UNIBUS Monitor for PDP 11[1]

M. D. Donner
Communications Systems Research Section

A UNIBUS Monitor has been designed and constructed to facilitate development of hardware interfaces with the PDP 11 minicomputer. The Monitor provides useful displays of UNIBUS conditions and provides the user with a flexible diagnostic tool. It can also serve as a simple display and data entry device, permitting extremely simple input/output for development software.

I. Introduction

A UNIBUS Monitor has been designed and constructed to facilitate development of hardware interfaces with the PDP 11 minicomputer (Figs. 1 and 2). The Monitor provides useful displays of UNIBUS conditions and provides the user with a flexible diagnostic tool. It can also serve as a simple display and data entry device, permitting extremely simple input/output (I/O) for development software. At this time the Monitor is being used with the DSN Planetary Radar System, which uses a PDP 11.

II. The Problem

While the PDP 11's UNIBUS system simplifies peripheral and I/O interfacing and handling, it also introduces a single point of failure which can bring down a whole system. If a peripheral or I/O device fails in a way that interferes with UNIBUS functioning, it is possible that the processor will be unable to execute the code. In a situation like this it would be convenient to be able to view the UNIBUS status directly without having to probe all 56 UNIBUS signal lines individually. In a static situation this would be comparatively simple; simply hook an indicator light up to each signal line. Since the UNIBUS is a dynamic system involving various time-varying signals which typically change too fast for an engineer or technician to see, some capability must be added in the monitor to recognize and display this dynamic activity in a useful way.

III. The Solution

A. Single Address, Synchronous

In this mode (*MONITOR* switch – *"OFF,"* *SYNCHRO/IO* switch – *"SYNCHRO,"* *SA/RANGE* switch – *"SA"*) the UNIBUS Monitor watches for bus transactions involving the bus address specified by the top row of octal lever wheel switches. If the *A* lines contain that address the monitor latches the *A* lines on the arrival of *MSYN*. If the *C* lines indicate a *DATO* or *DATOB* operation, the *D* lines are latched at the same time. If the operation is a *DATI* or *DATIP*, the *D* lines are latched on the arrival of *SSYN*.

[1] UNIBUS and PDP are registered trademarks of the Digital Equipment Corporation.

B. Range, Synchronous

This mode is similar to mode A (*MONITOR* – "*OFF*," *SYNCHRO/IO* – "*SYNCHRO*," *SA/RANGE* – "*RANGE*") except that instead of responding only to the address dialed into the *A* switches, the Monitor responds to all addresses less than or equal to the *A* switches and greater than or equal to the *D* switches.

C. Single Address, IO

In this mode (*MONITOR* – "*OFF*," *SYNCHRO/IO* – "*IO*," *SA/RANGE* – "*SA*") the UNIBUS Monitor serves as a UNIBUS peripheral, responding as a peripheral or input/output device would. It responds to the address contained in the upper row of lever wheel switches. When the *A* lines contain the correct address and *MSYN* is asserted by the bus master, the UNIBUS Monitor latches down the *A* lines and responds with *SSYN*. On *DATO* or *DATOB* operations the Monitor latches down the *D* lines at the same time as the *A* lines. On *DATI* and *DATIP* operations the Monitor asserts the contents of the lower row of lever switches onto the *D* lines until *MSYN* is released. In *IO* mode the monitor observes the UNIBUS handshaking protocols according to Digital Equipment Corp. specifications.

D. Range, IO

This mode (*MONITOR* – "*OFF*," *SYNCHRO/IO* – "*IO*," *SA/RANGE* – "*RANGE*") is essentially the same as Mode C except that the Monitor responds to the range of addresses between *A* and *D* inclusive. On *DATI* and *DATIP* instructions the contents of the lower row of switches are asserted onto the *D* lines as in Mode C. In this mode the lower address boundary and the returned data are the same, but this shouldn't cause any problem.

E. Monitor Mode

In this mode both the *D* and *A* latches are held enabled. No dynamic responses are made. All addresses are displayed for as long as they are present. This mode is useful for taking a look at the UNIBUS in static situations, such as when the processor is stalled.

F. Non-Modal Displays

All the other UNIBUS signals are displayed on LEDs directly on the front panel with no dynamic interactions with the bus. In addition, the *C* lines are decoded into the four bus transactions, *DATO*, *DATOB*, *DATI*, *DATIP*, and displayed. Also, the *MSYN*, *SSYN*, *SACK*, and *BUS GRANT* lines have pulse stretching one shots so that the signal and an "activity" indicator are both displayed. In the case of the *BUS GRANT* lines the one shot is triggered by the assertion of any grant line; there is only one activity indicator for the grant lines. One particular reason for activity indicators on the *GRANT* lines and on *SACK* is that should a UNIBUS device fail with its *BUS REQUEST* asserted and be incapable of responding to the *BUS GRANT*, the processor will attempt over and over to grant the request without success, timing out and starting over again each time. The *GRANT ACTIVITY* indicator will catch this kind of failure.

IV. Conclusion

After construction and testing the UNIBUS Monitor was taken out to DSS 14, where it was installed with the planetary radar equipment. In this application the Monitor soon proved its usefulness in analyzing UNIBUS communication performance.

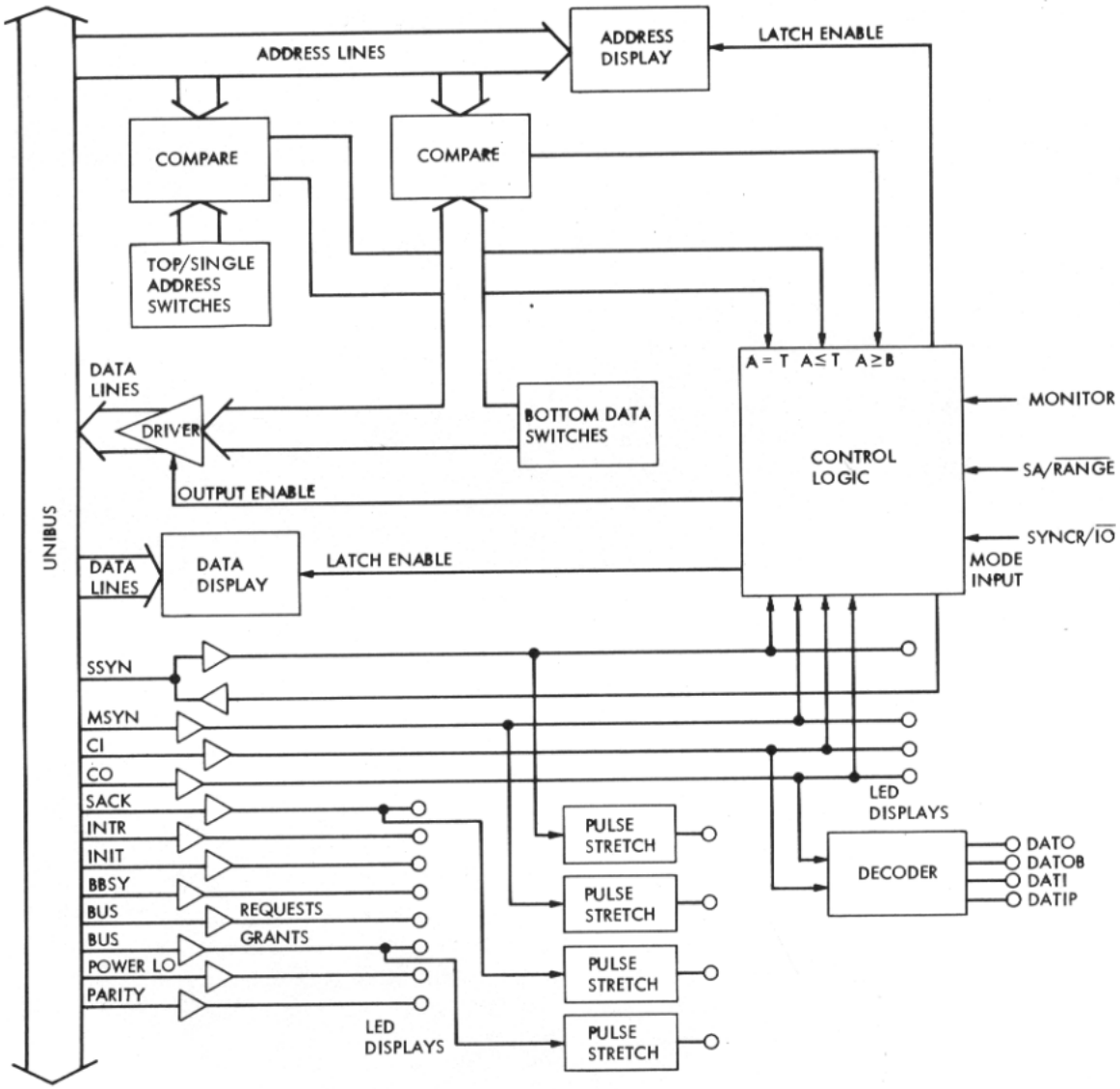

Fig. 1. UNIBUS Monitor block diagram

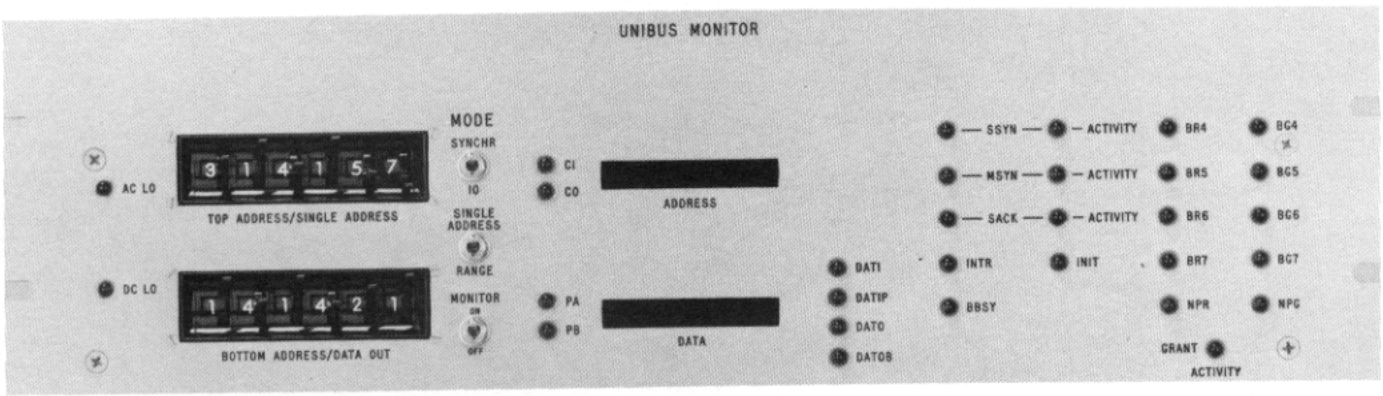

Fig. 2. UNIBUS Monitor panel