Inter Integrated Circuit (IIC)
(I2C Protocol Basics)

- I2C (Inter connected IC)

- Developed by PHILIPS SC. (low cost and simple interface, easy to use, used for simple interconnect)

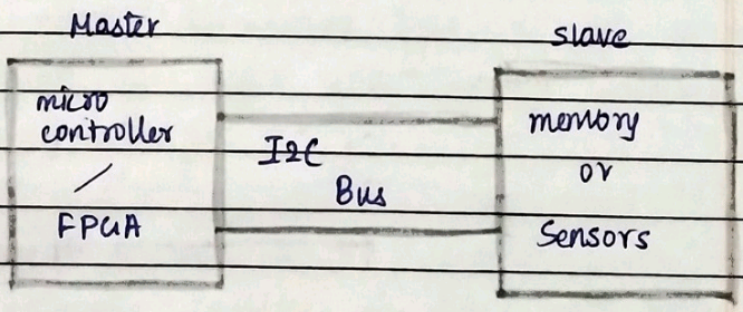
- Used to send data between microcontrollers and peripherals like EEPROM, RTC, SENSORS, SD CARD, LCD, RFID CARD MODULE, consumer electronics.

- It is a serial communication protocol

- Max speed 5 Mbps.

- Important bus used in consumer electronics.

eg:



- It is a simple bus having 2 wires for data communication.

- SCL : clock signal line (serial clock used for data communications)
- SDA : data signal line (Serial Data)

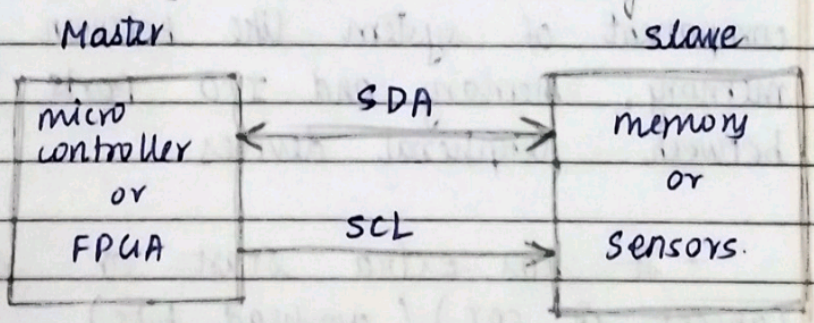
- It is half duplex. (either master or slave can send data at same time through SDA line). Either read or write operation possible via bus at a single time.

- Transmitter : A device that sends data to the bus. It can either put data on the bus of its own or in response to a request from another devices.

- Receiver : A device that recieves data from bus.

- Master : The one which initializes the transfer, generates clock signal, terminates the transfer.

half duplex → one way communication
full duplex → two way communication



⟷ Master can put data on SDA line or slave can put data.

⟶ Only master can generate the clock.

- It's normally used for short distance communication (communication within same circuit board).

- It supports multi master means here many devices can access the I2C bus at a given time with arbitration process (it decides which devices act as master in multi master system). Slaves takes instruction from master

- Adding new slave is easy. Add slave device without adding a new slave select line unlike SPI. It is the advantage.

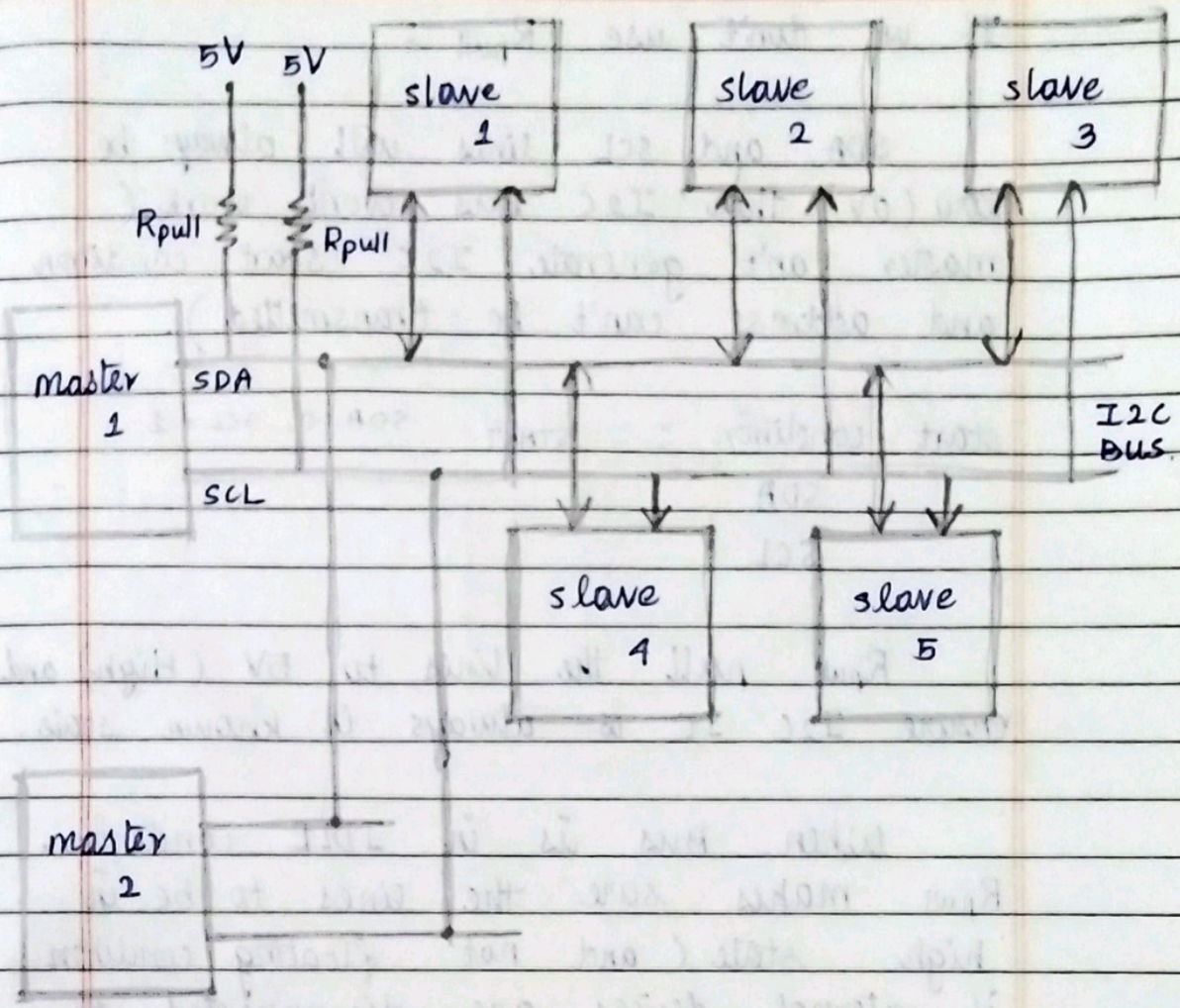
- I2C is slower than SPI (5Mbps, 10 Mbps)
- I2C uses a pull up resistor
- It preferred where large amounts of high speed data is not transferred.

- This bus is used to connect component of system like between CPU and memory, memory and I/O ports or between peripheral devices.

- It has extra start or stop bit (absent in SPI) (overhead bits).

$R_{pull} \Rightarrow$ 1.8 kΩ, 4.7 kΩ, 10 kΩ } commonly used values for pull up resistor

In a multi-master system, at a time usually only one master access the slave.

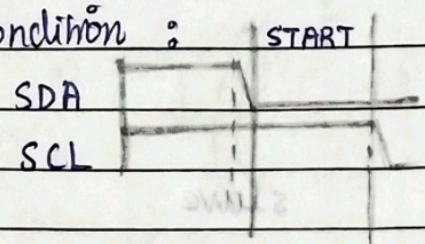


Block Diagram for I2C protocol
- Multi-master and 5 slaves.

If we don't use R_{pull} :

SDA and SCL lines will always be low (0V) then I2C bus won't work (master can't generate I2C 'start condition and address can't be transmitted).

start condition :

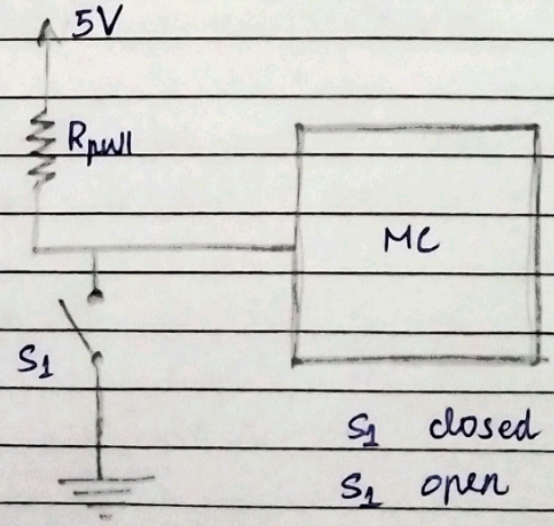


SDA=0, SCL=1.

R_{pull} pull the lines to 5V (High) and ensure I2C IC is always in known state.

When Bus is in IDLE condition, R_{pull} makes sure the lines to be in high state (and not floating condition if external devices are disconnected or high 'z' is introduced.

It prevents undefined state at input.



S_1 closed → gnd

S_1 open → undefined state.