Microcontroller & Embedded Systems-Module-3-2

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3.2.5 Embedded firmware

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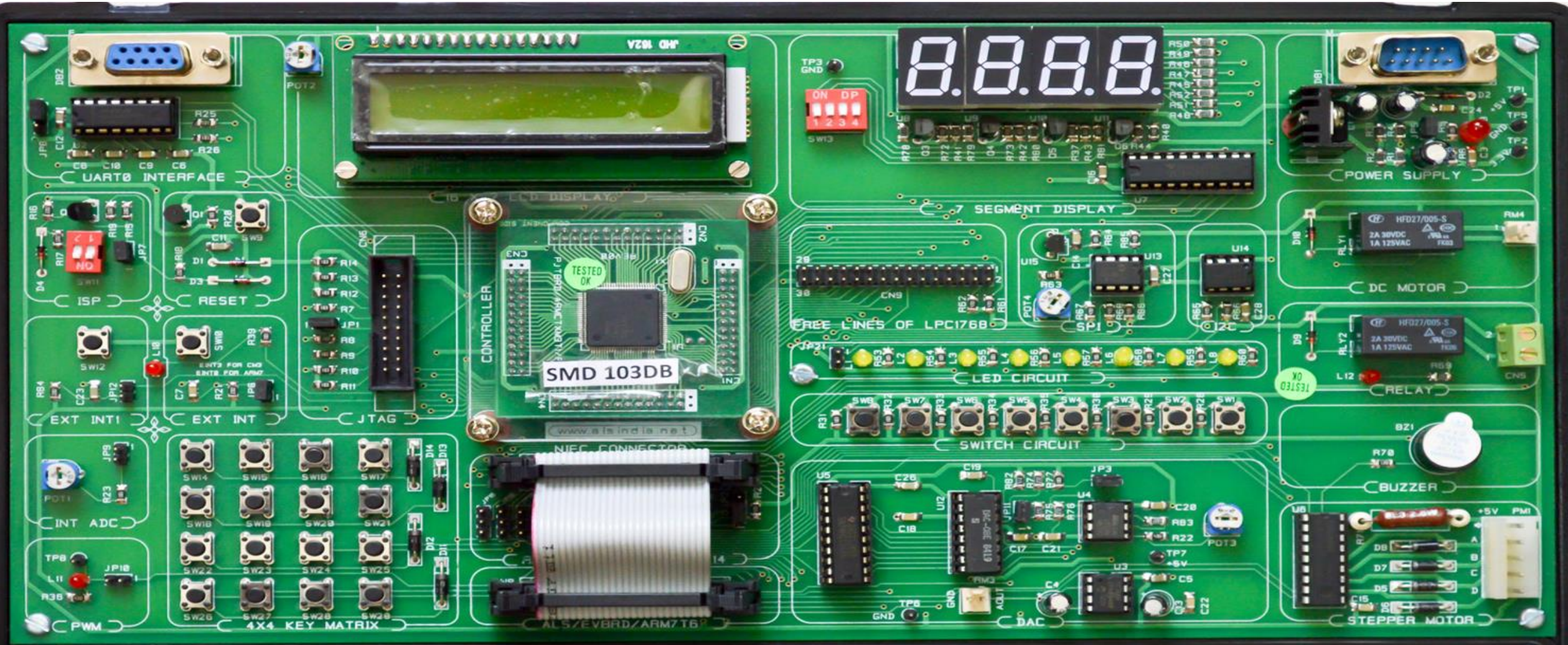
Text book 2: Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education, Private Limited, 2nd Edition.
Chapter 1(Sections 1.2 to 1.6) ,Chapter 2(Sections 2.1 to 2.6)



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Communication Interface

- Communication interface is essential for communicating with various subsystems of the embedded system and with the external world.
- For an embedded product, the communication interface can be viewed in two different perspectives; namely;

1. **Device/board level communication interface (Onboard Communication Interface)**
2. **Product level communication interface (External Communication Interface)**

Communication Interface

- The communication channel which interconnects the various components within an embedded product is referred as Device/board level communication interface –**Onboard Communication Interface.**
- Serial interfaces like **I2C, SPI, UART, 1-Wire** etc and **Parallel bus interface** are examples of “Onboard Communication Interface”.

Communication Interface

- The external communication interface can be either wired media or wireless media and it can be a serial or parallel interface. Infrared (IR), Bluetooth (BT), Wireless LAN (Wi-Fi), Radio Frequency waves (RF), GPRS etc are examples for wireless communication interface.
- RS-232C/RS-422/RS 485, USB, Ethernet (TCP-IP), IEEE 1394 port, Parallel port, CF-II Slot, SDIO, PCMCIA etc are examples for wired interfaces.

On-board Communication Interfaces

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Inter Integrated Circuit (I2C) Bus

- I2C---synchronous ,bidirectional, half duplex, two wire serial interface bus.
- I2C bus was developed by “Philips semiconductors” in the early 1980s.
- The original intention of I2C was to provide an easy way of connection between a microprocessor/microcontroller system and the peripheral chips in television sets.
- The I2C bus comprise of two bus lines. Namely :**Serial Clock SCL and Serial Data SDA**.
- SCL line is responsible for generating synchronization clock pulses and
- SDA is responsible for transmitting the serial data across devices.

Inter Integrated Circuit (I2C) Bus

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- I2C bus is a shared bus system to which many number of I2C devices can be connected.
- Devices connected to the I2C bus can act as either 'Master‟ device or “Slave‟ device.
- The “Master' device is responsible for controlling the communication by initiating/terminating data transfer. Sending data and generating necessary synchronization clock pulses.
- Slave‟ devices wait for the commands from the master and respond upon receiving command, “Master‟ and “Slave‟ devices can act as either transmitter or receiver.
- I2C supports multi masters on the same bus.

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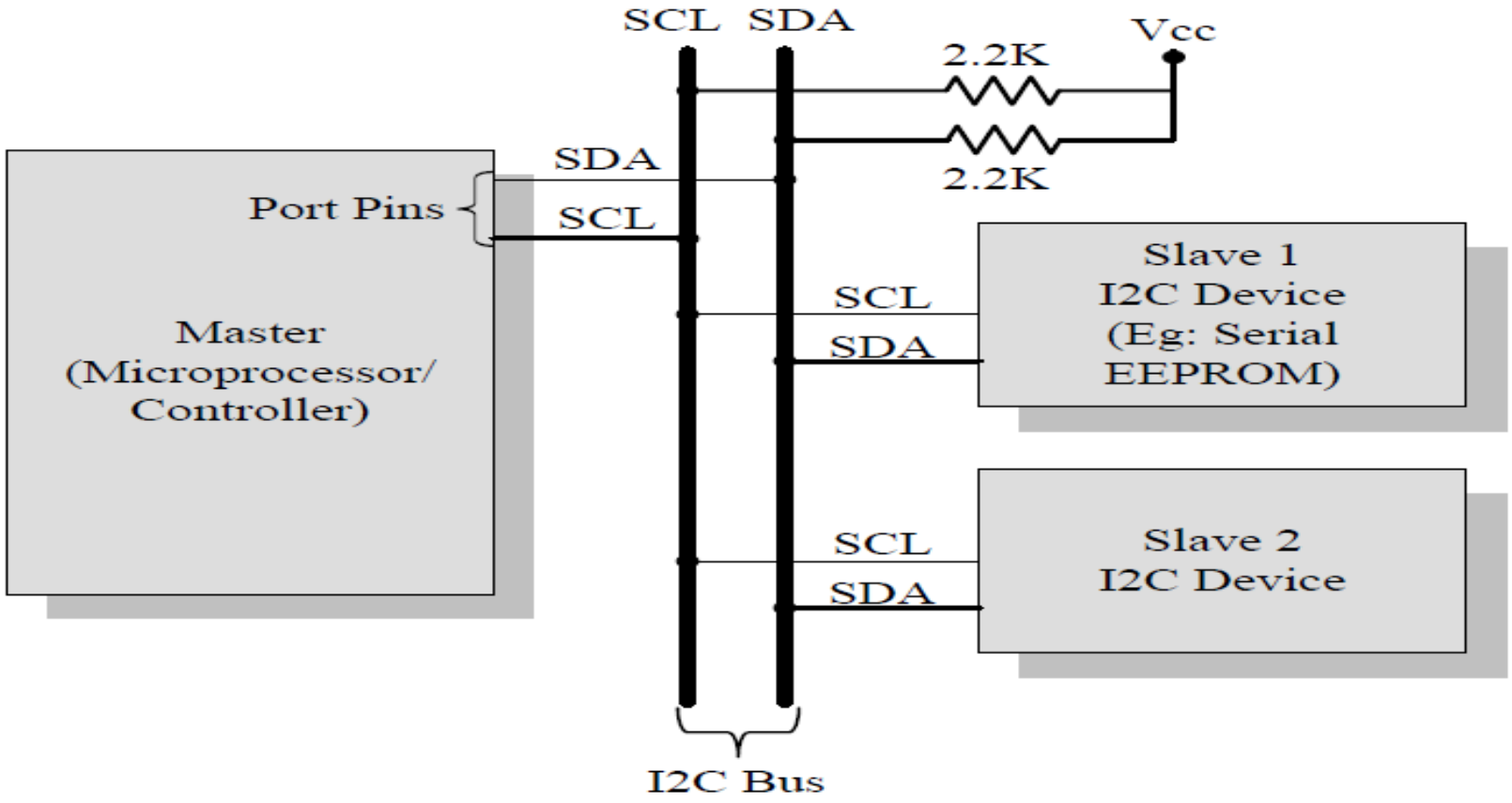
Inter Integrated Circuit (I2C) Bus



I2C Bus Interfacing

Inter Integrated Circuit (I2C) Bus

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- I2C bus supports three different data rates.
- **Standard mode** (Data rate up to 100kbits/sec (100 kbps)),
- **Fast mode** (Data rate up to 400kbits sec (400 kbps))
- **High Speed mode** (Data rate up to 3.4 Mbps).
- The first generation I2C devices were designed to support data rates only up to 100kbps.
- The new generation I2C devices are designed to operate at data rates up to 3.4Mbits/sec.

On-board Communication Interfaces-
Serial peripheral Interface (SPI) Bus

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- SPI is a synchronous, bi-directional ,full duplex, four-wire serial interface bus.
- The concept of SPI was introduced by Motorola.
- SPI is a single master multi-slave system.
- It is possible to have a system where more than one SPI device can be master, provided the condition only one master device is active at any given point of time, is satisfied.

On-board Communication Interfaces-
Serial peripheral Interface (SPI) Bus

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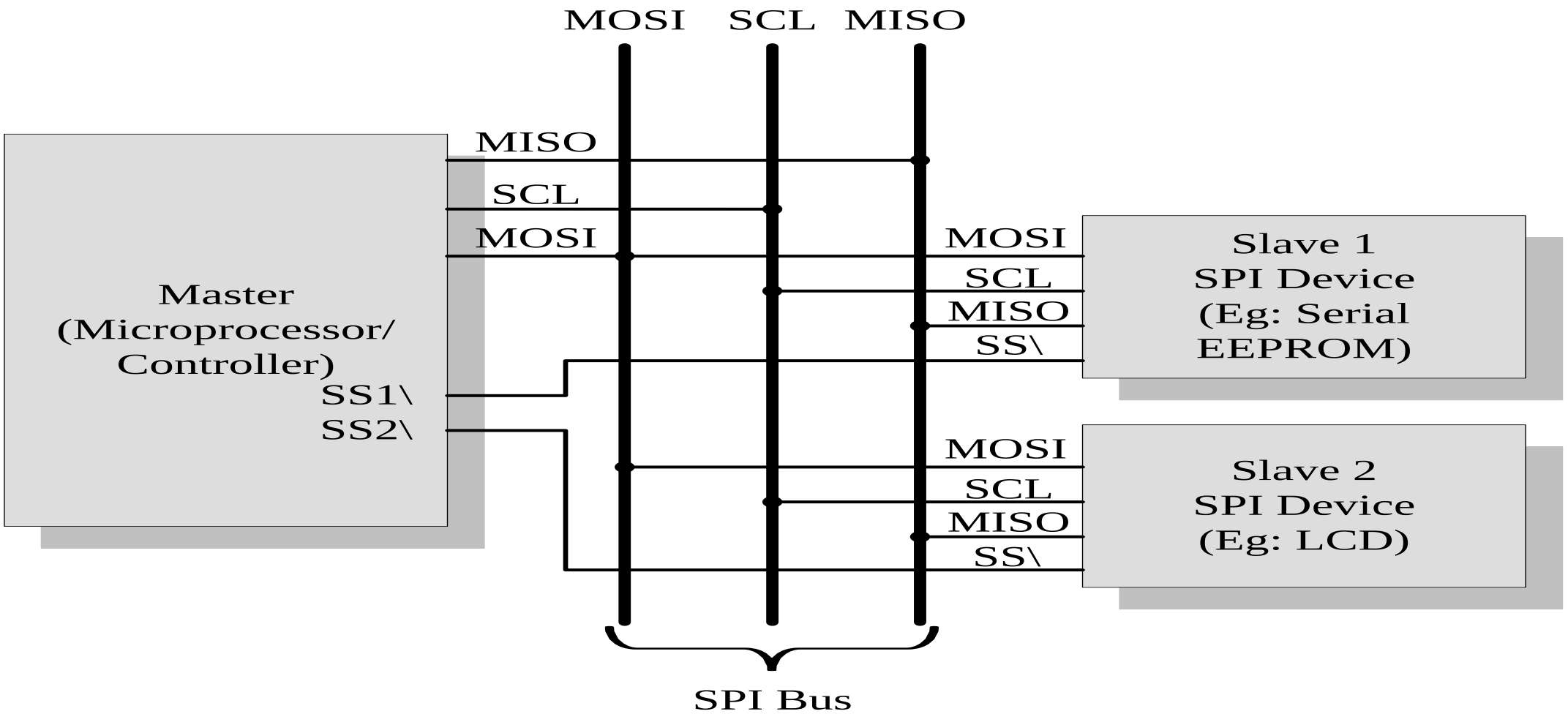
- SPI requires four signal lines for communication.
- **Master Out Slave in (MOSI):** Signal line carrying the data from master to slave device.

  It is also known as Slave Input/Slave Data in (SI/SD1)
- **Master in Slave out (MISO):** Signal line carrying the data from slave to master device.

  It is also known as Slave Output (SO/SDO)
- **Serial Clock (SCLK):** Signal line carrying the clock signals
- **Slave Select (SS):** Signal line for slave device select. It is an active low signal

Serial peripheral Interface (SPI) Bus



On-board Communication Interfaces -Universal Asynchronous Receiver Transmitter (UART)

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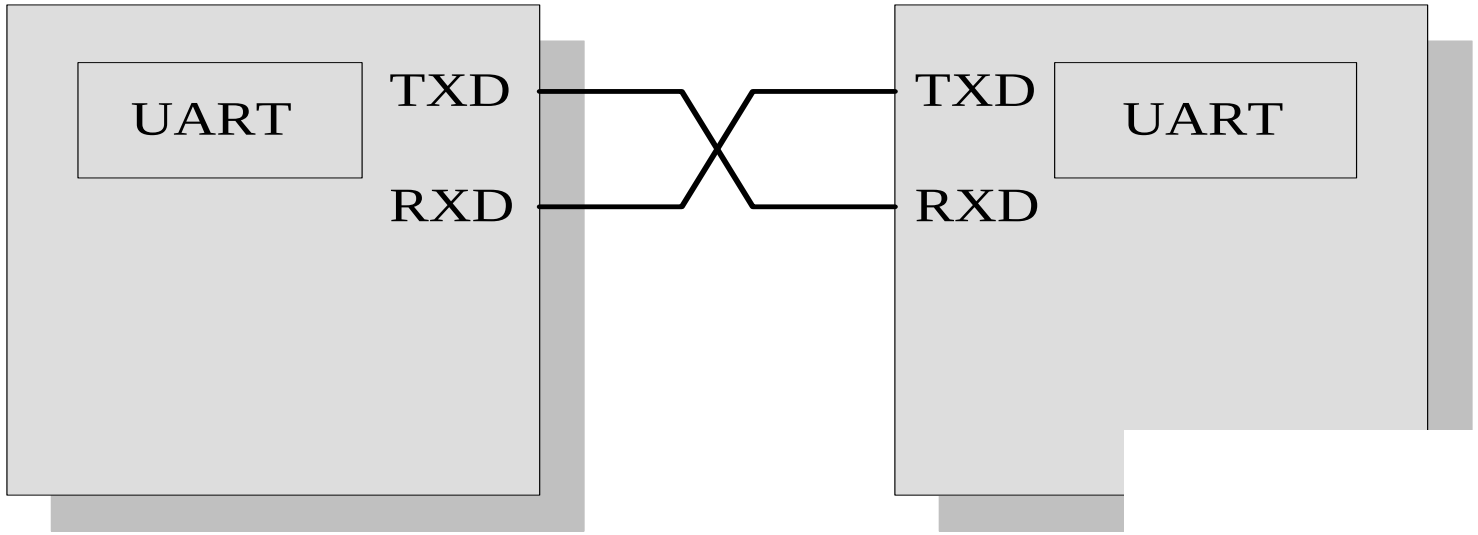
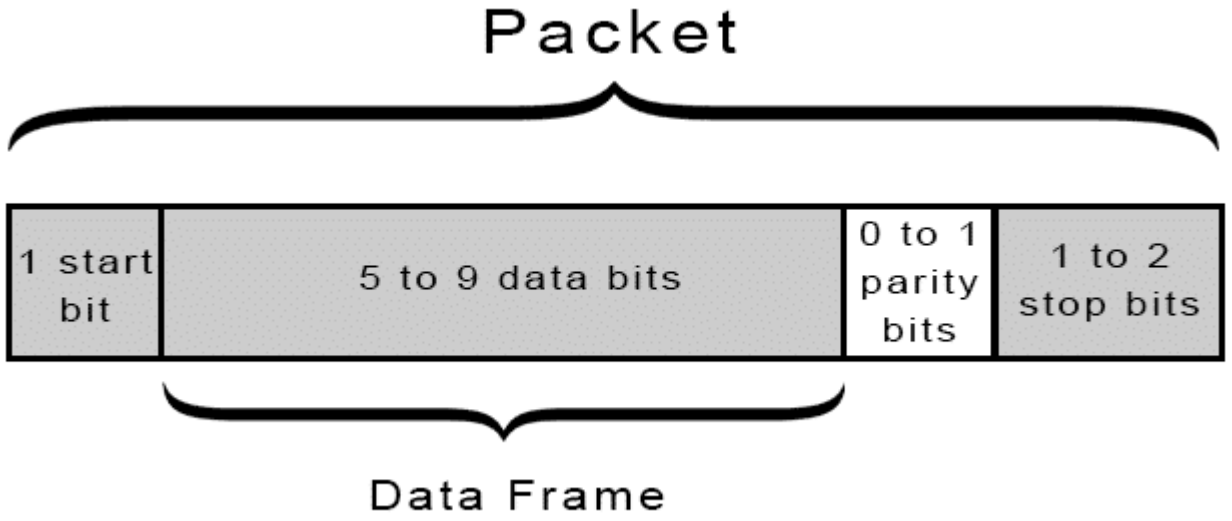
- Data transmission is an asynchronous form of serial data transmission.
- The serial communication settings (Baud rate, number of bits per byte. parity, number of start bits and stop bit and flow control) for both transmitter and receiver should be set as identical
- The start and stop of communication is indicated through inserting special bits in the data stream.
- While sending a byte of data, a start bit is added first and a stop bit is added at the end of the bit stream.

Universal Asynchronous Receiver Transmitter (UART)



TXD: Transmitter Line
RXD: Receiver Line



On-board Communication Interfaces -1–Wire Interface

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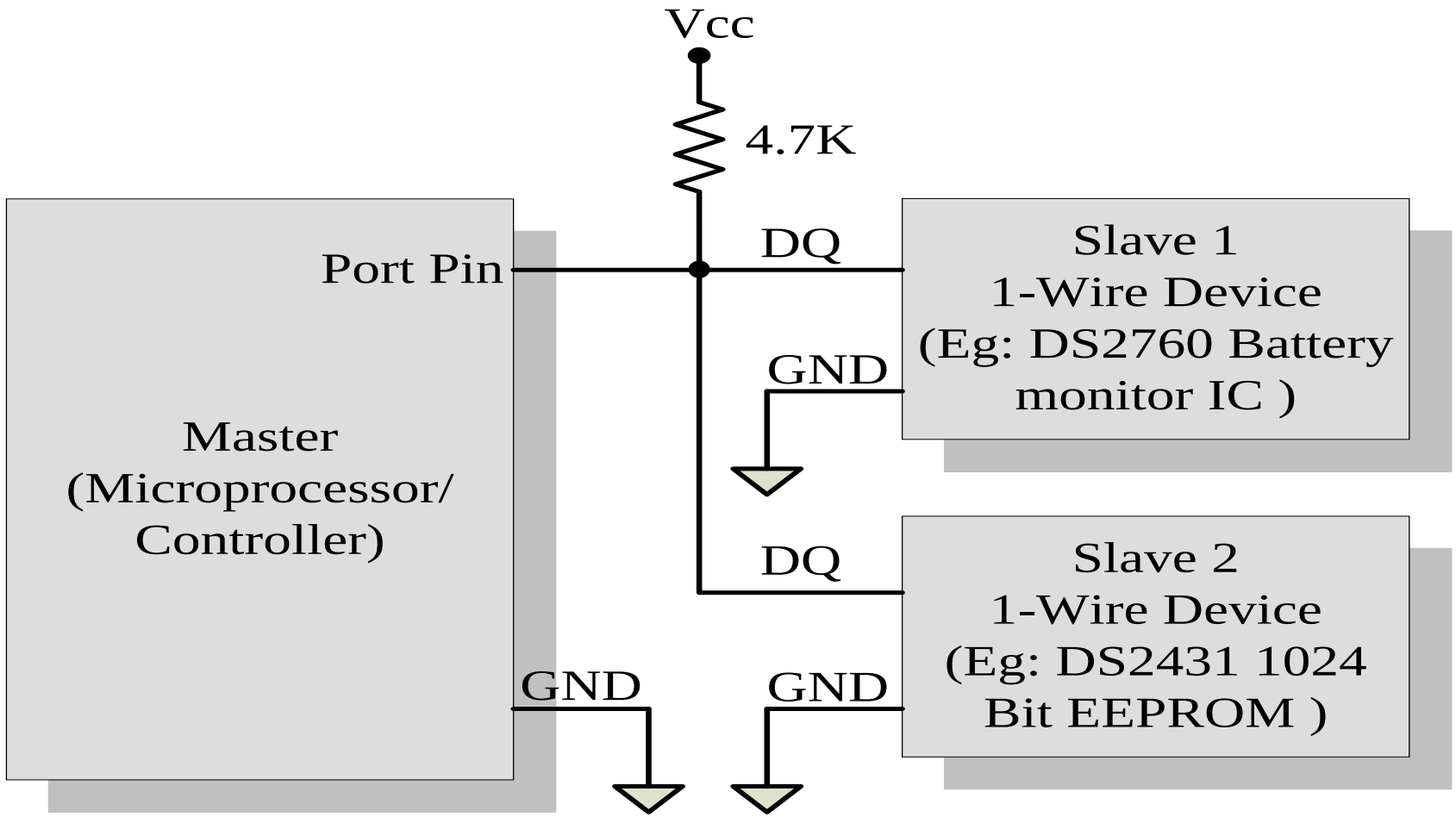
- It is an asynchronous half-duplex communication protocol developed by Maxim Dallas Semiconductor. I
- t is also known as Dallas 1-Wire® protocol.
- It makes use of only a single signal line (wire) called DQ for communication and follows the master-slave communication model.
- The l-wire interface supports a Single master and one or more slave devices on the bus.

1–Wire Interface



On-board Communication Interfaces-

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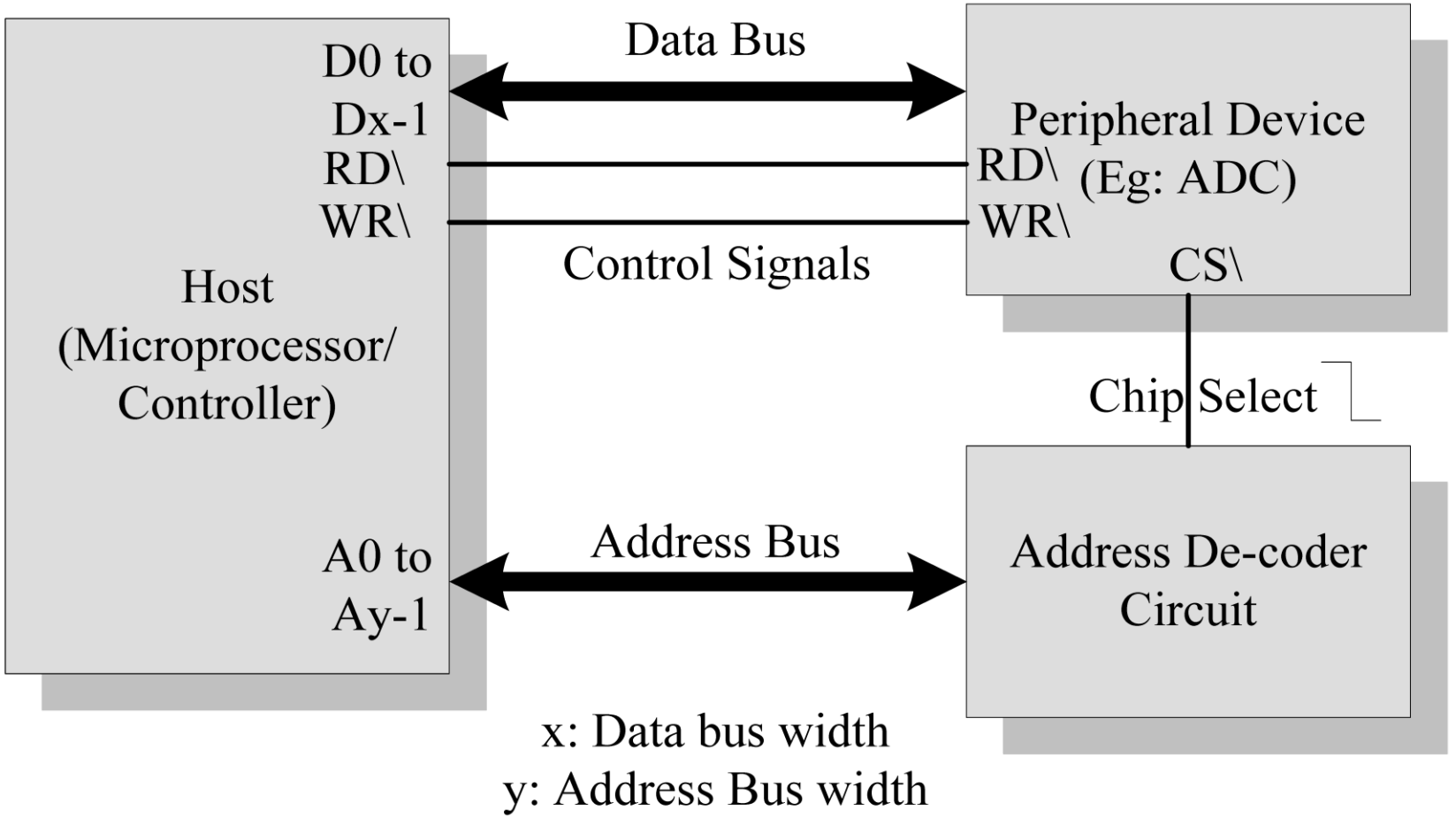
Parallel Interface

- The on-board parallel interface is normal used for communicating with peripheral devices which are memory mapped to the host of the system.
- The host processor/controller of the embedded system contains a parallel bus and the device which supports parallel bus can directly connect to this bus system.
- The communication through the parallel bus is controlled by the control signal interface between the device and the host.

Parallel Interface



Thank You