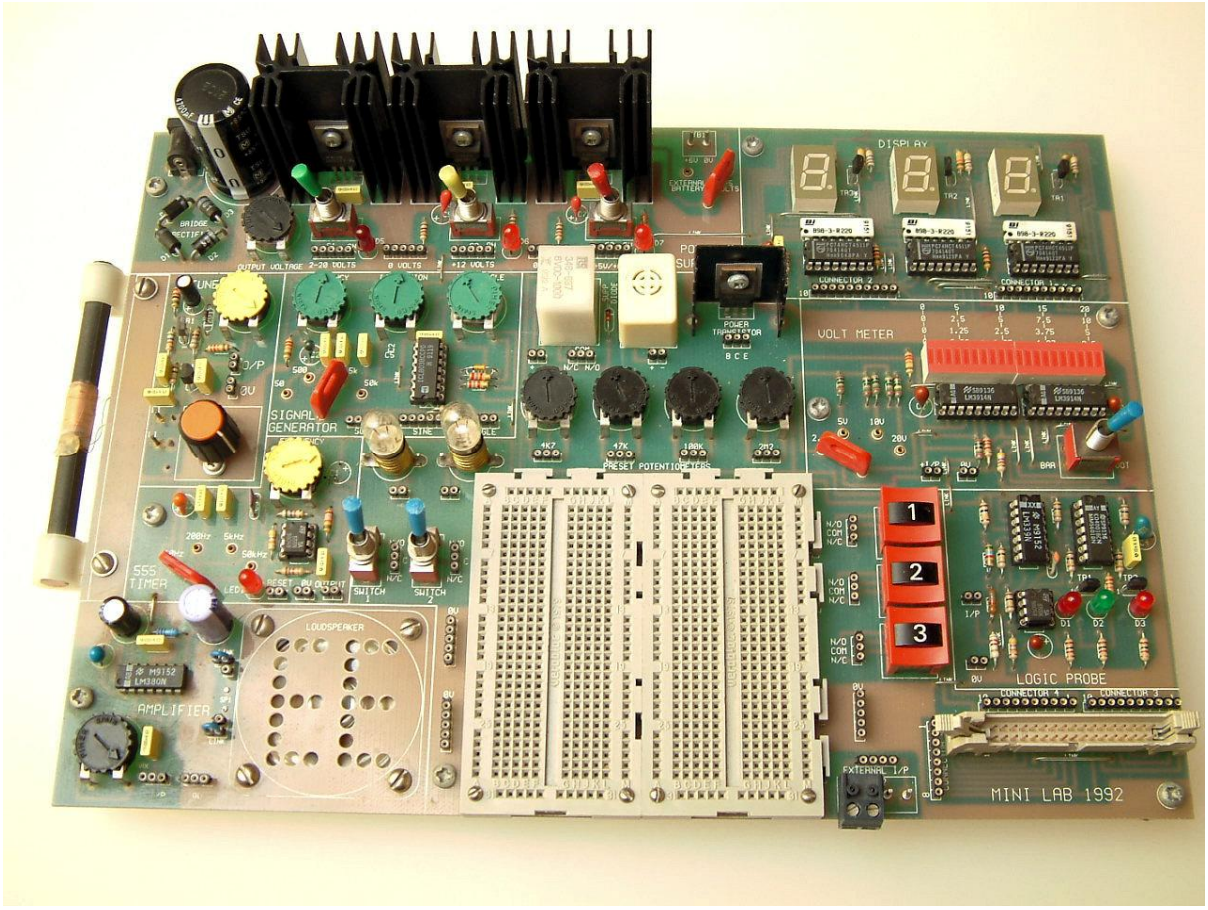
The Teach-In ‘93 Mini Lab – Project Notes

Hardware design – Keith Dye B.Eng(Tech), AMIEE



^ My own Teach-In 93 Mini Lab as used in the series, rescued from my archives. The board was divided into distinct areas, one module being used each month for that issue’s experiments. The ‘EE’ loudspeaker grille became obsolete when EPE came in Nov 1992; worse, the two Verobloc *solderless breadboards that I specified went obsolete just as publication commenced. By the way, this is the first time the Mini Lab has been seen in colour. The articles appeared in black and white.*

To create an electronics teaching aid I had the idea of a modular approach with new modules being offered to readers every month during the ten-part series. Co-writer and designer Keith Dye proposed having a large p.c.b. instead that could be completed over time. The result would an impressive and purposeful-looking electronics test bed that would add some inertia to the series: after all, no-one would want a half-completed circuit board, would they? Followers of the series would be keen to complete it!

A former Teach-In series also involved a “Mini Lab” which was built into an attaché case but it was entirely co-incidental that we adopted the same moniker for our own TI ’93 circuit board. Keith also designed and CADded the associated Teach-in 93 Micro Lab (described separately), a sophisticated 6502 single-board computer trainer with keypad, LCD and I/O designed for “A” Level students that could be powered from the Mini Lab if desired.

As the running order for Teach-In 93 took shape, I worked on the main text whilst Keith devised the Mini Lab modules that we could introduce in sync. with the core text. Keith deliberately over-engineered the Mini Lab board so that beginners who were new to soldering would have no difficulty in soldering the parts. In order to instil confidence in students and avoid disappointment the copper track pattern was made very robust, and solder resist and silk-screen printing made assembly even easier. The high-quality board would be a major success and we were delighted that there were no reports of students having hardware problems at any time throughout the series.

Making interconnections between the modules and the solderless breadboard was a very thorny problem to begin with. Keith then had the brilliant idea of using turned-pin i.c. sockets and we found that single-core 1/0.6mm wire pushed in and gripped perfectly. Thus, the last remaining problem was solved.

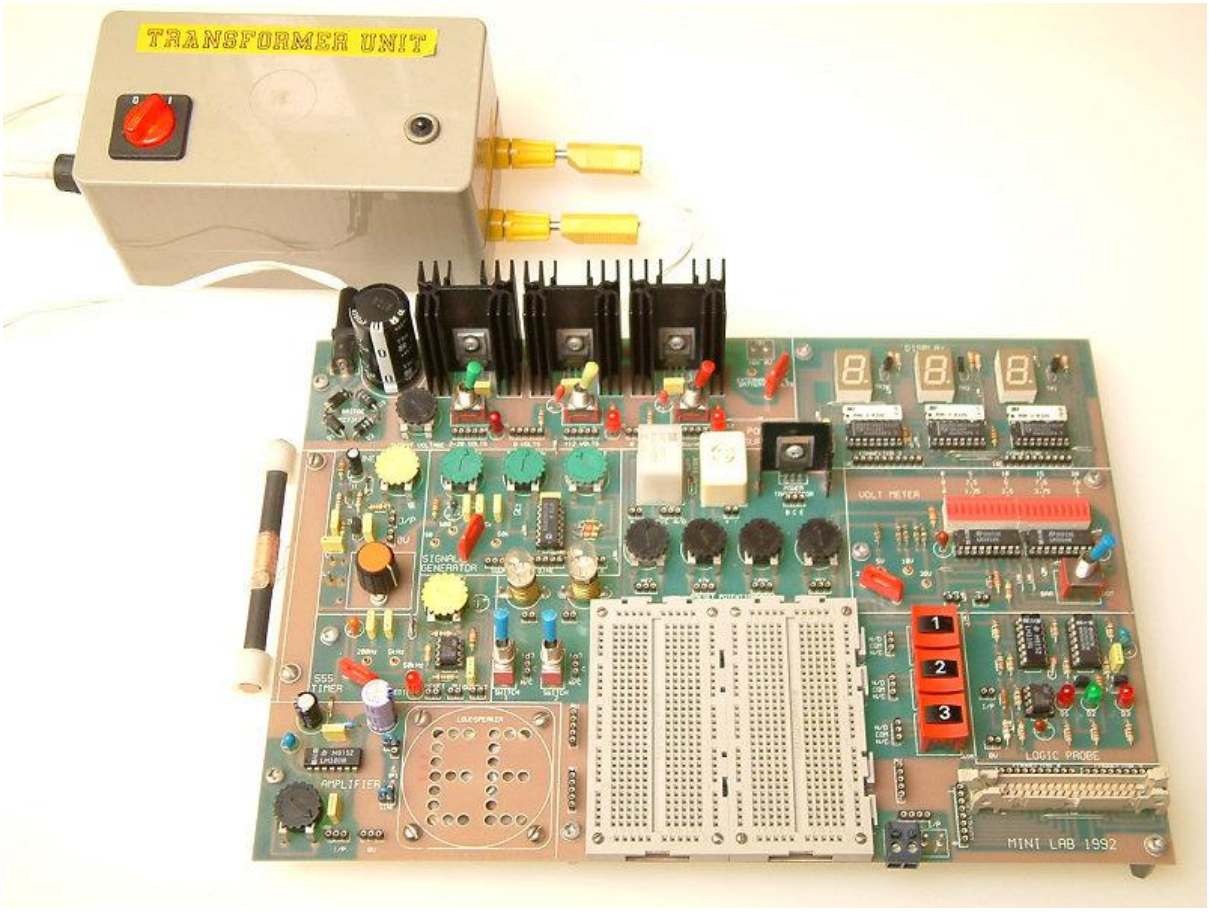
Keith had produced a roughly A4-size board split into distinct areas:

Mini Lab modules (in order of appearance)

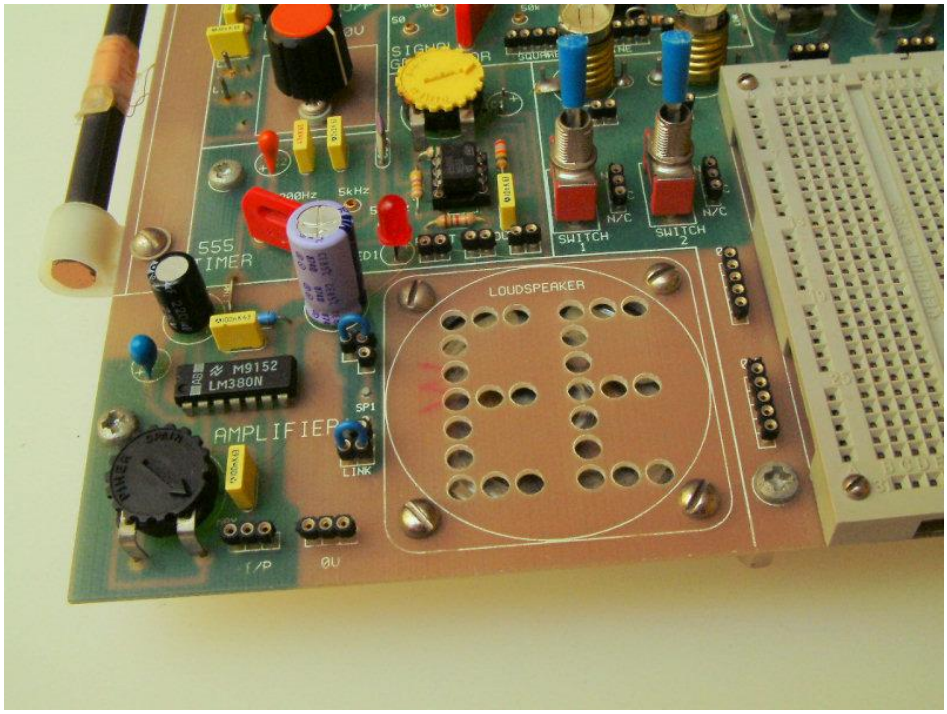
1. **Central test bed** area hosting a solderless breadboard, some toggle switches, push switches, a buzzer, relay, some preset resistors, a power transistor and two bulbholders.
2. **LED Bargraph Voltmeter** – featuring two LM3914 bargraph drivers, this had a moving dot or bar display and switchable 2,5,10, 20V ranges using a p.c.b. jumper plug.
3. **Power Supply** – a versatile PSU section that added mains power to the Mini Lab, we used a 7805, 7812 and LM317 to provide fixed and variable voltages that would power the experiments. The board carried three splendid-looking heatsinks. A separate transformer unit was encased in a plastic box and connected to the Mini Lab using an on-board d.c. power lead, which was a bit unusual at that time. It had a thermal cutout, which I demonstrated to Ed. by shorting out the transformer with a screwdriver. A smart rotary neon switch completed the PSU. I chose standard-size Piher preset resistors from Farnell because a neat thumbwheel could be clipped onto them to make a handy manual control.
4. **Signal Generator** – based on the popular ICL8038, this module offered square, sine and triangle waveforms with variable duty cycle, frequency and distortion controls. The TIP112 Power Transistor was also fitted to the Mini Lab at this time.
5. **Audio Amplifier** – a small amp. featuring an LM380 and panel-mounted speaker was fitted this month. I used a transparent mylar cone speaker to be different. Nothing we could do about that “EE” speaker grille, though...
6. **555 Timer** and **Logic Probe** – an NE555V oscillator with switchable range, and a Logic Probe with Hi/ Lo/ Pulse LEDs were added to the Mini Lab board. The Logic Probe threw some people at first, as they expected ‘no input’ to be depicted by a totally blank display, tri-state fashion.
7. **Digital Display** – to support the digital logic tutorials the display area contained three BCD-to-decimal decoder drivers using 74HCT4511 and common cathode LED digits.
8. **Radio Tuner** – the final module for the Teach-In ’93 Mini Lab was a simple radio tuner based on a ZN414Z. It could be hooked to the Audio Amp. I see that GPS got a mention in this section too, dealing with telecommunications, satellite systems and GPS, the precursor heralding things to come.

To avoid any mains voltage work early on, a simple external 4xD cell battery pack was hooked up for the initial stages, using a push-on screw terminal block. The simple plug-link system enabled users to select options using an onboard jumper plugs and it worked perfectly. Interconnections between modules and components would be made via turned-pin p.c.b. terminals (Keith’s idea), with solid core wires pushed into a terminal to hook up a module, and this idea worked very well too.

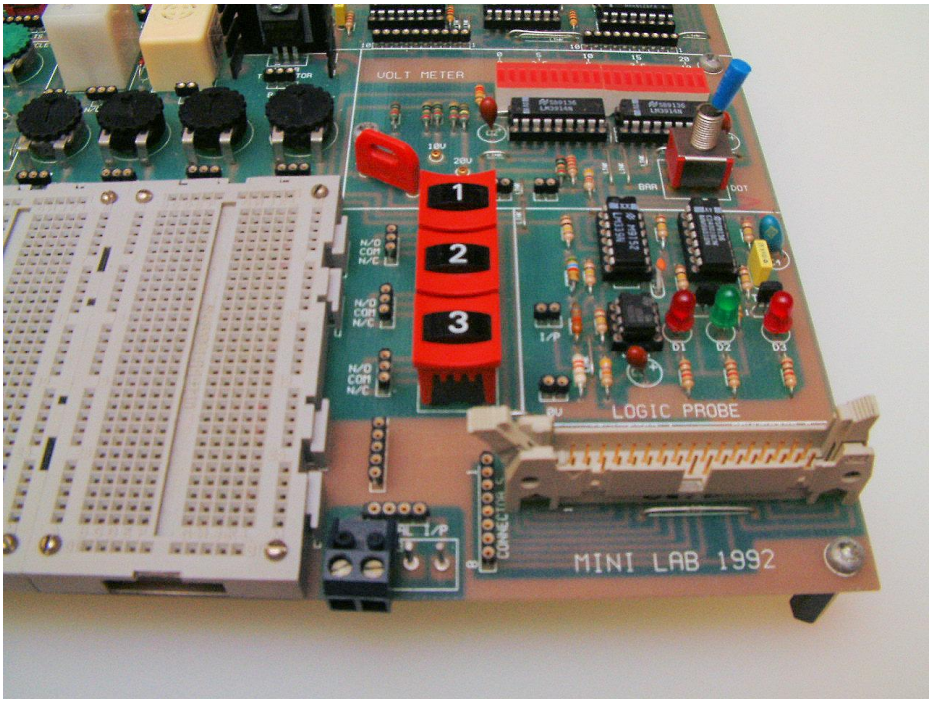
A solderless breadboard was also needed, and I chose Vero’s *Verobloc* to fit. Readers could fit either one or two such boards. We hit a problem though: the Verobloc that had been around since the late 1970’s went out of production just as our series was starting, so we had to do a quick shuffle and suggest an alternative “Euroboard”. The substitute part was near enough and we had no further problems with it. If nothing else, it highlighted the vagaries of electronic component supply lines and erratic logistics that put us at the mercy of industry and were beyond our control.



^ *My Mini Lab powered up by the original Teach-In 93 transformer unit*

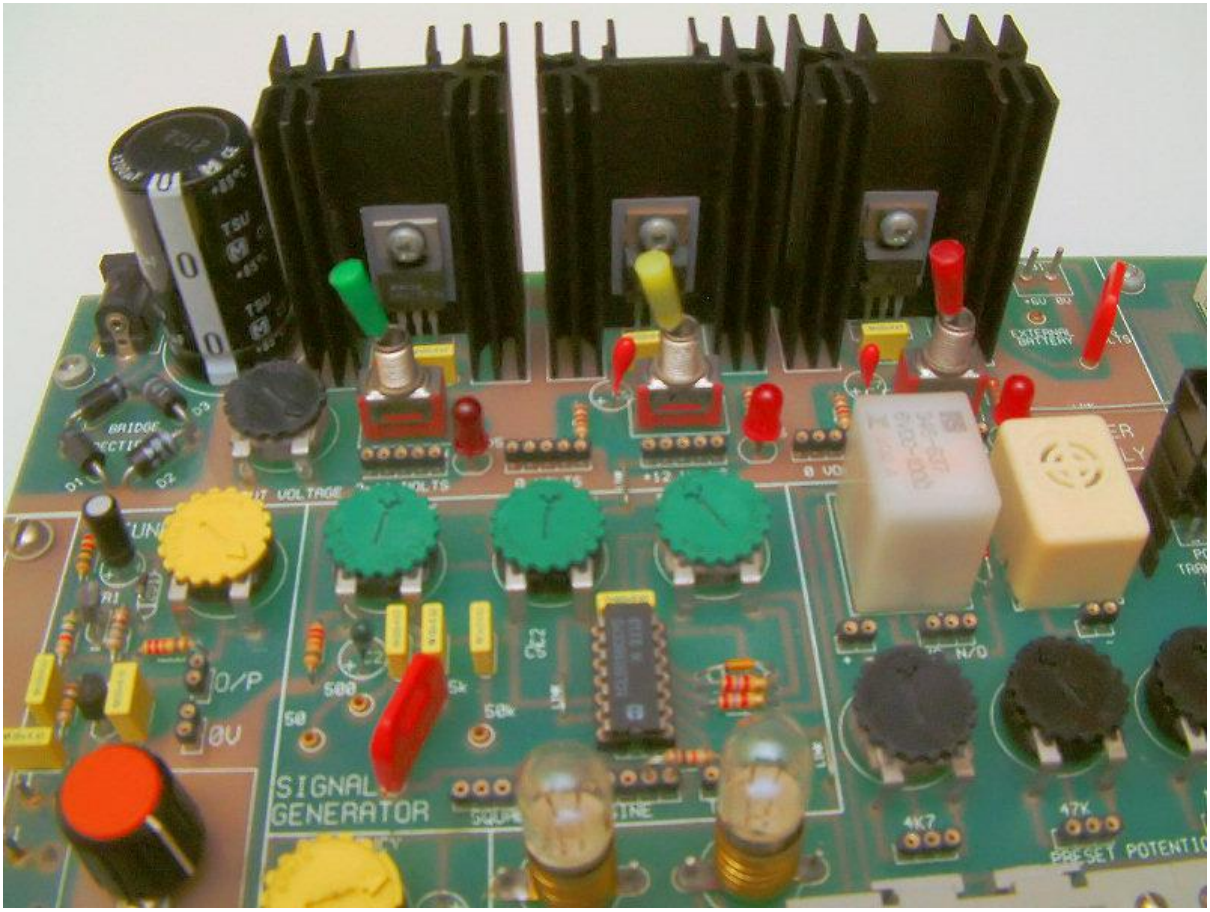


^ *Amplifier, 555 Timer sections (the tant cap C1 to the right of the yellow preset control, blew up!)*



^ *Bar/ Dot Voltmeter, Logic Probe and Micro Lab ribbon connector*

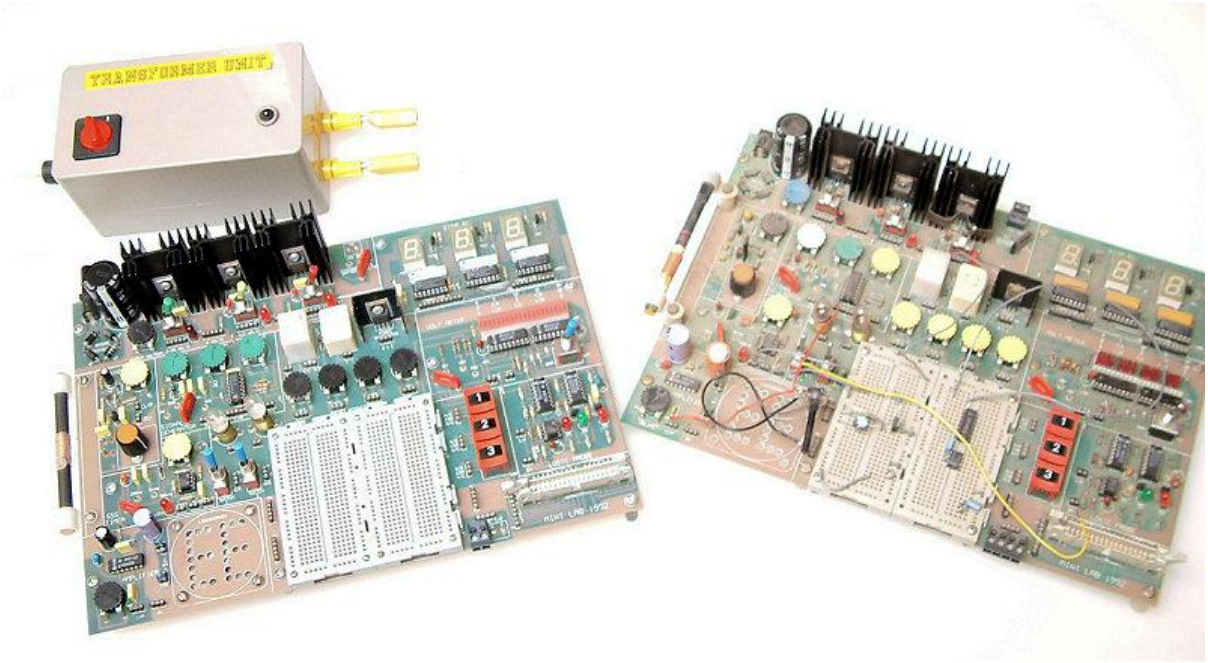
The push switches (Farnell) were neat as they could be numbered 1-2-3 and I added smart red bezels to make them look the part. The Voltmeter had a p.c.b. range selector switch using a jumper link plug (red) and p.c.b. sockets. It worked extremely well. Everything hinged around the single-in-line turned pin sockets which were used with solid core wires (Keith’s idea) to hook modules and components together. It worked perfectly and was very reliable in use, thanks to the contact wiping action.



^ *Power Supply Section and Signal Generator/ The three regulators offered 5, 12 and variable d.c. voltages. Thanks to the meaty heatsinks, it worked very well. The signal generator was a classic design using the much-lamented 8038 i.c.*

More recently (late 2013), Keith contacted me after suffering a serious flood at his home due to a tidal surge on the nearby River Humber, and he had been forced to rescue or scrap a lot of his materials. He had managed to pluck his old Mini Lab and Micro Labs out of the garage where they had been gathering dust. Keith duly presented them to me, the scruffy old prototypes looking much the worse for wear! I then spent some time helping Keith to put together various insurance claims for flood damage.

This is the first time that both Keith’s and my own Mini Labs have been photographed together. We each used our own Mini Lab in our own labs and they never got to be seen or used together.



^ *First time after 20+ years, my and Keith’s (rescued from a garage) original Mini Labs!*

In late 2013 I tried my Mini Lab for the first time in 20 years, and I hooked up the radio module to the audio amp. The first thing I heard, aptly enough, was the song “*The Sounds of Silence*” by Simon & Garfunkel. I’m not sure if the Mini Lab was complaining or not, it having been disturbed from its slumbers, but it was good to hear the little tuner burst into life after all this time.

In 2014 the original mains transformer powered up both prototypes successfully. Then my own Mini Lab took a minor nosedive when the tant. bead decoupling capacitor C1 on the 555 Timer erupted in a plume of smoke, followed by a bright flash and ‘crack’. Never did such a small thing make so much mess, and my room absolutely reeked of fumes for hours. Oh well, it’s 22 years old now and it’s earned its keep.

Alan Winstanley October 2014

- *The Micro Lab is described separately.*