IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 10, Issue 6, Ver. I (Nov - Dec .2015), PP 73-76
www.iosrjournals.org

Serial Communication Interface with Error Detection

[1]Divya c, [2] Grace John, [3]Jerrin Yomas
MTech Scholar,[2,3]Asst. Professor, ECE, [1,2,3]Vimal Jyothi Engineering, College, Chemperi, Kannur, Kerala, India

Abstract: *UART is used for serial data communication. UART is a piece of computer hardware that translates between parallel bits of data and serial bits. UART is usually an integrated circuit used for serial communications over a computer or peripheral device serial port. Bits have to be moved from one place to another using wires or some other medium. Over many miles, the expense of the wires becomes large. To reduce the expense of long communication links carrying several bits in parallel, data bits are sent sequentially. Errors may occur either internally or externally while we transmit information from source to destination. The errors generated during the transmission would affect the performance of the overall system. In order to reduce the errors we should incorporate any error detecting schemes like hamming decoder, check parity systems etc. Different serial communication devices are available.*
Index Terms: *Baurd rate, Universal asynchronous receiver transmitter*

I. Introduction

Serial communication interface (SCI) is the device that is used for the serial exchange of data between microprocessor and other peripheral device such as printers, scanners etc.SCI is similar to serial peripheral devices(SPI) .In SCI communication with another devices is also possible. This paper presents a brief explanation of serial communication interface with error detection. In SCI, parallel to serial converter is known as data transmitter and serial to parallel converter is known as data receiver.SCI uses Non Return to zero data format. Several protocols are available for SCI. A protocol is an agreement between 2 parties in the time of communication. Serial protocol helps to know bit order; transmission completeness etc.SCI is used for long haul communication. Serial transmissions are 2 types such as synchronous serial transmission and asynchronous serial transmission. Different serial communication architecture are available now.RS-232, I2C, SPI etc are the examples of these architectures.

Errors may occur internally or externally while us transmitting information from source to destination. General SCI devices have no such method to detect and correct errors. The error generated during the transmission of devices will affect the performance of the transmitting information and overall system. So we need to research for detecting and correcting errors. In order to reduce errors we need to incorporate with any error detecting schemes.

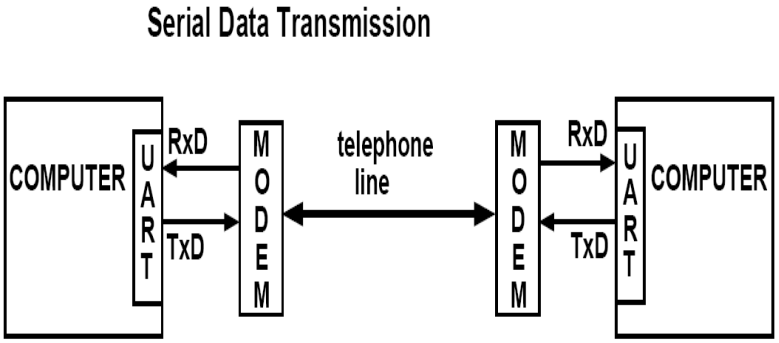

Figure 1: Serial data transmission

II. Different Serial Communication Interface Architecture

Different SCIs are available now.UART is mainly used as SCI.Different SCIs are described below.

RS 232: It is the common interface unit found in almost all computers. It is complete standard contains electrical, physical and mechanical.RS 232 is capable of moderate distance speed up to 20 kbps. For short distance, its speed limit is up to 115.2 kbps.Common cable length is 30 feet. Cable of length 200 feet can be attained with low capacitance. RS-232 bus is an unbalanced bus. It is used for full duplex communication. Each transmitter send a data. By varying the voltage on the line all the transmitter send datas.Voltage higher than 3V is binary 0 and voltage less than -3V is binary 1.value is undefined in between these values. -232 conversion IC,

such as the 1488, 1489, or ubiquitous MAX232, can be used for converting from logic levels (0 and 5V) to these levels and back. Typical RS-232 bit consist of a start bit, data bits, parity bits (if any), and stop bit(s).

I2C: Inter integrated circuit bus is an interface developed by Philips semiconductors. It is a half duplex synchronous communication. I2C bus has 3 speeds such as (under 100Kbps), fast (400Kbps), and high-speed (3.4Mbps).i2c uses the distance of successfully over distances of 50 feet.

Micro wire: Micro wire is a three-wire synchronous interface developed by National Semiconductor. It has master/slave bus, with serial data out of the master (SO), and serial data in to the master (SI), and signal clock (SK). Microwave has same advantages and disadvantages like SPI.it is limited to on board communication.

1-wire: Single-Link Failure Detection in All-Optical Networks Using Monitoring Cycles (MCs) and Monitoring Paths (MPs) [7] for identification of the link failure can be used detect the network failure. Three edge connectivity in WSNs and separate wavelengths for monitoring cycles and locations are the draw backs of this method.

UART: A UART is the microchip with programming that controls computer's interface to its attached serial devices. It act as intermediary between serial and parallel interface. One end of UART consist of a bus of eight-or-so data lines (plus some control pins), on the other is the two serial wires - RX and TX. UART are responsible for both sending and receiving serial data.

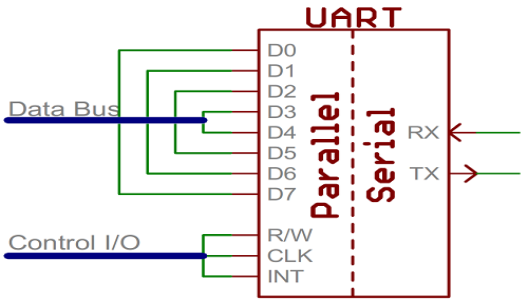

Figure 2: UART Interface

UART uses system on chip technology. The first UART devices are like rotating mechanical switch. They send 5 Bit Baudot codes for mechanical typewriters. Latter it was changed to 6 bit to reduce figure Vs character errors. Another UART was designed By Gordon Bell for PDP series of computers. In 1990s newer UART was developed with on-chip buffer. These UART allows to reduce error and higher transmission speed.

To identify the performance of UART, different manufacture uses different terms. 8251 devices are named as "programmable communication interface" by intel.6551 MOS Technology was known under the name "asynchronous communications interface Adapter". Motorola was introduced the term serial communication interface.

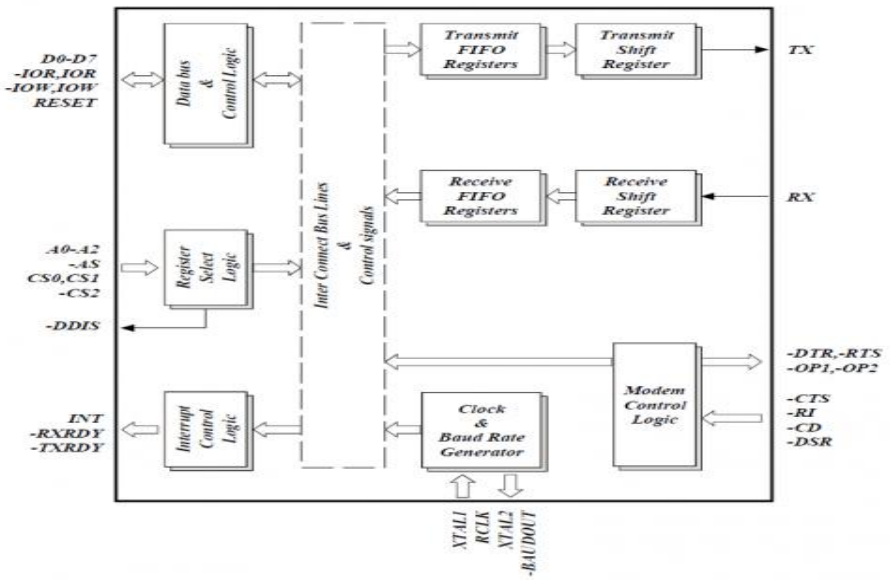

Figure 2: UART Internal block diagram

UART converts received parallel bytes in to serial.UART work as FIFO manner. For that they have transmit and receive FIFO registers. UART also provide additional circuits for signals that can be used to indicate the state of transmission media, To regulate the flow of data etc.

III. Serial Versus Parallel

Serial port is harder to interface than parallel port. Many registers are used in the case of parallel port. Serial cables can be longer than parallel cables. For examble serial port can transmit 1 as -3 to -25 Volts and 0 as 3 to 25 Volts. Serial transmission uses single wires where as parallel wires uses many wires. Infrared devices are used now in laptops and palmtops.IrDA-1 was the first infrared specification. This is capable of 115.2k baud and was interfaces in to UART. So pulse length cut down compared to RS 232 and reduce power consumption.SCI are now in on chip and it will reduce pin count. Communication system will support synchronous and asynchronous communications. Both forms are described in next section.

IV. Synchronous &Asynchronous Serial Communication

Synchronous and asynchronous communications have their own advantages and disadvantages. Synchronous communication depends on clock whereas asynchronous doesn't.

Synchronous serial communication: Sender and receiver share a clock or sender will provide timing signal that receiver so the receiver can able to know when the next data bit will comes. In case of synchronous communication, if there is no data to send then a fill character must be in each clock cycle. This process will cause wastage of time. Synchronous communications are more efficient because data are transmitted only between sender and receiver. Synchronous transmission is used in printers and fixed disk devices. Printers and fixed disk are not normally serial devices. Because each clock use separate wires.

Asynchronous serial communication: Data are transmitted without the support of external signal. It describes an asynchronous protocol in which a start signal send prior to each byte and stop signal is send after each byte. Start signals indicate to prepare the receiver to receive signal. Stop signal indicate the preparation for next signal. Bit rate, Baud rate etc are indicating the transmission speed in asynchronous communication.

Baurd rate is the number of times a signal in a communications channel changes start Bit rate is no. Of data bits transmitted in 1 sec.For sending 7 bits total of 10 bits must me transmitted. Start bit, stop bit, parity check bit and 7 bit data bit

V. Error Detection&Correction

To achieve better Quality Of data transmission, error detecting and correcting techniques are used. Different error detecting and correcting techniques are available. Here we are using hamming code for error detection and correction. Hamming code can correct single bit error and detect double bit error.

Hamming codes are used to detect and correct a larger set of errors. Hamming codes contain several parity bits and assign different bits to overlapping groups.

Error detection by hamming code: When we are transmitting data with 4 bits and 3 check bits. Different check bits have different functions. Check bit 1 establishes even parity over itself and data bits 1&2.check bit 2 establishes even parity itself and data bits 1&3.check bit 3 establishes even parity itself and data bit 2&4.

Assume only 1 bit can be in error. Then we can determine error using the following table.

Check bit in error	Data bit in error
None	None
1&2	1(odd numbered bits of the first two)
1&3	2(even numbered bits of the first two)
2 only	3(odd numbered bits of the second two)
3 only	4(even numbered bits of the second two)

Error correction by hamming code: In this check bits are added to the output of the message. Then message bits are numbered from left to right starting at 1.every bits whose number is a power of 2 is a check bit(1,2,4,8…).other bits are message bits(3,5,…).

When the transmitted message is received, parity bit is calculated over each group of bits. parity bits are placed at the positions 1,2,4 and so forth. If the syndrome value is zero then there is no error. For single bit error syndrome value identifies the erroneous bit. Below example shows how to detect and correct errors.

0	1	1	0	0	0	0	1	1	1	0	1

Figure 3: Received message on the receiver

0	1	1	0	0	1	0	1	1	1	0	1

Figure 4: Corrected message (Transmitted Data)

1 bit in the output message-number 6,in dark box has been inverted because of transmission error. When the ones count for check groups are calculated, group 2&4 have odd counts. So 1 is placed in the syndrome word. The resulting syndrome value is 6,which is the erroneous bit number. Inverting the bit and restore original data. Here 6 th position will inverted and change value from 0 to 1.

VI. Conclusion

Serial communication interface can increase the speed of data transmission. UART is used as serial communication interface with error detection and correction. So we can improve the performance as well as the quality of the data transmitted. By doing error correcting we can improve the reliability of IC.Now a days fault tolerant of IC is a major concern. It can be used for safety applications. As a future work we can enhance the error detection scheme to correct 3 bit error and detect up to 7 bits..This techniques is used for security applications.

References

[1] J.D.Lee,P.S Bhojwani and R.N Mahapatra, "A safety Analysis FrameWork for COTS Microprocessors In Sfety Critical Applications" Proc. Of the 10th IEEE High Assurance System Engineering Symposium,pp.407-408,2007.

[2] M.Razmkhah,S.G Miremedi& A.Ejlali,"A Micro-FT-UART for safety Critical SoC Based Applications";In Proc. ARES,2009,pp.316-321.

[3] Zhou Yi; Zhou Zhonghua; Hou Ligang; Wu Wuchen," Design and optimization of Serial communication system interface module" Computer Engineering and Technology (ICCET), 2010 2nd International Conference on Year: 2010, Volume: 7.

[4] Kumar, U.K.; Umashankar, B.S."Improved Hamming Code for Error Detection and Correction" Wireless Pervasive Computing, 2007. ISWPC '07. 2nd International Symposium on Year: 2007.

[5] Yuanyuan Cui; Xunying Zhang"Research and implemention of interleaving grouping Hamming code algorithm" Signal Processing, Communication and Computing (ICSPCC), 2013 IEEE International Conference on Year: 2013.

[6] Yongcheng Wang; Kefei Song," A new approach to realize UART" Electronic and Mechanical Engineering and Information Technology (EMEIT), 2011 International Conference on Year: 2011, Volume: 5.

[7] Blessington, T.P.; Murthy, B.B.; Ganesh, G.V.; Prasad, T.S.R.,"Optimal implementation of UART-SPI Interface in SoC" Devices, Circuits and Systems (ICDCS), 2012 International Conference on Year: 2012.

[8] Bhadra, D.; Vij, V.S.; Stevens, K.S."A low power UART design based on asynchronous techniques **"**Circuits and Systems (MWSCAS), 2013 IEEE 56th International Midwest Symposium on Year: 2013.

[9] Insup Lee; Davidson, S.B.,"A performance analysis of timed synchronous communication primitives **"**Computers, IEEE Transactions on Year: 1990.