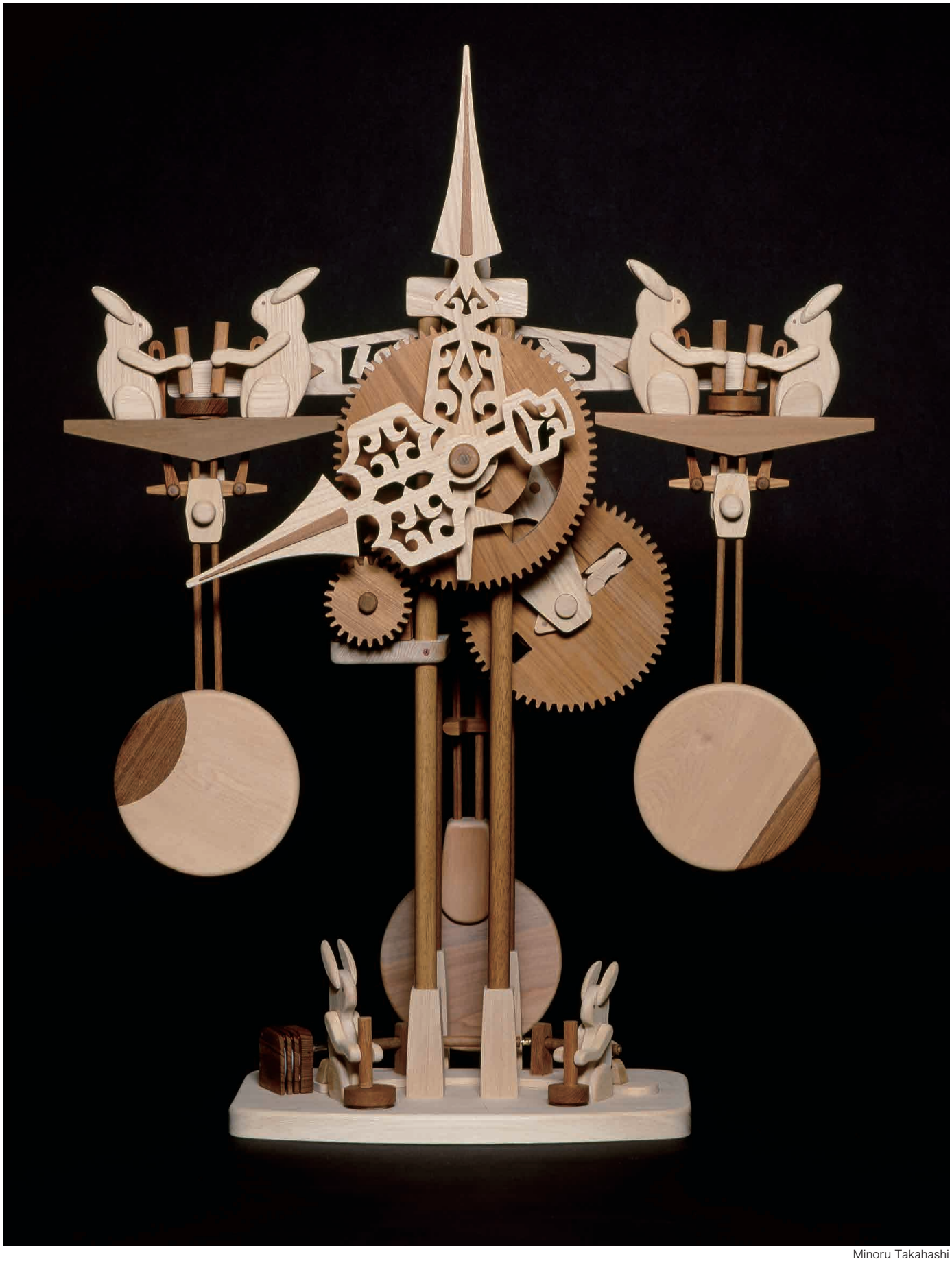
Aspiring always to be an environmentally friendly and trustworthy company

TAMAGAWA NEWS

2019.9
Vol. 23



Minoru Takahashi

Closing In on a Facilities' Mysteries! High Precision Angle Calibrator

Explore the Area **S-BIRD**

Amazing but complex! We showcase our very best technologies.

A top measuring capability of 0.062 seconds

High Precision Angle Calibrator

**Industrial robots are indispensable in the automation and labor-saving of a plant.
In order to accurately control their movements, it has become necessary to detect "angles" with high precision.
How can the detecting of angles with high precision be evaluated?
We will report on the devices born out of our unrelenting commitment to angle accuracy, together with one of our developer's thoughts on the business.**

Why Is the Accuracy of Angles Necessary?

The rotary encoder that is used for the angle sensors of servo motors and so on is a sensor that is indispensable for the control of industrial robots and semi-conductor manufacturing equipment.
The demand for miniaturization and densification of products requires manufacturing equipment to be capable of precision movements. The resolution of rotary encoders was 11 bits in the late 1990s (1 bit is about 0.18° = resolution that divides 360° into 0.18° segments), and although this was the mainstream, in the early 2000s, resolution saw dramatic improvements to 17 bits (1 bit is approximately 0.003° = resolution that divides 360° into 0.003° segments).
While resolution continues to improve, the need for calibration work to see whether the angles of angle sensors are correct and to evaluate the accuracy has also increased.

What Is the Calibration of Angles?

The calibration of angles refers to comparing the accuracy of an angle sensor with a reference to make an evaluation.
However, as comparing with a standard stipulated by law each time is difficult, a device is used to carry out calibration work to evaluate measuring capability with a rotary encoder acknowledged as a secondary standard for national standard instruments. (Figure 1)
Ensuring the connection between the user's angle sensor and the national standard in this way is called traceability, and is required by ISO9001 and IATF16949.
International standards for length and weight (standard instruments) have been established for a long time, but there are no international standards for angle criteria. In Japan, standard instruments were stipulated in 2003, and a traceability system was put in place.

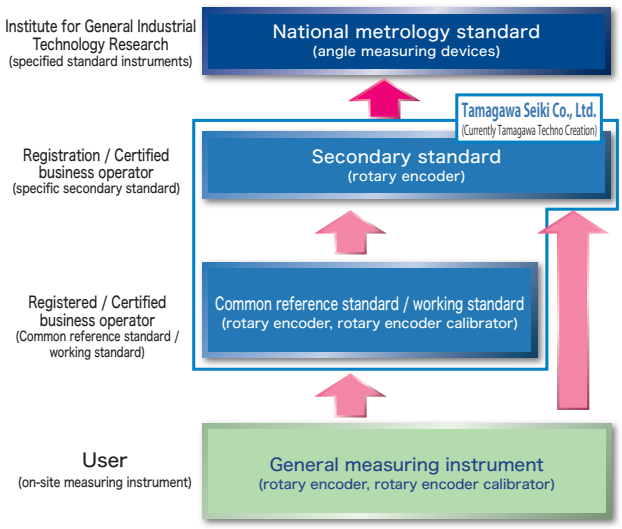


Figure 1

Angle calibration business of Tamagawa Seiki Co., Ltd.

While developing a general-purpose rotary encoder, we also worked on the development of a special sensor such as the angle sensor for antenna rotation of the National Astronomical Observatory of Japan. In 1999, our product was used for the angle sensor of the ALMA* telescope.
However, at the time, as the required angle accuracy could not be measured in-house, consideration was given to whether there was a way of being able to do it in-house. This became the impetus for our angle calibration business initiative.
Then, in 2008, our angle calibration business, which started out as a private enterprise, was registered as a business with the Japan Calibration Service System (JCSS), and thus our calibration business for angle sensors was born. (Figure 1)

Credit: ALMA (ESO/NAOJ/NRAO)

*The ALMA (Atacama Large Millimeter / Submillimeter Array) telescope is a project achieved in cooperation with 16 countries including Japan and the Republic of Chile, and sees the operation of 66 parabolic antennas in the Atacama Desert as one huge telescope.

High Precision Angle Calibrator

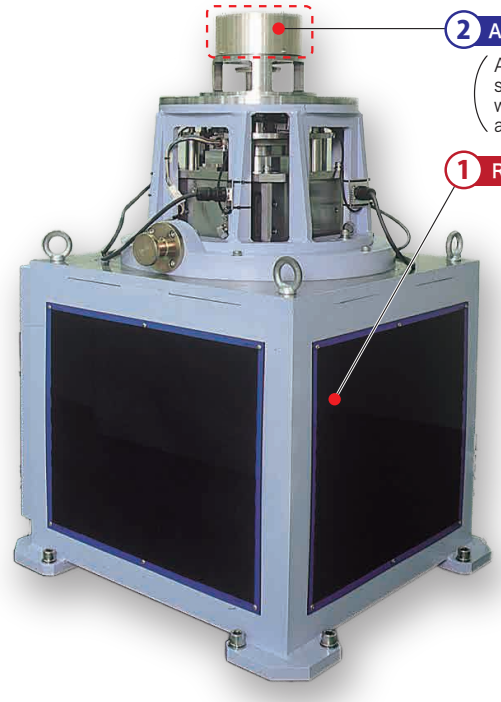
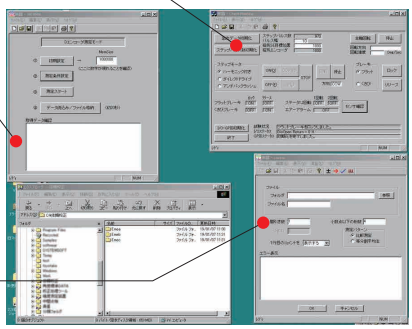


Figure 2

Device control software
Controls the mounting position to take evenly divided measurements.

Board control software
Sets the resolution of the angle sensor to be calibrated and measurement conditions such as rotation speed and so on to the device. In addition, the count value (data that is the basis of phase difference and time conversion) measured by the device is acquired from the device.

Data conversion software
The data (count value) measured by the board control software is converted into data such as a deviation (angle).



■Main Specifications

Item	Spec.value
Top measuring capability	**0.062 seconds**
Measuring resolution	0.001 seconds
Weight of equipment subject to calibration	50kg Max.
OD of equipment subject to calibration	φ400mm Max.

■Angle sensors subject to calibration

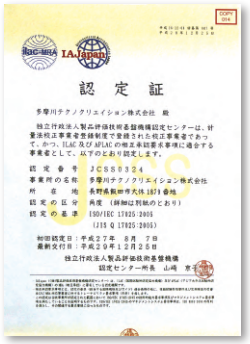
Rotary encoder, resolver, multipolar synchro

■Calibration certificate

Acquired the ISO/IEC17025 certification

JCSS registered

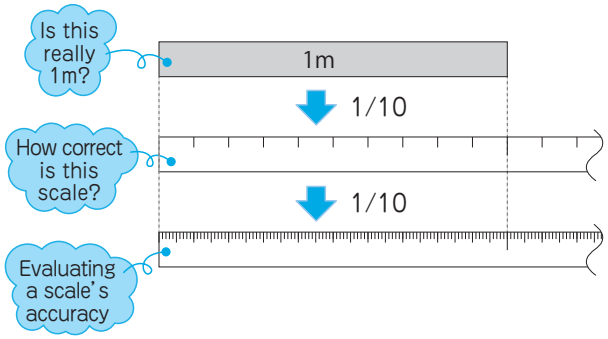
Supports international MRA



What Do You Mean the Top Measuring Capability Is “0.062 Seconds?”

This angle calibrator, for receiving certification by us as a calibration business, began development with the goal of “being a device that can measure the calibration accuracy of angle sensors in 0.1 seconds.”
In order to measure accuracy in 0.1 second, the calculation error of 1/10 (0.01 second) must be known, and the resolution required to understand the error is a precision of 0.001 second, which is 1/10 of the calculation error.
However, the top measuring capability of our completed angle calibrator is 0.062 seconds, which is dramatically better than our target value. This means that the device has an accuracy of 1/100 our original goal.

■ If you imagine calculation error and resolution as a length...



How Is Precision Measured?

The precision of an angle is evaluated by using the following two methods.
In consideration of the mounting calculation error, the device checks reproducibility (whether the same calculation error is produced) by changing the position of the installation multiple times.

(1) Phase difference time conversion method

The number of measurement clock pulses between the output pulse signals of the reference sensor (Figure 2 (1)) that rotates at a constant speed and the calibrated angle sensor (Figure 2 (2)) is calculated, and then this time is converted into an angle to measure the variation in the angle accuracy.

(2) Method for dividing equally (Figure 3)

The reference sensor and the angle sensor to be calibrated are divided into 5 equal parts, comparative measurements are repeatedly taken while changing the mounting position, and then the 5 comparative data items are added and averaged to obtain the deviation of the calibrated angle sensor.
This method enables the deviation of the reference sensor and the calibrated angle sensor to be completely separated, and the deviation of the calibrated angle sensor can be extracted.

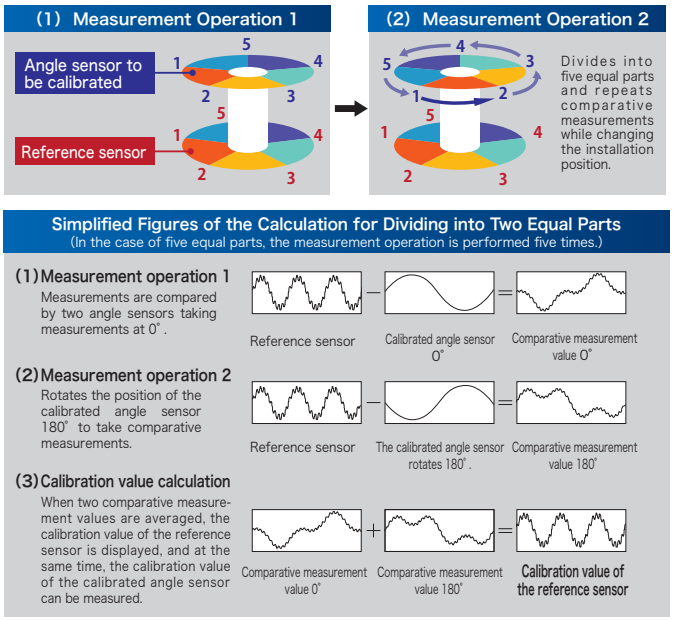


Figure 3

Procedure of Angle Calibration

If it is a rotary angle sensor, angle calibration can be done with a rotary encoder, resolver, or synchro.
For the procedure of requesting angle calibration, see Figure 4.
Group company, Tamagawa Technocreation Co., Ltd., is currently certified as an independent JCSS registered company and operates and manages this business.
In addition to angle calibration, Tamagawa Technocreation Co., Ltd. also provides calibration of mechanical measuring instruments such as micrometers and vernier calipers, as well as electrical measuring instruments such as oscilloscopes.

For angle calibration, it clearly states in IATF16949 (international standard for the development of quality control systems in the automotive industry) that it is recommended that external calibration be carried out by a JCSS-certified organization as a guideline for calibration. We are currently receiving more and more inquiries for angle calibration.
As we also have ILAC certification (mutually recognized with overseas accreditation bodies), we deliver certification that is also recognized overseas.

Procedure of Angle Calibration

1. Inquiry
2. Estimate
3. Sending of angle sensor
4. Angle calibration
5. Returning of angle sensor
   - Calibration result
   - Calibration certificate

   Attachments

Figure 4

【Contact details】
Tamagawa Technocreation Co., Ltd.
TEL:0265-21-7661 FAX:0265-21-7662
URL:http://www.tec-tamagawa.co.jp/homepage/kakudo/

Message From One of Our Developers

There is no ISO standard for angle calibration. In order to be certified, we had to devise our own angle calibration method that supports our angle calibration system. We continued to search for a solution, but we struggled to get the certification we needed. We found this really difficult.
What's more is that we were under enormous pressure on whether or not we could actually achieve what we wanted to because we set our sights on the ambitious goal of achieving an angle accuracy of 0.1 seconds, which enables the evaluation of angle sensors with top-level precision.
I think we were able to achieve our goal under such circumstances by clarifying, as necessary actions and elemental technology to achieve our goal, the securing of a high-precision angle sensor (specific secondary standard instrument rotary encoder), development of a motor and driver that rotates smoothly at a constant speed without cogging, development of a speed feedback sensor, and stop control design and issues when determining relative position, and then successfully completing each of these tasks one by one at a steady pace.
Some parts usually take nearly a year to deliver, but we were able to meet the deadline by delivering the product in about 6 months with the cooperation of everyone involved.
Going forward, as new calibration technologies have also been introduced, I would like to consider a new system that includes these new technologies.

Takaomi Kojima,
Doctor of Engineering,
Technology Management Section,
Technology Quality Management Department

Iida City, Nagano Prefecture

Introducing the new facility, S-BIRD, in a four-part series.

Explore the Area

A base for industrial development and human resource development

S-BIRD

The outside of the former Iida Technical High School

S-BIRD is a collaboration between Minami Shinshu Wide Area Union, Nagano Prefecture General Industrial Technology Center, Shinshu University, and Minami-Shinshu Iida Industry Center, among others. S-BIRD opened in January this year as a facility with the aim of advancing and adding value to the aircraft industry and other industries in the region.
The facility is home to the Iida Industrial Technology Test and Research Laboratory, and it has various test facilities in addition to Japan's only demonstration test equipment essential for the aircraft industry.
In the next issue we will introduce the facilities and how they are used.

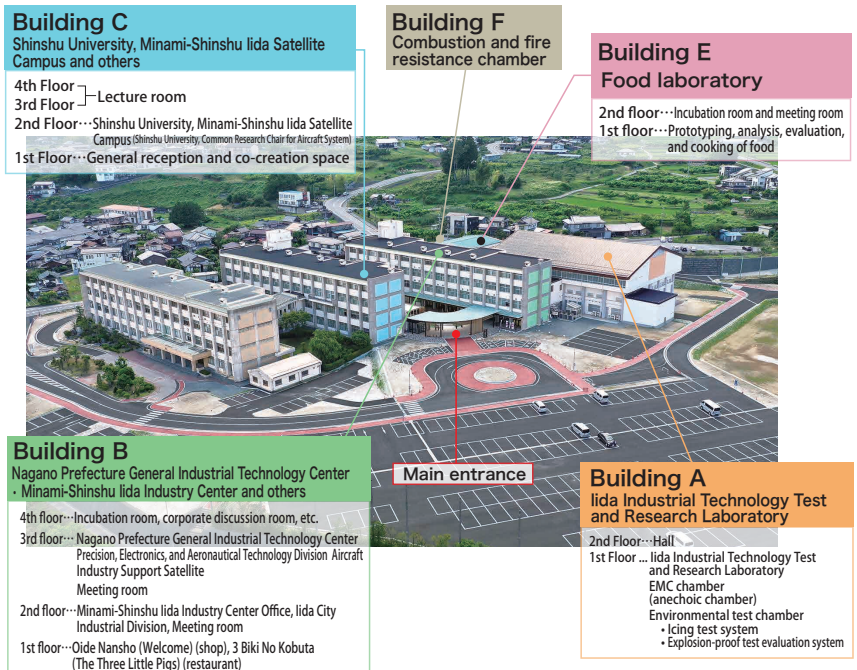
>>> Contents due to appear in Vol. 24

Explosion-proof test evaluation system

>>> Contents due to appear in Vol. 25

Icing test system

Layout



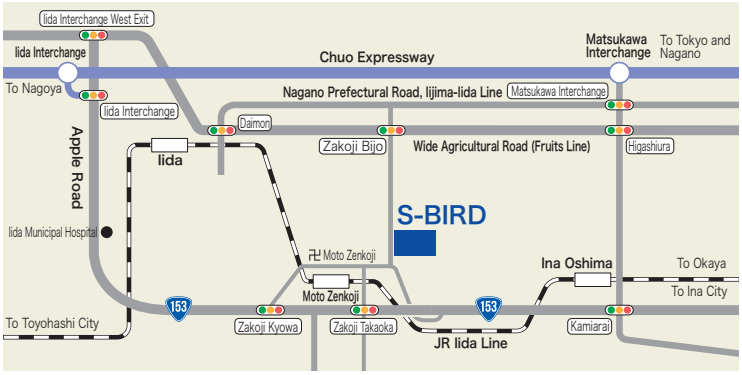
Main entrance

The experimental aircraft actually used in high-speed flight demonstrations by the former National Space Development Agency (NASDA*) and the former National Aerospace Laboratory (NAL*) (currently JAXA*) is on display.
Tamagawa Seiki Co., Ltd. was involved in the development of a compound inertia device that controls this demonstration aircraft.

Exhibition and experience areas

You can experience a flight simulator.

Access



S-BIRD

Address: 3349-1, Zakoji Iida City, Nagano
TEL:+81-0265-52-1613
FAX:+81-0265-24-0962

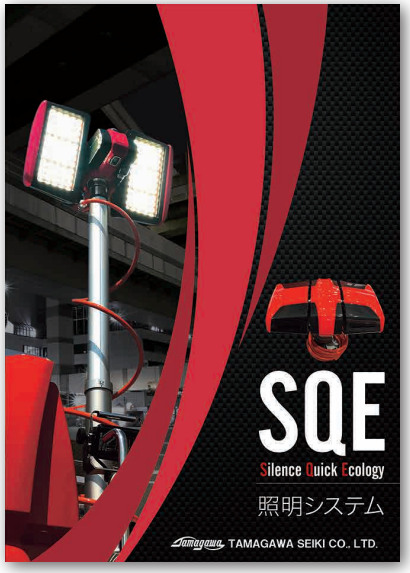
Minami-Shinshu Iida Industry Center (within S-BIRD)
http://www.isilip.com/

Reservations to use a part of the facility can be done here.
https://mi-sangyoucenter.com/

Information 01

Showcase of New Products

We Have Produced a Catalog for Our SQE Lighting System



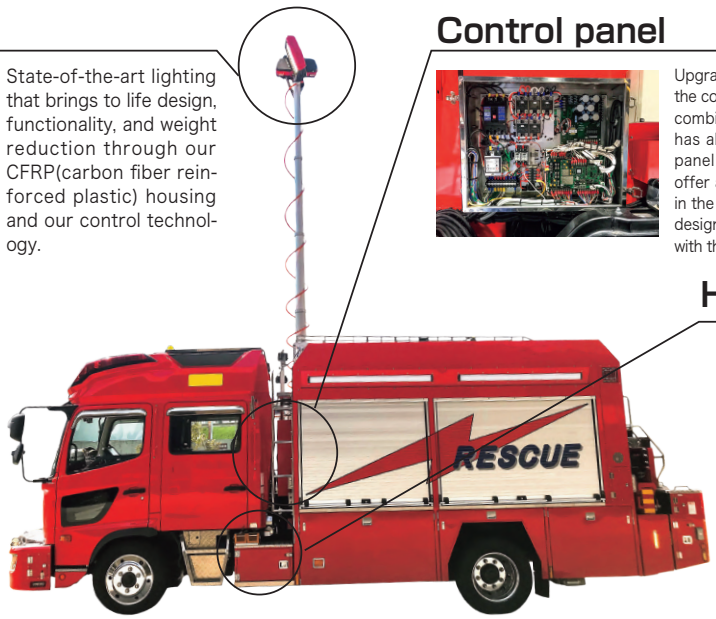
Our SQE lighting system is a high-intensity, low-power LED lighting system installed in rescue vehicles* to support nighttime rescue activities. We have created a new catalog for this system, and will introduce it here together with an overview of the system.

*"Rescue vehicle" is a fire truck that, together with rescue activities, is designed to load necessary materials and equipment and transport them to the site of an emergency.

This product utilizes the technology cultivated in the development of "ATLAS," a surveillance camera system.
The floodlight uses a slip ring on the vertical axis to achieve 360˚,endless operation, and a servo driver to control a high-speed and smooth drive system.
The SQE lighting system also adopts a hydraulic generator that enables large-capacity power generation even at low engine speeds and a three-throttle control system that can switch the engine speed to three modes (slow, fast, normal) according to the situation. There are also a wealth of options that can be selected to tailor the SQE lighting system to situations in which it will be used.

Floodlight

State-of-the-art lighting that brings to life design, functionality, and weight reduction through our CFRP(carbon fiber reinforced plastic) housing and our control technology.



Control panel

Upgrades from the conventional type are that the control system and drive system have been combined into one, and the amount of wiring has also been greatly reduced. The control panel has been made thinner and lighter to offer a space-saving structure that fits neatly in the gap between the cab and the body. The design gives peace of mind by not interfering with the space for mounted equipment.

Hand controller

A wired, touch-panel type hand controller.
A dust-proof and splash resistant structure means it is also suitable for outdoor use.

The product name, SQE , is an acronym of the product's three features.

Silence	A silent design due to lower engine speeds
Quick	Illuminates instantaneously due to LED lighting
Ecology	Improved fuel economy due to lower engine speeds

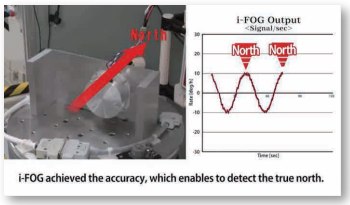
For this product, a team has been organized since April of this year consisting of members from design, quality assurance, manufacturing, and sales departments. The team currently conducts activities that integrate manufacturing and sales.

Information 02

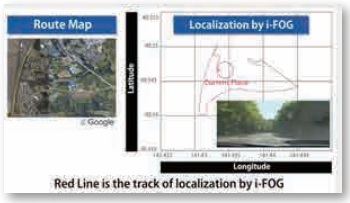
TA7774
i-FOG
Interference type fiber optic gyro sensor

We have uploaded an introductory video

A high-precision [0.1˚ /h] gyro
that achieves the accuracy required for fully automated driving technology in automobiles.
The features are introduced in an easy-to-understand manner and the video includes footage of our tests for auto position estimation with an automobile equipped with due north detection and i-FOG, which can only be achieved with our high accuracy.
We hope you give it a watch.



Due north detection test



Auto position estimation test

◆Link to the i-FOG video

https://www.tamagawa-seiki.co.jp/products/gyro/1-axis-gyro-TA7774.html

Information 03

Our catalog for “Trackballs” has been updated

Our all-new product catalog is ready to pick up.
One-inch size models that were not available in our previous lineups and types where the ring part can be operated (press, pull, and twist) have been added.

One-inch size model
Product code: TAS4721N1113

This ring part is also movable.

Two-inch sized model
Type: TAS4723N2000

The contact point for technical inquiries relating to trackballs has been changed to the following address.
Minami Co., Ltd.
E-mail : infotb@minami-web.com

◆ Link to catalog

https://www.tamagawa-seiki.com/downloads/pdf/

Our New Face

My ambition is "To push myself until I land on my feet"

Toshitaka Shiozawa, Nagoya Office

I'm mainly carrying out sales work in and around Shizuoka Prefecture while accompanying senior members of staff. There are lots of things I have to remember, and I find myself being challenged every day, however, I want to work hard so that I can get used to my new position quickly. I look forward to working with everyone here at Tamagawa Seiki Co., Ltd.

(We have updated the design of our uniforms to tailor them to the new Reiwa era!)

Information on Exhibitions

We will be exhibiting at the following upcoming exhibitions. We hope you drop by and say hello.

DSEI JAPAN '19
(Defense & Security Equipment International)

Dates: Monday, November 18 to Wednesday, November 20, 2019

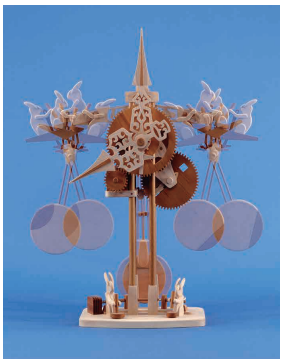
Venue: Makuhari Messe

International Robot Exhibition 2019

Dates: Wednesday, December 18 to Saturday, December 21, 2019

Venue: Tokyo Big Sight

The cover of this edition



Rabbit karakuri (automaton) clock

Made by Mr. Minoru Takahashi

Mr. Takahashi is currently working as a karakuri (the art of creating machines without an external power source) craftsman in Hachinohe City, Aomori Prefecture.
Mr. Takahashi's work also includes "Karakuri Shishimai," which is on display in the Hachinohe Portal Museum "Hacchi."
Our servo system is used for the drive unit.
The work on the cover is a moon rabbit pounding steamed rice to make a rice cake in time with the swaying of the clock pendulum. A small rabbit also appears and disappears.
I want to relax and gaze up at the harvest moon this year.

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