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The Electrical Characteristics of a Bus

A bus is a highway composed of one or more paths which transfer information and electrical power between the various components of a digital system. The concept of a common bus, carrying data from one part of a system to another, is so obvious that it is difficult to imagine a complex digital system without one.

To many microprocessor users the bus structure of their system is as important as the microprocessor chip itself. This is because engineers do not always wish to design an entire microprocessor system, and would rather couple their own processor module to, say, a commercially available memory board. Clearly, manufacturers produce bus-compatible peripherals and memories only if the bus is a standard bus, guaranteeing high sales to many different users.

One of the most famous buses is the UNIBUS found in the DEC PDP-11 system. This is a well-designed bus whose principal feature is its asynchronous operation, allowing peripherals of various speeds to share the same bus. Microprocessor buses have developed on a rather *ad hoc* basis. For example, the ubiquitous S100 bus was originally introduced by MITS Inc in their Altair microprocessor kit, and has become a *de facto* standard in the 8080 and Z80 hobby computer market. The IEEE has now produced a draft of a formal standard for this bus.

The lines, or information highways, which form a microprocessor bus may be characterized in four ways:

(1) The function of the highway: for example, address lines, data lines, VMA, R/$\overline{W}$.
(2) The direction of data transfer—to the CPU, from the CPU, bidirectional.
(3) The protocol observed by the lines. This includes the sequence of events which must take place for data to be moved on the bus.
(4) The electrical specification of the signals on the bus: for example, the guaranteed electrical levels representing the logical one and zero states.

In this section we are concerned largely with the electrical characteristics of a bus. It