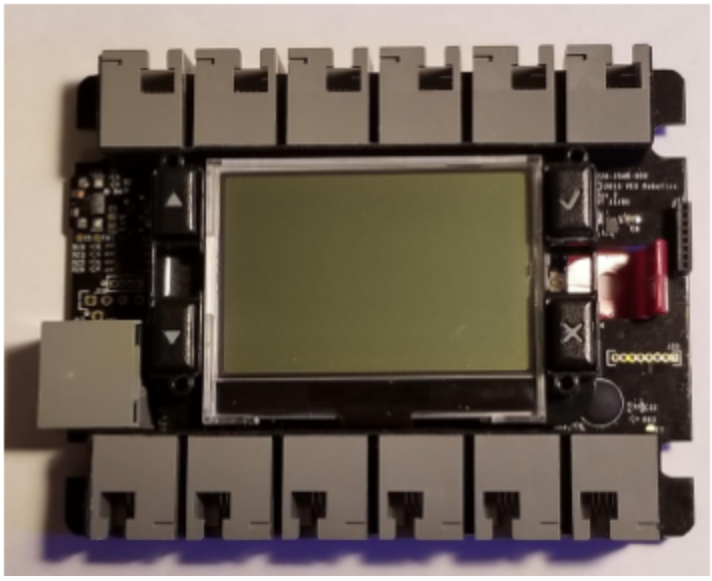
2018 TI Electronics Online Challenge: Vex Iq brain revision 2 PCB

Rolling Robots Team 7700R

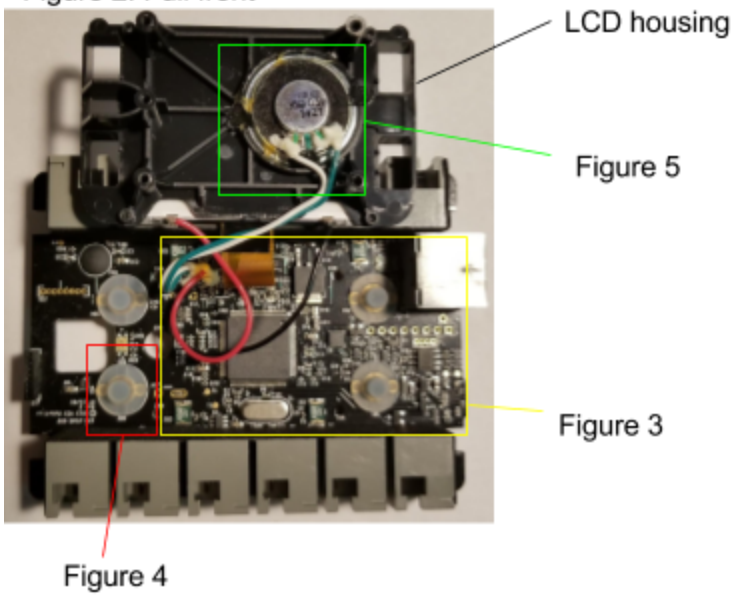
Whilst mentoring our VEX-iq team(7700J), we noticed that their VEX-iq brain had a broken micro-usb port. We decided to investigate the reason for this issue, by analysing the internals of the VEX-iq brain. We felt that it is not only important to learn this information to increase our own understanding of the VEX-iq brain, but also to be able to teach our VEX-iq team how the heart of their robot works.

Figure 1: iq brain without plastic chassis



To access the main PCB, we removed the screws holding the VEX-iq brain's chassis and LCD together. Upon an initial glance, the VEX-iq brain is observed to be highly compact(fig. 1, fig.2), due to the stacking of the LCD over the PCB.

Figure 2: Full front



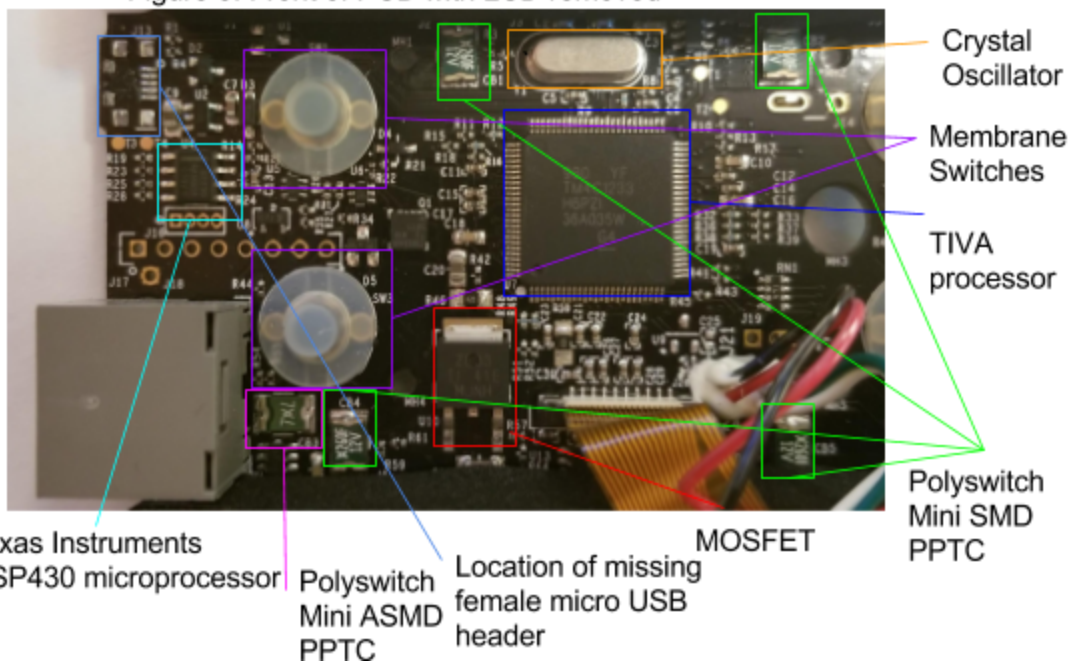
At its heart, there is a Texas Instruments Tiva TM4C1233H6PZ microcontroller with a speed of 80MHz, 256KB of flash storage, and 32KB of SRAM(Static Random Access Memory).

Flash storage is non volatile, meaning that the programs and data stored here will not be lost when the VEX-iq brain is shut down. SRAM, unlike the more common DRAM(Dynamic RAM), does not store data in a capacitor's charge. Instead, SRAM is much faster relying on mosfets in cross coupled configurations, resulting in SRAM not needing to be refreshed.

Towards the left end is a secondary microcontroller: a Texas Instruments 16 bit MSP430 microprocessor. This weaker processor contains 2kB of flash storage, 128B of SRAM, and a 16 MHz CPU. From its location and power, we speculate this microprocessor is utilized for the file management and operating system firmware which is why it is not as powerful as the Tiva TM4C1233H6PZ.

Around the microcontroller are 4 mini SMDC260F/12 PolySwitch PPTC's (Polymeric Positive Thermal Coefficient)which can be seen in figure 3. There is 1 miniASMDC075F which is the same as the miniSMDC260F/12, except with a higher current rating. Essentially, this chip raises resistance as temperature rises, preventing any smart motor from drawing too much current.

Figure 3: Front of PCB with LCD removed



Next to two of the polyswitch Mini SMD PPTC's, is a Crystal oscillator. Inside of this, a quartz crystal vibrates as a voltage is applied across it, allowing the VEX-iq brain to keep track of time, making programs more accurate. There are also 4 membrane switches(figure 4) to navigate the VEX-iq brain. These membrane switches are normally open switches, meaning it does not let electricity through, until it is closed by pressing the button. The VEX-iq brain features a backlit lcd display, and a 5 watt speaker behind it helping relay any user information. Along its outer perimeter are 12 ports for I/O, a micro-USB port, and a tether port to connect to a remote.

Figure 4: close-up of membrane switch


Figure 5: close-up of 5 watt speaker behind lcd housing

In conclusion we found out that the reason behind the broken micro-usb port was because it was completely ripped off of its soldering on the PCB. From this analysis, we have learned the reason behind the broken micro-USB port, and about the PCB design that allows for thousands of students to express their learning and curiosity.

Sources

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