OE OMEGA®

PLATINUM Controller
Feature-Rich, State-of-the-Art Controller

The PLATINUM Controller family is a state-of-the-art temperature and process loop controller with an advanced PID control algorithm augmented with a fuzzy logic based adaptive control mechanism. Built on a fully featured 32-bit RISC processor PLATINUM controllers offer unprecedented performance, flexibility and ease-of-use in the mid-range controller market.

The RISC based processor provides high speed execution, providing 20 sample/second inputs and allowing all internal processing to use full double precision floating point calculations where appropriate to support wide dynamic ranges and to achieve the required accuracy.

A high performance 24-bit A/D with digital filtering provides 0.1% accuracy for a full range of thermocouple, RTD (2-, 3- and 4-wire) and thermistor inputs and wide range bi-polar process input signals of ±0.1, 1.0, and 10 volts and 0 to 20, 4 to 20 and 4 to 24 mA at 0.01% FS.

The universal input circuit is configured entirely under firmware control, eliminating the need for jumper settings or multiple model options and all inputs are provided with a 'loss of signal' detect mechanism.

A second auxiliary input is provided to support a remote setpoint capability. The input accepts 0 to 0.1, 0 to 1.0 and 0 to 10.0 Vdc or 0 to 24 and 4 to 20 mA input signals. The remote setpoint allows cascaded control as well as remotely setting the process level.

An internal menu selectable auxiliary power supply provides 5, 10, 12 or 24 Vdc for external sensor power and for use with the remote Setpoint function.

Flexible output configurations allow for relay, DC Pulse, SSR and analog control and signal retransmission, with outputs of 0 to 5, 0 to 10 Vdc and 0 to 20, 4 to 20 and 0 to 24 mA with 0.1% accuracy. Each output is fully assignable between PID, ON-OFF control, alarm, ramp/soak state monitoring and signal retransmission.

When used as PID control outputs the relay, SSR and DC pulse PWM outputs may be set to cycle times of 0.1 to 199.9 seconds, supporting both traditional PWM control as well as servo-control systems. When used for signal retransmission the analog output may be scaled, allowing the conversion to true engineering units.

ON-OFF control supports both REVERSE (heating) and DIRECT (cooling) control functions. The control setpoint may be selected from one of two setpoints with a user defined dead-band.

Two setpoints are available, one providing control of the process and the second providing a fixed or deviation setpoint for alarm monitoring. The control setpoint may be set as an absolute value, a remote value based on the scaled auxiliary input or be driven by the Ramp and Soak controller.

The second setpoint may be set as an absolute value or to be a ± deviation from the control setpoint.

The internal autotune function supports both REVERSE (heating) and DIRECT (cooling) control and the calculated P, I and D terms may be manually adjusted if required.

Two independent alarm controls support HI (alarm if above), LOW (alarm if below), HI-LO (alarm if outside of bounds) or BAND (alarm if inside bounds) conditions. An additional HI-HI alarm condition may be set for cases where the alarm condition is exceeded by a ± offset. Alarm conditions may be directed to change the color of the display, activate a front panel annunciator and/or active an output.

Alarm setpoints may be configured as an absolute value or linked to either setpoint 1 or setpoint 2. In addition to acting as an alarm function, the alarm control blocks may be used to drive outputs in advanced heating/cooling applications.

Alarm conditions may be latched and are supported with a user defined 'on delay' and 'off delay' to minimize false triggering. Latched alarms may be cleared thru the menu keypad or from by a remote digital signal.

An extensive ramp and soak control function is provided to support controlled process profiles and advanced cycling applications. PLATINUM controllers support up to 99 user programmable ramp and soak profiles and each profile supports up to 8 ramp/soak cycles. Profiles may be chained together allowing arbitrarily complex controls to be implemented. At the end of each profile the unit may be directed to return to IDLE (single cycle), maintain the last SOAK value (ramp and hold) or linked to another profile (chained). When the last profile of a chain is linked back to the starting profile the unit will continuously cycle thru the defined profile chain.

Fault monitoring during ramp and soak cycles include guaranteed RAMP (fault if process does not meet SOAK level in specified ramp time), guaranteed SOAK (total cycle time adjusted to ensure specified SOAK time is met) or guaranteed CYCLE (cycle time is maintained regardless of time required to reach SOAK level).

PLATINUM controllers feature a full 4-digit plus sign tri-color LED display for enhanced viewing in dimly lit or harsh environments. A second 4-digit setpoint display is available to allow visual tracking of process value verses setpoint. Display color may be user selected and forced to change under alarm conditions, providing an immediate visual indication.

A flat, simplified menu structure ensures ease of use, adapting to the hardware configuration and current user choices to present only relevant options at each stage. User options are maintained in non-volatile memory and the unit allows the option of automatic start-up when power is applied. A 3 level password mechanism allows locking out sensitive configuration options and simplified operation for line operators.

omega.com / info@omega.com / 800.826.6342

PLATINUM controllers are provided with a USB interface configured as a virtual comm device, appearing as a serial COM channel to host computers or tablets/smart phones. Communication options include RS232/RS485 and ethernet with an embedded web server.

The USB channel also supports USB 'thumb drives', allowing configuration data to be easily transported between units for rapid deployment. The file format used for configuration data is compatible to Microsoft Excel, allowing configuration information to be saved, edited and distributed from Window based systems.

A proprietary OMEGA protocol, suitable for direct command line interfacing is provided which is backwards compatible to OMEGA iSeries products. All communication channels support Modbus®/ASCII and Modbus/RTU. Modbus/TCPIP is supported on the ethernet channel.

The PLATINUM controller is UL, cUL, CE and RoHS certified, is offered in ⅛, ⅟₁₆ and ⅟₃₂ DIN cases and may be powered from 12 to 36 Vdc or 90 to 240 Vac.

The PLATINUM controller was designed and is manufactured in the United States and is backed with a 5 year warranty.

Applications

As a general purpose temperature/process loop controller the PLATINUM product addresses the needs of the well-established process control industry.

Existing industrial use includes a wide range of temperature and process control in applications as diverse as metal refining/smelting, chemical process control, heat exchangers, temperature cycling, refinery, food processing, environmental control and pharmaceuticals.

The higher performance, in both accuracy and loop control timing and capability opens up applications that have traditionally required high end controllers for industries including semiconductor processing, scientific laboratory, medical monitoring and test calibration equipment.

The auxiliary input opens up applications requiring cascaded control systems, where the setpoint of one controller is dependent on the control output of a second, upstream controller.

The ability to link the analog output to either the process variable (retransmission) or the process control level (PID output) allows the PLATINUM to act as an upstream controller in cascaded control systems or to share the process input between multiple controllers for parallel control and batching systems.

The flexible ramp and soak mechanism, with the ability to trigger external events based on the ramp or soak state, the option to guarantee ramp, soak or overall cycle time and ability to chain multiple profiles together allows the PLATINUM to address a wide range of complex batching and temperature cycling applications. The unit may be preprogrammed with multiple 'recipes', selected by choosing the appropriate starting profile number. These applications are found in the Plastics industry, dry goods processing, annealing, metal processing and manufacturing industries.

The communications structure, coupled with the auxiliary analog and digital input/output capabilities have positioned the PLATINUM to address process control needs currently implemented using PLC's coupled with internal PLC control blocks and customized control firmware.

Adhering to the industry standard Modbus protocol, providing full access to the internal data base of the PLATINUM controller and utilizing industry standard file formats for configuration data transferred thru the USB thumb drive allows the PLATINUM to be quickly integrated into educational and scientific lab applications.

Innovative Design Features

The two key requirements in the highly competitive mid-range controller market place are ease-of-use and performance, specifically accuracy. Secondary requirements include speed of operation, flexibility of input/outputs and communication capabilities.

Addressing 'ease-of-use', the primary requirement is that the user must be able to quickly set up a unit and should have to only address those parameters applicable to the current configuration.

The PLATINUM menu navigation system is modelled on a standard 'spreadsheet', where each 'row' represents a

different 'limb' on the menu tree and each 'column' represents a node (parameter value) or sub-limb in the menu tree. The 'spread sheet' structure is familiar to the entire modern workforce, eliminating any required learning curve. Two buttons allow navigating to different limbs, and a second pair allow navigating across the limb. Data may be viewed at each node, and data is entered at the end of each particular limb. Each 'node' on a limb may contain a parameter value or a sub-limb which exposes further limbs.

Again, using the 'spreadsheet' model, it is often common to 'hide' particular rows which are not applicable to the current

application. The PLATINUM menu structure will enable/disable particular 'rows' based on the hardware configuration and user selected options. When a limb is disabled it, and all sub limbs, are hidden from the user eliminating the need to navigate thru parameters that do not pertain to the current configuration choices.

Recognizing that ease-of-use is a key requirement and one that should be easily customizable, internal tools have been developed to allow quickly implement menu structures to directly address custom requirements.

Overall performance is driven by the microcontroller capabilities. The PLATINUM controller design is centered on a high performance 120 Mhz 32-bit RISC processor operating a robust real time operating system. This platform provides the basis for a unique data driven design, allowing a highly modular firmware architecture that supports flexible hardware and firmware modules. A hardware supported floating point unit eliminates any compromises between speed of execution and mathematical accuracy.

Unlike classic controllers, the PLATINUM utilizes a centralized data distribution model that streamlines all data exchange between the client control blocks. Each control block is highly independent, allowing features to be easily added or updated with a minimum of design effort.

The key control function for any loop controller is the internal PID algorithm used. Extensive software modelling for advanced control systems is provided by third party tools such as MATLAB, a software package that provides a 'graphical' front end to support complex control systems and is used widely through-out the controls industry.

One of the powerful features of MATLAB is that it may be configured to generate the 'software code' from the data model. Coupled with a fuzzy logic control block generator the entire control functionality of the PLATINUM is supported by a set of high level tools, allowing for extensive control function

modelling and tuning and the introduction of custom control algorithms where needed.

The universal input found in the PLATINUM is fully configured thru firmware controlled switches. Utilizing a high speed 24-bit ADC, with integral digital filtering and signal integrity checking, the hardware 'block' significantly offloads the processor to ensure stable, low level (uV) analog signals are available at the required 20 samples/second rate.

The output control block firmware and the associated hardware has been architected as independent, standalone functions. Unlike many conventional controllers that mix various alarm, control and retransmission capabilities into specific outputs, the PLATINUM architecture allows outputs to be assigned to any control point and multiple outputs may be assigned to any one control point. In a recent application a customer required that the PID control output (0 to 100% of full scale) be used to drive both a convention PWM TRIAC controlled heater as well as an analog DC servo motor. A relay output coupled to an alarm control block provided an over-temperature shut off mechanism.

The data driven centralized database design ensures that all functionality is initiated thru a common, universally accessible set of client requests. A clear example is shown in the PLATINUM configurator support software that utilizes Modbus communication requests to duplicate the functionality offered from the embedded menu navigation system.

The PLATINUM output architecture has been modelled around smart outputs that identify the output capability to the processor on power up, providing a 'plug and play' capability for future designs. Similar support has been designed in for digital input devices, communication options and the display subsystem. Coupled with the auto-adapting menu subsystem this provides a solid foundation for future PLATINUM products to act as self-configuring programmable analog controllers.

A Platform Foundation

The most immediate effect of the PLATINUM controller on industry is the introduction of many features found in 'high end controllers' at a mid-market price. Key features include:

- 24-bit, high performance ADC with universal user configurable inputs

- 32-bit, high performance RISC processor with integral floating point operating under a robust RTOS system

- Simplified menu navigation using familiar spread sheet format with adaptive enabling

- Advanced 'model generated' PID control with fuzzy logic

- Extensive communication support

- Plug and play hardware configuration, universal input to minimize inventory requirements

- Advanced ramp and soak capability with chaining for complex controlled profile, cycling and batching systems

In the past compromises were made between price and performance, with many existing mid-range controllers offering ±2°C accuracy vs. the PLATINUM ±0.1°C. Coupled with the high 20 sample/second input rate, the PLATINUM will greatly simplify the design choice in applications requiring anything more than mediocre control.

Due to the relative low performance and lack of communication options in similar priced controllers the industry has seen a shift to PLC based closed loop control. Arguments in favor of

this trend is the need for interaction between the PID control and other aspects of the controls system, lack of available panel space and the higher perceived performance of PLC based systems that allowed user optimization of the control loop. The cost of the necessary control block required for PLC based systems is typically the same as a standalone mid-range controller.

Counter arguments have been the lack of a 'user accessible' control panel—an added component in PLC based designs, the cost of adding and maintaining the control firmware in the PLC and the optimized functionality offered in a dedicated controller.

The PLATINUM addresses the interaction with other control functions by providing multiple means to control the setpoint value—front panel, remote analog signal or thru any of the communication channels. Using the analog retransmission capability the process control signal or the raw process input signal can be provided to the PLC. Finally, the current state of the control cycle is readily accessible thru relay outputs. The flexible communication options provide access to the entire internal database allowing any PLC full access and control of the closed loop control system.

In addition to providing full accessibility, the PLATINUM provides an integral display/keyswitch interface in as little as a $\frac{1}{32}$ DIN panel footprint, with suitable password lock-outs to allow line operators display and interaction, an extensive suite of alarm monitoring features to off load from the PLC and high precision, high performance loop control firmware without the user needing to customize and maintain specialized PLC code.

Related to the embedding PID control in PLC's has been the need to augment PID controllers with simple sequencers in applications such as batch processing and temperature cyclers. The PLATINUM ramp and soak control has been designed to address these needs by allowing the RAMP/SOAK states to be presented as digital signals. A multi-segment ramp and soak profile that uses a constant SOAK temperature and 'guaranteed cycle times' allow the state information to act as sequence control signals, with the chaining capability enabling temperature cycling, batching or continuous processing.

The PLATINUM controller platform has been designed and implemented as a set of flexible, independent control modules, opening a wide range of choices to OEM's requiring customized controllers. In the simplest case, it may just be the streamlining of the menu choices offered to inexperienced operators, supported thru a multi-level password protection mechanism that locks out specific parts of the menu structure.

In more advanced cases OEM's have been required to fund the full development of custom control subsystems due to specific operating interface requirements, specialized I/O configurations or even application specific control algorithms. The underlying control algorithm may be defined by the OEM using MATLAB, the operator interface may be defined in familiar spreadsheet format and initial prototypes may be returned in weeks. The PLATINUM controller offers a UL, cUL, CE and RoHS certified platform that can be quickly adapted to specialized requirements at a fraction of the typical development cost.