

# 5699 I/O Simulator Module

Installation, Operation and Maintenance  
Setup Manual

5/19/2011



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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## Safety Information

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Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **DANGER**

**DANGER** indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

### **WARNING**

**WARNING** indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

### **CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate.

### **CAUTION**

**CAUTION** used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** equipment damage..

**PLEASE NOTE**

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

**BEFORE YOU BEGIN**

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

 **CAUTION****EQUIPMENT OPERATION HAZARD**

Verify that all installation and set up procedures have been completed.

Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.

Remove tools, meters, and debris from equipment.

**Failure to follow these instructions can result in injury or equipment damage.**

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

**Software testing must be done in both simulated and real environments.**

Verify that the completed system is free from all short circuits and grounds, except those grounds installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

**OPERATION AND ADJUSTMENTS**

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

## About The Book

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### At a Glance

#### Document Scope

This manual describes the operation of the 5699 I/O Simulator module.

#### Validity Notes

This document is valid for all versions of the 5699 I/O Simulator module.

#### Product Related Information

 <b>WARNING</b>
<b>UNINTENDED EQUIPMENT OPERATION</b>
The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter and apply this product.
Follow all local and national safety codes and standards.
Failure to follow these instructions can result in death, serious injury or equipment damage.

#### User Comments

We welcome your comments about this document. You can reach us by e-mail at [technicalsupport@controlmicrosystems.com](mailto:technicalsupport@controlmicrosystems.com).

## Overview

The Model 5699 simulator module provides three adjustable analog inputs and four toggled digital inputs to the SCADAPack controller. The 5699 can also simulate a controlled process in order to demonstrate the PID control capabilities of the SCADAPack.

The Model 5699 is designed to work with the SCADAPack controller only.

## Specifications

Model 5699 Specifications		
I/O Summary	<u>Signal</u>	
	Analog Inputs	3
	Digital Inputs	4
Analog Inputs	0 - 5V or 4 - 20mA	potentiometer adjustable
Digital Inputs	24V	toggle switch
Power Requirements	24V	
Dimensions	5.650 inch (143.51mm) wide	
	1.250 inch (31.75mm) deep	

## Installation

The Model 5699 simulator module is installed on the SCADAPack controller by inserting the 5699 connector pins into terminal blocks P3, P4 and P5. To install the 5699 Simulator Module on the SCADAPack controller:

Remove power from the SCADAPack controller.

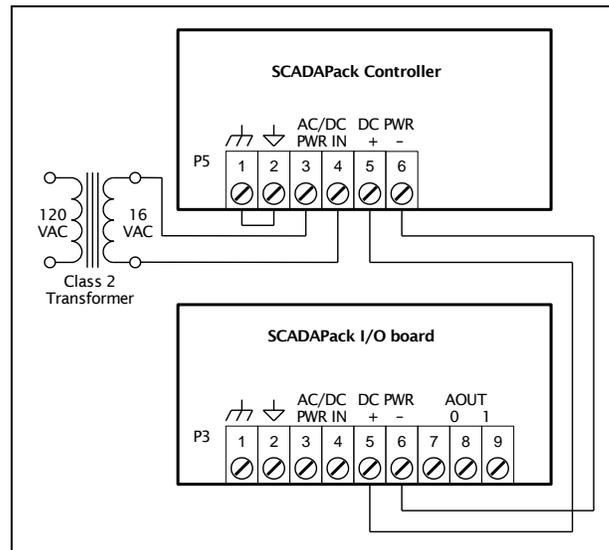
Align the 5699 module such that the farthest left connector pin is inserted into terminal 1 of terminal block P3 on the SCADAPack controller. See **Figure 2: Module Installation**.

Ensure all connector pins are aligned with the terminals on terminal blocks P3, P4 and P5.

Tighten the 27 screws on the terminal blocks for proper connection.

## Wiring

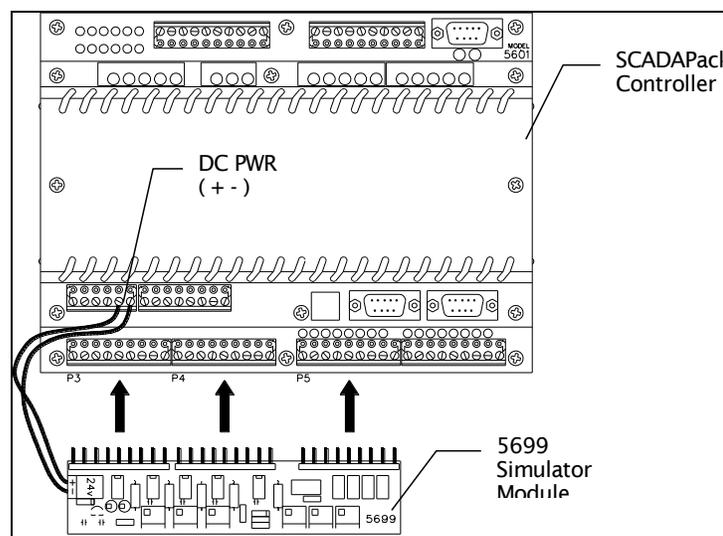
The SCADAPack controller power supply accepts AC or DC input power. A 16Vrms source connects to the AC/DC PWR IN terminals. **Figure 1: AC Power Supply Configuration** shows this AC power source coming from a Class 2 transformer. 24 VDC is available on the SCADAPack controller connector P5 and is used to power the 5699 Simulator board.



**Figure 1: AC Power Supply Configuration**

The 5699 requires an external 24V power supply. The SCADAPack supplies this power from its DC PWR terminals.

Connect DC PWR (+ -) from P5 on the upper board of the SCADAPack controller to the 24V (+ -) on the 5699 simulator module, observing polarity. See **Figure 2: Module Installation**.



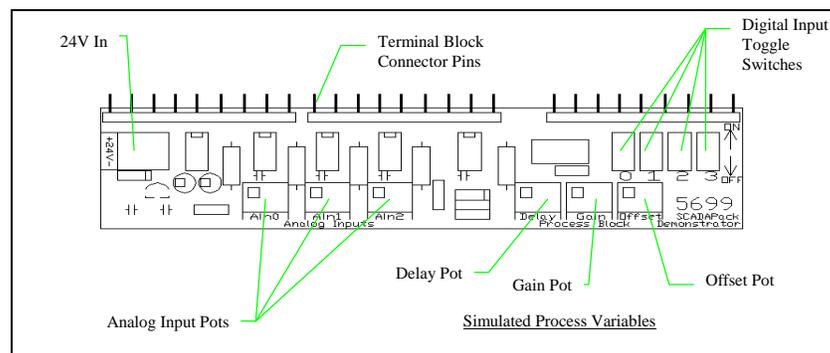
**Figure 2: Module Installation**

## Maintenance and Operation

This module requires no maintenance or calibration. If the module is not functioning correctly, return it to Control Microsystems for repair.

## Component Layout

The 5699 has been laid out in a logical manner. The three analog input potentiometers, AIN0, AIN1 & AIN2 are located on the left end of the 5699. The four digital input toggle switches, 0, 1, 2 & 3 are located on the right end of the 5699. The three simulated process variables, Gain, Delay & Offset are also located on the right end of the 5699. See **Figure 3: 5699 Module Component Layout**.



**Figure 3: 5699 Module Component Layout**

## Analog Inputs

There is one potentiometer corresponding to each of the three SCADAPack analog inputs, address 30001, 30002 and 30003. The potentiometers are the multiple turn type. This provides very fine control over the analog input value.

To adjust the input:

- Turn the potentiometer adjustment screw clockwise to increase the input value.
- Turn the potentiometer adjustment screw counter-clockwise to decrease the input value.

The input value will stop changing when the potentiometer reaches its limits. The screw will continue to turn.

## Digital Inputs

There is one toggle switch corresponding to each of the four SCADAPack digital inputs, address 10001, 10002, 10003 and 10004.

To control the input:

- Toggle the input switch towards the SCADAPack to turn the input on.
- Toggle the input switch away from the SCADAPack to turn the input off.

## **PID Process Simulator**

There is one potentiometer for each process variable, Gain, Delay and Offset. The potentiometers are the multiple turn type.

To adjust the variable:

- Turn the potentiometer adjustment screw clockwise to increase the process variable.
- Turn the potentiometer adjustment screw counter-clockwise to decrease the process variable.

The process variable will stop changing when the potentiometer reaches its limits. The screw will continue to turn.

## 5699 PID Demonstration

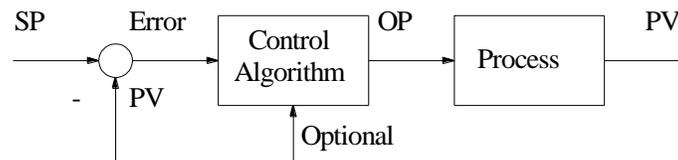
### Overview

The 5699 simulator module PID demonstration may be used to demonstrate the use of PID control in the SCADAPack controller. Using the 5699 simulator PID process block a 'process' may be simulated. This demonstration uses a Telepace Ladder Logic program and a Lookout Process program to configure and monitor the operation of a PID controller.

The Telepace Ladder Logic program contains the logic to configure the PID controller and to start the execution of the PID. The Lookout process program is used to monitor and 'tune' the PID controller as the process is controlled.

A detailed explanation of PID process control is beyond the scope of this demonstration. A detailed explanation of the SCADAPack PID control is found in the *TeleSAFE PID Controllers Reference Manual*. An example typical feedback control loop is shown in **Figure 4: Typical Feedback Control Loop**.

In this example the PID Controller maintains the PV ( process variable) signal equal to the SP (setpoint) signal. The PID controller does this by first calculating an Error signal. the Error is equal to the SP signal minus the PV signal. The Control Algorithm calculates an OP (output) signal that is sent to the Process. The process is changed by the OP signal resulting in a change to the PV signal. The PID controller continues this process until the error is equal to zero.



**Figure 4: Typical Feedback Control Loop**

### PID Demonstration Program Installation

To use this demonstration package the following installation steps are required to load the software.

- Install the Telepace Ladder Editor version 1.36 on your PC.
- Run the Telepace Ladder Editor.
- Service boot the SCADAPack Controller.
- Initialize the SCADAPack Controller.
- Write the Ladder Logic program *5699demo.lad* to the SCADAPack controller.
- Run the *5699demo.lad* program and start the PID execution.

- Open the Lookout process file 5699demo.lkp.
- Configure the Lookout Modbus object for the serial parameters of your PC.

### **Install Telepace Ladder Logic Editor**

To install the Telepace Ladder Logic Editor:

- Insert the setup disk into drive A or your CDROM.
- To install the Telepace Ladder Logic Editor using Windows:
- From the Windows Program Manager **File** menu choose **Run**.
- In the command line box, type **a:\Setup or D:\setup** and press ENTER.
- Follow the setup directions on the screen.

To install the Telepace Ladder Logic Editor using Windows95:

- Click the **Start** button, and then click **Run**.
- In the Open box, type the location and name of the program you want to start.

Follow the setup directions on the screen.

### **Run the Telepace Ladder Logic Editor**

To run the Telepace Ladder Logic Editor:

- In the Telepace group of the Program Manager, double click on the Telepace Ladder Logic Editor icon.

### **Service Boot the SCADAPack Controller**

A SERVICE BOOT is performed using the following procedure:

- Remove power from the controller.
- Hold down the LED POWER button.
- Apply power to the controller.
- Continue holding the LED POWER button until the STAT LED turns on.
- Release the LED POWER button.

### **Initialize the SCADAPack Controller**

Initialize the controller before the 5699demo.lad program is loaded into the controller. The **Initialize Controller** dialog appears when **Initialize** is selected in the **Controller** menu. Ladder Logic programs, C programs and the Register Assignment may be erased from this dialog.



Figure 5 Initialize Controller dialog

### Write the 5699demo.lad program to controller

Open the 5699demo.lad program using the **Open** command in the **File** menu. Use the **Write to Controller** command in the **Communications** menu to write the 5699demo.lad program to the controller.

### Run the 5699demo.lad Program

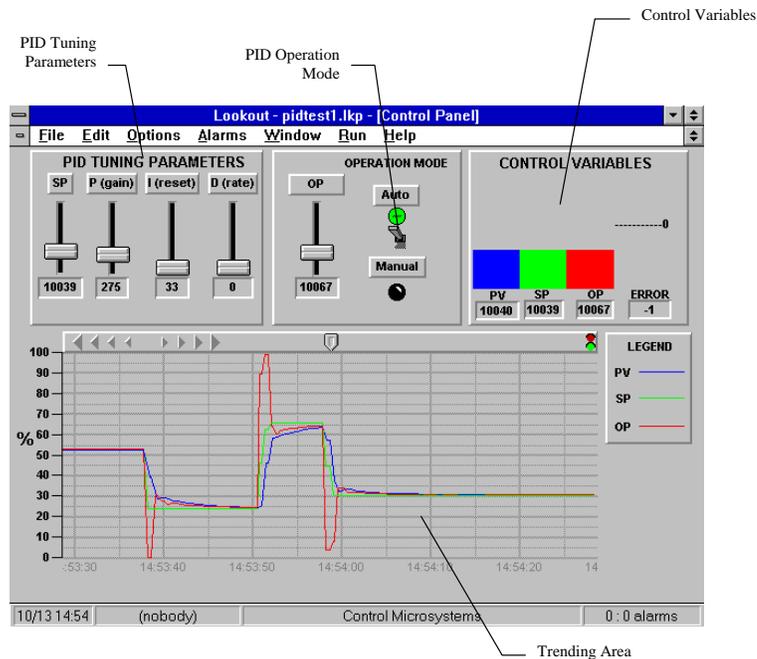
Exit the Telepace Ladder Editor and then cycle the power to the SCADAPack controller to start the PID execution.

### Lookout Program

Install the Lookout Process Control software into your computer according to the instruction manual.

- Select the Lookout program icon and start Lookout.
- Select *File - Open* and open the 5699demo.lkp file from the floppy disk drive.
- Press *Ctrl - Spacebar* to switch to the edit mode.
- Select *Object - Modify - Modbus1* and verify that the serial port selected is the same as the serial port on your computer. The communication parameters should already be set to 9600,n,8,1, address 1.
- Select *Options - Serial Ports* and check that the comport through which you will be communicating is set to *Hardwire* with a *Receive Gap = 50*.
- Press *Ctrl - Spacebar* to turn the edit mode off.
- Expand the control panel to its maximum size.
- Toggle the Operation Mode switch to Auto.
- Vary the SP with the sliding fader and observe changes in OP.

## OPERATION



**Figure 6: Lookout Sample Program Screen**

### PID Tuning Parameters

Four parameters are available. They are SP (Setpoint), P (Gain), I (Reset) and D (Rate). They are adjusted by sliding a “fader” potentiometer in the PID Tuning section of the Lookout sample screen. See **Figure 6: Lookout Sample Program Screen**.

- SP has an operating range of 0 to 32760 (0 to 100%).
- P has an operating range of 0 to 1000 (0 to 10)
- I has an operating range of 0 to 1000 (0 to 10 sec.)
- D has an operating range of 0 to 1000 (0 to 10 sec.)

### Operation Mode

The PID control block can operate in two modes: automatic and manual.

In automatic mode, the PID block sets the output in response to the process variable and attempts to maintain it at the setpoint. Automatic mode is selected by toggling the operation mode switch up.

In manual mode, the SP will “track” or follow PV but OP will not be affected. In this mode only, OP may be changed by sliding the OP fader potentiometer.

## Control Variables

These are the real-time values of PV, SP and OP displayed in an easy to read bar chart format. The Error value is the difference between SP and PV. When PV equals SP, there is no error and the bar chart displays nothing. If PV is less than SP, a positive error is generated and a bar will appear above the -----0 mark. If PV is greater than SP, a negative error is generated and a bar will appear below the -----0 mark. This method of displaying the error allows the demonstrator, at a quick glance, to assess how well the PID block is reacting to the process.

## Trending Area

This graph, which scrolls from right to left, records the values of PV, SP and OP. A 1 minute "window" of data can be seen at any one time. The recording pen is located at the right side of the trending area.

Real-time trending may be stopped by clicking the small red circle at the upper right end of the trending area or by clicking the cursor symbol in the center of the thin bar that runs across the top of the trending area. Viewing historical trends is then made possible by dragging the thin cursor line to the right or left. Real-time trending is then reactivated by clicking on the little green circle above the red circle.

## Resetting the 5699 Process Variables

Before attempting to tune the PID block, the simulated process variables are reset to known values by adjusting their potentiometers. This technique can also be employed when the 5699 has been previously used and you want to return to a known point of calibration.

- Toggle the Operation Mode switch to manual.
- Adjust the OP fader to approximately 10000.
- Decrease the Gain on the 5699 to 0. This will take approximately 20 counter-clockwise turns of the potentiometer screw.
- Decrease the Delay to zero. Again this will take approximately 20 counter-clockwise turns.
- Reduce the Offset (counter-clockwise turns) until PV decreases to the smallest number you can obtain. Due to the resolution of the analog input, the closest to 0 could be 15 or 16.
- If PV appears to be increasing as Offset is being decreased, the Offset is in the negative range. Increase the Offset (clockwise turns) until PV approaches 0. Again, due to the resolution of the analog input, the closest to 0 could be 15 or 16.
- The Offset has now been set to approximately 0.
- Increase the Gain until PV reaches approximately 10000. The Gain has now been set to 1 (100%).

- Increase the Delay, change the OP and watch how long it takes for PV to follow OP. Keep increasing the delay until there is approximately 3 seconds delay between OP and PV. The delay has now been set to 3 seconds.

The process response now looks like this:

$$PV = (OP \times 1 \times 3s \text{ Delay}) + 0$$

### Preparing the Demonstration PID

With the 5699 simulated process reset to the default values of

Gain = 100%,

Delay = 3s and

Offset = 0%,

- The PID control block can now be tuned to respond to this process. The following steps explain how to prepare for the PID demonstration.
- Adjust the P (gain) fader to approximately 270.
- Adjust the I (reset) fader to 33.
- Adjust the D(rate) fader to 0.
- Toggle the Operation Mode switch to Auto.
- Vary the Setpoint SP by moving the SP fader to different values and observe the PV response on the trending chart.

A good response to setpoint changes should be visible now. The effect of changing the PID Tuning Parameters can be shown by adjusting the faders and observing the trend. The effect of a changing process on a tuned PID block can be illustrated by adjusting the process variable potentiometers on the 5699.