This syllabus is intended to aid instructors in providing training for this tool, and for quick reference by existing users. It is not intended to teach you the tool by itself.

1. Safety

1.1. Materials

- Fibre glass substrate (FR4) produces silica particles during cutting
- Stray copper layer chips can be sharp

1.2. PPE

- Eye protection
- Nitrile gloves

1.3. Operation

- Do not touch or manipulate the end tool during cutting or movement operations
- Only operate the mill with the vacuum extraction unit plugged in and powered on

1.4. Training

Start with a safety briefing - go through all the points above, in front of the machine. During subsequent training, be ready to prompt if any safety measures or considerations seem to have been forgotten by the trainee.

1.5. Evaluation

The trainee must be able to identify risks associated with the machine and the safety measures that should be used. The trainee must be observed to routinely use safe working practices when working without prompting or reminding.

2. Pre-Startup checks

2.1. Extraction

- Nitrile gloves to be worn while handling any parts or material covered in silica dust. This includes the inside of the extractor
- Open the extractor, ensure a bag is present, secured correctly and not full
- Check the extractor is connected and powered on

2.2. Material preparation and mounting

- Ensure your chosen material sheet has indexing holes drilled.
- Mount the sacrificial layer and material onto the mill using tape.

2.3. Training

Start by demonstration. Go through the process of checking the machine and making it ready for use, talking the trainee through each step and the reasons for it. The trainee will get further practice through routine use as they go through the training process. Be ready to prompt and remind as needed.

2.4. Evaluation

The trainee must be able to set up the machine correctly without assistance or prompting, regardless of the state they find it in.

3. Usage

3.1. Hazards

- During cutting the drill is exposed and the machine should not be touched.
- The cutting can produce sharp copper shavings and in rare circumstances they will not be all vacuumed up.
- Cutting always produces a non-zero amount of silica particles. The extractor ensures safe levels in the surrounding air, but the cut materials should always be handled using latex gloves until cleaned.

3.2. Starting the machine

- Turn the mill on using the power switch

- Connect to a PC running the required software.
- Refer to wiki or manual for connection, usage and control

3.3. Running

- Start the job wizard from the software.
- set up your work area, ensuring the head will not run into the holding tape.
- Remove/Attach end bits when prompted.
- When prompted to calibrate an end mill always proceed to calibration for optimal results.
- Tune in the offset on the cutting head using cuts, a microscope glass ruler and a microscope
- when tuning end mills, ensure not just cut width is optimal, but also the **minimal** depth to minimise the amount of fibre glass removed.

3.4. Stopping the machine

- Disconnect in the software by closing the application, follow the prompt to move the head to a safe position.
- Remove your work piece.
- Dust off/vacuum up any remaining silica dust.
- Move the machine and accessories to the storage or to the place it was found originally.

3.5. Emergency stops

- Try to stop the machine using the control software first.
- If that fails always use the switch at the wall, not the machine switch to avoid bumping into the head.

3.6. General

- Operation of the machine requires familiarity with the control software. This will be documented over time on the wiki, but it is expected that during training all the required sections are understood.
- End bit calibration is very important and requires patience.
  - This cannot be achieved once. Sometimes the bit seems to be almost impossible to tune to its stated width, switch to a different bit of this size.
  - Understanding of lighting and shadows during measurements is crucial.
- Postprocessing is an important part to ensure the finished piece is not sharp and inert.
  - Transfer the finished PCB to g* while wearing gloves and using the belt sander, files and any other suitable tools, de-burr the edges.
  - Clean the PCB under running water, with plenty of detergent and scrubbing.

3.7. Materials

- Refer to the wiki for materials available at the lab and pricing.
- Personal materials are allowed as long as the machine supports them and they are calibrated.

3.8. Cleaning up

- General maintenance includes cleanup of any silica build-up. Any visible clumps should be cleaned to avoid them becoming airborne.

4. Maintenance

4.1. General

5. Other