment Corp; Maynard
R. A. Stiver	Digital Equipment Corp; Los Angeles

****

H. Anderson

INTEROFFICE MEMORANDUM

To: PDP-6 Group October 28, 1963

From: Robert E. Savell

Subject: PDP-6 IO Schedule of October 23, 1963

Clarification of the reason stated for the delays that have occurred subsequent to the prior revision are in order.

Drafting delays and drafting errors are not all the fault of the Drafting Department. A considerable portion of the delay was due to our request for wiring drawings to be delivered prior to block schematics.

dec INTEROFFICE MEMORANDUM

DATE October 25, 1963

SUBJECT

TO Kenneth Olsen
cc Harlan Anderson

FROM Jack Atwood

Those five-year-service-award pins and tie clips are burning a hole in my pocket. Is there any possibility of getting some sort of presentation program going in the near future? The luncheon approach I suggested earlier still seems to be a relatively painless way to accomplish this.

H. Anderson

INTEROFFICE MEMORANDUM

To: PDP-6 Group

October 23, 1963

From: Bob Savell

PDP-6 IO Schedule

Units	To Drafting	Production Start	Interwiring Start	Off-line C.O. Start	On-Line to be checked	On-Line and checked
Teleprinter	Aug. 23	*Sept. 30	*Oct. 21	None	*Oct. 21	Oct. 22
Teleprinter 35						
Paper Tape Reader	Aug. 23	*Sept. 20	*Oct. 14	*Oct. 13	*Oct. 17	*Oct. 18
Paper Tape Punch (BRPE-11)	Aug. 23	*Sept. 13	*Oct. 14	*Sept. 20	*Oct. 16	*Oct. 17
Card Reader BC-122	Aug. 30	Sept. 31	Oct. 23	Oct. 22	Oct. 23	Oct. 25
Card Punch BC-303						
Line Printer 300 lpm						
Line Printer Buffer						
Display						

Revised October 21, 1963

*Actual dates — others are estimated

Changes due to drafting delays and drafting errors.

INTEROFFICE MEMORANDUM

DATE October 23, 1963

SUBJECT

TO K. Olsen, H. Anderson, R. L. Best, G. Bell, N. Mazzarese, A. Kotok, S. Olsen, H. Morse, J. Jones, R. Beckman, J. Shields, E. DeCastro

FROM Bob Savell

Nick Mazzarese expressed concern the other day about the problems that have been arising with Model 33 Teletypewriters on the PDP-5 since he estimates that we will have a dozen PDP-5's in the field by the end of this year and will produce approximately 100 next year. This memo contains my opinion of what we should do about the problem, and will do unless anyone has objections or better ideas.

1. I feel that Teletype will solve the problems that exist, but it may take six months to a year until things really settle down. This feeling is based on our experiences with the Model 28 and the BRPE-11 punch.

2. I may be wrong, however, so I feel it is necessary to keep extremely good track of all troubles that occur and to communicate with Teletype every two weeks to make sure they are aware of the problems and also to make sure that the problem occurrence rate decreases with time. If the problems do not abate we must select another device.

3. Two new Model 33 ASR's will be put on a life test that will check their readers, punches, and printers as soon as we can get our hands on the units.

4. Model 35's will also be tested both on and off line as soon as they are received.

I do not believe the company should commit itself to the use of the Model 33 in any other applications than console use on PDP-5 and PDP-6 at present.

dec INTEROFFICE MEMORANDUM

DATE 23 October 1963

SUBJECT Results of the PDP-1 and PDP-4 Interviews

TO Ken Olsen
Harlan Anderson
Stan Olsen
Nick Mazzarese
Gordon Bell
Jack Atwood

FROM R. Beckman

Some time back, as part of the planning for the PDP-6 Maintenance Manual, I asked Bill English to see if he could find out what our customers' reactions were to the PDP-1 and PDP-4 Maintenance Manuals. Bill contacted as many as he could, explained that he was not a DEC employee, but that he had been involved in the writing of the manuals, and asked for comments and suggestions. Attached is a copy of his report on these interviews.

*****

RESULTS OF THE PDP-1 AND PDP-4 INTERVIEWS

When writing the logic portions of these manuals, I aimed the discussion at essentially a middle level – that is, I wrote a fairly detailed and complete description of exactly how the machine works so that an average technician could understand it without any great difficulty. I felt that a very sophisticated engineer having considerable familiarity with digital equipment might find it a little boring, but that such a person would more likely be in charge of a maintenance group rather than maintaining the machine himself. At the other end of the scale, I didn't expect it to satisfy anyone who desired the more military type of approach. Happily the interviews seemed to indicate that the relatively intelligent technician was the proper level to write to. Only one client (Raytheon) suggested that a more detailed manual would be preferred and he admitted that he felt this way because he was more used to military manuals and equipment. On the other hand, people at LRL and AECL said they really didn't need the manual in learning the machine, but they did take the course offered at DEC and do use the manual for reference when working with the machine.

Between these two extremes everyone felt that the writing was at approximately the level of the people who were maintaining the equipment. The only remarks concerning any difficulty in the material were in the area of the memory. Both of the people who mentioned this specifically also pointed out that this did not necessarily indicate a failure in the writing but rather that the memory is the most difficult part of the machine to understand. This possibility was reinforced by the people at LRL who claimed to use the manual only for reference but who in fact referred most often to the memory section because this was the hardest part of the machine to remember.

To quote a couple of accolades, Ron Gotch of UA had this to say about the PDP-1 manual: "If something goes wrong we sit down and read for a while and really have very little trouble getting to the source of the problem." He then mentioned that they were modifying various things in the in-out equipment and added, "After going through the manual and looking up how they did their in-out stuff and things like this, we had no trouble.

I can't give very many suggestions on how to improve it because the other equipment is so far out of it in this respect that we think this is the greatest. It looks like an awful lot of work was put into that thing, whereas most of the other manuals look like they were just slapped together with no work." Bill Norris, also of UA: "Well, my impression has always been that it is terrific. It is very unusual compared to most of the manuals that we get with equipment, because most of them are written terribly. This has always been one of my pets because I think it was really very well written."

Another respondent was a bit more specific and said, "Well, let's put it this way – I couldn't help comparing it with other publications I've seen DEC produce and I was very favorably impressed by it. It seemed to me to be very well organized and quite clear." He singled out the flow charts – especially those of the more complicated features such as the automatic multiply and divide – remarking that it was very helpful to be able to follow an accurate and well-organized flow chart along with the verbal description of the equipment.

Considering more specific portions of the manual, everyone was quite pleased with the functional block diagram description of the equipment and was quite opposed to any reduction of the material included in that portion. On the other hand, almost no one read either the instruction list or the operation chapter, instead relying on the little blue book (PDP-1). This was quite a disappointment to me as I edited the blue book instruction list very carefully, adding a missing instruction, correcting wrong ones and making the write-ups of similar instructions consistent with one another – and then no one read it. On the other hand, several people complained about the inadequacy of DEC's programing information, especially in such things as describing the limitations of the sequence break system. For example, Ed Benz of NSA complained that nowhere is the programer told how to return from a sequence break in PDP-1 if the machine has more than one memory. I informed him (and the others) that this and other omissions mentioned were described in detail in the logic part of the maintenance manual, but all my respondents felt that the programer should definitely not have to go there to find them out. It would thus seem that a good, complete programing manual is necessary, and that the maintenance manual

should refer the reader to the programing manual for this information and provide only that additional programing information that is relevant particularly to maintenance (plus perhaps including a short ready reference table of instructions, codes, etc).

Similarly, in the case of the operation information, everyone preferred to use the little blue book, even though it described only the switches and indicators and gave no directions on how to load the reader, punch, etc. This would seem to indicate that the machine operator does not wish to bother with a huge maintenance manual. Perhaps a separate, complete manual specifically for the operator should be printed and the information left out of the maintenance manual. Of course, most of the people with whom I spoke were those in charge. At the very end of my interviews I spoke with a Foxboro technician who had just been assigned to the PDP-4 and had spent the previous four or five days reading the manual for the first time. He read both the instruction list and the operation chapter and was very much against having them removed from the manual. He said he preferred a self-contained manual which presented each part of the information in the order it should be received, and that he hadn't come across anything that he felt he could do without. One other respondent mentioned that people did look things up in the operation section, but did not read it all.

Naturally no one sat down to read the circuit chapter. Whenever a module failure occurred, the technician went first to the schematic and, only if he could not understand the circuit thoroughly from the schematic, referred to the circuit description. Everyone felt that, even though they used the material very little, they all wanted it there so they could use it whenever necessary. Of course the machines are still very new and there have been very few module failures. Many are still on warranty so modules are sent back to DEC for repair, but most people indicated that after the warranties run out they will try to repair most modules themselves. Almost everyone mentioned, however, that even though detailed descriptions of the more difficult circuits are desirable, excessively detailed descriptions of mere inverters, diodes and the like are unnecessary. The people at LRL used the descriptions only of the sophisticated memory circuits, and were familiar enough with the other circuits so that no description would have been necessary.

Lastly the maintenance. Most owners made their initial spare module order from the list provided in the manual. Except in the case of modules introduced after publication (eg the 1538 for PDP-1) no one has been caught without a spare for one that failed. Of course this doesn't mean too much yet since there have been so few failures. There were complaints about other spares, however. In particular, after experience with the equipment, AECL made up its own list of reader spares. In the case of the trouble-shooting information, everyone felt that it was aimed primarily at giving a technician a general background in how to troubleshoot digital equipment. Most thought this the best approach, rather than attempting to deal too much in the details and intricacies of any particular part of the machine. Those with considerable background in such work did not bother to read it. All those without such background found it useful. Bill Norris of UA mentioned in particular that he liked the readability of this part of the manual – the colloquial way in which it was written, the little bit of humor that crept in. The people at Raytheon and Corning on the other hand indicated that they would prefer more specific information – detailed examples, perhaps tables, indication of voltage levels or waveforms at certain points for probing with a scope, etc. Several suggested that there should be more information for maintaining the temperamental in-out devices and a few mentioned that they knew of certain DEC maintenance memoranda and the like which should be in the maintenance manual but are not there.

In addition to discussing the maintenance manual I also asked about other DEC software. Most people felt the programing information was not adequate – especially that it was not complete. One man insisted that he received DEC programs which were not even well debugged. Apparently, however, this situation could be much worse. Bryan Myles of AECL mentioned that DEC's software was not sensational and remarked on the programing restrictions – receiving programs written for a machine with only one memory and not using the sequence break system, whereas they had two memories and do use sequence break. However he did mention, "We only get the very basic program from the manufacturer but this enables us to get going – to get off the ground. I'm very pleased in this limited context that the program did work, because lots of manufacturers give you programs that are all wrong, cannot possibly be used and never worked."

PDP-1 users to a man praised the MAINDEC programs – insisted that they run them regularly and the MAINDECs have never failed to lead them to the trouble. To quote Glen Strahl of LRL, "The operating instructions lead you step by step – that is, a person doesn't have to remember how to run this thing. He simply has to open the book to do it. I've never before seen write-ups that were this complete." He was referring of course to the operating procedures, error stop tables, etc. I then asked him what he thought of the actual program descriptions and he replied, "The part that describes the theory of the program is useful – especially when you come up with something that really isn't explained in the rest of it. You can't cover all details in the operation section. The other background is necessary then. Also in one or two cases we felt the need to make some change in the program and of course you can't do that unless you know how it works. So the description is really necessary. We don't normally use the write-up but when we do use it we really need the detail." Most of the MAINDECs that are out are for PDP-1 and it is mostly these people that I talked to. However, one PDP-4 user had this to say about CONTEST. "We don't have anything to correlate CONTEST with what goes wrong." He remarked that unless you know the machine pretty thoroughly you don't get too much of an idea what has happened when the program stops.

October 22, 1963

Module Sales Literature

Stan Olsen
Jack Atwood
cc: Dick Best
Harlan Anderson
Howard Painter
Russ Doane

Kenneth H. Olsen

COPY

We go to a lot of trouble to put features in our modules but we don't get around to telling people about them. We have a truly sincere desire to make a quality module and yet I don't think that we really get this across to the potential customers at all times. I propose that we have a page in our new catalog which lists these features. This also might be part of a loose brochure and maybe if we do it right, it might even be a one-page ad. Here are a few features which I think we ought to mention and maybe we can add some more:

1. The handle which protects the components and keeps the board from flexing.
2. Machine to male contact.
3. Flexible wires from the male contact to the etched board
4. 20-Fork female contact with high contact pressure
5. Deep fork solder contacts on the socket
6. Conveniently separated solder contacts to make simplified wiring.
7. Eyelet on each transistor lead to simplify replacement.
8. We might mention our inspection tolerances on etched wiring.
9. Glass base board.
10. Filtering on the power leads to the mounting panel.
11. Brute force Power supplies.
12. Wiring on convenient side of mounting panel.
13. Reversible mounting panel.

We are coming out with a new mounting panel which is about ready to be released. This will have a number of features. It will not be painted which will make it much more attractive in most systems. This will also lower the cost. In advertising this mounting panel, we will push the new sockets. We will actually include new sockets in all mounting panels but we will advertise it as a feature of this one. We will not do any wiring of this mounting panel and, therefore, will scantly lower the cost and we feel that this will be reason for people to order this mounting panel.

We will not include the old mounting panels in the catalog but we will sell them as people ask for them. The sides will be a lot narrower so it will be easier to put the modules in place and they will run a lot cooler.

INTEROFFICE MEMORANDUM

DATE October 22, 1963

SUBJECT

TO Harlan Anderson
Dick Best

FROM Kenneth H. Olsen

General Doriot asked me to meet with his staff and a few of his directors on November 8th for a long afternoon session in which we will present to them a picture of the products of Digital. They would like to know more of what our product line is and how our techniques compare with the competition and what are our advantages and disadvantages of this in respect with the competition. They would also like to know what our problems are. I'm not sure whether I should do this alone or whether I should ask you people to come in. I would like to hear your ideas and have you think about it because I would like to have your help in preparing for it.

Besides their staff, there will probably be Mr. Elliott from John Hancock and Mr. Lund. They asked if it would be all right to have Mr. Skifter from Airborne Instruments and I suggested that they are, in a sense, competition and therefore, I didn't think it was wise.

INTEROFFICE MEMORANDUM

DATE October 22, 1963

SUBJECT PDP-5

TO K. Olsen
✓H. Anderson
S. Olsen
N. Mazzarese
E. Harwood
J. Jones

FROM J. Smith

The 4206 model for PDP-5 was received from Engineering yesterday. First production lots should go into test Monday or Tuesday of next week. They should be tested and ready for installation into PDP-5's the end of the week. Once the 4206 are received, we can start sending PDP-5's to Checkout.

INTEROFFICE MEMORANDUM

DATE October 22, 1963

SUBJECT BULLETIN NUMBERS FOR PDP-6 LITERATURE

TO Gordon Bell

FROM Jack Atwood

CC Harlan Anderson ✓
Nick Mazzarese
Dit Morse
Alan Kotok
Stu Grover
Joe Nangle

Unless there are overwhelming reasons to the contrary, I would like to follow our standard method of bulletin numbering for the PDP-6 literature. I feel this would have several important advantages:

1. It would organize the PDP-6 literature in a logical manner, whether the bulletins are filed independently or incorporated in an eventual DEC Computer Catalog.

2. It would preserve a good working identity across product lines, making it easy to reference all computer system descriptions, for example, as F-11, F-41, F-51, and F-61; all price lists as F-12, F-42, F-52, and F-62; etc.

3. It would provide enough alpha-numeric prefixing to avoid any confusion about the proper filing sequence.

The main categories according to our standard system would be:

F-61	System Description
F-62	Price List
F-63	Equipment Options
F-64	Software
F-65	Handbook (Short Form Manual)
F-66	Instruction Cards
F-67	Maintenance Manuals
F-68	Installation Manual
F-69	Log Book
G-600	Applications

Some of these, of course, are not applicable at this time.

The attached sheet illustrates how the system would apply to some of the PDP-6 literature in process and in prospect and the order in which the bulletins would fall.

Initial Designation	Suggested Designation	Subject
F6S*	F-61	System Description
		(Core Memory 8K 161A)
		(Core Memory 16K 161B)
		(Fast Memory 162)
		(I-O Processor 163)
F6166*	F-63(166)	Central Processor 166
F6IO*	F-63(200)	In-Out Equipment
F6236*	F-63(236)	Drum Processor and Control 236
		(Electrostatic Display 336)
		(Incremental Display 340)
		(340 Options 341-345)
		(Card Punch and Control 460)
		(Card Reader and Control 461)
F6516*	F-63(516)	Magnetic Tape Control 516
F6551*	F-63(551/555)	MICRO TAPE Control 551
		MICRO TAPE Transport 555
		(TTY Printer-Keyboard 626)
		(Printer and Control 680)
		(Perforated Tape Reader and Control 760)
		(Perforated Tape Punch and Control 761)
F-6PROG*	F-64	Programming Techniques
F6AS*	F-64AS	Assembler
F6DDT*	F-64DDT	DDT
F6EXEC	F-64EXEC	Executive Routines
F6FT*	F-64FT	FORTRAN
F6M166	F-67(166)	Processor 166 Manual
F6M167	F-67(167)	Processor 167 Manual
	etc.	
F6APPS*	G-600	Applications - General
	G-610	Process and Manufacturing Control
	G-620	Engineering and Scientific Computations
	G-630	Satellite Operations
	G-640	Communications
	G-650	Data Acquisition and Reduction
	G-660	Simulation
	G-670	Medical and Psychological
	G-680	Hybrid Systems
	G-690	Data Processing and Management Support

*Items left on the board at Friday's meeting

INTEROFFICE MEMORANDUM

DATE October 21, 1963

SUBJECT MODULE PRODUCTION RELEASE AND CHANGE NOTICE PRIORITY

TO All Engineers
Drafting
Model Shop
Quality Control
Production

FROM D A White

Much chaos has arisen with regard to the priority by which modules are processed. Our system has been somewhat hit or miss and very much based on the squeaking wheel method.

Effective immediately, I will assign priority to all modules being released or changed. If you have any complaints with your priority, please contact me.

DAW:ASJ
Encl

D A White - October 21, 1963

OVERDUE MODULES — PRIORITY ONE

1021	PR3638
1570	EC3631
1571	EC3619
1991	PR3445
1992	PR3468
1993	PR3464
1994	PR3469
4206	EC3632
4221	EC3618
4527	PR3560
4552	PR3643
4801	PR4641
4802	PR4640

ORDERED BY EXTERNAL CUSTOMERS OR FOR SYSTEMS FOR EXTERNAL CUSTOMERS — PRIORITY TWO

722A	PR3587
728A	PR3591
1304	EC3646
1567	EC3613
1806	PR3621
1807	
1989	EC3650
4220	EC3580
4222	EC3610
4227	PR3644
4551	EC3607
4704	
4705	PR3381

IN HOUSE SYSTEMS, PROTOTYPES, MODULES FOR WHICH NO DELIVERY COMMITMENT HAS BEEN MADE

PRIORITY THREE

776A	PR3593
779A	PR3592
1664	PR3547
1250	PR3600
1665	PR3541
4290	PR3558
4320	PR3559
4526	PR3546
4658	PR3626
4800	PR3617
6203	PR3629
6205	PR3597
6206	PR3622
6609	PR3399
6615	PR3614
15591	PR3514
61220	PR3463

ROUTINE CHANGES TO MODULES

PRIORITY FOUR

4206	EC3647

INTEROFFICE MEMORANDUM

DATE October 21, 1963

SUBJECT Overdue Computer Systems and Options.

TO K. Olsen
H. Anderson ✓
S. Olsen
G. O'Dea
W. Hindle
D. Best
D. Mills
M. Sandler
R. Beckman
R. Savell
B. Stephenson
E. Harwood
J. Shields
D. Smith
J. McCalip
T. Stockebrand

FROM N. Mazzarese
J. Smith
S. Lambert

The following is a list of overdue computer systems and options. The engineer responsible for the project's completion is indicated in each case.

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Acceptance Expected	Engineer in Charge
Multiplexer 133	1	JPL	2632	8/15/63	Installed waiting for acceptance	Mid. Nov.	R. Beckman
Tape Control Type 57A	1	JPL	2633	8/15/63	Installed waiting for acceptance	Mid. Nov.	R. Beckman
A to D Multiplexer Switches	1 1 1	Raytheon Wayland	2662 2663 2664	9/5/63 9/5/63 9/5/63	Installed and still waiting for acceptance	Latter part of Oct.	B. Stephenson B. Stephenson B. Stephenson
PDP-1C-41	1	Harvard University	2655	9/15/63	Customer's building not available until Oct. 21, 1963	11/1/63	E. Harwood
Date Control 131	1	Harvard University	2659	9/15/63	Customer's building not available until Oct. 21, 1963	11/1/63	E. Harwood
Micro Tape 555	1	Ft. Meade	2609	8/15/63	System Checkout Problems	11/21/63	T. Stockebrand
Micro Tape Control 550	1	Ft. Meade	2604	8/15/63	System Checkout Problems	11/21/63	T. Stockebrand
16K Memory	1	Princeton	2554	9/15/63	Design Problems	11/19/63	R. Beckman

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Acceptance Expected	Engineer in Charge
Tape Control 510	1	Princeton	2558	9/15/63	Design Problems	11/5/63	R. Beckman
Data Control 131	1	Princeton	2559	9/15/63	Design Problems	11/5/63	R. Beckman
High Speed Channel Type 19	1	Princeton	2560	9/15/63	Waiting for Data Cont'l 131	11/5/63	R. Beckman
Tape Control 510	1	MIT, Lincoln Lab.	2580	8/1/63	Design Prob.	11/8/63	R. Beckman
Data Control 131	1	MIT, Lincoln Lab.	2579	8/1/63	Design Prob.	11/8/63	R. Beckman
Data Speed Channel 19	1	MIT, Lincoln Lab.	2581	8/1/63	Waiting for Data Control 131	11/8/63	R. Beckman
Micro Tape Control 550	2	Kie	2594	7/20/63	Installed, not accepted. Over heats.	10/31/63	T. Stockebrand
Micro Tape Transport 555	6	Kie	2595	7/20/63	Installed, not accepted, drive 4 not working	10/31/63	T. Stockebrand
Mul. & Div. 10	1	AECL	2610	8/15/63	Installed not accepted. Entire P.O. not complete	Contingent on Micro Tape	J. Shields

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Acceptance Expected	Engineer in Charge
Micro Tape 555	3	AECL	2611	8/15/63	Training Checkout Personnel & Design Prob.	10/23/63	T. Stockebrand
Micro Tape 550	1	AECL	2612	8/15/63	Training Checkout Personnel & Design Prob.	10/23/63	T. Stockebrand
16 Channel Seq. Break	1	AECL	2613	8/15/63	Installed - not accepted Entire P.O. not complete	Contingent on Micro Tape	J. Shields
IBM Interface	1	JPL	2628	8/15/63	Shipped not accepted - Entire P.O. not complete	Mid. Nov.	R. Beckman
Q-32 Interface	1	System Development Corp.	2614	7/22/63	Waiting for Interface acceptance	End of Nov.	D. Smith
Line Units	56	System Development Corp.	2615	7/22/63	Dependent upon Module & Checkout	End of Nov.	D. Smith
4K Word Core Memories	2	ITT	2721	10/9/63	General Ceramic Core Problems	10/22/63	J. Smith
Convert Type 57 Tape Cont'l to Type 57A Cont'l with 522 Option for IBM Type 729 Transport	1	JPL	2739	10/4/63	Design & Checkout	Mid. Nov.	S. Lambert

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Acceptance Expected	Engineer in Charge
Micro Tape Control 550	1	DEC - PDP-4 Prototype	2719	10/14/63	Checkout Prob.	Nov. 15	T. Stockebrand
Micro Tape Transports 555	3	DEC - PDP-4 Prototype	2720	10/14/63	Checkout Prob.	Nov. 15	T. Stockebrand
CRT Display with yellow filter	1	DEC Sales (PDP-5-3)	2763	10/18/63	Ordered late	Indefinite	B. Beckman

dec INTEROFFICE MEMORANDUM

DATE October 21, 1963

SUBJECT Australian Computer

TO Gordon Bell
Harlan Anderson
Nick Mazzarese
Stan Olsen

FROM A. Titcomb

The attached list of exceptions has been prepared after examining the Aeronautical Research Laboratories Specification.

Paragraph 8.1 requests ALGOL 60, however as FORTRAN is being written at M. I. T. for PDP-1* and PDP-6 will offer FORTRAN, it is hoped that FORTRAN will be acceptable and might be substituted.

The accuracy requirements exceed single precision capability (fixed point) in PDP-1.

*It seems unlikely that we can get their specification to call out DECAL.

Aeronautical Research Laboratories

List of Exceptions

Paragraph No.	Exceptions
2.0	Wiring standards will be our own (USA)
4.1	Accuracy
	PDP-1 5 + decimal figure accuracy
	PDP-6 OK - no exception
4.7	Error treatment (exception)
	No internal parity PDP-1 or PDP-6
2.1	Character Sets
	PDP-1 FIO-DEC
	PDP-6 Teletype (7 level)
8.1	(a) FORTRAN or ALGOL 60

INTEROFFICE MEMORANDUM

SUBJECT: JOB ALLOCATION, MECHANICAL DESIGN DATE: October 18, 1963

TO: All Engineers
K. Olsen
S. Olsen
H. Anderson
N. Mazzarese
M. Sandler
J. Smith
R. Maxcy
R. Maroney
K. Peirce
H. Crouse
B. Brackett
W. Hindle

FROM: Loren Prentice

To better acquaint all engineers and management with job responsibility within the mechanical design department, a memo will be issued periodically as required.

ENGINEER	JOB NUMBER OR EN NUMBER	DESCRIPTION	% COMPLETE
Ken FitzGerald	1023	Additional assembly jig for 1914 mounting panels	75%
	1000	Paint adhesion on steel components	30%
	1053	Welding jigs for standard computer cabinets	99%
	1000	Sheet metal, machine, cabinet assembly and carpenter shop supervision and administration	--
	1178	PDP-6 console mechanical design and prototype fabrication	95%
	1208	DEC paper tape reader (Stepping motor drive)	30%
	1000	"Plastic" doors and end panel research	0%
	1000	Programming tape controlled milling machine	--
	1097	Automated module production	05%
	2740	Mechanical parts for "Havoc" computer	10%

ENGINEER	JOB NUMBER OR EN NUMBER	DESCRIPTION	% COMPLETE
Loren Prentice	1136	555 Tape Unit E.C.O.'s	75%
	1065	Large Display	10%
	1000	Building layout	75%
	1196	Tape transport type 570	75%
	1000	Quotation - plastic parts	50%
	1000	Engineering standards	0.5%
	1237	555-A tape unit Solid State Dev.	20%
	unassigned	Link computer	0%
Scott Miller	1000	Tiltable mounting panel	80%
	1022	Power supply redesign	50%
	1023	Mounting panel redesign	50%
	1088	Package design - modules	50%
	1177	PDP-5	85%
	1178	PDP-6	95%
	1196	Tape transport 570	98%
	1209	PM light pen	80%
	2623	Typewriter buffer - 2308	98%
		Product Identification	Open
Phil Backholm	1196	M3000 tape transport Prototype type 570	85%
	1185	Automatic silk screen	0.5%
	1191	PDP-5 Prototype	80%
	2723	Teletype machine rework	50%

ENGINEER	JOB NUMBER OR EN NUMBER	DESCRIPTION	% COMPLETE
Ron Cajolet	1178	PDP-6	80%
	1236	Display 340	50%
	1027	Stability test stand (Display 30)	50%
	2667	PDP-1D	65%
	1170	7090 Data Channel	5%
	1181	Camera Mount	5%
	1000	Mounting panel development	--

JOBS PENDING - UNASSIGNED		ASSIGNED ELECTRONIC ENG.
1151	Large Tape Storage - Hold	T. Stockebrand
1165	Projection display	R. Savell
1180	Camera equipment for 30 display	R. Savell
1181	Camera equipment for 31 display	R. Savell
1182	Electrostatic display development	R. Savell
1086	Holley printer	R. Savell
1064	Eye-ball unit	R. Savell

INTEROFFICE MEMORANDUM

DATE October 18, 1963

SUBJECT Commission to J. J. Masur on DEC Order 5672, Australian Consultate General

TO Harlan Anderson ✓ FROM Dick Mills

We received an order from the Australian Consultate General on October 8, 1963, their Order CG63929 in the total amount of $7,149.58. On the basis of the discount schedule which we quoted to J. J. Masur, their full commission, if we are to give it on this order, would be $693.44.

The order, at present, is being held up for 50 cycle transformers to be installed in the 728 Power Supplies. We estimate that the order can be completed and shipped on October 31, 1963, as promised to them. The shipment is to go via air to San Francisco where the Australian government has a consolidating service that will process the shipment from there on. All modules are packed and ready to be shipped.

We wrote the J. J. Masur agreement for a period of October 1, 1963 through September 30, 1964, which puts the order receipt within this time period.

RFM/bl

H. Anderson

Programming Note No. 1 October 16, 1963
Subject: Use of ACS II

There is now available, on the PDP-4 Prototype console LISTER II, a program which will list paper tapes prepared on the Type 33 teletype, on the line printer. For this reason the relations between the ASC II character set and FIO-DEC have been established (de facto) as follows:

TYPE 33	Anelex
A TO Z	A to Z
Ø TO 9	0 to 9
(	(
)	)
[	[
]	]
+	+
-	-
*	×
/	/
↑	↑
"	"
'	'
:	: (center dot, period)
;	; (center dot, comma)
.	.
,	,
$	$ (an anelex but not a fio-dec character)
=	=
<	<
>	>
?	?
@	→
&	∧
!	∨
\	|
←	~
%	⊃
#	= (overbar)

Harrison R. Morse III

HRM/nbh

INTEROFFICE MEMORANDUM

DATE October 16, 1963

SUBJECT EN 1000 Series

TO R Mills

FROM J Hastings

Please provide Harlan Anderson with the dollar amounts in each of the categories on the attached October 1, 1963 list of EN numbers in the 1000 series.

Andy would like to see the dollar amounts per number for the past six months in each category, and the totals.

I would appreciate a copy of this information also.

JPH:ASJ
Encl

CC
H Anderson

CURRENT ENGINEERING NUMBERS

October 1, 1963

General

EN 1000	General Engineering	R L Best
EN 1023	Mounting Panels	L B Prentice
EN 1031	Computer Development (See special numbers for PDP-1, PDP-4, PDP-6	G Bell
EN 1048	New Test Equipment	R Hughes
EN 1049	Engineering Stockroom	D A White
EN 1053	Computer Cabinet	L B Prentice
EN 1067	Information Int'l (E Fredkin)	S C Olsen
EN 1072	Standards	R L Best
EN 1087	Relay and Switch Investigation	R L Best
EN 1099	Field Service - General	R J Beckman
EN 1100	Power Controls	D A White
EN 1115	Repairs to goods damaged in shipment	R L Best
EN 1132	ADX Systems Administration	N J Mazzarese
EN 1158	Production Engineering	K Wakeen
EN 1175	Computer Reliability Investigation	A H Hall
EN 1176	Computer Check-Out Administration	E Harwood
EN 1192	Wire Taping Machine	K Wakeen
EN 1200	Exhibits	H Painter
EN 1210	Drafting Automation	L Hantman
EN 1212	Technician Training Classes	D A White
EN 1213	Library	R L Best
EN 1225	Indicator Development	R L Best
EN 1226	Drafting Dept Administration	R Melanson
EN 1227	Reproduction Dept - Drafting	R Melanson
EN 1235	Obsolete Goods Stockroom	R L Best
EN 1238	Computer Engineering Administration	A H Hall

CURRENT ENGINEERING NUMBERS October 1, 1963

Analog-to-Digital
Digital-to-Analog

EN 1014	Digital-to-Analog Converter	B W Stephenson
EN 1044	Analog-to-Digital Converter	B W Stephenson
EN 1138	Prototype A-D for PDP-4	B W Stephenson
EN 1163	6 μsec A-D Converter Model 142 Development	B W Stphenson
EN 1174	Adage A-D Evaluation	B W Stephenson
EN 1202	General Purpose A-D Model 138 Development	B W Stephenson
EN 1203	Basic Multiplexer Control Model 139 Development	B W Stephenson
EN 1204	High-Speed Multiplexer Control Model 141 Development	B W Stephenson
EN 1215	Type 142 A-D Converter for Sales	B W Stephenson
EN 1220	138 A-D Prototype	B W Stephenson
EN 1221	139 Multiplexer Control Prototype	B W Stephenson
EN 1222	141 High-Speed Multiplexer Control Prototype	B W Stephenson
EN 1223	142 High-Speed A-D Prototype	B W Stephenson
EN 1224	A-D and D-A and Multiplexer System Sales	B W Stephenson
EN 1244	A-D Converter Aperture and Accuracy Checker	B W Stephenson

CURRENT ENGINEERING NUMBERS

October 1, 1963

Card Readers & Punches

EN 1232	461 Card Reader and Control, Development and Prototype	R E Savell
EN 1068	41 Card Reader and Control	R E Savell
EN 1245	460 Card Punch (PDP-6) Development and Prototype	R E Savell

CURRENT ENGINEERING NUMBERS

October 1, 1963

Drums

EN 1242	Drum Circuit Development	A N Blumenthal
EN 1243	New Drum Development	A N Blumenthal

CURRENT ENGINEERING NUMBERS October 1, 1963

Displays

EN 1027	Display 30 Development	R E Savell
EN 1036	Light Pen Development	R E Savell
EN 1064	Display 31 Development	R E Savell
EN 1129	Character Generator Development	R E Savell
EN 1135	Display 30-D, Prototype PDP-4	R E Savell
EN 1152	Digital Symbol Generator	R E Savell
EN 1156	Curve Drawing Display	T C Stockebrand
EN 1165	Projector Display	R E Savell
EN 1169	Display, CDC-160A Type 30 Interface	R E Savell
EN 1170	IBM 7090 Type 30 Interface	R E Savell
EN 1171	IBM 1410 Type 30 Interface	R E Savell
EN 1179	Display 30 Cost Reduction	R E Savell
EN 1180	Display 30 Camera Equipment	R E Savell
EN 1181	Display 31 Camera Equipment	R E Savell
EN 1182	Display Development, Electrostatic	R E Savell
EN 1184	Variable Field Light Pen Development	R E Savell
EN 1186	Display 30G Prototype with Symbol Generator	R E Savell
EN 1187	Display Sales	R E Savell
EN 1209	Display Development, General	R E Savell
EN 1211	PM Light Pen	R E Savell
EN 1236	340 Display (PDP-6) Development and Prototype	R E Savell
EN 1246	Display 34 development	RES

CURRENT ENGINEERING NUMBERS

October 1, 1963

Suggest we separate mag tape from micro-tape

Mag Tape - Micro Tape

EN 1026	Magnetic Tape Equipment	R Boisvert
EN 1136	Relay Micro-Tape Unit Development	T C Stockebrand
EN 1151	Coaxial Tape Transport Development	T C Stockebrand
EN 1161	Type 57A Mag Tape Control Development	S Lambert
EN 1162	Type 57A Mag Tape Control Prototype	S Lambert
EN 1189	Tape Control 510 Development	R Boisvert
EN 1196	M-3000 Tape Transport Prototype Type 570	S Lambert
EN 1199	Tape 510 Tape Transport	R Boisvert
EN 1237	Solid State Micro-Tape Development and Prototype	T C Stockebrand

CURRENT ENGINEERING NUMBERS October 1, 1963

Memories

EN 1016	Core Memory Development	A N Blumenthal
EN 1052	Memory Stack Assembly	A N Blumenthal
EN 1143	Magnetostrictive Delay Line Memory Development	D A White
EN 1150	Glass Delay Line Memory Development	D A White
EN 1173	Memory Extension Model 15 Prototype	A H Hall
EN 1193	Thin-Film Memory Development	A N Blumenthal
EN 1216	Memory Extension Control & Development	A H Hall

CURRENT ENGINEERING NUMBERS

October 1, 1963

MISCELLANEOUS IN/OUT

EN 1050	Data Phone	R E Savell
EN 1155	Houston X-Y Plotter	R E Savell
EN 1190	Data Control 131 Development	R Boisvert

CURRENT ENGINEERING NUMBERS October 1, 1963

Modules

EN 1010	Modules, 5 MC System	D A White
EN 1011	Modules, 500 KC System	D A White
EN 1012	Modules, Non-Compatible Low-Speed	D A White
EN 1013	Current Drivers, Vacuum Tube	D A White
EN 1017	Signal Converters	D A White
EN 1019	Module Sales	S C Olsen
EN 1022	Power Supplies	D A White
EN 1029	Modules, 10 MC System	D A White
EN 1030	Educational Modules	D A White
EN 1039	Current Drivers Solid State	D A White
EN 1042	Current Driver Power Supply 766	D A White
EN 1043	Modules VHF	D A White
EN 1051	Modules Classroom	D A White
EN 1088	Module Packaging for Shipment	R L Best
EN 1090	4203 Development	D A White
EN 1091	4204 Development	D A White
EN 1092	Modules, 10 MC Laboratory	D A White
EN 1093	Modules, 5 MC Laboratory	D A White
EN 1094	Modules, 500 KC Laboratory	D A White
EN 1097	Modules Construction Development	R L Best
EN 1098	Module Test Development	D A White
EN 1127	Current Calibrator Development	D A White
EN 1148	Modules, Teletype Line Unit	D A White
EN 1172	Modules, Analog Development	D A White
EN 1185	Modules, Mechanical Design	R L Best
EN 1206	Module Tester Sales	K Wakeen

CURRENT ENGINEERING NUMBERS

October 1, 1963

Paper Tape

EN 1025	Paper Tape Punch	R E Savell
EN 1028	DEC Paper Reader Designed and Prototype	R E Savell
EN 1153	PDP-4 Paper Tape Reader	R E Savell
EN 1217	77 Punch and Control Development	E de Castro
EN 1230	760 Paper Tape Reader and Control Development and Prototype	R E Savell
EN 1231	761 Paper Tape Punch and Control Development and Prototype	R E Savell
EN 1233	3-Phase Paper Tape Reader, Development and Prototype	T C Stockebrand

CURRENT ENGINEERING NUMBERS October 1, 1963

PDP-4

EN 1062	PDP-4 Development	A H Hall
~~EN 1068~~	~~PDP-4 Development, Type 41 Card Reader and Control~~	~~R E Savell~~
EN 1095	PDP-4 Sales	A H Hall
EN 1096	PDP-4 Programming	H R Morse
EN 1157	PDP-4 Automatic Module Tester	D A White/K Wakeen
EN 1159	PDP-4 Multiply and Divide Prototype	A H Hall
EN 1160	PDP-4 Installation Kit	A H Hall
EN 1164	PDP-4 Data Channel Prototype	A H Hall
EN 1195	PDP-4 -10 Operation - Engr Computer	A H Hall

CURRENT ENGINEERING NUMBERS

October 1, 1963

PDP-5 and PDP-6

EN 1177	PDP-5 Development	E de Castro
EN 1178	PDP-6 Development	G Bell
EN 1191	PDP-5 Prototype	E de Castro
EN 1205	PDP-6 Prototype	G Bell
EN 1219	PDP-5 Programming	A H HAll
EN 1240	PDP-5-3 DEC Sales	S C Olsen
EN 1241	PDP-5-4 Physics Sales	J Jones

Separate PDP-5 + PDP-6

CURRENT ENGINEERING NUMBERS October 1, 1963

Printers and Typewriters

EN 1015	PDP-1 Typewriter	R E Savell
EN 1058	Anelex Development	R E Savell
EN 1086	Holly Printer	R E Savell
EN 1134	PDP-4 Flexowriter Prototype	R E Savell
EN 1154	PDP-4 Typewriter	R E Savell
EN 1194	20 Column Line Printer	R E Savell
EN 1228	Printer Keyboard and Control Type 626 Development and Prototype	R E Savell
EN 1229	646 Line Printer and Control (300 lpm) Development and Prototype	R E Savell
EN 1239	680 Line Printer and Control (1000 lpm)	R E Savell

CURRENT ENGINEERING NUMBERS

October 1, 1963

Programming

EN 1141	Fortran	H R Morse
EN 1167	Decus Program Library Operation	H R Morse
EN 1168	Internal Program Library Operation	H R Morse

Need more numbers

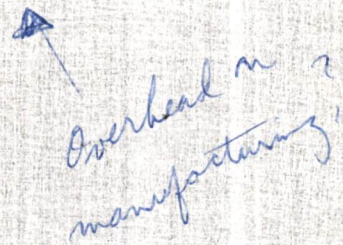
PDP-6
PDP-5
etc.
↓
DECAL

CURRENT ENGINEERING NUMBERS

October 1, 1963

Quality Control

EN 1073	Quality Control	R Hughes
EN 1144	Quality Control: Test Equipment - Labor - Materials	R Hughes
EN 1145	Quality Control: Model Test	R Hughes
EN 1146	Quality Control: Module Repair Field Failure	R Hughes
EN 1147	Quality Control: Module Repair Salvage	R Hughes
EN 1234	Finished Goods Sampling	R Hughes



CURRENT ENGINEERING NUMBERS October 1, 1963

Special Systems

EN 1018	Memory Tester Development	J R Fadiman
EN 1021	Core Handler	J R Fadiman
EN 1037	Core Tester and Memory Tester Sales	J R Fadiman
EN 1038	Special System Sales	J R Fadiman
EN 1057	Core Tester Development	J R Fadiman
EN 1074	Memory Tester Field Service	J R Fadiman
EN 1075	Core Tester Field Service	J R Fadiman
EN 1076	Memory Exerciser Field Service	J R Fadiman
EN 1077	Misc Spec System Field Service	J R Fadiman
EN 1116	Memory Tester Field Modification	J R Fadiman
EN 1123	Core Tester 2114 Development	J R Fadiman

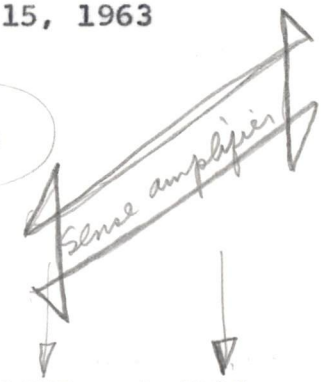
dec INTEROFFICE MEMORANDUM

DATE October 15, 1963

SUBJECT PDP-5 Construction

TO K. Olsen
H. Anderson
S. Olsen
M. Sandler
N. Mazzarese

FROM J. Smith



There continues to be an Engineering Hold on 1571 and 4206. Our Checkout people will not accept PDP-5's into Checkout without the 4206.

Machines being held up are PDP-5-5, PDP-5-6, PDP-5-7, and PDP-5-8. By the first of next week, PDP-5-9 and PDP-5-10 will also be held up.

dec INTEROFFICE MEMORANDUM

DATE October 14, 1963

SUBJECT PRODUCT IDENTIFICATION

TO Computer Guidance Committee FROM Loren Prentice

cc: Scott Miller
Paul Rawson, Van Dyck Associates
Roland Boisvert
Ted Johnson
Harlan Anderson
Nick Mazzarese
Bob Savell

I am proposing that we use a product identification similar to the type we have chosen for the 570 tape unit to be used on the following new devices: PDP-6 computer, 570 tape unit, 340 display, and the new, as yet unnamed, large drum system that is being proposed for use with the PDP-6.

Will all interested people look at the mock-up of the name plate and product identification for the 570 tape unit and make their comments known at an early date as we will soon be committed on the PDP-6, 570, and the 340 display.

INTEROFFICE MEMORANDUM

DATE October 14, 1963

SUBJECT

TO Harlan Anderson
Stan Olsen
Win Hindle
George O'Dea
Dick Best

FROM Kenneth H. Olsen

DuPont Corporation called General Doriot and said they had something very interesting and revolutionary which they can't handle themselves and would like to have a computer company take care of. They are out evaluating companies and they would like to visit us. I agreed to have the company visit us on next Thursday. They will leave Wilmington about 7 A. M. and get in about 9:15 A. M. at the Bedford Airport. I offered to have a car there to pick them up. They will try to leave by 4:30 in the afternoon which would mean a rather full day for us and we may want to divide off the responsibilities for the day. I have a visitor in the early afternoon so I would have to excuse myself at that time.

The people coming will be, Mr. J. V. Morris, Mr. V. W. Smith, and Mr. Daniel Friel.

CANADA (DECAN) H. Anderson

10-12-63

1. Progress Report July 1/63 - Oct. 1/63.

The following items mentioned in the last progress report require further comment:

Sales Tax - Federal

The information given in clause 1.3 on the subject of a wholesaler's licence is slightly inaccurate. A wholesaler's licence is granted only after I have actually done 3 months business and have actually paid sales tax on goods which were eventually sold to tax exempt customers. Since my customers have been clearing their own goods I have suffered no such penalty and therefore have no evidence to present to the Department of Revenue. This is of little consequence to me as I think the present method is working quite well.

The data on the manufacturer's licence as presented in the last report is correct, with the added stipulation that it is in fact mandatory that we obtain such a licence if we increase the value of our goods through extra work on them.

Pricing

I now have a better feel for the elasticity of demand for our equipment as mentioned in 1.5 of last report. I would still prefer to wait until January '64 before modifying price structure.

We have been confronted with the extra problem of the Department of National Defence limiting our mark-up to 15%, on all sales regardless of volume. Our new discount structure is perhaps more compatible with their buying policies, and perhaps something can be negotiated whereby they are not concerned about my mark-up providing they get the sizeable discounts which their volume warrants.

Sales Activity

The current backlog of orders and future sales prospects will bear out our $500,000 prediction for fiscal '63-'64. The overall interest in our product line is very encouraging, but the time delay involved in gaining firm customers is very discouraging. The value of travel, while at first questionable, is now very obvious to me. Extensive travel will be done until such time as I feel it is no longer necessary. A trip to Western Canada is the next big road project - scheduled for about November 1st.

General Comments

Less and less of my time is required for office work as Mrs. Murphy is now capable of handling our accounting problems.

The Company will begin to show a profit towards the turn of the year with the installation of the machines and extra equipment at Chalk River. At the present time we are being carried by accounts payable to parent company, which at this moment stands at approximately $20,000. The bank balance as of now is $11,000 approximately - a major expense (possibly $2,000) is forthcoming in the way of bills for the Toronto show.

As a general statement, our position in the Canadian market is now a strong one - we are steadily licking the problem of not being known. The factors involved are:

1. Travel
2. Proper listing in trade journals
3. Toronto CEE Show
4. Computer seminar in Ottawa office - visited by over thirty people in key positions.
5. Additions to mailing list - from 400 names to nearly 700.

A very flattering comment by the SDS people at the Toronto show to Nick Mazzarese:

"Everything was nice and quiet up here until DEC showed up on the scene".

2. Current Backlog of Orders

This refers to orders received by DECAN since May 1, 1963. . . . . $174,289.72

Amount of invoicing done on the above orders $52,339.82

Orders which were actually received by DEC (Maynard) but which will be invoiced through DECAN (this includes the PDP-4 computer installation scheduled for Nov./63 and modifications to the PDP-1 installation, part of which has already been done).

This figure is approximate (correct to a few percent) since conversion to Canadian dollars has not been done in all cases $280,000

In summary therefore we have a backlog of orders totalling $450,000 of which we have invoiced approximately $50,000 - the remainder to be invoiced by January 1, 1964.approx.

3. Sales Prospects in Excess of this $450,000

This will include only those prospects which I consider better than 50%. For example, a recent quote to Atomic Energy of Canada for another PDP-4 system in the amount of $213,000 I do not consider better than 50% sold, and this is not included in this forecast. Also, this forecast covers the period November 1/63 to June 30/64.

Dept. of National Defence (PDP-5 + modules)	$35,000
Northern Electric, Montreal (Memory Test Equipment)	13,000
Atomic Energy of Canada (Modules + miscellaneous)	10,000
Various small buyers	5,000
	$63,000

Total sales for fiscal '63-'64 will therefore slightly exceed $500,000, and in fact could do much better. I feel that we are still very much in a shakedown process and sales could very easily climb quickly towards the end of the year. The government fiscal year ends on March 31st, and we will therefore experience a serious slump during the winter months. Assuming that the Chalk River people will not buy computers at the same rate next year, we have something like a $300,000 vacuum to fill. This is going to be our biggest test up here-whether or not the computer prospects who are still a year or more away will in fact come to us when they do make the move.

My general thoughts on company expansion do not significantly differ from those of the previous report. To further investigate the benefits of a Canadian manufacturing facility, I have taken steps to assess the Commonwealth market. Our

Department of Trade & Commerce has a Commonwealth Trade Branch - they will do market research and provide information on Commonwealth preferential tariff. I sent a detailed enquiry to them on September 27 and should have their information within a month or so.

Most Commonwealth countries do offer more favourable tariffs to Canadian goods than to U.S. goods, the only stipulation being that over 50% of the value of the goods is Canadian content. This sounds good at first glance, but the Canadian advantage may or may not be a real one, depending on the end use to which the goods are put. For example, I would assume that places like Harwell in England or a University in Australia would import from both Canada and the U.S. under duty free conditions - as does Atomic Energy in Canada. Consequently our only real advantage over the U.S. would come in purely process control work and this sort of thing.

D. J. Doyle.

P.S. Since writing this, I have had a call from the Trade & Commerce Department regarding the British market only. I gather that all institutions pay a 20% tariff on U.S. computers regardless of end use - there is no tariff on Canadian computers. I would like to see this for myself before becoming too optimistic. John Leng should consult with our Trade & Commerce people before his trip to Britain this fall and I think he could follow this through.

Dick, perhaps John should get a copy of all this - I will send you extra copies by regular mail.

D.J.D.

dec INTEROFFICE MEMORANDUM

DATE October 10, 1963

SUBJECT CDC 3200

TO MR. HARLAN ANDERSON ✓
MR. GORDON BELL

FROM KENNETH LARSEN

The 3200 is CDC's computer entry for the Business Data Processing Market. It was previously called "Zeta"during the design and prototype phase and was designated 3200 for marketing. It is a 24-bit machine built with 3600 circuitry with an organization similarity to the 924. Its overall computing speed is about the speed of the 1604. It will be exhibited at the Fall Joint Computer Conference.

CDC is preparing also another machine called the Omega. It will be designated 3400 for marketing and will be between the 3200 and the 3600 in size. The 3400 will be marketed also in the Business Data Processing field.

I learned that they are planning to market similar machines using the 6600 circuitry.

It looks as if CDC is really trying to hit IBM head-on with these new machines, and I am wondering how this will affect the PDP-6.

K.L.
KL:es

Copy: Mr. S. Olsen

H. Anderson

INTEROFFICE MEMORANDUM

SUBJECT: 33rd Meeting of the Test Equipment Committee September 24, 1963

DATE: October 9, 1963

TO: Richard L. Best

FROM: Russell Doane

Members of the Committee:

Robert Hughes, Chairman
Russell Doane, Secretary
George Gerelds
Dave Dubay
Dick Tringale
Jim Cudmore
Steve Lambert
Larry White
Ed Harwood
Jack Shields

1. The following equipment has been ordered:

   A. 1 - Tek type 581 for Q. C.

   B. 1 - Tek type 581 for Production test

   C. 1 - Type 581 for Field Service

   D. 1 - Type 585 for Field Service

   E. 4 - Type 82 dual trace preamps for above

   F. 2 - Type CA dual trace preamplifiers for 551

   G. 1 - Type CA dual trace preamp to augment our spare preamp supply

   H. 1 - Tek type 661 sampling oscilloscope for VHF, current drivers, and other high-speed-circuit engineering

   I. 1 - Type 4S1 dual trace 1 gigacycle preamplifier for 661

   J. 1 - Type 5T1A timing plug-in unit for 661

   K. 1 - Bruel & Kjaer meter for incoming inspection of passive two-terminal components

   L. 1 - Dynatran type 1803B transistor h-parameter tester including ICO test down to 10 nanoamperes

M. 1 - Hewlett Packard DC VTVM type 412A 1% accuracy for test equipment service and all other applications where high sensitivity, high accuracy DC measurements must be made

N. 1 - John Fluke type 821A DC potentiometric voltmeter ±0.01% for analog modules and systems and assorted other uses where potentiometric DC measurements must be made

O. 1 - Hewlett Packard audio oscillator type 200 CD for 10 cycle to 600 KC sinusoidal generation to bring our total to 3 for mag tape, production test, and general purpose audio and low RF frequency sinusoidal generation

2. Jim Cudmore reported that the new standards laboratory has had benches and electrical wiring ordered for it and will be ready by October 7.

3. Dave Dubay was asked to determine what modifications are available for our 581 and 585 Tektronix oscilloscopes and to order all applicable mod. kits and install them. These improvements include DC filaments for the 581's and improved triggering for all three oscilloscopes.

4. We received our 3 Epply Standard cells, (±0.01% certification) as a further step towards traceability.

5. We will buy 16 leather cases for the Triplett meters received for Jack Shields.

6. Jim Cudmore will order a storage cabinet for the storage of equipment in the new standards laboratory area.

7. We will borrow a Hewlett Packard type 1750A dual trace plug-in unit from the local rep. until the 4-trace plug-in we have ordered arrives, so all our HP 175A 'scopes will be dual trace.

8. A Hewlett Packard DC milliameter with clip-on probe has been available in Test Equipment Service for over a year, but is seldom used. It was originally ordered for computer In-Out equipment engineering but can measure 1 ma to 10 amps for anybody. It measures DC current easier and quicker than a VTVM measures voltage.

9. We agreed to explore further the possibility of installing elapsed time meters on our oscilloscopes and possibly on other periodically calibrated equipment as well, so as to determine the actual use between calibrations, both to eliminate unneeded calibrations and to insure that necessary calibrations are performed before equipment is used excessively. Estimated purchase and installation costs for each equipment are estimated at about $6.50 and $8. respectively for a 1000 hr. electrochemical elapsed-time meter.

dec INTEROFFICE MEMORANDUM

DATE October 9, 1963

SUBJECT PROPOSED ITINERARY FOR PDP-5 PULSE HEIGHT ANALYSER

TO K. Olsen
H. Anderson ✓
G. O'Dea
S. Olsen
N. Mazzarese
J. Fadiman
H. Painter
J. Jones

FROM Bill Farnham

Jon Fadiman has indicated the following itinerary for the PDP-5 Pulse Height Analyser:

November 12 - 21	MERSUCORA, Paris, France
November 23 - 29	CERN, Geneva, Switzerland
December 1 - 16	AEC, Harwell, Didcot, England
December 18	DEC, GmbH, Munich, Germany

John Jones has specified that the following equipment is involved:

(1)	PDP-5-4 4K Memory	27,000.
(1)	Display Type 34 with Tektronix Scope	3,900.
(1)	Nuclear Data 160F (Analog Digital Converter)	8,100.
(1)	Band - Power Supply, Model 318A	410.
(2)	Baird 812B Scintillation Probes	990.
(1)	Baird Soduim 22 Source	50.
(1)	Spare Parts Kit	1,500. (Est)

Due to export arrangements and the fact that we are dealing with the export-import regulations of five countries, if anyone can see any change to the above arrangements, it would be appreciated that they be brought to my attention.

Bill
Check above with John Leng.
Also cable itinerary to Brewster.
We should have advance publicity explaining what will be demonstrated and local arrangements made.
H. E. G.

dec INTEROFFICE MEMORANDUM

DATE October 7, 1963

SUBJECT Industrial Research Magazine

TO Jack Atwood

FROM Harlan E. Anderson

I read in Industrial Research Magazine recently that they plan to publish a directory of organizations that provide research type equipment. The deadline for being included in their categorical listings is November 1st. Would you investigate this further and make sure we get listed?

Harlan Anderson

HEA:ncs

We have completed and returned the necessary forms for the appropriate products.

Jack

H. Anderson

dec INTEROFFICE MEMORANDUM

DATE October 9, 1963

SUBJECT Software

TO Sales Personnel

FROM Jack Ridgeway

Potential customers that are evaluating DEC hardware systems continually have to be convinced that DEC computers will satisfy their system requirements, and that our instruction repertoires and programming aids are extensive enough to permit expedient program implementation.

In many instances to convince customers that our computers will satisfy their system requirements we will have to do a preliminary program design of their applications and with trial programming estimate instruction cycle time, storage requirement and necessary equipment configuration. In some situations actual codeing and checkout of portions of the program might be necessary to more quantitatively demonstrate fulfillment of requirements.

To impress customers with the relative ease of program implementation on our computers, we should know what software is available and how to use it as a programming aid, and we should know some programming techniques such as interrupt servicing, teletype conversion, usage of multiply and divide (EAE or subroutines), etc.

One way for individuals involved in computer sales to become more software oriented is to design, write, and implement a program. In the process you will gain programming experience and be introduced to the software systems and many programming techniques.

The programs written could be demonstration programs that would display the competence of our processors in various data processing areas (i.e. process control, physics applications, medical applications, etc.), they could demonstrate the use of the interrupt system, or they could be programs that perform tasks that are typical of our customers applications where some initial research and understanding of an applications would have to be undertaken before the program is written.

I will be available to assist in the program planning (possibly help decide on a program), help with the codeing, arrange for some tape punching service and machine time, and help with the debugging. So writing the program can be done on a part-time basis without neglecting sales efforts. The subject of software orientation will be discussed more extensively at our next sales meeting, however, I am available now for anyone who wants to get started.

dec INTEROFFICE MEMORANDUM

DATE October 7, 1963

SUBJECT Competition - PDP-5 - Technical Measurement Co. (TMC)

TO K. Olsen
H. Anderson
Engineering
Sales

FROM J. A. Jones - Sales

The following was taken from a Sales Call Report dated 9/26/63. It was felt that you should have access to this information.

"We went to see these people to find out the technical details of interfacing their ADC with our computers. We found out, but more important are some impressions we gained.

TMC is going to be the company to beat in the PHA game. They probably have one of the largest shares of the market and they don't intend to lose it. Dr. Stone made it quite clear that they would only cooperate with us if they thought our sales would not affect their own.

Since TMC has so much to lose (they have 300+ employees), they may well try to enter the computer market. My impression of them is such that I suggest we be most cautious with any information we give them. Also, they could conceivably try to hire away DEC employees. For these reasons, TMC employees should no longer be permitted within the manufacturing area of the plant.

We will interface TMC equipment with our own by request only."

dec INTEROFFICE MEMORANDUM

DATE October 7, 1963

SUBJECT

TO Stan Olsen
cc: Harlan Anderson

FROM Kenneth Olsen

I think it is a good idea to get modules cast in plastic and give them away for Christmas presents, but I think maybe we ought to hold off until we get some new modules. Then we could include a very short but well-written pitch which would say that we, like the Volkswagen, have carefully evaluated our modules and we designed different kinds but have come back to the same ones and made many not very obvious but very significant improvements such as new plugs and new sockets and also tell them about automation which allows us to lower the price or keep it the same when the price of semi-conductors have gone up.

KHO;jb

INTEROFFICE MEMORANDUM

DATE October 7, 1963

SUBJECT Overdue Computer Systems Options

TO Nick Mazzarese

FROM Bob Savell

cc: K. Olsen
H. Anderson
S. Olsen
R. Beckman

The modification to 31-B Display is not overdue. The system has been completely installed, the acceptance test sheet was signed and the original given to Bob Beckman on September 13, 1963. It was field installed by the Peripheral Equipment Department not by Bob Beckman.

The first item on page two, Symbol Generator 33 for CRC-OAL, EN-2542, was shipped from here according to our records on May 13, 1963 to be installed by Customer Relations. Hence, to the best of our knowledge, it has been installed and completely accepted since sometime in the middle of May.

The second last item on page 2, Perforated Tape Reader for Fort Meade, EN-2590: This entry should read Perforated Tape Reader and Spooler. This unit has never been sent back for replacement. It was due to be delivered to the customer on 8/16/63 and was indeed delivered late. It was accepted by Customer Relations on 9/26/63 retained by them for delivery to the customer.

Card Reader and Control, Ft. Meade, EN-2457: The due date as stated on the list is wrong. The correct date is 10/16/63. The unit is expected to be delivered on time.

I believe that covers all the entries that pertain to me.

INTEROFFICE MEMORANDUM

DATE October 7, 1963

SUBJECT New Pitch on Modules

TO Stan Olsen
Harlan Anderson

FROM Kenneth H. Olsen

We need a new gimmick to sell modules. I thought that the new design would be it, but as I get closer to it, it doesn't seem as practical as our present design. This is very good because it proves that what we have is really good.

However, we need something to make a splash. Here are a few ideas I have and maybe you might come up with something else.

We could have a 200 kc line.
We could have silicone units but they probably cost more.
A new book describing how you can do logic with just a small number of units so that anybody could pick it up and read it and think they understand the whole thing.

Russ Doane thinks he can do everything with the three modules. Well, this may be pushing it too far but the idea might be good.

We might have colored boards to add a little flash. Of course, we can always just lower the price and push down like mad. Another possibility, is do all of these things.

KHO:jb

INTEROFFICE MEMORANDUM

DATE October 4, 1963

SUBJECT Commercial Blanket Employee Dishonesty Insurance

TO Ken Olsen
Harlan Anderson

FROM R. Mills

Summary

After having received quotes from Liberty Mutual, Insurance Company of North America, Lumbermen's Mutual, Seaboard Surety, and Federal Insurance Company, we conclude that the Liberty Mutual net premium is the lowest.

Present Coverage

Dishonesty Blanket Position	-	$10,000
Burglary of Merchandise	-	$10,000
Theft of Merchandise	-	$10,000

Recommended Coverages

Commercial blanket employee dishonesty	$200,000
Money in securities on premises	5,000
Money in securities in transit	5,000
Depositors forgery coverage	200,000
Forgery of rail, air and automobile credit cards	10,000
Open stock burglary and theft	25,000

Explanations of Coverages

a. Commercial Blanket Employee Dishonesty 200,000

1. Of Money, Securities and other property through fraudulent or dishonest act or acts (including larceny, theft, embezzlement, forgery, misappropriation, wrongful abstraction or willful misapplication) committed by any of the Employees acting alone or in collusion with others.

b. Money and Securities on Premises 5,000

1. Of Money and Securities by the actual destruction, disappearance or wrongful abstraction thereof (including larceny, theft, burglary, robbery, hold-up, misplacement or damage) within the Premises or within the premises of any bank, trust company or similar recognized place of safe deposit or from within a night depository chute or safe into which such chute shall enter maintained by any bank or trust company.

b. Money and Securities on Premises (Continued)

Of other property by Safe Burglary or by Robbery within the Premises and for damage to other property by such Safe Burglary, Robbery or attempt thereat, and for damage to a locked cash drawer, cash box or cash register by from within the Premises, and for damage to the Premises by such Safe Burglary or Robbery or by or following burglarious entry into the Premises or attempt thereat.

c. Money and Securities in Transit 5,000

1. Of Money and Securities by the actual destruction, disappearance or wrongful abstraction thereof (including larceny, theft, burglary, robbery, hold-up, misplacement or damage) outside the Premises, while being conveyed by the Assured or a partner or Employee thereof or by an armored motor vehicle company or by any other person who is duly authorized by the Assured to have custody thereof (except while in the mail or with a carrier for hire other than an armored motor vehicle company) or while temporarily within the home of the Assured or a partner or Employee thereof or any such other person. Of other property by Robbery outside the Premises or attempt thereat or for damage to other property by such Robbery or attempt thereat while being conveyed by the Assured or a partner or Employee or armored motor vehicle company or by theft of such property while temporarily within the home of the assured or a partner or Employee.

d. Depositors Forgery Coverage 200,000

1. Caused by forgery or alteration of, on or in any check, draft, promissory note, bill of exchange, or similar written promise, order or direction to pay a sum certain in money, made or drawn by, or drawn upon or as a direction to the Assured or purporting to have been made or drawn as herein before set forth including (a) any check or draft made or drawn in the name of the Assured, payable to a fictitious payee and endorsed in the name of such fictitious payee, (b) any check or draft procured in a face-to-face transaction with the Assured or with one acting as agent of the Assured by anyone impersonating another and made or drawn payable to the one so impersonated and endorsed by anyone other than the one so impersonated and (c) any payroll check, payroll draft or payroll order made or drawn by the Assured payable to bearer as well as to a named payee and

d. Depositors Forgery Coverage (Continued)

endorsed by anyone other than the named payee without authority from such payee; whether or not any endorsement mentioned in sub-division (a), (b), or (c) of this paragraph be a forgery within the law of the place controlling the construction thereof.
Mechanically reproduced facsimile signatures are treated the same as handwritten signatures.
If the Assured or the Assured's bank of deposit, at the request of the Assured, shall refuse to pay any of the foregoing instruments made or drawn as hereinbefore set forth alleging that such instruments are forged or altered, and such refusal shall result in suit being brought against the Assured or bank or enforce such payment and the Company shall give its written consent to the defense of such suit, then any attorney's fees, court costs or similar legal expenses incurred and paid by the Assured or bank in such defense shall be construed to be a loss under this insuring clause, and the liability of the Company for such loss shall be in addition to any other liability under this insuring clause. If the Assured shall so request, the Company agrees to waive any rights (by subrogation orotherwise) against the bank upon which such an instrument shall be drawn; however, the Assured and such bank shall assign to the Company all of their rights against any other person, firm or corporation.

e. Forgery of Railroad, Airline and Automobile Rental Cards 10,000

1. Loss through forgery or alteration of, on or in any request for transportation required in connection with air or railway travel cards issued by or on behalf of an Airline or Railroad to the Insured or to any employee of the Insured.

f. Open Stock Burglary and Theft 25,000

1. Burglary or theft of inventory.

Formula for Development of Dishonesty and Forgery Coverage Exposure

5% of inventory value
20% of the difference between current assets in inventory value
10% of gross annual sales
Plotted on an exposure index table.

Current Status

This policy expired October 1 at midnight but we have requested Liberty Mutual to place a binder on this until we choose our carrier.

INTEROFFICE MEMORANDUM

DATE: 10/3/63

SUBJECT: Computer Systems Project Engineers

TO: K. Olsen
H. Anderson
S. Olsen
G. O'Dea
D. Mills
M. Sandler
D. Best
W. Hindle
G. Bell
D. Morse
J. Hastings
R. Wilson
P. Greene
G. Moore
S. Mikulski

FROM: N. Mazzarese

The following is a list of project engineers and the machine(s) that has been assigned to them.

Customer	Description	EN #	Engineer
Stanford University		2692	R. Wilson
System Development Corp.	ADX System	2596	D. Smith
Atomic Energy of Canada Ltd.	PDP-4 and PDP-5 Nuclear Reactor Control	2565 2566	P. Greene
BB&N - Cambridge	Hospital Project	2649	G. Moore
CRC-DSL		No P.O.	S. Mikulski
Atomic Energy of Canada Ltd.	Memory Switch Modification to PDP-1	2737	G. Moore

NM/jr

dec INTEROFFICE MEMORANDUM

DATE 10/2/63

SUBJECT Overdue Computer Systems and Options.

TO K. Olsen
H. Anderson ✓
S. Olsen
G. O'Dea
W. Hindle
D. Best
D. Hills
M. Sandler
R. Beckman
R. Savell
B. Stephenson
E. Harwood
J. Shields
D. Smith
J. McCalip
T. Stockebrand

FROM N. Mazzarese

The following is a list of overdue computer systems and options. The engineer responsible for the project's completion is indicated in each case.

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Delivery Expected	Engineer in Charge
Extended Arithmetic	1	JPL	2631	6/30/63	Entire P.O. still incomplete	1st half of October	R. Beckman
Multiplexer 133	1	JPL	2632	8/15/63	"	"	R. Beckman
Tape Unit Type 50	1	JPL	2634	8/15/63	Shipped waiting for acceptance	"	R. Beckman
Modif. to 31B display	1	MIT Lincoln	2603	6/30/63	Completed waiting for Beckman to field install	10/11/63	R. Savell
A to D	1	Raytheon	2662	9/5/63	Now installed & undergoing acceptance	1st half of October	B. Stephenson
Multiplexer	1	Wayland	2663	9/5/63			B. Stephenson
Switches	1		2664	9/5/63			B. Stephenson
PDP-1C-44	1	Information Internat'l	2644	7/30/63	Shipped accepted payment deferred until Dec. 30		E. Harwood
PDP-1C-42	1	Harvard University	2655	9/15/63	Waiting for acceptance	10/11/63	E. Harwood
Data Control 131	1	Harvard University	2659	9/15/63	Design Problems	10/11/63	E. Harwood
Mul. & Div. 10	1	CRC	2703	9/9/63	CRC running demonstration & asked DEC to hold off installation	10/11/63	J. Shields
Tape Unit Type 50	1	CSL	2716	9/24/63	Shipped but not accepted	9/30/63	J. Shields

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Delivery Expected	Engineer in Charge
Symbol Generator 33	1	CRC-OAL	2542	5/14/63	Not yet accepted	Sometime in October	R. Beckman
Memory 134	1	JPL	2712	9/25/63	Faulty Stack	Oct. 11, '63	R. Beckman
Teletype Line Units & Associated Logic	4	BBN	2469	2/15/63	superseded by EN 2602		D. Smith
Micro Tape 555	1	Ft. Meade	2609	8/15/63	Design Prob.	10/21/63	R. Beckman
Micro Tape C. 550	1	Ft. Meade	2604	8/15/63	" "	10/21/63	R. Beckman
Data Control 131	1	Univ. of Calif.	2524	6/30/63	Shipped not accepted - design prob.	11/13/63	R. Beckman
Tape Control 510	1	Univ. of Calif.	2525	6/30/63	"	11/1/63	R. Beckman
PDP-1C-36 & options	1	CRC-CSL	2472	5/23/63	A to D troubles Adage called in	11/3/63	E. Harwood
Perforated Tape Reader	1	Ft. Meade	2590	8/18/63	Sent back for replacement	10/11/63	R. Savell
Card Reader & Control	1	Ft. Meade	2457	9/16/63	Burroughs delivery	1st half of Oct.	R. Savell

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Delivery Expected	Engineer in Charge
16K Memory	1	Princeton	2554	9/15/63	6/30 Design Prob.	11/1/63	R. Beckman
Tape Control 510	1	Princeton	2558	9/15/63	6/30 "	10/21/63	R. Beckman
Data Control 131	1	Princeton	2559	9/15/63	6/30 "	10/21/63	R. Beckman
High Speed Channel Type 19	1	Princeton	2560	9/15/63	Waiting for Data Cont'l 131	10/21/63	R. Beckman
16K Memory	1	MIT, Lincoln Lab.	2506	9/1/63	Design Prob.	10/11/63	J. McCalip
Tape Control 510	1	MIT, Lincoln Lab.	2580	8/1/63	" "	10/11/63	R. Beckman
Data Control 131	1	MIT, Lincoln Lab.	2579	8/1/63	" "	10/11/63	R. Beckman
Data Speed Channel 19	1	MIT, Lincoln Lab.	2581	8/1/63	Waiting for Data Control 131	10/11/63	R. Beckman
Micro Tape Control 550	2	Kie	2594	7/20/63	Shipped not accepted Design Prob.	9/30/63	T. Stockebrand
Micro Tape Transport 555	6	Kie	2595	7/20/63	"	9/30/63	T. Stockebrand
8-bit Teletype Receivers	4	BBN	2602	7/8/63	Shipped not accepted - broken part	10/11/63	D. Smith

Item	Quantity	Customer	EN#	Orig. Due Date	Reason for Delay	Delivery Expected	Engineer in Charge
Mul. & Div. 10	1	AECL	2610	8/15/63	Shipped not accepted - Entire P.O. not complete	10/14/63	J. Shields
Micro Tape 555	3	AECL	2611	8/15/63	Training Checkout Personnel & Design Prob.	10/14/63	J. Shields
Micro Tape 550	1	AECL	2612	8/15/63	"	10/14/63	J. Shields
16 Channel Seq. Break	1	AECL	2613	8/15/63	Shipped not accepted - Entire P.O. not complete	10/14/63	J. Shields
Tape Control 57A	1	JPL	2627	8/15/63	Shipped not accepted - Design prob.	1st half of Oct.	R. Beckman
IBM Interface	1	JPL	2628	8/15/63	Shipped not accepted - Entire P.O. not complete	1st half of Oct.	R. Beckman
Spare Paper Tape Punch BPRE-11	1	Yale Univ.	2710	9/30/63	Lack of personnel	10/8/63	J. Shields
16K Memory	1	Yale Univ.	2551	10/1/63	Design Prob.	11/4/63	B. Beckman
Q-32 Interface	1	System Development Corp.	2614	7/22/63	Waiting for Interface acceptance	10/15/63	D. Smith
Line Units	56	"	2615	7/22/63	"	10/15/63	D. Smith

P. Anderson

INTEROFFICE MEMORANDUM

DATE October 2, 1963

SUBJECT Programming Conventions for PDP-6

TO PDP-6 List

FROM Harrison R. Morse III

On Friday, October 4, 1963 at 1 P.M., in Gordon's office, there will be a meeting of those interested in establishing conventions to be used when writing PDP-6 programs. This meeting will be primarily to determine in what areas conventions need to be established, and what.

HRM/nbh

INTEROFFICE MEMORANDUM

DATE October 2, 1963

SUBJECT Semiconductor Price List

TO All Sales Personnel, Engineering Personnel & Administration

FROM Bob Maxey & A. L. Fortin

H. Anderson ✓
K. Olsen
S. Olsen
N. Mazzarese
G. Bell
R. Best
A. Blumenthal
H. Crouse
D. Chin
R. Doane
E. Harwood
J. Richardson
J. Ridgeway
R. Hughes
R. Mills
R. Boisvert
R. Leonard
R. Savell
J. Rutschman
J. Shields
J. Koudela
P. Bonner
B. Beckman
J. Myers
A. Hall
B. Farnham
B. Towle
D. Smith
G. Rice
R. Lane
H. Painter
S. Mikulski
J. O'Connell
F. Gould
H. Ruderman
G. Moore
A. Titcomb
R. Wilson
J. Padiman
J. Jones
A. Ross
J. Long
R. Coleman, Los Angeles
W. Henton, " "
T. Johnson, " "
R. Oakley, " "
K. Larsen, San Francisco
J. Burley, Washington
D. Denniston, New York
G. Huewe, Munich, W. Germany
D. Doyle, Ottawa, Canada

All DEC Sales Offices (2 copies).

The attached list of Semiconductors has been updated. Please destroy all previous copies in your possession.

H. ANderson

SEMICONDUCTOR PRICE LIST
DIGITAL EQUIPMENT CORPORATION

NOTICE: Prices are subject to change without notice.

TRANSISTORS

NUMBER	REPLACEMENT TYPE & MANUFACTURER	PRICE
FSP24	FSP-24 Fairchild	$35.40
GA212	2N599 Tex. Inst.	3.08
MA89	2N2451 Sprague	4.85
MA90	2N2451 Sprague	4.85
MA90(R)	2N2451 with ices. 10uA 15V Sprague	4.85
MA90(BR)	2N2451 with ices and iecs 10uA @ 15V Sprague	4.85
MD93	2N2487 Sprague	4.85
MD94	2N2488 Sprague	2.95
MD95	2N2489 Sprague	3.65
MD109	2N2489 Sprague	3.65
2N1132	Motorola 2N1132	13.02
SDA-1	Obtainable from Digital	11.57
SDA-1(R)	Obtainable from Digital	11.57
SJ1071	SJ107 Tex. Inst.	.73
SP390	2N1719 with Special Rise Time Test Tex. Inst.	14.96
SW1250-3	SW1250 NAE	4.50
S1188A	S1188A Tex. Inst.	28.00
T1796	T1796 Tex. Inst.	4.88
2N398A	2N398A Motorola	1.30
2N456A	2N456A Tex. Inst.	2.60
2N457A	2N457A Tex. Inst.	3.30
2N522A	2N522A Gen. Inst.	1.35
2N598	2N598 Philco	2.55
2N656	2N656 Tex. Inst.	9.85

A. L. Fortin 10/1/63

Transistors

NUMBER	REPLACEMENT TYPE & MANUFACTURER	PRICE
2N711A	2N711A Tex. Inst.	$ 1.45
2N744	2N744 Tex. Inst.	8.25
2N813	2N813 Ray	6.87
2N835	2N835 Motorola	2.90
2N994	A selected 2N964A	3.67
2N1146A	2N1146A Clevite	4.70
2N1184	2N1184 RCA	2.48
2N1184B	2N1184B RCA	3.47
2N1204	2N1204 Motorola	6.38
2N1218	2N1218 Sylvania	7.50
2N1304	2N1304 Tex. Inst.	.61
2N1305	2N1305 Tex. Inst.	.61
2N1308	2N1308 Tex. Inst.	1.12
2N1309	2N1309 Tex. Inst.	1.12
2N1310	2N1310 Gen. Inst.	4.51
2N1494	2N1494 Motorola	6.83
2N1495	2N1495 Motorola	7.35
SF2506	SF2506 Motorola	18.00
2N1600	2N1600 Transitron	6.15
2N1613	2N1613 Fairchild	3.71
2N175A	2N175A Philco	1.35
2N2099	2N2099 Sprague	4.20
2N2218	2N2218 Motorola	5.85
2N2475	2N2475 RCA	6.19
4JX1C741	2N527 Gen. Elec.	1.91
16B-1	2N2713 Gen. Elec.	1.50
SF2507	SF2507 Motorola	24.00
2N1754(R)	2N175A with BVCES ≥ 40V @ 100 uA Philco	1.35

A. L. Fortin 10/1/63

Transistors

NUMBER	REPLACEMENT TYPE & MANUFACTURER	PRICE
2N1304(R)	2N1304 with VEC Spec. from Digital	$ .63
2N1305(R)	2N1305 with VEC Spec. from Digital	.63
2N2100	2N2100 Sprague	7.20
2N2219	2N2219 Motorola	6.75
3N76	NS-3033 - 1 thru 8 National Semiconductor	24.75
2N2714	2N2714 Gen. Elec.	1.65
2N2804	2N2804 Tex. Inst.	33.00
2N2904	2N2904 Motorola	11.00
SD4-4	SD4-4 Gen. Elec.	6.30
MD114	2N1754 Sprague	1.35

A. L. Fortin 10/1/63

DIGITAL EQUIPMENT CORPORATION

NOTICE: Prices are subject to change without notice

DIODES

NUMBER	REPLACEMENT TYPE & MANUFACTURER	PRICE
¼M6.8AZ5	¼M6.8AZ5 Motorola	$ 2.60
¼M8.2Z5	¼M8.2Z5 Motorola	4.00
6RS21SA2D2	6RS21SA2D2 Gen. Elec.	2.00
CRS20SP4B4	20SP4B4 Gen. Elec.	1.03
IN429	IN429 Transitron	5.70
IN469	IN469 Hoffman	3.75
IN469A	IN469A Hoffman	4.75
IN748	IN748 Transitron	2.00
IN748A	IN748A Transitron	2.80
IN750	IN750 Transitron	2.00
IN750A	IN750A Transitron	2.80
IN758A	IN758A Transitron	2.80
IN762	IN762 Transitron	2.00
IN764	IN764 Transitron	2.00
IN964A	IN964A Dickson	2.00
IN1315	IN1315 US Semcor	3.25
IN1875	IN1875 US Semcor	3.50
IN1982	IN1982 US Semcor	7.92
IN1998	IN1998 US Semcor	3.25
IN2175 (Photo Diode)	LS400 Tex. Inst.	11.50
IN2970B	IN2970B Motorola	6.05
IN2974B	IN2974B Motorola	7.60
IN2976B	IN2976B Motorola	7.60
LS400 (Photo Diode)	LS400 Tex. Inst.	13.50

A. L. Fortin 10/1/63

Diodes

NUMBER	REPLACEMENT TYPE & MANUFACTURER	PRICE
IN3156	IN3156 Motorola	$16.85
IN3316B	IN3316B Dickson	10.80
IN987B	IN987B Dickson	3.45
IN3496	IN3496 Transitron	19.00
D-001	IN276 Clevite	.64
D-003	IN994 National	1.75
D-007	Nat. Trans.	.18
D-662	IN645 Clevite Tex. Inst.	1.50
Q-5-100	Q-5-100 Int'l Diode Corp.	1.80
Q-6-100	Q-6-100 Int'l Diode Corp.	1.90
IN67A	IN67A Clevite	.60
IN91	IN91 Gen. Elec.	.85
IN270	IN270 Clevite	.50
IN1217	IN1217 Motorola	.68
IN1220	IN1220 Motorola	.60
IN1227	IN1227 Westing	1.25
IN1341	IN1341 Westing	1.79
IN3208	IN3208 Motorola	1.15
IN3209	IN3209 Motorola	1.30
IN3210	IN3210 Motorola	1.75
IN648	IN648 Clevite	1.95
D-664-3	IN3606 Gen. Elec.	2.90

A. L. Fortin 10/1/63

INTEROFFICE MEMORANDUM

DATE September 27, 1963

SUBJECT FIVE-YEAR SERVICE AWARDS

TO K. H. Olsen
H. E. Anderson
S. C. Olsen
W. R. Hindle
R. T. Lassen

FROM J. L. Atwood

I would like to suggest that the Five-Year Service Awards, which have finally been delivered, be presented at a series of buffet luncheons to be held semi-annually or quarterly - at least for the next three years. The type of luncheon I have in mind is similar to the annual stockholder buffet.

This approach, it seems to me, has several advantages:

1. It is more relaxed than a formal luncheon or dinner at the Company dining room.

2. On the other hand, it is sufficiently out of the ordinary to mark the presentation as a special occasion.

3. It presents an opportunity for casual conversation between management and employee and for very personal attention to be paid to each recipient.

4. It falls within the work day, so that neither the recipients nor the management representatives are likely to experience any conflict with personal plans.

5. It gives the recipients an excuse to dress for the occasion - to kings or queens for a day in their work areas.

6. The number of people involved would remain at a manageable level - at least through the first quarter of 1966. The distribution of recipients would be approximately as follows <u>if no one were to terminate:</u>

	<u>1st Qtr</u>	<u>2nd Qtr</u>	<u>3rd Qtr</u>	<u>4th Qtr</u>
1963			13	5
1964	8	8	6	1
1965	5	13	15	16
1966	14	30	36	42
1967	61	54	38	19 + 7*
1968	37	34 + 5*	71 + 1*	

*Ten-Year Award Recipients

HRA.

INTEROFFICE MEMORANDUM

DATE September 27, 1963

SUBJECT Proposed Wage Administration Policy--Hourly Employees

TO Works Committee FROM Bob Lassen

Attached is a proposed wage administration policy for Wage Class 1 and 2 employees (hourly - non-exempt). The policy outlines the ground rules for proposing changes in pay rates, job classifications and wage classes for all hourly employees during the annual review and also during interim periods.

We now have over 400 hourly employees, and it is becoming increasingly difficult to administer their wages in a fair and uniform manner. The proposed policy together with our job and wage class structure will primarily serve as a cost center manager's guide for consistent hourly wage administration.

September 26, 1963

WAGE ADMINISTRATION POLICY--WAGE CLASS 1 AND 2 EMPLOYEES

The normal time for the annual wage review for Wage Class 1 and 2 employees is July 1. Company policy considerations may make it necessary to change the normal date of the annual review; therefore, the actual review date will be confirmed at least a month in advance.

Annual Review Procedure

The Personnel Department will initiate the review by providing each cost center manager with necessary instructions and work sheets containing relevant information for conducting the annual review. This information will include the employee's previous quarterly merit scores, current job classification, wage class and pay rate. The work sheets will allow for equitable comparison with other Wage Class 1 and 2 employees in the department.

Each cost center manager will be responsible for reviewing the wage class and job classification of each Wage Class 1 and 2 employee in his department by carefully relating the appropriate job class and wage class descriptions to the employee's actual job responsibilities. Proposed changes in each employee's job classification, wage class, and pay rate must be submitted by the cost center manager in writing to the Personnel Department for review by the Personnel Committee and for subsequent management approval. (Appropriate forms will be provided for this purpose.)

The amount of the recommended increase should be determined first by the quality of the employee's work performance during the preceding year, using the quarterly merit scores as a guide, and secondly by the current rate range assigned to the employee's particular job classification.

The annual wage review for all technical Wage Class 1 and 2 employees will first be monitored by the Technician Review Committee and will then be submitted to the Personnel Committee.

The Personnel Department and the Personnel Committee will then review the combined results of the departmental reviews before submitting them for management approval.

Wage Increases Other than During the Annual Review

Wage Class 1 and 2 employees may be granted wage increases other than during the annual review only if:

a) the increase results from the 3-month review for new employees.

b) the increase results from the 2-month inter-departmental transfer review.

c) the employee's current pay rate is below the rate range assigned to his approved current job classification, and his work performance merits the increase.

d) the employee has shown exceptional work performance, and his current pay rate is below the maximum rate assigned to his job classification rate range. Recommendations for exceptional cases will be reviewed by the Personnel Committee.

All proposed changes in pay rates, job classifications, and wage classes must be submitted by the cost center manager to the Personnel Department on the appropriate forms supplied by the Personnel Office, and the reasons for the requested changes must be clearly stated.

INTEROFFICE MEMORANDUM

DATE September 27, 1963

SUBJECT Status of Linc Program

TO Ken Olsen
Harlan Anderson
Stan Olsen
Nick Mazzarese
Win Hindle
Ed De Castro

FROM Mort Ruderman

History to Date

The MIT Center Development Office module purchase order for the first 20 Linc computers was completed as of the middle of July. Also, Center Development Office is anticipating having six (6) to ten (10) more Lincs built before too long, and they have already ordered some of the modules and mounting panels for these systems.

I think it should be noted that DEC has performed better than most other suppliers in the Linc program. The people at Center Development are more than satisfied with the cooperation and the manner in which DEC was able to be of service. All deliveries were made in accordance with a predetermined schedule. DEC remained highly flexible regarding major changes in both types and quantities of modules. DEC was also very helpful in other areas: e.g. production people here at DEC were able to make useful suggestions as to the actual construction of the Linc, purchasing people were able to suggest vendors for various components and materials, a technician was at the Center Development Office for a week changing the jumpers on modules and advertising provided Linc users with schematic booklets of system modules. To make these Linc users even more aware of DEC Products, each users' package further contained literature such as, the catalogue PDP-5 brochure, one megacycle logic brochures and various brochures on DEC I/O equipment.

Other module sales have been made as a result of the Linc program and note should be made of these at this time. Each Linc computer has one console perunit, and this console has 8 blank Amphenol receptacles to allow connection of devices which are unique to the operator's system. A number of modules have already been ordered by Linc users for applications in this area. Staff people at the Center Development Office were, and are still doing work on peripheral equipment to be used with the Linc and more modules have been on order due to their efforts. Furthermore, other agencies and institutes who have applications and needs for Lincs and who also have the funds have placed orders for the full compliment of modules needed for the Linc.

In summary, DEC has performed extremely well and is continuing to do so with all concerned being most appreciative of this.

Future Sales

It is reasonable to assume that due to the above DEC will be asked to do any or all of the following: Supply Linc System Modules, build Linc Computers or sell PDP-4's and PDP-5's instead of Lincs to future customers.

Of the three above, the second area warrants particular consideration.

Against DEC marketing the Linc is the presence of the PDP-5 which can satisfactorily meet a portion of potential Linc users computing needs. Also, there is the PDP-4 which appears to be more powerful than the Linc for those people who need and can afford a larger computer. If it were to decide to market the Linc, DEC might want to do some redesigning and repackaging. This would essentially mean adding another computer which is in many ways similar to an existing product.

The principle argument for DEC to market the Linc is that the development is all done. Thus, it could be marketed exactly as it now exists. There appears to be a market for the Lincs, however, it is not exactly known how large the market for Linc computers is at this time. The below affords some indication of a marketing potential.

There were 75 proposals written to obtain Lincs through Center Development Office. Only 16 Lincs were awarded through Center Development Office. It is invalid to assume that all the people that were not awarded Lincs will necessarily buy Lincs. Indications are that not all of the original 75 applicants have sufficient funds available to purchase a computer.

The figure previously stated in paragraph 1 above of six (6) to ten (10) more Lincs is where the indication comes from. Six (6) of these Lincs are being independently financed and there very well could be more. Central Institute for the Deaf is independently building a Linc. Also, Lincoln Laboratory, National Institute of Health, and AFCRL, are also independently financing Lincs. To date at least 10 of the 30 Lincs are independent of MIT and NIH.

Pertinent facts regarding Linc pricing are as follows. I estimate that it is costing CDO approximately $32,000 for the Bill of Materials, wiring and assembly of one Linc system. This price includes DEC Modules after a 22% discount. Center Development Office

did not do the wiring or mechanical assembly but rather subcontracted this portion of the system. A preliminary pricing of the Linc has been done using the DEC Pricing Form, with Engineering development being amortized over 25 systems. Preliminary pricing of a Linc indicates that if DEC were to market the system, the selling price would be approximately $50,000.

Nevertheless, there is still a market present and the following are of primary consideration.

a) Potential customer feeling about using a PDP-4 or PDP-5 in liew of a Linc (the indication being that a majority would strongly desire purchasing a Linc as opposed to either building a Linc or purchasing a PDP).

b) Production cost of Linc compared to the selling price of Linc.

c) The PDP-5's ability to functionally compete with the Linc.

In summary, it is (my feeling) that a market for Linc computers definitely exists and that DEC would be wise to consider marketing as it presently exists, thus eliminating redesigning efforts.

The final decumentation of the Linc is now taking place. A meeting of potential manufacturers is tentatively scheduled for the end of November.

INTEROFFICE MEMORANDUM

DATE 9/26/63

SUBJECT DEC Type 50 Tape Transport
DEC Type 52 Tape Control Unit

TO Distribution

FROM R. L. Lepe

H. Mazzarese
S. Olsen
K. Olsen
H. Anderson ✓
R. Boisvert
D. Best
G. Bell
S. Lambert

Attached is a report prepared at ITT. The purpose of this report is twofold:

(1) Determine why ITT is having so many tape problems.

(2) Determine whether the units meet DEC specifications.

This report was sent to me personally and should not be discussed with ITT at this time. I recommend we pursue each point internally to determine what action might be taken. I am sure we will be confronted with these problems at some future date.

ITT Data & Information Systems Division

August 30, 1963

MEMORANDUM

TO: Mr. J. M. Kolb

FROM: S. Salzman SS
J. Panzitta J.P.

APPROVED: G. P. Panchak G.P.P.

SUBJECT: Review of ADX-Mod I Magnetic Tape System Specifications

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This report is intended to review the ADX-Mod I Magnetic Tape System specifications. It will point out a number of areas in which discrepancies exist between the specifications and actual hardware performance. Corrective measures which must be taken will be outlined.

It should be noted that this report does not cover the complete Tape System Evaluation Schedule submitted July 23, 1963. The items that are covered are listed below:

a.) Loading Specifications
b.) Hardware Location
c.) Control Delays
d.) Timing - Variations 0, 1, and 2
e.) Scatter Gather

LOADING SPECIFICATIONS:

The first item to be covered is the loading specifications. By loading specifications we mean the number of Tape Units (TU) which can be controlled by each Tape Control Unit (TCU) and the number of Tape Control Units that can be handled by each Multiplexed Message Processor (MMP).

According to our specifications, the maximum number of TU's which can be handled by a TCU is eight. This figure was initially obtained from Digital Equipment Corporation (DEC) specifications.

There is some question as to whether or not DEC has ever checked the system with 8 tape units on-line. This figure seems to stem from the fact that 8 unit select states are provided for in the TCU. There does exist a loading problem due to the excessive amount of cable required when hooking up 8 TU's. Since the Read Signals of each TU, per channel, are tied to a common point in the TCU, the Read Electronics of each TU will see its own cable plus the cables of the remaining TU's. The number of TU's which can be connected per TCU will depend upon the type of Read Amplifier being utilized. DEC has two types of Read Amps, the 1549 and 1536. It is recommended that for TU's using 1549 cards, that no more than 3 of these TU's be connected per TCU. No more than 6 TU's should be connected per TCU if they use 1536 cards.

The maximum number of TCU's which should be connected per MMP should be one. The limiting factor in this case is the loading presented to Memory Buffer Bit 10 of the MMP. This condition is a result of the design of the 4127 negative C-D inverter circuit which this output must drive. MB10 must drive more of the 4127 circuits than any other control signal of the MMP. Two TCU's can be connected to an MMP if an extra cable driver circuit (1685) is incorporated in the MMP. If an additional cable driver is incorporated for MB10, the maximum number of TCU's that can be hooked up to the MMP is two. The limiting factor then, is a programming restriction utilizing the Scatter Gather feature which will be covered later in the report.

HARDWARE LOCATION:

The problem area which exists related to the location of hardware are the location of the Read Electronics. The Read Electronics includes the Read Amplifier (1536 or 1549), Gatable Rectifier and Slicer (1542), and Peak Detector (1539). In the present system, the Read Amplifier, Rectifier and Slicer are located in the TU and the Peak Detectors in the TCU. There are 7 Peak Detectors, one for each channel of data on tape, and there are 7 Read Amplifiers and Slicers per TU. The read signal supplied to the TCU is a low level analog signal. Cable length becomes an important factor in keeping distortion and noise susceptibility to a minimum. If the loading specifications as described in the previous two paragraphs are followed, this present location of hardware is satisfactory. If we desire to use 8 TU's per TCU, it is st[illegible]y

recommended that the Peak Detectors be placed in each TU. This would allow us to supply the TCU with DC levels instead of analog signals. The driving capabilities of each TU would be increased. The noise susceptibility of the system would be decreased considerably. The modifications of the present system requires the addition of 3 Peak Detector (1539) cards, a Negative C-D Inverter (4127) card and a Cable Drive (1685) card in each TU. These cards would require an additional card rack.

Another area related to the Read Electronics, which has been troublesome, is the First-Bit-of-Character detection circuitry. Since a clock track is not recorded on tape, a circuit is required to generate a Read Strobe. This is accomplished by looking for a "1" bit in each character. By "or" gating the "set" output of the Read Buffers (7 bits) in the TCU, a read strobe is initiated for each character. Delaying this detection to allow the character to be dumped into the Data Word Buffer (18 bits), a reset pulse is generated to clear the Read Buffer. The Read Buffer is then ready to accept the next character of the word. The time between characters of the same word is 66.67 microseconds. The Read Buffers are cleared 25 microseconds after the first "1" bit of the character is detected. The Read Buffers are collector triggered by the output of a negative C-D Inverter (4127). This C-D gate is controlled by the outputs of the Peak Detectors. Because of collector triggering, the "set" input to these Buffers takes precedence over the "reset" input. If a "set" level is generated due to either noise picked up in the Read Electronics or possibly inter-record trash existing on tape, and this occurs at the same time as a initial reset pulse, the Read Buffers will not be reset. Since the inputs of the "or" gate for First-bit-of-character detection are taken at the output of the Read Buffers, the following data pulses will not generate any reset or strobe pulses. This will cause the TU selected to run away (pass tape without reading in each character). In order to eliminate this condition from occurring, one possible method could be the separate generation of the Read Strobe and reset pulses for the Read Buffers.

CONTROL DELAYS:

The TCU contains 23 control delays and the TU one. Four of these control delays have been changed from the original DEC specification. The delay changes have been picked up on ECR 00210. Delay card 1B2 in the TCU was changed from 2.5 milliseconds to 3.6 milliseconds. This delay generates part of the inter-record gap. It

was increased to assure a 3/4 inch gap for all tape operations and variations used by programmers. The worst case condition results when a read or forward space is followed by a write command. If this delay is not increased to 3.6 milliseconds, the inter-record gap generated will be less than 3/4 inch. A minimum inter-record gap of 3/4 is required for IBM compatibility. Another delay card which was changed is 1B18 in the TCU. It was changed from 4.6 milliseconds to 5.0 milliseconds. This delay generates part of the inter-record gap and precedes the initiation of stopping tape motion in Variations Ø and 1. The time that the longitudinal parity is written to the time the tape comes to a stop beyond the write head is 6.80 milliseconds. At this time, write enable is dropped. This represents approximately 0.5075 inches of tape that has been erased after writing the longitudinal parity. At the completion of a read, the time from sensing the longitudinal parity to the time tape stop is 2.68 milliseconds. This places the write head 0.4985 inches from the longitudinal parity marker. The position of the write head after a read operation is 0.5075-0.4985 or 9 mils before the spot where it would have been after the completion of a write operation. This distance of 9 mils is highly dependent upon mechanical adjustments. By increasing the delay of 1B18, this difference now becomes 39 mils. This setting makes some of the adjustments less critical. Delay card 1B19 in the TCU was changed from 3.0 milliseconds to 10.0 milliseconds. This delay was increased to assure that the pinch roller comes to rest before another tape command is initiated. This becomes a problem area when you have consecutive forward or reverse commands. Three milliseconds is not sufficient time to allow the pinch rollers to come to rest. This results in non-uniform inter-record gaps, some of which could be less than 3/4 inch. The fourth delay change was card 2G9 in the TU. This was changed from 3.0 to 4.0 milliseconds to assure that write current flows in the write heads for a sufficient period of time to erase the first part of the inter-record gap when tape motion is terminated.

The load point delays 1E1 and 1E2 are presently set at 50 milliseconds and 24 milliseconds respectively. According to EN-0315, these delays setting are not set to the optimum values. By optimum value is meant the minimum length of tape from load point which can not be utilized before recording or reading the first record. It is recommended that 1E1 be changed to 21 milliseconds and 1E2 to 42 milliseconds. These delay settings will disable the read lines for 42 milliseconds instead of 24 milliseconds. This

reduces the possibility of read in trash at the load point area of tape. The time that must elapse before writing the first record after load point is the sum of 1E1 and 1E2. This is presently 25+50 or 75 milliseconds. If the change recommended is incorporated, the sum would be 21+42 or 63 milliseconds. This will result in better tape utilization and still be IBM compatible.

TIMING VARIATIONS Ø, 1, and 2:

In reference to timing for Variations Ø, 1, and 2 there exist two areas which should be cleared up. These areas should be covered in the Programming Manual. When the TU unit selected is anything but zero, a Complete Tape Sequence (cts) instruction should not follow an Initiate Tape Sequence (its) instruction immediately. It is recommended that a (NOP) or any other one-cycle instruction be inserted between the its and cts instruction. This will allow you enough time to clear the Unit Select Register, set the Register to the proper unit desired and receive a ready signal back from the TU selected. This will allow the Local Tape Unit (LTU) register to be set prior to the cts instructions. A similar problem exists when an its immediately follows a cts instruction. A one cycle delay should be programmed to allow the TC sync. register to reset. Another area which should be cleared up in the Programming Manual concerns counting the number of records written in Variation 2. If the stop instruction is not programmed, which is normal in Variation 2, when the last record is written an inter-record gap is generated. Before tape does come to a stop, a second inter-record gap is generated immediately following the previous one. This means an additional complete pulse is obtained. If the Programmer counts the number of records he has written by the number of complete pulse he obtains, he will obviously count one more record than he actually wrote. If he now backspaces the number of records he thinks he has written, he will backspace past load point. This will result in tape going off the reel and removing power from the selected TU.

The Scatter Gather feature incorporated in the ADX-Mod I systems allows you to write data on tape from a number of locations in core which may not be sequentially located. It will also allow you to read data from tape and dump it into various locations in core. One troublesome area in connection with the Scatter Gather

feature exists on systems which utilize two TCU's per MMP. In order to utilize this feature on both TCU's very tight programming is necessary. This results from the high priority required to change the block parameters within the limited time available.

This investigation has led to the conclusion that the Mod I Tape System will function satisfactorily when the hardware limitations and program restrictions are recognized and observed.

Several hardware changes have already been initiated to guard against certain "worst case" conditions. Additional hardware changes can be made to improve the system and have it meet the loading specifications. The study has also uncovered some program restrictions which were not clearly defined.

Still remaining to be done is the broad area relating to the reliability and maintainability of the system. This includes evaluation of the mechanical components and adjustments, accelerated life testing, failure rate data, maintenance diagnostic program, and revised maintenance procedures based upon this work.

SS/JP:jg

dec INTEROFFICE MEMORANDUM

DATE September 24, 1963

SUBJECT Cost of Micro Tape Development.

TO K. Olsen
H. Anderson
E. Simeone

FROM R. Maxcy

The attached sheet gives the estimated and actual costs of micro tape development as of June 30, 1963. Pricing was based on the estimated cost.

Micro Tape Unit

Total Cost as of June 30, 1963

	Actual	Estimated
Labor:		
Engineers	14,804.78	7,780.00
Tech.	12,309.74	8,500.00
Overhead	31,270.41	22,280.00
Outside Contracts	1,268.52	4,000.00
Materials:		
Raw	7,842.91	—
Direct	9,942.01	—
Mfd. Parts	1,191.35	1,900.00
Finished Goods	2,801.39	—
Travel	4.64	—
Total:	81,435.75	44,460.00

File

INTEROFFICE MEMORANDUM

DATE: September 23, 1963

SUBJECT: Preliminary Information on The PDP-6 Programming Systems

TO: PDP-6 Group

FROM: Harrison R Morse III

This memo states the presently projected schedule for the large pieces of programming necessary to make up the basic PDP-6 Programming System. The people presently involved are Harris Hyman, Steve Piner and myself.

I will qualify this memo by stating that the estimates on the conservative side. Also, this memo contains only a brief description of each program. The preliminary specification of MACRO6 is now available. A preliminary specification of EXEC1 will be available on Wednesday. For the time being (until at least January 1) the PDP-4 FORTRAN Manual (available Monday) may be safely used as a specification for PDP-6 FORTRAN II, as we intend to be compatible at the FORTRAN II level.

SCHEDULE

The following schedule is based on the following considerations:

a) the basic computer will be available to being program checkout about November 1, 1963.

b) Microtape will be available by January 30, 1964.

c) protect mode will be available by January 30, 1964.

Assuming the above dates, the following target dates have been set:

Program	Usable	Complete
Assembler I	Nov. 15	Dec. 1
(Macro facility)	Dec. 1	March 1
EXEC1	Feb. 15	March 15
Debug	March 1	May 1
Editor	March 15	May 1
FORTRAN II System	May 1	July 1

The figures under the useable column indicate when each program becomes operational, and may be used by other than the author. The 'complete' date indicates the date on which work should terminate.

The preliminary specification of the basic Assembler is presently available under the name MACRO6.

Specifications for the FORTRAN II compiler will not be seperately available for some time. However, the language will include at least that available on PDP-4, with the addition of "EQUIVALENCE", and the PDP-4 FORTRAN Manual may be used as a reference manual for PDP-6 FORTRAN II.

The debugging program will not be specified until we become more familiar with the use of the PDP-6. However, it will have features which permit symbolic debugging, as do DDT-1 and DDT-4.

Similarly, the editor will be specified in detail later. Presently intended features include the ability to reference any program on the personal microtape by name; add, delete, change and examine lines of text by number or relation to other lines.

The editor will be an integral part of EXEC I, and service peripheral teletypes which a main program is running.

The initial EXECUTIVE program will have the ability to set up I/O transfers when requested by the running program, monitor programmed I/O to insure non-interference with running devices, and control a number of teletypes being used for microtape editing.

HRM/nbh

INTEROFFICE MEMORANDUM

SUBJECT: LIFE TESTS AND OTHER EQUIPMENT THAT IS TO BE LEFT RUNNING FOR EXTENDED PERIODS, AFTER HOURS AND SO FORTH

DATE: September 20, 1963

TO: All Engineers
K. Olsen
S. Olsen
H. Anderson
N. Mazzarese
M. Sandler
J. Smith
R. Maxcy
R. Maroney
K. Peirce
H. Crouse
W. Brackett
W. Hindle

FROM: Loren Prentice

Anyone running equipment on life tests or equipment that is to be left on overnight will post conspicuously, a sign in the vicinity of the equipment or appended thereto noting that the equipment is to be left on and notify the Pinkerton Guard on leaving the building that such equipment and its location is on life test or is to be left running for an extended period. Written notes must be signed.

cc: Pinkerton Guards

dec INTEROFFICE MEMORANDUM

DATE September 20, 1963

SUBJECT Status of Mag Tape Control 510 and Data Control 131

TO K. Olsen
H. Anderson
S. Olsen
N. Mazzarese
R. Beckman
J. Shields

FROM J. Smith

LRL (510-131)

This system is currently undergoing its final stages of checkout. Shipping date 9/23/63.

Lincoln Labs

1 - 510 2 - 131

Will start off-line checkout 9/23/63. Will be tied on to the computer on 10/7/63.

AEC Princeton (510-131)

Wiring 80% complete. Will be completed and delivered to off-line checkout on 10/7/63. Will be delivered to Customer Service on or before 10/21/63.

AEC Harvard (131)

Off-line checkout will begin 9/23/63. Installed on to the computer on 9/30/63.

Stanford (Modified 131)

Modification not received to date.

DEC Stock (131-510)

Wiring to be completed on 10/14/63.

INTEROFFICE MEMORANDUM

DATE: 9/20/63

SUBJECT: Microtape---PDP-5

TO: All Sales Personnel
PDP-5 Distribution List

FROM: Nick Mazzarese

Microtape is not presently available on PDP-5. A mistaken impression exists that PDP-4 Microtape prices can be quoted on PDP-5. THIS IS NOT TRUE.

A control is now being designed by Ed DeCastro and price information will be available by November 1, 1963.

NM/jr

Andy:

TO: H. Anderson
Stuart Grover
Alan Kotok
Gordon Bell
Bob Lane
Len Hantman
Programming Group

Attached is the first draft of a note which contains some random thoughts about PDP-6. These are not completely developed as yet, and the paper also lacks an intended final section.

There is certainly nothing sacred about the contents, and comments (both critical and extensional) should be freely made.

H. R. Morse III

PDP-6 Hardware Configurations, Corresponding Programming Systems and Machine Use.

1. Common Features

1.1 Hardware

1.1.1 Protect Mode

The Central Process will be able to operate in two modes: normal and protect. The protect mode permits an undebugged program to be run while the executive program is in memory with no fear of the undebugged program destroying any part of the executive. I/O commands given by the main program will be trapped so that the executive can insure none-conflicting use of I/O devices. The hardware will have two boundary registers which indicate the upper and lower core limits of the main program. When in protect mode any memory reference outside the bounded area of memory will trap to the executive program.

1.1.2 Desirable Hardware Features

It is extremely desirable to have no options in the central processor. The reasons for this from the production, checkout, design and software point of view are obvious. An additional desirable feature would be for each system to have the ability to be completely self-contained, i.e., need no support from any off-line equipment. The reasons for this are many fold, in particular it is generally true that the computer is its own best I/O Processor, if one can afford to perform I/O on-line.

1.1.2 Desirable Hardware Features (Cont'd)

Off-line equipment is by its very nature undesirable if the computer can perform the normal off-line functions in an economical way on-line.

The last reason for providing self-contained systems is that a user buying a minimum system not be required to provide off-line supporting equipment.

2.0 Minimum System

2.1 Configuration

2.1.1 Basic Equipment

Central processor, 16K memory, 1 type 33 teletype KSR, 1 dual micro-tape transport and control.

2.1.2 Peripheral Consoles

Additional consoles consisting of 1 dual micro-tape and 1 type 33 teletype. The equipment specified in 2.1.1 is sufficient for a usable computing system. The additional consoles are to replace off-line program preparation equipment.

2.2 Operation

2.2.1 Program Preparation

All program preparation will be done on-line in a simple time sharing mode. This implies that the supplied programming system will contain at least a text editor which works from micro-tape to teletype and teletype to micro-tape, and an executive program which will permit the "peripheral teletypes" to be serviced in a simple time sharing mode while the main program is running. Note particularly that the data rate of the teletypes is extremely slow compared to

2.2.1 Program Preparation (Cont'd)

the central processor speed, and the use of three or four teletypes simultaneously with the operation of main program will not significantly slow down the operation of the main program. It is this feature which makes using the central processor for tape preparation, simultaneous with the running of the main program, attractive

2,2.2 Systems

All systems program and the program library (symbolic and binary) will be stored on micro-tape. In addition all user's program will be on personal reels of micro-tape and each user may have a sufficient number of micro-tapes to contain the information he needs.

Distribution of DEC Systems will be on micro-tape rather than paper tape or punched cards.

2.3 Advantages

2.3.1 Self-contained System

The minimum system so specified is completely self-contained. That is, there is no need to have off-line peripheral gear such as key punches, teletype units, or card to tape equipment. If a printer were added to the system it would be advantageous to add it to the central processor rather than having off-line tape to printer station.

2.3.2 Program Preparation

The full capabilities of the PDP-6 are available for tape preparation. The editing function can be performed in a sophisiticated manner with the output on a device designed for rapid input to the computer.

2.3.3 Program Storage

All program texts will be on rapid access, compact and easily correctable micro-tape. One advantage of this is the elimination of the need to handle paper tape and punched cards. Another advantage is the elimination of tape (or card) readers and punches.

2.4 Disadvantages

The system must be specified, designed and programmed and workable to the customers. In this case, a computer system depends upon software, which is a somewhat touchy circumstance.

3. Large self-contained Systems

A large self-contained system could be defined as a system like that described in Section 2 with the additional feature that it may be advantageous, because of hardware configuration, to perform a program's I/O asynchronously with the operation of the program. In this case 'asynchronously' means that the final I/O operation may be performed well after the program has finished running.

The basic premise is that a computer has facilities to perform I/O more efficiently than special purpose devices, specially those which use magnetic tape for comminication. However, because of the relative speeds of magnetic tape, and devices which produce 'hard output' (line printers, card punches), it has been advantageous to record all output data on magnetic tape for later off-line processing, rather than tie up the computer waiting for a printer or card punch.

However, the actual computer time used during printing using a 1000 lpm printer on PDP-6 is less than 1 %. Consequently, if we could 1)stack output data, so as not to delay the main program.

2)print this later after the program has completed, still not disturbing the present main program.

3. Large self-contained Systems

then we should be able to perform I/O at least as satisfactorily as we could with magnetic tape and off-line stations.

We also have the possibility of performing I/O much better if we have a drum or disc available for output data stacking.

3.1 Configuration

The system will contain all equipment specified in Section 2.1 as well as at least one line printer and possibly large magnetic tape units. However, no off-line supporting hardware is required.

3.2 Operation

3.2.1 Program Preparation

Programs will be prepared in the same manner as the systems described in Section 2.

3.2.2 I/O Control System

The executive routine must have the ability to control and direct the I/O operations. This implies that there will be available to the programmer I/O commands such as the following:

Output data visual
Output data retrievable
Output data visual and retrievable

Associated with such commands must be a statements which specify what data, in what format, is to be output, and statements which specify how the data is to be labeled. The I/O routine would then perform the output operation. If the command were 'output visual' then the data will be printed directly on the line printer, if the printer were available. Otherwise, the data will be stacked on the active output tape (if we were using tape; a drum or disc file if we were using either of the latter) for printing when the printer becomes available.

3.2.2 I/O Control System

The executive I/O Control System would need to keep track of which tapes, drum tracks and/or disc tracks were being used for stacking the output data. It would need to switch from one to the other when the printing of one of the files was completed and that file became available for stacking output data. It would need to know that, for example, if some data were to be output in the 'visual and retrievable' mode, then it must be labeled and stored in such a way that the user could recall it at a later time, by name, and not need to know on what particular device the data were stored. There must also be commands available which allow the user to immediately print a message on-line.

4. Programming Systems

4.1 Users Needs

There are three basic types of users which will have contact with the PDP-6.

1) Systems programmers
2) Numerical problem solver
3) General problem solver

These three types of users have different needs when communicating their problem to the machine.

4.2 Systems programmer

The systems programmer usually needs to be in intimate contact with the machine, and must have available a language which accurately reflects the structure and organization of the computer.

In particular the ability to specify any machine command at any place in the program, and the ability to precisely specify the allocation of storage are necessary when building systems programs. Features which allow

4.2 (Cont'd)

such things as the placement of any "quantity" (such as (a) an octal number, (b) a decimal number, (c) the codes for a specified sequence of characters, and (d) and arbitrary part of an arbitrary "expression") in any specified part of a word are also necessary.

4.3 Numerical Problem Solver

This user requires the solution to a problem which is basically arithmetic (or algebriac) in nature. Since the computer is a tool to perform the computation, the closer the problem description (to the computer) can be to the original problem statement, the better this user is able to use the facilities available to him.

This user has no need (nor should he be so burdened) to become closely acquainted with the internal organization of the machine.

The general class of user under "numerical problem solver" can be serviced with a system such as FORTRAN. In addition, this class may be extended to include "logical problem solver", and a large portion of the class "general problem solver"by the use of a good ALGOL Compiler in place of FORTRAN.

4.4 General Problem Solver

The class includes those people who have problems which cannot be expressed well in the algebraic or algorithm languages, yet have problem which do not inherently relate the machine structure.

4.4 General Problem Solver (Cont'd)

In the past, these people have followed one of three paths:

a) Programmed in machine language, even though the detail available at that level did not necessarily facilitate the problem statement.

b) Programmed in FORTRAN, etc., even though it was sometimes excruciating to express the problem.

c) Developed special purpose languages to facilitate problem solution. Examples of this resulted in the development of COMIT, and DYNAMO, which are special purpose languages intended for research type programming in special and restricted areas.

As an aid to the user who falls in the last category, it would be to our advantage to develop a language which has the following properties:

1) There is a one-to-one correspondence between statements in the language, and machine language.

2) The language has an extensive facility to permit the user to define, and specify the meaning of symbols.

3) The commands in the language are simple to learn, use and read.

4) The processor is sophisticated enough to generate the proper instruction, as specified by the statement and the data names, and recognize any errors that arise.

5) The user has the ability to specify virtually any meaningful machine instruction.

6) Machine language is imbedded in the language.

7) The language has a fairly sophisticated I/O control facility.

8) The language has a structure which permits easy understanding of the meaning of statements in the language.

4.4 General Problem Solver (Cont'd)

The lineage of the language should be a very good assembler mated to a poor compiler. The fairly tricky problems of storage allocation, index register and accumulator assignments, and statement parsing are removed, while the trivial problems, such as realizing that a symbol cannot be indexed since it was defined as a simple storage location, may be handled automatically.

Briefly, the problems a compiler can handle simply, will be handled, while the more difficult ones are left to the programmer.

4.5 Summary

It is desirable to provide programming language for (a) the user who must commune with the machine intimately.

(b) The user who must deal with the machine on an instruction by instruction basis, but does not need to be aware of the lowest level of detail about the machine.

(c) The user who has no need nor desire to know any but the grossest level of detail about the machine.

Ideally, all three needs would be satisfied by one language; practically we will need 2 1/2 or 3 levels of language.

INTEROFFICE MEMORANDUM

H. Anderson

DATE: September 20, 1963

SUBJECT: PDP-5 Assembler Write-Up

TO: PDP Distribution List

FROM: John Koudela, Jr.

The attached PDP-5 Assembler Write-Up may be referred to as Operational, Revision A. Tapes for the Assembler that correspond to this Revision A Write-Up may be requested by the usual means from the Central PDP Program Library.

PDP-5 PROGRAM LIBRARY

NUMBER: DEC 5-1-S

NAME: PAL (Program Assembly Language for PDP-5)

AUTHOR: John Koudela, Jr. - DEC

DATE: August 1, 1963 (Revision A, September 20, 1963)

PURPOSE: Convert programs from symbolic language to machine language

PAL Programming Guide

(Program Assembly Lanugage for PDP-5)

Equipment Required

1. Basic PDP-5 with 1024- or 4096- words of core storage and a Control Console
2. Teletype Model ASR-33 consisting of:

    a) Typewriter (10 cps)
    b) Paper Tape Reader (10 cps)
    c) Paper Tape Punch (10 cps)

    (Note: This version of PAL will not operate with the optional Digitronics Model 2500 Paper Tape Reader and/or the Teletype Model BRPE-11 Paper Tape Punch)

General Procedure

Two-pass Assembler:

a) Input for pass 1 and 2: symbolic tape in Teletype 8-bit code
b) Output for pass 1: typeout symbol table and error indicators
c) Output for pass 2: punchout binary tape with origin settings and sum check

Language Details

1. Definition of Assembly Language Elements

    a) Character: any one of 26 letters, 10 numbers, 27 special characters and 6 non-printing characters (see Attachment I)
    b) Word: any one or combination of 2, 3, or 4 consecutive letters or numbers. Words may be symbolic (consisting of all letters or any combination of letters and numbers) or octal (consisting of octal numbers only)
    c) Symbol: a symbol is a special kind of word that specifically represents a memory address.
    d) Statement: any one or combination of words preceded and terminated by a Carriage Return Line Feed combination.

2. Character Groups: Their Use and Notation

a) Delimiters: terminate characters, words and statements (two or more consecutive delimiters are taken as one). The notation ⧽, ⧼, ⧻ will be used in examples in this write-up to indicate required key strokes for characters that do not print.

(1) Space (⧽ or S/P) character or word delimiter
(2) Carriage Return (⧼ or C/R) statement delimiter
(3) Line Feed (⧻ or L/F) must immediately follow a C/R for the statement to be properly delimited; it is <u>not</u> a delimiter by itself.

b) General Characters: form words

26 Letters
10 Numbers

c) Control Characters: guide assembly functions

Dollar Sign	($)	end of symbolic program
Minus Sign	(-)	address arithmetic; subtract the octal values of two words
Plus Sign	(+)	address arithmetic; add the octal values of two words
Period	(.)	Contents of current location counter
Asterisk	(*)	following symbol resets origin
Slash	(/)	initiates comment; comment terminated by C/R and L/F which also terminates statement
Letter i	(i)	Sets indirect address bit to 1
Letter z	(z)	Sets page bit to 0
Comma	(,)	Defines previous symbol as a tag (see below)

d) Special Characters: for paper tape editing and formatting:

Rub Out (R/O) all tape channels punched (377)
Leader-Trailer (L/T) only channel 8 punched (200)

e) Illegal Characters: the following characters will cause error halts in PAL (see section on error indicators in PAL):

Number Sign (#) Code 243
Percent (%) Code 245
At (@) Code 300
All codes less than 200

3. Content and Format of a Symbolic Program

a) A symbolic program is a series of statements (one per line) each of which is, in general, translated into 4 octal digits representing an absolute machine language instruction or constant.

b) Each statement consists of 6 fields not all of which need be used to form a valid statement:

Tag	Instruction	i	z	Address	Comment

c) A Tag is one symbol terminated by a comma. It represents the address of a memory location containing the instruction or constant that follows on the same line. A tag may consist of 1, 2, 3, or 4 Characters from the General Character Group (except that the letters i or z may not be used alone). Omission of a tag generally means that no other instruction in the program refers directly to the contents of this memory location. Tags cannot be represented by Symbols combined with plus or minus; cannot conflict with instruction mnemonics; and cannot be the only word on a line.

examples:		
	a,⌘	symbolic
	abcd,jmp⌘	symbolic
	8977,⌘	symbolic

d) An Instruction is normally one symbolic word terminated by a delimiter and specifically represents one of the machine language instructions defined in the Operation Table (see Attachment II) of the Assembler. An instruction always consists of 3 letters. Two or three instructions separated by spaces can be used and will be combined by the Assembler with an Inclusive-Or Subroutine (only the In-Out-Group and Operate-Group instructions can be so combined). Omission of an instruction generally means that this memory location contains a constant.

examples:		
	jmp⌘	jump
	krb⌘	read keyboard buffer
	cma⌘iac⌘	compl and index AC
	tad⌘⌘	2s compl add

e) An i is a Control Character terminated by a delimiter that directs the Assembler to set the indirect-bit of the instruction to one (thus the instruction specifies indirect addressing). Omission of an i causes the Assembler to set the indirect-bit to zero.

f) A z is a Control Character terminated by a delimiter that directs the Assembler to set the page-bit of the instruction to zero (thus the instruction specifies a reference to core-page zero). Omission of a z causes the Assembler to set the page-bit to one (thus the instruction specifies a reference to the current core-page).

g) An Address is normally one word terminated by a delimiter and represents the address of a memory location the contents of which is to be used as an operand. An address may consist of 1, 2, 3, or 4 characters from the General Character Group (except the letter i or z alone). An all-octal address is taken as a right-justified, absolute memory address. A statement may contain two or more addresses separated by plus or minus signs indicating that their octal values are to be combined by addition or subtraction. The Current Location Counter is a memory location in the Assembler, the contents of which specifies the absolute, octal memory address into which the statement currently being processed will be stored. The Current Location Counter may be specified as an address by writing a period (.). Omission of an address generally means that this memory location contains a constant or that the address part of the instruction is formed and inserted by other instructions in the program. Addresses cannot conflict with instruction mnemonics. Spaces before and after plus and minus signs are optional. If an address appears in a statement without an instruction, it is assigned as an absolute address (i.e., not as a page address as it is when an instruction also appears).

examples:

```
a⇩
abc⇩⇩
.+7⇩            location counter +7
abc+rstu⇩⇩
126⇩            octal (=0126)
a+b-6⇩
```

h) A Comment is any combination of any available characters (except L/F and C/R) occurring between a slash (/) and a C/R and L/F. Such a string of characters is ignored by the Assembler. Comments may continue for two or more lines as long as each comment-string begins with a slash and ends with a C/R and L/F.

examples:

```
/mask to save last 6 bits of AC⇩⇩
/calling sequence:  jms⇩subt⇩⇩
/                   (subtrahend)⇩⇩
/                   (return)⇩⇩
```

i) A statement may represent an instruction or a Constant. A constant may be tagged or untagged and may be formed in any one of the many ways an address is formed.

examples:
```
127+abc$
  .+mnp$
100+67¢£        octal (=0167)
     2$         octal (=0002)
mnp+.-4$
```

4. The Use of Control Characters

a) Dollar Sign ($) signifies the end of the symbolic program and causes the Assembler to terminate the pass in process. The Dollar Sign need not be delimited.

examples:
```
jmp$abc¢4
$
hlt¢£
$
```

b) Minus Sign (-) signifies address (or constant) arithmetic and causes the Assembler to subtract the octal values of two words. The Minus Sign need not be delimited.

examples:
```
jmp$abc$-4$
dca$.-177¢£
tad$rst$-mn98$
jmp$.-$3$
1777$-abc$
.-42$
```

c) Plus Sign (+) signifies address (or constant) arithmetic and causes the Assembler to add the octal values of two words. The Plus Sign need not be delimited.

d) Comma (,) defines the previous word as a tag and causes the Assembler to assign that tag the octal value found in the Current Location Counter. The Comma need not be delimited. A Tag cannot be the only word in a statement.

examples:
```
rst,and$mask$
ctr,$0¢£
temp,$.¢£
```

e) Period (.) refers to the Current Location Counter and causes the Assembler to use the contents of that counter as an address or constant. The Period need not be delimited.

examples:
```
jmp$.+2$
dca$abc$-.$
tad$.¢£
abc,$.¢£
```

f) Asterisk (*) defines the following symbol as an origin setting and causes the Assembler to reset the Current Location Counter. The Asterisk must not be delimited. An origin declaration must be an independent statement and may contain two or more words separated by plus or minus signs.

examples: *1200¢£
*abc+17¢£
*127¢£ (=0127)

g) Slash (/) initiates a comment and causes the Assembler to ignore all characters following the Slash until a C/R and L/F is found.

h) Letter i (i). The indirect address bit of an instruction is always set to zero unless an i is given. The i must be delimited.

examples: jmp$i$abc$
rst,i (=0400)

i) Letter z (z). The core-page bit of an instruction is always set to one unless a z is given. The z must be delimited.

examples: tad$z$mtr¢£
con1,z (=200)
jms$i$zabc

5. Notes about Indirect Addressing

a) It is single-step and adds 6 microseconds to the instruction access-execution time.

b) An instruction on any given core-page can indirectly address any memory location on the same page or on page zero.

c) When an instruction on any given core-page indirectly addresses one of the memory locations 10 through 17 (on page zero) the contents of that location is first indexed then used as the effective address.

d) When a memory location is indirectly addressed the full 12-bits contained in that location are used as the Effective Address (not just the address part).

6. Notes about Page Addressing

   a) An instruction on any given core-page can directly address any memory location on the same page or on page zero.

   b) Page addressing is simplified by using program sheets pre-numbered with page addresses; a set of 4 sheets represents one core-page:

Sheet 1:	page addresses	0- 37 (octal)
Sheet 2:	page addresses	40- 77 (octal)
Sheet 3:	page addresses	100-137 (octal)
Sheet 4:	page addresses	140-177 (octal)

7. Indirect and Page Addressing Examples

   a) Example 1 (A program begins on Page 1 at memory location beg and loads the Accumulator with the contents of location temp on Page 2).

```
Page 1                  Page 2
beg,cla                   .
    tad i abc             .
     .                    .
     .                 temp,XXXX
     .
abc,temp
```

   b) Example 2 (same as Example 1 except using Page 0)

```
Page 0        Page 1            Page 2
  .           beg,cla             .
  .               tad i z abc     .
  .             .
abc,temp        .               temp,XXXX
                .
                .
```

   c) Example 3 (same as Example 1 except using Auto-Indexing Register 10 on Page 0)

```
Page 0          Page 1                Page 2
  .             beg,cla                 .
  .                 tad i z 1Ø          .
  .               .
1Ø,temp-1         .                   temp,XXXX
                  .
```

Perforated Tape Formats

1. Symbolic Tape

   a) This is a tape that is produced by typing the Symbolic Program (written in assembler language) on a suitable tape typewriter such as a Flexowriter or Teletype ASR-33. This tape is processed by an assembler which, in turn, produces a Binary Tape (see below).

b) The symbolic tape read and processed by PAL must contain standard Teletype 8-bit codes. Such a tape can be directly produced on a Teletype ASR-33. A tape typewriter that generates any other kind of code can be used, but then the resulting symbolic tape must first be translated to Teletype 8-bit code before being processed by PAL. A PDP-5 can be programmed to accomplish such a translation.

c) The format of a symbolic tape is as follows:

(1) Leader: about 2 feet of Rub Out codes; see Symbolic Tape Preparation in section on Operating Procedures.
(2) Characters representing symbolic program.
(3) Trailer: Same as leader.

d) Rub Out codes can occur anywhere in the symbolic tape and are ignored by PAL.

e) Two or more consecutive delimiters are taken as one. Spaces, line feeds, and carriage returns may, therefore, be used to format for type-in and print-out.

f) A statement must be terminated by a Carriage Return immediately followed by a Line Feed. The absence of a Line Feed results in an error print-out. Line Feeds alone are not delimiters. Two or more Line Feeds can follow a C/R for formatting purposes, but otherwise should never occur. A statement will not be delimited if it ends with the sequence $CL.

2. Binary Tape

a) This is a Tape that is produced by the Assembler and represents the absolute, machine language version (object program) of the symbolic program (source program).

b) The format of a binary tape is as follows:

(1) Leader: about 2 feet of Leader-Trailer codes.
(2) Characters representing the absolute, machine language program in easy-to-read binary (or octal) form. This section of tape may contain characters representing instructions (Channels 8 and 7 not punched) or origin resettings (Channel 8 not punched; Channel 7 punched) and is concluded by 2 characters (Channels 8 and 7 not punched) that represent a "check-sum" for the entire section.

(3) Trailer: same as leader

c) Example of the format of a binary tape:

Tape Channel	Memory Location	Contents
87654S321		
10000.000	Leader-Trailer Code	
01000.010		
00000.000	origin setting of 0200	
00111.010		
00000.000	0200	cla
00001.010		
00111.111	0201	tad 277
00011.010		
00111.110	0202	dca 276
00111.100		
00000.010	0203	hlt
01000.010		
00111.111	origin setting of 0277	
00000.000		
00101.011	0277	0053
00001.000		
00000.111	sum check 1007	
10000.000	Lead-Trailer Code	

Symbol Table

The symbol table is printed at the end of pass 1. It consists of the list of unique symbolic tags and addresses used in the symbolic program together with their corresponding absolute addresses (in octal) as assigned by PAL.

1. Tags must be unique; duplicate Tags are in error and noted in the printout by the letters dt (duplicate tag).

2. Each address must refer to a tag; if such a tag does not exist, the address is said to be undefined and is noted in the printout by the letters ua (undefined address).

3. Example of the format of a symbol table printout:

Symbol	Abs. Addr.
mask	1277
ctr	742
a27	22
next	ua

1. Symbolic tape preparation using the ASR-33
(see Attachment III for diagram of ASR-33)

(a) Turn the Line Switch to Off-Line to disconnect the ASR-33 from the PDP-5.
(b) Turn the Power Switch On.
(c) Check quantity and positioning of typewriter paper and paper tape for the punch.
(d) Press the Punch On Button.
(e) Generate about 2 feet of Rub Out codes for leader by first pressing and holding down the Rept key and then pressing down the Rub Out key once; continue to hold down the Rept key until the necessary amount of leader has been generated.
(f) Type the Symbolic program.
(g) Generate about 2 feet of Rub Out codes for trailer.
(h) Tear-off tape on cutting edge of punch output slot.
(i) Verify tape as follows (suggested procedure):

(1) Turn Reader Switch to Free
(2) Place tape in Reader
(3) Press Punch Off Button (so the tape read is not duplicated)
(4) Turn Reader Switch to Start
(5) The entire contents of the tape is printed for visual verification and the reader stops automatically at the end of the tape.

2. Symbolic tape editing using the ASR-33

(a) An incorrect character may be typed while preparing the symbolic tape. Use the following procedure to correct the tape: (the error is detected N characters after typing the incorrect character) press the Punch B.SP. Button N+1 times to backspace N+1 characters, press the Rub Out key N+1 times, and continue.

(b) Characters, words, or statements can be inserted or deleted after the entire symbolic tape has been prepared. Use the following procedures to accomplish such changes:

(1) Insertions: duplicate the tape up to the point at which it is desired to make an insertion (by turning the punch on, placing the tape in the reader, starting the reader, and stopping the reader with the reader switch using the printout as a guide). Next, type the insertion. Continue by pressing the reader switch to start and duplicate the remainder of the tape.

(2) Deletions: duplicate the tape up to the point at which it is desired to make a deletion (see Insertions). Next, turn the punch off, start the reader, and using the printout of the information to be deleted as a guide, stop the reader. Continue by turning the punch on and starting the reader to duplicate the remainder of the tape.

3. How to assemble a program with PAL

(a) Computer: turn on computer power; turn off Single Step and Single Instruction switches.

(b) ASR-33: turn on power; turn on line switch to connect ASR-33 to PDP-5; turn off punch; set reader switch to Free.

(c) Paper: check quantity and positioning of typewriter paper and paper tape for the punch.

(d) Set the PAL program Tape into the reader and set the reader switch to Stop.

(e) Check that the so-called RIM Loader (see Attachment IV) is, as it always should be, stored in locations 20 through 40.

(f) Load PAL: set Switch Register (SR) to 0020; press Load Address, then Start. Start the reader. When the entire tape has been read-in, the reader will automatically stop, the Console Run light will be off, and the Accumulator will contain 0200. (This is the Starting Address, SA, of PAL) If the loading process ends with other than 0200 in the AC see "Error Indicators in PAL" at the end of this section.

(g) Set the Symbolic tape of the program to be assembled into the reader.

(h) Set Switch Register (SR) to specify the assembly pass number and the page-number origin as follows:

(1) SR bits 0-1 specify pass 1 or 2. (these bits must be set before starting each pass; in this way, passes can be repeated or omitted if necessary; if these bits equal zero or three, PAL will respond with an error indicator)

(2) SR bits 7-11 may specify a page-number origin (for a 1024-word PDP-5 set these bits for one of the pages 1 through 7; for a 4096-word PDP-5 set these bits for one of the pages 1 through 37; if these bits equal zero, the origins will be taken from the Symbolic tape; origins on tape specifying page zero cause PAL to ignore these

bits; all page-number origins on tape, except the first one, are incremented or decremented by the difference between the first page-number origin on tape and the SR bits 7-11; thus, the same relative positioning of program segments is retained.)

(3) Note that an absolute-address origin on tape in effect consists of a page-number origin and a page-address origin. The latter is always taken from tape; SR bits 7-11 only effect the page-number origin.

(4) If SR bits 7-11 are zero and no origins exist on tape, PAL will assume an origin of 0200.

(i) For pass 1 turn punch off; for pass 2 turn punch on.

(j) Press Continue, wait for the program to get to the reader wait loop (in pass 2, leader will be punched before the program gets to the reader wait loop), then start reader to process the specified pass.

(k) Repeat steps g, h, i, and j for each pass.

4. Error Indicators in PAL

(a) After loading PAL itself, if the AC is not 0200, a sum check error has occurred (the computed sum check is in the AC); try loading again.

(b) The following errors cause the indicated printouts:

(1) ST (then halt): Symbol Table full; use less symbols by using more address arithmetic or divide program into several small segments and assemble each separately (PAL is set for a 1K PDP-5 which allows for 60 (decimal) symbols each occupying 3 words from 1513 through 1776 (octal)). The location sful (at location 141 absolute) contains 1777 which limits the size of the symbol table. On a 4K PDP-5 sful can manually be changed to 7776 to serve as the upper limit of the table. The printout ST may also indicate Memory Limit (i.e., an attempt has been made to store an assembled statement in Location 2000 in a 1K PDP-5 or Location 0000 in a 4K PDP-5). Location mlim at 133 absolute is set to 2000 in PAL and may be changed manually to 0000 for a 4K PDP-5.

(2) DT¢Z (and Halt): Duplicate Tag.=

(3) UA¢Z (and continue printing symbol table): Undefined Address.

(4) LF (then halt): No Line Feed code immediately following a Carriage Return code.

(c) The following errors cause computer hangup:

(1) paper tape ran-out of reader: reader stops automatically and computer continues to look for a character (e.g., dollar sign not found at end of symbolic tape)

(2) trying to read paper tape with the reader switch in the stop or free position; generally a normal condition: press start reader.

(3) trying to input or output with ASR-33 power switch or line switch off.

(d) The following errors can only be visually detected:

(1) paper tape ran-out of punch; it keeps trying to punch.

(2) trying to punch tape with punch off when punching is desired; computer hangup if trying to punch binary tape; printout only if trying to punch ASR-33 8-bit codes.

(e) Illegal Character codes are 243(#), 245(%), 300 (@) and all codes less than 200. If any one of these is read by PAL, it will be displayed in the AC and the computer will halt at absolute address 1237.

Useful Mechanical Details

1. General Storage Allocation for PAL

Page	Abs. Addresses	Contents
0	0	Program Counter
	1-7	Reserved for Interrupt
	10-17	Auto-Indexing Registers
	20-40	RIM Loader
	41-177	Common Constants
1	200-377	Main PAL Routines ($687_{10}=1257_8$ Locations)
2	400-577	
3	600-777	
4	1000-1177	
5	1200-1317	
5	1320-1377	Operation Table ($123_{10}=173_8$ Locations; 41_{10} Operations)
6	1400-1512	
6	1513-1577	Symbol Table ($181_{10}=265_8$ Locations; 60_{10} Symbols)
7	1600-1777	

2. Notes about Octal Addresses

(a) The following table defines the PDP-5 memory organization:

	1K Mem	4K Mem
Page Nos. (oct)	0-7	0-37
No. of Pages (dec)	8	32
Page Addresses (oct)	0-177	0-177
No. of Locations per Page (dec)	128	128
Absolute Addresses (oct)	0-1777	0-7777
No. of Locations per Memory (dec)	1024	4096

(b) The relations between page numbers, page addresses, and absolute addresses may be useful in coordinating work with program sheets and the Computer Control Console:

(1) Bits 0-4 (taken as an integer) of a 12-bit absolute address is the page number.

(2) Bits 5-11 (taken as an integer) of a 12-bit absolute address is the page address.

(3) Given an octal page number and page address, find the octal absolute address:

	Page No.	Page Addr.
Octal	26	012
Binary	010 110	000 001 010
Drop First	10 110	
Drop first two		0 001 010
Rewrite	101 100 001 010	
Octal Abs.	5412	

3. ASR-33 8-bit Character Code Trimming and Packing

(a) Normally, 8-bit Characters are trimmed to 6-bits (the 6 least significant) and stored two per word.

(b) The L/F and C/R codes are specially treated:

(1) L/F Code 212 is forced to 43 thus rendering the # Character illegal since its code, 243, trimmed would be 43.

(2) C/R code 215 is forced to 45 thus rendering the % character illegal since its code, 245, trimmed would be 45.

(c) Deletes and Blanks appear to present problems, but are handled as follows:

(1) Delete code 377 if trimmed would be 77; the ? character, code 277, when trimmed is 77. Delete codes, however, are never trimmed and stored, but occur only in the off-line tape preparation procedure. Deletes are filtered-out when read as input to PAL.

(2) The use of a Blank Character for which the code would be 000 is prohibited. Note that the @ Character, code 300, when trimmed is 00. The @ Character is illegal since 00 is used by PAL to define the end of variable length symbols.

Attachment I

ASR-33 8-Bit Character Set

Character	8-Bit Code (in Octal)	6-Bit Trimmed (in octal)	Remarks
A	301	01	All letters
B	302	02	print as
C	303	03	capitals only
D	304	04	
E	305	05	
F	306	06	
G	307	07	
H	310	10	
I	311	11	
J	312	12	
K	313	13	
L	314	14	
M	315	15	
N	316	16	
O	317	17	
P	320	20	
Q	321	21	
R	322	22	
S	323	23	
T	324	24	
U	325	25	
V	326	26	
W	327	27	
X	330	30	
Y	331	31	
Z	332	32	
ø	260	60	
1	261	61	
2	262	62	
3	263	63	
4	264	64	
5	265	65	
6	266	66	
7	267	67	
8	270	70	
9	271	71	

Attachment I (Continued)

Character	8-Bit Code (in octal)	6-Bit Trimmed (in octal)	Remarks
!	241	41	Hold Shift Key
"	242	42	Hold Shift Key
#	243	43	Illegal in PAL
$	244	44	Hold Shift Key
%	245	45	Illegal in PAL
&	246	46	Hold Shift Key
'	247	47	Hold Shift Key
(	250	50	Hold Shift Key
)	251	51	Hold Shift Key
*	252	52	Hold Shift Key
+	253	53	Hold Shift Key
,	254	54	No Shift
-	255	55	No Shift
.	256	56	No Shift
/	257	57	No Shift
:	272	72	No Shift
;	273	73	No Shift
<	274	74	Hold Shift Key
=	275	75	Hold Shift Key
>	276	76	Hold Shift Key
?	277	77	Hold Shift Key
@	300	00	Illegal in PAL
[	333	33	Hold Shift Key
\	334	34	Hold Shift Key
↑	335	35	Hold Shift Key
←	336	36	Hold Shift Key
	337	37	Hold Shift Key
Leader/Trailer	200	Never Trimmed	Computer output only
Line Feed	212	43	Forced conversion
Carriage Return	215	45	Forced conversion
Space	240	40	OK
Rub-Out	377	Never Trimmed	Filtered-out
Blank	000	Never Trimmed	Illegal in PAL

(All Characters less than 200 are illegal in PAL)

Attachment II

PAL Operation Table

and	0000	Logical And
tad	1000	Two's Complement Add
isz	2000	Index and Skip if Zero
dca	3000	Deposit and Clear AC
jms	4000	Jump to Subroutine
jmp	5000	Jump
iot	6000	In-Out Transfer
opr	7000	
nop	7000	No Operation
cla	7200	Clear AC
cll	7100	Clear Link
cma	7040	Complement AC
cml	7020	Complement Link
rar	7010	Rotate AC and Link Right One
ral	7004	Rotate AC and Link Left One
rtr	7012	Rotate AC and Link Right Two
rtl	7006	Rotate AC and Link Left Two
iac	7001	Index AC
sma	7500	Skip on Minus AC
sza	7440	Skip on Zero AC
spa	7510	Skip on Plus AC
sna	7450	Skip on Non-Zero AC
snl	7420	Skip on Non-Zero Link
szl	7430	Skip on Zero Link
osr	7404	Inclusive or Switch Register to AC
hlt	7402	Halt
ion	6001	Turn Interrupt On
iof	6002	Turn Interrupt Off
ksf	6031	Skip if Keyboard-Reader Flag =1
kcc	6032	Clear AC and Keyboard=Reader Flag
krs	6034	Read Keyboard-Reader Buffer, Static
krb	6036	Clear AC, Read Keyboard Buffer
		Clear Keyboard Flag

tsf	6041	Skip if Teleprinter-Punch Flag =1
tcf	6042	Clear Teleprinter-Punch Flag
tpc	6044	Load Teleprinter-Punch Buffer, select and print
tls	6046	Load Teleprinter-Punch Buffer, select and print, and Clear Teleprinter-Punch Flag
cia	7041	Complement and Index AC
las	7604	Load AC with Switch Register
stl	7120	Set Link (to one)
glk	7204	Get Link (put in AC bit 11)
skp	7410	Skip Unconditionally

Attachment III

Functional Representation of ASR-33

PAPER TAPE SUPPLY

Punch Buttons

REL. Release to remove tape

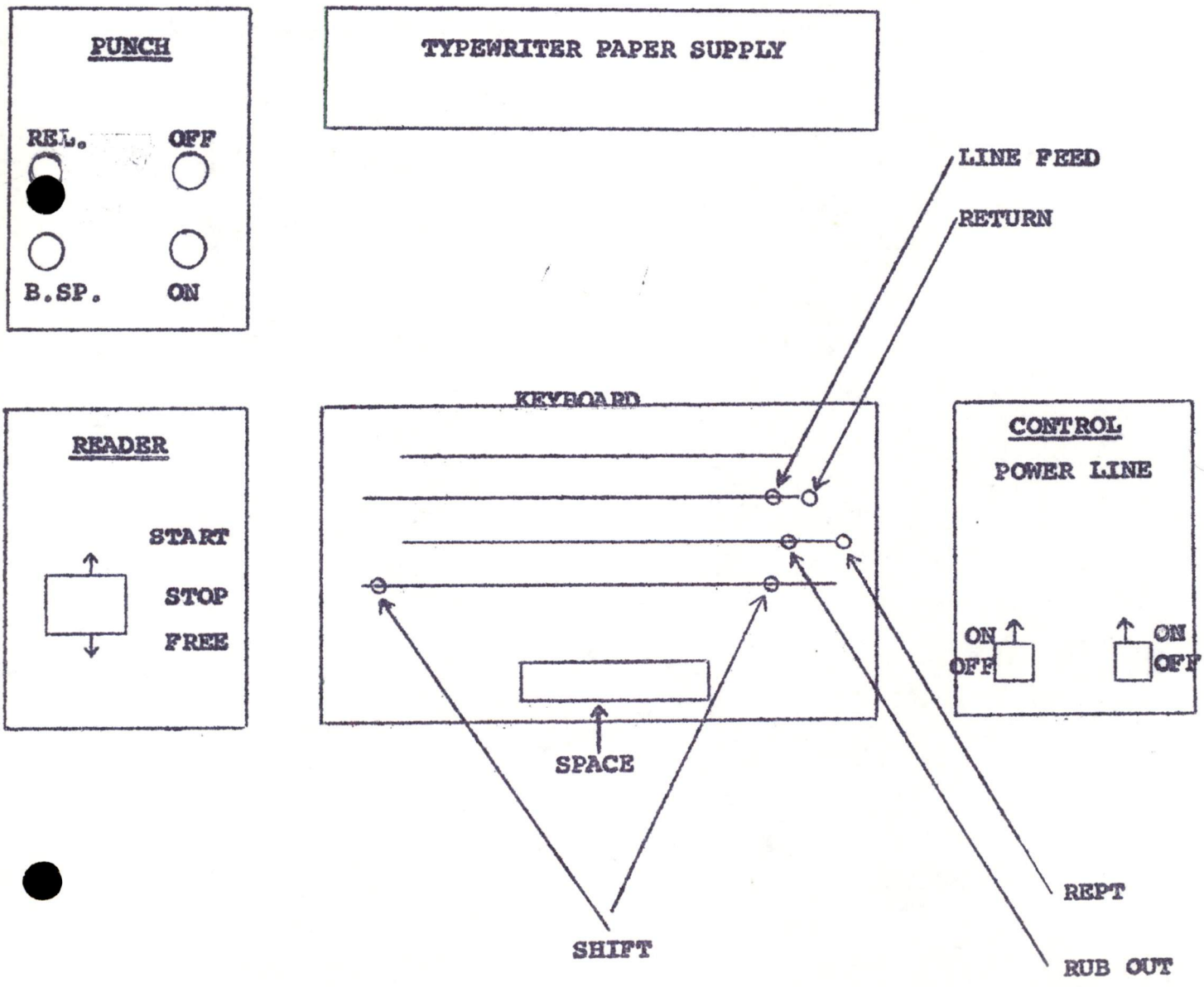
B.SP. Backspace one character

Reader Switch

FREE Free-wheeling to set and remove tape

Control Switches

LINE On-Line, Off-Line to connect or disconnect to PDP-5



Attachment IV

RIM and BIN Paper Tape Loaders

1. RIM Loader (Read-In-Mode Loader)

a) The RIM Loader is a minimum-length, basic paper tape loader for the PDP-5. It is initially stored in memory by way of the Control Console switches. Once stored, it is considered to be a permanent occupant of locations 20 through 40 (absolute octal addresses) and care should be taken to keep it from being destroyed.

b) A paper tape to be read-in by the RIM Loader must be in RIM format:

Tape Channel

8 7 6 5 4 S 3 2 1	
1 0 0 0 0 . 0 0 0	Leader-Trailer Code
0 1 A1 . A2	Absolute Address to
0 0 A3 . A4	contain next 4 digits
0 0 X1 . X2	Contents of previous
0 0 X3 . X4	4-digit address
0 1 A1 . A2	Address
0 0 A3 . A4	
0 0 X1 . X2	Contents
0 0 X3 . X4	
(ETC.)	(ETC.)
1 0 0 0 0 . 0 0	Leader-Trailer Code

c) A tape in RIM format is generally concluded with Address = 0000 and Content = SA-1. In this way, the starting address (SA) of the routine just loaded is stored into the Program Counter of the PDP-5. The next instruction to be executed will then be taken from the SA, (i.e., the Program Counter is indexed first, then the instruction is accessed). Therefore, the loaded routine can be said to be self-starting. It is suggested that this procedure always be used. If it is not desirable for the routine to be self-starting, simply store a halt instruction in the SA. Pressing Continue could then start the routine.

d) The RIM Loader can only be used in conjunction with the ASR-33, 10cps reader (not the optional Digitronics Model 2500, 300cps reader). Because a tape in RIM format is, in effect, twice as long as it need be, it is suggested that the RIM Loader only be used to read-in the BIN Loader when using the ASR-33 (see Item 2 of this Attachment).

e) The complete PDP-5 RIM Loader (SA=20) is as follows:

Abs. Addr.	Octal Contents	Tag	Instn i z	Addr.	Comments
20,	6032	beg,	rcc		/clear AC and Flag
21,	6031		rsf		/skip if Flag=1
22,	5221		jmp .-1		/looking for Char
23,	6036		rrb		/read buffer
24,	7106		cll rtl		
25,	7006		rtl		/ch 8 in ACØ
26,	7510		spa		/checking for leader
27,	5221		jmp beg +1		/found leader
30,	7006		rtl		/OK, ch 7 in Link
31,	6031		rsf		
32,	5231		jmp .-1		
33,	6034		rrs		/read, do not clear
34,	7420		snl		/checking for address
35,	3640		dca i temp		/store contents
36,	3240		dca temp		/store address
37,	5220		jmp beg		/next word
40,		temp,	.		/temp storage

f) Placing the RIM Loader in memory by way of the Control Console switches is accomplished as follows:

(1) Set 0020 in the Switch Register (SR)
(2) Press Load Address
(3) Set the first instruction in the SR
(4) Press Deposit
(5) Set the next instruction in the SR
(6) Press Deposit
(7) Repeat steps (5) and (6) until all 16 instructions have been deposited (it is not necessary to deposit anything in 0040).

g) To load a tape in RIM format, place the tape in the reader, set the SR to 0020, press Load Address, press Start, and Start Reader.

2. BIN Loader (Binary Loader)

a) The BIN Loader is used to read-in the machine language tapes (in binary format) produced by PAL. A binary formatted tape is about one half the length of a comparable RIM formatted tape. It can, therefore, be read-in about twice as fast as a RIM tape and is, for this reason, the more desirable format to use with the 10cps ASR-33 reader.

b) The format of BIN tapes has been described (see pages 8 and 9).

c) After a BIN tape has been read-in, one of the two following conditions exist:

(1) No check sum error: halt with AC=0
(2) Check sum error: halt with AC=(computed check sum) - (tape ck sum)

d) The BIN Loader in no way depends upon or uses the RIM Loader.

e) To load a tape in BIN format, place the tape in the reader, set the SR to 1777, press Load Address, press Start, and Start Reader.

f) Remember that PAL produces only a Binary Tape, the BIN Loader is not punched by PAL.

INTEROFFICE MEMORANDUM

DATE September 19, 1963

SUBJECT Delivery of PDP-5 to Checkout

TO K. Olsen
H. Anderson
S. Olsen
N. Mazzarese
E. Harwood

FROM J. Smith

1 - 9-20-63

1 - 9-30-63

1 - 10-11-63

2 - 10-18-63

2 - 10-25-63

2 - 10-31-63

2 - 11-8-63

2 - 11-15-63

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

dec INTEROFFICE MEMORANDUM

4/36.

DATE September 19, 1963

SUBJECT Status of 16K Memory Systems

TO K. Olsen
✓H. Anderson
S. Olsen
M. Sandler
N. Mazzarese

FROM J. Smith

Two systems are completely wired and awaiting modules. Two additional units are approximately 80% wired. Stacks for these systems have been delivered by Ferroxcube. Modules still not available and their status are listed below.

1021	Engineering
1991	Drafting
1992	Drafting
1993	Engineering
1994	Model Shop
4527	Drafting
4552	Engineering Check

dec INTEROFFICE MEMORANDUM

DATE September 19, 1963

SUBJECT MODEL 911 PATCH CORDS

TO Maynard Sandler

FROM Jim Myers

cc: K. Olsen
S. Olsen

On September 9, 1963, Frank Kalwell and I visited the Component Manufacturing Service.

In response to my inquiry about their late deliveries, I was informed that the difficulties in receiving Ucinite Pins, the difficulties in receiving special wire from Supernant and late ordering from Digital were the main reasons, in that order.

Mr. Owens of Component seems to think that the problem with the pins will be resolved if he has the go-ahead from Digital to manufacture his own. He agreed to stock quantities of wire to resolve that problem.

With respect to the ordering process, I suggest we place larger and more frequent orders, bearing in mind Component's required four week lead time, to avoid our running out of these items and having to wait the minimum four week period for deliveries to begin.

V

DIGITL EQ LA

V

DIGITAL MAYNAD

MSG 158

TO JILL MEANS FOR BOB OAKLEY

FROM HARAN ANDERSON

IN ANSWER TO MSG 017

LEAVING BOSTON NEWYOTXXXXXXNEW YORK ON AUG 21 TO JAPAN

LEAVING JAPAN ON AUG 25 TO AUSTRALIA

END GA

OK TU VERY MUCH END JILLV

RECEIVED
1963 AUG 19 PM 2:52
DIGITAL EQUIPMENT CORP.
SALES DEPARTMENT

DIGITAL MAYNAD

DIGITL EQ LA

8/19/63

MSG. NO. WC-017

XXXXXXXXXXXXXXE

MSG. NO. WC-1017

TO HARLAN ANDERSON

FROM JILL MEANS

PLS ADVISE WHENYOU ARE LEAVING FOR AUSTRALIA. BOB OAKLEY WOULD LIKE TO KNOW AND I WILL RELAY MSG TO HIM AT WESCON.

H. Anderson,

INTEROFFICE MEMORANDUM

To: R. L. Best
M. Sandler
J. Smith
W. Colburn
A. Kotok
A. Hall
B. Scudney
R. Doane
G. Gerelds
R. Lane
R. Reed
D. Brown
E. Harwood
J. Myers
R. Savell
S. Miller
R. Cajolet
K. FitzGerald
S. Grover

Computer Guidance Committee Members

September 16, 1963

From: Gordon Bell

The PDP-6 prototype is entering final phase of development, and the November 11, 1963 FJCC date for completion may prove tight. In order to display PDP-6 at the conference, the schedule will have to be realized.

I would like to review the schedule, its problems, etc. on Wednesday, September 18, 1963 in the engineering conference room at 1:00 p.m. This machine is comparable in performance with the IBM 7090, 7040 series (at .1 - .3 their selling price) and has been in the design stage for the past six months, and is conceptually complete. Now its obsolesence begins. Thus marketing and sales are of the essence. As everyone realizes it is easier to sell a physical product than a well written idea.

LET'S GET THE PRODUCT!...

Cheretting never hurt anyone.....

To: Bob Savell September 13, 1963

From: Bill Long

H.B.L.

Type 340 Display Specifications

The following description and preliminary set of specifications is intended for internal distribution and as a basis for a quote to Henry MacDonald of Bell Laboratories. Mr. MacDonald has already received a verbal description of the Type 340 Display from Alan Titcomb; there have been no important changes in the display format or specification since that discussion.

Apart from PDP-6, the input word to the Type 340 Display consists of 18 bits. Input data is applied to capacitor diode gates with a set-up time of 2 microseconds, and strobed into a buffer register with a pair of clear and set pulses also provided with the input data.

This display is capable of operating in four modes:

1) Control Word or Point-Plotting mode. This mode can be used to plot individual points located at random on the tube face. In addition, the starting point and various parameters for one of the alternative modes are established with a control word. With reference to the accompanying sketch entitled "Type 340 Display Instruction Format", the display is programmed with a control word in the following manner.

A single control word consists of two 18 bit halves. The first half of the control word is always designated with a '0' in bit 6; the second half of the control word contains a '1' in bit 6. The second half of the control word establishes the initial starting position in the horizontal axis. Under certain circumstances in a program

It may be desirable to provide a control word to modify a given parameter without altering the horizontal or vertical position of the spot. This can be accomplished by inserting a '1' in bit 5 of the control word, which serves to inhibit the loading of a new starting position in the horizontal register.

Bits 0 and 1 in the second half of the control word specify the mode of operation for the subsequent data. These two bits are stored so that all data words following a single control word are interpreted in the mode specified by the previous control word. An escape mechanism is provided in each mode, in order that the display can be forced to return to the control word mode for a change in position, parameter, or mode.

Bits 2 and 3 of the second half of the control word are used to establish one of four character sizes in the character mode; bit 3 is used for scaling in the vector and increment modes.

Bits 8 through 17 in the first half of the control word specify the initial starting position in the vertical axis. Bit 5 is again used to prevent loading of the new data in the Y axis register only. Bits 2, 3, and 4 are used to establish one of eight possible intensity levels for displaying of the subsequent data. Bit 1 is called the Continue bit; this bit is used to simplify the programming of long straight lines as described under increment mode below.

2) The Increment mode. In the increment mode an 18 bit data word will cause the plotting of four successive points. Each point is specified with 4 bits with the following format. One bit specifies a move in the horizontal direction.

A second bit specifies the direction of movement in the horizontal axis. A third bit indicates a move in the vertical direction, while the fourth bit specifies the direction of motion in the vertical axis. Thus with 4 bits one can plot one of eight possible points immediately adjacent to the present spot location. Four zeros in an increment character inhibit motion in either direction and no point will be plotted. In order to increment the spot without intensifying, the intensity bit, bit 1, is made a 1.

Once the display has been programmed to the increment mode, all incoming data is interpreted as increment mode data. Escape from the increment mode is accomplished by making bit 0 a '1'. When the escape bit has been enabled, the four specified points are plotted, and an escape is automatically effected into the control word mode prior to the next incoming data cycle.

The Continue feature mentioned above when used with the increment mode enables rapid plotting of long straight lines oriented horizontally, vertically or at 45 degrees. During a Continue cycle, the directions specified by the first increment data point is maintained until the edge of the screen is detected, that is, until either the X or Y register reads all ones. For example, to draw a horizontal grid line with a single increment instruction, the control word specifies a given vertical position, all zeros for a horizontal coordinate, and the continue bit is enabled. The succeeding increment mode data word specifies move X only to the right, and an entire line is displayed across the screen with a single instruction. It is not necessary to enable the

escape bit for a Continue cycle, since escape to control word results necessarily from a Continue cycle.

When the scale bit is enabled, the X and Y registers will be incremented by two. This has the effect of 'double-spacing' the points, and is a feature which can be put to a variety of useful purposes.

3) Vector mode. The vector mode provides a means for displaying straight lines between two points without specifying any in-between points. The vector mode data word consists of 8 bits of Delta-X information, 8 bits of Delta-Y information, an intensity bit and an escape bit. Delta X and Delta Y each comprise seven magnitude bits and one direction bit. Since the display area consits of a 1024 x 1024 point matrix, the maximum length vector which can be drawn with a single instruction is ± 1/8 of the display width. There is no limitiation for a minimum length vector.

The escape and intensity bits are used the same in the vector mode as in the increment mode.

As in the increment mode, the Continue bit in the vector mode enables the drawing of straight lines from any given point within the matrix to the edge of the screen with a single instruction. However, in the vector mode, any angle, subject to the maximum (or minimum) delta Y-delta X ratio, can be achieved. Here again, escape to the control word mode is effected when the edge of the screen is detected.

4) The Character mode. We are not prepared at this time to quote specifically on a character generator for the Type 340 Display. Provision will be made for inclusion of a character generator on a modular basis in all displays of this type. We expect in the near future to make firm our plans for the character generator, but at this time only the data format has been formally

specified.

Each character or symbol will be encoded with 6 bits, packed 3 to an 18 bit word. We shall ultimately provide for a 128 character alphabet, utilizing a pair of case-shift codes to achieve the required encoding ability. The character generator also will be capable of performing the space and carriage return functions upon specific character-like commands. Escape from the character mode is accomplished with another character-like code.

The Type 340 is essentially an incremental display, with line generator and character generator available as options. The line generator module contains a high-speed binary rate multiplier and control hardware. One feature of this binary rate multiplier is its ability to plot lines at speeds porportional to their length; that is, half length lines require half the plotting time of full 7-bit length lines. Each individual point in the vector or increment mode requires one and one half microsecond plotting time. There are no firm speed specifications yet derived for the character generator; however on an incremental basis we should require on the order of 30 microseconds per character on the average.

We intend at present to use the standard Type 30 deflection system for the Type 340. The Type 30 will limit us to approximately 35 microseconds per point in the random point-plotting mode; this same delay is initiated whenever a new starting point is instructed in the control word. This set-up delay is by-passed when the load inhibit is enabled.

Since the Type 340 utilizes the Type 30 deflection system, all repeatability, stability and accuracy specifications of the Type 30 are applicable to the Type 340. For internal information only, we are currently working along two lines to increase

plotting speeds over our present capability. We have ordered an electrostatic tube from Thomas Electronics for evaluation; this investigation is proceeding on a relatively low priority basis. In addition, high power, high frequency transistors have recently become available which may make possible substantial increases in the plotting speed of our present electro-magnetic unit. These transistors should be available to us in the near future for evaluation.

The high-speed photo-multiplier light pen will also be available as an option in the near future. Questions regarding light pen should be directed to Derrick Chin.

The system for Henry MacDonald consists of the basic Type 340 Incremental Display with line generator and Type 30 deflection system. All of the capability described above with the exception of character generation and light pen will be included in his system. Provision will be made for plugging in a modular character generator when it becomes available. The system price, excluding character generator, for quotation to Bell Labs only is $28,600.

This system will be housed in two vertical cabinets, with an integrated shelf-type table at a comfortable height below the disblay tube. One cabinet will contain the display hardware, the second the display tube. Apart from PDP-6, the extra space in the second cabinet is available for customer's use. An indicator panel, illustrating the status of all pertinent flip-flops in the display, will be included.

5010
4000
5010
970
10,080

H. ANderson

INTEROFFICE MEMORANDUM

DATE September 12, 1963

SUBJECT PDP-5 Options

TO PDP-5 Distribution List and All Sales Personnel

FROM R. Maxey

The following options are now available and will be included on future editions of the price list.

Card Reader and Control Type #41

Provides on-line reading of up to 200 standard punched cards per minute in either alphanumeric or binary mode.

$14,900

High Speed Perforated Tape Reader and Control Type #750

Reads 8 hole tape at 300 characters per second.

$ 3,500

Incremental Plotter and Control Type #350

Controls the following Calcomp Plotters:

Model	563	564	565	566
Speed	12,000 steps/min.	18,000 steps/min.	18,000 steps/min.	18,000 steps/min.
Step size	.01 in.	.008 in.	.01 in.	.005 in.
Paper width	31 in.	31 in.	12 in.	12 in.
Price	13,400	15,500	8,900	9,300

INTEROFFICE MEMORANDUM

DATE: September 13, 1963

SUBJECT: New ADA Conversion Equipment Available

TO: All Concerned FROM: B Stephenson

The attached shows a summary of standard systems and modules which are available for analog-to-digital and digital-to-analog conversion. From our detailed information preliminary bulletins are being made on all the units that are not in the catalog. Preliminary information on systems can be obtained from Bob Maxcy in the Sales Department and preliminary information on modules can be obtained from Velma Grasseler, Sales Department.

BWS/dhw

SUMMARY OF ADA EQUIPMENT AVAILABLE

Converters and Multiplexers:

Three standard systems are available for use with PDP's or separately. These include a general-purpose analog-to-digital converter, a special high-speed analog-to-digital converter, and a general-purpose multiplexer.

High-Speed AD Converter Model 142:

A Model 142 is a very high speed unit which converts input voltages to 10-bit digital information in 6 microseconds. The unit operates by making a series of simultaneous comparisons. Its self-correction feature provides reduced aperture, depending on the rate of change to the input.

Specifications:

Input Range -	0 to -9 volts (single ended)
Input Current -	$\pm$ 25 microamperes max.
Output -	10 binary bits, two's complement representation for negative numbers
Conversion Time -	6 microseconds
Conversion Rate -	asynchronous, up to 166 KC
Accuracy -	.15% + 1/2 LSB
Operating Temp. -	70 $\pm$ 5°C
Price -	$16,400.

General Purpose AD Converter Model 138

This unit converts input voltage to a digital number with a resolution of six to eleven bits. Two switches control the resolution and the speed-accuracy characteristic. The table below shows the total conversion time as a function of these switches. The "number-of-bits" switch controls how many information bits are available in the output. There will also be one additional bit read at the least significant end of the word. This bit will always be a one, so that the quantization error will be centered independent of the resolution. The maximum conversion error will be the sum of the maximum switching point errors shown in the lefthand column of the table $\pm$1/2 of the least significant information bit selected.

The Model 138 has an input range of 0 to -10 volts, and drives $\pm$1 microampere. The conversions are asynchronous and may take place in any rate up to the inverse of that indicated in the table, or the limit of the controlling device.

The digital output is N+1 bits with negative numbers represented in two's complement notation. The price is $5000.

CONVERSION TIME

NUMBER OF BITS

MAX SWITCHING *

POINT ERROR	6	7	8	9	10	11
.05%	60	70	80	90	100	110
.1%	30	35	40	45	50	---
.2%	24	28	32	36	---	---
.4%	21	24-1/2	28	--	---	---
.8%	18	21	--	--	---	---
1.6%	15	--	--	--	---	---

*Conversion Error = Max Switching Point Error ± 1/2 LSB

General Purpose Multiplexer Control Model 139:

This unit is designed for use with the Model 138. It will allow up to 64 channels of information to be multiplexed into the input of the ADC. Channels may be individually addressed or sequentially selected. Multiplexer's switches are the type 1578 and are purchased separately. Each group of four switches costs $425. The multiplexer control unit costs $3600.

Switching Time

Modules:

DEC modules are available for use in constructing analog-to-digital conversion devices. This summary describes those modules which are specifically designed for ADA applications.

Ladder Networks:

The ladder network is a resistive divider circuit which converts discreet levels into a voltage which is proportional to the sum of weights of inputs. These are completely passive units and hence can be used with any voltage range. The input impedance of any of the terminals is at least 3,000 ohms, and the output impedance is 900 to 1000 ohms. The most significant bits have trimpots to adjust for variation in output impedance of the ladder drivers. Individual characteristics are shown in the summary table.

Ladder Network Summary Table

Model No.	Type	No. of Circuits	No. of Bits	T.C. ppm/°C	Speed (μs)	Cost
1563	binary	2	8	20	1.0	180
1564	binary	1	14	20	1.0	180
1566	BCD	1	13	20	2.5	200
1568	binary	1	12	50	0.3	180
1574	binary	1	12	14	0.3	

Level Amplifiers:

Single ended bridge circuits switch the precise voltages which are necessary for high-accuracy conversion. The output levels are 0 and -10 volts. The variation in equivalent output resistance for two different states is shown in the column headed ΔR Output. The next to the last column shows the resolution with which these units can generally be used. This will depend somewhat on the application.

Level Amplifier Summary Table

Model No.	No. of Circuits	Speed (μs)	ΔR Output	General Applications (No. of bits)	Cost
4677	4	0.2	8	up to 8	62
4678	5	0.8	1.2	up to 11	78
4679	4	0.1	.5	up to 12	77

For systems where the accuracy requirement is less than 6 bits, inverter amplifiers may sometimes be used. Two circuits have provision for an external negative reference. This should be between -3 and -14 volts. Speed will depend on voltage. The speed shown is for -3 volts.

Inverter Amplifier Summary Table

Model No.	No. of Circuits	Speed (μs)	ΔR Output	Cost
1667	6	0.05	35	78
4667	6	0.3	31	53

Reference Supplies:

The reference supply is used to drive the single-ended bridges or inverter amplifiers, and therefore determines the analog voltage range. These units are available on a module card and are driven by DEC standard power supplies, +10 and -15 volts.

Reference Supply Summary Table

Model No.	Output Voltage	Output Variation Line, Load, ripple	Output Variation 20°C to 30°C	Cost
1562	-10V	10 MV	20 MV	140
1704	-10V	0.2 MV	1 MV	242

Comparator:

The Model 1572 is a high gain difference amplifier. The Double-ended outputs saturated at 0 and -3 volts. The resolution of the 1572 is one millivolt at low frequency. The input voltage range is 0 to -10 volts, and the input current will not exceed ± 1 microampere. The common mode rejection ration is less than 5 millivolts equivalent input offset for a 10 volts common voltage change at the input and a 20°C temperature change. Potentiometers are available for common mode and offset adjustments.

The switching speed of the comparator circuit depends strongly on the driving source, the mode of operation of the unit, and the desired resolution. At least one microsecond should be allowed. The switching time as a function of the conversion method and number of bits is shown in the table below.

Comparator Switching Times - Type 1572 - Cost $180

	Time (μs)	No. of Bits
Counter Converter	0.15 + 0.05 N	$6 \leq N \leq 9$
Continuous Converter	0.15 + 0.05 N	$6 \leq N \leq 9$
Successive Approx.	0.2 N	$6 \leq N \leq 9$
	2.8 μs	N = 10
	9 μs	N = 11

Multiplexer Switches:

These units can switch signals of up to 12 volts. The speed and offset voltage are functions of the driving source and method of use. The table below shows typical specifications when these units are used to drive a 1572 comparator circuit.

The control signals include a 3-input gate per switch. A 5 megacycle square wave should be provided as a carrier for the gate input to the switch.

Multiplexer Switch Summary

Model No.	Offset	On Resistance	Leakage	Storage Time	Cap.	Cost
1578	200 μv	50 ohms	2na	200 ns	10 pf	$425
15781	100 μv	50 ohms	2 na	400 ns	10 pf	$425

Note: The specifications shown here are for general applications. Bulletins available on the individual modules show detailed specifications for special uses.

Digital Circuits:

The Type 4226 is a Serial to Parallel Assembler for successful approximation type Analog-to-Digital converters. It contains four flip-flop stages and a sequence generator circuit. The two pulse inputs, set and reset, are operated in synchronousism. Whenever the set input is activated, the next flip-flop in line will be set to the ONE state. Whenever the clear input is activated, the last flip-flop to have been set will be reset. The clear input may be jumpered so that the first flip-flop can be set or cleared as desired. The flip-flop circuits are similar to the type 4218.

Report to Works Committee

Production Engineering

FROM: Ken Wakeen

The module testing is continuing with Don Zereski and Russ Winslow carrying most of the load. This is covered in a separate report (included).

Additional activities in the module assembly have been mainly centered around the soldering and drilling of boards. There are a vast number of problems here that need the attention of a full-time man.

Briefly, they are in the following areas of activity:

Silk Screening

1. More accurate screening
2. Multiple screening - 8 boards at a time — Methods Committee
3. Etching and plating

Drilling

1. Master drilling templates
2. Multiple drilling

Photography

1. Multiple exposures of positive

P.C. Boards

1. Increasing tolerence
2. Handling of large boards
3. Eyeletting
4. Registration of two-sided boards

Component Insertion

1. Hole locations on drilled boards
2. Resistor insertion
3. Diode insertion
4. Other components

Soldering

1. Board solderability
2. Component solderability
3. Fluxing
4. Cleaning - transipads

Mounting Panel Assembly

1. Assembly tolerences
2. Nut driver
3. Strip lugs
4. Screw drivers

Other

1. Wire wrap of panels
2. Wire wrap of bays

Report to Works Committee

Automatic Module Testing at DEC FROM: Ken Wakeen

The list of modules tested on the Automatic Module Tester is steadily increasing.

In the last four months we tested almost 9,000 modules, 2,755 of which were tested during September.

We save $2-5 each time we test a module.

Attached is the most recent list of modules being tested. This includes the first of the flip-flops, 4201.

Future plans include 16 column high speed printer. The logic is built and we expect the printer October 30. This should be a saleable product around December 30, in the $15,000 price range.

Micro tape will also be added March 1.

The addition of these two items to the tester should increase its value to the company as a demonstration tool.

Module types presently being tested:

1000 - load board
1001 - load board
1002 - load board
1103 - inverter
1104 - inverter
1105 - inverter
1110 - diode gate
1111 - diode gate
1113 - diode gate
1115 - diode gate
1117 - diode gate

1684 - buss driver
1685 - buss driver
1690 - buss driver

4102 - inverter
4105 - inverter
4106 - inverter
4110 - diode
4111 - diode
4112 - diode
4113 - diode
4114 - diode
4115 - diode
4116 - diode
4117 - diode
4201 - flip-flop

6102 - inverter
6104 - inverter
6105 - inverter
6106 - inverter
6110 - diode
6111 - diode
6113 - diode
6115 - diode
6117 - diode
61220 - diode
4143 - diode

Modules that are being added via keyboard:

1669
1675
1678
1681
4139
4141
4689

Flip-flops to be added via keyboard:

1201
1204
1209
1213
4202
4209
4213
4214
4215
4216
4217
4218

Sequence of module types to be added after flip-flops:

C-D Gates
Pulse Amp.
Pulse Generator
Delays

Report to Works Committee

October 1, 1963 FROM: Ken Wakeen

(Sales of Automatic module Tester)

Reaction to the concept of testing devices using a computer as the control element has generally been excellent.

There has been some concern over the price compared to the usual methods of testing. It is more expensive; however, the flexibility of computer control makes it attractive to large-volume producers and to those who require data-logging capability.

We feel that a couple of articles in the trade journals will help to "educate" all levels of management to our concept. These articles will be started on October 3, 1963.

Below is the latest status of our Module Tester sales activity:

Resistor and Module Tester Sales

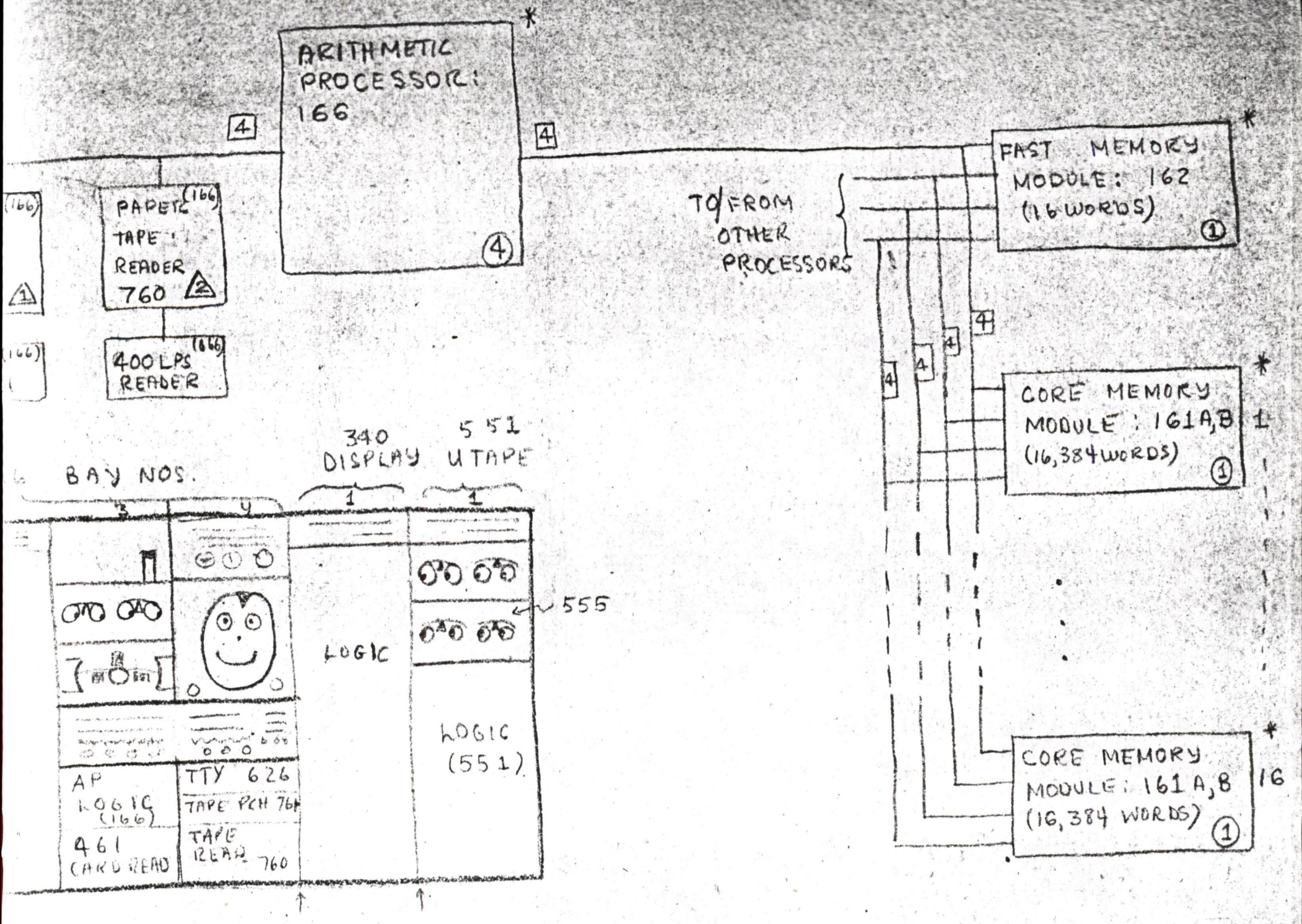
Quotes to Customers

Customer	Price	Date	Status
Weston Instruments (Resistors Temp Coef)	$60,000	6/11/63	Factory trying to get appropriation from corporate, 1 week to 10 days - 60% .6
Texas Instruments (~~Micro Modules~~ Solid Networks)	$90,000	8/9/63	T.I. in austerity program. Andro wants the system but cannot get approval as yet. .1
Western Electric Allentown Pa. Micro Modules	$70,000	9/12/63	At top management now for approval. .3
Allen-Bradley (Resistors Temp Coef)	$60,000	10/1/63	Same as Weston quote of 6/11/63. Fred Gould will call on them October 10. .5
Burroughs Corp. (Electrodata) 100% tested. (Modules)	$110,000	9/26/63	Will be presented to Burroughs management. Maintenance policy important to them. Bob Beckman will call on them this week to discuss our policy. .3

$390,000

Other Prospects

Burroughs Corporation (Tireman)	Asked for prelimenary information. Anticipating a government contract.
Burroughs Corporation (Plymouth)	Cut back in production, still interested.
Fairchild Semiconductor	Competing here with Fairchild Equipment Division. Chances slim.
Sylvania - (Woburn)	Wakefield Division of Sylvania building something for them. Woburn not confident of their ability to do the job.
RCA, Somerville	Are trying a piece of gear built for micro-module program. If it does not work out, they will look to outside sources.
Motorola	Just starting on solid circuits program. They will be in a better position to consider equipment requirement January 1. Sent specs. to Dan Noble.
Beckman	Q.C. Manager saw our tester 3 weeks ago. Alan Ross says there is a strong interest here.

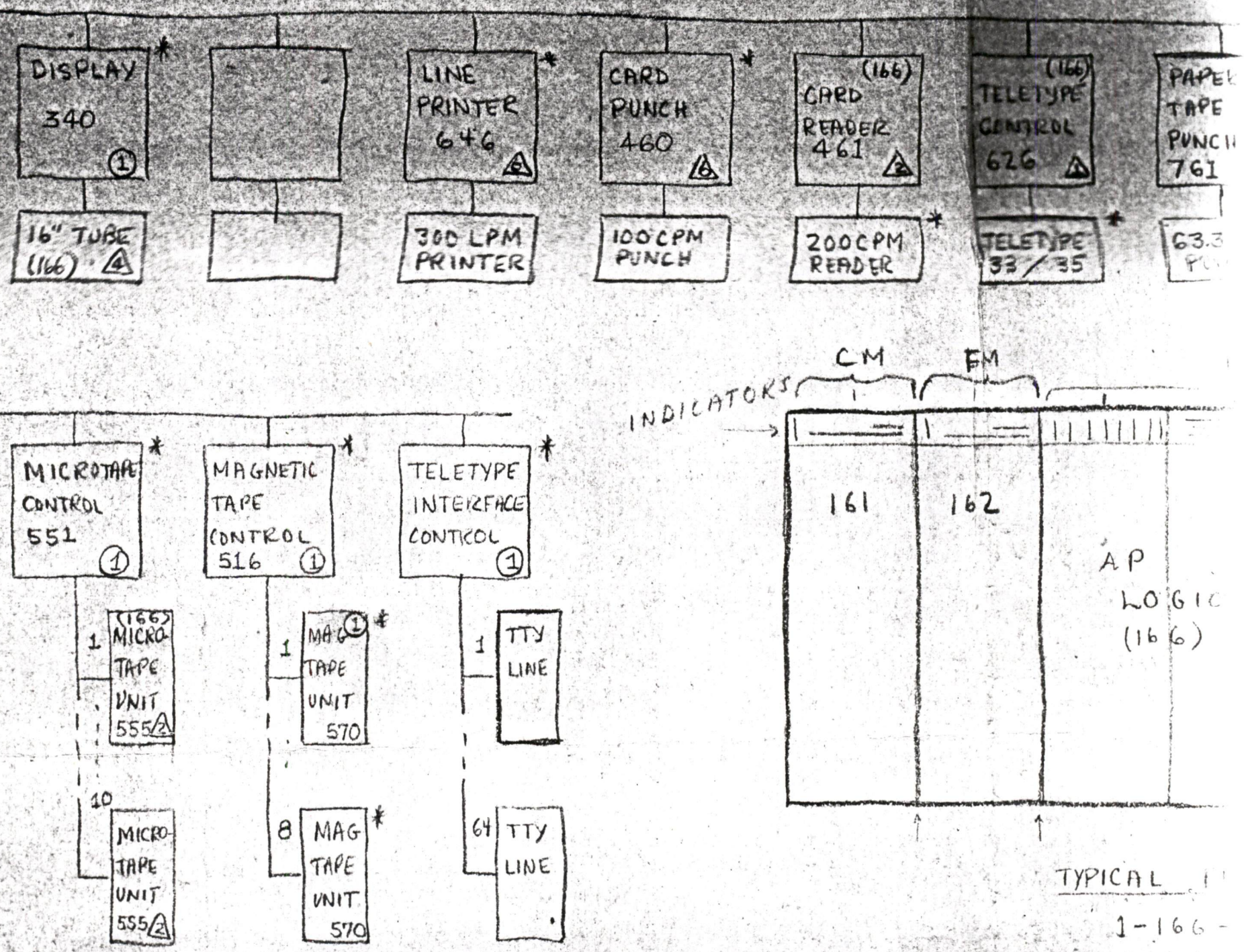


6 INSTALLATION (FRONT VIEW)

C.P.
CORE MEMORY
FAST "
READER
PUNCH
TTY
CARD READER
DISPLAY
O - MICRO TAPE CONTROL
- " UNIT

* FREE STAND
(REQUIRING P
MEMORY MODULES
IO MODUL
IO UNIT
PROCESSO
( ) MODNT LOC
- NO. OF CABINET
- NO. OF 18 COND. CO-AX CABLES
- NO. MTG PANELS

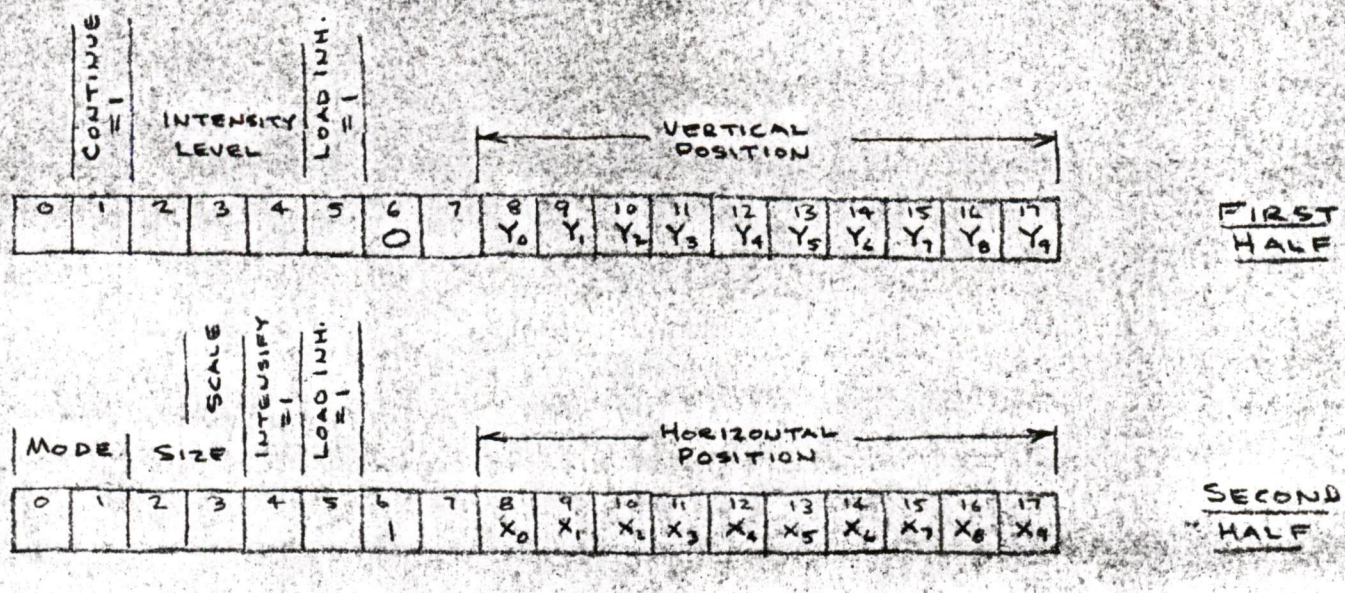
jb
9/24/63



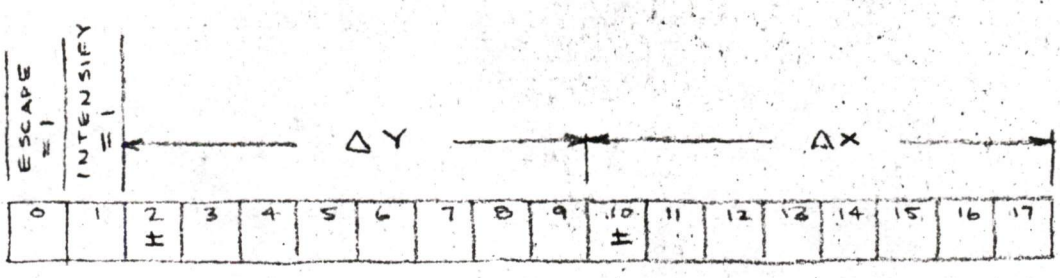
TYPICAL

1 - 166
1 - 161
1 - 162
1 - 760
1 - 761
1 - 626
1 - 461
1 - 340
1 - 5
3 - 55

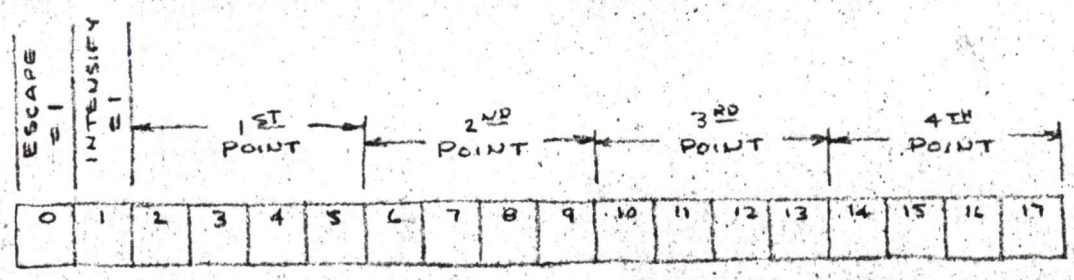
DISPLAY INSTRUCTION CODE FORMAT



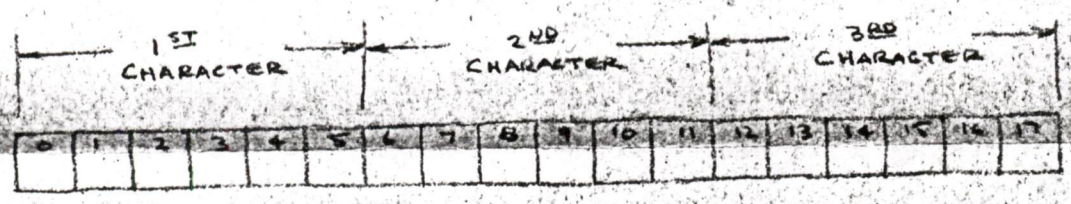
POINT-PLOTTING AND/OR CONTROL WORD MODE



VECTOR MODE



INCREMENTAL MODE



CHARACTER MODE

WL
12 SEPT 63

INTEROFFICE MEMORANDUM

DATE September 12, 1963

SUBJECT UPCOMING DEADLINES FOR TECHNICAL CONFERENCE PAPERS

TO R. Best
J. Fadiman
G. Bell
H. Morse
T. Stockebrand
R. Doane
R. Savell
A. Blumenthal

FROM Stu Grover

CC K. Olsen
H. Anderson
S. Olsen

Paper calls have been announced for two conferences of interest, with manuscript deadlines as follows:

IEEE	Mar. 23-26, 1964	New York	Deadline Oct. 18
SJCC	May 5-7, 1964	Washington, D. C.	Deadline Oct. 25

As usual I have the essential information on these meetings and will be glad to provide any writing, editing, or preparation services desired.

dec INTEROFFICE MEMORANDUM

DATE September 11, 1963

SUBJECT Midwestern Instruments - Tape Deck Pricing

TO
K. Olsen
H. Anderson
S. Olsen
R. Best
N. Mazzarese
G. Bell
W. Hindle
D. Morse

FROM
R. Boisvert
H. Crouse

The price structure of the "tape deck" has been finalized by Midwestern Instruments:

1 - 9	$12,400.00
10 - 14	$10,145.00
15 - 24	$ 9,534.00
25 - 49	$ 9,064.00
50 - 99	$ 8,302.00
100+	$ 7,936.00

This price schedule includes M3000 with IBM compatible head and photo tape sensing and excludes cabinetry.

K. Anderson

INTEROFFICE MEMORANDUM

DATE September 11, 1963

SUBJECT The development of a program of technical diplomacy for computers.

TO Nick Mazzarese
Computer Guidance Committee Members

FROM Gordon Bell

Rationale

1. Interaction of technical personnel between Digital and customers is desirable for:

   (a) Current sales
   (b) Development orientation
   (c) Avoidance of insular outlooks

2. Reinforce feedback between Sales-Engineering, which in our smaller days was carried out informally. This is particularly necessary for new-comers in either area. (In fact, an "informal" training program may be necessary.)

3. An efficient training program for both salesmen and engineers is to talk to customers as various teams.

Implementation

1. Organized by Sales.

2. The people below are to be called on to make customer contact in the systems design and or programming areas ten percent of the time. (The average taken over a year.) Perhaps if this figure is not reached, we are not realizing the full potential of the people.

Len Hantman	Robert Savell
Tom Stockebrand	Steve Lambert
Dit Morse	Roland Boisvert
Steve Piner	William Long
Dave Fellows	David Brown
Gino Collecelli	
Alan Kotok	

dec INTEROFFICE MEMORANDUM

DATE September 11, 1963

SUBJECT Cafeteria Operation

TO Works Committee

FROM Henry J. Crouse

The Cafeteria has been in operation for one year under the management of Tobin Vending Service.

The first six months of the operation were at a loss— Digital Equipment Corporation incurred half of the loss for that period, $725.00.

Tobin Vending Service has been operating the cafeteria for the past six months on a profit and loss basis. The sales have increased steadily since Anne Staples began supervising the line. A profit of five per cent on $7,300.00 sales for an eleven week period, beginning June, 1963, are an indication that the cafeteria can stand on its own.

A review of equipment needs was discussed with John Tobin. John agreed to accept partial responsibility for the purchase of new equipment.

Tobin Vending Service

Hot Food Warmer	$110.00
Sandwich Unit	$590.00
Worktable	$270.00
Utensils (pots, pans and SS knives forkes, spoons)	
	$970.00

Digital Equipment Corporation

Fryer	$350.00
Grille	$491.70
Hood (Kitchen, wiring included)	$1,200.00
Plastic Trays $18.92/12 (300)	$474.00
	$2,715.70

Paper Trays $0.065/ea, usage....4,000/mo. $240

Digital Equipment Corporation will reinstall the dishwasher.

September 11, 1963

Vending Operation -

Tobin Vending Service has fourteen vending machines in operation at Digital Equipment Corporation, which is a profitable operation.

John Tobin agreed to remit commissions to Digital Equipment Corporation to the extent of five per cent of gross sales of the cigarettes, coffee, candy and soda machines. The average monthly commission is estimated to be $90.00. August 1, 1963 is the starting point.

To be paid on a quarterly basis.

The following is the basis for a five per cent commission:

Coffee	$526.55
Candy	$218.55
Cigarettes	$894.95
Soda	$154.20
	$1,794.25
	.05
	$89.71

Henry J. Crouse

INTEROFFICE MEMORANDUM

SUBJECT: JOB ALLOCATION, MECHANICAL DESIGN DATE: September 10, 1963

TO: All Engineers
K. Olsen
S. Olsen
H. Anderson
N. Mazzarese
M. Sandler
J. Smith
R. Maxcy
R. Maroney
K. Peirce
H. Crouse
W. Brackett
W. Hindle

FROM: Loren Prentice

To better acquaint all engineers and management with job responsibility within the mechanical design department, a memo will be issued periodically as required.

ENGINEER	JOB NUMBER OR EN NUMBER	DESCRIPTION	% COMPLETE
Phil Backholm	1196	M3000 tape transport Prototype type 570	85%
	1191	PDP-5 Prototype	80%
Ron Cajolet	1178	PDP-6 Development	70%
	1027	Microscope holder jig	50%
	1016	Memory mounting panels	90%
	2667	BBN - Syatem modifications	60%
	1170	Display 30 - 7090 Data Channel	
	1177	PDP-5 Development	90%
[redacted] FitzGerald	1023	Additional assembly jig for 1914 mounting panels	75%
	1000	Paint adhesion on steel components	30%

ENGINEER	JOB NUMBER OR EN NUMBER	DESCRIPTION	% COMPLETE
Ken FitzGerald (continued)	1053	Welding jigs for standard computer cabinets	90%
	1000	Sheet metal, machine, cabinet assembly and carpenter shop supervision and administration	--
	1178	PDP-6 console mechanical design and prototype fabrication	85%
	1208	DEC paper tape reader (Stepping motor drive)	15%
	1000	"Plastic" doors and end panel research	0%
	1000	Programing tape controlled milling machine	--
Scott Miller	1020	PDP-1D redesign	90%
	1022	Power supply redesign	50%
	1023	Mounting panel redesign	30%
	1088	Package design - modules	25%
	1177	PDP-5	85%
	1178	PDP-6	
	1196	Tape Transport 570	95%
	1209	Display 30 (cabinet module)	10%
	1211	Light pen (Fibre optics)	75%
	2590	Auxiliary reader spooler	95%
	2623	Typewriter buffer - 2308	75%
	2685 2691	Beckman Special Paint	98%
	2705	Punch - Reeler	90%
		Product Identification	Open

ENGINEER	JOB NUMBER OR EN NUMBER	DESCRIPTION	% COMPLETE
Loren Prentice	1136	555 Tape Unit E.C.O.'s	--
	1065	Large Display	10%
	1000	Building layout	75%
	1196	Tape transport type 570	20%
	1000	Quotation - plastic parts	--
	1000	Engineering standards	0.5%
	1237	555-A tape unit Solid State Dev.	--

JOBS PENDING - UNASSIGNED		ASSIGNED ELECTRONIC ENG.
1151	Large Tape Storage - Hold	T. Stockebrand
1165	Projection display	R. Savell
1180	Camera equipment for 30 display	R. Savell
1181	Camera equipment for 31 display	R. Savell
1182	Electrostatic display development	R. Savell
1086	Holley printer	R. Savell
1064	Eye-ball unit	R. Savell

H. ANDERSON

dec INTEROFFICE MEMORANDUM

DATE September 10, 1963

SUBJECT For Approval 9/9/63
PDP-1 - (A) Pricing for new memory increments
(B) Adding new memory to old style machines.

TO
K. Olsen
H. Anderson
S. Olsen
H. Mazzarese
W. Hindle
D. Morse
G. Bell
D. Best

FROM R. Maxcy

(A) The following list suggests a reasonable pricing structure for the PDP-1 with 4K increments of the new memory.

PDP-1	with	4K	memory	$120,000
"	"	8K	"	140,000
"	"	12K	"	150,000
"	"	16K	"	160,000
"	"	20K	"	190,000
"	"	24K	"	200,000
"	"	28K	"	210,000
"	"	32K	"	220,000

(B) In adding new memory to machines having old style memory, it is proposed that no trade in be given for the old stacks, but rather, the new memory be made compatible with the old. The following table suggests such a pricing structure.

Wants to Add

Has	4K	8K	12K	16K	20K	24K	28K	32K
4K	35	45	55	65	95	105	115	125
8K	25	35	45	55	85	95	110	120
12K	25	35	45	55	85	100	110	120
16K	25	35	45	55	90	100	110	120
20K	25	35	45	60	90	100	110	120
24K	25	35	50	60	90	100	110	120
28K	25	40	50	60	90	100	110	120
32K	30	40	50	60	90	100	110	120

indicates memory extension

The above figures plus the standard 5% installation charge apply to the first addition of new memory in old style machines. Subsequent additions (adding to a mixed memory system) should carry an extra $1000 charge in addition to the standard 5% installation fee. This is to cover re-addressing modifications.

INTEROFFICE MEMORANDUM

DATE: September 9, 1963

SUBJECT: Increase of PDP-5 Construction Schedule

TO: K. Olsen
√H. Anderson
S. Olsen
G. O'Dea
N. Mazzarese

FROM: J. Smith

Present schedule is two PDP-5 computers per month. Planned increase, four per month starting in October.

Both Teletype and Ferroxcube have been contacted in relation to a step up in delivery of major components to meet the increased schedule. Both suppliers have assured me that they could deliver to a schedule that would enable realization of the increased construction rate. I am just a little leary of Ferroxcube delivery quotes at this time. They have been falling behind on their delivery of 16K Memory stacks. Teletype, I am sure, will meet the delivery of the ASR 33 teleprinters.

To meet wiring demands for the increased schedule, sub-contracting expenditures will have to increase approximately $6,500 per month.

Major components expenditures will increase by $9,436 per month.

I am quite confident that we will be capable of producing four PDP-5 computers per month starting in October. The major trouble area will be delivery of stacks from Ferroxcube. This area will be expedited very carefully and you will be notified of any changes.

H. Anderson

TRW
CANOGA PARK
CALIF

INDUSTRIAL COMPUTERS

INTEROFFICE CORRESPONDENCE

To: H. H. Flum

cc: W. S. Aiken
H. J. Henderson
P. Likins
L. B. Perillo
D. L. Stevens

Date: September 4, 1963

Subject: Digital Equipment Cooperation PDP-5 Programmed Data Processor Computer

From: J. G. MacArthur

ABSTRACT

This report describes the physical and logical characteristics off the PDP-5 Programmed Data Processor Computer manufactured by Digital Equipment Corporation Maynard, Massachusetts. The results outlined in this report were gathered by the writer from (a) examining a PDP-5 Computer at the Westcon Show at San Francisco, (b) discussing characteristics of the computer with Mr. Stanley C. Olson, General Sales Manager and Mr. Ed DeCastro, Project Engineer on the PD-5 Computer System, (c) perusal of the Computer literature obtained from Digital Equipment Corporation.

GENERAL

The PDP-5 is a single address, 6-word, stored program computer operating on 12 bit, 2's complement binary numbers. It has a 6-microsecond memory cycle time and fully parallel processing, which provide a computation rate of 55, 555 additions per second.

The interface is extremely flexable, accommodating the wide range of external devices with ample provision for future expansion.

The use of solid state components and provision for margin checking help to assure machine reliability, even under extreme operating conditions - (or so they say).

The basic PDP-5 system includes the central processor, 1024 (expandable to 4096) words of random access magnetic core memory, perforated tape reader and Input/Output control (teletype unit). Standard features include a complete order code structure, indexing, indirect addressing, data interrupt and program interrupt.

GENERAL (Contd)

The cost for the above described basic unit is $24,000. with one K of core and $27,000. with 4097 word core memory.

PDP-5 PROGRAM DATA PROCESSOR

1. MEMORY

The basic memory size of the PDP-5 is 1000 words of core expandable to 4096 words of core. In addition to this the computer system is capable of connecting to additional block memory such as:

(a) Magnetic Tape Transport Type 50 (IBM) with a tape transport rate of 15000 cycles per second. A maximum of 8 of the transport type 50 may be added to the system.

(b) Magnetic drum for memories up to 64K or more.

(c) Dual Micro-Tape system (presently under development) which provides a fixed address magnetic tape facility for high-speed loading, read out and program up dating. Key features of the Micro-Tape design are:

(1) Phase rather than amplitude recording, and a permanent timing track.

(2) Drive system does not use conventional capstans, pressure pads or mechanical buffering.

(3) Each of the three date tracks is redundantly paired with a second, non-adjacent track. A speck of dust on one track will not prevent the normal operation of its alternate.

(4) Search speed 80 inches per second, with search in either direction.

(5) Tape transport occupies less than two cubic feet.

(6) Bit density is 400 bits per track inch with each 3 1/2" reel capable of holding 250 feet of 3/4" tape. Total storage using two reels is approximately eight million bids.

2. REGISTERS

The basic unit has 6 registers with only one full length register available to the programmer. These registers are:

(a) Accumulator 12 bit available to the programmer.

(b) Memory Buffer - 12 bit not available to programmer.

(c) Memory Address - 12 bit not available to programmer.

(d) Instruction Register - 4 bit not available to programmer.

(e) Switch register - available only to the extent that Inputs can be written into this register from toggles on the maintenance and control panel.

(f) Link Register - 1 bit available to the programmer. The Link Register is an extension of the accumulator. Appendix A shows a block diagram of the registers and Input/Output blocks of the basic system.

3. DIGITAL INPUTS/OUTPUTS

All digital inputs and outputs are controlled by a "Device Selector". The Device Selector has the capability (by adding elements) of selecting 64 groups of lines. Each group consists of 3 wires and under programm control a DC pulse will appear on wire one. One microsecond later a pulse will appear on wire two. A microsecond later a pulse will appear on wire three. All pulses are 4 microsecond duration. Thus 64 x 3 unique pulses on 64 x 3 wires can be given. These pulses can be used to reset control flip-flops, trigger digital output flip-flops etc.

(a) Digital Outputs

Digital outputs utilize the Device Selector and the Information Distributor. The Information Distributor (12 output lines) distributes static information contained in the accumulator. The control of information transfer from the accumulator to the external would be by the Device Selector pulses.

Example

For a system capable of driving 12 output contact relays, the following control elements would be required.

Example (cont'd)

(1) 12 Buffer Flip-flops

(2) 12 relay drivers

(3) 1 delay generator and driver to activate the above output elements . The following would occur using the Device Selector:

(a) A pulse on wire one would clear the buffer.

(b) A pulse on wire two would transfer information from the accumulator to the buffer.

(c) A pulse on wire 3 would trigger the delay generator to cause the relay drivers to transmit information from the flip-flops to the relays for the time interval of the delay generator timing.

(b) Digital Inputs

Digital Inputs utilize the Device Selector and the Input Mixer. The Input Mixer allows static information (on 12 lines) to be read into the accumulator by device selection pulses. The Input Mixer has connections for two groups of 12 bit information inputs, but may be expanded to almost indefinitely.

4. ANALOG INPUTS/OUTPUTS

(a) Analog Inputs

As an optional item a 10 bit Analog Digital Convertor can be wired into the computer. The A-D convertor requires a 0-10 volt input voltage. The convertor makes use of existing registers in the computer therefore the computer is not available for normal computation during a conversion phase. Utilizing a successive approximation technique the convertor requires 44.8 microseconds to convert an analog input voltage to 10 binary bits.

The Analog Inputs system does not have a low-level amplifier or a relay selection system for low-level inputs.

(a) Analog Inputs (cont'd)

Supposedly any commercial low-level amplifier can be used to accept low-level signals and feed them to the AD convertor.

Relay selection can be accomplished with the digital output system as previously described.

(b) Analog Outputs

Analog Outputs are of the resistance divider type (12 bit) and optional to the standard equipment. In order to add Analog Outputs it is necessary that memory in the form of flip-flops and resistor divided networks be provided. The accuracy for Analog Outputs is 0.1%.

6. COMMAND STRUCTURE

The Command Structure of the PDP-5 has most emphasis on Input/Output capability. It is quite limited in arithmetic operations having only the capability of adding. The Command field consists of 3-bits giving 8 possible commands. 6 of these Commands refer to memory and utilize 8 bits for the operand address. The remaining two commands are used for Input/Output control and for various logical commands that do not require a memory address. These latter two commands by utilizing various bits in the operand address portion of the word give a total of 23 instructions.

7. IN/OUT EQUIPMENT and OPERATION

The operation of the Input/Output Equipment connected to the computer is handled by various Output select pulses. These pulses are (a) sample device flag conditions which are fed into the computer, (b) reset external registers, (c) readout information to external registers from the A/C Unit, (d) readin information from the external registers to the A/C Unit, (e) control devices, (f) halt the computer until external device has finished its operation. An example of this is during the analog to digital conversion phase where the registers of the computer are utilized for conversion. The Input/Output equipment consists of:

(a) Punched Paper Tape Reader

(b) Printer Keyboard - teletype model

(c) Analog Digital Convertor

(d) Program Interrupt.

There is only one Interrupt in the system. However, by means of the Input/Output equipment many lines can be tied into the one Interrupt system. The Interrupts will record the present instruction address and jump to an assigned location in the computer.

8. SOFTWARE

The Software library available is quite limited. A sub-routine multiply, has been written however, it has not been debugged. The operating time for the multiply is estimated to be 2.1 milliseconds. No sub-routine is available for the divide, however, one will be completed with probably a three to four millisecond operation time.

A symbolic assembler - three pass type- is available which will work in one K of core. Whether the assembler has debugged or not is not known to the writer at this time.

9. CONCLUSIONS

A. Fabrication

The individual plug-in cards and modules utilized a satisfactory fabricating technique. Each card was connected to a plug and the plug was connected to a band of metal which completely surrounded the perimeter of each card. The cards were plugged into module assemblies quite similar to the Malco baskets presently utilized on the 330 computer. One aspect that seemed to characterize the system was the lack of interconnecting cables. Each module was electrically connected to the next module if in the same cabinet by wire jumpers rather than cables. The basic unit including the power supplies can be mounted in one cabinet 24" x 24" x 72". The basic cabinet had one fan mounted on the floor blowing air up the center of the cabinet, however no escape vent could be found except for the cracks around the cabinet doors.

Germanium transistors and silicone diodes were used throughout for all circuits.

B. Temperature

The only available information on temperature was that the equipment was tested in temperatures up to 100 degrees. At that temperature the equipment operated satisfactorily. On inspection of the equipment the cooling technique did not seem too efficient in that an opening either the front or rear doors one felt a very warm blast of air come out of the cabinets.

C. Deliveries

One interesting aspect is that deliveries can be made in approximately 6 to 10 weeks. This would include both standard equipment and additional hardware to some extent.

9. RECOMMENDATIONS

The writer feels that the programming capabilities timewise is heavily complicated by the computer having only one register, namely the accumulator. The first, and obvious, complication is the time required to do a subtraction, multiply and divide, 2 and 3 milliseconds respectively. Since a rough figure for the percentage of multiply commands in the normal programming application is approximately 1 and 20 to 1 and 30, it is seen that the multiplying time considerably reduces the overall speed of the computer. It is strongly suggested that if this computer system be utilized by TRW that an extra register be added to the system. This register should have the capabilities of being linked to the present accumulator register and have available commands to shift information from the accumulator register into the added register either right or left. The availability of such a register would increase the overall speed of the computer by approximately 30% and reduce memory requirements.

Without the additional register the PDP-5 would operate slower than the 330 and with this register the computer would operate faster than the 330. Scope wise the PDP-5 can presently to just handle a logging and scanning job similar to the Colbert or Widows Creek application, less performance calculations.

Perhaps the item that most impressed the writer is the availability from the company of a large variety of registers, flip-flops, clocks, power amplifiers and associate circuitry, which can be utilized to build up the scope of the basic computer unit. To get a better feel for what the overall cost of PDP-5 in regards to handling a simple scan, log, alarm and trend system would be, to request a cost on a system having the following characteristics:

(a) Add an additional register with commands to shift the contents from the existing accumulator register into the added register.

Wired mult.

(b) Basic capability to select 12 digital outputs where each output would be required to drive 12 Mercury wetted contract relays. (Type HC-SH 1046). Cost for additional groups of 12 Outputs.

Dig outs : Up to 75

Dig Ins : Up to 100

9. RECOMMENDATIONS (Cont'd)

(c) Capability for driving analog relays for low-level and high-level input selection. Cost for additional Block of 12 Inputs. Up to 200 inputs
An. outs: Up to 200 outputs

(d) Cost for adding Red ~~Cose~~ or equivalent low-level amplifier to couple into the PDP-5, A-D convertor.

(e) Additional cost for adding memory backup in the form of a magnetic drum, tape, etc.

(f) Wired-in Multiply Command

These could be some of the key items required to give a better view of the overall cost of a system which could be capable in scope of performing the functions of logging and scanning presently carried out on the Colbert and Widows Creek 8 Units.

Further consideration should be given this computer both from the point of view of a satelite unit and as an individual unit handling basic log, alarm scan requirements. The author also feels that some caution should be executed when viewing the basic price (27K) as the cost can probably triple or more, when the basic system has the scope of a Colbert system.

Caution should also be executed in the programming of the computer since the command structure is so limited and also the lack of software.

The author does feel that with the available modules as building blocks, systems can be built that meet the requirements and only the requirements of a customer with no extra "goodies" thrown in for free.

/dj