SOUTHEASTCON 2017 HARDWARE COMPETITION RULES

Episode MMXVII: The Engineering Force Awakens

FAQ Document

The official rules document was frozen on October 10th. In addition to the official rules document is both an errata document, and this FAQ document. While the errata document contains minor revisions to the rules, this document does not change the rules, but instead helps answer some of the more frequently asked questions and their answers.

Each FAQ item will be added to the list below, along with the date each item was added or last changed. In addition, the source of the question is included (FB – Facebook, IM – Facebook message, email, or other):

➢ Do the stages have to be completed in order? (FB, April 6, 2016)

No, the stages do not have to be completed in order of 1..4, but can be completed in any order with the following restrictions:

- Stage 1 must be completed before stage 3 to get the necessary data
- The first two darts of stage 4 can be fired at any time.
- The competition is over once the 3rd and final dart is fired (even if the other stages have not yet been completed).

➢ Can more than one dart be fired at a time? (FB, April 6, 2016)

Yes, any number of darts can be fired at one time – just remember than the match is over as soon as the 3rd dart is fired.

➢ Can we use CO2 for the compressed air? (FB, April 19, 2016)

Any gas can be used as long as it does not pose a danger (flammable, poisonous) as long as the maximum allowable pressure is not exceeded at any point in the system.

➢ Will the robots be sequestered between rounds? (FB, May 10, 2016)

The robots will not be sequestered between rounds, and teams will have at least 30 minutes of available time between rounds for any repairs, updates, battery or pressure charging, etc.

➢ Can the robots communicate wirelessly? (FB, May 10, 2016)

No. While this was not stated in the original rules, the rules were modified after this question to specifically rule out any wireless communication channels. The robots must be tethered to each other, or work independently without communication.

➢ Is the course mirrored, or are they all identical? (FB, May 10, 2016)

All copies of the course arena are identical.

➢ What is the specified magnetic field strength for the stage 2 coil (FB, June 9, 2016)

The coil strength is not specified – instead the diameter of the coil, number of turns, current and steel bolt core are specified. Teams should be able to calculate the theoretical field strength of the coil to get an idea of expected range.

(Hint – several teams have staged that the field strength is way less than a Tesla – that is correct. Don't think Telsa, but think in terms of gauss. Teams should build the coil and measure the field strength directly. I suspect that most team members already have a meter capable of measuring magnetic fields of this strength and probably carry it with them every day).

(Additional hint – do not look for a specific field strength, but look for a change in field strength, plus or minus, from the initial value).

➢ Could you provide a copy of the arena in Inventor CAD file? (FB, May 14, 2016)

No. The only official file format for the arena, stage 2 coil and stage 2 lightsaber is OpenSCAD. You can download viewers/editors of this file format for any operating system. This format is also a human readable file, and is meant to be the documentation for the sizes. Read through the files, look at the comments, look at the sizes.

It is possible to export this format to several other file formats, and to import it into several CAD programs. Check google to find advice on how to convert it to the file format you may need. However, I strongly urge you to take some time to investigate and learn OpenSCAD first as it is a very powerful, and easy to learn, 3D modeling system.

➢ Does the match end when the 3rd dart is fired, or when the last one in the magazine is fired? (FB, June 21, 2016)

The match is over when the 3rd dart is fired.

➢ What material are the bolts made of for mounting the stages to the walls? (FB, August 2, 2016)

When this question was asked, I provided the link to the bolts I purchased (from Lowes) and answered the question as zinc. However checking the same link I gave, I see the material is actually stainless steel. The bolts are ¼" in diameter.

https://www.lowes.com/pd/The-Hillman-Group-1-4-in-20-x-3-1-2-in-Stainless-Steel-Standard-SAE-Hex-Bolt/3701974

➢ Can you provide dimensions of the light saber? (FB, August 3, 2016)

The OpenSCAD file is a self documenting file format. You can read through the source code and find any dimension you need. The lightsaber is a little over 7" tall, consisting of hilt (a little over 3") and the blade. The rules state that all hits must be in the bottom 3" to the hilt to avoid damage to the saber from a direct hit to the blade area (which is more fragile). The hilt is designed to take a fairly strong hit (definitely strong enough to trigger the vibration sensor).

➢ Can a robot use a laser for navigation? (August 23, 2016)

That is a difficult question to answer as yes/no. While laser distance devices do exist and are okay, any lasers chosen must be safe to those around the arena and must take into consideration reflectance off of robot parts, other robots, the arena, bolts, on the arena, etc to determine if they pose a risk to anyone standing nearby. In addition, lasers may not be used for communication.

- I competed as a student last year, but have now graduated – can I still compete? (email, August 26, 2016)

  Yes, you can compete in the Open category, but you may not compete in the general category with the other student teams. The open category includes non-students who have graduated, or in junior/high school, professionals, and non region 3 teams.

- If multiple robots are used, is a single stop button required for all the robots, or a separate stop button per robot? (FB, August 24, 2016)

  It is recommended to have one cutoff that will stop all robot motion, but that is to help teams avoid damage to the robot if it needs to be stopped quickly. This is a recommendation, and not a requirement, but the intent is to allow the team to grab the robots quickly as possible if something is going wrong. Without it, teams may have to grab multiple moving robots and possibly damage it in the process. Teams are responsible for stopping their robot rapidly if a problem exists, and if not, the arena controller may have to step in and do it for you (and may cause damage to the robot in the process).

- When qualifying, does the entire robot need to move (FB, August 24, 2016)
  There is no qualification round.

- Can non students, or former students, compete? (FB, August 26, 2016)

  All student teams are to be composed of only existing IEEE student members, with a maximum entry of one per school. Additional teams, or teams consisting of non-student members, or even people outside of region 3, can compete in the open category.

- Can friends and family spectate? (FB, August 26, 2016)

  Yes, they can purchase a spectator badge.

- The inductor is listed as end of life and no longer available. (FB, September 1, 2016)

  Arrangements have been made to give each team one inductor, free of charge. Contact Rodney (info available on the official IEEE Southeastcon 2017 web page) if you would like an inductor shipped to you. These are the identical inductors specified in the hardware rules and were purchased in bulk by IEEE to help the students.

- Is there a limit on team size? (email, September 1, 2016)

  No, there is no fixed team size, but there is a practical limit as to how many can be in the practice room at one team. Each team will be given one table, and if the team size is too large to fit at the table at one time, they may need to rotate members into the practice area.

- Will any points be deducted for stage 2 after the 30 second lightsaber battle is over? (FB, September 7, 2016)

  No. Once the 30 second timer is up, no changes in score for stage 2 are possible – either positive or negative.

- What happens if the lightsaber is accidentally triggered? (other, September 7, 2016)

  The stage 2 lightsaber is not active during the first 5 seconds of the match to avoid any accidental triggering while enabling the robot and clearing the arena. However, if the robot hits another wall with enough force after the 5 second initial period, it may be possible to trigger the lightsaber and the 30 second timer for stage 2 will begin. Teams should take this into consideration when designing their robot and determining the order in which the stages are started.

- For the vibration sensor, do you have any details on the flooring under the arena? (IM, September 9, 2016)

  The flooring is a typical dense, commercial carpet, as found in most hotel conference floors.

- Do you have a part number for the slow blow fuse of stage 1? (FB, September 12, 2016)

  No. The rules state a maximum current of 25 ma for stage 1, with a slow blow fuse of 100 ma. Teams should be able to stay below the maximum current, and way below the fuse value.

- For stage 1, will a copper sheet of metal or a copper PCB be used? (FB, September 16, 2016).

  The Errata document provides the additional information about the pads:

"The initial document described the probe pads as "six flag conductive copper pads". The pads, as fabricated, are standard FR4 fiberglass (1.6 mm thick) with 0.35 mm copper pads with a HASL finish. HASL stands for hot air solder finish and the finish is applied by dipping the boards in molten solder and then hot air is used to blow off the excess solder from the surface. This will result in a finish that is smooth and will not tarnish like a bare copper pad. The pads are 0.7" in diameter to allow, at most, a 0.1" variation in placement of the 0.5" diameter holes in the plywood."

➤ In stage 1, can a component type be repeated? (FB, September 18)

No. The rules state that "each component will exist once, and only once, but their order will be chosen randomly at the start of each match"

➤ What is the orientation of the coil for stage 2? What is the OD diameter of the bobbin? Are the turns overlapping?

The bolt for stage 2 passes through the middle of the bobbin. The rules state that each stage 2 electromagnet will consist of 40 turns of #20 stranded copper wire wound around a 0.5" bobbin". The OpenSCAD files for the bobbin are available on the IEEE Southeastcon 2017 web page. For the test bobbins I made, I was able to get 10x turns on each layer, so a total of 4x layers were needed.

➤ Is it possible to have multiple, separate robots, as long as they fit into the starting area? (FB, September 20, 2016)

Yes, as long as the robots fit within the 12" x 12" x 12" initial starting size, and do not violate the communication specifications (only tethered or completely independent).

➤ Can more than one team compete from a school? (IM, September 23, 2016)

Only one team can compete in the hardware competition; however, additional teams can compete in the open category that is open to non-students, non-region 3 teams, etc.

➤ For stage 1, is one end of each component attached to the center common pad, and the other end to a surrounding pad? (FB, September 23, 2016)

Yes. Each component is connected to the center and the the other end is connected to one of the surrounding pads. There are 5x component types and 5x surrounding pads, so 1 component per pad, with no duplicates. The diode may be installed as either cathode or anode attached to the common pad, so your robot should handle both.

➢ Is there a time limit for stage 1, and in what order should the codes be read? (FB, September 23, 2016)

There is a time limit for the entire contest, but the only stage with a time limit is stage 2. The rules clearly state the order the codes should be read from stage 1.

➢ Are the darts for stage 4 Nerf N-Strike darts or suction cup darts? (FB, September 30, 2016)

Non-suction cup darts.

➢ Can the robot fly, or part of it break off and fly? (email, October 2)

No. The robot can split into multiple pieces as long as all pieces remain in contact with the ground. The rules were updated to include the following phrase:

"Aerial or flying and/or launched robots are not allowed."

➢ I downloaded the lightsaber OpenSCAD file, but only see the blade. (FB, October 5, 2016)

The same OpenSCAD file contains the blade, hilt+support, inner support for the neopixel and vibration sensor, and the two halves of the stage 2 bobbin. Read through the source code to see how to manually modify the OpenSCAD source to display each item individually. Look for the draw("blade") line and change it to either draw("bracket+hilt") to see the hilt and bracket, or draw("innersupport") to see the inner support, or draw("spool_inner") or draw("spool_outer") to see the two halves of the spool. Once you view each file, you can export it as an .stl for 3D printing.

In addition, note the comment above the $fn=20 line for suggestions on increasing the value to a higher number (I used 200) for the model to 3D print, but keep the value at 20 for fast display.

➢ Do you have a solidworks file for the lightsaber? (FB, October 18, 2016)

No. As with the arena, the only official source file is the provided OpenSCAD file and it is recommended to use that file for printing, and viewing, but it is possible to export it to other formats (or import it into other packages).

➢ What are the dimensions of the knob for stage 3? (FB, October 19, 2016)

The rules state the part number for the knob and Sparkfun provides measured drawings of the knob. The quadrature will be mounted so that the threaded portion protrudes through the front of the stage just enough to fully engage the knut (about 2-3 mm). This will require drilling out the back of the stage 3 plywood for the encoder.

➢ Are we allowed to bring and use our own darts? (FB, October 26, 2016)

The nerf darts for stage 4 will be provided to the teams for the competition. Teams may bring their own darts for the practice runs.

➢ The rules state that the robot "must battle using its own lightsaber" – do we need to actually build a lightsaber? (FB, October 27)

No. That verbage was added after the initial rule release and was badly worded. The robot should engage and hit the lightsaber, but it does not have to engage with stage 2 using a lightsaber – any item that can hit the lightsaber and activate the vibration sensor.

➢ We have not been able to locate a hall effect sensor that can detect the stage 2 coil (IM, October 31, 2016)

As mentioned earlier in this FAQ, I recommend teams to first calculate the theoretical field strength for the coil specifications first. You will discover that the field strength is below what can be accurately measured by most (perhaps all) hall effect sensors, so teams should look for other options (see the hint for June 9 FAQ).

➢ What direction is the coil wound? (IM, October 31, 2016)

This question is answered in the stage 2 description. What is not stated is the direction of current flow in the coil, so teams should be prepared for current in either direction (I intend to build all the arenas the same way for fairness, but not providing that detail in the rules or FAQ).

- Are you using 100% fill for the stage 2 lightsaber? (FB, November 1, 2016)

  No. I used 20% infill, 2 outer layers, 0.2mm layer resolution PLA.

- Our team does not have access to a 3D printer – could you print one for us? (IM, October 2, 2016)

  No, unfortunately I cannot. However, if you check the Facebook discussion threads, you will see that one team has volunteered to print the items for any team that needs a set. In addition, 3D printing services are available online (make sure they are using PLA).

- How hard does the arm have to hit the lightsaber to trigger the vibration sensor? (IM, September 8, 2016)

  It is hard to define the force in a meaningful way, but a one finger thump triggers it. As for max, don't break it, but I have slammed the stage 2 lightsaber hard into a table with no damage. I recommend printing the lightsaber and testing it out, and verify how much is required to trigger it, and also verify how little force is required away from stage 2 that can result in a false trigger (ie: hitting another wall hard).

- When the rules state 6" x 6" for a stage, does that include the inside square or the entire stage with the pine border? (IM, October 11, 2016)

  The dimensions of 6" x 6" for stage 1 and 3, and 3" x 6" for stage 2, are just for the plywood, with the pine border extending the width an additional 1.5" and the height an additional 0.75" (nominally).

- How are the vibration sensor and neopixel stick attached to the lightsaber? (IM, November 2, 2016)

  Both attach to the inner support. The vibration sensor is held in place with a ziptie (notches in the inner support are added for that purpose). The neopixel stick is held in place with two small M-2 nylon screws. Photos of this are on the Facebook group and will be added to the IEEE Southeastcon 2017 web page.

- If using multiple robots, do we need to have a single kill switch, or one per robot? (IM, November 13, 2016)

  This question is answered in this FAQ on August 24, 2016.

- During the 2 minutes from sequestration to the arena, are teams allowed to do anything to their robots? (FB, November 16, 2016)

  The short answer is yes, teams should be able to do whatever they need to get their robots ready. Teams must be ready at the end of the two minutes. In addition, if you have an action that may be unusual, teams are encouraged to send a private question to Rodney for clarification. The team that raised this question and I did exchange several messages and while I will allow their request, I suggested it would be best to redesign the robot to avoid it (no more further details can be given as I keep all team discussions in private).

- I am trying to set up the vibration sensor and it is not responding consistently (FB, November 20, 2016)

  The code for vibration sensor has been uploaded to the IEEE Southeastcon 2017 web page showing how to set up an interrupt handler to detect the very short signals from the vibration sensor when it is triggered.

- How are you selecting the values for stage 1 in the competition? (other, November 23, 2016)

  Initially the thought was to build a set of personality module that would choose the values and a different one plugged in each time. However, the final design involves the arena Arduino choosing a random number and selecting the components via a relay tree.

  Ideally we would have 5x single pole, 5-throw relays attached to the 5x pads to select which of the 5x components is connected. Unfortunately 5-throw relays are about as mythical as unicorns. Instead a single pole, singlt throw (SPST) relay is used to select which of two other SPST relays are connected to the pad, allowing 4x parts to be connected to the pad with only 3 relays. To add the 5th component, another relay could be used, giving 4x relays per pad. Then, we have the added complexity of the diode can be mounted anode or cathode to the common pad. While this is possible, the cost of 20+ relays per arena was prohibitive.

  A compromise was chosen that allows each components to select between 4x of the 5x pads, allowing each component to be controlled with 3x relays, for a total of 15x

relays. The diode orientation was solved by having another relay choose a diode in either anode or cathode position (two diodes available, both have one lead connected to the center pad, but only one chosen), This allows for an implementation using only 16x relays. This limits the number of component combinations to 106 (down from the maximum number of 2x 5! = 240), but provides a reasonable compromise of arena control complexity and number of combinations.

A computer program was written to generate the 16x relay control combinations in the relayTable.h file of the Arduino arena control.

The stage 1 PCB has 6 components installed (the diode twice) and the 6x pads, and the 6x components and their common, are brought out to a 2x7 header. This header will connect to the relay board. Take a look at the arena control schematics and PCB, as well as the control software to see the current solution.

It is not expected, or required, for teams to replicate the cost and complexity of this for their stage 1 practice arenas. Instead, teams can manually select the component placement by using male to male jumper wires connected across the header, and then comment out the random selection of the stage 1 arena controller and substitute in the correct code for the jumpers selected.