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'SELF-IDENTIFYING SCHEME FOR MEMORY'BACKGROUND OF THE INVENTION

## 1. Field of the Invention.

This invention relates to computer memories, and more specifically for a memory to self-identify its access time.

## 2. Prior Art.

The use of various memory devices for storing information is well-known in the prior art. These memory devices can be internal or external devices and are coupled to a host unit, such as a central processing unit (CPU). The host unit provides the addressing, as well as other control signals, to access a location in memory for reading or writing information to and from such location.

Although various memory units can be configured with a given host hardware, the memory unit must be configured to function with a particular host unit. At the time a particular memory unit is configured within the system, the host unit must be capable of operating with the memory unit. Proper hand shaking and synchronization are essential elements for information transfer to be established between the two units. In a typical situation, the memory unit is configured to a previously determined host unit, such as a CPU, so that the memory unit must be specially designed to operate within certain limited constraints imposed by the host unit.

Because different memory units operate at different speeds, each memory unit must be specially configured and interfaced to operate with a given CPU. Such interfacing must be accomplished at the time the memory unit is coupled to the CPU, or typically,

the memory unit is predesigned to operate at a given speed determined by the CPU.

Where a number of memory units are coupled to the same CPU, a further problem is encountered in that some of the memory units may operate at different speeds. Because random-access memories (RAM) are capable of running at a faster speed than read-only memories (ROM), the CPU must know the location or address of these various memory units so that the host unit can change its accessing speed if efficient use of these memories is desired. If the CPU cannot differentiate among the different memories, then it must operate at the accessing speed of the slowest memory unit.

In another related technology, modulized memory units are being designed for various uses. In one area, memory modules are designed to be plugged into various interfacing connectors, such that various modules representing different memory types are interfaced with the same host unit. In the prior art a given memory type must be plugged into a predesigned location, so that the CPU knows the characteristics of the memory unit by its location. However, such a preordained system limits the flexibility of modulized design. What is desired in this instance is to have a memory unit having a capability of being plugged into any given module location and permitting the CPU to identify that memory unit by its type and not by the location that it is plugged into.

In another application, a memory connection is coupled to a host unit. However, the memory connection is capable of interfacing with various types of memory units. For example, in an automatic bank teller machine, or a security/identification

machine, a memory unit, such as a bankcard having a magnetic strip, is inserted into the connection for accessing the host unit. Although the bank teller machines of today read magnetic strips on cards, a more sophisticated unit can access memory devices which contain substantial memory mass storage. Compact and portable mass storage units are achieved by utilizing integrated circuit semiconductor memories. In the above example, the host unit must be capable of identifying the different types of memory units which plug into the machine and for efficient operation the machine must be capable of accessing these various memory units at accessing speeds which correspond to the different memory units.

Therefore, in implementing modularized memory designs, it is appreciated that what is needed is a self-identifying memory, wherein a particular memory unit provides certain identifying information for its access by the host unit. One such information being its memory accessing speed.

SUMMARY OF THE INVENTION

The present invention provides, in a data processing system including a variety of plug compatible memory devices coupled to a host processor, wherein an accessing speed of a given memory device by said host processor varies according to the type of said given memory device which is coupled to said processor, a self-identifying portable memory card operated with said host processor, said memory card comprising:

storage means coupled to said host processor for storing information, wherein said host processor accesses said storage means for transfer of said information;

encoding means coupled to said host processor, for inputting encoded information to said host processor which identifies a particular accessing speed of said memory card, wherein when said memory card is selected by said host processor for said transfer of said information, said encoding means generates a predetermined coded signal to identify said accessing speed of said memory card to said host processor in order for said host processor to produce its memory accessing speed to correspond to said particular accessing speed of said memory card, and said memory devices can be identified as to said accessing speed independently from address location.

Also according to the invention there is provided, in a data processing system including a variety of heterogeneous memory devices coupled to a host processor through an interface connector and wherein an accessing speed of a given memory device by said host processor varies according to the type of said given memory device which is coupled to said processor, a self-identifying, portable and insertable

integrated circuit memory card operated with said host processor, said memory card comprising:

an integrated circuit memory coupled to said host processor for storing digital data, wherein said host processor accesses said integrated circuit memory for transfer of said data;

encoding means coupled to said host processor inputting an encoded information to said host processor which identifies a particular accessing speed of said integrated circuit memory, said encoding means capable of being located in any memory module slot, and said encoding means having a fixed predetermined coded signal stored therein and generating said coded signal when said host processor selects said memory card.

Further according to the invention there is provided, in a data processing system having a host device and a plurality of portable, integrated circuit memory modules, each of said modules being located in one of a plurality of memory interface slots, a method of self-identifying an accessing speed of each memory module, comprising the steps of:

pre-encoding each of said memory modules to generate a coded signal when said memory module is selected;

selecting a certain memory module by inputting a memory select signal from said host device to said certain memory module;

generating said coded signal from said certain selected memory module, wherein said coded signal provides information to said host device as to the accessing speed of said certain selected memory module and wherein said information from said certain selected memory module is not dependent on which of said memory interface slots said certain memory module is located in.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram showing the interfacing of various memory modules to a host unit.

Figure 2 is a schematic diagram showing a self-identifying encoding feature of a memory module shown in Figure 1.

Figure 3 is a schematic diagram showing one example of using diodes to encode the self-identifying feature.

Figure 4 is a pictorial representation of an integrated circuit memory module which is used in the preferred embodiment.

Figure 5 is a block diagram showing the interface of a host CPU to a modulized memory interface connector which permits various homogeneous memory units to be plugged into it.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

The present invention provides for an apparatus and a method for self-identifying an accessing time of a given memory. In the following description, numerous specific details are set forth, such as specific number of bits, memory configuration, etc., in order to provide a thorough understanding of the present invention. It will be obvious, however, to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known structures, such as control lines, have not been set forth in order not to unnecessarily obscure the present invention.

Referring to Figure 1, a circuit block diagram 10 of the present invention is shown. Circuit 10 is comprised of a host hardware 11, interconnections and various memory units 13-16 of the present invention. The host hardware of the present invention includes a CPU 12; however, a variety of other hardware controllers can provide equivalent functions in communicating and controlling memories 13-16. Each of the memories 13-16 are coupled to an address bus 20 and data bus 21. Address bus 20 and data bus 21 may be of a variety of prior art buses for accessing memories by providing an address on address bus 20 and reading or writing data from and to memories 13-16 on data bus 21. Address bus 20 and data bus 21 are coupled to the CPU 12, but can readily be coupled to other data exchanging units, such as decoders, as well. Although four memories are shown in Figure 1, any number can be utilized without departing from the scope of the invention.

Each of the memories 13-16 are coupled to a memory identification bus 25 which is then coupled to the host unit 11. Bus 25 can be coupled directly to the CPU 12 or to interfacing means within host 11, such as the earlier stated decoder, wherein the interfacing means can further decode signals on bus 25. Bus 25 of the preferred embodiment is comprised of four lines labeled ACC0, ACC1, ACC2 and ACC3, which designate bits 0-3 for identifying the various accessing times of memories 13-16. In the preferred embodiment, bus 25 is comprised of four lines for carrying four bits ACC0-ACC3 such that 16 possible encoding combinations are available to select 16 possible memory accessing speeds. It is readily possible to have less or more lines to bus 25 to provide other than 4-bit encoding combinations for identifying the various memories 13-16. Each of the memory units 13-16 are coupled to the CPU 12 by an individual chip select line, wherein  $\overline{CS0}$  is coupled to memory 13,  $\overline{CS1}$  to memory 14,  $\overline{CS2}$  to memory 15 and  $\overline{CS3}$  to memory 16. It is appreciated that other memory select schemes, well-known in the art, can be used for activating each of the memories 13-16.

In operation, CPU 12 will select one of the memory units 13-16 to be activated, at which time one of the  $\overline{CSn}$  lines corresponding to the memory unit which is to be activated is pulled low. Only one memory is selected at any given period of time. The selected memory will access bus 25 for providing coded signals onto bus 25 for coupling to CPU 12. The unselected memories will not access bus 25 in order not to interfere with the properly encoded signal.

Functionally, memory units 13-16 may be comprised of a variety of memory units and devices; however, as used in the

preferred embodiment, each of the memory units 13-16 are integrated circuit modules and more specifically, integrated-circuit semiconductor memory modules. Memories 13-16 are integrated circuit devices which are formed from a semiconductor device and may include main memory for computers, read/write mass storage units, or read-only mass storage units. Memories 13-16 may be comprised of any or all of these various integrated circuit modules.

To optimize the accessing speed of the CPU 12 to each of the memories 13-16, each memory 13-16 must self-identify its accessing speed by the CPU 12. For example, RAMs typically operate much faster than ROMs and therefore, RAM accessing speed by the CPU 12 should be at a faster rate than that of a ROM to take advantage of the faster data transfer rate of RAMs. That is, if memories 13-16 contain both ROMs and RAMs, it is an advantage to access ROMs at a first speed and RAMs at a second speed which is faster than the first. For each memory 13-16 to inform the CPU 12 as to its accessing time whenever its appropriate chip select signal is activated, the corresponding memory unit will provide a coded signal to bus 25 to inform the CPU 12 as to the type and accessing speed of its memory.

Further, because the memory units 13-16 are self-identifying, if they are constructed homogeneously, then they are capable of being inserted in any of the four locations shown in Figure 1.

Referring to Figure 2, a portion of a memory unit 30 is shown. Memory unit 30 is a detailed description of any of the memory units 13-16 of Figure 1. A chip select signal  $\overline{CS_n}$  is coupled to the memory unit 30 and a supply voltage  $V_{cc}$ , which can be generated internally or externally to memory 30, is

coupled to memory 30 also. ACC0-ACC3 outputs from memory unit 30 are coupled to bus 25 of Figure 1. In this particular embodiment, pull-up resistors 40-43 are utilized to couple ACC0-ACC3 lines to Vcc, respectively. Alternatively, any, all or none of the resistors 40-43 can be coupled to other state levels, such as ground. It is to be appreciated that although only one voltage source is shown, any number may be utilized with the configuration of the present invention. Further, other components besides pull-up resistors can be utilized to provide coded signals onto lines ACC0-ACC3.

Referring to Figure 3, one example is shown wherein memory 30a, which is equivalent to memory 30 of Figure 2, is pre-encoded to provide a four-bit coded signal onto lines ACC0-ACC3. In this particular example, diodes 44 and 45 are coupled to ACC0 and ACC3. Diode 44 is coupled having its anode coupled to ACC0 and diode 45 having its anode coupled to ACC3. The cathodes of diodes 44 and 45 are coupled to the chip select line  $\overline{CSn}$ .

In operation, when memory 30a is not selected, line  $\overline{CSn}$  is in a high state wherein all lines ACC0-ACC3 are pulled up to the higher voltage level of Vcc through pull-up resistors 41a-43a. When memory 30a is selected, chip select signal  $\overline{CSn}$  goes to a low state, causing diodes 44 and 45 to conduct. Conduction of diodes 44 and 45 pull lines ACC0 and ACC3 low causing those lines to generate coded signal of 0110 onto bus 25 which is then coupled to CPU 12 of Figure 1. Thus, the host unit 11 need only know the coded interpretation of the coded signal generated from memory unit 30a. The hardware providing the predetermined encoding within memory unit 30a provides the self-identifying feature for each of the memory units which are coupled to CPU 12

of Figure 1. In this preferred embodiment, the encoding is utilized to inform the host unit 11 the desired memory accessing speed for accessing each of the memory units for data transfer. Further, because the chip select signal selects this particular memory and not others, the ACC0-ACC3 output from the unselected memories are in a high state, thereby not interfering with the coded signal of the selected memory.

Referring to Figure 4, a pictorial representation of an integrated circuit semiconductor memory module 46 of the present invention is shown. These homogeneously constructed modularized memory units can be made portable and pluggable such that these memory units can be readily interchanged with various interconnecting means. The preferred module 46 has a frame 47, top and bottom coverings 48 and connection 49.

Referring to Figure 5, an alternative embodiment of the present invention is shown. In this embodiment, CPU 50 is coupled to a connector 51, which operates as an interfacing means to a memory unit 52. Memory unit 52 has a mating contact 53 for plugging into connector 51. Address bus 54 and data bus 55 couple CPU 50 to connector 51. Bus 56, which is equivalent to bus 25 of Figure 1, also couples CPU 50 to connector 51. A dotted line 57 separates CPU 50 from connector 51 to show that connector 51 can be located a significant distance from CPU 50. To connector 51, various memory units 52 can be coupled, wherein these various memory units can be of different types of memory having different accessing speeds. By utilizing the self-identifying encoding scheme of the present invention, the CPU 50 can identify the type of memory being coupled to connector 51. By knowing the type of memory unit 52, CPU 50 can change its

accessing speed to a particular interchangeable memory unit being inserted into connector 51, so that a much more efficient transfer of information can be achieved.

It is also appreciated that although the present invention is utilized to provide coded signals to determine the accessing speed of memories, other information, such as memory size, can be encoded as well. Further, the identifying scheme can be used with peripheral units as well and is not limited for use with memory units only.

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Thus a self-identifying memory scheme for use in a modularized memory is described.



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CLAIMS

1. In a data processing system including a variety of plug compatible memory devices coupled to a host processor, wherein an accessing speed of a given memory device by said host processor varies according to the type of said given memory device which is coupled to said processor, a self-identifying portable memory card operated with said host processor, said memory card comprising:

storage means coupled to said host processor for storing information, wherein said host processor accesses said storage means for transfer of said information;

encoding means coupled to said host processor, for inputting encoded information to said host processor which identifies a particular accessing speed of said memory card, wherein when said memory card is selected by said host processor for said transfer of said information, said encoding means generates a predetermined coded signal to identify said accessing speed of said memory card to said host processor in order for said host processor to produce its memory accessing speed to correspond to said particular accessing speed of said memory card, and said memory devices can be identified as to said accessing speed independently from address location.

2. The memory card defined in claim 1, wherein said storage means is a semiconductor integrated circuit memory.



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3. The memory card defined in claim 2, wherein said memory card is modularized and is coupled to said host processor through a connector such that it can be readily removed for portability.

4. In a data processing system including a variety of heterogeneous memory devices coupled to a host processor through an interface connector and wherein an accessing speed of a given memory device by said host processor varies according to the type of said given memory device which is coupled to said processor, a self-identifying, portable and insertable integrated circuit memory card operated with said host processor, said memory card comprising:

an integrated circuit memory coupled to said host processor for storing digital data, wherein said host processor accesses said integrated circuit memory for transfer of said data;

encoding means coupled to said host processor inputting an encoded information to said host processor which identifies a particular accessing speed of said integrated circuit memory, said encoding means capable of being located in any memory module slot, and said encoding means having a fixed predetermined coded signal stored therein and generating said coded signal when said host processor selects said memory card.

5. The memory card defined in claim 4, wherein said encoding means includes a plurality of bit lines, each said bit line is coupled to a supply voltage through a resistor on each said bit line; and with certain preselected bit lines being coupled to a memory select line, wherein when said memory card is selected



by said host processor, said select line causes said preselected bit lines to change to a low state to generate said coded signal.

6. In a data processing system having a host device and a plurality of portable, integrated circuit memory modules, each of said modules being located in one of a plurality of memory interface slots, a method of self-identifying an accessing speed of each memory module, comprising the steps of:

pre-encoding each of said memory modules to generate a coded signal when said memory module is selected;

selecting a certain memory module by inputting a memory select signal from said host device to said certain memory module;

generating said coded signal from said certain selected memory module, wherein said coded signal provides information to said host device as to the accessing speed of said certain selected memory module and wherein said information from said certain selected memory module is not dependent on which of said memory interface slots said certain memory module is located in.

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