

## SDP Electronic Hardware Requirements and Recommendations

Each SDP project must have a significant electronic hardware component. More specifically, each SDP project must include at least one significant custom analog and/or digital electronic circuit which is demonstrated on a solderless breadboard at MDR and as a Printed Circuit Board Assembly (PCBA) at CDR, FPR and at the SDP demo days. A PCBA is a Printed Circuit Board (PCB) which has been fully populated with its electronic, electrical and mechanical components. That is, a PCBA is PCB with all of its components soldered in place such as the one shown below.

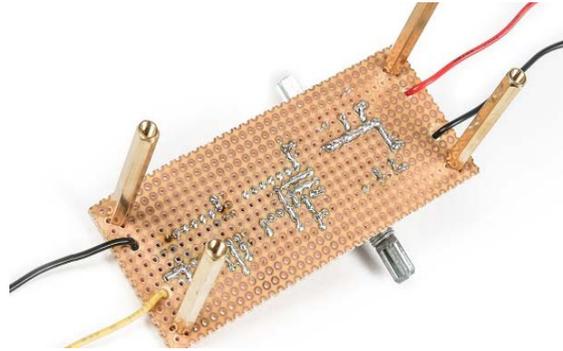


*UMass Amherst ECE SDP17, Team 4, Autonomous Search and Rescue Based on Cellular Beacon*

### Requirements:

1. At each of the four reviews (PDR, MDR, CDR, FPR), teams identify the team member taking primary responsibility for the PCBA.
2. The PCB must be professionally manufactured. Teams may not fabricate their own PCBs. For PCB fabrication, previous SDP teams have had success with boards from OSHPark.com (Portland, Oregon) and JLCPCB.com (Shenzhen, China). OSHPark is a supporter of the Open Source Hardware (OSH) community, but PCB designs need not be an Open Source project in order to use their board service.
3. Teams will receive feedback from their advisor, the course coordinators and/or their faculty evaluators regarding whether or not your proposed PCB has an appropriate amount of significance and complexity to qualify as your required PCB.
4. If your primary PCB has been approved and your design calls for one or more circuit boards, they can either be PCBs or hand-soldered protoboards such as the one shown below. Solderless breadboards are only allowed at PDR and MDR. Solderless breadboards are not allowed at CDR, FPR and at the SDP demo days.
5. It is important for you to prototype your design ideas rapidly in the fall semester, therefore you are encouraged to use development boards (aka dev boards) and breakout boards in the fall semester. In many cases these boards will not be allowed at CDR, FPR and at the SDP demo days. For example, Arduino, mbed and other no-operating-system 8-bit and 32-bit dev boards are not allowed after MDR. Instead, you'll

need to migrate your design onto your custom PCB prior to CDR. In addition, you'll be required to migrate your Arduino code to ANSI C code prior to CDR.



Hand-soldered protoboard: <https://makezine.com/2015/10/15/how-and-when-to-use-protoboard/>

6. Single-board Linux-based computers such as the Raspberry Pi and the Beagles (beagleboard.org) are allowed throughout the course unless it is determined that your justification for using a power-hungry and complex single-board Linux-based computer is not compelling. In those cases, the team will be required to migrate the design to an 8-bit or 32-bit microcontroller on a PCB.
7. In many cases radio/RF dev boards are allowed throughout the course due to the difficulty of designing reliable radio/RF boards. Check with a course coordinator regarding these radio/RF board questions.

### Recommendations:

1. We recommend that teams Altium Designer for schematics and PCB layout. M5 will provide introductory Altium Designer workshops to ease you into this professional Windows app. We have a license for up to 51 concurrent users.
2. It is recommended that electronic components use Surface-mount Technology (SMT) components in lieu of through-hole technology. SMT devices can be easier to solder and provide a professional, modern appearance.
3. Be aware that the spacing between pins (called pitch which is the center-to-center distance between two adjacent pins of an integrated circuit) can be so small that it can be impossible for even an experienced technician to solder the parts. (Some SMT devices can only be soldered by robots.) Do your research and order your parts with a pitch that is large enough to either be hand-soldered or soldered with aid of solder stencil and paste.
4. If the team opts for the soldering stencil, we recommend Ryan O'Hara's OHARARP.com and stencilsunlimited.com. They'll convert your file into either stencil made of Kapton polyimide film (pronounced CAP-tahn poly-emmid) or stainless steel.