Compact single loop controller: Model C1M for improved performance while maintaining compatibility, Model C1A for high accuracy and high speed control

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1. Introduction

The previous single loop controller, model C15, released in 2003, was a hit product due to it achieving multifunctionality in a compact body and reducing equipment design and setup labor using PC tools.

To mark its 20th anniversary, we have developed model C1A featuring improved key performance indicators such as indication accuracy and sampling speed. We have also developed model C1M, which can easily replace model C15 and offers an easy-to-read PV (Process Value: current/measured values) display.

2. Product overview

In model C1A, the basic functions, such as indication accuracy and sampling cycle, have been enhanced. It is equipped with a removable structure that allows the body to be detached from the case without disconnecting the rear terminal wiring, and is designed to reduce the influence of ambient temperature. It also meets demands for features such as heater maintenance and monitoring functions, and full multi-input compatibility with thermocouples, resistance temperature detectors, and DC current/voltage inputs. With these features, the model realizes high serviceability.

Model C1M is compatible with model C15 (model selection, terminal layout, parameters, communication address, etc.), which makes replacement easy. In addition, the PV display has been enlarged to improve visibility.

3. Product features

3.1 High accuracy and high-speed control

In order to realize accurate temperature management and control, the circuit configuration and layout were redesigned and all the components were reviewed. As a result, the indication accuracy (model C15: ±0.5% FS) has been improved as follows.
Model C1M: ±0.2% FS (resistance temperature detector (RTD), DC current/voltage input)
±0.3% FS (thermocouple input)
Model C1A: ±0.1% RD (thermocouple, RTD input)
±0.1% FS (DC current/voltage input)

In addition, through the adoption of a low-noise, high-resolution delta-sigma (ΔΣ) analog-to-digital (AD) converter and control of PV value acquisition timing, both commercial frequency noise protection and high-speed sampling (model C1M: 50 ms, model C1A: 25 ms) have been simultaneously achieved. To accommodate various device conditions, the sampling period can be adjusted up to a maximum of 500 ms.

3.2 Visibility and design

In model C1M, PV values are displayed using large characters (character height: 15.4 mm) on a high-contrast white LCD with well-balanced aspect ratios and line widths to enhance onsite visibility.

In model C1A, a balance is achieved between information density and visibility by employing a 4.5-digit display for high-resolution compatibility. It has an increased number of display items, such as a multi-status indicator, and ensures sufficient space between characters while maintaining an ideal aspect ratio (fig. 1).

Fig. 1. Front of display (left: model C1M, right: model C1A)

3.3 Smart Loader Package model SLP-C1F

The free engineering tool model SLP-C1F incorporates a PID simulator (fig. 2) for the purpose of achieving energy-savings and reducing the man-hours for adjustment, in addition to previously added functions such as parameter settings and numeric/trend monitors.
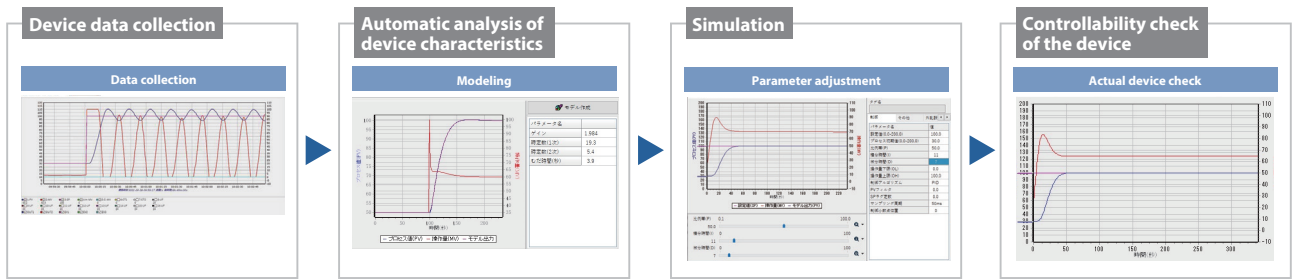
Fig. 2. Examples of PID simulator operation

3.4 Setting compatibility

To reduce the burden of model changeover tasks, model C1M uses the same model selection, functions, setting parameters, communication addresses, and terminal layout as those of model C15. In addition, model C15 project files or parameters that are read via direct communication can be seamlessly converted into model C1M parameters using model SLP-C1F.

3.5 PLC link function

To reduce engineering costs during the installation or modification of small to medium-sized systems with 31 or fewer model C1M or model C1A units, the RS-485 communication model is equipped a PLC link function that enables data exchange with PLCs without the need for programming (fig. 3).
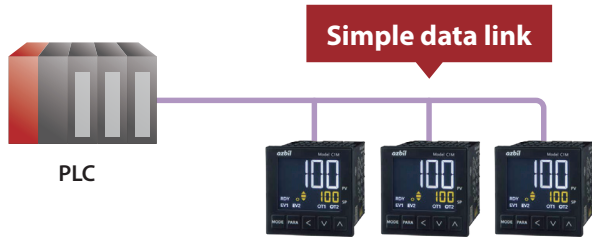
Max. number of connected units: 31
Max. communication volume: 64 words per model C1M unit

Fig. 3. PLC Link

3.6 Step operation and pattern operation

In order to realize multiple recipes with detailed temperature profiles, step operation is enabled in model C1M, which was previously enabled only in higher-end models. For each of the eight steps, SP value, PID group, slope, and soak time can be set (equivalent to 16 segments of simple pattern operation).
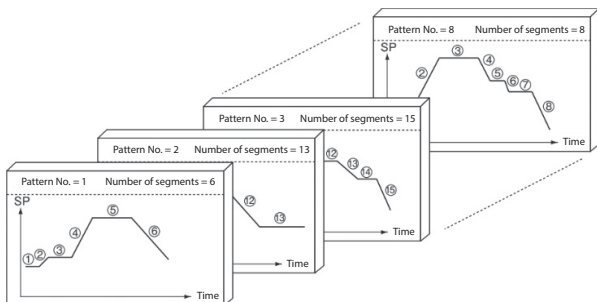

Fig. 4. SP generation by pattern operation of model C1A

The extended data memory model of model C1A is equipped with a pattern operation function capable of handling up to eight patterns with 16 segments each (fig. 4). In each segment, PID group number, guarantee soak, and segment events can be set. In addition, the power outage recovery function makes it possible to resume operation with the pattern number, segment number, remaining cycle count, and segment elapsed time that were in effect before the outage. In both model C1M and model C1A, the ramp/soak status can be checked in the slope display field.

3.7 Heater maintenance and monitoring

For abnormalities such as heater burnout, short circuit, or overcurrent and to measure current values, model C1M and model C1A offer a CT (current transformer) input model. In model C1A, a model with micro CT input suitable for heaters with a small capacity of 10 A or less is available, as well as a CT/VT input model capable of monitoring heater resistance values. By monitoring heater resistance values obtained via true RMS measurement of VT (voltage transformer) voltage and CT (current transformer) current, service life deterioration of electric furnace heaters can be diagnosed. The event function and logical operation function also make it possible to output an alarm based on the heater resistance value.

3.8 Reduction of the effects of ambient temperature

To reduce constraints on device usage environments and design, the temperature characteristics of the analog input/output circuits have been improved. The reference temperature conditions (model C15: 23±2°C) have been expanded to 25±3°C, and the operating temperature conditions (SDC model C15: 0°C to 50°C) have been extended to -10°C to 55°C.

4. Conclusion

We have provided an overview of the model C1M and model C1A and their features. To address issues such as severe personnel and skills shortages in device design and maintenance, high-performance controllers equipped with functions such as PLC link, smart loader package (SLP), step operation/pattern operation, and heater maintenance and monitoring, and that have high compatibility with existing models, can serve as effective solutions.

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