Genpcb3_user_guide-02.doc

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Subject: Generic Digital Circuit Card
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This memo is a "Users Guide" to the Generic Digital Circuit Card. This quite simple card basically is a blank slate into which we can program almost any digital circuit. We typically will work with the beamline scientist, and place this card in an box enclosure (often a 1U chassis) with the desired number of input and output connectors, and LED's. Typical applications then can include:

- control and state machine circuits
- simple combinatorial logic (and/or etc)
- digital dividers, e.g. divide down the P0 clock to trigger slower equipment
- counters (scalers), summers (adders)
- interfaces with the E-BRICK.

The circuitry on the card consists of the connectors, going to CMOS driver integrated circuits (74HC245M), (0 to +5 volt signals). These drivers then input or output from an Altera field programmable gate array (FPGA). The Altera chip is a programmable gate array which can do many digital functions. The chip mounted on the board, an EPC10K40 family chip, has a large amount of room for logic. See www.altera.com. Altera releases for free the development software (called maxplus2). There is a connector on board to interface easily to the E-BRICK's parallel i/o port.

So one path is you have us do the digital design, and just deliver the complete circuitry. Another path is for you get a copy of the Altera software (Windows OS). Then you design your digital logic circuit using the graphical user interface – basically you draw a standard digital schematic. Then you compile the schematic. Altera sells a Byte blaster download cable that plugs into your parallel port. After you have compiled your design, you can download the design into the hardware chip over the Byte blaster cable. You can do this as often as you wish. The Altera chip looses the program when it looses power (this then is an easy way to reset things, or initialize things, just cycle power and reload). After you have the digital design you wish to keep for awhile, then you can burn a PROM chip (they cost about $7 each). This PROM chip is then placed into a socket on the circuit card. Now whenever power is applied, the Altera chip boots from the PROM. You cannot use the PROM and the Byte blaster at the same time. There are several people in building 401 who have a PROM burner.

These now somewhat old Altera chips can be clocked at up to 100 MHz, but typically we go slower. There is a large amount of logic space inside the 10K40 chip, one way to

quantify this is to say it can hold many human-style pages of schematics. Altera supplies an excellent digital simulator, you can simulate your designs on your PC computer, and if it works on the simulation, it will very likely work in real life. Development times can be sped up a lot this way. This circuit card is then essentially a development demo card, and there are similar products available commercially. One reason I use these type cards instead of commercial ones is that I can easily re-do the printed circuit board to add functionality as things grow. (This card has had a RS422 driver pair added to it for example).

Below is a photo of a typical unit, along with its wall cube power supply. I also attach the following files:

(1) An AutoCAD drawing of the printed circuit board **genpcb3_pcb.dwg.**
(2) An AutoCAD drawing of the box, **genpcb3_box.dwg**.
(3) An AutoCAD drawing of the electrical schematic **genpcb3_dsn.dwg.**

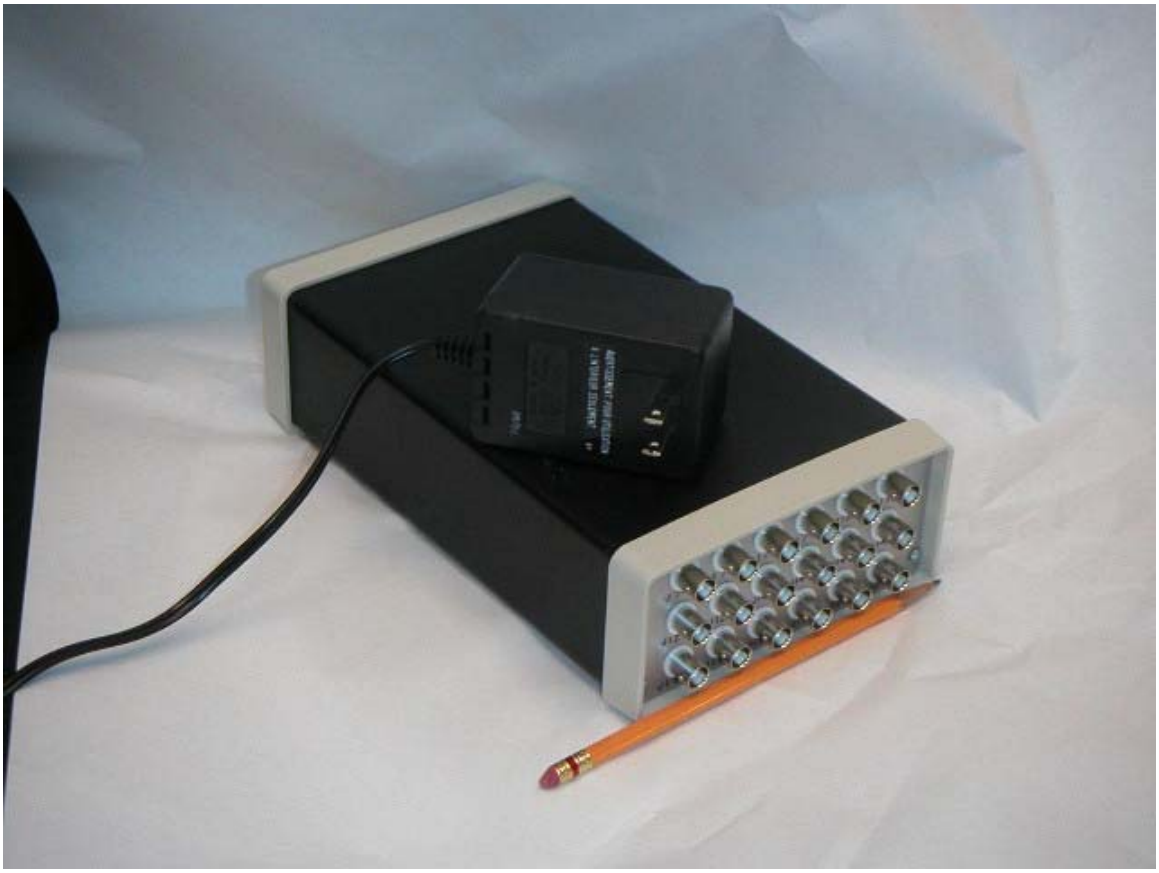


Fig 1 – photograph of the box holding the generic digital circuitry. In this version, on the front of the box are 18 BNC connectors. The box is powered by a wall cube supply.

In general we build a new enclosure to match your specific needs – what connectors you want, how many inputs, outputs, LED's etc.

FIG 2. Schematic showing Altera IC, and the various driver chips.
(GENPCB3_DSN.DWG)

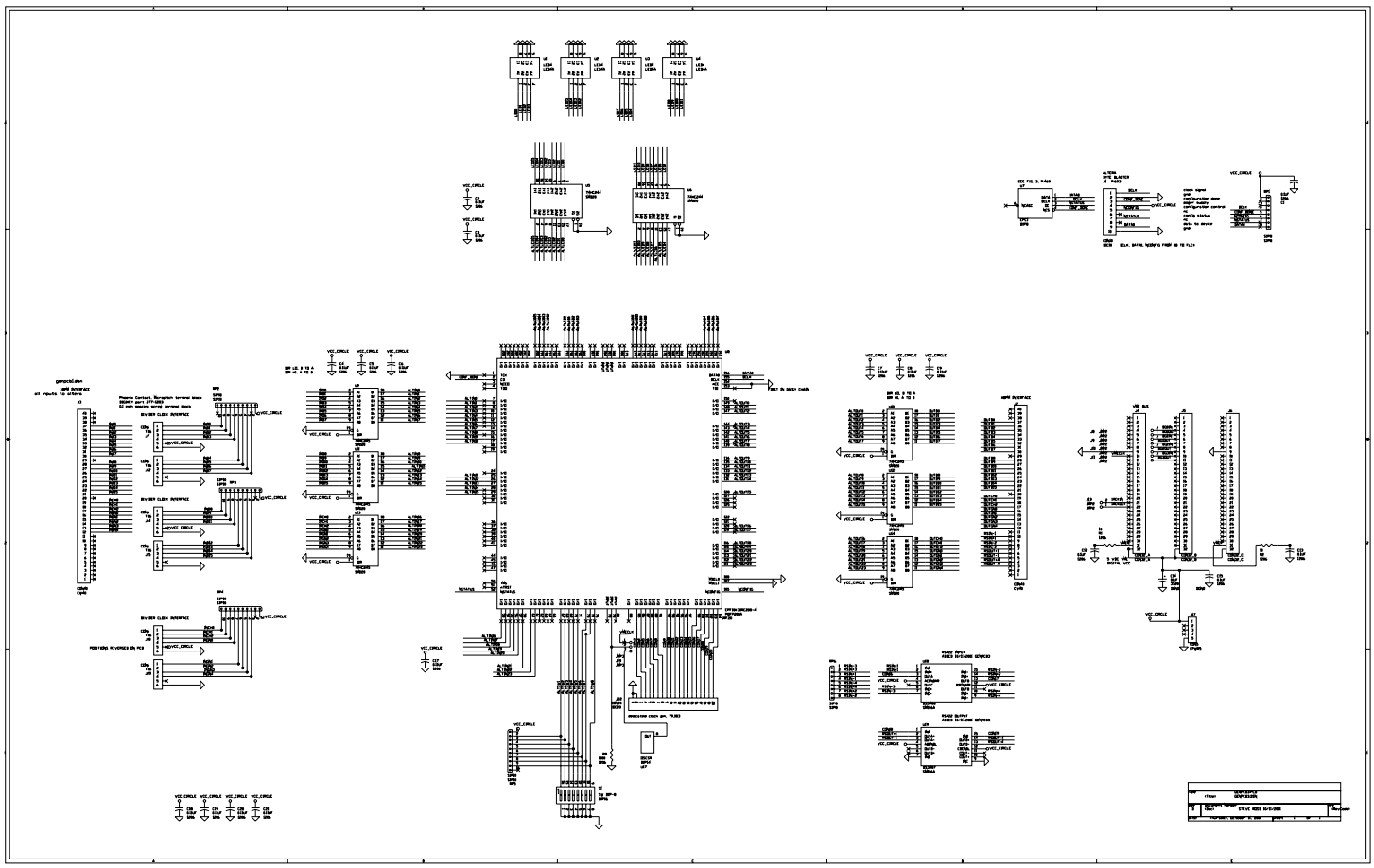
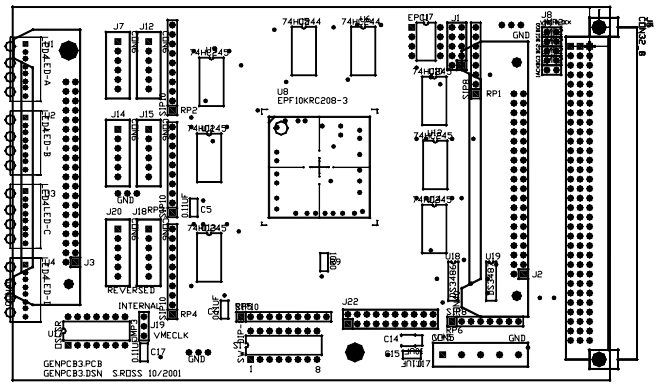


Figure 3 – layout of the Printed circuit board



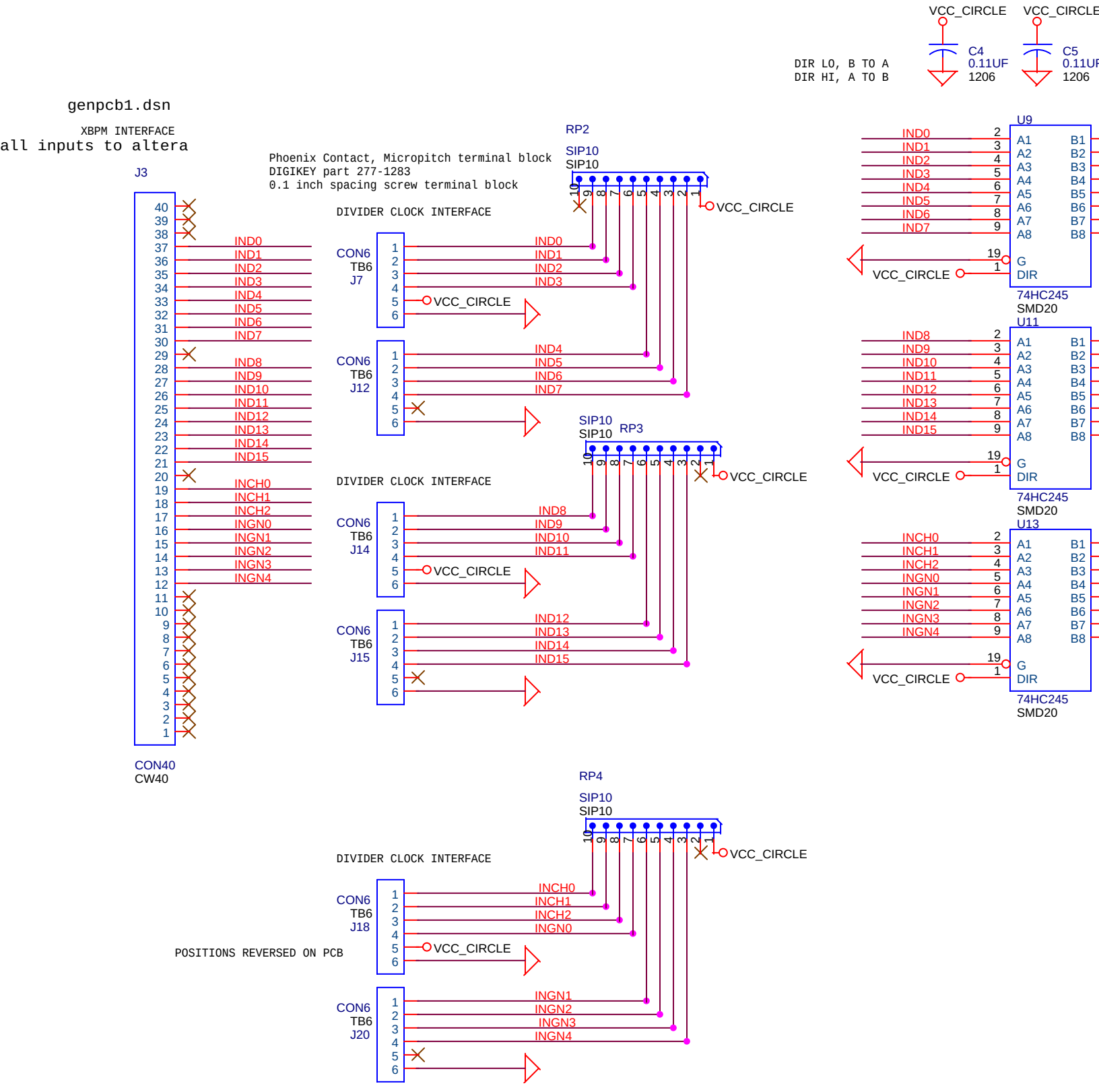


FIG 5, detail of the wiring schematic.