

## CLUTCH AND ENCODER CHARACTERIZATION

### *Challenge*

Our customer needed an accurate way of testing encoders and electromagnetic clutches from suppliers to characterize performance, errors, and imperfections for manufacturing quality assurance.

### *Viewpoint's Solution*

Viewpoint developed a system using National Instrument's LabVIEW and Viewpoint's DIO-128 Dynamic Digital I/O System to perform the clutch and encoder tests.

### *Technical Highlights*

- NI's LabVIEW Software
- DIO-128 enable sub microsecond precision
- Multi-board synchronization using the RTSI bus
- Excel compatible output files

### *Description*

#### Clutch Test

The clutch test system was designed to repetitively drive the clutch under test and measure specific parameters such as time to engage, time to disengage, time to full speed, and time to zero speed. The clutch test software prompts the user to input timing information for clutch actuation and release. The clutch is driven by solid state relays connected to the digital outputs of the DIO-128. The DIO-128's time stamped digital output capabilities permit the times of transitions on its digital outputs to be explicitly specified. A digital waveform is calculated by the software and downloaded to the DIO-128 to precisely engage and disengage the clutch at the specified time intervals. An analog velocity sensor connected to National Instruments MIO16E-4 data acquisition card and synchronized with the DIO-128 using National Instrument's RTSI bus is used to monitor

velocity of the driveshaft attached to the clutch. Because of the high accuracy of the DIO-128 and the ability to synchronize A/D measurements with the digital output pulses, measurements were made with microseconds of precision.

The software can run through numerous cycles of clutch actuation and calculate statistics that are displayed on a screen. A graph of the clutch drive shaft velocity for the entire clutch actuation cycle is also displayed on the screen. There is an option that allows the user to choose to save data to an Excel file or print a hardcopy.

#### Encoder Test

The encoder test system enables Viewpoint's client to characterize the positional accuracy (spacing, repeatability, etc.) of each encoder pulse. Encoder testing can be performed on incremental or quadrature encoders. The encoder is turned at a constant velocity and a DIO-128 is used to accurately measure the timing of the pulse train generated by the encoder with 0.5 microsecond precision. The DIO-128's time stamped digital input capabilities make it ideally suited to this application's demand for precise time measurement of transitions on digital inputs. Encoder parameters such as encoder type and pulses per revolution are entered into the software and used in the analysis of the timing data obtained from the DIO-128. The results of this analysis are data characterizing the measured position of the encoder. This measured position is compared to the expected position to calculate position error. Statistics on pulse widths, waveform period, jitter, position error, etc. are displayed on the screen along with a real-time graph of the waveform(s) generated by the encoder.

Results from the test may be printed or saved with the raw data to an Excel compatible spreadsheet file for further analysis and archival purposes.



Encoder Measurement ✕

### Encoder Measurement

Part Number:

Supplier:

Sample #:

Mode:  1 channel  
 2 channels

Pulses/Rev:

Test Revolutions:

Deglitch Signals

Deglitch Pulses   $\mu$ s

GO

Speed (RPM)

952.50

Revs to go

-0.43

Encoder A

Encoder B

Channel	Stats	On Time (usec)	Off Time (usec)	Period (usec)	Jitter (deg)	Symmetry (deg)	Position Error (arcmin)	Quad Offset (deg)
1	Min	151.500	125.000	287.000	0.023	169.642	-22.365	62.340
	Max	196.000	170.000	355.500	35.138	216.786	5.926	124.312
	Mean	162.066	159.125	321.191	0.269	181.648	-2.643	96.733
	Std Dev	0.913	0.930	0.960	0.843	0.885	5.865	1.429
2	Min	149.500	133.000	306.000	0.050	172.125	-11.764	0.000
	Max	188.500	172.000	335.500	17.230	200.250	8.229	0.000
	Mean	163.290	157.901	321.191	0.358	183.020	-2.884	0.000
	Std Dev	1.067	1.007	0.752	0.757	0.838	5.845	0.000

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