

# Simple LED Project for the Electronics Explorer Board

Revision: March 10, 2011

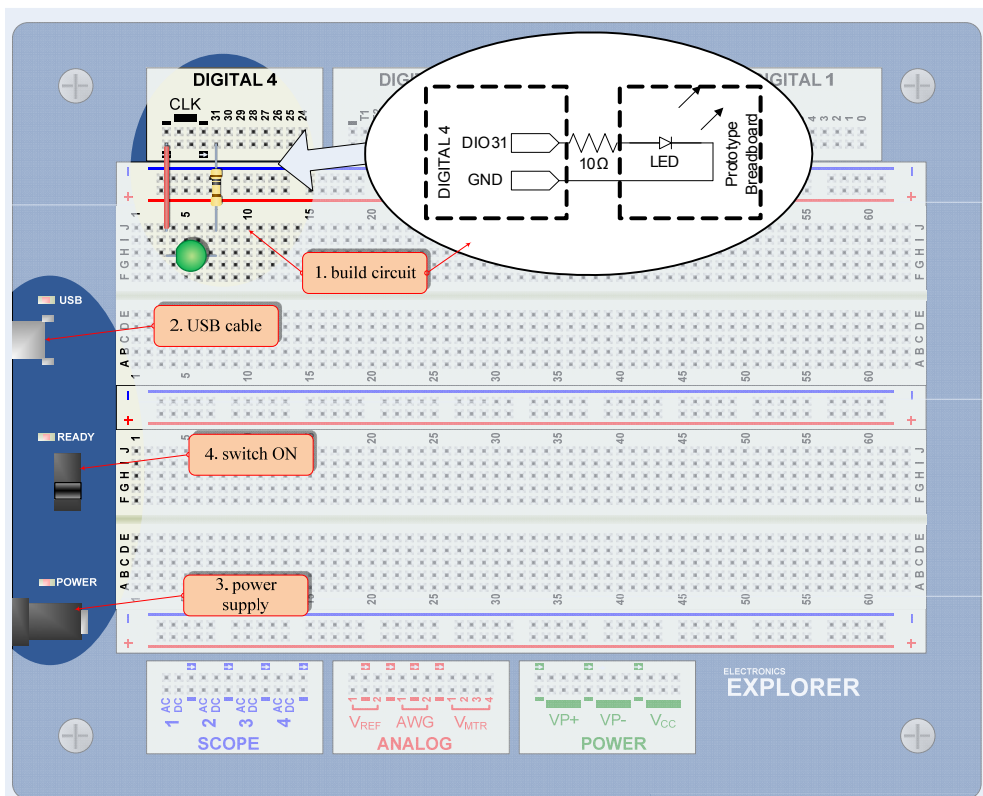
Note: This document applies to REV D&E of the board.

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This project demonstrates some basic features of the Digiilent Electronics Explorer Board. Using just a resistor and an LED, the project introduces the Static I/O and Digital Pattern Generator instruments in the WaveForms software. To keep the project simple for new users, only a few features of the software are used.

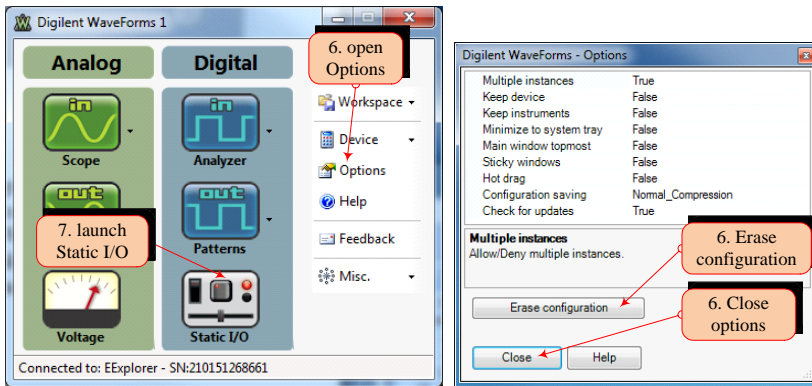
## Turn an LED on and off with the Static I/O instrument:

1. Build the schematic below.

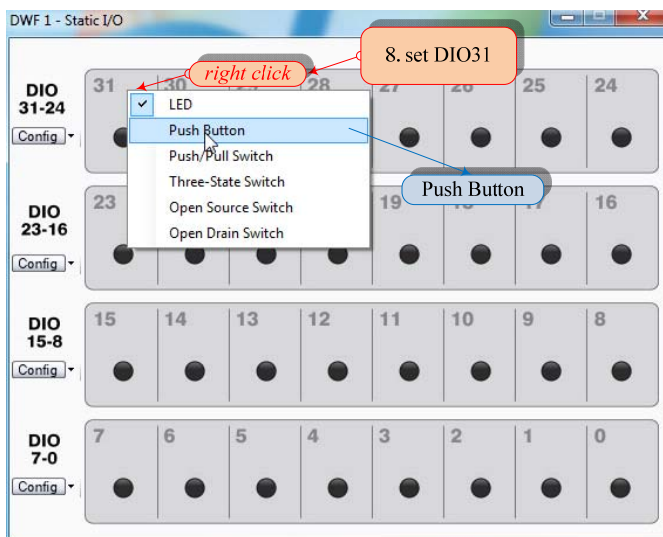


2. Connect the EE Board to the PC with a USB micro AB cable.
3. Connect the board power supply.
4. Turn the On-Off switch ON.
5. Launch the WaveForms Software.

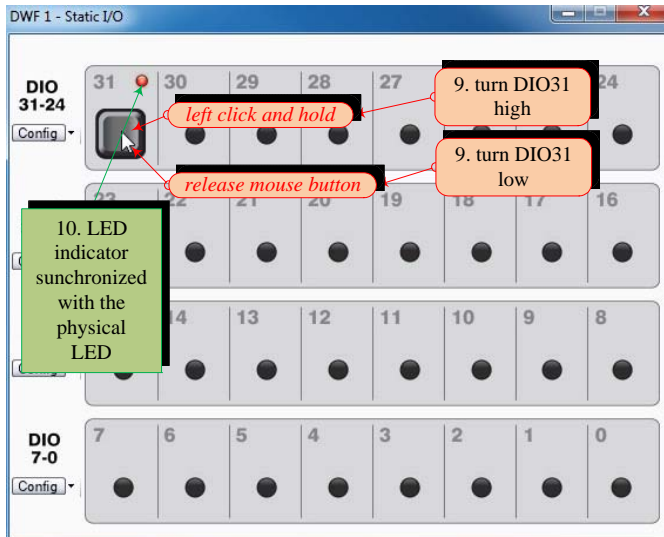
- When closing, WaveForms stores the last configuration (by default). To restore the factory default settings, click Options in the WaveForms main window, then click Erase Configuration in the Options window. Close the Options window, if it does not close automatically.



- Launch the Static I/O instrument.
- Set DIO31 as a Push Button. First right-click LED 31, then select Push Button.



9. Push and hold the button, then release.
10. Note that the physical LED (on the board) and the virtual LED (in the Static I/O user interface) light when the button is pressed. Note that a Push Button actively drives Logical HIGH and LOW levels.
11. Set DIO31 as a Push/Pull Switch. Right-click Push Button 31 and select Push/Pull Switch

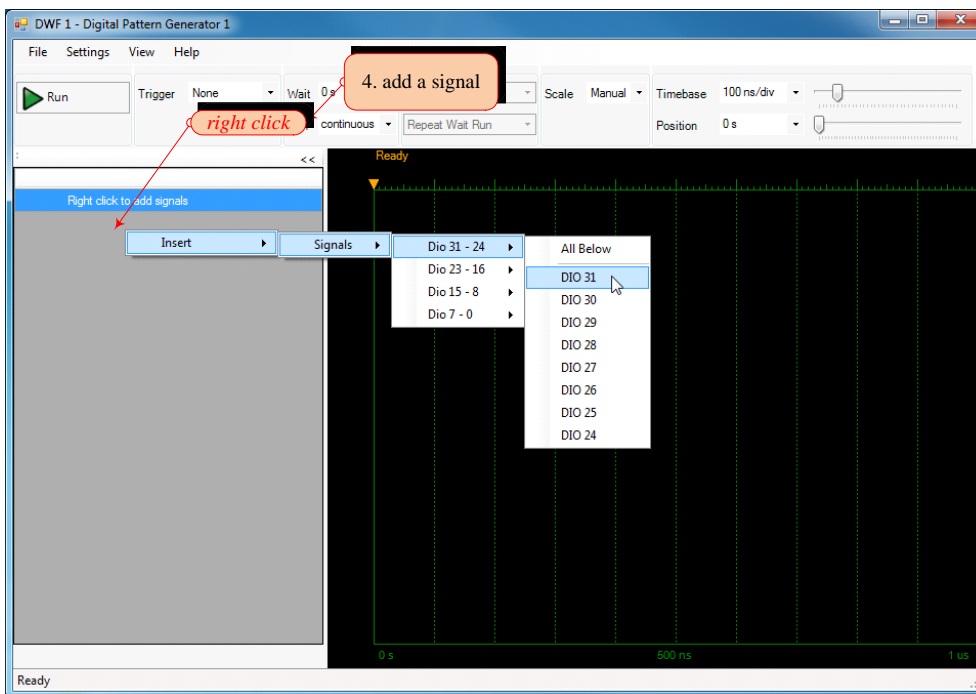


12. Click or click-and-drag the switch symbol to change it from 1 to 0. Note that the physical and virtual LEDs light when the switch is 1. Note that a Push-Pull Switch actively drives Logical HIGH (1) and LOW (0) levels.
13. Set DIO31 as Three-State Switch. Turn the Switch to 0, Z, and 1. Note that the physical and virtual LEDs light when the switch is 1. Note that a Three-State Switch actively drives Logical HIGH (1) and LOW (0) levels but can also be in a high impedance (Z) state.
14. Set DIO31 as Open-Source Switch. Turn the Switch to Z and 1. Note that the physical and virtual LEDs light when the switch is 1. Note that an Open-Source Switch actively drives Logical HIGH (1) level but can also be in a high impedance (Z) state. An Open-Source Switch is not able to drive an active LOW (0) level.
15. Set DIO31 as Open-Drain Switch. Turn the Switch to 0 and Z. Note that the physical and virtual LEDs never light. Notice that an Open-Drain Switch actively drives Logical Low (0) level but can also be in high impedance (Z) state. An Open-Drain Switch is not able to drive an active High (1) level. How should the schematic change to work with an Open-Drain Switch?

**Make an LED blink with the Digital Pattern Generator:**

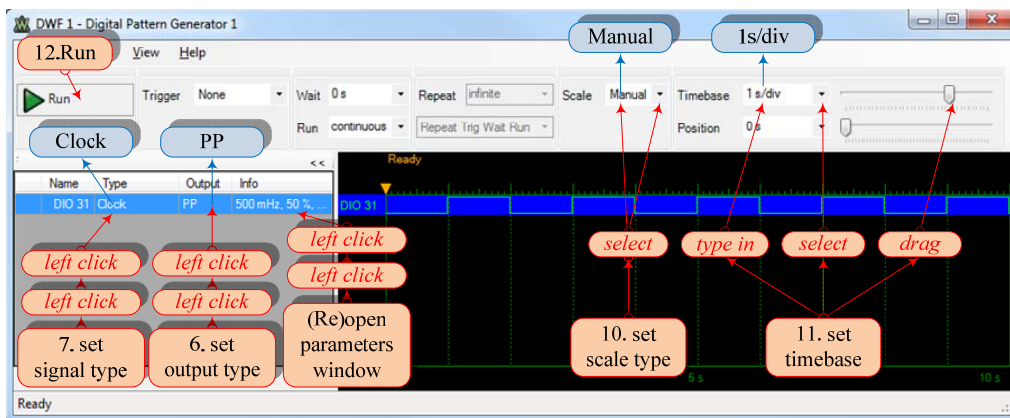


1. Use same schematic as above.
2. Set DIO31 as an LED indicator.
3. Launch the Digital Pattern Generator instrument.
4. Configure signal DIO31. First right-click the signal name field.



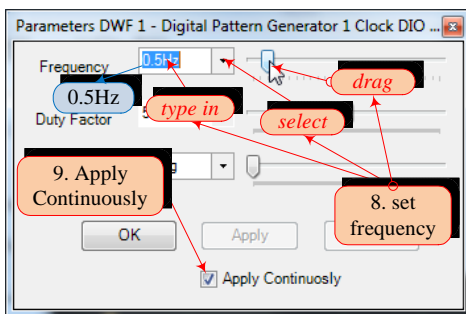
5. Then select Insert > Signals > Dio31-24 > DIO 31.

6. Change Output type from OD (Open Drain) to PP (Push-Pull).



7. Change Type from Undefined to Clock.

8. In the Parameters window, set frequency to 0.5Hz.



9. Make sure that the Apply Continuously checkbox is set.

10. In the Digital Pattern Generator window, change Scale to Manual.

11. Set Timebase to 1s/div.

12. Click Run.

13. Note that the physical LED (on the board) and the virtual LED (on the Static I/O user interface) blink for one second ON, one second OFF. Note that a Push-Pull Output type actively drives Logical HIGH (1) and LOW (0) levels.

14. Change the Output type of signal DIO31 and note the behavior of Open-Drain (OD) and Open-Source (OS) types. Set the Output type of DIO31 back to Push-Pull (PP).

15. Change the clock frequency.

16. To re-open the Parameters window (if necessary), double-click the Info field of the DIO31 signal.

17. In the Parameters window, increase the clock frequency. Click and drag the slider, and type the value or select it from drop menu.

18. Note the blink frequency for both the physical and virtual LEDs. Above 10Hz (depending on your USB port loading), the virtual LED lags the physical LED due to USB communication delays.

19. In the Parameters window, increase the clock frequency until you see the physical LED lit continuously.

20. Note the physical LED behavior when increasing the frequency above 30Hz. The human eye cannot sense individual light pulses. Instead, the pulses are integrated to seem like a luminous intensity average.
21. In the Parameters window, click the Duty Factor slider, then use the mouse scroll wheel or the keyboard up/down arrow keys to change the duty factor of the clock signal.
22. Note the physical LED behavior when changing the clock duty factor. The LED seems to change the light intensity.