Kenneth H. Olsen
Memos Received, May, 1969

TO:	FROM:	RE:	DATE:
Ken	TWX Franklin S. Heiss, Jr. Strategic Timesharing	TSS-8 System	5/5/69
Ken	Gabe d'Annunzio	Fortune Magazine Readership Study	5/5/69
Ken	John Naples	European Module Business - Present and Future	5/6/69
Ken	Geoff Shingles	Meeting at the Board of Trade May 5th, 1969	5/7/69
Ken	Al Hanson	FY70 Facilities-related Capital & Extraordinary Spending Budgets	5/8/69
Ken	Gabe d'Annunzio	Hanover Show	5/9/69
Ken	Bill Owens	Small Printer Development	5/13/69
Ken	Denny Doyle	European Standards	5/14/69
cc: Ken	Pierre Schneebeli	CMD 1101 Mono Disk Memory	5/19/69
Ken	Pierre Schneebeli	CMD 1101 Disk Cartridge Drive at the SJCC	5/20/69
cc: Ken	Ron Rutledge Alan Perlis Gordon Bell	CMU Visit	5/20/69
Ken Olsen	Ed Savage	Engineering Review Committee	5/22/69
Ken	Geoff Shingles	MINTECH	5/27/69
Ken	Klaus Pichler	VR12 Literature	5/21/69
Ken	Richard May	FOCAL versus BASIC	5/27/69
Schedule Review Committee	Don Murphy	6801 Status	5/28/69

Kenneth H. Olsen
Memos Received, May, 1969

TO:	FROM:	RE:	DATE:
Ken	J. Smith	material to be freed up by Ken	5/29/69
Ken	John A. Bellantoni	Ways to reduce the cost of manuals	5/29/69
Ken	Clayton Rix	engineering projects	5/12/69

digital INTEROFFICE MEMORANDUM

DATE: May 5, 1969

SUBJECT: FORTUNE MAGAZINE READERSHIP STUDY

TO: K. Olsen
S. Olsen
N. Mazzarese
T. Johnson
P. Kaufmann
W. Hindle

FROM: Gabe d'Annunzio

The attached booklet summarizes the results of the first phase of a two-part readership awareness survey, conducted with the cooperation of FORTUNE. We shall conduct a second survey in approximately 9 months to determine what changes (hopefully positive) in awareness of DEC have occurred during this period.

/meb

Attachment

Digital Equipment Corporation

Campaign Study #1

April 1969

CONTENTS

Digital Equipment Corporation
Campaign Study #1

Background

In March 1969 the FORTUNE Market Research Department conducted a campaign study on behalf of Digital Equipment Corporation and its advertising agency, Kalb and Schneider, Inc.

The overall objective of the study was to establish benchmark levels of FORTUNE subscribers' familiarity with Digital against which the effects of an advertising campaign in FORTUNE could be measured. However, the results cannot be considered true "benchmark" levels since the campaign actually began in February -- two ads appeared prior to the closing of this survey (one black-and-white page in the February and the March Manufacturing Editions of FORTUNE).

Specifically, the study sought to determine:

1. FORTUNE subscribers' familiarity with Digital Equipment Corporation;

2. Their knowledge of the type (by function) of computer made by Digital;

3. Whether the respondents know the broad size/price grouping of computers in which Digital specializes.

Method

On March 3, 1969, questionnaires with personalized covering letters were mailed to a systematic random sample of 600 FORTUNE subscribers known to be in the manufacturing field (SIC 19-39) and having one of the following titles:

Top Management

Chairmen of the board, directors
Presidents, chief executive officers
Vice presidents
Treasurers, secretary-treasurers and secretaries
Other company officers and assistants
General managers, managing directors
Division managers
Owners and partners

Engineering & Scientific Management & Staff

Top technical management
Senior engineers, section heads, project leaders
Production and manufacturing engineers, systems engineers, and systems analysts

Production Management

Plant managers, superintendents
Production managers, superintendents and supervisors

... continued

Method (continued)

To increase response, a 25¢ premium was included with the questionnaire, and a reminder postcard was mailed on March 6th. Returns were cut off on March 27th with a postmark of March 24th and at that time numbered 395 or 66% of the total mailout.

There was nothing in the covering letter or the questionnaire that connected FORTUNE with the survey; the letterhead used was that of Madison Research Associates. The results were tabulated by the independent research firm of Norbert J. Prager Associates, New York.

SUMMARY OF RESULTS

Familiarity with Digital Equipment Corporation

Just over one fourth (26%) of the respondents indicated some degree of familiarity with Digital -- 3% "very," 9% "somewhat" and 14% "slightly familiar." Another 36% said they have "heard the name but know nothing further," and 37% said they have "never heard of it."

Knowledge of the Type of Computer Made by Digital

About one fifth (21%) recognized Digital as the manufacturer of "computers for production and process control." Almost as many subscribers -- 19% of the respondents -- said "computers for scientific applications" are made by Digital, and 10% checked "computers for accounting and inventory control." One fifth (21%) did not answer even though they had indicated some degree of familiarity with Digital in Question 1.

Subscriber Awareness of Digital's Specialization in Small, Low Priced Computers

When asked to indicate in which of three broad size/price groupings Digital specializes, 24% of the respondents correctly named "small, low priced computers." Almost one fifth (18%) said "medium-size, medium priced" and just 3% said "large, high priced computers."

In addition to the 38% who indicated they had "never heard" of Digital or didn't answer Question 1, over one fourth (28%) of the respondents did not answer this question.

Question 1: How familiar would you say you are with a company named Digital Equipment Corporation?

Very familiar	3%
Somewhat familiar	9
Slightly familiar	14
I've heard the name but know nothing further	36
I've never heard of it	37
No answer	2
Base	(395)

Note: Percentages do not add to 100 because of rounding.

Question 2: To the best of your knowledge, which of the following types of computers are made by Digital?

Computers for accounting and inventory control	10%
Computers for scientific applications	19
Computers for production and process control	21
"I've never heard of it" or no answer to Question 1	38
No answer	21
Base	(395)

Note: Percentages do not add to 100 because of multiple answers.

Question 3: Computers are now available in a great range of sizes and prices. In which of these broad size/price groupings do you think Digital specializes?

Large, high priced computers	3%
Medium-size, medium priced computers	18
Small, low priced computers	24
"I've never heard of it" or no answer to Question 1	38
No answer	28
Base	(395)

Note: Percentages do not add to 100 because of multiple answers.

APPENDIX

Mailout vs. Response by Job Title

Reproductions of Covering Letter, Questionnaire, and Follow-up Postcard

Mailout vs. Response
by
Job Title

	Mailout	Response
Chairmen of the Board, Directors	3%	3%
Presidents, Chief Executive Officers	22	22
Vice Presidents	19	19
Treasurers, Secretary-Treasurers & Secretaries	7	5
Other Company Officers & Assistants	3	3
General Managers, Managing Directors	3	3
Division Managers	3	4
Owners & Partners	4	3
Total Top Management	65	61
Top Technical Management	12	13
Senior Engineers, Section Heads, Project Leaders	10	11
Production & Manufacturing Engineers, Systems Engineers & Systems Analysts	3	4
Total Engineering & Scientific Management & Staff	26	28
Plant Managers, Superintendents	2	2
Production Managers, Superintendents & Supervisors	7	9
Total Production Management	10	11
Base	(600)	(395)

Note: Percentages do not add to 100 because of rounding.

MADISON RESEARCH ASSOCIATES
27 EAST 22ND STREET
NEW YORK, NEW YORK 10010, U.S.A.

March 3, 1969

Dear Mr. Craig:

Would you please do me a favor?

A client of ours has asked for our help in determining the familiarity of important men in business and industry with certain companies and their opinions of some others.

You were included in the small, scientifically selected sample to whom the enclosed confidential questionnaire is being mailed. Because our sample contains only a few hundred people, each and every answer is extremely important to the reliability of the results of the survey. So please take a few moments to fill out the short questionnaire and return it in the enclosed stamped envelope.

Our client, and I personally, will be grateful for your help.

Sincerely,

Franklin M. Heller

Franklin M. Heller
President

FMH:ci
Enclosures

P. S. The enclosed coin is simply a token of our appreciation. It may brighten the day of a youngster you know.

QUESTIONNAIRE

1. How familiar would you say you are with a company named Digital Equipment Corporation?

Very familiar	☐	I've heard the name but know nothing further	☐
Somewhat familiar	☐	I've never heard of it	☐
Slightly familiar	☐		

2. To the best of your knowledge, which of the following types of computers are made by Digital?

Computers for accounting and inventory control	☐
Computers for scientific applications	☐
Computers for production and process control	☐

3. Computers are now available in a great range of sizes and prices. In which of these broad size/price groupings do you think Digital specializes?

Large, high priced computers	☐
Medium-size, medium priced computers	☐
Small, low priced computers	☐

Many thanks for your help.

Dear Mr. Craig:

Recently we mailed you a questionnaire asking for your participation in an important survey. If you have already returned the questionnaire, please consider this card a "thank you" for your valuable help.

If you have not had a chance to do so as yet, may we ask you to return the completed form now?

Sincerely yours,

Franklin M. Heller

Franklin M. Heller, President
Madison Research Associates

digital EQUIPMENT G. M. B. H.

May 6, 1969

5-9-69
cc: Stan Olsen
Al Devault
Fred Gould
from Ken Olsen

To: Ken Olsen

From: John Naples

Re: European Module Business - Present and Future

As you requested in Munich, this is a summary of our present and future module business in Europe, and my opinions on how Maynard can help more.

Our module sales effort now has a specialist in each of these places,

U.K.	Reading, London, Manchester
Germany	Cologne, Munich (myself temporarily)
Scandinavia	Stockholm
France	Paris
Italy	Milan
Benelux	The Hague (effective from June 1st)

The majority of these engineers began to be new business generators around November 1968.

Our module potential in Europe is large, but even with the best sales efforts there are a few historic problems which must be overcome before we can realise that potential.
Some of the problems are local and can only be solved here, some need the help and understanding of Maynard.

1. Europe appears to be appreciated and understood better by the Computer Product Lines, than by the Module Product Line. During my year with the module people I attempted to inject some more European attitudes. Stan and Russ Doane have a good feel for Europe and I now have arranged for someone to come from the group every 4 or 5 months to meet our customers here and get to see the problems. Russ was here in November and should come again this month.
I feel that much more exchange of other people is needed to wipe out this grey area.

2. With the exception of the U.K., language is increasingly becoming a problem. As we get to the non-English speaking potential module users, we need German and French literature. I am working with Steve Bowers on brochures, also French and German Logic Handbooks.

These should help solve a lot of problems.
We are also providing publicity for our module products here, in increasing volume. People just don't know of DEC as a module producer. This is one of the local problems only we can solve.

The following two problems were looked at in detail over the past few months and I recommended solutions with which Jean-Claude agreed.

3. Module repair in Europe is now done by Field Service and we have repair centers in U.K., Cologne, and soon in Paris. These centers need help and support from their equivalents in Maynard. The first form this help should take, is in visits by the Repair Group people. There has never been personal contact between our European repair people and Maynard and trying to get some to happen is like pulling teeth. We train Field Service people well, but our module repairers not at all.
The contact would also help Maynard see our repair problems, it is important that they do.

4. With the exception of the U.K., there are no module inventories in Europe. This has caused frustrations on delivery times, but this is becoming more acute with the sale of K and M-series modules. The K-series customer typically wants only a few common modules to "try out" in Europe before his larger orders.

   I have recommended we stock, in small quantity, catalog modules, valued around $ 13.000 in the main office of each country in Europe to satisfy the demands of these customers. Large orders continue to be placed on Maynard.
   Already in the U.K. this has payed off and continues to win new customers.

   A central European stock would not appear to help much in these cases as customs delays in the majority of countries are the cause of most of our holdups. This is also a local problem and we are tackling it.

To sum up, we have problems in selling modules in Europe; publicity, language, repair, delivery, confidence in DEC.
The Module Group can help more by realising that Europe is an assembly of different countries with differing attitudes, customs between, and not just one large state.
Industry and Research throughout Europe offer an incalculable potential for DEC modules and PDP-14, we have a good Module Sales Group who needs more sympathy and support from Maynard.

I hope this is not construed as a gripe, but more as yet another step towards DEC's greater success in European module business.

John Naples

Western Union

2:00 p.m.

May 5, 1969

Help! Your first TSS-8 system desperately needs help. All the work done earlier at Maynard to get this system together for us seems to be going for naught. It is ten days now since the TSS-8 was crated at Maynard and placed on a Globe truck. It spent the first five days in cold storage in a warehouse in Boston before we were able to track it down. It had to stay on the truck overnight because all four cabinets were packed into one crate and there are no elevators large enough to handle a package that big. The last four days it has been collecting dust, all but ignored by your field service people. A grand total of eight - repeat, eight - man-hours have now been extended by them to get it up and running. We have been unable to get them to work outside the bankers hours of 10:00 a.m. - 4:00 p.m. Am I right in assuming that some day it will be up and running? Am I right in assuming that some day we will receive RX the TSS-8 program tapes, listings and manuals necessary to make the system do something? It is a great disappointment to me ~~that~~ we to see this happen in such an excellent company as DEC. Somehow I thought DEC was just as interested as STI in getting TSS-8 up and running. It would have been nice to say at SJCC that the system was operational in the field and that you have a happy customer. If something is not done soon, TSS-8 will win hands down the record for the most neglected new system installation in computer history.

Franklin S. Heiss, Jr., President
Strategic Timesharing, Inc.
132 W. 31st Street
New York, New York
area code 212 - 736-6266

From Anthony Wedgewood-Benn, Minister of Technology, to Sir Gerald Nabarro, M.P.

Minister of Technology
Millbank Tower
London S.W.1

7th May, 1969.

Dear Gerald:

You wrote to me on 16th April about computers made by Digital Equipment Company. Officials of the Ministry of Technology have from time to time been in touch with the Company and we have some knowledge of their plans for expanding manufacture in the UK.

However I think it would be useful if a further visit were made to see how their activities are progressing and you might like to suggest to them that they should get in touch with Mr. R.O. Bennett of the Ministry's Technical Support Unit (Tel. No. 739-3464, Ext. 334) to make arrangements.

The Government's policy is to purchase computers made in Britain whenever reasonably possible and for this purpose we take account of whether there is a substantial proportion of imported components and sub-assemblies and of the extent of manufacture in Britain. So far we have not taken the view that any of the DEC computers could be regarded as British made for this purpose. As your letter indicates, quite a number of computers made by DEC have been purchased from public funds and I should not have thought that there were any grounds for the company feeling that we were not prepared to do business with them.

I am of course very conscious of the advantages to our economy if American companies increase the extent of their manufacturing operations in Britain and so reduce our import bill, and this certainly applies in the case of the Digital Equipment Company. If you still wish to come along to see me I shall be very glad to have a chat with you, but you may feel that it would be better for the visit of officials which I have suggested to take place first.

Yours ever

Anthony

Sir Gerald Nabarro, MP

INTEROFFICE MEMORANDUM

CONFIDENTIAL

DATE 7th May 1969

SUBJECT MEETING AT THE BOARD OF TRADE, May 5th, 1969

TO Ken Olsen
Ted Johnson
Jean-Claude Peterschmitt
cc Al Gordon

FROM Geoff Shingles

Geoff

Those present:-

F Lacey.....Regional Controller)
J Thomas.....) BOARD OF TRADE

J-C Peterschmitt)
G S Shingles) D. E. C.
A Gordon)

OBJECT OF MEETING

To update Board of Trade on our present position in Europe and to outline our future plans.

CONTENT OF MEETING

Mr Lacey outlined very clearly the Board of Trade position regarding Reading expansion:

a) obtaining an I.D.C. (Industrial Development Certificate) for further manufacturing space above that for 10,000 feet at 3 Arkwright Road would be very tough.

b) obtaining an I.D.C. for 7-8,000 feet for Training School along with 3,000 feet for Accounts will present no problems, unless Local Planning objects.

Continued.....

Mr Lacey also made it abundantly clear that:

a) if we contemplate R & D fo any magnitude,

or

b) further expansion of production space,

then,

large pressure will be brought on us to move to a development area (who will welcome us with open arms),

e.g. 40% grant for capital equipment,
subsidised factory space,
employee premiums, rather than taxes.

(Already, IBM, NCR, HP, Varian and Honeywell have done this with obvious advantage).

J-C Peterschmitt outlined our progress to date detailing exports of components and U.K. content - these points certainly made their mark. The German "offset agreement" position was mentioned and Mr Lacey promised to give a definition of content for this and Commonwealth preference purposes. This will be a most useful pointer to one definition of what is "British" from a content standpoint. It would appear that U.K. content is defined as "added value" in the U.K.

CONCLUSION

The meeting was very useful in generating contact and interest. Mr Lacey is a very jolly person, but has a cunning interviewing technique which needs close watching. As a friend he could be invaluable, as an enemy, disastrous.

ACTIONS

1. Obtaining views of County Planning officer re. Training School. G.S.S.

2. Chase Board of Trade for contact definition. G.S.S.

3. Arrange similar meeting at the Treasury. G.S.S.

digital INTEROFFICE MEMORANDUM

Memo #516

DATE: May 8, 1969

SUBJECT: FY 1970 Facilities-related Capital & Extraordinary Spending Budgets

TO: Ken Olsen
Stan Olsen
Nick Mazzarese
Win Hindle
Pete Kaufmann
Ted Johnson
cc: Phil Feeney

FROM: Al Hanson

The attached list of capital and extraordinary expense projects was prepared as a result of informal discussions with you.

Would you please review this list and add or expand upon any of the projects which you foresee as necessary from your viewpoint. With your input, a realistic capital and extraordinary expense budget for facilities-related spending can be prepared.

This office will aid you in estimating the cost of each project.

May 8, 1969

PROPOSED

1970 CAPITAL BUDGET

	Requesting Vice-Pres.		Cost
1.	Treasurer	Central Computer System to centralize Security System	$ 100,000
2.	Treasurer	Air-condition 1/3 of Maynard Plant	250,000
3.	Treasurer	High voltage dual switch gear for Maynard	25,000
4.	Treasurer	Phase III - Primary metering for Maynard	50,000
5.	Treasurer	Maintenance Equipment	75,000
6.	Treasurer	Additional Parking Lots - 500 spaces	140,000
7.	Treasurer	Parking Lot lighting	35,000
8.	Treasurer	Two 50 cycle alternators	24,000
9.	Treasurer	Two air compressors	30,000
10.	Treasurer	**Leasehold Improvements - Maynard complex	220,000
11.	Treasurer	Stairs near Thompson Street ramp	3,000
12.	W. Hindle	Training Center - 30,000 sq. ft. building on 40 acre parcel	
		Land	80,000
		Building	300,000
13.	P. Kaufmann	Leasehold Improvements - Temporary Rented Plant - Leominster - 60,000 sq. ft.	160,000
14.	T. Johnson	Sales and Service Center - Chicago-15,000 sq. ft.	
		Land	80,000
		Building	200,000
15.	P. Kaufmann	New Plant - Computer Production - Leominster	
		Land - 100 acres	280,000
		Building - 250,000 sq. ft.	2,500,000
16.	P. Kaufmann	New Plant - Sheetmetal & PTH - Westfield	
		Land - 250 acres	450,000
		Building - 150,000 sq. ft.	1,500,000
17.	P. Kaufmann	Silk Screen Clean Room	83,000
18.	P. Kaufmann	Leasehold Improvements - Puerto Rico	
		Plant #3 - 60,000 sq. ft.	300,000
		Plant #4 - 60,000 sq. ft.	250,000
		Plant #5 - 60,000 sq. ft.	250,000
19.	Treasurer	Additional Sprinkler Work - Maynard	100,000
20.	Treasurer	Three Guard Houses - Security	15,000
		TOTAL	$7,500,000

**Leasehold Improvements to the following buildings: 1-1, 1-2, 6A-1, 6A-2, 6A-3, 6B-1, 6B-2, 6B-3, 6C-1, 6C-2, and 8A-1

May 8, 1969

FY 1970

EXTRAORDINARY EXPENSE BUDGET

($'s are in 648 Cost Center Budget)

1.	Various	Miscellaneous expansions and relocations (Proposal # 4)	$250,000
2.	P. Kaufmann	Relocate PTH & Fabrication Shop to new facility	50,000
3.	Treasurer	Re-oil Parking Lots	40,000
4.	Treasurer	Heating and Zoning valves	40,000
5.	Treasurer	Repair fencing - Security	10,000
		TOTAL	$390,000

digital INTEROFFICE MEMORANDUM

DATE: May 9, 1969

SUBJECT:

TO: K. Olsen

FROM: Gabe d'Annunzio

I read over with interest your letter regarding the Hanover Show and will be in touch with Steve Bowers to plan for next year's show.

Your comments of a record for the PDP-10 are very interesting. I have been looking into the possibility of doing such a record. Instead of 25 or 50 cents per record, I have found that it will cost approximately 10¢ if a sufficient quantity is ordered.

I would like to try pursuing this record purchase and get them ready for the Fall Joint Computer Conference Show.

/meb

digital INTEROFFICE MEMORANDUM

DATE: May 12, 1969

SUBJECT: Engineering Projects

TO: Ken Olsen

CC Nick Mazzarese

FROM: Clayton Rix

If your recent memo on Engineering Projects was a recommendation to use more widely the discrete project report system it will be done. This is, however, contrary to what has been previously preached in the Accounting Department. We had been cautioned to concern ourselves with only the gross charges by Product Line and not allow large numbers of meaningless discrete projects to be opened within Product Lines.

The emphasis of control within Product Lines was placed upon each cost center. Your memo shows $23,400 Non-Segregated by Discrete Projects for the 8I and suggests lack of control. Knowing from which Cost Center these expenses are coming does give some control:

Department	Expense
Model Shop	$(7,613)
Drafting	308
Mechanical Engineering	337
Programming - Systems	8,765
Programming - Diagnostic	5,341
Programming - Manuals	1,744
A/D Development	1,219
Production Engineering	(613)
PDP-8 Engineering	1,773
PDP-11 Engineering	386
Printing - Hardware	1,985
Printing - Software	136
Tech. Writing - Hardware	8,112
Tech. Writing - Software	1,495
TOTAL	$23,371

CER/ba

digital INTEROFFICE MEMORANDUM

DATE: May 13, 1969

SUBJECT: Small Printer Development Progress Report

TO: Ken Olsen FROM: Bill Owens

Small Printer Design Review Committee
Special Products Development Engineers - Joe St. Amour
Mechanical Engineering Department - Loren Prentice
Engineering Committee

The following is a preliminary summary of the small printer development work now taking place.

We are now in the laboratory evaluating our printing concept.

It is hoped that by telling you our ideas now and publishing some preliminary results and problems now, we can get back from you early enough in the evaluation inputs about things we should try, problems we haven't thought of, solutions we haven't thought of.

The goal is to speed up the process of deciding whether or not we have a worthwhile printing technique.

The report is divided into eight sections:

/bca

May 13, 1969 William W. Owens

Printing Technique Specification

The printing concept under development is intended to print a minimum of 64 .105 inch x .070 inch alpha-numeric characters at a print rate of 100 characters per second (not including carriage returns or line feeds).

In order to achieve a minimum cost/maximum reliability configuration, mechanical motions are to be kept simple and the number of moving parts kept few.

In order to achieve maximum versatility the concept must be capable of printing characters asynchronously, although not necessarily at the 100 character per second rate.

General Approach

The most important design considerations are (1) total printer cost (including supplies), (2) output rate, (3) field reliability and repairability.

A dot matrix printing scheme using heat sensitive paper was selected.

The use of dot matrix character generation can be mechanically much simpler than techniques requiring that each character be preserved in iron awaiting presentation to the page. The use of sensitive paper eliminates the need to impact ink onto the page; a complex mechanical interaction requiring a single fast hammer (Univac Incremental-Printer) motion (expensive and difficult to achieve) or multiple slower hammer (LA-20) motions (still expensive). A 35 dot matrix (5 x 7) has been selected as the minimum which can produce a 64 character font legibly.

Sensitive papers come in wide varieties. Important to our customers is: paper cost, unusual handling techniques, aesthetic qualities of output, and legibility.

Light sensitive papers were in general expensive, required special storage and handling, the image required "developing", and the printer, being basically a high intensity display, was not a device we might build for a thousand dollars.

Electrostatic or electrosensitive papers were in general expensive, easy to print on, but sometimes smelled or smoked, and legibility and overall aesthetics were proportional to the

price. A printer developed for use with this type of paper is potentially the simplest of all from a mechanical viewpoint, possibly requiring only a paper motion mechanism. However, the cost and lack of customer appeal of the paper was judged to outweigh printer simplicity in value. Best indications are that new paper developments will come in the areas of light sensitive and heat sensitive papers, rather than in this area of electrosensitive papers.

Heat sensitive papers in general are expensive and as aesthetically unpleasing as are the electrosensitive papers with the exception of the NCR thermal sensitive paper. The NCR paper is low in price, about twice as much as regular teletype paper, makes no smell or smoke during the printing cycle, and is hard to distinguish from a good grade of teletype paper both in appearance and feel. Both NCR and Texas Instruments manufacture or plan to manufacture thermal printers in considerable volume, so it is expected that other papers competitive with the NCR product will emerge shortly. In general, the increase in printer mechanical complexity required to use heat sensitive rather than electrosensitive papers was judged to be outweighed by the low cost and desirability of the NCR type of paper.

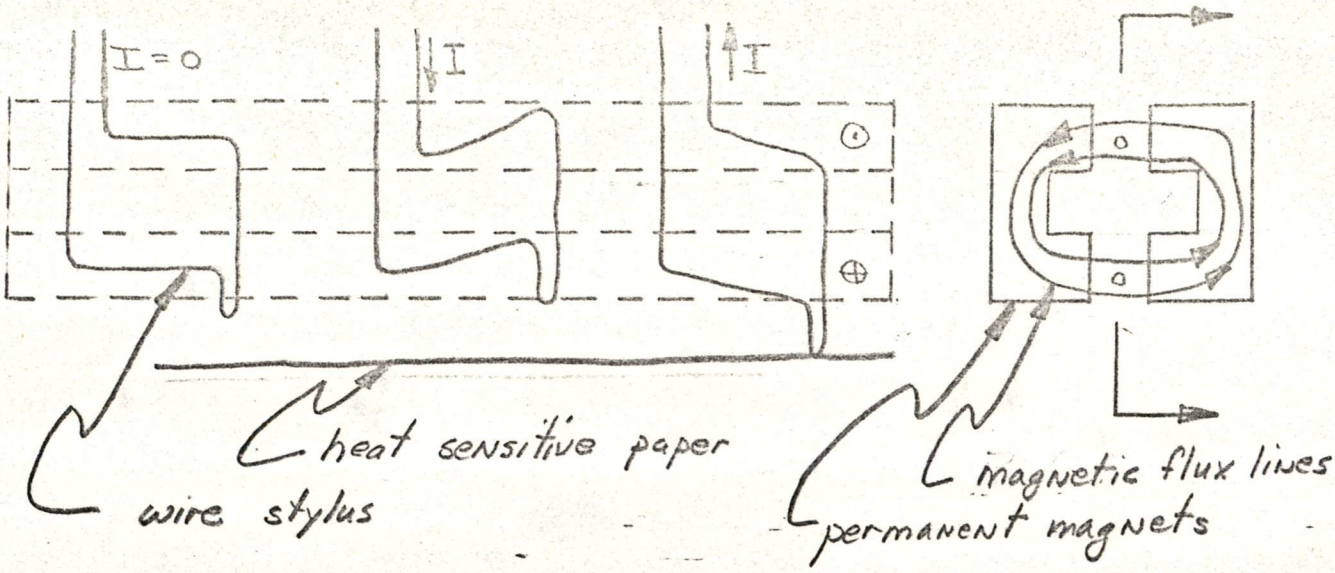
May 13, 1969 William W. Owens

Specific Design Concept

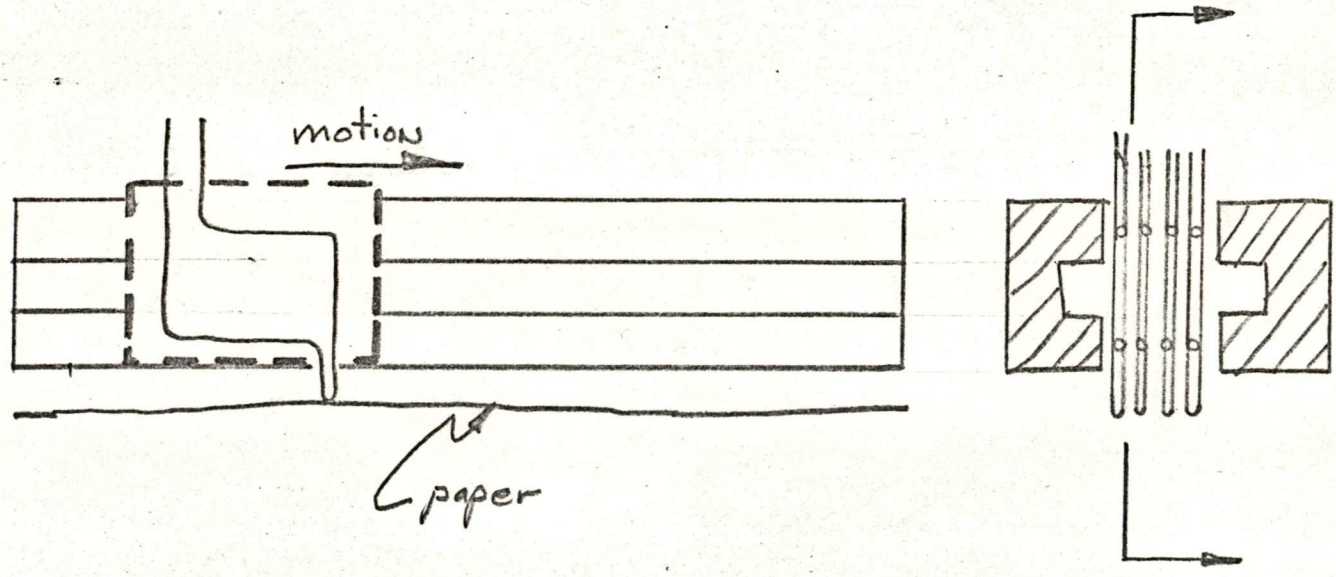
Several techniques for marking on heat sensitive paper have been evaluated and several concepts seem feasible for printing at speeds up to about 40 characters per second; however, at the specified rate of 100 characters per second one concept appears theoretically and economically much more feasible than the others.

The selected concept makes use of a current carrying conductor in a magnetic field. The conductor is in the shape of a rectangular loop. A current in the conductor generates I^2R heat and also causes the conductor to deflect due to the EM forces on the moving charges in the wire. Reversing the direction of current in the wire continues the heat dissipation but deflects the loop in the opposite direction (See Sketch I). On the downward stroke, the hot loop contacts the paper and prints a dot. Controlling the current in the wire determines when dots are printed as well as dot shape and size.

A printing device then would use several of these wire loops side by side in the same magnetic field. The current through each loop can be controlled independently, and the whole assembly of loops can be moved across the page. (See Sketch II). To print a line of characters requires that the assembly motion and each stylus motion (loop deflection) be coordinated so that dots or lines appear in the appropriate patterns.



Sketch I

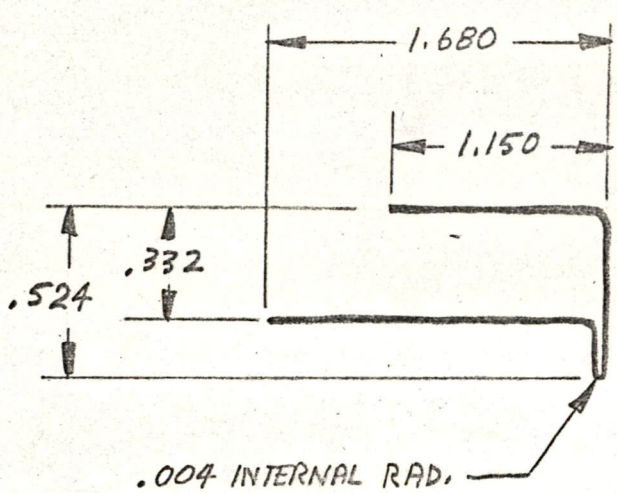


Sketch II

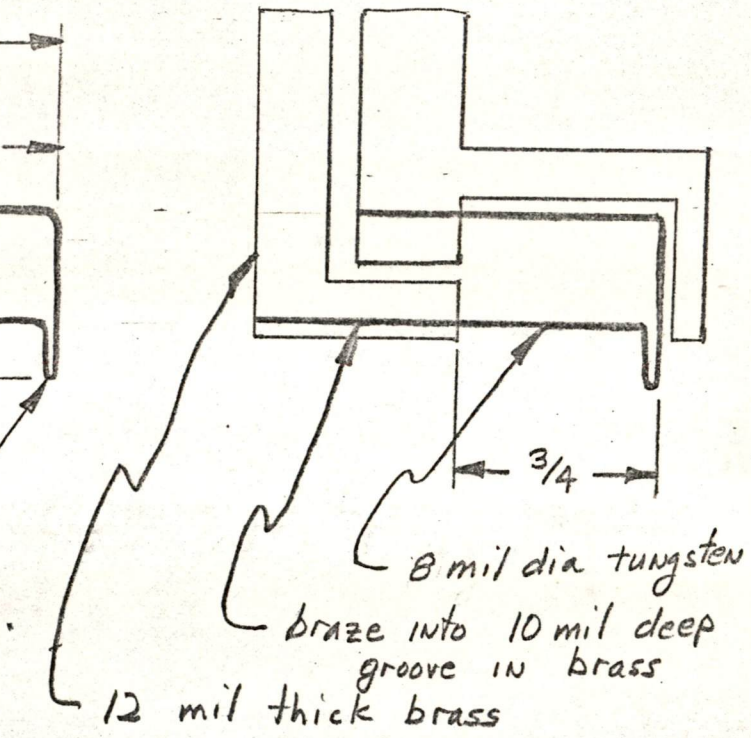
May 13, 1969 William W. Owens

Prototype Printing Device Description

A hot wire stylus print head was built by bending 8-mil. dia. tungsten wire into the stylus configuration shown in Sketch IIIa. Each tungsten wire was then brazed into groves in two flat pieces of brass (Sketch IIIb). This brass-tungsten



Sketch IIIa



Sketch IIIb

brazement forms the meat in a mica sandwich. 4-mil thick mica sheets separate and insulate adjacent styli from one another. During assembly an epoxy adhesive is used to bond the layers together, being careful that each stylus is left free to deflect in its own plane. Later, a mechanical fastener is added. The large brass pieces serve to conduct current to the wire loop and conduct heat away from the loop without themselves reaching a high enough temperature to destroy the adhesive bond.

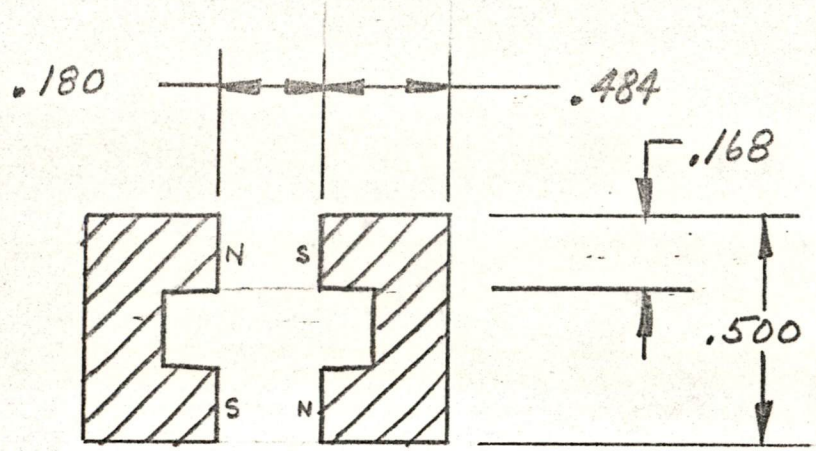
The stylus laminate ultimately used will consist in seven or more styli side by side. For simplicity, the prototype device contains only five styli. The laminated stylus package is then mounted on a carriage which is stepped back and forth across the page by a stepping motor. Electrical connections are made to the brass tabs brazed to the styli.

A production stylus package will probably not use a brazement but rather a stylus etched in foil. The brazement was a fast and easy first attempt.

May 13, 1969 William W. Owens

Theoretical Calculations

Permanent magnet field strength in the air gap is estimated to be 1000 gauss. Magnets are Alnico 5 with the configuration shown in Sketch IV.

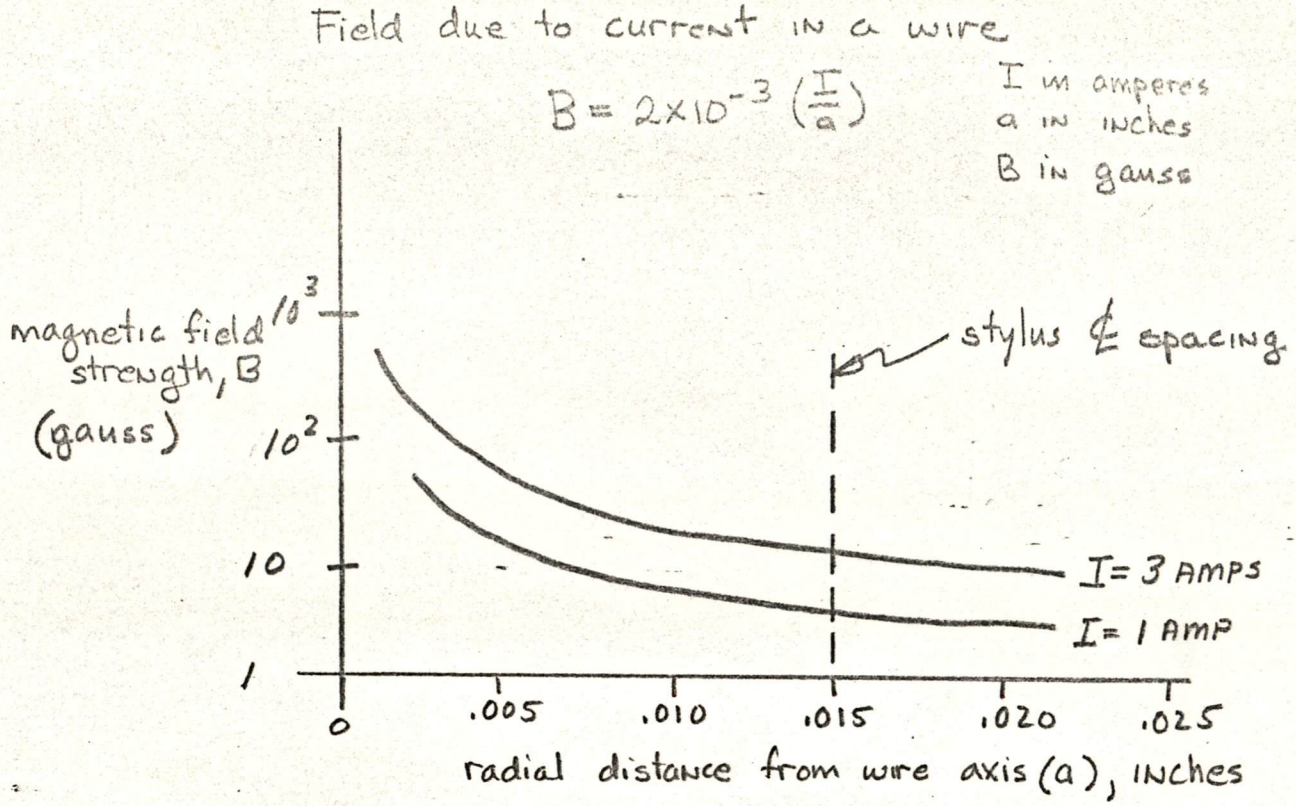


total magnet length (⊥ to paper): 12 inches

Sketch IV

Magnetic field due to current in the wire is computed and graphed in Sketch V. The force due to this secondary field acts perpendicular to the direction of deflection of the styli. The magnitude of this extraneous field is only about 1% of the total static field strength, hence its effect is ignored.

May 13, 1969 William W. Owens



Sketch V

Static deflection of the tip of the current loop is given approximately by

$$A_{STATIC} = 2 \times 10^{-8} \frac{iB}{EI} L^4 \text{ (inches)}$$

where i = current in the loop, amps

B = magnetic field strength, gauss

L = loop cantalever length, inches

E = elastic modulus, psi

I = wire moment of inertia, $in.^4$

$$A_{STATIC} = .013 \text{ inches}$$

if i = 4 amps

B = 1000 gauss

L = 3/4 inch

E = 10^7 psi (hot tungsten, estimate)

I = 2 x 10^{-10} in.^{4}

The Resonant Frequency is estimated by the formula

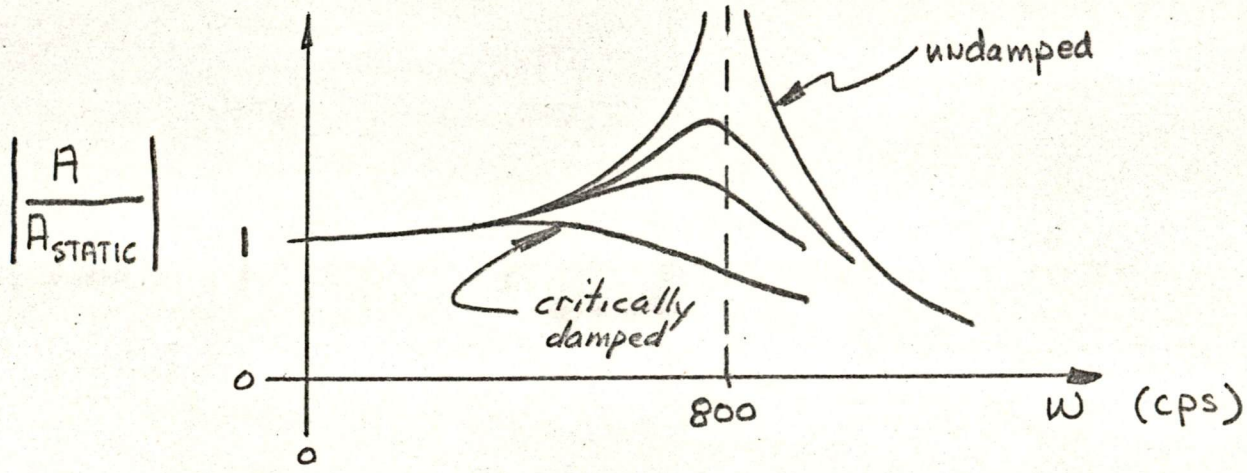
$$W_{RES} = \frac{10}{\pi}\sqrt{\frac{EI}{A\rho}}\ \frac{1}{L^2} \qquad (cps)$$

where Ap is the mass per unit length of the wire. For the same 8-mil stylus

$$W_{RES} = 800 \text{ cps}$$

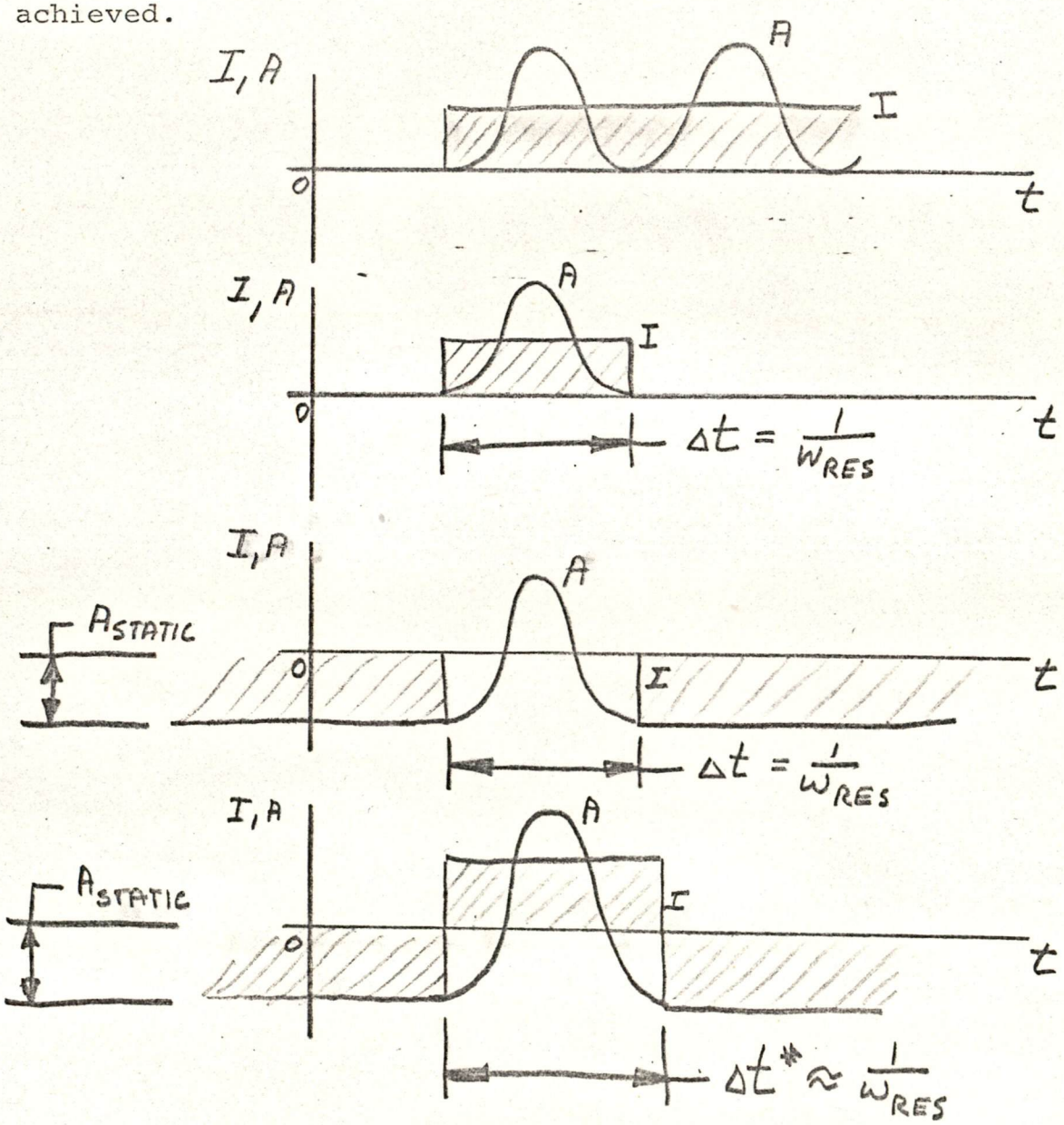
where $$Ap = 9.6 \times 10^{-8} \frac{\text{lbf sec}^2}{\text{in}^2}$$

Estimated frequency response, depending on damping is:



The most important aspect of the stylus is its transient response. When the force on the wire is a simple impulse of short duration, the stylus must move from its initial position,

go through a large enough deflection to contact the paper, and then return to its initial position without grossly overshooting. Several diagrams of current (i.e. force) and displacement versus time illustrate how this motion may or may not be achieved.



There is a Δt^* at which the last response above can happen, and this is the manner in which the styli will be forced.

May 13, 1969 William W. Owens

Theoretical Conclusions

In order to print 100 characters per second, each stylus must be capable of printing at a rate of about 700 discrete dots per second. This means the current reversal time must at most be

$$\Delta t^* \leq \frac{1}{700}$$

and this means the stylus resonant frequency must be

$$W_{RES} \geq 700 \text{ cps.}$$

In addition it is desireable to have the static deflection as large as possible. The prototype device using an 8-mil dia. by 3/4 inch long tungsten stylus drawing 4 amps is a temporary compromise with

$$W_{RES} = 800 \text{ cps}$$

$$A_{STATIC} = .013 \text{ inches}$$

The impact which occurs when the styli hit the page will have an important effect upon the dynamic behavior of the styli. The hope is that, either the impact can occur near the bottom of the stylus swing, be fairly elastic and probably not affect dynamic characteristics much, or that the impact may have a large effect but a compensation will be possible by adjusting Δt^*. The characteristics of the impact will be important and must remain consistent with time.

May 13, 1969 William W. Owens

Experiments to Date

Thus far two basic types of experiments have been performed.

Experiment I

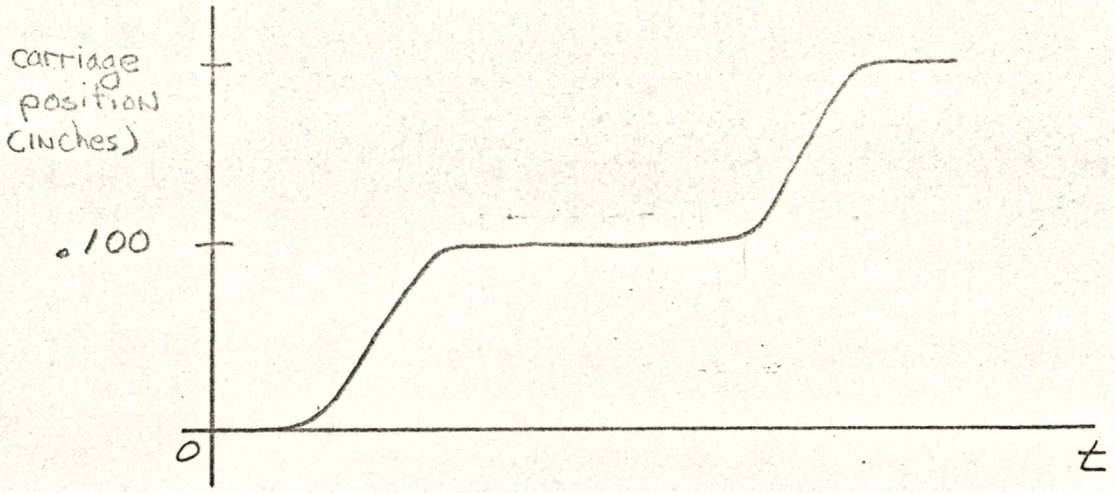
By stepping the carriage motion stepping motor at a uniform pace and by driving the stylus with a square wave current reversal of the same frequency as the motor steps, a mode of synchronous operation was simulated.

Discrete dots, having a fair degree of uniformity in size and spacing were formed at the rates of 700 dots/sec, 500 dots/sec, and 300 dots/sec. At 100 dots/sec discrete dots were not formed, probably because 100 motor steps/sec caused extreme vibration of the carriage; dots were blurred together.

Experiment II

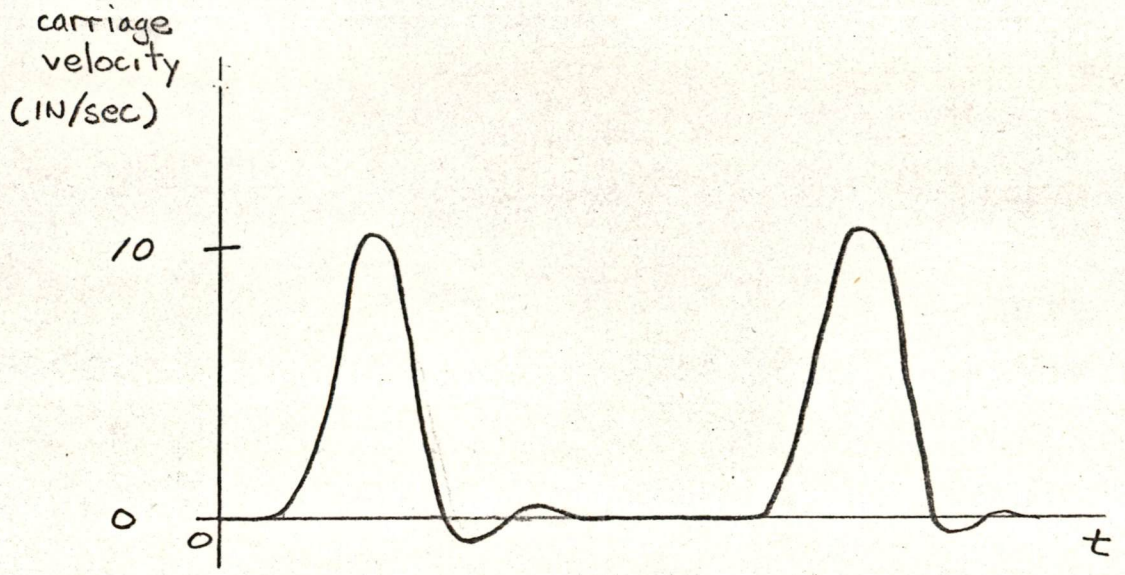
This experiment attempted to simulate asynchronous operation of the printer.

Seven motor steps move the carriage .100 inches or one character space. The carriage motor was stepped in an irregular way to provide a fast carriage acceleration, uniform carriage velocity, and then a smooth deceleration to dead stop, all within seven steps. Then, after a several milliseconds delay the seven step cycle was repeated. So distance as a function of time theoretically looked like the graph in Sketch VI below.



Sketch VI

Tachometer measurements of velocity do indicate that very little overshoot occurs, probably .010 - .015 inches at most, and is damped out rapidly.



Sketch VII

May 13, 1969 William W. Owens

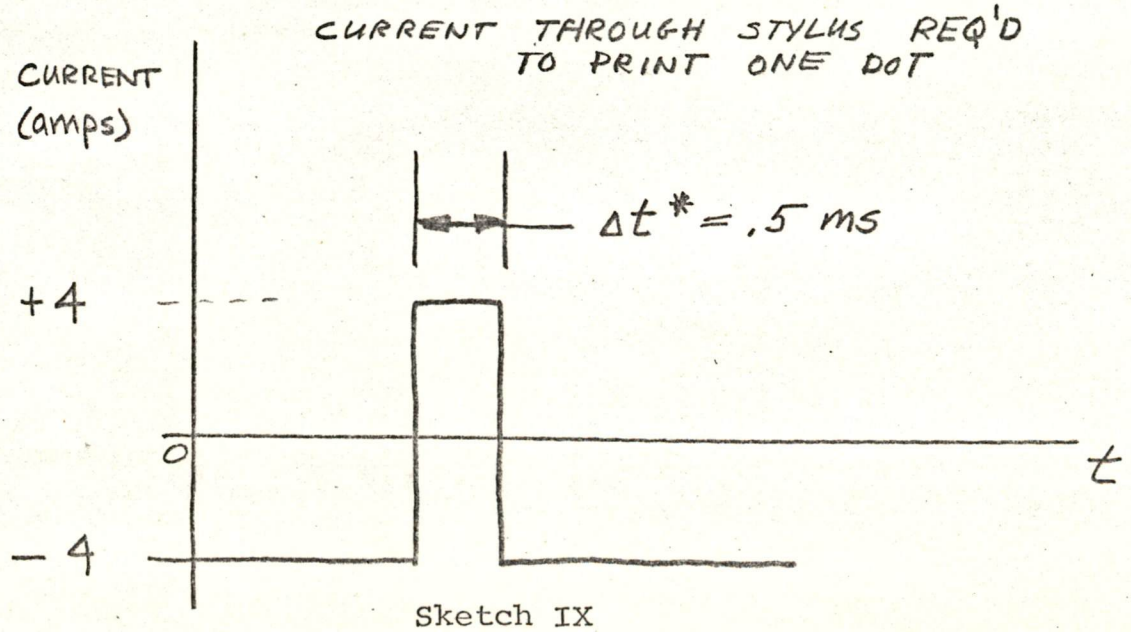
The velocity indeed never stayed at a uniform value during the print cycle. However, adjustments to dot print times were made so that dots were printed at uniform increments across the page.

The table in Sketch VIII gives motor step and dot print times used in one experiment, which worked well and gave uniformly spaced dots.

Step No.	ΔTime (ms)	Dot No.	ΔTime (ms)
1	0	1	0
2	3.0	2	2.6
3	1.7	3	1.9
4	1.3	4	1.9
5	1.8	5	1.6
6	2.3	6	1.5
7	3.0	7	3.0
	13.1		12.5

Sketch VIII

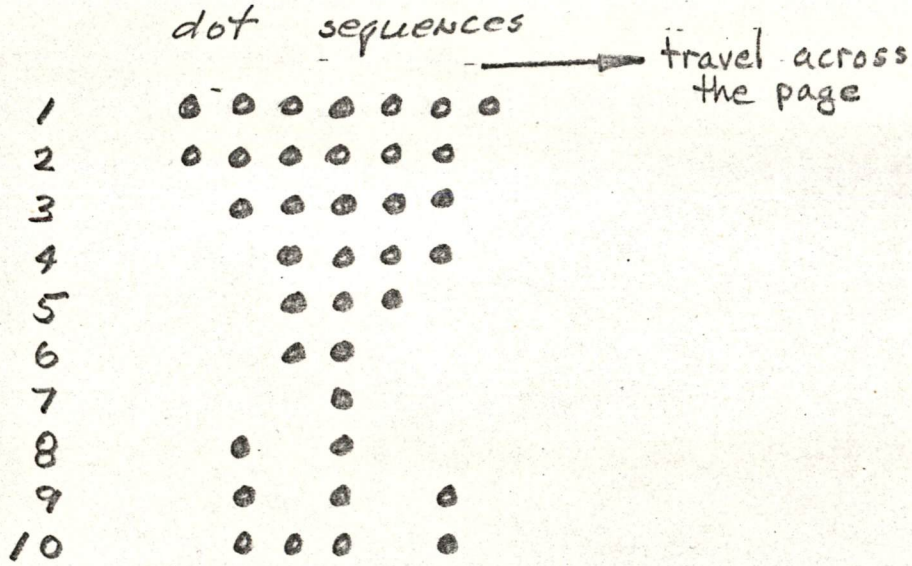
The stylus forcing function (current reversal impulse) was adjusted to be a .5 ms impulse as shown in Sketch IX.



Sketch IX

May 13, 1969 William W. Owens

Using this forcing function it was possible to make one stylus print one dot on command at any specified time. During the seven motor steps any one or all of seven dots could be printed across the line. The dot sequences shown schematically in Sketch X were actually printed. The time required to print the "character" was 12.5 ms. The arbitrary delay between characters was about 10 ms, so we were simulating asynchronous printing at an average character rate of about 45 char/sec.



Sketch X

The implication is that any combination of dots desired can be achieved using the same forcing function (i.e. the stylus really pecks once and comes to rest). The next step is to try this same experiment at a faster dot rate.

Problems

There appear to be three major problems with the prototype printing device.

Problem I

If the carriage remains stationary for more than a few tenths of a second, with the styli up off the page, darkening of the page due to radiant heating from the stylus still occurs.

Several solutions seem possible:

(a) Adjust stylus parameters, other than current, so that the stylus deflections are larger than the present total amplitude of .026 inches. Radiant energy hitting a unit area of the page drops off as the square of the stylus displacement, so this idea really wins.

(b) invent an opaque shield which covers the styli when they are in the "up" position. This might be a simple mechanical shutter attached to the carriage which would be energized by the accelerations and decelerations of the carriage.

(c) a small jet of cool air might be directed at the page directly under the styli.

Problem 2.

Dot dia. using the 8-mil dia. stylus is only about .005 inches. (The stylus is slightly cut away on its contact surface to give a face dia. of about 5-mil. Dot size equals contact area size.)

Putting more current through the stylus to make the wire hotter does not appreciably increase dot size because the stylus is

not in contact with the page long enough for that extra heat transfer to take place.

Dot dia. must be about .010 inches if suitable legibility is to be achieved.

The only answer seems to be to use a larger dia. wire (say .016 in.) in the stylus. This creates a packaging problem since styli must be on .015 centers.

If the stylus is etched from flat stock or if rectangular wire is used, a dot size of 10 mils may be achievable with a stylus thickness of 10 mils, which presents an easier packaging problem.

Problem 3.

Lack of uniformity of lamination presents a problem in that each stylus finds itself in a slightly different environment from the rest.

Of most importance is the amount of damping associated with each stylus. This depends on how much the stylus rubs on its mica neighbors. The prototype was designed to give each stylus 2 mils clearance on each side (i.e. mica air gap was to be 12 mils). In practice this "elbow room" ranged from 13 mils to 19 mils, so each stylus had quite different response characteristics.

In addition, each stylus warps out of plane when heated, thus adds to uncertainties in response.

These are the reasons why, in experiment 2, the chosen forcing function caused only one stylus to operate properly. Each stylus would require a different forcing function. (The other styli almost fundtion properly.)

Possible Solutions:

(a) Etch styli out of flat stock to minimize distortion when heated. Stresses at wire bends are major causes of warping.

(b) Use no adhesive in laminate assembly. Adhesive thickness is difficult to control.

(c) Assemble in such a way that total laminate flatness is controlled. This was not done with the prototype; it was simply glued together (brass layers were not flat).

There are a number of minor problems.

Problem 4.

Flatness of the surface being written on, ripples in the paper, variations in the surface position with respect to the styli causes irregular dot formation.

Possible Solutions:

(a) Pull paper around a cylinder; write dots on the cylindrical surface. In the prototype we try to hold the paper flat, almost impossible to do without vacuum or electrostatic hold down.

(b) Use larger amplitude of stylus motion. Paper irregularities become less important.

Problem 5.

Stylus wear seems to be no problem, however only a few hours

operation have been logged. However, the mica interlayers are wearing away where the styli rub.

Preliminary Conclusions

The stylus concept is capable of printing dots asynchronously at the speed specified.

Unlike most thermal printers, we seem to be free from paper/stylus compatibility problems. Almost any heat sensitive paper will work in our printer without adversely affecting the device.

The concept seems to be relatively simple from a manufacturing viewpoint. Cost targets look realistic.

More amplitude of stylus motion is required; a stylus having a rectangular cross section is required; better control over tolerances is required in stylus laminate; the paper must be flat to within $\pm$.005 inches, at least along the line being printed; and more durable insulators must be used in place of the mica sheets (we would like to remove the insulators entirely, but for the moment stylus warp prohibits this).

dec INTEROFFICE MEMORANDUM

DATE May 14, 1969.

SUBJECT EUROPEAN STANDARDS

TO Ken Olsen

FROM Denny Doyle

c.c. Ted Johnson
Ron Smart
Jean-Claude Peterschmitt

In your memo of April 28th to Jean-Claude Peterschmitt you proposed that he prepare a book or a group of memos which could be used as guidelines for dealing with Europe.

I would like to suggest that we prepare a booklet within the Corporation known as an International Handbook which would, I think, serve the purpose that you are discussing here.

In fact Ted and I discussed this back in 1967 and Ted asked me to take a first pass at it which I did. I am sending along the few introductory pages that I wrote at that time. This handbook would be a little broader in scope than just the discussion of standards and practices but I think it would be very useful in keeping people informed at the plant on some of the differences in dealing with subsidiaries.

I feel that there is a lot of undue criticism directed towards the plant to the effect that Americans do not take into account the differences between America and Europe. I think that most of these complaints are barking up the wrong tree because indeed in my view I feel that most of our senior management at Maynard are very sensitive towards the differences between doing business in the States and in foreign countries. The differences in the case of Canada, of course, are not nearly so great but I have been very gratified to see the efforts that senior management personnel go to in order to accommodate even the subtle differences. I am sure this effort is being put into our dealings with our European operations as well.

Where I think the problem lies is that not enough people in the middle and junior management levels in the company have been advised on the mechanics of doing business through foreign subsidiaries as opposed to doing business within regions. My own personal complaint is that there is a great deal of"double administration" going on in such areas as accounting, personnel administration and contracts administration for the simple reason that the groups who normally do these functions back at the plant feel that they have the responsibility for doing them world-wide. However, these are functions which must be done within the

..2

dec INTEROFFICE MEMORANDUM

DATE May 14, 1969.

SUBJECT EUROPEAN STANDARDS

TO FROM

jurisdiction of the foreign subsidiary since generally they are subject to foreign legislation such as foreign labour laws, foreign customs, foreign income taxes, etc., etc. I find myself communicating far too much with people at Maynard who are in effect doing the same thing down there but cannot actually do it effectively since they do not have the raw data with which to work. Therefore the tendancy is for them to request all the raw data from us and then they go through the mechanics of doing it back at the plant. Obviously this is a time consuming and very inefficient procedure and one that I think could be resolved if they were better informed as to the mechanics of doing business in the subsidiaries.

Therefore I suggest that any such international handbook have sections devoted to each of these various functions. Specifically I am suggesting the following sections:

Accounting
Personnel
Sales
Field Service
Engineering
Manufacturing.

To illustrate how this would cover the various topics raised in your memo of April 28th I feel that the question of electrical and mechanical standards could be covered under engineering whereas the question of holidays and local labour laws, etc., could be covered under personnel and finally the layout of literature and pricing information could be covered under sales. I would certainly like to see such a project given some priority but I do feel that it should be spearheaded from the plant by a single individual who would visit the various foreign countries and take these inputs from the foreign managers and then fit them into the appropriate sections in the international handbook. I have a feeling that we could trim some of the staff from our foreign operations by taking a hard look at some of the double administration that I refer to and this handbook might pay for itself many times over before it goes obsolete on us.

Denny

DJD/es

DEC International Handbook

INTRODUCTION

Digital Equipment Corporation operates subsidiary companies in Canada, Germany, England, France and Australia. The primary functions of these companies is to sell and service DEC products in their respective countries. Other activities such as manufacturing, and software development are also carried out in some of these foreign operations.

There are several unique aspects to the make-up and administration of a foreign subsidiary which make it somewhat different from a domestic organization performing the same functions. The success of DEC's international operations is heavily dependent on their complete understanding by all levels of management at Corporate Headquarters in Maynard.

It is the purpose of this booklet to acquaint all concerned with some of the logistics problems of dealing with subsidiaries and to provide guidelines for dealing with situations as they occur. These notes should be used with some discretion, they are intended mainly for use by managers in instructing their people on the details of dealing with the subsidiaries but not for wholesale distribution throughout the plant. Further notes will be added by the Sales Department and by the other foreign managers, and a final International Handbook will be completed by January, 1968.

1. WHY A SUBSIDIARY OPERATION?

DEC's involvement in foreign operations began with the incorporation of subsidiaries in Canada and Germany in 1963. These were set up to serve the markets which had grown in these countries over the years since DEC itself was incorporated. They were set up with terms of reference very similar to a U.S. domestic sales office. Their primary functions were to expand the existing markets and to provide them with all of the services normally provided to a U.S. market, such as applications engineering and field service support.

However, the rules of operating a sales outlet in a foreign country are somewhat different than for operating a similar outlet within the U.S. Probably the most important rule is that you must set up in such a way that the foreign government derives a tax revenue from your operations. If DEC were to operate through a representative on a commission basis, then the foreign government would be happy since it would be deriving revenue from the corporation tax paid by the representative, (this assumes that the foreign representative is incorporated as a taxable company). However, DEC has elected to set up its own operations, and has incorporated subsidiary companies. DEC sells its products to its subsidiaries at a discount and the subsidiary manager is then given the responsibility of operating his sales, field service and all other functions on this discount. He must also show a profit on his operations that is reasonable in the judgement of the foreign tax authorities.

2. WHAT IS DIFFERENT ABOUT A SUBSIDIARY OPERATION?

The first thing that is unique about a subsidiary operation of course is its "buy-sell" relationship with the Corporation. The second thing that is different is that it must maintain an accounting department to keep track of the inter-company transactions, and to ensure that the fiscal obligations to the foreign government are met. To get down to the level of practical details, a foreign manager issues his own invoices and usually signs his own pay cheque. These sound like unusual elements of freedom, but in fact the foreign manager finds that all of his activities come under the very close scrutiny of our public auditors, the foreign government's auditors, and the Corporation's own internal auditor, so the position is indeed one that requires a high level of integrity and responsibility.

The third thing that is different about a subsidiary is that it faces foreign import duties on the U.S. products that it brings into the country. This duty may range anywhere up to 20% depending on the product and on end use. This therefore puts an extra load on the marketing job which is non-existent in the U.S. In addition to duties, there are sales taxes, but these are similar in many ways to equivalent U.S. taxes. It is however, the responsibility of the foreign manager to collect all such taxes and all applicable duties, and remit them to the foreign revenue authorities.

A final distinguishing characteristic that is worthy of mention concerns the political and economic factors which influence our operations in each of the various countries. Many of the highly industrialized nations of the world encourage domestic manufacturing and usually offer significant incentives to foreign operations that are prepared to engage in production or assembly operations. Some of these incentives are real and some are very intangible. There is a world-wide trend towards lowering of tariff barriers, and the offering of such incentives will likely continue.

The combination of the above factors usually leaves a foreign manager with aims and ambitions which are markedly different than those of his U.S. counterpart. A clearer understanding of his environment will assist the Corporation in choosing those courses of action which are consistent with his ambition and which are profitable to the Corporation as a whole.

3. THE "BUY-SELL" RELATIONSHIP

Because of the interest that foreign governments have in the pricing policies between DEC and its subsidiaries, it is important that all foreign shipments are priced and invoiced properly. It is also important that the pertinent customs papers be prepared prior to shipment. Inaccuracies in either of these areas can result in penalties by the foreign revenue authorities, particularly by the customs authorities.

Digital operates an Import/Export group under the direction of an Export Manager. It is essential that this group be used to coordinate all foreign shipments, including such items as literature, field-service tool kits, field-service spares, and sales samples. This is true even when such items are hand-carried.

4. SOME TIPS ON SUPPORTING OUR SUBSIDIARIES

The various support functions such as personnel, advertising, etc., that are available to the U.S. regions are also available to the foreign operations. The degree to which they can be used in the foreign operations varies both with the function and with each of the subsidiaries. Clearly the accounting function is one that has to be done almost entirely on-the-scene. Certain aspects of personnel administration must also be done locally. Payroll cheques must be prepared in foreign currency, income taxes must be deducted, fringe benefits such as insurance plans and government social security programmes must also be implemented.

There are other functions which must be provided almost entirely from Maynard, since the cost of setting up equivalent functions of the same calibre locally, would be prohibitively expensive. Included among these functions are:

a) Promotion and Advertising.
b) The scheduling and arranging of trade shows.
c) Marketing support.
d) Legal support.
e) Technical literature.
f) Direct mail.

To make these functions truly available to our foreign subsidiaries, the managers of these services must become as familiar as possible with the peculiarities of each of the foreign operations, and with the problems which are unique to each of them. For example, legal advice must be based on the laws of the foreign country, and not on the laws of Massachusetts. The following is a listing of "do's" and "don'ts" which are by no means complete, but which are meant as guidelines around which an international image can be built.

1. The correct names of our foreign subsidiaries should be used in all references which are made to them when communicating with foreign customers. Do not refer to DEC's "German Office" and do not refer to "Digital Equipment Corporation of Canada Ltd.".

2. Trade shows should be operated under the name of the subsidiary. All reply cards and show hand-outs should be printed in the name of the subsidiary.

3. Sufficient lead-time should be given to allow for customs clearing of the equipment required for the show. In Canada, for example, it is possible to

to import such items on a duty-free basis if arrangements are made with the trade-show management. Otherwise, duties must be paid and drawn-back (99% drawn-back). However, this ties up a large sum of money and in fact forfeits 1% of it entirely. In the case of some trade shows, the applicable duty and taxes may run as high as $20,000.

4. All foreign advertising should be done in the name of the foreign subsidiary involved.

5. Customers of our foreign subsidiaries are to be invoiced by the subsidiary and not by Maynard.

6. Under no circumstances should customers receive copies of inter-company invoices.

7. Due consideration should be given to the foreign operations when reorganizing the support functions or planning new ones at Maynard.

8. The foreign subsidiaries should be mentioned whenever possible in press releases since this can be beneficial to both the domestic and foreign operations.

9. Frequent press releases and literature announcements should be made in the trade literature published in the foreign countries in which DEC operates.

CONCLUSION

Foreign markets can be very lucrative or they can be financial disasters. The difference between the two is usually not the product, but how it is promoted, and the degree to which the foreign operations are understood at the home plant. Some U.S. companies have foreign operations which are equal in volume to the U.S. domestic operation. Others have failed even in Canada, the country which is considered to be most like the U.S. The importance of understanding and supporting our foreign operations in a professional, business-like manner therefore cannot be overemphasized.

digital INTEROFFICE MEMORANDUM

DATE: 19 May 1969

SUBJECT: CMD 1101 Mono Disk Memory (Disk Cartridge) Versus Others

TO: R. Clayton/B. Vachon FROM: Pierre Schneebeli

cc: J. St. Amour
J. Carroll
L. Gale
P. Greene
T. Johnson

There are presently, to our knowledge, five IBM 2310 Compatible Cartridge Drives. They all use the same IBM 2315 Disk Cartridge (or MAC PACK 2315).

1. Computer Memory Devices - Phoenix, Arizona

   Eleven (11) million bits (unformated) 200 usec average access time

   Available as production model by 15 July 1969 (100 drives by 30 December 1969).

   Price to DEC is $4,950 with read/write electronics, $3,000 without electronics.

2. Hewlett Packard - Mountainview, California

   Possibly 12 million bits (unformated) 90 usec average access (4 magnetic heads instead of 2 to reduce access time in half)

   Available for evaluation by January, 1970. Available as production model by early spring 1970.

   Price to DEC is "above $6,000" (quoted by Chief Engineer at SJCC).

3. Bell & Howell - Pasadena, California

   Sixteen (16) million bits (unformated) 200 usec average access time.

   Available for evaluation August, 1969. Production model available early 1970.

   Price to DEC is between $6,000 and $7,000.

4. Caelus Data Products - San Jose, California

   Twenty (20) million bits (unformated) 30 usec average access time

   Available for evaluation by 1 August 1969. Production model available early 1970.

   Price to DEC between $6,000 and $7,000.

5. I.O. Mech - Santa Clara, California

   Probably 18 million bits (unformated) probably 45 usec average access time

   Available for evaluation probably September 1969. Production model available in early spring, 1970.

   Price to DEC is probably between $6,000 and $7,000.

For comparison, the original IBM 2310 Drive has the following parameters:

   Eleven (11) million bits (unformated) 500 usec average access time

   Available for evaluation now. Production model available after study of "priority" charts.

   Price to DEC is approximately $10,000.

Summary:

The PDP-12 has now interfaced a CMD 1101 in a special system configuration. The drive is working well. Eugene Perry, President of CMD, discussed performance and deliveries with us Friday, 16 May and gives the impression of total commitment. Caelus and I.O. Mech will produce faster machines (which may require more complex controlers) at a later date.

Conclusion:

CMD is still our best present choice. To give faster access time to our customer at a later date and to allow double sourcing, the final PDP-12 standard option controler should be designed in such a way as to accommodate for the sophistication required by other drives.

/gp

File

digital INTEROFFICE MEMORANDUM

DATE: 20 May 1969

SUBJECT: CMD 1101 Disk Cartridge Drive
at the SJCC

TO: Ken Olsen FROM: Pierre Schneebeli

The PDP-12 performance at the show has been a source of satisfaction for us all. It is the result of dedication and hard work from many of us in many ways.

From December, 1968, when this effort was initiated, several decisions were taken which only now can be evaluated in their perspective. (Please see attached memo.)

My appreciation goes to Brad Vachon for involving himself in the disk controler support, to Dick Clayton for taking the risk of bringing the PDP-12 at the show with a new disk memory, to Jack Carroll for making the CMD 1101 DEC compatible from the industrial design standpoint, and more particularly to Jim Carroll who not only designed, built, and debugged the disk controler in a self-imposed tight schedule but also helped us get a better understanding of the CMD drive and its potential for DEC.

cc: Jack Carroll
Jim Carroll
Dick Clayton
Lorrin Gale
Joe St. Amour
Brad Vachon
Ron Wilson

digital INTEROFFICE MEMORANDUM

DATE: May 20, 1969

SUBJECT: CMU Visit

TO: Win Hindle
Bob Savell
Dave Cotton
Hartley LaDuke
Fred Wilhelm
Alan Kotok

FROM: Alan Perlis (CMU)
Gordon Bell (CMU)
Ron Rutledge (CMU)

cc: Ken Olsen
Dave Nickerson (CMU)
Nick Mazzarese
Roger Cady

We enjoyed the CMU-PDP-10 network discussion with DEC. The following discussion, together with our initial proposal, represents our view of what we need, and what we hope DEC will gain. A principle gain for DEC will probably be people in a research capacity, who will work in the understanding and exposure of the computer and network systems. The network research would be very difficult to undertake in the DEC product line structure. A research effort of this magnitude would be too costly and inappropriate for DEC alone.

Financial Consideration

CMU's main problem is phasing out its present machines. The 1108 probably cannot be sold soon enough to recover most of the initial investment. The 360/67 is on a rental basis and can be removed on a three months notice. Both the 67 and the 1108 will require a phase-over period during which a PDP-10 must be available for several months before the 67 or 1108 leaves to transfer the load.

The first PDP-10 to arrive at CMU will be a research machine used to develop the implementation language, to debug modifications to the present DEC monitor, and to perform all the computer science research. The presence of a machine for systems development is a major attribute of the proposed PDP-10 network but also represents a machine which is a financial burden as it will bring in no revenue.

The major financial liabilities to CMU are the research machine and the phase-over period when the 67 and/or 1108 are phased out. The ideal situation from CMU's viewpoint would be a free research machine and during the phase-over period a rent-free machine on which to transfer the computing load. The capital loss from selling the 1108 might still be a large loss to CMU.

We propose that DEC furnish CMU a PDP-10 configuration for research and a machine rent free. for the first phase-over period. DEC will transfer title of the research machine to CMU after CMU purchases three PDP-10's. The purchase of additional machines by CMU after the third

machine would be at 80% of DEC's list price. This agreement would hold for two years starting 10 October 1969 or until CMU has purchased a total of seven PDP-10 type machines.

Hardware Needs

Basically, we feel that our specialized hardware needs are quite small and in line with DEC's present goals. The particular needs are:

1. Very clean intercommunications hardware.

   a. A large number (300) of asynchronous 100 ~ 300 bits / sec. ports for typewriters.
   b. A large number (50 ~ 100) of 1000 ~ 2000 bits/sec. ports for scopes.
   c. Approximately 20 bit synchronous interfaces for peripheral computers and peripheral line printer/card readers. The rate should be 2000 ~ 10 kilobits/sec.
   d. Ability for synchronous interfaces at Telepak 50 kilobits/sec for interface to other computers.
   e. Communications among the large processors using bit synchronous standards at 500 ~ 2000 kilobits/sec. (We assume no other physical interconnections except via these lines.) This interface is also used between the small and larger computers.

   Bill Wulf and Gordon Bell feel that the communications needs (a, b, c, and d) can be satisfied using PDP-11's for switching and store-and-forward. This approach is also apparently along the same lines considered by DEC. Gordon Bell would like to spend the summer at DEC (beginning approximately June 15) in specifying these interfaces. (Such an approach would have the added benefit of orienting the PDP-11 to a particular market initially.)

2. Remote Job Entry Terminals. We would hope that DEC would be interested in the design of these terminals consisting of high speed line printers, (600 ~ 1000 lines/minute) and medium speed card readers (200 - 400 card/minute). This device is similar to the Badger, COPE, CDC terminals. Such a terminal might also control remote plotters using local character generation. A storage scope attached to such a device might be useful to display system and job status information. An interface option to an IBM 1403 chain printer would be desirable.

3. Interfaces to special IBM equipment.

   a. We are happy with the 2314's. It's not clear how much effort is required to maintain them.

   b. The 2741 typewriter is a very nice console. We would continue to have these consoles at CMU.

   c. The Data Cell, although it may be or may have been unreliable, represents a reasonable method to store a large amount of information (approx. 3.2×10^9 bits for about $125,000).

4. The diskpak drives require controls so that two computers can access them.

5. We would require at least 1 million words of memory on a two processor system, although we would run this in a dual computer partioned mode.

6. The new processor's double precision and increased speed will undoubtedly satisfy our present computer needs.

7. The paging mechanism is barely adequate. Some thought should be given as to how several page tables might be switched so as to extend the addressing space beyond 262,144 words. This might be partially provided by software control. (We would like to discuss this with perhaps Alan Kotok and Tom Hastings.)

Software Needs

1. We assume that DEC will supply a new monitor for the 10I. We would like to convince them to use our implementation languages, IL. A spec of IL will be sent to DEC within the next two weeks. We would anticipate IL ready by September. (A predecessor version for the 1108 exists already.)

2. The remote job entry capability presently considered by DEC, if correctly designed, should be adequate. We would require multiple remote entry batch entry terminals. Each terminal in turn might have work with multiple job strands. The job strands in turn would be scheduled by the remote terminal control program. This design should be carried out in a highly modular fashion, because every installation needs though similar will be slightly different. Such a structure is akin to a small monitor. A table driven approach might be ideal. Concurrent input spooling, output spooling, and computing is necessary.

3. We would hope that the speed (1000 lines/minute) of the present 1 pass Fortran IV can be improved.

4. A WATFOR type compiler would be highly desirable. It's possible to get one written for money, but it is not out of the question to try to get a present university user to transliterate WATFOR for PDP-10. A visit to Waterloo is probably worth a trip by one or two DEC people. There is a large, recent paperback book (Prentice-Hall ?) on WATFOR by several Waterloo people. By contacting Waterloo, DEC could probably get a listing and internal documentation. I'm sure they would like their compiler reconstructed for a machine other than the 360.

5. We are looking forward to having ALgol. Since SIMULA is a superset of ALGOL, perhaps designing SIMULA may be a better approach. In this way, we also obtain the finest available discrete simulation language. (It would be worthwhile inviting Jack McCredie from the CMU Computer Science faculty to give a talk about it, and how he has used it to model the 1108 operating system.)

6. A discrete simulation language such as GPSS or Simscript would also be desirable.

7. A continuous system simulation language such as CSSL would be desirable. Such a language has been coded at CMU for PDP-9, and no doubt could be transferred to the 10.

8. The Artificial Intelligence group at CMU currently uses IPL V, LISP 1.5, and SNOBOL. We might code IPL V for the PDP-10, but we would rely on the other users for LISP. Perhaps some other university would code SNOBOL.

9. STATPAK, MATHPAK, or BIOMEDICAL Packages are written in Fortran. A universities group could provide some of these packages.

Interface Among PDP-10 Universities Users

We would hope that the user's organization be strengthened for universities computation centers. Such an organization could probably agree to provide certain basic languages and special packages. The important ones are probably continuous modeling, discrete modeling, and statistical analysis.

Benefits to DEC

DEC will receive a particular exposure in terms of papers, publicity and people. This exposure in the university computation center market where DEC has not realized its potential would represent a marketing breakthrough. The fact that CMU is willing to devote its research energies to the PDP-10 network demonstrates CMU confidence in the suitability of the 10's to the university environment. We feel that our computation center is typical of most university centers. Our needs are based on a low cost/job which, if properly tuned, the PDP-10 should provide.

The idea of a network is a completely new market area. We feel it will be a significant market area of the future. The friendly atmosphere afforded by CMU in which to develop and tune for computation center operations where both parties share the responsibility and burden at making the project succeed would be a unique opportunity for DEC. The large commitment by CMU to the PDP-10 network insures the cooperative spirit needed for a joint effort.

Software will be a major return to DEC. An implementation language written for the PDP-10 and tested by CMU on the present 10 monitor which could be of enormous benefit would be done at no risk or involvement by DEC. The implementation language will be ready for DEC to evaluate in September, which would be in time to allow DEC to write the paging monitor in the implementation language if acceptable to DEC. (The spec's will be available in a few weeks.)

CMU will be working closely with DEC on the specification for the paging monitor as the network will require additional functions. The network software outside the monitor will be the responsibility of CMU and would be at no liability to DEC. A spectrum of language in addition to LCC, language for Conversational Computing, and IPL-V would evolve naturally as CMU is a language center.

A user's manual for the network and the specialized notes written by CMU for CMU operation would be available. By the time DEC begins to deliver other computers and networks, the CMU manual would be well tested.

A software interface to the IBM 2741 terminal will be written by CMU to allow use of the 2741's at CMU. This will give immediate use of the 2741's by DEC but we feel that the final interface must be a universal hardware function. The 2741's while not perfect are the best terminals generally available, have already received wide acceptance and are a significant portion of the equipment in use by potential DEC customers.

Simulations and models of the monitor and network will be made by CMU as part of the design phase. Measurement of the present monitor will aid in developing the simulation and models. Continuous simulation will be the first method tried as it represents the proper level of initial approximation and avoids the additional complexity of discrete simulation.

bwf

digital INTEROFFICE MEMORANDUM

DATE: May 21, 1969

SUBJECT: VR12 Literature

TO: Ken Olsen FROM: Klaus Pichler

Reference your memo dated April 30

Please find attached the requested drawings of the VR12 Display. Drawings of the G917, G819 and G912 modules have not completed the release procedure yet. They will be available on May 29. All drawings listed on the Drawing Index List are signed and ready.

The Manual is well on the way but far from ready. John Cromwell (Tech. Pubs.), Don Crowther (Field Service), and myself have formed a working committee to complete the Manual. I expect it to be ready and finalized in the second week of June.

I'll be glad to answer further questions, if you have any.

KP/tkw

Attachments:

VR12 Specifications (tentative)
Block Schematic
Power Supply
Drawing Index List
Module Utilization
G817 Power Supply
G818 Power Supply
W682 Intensity Amplifier
G917 XY-Control)
G819 H.V. Supply) sketch only
G912 Defl. Amplifier)
VR12 Manual - Table of Contents

TABLE OF CONTENTS

5/21/69

Specifications of the VR12 Display (tentative)

The VR12 is a low-cost, compact, solid-state CRT display with self contained power supplies and a viewing area of 6 3/4" x 9". The VR12 is capable of presenting 2000 random points or up to 750" of vector.

The deflection amplifiers of the VR12 utilize a unique switching technique that provides high speed at low power consumption levels. The modular construction gives the VR12 maximum flexibility while simplifying maintenance. With the front panel controller, picture size and position can easily be adjusted. A three-position "channel select switch" allows the choice of Channel I, Channel II or Channel I & II simultaneously when a multiplexed z-signal is provided.

Various optic filters can be slid in front of the CRT screen to suit particular applications. The VR12 is available in either a 19" rack-mounted or table top version.

PHYSICAL SPECIFICATIONS:

Height	10 1/2 in. (267 mm)
Width	19 inch (483 mm)
Depth	17 inch (432 mm)
Weight (Net)	53 lbs. (24 kg)
Weight (Shipping)	63 lbs. (28 kg)
Screen Dimensions (Overall)	7 5/8 inch x 10 1/8 inch (193 mm x 258 mm)
Screen Dimensions (Useful)	6 3/4 inch x 9 inch (171 mm x 228 mm)
Aspect Ratio	3:4
Phosphor Type	P31 or P7 (others available upon request)
Optical Screen Transmission	50%
Operating Temperature Range	50°F to 130°F (10°C to 55°C)

ELECTRICAL SPECIFICATIONS:

Power Requirements	117V ± 10%
	220V ± 10%
	50 or 60 cps
Power Dissipation	150 Watt

ELECTRICAL SPECIFICATIONS (cont'd.)

XY-Input Sensitivity	200 mV/inch (sensitivity switch at H)
(Max. Gain Setting)	500 mV/inch (sensitivity switch at L)

XY-Input Impedance	Max. Gain Setting	Min. Gain Setting
Low Sensitivity (L)	25 K	20 K
High _____.._____(H)	10 K	5 K

XY Defl. Amplifier Speed	400 ns for 1/1024 of full scale deflection 15µs for full step along X-axis
Deflection Method	Electromagnetic (70° Diagonal Defl. Angle)
Focus	Electrostatic
High Voltage	12 K Volt
CRT	Type 12 M63 12 inch 70° with inherent impulsion protection
Spot Size	Less than 12 mils at 50 ft/lb (P31 phosphor)
Linearity	Better than ± 1% over full screen.
Repeatability	Better than .1%
Stability and Drift	Less than 0.15" over 8hr. period after 1/2hr. warm up.
Max. XY-Input Signal	± 50V (Absolute Max.; AC Peak + DC)
Z-Input	Level Change from +3 V to GND

ELECTRICAL SPECIFICATIONS (cont'd.)

Z-Select	+3V for Channel I Ground for Channel II
Z-Direct	A positive going pulse not exceeding 35V (AC coupled)
Intensity Amplifier Output	+ 60V to ground, negative-going 200 ns pulse at the CRT cathode delayed 50 ns with respect to z-input level transient.

FRONT PANEL CONTROLS:

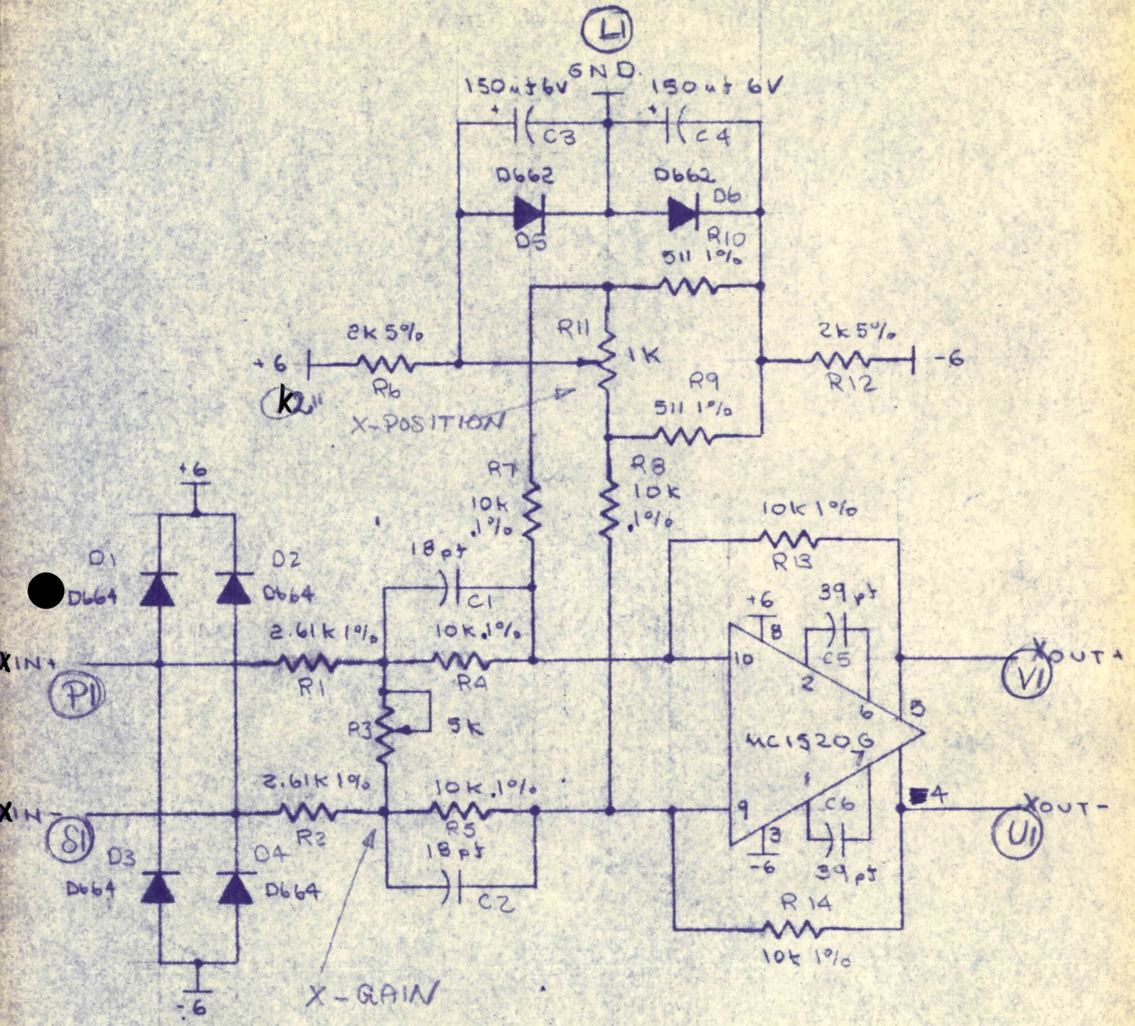
Brightness/On-Off	Manual brightness control combined with power on Off switch.
Channel Select Switch	Allows manual selection of intensity Channel I, I & II, or II if a channel select signal is provided and the Z-signal multiplexed.
X & Y Position (Screwdriver Adjustment)	Allows to adjust the horizontal and vertical position of the picture to be displayed.
X & Y Gain (Screwdriver Adjustment)	Allows to adjust the horizontal and vertical size of the picture to be displayed.
Pilot Light	When lighted, power to the VR12 is on.

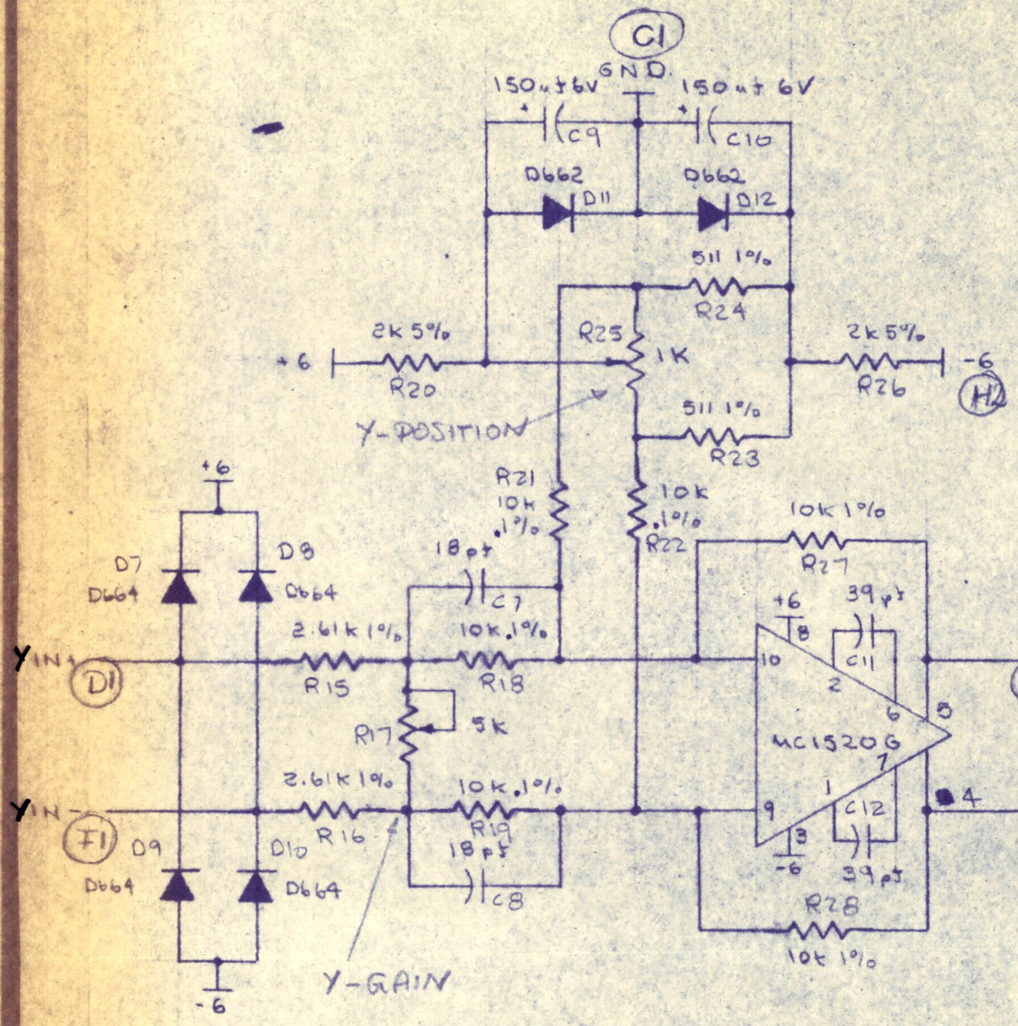
REAR PANEL CONTROLS AND CONNECTORS:

X-Input	Differential Analog Signal Input for X-Deflection.
Y-Input	Differential Analog Signal Input for Y-Deflection.
X & Y Sensitivity	In position "L" input signal is attenuated 1:2,5 with respect to position marked "H".

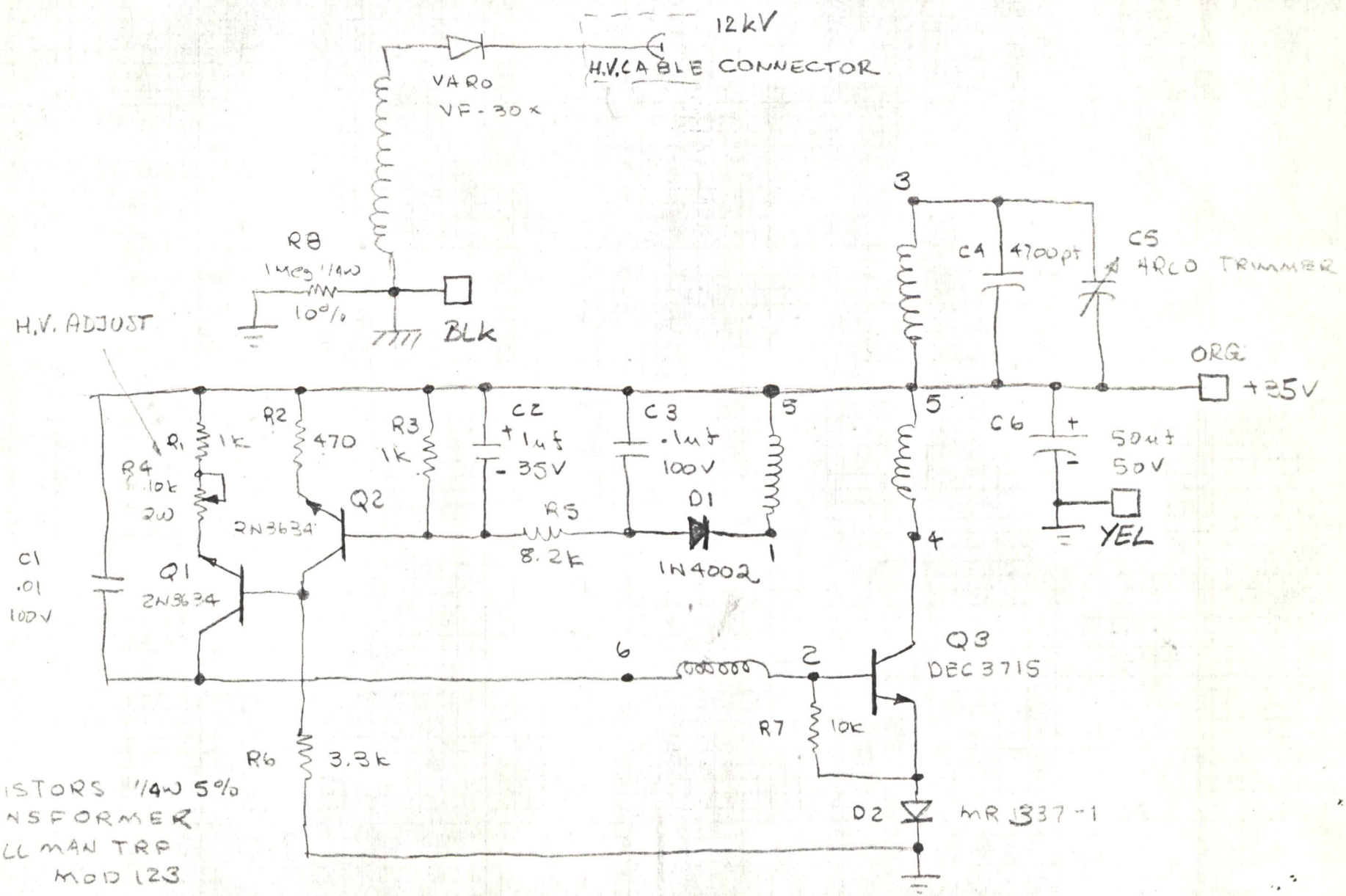
REAR PANEL CONTROLS AND CONNECTORS (cont'd.)

X & Y Polarity	When in "_" position, the X resp. Y coordinates of the picture reverse polarity.
Z-Input	BNC signal input which initiates the intensity circuit.
Z-Direct	BNC signal input pulses of variable width or amplitude can be used to plot variable intensity pictures.
Z-Select	BNC signal input. Signal causes the CRT to be blanked during the period of Z signal assertion associated with the channel which is not selected for display.
Blue Ribbon 24 Pin Remote Connector	All inputs of the VR12 are paralleled through this connector which particularly makes remote operation wiring practical.





G 917 XY-CONTROL
(MS 907)



~~H712~~ G 819

B. NOLAN

1/9/69

DEFLECTION AMPLIFIER G 312 (2×)

POWER SUPPLY INPUTS

+6 — C11 180M 6V

-6 — 180M 6V — C9

+5V — 180M 6V — C20

ALL UNUSED IC INPUTS SHORT TO GND.
THE UNUSED OUTPUTS LEAVE OPEN.
IC PIN 7 TO +5V PIN 14 TO GND.

A.O.S.
ALL RESISTORS ¼W 5%
ALL 1% RESISTORS ⅛W
DIODES ARE D664

I_1 = SN 7400N I_2 = SN 7410
I_3 = SN 7402

NOTE L4 & L3 are not located on board. Their terminals go to double pins

+8V input carries 12A.
G.N.D. carries 15A

TO POINT B

TO POINT A

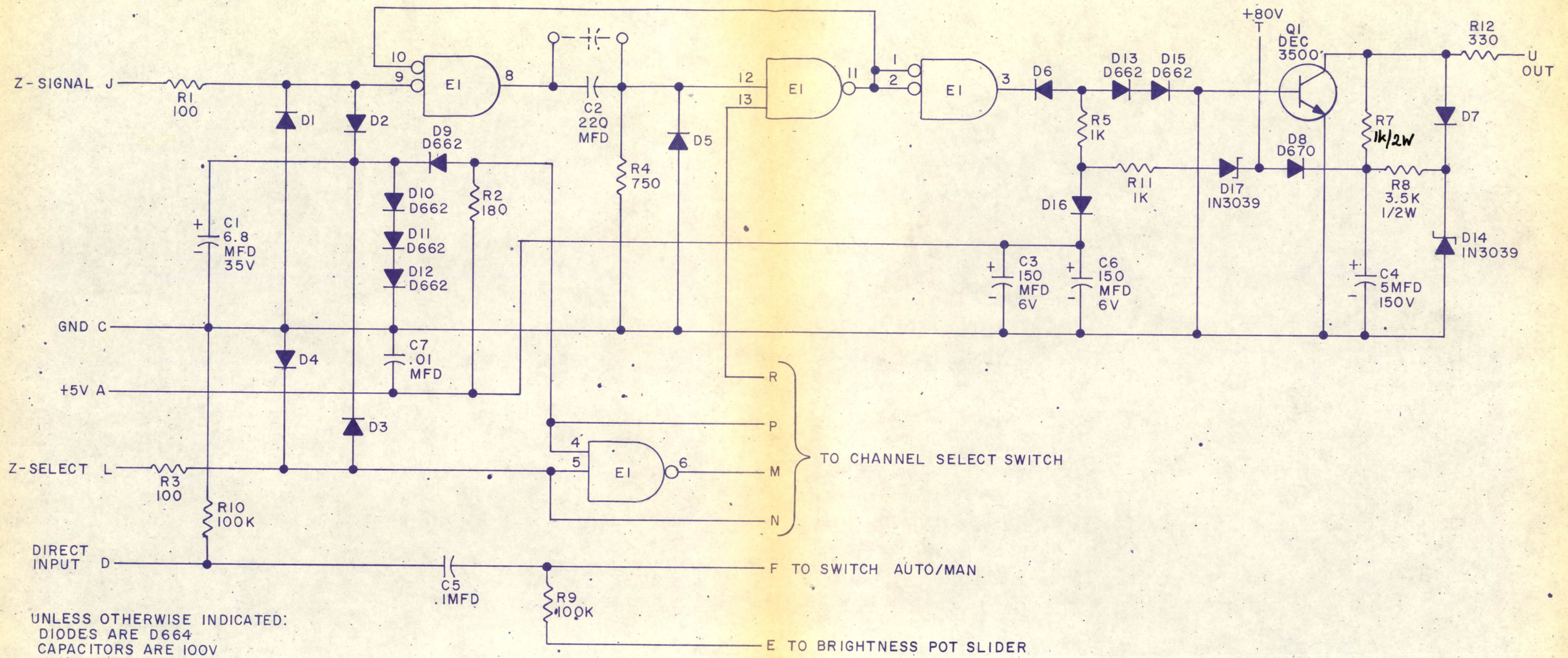
OUT

F.B.

QUIESCENT ADJUSTMENT

DEFL COIL

SIZE	CODE	NUMBER	REV.
B	CS	W682-0-1	



UNLESS OTHERWISE INDICATED:
DIODES ARE D664
CAPACITORS ARE 100V
E1 IS DEC7400N
PIN 7 ON IC = GND
PIN 14 ON IC = +5V

REVISIONS	REV.	CHG NO.	CHK

DRN. M. Haller	DATE 5-20-69	
CHK'D	DATE	
ENG.	DATE	
PROD.	DATE	

TRANSISTOR & DIODE CONVERSION CHART

DEC	EIA	DEC	EIA
D662	IN645		
D664	IN3606		
D670	IN3653		
IN3039	SAME		
DEC3500	2N3500		

digital EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

TITLE: INTENSITY CIRCUIT W682

SIZE	CODE	NUMBER	REV.
B	CS	W682-0-1	

PRINTED CIRCUIT REV. A

DEC FORM NO.
DRB 102

+X INPUT
YEL
YEL
-X INPUT
WHT
7.2K 100
X-POLARITY
X-SENSITIVITY
RED
BLK
AIS #22 BLU
BIC #22 WHT
G917 XY-SET & GAIN CONTROL
1 OR 3 +8V
10 +6V
11 +5V
12 -6V
14 +35V
G912 AØ1 X-DEFLECTION AMPLIFIER
BUSS: AA-AB, AC-AD, AE-AF, AN-AP, BE-BF, BP-BR, BS-BT, BU-BV, AE-BP, AP-BE
13 OR 15 GND
MAT-N-LOCK SOCKET-AMP DEC# 129840-00
MAT-N-LOCK PLUG-AMP DEC# 1209340-01
H1
DEFL•YOKE SYNTRONIC TYPE
RIGHT
LEFT
UP
DOWN
GRN
BLU
YEL
RED
WHT
C GND COIC
24 CONN AMPHENOL
WHT/ORN
WHT/YEL
WHT/RED
Z-INPUT
Z-SELECT INPUT
Z-DIREC INPUT
C4J
C4L
C4D
C4C
C4E
C3E
C3H
C3F
+Y INPUT
-Y INPUT
Y-POLARITY
Y-SENSITIVITY
G912 AØ4 Y-DEFLECTION AMPLIFIER
BUSS: AA-AB, AC-AD, AE-AF, AN-AP, BE-BF, BP-BR, BS-BT, BU-BV, AF-BR, AN-BF
CHANNEL SELECT SWITCH
CH I & II
CH I
CH II
CH
BRN/WHT
YEL/WHT
RED/WHT
ORN/WHT
12KV TO CRT SCREEN
TO POWER SUPPLY
INTENSITY AMPLIFIER W682 CØ4
100K 1/4W 10%
C4F C4U C4M C4N C4P C4R C4C C4E C4T C4A
Z-INPUT
Z-SELECT
Z-DIRECT
G914 CØ3 BRIGHTNESS CONTROL (OPTION)
GRY/WHT
C3D C3C C3P C3A C3N
CØ1 AUX POWER SUPPLY (OPTION)
C1F C1C C1A C1E
AM3 AM2 AM1
+8V
GRN/WHT
GRY/WHT
4
C GND
BLK
WHT

POWER SUPPLY CONNECTOR SOCKET HOUSING DEC#1209350-15

GRN #14	1
BLK #18	2
GRN #14	3
BRN #22	4
GRN #22	5
BLU/WHT #22	6
VIO/WHT #22	7
BLK/WHT #22	8
GRY/WHT #22	9
BLU #22	10
YEL/WHT #22	11
WHT #22	12
YEL #14	13
ORN #18	14
YEL #14	15

POWER SUPPLY CONNECTOR PIN HOUSING DEC#1209350-15 — J1

1	+8V	AØ1E OR AØ1F
2	G-GND	CØ4C
3	+8V	AØ4E OR AØ1E
4	6.3VAC	CØ1F
5	GRID 1	
6	0 TO -80V	CØ4E
7	+80V	CØ4T
8	+5V/C GND	CØ4A
9	-80V	CØ3N
10	+6V	AØ1S
11	+5V/F GND	AØ1H
12	-6V	BØ1C
13	F-GND	AØ1P OR AØ4N
14	+35V	BØ1N
15	F-GND	AØ1P OR AØ4N

LV POWER SUPPLY 713
HV POWER SUPPLY G819
POWER SUPPLY G817 & G818
117 VAC 60HZ
TRANSFORMER TAP 1 2 3
FAN
117 VAC EXCHANGE IN VR12 WITH 220VAC PRIMARY WIRING
RED/WHT #14 TWP
CRT SOCKET PIN #11 (CATHODE)
YEL
C4U

* MODELS NOT USING G914 OPTION PIN #5 P.S. CONN. IS WIRED TO "AM1" OF SELECT SWITCH. OTHERWISE TO "AM2"

REVISIONS

REV.	CHANGE NO.	CHK

FIRST USED ON OPTION/MODEL	QTY.	DESCRIPTION	PART NO.	ITEM NO.
VR12		PARTS LIST		

UNLESS OTHERWISE SPECIFIED
UNLESS OTHERWISE SPECIFIED DIMENSION IN INCHES
TOLERANCES
DECIMALS ± .005 FRACTIONS ± 1/64 ANGLES ± 0°30'
FINAL SURFACE QUALITY ✓
REMOVE BURRS AND BREAK SHARP CORNERS
MATERIAL
FINISH

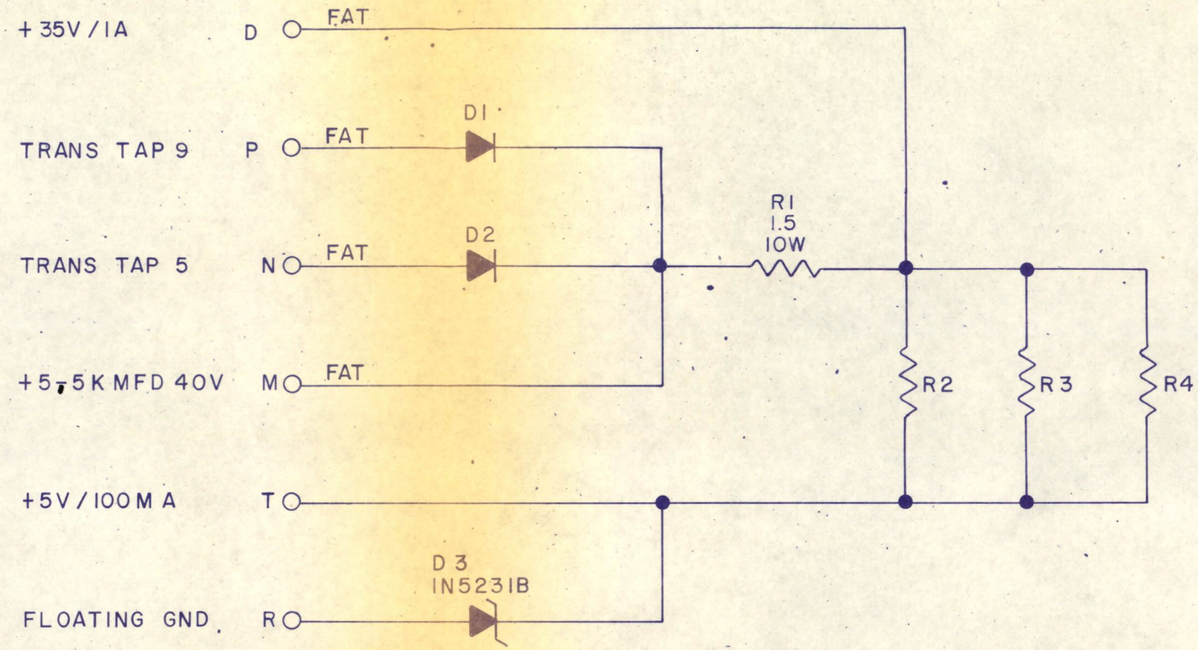
DRN. Robert Kalmak	DATE 3/20/69	digital EQUIPMENT CORPORATION MAYNARD, MASSACHUSETTS
CHK'D. D. Neale	DATE 4/7/69	
ENG. K. Pillar	DATE 5/5/69	
PROJ. ENG. V. Miller	DATE 5/5/69	
PROD. W. Mille	DATE 5-5-69	

NEXT HIGHER ASSY D-UA-VR12-Ø-Ø
SCALE NONE
SHEET 1 OF 1

TITLE: BLOCK SCHEMATIC (VR12)

SIZE D CODE IC NUMBER VR12-Ø-1 REV.
DIST.

DEC FORM NO. DRD 102A



UNLESS OTHERWISE INDICATED:
CAPACITORS ARE 10 MFD 450V
DIODES ARE MR1033B
RESISTORS ARE 1K 2W 5%

REVISIONS	REV.	CHK	CHG NO

DRN. R Gutierrez	DATE 4-28-69	
CHK'D	DATE	
ENG.	DATE	
PROD.	DATE	

TRANSISTOR & DIODE CONVERSION CHART

DEC	EIA	DEC	EIA
MR1033B	SAME		
IN5231B	SAME		
IN4004	SAME		

digital EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

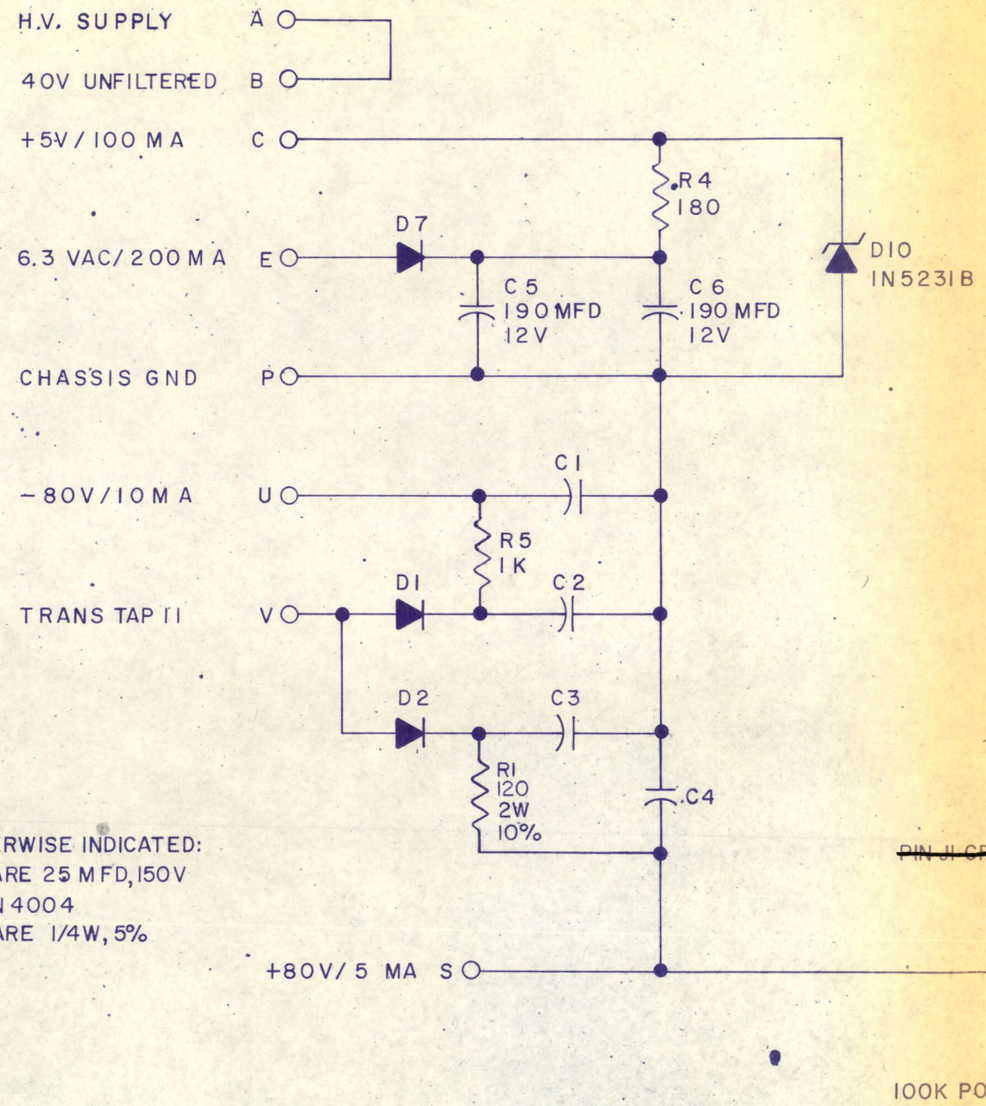
TITLE: POWER SUPPLY B2
G818

SIZE	CODE	NUMBER	REV.
B	CS	G818-0-1	

PRINTED CIRCUIT REV. A

DEC FORM NO.
DRB 102

SIZE B | CODE CS | NUMBER G817-0-1 | REV.



UNLESS OTHERWISE INDICATED:
CAPACITORS ARE 25 MFD, 150V
DIODES ARE IN4004
RESISTORS ARE 1/4W, 5%

REVISIONS	CHK	CHG NO.	REV.

DRN.	R. Gutierrez	DATE 4-25-69
CHK'D		DATE
ENG.		DATE
PROD.		DATE

TRANSISTOR & DIODE CONVERSION CHART

DEC	EIA	DEC	EIA
IN5231B	SAME		
IN3785	SAME		
IN4004	SAME		

digital EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

TITLE POWER SUPPLY BI
G817

SIZE	CODE	NUMBER	REV.
B	CS	G817-0-1	

PRINTED CIRCUIT REV. A

DEC FORM NO.
DRB 102

5-29-69

K. H. OLSEN

William Colsey
Research in Securities
Mt. Holly, New Jersey
ac 609 267-0440

Call on Monday

DIGITAL EQUIPMENT CORPORATION

Jack Shields

Disk in neck —

from hip to neck

June 6 stitches out

5th girl

10

K. H. OLSEN

5-20

Jake -

Man at MIT you wanted him to get to know. Lab for Computer Science.

DIGITAL EQUIPMENT CORPORATION

5-29

K. H. OLSEN

Prof. Smullin

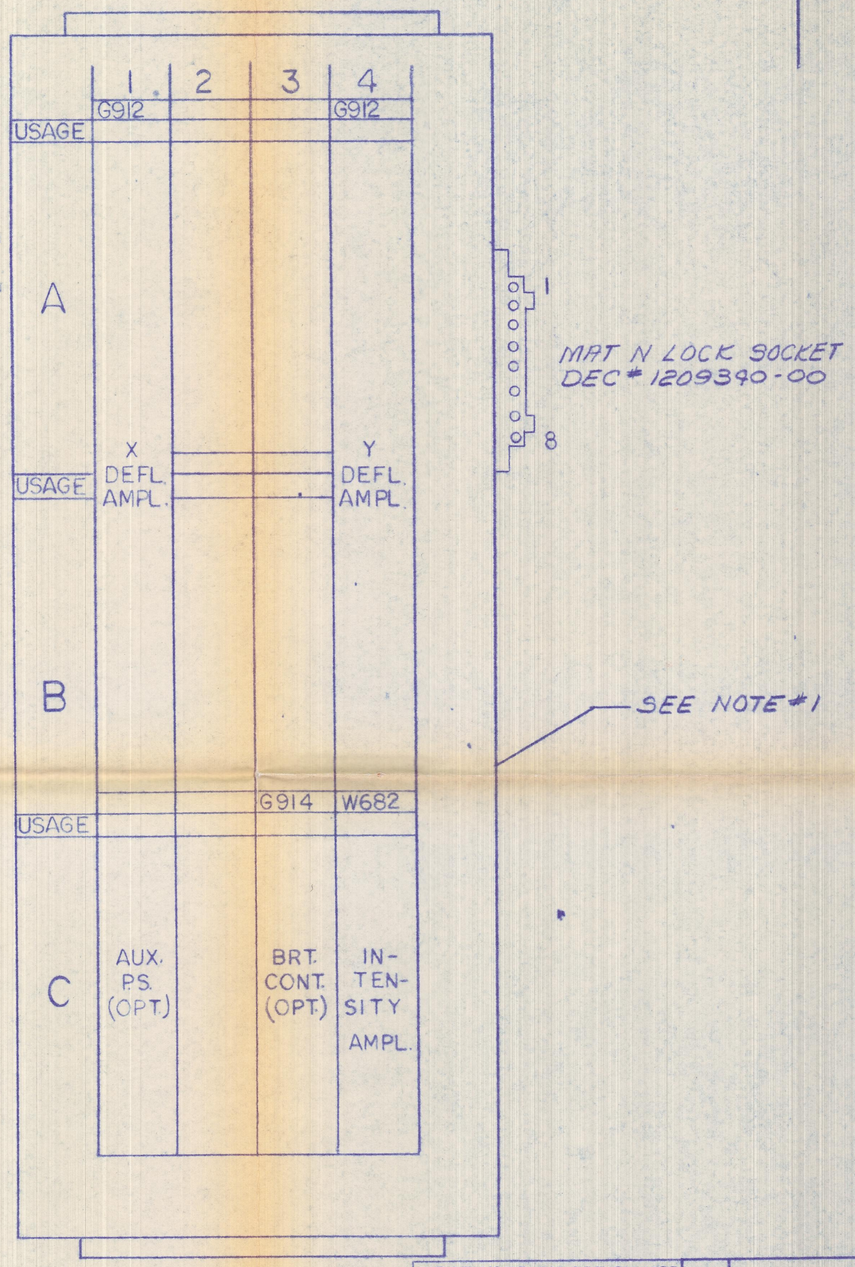
MIT

UN 4-6900

x4601

DIGITAL EQUIPMENT CORPORATION

NOTES:
1. MODULE INFORMATION SHOWN IS SEEN FROM WIRING SIDE



FIRST USED ON OPTION MOD	QTY.	DESCRIPTION	PART NO.	ITEM NO.
VR12		PARTS LIST		

UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED
DIMENSION IN INCHES
TOLERANCES
DECIMALS ± .005 FRACTIONS ± 1/64 ANGLES ± 0°30'
FINAL SURFACE QUALITY ✓
REMOVE BURRS AND BREAK SHARP CORNERS

MATERIAL —"—

FINISH —"—

DRN.		DATE 5-9-69
CHK'D	D. Hoag	DATE 5-12-69
ENG.		DATE
PROJ. ENG.		DATE
PROD.		DATE

NEXT HIGHER ASSY
A-ML-VR12-Ø

SCALE —"—

SHEET 1 OF 1

digital EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

TITLE
MODULE UTILIZATION

SIZE	CODE	NUMBER	REV.
C	MU	VR12-Ø-3	

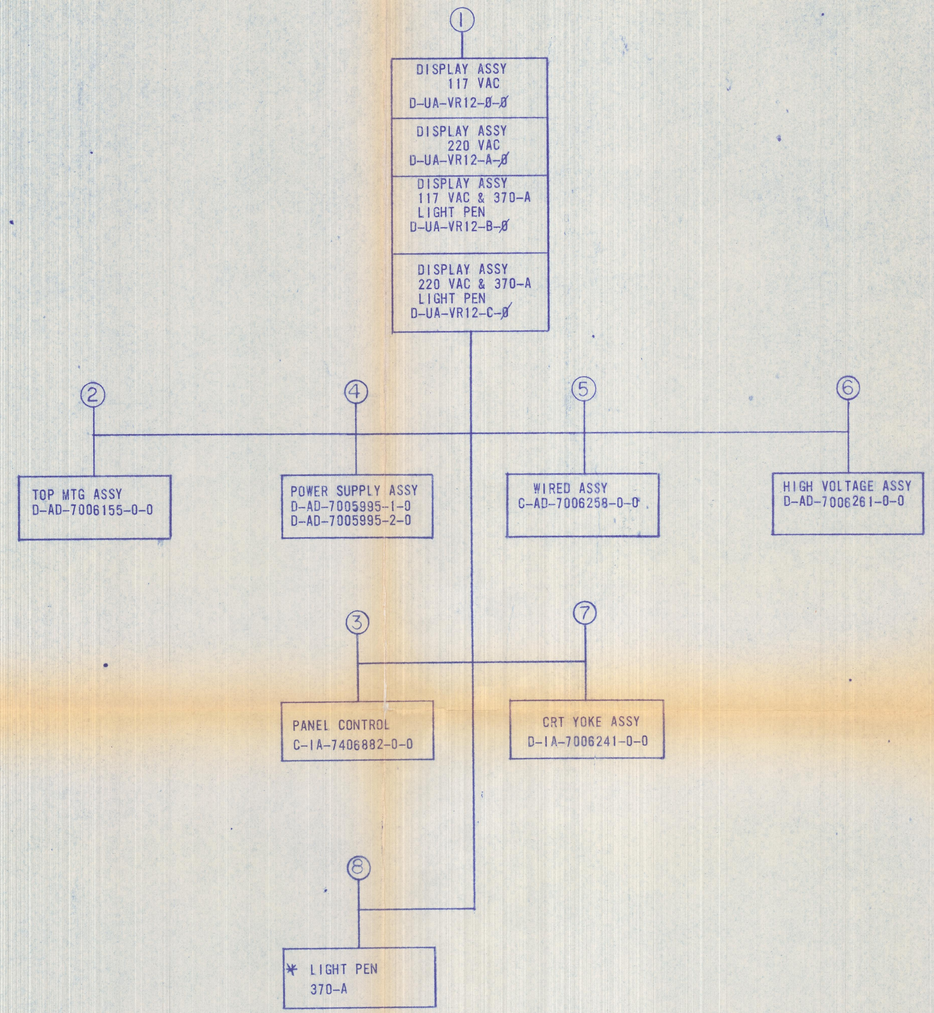
DIST.

REVISIONS

REV.	CHANGE NO.	CHK

SIZE C CODE MU NUMBER VR12-Ø-3 REV.

DEC FORM NO. DRC 100.



MECHANICAL			DEPT USAGE		
FIND NO	DESCRIPTION	PART NO	PROD	CUST	F/C
1	VR12 DISPLAY ASSY	D-UA-VR12-Ø-Ø			
	VR12-A DISPLAY ASSY	D-UA-VR12-A-Ø			
	VR12-B DISPLAY ASSY	D-UA-VR12-B-Ø			
	VR12-C DISPLAY ASSY	D-UA-VR12-C-Ø			
	VR12 DISPLAY ASSY (P L)	A-PL-VR12-Ø-Ø			
	BEZEL CONTROL PANEL (VR12)	E-1A-7406891-0-0			
	CAP (VR12)	C-MD-7406884-0-0			
	MASK, CATHODE RAY TUBE	D-MD-7406839-0-0			
	FILTER	C-1A-7406881-0-0			
	TRIM STRIP, BOTTOM MASK	C-MD-7407041-0-0			
	SCREEN, SAFETY	E-1A-7406880-0-0			
	PLATE, BOTTOM, MTG	D-1A-7406858-0-0			
	FAN, SCREEN	C-MD-7404881-0-0			
	SHIELD, C.R.T.	D-1A-7407111-0-0			
	MAIN CHASSIS CABLE HARNESS	E-1A-7006242-0-0			
	CLIP, AMPLIFIER	B-MD-7407155-0-0			
	BRKT, PROTECTION	C-MD-7406855-0-0			
	CLAMP, RETAINER	B-1A-7407172-0-0			
	PLATE, END HIGH VOLTAGE BOX	C-MD-7407411-0-0			
	SPACER, ETCH BOARD	A-MD-7407420-0-0			
	GROUND, TUBE	C-1A-7407429-0-0			
2	TOP MTG ASSY	D-AD-7006155-0-0			
	TOP MTG ASSY PARTS LIST	A-PL-7006155-0-0			
	PLATE, TOP MTG	E-1A-7406889-0-0			
	SCOTCHCALS	A-DC-7406890-0-0			
3	PANEL CONTROL	C-1A-7406882-0-0			
	PANEL CONTROL SILK SCREEN	B-SS-7406882-0-1			
4	POWER SUPPLY ASS'Y 117 VAC	D-AD-7005995-1-0			
	POWER SUPPLY ASSY 220 VAC	D-AD-7005995-2-0			
	POWER SUPPLY ASSY PARTS LIST	A-PL-7005995-0-0			
	PLATE, SIDE MTG	E-1A-7406883-0-0			
	BRKT, MTG FLIP CHIP BDS	D-1A-7406887-0-0			
	PLATE, GROUND	B-MD-7406852-0-0			
	COVER, CAP HOLD DOWN	C-1A-7406849-0-0			
	BRKT, TRANSFORMER	B-1A-7406854-0-0			
	RETAINER, TERM STRIP	C-MD-7406853-0-0			
	L BRACKET SHORT	B-MD-7407156-0-0			
	POWER SUPPLY CABLE HARNESS	E-1A-7006306-0-0			
5	WIRED ASSY	C-AD-7006258-0-0			
	WIRED ASSY PARTS LIST	A-PL-7006258-0-0			
	FRAME LOGIC	C-1A-7406856-0-0			
	BAR MTG	B-MD-7407114-0-0			
	L BRACKET LONG	B-MD-7407157-0-0			
	LOGIC FRAME DECALS	A-DC-7406371-0-0			
6	CRT YOKE ASSY	D-1A-7006241-0-0			
	CRT YOKE ASSY PARTS LIST	A-PL-7006241-0-0			
7	HIGH VOLTAGE ASSY	D-AD-7006261-0-0			
	HIGH VOLTAGE ASSY PARTS LIST	A-PL-7006261-0-0			
*8	LIGHT PEN 370-A				

ELECTRICAL			DEPT USAGE		
FIND NO	DESCRIPTION	PART NO	PROD	CUST	F/C
1	VR12 DISPLAY 117 VAC	A-ML-VR12-Ø			
	VR12-A DISPLAY 220 VAC	A-ML-VR12-A			
	VR12-B DISPLAY 117 VAC & LIGHT PEN	A-ML-VR12-B			
	VR12-C DISPLAY 220 VAC LIGHT PEN	A-ML-VR12-C			
	BLOCK SCHEMATIC VR12	D-IC-VR12-Ø-1			
	MODULE UTILIZATION	C-MU-VR12-Ø-3			
	MODULE UTILIZATION (P L)	A-PL-VR12-Ø-3			
	WIRED ASS'Y	C-AD-7006258-0-0			
	WIRED ASS'Y (P L)	A-PL-7006258-0-0			
2	TOP MTG ASSY	D-AD-7006155-0-0			
4	POWER SUPPLY ASSY	D-AD-7005995-0-0			
	CIRCUIT SCHEMATIC	D-CS-7005995-0-1			
6	CRT YOKE ASS'Y	D-1A-7006241-0-0			

NOTE : * LIGHT PEN ASS'Y 370-A USED ONLY WITH MODELS VR12-B & VR12-C

REVISIONS			
REV.	CHANGE NO.	CHK	

FIRST USED ON OPTION/MOD: VR12-Ø

UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED
DIMENSION IN INCHES
TOLERANCES
DECIMALS ± .005 FRACTIONS ± 1/64 ANGLES ± 0°30'
FINAL SURFACE QUALITY ✓
REMOVE BURRS AND BREAK SHARP CORNERS

MATERIAL —

FINISH —

QTY.	DESCRIPTION	PART NO.	ITEM NO.
PARTS LIST			

DRN.	DATE	5-8-69
CHK'D	DATE	5-13-69
ENG.	DATE	5/14/69
PROJ. ENG.	DATE	5/15/69
PROD.	DATE	

NEXT HIGHER ASSY: A-ML-VR12-Ø

SCALE —

SHEET 1 OF 1

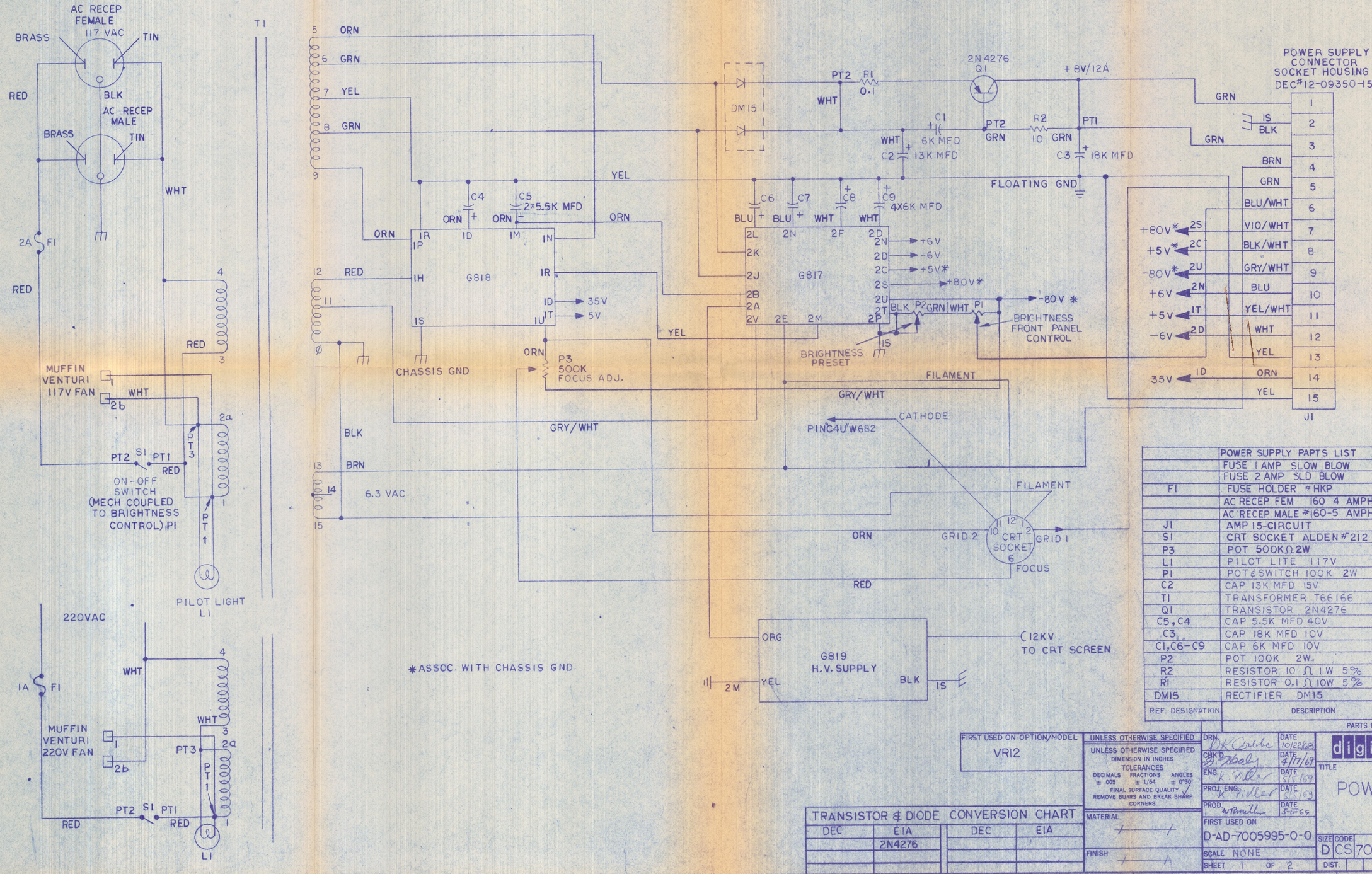
digital EQUIPMENT CORPORATION MAYNARD, MASSACHUSETTS

TITLE: DWG INDEX LIST VR12

SIZE	CODE	NUMBER	REV.
D	DI	VR12-Ø-2	

DIST.

DEC FORM NO. DRD 10-A



	POWER SUPPLY PARTS LIST	A-PL-7005995-0-0
	FUSE 1 AMP SLOW BLOW	9007212
	FUSE 2 AMP SLD BLOW	9007216
F1	FUSE HOLDER #HKP	9007242
	AC RECEP FEM 160 4 AMPH	1201251
	AC RECEP MALE #160-5 AMPH	1201252
J1	AMP 15-CIRCUIT	1209350-15
S1	CRT SOCKET ALDEN #212	1203480
P3	POT 500KΩ 2W	
L1	PILOT LITE 117V	1209348
P1	POT & SWITCH 100K 2W	1309346
C2	CAP 13K MFD 15V	1009436
T1	TRANSFORMER T66166	
Q1	TRANSISTOR 2N4276	1509455
C5, C4	CAP 5.5K MFD 40V	1009434
C3	CAP 18K MFD 10V	1009437
C1, C6-C9	CAP 6K MFD 10V	1009435
P2	POT 100K 2W.	1300530
R2	RESISTOR 10 Ω 1W 5%	1300171
R1	RESISTOR 0.1 Ω 10W 5%	1309452
DM15	RECTIFIER DM15	1105799
REF DESIGNATION	DESCRIPTION	PART NO.

PARTS LIST

TRANSISTOR & DIODE CONVERSION CHART			
DEC	EIA	DEC	EIA
	2N4276		

FIRST USED ON OPTION/MODEL: VR12

UNLESS OTHERWISE SPECIFIED
UNLESS OTHERWISE SPECIFIED DIMENSION IN INCHES
TOLERANCES
DECIMALS ± .005 FRACTIONS ± 1/64 ANGLES ± 0°30'
FINAL SURFACE QUALITY REMOVE BURRS AND BREAK SHARP CORNERS
MATERIAL
FINISH

		DATE
DRN.	J.K. Gabbe	10/22/68
CHK'D.	P. Daly	4/11/69
ENG.	K. Fidler	5/5/69
PROJ. ENG.	K. Fidler	5/5/69
PROD.	W. Smith	5-5-69

FIRST USED ON D-AD-7005995-0-0
SCALE NONE
SHEET 1 OF 2

digital EQUIPMENT CORPORATION MAYNARD, MASSACHUSETTS

TITLE
POWER SUPPLY
~~VR12~~ 713

SIZE D | CODE CS | NUMBER 7005995-0-1 | REV. P00
DIST.

REVISIONS

REV.	CHANGE NO.	CHK

DEC FORM NO.

E-5
c - Tom Strickland

digital INTEROFFICE MEMORANDUM

DATE: May 22, 1969

SUBJECT: Engineering Review Committee

TO: Ken Olsen

FROM: Ed Savage

In my opinion one of the items that is missing from the Engineering Review Committee is that when the various Engineers are reporting on the progress of their individual projects that the dollars related to these projects should also be part of that review.

There seems to me that there is a direct correlation between the effort being expended on a project and the dollars that are being incurred on that same project and I suggest that a member of the Financial Analyst Group be assigned to the Engineering Review Committee to report on the dollar expenditures related to the various projects being reviewed.

If you agree with this particular suggestion I will appoint one member of the Financial Analyst Group to participate in this group.

bma

dec INTEROFFICE MEMORANDUM

DATE 27th May 1969

SUBJECT MINTECH

TO Ken Olsen
Ted Johnson
Pete Kaufmann
Nick Mazzarese
Dave Knoll
Jean-Claude Peterschmitt
Al Gordon

FROM pp Geoff Shingles
GSHC.

Minutes of Meeting with
MINISTRY OF TECHNOLOGY
at
Digital, Reading
on
23rd May 1969
****

Present:	Mr Thompson)	Ministry of Technology
	Mr Hensby)	Technical Support Unit
	Geoff Shingles)	Digital
	Al Gordon)	

BACKGROUND TO MEETING

This meeting was requested by Min.Tech. to measure our U.K. content in 8/I and 8/L computers. The attached memo from Anthony Wedgewood-Benn, Minister of Technology, to Sir Gerald Nabarro, M.P., was a result of our meeting with the latter, and the communication he subsequently had with the Minister. It looks as though these sorts of personal contacts and pressures will at least cause things to move more freely.

Continued.....

Had Min.Tech. not approached us, we would have approached them as it was an opportune time for us to have such a meeting because:-

a) 8/L (as well as 8/I) is now in quantity production.

b) Al Gordon's shop floor and general manufacturing re-organisation has been completed.

c) The results of the cost accounting procedures set up by production and accounts now allow accurate content analysis to be performed and substantiated.

THE MEETING

Mr Thompson opened by detailing the re-organisation of the Computer Division of Min.Tech. (A chart is attached).

The question of U.K. content was gone into for the 8/I and 8/L in great detail. We supplied vendors names and purchasing details. A summary sheet detailing U.K. and U.S. costs for the 8/I and 8/L were prepared and a copy is attached to this report. Hensby and Thompson had a copy of this document. They realised its very confidential nature and it was emphasised that it was not an audited version and one which had been verified in every detail by our accountants, Cooper Brothers, could be provided if required. Their comments were:_

a) They were there to vet us for technical content - they did not make the policy decision - British/non-British (which is on a machine by machine basis).

b) We have come a long way since our last progress meeting (last Autumn) and our position must be very much in the balance - they stated that they felt wire wrapping could well be the deciding factor from a manufacturing stand-point.

c) They look at the total company contribution (to this end, a selling job was again done on Field Service, the increase in software support, and the expansion of Special Systems).

d) They will make a report which is submitted to Mr Aylward, whose department makes the decisions. (This is a new tack,

Continued.....

as it has previously always been said it was up to Llewellyn by Min.Tech. people themselves - this is a result of the re-shuffle).

CONCLUSIONS

1. This was the most positive reaction yet received from this group, who had always had a doubtful approach before.

2. They actually offered to let us know when their technical report goes to Ayleward and said after that time we should leave it a week or two and then pursue it agressively and arrange a meeting with him to get his reading.

3. They were quite positive about our other support efforts and the Algol Compiler for PDP-15.

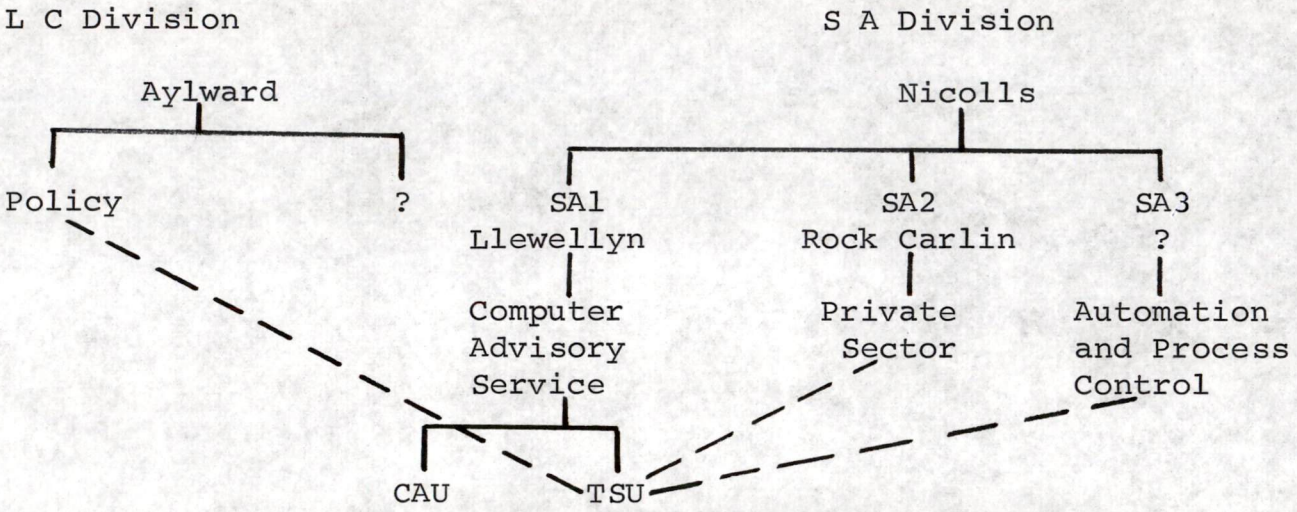
4. The future plans were not discussed but the thought that we might become a feeder plant for Europe was mentioned - this is a very positive thought as far as Min.Tech. and the Board of Trade are concerned.

Their comments that they do see real progress and their positive attitude towards us suggests that we are very close to the point with the 8/I and 8/L.

GSS/BAK/3MinT.

MINISTRY OF TECHNOLOGY (Dis)ORGANISATION

Computers and Electronics Division have joined and they are still trying to sort it out.



27th May 1969

GSS/BAK/3MinT.

FILE

digital INTEROFFICE MEMORANDUM

DATE: May 27, 1969

SUBJECT: Microsystems Technology Corporation

TO: Bill Long
cc: Paul Puschak
Dick Mitchell
Dave Estrabrooks
Bob Walsh

FROM: Phil Markell

The agreement between DEC and Microsystems has now been executed.

Under the terms of the agreement, DEC is to deliver to Microsystems:

a. A set of sepia prints of both the mechanical and parts drawings and wiring and installation drawings of the wire wrap station, entitled "N/C Wire Wrap Machine 7-14."

b. The operation manual entitled "DEC Semi-Automatic Wire Wrap Operation Manual,"

c. Program listing entitled "DEC PDP-8 Semi-Automatic Wire Wrap Program."

d. A binary tape of the DEC PDP-8 Semi- Automatic Wire Wrap Program.

Microsystems is to reimburse DEC for the costs of the preparation of the Sepia prints.

DEC has two other obligations under the terms of this agreement. The first is to sell to Microsystems under DEC's standard terms and conditions 10 DEC Computer Systems at the price of $10,000. or more per system within 15 months from the delivery of the first computer system. Secondly, DEC will make available to Microsystems a programmer who has worked on the development of the PDP-8 Semi-Automatic Wire Wrap Program for consultation with Microsystems personnel or personnel of a consulting firm retained by Microsystems. Said consultation is to be limited to two half working days only. DEC is under no further obligation to furnish Microsystems any additional information.

The listing and drawings were furnished to Microsystems on the basis that Microsystems would not disclose the contents of the drawing and listings to third parties without first receiving the written approval of DEC and entering into a non-disclosure agreement with such third parties.

The binary tape and the operation manual where furnished to Microsystems on the basis that disclosure of the contents of the tape and the manual would be restricted to customers of Microsystems, others whose use of Microsystems products is dependent on knowledge of the contents of the manual and the tape and other parties for whom approval in writing was obtained from DEC.

The information furnished to Microsystems by DEC, the manual, the tape, the drawings and the listings are on a non-exclusive basis. DEC has the right to use any or all of such material for any use whatsoever which would include the manufacture by itself or by others of products utilizing such information.

Microsystems is obligated to purchase ten (10)DEC Computer Systems at a price of $10,000. or more per system within 15 months of the delivery of the first computer system, purchases include purchases made either directly by Microsystems or by a customer of Microsystems for installation in a product to be sold by Microsystems. In the event Microsystems purchases less than 10 computer systems during the 15 month period, Microsystems is to paid DEC an amount equal to $1,000. multiplied by the difference between 10 and the number of systems purchased during the 15 month period. As an additional provision of the agreement, Microsystems is not to use in advertising publicity or other promotional activities, any name, trademark or other reference of DEC other than for the purpose of identifying promoting and publicizing the use of a DEC computer in a Microsystems product. In other words, Microsystems is not to publicize the fact that its wire wrap system is based on any information received from DEC. The only publicizing that Microsystems can do under this agreement is to inform the public that its systems the DEC computer.

To summarize briefly:

1. After delivery of the drawings, manual, listings and tape, DEC is to make available a programmer for a period not to exceed two half working days. DEC is under no obligation to furnish Microsystems any additional information.

2. Microsystems is to purchase 10 Computer Systems at a price of $10,000. or more per system within 15 months of delivery of the first system. If Microsystems purchases less than 10 systems within the 15 month period. It is to pay DEC an amount equal to $1000. multiplied by the difference of 10 and the number of systems purchased during the 15 month period.

3. Microsystems is only to publicize that its system includes a DEC computer. Microsystems is in no way to publicize the fact that it was furnished material or information from DEC or that it has incorporated in its system materials concerning DEC's wire wrap system.

It should be the responsibility of the programmer department to comply with the limitations of the two half working days.

It should be the responsibility of Paul Puschak to be sure that Microsystems keeps within the confines of the restriction of publicizing it association with DEC.

It should be the responsibility of the Contracts Department to monitor the purchase of the PDP systems within the 15 months period.

I also assume that the necessary paper work will be prepared to enable DEC to be reimbursed for the Sepia Prints.

We have also agreed with Microsystems to exclude from the confidentiality requirements of the agreement any drawings which both DEC and Microsystems agree are not proprietary to DEC. Microsystems will furnish us with a list of drawings which they do not consider proprietary to DEC and at that point we will be in a position to accept or reject their requests.

digital INTEROFFICE MEMORANDUM

DATE: May 27, 1969

SUBJECT: FOCAL versus BASIC

REM

TO: Ken Olsen

FROM: Richard May

Ken, the following dialogue is a discussion of the characteristics of Focal and Basic, and the advantages, as I see them, of Focal over Basic.

Both Focal and Basic are conversational type languages which can be learned by the average ninth and tenth grade high school student in a matter of two to five hours. The single advantage of Basic over Focal is the format of the IF statement (see Example One). The format of the Basic IF statement is similar to longhand notation and teachers in the secondary environment feel that it is easier to learn initially than the Fortran IF which Focal uses. When a person learns to use the Focal IF statement, however, it is a much more powerful statement than the Basic IF, in that it allows the user to make a 3-way check in one statement, as Example One illustrates.

The syntax of Focal and Basic are almost identical. The major advantage of Focal over Basic is the re-entrant and recursive feature. This feature of Focal allows the program to exit from an iterative loop and go to a number of sub-routines and return to the same point in the loop from which it exited. The comparable statement in Basic is the GOSUB command. This Basic command however, is not re-entrant. Example No. Two illustrates the power of the re-entrant, recursive feature of Focal and clearly demonstrates why it is a major advantage over Basic.

Ease of use is another major advantage of Focal. People in general and students in particular are, as a rule, rather poor typists. If the user makes a mistake in typing a line, Basic requires that the whole line be retyped. Focal on the other hand, allows editing of a <u>single character</u>. This feature is very convenient to both the beginner and sophisticated user. We will agree, I think, that when a person is hurried or under pressure his typing skill deteriorates or vanishes. Focal's modify command allows the user to type only the <u>characters of interest</u>; the computer types the other characters of the line.

As we are all well aware, Fortran is the established language of the technical world and will continue to be so for some time into the future. Many colleges are currently requiring knowledge of computer programming as a prerequisite for entrance into their engineering schools. A knowledge of computer programming implies a knowledge of Fortran computer programming. Unfortunately, Fortran is a rather difficult language to learn because of its strict formatting and punctuation requirements. Because of these requirements, people at the secondary level refuse to learn or teach Fortran; Focal, however is very easy to learn and use but has many characteristics of Fortran. After a person has become familiar with Focal he can easily phase into Fortran programming by learning the input-output and formatting requirements of Fortran. Basic, on the other hand, does not have Fortran characteristics and is a completely foreign language. Time spent learning Basic and becoming a proficient Basic programmer does not help prepare the student to be a Fortran programmer; Focal,on the other hand, does prepare the student to phase into Fortran programming. Herein lies Focal's major advantage.

In addition to being easy to learn, powerful, and easy to use, Focal also has a cost advantage over Basic. Basic is a compiled language, thus requiring mass storage devices for system program storage (Editor, Compiler, Operating System) and increasing the cost of the machine to run the program. Focal, on the other hand, is interpretative and runs on a minimum 4K PDP-8/L machine. Many groups who cannot afford a time-sharing terminal, or the options required to run Basic (DF-32 or TSS-8) on a DEC machine can afford a PDP-8/L. And Focal handles multiple terminals - economically. A $19,000 PDP-8/L supports four users; a $45,000 machine supports four Basic users.

In summary, both Focal and Basic are very easy to learn and use. Focal is more desirable because its commands are more powerful, it has very powerful editing features, it prepares the user to phase into Fortran without learning a completely new language, and it runs on a low cost machine.

EXAMPLE ONE

BASIC

```
30 IF (A)  < 10 then 40
31 IF (A) => 10 then 50
40 Print "Next Value Please"
50 Print "Your Value is Too Large"
```

FOCAL

```
3.1 IF (A-10) 4.1, 5.1, 5.1
```

[Format IF (VAR) <, =, >]

```
4.1 Type "Next Value Please"

5.1 Type "Your Value is Too Large"
```

EXAMPLE TWO

FOCAL

```
*@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
*C-FOCAL,1969
*
*01.10 ASK "LOWER LIMIT",LL,!,"UPPER LIMIT",UL,!,"INCREMENT",IN,!
*01.20 FOR X=LL,IN,UL; DO 2.0
*
*02.01 IF (X) 2.1,2.02,2.1
*02.02 TYPE "          Y........................................",#
*02.10 FOR Y=0,30; TYPE " "
*02.20 TYPE ".",#
*02.30 FOR Y=0,30+(-X-3); TYPE " "
*02.40 TYPE "*",#
*02.50 FOR Y=0,30+(3+4*X-X↑2); TYPE " "
*02.60 TYPE "O",!
*02.70 RETURN
**@@@@@@@@@@@@@@@@@@@@@
*
```

```
 GO
LOWER LIMIT:-10

UPPER LIMIT:10

INCREMENT:1

 O                             .      *
 O                             .     *
 O                             .    *
 O                             .   *
 O                             .  *
 O                             . *
  O                            .*
             O                 *
                      O       *.
                             ⊛ .
          Y.................*.....O................
                           *   .     O
                          *    .      O
                         *     .     O
                        *      .  O
                       *     O .
                      ⊛        .
             O       *         .
  O                 *          .
 O                 *           .
 O                *            .
*
```

BASIC

KEN,

This routine requires a knowledge of BASIC'S "string function" and is almost impossible to program in BASIC.

I have asked my customer at South Portland High School, (Maine) to send me a listing of a plot routine in both FOCAL and BASIC.

The FOCAL listing is about 15 statements; the BASIC listing is almost three pages. Should have actual example by end of week.

7-1-69 Copy to John Jones

digital INTEROFFICE MEMORANDUM

DATE: May 28, 1969

SUBJECT: 680I Status

TO: Schedule Review Committee FROM: Don Murphy

CC: Bill Long
Ashwani Chaddha
Remi Lisee

Attached is a schedule and status report for the 680I system.

DM:jah

Att.

May 19, 1969

680I STATUS

During the recent presentation of the 680I schedule, you expressed concern that it was continuously slipping and there seemed to be an unending number of projects.

The purpose of this report is to define what the 680I is from a product point of view, and where it is from a schedule point of view.

WHAT IS THE 680I

The 680I consists of four major components:

1. PDP-8I
2. DL8I
3. DC08A
4. M750

This hardware provides an attractive system for servicing a number of low speed communication terminals. However, the hardware listed above has no facilities by which the low speed terminals can be interfaced with the system. Basically, there are three types of interfaces required to accommodate the interfacing of low speed terminals.

1. Local Terminal Interfacing capability

2. Modem Terminal Interfacing capability

3. Telegraph Terminal Interfacing capability

A great deal of confusion has arisen because of the extensive number of option numbers that are involved on the project. Although some of these numbers represent engineering projects, others are merely modules or jumpers within another option.

In future presentations, option numbers will be used only when necessary to define a problem. Otherwise, the following four categories will be used.

1. Basic 680I

2. Local Interfacing Hardware

3. Modem Interfacing Hardware

4. Telegraph Line Interfacing Hardware

680I STATUS

A. <u>Customers and Delivery</u>

We originally scheduled 680I systems to start delivery in October. As a result of this, we accepted orders for approximately 10 systems before realizing that we could not deliver.

Having no control over engineering, my effort to get the engineering projects back on schedule was in vain. I then took the approach of asking engineering to give me a revised engineering schedule.

I finally received a schedule from engineering which indicated we could ship systems in January. I later discovered that this schedule could not be met. After some extensive checking, I discovered that most of the hardware was in a state of flux and could not be built by production for a number of reasons.

The end result is that we did not start delivery until March and as of this date we are backlogged approximately 45 systems, some of which are serious. The backlogged systems which I consider serious are:

1. Badger Meter (Mid West Stock Exchange System)
2. T. H. Karlshure
3. Stichting Math
4. SEL
5. International Radio

The current status of the 680I hardware is:

1. Basic 680I (DL8I and DC08A)

   A. Started delivery of systems in April

   B. Limited availability of H710 power supplies can limit a system to only 40 lines.

2. Local Terminal Interface (DC08B)

   A. Available in production, no problems

3. Modem Terminal Interfacing (DC08F)

   A. Using unit from 680 system, no problem

   B. Replacement of above unit is in production. (Released to build) First unit will ship in July. Only three have been sold, all to UCC.

   C. Inexpensive modem interface will start delivery in July, no problem.

4. Telegraph Line Interface (DC08C)

   A. Domestic and Canadian equipment is in production. (Released to build) See no problems.

B. European telegraph equipment is not designed. The only unit that has been sold is the Melbourne Stock Exchange. We are working on this problem now. Other telegraph equipment has been sold, but is being handled by Special Systems.

FUTURE PROJECTS

At present, there are two more hardware projects intended for the 680I.

1. Character buffered line interface
   A. In preliminary design stage
2. Synchronous Modem Interface to replace DP01A
   A. This design should start as soon as Computer Special Systems makes special modules available.

PRODUCTION DELIVERY STATUS

Production has agreed to the following delivery schedule for the PDP-8 Product Line.

April	5 systems
May	5 systems
June	10 systems
July	10 systems

At present, production is approximately 30 days behind schedule.

PROJECT	P/E	MAR-69	APR-69	MAY-69	JUNE-69	JULY-69	AUG-69	SEPT-69
DL81	AC	IP	START DELIVERY					
DC08A	AC	IP	START DELIVERY					
DC08B	AC	IP	START DELIVERY					
DC08F	AC	RTB				START DELIVERY		
DC08G	AC	RTB				START DELIVERY		
DC08H	RL	RTB				START DELIVERY		
DC08J	RL	RTB				START DELIVERY		
DC08C	NW	W.L. COMPLETE		RTB				
G856	NW		RTB					
DC08D	NW			RTB				
DC08E	NW			HOLD (UK)				
DC08EA	NW			DEFINE				
DC08EB	NW			DESIGN	RTB			
793-PS	NW	RTP						
793A-PS	NW	RTP						
BC01A	DW			AVAILABLE (LIMITED)		START DELIVERY		
BC01C	DW			AVAILABLE (LIMITED)		START DELIVERY		
SOLID STATE SWITCH	NW			DEFINE				
DC02B	RL			DEFINE				

IP IN PRODUCTION
RTB RELEASE TO BUILD
RTP RELEASE TO PROD.

COMMUNICATIONS
ENG. PROJECT
SCHEDULE STATUS
MAY 1 1969
D Murphy

digital INTEROFFICE MEMORANDUM

DATE: May 29, 1969

SUBJECT: Ways to Reduce the Cost of Manuals

TO: Ken Olsen

FROM: John A. Bellantoni JAB

As a result of your suggestion I am submitting the following list which briefly describes ways in which it might be feasible to reduce the overall cost of Technical Manuals.

1) More qualified Technical Writers.

2) Well defined requirements for all technical documents.

3) Standards and specifications for all phases of documentation.

4) Integration of various areas within the company to reduce overlap and duplication of effort.

5) Central computerized system to eliminate rechecking, retyping and proofreading - this effectively reduces writer time, reduces and holds the line on technical typists and editors depending on rate of growth.

6) Eliminate all but the most necessary illustrations and photographs.

7) Place more text and illustrations on a page.

8) Use a good quality, but low cost paper.

9) Print on two sides.

10) Determine a type of binding that will be adequate for usage.

11) Anticipate usage and define quantities of documents.

12) Establish and maintain good storage and control for all manuals.

digital INTEROFFICE MEMORANDUM

DATE: May 29, 1969

SUBJECT:

TO: K. Olsen FROM: J. Smith

Attached material could be freed up for contributions.

Jack

sm

Attachment

SYSTEMS	DOLLAR AMOUNT
PDP8/S	
103	1,374.72
307	4,473.80
338	4,151.80
202	3,357.36
PDP8	
28	Capitalized
464	6,365
331	6,532
PDP8I	
1009	8,500
1008	8,500
1006	8,500
PDP8L	
622	8,500
696, KP8L, KD8L, BA08A, MC8L	14,000
693, KP8L, KD8L, BA08A, MC8L	14,000
532	8,500
611	8,500
658, KP8L, KD8L, BA08A, MC8L	14,000
677, KP8L, KD8L, BA08A, MC8L	14,000
PDP9	
383, MC70B, KC09A, KD09A, PCO9, LT19A, LT19B, LT19C, DR09A	38,500
334, AF01B, MC70B, AA01A, KC09A, DA09B, KD09A, DB97A, PCO9	53,400
OPTIONS	
PT08B	2,000
139E	2,000
PCO1	900
683-12	1,200
UA38	6,000
34D	750
CR01E	4,000
DA09A	1,741
AA05	4,200
NCR card reader	2,500
8I Cabs.	500
LT09A	1,200
LT09B	1,200
DF32	7,000
CAB9A	500
CAB1	500

8/SCAB	700
8ICAB	500
KE09A	4,000
KF09A	5,000
19" Cab	500
MB10-22	28,000
KE8I	2,500
KP8I	500
KW8I	225
AA01A	1,600
34D	843
34D	870
34D	531
PCO3	2,500
PCO3	2,500
804	950
CR01B	4,000
AD08A	1,200
KE09A	218
AA01A	1,600
KF09A	5,000
AD08A	1,200
LT09A	228
PCO3	2,500
804	1,000
KE09A	218
KF09A	5,000
LT09A	312
KX09A	1,500
KE09A	218
34D	750
34D	686
34D	1,072
34D	729
34D	585
CR01E	328
AA01A	1,600
DP01A	4,900
138 - 139	2,163
138/139E	2,207
804	1,000
LT08-30	900
DP01A	4,900
138/139E	2,080
189	303
189	233
189	232
8I Cab	500
ASR33	1,200
189	260
189	256
189	403
189	258
CR01E	4,000
ADC1	1,200
AA01A	1,600
AF01A	4,500
PCO,	2,500
565	8,900
647	27,000
ASR33	1,200
AX08	4,600
PCO	2,500
AF01A	4,500
AX08	4,600
PCO1	3,500
8ICAB	500

digital INTEROFFICE MEMORANDUM

DATE: March 25, 1969

SUBJECT: Superfluous Material Bulletin

TO: Distribution

FROM: Ted John ✓

There were no modules added to the Superfluous Material Bulletin during the month of March. However, a total of 2,140 modules were withdrawn during the corresponding period.

It should be noted that the module withdrawals were not the result of the product lines utilizing this bulletin and requesting modules available to them through the slow moving/obsolete inventory procedures, rather, they were withdrawn by module production control to meet product line requirements reflected in the modules requirement/forecast dated 7 March 1969.

The success and continuance of the Superfluous Material Bulletin is predicated on its full utilization. Therefore, we would like to again point out that all modules listed in this publication are available for immediate issue/delivery, and should be reviewed by all product lines/stock rooms prior to ordering modules from Production.

Distribution:

Frank Kalwell	Bill Brackett	Bill Hanson
Jean Haynes	George Geralds	Russ Kew
Mary Zimmer	Jim Castino	~~Jim Cudmore~~ ED GIANETTO
John Woodman, Jr.	Rod Schmitt	Don White
John Fortier	Frank Fortin	Ben Pakus
Bob Lane	Glen Ford	Dan Riordon
Bob Reed	John Keddy	Tom Norton
Dave Kicilinski	BURTON FOSTER	

mo

Module Type	Quantity
1999	3
4110	54
4111	1
4112	1
4118	8
4119	8
4123	29
4125	45
4126	17
4128	57
4129	54
4130	18
4139	9
4150	2
4151	23
4155	16
4161	4
4201	79
4202	19
4202A	20
4203	1
4204	176
4205	58
4207	21
4209	23
4216	6
4219	10
* 4909	141
4996	3
4997	4
4998	24
6104	3
6105	2
6109	27
6111	37
6114	52
6116	19
6117	57
6118	7
6119	28
6122	15
6123	23
6124	10
6131	4
6132	12
* 4995	3

Module Type	Quantity
4230	65
4231	5
4290	2
4304	2
4305	2
4306	23
4320	2
4321	16
4410	6
4504	14
4506	8
4507	4
4508	14
4509	8
4514	56
4517	10
4518	2
4521	15
4522	1
4524	4
4525	4
4526	24
4527	32
4528	6
4529	3
4530	3
4531	8
6133	5
6151	12
6155	17
6161	17
6202	22
6203	41
6206	26
6207	63
6227	5
6304	3
6310	9
6311	18
6401	4
6603	5
6609	3
6615	8
8120	3
6150	19

Module	Quantity
4550	23
4553	7
4605	27
4610	9
4658	18
4659	5
4661	2
4669	25
4670	10
4673	12
4676	14
4677	5
4678	15
4679	17
4680	9
4682	14
4685	10
4686	3
4689	2
4703	15
4704	3
4705	6
4709	19
4800	15
4802	3
4901	15
4903	3
15780	56
15782	11
15783	14
42281	5
45522	32
46761	1
54-3711	86
54-3712	159
54-3467	82
15781	1

FLIP CHIPS

Module Type	Quantity	Module Type	Quantity	Module Type	Quantity
A100	119	G263A	30	G906	40
A101	26	G264A	27	G950	18
A102	46	G270A	26	G953	16
A201E	39	G271C	1	G971A	123
A300C	64	G272D	2	G981	18
A500C	34	G273D	3	G982	17
A501C	261	G274A	87	R407	29
A605	19	G275A	85	R488	35
A990	385	G276A	24	W1	63
B129A	10	G277A	12	W2	2
B201K	346	G278A	75	W8	20
* B620D	97	G280C	88	W024	450
G004A	19	G281B	81	W026	938
G006A	4	G282C	65	W030B	52
G011A	335	G283B	36	W034	865
G019B	16	G370	17	W035	35
G200	91	G373A	68	W036	209
G203C	8	G376A	61	W073	1
G204	5	G605A	100	W074	217
G250A	86	G606A	2	W077A	183
G251A	57	G609D	265	W310A	81
G252A	39	G621B	61	W690	42
G260A	79	G627A	43	W971	23
G261A	32	G870A	28		
G262A	86	G880A	15		
* G003A	1	G901B	23		
		G905	46		
1000	17	1539	19	1706	1
1001	38	1542	35	1707	1
1002	3	1554	5	1772	24
1021	23	1556	1	1783	4
1030	16	1561	2	1804	5
1031	7	1563	1	1805	6
1032	37	1564	2	1807	34
1033	1	1570	14	1950	121
1034	30	1571	1	1954	23
1040	27	1572	2	1956	12
1104	27	1577	2	1957	18
1105	6	1578	4	1964	14
1110	9	1581	23	1972	64
1111	21	1606	18	1973	12
1115	29	1607	8	1976	5
1117	1	1663	15	1978	18
1130	59	1664	32	1981	22
1151	69	1665	33	1982	7
1161	5	1669	13	1987	39
1260	31	1672	7	1989	34
1310	20	1675	2	1990	2
1316	19	1678	31	1991	7
1317	96	1681	27	1992	43
1404	25	1687	16	1993	11
1406	26	1689	4	1994	42
1502	13	1692	5	1996	96
1503	12	1701	26	1997	28
1536	31	1703	104	1998	10

Power Supply

☐ FINISHED GOODS REQUISITION

☐ MATERIAL REQUISITION STOCKROOM # 11 NUMBER 526364

☐ FIELD SERVICE REQUISITION DATE 4/24/69

Badge No.	Cost Center	DEC Model / Part Number	Description	Unit Cost	Code No.	Post. Inv.	Quantity	Act. Code	Job Order Number 1	2	3	Account No.
		701		—			Ø					
		703		—			Ø					
		707		168 75			7					1,181.25
		739		—			Ø					
		739D		—			Ø					
		739E		—			Ø					
		785		—			Ø					
		786		—			Ø					
		786-A		—			Ø					
		790		241 97			10					2,419.70
		790-A		277 43			22					6,103.46
		826		—			Ø					
		H702-A		102 61			1					102.61
		H724-A		—			Ø					

☐ FINISHED GOODS REQUISITION

☐ MATERIAL REQUISITION STOCKROOM # 11 NUMBER 526379

☐ FIELD SERVICE REQUISITION DATE 4/23/69

Badge No.	Cost Center	DEC Model / Part Number	Description	Unit Cost	Code No.	Post. Inv.	Quantity	Act. Code	Job Order Number 1	2	3	Account No.
12	[illegible]	E001	Module	2 35			5					11.75
1		E002		2 35			7					16.45
		E003		2 35			6					14.10
		E004		2 69			7					18.83
		E005		2 69			10					26.90
		E006		3 86			9					34.74
		G797		1 68			273					458.64
		M040		12 52			1					12.52
		W015		4 63			264					1,222.32
		W016		8 83			45					397.35
		W017		7 09			25					177.25
		W052		8 99			52					467.48
		W071		3 28			493					1,617.04
		W073		2 57			5					20.56
		W841		4 69			108					504.34
	54	3814		11 96			20					239.20
12	54	3823	Module	80 57			17					1,372.58

☐ FINISHED GOODS REQUISITION

☐ MATERIAL REQUISITION

☐ FIELD SERVICE REQUISITION

STOCKROOM # 11

NUMBER 326380

DATE 4/23/67

Badge No.	Cost Center	DEC Model / Part Number		Description	Unit Cost		Code No.	Post. Inv.	Quantity	Act. Code	Job Order Number 1	Job Order Number 2	Job Order Number 3	Account No.
12	434	54	4156	Module	14	51			50					725.50
12	434		4803	Module	14	93			7					103.81
12	436		4903	Module	21	92			26					569.92

Memos Received, June, 1969
Kenneth H. Olsen

incomplete

TO:	FROM:	RE:	DATE:
Ken	Robert Barker Wm. A. Burden & Co.	TWX concerning Fast Fourier Transform	6/3/69
Ken	Pierre Schneebeli	Burroughs Pneumatic Circuit Investigation	6/4/69
Rick Merrill	Bob Allison	curriculum oriented book using FOCAL	6/6/69
cc: Ken	Gordon Bell Nicco Habermann Ron Rutledge William Wulf	Supplement to CMU Research Contract	6/9/69
Ken	Dave Packer	Comments on Commercial Applications Proposal	6/16/69
Ken	Klaus Pichler	New Display Products	6/17/69
Ken	Tom Stockebrand	In-House Use of NC Equipment	6/17/69
Ken	Al Hanson	Planning process for new plant construction	6/18/69
Ken	Roy Gould Gabe d'Annunzio	Proposal for New Exhibit System	6/20/69
Ken	Joe St. Amour	New Engineers' "Tea Party"	6/20/69
Stan Olsen cc: Ken	Al Devault	Licensing of Japanese Firm for Module Manufacture	6/23/69
Ken	Phil Markell	Carter's Ink Company	6/23/69
cc: Ken	Gerry Moore	Pirating by Infocom	6/24/69
Norm Doelling	Bob Allison	Use of Computers in Schools	6/30/69

6/3/69

Robert Barker

Wm. A. Burden & Co.

ac 212 CI 6-9300

Has an investment in a small, privately-owned, 3-year-old company, Time Data, Inc., Palo Alto, California. They have developed a Fast Fourier Transform, and would like someone to market it.

Very expert people who have seen it say it is an outstanding machine. They have sold two dozen already.

Their chief engineer, the one who designed the machine, is on the East Coast this week, and would like to visit someone at DEC. His name is Ed Sloan, and the machine is called Time Data 100.

They are coming out with a new machine called, Time Data 90, to sell for about $35,000.

Gene Fubini, formerly of IBM, has looked at it and said it is outstanding.

Nick Mazzarese called re 6/3 - Ed Sloan is to call him for an appt. re

digital INTEROFFICE MEMORANDUM

DATE: 6/4/69

SUBJECT: Burroughs Pneumatic Circuit Investigation

TO: Fred Wilhelm

FROM: P. Schneebeli

cc: Ken Olsen ✓
Joe St. Amour
Dick Allen
Henry Crouse
Allan Kent

In my memo of January 16, 1969 to Mr. E. L. Lyons, Manager of OEM at Burroughs (see copy attached) I requested a better air pressure regulator (1) and a chart to show secondary (regulated) pressure variation in function of primary (compressor) pressure variation.

We never got satisfaction on these matters and the RD10 are still difficult to bring up.

I have now done myself what I asked them to do:

Using a pneumatic transducer (capacitive) with a sensitivity of 1/100 PSI (MKS Baratron Type 77H-100 with indicator 77M-XR manufactured by MKS Instruments Incorporated, 45 Middlesex Turnpike, Burlington, Mass.) and a Leeds and Northrup strip chart recorder borrowed from Clark Crocker's Group, I have monitored the variations in secondary pressures on four RD10 (No. 102, 103, 112 and 100).

Variations of 1.2 PSI total on the secondary are common with variation of 25 PSI on the primary. On the #100 file variation of 2 PSI were observed.

By replacing the present Norgren R06 regulator used by Burroughs by a Norgren 11-002-021 the variation came down to .2 PSI on the RD10 #100.

The RS06 costs $4.50 to Burroughs and the 11-002-021 would cost $9.85.

Recommendation:

To reduce head read-back signal variation it is imperative to reduce the head load variation. This can be accomplished on the long run by replacing the Norgren regulator.

The first RD10 will be modified along these lines by June 6,1969; if results look encouraging from the systems standpoint, all the RD10 now in test will be modified during the week of June 9, 1969 to June 13, 1969.

/bca

16 January 1969

Burroughs Corporation
1649 Wilshire Boulevard
Los Angeles, California 90017

Attention: Mr. Edgar L. Lyons, Manager
OEM Sales

Dear Ed:

We have enjoyed the visit to your Los Angeles Facilities on 6 January 1969. The Westlake Plant shows a generosity in the planning which should insure us of the best services on the next 9370 Systems Memories.

This comes at a critical moment from our point of view because of the present shortcomings found in your 9370. Improvement in the System's reliability must be achieved at once if the confidence in the Systems and our commitments are to be kept.

From the engineering standpoint, I see several areas where minor modifications could be included to provide us with an acceptable safety margin. They are as follows:

1. A back-up air system including a better grade regulator (Bellowfram type) should be designed and tested in kit form (stocked and available on short notice) for later incorporation in the pneumatic line, should the need arise.

   One kit should be sent to DEC no later than 15 February 1969.

2. Flying Height Chart in function of air pressure (μ inch/PSI) should be computed, verified experimentally, and shipped to us before 7 February 1969.

With the present regulator, a test should be performed whereby a pneumatic transducer (sensitivity 1/100 PSI; reaction time 1/10 of a PSI/milliseconds) is mounted on the regulated side of the air system, and a standard high speed plotter records the pressure variations in a 1/10 of a PSI during a full week of operation while switching heads off two times a day for two hours.

Each file that is to be shipped from 1 February 1969 on should have this chart attached (covering one to two days' running time minimum).

A full description of the test instrumentation and procedure should be sent to our Mr. Richard Federico.

3. The new R/W card schematic should be immediately forwarded to us for design and function evaluation. The schematic will be kept in strict confidence and returned to you with our comments.

4. The "touch and tach" card design should be seriously investigated and the ECO sent to us as soon as possible.

5. The hub casting should be tested for rigidity and modified if present flexibility endangers head to track alignment.

Your response to these recommendations is requested by 31 January 1969.

Yours very truly,

J. Pierre Schneebeli, Project Engineer

cc: Burroughs Corporation
Mr. Fred Adams
Mr. John Brown, Plant Manager, Westlake Facility
Mr. Robert Groom, Engineering Manager, Westlake Facility
Mr. DuRay Stromback, Vice President, Manufacturing, Dearborn, Michigan

Digital Equipment Corporation

K. Olsen H. Crouse A. Kent
J. St. Amour R. Federico

digital INTEROFFICE MEMORANDUM

DATE: June 4, 1969

SUBJECT: "Proposed Facilities Planning Priority Schedule #5

TO: Ken Olsen
Stan Olsen
Pete Kaufmann
Ted Johnson
Nick Mazzarese
Win Hindle

FROM:

For your approval, you will find attached "Proposed" Facilities Planning Priority Schedule #5, which includes projects carried over from Schedules #3 and #4, and all of "Proposal #4", which the Operations Committee approved in its entirety.

Would you please study Schedule #5 and submit to me, as soon as possible, any errors or omissions, so that I can properly schedule my work force for the next few months. Because of the limited number of maintenance people available and the vacations that have been scheduled for the next few months, any deviations from this Schedule should be approved by the Operations Committee, so that we will all be in agreement about the various projects.

Before work is started on any of these projects, would each of you like to see a finished set of drawings and final estimates? If so, please advise me immediately. I would prefer that each of you do see the finished drawings and final estimates, to eliminate any minor disagreements with your subordinates.

This Schedule is based upon using DEC labor, working a 40 hour work week. Overtime will not be used to meet this Schedule unless approved by the Operations Committee

Ray Baum

June 3, 1969

APPROVED

SCHEDULE NO. 5

FACILITIES PLANNING PRIORITY SCHEDULE

No.	Cost Center	Department	Supervisor	Pres. Loc.	Prop. Loc.	Sq. Ft.	Budget Est.	Project Number	Start Date	Comp. Date
1		* Company Signs	A. Hanson		Site		6K			7/1/69
2		* Sprinkler System A. Sprinkler Heads	A. Hanson		Site		225K	X95-07254		7/1/69
3		* Painting Facilities	D. Sullivan	6D-1	6D-1		12K	X95-07260		8/30/69
4		* Environmental Chamber	A. Hanson				25K	X95-07259		8/15/69
5		* Plant #3 - Puerto Rico	A. Hanson				300K			12/1/69
6		* Fire Alarm System 20 Sta.	A. Hanson	Site	Site					
7		* Parking Lots Oil & Paint	A. Hanson							9/1/69
8		* Foundation Pratt & Whitney	D. Sullivan		5-1					7/30/69
9		* Lg. Comp. Eng. Expansion	W. Hindle	5-5	5-5	8400	13K	X99-07337	6/1/69	7/5/69
10		* Computer Center	L. Portner	12-1	3-5	5000	13K	X99-07332		7/7/69
11		* Prod. Eng.		1-4	Temp. Offices					7/12/69
12		* Bryant Disk		5-3	Pending Approval by Larry Portner					

No.	Cost Center	Department	Supervisor	Pres. Loc.	Prop. Loc.	Sq. Ft.	Budget Est.	Project Number	Start Date	Comp. Date
13		Puerto Rico 2A	C. Kendrick							
14		Silk Screen			5-1				5/28/69	9/25/69
15	461	PDP 10 Prod.	J. Smith	5-5	5-5				6/9/69	7/14/69
16	646	Personnel	R. Lassen	5-4	5-5	7200			6/23/69	8/5/69
17	257	Shipping and Crating	F. Kalwell	1-1	21-1	6200		X95-07255	7/7/69	8/4/69
18	257	Module Stock Room	F. Kalwell	1-1	21-1	4800		X95-07255	7/7/69	8/4/69
19	257	Crating Supplies	F. Kalwell	1-1	21-2	3000		X95-07256	7/7/69	8/4/69
20	257	Prod. Line 99 Stock Room	F. Kalwell	New	21-2	2000		X95-07256	7/7/69	8/4/69
21	257	Corrugated Storage	F. Kalwell	8-2	21-2	6000		X95-07256	7/7/69	8/4/69
22	436	Wire Wrap Dept.	J. Smith	4-3 1-4 6D-1	1-1	3000			7/7/69	
23	550	Print Shop (Temp.)	N. LoRusso	3-5	5-B	5000			7/7/69	8/25/69
24	436	Sub-Assy. Staging	J. Smith	5-3	1-1	5000			7/14/69	7/28/69
25	436	Touch Up	J. Smith	1-1	1-1	2000			7/14/69	7/28/69
26	436	Material Control	J. Smith		1-1	3000			7/14/69	7/28/69
27	466	Special Systems (Office)	B. Vachon	5-2	21-3	4500		X95-07257	7/15/69	8/25/69

No.	Cost Center	Department	Supervisor	Pres. Loc.	Prop. Loc.	Sq. Ft.	Budget Est.	Project Number	Start Date	Comp. Date
28	466	Special Systems (Lab)	B. Vachon	5-2	21-3	6500		X95-07257	7/15/69	8/25/69
29	742	Field Service (Office)	J. Shields	5-3	21-4			X95-07258	7/15/69	8/25/69
30	742	Field Service (Lab)	J. Shields	5-3	21-4			X95-07258	7/15/69	8/25/69
31	360	Programmers (Office)	L. Portner	3-5	3-5	6700			8/25/69	11/15/69
32	324	Model Shop	G. Gerelds	5-3	5-3	7500			8/25/69	9/30/69
33	324	P.C. Drafting	G. Gerelds	5-3	5-3	1400			8/25/69	9/30/69
34	490	Semi-Cond. Test	H. Crouse	5-4	5-3	2600			8/25/69	9/30/69
35	490	Inc. Mech. Insp.	H. Crouse	5-4	5-3	2450			8/25/69	9/30/69
36	381	PDP 8 Eng.	B. Long	5-2	5-2	3000			8/25/69	9/30/69
37	256	Mod. Adm. (Office)	F. Kalwell	5-3	5-3	3300			9/15/69	11/15/69
38	357	Mod. Eng. (Office)	A. Davault	5-3	5-3	6800			9/15/69	11/15/69
39	101	General Sales	T. Johnson	5-3	5-3	8400			9/15/69	11/15/69
40	276	PDP 9 Comp. Mkt.	McGinnis	5-3	5-3	2400			9/15/69	11/15/69
41	377	9/I Engineering	G. Butler	5-3	5-3	2400			9/15/69	11/15/69
42	178	Computer Admin.		5-3	5-3	3700			9/15/69	11/15/69
43		Prod. Line Mgt.	J. Jones	5-3	5-3	3700			9/15/69	11/15/69
44	381	PDF 8 Eng. (Lab.)	B. Long	5-2	5-2	3000			9/29/69	10/21/69

No.	Cost Center	Department	Supervisor	Pres. Loc.	Prop. Loc.	Sq. Ft.	Budget Est.	Project Number	Start Date	Comp. Date
45	435	Module Test	J. Cudmore	5-4	5-4	12000			9/30/69	11/10/69
46	490	Purchasing	H. Crouse	5-4	5-4	4800			9/30/69	
47	551	Tech. Doc.	J. Belantoni	5-2	11-4	3000			8/1/69	11/1/69
48	549	Photo Lab.	J. Belantoni	3-5	11-4	1500			8/1/69	11/1/69
		Photo Lab.	J. Belantoni	12-3	11-4				8/1/69	11/1/69
49	287	Advertising	C. Dannunzio	5-2	8-4	2000			8/1/69	11/1/69
50	252	Art Dept.	E. Hendrickson	3-5	8-4	1400			8/1/69	11/1/69
51	387	Desk Calculator	R. Cady	5-2	5-2	2400			11/1/69	11/21/69
52	288	Trad. Prod.	R. Lane	5-2	5-2	6200			11/8/69	11/28/69
53	363	Sm. Comp. A/D Dev.	C. Crocker	5-2	5-2	2000			11/8/69	11/28/69
54	375	Display Eng. (Off.)	R. Collings	5-2	5-2	2000			11/15/69	12/20/69
55	387	Desk Cal. (Lab)	R. Cady	5-2	5-2	2400			11/15/69	12/20/69
56	262	PDP 8 Mkt. Adm.	G. Rice	5-2	5-2	5200			11/15/69	12/20/69
57	290	PDP 11 Marketing	J. Conen	5-2	5-2	2500			11/15/69	12/20/69
58		Legal Department	E. Schwartz	5-2	5-2	600			11/15/69	12/20/69
59	649	E.D.P.	D. Packer	5-2	5-2	5500			11/1/69	12/15/69
60	647	Accounting	R. Dill	5-2	5-2	8000			12/1/69	12/20/69
61	374	Prod. Eng. Permanent		1-4	1-5	5000			12/1/69	12/30/69

No.	Cost Center	Department	Supervisor	Pres. Loc.	Prop. Loc.	Sq. Ft.	Budget Est.	Project Number	Start Date	Comp. Date
62		Refurbish Bldg. 1-2 Manuf.							1/1/70	2/15/70
63		Refurbish Bldg. 1-1 Manuf.							1/1/70	2/1/70
64		Module Repair	F. Kalwell	5-3	1-2	3000			2/15/70	2/30/70
65		Test Equip. Serv.	J. Cudmore	5-3	1-2	1000			2/15/70	2/30/70

* Carry over projects

MR. KEN OLSEN

digital INTEROFFICE MEMORANDUM

DATE: June 6, 1969

SUBJECT:

TO: Rick Merrill

FROM: Bob Allison

Regarding our conversations concerning the way FOCAL could become the standard language in education, I believe the publishing of a curriculum oriented book using FOCAL would be the best means of exposing teachers and students to the merits of FOCAL and ultimately leading to the purchase of a DEC computer. The most widely used language to date is BASIC. This is due to the fact that textbooks are written in BASIC, timesharing companies use the language, NSF institutes teach the language, and colleges introduce the language in teacher training and in-service training classes. The key factor is not the merit of the individual language, but the promotion and availability of the language to the educator.

A curriculum oriented book should have wide appeal to the various levels of sophistication within the ranks of thousands of teachers and millions of students who will be exposed to its contents. It must have an attractive physical format. A teachers' edition should be provided. The content should be divided into three sections; the first assuming no previous knowledge of computers and the computer language, the second assuming a limited exposure to computers, a computer language and terminology, and the third assumes a fairly complete knowledge of the subject and introduces the use of the computer in specific academic areas. Specifically, these sections would contain:

1) A brief history of computers and a gradual introduction of terminology. All computer systems could be discussed including DEC's. Pictures and illustrations would be beneficial. Terms such as I/O, memory, disc, core, and the like must be presented along with the uses of computers. This section could stand alone. If a teacher did not desire to introduce a computer language except in general terms or did not have a computer available, he could stop at this point. At this juncture we must assume a limited knowledge on the part of teachers and students and take this factor into

consideration. This would be a limited section, however, it would be a start toward building a base for added learning.

2) The beginning part of the second section would reinforce the first section. Then the subject of languages would be discussed in detail. This would lead into the learning of FOCAL and its benefits. Flow charting would be discussed. This section could contain tapes and be used for teaching the basics of computer science.

3) The third section would contain a detailed explanation of how DEC computers are used in mathematics, science, and any other academic subjects. FOCAL would be reinforced and examples of ways to use the computer would be shown. This section would be written by teachers who have used the computer. It would be correlated to established textbooks currently available. Sample tapes could be provided.

The book should have several authors. In addition to Rick Merrill, several educators should write the book. The editorial responsibilities could be handled by DEC. The most salient factor of this project is that the book not only be technically proficient but also possess empathy for its intended readers.

The attached book, Computer Assisted Mathematics Program is an example of what commercial publishers are publishing. The introductory remarks section is worth noting. There are similar books available if you desire additional examples. In particular, note the authors' comments on the computer language he employs.

d,12

digital INTEROFFICE MEMORANDUM

DATE: June 9, 1969

SUBJECT: Supplement to CMU Research Contract

TO: Win Hindle
Robert Savell
Dave Cotton
Gale Morgan (Pgh)

FROM: Gordon Bell (author) CMU
Nicco Habermann
Ron Rutledge
William Wulf

cc: Ken Olsen
Alan Perlis
Alan Newell
Dave Nickerson

This memo supplements the memo sent today with a few philosophical remarks.

Generally I don't believe DEC should view our purchase as a marketing decision. Even though "the sale" can be made at some price, we view this sale as necessary Computer Science research which is very relevant for DEC. If DEC were motivated to have a research organization it could not have one at the low price we are suggesting. (The salaries and overhead) for the $250,000 per year would hire about 5 researchers. If the researchers were to engage in network studies the equipment cost would be inordinate and they could not obtain a user population to do the testing.

Nearly all the principle investigations at Carnegie have been engaged in pioneering computer science work. Although we have all been optimistic of when ideas will become important, I don't believe we have been wrong about selecting the relevant future ideas. We all agree that the network is the future form of computational power. Personally, I am interested in providing large, reliable computational structures, and thus feel that we have to do the network experiments now in order to know how future computers need to be changed for networking, (also this technology is moving this way).

At present we have a research contract with IBM for $175,000 per year (while we have the 360/67). IBM has generally received its moneys worth, because their $100,000,000 expenditures on TSS has been made practical by using large core storage (which was demonstrated via our research and system). Last year, a user simulation was developed for the system which made system testing practical. (We would provide this initially on the PDP-10.) The level of research we are suggesting to DEC would go well beyond the involvement with the IBM system. (It's difficult to arouse faculty interest in the 360.) In this case, if the implementation language is successful, it might eventually be used at DEC for other programming. (A 10% cost saving per year in programming at DEC would cover this contract.)

Other possible arrangements so that we could have enough machines for an interesting experiment include our providing time, via the network to fulfill some of DEC's user time commitments--alternately a message concentrator could be placed in Maynard, and we could be loaned the very large PDP-10 that is used by marketing. When the network is operational, the location may be less important.

As a by-product of having machines here, it's conceivable that other machines will be sold (certainly directly for networks -- if the software can be written). Our computation center will be making a commitment to change in fall -- hopefully they will be influenced by our decision.

At this time, our ARPA proposal for this next fiscal has just been submitted based on this plan. We believe they think it's relevant, hopefully, DEC will too.

bwf

digital INTEROFFICE MEMORANDUM

DATE: June 16, 1969 7-1-69 Copy to: Operations Comm. Bill Long from K. Olsen

SUBJECT: Comments on Commercial Applications Proposal

TO: Ken Olsen FROM: David W. Packer Dave

As you requested, I have looked at the documentation on the Commercial Applications Project and listed my observations below. Basically the answer to your question of whether it is possible to do is yes. The answer to the second question as to whether it is wise is that I believe there is an extremely lucrative field for Digital in commercial applications. But, as you will see below I am not sure that the existing proposal goes to the right segment of that market.

Here are my comments:

1. My major observation is that the size of the system that is conceived as providing the hardware for commercial applications is in fact extremely large. The prices for the systems are approximately $75,000. This means that the equivalent rental, assuming a factor of 40, is almost $1,900 a month. This is dangerously close to the cost of systems such as the IBM 360/20. A 360/20 can be rented with a moderate speed line printer, card reader, and card punch for approximately $1,900 a month. Off-line sorting capability - again on cards, would bring the level up to somewhere about $2,000 a month. Another example is the Burroughs 500 System, which on a 100 hour contract with two tape units, can be rented for slightly over $2,000 a month.

   What this means is that we would be selling to people who would also be talking with heavy commercial manufacturers, such as IBM and Burroughs. I believe we would not be in a very good position to convince prospects that they should take a system that can essentially not be upgraded in the face of growth, that involves a unique programming language, from a company without heavy business applications, marketing, or sales support expertise. Also, it is likely we will be pulled into the rental business simply because the users will not want to lay out $75,000 for a computer when given the alternative of a 360/20 on 30-day cancellable rental. So, if the pilot systems indicate the scope of system that we envision entering this market with, I suspect that its just too big.

2. Input Device:

   It seems to me that the type of input device is extremely important to the successful operation of our small business computer. I believe that most people have agreed - although this may be a myth - that the teletype is an extremely poor input device and that something better is needed. For example, Infocom is using flexowriter keyboards, which are very nice devices, for good reliable heavy-duty, human-engineered input stations.

3. We should think carefully about marketing and sales support activities for systems of this type. The concept of a turn-key system is nice - as is the concept of a generalized applications package, but I believe we will invariably find users wanting to upgrade their applications, add new features to existing programs, and in general become competent to deal effectively with the hardware and software. One who is spending $75,000 on a system will want to get maximum utilization out of it, so the idea of being constrained to whatever restrictions are imposed by our own turn-key applications packages may be short-lived. We must also be very sure to have reliable estimates of field service and maintenance expenses. In nature, they will be more like the type-setting system; where I believe our maintenance costs are significantly higher than for other types of systems, because they will be used heavily in a production environment.

4. The one proposal that I have participated in to some extent is our purchasing application - essentially a system to prepare purchase orders (generally paper tape output) for entry into our larger EDP systems and to do calculations, etc. This system would involve a flexowriter keyboard attached to an 8-family machine and would in fact be quite price competitive with, for example, the TC500 through the ability to attach more than one keyboard to the same central processor. In addition, it has all of the advantages of an internally programmed computer in that new operations and peripherals can be added, although the initial application is quite simple and straightforward in nature. This system will fall into the $15,000 to 30,000 price range and I think is very competitive with what is available from alternative sources.

DWP:tw
Attach: Memo Small Comp. Business Applications

digital INTEROFFICE MEMORANDUM

DATE: June 17, 1969

SUBJECT: Small Computer Business Applications

TO: Nick Mazarese
John Cohen

FROM: David W. Packer

Now that we are moving in the commercial area for small computers, let me present some thoughts on possible markets.

Two examples of highly successful small business computer systems that are relevant here.

One is the Burroughs TC500, that is essentially a programmable small computer which will sell for somewhere in the $14,000 price range. It has limited input/output capabilities i.e. can handle only punched paper tape, edge punched cards, or regular punched cards and has no sorting capability. However it does have a full-scale assembly language, a reasonable amount of storage and uses as its memory a disk with 5 ms. access time. In addition, it has an extremely sophisticated keyboard arrangement, using two keyboards and two independent form feed mechanisms, designed from the Burroughs expertise in the business machine market. In fact, this device represents the marriage of Burroughs computer competence with their business machine competence. At any rate, it is a relatively inexpensive system which is essentially a small computer that could very effectively handle various kinds of applications.

It is also designed to be a terminal computer, very easily interfaced to a larger system. Experience in the real time area has shown that for handling large volumes of data there are tremendous inefficiences and difficulties with having a central computer doing for example, data editing, formatting, and all the detailed work that is required at each terminal. The concept of the terminal computer is that it can be interfaced to a large central computer which sends and receives data in simple blocks to the terminal computer when requested. The terminal computer can then do all of the detailed work of setting print lines and printing the data, etc. So, the TC500 is an extremely well human-engineered device which can either be an off-line small computer and in addition or parallel serve as a terminal computer interfaced to a larger system. The TC500 has been extremely successful and I understand that the Flexowriter, for example, is very worried about the impact of this device on their market.

The other example is the Viatron device which incorporates a keyboard and display and tape cassette. It has no sophisticated programming logic, but conceptually is a device for capturing data and can be classified at the least sophisticated end of the small computer arena. Market response to the Viatron system has been extremely strong.

Based on looks at these systems and my general feeling for the needs, I would suggest that a system in the $15,000 to $30,000 price range, which would offer basically the same programming features as outlined in the commercial applications proposal and would have internal sorting capability through DECtapes, would be extremely competitive. It would offer more memory and computing power than the TC500 and also much more flexibility and expandibility in terms of the peripherals that could be added.

Based on these observations, I would see the components of a hardware/software system as being represented by the following points:

1. A hardware configuration consisting of a CP, flexowriter keyboard, DECtapes, and papertape I/O. 15-35K price range.

2. A character oriented assembly language. Sophistication is probably not great; limited by core available.

3. A DECtape sort/merge package.

4. A set of stand-alone application packages.

5. Datacomm capability for use as a terminal computer.

Essentially, I'm recommending a system with two markets.

1. A stand alone system for the small, unsophisticated business operation. A very powerful business machine.
2. A good terminal computer for sophisticated on-line business users.

DWP:tw

digital INTEROFFICE MEMORANDUM

DATE: June 17, 1969

SUBJECT: New Display Products

TO: Ken Olsen

FROM: Klaus Pichler

The list of worthwhile new display product developments you have asked me for is rather short--it contains a real "hot" item however.

1) Alphanumeric Communications Terminal

2) VR-19

It seems to me the Corporation can invest its money very effectively with good return prospects if you would o.k. Item 1.

Item I: I see an alphanumeric terminal using MOS-MSI device extensively, using medium size complex function boards and being still very versatile due to a clever modular design: A terminal which is compatible with ordinary closed-circuit TV and interfaces to the public telephone communication network (remote communication, timesharing). I want to cover a wide variety of applications from educational through scientific and industrial to business. Color (similar to Viatron) could be added at a later stage if there is enough interest in it.

I firmly believe we can manufacture a terminal with similar characteristics as the VT03 (CONRAC) for slightly below $1,000.

What do we need:-

a) Generate a sound and attractive industrial design (you really have Jim Jordan thinking).

b) Negotiate with a potential TV manufacturer to supply us a TV chassis for about $80. (Sylvania would be a good choice.)

c) Get a MOS-ROM custom designed. (All major U. S. microcircuit manufacturers are active in this field. I will get a 2240 bit MOS-ROM for $65.00; i.e. 3ct/bit soon.)

d) Buy a magnetostrictive delay line. (I have an offer to buy for $75.00 per piece in quantities of 1000; i.e. 1/2ct/bit. I also have a

prototype under evaluation. At least four manufacturers can supply what we want.)

e. Buy the keyborad, probably "Control Research Corp.'s", for $120 in quantities. (One day we will decide to make it ourselves.)

f. Build an expandable and carefully weighted modular control logic.

g. Before freezing the design, we will have to do more research in the direction of multiterminal network configurations and optimization of communication code.

h. Set up a not too small engineering team (I have three particular men in mind) and plan ahead for a very large, very automated production.

I firmly believe that going the TV raster route means choosing the least expensive and, at the same time, most versatile technique in the long run, which will assure an uncommonly long product life.

Besides, I believe we have to do it big or not at all if we want to be successful in this exploding field. Our price has to be very attractive to have a chance for significant sales. (We need quantities.) There will be tough competition, and we have to go "OEM" besides our in-house uses because the latter is very small relative to the potential of this particular market. The device will, on the other hand, carry some computer sales (like the VR-12 did and will with the PDP-12).

Item II: Len Halio's stroke vector type of display system, which will enable us to display about 50 times more inches of flicker-free vector than we can generate on the 338 system, requires a super fast analog front end and a large screen where 19" diagonal is considered to be a minimum. I have checked into the tube availability. We can get a 19" industrial (high quality) type tube for about $80. The VR-12 circuitry cannot be used, however, since it was specifically designed for random point plotting purposes to be operated by our existing display controllers. Prices of displays with the properties requested by the PDP-15 group run between $1.2K & $4K.

The VT-15 project requires a display by the end of this year, and we will not be able to develop a VR-19 in time for this particular application.

Conclusion: The two products listed represent our short term requirements. I think at the time we should rather buy a VR-19 type of display and develop an inexpensive terminal than buy the VT-03 which we cannot sell because of its high price.

In addition, as soon as large all solid-state random access memories will be available at reasonable prices, (the industry expects to get them down to 1ct/bit including read/write electronics by late 1970), the high density graphics display hardware for applications like architectural drawings, IC Mask Design, Mechanical Parts Design, etc. will most likely be built around those memories. Why don't we bridge this time with a purchased VR-19?

cc: Nick Mazzarese
Bob Collings
Dick Clayton

KP/tkw

digital INTEROFFICE MEMORANDUM

DATE: June 17, 1969

SUBJECT: IN-HOUSE USE OF NC EQUIPMENT

TO: Ken Olsen ✓
cc: Pete Kaufmann
Joe St. Amour
Russ Doane
Al Devault

FROM: Tom Stockebrand

The first major use is the semi-automatic wire wrapping system. We have a prototype installation of three stations on a computer here at Maynard, a production system of 14 stations on two computers in Canada and in the fall we will add an additional system in Canada of 30 stations on two computers. We will expand that the first of next year to 45 stations.

The essential features of these stations are that the programming is simple, the axis are driven by complex motors (Fujitsu), no acceleration tapering is used nor overall feedback, and very many axis can be driven simultaneously on one computer (120 max. at 1KHZ).

The next major system is the automatic inserting project which has a prototype running now. In July we will have two stations on-line (to about 8 by fall). These systems are <u>much</u> higher performance systems, using "dynamic feedback" which is electrically equivalent to the Fujitsu's hydraulic feedback and can move a 20# table 2/10 of an inch in 90 milliseconds. The resolution is 2.5 mills. A peak velocity of around 10" per second is achieved. A fairly simple hardware interface cuts the programming complexity so that many systems can be installed on one computer. A three cycle data break is used. We currently insert parts which are closely spaced at the rate of 3 per second.

The current project is a Behrens 25 ton rotary turret punch press installation in which we are moving a ½ ton table at speeds up to 16" per second accelerating in about 1 second over 1½". In the future when we add more punch presses, we will use powerful electric steppers (Fujitsu 111) and build a system almost identical electrically to the insertion machines mentioned above. But now we are using hydraulic steppers and a full contouring control program in open loop in order to get experience with software function generators for the contouring projects to come. In addition to approximately doubling the number of holes punched per hour, we will make the first step toward keeping the "drawings" on mag tape readily accessible to the machinist via the equipment.

In the module production area a series of interconnected computers and programs exist. The main input device is a digitizer which is unique in that it uses two strings (patents applied for) and two drums and costs about $1,000 instead of $10,000 as is usual for digitizers. A digitizer, the typewriter and computer are welded together with a program which allows the production of "data base tapes". It is the intent to grow the data base tape in a general way to be used both in the module world and also in the fab shop area. It will provide a base of communication between all our plants. An output device which is now used only for checking is a light beam plotter which exposes spots on film. At the present it's to verify that the digitizing was done correctly. A follow-on for this project will allow the dots to be used directly to expose copper on the board and perhaps further in the future we will be able to draw lines. A major point behind this plotter is that it eliminates photo reduction completely and substitutes computer mathamatics. A second set of outputs are tapes which run various numerical control equipment:

1) Excellon automatic drills (which will be eventually converted to computer use to gain flexibility and speed).

2) Pratt & Whitney milling machines to produce the templates for automatic insertion at the present.

3) The automatic insertion machine mentioned above will gradually eliminate the use of templates altogether.

Tom

bn

digital INTEROFFICE MEMORANDUM

DATE: June 18, 1969

SUBJECT: Planning process for new plant construction

TO: Ken Olsen
Stan Olsen
Pete Kaufmann
Dave Knoll
Dan Sullivan
George Wood

FROM: Al Hanson

In order to expedite the design and construction of our new facilities in Westfield and Leominster, I would like to suggest the following schedule of meetings:

I. Engineering Meeting

A. Time: Every Wednesday at 8:30 a.m.
B. Place: Plant Engineering Conference Room
C. Attending: Al Hanson
Dan Sullivan
George Wood
Dave Knoll
The Carlson Corporation
D. Purpose: To furnish the Carlson Corporation with the criteria for a new sheet metal and plated through hole facility.

II. Executive Level Facilities Planning Meeting - Part One

A. Time: Friday at 1:30 p.m. as often as needed
B. Place: Ken Olsen's office
C. Attending: Ken Olsen
Stan Olsen
Pete Kaufmann
Al Hanson Dave Knoll
D. Purpose: To make any major decisions, requiring executive level planning, concerning the new plant construction.

III. Executive Level Facilities Planning Meeting - Part Two

A. Time: Immediately following above meeting
B. Place: Ken Olsen's office

C. Attending: Ken Olsen
Stan Olsen
Pete Kaufmann
Al Hanson Dave Knoll
The Carlson Corporation

D. Purpose: To present to DEC management various alternatives for building design, budget estimates, etc. for the new plant facilities.

CONFIDENTIAL

digital INTEROFFICE MEMORANDUM

DATE: June 20, 1969

SUBJECT: LONG RANGE MODULE PLAN

TO: Ken Olsen

FROM: Fred Gould

The attached is the first draft of what our business is like and where we can go in it.

I'd like to talk it over with you after you form your own opinions.

:cm

THE PRINTED CIRCUIT BUSINESS - THE ANALYSIS

Major Sectors

1. Catalog Mfg. Digital and Industrial Control Circuits
2. Custom Board Houses
3. In-House Mfg. and consumption
4. Hardware, Supplies, and Process
5. Analog Catalog Mfg.

Sector 1 - Catalog Mfgs. of Digital and Industrial Control Circuits

Estimated Rank	Name	Estimated Sales
1	Digital Equipment Corporation	10,000,000
2	Computer Control Div. of Honeywell	9,000,000
3	Scientific Data Systems	7,000,000
4	Raytheon	5,000,000
5	EECo	4,000,000
6	Cambion	3,000,000
7	Data Technology	2,500,000
8	Wyle Laboratories	2,000,000
9	Control Logic	2,000,000
10	General Electric *	2,000,000
11	Seltzer**	2,000,000
12	Phillips **	2,000,000
13	Cutler Hammer*	1,500,000
14	Square "D" *	1,500,000
15	Monitor Systems	1,000,000
16	Design Products	1,000,000
17	CEC	1,000,000
18	Allen Bradly *	1,000,000
19	Ault *	1,000,000

Estimated Rank	Name	Estimated Sales
20	Baily Meter *	1,000,000
21	English Electric **	1,000,000
22	Nor Bits **	1,000,000
23	BRS ***	1,000,000
24	Data Scan	1,000,000
25	Grayson Stadler***	750,000
26	Leigh Valley ***	500,000
27	Massey - Dickenson ***	500,000

Key: * Industrial Control

** European Mfg.

*** Behavioral Research

A study performed several years ago by the Module Product Line indicated an additional 50 minor companies. Estimated total sales at 5 - 10 million for all.

In sector 1 the business is divided into roughly five catagories :

a. Computer Oriented
b. Industrial Control
c. Logic Elements
d. Behavioral Research
e. Data Communications

a. Computer Oriented

Major small computer manufacturers have a captive module business due to the wide range of applications for the computers and the interfacing of those computers. This has been the major segment of our business.

b. Industrial Control

Relay manufacturers have had for some time competing solid state controls if for no other reason than to provide a single source for their customers thereby freezing out possible competitors. We are looking at our K series line as our most promising effort. This line is not tied to the computer growth curve and the market requirements for more speed and higher reliability is in our favor.

c. Logic Elements

This class of supplier caters to a market not industrial based and not necessarily tied to a computer although some peripheral manufacturers are in this group.

d. Behavioral Research

With the entry of our LAB K application into this market we will quickly move into dominance of this relativly small but vocal sub-sector.

e. Data Communications

The development of a line of communications oriented modules and complete acoustical couplers will open a new market during the next year.

Sector 2 - Custom Board Manufacturing

1. Elgin Electronics
2. Texas Instruments
3. Data Scan
4. Defiance Electronics
5. Electro Optical Systems
6. Goodyear Aerospace
7. Electro pac (CC of Honeywell)
8. Motorola
9. General Electric
10. Digital Equipment Corp.

In this group we can only guess at what the level of business is. We have bid and no bid on work in excess of 5 M per year for the past couple of years. I estimate that 40 - 50 million is done in this sector annually. It is chastized by shops working on 100% overhead and working on a mark-up of 150 - 190%.

Testing is not a requirement and quality requirements vary from transistor radio variety to computer-aero space specs. All manner of shapes and components are used. Quick turnaround work is one class of operations while long run, long forecast is the rule rather than the exception. It is my opinion that our greatest growth opportunity exists in this area of business.

Sector 3 - In-House Mfg. & Consumption

This group exists in spite of sectors 1 and 2 for several reasons. Control being the most important , cost being second. This is undoubtly the largest dollar sector of the printed circuit business. In order to dislodge it we would have to be in the custom board business and develop the proper selling approach.

People in this business could best be described by looking at Pratt & Whitney, Machine Tool and by Cincinnati Milling & Grinding, large volume mfg used completly in-house.

Sector 4 - Hardware Supplies

1. Augut
2. Cambion
3. Vero
4. Amphenol
5. Kodak
6. Scanbe
7. Interdyne
8. Vector
9. EECo
10. Gardner-Denver

Products - connectors, connection systems, enclosures, cables, front panels, pc board components and processes.

This too has very strong growth potential, Augut has capatilized on the mother board approach to cash in on what was both sector 1 & 2 business. Without considering the Connectors supplied to prime manufacturing I would say this is a 20 - 30 million business.

Sector 5 - Analog Catalog Manufacturing

There are perhaps 10 major manufactures in this market and with our volume of 600K we would place high among them. The number one manufacturing in this group is Philbrick. Total sales in this sector is estimated at $10,000,000 with a large percentage being add on and spares to analog computing devices. It is my opinion that the expertise required to enter this market more strongly dose not exist at Digital and would be difficult to develope. Furthermore, growth in this sector is quite small. Raytheon has done very well by selling D/A - A/D systems in this area.

PRINTED CIRCUIT BUSINESS - THE PLAN

Sector 1 - Catalog Manufactures

Based on an identifiable market in excess of $65,000,000 (est. sales of 27 companies) and an additional $5,000,000 scattered among some 50 minor competitors,we presently have a 14% share of Sector 1 business.

To improve our share of this market I suggest the following plan be implemented.

Sales Effort - Historically, Digital's module sales have been limited by inadequate sales effort. The last three years have seen sales time percentage (of budget) run 50%, 60%, 70% (FY 67, 68, 69). All other factors considered this has been the most serious obstical to increased penetration.

The Module Specialist Program temporarily arrested the problem but this is starting to erode quickly. In spite of all the emphasis during FY69 we achieved only 70% of the budgeted time.

The first step in any effort to improve our market share would be to break away the module sales force from the present organization.

Secondly, I would reprice selected types to make competitive analysis of lines decidedly in our favor.

Third, I would design interface modules for all major small computers. This would reduce the forced entry of small computer manufacturing into the module business.

Fourth, expand upon the assembled system business (similar to Marty Gordon's group) on a regional basis. This overcomes customer hesitance to move into a new technology. An alternative would be to acquire existing Panel Builders in the several regions to accomplish the same thing.

Fifth, the most obvious way to increase the business is to put the competition out of business and pick up their share. To this end a plan should be developed to accomplish the following objectives.

1. Identify the weakest competitors
2. Identify the key men in their organization
3. Obtain customer lists of the competitors
4. Establish the weak points in line or company
5. Hire away key men from them
6. Buy these companies that fit into our needs for Regional Systems House or Custom Board Program.

Summary - Sector 1

It is my opinion that the above program would give Digital a minimum of 25% of the catalog business. If successful with item fives proposal we could reach 50% penetration.

Sector 2 - Custom Board Manufacturing

I have estimated this sector to be a 40-50 M business annual. We presently are in it in a very minor way (Xerox and a single board for Xcello). We have no bid in the last 12 months major jobs (i.e. Graphic Sciences, Xerox, & Xcello) face value of over 5 million.

We require the capability to handle various board shapes, start up quickly (a 16 week production release cycle would kill us) a low overhead, and the willingness to work on a narrower margin. Testing is only required in a few cases. Both silk screen and PTH process are required.

In entering this business I feel we must make the manufacturing operation independent from the facilities making catalog modules. The release requirements and the inevitable priority decisions being make between in-house and customer jobs would limit us to severly in this market.

The most obvious route to take would be to acquire an existing P.C. Board Mfg. (catalog type) and convert his capacity to this function.

By being willing to take on this kind of work I see a first year volume of 3 - 5 M. The sales effort is small compared to Sector 1. The profits are also not as great. My examination of our competitors showed that they are operating with 100% overhead and mark-up 1.5 - 2.0. (I will remind you we landed Xerox with a 1.75 mark-up and that year we made a 35% profit which is somewhat contrary to the smaller profit statement above.)

Summary - Sector 2

In three years we could move from our present 500K yr. average to 10 M annual this would be a 20% share of the present market and place us in a dead heat with the present leader, Elgin Electronics.

Sector 3

Simply stated we must be more effective in Sector 1 and must be in the business of Sectors 2 & 4 to shake out any significant in-house PC board manufactures.

If we could get just 10% of what's being done today it would be on the order of 5 M. Let's assume that is our target for this sector. This would be measured in terms of how much existing in-house capacity we cause to be shut down due to our sale.

Sector 4 - Hardware, Supplies & Processes

We are estimating this sector to be 20 - 35 M. We are a minor mfg. in it now. With the introduction of the H950 - H960 Cabinet Line and a single catalog for module hardware we will make the first move towards capturing a larger share of this sector.

Additional step to be taken is in wire wrap centers. We should move solidly in to the wire wrap game. Raytheon's highest profit operation is the wire wrap operation

By setting up wiring centers on a regional basis, with a new pricing policy and equipped to handle various connector grids we will reinforce our catalog sales, custom board sales

and attract wiring business on competitors frames too.

EECo is entering this business quite strongly, we are competitive with them on system runs of 10 or better but lose out on the smaller runs.

We are laying down 100,000 wires a month just fooling around with this business. I have no doubt that this could be raised to 1 M in a years time.

In this line we could market production equipment such as automatic insertion, wiring and test equipment (both component and functional).

Our potential in this area breaks down as follows:

1.	Cabinets	2 M
2.	Hardware	1 M
3.	Wiring Service	4 M
4.	Production Equip.	1 M
	Total	8 M

This represents 25% share of this sector.

Sector 5 - Catalog Mfg. Analog Modules

We presently do 600K annual in this sector. Raytheon is very strong with their function cards (Mux, D/A A/D) and Philbrick dominates the real analog segment.

It is my opinion that we put minimum effort in attempting to unseat a major share of the Philbrick kind of business. However, concentrated effort on the marriage of Digital/Analog devices, as Raytheon has shown, is justified. By countering their product line one for one we should be able to capture 2 - 3 million in this sector. We will require a different set of engineers than we have available now as the analog products we have developed to date have had the worst combination of fault (i.e., costly and don't work).

Overall Summary

Given the mandate and assuming we are expert and also correct in our approach we could expect to move over a 3 year period from our present sales level of 12M to the position shown on the following page.

SECTOR	NOW		CONSERVATIVE	OPTIMISTIC
1	10.0 M		17.5 M	35.0 M
2	.5		10.0	15.0
3	-		5.0	7.0
4	1.0		8.0	10.0
5	.6		2.0	3.0
	Now 12.1	3 Yrs.	42.5	70.0

digital INTEROFFICE MEMORANDUM

DATE: June 20, 1969

SUBJECT: Proposal for New Exhibit System

TO: Ken Olsen

FROM: Roy Gould
Gabe d'Annunzio

Old Exhibit System

The old system has served us well. It was originally designed for three years of use. This was originally based on our schedule three years ago of 20-25 shows. The booth is beat. The rug definitely has to be changed and all the floor and backwall panels need to be reworked. My estimate of a total refurbishing would be 15-20K. The following are some of the other points we have learned from using the old booth:

A) Weight

The exhibit is hard to handle. The average shipping weight for 20' of the system is approximately 4,000 lbs.

B) Raised Floor

We are forced to have a raised floor. This is not always good. The floor is not high enough. I've noticed that the floor when in a straight line tends to reject people. People are afraid to step up into the booth. The ramp is clumsy and dangerous.

C) Storage

Cities have become very strict about storage behind booths since the McCormick Place fire. In the old booth our only storage for bulk literature was behind the booth. We cannot do this anymore.

D) Islands

The old system is very difficult to use in island configurations. Many holes have to cut and drilled for cabling and most of the system has to be used.

E) Graphics

Graphics are very hard to intergrate to the exhibit. For each show new graphics have to be made and the only place to put them is to hang them off the backwall.

F) Lighting

The only way to light our booth is to hang light bars off the backwall or the light trees.

G) Company Identification

The logo is not pronounced enough in the old exhibit. It should stand out more; be backlit and with color.

The above comments are my own feelings and inputs I have received over the last three years.

New Exhibit System

Attached is a proposal from Atkins & Merrill stating what they can do for us in the design of a new exhibit system. Their cost for the design would be $3,000. If possible, their designers would meet with our designers (Industrial Design). Some of the points Atkins & Merrill has been instructed to incorporate into the design are listed below.

A) Lightweight

B) No raised floor

C) Simple interchangeable graphics

D) Unique hidden lighting, also "black light"

E) A canopy for Company identification

F) Color

G) Consideration given for Modules, small, middle size, and large computers

H) Easily adaptable to island configurations

I) No crates. We ship by van now so let's make good use of it. Crates are added weight and costs. Most cities we go to now have facilities for direct loading and unloading to your booth by padded van.

J) A minimal amount of refurbishing

K) Storage easily accessible

L) Inquiry processing

M) Information center

N) Union label to appear on all pieces. This is very important.

Your comments and ideas are welcome. We have to make a decision on this as soon as possible.

ATKINS & MERRILL INC.

Telephone (all locations) 617:485-8000
TWX (all locations) 710:347-0389

Creative Environments Division • Route 117 • Maynard • Massachusetts • 01754

June 10, 1969

Mr. Roy Gould, Exhibits Manager
Digital Equipment Corporation
146 Main Street
Maynard, Massachusetts 01754

Dear Roy:

It was a pleasure meeting with you and Gabe last week to discuss your plans for a new trade show exhibit system. As a result of our discussion it is apparent that you desire some professional guidance in terms of the scope, direction and budget for this new exhibit.

To briefly review my understanding of your basic requirements, Digital's new exhibit system should be modular and easier to handle than your existing one. Graphic treatment should be designed for quick and easy changes because of the several markets in which your products are sold. The system would be used primarily in straight backwall configurations but adaptable to island space configurations. Provision must be made for inquiry handling, information center, storage (for both literature and personal belongings) lighting, company identification and minimum refurbishing.

The purpose of this letter is to present in summary form our proposal for handling a design feasibility study which would give you a working tool to present to your management for evaluation and approval.

We would plan to give you professional guidance and design assistance in the following areas. We would:

Meet with Digital staff members to discuss specific objectives, design criteria and techniques which might be employed in the new exhibit system.

Develop an overall plan and preliminary design concept for the exhibit.

Review traffic flow relative to your products when the system is used either in-line or in island configurations.

Develop from the above information the final concept as a result of your review of the preliminary design.

Prepare sketches, color renderings and perhaps a model to present our final concept.

Establish appropriate budgets and schedules for the construction of the exhibit.

Pending your approval, we could start work immediately on this project. The professional design fee to accomplish this design feasibility study would be $3,000. In order to complete this project for your first use at the ISA Show, October 27th in Houston, I strongly recommend that you begin this preliminary concept phase by July 7th at the latest. Historically, a 10-14 week period is required for the complete design and fabrication of an exhibit system of this size.

We are certainly looking forward to working with you on this project. I hope to hear from you shortly.

Sincerely,

ATKINS & MERRILL INC.

Timothy J. McInerney
Account Executive

TM:jjs
cc: Mr. Gabe d'Annunzio, Mktg. Promotion Manager

digital INTEROFFICE MEMORANDUM

DATE: 20 June 1969

SUBJECT: New Engineers' "Tea Party"

TO: Ken Olsen FROM: Joe St. Amour

Ken - Scheduled for July 10 at 5:30

In our previous conversation, we discussed the possibility of a meeting between yourself and some of the new Engineers in the Special Projects area so that each of you would get the opportunity to meet and discuss Digital's philosophy and goals.

The people that I suggest for the first meeting are the following:

1. Ed Corell - Ed is a Mechanical Engineer who has just come on board and will head up our efforts in the printer area.

2. Chuck Youse - Chuck is an Electrical Engineer who has also just come on board, and he has had previous experience at Teletype where he spent a large amount of his time on the Inktronic.

3. Grant Saviers - You have previously met with Grant, and he is presently responsible for our disk projects.

4. John Bardone - John is a Mechanical Engineer and has been doing the mechanical design work on our tape transport.

5. Jacob Ginsberg - Jacob is both an Electrical Engineer and a Mechanical Engineer and has work experience as a Tool and Diemaker. He is presently working in the tape transport area.

6. Jim Lawrence - Jim is a Mechanical Engineer and is presently working for Loren Prentice in the area of product packaging for shipment.

Gail will arrange with Elsa specific time for this meeting.

/gp

7-1 Pete - Brewster

digital INTEROFFICE MEMORANDUM

DATE: June 23, 1969

SUBJECT: LICENSING OF JAPANESE FIRM FOR MODULE MANUFACTURE

TO: Stan Olsen FROM: Al Devault

On Monday, June 16, Fred Gould and I met with Mr. Mikiya Suzuki of Sumitomo, and Mr. Akahiro Ito of Meidensha Electric, a subsidiary of Sumitomo. They wanted to discuss the possibility of Meidensha manufacturing DEC modules, first for internal use, and second, for sale outside of their company in Japan in the near future.

No firm conclusions were reached but our basic stand was outlined:

1. Any agreement would include catalog modules only.

2. Capital equipment (such as computer test equipment) would be purchased by Meidensha.

3. Individual tooling for each module type would be purchased by Meidensha at approximately DEC cost.

4. DEC would receive a royalty of up to 30% of the catalog sales price for each module produced by Meidensha.

A number of other topics were generally discussed but no resolutions were made. Mr. Ito was to return to Japan to forecast their requirements and present a proposal to us in the near future.

kl
cc: Ken Olsen
Ted Johnson
Pete Kaufmann

6/18/69 BDA

AGREEMENT dated June , 1969 between The Carter's Ink Company ("Carter's"), a Massachusetts corporation having an address at 239 First Street, Cambridge, Massachusetts, and Digital Equipment Corporation ("DEC"), a Massachusetts corporation having an address at 146 Main Street, Maynard, Massachusetts.

WHEREAS (A) Carter's has developed a high speed, non-impact, printing process employing confidential, proprietary information;

(B) DEC is willing to receive such information from Carter's with a view to obtaining the capability of developing and manufacturing electronic and mechanical printing devices based upon and employing said process and of obtaining an option for a non-exclusive license to use, manufacture and sell such printing devices on the basis hereinafter set forth; and

(C) Carter's is willing to supply such information to DEC, to grant an option on such basis, and - in conjunction with the development of such printing devices - to undertake the development of ink, carbons, ribbons, paper and other consummable products specifically designed for use therein or therewith;

NOW, THEREFORE, the parties, each in consideration that the other joins herein, hereby act and agree as follows:

I. Definitions

1.01 "Basic Information" means all plans, drawings, formulas and other technical data and know-how to be supplied hereunder by Carter's to DEC under Section 2.01 hereof.

1.02 "Additional Information" means any information of the nature described in Section 2.01 supplied by Carter's to DEC hereunder subsequent to the disclosure of Basic Information.

1.03 "Carter's Information" means Basic Information and Additional Information.

1.04 "EP Process" means a high speed, non-impact printing process employing Carter's Information.

1.05 "DEC Hardware Products" means electronic mechanical alphanumeric printing devices employing the EP Process developed or invented by DEC hereunder, and any improvements of the same.

1.06 "Carter's Consummable Products" means inks, carbons, ribbons, paper and other consummable products developed by Carter's hereunder, and any improvements of the same.

1.07 "Products" means printers and other electronic and mechanical devices and inks, carbons, ribbons, paper and other consummable products based upon and employing the EP Process, and any and all improvements of such printers, devices and products, whether made or acquired by Carter's or DEC, and specifically includes both DEC Hardware Products and Carter's Consummable Products.

1.08 "Patent" means all rights to apply for patents, all applications for patents, and all issued patents, upon any

of the Products (including DEC Hardware Products and Carter's Consummable Products) throughout the world.

1.09 "License Agreement" means a license agreement between Carter's and DEC in the tenor described in Part V hereof.

1.10 "License Royalties" means the royalty payments to be provided for in the License Agreement.

1.11 "DEC Information" means proprietary technical information relating to the Products which DEC may disclose to Carter's during the term of this Agreement.

1.12 "Effective date of this Agreement" means the date which Carter's designates to be such effective date by at least seven (7) days' prior written notice to DEC, or such earlier date as the parties may agree upon in writing.

II. Phase One - Feasibility Evaluation

2.01 Promptly upon the effective date of this Agreement, and subject always to Part VII hereof (relating to confidentiality), Carter's shall supply to DEC copies of all relevant and current plans, drawings, formulas and other technical data and know-how in the possession of Carter's and relating to the EP Process. If Carter's shall not have designated an effective date of this Agreement within 30 days after the date hereof, then this Agreement shall automatically terminate.

2.02 Promptly upon its receipt of Basic Information hereunder, DEC shall initiate and proceed with a study to

evaluate development and products costs and to determine whether it is commercially feasible to manufacture and market DEC Hardware Products.

2.03 Within 90 days after the effective date of this Agreement, DEC shall submit to Carter's a written evaluation and feasibility study stating whether or not DEC decides to proceed to Phase Two and (a) if DEC so decides, setting forth DEC's findings and proposed overall development program in reasonable detail and describing the equipment which DEC proposes to develop thereunder or (b) if DEC does not so decide, setting forth in reasonable detail DEC's reasons for such negative decision. DEC shall produce such test devices and apparatus as may be required in DEC's reasonable judgment in connection with the aforementioned evaluation and feasibility study. Upon submission of such study, Phase One shall be deemed to have been completed and Phase Two to have commenced. The parties agree beginning promptly with the commencement of Phase Two to undertake the development phase of DEC Hardware Products and Carter's Consummable Products, respectively.

2.04 All expenses of DEC incurred by it during Phases One and Two hereunder shall be borne by it except as expressly otherwise indicated in Part VI hereof. During Phases One and Two, DEC shall have the right to call upon Carter's for its assistance, consultation and advice in the development and improvement of hardware hereunder on the basis set forth in Part VI hereof.

III. Phase Two - Hardware Development

3.01 If DEC decides to proceed with Phase Two as contemplated by Section 2.03 above, and if Carter's approves of DEC's evaluation and feasibility study and its development program, Carter's shall, within the 30-day period after submission of the aforementioned evaluation and feasibility study, so notify DEC in writing. During the first 90 days following the completion of Phase One, it is contemplated that the parties will seek to reach agreement upon (a) the term of the License Agreement and (b) the amount of the License Royalties to be provided therein. Unless (i) DEC shall have elected to proceed to Phase Two and Carter's shall have notified DEC of its approval of DEC's evaluation and feasibility study and (ii) the parties shall have reached agreement upon the matters referred to in the preceding sentence, all as provided above, then this Agreement shall terminate automatically.

3.02 Beginning promptly with the commencement of Phase Two, DEC shall initiate and proceed with its proposed overall development program. If the parties shall have reached timely agreement as to the matters referred to in Section 3.01 and if DEC shall not have elected to terminate this Agreement within the first 90 days of Phase Two, then DEC shall produce and deliver to Carter's at least one full-size working experimental model of a printer employing the EP

Process within 150 days after the commencement of Phase Two.

3.03 Not less than ~~150~~ 240 DEC days after the commencement of Phase Two, DEC shall, unless it shall have elected not to proceed further with Phase Two as permitted by the foregoing Section 3.02, also produce and deliver to Carter's at least one working commercial prototype of such a printer. It shall be a pre-requisite to DEC's right to exercise the option provided for in Section 3.04 that DEC shall have produced such a commercial prototype. Failure to accomplish timely production of either the experimental model under Section 3.02 or the commercial prototype under this Section 3.03 shall result in the automatic termination of this Agreement unless Carter's otherwise waives or extends the period in writing. Subject only to its obligations to produce the aforesaid experimental model and commercial prototype in accordance with the foregoing provisions of this Part III, DEC may at any time during such period inform Carter's in writing (setting forth its reasons in reasonable detail) that it does not wish to proceed further with Phase Two, whereupon this Agreement shall terminate automatically.

3.04 At any time after delivery of the commercial prototype contemplated by Section 3.03, DEC shall have the right to notify Carter's (in writing) that it elects to exercise its option to enter into the License Agreement described in Part V hereof, whereupon Phase Two shall be deemed to have

been concluded, and this Agreement shall thereafter be terminable only upon termination of the License Agreement.

3.05 Unless this Agreement shall have been previously terminated, and unless DEC exercises its option under Section 3.04, this Agreement shall automatically terminate nine (9) months after the commencement of Phase Two.

3.06 In the event of any automatic termination of this Agreement as expressly hereinbefore provided in Parts II and III, it is understood that such termination shall occur without any further obligations or liability on the part of either party, except as follows:

(a) DEC shall continue to be bound by Sections 5.01 and 7.02 hereof; and

(b) DEC shall be obliged to return all written material and physical properties supplied to DEC hereunder as Carter's Information and all additional plans, drawings, formulas and other technical data, information and property, including any test and experimental models and prototypes developed by DEC hereunder - it being agreed that the same shall be and at all times remain the sole property of Carter's, provided always that nothing herein shall give Carter's any rights to any DEC computer and DEC standard computer product incorporated or employed in connection with the development program contemplated by this Agreement.

It is further provided, notwithstanding the foregoing provisions of this Section 3.06, that if the parties enter upon Phase Two of this Agreement as contemplated by Section 2.03 and DEC does not exercise its election to terminate under Section 3.02, then DEC shall in any event be obligated to

produce and deliver the experimental model described in said Section 3.02 and the commercial prototype provided for in Section 3.03.

IV. Development of Consummable Products

4.01 Within 90 days following execution of this Agreement, Carter's shall, unless DEC shall have previously advised Carter's in writing of its intention not to proceed with Phase Two, furnish DEC with a written evaluation setting forth Carter's price range estimates and Carter's objectives for product performance specifications for Carter's Consummable Products.

4.02 Promptly after commencement of Phase Two, Carter's shall undertake development of Carter's Consummable Products, i.e., inks, carbons, ribbons, paper and other consummable products specifically designed for use in or with DEC Hardware Products, and to use its best efforts to develop and improve Carter's Consummable Products in a manner compatible with DEC Hardware Products and consistent with the written evaluation contemplated by Section 4.01.

4.03 During Phases One and Two, Carter's shall have the right to call upon DEC for its assistance, consultation and advice in the development and improvement of Carter's Consummable Products on the basis set forth in Part VI hereof.

4.04 It is contemplated by this Agreement that Carter's will use its best efforts to acquire the capability of manufacturing marketable Carter's Consummable Products compatible with DEC Hardware Products for sale to DEC and its customers, as well as to others. If Carter's, in the exercise of its sole discretion elects not to manufacture such Consummable Products as aforesaid, and so notifies DEC in writing setting forth its reasons in reasonable detail, or is unable to manufacture such Consummable Products, within nine months after the date when DEC exercises the option provided for in Section 3.04, then Carter's agrees that it will furnish DEC for its own use or for re-sale to other parties DEC's reasonable requirements for the coating liquids that are necessary in the manufacture of consummable products for use in or with DEC Hardware Products. Carter's agrees to furnish such coating liquids thereafter to DEC pursuant to DEC's orders as submitted from time to time at reasonable prices and on reasonable terms and conditions pursuant to which DEC or such other parties (as the case may be) may utilize such liquids in such manufacture. Such reasonable terms and conditions may include, if Carter's so elects, provision for protection of proprietary formulas from which such liquids are made.

V. Licenses and Other Rights

5.01 With respect to all of the Products, it is agreed that Carter's shall at all times own all rights, titles and

interests in and to any inventions represented thereby or included therein, including the exclusive right to apply for and hold Patents, said right being, however, subject to DEC's obligations under Section 5.08 hereof. It is nevertheless understood that DEC shall retain all rights, titles and interests in any inventions or discoveries by DEC which are not based upon, or do not employ, the EP Process.

5.02 Upon the exercise of the option provided for by Section 3.04, Carter's shall grant to DEC a non-exclusive license for the use, manufacture and sale throughout the world of DEC Hardware Products; and the parties shall enter into the License Agreement for such a license which shall contain the terms and provisions hereinafter described.

5.03 The License Agreement shall provide for (a) the length of its term (which as to DEC Hardware Products covered by a Patent - including a Patent on the EP Process - shall be for the life of the youngest such Patent and as to non-patented DEC Hardware Products shall be for the longer of 2 years from the date of the first marketing of the DEC Hardware Product in question or the period while any Patent application shall be pending), and (b) the amount of the License Royalties (as to U.S. sales, in terms of a percentage in the range of 3 to 10% of net sales and as to foreign sales, such royalty, license fee or other consideration as the parties agree upon at the conclusion of Phase One), all subject to

agreement by the parties as contemplated by Section 2.04. DEC may include net sales by third parties licensed under Section 5.04 with its own net sales for the purpose of determining applicable sliding scale License Royalties. On sales within the limits of DEC's present in-house requirements, License Royalties shall be one-half of the License Royalties on other sales. DEC's present in-house requirements, within the meaning of the foregoing sentence, consist of $10,000,000 in total net sales of ASR33 Teletypewriters (or their equivalent), and $4,000,000 in total net sales of Anelex printers to be made during the 3 years following execution of the License Agreement.

Net sales shall be defined in the usual manner allowing credits for returns, discounts, sales and excise taxes and the like. It is contemplated that special provision for License Royalties will be agreed upon in cases in which a DEC Hardware Product comprises a component of a larger device or system depending on the contribution of such component to the marketability of the system or device. The License Agreement shall provide for periodic reports (at least as often as quarterly) by DEC showing the amount of the License Royalties payable by DEC under the License Agreement, which reports shall be subject to verification by independent auditors selected by Carter's and reasonably acceptable to DEC.

5.04 The License Agreement shall confirm and continue DEC's obligations under Section 7.02, shall oblige each party to disclose to the other any improvements of the DEC Hardware Products and Carter's Consummable Products, and shall deal with the situation in case Carter's should decide to manufacture DEC Hardware Products.

5.05 The License Agreement shall also provide that Carter's may grant licenses to others of any DEC Hardware Products subject to Patent; provided, however, (i) such licenses as to DEC Hardware Products shall be on terms not more favorable to the licensee than the terms of the License Agreement except as Carter's may offer such more favorable terms to DEC, (ii) until DEC shall have recovered the full amount of its development costs under Phase One and Two hereof, any royalties received by Carter's during the first two years of the term of any such other license shall be paid over to DEC, and (iii) thereafter an amount equal to 25% of any such royalties shall be paid over to DEC and an additional 25% of such royalties may be offset by DEC against royalties payable by DEC to Carter's as contemplated by Section 5.03. The amount of such development costs (which shall include the cost to DEC of Patent acquisition under Section 5.08 and shall not include any allocation of general overhead or administrative expenses except as otherwise agreed to by Carter's) shall also be subject to verification by independent auditors selected by Carter's and reasonably acceptable to DEC.

5.06 The License Agreement shall be in such form and contain such additional terms as shall be mutually agreeable to the parties, including usual and ordinary provisions for termination upon breach, financial difficulties and the like.

5.07 In the event of any material breach by Carter's under this Agreement, DEC shall - by exercising the option provided for by Section 3.04 hereof and specifying in its notice of exercise that it is acting pursuant to this Section 5.07 and setting forth in reasonable detail the grounds for its belief that it is entitled so to act - be entitled, as its sole remedy for such breach, to a non-exclusive license of the right to manufacture, use and sell DEC Hardware Products and Carter's Consummable Products, which license as to DEC Hardware Products shall be royalty-free, and shall include the right to sub-license others to the extent the parties may agree during the 90-day period following the commencement of Phase Two. As to Carter's Consummable Products, such license shall be subject to a reasonable royalty in favor of Carter's. In case the parties cannot agree upon the aforementioned royalty as to Carter's Consummable Products and the term of the license therefor within 90 days after such notice of exercise by DEC and a final adjudication by a court having jurisdiction (all applicable appeal periods having lapsed) that a material breach has occurred, then either party may refer the matter of the amount of such royalty and the term of the license(which shall

extend at least for the life of any applicable Patent) to a single arbitrator in accordance with then prevailing Commercial Rules of the American Arbitration Association (or its successor organization, if any), and judgment upon the award of said arbitrator may be entered in any court having jurisdiction thereof.

5.08 As to any DEC Hardware Products, DEC agrees - subject always to Carter's exclusive rights of ownership as provided in Section 5.01 - diligently to prepare and prosecute, at DEC's expense (but in Carter's name, or in the name or names of persons designated by Carter's), applications for such United States letters patent as Carter's shall reasonably determine upon after consultation with DEC. Carter's agrees to provide all reasonable cooperation necessary in order to permit DEC to carry out its obligations under this Section 5.08. If DEC fails so to carry out such obligations, Carter's may decline to license DEC hereunder in respect of any Product as to which any such failure has occurred and may terminate any license theretofore granted to DEC in respect of any such Product.

VI. Mutual Assistance, Consultation and Advice

6.01 Each party agrees to furnish to the other such assitance, consultation and advice as such other party may reasonably request under the provisions of this Agreement, subject always to the reasonable requirements of the furnishing

party's other business activities. Each party will be responsible for the salaries and expenses of its own personnel utilized hereunder.

6.02 Carter's agrees to make available to DEC at reasonable times during Phases One and Two hereunder its test facilities in Cambridge, Massachusetts, including Carter's own test devices relating to the Products, in order to assist DEC in performing its part of the development program contemplated by this Agreement.

VII. Confidentiality

7.01 DEC acknowledges that Carter's is in possession of pertinent proprietary technical information relating to a high-speed non-impact printing process, and that Carter's considers this information confidential and is therefore willing to disclose it to DEC only upon the basis set forth in Section 7.02. Carter's acknowledges that during the term of this Agreement DEC may disclose proprietary technical information relating to the DEC Hardware Products, and that DEC considers this information confidential and is therefore willing to disclose it to Carter's only upon the basis set forth in Section 7.02.

7.02 DEC agrees as to Carter's Information, and Carter's agrees as to DEC Information, that it will hold in confidence all such Information disclosed under this Agreement, except insofar as the same

(a) is known to the receiving party and the receiving party provides the disclosing party with documentary proof thereof within 30 days after the disclosure thereof, or

(b) is thereafter received by the receiving party from another source which is independent of the disclosing party and which is properly authorized to disclose such information, or

(c) is or becomes known to the public by publication.

No receiving party may use or disclose to others any such Information which it is required hereunder to keep confidential without the prior written permission of the disclosing party.

7.03 The receiving party's obligations under the foregoing Section 7.02 shall survive any termination of this Agreement or the License Agreement; provided, however, that unless DEC elects to exercise the option contemplated by Section 3.04, it is understood that Carter's may utilize DEC Information in development of Products for manufacture and sale in any manner which Carter's may determine upon.

VIII. Term of This Agreement

8.01 This Agreement shall remain in effect until execution of the License Agreement, unless sooner terminated as expressly provided for herein.

IX. General

9.01 The parties hereto are independent contractors, and nothing herein contained shall be construed as making either party (or such party's employees) the agent of the other.

9.02 Neither party may assign or transfer any of its

rights under this Agreement without the prior written consent of the other party. A merger, consolidation, exchange of stock or other transaction which results in a change of control of either party shall be deemed to be an assignment or transfer within the meaning of this Section 9.02. Any breach by one party of the prohibition against assignment or transfer herein contained shall give rise to a right of termination in the other party effective promptly upon written notice by such other party of its election to exercise such right.

9.03 A failure by one of the parties to this Agreement to assert its rights upon any breach of this Agreement shall not be deemed a waiver of such rights, nor shall any such waiver be implied from the acceptance of any payment. No waiver in writing by one of the parties hereto with respect to any right, shall extend to or effect a waiver of any subsequent breach either of like or different kind.

9.04 This Agreement, and each and every purchase and sale or other contract hereunder or pursuant hereto, shall be construed, and the rights and liabilities of the parties hereunder shall be determined, in accordance with the laws of the Commonwealth of Massachusetts.

9.05 Notices pursuant to this Agreement shall be sufficiently given to a party if sent by registered or certified mail to such party at its address given at the outset of this Agreement, or at such other address as such party shall hereafter specify in writing to the other party.

9.06 This Agreement constitutes the entire understanding between the parties and all inducements to the making thereof. This Agreement supersedes any and all prior written or oral contracts between the parties hereto. No provision herein contained shall be waived or modified or altered except by an instrument in writing properly executed by the party to be charged.

9.07 Each party agrees that from time to time, upon the written request of the other, and without further consideration, it will execute and deliver to the other such instruments, and will take such action, as such other reasonably may request in order more effectively to carry out the intentions of this Agreement.

9.08 The time within which any party is required to fulfill any obligation on the part of such party provided for herein, shall be deemed extended for the effective period of any event beyond the control of such party as hereinafter specified, to such extent that such party shall have been afforded a full normal period as provided in the Agreement in which to fulfill such obligation. The events beyond the control of such party shall, for the purposes hereof, be deemed the following: any strike, labor dispute, riot, rebellion, war, storm, earthquake or other natural calamity, fire, flood, or any cause beyond such party's reasonable control; provided that any such cause shall have directly orindirectly interfered

with or otherwise disrupted the regular course of business of such party, and provided further that such party shall, as promptly as reasonably may be after the occurrence of such event give notice of such occurrence in writing to the other party.

EXECUTED as an instrument under seal on the date first set forth on page 1 of this Agreement

THE CARTER'S INK COMPANY

ATTEST:

By_____
President

_____

DIGITAL EQUIPMENT COMPANY

ATTEST:

By_____
President

_____

digital INTEROFFICE MEMORANDUM

DATE: June 23, 1969

SUBJECT: Carter's Ink Company

TO: Ken Olsen FROM: Phil Markell
CC: Joe St. Amour

A proposed agreement has been reached with Carter's Ink Company for the joint development of Hardware and Consumable Products, ink, carbon, ribbons, paper, etc., for a high speed, non-impact printing process referred to by Carter's as the EP Process.

The purpose of this memorandum is to point out certain reservations of which I have and which should be evaluated before final agreement is reached.

There has been one significant handicap all through the negotiations which have colored the final form of the agreement. Carter's is willing to share with DEC the information concerning the EP Process, including all plans, drawings, formulas and other technical data and know how. However, much of this information Carter's considers goes to the essence of any or all of the products which it markets whether or not such products employs the EP Process. Accordingly, Carter's at no time, including the occurrence of a material breach of its agreement with DEC, or upon its inability to manufacture Consumable Products during the time period specified in the agreement, or upon its election not to proceed with such development or manufacture, is willing to allow this information to be disclosed to any one other than DEC employees, whether or not such disclosure is on a confidential basis. On the other hand, Carter's will only enter into an agreement if all technical data, information and property, including any test or experimental models and prototypes developed by DEC are turned over to Carter's to remain their sole property in the event DEC is unable to manufacture Hardware Products within the time period specified in the agreement or elects not to manufacture such products.

Notwithstanding the foregoing, Carter's is given no rights in any DEC computer or DEC standard computer products incorporated or employed in connection with the development of Hardware products.

The only rights which DEC obtains in the event Carter's elects not to proceed with development of Consumable Products or is unable to manufacture such Consumable Products within the period specified in the agreement, is a right to call upon Carter's to furnish DEC, for its own use or resale to others, coating liquids in the manufacture of Consumable Products for use in or with DEC Hardware Products. DEC shall pay reasonable prices for such Consumable Products and can be subject to a provision for protection for proprietory formulas which such liquids are made. In addition, DEC can be subject to paying a royalty on any license which Carter's

may have or may obtain on the EP Process. There have been no assurances given, nor is there any way to determine at this time, whether Carter's has now developed a coating liquid, nor do we have any assurances that the coating liquid alone is the major contribution to the successful development of Consumable Products for use on Hardware products.

At all times Carter's is to have right, title and interest in any invention represented by the Hardware and Consumable Products developed pursuant to the agreement, including the exclusive right to hold all patents. Nevertheless, DEC is to retain all right, title and interest in any invention or discovery by DEC which are not based upon or do not employ the EP Process.

Accordingly, even in the event of a material breach by Carter's under this agreement, Carter's is to retain any DEC patents and is to have right to any pending patents. However, Carter's is to grant DEC a license which is to be royalty-free as to Hardware Products but is to be subject to a reasonable royalty as to Consumable Products.

I believe that Joe St. Amour will concur with me that Carter's would be unwilling to enter into an agreement if it was to be required to have disclosed to others other than DEC, any information which Carter's considers proprietory and which concerns the know how or technical data to be disclosed to DEC under this agreement. Therefore, Carter's is only willing to sell what liquid coating it might then have developed to the point of manufacture.

Carter's has made quite clear to us that it would be unable to realize a return on its development costs unless it was able to obtain royalties on the Hardware Products to be developed for use with Consumable Products. The profit margin on consumables is not sufficient to allow Carter's such a return on its investment, therefore Carter's maintains that even on a material breach it should be entitled to royalty payments. This point of view is coupled with the point of view of its attorney, that without a provision for royalties, DEC would more likely attempt to provoke Carter's into a material breach of the contract, a position which I find hard to justify. A Court would be leery to find a material breach if it can be shown that the breach was caused by action which otherwise violated the terms of the obligations of DEC under the agreement.

For this reason, I very much question first, whether Carter's should retain rights in DEC's patents and pending applications for patents on Hardware Products in the event of a material breach, and secondly, whether DEC should be required to pay royalties to Carter's on a material breach.

With the foregoing as background which in particular highlights the attitude of Carter's, a brief synopsis of certain other provisions of the agreement follows.

There is to be an initial 90 day period in which DEC evaluates the information disclosed to it by Carter's, to determine whether it is commercially feasible to manufacture and market Hardware Products. Within this 90 days DEC is to submit to Carter's a feasibility study and state

whether it wishes to proceed. Carter's on its part is to continue the development of its Consumables and within this 90 day period is to submit to DEC a written evaluation setting forth Carter's price range estimates and objectives for product performance specifications for Consumables.

Subsequent to this period, DEC during the next 90 days is to continue its development and evaluation. During this period DEC is to determine whether it shall proceed. If it elects to proceed beyond this second 90 day period, it is obligated to develop an experimental model and a commercial prototype. The experimental model is to be produced within 150 days after the end of the first 90 day period, and the commercial prototype within 240 days after the end of the first 90 day period.

During the second 90 day period Carter's and DEC are to agree upon a license agreement, certain terms and conditions of which have already been spelled out in this agreement. Notwithstanding this, Carter's must first notify DEC in writing within 30 days after the submission of DEC's evaluation and feasibility study, whether it wishes DEC to continue.

In reality, this second 90 day period in which DEC and Carter's are to agree on a license agreement makes the initial agreement between the parties an agreement to agree at a later date subject to what both parties learn about each other during the initial period of this agreement. DEC can elect to discontinue development which from the reasons given would appear to be its unfavorable analysis of the marketability of Hardware Products or Consumable Products. In reality this election could be based on certain unfavorable ground rules which have been set down for the terms of the license agreement, which is to be entered into between the parties.

Under the terms of the license agreement, DEC is to obtain a non-exclusive license on DEC's Hardware Products throughout the world. The term of the license agreement is to be the life of the youngest patent and as to non-patented DEC products, the longer of two years from the date of first marketing of a DEC Hardware Product or the period where a patent is pending. DEC is to pay a royalty to Carter's on all sales in a range of 3 to 10% of net sales domestically; and as to foreign sales, a royalty, license fee or other consideration as is to be agreed upon prior to the execution of the license agreement. The royalty payment however, is subject to reduction as follows:

1. DEC may include net sales by third parties with its own net sales for the purpose of determining applicable sliding scales royalties. On sales within the limitation of DEC's present in house requirements, royalties are to be one-half royalties on other sales. Present in house requirements are defined as $10,000,000.00 and total net sales of ASR33 Teletypewriters or their equivalent, and $4,000,000.00 in total net sales of Analex Printers made during the 3 years following execution of the license agreement.

2. In addition, until DEC has recovered the full amount of its development costs, any royalties received by Carter's during the first 2 years of the term of any other license shall be paid to DEC. After the 2 year period, DEC is to

receive an amount equal to 25% of such royalties and an additional 25% is to be offset against royalties otherwise payable by DEC to Carter's.

It is my recommendation that one substantial change be made at this point in time. I believe the only way this can be made is through your direct intervention with the President of Carter's. I believe reference to DEC's present in house requirements and the breakdown between teletype and Analex Printers should be eliminated and in its place the following should be substituted:

"On the first $15,000,000.00 of sales license royalties should be one-half the licensed royalties on other sales."

The present provision dealing with one-half royalties does have a 3-year limitation. Possibly, in order to obtain Carter's agreement to the $15,000,000.00 figure, a provision should be added which allows for the $15,000,000.00 in sales or 3 years following execution of the license agreement, whichever event occurs first.

It is, of course, desirable to obtain the formula for determining royalties on foreign sales. However, Carter's does not yet know how it would treat payments for sales in Europe. This indecision at this time is based upon tax considerations which Carter's wishes to pursue during the next 90 days.

In addition, there is one other area which has been left to further discussions. In the event the DEC Hardware product comprises a component of a larger divise or system, royalties are to be based upon the contribution of such component on the marketability of the system or devise. We have proposed that this contribution be based on the ratio of the cost of the DEC Hardware Product to the cost of the system or devise which physically incorporates the DEC product. Carter's would not agree to this formula. It remains to be seen exactly what type of formula can be arrived at prior to the execution of the license agreement.

The license agreement will also deal with the situation in case Carter's decides to manufacture DEC Hardware Products.

Joe St. Amour has assured me that if he determines that it is commercially feasible to market Hardware Products, he can live within the time restrictions of this agreement. He has also assured me that the development work he would do under this agreement and information disclosed to Carter's, particularly during during the initial periods of this contract, and until he was confident that a Hardware and a Consumable Product could be marketed, would be severely limited to know how and technical data, which would not be a benefit to DEC unless it was employed with the EP Process. Thus DEC's exposure to giving up development work which would otherwise be of use to DEC without Carter's assistance should be greatly limited.

In addition, Joe agrees that if Carter's is unable to develop and manufacture Consumable Products,that no other similar type company would be willing or able to do the same

I, of course, can not make a business determination as to whether the amount of the royalty we will receive or the credits against royalties which we will receive would allow DEC to obtain a significant return on its investment in this project.

PM:lmt
Encl.

digital INTEROFFICE MEMORANDUM

DATE: June 24, 1969

SUBJECT: Pirating by Infocom

TO: Ted Johnson
John Leng, Palo Alto
Roger Handy, Maynard
Dave Denniston, Princeton

FROM: Gerry Moore

CC: Ken Olsen
Nick Mazzarese

When I ran into Mike Ford at the recent ASTME Show in Chicago, he affirmed that it would be Infocom's policy not to pirate our people. It was to his interest, he said, to work cooperatively with us. In fact, we had been cooperating very closely with Mike's people. Our people, particularly our typesetting salesman, Loehr Clark, had made several joint sales calls with Tony Padula of Infocom. The cooperation seemed to work well and produced some business for us and for Infocom with newspapers where some business data processing capability was important.

During this past week I have received the resignation of Frank Edelman, one of my salesmen in Ann Arbor, who is accepting an offer from Infocom, including both salary and stock options. I have also just discovered that Infocom has discussed a position with at least one additional salesman in the Central Region.

I have spoken to both Bill Landis and Mike Ford on the phone and told them that there would, hereafter, be no cooperation between the Central Region and Infocom. We will no longer make joint sales calls nor will we recommend Infocom. In short, I want his people to stay away from my people.

I don't know what the position of each of you will be. If some of you are working closely with Infocom and wish to continue to do so, I recommend that you at least let Mike know that you are displeased with his pirating of Frank Edelman. Personally, I think you will be better off not working with Infocom.

The Beloit Corporation of Beloit, Wisconsin, has written some software for the Freeport Journal on a typesetting system we sold to the Journal. Although Beloit Corporation has less experience with 8-family machines than Infocom, the software seems to be working well and the Journal is satisfied. If you have customers that are interested in the capabilities of the Beloit Corporation, please let me know.

ah

Copy to 9/10 Ted Johnson

dec INTEROFFICE MEMORANDUM

SUBJECT OLIVETTI
Your memo of 29 May

DATE 25 June 1969

TO Bob Collings

FROM Jean-Claude Peterschmitt

cc: Ken Olsen
Nick Mazzarese - for information
Ted Johnson - for action

Our latest information is that Olivetti is now working with GE on controlling computers for the SEARS system, apparently because DEC is not willing or in a position to supply the assistance needed.

I am very concerned about this, as Olivetti has been consistently and actively interested in working with us on a world-wide basis for this sort of application. A lot of effort has already been put into the Olivetti co-operation on our side here. Please let me know the latest developments, and also who is responsible for relations with Olivetti in the US.

Here in Europe, Olivetti is under Italian Government pressure to use the GP 16, a copy of the HP 2115 developed by Selenia (a joint venture between Raytheon and the Italian Government). However, top Olivetti management continues to express their great desire to work with us.

JCP:CAH

Mr. Ken Olsen

digital INTEROFFICE MEMORANDUM

DATE: June 30, 1969

SUBJECT:

TO: Norm Doelling FROM: Bob Allison

During the past two years, secondary schools have purchased DEC computers for classroom use. To determine the overall market for computers during the next three years, two surveys were conducted; the first of 3,961 secondary schools of all types in twelve states and the second of 3,950 public schools which have a minimum of 500 students in 24 states. The evaluation is based on an analysis of the number of computers currently in use in schools, anticipated purchase of computers by schools, the professional status of teachers regarding the teaching of computers, and the effect student population and category of school has upon the purchase or anticipated purchase of a computer.

The surveys show it is advisable for DEC to pursue the educational market because:

1. Twenty-five percent of the classroom computers currently in use are DEC computers.

2. The use of computers in schools is rapidly expanding.

3. Schools which currently lease timesharing terminals are prime prospects for DEC computers.

4. Teacher training efforts are increasing.

5. Competition is currently limited to IBM and time-sharing companies.

The overall market for educational computers is expected to grow from the 200 plus in current use to 800 in the next three years. A breakdown of equipment in use and planned purchase of equipment is given below.

All Schools 12 States	Total Mailed	Response	Percent	Have Computer	Percent	DEC Computer	Percent	TS Installation	Percent	Plan to Purchase	Percent
Public	2608	435	17	33	1	12	.4	37	1.5	146	5
Private	361	49	14	6	1	5	.9	5	1.5	16	4
Vocational	326	18	5.5	6	1	0	0	1	.3	11	3
Catholic	666	55	9	1	0.1	0	0	1	.1	9	1.5
TOTAL	3961	557	14%	46	1.1%	17	.4%	45	1.1%	182	4%
Public Schools with 500 + Enrollment 24 States											
TOTAL	3590	543	14%	65	1.5%	10	1.2%	65	1.5%	118	3%

The above represents forty percent of the public and vocational schools in the country and thirty percent of the private and Catholic schools. There are 20,000 secondary schools in the country with a student body of 100 plus. Extending the above figures on a nationwide basis, the percentage of schools which currently have computers is one percent or 200 schools. One and one-half percent or 300 schools have timesharing terminals. Four percent of the schools plan to purchase a computer in the next three years. This is a potential market of 800 computers. The survey shows there is no advantage to limiting future contacts with only schools of a certain size or category. Level of interest and potential interest is the criteria. Geographical location is of importance.

Revealing facts regarding the potential of this market are shown in the number of school faculties which have had or are currently being trained in the use of computers and are introducing the subject into the curriculum as indicated below.

All Schools 12 States	Total Mailed	Response	Percent	Faculty Training	Percent	Scheduled C S Classes	Percent	Computers in Curriculum	Percent
Public	2608	435	17	315	11	85	3.5	88	3.5
Private	361	49	14	25	7	10	3.0	8	2.7
Vocational	326	18	5.5	18	5	8	2.7	7	2.0
Catholic	666	55	9	33	5	7	1.0	12	2.0
TOTAL	3961	557	14%	391	10%	110	3%	115	3.0%
Public Schools over 500 students 24 States									
TOTAL	3950	543	14%	412	11%	138	4%	138	4%

These figures are more salient when one notes the increased number of NSF summer institutes in computers and the discussion of the subject at professional meetings.

Specifically, the survey enables DEC to:

1. Analyze a large market prior to expending direct sales effort.

2. Locate timesharing terminals

3. Build a qualified prospect list

4. Shorten selling time

5. Concentrate selling effort geographically

A similar questionnaire should be sent in the Fall of '69 to all schools in all states. From this survey DEC will be able to pinpoint potential sales prospects for the Spring of 1970.

BA:jah