Spin Coating Application for Semiconductor Wafers

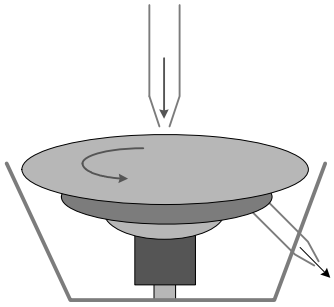
Accurate velocity-contouring for controlled coating thickness

Application Challenge: Maximize the uniformity of thin film thickness

Spin coating is a procedure used to apply uniform thin films to flat substrates. In short, an excess amount of a solution is placed on the substrate, which is then rotated at high speed in order to spread the fluid by centrifugal force. The thickness of the coat is related to the spinning velocity, and for how long it is spinning at different speeds. Acceleration also affects the coated film's properties as it provides a twisting force to the resin. Spin speeds vary between 500 rpm and 10,000 rpm, depending on the resin used and the required thickness.

Application considerations:

Feature/Function	Units
Velocity range:	500 rpm – 10,000 rpm
Accuracy and repeatability:	+/- 1 rpm
Accelaration/ Deceleration:	+/- 1 rpm/sec



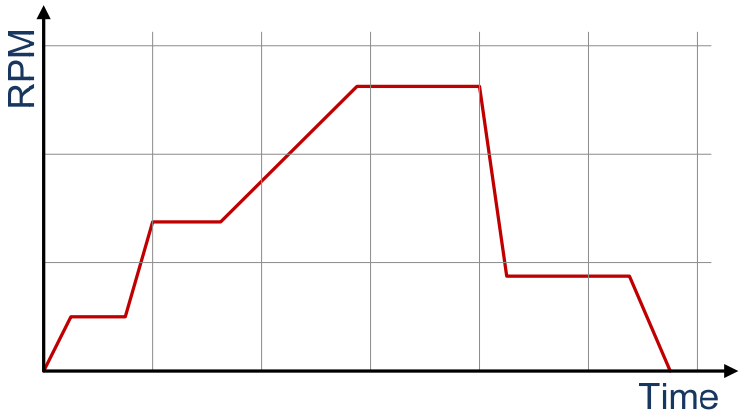
Spin Coating Process

Motion Control Solution

The diagram on page two shows an implementation using an ION 500 Digital Drive to control the spin velocity and acceleration. The system host computer controls the ION 500 through a serial RS485 link.

Velocity profile mode with time break points

Using the velocity profile mode the system can be set up to change the velocity at predetermined time points that match the specific thin film coating recipe. In velocity contouring profile mode the motion is controlled by changing the acceleration, velocity, and deceleration parameters while the profile is being executed.



Breakpoints

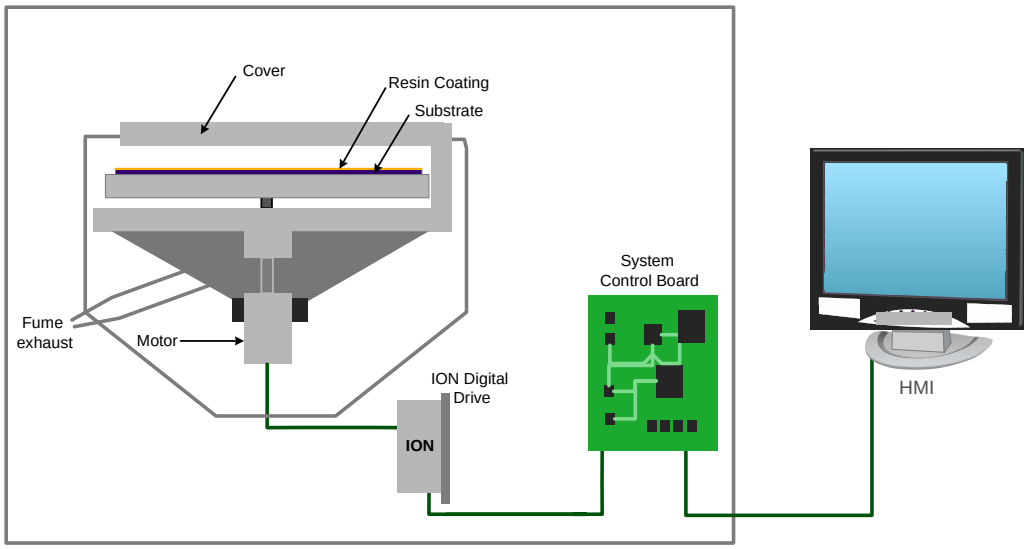
The ION supports up to 2 breakpoints. The trigger condition can be one of 10 parameters. For this application the trigger condition is time. At each trigger point the acceleration and velocity parameters are updated and the next set of parameters is buffered in preparation for the next trigger.

Field Oriented Control (FOC)

Field oriented control is ideal for this high RPM spinning application. Field Oriented Control provides the smooth motion at slow speeds as well as efficient operation at high speeds. FOC also can improve motor efficiency and can help in motor sizing. Also, the fully digital control loops, and easy to use hardware trace feature for ultra-accurate tuning can improve the overall motion system.

Auto tuning, set-up features and programming

Pro-Motion® GUI offers an axis wizard which helps designers quickly configure motion architectures for testing and includes an auto-tuning feature for both current loop and position loop of servo motors. Scope tracing of motion parameters is a feature offered that is a useful tool for this application, as a way of measuring the velocity contouring profile. Programming is managed with C-Motion®, a source code library of motion commands for development of C/C++ programs that run on the motion processor.



The figure above illustrates the motion control connections from the system control card to the digital drive, motor and spin coating substrate. The digital drive provides motor control and amplification and can be connected via CAN or serial communication.

The motion control features and products described in this solution would also apply to many other industrial applications such as spindle control, bar code reader or drum scanners/printers.

The **ION® Digital Drive** is a compact, fully enclosed module that provides high performance motion control, network connectivity and power amplification for DC brush, brushless DC or step motors. Using advanced MOSFETs and surface mount technology, ION provides very high power density in a rugged, flexible form factor. It performs profile generation, servo compensation, stall detection, field oriented control, digital torque control and many other motion control functions.

Contact our customer support team at +1 781 674 9860 for more information including details on Developer's Kits and application support. We would like to assist you in improving your motion system.