

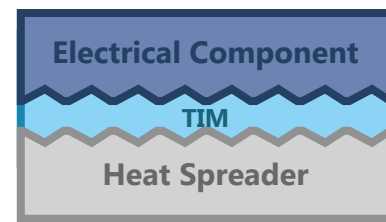
Automated Thermal Interface Material Applicator



Background

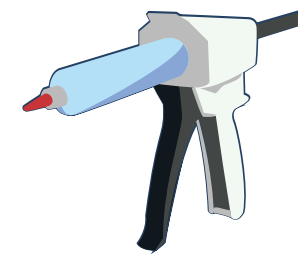
Thermal Interface Material (TIM)

Blue Origin uses TIM to act as a thermal conductivity booster in electronic components. In the avionics lab, technicians apply TIM by hand onto heat spreaders (high-conductivity components used to draw heat away from electronics).



Current Application Process

The technicians at Blue Origin currently use a handheld machine to apply TIM to circuit boards and heat spreaders. This process uses a caulk gun filled with TIM and manually apply the paste, which is a time consuming and inefficient method.



The Challenge

Blue Origin tasked us to make a CNC automated TIM dispensing machine. This process must be repeatable and the machine must be rebuildable. This will both reduce time and labor for this process, but it will also allow for accuracy and complete control over the dispensing process.

Solution

Removable Back

Allows easy access to all electrical and pneumatic components.

Modular Fixturing

Designed to securely hold most heat spreader and PCB boards

40x40 in Footprint

Fits most lab and workstation table sizes.

Pneumatic TIM Dispensing Nozzle

Binary on/off valve to control flow of TIM material from pressurized storage vessel.

Interface Panel

Houses power, air, and ports for data transfer for ease of use

3-Axis Gantry

Allows precise movement of toolhead through printbed.

Depth-Sensing Camera

Multipurpose camera for topographic scanning of pieces, monitoring of print area.

24x20 Dispensing Area

Able to fit up to 4 large heat spreaders at once to efficiently dispense TIM.

Ergonomic Lift Handles

Lift points for safe and secure moving of device.

Approach

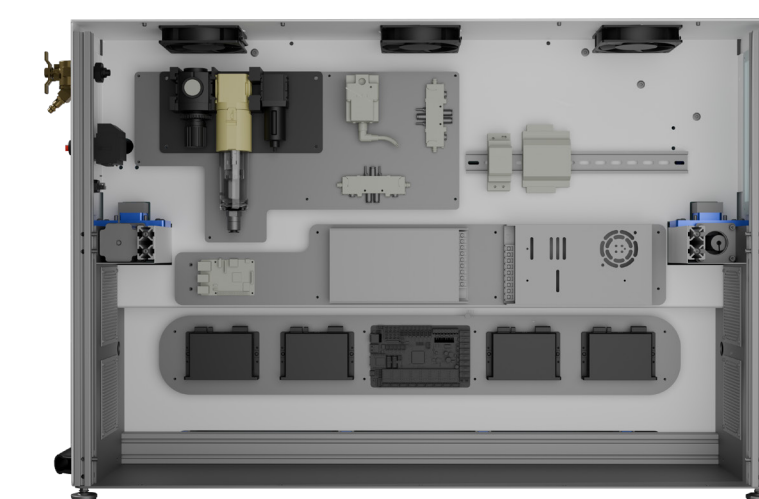
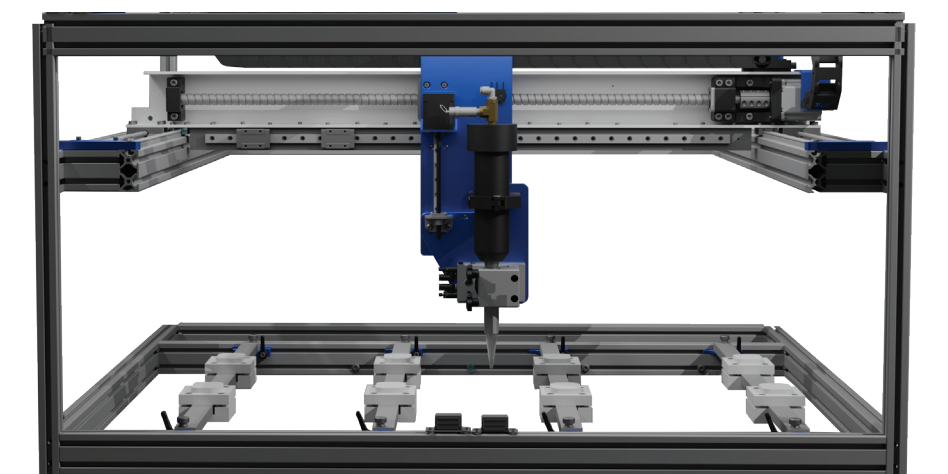


Nozzle Prototyping

To determine which nozzle type would be most effective for dispensing TIM, we prototyped and analyzed 5 nozzle types. These prototypes heavily influenced our decision to purchase an off-the-shelf nozzle.

Gantry Development

We initially built a bare-bones 40 x 40 in gantry to test the motor movement, X, Y, and Z-axis capabilities, and initial wiring. We were able to fine-tune the print area and add a Z-axis for vertical movement.

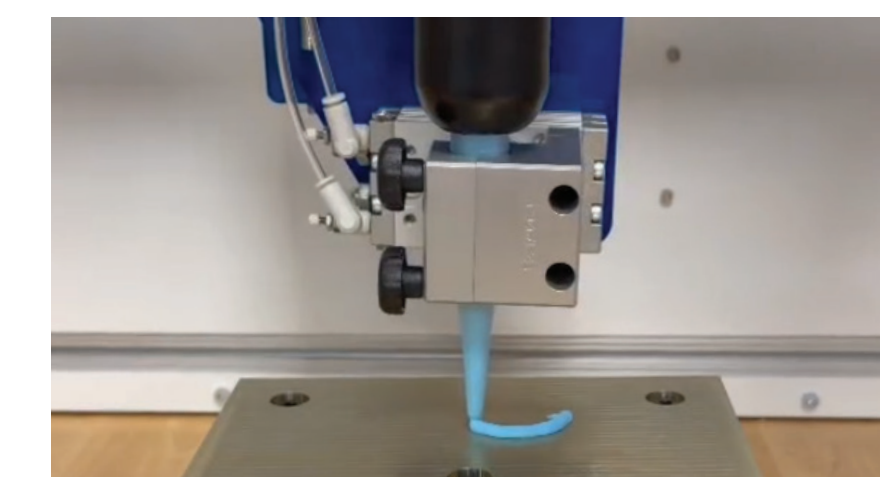
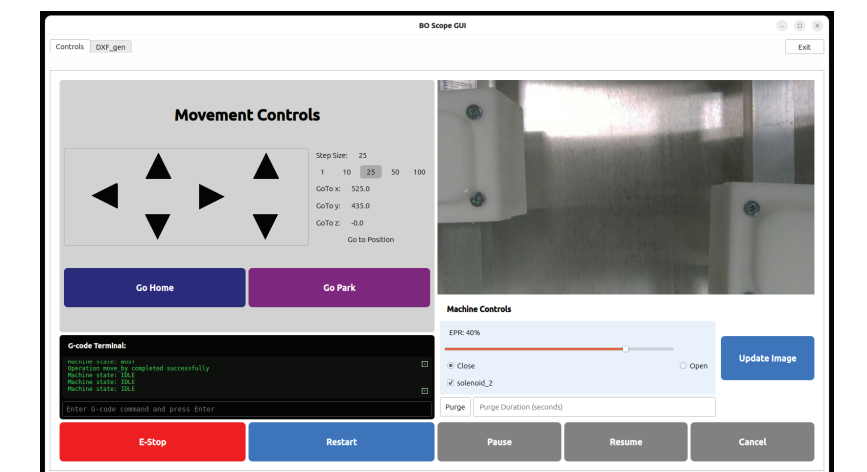


Electrical Integration

The electrical interface utilizes 48V and 24V rails powered by standard 120V power. The system has integrated mechanical and software safety measures to allow safe and swift shutdown when needed.

User Interface

The User Interface allows for easy usage of the machine. Technicians easily move the gantry and control the pneumatics with the program. The UI contains a built-in GCODE generator, where the user selects parts of the boards to print on.



Testing

After the machine was built and integrated with electrical and software, we tested the dispensing of TIM. This started with lines, circles, and basic shapes, and later moved to converting DXF drawing files into print paths.

Team



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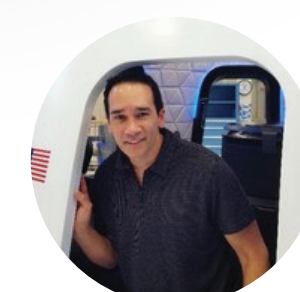
Austin Cline



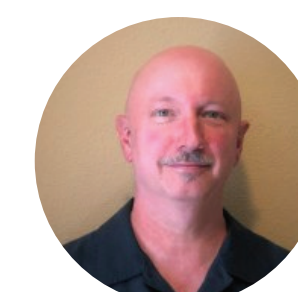
Rohan Giancaspro



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David Llapitan
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Alan Tate
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Impact

The TIM dispensing machine provides an efficient and reproducible application method, which can be easily spread to other locations to have uniform application across facilities. It saves technicians time and hand strain during the dispensing process on precision components, and saves hours of labor, allowing the technicians more time to work on other components. This machine provides precision that eliminates human error and applies an accurate, repeatable coating of TIM to improve the quality of life in the lab.