

# Setup Instructions for Propeller 1 Design Execution

## *using a DE0-Nano Development Board*

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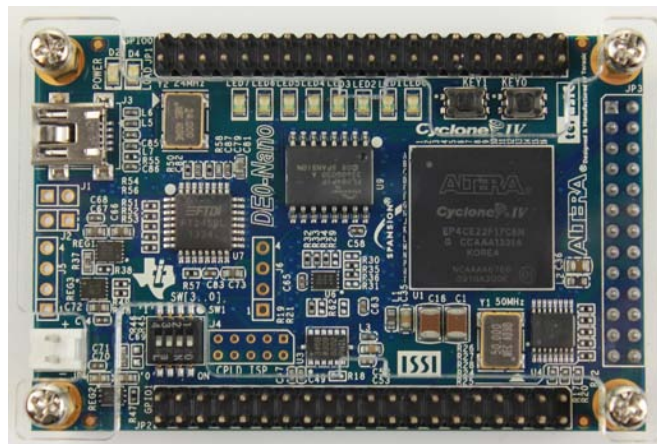
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### Introduction

The Propeller 1 (P8X32A) is the first generation of the Parallax Propeller multicore microcontroller released in April 2006. As of August 2014, the Propeller 1 is a 100% open multicore microcontroller, including all of the hardware and tools: Verilog code, Spin interpreter, PropellerIDE and SimpleIDE programming tools, and OpenSpin and Propeller GCC compilers. The Propeller 1 may be the most open chip in its class.

Parallax has opened the hardware and software source files to inspire others to learn and create (a constant key mission of Parallax), to equip and support higher education, and to invite further contributions from the community. We hope that our free software will give you the freedom to innovate with Parallax!

These instructions show you how to download and run the Propeller 1 architecture using a Terasic DE0-Nano development board.



## Parts List

For this setup, you'll need the following components:

- Windows or Linux-based computer
- DE0-Nano Development Board (#60056) plus the USB cable provided with it
- Propeller Plug (#32201)
- USB A to Mini-B cable (for the Propeller Plug)

## Install and Configure

### Install the Quartus II Software and Altera USB Drivers

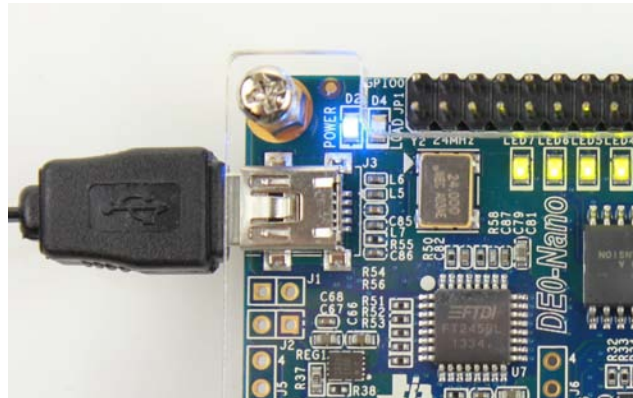
- You can choose either to download (recommended) or use the DVD...
  - The Quartus II Web Edition (<https://www.altera.com/download/sw/dnl-sw-index.jsp>)  
--or--
  - The Quartus II Subscription Edition (included on the DE0-Nano's Design Suite DVD).
- If downloading (recommended)...
  - First create a myAltera Account (required for the download process).
  - To speed up the download process, select the *Individual Files* tab and choose only the needed software files. All that is needed for Propeller 1 Design coding and execution is:
    - the Quartus II Web Edition installer, and
    - the Cyclone IV device support file.
  - Place the installer and the device file in the same folder to ease installation.
- Launch the Quartus II installer, select the defaults, then wait until installation is complete.
  - On the last screen, make sure the USB Drivers item is checked (if it exists) and make sure the *Start Quartus II* item is unchecked; we'll start Quartus II later.
    - Using Windows?
      - The USB Drivers will be "stored" but not actually installed until the "[Connect the Board...](#)" step.
    - Using Linux?
      - The Quartus II software uses the built-in `usb_device` drivers to access the DE0-Nano (via its built-in USB-Blaster circuit). By default, root is the only user allowed to use these devices. You must change the permissions on the ports before you can download to the DE0-Nano from Quartus II. See Altera's instructions here: [http://www.altera.com/download/drivers/dri-usb\\_b-lnx.html](http://www.altera.com/download/drivers/dri-usb_b-lnx.html)

### Install Propeller Plug Drivers

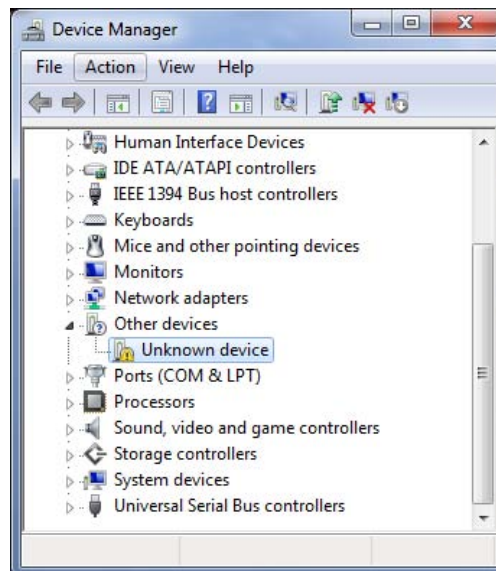
- Using Windows?
  - Download and install the Parallax USB Driver Installer; available at <http://www.parallax.com/usbdriers>.
- Using Linux?
  - Some distributions already include the proper FTDI USB Drivers. If you need to add them to your system, they are available at <http://www.ftdichip.com/>; click on the "Drivers" link.

## Connect the Board and Install the Drivers

- Using the provided USB A to Mini-B cable, connect one end to your computer and the other end to the DE0-Nano's port near the *Power* indicator.
- The DE0-Nano should power up (blue indicator lights up) and, if it hasn't been reprogrammed yet, will display a pattern of fading lights on the 8-LED display.

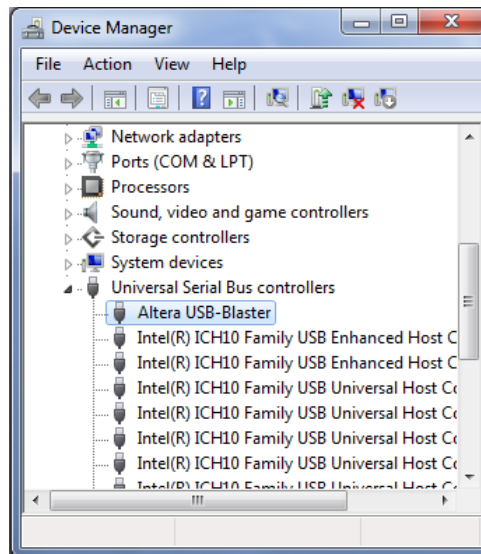


- The computer may or may not indicate that it sees a new USB connection.
  - Using Windows?
    - If the driver wizard doesn't automatically appear...
      - Press the Windows button on the keyboard (to open the start menu and search field) and type "Device Manager" into the search field.
      - Select and start the Device Manager program.
      - The DE0-Nano may show up in Device Manager as an *Other devices > Unknown device* or as *Other devices > USB-Blaster*. If so, follow the next steps.



- Right-click "Unknown device" or "USB-Blaster" and select *Update Driver Software...*
- The driver wizard will start.

- On the driver installation wizard, select the *Browse my computer for driver software* option.
- Click the Browse button and navigate to and select the “C:\altera\xx.x\quartus\drivers” folder, then click the OK button.
  - NOTE: xx.x is the Quartus software version number.
- Click the Next button.
- Windows should find and prepare to install the Altera USB-Blaster Device Driver Package. Click the *Install* button.
- After successful installation, the Device Manager should report the DE0-Nano board connection as a *Universal Serial Bus Controllers > Altera USB-Blaster*.



- Using Linux?
  - Continue to next section as long as you've [set permissions](#) for your USB-Blaster port.

## Run Quartus II and Configure Tab Preference

- Run the Quartus II software.
  - Upon first run, the license option prompt may appear. Select the *Run the Quartus II software* option and click the OK button.
- Select the *Tools > Options...* menu item, select the *Text Editor* item in the left pane, and set the *Tab size (in spaces)*: field to 4, then click the OK button.
  - The Propeller 1 source files (\*.v) require a tab setting of 4 (not Quartus II's default of 3) in order to line everything up nicely.

## Execute and Develop

### Download the Propeller 1 Design Files

- Download the latest Propeller 1 Design from the [www.parallax.com](http://www.parallax.com) website. You can find it in the DE0-Nano (#60056) product page's *Downloads* section, or by going to the *Support > Downloads* area and entering “Propeller 1 Design” in the *Download Title* field.
- Extract the Propeller 1 Design file to a folder of your choice.
  - The files in the “...DE0\_Nano” subfolder will be used by the steps below.

## Compile the Propeller 1 Design

NOTE: You only need to compile the Propeller 1 design if there is no P8X32A\_DE0\_Nano.jic file in the "...DE0\_Nano" project folder, or if you changed the hardware description source files; otherwise, proceed to the [Load the Propeller 1 Design](#) section.

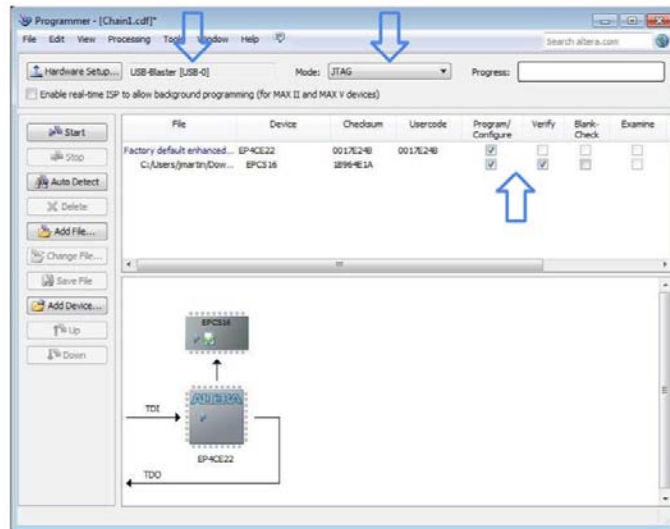
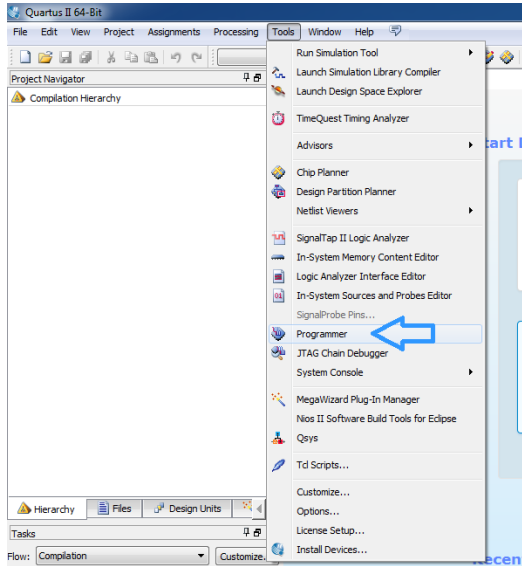
- Run the Quartus II software.
- Select the *File > Open Project* menu item.
- Browse to and select the "top.qpf" file and click the *Open* button.
- Select the *Processing > Start Compilation* menu item (or press the *Compile* (play) button).
  - This may take several minutes.
- Select the *File > Convert Programming Files...* menu item.
- Click the *Open Conversion Setup Data...* button.
- Select the "P8X32A\_DE0\_Nano.cof" file and click the *Open* button.
- If an "... older conversion file format" dialog appears, click the *OK* button.
- Click the *Generate* button.
  - A success dialog should appear, click the *OK* button.
  - A P8X32A\_DE0\_Nano.jic file should appear in the "...DE0\_Nano" project folder.
- Close the "Convert..." dialog.
- Proceed to [Load the Propeller 1 Design](#).

## Load the Propeller 1 Design

NOTE: If there is a P8X32A\_DE0\_Nano.jic file in the "...DE0\_Nano" project folder, follow the instructions below; otherwise, go back to the [Compile the Propeller 1 Design](#) section first.

- Ensure that the DE0-Nano board is connected to the computer.
- Run the Quartus II software.
- Select the *Tools > Programmer* menu item.
- On the Programmer window, click the *Hardware Setup...* button.
- Select the "Currently selected hardware" field's *USB-Blaster* item, click the *Close* button.
- Select the Mode field's *JTAG* option.
- Select line items in the *File/Device* list and click the *Delete* button to clear the list completely.
- Starting with a completely clear *File/Device* list, click the *Add File...* button.
- Navigate to the Propeller 1 Design folder that you extracted or generated earlier. Select the P8X32A\_DE0\_Nano.jic design file, then click the *Open* button.
- On the line item for the P8X32A\_DE0\_Nano.jic file, click the *Program/Configure* and *Verify* checkboxes.

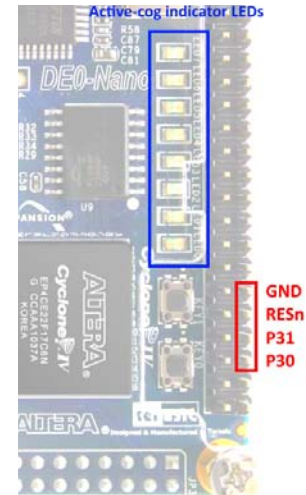




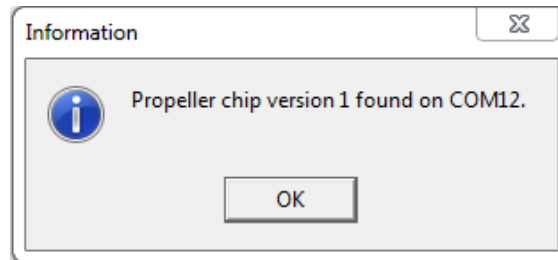
- Click the *Start* button.
- The Progress bar will update accordingly.
  - It may appear to transition quickly, then clear to blank, then transition again very slowly.
  - Be patient, this process may take a few minutes to complete.
- When the Progress bar fills green and says “100% (Successful),” the Propeller 1 Design is completely downloaded into the DE0-Nano and will start up each time the board is power-cycled.

## Load and Run Propeller 1 Applications

- Disconnect and reconnect the DE0-Nano’s USB cable to power-cycle the board and start the Propeller 1 design.
  - Alternatively, you may also power the DE0-Nano by leaving its USB cable disconnected and make a custom power connection to the connector marked JP4 according to the specifications for the DE0-Nano.
- The Propeller 1 Design will start up and will be fully-functional in a fraction of a second. LED0 will light up, indicating Cog 0 is running.
  - The eight indicator LEDs labeled LED0..LED7 will each light up to indicate when their corresponding cogs are running; 0..7 respectively.
- Connect a Propeller Plug to the DE0-Nano board (as shown) and connect the Propeller Plug to your computer via a USB cable. Be sure to plug it into exactly the right pins of the DE0-Nano’s JP1 header.



- Start the Propeller development software of your choice
  - Windows: Propeller Tool, SimpleIDE, PropellerIDE, BST, etc.
  - Linux: SimpleIDE, PropellerIDE, BST, etc.
- In the development software...
  - Select the *Identification* feature to search for and identify the Propeller 1.



- Open the desired Propeller 1 application code (\*.spin).
- Compile and download the code with the software's available options.
  - Note: There is no EEPROM built-in to the DE0-Nano for Propeller 1 use; the development software's *Load EEPROM* download features will fail for this reason. Use the *Load RAM* features instead.

## More Information

- The DE0-Nano memory constraints limit the Propeller 1 Design to less memory than in the Propeller P8X32A microcontroller; the ROM character map has been removed to accommodate this limitation.
- View the other files in the Propeller 1 Design folder(s) you extracted earlier. Some important files are listed here:
  - **P8X32A\_DE0\_Nano.png** - Image with pinouts for I/O, Prop Plug connection and LEDs.
  - **readme.txt** - (at root and project subfolders) - Supplementary notes about the project.
  - **\*.src** - Code used to generate the ROM image in the Propeller 1 microcontroller.
  - **\*.v** - Verilog hardware description of the Propeller 1. Explore and change these files in Quartus II and recompile to try out your new emulated hardware!
- Visit the Propeller 1 forum at <http://forums.parallax.com/forums/>
- Visit the Propeller webpage at <http://www.parallax.com/microcontrollers/propeller>
- Visit the Propeller Object Exchange at <http://obex.parallax.com>