

S9000 Controllers Technical Overview

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S9000 Controllers

Overview

About this document

Starting with this page, there is a general description of the S9000 Controller, followed by detailed Specifications starting on page 18.

Flexible architecture

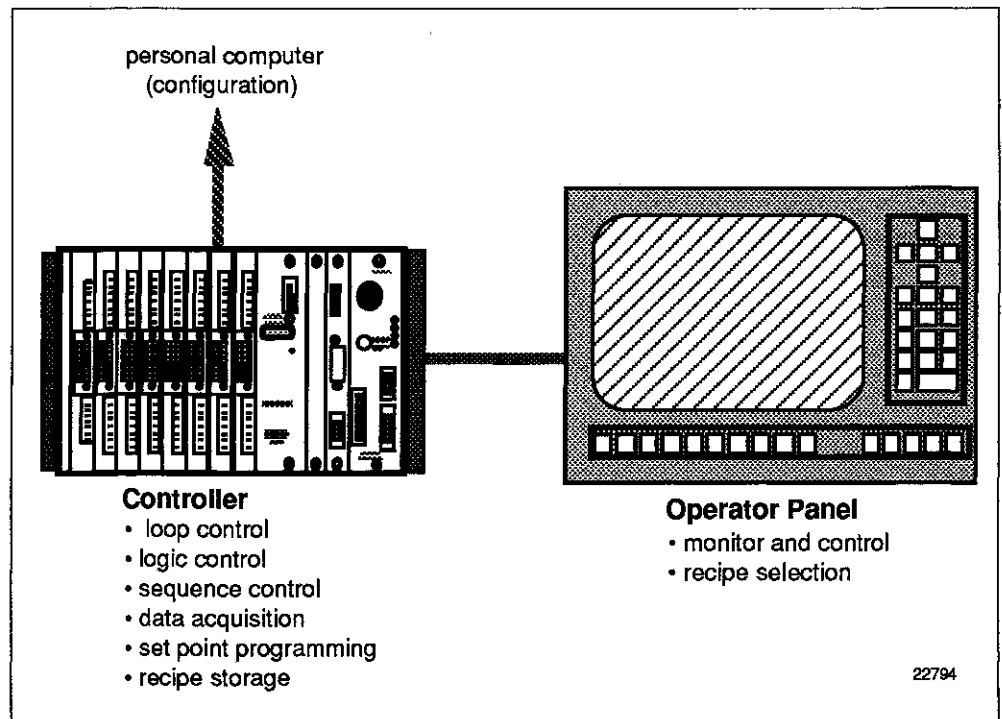
The S9000 integrates loop control, sequential control, interlock logic control, and operator interface functions in a single, but extremely flexible, controller architecture.

Its major components include:

- Controller,
- optional remote I/O, and
- optional Operator Panel.

Figure 1 is an illustration of a Controller with an Operator Panel as the local operator interface.

Figure 1 Model 9000e Controller with Operator Panel for Local Operator Interface



Continued on next page

Overview, Continued

Controller

The Controller includes two separate processors, one dedicated to loop and sequence control and the other to high speed logic control. Loop functions include concurrent control of multiple loops, a comprehensive set of auxiliary control algorithms that support and/or modify control actions, and links that connect all elements of the strategy including logic control functions.

Sequential control functions include a “flow diagram” approach modeled after sequential function charts. Sequential control charts are made up of Basic Process Operations (BPOs) which are defined by the user.

Logic control functions include elements such as contacts, latches, sequencers, timers, and counters.

Communications options include MASnet which utilizes standard IEEE802, 3 Ethernet TCP/IP. Communication modules are also available on some Controllers for data exchange with Honeywell’s TDC 3000 control systems or other computer systems.

Flexible I/O expansion

The S9000 Controllers use the same flexible I/O as the 620 Controllers. Process I/O can be located locally or remotely, up to 10,000 feet, through a serial I/O link. Remote I/O allows shorter process wiring runs which can greatly reduce overall wiring costs.

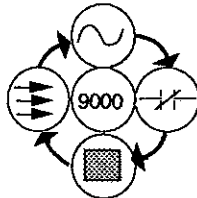
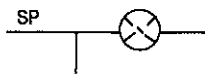
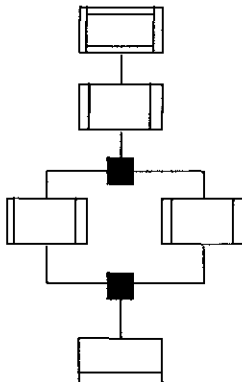
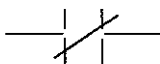

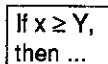

Operator panel

The Operator Panel includes preformatted displays that organize data for convenient, local monitoring and control tasks in real time.

S9000 Features

Summary

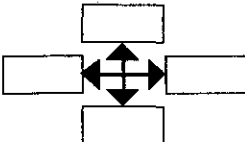

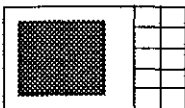
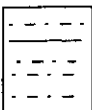
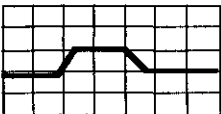
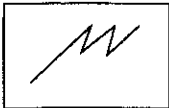
Some of the key features of the S9000 Controllers are:

Integrated Control		The S9000 integrates loop, logic, and sequential control. Real-time data is shared. For example, Sequential Control Chart can read the status of a ladder logic contact and, if true, change the setpoint of a continuous control chart PID loop.
Loop Control		An independent loop processor in the S9000 Controller provides PID control loop capability. PID control blocks let you graphically build single and cascade control loop strategies with the Continuous Control Chart. Adaptive autotune is available with all 32 loops to help optimize control.
Sequence Control		Integrated within the loop processor is the sequence control. Sequential Control Charts organize batch or other sequential operations. Sequential control strategies are designed using a simple flow chart approach.
Logic Control		An independent logic processor in the S9000 Controller provides logic capabilities such as contacts, latches, sequencer, timer and counter. Configuration software includes relay ladder programming using familiar logic elements. Ladder type control blocks let you interface logic functions with loop control functions in the Continuous Control Chart configuration.
Inputs/Outputs (I/O)		A Controller can handle from 256 to 960 I/O, depending on the model.
Auxiliary Functions		Numerous Math, Calculations, and Boolean type control blocks let you include analog decision making and other special functions in your control strategy configuration.
Alarms		Each PID control block includes two configurable alarms, and alarm type control blocks let you configure high, low, deviation, and rate of change monitoring.

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S9000 Features, Continued


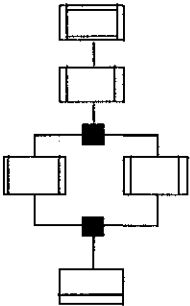
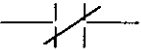


Summary , Continued

Partitioned Architecture		The Controller features independent logic and loop processors for fast and accurate control response.
Configuration Software		The keys to the S9000's operation are its Continuous Control Chart and Sequential Control Chart configuration. The configuration software includes all the tools you need to build your customized control strategy. This software is factory installed in the PC Supervisor.
Operator Interface		<ul style="list-style-type: none"> • The Operator Panel is the local operator interface from which an operator can monitor and control selected operations through preconfigured displays. • The PC Supervisor is required to configure the S9000 Controller, and it can be used as a centralized, enhanced operator interface in conjunction with or in place of the Operator Panel.
Recipe Control		Recipes allow an operator to quickly substitute a preconfigured set of control parameters and/or setpoint programs for the S9000 execution.
Setpoint Programming		Setpoint Programmer control blocks let you execute ramp/soak setpoint programs jointly with PID control blocks. You create the ramp/soak programs using a fill-in-the-blanks method of programming that is also provided in the configuration software.
Communications		<p>The S9000 Controller has communication links to the Operator Panel, the PC Supervisor, Manufacturing Supervisor, and optional stand-alone Honeywell devices. Depending on the Controller, Ethernet communications is available; a link to other systems is also possible.</p> <p>All S9000 Controllers can now communicate with each other on Peer Data Net, a proprietary peer-to-peer data network.</p>

S9000 Capabilities

Summary


The following table summarizes the S9000 capabilities.

Function	Maximum Capacity		
	Model 9000e	Model 9100e	Model 9200e
 Loop Control	32 Loops	32 Loops	32 Loops
 Sequence Control <ul style="list-style-type: none"> • Simultaneous sequences per controller • Simultaneous threads per sequence • Elements per controller (total of Steps, Forks, Branches, BPOs, etc.) • Continuation conditions per step • Control instructions per step • Conditions and instructions per controller • Calculation statements per controller 	8 6 500 8 12 2500 600	8 6 500 8 12 2500 600	8 6 500 8 12 2500 600
 Logic Control <ul style="list-style-type: none"> • Processor memory • Internal coils • Internal registers • Timers/counters • Sequencer steps 	2K 3840 256 128 1024	8K 3072 4096 1024 1024	32K 2048 4096 2048 1024
 Inputs/Outputs	256	640	960
 Recipe Control <ul style="list-style-type: none"> • Recipes • Items per recipe 	50 50	50 50	50 50

Continued on next page

S9000 Capabilities, Continued

Summary, continued

	Setpoint Programming			
	• Setpoint programmer blocks	8	8	8
	• Setpoint programs*	99	99	99
	• Segments per program*	98	98	98
	• Events per program	12	12	12
	*Total Segment Maximum	1000	1000	1000

Partitioned Architecture

Promotes flexibility

The S9000 Controller partitions control and operator interface into separate components. This promotes flexibility by giving you a choice of an Operator Panel and/or a PC Supervisor or Manufacturing Supervisor as the operator interface. Except for the desktop version of the PC Supervisor all hardware is shop-hardened for common industrial environments, and can be mounted flush in a panel or a nineteen-inch, relay rack.

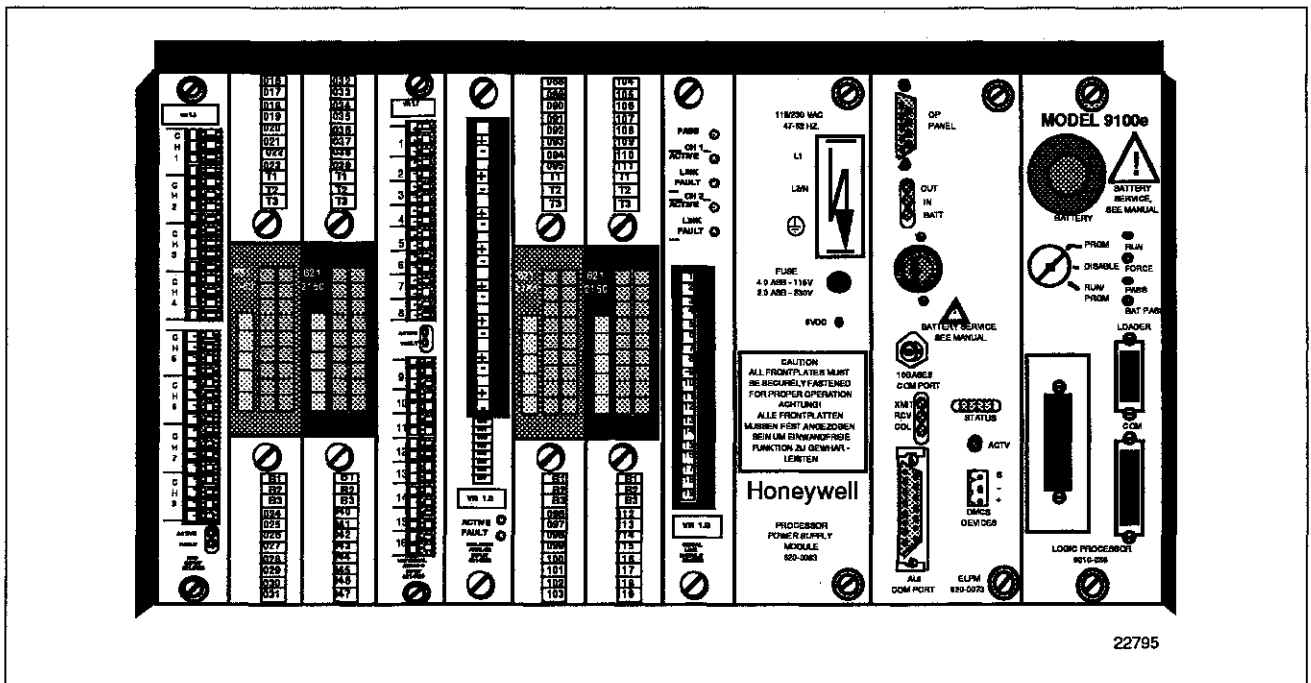
Controller functions

The Controller provides loop control, sequence control, logic control, data acquisition, and communications. The Controller can handle up to 32 PID loops, and 256 to 960 I/O. Its logic memory capacity varies from small for Model 9000e, to medium for Model 9100e, and to large for Model 9200e to meet varying application requirements. It includes:

- a dedicated loop processor,
- a dedicated logic processor, and
- communications ports to the Operator Panel, PC Supervisor, or Manufacturing Supervisor, and optional external devices.

Figure 2 shows the Model 9100e Controller.

Figure 2 Controller Includes Separate Processors for Loop and Logic Control, and Communications Port (Model 9100e shown)



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Partitioned Architecture, Continued

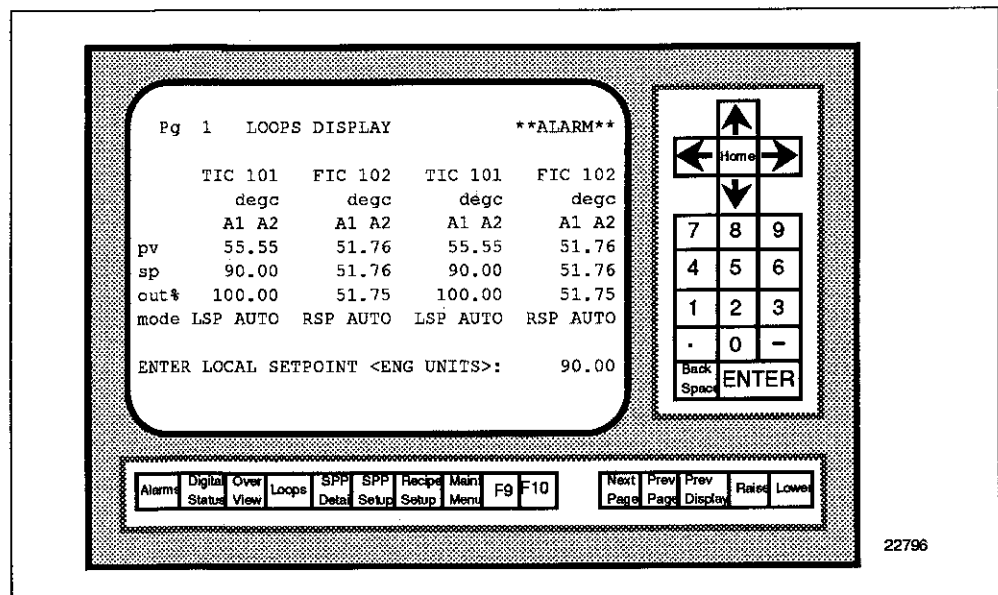
Operator panel functions

The Operator Panel (see Figure 3) is used for monitoring and controlling process operations; it can be used alone for this purpose, or in conjunction with a PC Supervisor.

It includes:

- dedicated keys for display selection, cursor control, and numerical data entry,
- a monochrome (amber) or color CRT that displays 12 lines by 40 columns of double-sized characters for easy reading, and
- standard, preformatted operating displays for monitoring and controlling process operations.

Figure 3 Operator Panel Includes Dedicated Keys, Monochrome or Color CRT, and Preformatted Displays



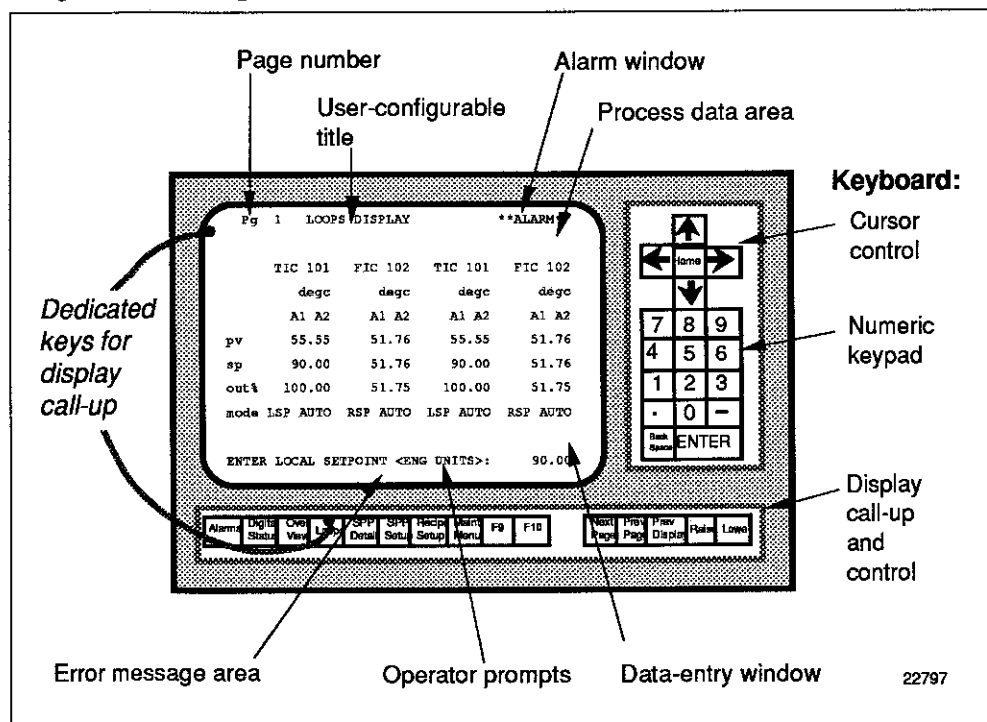
Configured Displays and Dedicated Keys

Fast, easy operation

Operation is simple, quick, and sure from either the Operator Panel, the PC Supervisor, or the Manufacturing Supervisor. As indicated in Figure 4, the keyboard functions and displays have coordinated designs to help the operator focus on the requirements of operating the process application, rather than on the requirements of operating the control equipment. For example:

- The layout and functions of the keyboard on the Operator Panel and PC Supervisor are very similar, which simplifies dual-interface operation.
- Dedicated display keys mean that a desired display is only a single keystroke away, and display-control keys speed access to or return to a desired display.
- All displays have the same general format, and their data is configured through the PC Supervisor. Both the Operator Panel and the PC Supervisor color displays use the same colors for the same types of data.
- Every preformatted display includes an alarm window for immediate indication of an abnormal process condition.
- A comprehensive set of screen prompts and error messages guides operator action.

Figure 4 Operator Panel Design Features



Operator Panel Displays

Configurable data in standard, preformatted displays

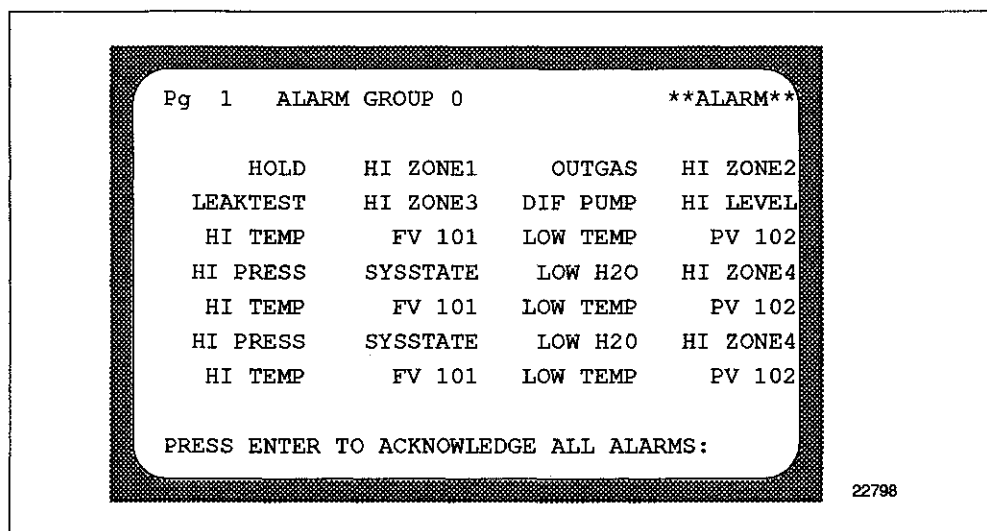
The following paragraphs describe the data that you can configure in these standard, preformatted displays for an Operator Panel. An example is given for each display.

Alarms

Provides the functional equivalent of an annunciator panel. Format features include:

- up to 28 pointnames per page,
- up to 10 pages,
- alarm status indication:
 - blinking = active, unacknowledged
 - reverse video = active, acknowledged
 - normal = not active
- acknowledgment of alarms per page.

When ****ALARM**** message appears in another display, you only have to press the [ALARMS] key to call up the alarms display, and pressing the [PREV DISP] key will return you to the previous display.



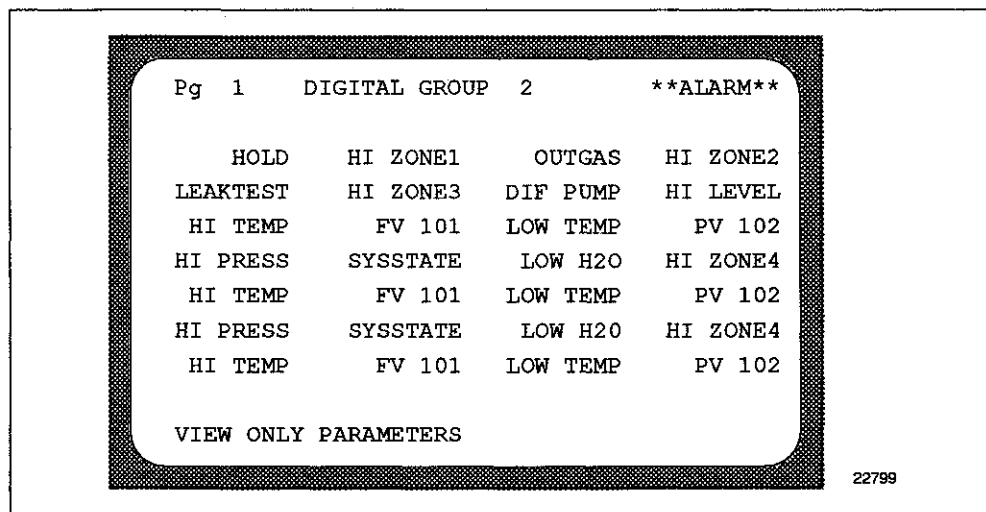
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Operator Panel Displays, Continued

Digital status

Provides the functional equivalent of pilot lights on a panel. Format features include:

- up to 28 pointnames per page,
- up to 10 pages, and
- digital status indication (pointnames of digitals in ON state are in reverse video).

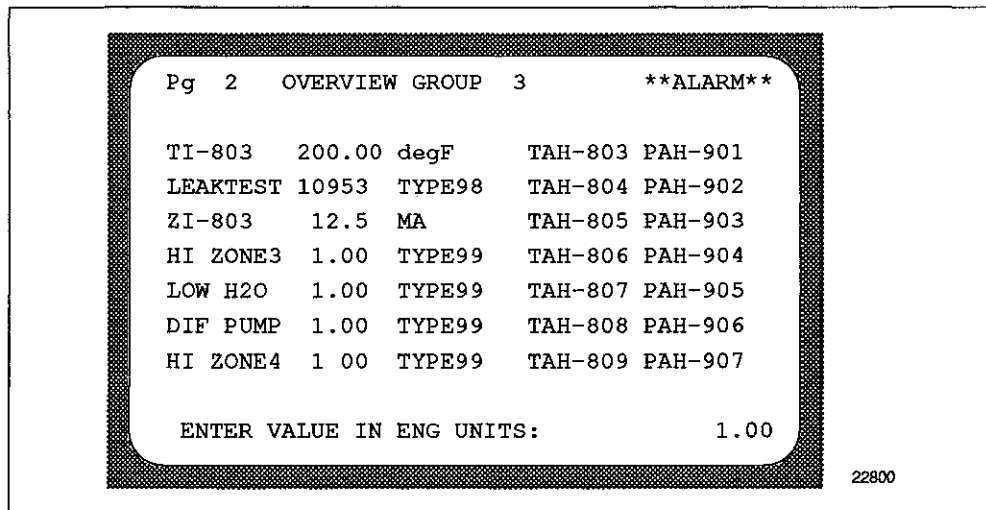


Overview

Provides the functional equivalent of a complement of thumbwheels, selector switches, and LED displays.

Format features include:

- up to 7 analog or digital pointnames per page which an operator can edit,
- up to 14 digital pointnames per page,
- up to 10 pages,
- shows the current values of parameters, and
- digital status indication (pointnames of digitals in ON state are in reverse video).



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Operator Panel Displays, Continued

Loops

Provides the functional equivalent of a set of stand-alone PID loop controller faceplates.

Format features include:

- up to 4 pointnames per page,
- up to 10 pages,
- shows current values of PV, SP, Out, Mode,
- operators can edit SP, Out and Mode values, and
- calls up the Loop Detail display.

Pg 1		LOOPS DISPLAY				**ALARM**	
		TIC 101		FIC 101		TIC 102	
		degc		gals		degc	
		A1	A2	A1	A2	A1	A2
pv		55.55		51.76		55.55	
sp		90.00		51.76		90.00	
out%		100.00		51.75		100.00	
mode		LSP	AUTO	RSP	AUTO	LSP	AUTO
ENTER LOCAL SETPOINT <ENG UNITS>:		90.00					

22801

Loop detail

Provides additional data for loop selected from Loops display. Operators can view and edit these parameters:

- tuning,
- setpoint limits,
- output limits, and
- alarm setpoints.

Pg 1		TIC 101 Loop Detail		**ALARM**	
gain	12.00	at type	SP ONLY		
rate-min	0.20	sp step	10.00		
rset-min	0.10	at state	DISABLED		
sp hilim	70.00	at status	INACTIVE		
sp lolim	5.00	pend ovr	NOT AVAIL		
pv hilim	100.0	init tune	NOT AVAIL		
pv lolim	0.00	more on next page			
ENTER GAIN (.1 TO 1000):		12.00			

22802

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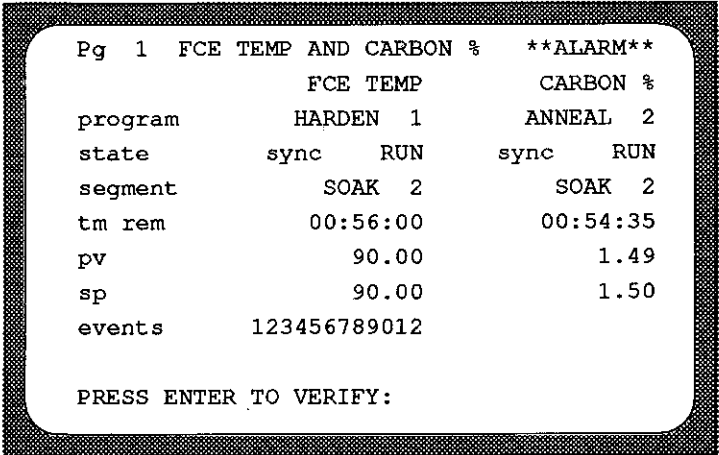
Operator Panel Displays, Continued

Setpoint program operate

Provides the functional equivalent of a set of stand-alone setpoint programmer faceplates.

Format features include:

- up to 2 setpoint programs per page,
- up to 8 pages,
- shows the current operating status of the setpoint programs,
- operators can start and stop the selected program,
- operators can view and edit these parameters:
 - program mode
 - segment number
 - soak SP
 - soak time remaining
 - program state
 - PV (view only)
- calls up the SPP Detail display.



The screenshot shows a monochrome display with a dark background and light-colored text. The text is organized into a table-like structure with two main columns: FCE TEMP and CARBON %. The FCE TEMP column has sub-columns for program, state, segment, tm rem, pv, sp, and events. The CARBON % column has sub-columns for program, state, segment, tm rem, pv, sp, and events. The display is titled 'Pg 1 FCE TEMP AND CARBON % **ALARM**'. At the bottom, it says 'PRESS ENTER TO VERIFY:'. The number '22803' is visible in the bottom right corner of the display area.

Pg 1	FCE TEMP	CARBON %
program	HARDEN 1	ANNEAL 2
state	sync RUN	sync RUN
segment	SOAK 2	SOAK 2
tm rem	00:56:00	00:54:35
pv	90.00	1.49
sp	90.00	1.50
events	123456789012	

PRESS ENTER TO VERIFY:

22803

Continued on next page

Operator Panel Displays, Continued

Setpoint program setup Provides a list of all available setpoint programs (up to 99).

Format features include:

- up to 12 setpoint programs per page,
- up to 9 pages, and
- calls up the Setpoint Program Detail display.

Pg 1 SETPOINT PROGRAMS		**ALARM**	
no.	name	no.	name
1	HARDEN	2	ANNEAL
3	CARBURIZ	4	NI BRAZE
5	CU BRAZE	6	H2 CLEAN
7	TEMPER	8	
9		10	
11		12	
PRESS ENTER TO VERIFY:			

22804

Setpoint program detail Provides additional data for the setpoint program selected from the Setpoint Program Operate or Setup display. Operators can view and edit these parameters:

- soak setpoint,
- guaranteed soak deviation band,
- soak duration,
- ramp rate, and
- segment events.

Pg 1 SP Program 1		HARDEN		**ALARM**	
seg	sp	rt/tm	gsband	events	
1	RAMP	10.00		123456789012	
2	SOAK 20.00	00:01:30	0.00	123456789012	
3	RAMP	10.00		123456789012	
4	SOAK 20.00	00:01:12	0.00	123456789012	
5	RAMP	10.00		123456789012	
6	SOAK 30.00	00:01:54	0.00	123456789012	
ENTER RAMP RATE IN ENGR UNITS/MIN:					10.00

22805

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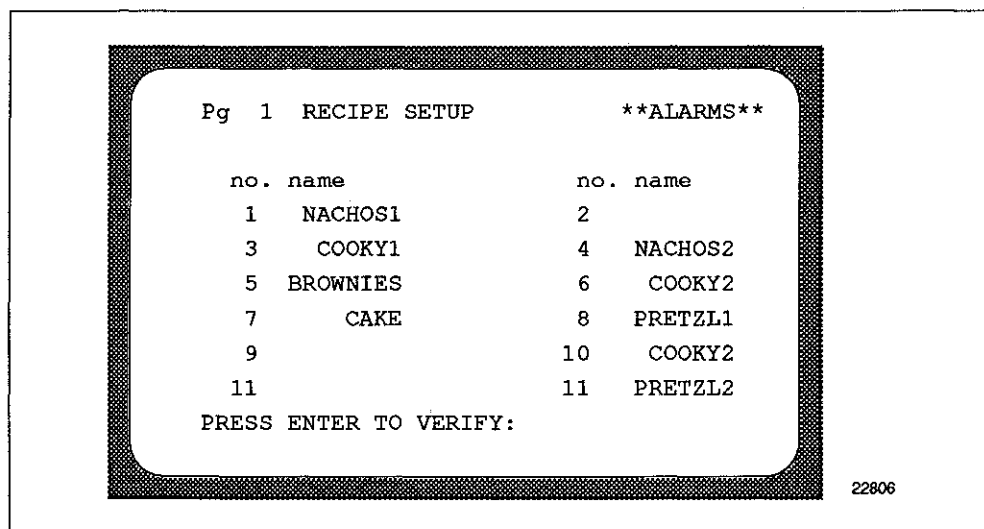
Operator Panel Displays, Continued

Recipe

Provides a list of all available recipes (up to 50).

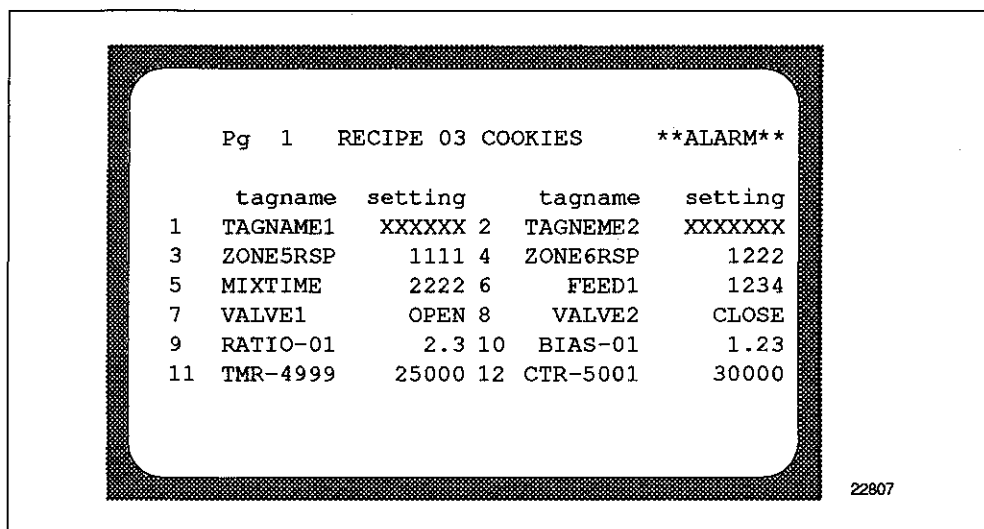
Format feature include:

- up to 12 recipes per page,
- up to 5 pages,
- operators can load or verify a recipe, and
- calls up the Recipe Detail display.



Recipe detail

Provides additional data for the recipe selected from the Recipe display. Operators can view pointnames (up to 50) and edit any value.

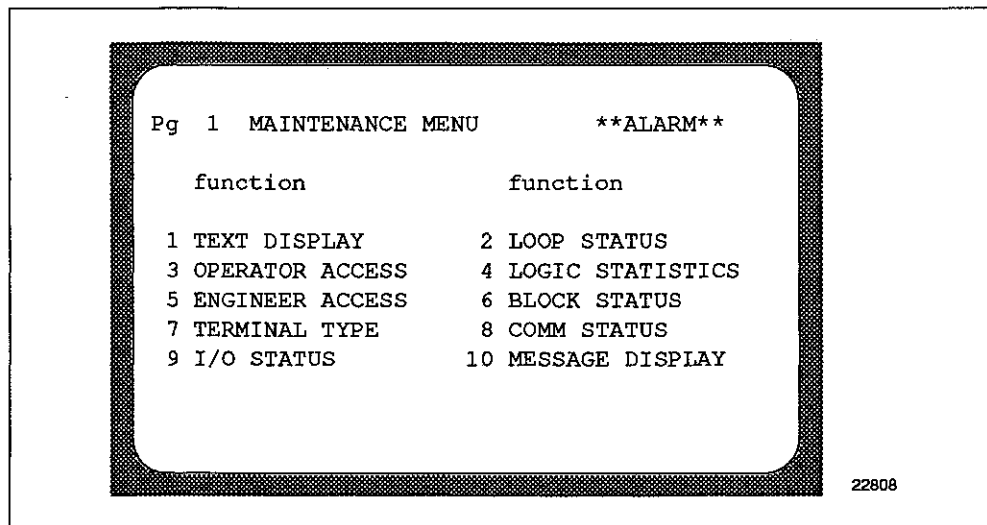


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Operator Panel Displays, Continued

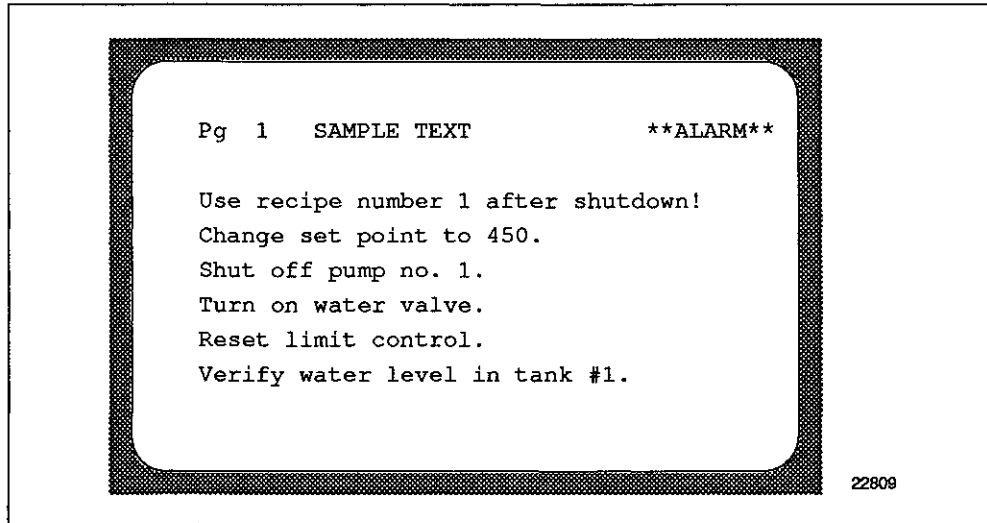
Maintenance menu

Provides easy access to service-related displays as well as the means to restrict access to detail displays.



Text display

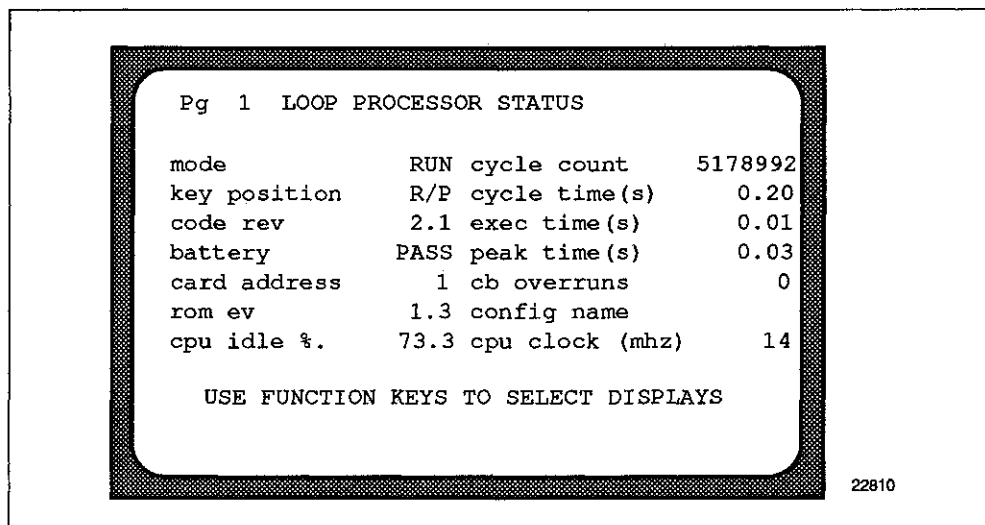
Provides personalized message consisting of 1 page with up to 8 lines at 40 characters per line.



Operator Panel Displays, Continued

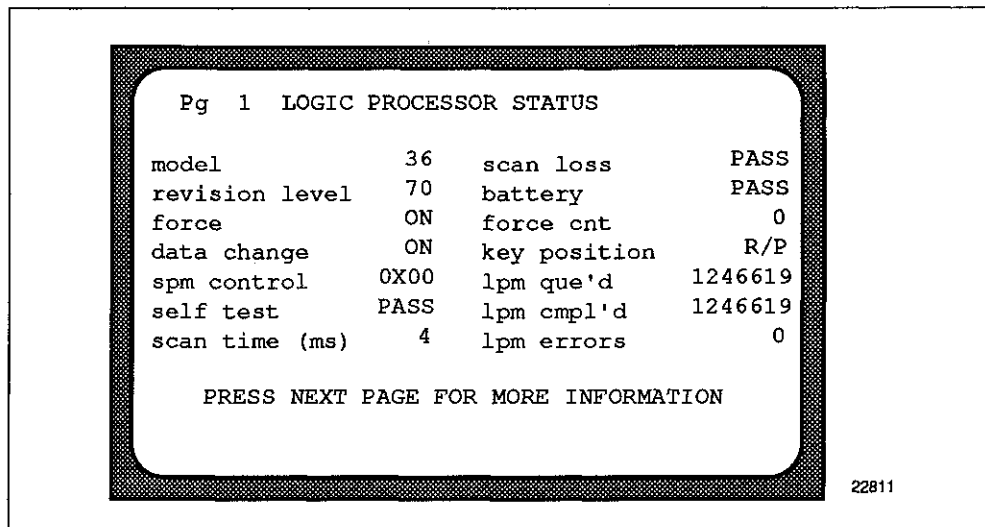
Loop status

Provides diagnostic information for the Loop Processor Status display.



Logic statistics

Provides diagnostic information for the Logic Processor Status display.



Operator Panel Displays, Continued

Communication status Provides diagnostic information for the Ethernet Status display.

```
Pg 1  ETHERNET STATUS
server1 server2 server3 server4 server5
reads   1124067 1459965 10012088 1120410 1221396
writes  4068   1459965 10012088 1220410 1221396
acpt errs    0      0      0      0      0
close errs   0      0      0      0      0
recv errs    1      1      0      0      0
send errs    0      0      0      0      0
selct errs)  0      0      0      0      0
IDLE:0 SELECT:0 RECV:216 RECV:283 IDLE:0
flags Internet Address: 099.098.097.006
reads      0
writes     0 Chnl Internet Address Task
bind errs  0  1    099.098.097.103  0  <-CN
cnct errs  0  2
close errs  0  3
recv errs  0  4
send errs  0  5
selct errs  0  CN Chnl 1 CN Name pcs103
USE FUNCTION KEYS TO SELECT DISPLAYS
```

22812

Options

I/O expansion rack (local or remote)

I/O expansion racks provide additional I/O slots. The standard I/O expansion rack has 12 I/O slots and can handle 3 analog I/O modules. The extended I/O expansion rack has 11 I/O slots and can handle 8 analog I/O modules. You can locate remote I/O racks up to 10,000 feet (3,048 meters) away from the controller. This means shorter process wiring runs which can greatly reduce overall wiring costs. You should restrict the use of UAIM and RTD modules in remote I/O racks to temperature loops and/or data acquisition. Contact Honeywell for details.

External devices

The controller can communicate with stand-alone single loop controllers. External loop controllers should be used in applications which require emergency auto/manual stations. External recorders should be used in applications which require hard-copy recording. The controller uses DMCS communications to connect to:

- up to twenty-nine single loop controllers (UDC 3000, UDC 5000, UDC 6000), or
- up to two DPR 1500 or two DPR 3000 multipoint recorders.*

*External device communications does not support both a DPR 1500 and a DPR 3000 on the same network.

Communication modules

The S9000 Controllers are available with Ethernet communications (that is, MASnet) that lets you connect the S9000 to other computer systems. You still use the PC Supervisor or Manufacturing Supervisor for configuration and/or operator interface, but you can use the other computer system for plant-wide data collection or sophisticated process analysis. The Ethernet interface has direct access to the logic processor's I/O table (ON/OFF states) and Register Table (integer numbers from 0 to 65535). It also has access to loop data in the control blocks. They do not have access to logic or loop configuration. Contact Honeywell for more information.

Specifications

Control Functions

Summary

The following table lists the S9000 control functions.

Description	Model 9000e	Model 9100e	Model 9200e
Loop Control			
Loop Control Blocks	32	32	32
Control Blocks (see Control Blocks List)	250	250	250
Typical Loop Cycle Time (8 loops)	0.5 sec/8 loops	0.5 sec/8 loops	0.5 sec/8 loops
Sequence Control			
Simultaneous Sequences per Controller	8	8	8
Simultaneous BPOs per Sequence	6	6	6
Elements per Controller (total of all Steps, Branches, Forks, BPOs, etc.)	500	500	500
Continuation Conditions per Step	8	8	8
Control Instructions per Step	12	12	12
Conditions and Instructions per Controller	2500	2500	2500
Calculation Statements per Controller	600	600	600
Logic Control			
Internal Coils	3840	3072	2048
Internal Registers	256	4096	4096
Timers/Counters	128	1024	2048
Sequencer Steps	1024	1024	1024
Ladder Logic Memory	2K	8K	32K
Logic Scan Rate (see Ladder Logic Instructions List)	2.5 ms/K	2.5 ms/K	2.5 ms/K
Recipes			
Stored Recipes per Controller	50	50	50
Ingredients per Recipe	50	50	50
Setpoint Programs			
Setpoint Program Control Blocks	8	8	8
Stored Programs	99	99	99
Events per Program	12	12	12
Segments per Program	98	98	98
Total Segments for All Programs	1000	1000	1000
Inputs and Outputs			
Total I/O (digital and analog)	256	640	960
Analog Inputs	96	96	96
I/O and Option Slots			
I/O Slots in Controller Rack	8	8	6
Supported I/O Expansion Racks (11 or 12 slots per rack)	1	3	5
Total I/O Slots (Controller + I/O Racks)	20	44	66
Option Slots	1	1	3
Option Modules (contact factory for information)	HIM CIM	HIM CIM	HIM CIM

Control Block List

Block types

The following table gives a brief description of the control block types by category.

Category	Block Type	Description
Loops	PID1* PID2* PID3*	<ul style="list-style-type: none"> Proportional, Integral, Derivative control loop Proportional, Integral, Derivative control loop (Cascade) Proportional, Integral, Derivative control loop (with interlocking)
	AI AO WTUN UDC1 UDC2 UDC3 UAI UAI6 RTD RTD8	<ul style="list-style-type: none"> Analog Input Analog Output Write Tuning Constants Supervisory setpoint, monitoring of a UDC on the DMCS network Monitor analog Input of a UDC on the DMCS network Auto/Manual station Universal Analog Input Read 16 Universal Analog Inputs Resistance Temperature Detector Module input Read 8 RTD Inputs
SPP (Setpoint programmer)/recipe	SPP SPP2 SPEV	<ul style="list-style-type: none"> Setpoint Programmer (up to eight available) Setpoint Programmer (saves operator edits on-line) Setpoint Programmer Events (up to 12 events per block available)
	SYNC RCP RAMP	<ul style="list-style-type: none"> Setpoint Programmer Synchronization Loads a specified Recipe Ramps to input target at specified rate.
Ladder	RDIG RREG WDIG WREG PB TOT DEV RFP8 WFP8 RRG8 WRG8	<ul style="list-style-type: none"> Read Digital (contact value from Ladder Logic) Read Register (analog value from Ladder Logic) Write Digital (to Ladder Logic latch coil) Writer Register (analog value to Ladder Logic Register) Pushbutton (momentary) Totalization using pulse input module Digital Device Interface Read 8 floating points, register pairs Write 8 floating points, register pairs Read 8 Integer Registers Write 8 Integer Registers
	SCB SUB ADD MUL DIV	<ul style="list-style-type: none"> Scale and Bias; Out = $AX + B$ Subtract; Out = $X - Y$ Add; Out = $X + Y$ Multiply; Out = $(X * Y)$ Divide; Out = X/Y
Math	SQRT ABS CMPR MMA MSF CALC	<ul style="list-style-type: none"> Square Root; Out = \sqrt{X} Absolute Value; Out = X Compare; X:Y. Out = $X > Y$, or $X = Y$, or $X < Y$ Min/Max/Avg/Sum/Standard Deviation Mass Flow; Out = $Kg * \sqrt{(dp * P) / T}$ Custom Calculation = +, -, *, /Log 10, Ln, exp, ΔT

*All PID control blocks offer adaptive autotune.

Continued on next page

Control Block List, Continued

Block types, Continued

Category	Block Type	Description
Alarm/signal	HMON LMON ALM	<ul style="list-style-type: none">• High Monitor; if $X > Y$, Out = On• Low Monitor; if $X < Y$, Out = On• Compare analog value to 5 different configurable alarm limits
Auxiliary	HLLM VLIM HSEL LSEL SW XFR LDLG FGEN RCON TAHD	<ul style="list-style-type: none">• High-Low Limiter• Rate/Velocity Limit• High Selector• Low Selector• Switch; Out = X input or Y input• Bumpless Analog Transfer Switch• Lead/Lag• Function Generator• Read Configuration Parameter• Track and Hold
Boolean	NOT AND OR XOR LTCH TRIG BOOL	<ul style="list-style-type: none">• Logical Boolean Complement• 2-input AND Gate• 2-input OR Gate• 2-input Exclusive-OR Gate• Bi-stable Element (flip-flop)• Triggered pulse• 8 input configurable Boolean expression; AND, OR, XOR, NOT
Recorder	RCH WCH	<ul style="list-style-type: none">• Read Recorder Channels• Recorder Pen Output

Control Chart Elements

Sequential control chart This table describes the functions of the Sequential Control Chart Elements.

Element Type	Chart Type	Description of Functions
Begin Sequence	SCC	Identifies the beginning of a sequence <ul style="list-style-type: none">• Initialization instructions• Abnormal condition identification• Abnormal condition actions
Basic Process Operation	SCC	Identifies a Basic Process Operation <ul style="list-style-type: none">• Continuation condition evaluated before entry• Consists of a BPO chart
Fork	SCC	Allows simultaneous execution of up to six BPOs in "parallel" <ul style="list-style-type: none">• Continuation conditions• 1 input• Up to six outputs
Join	SCC	Functionally opposite to a Fork <ul style="list-style-type: none">• Multiple inputs• 1 output
End Sequence	SCC	Identifies the end of a sequence <ul style="list-style-type: none">• Continuation conditions• No instructions

BPO control chart This table describes the functions of the Basic Process Operations Control Chart Elements.

Element Type	Chart Type	Description of Functions
Begin BPO	BPO	Identifies the beginning of a BPO <ul style="list-style-type: none">• Entry instructions• Abnormal condition identification• Abnormal condition instructions
Step	BPO	Performs all normal instructions <ul style="list-style-type: none">• Up to eight continuation conditions evaluated before entry• Up to 12 instructions which can be executed upon entry, exit, timeout and/or mode change.
Branched Step	BPO	Same as Step but with up to four outputs. <ul style="list-style-type: none">• Logic control branches to one (and only one) of the four outputs.
Branch-in	BPO	Up to four inputs and one output.
End BPO	BPO	Required final element of a BPO <ul style="list-style-type: none">• Continuation conditions evaluated before entry.

Logic Instructions

List of logic instructions The following is a list of S9000 Controller logic instructions.

Instruction Type	Instruction
Relay Logic	Normally Open Contacts Normally Closed Contacts Transition On Contacts Transition Off Contacts Branch Output Retentive Output Latch Output Unlatch Output
Timer and Counter	ON Delay Timer (0.1 second, 1.0 second) OFF Delay Timer (0.1 second, 1.0 second) Retentive ON Delay Timer Up/Down Counter
Skip	Not Skip and Retain (NSKR) Not Skip and De-energize(NSKD) End of Skip (EOS) Return to Beginning of program Jump Jump to Subroutine Subroutine Return to Subroutine
Sequencer	Sequencer Load Sequencer Unload Sequencer
Miscellaneous	Input Status Scan (ISS) No Operation Matrix Instructions Conditional Data Handling Binary to BCD Conversion BCD to Binary Conversion

Continued on next page

Logic Instructions, Continued

List of logic instructions, Continued

Instruction Type	Instruction
Data Manipulation	Bring In Send Out PUSH PULL Constant Indirect Bring In Indirect Send Out Floating Point Most Significant Register Floating Point Least Significant Register Floating Point Bring In Floating Point Send Out Bit Write Floating Point to Integer Conversion Integer to Floating Point Conversion
Arithmetic	Addition Subtraction Multiplication Division Equality Comparison Less-Than Comparison Greater-Than Comparison Test for Zero Floating Point Square Root

Input/Output Modules

Summary

The following tables list the specifications for the S9000 Input/Output modules.

Analog input

Parameter	Module Type		
	Universal Analog	Fast High Level Analog	Resistance Temperature Detector
Inputs	16 differential (isolated)	8 differential (isolated)	8 isolated (2, 3, or 4 wire input) ⁵
Resolution	14 bits	12 bits	14 bits
Accuracy	±0.05% full scale	±0.1% of span	±0.8°F or ±0.48°C
Conversion Speed	20 conversions/sec without burnout 16 conversions/sec with burnout	33 milliseconds for 8 inputs	20 conversions/sec at 60 Hz
Input Impedance	10 megohms	Greater than 200K ohms	1 megohm (minimum)
Input Voltage Range/RTD Type¹	1 to 5V 0 to 5V 0 to 10 mV ² 10 to 50 mV ² Direct sensor ^{*2,3}	0 to 10V -10 to 10V 0 to 5V -5 to 5V 1 to 5V	IEC RTD platinum 100, 200, 500 ohms JIS RTD platinum 100 ohms BURNS RTD platinum 100, 200, 500 ohms GE RTD copper 10 ohms
Input Current Range (use 1 to 5V range with external shunt)	4 to 20 mA 0 to 20 mA	4 to 20 mA 0 to 20 mA	Not applicable
Common Mode Voltage	30V rms maximum continuous	30V rms maximum continuous	30V rms maximum continuous
Temperature Coefficient	0.004% per °C	0.006% per °C	0.004% per °C
Point-to-Ground and Point-to-Point Isolation	300V peak 300V peak	1000V peak 1000V peak	300V peak 300V peak

¹ See Table 2 for RTD range data.

² Requires software filtering to meet accuracy specification.

³ See Table 1 (on the next page).

⁴ Eight 250 ohm shunt resistors supplied per module.

⁵ 4-wire, separate loop, dual connector hookup is not supported.

Continued on next page

Input/Output Modules, Continued

Analog Input, Continued

Table 1 Direct Sensor Actuation (Universal Analog Input Module)

		Range		Reference Accuracy		Temp. Stab. 59 to 131°F or 15 to 55°C
				72°F ±5°	22°C ±3°	
		°F	°C	±°F	±°C	±Degrees Error per 1° ΔT °F
Thermo- couples	B	105 to 3300 105 to 150 150 to 500 500 to 1000 1000 to 3300	41 to 1815 41 to 66 66 to 260 260 to 538 538 to 1815	30.0 20.0 4.0 1.7	17.0 11.0 2.2 1.0	1.67 1.67 0.39 0.18
	E	-454 to 1832 -454 to -202 -202 to 1832	-270 to 1000 -270 to -130 -130 to 1000	7.0 1.0	3.8 0.5	0.67 0.33
	J	0 to 1600	-18 to 871	1.0	0.55	0.06
	K	0 to 2400	-18 to 1316	1.0	0.55	0.09
	Ni-Ni- Moly	32 to 2500 32 to 500 500 to 2500	0 to 1371 0 to 260 260 to 1371	1.26 1.0	0.7 0.54	0.09 0.07
	N*	0 to 2372	-18 to 1300	1.0	0.55	0.09
	R	0 to 3100 0 to 500 500 to 3100	-18 to 1704 -18 to 260 260 to 1704	2.5 1.5	1.5 0.9	0.23 0.13
	S	0 to 3100 0 to 500 500 to 3100	-18 to 1704 -18 to 260 260 to 1704	2.5 1.5	1.5 0.9	0.23 0.13
	T	-300 to 700	-184 to 371	0.8	0.48	0.07
	W5W26 (W)	0 to 4200 0 to 600 600 to 3600 3600 to 4200	18 to 2316 18 to 316 316 to 1982 1982 to 2316	8.5 2.5 4.0	4.7 1.4 2.2	0.17 0.17 0.28

Continued on next page

Input/Output Modules, Continued

Analog Input, Continued

Table 1 Direct Sensor Actuation (Universal Analog Input Module), Continued

		Range		Reference Accuracy		Temp. Stab. 59 to 131°F or 15 to 55°C
				72°F ±5°	22°C ±3°	
		°F	°C	±°F	±°C	±Degrees Error per 1° ΔT °F
Carbon Potential**	ZrO ₂ Probe	measured carbon potential	0 to 2.00% 0.10 to 1.40% C	±0.02% carbon (natural gas enriching atmosphere)		
Dewpoint***	ZrO ₂ Probe	-50 to 100	-45 to 38			
% Oxygen**	ZrO ₂ Probe	0 to 20% O ₂ 20 to 40% O ₂		±0.5% O ₂ ±1.0% O ₂		
Honeywell RH Radlamic		1400 to 3400 1400 to 2100 2100 to 3400	760 to 1871 760 to 1149 1149 to 1871	4.2 1.4	2.3 0.8	0.17 0.05

*Nicrosil-Nisil or Omegalloy™ 14 AWG

**One ZrO₂ probe per module; probe can be Marathon Monitors, Corning, AACC, Furnace Control Corp. MacDhui, Barber Coleman, or Bricesco model.

***Furnace Control Corp. probe—one per module.

Continued on next page

Input/Output Modules, Continued

Analog Input, Continued

Table 2 Resistance Temperature Detector Input Range (RTD Module)

Type of Input Actuation	Range		Reference Accuracy		Temp. Stab. ±Degrees Error per 1° ΔT °F	0% Value In Ohms	100% Value In Ohms
			72°F ±5°	22°C ±3°			
	°F	°C	±°F	±°C			
IEC RTD—Platinum alpha = 0.00385 100 ohms 200 ohms 500 ohms	–300 to 900	–184 to 482	0.8	0.48	0.05	25.18 50.36 125.9	274.96 549.92 1374.80
JIS RTD—Platinum alpha = 0.003916 100 ohms	–300 to 900	–184 to 482	0.8	0.48	0.05	23.90	277.98
Burns RTD—Platinum alpha = 0.003902 100 ohms 200 ohms 500 ohms	–300 to 900	–184 to 482	0.8	0.48	0.05	23.86 47.72 119.20	277.37 554.74 1386.85
GE RTD—Copper alpha = 0.003856 10 ohms	–4 to 482	–20 to 250	2.00	1.11	0.12	8.26	18.68
Relative Humidity IEC RTD alpha = 0.00385 Dry/Wet Bulb	0 to 300	–18 to 149	0.3	0.2	0.02	93.03	156.90
<div>Relative Humidity calculation done for temperatures in the range of 21 to 212°F (–6 to 100°C)</div>							
Measured RH	Dry Bulb Range						
0 to <20	35 to 212	2 to 200	2% RH		0.11%RH/F		
20 to 100	35 to 40	2 to 4	2% RH		0.11%RH/F		
	>40 to 100	>4 to 38	1% RH		0.06%RH/F		
	100 to 212	38 to 100	1% RH		0.03%RH/F		

Continued on next page

Input/Output Modules, Continued

24 Vdc input module

Inputs	16
Voltage Range	18 to 28V
Current Range	3 to 9 mA
Switching Level: Logic 1 Logic 0	18 Vdc 11 Vdc
Allowable Leakage Current	1.3 mA
Input Delay OFF to ON ON to OFF	2.4 ms $\pm 20\%$ 17 ms $\pm 20\%$

115 Vac input module

Inputs	16
Voltage Range	90 to 140V
Current Range	6 to 24 mA
Switching Level: Logic 1 Logic 0	75V 43V
Allowable Leakage Current	1.5 mA
Input Delay OFF to ON ON to OFF	2.4 ms $\pm 25\%$ 30 ms $\pm 50\%$

Pulse input module

Inputs	4
Voltage Ranges	4.7 to 9 Vdc 10 to 32 Vdc 32 to 60 Vdc
Current (Typical)	7 to 15 mA
Maximum Input Frequency Low (filtered) High (unfiltered)	200 Hz 100 KHz
Minimum Pulse Width Filtered Unfiltered	2.5 ms $\pm 25\%$ 5 μ sec
Input Isolation	2500 Vdc optical

Continued on next page

Input/Output Modules, Continued

230 Vac/Vdc input module

Inputs	8
Voltage Range	195 to 250V
Current Range	4.5 to 10 mA (8.5 mA at 230V typical)
Switching Level: Logic 1 Logic 0	140 Vac/155 Vdc 63 Vac/90 Vdc
Allowable Leakage Current Vac Vdc	1 mA 1.5 mA
Input Delay OFF to ON ON to OFF	2.4 ms \pm 20% (plus 0 to 0.5 cycles) 17 ms \pm 20%

Analog output module

Outputs	4 non-isolated
Resolution	12 bits
Module Power Requirements	+5 Vdc, 285 mA -15 Vdc, 120 mA* +15 Vdc, 85 mA* plus 20 mA for each current output used
Output Ranges Voltage Current	\pm 10 Vdc, \pm 5 Vdc, 0 to 10 Vdc 4 to 20 mA
Load Voltage Current	8K ohm minimum 0 to 600 ohm
Accuracy	0.15% of Full Scale Range at 25°C
Temperature Coefficient Voltage Current	\pm 0.006% of FSR per °C plus 3/4 LSB \pm 0.03% of FSR per °C plus 3/4 LSB

*Voltage outputs not loaded.

Continued on next page

Input/Output Modules, Continued

24 Vdc output module

Outputs	16
Voltage Range	18 to 28 Vdc
Maximum Current Range	2A per circuit 5A per group of 4 12A per module
Surge Current	8A for 10 ms (non-repetitive)
Field Power Requirement	25 mA for each energized output
Off State Leakage Current	≤5 mA (typical)
On State Voltage Drop	≤2V at 2A
Fusing	1 per group of 4, 7A Fast-Blo

115 Vac output modules

Outputs	6 (isolated)	16
Voltage Range	90 to 140V	90 to 140V
Maximum Current Range	2A per circuit	2A per circuit 12A per module
Surge Current	10A, 1 cycle (non-repetitive)	8A, 1 cycle (non-repetitive)
Off State Leakage Current	≤5 mA (typical)	≤5 mA (typical)
On State Voltage Drop	≤2V at 2A	≤2V at 2A
Fusing	1 per circuit, 3A Fast-Blo	1 per circuit, 3A Fast-Blo

230 Vac output module

Outputs	8
Voltage Range	195 to 250V
Maximum Current Range	2A per circuit 6A per common 8A per module
Surge Current	8A, 1 cycle (non-repetitive)
Off State Leakage Current	≤5 mA (typical)
On State Voltage Drop	≤2V at 2A
Fusing	1 per circuit, 3A Fast-Blo

Environmental and Electrical Specifications

Summary

The following table lists the environmental and electrical specifications for the S9000 Controllers.

Description	Model 9000e	Model 9100e	Model 9200e
Power Requirements Voltage, Vac Frequency, Hz Power Consumption, VA	115 to 230* ±15% 50/60 95 or 110	115 to 230* ±15% 50/60 110	115 to 230* ±15% 50/60 110
Battery Backup	6 mo. minimum	6 mo. minimum	6 mo. minimum
Communications RS-232 port to the Operator Panel DMCS port to the PC Supervisor or Manufacturing Supervisor, optionally 10 BASF ethernet port or general AUI ports. DMCS port to external Honeywell devices	1 1 1	1 1 1	1 1 1
Ambient Temperature (Operative Limits) °C °F	0 to 60 32 to 140	0 to 60 32 to 140	0 to 60 32 to 140
Relative Humidity % (non-condensing)	5 to 95	5 to 95	5 to 95
Vibration Frequency, Hz Acceleration, g	500 2	500 2	500 2
Mechanical Shock Acceleration, g Duration, msec	15 11	15 11	15 11
Dimensions Height, inches (millimeters) Width, inches (millimeters) Depth, inches (millimeters)	10.7 (272) 19 (483) 7.5 (191)	10.7 (272) 19 (483) 7.5 (191)	10.7 (272) 19 (483) 7.5 (191)
Mounting	Panel or 19-inch rack mount	Panel or 19-inch rack mount	Panel or 19-inch rack mount
Weight Pounds Kilograms	39.5 18	39.5 18	39.5 18

*Field selectable.

Operator Panel

Summary

The following tables summarize the specifications for the Operator Panel.

Design features

Description	Monochrome	Color
Hardware	12-inch diagonal CRT. 12 lines by 40 columns of double-spaced characters.	12-inch diagonal CRT. 12 lines by 40 columns of double-spaced characters.
Operator Interface	Preformatted operator displays with up to 400 tagnames: <ul style="list-style-type: none">• Alarms• Digital Status• Overview• Loops• Loop Detail• Setpoint Program Operate• Setpoint Program Setup• Setpoint Program Detail• Recipe Setup• Recipe Detail• Text Information	Preformatted operator displays with up to 400 tagnames: <ul style="list-style-type: none">• Alarms• Digital Status• Overview• Loops• Loop Detail• Setpoint Program Operate• Setpoint Program Setup• Setpoint Program Detail• Recipe Setup• Recipe Detail• Text Information
Communications	One RS-232 port to the Controller	One RS-232 port to the Controller

Continued on next page

Operator Panel, Continued

Electrical, environmental and physical

Description	Monochrome	Color
Power Requirements Voltage, Vac Frequency, Hz Power Consumption, Watts	120/240* $\pm 12.5\%$ 50/60 45	120 $\pm 12.5\%$ 60 65
Ambient Temperature (Operative Limits) °C °F	0 to 50 32 to 122	0 to 50 32 to 122
Relative Humidity % (non-condensing)	5 to 95	5 to 95
Vibration Frequency, Hz	5 to 10, 0.200 in peak-to-peak 10 to 200, 1g peak-to-peak	5 to 10, 0.200 in peak-to-peak 10 to 200, 1g peak-to-peak
Mechanical Shock Acceleration, g Duration, msec	5 10	5 10
Magnetic field	0.1 oersted	0.1 oersted
Dimensions Height, inches (millimeters) Width, inches (millimeters) Depth, inches (millimeters)	14 (356) 19 (483) 16.1	14 (356) 19 (483) 16.1
Mounting	Panel mount—NEMA 4/12 enclosure	Panel mount—NEMA 4/12 enclosure
Weight Pounds Kilograms	42 20	42 20

*Field selectable.

Options

Summary

The following table lists specifications for the S9000 options.

I/O Expansion Rack (Local or Remote)	<p><i>Standard:</i> 12 input/output module slots and handles up to 3 analog I/O modules.</p> <p><i>Extended:</i> 11 input/output module slots and handles up to 8 analog I/O modules.</p> <p>ATTENTION Restrict the use of UAIM and RTD modules in remote I/O racks to temperature loops and/or data acquisition. Contact Honeywell for details.</p>
External Devices	<p>Up to 29 UDC 3000, UDC 5000, or UDC 6000 stand-alone loop controllers can be connected to the Controller. Note that a maximum of 32 loops can be configured in the Control Chart. This includes all internal and external PID sources.</p> <p>Up to two DPR 1500 Multipoint Recorders or two DPR 3000 Multipoint Recorders can be connected to the Controller. Note that external device communications does not support a DPR 1500 and a DPR 3000 on the same network.</p>

Ordering Information

Complete information

For complete ordering information, request these Model Selection Guides:

51-51-16-34 for Model 9000e Controller,
51-51-16-35 for I/O Expansion Rack,
51-51-16-36 for Model 9100e Controller,
51-51-16-37 for Model 9200e Controller,
51-51-16-38 for PC Supervisor,
51-51-16-39 for PC X-Terminal,
51-51-16-40 for Software Packages,
51-51-16-41 for Operator Panel.

For more information, contact your nearest Honeywell branch office or call:

1-800-328-5111, extension 99

Specifications are subject to change without notice.

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