
Linear Velocity Sensing in a PC Board Drilling Machine

According to Faraday's Law, moving a magnet through a coil of wire will induce a voltage proportional to the magnet's velocity and field strength. By using this principle of magnetic induction, with a permanent magnet and a fixed geometry, Trans-Tek Series 100 Linear Velocity Transducers (LVT) provide a simple yet accurate means of measuring linear velocity.

The coil winding is divided into two sections, whereby the N (North) pole of the magnet induces a voltage in one coil and the S (South) pole induces a voltage in the other coil. With the two coils connected in series-aiding, a DC voltage output is generated that is proportional to the magnet's velocity.

One OEM user of Trans-Tek LVT's is a prominent manufacturer of precision drilling equipment for the circuit board industry. These highly productive machines provide a reliable and accurate drilling process with minimal operator intervention. A single machine is used to produce literally millions of drill holes per day.

One very popular model of drilling machine made by Dynamotion that utilizes a Trans-Tek LVT is the Six-Pack. The drilling mechanism is referred to as the Z axis drive, where motion is provided by a linear motor. Peak thrust of the motor can reach 150 lb of force. An air-bearing spindle, driven by the linear motor, yields the highest *mean time before failure* attainable with this type of equipment. The spindle, which

can rotate at speeds up to 110,000 rpm, is guided by two shafts which are supported by four pre-loaded ball bushings. The LVT is directly in line with the drilling mechanism. This configuration allows the core magnet to move through the center of the LVT with each up and down motion of the spindle assembly. Please see the figure below and note the LVT mounted vertically at the top of the assembly.

The output signal of the LVT is the main component of the velocity control loop and is checked continuously with the servo algorithm. If an error is detected causing the system to speed up or slow down, a correction is made by the controller. This self-adjustment allows the mechanism to stabilize and creates a more consistent drilling process.

Stability of the drilling machine is a main design focus for high speed and high accuracy operation. By incorporating the Z axis drive, along with a transducer and excellent guidance systems, this company has ensured maximum stability over millions of cycles.

The primary benefit realized with the Linear Velocity Transducer is its simplicity. No excitation voltage is required, while the DC voltage output is varied only by the velocity of the moving magnet through the center of the device. This basic principle makes the LVT easy to use for countless applications.