

# APPLICATION NOTE

## HOW MINIATURE ENCODERS ENHANCE PERFORMANCE AND REDUCE COST IN MOTION CONTROL SYSTEMS

Motion system designers constantly strive to meet the goal of improved performance at lower costs. Speed, resolution requirements, space constraints and manufacturing procedures must all be addressed. One important design criteria that affects these objectives is encoder selection. Sensor size, ease of set up and alignment, as well as inherent flexibility, all have a direct impact on system performance and cost.

The new Mercury Series encoder excels in each of these areas. It is capable of high speed and high resolution. Its sensor is nearly 50% shorter than the smallest encoder currently available. And finally, set up and alignment procedures are possible with virtually no training or test gear. The net result is a significant reduction in manufacturing costs.



Mercury encoder sensors Z height is as little as 5.6 mm high

The Mercury Series encoders are half the height of the smallest competitive encoders. This allows engineers to dramatically reduce the size, weight and volume of their motion system designs.

Another benefit of the Mercury Series is that within product lines, the same miniature sensor may be used for both linear or rotary applications, at either low or high resolution. This greatly simplifies engineering design and field support. And PC board sensors enable mounting directly to the PC board for sub-miniature motion control applications.

### The First and Only Programmable Encoder System

Where system flexibility is paramount, the Mercury 2100 or 3100 with SmartSignal™ electronics and SmartSignal™ software enables programmability of key parameters. These features produce unique benefits, including customer-programmable interpolation in integer steps for quick performance optimization of proto types or custom motion systems. SmartSignal software displays engineering units, data plots and captures data. It also enables technical support over the Internet.



SmartSignal™ Software enables encoder programming, set up and diagnosis in under 5 minutes.

Another critically important benefit of the Mercury programmable encoder systems is intuitive sensor alignment using LED indicators. The SmartSignal electronics' onboard computer and the broad alignment tolerances of the sensor make alignment quick and easy. Alignment and automatic index set up allows assemblers with little training or equipment to perform these procedures. This reduces manufacturing costs and improve productivity.

### High-performance encoders for leading-edge motion systems

The Mercury Series encoders provide linear resolutions up to 0.020µm and rotary resolutions up to 16.8M CPR for high performance motion platforms. And high speed motion at high resolution is possible as well— up to 576mm/sec at 0.020µm resolution. In summary, the new technology exemplified by the Mercury Series encoders can provide design engineers with performance improvements, size reductions and overall cost savings.

### MOTION CONTROL APPLICATIONS

- MICRO ACTUATORS
- LINEAR MOTORS
- SINGLE AND MULTI-AXIS STAGES
- AIR BEARING SYSTEMS
- SPECIAL HIGH SPEED, HIGH RESOLUTION SYSTEMS
- FIBER OPTICS ASSEMBLY AUTOMATION
- CUSTOMIZED MICRO-MOTION SUBSYSTEMS

### MERCURY ENCODER BENEFITS

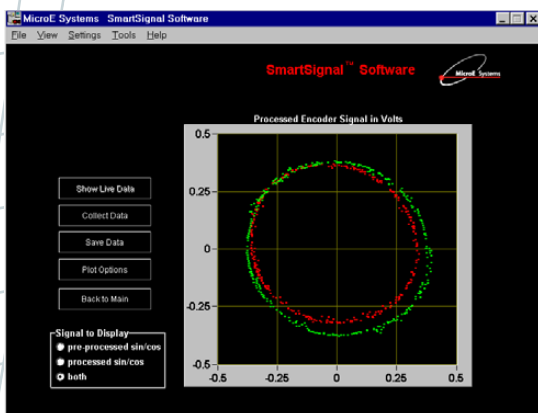
- SMALLER STAGES CAN BE USED, REDUCING SYSTEM FOOTPRINT
- SMALLER COMPONENTS WITH LOWER MASS, ACCELERATE FASTER FOR GREATER THROUGHPUT
- SMALLER MOTION SYSTEM COMPONENTS USE SMALLER MOTORS AND DRIVES, REDUCING COST
- SMALLER MOTION SYSTEMS USE LESS POWER

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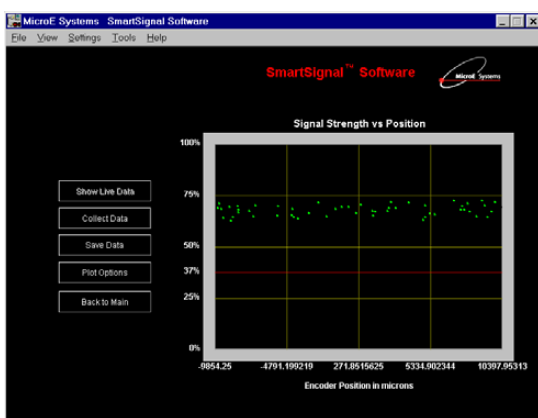
## How Motion Control Software can Improve System Performance and Reduce Time to Market

Motion control system engineers need to boost system performance, reduce time to market and improve manufacturing productivity. Now, encoder software can be utilized to help achieve these goals. It's called SmartSignal software and it allows engineers to reprogram encoder resolution and output bandwidth, dynamically.

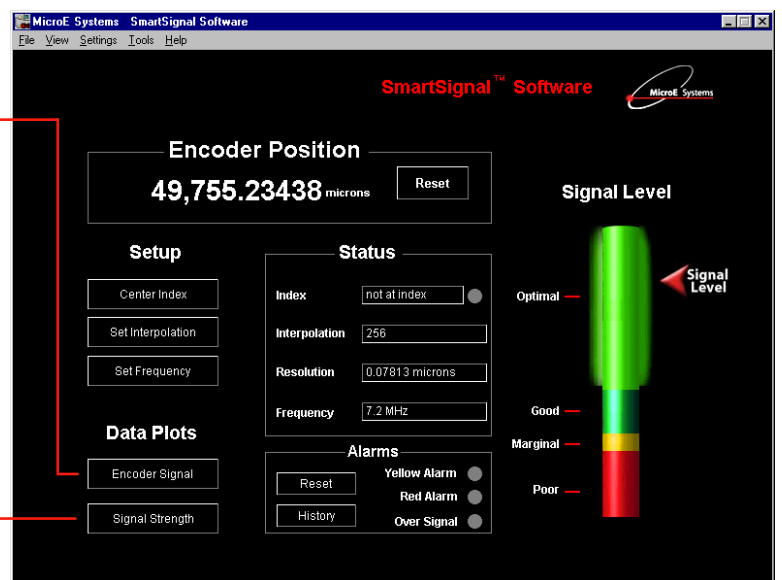
In addition, the software provides diagnostic tools and remote communication via the Internet. Now, for the first time design and manufacturing engineers have a common software tool that can enable both improved system performance and enhanced productivity.



Encoder signals can be emailed to MicroE for rapid technical support.



The SmartSignal Software system includes diagnostic tools such as the signal strength plot that lets you isolate problems quickly.



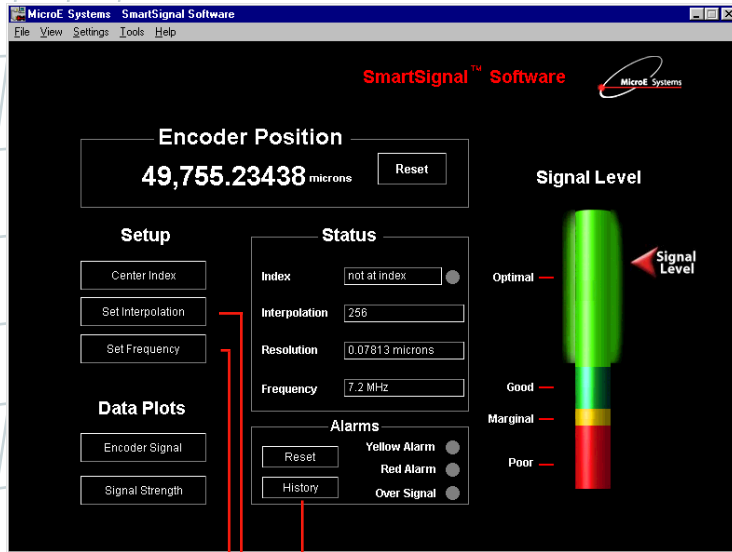
The SmartSignal Software system includes Windows software, cables a power adapter and a computer interface adapter for Mercury 2100 and 3100 series encoders.

### Dynamic performance tuning

Getting the best performance from a motion platform requires the right system resolution at the right motion speed. Traditionally this meant specifying the desired resolution and bandwidth from an encoder supplier. Yet, motion engineers often encounter applications where the ideal encoder resolution is unknown until they try out the system for the first time.

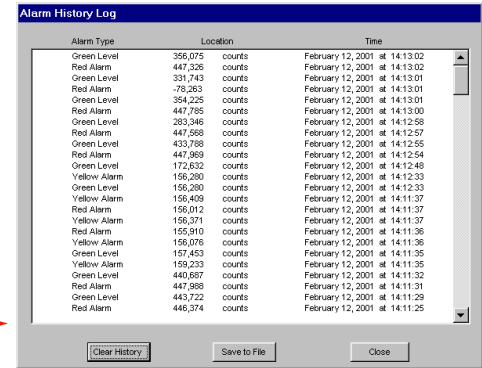
Too little resolution causes bumps where smooth motion is required; too much resolution can overwhelm the motion controller during fast moves, causing critical system errors. By standardizing on the Mercury 2100/3100 encoder platform with SmartSignal software, dynamic set up and loop tuning is now possible on the production floor.

The SmartSignal Software offers engineers a rich source of data on system performance. In addition it facilitates set up and allows easy motion loop tuning.



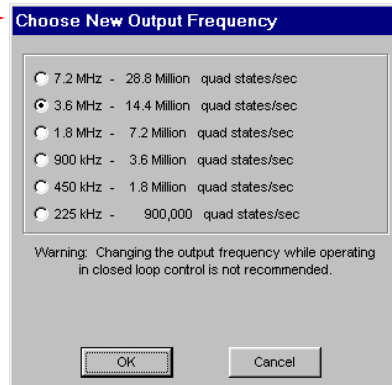
The main interface displays the following information:

- Encoder Position:** 49,755.23438 microns (with a Reset button)
- Signal Level:** A vertical bar with a green-to-red gradient, labeled with Optimal, Good, Marginal, and Poor levels.
- Setup:** Buttons for Center Index, Set Interpolation, and Set Frequency.
- Status:** Fields for Index (not at index), Interpolation (256), Resolution (0.07813 microns), and Frequency (7.2 MHz).
- Data Plots:** Buttons for Encoder Signal and Signal Strength.
- Alarms:** Indicators for Yellow Alarm, Red Alarm, and Over Signal, along with Reset and History buttons.



Alarm Type	Location	Time
Green Level	356,075 counts	February 12, 2001 at 14:13:02
Red Alarm	447,326 counts	February 12, 2001 at 14:13:02
Green Level	331,743 counts	February 12, 2001 at 14:13:01
Red Alarm	-78,263 counts	February 12, 2001 at 14:13:01
Green Level	354,225 counts	February 12, 2001 at 14:13:01
Red Alarm	447,785 counts	February 12, 2001 at 14:13:00
Green Level	283,346 counts	February 12, 2001 at 14:12:58
Red Alarm	447,568 counts	February 12, 2001 at 14:12:57
Green Level	433,788 counts	February 12, 2001 at 14:12:55
Red Alarm	447,969 counts	February 12, 2001 at 14:12:54
Green Level	172,532 counts	February 12, 2001 at 14:12:48
Yellow Alarm	156,280 counts	February 12, 2001 at 14:12:33
Green Level	156,280 counts	February 12, 2001 at 14:12:33
Yellow Alarm	156,409 counts	February 12, 2001 at 14:11:37
Red Alarm	158,012 counts	February 12, 2001 at 14:11:37
Yellow Alarm	156,371 counts	February 12, 2001 at 14:11:37
Red Alarm	156,910 counts	February 12, 2001 at 14:11:36
Yellow Alarm	156,076 counts	February 12, 2001 at 14:11:36
Green Level	157,453 counts	February 12, 2001 at 14:11:35
Yellow Alarm	158,233 counts	February 12, 2001 at 14:11:35
Green Level	440,687 counts	February 12, 2001 at 14:11:32
Red Alarm	447,988 counts	February 12, 2001 at 14:11:31
Green Level	443,722 counts	February 12, 2001 at 14:11:29
Red Alarm	446,374 counts	February 12, 2001 at 14:11:25

Encoder Alarm History log lets engineers rapidly review any system problems.



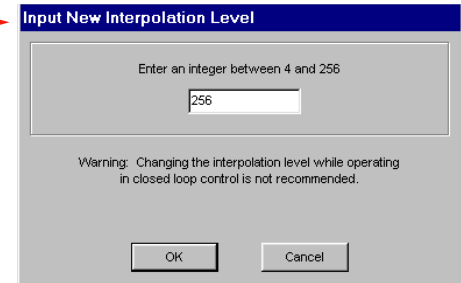
**Choose New Output Frequency**

- 7.2 MHz - 28.8 Million quad states/sec
- 3.6 MHz - 14.4 Million quad states/sec
- 1.8 MHz - 7.2 Million quad states/sec
- 900 kHz - 3.6 Million quad states/sec
- 450 kHz - 1.8 Million quad states/sec
- 225 kHz - 900,000 quad states/sec

Warning: Changing the output frequency while operating in closed loop control is not recommended.

OK Cancel

Encoder output frequency may be set to match that of the controller for optimal performance.



**Input New Interpolation Level**

Enter an integer between 4 and 256

256

Warning: Changing the interpolation level while operating in closed loop control is not recommended.

OK Cancel

Encoder interpolation depth may be set in integer levels.

Resolution can be reprogrammed in integer interpolation steps, giving motion system engineers exactly the resolution they need. Maximum encoder A-quad-B output frequency is also reprogrammable to match the encoder to the controller. Settings are changed using a PC and the SmartSignal Software system, which includes the software, cables, power adapter and electronics to interface to the encoder. Changes are instantaneous.

Another critical benefit is the ability to perform complex alignment procedures easily. The Mercury Series' encoder design delivers substantially wider sensor alignment tolerances which, when combined with SmartSignal software makes alignment possible without bulky external test gear or elaborate training procedures. The software's graphical displays provide

visual feedback for precise sensor alignment. This allows assemblers rather than test engineers to perform these operations faster and at lower cost.

#### SmartSignal Software Benefits

- Instantly change interpolation depth or maximum output frequency yourself to quickly optimize your motion system- no need to send the encoder back to the manufacturer to get a different interpolation (Mercury 2100 & 3100)
- Change interpolation levels in integer steps to optimize the encoder's resolution for your application (Mercury 2100 & 3100)
- Quickly set up the encoder using multiple software displays and tools
- Use the software's Position Display to verify your controller's setup
- Use multiple plots with data capture and the alarm history log to rapidly diagnose the motion system
- Get rapid technical support using the Internet