# Evaluation of the Altera™ DE3 Platform for EECS150

# Farzad Fatollahi-Fard University of California: Berkeley Electrical Engineering and Computer Science

## Goal

The goal of this evaluation is to find a viable upgrade to the CaLinx2+ currently in use for EECS150. We would like to have a newer FPGA as well as updated peripheral to prepare students for the future. This report is evaluating the Altera™ DE3 as a possible upgrade using these criteria.

## Details

Table 1 outlines FPGA and the peripherals on the DE3 versus the CaLinx2+.

|  |  |  |
| --- | --- | --- |
|  | **DE3** | **CaLinx2+** |
| ***FPGA*** | Stratix III EP3SL150 (340) | VirtexE XCV2000E |
| ***LUTs/ALEs*** | 57K (135K) (8LUTs) | 43K (4LUTs) |
| ***RAM*** | 5Mb (16Mb) | 655Kb (Block)  614Kb (Distributed) |
| ***On Board Clocks*** | 2 × 50MHz  1 × 24Mhz | 1 × 27MHz  1 × 25MHz |
| ***Memory*** |  |  |
| ***DRAM*** | DDR2 SO-DIMM (2GB Included) | 2 × 256MB SDRAM |
| ***SRAM*** | None | None |
| ***Flash*** | None | None |
| ***Removable (Flash)*** | SD Card | CompactFlash (SystemACE) |
| ***User Level I/O*** |  |  |
| ***Slide Switches*** | 4 | None |
| ***Dip Switches*** | 8 (Tiny) | 16 |
| ***Push Buttons*** | 4 | 8 |
| ***7-Segment Display*** | 2 | 8 |
| ***LEDs*** | 8 × RGB | 8 × Red |
| ***LCD*** | None | 16 × 2 Character Matrix |
| ***Ethernet*** | None | 4 × 10/100 (PHY Interface) |
| ***USB*** | 2/3 × Host  1/0 × Device (Chosen by jumper) | 1 (PHY) |
| ***RS232*** | None | 2 |
| ***Video In*** | None | 1 × TV In (NTSC) |
| ***Video Out*** | None | 1 × TV Out (NTSC)  1 × S-Video Out (NTSC) |
| ***Audio In*** | None | 1 × Mic  1 × Stereo |
| ***Audio Out*** | None | 1 × Stereo |
| ***Temperature Sensor*** | 1 | None |

Table 1 - Comparison of DE3 against CaLinx2+   
(Parenthesis indicate bigger chip option)

## Expansion Boards

The DE3 has four 120-pin high-speed expansion ports. However, if one wants to use the DDR RAM, you lose one of the ports. There are also two 40-pin connectors, which if used, another high-speed port is lost. Therefore, you’re left with only two 120-pin high speed connectors.

The DE3 comes packaged with several expansion modules:

* THDB-ADA
  + Provides two high-speed Digital-to-Analog and two high-speed Analog-to-Digital converters
* THDB-H2S
  + Provides support for legacy Altera™ expansions
  + Adds RS232
  + Four push buttons
* THDB-H2G
  + Provides three 40-pin connectors
* MTDB
  + See Table 2

|  |  |  |
| --- | --- | --- |
|  | **MTDB** | **CaLinx2+** |
| ***Ethernet*** | 1 × 10/100 (PHY Interface) | 4 × 10/100 (PHY Interface) |
| ***PS/2*** | 1 | 2 |
| ***RS232*** | 1 | 2 |
| ***LCD Screen*** | 4.3” LCD Touchscreen  (Same as LTM; See DE2-70\_Eval) | None |
| ***Video In*** | 1 × TV In (NTSC) | 1 × TV In (NTSC) |
| ***Video Out*** | 1 × VGA (10 bit) | 1 × TV Out (NTSC) |
| ***Audio In*** | 1 × Mic  1 × Line In (Stereo) | 1 × Mic  1 × Stereo |
| ***Audio Out*** | 1 x Line Out (Stereo) | 1 × Stereo |
| ***Removable (Flash)*** | SD Card | CompactFlash (SystemACE) |

Table 2 – Comparison of MTDB against CaLinx2+

## Conclusion

From the above observations, the Altera™ DE3 is comparable to the CaLinx2+, with the added benefit of being expandable. However, our work with the Altera™ DE3 uncovered some problems with it.

* **Not much of an upgrade in I/O**

The MTDB offers a similar selection of I/O as the CaLinx2+. For example, it has VGA Video out, which is different from the CaLinx2+, but it has the same NTSC Video In. In keeping with the spirit of keeping up with updated I/O, NTSC seems like a dated standard; it would have been better if it had a newer interface (i.e. DVI). We also loose Ethernet bandwidth by having only one 100Mbps Ethernet port.

* **Too New of a Board**

As is well known, this board is fairly new to the market. So new, in fact, that Altera’s own employees hadn’t received one yet. Therefore, not much real-world testing has gone into this board. Also, it has been mentioned that they are readily willing to redesign the board for us, giving the impression that the design is not a final design. Furthermore, though redesign is a generous offer, our problems with the custom nature of the CaLinx2+ are well known, and a more industry standard board would be desirable.

* **Too Soon to Adopt**

When the board was first released to us, there was absolutely no documentation or tools to help us use the board. Over the course of a few weeks, we finally managed to acquire what seem to be working tools. However, these tools haven’t been well tested; given that according to Altera™ we are the only group with DE3 boards outside Terasic (including Altera™), there may be issues down the line that may pop up with these tools.

Also, given the fact that we will likely be designing our own custom board (i.e. Bluetooth/ZigBee support, etc.) , it will be near impossible to get the current tools to work with any custom board we design.

* **Unsuitable for a Student Lab**

The combination of the physically ungainly expansion connectors, and a user programmable (through the FPGA no less) power supply make this board extremely dangerous in a lab situation. Altera and Terasic’s generous offer to lock down the programmable power supply would help, but again lands us with a custom board. Nothing short of a complete custom board would help with the physical issues which will plague the DE3 in students’ hands, and we would expect many broken expansion connectors.

The Altera™ DE3 started off as a very promising board, offering some new and interesting possibilities, including its primary advantage over the CaLinx2+: a newer FPGA and commercial support. However, due to its novelty and physical design, it’s way too early to adopt such a board into the educational setting, and we would expect teething troubles to affect the board for quite some time to come. In short, working with it was an incredibly frustrating experience, and we have no reason yet to suspect students would find it otherwise.