

2 *MOD 30ML Operation Lab 2*

2.1 Foreword

MOD 30ML can perform complex continuous control as well as discrete control. The Sequencer block in the MOD 30ML can be used for executing complex batch and sequencing control. Custom displays can be built for information and operation of the advanced control.

2.2 Objectives

In this lab we will download a batch control strategy from the memory module to the MOD 30ML controller and run the batch from the custom displays.

Control of a batch reactor includes sequential and continuous elements, and tight control of the reaction temperature. Ideally, only one device is used to perform both types of control, with a common local display interface providing complete process information. The following demonstration will show:

- integration of automatic sequential and continuous control
- front panel display of sequence steps
- cascade control
- front panel recipe selection and entry of recipe data
- manual control of sequence steps through front panel

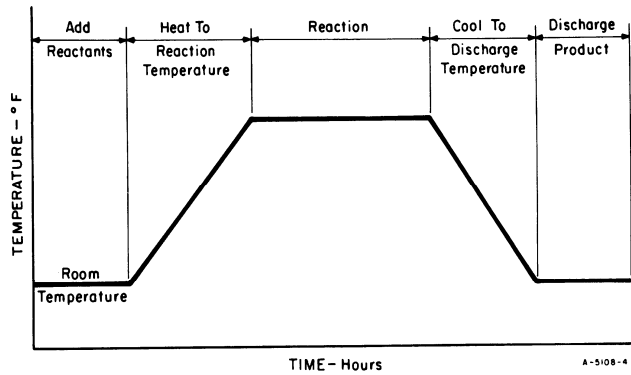
2.2.1 The Control System

The batch reaction is conducted according to a definite time-temperature cycle. The next figure illustrates a typical cycle of many industrial processes.

Reactants are added to the reactor at room temperature; the reaction mass is heated to reaction temperature; the reaction is carried out to form products; the batch is cooled; and the reactor is emptied. Total batch time in reactors used in the manufacture of PVC or polystyrene, for example, is approximately fourteen to eighteen hours. The progression of the batch cycle is controlled by the sequence operation. It may sometimes be necessary for the operators to pause, stop, or manually advance the cycle to another step.

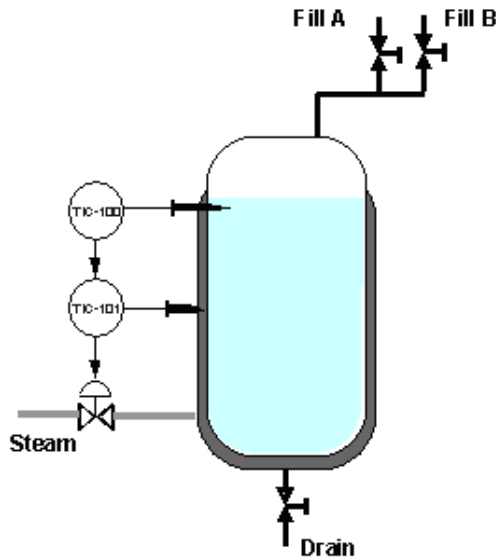
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Figure 2 .1.
Batch Temperature
Cycle



During the heat stage of the batch cycle, a cascade temperature loop is used to control temperature. At the time the sequence enters the heating step, the setpoint of the master controller is ramped to the reaction temperature; the master controller measures the product temperature while the slave measures jacket temperature. At the cooling stage, the setpoint is ramped back to the cool setpoint.

Figure 2 .2.
Batch Reactor



The MOD 30ML is performing the process simulation as well as the sequence control and temperature cascade control. Once started, the batch cycle will progress automatically unless it is switched to manual mode.

The following operations may be done from the front panel displays:

- Batch initialization
- Recipe selection
- Recipe parameter entry

- Manual advance of sequence

Initial Conditions:

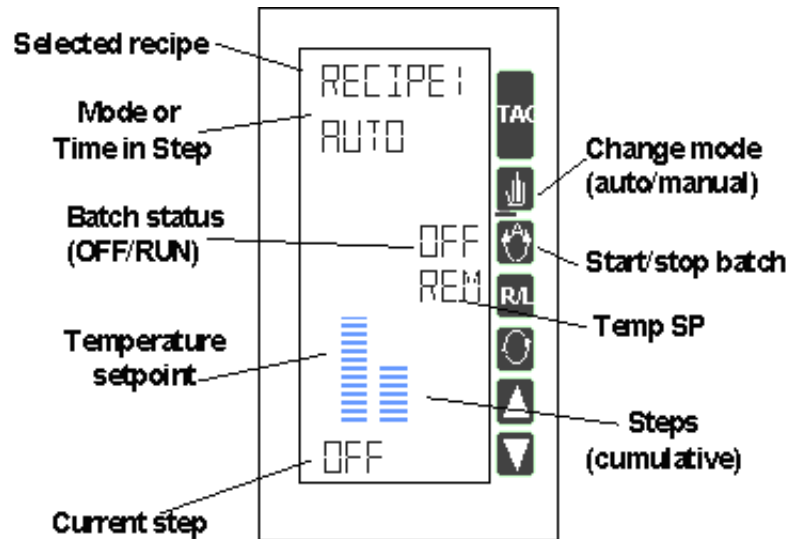
1. Batch AUTO, OFF (Note: once the batch has been started, Line 2 will indicate the Time in Step for each step. If the batch is put into manual mode, Line 2 will display Manual. The “time in step” timer does not stop if the batch is put into manual. However, if you manually advance to another step, the step timer re-starts).
2. RECIPE 1 selected
3. Temperature setpoint LOCAL
4. Level 0.0” H²O
5. Step OFF

2.3 Instructions

2.3.1 Download Reactor database from the memory module:

Step	Procedure	Comments
1	Make sure the SERV/RUN switch under the front face is set to the RUN position	This ensures that after a download the database will be able to run. This switch is located behind the front panel in the NEMA 4 option. You will need to remove the instrument from its housing to set it.
2	Make sure the switches on the memory module are set to READ ONLY and NORMAL	This ensures that the database stored in the memory module is downloaded to the instrument during a power-up sequence. Normal = Transfers the database contained in the memory module to the instrument. Module Load = Transfers the database contained in the instrument to the memory module
3	Loosen the retaining screw and slide the instrument from the housing	CAUTION ! Ensure that the main circuit board is supported at all times.
4	Install the memory module	With the catalogue number of the memory module facing upwards, install the memory module onto the connector of the main circuit board
5	Place the instrument back into the housing and tighten the retaining screw	You should see ***** appear for a short while, then a display as shown in the next figure should appear.

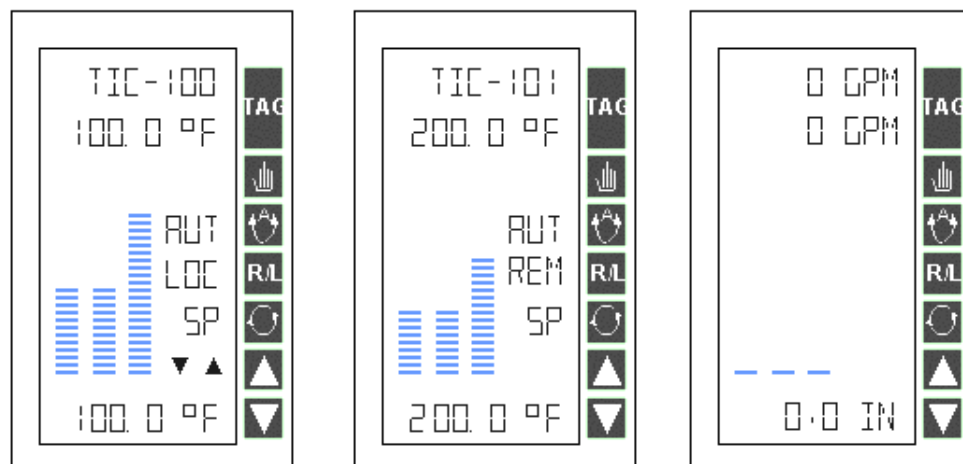
Figure 2 .3.
Batch main display



2.3.2 Scroll through the displays:

- | Step | Activity | Look For |
|-------------|--|--|
| 1 | The first display as shown in the previous page is the main batch display. This is the display where we will start the batch. But before that, we will scroll through the other displays to get an overview. | Note that the batch is in AUTO mode and is not running right now (OFF). The setpoint is in local (LOC) mode. |
| 2 | Press the TAG key once to go to the TIC-100 temperature control loop display. See the next figure. | This is the Master temperature controller. |
| | Read the temperature of the product. Read the output. Press the SCROLL key to show the setpoint at the bottom. | Master temperature controller TIC-100 setpoint 100°F. |
| | Press the TAG key again to go to TIC-101 control loop display. See the next figure. | This is the Slave temperature controller. |
| | Read the process, setpoint and output values. | Slave temperature controller TIC-101 setpoint 200°F. |
| | | Setpoint is in Remote mode (REM). Its value is same as the output value of the TIC-100 loop. |
| | Press the TAG key to go to the next display. See the next figure. | This display shows the Flow rates of Product A and B and also the Level value in inches. |
| | | Product A and B flow 0 GPM |
| | | Level in vessel 0.0" H ₂ O |

Figure 2.4.
TIC-100, TIC-101
and Flow/Level
Displays





You can display and manipulate on one instrument, all process and calculated values associated with the process unit, including both sequence and continuous control.

2.3.3 View the Tuning displays and change the batch recipe:

- | | |
|---|---|
| <p>3</p> <p>Display tuning pages for TIC-100 and TIC-101.</p> <p>First switch to the control display (TIC-100 or TIC-101) and then hold down Scroll key to access the tuning display.</p> | <p>Tuning displays for controller algorithm type, controller action, gain, reset</p> <p>Commissioning activity can take place through front panel of instrument.</p> |
| <p>4</p> <p>Display recipe selection by returning to main batch display and holding down scroll key.</p> <p>Enter tuning password of 1 (if required; the tuning password from the previous activity may still be in effect)</p> <p>Select recipe 1 using UP/DOWN arrows and press ENT (Scroll key).</p> <p>Press NXT key to view recipe parameters</p> <p>Change Recipe 1 target level to 15 inches water. See the next figure.</p> | <p>This is a tuning display within the main batch display to select and change the recipe for the batch.</p> <p>Once tuning password is entered the recipe can be scrolled between the choices of Recipe 1 and Recipe 2</p> <p>You can view and change the following parameters: Reaction temperature setpoint entry, Reactor level, Fill A rate, Fill B rate</p> |

Figure 2 .5.
Recipe Tuning display



2.3.4 Run the Batch:

- 5 Press the TAG key to return to main Batch display

Press AUTO key to start the batch

See the next figure.

Batch status changes to RUN

Setpoint status changes to REMOTE

Step indication on Line 6 changes to START and then to FILL.

Figure 2 .6.
Batch main display

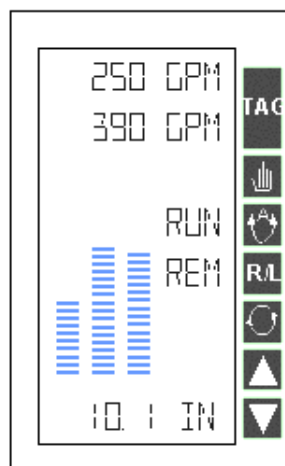


- 6 Scroll to fill display

See the next figure:

Fill A and Fill B flow rates displayed on lines 1 and 2, left and middle bar
Reactor level displayed on Line 6 and right bar

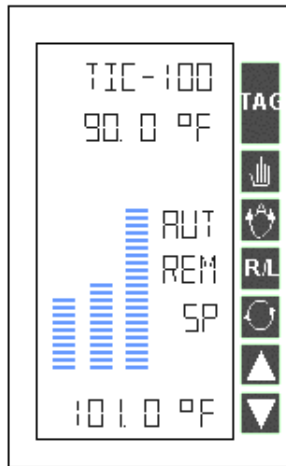
Figure 2 .7.
Batch Flow/Level display



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- 7 Return to main batch display and observe step.
 - 8 When controller has entered HEATUP step, scroll to temperature control displays (TIC-100 and TIC-101)
 - Cascade control for temperature is now active
Master controller setpoint value ramps to 111°F.
- Read the process value of TIC-100. This will also ramp to 111 def F in a couple of minutes
- Refer to the next figure.

Figure 2 .8.
Master
Temperature
control loop



Note that in MOD 30ML, continuous control is completely integrated with sequential control without the need for an external device. Cascade with full tracking provides tight temperature control.

2.3.5 Switch the batch control modes:

- 9 When batch cycle has entered HOLD step, return to main batch display
- Batch status on line 2 changes to MANUAL.
- Press MAN key to put batch cycle in manual control
- STP indication appears next to Scroll key

Figure 2 .9.
Batch in Hold



- 10 Press STP key (scroll key) to scroll to COOLDOWN
- Press MAN key again to return batch cycle to automatic control
- Batch time shows on line 2.
- Batch resumes automatic control in COOLDOWN step

Figure 2 .10.
Cool Down Step



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- | | | |
|----|---|---|
| 11 | Scroll to TIC-100 display | Temperature setpoint ramping down to cool setpoint |
| 12 | When batch cycle has entered DRAIN cycle, scroll to level display | Falling reactor level as vessel is drained |
| 13 | Scroll back to the main display | When drain cycle is finished (level has returned to 0) and current step shows as END. |

Figure 2 .11.
Batch End



- | | | |
|----|---|---|
| 13 | Press the MANUAL key, change the step to OFF, and press the AUTO key to return the batch to OFF status.
Press the MAN key again to change to automatic mode. | The display will look like the initial display as shown in Figure 2 .3.
The batch can be repeated now. |
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