

Renovation Controller to Realize Long-Life of Chiller



**Mitsubishi Heavy Industries
Air-Conditioning & Refrigeration
Corporation**
Chiller Systems Headquarters
**Mitsubishi Heavy Industries Thermal
Systems, Ltd.**
Chiller & Heat Pump Engineering
Department

The controllers of centrifugal chillers manufactured by Mitsubishi Heavy Industries Thermal Systems, Ltd. (MTH) are proprietary products of MTH. However, it was impossible to replace existing controllers with the latest ones due to the significant difference between old and new controllers and the difficulty in ensuring compatibility. Nevertheless, many centrifugal chillers that were released more than 10 years ago and are equipped with old controllers are still in service and they will continue to be used for a long time in the future. In order to reassure our customers that they can operate MTH centrifugal chillers for a long time without issue, we have developed a renovation controller with the latest features compatible with older controllers.

1. Introduction

The service life of centrifugal chillers is more than 15 years. However, the controllers that chillers are equipped with are updated to the newer generation every five to six years. MTH has developed three generations of original chiller controllers for 20 years: the fifth, sixth and seventh generations. In the development of these controllers, the adoption of the functions and performance required at that time was prioritized over compatibility between controller generations. As a result, the differences in specifications between controller generations were significant, so that it was not possible to use the latest controller for a chiller equipped with an older generation controller when the replacement parts of the older generation controller had already become discontinued. **Figure 1** illustrates the transition of the controllers.

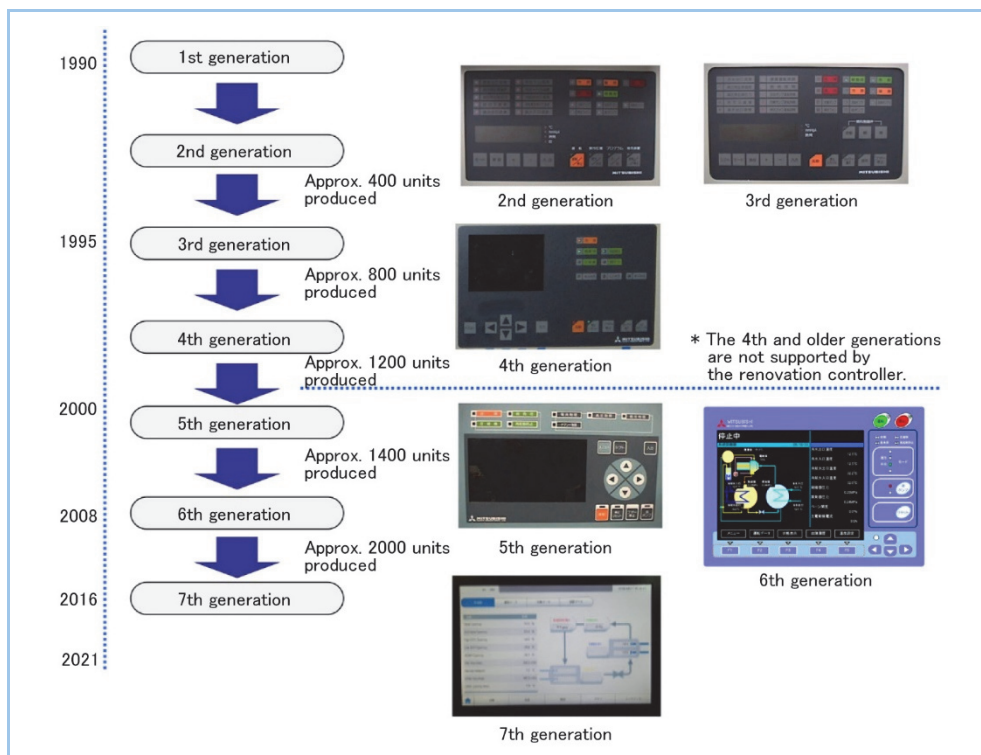


Figure 1 Transition of controller

More than 15 years have passed since the end of production of the fifth-generation controller, so we have been proposing to customers updating (replacing) a complete set of the Control Panel when it becomes necessary to replace a fifth-generation controller. However, the replacement of a complete set of the Control Panel required time and cost, which placed a burden on the customer.

Therefore, we have developed a retrofit product that can be replaced more easily at a lower cost than updating a complete set of the Control Panel. This report describes the developed retrofit product, the renovation controller.

Fourth-generation and older controllers are not included in the target of the renovation controller because the number of in-service chillers equipped with such controllers has been decreasing.

2. Overview

Figure 2 depicts the internal structure of the chiller Control Panel.

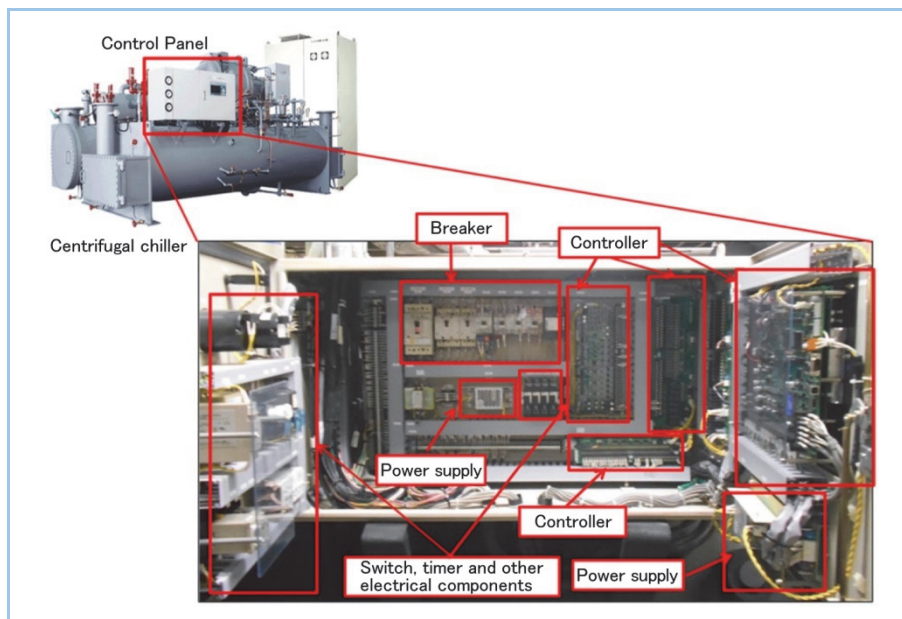


Figure 2 Internal structure of chiller Control Panel

Chiller Control Panel consists of the controller, power supply, breaker, switch, etc. and has control and operation functions for the chiller operation.

The controller is a component of the control device and includes a centrifugal chiller operation controller, an Liquid Crystal Display (LCD) controller that displays the operating status, an analog input/output controller that measures temperature and pressure, as well as a digital input/output controller that directs pump operation, etc. Table 1 and Figure 3 show the types and specifications of the fifth-generation controller.

The manufacture of Control Panel takes several months and the replacement thereof about one week. Because the customer's intention is to maintain the chiller functions, it is desirable to replace fewer parts and perform the minimum amount of work in order to shorten the chiller outage period.

For this reason, the developed renovation controller reuses the existing chiller Control Panel as much as possible, under the concept of replacement at a low cost in a short amount of time.

Table 1 5th-generation controller

Name	Display controller	Main controller	DI controller	DO controller	AIO controller
Size (mm × mm)	325.8 × 265.75	310 × 250	300 × 70	360 × 115	300 × 135
Power supply (DC)	-	5 V ±15 V 12 V 24 V	5 V 24 V	5 V 24 V	5 V ±15 V
Function	Chiller status display	Chiller control Analog input/output	Digital input	Digital output	Analog input/output

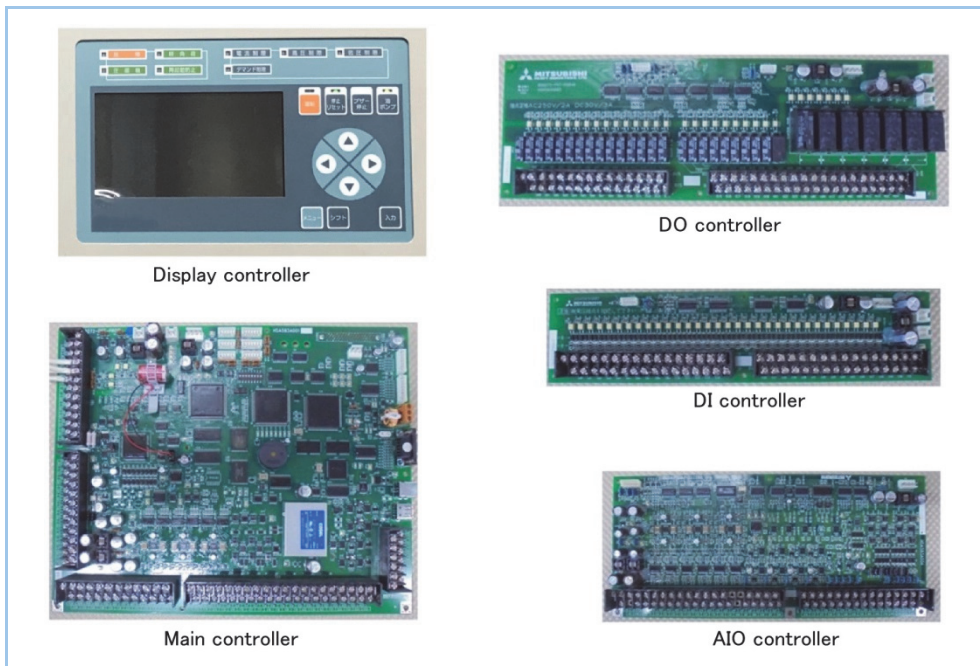


Figure 3 5th-generation controller

3. Features of renovation controller

3.1 Controller types

Table 2 and Figure 4 show the types and specifications of the renovation controller. The renovation controller, which was developed under the concept of replacement at a low cost in a short amount of time, has almost the same installation dimensions and configuration as the fifth-generation controller.

Table 2 Renovation controller

Name	Display controller	Main controller	Main AIO controller	DI controller	DO controller	AIO controller
Size (mm × mm)	325.8 × 265.75	200 × 250	310 × 250	300 × 70	360 × 115	300 × 135
Power supply (DC)	24 V	24 V	24 V	24 V	24 V	24 V
Function	Chiller status display	Chiller control	Analog input/output	Digital input	Digital output	Analog input/output

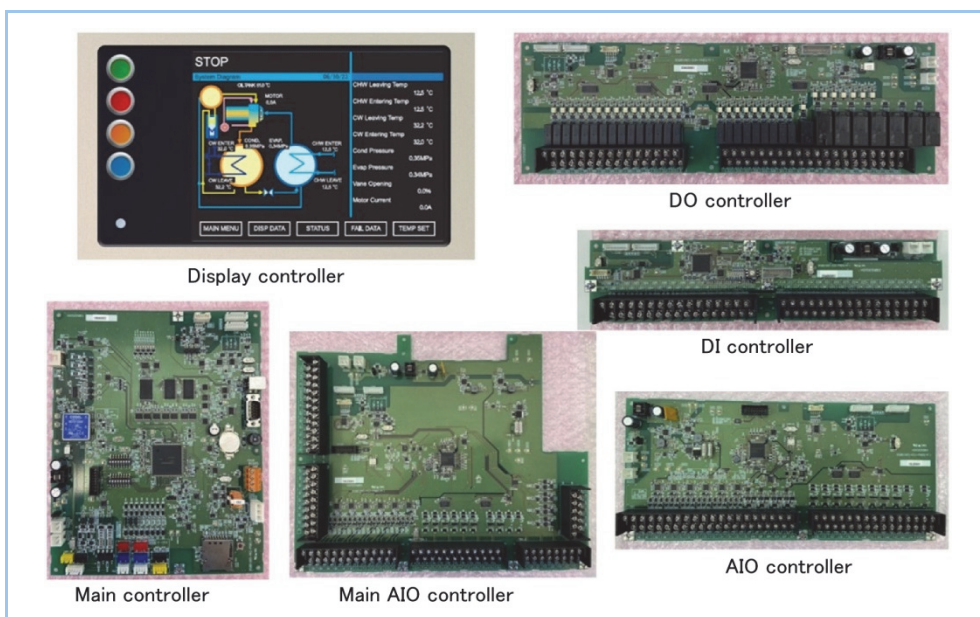


Figure 4 Renovation controller

The renovation controller has a Main AIO controller, which the fifth-generation controller does not have. This is because the renovation controller has a configuration in which the chiller control and analog input/output functions of the fifth-generation main controller are separated.

This separation of the controller functions is intended to use the renovation controller as a sixth-generation controller in the future, which will be described in the chapter 4.

3.2 Comparison of LCD specifications

Table 3 and **Figure 5** compare display specifications between the fifth-generation controller and the renovation controller.

The renovation controller displays the system diagram and main measured values on the top screen and has a touch panel with an LCD larger than that of the fifth-generation controller, which increases the number of items that can be displayed on a single screen from 12 to 16, resulting in improved visibility and operability.

Table 3 Comparison of display specifications

Item	5th-generation controller	Renovation controller
LCD	7 inches	10.4 inches
Operating method	Button	Touch panel + Button
Human detecting sensor	Not include	Include

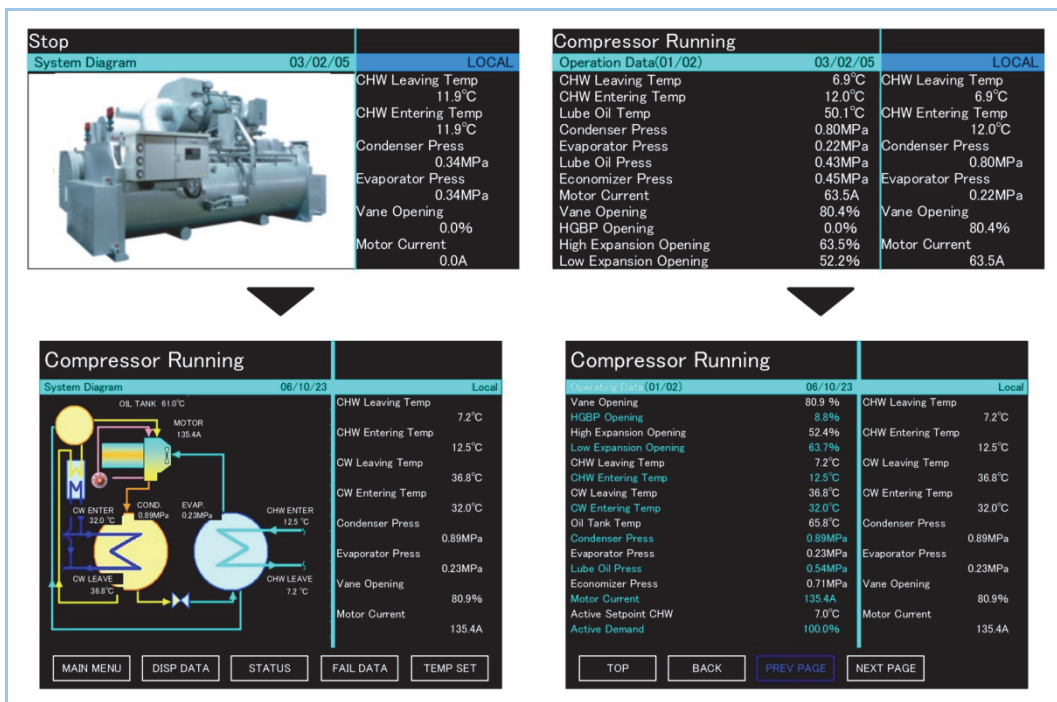


Figure 5 Comparison of display

3.3 Automatic operation data sampling

The renovation controller comes equipped with a function to measure the operation data of the centrifugal chiller and store it on an SD card in the main controller as standard.

The measured data can be utilized to evaluate the operating status of the centrifugal chiller, which enables proposals for optimal operation to customers. The data can also be used for data analysis when an abnormality occurs in the centrifugal chiller, which enables quick investigation of the cause.

3.4 Human detecting sensor

The renovation controller has a power saving function that automatically turns off the screen after a certain period of time during which the LCD is not operated in order to reduce power consumption and extend the life of the display. For the purpose of preventing erroneous operation when recovering from this power saving state, the renovation controller is equipped with a human detecting sensor, which uses infrared rays and enables easy recovery from the power saving state without contact.

The fifth-generation controller also has a power saving function, but recovery from the

power saving state requires the operation of any button on the display controller, which can lead to erroneous operation because buttons for operating the chiller such as Run and Stop buttons are always live, even in the power saving state. The adoption of the human detecting sensor for the renovation controller attains improved safety.

4. Use of renovation controller as 6th-generation controller

Table 4 and Figure 6 show the types and specifications of the sixth-generation controller.

Table 4 6th-generation controller

Name	Display controller	Main controller	DI controller	DO controller	AIO controller	M-IF controller	M-AIO controller
Size (mm × mm)	213 × 161.5	200 × 250	380 × 95	460 × 125	325 × 170	325 × 250	325 × 250
Power supply (DC)	5 V 12 V	5 V 12 V 24 V	5 V 24 V	5 V 24 V	±15 V 5 V 24 V 12 V	24 V	12 V 24 V
Function	Chiller status display	Chiller control	Digital input	Digital output	Analog input/output		

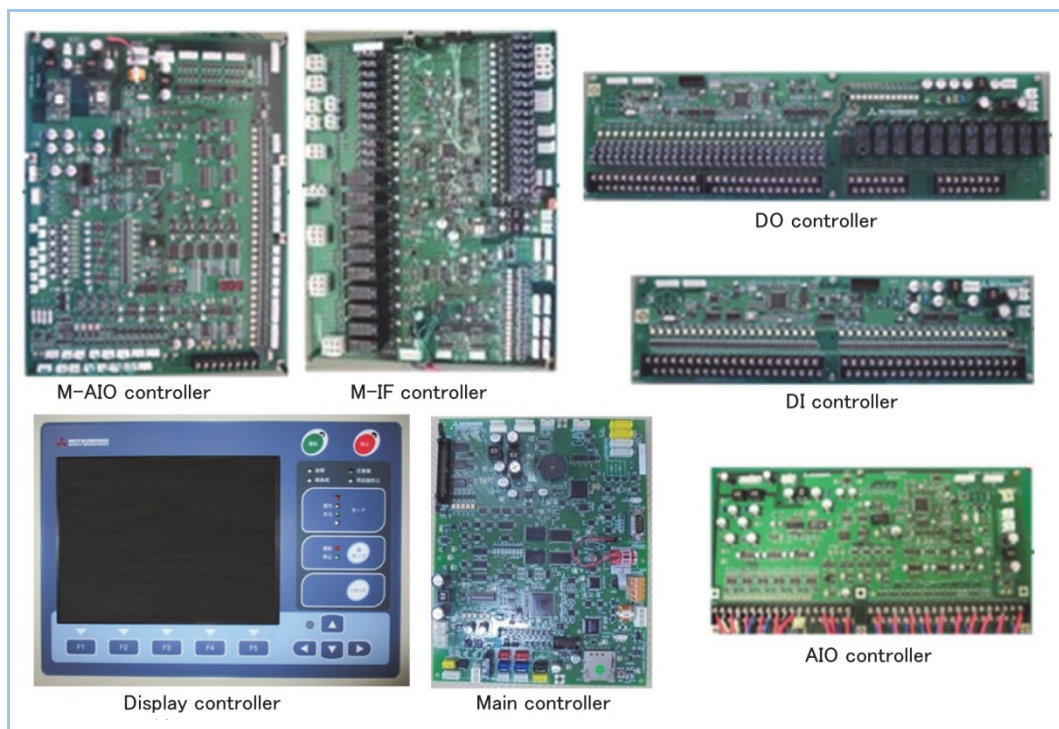


Figure 6 6th-generation controller

The sixth-generation controller, which is still available as of 2021, has been on sale for more than 13 years and is the most used controller for MTH centrifugal chillers ever. However, some of the electrical components used in the sixth-generation main controller have become difficult to obtain and the production thereof will soon be discontinued, as was the case with the fifth-generation controller.

For this reason, the renovation main controller developed this time has a configuration that also allows it to be used as a substitute for not only the fifth-generation main controller, but also the sixth-generation main controller.

The sixth-generation main controller has the function of chiller control and the fifth-generation main controller has the functions of chiller control and analog input/output. The renovation main controller has a configuration in which the chiller control and analog input/output functions of the fifth-generation main controller are separated and enables its use as a renovation main controller by making the chiller control function independent, a feature of both the fifth- and sixth-generation main controllers.

We plan to start consideration of the use of the renovation main controller as a sixth-generation main controller from fiscal 2022 or later.

5. Conclusion

This report described the development of a renovation controller as a retrofit product for the fifth-generation controller in order to allow our customers to use our centrifugal chillers for a long time. This not only enables quick recovery when a controller fails, but also makes it possible to propose easier maintenance (part replacement) at a lower cost than conventional replacement of the Control Panel.

Moving forward, we will consider the use of the renovation controller as a replacement sixth-generation controller and establish firm support to allow more customers to continue to use their centrifugal chillers for many years.