

Field Wireless Communication Module to Promote Field Wireless

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Yokogawa has developed the FN110, a small, light, intrinsically safe construction communication module conforming to ISA100.11a to resolve various problems for vendors. The FN110 was developed to promote ISA100.11a compliant products. By combining the co-developed FN310 field wireless multi-protocol module, the FN110 can unwire various existing wired field devices. The FN110 achieves better communication performance than existing field wireless devices by integrating components and circuits into the antenna module, such as an antenna and radio frequency (RF) circuits.

INTRODUCTION

Since ISA100.11a⁽¹⁾, an open-standard wireless networking standard for industrial automation developed by the ISA100 Committee of the ISA, was established in 2009, wireless has been introduced into various industrial applications. As the number of applications increases, the recognition of wireless technology is growing and various types of wireless field devices are beginning to be required to extend wireless application coverage. Even in control systems using conventional wired communications, wireless technology is expected to be used as a communication means to collect information from existing field devices such as diagnostic information.⁽²⁾

Although expectations for wireless field devices are increasing as described above, wireless field devices require further development in addition to the sensor function. Development includes an intrinsically safe design, acquiring radio law certification, implementing wireless communication protocols, and high frequency circuit design. As a result, many field device vendors take a lot of time to develop devices. Under such circumstances, in order to promote field wireless, Yokogawa has developed the field wireless communication module FN110 on the basis of the Wireless Anywhere concept⁽³⁾, which can drastically reduce cost and time for new product development. The FN110 not only contributes to reducing development costs and time, but also improves various factors such as communication performance. This paper describes the FN110.

ISSUES IN DEVELOPING WIRELESS FIELD DEVICES AND MEASURES TAKEN

As shown in Figure 1, the development of wireless

devices requires various technologies, such as high frequency and wireless communication technologies that are different from conventional ones. However, field device vendors do not have the know-how regarding such technologies because they are not required for conventional field devices. In addition, wireless communication protocol technology cannot differ among products because it is standardized. Furthermore, to develop wireless products, various tasks such as intrinsically safe design for high-frequency circuits, batteries and antenna, and acquiring radio law certification are required. In particular, vendors must acquire certification for their wireless products according to radio regulations and certification procedures defined in each country (in Japan defined as the Radio Act). The following are hurdles to be overcome when developing wireless field devices.

- > Explosion-proof design for wireless-related part and battery
- > Battery-driven design, low power consumption design
- > Wireless related
 - High frequency circuit design (2.4 GHz)
 - Manufacturing wireless devices
 - Certification for the radio laws in each country

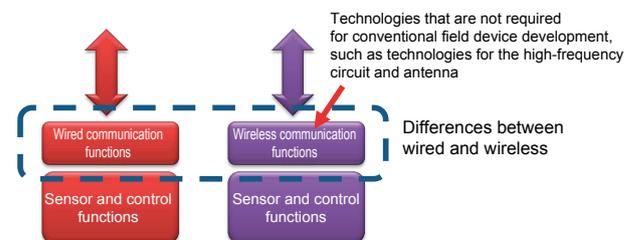


Figure 1 Functional difference between wireless and wired field devices

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Accordingly, to overcome the hurdles, Yokogawa has developed the FN110 in which the hardware and software for wireless communication are modularized. The FN110 has a simple serial interface to connect with many field devices that have a digital communication capability, and its wireless communication functions can link with field device functions. Device vendors develop the software for linking used on the device. Accordingly, device vendors do not need to face to the hurdles described above, and can concentrate their development on the development of sensor and control functions where they have an advantage.

FIELD WIRELESS COMMUNICATION MODULE

Overview

Figure 2 and 3 shows the appearance of the FN110 and the configuration using the FN110 respectively.



Figure 2 Appearance of FN110

Figure 3 (a) shows the configuration of connecting to a field device without the FN310 and Figure 3 (b) shows the configuration with the FN310. The FN310 is a field wireless multi-protocol module, and its details are described in “Functionality and Application of Field Wireless Multi-protocol Module” in this issue. In the configuration with the FN310, its built-in battery supplies power to both the FN110 and the field device. Meanwhile, in the configuration without the FN310, the field device needs to supply power to the FN110 through the serial interface.

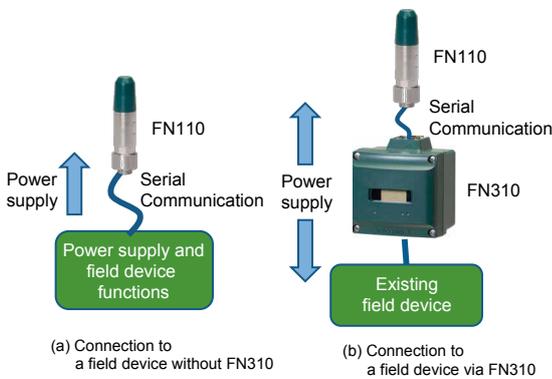


Figure 3 Configuration using FN110

Figure 4 shows the case, internal structure and dimensions of the FN110. The FN110 is a 90 mm length

module which includes an antenna function, high frequency circuits, a wireless communication protocol, control functions for sensor data acquisition and conversion, and a connection interface to a field device capable of digital communication.

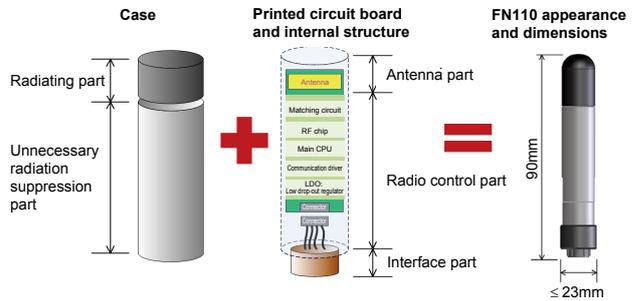


Figure 4 Case, internal structure and dimensions of FN110

Features

The FN110 incorporates all of the wireless functions in one compact module, and an antenna is integrated into it. As a result, its performance and usability are improved as described below. In particular, constraints on installation of field devices have been decreased and the communication performance has been improved compared to the conventional configuration in which an antenna is apart from a wireless high frequency circuit. In addition, since the FN110 is a complete stand-alone product, additional work including acquisition of intrinsically safe and radio law certification are not required as long as the FN110 is used. The details of these features are described below.

1) Reducing constraints on installation

As with the case of conventional wireless field devices, the antenna is located on the FN310 by connecting the FN110 directly to the FN310 as shown in Figure 5 (a), or it is remotely located by using the extension cable as shown in Figure 5 (b). Although the length of the extension cable used for conventional wireless field devices is up to 13 m, that for the FN110 is up to 20 m in non-hazardous areas. Because the FN110 includes a radio circuit as shown in Figure 4, there is no need to provide high-frequency signals on the extension cable nor to take the attenuation of high-frequency signals in a coaxial cable into account. This is the reason for the difference in extension distance. This also contributes to reducing the cost of the extension cable.

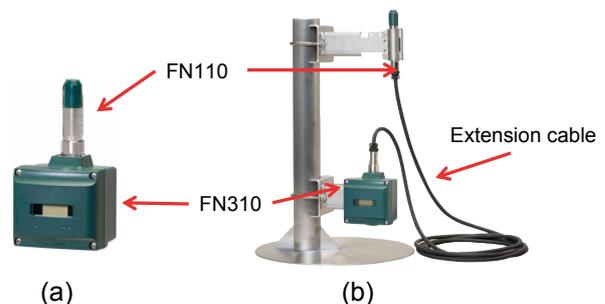


Figure 5 Flexible antenna installation

2) Extending communication distance by enhanced receiver performance

Radio chips with higher receiver sensitivity have become available at low cost owing to the evolution of radio technology. The FN110 with the latest chips has achieved twice the receiver performance compared to existing products (increase by 6 dB). This improvement in receiver performance directly leads to greater communication range, achieving a line-of-sight communications range of 1200 m. This improvement directly leads to better communication performance at plant sites called ‘pipe jungles’ where metal tanks and pipes are crowding together. Even in other areas with many obstacles in them, the FN110 can cover a wider range of communication compared to existing products.

3) Explosion-proof certification

Field device vendors have advanced intrinsically safe design technology, know-how and other things required for product development. However, they do not have much experience in wireless technology which has been spreading rapidly in recent years. Thus, they may fail to effectively deal with issues such as cost, development time and wireless performance in their development of wireless field devices. However, they can resolve the problems related to intrinsically safe certification by using the FN110 certified in each country, and they can develop high-quality products more effectively while focusing on technologies advantageous to them.

4) Radio law certification

To release a wireless device on the market, radio law certification must be acquired in each country where it is to be used. However, because the FN110 is already certified as a stand-alone unit in each country, the vendor does not need to go through the trouble of certifying in each country and can effectively develop a product as long as it is configured using the FN110. For example, even if a device is certified and conforms to the radio law in Japan, it cannot be sold in the US if it has not been certified to conform to the radio law in the US. However, if the FN110 is used, no radio law certification is necessary in the US.

5) Developing a wireless device without knowledge of ISA100.11a standards

ISA100.11a communication stack and ISA100.11a specific application processing are implemented together in the FN110, and so field device developers are no longer required to develop ISA100.11a communication functions and the part of the application to interface with it. This makes design and development of the device easier.

6) Simple and standard serial interface connection

Due to the reason described above, the FN110 interface with a field device doesn’t need to handle ISA100.11a communication functions. This makes the interface simple. To reduce the burden on field device developers, the FN110 employs a standard serial interface and command-response-

type protocol for easy software implementation.

Software architecture

Figure 6 shows the software architecture of the FN110.

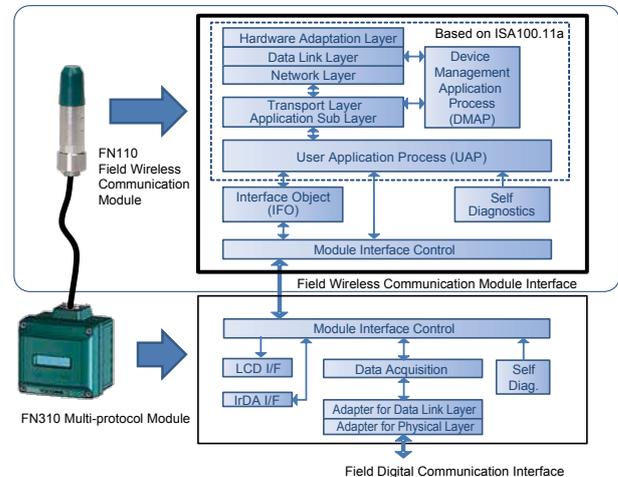


Figure 6 Software architecture

1) ISA100.11a-compliant protocol stack

FN110 completely contains all items defined in the ISA100.11a from the data link layer to the application sub-layer, the field device user application process (UAP) for field device applications, and the device management application process (DMAP) which sets the parameters of field devices. The wireless communications processing part of the FN110 is designed to integrate the hardware-dependent software into the hardware adaption layer so that the effects caused by the vendor dependent specifications of IEEE802.15.4-compliant chips are limited. The IEEE802.15.4 is a wireless communication standard for low-speed, low-power consumption wireless networks. Thus, optimal chips can be easily chosen in consideration of their cost, performance, and availability. In addition, this reduces the future risks of dependency on specific chip vendors.

The UAP manages the data update interval of field devices, and transmits diagnostic information and normal or abnormal status of the data from field devices. In addition, it has functions to hold previous values in the case of failures, display test values during maintenance, transmit alert messages on failure detection, update the software of field devices, and others. A wide range of functions required for installation, operation and maintenance of field devices are provided according to the framework of the standardization with no omissions.

2) Interface object

The interface object (IFO) assists protocol conversion between various digital communication protocols and the ISA100.11a protocol covered by the FN310 and FN110. This enables the FN110 to be flexibly applied to a wide variety of existing wired field devices. By implementing a Modbus interface with relatively simple structures in addition to major

digital communication protocols such as HART, development work required by device vendors can be significantly reduced and development of new wireless devices is promoted.

BENEFITS FOR WIRELESS FIELD DEVICE VENDORS

Because the FN110 eliminates most of the hurdles for wireless field device developers, it is a very powerful function module that promotes the diffusion of ISA100.11a-based wireless devices. Device vendors can obtain the following merits when developing wireless field devices with the FN110.

- Reducing the work, cost and time for radio law certification
The FN110 integrates an antenna and a wireless control unit in it, and is certified to conform to the radio law as a stand-alone unit. Thus, a wireless field device itself does not require certification, and device vendors can reduce time and cost during development.
- Reducing material cost
Radio frequency (RF) coaxial cables and connectors are no longer required, drastically reducing the cost of wireless field devices.
- Compact size and light weight
A wireless circuit can be removed from the field device communication module of a field device, making its structure simple. Wireless field devices can be made smaller and lighter.

The FN310 is a communication adapter to unwire field devices using a digital communication protocol without the need to modify those devices. On the other hand, the FN110 is a product that can significantly reduce cost and time for new wireless field device development by eliminating the man-hours required for wireless function development. Primary users of the FN310 are users of wireless field devices, and primary users of the FN110 are developers of wireless field devices.

BENEFITS FOR WIRELESS FIELD DEVICE USERS

The benefits for wireless field device vendors were described above. In addition, the spread of wireless technology owing to the FN110 brings the following benefits to wireless field device users.

- Increase in the number of types of wireless field devices
Increase in the number of types of wireless field devices means that applications in which wireless technology can be

applied will increase. Wireless users can enjoy the benefits of wireless technology, such as installation cost reduction and monitoring at locations where it used to be difficult to deploy devices, in a wider range of applications.

- Increased choices of wireless field devices
The demand for field devices may vary depending on the application. Some applications require high performance and regular performance is sufficient in other applications. More choices are given to wireless users. For example, users can implement best-in-class solutions by selecting the most suitable field device in cost and performance even among field devices of the same type.

CONCLUSION

Yokogawa developed the wireless field communication module FN110, a compact, lightweight and intrinsically safe product conforming to ISA100.11a for outdoor use. If device vendors who don't have wireless technology apply the FN110, the obstacles in developing various wireless field devices such those described above are eliminated at once, and thus the development of ISA100.11a-based products are promoted. As a result, users can benefit by being able to select field devices that are optimal in performance and cost for their intended applications.

As described above, the FN110 is a useful function module that increases the available types of wireless field devices and promotes field wireless. The FN110 along with the FN310 is one of the devices that realizes the Wireless Anywhere concept advocated by Yokogawa. The FN110 is a powerful enabler to unwire existing field networks while effectively utilizing the users' assets.

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