Honeywell

UDC5300 Controller User Manual

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Rev 1
5/00

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Revision 1 – 5/00

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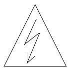
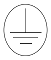
While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

SYMBOL DEFINITIONS

This **CAUTION** symbol on the equipment refers the user to the Product Manual for additional information. This symbol appears next to required information in the manual.



WARNING
PERSONAL INJURY: Risk of electric shock. This symbol on the equipment warns the user of potential shock hazard where voltages greater than 30 Vrms, 42.4 Vpeak, or 60 Vdc may be accessible. **Failure to comply with these instructions could result in death or serious injury.**



Protective earth terminal. Provided for connection of the protective earth (green or green/yellow) supply system conductor.

Sensing and Control
Honeywell
11 West Spring Street
Freeport, Illinois 61032

About This Document

Abstract

This manual contains instructions for installation and operation of the UDC5300 Controller.

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

Honeywell Organization	WWW Address (URL)
Corporate	*http://www.honeywell.com*
Sensing and Control	*http://www.honeywell.com/sensing*
International	*http://www.honeywell.com/Business/global.asp*

Telephone

Contact us by telephone at the numbers listed below.

	Organization	Phone Number	
United States and Canada	Honeywell	1-800-423-9883 1-888-423-9883 1-800-525-7439	Tech. Support Q&A Faxback (TACFACS) Service
Asia Pacific	Honeywell Asia Pacific Hong Kong	(852) 2829-8298	
Europe	Honeywell PACE, Brussels, Belgium	[32-2] 728-2111	
Latin America	Honeywell, Sunrise, Florida U.S.A.	(854) 845-2600	

CE CONFORMITY

This product is in conformance with the protection requirements of the following European Council Directives: 89/336/EEC, the Electromagnetic Compatibility Directive and 73/23/EEC, the Low Voltage Directive. Conformance of this product with any other “CE Mark” Directive(s) shall not be assumed.

ATTENTION

The emission limits of EN 50081-2 are designed to provide reasonable protection against harmful interference when this equipment is operated in an industrial environment. Operation of this equipment in a residential area may cause harmful interference. This equipment generates, uses and can radiate radio frequency energy and may cause interference to radio and television reception when the equipment is used closer than 30 m to the antenna(e). In special cases, when highly susceptible apparatus is used in close proximity, the user may have to employ additional mitigating measures to further reduce the electromagnetic emissions of this equipment.

Contents

Tables

Figures

1. Introduction

1.1 Features and Benefits

Versatile instrument

The UDC5300 controller offers flexibility and performance typically found in a controller much larger than its 1/4 DIN size. The use of function blocks for configuration and a large variety of standard control algorithms allow the controller to satisfy the most demanding control applications.

The controller is available for one or two loops of independent or cascade control, and offers a diversity of output types. The optional Setpoint Profiler allows the configuration of a profile with up to sixteen ramp and soak segments for batch cycle operations. An optional data storage feature allows real-time storage of process data and operator actions, as well as storage and recall of configuration, calibration, and setpoint profiles.

User interface

An easy-to-read display provides instant access to process values on operator displays. Every live display includes a bargraph indicating deviation of process variable from setpoint. In addition, display indicators alert the operator to process alarm conditions, loop selected, setpoint selected, Auto/Manual status, and setpoint profile status. During programming you select which operator displays are used and their sequence.

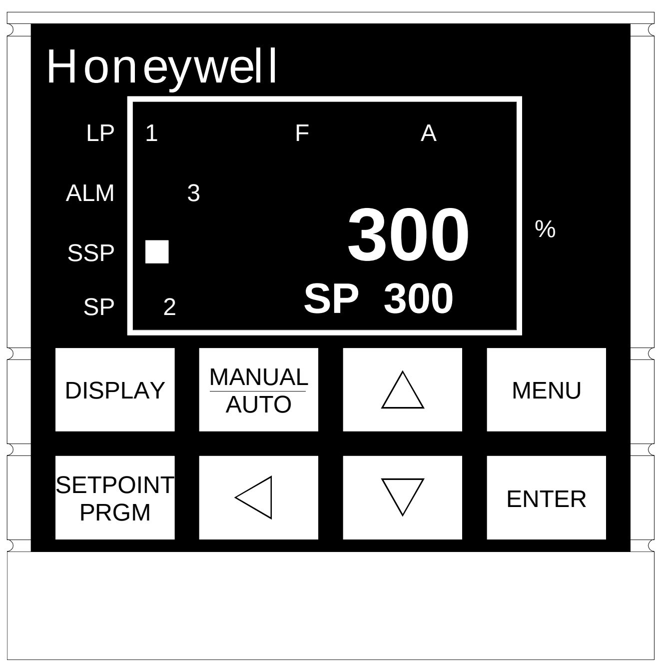


Figure 1-1 UDC5300 Front Panel

With three modes of operation (Online, Program, and Maintenance) the full range of setup, operation, and maintenance functions are performed using the eight keys on the monoplanar front panel. These keys provide push-button entry with tactile feedback, and are large enough to avoid entry errors, even for operators wearing gloves.

Every parameter in the controller's configuration database, and the current value of each, can be accessed by cycling through menu displays. Access can be password-protected, or limited to read-only.

More information about the user interface is provided in 1.2. Basics of mode, menu, and keypad use are provided in Section 6. Operator displays are described in Section 14.

Easy to configure

Menu driven configuration is fast and easy. A control strategy can be loaded at the factory, leaving only site-specific values such as tuning parameters and range limits to be entered on-site. These "factory configurations" are built into the firmware of every UDC5300, so a different strategy can easily be loaded if process requirements change.

These factory configurations can be modified, or a completely new strategy be built "from scratch", using the complement of function blocks built into every unit. A function block is a software object that performs a piece of the control strategy, making data available to other blocks. Your job is to link these together to define the data flow, and to specify their operation by modifying parameter values (if the default values are not suitable for your application).

For example, to use an alarm type function block, you specify that its input will be the value from an analog input. You specify its operation, such as high alarm, low alarm, or deviation alarm, by selecting its action from a list, then you enter the setpoint. If you want a relay to activate when the block detects an alarm state, "point" to the alarm block's output with the DO (discrete output) function block associated with the relay.

Function block basics are provided in 1.4. Section 5 contains more information about factory configurations and function blocks, so you can plan how to use the controller to implement your strategy. Section 7 provides detailed information about each factory configuration.

Inputs and outputs

The standard inputs and outputs provided in the controller include one universal analog input, one current or voltage output (can be switched on-site), 1 form C relay, and 1 form A relay to support a wide range of loop configurations. Two additional analog inputs are available. You can also have your choice of two discrete inputs and two more relays, or three discrete inputs with another current or voltage out.

The controller has dozens of built-in analog input algorithms to handle signals from a wide variety of thermocouple, RTD, or pyrometry sources, as well as any linear input. Alternatively, you can enter a custom conversion curve by defining up to twenty points.

Each hardware input and output has an associated function block to serve as an interface between the field signal and the rest of the controller functions. For example, the analog input (AI) block type converts the incoming voltage signal[1] to a value usable by other blocks, such as the loop (LP) block executing the control algorithm.

Analog output (AO) blocks can provide your choice of current adjusting type (CAT), voltage adjusting type (VAT), duration adjusting type (DAT), and position proportioning (PP) output. In addition, direction impulse adjusting type (DIAT) output can be achieved with a special DIAT PID control algorithm and the PP output type configured to use the DIAT positioning algorithm.

Function block complement

In addition to the function blocks that interface with the analog inputs and outputs (AI and AO), and discrete inputs and outputs (DI and DO), four other block types perform a wide variety of functions.

Two LP (loop) blocks execute your choice of standard PID, advanced PID, PID ratio, PID with DIAT output, PID cascade, or ON/OFF control. Two sets of tuning parameters can be programmed for each PID strategy; switching between the sets is fast and easy. The switchover can be triggered from an external device.

Sixteen CV (calculated value) blocks can each perform any of twelve functions such as peak picking, interval timing, math or logical operations, or output splitting for greater flexibility when configuring your strategy. For example, inserting a “standard splitter” type CV block in the data flow between your loop block and the output blocks can send the output to one actuator when the PV is above setpoint, and a different actuator when PV is below setpoint. Several factory configurations take advantage of this splitter to provide reliable control of both heating and cooling equipment by a single loop.

Nine CN (constant) blocks can each provide a true constant or a variable read from another block for use as an input from anther block. Use this block type to provide dynamic values to ratio setpoints or tuning parameters.

Four AL (alarm) blocks can monitor process variables (see below).

These block types are supplemented by the **SP (setpoint profiler)** block used to configure the values, times and event statuses associated with each ramp or soak segment of the profile (see below).

A special **SY (system)** block monitors the status of the controller’s operations, and makes these statuses, as well as the reference junction temperature, available as outputs readable by other blocks.

Alarms

Up to four process alarms can be configured. If the alarm state becomes active, an indicator lights on the display to alert the operator. The alarm is entered in an “Alarm Summary” that lists all active alarms. As an option, it can also be logged by the data storage function.

[1] If current signal is used instead of voltage, use a shunt resistor as described in Section 4.

Any alarm can be programmed with a delay, preventing nuisance alarms from brief process upsets. Alarm hysteresis time can also be configured, to prevent an alarm from “clearing” from the display too quickly, even if the alarm condition is corrected.

Setpoint profiles

The optional Setpoint Profiler feature lets you configure a profile with up to sixteen ramp or soak segments by entering a setpoint and time for each segment. The setpoint generated by the profiler can then be used by either loop.

Two “event” bits can be configured to be turned ON or OFF for the duration of a segment, permitting discrete actions to be tied to individual segments. A “deviation hold” function is configurable. This puts the profile execution “on hold” if the process variable strays from the setpoint by more than a user-specified amount.

A dedicated setpoint profile key provides quick access to online operation of the profiler. Every operator display provides indication of the status of the profile execution.

Profiles can be stored in the removable PCMCIA card for error-free recipe loading. Use of the Setpoint Profiler is described in Section 11.

Carbon potential

The carbon potential option makes a special calculated value type function block available that uses the input from a zirconia oxygen probe, the probe temperature, and other user-supplied values to calculate a percent carbon output, as well as the dewpoint and the highest furnace temperature that will avoid production of soot. When used in conjunction with other function blocks, this carbon potential block is useful for applications such as carburizing the surface of low-carbon steel and heat-treating carburized parts, as well as in atmosphere generating applications.

Serial communication

An optional serial communications card permits use of the UDC5300 with up to thirty other devices on a multi-drop datalink from a personal computer using either the traditional Honeywell binary or Modbus RTU protocols. Setup for serial communication is described in Section 18.

Data storage

The controller can be equipped with a PCMCIA (Personal Computer Memory Card International Association) storage card interface to store process data, log alarms and events, save controller configurations and calibration, and maintain multiple setpoint profile files. The PCMCIA card interface accepts 256KB, 512KB, and 1 MB SRAM memory cards. Data storage can be continuous, or linked to certain events.

To view and analyze data (including trends) from these cards, use Honeywell SDA software running on a personal computer. Use of the data storage feature is described in Section 17.

Password protection

Protect your choice of operator functions using a configurable three-digit password. A second "master" password can be specified to protect the integrity of the controller's configuration database.

Extensive diagnostics

The controller performs extensive self-diagnostics as a background task during normal operation. If a problem is detected, a message is displayed to alert the operator. In addition, the operator can initiate keypad and display tests using the Maintenance menu.

NEMA 12 case

With the proper mounting and the front bezel firmly closed, the UDC5300 meets the criteria for NEMA 12 Type enclosures for protection from falling dirt and dripping water from the front of the panel. See Figure 3-1 for mounting.

SCF software extends functionality

SCF software is available from Honeywell to do all UDC5300 configuration tasks. Two features supported by the controller can be configured only using the software: entering freeform math expressions for a Math type calculated value (CV) block, and adding custom identifiers for constants (CN blocks) and calculated values (CV blocks). These configuration tasks cannot be accomplished using the keypad on the controller's front panel.

1.2 Operator Interface

Front panel keys used for all setup and operation tasks

Eight keys with dedicated functions are on the front panel (see Figure 1-2). Use these keys to do all setup, operation, and maintenance functions.

Operator displays provide quick access to process values

Select the operator displays to be included in the viewing sequence for each loop. All include the PV. A second value can also be seen: setpoint, output value (PID) or status (ON/OFF), ratio setpoint, a calculated value, a CN (constant) block's output. A display is available for quickly switching between setpoints for the selected loop.

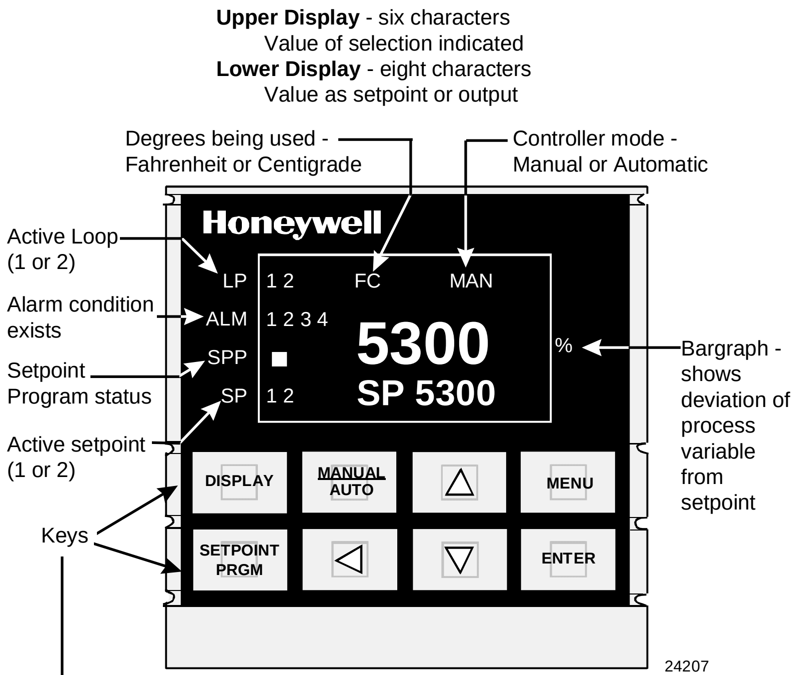
Display indicators for key system functions

The display indicators shown in Figure 1-2 alert the operator to process alarm conditions, loop selected, setpoint selected, Auto/Manual status, and setpoint profile status. Any process values on display pertain to the loop indicated.

Online menus provide quick access to tuning parameters, alarm setpoints, and datapoint values

The Online menus provide quick access to summaries of alarm setpoints, values of all analog and discrete data points, most recent diagnostic failure messages, and other information. Unless programmed to lockout the operator, tuning parameters can be viewed and changed, alarm setpoints altered, and constants and other discrete parameters turned on and off.

Basics of mode, menu, and keypad use are provided in Section 6. Operator displays are described in Section 14.



DISPLAY	o Accesses up to 10 on-line displays. o Changes controller to on-line mode.
MANUAL / AUTO	o Toggles loop between automatic and manual modes, or between remote manual and manual modes when remote manual is ON.
△	o Moves cursor up a menu or list of choices. o Increases the setpoint, output, or configuration values displayed.
MENU	o Accesses on-line mode menu. o Moves cursor to first item on menu. o Backs cursor out of a menu to next higher menu level. o Exits menu without saving changes if pressed when prompted to save changes.
SETPOINT PRGM	o Accesses setpoint profile displays.
◁	o Selects the digit to be changed.
▽	o Moves cursor down a menu or list of choices. o Decreases the setpoint, output, or configuration values displayed.
ENTER	o Selects displayed menu item. o Enters a changed value or parameter o Saves changes made and returns to higher menu if pressed when prompted to save changes.

Figure 1-2 Display Indicators and Key Functions

1.3 Overview of Tasks in Each Mode

Menus for every mode and task

For your convenience, a menu is provided to perform all tasks in each mode: Online, Program, and Maintenance.

Online mode tasks

Online mode tasks include:

- tuning the control loops
- defining and operating a setpoint profile
- viewing summaries of system and process data
- changing setpoints, discrete point statuses, and analog output tuning values
- storing data
- pretuning the loop
- reviewing programmed entries

Program mode tasks

Program mode tasks include:

- programming all parameters of all function block types (except system status block)
- copying blocks
- selecting the displays for the viewing cycle
- enabling/disabling features such as the use of alarms and constants, display of pyrometry input types
- specifying passwords and selecting the functions to be protected
- assigning datalink address and other serial communication parameters
- setting the clock and calendar
- storing and loading configuration files on removable PCMCIA cards
- loading a factory configuration
- setting the scan frequency
- specifying the language for prompts and menu choices

Maintenance mode tasks

Maintenance mode tasks include offline functions:

- calibrating analog inputs and outputs
- running keypad, display, and memory diagnostics
- using database services such as clearing the memory, clearing calibration, and performing upgrades
- resetting the unit
- specifying the mains power frequency
- displaying product ID information, including firmware version
- specifying the length of a power failure that the controller should tolerate without clearing process values, interval timer and totalizer values, etc.

1.4 Overview of Function Block Programming Concepts

1.4.1 What a Function Block Is

Definition

A function block is a software object that performs a piece of a control strategy, such as processing an analog input, or calculating a value. A function block can be thought of as a "black box" that takes data in one end, does something to the data inside the box, and at the other end makes the data available to other function blocks.

Internal parameters influence operation

How a function block does its job depends on the values programmed for the block's internal parameters. For example, a loop function block has a parameter that determines the type of algorithm used by the loop.

1.4.2 How Function Blocks Work Together

Data flow depends on programming

Values flow between the function blocks based on the programming of the function blocks. With the exception of the system function block, every function block type has at least one input parameter and at least one output parameter.

Input parameters are used to specify where a function block reads its incoming data. Although an input can be configured to be a number, usually the source of the input is another block's output. For example, the input (process variable) of a loop block would be the output value from an analog input block. This same output value could also be the input for an alarm block.

Feedback essential to successful operation

Every control loop (except ON/OFF type) must have feedback to operate. The loop (LP) block has an input pointer for this purpose. The analog output (AO) block and calculated value (CV) block types each have an output value that can be used by this loop feedback input as the source of a "back calculation" value. This verifies that the output generated by the PID algorithm successfully reached the "downstream" block.

1.5 Overview of Installation, Configuration, and Startup Tasks

Setup tasks described in this manual

This manual contains instructions for all installation and operation tasks. Table 1-1 provides an overview of the installation tasks, as well as providing references to the relevant sections of the manual.

Note that no one needs to read the entire manual. If this is the first time you have used a UDC5300, read the first six sections. Based on what you learn in Section 5, pick out the subsequent sections that apply to your configuration approach and options used.

Table 1-1 Overview of Controller Installation Tasks

Sequence	Task	Section
1	Consider the environmental and electrical specs when selecting a site to install the controller.	2
2	Unpack, inspect and mount the unit.	3
3	Install power and signal wiring.	4
4	Specify the mains frequency at your site.	19
5	Plan whether to load and use a factory configuration, or do freeform programming, starting “from scratch”.	5
6	***First time users only*****:** Familiarize yourself with the modes, menus, and use of the keypad to select and change values.	6
7	***If using a factory configuration:*** Review the detailed diagram for your strategy, and modify any parameter values necessary.	7
8	***If you are a first time user and have decided to do freeform programming:*** Review the theory of creating a function block diagram and programming the strategy.	8
9	Do freeform programming, and take care of other Program mode functions such as setting the clock and programming security.	9
10	***If the carbon potential option will be used:*** Refer to the special carbon potential programming instructions, then configure the controller as required.	12
11	***If position proportional output will be used:*** Follow the special PP programming instructions, then calibrate the controller and positioner combination to take advantage of the full travel of the actuator.	10
12	***If the optional Setpoint Profiler will be used:*** Configure the inputs to the profiler, and setup one or more profiles.	11

Sequence	Task	Section
13	Pretune the loop(s) and perform other final commissioning tasks.	13
14	***First time users only:*** Become familiar with operator displays and Online mode functions.	14 and 15
15	***If the optional data storage feature will be used to store calibration and configuration data:*** Become familiar with these operations.	16
16	***If the optional data storage feature will be used to store process data and operator actions:*** Select the data to be stored, and specify under what circumstances it will be saved.	17
17	***If the serial communications option will be used:*** Configure communication parameters.	18
18	Display part number and version of firmware. Note these for future reference. (If you call for technical assistance, you will need this information.)	19

The manual also contains:

- information about diagnostics, status messages, and system error messages (Section 21)
- instructions for setting an output board's switches to change from CAT to VAT operation (or vice versa) (Section 20)
- instructions for resetting the unit, clearing the memory, calibrating the analog inputs and outputs (Section 19)
- parts list (Section 22)

2. Specifications and Model Number

2.1 Overview

This section provides hardware specifications and the model selection guide.

What's in this section?

The following topics are covered in this section.

2.2 Specifications

Table 2-1 shows the UDC5300 specifications.

Table 2-1 Specifications

Physical	
Enclosure	Drawn aluminum case with high impact resistant polycarbonate plastic bezel and scratch resistant lens.
Mounting (Panel):	1.52 mm to 12.7 mm (0.06 in. to 0.50 in.) thickness.
Dimensions:	Bezel: 96 mm (H) x 96 mm (W) 3.78 in. (H) x 3.78 in. (W) Case: 92 mm (H) x 92 mm (W) x 192 mm (D) 3.62 in. (H) x 3.62 in. (W) x 7.55 in. (D)
Weight	1.5 kg (3.3 lbs).
Environmental	
Temperature	Operating: 0 °C to 55 °C (32 °F to 131 °F). Storage: -10 °C to 70 °C (14 °F to 158 °F). Relative Humidity: 10 % to 90 %, non-condensing at 40 °C.
Altitude	< 2000 meters
Vibration Level	5 Hz to 15 Hz, 1 mm displacement; 15 Hz to 150 Hz, 0.5 g acceleration
Power	Universal supply, 85 Vac to 265 Vac, 50/60 Hz, 18 VA.
Fuse Rating	1.0 amp/250 Vac fast acting type, not replaceable by operator.

Table 2-1 Specifications, continued

This product is designed and manufactured to be in conformity with applicable U.S., Canadian, and International (IEC/CENELEC/CE) standards for intended instrument locations. The following Standards and Specifications are met or exceeded.	
CE Conformity	This product is in conformity with the protection requirements of the following European Council Directives: 73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directove. Conformity of this product with any other "CE Mark" Directive(s) shall not be assumed.
Safety	For US, ANSI/ISA S82-1994 For Canada, CAN/CSA – C22.2 No. 1010.1-92 For Europe, EN61010-1
Product Classification	Class I: Permanently Connected, Panel Mounted Industrial Control Equipment with protective earthing (grounding). (EN61010-1)
Enclosure Rating	Panel Mounted Equipment, IP 00, this controller must be panel mounted. Terminals must be enclosed within the panel. Front panel IP52 (NEMA 12). With the proper mounting and the front bezel firmly closed, the UDC5300 meets the criteria for NEMA 12 Type enclosures for protection from falling dirt and dripping water from the front of the panel. See Fig. 3-1 for mounting.
Rear of Panel	IEC 529, IP 20; EN 60529, IP 20
Installation Category (Overvoltage Category)	Category II: Energy-consuming equipment supplied from the fixed installation. Local level appliances, and Industrial Control Equpment. (EN 61010-1)
Pollution Degree	Pollution Degree 2: Normally non-conductive pollution with occasional conductivity caused by condensation. (Ref. IEC 664-1)
EMC Classification	Group 1, Class A, ISM Equipment (EN 55011, emissions), Industrial Equipment (EN 50082-2, immunity)
Method of EMC Assessment	Technical File (TF)
Declaration of Conformity	51197705
Flammability Rating	UL 94 – V2

Table 2-1 Specifications, continued

Attributes	
Display	Fixed segment vacuum fluorescent alphanumeric A six-character upper display dedicated to the process variable (4 digits). Alternate information displayed during configuration mode. An eight-character lower display primarily shows key selected operating parameters (4 digits). Also provides guidance during controller configuration.
Switches	Monoplanar front panel with 8 keys. Push-button entry with tactile feedback.
Control loops	Number: 1 or 2. Type: PID, On/Off.
Analog Inputs	
Number	1 or 3
Input types	EMF (mV, V, mA via shunt), thermocouple, RTD (Input 1, 2) and pyrometer.
TC and EMF types	Resolution: 15 bits (14 bits plus sign). Scan Rate: 125 msec (1 analog input only). 250 msec, 500 msec, 1 sec (1 or 3 analog inputs). Normal Mode Rejection: 60 dB (1000:1). Common Mode Rejection: 120 dB (1,000,000:1) (@ 100 ohm source). Normal Mode Voltage Limit: RMS equal to high span limit (@mains/line frequency). Common Mode Voltage Limit: 400 volts peak. Isolation: Fully isolated, 400 Vdc peak. Input Impedance: >20 megohms. Accuracy: See Table 2-2 and Table 2-3. MeasurementResolution: Accuracy: See Table 2-2 and Table 2-3. Temperature Effects: See Table 2-2 and Table 2-3. Ranges: Assigned per input based on range table.
TC/EMF	Source Resistance Error: 0.3 microvolts per 100 ohms. Reference Junction Error (TC only): 0.3 °C (0.5 °F). Open Input Check: Bleeder type (upscale, downscale, off).
RTD	Inputs: 2. Excitation Current: 0.15 mA. Switching: Common "B" lead. Maximum Lead Resistance: 5 ohms. Accuracy: See Table 2-3 Resolution: See Table 2-3 Temperature Effects: See Table 2-3

Table 2-1 Specifications, continued

Analog Output Algorithms	
Number	1 current standard, others selectable.
Type	CAT, VAT, DAT, PP, DIAT, ON/OFF
CAT Current Adjusting Type	Current: Selectable from 0 to 20 mA (2 maximum). Maximum Load: 800 ohms maximum per CAT output. Isolation: 400 volts peak (input/output), 30 volts (output to GND). Resolution: 12 bits, 0.025 %.
VAT Voltage Adjusting Type	2 maximum Voltage: Selectable between 0 Volts and 5 Volts. Minimum Load: 1000 ohms. Isolation: 400 volts peak (input/output), 30 volts (output to GND). Resolution: 12 bits, 0.025 %.
DAT Duration Adjusting Type (Time Proportioned)	4 maximum (no loop dependent) (Uses any discrete output relay) Impulse Time: 1 second to 300 seconds. Resolution: 4.5 msec. Minimum Off Time: Off to 30 seconds. Minimum On Time: Off to 30 seconds.
PP Position Proportioning	1 maximum (Uses two discrete relay outputs, requires third analog input) Slidewire Power Supply: 1 Vdc. Slidewire Resistance: 100 ohms to 1000 ohms. Drive Unit Speeds: 10 seconds to 220 seconds.
DIAT Direction Impulse Adjusting Type	2 maximum (Uses two discrete relay outputs) Drive Unit Speeds: 10 seconds to 220 seconds.
ON/OFF	2 maximum (not preconfigured for carbon control) (Uses any discrete relay output) Adjustable Deadband: 0 % to 10 % of span.

Table 2-1 Specifications, continued

Discrete Inputs/Outputs	
Inputs	Number: 0, 2 or 3. Type: Dry contact actuation. Input Level: 24 Vdc, 15 mA (internally supplied). Isolation: 30 volts point-to-ground.
Relay outputs	Number: 2 or 4. Type: Form C and Form A in pairs. Max Switch Current: 14/5 (NO/NC) Amps, 120 Vac resistive. Max Switch Voltage: 265 Vac. Max Switch Power: 200W, dc; 2000 VA, ac Max Carrying Current: 2 Amps @ 250 Vac; 5 Amps @ 120 Vac, 2 Amps @ 24 Vdc.
Performance/Capacities	
Control loops	Number: 1 or 2 Algorithms: Standard PID, Advanced PID, Ratio, Cascade Primary, Cascade Secondary, Split Output (Heat/Cool), DIAT, On/Off.
Calculations	16 standard (11 types).
Constants	9 standard.
Alarms	4 standard (Types: high, low, high rate, low rate, deviation)
Autotune	Pretune
Setpoint Profiler	Number of segments: 16 Event outputs: 2
Data storage	Media: SRAM PCMCIA card: 256K, 512K, 1M. Points Stored: up to 6. Storage Rate: 1 second to 3600 seconds. Alarm History: 100 records. Event History: 100 records Diagnostic History: 100 records. Requires Honeywell SDA software for review and analysis. Setpoint Profiles: Local storage Unit Configuration: Local storage or with Honeywell SCF software.

Table 2-1 Specifications, continued

Performance/Capacities	
Communications (Optional)	Type: RS-485 multidrop, Honeywell Instrument Link protocol or Modbus RTU, 31 units maximum. Connection: 2 twisted pairs with shield [1] Distance: 600 meters, (2000 feet). Baud Rate: 1.2 K, 2.4K, 4.8K, 9.6 K, 19.2 K, 38.4 K baud Parity: Selectable; odd, even, none.

Table 2-2 Analog Input Accuracy—Linear Types

Input Range	Accuracy at Calibration Temperature		
	+/- Accuracy (typical)		+/- Temperature Effects
	% Range	mV	
-25 mV to 25 mV*	0.03	0.015	0.003 mV per °C
-75 mV to 75 mV*	0.03	0.045	0.009 mV per °C
-200 mV to 1000 mV**	0.04	0.48	0.037 mV per °C
-200 mV to 5000 mV*	0.03	1.56	0.150 mV per °C

* Field calibrated to ± 0.01 % of span (typical).

** Field calibrated to ± 0.03 % of span (typical).

[1] For CE compliance a connection is provided between protective earth ground (TB4 Terminal 25) and earth ground for the communication connections (TB1 Terminal 8). This wire will connect all of the suppression circuitry on the receive and transmit lines to the earth ground. A triple-shielded cable (with a shield around each of the twisted pairs) should be used for communications wiring. The recommended cable is Belden 8728, 80C. The outermost shield must be connected to TB1 Terminal 8.

Table 2-3 Analog Input Accuracy—Non-linear Types

Type	Accuracy at Calibration Temperature						
	Operating Span[1]		+/- Accuracy (typical)			+/- Temperature Effects	
	°F	°C	% Range	°F	°C	mV per °F	mV per °C
Thermocouples - ITS-90 except where noted							
J	*0* to *2190*	*-18* to *1199*	0.1	2.2	1.2	0.005	0.009
K	*0* to *2500*	*-18* to *1371*	0.1	2.5	1.4	0.005	0.009
E	*-450* to -241 -240 to *1830*	*-268* to -152 -151 to *999*	0.6 0.1	13.7 2.3	7.6 1.3	0.005	0.009
T	*-300* to *-1* *0* to *700*	*-184* to *-19* *-18* to *371*	0.3 0.1	3.0 1.0	1.7 0.6	0.002	0.003
N	*0* to *2372*	*-18* to *1300*	0.1	2.4	1.3	0.005	0.009
B	*110* to 300 301 to *3300*	*43* to 149 150 to *1816*	0.6 0.1	20.7 3.4	11.2 1.9	0.002	0.003
R	*0* to *3210*	*-18* to *1766*	0.1	3.2	1.8	0.002	0.003
S	*0* to *3210*	*-18* to *1766*	0.1	3.2	1.8	0.002	0.003
W5/W26[2]	*0* to *4200*	*-18* to *2316*	0.1	4.2	2.3	0.005	0.009
PLAT II[2]	*-100* to *2500*	*-73* to *1371*	0.1	2.6	1.4	0.005	0.009
NI-NIMO	*32* to *2502*	*0* to *1372*	0.1	2.5	1.4	0.005	0.009
RTD							
PT100	*-300* to *1570*	*-184* to *854*	0.1	1.9	1.1	0.005	0.009
Pyrometry (Rayotube & Spectray) Types							
18890-3302	*750* to *1600*	*399* to *871*	0.1 typical	0.8	0.4	0.002	0.003
18890-0073	*800* to *1800*	*427* to *982*	0.1 typical	1.0	0.5	0.002	0.003
18890-0074	*1100* to *2300*	*594* to *1260*	0.1 typical	1.2	0.6	0.002	0.003
18890-0035	*1200* to *2600*	*649* to *1426*	0.1 typical	1.4	0.7	0.002	0.003
18890-0412	*1375* to *3000*	*747* to *1648*	0.1 typical	1.6	0.9	0.002	0.003
18890-0075	*1500* to *3300*	*816* to *1815*	0.1 typical	1.8	1.0	0.002	0.003
18890-1729	*1650* to *3600*	*899* to *1982*	0.1 typical	0.9	1.0	0.002	0.003
18890-00643	*1850* to *4000*	*1010* to *2204*	0.1 typical	2.2	1.2	0.002	0.003
18890-0216	*2110* to *4600*	*1155* to *2537*	0.1 typical	3.5	1.4	0.002	0.003
18890-5423	*2210* to *5000*	*1210* to *2760*	0.1 typical	3.8	1.5	0.002	0.003
18890-0163	*200* to *1000*	*94* to *537*	0.1 typical	0.8	.4	0.002	0.003
18899-8814	*340* to *1800*	*172* to *982*	0.1 typical	1.4	.81	0.002	0.003
18894-9014	*752* to *2552*	*400* to *1400*	0.1 typical	1.7	1.0	0.002	0.003
18894-0579	*752* to *2552*	*400* to *1400*	0.1 typical	1.7	1.0	0.002	0.003
Spectray 18885	*1832* to *3452*	*1000* to *1900*	0.1 typical	1.6	0.9	0.005	0.009
Spectray 18886	*1833* to *3452*	*1001* to *1900*	0.1 typical	1.6	0.9	0.005	0.009
Spectray 18886-1	*1292* to *2912*	*700* to *1600*	0.1 typical	1.6	0.9	0.021	0.037
Spectray 18885-1	*1292 to 2912*	*700 to 1600*	0.1 typical	1.6	0.9	0.005	0.009
Spectray 18885-2	*806 to 1400*	*430 to 760*	0.1 typical	0.6	0.3	0.005	0.009
18874-0578	*752* to *2552*	*400* to *1400*	0.1 typical	1.7	1.0	0.083	0.150
18875-0579	*752* to *2552*	*400* to *1400*	0.1 typical	1.7	1.0	0.083	0.150

1 *Italicized values* indicate overall input range.

2 IPTS-68

2.3 Model Selection Guide

Introduction

All UDC5300 Controllers are supplied with one current output (CAT) and two relays. When factory configuration models are specified, the current output or relays may be used by the configuration. For some factory configuration types, additional hardware may be needed as specified in the notes. If relays or current outputs are not used by the configuration, they are available to perform other functions in the controller.

The position proportioning output uses the standard CAT output to power the feedback slidewire. (Current output is changed to voltage out for this purpose.)

Instructions

The model number breakdown is presented in the tables that follow.

The basic model number consists of a key number. Appended to this key number are characters that identify the features in various categories. The meaning of the characters in each category is presented in a table.

The arrow to the right of the key number marks the selections available. One selection is made from each of the tables using the column below the proper arrow.

A dot (•) denotes unrestricted availability. Restrictions follow Table VI.

Key Number		I		II		III		IV		V		VI
_ _ _ _ _ _	-	_ _ _	-	_	-	_ _	-	_	-	_ _ _ _	-	_

KEY NUMBER - CONTROLLER

Description		Selection	Availability
Standard	(Note 1)	DC5300	⇓
Standard - CE Compliant	(Note 1)	DC530C	⇓

TABLE I - SINGLE LOOP

No Preconfiguration, Factory Defaults	100	
4 - 20mA Output Controller Current	101	•
Heat/Cool, 4 - 20 mA and 4 - 20 mA (Specify Table III, _C).	102	a
Heat/Cool, 4 - 20 mA and Time Proportioning Relay	103	•
Heat/Cool, 4 - 20 mA and Position Proportioning (Specify Table III, 3C)	104	b
Ratio Control, 4 - 20mA Outout (Specify Table III, 3_)	105	c
Backup Control, 4 - 20mA output (Specify Table III 3D)	106	d
Time Proportioning Relay Output Controller	107	•
Heat/Cool, Time Proportioning Relay & Time Proportioning Relay	108	•
Heat/Cool, Time Proportioning Relay & Position Proportioning Outputs (Specify Table III 3D)	109	d
Ratio Control, Time Proportioning Relay Output (Specify Table III, 3_)	110	c
Position Proportioning Output (Specify Table III, 3_)	111	c
Ratio Control, Position Proportioning Output (Specify Table III, 3_)	112	c
Backup Control, Position Proportioning Output (Specify Table III 3D)	113	d
Position Proportioning Output, (DIAT/3 Position Step)	114	•
ON/OFF Relay Output	115	•

TABLE I - (Continued) DUAL LOOP	Selection	Availability
No Preconfiguration, Factory Defaults (Specify Table III, 3_)	200	**c**
Cascade Control, 4 - 20 mA Output (Specify Table III, 3_)	216	**c**
2 Loops, 4 - 20mA and 4 - 20mA (Specify Table III, 3C)	217	**b**
2 Loops, 4 - 20mA and Time Prop. Relay Output(Specify Table III, 3_)	218	**c**
2 Loops, 4 - 20mA and Position Proportioning Output(Specify Table III, 3C)	219	**b**
2 Loops, 4 - 20mA & Position propportioning Output (DIAT/3 position step)	220	**c**
(Specify Table III, 3_)		
Cascade, Time Proportioning Relay Output (Specify Table III, 3_)	221	**c**
2 Loops, Time Proportioning Relay & Time Proportioning Relay Outputs	222	**c**
(Specify Table III, 3_)		
2 Loops, Time Proportioning & Position Proportioning Outputs	223	**d**
(Specify Table III, 3D)		
2 Loops, Time Proportioning & Position Proportioning (DIAT) Outputs	224	**d**
(Specify Table III, 3D)		
Cascade, Position Proportioning Output (Specify Table III, 3_)	225	**c**
2 Loops, Position Proportioning & DIAT Position Proportioning Outputs	226	**d**
(Specify Table III, 3D)		
2 Loops, DIAT Position Proportioning & DIAT Position Proportioning	227	**d**
(Specify Table III, 3D)		
2 loops, ON/OFF Relay and ON/OFF Relay (Specify Table III, 3_)	228	**c**

TABLE II - FIRMWARE

A. Features	None	0	•
	Setpoint Programming	P	•
	Data Storage interface	S	•
	Setpoint Programming & Data Storage interface	B	•

TABLE III - I/O

A. Number of Inputs	One Analog Input (Note 3)	1 _	•
	Three Analog Inputs	3 _	•
B. Inputs/Outputs	None	_ 0	•
	2 Discrete Inputs & 2 Relay Outputs	_ D	•
	3 Discrete Inputs & 1 Current Output	_ C	•
	3 Discrete Inputs & 1 Voltage Output	_ V	•

TABLE IV

A. Communications	None	0	•
	RS-485 - Binary or Modbus RTU	C	•

TABLE V - OPTIONS

A. Documentation	English		E _ _ _	•
B. Tagging	None		_ 0 _ _	•
	Linen Tag	(Note 2)	_ L _ _	•
	Stainless Steel Tag	(Note 2)	_ S _ _	•
C. Approval	None		_ _ 0 _	•
D. Carbon Potential	None		_ _ _ 0	•
	Carbon Potential		_ _ _ C	c

TABLE VI

A. Factory Use Only		0	•

RESTRICTIONS

Restriction Letter	Available Only With		Not Available With	
	Table	Selection	Table	Selection
a	III	_ C		
b	III	3C		
c	III	3 _		
d	III	3D		

Notes:

1. Includes one current and two relay outputs.
2. Customer must supply Tagging Information:
   Up to 3 lines allowed. (22 characters for each line)
3. For 4-20 mA inputs a 250 ohm shunt resistor on the input terminals must be used. Specify resistor Part #074477 or 311285 for each 4-20 mA input. (A range of 1-5 volts is used).

3. Unpacking, Preparation, and Mounting

3.1 Overview

This section contains instructions for unpacking, preparing, and mounting the controller. Instructions for wiring are provided in Section 4.

What's in this section?

The following topics are covered in this section.

3.2 Unpacking and Preparing

Procedure

Table 3-1 contains the procedure for unpacking and preparing the controller.

Table 3-1 Procedure for Unpacking and Preparing the Controller

Step	Action
ATTENTION	For prolonged storage or for shipment, the instrument should be kept in its shipping container. Do not remove shipping clamps or covers. Store in a suitable environment only (see specifications in Section 2).
1	Carefully remove the instrument from the shipping container.
2	Compare the contents of the shipping container with the packing list. • Notify the carrier and Honeywell immediately if there is equipment damage or shortage. • Do not return goods without contacting Honeywell in advance.
3	Remove any shipping ties or packing material. Follow the instructions on any attached tags, and then remove such tags.
4	All UDC5300 Controllers are tested at the factory prior to shipment. Examine the model number on the nameplate to verify that the instrument has the correct optional features. (See Section 2 for model number breakdown.)
5	Select an installation location that meets the specifications in Section 2. The controller is designed for installation in a control room or relatively clean factory environment. Do not install it in offices or residential locations. The front of the instrument is gasketed and will provide reasonable protection from dust and moisture when properly installed in a panel. The keypad/display/bezel assembly at the front of the unit is a gasketed lift-up module providing easy access to the optional data storage device.
6	If extremely hot or cold objects are near the installation location, provide radiant heat shielding for the instrument.

3.3 Mounting

Introduction

Figure 3-1 illustrates how the instrument is attached to a panel. Provide the panel cutout as shown. Note that the panel may be up to ¾ in. thick.

ATTENTION

The controller is considered “rack and panel mounted equipment” per the safety standards listed in 2.2 *Specifications*. Conformity with these standards requires the user to provide adequate protection against a shock hazard. The user shall install this controller in an enclosure that limits OPERATOR access to the rear terminals.

ATTENTION

If the controller is used in a manner not specified by Honeywell, the protection provided by the equipment may be impaired.

Procedure

To mount the instrument to the panel, follow the procedure in Table 3-2.

Table 3-2 Panel Mounting Procedure

Step	Action
1	Place the unit in the panel cutout as shown in Figure 3-1. Optional NEMA 12 (from front panel only) requires panel gasket (part no. 046955) between unit and panel.
2	Engage the rounded projection on the mounting T-bar in the slot on the top of the unit's case. Note the end with the notch. For thin panels (up to 7.92 mm (5/16 in.)), place the notched end toward the panel. For thick panels (up to 12.7 mm (1/2 in.)), place the notched end away from the panel. For thicker panels, up to 6.35 mm (1/4 in.) can be cut off the unnotched end.
3	Slide the bar up against the panel and insert the 0.472 in. (12 mm) long screw at the end of the case as shown. Tighten it loosely.
4	Install the second T-bar and screw in the slot on the bottom of the case in the same way.
5	Check the fit and alignment of the unit and tighten the screws on the top and bottom to 3 lb-in (.35 N-m) maximum torque. NOTE: Three shorter screws supplied are not required for this mounting application.

Mounting adjacent controllers

Horizontal – For closest spacing horizontally, spacing of 6.35 mm (0.250 in.) will provide zero clearance between bezels of adjacent units. For applications where units will be opened frequently for access to removable cartridge, increase this spacing slightly to avoid the possibility of units touching when opening or closing.

Vertical – Space must be allowed for fingertip access to the latch button on the bottom of the bezel. Recommended vertical spacing is 32 mm (1.250 in.) between cutouts. This will allow 25.4 mm (1.00") between bezels of adjacent units.

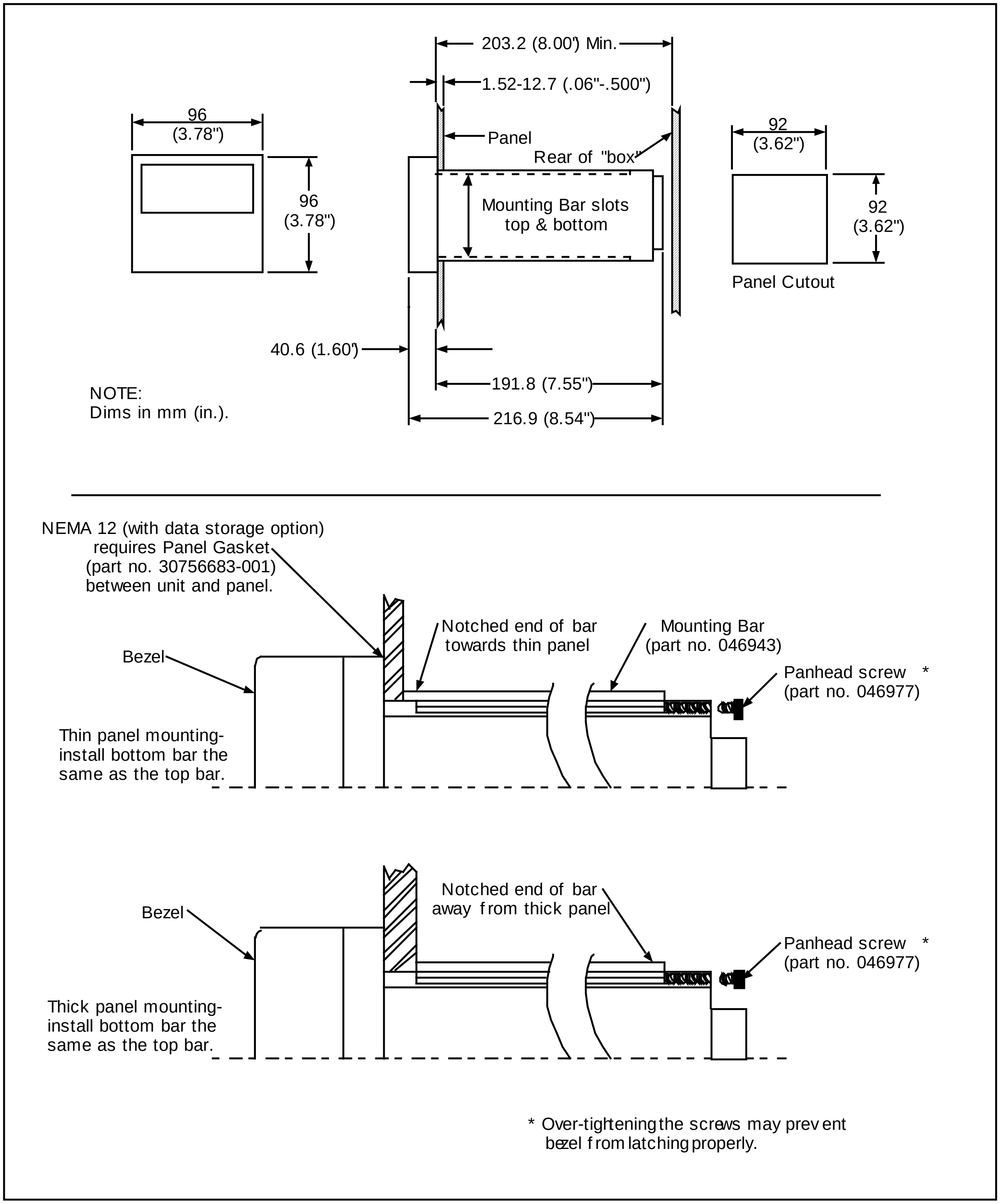


Figure 3-1 Mounting

4. Wiring

4.1 Overview

This section contains instructions for installing ac power wiring and connecting signal wiring to the controller.

This controller is a complex electronic device measuring low level electrical signals. Proper site preparation and installation practices are important in achieving a trouble-free system. Experience indicates that many problems are the result of improper installation. Follow the procedures and recommendations in this section to ensure a successful installation.

Consider the following items for each installation:

- Power line (mains) conditioning
- Grounding for personal safety
- Grounding for noise immunity
- Suppression of noise from electrically connected loads
- Suppression of noise from nearby (not connected) sources
- Proper connections and terminations of communications links

What's in this section?

The following topics are covered in this section.

4.2 General Wiring Practices

ATTENTION

Wiring to be performed by qualified personnel only.

Mains power supply

This controller is suitable for connection to 85 to 265 Vac, 50/60 Hz, power supply mains. It is the user's responsibility to provide a switch or circuit-breaker as part of the installation. The switch or circuit-breaker shall be located in close proximity to the controller, within easy reach of the OPERATOR. The switch or circuit-breaker shall be marked as the disconnecting device for the controller.

Safety precautions

An external disconnect switch is recommended for any hazardous voltage connections (>30 V rms, 42.4 Vpeak or 60 Vdc) to the relay terminals.

Avoid damage to components

CAUTION

This equipment contains devices that can be damaged by electrostatic discharge (ESD). The damage incurred may not cause the device to fail completely, but may cause early failure. Therefore, it is imperative that assemblies containing static sensitive devices be carried in conductive plastic bags. When adjusting or performing any work on such assemblies, grounded work stations and wrist straps must be used. If soldering irons are used, they must also be grounded.

A grounded work station is any conductive or metallic surface connected to an earth ground, such as a water pipe, with a 1/2 to 1 megohm resistor in series with the ground connection. The purpose of the resistor is to current limit an electrostatic discharge and to prevent any shock hazard to the operator. The steps indicated above must be followed to prevent damage and/or degradation, which may be induced by ESD, to static sensitive devices.

Wiring for immunity compliance

In applications where the power, input or output wiring is subject to high level electromagnetic disturbances, shielding techniques will be required. Grounded metal conduit with conductive conduit fittings is recommended.

In all applications separation of low level wiring and high level wiring is recommended.

To avoid electrical interference with signals, do not run low level signal leads close to or parallel with line voltage leads or other power leads.

Twisted signal pairs and shielded cable will improve noise immunity if wire routing is suspect.

Conform to code

Instrument wiring is to conform to national and local electrical codes.

Recommended wire

In general, use stranded copper wire for non-thermocouple electrical connections. Keep in mind that the maximum load resistance for many process instruments includes the interconnecting wire.

Observe all local electrical codes when making power connections. Unless local electrical codes dictate otherwise, the recommended minimum wire size for connections is given in Table 4-1.

Table 4-1 Wire Size (Recommended Minimums)

Gage No.	Description
14	Earth ground wire to supply ground
20	DC current and voltage field wiring
22	DC current and voltage wiring in control room

4.3 Specific Instructions

Power connections

Connect the instrument to a power mains source of from 85 Vac to 265 Vac (50 Hz or 60 Hz). No conversion or special installation is required. Figure 4-5 shows power terminals. The power supply voltage and frequency must be within the limits stated in the specifications in Section 2.

Specify the mains frequency used at your site using the Maintenance menu as described in Section 19.

WARNING

Turn power off at mains before installing AC power wiring.

Protective bonding (grounding)

PROTECTIVE BONDING (grounding) of this controller and the enclosure in which it is installed shall be in accordance with national and local electrical codes. The PROTECTIVE EARTH terminal shall be connected to the supply ground.

Noise suppression

Protect the controller from noise sources such as:

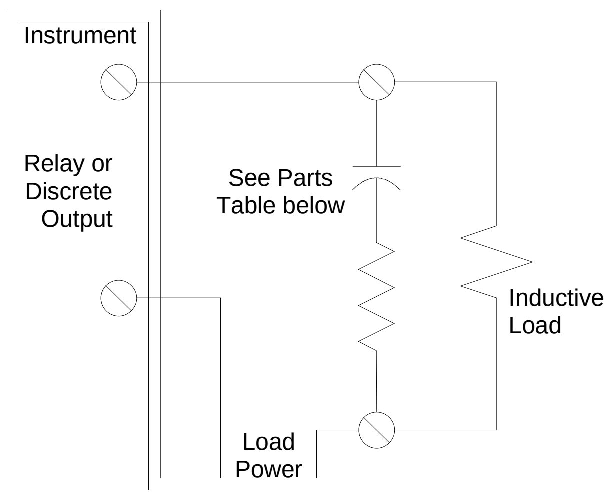
- relays switching inductive loads
- switching solid state devices, SCR's, etc.
- welding machines
- nearby conductors carrying heavy currents
- fluorescent lights
- thyratron and ignition tubes
- neon lights
- communications equipment
- common impedance (conductive) coupling
- magnetic (inductive) coupling
- electromagnetic (radiation) coupling

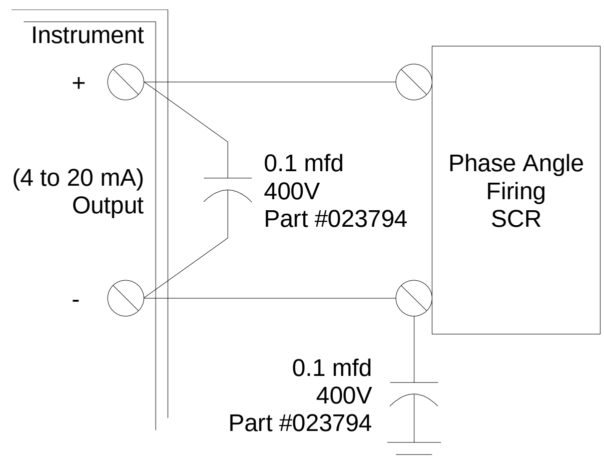
To minimize electrical noise and transients that may adversely affect the system, supplementary bonding of the control enclosure to a local ground, using No. 12 ($4mm^2$) copper conductor, is recommended.

To protect outputs, use the techniques in Figure 4-1.

ATTENTION

In exceptional cases where the device connected to a relay contact requires a very low nominal energizing current, it is possible that the current through the snubber network capacitor(s) (located on the circuit card and used to protect relay contacts from arcing when the relay contacts are open) will be sufficient to continue to energize the relay. To prevent this unwanted energizing, install a load resistor in parallel with the device.

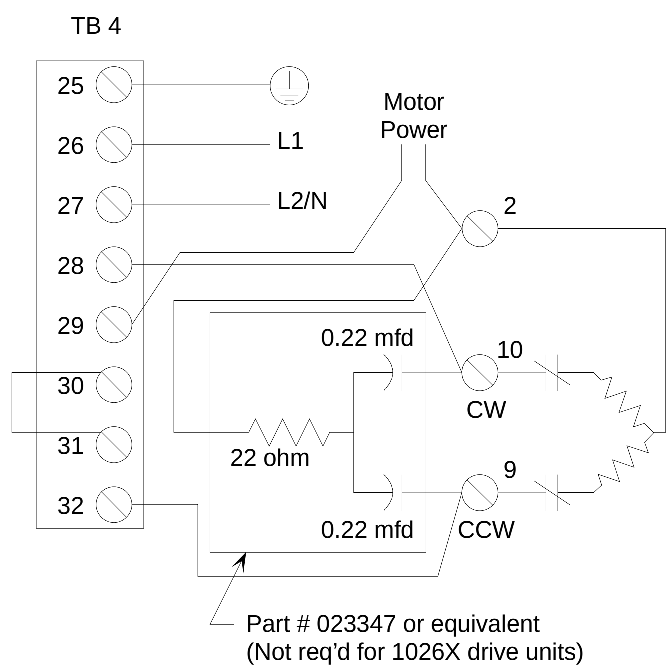




Phase Angle Firing SCR

Parts Table

Load Current	C (mfd)	Part #	R (ohms)	Part #
100mA	0.01	023474	470	011140
0.5 A	0.02	023096	12	011133
1.0 A	0.1	023794	39	011127
2.0 A	0.3	Not Avail.	39	011127
5.0 A	1.0	Not Avail.	10	011120



Position Proportioning (PP)

Figure 4-1 Noise Suppression For Outputs

Signal input and output wiring

Terminal configurations are factory-assigned according to the circuit cards installed in each individual controller. Customer I/O terminals are illustrated in Figures 4-4 through 4-7. Note that terminal usage depends on the hardware options selected. (See model selection guide in Section 2.)

Make a list of all input and output connections then double-check it for accuracy; a mistake could be costly and time-consuming to correct.

Wiring diagrams for factory configurations

If you ordered the controller with a factory configuration already loaded or if you load one yourself, it is essential that the I/O wiring be installed correctly for the factory configuration to work as expected. For your convenience a wiring diagram for each factory configuration is provided in Section 7.

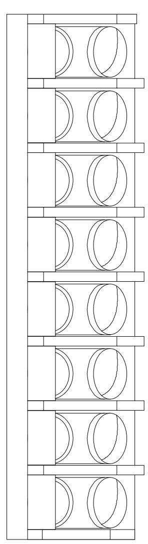
WARNING

The diagrams in Section 7 are intended to supplement, **not replace**, the instructions in this section. Be sure to read and understand this section before attempting to connect power or signal wires. Turn power off at mains before installing AC power wiring.

Slot 1

If model selection from Table IV is 0 (No Communications)

TB 1 1



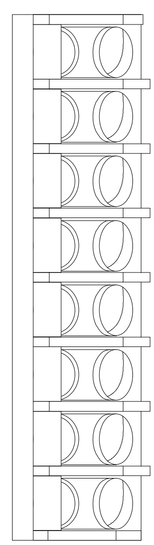
8

TB #1	CONN.
1	AO1 A+
2	AO1 A-
3	
4	
5	
6	
7	
8	

(3–8: Not Used)

If model selection from Table IV is C (Serial Comm. Option)

TB 1 1



8

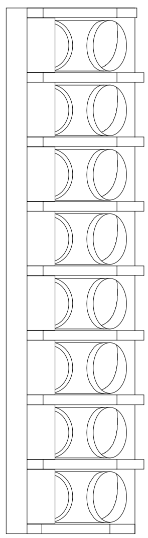
TB #1	CONN.
1	AO1 A+
2	AO1 A-
3	TX+
4	TX-
5	COMM
6	RX-
7	RX+
8	

(8:) Connect to TB4 terminal 25 for Earth Ground

Figure 4-2 Slot 1 Terminal Connections

Slot 2

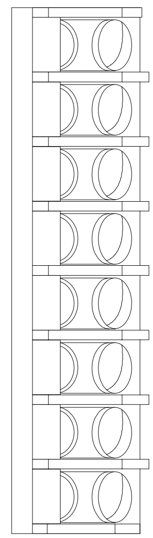
If model selection from Table III is 1_ (One Analog Input)



TB #2	CONN.
9	AI1 A+
10	AI1 C-
11	AI1 B
12	
13	
14	
15	
16	

(Terminals 12–16: Not Used)

If model selection from Table III is 3_ (Three Analog Inputs)

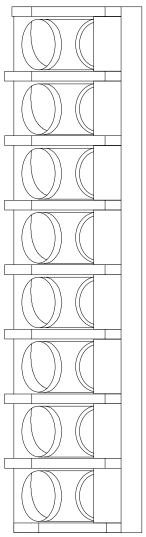


TB #2	CONN.
9	AI1 A+
10	AI1 C-
11	AI1 B
12	AI2 A+
13	AI2 C-
14	AI2 B
15	AI3+
16	AI3-

Figure 4-3 Slot 2 Terminal Connections

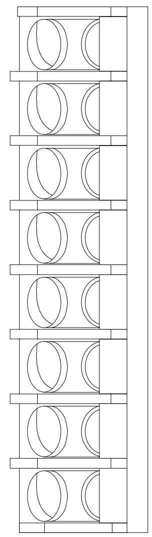
Slot 3

If model selection
from Table III is
_C (Three Discrete Inputs
and One Current Output)
or
_V (Three Discrete Inputs
and One Voltage Output)



TB #3	CONN.
17	AO2 A+
18	AO2 A-
19	DI1
20	DI1 C
21	DI2
22	DI2 C
23	DI3
24	DI3 C

If model selection
from Table III is
_D (Two Discrete Inputs
and Two Output Relays)



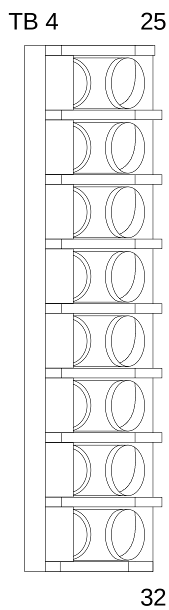
TB #3	CONN.
17	DO3 NO
18	DO3 C
19	DO3 NC
20	DO4 NO
21	DO4 C
22	DI1
23	DI1/2 C
24	DI2

Note: If Table III selection is
-0, TB3 is not used.

Figure 4-4 Slot 3 Terminal Connections

Slot 4

All models
(Power and Two
Output Relays)



TB #4	CONN.
25	⏚
26	L1
27	L2/N
28	DO1 NO
29	DO1 C
30	DO1 NC
31	DO2 C
32	DO2 NO

Figure 4-5 Slot 4 Terminal Connections

Analog input signal connections

See the specifications in Section 2 for acceptable voltage and current signal inputs. Connect current and voltage inputs to the appropriate terminals. See Figure 4-6 for input connection methods.

ATTENTION

Any analog channel left unused after wiring the instrument for its intended application should be shorted. Do not leave unused analog inputs unwired and open. If, for example, the controller's analog input 3 (AI3) will not be used, connect a wire between terminals 15 and 16 (see Figure 4-3).

CAUTION

Safety isolation exceeding the safe working level of 30 V RMS (42.4V peak) is not provided between analog inputs. If the working voltage of *any* analog input exceeds this level, use suitable wire gauge and insulation on *all* analog inputs, and use proper safety precautions when handling all analog input wiring.

ATTENTION

When the incoming field signal is current instead of voltage, a 250-ohm resistor with 0.1 % tolerance is used as a current shunt mounted on the input terminals as shown in Figure 4-8.
Use p/n 074477 for 4 mA to 20 mA input conversion to 1 V to 5 V. Shunt resistors are not supplied automatically with the controller and must be ordered separately.

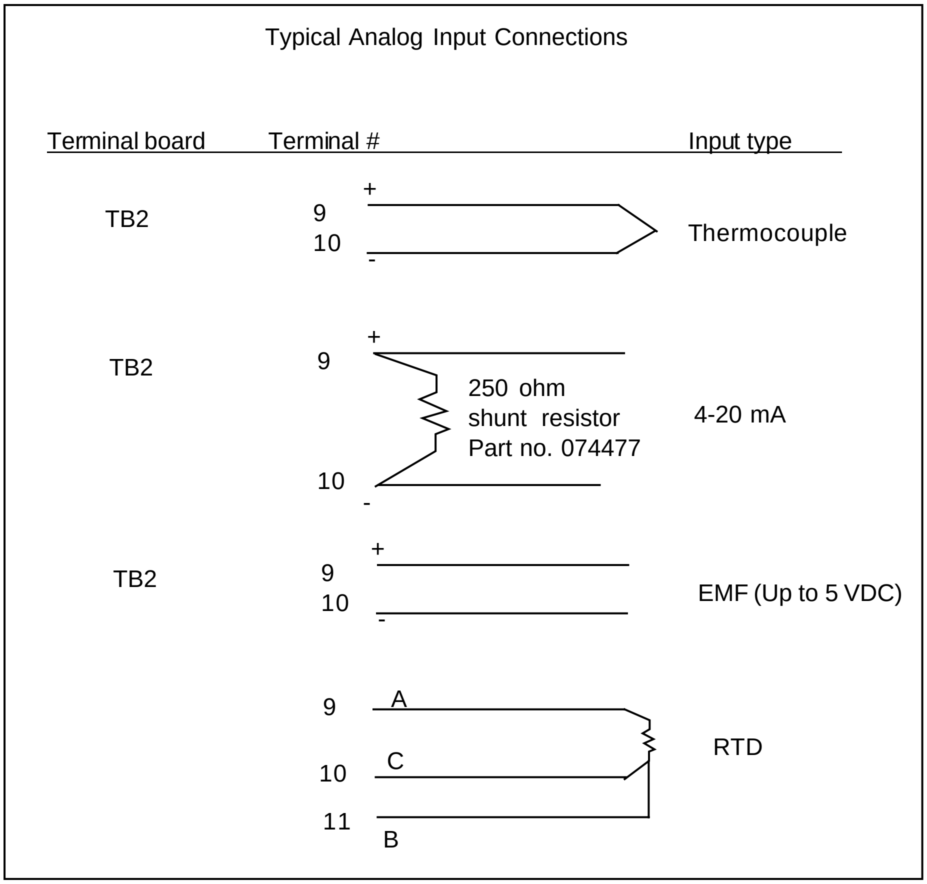


Figure 4-6 Typical Analog Input Connections

Thermocouple inputs

Connect thermocouple input leads to the (+) and (-) terminals for analog inputs in card slot 2 (Figure 4-3 and Figure 4-6). Use the correct type of extension leadwire for the particular type of thermocouple. Thermocouples may be grounded or ungrounded, since each point is isolated.

RTD inputs

See Figure 4-6. The A and B leads must be equal in resistance; the C lead resistance is not critical.

ATTENTION

In the same controller avoid:

- Both a thermocouple input tied to ground and an RTD input tied to ground. The thermocouple measurement would be incorrect.
- A thermocouple at a common mode voltage and an RTD tied to ground. The common mode voltage would be connected to the ground.
- A thermocouple at a common mode voltage and an RTD that is ungrounded. The common mode voltage would be placed on the RTD.

Discrete output signal connections

Connect discrete output loads to the terminals for discrete outputs in card slot 3 or 4 as shown in Figure 4-7. See Section 2 for output signal specifications (switch characteristics) for output circuit card modules.

CAUTION

Safety isolation exceeding the safe working level of 30 V RMS (42.4V peak) is not provided between discrete outputs. If the working voltage of any discrete output exceeds this level, use suitable wire gauge and insulation on all discrete outputs, and use proper safety precautions when handling all discrete output wiring.

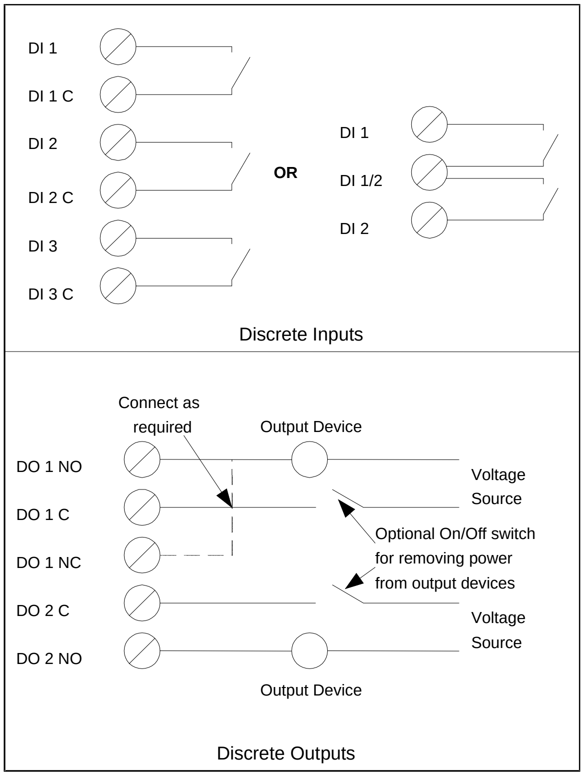


Figure 4-7 Discrete I/O Connections

We recommend you provide the ac or dc voltage supply with an on-off switch in the circuit supplying power to the field output devices (Figure 4-7). This will enable removal of output power while the Controller and input devices remain operational during troubleshooting.

Discrete input signal connections

See the label on the side of the controller to determine card types. Connect discrete (switch-type) inputs to the terminals for discrete inputs in card slot 3 (Figure 4-7). Connect input switches and power commons as shown in Figure 4-7.

Analog output connections

See the terminal label on the side of the controller for analog output card terminal designations. Connect analog output leads to the appropriate terminals for analog outputs in card slot 1 or 3 (Figure 4-4 and Figure 4-6). Analog outputs may be current or voltage types. Maximum load resistance for current outputs is 800 ohms. Minimum load resistance for voltage outputs is 1000 ohms.

PP output connections

Position Proportional (PP) type outputs require two analog inputs, two discrete outputs and one analog output (Figure 4-8). The analog output must be a voltage type (VAT) programmed to provided a constant 1 V to power the slidewire feedback. See Section 10 for sample PP feedback configuration.

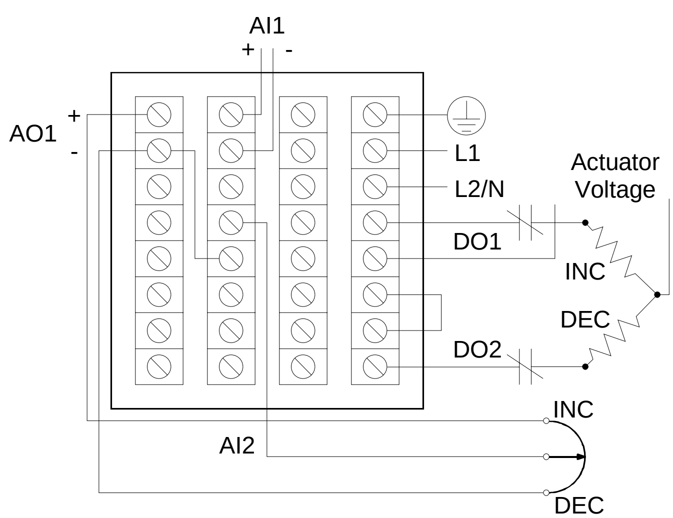


Figure 4-8 PP Typical Wiring

DIAT connections

Motor Direction Control DIAT requires two discrete outputs (Figure 4-9).

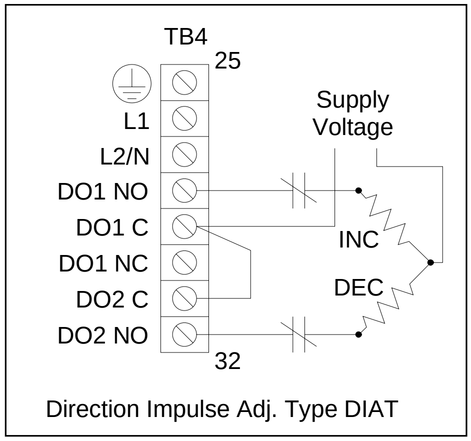


Figure 4-9 DIAT Typical Wiring

DAT connections

DAT output types use any discrete output relay. Up to four DAT type outputs may be assigned to a single loop (Figure 4-10).

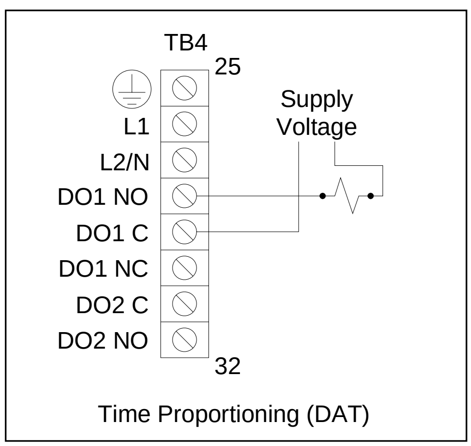


Figure 4-10 DAT Typical Wiring

Communications

The communications network is based on a Honeywell protocol with a Master/Slave relationship. (Alternatively, Modbus may be used.) This network is configured around the IEEE RS-422/485 multi-drop standard. The Master is a PC host running any software compatible with Honeywell protocol. A slave can be any instrument equipped with serial communications capability.

All communication equipment supporting the 422/485 (differential drive) must be correctly installed and properly terminated to ensure a reliable network. Instructions for terminating the last controller on the data link are provided in Section 18.

Table 4-2 shows the five connections per device.

Table 4-2 Communications Connections

Connection	Meaning
TX+	The positive signal of the transmitter
TX-	The negative signal of the transmitter
SHield	The shield of the communications cable
RX+	The positive signal of the receiver
RX-	The negative signal of the receiver
Shield Ground	For CE compliance a connection is provided between protective earth ground (TB4 Terminal 25) and earth ground for the communication connections (TB1 Terminal 8). This wire will connect all of the suppression circuitry on the receive and transmit lines to the earth ground. A triple-shielded cable (with a shield around each of the twisted pairs) should be used for communications wiring. The recommended cable is Belden 8782, 80C. The outermost shield must be connected to TB1 Terminal 8.

We recommend using a conduit for each cable, or at least separating them from high voltage lines or magnetic fields.

Table 4-3 shows the communications wiring procedure (Figure 4-11).

Table 4-3 Communications Wiring Procedure

Step	Action
1	4 wire: Connect the Master’s TX signals to each of the RX signals of the Slaves, and all the Slave’s TX signals to the Master’s RX terminals, plus-to-plus and minus-to-minus. 2 wire: Connect the instrument’s TX+ to the RX+. Then connect the instrument’s TX- to the RX-. Connect master’s A or + wire to the TX+/RX+ pair on the instrument. Connect master’s B or – wire to the TX-/RX- pair on the instrument.
2	Connect unit to unit in a serial or daisy chain fashion with the Master unit at one end and the last unit at the other as shown in Figure 4-11.
3	Set only the last unit’s termination ON. All other slave units must be unterminated. To change a termination setting, see Section 18.

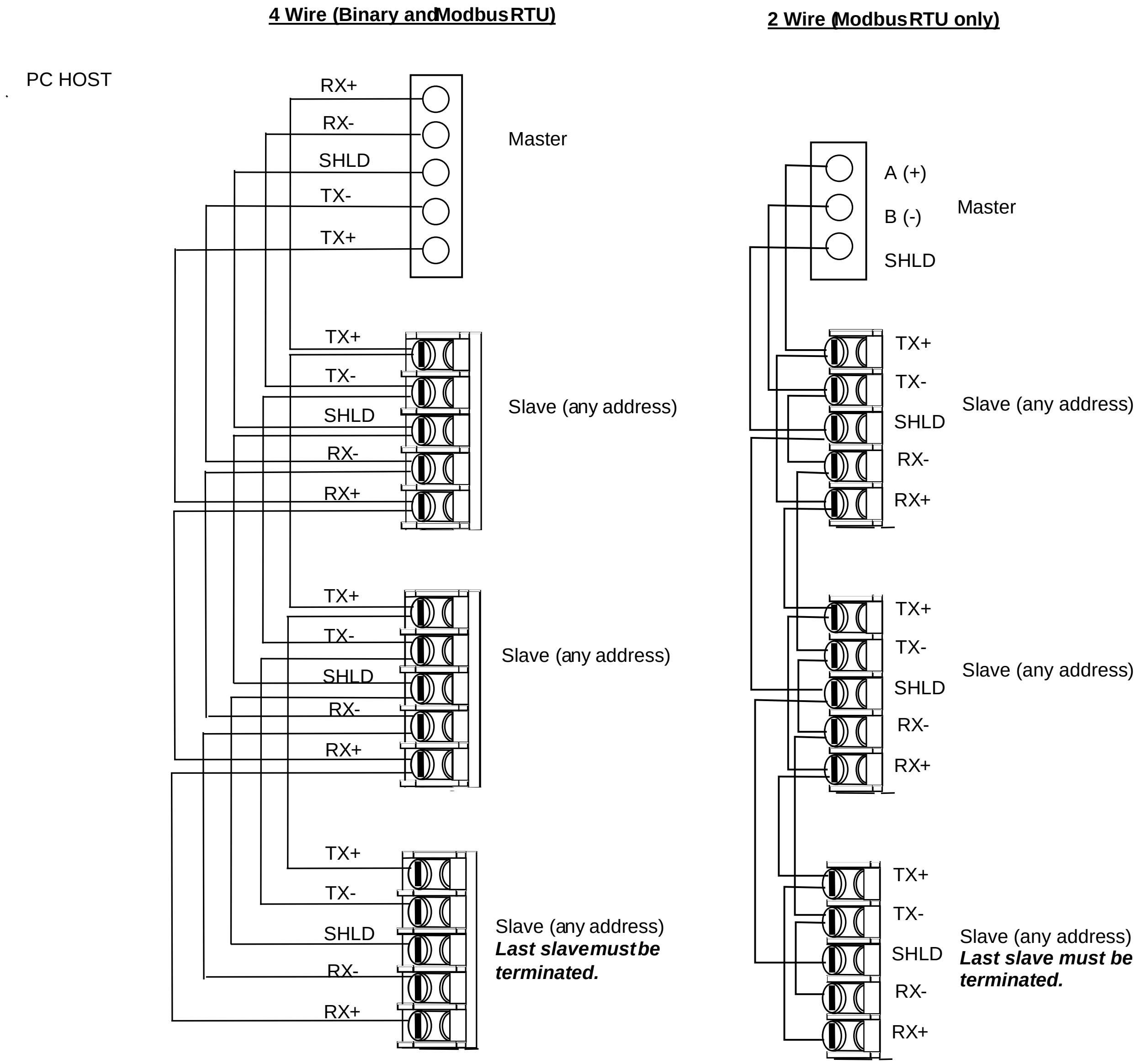


Figure 4-11 Network Data Cable Connections

5. Planning

5.1 Overview

Introduction

When programming your controller you have two options:

- Begin function block programming "from scratch". Using this freeform approach means that you do all the programming required to link function blocks for data flow, and specify the operation of every block needed to process inputs, execute a control algorithm, and make the output available to field devices.
- Begin with one of the built-in factory configurations and customize it for your application. Factory configurations use the same function block types as the freeform approach. However, when using a factory configuration the basic data flow between function blocks has already been established. Your job is to specify site-specific values such as tuning parameters and, if necessary, to link additional function blocks to the factory configuration to accommodate special requirements of your application.

If you are a first-time user of the UDC5300, we strongly recommend that you read this section. It provides information to help you make this decision. Specifically, it provides:

- information about the capabilities of each type of function block
- a description of each factory configuration, so that you can decide which, if any, is closest to your needs

In addition, this section will alert you to features you can enable/disable before beginning programming.

This section stresses concepts underlying configuration of the UDC5300. Instructions for actually doing the programming are provided in later sections. The end of this chapter tells you what to read next once you have decided whether to use a factory configuration or do freeform programming.

What's in this section?

The following topics are covered in this section.

5.2 Function Block Capabilities

5.2.1 What a Function Block Is

Definition

A function block is a software object that performs a piece of a control strategy, such as processing an analog input, or calculating a value. A function block can be thought of as a "black box" that takes data in one end, does something to the data inside the box, and at the other end makes the data available to other function blocks.

Internal parameters influence operation

How a function block does its job depends on the values programmed for the block's internal parameters. For example, a loop function block has a parameter that determines the type of algorithm used by the loop. Values for internal parameters are always either numbers or a string of characters selected from a list.

5.2.2 How Function Blocks Work Together

Data flow depends on programming

Values flow between the function blocks based on the programming of the function blocks. With the exception of the system function block and the setpoint profiler, every function block type has at least one input parameter and at least one output parameter.

Input parameters are used to specify where a function block reads its incoming data. Although an input can be configured to be a number, usually the source of the input is another block's output. For example, the input (process variable) of a loop block would be the output value from an analog input block. This same output value could also be the input for an alarm block.

When you have to specify another block's parameter as the source of data for the block being programmed, you are presented with a list from which to make your selection.

Function blocks interface with field signals

Each input and output supported by the controller's hardware is associated with its own instance of the appropriate function block type. The input or output's function block interfaces between the field signal and the rest of the function blocks in the controller.

Each hardware discrete input is served by a DI block, and each output relay by a DO block. If another block, such as an alarm (AL) block, needs to activate a relay, it does so through the DO block.

Each analog input signal is associated with an analog input (AI) block. The AI function block processes the signal (based on the type of input) and makes the value available in a form usable by other function blocks. Similarly, an analog output (AO) block is associated with each analog output signal to be produced by the controller. This AO block converts the output value calculated by the control algorithm in the loop (LP) block into the appropriate current or voltage output signal.

In addition to serving as the interface between a loop block and hardware output terminals, an AO is used in some types of discrete control. Only when ON/OFF control is used does the DO block interface directly with the LP block. All other discrete strategies require a specially configured AO to interface between the LP and the DI for each relay used for control. (More information about this use of AO blocks is provided in 5.2.4.3.)

Configuration example

Figure 5-1 diagrams an example of the way function blocks can be linked to implement a control strategy.

In this example the input is a Type J thermocouple. The output value (OV) of the analog input AI1 is the process variable acted on by the loop (LP1). The setpoint of the loop is 1500. The output value (OV) of the loop is the input of the analog output (AO1). AO1 makes the current adjusting type signal available at the controller's output terminals.

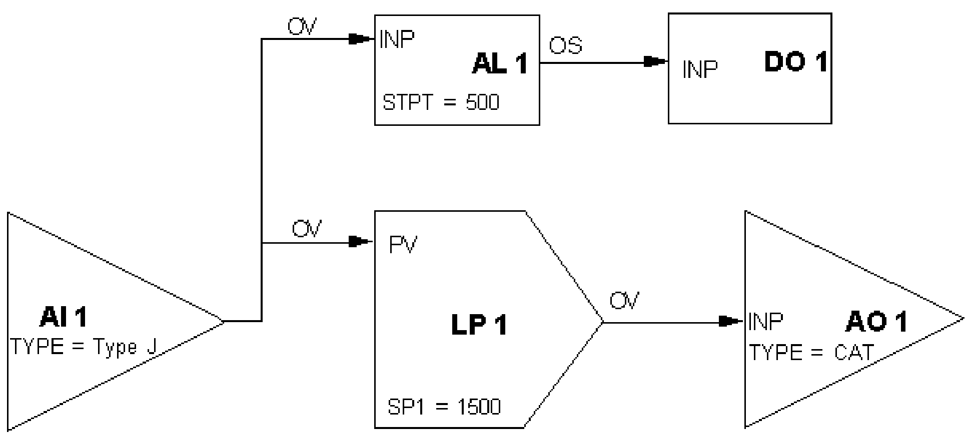


Figure 5-1 Sample Function Block Connections

The output value of AI1 is also used as the input to an alarm block (AL1). If the process value falls below the alarm setpoint (500), the alarm block changes the value of its discrete output (OS) to 1. AL1 OS is, in turn, the input to a discrete output block (DO1). DO1 is associated with a relay. When the input to DO1 becomes 1, the relay goes to its alarm state and the annunciator wired to the relay alerts the operator to the alarm condition. (Alarms are also indicated on the controller display.) Table 5-1 summarizes this configuration. Not all parameters are shown.

Table 5-1 Programming Required to Accomplish Connections in Figure 5-1

Function Block:	Input Parameter:	Programmed With Output Parameter:	Internal Parameter:	Programmed As:
AI 1	--	--	TYPE	J
LP 1	PV	AI1 OV	SP1	1500
AL 1	INP	AI1 OV	STPT	500
DO 1	INP	AL1 OS	--	--
AO 1	INP	LP1 OV	TYPE	CAT

5.2.3 Function Block Complement

Overview

The function block types available are designed to enable you to configure the controller to satisfy the requirements of a wide range of applications. Additional versatility has been designed into each function block type. For example, the CV (calculated value) block can be set up to do any one of twelve different operations such as serving as a periodic timer, performing a comparison, making a calculation, or splitting an output.

Table 5-2 lists the block types, their functions, and the quantity of each type available.

Table 5-2 Function Block Types

Function block name	Code	Function	Quantity
Alarm	AL	Monitors for process alarm conditions.	4
Analog Input	AI	Interfaces with measuring input hardware.	3*
Analog Output	AO	Interfaces with analog output hardware (CAT, VAT) or with discrete output blocks (DAT, PP).	4*
Calculated Value	CV	Performs various calculations on specified analog or discrete values.	16
Constant	CN	Outputs a constant or a value from another blocks' analog parameter.	9
Discrete Input	DI	Interfaces between discrete input hardware and other blocks.	3*
Discrete Output	DO	Interfaces between other blocks and output relay hardware.	4*
Loop	LP	Executes selected control algorithm.	1 or 2***
Setpoint Profiler**	SP	Outputs a time-varying setpoint used by a loop's SP2.	1
System	SY	Outputs discrete status of alarms, data storage, and diagnostics; outputs analog value of reference junction temperature. This function block is not programmable; its outputs are produced automatically.	1

*Maximum; configurable quantity depends on I/O hardware options in the model.
**Models DC530_ - _ _ _ - P and DC530_ - _ _ _ - B only.
***Number of loops depends on model selected.

5.2.4 Brief Descriptions of Block Types

Introduction

This subsection is intended to provide enough information about each function block type to give you an idea of the "raw material" available to build control strategies. Inputs and outputs are emphasized here. With the exception of the system block, every function block uses configurable internal parameters to determine how it processes data. All configurable parameters, including these internal parameters, are described in detail in Section 9.

5.2.4.1 Alarm Block

Use

Use alarm type (AL) function blocks to monitor process values. An AL block can be programmed as a traditional high or low alarm, as a deviation (high, low, or both), or as a high or low rate alarm. Hysteresis and delay time are configurable. The initial alarm setpoint is programmed during setup. However, the operator can change the setpoint while the controller is online.

Input

The input to an AL block is usually the output of the analog input block interfacing with the field device providing the process variable value to the controller. However, an AL can be programmed to monitor another analog value, such as the reference junction temperature, available from system block parameter SY1 RT.

Output

When an alarm is active an indicator lights on the display. For additional alarm annunciation, the output status (OS) of an AL block can be used as the input to a discrete output block. The discrete output's relay can turn on an external annunciator when an alarm state occurs.

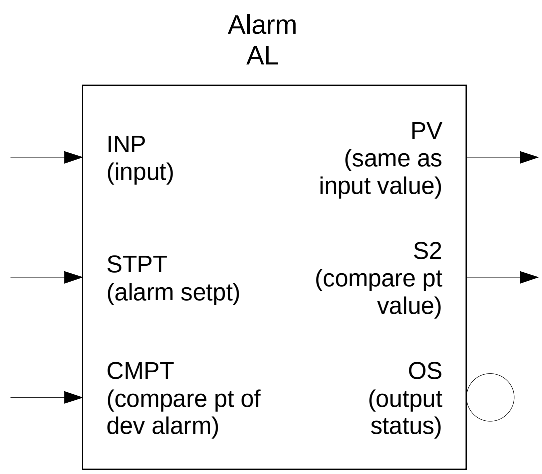
The alarm's input (PV) and the compare point value of a deviation alarm (S2) are also available as AL outputs.

Special information

If alarming is not necessary at your site, or if alarming is being handled by another device, you can simplify the menus by turning off all references to alarms. (See 9.12.)

After alarms have been programmed, access to setpoints can be removed from menus by turning off all references to alarms. The programmed alarms will continue to operate.

Diagram



5.2.4.2 Analog Input Block

Use

Use the analog input (AI) function block type to serve as an interface between the field device and the controller. One AI block is associated with each hardware analog input. The AI block converts the field signal to a form usable by the control loop. Standard input algorithms are available to handle input from a variety of commonly used devices. Input types that the AI can handle include EMF linear, many common thermocouples, and Rayotube and Spectray pyrometers. For special applications, a custom input linearization curve can be specified using two to twenty points. The custom algorithm includes a lag filter and the capability to hold the input value if a discrete parameter goes ON (has a value of 1).

Input

You never have to program the source of an AI block's input because the association between input terminals and an AI block is fixed. If you have more than one input, be sure to observe this correlation. (A label on the side of the controller identifies the AI number for each set of input screw terminals.)

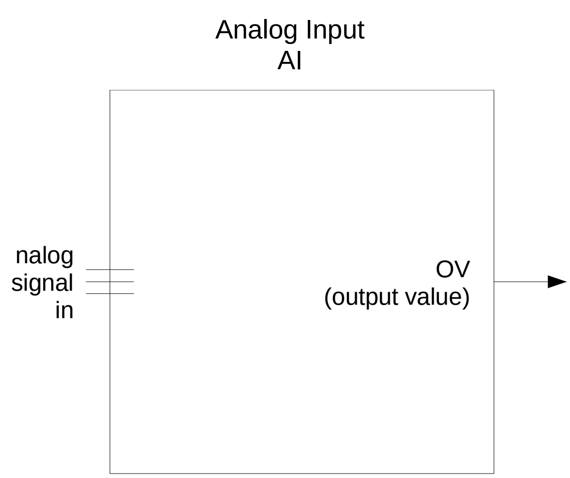
Output

Any block's output value, including the AI output value (OV), can be used as source of the input to more than one function block simultaneously. As our example in Figure 5-1 shows, the AI OV is usually read by a loop (LP) block. AI OV is also frequently used as the input to one or more alarm (AL) blocks.

Special information

If pyrometry is not used at your site, you can streamline the list of configurable standard AI types by turning off the display of pyrometer types. (See 9.12.)

Diagram



5.2.4.3 Analog Output Block

Use

Each analog output (AO) function block serves one of two purposes:

- If your strategy uses Current Adjusting Type (CAT) or Voltage Adjusting Type (VAT) control output (that is, if the field device being controlled needs an analog signal), then the AO block is the interface between the control loop and the actuator in the field. For this purpose, one AO block is associated with each hardware analog output. Depending on the model purchased, the unit can support one or two hardware outputs. AO1 is associated with hardware output 1. AO2 is for hardware output 2.
- If your strategy uses Duration Adjusting Type (DAT) or Position Proportional (PP) control output, then the AO block serves as an intermediary between the control loop and the discrete output blocks serving the relays that are wired to the controlled device. (DAT uses one relay. PP uses two.) Although AO2 can be associated with an actual hardware output for CAT or VAT control, alternatively it can be used as an intermediary for DAT or PP control. AO3 and AO4 are also available for use in DAT and PP control. Remember, though, that AO3 and AO4 are software objects only and can never be associated with a physical output terminal.

  Note that ON/OFF control loops do not use an AO as intermediary. This is the one case where a discrete output can be programmed to read the output of a control loop directly. The loop simply turns a relay on and off through the discrete output block.

Because of this flexibility in the use of AO blocks, the first step during AO programming is specifying the correct type of output for your strategy. The prompts for the appropriate AO internal parameters will then be displayed.

Input

Most strategies use the output of a loop as the input to the AO block. However, other analog output parameters such as a calculated value can be used as the AO INP.

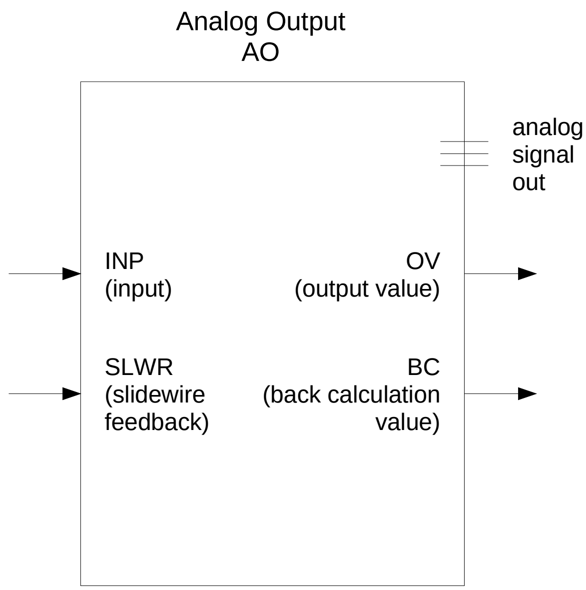
Output

When doing CAT or VAT control the output value (OV) of AO1 and/or AO2 is automatically supplied as a field signal at the screw terminals associated with each block. (Refer to the terminal label on the controller.) This OV can also be read by another block, such as an alarm block, that is programmed to use the AO OV as its input. A back calculation value (BC) is also provided by the AO block, as well as a special output S2 that retransmits the process variable (AO's input).

Although in DAT control a discrete output (DO) block is used to implement the control through a relay, the DO is <u>not</u> programmed to read the AO OV during configuration of the DO block. Instead, the association between the AO and the DO is made during AO configuration. The AO has an OUT parameter for this purpose. During AO programming the numbered DO associated with the relay to be used for DAT control is assigned to AO OUT. (This means that particular DO is no longer available for other purposes, such as alarm annunciation.)

In PP control (including its sub-type DIAT), two relays are needed, so two DO blocks must be associated with the AO. During AO programming, the AO parameters INC (increase output) and DEC (decrease output) are used to specify the numbered DO blocks associated with the screw terminals for the relays. (These DO blocks are not configurable for another purpose once they have been designated for use in control.)

Diagram



5.2.4.4 Calculated Value Block

Use

Use the versatile calculated value (CV) block type to customize your strategy. The CV can be programmed for the following functions: peak picking; signal selection; math or logical operations; totalizing; interval or periodic timing; discrete signal inversion; standard or advanced output splitting; comparison; or computing carbon potential.

The first step in programming a CV is to specify the type of function. Subsequent prompts will be appropriate for this function.

Input

The inputs used by the CV depend on its type. Generally, the input can either be specified as a number directly during CV programming, or the input can be programmed to read a value from another block's output.

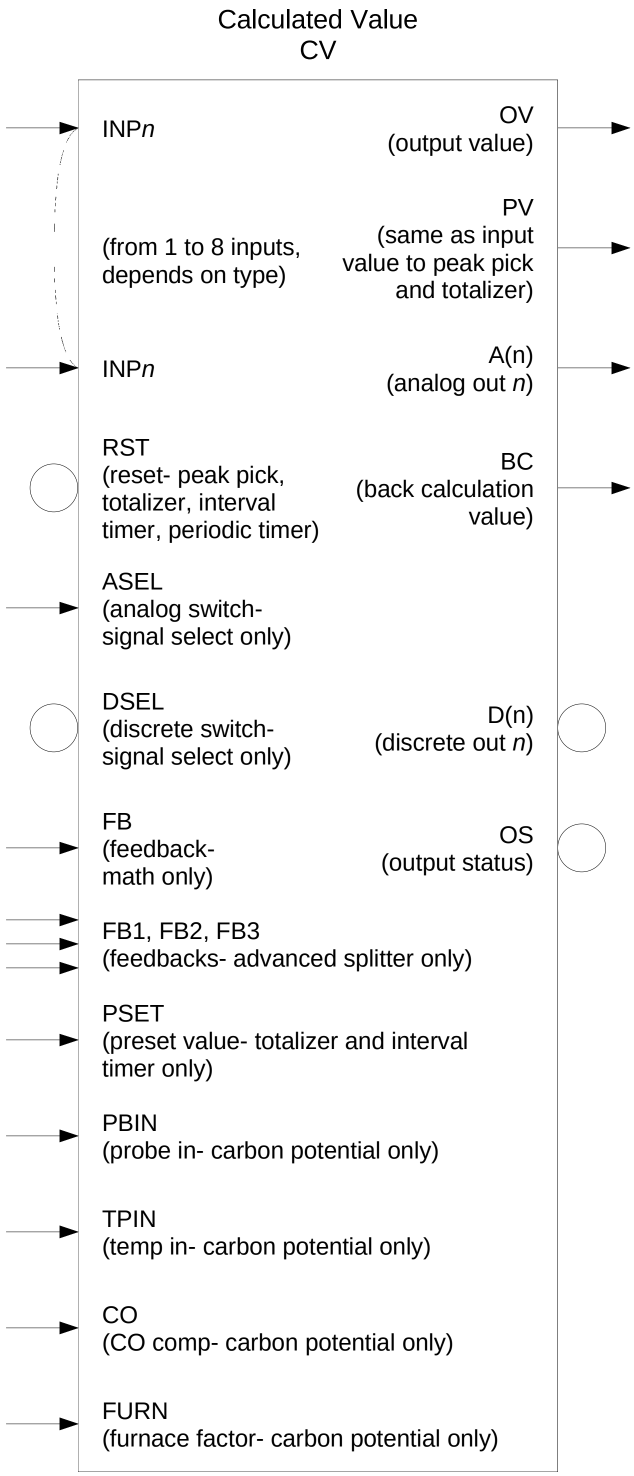
Output

The CV block type provides a variety of outputs readable by other blocks. An analog output value (OV) or the discrete output status (OS) is the most commonly used. However, other special output types are available, such as PV, which retransmits the input to the peak picking or totalizer type CV blocks. (See Table 5-3 for a complete listing of CV outputs.)

Special information

If you plan to program another function block to use a calculated value as its input, you must program the CV first.

Diagram


Calculated Value
CV
INPn
OV
(output value)
PV
(same as input
value to peak pick
and totalizer)
(from 1 to 8 inputs,
depends on type)
INPn
A(n)
(analog out n)
RST
(reset- peak pick,
totalizer, interval
timer, periodic timer)
BC
(back calculation
value)
ASEL
(analog switch-
signal select only)
DSEL
(discrete switch-
signal select only)
D(n)
(discrete out n)
FB
(feedback-
math only)
OS
(output status)
FB1, FB2, FB3
(feedbacks- advanced splitter only)
PSET
(preset value- totalizer and interval
timer only)
PBIN
(probe in- carbon potential only)
TPIN
(temp in- carbon potential only)
CO
(CO comp- carbon potential only)
FURN
(furnace factor- carbon potential only)

5.2.4.5 Constant Block

Use

Constant (CN) blocks can provide values for use by other function blocks as tuning constants, slew limits, setpoint limits, and as the DAT impulse time. Do not let the name fool you. While the CN block can be configured to provide a fixed number (truly a constant) as its output, it can also be programmed to receive a variable as its input from another block, then write this value to another block's input.

Input

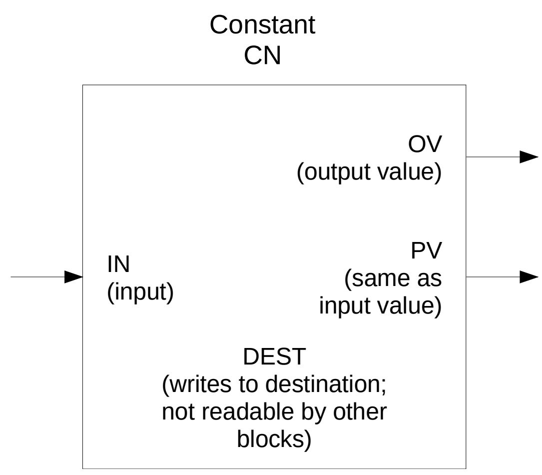
The input to a CN can be a fixed number, or the CN can be programmed to read its input value from another block's (analog) output value.

Output

While the CN has an output value parameter (OV) and an output to retransmit its input value (PV), the CN type is unique in that it contains internal parameters that can be programmed to write the CN input value to a destination in another block. (The list of valid destinations is available when the CN DEST prompt is displayed.)

This destination programming provides addition flexibility because it provides the only way to use a variable as the value of some parameters, such as a loop's proportional band or slew limits. During configuration of the proportional band value, for example, the only valid entry is OFF or a number. However, if a number is specified during loop programming, this number can be overwritten with a variable if you configure the CN DEST to be LPn PB (Loop n's proportional band).

Diagram



5.2.4.6 Discrete Input Block

Use

A DI/DO card supporting two or three discrete inputs is a controller option. Each hardware discrete input is associated with a DI function block. This DI block makes the field signal available to the other function blocks in the controller. Whether the input is normally open or normally closed is configurable, as is a delay time. If a delay time is specified, the DI will wait before indicating that it is ON.

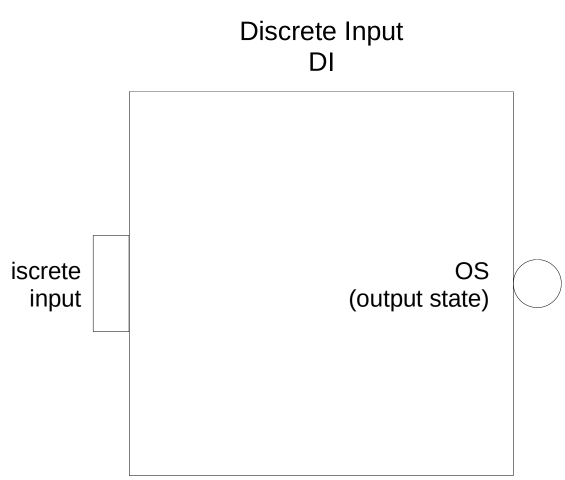
Input

You never have to program the source of a DI block's input because the association between input terminals and a DI block is fixed. Be sure to observe this correlation. (A label on the side of the controller identifies the DI number for each set of input screw terminals.)

Output

The DI block has a single output OS (output state). This can be read by other function blocks that can use a discrete value as their input. For example, a CV block performing a logic operation could point to DI blocks as the source of its inputs.

Diagram



5.2.4.7 Discrete Output Block

Use

Two output relays are standard on every controller. Two more are optional. Each discrete output (DO) block has a fixed association with a relay and its output terminals. (See terminal label on controller.) The DO block serves as the interface between other function blocks and the relay.

Input

When ON/OFF control is used, the DO is programmed to read its input from the output of the control loop.

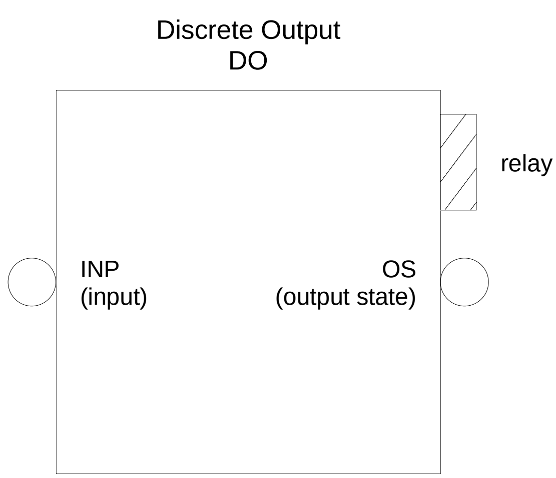
When Duration Adjusting Type (DAT) or Position Proportioning (PP) control is used, an AO block reads the loop's output, then the AO uses one (DAT) or two (PP) DO blocks and their relays to send control signals to the field. (Additional information about this use of DO blocks is provided in 5.2.4.3.)

A DO can also be programmed to read a discrete parameter value from another type of block, such as SY1 SF, the system block parameter that indicates that the optional data storage memory card is full.

Output

The output state (OS) of the DO block is automatically used to open and close the relay associated with each block. (Refer to the terminal label on the controller.) This OS can also be read by another block, such as a CV block, that is programmed to use the DO OS as its input.

Diagram



5.2.4.8 Loop Block

Use

The controller can provide one or two loops of independent or cascade control, depending on the model purchased. Each loop has an associated LP function block. Programming of the internal parameters for the LP block determines the control algorithm used, as well as the tuning parameters and other custom values associated with the loop. Available control types are:

- Standard PID for less complex applications
- Advanced PID to accommodate feedforward input with gain, output tracking, setpoint approach compensation, soft PID (PIDB) and remote control actions using logic inputs for more demanding control applications
- Split to provide –100 % to +100 % output to drive two control outputs for heat/cool or other dual energy processes
- Ratio providing ratio adjustment for the loop remote setpoint and a manual bias input value
- Cascade Primary with engineering unit scaling of the control output, interlocking with the Cascade Secondary loop to prevent windup and provide bumpless recovery from manual override actions or other process interruptions
- Cascade Secondary which accepts a remote setpoint from the Cascade Primary and initiates loop tracking during abnormal conditions
- DIAT (Duration Impulse Adjusting Type) to increase and decrease output to a motor actuator without a feedback slidewire; (output percentage disabled)
- ON/OFF to provide an ON or OFF output signal to a discrete output relay based on the deviation of the process variable from setpoint

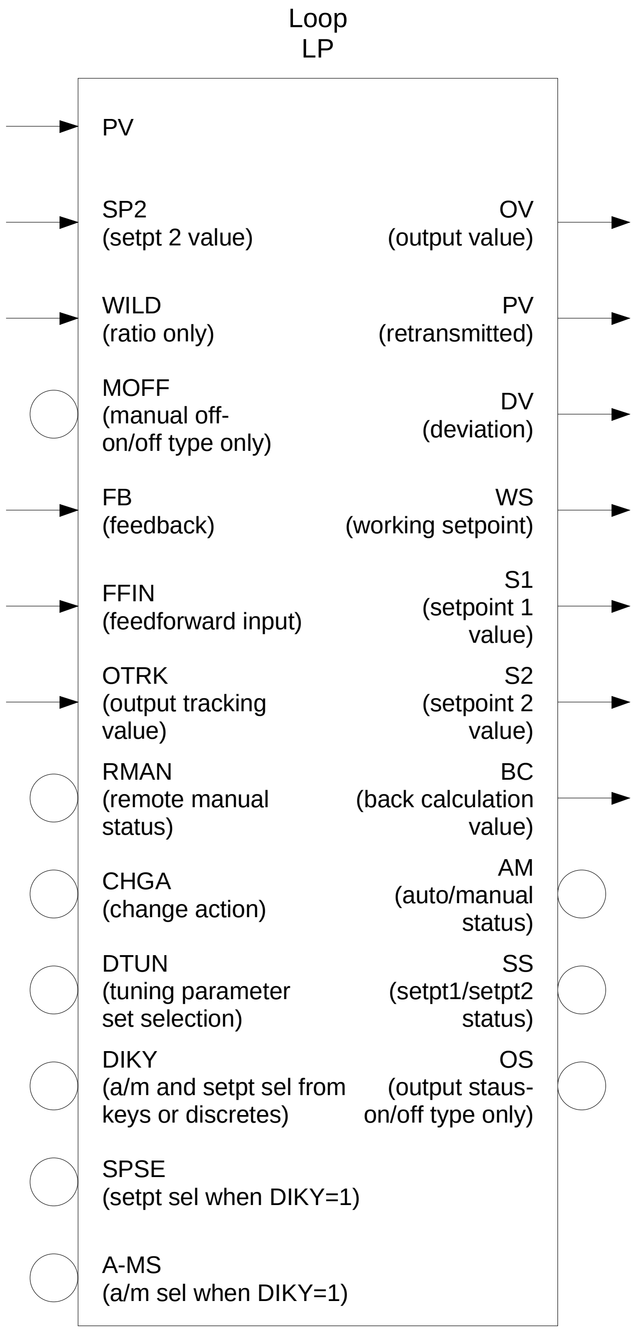
Input

While the input to the loop is usually the output value (OV) of an analog input (AO) block receiving a field signal, the loop's input parameter PV can be programmed to read its value from other analog input parameters such as the output value (OV) of a peak picking calculated value (CV) block.

Output

A number of analog outputs are provided by the LP block. In addition to the OV calculated by the control algorithm, the PV input value can be read as an output, as can the deviation value (DV), which is useful for alarming. Setpoint analog values, as well as status discretes are also available. See Table 5-3 for a complete list.

Diagram


Loop
LP
PV
SP2
(setpt 2 value)
OV
(output value)
WILD
(ratio only)
PV
(retransmitted)
MOFF
(manual off-
on/off type only)
DV
(deviation)
FB
(feedback)
WS
(working setpoint)
FFIN
(feedforward input)
S1
(setpoint 1
value)
OTRK
(output tracking
value)
S2
(setpoint 2
value)
RMAN
(remote manual
status)
BC
(back calculation
value)
CHGA
(change action)
AM
(auto/manual
status)
DTUN
(tuning parameter
set selection)
SS
(setpt1/setpt2
status)
DIKY
(a/m and setpt sel from
keys or discretes)
OS
(output staus-
on/off type only)
SPSE
(setpt sel when DIKY=1)
A-MS
(a/m sel when DIKY=1)

5.2.4.9 Setpoint Profiler Block

Use

An optional feature is the setpoint profiler. When this feature is included in the model, a SP function block is programmable. The SP block does not process data. Instead, it is used to generate a setpoint for control consisting of up to sixteen ramp or soak segments. These segments are programmed based on setpoint value and time. Two event outputs can be used to initiate discrete actions during particular segments. Internal parameters can be used to program the profile execution to be held if an analog value, usually the PV, deviates too much from a specified value.

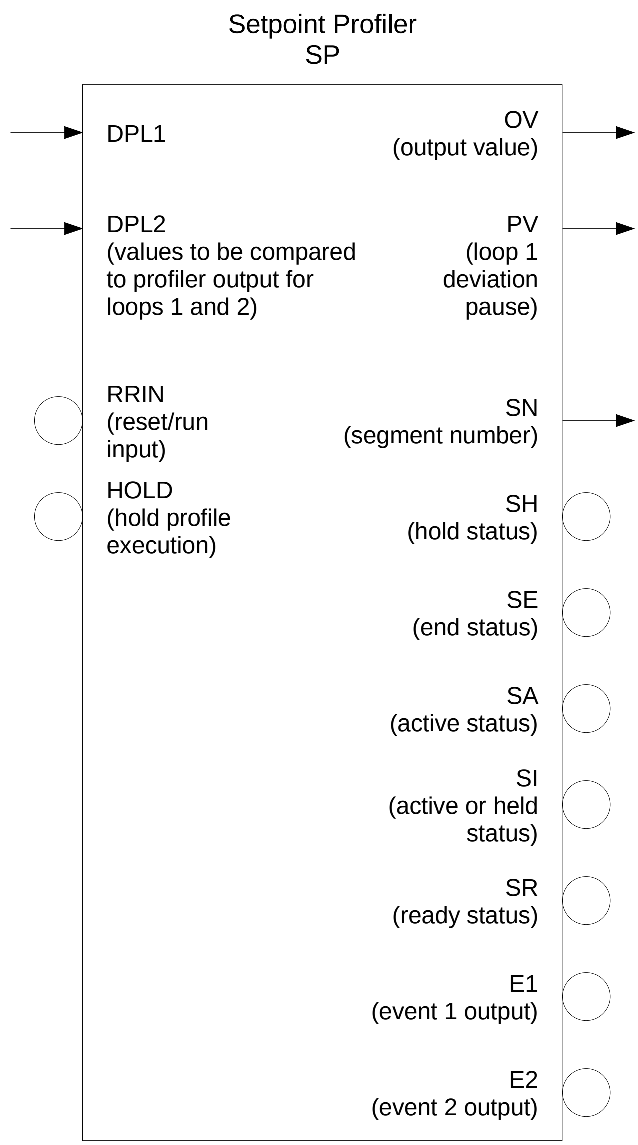
Input

Because the setpoint profiler does not process data, it has no traditional inputs. It does not need to read a value from another block to perform its function. However, some internal parameters can point to other function blocks. For example, the source of the value to which the setpoint profiler's output is compared for deviation calculation during profile execution can be an analog value from another block. The profiler's operation can be set to hold or run based on the value of a discrete output from another block.

Output

The "output" of the profiler is the setpoint (always the loop's SP2) when the profile is being executed. In addition, this value can be read from the analog SP OV parameter. The deviation hold value and segment number are also available as analog output values. A number of discrete status values are also available to be read by other blocks. See Table 5-3 for a complete list.

Diagram


Setpoint Profiler
SP
DPL1
DPL2
(values to be compared
to profiler output for
loops 1 and 2)
RRIN
(reset/run
input)
HOLD
(hold profile
execution)
OV
(output value)
PV
(loop 1
deviation
pause)
SN
(segment number)
SH
(hold status)
SE
(end status)
SA
(active status)
SI
(active or held
status)
SR
(ready status)
E1
(event 1 output)
E2
(event 2 output)

5.2.4.10 System Block

Use

The system (SY) block is the one block type not used to implement your control strategy. It has no configurable inputs or internal parameters. Its function is to monitor the activity of the controller and make this information available for display or reading by other blocks. For example, a DO can be programmed to open or close a relay when the memory card for the optional data storage feature is full.

Outputs

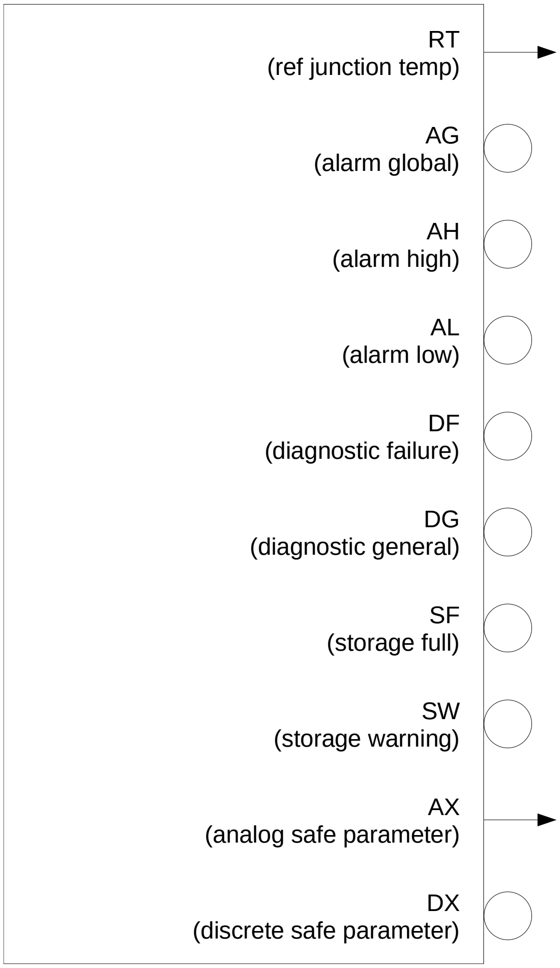
The reference junction temperature of a thermocouple is available as an analog output RT. A number of discrete outputs are available to provide awareness of conditions:

- AG - An alarm state is active
- AH – A high alarm condition is active
- AL - A low alarm condition is active
- DG – At least one diagnostic message present (DF is not used at this time; it is always OFF)
- SF - The removable memory card is full.
- SW - The available space on the removable memory card has reached the programmed warning limit. (See Section 17 for more information about data storage.)

Note that the AX (analog safe) and DX (discrete safe) outputs are used by the controller's software to replace an unavailable function block output that another block is programmed to use. AX and DX always have a value of OFF. Use them only if you need to simulate connection to an OFF input.

Diagram

System
SY



5.2.5 Summary of Outputs Available

Introduction

Table 5-3 provides a complete listing of all output parameters that can serve as inputs to other function blocks.

Table 5-3 Function Block Output Designators

Function Block Code	Function Block Name	Output Code	Output Name	Output Type
AI	Analog Input	OV	Output Value	analog
AO	Analog Output	OV	Output Value	analog
		BC	Back Calculation Value (Feedback)	analog
DI	Discrete Input	OS	Output State	discrete
DO	Discrete Output	OS	Output State	discrete
LP	Control Loop	OV	Output Value	analog
		PV	Process Variable	analog
		DV	Deviation Value	analog
		WS	Working Setpoint	analog
		S1	Setpoint #1 Value	analog
		S2	Setpoint #2 Value	analog
		BC	Back Calculation Value (Cascade feedback)	analog
		AM	Auto/Manual Status	discrete
		SS	Setpoint 1/Setpoint 2 Status	discrete
		OS	Output Status (ON/OFF loop only)	discrete
AL	Alarm	PV	Process Variable (alarm's input)	analog
		OS	Output Status	discrete
CN	Constant	OV	Output Value	analog
		PV	Process Variable (Constant's input)	analog

Table 5-3 Function Block Output Designators

Function Block Code	Function Block Name	Output Code	Output Name	Output Type
CV	Calculated Value	OV	Output Value	analog
		PV*	Process Variable	analog
		A(n)	Analog Output #n	analog
		BC	Back Calculation	analog
		D(n)	Discrete Output	discrete
		OS	Output Status	discrete
*Input to the following CV types: Peak Pick, Totalizer.				
SY	System Parameter	RT	Reference Junction Temp.	analog
		AG	Alarm Global	discrete
		AH	Alarm High	discrete
		AL	Alarm Low	discrete
		DF	Diagnostic failure *(not used)*	discrete
		DG	Diagnostic General	discrete
		SF	Storage Full	discrete
		SW	Storage Warning	discrete
		AX	Analog Safe Parameter	analog
		DX	Discrete Safe Parameter	discrete
SP	Setpoint Profiler	OV	Output Value	analog
		PV	Process Variable (Loop1 Deviation Hold)	analog
		SN	Segment Number	analog
		SH	Hold Status	discrete
		SE	End Status	discrete
		SA	Active Status	discrete
		SI	Active or Held Status	discrete
		SR	Ready Status	discrete
		E1	Event#1 Output	discrete
		E2	Event#2 Output	discrete

NOTE: If an output code is programmed as input but is not available, it will not be saved

5.3 Factory Configuration Basics

What a factory configuration is

A factory configuration is a built-in control strategy. A factory configuration strategy uses the same function block types that are available for freeform programming. When a factory configuration is loaded, the function blocks needed to implement the strategy are automatically programmed to pass the required data. In addition, the internal parameters in each function block used by the strategy are set to do the job required.

For example, if the basic single loop PID strategy with CAT output is selected, an loop block's internal parameters are set to perform PID control. The loop's input is programmed to read the output of the analog input block associated with the terminals where the field signal comes in. The loop's output is used by an analog output block. This is accomplished by the AO block's input pointing to the loop's output. The analog output block type is set to CAT so that it makes the appropriate current output signal available at the output terminals connected to the controlled device.

Availability of factory configurations

All factory configurations are stored in the firmware of every UDC5300 controller, although not every controller has the I/O hardware to support every strategy.

How a factory configuration is used

If you specified a factory configuration during model selection (see Section 2), then the correct strategy will be loaded into memory before the unit is shipped. All that will be left for you to do is program site-specific values such as display ranges and tuning parameters.

If you did not specify a factory configuration, or specified the wrong one, you can load a different factory configuration using Program Mode as described in Section 7. Proceed with programming site-specific values for internal parameters, and the job is done.

If none of the factory configurations exactly matches your requirements, load the one that is the closest match. Customize it by adding and/or subtracting function blocks until the configuration is precisely what you need.

5.4 Factory Configuration Applications

Introduction

This subsection is intended to provide the “big picture” on each of the available factory configurations, so you can decide which one meets your needs.

To see basic diagrams of each factory configuration, see Figure 5-2 and Figure 5-3.

To see a listing of the basic features, such as control type and output type, see Table 5-5 and Table 5-6.

Before loading one of these strategies, go to Section 7. Additional information is provided there about each strategy, including a more detailed diagram identifying the function blocks used and a wiring diagram. That section also advises you which parameters require your custom values before the controller goes online.

When considering the available strategies, remember that not every controller model has the I/O hardware to support every configuration.

The tables and figures use the abbreviations shown in Table 5-4.

Table 5-4 Abbreviations Used in This Section

Abbreviation	Meaning
CAS_P	cascade primary loop
CAS_S	cascade secondary loop
CAT	current adjusting type output (selectable between 0 mA to 20 mA)
CV block	calculated value type function block
DAT	duration adjusting type output; also known as time proportioned; uses a single relay
DIAT	direction impulse adjusting type output; two relays used, one each for increase and decrease
PID	proportional integral derivative control algorithm
PLC	programmable logic controller
PP	position proportioning output using slidewire feedback via analog input; two relays used for output, one each for increase and decrease
PV	process variable
VAT	voltage adjusting type output (selectable between 0 V and 5 V)

Table 5-5 Single-Loop Factory Configurations

Load Number* (Model Selection**)	I/O Hardware Needed	Control Type	Input Signals	Output Signals	Special Features	Application
(100)	---	*no preconfiguration; factory defaults*				
01 (101)	**In:** 1 analog **Out:** 1 current	STD (standard PID)	analog PV	CAT		any PID with current output
02 (102)	**In:** 1 analog **Out:** 2 current	SPLIT (PID with split output)	analog PV	CAT for heat and CAT for cool	CV block splits output	heat/cool with current output for each
03 (103)	**In:** 1 analog **Out**:1 current 1 relay	SPLIT (PID with split output)	analog PV	CAT for heat and DAT for cool	CV block splits output	heat/cool with current out for heat and time proportioned relay for cool
04 (104)	**In:** 2 analog **Out:**1 current 1 voltage 2 relays	SPLIT (PID with split output)	analog PV and analog slidewire feedback from positioner	CAT for heat and PP for cool	CV block splits output VAT output provides constant 1 V to power slidewire feedback	heat/cool with current out for heat and position proportioning relays for cool
05 (105)	**In:** 2 analog **Out:** 1 current	RATIO (PID for ratio)	analog controlled variable and analog wild variable	CAT		PID ratio control with current out
06 (106)	**In:** 2 analog 1 discrete **Out:** 1 current 1 relay	ADV (advanced PID)	analog PV and analog source of Remote Manual output value and discrete input for Remote Manual status	CAT	relay out used for Remote Manual status	back-up to primary controller or PLC; uses current out
07 (107)	**In:** 1 analog **Out:** 1 relay	STD (standard PID)	analog PV	DAT		PID control with time proportioned out
08 (108)	**In:** 1 analog **Out:** 2 relays	SPLIT (PID with split output)	analog PV	DAT for heat and DAT for cool	uses CV block to split output	heat/cool with time proportioned relay for each

* Number identifying the strategy when loading as described in Section 7.

** Number in Table I of Model Number Breakdown; see Section 2.

Table 5-5 Single-Loop Factory Configurations (continued)

Load Number* (Model Selection**)	I/O Hardware Needed	Control Type	Input Signals	Output Signals	Special Features	Application
09 (109)	**In:** 2 analog **Out:** 1 voltage 3 relays	SPLIT (PID with split output)	analog PV and analog slidewire feedback from positioner	DAT for heat PP for cool	VAT output provides constant 1 V to power slidewire feedback	heat/cool with time proportioned relay for heat and position proportioning relays for cool
10 (110)	**In:** 2 analog **Out:** 1 relay	RATIO (PID for ratio)	analog controlled variable and analog wild variable	DAT		PID ratio control with time proportioned relay out
11 (111)	**In:** 2 analog **Out:** 1 voltage 2 relays	STD (standard PID)	analog PV and analog slidewire feedback from positioner	PP	VAT output provides constant 1 V to power slidewire feedback	PID control with position proportioning relays out
12 (112)	**In:** 3 analog **Out:** 1 voltage 2 relays	RATIO (PID for ratio)	analog controlled variable and analog wild variable and analog slidewire feedback from positioner	PP	VAT output provides constant 1 V to power slidewire feedback	PID ratio control with position proportioning relays out
13 (113)	**In:** 3 analog 1 discrete **Out:** 1 voltage 4 relays	ADV (advanced PID)	analog PV and analog source of Remote Manual output value and discrete input for Remote Manual status	PP	VAT output provides constant 1 V to power slidewire feedback 2 relays used to transfer line voltage and slidewire power from primary's output circuits to UDC in case of primary failure	back-up to primary controller or PLC; uses position proportioning relays out
14 (114)	**In:** 1 analog **Out:** 2 relays	DIAT (PID with Direction Impulse Adjusting Type output)	analog PV	DIAT		PID control with DIAT relays out
15 (115)	**In:** 1 analog **Out:** 1 relay	ON/OFF	analog PV	ON/OFF		single loop with ON/OFF relay

Table 5-6 Two-Loop Factory Configurations

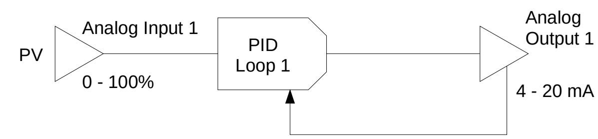
Load Number* **(Model Selection**)**	**I/O Hardware Needed**	**Control Type**	**Input Signals**	**Output Signals**	**Special Features**	**Typical Use**
-- (200)	---	*no preconfiguration; factory defaults*				
16 (216)	**In:** 2 analog **Out:** 1 current	Loop 1: CAS_P Loop 2: CAS_S	Loop 1: analog PV Loop 2: analog PV	CAT		cascade PID with current output
17 (217)	**In:** 2 analog **Out:** 2 current	Loop 1: STD (standard PID) Loop 2: STD (standard PID)	Loop 1: analog PV Loop 2: analog PV	Loop 1: CAT Loop 2: CAT		two independent PID loops, both with current out
18 (218)	**In:** 2 analog **Out:** 1 current 1 relay	Loop 1: STD (standard PID) Loop 2: STD (standard PID)	Loop 1: analog PV Loop 2: analog PV	Loop 1: CAT Loop 2: DAT		two independent PID loops, one with current out and one with time proportioned relay out
19 (219)	**In:** 3 analog **Out:** 1 current 1 voltage 2 relays	Loop 1: STD (standard PID) Loop 2: STD (standard PID)	Loop 1: analog PV Loop 2: analog PV and analog slidewire feedback from positioner	Loop 1: CAT Loop 2: PP	VAT output provides constant 1 V to power slidewire feedback	two independent PID loops, one with current out and one with position proportioning relays out
20 (220)	**In:** 2 analog **Out:** 1 current 2 relays	Loop 1: STD (standard PID) Loop 2: DIAT (PID with Direction Impulse Adjusting Type output)	Loop 1: analog PV Loop 2: analog PV	Loop 1: CAT Loop 2: DIAT		two independent PID loops, one with current out and one with DIAT relays out
21 (221)	**In:** 2 analog **Out:** 1 relay	Loop 1: CAS_P Loop 2: CAS_S	Loop 1: analog PV Loop 2: analog PV	DAT		cascade PID with time proportioned relay out
22 (222)	**In:** 2 analog **Out:** 2 relays	Loop 1: STD (standard PID) Loop 2: STD (standard PID)	Loop 1: analog PV Loop 2: analog PV	Loop 1: DAT Loop 2: DAT		two independent PID loops, each with time proportioned relay out
23 (223)	**In:** 3 analog **Out:** 1 voltage 3 relays	Loop 1: STD (standard PID) Loop 2: STD (standard PID)	Loop 1: analog PV Loop 2: analog PV and analog slidewire feedback from positioner	Loop 1: DAT Loop 2: PP	VAT output provides constant 1 V to power slidewire feedback	two independent PID loops, one with time proportioned relay out and one with position proportioning relays out

Table 5-6 Two-Loop Factory Configurations (continued)

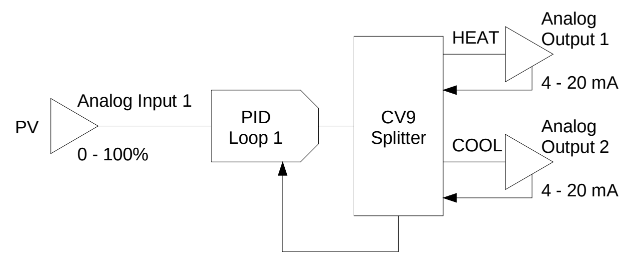
Load Number* (Model Selection**)	I/O Hardware Needed	Control Type	Input Signals	Output Signals	Special Features	Typical Use
24 (224)	**In:** 2 analog **Out:** 3 relays	Loop 1: STD (standard PID) Loop 2: DIAT (PID with Direction Impulse Adjusting Type output)	Loop 1: analog PV Loop 2: analog PV	Loop 1: DAT Loop 2: DIAT		two independent PID loops, one with time proportioned relay out and one with DIAT relays out
25 (225)	**In:** 3 analog **Out:** 1 voltage 2 relays	Loop 1: CAS_P Loop 2: CAS_S	Loop 1: analog PV Loop 2: analog PV and analog slidewire feedback from positioner	PP	VAT output provides constant 1 V to power slidewire feedback	cascade PID with position proportioning relays out
26 (226)	**In:** 3 analog **Out:** 1 voltage 4 relays	Loop 1: STD (standard PID) Loop 2: DIAT (PID with Direction Impulse Adjusting Type output)	Loop 1: analog PV and analog slidewire feedback from positioner Loop 2: analog PV	Loop 1: PP Loop 2: DIAT	VAT output provides constant 1 V to power slidewire feedback	two independent PID loops, one position proportioning relays out and one with DIAT relays out
27 (227)	**In:** 2 analog **Out:** 4 relays	Loop 1: DIAT (PID with Direction Impulse Adjusting Type output) Loop 2: DIAT	Loop 1: analog PV Loop 2: analog PV	Loop 1: DIAT Loop 2: DIAT		two independent PID loops, both with DIAT relays out
28 (228)	**In:** 2 analog **Out:** 2 relays	Loop1:ON/OFF Loop2:ON/OFF	Loop 1: analog PV Loop 2: analog PV	Loop1:ON/OFF Loop2:ON/OFF		two independent loops, each with ON/OFF relay

* Number identifying the strategy when loading as described in Section 7.

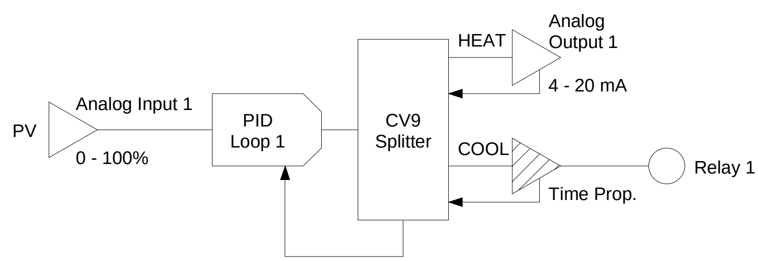
** Number in Table I of Model Number Breakdown; see Section 2.



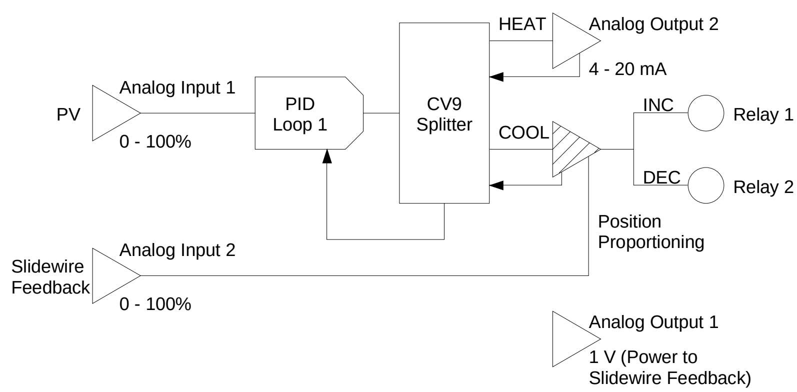
Configuration 01 (101) – PID with Current Output



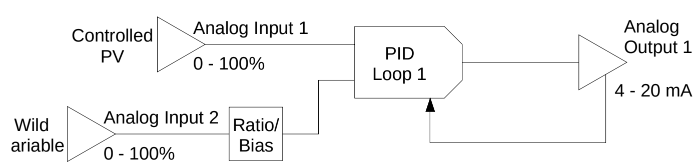
Configuration 02 (102) – Heat/Cool with Current Output for Each



Configuration 03 (103) – Heat/Cool with Current Out for Heat and Time Proportioned Relay for Cool

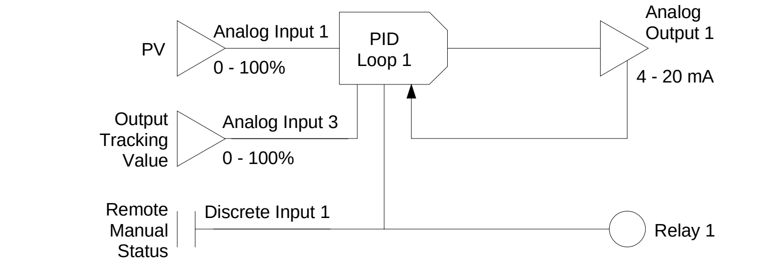


Configuration 04 (104) – Heat/Cool with Current Out for Heat and Position Proportioning Relays for Cool

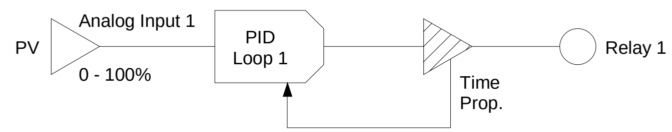


Configuration 05 (105) – PID Ratio Control with Current Output

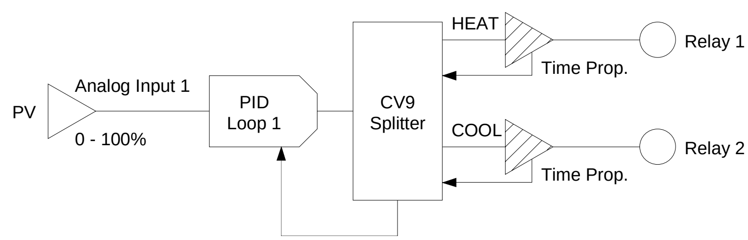
Figure 5-2 Single-Loop Factory Configurations



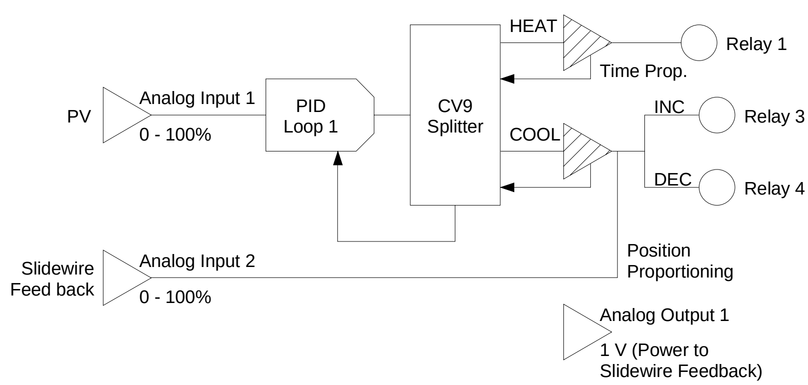
Configuration 06 (106) – Backup to Primary Controller or PLC; Current Output



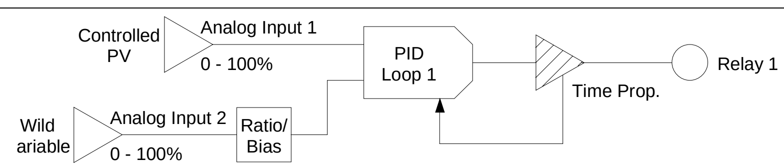
Configuration 07 (107) - PID with Time Proportioned Relay Output



Configuration 08 (108) - Heat/Cool with Time Proportioned Relay for Each

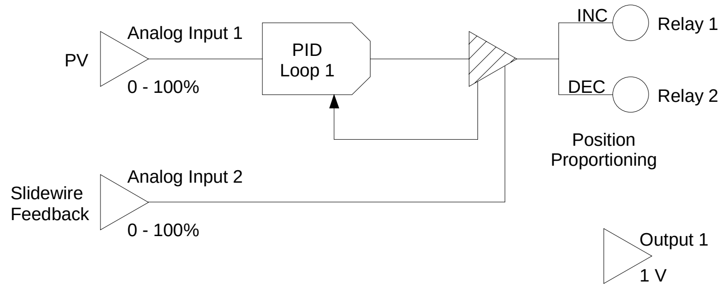


Configuration 09 (109) – Heat/Cool with Time Proportioned Relay for Heat and Position Proportioning Relays for Cool

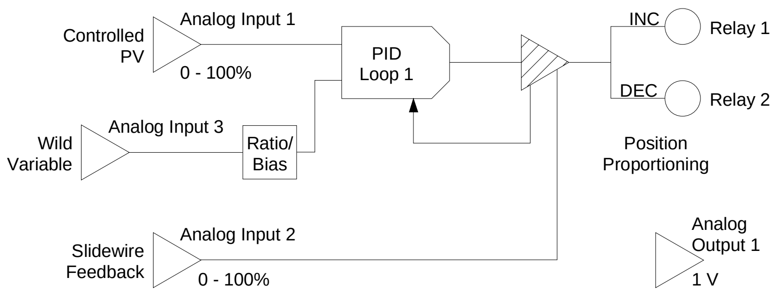


Configuration 10 (110) – PID Ratio Control with Time Proportioned Relay Out

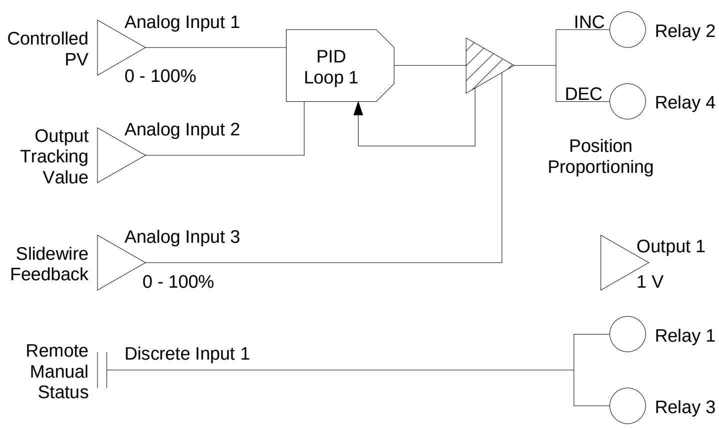
Figure 5-2 Single-Loop Factory Configurations (continued)



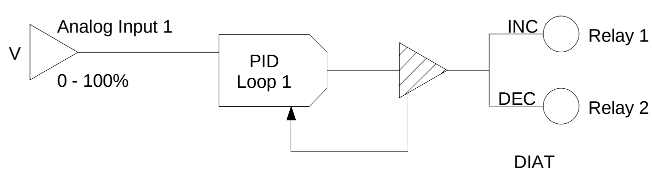
Configuration 11 (111) – PID with Position Proportioning Relays Out



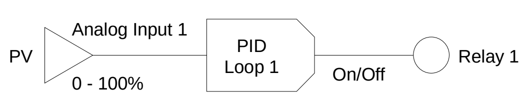
Configuration 12 (112) - PID Ratio Control with Position Proportioning Relays Out



Configuration 13 (113) – Backup to Primary Controller or PLC; Position Proportioning Relays Out

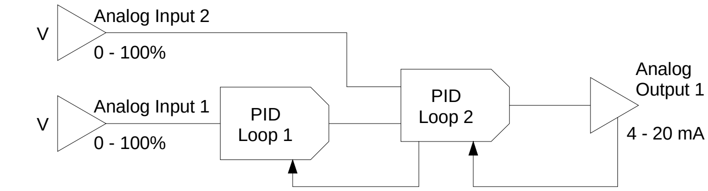


Configuration 14 (114) – PID with Direction Impulse Adjusting Type Relays Out

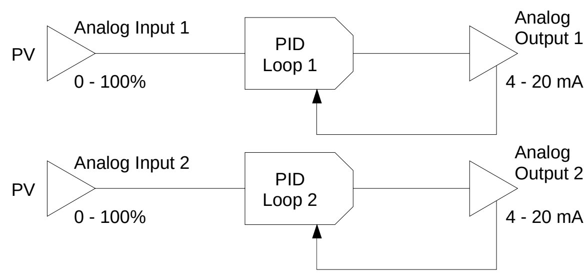


Configuration 15 (115) – Single Loop with ON/OFF Relay

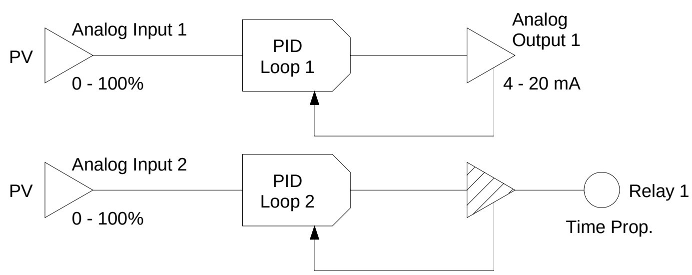
Figure 5-2 Single-Loop Factory Configurations (continued)



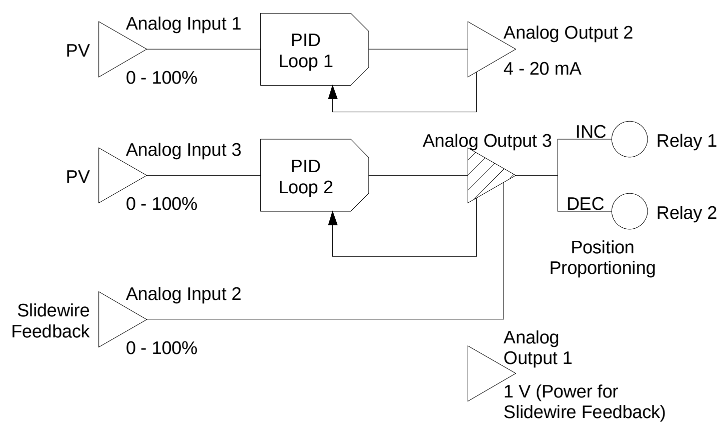
Configuration 16 (216) – Cascade PID with Current Output



Configuration 17 (217) – Two Independent PID Loops, Each with Current Output

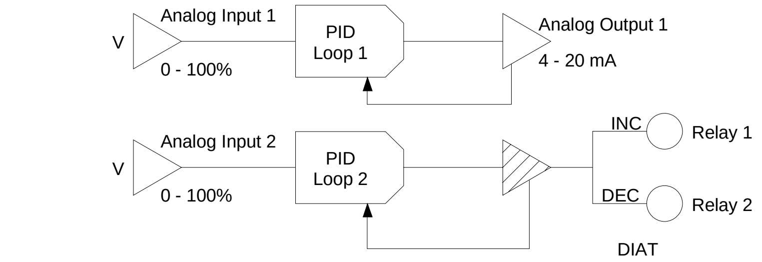


Configuration 18 (218) - Two Independent PID Loops, One with Current Output and One with Time Proportioned Relay Out

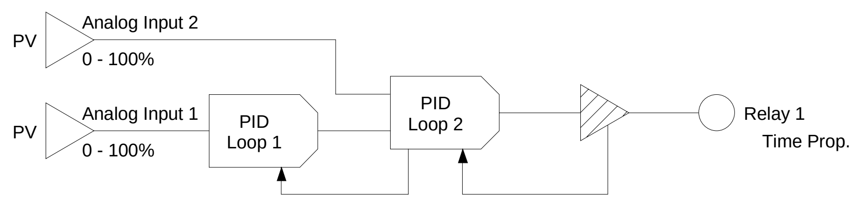


Configuration 19 (219) - Two Independent PID Loops, One with Current Output and One with Position Proportioning Relays Out

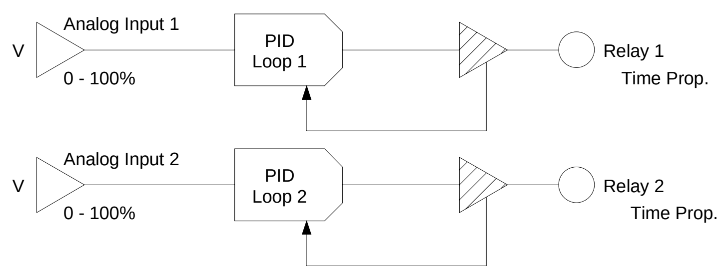
Figure 5-3 Two-Loop Factory Configurations



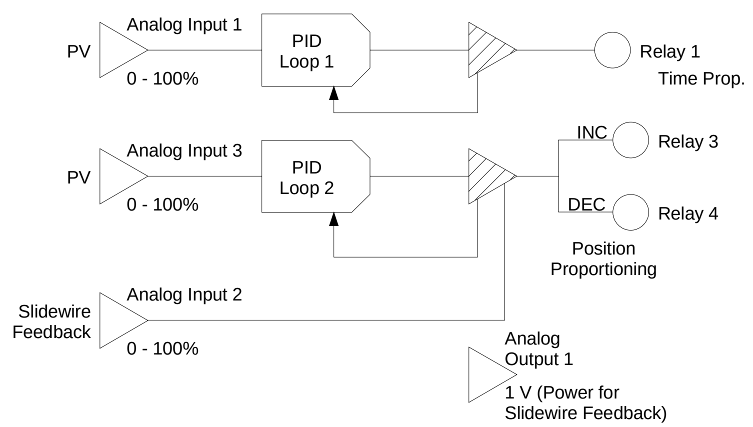
Configuration 20 (220) - Two Independent PID Loops, One with Current Output and One with Direction Impulse Adjusting Relays Out



Configuration 21 (221) – Cascade PID with Time Proportioned Relay Out

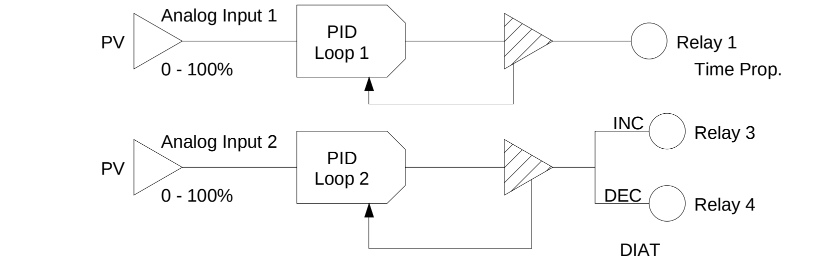


Configuration 22 (222) - Two Independent PID Loops, Each with Time Proportioned Relay Out

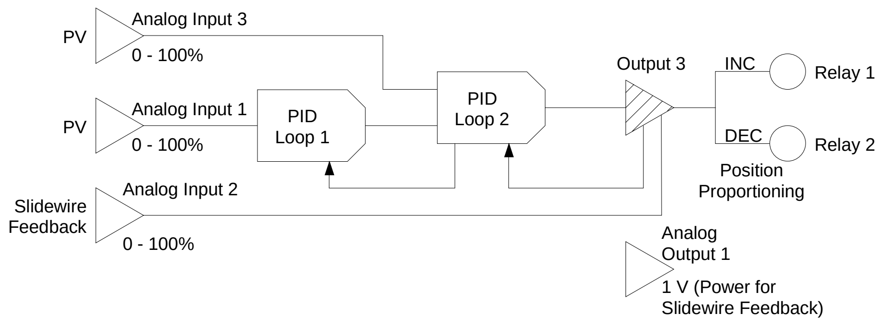


Configuration 23 (223) - Two Independent PID Loops, One with Time Proportioned Relay Out and One with Position Proportioning Relays Out

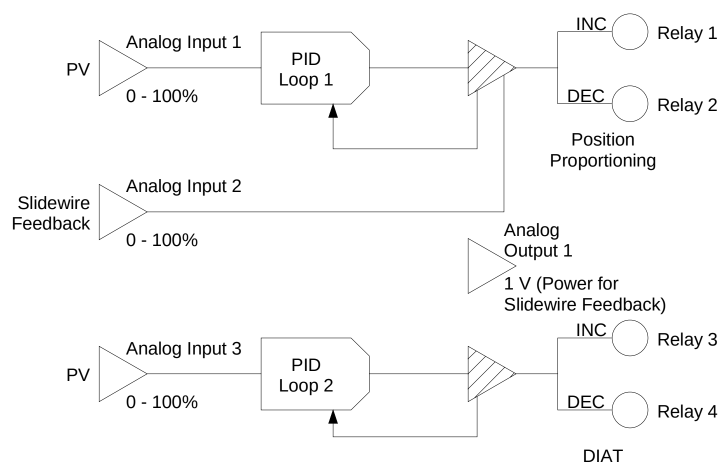
Figure 5-3 Two-Loop Factory Configurations (continued)



Configuration 24 (224) - Two Independent PID Loops, One with Time Proportioned Relay Out and One with Direction Impulse Adjusting Relays Out

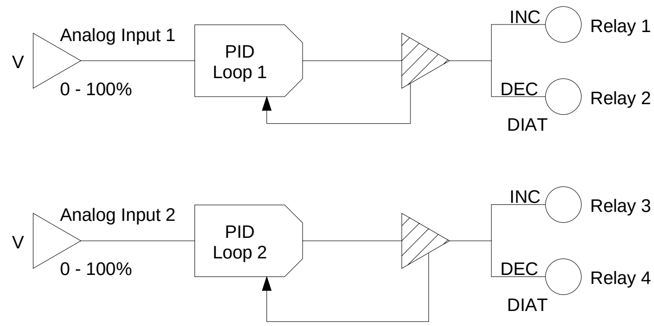


Configuration 25 (225) – Cascade PID with Position Proportioning Relays Out

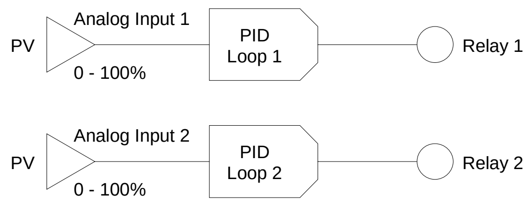


Configuration 26 (226) - Two Independent PID Loops, One with Position Proportioning Relays Out and One with Direction Impulse Adjusting Relays Out

Figure 5-3 Two-Loop Factory Configurations (continued)



Configuration 27 (227) - Two Independent PID Loops, Each with Direction Impulse Adjusting Relays Out



Configuration 28 (228) – Two Independent Loops, Each with ON/OFF Relay

Figure 5-3 Two-Loop Factory Configurations (continued)

5.5 Tasks That Precede Programming

Introduction

Regardless of whether you decide to do freeform programming, or to start with one of the factory configurations, there are a few other things to be considered before programming the controller. Each is described in this subsection.

Will a custom linearization curve be needed for an analog input?

By default the controller is ready to use a standard input algorithm. If your application needs a custom linearization curve, enable "CUST INP" under “FEATURES” in the Program mode as described in Section 9.

Do you need lag and ability to hold input value?

If your application does not require using a digital filter (lag) or holding the input under some circumstances, simplify the AI programming menus by disabling “EXPINP” (expanded input) under the “FEATURES” prompts described in Section 9.

Will the controller monitor for process alarms?

If alarming is not required at your site, or process alarms are monitored by another device, disable “ALARMS” under the “FEATURES” prompts described in Section 9.

Will any values used by the strategy come from a CN (constant) block?

If no function blocks will read a value for a CN block, simplify the menus by disabling “CN” (constants) under the “FEATURES” prompts described in Section 9.

Will operator need to review programming while controller is online?

If you want to be able to display (but not change) values of function block parameters while the unit is online, enable “REVIEW” under the “FEATURES” prompts described in Section 9.

5.6 Where To Go From Here

Modes, menus, prompts, and keypad basics

Regardless of how you plan to program your controller, if this is the first time you have used a UDC5300 controller, **read Section 6.** It contains basic information about using the controller's user interface. All subsequent sections assume that you know the basic ideas and terminology presented in Section 6.

Using a factory configuration

If you decide to use a factory configuration and have not configured a UDC5300 before, then after reading Section 6 go to Section 7. That section includes instructions for loading and customizing factory configurations.

After implementing your control strategy, read Subsection 9.8 to learn how to configure process alarms.

If you want to require use of a password to restrict access to the controller's database, read Subsection 9.13 to learn how to define passwords and specify what functions require their use.

Finally, read Subsection 9.11 to learn how to specify which displays are available to the operator, and their sequence.

Freeform programming

If you have decided to do freeform programming and have not configured a UDC5300 controller before, then after reading Section 6 move on to Section 8. That section provides a demonstration of function block programming basics. It tells you how to approach the task and what to do to implement your strategy. Every function block type is described in Section 9. For each type the description includes the prompts (in the order displayed), the purpose of each prompt, and the selection of choices or range of valid values you can enter in response to the prompt.

After implementing your control strategy with freeform programming, read Subsection 9.8 to learn how to configure process alarms.

If you want to require use of a password to restrict access to the controller's database, read Subsection 9.13 to learn how to define passwords and specify what functions require their use.

Finally, read Subsection 9.11 to learn how to specify which displays are available to the operator, and their sequence.

6. Modes, Menus, Prompts, and Keypad Basics

6.1 Overview

This section contains general information about:

- the controller's operation
- the user interface

This section is aimed at first-time users of the UDC5300 controller. Subsequent sections of the manual were written with the assumption that you understand the concepts and terminology presented in this section.

What's in this section?

The following topics are covered in this section.

6.2 Modes of Operation

6.2.1 Introduction

Overview

The instrument has three modes of operation: Program, Online, and Maintenance. Each mode has its own menus and prompts. The SET MODE prompt is available in all three modes. Use it to switch the controller from one mode to another.

Program mode

Program mode is an offline mode for programming (configuring) the instrument. In this mode, all outputs are frozen.

Online mode

Online mode enables full use of the instrument with its inputs, outputs and internal programming. In this mode, it is fully interactive with all externally connected elements.

Maintenance mode

Maintenance mode is an offline mode. Functions include calibration, offline diagnostic testing, and various setups for operation. In Maintenance mode, all outputs are frozen.

6.2.2 Menu for Each Mode

Overview

Each mode of operation has its own menu of functions or programmable items. Many of the top level items in these menus, particularly in Program and Online mode, have sub-menus of functions or configurable parameters below this top level.

Figure 6-1 shows the main (top level) menu choices for each mode.

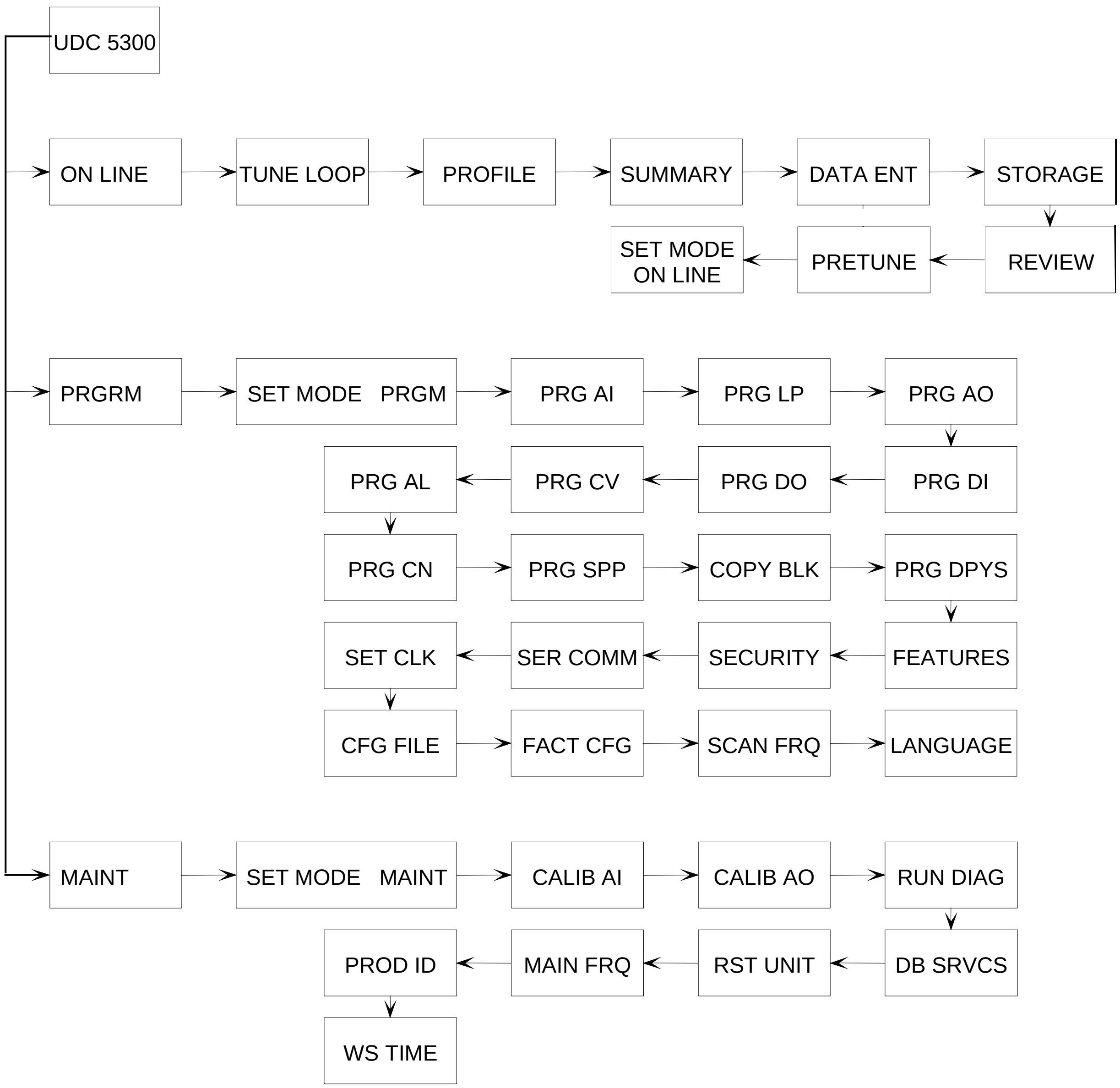


Figure 6-1 Top Level Menu Choices

Online mode submenus

Figure 6-2 shows the functions in the Online mode menu submenus. These are presented here to give you a general idea of what you can do in Online mode. Use of these menus is described in Section 15.

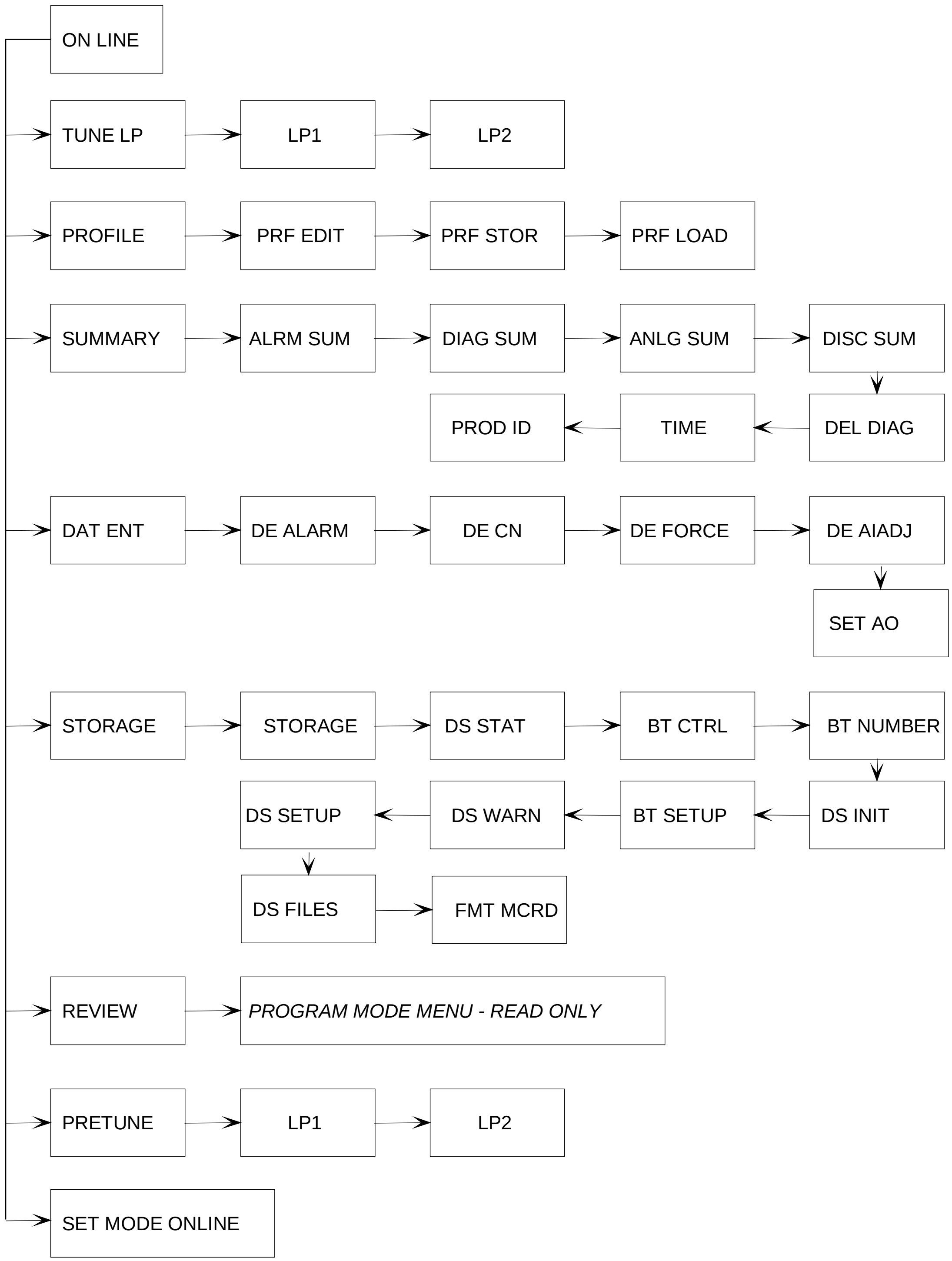


Figure 6-2 Online Mode Menus

Program mode prompts

Figure 6-3 shows the prompts in Program mode. Program mode is used to configure every type of function block (except the system block) and to perform setup functions such as setting the clock and programming security passwords.

Note that when a function block is selected for edit, the subsequent prompts are the names of input and internal parameters for which values must be specified if the factory defaults are not appropriate. The basic idea is that you work your way through the parameters in the order they are displayed to program the function block. This sequence is recommended because the value specified for a parameter early in the sequence of prompts for a particular block type can affect what subsequent parameters are selected. A parameter's value may also affect what are valid values for other parameters.

Function block programming and other activities accomplished in Program mode are described in Section 9.

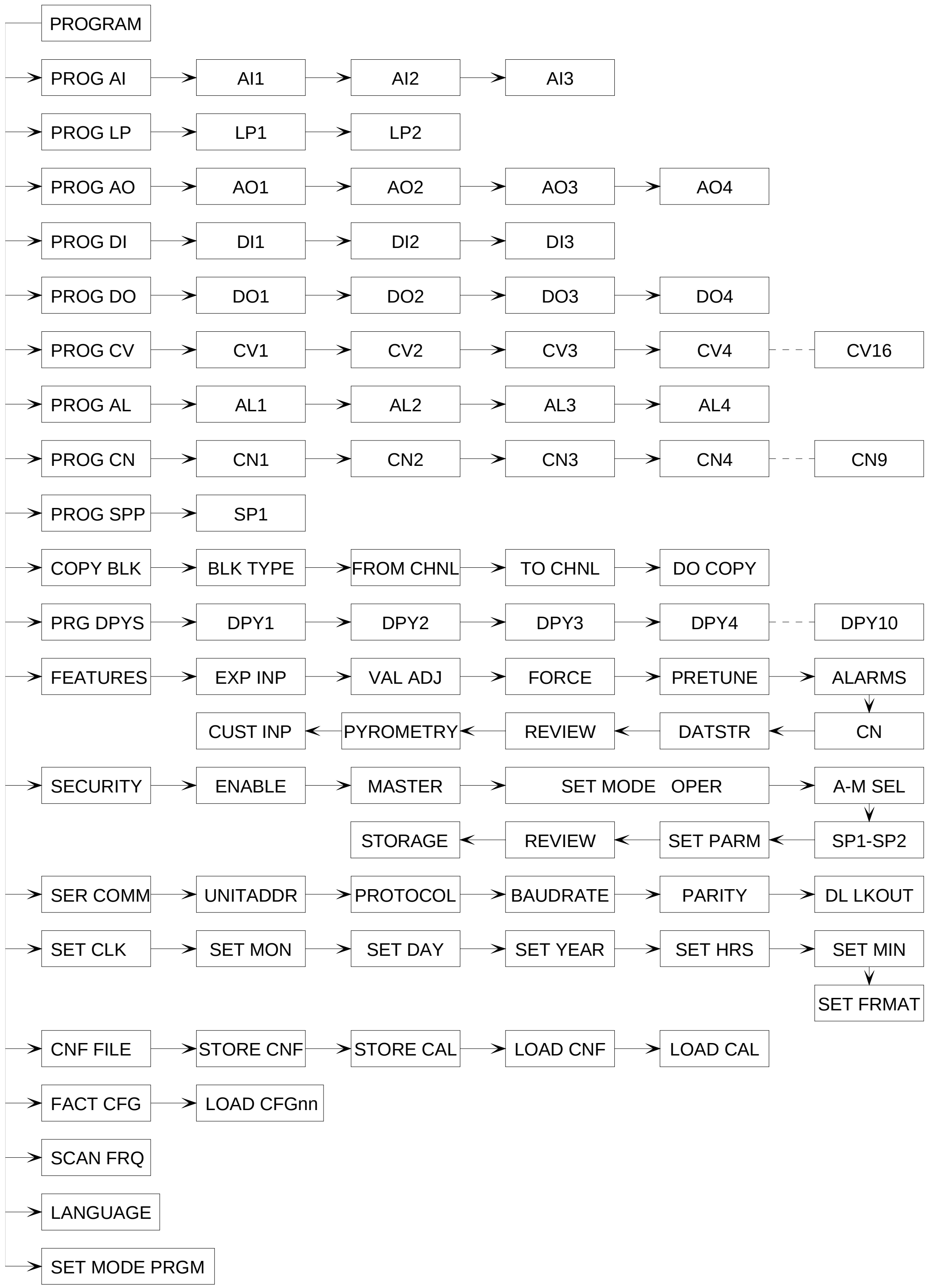


Figure 6-3 Program Mode Prompts

Maintenance mode functions

Figure 6-4 lists the function prompts in Maintenance mode. These are presented here to provide an overview of the uses of Maintenance mode. Instructions for performing these functions are provided in Section 19.

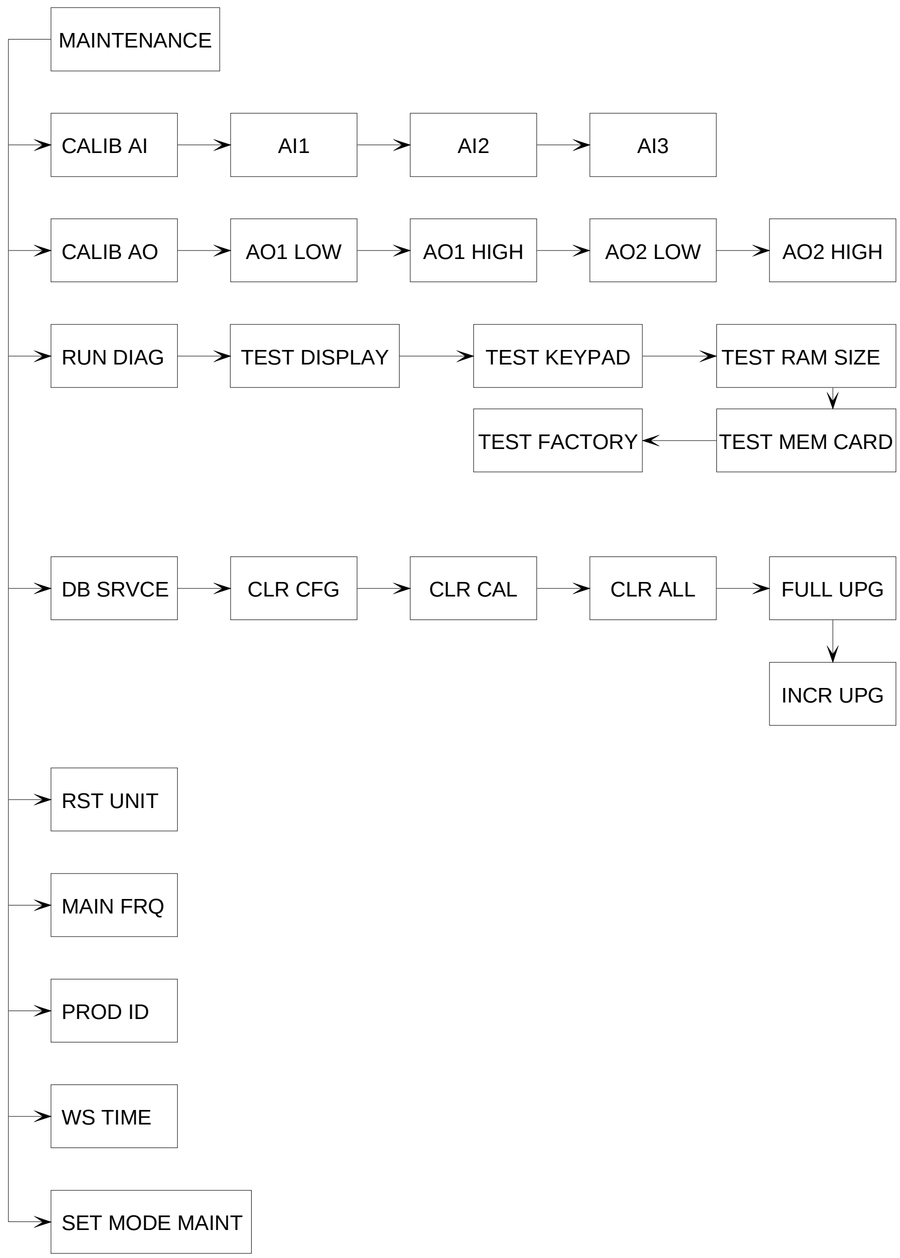


Figure 6-4 Maintenance Mode Prompts

6.3 User Interface

Overview

This subsection explains the theory of key and menu use. An example of how to use the keys to select a parameter value is in 6.5.

6.3.1 Introduction

Use keypad for everything

All programming, operator, and maintenance functions are accomplished using the keypad on the front of the controller (see Figure 6-5). A summary of key functions is provided in Table 6-3.

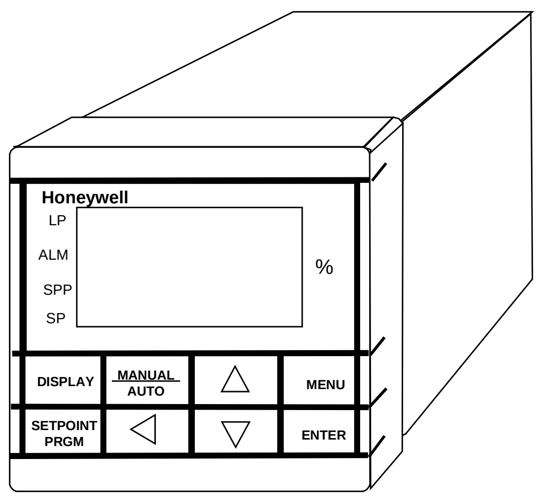


Figure 6-5 UDC5300

Viewing and selecting menu items with the INCREMENT (▲), DECREMENT (▼) and ENTER keys

Items from the top level of the Program mode, Online mode, or Maintenance mode menu are displayed on the bottom line of the screen. Use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to cycle through a menu. When the function to be used or item to be configured is displayed, press the **ENTER** key to select it.

The **INCREMENT** (▲) and **DECREMENT** (▼) keys are also used to cycle through the list of valid selections for a particular prompt.

MENU key has several important functions

Use the **MENU** key to acknowledge diagnostic and other messages.

When an operator display (one showing process values as opposed to a menu item) is on view, use the **MENU** key to switch to the Online mode menu.

When a menu is already on display, use the **MENU** key to move up a level in the menu hierarchy. (When in doubt where you are in the menu hierarchy, use the **MENU** key to take you back up to something you recognize.)

If you are already at the top level of the menu in one of the modes, use the **MENU** key to go to the first item in the menu.

If you make a change to a parameter value, then change your mind, press **MENU** instead of **ENTER.** The change will be discarded.

What to do when pressing MENU does nothing

When you already are at the first item at the top level of the menu hierarchy in any of the three modes, pressing **MENU** will have no effect.

To continue to work in the current mode, use the **DECREMENT** (▼) key to move through the top level menu for the mode.

To go to another mode, press the **INCREMENT** (▲) key to display the “SET MODE” prompt in the lower display. Note that the upper display will only ever cycle through two modes for your selection. The mode not shown is the one you are already in.

Security locks

The controller can be programmed to require entry of a password to perform some functions and to change some values. One of the items that can be password protected is changing from Online mode to Program or Maintenance mode. You will know security has been enabled and that a password is required if, when you try to do something, you are presented with a display that says:

∗000∗ ⩧

SEC LOCK

Use the procedure in Table 6-1 to enter the appropriate password. The “operator password” is expected when this display results from trying to change a value using Online mode displays. The “master password” (which can be different from the operator password) is needed to change modes, clear the memory, or alter security programming.

Security is not enabled on out-of-the-box controllers.

6.3.2 Using the Menus

6.3.2.1 Selecting an Instance of a Function Block Type or Other Item for Configuration

Program mode

The controller can contain more than one instance of a function block of a particular type. Therefore, after a function block type has been selected for edit, the next step is to specify which of the blocks of that type you want to program.

For example, the controller can support two loops. Therefore, when you select “PRG LP” (program loop) by pressing **ENTER**, the prompt will change to “PRG LP1”. If you want to configure loop 1, press **ENTER**. If you want to configure the second loop, press the **DECREMENT** (▼) key to change the prompt to “PRG LP2”, then press **ENTER.**

Maintenance and Online modes

The same principle applies in Maintenance mode when selecting the analog input or analog output to calibrate, and in Online mode when selecting an item from multiple instances, such as tuning parameter sets. (There can be two.) Use the **DECREMENT** (▼) key to display the item to be edited, then press **ENTER.**

6.3.2.2 General Format of Displays Using Menus

Value on top line, prompt on the bottom

Once an item has been selected from the top level menu and, if necessary, an instance of a numbered item has been selected, the display changes. The general format of displays used for programming and maintenance is to have a prompt (eight characters maximum) on the lower line of the display, and the current value of the parameter or function represented by the prompt displayed on the upper line of the display (six characters maximum).

Example

For example, in Program mode once you have selected an AI block to program you will see:

LINEAR
AI1 TYPE ≡

In this case “AI1 TYPE” is the prompt and “LINEAR” is the current selection for the “TYPE” parameter for analog input 1’s function block.

The “1” after the AI is significant because the controller can use more than one function block of a particular type. Therefore, the particular instance of the function block type being edited is always displayed.

Operator display formats vary

In Online mode some displays follow this same “value over prompt” format. These are the displays used with the Online menu. In Online mode operator displays are also available that show process values, alarm status, etc. Operations performed with Online mode menus are described in Section 15. Online mode operator displays are described in Section 14.

6.3.2.3 Using the Cursor

Significance of location

The three small lines to the right of “AI1 TYPE” in the example above are the cursor. Because it is positioned next to the prompt, we know that this prompt has not yet been selected for editing.

Moving the cursor

Pressing the **ENTER** key would select the parameter for editing. The cursor would change shape and move up next to the value like this:

LINEAR ⩧
AI1 TYPE

Once you have cycled through the choices (or editing a number as described below) and pressed **ENTER**, the cursor will movc back down next to the prompt.

Use the **INCREMENT** (▲) or **DECREMENT** (▼) key to move on to the next item to be configured.

6.3.2.4 Viewing and Changing Values

Viewing valid selections

Once a prompt has been selected for editing, the valid choices available can be displayed using the **INCREMENT** (▲) and **DECREMENT** (▼) keys to cycle through the list.

Valid values or selections fall into three categories:

- strings of characters representing choices in a list, such as the types of analog input types
- a number, such as the range high and range low limits for an analog input
- a parameter in another function block, such as the source of the process variable (PV) used by a loop (LP) function block

The following paragraphs describe how each type of value or selection is edited.

Selecting a text string

When the prompt requires that you select an item from a list, such as the AI1 type in our example, simply use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to cycle through the list. When the one you want is displayed, press **ENTER**. The item will be selected and the cursor will move back down next to the prompt. Use the **DECREMENT** (▼) key to go on to the next parameter.

Editing a number

If the prompt requires that you enter a number, use the procedure in Table 6-1 to enter the number.

Note that sometimes the valid responses to a prompt include either entering a number or selecting “OFF”. In this case use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to display your choice of “OFF” or “NUMBER”. Press **ENTER** to make your selection.

If your choice is “OFF”, indicating that the parameter will not be used, then the edit is complete and the cursor will move back down next to the prompt. You are ready to use the **DECREMENT** (▼) key to go on to the next parameter.

If you want to enter a number, press **ENTER** when the word “NUMBER” is on display, then follow the procedure in Table 6-1.

Table 6-1 Procedure for Entering a Number

Step	Action
1	When the controller is ready to accept a numerical value the upper display will show the current value of the parameter (with zeros preceding it if the value has fewer digits than the display supports). When appropriate, the string of zeros includes a decimal point. (Note that the location of the decimal point is usually configurable using a different parameter.) The right-most digit (least significant digit) will be flashing. This indicates that the digit is selected for editing.
2	To change a number, press the **INCREMENT** (▲) or **DECREMENT** (▼) key. The display will cycle through the numbers 0 through 9.
3	When the desired value is displayed for the least significant digit, use the **LEFT** (◄) key to select a different digit for edit. Use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to change each digit to the desired value.
4	When the number has been edited to the desired value, press **ENTER** to move the cursor back to the prompt.

Specifying a parameter

Note that sometimes the valid responses to a prompt include entering a number, specifying a parameter in another function block, or selecting "OFF". In this case use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to display your choice of "OFF", "NUMBER" or "PARM". Press **ENTER** to make your selection.

If you want to specify an output value parameter in another function block as the source of a value in the block being edited, the follow the procedure in Table 6-2.

Table 6-2 Procedure for Selecing a Parameter

Step	Action
1	When a valid response to a prompt is selecting a parameter value from another block, the top line of the display will flash "PARM". To begin to specify a parameter, press **ENTER.** The top line of the display will change to show a function block type having a parameter which could be read by the parameter being configured. In the case of analog values, this is usually "AI".
2a	If this is the type of block you want to specify press **ENTER.** The first block number of this type will be displayed. For example. the display will change to "AI1". Use the the the **INCREMENT** (▲) or **DECREMENT** (▼) key to scroll to another block of the same type. When the one you want is on display, press **ENTER.**
2b	If the first block type displayed is not you choice, use the **INCREMENT** (▲) or **DECREMENT** (▼) key to scroll to the desired type. For example, if you want to read a value from an CN block, press ▼ until "CN" is on display. Next do step 2a to select a numbered block instance within the type.
3	Once the block ID is displayed on the top line, press **ENTER.** The display will change to show the block ID and the code for one of its output parameters that is a valid choice. To see other outputs from the same block that can be used as the source of the value of the parameter being configured, use the **INCREMENT** (▲) and **DECREMENT** (▼) keys.
4	If you change your mind and want to select a different type of block, use the **MENU** key to move back up through the hierarchy, then use the ▲ and ▼ keys to select another type.
5	When the desired block ID and output code are on display, press **ENTER** to select it. The cursor will move back down to the prompt. You are ready to use the ▼ key to go on to the next prompt.

6.4 Summary of Key Functions

In all modes, the instrument is operated by using the front panel keys to view and select items from menus and displays. Table 6-3 describes each panel key and its functions.

Table 6-3 Key Functions

Symbol	Name	Function	Operating mode in which function applies		
			Program	Online	Maint
MENU	**MENU**	• Acknowledges diagnostic and other messages.		✓	
		• Accesses Online mode **MENU** from online primary display.		✓	
		• Backs cursor out of a menu to next higher menu level. Use when finished looking at or changing menu items.	✓	✓	✓
		• When at the top level of a menu, goes to first item on menu.	✓	✓	✓
		• If prompted to SAVE CHANGES?, press to exit menu without saving changes.	✓	✓	✓
▲	**INCREMENT**	• Moves cursor up a menu or list of choices.	✓	✓	✓
		• When entering the most significant digit of a number, scrolls through 0 to 9 and the minus sign (if applicable). For other digits, scrolls through 0 to 9.	✓	✓	
		• In loop display, increases alterable value. For example, if the loop is in Auto, the setpoint can be increased. If the loop is in Manual, the output can be increased.		✓	
		• Accesses setpoint profile start, advance, hold, reset operations.		✓	

Table 6-3 Key Functions (continued)

Symbol	Name	Function	Operating mode in which function applies		
			Program	Online	Maint
▼	DECREMENT	• Moves cursor down a list/menu.	✓	✓	✓
		• When entering the most significant digit of a number, scrolls through 9 to 0 and the minus sign (if applicable). For other digits, scrolls through 9 to 0.	✓	✓	
		• In loop display, decreases alterable value. For example, if the loop is in Auto, the setpoint can be decreased. If the loop is in Manual, the output can be decreased.		✓	
		• Accesses setpoint profile start, advance, hold, reset operations.		✓	
ENTER	ENTER	• Selects displayed menu item.	✓	✓	✓
		• Enters a changed value or parameter.	✓	✓	✓
		• If prompted to SAVE CHANGES?, saves changes made and returns to higher menu.	✓	✓	
◀	LEFT	• When editing a number, selects the digit to be edited.	✓	✓	
DISPLAY	DISPLAY	• From any display or menu, accesses up to 10 online displays assigned to this key and changes instrument to online mode.	✓	✓	✓
		• Each press accesses the next display in the sequence.	✓	✓	✓

Table 6-3 Key Functions (continued)

Symbol	Name	Function	Operating mode in which function applies		
			Program	Online	Maint
MANUAL AUTO	**MANUAL AUTO**	• In a loop display, toggles loop between Auto and Manual modes; loop's Remote Manual (RMAN) discrete must be OFF.		✓	
		• In a loop display, toggles loop between Remote Manual and Manual modes; loop's Remote Manual (RMAN) discrete must be ON.		✓	
		• Does not function if loop's Discrete vs. Key discrete is ON. In this case, the key's functioning has been transferred to the loop's Auto/Manual Select (A-MS) discrete in the loop block.		✓	
SETPOINT PRGM	**SETPOINT PRGM**	• Accesses displays used to view setpoint profile status.		✓	
		• Enables ▲ and ▼ for setpoint profile operation functions.		✓	

6.5 Example

Introduction

Table 6-4 presents an example of the key sequences needed to select an item from a list of choices. In this case, we will specify that AI2 is a T thermocouple.

Table 6-4 Example Procedure for Selecting an Item

Step	Action
1	Upon powering up the controller for the first time, a logo will be displayed. Press **MENU** until a prompt is displayed. If it is “PRG AI”, you are already in Program mode, and can skip to Step 4. If it is not “PRG AI”, then press the the **INCREMENT** (▲) key. The prompt “SET MODE” will be displayed on the bottom line. The cursor wll be next to it. A mode name will be displayed on the top line.
2	Press **ENTER** to go into edit. The cursor will move to the top line.
3	Press **INCREMENT** (▲) or **DECREMENT** (▼) until the top line of the display reads “PRGRM”. Press **ENTER** to select it. The display will change to the first item on the Program menu, “PRG AI”, and the cursor will return to the bottom line.
4	To indicate that you want to program an AI block, press **ENTER.** The text on the bottom line will change to “PRG AI1”.
5	To select AI2 for edit press ▲ or ▼ until the display reads “PRG AI2”. Press **ENTER** to select it. The display will change to show “AI2 TYPE” (the prompt for the first AI parameter) on the bottom line, and the currently assigned value or choice on the top line. The cursor will remain on the bottom line.
6	To edit the AI2 input type, press **ENTER** to go into edit mode. The cursor will move to the top line.
7	To scroll through the available choices, use ▲ or ▼.
8	When “T” is displayed on the top line of the display, press **ENTER**. This selects “T”. The cursor returns to the bottom line.
9	To move on to the next parameter, use ▲ or ▼. The prompt will change to “AI2 ODPT”, the next parameter available for configuration.

Step	Action
10	To exit the menu, press To exit the menu, press **MENU**. The display will read "SAVE CHANGES?"
11	To save the changes press **ENTER**. To abandon the changes press **MENU**. Either way, you will remain in Program mode, ready to edit AI2.
12	To move back up the menu hierarchy, press **MENU**. The prompt will change to "PRG AI".
13	At this point you are at the first item in the Program menu. You can confirm this by pressing **MENU** again. If nothing happens, you really are at the first item in the menu.
14	To change to a different mode, press ▲. The "SET MODE" prompt will again be displayed.

7. Using a Factory Configuration

7.1 Overview

Factory configurations are built-in control strategies, with the necessary function blocks already programmed to pass the required data. All factory configurations are stored in the firmware of every UDC5300 controller, although not every controller has the I/O hardware to support every strategy.

This section provides details about the available factory configurations, and about how to tailor them to your application.

If you specified a factory configuration during model selection (see Section 2), then the correct strategy will be loaded into memory before the unit is shipped. All that will be left for you to do is program site-specific values such as ranges and tuning parameters.

If you did not specify a factory configuration, or specified the wrong one, you can easily load a different factory configuration using Program Mode.

This section assumes that you are already familiar with the information in Section 5, *Planning*, and Section 6, *Modes, Menus, Prompts, and Keypad Basics*.

Once you have programmed your factory configuration for your application, it is good practice to save the configuration to a removable PCMCIA memory card as described in Section 16 (if you controller supports use of a data cartridge).

What's in this section?

The following topics are covered in this section.

7.2 Loading a Factory Configuration

Overview

Depending on the hardware on your controller, up to twenty-eight commonly used factory configurations are available to load into the controller. The result of loading a factory configuration is that the function blocks in the controller are programmed to implement the strategy.

The factory configurations as specified in Table I of the model selection guide (see Section 2) are the same as the factory configurations loaded using the Program menu.

In the Model Selection Guide the numbers range from 101 through 115, 216 through 228. In Program mode the selections range from 01 to 28. To make the correlation, simply drop the first digit from the model number designation.

How to load

Change to Program mode and select “FACT CFG”, then select one of the configurations and press **ENTER**.

The configuration will be loaded. A message will advise you when the load is completed. If the message is “LOADED W(ith) ERRORS”, press **MENU** to view the first error, then use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to view any additional errors.

ATTENTION

Loading a factory configuration only alters the values of parameters actually used by that configuration. To avoid unpredictable results, **clear the old configuration from the controller’s memory before loading a factory configuration.** Instructions for clearing the memory using the “Database Services” item from the Maintenance menu are provided in Section 19. If desired, you can first save the previous configuration on an optional PCMCIA memory card as described in Section 16.

7.3 Tailoring a Factory Configuration to Your Application

Overview

Programming tasks following the loading of a factory configuration fall into two categories:

- **NECESSARY CONFIGURATION -** After loading the configuration, you must assign site-specific values to function block parameters such as ranges and tuning parameters. Each parameter for each function block type is described in detail in Section 9. In addition, for the strategy to work as intended, it is essential that I/O wiring be installed at the terminals matching the use of I/O function block types in the factory configuration. (A wiring diagram for each strategy is provided later in this section.)

  If none of the strategies exactly match your requirements, start with the factory configuration that is closest to your needs. Once it is loaded, modify it to suit your application by changing I/O types, changing control action, or other essentials.

- **CUSTOMIZATION** If desired, you can further customize the strategy by adding functionality with additional blocks. For example, it is easy to add alarms or a totalizer type calculated value (CV) block.

7.3.1 Necessary Configuration

Ranges

Factory configurations preset the controller ranges for 0 % to 100 %. If these are not suitable for your application, change them.

Analog inputs

Factory configurations set all analog inputs to INDIRECT type, with 1 V to 5 V input span. Modify as needed. .

All analog inputs have their type set to LINEAR. Specify the proper analog input type and range for each input. If the input is a direct sensor such as a thermocouple, start by changing the D-ID parameter from INDIRECT to DIRECT, then select the sensor type, range limits and other desired actions. If the input is from a flow transmitter requiring square root, change the D-ID from INDIRECT to SQRT, then complete the engineering unit range low, range high limits and other desired actions.

Analog outputs

After the controller is placed in service you will typically be required to edit appropriate controller output settings such as impulse time for time proportioning outputs, actuator speed for PP and DIAT output types, output value and rate of change limits for CAT outputs.

Tuning parameters

PID tuning parameters are configured with a default value for the Proportional term, but the Integral (reset) and Derivative (rate) terms are turned off.

Specify a RST1 (reset in tuning parameter set 1) value. This may require modification when placed in service, but a value other than OFF will typically provide more predictable operation. For split output control loops, specify a RST2 (reset in tuning parameter set 2) value for the controlled cooling portion of the control output.

Retain the OFF state of RST1 and RST2 if Proportional Only control is to be implemented and enter a value of MRST (manual reset).

Once the unit is placed in service, experience will dictate fine-tuning. Tuning the loop in Online mode is described in Section 14.

Control loop ranges

Update the range limits of each PID loop PV input to match the input span specified for its associated analog input. In most cases, analog input 1 is used as the PV of Loop 1.

Note: The range limits specified for the PID algorithm are the limits used in the operating displays of the controller, including decimal point location. Failure to match the PID range limits with the analog input range limits may cause undesirable operation.

Control action

Specify the desired control action CTLA for the PID algorithm. The control action supplied will be REV (reverse). Direct (DIR) action is typically used for controlled cooling application.

Temperature units

For temperature control, specify an engineering unit for the display (F or C) for the INEU menu item. (The controller can display Kelvin or Rankine values, but the display only allows for the indication of F or C. If K or R is used, leave INEU set to NONE.)

Cascade control

For cascade control configurations, enter CAS_P (Cascade Primary) loop output high and low limits (OVHL and OVLL) to match the engineering unit span of the secondary loop’s process variable. The cascade primary control loop is the only loop that provides output scaling. Setting these limits to the span of the secondary loop’s PV allows the output of the primary loop to be in the proper setpoint units for the secondary controller.

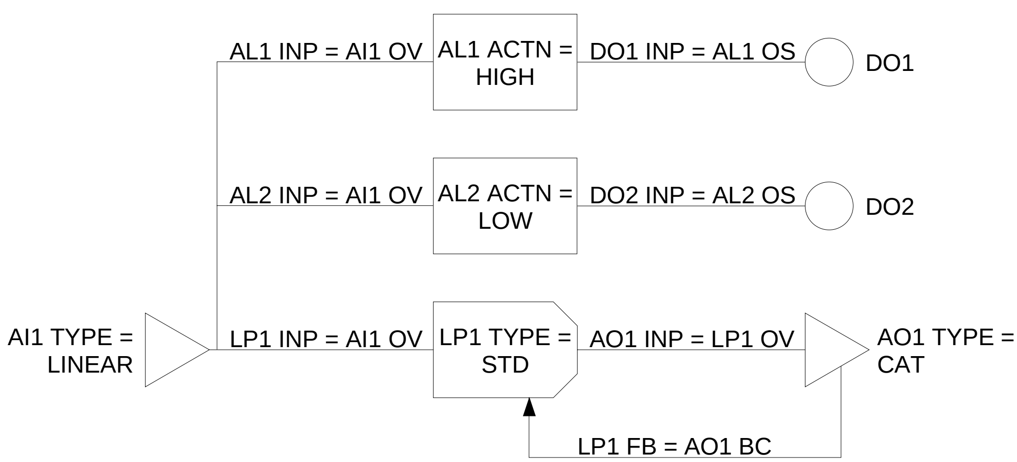
7.3.2 Customization

Introduction

You can program additional function blocks to add custom features to the strategy. For example, you may want to add alarm blocks to monitor process values. Because any function block's output value can be read by any number of other blocks, this is not a problem. Be guided by the diagrams for your factory configuration so that you do not change the signal flow of the basic strategy accidentally!

Example: adding an alarm

A diagram is provided here for adding high and low alarms to factory configuration 01 (101). Following this same design you can add one or more alarms to any other factory configuration. If a process alarm occurs, the appropriate alarm indicator on the display will light, alerting the operator. If you have any unused relays, you configure a DO function block to use the relay to turn on an external annunciator in case of alarm.



7.4 Detailed Information About Each Strategy

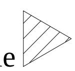
Overview

The remainder of this section provides the information you need to use each strategy successfully. For each strategy this section includes:

- a basic block diagram of the strategy; this is the same as the diagram in Section 5
- a block diagram that shows the parameters and their values used to accomplish the strategy’s signal flow
- a wiring diagram showing the I/O terminal use that matches the configuration’s use of AI, AO, DI, and DO function block types

WARNING

The diagrams in this section are intended to supplement, not replace, the instructions in Section 4, *Wiring*. Be sure to read and understand Section 4 before attempting to connect power or signal wires. Turn power off at mains before installing AC power wiring.

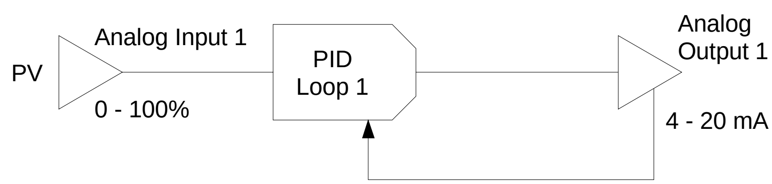
Note that in the diagrams a cross-hatched triangle  represents an analog output function block that is not associated with analog output hardware.

7.4.1 Configuration 01 (101) - PID with Current Output

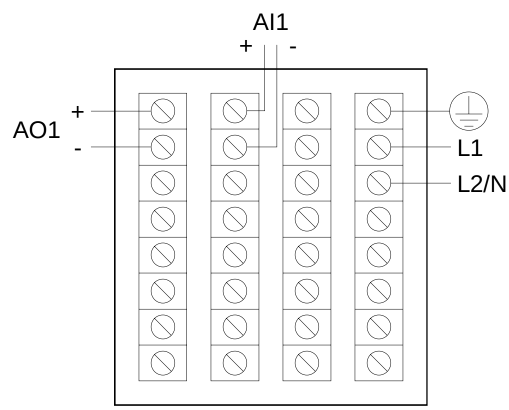
Description

This is the most basic PID control loop: a linear input served by an analog input (AI) block supplies the process variable to a standard PID loop. The output is through a CAT (current adjusting type) analog output (AO) block.

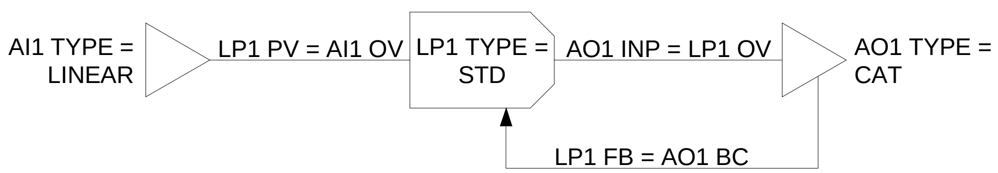
Basic diagram



Wiring diagram



Programming diagram

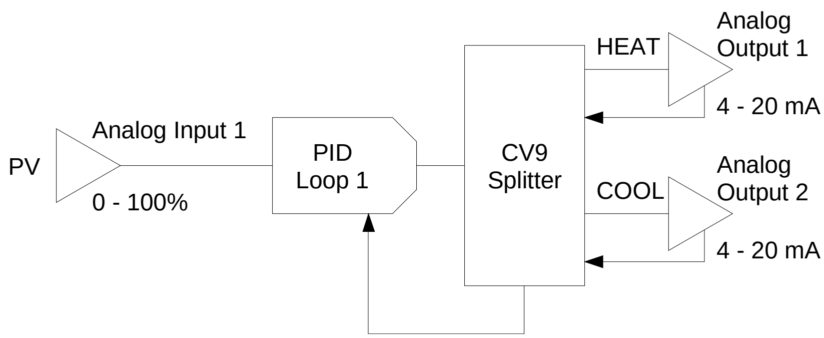


7.4.2 Configuration 02 (102) – Heat/Cool with Current Output for Each

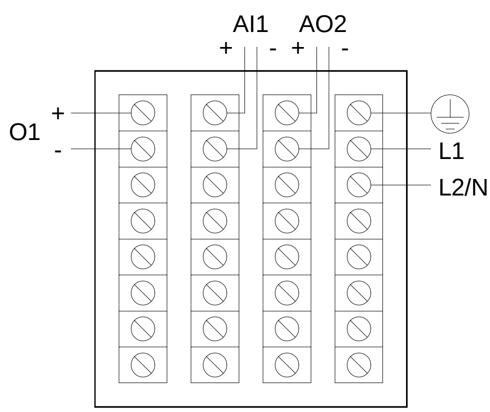
Description

This PID loop with split output provides a current output to one actuator when the process variable is above setpoint, and to another when the PV is below setpoint. A control deadband is configurable. (Although it is titled “heat/cool”, it can be used for other applications.) The split output is achieved with a calculated value (CV) function block programmed to be a “standard splitter”.

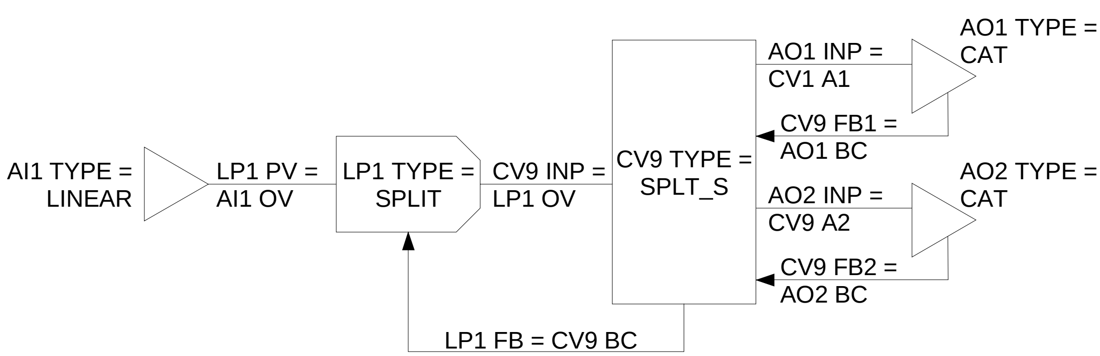
Basic diagram



Wiring diagram



Programming Diagram



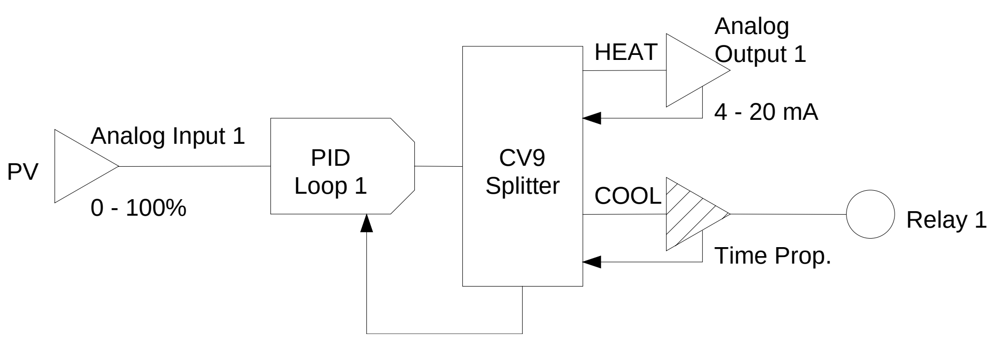
7.4.3 Configuration 03 (103) – Heat/Cool with Current Out for Heat and Time Proportioned Relay for Cool

Description

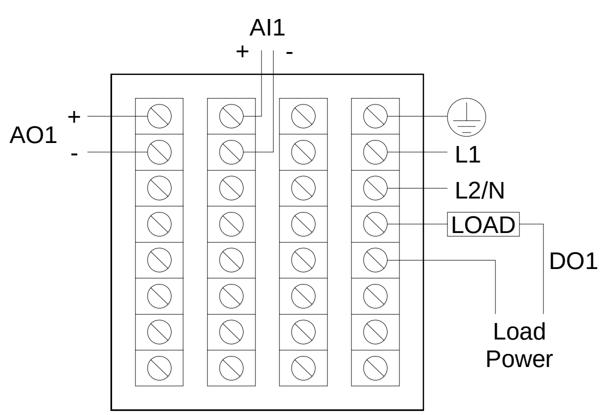
This PID loop with split output provides a current output to one actuator when the process variable is above setpoint, and a time proportioned relay output to a different actuator when the PV is below setpoint. A control deadband is configurable. (Although it is titled "heat/cool", it can be used for other applications.) The split output is achieved with a calculated value (CV) function block programmed to be a "standard splitter".

A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the loop (LP) block and the discrete output (DO) block associated with the relay. In this application the AO block is not associated with analog output terminals.

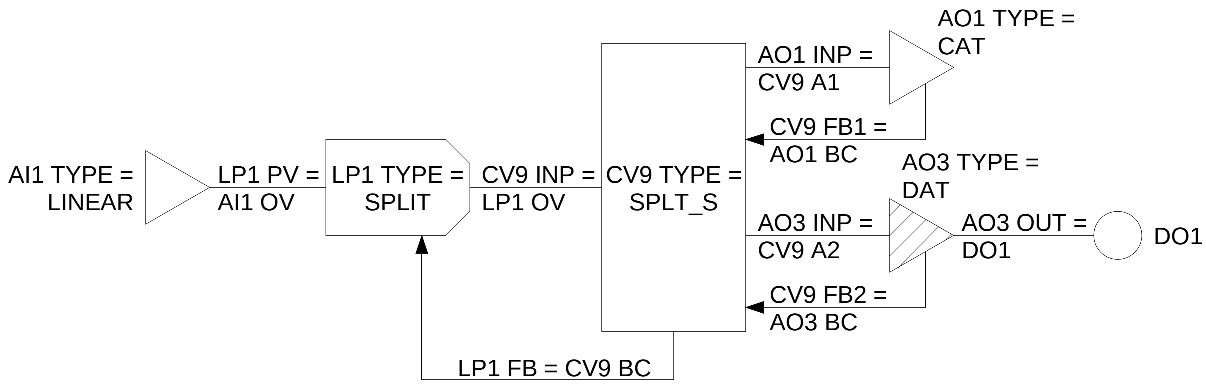
Basic diagram



Wiring diagram



Programming diagram



7.4.4 Configuration 04 (104) - Heat/Cool with Current Out for Heat and Position Proportioning Relays for Cool

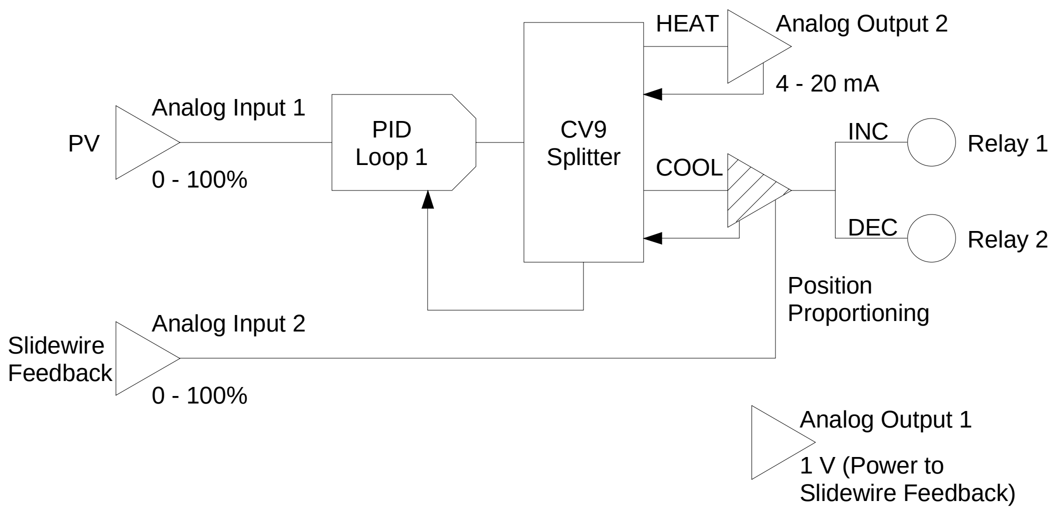
Description

This PID loop with split output provides a current output to one actuator when the process variable is above setpoint. When the PV is below setpoint, two position proportioning relays control a different actuator. The split output is achieved with a calculated value (CV) function block programmed to be a “standard splitter”. A control deadband is configurable.

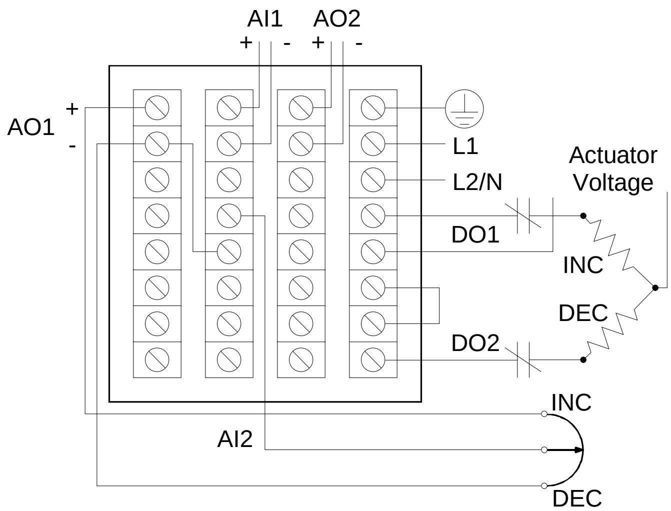
An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the “increase” and “decrease” relays. In this application the AO block is not associated with analog output terminals.

The analog feedback signal from the positioner’s slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

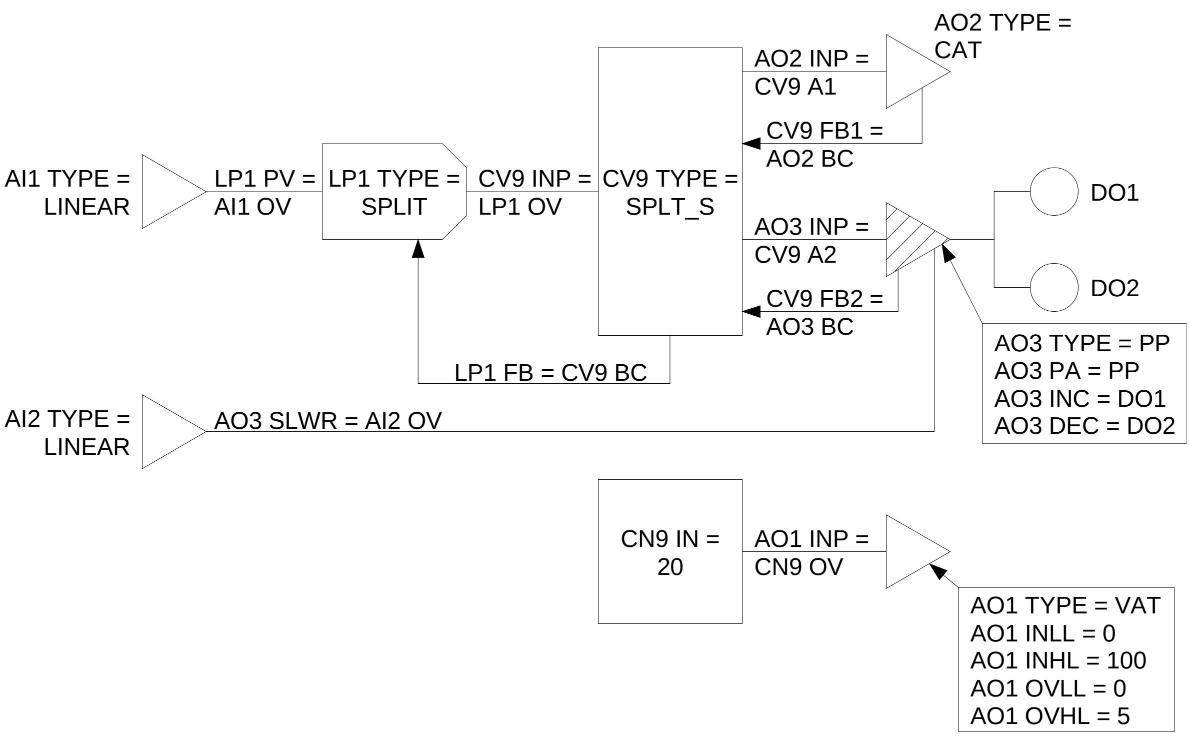
Basic diagram



Wiring diagram



Programming diagram

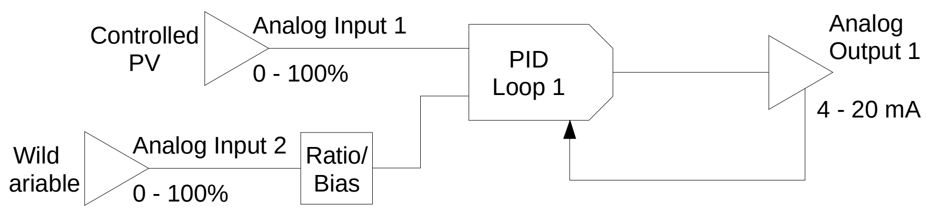


7.4.5 Configuration 05 (105) – PID Ratio Control with Current Output

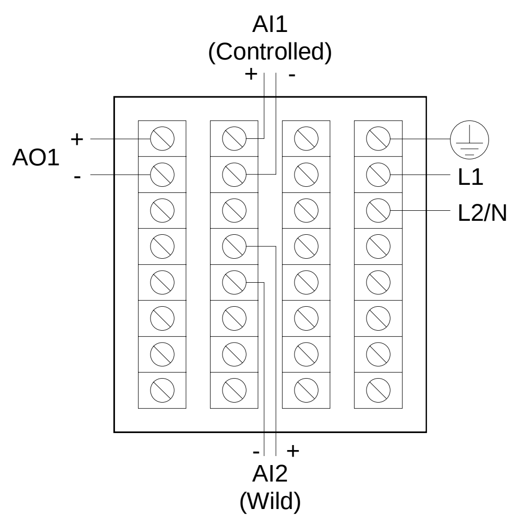
Description

This strategy keeps the controlled variable in ratio with the wild variable. Both variables are supplied as linear analog inputs via analog input (AI) blocks. The output is CAT (current adjusting type).

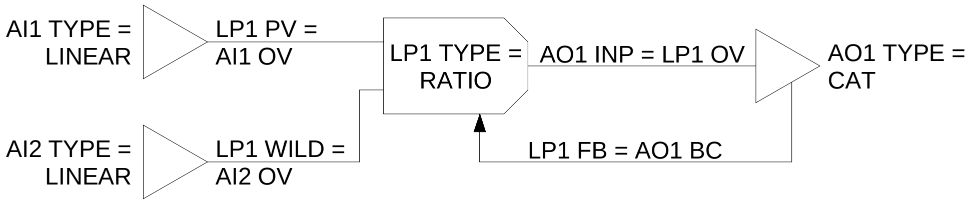
Basic diagram



Wiring diagram



Programming diagram

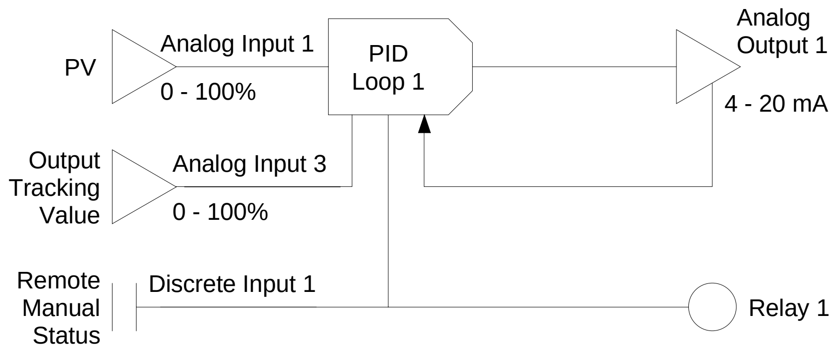


7.4.6 Configuration 06 (106) – Backup to Primary Controller or PLC; Uses Current Output

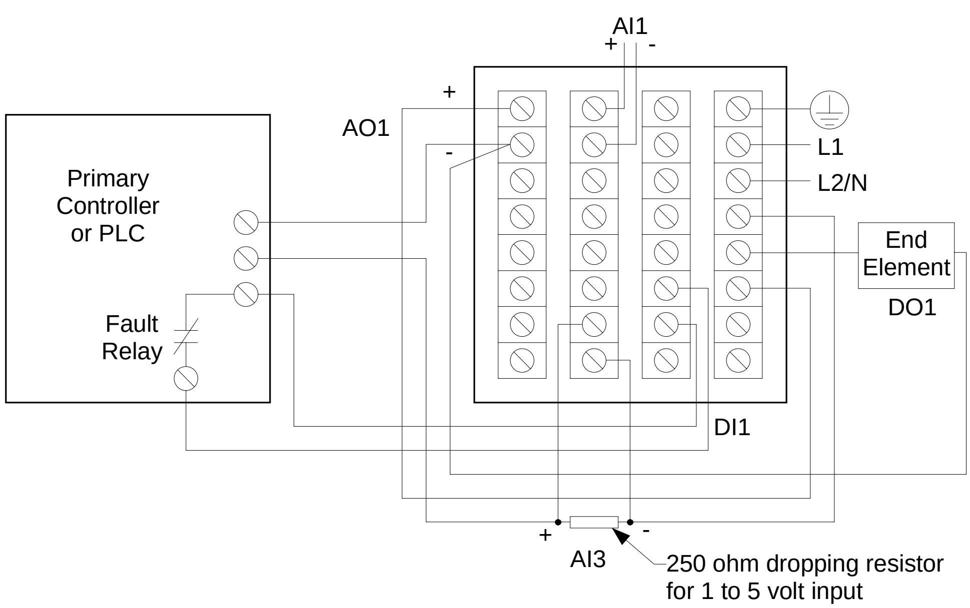
Description

This strategy provides PID control as a backup to a primary controller or PLC. One analog input is used for the PV; another is used to provide the value (from the primary) to be used as the loop's output when "Remote Manual" is enabled via a discrete input. Each input is served by an analog input (AI) block. The current output is supplied by a CAT type analog output (AO) block.

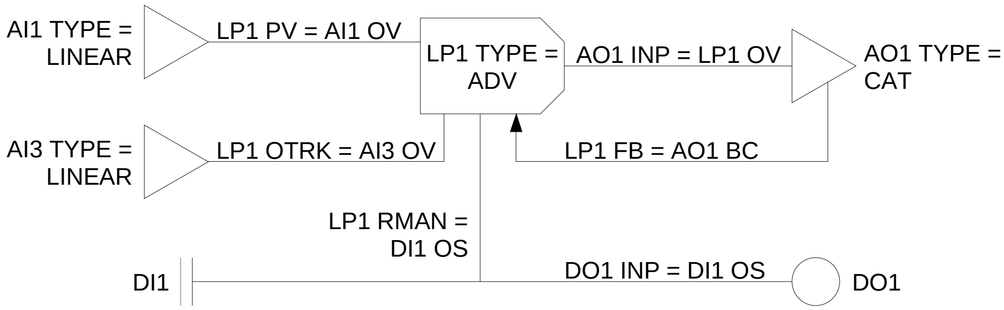
Basic diagram



Wiring diagram



Programming diagram

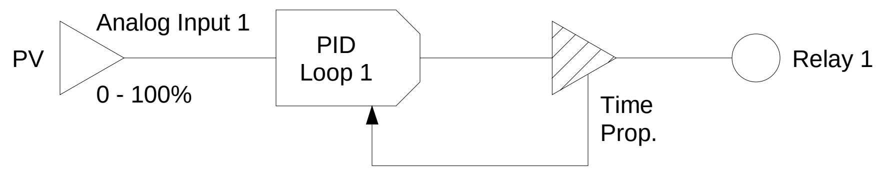


7.4.7 Configuration 07 (107) - PID with Time Proportioned Relay Output

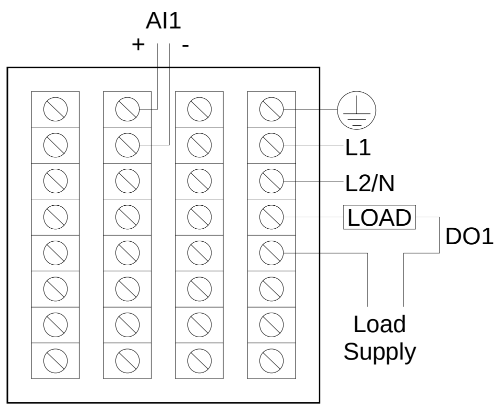
Description

This PID strategy uses a DAT (Duration Adjusting Type) analog output (AO) function block to interface between the loop (LP) block and the discrete output (DO) block associated with the relay. In this application the AO block is not associated with analog output terminals.

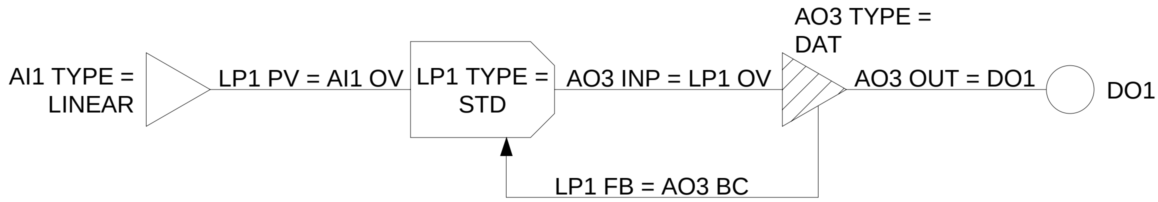
Basic diagram



Wiring diagram



Programming diagram



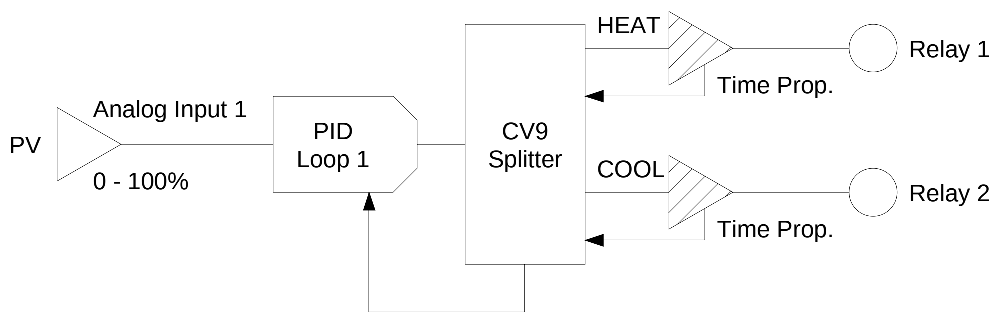
7.4.8 Configuration 08 (108) – Heat/Cool with Time Proportioned Relay for Each

Description

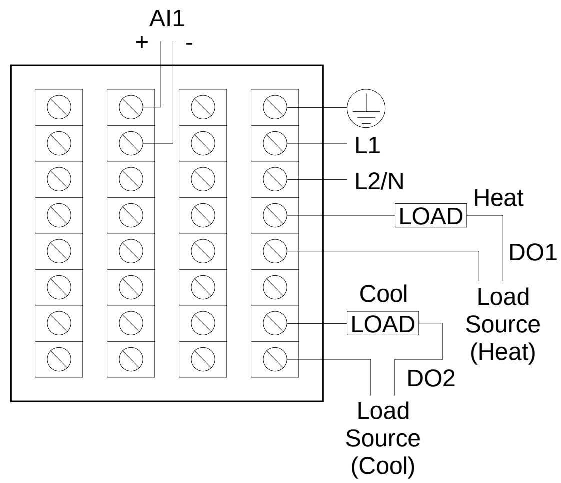
This PID loop with split output uses one relay to provide a time proportioned output to the heater when the process variable is above setpoint, and uses another relay to provide time proportioned output to the cooler when the PV is below setpoint. A control deadband is configurable. The split output is achieved with a calculated value (CV) function block programmed to be a "standard splitter".

A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the loop (LP) block and the discrete output (DO) block associated with each relay. In this application the AO block is not associated with analog output terminals.

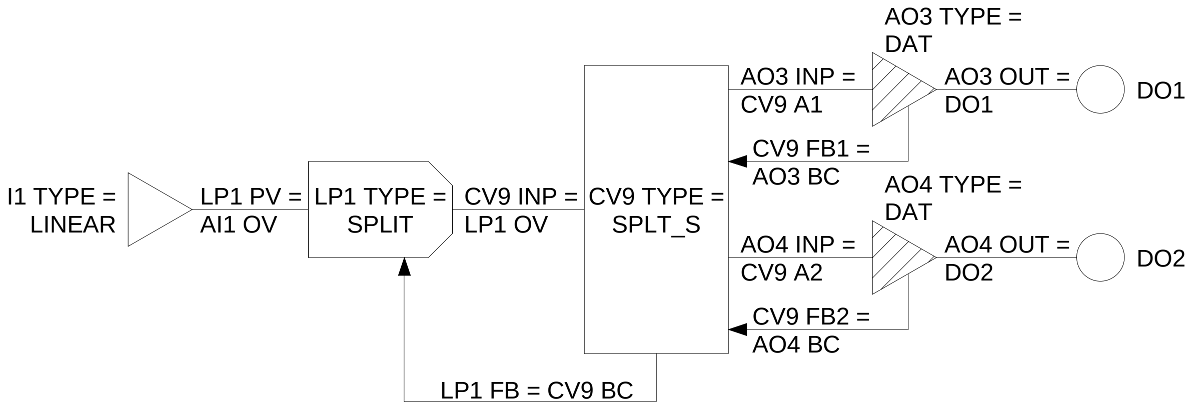
Basic diagram



Wiring diagram



Programming diagram



7.4.9 Configuration 09 (109) - Heat/Cool with Time Proportioned Relay for Heat and Position Proportioning Relays for Cool

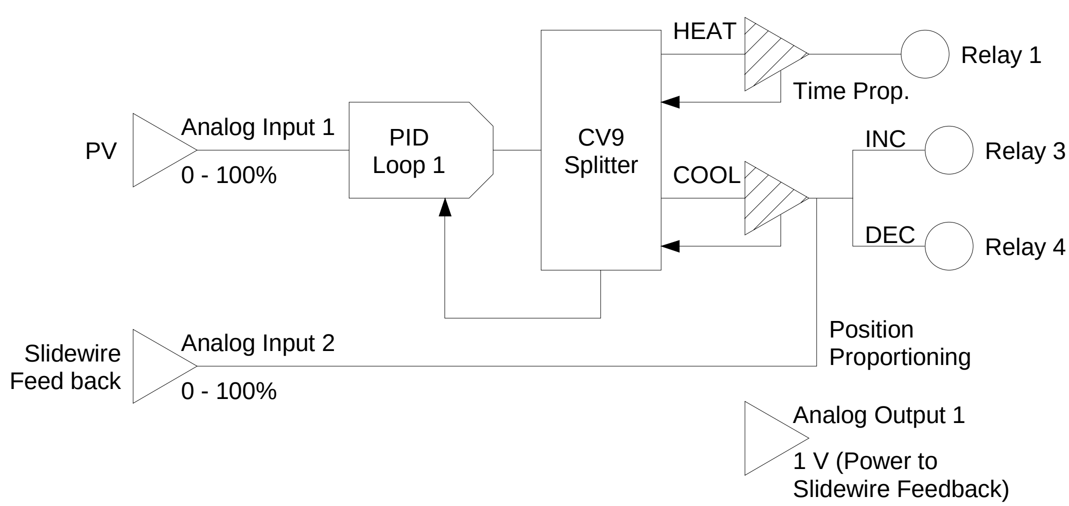
Description

This PID loop with split output uses one relay to provide a time proportioned output to the heater when the process variable is above setpoint, and uses two other relays to provide position proportioning output to the cooler when the PV is below setpoint. A control deadband is configurable. The split output is achieved with a calculated value (CV) function block programmed to be a "standard splitter".

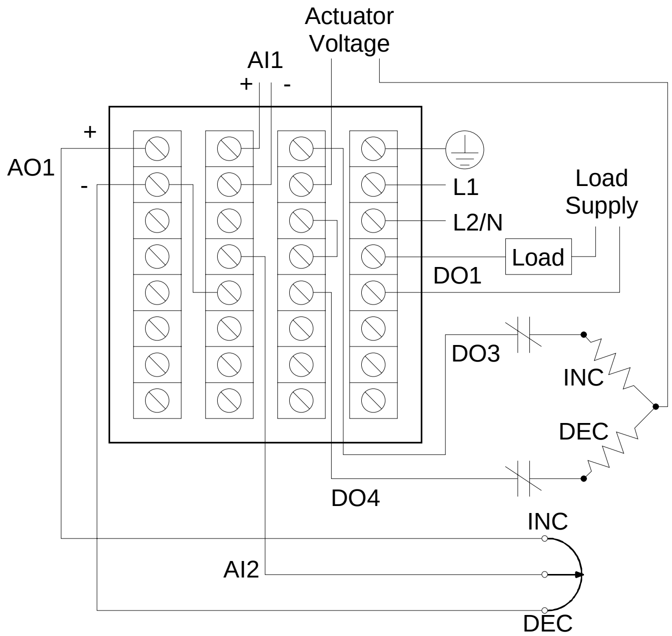
A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the loop (LP) block and the discrete output (DO) block associated with the time proportioned relay. An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO blocks are not associated with analog output terminals.

The analog feedback signal from the positioner's slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

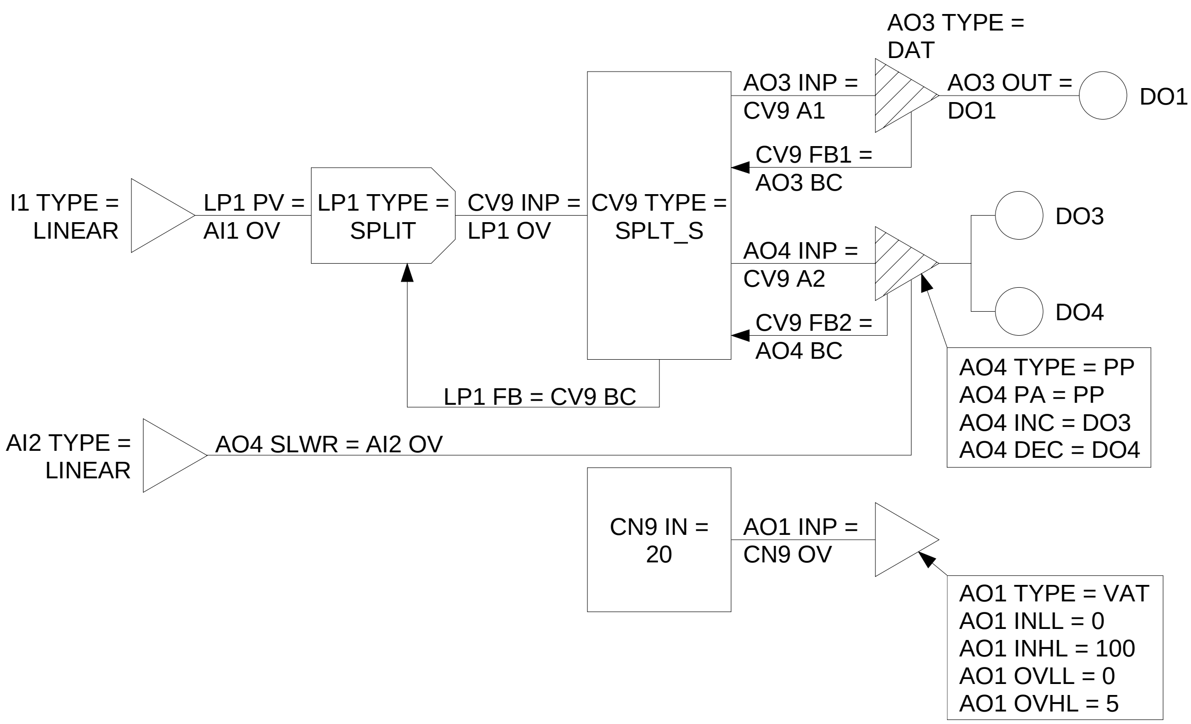
Basic diagram



Wiring diagram



Programming diagram



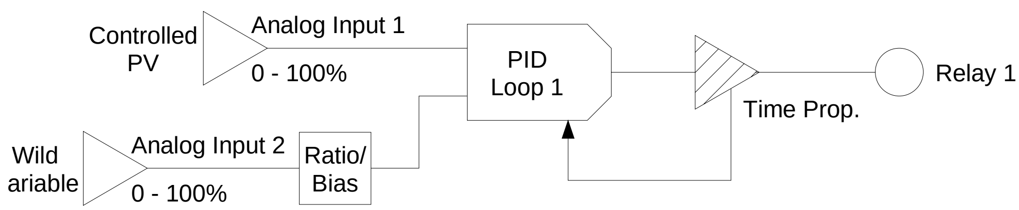
7.4.10 Configuration 10 (110) - PID Ratio Control with Time Proportioned Relay Out

Description

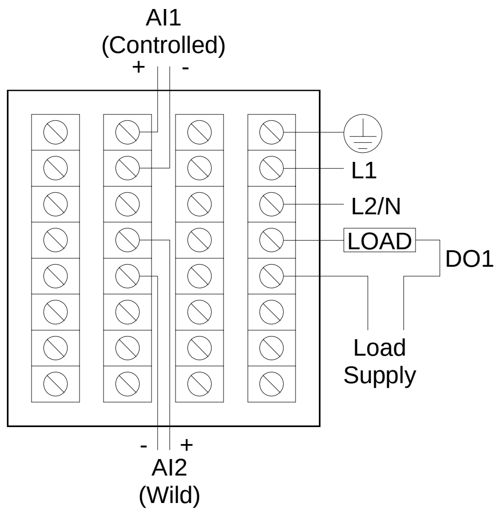
This strategy keeps the controlled variable in ratio with the wild variable. Both variables are supplied as linear analog inputs, each served by an analog input (AI) block.

One relay is used to provide a time proportioned output. A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the loop (LP) block and the discrete output (DO) block associated with the time proportioned relay. In this application the AO block is not associated with analog output terminals.

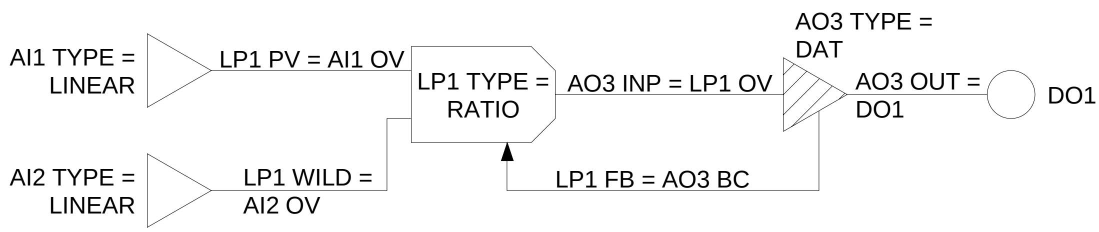
Basic diagram



Wiring diagram



Programming diagram



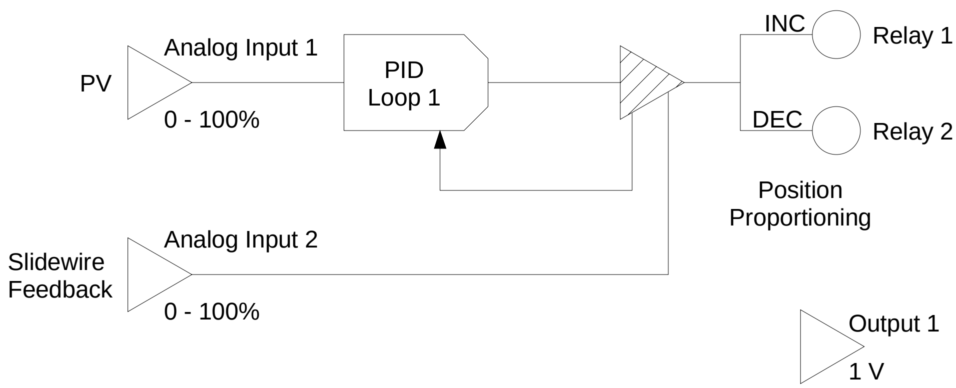
7.4.11 Configuration 11 (111) - PID with Position Proportioning Relays Out

Description

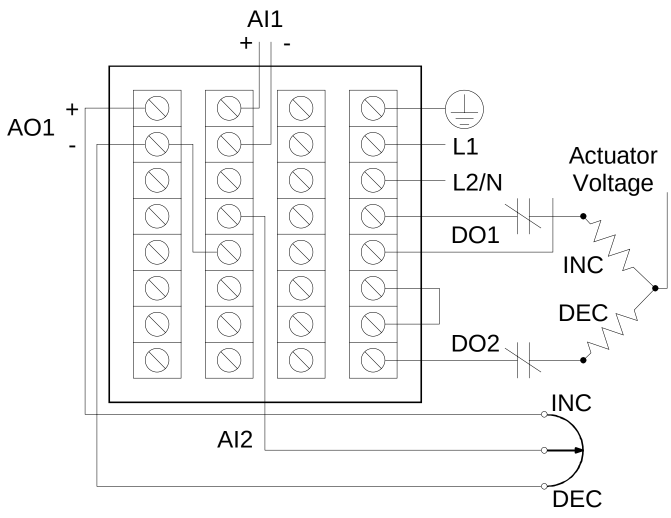
This PID loop's output uses two position proportioning relays. An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO block is not associated with analog output terminals.

The analog feedback signal from the positioner's slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

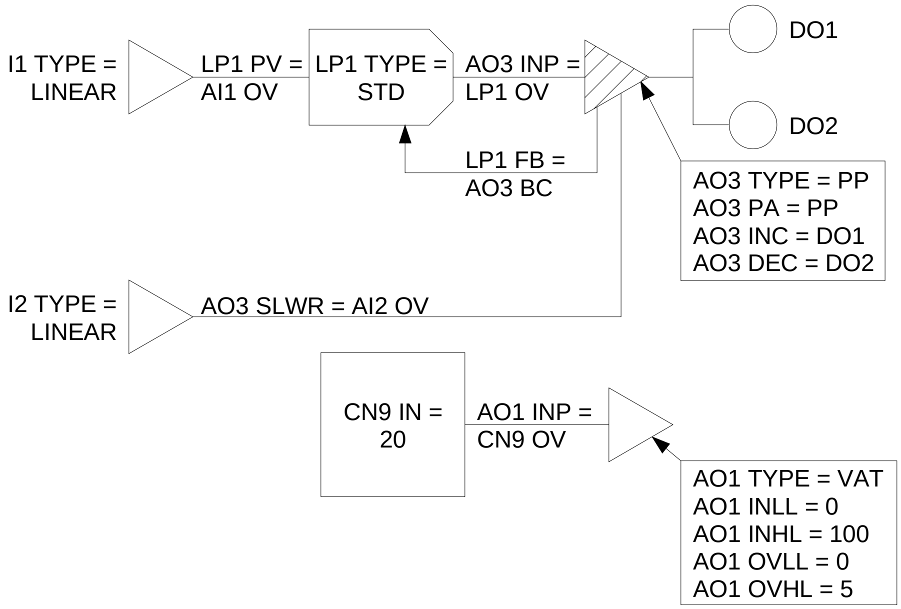
Basic diagram



Wiring diagram



Programming diagram



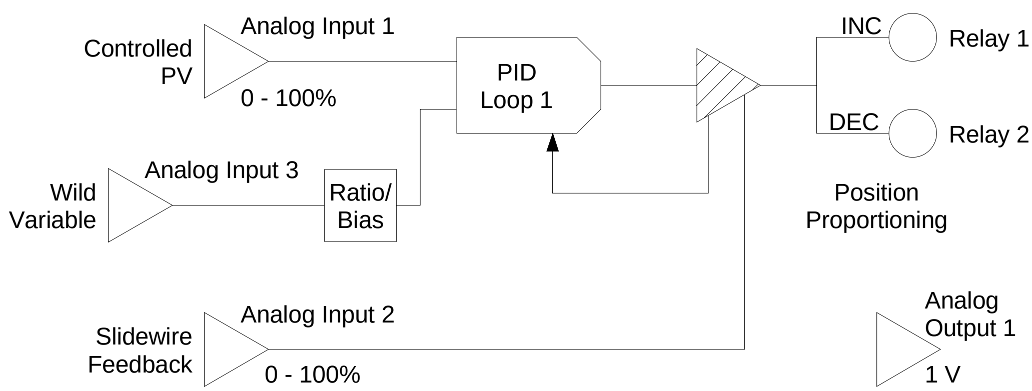
7.4.12 Configuration 12 (112) - PID Ratio Control with Position Proportioning Relays Out

Description

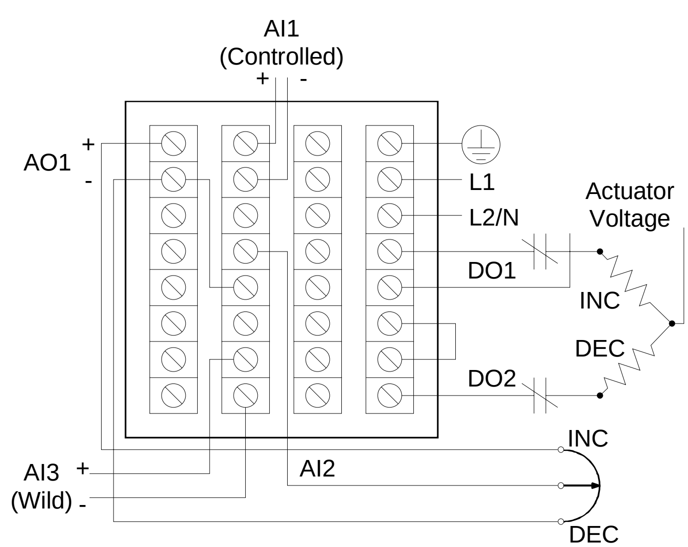
This strategy keeps the controlled variable in ratio with the wild variable. Both variables are supplied as linear analog inputs, each served by an analog input (AI) block. Two relays are used for position proportioning output. An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO block is not associated with analog output terminals.

The analog feedback signal from the positioner's slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

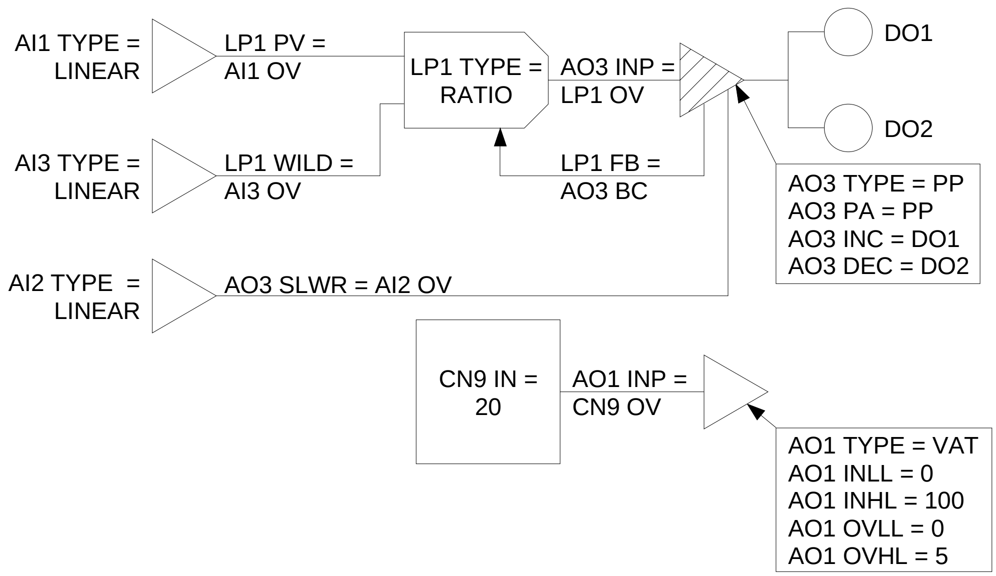
Basic diagram



Wiring diagram



Programming diagram



7.4.13 Configuration 13 (113) – Backup to Primary Controller or PLC; Uses Position Proportioning Relays Out

Description

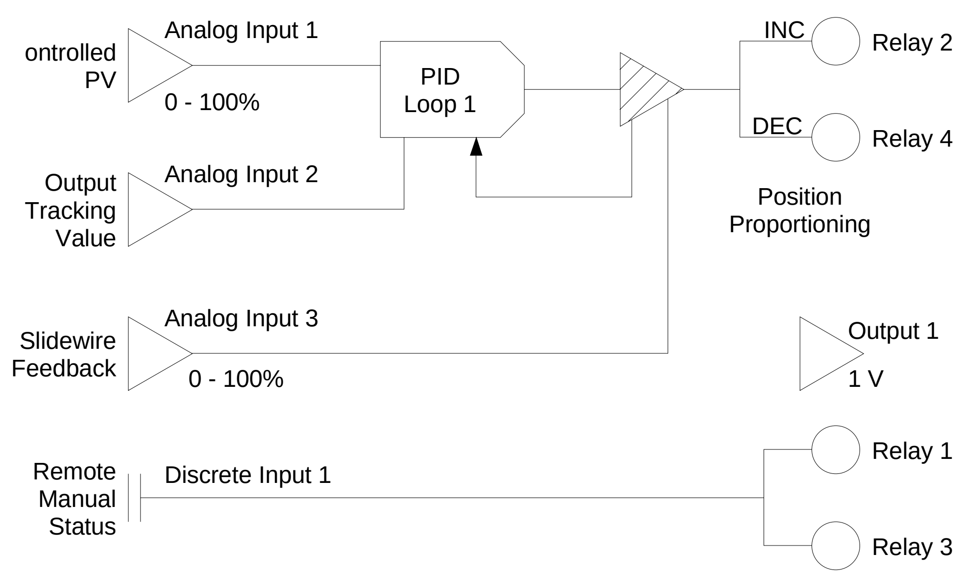
This strategy provides PID control as a backup to a primary controller or PLC. One analog input is used for the PV; another is used to provide the value (from the primary) to be used as the loop's output when "Remote Manual" is enabled via a discrete input.

Two relays are used for position proportioning output. An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO block is not associated with analog output terminals.

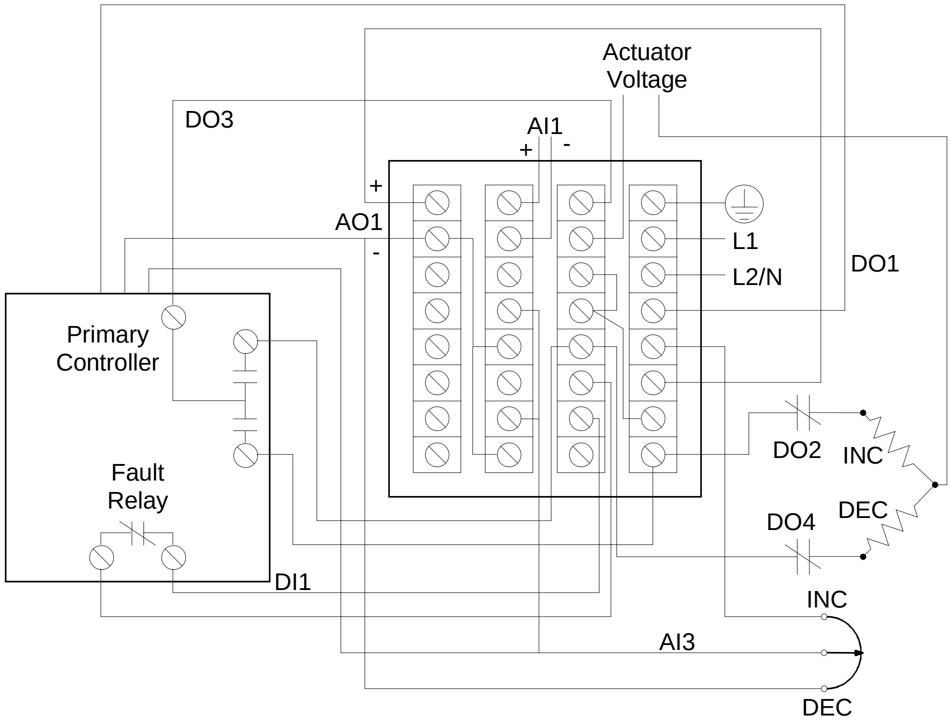
The analog feedback signal from the positioner's slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

A discrete input is used to trigger failover. Its status turns on two relays in the UDC5300: one used to transfer line voltage from the primary controller's output circuits to the UDC5300 output circuits, the other to transfer the feedback slidewire voltage from the primary controller to the UDC5300. Control will be maintained when either the primary controller or the UDC5300 is powered down. If the primary controller's output fails ON, power will be cut to its output circuit.

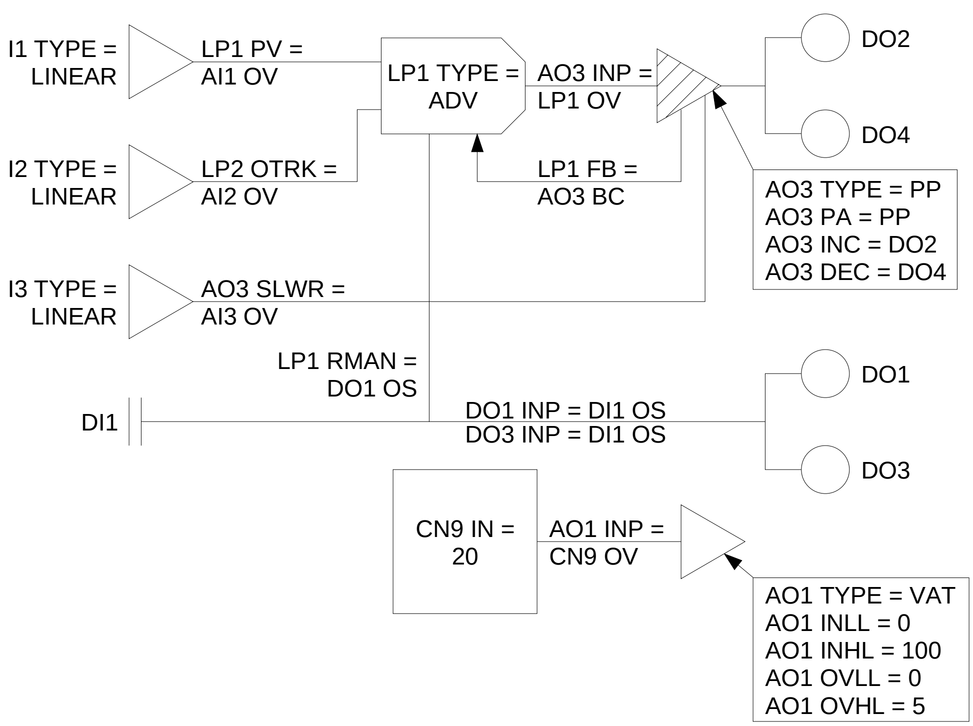
Basic diagram



Wiring diagram



Programming diagram

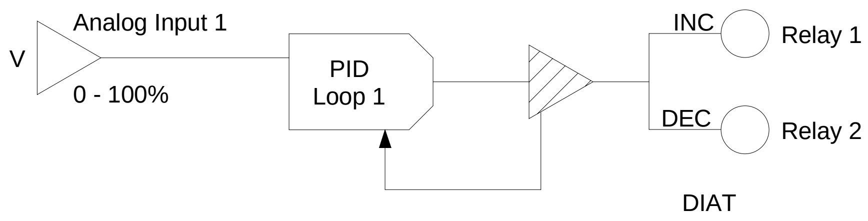


7.4.14 Configuration 14 (114) - PID with DIAT Relays Out

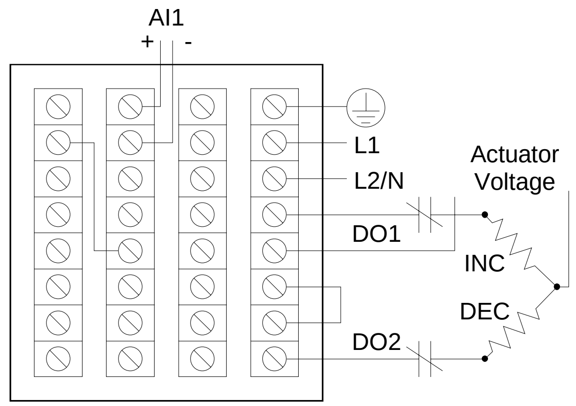
Description

This PID loop uses two relays for DIAT (direction adjusting impulse type) output. An analog output (AO) block with its type set to PP (position proportioning) and its positioning algorithm set to DIAT interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO block is not associated with analog output terminals.

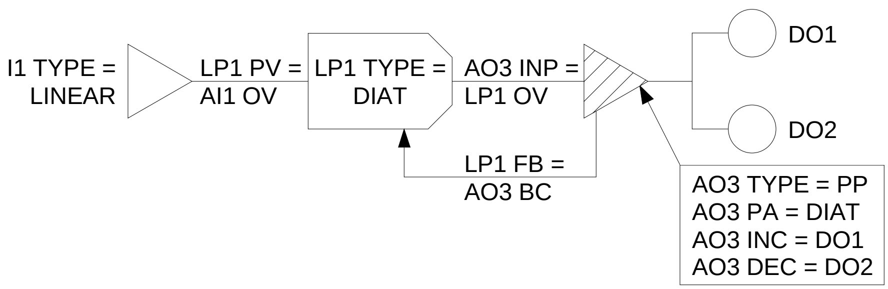
Basic diagram



Wiring diagram



Programming diagram

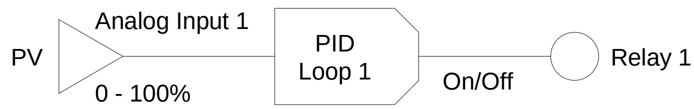


7.4.15 Configuration 15 (115) – Single Loop with ON/OFF Relay

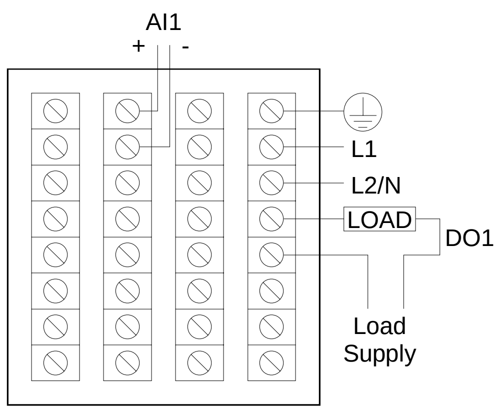
Description

This loop provides ON/OFF control. Its PV input is a linear signal received by an analog input (AI) block. A relay served by a discrete output (DO) function block provides the output.

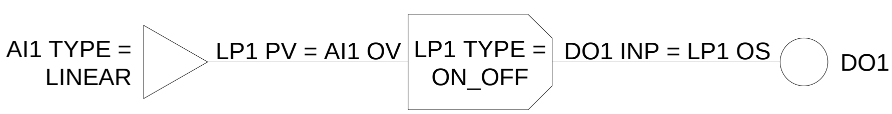
Basic diagram



Wiring diagram



Programming diagram

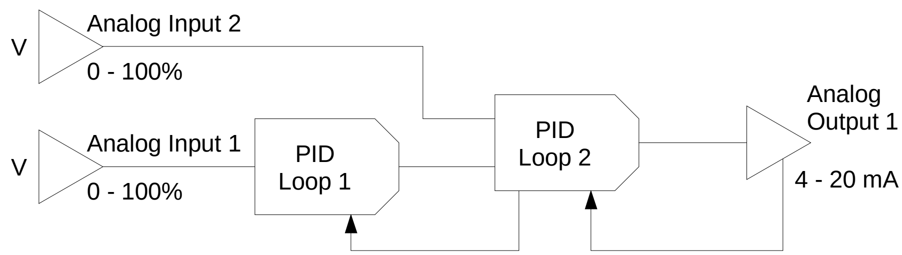


7.4.16 Configuration 16 (216) – Cascade PID with Current Output

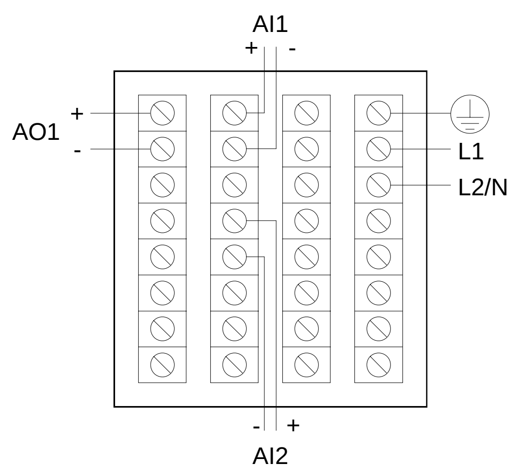
Description

This strategy provides cascade control in which the setpoint of the secondary loop is read from the output value of the primary loop. Each loop uses a linear PV input via an analog input (AI) block. The output is through a CAT (current adjusting type) analog output (AO) block.

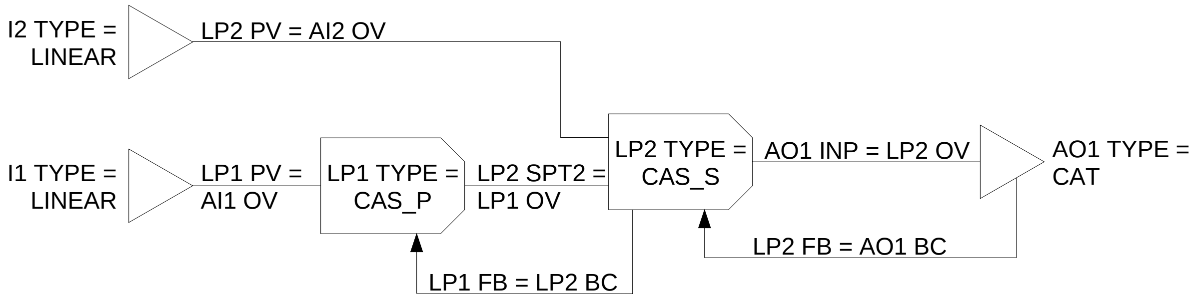
Basic diagram



Wiring diagram



Programming diagram

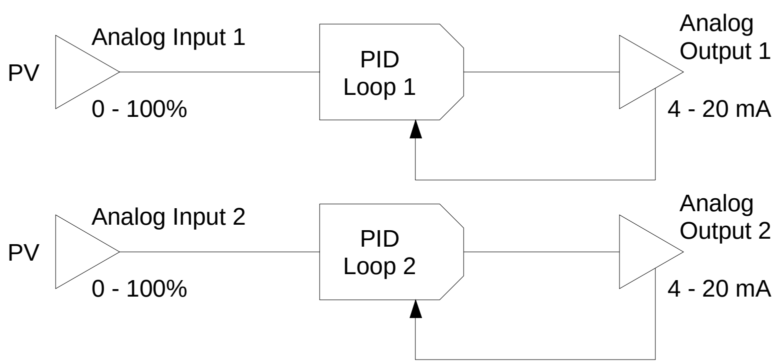


7.4.17 Configuration 17 (217) – Two Independent PID Loops, Each with Current Output

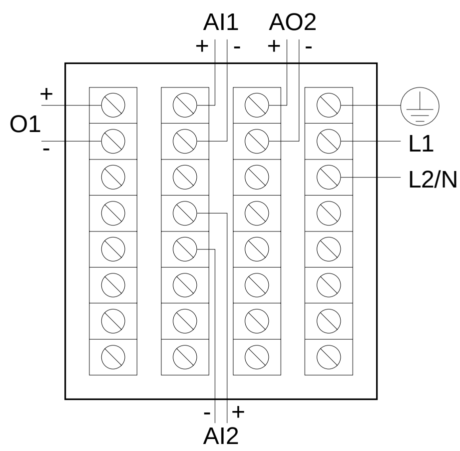
Description

Two independent loops each provide basic PID control. For each a linear input served by an analog input (AI) block supplies the process variable to a standard PID loop. The output of each loop is through a CAT (current adjusting type) analog output (AO) block.

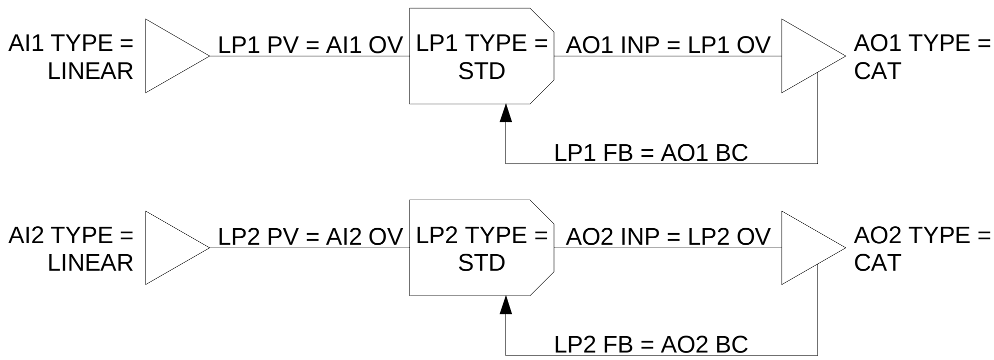
Basic diagram



Wiring diagram



Programming diagram



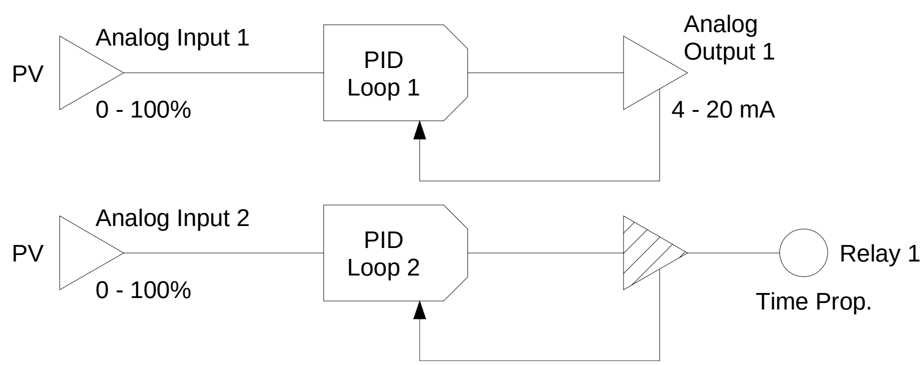
7.4.18 Configuration 18 (218) - Two Independent PID Loops, One with Current Output and One with Time Proportioned Relay Out

Description

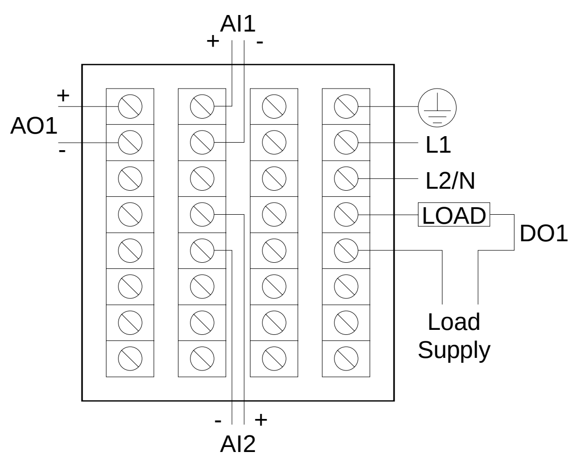
Two independent loops each provide basic PID control. For each a linear input served by an analog input (AI) block supplies the process variable to a standard PID loop. The output of one loop is through a CAT (current adjusting type) analog output (AO) block. The other loop uses one relay to provide a time proportioned output.

A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the loop (LP) block and the discrete output (DO) block associated with the time proportioned relay. In this application the AO block is not associated with analog output terminals.

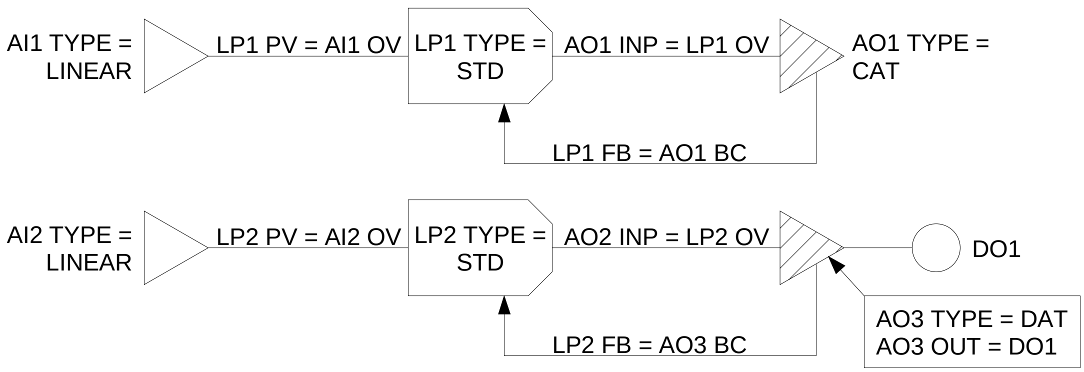
Basic diagram



Wiring diagram



Programming diagram



7.4.19 Configuration 19 (219) - Two Independent PID Loops, One with Current Output and One with Position Proportioning Relays Out

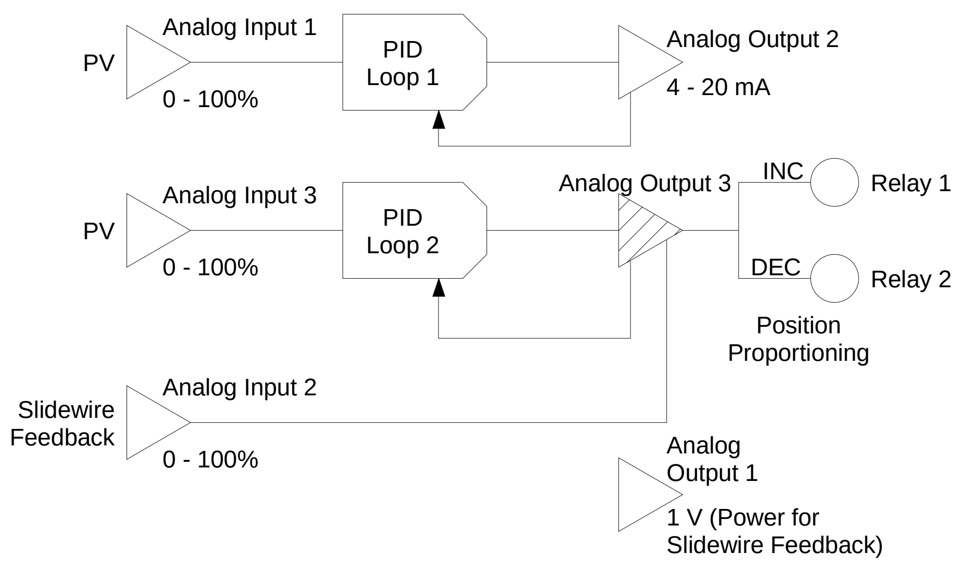
Description

Two independent loops each provide basic PID control. For each a linear input served by an analog input (AI) block supplies the process variable to a standard PID loop. The output of one loop is through a CAT (current adjusting type) analog output (AO) block. The other loop uses two relays to provide a position proportioning output.

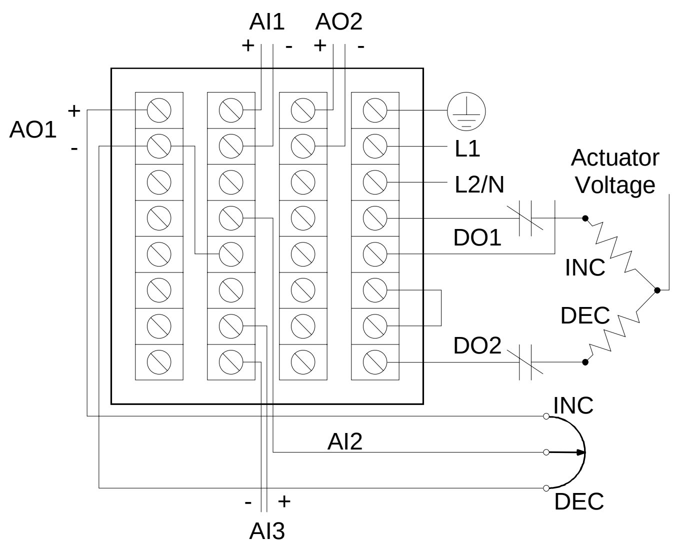
An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the loop (LP) block and the discrete output (DO) blocks associated with the “increase” and “decrease” relays. In this application the AO block is not associated with analog output terminals.

The analog feedback signal from the positioner’s slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

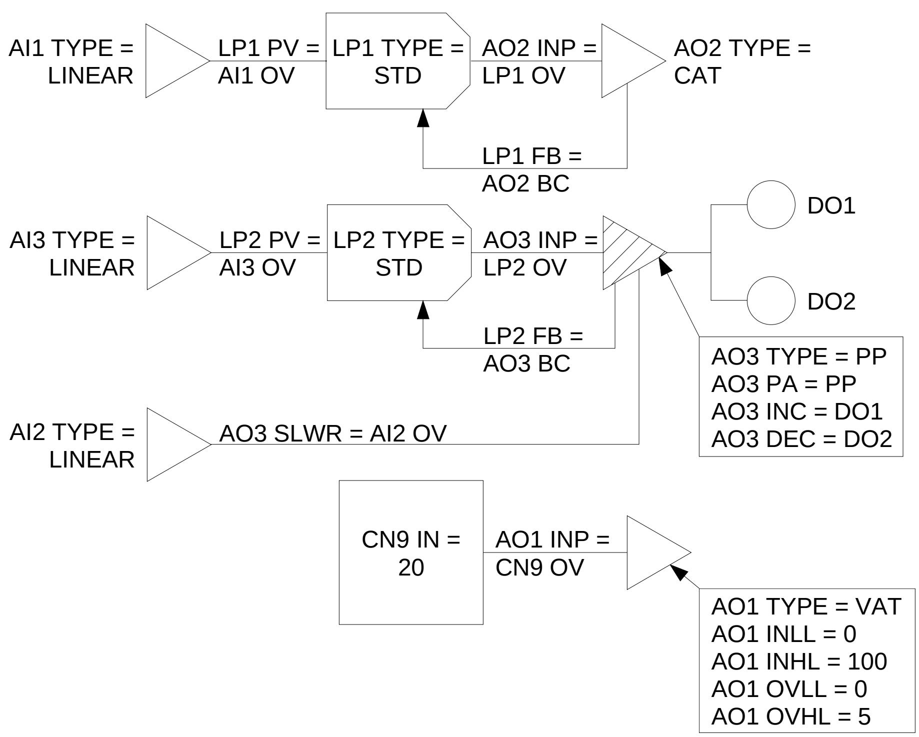
Basic diagram



Wiring diagram



Programming diagram



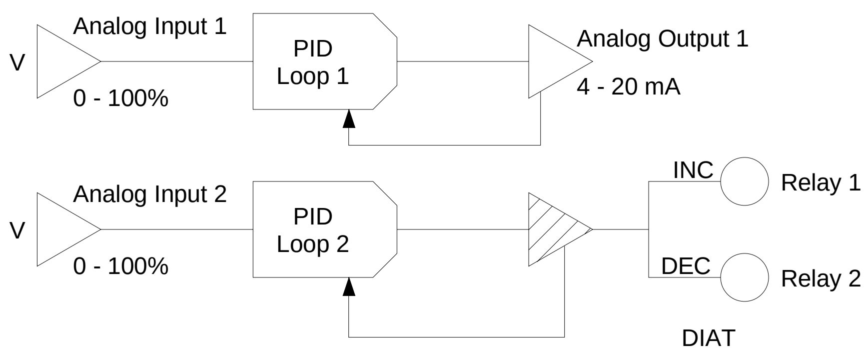
7.4.20 Configuration 20 (220) - Two Independent PID Loops, One with Current Output and One with Direction Impulse Adjusting Relays Out

Description

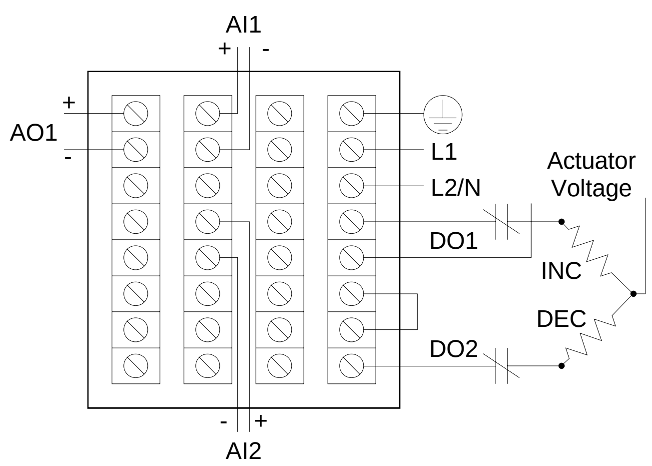
Two independent loops each each have a linear input served by an analog input (AI) block to supply the process variable to the loop. Loop 1 is a standard PID loop with a CAT (current adjusting type) analog output (AO) block. Loop 2 provides PID control using direction impulse adjusting output through two relays.

An analog output (AO) block with its type set to PP (position proportioning) and its positioning algorithm set to DIAT interfaces between the Loop 2 (LP2) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO block is not associated with analog output terminals.

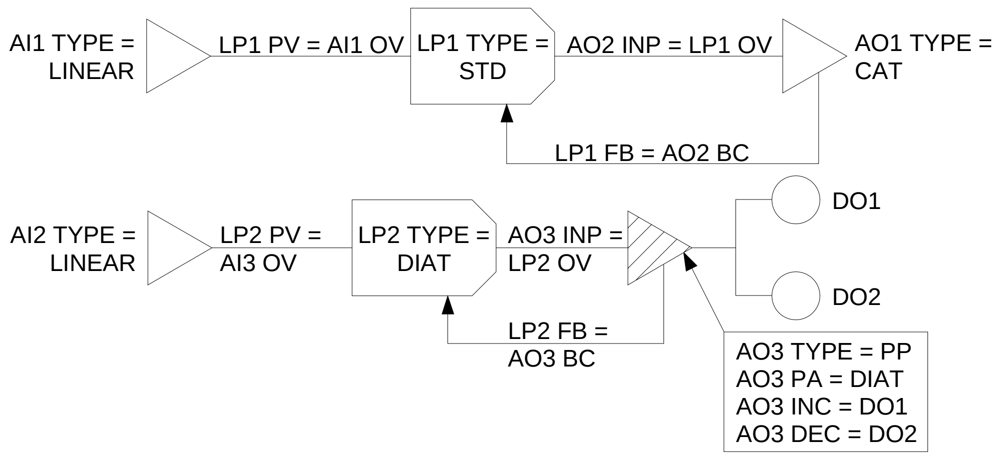
Basic diagram



Wiring diagram



Programming diagram



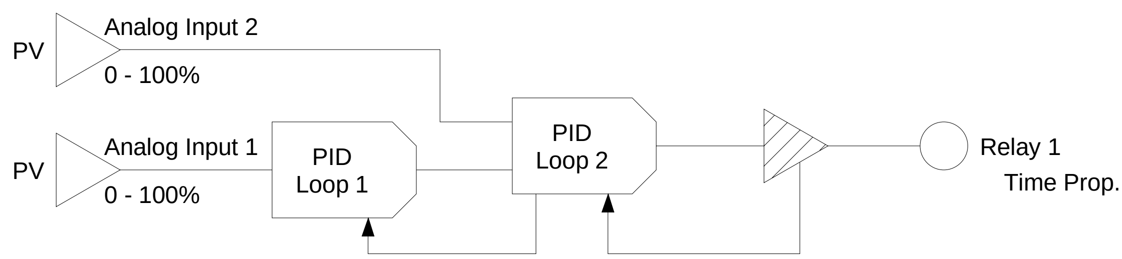
7.4.21 Configuration 21 (221) – Cascade PID with Time Proportioned Relays Out

Description

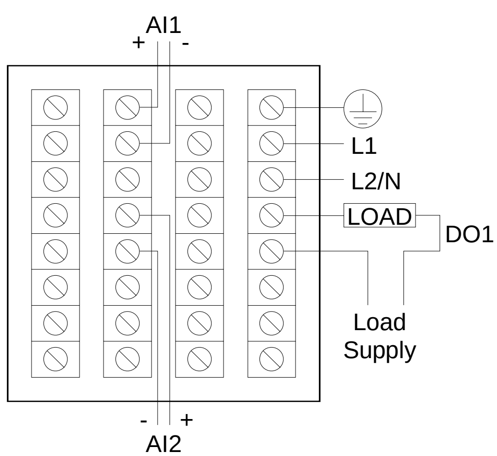
This strategy provides cascade control in which the setpoint of the secondary loop is read from the output value of the primary loop. Each loop uses a linear PV input via an analog input (AI) block. One relay is used to provide a time proportioned output.

A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the secondary loop (LP2) block and the discrete output (DO) block associated with the time proportioned relay. In this application the AO block is not associated with analog output terminals.

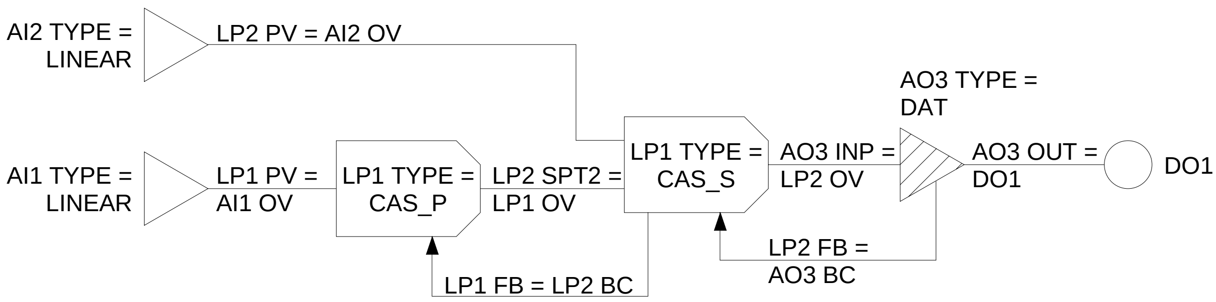
Basic diagram



Wiring diagram



Programming diagram

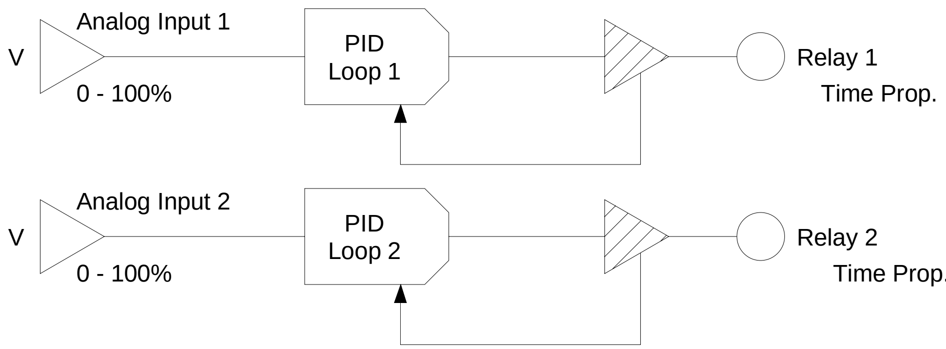


7.4.22 Configuration 22 (222) - Two Independent PID Loops, Each with Time Proportioned Relay Out

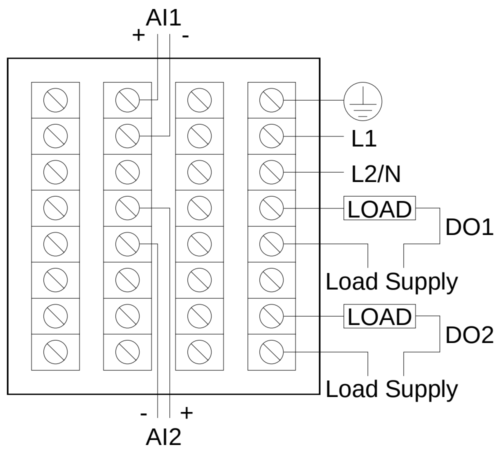
Description

Two independent PID loops each provide time proportioned relay output. Each has a DAT (Duration Adjusting Type) analog output (AO) function block to interface between the loop (LP) block and the discrete output (DO) block associated with the relay. In this application the AO block is not associated with analog output terminals.

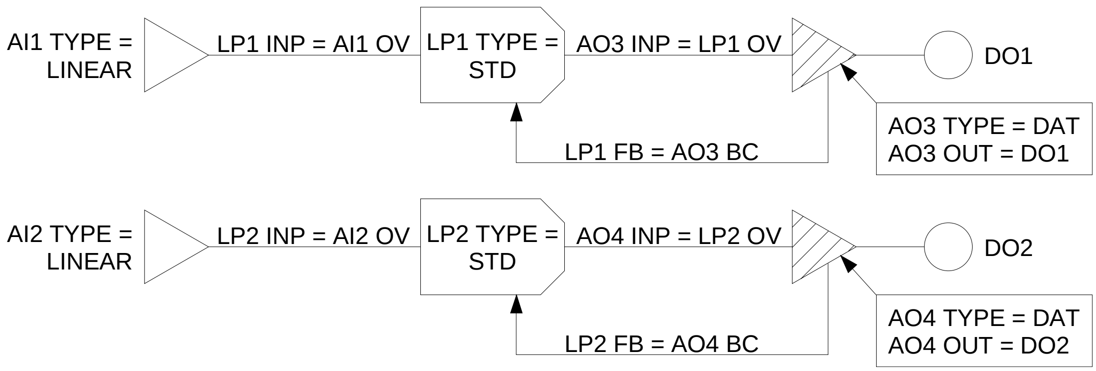
Basic diagram



Wiring diagram



Programming diagram



7.4.23 Configuration 23 (223) - Two Independent PID Loops, One with Time Proportioned Relay Out and One with Position Proportioning Relays Out

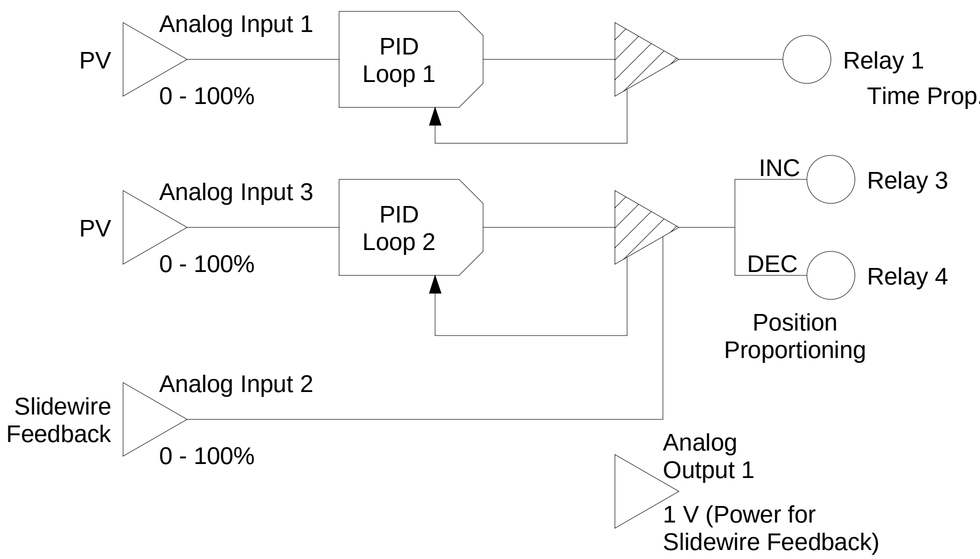
Description

Two independent PID loops are configured. Loop 1 uses one relay to provide a time proportioned output. Loop 2 uses two other relays to provide position proportioning output.

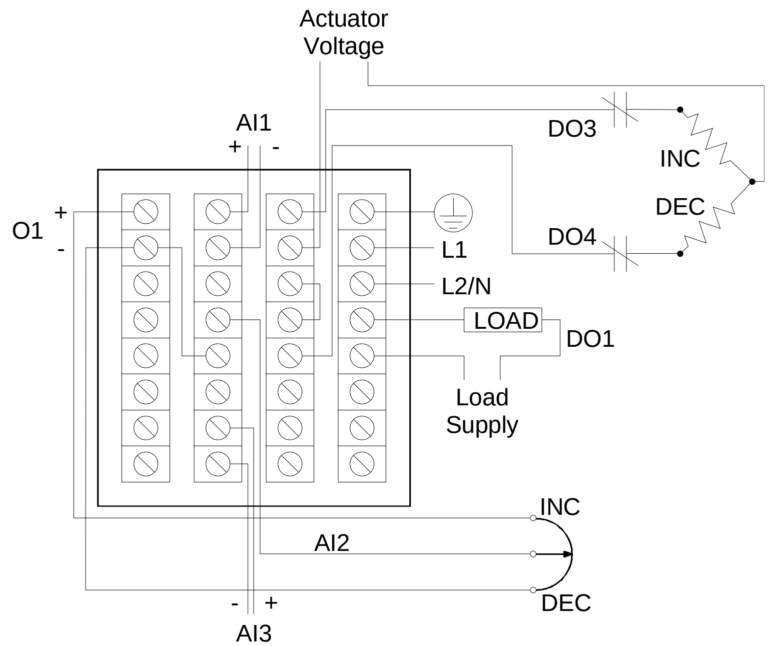
A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the Loop 1 (LP1) block and the discrete output (DO) block associated with the time proportioned relay. An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the Loop 2 (LP2) block and the discrete output (DO) blocks associated with the “increase” and “decrease” relays. In this application the AO blocks are not associated with analog output terminals.

Loop 2 uses an analog feedback signal from the positioner’s slidewire, received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

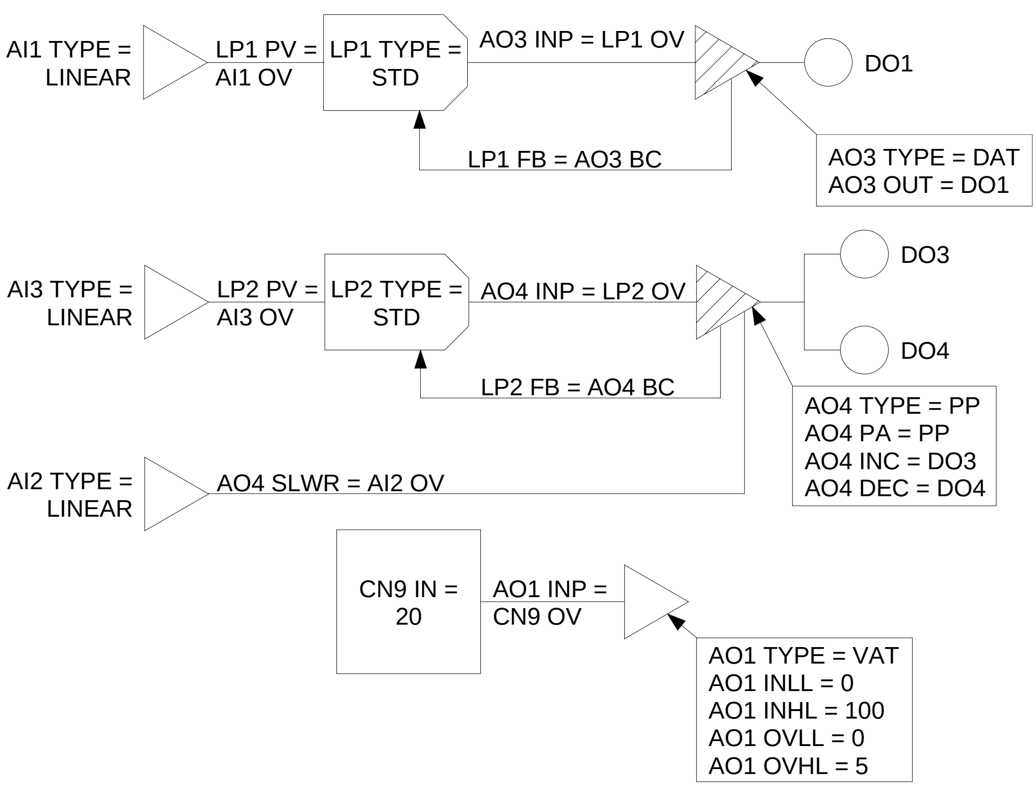
Basic diagram



Wiring diagram



Programming diagram



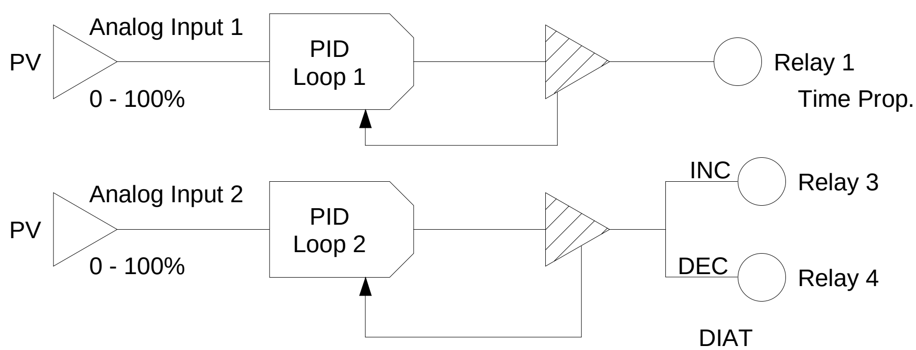
7.4.24 Configuration 24 (224) - Two Independent PID Loops, One with Time Proportioned Relay Out and One with Direction Impulse Adjusting Relays Out

Description

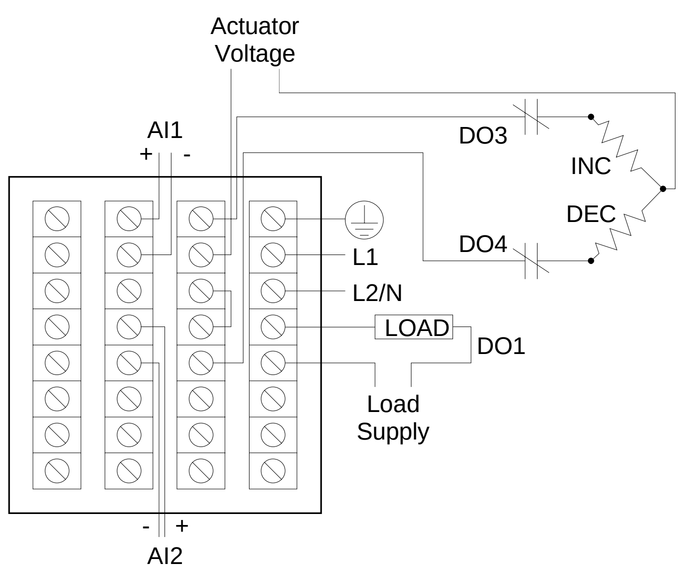
Two independent PID loops are configured. Loop 1 uses one relay to provide a time proportioned output. Loop 2 uses two other relays to provide direction impulse adjusting output.

A DAT (Duration Adjusting Type) analog output (AO) function block interfaces between the Loop 1 (LP1) block and the discrete output (DO) block associated with the time proportioned relay. An analog output (AO) block with its type set to PP (position proportioning) and its positioning algorithm set to DIAT interfaces between the Loop 2 (LP2) block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO blocks are not associated with analog output terminals.

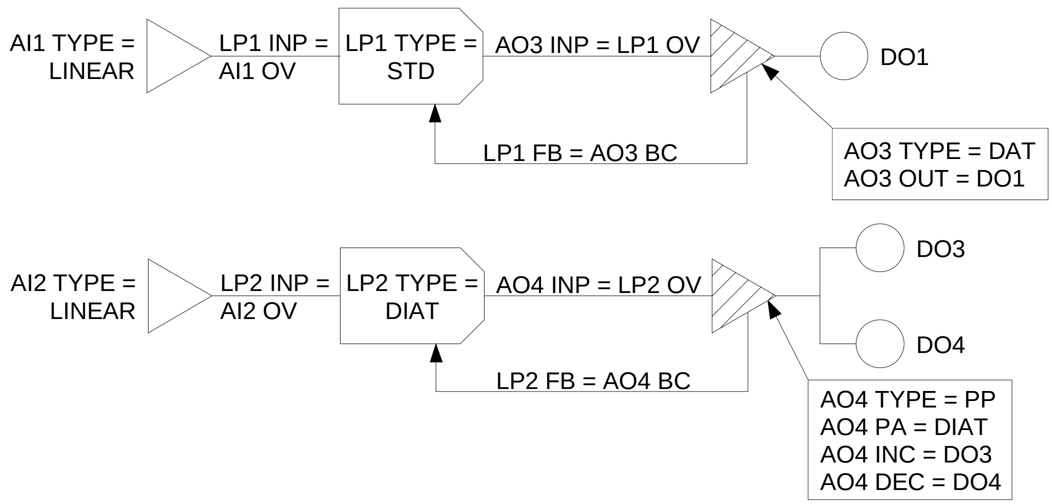
Basic diagram



Wiring diagram



Programming diagram



7.4.25 Configuration 25 (225) – Cascade PID Position Proportioning Relays Out

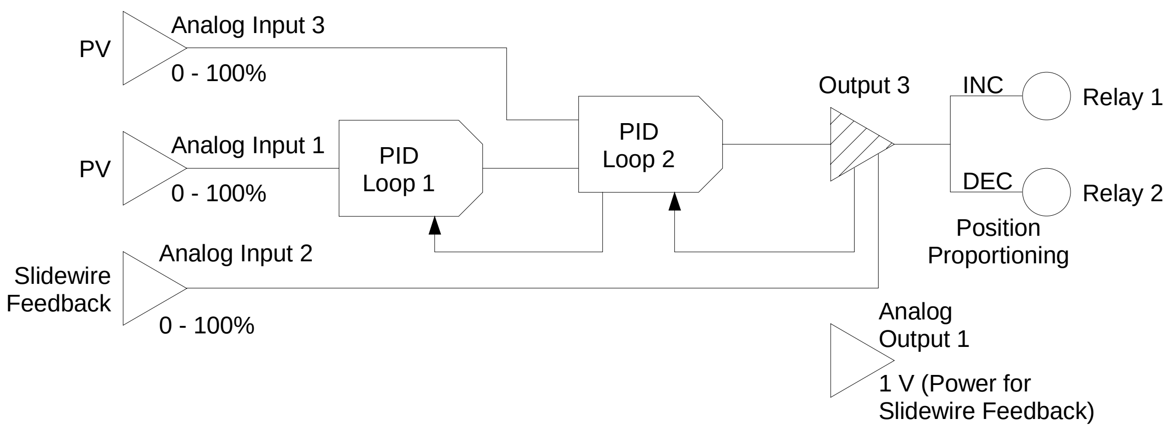
Description

This strategy provides cascade control in which the setpoint of the secondary loop is read from the output value of the primary loop. Each loop uses a linear PV input via an analog input (AI) block. . Two relays are used to provide a position proportioning output.

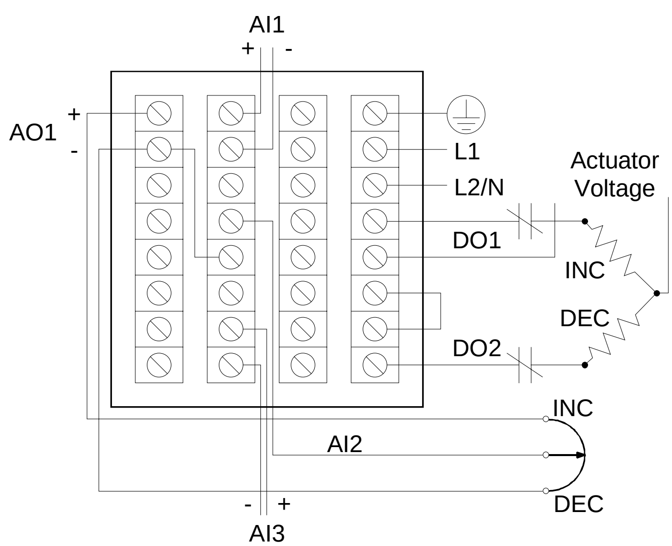
An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the secondary loop block and the discrete output (DO) blocks associated with the "increase" and "decrease" relays. In this application the AO block is <u>not</u> associated with analog output terminals.

An analog feedback signal from the positioner's slidewire is received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

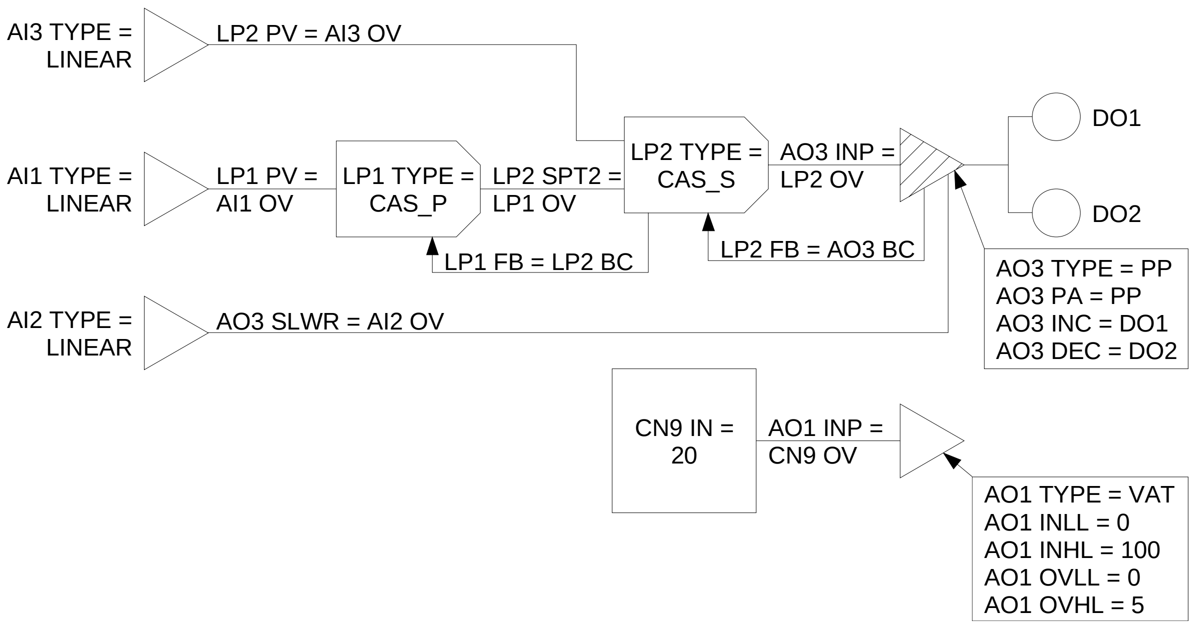
Basic diagram



Wiring diagram



Programming diagram



7.4.26 Configuration 26 (226) - Two Independent PID Loops, One with Position Proportioning Relays Out and One with Direction Impulse Adjusting Relays Out

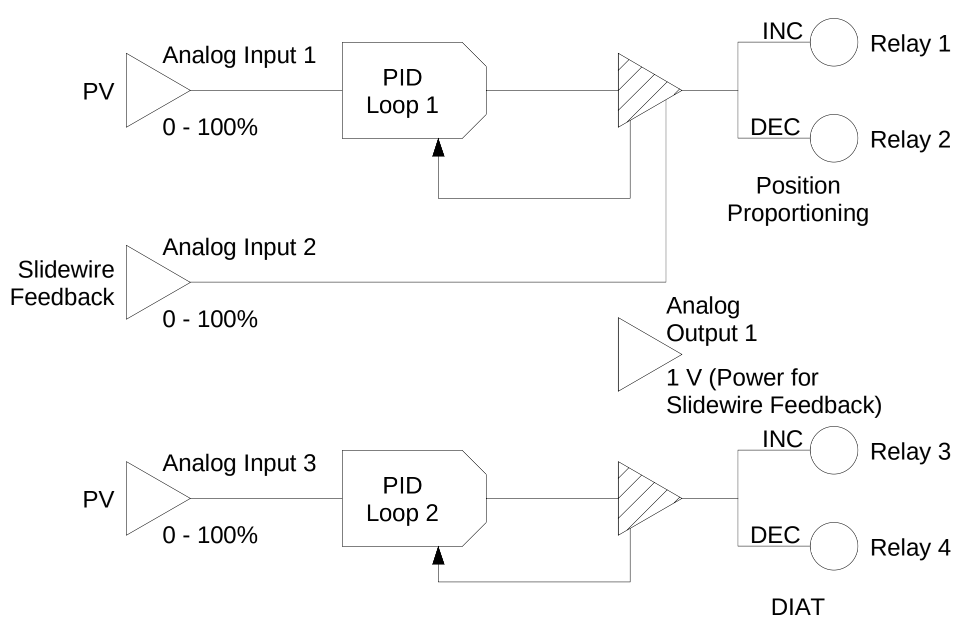
Description

Two independent loops each provide basic PID control. For each a linear input served by an analog input (AI) block supplies the process variable to a standard PID loop. Loop 1 uses two relays to provide position proportioning output. Loop 2 uses two relays to provide direction impulse adjusting output.

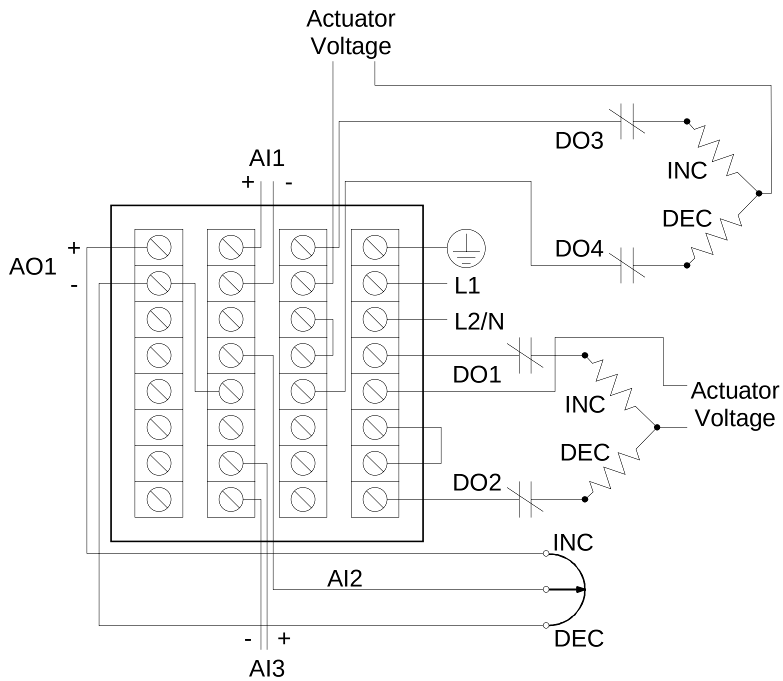
An analog output (AO) block with both its type and its positioning algorithm set to PP (position proportioning) interfaces between the Loop 1 (LP1) block and the discrete output (DO) blocks associated with the PP "increase" and "decrease" relays. An analog output (AO) block with its type set to PP (position proportioning) and its positioning algorithm set to DIAT interfaces between the Loop 2 (LP2) block and the discrete output (DO) blocks associated with the DIAT "increase" and "decrease" relays. In this application the AO block is not associated with analog output terminals.

Loop 1 uses an analog feedback signal from the positioner's slidewire, received at AI2. The feedback is powered by a constant 1 V from the terminals associated with AO1 and its VAT (voltage adjusting type) AO function block having an output range from 0 to 5. Because the input to the AO is 20 (from a constant (CN) block), a steady 1 V out is achieved (20 % of the 5 V range).

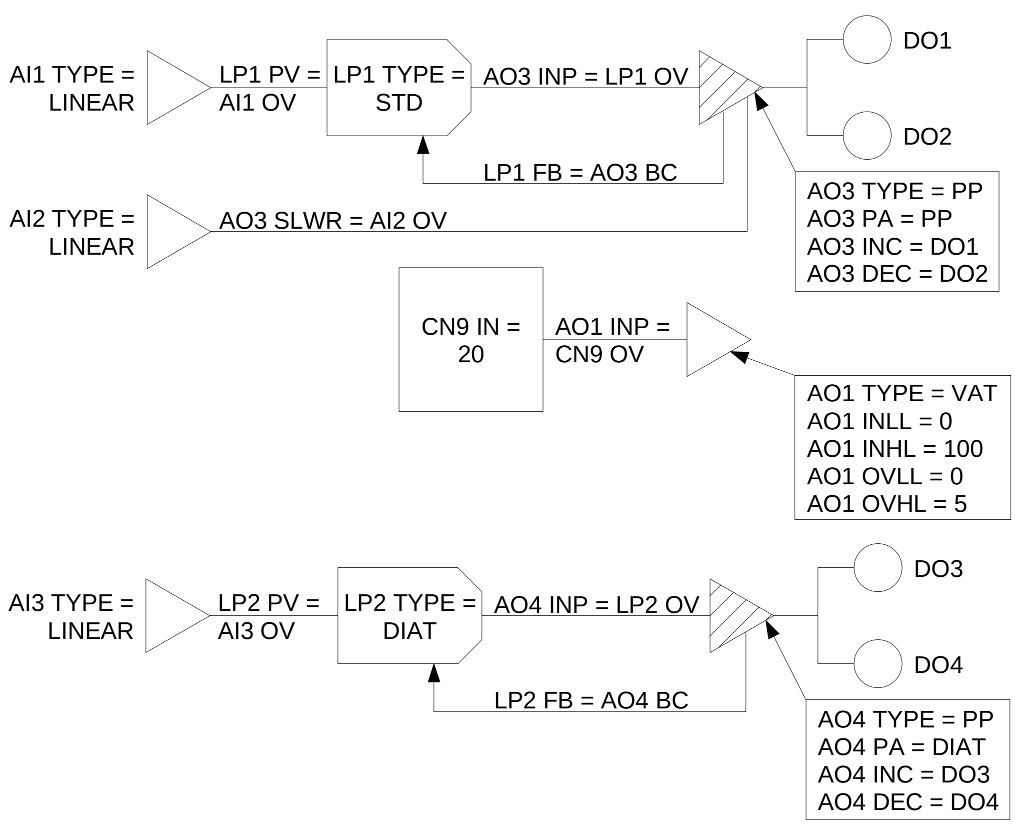
Basic diagram



Wiring diagram



Programming diagram



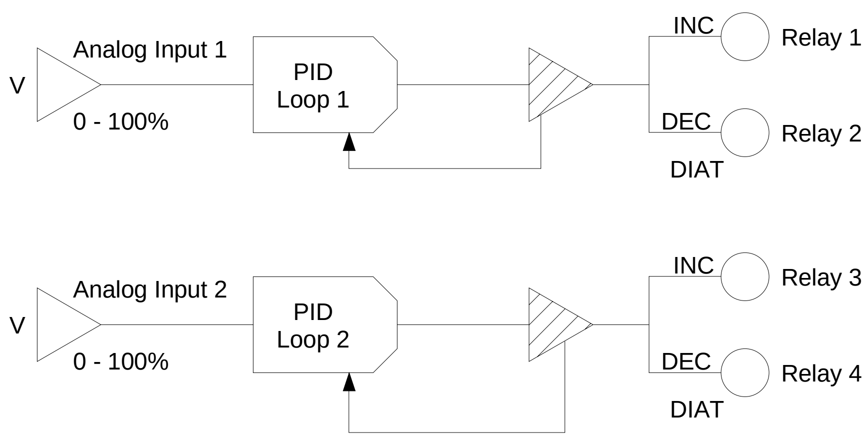
7.4.27 Configuration 27 (227) – Two Independent PID Loops, Each with Direction Impulse Adjusting Relays Out

Description

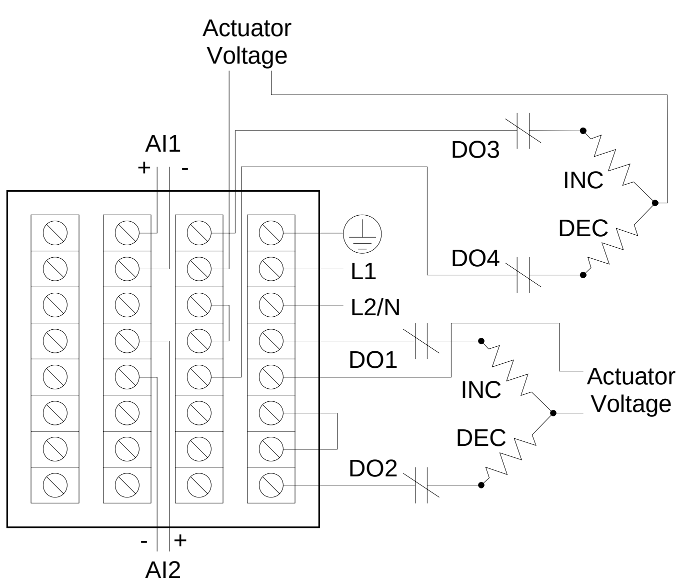
Two independent loops each provide PID control with direction impulse adjusting output using two relays for each loop. For each loop a linear input, served by an analog input (AI) block, supplies the process variable.

An analog output (AO) block with its type set to PP (position proportioning) and its positioning algorithm set to DIAT interfaces between each loop (LP) block and the discrete output (DO) blocks associated with the loop's "increase" and "decrease" relays. In this application the AO blocks are not associated with analog output terminals.

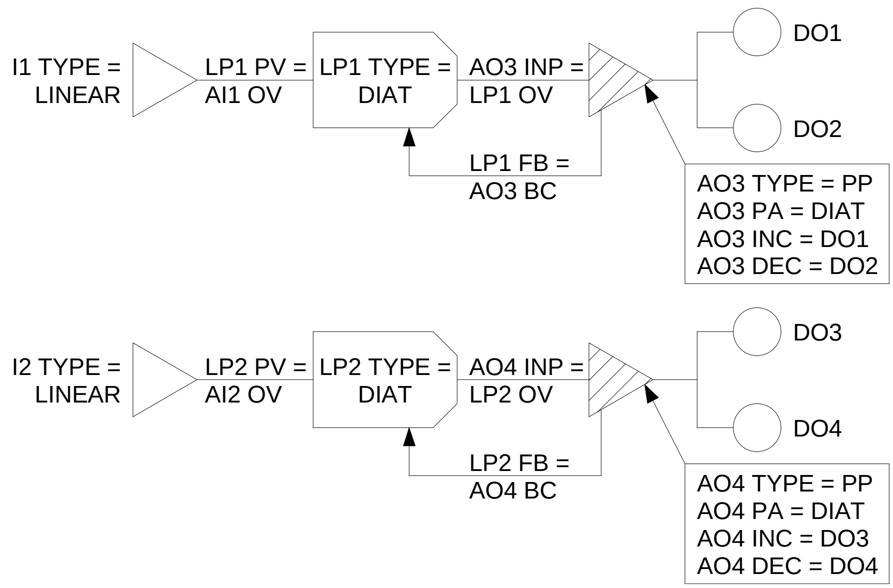
Basic diagram



Wiring diagram



Programming diagram

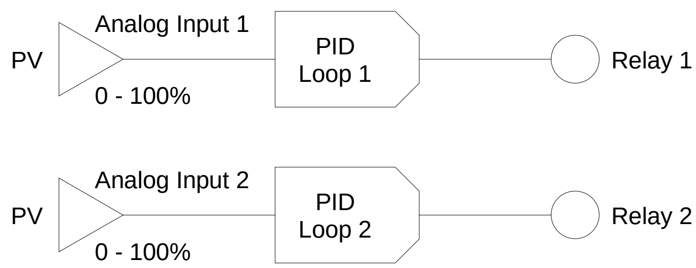


7.4.28 Configuration 28 (228) – Two Independent Loops, Each with ON/OFF Relay

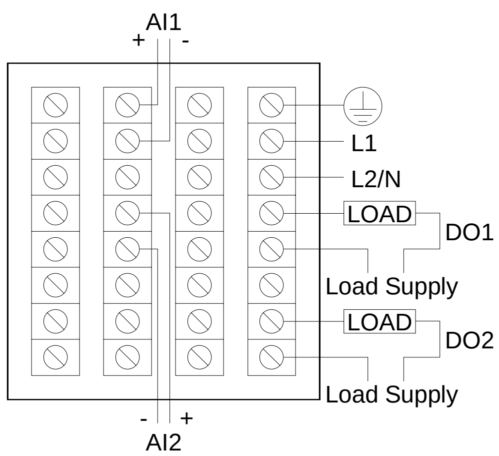
Description

Two independent loops each use a linear input signal served by an analog input (AI) block for the PV. Each uses a relay served by a discrete output (DO) function block for ON/OFF control.

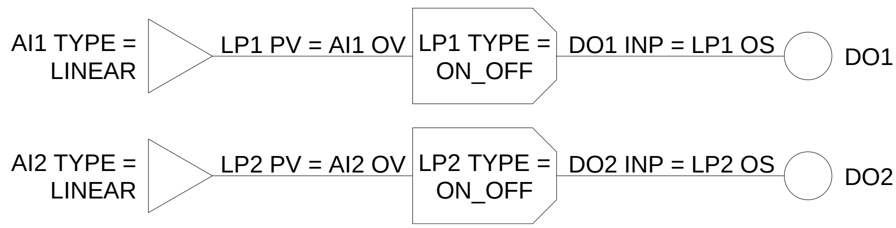
Basic diagram



Wiring diagram



Programming diagram



8. Learning to Create Custom Programs

8.1 Overview

Introduction

This section is intended to show first-time users of the UDC5300 controller how to approach the task of creating a custom program. **If you plan to use a factory configuration. this section provides more details than you need to know.** It provides sample applications, along with their function block diagrams. The first example is a simple control arrangement described in great detail to help you understand function block diagram basics, followed by more sophisticated examples. Once you understand how to diagram function blocks, you will be able to draw a diagram for virtually any control strategy regardless of complexity.

This section assumes that you are already familiar with the information in Section 5, *Planning*, and Section 6, *Modes, Menus, Prompts, and Keypad Basics*.

What's in this section?

The following topics are covered in this section.

8.2 Programming a Current Driven Heat Treat Element

Introduction

An example of one of the most common and simple control strategies is in Figure 8-1 below.

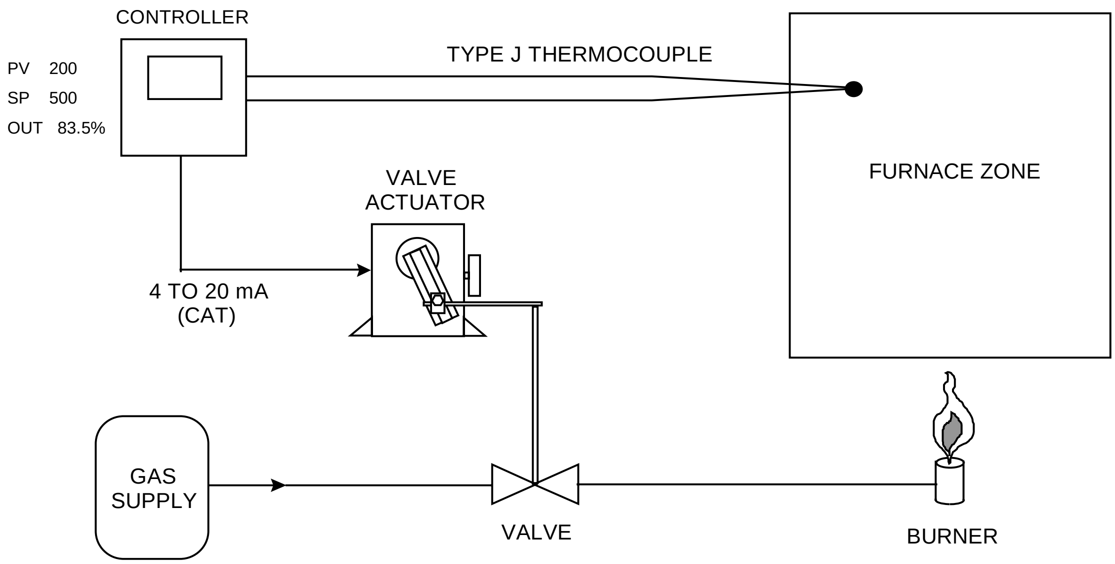


Figure 8-1 Control of Furnace Zone Temperature with 4-20 mA (CAT) Control Signal

1. Diagram the function blocks

To configure this application using the instrument, your task is to build up a simple current control loop. Note that this control loop must monitor and control the temperature of the furnace zone to a local set point of 500 ºF. Using a 4 mA to 20 mA signal applied to a gas valve actuator, the furnace zone's temperature will be controlled by regulating the flow of gas to the zone's burner. The instrument will measure temperature, in a range between 0 °F and 1000 °F, by means of a Type J thermocouple.

To support this application, a 4 mA to 20 mA control loop with a thermocouple process variable must be configured. Three function blocks—one for specifying a thermocouple analog input, a second for a standard PID control loop, and a third defining a 4 mA to 20 mA analog output—are needed to produce this control strategy's function block diagram.

Each function block should first be arranged as in Figure 8-2. Analog input and output function blocks are represented by right-pointed triangles. Control loop function blocks are represented by right-pointed parallelograms.

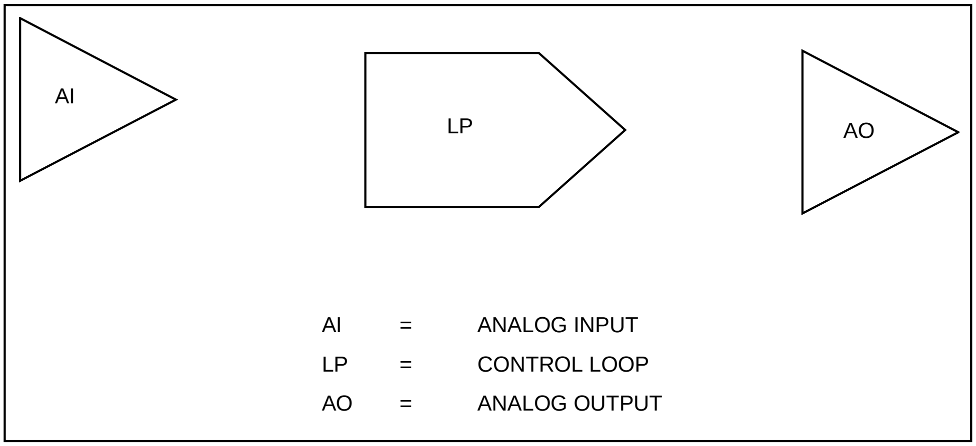


Figure 8-2 Basic Function Blocks Required for Control Configuration of Figure 8-1

2. Label input parameters

Properly label each function block. First, assign to each function block a name that identifies it within the hardware and feature capacities of the instrument being worked with. You may assign any of the analog inputs, control loops, and analog outputs that your instrument has to the blocks comprising the function block diagram drawn. For simplicity, AI1, LP1, and AO1 will be used in this example. Refer to Figure 8-3. Note that AI5, LP2, and AO2 could just as easily have been used.

3. Label output parameters

The second part in labeling each function block is to denote the blocks' major input and output parameters. Each of these parameters will correspond to actual menu settings that you program on the instrument. As shown in Figure 8-3, the AI1 function block's input parameter will be the actual Type J thermocouple run from the furnace to the instrument's AI1 input terminals. The AI1 block will process the thermocouple's millivolt signal to generate a temperature measurement. AI1's output value, denoted "AI1 OV", will essentially be the furnace zone temperature. The LP1 function block is shown, for now, with one input denoted by "PV". Here, the control loop block will expect to find the data comprising its process variable. The LP1 block's single output is the loop's main control output. Denoted "LP1 OV (Loop 1's Output Value)", it will range between 0 % and 100 %. The value of LP1 OV at any given instant will be determined by the control loop function block's PID algorithm.

The last block in the diagram is the analog output function block, AO1. Drawn at this point with just a single input and output, its primary purpose will be to generate a 4 mA to 20 mA signal that linearly corresponds to whatever value is applied at its input. For example, if AO1's input is defined as some value that ranges from 0 % to 100 %, an input value of 0 % will cause AO1 to generate a 4 mA signal at the instrument's AO1 output terminals. A 12 mA signal will be generated in response to an input of 50 %, while 20 mA will result when a 100 % input value is applied. AO1's input parameter is denoted "IN", with its output parameter labeled to identify it as the physical 4 mA to 20 mA signal detectable at the pair of instrument rear terminals dedicated to AO1.

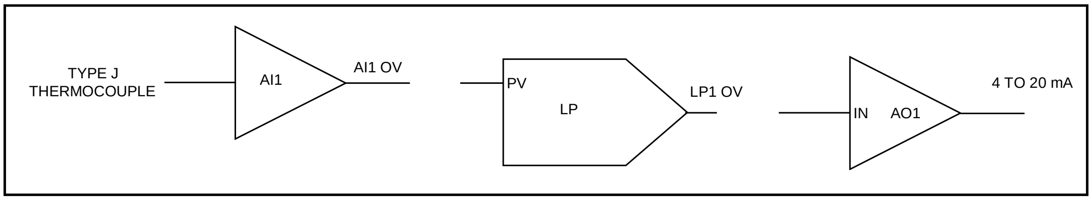


Figure 8-3 Labeling Each Function Block's Name, and Major Inputs and Outputs

4. Label function block parameters

Finally, label each block's internal parameters. "Internal parameters" may also be referred to as "function block parameters." As in the case of input and output parameters, internal parameters associated with each block correspond to actual menu settings you program in the instrument. While input and output parameters constitute either data exchanged between function blocks or physical signals exchanged between the instrument and the outside world, internal parameters are settings that uniquely define the operation of the function block they are associated with. Use of a function block's internal parameters is for the most part limited to within the operations of the function block itself.

It is not always possible, or even practical, to draw every internal parameter that a function block has or might need. Therefore, as a rule-of-thumb for starting out, you should first think of internal parameters as simple labels that further define and clarify the internal operation of the function block. With this rule-of-thumb in mind, internal parameters become items that are hopefully intuitively obvious. At this point, what may or may not be an "intuitively obvious" internal parameter will depend on your level of process control expertise. For the function block diagram built up so far, internal parameters that can be presumed from the control strategy of Figure 8-1 are indicated in Figure 8-4. Here, the AI1 function block has been labeled to show that its "INPUT TYPE" will be a Type J thermocouple with a measurement range between 0 (RANGE LOW) and 1000 ºF (RANGE HIGH). The label "STANDARD" has been used to indicate the type of control loop LP1 will be, along with the notation "SP = 500" to show that the loop's set point will be 500 ºF. The loop tuning constants of GAIN, RESET, and RATE have been initially indicated as 10, 1 repeat/minute, and 0 minutes, respectively. As far as the AO1 function block is concerned, its input range has been defined between 0 (IN LOW LIMIT) and 100 (IN HIGH LIMIT) in anticipation of using LP1's output to drive the 4 mA to 20 mA signal it will generate. Note how AO1's output range has been defined through use of the notation "OUT LOW LIMIT = 4" and "OUT HIGH LIMIT = 20."

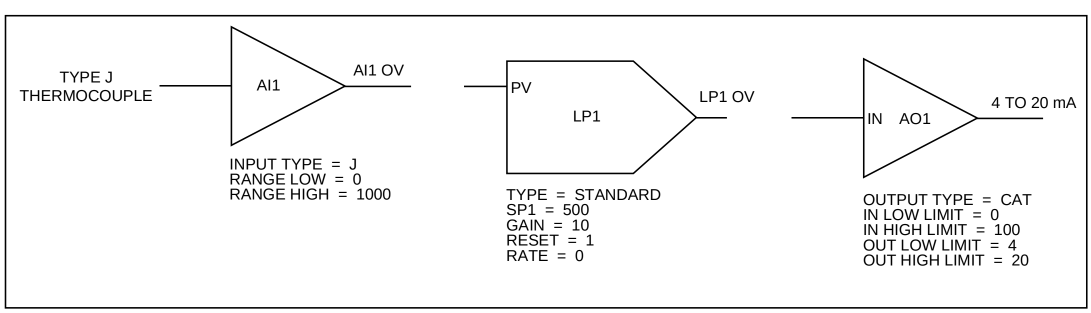


Figure 8-4 Labels for Internal Function Block Parameters

Note that the internal parameters that we have specified in the function block diagram built up so far are based largely on what can be inferred from the elements of the control configuration depicted in Figure 8-1. These internal parameters will relate directly to settings found in instrument programming menus that exist for each particular function block. As your experience and familiarity with programming the instrument increases, you will become more familiar with some of the less intuitive parameters and you will include these in your diagrams.

5. Connect the blocks

The next step is to connect the function blocks in the diagram. Refer to Figure 8-5. The interconnection lines drawn depict the flow of information between function blocks and represent how the blocks work together to support the complete control strategy. As shown, the furnace zone temperature measurement that AI1 generates will essentially be used as the process variable of the LP1 control loop. Based on the values of the loop's tuning constants and on how far AI1 OV deviates from the 500 ºF set point, the control loop function block's PID algorithm will accordingly adjust LP1 OV to whatever value will be necessary to maintain the process' set point. LP1 OV, which ranges from 0 % to 100 %, will in turn be applied to AO1's input to drive the 4 mA to 20 mA control signal applied to the valve actuator. By modulating the valve actuator's position, this 4 mA to 20 mA signal will regulate the gas flow to the furnace zone burner and thereby allow the instrument to control the heat levels measured in the zone.

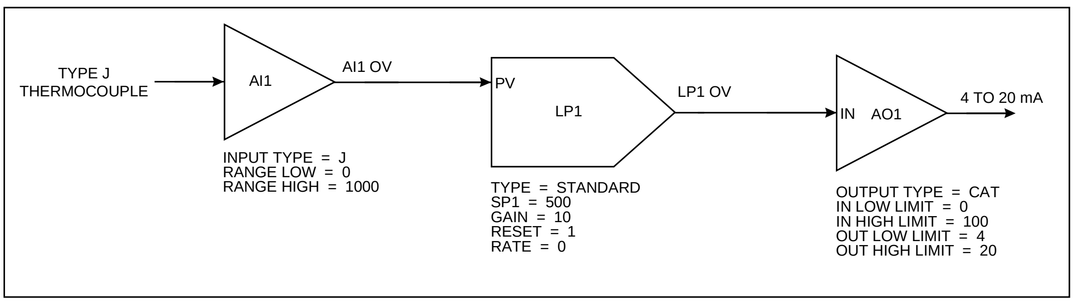


Figure 8-5 Interconnections Between Function Blocks

6. Draw the Feedback connection

To fully complete the function block diagram, one final and very important interconnection must be drawn. In setting up control loops in this instrument, a feedback path must be specified between the loop function block itself and the hardware element that externalizes the loop's output to the real world. That is, the control loop block needs confirmation from the analog output block connected to it that the percent output levels it calls for have been correctly translated into accurate output signals. The feedback path that provides LP1 with this confirmation is established by means of program settings depicted in Figure 8-6.

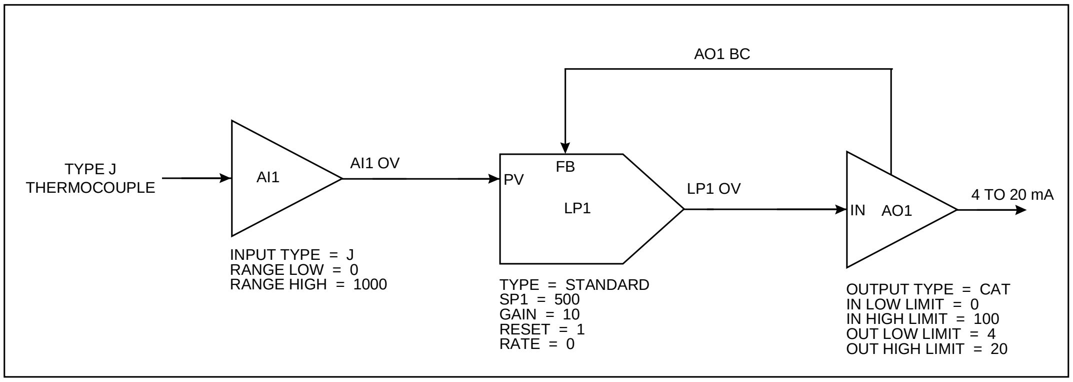


Figure 8-6 Complete Function Block Diagram of Figure 8-1

Here, the function block diagram is drawn to include the key components of a typical loop feedback path. The AO1 function block has been changed to feature a second output denoted "AO1 BC." This output has been connected to a feedback input at LP1 identified by the notation "FB." The "AO1 BC" designator stands for "Analog Output 1's Back Calculation." When the control loop is brought on-line, AO1 BC will essentially represent the value of AO1's 4 mA to 20 mA output at any particular instant. The term "Back Calculation" is used to reinforce the idea that this information is being sent "upstream" against the flow of all other information within the function block diagram.

8.3 Time Proportioning Relay Driven Pump

Introduction

A second control scheme is to use a relay to produce a time proportioning or Duration Adjusting Type (DAT) control signal. Such an application is depicted in Figure 8-7.

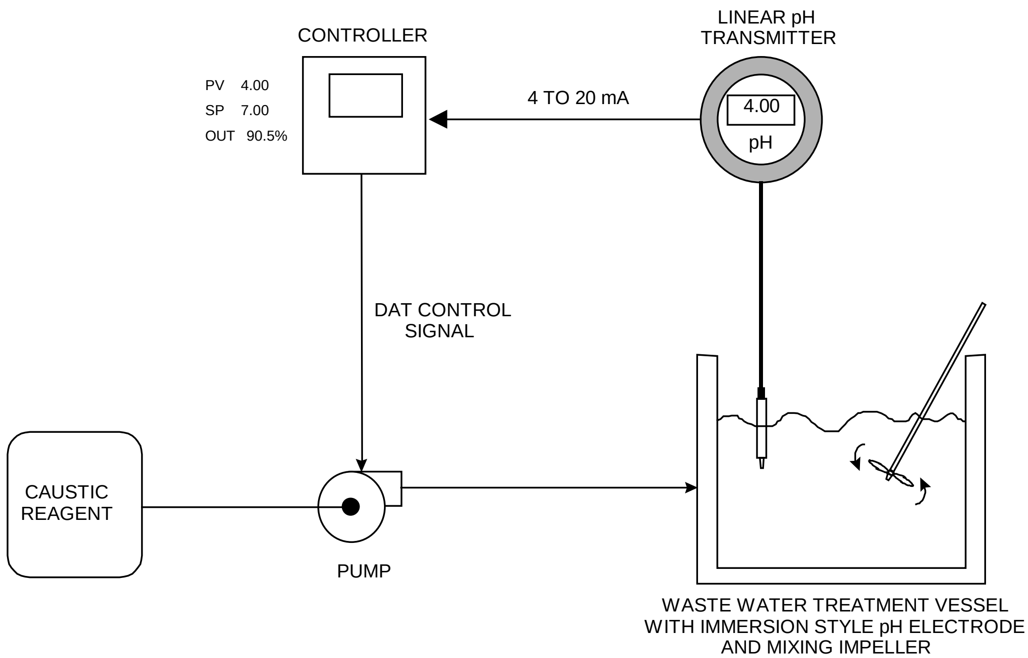


Figure 8-7 Control of Wastewater pH Using a Time Proportioning (DAT) Control Signal

This application requires a basic time proportioning control loop to monitor and control the pH of the wastewater to a local set point of 7 pH units. That is, the loop will "neutralize" the wastewater so that it can be safely released to the environment. The wastewater pH, which is assumed to be primarily acidic, will be controlled by introducing a caustic reagent to the contents of the treatment vessel. This will be done through use of a time proportioning relay signal that will pulse a pump connected to a caustic reagent source.

A function block diagram representing the control scheme of Figure 8-7 has been drawn in Figure 8-8. The same diagram method was used to produce Figure 8-6.

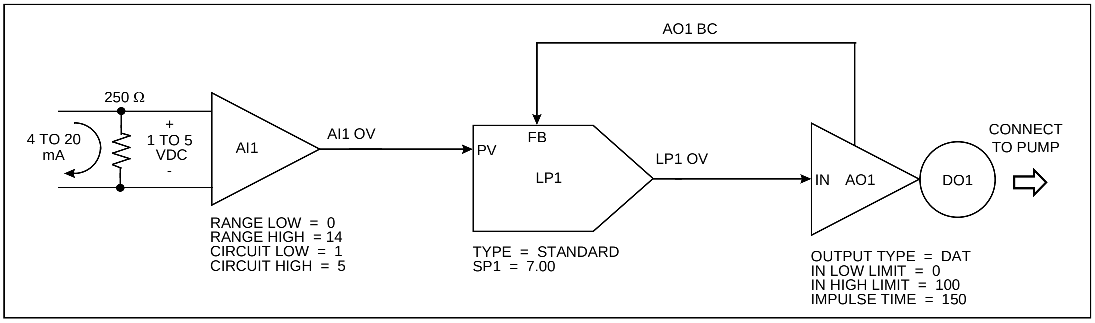


Figure 8-8 Function Block Diagram of Figure 8-7

This drawing is similar to the temperature control application. The analog input, control loop, and analog output function blocks (AI1, LP1, and AO1) have been used similarly. The discrete output function block was added, drawn as a circle at AO1's apex and named "DO1." Recall that any analog input, control loop, analog output, or discrete output available may be used. Up to 24 discrete outputs (DO1 through DO24) are potentially available depending on the instrument's model number.

From Figure 8-8, the instrument's AI1 function block will essentially process the 4 mA to 20 mA transmitter signal to generate a pH measurement. This measurement will be "AI1 OV" which, in turn, will be applied to LP1's process variable input, "PV." Before the 4 mA to 20 mA signal is applied to AI1, it will be converted to a 1 to 5 Vdc signal with a 250 Ω shunt resistor. AI1 will be configured to generate a pH measurement in a range from 0 (RANGE LOW = 0) to 14 (RANGE HIGH = 14) in response to a voltage input between 1 (CKT LOW = 1) and 5 (CKT HIGH = 5) Vdc. The PID algorithm of the control loop function block will adjust the value assumed by LP1 OV between 0 % and 100 %. This 0 % to 100 % signal will be applied to AO1, which will be configured as a DAT type analog output. The internal parameter of "IMPULSE TIME" in AO1 is the DAT analog output's cycle time or period. With a specified impulse time of 150 seconds (an arbitrarily picked value), the DAT output will be ON for 75 seconds and OFF for 75 seconds when the input from LP1 is set to 50 %. The ON and OFF times will be determined completely by the % output levels called for by LP1. Finally, to externalize the ON and OFF output states of AO1 to the outside world, the DO1 output relay, represented by the DO1 function block, will be programmed for AO1's exclusive use. Hence, as AO1 switches between ON and OFF states in response to LP1 OV's % output levels, so too will the DO1 output relay to generate the pulses required to drive the caustic reagent pump.

8.4 Split Output or Duplex Control

Introduction

Split output or duplex control loops are typically used in heat/cool applications. Temperature is controlled through simultaneous use of both heating and cooling elements. If the instrument was to support a heat/cool control configuration, an example of the control scheme that might be dealt with is illustrated in Figure 8-9.

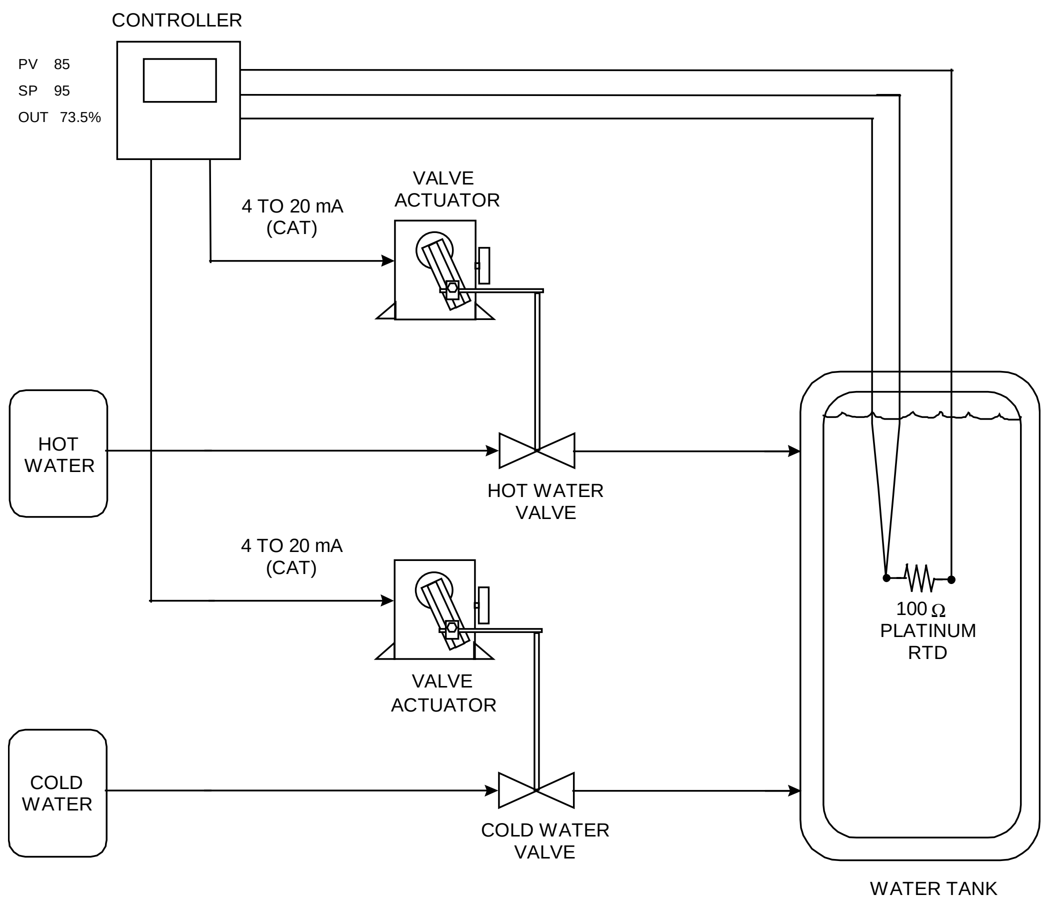


Figure 8-9 Temperature Control of Water Using Split Output or Duplex Control

The instrument must be set up to produce two 4 mA to 20 mA control signals. By applying them to current-controlled valve actuators coupled to hot and cold water valves, these signals will regulate the amount of hot and cold water introduced to the vessel to maintain the water temperature at whatever set point will be programmed. The temperature of the water will be measured by means of a three-wire 100 Ω Platinum RTD. This process may be likened to manipulating hot and cold faucets regulate water temperature.

In Figure 8-10, the analog input function block AI1 is depicted processing the resistance values produced by the RTD. The resulting water temperature measurements (AI1 OV) are then fed to the process variable input (PV) of the LP1 control loop block. Note how LP1 has been defined as a split output control loop using the notation “TYPE = SPLIT.” Unique to this control loop is the defined range of its output value, LP1 OV. Where the standard control loops mentioned thus far have had outputs ranging exclusively between 0 % and 100 %, the % values of the split output control loop vary between -100 and 100. 0 % is considered the midpoint for this control loop’s output range. When brought on-line, a 0 % to 100 % output value will be generated by LP1 when hot water is needed to maintain the temperature at set point. When the addition of cold water is necessary, the loop’s output will assume a value between 0 % and –100 %. Note that to externalize the control signals generated by LP1, two analog output blocks, AO1 and AO2, will be used. AO1’s 4 mA to 20 mA signal will be tied to the hot water valve actuator, while the actuator that adjusts the position of the cold water valve will receive its mA control signal from AO2. To provide AO1 and AO2 with usable input driving signals, LP1’s output will be applied to a function called a “standard splitter (STD SPLITTER).” Made from one of the instrument’s calculated value function blocks (“CV’s”), the standard splitter will essentially be a mechanism that translates the % values of the split output control loop into two distinct 0 % to 100 % signals. They will be applied to the inputs of AO1 and AO2 and, as such, will drive and linearly correspond with AO1 and AO2’s 4 mA to 20 mA outputs.

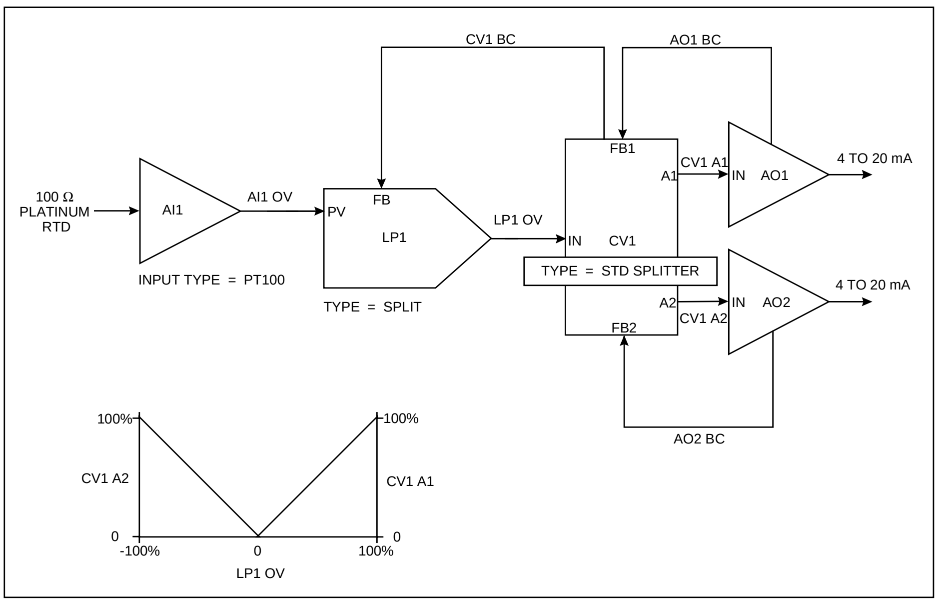


Figure 8-10 Function Block Diagram of Figure 8-9

The two outputs on CV1 that will drive AO1 and AO2 are respectively labeled “CV1 A1” and “CV1 A2.” CV1’s basic operation is described by a plot of these outputs versus LP1 OV. Shown in the lower left of Figure 8-10, the plot demonstrates that CV1 will produce a 0 % to 100 % value at its CV1 A1 output when LP1 calls for an output level between 0 % and 100 %. CV1 A2 will remain at 0 %. When applied to AO1, the CV1 A1 value will activate the 4 mA to 20 mA signal needed at the hot water valve actuator to make the water temperature in the vessel rise. Similarly, when LP1 calls for an output level between 0 % and –100 %, CV1 will produce a corresponding 0 % to 100 % value at CV1 A2. This time, CV1 A1 will remain at 0 % and the CV1 A2 value generated will induce the introduction of cold water into the vessel to cool its contents down.

Note the function block diagram’s use of three back calculated feedback paths. Two such paths are labeled AO1 BC and AO2 BC. They are connected to CV1 from the analog output function blocks at inputs denoted “FB1” and “FB2.” CV1 BC, the third feedback path, runs from CV1 to the FB input of LP1. All three feedback paths work together to acknowledge to LP1 that the appropriate output signals have been generated in response to the % output levels the loop has called for.

8.5 Cascade Control

Introduction

An example of a cascade control application is featured in Figure 8-11. Cascade control is typically used when two process values must be simultaneously controlled, with one process value directly influencing the behavior of the other. In this control strategy, each process value is supported by its own dedicated control loop. The term “cascade” is used because it describes how this control approach literally attaches both control loops together. This act of linking control loops allows for the regulation of both process values using one and only one % output control signal.

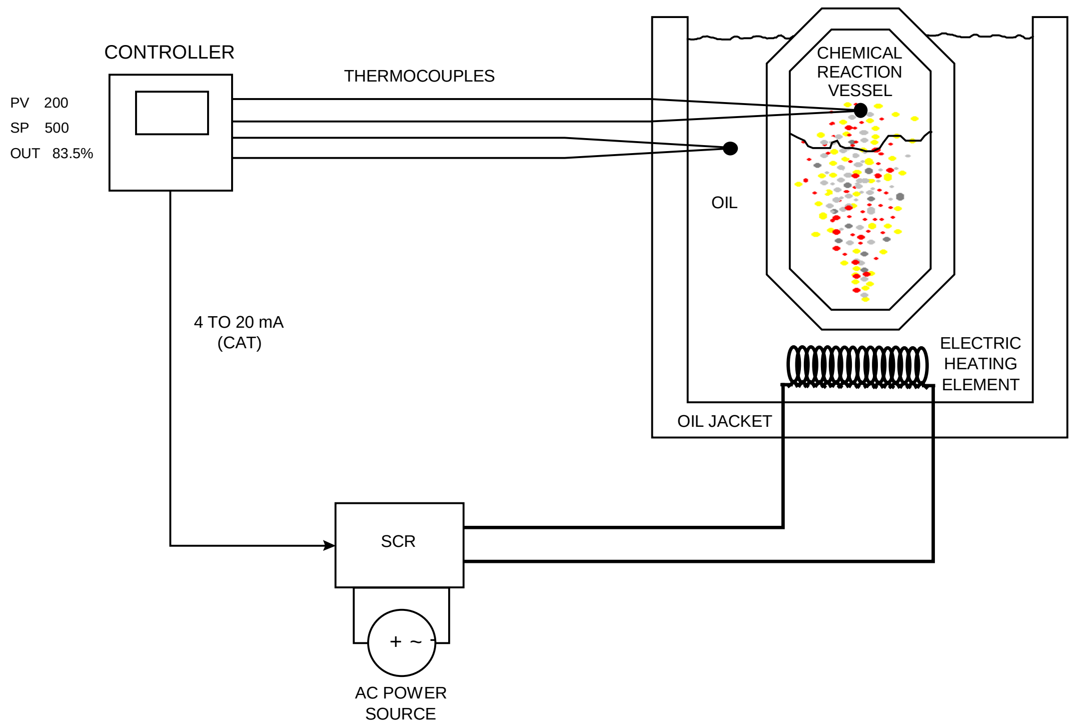
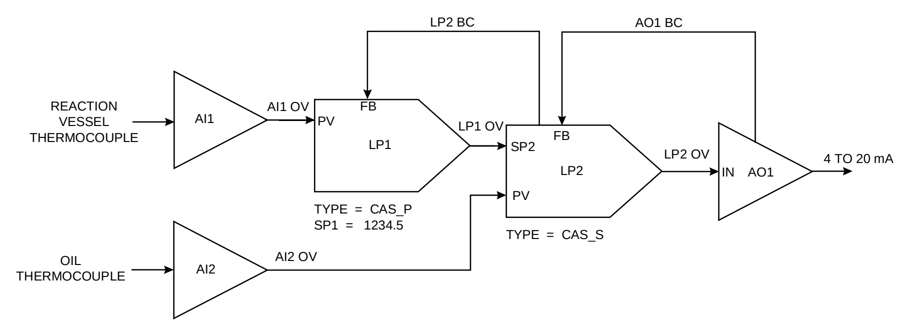


Figure 8-11 Temperature Control of an Oil Heated Chemical Reaction Chamber

In Figure 8-11, the temperature in a chemical reaction chamber is determined by the temperature of the heated oil surrounding it. Heating the oil is done by an electric heating element driven by a 4 mA to 20 mA controlled SCR and external power source. In this application the instrument controls the temperature of the chemical reaction chamber through control of the heat emitted by the jacket tank oil. The instrument must provide a single 4 mA to 20 mA control output to govern the voltage switched by the SCR and, hence, the heat applied to the entire system. Temperature is monitored with thermocouples.

The function block diagram of the required instrument configuration is featured in Figure 8-12.

Note that this diagram illustrates the classic cascade arrangement of two control loops that defines the cascade control strategy. The first control loop, LP1, is designated as the primary cascade loop by the notation “CAS_P.” The notation “CAS_S” indicates LP2’s designation as the secondary cascade loop. Note how both control loops are joined together. In addition to the back-calculated feedback path set up between the two (LP2 BC), LP1’s output is connected to an input on LP2 that at this time must be introduced. Denoted as SP2, this input is LP2’s remote set point input.



NOTE: 1) SP1 is desired reaction vessel temperature.

2) SP2 is the remote setpoint input of LP2.

Figure 8-12 Function Block Diagram of the Cascade Control Strategy

Both control loops in this product may be programmed to operate using up to *two* *user defined set point parameters, designated by SP1 and SP2.* Should you implement a control loop using one or both setpoints? That depends on what is necessary to meet the requirements of the specific application being dealt with. When in the on line mode and viewing a control loop’s dedicated on line display, the active set point of the live control loop can be switched between SP1 or SP2 as described in Section 14. Note that while both set point parameters may be programmed to have straight numeric values, only SP2 may be defined as a remote set point. That is, SP2 may be set up so that its value is determined by the output value of another function block, such as a setpoint profile. In the cascade control strategy demonstrated in Figure 8-12, SP2’s remote set point functionality is exploited by the LP2 secondary cascade loop. When this control configuration is made operational, LP2’s working set point, SP2, will have a value determined by LP1 OV.

In Figure 8-12, the process values of each loop are the output values of the AI1 and AI2 analog input function blocks. AI1 will produce temperature measurements of the reaction chamber and provide them to the process variable input of LP1, while measurements of the oil temperature in the jacket tank will be furnished to LP2’s PV input by AI2. Because LP1 OV will provide LP2 with its operating set point, LP1’s output range will be defined in engineering units of temperature instead of the usual 0 % to 100 %. LP2’s output range is 0 % to 100 %, in anticipation of using it to drive the AO1 function block’s 4 mA to 20 mA signal. Note that the range covered by LP1 OV will have to be consistent with the operating temperature range of the oil. For example, if it is determined that the oil temperature will be manipulated between 75 °F and 500 ºF, the low and high limits assumed by LP1 OV (and, for that matter, SP2) will equal 75 and 500, respectively. Finally, LP2 BC and AO1 BC are the two back-calculated feedback paths shown. As is true for the operation of all back-calculated feedback paths, both LP2 BC and AO1 BC work together to acknowledge the cascaded control loops that the appropriate actions have taken place in response to both loops' output values.

The method used to coordinate the tuning of the cascaded loops is particularly interesting. Using the diagram of Figure 8-12, the first priority is to tune the secondary cascade loop of LP2. With LP1 kept in manual mode, tuning may begin by first placing LP2 in manual mode and then manipulating LP1's output.   This will allow the generation an LP2 set point that will induce a process upset when the secondary loop is placed back in automatic mode. Only after LP2 has been tuned can LP1 be tuned.   When tuning LP1, LP2 will be kept in automatic mode throughout the entire time LP1 is exercised. Since the tuning of LP2 will have already been established, tuning LP1 may be approached by first mentally "blocking out" the secondary control loop's existence and visualizing LP1's output as connected to a sort of virtual analog output function block. In this light, tuning the overall cascade control configuration becomes the considerably simpler matter of tuning a single control loop.

9. Using Program Mode to Configure Function Blocks and Features

9.1 Introduction

Overview

This section describes all the prompts used in Program Mode to configure individual function blocks. In addition, other Program Mode operations such as copying a block and enabling/disabling features are described.

A few tasks accomplished in Program Mode are not described in this section. Instead, those tasks are described in separate sections:

- loading a factory configuration – see Section 7
- configuring Setpoint Profiler – see Section 11
- configuring the optional carbon potential type CV (calculated value) block – see Section 12
- storing and loading configuration and calibration – see Section 16
- storing data – see Section 17

Before attempting to configure a UDC5300 controller for the first time, read Section 5, *Planning*, and Section 6, *Modes, Menus, Prompts, and Keypad Basics*.

ATTENTION

All prompts and selections in this section are listed as displayed when the controller's language is set to English. Other languages are available as described in 9.16.

What's in this section?

The following topics are covered in this section.

ATTENTION

If you plan to program another function block to use a Calculated Value as the source of a value, you must program the Calculated Value first.

9.2 Programming Analog Inputs

Introduction

Each controller can support up to three analog inputs, depending on the hardware options installed. (One is standard.) Each analog input is associated with an AI function block. Use the prompts described in this subsection to specify the type of input to be used, how the input will be converted by the controller, the input range, etc.

Analog inputs typically have a ± 10 % over/under range. If the input will be used in a calculation that cannot accept a negative value or tolerate the over/under range condition, use the range clamp parameter (CLMP) to clamp low, high, or either direction.

To program Analog Inputs, select "PRG AI" from the Main Program Menu. Select the AI to program.

Specifying the type of input algorithm

If "CUST INP" is enabled under "FEATURES" in the Program Mode Menu (Section 9.12), then the first step in programming the input is specifying whether a built-in input algorithm is acceptable, or a custom conversion curve will be specified. Table 9-1 provides information about the input algorithm types.

If "CUST INP" is disabled, then the standard input algorithm prompts in Table 9-3 will be displayed as soon as an AI function block is selected for programming.

Table 9-1 Analog Input Algorithm Type Definitions

Prompt (Full Name)	Range/Selections	Definition
ALGR (Algorithm)		Algorithm is used to specify the type of algorithm used by the controller to process the field signal providing the input to the AI function block.
	STD	**STANDARD** – Use STD if one of the standard algorithms for an input type listed in Table 9-3 will be used. The prompts available when STD is selected are shown in Table 9-2.
	CUSTOM	**CUSTOM –** Select CUSTOM if conversion of the input from a thermocouple, EMF, or RTD to engineering units must be done using a custom curve. Use the prompts in Table 9-4 when CUSTOM is selected to specify the custom curve by defining up to 20 points.

Standard analog input algorithm prompts

Table 9-2 describes all the prompts associated with the standard analog input algorithm. These prompts are displayed if “STD” is selected in response to the “ALGR” prompt.

Table 9-2 Standard AI Algorithm Prompts

Prompt (Full Name)	Range/Selections	Definition
TYPE (Type)	*See Table 9-3 for available choices.* *The default type is LINEAR*.	**Type** – Used to specify the standard input type.
ODPT (Out Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Out Decimal Position** - Move the decimal point to the position to be used in the output value provided to other function blocks and the optional data storage database by the AI block.
OTEU (Out Engineering Units)	NONE F C	**Out Engineering Units** – Unit of measure (Fahrenheit or Celsius) for the output value provided to the optional data storage database.
RGLO (Range Low)	OFF NUMBER *4*	**Range Low** and **Range High** – Specify the input range. The values must be within the limits valid for the input type (see Table 9-3) except for Pyrometry types which must be exactly as shown in Table 9-3. Be sure to use the correct values for the temperature units used (°F, °C, °K, °R). To enter the full range for the temperature units selected (see TMPU), select TYPE again and press **ENTER** without changing the range type.
RGHI (Range High)		
TMPU (Temperature Unit)	 F C K R NONE	**Temperature Unit** – Specifies the input value’s unit of measure with thermocouple, pyrometer, and RTD input types. If you change from the default (F), change the “RGLO” and “RGHI” accordingly. (The range limits will not be recalculated automatically.) **Fahrenheit** **Celsius** **Kelvin** **Rankine** **None** – Use NONE if the input is not a temperature measurement or linear type is selected.

Table 9-2 Standard AI Algorithm Prompts

Prompt (Full Name)	Range/Selections	Definition
D-ID (Direct/Indirect/ Square Root)		**Direct/Indirect/Square Root** – Specifies the category of input source. The selection made here affects what other prompts are displayed.
	DIRECT	**Direct –** Input is a direct sensor measurement from a thermocouple, pyrometer, or RTD.
	INDIRE	**Indirect –** Input comes from a transmitter. When INDIRE is selected, the voltage input will be linearized. Also, you will be prompted to assign engineering units to a specific voltage or millivoltage span.
	SQRT	**Square Root –** Input from a flow transmitter. When SQRT is selected, square root of input will be calculated. Also, you will be prompted to assign engineering units to a specific voltage or millivoltage span. Engineering units of flow may be used for the span limits of flow inputs.
CKLO (Circuit Low) **CKHI** (Circuit High)	OFF NUMBER	**Circuit Low** and **Circuit High –** Actual low and high end values of voltage to be used for indirect measurements. Appears only if "INDIRE" or "SQRT" was previously selected for “D-ID”.
CKUN (Circuit Electrical Unit)	MV VOLTS OHMS	**Circuit Electrical Unit –** Unit of measure in which “CKLO” and “CKHI” are expressed. **Millivolts** **Volts** **Ohms**
LAG (Lag Time Constant)	OFF NUMBER *range is 0 to120 seconds*	**LAG –** Time constant applied to the input measurement value. This provides digital filtering (LAG) to the measurement. LAG prompt only appears if "EXPINP" is enabled under “FEATURES” on the Program Mode Menu.
HOLD (Sample Hold)	OFF PARM (*discrete)* 0 1	**Sample Hold –** When HOLD has a value of 1 (entered here or read from the specified parameter) the input value is held at the last value. The input value is measured normally when HOLD (or the specified parameter) has a value of 0. HOLD appears only if "EXPINP" is enabled under “FEATURES” on the Program Mode Menu.

Table 9-2 Standard AI Algorithm Prompts

Prompt (Full Name)	**Range/Selections**	**Definition**
FAIL (Failsafe)		**Failsafe –** Specify whether or not failsafe is active in case of thermocouple failure (burnout) and, if so, which direction. An input is considered to have failed when the controller detects loss of continuity or when the input is more than 10 % outside the range defined by “RGLO” and “RGHI”.
	NONE	**None** – Failsafe disabled
	UP	**Up** – Input will go to full scale value in case of input failure (upscale).
	DOWN	**Down** – Input will go to low value in case of input failure (downscale).
CLMP (Range Clamp)		**Range Clamp –** Specify whether and how out-of-range input should be clamped. **ATTENTION:** Clamping is not recommended for process variable inputs to control loops.
	NONE	**None –** Clamping disabled.
	LO RNG	**Low Range –** Input below “RGLO” value is held at “RGLO”. No clamping on value exceeding “RGHI”.
	HI RNG	**High Range –** Input above “RGHI” value is held at “RGHI”. No clamping on value below “RGLO”.
	RANGE	**Range –** Input that is out-of-range in either direction is clamped at value of applicable range limit.

Table 9-3 Analog Input Types

Display Symbol	Type	Operating Span	
EMF			
LINEAR	Volts	–0.2 V to 5 V	
Thermocouples ITS-90 except where noted		**°F**	**°C**
J	Type J	0 to 2190	–18 to 1199
K	Type K	0 to 2500	–18 to 1371
E	Type E	-450 to 1830	–268 to 999
T	Type T	–300 to 700	–184 to 371
N	Type N	0 to 2372	–18 to 1300
B	Type B	110 to 3300	43 to 1816
R	Type R	0 to 3210	–18 to 1766
S	Type S	0 to 3210	–18 to 1766
W5W26	Type W5-W26 [1]	0 to 4200	–18 to 2316
PLAT II	Type Plat II [1]	–100 to 2500	–73 to 1371
NINIMO	Type Ni - Ni/Mo	32 to 2502	0 to 1372
RTD			
PT100	100 ohm Pt	–300 to 1570	–184 to 854
Pyrometry (Rayotube & Spectray) Types **ATTENTION: These types will be available for selection only if "PYROMTRY" is set to "ENABLE" under "FEATURES" in the Programming Menu as described in 9.12.**			
903302	18890-3302	750 to 1600	399 to 871
900073	18890-0073	800 to 1800	427 to 982
900074	18890-0074	1100 to 2300	594 to 1260
900035	18890-0035	1200 to 2600	649 to 1426
900412	18890-0412	1375 to 3000	747 to 1648
900075	18890-0075	1500 to 3300	816 to 1815
901729	18890-1729	1650 to 3600	899 to 1982
900643	18890-00643	1850 to 4000	1010 to 2204
900216	18890-0216	2110 to 4600	1155 to 2537
905423	18890-5423	2210 to 5000	1210 to 2760
900163	18890-0163	200 to 1000	94 to 537

Table 9-3 Analog Input Types

Display Symbol	Type	Operating Span	
998814	18899-8814	340 to 1800	172 to 982
940579	18894-0579	752 to 2552	400 to 1400
949014	18894-9014	752 to 2552	400 to 1400
188861	Spectray 18886-1	1292 to 2912	700 to 1600
18886	Spectray 18886	1833 to 3452	1001 to 1900
188852	Spectray 18885-2	806 to 1400	430 to 760
188851	Spectray 18885-1	1292 to 2912	700 to 1600
18885	Spectray 18885	1832 to 3452	1000 to 1900
750579	18875-0579	752 to 2552	400 to 1400
740578	18874-0578	752 to 2552	400 to 1400

[1] IPTS-68

Custom analog input algorithm prompts

Table 9-4 describes the custom analog input algorithm prompts. These prompts are displayed if "CUSTOM" is selected in response to the "ALGR" prompt.

Table 9-4 Custom AI Algorithm Prompts

Prompt (Full Name)	Range/Selections	Definition
SIG (Signal)	 OFF TC EMF RTD	**Signal –** Specifies the input hardware type. **Thermocouple** **Electromotive Force** **Resistance Temperature Detector**
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position to be used in the input value provided to the AI function block .
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value to other function blocks by the AI block.
OTEU (Out Engineering Units)	NONE F C	**Out Engineering Units –** Unit of measure (Fahrenheit or Celsius) for the output value provided provided to the optional data strorage database.
RJ (Reference Junction)	 YES NO	**Reference Junction:** Enable/disable reference junction compensation. **Yes -** Enables compensation; can only be used with a thermocouple if the ambient temperature is within the thermocouple's operating range **No -** Disables compensation
EMIS (Emissivity)	 YES NO	**Emissivity –** Enable/disable emissivity compensation for EMF input. This prompt is displayed only if "EMF" is selected in response to "SIG" prompt. **Yes -** Enables compensation **No -** Disables compensation

Table 9-4 Custom AI Algorithm Prompts

Prompt (Full Name)	**Range/Selections**	**Definition**
TMPU (Temperature Unit)	 F C K R NONE	**Temperature Unit** – Specifies the input value's unit of measure with thermocouple, pyrometer, and RTD input types. If you change from the default (F), change the "RGLO" and "RGHI" accordingly. (The range limits will not be recalculated automatically.) **Fahrenheit** **Celsius** **Kelvin** **Rankine** **None** – Use NONE if the input is not a temperature measurement.
SQRT (Square Root)	 YES NO	**Square Root –** Enables/disables calculation of square root of input before value is passed to another function block. **YES –** Enables square root calculation **NO -** Disables square root calculation
CKLO (Circuit Low)	OFF NUMBER	**Circuit Low** – Actual low end value of voltage to be used for measurements. Appears only if "SQRT" was set to "YES".
CKHI (Circuit High)	OFF NUMBER	**Circuit High** – Actual high end value of voltage to be used for measurements. Appears only if "SQRT" was set to "YES".
CKUN (Circuit Electrical Unit)	 MV VOLTS OHMS	**Circuit Electrical Unit** – Unit of measure in which input will be expressed. Unit is used for "CKLO" and "CKHI" (if "SQRT "is used), as well as for definition of the X coordinates of the custom curve. **Millivolts** **Volts** **Ohms**
LAG (Lag Time Constant)	OFF NUMBER *range is 0 to 120 seconds*	**LAG –** Time constant applied to the input measurement value. This provides digital filtering (LAG) to the measurement. LAG prompt only appears if "EXPINP" is enabled under "FEATURES" on the Program Mode Menu.

Table 9-4 Custom AI Algorithm Prompts

Prompt (Full Name)	Range/Selections	Definition
HOLD (Sample Hold)	OFF PARM *(discrete)* 0 1	**Sample Hold –** When HOLD has a value of 1 (entered here or read from the specified parameter) the input value is held at the last value. The input value is measured normally when HOLD (or the specified parameter) has a value of 0. HOLD appears only if "EXPINP" is enabled under “FEATURES” on the Program Mode Menu.
Xn *and* Yn (X and Y Coordinates)	OFF NUMBER	**X and Y Coordinates –** Define the custom curve to be used by the input algorithm. Interpolation is straight line. **Xn –** Represents the incoming signal in the “CKUN” unit of measure. **Yn –** Represents the corresponding value in the “TMPU” unit of measure. A minimum of two and a maximum of twenty points can be defined.

9.3 Programming Loop Blocks

Control loop programming requires multiple blocks

The controller can provide one or two loops of independent or cascade control. Each loop has an associated loop LP (loop) function block. Programming of the internal parameters for the LP block determines the control algorithm used, as well as the tuning parameters and other custom values associated with the loop. The LP block parameters are described in this subsection.

An LP block cannot function in isolation. To perform control, at least two more blocks are required: one for input and one for output. For example:

- Basic PID control using a Current Adjusting Type (CAT) or Voltage Adjusting Type (VAT) output would use an analog input (AI) block to process the incoming process variable and an analog output (AO) block to provide the output signal.
- ON/OFF control would use an AI for the input and a discrete output (DO) to control the output relay.

Depending on the type of control, additional blocks are required to handle input and output. For example:

- Ratio control requires two analog inputs, one for the wild variable and one for the controlled variable.
- PID control using Duration Adjusting Type (DAT) output requires an AO block to receive the output from the LP and a DI block to transfer the output from the AO to the relay.
- PID control with Position Proportional (PP) output requires two relays, so two sets of paired AI and DI blocks are used.
- PID control with split output uses a calculated value (CV) block to split the output between two or three analog outputs (each with an associated AO block).

Complex strategies are supported

The capabilities of the controller permit many variations on the basic control strategies by allowing both analog and discrete calculated values (from CV blocks) to be used as the source of the values for the various parameters within the control algorithms.

Constant (CN) blocks can be used to provide true constants (programmed in the CN block) or variable values (read by the CN from other blocks) to other blocks, adding flexibility to the strategies.

A single parameter can be read by any number of function blocks in the unit.

Loop characteristics

Table 9-5 lists loop characteristics and issues to think about when configuring your controller.

Table 9-5 Loop Characteristics

Characteristic	What to be aware of
Choice of algorithm type	Two PID algorithm types, interacting and noninteracting. Noninteracting is the default type. However, this may be changed (see "IACT" prompt described in Table 9-8). If you want to change the algorithm, change it before starting loop configuration.
Eight loop types available	If the loop type is changed after LP configuration is completed, all previously programmed entries for the LP block will be set back to the defaults.
Configuration checks	You will be prompted to save your entries when leaving the loop program sequence. Configuration checks are executed at this time to verify all entries are complete and compatible. A FAIL message at this time may indicate incomplete entries or incompatible selections.
Split output tuning	When programming Split Output control loops, tuning parameter set 1 is automatically applied to output values between 0 and +100. Tuning parameter set 2 is automatically applied to output values between 0 and -100.
Control with position proportioning devices with and without feedback capabilities	True position proportioning (PP) output is available. This requires the use of an analog input from a slidewire feedback and is available with standard PID, Advanced PID, ratio, and cascade secondary loop types. The analog output block used must have its output type specified as "PP" and it output positioning algorithm specified as "PP". If the positioning device does not provide feedback, then use the loop type "DIAT" (Direction Impulse Adjusting Type). When configuring the analog output block, specify the output type as "PP", but then select the output positioning algorithm as "DIAT". If the positioning device does provide feedback under normal operation, but you want to use direction impulse adjustment if the feedback fails, program the loop type as "DIAT", the output type as "PP", and the position algorithm as "AUTO".
Minimum programming requirements	Many of the prompted entry fields for control loops are optional. As a general rule, the minimum entry information for control loops includes the Process Variable (PV) with range limits, setpoint value, some combination of gain, reset and rate, and a source for the feedback. In most cases, the feedback source will be the back-calculation output (BC) value of the analog output (AO) function block.

Table 9-5 Loop Characteristics

Characteristic	What to be aware of
Split output programming requirements	When the LP type is "SPLIT", a calculated value (CV) block must be used to send the split loop's output to two (standard splitter) or three (advanded splitter) analog output (AO) blocks. Program the control loop to receive a feedback from the back calculation output of the splitter calculated value. In other words, loop Feedback = CV*n* BC (where CV*n* is a splitter type calculated value and BC is its output). Program the splitter calculated value to accept the back-calculation values (BC) of each analog output function block (AO) as its feedback source. In other words, CV*n* FB = AO*n* BC.

Loop programming procedure

To program Control Loops, select "PRG LP" in the Main Program Menu. Select LP1 or LP2 to program, then select a loop type listed in Table 9-6.

Table 9-6 Loop Types

Type as displayed	Full name of loop type
STD	Standard Loop
ADV	Advanced PID Loop
ON_OFF	On/off Loop
RATIO	Ratio Loop
CAS_P	Cascade Primary
CAS_S	Cascade Secondary
DIAT	Direction Impulse Loop
SPLIT	Split Loop

Table 9-7 lists the prompts for the various control loop types. See Table 9-8 for descriptions of these prompts.

Enter all desired choices, then repeat the procedure, if desired, for the other Loop (LP 1 or LP 2).

Table 9-7 Control Loop Prompts

STD	ADV	ON_OFF	RATIO	CAS_P	CAS_S	DIAT	SPLIT
IDPT	IDPT	IDPT	IDPT	IDPT	IDPT	IDPT	IDPT
ODPT	ODPT	ODPT	ODPT	ODPT	ODPT	ODPT	ODPT
PV	PV	PV	PV	PV	PV	PV	PV
PVLL	PVLL	PVLL	PVLL	PVLL	PVLL	PVLL	PVLL
PVHL	PVHL	PVHL	PVHL	PVHL	PVHL	PVHL	PVHL
CTLA	CTLA	CTLA	CTLA	CTLA	CTLA	CTLA	CTLA
GNPB	GNPB		GNPB	GNPB	GNPB	GNPB	GNPB
PB1/GN1	PB1/GN1		PB1/GN1	PB1/GN1	PB1/GN1	PB1/GN1	PB1/GN1
RST1	RST1		RST1	RST1	RST1	RST1	RST1
RTE1	RTE1		RTE1	RTE1	RTE1	RTE1	RTE1
PB2/GN2	PB2/GN2		PB2/GN2	PB2/GN2	PB2/GN2	PB2/GN2	PB2/GN2
RST2	RST2		RST2	RST2	RST2	RST2	RST2
RTE2	RTE2		RTE2	RTE2	RTE2	RTE2	RTE2
MRST	MRST		MRST	MRST	MRST	MRST	MRST
	APHI		APHI			APHI	APHI
	APLO		APLO			APLO	APLO
SPTR	SPTR	SPTR	SPTR			SPTR	SPTR
SPT1	SPT1	SPT1	SPT1	SPT1	SPT1	SPT1	SPT1
SPT2	SPT2	SPT2		SPT2	SPT2	SPT2	SPT2
	ISLW	ISLW	ISLW	ISLW	ISLW	ISLW	ISLW
	DSLW	DSLW	DSLW	DSLW	DSLW	DSLW	DSLW
SPLL	SPLL	SPLL	SPHL	SPLL	SPLL	SPLL	SPLL
SPHL	SPHL	SPHL	SPHL	SPHL	SPHL	SPHL	SPHL
INEU	INEU	INEU	INEU	INEU	INEU	INEU	INEU
				OTEU			
			RATO				
			BIAS				
			WILD				
PVTR	PVTR	PVTR	PVTR			PVTR	PVTR
	SPID		SPID	SPID	SPID	SPID	SPID
FB	FB		FB	FB	FB	FB	FB
	FFIN		FFIN	FFIN	FFIN	FFIN	FFIN
	FFGN		FFGN	FFGN	FFGN	FFGN	FFGN
OSUP	OSUP			OSUP		OSUP	OSUP
	OTRK		OTRK		OTRK	OTRK	OTRK
	RMAN		RMAN		RMAN	RMAN	RMAN
	CHGA		CHGA	CHGA	CHGA	CHGA	CHGA
DTUN	DTUN		DTUN	DTUN	DTUN	DTUN	DTUN
	DIKY		DIKY	DIKY	DIKY	DIKY	DIKY
	SPSE		SPSE	SPSE	SPSE	SPSE	SPSE
	A-MS		AMS	A-MS	A-MS	A-MS	A-MS
				OVLL			
				OVHL			
IACT	IACT		IACT	IACT	IACT	IACT	IACT
		HYST					
		MOFF					
RLIM	RLIM		RLIM	RLIM	RLIM	RLIM	RLIM
LBAD	LBAD	LBAD	LBAD	LBAD	LBAD	LBAD	LBAD

Loop Prompt Descriptions

The loop prompts are in Table 9-8 in the order in which they are displayed. Not every prompt applies to every loop type. Refer to the "Applies To" column or to Table 9-7 to determine whether a particular prompt applies to a loop type.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
IDPT (Input Decimal Position)	*all loop types*	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position to be used in the input value provided to the control loop.
ODPT (Output Decimal Position)	*all loop types*	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the loop's output value OV.
PV (Process Variable)	*all loop types*	OFF NUMBER PARM *(analog)*	**Process Variable –** Source of the PV for the loop. Select the function block whose output value will serve as the source of the PV. A number can be entered here to serve as PV during troubleshooting. To use a value from a CN function block, select PARM, then select the block.
PVLL (Process Variable Low Limt) **PVHL** (Process Variable High Limit)	*all loop types*	OFF NUMBER	**Process Variable Low Limit** and **Process Variable High Limit –** Enter the range limits for the process variable being controlled. Loop tuning parameters are based on the span defined by PVLL and PVHL. This value also specifies the displayed range for the operating displays. Inputs that exceed these limits will cause the PV to flash on primary displays.
CTLA (Control Action)	*all loop types*	 REV DIR	**Control Action** **Reverse Acting Control –** The loop output will increase as the process variable becomes greater than setpoint, and will decrease as it becomes less than the setpoint. **Direct Acting Control –** The loop output will decrease as the process variable becomes greater than the setpoint, and will increase as it becomes less than the setpoint.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
GNPB (Gain or PB)	*all loop types except ON_OFF*		**Gain or PB –** Use this prompt to choose whether you want to specify the proportional term in the control algorithm in terms of percent proportional band or of gain. Your choice here affects which prompts PB1 and PB2, or GN1 and GN2 are displayed next.
		GAIN	**Gain** is the ratio of output change (%) over measured variable change (%) that caused it.
		PB	**Percent Proportional Band** is the percent of the range of the measured variable for which a proportional-only controller will produce a 100 % change in its output. The relationship between % PB and gain can be expressed as: $GAIN = \frac{100}{\%\ PB}$ For example, setting PB = 20 % will have the same effect on control as setting GAIN = 5. Therefore, if the change in PV input were 3 % of the whole range of possible input values, then the resulting change in the output due to proportional only control would be 15 % of the output's range, regardless of whether GNPB = PB and PB = 20, or GNPB = GN and GAIN = 5. Another example: Setting PB = 50 % will have the same effect as setting GAIN = 2. In this case, if the change in input were again 3 % of range, then the resulting output change would be 6 %.
GN1 (Gain1) or **PB1** (Proportional Band 1)	*all loop types except ON_OFF*	OFF NUMBER *range is 0.1 to 200 for Gain or 0.5 to 1000.0 for Proportional Band*	**Gain 1** or **PB1 –** Which prompt is displayed depends on the setting entered for "GNPB". Enter the proportional component to be applied by the control algorithm in the first set of tuning parameters. Enter a starting value at initial configuration. The value may be altered online for final loop tuning. If an indirect source is specified as in an adaptive gain configuration, the value can only be altered at the source. Variable Gain1 or PB1 is available by programming a CN (constant) block's Destination with GN or PB. See Programming Constants, Section 9.9. To allow integral only control, select OFF.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
RST1 (Reset 1)	*all loop types except ON_OFF*	OFF NUMBER *range is 0.005 to 99.99 repeats per minute*	**Reset in Repeats per Minute –** Specify how many times proportional action should be repeated per minute (first set of tuning parameters). This is the "integral" component of control. Reset adjusts the controller's output taking into consideration both the size of the deviation (SP-PV) and the duration of the deviation. The amount of corrective action depends on the value of PB1 or GAIN1. Enter a starting value at initial configuration. The value may be altered online for final loop tuning. Variable reset 1 is available by programming a CN (constant) block's Destination with RS. See Programming Constants, Section 9.9. To allow proportional only control, select OFF. When reset is turned off, the "MRST" (manual reset) value determines the loop output at setpoint. Bumpless manual to automatic transfer is cancelled when proportional only control is selected.
RTE1 (Rate 1)	*all loop types except ON_OFF*	OFF NUMBER *range is 0.02-10.00 minutes*	**Rate 1 –** Enter the time period to be used by the derivative component of control, which affects the loop's output whenever the deviation between setpoint and process variable is changing. The output will be affected more when the deviation is changing faster. The output is modified by a value that assumes the rate of change of the process variable will continue for the time period specified using this prompt (first set of tuning parameters). Enter a starting value or OFF at the time of configuration. The value may be altered online for final loop tuning. Variable rate1 is available by programming a CN (constant) block's Destination with RT. See Programming Constants, Section 9.9.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
GN2 (Gain2) or **PB2** (Proportional Band 2)	*all loop types except ON_OFF*	OFF NUMBER *range is 0.1 to 200 for Gain or 0.5 to 1000.0 for Proportional Band*	**Gain 2** or **PB2 –** Which prompt is displayed depends on the setting of "GNPB". Enter the proportional component to be applied by the control algorithm in the second set of tuning parameters. (Use of the second set of tuning parameters is enabled with "DTUN", a loop prompt appearing later in the cycle.) Enter a starting value at initial configuration. The value may be altered online for final loop tuning. To allow integral only control, select OFF.
RST2 (Reset 2)	*all loop types except ON_OFF*	OFF NUMBER *range is 0.005 to 99.99 repeats per minute*	**Reset in Repeats per Minute –** Specify how many times proportional action should be repeated per minute (second set of tuning parameters). This is the "integral" component of control. Reset adjusts the controller's output taking into consideration both the size of the deviation (SP-PV) and the duration of the deviation. The amount of corrective action depends on the value of PB2 or GAIN2. Enter a starting value at initial configuration. The value may be altered online for final loop tuning. To allow proportional only control, select OFF. When reset is turned off, the "MRST" (manual reset) value determines the loop output at setpoint. Bumpless manual to automatic transfer is cancelled when proportional only control is selected.
RTE2 (Rate 2)	*all loop types except ON_OFF*	OFF NUMBER *range is 0.02 to 10.00 minutes*	**Rate 2 –** Enter the time period to be used by the derivative component of control, which affects the loop's output whenever the deviation between setpoint and process variable is changing. The output will be affected more when the deviation is changing faster. The output is modified by a value that assumes the rate of change of the process variable will continue for the time period specified using this prompt (second set of tuning parameters). Enter a starting value or OFF at the time of configuration. The value may be altered online for final loop tuning.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
MRST (Manual Reset)	*all loop types except ON_OFF*	OFF NUMBER range is -100 to +100	**Manual Reset -** This feature functions only when OFF is entered for RST1 and RST2. Enter a value equal to the desired loop output when the process variable is at setpoint. This allows correction of output to account for load changes to bring the process variable up to setpoint. The controller output is the computed output value plus the value of MRST. Note: If both reset and manual reset are set to OFF the loop output will be zero at setpoint.
APHI (Approach High)	ADV RATIO DIAT SPLIT	OFF NUMBER *range is 0.1 to 100*	**Approach High –** This function affects the process variable approach to setpoint when the process variable value is less than the setpoint value. The value entered is the percent of span deviation from setpoint at which a recalculation of the loop integral value will occur. Enter a starting value equal to the proportional band value (if Gain is used enter value = (1/gain value) x 100) or OFF at initial configuration. The value may be altered online for final loop tuning. This function is useful for batch startup from a "cold" condition to control excessive overshoot when setpoint is reached.
APLO (Approach Low)	ADV RATIO DIAT SPLIT	OFF NUMBER *range is 0.1 to 100*	**Approach Low:** Value entered affects the process variable approach to setpoint when the process variable value is greater than the setpoint value.
SPTR (Setpoint Tracking)	STD ADV ON_OFF RATIO DIAT SPLIT	NONE SP2	**Setpoint Tracking -** When SP2 is selected, setpoint tracking is enabled. This means that when control action begins to use Setpoint 2, the value of Setpoint 2 is copied to Setpoint 1. Adjustment of Setpoint 1 may be made after the switchover.
SPT1 (Setpoint 1)	*all loop types*	OFF NUMBER	**Setpoint 1 -** Setpoint 1 and Setpoint 2 are independent setpoints. Either may be the active setpoint for the loop. Enter the value to be used as the initial setpoint. This can be changed online.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
SPT2 (Setpoint 2)	*all loop types except RATIO*	OFF NUMBER PARM *(analog)*	**Setpoint 2 –** Enter the value to be used as the setpoint, or use the PARM selection to specify the function block whose output value will serve as the source of the PV. When Setpoint 2 is specified as an analog parameter, the value may not be changed from the front panel. To use an output value from a CN function block, select PARM. If you are using the setpoint profiler option, set SPT2 to the setpoint profiler block's output value (SP1 OV).
ISLW (Increasing Slew Limit) **DSLW** (Decreasing Slew Limit)	*all loop types except STD*	OFF NUMBER	**Increasing Slew Limit** and **Decreasing Slew Limit –** Specify limits for rate at which operator can change the setpoint using the keys on the front panel. Rate is expressed in the block input's engineering units per minute. Variable slew limits are available by programming CN (constant) blocks' Destinations with IS (increase slew) and DS (decrease slew). See Programming Constants, 9.9.)
SPLL (Setpoint Low Limits) **SPHL** (Setpoint High Limits)	*all loop types*	OFF NUMBER	**Setpoint Low Limit** and **Setpoint High Limit –** Specify the limits to be imposed on the active setpoint value, regardless of source. A setpoint value below or above the limits will be entered into the loop at the applicable limit value. OFF entry will assume process variable limits. (Variable limits are available by programming a CN (constant) block's Destination with LS or HS. See Programming Constants, Section 9.9.)
INEU (Input Engineering Units)	*all loop types*	NONE F C	**Input Engineering Units -** Units of measure (Fahrenheit or Celsius) for values of process variable or setpoint which will appear on online loop displays. Note that the controller can display Rankine or Kelvin values. If one of these are used, select NONE.
OTEU (Output Engineering Units)	CAS_P	NONE F C	**Output Engineering Units -** Units of measure (Fahrenheit or Celsius) for block's output value.
RATO (Ratio Setpoint)	RATIO	OFF NUMBER	**Ratio Setpoint –** Enter initial ratio setpoint. Value can be changed online.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
BIAS (Ratio Bias)	RATIO	OFF	**Ratio Bias –** Enter the value of ratio offset. Variable Bias is available by programming a CN (constant) block's Destination with RB. See Programming Constants, Section 9.9.)
WILD (Ratio Wild Variable)	RATIO	OFF NUMBER PARM *(analog)*	**Ratio Wild Variable –** Select the function block whose output value will provide the wild variable value to the loop. The wild variable is the process value that fluctuates with the requirements of the process. The controlled variable will be proportioned to the value of the wild variable, based on the ratio setpoint. A number may be entered to serve in place of the wild variable. This may be useful during troubleshooting. To use an output value from a CN function block, select PARM.
PVTR (Process Variable Tracking)	STD ADV ON_OFF RATIO DIAT SPLIT	NONE PV	**Process Variable Tracking -** When PV is selected, process variable tracking is enabled. This means that Setpoint 1 of the control loop will track the process variable when the loop is in Manual mode. A transfer to Automatic mode will maintain the tracked setpoint value as the active setpoint of the loop unless the loop was operating from Setpoint 2 prior to the transfer to Manual.
SPID (Soft PID Action)	ADV RATIO CAS_P CAS_S DIAT SPLIT	NO YES	**Soft PID Action –** When YES is selected soft PID action is enabled. This causes the control algorithm to not calculate proportional output corresponding to errors resulting from changes to setpoint. The algorithm will adjust its Reset (Integral) term to a value required to maintain the present output when the setpoint is changed. Normal proportional action should occur for all changes and variations to the controlled variable.
HYST (Hysteresis)	ON_OFF	OFF NUMBER *range is 0 % to 100 % of PV span*	**On/OFF Hysteresis –** The value entered here will be used to define a deadband above and below the setpoint. If the PV varies from the setpoint while the output is ON, but by less than the value specified here, the output will remain ON, preventing excessive output oscillation.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
MOFF (Manual Off)	ON_OFF	OFF 0 1 PARM *(discrete)*	**ON/OFF Manual Off -** A logic high (1) value for MOFF (entered here or read from the selected parameter) causes the control output to OFF. The control output will remain OFF until MOFF (or the parameter to which it points) goes to a logic low (0). **If configuring On/Off loop, skip to "LBAD" (last prompt in table) after configuring MOFF.**
FB (Feedback)	*all loop types except ON_OFF*	OFF NUMBER PARM *(analog)*	**Feedback –** Specify the source of the loop's feedback (or enter a number during troubleshooting). Feedback provides verification to the loop that the loop output value (LP OV) was processed by the analog output block (AO). The source of feedback is typically the associated Back Calculation Value (BC) of the analog output block. Feedback inputs must have a span equal to the loop output span when they are not pointed directly to analog output blocks.
FFIN (Feed Forward Input)	ADV RATIO CAS_P CAS_S DIAT SPLIT	OFF NUMBER PARM *(analog)*	**Feed Forward Input –** The FFIN value is applied to the PID equation as an addition. It is included in the bumpless transfer calculations. The value of FFIN should not exceed 0 to 100 units. Feedforward is typically used to provide an output change in anticipation of a change to the loop process variable.
FFGN (Feed Forward Gain)	ADV RATIO CAS_P CAS_S DIAT SPLIT	OFF NUMBER *range is -10.00 to 10.00*	**Feed Forward Gain –** Specified value is applied as gain to the feed forward input value.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
OSUP (Fuzzy Overshoot Suppression)	STD ADV CAS_P DIAT SPLIT	NO YES	**Fuzzy Overshoot Suppression –** When YES is selected suppression is enabled, limiting the overshoot of the setpoint by the process variable after a disturbance in the process such as a load change or setpoint change. Through “fuzzy logic” the working setpoint of the control loop is dynamically modified by the control algorithm to reduce or eliminate overshoot. **ATTENTION:** Regardless of the setting of this parameter, overshoot is not suppressed when the process disturbance causes an initial deviation (PV-SP) between –0.7 and +0.7 engineering units. Consequently, overshoot may not be suppressed in applications which require numerically small loop PV ranges such as carbon potential, in which this range is typically 0.0 to 2.0 engineering units.
OTRK (Output Tracking)	ADV RATIO CAS_S DIAT SPLIT	OFF NUMBER *range 0 % to 100 %* PARM *(analog)*	**Output Tracking –** Specify the source of the value (or a constant) to be used as the loop’s output value when Remote Manual is enabled by the value of RMAN (or the value it points to) being 1. To have the loop hold its last value when RMAN is 1, set OTRK to “LP*n* OV”. To use an output value from a CN function block, select PARM.
RMAN (Remote Manual)	ADV RATIO CAS_S DIAT SPLIT	OFF 1 0 PARM *(discrete)*	**Remote Manual -** Remote Manual Mode is enabled when the value of RMAN = 1, or the value of the selected discrete parameter = 1. When Remote Manual Mode is enabled, the loop is taken out of Automatic Mode, and the loop output is determined by the output tracking value (OTRK). In Remote Manual Mode the local **DECREMENT** and **INCREMENT** keys are disabled for manual output adjustment. In Remote Manual the automatic indicator of the display will flash. To override Remote Manual, placing the controller in local Manual Mode, press the **MANUAL/AUTO** key.
CHGA (Change Action)	ADV RATIO CAS_P CAS_S DIAT SPLIT	OFF 1 0 PARM *(discrete)*	**Change Action -** Selects the opposite control action from that selected for the control action (see CTLA). Control action is opposite when the value of CHGA = 1, or the value of the selected discrete parameter = 1.

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
DTUN (Dual Tuning Selection)	*all loop types except ON_OFF*	OFF 1 0 PARM *(discrete)*	**Dual Tuning Selection –** A logic high (1) value for DTUN (entered here or read from the selected parameter) causes the loop to used the second set of tuning constants (PB2/GN2, RST2, RTE2). A bumpless transfer (integral term adjusted) calculation will be made on transition. The loop will continue to use the second set unit the value of DTUN (or the selected discrete parameter) = 0,
DIKY (Discrete vs. Keypad)	ADV RATIO CAS_P CAS_S DIAT SPLIT	OFF 1 0 PARM *(discrete)*	**Discrete vs. Keypad -** A logic high (1) value for DIKY (entered here or read from the selected parameter) disables the **MANUAL/AUTO** key and selection of the setpoint using the keys on the front panel. The functions are transferred to the A-MS and SPSE discrete parameters. See A-MS and SPSE. Status changes made by A-MS and SPSE will remain when DIKY goes to 0.
SPSE (Setpoint Select)	ADV RATIO CAS_P CAS_S DIAT SPLIT	OFF 1 0 PARM *(discrete)*	**Setpoint Select -** This takes the place of the "TOGGLE SPT" item on the Loop Tuning Menu when the Discrete vs. Keyboard (DIKY) discrete has a value of 1. If SPSE = 1, then Setpoint 2 is used. If SPSE = 0, then Setpoint 1 is used. When DIKY or SPSE is OFF, SPSE has no effect.
A-MS (Auto-Manual Select)	ADV RATIO CAS_P CAS_S DIAT SPLIT	OFF 1 0 PARM *(discrete)*	**Auto-Manual Select -** This takes the place of the **MANUAL/AUTO** key when the Discrete Vs Keyboard (DIKY) discrete has a value of 1. If A-MS = 1, then Manual Mode. If A-MS = 0, then Automatic mode When DIKY or A-MS is OFF, A-MS has no effect.
OVLL (Output Low Limit) **OVHL** (Output High Limit)	CAS_P	OFF NUMBER	**Output Low Limit and Output High Limit -** Use these to specify the range of the output of the primary loop in a cascade control strategy. This primary output range should match the range specified for the PV of the secondary loop. Usually the loops should be configured so that LP1 OVLL = LP2 PVLL LP1 OVHL = LP2 PVHL

Table 9-8 Loop Prompt Descriptions

Prompt (Full name)	Applies To	Range/Selections	Definition
IACT (Interacting)	*all loop types except ON_OFF*	NO YES	**Interacting –** When YES is selected the Gain (or PB), reset, and rate terms interact. When NO is selected Gain affects reset and rate, but rate and reset do not affect Gain, more closely approximating analog control.
RLIM (Reset Limit)	*all loop types except ON_OFF*	OFF NUMBER *range is 100 % to 200 %*	**Reset Limit –** Enter value to restrict the calculated integral term of the loop during “cold start” (see 18.9), or upon transfer from Manual to Automatic Modes.
LBAD (Loop Bad Action Required)	*all loop types*	 NO YES	**Loop Bad Action Required –** Specify whether the operator must take action to return the loop to normal operation after a loop block has gone to failsafe because of an abnormal loop condition. (See Table 21-3.) **NO –** No operator action needed to return the loop to normal operation when the abnormal condition has been cleared. **Yes –** Operator action needed.

9.4 Programming Analog Outputs

Introduction

Each analog output (AO) function block serves one of two purposes:

- If your strategy uses Current Adjusting Type (CAT) or Voltage Adjusting Type (VAT) control output (that is, if the field device being controlled needs an analog signal), then the AO block is the interface between the control loop and the actuator in the field. For this purpose, one AO block is associated with each hardware analog output. Depending on the model purchased, the unit can support one or two hardware outputs. AO1 is associated with hardware output 1. AO2 is for hardware output 2. (See terminal label on controller case.)
- If your strategy uses Duration Adjusting Type (DAT) or Position Proportional (PP) control output, then the AO block serves as an intermediary between the control loop and the discrete output blocks serving the relays that are wired to the controlled device. (DAT uses one relay. PP uses two.) Although AO2 can be associated with an actual hardware output for CAT or VAT control, alternatively it can be used as an intermediary for DAT or PP control. AO3 and AO4 are also available for use in DAT and PP control. Remember, though, that AO3 and AO4 are software objects only and can never be associated with physical output terminals.

  Note that ON/OFF control loops do not use an AO as intermediary. This is the one case where a discrete output can be programmed to read the output of a control loop directly. The loop simply turns a relay on and off through the discrete output block. To complete an ON/OFF loop configuration, assign the ON/OFF loop's output (LPn OS) to a Discrete Output Relay (see Section 9.6).

Because of this flexibility in the use of AO blocks, the first step during AO programming is specifying the correct type of output for your strategy. The prompts for the appropriate AO internal parameters will then be displayed.

To program the Analog Output function blocks, select "PRG AO" on the Main Program Menu. Select an AO to program.

Specifying the type of output

The first step in programming an AO function block is to specify the output type. The available types are listed in Table 9-9.

Table 9-9 Output Type

Type as displayed	Full name of output type
CAT	Current Adjusting Type
VAT	Voltage Adjusting Type
DAT	Duration Adjusting Type
PP	Position Proportional

Analog output prompts

The prompts displayed during AO configuration depend on the type of output specified.

- Table 9-10 describes each prompt used to program CAT and VAT analog output blocks.
- Table 9-11 describes each prompt used to program DAT analog output prompts.
- Table 9-12 describes each prompt used to program PP analog outputs.
  Additional information about configuring and calibrating the controller to provide Position Proportional output is in Section 10.

The prompts in each table are listed in the order in which they are displayed.

Table 9-10 CAT and VAT Analog Output Prompts

Prompt (Full name)	Applies To	Range/Selections	Definition
IDPT (Input Decimal Position)	*all output types*	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position to be used in the input value provided to the AO block.
INP (Input)	*all output types*	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the input to the AO function block.
IN LL INPUT LOW LIMIT) **IN HL** INPUT HIGH LIMIT)	CAT VAT	OFF NUMBER	**Input Low Limit** and **Input High Limit –** Specify the value of the low limit and high limit for the input to the function block. If the AO's input source is a PID control loop, specify a high value of 100 and a low value of 0. For other input sources, specify limits using the same units as the AO's input source Variable input limits are available by programming a CN (constant) block's Destination with HS or LS. See Programming Constants, Section 9.9.
ODPT (Output Decimal Position)	CAT VAT	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the AO block.
OVLL OUTPUT LOW LIMIT) **OVHL** (OUTPUT HIGH LIMIT	CAT VAT	OFF NUMBER	**Output Low Limit** and **Output High Limit –** Enter limits to be used when scaling the output to the input limits. • For CAT, enter any output range within 0 mA to 20 mA. For example, a low limit of 4 and high limit of 20 will provide a 4 mA to 20 mA output range. • For VAT, enter any output range within 0 V to 5 V. For example, a low limit of 1 and a high limit of 5 will provide a 1 to 5 Vdc output range.
OTEU (Output Engineering Units)	CAT VAT	NONE F C	**Output Engineering Units –** Specify the unit of measure (Fahrenheit or Celsius) for the output; this unit is used in the optional data storage database.

Table 9-10 CAT and VAT Analog Output Prompts

Prompt (Full name)	Applies To	Range/Selections	Definition
ISLW (Increasing Slew Limit)	CAT VAT DAT	OFF NUMBER *range is 0.1 to 999.9 units/minute (units of the AO's input source).*	**Increasing Slew Limit** and **Decreasing Slew Limit -** Limits the rate of increase or decrease of the analog output. Value entered is in terms of the AO's input source, not in terms of the output as defined by OVLL and OVHL
DSLW (Decreasing Slew Limit)			Variable slew limits are available by programming a CN (constant) block's Destination with IS or DS. See Programming Constants, Section 9.9.
FSAF (Failsafe)	CAT VAT DAT		**Failsafe –** Specify whether or not failsafe is active in case of thermocouple failure (burnout) and, if so, which direction. An input is considered to have failed when the controller detects loss of continuity or when the input is more than 10 % out of range.
		NONE	**None** – Failsafe disabled.
		UP	**Up** – Output will go to full scale value in case of input failure (upscale).
		DOWN	**Down** – Output will go to low value in case of input failure (downscale).
		VALUE	**Value –** Select this to permit entry of a value using "FSV" (see below).
FSV (Failsafe Value)	CAT VAT DAT	OFF NUMBER	**Failsafe Value –** Specify the value at which the output will be held if input fails while FSAF = VALUE. The FSV value is also the initial output of the loop on "cold start". If FSV is set to OFF, the output will go to 0. Value entered is in terms of the AO's input source, not in terms of the output as defined by OVLL and OVHL.

Table 9-11 DAT Analog Output Prompts

Prompt (Full name)	Applies To	Range/Selections	Definition
IDPT (Input Decimal Position)	*all output types*	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position to be used in the input value provided to the AO block.
INP (Input)	*all output types*	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the input to the AO function block.
ISLW (Increasing Slew Limit) **DSLW** (Decreasing Slew Limit)	CAT VAT DAT	OFF NUMBER *range is 0.1 to 999.9 units/minute (units of the AO's input source).*	**Increasing Slew Limit** and **Decreasing Slew Limit -** Limits the rate of increase or decrease of the analog output. Value entered is in terms of the AO's input source, not in terms of the output as defined by OVLL and OVHL Variable slew limits are available by programming a CN (constant) block's Destination with IS or DS. See Programming Constants, Section 9.9.
FSAF (Failsafe)	CAT VAT DAT	 NONE UP DOWN VALUE	**Failsafe –** Specify whether or not failsafe is active in case of thermocouple failure (burnout) and, if so, which direction. An input is considered to have failed when the controller detects loss of continuity or when the input is more than 10 % out of range. **None** - Failsafe disabled **Up** – Output will go to full scale value in case of input failure (upscale). **Down** – Output will go to low value in case of input failure (downscale). **Value –** Select this to permit entry of a value using "FSV" (see below)
IMPT (Impulse Time)	DAT	OFF NUMBER *range is 0 to 300 seconds*	**Impulse Time -** Specify the cycle duration for On and Off time of the output. For example, a time of 150 seconds will cause the output to be on for 75 seconds and off for 75 seconds when the input source is at 50 %. Variable impulse time is available by programming a CN (constant) block's Destination with IT. See Programming Constants, Section 9.9.

Table 9-11 DAT Analog Output Prompts

Prompt (Full name)	Applies To	Range/Selections	Definition
MON (Min On Time) **MOFF** (Min Off Time)	DAT	OFF NUMBER	**Min On Time** and **Min Off Time –** Specify the minimum time the output should be ON and OFF, even if the output source calls for less time. Take into account the requirements of the device being controlled when configuring these times. (Some motors can be damaged if cycled on and off too quickly.)
FSV (Failsafe Value)	CAT VAT DAT	OFF NUMBER	**Failsafe Value –** Specify the value at which the output will be held when failsafe is active. This value is also the initial output of the loop on "cold start". If the value is set to OFF, the output will go to 0. Value entered is in terms of the AO's input source, not in terms of the output as defined by OVLL and OVHL.
OUT (Discrete Output Channel)	DAT	DO0 DO1 DO2 DO3 DO4	**Discrete Output Channel –** Specify the discrete output used to implement DAT control. Select DO0 for "None". The input and action of the selected DO function block will be unprogrammable under the PRG DO menu item.

Table 9-12 PP Analog Output Prompts

Prompt (Full name)	Applies To	Range/Selections	Definition
IDPT (Input Decimal Position)	*all output types*	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position to be used in the input value provided to the AO block.
INP (Input)	*all output types*	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the input to the AO function block.
DUSE (Drive Unit Sensitivity	PP	OFF NUMBER *range is 80 % to 100 %*	**Drive Unit Sensitivity –** Enter the largest value that does not cause drive motor oscillation.
DUSP (Drive Unit Speed)	PP	OFF NUMBER *range is 1 to 300 seconds*	**Drive Unit Speed –** The full scale travel time for the motor.
SLWR (Slidewire Feedback Source)	PP	OFF NUMBER PARM *(analog)*	**Slidewire Feedback Source –** The AI block associated with the hardware input connected to the slidewire (typically AI2). The range of the feedback analog input must be programmed for engineering units of 0 to 100 units, indirect range, with a circuit span of 0 to 1 Vdc.
PA (Positioning Algorithm)	PP	AUTO PP DIAT	**Positioning Algorithm –** Specify the appropriate algorithm. The rules are: • AUTO and DIAT algorithm can be used only with DIAT loop type. • PP algorithm can be used only with loop types <u>other than DIAT.</u> • PP and AUTO algorithms require a feedback analog input. AUTO permits normal feedback positioning of the drive motor when the feedback input is good, and defaults to DIAT operation if the slidewire feedback input fails.

Table 9-12 PP Analog Output Prompts

Prompt (Full name)	Applies To	Range/Selections	Definition
INC (Increase Output)	PP	DO0 DO1 DO2	**Increase Output** and **Decrease Output –** Specify the discrete outputs used to implement PP or DIAT output. Select DO0 for “None”.
DEC (Decrease Output)		DO3 DO4	The input and action of the selected DO function blocks will be unprogrammable under the PRG DO menu item.

9.5 Programming Discrete Inputs

A DI/DO card supporting two or three discrete inputs is a controller option. Each DI has an associated DI function block. The Discrete Input menu item used to configure the DI blocks will appear if a DI/DO card is installed.

Select "PRG DI" on the Main Program Menu. Select a discrete input to program.

Discrete input prompts

Table 9-13 describes the prompts for DI blocks.

Table 9-13 Discrete Input Prompts

Prompt (Full name)	Range/Selections	Definition
ACST (Action State)	 NORMAL INVERT	**Action State –** Specify whether the input will be normally closed or normally open when ON. **Normal -** Closed when ON (not inverted). **Invert -** Closed when OFF.
DELA (Delay)	OFF NUMBER	**Delay –** Specify the delay time (in seconds). When the discrete input goes to its ON state, the DI function block will wait for the specified delay time before indicating the ON condition as an output. If the discrete input goes to OFF before the delay time expires, no ON output will be indicated by the function block.
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the discrete input is ON (value = 1) and OFF (value = 0).

The available selections for ONL and OFFL parameters are listed in Table 9-14.

Table 9-14 Selections for ONL and OFFL Parameters

Selections
OFF
ON
UP
DOWN
START
STOP
LOW
HIGH
RESET
RUN
TRUE
FALSE
LEFT
RIGHT
DECRS
INCRS
LOAD
UNLOAD
COOL
HEAT
FILL
DRAIN
EMPTY
FULL
IN
OUT
OPEN
CLOSED
HOLD
ACTIVE
READY
ABORT
ALARM
AUTO
MANUAL
SP1
SP2
NORMAL
YES
NO

9.6 Programming Discrete Output Relays

Two output relays are standard. Two more are optional. Each has an associated DO function block. The Discrete Output menu item will appear if the optional output relays are installed.

ATTENTION

If a DO block (and its relay) has been assigned to a DAT or PP function during programming of AO blocks, the action state (ACST) and the input (INP) of the DO block will not be configurable here. See "OUT" (DAT), and "INC and DEC" (PP) in Section 9.4.

Select "PRG DO" on the Main Program Menu. Select a DO to program.

Discrete output prompts

Table 9-15 describes the Discrete Output prompts.

Table 9-15 Discrete Output Prompts

Prompt (Full name)	Range/Selections	Definition
ACST (Action State)	 NORMAL INVERT	**Action State –** Specify whether the input will be normally closed or normally open when ON. **Normal -** Closed when ON (not inverted). **Invert -** Closed when OFF.
INP (Input source)	OFF 1 0 PARM *(discrete)*	**Input –** Specify the source of the input to the DO function block, or enter a value of 0 or 1 here.
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the discrete output is ON (value = 1) and OFF (value = 0).

9.7 Programming Calculated Values

A Calculated Value (CV) block provides an output value derived from calculations involving values read from other blocks (including other CV blocks). The calculations can be mathematical or logical operations, and the CV output can be analog or discrete. Once a CV is created, it can be used by any function block as many times as necessary.

ATTENTION

If you plan to program another function block to use a Calculated Value, you must program the Calculated Value first.

Up to sixteen Calculated Values can be programmed (CV1 through CV16).

Select "PRG CV" on the Main Program Menu. Select a CV to program.

Select a type

The first step in programming a CV block is to specify the CV type. Each type has its own set of prompts. Available types are listed in Table 9-16.

Table 9-16 CV Types

Type as Displayed	Full Name of Type	Prompts Described In
NONE	*CV not used*	-----
PP	Peak Picking Function	Table 9-17
SSEL	Signal Select Function	Table 9-18
MATH	Math Operator	Table 9-19
LOGIC	Logical Operator	Table 9-20
TOTL	Totalizer Function	Table 9-23
ITIMER	Interval Timer Function	Table 9-24
PTIMER	Periodic Timer Function	Table 9-25
INV	Inverter	Table 9-27
SPLT-S	Standard Split Output Function	Table 9-28
SPLT-A	Advanced Split Output Function	Table 9-29
CMPARE	Compare Function	Table 9-30
CARBON	Carbon Potential (optional)	*see Section 12*

ATTENTION

The Free Form Math CV lets you create custom equations. It is available only on SCF software. The configuration must be downloaded to the controller from the computer running SCF software.

9.7.1 CV Peak Picking (PP)

Introduction

The peak picking function monitors the input and determines a peak value reached during the specified time interval (in minutes). The peak can be chosen to be a maximum, minimum, or average. At the end of the time interval, the output CV*n* OV steps to the value of the peak and holds this value until the next time interval has elapsed. If the Reset Input (RST) turns ON, the output is held and the time interval restarts.

CV pick picking prompts

Table 9-17 describes the Peak Picking prompts.

Table 9-17 CV Peak Picking Prompts

Prompt (Full name)	**Range/Selections**	**Definition**
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
INP (INPUT)	OFF NUMBER PARM *(analog)*	**Input Source -** Specify the source of the input to the CV function block.
OTEU (Output Engineering Units)	OFF F C	**Output Engineering Units –** Specify the unit of measure (Fahrenheit or Celsius) for the output.
RST (Reset Input)	OFF 1 0 PARM *(discrete)*	**Reset Input** – A logical high (1) entered here or read from the selected parameter causes the output of the CV function block to be held, and the time interval to be reset to the beginning.
MIN (Minutes)	OFF NUMBER	**Minutes –** Specify the duration of the time interval.
ACTN (Action)	MAX AVG STDDEV MIN	**Action -** Select the type of peak pick. The sampling rate matches the scan frequency (see 9.15). **Maximum** value reached by input during period. **Averages** input values during time period. **Standard Deviation** of the input value during period. **Minimum** value of input during time period.

Table 9-17 CV Peak Picking Prompts

Prompt (Full name)	**Range/Selections**	**Definition**
RNGL (Range Low Limit)	Numerical range	**Range Low Limit** and **Range High Limit -** Enter the output's range when displayed as a trend with Honeywell SDA software. **These limits do not clamp or flash the output's display on the controller**.
RNGH (Range High Limit)		

9.7.2 CV Signal Select (SSEL)

Introduction

The signal select operation selects the value of one or more of its inputs and makes it available as CV*n* OV, based on the action specified using the "ACTN" prompt.

CV signal select prompts

Table 9-18 describes the Signal Select prompts.

Table 9-18 CV Signal Select Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
OTEU (Output Engineering Units)	OFF F C	**Output Engineering Units –** Specify the unit of measure (Fahrenheit or Celsius) for the output.
INP1 (Input 1) through **INP8** (Input 8)	OFF NUMBER PARM *(analog)*	**Input Source 1 through Input Source 8 –** Use these prompts to specify the source of the inputs to the CV function block. Inputs 3 through 8 are not used if the signal selection action is based on a discrete switch. See "ACTN" selection "DIS-SW" below.

Table 9-18 CV Signal Select Prompts

Prompt (Full name)	Range/Selections	Definition
ACTN (Action)	 HIGH LOW AVG MIDDLE F-GOOD ANA-SW DIS-SW	**Action -** Select the action type to be used as the basis for signal selection. **High** selects the signal with the highest value. **Low** selects the signal with the lowest value. **Average** computes an average of all the input values. **Middle** selects the median input value. If the number of inputs is even, then the output equals the sum of the two middle values divided by two. **First Good** selects the first signal to reach the function block in case of input failure. Input failure is recognized by the controller when the input is more than 10 % out of range or when the controller detects lack of continuity. This “bad input” status is propagated to any other function blocks using the input (or the “failsafe” value for the input will be used if enabled). FIRST GOOD will stop the propagation of the bad input status and presents a “known good” output from the CV block. **Analog Switch** selects the signal associated with the input whose number equals the value specified for “ASEL”. For example, if the value of “ASEL” is 3, then “INP3” signal is selected. If the value of “ASEL” < 1, then INP1 is selected. The value of “ASEL” is truncated. For example, if the value is 3.55, the value used is 3 and “INP3” is selected. **Discrete Switch** selects the input signal on the basis of the value of a discrete parameter “DSEL”. “INP1” is selected when “DSEL” has a value of zero. “INP2” is selected when “DSEL” has a value of one. “INP3” through “INP8” are not used.
ASEL (Analog Switch)	OFF NUMBER PARM *(analog)*	**Analog Switch –** If the action selected is “ANA-SW”, then this prompt is available. Use it to specify the source of the value used by the analog switch action.
DSEL (Discrete Switch)	OFF NUMBER PARM *(discrete)*	**Discrete Switch –** If the action selected is “DIS-SW”, then this prompt is available. Use it to specify the source of the value used by the discrete switch action.

9.7.3 CV Math Operator (MATH)

Introduction

The math operation performs math on up to eight input values using a single operator. The result is used as CV*n* OV. Division by 0 indicated by flashing 0 on primary display showing CV value.

ATTENTION

The controller also supports a function block configured to perform a freeform equation of up to 32 characters. Use Honeywell SCF configuration software to configure freeform equations such as:

Input 1 ∗ Input 2 ∗ SQRT(ABS(Input 3 ÷ Input 4))+5

CV math prompts

Table 9-19 describes the Math prompts.

Table 9-19 CV Math Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
INP1 (Input 1) through **INP8** (Input 8)	OFF NUMBER PARM *(analog)*	**Input Source 1 through Input Source 8 –** Use these prompts to specify the source of the inputs to the CV function block. **Attention:** If connecting to an upstream loop, that loop output (LPn OV) MUST be INP1. See “FB” (feedback) below.
OTEU (Output Engineering Units)	OFF F C	**Output Engineering Units –** Specify the unit of measure (Fahrenheit or Celsius) for the output.

Table 9-19 CV Math Prompts

Prompt (Full name)	Range/Selections	Definition
OPER Operator)	ADD SUBT MULT DIV ABSVAL SQRT STDDEV	**Operator –** Select the math operator to be used by the function block. The values provided by the inputs will be the operands. The rules follow: • If the operator is add, subtract, multiply, or standard deviation, the block will do the calculation: Input 1 OPER Input 2 OPER...Input 8 Example: Input 1 minus Input 2 minus ...Input 8. Only standard deviation requires the use of all inputs. • If the operator is absolute value or square root, the block will calculate the absolute value or square root of Input 1's value. The other inputs are not used. • If the operator is division, the block will divide Input 1 by Input 2. The other inputs are not used. • If the CV block is part of a loop output configuration, the math operator cannot be ABSVAL, SQRT, or STDDEV.
FB (Feedback)	OFF NUMBER PARM *(analog)*	**Feedback –** Specify the source of the feedback value used when this block is part of a control loop output configuration. Select LP*n* BC or AO*n* BC to propagate the back calculation (BC) value from a downstream loop or AO. Also, program the upstream loop's feedback with this Math CV's back calculation value (CV*n* BC). You MUST program this CV's feedback to OFF if this CV is not used as part of a control loop output configuration.
OVLL (Output Low Limit)	OFF NUMBER	**Output Low Limit** and **Output High Limit –** Specify the output range. Any computed output value that is outside the range will be clamped at the appropriate limit. The clamped output value will flash when displayed.
OVHL (Output High Limit)		

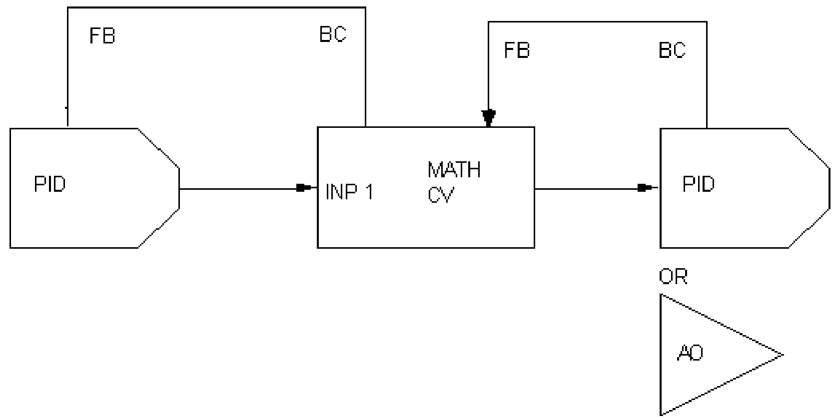


Figure 9-1 Math CV Feedback Programming

9.7.4 CV Logic (LOGIC)

Introduction

The logic CV function block performs logic operation on the values from up to eight inputs using a single operator. The result is available as CV*n* OS. The output CV*n* OS = 1 if the logic is true.

CV logic prompts

Table 9-20 describes the Logic prompts.

Table 9-20 CV Logic Prompts

Prompt (Full name)	Range/Selections	Definition
OPER (Logical Operator)	AND OR XOR PASS R S FF TGL FF 1 SHOT	See Table 9-22 CV Logical Operator Definitions.
INP1 (Input 1) through **INP8** (Input 8)	OFF 1 0 PARM *(discrete)*	**Input Source 1 through Input Source 8 –** Use these prompts to specify the source of the inputs to the CV function block.
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the output is ON (value = 1) and OFF (value = 0).
CTYP (Condition Type)	NONE DELAY EXTEND PULSE RT PLS	**Condition Type – Specify the condition type.** See Table 9-21 for interaction between condition types and times.

Table 9-20 CV Logic Prompts

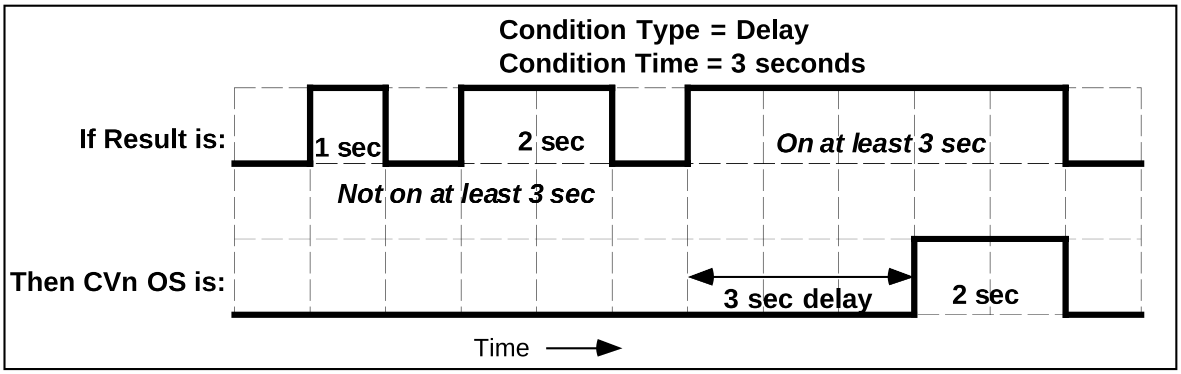
Prompt (Full name)	Range/Selections	Definition
CTIM (Condition Time)	OFF NUMBER	**Condition Time – Specify the condition time.** See Table 9-21 for interaction between condition types and times.

Table 9-21 illustrates the interaction between the condition type and the condition time.

Table 9-21 CV Condition Time and Condition Type Prompts

Condition type	Application	If this is true	then CV*n* OS is
NONE	--	Result	Result

Condition type	Application	If this is true	then CV*n* OS is
DELAY	Filters short pulses Delays rising edge of Result for CONDITION TIME	Result switches ON(1) for n seconds ≥ CONDITION TIME.	ON n seconds minus CONDITION TIME
		Result switches OFF(0)	OFF(0)



Condition type	Application	If this is true	then CV*n* OS is
EXTEND	Used for interfacing with slower circuits.	Result switches ON(1) for n seconds, then OFF(0)	ON(1) for n seconds plus CONDITION TIME, then OFF(0)
	Extends falling edge of Result for CONDITION TIME.	Result switches ON(1)	ON with no delay

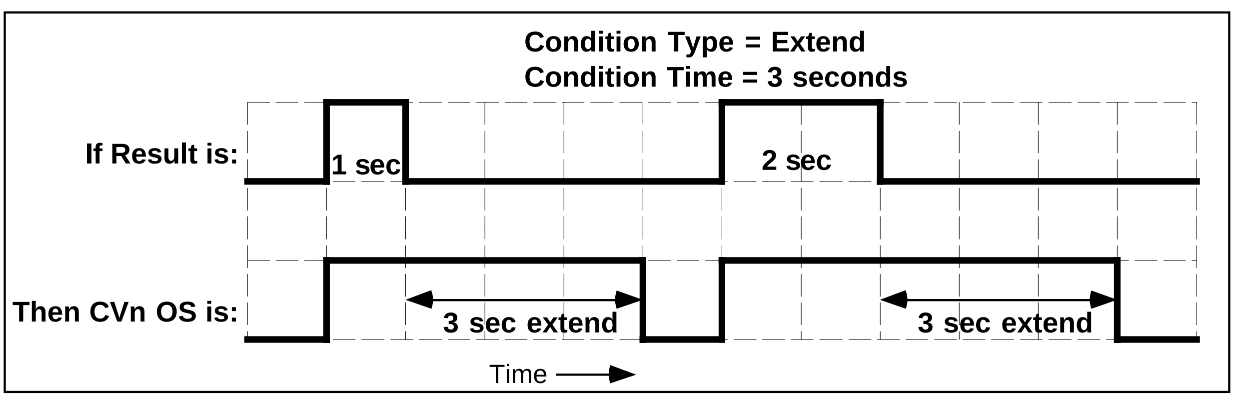
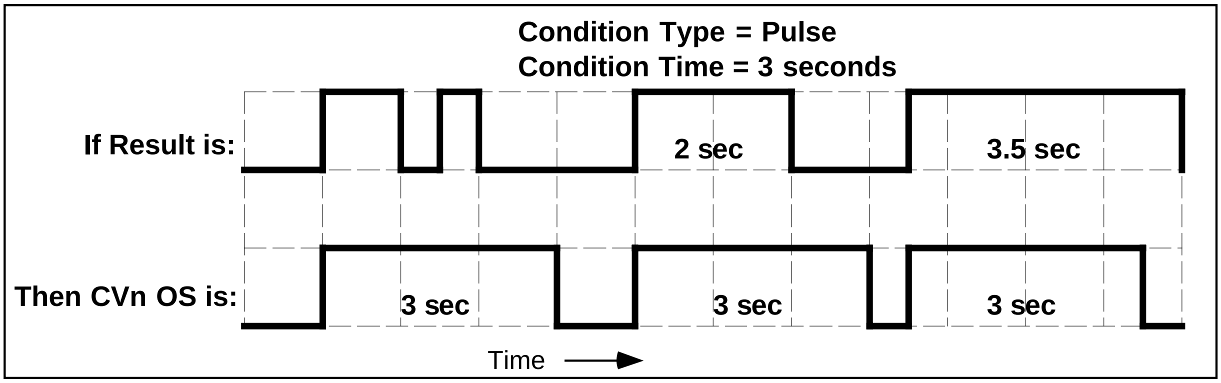


Table 9-21 CV Condition Time and Condition Type Prompts

Condition type	Application	If this is true	then CV*n* OS is
PULSE	Used for interfacing with slower circuits. On rising edge of Result, creates pulse length CONDITION TIME and ignores additional rising edges of Result within that CONDITION TIME.	Result switches ON(1) for ≤ CONDITION TIME, then OFF(0).	ON(1) for CONDITION TIME, then OFF(0). During CONDITION TIME, any additional OFF(0)-to-ON changes of Result are ignored.



Condition type	Application	If this is true	then CV*n* OS is
RT PULSE (Re-triggerable pulse)	Used for slower circuits.	Result switches ON(1) for ≤ CONDITION TIME, then OFF(0)	ON(1) for CONDITION TIME, then OFF(0).
	Guarantees that CV*n* OS will be ON for CONDITION TIME after most recent rising edge of Result.	Result switches ON(1) multiple times before CONDITION TIME expires	ON(1) when Result first switches ON(1) and remains ON(1) until Result has not switched ON(1) for CONDITION TIME.
		Result switches ON(1) for ≥ CONDITION TIME, then OFF(0)	ON(1) for CONDITION TIME then OFF(0).

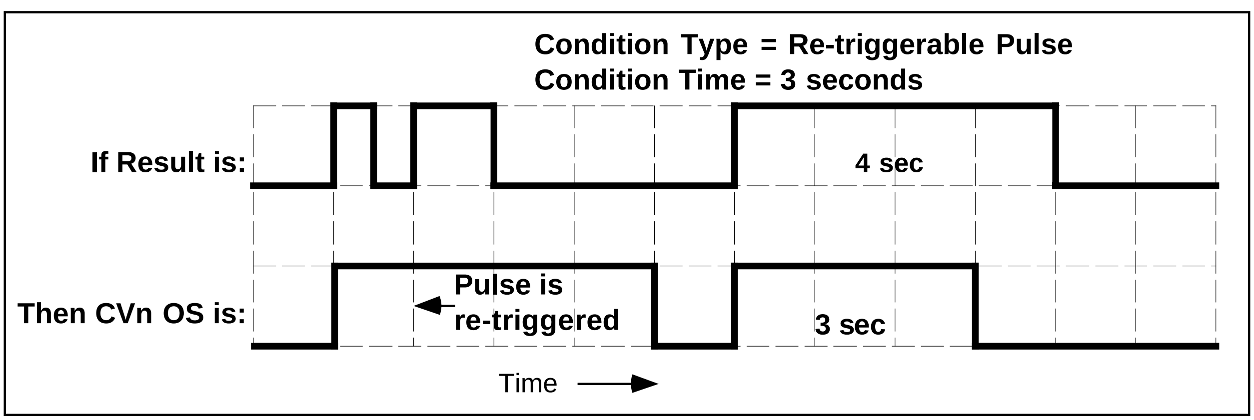
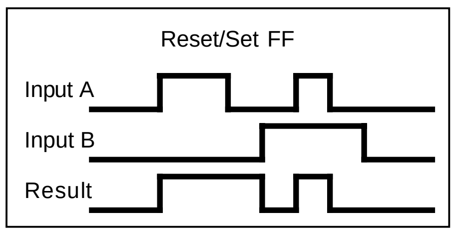
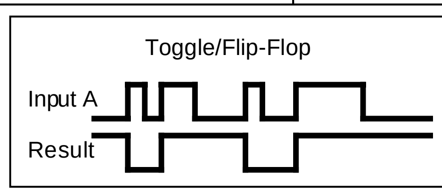


Table 9-22 CV Logical Operator Definitions

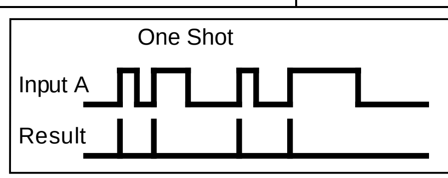
For this operator	Definition	if this is true	then Result is
AND	If all programmed inputs are ON, Result is ON.	All programmed inputs are ON(1)	ON(1)
OR	If at least 1 programmed input is ON, Result is ON.	At least 1 programmed input is ON(1)	ON(1)
XOR	Uses Inputs A and B only.	Input A is ON(1) and Input B is OFF(0).	ON(1)
	If one and only one input is ON, Result is ON.	Input A is OFF(0) and Input B is ON (1).	ON(1)
RESET/SET FF	Rising edge of Input A turns Result ON.	Input A is ON(1).	ON(1)
(Reset/Set Flip-Flop)	Rising edge of Input B resets Result.	Input A is OFF(0) and Input B is ON (1).	OFF(0)



TOGGLE/FF	Toggle Flip-Flop. Rising edge of Input A inverts Result	Input A changes from OFF(0) to ON(1) (rising edge)	ON(1) if it was OFF(0), or OFF(0) if it was ON(1).
		Input A changes from ON(1) to OFF(0) (falling edge)	unchanged



ONE SHOT	Rising edge of Input A turns Result ON for one machine scan cycle.	Input A is ON(1) for any length of time	ON(1) for 1 scan cycle of the instrument, then OFF(0)



PASS	Passes Input A's state unchanged to CONDITION TYPE.	Input A changes state	same as Input A

9.7.5 CV Totalizer (TOTL)

Introduction

This function totalizes a value, such as a flow rate, over time. The output CV*n* OV is a running total. When this total reaches or exceeds the preset limit value (PSET), the totalizer resets to zero, the discrete output CV*n* OS turns on (goes to 1) for one cycle, and the totalizing restarts.

Using "PRG DPYS" you can specify that the output value of the CV used as a totalizer be included in a primary operator display.

CV totalizer prompts

Table 9-23 describes the Totalizer prompts.

Table 9-23 CV Totalizer Prompts

Prompt **(Full name)**	**Range/Selections**	**Definition**
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
INP (Input)	OFF NUMBER PARM *(analog)*	**Input Source –** Specify the source of the input to the CV function block.
OTEU (Output Engineering Units)	OFF F C	**Output Engineering Units –** Specify the unit of measure (Fahrenheit or Celsius) for the output.

Table 9-23 CV Totalizer Prompts

Prompt (Full name)	Range/Selections	Definition
ACTN (ACTION)		**Action –** Select the totalizer action. Note that the preset value "PSET" is assumed to be in the same units as "OTEU".
	UP	**Up -** Each scan cycle the input value is added to the running total. When total reaches or exceeds "PSET", the discrete output of the CV goes to 1 and remains 1 for one scan cycle. The totalizer then resets and starts again. The value resets to either zero or the residual total. The residual total is the final total minus the preset value, that is, the value that accumulated during the one scan cycle that it takes the totalizer to reset.
	DOWN	**Down -** Each scan cycle the input value is subtracted from the "PSET" value. When this result reaches or goes below zero, the discrete output of the CV goes to 1 and remains 1 for one scan cycle. The totalizer then resets and starts again. The value resets to either "PSET" or the residual total. The residual total is preset plus final total, since final total is either zero or negative.
	DEMD	**On Demand -** Same as UP, except input is added only while the "ENAB" discrete has a value of 1. Input is ignored while ENAB is 0.
	CONT	**Continuous -** Same as UP except the total ignores the "PSET" value and increments to the maximum value (999,999,999) then resets to 0 and continues.
PSET (Preset Output Value)	OFF NUMBER PARM *(analog)*	**Preset Output Value –** Specify the value or its source. When the RST goes high (1) an UP action totalizer will reset to zero, or a DOWN action totalizer will reset to the preset value.
RST (Reset)	OFF 1 0 PARM *(discrete)*	**RST –** Specify the parameter to serve as the reset discrete or specify a value directly. When the RST goes to 1 an UP action totalizer will reset to zero, or a DOWN action totalizer will reset to the preset value.
ZCUT (Zero Cutoff)	OFF NUMBER	**Zero Cutoff –** Specify the least value to be accumulated in the totalizer. Input values below this value will be input as zero.
TUNT (Time Units)	SEC MIN HOUR DAY	**Time Unit –** Configure this to match the time units of the flow rate being totaled. For example, if the flow rate is in gallons per minute, select MIN.

Table 9-23 CV Totalizer Prompts

Prompt (Full name)	Range/Selections	Definition
ENAB (ENABLE)	OFF 0 1 PARM *(discrete)*	**Enable –** Specify the parameter whose input will be the On Demand input for the DEMD action. Activates totalizer when ENAB = 1.
OVLL (Output Low Limit)	OFF NUMBER	**Output Low Limit** and **Output High Limit –** Specify the output range.
OVHL (Output High Limit)		**If the output is outside the range the displayed value will flash to alert the operator of an unusual condition. The output will not be clamped.**

9.7.6 CV Interval Timer (ITIMER)

Introduction

This timer counts down from the preset value in minutes (range of 0.1 to 9999.9 minutes). This time remaining is CV*n* OV. The timer has a single discrete output CV*n* OS which is ON (1) while the timer is actively counting or while reset (RST) is ON (1), and OFF (0) while the timer has timed out to zero. When RST switches ON (1) the timer resets to the preset value; an ON(1) to OFF(0) transition starts the timer.

Internal timer prompts

Table 9-24 describes the Interval Timer prompts.

Table 9-24 CV Interval Timer Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
OTEU (Output Engineering Units)	OFF F C	**Output Engineering Units –** Specify the unit of measure (Fahrenheit or Celsius) for the output.
PSET (Preset Output Value)	OFF NUMBER PARM *(analog)*	**Preset Output Value -** Timer counts to zero from this number of minutes.
RST (Reset)	OFF 1 0 PARM *(discrete)*	**Reset –** Specify the discrete (or enter a value directly here) to control the operation of the timer.
OVLL (Output Low Limit) **OVHL** (Output High Limit)	OFF NUMBER	**Output Low Limit** and **Output High Limit –** Specify the output range. **If the output is outside the range the displayed value will flash to alert the operator of an unusual condition. The output will <u>not</u> be clamped.**

Table 9-24 CV Interval Timer Prompts

Prompt (Full name)	Range/Selections	Definition
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the output is ON (value = 1) and OFF (value = 0).

9.7.7 CV Periodic Timer (PTIMER)

Introduction

The periodic timer sets the discrete output CV*n* OS to 1 at the specified start time and periodically thereafter. Use this to activate a discrete parameter at a particular time and at regular intervals.

In case of Warm Start: If the Start Time is programmed, the timer will synchronize itself to the real time clock. If the Start Time is OFF, the timer will continue as if the Warm Start has not occurred.

In case of Cold Start: If the Start Time is programmed, the timer will synchronize itself to the real time clock. If the Start Time is not programmed (OFF entered in response to time definition prompts), the timer will be reset to zero and begin a new periodic cycle.

See Subsection 19.9 for a description of Warm and Cold Starts.

ATTENTION

The Start Time's value cannot exceed the Period. An error message is displayed if you enter a Start Time of 8:00:00 and a Period of 4:00:00, for example.

Prompts

Table 9-25 describes the Periodic Timer prompts.

Table 9-25 CV Periodic Timer Prompts

Prompt (Full name)	Range/Selections	Definition
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the output is ON (value = 1) and OFF (value = 0).
TIMR (Set Up Timer)		**Set Up Timer –** Pressing **ENTER** when this prompt is on display takes you into a sub-menu of prompts shown in Table 9-26. Use these prompts to set up the timer.

Table 9-26 CV Periodic Timer "Set Up Timer" Prompts

Prompt (Full name)	Range/Selections	Definition
PHSE (Phase)	 NONE MNTHLY WEEKLY DAILY	**Phase –** Specify the timer phase. **None -** Discrete switches ON at end of each period. **Monthly -** Each month, discrete switches ON at start day and time. **Weekly -** Each week, discrete switches ON at start day and time. **Daily -** Discrete switches ON at start time then after each period.
PHRS (Period Hours)	*range is 0 to 23 hours*	**Period Hours –** This prompt is displayed if PHSE = DAILY or NONE. Specify the number of hours in the period.
PMIN (Period Minutes)	*range is 0 to 59 minutes*	**Period Minutes –** This prompt is displayed if PHSE = DAILY or NONE. Specify the number of minutes in the period.
PSEC (Period Seconds)	*range is 0 to 59 seconds*	**Period Seconds –** This prompt is displayed if PHSE = DAILY. Specify the number of seconds in the period.
SDAY (Start Day)	*if PHSE = MONTHLY, then range is 00 to 31* *if PHSE = WEEKLY, then choices are days of the week*	**Start Day –** This prompt is displayed if PHSE = MNTHLY or WEEKLY. Specify the day component of the Start Time. When PHSE = MNTHLY: If SDAY exceeds the number of days in a particular month, then the discrete switches to 1 on the last day of that month. For example, if SDAY = 31, then the discrete will go to 1 on 30 September.
SHR (Start Hours)	*range is 0 to 23 hours*	**Start Hours –** This prompt is displayed if PHSE = MNTHLY, WEEKLY, or DAILY. Specify the hour component of the Start Time.
SMIN (Start Minutes)	*range is 0 to 59 minutes*	**Start Minutes -** This prompt is displayed if PHSE = MNTHLY, WEEKLY, or DAILY. Specify the minute component of the Start Time.
SSEC	*range is 0 to 59 seconds*	**Start Seconds -** This prompt is displayed if PHSE = MNTHLY, WEEKLY, or DAILY. Specify the seconds component of the Start Time.
RST (Reset)	OFF 1 0 PARM *(discrete)*	**Reset –** This prompt is displayed if PHSE = NONE. Specify the discrete to be used as the Reset trigger, or enter a discrete value directly here.

9.7.8 CV Inverter (INV)

Introduction

For this type, the output CV*n* OS is the logical inverse of the input parameter.

CV inverter prompts

Table 9-27 describes the Inverter prompts.

Table 9-27 CV Inverter Prompts

Prompt (Full name)	**Range/Selections**	**Definition**
INP (INPUT)	OFF 1 0 PARM*(discrete)*	**Input –** Specify the parameter whose value will be inverted or enter a discrete value directly here.
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the output is ON (value = 1) and OFF (value = 0).

9.7.9 CV Standard Splitter Output (SPLT-S)

Introduction

This operation divides a Split loop's output (-100 % to +100 %) into two outputs CV*n* A1 and CV*n* A2, both of which are zero when the loop output is zero (Figure 9-2). A deadband can be defined. When the loop output is within the deadband both split outputs will remain at zero.

Note: A third output CV*n*A3 is displayed online and should be ignored.

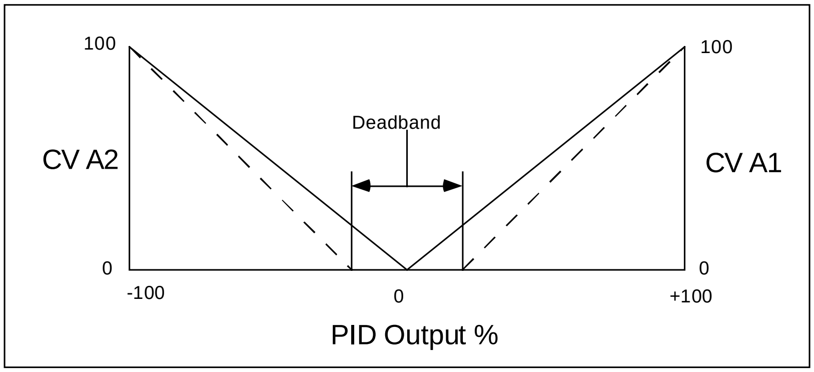


Figure 9-2 CV Standard Split Output Function

CV standard splitter prompts

Table 9-28 describes the Standard Splitter prompts.

Table 9-28 CV Standard Splitter Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
INP (Input)	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the analog input. Typically, this is the output value (OV) of a Split Output type of loop.

Table 9-28 CV Standard Splitter Prompts

Prompt (Full name)	Range/Selections	Definition
FB1 (Feedback 1) **FB2** (Feedback 2)	AO*n* BC LP*n* BC CV*n* BC	**Feedback 1 and Feedback 2 –** Specify the source of the back calculation value (BC) of the analog output assigned to the A1 output (Feedback 1) and A2 output (Feedback 2).
OVDB (Output Value Deadband)	OFF NUMBER *range is 0 % to 10 % of the input span*	**Output Value Deadband –** Specify the deadband value. If the value of INP is less than or equal to this percentage of the input range, both A1 and A2 split outputs will remain at zero.
RNGL (Range Lower Limit) **RNGH** (Range High Limit)	OFF NUMBER	**Range Lower Limit** and **Range High Limit –** Enter the output's range when displayed as a trend with Honeywell SDA software. **The output is not clamped, nor does it flash, when the output value is outside the range.**

9.7.10 CV Advanced Splitter Output (SPLT-A)

Introduction

This function splits an input into three independently scaled outputs: CV*n* A1, CVn A2 and CV*n* A3 (Figure 9-3). For each output, when the input is between IL and IH, the output is scaled between the OL and OH limits. Each output holds its OL value when the input is less than the IL value for that output. Each output holds its OH value when the input is greater than the IH value for that output. Output limits (OL and OH) cannot exceed 100 % but can be negatively sloped (OH less than OL).

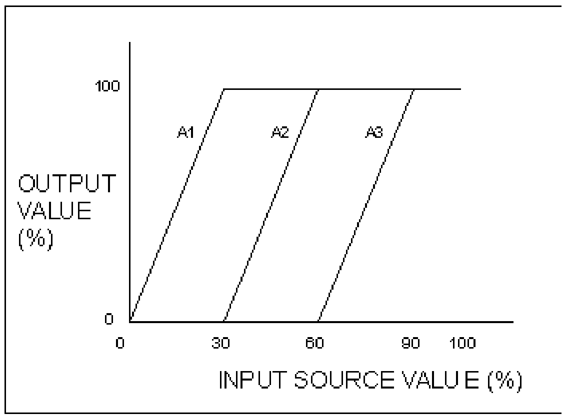


Figure 9-3 CV Advanced Splitter (Default Outputs)

CV advanced splitter prompts

Table 9-29 describes the Advanced Splitter prompts.

Table 9-29 CV Advanced Splitter Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output value provided by the CV block.
INP (Input)	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the analog input. Typically, this is the output value (OV) of a Split Output type of loop.

Table 9-29 CV Advanced Splitter Prompts

Prompt (Full name)	Range/Selections	Definition
FB1 (Feedback 1)	OFF NUMBER PARM	**Feedback 1, Feedback 2 and Feedback 3 –** Specify the source of the back calculation value (BC) of the analog output assigned to the A1 output (Feedback 1), A2 output (Feedback 2), and A3 output (Feedback 3).
FB2 (Feedback 2)		
FB3 (Feedback 3)		
IL1 (A1 Input Low Limit)	OFF NUMBER	**A1 Input Lower Limit** and **A1 Input High Limit –** When input is within the range defined here, the A1 output is scaled between OL1 and OH1.
IH1 (A1 Input High Limit)		
OL1 (A1 Output Low Limit)	OFF NUMBER	**A1 Output Lower Limit** and **A1 Output High Limit –** Specify the scaled range for A1.
OH1 (A1 Output High Limit)		
IL2 (A2 Input Low Limit)	OFF NUMBER	**A2 Input Lower Limit** and **A2 Input High Limit –** When input is within the range defined here, the A1 output is scaled between OL2 and OH2.
IH2 (A2 Input High Limit)		
OL2 (A2 Output Low Limit)	OFF NUMBER	**A2 Output Lower Limit** and **A2 Output High Limit –** Specify the scaled range for A2.
OH2 (A2 Output High Limit)		

Table 9-29 CV Advanced Splitter Prompts

Prompt (Full name)	Range/Selections	Definition
IL3 (A3 Input Low Limit)	OFF NUMBER	**A3 Input Lower Limit** and **A3 Input High Limit –** When input is within the range defined here, the A1 output is scaled between OL3 and OH3.
IH3 (A3 Input High Limit)		
OL3 (A3 Output Low Limit)	OFF NUMBER	**A3 Output Lower Limit** and **A3 Output High Limit –** Specify the scaled range for A3.
OH3 (A3 Output High Limit)		
RNGL (Range Lower Limit)	OFF NUMBER	**Range Lower Limit** and **Range High Limit –** Enter the output's range when displayed as a trend with Honeywell SDA software. **The output is not clamped, nor does it flash, when the output value is outside the range.**
RNGH (Range High Limit)		

9.7.11 CV Compare (CMPARE)

This operation compares the values of two inputs, using the operator selected during configuration. The output of the block, CV*n* OS, is ON (1) if the input comparison is true.

Compare can be used instead of an Alarm's output to control a relay. It can also provide ON/OFF control with hysteresis. If hysteresis is given a value, then CV*n* OS will not go OFF (0) until hysteresis value is exceeded. (See Figure 9-4 and Figure 9-5.) Result is then processed according to the specified condition type and condition time.

CV compare prompts

Table 9-30 describes the Compare prompts.

Table 9-30 CV Compare Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
INP1 (Input 1 Source) **INP2** (Input 2 Source)	OFF NUMBER PARM *(analog)*	**Input 1 Source** and **Input 2 Source –** Specify the source of the input values to be compared.
OPER (Operator)		**Operator –** Specify the operator to be used for the comparison Input 1 *OPER* Input 2. The output CV*n* OS will be set to ON if the comparison is true.
	GTE	**Greater Than or Equal To** (≥)
	GT	**Greater Than** (>)
	LT	**Less Than** (<)
	LTE	**Less Than or Equal To** (≤)
	EQ	**Equal To** (=)
	NEQ	**Not Equal To** (≠)
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the output is ON (value = 1) and OFF (value = 0).

Table 9-30 CV Compare Prompts

Prompt (Full name)	Range/Selections	Definition
CTYP (Condition Type)	NONE DELAY EXTEND PULSE RT PLS	**Condition Type – Specify the condition type.** See Table 9-21 for interaction between condition types and times.
CTIM (Condition Time)	OFF NUMBER	**Condition Time – Specify the condition time.** See Table 9-21 for interaction between condition types and times.
HYST	OFF NUMBER	**Hysteresis -** Applies to all operators except EQ and NEQ. If given a value, hysteresis determines when Result goes OFF(0) after the comparison becomes false. Operator — Hysteresis Function GT: Result goes OFF when Input 2 - Input 1 ≥ Hyst GTE: Result goes OFF when Input 2 - Input 1 > Hyst LT: Result goes OFF when Input 1 - Input 2 ≥ Hyst LTE: Result goes OFF when Input 1 - Input 2 > Hyst See Figure 9-5.

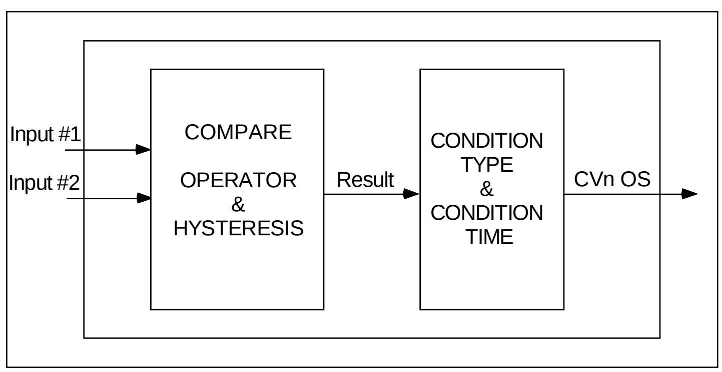


Figure 9-4 Compare Signal Flow

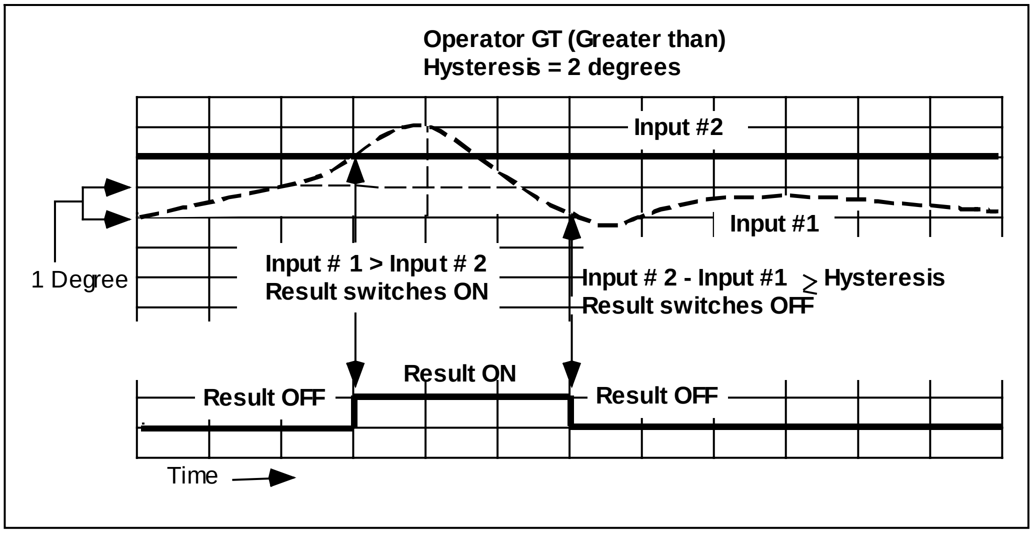


Figure 9-5 Compare's Greater Than Result With Hysteresis

9.8 Programming Alarms

Up to four process alarms can be programmed on the controller. When an alarm condition occurs, a display indicator will light to alert the operator. In addition, a relay can be used for control or alarm annunciation when a process alarm occurs. See 9.6 for DO programming instructions.

To program alarms, select "PRG AL" on the Main Program Menu. Select an alarm to program.

ATTENTION

Alarms are configurable only if “ALARMS” is set to “ENABLE” under “FEATURES” in the Programming Menu as described in 9.12.

Alarm prompts

Table 9-31 describes the Alarm prompts.

Table 9-31 Alarm Prompts

Prompt (Full name)	Range/Selections	Definition
ACTN (Action)		**Action –** Specify the alarm action.
	NONE	**None –** No alarm action.
	HIGH	**High –** Alarm condition when input value ≥ alarm setpoint value.
	LOW	**Low -** Alarms when input value ≤ alarm setpoint value.
	DEV	**Deviation –** Alarms when input value deviates above or below compare point value by an amount ≥ alarm setpoint value.
	HDEV	**High Deviation –** Alarms when input value deviates above compare point value by an amount ≥ alarm setpoint value.
	LDEV	**Low Deviation -** Alarms when input value deviates below compare point value by an amount ≥ alarm setpoint value.
	H RATE	**High Rate -** Alarms when input value increases at rate ≥ alarm setpoint value, in input units per minute. Negative rate setpoints are processed as positive values. May take up to 30 seconds to activate.
	L RATE	**Low Rate -** Alarms when input value decreases at rate ≥ setpoint value, in input units per minute. Negative rate setpoints are processed as positive values. May take up to 30 seconds to activate.

Table 9-31 Alarm Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the input to the alarm function block.
INP (Input)	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the value to be monitored.
STPT (Alarm Setpoint)	OFF NUMBER PARM *(analog)*	**Alarm Setpoint –** Specify the source of the alarm setpoint or enter a number here. If a number is entered here, the operator will be able to change the alarm setpoint when the unit is online.
CMPT (Compare Point)	OFF NUMBER PARM *(analog)*	**Compare Point –** For DEV, LDEV, and HDEV types only: Specify the value against which the input value will be compared. The alarm will be activated only if this difference is $\geq$ the value of "STPT".
HYST (Hysteresis)	OFF NUMBER	**Hysteresis –** If hysteresis is desired, specify the value. Hysteresis affects only the point at which an alarm clears. A high alarm will clear when the input is less than the setpoint minus the hysteresis value. A low alarm will clear when the input is greater than the setpoint plus the hysteresis value. A deviation alarm will clear when the input is less than the setpoint minus the hysteresis value.
D-TM (Delay Time)	OFF NUMBER *range is 0 to 240 seconds*	**Delay Time –** To prevent brief process upsets from triggering an alarm, enter an alarm delay time. If the alarm condition clears before the delay time expires, no alarm will occur.
HOLD (Alarm Hold)	OFF PARM 0 1	**Alarm Hold –** When this parameter level = 1 (ON), the alarm processing is disabled and the output is held.
ONL (On Label) and **OFFL** (Off Label)	*See* Table 9-14	**On Label** and **Off Label –** Select the labels to be used in the Summary display (and by optional data storage feature) when the output is ON (value = 1) and OFF (value = 0).

9.9 Programming Constants

Introduction

Up to nine constants (CN1 through CN9) can be programmed for use by other function blocks as tuning constants, slew limits, setpoint limits, and as the DAT impulse time. The output value of a CN block can be a true constant specified during CN programming, or a variable value read from another block selected during CN programming.

The way you make the association between a CN block and the block using its value is unique to CN programming. Usually when one function block (Block A) needs a value from another function block (Block B), Block A is programmed to read the value of the Block B parameter. For example, when a loop (LP) block needs a process variable from an analog input (AI) block, the connection is made during configuration of the LP block. In response to the loop's "PV" prompt you would select "PARM", then select the AI*n* OV from the list of available parameters. The loop block would read the value from the AI block.

The CN does provide an OV (output value) and PV output parameter that are readable by some other blocks. During programming of the other block, the CN OV would be selected in response to a "PARM" prompt. However, there is another way to make the association when Block A needs a value from a CN type Block B, but Block A's can only be configured with a number. In this case the association is made during configuration of the CN Block B.

For example, suppose you want the loop block to use a constant from the CN block as the loop's bias. When configuring the loop you would enter a number in response to the "BIAS" prompt. Then when configuring the CN block you would specify the loop's bias parameter as the destination of the CN block value. At runtime the CN block will write the value to the loop block, overwriting the configured number. More information about configuring destinations is provided in "Destination Programming Issues" below.

To configure a CN block, select "PRG CN" on the Main Program Menu. Select a constant to program.

ATTENTION

Constants are configurable only if "CN" is set to "ENABLE" under "FEATURES" in the Programming Menu as described in 9.12.

Constant prompts

Table 9-32 describes the Constant prompts.

Table 9-32 Constant Prompts

Prompt (Full name)	Range/Selections	Definition
IN (Input)	OFF NUMBER PARM *(analog)*	**Input –** Specify the source of the input to the CN block, or enter a number. If a number is entered here, the operator can change the value online using the Data Entry menu.
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the input to the alarm function block.
INLL (Input Low Limit)	OFF NUMBER	**Input Low Limit** and **Input High Limit –** Specify the display limits used only by the SCF software.
INHL (Input High Limit)		
INEU (Input Engineering Units)	NONE F C	**Input Units –** Specify the unit of measure (degrees Fahrenheit or Celsius) of the input.

Table 9-32 Constant Prompts

Prompt (Full name)	**Range/Selections**	**Definition**
DEST (DESTINATION)	OFF PARM	**Destination –** Select the string representing the function block parameter which will use the constant from this block. See “Destination Programming Issues” below. If PARM is selected, the following block and parameter combinations are available: **None –** No destination; CN value not used. **AO*n* DS –** AO*n* DSLW (Decreasing Slew Limit) **AO*n* IS –** AO*n* ISLW (Increasing Slew Limit) **AO*n* HS –** AO*n* INHL (Input High Limit) **AO*n* LS –** AO*n* INLL (Input Low Limit) **AO*n* IT –** AO*n* IMPT (DAT Impulse Time) **PT*n* GN –** *not used* **PT1 PB –** *not used* **PT*n* RS –** *not used* **PT*n* RA –** *not used* **LP*n* DS –** LP*n* DSLW (Decreasing Slew Limit) **LP*n* IS –** LP*n* ISLW (Increasing Slew Limit) **LP*n* HS -** LP*n* SPHL (Setpoint High Limit) **LP*n* LS –** LP*n* SPLL (Setpoint Low Limit) **LP*n* GN –** Loop *n* GN1 (Gain 1) **LP*n* RS –** LP*n* RST1 (Reset1) **LP*n* RA –** LP*n* RTE1 (Rate1) **LP*n* RB –** LP*n* BIAS **LP*n* PB –** LP*n* PB1 (Prop. Band1)

Destination programming issues

When programming loop (LP) blocks and analog output (AO) blocks, some parameters, such as proportional band or slew limits, can be programmed with numerical values only. However, if such a parameter is programmed to be the destination of a CN block, then at runtime the CN block overwrites that numerical value with a live value (variable) provided by the CN block’s input.

For example, suppose LP1’s Gain is programmed as the number 5, and CN1’s Input is CV2 OV, the output of Calculated Value 2. By selecting CN1’s Destination to be LP1GN, LP1’s Gain will be continuously updated by the live value provided by CV2 OV.

ATTENTION

Always be certain that the destination is compatible with its associated loop or analog output. A mismatched destination can affect your output and can be difficult to diagnose. Examples: If destination is AO1 IT (impulse time), be sure that AO1 is programmed as a DAT. If destination is LP2 IS, be sure that Loop2 is a type that has increasing slew limit on its menu.

ATTENTION

- If you remove AO*n* HS or AO*n* LS from the destination, you must perform these additional steps:
    1) Access AO*n*'s program menu. Change the decimal point position, then save the change.
    2) Re-access AO*n* 's program menu. Change the decimal point position back to its previous position, then save the change.
- If the destination is a loop parameter, it cannot be tuned online in the TUNE LOOP menu.
- If you reprogram destination to another parameter or NONE, the original destination parameter maintains its last live value as determined by the constant's input. If you want the destination's last live value to be zero or NONE:
    1) Change the constant input to zero or NONE.
    2) Change to online mode for 5 seconds to override the previous live value with zero or NONE.
    3) Change back to program mode.
    4) Re-program constant's destination to NONE.
- If you program multiple constants with the same destination, only the highest numbered constant's destination takes effect. For example, if CN1 and CN5 both have DEST = AO2 IT, then only CN5's input is used by AO2 IT.

9.10 Copying a Block

Introduction

Use Copy Block to copy the setup of any function block to another function block of the same type. For example, if you have programmed AI 1 and want AI 2 to have the same settings, use Copy Block. If desired, you can make program changes to AI 2 after the copy is complete.

Copy block prompts

Table 9-33 describes the Copy Block prompts.

Table 9-33 Copy Block Prompts

Prompt (Full name)	Range/Selections	Definition
BLK TYPE (Block Type)	 AI AL AO CN CV DI DO LP	**Block Type -** Select the function block type to be copied. **Analog Input** **Alarm** **Analog Output** **Constant** **Calculated Value** **Discrete Input** **Discrete Output** **Loop**
FRM CHNL (From Channel)	*range depends on type of block*	**From Channel -** Enter the number of the block within the type to be copied.
TO CHNL (To Channel)	*range depends on type of block*	**To Channel –** Enter the number of the block that is the destination of the copy operation.
DO COPY		**Do Copy –** Press **ENTER** to initiate the copy operation. The display will ask for confirmation. Press **ENTER** again to complete the operation, or press **MENU** to cancel. If the copy is successful, the message “COPY COMPLETE” will be displayed.

9.11 Programming Primary Displays

In Online Mode the operator can step through up to ten primary displays by pressing the **DISPLAY** key. Specify which displays are in the sequence, and their order, using "PRG DPYS" on the Main Program Menu. (The online use of these displays is described in Section 14.)

Not all displays apply to every control strategy. For example, one primary display shows deviation of the process variable from setpoint and the value of a selected Calculated Value (CV) for a loop. If the loop does not use any Calculated Values, this display will not be available.

Program primary displays prompts

Table 9-34 describes the Program Primary Display prompts.

Table 9-34 Program Primary Display Prompts

Prompt (Full name)	Range/Selections	Definition
PRG DPY1 (Program Display 1) through **PRG DPY10** (Program Display 10)	*Note : n = 1 or 2, corresponding to Loop 1 or Loop 2.*	**Program Display 1** through **Program Display 10 –** For each Display X prompt, select the primary display (if any) to appear in that position in the sequence. The display you assign to PRG DPY 1 will appear when the **DISPLAY** key is pressed once, the display assigned to PRG DPY 2 will appear when the **DISPLAY** key is pressed a second time, etc.
	PVSPL*n*	**PV and working SP -** Allows online changes to working setpoint. If the working setpoint is not clamped at the setpoint low or high limit, changing the working setpoint will also change SP1 or SP2, whichever is being used (assuming that SP2 is not originating from the setpoint profiler).
	PVOUL*n*	**PV and loop output -** Allows online changes to loop output.
	PVOOL*n*	**PV and loop output state –** Available for ON/OFF loop only.
	PVDVL*n*	**PV and deviation** - Read-only.
	PVRAL*n*	**PV and ratio -** Allows online changes to ratio value.
	PVCVL*n*	**PV and specified CV -** Read only PV and CV.
	PVCNL*n*	**PV and specified CN -** Allows online changes to constant.
	PVS1L*n*	**PV and SP1 -** Allows online changes to SP1. If the working setpoint is clamped at the setpoint low or high limit, this display is necessary to change Setpoint 1.
	PVSSL*n*	**PV and Setpoint Select** - Allows toggling between SP1 and SP2 for the loop.
	NONE	**None –** When the **DISPLAY** key is pressed, the next display in the sequence will appear.

Table 9-34 Program Primary Display Prompts

Prompt (Full name)	Range/Selections	Definition
DPYx CV (Display x Calculated Value)	*range is 1 to 16*	**Display x Calculated Value -** If you select a display containing a CV, this prompt appears. Enter the number (1 to16) of the CV whose output value should be displayed. You must select a CV whose output is OV, that is, Peak Picking, Signal Select, Math, Totalizer, Interval Timer, or Carbon Potential.
DPYx CN (Display x Constant)	*range is 1 to 9*	**Display x Constant -** If you select a display containing a constant (CN), this prompt appears. Enter the number (1 to 9) of the CN whose value should be displayed.

9.12 Enabling Features

Introduction

You can add or remove (enable or disable) certain prompts to simplify the programming and online menus. Disabled functions or data are not destroyed or erased, they just cannot be accessed. For example, a programmed constant retains its value and continues to function in calculations, regardless of whether programming of constants is disabled or enabled.

To enable/disable menu items, select "FEATURES" on the Main Program Menu.

Prompts

Table 9-35 describes the Features prompts.

Table 9-35 Features Prompts

Prompt (Full name)	Range/Selections	Definition
EXP INP (Expanded Input)	ENABLE DISABL	**Expanded Input -** DISABL removes the LAG and SAMPLE/HOLD functions from the Analog Input Programming menu.
VAL ADJ (Value Adjust)	ENABLE DISABL	**Value Adjust -** DISABL removes the Analog Input Value Adjust function and the ability to apply value adjust or emissivity corrections online.
FORCE	ENABLE DISABL	**Force -** DISABL removes FORCE from the Online Mode Menu item and the ability to Force any DI or DO.
PRETUNE	ENABLE DISABL	**Pretune -** DISABL removes all loop pretune menu items from the Online Mode Menu.
ALARMS	ENABLE DISABL	**Alarms -** DISABL removes alarm configuration from the Main Program Menu. Any alarms already programmed will still operate, providing alarm indication and operating relays (if so configured).
CN (Constants)	ENABLE DISABL	**Constants -** DISABL removes constant configuration from the Main Program Menu, thus removing the ability to set or adjust CN values. Constants previously programmed will continue to exist.
DATSTR (Data Storage)	ENABLE DISABL	**Data Storage -** DISABL removes all menu items relating to data storage.
REVIEW (Review Programming)	ENABLE DISABL	**Review -** DISABL removes the "Review" function from the Main Online Menu.
PYROMTRY	ENABLE DISABL	**Pyrometry -** DISABL removes all of the Rayotube and Spectray choices from the list of standard input type selections on the analog input programming menu.

Table 9-35 Features Prompts

Prompt (Full name)	Range/Selections	Definition
CUST INP (Custom Input)	ENABLE DISABL	**Custom Input -** DISABL removes all custom input prompts from the analog input programming menu.

9.13 Programming Security

Introduction

You can protect certain menu items and functions from unwanted or accidental access. Access to a secured item requires entry of a three-digit master or operator code.

To program security functions, select "SECURITY" to display the Security menu. (If security is active, you will be prompted to enter the master code before continuing). Out-of-the-box units do not have security enabled.

ATTENTION

If the master or operator's security code is lost or forgotten, a security bypass procedure is available as described in an appendix. **We recommend that the security bypass appendix be removed from any manual used by operators.**

Security prompts

Table 9-36 describes the Security prompts.

Table 9-36 Security Prompts

Prompt (Full name)	Range/Selections	Definition
ENABLE (Enable Security)	YES NO	**Enable Security -** Set to YES to activate security on all security items having a non-zero Master or Operator Security Code. **If set to NO, no items will be secure!**
MASTER (Master Security Code)	*range is 000 to 999*	**Master Security Code –** Enter the security code to be required to access "DB SERV" (Database Services) in Maintenance Mode and "SECURITY" in Program Mode. If "SET MODE" is set to "YES", this code will also be required to go from Online Mode to Program or Maintenance Modes. **The Master Security Code must have a non-zero value. A code of 000 has the same effect as setting Enable Security to NO.**
SET MODE	NO YES	**Set Mode –** Specify whether entry of the Master Security Code should be required to go from Online Mode to Program or Maintenance Mode.
OPER (Operator Security Code)	*range is 000 to 999*	**Operator Security Code -** Enter the security code to be required to access the operator functions for which security has been enabled using the remaining prompts in this table. **The Operator Security Code must have a non-zero value. A code of 000 has the same effect as setting the feature's security to NO**

Table 9-36 Security Prompts

Prompt (Full name)	Range/Selections	Definition
A-M SEL (Auto-Manual Select)	NO YES	**Auto-Manual Select -** Set to YES to protect changing between a loop's Auto and Manual modes online.
SP1-SP2	NO YES	**SP1-SP2 -** Set to YES to protect changing between a loop's SP1 and SP2 while online.
SET PARM	NO YES	**Set Parameter -** Set to YES to protect changes to: • Tuning Parameters (Gain, Reset, Rate, Manual Reset) • Pretune • Approach High/Low • Output Deadband (On/Off Control) • Bias • Working (active) Setpoint Slew Limit • Data Entry (alarm setpoints, constants, forcing discretes, bias and gain adjustments to analog inputs) • Failsafe Value • Analog Input Lag Time • Split Output Deadband • Impulse Time (DAT) • Minimum On/Off Times (DAT)
REVIEW	NO YES	**Review -** Set to YES to protect online access to Review Programming (via REVIEW menu).
STORAGE	NO YES	**Storage -** Set to YES to protect access to any part of data storage (via online STORAGE menu). Does not affect access to online Data Storage Status (DS STAT) display.

9.14 Setting the Clock

This optional real time clock is provided when either the Data Storage feature or the Setpoint Profiling feature is used. To ensure that data, alarms, and events receive the correct time stamp, set the clock and calendar. The clock uses "military time" (twenty-four hour clock).

To set the date and time select "SET CLK" from the main Program Menu.

Set Clock prompts

Table 9-37 describes the Set Clock prompts. The clock and calendar will be updated when **ENTER** is pressed in response to the "SAVE CHANGES?" prompt.

Table 9-37 Set Clock Prompts

Prompt (Full name)	Range/Selections	Definition
SET MON (Set Month)	*range is JAN through DEC*	**Set Month –** Select the current month.
SET DAY	*range is 1 to 31*	**Set Day –** Select the current day of the month.
SET YEAR		**Set Year –** Enter the year.
SET HRS	*range is 0 to 23*	**Set Hours –** Set current hour.
SET MIN	*range is 0 to 59*	**Set Minutes –** Set current minutes.
SET FRMAT (Set Date Format)	USA INTRNL	**Set Date Format –** Select the date format. **USA –** MMDDYY **INTRNL –** DDMMYY

ATTENTION

Resetting the clock can affect the storage schedule of a unit in service.

If the clock time is reset more than 5 minutes back, the following actions will take place:

1) Data in storage buffers will be copied to the memory card and the buffers will then be cleared.

2) Data collection for storage will stop until the operator reinitializes the schedule.

If the clock is set back less than 5 minutes, collection of the data for data storage feature will stop until the setback time elapses and the clock "catches up" with the original collection schedule.

See Section 17 for more information about data storage.

9.15 Specifying the Scan Frequency

Introduction

The scan frequency (also known as scan rate, scan cycle, update rate) is configurable. This is the time used to read inputs, execute function blocks, and update outputs. To specify the frequency select "SCAN FRQ" from the main Program Menu.

Scan Frequency selections

Table 9-38 lists the Scan Frequency selections available when the “SCAN FRQ” prompt is on display.

Table 9-38 Scan Frequency Selections

Selections
1 SEC (second)
500 MS (milliseconds)
250 MS (milliseconds)
125 MS (milliseconds) *only for model with single analog input*

9.16 Selecting Display Language

Introduction

The language used for prompts and selections is configurable. To select the language select "LANGUAGE" from the main Program Menu.

Language selections

Table 9-39 lists the Language selections available when the “LANGUAGE” prompt is on display.

Table 9-39 Language Selections

Selections
ENGLSH (English)
SPANSH (Spanish)
FRENCH (French)
ITALAN (Italian)

10. Position Proportioning Output Setup and Calibration

10.1 Introduction

Overview

The controller can be programmed to provide position proportioning (PP) output using two relays, one "increase" and one "decrease". Each relay has an associated DO block. An AO block serves as the interface between the loop (LP) block and the DO blocks. This AO needs an analog signal (from an AI block) for the slidewire feedback. The feedback is powered by a constant 1 V from the controller's VAT output. A CN block provides the input to the VAT AO block. This section provides instructions for programming and wiring the controller to provide PP output.

In addition, instructions are provided for the important final step of calibrating the output using the actual positioning device to be controlled.

What's in this section?

The following topics are covered in this section.

10.2 Configuring the Blocks Used for PP

Introduction

Figure 10-1 shows factory configuration 11 (111 in Table I of the model selection guide). This is a representative example of PP configuration. Note, however, that other loop types can be used with PP output, and that, with one exception, any available hardware inputs, output, and relays, with their associated function blocks, can be used. **The exception is that the slidewire feedback input must always use hardware analog input 2. Program block AI2 without lag.**

There is nothing special about CN9 used by this configuration; any appropriately configured CN block will do.

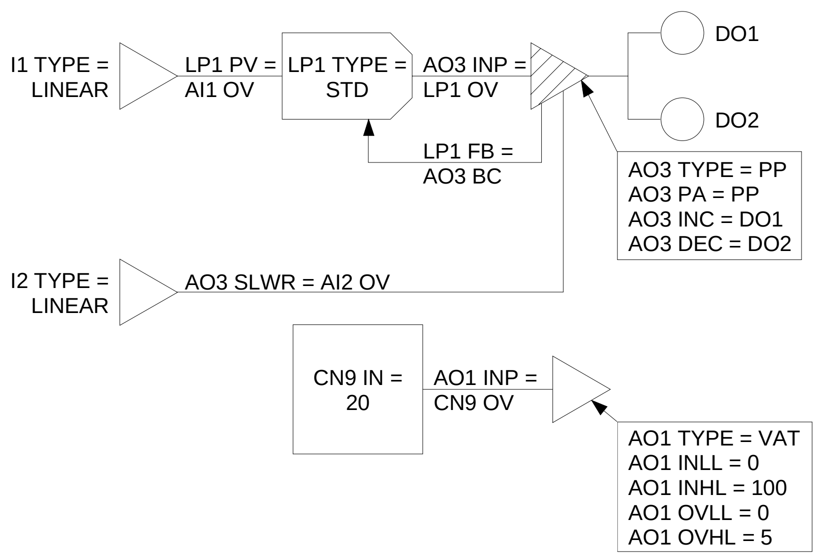


Figure 10-1 Factory Configuration 11 (111)

Check analog output switch setting

Before beginning this configuration, verify that the analog output hardware to be used to power the slidewire feedback is set to provide voltage output (instead of current). This is set using switches on the card with the analog output hardware. Section 20 provides details.

Procedure

Table 10-1 indicates the key parameters to be programmed to implement the PP strategy illustrated in Figure 10-1. **Your application may require the configuration of additional parameters (unrelated to PP) in these function blocks.** Be sure to review the available parameters in Section 9 or step through all the parameters for each block programmed to be sure you do not miss anything applicable.

Remember, if factory configuration 11 (or one of the other factory configurations providing PP output) suits your needs, load it. Much of the programming described in Table 10-1 will be done for you automatically. We list the configuration steps in detail in that table to demonstrate the principles of PP configuration.

Table 10-1 Block Configuration to Implement PP Shown in Figure 10-1

Step	Action
Analog Inputs	
1	Program the block being used for PV to match the sensor input type and range for the controlled variable. In our example: AI1 TYPE = LINEAR AI1 RNGL = 0.0 AI1 RNHI = 100.0
2	AI2 must be used for the slidewire feedback. Program the block with: AI2 TYPE = LINEAR AI2 RNGL = 0.0 AI2 RNHI = 100.0 AI2 D-ID = INDIRE AI2 CKLO = 0.00 AI2 CKHI = 1.00 AI2 CKUN = VOLTS AI2 LAG = 0.0
Loop	
3	Select a loop type from the available selections, STD, ADV, SPLIT, RATIO, CAS_P or DIAT. Configure the loop's input to be read from the AI block receiving the PV. Program the loop's feedback to be read from the AO block interfacing between the loop and the discrete outputs. In our example: LP1 TYPE = STD LP1 PV = AI1 OV LP1 FB = AO3 BC • If SPLIT is used, a CV (calculated value) block must be configured as a "standard splitter" and additional AO and DO blocks are used. Use factory configuration 04 as an example. (See Section 7.) • If CAS_P (cascade primary) is used, you must also configure the secondary loop as CAS_S. Use factory configuration 25 as an example. (See Section 7.) • If you want the controller to use DIAT output if the slidewire feedback fails, the loop type must be DIAT, the AO's type must be PP, and the AO's positioning algorithm must be AUTO. The AUTO/DIAT operation uses a differential increment or decrement routine when in manual mode. Example: To change from 50 % to 60 % output. 50 % output will be initially displayed. Pressing the increment button will cause the display to increment from 0 to the desired differential (+10). When the button is released, the display will change back to 50 % output and the actuator motor will drive to the desired 60 % output.

Table 10-1 Block Configuration to Implement PP Shown in Figure 10-1

Step	Action
Analog Outputs	
4	Program the block associated with the hardware output providing the voltage to power the slidewire feedback. This must be a VAT type. Other significant parameters are the input source (a CN), the input range, and the output range. Turn all other selections to OFF or NONE. (Leave the decimal positions at the defaults.) In our example: AO1 TYPE = VAT AO1 INP = CN9 OV AO1 INLL = 0.0 AO1 INHL = 100.0 AO1 OVLL = 0.00 AO1 OVHL = 5.00
5	Program the AO block that will interface between the loop and the DO blocks for the relays. This must be a PP type. Its input must be the output of the control loop. The selection for the positioning algorithm can be PP (any control algorithm) or AUTO (DIAT control type only). The source of the slidewire feedback must also be specified, as well as the discrete outputs associated with the “increase” and “decrease” relays.[1] In our example: AO3 TYPE = PP AO3 INT = LP1 OV AO3 SLWR = AI2 OV AO3 PA = PP AO3 INC = DO1 AO3 DEC = DO2 Make the initial setting for the drive unit sensitivity (DUSE) at 99.8 %. This may be adjusted later if necessary to prevent motor oscillation and position overshoot. Maximum sensitivity is 100 %. Set the drive unit speed (DUSP) to match the full scale travel time of the actuator. Example: If the actuator takes 40 seconds to travel from 0 % to 100 % position, use 40.0 as the "DUSP" value.

[1] Any DO blocks (and their relays) used for the PP output cannot be used for another purpose such as alarm annunciation. Therefore, once a DO block has been selected for an INC or DEC parameter here, the DO block’s action and input will not be configurable in DO programming. Labels are still configurable.

Table 10-1 Block Configuration to Implement PP Shown in Figure 10-1

Step	Action
Constant	
6	Program the CN block specified in Step 4 as the source of the input to the AO providing the 1 V to power the slidewire feedback. The input of the CN block must be a number that, when applied to the AO block's output range, will result in the AO block making a constant 1 V available at its output terminals. In our example, the output range for AO1 is 5 volts. Therefore, our constant block is configured: CN9 IN = 20 (20 % of 5 V = 1V) CN9 INLL = 20 CN9 INHL = 20 CN9 DEST = OFF (because we do not want the CN block to write the 20 to another block; AO1 will read the 20 from CN9 OV.)

10.3 Wiring the Controller for PP

Introduction

For the position proportioning output to work as anticipated, the connections to the I/O terminals must match the usage of the associated function blocks.

ATTENTION
Honeywell 10260 series drive units provide motor winding noise suppression. If your drive unit does not suppress winding noise, wire a capacitor (.22 µF, 400 Vac) to the INC line and another to the DEC line, and a resistor (22 ohm) to the neutral or ground connection. Honeywell part 023347 contains the needed resistor and capacitors.

Diagram

Figure 10-2 shows the wiring necessary to implement our example, factory configuration 11 (111).

WARNING
The diagram in this section is intended to supplement, not replace, the instructions in Section 4, *Wiring*. Be sure to read and understand Section 4 before attempting to connect power or signal wires. Turn power off at mains before installing AC power wiring.

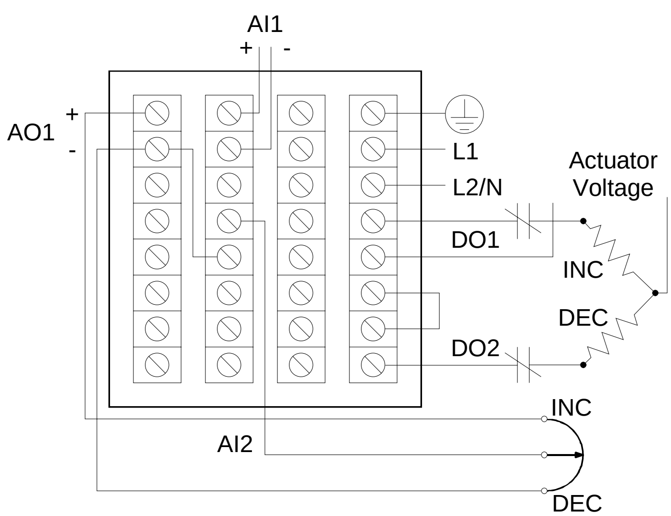


Figure 10-2 Wiring for Factory Configuration 11 (Shown in Figure 10-1)

10.4 Calibrating

Introduction

Once the controller has been programmed and wired correctly to support PP output, the controller's position output must be calibrated with the device to be controlled.

ATTENTION

Calibrating the PP output requires stroking the drive motor over 100 % of its travel. This procedure is recommended as an offline procedure only. If the calibration procedure is bypassed, PP operation may proceed, but full scale travel of the actuator may not be achieved during online operation.

Procedure

Instructions for calibrating the PP output are in Table 10-2.

Table 10-2 Procedure for Calibrating the PP Output

Step	Action
1	After the controller is wired to the drive unit according to the instructions in Section 4, place the controller in Online mode briefly before proceeding with the feedback calibration. The following procedure calibrates the feedback slidewire input to achieve 0 to 100 % of the actuator travel.
2	Enter the controller Maintenance mode and select "CALIB AO" (calibrate analog outputs).
3	Select the AO being used for the loop output. In the case of our example it would be "CALIB AO3 LOW". Press **ENTER.** The decrease output relay will energize to drive the motor to near 0 % output. Use the **DECREMENT** (▼) or **INCREMENT** (▲) key to place the drive unit at the desired low end position while watching motor position in percent on the display. Press **ENTER** to establish the 0 % position of the motor.
4	Select "CALIB AO3 HIGH". Press **ENTER.** The increase output relay will energize to drive the motor to near 100 % output. Use the ▼ or ▲ key to place the drive unit at the desired high end position while watching motor position in percent on the display. Press **ENTER** to establish the 100 % position of the motor.
5	Exit calibration and Maintenance mode.
6	Go to Online mode and, with the control loop in manual, increase and decrease the control loop output and verify proper actuator operation before placing the loop into automatic control.

11. Configuring and Using Setpoint Profiler

11.1 Introduction

Overview

The optional Setpoint Profiler produces a time-varying setpoint for a loop's Setpoint 2. Setup and configuration are done through a Program mode menu (PRG SPP) and an Online mode Menu (PROFILE).

Online operation is controlled through two menus: one is accessed by pressing the **SETPOINT PRGM** key, the other appears in the Online Mode Menu (SP PRFLR) only when a profile is active.

What's in this section?

The following topics are covered in this section.

11.2 Description

Configurable elements

The Setpoint Profiler supports up to sixteen segments. During configuration of a profile the value and time at that value are specified for each segment. If the next segment's value is the same as the current segment's value, the current segment's time will specify a SOAK time at that value. If the next segment's value differs from the current segment's value, the profile output will RAMP to the next value in the current segment's time. The time base for all profile segments may be set to HOURS, MINUTES, or SECONDS.

In addition, for each segment the ON (1) or OFF (0) state of each of the two "event" discrete outputs "E1" and "E2" is specified. By selecting one of these outputs as the input source for another block, you can program the controller to take an action, such as closing a relay, during any segment for which you have programmed E1 to be ON.

The setpoint calculated by the Setpoint Profiler's function block SP1 is available as the output value "SP1 OV". This one profile can be used by both loops of a two loop controller. Select "SP1 OV" as the source of SP2 (Setpoint 2) for each loop.

Deviation hold

A single set of deviation hold entry values are provided for the entire profile. The deviation hold feature may be disabled or activated on any segment to allow set point guarantees on soak segments only when desired. When active, the deviation hold feature allows separate enable and disable entries for each loop of the controller.

The profiler supports discrete inputs which reset/run and hold the profile's operation.

11.3 Defining the Profiler Inputs and Range

Introduction

To program the Setpoint Profiler function block (SP1), select "PRG SPP" from the Program mode menu. (PRG SPP will appear only if the Profiler is in the READY or ENDed state.)

Setpoint Profiler prompts

Error! Reference source not found. describes the Program Setpoint Profiler prompts.

Table 11-1 Program Setpoint Profiler Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position to be used in the input value provided to the profiler.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in all output parameters of the profiler.
LO LI (Low Limit) **HI LI** (High Limit)	OFF NUMBER	**Low Limit** and **High Limit –** Specify the limits for the profiler's output range (SP1 OV).
DP L1 (Deviation Hold Loop 1) **DP L2** (Deviation Hold Loop 2)	OFF NUMBER PARM *(analog)*	**Deviation Hold Loop 1** and **Deviation Hold Loop 2 –** Select the parameter (typically LP*n* PV) whose value will be compared to the profiler output value (SP1 OV). The set point profiler holds if this source deviates from the profiler's output by more than the Deviation Limits (see DVPLL and DVPHL in Table 11-2).
RR IN (Reset/Run Input)	OFF 1 0 PARM *(discrete)*	**Reset/Run Input –** When the profiler is in a HELD, ENDed, or ready state, the transition of RRIN (or the parameter pointed to) from 0 to 1 resets the profile to the beginning. The transition from 1 to 0 starts it running again (at the beginning). The value of RR IN is ignored while the profiler is active.

Table 11-1 Program Setpoint Profiler Prompts

Prompt (Full name)	Range/Selections	Definition
HOLD	OFF 1 0 PARM *(discrete)*	**Hold –** When the HOLD = 1, the active profiler is held. The transition of HOLD from 1 to 0 resumes the active profile at the point in its execution it had reached before it was held.

11.4 Setting Up a Profile

Introduction

To set up a profile select "PROFILE" from the Online mode menu. (PROFILE will appear only if the Profiler is in the READY or ENDed state.)

Next, select "PRF EDIT".

Profile Edit prompts

Table 11-2 describes the Profile Edit prompts.

ATTENTION

Be sure to read and follow the instructions for configuring the last segment of a profile. These instructions appear after Table 11-2.

Table 11-2 Profile Edit Prompts

Prompt (Full name)	Range/Selections	Definition
T UNIT (Time Units)	SECS MINS HOURS	**Time Units -** Specify the time unit of the profile.
DVPLL (Deviation Hold Low Limit) **DVPHL** (Deviation Hold High Limit)	OFF NUMBER	**Deviation Hold Low Limit** and **Deviation Hold High Limit –** Specify the limits to be used when the value of the parameter specified for DP L1 or DP L2 (typically LP*n* PV), is compared to the profiler output value (SP1 OV). If the deviation is outside these range limits, the profile will be held until the deviation is not outside the range. See Table 11-1 to program DP L1 and DP L2.
The controller will cycle through the remaining prompts in this table 16 times. Use each set to program the segment Nn.		
S*nn* VAL (Segment *Nn* Value)	OFF NUMBER	**Segment Value -** Enter the setpoint value for the segment, or OFF. For a soak, enter the previous segment's value (see Figure 11-1.)
S*nn* TIM (Segment *Nn* Time)	OFF NUMBER	**Segment Time** - Enter the amount of time to reach the next segment value.

Table 11-2 Profile Edit Prompts

Prompt (Full name)	Range/Selections	Definition
S*nn* EV1 (Segment *Nn* Event1)	OFF ON	**Segment Event 1** and **Segment Event 2 -** Specify whether the SP1 E1 output and SP1 E2 output should be 1 (ON) or 0 (OFF) during the segment. The transition to the programmed value will occur at the start of the segment and continue to the end of the segment.
S*nn* EV2 (Segment *Nn* Event2)		
S*nn* DV1 (Segment *Nn* Deviation Hold1)	OFF ON	**Segment Deviation Hold 1 –** Specify whether the deviation hold should be enabled (ON) or ignored (OFF) during this segment when the value of the parameter specified for DP L1 is compared to the profiler output value (SP1 OV). See Table 11-1 to program DP L1.
S*nn* DV2 (Segment *Nn* Deviation Hold2)	OFF ON	**Segment Deviation Hold 2 –** Specify whether the deviation hold should be enabled (ON) or ignored (OFF) during this segment when the value of the parameter specified for DP L2 is compared to the profiler output value (SP1 OV). See Table 11-1 to program DP L2.

Configuring the last segment of a profile

To properly terminate a profile you must configure one segment beyond the last segment used by your control strategy. The VAL of this final segment should be set to the same value as the last "real" segment. The TIM of the last segment should be set to OFF.

For example, suppose your process requires a profile with twelve segments, and that the twelfth segment must be a "soak" with a VAL of 50. Configure S12 VAL = 50, but also configure S13 VAL = 50, and set S13 TIM = OFF. Any other value for S13 VAL will result in segment 12 being a "ramp" as the controller tries to accommodate the transition to the different S13 VAL.

If all sixteen segments are programmed and S16 TIM does not equal 0, then the profile will behave as if a seventeenth segment exists. This "pseudo-segment" will be a ramp (up or down) to 0. The time will be the same as S16 TIM.

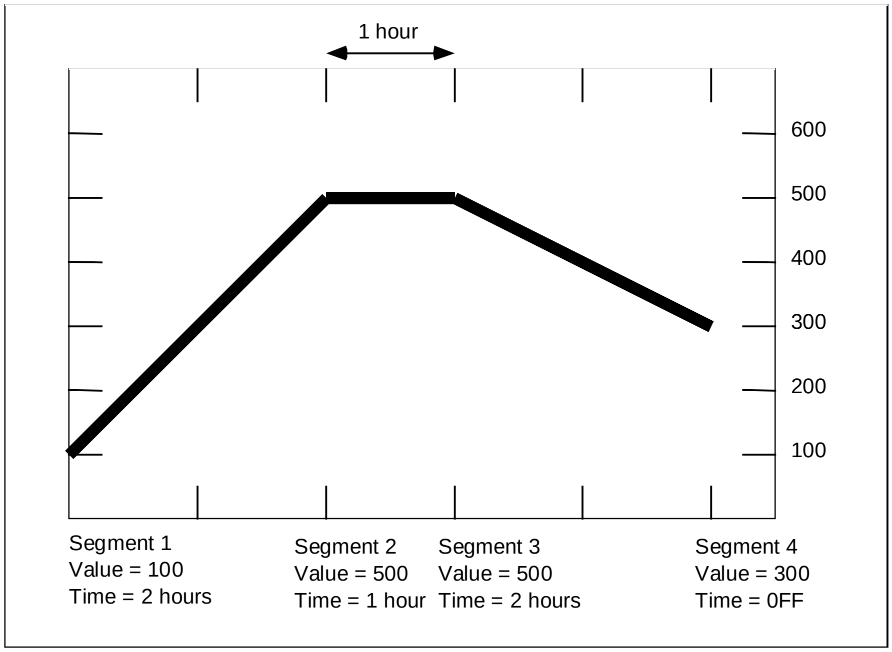


Figure 11-1 Sample Setpoint Profile

11.5 Storing and Loading Profiles

Introduction

If the controller includes the Data Storage feature, setpoint profiles may stored on a removable SRAM PCMCIA card for archiving or for transferring the profile to other controllers. Stored profiles contain the data entered through the Online mode Profile Edit function, but do not contain information entered through the Program mode. (Parameters configured during Program mode are stored when the entire configuration is stored as described in Section 16.)

When storing the profile you will have the opportunity to assign a name by selecting one of profile type choices and appending a number from 1 to 99.

ATTENTION

Before inserting or removing a card, be sure to discharge any static buildup on your body or clothing.

Procedure for storing a profile

The procedure for storing a profile is provided in Table 11-3. This procedure assumes that you know how to lift up the front of the controller and insert a PCMCIA card. If you need instructions for those tasks, see Section 16.

Table 11-3 Procedure for Storing a Profile

Step	Action
1	To store a completed profile the profiler must be in the ENDed or Ready state. Insert a PCMCIA card into the controller and close the bezel.
2	Select “PROFILE” from the Online mode Menu and advance to the “PRF STOR” menu selection. Press **ENTER** to start the procedure. The display will change to “STORE PROFIL01”.
3	To select a different name and number press the **DECREMENT** (▼) key. The display will change to “STORE FILE 01”.
4	Press the ▼ key to scroll through the name choices. When the name string you want is displayed, press **ENTER.** The controller is now ready for you to change the number “01”, if desired.
5	To change the number press the ▼ key to scroll through the number from 01 to 99. When the number you want is displayed, press **ENTER.** This initiates the storing operation.
6	During the storing operation the display will read “FILE STORING”. When the display reads “STORE COMPLETE” you can press **MENU** to exit the function. Remove and label the card.

Procedure for loading a profile

Loading a profile transfers profile data from a SRAM PCMCIA card to the controller's memory. The procedure for loading a profile is provided in Table 11-4. This procedure assumes that you know how to lift up the front of the controller and insert a PCMCIA card. If you need instructions for those tasks, see Section 16.

Table 11-4 Procedure for Loading a Profile

Step	Action
1	Put the PCMCIA card containing the profile to be loaded into the controller and close the bezel.
	Select "PROFILE" from the Online mode Menu and advance to the "PRF LOAD" menu selection. Press **ENTER** to start the procedure. The display will change to "LOAD XXXXXX", where XXXXXX is the name of a file on the card.
2	To select a different file press the **DECREMENT** (▼) key to scroll through all the names of all the files on the card.
3	When the desired file's name is display initiate the loading by pressing **ENTER.**
5	During the loading operation the display will read "FILE LOADING". When the display reads "LOAD COMPLETE" you can press **MENU** to exit the function. Remove the card.

11.6 Using a Setpoint Profile

Introduction

Once a profile has been defined as described 11.4, it can be used to provide the value of setpoint 2 to either loop. Online operation is controlled through two menus: one is accessed by pressing the **SETPOINT PRGM** key, the other appears in the Online menu (SP PRFLR) only when a profile is active. Both menus are explained here.

Using the SETPOINT PRGM key

To cycle through the item in Table 11-5, press the **SETPOINT PRGM** key repeatedly.

Table 11-5 SETPOINT PRGM Key Menu

Prompt (Full name)	Definition
STATUS	Shows profile's current segment number and status. Status can be: **RDY** - Ready. Available to start running (SPP indicator OFF) **ACT** - Active. Profile is running (SPP indicator ON) **HLD** – Held (SPP indicator FLASHING) **END** - End. Finished; must reset to run again (SPP indicator OFF)
SET PT (Setpoint)	Indicates the current output value of the profiler.
SEG n (Segment n)	Current segment number and time remaining in segment.
E TIME (Elapsed Time)	Indicates the elapsed time since the profiler was started, including any holds.
EVENTS	Shows the ON or OFF status of event outputs 1 and 2.
FILENAME	Shows the name of the currently running profile.

Changing profiler's status

When "STATUS" is displayed, pressing the **INCREMENT** (▲) and **DECREMENT** (▼) keys will sequence through the operating menu of the Profiler. The selections are shown in Table 11-6.

Table 11-6 Setpoint Profiler Status Menu

Prompt (Full name)	Definition
START	Starts a profile from the Ready (RDY) or Held (HLD) states. SPP indicator ON**.**
HOLD	Holds the profile; holds time remaining in the segment to its current value. SPP indicator FLASHING.
ADVNCE	When the profile is held or ready, select this to advance the profile to the next segment in sequence. After ADVANCE, START will start the profile at the beginning of the selected segment.
RESET	Resets a HLD or ENDed profile to the RDY (ready) status. Profiles may not be Reset from the Active state. No SPP indicator.

Changing a segment time or value

While a setpoint profile is in the active or held state, the segment values and segment time may be altered in any segment.

Table 11-7 Changing a Segment Time Or Value

Step	Action
1	Select "SP PRFLR" from the Online menu. The value of the current segment after the active one will be displayed.
2	Go to the segment to be altered using the **INCREMENT** (▲)and **DECREMENT** (▼)
3	Press **ENTER** to select VALue or TIMe.
4	Use the ▲ and ▼ keys to set the desired value and press the **ENTER** button.
5	Scroll to another segment to be edited, or use **MENU** to exit.

Holding a Profile

An active profile may be held by five methods. When online and in "hold", the SPP indicator flashes. The five hold methods are:

1. **By the operator:** When "STATUS" is on display, using the ▲ and ▼ keys to access "HOLD" item (see Table 11-4.).

- Selecting "START" cancels the manual hold and resumes execution at the point where it was held.
- To resume at a different segment, use the ▲ and ▼ keys.

2. **By the value of a discrete changing:** When SP1 HOLD = 1, the profile is held. A logic low (0) returns the profile to the active state.

3. **Based on analog value:** High deviation - If SPDPL1 or SPDPL2 (deviation parameter input) is greater than SP1 OV (setpoint profiler output) by more than the DVPHL (deviation high limit), profile holds (see Table 11-2).

4. **Based on analog value:** Low deviation - If SPDPL1 or SPDPL2 (deviation parameter input) is less than SP1 OV (setpoint profiler output) by more than the DVPLL (deviation low limit), profile holds (see Table 11-2).

5. **Based on controller mode:** Changing into Program or Maintenance mode will hold execution of the profile. (Indicator does not flash.) Profile execution resumes when Online again.

Resetting a Profile

A held or ended profile may be reset to the Ready status by two methods:

1. **By operator:** Using the **SETPOINT PRGM** key, and the ▲ and ▼, select "STATUS RESET" (see Table 11-4).

2. **By the value of a discrete changing:** When value of discrete "SP1 RRIN" changes from logic low (0) to logic high (1), the profile resets. A logic high (1) to logic low (0) change restarts the profile.

Advancing the profile

In addition to using the ▲ and ▼ keys to advance a running, but held, profile to a different segment as described above, the ▲ and ▼ keys can be used to advance a stopped profile so that it starts at a segment other than 1.

12. Carbon Potential Option

12.1 Introduction

Overview

When the carbon potential option is selected (see model selection guide in Section 2), a "CARBON" type CV (calculated value) block is available. This block provides a %C output value useful in applications such as:

- carburizing (increasing the carbon content of the surface of low-carbon steel)
- hardening (heat-treating carburized parts)
- atmosphere generating applications

This section describes the CARBON type CV block's inputs, outputs, and internal parameters. It also provides important information about using this block with other types of blocks to provide carbon control.

What's in this section?

The following topics are covered in this section.

12.2 Functionality

12.2.1 Actions Performed

Overview

The CARBON type CV block will perform the following actions:

- Produce a value (output OV) which represents the percent carbon (%C) present in a furnace atmosphere based on the probe type (“PROB”), furnace correction factor (“FURN”), and three inputs:
  - a mV signal from a zirconia oxygen probe; the value is read by input “PBIN”
  - the probe temperature; the value is read by input “TPIN”
  - the percent carbon monoxide (%CO) present in the gas used for carburizing; the value is provided by parameter “CO”. It can be a fixed value or read from an analog input.
- Produce a value (output A2) which represents the dewpoint of the furnace atmosphere based on the probe type (“PROB”), percent hydrogen (“HYDR”) and two inputs:
  - a mV signal from a zirconia oxygen probe; the value is read by input “PBIN” ;
  - the probe temperature; the value is read by input “TPIN”
- Produce an anti-sooting value (output A1), based on probe temperature from “TPIN”; this value can be used as a setpoint high limit for a downstream control block (see 12.4)
- Provide a discrete parameter (output OS) which is HIGH (1) when the probe temperature is below a customer configured limit (“TPLL”) and LOW (0) when the probe temperature is above that limit. This discrete can be used in conjunction with other parameters to clamp the output of a downstream control loop at zero until the TPLL temperature is reached.

Probes supported

The probes supported include:

- Advanced Atmosphere Control Corp.
- Furnace Control Corp.
- Marathon Monitors
- Super Systems, Inc.

The CARBON type CV block has a “PROB” parameter used to specify the probe type.

12.2.2 Limits and Accuracy

Introduction

The probe linearization equations used in this design have been verified against the oxygen probe manufacturers' supplied tabular data. Table 12-1 shows the ranges of that data. The performance of the probes is specified only while the parameters remain within the *Specified Performance Range* in Table 12-1. Refer to probe manufacturers' documentation for probe accuracy specifications.

However, the equations yield continuous results while the parameters are outside the *Specified Performance Range* in Table 12-1, but within the *Valid Working Range* in Table 12-2. The function block will produce continuous values for %C and Dewpoint while the parameters are outside the *Specified Performance Range* and within the *Valid Working Range*, but no claim is made with respect to the accuracy of those values. For example, on a Furnace Control Corp.'s probe, %C values outside of the range 0.35 % to 1.65 %, but within the range 0.00 % to 2.00 % are produced by the block, but the accuracy is not guaranteed.

Table 12-1 Probe Manufacturers' Specified Ranges

PARAMETER	SPECIFIED PERFORMANCE RANGE			
	Advanced Atmosphere Control Corp.	**Furnace Control Corp.**	**Marathon Monitors**	**Super Systems, Inc.**
Output of the %C calculation before addition of the value of the "FURN" (furnace factor) parameter	0.10 to 1.40 %	0.35 to 1.65 %	0.20 to 1.40 %	0.20 to 1.40 %*
Oxygen Probe mV Output (provided by "PBIN" input)	1006 to 1207 mV	1054 to 1219 mV	1037 to 1224 mV	1032 to 1224 mV*
Oxygen Probe Temperature (provided by "TPIN" input)	1500 to 1900 °F	1400 to 1900 °F	1500 to 2000 °F	1500 to 2000 °F*
%CO Compensation (provided by "CO" parameter)	20 %	20 %	20 %	20 %*

*Super Systems information is based on an equation, but no tabular data; these limits are based on typical probe limits.

Table 12-2 Probe Manufacturers' Valid Working Ranges

PARAMETER	VALID WORKING RANGE
	All Probe Types
Output of the %C calculation before addition of the value of the "FURN" (furnace factor) parameter	0.00 % to 2.00 %
Oxygen Probe mV Output (provided by "PBIN" input)	0 mV to 1250 mV
Oxygen Probe Temperature (provided by "TPIN" input)	0 °F to 2000 °F
%CO Compensation (provided by "CO" parameter)	1 % to 100 %

12.3 CARBON Type CV Prompts

Introduction

When CARBON is specified as the type during configuration of the CV block as described in Section 9, the prompts in Table 12-3 are available for configuration.

Table 12-3 CV Carbon Potential Prompts

Prompt (Full name)	Range/Selections	Definition
IDPT (Input Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Input Decimal Position –** Move the decimal point to the position used by the inputs to the CV block.
ODPT (Output Decimal Position)	XX.XXXX XXX.XXX XXXX.XX XXXXX.X XXXXXX.	**Output Decimal Position –** Move the decimal point to the position to be used in the output values provided by the CV block.
PROB (Probe Type)	NONE AACP FCC MARTHN SUPSYS	**Probe Type –** Specify the type of oxygen probe supplying the input. **Advanced Atmosphere Control Corp.** **Furnace Control Corp.** **Marathon Monitors Co.** **Super Systems Inc.**
PBIN (Probe Input)	OFF NUMBER PARM *(analog)*	**Probe Input –** Specify the source of the oxygen probe input to the CV block.
TPIN (Temperature Input)	OFF NUMBER PARM *(analog)*	**Temperature Input –** Specify the source of the oxygen probe's temperature input to the CV block.
TPUN (Temperature Units)	NONE F C K R	**Temperature Units –** Specify the unit of measure (Fahrenheit, Celsius, Kelvin, or Rankine) in which the temperature input value at TPIN is supplied.

Table 12-3 CV Carbon Potential Prompts

Prompt (Full name)	Range/Selections	Definition
TPLL (Temperature Low Limit)	OFF NUMBER	**Temperature Low Limit –** When TPIN < TPLL, then OS = 1. When TPIN ≥ TPLL, then OS = 0. This limit can be used along with a loop force manual input to ensure that the output of a control loop is clamped at zero until the furnace temperature is at the desired level. **WARNING: In order for the output of the control loop to be clamped at zero until the temperature of TPIN equals TPLL you must also program the following:** **1) Configure LP*n* RMAN = CV*n* OS.** **and** **2) Configure LP*n* OTRK = 0.0 (<u>not</u> "OFF"). THE VALUE 0.0 IS NOT THE DEFAULT FOR OTRK.**
CO (CO Compensation)	OFF NUMBER PARM *(analog)*	**Carbon Monoxide Compensation** – Specify the source of the value of the percent carbon monoxide (%CO) present in the gas used for carburizing. This value is required by the algorithm that computes output OV, the %C present in the furnace atmosphere. The default is 20 %.
FURN (Furnace Factor)	OFF NUMBER PARM *(analog)*	**Furnace Factor –** The value of FURN will be added to the calculated %C before the value is made available as *CVn* OV. Use this furnace factor to compensate for sensor location or other variables. The default is 0.0.
SOOT (Sooting Factor)	OFF ON	**Sooting Factor –** When SOOT = ON, the anti-sooting factor provided at output A1 will be based linearly on the probe temperature. When SOOT = OFF, the value of output A1 will be 2.0. If SOOT = ON, a probe temperature ≤ 1408 °F limits %C output OV to 0.75 %, and a probe temperature ≥ 2086 °F limits OV to 2.0 %. See 12.4 for an example of an application using the anti-sooting factor as the setpoint high limit of a control loop.
HYDR (Percent Hydrogen)	*range 0 to 100*	**Percent Hydrogen –** Specify the percentage of hydrogen in the gas used for carburizing. This value is used in the calculation of the dewpoint value for output A2. The default is 40 %.

12.4 Application Notes

12.4.1 Overview

Introduction

The CARBON type CV block is intended to be used with other function blocks to provide a complete control solution. The configuration described in this subsection is only an example; other configurations can be accomplished. For example, the second loop of the controller can be used for furnace temperature control based on the probe temperature input or a separate analog input from a different sensor. For boost and diffuse cycles in batch carburizing, use the optional setpoint profiler to generate timed setpoints as described in Section 11.

WARNING

In order for the output of the control loop LP*n* to be clamped at zero until the furnace temperature TPIN equals TPLL, the LP*n* RMAN parameter must be set to CV*n* OS and LP*n* OTRK parameter must be programmed with a value of 0.0 (not OFF). The value 0.0 is not the default for OTRK.

Description of example

The configuration shown in Figure 12-1 uses the %C value provided by the OV output of the CARBON type CV block as the PV of a downstream control loop. By using a CN (constant) block programmed with its destination as LP1 HS. This loop's setpoint high limit is the anti-sooting factor value available as the carbon potential block's auxiliary output A1.

Enrichment and dilution of the carburizing gas is accomplished using duration adjusting type (DAT) output. This requires a standard splitter type CV block to activate one relay when the %C (the loop's PV) is above setpoint, and a different relay when the PV is below setpoint. (A control deadband is configurable.)

To permit the display of various values, extra CV blocks are used as described below.

To permit changing values online for the compensation factor representing the %CO in the carburizing gas (CO parameter) and the furnace factor (FURN), CN (constant) blocks are used.

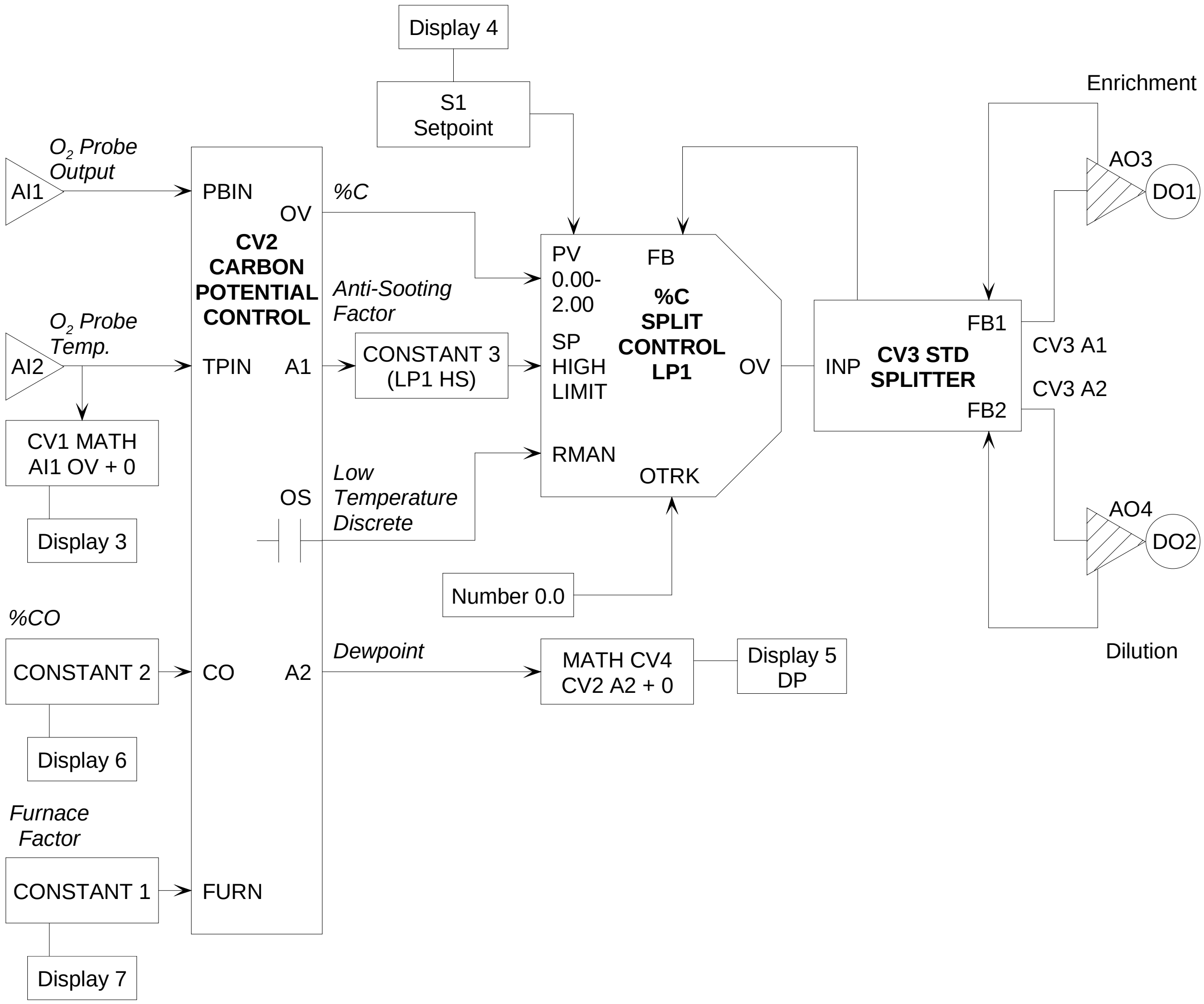


Figure 12-1 Diagram of Carbon Potential Configuration Example

12.4.2 Function Block Configuration

Millivolt input from oxygen probe

The mV signal from the zirconia oxygen probe is processed by an AI function block. In our example, the field wiring goes to the AI1 input terminals. Table 12-4 shows the programming for the AI1 block in Figure 12-1.

Table 12-4 AI1 Configuration for Oxygen Probe Input

AI1 Programming	Notes
ALGR = STD	A custom curve is not required for this input, so use the standard input algorithm and set the type to linear.
TYPE = LINEAR	
ODPT = XXXXX.X	Set the decimal point to the appropriate position.
RGLO = 0.0	Specify the input range.
RGHI = 1250.0	
D-ID = INDIRE	Specify indirect input; you will be prompted to assign engineering units to a specific millivolt or voltage span (see below).
CKLO = 0.0	Specify the actual low and high values of voltage used for this indirect measurement, as well as the unit of measure in which the range values are expressed.
CKHI = 1250.0	
CKUN = MV	

Temperature input from oxygen probe

The temperature input from the thermocouple in the oxygen probe is processed by an AI function block. In our example, the field wiring goes to the AI2 input terminals. Table 12-5 shows the programming for the AI1 block in Figure 12-1.

If you want to have this temperature value available for display while the controller is online, you must program a CV block as shown in Table 12-6. Then, during programming of the display cycle (see Section 9), select this calculated value for display on a “PVCV” display for the associated loop.

Table 12-5 AI2 Configuration for Oxygen Probe Temperature

AI2 Programming	Notes
ALGR = STD	A custom curve is not required for this input, so use the standard input algorithm and set the type to match the thermocouple in the oxygen probe.
TYPE = K	
ODPT = XXXXXX	Set the decimal point to the appropriate position.
RGLO = 0.0	Specify the input range.
RGHI = 2500	
D-ID = DIRECT	Because the input is from a thermocouple, specify direct input.
FAIL = DOWN	Specify that in case of input failure, the input value used should be the lower range limit (“downscale burnout”).

Table 12-6 CV1 Configuration to Enable Display of Temperature

CV1 Programming	Notes
TYPE = MATH	This CV block reads the temperature value from the output OV of AI2 and adds zero to it, thus making the temperature available as the CV block's output value. The output of any CV block can be displayed on a "PVCV" type primary display for the loop, but not changed by the operator.
INP1 = AI2 OV	
INP2 = 0	
OPER = ADD	

Furnace factor

The CARBON type CV block provides a FURN (furnace factor) parameter. The value of FURN will be added to the calculated %C before the value is made available as CV2 OV. This furnace factor is used to compensate for sensor location or other variables. Instead of entering the value directly for the FURN parameter during configuration of CV2 CO, a CN (constant) block is selected as the source of the value. This enables the FURN value to be displayed and changed on a "PVCN" primary display while the controller is online. Table 12-7 shows the programming for the CN1 block.

Table 12-7 CN1 Configuration for FURN Value

CN1 Programming	Notes
IN = *enter initial FURN value*	This value can be changed online.
IDPT = XXXXX.X	Set the decimal point to the appropriate position.
INEU = NONE	Set input engineering units to NONE.
DEST = OFF	The application does not require that the CN value be written to any destination.

%CO value required for %C calculation

In order for the %C to be computed correctly by the CARBON type CV block, the percent carbon monoxide in the carburizing gas must be specified using CV2 CO. This can be a dynamic value from an analog input. However, in our example, a fixed value is entered. Instead of entering the value directly for the CO parameter during configuration of CV2, a CN (constant) block is selected as the source of the value. This enables the %CO value to be displayed and changed on a "PVCN" primary display while the controller is online. Table 12-8 shows the programming for the CN2 block.

Table 12-8 CN2 Configuration for %CO Value

CN2 Programming	Notes
IN = *nnnnn.n*	Enter initial %CO value. This value can be changed online.
IDPT = XXXXX.X	Set the decimal point to the appropriate position.
INEU = NONE	Set input engineering units to NONE.
DEST = OFF	The application does not require that the CN value be written to any destination.

CARBON type CV block

The configuration of the CARBON type CV block used in our example is detailed in Table 12-9.

Table 12-9 CV2 Configuration for Carbon Potential Calculation

CV2 Programming	Notes
IDPT = XXXXX.X	Set the decimal point to the appropriate position.
ODPT = XXXXX.X	Set the decimal point to the appropriate position.
PROB = AACO, FCC, MARTHN or SUPSYS	Select probe manufacturer.
PBIN = AI1	These assignments match our use of input terminals and the associated AI function blocks.
TPIN = AI2	
TPUN = F, C, K, R	Specify unit of measure for TPIN. (Entry should match AI2 range.)
TPLL =	Specify low temperature limit. **See Warning on page 12-6. (1400 °F is recommended.)**
CO = CN2 OV	As described above, using a CN as the source of the CO and FURN values allows you to display and change the values online.
FURN = CN1 OV	
SOOT = ON	Enable use of the anti-sooting factor.
HYDR = *XXX*	Specify the percentage of hydrogen in the gas used for carburizing. (Default is 40 %.)

LP block to control enrichment and dilution of carburizing gas

The PID loop controls enrichment and dilution of the carburizing gas based on the %C value produced by the CARBON type CV block. In our example, we use a standard splitter with DAT (duration adjusting type) output. The configuration of the LP block is detailed in Table 12-10.

Note that not all internal parameters are listed. Configure the tuning parameters and other internal parameters not listed in this table as appropriate for your site. See Section 9 for a complete list of SPLIT type LP parameters.

Table 12-10 LP1 Configuration for Control of Carburizing Gas

LP1 Programming	Notes
TYPE = SPLIT	The loop must be a SPLIT type to implement our split output in the example. If another type of output is used, change the type. However, the loop cannot be a standard PID (STD), because the STD type does not support the required RMAN and OTRK parameters.
IDPT = XXXXX.X	Set the decimal point to match CV2 ODPT.
ODPT = XXXXX.X	Set the decimal point to the appropriate position.
PV = CV2 OV	The process variable will be the %C value calculated by the CARBON type CV block.
SPHL = *nnn*	Enter some number for the setpoint high limit. This number will be overwritten at runtime by the dynamic value from CN3 as described below. Do not set the limit to OFF.
FB = CV3 BC	Every loop must receive feedback. In this case the feedback will come from the back calculation value of CV3, the standard splitter.
OTRK = 0.0	If OTRK and RMAN are to be used to clamp the output at 0.0 until the furnace temperature reaches CV2 TPLL, you must specify a value of 0.0 (not OFF or some other value) for OTRK. The 0.0 is not the default. You must specify that LP1 RMAN = CV2 OS, the discrete that will have a value of 0 until CV2 TPIN = CV2 TPLL.
RMAN = CV2 OS	

CN block required to provide dynamic setpoint high limit based on sooting factor

The SPHL parameter in the loop block can only by configured to be OFF or a number. However, in our example we want to take advantage of the fact that the CARBON type CV block calculates a value (CV2 A1) representing the highest %C that will not result in production of soot. To use this value as the LP1 SPHL requires use of a CN block with its destination programmed as the LP1 SPHL. The value from the CN block will overwrite the configured value of SPHL at runtime. Table 12-11 shows the programming for the CN3 block used to accomplish this.

Table 12-11 CN3 Configuration for Dynamic Setpoint High Limit

CN3 Programming	Notes
IN = CV2 A1	The input will be the anti-sooting factor.
IDPT = XXXXX.X	Set the decimal point to match CV2 ODPT.
INEU = NONE	Set input engineering units to NONE.
DEST = LP1 HS	Making this choice for DEST results in the CV value being written to the SPHL of LP1.

Splitting the output with a CV block

To implement the split output a standard splitter type CV block is needed. Table 12-12 shows the programming for the CV3 block used for this purpose.

Table 12-12 CV3 Configuration for Splitting Output

CV3 Programming	Notes
IDPT = XXXXX.X	Set the decimal point to match the ODPT of LP1.
ODPT = XXXXX.X	Set the decimal point to the appropriate position.
INP = LP1 OV	The input will be the output of the PID block.
FB1 = AO3 BC	The feedback needed by the splitter will be provided by the back calculation values of the AO blocks interfacing with the DO blocks associated with the relays used for DAT output.
FB2 = AO4 BC	
OVDB = *nn*	If appropriate, enter a control deadband.
RNGL = *nnn*	Specify the range limits for display. The output is not clamped, nor will it flash on the display, when it is outside this range.
RNGH = *nnn*	

AO blocks to interface between the splitter and the relays

DAT output requires two AO blocks to serve as the interface between the splitter and the DO blocks associated with the relays wired to the controlled devices. These AO blocks are <u>not</u> associated with any analog output hardware. Table 12-13 and Table 12-14 show the programming for the AO blocks used for this purpose.

Note that the block also has other internal parameters that should be configured, such as the minimum on and off times appropriate for the devices being controlled, slew limits, a failsafe value (if enabled), etc. See Section 9 for the complete list of DAT type AO parameters. Figure 12-1.

Table 12-13 AO3 Configuration for DAT Output

AO3 Programming	Notes
TYPE = DAT	Our example uses time proportioned output.
IDPT = XXXXX.X	Set to match the CV3 ODPT.
INP = CV3 A1	When LP1 PV is less than its setpoint, the splitter will use its A1 output.
OUT = DO1	The device enriching the carburizing gas should be wired to the terminals for DO1. Note that once DO1 has been assigned to work with AO3, the DO1 input and action cannot be programmed. However, the labels associated with DO1's on and off state can be configured.

Table 12-14 AO4 Configuration for DAT Output

AO4 Programming	Notes
TYPE = DAT	Our example uses time proportioned output.
IDPT = XXXXX.X	Set to match the CV3 ODPT.
INP = CV3 A2	When LP1 PV is greater than its setpoint, the splitter will use its A2 output.
OUT = DO2	The device diluting the carburizing gas should be wired to the terminals for DO2. Note that once DO2 has been assigned to work with AO3, the DO1 input and action cannot be programmed. However, the labels associated with DO2's on and off state can be configured.

Displaying dewpoint uses another CV block

If you want to have the dewpoint calculated by the CARBON type CV block available for display while the controller is online, you must program a CV block as shown in Table 12-15. Then, during programming of the display cycle (see Section 9), select this calculated value for display on a "PVCV" display for the associated loop.

Table 12-15 CV4 Configuration to Enable Display of Dewpoint

<table>
<tr><th>CV4 Programming</th><th>Notes</th></tr>
<tr><td>TYPE = MATH</td><td rowspan="4">This CV block reads the dewpoint from the auxiliary output A2 of CV2 and adds zero to it, thus making the dewpoint available as the CV block's output value.
The output of any CV block can be displayed on a "PVCV" type primary display for the loop, but not changed by the operator.</td></tr>
<tr><td>INP1 = CV2 A2</td></tr>
<tr><td>INP2 = 0</td></tr>
<tr><td>OPER = ADD</td></tr>
</table>

Ensure that Setpoint 1 is viewable

As described in Section 9, you can configure which online displays are included in the cycle of primary displays accessed with the **DISPLAY** key. Be aware that specifying "PVSPL1" during display programming selects a display that shows the working setpoint. If the working setpoint is clamped at the LP1 SPHL based on the anti-sooting factor, this working setpoint will not be the same as Setpoint 1. If you want to also be able to view and change Setpoint 1, then also select "PVS1L1" to be included in the display cycle.

12.4.3 Display Configuration

Introduction

Our example uses primary displays to enable the operator to view and change values in the carbon potential strategy. Table 12-16 shows the selections recommended. Add or remove displays to satisfy your particular operational requirements. Instructions for selecting the displays to be included in the online display cycle are provided in 9.11.

Table 12-16 Displays Used by Carbon Potential Example

PRG DPYS Prompt	Selection	Purpose
PRG DPY1	PVSPL1	display PV and display/change working SP of loop 1
PRG DPY2	PVOUL1	display PV and display/change loop 1 output
PRG DPY3 DPY3 CV	PVCVL1 1	display PV and CV1 probe temperature
PRG DPY4	PVS1L1	display and display/change Setpoint 1
PRG DPY5 DPY5 CV	PVCVL1 4	display PV and CV4 dewpoint
PRG DPY6 DPY6 CN	PVCNL1 2	display PV and display/change CN2 CO value
PRG DPY7 DPY7 CN	PVCNL1 1	display PV and display/change CN1 FURN value

13. Final Preparations for Bringing Controller Online

13.1 Introduction

Overview

Once you have programmed the controller, you can use the "pretune" feature to bring your tuning parameters to the best approximation of good operating values.

This section contains instructions for using the pretune feature, as well as some tips for successfully commissioning the controller.

What's in this section?

The following topics are covered in this section.

13.2 Pretuning a Loop

Introduction

"Pretune" is a feature that calculates optimum values for a loop's Proportional Band/Gain, Reset and Rate by analyzing the reaction of the loop to a "step change" in setpoint or output. After these new tuning values have been calculated you have the option of applying (installing) or not applying them to a preselected set of tuning parameters for the loop. You can pretune a loop while another loop is pretuning.

To pretune a loop, select "PRETUNE" from the Online menu. Select LP1 or LP2 to tune.

Pretune occurs in four stages as indicated by the status (PT# STATUS). Each status has its own menu. Table 13-1 shows the stages of pretune.

Table 13-1 Stages Of Pretune

Order	Status	Meaning
1	**STOP**	Pretuning not operating, waiting to be started by operator. See STOP menu.
2	**IDENT**	Pretune is identifying process dynamics as a result of a setpoint or output change. See IDENT menu.
3	**CALC**	Identification is complete and calculation of new tuning parameters is in process. See CALC menu.
4	**COMP**	Calculations are complete and new parameters are ready to replace the loop's tuning parameters, if desired. See COMP menu.

STOP menu

Table 13-2 describes the Pretune STOP prompts.

Table 13-2 Pretune STOP Prompts

Prompt (Full name)	Range/Selections	Definition
PT# STATUS		Status stopped.
PT# TSET (Tuning Set)	Select which set of tuning parameters (1 or 2) will be pretuned and installed.	If tuning a split loop, set 1 applies to loop output between 0 and +100; set 2 applies to loop output between 0 and -100.
PT# OPTZ (Optimize)	Select SET PT or LOAD	This optimizes the new tuning parameters according to their intended use (that is, controlling changes in setpoint or process load).
PT# OSHT (Overshoot)	Select YES or NO.	This determines whether or not some overshoot is acceptable in the pretune specified tuning.

Table 13-2 Pretune STOP Prompts

Prompt (Full name)	Range/Selections	Definition
PT# OTSZ (Output Size)	-100 to +100	Appears if loop is in Manual. Enter the largest change in output (+ or -), in engineering units, that the process will tolerate. The pretune will initiate and analyze this output change.
PT# SPSZ (Setpoint Size)	-100 to +100	Appears if loop is in Auto. Enter the largest change in setpoint (+ or -), in engineering units, that the process will tolerate. The pretune will initiate and analyze this setpoint change.
PT# STRT (Start)		Select to start the pretune function. See **Before Starting Pretune** below.

Before Starting Pretune

Before starting Pretune, configure/adjust the loop as follows:

Auto/Manual: Either mode is acceptable. Changing the loop mode after starting pretune will abort the pretune, causing an error message to appear.

Process Variable: Adjust setpoint or output to bring the process variable to normal operation range. Adjusting or switching setpoints or output after starting pretune will abort the pretune, causing an error message to appear.

Gain/Proportional Band, Reset: Use known good settings. Alternatively, set Gain = 1.0 (PB = 100), Reset = 1.0 and place loop in Manual mode.

Rate: Optional. If OFF, pretune will not calculate a Rate.

OSUP (fuzzy overshoot loop parameter): Set to OFF. If left on, it may cause pretune to abort. If desired, set OSUP to ON after pretune has been completed.

After Starting Pretune

After starting the pretune, do not change/adjust the loop mode, loop output, loop setpoint, or operating mode. If you do, the pretune will abort. See Pretune Abort Messages later in this section.

IDENT and CALC menus

During IDENT and CALC status, a TUNE indicator appears on all primary displays (not on menus) for the loop being pretuned.

Table 13-3 describes the Pretune IDENT and CALC prompts.

Table 13-3 Pretune IDENT and CALC Prompts

Prompt (Full name)	Definition
PT# STATUS	Status Identifying or Calculating.
PT# TIME	Elapsed time since pretune was started.
LP# SP (Setpoint)	Current working set point value of the loop being tuned
LP# PV (Process Variable)	Current process variable value of the loop being tuned.
LP# OUT (Output)	Current output value of the loop being tuned.
PT# ABRT (Abort)	Select to cancel identifying and calculating and return to the stopped status.

COMP menu

Table 13-4 describes the Pretune COMP prompts.

Table 13-4 Pretune COMP Prompts

Prompt (Full name)	Definition
PT# STATUS	Status Completed
PT# PB/GAIN	New proportional band or gain determined by pretune
PT# RST (Reset)	New reset determined by pretune
PT# RTE (RATE)	New rate determined by pretune
PT# ISTL (Install)	Select to install the new pretune values into loop's tuning parameters (specified by TSET in Table 13-2.)
PT# ABRT (Abort)	Select to delete the new pretune values if you do not wish to install them.

Pretune Abort messages

One of the following messages is displayed when an unusual event has aborted the pretune. “PTA” means “Pretune Abort.”

Table 13-5 Pretune Abort Messages

Message	Meaning/User Action Required
PTA-WARM START	A warn start occurred during pretune. Repeat pretune.
PTA-WENT OFFLINE	Instrument went out of Online mode during pretune. Repeat pretune.
PTA-LOOP STATUS	Loop has PV that is bad (i.e. failed sensor). or PV is a constant value such as from an upstream block in manual. or Loop has back calculation value from a downstream block that is bad or is the result of the downstream block being in manual. Repeat pretune.
PTA-AM SEL CHNGE	Loop switched between automatic and manual modes. Repeat pretune.
PTA-SP SEL CHNGE	Loop was in automatic mode and an attempt was made to switch between Setpoint 1 and Setpoint 2. Repeat pretune.
PTA-OUT MOVED	Loop was in manual mode and loop’s output value changed. Repeat pretune.
PTA-SP MOVED	Loop was in automatic mode and setpoint value changed. Repeat pretune.
PTA-LOOP OS	Loop is out of service. Fix loop before repeating pretune.
PTA-LOOP NOT CFG	Loop is not configured. Configure loop before repeating pretune.
PTA-BAD STEP SIZ	Step size is turned off. Set step size to a value before repeating pretune. See Table 13-2.
PTA-ONOFF LOOP	Cannot pretune an ON/OFF type loop.
PTA-BAD SN RATIO	Increase step size. See Table 13-2.
PTA-BAD OSC	Repeat pretune with smaller gain or proportional band in loop.
PTA-BAD ID VALUE	Increase step size. See Table 13-2.
PTA-DB ACCESS	Unknown hardware problem. Consult technical support.
PTA-TASK FAIL	Unknown hardware problem. Consult technical support.

13.3 Commissioning Hints

Introduction

When you put your controller online, it will not operate unless you take into account certain features of its design. This subsection to intended to make you aware of these features.

Five good scans needed before it will go online

A safety attribute built into the controller function blocks is to assume at startup that input values to the blocks are bad until they are measured good. This attribute causes the controller to execute up to five scans of the control strategy before going online. Failure to process all good inputs will result in the main display showing flashing asterisks (******) instead of values.

Impossible to verify configuration without inputs

A common error made during commissioning a controller is to attempt to verify a configuration with the inputs to the controller disconnected. This will typically result in the main display flashing asterisks (******). There are many online diagnostic routines that identify faults after the controller has successfully been placed in service, but upon power-up, the controller must first be able to verify all inputs to all function blocks are good before these secondary routines are enabled.

Importance of feedback

Configuration errors may also cause function blocks to fail to operate on startup. One common error is to omit the feedback source for a PID algorithm. With the exception of ON/OFF control, the loop must have feedback to operate. The feedback is used to verify that the output generated by the PID algorithm successfully reached the controller output block. The AO and CV blocks provide a BC (back calculation) output value for this purpose.

Sometimes, however, during configuration the need for feedback is ignored by the programmer. Most signal flow is "forward" through the controller as the incoming field signal is processed, and its value used and manipulated by various blocks until a value is processed into a field signal to the controlled device. However, the loop feedback connection is sometimes forgotten, because it is in the reverse direction, from "AO*n* BC" (back calculation) output back "upstream" to "LP*n* FB" (feedback) input.

Although the loop must have feedback to operate, some function blocks do not propagate a back calculation value, providing the output value that is needed for PID control loop operation. If your configuration uses one of these blocks between a PID loop and an analog output, use the control loop's own output value (LP*n* OV) as the feedback source for the loop to complete the signal flow connection.

Take advantage of the summary displays

One approach to diagnosing sources of the flashing asterisk (******) display is to use the SUMMARY displays in the Online menu (see Section 15) to view the outputs of the function blocks that have been configured. If the controller analog input values appear to be within range, check for proper signal levels on other function blocks. Finally, verify proper signal flow has been maintained throughout your configuration.

14. Using Primary Displays to View Process Values and Change Setpoints

14.1 Introduction

Overview

Up to ten primary operator displays can be accessed in the configured sequence by pressing the **DISPLAY** button repeatedly. Primary displays contain live process data such as setpoint, process variable, deviation, loop mode (Automatic or Manual), Setpoint Profiler status, engineering units and alarm status, as well as constants from CN blocks and calculated values from CV blocks.

This section describes the displays and their use.

Functions performed using the Online mode menu are described in Section 15.

What's in this section?

The following topics are covered in this section.

Topic	Page
14.2 Primary Display Description	14-2
14.3 How to Use Primary Displays	14-5

14.2 Primary Display Description

Introduction

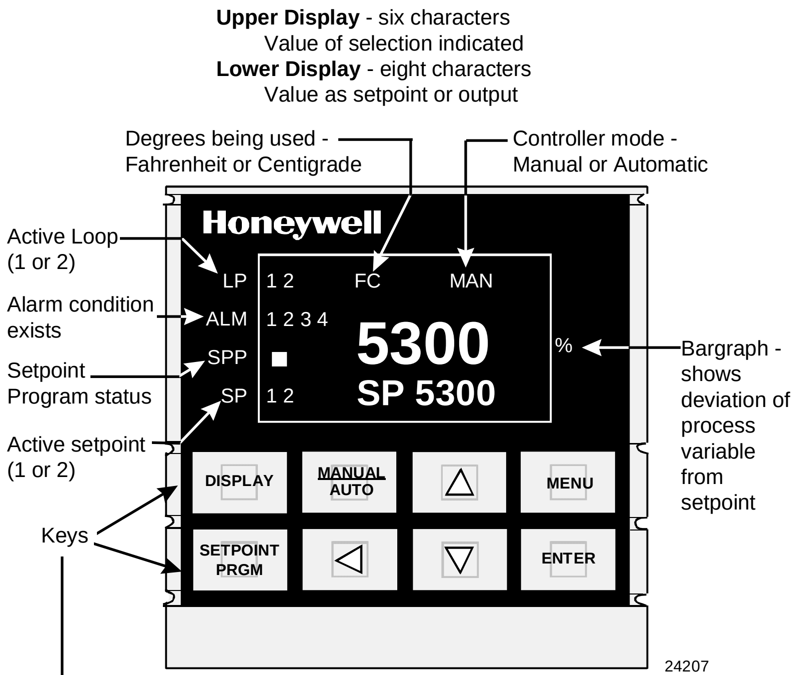
Figure 14-1 shows an example of a primary display. All primary displays follow the same basic format:

- The PV is shown in the middle of the display.
- Another value, identified by a label such as "SP1" is at the bottom of the display in slightly smaller characters.

In addition, indicators above the PV and to the left of the data show:

- Loop number 1 or 2 – Indicates loop for which values are on display.
- Engineering units - F or C or none
- manual/auto status:
  - **MAN** lit when the loop is in manual mode
  - **A** lit when the loop is in auto mode
  - **A** flashing when the loop is in remote manual
  - **A** lit with flashing M and N when loop is in "init" manual; the controller puts the cascade primary in init manual if the cascade secondary is put into manual mode by the operator or by the action of a discrete parameter. In init manual the output of the primary loop is adjusted to match the setpoint of the secondary, so that the transition back to auto mode is bumpless.
- Active alarm number 1, 2, 3, or 4
- Setpoint profile status; lit when the setpoint profile is executing, flashing when the profile execution is being held, and off when the profile is "at end" or "ready".
- Working (active) setpoint 1 or 2

- The bargraph on the right is a 21-segment deviation bar. The middle segment represents 0 % deviation of PV from the working (active) setpoint. Each segment above and below the middles represents 0.1 % for a total of +/-1 % of range.



DISPLAY	o Accesses up to 10 on-line displays. o Changes controller to on-line mode.
MANUAL / AUTO	o Toggles loop between automatic and manual modes, or between remote manual and manual modes when remote manual is ON.
△	o Moves cursor up a menu or list of choices. o Increases the setpoint, output, or configuration values displayed.
MENU	o Accesses on-line mode menu. o Moves cursor to first item on menu. o Backs cursor out of a menu to next higher menu level. o Exits menu without saving changes if pressed when prompted to save changes.
SETPOINT PRGM	o Accesses setpoint profile displays.
◁	o Selects the digit to be changed.
▽	o Moves cursor down a menu or list of choices. o Decreases the setpoint, output, or configuration values displayed.
ENTER	o Selects displayed menu item. o Enters a changed value or parameter o Saves changes made and returns to higher menu if pressed when prompted to save changes.

Figure 14-1 Example Of A Primary Display

If a value is flashing, either the value is clamped at its output limit, or, in the case of a totalizer or interval timer value, the value is outside its limits, but not clamped.

If a value alternates with a string of asterisks, either the relevant AI is an open circuit with failsafe, or the AI is linear and is outside the programmed range by 10 % or more.

Available displays

The displays actually available to an operator, and the sequence in which the displays are presented, is configurable using "PRG DPYS" from the Program menu. Table 14-1 lists all the possible displays.

Table 14-1 Primary Displays

Displayed Values	Function
PV **Working SP**	Allows online changes to working setpoint while viewing read-only PV. Note that your attempts to change the working setpoint will be unsuccessful if it is clamped at the setpoint high or low limit for the loop.
PV **Loop Output**	Allows online changes to loop output while viewing read-only PV; for types other than ON/OFF
PV **ON/OFF Loop Output State**	Read-only PV and state of ON/OFF type loop only.
PV **DV**	Read-only PV and deviation of PV from setpoint.
PV **Ratio Setpoint**	Allows online changes to ratio setpoint while viewing read-only PV.
PV **CV**	Read only PV and Calculated Value (selected during "PRG DPYS" programming).
PV **CN**	Allows online changes to constant (selected during "PRG DPYS" programming) while viewing read-only PV.
PV **SP1**	Allows online changes to SP1 while viewing read-only PV. If the working setpoint is clamped at the setpoint high or low limit for the loop, this can be different than the value of the working setpoint.
PV **Setpoint Select**	Use **ENTER**, ▲ or ▼ to toggle between SP1 and SP2 for the current loop.

14.3 How to Use Primary Displays

Introduction

When a primary display is shown, the keypad can be used to:

- select auto or manual mode for the loop
- change loop output
- change the setpoint value
- change a constant value
- change ratio value of a ratio control loop
- control the status of a setpoint profiler (see Section 11).

Instructions for performing these functions are described below.

ATTENTION

These functions all apply to the "currently selected loop", which is designated on the display. Instructions for changing (tuning) the selected loop’s parameters are provided in Section 15.

Selecting auto or manual mode

This function can be performed on all primary displays. Pressing **MANUAL/AUTO** toggles the loop between auto and manual modes. In auto the controller’s output is calculated by the control algorithm. In (local) manual the output is set by the operator using the controller’s keypad.

To use the **MANUAL/AUTO** key three conditions must be met:

1. The loop must be in local mode, which means the value of the loop’s remote manual control (RMAN) parameter must be zero.

2. The loop’s Discrete vs. Key (DIKY) discrete must have a value of zero.

3. If security is active for manual/auto changes, the security code must be entered first.

For a description of the loop parameters RMAN , and DIKY, see Section 9.

Using remote manual mode

When the loop is in “remote manual” its RMAN parameter has a value of one. This forces the controller's output to be the Output Tracking (OTRK) value. Usually, the source of the OTRK value is an analog input block receiving the value from a primary controller or PLC. Remote manual mode can only become active when the loop is in auto. Remote manual is indicated by the “A” (for auto) indicator flashing. In remote manual the **DECREMENT** (▼), **INCREMENT** (▲), and **LEFT** (◀) keys are disabled. Pressing **MANUAL/AUTO** while in remote manual switches the controller back to local manual mode.

Changing loop output

This function can be performed on any primary display where output is shown. Pressing the **DECREMENT** (▼) and **INCREMENT** (▲) keys will lower or raise the loop output (displayed as %). The **LEFT** (◄) key can be used to select a digit to change.

The loop must be in local manual mode, not in remote manual mode.

Changing setpoint value

This function can be performed on any primary display that shows the setpoint value. Pressing the **DECREMENT** (▼) and **INCREMENT** (▲) keys increases or decreases the setpoint value. The **LEFT** (◄) key can be used to select a digit to change.

The following conditions apply:

1. Only numerically assigned setpoint values can be changed online. If Setpoint 2 is the working setpoint, it cannot have been programmed as an analog parameter.
2. If the currently active loop is a Ratio Loop, only SP1 can be changed.

Changing a constant's value

This function can be performed on any primary display that shows a constant's value. Pressing the **DECREMENT** (▼) and **INCREMENT** (▲) keys increases or decreases the constant's value. The **LEFT** (◄) key can be used to select a digit to change.

Changing ratio value

Ratio is a gain value applied to an analog parameter which is programmed as the "wild" input for the ratio control loop. The result of the (wild variable x Ratio) + bias calculation is the setpoint for the ratio loop, designated as Setpoint 2 (SP2). Ratio loops must use only SP2. If the setpoint is changed online to SP1, ratio action will be canceled and the setpoint value will be determined by direct front panel numerical entry.

You can change the ratio value only on the primary display which shows the process variable and ratio value. Pressing **DECREMENT** (▼) and **INCREMENT** (▲) keys increases or decreases the ratio value. The **LEFT** (◄) key can be used to select a digit to change.

The following conditions apply.

1. Only numerically assigned ratio values can be changed online. (Ratio value must not have been programmed as an analog parameter.)
2. The currently active setpoint must be SP2.

15. Using Online Menu Functions

15.1 Introduction

Overview

This section describes the use of Online menu functions. These menus are accessed, and values entered or selected, as described in Section 6, *Modes, Menus, Prompts, and Keypad Basics.* If you are not familiar with the contents of that section, review it before using the Online menus.

The tasks described in this section are:

- tuning a loop (pre-tuning the loop before the controller is brought online is described in Section 13)
- viewing displays in the summary group: alarms; diagnostics; I/O points; current time and date; product information, including firmware version
- data entry
- adjusting analog outputs
- reviewing (read-only) the values of function block parameters and other Program mode functions

Other functions accomplished with the Online menu are described in other sections:

- setting up, storing, loading, and using a setpoint profile - Section 11
- storing data – Section 17

Use of primary operator displays is described in Section 14.

What's in this section?

The following topics are covered in this section.

ATTENTION

All prompts and selections in this section are listed as shown when the controller's language is set to English. The controller can be configured to display prompts and messages in other languages as described in Section 9.

ATTENTION

The controller can be programmed to require the entry of a password before changing tuning parameters, changing alarm setpoints, and other activities described in this section. If you are locked out of any function described here, see your process engineer.

15.2 Tuning a Loop and/or Toggling the Setpoint

Introduction

The value of loop tuning parameters can be changed online to adjust the operation of a loop to best respond to the requirements of the process.

In addition, the Online menu "TUNE LP" item is used to toggle between Setpoint 1 and Setpoint 2 for the selected loop. (Some primary displays can also be used to toggle between setpoints; see Section 14 for details.)

Loop tuning procedure

To toggle the setpoint and/or tune a loop, follow the procedure in Table 15-1.

Table 15-2 describes the Loop Tuning parameters.

Table 15-1 How To Toggle and/or Tune A Loop

Step	Action
1	Select "TUNE LP" from the Online menu by pressing **ENTER** when it is on display.
2	Scroll to Loop1 or Loop 2 and press **ENTER**. The selected loop will be displayed on the bottom line of the display along with the prompt "SPT". Above it will be the option "TOGGLE". Note that the appropriate setpoint indicator "1" or "2" will be lit.
3	To toggle to the other setpoint, press **ENTER**. The setpoint indicator will change to the other number.
4	If you do not want to change the value of any tuning parameters at this time, press **MENU** to exit loop tuning for the selected loop. If you do want to change the value of a tuning parameter, then instead of pressing **MENU,** press the **DECREMENT** (▼) key. Use it to scroll through the tuning parameters for the selected loop.
5	Select any of the parameters in to be tuned. Parameters available depend on the loop type being tuned. Tuning parameters are described in Table 15-2.

Table 15-2 Loop Tuning Parameters

Prompt **(Full name)**	**Range/Selections**	**Definition**
GN1/GN2 (Gain) or **PB1** (Proportional Band)	OFF NUMBER *range is 0.1 to 200 for Gain* *or* *0.5 to 1000.0* *for Proportional Band*	**Gain 1** and **Gain 2** or **PB1** and **PB2 –** Which prompt is displayed for each set of tuning parameters depends on the setting entered for "GNPB" in Program mode. Enter the proportional component to be applied by the control algorithm. If an indirect source was specified during programming, the value can only be altered at the source, not here in Online mode. To allow integral only control, select OFF. Note that use of the second set of tuning parameters is enabled with "DTUN", a loop prompt available in Program mode.
RST1/RST2 (Reset)	OFF NUMBER *range is 0.005 to 99.99 repeats per minute*	**Reset in Repeats per Minute 1** and **2 –** Specify how many times proportional action should be repeated per minute. This is the "integral" component of control. Reset adjusts the controller's output taking into consideration both the size of the deviation (SP-PV) and the duration of the deviation. The amount of corrective action depends on the value of PB1 or GAIN1. To allow proportional only control, select OFF. When reset is turned off, the "MRST" (manual reset) value determines the loop output at setpoint. Bumpless manual to automatic transfer is cancelled when proportional only control is selected.
RTE1/RTE2 (Rate)	OFF NUMBER *range is 0.02-10.00 minutes*	**Rate 1** and **Rate 2 –** Enter the time period to be used by the derivative component of control, which affects the loop's output whenever the deviation between setpoint and process variable is changing. The output will be affected more when the deviation is changing faster. The output is modified by a value that assumes the rate of change of the process variable will continue for the time period specified using this prompt. Enter a starting value or OFF at the time of configuration. The value may be altered online for final loop tuning.

Table 15-2 Loop Tuning Parameters

Prompt (Full name)	Range/Selections	Definition
MRST (Manual Reset)	OFF NUMBER range is -100 to +100	**Manual Reset -** This feature functions only when OFF is entered for RST1 and RST2. Enter a value equal to the desired loop output when the process variable is at setpoint. This allows correction of output to account for load changes to bring the process variable up to setpoint. The controller output is the computed output value plus the value of MRST.
APHI (Approach High)	OFF NUMBER *range is 0.1 to 100*	**Approach High –** This function affects the process variable approach to setpoint when the process variable value is less than the setpoint value. The value entered is the percent of span deviation from setpoint at which a recalculation of the loop integral value will occur. This function is useful for batch startup from a "cold" condition to control excessive overshoot when setpoint is reached.
APLO (Approach Low)	OFF NUMBER *range is 0.1 to 100*	**Approach Low:** Value entered affects the process variable approach to setpoint when the process variable value is greater than the setpoint value.
SPT1 (Setpoint 1) and **SPT2** (Setpoint 2)	OFF NUMBER	**Setpoint 1** and **Setpoint 2 -** Setpoint 1 and Setpoint 2 are independent setpoints. Either may be the active setpoint for the loop. Setpoints can be changed using some primary displays when the controller is in Online mode.
ISLW (Increasing Slew Limit) and **DSLW** (Decreasing Slew Limit)	OFF NUMBER	**Increasing Slew Limit** and **Decreasing Slew Limit –** Specify limits for rate at which operator can change the setpoint using the keys on the front panel.
HYST (Hysteresis)	OFF NUMBER *range is 0 to 100 % of PV span*	**On/OFF Hysteresis –** The value entered here will be used to define a deadband above and below the setpoint. If the PV varies from the setpoint while the output is ON, but by less than the value specified here, the output will remain ON, preventing excessive output oscillation.

Table 15-2 Loop Tuning Parameters

Prompt **(Full name)**	Range/Selections	Definition
FFGN (Feed Forward Gain)	OFF NUMBER *range is -10.00 to 10.00*	**Feed Forward Gain –** Specified value is applied as gain to the feed forward input value.
RATO (Ratio Setpoint)	OFF NUMBER	**Ratio Setpoint –** Enter ratio setpoint (RATIO type loops only).
OSUP (Fuzzy Overshoot Suppression)	NO YES	**Fuzzy Overshoot Suppression –** When YES is selected suppression is enabled, limiting the overshoot of the setpoint by the process variable after a disturbance in the process such as a load change or setpoint change. Through “fuzzy logic” the working setpoint of the control loop is dynamically modified by the control algorithm to reduce or eliminate overshoot. **ATTENTION:** Regardless of the setting of this parameter, overshoot is not suppressed when the process disturbance causes an initial deviation (PV-SP) between –0.7 and +0.7 engineering units. Consequently, overshoot may not be suppressed in applications which require numerically small loop PV ranges such as carbon potential, in which this range is typically 0.0 to 2.0 engineering units.

15.3 Viewing Displays in the Summary Group

Introduction

The "SUMMARY" item in the Online menu provides access to a wealth of information about the controller as it interacts with the process. Table 15-3 describes the Summary prompts.

Table 15-3 Summary Prompts

Prompt (Full name)	Definition
ALRM SUM (Alarm Summary)	*See 14.3.1.*
DIAG SUM (Diagnostic Summary)	*See 14.3.2.*
ANLG SUM (Analog Summary)	Displays current value of all analog values in the controller. These include all analog I/O, loops, calculated values, totalizers and system parameters.
DISC SUM (Discrete Summary)	Displays current status of all discrete values in the controller. These include all discrete I/O, alarms, loops, totalizers and system parameters.
DEL DIAG (Delete Diagnostic)	*See 14.3.2.*
TIME	Displays current time and date. (If these are incorrect they can be reset in Program mode using "SET CLK").
PROD ID	Displays part number and version of installed firmware.

15.3.1 Alarms

Introduction

Up to four process alarms (AL1 through AL4) are configured as part of the controller programming procedure (see Section 9).

Alarm types

An alarm can be assigned to any analog data point (Analog Input, Analog Output, or Calculated Value) and can be one of the types in Table 15-4.

Table 15-4 Alarm Types

Alarm type	Meaning
HIGH	Alarm when input value ≥ alarm setpoint value.
LOW	Alarm when input value ≤ alarm setpoint value.
DEV (Deviation)	Alarm when input value deviates above or below compare point value by an amount ≥ alarm setpoint value.
HDEV (High Deviation)	Alarm when input value deviates above compare point value by an amount ≥ alarm setpoint value.
LDEV (Low Deviation)	Alarm when input value deviates below compare point value by an amount ≥ alarm setpoint value.
HRATE (High Rate)	Alarm when input value increases at rate ≥ alarm setpoint value, in units per minute. Negative rate setpoints are processed as positive values. May take up to 30 seconds to activate.
LRATE (Low Rate)	Alarm when input value decreases at rate ≥ alarm setpoint value, in units per minute. Negative rate setpoints are processed as positive values. May take up to 30 seconds to activate.

Alarm actions

The following things happen during an alarm:

- The appropriate alarm number indicator lights on the display
- The alarm is entered into the Alarm Summary which shows all active alarm sources.
- If so configured, the alarm is stored in data storage (see Section 17).
- If so configured, the alarm triggers a discrete output relay (see Section 9). The relay action returns to normal state only when the alarm state has cleared.

The alarm will remain active as long as the conditions causing it remain. When the conditions no longer exist, the alarm will be "cleared" automatically. "Clear" means that the indicators for the particular alarm on all displays will be removed and the alarm will be removed from the Alarm Summary list.

An alarm programmed with delay will not activate until its delay time expires. An alarm programmed with hysteresis will not clear until its hysteresis time expires.

Viewing alarm types and setpoints online

Instructions for viewing alarm types and setpoints are in Table 15-5.

Instructions for changing alarm setpoints online are provided in 15.4.

Table 15-5 Procedure for Viewing Alarm Types and Setpoints

Step	Action
1	Select “SUMMARY” from the Online menu. “ALM SUM” will be displayed.
2	To see the alarm summary press **ENTER**.
3	Use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to review any alarm on the list.
4	Press **MENU** to exit to the menu or **DISPLAY** to go to primary displays.

15.3.2 Self-Diagnostics

Introduction

The controller runs self-diagnostics at powerup and, as a background task, during operation. Diagnostic messages indicate failure of one of these self-tests. The messages are listed, along with possible causes, in Section 21.[1]

The following things happen when a self-test is failed:

- A diagnostic message is displayed.
- The most recent diagnostic appears at the top of the Diagnostic Summary. The ten most recent diagnostics can be viewed here. As new diagnostics occur, the oldest of the ten is removed from the list.
- If so configured, the diagnostic is stored in Data Storage (see Section 17).

Viewing the ten most recent diagnostic messages

Instructions for viewing the ten most recent diagnostic messages are in Table 15-6.

Table 15-6 How To View Diagnostic Messages

Step	Action
1	Select "SUMMARY" from the Online menu. "ALM SUM" will be displayed.
2	Scroll down to "DIAG SUM" and press **ENTER**. The most recent diagnostic message (or a message that there are no diagnostic failures) will be displayed.
3	Use the ▲ and ▼ keys to scroll through the list.
4	Press **MENU** to exit to the menu or **DISPLAY** to go to primary displays.

Clearing the Diagnostic Summary

A diagnostic message is not automatically cleared from the summary when the error has been found and corrected. Instructions for clearing all diagnostic messages from the summary are in Table 15-7.

Table 15-7 How To Clear Diagnostic Messages

Step	Action
1	Select "SUMMARY" from the Online menu. "ALM SUM" will be displayed.
2	Scroll down to "DEL DIAG" and press **ENTER**. All diagnostics will be deleted from the summary.
3	Press **MENU** to exit to the menu or **DISPLAY** to go to primary displays.

[1] Note that offline tests of the keypad, display, memory, etc. can be initiated by the operator in Maintenance mode as described in Section 18.

15.4 Data Entry

You may change the following items online using the “DATA ENT” item on the Online menu:

- alarm setpoints; an alarm can also be disabled
- constant values
- on/off status of any DI or DO, and alarm setpoints; the capability to force the state of DI and DO parameters can be disabled in Program mode using “FEATURES”
- analog input value; the capability to change AI values disabled in Program mode using “FEATURES”
- analog output value; the capability to tune AO values.

The prompts available when “DATA ENT” is selected from the Online menu are shown in Table 15-8.

ATTENTION

The “FORCE” feature can be disabled in Programming mode. If it has been disabled, it will not appear as a prompt under “DATA ENT”.

The procedure for changing alarm setpoints is in Table 15-9. The procedures for using other data entry functions parallel that for changing alarm setpoints.

Table 15-8 Data Entry Prompts

Prompt (Full name)	Range/Selections	Explanation
ALARM	Select an alarm to adjust.	The setpoint will be displayed. Press **ENTER** to access it. Adjust with the ▲ and ▼ keys. Press **MENU** to leave the menu.
CN (Constant)	Select a Constant to adjust.	Press **ENTER** to access it. Adjust with the ▲ and ▼ keys. Press **MENU** to leave the menu.
FORCE	**FORC DI**	Select **FORC DI** or **FORC DO** to force the change of state of any DI or DO. After selecting a DI or DO, its current state will be displayed. Press **ENTER** to show the forced state. An unforced DI or DO will display “RELEAS”; a forced DI or DO will display “F-OFF” or “F-ON”. Press **ENTER** to access the forcing choices. Adjust with the ▲ and ▼ keys. Press **MENU** to leave the menu. Note that when the programmed label for a DI or DO is on display, the **“F”** that usually indicates Fahrenheit (see Figure 14-1) will be lit if the current value of the DI or DO is the result of its having been forced to that state.
	FORC DO	

Table 15-8 Data Entry Prompts

Prompt (Full name)	Range/Selections	Explanation
AIADJ (AI Adjust)	Select an AI to adjust.	Use this function to: • adjust the gain applied to the input from a Spectray or Rayotube pyrometer (emissivity adjustment to compensate for the color of the objects on which the pyrometer is sighting), or • to adjust the bias (zero) if the input comes from a thermocouple. First use a reference device to determine the actual temperature the input should represent. Next, when the AIADJ prompt is on display, press **ENTER** to display the current AI value. Use the ▲ and ▼ keys to make the displayed value match the actual temperature. Press **ENTER** and the controller will adjust the gain or bias accordingly.
SET AO	Select an AO to adjust.	Use this function to tune Analog Output parameters. See Table 15-10.

Changing Alarm Setpoints Online

If an alarm setpoint was configured in Program mode as a number (not read from another parameter), the value of the alarm setpoint can be changed online using the procedure in Table 15-9.

Table 15-9 Procedure for Changing Alarm Setpoint

Step	Action
1	Select “DATA ENT” from the Online menu. “DE ALARM” will be displayed.
2	To view and/or edit an alarm setpoint press **ENTER**.
3	Scroll to Alarm 1 through 4 and press **ENTER**. The alarm type and current setpoint will be displayed.
4	To change the setpoint, edit as you would any number: press **ENTER** to move the cursor to the data line, and the display will change to the word “NUMBER”.
5	Press **ENTER** to indicate that you want to edit the number (or scroll to the “OFF” choice to disable the alarm). If you press **ENTER** the current value will again be displayed.
6	Use the ▲, ▼, and ◄ keys to change the value.

Step	Action
7	When the new setpoint is displayed, press **ENTER** to move the cursor back to the prompt line.
8	Press **MENU** to exit to the menu or **DISPLAY** to go to primary displays.

Adjusting Analog Outputs

You can adjust analog outputs using the “SET AO” item on the Data Entry menu. Tunable parameters depend on the AO type selected (CAT, VAT, DAT, PP). The tunable parameters for all AO types are identified in Table 15-10. (Input bias and gain can be adjusted using the “DATA ENT” item on the Online menu; see Table 15-8.)

To tune Analog Outputs, select "SET AO" on the Data Entry menu. Select an AO to adjust.

Table 15-10 Tunable Analog Output Parameters

Prompt (Full name)	Range/Selections	Definition
DUSE (Drive Unit Sensitivity)	Adjust the value to the desired amount (between 80 and 100).	Applies to PP type AO only. This is a percentage value. This value should be set to the highest number which does not cause drive motor oscillation.
PA (Positioning Algorithm)	Select the algorithm type to be used: PP, DIAT, or AUTO.	Applies to PP type AO only. The PP and Auto algorithms require a feedback analog input. The selection of Auto allows normal PP feedback positioning of a drive motor when the feedback input is good, and defaults to DIAT operation if the slidewire feedback input fails. Use of Auto requires that the loop type be DIAT. The PP algorithm can be used with all other PID loop types.
MON and **MOFF** (Min On Time and Min Off Time)	Specify the minimum on/off times (0-30 seconds) for the output.	Applies to DAT type AO only. The output will be on or off for at least this long, even if the input source calls for less time.
IMPT (Impulse Time)	1 to 300 seconds.	Applies to DAT type AO only. Enter the cycle time for on and off time of the output. For example, a time of 150 seconds will cause the output to be on for 75 seconds and off for 75 seconds when the input source is at 50 %.
FSV (Failsafe Value)	Enter a number	Applies to CAT, VAT, and DAT types of AO only. The failsafe output is the initial output of the analog output on "cold start". If the Failsafe Value is set to OFF, the output will go to 0 on a "cold start" startup and when a failure occurs.

15.5 Reviewing Programming

Introduction

Use the "REVIEW" item on the Online menu to examine current programming settings without taking the controller offline. The settings cannot be edited in Online mode.

Viewing program settings

To review the current value of all function block parameters and other Program mode prompts, use the procedure in Table 15-11.

See Section 9 for descriptions of the prompts seen in Program mode.

ATTENTION

This feature can be disabled in Programming mode. If the instructions in this subsection do not work, see your process engineer.

Table 15-11 Procedure for Viewing Program Settings

Step	Action
1	Select “REVIEW” from the Online menu. “PRG AI”, the first item in the Program menu will be displayed.
2	Access all the prompts using standard navigation methods: press **ENTER** to select something, but instead of selecting it for edit, you are selecting it for viewing. Use the ▲ and ▼ keys to scroll through the lists.
3	Press **MENU** to exit to the menu or **DISPLAY** to go to primary displays.

16. Storing and Loading Configuration and Calibration

16.1 Introduction

Overview

The optional data storage interface feature lets you store controller configurations and calibrations on the PCMCIA card or load them from the card to the controller.

What's in this section?

The following topics are covered in this section.

16.2 Installing a PCMCIA Card

Introduction

The PCMCIA card (“memory card”) must be a DOS-formatted, SRAM card, up to 1 megabyte. Formatting may be done in the controller with Online mode “STORAGE” menu item “FMT MCRD” (see Section 17). **DO NOT FORMAT THE CARD WITH A PC; USE THE CONTROLLER.**

Maintaining a stock of several formatted cards is recommended to minimize maintenance time on the controller. The cards are battery supported memory devices and contain a write protect switch to secure stored data. Follow instructions supplied with the PCMCIA cards for battery maintenance.

ATTENTION

Before inserting or removing a card, be sure to discharge any static buildup on your body or clothing.

Table 16-1 shows the procedure for installing and removing memory cards.

Table 16-1 Memory Card Installation and Removal Procedure

Step	Action
1	Press the button on the underside of the bezel to release the latch. The latch will release easily if you press the bottom of the bezel back towards the panel to compress its gasket as you press the button.
2	Pull the bottom of the bezel outwards slightly away from the panel and then lift it gently up to fully open it as shown in Figure 16-1.
3	Insert the card into the slot until it catches in place.
4	To remove the card, press the rectangular button next to the slot.
5	To close the bezel, lower it until it is almost closed. Engage the top edge of the bezel first and then swing the bottom inward. Press the bottom in firmly until the latch clicks into place. Be careful to fully close the bezel, or the unit will not function normally.

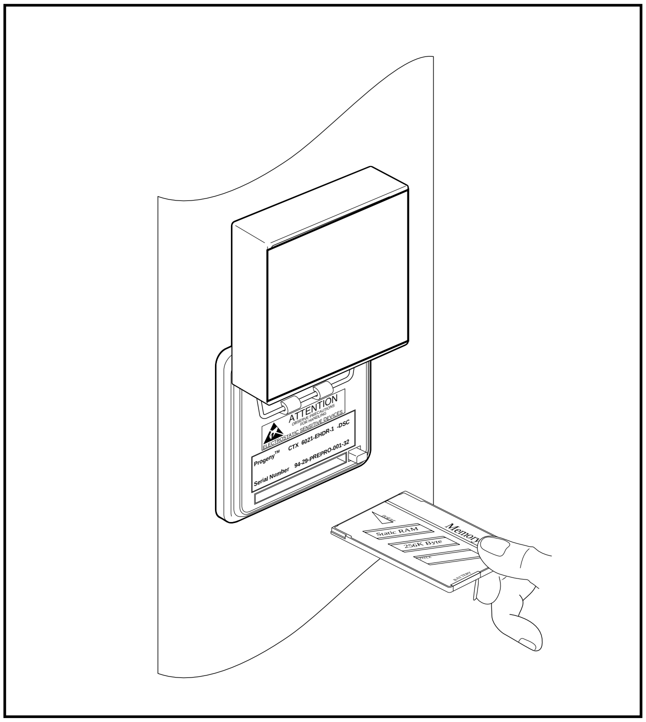


Figure 16-1 Inserting A Memory Card

16.3 Storing and Loading Configuration and Calibration

Introduction

Loading and storing configuration and calibration data are done in Program mode.

Select “CFG FILE” from the Program menu.

16.3.1 Storing to Card

Procedure

The procedure for storing configuration and/or calibration to a memory card is in Table 16-2.

Table 16-2 Procedure for Storing Configuration and/or Calibration

Step	Action
1	Insert a PCMCIA card into the controller.
2	Go to “CFG FILE” in the Program mode menu and press **ENTER.** The display will show “STORE CFG -> MOD”.
	To take this action (storing the configuration) press **ENTER.** The display will change to “STORE PROFIL01”.
3	To select a different name and number press the **DECREMENT** (▼) key. The display will change to “STORE CONFIG01”.
4	Press the ▼ key to scroll through the name choices. When the name string you want is displayed, press **ENTER.** The controller is now ready for you to change the number “01”, if desired.
5	To change the number press the ▼ key to scroll through the number from 01 to 99. When the number you want is displayed, press **ENTER.** This initiates the storing operation.
6	During the storing operation the display will read “FILE STORING”. When the display reads “STORE COMPLETE” you can press **MENU** to exit the function. Remove and label the card, or go on to Step 7 to store the calibration.
7	To store the calibration also, press **MENU** until “STORE CFG -> MOD” is again displayed, then press ▼. “STORE CAL -> MOD” will be displayed.
8	Press **ENTER** to select this function and the display will change to “STORE CALIB 01”.
9	Repeat Steps 3 through 6 to save the calibration to file.
10	Press **MENU** to exit the function.
11	Remove and label the card.

16.3.2 Loading from Card

Procedure

The procedure for loading configuration and/or calibration from a memory card to the controller is in Table 16-3.

Table 16-3 Procedure for Loading Configuration and/or Calibration

Step	Action
1	Clear the old configuration and/or calibration from the controller's memory using the "CLR CFG", "CLR CAL", or "CLR ALL" items from "DB SRVCE" (database services) in Maintenance mode as described in Section 19.
2	Once the memory is clear, put the card containing the configuration to be loaded into the controller.
3	Go to "CFG FILE" in the Program mode menu and press **ENTER.** The display will show "STORE CFG -> MOD".
4	Press the **DECREMENT** (▼) key to cycle down to "LOAD CFG -> UDC" and press **ENTER.** The display will change to show the name of the first file on the card. (Remember that the card can also contain setpoint profile files.)
5	To select a different file press the **DECREMENT** (▼) key until the desired file's name is displayed.
6	To initiate the load operation press **ENTER.**
7	During the storing operation the display will read "FILE LOADING". When the display reads "LOAD COMPLETE" you can press **MENU** to exit the function. Remove the card, or go on to Step 8 to load the calibration.
8	To load the calibration also, press **MENU** until "LOAD CFG -> UDC" is again displayed, then press ▼. "LOAD CAL -> UDC" will be displayed.
9	Press **ENTER** to select this function. The display will change to show the name of the first file on the card.
10	Repeat Steps 5 through 7 to load the calibration file.
11	Press **MENU** to exit the function.
12	Remove the card.

17. Storing Data

17.1 Introduction

Overview

The optional data storage interface enables you store process data, alarm, event, and diagnostic information on a portable PCMCIA card (Personal Computer Memory Card International Association) for later analysis and review.

Reviewing stored data requires Honeywell's SDA software on a PC. Reading the PCMCIA card requires a compatible card reader (available from Honeywell as P/N 089435).

What's in this section?

The following topics are covered in this section.

17.2 Data Storage Setup

Introduction

Data storage setup consists of specifying:

- what process data, alarm, event, and diagnostic information is to be saved
- in the case of batch data, specifying what will trigger data storage
- whether old data should be overwritten by new data

Definition of event

An event is a change to certain loop parameters, to the instrument operating mode, and to discrete inputs. Event storage consists of a complete log of events including the event title, time of occurrence, the status or value after the change, and the batch number, if batch storage is used. Table 17-1 shows the events that are stored.

Table 17-1 Events Storage

Event title	Event status/value
Setpoint choice	SP1, SP2
Control action	Forward, Reverse
Tuning Set	Set 1, Set 2
Instrument Mode	Online, Program, Maint
Control Mode	Auto, Manual, RMan
SPP	Start, Pause, Reset
Setpoint 1	SP1's value
Setpoint 2	SP2's value
Control Output	Loop's output value
Ratio Setpoint	Ratio setpoint value
Discrete Input	On, Off
AI/AO Calibration	Time, channel, type of calibration (25 mV, 75 mV, etc.)

Setting Up Data Storage

Data Storage setup is done Online to avoid interruption of current storage. All setup selections are found in the Online mode menu item STORAGE. See Table 17-2.

ATTENTION

Before inserting or removing a card, be sure to discharge any static buildup on your body or clothing.

Table 17-2 Data Storage Setup Procedure

Step	Action
1	Insert a formatted memory card in the card slot. If necessary, format card using FMT MCRD in the Storage menu. (Instructions for inserting a card are provided in Section 16.)
2	Go the "STORAGE" item in the Online menu.
2	Set STORAGE to ENABLE. No storage can occur if this is disabled, regardless of other settings.
3	Select DS SETUP to specify storage mode and other settings. See DS SETUP in this section. If you choose BATCH storage mode, the discrete parameter that will control start and stop of data storage must be defined. See BT SETUP in this section.
4	Select DS WARN to enter 0-99 %. When trend, alarm, or diagnostic storage reaches this % capacity the operator will be warned.
5	Select DS INIT, INITTYPE NEW to initialize the memory card with the settings from steps 3 and 4. Initialization activates storage and allots a file for each data type (trend, alarms, events, diagnostics). The filename extensions identify the file contents: FILENAME.EXT — Contents FILE01.LNT — Trend FILE01.LNA — Alarms FILE01.LNE — Events FILE01.LND — Diagnostics If you choose INITTYPE CURRENT, the card is initialized using the current setup (the setup from the last initialization), not the new setup. Typically the online operator will use INITTYPE CURRENT to continue the same storage settings onto a new card. **ATTENTION** Initialization deletes any data already on the card; therefore, you must press **ENTER** at the *SURE?* prompt to proceed. To cancel, press **MENU**.
6	Verify that the new setup is being stored by viewing the DS STATS menu. SETUP should indicate CURRENT. If NOT CRNT, an initialization error may have occurred; repeat the initialization. NOT CRNT means that a new setup is pending but is not in effect.

Specifying storage mode

Select DS SETUP (Data Storage Setup) to specify storage mode and other settings. DS SETUP provides access to a submenu to establish a data storage schedule of parameters, storage rates and response characteristics. Press **ENTER** to access the submenu, and when exiting, press **ENTER** at the SAVE? prompt to retain setup selections.

Table 17-3 describes the DS SETUP prompts.

Table 17-3 DS SETUP Prompts

Prompt (Full name)	Range/Selections	Definition
SET TRND (Set Trend)	See Table 17-4	Lets you store points that can be displayed graphically on a PC using Honeywell SDA software.
SET AED (Set Alarms, Events, Diagnostics)	See Table 17-5	Lets you store all alarms, events, and diagnostics.

Setting up trends

Table 17-4 describes the SET TRND prompts.

Table 17-4 SET TRND Prompts

Prompt (Full name)	Range/Selections	Definition
STRG MOD (Storage Mode)	CONT (Continuous). BATCH OFF	CONT (Continuous) storage becomes active immediately upon initialization. BATCH storage is controlled by discrete parameters defined under the BT SETUP menu. Batch data may started and stopped several times in a single file until the card is full. Batch start increments a batch number that is stored along with the data. The batch number may be used for data retrieval and analysis using SDA software. OFF means no trend storage will occur.
EXT ENAB (External Enable)	NONE PARM *(discrete)*	Use this item to enable/disable remote control of data storage through a discrete parameter. When this discrete is high (logic 1) storage is enabled; when low (logic 0) storage is disabled. This is a separate enable from the STORAGE ENABLE menu item.

Table 17-4 SET TRND Prompts

Prompt (Full name)	Range/Selections	Definition
ROLLOVER	ENABLE DISABL.	Rollover enabled causes new data to replace the oldest data when the file is full; old data will be lost. Rollover disabled causes storage to stop when the file becomes full; new data will be lost.
RATE	Seconds: .25, .5, 1 through 10, 20, 30, 40, 50 Minutes: 1 through 5, 10, 20, 30 Hours: 1	Select the storage rate for trend data storage schedule. A maximum of 3 points may be stored at the 0.25 second rate. The rate selected combined with the number of points will determine the length of time before the memory card becomes full. See Table 17-6 and Table 17-7 for sample storage capacities.
POINT1 - POINT 6	Enter up to 6 analog or discrete points to be stored in the Trend file.	Beware of programming changes made to collected points. For example, if you are storing CVn OV or CVn OS, and CVn itself gets reprogrammed to type NONE, then CVn OV and CVn OS will no longer be stored but will be replaced by dummy points SY1AX and SY1DX, respectively. Storage of the other points will continue.

Setting up storage of alarms, events, and diagnostics

Table 17-5 describes the SET AED prompts.

Table 17-5 SET AED Prompts

Prompt (Full name)	Range/Selections	Definition
STRG MOD (Storage Mode)	CONT (Continuous) BATCH OFF	CONT (Continuous) storage becomes active immediately upon initialization. BATCH storage is controlled by discrete parameters defined under the BT SETUP menu. Batch data may started and stopped several times in a single file until the card is full. Batch start increments a batch number that is stored along with the data. The batch number may be used for data retrieval and analysis using SDA software. OFF means no AED storage will occur.
EXT ENAB (External Enable)	NONE PARM *(discrete)*	Use this item to enable/disable remote control of data storage through a discrete parameter. When this discrete is high (logic 1) storage is enabled; when low (logic 0) storage is disabled. This is a separate enable from the STORAGE ENABLE menu item.
ROLLOVER	ENABLE DISABL.	Rollover enabled causes new data to replace the oldest data when the file is full; old data will be lost. Rollover disabled causes storage to stop when the file becomes full; new data will be lost.

Specifying the discrete to start and stop batch data collection

BT SETUP (Batch Setup) appears only if BATCH mode is selected as the storage mode for trends or alarms, events, and diagnostics. Select a discrete parameter (or none) that will start and stop storage in numbered batches. When this discrete is on (1), the batch number increments and storage begins. When off (0), storage stops and the batch ends.

ATTENTION

If no parameter is defined for BT SETUP, batch storage is controlled instead through the online STORAGE menu item BT CTRL. If a parameter is defined for BT SETUP, BT CTRL is disabled.

Memory card capacities for trend storage

The number of hours a single memory card can store trend data depends on:

a) the card type (256 K, 512 K, 1 Meg)

b) the number of points for which trend data is collected

c) the sample rate at which trend data is collected

d) whether or not the controller is configured to collect alarm, event, and diagnostic messages. When SET AED prompt STRG MOD is set to CONT or BATCH, space on the memory card is allocated for the storage of 100 alarms, 100 events, and 100 diagnostic messages. When STRG MOD is set to OFF, the entire memory card is allocated for storage of trend data.

Table 17-6 shows the trend storage capacity in hours for the combinations of (a), (b), and (c) when SET AED STRG MOD is set to CONT or BATCH.

Table 17-7 shows the trend storage capacity in hours for the combinations of (a), (b), and (c) when SET AED STRG MOD is set to OFF.

Table 17-6 Memory Card Capacities for Trend Data When AED Storage is Enabled

		256K card				
		Sample rate in seconds				
		1	10	20	30	60
		Storage capacity in hours				
Trend Data Number of points	1	4.67	46.70	93.40	140.10	281.20
	2	3.24	32.43	64.86	97.29	194.58
	3	2.46	24.65	49.29	73.94	147.88
	4	1.95	19.46	38.92	58.38	116.75
	5	1.69	16.86	33.73	50.59	101.18
	6	1.42	14.24	28.48	42.72	85.43

		512K card				
		Sample rate in seconds				
		1	10	20	30	60
		Storage capacity in hours				
Trend Data Number of points	1	9.75	97.50	195.00	292.50	585.00
	2	6.77	67.71	135.42	203.13	406.25
	3	5.15	51.46	102.92	154.38	308.75
	4	4.06	40.63	81.25	121.88	243.75
	5	3.52	35.21	70.42	105.63	211.25
	6	2.98	29.76	59.52	89.28	178.57

		1 Meg card				
		Sample rate in seconds				
		1	10	20	30	60
		Storage capacity in hours				
Trend Data Number of points	1	19.91	199.10	398.20	597.30	1194.60
	2	13.83	138.26	276.53	414.79	829.58
	3	10.51	105.08	210.16	315.24	630.48
	4	8.30	82.96	165.92	248.88	497.75
	5	7.19	71.90	143.79	215.69	431.38
	6	6.08	60.81	121.61	182.42	364.83

Table 17-7 Memory Card Capacities for Trend Data When AED Storage is Disabled

		256K card				
		Sample rate in seconds				
		1	10	20	30	60
		Storage capacity in hours				
Trend Data Number of points	1	4.94	49.40	98.80	148.20	296.40
	2	3.43	34.31	68.61	102.92	205.83
	3	2.61	26.07	52.14	78.22	156.43
	4	2.06	20.58	41.17	61.75	123.50
	5	1.78	17.84	35.68	53.52	107.03
	6	1.51	15.06	30.13	45.19	90.38

		512K card				
		Sample rate in seconds				
		1	10	20	30	60
		Storage capacity in hours				
Trend Data Number of points	1	10.02	100.20	200.40	300.60	601.20
	2	6.96	69.58	139.17	208.75	417.50
	3	5.29	52.88	105.77	158.65	317.30
	4	4.18	41.75	83.50	125.25	250.50
	5	3.62	36.18	72.37	108.55	217.10
	6	3.06	30.59	61.17	91.76	183.52

		1 Meg card				
		Sample rate in seconds				
		1	10	20	30	60
		Storage capacity in hours				
Trend Data Number of points	1	20.18	201.80	403.60	605.40	1210.80
	2	14.01	140.14	280.28	420.42	840.83
	3	10.65	106.51	213.01	319.52	639.03
	4	8.41	84.08	168.17	252.25	504.50
	5	7.29	72.87	145.74	218.62	437.23
	6	6.16	61.63	123.26	184.89	369.78

17.3 Data Storage Operation

Introduction

Here are some typical Data Storage operating tasks.

- Initializing a card.
- Starting and stopping storage (3 methods):
  - Start/stop all storage via STORAGE ENABLE/DISABLE menu.
  - Start/stop all storage via external enable discrete.
  - Start/stop storage batches via BT CTRL menu or via remote discrete.
- Checking status with DS STATS menu or BT NUMBER.
- Checking contents of the card.
- Reading data storage messages.

These tasks are described below.

Initializing a card

When replacing a card with a newly formatted or preused card, it is not necessary to reenter the schedule to continue data storage. Instead, select the online STORAGE menu, select DS INIT, then select INITTYPE CURRENT. The current schedule will be established on the new card, buffered data will be stored to the card, and if in batch mode, the batch counter will be reset to zero (0). **Any data previously on the card is deleted during initialization.**

To initialize a card using a new storage setup, see 16.2.

Initialization activates storage and allocates a file for each data type (trend, alarms, events, diagnostics). Filenames and extensions are as follows:

Trend Data:	FILE01.LNT
Alarms:	FILE01.LNA
Events:	FILE01.LNE
Diagnostics:	FILE01.LND

Starting and stopping storage

All applicable discretes and menus must be enabled for storage to be active. If any are disabled, no storage will occur. The following items enable/disable storage.

1. **STORAGE (Storage) -** Use to "ENABLE" or "DISABL" data storage. This command must be set to ENABLE to allow data storage as a background task. Once enabled, changing the setting to "DISABL" will stop storage of data. Storage and loading of Setpoint profiles and configuration will function with storage disabled.

2. **EXT ENAB (External Enable) -** Any discrete parameter specified here will control data storage in either continuous or batch modes. A high (logic 1) enables storage and a low (logic 0) disables storage. This item is found under DS SETUP.

3. **BT CTRL (Batch Control) or BT SETUP (Batch Setup) -** BT CTRL appears only if BATCH mode is selected. If BT SETUP is set to NONE, you must select BT CTRL items START and STOP to control batch data storage. START starts storage and increments the batch number. STOP is the default upon initialization and stops batch storage. If BT SETUP is defined with a discrete, BT CTRL displays (read-only) the status of that discrete (START or STOP) and the discrete parameter specified will start and stop storage in numbered batches. When the BT SETUP discrete is on (1), the batch number increments and storage begins. When off (0), storage stops and the batch ends. BT SETUP is found under DS SETUP.

Checking storage status

DS STATS (Data Storage Status) - Select this from the Online menu. Provides status information, depending on whether rollover is enabled or disabled. See Table 17-8 and Table 17-9 for definitions of prompts.

Table 17-8 Rollover Enabled Menu

Prompt (Full name)	Definition
STATUS	Running or stopped
TREND	Rollover (New data replaces older data)
ALARM	Rollover (New alarms replace older alarms)
EVENT	Rollover (New events replace older events)
DIAG	Rollover (New diagnostics replace older diagnostics)
SETUP	Indicates DS SETUP status CURRENT: Setup has not changed since last initialization NOT CURRENT: Setup has changed since last initialization.
SU CAP	Indicates the trend capacity, based on the storage rate and number of points being stored. Shown as follows. 00 00 00 Days Hours Minutes

Table 17-9 Rollover Disabled Menu

Prompt (Full name)	Definition
STATUS	Running or stopped
TREND	Indicates the time remaining for trend storage on the memory card. Based on the storage rate and number of points being stored. Shown as follows. 00 00 00 Days Hours Minutes
ALARM	Indicates the number of alarm records remaining before the memory card alarm file is full.
EVENT	Indicates the number of event records remaining before the memory card event file is full.
DIAG	Indicates the number of diagnostic records remaining before the memory card diagnostic file is full.
SETUP	Indicates DS SETUP status CURRENT: Setup has not changed since last initialization NOT CURRENT: Setup has changed since last initialization.
SU CAP	Indicates the trend capacity, based on the storage rate and number of points being stored. Shown as follows. 00 00 00 Days Hours Minutes

Checking batch number

BT NUMBER (Batch Number) - This item appears only if BATCH mode is selected. Shows the number of the current batch being stored. The number may be used later with the SDA software to locate data.

Checking card contents

DS FILES (Data Storage Files) - Provides a directory of the files on the memory card. The directory may be used to review any data file type, including configuration and profiles. Press **ENTER** to select DIR. Use **DECREMENT** (▼) and **INCREMENT** (▲) to see all files.

Data storage messages

The following messages may appear during data storage operation. Pressing any button will clear the message.

Table 17-10 Data Storage Messages

Message	Meaning
MCARD NOT CURNT	When the memory card is initialized, the controller marks it as the "current" card. The controller will only store data to the "current" card. If any other card is used, this message will appear.
BEZEL OPEN	The front bezel of the controller is open. When the bezel is open, data will be buffered in controller memory until the buffer capacity is exceeded. Data is stored to the memory card only when the bezel is closed and latched.
MEM CARD WARNING	Available space on the memory card has reached the programmed warning limit. When active, the SY1 SW system parameter output status will be high (Logic 1) which may be used to trigger a discrete output.
MEM CARD FULL	Memory card is full. Data will continue to be buffered to the limit of the buffer capacity. When active, the SY1 SF system parameter output status will be high (Logic 1) which may be used to trigger a discrete output.
INITIALIZING	Initialization is in progress. Disappears when initialization is complete.
INIT FAILED	Initialization failed. Possible reasons for failure are: 1. The memory card was not formatted. 2. The memory card is write-protected. 3. The memory card is defective.
MEMCARD MISSING	Storage schedule is initialized and the memory card is missing. Disappears when the proper card is inserted.
WRITE-PROTECTED	Storage schedule is active and the memory card is write protected. Disappears when writing to the card is enabled.
STORAGE FULL	Buffer memory for data storage in the controller is full.
DATA-STRG ERROR	Storage has found an error not mentioned above.
BATTERY LOW	The memory card battery is low and should be replaced.
BATTERY DEAD	The memory card battery is dead. To avoid losing the card’s data, replace the battery while the card is still inside the controller.
UPDATING MEM CARD	Controller is flushing all buffered data to the memory card.
CHECKING MEM CARD	The front panel has been opened and closed and the controller is checking for a properly installed memory card.

18. Setting Up for Serial Communications

18.1 Introduction

Overview

Serial communications capability is an optional feature that enables the controller to exchange data with a host device (a PC running Honeywell or other compatible software) on an RS422/485 data link. Using a proprietary Honeywell protocol or Modbus RTU, this link can be used to transfer configurations and data.

To see if your controller is capable of performing serial communications, compare the model number on the instrument tag with the model selection guide in Section 2.

If the controller will use serial communications, the unit must be programmed as described in this section.

In addition, the last instrument in the data link must be terminated. This is also described in this section. (Wiring the controller to the data link is discussed in Section 4.)

What's in this section?

The following topics are covered in this section.

18.2 Programming Serial Communications

Introduction

To program communications, select "SER COMM" from the main Program Menu.

Serial Communication prompts

Table 18-1 lists the Serial Communications prompts.

Table 18-1 Serial Communications Prompts

Prompt (Full name)	Range/Selections	Definition
UNITADDR (Unit Address)	*range is 1 to 254*	**Unit Address -** Enter the unit's address. **Each address on the link must be unique.**
PROTOCOL	BINARY MODBUS	**Protocol –** Select the protocol. If the controller is being added to a link containing older Honeywell and/or Leeds&Northrup instruments, BINARY is probably the correct choice.
BAUDRATE	19200 9600 4800 2400 1200 76800 38400	**Baud Rate –** Select the rate of data transfer. **All equipment on the link must be set to match the host setting.**
PARITY	NONE ODD EVEN	**Parity –** Select the parity used, if any. **All equipment on the link must be set to match the host setting.**
BYTE ORDER	FP B FP BB FP L FP LB	Appears for Modbus protocol only. Example Decimal number 25.38 | Floating point number | | Register 1 | Register 2 | Choice Byte Order Result for 25.38 FP_B 0123 41 CB 0A 3D FP BB 1032 CB 41 3D 0A FP_L 3210 3D 0A CB 41 FP LB 2301 0A 3D 41 CB
DL LKOUT (Download Lockout)	NO YES	**Download Lockout –** Set to YES to prevent configuration from being downloaded from a PC running Honeywell SCF software.

18.3 Setting the Communications Link Termination Jumper

Introduction

In order for data transfer to be successful the last unit in the communications link (see Figure 4-11) must be terminated and all other slave units in the link must be unterminated.

Units are shipped from the factory set for unterminated operation. To change the termination setting of the last unit on the link, follow this procedure in this sub-section.

WARNING

This procedure should be performed by qualified personnel only.

It is not necessary to remove power before using the button below the front panel to release the bezel latch, nor before lifting the bezel out of the way (on its bail linkages) to access the PCMCIA card used to store data.

However, disconnect power before using a tool to open the latches on the plate uncovered when the bezel is lifted out of the way. Opening these latches provides access to the instrument assembly which slides out of the case. A potentially lethal shock hazard exists if the instrument assembly is accessed while powered. More than one switch may be required to disconnect power.

ATTENTION

This equipment contains devices that can be damaged by electrostatic discharge (ESD). As solid state technology advances and as solid state devices get smaller and smaller, they become increasingly sensitive to ESD. The damage incurred may not cause the device to fail completely, but may cause early failure. Therefore, it is imperative that assemblies containing static sensitive devices be carried in conductive plastic bags. When adjusting or performing any work on such assemblies, grounded work stations and wrist straps must be used. If soldering irons are used, they must also be grounded.

A grounded work station is any conductive or metallic surface connected to an earth ground, such as a water pipe, with a ½ to 1 megohm resistor in series with the ground connection. The purpose of the resistor is to current limit an electrostatic discharge and to prevent any shock hazard to the operator. The steps indicated above must be followed to prevent damage and/or degradation, which may be induced by ESD, to static sensitive devices.

Procedure

The procedure for terminating the controller is provided in Table 18-2.

Table 18-2 Termination Procedure

Step	Action
1	Turn off power to the controller. **More than one switch may be required to remove power.**
2	**With the power off** access the instrument assembly: • Open the front of the controller by pressing the button under the bezel to release the latch, and then pulling the bezel forward and up. (The bezel is mounted on bails.) If you press the bottom of the bezel toward the back of the instrument to compress the gasket slightly, the latch will open easily. • When the bezel is lifted out of the way, a plate is uncovered. A latch on either side of the label on this plate holds the instrument assembly in the case. • To release these latches, insert a screwdriver tip next to the lever on the right side and gently pry the lever to the left while pulling gently on the right side of the bail linkage (see Figure 18-1). Repeat on the left latch, then using the bail as a handle, gently slide the entire card cage assembly forward.
3	The assembly will strike a stop when it is almost all the way out. Lift the back end of the card cage to clear the stop, then the entire assembly can be removed. There are no cables to be disconnected.
4	When present, the serial communications card (p/n 046925) is in Slot 1 (on the right side when facing the case). See Figure 18-2. To terminate a controller, jumpers W2 and W3 must both be set to the 1-2 position. To remain unterminated, jumpers W2 and W3 must be in the 2-3 position.
5	After setting the jumpers, put the rear of the card cage assembly into the case.
6	Press the instrument assembly back to fully engage the rear card edge connectors. When the assembly is correctly positioned the two latches will snap into place.
7	Pull on the bail to verify that the assembly is fully seated and firmly latched, then swing the bezel down into position.
8	Engage the top edge of the bezel first, then swing in the bottom and press in until the button latch snaps into place.
9	**Do not power up the unit until the instrument assembly has been replaced and the assembly latches are firmly hooked.**

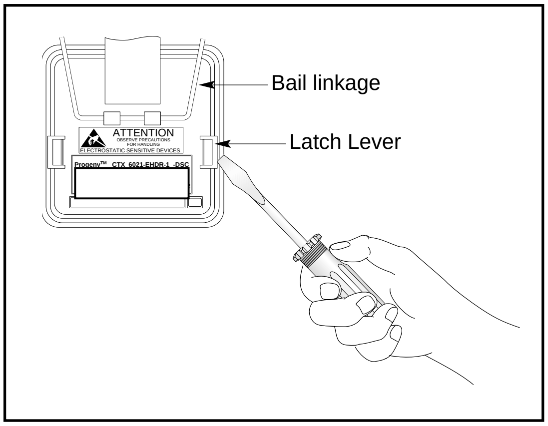


Figure 18-1 Releasing Latch Levers

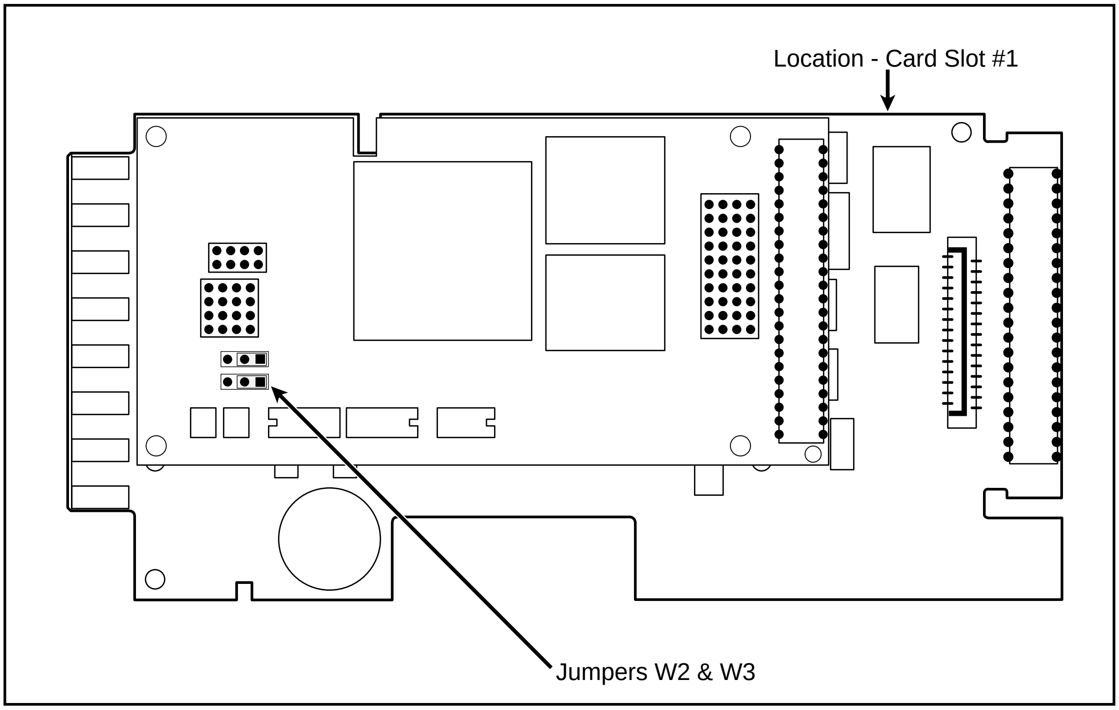


Figure 18-2 Location Of Termination Jumpers W2 And W3

19. Using Maintenance Mode

19.1 Introduction

Overview

Maintenance mode functions are available for:

- calibrating analog inputs and outputs
- running diagnostics
- clearing configuration and calibration
- resetting the unit
- specifying the frequency of the AC power at the site
- performing full or partial upgrade of optional features
- displaying firmware version information
- specifying the power-off period that will trigger a “cold start”

ATTENTION

Maintenance mode is an offline mode. All outputs will be frozen while in Maintenance mode, and data storage will stop until the controller is returned to Online mode.

ATTENTION

All prompts and selections in this section are listed as shown when the controller’s language is set to English. Other languages are available as described in Section 9.

What’s in this section?

The following topics are covered in this section.

19.2 Calibrating Analog Inputs

Introduction

Periodic calibration of the inputs is recommended to ensure conformity to the specifications. Calibration of new controllers is not necessary; however, field calibration may optimize accuracy if proper eqiupment is used.

WARNING

This procedure should be performed by qualified personnel only. Disconnect power to all terminals before connecting or disconnecting calibration leads. A potentially lethal voltage is present on the mains terminals and may be present on other terminals. More than one switch may be required to disconnect power.

Select CALIB AI from the Maintenance Menu. Select an AI to calibrate. **Calibrating one analog input results in all analog inputs being calibrated.**

19.2.1 Calibrating for EMF or Thermocouple Inputs

Materials required

To calibrate the inputs you will need:

- a screwdriver to fit the terminal blocks on the rear of the controller
- an adjustable precision 25 mV-to-5 V voltage source

Procedure

The procedure for calibrating inputs used for EMF or thermocouple inputs is provided in Table 19-1

Table 19-1 Analog Input Calibration Procedure for EMP or Thermocouple Inputs

Step	Action
1	Disconnect power to all terminals. **More than one switch may be required to remove power.**
2	**With the power off** connect the adjustable voltage source to the terminals of the input to be calibrated. **Calibrating one analog input results in all in analog inputs being calibrated.**
3	**Power up the unit.**
4	Go into Maintenance mode and scroll to the "CALIB AI" prompt. Press **ENTER.**
s5	Select the input to be calibrated and press **ENTER**. "CAL 25MV" will be displayed.
6	Adjust the voltage source to supply 25 mV, then press **ENTER** on the controller. The message "CALIB IN PROG" will be displayed. If the calibration is successful, the Maintenance menu item "CAL*nn"* will be displayed. If the calibration fails because the required adjustment exceeds the acceptable range, the message "CALIB FAIL" will be displayed.
7	Press the **DECREMENT** key to display "CAL 75MV" and repeat Step 6.
8	Continue to calibrate at 1 V and 5 V. (After the "CAL 5V" prompt the next prompt is "CAL 100"; this is for RTD input calibration as described in 19.2.2.)
9	**When calibration of the input is complete, power down the controller and the voltage source before disconnecting the test leads. Restore the field wiring to the calibrated input with all power removed.**

19.2.2 Calibrating RTD Inputs

Materials required

To calibrate the inputs you will need:

- a screwdriver to fit the terminal blocks on the rear of the controller
- a precision variable resistor

Procedure

The procedure for calibrating inputs used for RTD inputs is provided in Table 19-2.

Table 19-2 Analog Input Calibration Procedure for RTD Inputs

Step	Action
1	Disconnect power to all terminals. **More than one switch may be required to remove power.**
2	**With the power off** connect the precision variable resistor to the terminals of the input to be calibrated. **Calibrating one analog input results in all in analog inputs being calibrated.**
3	**Power up the unit.**
4	Go into Maintenance mode and scroll to the "CALIB AI" prompt. Press **ENTER.**
5	Select the input to be calibrated and press **ENTER**. "CAL 25MV" will be displayed.
6	Scroll down to the prompt "CAL 100".
7	Set the resistor to 100 ohms, then press **ENTER** on the controller. The message "CALIB IN PROG" will be displayed while the RTD low range calibration is accomplished. If the calibration is successful, the Maintenance menu item "CAL*nn"* will be displayed. If the calibration fails because the required adjustment exceeds the acceptable range, the message "CALIB FAIL" will be displayed.
8	Press the **DECREMENT** key to display "CAL 500" and repeat Step 7.
9	**When calibration of the input is complete, power down the controller before disconnecting the test leads. Restore the field wiring to the calibrated input with all power removed.**

19.3 Calibrating Analog Outputs

Introduction

Periodic calibration of the outputs is recommended to ensure conformity to the specifications. Except in the case of Position Proportioning output (see Section 10), calibration of outputs in new controllers is not necessary; however, field calibration may optimize accuracy if proper eqiupment is used.

WARNING

This procedure should be performed by qualified personnel only. Disconnect power to all terminals before connecting or disconnecting calibration leads. A potentially lethal voltage is present on the mains terminals and may be present on other terminals. More than one switch may be required to disconnect power.

Select CALIB AO from the Maintenance Menu. Select an AI to calibrate.

Materials required

To calibrate the output you will need:

- a screwdriver to fit the terminal blocks on the rear of the controller
- for VAT outputs: a precision voltmeter
- for CAT outputs: a precision milliammeter or a precision resistor and voltmeter

ATTENTION

If you are calibrating an analog output that was changed from a CAT to VAT (or vice versa) as described in Section 20, put the controller online for several seconds before calibrating.

Procedure

The procedure for calibrating outputs in Table 19-3.

Table 19-3 Analog Output Calibration Procedure

Step	Action
1	Disconnect power to all terminals. **More than one switch may be required to remove power.**
2	**With the power off** connect the meter to the terminals of the output to be calibrated.
3	**Power up the unit.**
4	Go into Maintenance mode and scroll to the “CALIB AO” prompt. Press **ENTER.**
5	Select the input to be calibrated and press **ENTER**. “CALIB Ao*n* LOW” will be displayed.
6	The meter will read approximately 4 mA (CAT) or 1 V (VAT). Press **ENTER**. The display will show “ENTER WHEN SET”.
7	Use the **INCREMENT** (▲) and **DECREMENT** (▼) keys to adjust the output until the meter reads the correct low value. Press **ENTER** to store the calibration.
8	Scroll down to “CALIB Ao*n* HIGH” and follow the same procedure. The meter should read 20 mA (CAT) or 5 V (VAT).
9	**When calibration of the output is complete, power down the controller before disconnecting the test leads**. Move the meter to another output if desired and repeat the procedure**. Restore the field wiring to the calibrated output with all power removed.**

19.4 Running Diagnostics

Introduction

Select RUN DIAG to test any of these areas:

TEST DISPLAY - Select this to test all display characters. Any failed display items should be apparent.

TEST KEYPAD - Select this to verify operation of each key. When each key is pressed, its name should be displayed (except **MENU** which terminates the keypad test).

TEST RAM SIZE - Shows amount of RAM. If less than 384KB, replace the CPU**.**

TEST MEM CARD - Select this to verify read/write PCMCIA card function. This test destroys all card data, so use an appropriate card. You can use an unformatted card.

TEST FACTORY- *This test is used only at the factory*.

19.5 Database Services: Clearing Configuration and Calibration, and Upgrading Optional Features

Introduction

When "DB SRVCE" is selected from the Maintenance menu, a submenu is accessible. It contains the following items:

CLR CFG - Clears only configuration, excluding profiles; factory default values are assigned to all parameters.

CALIB - Clears only controller calibration.

ALL - Clears all controller memory; factory default values are assigned to all parameters.

FULL UPGRADE – *If you purchase an upgrade, instructions for using this item will be included in the kit.*

INCREMENTAL UPGRADE – *If you purchase an upgrade, instructions for using this item will be included in the kit.*

19.6 Resetting the Unit

Description

To restart the instrument to recognize changes to Scan Frequency or Mains Frequency, select "RST UNIT" from the Maintenance menu. This function does ***not*** clear memory.

19.7 Specifying the AC Power Frequency

Description

To specify either 50 Hz or 60 Hz, select “MAIN FRQ” from the Maintenance menu. Afterward you must select “RST UNIT” to activate this change.

19.8 Displaying Firmware Version Information

Description

When “PROD ID” is selected from the Maintenance menu the firmware part number and version will be displayed.

19.9 Specifying the Power-Off Period for “Warm Start”

Introduction

The behavior of the controller when recovering from a short-term power failure is different than that following a long-term power failure. After a short power failure the controller will resume operations using process values retained from before the power failure. This is referred to as a “warm start”.

However, after a longer power failure all buffers (storage and display) are cleared, accumulated values of interval timers and totalizers are reset to initial values, the loop auto/manual and setpoint1/setpoint2 statuses are retained, and the loop output is set to zero (0) unless configured to use a Failsafe value for the analog output.

You must specify the length of time that is the maximum for which the process can safely resume at pre-power loss conditions. The Maintenance menu contains the item “WS TIME” for this purpose.

- Any interruption of power less than or equal to this time will result in a warm start when power is restored.
- Any interruption of power greater than this time will result in a cold start when power is restored.

Choices

The “warm start” time choices are:

- NONE: Always executes cold start
- Minutes: 1 through 5, 10, 15, 20, 30, 60, 90
- Seconds: 5, 10, 20, 30

20. Changing the CAT/VAT Switch Settings

20.1 Introduction

Overview

When the controller is shipped from the factory, analog output 1 (AO 1) is always a current output. Whether the second (optional) analog output provides a current output or a voltage output depends on the model selected (see Section 2). However, analog outputs can be converted from current to voltage output (or vice versa) using the procedure in this section to change DIP switch settings on printed circuit cards in the controller.

What's in this section?

The following topics are covered in this section.

20.2 Settings for Current or Voltage Output

Introduction

The setting on switchbank S1 on the printed circuit cards providing analog outputs determines whether those outputs will be current or voltage. Either can be used as the output of a control loop.

When two relays are used to provide position proportioning output, a VAT output is used to provide a constant 1 V to power the required slidewire feedback.

Switch settings

Table 20-1 shows the switch settings needed to select current or voltage output.

Table 20-1 S1 DIP Switch Settings

	S1-1	S1-2	S1-3	S1-4
CAT	OFF	OFF	ON	ON
VAT	ON	ON	OFF	OFF

20.3 Setting the Switches

Introduction

Read the warning and other information on this page before changing the switch settings for an analog input.

WARNING

This procedure should be performed by qualified personnel only.

It is not necessary to remove power before using the button below the front panel to release the bezel latch, nor before lifting the bezel out of the way (on its bail linkages) to access the PCMCIA card used to store data.

However, disconnect power before using a tool to open the latches on the plate uncovered when the bezel is lifted out of the way. Opening these latches provides access to the instrument assembly which slides out of the case. A potentially lethal shock hazard exists if the instrument assembly is accessed while powered. More than one switch may be required to disconnect power.

ATTENTION

This equipment contains devices that can be damaged by electrostatic discharge (ESD). As solid state technology advances and as solid state devices get smaller, they become increasingly sensitive to ESD. The damage incurred may not cause the device to fail completely, but may cause early failure. Therefore, it is imperative that assemblies containing static sensitive devices be carried in conductive plastic bags. When adjusting or performing any work on such assemblies, grounded work stations and wrist straps must be used. If soldering irons are used, they must also be grounded.

A grounded work station is any conductive or metallic surface connected to an earth ground, such as a water pipe, with a ½ to 1 megohm resistor in series with the ground connection. The purpose of the resistor is to current limit an electrostatic discharge and to prevent any shock hazard to the operator. The steps indicated above must be followed to prevent damage and/or degradation, which may be induced by ESD, to static sensitive devices.

ATTENTION

After changing an S1 DIP switch's settings, make sure you put the controller in online mode for at least several seconds before you calibrate the analog output.

Procedure

The procedure for accessing the DIP switches is provided in Table 20-2.

Table 20-2 Procedure for Accessing the DIP Switches

Step	Action
1	Turn off power to the controller. **More than one switch may be required to remove power.**
2	**With the power off** access the instrument assembly: • Open the front of the controller by pressing the button under the bezel to release the latch, and then pulling the bezel forward and up. (The bezel is mounted on bails.) If you press the bottom of the bezel toward the back of the instrument to compress the gasket slightly, the latch will open easily. • When the bezel is lifted out of the way, a plate is uncovered. A latch on either side of the label on this plate holds the instrument assembly in the case. • To release these latches, insert a screwdriver tip next to the lever on the right side and gently pry the lever to the left while pulling gently on the right side of the bail linkage (see Figure 20-1). Repeat on the left latch, then using the bail as a handle, gently slide the entire card cage assembly forward.
3	The assembly will strike a stop when it is almost all the way out. Lift the back end of the card cage to clear the stop, then the entire assembly can be removed. There are no cables to be disconnected.
4	The card in Slot 1 (on the right side when facing the controller) contains the S1 DIP switchbank for AO1. See Figure 20-2 for switch locations. If the controller supports optional AO2, the circuit card in slot 3 (counting from the right when facing the controller) contains the S1 DIP switch for AO 2. Not all models contain this card. Some contain a 2DI/1DO card in slot 3. **The ON position is toward the top edge of the card.**
5	After setting the switches, put the rear of the card cage assembly into the case.
6	Press the instrument assembly back to fully engage the rear card edge connectors. When the assembly is correctly positioned the two latches will snap into place.
7	Pull on the bail to verify that the assembly is fully seated and firmly latched, then swing the bezel down into position.
8	Engage the top edge of the bezel first, then swing in the bottom and press in until the button latch snaps into place.
9	**Do not power up the unit until the instrument assembly has been replaced and the assembly latches are firmly hooked.**

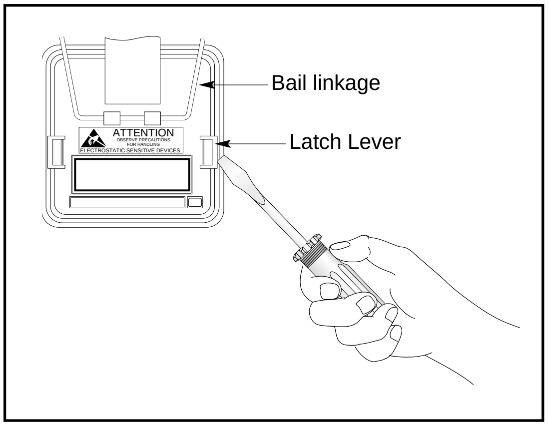


Figure 20-1 Releasing Latch Levers

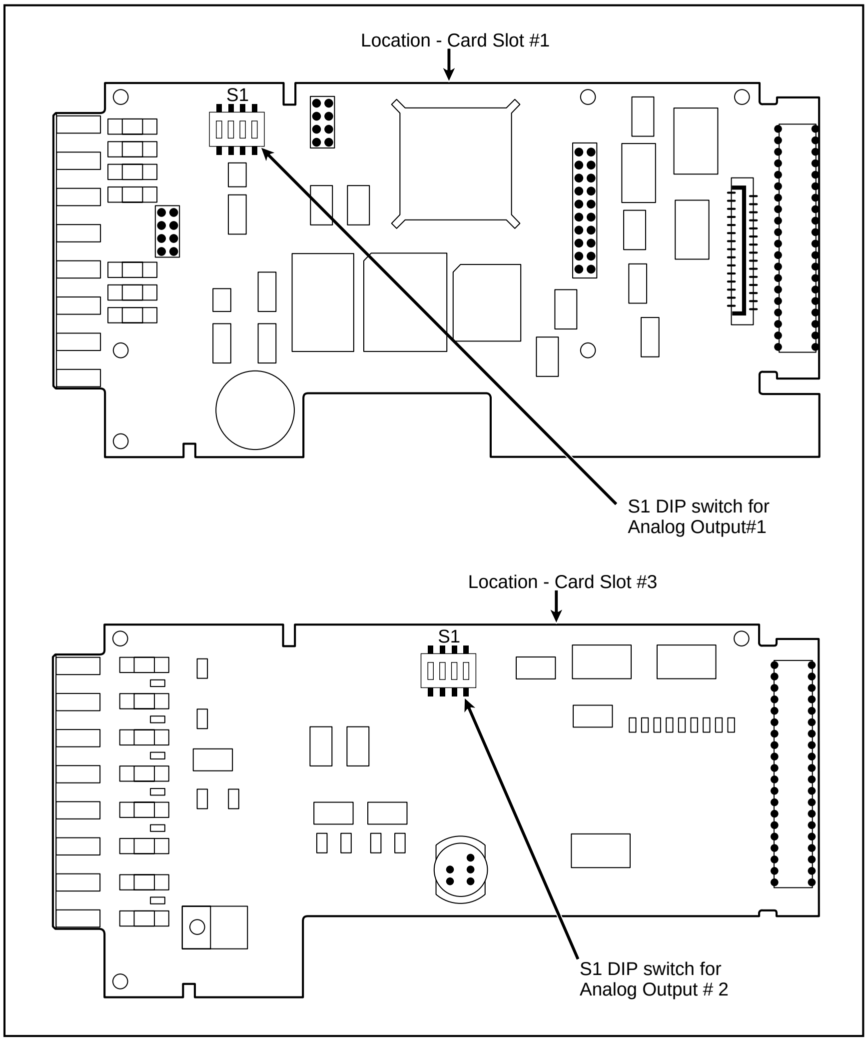


Figure 20-2 Location Of S1 Switches

21. Messages

21.1 Overview

This section provides information about system messages.

Messages relating to data storage are listed in Section 17.

What's in this section?

The following topics are covered in this section.

21.2 Diagnostic Messages

Introduction

The controller executes diagnostic routines during instrument start-up and during maintenance procedures such as calibration. It also monitors online operation for both process faults and controller errors.

Diagnostic messages

Table 21-1 shows messages that may appear on the controller displays if a diagnostic condition is detected, along with the action you should take.

Table 21-1 Diagnostic Messages

Message	Description	User action
INPUT FAILURE*nn* *(Other results of input problems are described on the next page.)*	1) Number *nn* analog input wiring to instrument has opened or shorted. 2) The analog inputs have been exposed to electromagnetic noise. 3) The electrical signals to the instrument's analog inputs have gone above or below the input's measurable range. (The measurable range will be determined by the input's "gain setting".)	1) Check input devices for open or short. 2) Shield the inputs. 3) See Note 1 below. Instructions for clearing the message are provided on the next page.
FLOAT PT ERROR	A floating point calculation error has occurred. (divide by zero, underflow, overflow).	Check Free Form Math and Math CV inputs for division by 0. Also check for input values producing a underflow or overflow error (that is, calculation is not between $-1x10^{-38}$ and $-3x10^{38}$ or not between $1x10^{-38}$ and $3x10^{38}$).
CHECKSUM ERROR	An error was detected in the database of one or more function blocks. The affected function blocks are reset to their defaults.	Inspect entire instrument configuration and reconfigure as needed.
SLIDEWIRE FAIL	The PP slidewire feedback failed.	Cycle the controller Auto to Manual and Manual to Auto. If failure continues, check the integrity of slidewire input.

Note 1: When an analog input has been programmed for a particular input type and/or electrical range, a specific "gain setting" is applied to the signal within the controller. This gain setting is part of the signal conditioning used to prepare the measurement for the control algorithms. There are four gain settings as indicated in the table below. Each is expressed in terms of voltage units. The gain setting is automatically selected by the controller to cover the high and low limits established by the input span configuration. The table below indicates the electrical signal span that each gain setting will accommodate.

When the gain setting is…	the lowest measurable signal will be…	the highest measurable signal will be…
25 mV	-30 mV	30 mV
75 mV	-90 mV	90 mV
1 V	-200 mV	1200 mV
5 V	-300 mV	5200 mV

Example: An analog input is configured to accept a 1 V to 5 V signal. Its gain setting will be 5 V. With this setting, if the input signal ever falls below –300 mV or goes above 5.2 V, and **INPUT FAILURE** diagnostic message will be displayed.

Clearing the INPUT FAILURE message

To clear the **INPUT FAILURE** message from the display, press the **MENU** key. If you do not press the **MENU** key, the controller will stop showing the message after it has scrolled across the display twice.

Once the message is no longer displayed, it will still be listed in the summary of diagnostics, but it will no longer be present in the online displays.

To delete the **INPUT FAILURE** message from the summary of diagnostics, go to the Online menu and select **SUMMARIES,** then select **DEL DIAG.**

What to do if transmitter out of range condition is normal

If a transmitter out of range condition is normal for your application and the latched diagnostic is undesirable, clamp the input value at the range limits, preventing the input diagnostic failure. To do this, go the Programming mode and select the input’s AI block. In response to the “CLMP” prompt select “LO RNG” to limit underrange input, “HI RNG” to limit overrange input, or “RANGE” to limit both overrange and underrange input values.

Other results of input problems

During power-up, if an analog input is open or is out of range, the setpoint and process variable values will display OFF and the loop's AUTO mode is disabled. Check connections to determine problem. During calibration if the input reference voltages supplied by the technician are outside acceptable limits a **CALIB FAIL** message will be generated.

Internal fault messages

In addition to diagnostic messages, internal fault messages are presented to indicate a hardware problem. Table 21-2 lists the probable circuit card associated with error condition.

Table 21-2 Internal Fault Messages

Diagnostic	Meaning	Suspected Hardware
NONV-RAM ERROR	EEPROM Problem	CPU
PROCESSOR EXCEP	Processor Exception	CPU
PROCESSOR RESET	Processor Reset	CPU
TASK INIT FAIL	Task Initialization Failure	CPU
QUEUE READ FAIL	Queue Read Failure	CPU
RESPONSE FAIL	Response Failure	CPU
REQUEST FAIL	Request Failure	CPU
AED REPORT FAIL	AED Report Failure	CPU
HANDSHAKE FAIL	AED Handshake Failure	CPU
AI TASK OVERRUN	Analog Input Task Overrun	AI
FB TASK OVERRUN	Function Block Task Overrun	CPU
SLOT CARD FAIL	Slot Card Failure	AI, CPU, PS, MEM
STORAGE FAILURE	Storage Failure	MEM, CPU
DS STATUS LOST	Data Storage Status Lost	CPU
RJ FAILURE	Reference Junction Failure	RJ, AI, CPU
CLOCK FAILURE	Clock Failure	CPU
CLOCK RESET	Clock Reset	CPU
TIMING ERROR	Timing Error	CPU

21.3 Loop Error Indicators

Introduction

When a loop's PV, SP2, or other parameter fails, the loop switches to its default/failsafe condition, indicated by certain display symbols flashing. To return the loop to its desired condition, correct the failure. Then, if the loop's LBAD latching (under LP SETUP) is NO, the loop will return to normal automatically. If latching is YES, also perform the action needed to return the loop to normal.

Table 21-3 Abnormal Loop Conditions and Indicators

Desired Condition	Abnormal Condition	Default condition (Failsafe)	Flashing symbols	Action needed (if LBAD = YES)
Auto & SP2	SP2 Failure	Working SP=SP1	SP2	Select SP1 then SP2
Manual & SP2	SP2 Failure	Working SP=SP1	SP2	Select SP1 then SP2
Auto & SP2	SP2 & PV Failure	Working SP=SP1 Mode = Suspend Auto* Output = Failsafe	SP2 MAN PV value	Select SP1 then SP2 Select Manual then Auto
Manual & SP2	SP2 & PV Failure	Working SP = SP1 Mode = Manual Output = Last value	SP2 PV value	Select SP1 then SP2
Auto & SP1/SP2	PV Failure or RMAN Failure or OTRK Failure or FFIN Failure	Mode = Suspend Auto* Output = Failsafe	MAN	Select Manual then Auto
Manual & SP1/SP2	PV Failure	Mode = Manual Output = Last Value	PV value	None required
Auto & SP1/SP2	see below**	Mode = Suspend Auto* Output = Back Calc. Value	MAN	None required
Auto & SP1/SP2	Force Remote Manual	Mode = Suspend Auto* Output = Tracking value	A	None required

*Due to the abnormal condition the loop cannot be in Auto and therefore is in a temporary mode which forces the output as indicated.

** Status from a downstream function block indicates that there is no path to final output element. For example, the secondary control loop of cascade configuration was changed to manual mode.

21.4 Error Messages

Introduction

Sometimes errors occur while you are programming or operating your controller. In most cases the controller displays a descriptive error message. For example, if you try to program a function block incorrectly, the controller tells you the problem.

ATTENTION

Displayed messages (such as error messages displayed after a factory configuration is loaded) can be followed by a number. **That number is not an error code number.** The number identifies the line in the file where the error occurred.

Table 21-4 lists these error messages alphabetically, along with a description of each one and what action to take.

Table 21-4 Error Messages

Error	Description	User Action
Channel Does Not Exist	A channel was loaded that does not exist. For example, you loaded AI3, but your unit is only equipped with AI1.	Re-program or re-load correctly.
Circuit Limits Equal	Indirect circuit low/circuit high limits must be unequal.	Change to unequal limits.
Condition Type Out of Range	Internal Error	No user action
Database Checksum Error	Occurs during software upgrade.	Restore configuration.
Deviation Limit Must be Positive	Setpoint Profiler Deviation Low Limit and Deviation High Limit must be positive.	Change limit.
Drive Unit Speed Less than or Equal to 0	For PP type analog outputs, the drive unit speed should be greater than 0.	Increase drive unit speed to greater than 0.
High Limit Outside of circuit	AI circuit high limit is > voltage limit of 5200 mV.	Change limit to within specified limits for that type (Table 9-3)
High Output Limit Greater than 20	A CAT high output limit cannot be greater than 20	Change high limit
High Output Limit Greater Than 5	A VAT high output limit must not be greater than 5	Change high limit
Hysteresis Less Than Zero	Alarm Hysteresis parameter should be greater than or equal to zero.	Change Hysteresis.

Error	Description	User Action
Impulse Time less than or Equal to 0	Impulse time on a DAT output cannot be less than or equal to zero.	Change DAT impulse time
Incompatible Curve Type	AI is custom type, thermocouple class, reference junction enabled but Y values are not always increasing or not always decreasing.	Reprogram curve so that for all n: $Y_n > Y_{n+1}$ or $Y_n < Y_{n+1}$
Incorrect Number of Parameters for function	The function was not programmed with the minimum number of parameters. For example, the Math CV requires at least 2 inputs to function properly.	Program function with at least the minimum number of parameters.
Incorrect Input coordinates	The Advanced Splitter CV was programmed with input limits for Output 2 (A2) only, or for Output 1 & 3 (A1 & A3) only, or for Output 3 (A3) only.	Re-program input limits for Output 1 only, Outputs 1 & 2, or Outputs 1, 2, & 3.
Incorrect Output Coordinates	The Advanced Splitter CV was programmed with output limits for Output 2 (A2) only, or for Output 1 & 3 (A1 & A3) only, or for Output 3 (A3) only.	Re-program output limits for Output 1 only, Outputs 1 & 2, or Outputs 1, 2, & 3.
Invalid Type in Point Spec	A class of block was detected that is invalid for the product. For example, you tried to load a 2-loop configuration into a 1-loop product.	No user action
Invalid Parameter Code	Bad parameter has been found	No user action
Invalid Parameter for Data Type	Internal error	No user action
Invalid Block Type	May appear when trying to make an out-of-range subtype selection. For example, if choosing analog output type, compare type, or alarm type, message appears if the value of the type is out of range.	Change type selection
Invalid Tag Request	Internal Error	No user action
Invalid Block Number	Internal Error	No user action
Invalid Machine Update Rate	Bad machine update rate	No user action
Invalid Tag	Internal Error	No user action
Invalid Channel in Point spec	Invalid channel has been found	No user action
Invalid Index code	Bad index	No user action
Invalid Input Connection	Function block is programmed with wrong input type. Probably caused by someone incorrectly editing the configuration file itself.	Re-configure on the product with Progeny SDA software.

Error	Description	User Action
Invalid Algorithm Code	Bad algorithm code has been given, bad algorithm choice.	No user action
Invalid Function Block Request	Internal Error	No user action
Lag or Delay Less than Zero	AI lag or delay is less than zero	Change lag or delay to greater than or equal to zero.
Low Limit Outside of Circuit	AI circuit low limit is < voltage limit of -500 mV.	Change circuit low limit to > -500 mV.
Low Limit Outside of Table	For thermocouple or RTD, Range Low limit is < the low limit for that type.	Change limit to within specified limits for that type. See Table 9-3.
Low Output Limit less than Zero	A CAT or VAT low limit is less than zero.	Change CAT or VAT low limit to greater than or equal to zero.
Must have at least one Step	Setpoint Profiler was programmed with no steps.	Program Setpoint Profiler with at least one step.
No Room for Function Block	System has used all allocated function blocks.	No user action
Number of Frames Out of Range	Rolling Average CV # of Samples is less than 1 or greater than 60.	Change # of Samples to 1-60.
Out of RAM Memory	No more RAM available	No user action
Out of EEPROM Memory	No more static memory or EEPROM memory	No user action
Output Limits Equal	Output (range) limits (low and high) must be unequal.	Change to unequal limits
Pairs Inconsistent	AI is custom type and curve has Xn but no Yn or vice versa. AI is custom type but curve does not have at least 2	Program a Y for each X or vice versa. Program at least 2 X's and 2 Y's.
Profile Data Inconsistent	Setpoint Profiler contains a step time and step value that are not both OFF or that are not both a value.	Correct inconsistency.
PTA – ***Any message beginning with "PTA" is a pretune abort message. See Section 13.***		
RJ Not in Curve	AI is custom type, class thermocouple, RJ enabled but curve does not contain 0-65 degrees C (32-149 degrees F).	Y values must contain 0-65 degrees C (32-149 degrees F).
Request Made with Invalid Tag	Invalid tag has been made in a request	No user action
Requires Setpoint Parameter	Alarm does not contain a setpoint.	Program alarm with a setpoint.

Error	Description	User Action
Requires Input Parameter	Alarm does not contain an input.	Program alarm with input.
Requires a Deviation Parameter	Deviation alarm does not contain deviation.	Program alarm with deviation.
Trend Has Too Many Points For **Rate Selected**	Data Storage cannot store more than 3 points at 1/4 second scan rate.	Change number of points to be compatible with scan rate.
Type Does Not Exist	A function block type was loaded that does not exist. For example, you loaded a Profile but the unit does not have the Profile option.	Re-program or re-load correctly.
Type Incompatible With Hardware	Analog output type is different from hardware setting. For example, analog output is programmed as CAT but hardware is set to VAT.	Change programming to be compatible with hardware or vice versa, then reload configuration or reconfigure the block.
Type Requires Hardware	Hardware is missing for the programmed analog output or discrete output relay.	Either ignore the message knowing that those particular points did not get loaded or verify configuration and make sure that the points that are in the configuration match the hardware components.
Undefined Function Block Request	Internal Error	No user action
Value Written to Indirected Point	An input has been connected and user has tried to write a value to that input. For example, if a control loop setpoint is connected to AI1 OV, you will receive this message if you try to change the loop setpoint online.	Avoid changing connected values.
X Axis Must Increase	AI is custom type but $Xn \geq Xn+1$.	Re-program $Xn < Xn+1$.
X Axis Not Increased Enough	AI is custom type but X does not increase by at least 0.00001.	Re-program X.
Y Axis Not Increased Enough	AI is custom type but Y does not change by at least 0.00001	Re-program Y.

22. Parts List

Introduction

All replacement parts for the instrument are consolidated into the replacement parts kits described below. The parts in the kits are shown in the figures referenced in the kit descriptions. The numbers at the left below identify the kits in the drawings.

To obtain a particular replacement part, order the appropriate kit using the eleven-digit Kit Part Number shown in the table.

Kit numbers and descriptions

	Kit Part Number	Kit Description
1	**51197833 -501**	***Case Assembly Replacement Kit***

Kit includes:

Figure	Detail #	Part Description	Quantity
22-2	1	Aluminum Case	1
22-2	2	Case Sub Bezel	1
22-2	44	Shell Seal Gasket	1
22-2	25	Sub-bezel Screws	4
22-4	3	Case Rear Screws	4
22-4	5	Reference Junction Bushing	1
22-4	6	Reference Junction Bushing Retainer	1
22-4	7	Case Rear Cover	1
22-4	8	Rear Terminal Boards	2
22-4	24	Ground Bus Bar	1
22-4	43	Cover Plate	2

	Kit Part Number	Kit Description
2	**51404603 -501**	***Complete Display Assembly Replacement Kit***

Kit Includes:

Figure	Detail #	Part Description	Quantity
22-2	4	Complete Display Assembly (Includes Membrane Keypad)	1

	Kit Part Number	Kit Description			
3	**51309705 -501**	***Membrane Keypad Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-2	7	Membrane Keypad	1
		22-3	3	Switch Caps	8

	Kit Part Number	Kit Description			
4	**51197835 -501**	***PC Molding Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	14	PC Molding	1

	Kit Part Number	Kit Description			
5	**51197838 -501**	***Pivot Arms Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-2	49	Upper and Lower Pivot Arms	1

	Kit Part Number	Kit Description			
6	**51197842 -501**	***CPU Board Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	27	046999 CPU Board	1

	Kit Part Number	Kit Description			
7	**51197844 -501**	***Single TC/EMF/RTD Input Board Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	28	046993 Single TC/EMF/RTD Input Board	1

	Kit Part Number	Kit Description			
8	**51197846 -501**	***Three TC/EMF/RTD Inputs Board Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	28	047251 Three TC/EMF/RTD Inputs Board	1

	Kit Part Number	Kit Description			
9	**51197850 -501**	***Power Supply/Relay Outputs Board Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	29	046989 Power Supply with Two Relay Outputs Board	1

	Kit Part Number	Kit Description			
10	**51197851 -501**	***RS-485 Serial Communications Board Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-4	8	Rear Terminal Block	1
		22-5	32	046925 RS-485 Serial Communications Module	1
		22-5	33	5/16" Large Plastic Standoffs	4
		22-5	34	Serial Communication PROM (U3)	1

	Kit Part Number	Kit Description			
11	**51197853 -501**	***PCMCIA Memory Card Interface Board Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	31	046995 PCMCIA Memory Card Interface Board	1

	Kit Part Number	Kit Description			
12	**51197854 -501**	***Plate Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	31	Plate	1

	Kit Part Number	Kit Description			
13	**51197856 -501**	***Current/Voltage Output/Three Discrete Inputs PCA Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	30	047257 Analog Output/3 DI Printed Circuit Assembly	1
		22-4	8	Terminal Block	1
		22-4	50	Suppression Assembly	1

	Kit Part Number	Kit Description			
14	**51197858 -501**	***Two Relay Outputs/Two Discrete Inputs PCA Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	30	047255 Two DO/Two DI Printed Circuit Assembly	1
		22-4	8	Terminal Block	1
		22-4	50	Suppression Assembly	1

	Kit Part Number	Kit Description			
15	**51197859 -501**	***PCMCIA Card Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-2	54	PCMCIA Card, 256 KB capacity	1
	Kit Part Number	Kit Description			
16	**51197860 -501**	***Front Plane PCA Replacement Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	12	Front Plane Printed Circuit Assembly	1
		22-5	26	Display Cable Protector	1

	Kit Part Number	Kit Description			
17	**51197861 -501**	***Panel Mounting Hardware Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-1	46	Panel Mounting Screws	2
		22-1	47	Panel Mounting T-Bars	2
		22-1	48	NEMA 12 Panel Mounting Gasket	1

	Kit Part Number	Kit Description			
18	**51197862 -501**	***Cables & Ground Connectors Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	13	Flat Display Cable	1
		22-4	49	Ground Wire	1
		22-4	24	Ground Bus Bar	1
		22-4	50	Suppression Assembly	1

	Kit Part Number	Kit Description			
19	**51197863 -501**	***Miscellaneous Hardware Kit***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-4	8	Terminal Blocks	5
		22-2	44	Shell Seal Gasket	1
		22-4	43	Cover Plate	5
		22-4	51	Ferrite Clamp	1
		22-4	52	Nylon Cable Ties	2
		22-5	10	Upper & Lower Rear Supports	1
		22-5	11	Reference Junction Sensor & Cable	1
		22-5	53	Lithium Battery	1

	Kit Part Number	Kit Description			
20	**51404667 -501**	***Operating PROM Set Replacement Kit for units <u>with</u> Data Storage Capability***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	36	51404667-001 PROM Set (U5 & U22)	1

	Kit Part Number	Kit Description			
21	**51404654 -501**	***Operating PROM Set Replacement Kit for units <u>without</u> Data Storage Capability***			
		Kit includes:			
		Figure	**Detail #**	**Part Description**	**Quantity**
		22-5	36	51404654-001 PROM Set (U5 & U22)	1

Exploded views

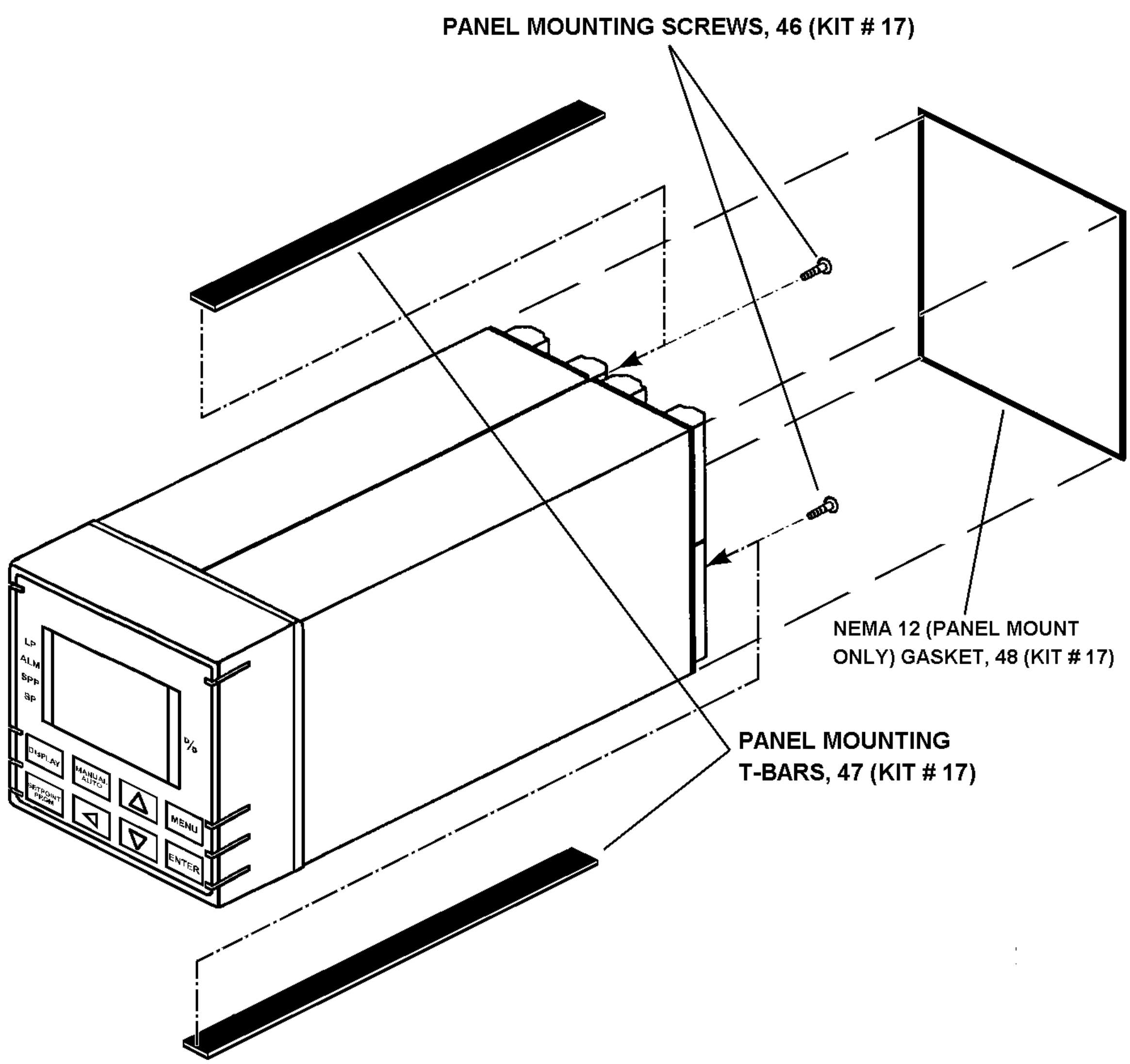


Figure 22-1 Instrument Panel Mounting Hardware

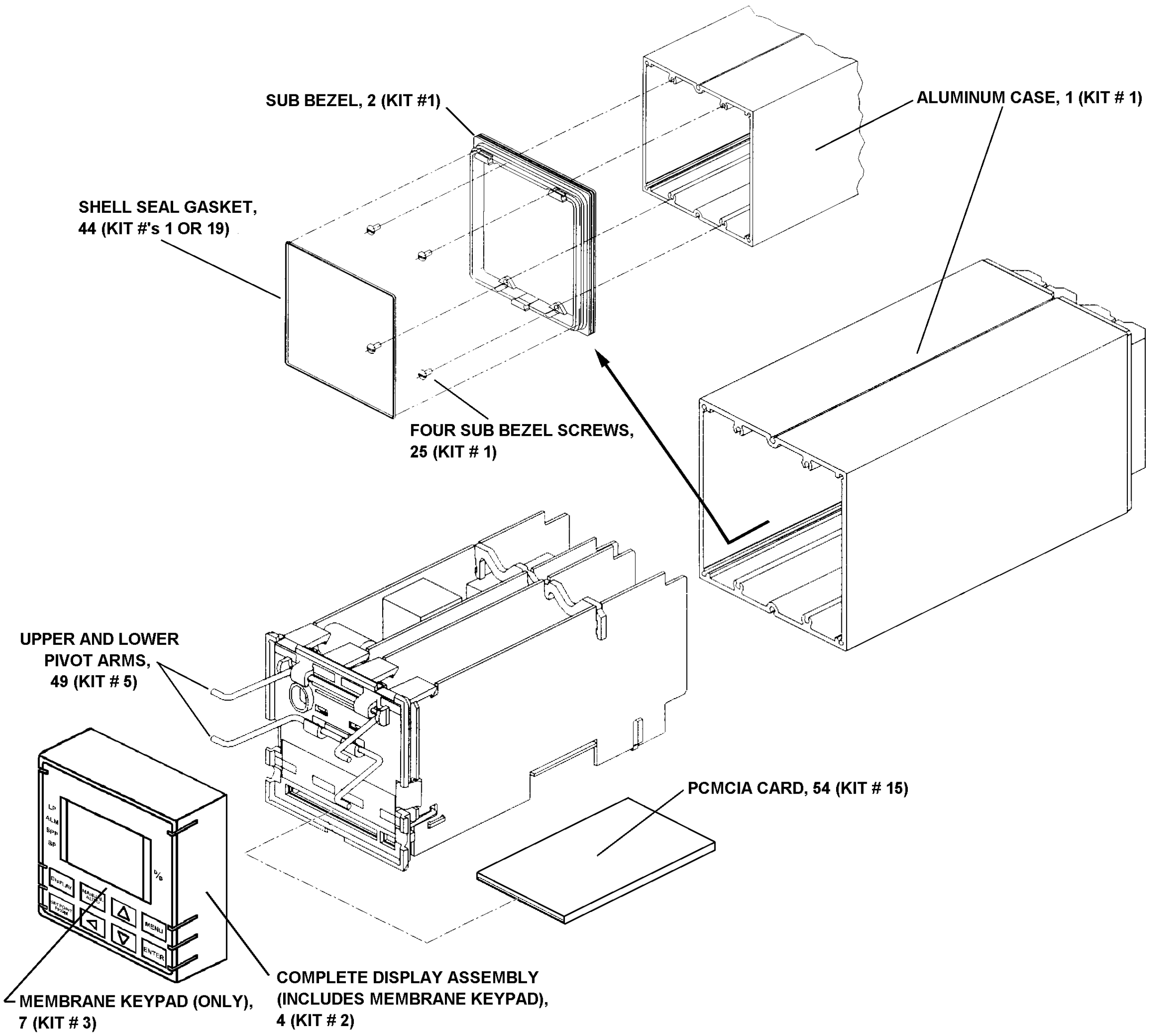


Figure 22-2 Instrument Card Cage Removed From Case along with Sub Bezel and Gasket

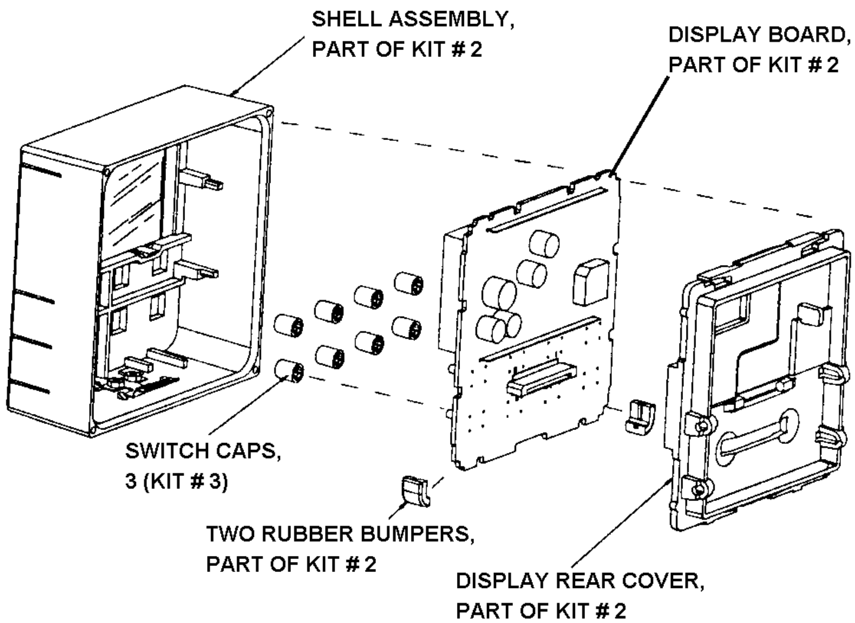


Figure 22-3 Exploded View of Instrument's Display

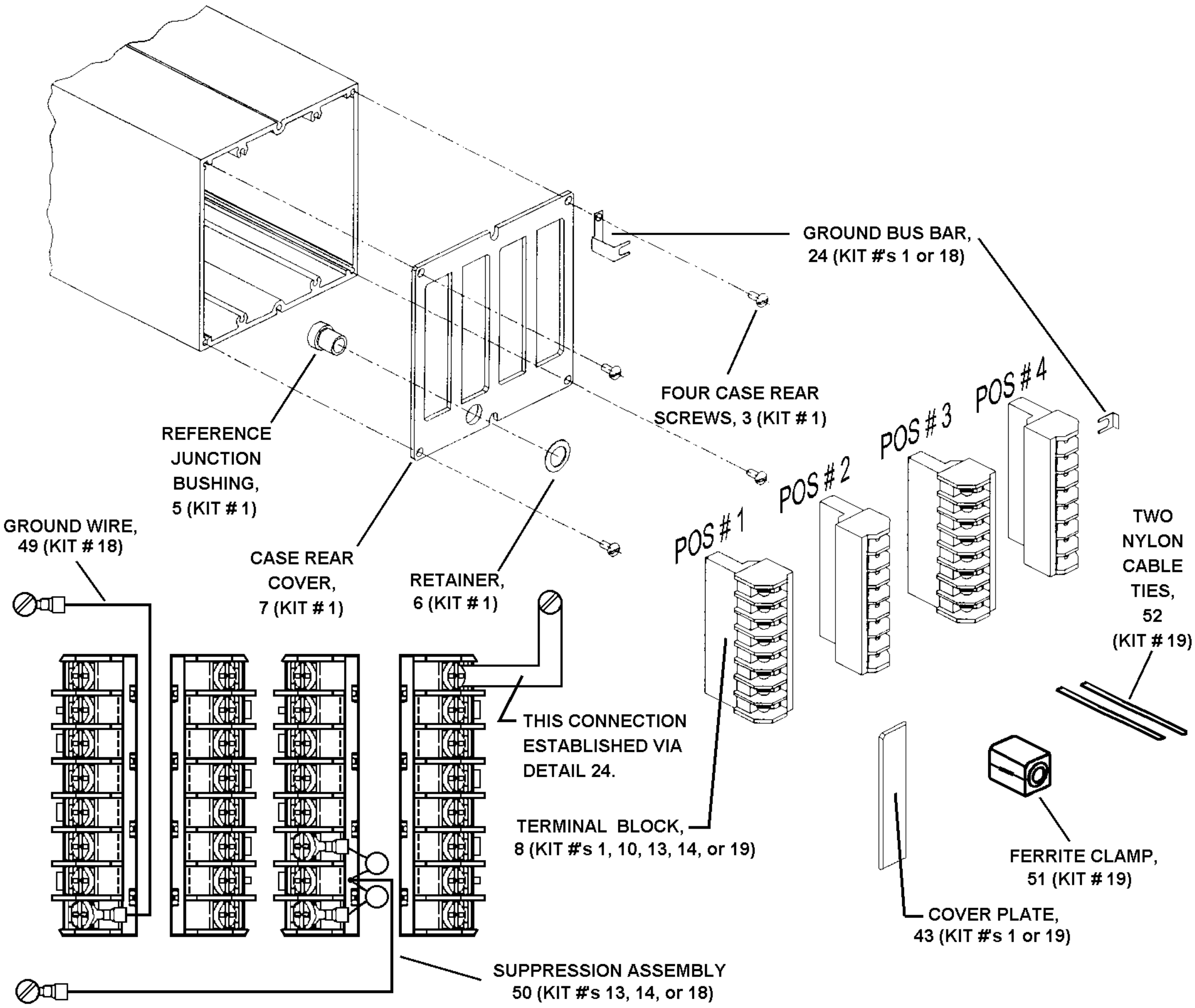


Figure 22-4 Components of Instrument Rear Assembly

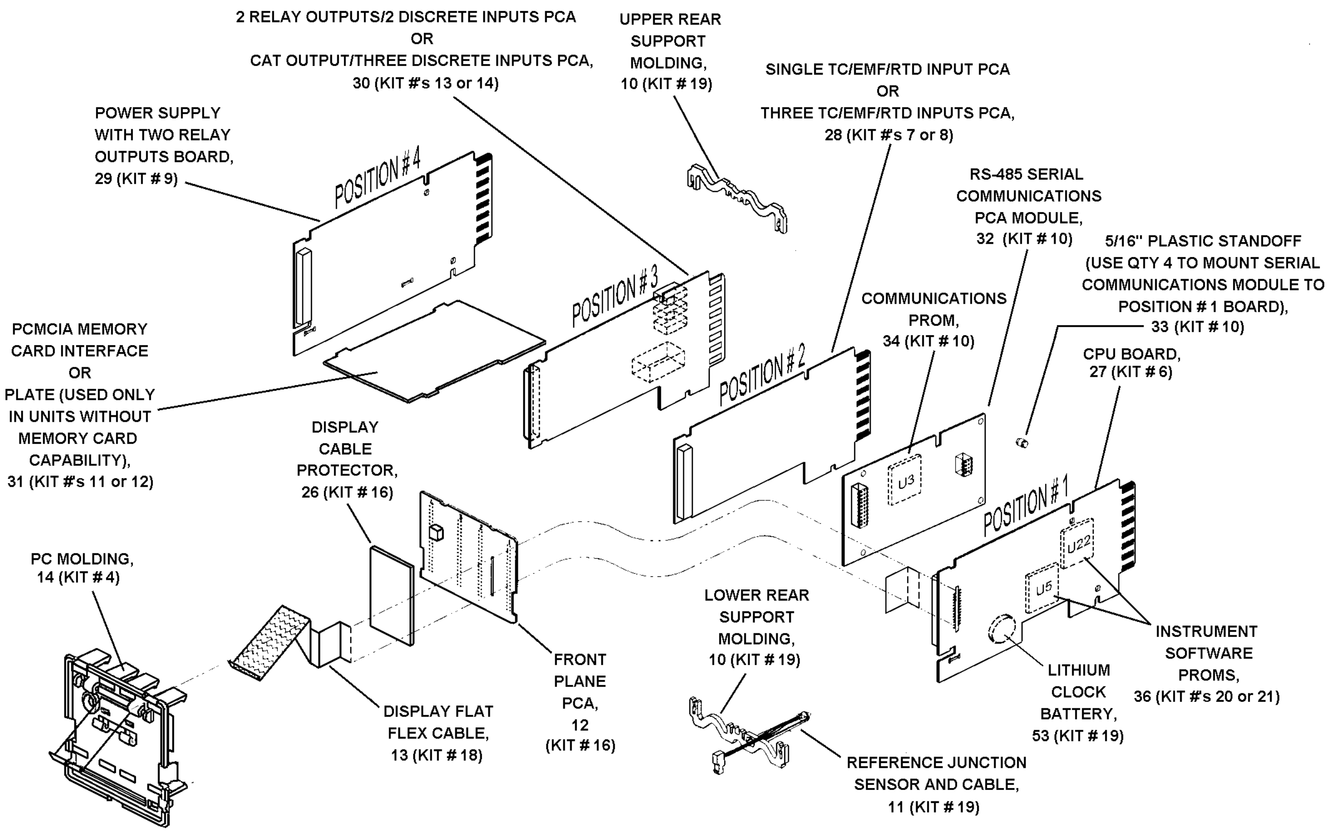


Figure 22-5 Exploded View of Instrument's Card Cage

Appendix A – Cleaning the Front Panel

Guidelines

The following are guidelines for cleaning the front panel of the controller **when it has been properly installed in a panel as described in Section 3, and grounded as described in Section 4.**

- Clean the front panel with a damp cloth.
- If needed, use a detergent containing no abrasives. **Do not use solvent cleaners.**
- Always clean the front panel with the bezel closed.

Appendix B - Security Bypass Procedure

Overview

Your controller has a security bypass code which allows you to enter secured areas of the product without using the master and/or operator passwords described in Section 9.

Bypass procedure

The table below describes the security bypass procedure.

Security Bypass Procedure

Step	Action
1	When you are prompted for the master or operator security code, enter the bypass code 783.
2	Press the **DISPLAY** button to display the forgotten master or operator code.
3	To return to the previous menu without entering the secured area, press the **MENU** button. To enter the secured area, press **ENTER**.

ATTENTION

Remove this page for security.

Index

D

K

L

M

N

O

P

R

S

T

U

V

W

X

Y

Z

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