High-Speed Centrifuge Motion Control Application

Very high speed BLDC rotation while maintaining perfect position registration

Application Challenge:

Centrifuges are common elements of many medical and biotech laboratory instruments. They require very high rotation speeds, and often have a need for positioning to receive, and deliver, samples. Quadrature encoders give the lowest cost, but will we lose quadrature counts at high speeds?

Application considerations:

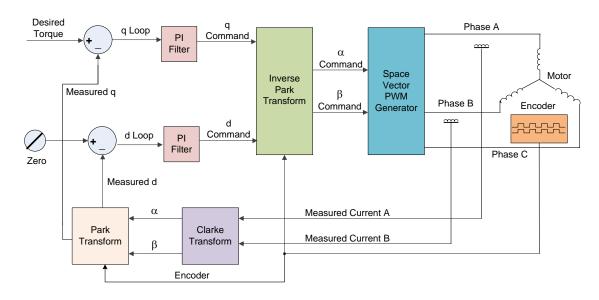| Feature/Function	Units
Speed:	20, 000 rpm
Architecture:	Single Access Module
Motor Type:	Brushless DC
Motor Power:	350 W

Motion Control Solution

The diagram on page two shows an ION 500 Digital Drive module connected by RS-485 serial to a host PC. A 60V BLDC motor will be driven using Field Oriented Control to maximize speed. The motor will utilize a low-cost quadrature encoder with index signal to provide automatic on-the-fly position correction. Using the ION, position profile mode will be used throughout to execute the spin profile and land the samples to an exact destination.

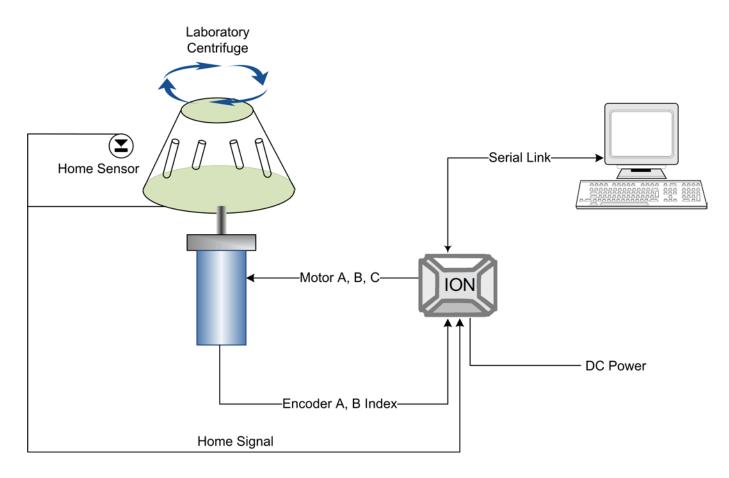| Components	Specification	Description
Motor:	350W Brushless DC Motor	Permanent Magnet Brushless DC motor with 1,024 count encoder
Controller:	ION 500W Digital Drive	Provides RS-485 communications, Field Oriented Control, position control, encoder feedback and quadrature auto-correct feature
Hardware:	Centrifuge w/ optical home sensor	Top speed 20,000 RPM, encoder directly encoder motor angle. Home sensor initializes position reference

Field Oriented Control (FOC)

Field Oriented Control (FOC) provides a significant advance over Hall-based control in the area of efficiency and top speed. Typically, top speeds are improved 10-15% using FOC, which utilizes special mathematical transforms to determine an optimum multi-phase vector command at a given moment in time. The ION manages all of these details automatically. The user simply specifies the desired speed profile and destination position.

Automatic Position Correction

Quadrature encoders may occasionally lose position counts during high speed motion. In position-sensitive applications, these small errors can eventually accumulate and result in mis-registration. The solution is on-the-fly position correction using an index signal. Upon power up, the ION automatically records the location of the first index, and thereafter makes small adjustments as needed to eliminate encoder count losses.

The figure above shows an ION Digital Drive, which contains a single-axis motion controller and amplifier, driving the centrifuge. The centrifuge provides quadrature A, B, and Index signals, and a home signal is input to the ION to reference the axis after power up.

All **ION Digital Drives** provide high performance motion control supporting multiple motor types including DC brush, brushless DC, step and microstepping motors, and are based on PMD's Magellan® Motion Processor, which provides user-selectable profile modes including S-curve, trapezoidal, velocity contouring and electronic gearing.

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.