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Review of SPI to I2C Bridge

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Abstract: **The paper converses the two protocols in detail and a SPI to I2C Bridge.These two are commonly used serial data transfer protocol in embedded system.I2c is having advantages on few issues in comparison to SPI. The most important advantage of I2C is less number of pins and signals require. The Bridge helps SPI master to control a number of I2C slave devices for better transmission of information.**

Keywords: **SPI, I2C, MISO (Master in Slave Out), MOSI (Master Out Slave in), SCLK (Serial Clock), SS_n (Slave Select Line #n), Bridge.**

I. INTRODUCTION

Many embedded systems today have SPI interfaces, making it difficult to connect them with peripheral devices in an I2C fashion. We can make the connection by modifying the system, but this is economically inefficient. The best solution is to use a Bridge to connect the two interfaces, so that, by using the Bridge we convert SPI protocol into I2C.

II. SPI (SERIAL PERIPHERAL INTERFACE)

SPI (serial peripheral interface) is a synchronous serial communication protocol which was invented by Motorola in 1979 .Main features of SPI is:

1. High speed (10 Mbps or 10,000 Kbps) communication with four numbers of wires.
2. Possibility of full duplex mode.
3. Having master slave architecture with single Master only.
4. Multiple slave devices are connected through selection with the (ss_n) slave select line. It provides a simple connection with only four pins to the external world MISO, MOSI, SCLK and SSN.

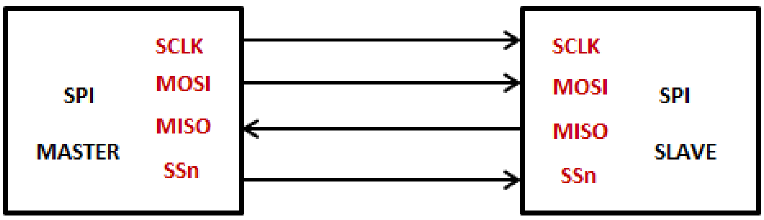

Figure 1: Block Diagram of Single Master, Slave Device

III. I2C (INTER INTEGRATED CIRCUIT)

There are many protocols which communicate serially like RS-232, RS-422, RS-485 and SPI (Serial peripheral interface) for interfacing high and low speed peripherals. But the disadvantage of these protocols is that they require more number of pin connections. The IC (Integrated Circuit) in order to take place a serial data communication, and also the physical size of IC have decreased and it requires a less amount of pin connection for serial data transfer. Many protocols require multiplexing.So to overcome this problem, I2C protocol is introduced. It is the two wire communication protocol, these two wires can support up to 1008 slave devices. Dissimilar to SPI, I2C can support a multi-master system; it means there is more than one master to communicate with all devices on the bus.**I2C**bus is one in which there data line SDA is and a clock line **SCL**. This serial bus is synchronous only due to these two lines. The total number of devices connected to the bus depends on the permitted bus capacitance which is not more than 400 pF. It is because most **IC**s with an **I2C** interface consume low-`power, high-impedance **CMOS** technology. The clock signal on the bus is generated only by one of the master device of I2C.

I2C data transfer rate lies between SPI and other serial device. I2C bus uses Standard mode of transfer rates up to 100 Kbit/s and 7-bit of addressing. Such I2C interface is used in many I2C compatible devices .But there is advancement in the technology which needs higher transfer rates and larger address space are emerged. There are many cases in which large amount of data needs to be transferred.

Signals: I2C bus consists of two signals:

Serial Clock Line (SCL)

SCL is the clock signal. This clock signal is always generated by the master device which is currently worked, to prepare a data before sending itout.

Serial Data Line (SDA)

It is the data line that transmits all the data among the devices. Both these line are connected with resistors and applying the positive power supply voltage. Both lines are high when the bus is free, all devices on the bus must have open-collector or open-drain pins. There is almost unlimited number of the devices on a single bus, but only the necessity is that the capacitance of bus does not go above 400 pF.

A. Data Transfer in I2C:

Messages are broken up into two types of frame an address frame, where the master indicates the slave to which the message is being sent, and one or more data frames, which are 8-bit data messages passed from master to slave or vice versa. Data is placed on the SDA line after SCL goes low, and is sampled after the SCL line goes high.

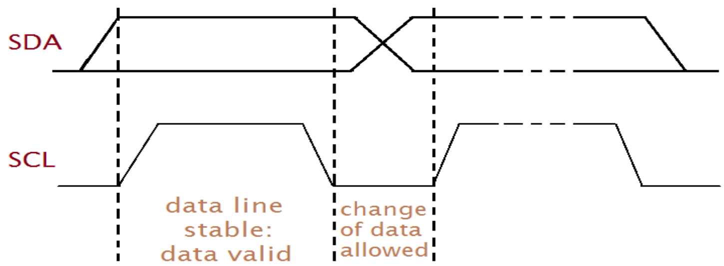

Figure 2: Data Transfer in I2C

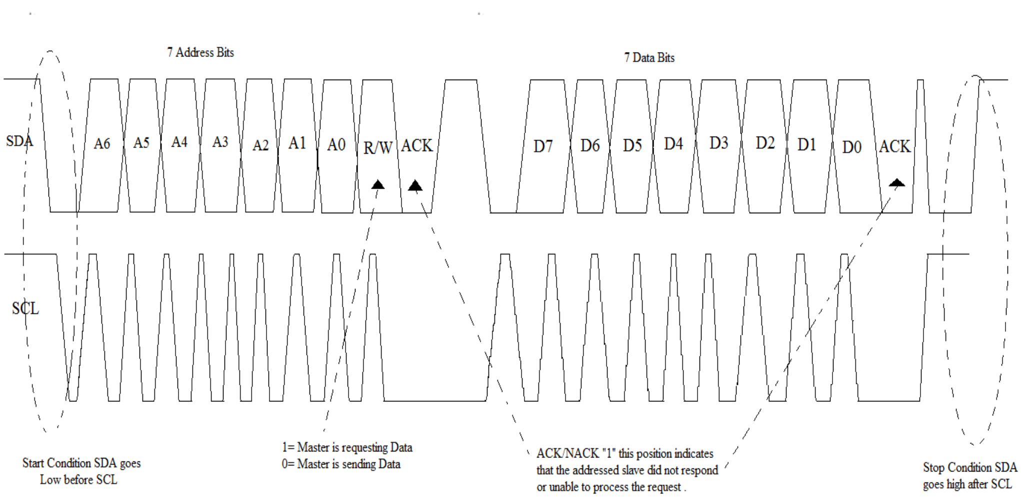

Figure 3: Transfers of Address and Data Frame on SDA Line

B. Start condition:

To initiate the address frame, the master device leaves SCL line is high and falling edge is detected on the SDA line. This will alert to all the slave devices that a transmission is going to start. If two master devices want to share the bus at the same time, then the device which pulls the SDA line low first will get the right to control the bus. It is possible to issue repeated starts, to initiate a new communication sequence without disturbing the other master device.

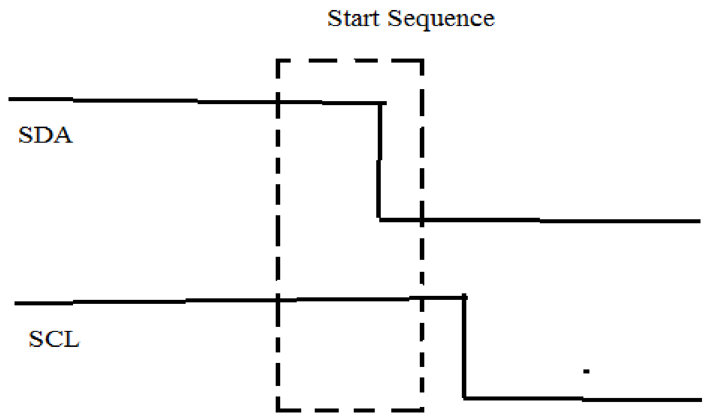

Figure 4 Detection of Start Condition:

C. Stop condition:

When all the data frames have been sent, the master will generate a stop condition. Stop conditions are determined when SCL is remaining high and rising edge is detected on the SDA line

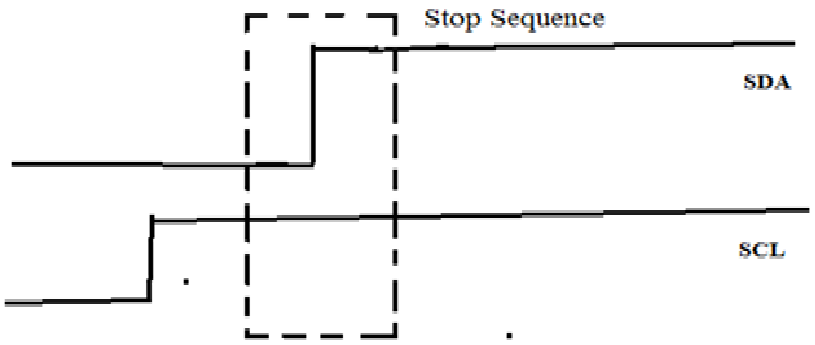

Figure 5: Detection of Stop Condition

IV. SPI TO I2C BRIDGE

Bridge is the device that is used to transfer the data from one device to another. In this paper a bridge for SPI and I2C is introduced. It may consist of several devices such asaddress encoder, address frame generator, input /output register, data register, channel selector and clock generatorcircuit. .

V. CONCLUSION

Basic functions and operation of the SPI and I2C protocol are discussed. Serial communication environment between SPI and I2C is studied with the help of Bridge. It is also studied that by using I2C as a slave side we increase the number of I2C peripheral devices, it is not possible with SPI because it requires separate SS_n line for different slave devices which increase the board complexity.

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