4.3 I/O PINS, PORTS AND CIRCUITS

I/O PORTS AND CIRCUITS

Each port of 8051 has bidirectional capability. Port 0 is called 'true bidirectional port' as it floats (tristate) when configured as input. Port 1, 2, 3 are called 'quasi bidirectional port'.

Port-0 Pin Structure

Port -0 has 8 pins (P0.0-P0.7) and its structure is shown in Figure 4.3.1.

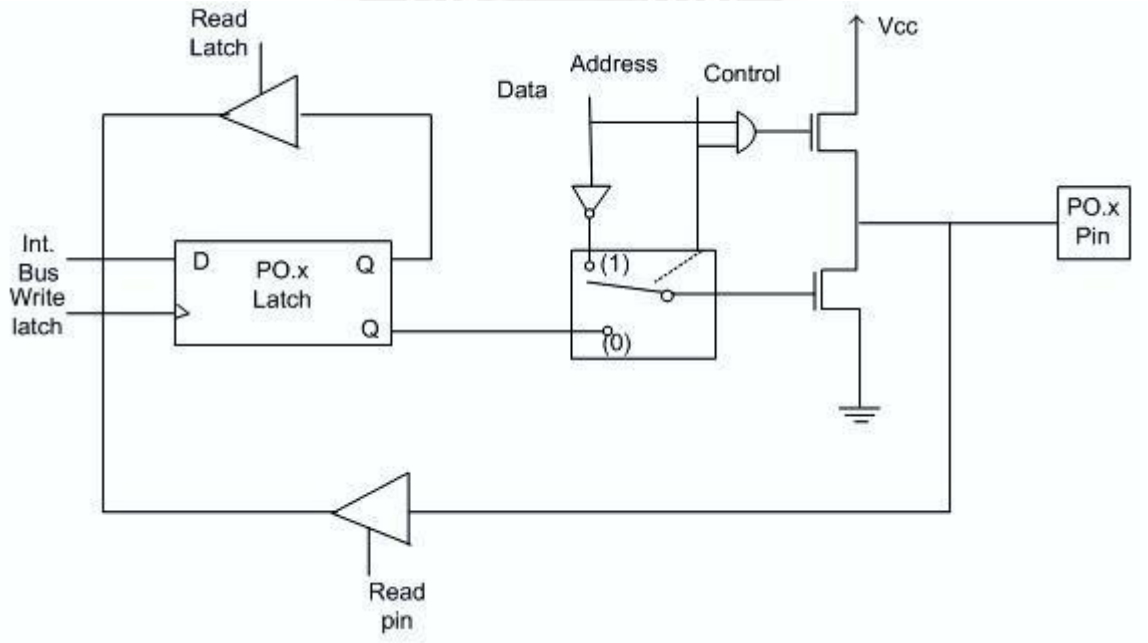

Figure 4.3.1 Port-0 Structure

[Source: "The 8051Microcontroller and Embedded Systems: Using Assembly and C" by Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay , pg.no.581]

Port-0 can be configured as a normal bidirectional I/O port or it can be used for address/data interfacing for accessing external memory. When control is '1', the port is used for address/data interfacing. When the control is '0', the port can be used as a normal bidirectional I/O port.Let us assume that control is '0'. When the port is used as an input port, '1' is writtento the latch. In this situation, both the output MOSFETs are 'off'. Hence the output pin floats. This high impedance pin can be pulled up or low by an external source. When the port is used as an output port, a '1' written to the latch again turns 'off' both the output MOSFETs and causes the output pin to float. An external pull-up is required to output

a '1'. But when '0' is written to the latch, the pin is pulled down by the lower MOSFET. Hencethe output becomes zero.

When the control is '1', address/data bus controls the output driver MOSFETs. If the address/data bus (internal) is '0', the upper MOSFET is 'off' and the lower MOSFET is 'on'. The output becomes '0'. If the address/data bus is '1', the upper transistor is 'on' and the lower transistor is 'off'. Hence the output is '1'. Hence for normal address/data interfacing (for external memory access) no pull-up resistors are required.

Port-1 Pin Structure

Port-1 has 8 pins (P1.1-P1.7). The structure of a port-1 pin is shown in Figure 4.3.2 below.

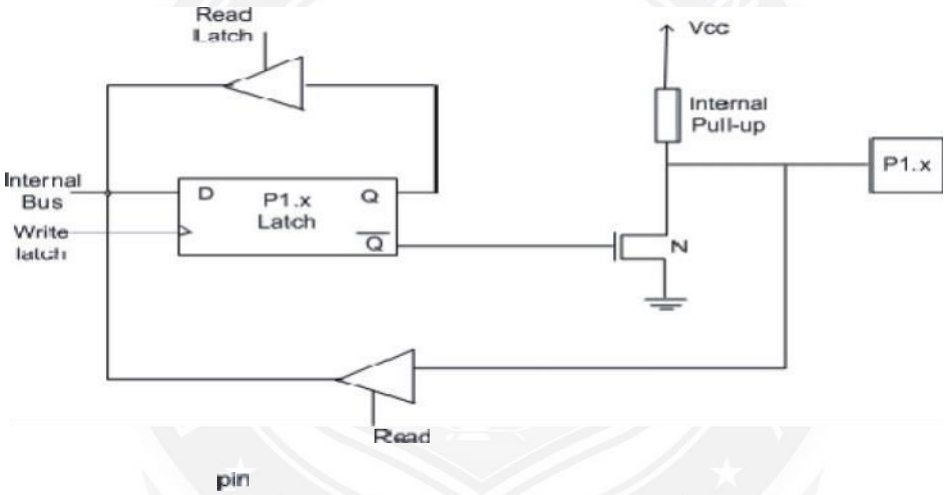

Figure 4.3.2 Port-1 Structure

[Source: "The 8051Microcontroller and Embedded Systems: Using Assembly and C" by Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay , pg.no.577]

Port-1 does not have any alternate function i.e. it is dedicated solely for I/O interfacing. When used as output port, the pin is pulled up or down through internal pull-up. To use port-1 as input port, '1' has to be written to the latch. In this input mode when '1' is written to the pin by the external device then it read fine. But when '0' is written tothe pin by the external device then the external source must sink current due to internalpull-up. If the external device is not able to sink the current the pin voltage may rise,leading to a possible wrong reading.

PORT 2 Pin Structure

Port-2 has 8-pins (P2.0-P2.7). The structure of a port-2 pin is shownin Figure 4.3.3 below:

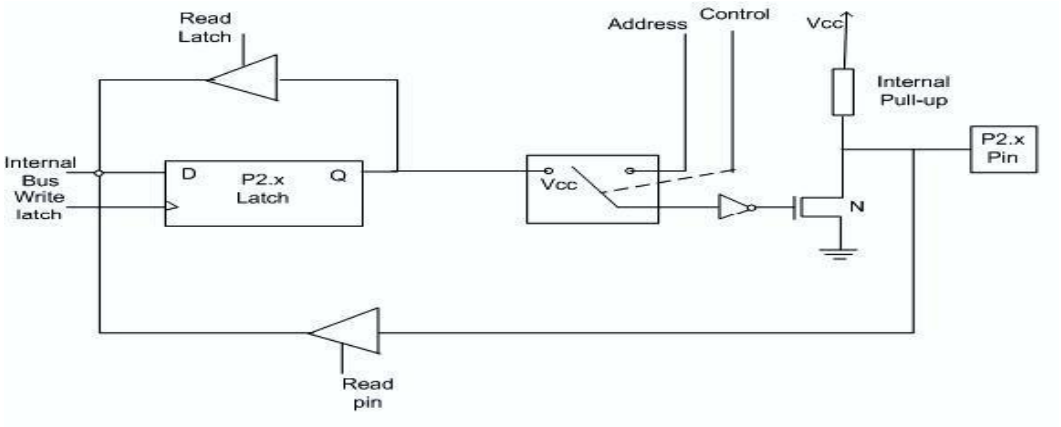

Figure 4.3.3 Port-2 Structure

[Source: "The 8051Microcontroller and Embedded Systems: Using Assembly and C" by Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay , pg.no.577]

Port-2 is used for higher external address byte or a normal input/output port. The I/O operation is similar to Port-1. Port-2 latch remains stable when Port-2 pin are used for external memory access. Here again due to internal pull-up there is limited current driving capability.

PORT 3 Pin Structure

Port-3 has 8 pin (P3.0-P3.7). Port-3 pins have alternate functions. The structure of a port-3 pin is shown in Figure 4.3.4.

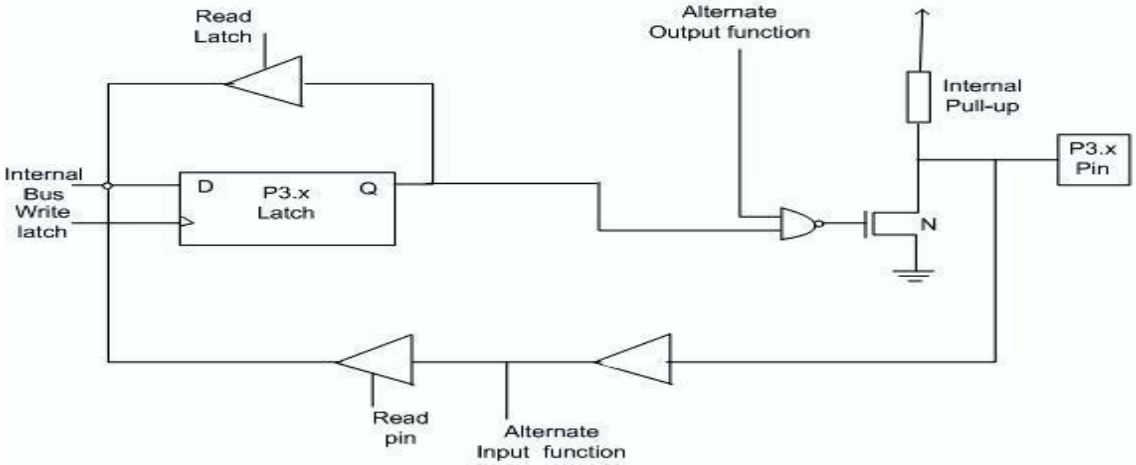

Figure 4.3.4 Port-3 Structure

[Source: "The 8051Microcontroller and Embedded Systems: Using Assembly and C" by Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay , pg.no.577]

Each pin of Port-3 can be individually programmed for I/O operation or for alternate function. The alternate function can be activated only if the corresponding latch has been written to '1'. To use the port as input port, '1' should be written to the latch. This port also has internal pull-up and limited current driving capability.