Technical Features of the Newly Developed General Controller and Compact Remote I/O Module for the savic-net G5 Building Management System

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In addition to large-scale downtown redevelopment of property spurred by the 2020 Tokyo Olympic and Paralympic Games, demand for renovation of existing buildings has also increased and is expected to continue even after 2020. To solve problems such as labor shortage in the construction of new buildings and in the instrumentation of renovations at the site of existing buildings in Japan, the General Controller and the Compact Remote I/O Module have been added to the savic-net G5 system product lineup. We describe their technical features.

1. Introduction

With the aim of further expanding its global market share, Azbil Corporation released a new building automation system, savic-net G5, with enhanced open-network support, and launched overseas sales in 2016.

Meanwhile, in the Japanese market, large-scale redevelopment projects, including those for the Tokyo Olympic and Paralympic Games, as well as an increase in existing building renovation work, are expected. The buildings involved in these projects require comfortable spaces that foster intellectual productivity, as well as sustainable and advanced energy management, both from the viewpoint of global warming prevention and reliable energy supply. However, with the decline in Japan's labor force and the government's promotion of "work-style reform," labor shortages have become an issue in instrumentation work.

In view of the labor shortage, and in order to save energy, provide comfortable spaces, and reduce man-hours in the field, we have added a General Controller (hereafter WJ-1111) and a Compact Remote I/O Module (RJ-12) to the product lineup of the savic-net G5 system (see fig. 1). In this paper, the functions of the WJ-1111 and RJ-12 are described.

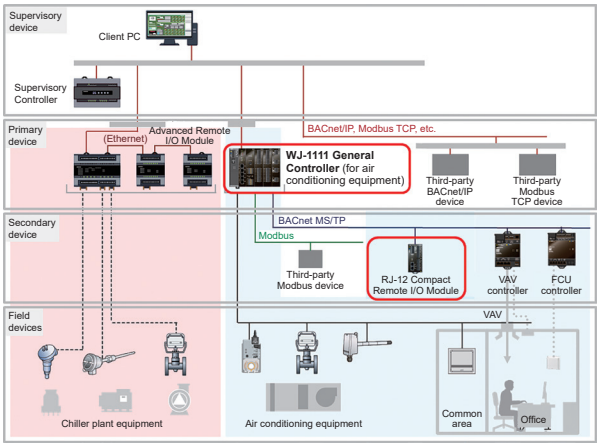

Figure 1. System configuration of savic-net G5

2. Overview of WJ-1111 and RJ-12

2.1 WJ-1111

The WJ-1111 (shown on the left in fig. 2) is a general-purpose controller that manages air handling units (AHUs) and monitors and controls equipment such as the variable air volume (VAV) devices in the savic-net G5 system. Its input/output signals are compatible with our conventional products. Nineteen types of Direct-Mount I/O Module (model RY51), which can be plugged together, are available, and up to 16 modules can be connected in any combination. Also, standard international communication protocols such as BACnet and Modbus™, and open networks, are supported, so it is possible to connect a variety of devices from various manufacturers.

2.2 RJ-12

The RJ-12 (shown on the right in fig. 2) is a remote I/O module compatible with BACnet communication. It is sufficiently compact to be installed in the free space in a control panel or the like. Also, it is possible to reduce wiring by installing modules near various other relevant devices. Five types of lineup are available according to the input/output signal type.

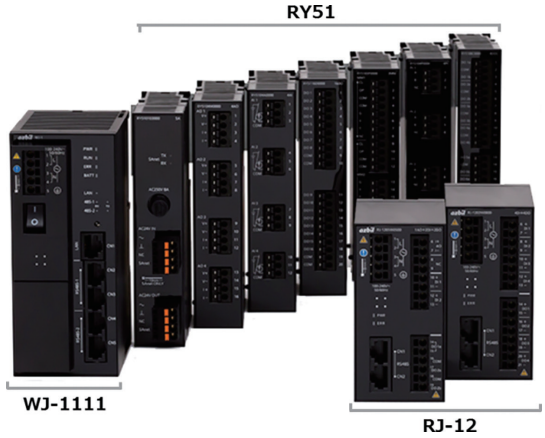

Figure 2. WJ-1111 and RJ-12

In the following, we describe the technical features of the WJ-1111 and RJ-12 that are aimed at realizing reduced man-hours in the field, the method of reducing installation man-hours, the simplification of engineering work, and compatibility with conventional products in cases of renovation of existing buildings.

3. Reduction of Installation Man-hours

3.1 Reduction of Man-hours for Wiring

Air conditioning control is carried out by the exchange of signals between controllers and various devices. The controller is often connected by individual signal lines to each device. In this case, since the controller has many input/output signals, many man-hours are required for wiring, in addition to the cost of cables and other installation materials.

To reduce the cost of materials and the man-hours required for wiring, it is necessary to reduce the number of signal lines between the controller and the devices. Consequently, we developed the RJ-12 as a remote I/O module that can be installed locally near the relevant device.

The RJ-12 is connected to the WJ-1111 by BACnet communication, and by installing it locally near each device, it is possible to reduce the amount of wiring (see fig. 3).

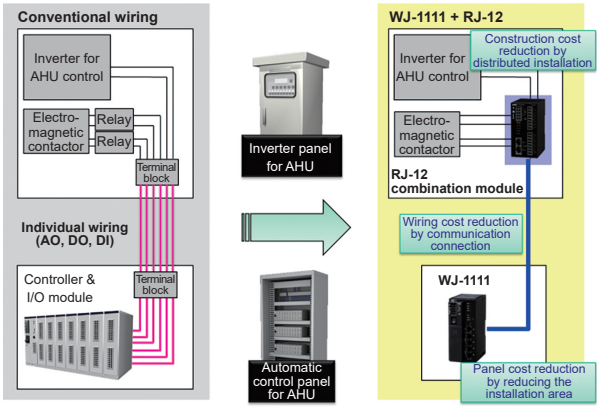

Figure 3. Reduction of wiring by distributed arrangement of RJ-12

3.2 RJ-12 Design for Distributed Installation

The following describes the features of RJ-12 design aimed at realizing the distributed installation described in section 3.1.

3.2.1 Compact size

For distributed installation locally near each device, in small free spaces such as are found in a control panel or power board, the RJ-12 had to be designed with a compact size, requiring little installation area and few installation restrictions.

The RJ-12 is 50 mm in width, and requires approximately 30 % less installation space than our conventional product (see fig. 4). The slim, compact size was achieved by optimizing the parts layout, after analyzing the thermal distribution in order to reduce the effect on service life. We also examined the terminal shape and arrangement for ease of wiring work. Our conventional product requires a 20 mm margin on the left and right sides of the product and 50 mm on the top and the bottom for installation and maintenance work. But for the RJ-12, no space is needed on the left and the right due to our battery-less design, which uses nonvolatile memory. The space required on the top and the bottom was reduced to 35 mm (see fig. 4).

3.2.2 Optimization of input/output product lineup

For distributed installation locally near each device, in addition to having a compact size, the RJ-12 must be compatible with the input/output signals of the connected devices.

In order to enhance the RJ-12 lineup, we developed a combination module optimized for AHU inverter control applications, and also a universal input/output (UIO) module that can support various input/output types simply by changing the software settings. These modules are described below.

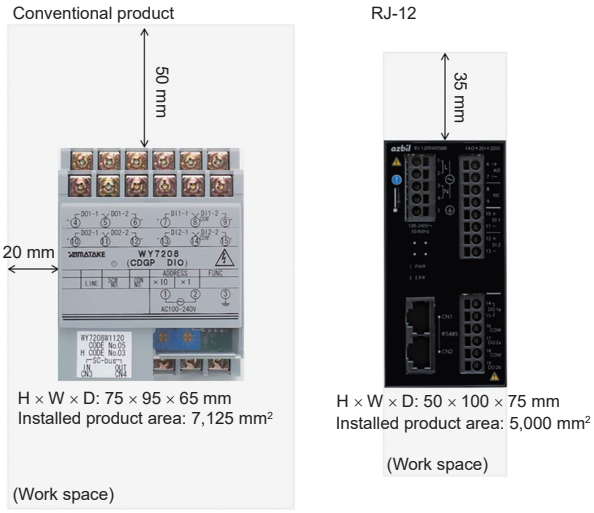

Figure 4. Comparison of RJ-12 and conventional product sizes

(1) Combination module

As a result of the analysis of signal interaction between the AHU controller and the equipment, we knew that for many types of instrumentation the most suitable combination of signals includes an inverter frequency setting signal (analog output), a fan on-off signal (digital output), and a fault-state signal (digital input). Accordingly, we developed a combination module that handles analog output and digital input/output signals. By installing this module locally in an equipment power board, it is possible to reduce costs by distributed installation because relays and terminal blocks for the equipment are unnecessary (upper right in fig. 3). Moreover, wiring costs are reduced by a communication connection (lower right in fig. 3).

(2) UIO module

In order to change the input/output types after installation of our conventional product, it was necessary to rework the wiring and change the product itself. Therefore, a product whose input/output types could be changed by changing the settings was desired. Until now, however, dedicated circuits for each signal type were required, leading to complicated circuit configuration that was particularly difficult to implement in small products.

To solve this problem, we used Azbil's UIO chip[(1)] to develop a UIO module, achieving a universal input/output function with a simple circuit configuration. The UIO module is compatible with various types of signal, such as analog input (voltage, current, and resistance temperature detector), digital input, and analog output (voltage and current).

One module has 2 inputs or outputs (up to 4 for voltage or current inputs), and it is possible to change the input/output signals simply by setting software parameters, helping to reduce the workload in the field.

3.3 Push-in Terminal Blocks

The power terminals of our conventional product were on a screw-type terminal block, but we used spring terminals for all the WJ-1111 and RJ-12 terminal blocks (see fig. 5).

This not only helps to reduce the space needed for maintenance as described above, but also eliminates the need for screw tightening when wiring and screw retightening in maintenance, making wiring work more efficient.

In addition, in the control panel, the power is often connected by daisy chain wiring, which with conventional screw-type terminal blocks is carried out by clamping the terminals together. However, on the WJ-1111 and RJ-12, the daisy chain wiring uses dedicated terminals.

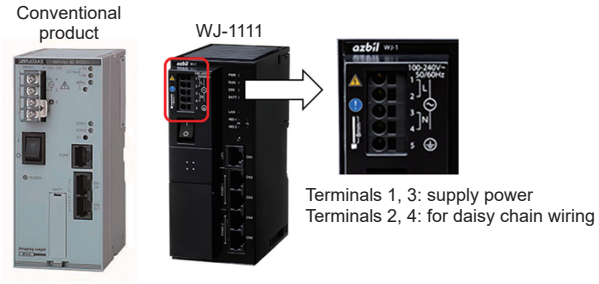

Figure 5. Power terminal block

3.4 Other Enhancements

In order to reduce the cost of the entire control panel and make it easy to add onto a distribution panel or power panel, the power supplies of WJ-1111 and RJ-12 are compatible with a wide range of input voltage (100–240 V AC) so as to eliminate the need for an external transformer or switching power supply.

4 Simplification of Engineering Work by Integrating AHU and VAV Control Functions

In office buildings, air conditioning by VAV is the most widely used in order to save energy and improve comfort. With a VAV system, the AHU and VAV cooperate to provide optimal control of the air supply temperature (load reset control), fan rotation speed, etc.

In Azbil's conventional system, the main VAV controller supervises multiple VAV controllers and exercises cooperative control of the AHU and VAV by transferring data to the AHU's controller. In this case, however, there are limits on the amount of data that can be transferred, and with complicated VAV instrumentation the limits may be exceeded, making it necessary to add controllers. In addition, since it is necessary to set up the connected controllers correctly, the engineering work will require considerable effort.

In order to solve this problem, the WJ-1111 integrates both the AHU control function and VAV control function, eliminating the main VAV controller. Therefore, the WJ-1111 can directly connect to VAV controllers and a single WJ-1111 can also handle the AHU and VAV settings. This allows cooperative control to be carried out without worrying about limits on the transmission of data between controllers. This too reduces the required engineering effort (see fig. 6).

Since the WJ-1111 is compatible with open networks, it can execute cooperative control of the AHU and connected third-party VAV controllers compatible with BACnet MS/TP.

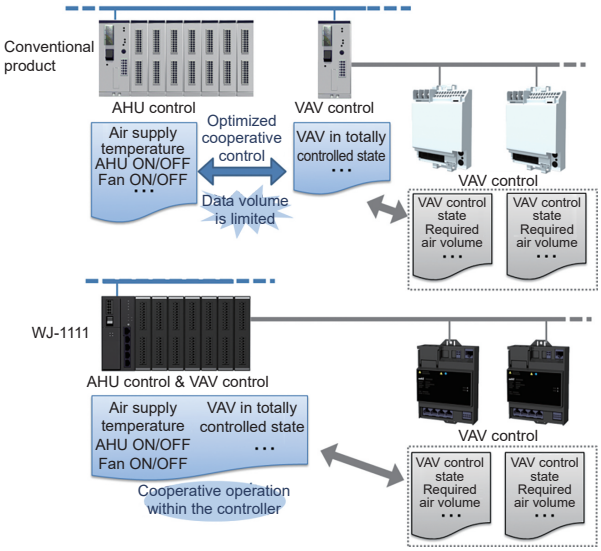

Figure 6. Cooperative control of AHU and VAV

5. Design Features for Renovation for Existing Buildings

After the 2020 Tokyo Olympic and Paralympic Games, the renovation of a number of buildings built during Japan's "bubble period" (the 1990s) is planned. Section 5 describes the features of the product (other than the reduction of man-hours in the field described in sections 3 and 4) that were designed for the renovation of existing buildings.

5.1 Compatibility in Size

When replacing a conventional product with a new product during the renovation of an existing building, if the size of the product is different, the control panel, etc., where the product is installed will also require change. Thus, to avoid additional design cost and installation man-hours, it is desirable for the product to be the same size as the old one. On the other hand, integration of the AHU and VAV control functions as described above necessitates enhancement of the CPU, memory, etc., which in turn increases power consumption as compared with the conventional product.

The WJ-1111 has the same size housing as the conventional product while integrating multiple functions of conventional products by arranging the parts in consideration of the internally generated heat distribution, based on thermal analysis. As a result, it was possible to upgrade the controller without changing the space needed for installation, making this product suitable for renovation projects of existing buildings. In addition, the orientation of the new product was designed to be the same as the old one in order to keep installation man-hours to a minimum.

5.2 Compatibilities in Input/Output

The WJ-1111 contains a module (RY51) that handles data input and output. The RY51 is completely compatible with the conventional product. As described in section 3, since input and output signals are often wired individually in conventional products, rewiring the signals requires a large number of man-hours. By making the input/output components completely compatible with the current products, it is possible to upgrade the controller without changing the wiring connections to connected devices (see fig. 7).

So long as the I/O module is within its service life, it is necessary only to replace the basic unit with the WJ-1111, so the controller can be upgraded with a minimum of man-hours of work.

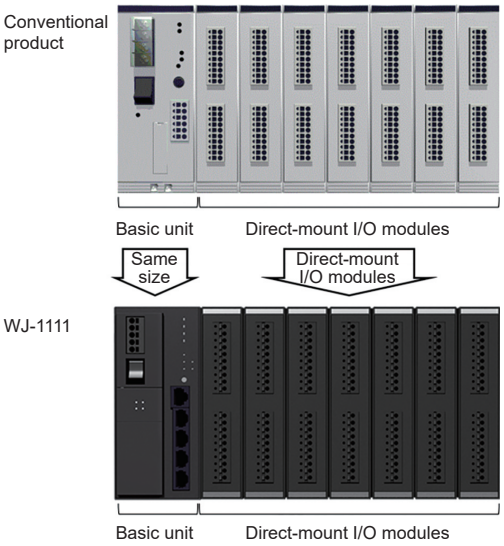

Figure 7. Compatibility with conventional product

6. Conclusions

We developed the WJ-1111 General Controller and RJ-12 Compact Remote I/O Module for the savic-net G5 system, which is designed to support buildings throughout their life cycle. Development of savic-net G5 is ongoing. Particularly, as described in section 5, we plan to further reduce the man-hours needed to renovate existing buildings by developing various interfaces that enable coexistence of elements of the old system and the new system.

We intend to continue to expand the savic-net G5 lineup to continue to provide an air conditioning system that is in tune with the building's life cycle, contributing to energy conservation and the realization of comfortable indoor spaces.

Reference

(1) Taichiro Kato et al., "An IC with Universal Input/Output Terminals" (Japanese with English abstact), *azbil Technical Review*, April 2018, pp. 36–40.

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