

Technical Information Sheet

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TIS#: 289, Issue 1

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Issued by: Chris Coogan

Subject
This Technical Information Sheet describes an application utilizing the Timestamp Math Channel function available in 5000 and 6000 Series recorders fitted with any Math, Totalizer, Counter (MTC) option.

Software and Hardware Used

Eurotherm Chessell 5000 Series recorder with version 3.4.4 firmware or greater OR
Eurotherm Chessell 6000 Series recorder with version 4.0 firmware or greater, both with
Any MTC option – at least 5 Math Channels are required
Timers option
User Screen option

Eurotherm Chessell 5000 Series Configuration Editor Version 3.4.4 or greater OR

Eurotherm Chessell 6000 Series C-Edit Version 4.0 or greater

Eurotherm Chessell 5000 Series Bridge Software version 3.4.4 or greater OR

Eurotherm Chessell 6000 Series Bridge Software 4.0 or greater

Dell Inspiron 8200 laptop, 1GB RAM

Microsoft Windows XP Professional, Version 5.1 (build 2600, xpsp_sp2_gdr.050301-1519 :
Service Pack 2)

Introduction

Some process applications require the specific time that a process value maximum or minimum occurred during a specific time interval. The specific time interval could be a batch, a day, a week, a month, etc. Depending on the time interval, not only is the specific time of the process value maximum or minimum required, but the specific date may also be required. Utilizing Eurotherm's Review application CSV Export feature, the CSV option of the 5000 and 6000 Series recorders or Eurotherm's Report 5000 application with any spreadsheet or database application, it is possible to determine the specific date and time a process value maximum or minimum occurred. Review exported CSV data, the CSV option of the recorders, or Report 5000 provide date and time stamped process values. Most spreadsheet and database applications provide MAX and MIN functions that can be used to determine not only the process value maximum or minimum, but the specific date and

time as well. While the preceding is possible, it does require the use of several applications; it is performed off-line from the recorder and the process; and it is not real-time. By utilizing Math channels and Math channel functions available within the 5000 and 6000 Series recorders, it is possible to implement an on-line, real-time determination of a process value maximum or minimum within the recorder without the use of additional applications. This is the subject of this Technical Information Sheet (TIS).

5000 or 6000 Series Implementation Overview

For the purpose of this Technical Information Sheet, the date and time of a process value maximum will be determined. The specific time interval will be 1 day. The term recorder and recorder configuration used in the following discussion, refer to either a 5000 or a 6000 Series recorder and its associated configuration. The following discussion is based on a 6000 Series recorder. When implemented in a 5000 Series recorder, there will be small differences in the recorder configuration, i.e. 5000 Series Events and Alarms only have two Jobs where as the 6000 has four Jobs per Event or Alarm; Channel Descriptor (Tag Names) are shorter in the 5000 Series than the 6000 Series. Lastly, the screen shots in the following discussion are from the 6000 Series C-Edit application.

The functions provided by the Math Channels of the recorders' MTC Option form the basis of the recorder configuration needed to implement the determination of the date and time a process value maximum occurred. One function provided by a Math Channel is the Channel Maximum function. This function provides the maximum value the Math Channel input has reached since last reset. A Math Channel configured with this function will provide the maximum value. In order to determine the date and time, two other Math Channels with the Timestamp function are required. When a Math Channel configured with the Timestamp function is triggered, the current number of milliseconds since 12:00 AM on January 1, 1970 appear as the Math Channel value. The Math Channel provides PV formats of Date and Time; thus, two Math Channels will provide a specific date and time associated with a process value maximum. In order to trigger the Timestamp Math Channels when the Channel Maximum Math Channel updates with a new maximum value, two additional Math Channels are required. One Math Channel with a Subtract function and one Math Channel with a Sample and Hold function will provide the simple trigger logic required.

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Also required is a recorder Timer, to provide the necessary timing of the specific time interval; and an Event to provide initial conditioning of the Channel Maximum and Sample and Hold Math Channels.

Example 5000/6000 Series Configuration

Figure 1 below graphically depicts the recorder configuration in block diagram form. Example 5000 Series and 6000 configurations are attached to this Technical Information Sheet. The following describes the recorder configuration in detail.

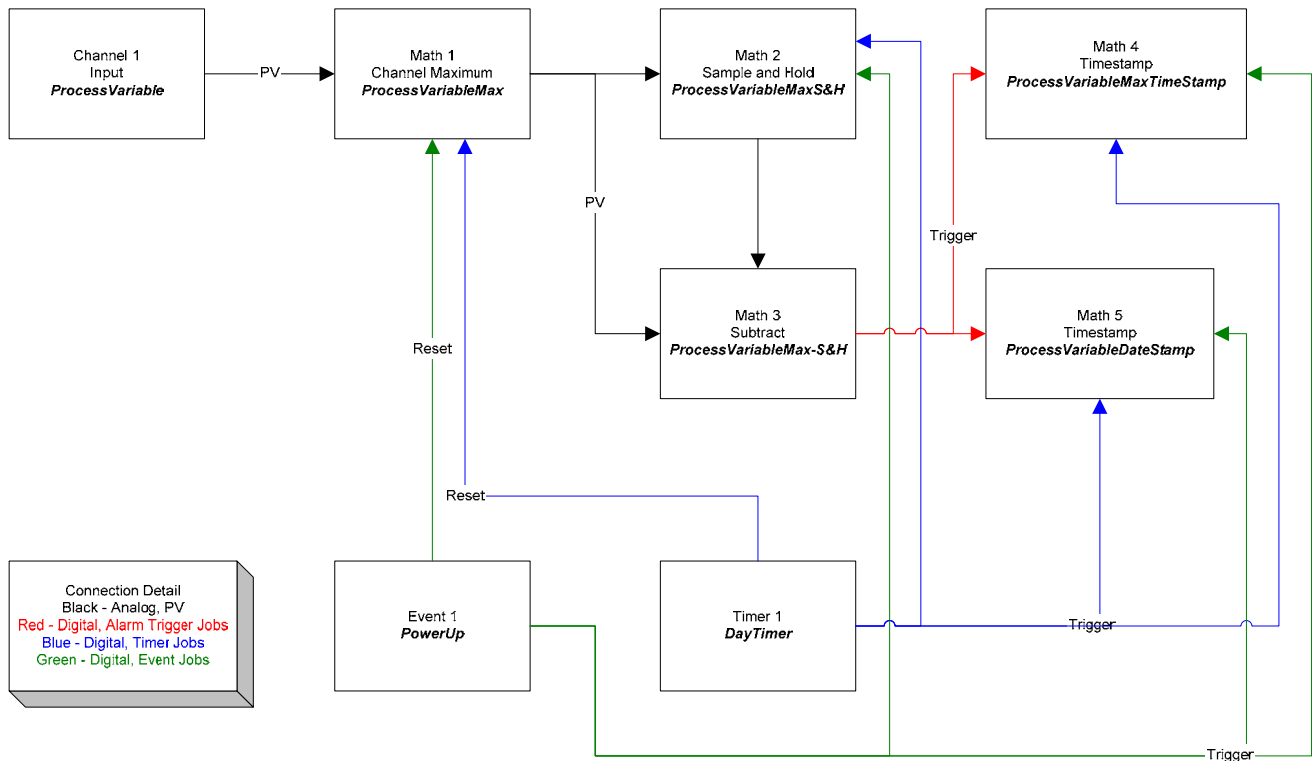
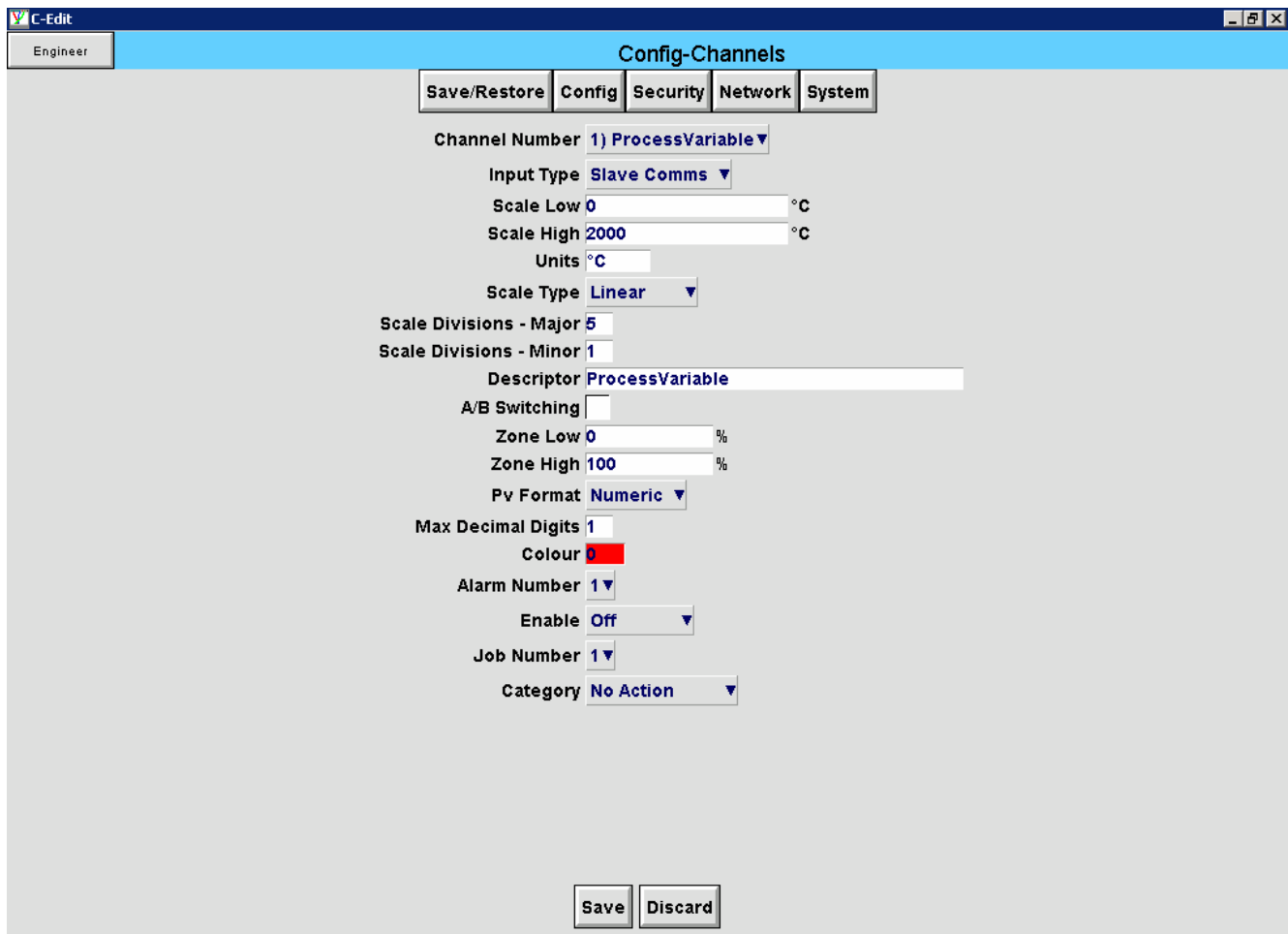


Figure 1 – Block Diagram of Example Recorder Configuration

Channel 1

Input Channel 1, **ProcessVariable**, is the process variable whose maximum value is to be determined along with the date and time of the maximum. The Input type and scale do not matter. For the purposes of this Technical Information Sheet, the Input type is Slave Comms with a scale of 0-2000 °C. Input Channel 1 does not have any configured Alarms or Jobs. This may not be the case in a production environment. The PV signal from the **ProcessVariable** Input Channel feeds Math Channel 1, **ProcessVariableMax**.



Config-Channels

Save/Restore Config Security Network System

Channel Number 1) ProcessVariable ▼

Input Type Slave Comms ▼

Scale Low 0 °C

Scale High 2000 °C

Units °C

Scale Type Linear ▼

Scale Divisions - Major 5

Scale Divisions - Minor 1

Descriptor ProcessVariable

A/B Switching

Zone Low 0 %

Zone High 100 %

Pv Format Numeric ▼

Max Decimal Digits 1

Colour 0

Alarm Number 1 ▼

Enable Off ▼

Job Number 1 ▼

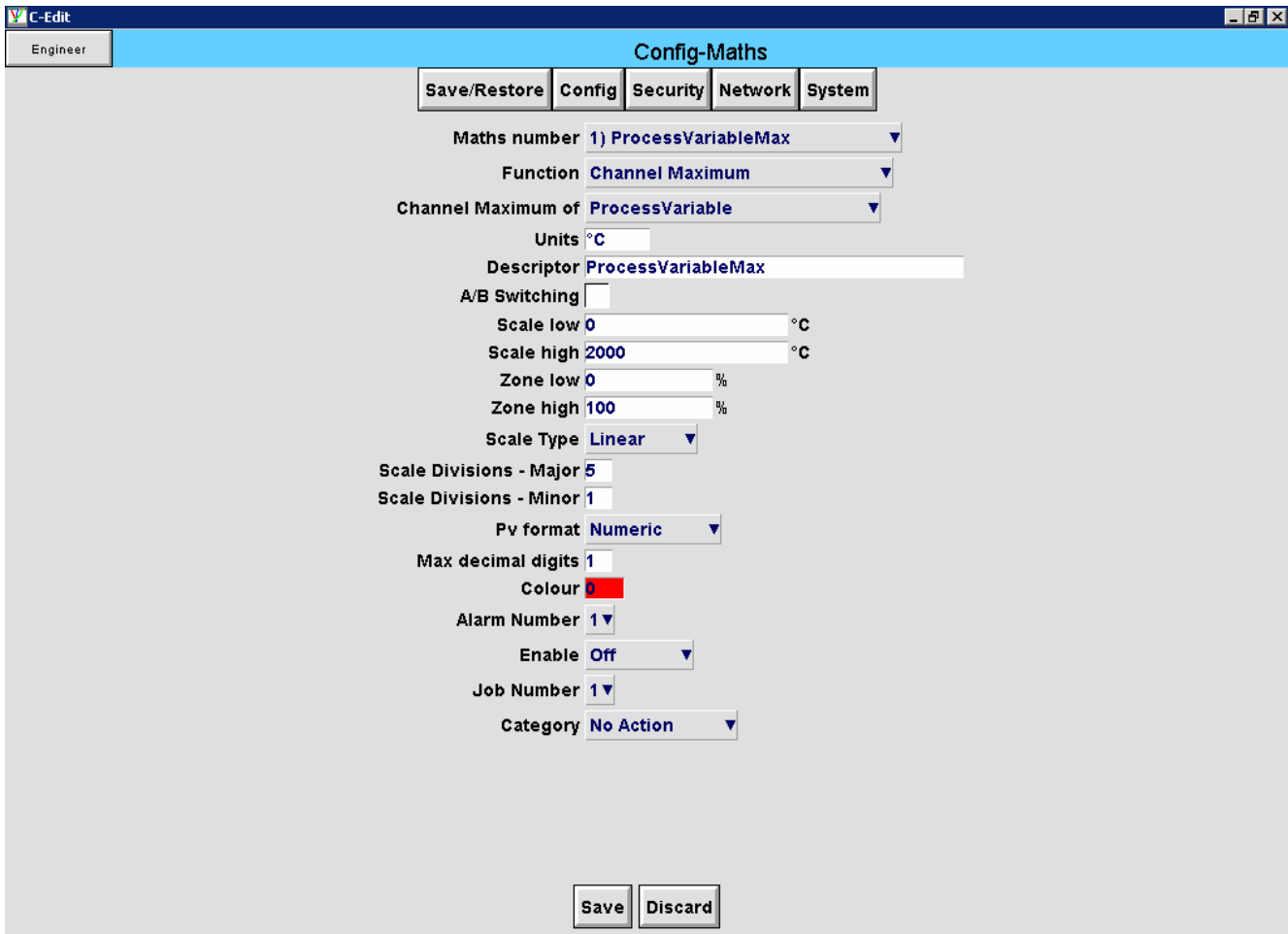
Category No Action ▼

Save Discard

Figure 2 - Input Channel 1 Configuration

Math 1

Math Channel 1, **ProcessVariableMax**, takes the PV signal from Input Channel 1 and performs a Channel Maximum function. The channel is scaled 0-2000 °C to match Input Channel 1. Math Channel 1 does not have any configured Alarms or Jobs. This may not be the case in a production environment. The PV signal from the **ProcessVariableMax** Math Channel feeds Math Channel 2, **ProcessVariableMaxS&H**, and Math Channel 3, **ProcessVariableMax – S&H**. Timer and Event Job signals to trigger the Channel Maximum Reset function come from Timer 1, **DayTimer**, and Event 1, **PowerUp**.



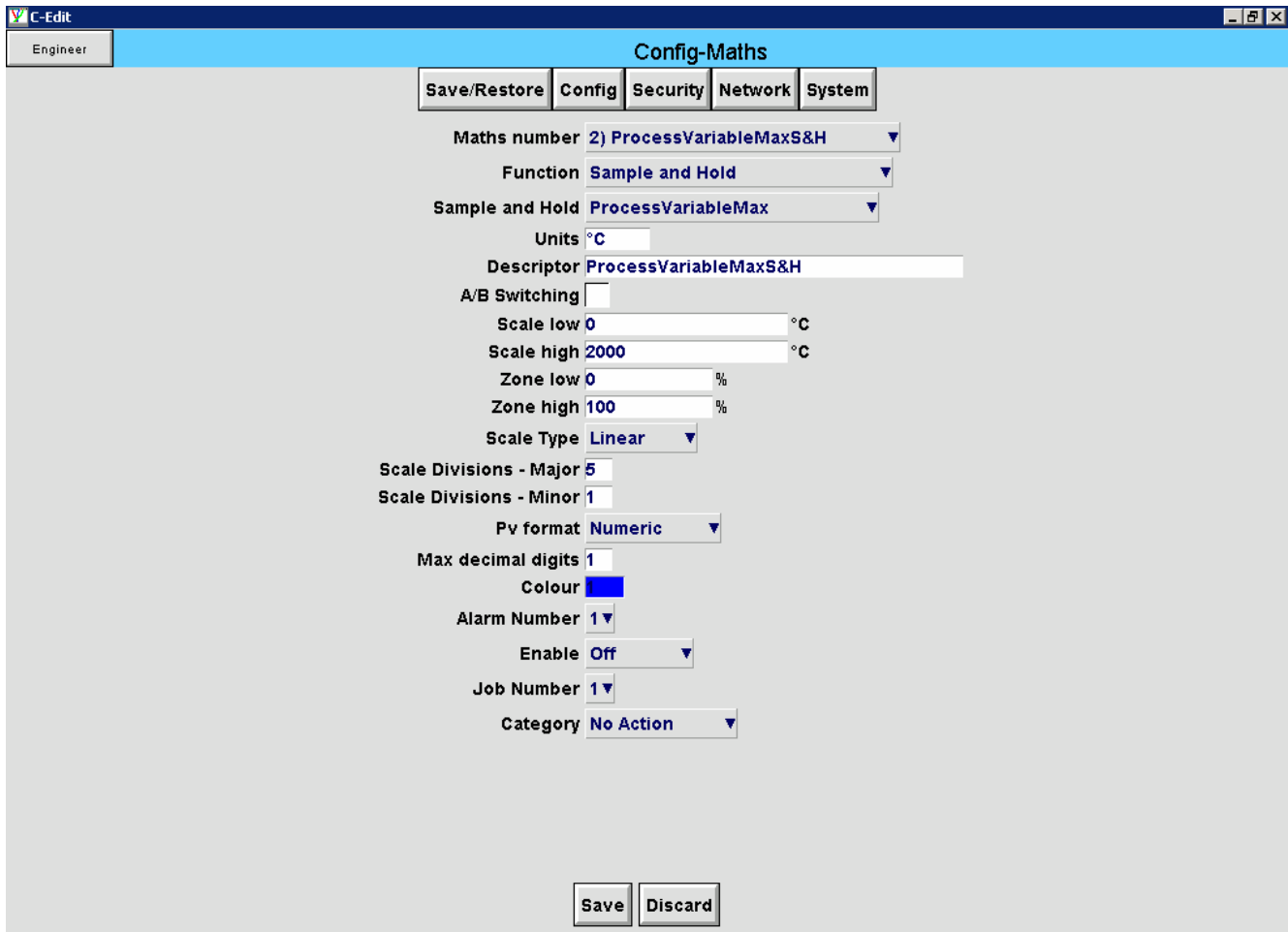
The screenshot shows the 'Config-Maths' window in the C-Edit software. The window has a blue header bar with the title 'Config-Maths' and a toolbar with buttons for 'Save/Restore', 'Config', 'Security', 'Network', and 'System'. The 'Config' button is selected. Below the toolbar, the configuration for 'Maths number 1) ProcessVariableMax' is displayed. The 'Function' is set to 'Channel Maximum'. The 'Channel Maximum of' is set to 'ProcessVariable'. The 'Units' are set to '°C'. The 'Descriptor' is 'ProcessVariableMax'. The 'A/B Switching' is set to 'Off'. The 'Scale low' is '0' and the 'Scale high' is '2000', both with units of '°C'. The 'Zone low' is '0' and the 'Zone high' is '100', both with units of '%'. The 'Scale Type' is 'Linear'. The 'Scale Divisions - Major' is '5' and the 'Scale Divisions - Minor' is '1'. The 'Pv format' is 'Numeric'. The 'Max decimal digits' is '1'. The 'Colour' is '0' (red). The 'Alarm Number' is '1'. The 'Enable' is 'Off'. The 'Job Number' is '1'. The 'Category' is 'No Action'. At the bottom of the window are 'Save' and 'Discard' buttons.

Figure 3 – Math Channel 1 Configuration

Math 2

Math Channel 2, **ProcessVariableMaxS&H**, takes the PV signal from Math Channel 1 and performs a Sample and Hold function. The channel is scaled 0-2000 °C to match Input Channel 1. Math Channel 2 does not have any configured Alarms or Jobs. Timer and Event

Jobs signals to trigger the Sample and Hold sample function come from Timer 1, **DayTimer**, and Event 1, **PowerUp**. The PV signal from the **ProcessVariableMaxS&H** Math Channel feeds Math Channel 3, **ProcessVariableMax – S&H**.



The screenshot shows the 'Config-Maths' window in the C-Edit software. The 'Config' tab is selected. The configuration for Math Channel 2 is as follows:

- Maths number: 2) ProcessVariableMaxS&H
- Function: Sample and Hold
- Sample and Hold: ProcessVariableMax
- Units: °C
- Descriptor: ProcessVariableMaxS&H
- A/B Switching: ☐
- Scale low: 0 °C
- Scale high: 2000 °C
- Zone low: 0 %
- Zone high: 100 %
- Scale Type: Linear
- Scale Divisions - Major: 5
- Scale Divisions - Minor: 1
- Pv format: Numeric
- Max decimal digits: 1
- Colour: 1
- Alarm Number: 1
- Enable: Off
- Job Number: 1
- Category: No Action

Buttons at the bottom: Save, Discard

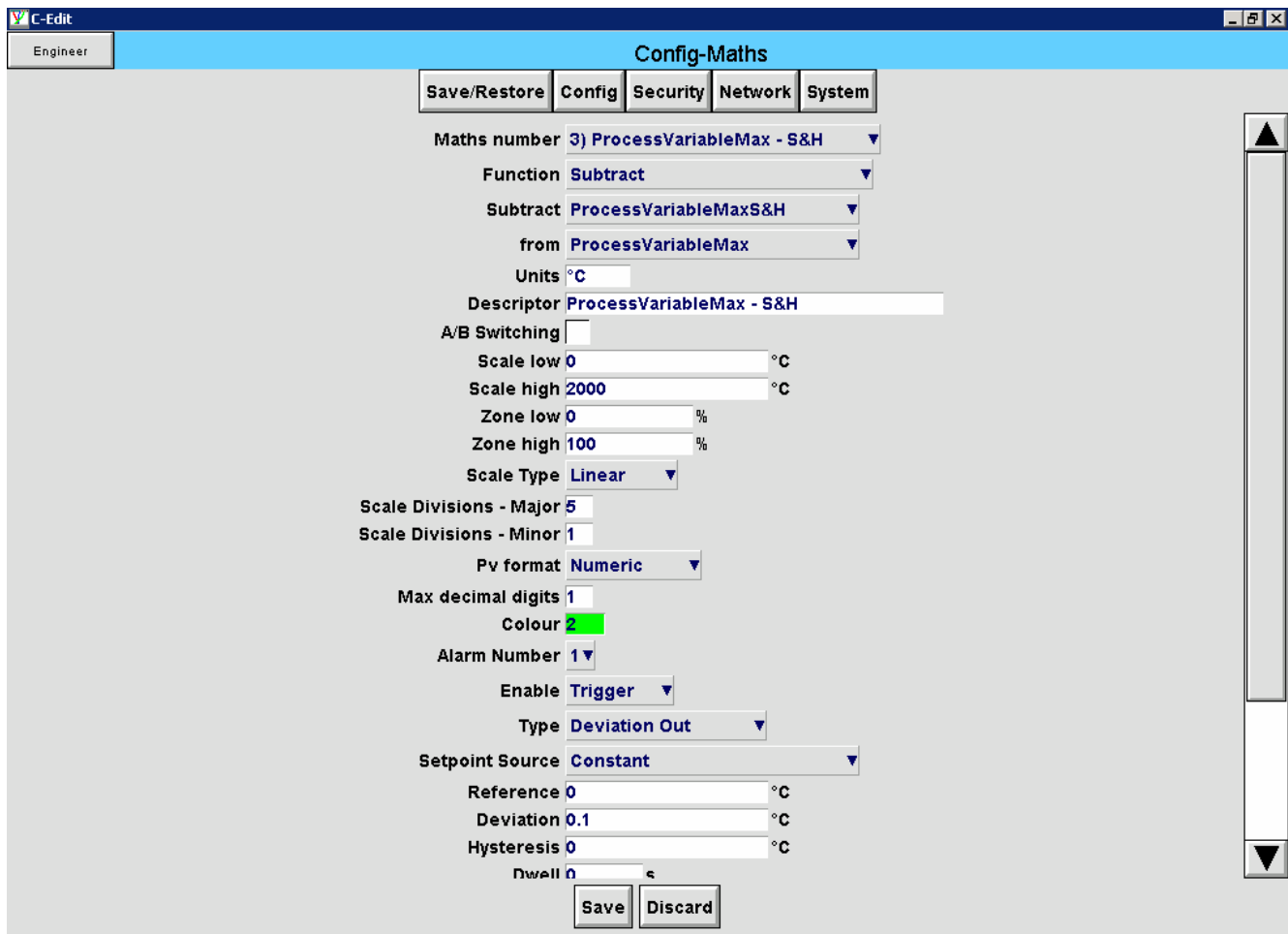
Figure 4 - Math Channel 2 Configuration

Math 3

Math Channel 3, **ProcessVariableMax - S&H**, takes PV signals from Math Channel 1 and Math Channel 2 and performs a simple Subtract function, ProcessVariableMax – ProcessVariableMaxS&H. The channel is scaled 0–2000 °C to match Input Channel 1. Math Channel 3 has one configured Alarm and three configured Jobs. Alarm 1 is configured as a Deviation Out Trigger alarm with a Constant Reference Setpoint of 0°C, a Deviation of 0.1 °C, no Hysteresis, and no Dwell. Alarm 1 Job 1 is configured to Trigger Math Channel 2, **ProcessVariableMaxS&H** on Active. Alarm 1 Job 2 is configured to Trigger Math Channel 4, **ProcessVariableMaxTimeStamp** on Active. Alarm 1 Job 3 is configured to Trigger Math Channel 5, **ProcessVariableMaxDateStamp**, on Active. The PV signal of **ProcessVariableMax – S&H** does not feed any other Channel.

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The screenshot shows the 'C-Edit' software window with the 'Config-Maths' tab selected. The 'Engineer' role is active. The configuration for 'Maths number 3) ProcessVariableMax - S&H' is displayed. The function is 'Subtract', subtracting 'ProcessVariableMaxS&H' from 'ProcessVariableMax'. The units are °C. The descriptor is 'ProcessVariableMax - S&H'. The A/B Switching is disabled. The scale ranges from 0 to 2000 °C, with zone limits at 0% and 100%. The scale type is 'Linear' with 5 major and 1 minor divisions. The PV format is 'Numeric' with 1 decimal digit, color 2 (green), alarm number 1, and enabled with a 'Trigger' type. The setpoint source is 'Constant' with a reference of 0 °C, deviation of 0.1 °C, and hysteresis of 0 °C. The dwell time is 0 seconds. 'Save' and 'Discard' buttons are at the bottom.

Field	Value
Maths number	3) ProcessVariableMax - S&H
Function	Subtract
Subtract	ProcessVariableMaxS&H
from	ProcessVariableMax
Units	°C
Descriptor	ProcessVariableMax - S&H
A/B Switching	<input type="checkbox"/>
Scale low	0 °C
Scale high	2000 °C
Zone low	0 %
Zone high	100 %
Scale Type	Linear
Scale Divisions - Major	5
Scale Divisions - Minor	1
Pv format	Numeric
Max decimal digits	1
Colour	2
Alarm Number	1
Enable	Trigger
Type	Deviation Out
Setpoint Source	Constant
Reference	0 °C
Deviation	0.1 °C
Hysteresis	0 °C
Dwell	0 s

Figure 5 - Math Channel 3 Configuration

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Alarm Number 1 ▼

Enable Trigger ▼

Type Deviation Out ▼

Setpoint Source Constant ▼

Reference 0 °C

Deviation 0.1 °C

Hysteresis 0 °C

Dwell 0 s

Job Number 1 ▼

Category Math ▼

Action Trigger ▼

Math ProcessVariableMaxS&H ▼

On Active ▼

Save Discard

Alarm Number 1 ▼

Enable Trigger ▼

Type Deviation Out ▼

Setpoint Source Constant ▼

Reference 0 °C

Deviation 0.1 °C

Hysteresis 0 °C

Dwell 0 s

Job Number 2 ▼

Category Math ▼

Action Trigger ▼

Math ProcessVariableMaxTimeStamp ▼

On Active ▼

Save Discard

Alarm Number 1 ▼

Enable Trigger ▼

Type Deviation Out ▼

Setpoint Source Constant ▼

Reference 0 °C

Deviation 0.1 °C

Hysteresis 0 °C

Dwell 0 s

Job Number 3 ▼

Category Math ▼

Action Trigger ▼

Math ProcessVariableMaxDateStamp ▼

On Active ▼

Save Discard

Figure 6 - Math Channel 3 Alarm and Job Configuration

Math 4

Math Channel 4, ***ProcessVariableMaxTimeStamp***, takes no PV signals from any other Math Channel, nor does this Channel feed any other Channel. No Alarms or Jobs are configured on the ***ProcessVariableMaxTimeStamp*** Channel. Math Channel 4 performs a Timestamp function where the PV parameter of this Math Channel is displayed as the real-time when the Channel is triggered. The Pv format parameter of this channel, configured

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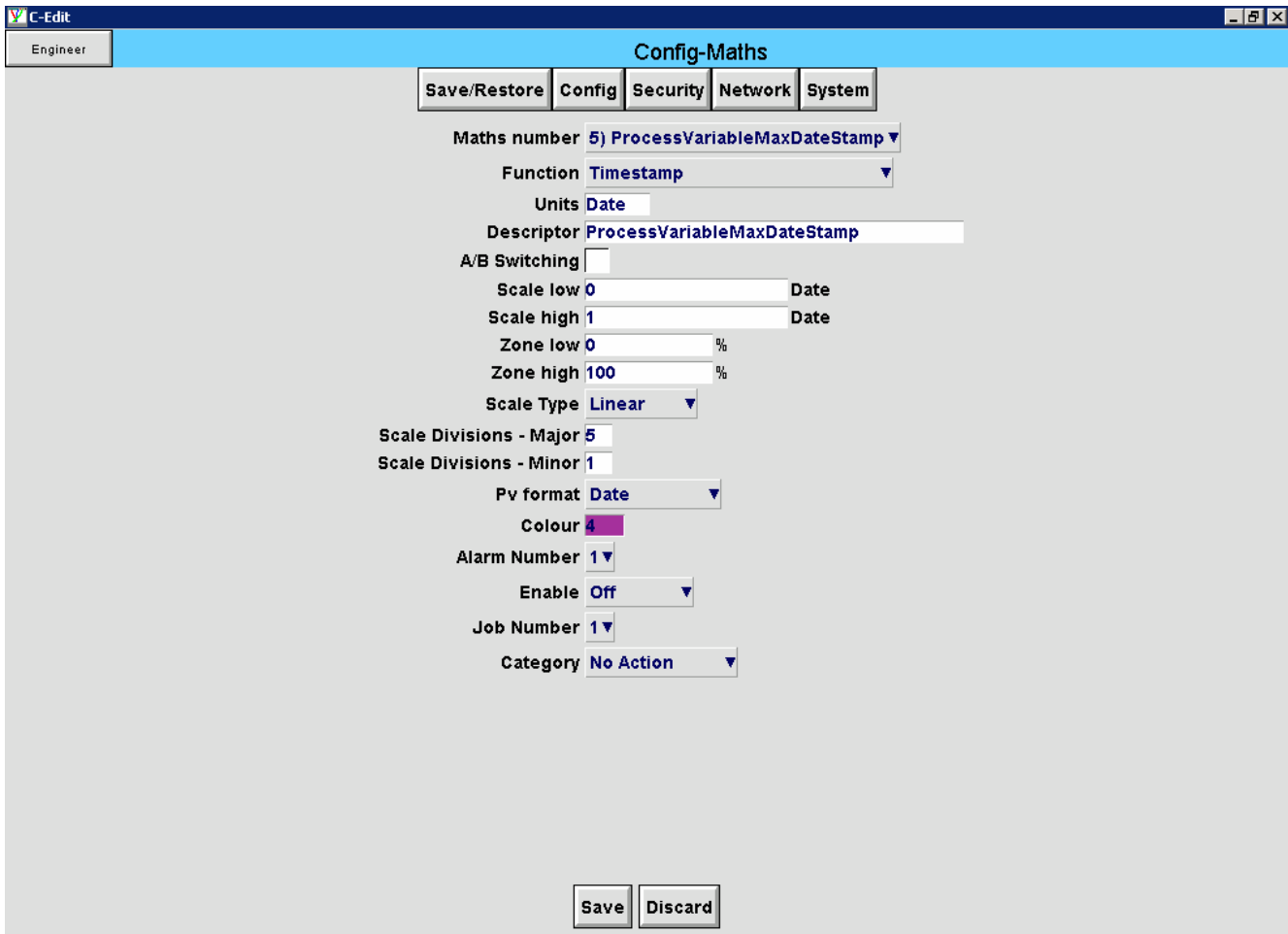
as Time, indicates that this Math Channel is to display real-time. Timer, Event, Alarm Job signals to trigger the Timestamp function come from Timer 1, **DayTimer**, Event 1, **PowerUp**, and Math Channel 3, **ProcessVariableMax – S&H**.

The screenshot shows the 'Config-Maths' window in a software interface. At the top, there are tabs for 'Save/Restore', 'Config', 'Security', 'Network', and 'System'. The 'Config' tab is active. Below the tabs, the configuration for 'Maths number 4) ProcessVariableMaxTimeStamp' is shown. The 'Function' is set to 'Timestamp'. The 'Units' are 'TOD'. The 'Descriptor' is 'ProcessVariableMaxTimeStamp'. There is an 'A/B Switching' checkbox. The 'Scale low' is 0 and 'Scale high' is 1, both with 'TOD' units. The 'Zone low' is 0% and 'Zone high' is 100%. The 'Scale Type' is 'Linear'. 'Scale Divisions - Major' is 5 and 'Scale Divisions - Minor' is 1. The 'Pv format' is 'Time'. The 'Colour' is 11. The 'Alarm Number' is 1. The 'Enable' checkbox is 'Off'. The 'Job Number' is 1. The 'Category' is 'No Action'. At the bottom, there are 'Save' and 'Discard' buttons.

Figure 7 – Math Channel 4 Configuration

Math 5

Math Channel 5, **ProcessVariableMaxDateStamp**, takes no PV signals from any other Math Channel, nor does this Channel feed any other Channel. No Alarms or Jobs are configured on the **ProcessVariableMaxDateStamp** Channel. Math Channel 5 performs a Timestamp function where the PV parameter of this Math Channel is displayed as the current date when the Channel is triggered. The Pv format parameter of this channel, configured as Date, indicates that this Math Channel is to display the current date. Timer, Event, and Alarm signals to trigger the Timestamp function come from Timer 1, **DayTimer**, Event 1, **PowerUp**, and Math Channel 3, **ProcessVariableMax – S&H**.



The screenshot shows the 'Config-Maths' window in the C-Edit software. The window has a menu bar with 'Save/Restore', 'Config', 'Security', 'Network', and 'System'. The 'Config' tab is selected. The configuration for Math Channel 5 is displayed as follows:

- Maths number: 5) ProcessVariableMaxDateStamp
- Function: Timestamp
- Units: Date
- Descriptor: ProcessVariableMaxDateStamp
- A/B Switching: ☐
- Scale low: 0 Date
- Scale high: 1 Date
- Zone low: 0 %
- Zone high: 100 %
- Scale Type: Linear
- Scale Divisions - Major: 5
- Scale Divisions - Minor: 1
- Pv format: Date
- Colour: 4
- Alarm Number: 1
- Enable: Off
- Job Number: 1
- Category: No Action

At the bottom of the window are 'Save' and 'Discard' buttons.

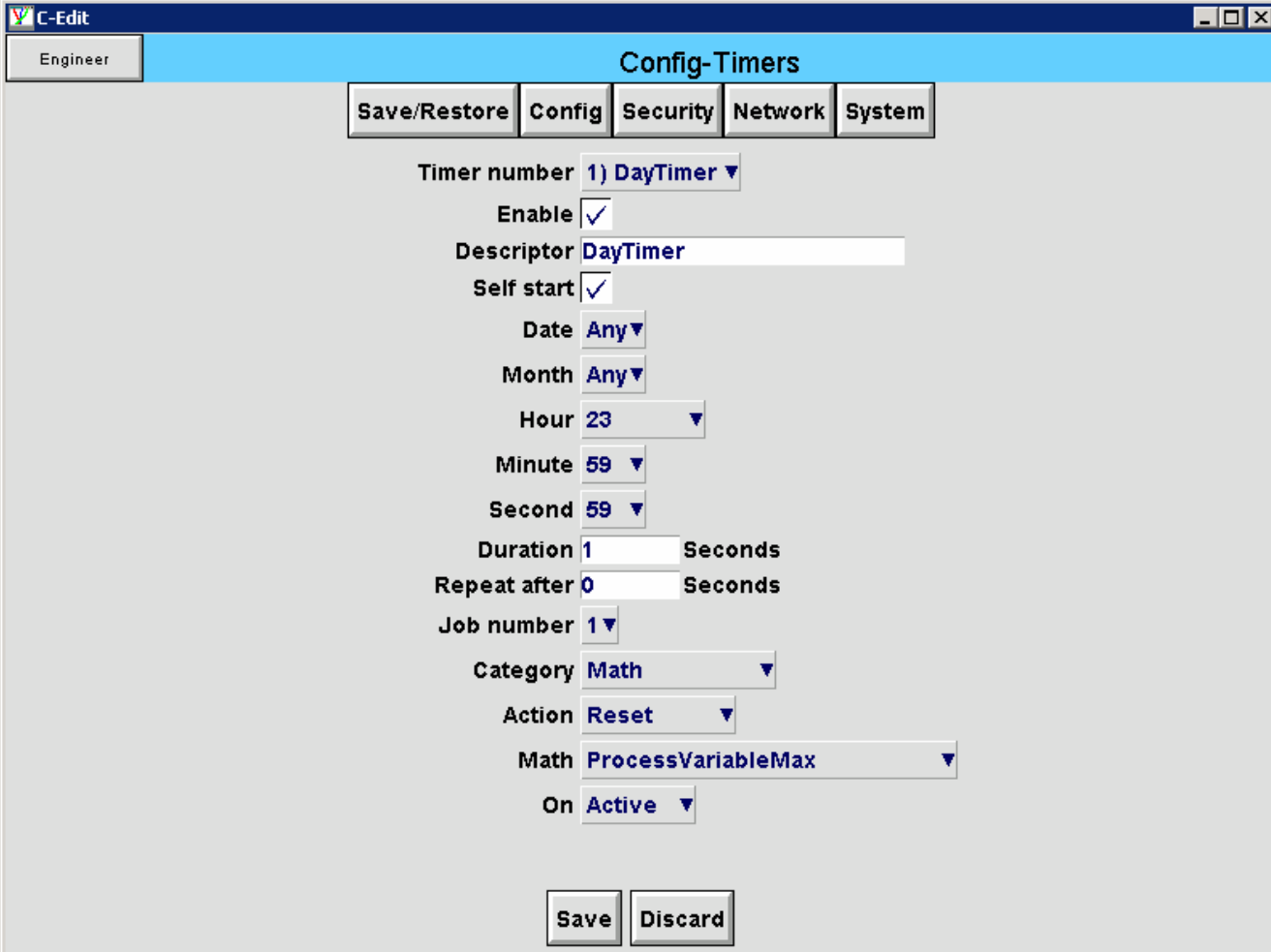
Figure 8 – Math Channel 5 Configuration

Timer 1

Timer 1, **DayTimer**, takes no input signals, but this Timer does feed Job signals to several other Channels. Timer 1 is configured as a self-starting Timer which starts on Any Day of Any Month at 11:59:59 PM and runs for 1 second. Timer 1 has four configured Jobs. Job 1 is configured to Reset Math Channel 1, **ProcessVariableMax** on Active. Job 2 is configured to Trigger Math Channel 2, **ProcessVariableMaxS&H** on Inactive. Job 3 is configured to Trigger Math Channel 4, **ProcessVariableMaxTimeStamp** on Inactive. Job 4 is configured to Trigger Math Channel 5, **ProcessVariableMaxDateStamp**, on Inactive.

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C-Edit

Engineer

Config-Timers

Save/Restore Config Security Network System

Timer number 1) DayTimer ▼

Enable ☒

Descriptor DayTimer

Self start ☒

Date Any ▼

Month Any ▼

Hour 23 ▼

Minute 59 ▼

Second 59 ▼

Duration 1 Seconds

Repeat after 0 Seconds

Job number 1 ▼

Category Math ▼

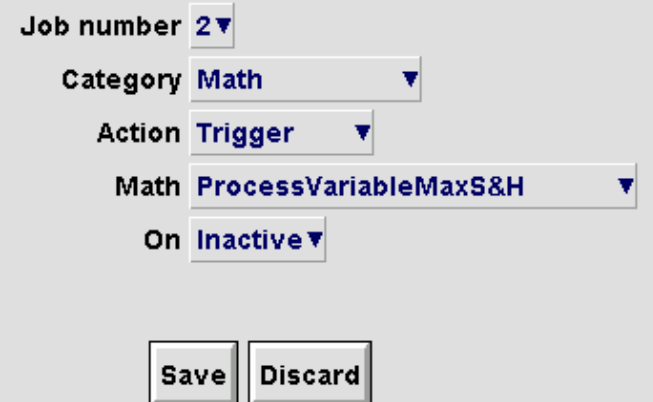
Action Reset ▼

Math ProcessVariableMax ▼

On Active ▼

Save Discard

Figure 9 – Timer 1 Configuration



Job number 2 ▼

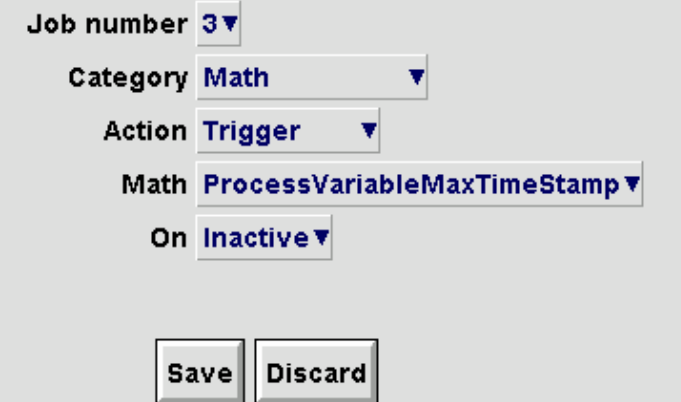
Category Math ▼

Action Trigger ▼

Math ProcessVariableMaxS&H ▼

On Inactive ▼

Save Discard



Job number 3 ▼

Category Math ▼

Action Trigger ▼

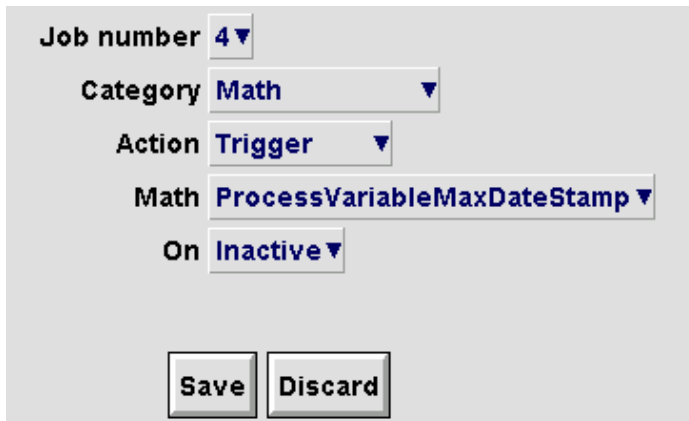
Math ProcessVariableMaxTimeStamp ▼

On Inactive ▼

Save Discard

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Job number 4▼

Category Math▼

Action Trigger▼

Math ProcessVariableMaxDateStamp▼

On Inactive▼

Save Discard

Figure 10 - Timer 1 Job Configuration

Event 1

Event 1, **PowerUp**, takes 1 Event input signal, Power Up, and this Event feed Jobs signals to several other Channels. Event 1 is configured to execute once on recorder power up. Event 1 does have four configured Jobs. Job 1 is configured to Reset Math Channel 1, **ProcessVariableMax** on Active. Job 2 is configured to Trigger Math Channel 2, **ProcessVariableMaxS&H** on Active. Job 3 is configured to Trigger Math Channel 4, **ProcessVariableMaxTimeStamp** on Active. Job 4 is configured to Trigger Math Channel 5, **ProcessVariableMaxDateStamp**, on Active.

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C-Edit

Engineer

Config-Events

Save/Restore Config Security Network System

Event Number 1) PowerUpEvent

Source 1 Power up

Source 1 Sense Source 1

Operator Only

Descriptor PowerUpEvent

Job Number 1

Category Math

Action Reset

Math ProcessVariableMax

On Active

Save Discard

Figure 11 – Event 1 Configuration

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Job Number 2▼

Category Math▼

Action Trigger▼

Math ProcessVariableMaxS&H▼

On Active▼

Save Discard

Job Number 3▼

Category Math▼

Action Reset▼

Math ProcessVariableMaxTimeStamp▼

On Active▼

Save Discard

Job Number 4▼

Category Math▼

Action Trigger▼

Math ProcessVariableMaxDateStamp▼

On Active▼

Save Discard

Figure 12 - Event 1 Job Configurations

Theory of Operation Overview

At some point during the recorder power up sequence, Event 1 will become active. When Active, Event 1 Jobs will execute and reset the Channel Maximum, Math Channel 1; trigger the Channel Maximum Sample and Hold, Math 2; trigger the Channel Maximum Timestamp Time Channel, Math 4; and trigger the Channel Maximum Timestamp Date Channel, Math 5. After execution of these Jobs, the Channel Maximum and the Channel Maximum Sample and Hold will have the same, current Process Variable input value. The Timestamp Time Math Channel will have the real-time value when Event 1 was triggered. The Timestamp Date Math Channel will have the current date value when Event 1 was triggered. At this time, the Channel Maximum recorder configuration is initialized and operational.

If the Process Variable input value increases from its initial Event 1 reset value, the Channel Maximum function of Math Channel 2 will update with a new maximum value. The subtract function of Math Channel 3 will execute, and if the Process Variable input value increase is greater than 0.1 °C, Math Channel 3 Alarm 1 will become active. When Math Channel 3 Alarm 1 is active, Jobs 1, 2 and 3 of Alarm 1 will execute. Job 1 triggers Math Channel 2 to sample and hold the new maximum value. Job 2 triggers Math Channel 4 to capture the current real-time value of the new maximum value. Job 3 triggers Math Channel 5 to capture the current date value of the new maximum value. Because of Math Channel 2 sampling and holding the new maximum input value, the result of the subtract function of Math Channel 3 will be zero. Alarm 1 will no longer be Active, and Math Channel 3 is again ready for a new maximum input value. If the Process Variable input value increases beyond its current maximum value, the preceding process will repeat resulting in a new Process Variable maximum value, and associated Date and Time Timestamp.

Timer 1 automatically executes once a day, on any day, of any month at 11:59:59 PM for 1 second. Timer 1 has Jobs that reset the Channel Maximum, Math Channel 1; trigger the Channel Maximum Sample and Hold, Math 2; trigger the Channel Maximum Timestamp Time Channel, Math 4; and trigger the Channel Maximum Timestamp Date Channel, Math 5. These are the same Jobs executed by Event 1 at recorder power up. Similar to Event 1, these Jobs initialize the Channel Maximum function for the next day.

Example 5000 Series SFC User Screen

A sample 6000 Series User Screen demonstrating the Channel Maximum with Date and Time Stamp function is shown in Figure 13. The User Screen is relatively simple. It contains a Group Vertical Trend object where the Group being trended contains just the **ProcessVariable** Input Channel. The User Screen also contains three Channel Numeric objects of the **ProcessVariableMax**, **ProcessVariableMaxDateStamp**, and **ProcessVariableMaxTimeStamp** Math Channels. The three Channel Numeric objects indicate that a **ProcessVariable** Input Channel Maximum of 500.0 °C was reached on 10/27/06 at 7:43:55 AM. The Vertical Trend object indicates that the temperature has increased twice and decreased once. The last temperature increase was to the maximum of 500.0 °C, and the temperature decrease did not change the Channel Maximum as expected.

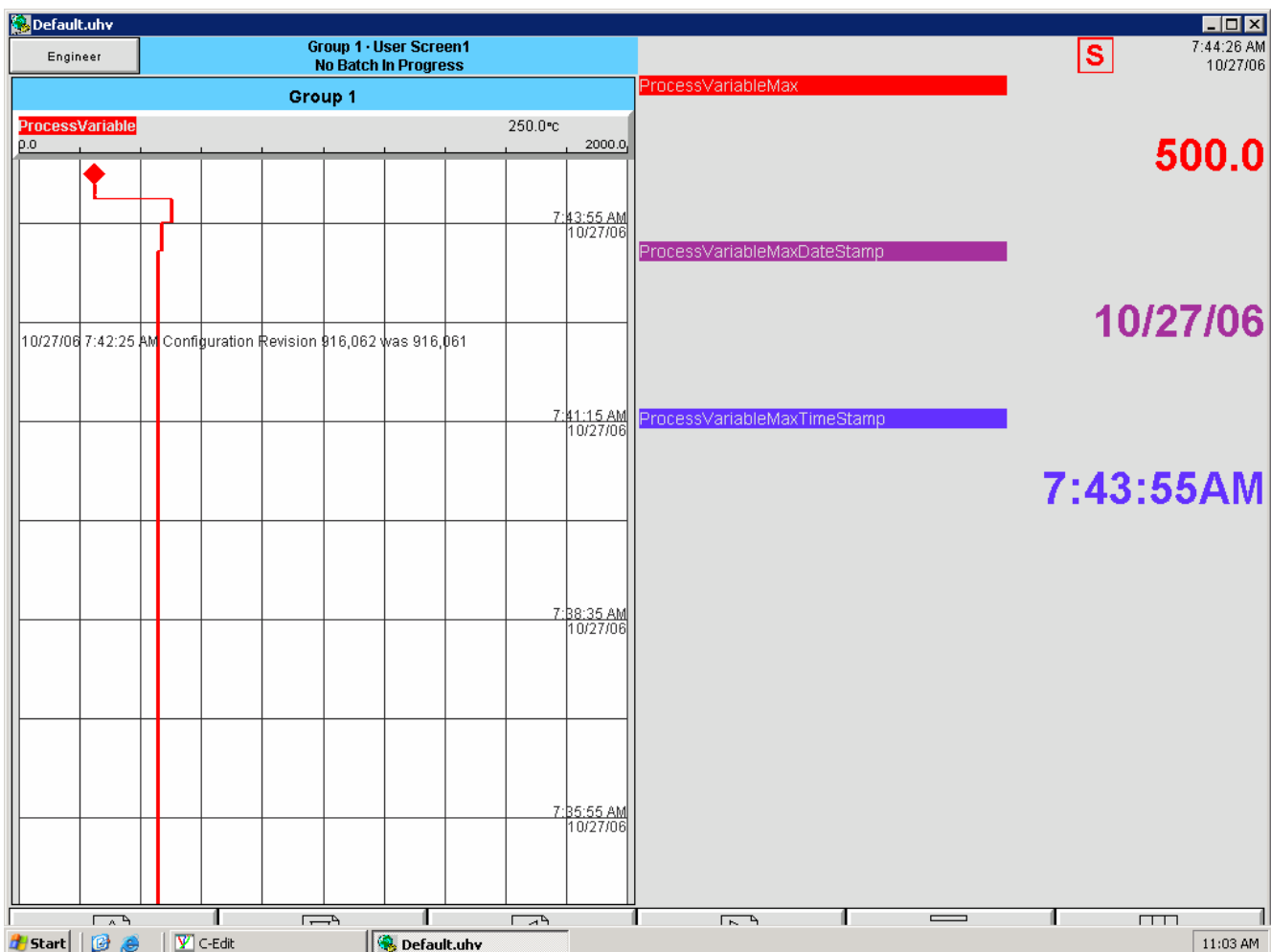


Figure 13 - Sample User Screen

Conclusion

This Technical Information Sheet demonstrated that it is possible to implement a Channel Maximum with Maximum Date and Time Stamp function in a 5000 or 6000 Series recorder. Implementation of this function is relatively simple and may be useful in process applications that require a real-time, on-line, determination of a process value maximum. Implementation of this function would also eliminate the requirement for off-line software applications and procedures. The function is not limited to determination of a Channel Maximum. The function could be modified to implement a Channel Minimum function with minor changes to the supplied recorder configuration. Additionally, the function could be modified to implement determination of an external, digital event occurrence.