INTEROFFICE MEMORANDUM

TO: Gordon Bell, Bruce Delagi, Ken Olsen ✓, Dave Peters, Lorrin Gale, Chuck Kaman

CC: John Fisher

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FROM: Roger Cady

DEPT: Engineering 12-1

EXT : 2328

SUBJ: CONTROLLERS, CABLES, PACKAGING

This memorandum serves as a vehicle for the combining of several ideas on ways to improve PDP-11 peripheral controller packaging, cabling, and hardware. It is the result of discussions with numerous people on various related subjects. It would appear that the goals for any redefinition of packaging should include:

1. Reduced manufacturing costs, simpler configuration rules, fewer parts to stock, etc.

2. Improved testability in the manufacturing phase, improved access and serviceability in the field.

3. Increased reliability--as it relates to cabling, power distribution, simple parts layout, lack of crowding, etc.

4. Improved interconnection method (e.g. improved UNIBUS) where signals travel a better defined pathway.

5. Provision for expansion of system concepts at larger end including multiported devices and memories, wider data bus, etc.

6. Include memory as an ingredient in the concept of flexible peripheral controller configuration.

Part 1 - Backpanel

Two present products help lead the way to improvements. The 8 OMNIBUS and the DD11 concept have proven themselves to be a good way of producing backpanels for smaller logic building blocks. By standardizing the wiring, there is an increase in flexibility without a corresponding increase in costs. Furthermore the packaging of 8's has become much simpler (mechanically) because the pin side of the OMNIBUS need not be accessible. Just compare the 11/05 package to the 8/M.

Standardizing the backpanel also standardizes some test vehicles for module testing. PDP-11 Engineering (Larry Condon) has developed an XOR tester for small peripheral controllers that plug into DD11 backpanels. Increased effort towards standardized testing could pay larger rewards in manufacturing as well as make equipping of field service repair depots much less costly.

Conclusion 1 - Expand and improve the concept of standardized backpanel.

1. Increase size of DD11 type panel to 20 (±) slots.

2. Develop mounting scheme for panel (see Fig.1) which allows easy access to modules, no access to pins, and easy access to power supply electronics.

3. Make panels mount similar to 1943's except recessed for modules--no box or other encumberances. Use the cabinet for the structural support--don't sell except in DEC standard cabinet (short or tall).

4. Use multilayer PCB backplane--control impedance of UNIBUS signals by adjusting line widths and/or glass epoxy thickness. Delete all wiring runs between area A, B and C,D,E,F (vertical along slot). This makes PCB simple.

5. Use PCB to distribute ground, +5. Perhaps also additional voltages via pre-assigned pins (-15, +15, +20, -5).

6. Delete UNIBUS wiring along area A,B. Bus would run in C,D,E,F (1) and out C,D,E,F (20). See companion paper on UNIBUS extensions for use of area A,B. This requires relayout of some existing small peripheral controllers, but this is a minor inconvenience as relayed out controllers will be 100% compatible with old ones.

Part 2 - Controllers

Present small peripheral controllers are successful because they utilize common mounting hardware (above) and because they require no specialized in/out connector mounting hardware requirements for peripheral cables. In general, BERG type headers are mounted on the controller module and the cable is plugged directly in. Major problem areas are, however:

1. Cables tend to get bulky and work loose. This is primarily because there must be slack to facilitate slide-out boxes, and because of inadequate places to tie cables down. The 11/40, 45 box is the best present solution, but far from perfect. Cables work loose from header. No locking mechanism; no cable strain relief. No indexing (polarizing) of BERG type cables.

2. Variety of cables that are required: round, flat, grounded, floating, 4 to 40 conductor. Variety of terminations at far end.

3. Small peripheral controllers easily sit on a single quad module. Complex controllers don't, can't seem to make it on a single hex module. Therefore, some mechanism must be available for handling multiple board controllers in the standardized backpanel.

Conclusion 2 - Improve the existing scheme for handling peripheral control cables.

1. Rigid mounting of backpanel solves many of the cable handling problems. Cables can be routed, and tied, or clamped (Dakota clamps, please) in place right up to the module, leaving only enough service loop to unplug it from the module.

2. Improve header and mating plug design:

   A. Polarizing notch, pin or other mechanism.

   B. Incorporate the new AMP locking contact into both ends of the plug so that pulling on wires or vibration won't work the connector loose.

   C. Design in a strain relief into the plug so cable is securely fastened.

   D. Pursue conversion to new viking design if that better solves above problems and reduces assembly costs.

3. Standardize a few cables: since the real cost in cables tends to be the termination cost and the inventory cost (too many or too few), we should worry less about wasting a few conductors. Ecologically, this is bad (copper is scarce) but perhaps we should pursue aluminum conductor cables anyway. There is no need to have 4 conductor and six conductor cables.

   A. Define a small, medium, and large round cable for cabling to free standing peripherals. (I.e. TTY, LA30: 8 cond.; Modems: 20 cond; card readers, line printers: 40 cond.) Define the far end connector and buyout peripherals should be so specified. Yes, it will cost us to get the special, but probably far less than our internal costs of not having the right cable.

   B. Define a flat cable (one or two sizes) for internal to cabinet peripheral cabling. Far end terminated like near end.

   C. We should end up with 6 or so cables, in 2 or 3 lengths each for a total of 15-18 cables. We probably now use 500.

   D. We have to look at MASSBUS--as it has unique problems that require additional study.

4. We need to solve the problem of controllers that don't fit into one hex module. The obvious solution is an 8/E over the back connector scheme. This has limitations (interference with die cast handles, serviceability, etc.). Alternatives:

   A. Flat cables like 11/40 CPU. Bad from cable dress and reliability points. Discard this idea.

   B. Build accordian module (Fig.2) with permanent or semipermanent interconnect between boards. Second board may (or may not) plug into the backpanel. Develop new cast "hinge-handle".

Part 3 - Controller Density/LSI

We should be making better use of LSI in controller design. It appears mandatory that we develop some custom chips that help us interface to the UNIBUS and reduce the DIP count on new designs. Such functions as now performed by M105, M7821, M795, M796 modules might well be integrated.

The definition of an NPR/Status/Control Module might be a reasonable approach to the implementation of 2 board (hinged type) controllers where one board is always the same: BUS interface, status, control, NPR, NPG, word count, current address, timeout, parity all included. Then the implementation of a DMA card reader, for example, requires the addition of a unique module that interfaces the CR to this building block--i.e. receives/transmits signals to CR and does code conversion, checking, etc.

Conclusion 3: Develope LSI circuits to aid in interfacing to the UNIBUS. A subsequent paper will define these chips.

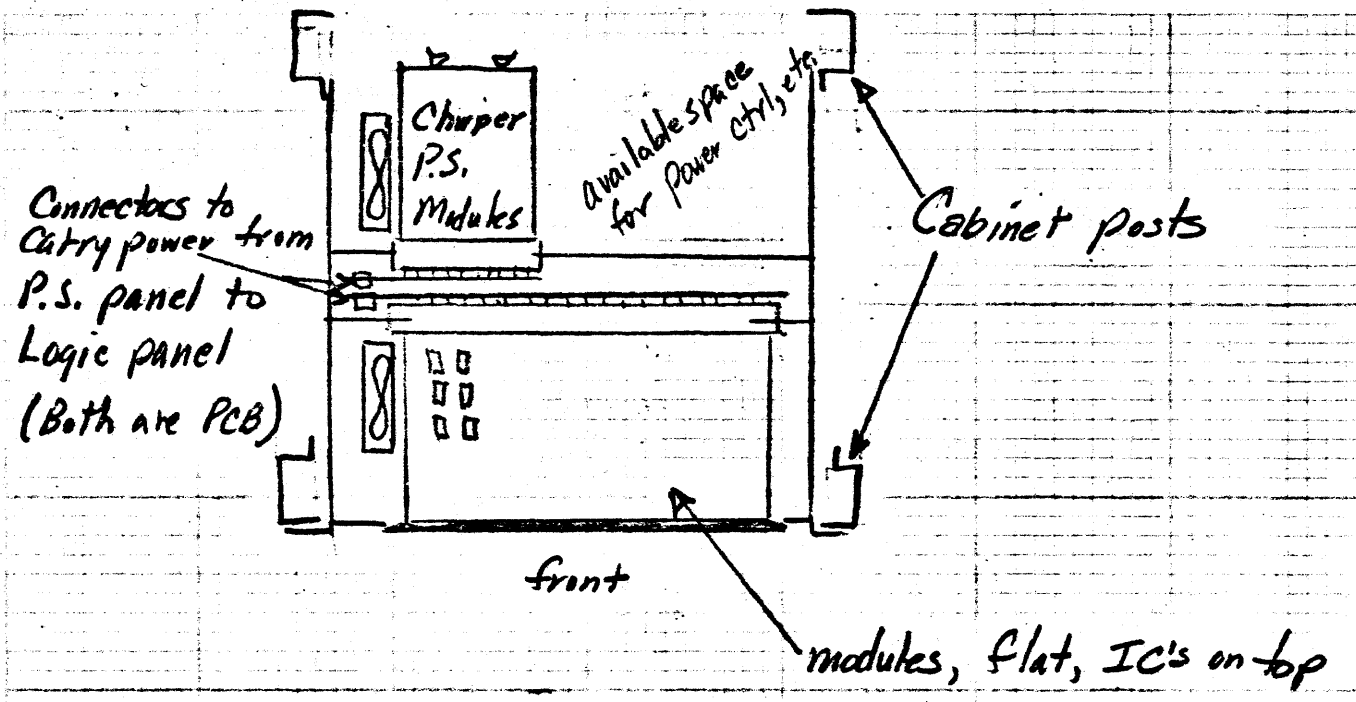
Part 4 - Memory

It is obvious that adoption of a standard panel requires that memory be designed to plug into such a panel. Present core memory designs are not readily adaptable. Semiconductor designs are readily adaptable to such a configuration. Jim Beatty estimates that a 16Kx16/18 bit array with UNIBUS interface and control can fit into a single hex module, using the 4K MOS chips.

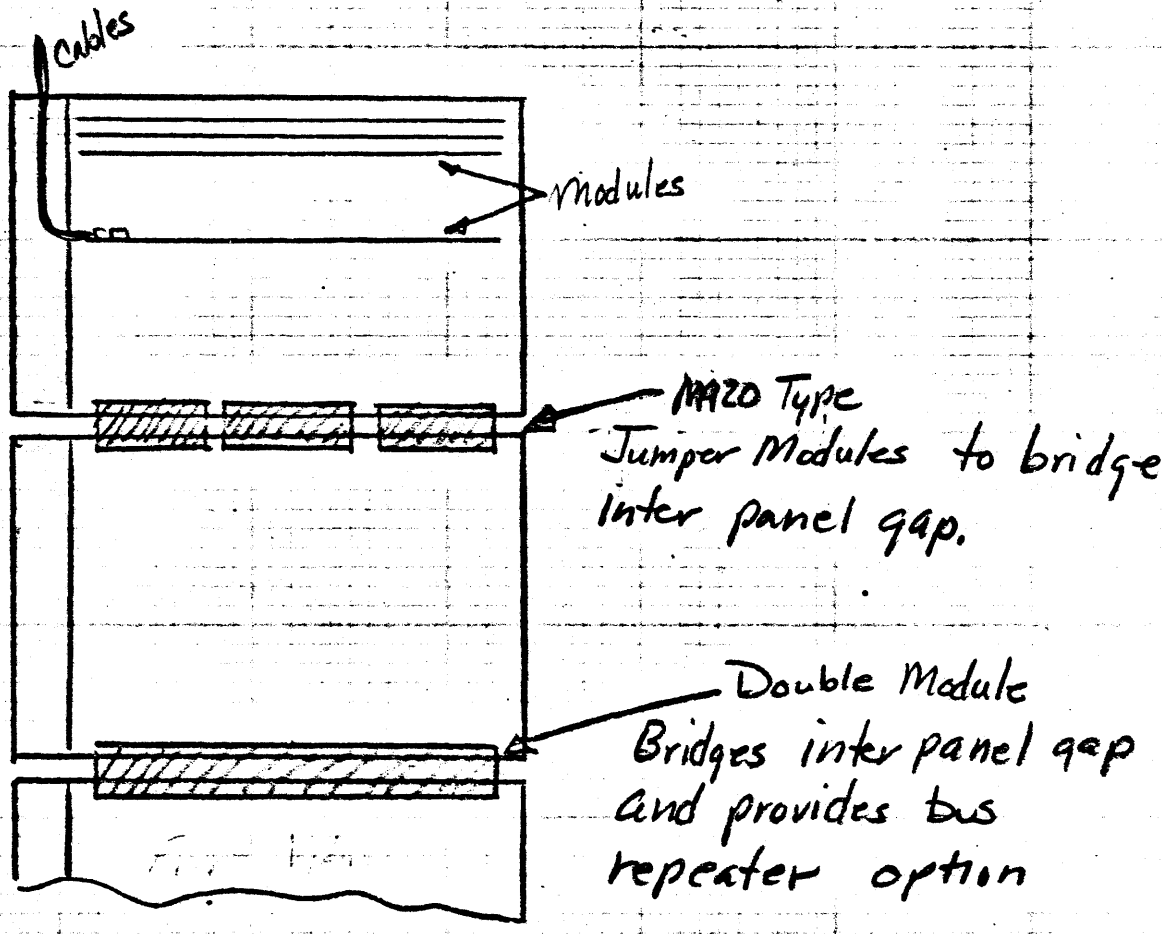
Core memory presents a bigger problem for 16K & 32K sense. These are now multiboard units requiring a special backpanel. It does not seem advantageous to try to "accordian" package a 4 board memory subsystem. Thus, we will probably have to live with a unique backpanel for core. This, however, can have the same mounting as the standard "peripheral" panel since it will be an MLB backpanel, and access to the pins need not be readily available. If necessary, that core mounting panel could be as in Fig. 3, using chirper power units intermixed with memory modules. This allows access to pins from back of machine, but at a lower cabinet density than with power units mounted in back of standard panels.

RC:mjk

Attachments--2



Top View



front view

Figure 1

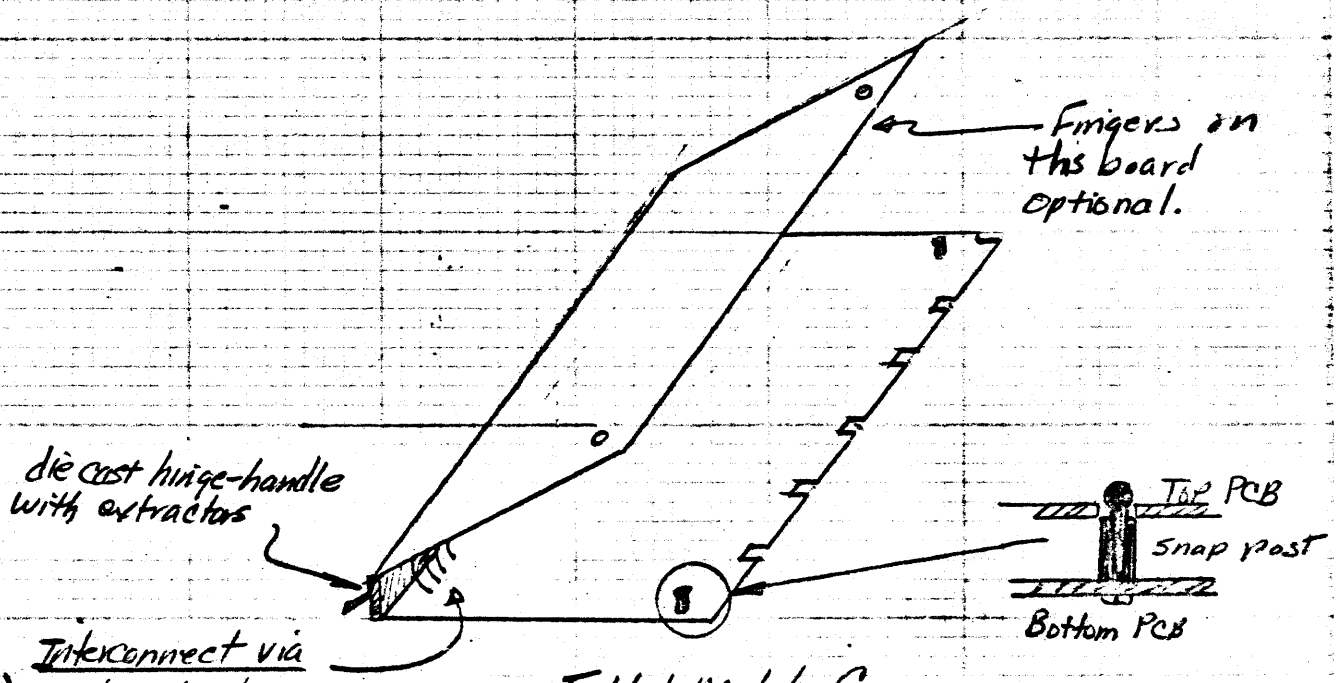


Figure 2

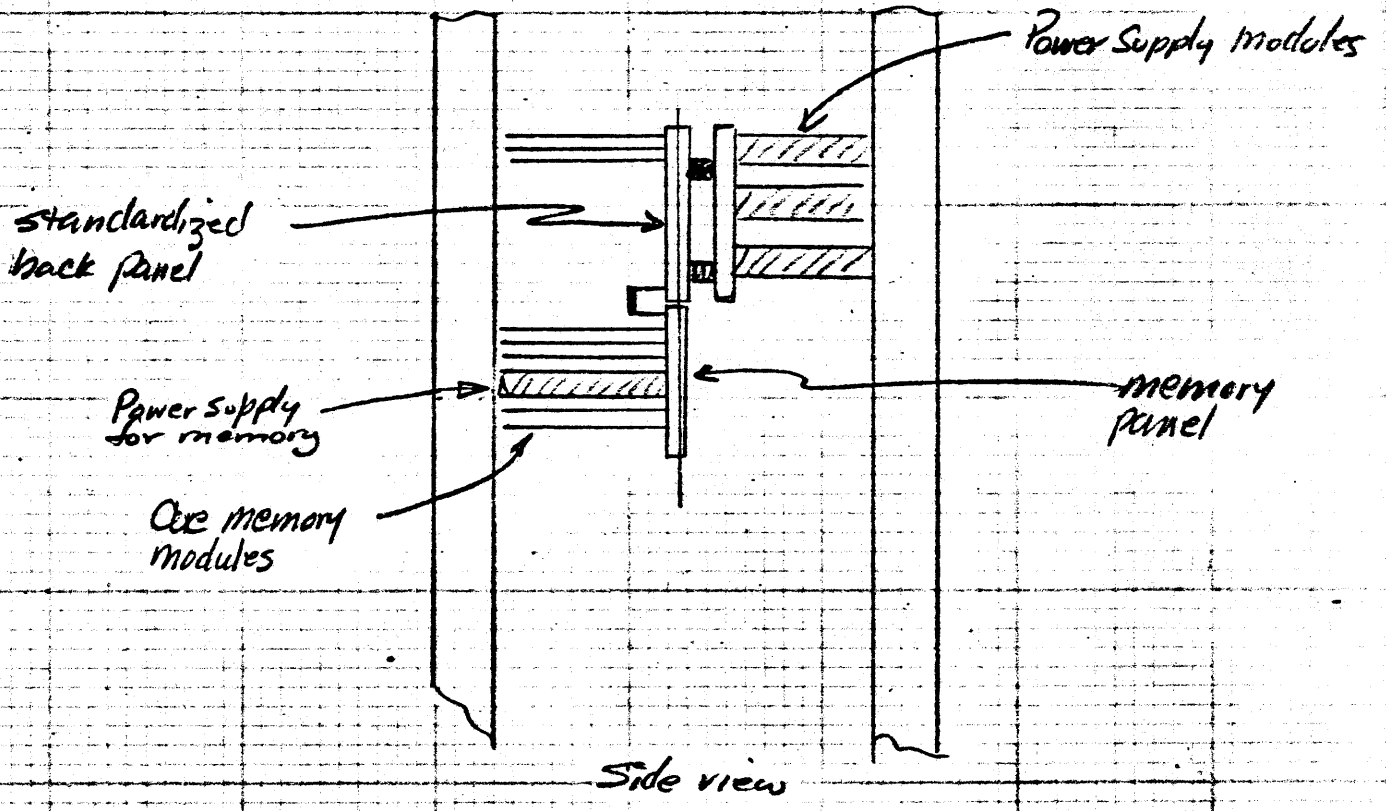


Figure 3