Construction of electronic systems

Exercise 4: USB DAQ project
Buses, harnesses and footprints

A Bus and a signal harness

Tasks 1 and 2 – creating a bus and a signal harness

Just to make the tasks clear, let's look at the bus and harness that you need to add from the "top sheet" perspective (see the figure below, the red parts). As you can see, the bus will connect signals from the microcontroller to the I/O connector directly, while the signal harness will connect the differential analog signals from the I/O connector to the input amplifiers first and then from the amplifier outputs to the microcontroller analog-to-digital converter. Do not forget to watch the video lecture about using signal harnesses.

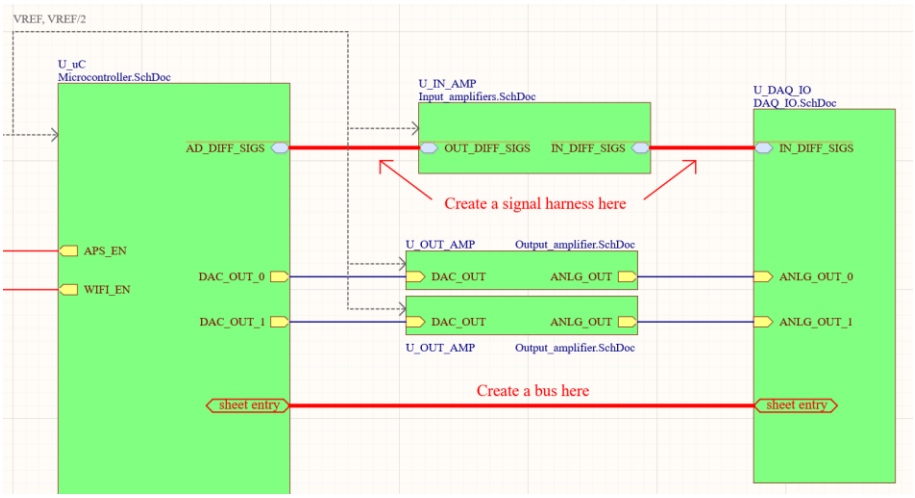

Figure 1 – the missing bus and signal harness as indicated in the top project schematic (the red parts)

About the difference between a bus and a signal harness

In case of the digital inputs/outputs `PIO1...PIO7` that the DAQ card provides, we actually have a *series of "equivalent" signals*. By "equivalent" we mean that, for example, the signal `PIO2` is as "equally important" as the signal `PIO5`. In such a *series* of "equivalent" signals we often distinguish these signals by using some kind of *numbering*. In our case, these signals are numbered from 0 to 7. And in case where we have a series of numbered signals, we can use a bus to represent such a group of signals.

If a bus is used to join "equivalent" signals, the signal harness offers quite the opposite. A signal harness can be used to *join signals* of a *completely different types into a single group of signals* that are *"traveling" in the same direction*. As such, a harness offers us to reduce the number of visible connections used in a schematic and at the same time still emphasize the signal path. On the other hand, using the "invisible" net label connections also reduces the number of wire connections but the signal path is invisible and not emphasized.

In our case you will create a so-called *nested signal harness*. This means that you will first *join signals for each differential pair into a single signal harness*. Then, on the "second level", you will join these signal harnesses into a single signal harness, containing all four differential pairs.

Note that you can ***use the same*** *signal harness* ***definitions*** for the differential signals at the connector input (U_DAQ_IO module), in the analog part (U_IN_AMP module) and for the A/D converter differential signals (U_uC module).