Digilent Reference Design

DC Motor Drive using the X-Board and PModHB3

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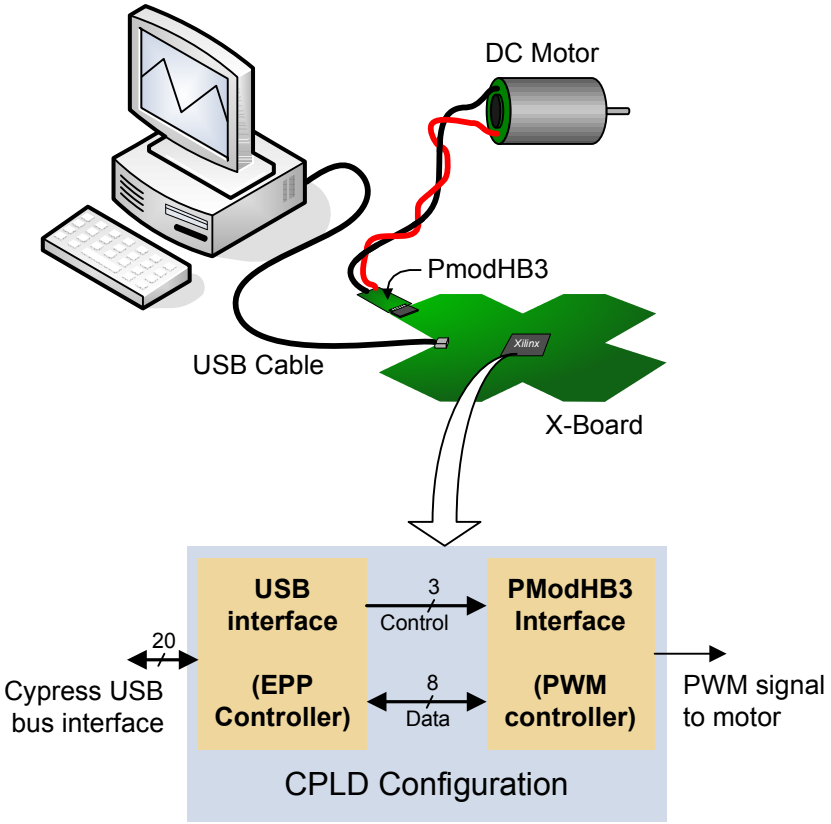
www.digilentinc.com
215 E Main Suite D | Pullman, WA 99163
(509) 334 6306 Voice and Fax

Overview

The Digilent X-board / PModHB3 reference design demonstrates driving a DC motor with PWM control from the X-board.

The X-board is a CPLD demonstration board based on a Xilinx CoolRunner-2 CPLD. The PModHB3 is a Digilent Peripheral Module board that contains a 2-Amp, 12V capable H-bridge amplifier that can be controlled with logic-level signals.

Digilent's Adept software is used to program the reference design into the CPLD, and to move PWM data from the PC to the X-board. Please refer to the Reference Manuals listed below for more detailed information.



References

Digilent X-board Reference Manual Schematic
Digilent PModHB3 Reference Manual and Schematic
Digilent Adept Reference Manual
Digilent Application Note AN0040 "Digilent Asynchronous Parallel Interface"
National Semiconductor DAC121S101 Data sheet
Xilinx CoolRunner-2 Data Sheet

Set-up

This reference design requires a PC running the Xilinx ISE or WebPack tools, Digilent's Adept software, an X-board, a Digilent PModHB3, a DC motor (5V to 12V, up to two amps), and some hook-up wire to connect the motor to the HB3 board. Suitable gear-motors are available from Digilent and from most catalog distributors.

Set the clock frequency select jumper (J11) on the X-board to select 100KHz.

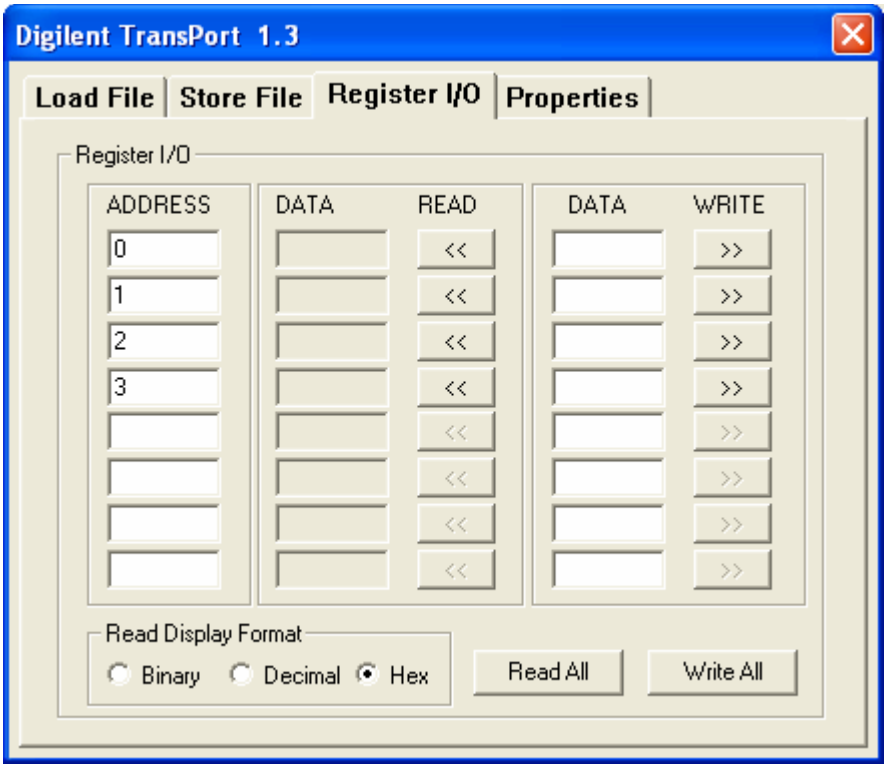
Description

This reference design is composed of two major blocks: a USB interface that implements registers in the CPLD that Adept can read and write; and a PWM controller that generates a PWM signal that can drive the H-bridge. A simple 8-bit control bus called the Digilent asynchronous parallel interface bus (based on the Enhanced Parallel Port, or EPP, specification) is used to move data internally between these two blocks.

The USB interface block works with firmware in the USB controller to implement two 8-bit registers in the CPLD. Registers can be written from the Transport application that is available as a part of Digilent's freely available Adept software (alternatively, the API's available through Adept can be used to create custom applications to access CPLD registers). Register writes are communicated from the USB interface block to the PWM controller using Digilent's asynchronous parallel interface bus. Bus timings and signal definitions closely follow the EPP specification; please see application note AN0040 available at www.digilentinc.com for a detailed description of bus timing and control.

The reference design uses two registers to control a DC motor. One register sets the PWM pulse period, and the other sets the PWM pulse length and rotational direction (both registers use 10us steps, so an entry of '3' would define a 30us period). Any PWM period that generates a PWM frequency in the 50Hz to 1KHz range can be used (for example, setting the pulse period to 100 would result in a 1KHz PWM frequency). Any pulse length can be used as well, but most motors will not start rotating until the length approaches 10% of the pulse period. The MSB of the pulse length register sets the rotational direction.

To use the reference design "as is", build a project in the Xilinx tools using the VHDL and UCF files that are downloaded from the Digilent website as a part of this reference design. Attach the PModHB3 to the J1 port on the X-board, and attach a motor to the H-bridge outputs. Program the CPLD on the X-board with the JED file created from the downloaded source files, and then run Digilent's Transport application (available as a part of the Adept software freely available at the Digilent website). Select the Register I/O tab, and add register addresses 0-1 to the address fields as shown. Add data to the "data write" boxes for address 0 & 1 to define the pulse period and pulse length. Click the write buttons to transfer data to the CPLD. Any non-zero pulse length may start the motor rotating, with longer pulse widths causing the motor to spin more rapidly.



Note that user-written, custom

applications can send sample data from the X-Board / PModHB3 hardware using the API's available as a part of Adept.

The following table summarizes the address definitions used in the reference design.

Address	Op	Data	Comments
0	Write	PWM pulse period	Defines pulse period in 10us steps
1	Write	PWM pulse length	Defines pulse length in 10us steps; MSB defines direction.