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Make That Laser Cutter Blaze: Upgrade a K40

Tim Deagan : 11-14 minutes : 1/30/2023

Digital fabrication tools can run from hundreds to many tens of thousands of dollars. For makers interested in a really useful tool at a relatively low initial cost with tremendous upgrade potential, the generic “K40” type 40W CO_2 laser platform is hard to beat.

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Significantly more powerful than diode lasers, K40 lasers can cut wood, leather, acrylic, paper, and a range of other materials (generally up to about ¼" thick, though that varies by material). It will engrave on many more types of material, though struggles with metal engraving. While more powerful (and expensive) lasers can outperform these capabilities, the K40 can be significantly improved with end-user upgrades. In almost all cases, applying every upgrade available to a K40 still results in a less expensive tool than moving up to a 50W or 60W laser.

For makers ready to move beyond diode laser solutions, the K40 is a fun, affordable platform ready for modification. Here are my recommendations, based on upgrades I've done to mine.

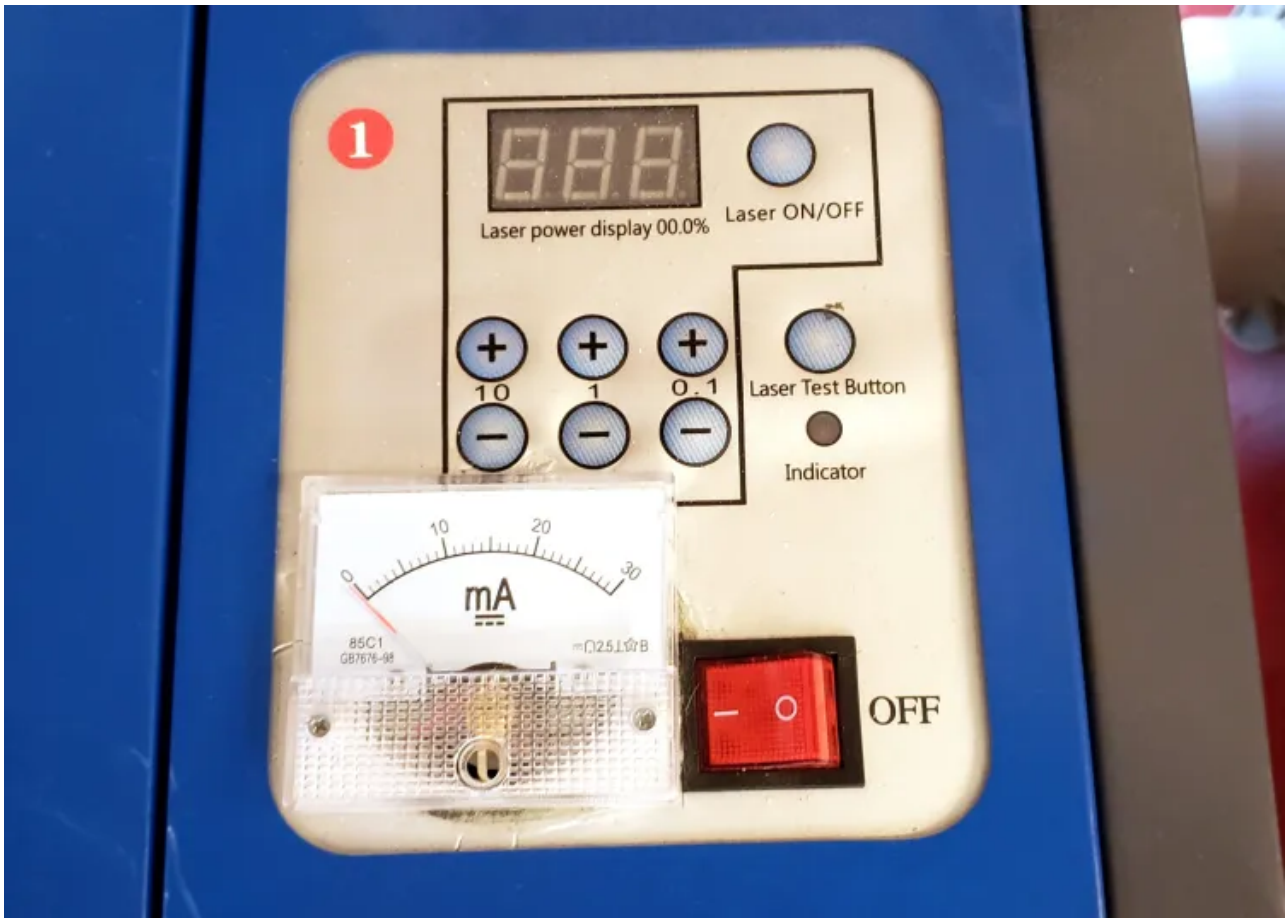
OMTECH K40

If you're going to upgrade a K40, you need to start with a K40. I got mine from OMTech, a U.S.- based company that adds value to the purchase of the general K40 model (for a price of course) by checking the

quality of build, components, etc. Cheaper, nearly identical units are directly importable, but often have component or build challenges. This unit is absolutely functional out of the box, but the platform is also a great base for upgrades.

- **Price:** $450, **Return on investment (ROI):** 8
- **Ease of installation (1=poor, 10=excellent):** 8
- Instructions
- **Recommendation:** TOTALLY NECESSARY!

3MA ANALOG METER



This is an essential upgrade. The stock units report power as a percentage of power supply capacity, but this varies from machine to machine. To be able to use cutting or engraving settings from other people, the actual amperage needs to be used, and a meter is needed to be able to discern it.

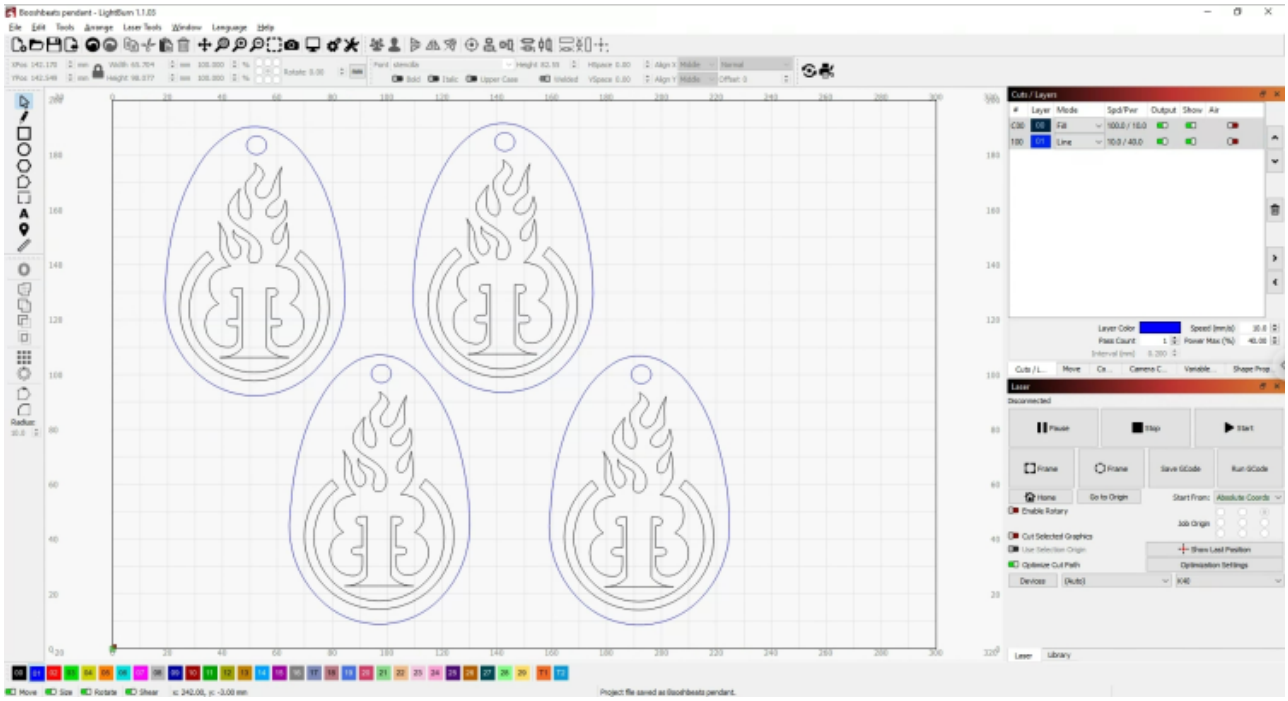
- **Price:** $10, **ROI:** 10
- **Ease of setup:** 4
- Instructions
- **Recommendation:** MUST DO

SAFETY GLASSES

CO_2 lasers are not visible to the human eye. You can't tell if backscatter from the beam is causing damage until after it's occurred. The lid of the K40 has a tinted panel that serves as a filter, but whenever you're aligning mirrors or doing other operations that need to fire the laser while the lid is up, appropriate eye protection is essential. The wavelength that the K40 CO_2 laser emits ranges from 10,400–10,600nm; glasses rated at 10,600nm are the most readily available.

- **Price:** $45, **ROI:** 10
- **Ease of installation:** 10
- **Recommendation:** MUST DO

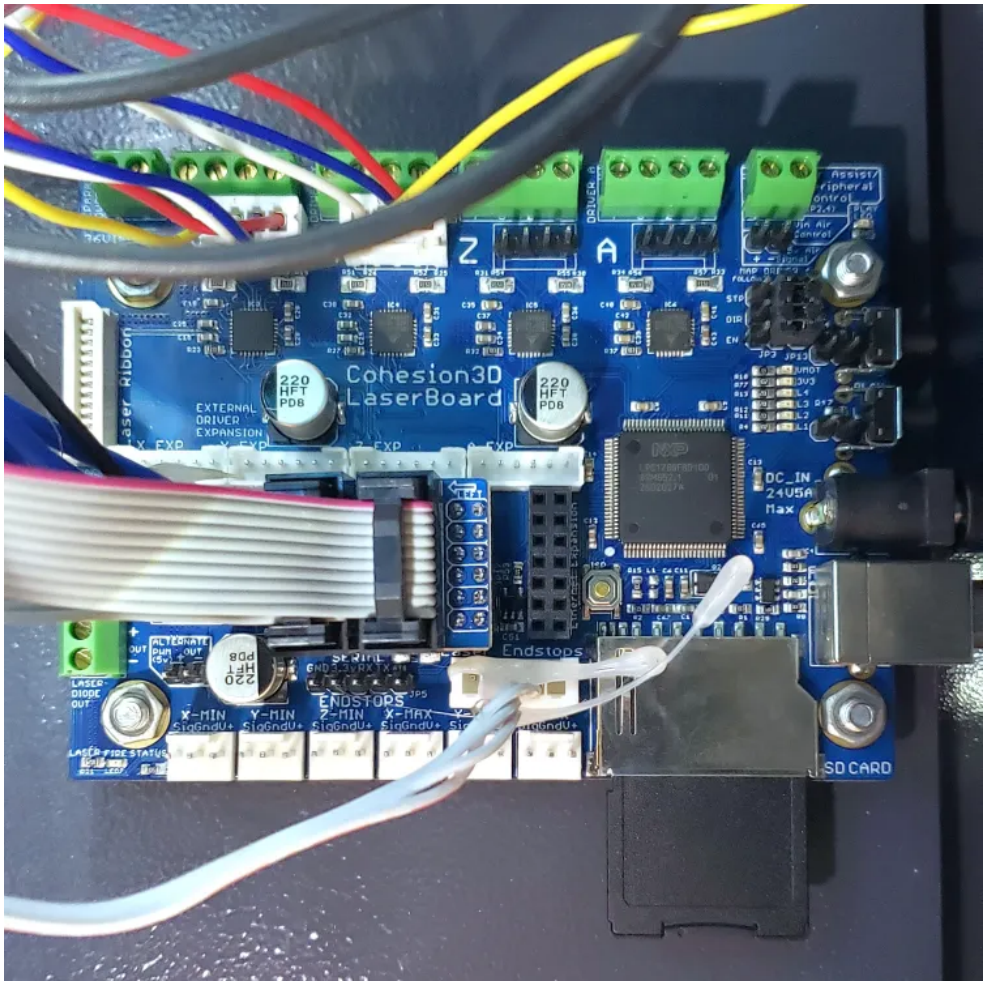
LIGHTBURN SOFTWARE



LightBurn is a full-featured laser controlling package. While a variety of functional freeware packages like K40Whisperer are totally usable, LightBurn offers many more features that make it worth the license fee. LightBurn requires an upgraded controller board (e.g. the Cohesion3D LaserBoard listed below) to work with a K40.

- **Price:** $60, **ROI:** 8
- **Ease of installation:** 10
- Instructions
- **Recommendation:** NICE TO DO

COHESION3D LASERBOARD



The stock K40 controller board cannot vary laser power, so it can't do actual grayscale images — it only does dither-type "grays." It also limits the software that can be used. A variety of after-market controllers are available, with the Cohesion3D LaserBoard arguably the most popular. This Smoothie firmware-based board supports external displays/controllers, grayscaling, rotary axis tools, air-assist relays, and advanced software packages like LightBurn.

- **Price:** $230, **ROI:** 7
- **Ease of installation:** 4
- Instructions
- **Recommendation:** NICE TO DO

LIGHTBURN CAMERA

This camera mounts in the lid and works with the LightBurn software to allow a picture of the material on the cutting bed to be used in the software to orient and position the images and lines to be engraved or cut. It's not essential, but once you use it, you'll never ever want to go back to other registration methods. It comes as a thin PCB; I printed an enclosure for mine.

- **Price:** $80, **ROI:** 8
- **Ease of installation:** 5
- Instructions
- **Recommendation:** NICE TO DO

LID STAND

The K40 lid will rest in the “far back” position (about 15° past vertical,) but given a bump or strong wind, it can come crashing down. This isn’t a big problem, but using a lid stand definitely feels safer.

- **Price:** $0, **ROI:** 10
- **Ease of installation:** 10
- **Link to part:** Scrap material and 3D printed (or laser cut!) parts
- **Recommendation:** NICE TO DO (MUST DO if using LightBurn camera)

NOTE: To use the LightBurn camera, you need to have the lid positioned consistently at about 60% of full open. I addressed this by cutting a piece of ½” angle aluminum and 3D printing ends that fit on the K40 base and lid. When I wedge open the lid with it, I know it’s in the correct position for the camera.

CROSSHAIR LASER SIGHTS

Without something like the LightBurn camera, laser crosshairs to visually display where the beam will hit are a great aid in positioning material.

- **Price:** $8, **ROI:** 7
- **Ease of installation:** 4

- **Recommendation:** NICE TO DO

AIR ASSIST HEAD

This device replaces the stock head (or just the bottom of it), allowing a source of compressed air to shoot down along the laser beam. This suppresses flames and the resulting char that the laser causes with many materials.

- **Price:** $25, **ROI:** 8
- **Ease of installation:** 9
- Instructions
- **Recommendation:** SHOULD DO

AIRBRUSH COMPRESSOR

For air, there are a variety of heavy duty aquarium pumps and other options. I bought an airbrush compressor since it is also useful for painting.

- **Price:** $65, **ROI:** 5
- **Ease of installation:** 7

- **Recommendation:** MUST DO (some solution if using air-assist)

EXHAUST SYSTEM

The stock exhaust fan is just barely able to clear smoke and fumes from the laser. A more powerful fan is a big win to keep from stinking up your shop and accumulating residue on your mirrors and lens.

- **Price:** $60, **ROI:** 8
- **Ease of installation:** 7
- **Links to parts:** 1, 2, 3, and 4
- **Recommendation:** SHOULD DO

Z-HEIGHT LAB JACK

By removing the static deck provided with the K40, you can put a height-adjustable table in its place. This is important because the focal point of the laser never changes; instead, you move the material up and down to accommodate different thicknesses. This jack's table surface is only 4″×4″, so it needs something on top of it. It's easy to accidentally tilt the top, so use a level to make sure it's true to the laser's X and Y axes.

- **Price:** $20, **ROI:** 8
- **Ease of installation:** 6
- **Recommendation:** SHOULD DO

LENS

This is a drop-in replacement for the stock focus lens that has better coatings and performance.

- **Price:** $25, **ROI:** 7
- **Ease of installation:** 9
- Instructions
- **Recommendation:** SHOULD DO

MIRRORS

Drop-in replacements for the stock mirrors that have better coatings and performance.

- **Price:** $33, **ROI:** 7
- **Ease of installation:** 9
- Instructions
- **Recommendation:** SHOULD DO

CW 5200 WATER CHILLER

The CO_2 laser tube is water cooled. Operating it above its desired temperature (around 77°F/25°C) rapidly degrades its performance and longevity. Routing the water through buckets of ice water is a cheap option, but difficult to maintain in hot climates for long runs. I opted for a significantly oversized active water cooler since my shop gets close to 100°F/38°C in the summer. Be careful of cheaper thermolysis-type “coolers” that only pass the water through a radiator with a fan, limiting the cooling ability depending on ambient temperatures.

- **Price:** $450, **ROI:** 6
- **Ease of installation:** 8
- **Recommendation:** MUST DO (something for cooling); NICE TO DO (active chiller)

DIY ROTARY AXIS

The K40 has a very limited Z-axis space. Most commercial rotary axis tools (that allow you to engrave or cut on cylindrical objects) will not fit inside and still keep your workpiece at or below the necessary focal height. A 3D printed, low-profile rotary axis is a fun project and can be the best use of space in the tool.

- **Price:** $35, **ROI:** 6
- **Ease of installation:** 4
- **Recommendation:** NICE TO DO

HONEYCOMB BED

When the laser finally punches through the material during cutting, it hits whatever the material was sitting on. If it's a material that burns, then smoke or stains may accrue on the bottom of the workpiece. Honeycomb is one way to address parts of the problem by providing a deck that is largely open under the workpiece. If the base under the honeycomb is closed, the smoke that collects in the cells can ignite and add oddly patterned char, so it's not perfect for all materials.

- **Price:** $18, **ROI:** 5
- **Ease of installation:** 7
- **Recommendation:** NICE TO DO

Z-AXIS TABLE

An adjustable-height table that evenly raises and lowers the deck while keeping it level is a big enhancement. Thingiverse has a number of models for both stepper-motor and manually driven tables.

- **Price:** Varies, **ROI:** 8
- **Ease of installation:** 4
- **Link to part:** Search “K40 table” (there are dozens) on Thingiverse or your favorite 3D repository. Add assorted nuts, bolts, shafts, etc. as directed.
- **Recommendation:** NICE TO DO

GRAPHIC LCD

This is an external display and knob/button that provides the same kind of on-machine information and control that you get on newer
3D printers.

- **Price:** $45, **ROI:** 4
- **Ease of installation:** 9
- **Link to part:** cohesion3d.com/shop/peripherals/graphic-lcd-control-panel-with-adapter
- **Instructions:** cohesion3d.com/knowledgebase/graphic-lcd-overview
- **Recommendation:** NICE TO DO

SUMMARY

I paid $454 for the OMTech K40, and $1,203 for the upgrades. Including sales tax in Austin, Texas, my final cost for this whole system was $1,794.

I was skeptical that a 40W laser cutter/engraver would be a practical tool. But despite its limited workspace (12″×8″, or about 300mm×200mm) the range of materials it works with combined with the ease of setup and use has made my K40 a go-to tool, especially for creative projects, in my shop. Plus, it was tons of fun to mod

and upgrade!

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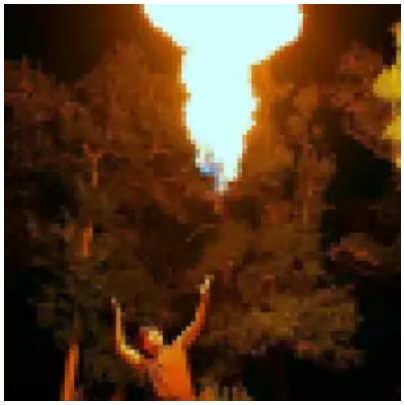

By Tim Deagan

Tim Deagan (@TimDeagan) likes to make things. He casts, prints, screens, welds, brazes, bends, screws, glues, nails, and dreams in his Austin, Texas, shop. He's spent decades gathering tools based on the idea that one day he will come up with a project that has a special use for each and every one of them.

Tim likes to learn and try new things. A career troubleshooter, he designs, writes, and debugs code to pay the bills. He has worked as a stagehand, meat cutter, speechwriter, programmer, sales associate at Radio Shack, VJ, sandwich maker, computer tech support specialist, car washer, desk clerk, DBA, virtual CIO, and technical writer. He's run archeology field labs, darkrooms, produce teams, video stores, ice cream shops, consulting teams, developers, and QA teams. He's written for Make: magazine, Nuts & Volts, Lotus Notes Advisor and Databased Advisor.

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