1 Introduction

Omega's Platinum family of temperature and process meter/controllers provide a rich foundation of programmable functions that allow systems to be implemented beyond classic PID loop controllers. The following application note addresses some of the flexibility offered by the Setpoint, Alarm and Output functions.

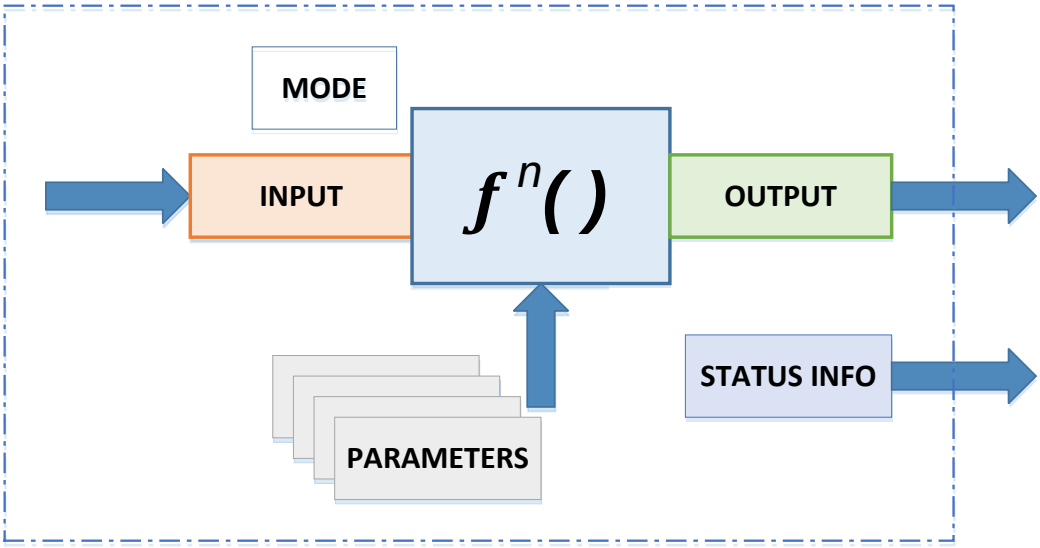

Figure 1. Programmable functions beyond classic PID loop controllers.

The Platinum family share a common architecture that provides 3 distinct setpoint values that determine the function of the PID control algorithm, ON/OFF control and Alarm functions. Setpoint 1 is primarily used to control the process (PID) and ON/OFF functions. Setpoint 2 is primarily used to control Alarm functions and secondary ON/OFF functions.

Two Alarm blocks are provided that allow for ABOVE (value above setpoint range), BELOW (value below setpoint range), HI-LO (value above or below setpoint range) and BAND (value between setpoint ranges). The alarm setpoint range values are derived from a base setpoint and by one or two offset values.

A HI-HI alarm mode provides a visual indication (display flashes) when the process value exceeds the specified setpoint range.

The Platinum family supports up to 6 outputs, including relays, SSR, DCPulse and Analog outputs.

Any output may be used to track the PID control value. Relay, SSR and DCPulse outputs may be assigned to track the state ON/OFF control, Alarm status and Ramp and Soak state status. Analog based outputs may be used to retransmit the input process variable.

The USB, Serial and Ethernet communication channels are used to configure and monitor the controller states. Thru a Modbus RTU (or Modbus TCP/IP) interface external devices may provide dynamic remote setpoint values and/or process input values; this allows the platinum to act as a stand-alone PID control system, a remote signal input / display unit or a remote control device.

2 Setpoints

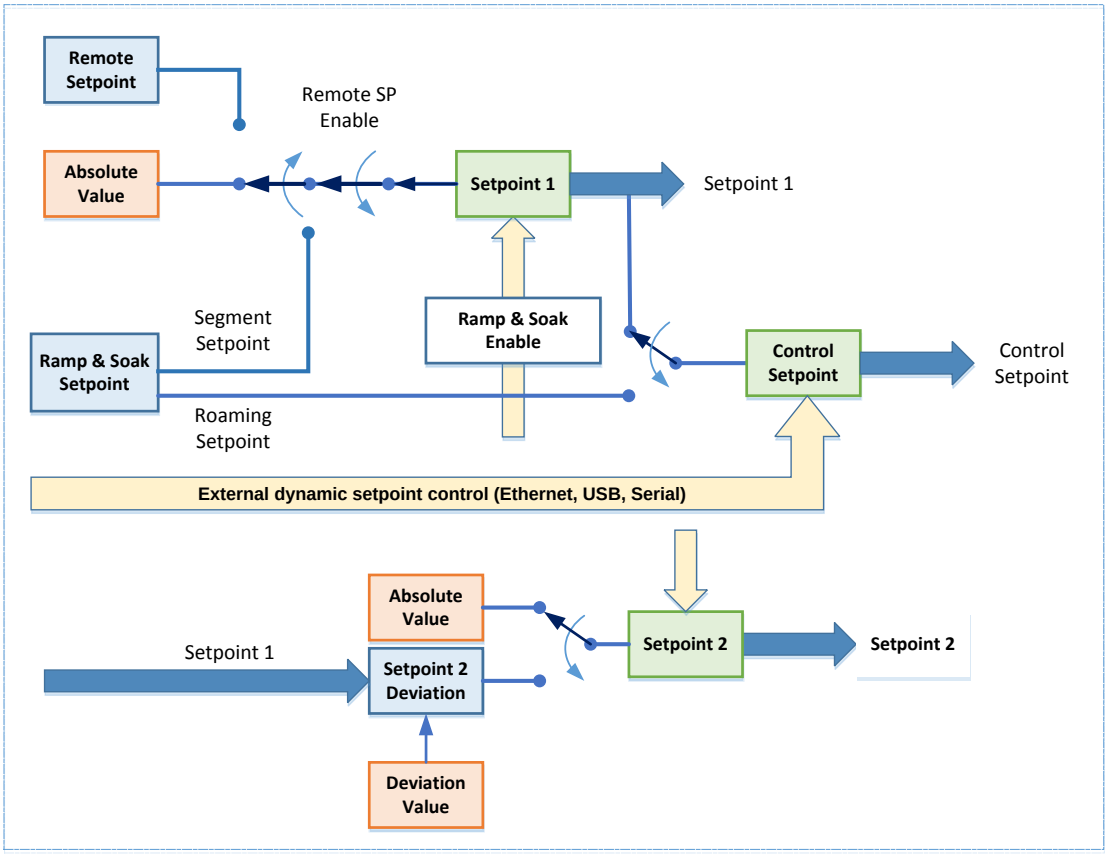

Figure 2. Setpoint Configurations.

2.1 Setpoint 1

Setpoint 1 is primarily used with the PID and ON/OFF control functions. The default value is derived from the ABSOLUTE VALUE that is entered thru the front panel in either the PROG or OPER menus. This value is retained in non-volatile memory.

If the Remote Setpoint feature is enabled the external analog signal is used to generate Setpoint 1. The PROG and OPER menu options flashes the setpoint value, indicating that it cannot be overwritten.

In absolute or remote setpoint modes the Setpoint 1 value is transferred to the Control setpoint which is used as the PID 'process' setpoint.

If the Ramp and Soak feature is enabled the internal Ramp and Soak sequence engine is used to generate Setpoint 1 (Target setpoint value) and the Control Setpoint value which changes with each calculated ramp step.

On dual display units, Setpoint 1 is displayed on the secondary display.

2.2 Setpoint 2

Setpoint 2 is typically used for auxiliary control and Alarm functions. It can be set to an absolute value or a 'derivative' of Setpoint 1, where Setpoint 2 = Setpoint 1 +/- a constant offset.

2.3 Control Setpoint

The Control setpoint, derived from Setpoint 1 sets the PID process setpoint value.

2.4 External Setpoint Control

The USB, Ethernet and Serial channels are used to configure the Platinum Setpoints by modifying the Setpoint mode registers, assign a value to the ABSOLUTE setpoint values or provide dynamic setpoint control. For dynamic external setpoint control, Setpoint 1 mode should be set to ABSOLUTE. At power up, the non-volatile retained value will be loaded, but the Setpoint 1 value will not be changed unless the front panel value changes. The external control program can write to either the volatile Setpoint 1 value or the volatile Control Setpoint value to control the PID and ON/OFF operation.

NOTE: Value written to the Setpoint 1 register will appear on the display and be transferred to the Control Setpoint. Values written directly to the Control Register will not appear on the secondary display.

NOTE: For applications requiring dynamic control of the set points the Setpoint 1, Setpoint 2 and Control setpoint may be continuously modified. Setpoint 1 and Setpoint 2 Absolute values should not be used for dynamic setpoint control, due to the requirements of performing non-volatile memory updates whenever the value changes. Values which are retained in non-volatile memory are marked as:

Non-volatile Values

3 Alarms

The Platinum controller supports 2 alarm blocks that compare the current input value against a user selectable setpoint. The setpoint value is derived from a base setpoint with an ALR. H and / or ALR.L offset.

The Alarm mode is selected thru the menu PROG/ALM.x/AB.DV menu selection.

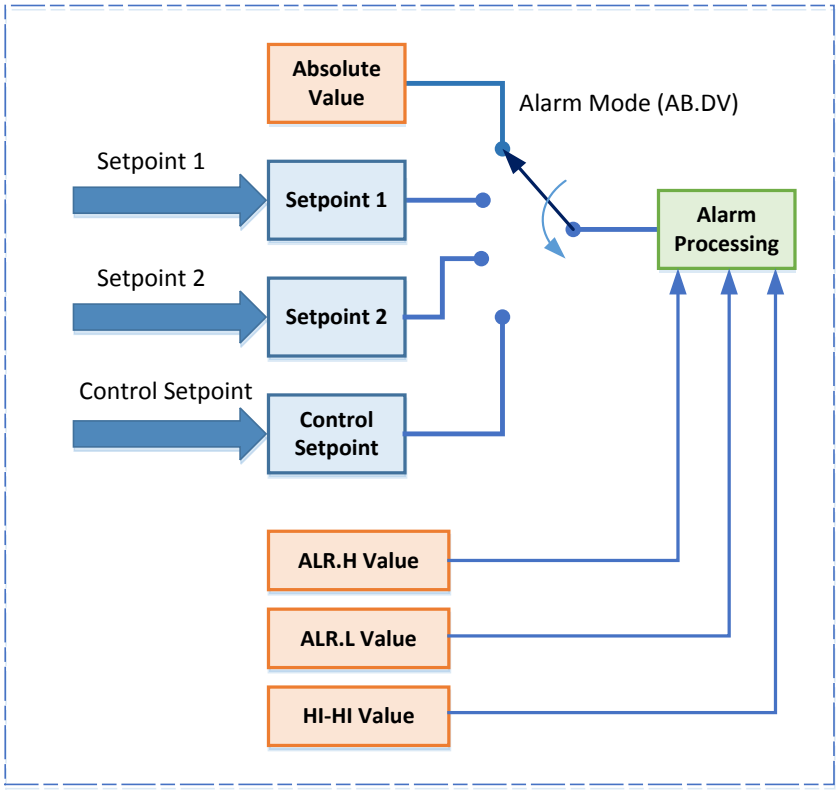

Figure 3. Alarms Compare Values & Setpoints.

3.1 Alarm Setpoint Selection

Each Alarm block may select from 4 different sources to establish the base setpoint value. The ABSO menu option selects an absolute value which is retained in non-volatile memory.

The D.SP1 and CN.SP options select from the Setpoint 1 derived values: Absolute, remote, Ramp and Soak target setpoint or the Ramp and Soak 'Ramping' setpoint which is continuously recalculated to ensure the setpoint is reached over the specified ramp time.

The D.SP2 option select from the Setpoint 2 derived values: Absolute or a value derived from Setpoint 1, which in turn may be an Absolute value, a remote setpoint value or the Ramp and Soak target setpoint value.

Alarm Mode (AB.DV)	**Alarm Behavior**		
ABSO	The absolute value entered by the user		
D.SP1	**Setpoint 1 Mode**		
	Absolute	**Remote**	**Ramp & Soak**
	Tracks Setpoint 1 Absolute value	Tracks remote Setpoint value	Tracks Ramp & Soak Target value
CN.SP	Tracks Setpoint 1 Absolute value	Tracks remote Setpoint value	Tracks Ramp & Soak 'Ramping' Setpoint
D.SP2	**Setpoint 2 Mode**		
	Absolute	**Derivative**	
	Tracks Setpoint 2 Absolute value	Tracks Setpoint 2 Derivative value which is based on Setpoint 1 value	

3.2 Alarm Types

The Alarm Block is triggered when the current process value (PV) is outside of a range determined by the alarm base setpoint (SP) and the ALM.H, ALM.L and HI.HI parameters.

Alarm Type	**ALM.H (TRIGGERED)**	**ALM.L (TRIGGERED)**	**HI.HI (FLASH)**
ABOV	PV > SP + ALM.H		PV > SP + ALM.H + HI.HI
BELO		PV < SP - ALM.L	PV < SP - ALM.L - HI.HI
HI.LO	PV > SP + ALM.H	PV < SP - ALM.L	PV > SP + ALM.H + HI.HI or PV < SP - ALM.L - HI.HI
BAND	PV < SP + ALM.H	PV > SP - ALM.L	PV < SP + ALM.H + HI.HI or PV > SP - ALM.L - HI.HI

3.3 Alarm Trigger Actions

When an alarm is triggered additional processing is performed depending on the Latch mode, Delay ON time and Delay OFF time.

The Delay ON time determines how long an alarm condition must be triggered before the alarm state is set to ON. If the alarm condition is removed before the Delay ON time expires the timer is cleared.

The Delay OFF time determines how long an alarm condition must be in the non-triggered state before the alarm state is set to OFF. If the alarm condition is re-asserted before the Delay OFF time expires the timer remains ON.

If the Alarm Latch mode is enabled, it will remain ON even if the alarm condition is removed until the alarms are cleared. Latched alarms may be cleared thru the front panel, a digital input or from external (USB, Ethernet or Serial) commands.

4 Outputs

The Platinum family supports up to 6 outputs, broadly classed as ‘Analog’ or ‘Digital’.

Digital outputs may be freely assigned to any control function. Analog outputs may be used both control and retransmission of the process value. Outputs in the ‘OFF’ state may be overwritten by external devices thru the Ethernet, USB or serial interfaces.

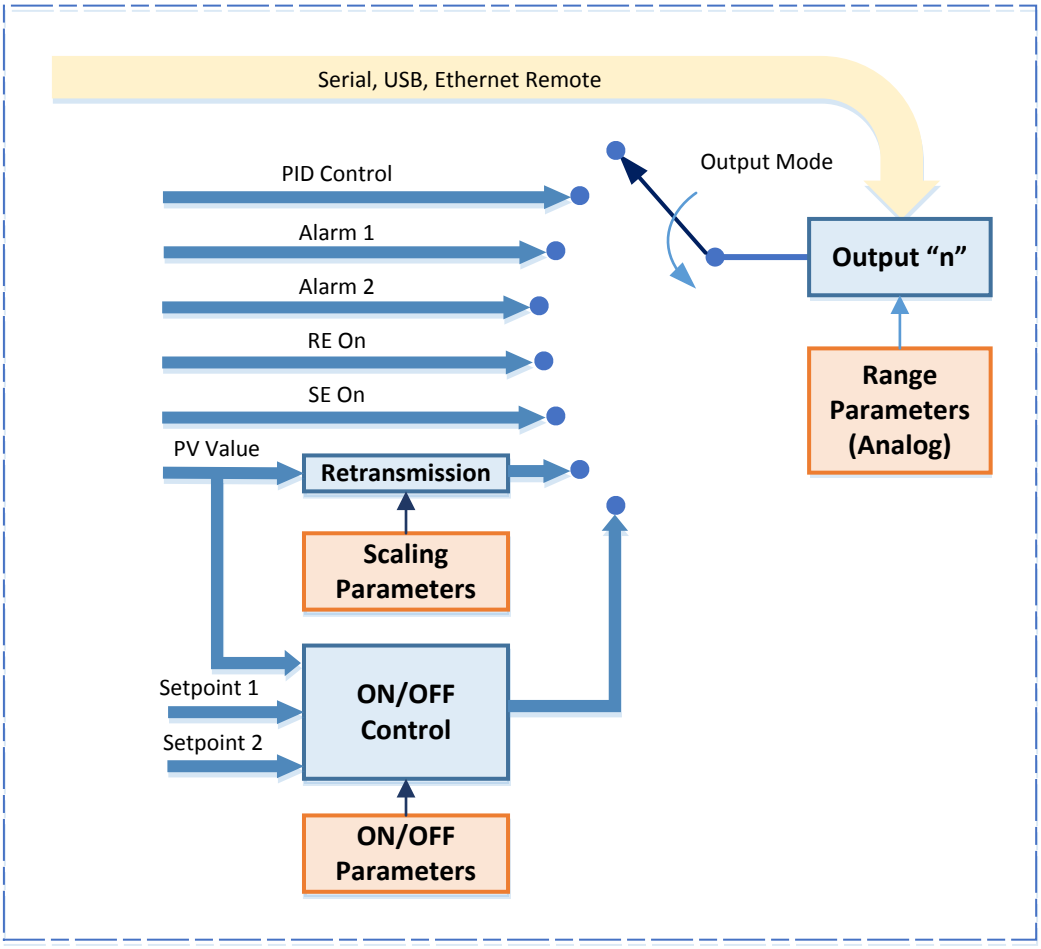

Figure 4. Outputs are Analog or Digital.

4.1 Physical Output Options

Analog outputs have specific parameters that allow selecting between 0-10 Vdc, 0-5 Vdc, 0-24 mA and 4-20 mA for analog outputs and if used for retransmission allow scaling the process to suitable control values value (i.e., 0 – 100 °C temperature to 0 – 10 Vdc).

Digital outputs are driven thru a PWM signal with a variable duty cycle which may be adjusted between 0.1 second to 99 seconds. Relay cycle time default to 5 seconds, SSR and DCPulse cycle time default to 0.1 second. When used in ON/OFF control or when reporting control signal status (alarms etc.) the digital outputs are driven to 100 % ON or fully OFF.

Output Mode	Action	Physical Output Type			
		Relay	SSR	DCPulse	Analog
PID	Control value varies from 0 to 100 %.	PWM signal varies duty cycle from 0 to 100%.			Analog output varies between 0 and 100 Full Scale
ON/OFF	Output OFF (0) or ON (100 %)	Digital device either OFF or ON			Not Available
ALM.1/2	Alarm state sets Output OFF (0) or ON	Digital device either OFF or ON			Not Available
RE.ON	Output ON if R&S is in RAMP state and RE.ON is enabled	Digital device either OFF or ON			Not Available
SE.ON	Output ON if R&S is in SOAK state and SE.ON is enabled	Digital device either OFF or ON			Not Available
RETRAN	Output tracks Process Value	Not Available			Scaled Process value

4.2 ON/OFF Control

ON / OFF control parameters allow selecting the Action (Normal or Reverse), a Deadband value and which setpoint source is used for the control. For Normal action the output will be ON if the process value is above the specified setpoint. For Reverse action the output will be ON if the process value is below the specified setpoint. An output will remain in the ON state until the process value drops below (or rises above) the setpoint + Deadband value.

4.3 Retransmission

Analog outputs may be used to re-transmit the process input signal with full scaling support.

4.4 Remote Outputs

External devices may overwrite the Output values thru the Serial, USB or Ethernet channels. The output mode should be set to OFF.

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