New products
Interference type fiber optic gyro (i-FOG)
Triaxial inertial measurement unit with built-in i-FOG
Third-generation MEMS IMU

Information
Soil Improvement Technology Expo 2018
Security & Safety Trade Expo 2018 (RISCON TOKYO)
Japan International Aerospace Exhibition 2018 Tokyo (JA2018 TOKYO)

Notice of Website Renewal
Yume Kurumin is baked goods sold at Cafe Furatto Hotto in Shopping Town Pier, which is located near Hirugami hot spring resort. The local walnuts that fill Yume Kurumin are carefully cut out one by one by members with a disability working for Yume No Tsubasa. Yume Kurumin is moist and rich with butter taste, and is popular as gift and souvenir. Since it is handmade, and thus cannot be mass produced, it is available only at Cafe Furatto Hotto.

Yume No Tsubasa produces and sells other products such as pain demie, tube cake, pound cake, and increasingly popular apple pie. Menus of the cafe include coffee using coffee beans of Maruyama Coffee established in Karuizawa, oyaki (bun), venison gibier curry, local apple juice, tomato juice, and other food and drink made in the local area. Please visit the cafe when you come to Minami Shinshu.
Introduction

Tamagawa Hightech Corporation

Following Aomori prefecture’s initiatives for attracting enterprises with the aim of regional development, Tamagawa Seiki Co., Ltd., in April 1991, established a local corporation Hachinohe Tamagawa in Kikyono Industrial Complex as its base in Tohoku region. Tamagawa Hightech Corporation started to produce mainly OEM products.

When Hachinohe Plant of Tamagawa Seiki Co., Ltd. was established in February 2000, Hachinohe Tamagawa changed its name to Hachinohe Hightech Corporation and started to supply processed precision parts. From January 2006, the company started sheet metal business, and from October 2009, servo motor sensor business. In February 2012, the company changed its name to Tamagawa High-tech Corporation. Production of large servo motors was transferred from Tamagawa Seiki Second Plant to Tamagawa High-tech Corporation in March 2013, which made the company a hub in Japan for production of servo motor for FA market.

Based on the manufacturing policy of limited production of a wide variety of products, the company tries its best to secure QCD to improve technologies and skills as well as itself so that customers are satisfied with our products.

Tamagawa High-tech Corporation aims to be a company loved by the community and customers, and appreciates your continued support.

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Tour of Iida City and Its Neighborhood

Minami Shinshu Toyooka Marche is surrounded by two alps mountains. It is located along side of the Tenryu River and opened in April 2018. Minami Shinshu area is characterized by small rainfall and big difference in temperature between day and night. Apple, grape, peach, pear, Japanese persimmon and many other fruits are cultivated every season.

With a farm stand selling agricultural products, a restaurant, and a cafe, Toyooka Marche, as a kitchen of Minami Shinshu, is crowded with people.

You can get fresh products in Shikisai Market, the farm stand, because farmers themselves bring in their fruits and vegetables.

It also has processed food and specialty of the region.

Apple pie made only of Fuji Apple produced in Toyooka Village and pickled local vegetables made by farmers are the two most popular products.

At Bakery Cafe Kirara, freshly baked bread and soft cream directly delivered form Nagato Ranch in Shinshu Shirokaba Kogen are popular.

Kitchen Sorara is the restaurant with popular menus of authentic western cuisine with lots of local ingredients such as Minami Shinshu beef and alps salmon prepared by the chef who has experienced in a hotel restaurant.

Handmade deli made mainly of local food ingredients are provided every day at a deli stand so-zai Kurara.

The deli stand has a spacious viewing deck where you can enjoy the view of alps and 360-degree sky without any obstacle. Please visit Roadside Station Minami Shinshu Toyooka Marche.

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Kitchen of Minami Shinshu

Toyooka Marche Roadside Station

Toyooka village

No. 22

[Inquiries]
Roadside Station Minami Shinshu Toyooka Marche
12410, Kuma-shiro, Toyooka village, Shimoina-gun, Nagano prefecture, 399-3202
TEL: 0265-48-8061
Website: https://www.toyooka-marche.jp/
Website in Japanese language only
facebook: https://www.facebook.com/toyookamarche/

[Opening hours]
Shikisai Market: 9:00 a.m. - 6:00 p.m.
(Open until 5:00 p.m. in winter season)
Bakery Cafe Kirara: 10:00 a.m. - 5:30 p.m.
(Open until 5:00 p.m. in winter season)
Kitchen Sorara: 11:00 a.m. - 4:30 p.m.
(Open until 5:00 p.m. in winter season)
Kitchen Sorara: 11:00 a.m. - 4:30 p.m.
(Open until 5:00 p.m. in winter season)
Information: 9:00 a.m. - 5:30 p.m.
(Open until 5:00 p.m. in winter season)
[Holiday] January 1 and 2. and temporarily closed for maintenance.
Kitchen Sorara only is closed on Thursdays.

TAMAGAWA NEWS 12
Interference type fiber optic gyro (i-FOG)

An interference type fiber optic gyro which managed to achieve both low price and 0.1°/h class high precision

Type TA7774 Series

Features
- High-precision [0.1°/h] gyro. Precision required for automated driving level 4 technology for vehicles was realized.
- Low price was realized by applying automated winding technology developed by the manufacturing process of our brushless resolvers (FA-Solver) and servo motors and by optical IC production technology of MEMS gyro oscillator.
- Precision was increased by adopting the closed loop method

Application examples
- Automated driving for vehicles (level 4)
- ADAS (Advanced Driver-Assistance Systems): For construction machine and agricultural machine as an attitude control sensor
- MMS (Mobile Mapping System): As a behavior measuring sensor for mobile objects such as vehicles
- As a complement for quasi-zenith satellites characterized by high-precision positioning
- Compass to measure true azimuth used with shield machine

Diagram

Specifications

<table>
<thead>
<tr>
<th>Types</th>
<th>TA7774</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic range</td>
<td>±200°/s</td>
</tr>
<tr>
<td>Bias repeatability</td>
<td>0.1°/h (1σ) (25°C static)</td>
</tr>
<tr>
<td>Bias instability</td>
<td>0.1°/h or below</td>
</tr>
<tr>
<td>Angular random walk</td>
<td>0.01°/√h or below</td>
</tr>
<tr>
<td>Precision of scale factor</td>
<td>100 ppm or below</td>
</tr>
<tr>
<td>Linearity of scale factor</td>
<td>100 ppm or below Full scale</td>
</tr>
<tr>
<td>Frequency response</td>
<td>40kHz</td>
</tr>
<tr>
<td>Mass</td>
<td>300 g or below</td>
</tr>
<tr>
<td>Input power source</td>
<td>±5V, ±15V</td>
</tr>
<tr>
<td>Power consumption</td>
<td>±5V/1.0A or less [normal use], 1.5A or less [while warming up]</td>
</tr>
<tr>
<td>Operational temperature range</td>
<td>−20~+60°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>−30~+70°C</td>
</tr>
</tbody>
</table>

Principle of fiber optic gyro: Sagnac effect

Angular velocity is given by the difference in length of light path caused by rotating the optical fiber after entering the light clockwise and counterclockwise to long coiled optical fiber.

There are several types of methods such as interference method and resonance method.

There is also an optical gyro called ring laser gyro that also applies Sagnac effect.
New products  Introduction of new products

Triaxial inertial measurement unit with built-in i-FOG
Precision was increased by using i-FOG, the closed loop method

**Types TA7589 Series**

**Features**
- Excellent bias reproducibility, stability and linearity were realized by using three axes of high-precision [0.1 °/h] gyro.
- True north can be detected.
- Compound navigation system with built-in GPS receiver

**Application examples**
- Measurement of behavior of mobile objects such as vehicle, vessel, and flying object.
- Attitude control of mobile objects

**Diagram**

**Specifications**

<table>
<thead>
<tr>
<th>Type</th>
<th>TA7589</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic range</td>
<td>Roll: ±180°</td>
</tr>
<tr>
<td>Angular accuracy of attitude</td>
<td>0.1° maximum</td>
</tr>
<tr>
<td>Angular accuracy of azimuth</td>
<td>0.5 maximum (*GPS composite)</td>
</tr>
<tr>
<td>Speed accuracy</td>
<td>50m/s/1s inertial, maximum, to 1m/s/1s composite/maximum</td>
</tr>
<tr>
<td>positional accuracy</td>
<td>120NM/1CPS</td>
</tr>
<tr>
<td>Input power source</td>
<td>28V DC</td>
</tr>
<tr>
<td>Mass</td>
<td>3.5kg or below</td>
</tr>
<tr>
<td>Power consumption</td>
<td>30W or below</td>
</tr>
<tr>
<td>Operational temperature range</td>
<td>−20～+60°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>−30～+70°C</td>
</tr>
</tbody>
</table>

**Price range and precision of gyro products**

<table>
<thead>
<tr>
<th>Price range (per axis unit: 10 thousand yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy (drift) (°/h)</td>
</tr>
</tbody>
</table>

- Sway control: | Spatial stability: | Detection of relative azimuth: | Detection of true azimuth: |

- MEMS gyro: | i-FOG: | Biaxial rate gyro: | MRG: |

- RLG: | MRLG: | FOG: | 3rd generation MEMS IMU: |
New products

Introduction of new products

Third-generation MEMS IMU

Types

- AU7684 Series: Substrate type
- TAG300 Series: Waterproof case type

Features

- Precision of built-in MEMS gyro doubled compared to the existing products. [Bias instability: 10°/h]
- Excellent functions
  - Waterproof case (IP65/TAG300 Series)
  - Built-in power protection circuit
  - Built-in magnetic direction sensor
  - CANID setting change function, etc.

HARDWARE

- Initial azimuth (with built-in magnet sensor)
- Lineup of standard vehicle detector I/F
- Waterproof case specifications (TAG300)
- 0.5 sq. m. of wire diameter for installing M6 (TAG300)
- Power protection circuit
- Making in-vehicle µ-GAIA as standard equipment

SOFTWARE

- Enhanced angular accuracy in dynamic posture (high-precision MEMS sensor is installed)
- Function to change setting of various constants (constant at the time of leveling, compound navigation system parameter)
- Function to set measuring coordinate system
- Increased efficiency of offset cancel operation

Principle of MEMS gyro: Coriolis force

Angular velocity is detected from Coriolis force (*) that is added to the element by vibrating the element.

(*) Force generated, when the object in motion is rotated, in a direction perpendicular to the direction of movement of an object and that of axis of rotation. (Deflecting force)
Precision of gyro sensor was enhanced and functions improved. IMU in the new stage was released.

### Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>External dimension (AU7644, sub-module)</td>
<td>35×35×16.1 mm</td>
<td></td>
</tr>
<tr>
<td>External dimension (AU3360: case)</td>
<td>100×98×49.5 mm waterproof</td>
<td>(IP65)</td>
</tr>
<tr>
<td>Power-supply voltage</td>
<td>8 ~ 28V DC</td>
<td></td>
</tr>
<tr>
<td>Output signal</td>
<td>RS232: 115.2 kbps CAN: 500kbps</td>
<td>User can change the CAN baud rate</td>
</tr>
<tr>
<td>Output cycle of data</td>
<td>RS232C: 200Hz, CAN: 1000Hz</td>
<td></td>
</tr>
<tr>
<td>Range of angular velocity detection</td>
<td>±200 deg/sec</td>
<td></td>
</tr>
<tr>
<td>Angular velocity bias</td>
<td>0.2 deg/s</td>
<td>Room temperature after warming up</td>
</tr>
<tr>
<td>Angular velocity SF error</td>
<td>0.2 deg/s rms</td>
<td>Temperature fluctuation range of standard room temperature</td>
</tr>
<tr>
<td>Range of acceleration detection</td>
<td>±3 G or ±5 G</td>
<td>Factory default</td>
</tr>
<tr>
<td>Acceleration bias</td>
<td>0.0196 m/s² rms (2mG)</td>
<td>Room temperature after warming up</td>
</tr>
<tr>
<td>Acceleration SF error</td>
<td>0.049 m/s² rms (5mG)</td>
<td>Temperature fluctuation range of standard room temperature</td>
</tr>
<tr>
<td>Angular accuracy in static posture</td>
<td>0.1 deg rms (Range 3G)</td>
<td>Room temperature after warming up</td>
</tr>
<tr>
<td>Azimuth drift</td>
<td>0.2 deg rms (Range 3G)</td>
<td>Temperature fluctuation range of standard room temperature</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-40 ~ +85°C</td>
<td></td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>29.4 m/s² rms 5 ~ 2 kHz</td>
<td>Random vibration</td>
</tr>
<tr>
<td>Impact resistance</td>
<td>20 G 10 ms</td>
<td></td>
</tr>
</tbody>
</table>

### List of functions

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterproof case</td>
<td>✓</td>
<td>Normal response</td>
</tr>
<tr>
<td>Magnetic direction sensor</td>
<td></td>
<td>Standard feature</td>
</tr>
<tr>
<td>Input of vehicle speed</td>
<td>RS232/CAN/ Pulse</td>
<td></td>
</tr>
<tr>
<td>Power protection circuit</td>
<td>✓</td>
<td>Standard feature</td>
</tr>
<tr>
<td>External GPS I/F</td>
<td></td>
<td>Recomended product (Responded individually)</td>
</tr>
<tr>
<td>CAN termination resistance</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Warming-up time</td>
<td>5 minutes or below (typical time: 3 minutes)</td>
<td>Recommended value</td>
</tr>
</tbody>
</table>

### Example of major use

- **Automobile**: Measurement of vehicle motion and attitude
- **Service robot**: Measurement of security robot attitude
- **Unmanned aircraft**: Measurement of drone attitude
- **Construction machine**: Measurement of inclination angle of unmanned construction machine
- **Agriculture machine**: Measurement of remote-controlled tractor attitude
Device to Measure Duct Hole Curvature with Built-in Camera and Inner Diameter Measuring Device

In collaboration with DAERYUK Electric facility Corporation (Incheon headquarters of Korea Electric Power Corporation (KEPCO)), we have developed TUG-NAVI with a built-in camera and inner diameter measuring device. It is a curvature measuring probe for KEPCO using our gyro technologies. TUG-NAVI is a device to measure duct hole curvature combined with our gyro technology and accelerometer. With this product, you can obtain accurate information about the duct hole curvature that cannot be seen from the ground. The sensor probe that goes through the duct buried underground provides you data that describes the shape of the line.

In the area with old underground duct lines in Korea, the map, which was created at the time the duct lines were buried, is often largely different from the reality. For example, the lines are straight on the map, but in reality, they are curved, which leads to damage accidents causing disconnected cable at the time of construction work in the neighborhood.

In addition, since most of the duct lines are bellows, many foreign substances such as water, dirt, stone, and sand come in. Sometimes inside the duct lines are distorted because of the earth pressure.

In the traditional measuring method, there were disadvantages in terms of time and cost because curvature measurement, examination for a foreign substance, and inner diameter measurement were carried out by individual sensors. Thanks to the development of the product, curvature measurement, examination for a foreign substance, and inner diameter measurement can be carried out at one time, and thus, measurement time and construction period are reduced.
Our new website was launched on November 21, 2018.
In this renewal, we redesigned the top page and product page to give the clear explanation about our applications and products. We will continue to enhance the content so that many customers can visit our website.

Features of New Website

01 New design
In the new layout, we put bigger images and contents with the purpose of showing our applications and products in a clearer manner and having viewers easily find the information they are looking for.

02 Switching design
Design of the top page can be switched by a click. There are two types of design: Visual Page, focusing on impact and Simple Page, focusing on functionality. Click the Switch tab on the lower right or upper right on the top page to switch the design.

03 Website converted from HTTP to HTTPS
URL of our website changed as the site was redesigned. If you have bookmarked our website, please register the new URL.

[New URL] https://www.tamagawa-seiki.co.jp/
Soil Improvement Technology Expo 2018

Soil Improvement Technology Expo 2018, where all kinds of soil improvement construction methods to control liquefaction damage of the ground caused by earthquake were gathered, was held at Tokyo Big Sight in September. We had 9-square-meter booth (W 3m x D 3m).

At our booth, we exhibited the panels showing the images of examples of construction management using TUG-NAVI and five series of sensor probes, showed a video featuring the actual measurement process, and demonstrated the measurement using the small probe.

There are huge expectations for TUG-NAVI in difficult constructions such as those carried out under deep-depth, which will increase in the future. We will strive to expand the sales together with the interested party with a view to install TUG-NAVI into the shield machine in the next phase.

Security & Safety Trade Expo 2018 (RISCON TOKYO)

Security & Safety Trade Expo 2018, where all kinds of security and safety construction methods to control crimes and accidents were gathered, was held at Tokyo Big Sight in October. We had 9-square-meter booth (W 3m x D 3m).

This year, we displayed the following four products: (1) 360-degree Security Camera with sway stabilizing functions. This is a versatile 360-degree security camera put on top of towers such as power pylon. (2) Three-wavelength infrared color camera system that colorizes black-and-white images with near-infrared illuminator. (3) ATLAS-PLDN Urban Style Model with the design suitable also for urban environment. (4) “Furusatokun,” the information camera that can transmit the shot images via our server. Number of visitors to our booth increased by 50% compared to the previous year. We will strive to expand the ATLAS business with new selling system because visibility of ATLAS in the market has been increased gradually, and so does its number of the products delivered.

Japan International Aerospace Exhibition 2018 Tokyo (JA2018 TOKYO)

Japan International Aerospace Exhibition, the biggest exhibition in Japan, where aviation, space, and defense industries across the world gather, was held at Tokyo Big Sight. Tamagawa Seiki Co., Ltd. participated in the exhibition with Tamagawa Aero Systems Co., Ltd., one of our group companies, and exhibited products installed in aircraft, satellites and other products that play active roles in outer space.

In the field of aircraft, we exhibited auto throttle lever and actuator for business aircraft and a wide variety of sensors for pilot control system of middle-size jet aircraft, as well as fuel pump and impeller of large-size aircraft and five-axis vibration-proof camera system ATLAS-HD that can be installed into aircraft and helicopter.

In the field of space, we showed inertial sensor unit for measuring attitude loaded into super-small-size satellite (triaxial FOG unit/IRU), reaction wheel controlling the attitude, high-precision angle detector used for antenna pointing mechanism and earth observation equipment pointing mechanism, and Interference Type Fiber Optic Gyro (i-FOG), the new product that realized both 0.1°/h-class high-precision and low cost. All of them attract many visitors’ attention.
Material Purchasing Control Center of our company hosted the exhibition for material suppliers. We held this exhibition first time in 32 years with the aim of strengthening the ability of our group to purchase in the increasingly globalized material-purchasing environment. 62 companies participated in the exhibition and we had 262 visitors from various kinds of sectors such as design, purchasing, and production technology who actively exchanged information. In the age of the Internet when access to information is facilitated, people have fewer opportunities to actually see and touch the machines and devices. Visitors told us that they were pleased to see the actual products. Many exhibitors, on the other hand, said that the exhibition was meaningful because they were given the chance to promote their products, and wanted us to hold it again. Details of the next exhibition are not decided yet, but we would like to develop the plan to hold it on a regular basis.

Venue of the exhibition

Exhibition information  We will be exhibiting at the following upcoming exhibitions. Please come along.

- **TECHNO-FRONTIER 2019 The 37th Motor-tech exhibition**
- **Automotive Engineering Exposition 2019 Nagoya**
- **DSEI JAPAN ’19 (Defense & Security Equipment International)**
- **2019 International Robot Exhibition**

<table>
<thead>
<tr>
<th>Exhibition</th>
<th>Period</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>TECHNO-FRONTIER 2019</td>
<td>Wed. April 17 to Fri. April 19</td>
<td>Makuhari Messe</td>
</tr>
<tr>
<td>DSEI JAPAN ’19</td>
<td>Mon. November 18 to Wed. November 20</td>
<td>Makuhari Messe</td>
</tr>
<tr>
<td>2019 International Robot Exhibition</td>
<td>Wed. December 18 to Sat. December 21</td>
<td>Tokyo Big Sight</td>
</tr>
</tbody>
</table>

Organizational change

On November 21, 2018, Biotronics Institute (BT Institute), which has been engaged in research and development of FG beads and related devices, became Third Plant Production Department. (Address and telephone/fax numbers are not changed)
Bio Sales Department of the sales company has taken over their tasks to the sales offices in North Kanto, Nagoya, and Fukuoka.
We strive to enhance the sales and service of FG beads and the related devices at the place closer to the customers. If you need anything, feel free to contact the nearest sales office.
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FAX: +81-3-3738-3134