GA144 on a Budget?

October 26, 2013

Software Version	Date
1.0.0.0	10/26/13

Contents

1 *Historical Context*

The GA144 on a Budget project started after I took SchmartBoard's soldering class at the SVFIG Forth Day in 2011, earning a SchmartBoard|ez QFN 88 Pins, 0.4mm Pitch with a GA144 and then winning a SparkFun Breakout Board for FT232RL USB to Serial. Following GreenArray's Breadboarding on a Budget instructions, I attempted to create a hardware platform to work on. Figure 1 shows how far I got, and the rest of this document describes how I got there and why I have stopped pursuing this path toward my own destruction.
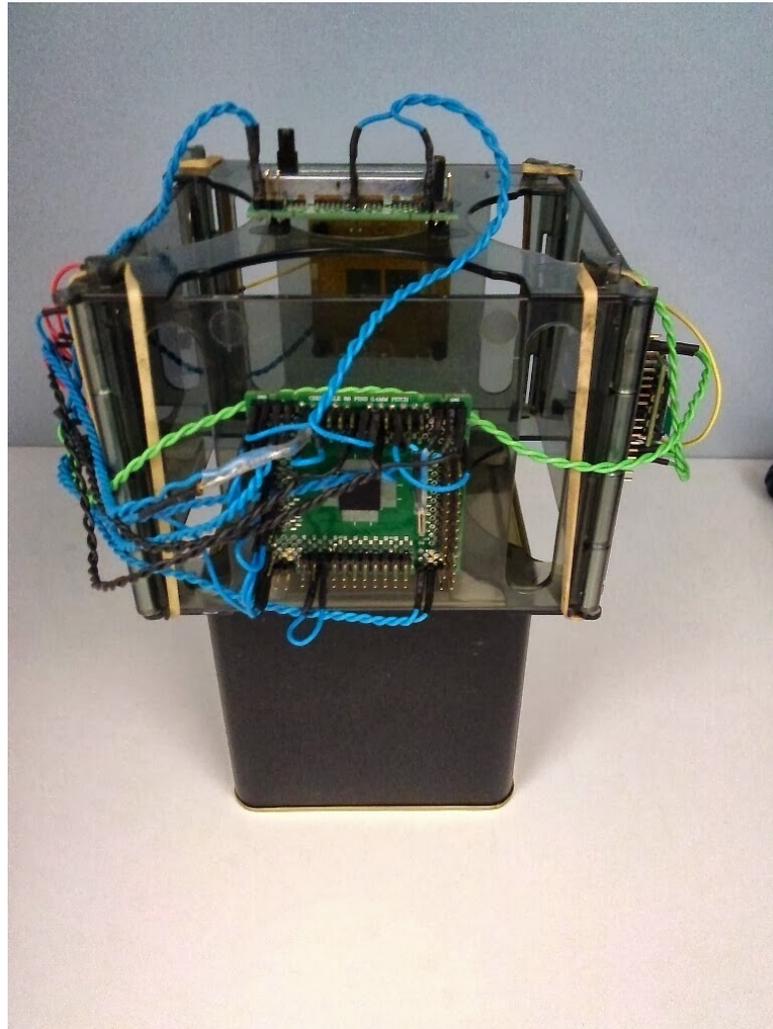
Figure 1:

2   Hardware References

Here are some links to the hardware that I am using:

`http://www.greenarraychips.com/home/documents/budget.html`

`http://www.gabotronics.com/development-boards/xmega-xprotolab.htm`

`http://www.schmartboard.com/schmartboard_pd_202-0048-01.pdf`

`http://www.schmartboard.com/schmartboard_dc_bypass.pdf`

`http://www.schmartboard.com/schmartboard_pd_201-0001-01.pdf`

`http://www.schmartboard.com/index.asp?page=products_populated&id=195`

`http://www.schmartboard.com/index.asp?page=products_services&id=444`

`https://www.sparkfun.com/products/718` Note comments for 1.8v workaround

`http://media.digikey.com/pdf/Data%20Sheets/BUD%20Industries%20PDFs/Board-ganizer.pdf`

`https://picasaweb.google.com/109296025738787385342/GA144SchmartBoard?authuser=0&feat=directlink`

`https://picasaweb.google.com/109296025738787385342/BoardGanizer?authuser=0&feat=directlink`

Figure 2 is a drawing of the power rails and decoupling capacitors on the GA144 chip

Figure 3 is a layout for mounting the xprotolab scope onto a SchmartBoard.

3   Bill Of Materials

| Qty	Supplier	Part#	Description	Unit Price	Date
2	DigiKey	VT 200F- 6PF20PPM	CRYSTAL 32.768KHZ 6PF THRU	$0.30	15Sep13
1	DigiKey	BG-32618	BOX ABS 5.00X5.00X3.50" SMOKE	$16.40	15Sep13
1	SparkFun	PRT-11248	SMD LED - Red (strip of 25)	$5.95	22Jun13
1	SparkFun	COM-11621	Slide Pot - Medium (10k Linear Taper)	$2.50	22Jun13
1	SparkFun	COM-00102	SPDT Mini Power Switch	$1.50	22Jun13
2	SchmartBoard	202-0048-02	ez QFN 88 Pins, 0.4mm Pitch w/ GA144	$34.95	27May13
1	SchmartBoard	100-0001-01	IC Hand Soldering Service	$3.00	27May13
2	Gabotronics	GT-0010	XMEGA Xprotolab	$49.00	18May13
1	American Tech Ceramics	ATC530L104KT16T	[Caps] 530L Series 10 pc Tape Snip Sample	$0.00	25Apr13
1	SchmartBoard	201-0001-01	T.H. 0.1" Spacing With 0.05" Offset, 2"	$5.00	13Apr13
1	SchmartBoard	710-0003-02	1.8 Volt Single Regulated Power Module	$10.00	13Apr13
1	SchmartBoard	920-0003-01	Mechanical Bridge - Quantity 20	$5.00	13Apr13
1	SchmartBoard	920-0006-01	Qty. 10 5" Female Jumpers and 40 Headers	$6.00	13Apr13
1	SchmartBoard	920-0007-01	Qty. 10 7" Female Jumpers and 40 Headers	$6.00	13Apr13
1	SchmartBoard	920-0012-01	Qty. 10 0.1" Spacing 40-Dual Row Headers	$8.00	13Apr13
1	SchmartBoard	920-0026-01	Kester Water Soluble Flux Pen	$8.00	13Apr13
1	SchmartBoard	920-0067-25	Qty. 5 each, 3, 5, 7, 9 and 12" Female Jumpers	$15.00	13Apr13
1	SchmartBoard	920-0081-01	Tip Tinner Cleaner	$10.99	13Apr13
1	SchmartBoard	981-0010-01	Desoldering Pump	$6.50	13Apr13
1	SparkFun	BOB-00718	Breakout Board for FT232RL USB to Serial	$14.95	19Nov11
			Total	$293.29	
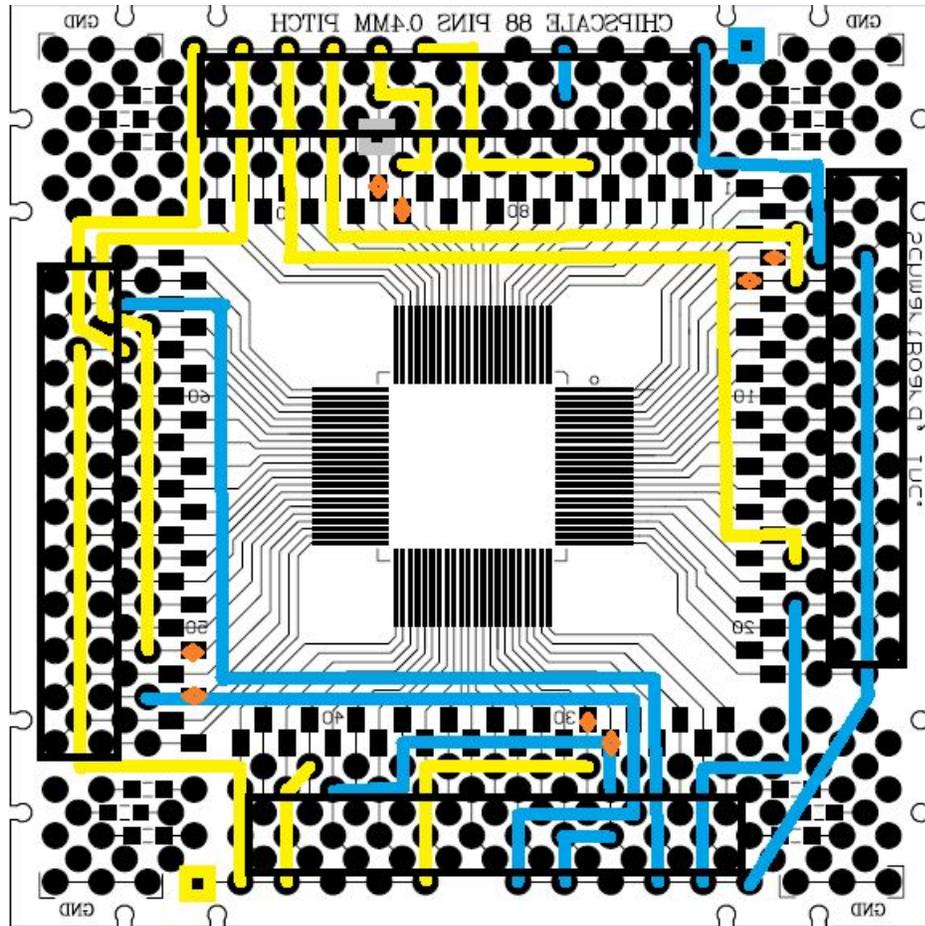
Figure 2:

Figure 3:

4 After the Facts

I am trying to recall my memory of events, after I have given up and can't even provide evidence of what I managed to accomplish, or experience. I wasn't expecting this to be such a big deal. Here's what I said on 29Sep2011 on the SVFIG mailing list:

> "So, if my math is right, $55+shipping and the price of some decoupling capacitors, and tools, and copious luck gets you a development platform."

I never expected that I would be writing this up as a postmortem.

4.1 In the beginning

As I said in the Historical Context, I earned the SchmartBoard and GA144 by soldering a chip onto "a limited edition key ring that was made with the SchamrtBoard|ez, a product that was awarded the annual "Inny" award from The Tech Museum of Innovation in San Jose, CA 2005/2006." and I won the FT232RL Breakout Board at the same SVFIG Forth Day on 19Nov11. Those parts then sat in an anti-static bag for another year, and I worked on the full GreenArrays Evaluation Board (EVB001) that SVFIG purchased using the discount certificates that Green Arrays awarded to its members. I went to Maker Faire 2012 in the Bay Area with an Initial PWM project which was marginally successful.

4.2 Dead Bug

For the 2013 Maker Faire in the Bay Area, I tried to solder the GA144 to the SchmartBoard myself. I managed to tear up a couple of the traces when I tried, but it looked like the hardware tech that I work with was able to "fix" that issue. However, I was still not getting any response from the chip. I heard about the Gabotronics XScope before the Faire and bought one on the way into the SVFIG booth. That also didn't indicate that the GA144 had any signs of life, so I asked if SchmartBoard had a soldering service and found out that it only cost $3. I highly recommend doing that. Once I got their chip, I could see that mine was ever so slightly offset.

4.3 Itsy Bitsy parts

One thing that you may notice is missing from my Bill Of Materials is a soldering iron. I already had two of them, one for high heat (i.e. automotive) applications and another for low temp DIP parts. This was probably one of my biggest mistakes, because, even though I did manage to not make too much damage soldering the power rails onto the back side of the SchmartBoard, the SMD capacitors and LEDs were impossible. Once again, my hardware tech saved the day and I now had a working board.

4.4 Portability

The Mechanical Bridges that SchmartBoard produces connects their 2" square boards together with each other and I found a 4x4x3" box that worked real good to carry my system around with me, but it was dark inside and difficult to work on without taking it out of the box. I found BUD's Board-ganizer and ordered one along with some crystal oscillators. That turned this project into a work of art. It was beautiful, but then I started to notice that it would crash quite frequently. You may have seen the Google hangout video from the 28Sep13 SVFIG meeting, where I struggled to make it work, and finally giving up.

4.5 Noisy Setup

You may notice that the final picture in Figure 1 has twisted pairs on everything that goes between boards. This still did not stop the ArrayForth IDE from showing 103ef's on the stack of a heartbeat node after some random amount of time. Sometimes it would run for hours, but never over night. Sometimes the IDE would lock up and I'd have to force it to exit and reload. I finally was just giving up, figuring I could live with it and get more of my design converted from VentureForth, but then it all just died. Static probably finally did it in, since I was not utilizing any guards against it, and the plastic case probably didn't help in that regard either. Frustrated, I tried to see if my brand new replacement XScope might help, and touched ground to 5 volts. That makes 2 of that part that I killed with carelessness.

4.6 Postmortem

I know now that I am probably not a good candidate for this experiment. I am a Computer Scientist, not an Electrical Engineer. Although, I have worked closely with hardware my entire career, I am obviously too careless about the physical constraints of this chip to be very successful working with its electronics. I can only blame myself for my failure, but I do wonder how successful 1.8v logic is going to be in a hobbyist world. I started my love/hate relationship with hardware in the automotive world, where the 50Kv spike from a spark plug will literally make your hair stand on its end. I don't know how to reconcile this chip to that world, at least not yet. I also know that GreenArrays is not happy with the distance between the chip and where the capacitors can be mounted on the SchmartBoard. So, I'm not sure there isn't a fundamental problem with this design. However, I do hope someone who is well versed in dealing with EMI issues does take this project on and figures out how to make it work. I just know that I am not that person.

5 Artifacts

A script for converting this document to PDF form and marking the output with a PRELIMINARY watermark follows:

7a ⟨*final* 7a⟩≡
```
if [ $OSTYPE != "cygwin" ]; then
   lyx -e latex Budget.lyx
   lyx -e pdf Budget.lyx
else # Either method works in cygwin, finally!
   lyx -e literate Budget.lyx
   noweave -delay -index "Budget.nw" > "Budget.tex"
   pdflatex Budget latex=pdflatex
fi
```

7b ⟨*preliminary* 7b⟩≡
```
echo "Make PDF release notes..."
final
pdftk Budget.pdf stamp Preliminary.pdf output out.pdf
rm Budget.pdf
mv out.pdf Budget.pdf
```

8   ⟨*₈⟩≡

```
echo "Extract script $1 from Budget.lyx..."
rm -f Budget.nw
lyx -e literate Budget.lyx
notangle -t4 -R$1 Budget.nw > $1
dos2unix $1
chmod a+x $1
```

Each of these scripts can be pulled out manually given the default * script defined above.