

FLXA21 Modular Two-wire Liquid Analyzer in FLEXA Series

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Yokogawa has developed the FLXA21 two-wire liquid analyzer as the first product in the FLEXA series. The FLEXA series, named after “Flexible EXA,” is a successor of the EXA series with advanced configurability and expandability. The FLXA21 is a successor of four EXA202 series products: pH/ORP analyzer (ORP: oxidation-reduction potential), contacting conductivity analyzer, inductive conductivity analyzer, and dissolved oxygen analyzer. FLEXA series was designed to put together common functions and have independent sensor parts, forming a modular architecture that allows easy assembling. This report introduces the specifications and functions of the FLXA21 and describes its hardware and software structure.

INTRODUCTION

Yokogawa has been offering the EXA200 series two-wire liquid analyzer for processes since 1990⁽¹⁾. This analyzer has been used in various fields including the quality control of raw materials in process plants in the electric power and petrochemical industries, reaction management of products, quality control in waste water facilities, and quality monitoring of river water and tap water.

The FLXA21 two-wire liquid analyzer, the first model of the modular-designed FLEXA series with flexible system configuration and expandability, is based on Yokogawa’s long experience and achievements in process analyzers. The FLXA21 is a successor of the PH202 pH/ORP analyzer (ORP: oxidation-reduction potential), SC202 conductivity/resistivity analyzer, ISC202 inductive conductivity analyzer, and DO202 dissolved oxygen analyzer. The FLEXA series is a successor of EXA series and is named after “Flexible EXA.” The FLXA21 offers improved operational performance, increased number of connectable sensors, and lower price than existing products. Each function is modularized, allowing the products to be quickly shipped to anywhere in the world and the lineup to be extended merely by developing dedicated modules. This modular architecture also enables response to far shorter product development cycles required in recent years.

Figure 1 shows the external view of the FLXA21. The housing is made of coated stainless steel (SUS). An electropolished SUS case as well as polycarbonate (PC) plastic case are also available.



Figure 1 External View of FLXA21

FEATURES

The enhancements made in the FLXA21 compared to existing models are as follows.

- Support of multiple sensors
- Improved HMI functions
- Improved diagnosis of sensor part
- Increased housing options

Support of multiple sensors

The FLXA21 can connect up to two sensors of the same type among pH, conductivity, and dissolved oxygen sensors, first in the industry as two-wire liquid analyzers. Users can monitor measured values from two sensors on the display or through HART communication. In addition, calculations of measured values such as calculating the difference or mean of two measured values at different points, can be performed by a single FLXA21, for which two analyzers were required until now.

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With this function, users can configure a redundant system and continue measurements during calibration.

In a redundant system, measurements can be continued even while repairing or replacing a faulty sensor. The FLXA21 can measure the same point with two sensors, so if one sensor fails, the output is automatically switched to that of the other sensor that is working properly.

Manual switching of measurement outputs is allowed as well, and this enables measurements during calibration. In previous models, measurements had to be suspended for calibration to be carried out, and measured values etc. just before the suspension were being sent to the upper system during the calibration. In the FLXA21, measurements can be continued by switching the output from the sensor being calibrated to the other sensor.

These functions enable building of a highly reliable system with backup function, reduce installation cost, and save installation space.

Improved human machine interface (HMI) functions

■ Dot-matrix LCD

The LCD display was upgraded from the character display type to the 3.3-inch black/white reflection type with 213 x 160 pixels, achieving graphical display of more information. Figure 2 shows examples of the screens.

1) Major display screens

The key display screens for measured values comprise the home screen which shows the values from two sensors and the main screen which shows the values from individual sensors. Besides the primary measured value, they display two auxiliary measured values, tag name, current outputs, a bar graph to show the healthiness of the sensors, and the state of the device. Switching between the home and main screen can be performed by one touch operation. The main screen leads to more detailed display screens. Moreover, confirmation messages displayed when setting critical items are easy to understand, detailed information for the quick setup function enabling easy setup is displayed, and detailed contents of errors and their countermeasures are displayed when errors occur. Routine operations can thus be carried out without referring to the instruction manual.

2) Trend data display screen

The display can show trend data of up to two weeks on up to three screens. Long-term measurement fluctuations can be easily confirmed by only FLXA21 without connecting to the upper system, etc.

3) Support of multilingual function

For convenience worldwide, a multilingual function is provided for the different languages used in main sales territories. The seven languages provided at present including Japanese and English will be increased to 12 languages by the end of 2010.

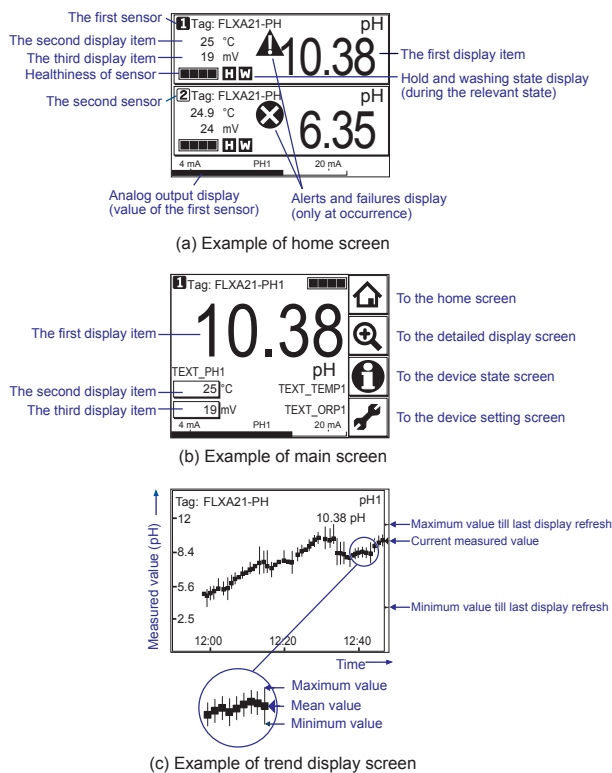


Figure 2 Examples of Display Screen Images

■ Adoption of touch screen

The touch screen system which enables operation at the front offers a more interactive HMI than previous models. Any item can be directly selected from multiple choices. Displays of touch target areas were removed from display screens for simple operations such as transition from the home screen to the main screen or return to the main screen from the trend display screen, which frees up space for displaying useful information.

Improved diagnosis of sensor part

The sensor diagnosis function has been improved by adopting a bar chart display. The healthiness of the sensor judged from the calibration results is displayed in a simple bar chart. It also includes historical information such as accumulated measuring time of the sensor and the number of heat shocks to the sensor. By setting the system to display the worst state among multiple items regarding the healthiness of the sensor on both the main and home screens, the healthiness can be checked on the screens usually used.

Increased housing options

Although previous models were housed in a aluminum coated case regardless of the installation environment, two types of housings have been developed to allow the FLXA21 to be installed in a wider range of environments: a PC plastic casting and SUS spinning housing. The SUS housing comprises electropolished type and coated type, making three types of case in total.

The low-price PC plastic case is for installations in

environments where metal cases is not required, the coated SUS case is for harsh environments, and the electropolished SUS uncoated case is offered for installations where paint peeling could be a problem. All types can be installed outdoors and comply with degrees of protection of IP66 of IEC 60529/JIS C0920.

The case is also modularized, and the three types of cases use common parts for most of their components. Figure 3 shows an internal configuration of the SUS case with coating for the FLXA21. The main parts shown in the figure are the common parts used in the three cases.

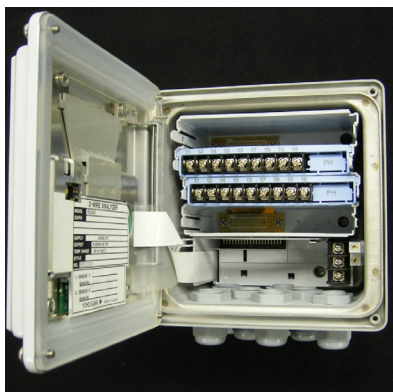


Figure 3 Internal Configuration of FLXA21

MODULAR ARCHITECTURE OF FLXA21

As shown in Figure 4, the FLXA21 contains the CPU assembly, power board assembly, and sensor modules (referred to I/O modules in the FLEXA series), and each assembly and sensor module is connected by a local bus. The local bus with simple functions of only serial communication and power supply does not restrict the hardware configuration and enables response to various protocols only with software implementation. The communication specifications in the FLXA21 are 9600 bps, 1-second cycle data refresh, variable-length data with cyclic redundancy check (CRC), and single-master multi-slaves communication. The data frame format was developed exclusively for the FLEXA series.

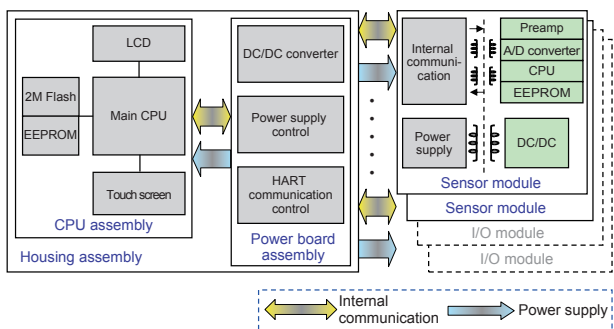


Figure 4 Modular Architecture of FLXA21

Each assembly and function module is described below.

CPU assembly

The CPU assembly is arranged on the front face of the case, and consists of the LCD for display and touch screen for operation. It receives data from the sensor module and displays it on the LCD, and has a function for sending operational information from the touch screen to the sensor module and a communication function with external HART devices (excluding physical layer).

The main CPU has 512 KB of flash memory for storing routine operation programs, and another 2 MB of flash memory for screen information of all sensors, multilingual information, etc. The latter memory is only for storage; it is used only for identifying the sensor module during the assembly process and to select the language at start-up, and is not used in usual measurement operations, thus achieving low-power consumption.

Power board assembly

The power board assembly is arranged in the innermost part of the case, and is connected to the CPU assembly via a flexible cable and with multiple sensor modules via a flexible PWB. This assembly generates the power required for the CPU assembly and each sensor module from the external power supply and supplies it to the CPU assembly and each module, and has a control function of the physical layer of the HART communication and a current control function. It also serves as a backboard for sensor modules; multiple sensor modules can be inserted into it. The FLXA21 accommodates only two modules because of the allowable power consumption, whereas the FLEXA series including a four-wire system type can accommodate up to four modules. To prevent cable connection interference between upper and lower slots, the sensor module uses a staggered arrangement for screw positions, each shifted by a half pitch.

Sensor module

The sensor module is categorized as an I/O module in the FLEXA series. The main functions are: converting signals from sensors to electrical signals at the preamp and converting them to corresponding physical values based on the individually calibrated values saved in the EEPROM, and sending converted physical values via the local bus. To accommodate two modules, the power consumption of respective sensor modules for pH/ORP, conductivity, and dissolved oxygen was suppressed to 15 mW or less. Figure 5 shows the external view of the pH/ORP sensor module.

Unlike the CPU and power board assemblies, the sensor module is enclosed in a resin case for easy handling. While having adequate reliability, the set-in sensor case and laser marking systems for the case have reduced manufacturing costs. M4 screws are used for the terminals for external connections, which allows them to be connected with pin connectors, a standard for sensors. They all serve as terminals for relay and analog output modules, which will be developed in future as I/O modules.

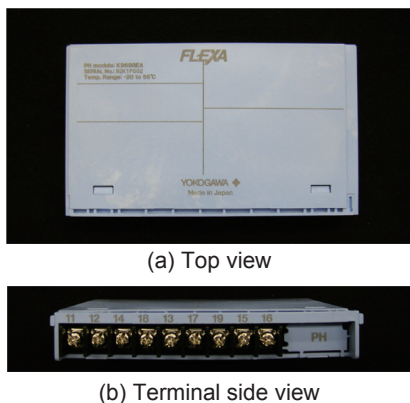


Figure 5 External view of Sensor Module (pH/ORP sensor module)

The FLXA21 has a function to save the same calibration data in the CPU assembly in case of failure of a sensor module. The calibration data of the sensor can be restored should a trouble occur.

EXPECTED FUTURE DEVELOPMENT OF THE FLEXA SERIES

The FLEXA series consists of assemblies and sensor modules, enabling a flexible and extendable system to be built. For example, to develop four-wire transducers, it is merely necessary to develop an AC power supply assembly and I/O modules such as digital input/output (DIO) and analog input/output (AIO) modules. Another CPU assembly can be developed to allow the analyzer to support a color LCD. Furthermore, developing a module dedicated for a new sensor available in future will expand applications. This suggests that the FLEXA series can be deployed not only for a liquid analysis but also for other analyses.

As previously described, I/O modules can be handled as ordinary parts, which facilitates maintenance. This also enables the analyzers to be easily assembled at any overseas affiliates in the world to meet short delivery schedules strongly desired in overseas affiliates recently. To deliver previous models quickly, we had to stock inventory of various

combinations of functions, or develop expensive all-in-one products and stock them. It was thus very difficult to respond to short delivery schedules. In contrast, for the FLEXA series, it is sufficient to keep inventory of I/O modules for each function and basic housings, and assemble them as required at the overseas affiliates. Once the customer decides the specifications, products can be delivered immediately.

Although the FLXA21 as a whole complies with intrinsic safety explosion-proof regulations just like previous models, the replaceable sensor module part and housing excluding the sensor modules shall be designed to conform to the regulations respectively. This will enable easy assembly of the FLXA21 conforming to the regulations with the parts themselves conforming to the regulations at any factories other than certified factories.

CONCLUSION

We have described the FLXA21, the first product in the FLEXA series. Following the development of the FLXA21, we will expand the lineup of the FLEXA series by making it comply with intrinsic safety explosion-proof regulations as mentioned above, making it comply with SIL2 (SIL: safety integrity level; a safety level defined by IEC61508, etc.), supporting the FOUNDATION Fieldbus, developing the four-wire multi-sensor/multi-output transducer, etc. Thus, we will enhance a wide variety of functions of the analyzers. The FLEXA is a flexible system that can handle new sensors available in future. This will help extend Yokogawa’s analyzer lineup.

REFERENCES

(1) Teruyoshi Minaki, Masashi Takeisi, et al., “EXA PH 2Wire Intelligent pH Transmitter Model PH200G/PH200S,” Yokogawa Technical Report, Vol. 34, No. 1, 1990, pp. 61-64 in Japanese

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