

## Modular Water Supply Quality Monitor that Reduces Time Spent on Site

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Monitoring the water quality at the end of water supply pipes is essential to supplying safe and secure tap water. In recent years, the introduction of systems has accelerated in capital cities in Southeast Asia, and the TW series of automatic tap water quality analyzers have been introduced in Malaysia and Thailand. Maintenance is essential for stable operation of the equipment, but there is a strong need to shorten on-site work as much as possible in terms of improving efficiency and ensuring the safety of workers working under high-temperature environments. We have recently developed the GX-100 modular water supply quality monitor to meet the aforementioned market challenges, and we would like to describe its features.

### Keywords

module sensor, modular water supply quality monitor, reduced work time, smartphone, Bluetooth® communication, USB communication.



### Introduction

In Japan, water quality standards for tap water are established under the Water Supply Act and related ordinances. Water quality inspections are conducted at various points, including the outlet of water purification plants, distribution reservoirs, and the endpoints of water supply pipes. The methods for these inspections are stipulated by Ministry of Health, Labour and Welfare Notification No. 99 (issued on March 21, 2024). As water quality checks by manual analysis take time, many local governments have adopted water quality measurement monitors. In order to ensure accurate measurements, water quality measurement monitors must be maintained at regular

intervals. However, due to labor shortages caused by the declining birthrate and the retirement of engineers with technical expertise, there is a need for simpler and less time-consuming maintenance methods. In other countries, tap water supply standards are also set in each country and the water quality monitoring systems at the end of water supply pipes is being introduced. In Southeast Asia, maintenance is major stress factor for maintenance companies. In addition to the harsh environments with high temperatures and squalls, the scattered locations of measurement devices require technicians to spend a lot of time not only travelling, but also maintaining the devices. Furthermore, missing data due to long maintenance times poses a risk to the quality of tap water.

Although our previous products are compactly packaged with multiple sensors to save space, their maintenance take time. This is because multiple parts must be removed in order to remove the sensor unit. Furthermore, calibration can be performed only on site and takes approximately one hour for all sensors. With GX-100, on-site work can be completed in approximately 15 minutes by simply replacing the sensor that is already calibrated at the office or laboratory because calibration data is stored in the sensor module.

## GX-100

GX-100 (Figure 1) employs a modular design to reduce on-site work time. Each module is described below.

**Interface Module (IM):** GX-100 communicates with external devices using this module.

It communicates with smartphones via Bluetooth® communication and connects to PCs via USB.

**Pre-Processing Module (PPM):** A filter is equipped to generate zero water\* for calibrating turbidity, color, and residual chlorine. The lines are automatically switched between in normal measurement and in zero calibration. It also measures pressure, temperature, and flow rate.

**Sensor Module (SM):** There are three types of modules for sample measurement: turbidity/color SM, free residual chlorine SM, and conductivity/pH SM. These SMs can be attached and detached without any tools.

**Flow Cell (FC):** This cell has a sample flow path and electrical contacts to the SM.

\* Zero water is water with zero turbidity, color, and free residual chlorine concentration.

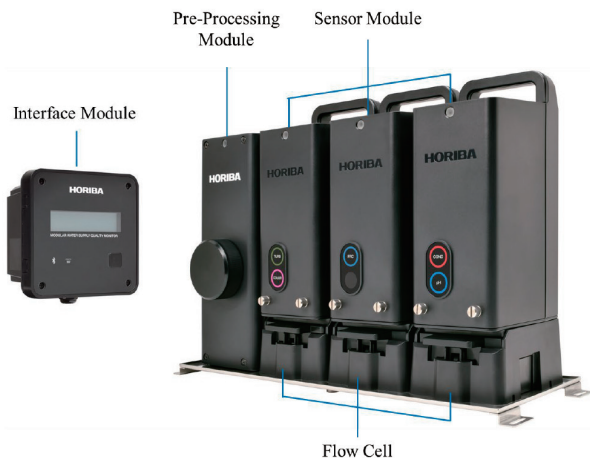


Figure 1 GX-100.

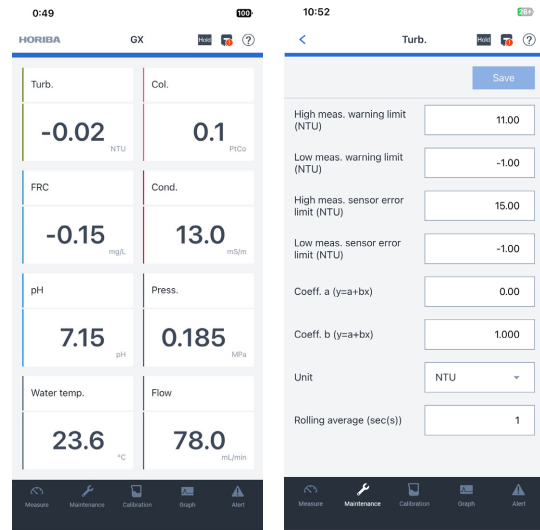


Figure 2 Measurement display of GX-100 application.

GX-100 consists of the above four modules. Measurement values can be checked and water quality meter settings can be changed using a mobile device or a PC with a dedicated application installed.

Compared to our previous products, GX-100 has a large screen with excellent visibility, allowing multiple measured components to be checked at once (Figure 2). GX-100 realizes reduced on-site time and easy maintenance through the modular design and the dedicated application. GX-100 also realizes maintenance cycle extension (reduce maintenance) with physical continuous cleaning function.

## Easy maintenance

Frequently maintenance work is necessary to obtain stable and accurate measurements with a continuous water quality monitor. Work on site is required with our previous products, but it may be interrupted or postponed due to weather conditions. To alleviate this stress, maintenance work for SM of GX-100 can be performed not only on-site but also at the office or a laboratory. Unlike on-site, the office has all the necessary tools and reagents for maintenance. We believe that performing maintenance work in this environment reduces maintenance-related stress.

We also provide a dedicated kit for calibration, which reduces calibration time and the amount of calibration reagents required.

Our previous products are compactly designed with multiple cells connected directly to each other and cannot be easily disassembled. Therefore, more reagents are required because all measurement cells need to be filled



Figure 3 GX-100 calibration kit.

with calibration reagents when a sensor for a single measured component is calibrated. The calibration for X-100 can be performed by attaching each SM to the calibration kit (Figure 3) and by pouring the target calibration reagent. When using this calibration kit, the calibration can be performed simply by using USB communication to connect the SMs with the PC in which the GX-100 dedicated app is installed.

This dedicated application allows checking the current measurement values, past calibration history, and calibration values on a single screen, which prevents unintended calibration (Figure 4). The calibration kit is easy to carry because it does not require a power source, such as a pump, to pour the calibration reagent into the SMs. Calibration can be performed anywhere.

## Reduce maintenance

If the maintenance is performed frequently, the stress to

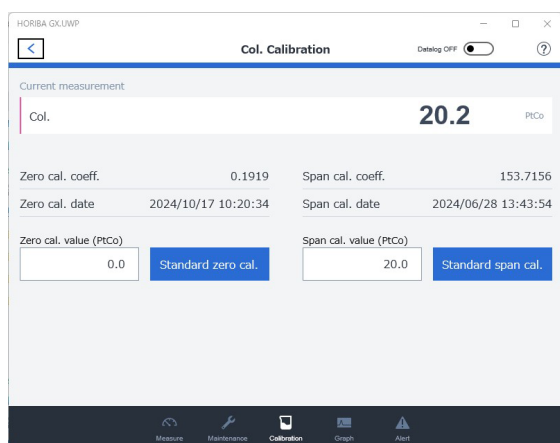


Figure 4 Calibration mode of app.

the operation of the water quality monitor remains unchanged despite of easy maintenance. The main factors requiring the maintenance are contamination, air bubbles, and flow rate. GX-100 has measures to reduce the frequency of maintenance. One of the measures is a continuous cleaning mechanism for the turbidity and color SM. Although our previous turbidity meter series also has a cleaning function, the light path is blocked by the cleaning mechanism during the cleaning because the optical measurement is used as the measurement principle, resulting in missing measurement data.

For a sample containing a large amount of dirt, the cleaning frequency increases and the number of missing measurement data also increases, which may prevent the seamless acquisition of water quality trend data. For GX-100, the cleaning mechanism has been redesigned to eliminate the missing data, enabling continuous cleaning and continuous measurement.

The cleaning method generally used in our previous products is a mechanism employing a wiper that moves to clean the inside of a fixed glass cell. GX-100 employs a fixed cleaning wiper and rotates the glass cell to enable the continuous cleaning and the continuous measurement without blocking the light path. This continuous cleaning reduces the frequency of the maintenance by removing dirt and bubbles adhering to the surface of the glass cell.

The wiper unit (Figure 5) where the wiper is fixed has three functions.

The first is to fix the cleaning wiper. This wiper is designed to be easily replaced by the user without special tools or skills.

The second is to prevent stray light. GX-100 turbidity meter uses a 90-degree scattering method.

In this method, the light emitted from the light source is

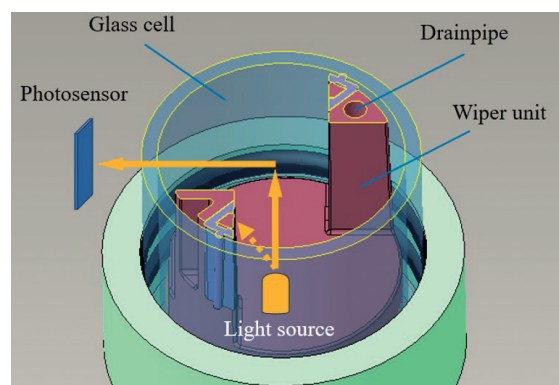


Figure 5 Wiper unit.

scattered by suspended substances and is received at a position 90 degrees to the light source. Ideally, only light scattered at a 90-degree angle should be detected. However, in reality, light other than pure scattered light, which is called stray light, also exists in the measurement cell. Light from the light source, as one of the stray lights, is directly detected by the photosensor. This stray light varies depending on the variation of the multiple components of the detection section and their operating temperature, causing measurement errors.

GX-100 prevents stray light by placing the wiper unit between the light source and the light receiving element located at a 90-degree angle, thereby reducing measurement errors.

The third is to remove bubbles remaining inside the measurement cell. Bubbles may form in the sample water when the sample water starts to flow or when the pressure or temperature of the sample water changes. These bubbles accumulate at the top of the cell and cause stray light, which leads to measurement errors. Therefore, a drainpipe is provided at the top of the wiper unit to prevent bubbles from remaining in the cell, thereby reducing measurement errors. The above three functions enable stable measurement of turbidity and color.

The second measure to reduce the maintenance is backwashing to ensure a stable flow rate necessary for measuring free residual chlorine.

As free residual chlorine meters produce unstable measurement values due to changes in the flow rate, it is necessary to supply new samples at a constant flow rate. The free chlorine electrode measures the current generated by the reduction reaction of free chlorine on the cathode surface. When the flow rate changes, the concentration of the free chlorine on the cathode surface becomes unstable. As

a result, when the flow rate decreases, the supply rate of the free chlorine decreases and the measurement value of the residual chlorine also decreases.

The cause of this flow change is dirt adhering to the piping and filters, and maintenance such as disassembly and cleaning of the water quality meter was necessary to remove this dirt. GX-100 performs automatic cleaning by reversing the flow of the sample inside the water quality meter to remove minute dirt adhering to the piping and filters, thereby reducing the frequency of maintenance requiring disassembly.

The above measures enable stable measurement of turbidity, color, and residual chlorine, which are important water quality indicators for water supply, with low maintenance frequency.

### Operation change of water quality meter by modularization

Maintenance of water quality meters is essential for stable water quality measurement, and therefore, water quality meters are maintained daily by engineers. We believe that the features of GX-100 described above will change the operation of the water quality meters.

First, since GX-100 employs the modular design, the only on-site work required is replacement of the SMs. Previous water quality meters required complex work at the installation site, which had to be performed by engineers on site. Furthermore, the distance between each site is far, and the number of sites that can be maintained in a day is limited. It took a long time to maintain the water quality meters at all sites. With GX-100, no tools are required to replace the SMs. The skill level of the workers is not an issue and on-site workers no longer need to be engineers.

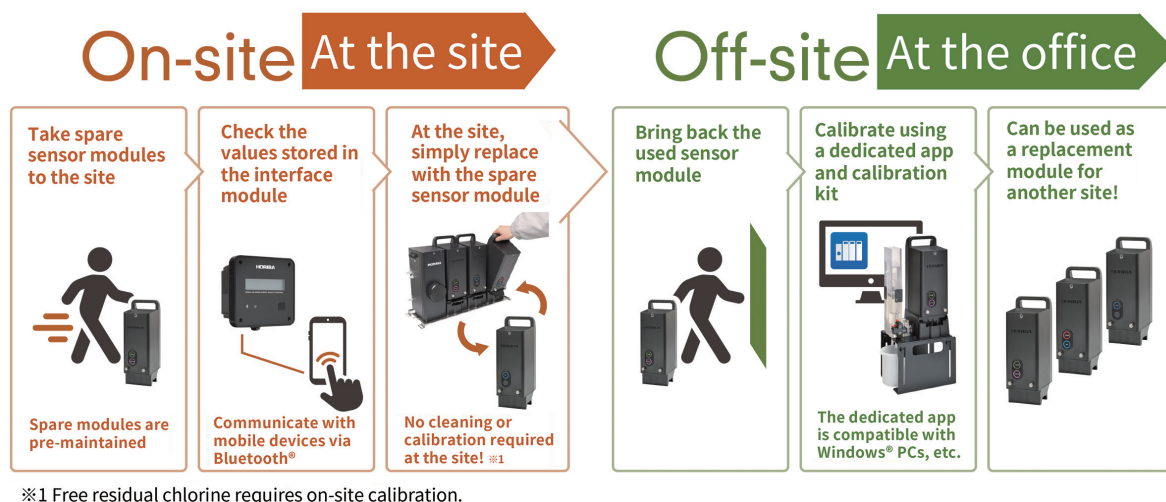


Figure 6 Operational method of GX-100.

Table 1 Comparison of calibration time and reagent volume between GX-100 and TW series.

Maintenance Item	GX-100 (min)	Current Product (min)	Reduction Rate
Zero Calibration for Turbidity, Color, Free residual chlorine	10 min	10 min	
Turbidity span calibration	3 min	10 min	
Color span calibration	3 min	10 min	
pH calibration	8 min	20 min	
Total calibration time	22 min	50 min	56%
Maximum reagent amount required for calibration (per 1 parameter) *	300 mL	800 mL	63%

\*Regarding the pH calibration, this is the amount of reagent required for one-point calibration.

Recently, the shortage of engineers has become a social issue, and we believe that GX-100 will play a major role in solving the issue.

Furthermore, SMs can be replaced in an environment with the necessary equipment, such as office or laboratory. Unlike before, it is no longer necessary to bring multiple tools and calibration reagents to the site. On-site work can be completed simply by bringing the replacement SM and a mobile device with the GX-100 app installed. (Figure 6)

The calibration time for SM is shorter than that of our previous products and the amount of calibration reagents to be used has been significantly reduced, resulting in lower running costs for maintenance. (Table 1)

### Conclusion

Reducing on-site work is now essential for the operation of the water quality meters, and we have described the features and the operation methods of GX-100 that make this possible. Globally, it is expected that the population will continue to grow and the demand for high-quality water supply will increase. In order to ensure the quality of the water necessary for people’s lives, it will become even more important to operate and maintain the water quality meters efficiently. We believe that GX-100 can solve this problem.

In addition, each country has its own specific measured components, and it is expected that the number of items that need to be measured to ensure the water quality will increase in the future. In order to meet these demands, we will continue to ensure the quality of the water supplies around the world with modularized SM, feature of GX-100, and with striving to stable the water quality measurement and to reduce the maintenance. We will continue to develop the water quality meters to meet the demands of each country.

\* Editorial note: This content is based on HORIBA’s investigation at the year of issue unless otherwise stated.



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