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EMAC SINGLE BOARD CONTROLLER INTERFACING GUIDELINES

- When connecting switches or other devices which do not provide both a high and a low output to a digital input make sure to use a resistor (~2.2K) to either pull-up or pull-down the input. For example if you are connecting a switch with one side of the switch connected to ground and the other side connected to the digital input, also connect a pull-up resistor with one side of the resistor connected to the input and the other side connected to system Vcc/Vdd (usually 3.3 or 5 VDC depending on the system; consult your system user manual). Generally any signal that is less than that is 50% of Vcc/Vdd (1.65V for 3.3V & 2.5V for 5V) is considered a low and any signal greater than 50% Vcc/Vdd is considered a high.

  Another thing to look out for when utilizing switches is something called Switch Bounce. This occurs when a switch is thrown. The switch does not actually flip all at once it bounces for a while before becoming stable. Most of us have seen this when switching a light switch, you will see and hear it arching for a short period of time until it settles. For example if we have a switch with a pull-up resistor connected as described above, when the switch is flipped to the on position it will initially bounce between high and low eventually settling low after a few milliseconds. If you happen to read this input while this is occurring you can have an erroneous result. This can be worked around in software by successively reading the input and making sure that it is stable before basing a decision on it.

- When connecting small relays to a General Purpose digital output, make sure that the digital output has ample current drive capability. Also most digital outputs can sink more current than they can source. So for example it would be better to connect one side of a relay to Vcc/Vdd and the other side to the digital output than vice-versa. Also a reversed bias diode (flyback diode) should be place across the relay coil. This suppresses the inductive kick that takes place when a relay is deenergized. It is also a good idea to put a snubber or a properly sized varistor across the relay contacts especially if switching a high power inductive load.

  As a rule of thumb most General Purpose digital outputs do not have enough current to drive a mechanical relay. And even if they do you have to make sure your not driving too many relays. For example it may be fine to connect a couple of relays to a couple of digital output lines. However, it may be not be okay to connect eight relays to eight digital output lines, if the potential exists for all eight relays to be on simultaneously. While each individual output line may be fine in terms of current, the total exceeds what the chip can safely provide.

  Most EMAC Single Board Controllers (SBCs) have a high-current digital output port. This port is more appropriate for driving relays and other relatively high-current digital loads. Each output line on this port is capable of sinking 500 ma. of current, although the total current capability is 1.5 amps. So for example you could drive 3, 500 ma. loads at the same time or drive 6, 250 ma. loads at the same time. Also provided with the high-current digital output port is built-in flyback diodes, alleviating the need for these to be added for inductive loads.

  EMAC's high-current digital output port is an open-collector port. What this means is that when the port is energized the output is at ground and when it's deenergized the output is open (connected to nothing). If you took a meter and placed it on a high-current, open-collector digital output port line, it would read about 0 Volts in both the energized and the deenergized state. This is usually okay when driving loads like relays. By connecting one side of the relay to +Volts DC (Vin of the SBC, 5 - 15 VDC) and the other side to the high-current digital output port line, energizing the output line (setting it High Vcc/Vdd), the relay will turn on (the driver chip is invertering), when deenergized the relay will turn off. If a situation arises where you need to be able to measure the output a pull-up resistor can be used similar to its use with the switch example mentioned above.

  Another thing to be careful of is the shorting of an output line. Depending on a number of factors (i.e. length of time of the short, type of output, etc.) the board can be damaged. If shorting out the output is a possibility in your application it would be wise to use a quick-blow fuse sized appropriately.

- While most EMAC boards are very noise immune, it is still a good idea to have a clean power supply with enough current to power the board and any I/O devices that may be connected to it. If the board mysteriously resets when turning on a relay, this could be the reason. Another reason could be the lack of a snubber on the relay contact. Be careful with sharing power with high noise sources such as AC drives. Also if switching a very large load it is best to use an optically coupled solid-state relay (SSR).

- Most EMAC Single Board Controllers (SBCs) come equipped with counter inputs. When using a counter most all the rules of digital inputs apply especially with regard to switch bounce. If a switch was connected to a counter every time the switch was flipped, the counter might count 5 or more pulses due to switch bounce. In order to allow the counter to count high-speed signals, software switch bounce is usually not an option. In this case a switch debounce circuit may be required. However, most counting devices, such as a water meter, an electric eye, etc. are solid-state devices and do not require switch debounce. The input voltage to a counter is 0 to Vcc/Vdd volts. Generally any signal that is less than 50% Vcc?vdd is considered a low and any signal greater than 50% Vcc/Vdd is considered a high. The counter is typically incremented when the signal transitions from low to high and will rollover when the counter reaches its maximum count.

- When interfacing an analog sensor to an Analog to Digital (A/D) input, remember that most A/D inputs on EMAC boards are 0 - 2.5 Volt or 0 – 5 Volt inputs (consult your user manual). If your sensor is unconditioned and does not put out that range then the sensor will require conditioning before it can be utilized with the board. Warning a sensor that puts out too much voltage (e.g. 10 Volts) can damage the board.

  Another issue of concern with A/D inputs is noise. Depending on the resolution of the A/D noise can be more or less of a problem. If using an 8-bit A/D then noise will be less of a problem than with using a 12-bit A/D. Again a clean power supply is essential to achieve good readings. Good wiring practices such as using shielded cable can also help. If the signal is very noisy then a filter circuit may be required between the sensor and the A/D input.

  The analog acquisition time of the board is a function of the A/D, the processor speed, and the type of software running on the board. These things should all be considered when selecting board for your application.

- When using a digital to analog (D/A) output, remember that these outputs have very limited drive capability. Trying to drive too large a load will cause the output voltage to drop and probably keep the output from attaining the maximum voltage (typically Vcc/Vdd). It can also cause the output to become noisy. If additional drive is required a driver circuit would have to added between the D/A output and the load.

  The analog output time of the board is a function of the D/A, the processor speed, and the type of software running on the board. These things should all be considered when selecting board for your application