# Various Retrofit Technologies

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**Abstract**

**In the technical term, "retrofit" is an abbreviation for "retroactive refit." This means "an action taken to renovate or modify an aged machinery into the latest model version" or "aged equipment improved for longer life cycle."**

**Some of Meiden products have operational lives of more than twenty years. Our products require partial renovation as a result of deterioration of key parts until complete renewal. For planning partial renovation, however, there are circumstances where a supplied product model (installed units) is no longer produced (discontinued) and there is no substitute product available that can be installed in the same sized space of the supplied units.**

**For a solution, it is necessary to develop a retrofitted product that assures the same size and function of the former model and can use the existing interface like connectors without modification. This is necessary to shorten the period of renovation work.**

## 1 Preface

Supplied electrical facilities to our customers can be operated reliably if they receive adequate maintenance and operation. If a system becomes very aged, however, it is preferable to completely renew the facilities. Due to strict budgets or other challenges, however, only partial renovation is performed in some cases. In such a case, issues arise with difficulty in getting the same key components supplied due to the model discontinued or model change. We make it a policy to provide a substitute component, equipment or parts that are difficult to get. If such replacement parts are adopted, we can apply such substitute units in the event of failure of the components that are difficult to replace. In this manner, we can realize improved quality of maintenance services and customer satisfaction.

This paper introduces the supply of the substitute equipment we supplied and our newly developed retrofit products for our customers.

## 2 Outline of Our Retrofit Products Development

### 2.1 Purpose

There are cases where a replacement unit necessary for the continuous operation is no longer available due to discontinued production or newly changed model not fitting the supplied system. In such a situation, by using our retrofit product, we attempted to replace the existing units requiring replacement by the minimum modification or renovation work.

### 2.2 Background

Due to the slowing of capital investment in Japan, our customers trend to use an existing facility for an extended period while conducting further maintenance work. Due to the difficulties in procuring key components and tools or because of discontinued production, however, it has become difficult to prolong a facility's operational life by simply replacing necessary parts. Given such a situation, we provide the necessary equipment, substitute parts, and tools for partial renovation to realize the extended operational life of existing systems and equipment.

Merits of our retrofit products are described as follows:

(1) It offers facility renovation with minimal cost compared with complete renewal.

(2) It reduces system or equipment downtime due to the replacement work. It utilizes existing wiring to connect the system by designing the same size replacement units.

**Table 1** Present Offerings and Future Planning of Retrofit Products

Retrofit products previously supplied and their contents are shown.

| Subject matter | ～ Fiscal 2015 | Fiscal 2016 | Fiscal 2017 and thereafter |
|---|---|---|---|
| Solutions for plant life extension<br>↓<br>(Retrofit products development) | Development of substitute due to discontinued production or stop of maintenance service | | |
| | [Products, units]<br>・Substitute for Mouse-2 for μPORT<br>・Substitute for small capacity tele-control<br>・Substitute for SCSI disk<br>・Printer subsystem (for upgrading to 7)<br>・Substitute for inductive relay<br>・Substitute for digital multi-relay<br>・P6 control box | Continued research on market needs and conducting of substitute development and taking measures against discontinued production | |
| | [Products, units]<br>・Substitute for multi-controller (integrated type, separate type)<br>・Development of GW for touch panels<br>・Substitute for printed circuit boards for emergency generator<br>・Substitute for 50kVA inverter (YAMTHC-500/600) | Substitute development of XTC1100 | |
| | [Power supply]<br>・Substitute power supply for ADC4000<br>・Reproduction of MVX028B-01/02 | Development of general-purpose PLC monitor (From 2015) | Order resulting from lack of products due to discontinued production |
| | [Measures taken against lack of parts]<br>・Selection/evaluation of substitute parts<br>・Production of small P-boards for substitute parts mounting | Substitute for SDS interface | |
| | [Substitute for loaders and authorization tools]<br>・For HD1000<br>・For P8000<br>・For P2000<br>・Setting tools for arithmetic units<br>・Setting tools for alarm setting units | ADC4000 loader for Ethernet | |
| | [Reduction of work time for renovation]<br>・P2-P4・P6-P4<br>・P2-V1・P6-V1<br>・HLD-FD100<br>Production of conversion adapters | | |
| | [Conversion tools]<br>・TACSYS HPC → RC500<br>・P2000 → RC500<br>・One-loop controller HLD → FD100 | Emergency measures required: Production for substitute, ordering for support, Lack of parts | |

(3) It realizes the continued use of familiar facilities with upgraded performance.
(4) It helps environmental preservation by partial renovation as it reduces industrial waste compared with complete renewal.

## 2.3 Technical Supports

Table 1 shows present offerings and future planning of the retrofit products.

## 2.4 Retrofit Products

### 2.4.1 Successor Models of Digital Multi-Relays

The M○90 digital protection relays became difficult to manufacture because production of major parts used in these relays were discontinued. For the successor models, we developed new versions of digital protection relays (MRR Series). Their major features are described below.
(1) Functional interchangeability
(2) Mounting interchangeability (In the event there is a package design change due to the integrated model, we manage this issue by using an attachment)
(3) Unification of model numbering (There used to be many model numbers according to mounted relay devices and trip output modes. The numbering was unified to the same type with the adoption of setup files and setting methods.)

Table 2 shows a list of the MRR Series and

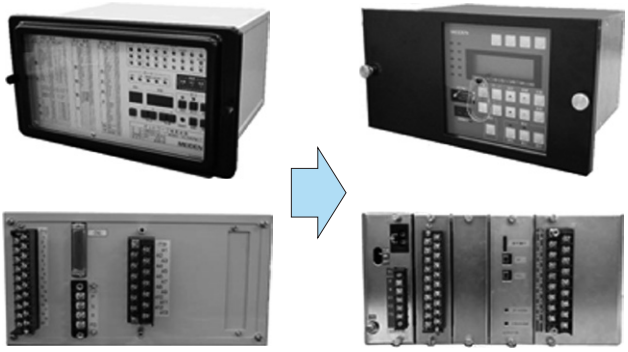
**Table 2** List of the MRR Series

A list of M○90 type digital protection relays and applicable items of the MRR Series is shown.

| Title | MRR Series | M○90 Series (Digital multi-relays) |
|---|---|---|
| Network protection relay unit | MN80S2-C01(A) | MN90S2-□□ |
| Generator ground fault protection relay unit | MG80S1-C01(A) | MG90S1-01 |
| Generator protection relay unit | MG80S2-C01(A) | MG90S2-01 |
| Generator short-circuit protection relay unit | MG80S2-C02(A) | MG90S2-02 |
| Generator protective control unit | MG80S2-C03(A) | MG90S2-03～07 |
| Feeder for digital protection relay unit | MF80S1-C01(A) | MF90S1-□□ |
| Incoming power for digital protection relay unit | MR80S1-C01(A) | MR90S1-□□ |
| Bank of digital protection relay unit | MB80S1-C01(A) | MB90S1-□□ |
| Digital protection relay unit for Transformer 1 | MT80S1-C01(A) | MT90S1-□□ |
| Digital protection relay unit for Transformer 2 | MT80S2-C01(A) | MT90S2-□□ |
| Digital protection relay unit for rectifiers | MJ80S1-C01(A) | MJ90S1-□□ |

Notes: ○ is type code.
□□ is type number.

Fig. 1 shows the substitute models of the digital multi-relays.




(a) Digital multi-relays (S2) (b) MRR Series (S2)

**Fig. 1 Substitute Models of Digital Multi-Relays**

Examples of substitute models from M□90 type digital protection relays to the MRR Series are shown. Both external dimensions and panel mounting hole sizes are completely compatible. For S1 and S2, external dimensions are shown and the width of S1 is 172mm and that of S2 is 260mm, respectively. Because of the integrated model impact, a small modification of external wiring is needed.

### 2.4.2 P6 Control Box

Since some items (electronic components and relays) used in generator starting controllers faced discontinued production, we developed substitute products. Their features are itemized as follows:

(1) Functional interchangeability
(2) Mounting interchangeability
(3) Wiring interchangeability

Fig. 2 shows printed circuit boards for the P6 control box.

### 2.4.3 Substitute Printed Circuit Boards for Emergency Generators

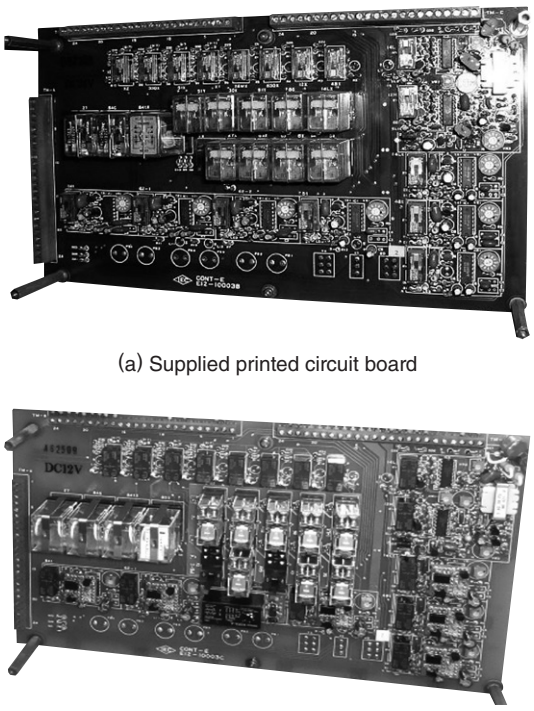
Since the supplied keep relays in operation are no longer produced, we developed substitute models. The socket design of this substitute relay is changed from a rectangular shape to a round shape. The circuit board was redesigned to fit the new socket shape. The features are itemized below.

(1) Functional interchangeability
(2) Mounting interchangeability
(3) Wiring interchangeability

Fig. 3 shows a printed circuit boards for the emergency generator.

### 2.4.4 P2-V1/P6-V1 Conversion Adapter

At the time of model changeover from our IO Module P2 Series and P6 Series into the V1 Series, we developed a new conversion unit so that internal cables of the existing panels can still be used. Fig. 4 shows an example of application to the P6-V1 conversion unit.

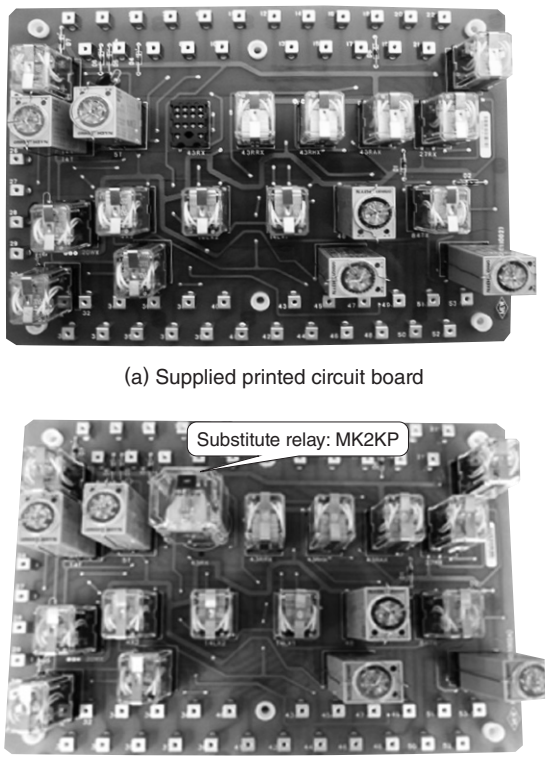



(a) Supplied printed circuit board

(b) Substitute printed circuit board

**Fig. 2 Printed Circuit Boards for the P6 Control Box**

A supplied printed circuit board for the P6 control box is shown in (a) and a newly developed substitute printed circuit board for the P6 control box is shown in (b).

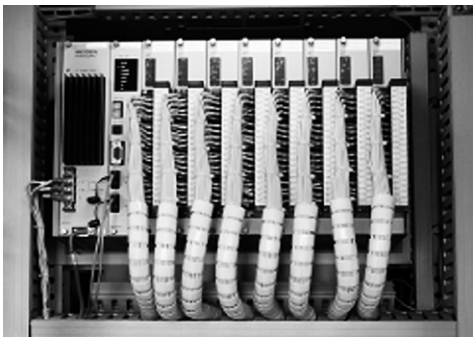



(a) Supplied printed circuit board

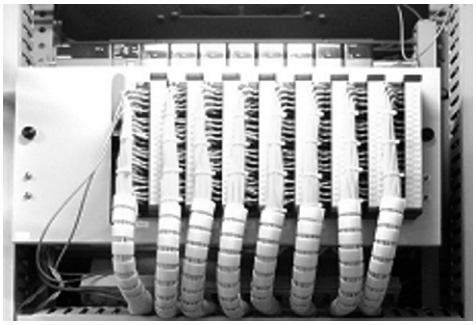
(b) Substitute printed circuit board

**Fig. 3 Printed Circuit Boards for the Emergency Generator**

A supplied printed circuit board is shown in (a) and a newly developed substitute printed circuit board is shown in (b).



(a) Before renovation



(b) After renovation

**Fig. 4** Example of Application to the P6-V1 Conversion Unit

A view before renovation is shown in (a) and a view after renovation is shown in (b).

### 2.4.5 Setup Tool for Process Instrumentation Equipment

The setup tool software for process instrumentation equipment used to run on an old type Personal Computer (PC) such as the NEC PC98 Series, popular in Japan in 1980s. In order to maintain equipment readiness, we provided a Windows version model. Fig. 5 shows process instrumentation equipment and a screen of the setting tool.

### 2.4.6 Substitute of the Substation Control Unit

Fig. 6 shows a supplied product and a substitute product of a substation control unit. The substitute product comes in the same size of the existing product and the design of connectors, etc. remain the same sizes as the existing ones to utilize the existing external wiring. The executing portion of this ladder program controlling external equipment offers the compatible functions of the latest Meiden Programmable Logic Controller (PLC). It realizes functional improvements from the supplied products. In addition, it improves on the operability and visibility such as power data indication like currents and voltages, in Japanese.

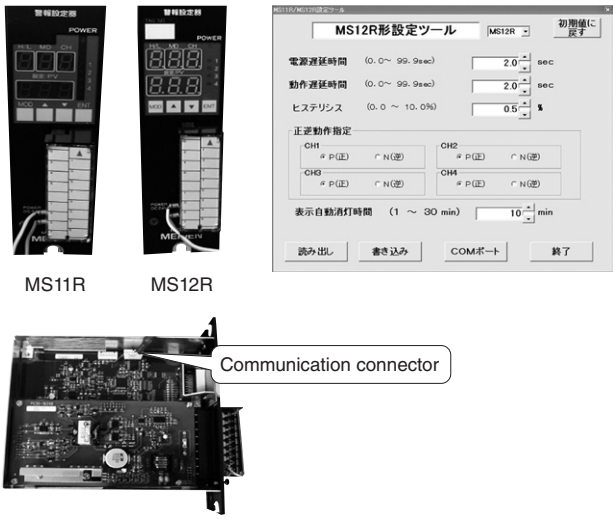



**Fig. 5** Process Instrumentation Equipment and a Screen of the Setting Tool

Our process instrumentation equipment, alarm setting tool (left), and an example screen (right) of the setting tool are shown.


(a) Supplied product


(b) Substitutive product

**Fig. 6** Substation Control Unit

A supplied substation control unit is shown in (a) and a newly developed substitute substation control unit is shown in (b).

### 2.4.7 Tools Related to Substation Control Unit

(1) Monitoring tool

Regarding our substitute products for the substation control unit, it shows telemetered power data sequentially by switching actions taken at the front panel. When a PC is connected with this monitoring tool software installed, it shows all power data and

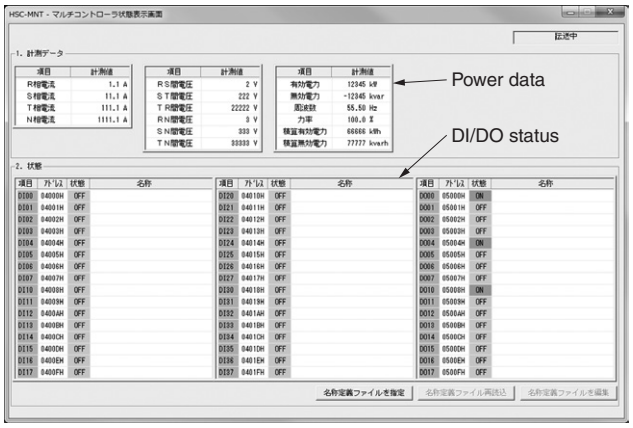



**Fig. 7** Screen of Monitoring Tool for the Substation Control Unit

An example screen display of monitoring tool for the substation control unit is shown.

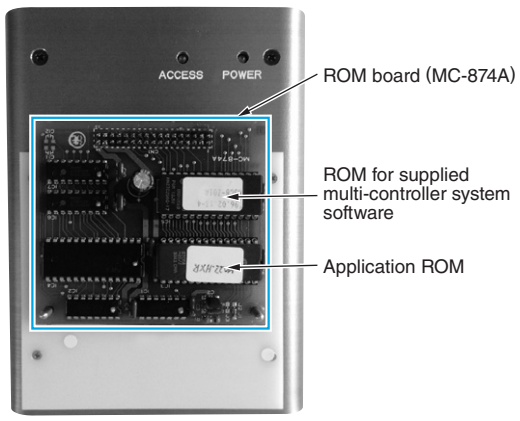



**Fig. 8** ROM Data Uploading Tool

An external appearance of the ROM data uploading tool is shown.

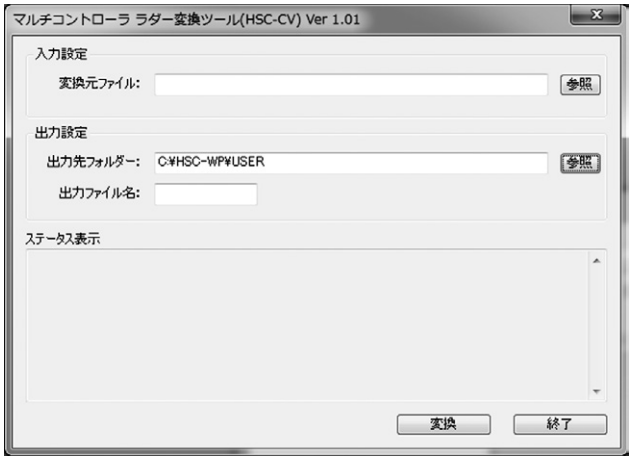



**Fig. 9** Screen of the M100 Program Conversion Tool

A screen of the M100 program conversion tool is shown.

the status of equipment operation at the PC screen in an overview mode. Fig. 7 shows an example of the screen of this monitoring tool. In addition, there is a function to display the operational data logs of equipment. This function is useful for equipment operation monitoring and troubleshooting.

(2) ROM data uploading tool

The ladder program of the existing substation control unit is stored in ROM. Therefore, at the time of existing facility renovation, it is necessary to upload the ladder program by means of the ROM writer. Recently, however, there are many operators who are not very experienced with ROM handling. This implies that there is some concern on bending the ROM leads when the ROM is being inserted in or pulled out of its socket. For a solution, we developed a tool that can upload ROM data without physically pulling out the ROM from the socket of the circuit board. Fig. 8 shows an external appearance of the ROM data uploading tool.

(3) M100 program conversion tool

The ladder programs of the existing substation control unit are designed for our PLC called “M100” which is a discontinued model. In order to convert the collected ladder program by using the aforementioned ROM data uploading tool into a ladder program that can be used by the latest PLC model, we developed a conversion tool. Using this tool, it is possible to realize automatic conversion of the ladder programs into the ones for a substitute PLC unit. This tool is useful in preventing human errors during manual program conversion. In addition, the time required for PLC replacement was greatly reduced. Fig. 9 shows a screen of the M100 program conversion tool.

### 2.4.8 Touch Panel Gateway (GW)

The supplied touch panel used to connect with our PLC unit through the IO link II metal that was used as our remote IO transmission path. Our PLC connections with the latest touch panel are made only through the Ethernet. For this reason, when replacing the touch panel, it became necessary to add the Ethernet interface port to the supplied PLC, attach an adequate application program, and lay a new Ethernet cable between the PLC and the touch panel. Such renovation work requires a high cost and long duration of time. As a solution, we developed a relaying GW to be laid between the IO link II metal and the Ethernet so that the supplied PLC and IO link II metal transmission path can be used continuously without any modification. This GW can

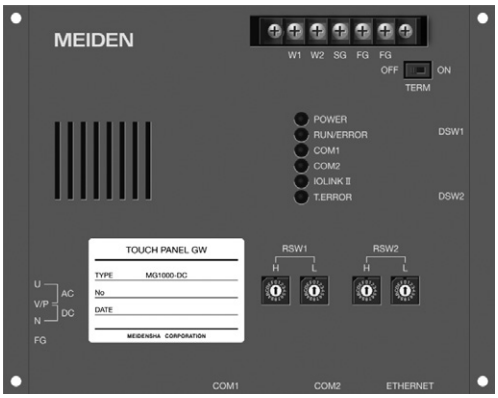



**Fig. 10** GW for the Touch Panel

An external appearance of the GW for the touch panel is shown.

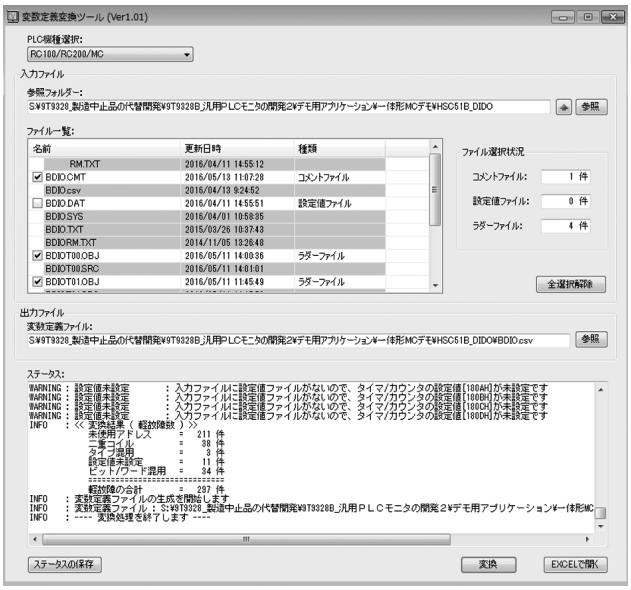



**Fig. 11** Screen of the Variable Definition Conversion Tool in Operation

An example screen display of the variable definition conversion tool in operation is shown.

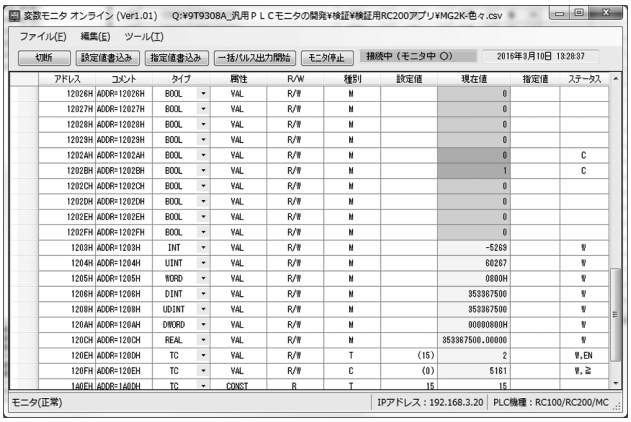



**Fig. 12** Screen of General-Purpose PLC Monitor in the Middle of Monitoring

An example screen display of general-purpose PLC monitor during the monitoring is shown.

be mounted on the rear side of the touch panel and the supplied panel need not be rearranged. As a result of such renovation, the touch panel can be renovated in a short time without changing the supplied PLC application. In addition, renovation cost is minimized. Fig. 10 shows an external appearance of the GW for the touch panel.

### 2.4.9 Variable Definition Conversion Tool

The data used in the ladder program of our PLC contain binary data and numerical data. The numerical data contain signed data, unsigned data, and Word data for logical operation. When the users monitor these data types using a data loader application, they may designate the data memory address and the data type. Some data types may have a unique access property such as readout only, write only, and both reading and writing. Still more, some data memory addresses may have data classes like I/O/M/T/C. Given the aforementioned, we developed a variable conversion tool that analyzes the ladder program and establishes a CSV-style variable definition file of type and property for each data. This conversion tool also can attach a comment to each variable in 16 Japanese characters. Fig. 11 shows a screen of this tool in operation.

### 2.4.10 General-Purpose PLC Monitor

We produced an on-line monitor tool that monitors the contents of PLC data by using variable definition file produced with the aforementioned variable conversion tool. The loader for our old PLC model was made to run on the MS-DOS. Hence, it is impossible to perform ladder program monitoring and setup data monitoring at the same time. This tool makes it possible to monitor the data set up with the variable definition file while monitoring the ladder program at the supplied loader. Accordingly, we could verify ladder programs of old PLC models effectively. Fig. 12 shows a screen of general-purpose PLC monitor in the middle of monitoring.

### 2.4.11 VP4000 Going Ethernet-Ready

The ADC4000 version of Meiden PLC has many supply records. The loaders for ADC4000 – VP4000 and ADC4000 are connected to the RS-232C. The new model of ADC4000 is ADC6000 (AM610). The loader connection for the AM610 is carried out through the Ethernet. The connection for the VP4000,

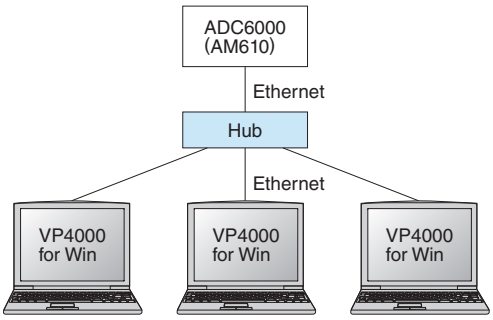



**Fig. 13** **Connections Made after VP4000 Became Ethernet-Ready**

Example connections of the VP4000 are shown made after it became Ethernet-ready.

however, requires a GW for conversion between the RS-232C and the Ethernet. Consequently, we made modification so that the VP4000 can be connected via the Ethernet. After this modification, the VP4000 can be connected directly to the AM610 without using a GW. In addition, when a hub is used, multiple VP4000 units can be connected to the AM610. Fig. 13 shows connections made after VP4000 became Ethernet-ready.

### 2.4.12 Substitute for Switching Interface of Operation Desk

Operation and monitoring for products in a plant often use a PC-based monitoring system. In some old plants, there is no screen display but they use illuminated push button switches on the operator console for connections between illuminated switches and PLC employed the SDS interface installed between the IO Link II metal and CAN interface. Connectable illuminated switches or SDS interfaces themselves, however, are no longer in production. As such, IO connections are only currently available for the illuminated switches. As a substitute for illuminated switches, we are developing an interface that can make connections via the PLC and the IO link II metal. Since the new interface is designed to be a compact model to allow installation in a narrow space inside the operator console, operator console can be renovated without changing the PLC application.

## 3 Postscript

For facility maintenance and extension of the facility operational life, repairs, modifications, expansion, and partial renovation are necessary. As such, procurement of substitute units is critical.

We will continue to make every effort to supply various substitute products to realize longer facility life and partial renovation. We also aim to minimize operational risk and running costs.