# MELSEC Process Control System

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## 1. Introduction

It has been about 30 years since the Distributed Control System (DCS) was first introduced in the process automation field, and most initial systems now need to be renewed. For customer projects related to system replacement or new construction, we receive increasingly urgent requests for downsizing and cost reduction. In response, we have developed component products and enhanced their functionalities for a process control system constructed on a platform based on the general-purpose programmable controller MELSEC-Q Series.

## 2. Key Products for MELSEC Process Automation

To realize a programmable controller-based full-scale process control system, we have developed the following key products: process CPUs, channel-isolated analog modules, programming and monitoring tools of PX Developer, and redundant systems.

The features of these products are introduced below.

## 3. Process CPU

The process CPU module is based on the high-performance programmable controller CPU of the MELSEC-Q Series and features 52 special instructions built in for process control. Some of these instructions are: basic PID (proportional, integral and differential) control, 2-degrees-of-freedom PID control, sample PI control, alarm detection, auto-tuning, and various correction operations. The process CPU is consequently able to perform both sequential control and loop control simultaneously. It can also execute PID control loops at about 400 μs/loop, achieving a fast control cycle of 10 ms.

## 4. Channel-Isolated Analog Module

For process automation, analog modules are frequently used for fluid and temperature control, etc. In the process control field, for the wiring to the sensors (flow meters, pressure gauges, etc.) and actuators (control valves, etc.), a channel fault caused by noise in the wire must not affect other channels. Also, measurement must not be disturbed if a potential difference arises between channels. To meet these requirements, we have developed channel-isolated analog modules for MELSEC process control.

The channel-isolated analog modules sufficiently offer useful functions for process automation such as analog input signal filters (first-order lag and average), wire-breaking detection, upper/lower-bound value output on being burned-out, tight-shut-off output, process alarm detection, and rate alarm detection.

## 5. Programming Tools of PX Developer

Programmable controllers generally use the LD (ladder diagram) programming language. However, for continuous processing of analog variable values such as the loop control, it is not easy to describe the algo-

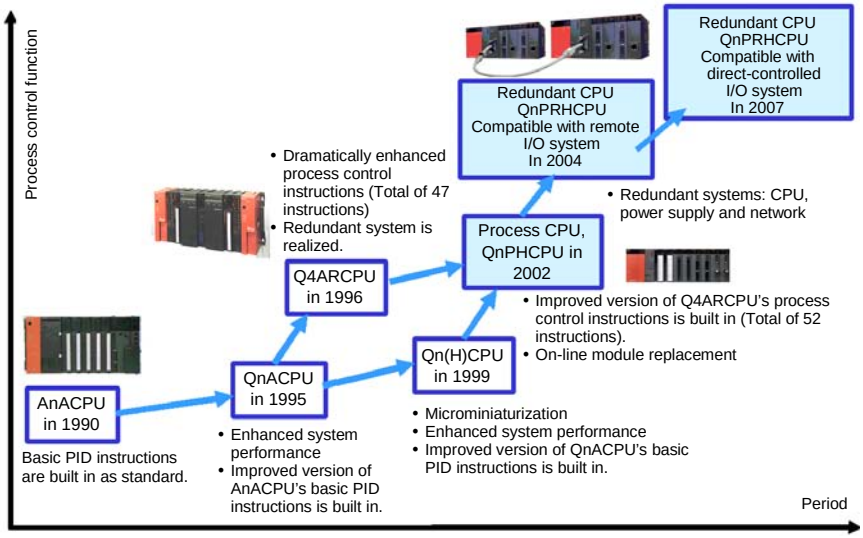


Fig. 1 Steps in the enhancement of process control functionality

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rithms using a ladder diagram. To help users describe the loop control, the MELSEC process control system adopts function block diagram (FBD) language conforming to the IEC 61131-3 standards. For even greater usability, the language specifications are partially extended to accept tag-based process control programming, which is used in process control engineering.

Various function blocks (FBs) are also provided as convenient programming tools, including an FB that encapsulates the special instructions built into the process CPU for process control, and a module FB that easily inputs or outputs external digital and analog signals. Simply by dragging and dropping these FBs to the sheet, wiring them, and setting parameters, programming can be easily accomplished for sophisticated process control algorithms comparable to those by conventional DCS (Fig. 2).

## 6. Monitoring Tools of PX Developer

For easy adjustment of the loop control parameters by comparing them to the response of the target system for process control (e.g., proportional, integral and differential parameters for PID control), the PX Developer is bundled with monitoring tools in addition to programming tools. The monitoring tools include standard screens (faceplates, tuning panels, control panels, trend graphs, alarm list and event list), which are frequently used for process control monitoring and operation. These tools allow users to immediately start adjusting the loop control for system startup.

## 7. Redundant System Configuration of MELSEC-Q Series

For continuous operation of the process control system even in the event of an unexpected failure, users often request redundancy of key system components, so we have provided a redundant system for MELSEC process control.

The redundant system for the MELSEC-Q Series is configured such that a CPU module (redundant CPU), a power supply module and a network communication module are attached to the two independent base units, and the two CPU modules are connected by tracking cables. The I/O system can be configured either in remote I/O or direct-controlled I/O configuration. The remote I/O configuration allows distributed arrangement using MELSECNET/H or CC-Link networking, while in the direct-controlled configuration, the I/O system is directly connected to the two redundant CPU modules by the internal data bus using a special extension base unit to provide high-speed response time (Fig. 3).

The redundant CPU modules are configured in the hot-standby style, where one of the two CPU modules performs control (control system), while the other remains in standby mode (standby system). If the control system is unable to continue operation due to failure of the CPU, power supply or network, the control is automatically switched to the standby system, which takes over and continues operation of the entire system. The two CPU modules continuously exchange data (data tracking) in preparation for system switching. The data tracking achieves a high data transfer rate of 22 ms/100K words, which allows for operation using a high-speed and large-scale control system.

We are developing products for the MELSEC process control system to realize sophisticated programmable controller-based process control systems. Leveraging our know-how acquired through the experience of factory automation, we strive for higher functionality and performance as well as providing “easy-to-use” products for the process control field.

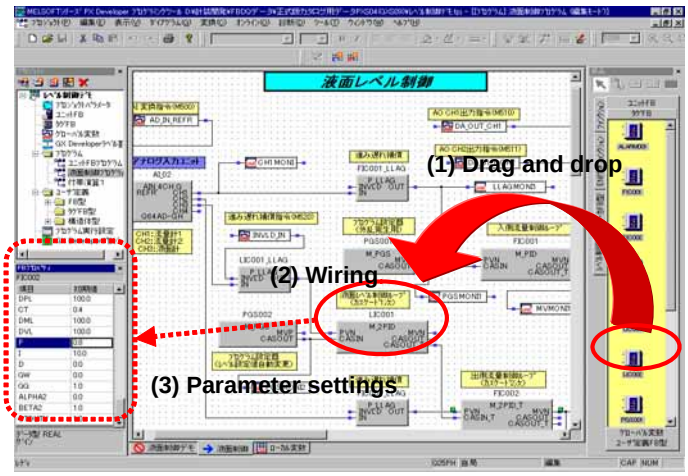


Fig. 2 Example of the operation of PX Developer programming tools

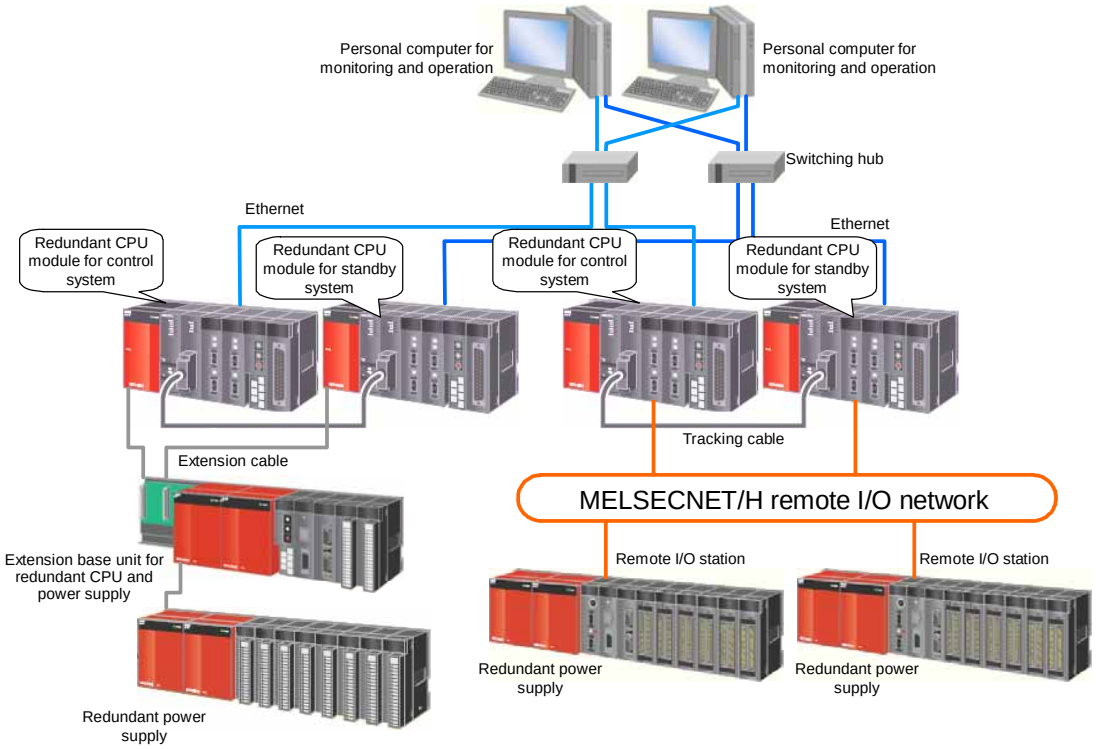


Fig. 3 Redundant systems for CPU, power supply and networking