Hitachi America, Ltd.

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Application Engineering
TechNote

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2, 3 or 4 Wire SCI Which one to use?

The Hitachi H8/300 family supports the Serial Communications Interface (SCI) peripheral I/O port. There are many external chips from various vendors that manufacture the support circuits that attach to the SCI port. The designer can add just the extra function required for the application. Some of the functions available are; RAM, EPROM, A/D Converters and Real Time Clock chip with battery back up.

After the function(s) is(are) selected, comes the question of which interface technique is best for a specific application? There are three basic techniques used for the interconnect, 2, 3 or 4 wire systems. Some of the peripheral chips are designed for a specific system and the decision may be made dependent on the hardware. However if the system can be selected, a knowledge of the Pro's and Con's would help.

From the software side the two wire interface is the most software intensive. This is due to the requirement to "assemble" the bit stream to send out and continually change the I/O of the data line. The two wire system has a Serial Clock (SCL) signal and a Serial Data (SDA) signal. When active, the SCL determines the state of the SDA I/O. The SCL rising edge defines a write operation and the data on the SDA is output from the processor. The SCL falling edge causes the microprocessor to read the SDA line as an input. There is no handshake as all of the data transfer is dependent on the SCL timing. The bi-directional SDA must have it's state changed (driven) during the SCL low period. Start and stop instructions are done with the transition of SDA with SCL high.

The data stream must be assembled (start, Address, data out, data in,.....) in software before starting this interface. All the bits are singularly interwoven, and during transmission an I/O port must be switched from input to output with each bit transferred. All of this uses a lot of software or tight subroutines and time thus this is a slow data transfer. The advantage is if you are not interested in what you transfer one way or the other you can easily read or write a bit stream. The simple hardware of two wires is only limited in length by the capacitive load and speed desired.

The three wire configuration is probably used the most. The software is fairly simple to assemble just requiring a start, instruction op code and data to be output and or a buffer to accept data being input. The instruction op code most often contains the start address for the remote device. The data is transmitted on Serial Data Out (SDO) from the processor and received on Serial Data In (SDI) into the processor. All clocking is controlled by the Serial Clock (SCL) from the processor. The software tests the SDO line to determine if the external device is ready or busy. The external device may indicate busy even if the entire data stream has not been fully transferred. This provides some handshaking to stop further data transfer until the data transmitted is accepted. Thus the busy state should be checked after each byte to avoid loosing any data.

The four wire configuration provides the fastest data transfer. It basically is the same as the three wire system but an additional signal indicating the Status Output is feed into the processor. The processor thus can continuously transfer data until the status line indicated it is busy. There should be less software not having to check after every byte. This allows to data to be continuously output to the peripheral if the peripheral device can handle it. The status line can be input to the processor and generate an interrupt to stop the processor from outputting any more data until the status line goes ready again.

Vendors for some of these peripheral devices are Maxim (analog inputs, A/D, 10bit 8 channel, three wire interface). ATMEL has a large selection of EEPROMS, RAM's and ROM parts. They are available in 2,3 or 4 wire interfaces. Motorola supplies a series of add-on computer parts such as a battery backed real time clock.

Again the decision as to which system to use is made using the design constraints for the target system. Some times the system is only used for diagnostics, calibration or system up date.

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