

Helios Analog to Digital Guide

Diamond Systems Helios Single Board Computer (SBC)

Overview:

The Helios SBC has 16 A/D input channels and 4 D/A output channels. This SBC supports both single ended (just one input) and differential inputs (analog difference between two inputs). A/D input ranges can be set up through ± 10 volts.

Summary of the A/D system:

The Helios User Manual is an essential document for using the A/D and digital I/O on the Helios SBC.

<http://www.se.rit.edu/~swen-563/resources/helios/Helios%20User%20Manual.pdf> In this manual some of the key page numbers are:

- Page 18 has the Data Acquisition connector layout that is on the top of the Helios box.
- Use a ribbon cable to connect to the Data Acquisition connector. Be sure to look for the small arrow on the ribbon cable connector (often an embossed triangle). This is by pin 1 of the connector.
- Be careful to not use the expansion 50 pin connector.
- The Data Acquisition Register Map section begins on page 36. Be aware that the diagram may be flipped from your viewpoint when looking at the ribbon cable.
- The base address for these registers is 0x280. The entire register block is 0x280 through 0x28F.
- Note that all of these registers are 8 bit (one byte) registers.
- Note that register offsets 12 through 15 (0x0c through 0x0f) are divided into 3 pages that have separate functionality. You switch these pages by writing to the bottom two bits – see the Page Register on page 40.
- These 16 registers are further divided into a set of Read Registers and a different set of Write Registers. Hardware interfaces often use the Read/Write memory access bit as an additional address bit in effect.

QNX Development Tips:

The key concept for accessing hardware using QNX is that you must use a set of function calls to get access to the hardware and to establish a pathway through the operating system to the actual hardware. Note that the tips below are numbered!

1. Upgrade your privileges by calling the ThreadCtl QNX function. Call that function with the `_NTO_TCTL_IO` value to request access to the hardware. Be sure to check the value returned by this function to verify that the call was successful.
2. Establish one hardware register channel for each register you will be using. Use the `mmap_device_io` QNX function to establish a channel to one register. The value returned is a handle to that one 8 bit register. With that handle you can do both input (read) and output (write) operations.

A/D Software Tips:

This section provides specific guidance on what you need to do in order to successfully use the A/D functions in the Helios SBC. You will need to refer to the Helios User Manual for the details on the bit settings and register definitions.

Initialization:

You will need access to these registers:

- Command Register (which also gives you read access to the A/D LSB register)
- A/D MSB Register (which also gives you access to the Page Register)
- A/D Channel Register
- Analog Input Gain and Scan Control Register
- Interrupt / Counter Control Register
- A/D Mode Configuration Register (note that this register is on Page 2). See page 51 of the User Manual.

Single ended bipolar range setup:

This is a little tricky because you must switch pages to access the A/D Mode Configuration Register.

1. Set the Page Register to page 2.
2. Set the A/D Mode Configuration to single ended bipolar operation.
3. Set the Page Register back to page 0.

Remaining Initialization:

- Clear the Command Register (be sure to not start a new A/D conversion).
- Set the gain to use the 10 volt range.
- Set the AINTE bit to off (no interrupts) since polling mode works well for this project.
- Select the desired A/D input channel by setting the low and high channels in the A/D Channel Register. Set the high and low to the same number to only use one channel. Be sure to wait for that channel selection to take effect. You are expected to use the status register to do this wait.

Performing a Reading:

Use the command register to start a measurement and use the status register to wait for the reading to be available. Then read the LSB register followed by the MSB register. Be sure to read the LSB first because reading the MSB clears the reading from both registers.

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