I/O Tolerance for 3-Volt and 5-Volt IBM DX2 Applications

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Application Note

Introduction

This paper identifies and explains I/O voltage tolerance design considerations when using a IBM DX2 processor, from a planar or motherboard design perspective.

Computer designers today are very conscientious of power consumption; therefore, every effort is made to achieve maximum performance with minimal power usage. One way to achieve minimal power consumption is to lower the voltage level that is needed by the microprocessor in a computer system. Instead of using the once standard 5-volt supply voltage, many processors today use a 3.3-volt or 3.6-volt input to their power pins. Many planars, however, have not followed this rapid change to lower-voltage logic.

Designers would still like to minimize overall system power by utilizing the lower-voltage processors in 5-volt system boards. Planar signals (data, addresses, or control lines) which use 5 volts for a logic '1', however, will damage sensitive I/O buffers on many of the lower voltage processors if a 5-volt reference voltage is not supplied to the processor. Intel's® low-power 486 processor is called the SL-Enhanced 486DX2 microprocessor. In the document "SL Enhanced Intel486 Microprocessor Data Sheet Addendum," Intel uses one pin to accomplish their sensitive I/O biasing. This pin is J1 on their 168-pin PGA package and is labeled Vcc(1). The IBM microprocessors do not have any special pin for I/O voltages.

There are three configurations to consider:

1. 5-volt processor with 5-volt planar logic
2. 3-volt processor with 5-volt planar logic, and
3. 3-volt processor with 3-volt planar logic.

5-Volt Processor with 5-Volt Planar Logic

This particular case is a representation of older planar designs which were not as concerned with power consumption as today's designs. Designers developing their 5-volt planars using Intel's 5-volt SL-Enhanced 486DX2 processors must set the J1 pin to 5 volts just as any other Vcc pin on the processor.

Since IBM 486DX2 microprocessors have very robust I/O buffers and no reference voltage is needed, pin J1 on the IBM 168-pin PGA package is Not Connected (NC) internally to the rest of the silicon chip. Planar designs which are currently designed for the Intel J1 pin will have no concerns about the 5-volts being supplied to the J1 pin, if they later wish to use a IBM part: the IBM module can simply be plugged into the same upgrade socket as the Intel part. If planar designers wish to accommodate the IBM part into their design, it is recommended that they have a jumper which truly detaches this pin from the rest of the planar logic.

3-Volt Processor with 5-Volt Planar Logic

This is a very common planar/processor combination. Designs which supply 3 volts to the microprocessor, yet still have 5-volt logic on the planar, must pay particular attention to the J1 pin on the 168-pin PGA package. For the 3-volt Intel-Enhanced 486DX2 microprocessor, this pin must be connected to 5-volts in order for the Intel I/O buffers to handle the 5-volt signals that will be supplied by the planar logic. All other Vcc pins on the Intel processor will be supplied with 3 volts.

Although the J1 pin on the IBM 168-pin PGA processor package is internally Not Connected (NC) to the rest of the silicon chip, it is recommended that planar designers place jumpers in their logic to accommodate this pin with no signal. As before, however, if the planar does still connect 5 volts to the J1 pin to support Intel's processor, this will not harm or affect the operation of the IBM processor. All Vcc pins will be supplied with 3 volts.

3-Volt Processor with 3-Volt Planar Logic

This combination is an example of the most power-conscious designs available. For designs which have 3-volt logic on their planar and are using a 3-volt Intel processor, the J1 pin must be supplied with 3 volts as are all Vcc pins. This biases the I/O buffers to properly accept a 3-volt signal as a logic '1'.

The IBM processor's J1 pin is handled the same way as the other two cases: designers should not connect any signal to this pin. If, however, the IBM processor is placed in an Intel-designed socket, there will be no damage or problems (from a J1 pin perspective) encountered when the power is turned on.

Example

Example of a Jumper to Accommodate the IBM 486DX2 Processor: