

# Programmable Turntable Indexer

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Following our successful design of a replacement for a no-longer-available controller our client, Island e-Beam, turned to us for another. Both are used in their vacuum deposition system. The first, a sweep controller, controls the motion of an electron beam which bombards a target coating material to vaporize it. See our white paper at [www.srqtechnology.com](http://www.srqtechnology.com). Under *Digital Designs*, click *Touchscreen*. Or, you can see it at [www.islandebeam.com](http://www.islandebeam.com). Under the *Electronics* tab, click *XY Sweep*.

Our new design, the CI-1400 Crucible Indexer, controls the position of a turntable containing a selection of coating materials. It fits side-by-side with the sweep controller in a standard control rack. (As of this writing the Island e-Beam web site still shows the old, obsolete indexer.)

### The application.

A film of a normally-solid material is deposited by vaporizing it in a high-vacuum chamber. As mentioned above, vaporization is done by bombarding the target material with a controlled, high energy electron beam. The vapor deposits on the objects to be coated, also located inside the chamber.

Some applications require more than one coating material. Rather than breaking the vacu-

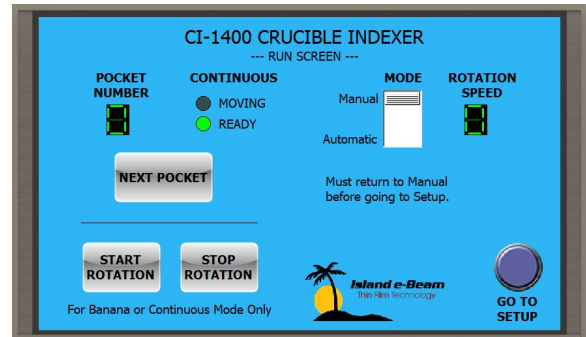


Figure 1: The indexer's Run screen

um, opening the chamber, changing the material, closing the chamber and again pulling a vacuum, a turntable is used.

Two, three or more materials are placed in crucibles on a rotating turntable. Figure 2(a) shows a four-crucible turntable. The indexer starts at crucible #1 then, for each additional material, steps the turntable to the next crucible. A stepper motor, located outside the chamber to avoid being coated, is connected to the turntable via a rotary vacuum feed-through.

### What it does.

The Crucible Indexer controls the rotation from one crucible to the next, but that's not all. Two other functions are needed.

One is the "Banana" mode. Figure 2(b) shows a

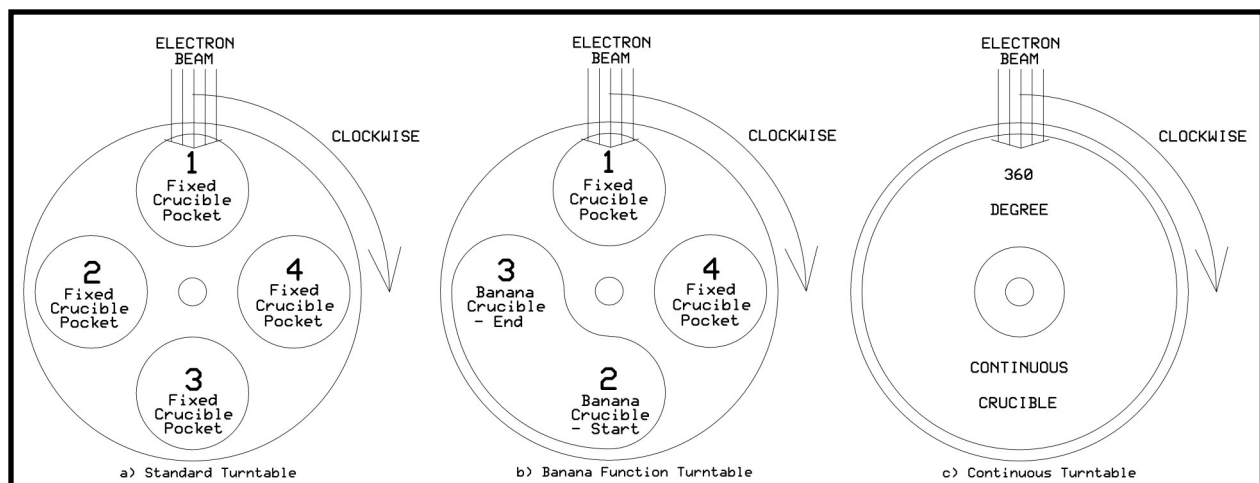


Figure 2: Turntables for three different applications

four-position turntable with a banana-shaped crucible. In this application the material in the banana crucible usually needs to be coated thicker than the other two. The indexer begins by holding the turntable steady at crucible #1. Then, when instructed, it advances to position 2 and proceeds to rotate back and forth between positions 2 and 3. After that coating is complete it advances to position 4.

The other is the Continuous mode, Figure 2(c). This turntable holds a large amount of a single material in a circular, donut-shaped crucible. The turntable rotates continuously under the electron beam during the coating operation.

In the Banana and Continuous modes rotation speed is variable. Some materials vaporize slowly and so need a long time under the electron beam. Others may melt when heated too much and so must be rotated quickly. The operator chooses the speed when programming the job.

Four positions are shown, but any number from two to eight may be programmed with any combination of fixed and banana pockets. The pockets do not need to be equally spaced.

*How it is used.*

Figure 3 shows the Set-up Screen. The indexer remembers its last settings when powered up, but this screen usually is checked first to verify or change settings. The operator starts by choosing any number of pockets from 2 to 8 along with the rotation speed. The buttons on the left side of the screen then allow the user to set the position and type of each pocket. He or she also can choose the Continuous mode instead of normal pockets. A BCD mode (remote input, discussed below) also is offered in which a remote device or switches controls the turntable.

Pressing “Return to Run” brings up the Run Screen (Figure 1). In the Normal mode the user simply pushes “Next Pocket” to move to the next crucible. “Start” and “Stop Rotation” function only in the Banana and Continuous modes.

“Automatic” selects the BCD remote input mode. The display shows the operation, but all controls are locked except for returning to Manual. Two different types of BCD coding are possible, selected by the “BCD Mode” switch on the Set-Up screen. Rear-panel inputs set the pocket position and, if a Banana pocket is selected, also control Start and Stop Rotation. Continuous operation is not available in the Automatic mode.

*The design.*

SRQ Technology worked with Island e-Beam to understand the operation of the original indexer. We then discussed and agreed upon specification for the new design. Island e-Beam provided the test facility as development proceeded. JH Technology, who now manufactures the product for Island e-Beam, assisted in the physical design of its housing.

All control functions were programmed into the touch-screen display, a gen4 display from 4D Systems ([www.4dsystems.com.au](http://www.4dsystems.com.au)). Simple interface circuitry connects the display to the motor, a Teknic Clearpath servo motor operating in the step and direction mode. ([www.teknic.com](http://www.teknic.com)).

Basic operation seems simple: count and remember steps and direction. Program complexity involved making sure every button, function and remote input operated properly and, especially, interacted correctly with each other. The motor does not provide any position feedback.

The motor was selected and the turntable system designed by our client, Island e-Beam. The

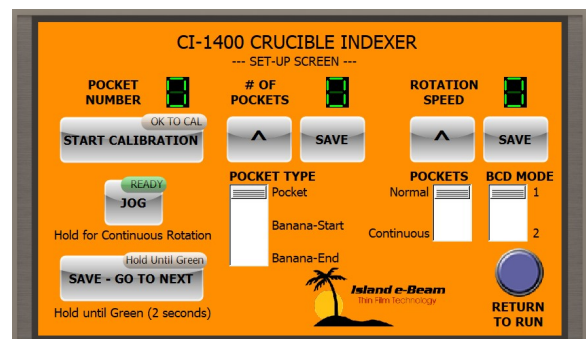


Figure 3: The indexer’s Set-up screen

display and electronics were housed in a half-rack control enclosure. This was chosen for compatibility with the rest of the sweeper controls: a much smaller design would have been possible.

*Conclusion.*

SRQ Technology successfully design a new turntable position controller, now completely tested and approved by our client. It is being manufactured for Island e-Beam by JH Technology ([www.jhtechnology.com](http://www.jhtechnology.com)), a manufacturer of industrial measurement and control products, who also assisted in the enclosure design. The three companies are located in the Sarasota-Bradenton FL area and have cooperated on previous projects.