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PRECEEDING

*One Day Seminar On MEMS Devices And Technology In
Mechatronics 2013*



國立高雄應用科技大學



國立高雄應用科技大學機械工程系

N.K.U.A.S. Mechanical Engineering

Micro Electro Mechanical Systems (MEMS)

PREFACE

Thank God, finally editors can completed The Journal Preceeding Student Bridging Course National Kaohsiung University of Applied Sciences (NKUAS).

The National Kaohsiung University of Applied Sciences (NKUAS) Students Bridging Course Journal Preceeding is present as report of all of student who studied in NKUAS. This journal also can be used as reading material which tells about the development in MEMS technology especially in mechatronics devices.

This journal is consisting of ten papers that made by students bridging with title namely:

1. The BMI055 6-Axis Inertial Sensor.
2. The Benefit of Mass Air Flow System PMF 2000.
3. The Function ZW Series Displacement Sensors For Ethercat.
4. Infrared Thermocopile Sensor Micro Electrical Mchanical Systems As Contactless Temperature Measurement: A Literature Review.
5. The Advantages of Model 4807A High Resolution Accelerometer.
6. Global Trend Pico Projector on Mobile Devices
7. LPS331AP Pressure Sensor With Embedded Compensation.
8. ..
9. Super-Sensitive Non-Contact of the D6T Mems Thermal Sensor.
10. Energy Harvesting for Wireless Sensor System With TE-Core.

The editors also want to say thanks to:

1. Prof. Dr. Da-Chen Pang who has lectured all students bridging from Indonesia in mechatronics subject.
2. Chi-Ting Yen (staff of International Office) has helped all students bridging from Indonesia.

Kaohsiung, January 24th 2013
Sincerely,

Editors





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THE FUNCTION ZW SERIES DISPLACEMENT SENSORS FOR ETHERCAT

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Keywords: Sensor, Ethercat, compact sensor heads

Abstract. The Excess ZW Series Displacement Sensors for EtherCAT with Compact Sensor Heads- Sysmac® Automation Platform™, Omron further expands the Sysmac lineup with the addition of new confocal fiber displacement sensors with EtherCAT interfaces to the ZW series released in February 2012. Connection with controllers and drive devices, such as servomotors, via ultra-high-speed open network EtherCAT enables flexible, high-speed machine control. The features of existing ZW series sensors that make them highly-suited to integration into devices have been retained including the following three important features; Ultra-compact and ultra-lightweight sensor head: 24 x 24 x 64 mm and only 105g, Sensor heads with low impact on operating environment: no noise or heat generation, Stable measurement from the same mounting position even for different materials. ZW series confocal fiber displacement sensors is controllers with EtherCAT and sensor heads (2 models with measuring distances of 7 mm and 30 mm). Ultra-compact sensor heads with measuring distances of 7 mm and 30 mm will also be released to enhance the sensor head lineup which currently features 20-mm and 40-mm models. With high-speed digital output through EtherCAT, it is possible to achieve a continuous output with a constant period as short as 500µs - eight times faster than Omron's previous models. This sensor head achieves separation for stable measurement of surface displacement of glass sheets as thin as 75µm while boasting a compact size.

Indtroduction

The Sysmac automation platform 1 launch in July 2011, Omron further expands the Sysmac lineup with the addition of new confocal fiber displacement sensors with EtherCAT interfaces to the ZW series released in February 2012. Connection with controllers and drive devices, such as servomotors, via ultra-high-speed open network EtherCAT enables flexible, high-speed machine control. The Sysmac automation platform has reduced the need for wiring work and has enabled centralized management with one single EtherCAT network allowing connection of the NJ series machine automation controller with vision sensors, AC servomotors/drivers, inverters, and I/O terminals. The addition of the ZW series confocal fiber displacement sensors to the Sysmac automation platform makes machine construction more convenient than ever.



Theoretical Background

1. **The features of existing ZW series sensors that make them highly-suited to integration into devices have been retained including the following three important features:**
 - o Ultra-compact and ultra-lightweight sensor head: 24 x 24 x 64 mm and only 105g
 - o Sensor heads with low impact on operating environment: no noise or heat generation
 - o Stable measurement from the same mounting position even for different materials
2. **The linking of height information and position coordinates helps to improve system productivity**

EtherCAT can be used to connect to servo drives or encoder input slaves to quickly get the position coordinates and ZW displacement. The height information and XY position coordinates can be easily linked, which increases processing precision in machine control applications and facilitates maintenance in the inspection applications, such as helping to isolate errors or carrying out alignment-drift monitoring management.

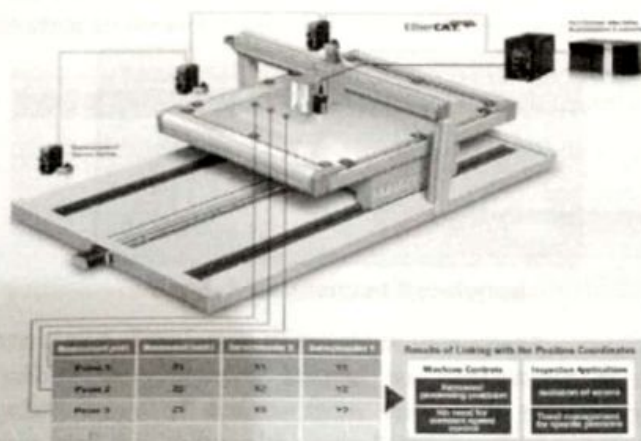


Fig 1. Information Coordinat Position

3. **Shorter machine take times with high-speed digital outputs.**

Response times for measurement commands when using the kind of Ethernet or RS-232C generally used for digital (serial) outputs of displacement sensors are both inconsistent and slow, making them unsuitable for real-time control. With high-speed digital output through EtherCAT, it is possible to achieve a continuous output with a constant period as short as 500 μ s - eight times faster than Omron's previous models. Digital communications also provides great immunity to noise and this solves common problems with analog output methods, such as the inability to support long-distance transmissions and noise countermeasures.

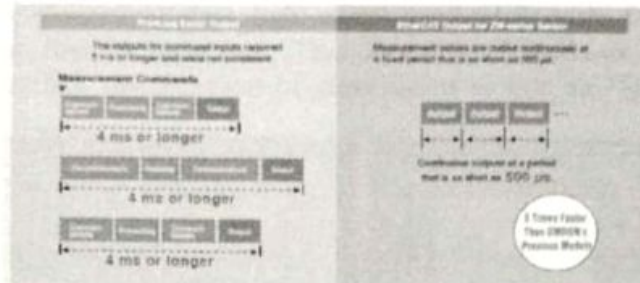


Fig 2. Output Measurement

4. **Improved measurement resolution for multipoint measurement applications**

The high speed and concurrency provided by EtherCAT enable high-precision multipoint measurements with multiple sensors for displacement sensor applications. More than one sensor can perform synchronous measurements of the distance from the sensor to the target surface and the thickness of wide objects such as sheets of metal and glass by eliminating the previous time error in measurements between different sensors.

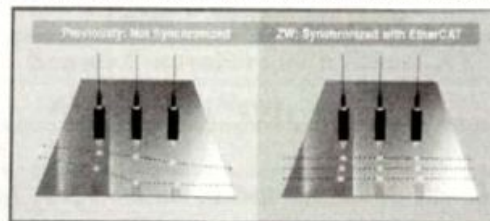


Fig 3. Measurement Resolution

5. **Tracing, adjustment, and simulation of machine movement.**

Sysmac Studio enables development, testing, and adjustment of devices connected via EtherCAT. The entire range of actions from sensing to motion control can be visually represented on screen and this reduces the man-hours required to set up systems and identify problems. There are also offline functions to debug signal control programming. It is also possible to simulate machine operation before actual installation onsite.

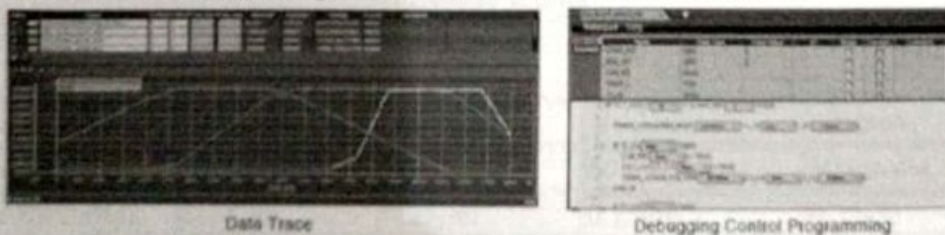


Fig 4. Tracing, adjustment, and simulation of machine movement

* As of November 2012, version 1.04 of Sysmac Studio does not have setting functions for the ZW-series Displacement Sensor and will be upgraded soon.

6. **Sensor head providing stable measurement of the thickness of thin sheets of glass**

The newly-released sensor head with a measuring distance of 7 mm can stably measure the thickness of thin sheets of glass, a feat not easily achieved with conventional compact sensor



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heads. To measure transparent glass, light waves received from the front and back surfaces of the glass must first be separated. This sensor head achieves separation for stable measurement of surface displacement of glass sheets as thin as $75\mu\text{m}$ while boasting a compact size.

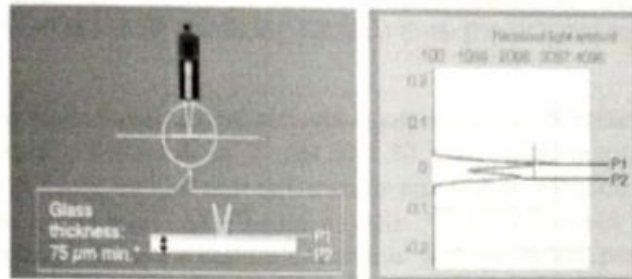


Fig 5. Sensor Head Providing Stable Measurement

ZW series confocal fiber displacement sensors is controllers with EtherCAT and sensor heads (2 models with measuring distances of 7 mm and 30 mm).

Tabel 1. Sensor Of Data

Sensor Controllers with EtherCAT				
	ZW-CE10T (New)	ZW-CE15T (New)		
Input/Output type	NPN	PNP		
External interface	EtherCAT, Ethernet, EtherNet/IP, RS-232C, Analog output, Parallel I/O			
Measurement cycle	500 μs to 10ms			
Filtering	Median/average/differentiation/high pass/low pass/band pass			
Outputs	Scaling/various hold values/zero reset/logging for a measured value			
Number of configurable banks	Max. 8 banks			
Sensor Heads				
	ZW-S07 (New)	ZW-S20	ZW-S30 (New)	ZW-S40
Measuring range	$7\pm 0.3\text{mm}$	$20\pm 1\text{mm}$	$30\pm 3\text{mm}$	$40\pm 6\text{mm}$
Spot diameter	18 μm dia.	40 μm dia.	60 μm dia.	80 μm dia.
Static resolution	0.25 μm	0.25 μm	0.25 μm	0.25 μm
Linearity	$\pm 0.8\mu\text{m}$	$\pm 1.2\mu\text{m}$	$\pm 4.5\mu\text{m}$	$\pm 7.0\mu\text{m}$
External Dimensions	24mm x 24mm x 64mm			
Weight	Approx. 105 g			



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Discussion

The newly-released sensor head with a measuring distance of 7 mm can stably measure the thickness of thin sheets of glass, a feat not easily achieved with conventional compact sensor heads, Sensor heads with low impact on operating environment: no noise or heat generation, Stable measurement from the same mounting position even for different materials.

Conclusion

ZW series confocal fiber displacement sensors is controllers with EtherCAT and sensor heads (2 models with measuring distances of 7 mm and 30 mm). Ultra-compact sensor heads with measuring distances of 7 mm and 30 mm will also be released to enhance the sensor head lineup which currently features 20-mm and 40-mm models. With high-speed digital output through EtherCAT, it is possible to achieve a continuous output with a constant period as short as 500 μ s - eight times faster than Omron's previous models. This sensor head achieves separation for stable measurement of surface displacement of glass sheets as thin as 75 μ m while boasting a compact size.

Reference

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3. <http://www.omron.com/> retrieved January 12th, 2013. Headquartered in Kyoto, Japan, OMRON Corporation is a global leader in the field of automation. Established in 1933