

IO_LED Component

Each bit of an IO_LED component simulates a standard light-emitting diode (LED) that would be driven by an output pin. IO_LED component bits can also simulate the operation of a toggle switch that would drive an input pin. Eight IO_LEDs are provided in this component, connecting to an 8-bit output port, with bit 0 being the right-most bit and bit 7 the left-most bit. These 8 bits can be any mix of inputs and outputs.

Setup of the IO_LED component differs according to whether it is to be used for output (LEDs) or input (switches). Right-clicking the component produces the setup window, in which two hexadecimal addresses must be specified in boxes labeled PORT and DDR.

To use the IO_LED component to display output data on simulated LEDs

- PORT: Address of the data register of the I/O port driving the LEDs.
Example: PORTA address is 0000 (or simply 0), PORTB =1, PORTE=8, PTT (Port T) =240..
- DDR: Address of the data direction register of the I/O port driving the LEDs.
Example: DDRA = 2, DDRB=3, DDRE=9, DDRT=242, etc.
- In the microcontroller, a 1 in the DDRx register configures the corresponding bit as an output pin, and values written to PORTx data register appear on these output pins. These values are displayed in the IO_LED component as Green (0) and Red (1). The values written to these two registers are also displayed as hex numbers at the bottom of the IO_LED component.
- In the IO_LED component, a 1 written to the address designated as DDR in the setup window “enables” the corresponding LED to display Red or Green. However, if a 0 is written to the DDRx register, configuring that port pin as an input, the corresponding LED will remain OFF (dark), no matter what the program writes to the data register.

To use the IO_LED component to simulate toggle switches driving input pins, the roles of PORT and DDR in the component setup window are reversed from the addresses used in the program.

- PORT: Address of the “data direction register” of the I/O port being driven by the simulated switches (IO_LED bits). In the assembly language or C program, 0 would be written to the data direction register to configure a pin as an input.
- DDR: Address of the “data register” of the I/O port being driven by the simulated switches (IO_LED bits). In the assembly language or C program, the state of the simulated switch would be tested by reading this address. Clicking on a bit of the IO_LED component will change the state of the switch from ON (Green) to OFF (dark).

Example: In the assembly language or C program, the PORTE address is 8, and DDRE address is 9. To configure bit 0 of Port E for input, the program would set DDRE = 0, and then test the states of the switch driving that port by reading a byte from PORTE and testing bit 0 of that byte.

HOWEVER, in the IO_LED component setup window, 9 should be entered as the PORT address and 8 as the DDR address.

PUSH BUTTON COMPONENT

To simulate push button switches, it is usually more convenient to use the “Push Button” component, rather than the more versatile IO_LED component. The push button component simulates 8 push buttons driving an 8-bit input port. The setup of this component requires only that the port’s data register address be specified. During program simulation, “press” a button via a mouse click (left mouse button). The push button remains pressed as long as the mouse button is held down.