

HC900 Hybrid Controller Technical Overview

Specification

Overview

The Honeywell HC900 Hybrid Controller is an advanced loop and logic controller offering a modular design sized to satisfy the control and data acquisition needs of a wide range of process equipment. When combined with the optional, performance rich 1042 or 559 Operator Interfaces that fully integrate the controller database, configuration and setup time is minimized. This powerful combination together with Honeywell's performance proven control technology provides users an ideal solution for process control. Open Ethernet connectivity also allows network access using a variety of HMI/SCADA software.

Easy-to-use Windows-based Hybrid Control Designer software, operable over Ethernet, an RS232 port or modem connection, simplifies controller and operator interface configuration. It provides advanced monitoring functions for debug, allows *run-mode* configuration changes while limiting process interruption, *uploads* the complete, annotated graphic

controller and operator interface configuration, plus supplies an array of printouts for enhanced documentation.

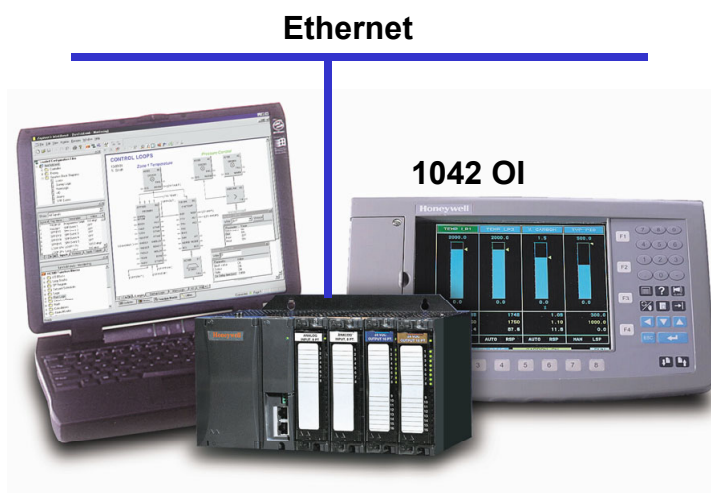
The HC900 Controller provides superior PID loop control and more robust analog processing than most logic controllers without compromising logic performance. A separate, fast scan cycle is available to execute a rich assortment of logic and calculation function blocks. Logic blocks may also execute synchronous with analog function blocks. These function blocks may be fully integrated into a combined analog and logic control strategy for uncompromising control performance.

Feature Summary

- Compact size – 5.4 "(137mm) high
- Up to 32 loops of PID Control
- Up to 960 points with remote I/O
- Remote I/O Racks
- Up to 256 Isolated, Universal Analog Inputs

- I/O Insert/Remove under power, auto-configured
- LED on/off indicators on digital I/O
- Graphic Function Block Configuration – up to 2000 blocks
- Boolean Logic programming
- Robust assortment of algorithms – over 100
- Advanced Floating Point Math Functions
- Fast updates – 27 ms logic, 0.5 sec analog
- Open 10MB Ethernet interface using Modbus/TCP protocol – supports 5 concurrent host connections
- Peer-to-peer communications via Ethernet
- Extensive Alarm and Event Monitoring
- E-mail alarm/event messaging on priority
- 8 Ramp/Soak Setpoint Programmers
- 2 Setpoint Schedulers with multiple outputs
- 4 Sequencers with 16 Outputs each
- Stored recipes, SP profiles, sequences, schedules
- Carbon Potential and RH Control

Hybrid
Control
Designer
Software



HC900 Hybrid Controller

- Furnaces
- Kilns
- Autoclaves
- Dryers
- Fermenters
- Water treatment
- Boilers
- Utility DAQ
- Pump stations
- Retorts
- Sterilizers
- Crystal Growing
- Extruders
- Pilot Operations

Figure 1—HC900 Hybrid Controller Overview

HC900 Controller

The rack based HC900 Controller is available in 3 rack sizes with 4, 8 or 12 I/O slots each to support a wide range of requirements.

C50 CPU -For greater installation flexibility the C50 CPU allows up to 4 additional remote racks to be connected to a single controller (with its local I/O rack) to reduce wiring and installation cost. A variety of analog and digital I/O modules are available to support a total of 960 I/O points, including up to 256 analog input points and 64 analog output points per controller.

C30 CPU -The C30 CPU supports a single rack with 4, 8 or 12 I/O slots and can accommodate up to 96 analog inputs or 192 total I/O points.

A standard Ethernet communication port on the C50 and C30 CPUs provides open connectivity to PCs or other supervisory interfaces and supports peer data exchanges to other controllers.

Inputs and Outputs - A variety of I/O modules are available for selection in creating a custom control solution. These include:

- 8 point universal analog input cards: Inputs may be mixed on a card and may include multiple thermocouple types, RTDs, ohms, voltage or millivoltage types – all easily assigned using the Hybrid Control Designer configuration tool. High point to point isolation simplifies installation and saves the expense of external isolation hardware.
- 4 point isolated analog output card: Supports from 0 to 20mA each.
- 16 point digital input cards: Contact closure type, DC voltage and AC voltage types.
- 8 point AC or 16 point DC digital output cards
- 8 point relay output card: four form C type and four form A type relays.

Remote I/O- Up to 4 I/O racks may be remotely mounted from the controller via an Ethernet-private 10Base-T connection at up to 300 meters (984 feet) between the controller and the most remote rack using two Ethernet hubs.

Insert & removal of I/O under power- For ease of maintenance, the HC900 controller supports removing and inserting I/O modules from the card rack without removing power from the controller. Each card is sensed for validity by the controller and auto-configured on insertion.

Remote Terminal Panels - Optional DIN rail mounted Remote Terminal Panels (RTPs) are available for use with pre-wired cables to reduce installation time and labor expense. Three types of RTPs are available: analog inputs, relay outputs and other I/O modules. Three cable lengths are also available to match hardware to installation variations. Analog input RTPs include transmitter shunt resistors and transmitter power terminals with individual circuit fuses. The RTP panels also switch field power to allow module removal and installation under controller power.

User configurations are permanently retained in flash memory in the controller. In the event a PC configuration file is lost or misplaced, it can be easily reconstructed using the upload function of the Hybrid Control Designer configuration software or via the 1042 and 559 OIs. Simply read the configuration from the controller to exactly duplicate the original configuration, including all text descriptions and operator interface display selections. In the event edits to a controller's configuration are required after the unit is in operation, the on-line download function of the HC900 Hybrid Control Designer software allows configuration changes while in the Run mode, limiting process disturbances.

The dynamic control status is retained in battery backed RAM memory in the controller. This function minimizes process upsets during momentary power interruptions and other discontinuous operations.

Advanced control and computational capability - A large assortment of analog and digital function blocks are available to solve the most demanding control requirements. Typical analog function blocks include totalizers, free-form math, average, mass flow, function generator, periodic timers based on real-time, carbon potential, RH, Dew Point, signal selection, comparison, and many others. These blocks may be configured to create control schemes that precisely address the needs of your process. Digital status outputs are also provided on many of the analog function blocks to facilitate intelligent signal alarming and default operation strategies. Typical logic function blocks include AND, OR, XOR, NOT, Latch, Flip-flop, On/Off Delay and Resettable timers, Counters, Free-form Boolean logic and more. The execution of analog and digital functions is seamlessly integrated into a single control strategy in the controller.

Function Blocks

Each HC900 Controller can support up to 2000 analog or digital function blocks. Each function block algorithm may be used any number of times in a control strategy unless specifically identified with quantity limits. Of the more than 100 function blocks available, 12 block types have limits imposed. These include:

	C50	C30
Control Loops –	32	8
Setpoint Programmers –	8	8
Setpoint Schedulers –	2	2
Sequencers –	4	4
Alternators –	6	6
Stages –	8	8
Ramps –	8	8
Hand/Off/Auto –	16	16
Device (Pump) Control –	16	16
Pushbuttons (4 PB's/block) –	8	8
Sel switches (4-position) –	8	8
Position Proportional Output –	64	16

I/O Capacity		
Input Type	Point per Module	Max. Points per C50/C30 Controller
Analog In	8	256/96
Analog Out	4	64/48
Digital In	16	960/192
Digital Out	8 AC or 16 DC	960/192

Loop Control- The robust control loops of the HC900 Controller support configurations from simple PID to interactive cascade, ratio, duplex, position proportioning and three position step for motor positioning or custom control strategies. Standard for every control loop is auto-tuning using Honeywell's performance proven Accutune II tuning algorithm. A selectable "Fuzzy Logic" algorithm is also provided for each loop to suppress unwanted process setpoint overshoot. A soft start feature allows output rate limiting for protection of a process load on startup or after power failure.

Sequencers - The HC900 controller supports up to four sequencer function blocks, greatly enhancing configuration of sequence operations. Each sequencer supports up to 16 digital outputs that may be either on or off in each of 50 states e.g. PURGE, FILL, HEAT, etc. The sequencer may have up to 64 sequential steps that activate within the states of the process. Steps of the sequencer may be configured to advance based on time, on event (2 per step), or a manual advance. A separate jog function is also provided. The function can also configure an analog output on a step basis. The operational sequence for the steps is retained in a separate sequence file in the memory of the controller that may be selected on-demand through a user interface or via a recipe. Up to 20 sequences may be stored.

Logic - Logic programming may be used to implement more robust and higher speed logic functions in the controller. The fast scan program executes all inputs, outputs and function blocks as fast as 27 milliseconds. The fast scan instruction set includes 2, 4 and 8 input logic blocks with selectable input inversion plus timers, triggers, latches, counters, timers, math and other supporting functions. A Sequencer function is also included with functionality beyond typical drum sequencers.

Sequence Control

			Outputs															
Step	State	State Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	PURGE	1	0	0	1	0	1	0	0	0	1	1	0	1	0	1	1
2	5	AGITATE	1	0	1	0	1	0	1	0	0	1	1	0	1	0	1	1
3	2	FEED B	0	1	1	1	1	0	1	0	0	1	1	0	1	0	1	1
4	3	MIX	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1
5	8	PREHEAT	0	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1
↓																		
64	50	STOP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Set Point Programming - Up to 8 independent set point programmers, each with an auxiliary soak output may be configured. A pool of up to 99 profiles, each with up to 50 segments may be stored in controller memory for user selection. Each programmer may have up to 16 event outputs for integration with the sequence control functions. Features such as guaranteed soak, jog to a segment and looping are also provided.

Setpoint Profile Table

Seg	Ramp/Soak	SP Value	Time/Rate	Aux Out	Guar Hold	Events
1	Ramp	100	20	0.0	OFF	1001100000000000
2	Ramp	500	30	1.1	OFF	1001001000000000
3	Soak	1300	90	1.1	ON	1011101000000000
4	Ramp	1300	50	1.1	OFF	1001001000000000
5	Soak	100	0.1	0.0	OFF	00000000100000

Setpoint Scheduling - Up to 2 independent set point scheduler functions may be configured. The scheduler function provides up to 8 ramp and soak outputs plus up to 8 soak only outputs that operate on a common time base. The scheduler also supports up to 16 event digital outputs. Soak guarantee, jog to a segment and nested looping features are also provided. Applications include multi-zone diffusion furnaces, CVD furnaces, and environmental chambers. Up to 20 schedules can be stored in the controller for user selection.

Recipes – Up to 50 recipes are stored in the controller. Recipes consist of up to 50 analog and digital Variables assigned within the configuration. This allows Variables representing setpoint profile, setpoint schedule, or sequencer numbers and/or other Variables for associated loop setpoints, bias values, alarm setpoints, limits, setpoints to external controllers, digital states, tuning constants, etc. to be part of a recipe. Recipes are selected by recipe tag name and descriptor from the HC900 Operator Interface or via a Recipe Selection block with a recipe # input.

Recipe: P1023-F7 TYPE 1023 HARDEN		
Variable		Value
Tag	Descriptor	
PROFNUM	Profile Number	2
BIAS2	TempBias–Zone2	12
BIAS3	TempBias–Zone3	18
Up to 50 Variables		
HIALMSP1	F1 Hi Temp Alarm	1280

HC900 Function Block Types

I/OBlocks (F=Fast Scan Rate, N=Normal Rate)

Analog Input	N	<p>Universal Analog Input, with table selection of input type (See Table 3)</p> <p>Filter – 1st order lag, 0 to 120 seconds</p> <p>Bias – Input value adjust for calibration correction</p> <p>Burnout – Off, Upscale, Downscale, Default Value</p> <p>Warn Output – activates if thermocouple resistance > 100 ohms.</p> <p>Input Disable –digital input when ON disables input, sets output to a defined default</p>
Analog Output	N	<p>Regulated analog output current</p> <p>Input scaling in Engineering Units, Output scaling within 0 and 20 mA</p> <p>Slew rate definable, Fail output pin is ON when output fail sensed, Failsafe definable</p>
Digital Input (1)	F,N	<p>Provides the digital status of a digital input point. The output status may be inverted. Both fast logic (27 ms) and normal logic (500ms analog rate) blocks available. Fail Output – activates on failed input channel or failed remote rack communications.</p>
Digital Input (Up to 8 inputs)	F,N	<p>Provides the digital status of the first or last 8 digital inputs of a 16 point input card. The output status may be inverted. Both fast logic (27 ms) and normal logic (500ms analog rate) blocks available. Fail Output – activates on failed input channel or failed remote rack communications</p>
Digital Output (1)	F,N	<p>Directs a digital status to a physical logic output. Output status may be inverted. Both fast logic (27 ms) and normal logic (500ms sec analog rate) blocks available. Fail Output – activates on output failure or failed remote rack communications.</p>
Digital Output (Up to 8 outputs)	F,N	<p>Directs 8 digital statuses to 8 physical logic outputs of an 8 point output card or to the first or last 8 physical logic outputs of a 16 point output card. Output status may be inverted. Both fast logic (27 ms) and normal logic (500ms analog rate) blocks available. Fail Output – activates on any one of 8 outputs with failed output or failed remote rack communications.</p>
Time Proportioning Output (applied to any PID output)	N	<p>Proportions the amount ON time and OFF time of a digital output.</p> <p>Input scaling in engineering units</p> <p>Cycle time—2 second to 120 seconds</p> <p>Output minimum ON and OFF time—0 seconds to 15 seconds</p>
Position Proportional Output C50 CPU up to 64 per controller C30 CPU up to 16 per controller	N	<p>A combination Input and Output function block that includes feedback input configuration and increase/decrease digital output configuration.</p> <p>Positions actuators with slidewire, current or voltage position feedback sensors. Provides outputs for actuator position (0 to 100%), motor fail, and feedback fail – automatically defaults to 3-position step on feedback fail.</p> <p>Input scaling in engineering units</p> <p>Actuator speeds from 12 to 300 seconds</p> <p>Output limits – adjustable (between 0 and 100%)</p> <p>Deadband – adjustable (0.5 to 5%)</p> <p>Feedback filter – adjustable (0 to 3 sec.)</p> <p>Feedback input types:</p> <ul style="list-style-type: none"> Slidewire 100 to 250 ohms (requires AI card 900A01-0002) Slidewire 250 to 1000 ohms (requires AI card 900A01-0002) mA - 4 to 20mA mA - 0 to 20mA Voltage - 0 to 1V Voltage - 0 to 5V <p>Feedback calibration – HC Designer, 1042 or 559 Operator Interfaces</p> <p>Automatic, Semi-automatic, and Hand methods supported.</p>

HC900 Function Block Types (continued)

Control Loop Function Blocks (F=Fast Scan Rate, N=Normal Rate)

<p>PID</p> <p>C50 CPU - up to 32 per controller</p> <p>C30 CPU – up to 8 per controller</p>	N	<p>PID algorithm includes:</p> <ul style="list-style-type: none"> • <u>Accutune II auto-tuning</u> and selectable fuzzy logic overshoot suppression • PID A (normal) or PID B (only integral response to SP change) operation, DUPA and DUPB operation which switches tuning constants for heat/cool applications • Two sets of PID constants selectable via program control. Choice of Gain or Proportional Band entry and Integral time or Repeats/minute entry • Setpoints—Two setpoint values or one value and one remote setpoint • Setpoint tracking – Local SP tracks PV or RSP on a RSP to LSP change • Setpoint limits, output limits, SP rate of change • <u>Soft start</u> for output rate limiting on startup or after power fail (not available with output tracking) • Ratio and Local/Remote Bias selections for Ratio control applications • Feedforward input (scaled in % of output) • Back calculation output for Cascade operation (supplied to primary loop) • Output tracking to track a remote input (for backup applications) • Remote A/M, R/L mode switching and mode status outputs • Function block access to tuning constants for gain scheduling • Alarms—Two outputs with up to two high, low, or dev band conditions each <p>Inputs: PV, remote setpoint, feedforward, output track and track command, ratio, bias, switch block connection, mode switch block connection, and back calculations</p> <p>Outputs: Control output, working setpoint, alarm status (2), Autotune indication, mode status</p>
<p>PID for Carbon Potential</p> <p>C50 CPU - up to 32 per controller</p> <p>C30 CPU – up to 8 per controller</p> <p>(displaces PID)</p>	N	<p>A combined carbon potential calculation and PID algorithm for controlling the carbon potential of furnace atmospheres using a zirconia probe input and temperature input. Local/remote %CO adjustment, probe manufacturer selection (4 selections), anti-sooting protection, dewpoint calculation output, and furnace factor adjustment is supported; probe burn-off configurable.</p>
<p>PID with 3 Position Step Output</p>	N	<p>Motor position control without position sensing. Standard PID features with addition of hysteresis (in %) and full stroke time (in sec.) entries for motor.</p>
<p>ON/OFF Control (32 standard)</p> <p>(displaces PID)</p>	N	<p>ON/OFF control algorithm with selectable hysteresis</p>
<p>Loop Switch Inputs</p>	N	<p>Digital interface to control loops to initiate autotuning, change control action, force bumpless transfer, select tuning set #1 and select tuning set #2. Connects to PID (all) and ON/OFF block switch input.</p>
<p>Loop Mode Selection</p>	N	<p>Digital interface to control loops to select automatic or manual modes and/or local or remote setpoint. Connects to all control loop types.</p>
<p>Mode Decoder (Mode Flags)</p>	N	<p>Decodes control loop mode status into a set of discrete (Boolean or digital) mode flags.</p>
<p>Write Tuning Constants</p>	N	<p>Automatically changes the GAIN, RATE, and RESET parameters of an internal PID loop without operator interaction. A digital input controls changes.</p>
<p>Auto-Manual Bias (32 standard, displaces PID) (for Boiler Control applications)</p>	N	<p>Allows a manually adjusted output to be maintained on transfer to automatic by applying bias to the input signal (from a Steam master to adjust participation of boiler). Bias value is maintained as output value tracks input value changes. Consumes 1 loop.</p>

HC900 Function Block Types (continued)

Setpoint Programmer and Recipe Function Blocks (F=Fast Scan Rate, N=Normal Rate)

Setpoint Programmer (8 maximum)	N	<p>Produces a setpoint output for a time-based ramp/soak profile that is loaded into the block. (See Setpoint Programming description for profile details.)</p> <p>Inputs:</p> <p>Process Variables, up to 3, to establish setpoint guarantee operation based on a deviation band from setpoint. Profile Number (for autoloading of a profile # for next run), New Starting Segment (uses a Set input to enter a new segment number).</p> <p>Digital Inputs:</p> <p>Enable (allows programmer to be operated), Set (to load a program or new start segment), Start, Hold, Restart (from power failure, can allow slower ramp up to previous SP to protect product), Reset, Advance, Jog (to a specified segment), and Guarantee Hold (to synchronize with another programmer).</p> <p>Outputs:</p> <p>Setpoint value, segment number, program number, time remaining in segment, time elapsed in segment, program elapsed time.</p> <p>Digital Outputs:</p> <p>Status (Ready, Running, Hold, Stopped), synchronize hold state, program state</p>
Setpoint Program Events (up to 16 events per block)	N	<p>Provides up to 16 digital status outputs that may be ON or OFF on a per segment basis. Inputs include program number, segment number, and program state (READY, RUN, HOLD, GHOLD, or STOP) from setpoint program block from program state output.</p>
Setpoint Program Synchronizer	N	<p>Used to synchronize the operation of two setpoint programs given the Run, Hold and Reset signals from each program.</p>
Recipe Block	F,N	<p>Used to initiate loading of recipe values into a chosen set of controller variables based on a recipe number. Inputs include recipe number and load command, allowing remote recipe selection.</p>

Setpoint Scheduler Function Blocks (F=Fast Scan Rate, N=Normal Rate)

Setpoint Scheduler (2 maximum)	N	<p>Produces up to 8 ramp or soak setpoint outputs on a common single time base. (See Scheduler description for details.)</p> <p>Inputs:</p> <p>Process variables, up to 8, to establish setpoint guarantee operation based on deviation from setpoint. Schedule number is used for automatic schedule loading and starting segment number allows first segment selection.</p> <p>Digital inputs:</p> <p>Dedicated input for connection to State Switch block output.</p> <p>Outputs:</p> <p>Up to 8 setpoint values, segment number, schedule number, time remaining in segment, time elapsed in segment, schedule elapsed time.</p> <p>Digital Outputs:</p> <p>Dedicated output for connection to State Flags block input.</p>
State Switch Block	N	<p>Provides digital switch status inputs to the Scheduler block for Run, Hold, Reset, Ghold, Advance and Jog.</p>
State Flags Block	N	<p>Accepts status output from the Scheduler block and provides digital output signals for Run, Hold, Ghold, Ready and Stop.</p>
Setpoint Scheduler Auxiliary Output Block	N	<p>Provides up to 8 additional analog setpoint (soak only) values for each segment of the schedule.</p> <p>Inputs: Up to 8 process variables used for display.</p>
Event Decoder	N	<p>Provides up to 16 digital outputs that may be ON or OFF on a per segment basis.</p>

HC900 Function Block Types (continued)

Auxiliary Control Function Blocks (F=Fast Scan Rate, N=Normal Rate)

Lead Lag Signal Conditioner	N	Modifies an analog input value to include lead and lag time constants when a digital input is true. Lead time constant = 0 minutes to 99 minutes Lag time constant = 0 minutes to 99 minutes
Function Generator	N	Generates an output characteristic curve based on up to 11 configurable "breakpoints" for input and output values.
High/Low Limiter	F,N	Limits an analog variable between high and low limit values. Provides separate digital status outputs when high or low limit values are exceeded.
Rate (Velocity) Limiter	N	Limits the rate at which an analog variable can change when a logic input is ON. Provides independent increasing and decreasing rate of change limit values. Separate digital status outputs indicate when high or low rate limits are active.
Rate of Change	N	Provides an output value representing the rate of change value of the input in units per minute. Output value is positive for increasing input values and negative for decreasing input values. Two setpoint values and digital outputs are provided to indicate excess increasing or decreasing rates of change or insufficient increasing or decreasing rates of change.
Read Constant	F,N	Provides a read access to internal static parameters of selected blocks by Block number and parameter index number.
Write Constant	F,N	Provides write access to internal static parameters of selected blocks by Block number and parameter index number.
Write Variable	F,N	Provides a write of a value to a selected analog or digital Variable number based on the ON state of a digital input.
Track and Hold	N	Allows updating or holding the value of an analog input based on the state of a digital input.
BCD Translator	F,N	Accepts up to 8 digital inputs in sequence and interprets the ON/OFF status of the first 4 inputs as a BCD value between 0 and 9, and the second 4 digits as a value between 10 and 90.
Digital Encoder	N	A 16 input block whose output is the decimal value of the number of ON inputs.

Specific Application Principal Blocks (F=Fast Scan Rate, N=Normal Rate)

Device Control (16 maximum) (for Pump Control)	N	Provides device control (pumps, etc) including Start, Stop, Feedback Delay times along with feedback confirmation and failure check.
Stage (8 maximum)	N	Accepts one or two analog variables and compares the values to high and low setpoints for each of 4 stages per block. Outputs are digital signals that remain ON after exceeding one setpoint until exceeding the second setpoint value for the specific stage.
Ramp (8 Maximum)	N	Accepts an analog variable and re-scales the value to new, user specified units. Up to 4 re-scale calculations may be configured per block. The re-scale calculation that is currently active is controlled by digital inputs to the block. Digital inputs may also be used to force the output to a high or low limit value.
Alternator (6 maximum)	N	The alternator accepts up to 16 digital inputs and, on a one for one basis, turns on up to 16 digital outputs as determined by a user specified alternating sequence. Alternator sequences include: Direct – Inputs are mapped to specific outputs. Rotary – Outputs are managed on a Last ON/ First Off (LOFO) basis and the mapped sequence indexes by one each time all of the outputs are off. FOFO – First On, First Off alternates the outputs based on the sequence in which the outputs were turned on. The first output to turn on is moved to the end of the list once it turns off. Fixed – The output sequence follows a user specified mapping sequence. A manual advance causes the mapping sequence to index by one when enabled. Both "make-before -break" and "break -before -make" selections are available for the block with user specified time delays for output changes.

HC900 Function Block Types (continued)

Signal Selector Function Blocks (F=Fast Scan Rate, N=Normal Rate)

High Selector/Low Selector	F,N	Provides the highest (high select) or lowest (low select) of two analog input variables.
Switch	N	Output switches between two analog input values based on the status of a digital input.
Bumpless Analog Transfer	N	Output switches between two analog input values based on the status of a digital input. When switched, output ramps to the new value at a specified rate. A rate value is available for each direction.
Rotary Switch	N	Single output is selected from up to 8 analog values based on the numerical value of a select input (1 to 8).

Calculation Function Blocks (F=Fast Scan Rate, N=Normal Rate)

Compare	F,N	Compares one analog variable to a second analog variable and generates separate digital outputs to indicate greater than, equal, or less than status.
Absolute Value	F,N	Provides an absolute value output for a single analog variable input.
Square Root	N	Output is the square root of a single analog variable input.
Mass Flow	N	Calculates the mass flow of gases when measuring flow using an orifice plate. Output = $K_g * \sqrt{(K_x * X + B_x) (K_y * Y + B_y) / (K_z * Z + B_z)}$ with inputs X = differential pressure Y = pressure, and Z = temperature. A low flow cut-off feature provides a user-specified drop-off value below which the output goes to zero.
Minimum – Maximum – Average – Sum	N	Accepts inputs from up to 6 analog variables and outputs analog variables representing the highest value, lowest value, average value, sum, and standard deviation. Removes bad inputs and provides an alarm output for deviations of any variable outside user-specified standard deviation.
Negate	F,N	Accepts a single analog variable input and negates the output.
Totalize	N	Integrates an analog variable using a specified rate. Rate may be in units per minute, hour, or day. A preset is provided to indicate when a specific quantity has been accumulated. Separate enable and reset inputs are provided.
Deviation Compare	N	Compares up to 6 analog variables to deviation limits set around a 7th variable. If any variable is outside the limits, a digital signal is provided.
Relative Humidity	N	Calculates the relative humidity using wet bulb, dry bulb, and atmospheric pressure inputs. Output may be in degrees Fahrenheit or Celsius.
Dewpoint (12 maximum)	N	A dewpoint PV is supplied to a PID function block for dewpoint control. Used in conjunction with other blocks including a PID to generate more elaborate control strategies than that provided by the carbon potential function block.
Continuous Average	N	Provides the average value of a single analog parameter for a user-specified time period, plus the running average within the time period. Average value is updated at the end of each sample period. Time periods to 1440.0 minutes are supported. A hold input allows excluding samples from the average when active.

Math Function Blocks (F=Fast Scan Rate, N=Normal Rate)

Scale and Bias	F,N	Output = $(K * X) + b$ with single analog variable input X.
Two and Four Input Math	F,N	Executes +, -, or * on two or four analog variable inputs, / on two inputs.
Free Form Math	N	Calculates the result of a user-specified equation with double precision. The block accepts up to 8 input signals (including Constants or Variables). Operators include: +, -, /, ^, and multiple levels of parentheses. Functions include: absolute value, exp, ln, Log, neg, sqrt. Example: $a*(\sqrt{b+c})+d$

HC900 Function Block Types (continued)

Logic Function Blocks (F=Fast Logic Rate, N=Normal Rate)

AND, OR, XOR (2 inputs) Boolean logic blocks	F,N	Provides a digital status output based on the digital status of two digital inputs for logic AND, OR, or XOR (exclusive OR) operations. Input status of each input may be inverted.
AND, OR (4 and 8 inputs) Boolean logic blocks	F,N	Provides a digital status output based on the digital status of four or eight digital inputs for logic AND or OR operations. Input status of each input may be inverted.
NOT (Complement)	F,N	Inverts a logic input status.
Latch	F,N	Provides a digital output that turns ON when a digital input turns ON and remains ON (latched) after the input goes OFF until an unlatch input turns ON.
Edge Detection Element (One-shot) [Trigger]	F,N	Provides an ON state of its output for one controller scan when a digital input goes from OFF to ON.
Toggle (Flip-Flop)	F,N	Provides an ON state output when a digital input goes from OFF to ON and the previous state of the output was OFF, and an OFF state output when the digital input goes from OFF to ON and the previous state of the output was ON. A reset input holds the output OFF when the digital input is ON or active high.
Free Form Logic	F, N	Reads eight digital inputs and calculates the output based on specified Boolean logic functions (e.g., AND, OR, NOT, etc.) and multiple levels of parentheses. Example: (A*B)+C
Pushbutton	F, N	Provides a one-shot output based on an OFF to ON change of an operator interface key action. Supports four pushbuttons per block.
Four Selector Switch	N	Provides up to 16 digital outputs in groups of four outputs each. Only one output from each group may be ON at a time and when selected automatically turns other outputs OFF. Simulates 4-position panel selector switches.
Sequencer (4 maximum) (Fast logic scan only)	F, N	The sequencer function block controls the output statuses of up to 16 digital outputs and one auxiliary analog output. Each combination of outputs represents a "State" of the sequence such as Heat, Mix, or Cool, for example. The function block supports up to 50 states. The sequencer contains up to 64 steps. Each step enables a State, allowing for a State to be designated for several steps. Each State supports two digital events as inputs that can designate the end of the associated step. Time in seconds or minutes, a manual advance, or a digital event can be used to terminate a sequencer step and cause the sequence to advance. A pool of 20 sequences, up to 64 steps each, may be stored in controller memory for quick recall and assignment to any of the 4 sequencers.
Hand/Off/Auto (16 maximum)	N	Provides Hand-Off-Automatic outputs based on digital inputs emulating a standard H-O-A panel switch

Counters/Timers Function Blocks (F=Fast Logic Rate, N=Normal Rate)

Resettable Timer	F, N	Provides a timing function based on an enable input. Elapsed time value is provided as an output. A Preset value allows settings from 1 second to 999999 seconds. A digital output is ON when time value is equal to the preset. An up/down digital input is provided to allow reverse timing from the preset value. A pre-load value allows initiating the timer to a non-zero starting time.
Periodic Timer	N	Provides an ON state output for one controller scan cycle based on a specified time period using the controller real-time clock. Periods may be monthly, weekly, daily, or time period in a day.
Up/Down Counter	F, N	Counts the number of raising edge logic transitions on the input to the block up to a preset value. When the preset value is reached a logic output is enabled. A reset input resets the block. Value may be set to increase to the preset value or decrease from the preset value (1-99999).
ON-Delay Timer	F, N	An OFF to ON change of the digital input is delayed on the block output by a user-specified time (0.1 seconds to 999.9 seconds).
OFF-Delay Timer	F, N	An ON to OFF change of the digital input is delayed on the block output by a user-specified time (0.1 seconds to 999.9 seconds).

HC900 Function Block Types (continued)

Alarm and Signal Monitoring Blocks (F=Fast Scan Rate, N=Normal Rate)

High Monitor	F, N	Accepts two analog values and provides a digital status output if the first input is higher than the second input. A hysteresis adjustment is provided to prevent output cycling.
Low Monitor	F, N	Accepts two analog values and provides a digital status output if the first input is lower than the second input. A hysteresis adjustment is provided to prevent output cycling.
Analog Alarm	N	The analog alarm block accepts an analog signal as a process variable and compares it to a user-entered limit value (setpoint) to determine an alarm condition. The setpoint may be entered by the user or be another analog signal in the controller. Alarm actions may be high, low or high deviation, low deviation or band deviation. For deviation alarming, a second analog signal provides the reference and setpoints represent deviation from the reference. The alarm output may be inverted to create normally active digital output. A user selection for latching until acknowledged or automatically reset is provided. A user-specified hysteresis value in the engineering units of the process variable is provided. An on-delay time value up to 240 seconds is available to prevent momentary alarm actions. A digital reset input is available to disable alarm actions.
System Monitor Block (1 block for normal scan and 1 block for fast logic scan) – (do not count against the maximum block count)	F, N	Provides system and start-up status outputs including: <ul style="list-style-type: none"> • Program scan cycle time • Newstart pulse (ON for one scan cycle after a “cold” start (reset)) • Restart pulse (to activate a custom control action on power-up after power loss) • Two common alarm outputs - Active Unacknowledged (ON when at least one alarm not ack'd), Active alarm (ON when at least one alarm is active), for assignment to digital outputs • Time off (the time that power has been off previous to restart) • Low Battery (alert to change battery without power shutdown) • Hardware OK (ON when all hardware including remote racks are OK) • Hi Temp (Cold Junction temperature exceeds limits on a rack) • Bad Block • Master Fail • Locked (controller toggle switch is in Run/Locked or Program position) • DS Limit (OI data storage has reached its alarm limit)

Alarm, Signal, and System Monitoring Blocks (continued) (F=Fast Scan Rate, N=Normal Rate)

IO Rack Monitor– (do not count against the maximum block count)	N	One monitor block per rack, 5 racks maximum (C50 CPU). Provides I/O module fault status
Alarm Group (Up to 20 blocks) – (do not count against the maximum block count)	N	Supports acknowledgement of a group of up to 12 alarms using a controller digital signal to block, internal or external (for remote acknowledge). Each alarm group consists of up to 12 alarms. Outputs include Unacknowledged alarm and Active alarm states. The 20 blocks support up to 240 alarms.

Communications Blocks (Peer to Peer) (F=Fast Scan Rate, N=Normal Rate)

PDE (Peer Data Exchange) Control	N	Interfaces to one HC900 peer device, accessed by controller name, supporting 8 parameter read requests and 4 event-triggered writes. Outputs may be given tag names for use in configuration strategy. Update rate can be configured from 500 ms to 5 sec.
PDE Read	N	Expands Read access for designated HC900 peer to an additional 16 parameters.
PDE Write	N	Expands Writes to designated HC900 peer by an additional 8 parameters, each triggered on event.

HC900 Function Block Types (continued)

Other Diagram Items (F=Fast Scan Rate, N=Normal Rate)

Analog Variable	F, N	Connects to a function block's inputs and can be changed from the operator interface or via serial communications addressing.
Digital Variable	F, N	Connects to a function block's inputs and can be changed from the operator interface or via serial communications addressing.
T (Text)	F, N	Allows descriptive data to annotate a specific area of a function block diagram to be entered. Four font sizes, four colors, bold/italics/underline supported. Text may be entered multi-line.
Soft Wire	F, N	For reference only. Soft-wiring method is to double click on a block pin and then clicks on a destination pin to complete soft-wire (or click to change direction en route to destination pin).
Connector	F, N	Connects tagged signals to function block inputs.
Signal Tag	F, N	Allows a name to be assigned to a wire and accessed by the operator interface or via serial communications.
Numeric Constant	F, N	A user-specified constant value that can be connected to function block inputs.

Alarms and Events

Alarms

An alarm may be assigned to any digital tag applied to a digital status output of a function block. Each control loop has two alarm status outputs, each corresponding to alarm setpoints of various types (e.g. PV HI, Dev High/Low, etc.). There are specialized alarm blocks for analog alarms with hysteresis adjustment. An expanded function analog alarm block also provides selection of alarm type, an on delay, selective latching, and a disable input to control when the alarm is active.

Alarm assignment is initiated by adding the digital "alarm" tags to an alarm group from a tag list. Alarm group blocks allow alarm partitioning into groups of 12 alarms. The 20 alarm group blocks allow up to 240 alarms to be defined. Each group may be assigned an alarm acknowledge function which permits external, panel acknowledge via a digital input or via a serial communications write to an internal Variable. Alarm groups may also be assigned to displays for the 1042 and 559 Operator Interfaces (OI).

Alarms can be assigned a priority (one of 4 levels - Low, Medium, High, Emergency) for use in routing a topic and 48 character alarm message electronically to any of three locations via the *e-mail* of alarms feature, if selected for an individual alarm. Alarm detection may also be on an off-to-on or on-to off transition, selectable on a per alarm basis. The method of acknowledgement is also selectable on a per alarm basis, manual or automatic. The Manual Ack selection requires user acknowledgement while Auto Ack will provide automatic acknowledgement on return to the non-alarm state. Active alarm indication is provided on all Operator Interface displays. Assigned alarm group displays show alarm status and permit group acknowledge of active alarms at the operator interface. An alarm detail display is provided for each alarm point which indicates the time and date of last alarm occurrence and offers up to 48 characters of user specified text for alarm actions or notes. Alarms may also be stored in an alarm file on the operator interface diskette or ZIP drive media (1042 only) configurable from 150 to 1500 records.

A resettable, common alarm output is available from a System block. This output can be directed to a DO or intermediate logic. An acknowledgement from any source can reset this output.

Events

Events are used for user alerts below an alarm priority (a non-alarm process condition) and may be assigned to any digital tag indicating function block output status. Up to 64 digital tags may be added to an event list and assigned to:

1. Trigger an *e-mail* for the event condition sent to any of up to 3 locations on occurrence
2. Be stored to the OI archive disk
3. Be displayed on the status line of the operator interface (16 characters) on occurrence.

Any one, two, or all three of these assignments may be selected.

Event detection may also be on an off-to-on or on-to off transition, selectable on a per event basis.

A standard operator interface Event Summary display lists the last 150 events by date, time, tag name, descriptor, and state text.

Communications

Ethernet Communications

HC900 controllers communicate with their host PC interfaces over an Ethernet 10Base-T communication network using the Modbus/TCP protocol, an open protocol interface available for most popular HMI software packages. Up to 5 hosts (servers or stand-alone) can be supported concurrently over an Ethernet network for control supervision and data acquisition. The Hybrid Control Designer software can also address any of the controllers concurrently over Ethernet for configuration monitoring, diagnostic interrogation, upload/ download, or on-line configuration changes. As a result, a HC900 network of controllers and operator interfaces can be partitioned into process segments to assure proper control performance. Each of these process segments, in turn, can be accessed via common HMI software within the plant environment using an Ethernet LAN.

Ethernet Peer to Peer Communications

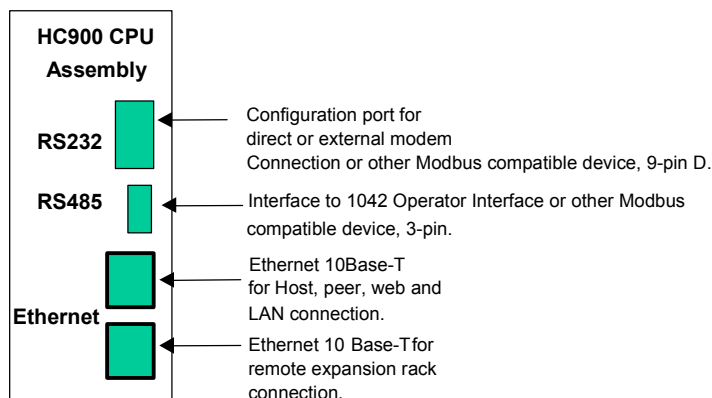
Peer data communications between one HC900 controller and up to 8 other HC900 controllers is supported over Ethernet via UDP protocol for process interlocks or data sharing. Both digital and analog data exchange are supported using peer data exchange function blocks, up to 1024 parameters between peer controllers. No specialized software is required. Peer data can be given signal tag references for use in a control or data acquisition strategy. Peer to peer data interchange does not consume one of the host connections.

Serial Modbus RTU

Communications -Serial Modbus RTU communications is available on the RS232 and RS485 (2 wire) ports of the HC900 Controller C50 and C30 CPU assemblies. The protocol of these ports is user selectable between a Honeywell private protocol for use HC Designer software and Honeywell operator interfaces, or Serial Modbus to interface with other compatible devices. (examples: 3rd party touch panels, PLCs, Modbus I/O for monitoring.)

Modbus RTU Slave - The RS232 and RS485 ports may be configured for simultaneous operation as a Modbus slave port to allow each to communicate with a single Modbus master. The Modbus protocol supports read and write access to variety of controller parameters using predefined address locations. In addition, a 1000 register array is available to allow the user to specify the address locations of specific controller data to optimize controller communications. The data in the array may also be accessed in user specified formats (data types) such as analog data in Float 32, unsigned 16, signed 16, unsigned 32, signed 32, and digital data in signed 16 or unsigned 16. The data type selections in the 1000 register array provide compatibility with devices such as 3rd party touch panels. HC Designer software supports communicating with HC900 controllers using the Honeywell private protocol or Modbus RTU protocol. Communications may be through a direct cable connection or via modem. When modem communication is selected, Modbus RTU communication timeouts are extended.

Modbus RTU Master - Either of the ports may be configured as a Modbus RTU master, one per controller. Up to 16 devices may be multi-dropped on the RS485 port or the RS232 port with an external, user supplied, RS232 to RS485 converter. Function blocks are available in the HC900 controller to allow the user to specify read and write operations to up to 16 external Modbus compatible slave devices and up to 384 data points. If the RS485 port is configured for Modbus RTU communications, a local 559 or 1042 operator interface will not be available.



E-Mail Alarming

HC900 alarms or events can be individually configured to send an e-mail alarm (or event) message to any or all of 3 e-mail addresses which have the associated alarm priority assigned.

Remote I/O Rack Port (C50 only) – A second private Ethernet port is provided and is dedicated to supporting expansion I/O racks. This 10Base-T connection will support a single direct connected expansion rack, or up to 4 expansion racks when connected through available external Ethernet hubs.

Operator Interface Port - An RS 485 port is provided for communications between the controller and a 1042 or 559 Operator Interface using a private protocol. This port supports a single Operator Interface for distances up to 2000 feet (609 meters) between the controller and operator interface.

Controller Configuration Access –

An RS-232 configuration port is provided and supports direct PC connection or external Modem connection for configuration upload, download, debug and maintenance. Once the HC900 controller has been configured with its companion Hybrid Control Designer Software, on-line configuration changes may be made with minimal process interruption. Configurations may also be loaded into the controller via the Ethernet TCP/IP network from a host PC. On-line monitoring for program debug and on-line program edit functions are also supported via the Ethernet port.

E-mail addresses	3 based on alarm priority
Message Content	From: Controller name (up to 16 characters) E-mail Subject: text (up to 32 characters) E-mail content: Alarm data including - Date, Time of alarm, alarm or event tag name, state text Message - 48 character alarm text (for alarms only)
Priority Levels	4 for alarms, 1 for events

PlantScape Supervisory Software

PlantScape SCADA or Vista Software, operating under Windows 2000, is available from Honeywell when PC-based supervisory control and data acquisition is required. Ethernet network interface to a PlantScape server is via the controller host Ethernet 10Base-T port using Modbus/TCP protocol. Client Stations over Ethernet allow multiple user access to an HC900 network. Using the large selection of standard operating display templates in PlantScape saves development time. When further customization is needed, the full graphic display development environment of PlantScape may be used to fully animate your process supervisory displays.

A batch reporting option is offered in Release 400 which enables batch reports to be created using a standard template. User-entered lot data is supported and up to 50 parameters can be defined for batch logging. The file can be exported in .csv format using a lot number-encoded filename.

SpecView32 Supervisory Software

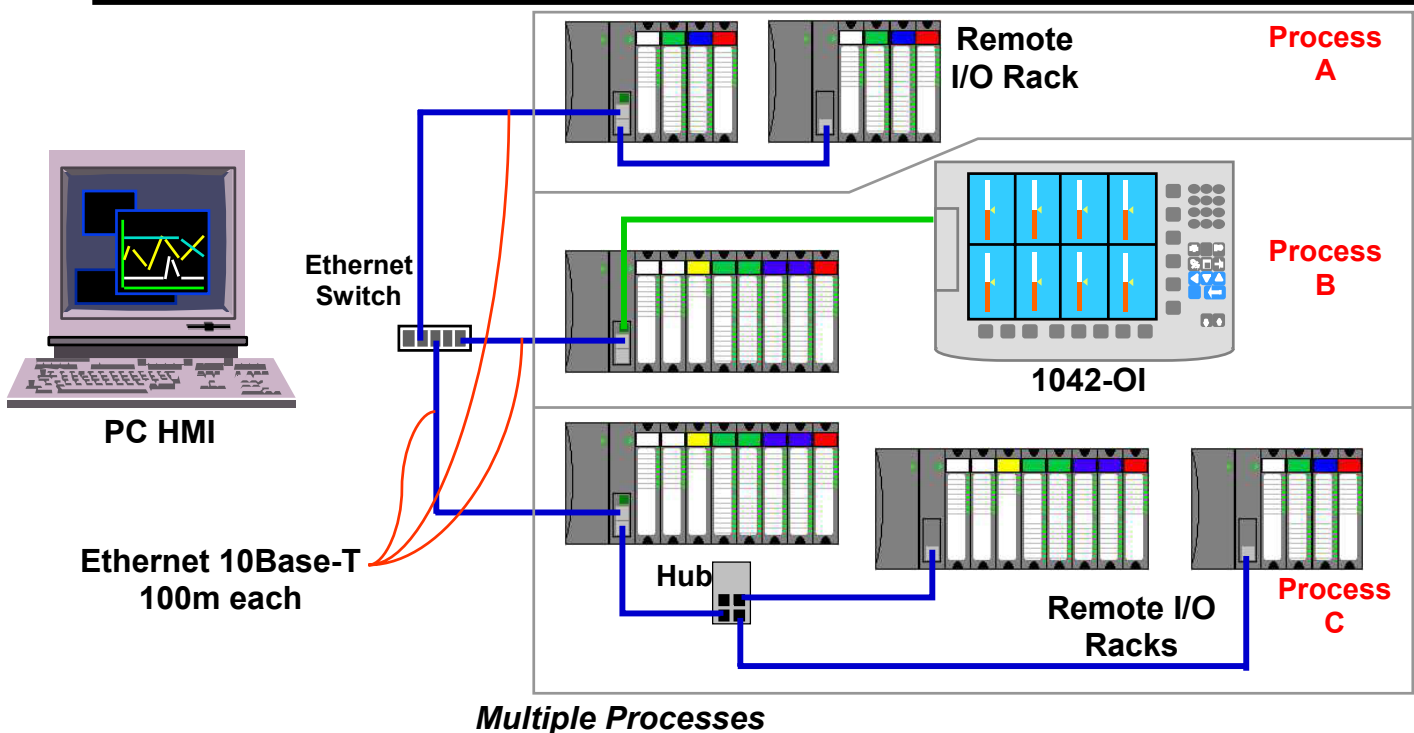
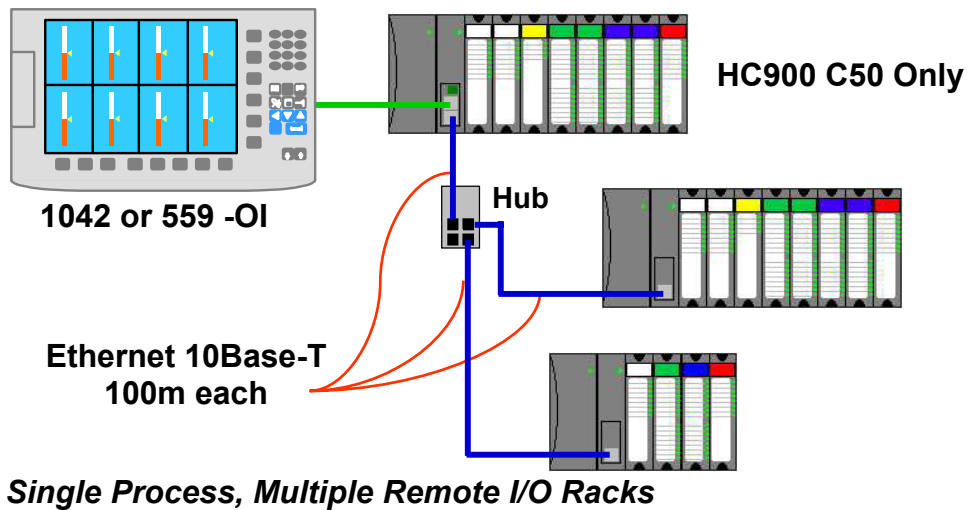
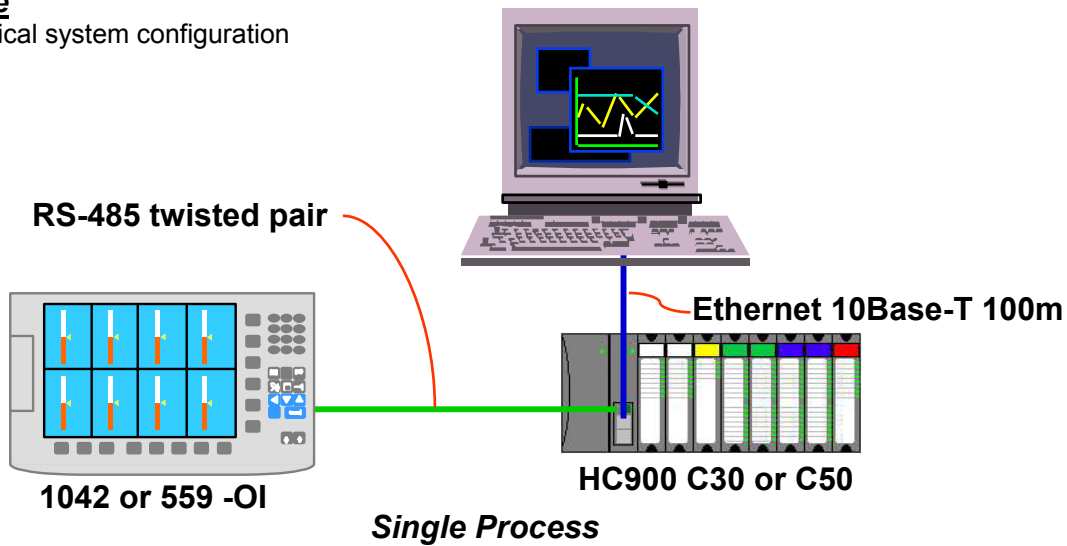
SpecView32 software can be used as a supervisory interface for thermal-based applications, offering historical trending, batch reporting, recipe development involving setpoint programs and simplified graphics configuration. HC900 parameters are simply selected from categorized lists for placement on user-configured displays or onto display objects. Network connection is via the controller host Ethernet 10Base-T port using Modbus/TCP protocol. A variety of Windows operating environments are supported including Windows 98, NT, 2000.

OPC Server

Serial communication access to the HC900 controller through third party PC interfaces is simplified with the OPC server software program available from KEPware. This software supports the Modbus/TCP interface to the HC900 controller. Compatible OPC client programs can use the Ethernet connection to the HC900 via the KEPware OPC Server for remote supervision, data collection or other supervisory functions.

Architecture

Below are typical system configuration architectures:



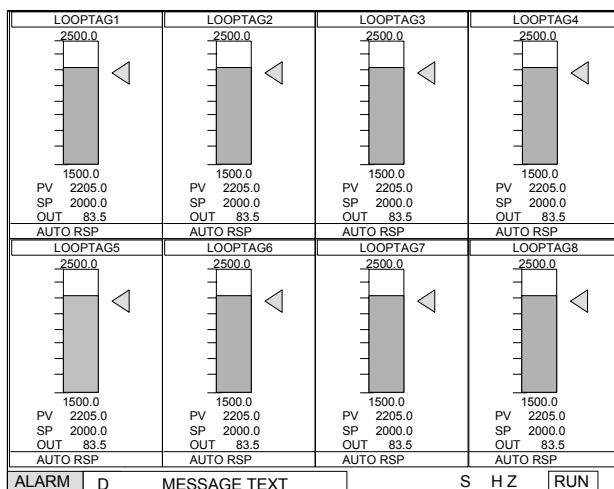
1042 Operator Interface

Features

- 10.4 in. bright, active matrix color LCD display
- Over 100 standard displays via a menu listing for setup, I/O summary displays, system diagnostics, I/O calibration, alarms, event summary, loop tuning, etc.
- Up to 80 operator displays, user-assigned to function keys
- 36 operator display formats for accessing loops, process data, or operator entry
- Setpoint programmer, Setpoint Scheduler, Sequencer interface
- Recipe and profile selection
- Recipe, Profile, Schedule and Sequence loading via floppy disk or ZIP.
- Data Archiving on floppy disk or Zip drive.
- Uses Hybrid Control Designer software for configuring display setup
- Controller configuration loading from floppy including on-line downloads
- Type 4X Front, CE Mark

The 1042 Operator Interface offers a wide assortment of standard display templates to get you up and running quickly. Single and multiple PID loop operate displays, setpoint program, setpoint scheduler, and sequencer operate displays, multi-pen trend graphs, bar charts, push button displays, text-based help displays, and overview displays are just a few of the many standard formats. Using the common HC900 Hybrid Control Designer configuration software, simply select the desired display format, select and visually apply the appropriate data for the display, then assign the display to a display button on the 1042 Operator Interface. Up to 10 displays may be assigned to each of 8 display buttons.

The 1042 OI configuration is automatically uploaded from the controller for synchronization. This simplifies replacement and also allows occasional use. The rugged 1042 panel mounted interface offers Type 4X ingress protection for the exposed components. A secure access door



8-Loop Display Format

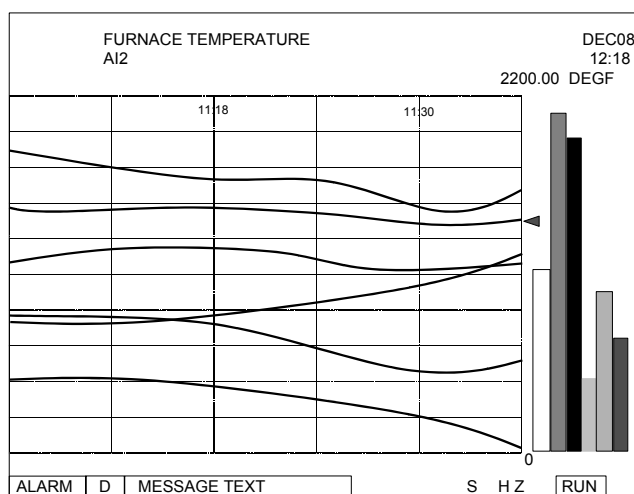
disk drive or optional 100 Meg ZIP disk drive.

Trend Displays – A selection of horizontal or vertical trend format displays are available to provide a historical record of recent control performance. Up to 4 trend displays may be configured with up to 6 analog or digital points on each display. Trend displays allow a user selectable time period of from 0.5 to 24 hours each. Each display will retain from 1.5 to 6 screens of historical data that may be recalled from memory.

Loop trends – A loop trend display is provided for each control loop for tuning or for short-term monitoring. Loop trend displays begin to collect

data when the display is accessed at approximately 1 sec. updates.

Alarms and Events – Alarms may be grouped and priority assigned to streamline on-line access to critical alarms. Each alarm point provides a detail display with the time and date of the recent alarm occurrence, plus an information field to further define the alarm condition, or to provide suggested operator action. Event messages are provided to prompt operators when a discrete action has occurred such as a completion of a batch segment. Up to 64 event messages may be configured. A time-stamped event summary display of the most recent 150 events is also provided.



Horizontal Trend with Bars

Data Storage – The 1042 Operator Interface provides a 1.44 Meg floppy disk drive that may be configured to store process data. Up to 2 trend files of 12 points each may be configured. A point log file of 12 points may also be setup to log asynchronous data based on digital events. Up to 5,000 records may be logged in a point log file. In addition to tabular data records, alarm and event records are also stored in individual files on the disk. When additional data storage capacity is needed, an optional 100 Meg ZIP drive is available in place of the 1.44 Meg. floppy drive.

559 Operator Interface

The 559-T4 and 559-T12 Operator Interfaces provide all the interface features of the 1042 Operator Interface, but use a 5.4 inch display window and increment and decrement keys for parameter entries. See Operator Interface specification 51-52-03-32 for product differences.

The **OI 559-T4** is packaged in a TYPE 4X enclosure to withstand wash-down at the front panel. The panel-mounted OI 559-T4 provides rear access to the floppy disk drive to protect the drive and your valuable data during wash-down operations. The **OI 559-T12** Operator Interface is packaged in a TYPE 12 enclosure ready to use with pre-packaged display formats and front panel access to the floppy disk drive for data archiving and configuration loading.

HC900 Hybrid Control Designer Software

Features

- Graphic drag and drop, soft-wire configuration
- Supports configuration edit downloads in RUN mode
- Configures:
 - Controller and Operator Interface (OI)
 - Peer-to-peer data exchange
 - OI data storage
 - Recipes, SP profiles, SP schedules, Sequences with file management and on-line operation
 - Alarms, events, e-mail alarms/events
- Allows function block configuration partitioning using "worksheets", up to 400 configuration pages.

- Configuration upload includes graphic configuration, OI assignments, and annotations
- Extensive on-line monitoring tools including the following:
 - User defined and pre-defined watch windows
 - Power flow indication
 - Pin value indication
 - Multiple block access,
 - Signal traceback
 - More
 - 5 Zoom levels for detail viewing
- On-line diagnostic windows for analyzing controller, I/O, network host and controller peer connections
- Windows NT, 2000, Me support
- Use Ethernet, RS-232 direct, or RS-232 modem connection to access controller

The HC900 Hybrid Control Designer software expands on the field proven concepts of the UMC800 Control Builder program (see Tables 3-5). The user-friendly graphic development environment allows partitioning of the control strategy into up to 20 "worksheets" of 20 pages each. This allows the configuration to be organized according to process function, providing faster configuration access, and improved documentation. In addition, OEMs may apply additional security to specific worksheets to prohibit access to proprietary operations while allowing their customers to modify unprotected worksheets.

Blocks are selected from a categorized list, dropped on a selected worksheet page, and soft-wired to other blocks directly or via tag references. Editing tools such as box copy and paste speed development. You may also copy and paste portions of strategies from other configurations.

On-Line Monitoring Features

Hybrid Control Designer on-line monitoring tools allow quick analysis of configuration problems. These include:

1. Multiple function block monitor access on a single display from multiple worksheets. Most internal parameters are available for read/write plus block outputs may be forced including I/O and logic blocks. Principle blocks such as PID, Setpoint Programmer and Sequencers have dialog boxes to allow operation and test. Stored profiles or sequences may also be selected on-line.

Logic Power Flow indication is provided when monitoring function blocks. Both color and line style

changes are used to indicate the ON and OFF status of logic signals on the graphic configuration diagram.

2. User-selected Watch Window lists allow access to digital and analog I/O, Signal Tags, Variables), and custom display data groups by tab selection. A user defined Watch Window may also be created by selecting parameters from the configuration diagram. Write capability from Watch Windows is supported.
3. Dynamic function block input and output values are provided when monitoring the function blocks of the configuration diagram. The dynamic value presentation may be limited to a single pin, a single function block or it may encompass the entire display window.
4. Signal Trace-back for any function block input. Used to find the signal source for quick identification of potential errors. A FIND function allows location of multiple instances of specific tags across all worksheets.
5. A separate Recipe Management feature allows creating, editing, copying and exporting recipes, profiles, schedules and sequences to allow transferring this information between configurations and controllers.

Configuration Edits-RUNMode

Configuration changes such as block additions or substitutions and soft-wiring can be transferred to the active configuration during the RUN mode, avoiding initialization. All outputs and status are held during a minimal transfer time after which processing continues at the start of a scan.

Operator Interface Configuration

Setup of the Operator Interface is an integral part of the controller configuration. Controllers configured for a 1042 or 559 interface can accept any 1042 or 559 OI and provide the necessary display format data without process interruption. This unique attribute guarantees compatibility of the controller and user interface databases, simplifying maintenance.

Hybrid Control Designer software uses the database of the function block program to develop operating displays for the Operator Interface. Simply select a display format and apply tags to the format from a drop-down menu. A large selection of display templates is provided that may be assigned to the display access hierarchy of the Operator Interface. Graphic objects

are used to identify the different classes of display types to simplify user selection.

In addition to creating displays and defining display access, Hybrid Control Designer software allows users to setup data archiving schedules, create alarm grouping, establish operator security, and define a number of other operator interface attributes.

Hybrid Control Designer Reports

Documenting your configuration is supported through a variety of report formats. Each can be print-previewed. A few of these include a summary of the controller I/O used, function block worksheet selection (each page of diagram worksheet printed as 8.5 x 11" sheet), function block properties, tag parameters, recipe listings, setpoint profile listings, sequencer listings, setpoint scheduler listings, OI display groups, and controller setup. For signal tracing, a Where Used list is also provided.

File Export for database transfer

When interfacing the HC900 controller to PC software programs, a time saving service is provided to export tag and variable definitions in CSV or tab delimited formats. In addition, the Modbus addresses of each configured data parameter may also be exported to a file.

Conversion from UMC800 Configurations

Users of UMC 800 controllers will benefit from their application engineering investment by converting UMC800 Release 5.0 (or later) configurations for file compatibility with HC900 controllers. There is no need to re-engineer the application.

HC Designer Revision Support

The latest revision of HC Designer may be used to configure any previous version of HC900 controllers and operator interfaces. Any features not supported in the previous version are ignored.

HC900 Hybrid Control Utilities Software

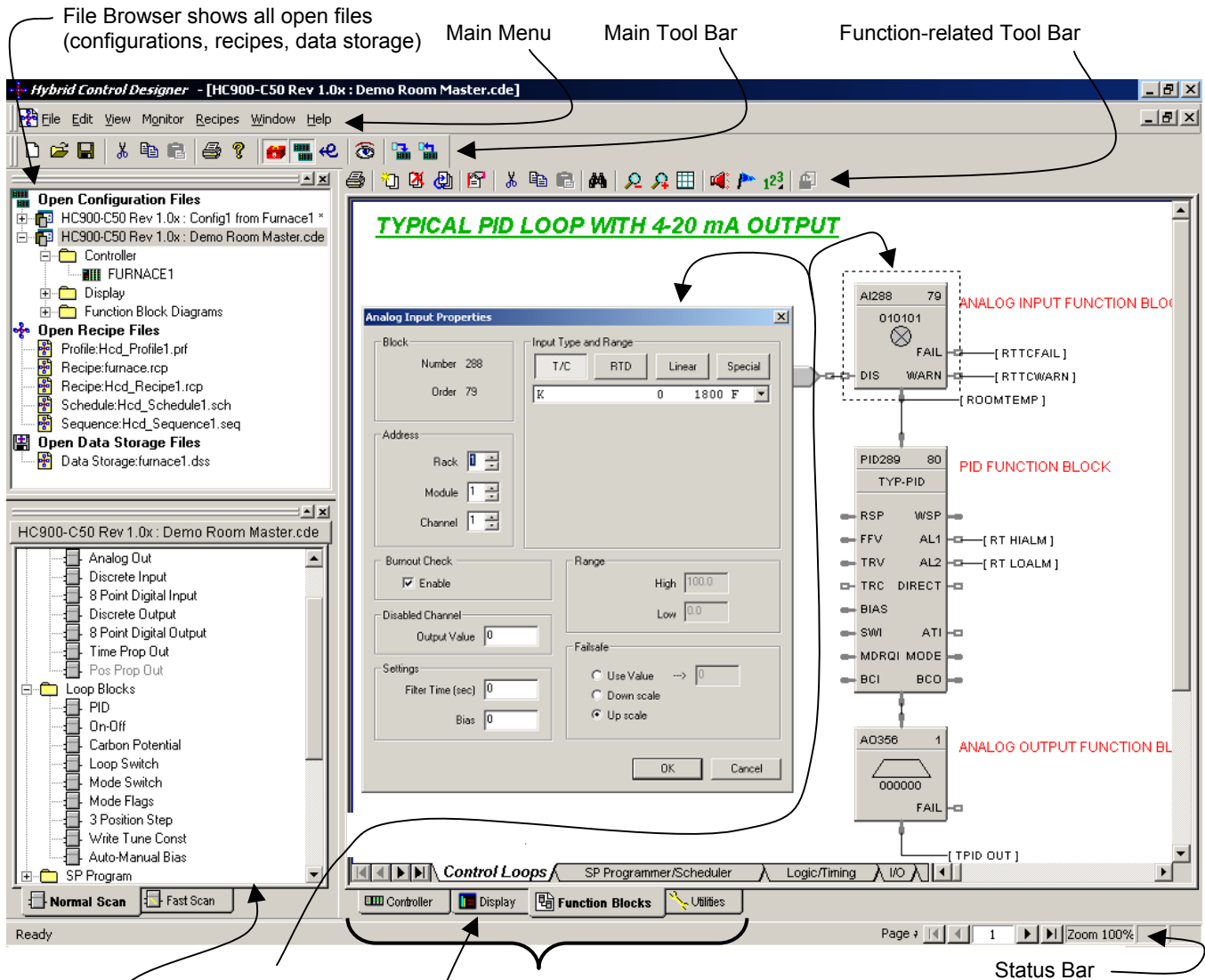
HC Utilities is a separate optional PC software application that provides many of the user maintenance and diagnostic functions of HC Designer software but restricts configuration changes. This software is an ideal program for OEMs and Integrators who wish to provide a maintenance program to their customers without the risk of unauthorized changes to the controller's program.

Files created in HC Utilities for Recipes, and Data Storage schedules may be loaded into the system via serial communications, network communications or by using a disk media through an operator interface.

The serial and network interface capabilities also allow users to download new controller configurations or perform equipment firmware upgrades without using an operator interface.

The following are a few of the services supported in HC Utilities:

- Recipe development: (Variables, Setpoint Profiles, Setpoint Schedules, Sequences)
- Data storage schedules
- Set controller communication ports
- Calibrate controller I/O
- Configuration reloads
- Firmware Upgrades
- View controller diagnostics
- Monitor controller configurations of unlocked worksheets

Hybrid Control Designer Software – Edit Mode

Hybrid Control Designer Software – Monitor Mode

User-defined Watch Summary Traceback Window Monitor Toolbar Zoom in/out

The screenshot displays the Hybrid Control Designer software in Monitor Mode. The main window shows a control loop diagram for F1-TEMP. The diagram includes a PID184 block, a comparator CMR291, and logic involving switches SW-A and SW-B. The status of various components is indicated by green (ON) and red (OFF) markers.

User-defined Watch Summary:

Tag Name	Descriptor	Value
RT LOAL	ROOM TE	OFF
RT HALM	ROOM TE	HITEMP
ROOMTE	ROOM TE	1800.0 DEGF
RTTOWA	ROOM TC	OK
RTTCFAIL	ROOM TM	TCOPEN
F2ZON2P	Loop 2 PV	0.0 degf
%CARB S		0
F2 %CAR	F2 % CAR	0.04 %C
ONE		1

Traceback Window:

Press to clear the traceback list

Function Block	Tag Name	I/O Pin	Worksheet Name
SPP126	SPPFURN2	SP	#2 - SP Programmer/Scheduler :
PID184	F1-TEMP	RSP	#1 - Control Loops :
CMR291		XGY	#1 - Control Loops :
AND292			#1 - Control Loops :
DI294			#1 - Control Loops :

Monitor - F1-TEMP:

Parameter	Value
Block status	OK
Mode	LSP MAN
Process Variable	0.000
Working Setpoint	0.000
Local Setpoint	0.000
Local Setpoint2	0.000
Manual Output Value	0.000
Out	0.0
Direct Control	OFF
Alarm 1	OFF
Alarm 2	OFF
Accutune	On Demand
Accutune In Progress	OFF
Gain	10.000

Monitor - CMR291:

Parameter	Value
Block status	OK
X	0.000
Y	1000.000
XGY	OFF
XEY	OFF
XLY	ON

Function Block Monitor Windows:

Write Constant Block for Loading via a Recipe Using Variable TMEI

Function Block Pin Monitoring Shows Pin Data:

Digital Signal Connector State Indicators:
Solid green = ON
Dashed red = OFF

HC900 Hybrid Controller Specifications

Controller Design

Modular design with metal rack enclosure, power supply, controller CPU and user selectable I/O module types.		
Controller System		
Network Communications Port	Ethernet 10Base-T, RJ-45 connection.	Supports Modbus/TCP Protocol to PC supervisory and data acquisition software packages, OPC server, and Hybrid Control Designer configuration software
	Max. number of concurrent Ethernet hosts	Up to 5 (peer data exchange does not consume a host connection)
Peer-to-Peer Communications	Ethernet 10Base-T via Network port	Supports UDP protocol and Peer Data Exchange function blocks for peer data exchange.
	No. of Peers/Controller	8 (9 total peer controllers)
	Update rate	500 ms to 5 sec., selectable
	Peer Data	Digital and Analog Signal Tags, Variables - up to 1024 parameters, addressed numerically
RS-232 Configuration Port	Ports per controller	One, 9-pin "D", private or Modbus RTU protocol. Supports link to PC running Hybrid Control Designer software or third party applications.
	Baud rates	9600, 19.2K, 38.4K, 57.6 K, configured by Hybrid Control Designer software or OI.
	Modem connection	For remote connection to Hybrid Control Designer software, requires external modem at controller, 9600 baud to 57.6KB
1042, 559, or third party Operator Interface Support	Ports per controller	One, RS-485 (connector supplied), private or Modbus RTU protocol
	Cable type	2-wire plus shield, Belden 9271 or equivalent
	Distance from controller	2000 ft.(600 m.)
	Power to OI	24VDC, user-provided at OI
Remote I/O (C50 CPU only)	Interface Type	Separate Ethernet 10Base-T port on CPU, RJ-45 connection, private communications link
	Remote racks	One without hub, using Ethernet direct cable Up to 4 with recommended Ethernet hub(s)
	Distance	328 ft. (100 m.) - controller to remote rack or controller to hub. Up to two hubs per connection, 984 ft. (300 m.), maximum distance.
Performance	Normal Scan Time	500ms. Each analog input card has its own A/D converter, providing parallel processing.
	C50 CPU Fast Scan Time	27ms for up to ~250 fast logic blocks 53ms for up to ~500 fast logic blocks 67ms for up to ~780 fast logic blocks 107ms for up to ~1040 fast logic blocks 133ms for up to ~1300 fast logic blocks
	C30 CPU Fast Scan Time	53ms for up to ~250 fast logic blocks 67ms for up to ~315 fast logic blocks 107ms for up to ~400 fast logic blocks

HC900 Hybrid Controller Specifications (continued)

C50 CPU Performance with Remote I/O	Normal Scan Time	500ms, included in normal scan	
	Fast Scan Time	27ms minimum for I/O within CPU rack, 53ms minimum with remote I/O	
Run-Mode Edit	Transfer Time	3 normal scan times (1.5 sec. typical) for all configuration edits not applicable to I/O	
Modes	3-position switch on controller – Run/Locked (No configuration download in this position), Run (Download allowed), Program/Locked (Outputs Off, initialization on download). Offline mode is available via software selection (for AI calibration).		
I/O Capacity	Maximum per controller	C50 CPU Combined Analog & Digital – Up to 960	C30 CPU Combined Analog & Digital - Up to 192
	Analog Inputs	Up to 256	Up to 96
	Analog Outputs	Up to 64	Up to 64
Size	4 I/O slot chassis	5.4"(137mm) H" x 10.5"(266.7mm) W x 6" (151.7 mm) D (rear mounting plate extends height to 6.9" (175.3mm)	
	8 I/O slot chassis	5.4"(137mm) H x 16.5"(419.1mm) W x 6" (151.7mm) D (rear mounting plate extends height to 6.9" (175.3mm)	
	12 I/O Slot chassis	5.4"(137mm) H x 22.5"(571.5mm) W x 6."(151.7mm) D (rear mounting plate extends height to 6.9" (175.3mm)	
Power (P01, P02)	Voltage	Universal power, 90 to 264VAC, 47 to 63 Hz	
	Rating	P01 Power Supply 130 VA	P02 Power Supply 90 VA
	In Rush Current	7 Amps peak-to-peak for 150 ms at 240VAC	7 Amps peak-to-peak for 120 ms at 240VAC
Wiring	Type	Removable terminal blocks	
	Styles	2, Screw terminal or Euro-style, tin-plated or gold-plated (for DC connections)	
	Gauge wires	Screw terminal – #14 to 26 AWG, solid or stranded Euro-style - #14 to 26 AWG, solid or stranded	
	Shield terminals	Optional brackets mounted top/bottom of rack	
Mounting/Installation		Surface mounting with 4 screws in back of rack Installation Category II, Pollution Degree 2, IEC 664, UL840 Installation coordination	
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 Directive. Conformity of this product with any other “CE Mark” Directive(s) shall not be assumed. EN61326: Electrical Equipment For Measurement, Control and Laboratory use. EMC requirements.		
General Purpose Safety	Compliant with EN61010-1, UL, UL 3121-1CSA, C22.2 No. 1010-1(All controller hardware and operator interfaces except for C30 CPU, P02 Power Supply and 559 OIs, which are currently planned.)		

HC900 Hybrid Controller Specifications (continued)

Hazardous (Classified) Location Safety	FM Class 1, Div. 2, Groups A, B, C, D Class 1, Zone 2, IIC	
	Module Type	"T" Rating
	Rack (4, 8, 12 I/O slots)	T6
	Power Supply (P01)	T4
	Controller C50CPU	T5
	I/O Scanner	T5
	Analog Input (8 channel)	T6
	Analog Output (4 Channel)	T5
	Digital Input, Contact type (16 Channel)	T5
	Digital Input, 24 Vdc (16 channel)	T4
	Digital Input, 120/240 Vac (8 channel)	T3C@ Ta= 60 deg. C T4 @ Ta = 40 Deg. C
	Digital Output, Relay type (8 channel)	T5
	Digital Output, 24 Vdc, (16 channel)	T4
	Digital Output, 120/240 Vac (16 channel)	T4

Ethernet Network Specifications	
Ethernet Network Connection	10Base-T, RJ-45 (10 Mbits/sec.)
Host Network Protocol	Modbus/TCP
Number of Concurrent Hosts	5
Peer Network Protocol	UDP
Number of Peers	9 (each controller has up to 8 peers)
Peer Data Update	500 ms to 5 sec., configurable

Serial Modbus RTU Specifications		
Ports	RS232 - user selectable protocol	Honeywell or Modbus RTU protocol
	RS485 – user selectable protocol	Honeywell for use with 1042 or 559 Operator interfaces or Modbus RTU protocol
	Modem (RS232 port only)	External, user supplied modem
	Unit addresses	1 to 254
	Parity (user selectable)	Odd, even, none
	Stop bits (user selectable)	1 or 2
	Speed (user selectable)	9600, 19200, 38400, 57600

HC900 Hybrid Controller Specifications (continued)

Serial Modbus RTU Specifications		
	Double Register Format for Modbus RTU Slave and Master data (User selectable)	FPB – Big Endian- (0,1,2,3) FP LB – Little Endian Byte Swap (2,3,0,1) FP BB – Big Endian Byte Swap (1,0,3,2) FPL – Little Endian (3,2,1,0)
Modbus Slave Operation	Number of ports per controller	Up to two
	Masters per port	One
	User Specified Register Address Array	1000 register addresses (45057 to 46056 decimal) Data Types; Unsigned 16, Signed 16, Unsigned 32, Signed 32, Float 32
	Principal Function Block Address Range	User selectable starting address range for registers assigned to each principal block type.
Modbus Master Operation	Number of ports per controller	One (RS232 or RS485)
	Function Block Types	Slave – 4 read and 4 write data points Read (Slave extension block) up to 16 parameters Write (Slave extension) up to 8 parameters (No limit on the number of Read and Write extension blocks per Slave block up to the maximum 384 parameters per controller.)
	Slave devices per controller	Up to 16
	Number of read/write Modbus Parameters	Up to 384 max. per controller
	Double Register Format	Selectable per device
	Speed	1 second max. – load dependent

Environmental Conditions				
Ambient Temperature F C	Reference	Rated	Extreme	Transportation & Storage
	77+/-5	32 to 140	32 to 140	-40 to 158
	25+/-3	0 to 60	0 to 60	-40 to 70
Ambient Relative Humidity	*10 % to 55 % RH non-condensing	*10% to 90 % RH non-condensing	*5 % to 90 % RH non- condensing	*5 % to 95 % RH non-condensing
Mechanical Acceleration Duration	0 g 0 ms	1 g 30 ms	1 g 30 ms	Not rated
Vibration	10 Hz to 60 Hz— amplitude 0.07 mm (peak-to-peak)	0 Hz to 14 Hz— amplitude 2.5 mm (peak-to-peak)		
	60 Hz to 150 Hz— acceleration 1 g	14 Hz to 250 Hz— acceleration 1 g		
* Applies up to 40C				

HC900 Hybrid Controller Specifications (continued)

I/O Module Attributes		
	Remove & Insert under power	Standard. Modules are automatically sensed and configured on insertion. Field power shall be disconnected before removing field terminal blocks.
	LED status indicators	Via light pipes at front of card for each digital I/O point – green indicates ON, logic side
	LED diagnostic indicator	One per card, tri-color to represent status, Green = OK, Red = Fault (# of flashes indicates fault), Amber = Override (Force)
	I/O Labels	Color-coded, on module door, removable, with write-on area to label I/O
	Processor	Microcontroller/module for parallel processing
	Terminal Boards	Removable, screw terminal or Euro-style
	Keying	Hardware keying matches module to connector

I/O Specifications.		
Universal Analog Inputs	Inputs per card	8 (isolated)
	Input types	mV, V, T/C, RTD, ohms, slidewire assigned to any channel
	Signal Source	See Table 2 for range types Thermocouple with cold junction compensation RTD , PT100 3 wire, 40 ohms balanced maximum Thermocouples: 100 Ohms/Leg 100 (except Low), 500 & 1000 RTD: 100 Ohms/Leg 100 YIS 100 Ohms/Leg 100-Low RTD & 10 ohm Cu: 10 Ohms/Leg Slidewire 100 to 1000 ohms 10% of total res./leg
	Input Impedance	10 megohms for T/C and mV inputs; >1 megohm for volts and mA inputs
	Input Isolation	400 VDC point to point, solid state switching 1K VDC to logic
	Noise Rejection	Series Mode >60dB. Common Mode >130dB at 120VAC.
	Burnout	T/C, mV, V (except following ranges) configurable to upscale, downscale, defined value, or none. Volt: –500 mV to 500 mV; –1 V to 1 V; –2 V to 2 V; –5 V to 5 V; 0 V to 10 V; –10 V to 10 V; inherent to zero volt RTD: Inherent upscale mA: Inherent downscale
	T/C Break Detection	Via current pulse
	Faulty thermocouple detection	If greater than 100 ohms, a warning status is provided as an output for the AI block

HC900 Hybrid Controller Specifications (continued)

Universal Analog Inputs (cont'd)	Accuracy	Factory configured accuracy = $\pm 0.1\%$ of range (all ranges except 0V to 10V and -10V to 10V, $\pm 0.2\%$ of range) Cold junction accuracy = $\pm 0.5\text{ }^{\circ}\text{C}$ Field calibration accuracy = $\pm 0.05\%$ of range <i>Reference conditions:</i> Temperature = $25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($77\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) Humidity = 45 % to 55 % RH non-condensing Line voltage = Nominal $\pm 1\%$ Source resistance = 0 ohm Series mode and common mode = 0 V Frequency = Nominal $\pm 1\%$
	Temp. Effect on Accuracy	$\pm 0.01\%$ of full scale per degree Celsius maximum
	A/D Converter	One per card
	A/D Resolution	15 Bits
	Reference Junction Sensing	Via 2 RTDs at top/bottom of module
	Update rate	500ms (Analog to Digital Converter per card)
	Long term Stability	0.1% per year

Analog Outputs	Outputs per card	4 (isolated)
	Current	0 to 21.8 mA, range selectable
	Load resistance	0 to 750 ohms
	Isolation	500VDC Channel to Channel
	Isolation from logic	600 VDC
	Accuracy	0.1% full scale at reference conditions
	D/A Resolution	12 bits

Digital Inputs	Inputs per card	AC Inputs	DC Inputs
		16	16 (sinking)
	Input Voltage Range	80 VAC to 264 Vac	10 VDC to 32 VDC
	Peak Voltage	264 Vac	32 VDC
	AC Frequency	47 Hz to 63 Hz	N/A
	Isolation	2 groups of 8 inputs	2 groups of 8 inputs
	ON Voltage Level	75 VAC	9.5 Vdc minimum
	OFF Voltage Level	20 VAC	3.5 Vdc maximum
	Input Impedance	48 K ohms	2.6 K
	Input Current	1 mA @ 120 Vac, 60 Hz 2 mA @ 230 Vac, 50 Hz	2.3 mA @ 12 VDC 6.9 mA @ 24 VDC
	Minimum ON Current	5 mA	3.5 mA
	Maximum OFF Current	2 mA	1.5 mA

HC900 Hybrid Controller Specifications (continued)

Digital Inputs (cont'd)	Base Power Required	50 mA maximum	230 mA max. for 5VDC
	OFF to ON Response	34 ms maximum	4 ms; 2ms nominal
	ON to OFF response	50 ms maximum	4 ms, 2 ms nominal
Digital Input (Contact type)	Inputs per card	16 (single-ended)	
	Voltage Supplied by controller	15 VDC nominal	
	Maximum contact resistance	1000 ohms	
	OFF to ON response	4 ms; 2ms nominal	
	ON to OFF response	6 ms; 5 ms nominal	
	Switching current	2.6 mA	

Digital Outputs		AC Outputs	DC Outputs
	Outputs per Module	8	16 (current sinking, low side)
	Isolation	Per output	2 groups of 8 outputs
	Operating Voltage	85 VAC to 240 VAC	6.5 to 32 VDC (5.0 to 6.5 V @ <0.5A per channel)
	Output Type	Triac	Intelligent power switch (IPS)
	Peak Voltage	250 VAC	34 VDC
	AC Frequency	47 Hz to 63 Hz	N/A
	ON Voltage Drop	<1.5 VAC (>0.1 A) <3.0 VAC (<0.1 A)	0.3VDC @ 1 A load
	Maximum Load Current	2 A per point, 8 A max. per card, resistive load	1 A per point, 8 A max. per card, resistive load
	Maximum Leakage Current	4 mA (240 VAC, 60 Hz) 1.2 mA (100 VAC, 60 Hz) 0.9 mA (100 VAC, 50 Hz)	0.15mA @ 32 VDC
	Maximum Inrush Current	60 A for 10 ms	4 A for 10 ms
	Minimum Load	50 mA	0.0 mA
	Base Power required	218 mA @ 5 V	426 mA @ 5 V
	OFF to ON Response	2 ms + ½ cycle	10 ms
	ON to OFF response	2 ms + 1/2 cycle	5 ms
	Fuses	1 per output, 3.15 A Time-lag	Electronic limiting
Relay Output	8 Relays per card	4 form A, 4 form C	
	Voltage	120/240 VAC, 30 VDC	
	Current Rating	4A @ 240VAC, 30VDC, resistive load 0.5 A, max. incandescent lamp load	
	Max. Leakage Current	1 mA @ 350 VDC	
	Minimum Load	0 mA	
	Base Power Required	140 mA @ 5 V 100mA @ 24 V	

HC900 Hybrid Controller Specifications (continued)

TABLE 1 – Controller Control Feature Summary

Feature	Description	
Control Loop/Outputs	C50 CPU 32 standard (current, time proportional, position proportional, 3-position step (motor positioning), dual output [heat/cool])	C30 CPU 8 standard (current, time proportional, position proportional, 3-position step (motor positioning), dual output [heat/cool])
Control Loop Types	PID A, PID B, Duplex A, Duplex B, Ratio, Cascade, % Carbon, Dewpoint, Relative Humidity, On-Off	
Auto-tuning	Accutune II, fuzzy logic overshoot suppression, applicable to all control loops	
Function Blocks	C50 CPU 2000	C30 CPU 400
System Blocks	100 (not part of 2000 or 400), for Alarm Group blocks, System block, Rack Monitor blocks	
Function Block Types	Greater than 100 (Same for C30 CPU and C50 CPU)	
Setpoint Programmers	8 (independent programmers) <i>Ramp Types:</i> Ramp Rate or Ramp Time <i>Time Units:</i> Hours or Minutes <i>Segment Time:</i> 0-99,999.999 hours or minutes <i>Program Cycles:</i> Up to 100 or infinite, configurable segment range	
Programmer Events	16, assignable to DO or internal status	
Setpoint Profiles	99 profiles of 50 segments each stored in controller	
Setpoint Scheduler	Two (2) <i>Ramp type:</i> Ramp time <i>Time units:</i> Hours or minutes <i>Segment time:</i> 0.001 to 9999.999 hours or minutes <i>Cycles:</i> Per segment to 999 or infinite	
Auxiliary Scheduler Setpoints	Up to 8 setpoints, soak only	
Schedule events	Up to 16, assignable to DO or internal status	
Setpoint Scheduler Schedules	20 Schedules stored in controller, 50 segments each	
Sequencers	Four (4) <i>States:</i> 50 <i>State text:</i> 12 characters <i>Steps:</i> 64 <i>Time Units:</i> Minutes or Seconds <i>Digital Outputs:</i> 16 <i>Analog Output:</i> 1, configurable value/step <i>Step Execution:</i> On Time, Event 1, Event2, or via Advance initiation <i>Next Step:</i> Any step	
Sequences	20 sequences stored in controller	
Recipes	50 stored in controller	
Recipe Parameters	Up to 50—including profile numbers, analog or digital Variables	
Signal Tags (Read only)	2000	
Tag Identification	8-character tagname, 16-character descriptor, 4-character units of measure (analog only), 6 character on/off state (digital only)	
Variables (Read/Write)	600	
Variable Identification	8-character tagname, 16-character descriptor, 4-character units of measure (analog only), 6 character on/off state (digital only)	

HC900 Hybrid Controller Specifications (continued)

TABLE 2 – Analog Input Reference Accuracy

Input Type	Range		Reference Accuracy	
	°F	°C	°F	°C
B T/C	0 to 105	-18 to 41		
	105 to 150	41 to 66	55.0	30.6
	150 to 500	66 to 260	30.0	16.7
	500 to 1000	260 to 538	8.0	4.5
	1000 to 3300	538 to 1815	4.0	2.3
E T/C	-454 to -202	-270 to -130	25.0	14.0
	-202 to 1832	-130 to 1000	2.3	1.3
E (low) T/C	-200 to 1100	-129 to 593	2.0	1.2
J T/C	0 to 1600	-18 to 871	1.2	0.6
J (low) T/C	20 to 770	-7 to 410	1.0	0.5
K T/C	0 to 2400	-18 to 1316	2.0	1.2
K (low) T/C	-20 to 1000	-29 to 538	1.6	0.8
K T/C (mid)	0 to 1800	-18 to 982	1.8	1.0
Ni-NiMo (NNM68)	32 to 500	0 to 260	2.0	1.2
	500 to 2500	260 to 1371	1.5	0.8
Ni-NiMo (low)	32 to 1260	0 to 682	1.3	0.7
NiMo-NiCo (NM90)	32 to 500	0 to 260	2.0	1.2
	500 to 2500	260 to 1371	1.5	0.7
NiMo-NiCo (low)	32 to 1260	0 to 682	1.3	0.7
NiCroSil-NiSil (Nic)	0 to 2372	-18 to 1300	2.0	1.2
Nic (low)	0 to 1472	-18 to 800	1.4	0.9
R T/C	0 to 500	-18 to 260	5.0	2.8
	500 to 3100	260 to 1704	2.2	1.2
S T/C	0 to 500	-18 to 260	4.5	2.5
	500 to 3100	260 to 1704	2.2	1.2
T T/C	-300 to 700	-184 to 371	2.0	1.2
T (low) T/C	-200 to 500	-129 to 260	1.0	0.5
W ₅ W ₂₆	-4 to 600	-20 to 2320	27.0	15.0
	600 to 3600	316 to 1982	4.0	2.3
	3600 to 4200	1982 to 2316	4.2	2.4
W ₅ W ₂₆ T/C *	0 to 600	-18 to 316	3.5	2.0
	600 to 3600	316 to 1982	3.0	1.7
	3600 to 4200	1982 to 2316	3.5	2.0
W ₅ W ₂₆ (low) T/C*	0 to 2240	-18 to 1227	2.5	1.4

HC900 Hybrid Controller Specifications (continued)

TABLE 2 – Analog Input Reference Accuracy (cont'd)

Input Type	Range °F	°C	Reference Accuracy °F	°C
Platinel	-94 to 1382	-70 to 750	3.0	1.7
Platinel (low)	32 to 2516	0 to 1380	1.5	0.8
100 Pt. (high) RTD	-300 to 1500	-184 to 816	1.8	1.0
100 Pt. (mid) RTD	-300 to 1200	-184 to 649	1.4	0.8
100 Pt. (low) RTD	-300 to 300	-184 to 149	0.6	0.3
500 Pt. RTD	-300 to 1200	-184 to 649	0.9	0.5
1000 Pt RTD	-40 to 500	-40 to 260	0.8	0.4
100 JIS	-328 to 932	-200 to 500	1.3	0.7
100 JIS (low)	0 to 212	-18 to 100	0.5	0.3
Cu10	-4 to 482	-20 to 250	2.0	1.0
YSI405	50 to 100	10 to 37.8	0.05	0.03
Input Type	Range	Reference Accuracy		
Ohms, 200	0 to 200	+/- 0.4 ohms		
Ohms, 500	0 to 500	+/- 1.0 ohms		
Ohms, 1000	0 to 1000	+/- 2.0 ohms		
Ohms, 2000	0 to 2000	+/- 4.0 ohms		
Ohms, 4000	0 to 4000	+/- 8.0 ohms		
Milliamperes	4 to 20 mA dc 0 to 20 mA dc	± 0.2% F.S. (mA)** ± 0.2% F.S. (mA)**		
Millivolts	0 to 10 mV dc 0 to 50 mV dc 0 to 100 mV dc -10 to 10 mV dc -50 to 50 mV dc -100 to 100 mV dc -500 to 500 mV dc	± 0.17% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.2% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV)		
Volts	1 to 5 V dc 0 to 2 V dc 0 to 5 V dc 0 to 10 V dc -1 to 1 V dc -5 to 5 V dc -10 to 10 V dc	± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV) ± 0.1% F.S. (mV)		
Slidewire	100 to 250 ohms 250 to 1000 ohms			
Carbon	0 to 1250 mV dc	± 0.1% F.S. (mV)		
Oxygen	-30 to 510 mV dc	± 0.1% F.S. (mV)		

* W₅W₂₆ is also known as type "C" Thermocouple.

** Tolerances for these input types include that of the external Dropping Resistors.

HC900 Hybrid Controller Specifications (continued)

Remote Terminal Panel Specifications		
Mounting	Standard 35mm wide DIN Rail	Provides connection of field wiring to controller I/O within an enclosure only.
Dimensions	4.38" (111.1 mm) x 3.70" (94.0mm) x 2.60" (66.0mm) (LxWxH)	
Vibration	Amplitude	5Hz to 15.77Hz, 2.03mm(0.08") amplitude (peak to peak)
	Acceleration	15.77 to 250Hz, 1.0-g
	Vibration	Sweeping, at rate of .33 octave/min.
Tray material	Tray and end caps	Polyvinyl Chloride (PVC)
	Flammability	UL94-V0
Environmental	Temperature	Operating: 0 deg. C (32F) to 60 deg. C (140F)
		Storage: -40 deg. C (140F) to 70 deg. C (158F)
	Relative Humidity	Operating: 10% to 90% Non-condensing
		Storage: 5% to 95% Non-condensing
Certifications	CE	EN61326, EN61010-1
	UL	UL 61010C – 1
	CSA	CSA 22.2 – 1010-1
	CSA	Class 1, Div 2 Hazardous (Classified) Locations
	FM	Class 1, Div. 2 Module Temperature Classifications Analog Input type = T6 Relay Output type = T5 DI, DO, AO Type = T4
Types	Compatible Modules	
Analog Input RTP	Analog input Module	Excludes Thermocouple Input types. Accuracy De-rating (Module + RTP) 100 ohm Plat. RTD = +/- 0.14% of range JIS RTD = +/- .22% of range 10 ohm Cu. RTD = +/- .67% of range 200 ohm = +/- 0.17% of range 0 – 10 mV = +/- 0.14% of range
	Transmitter power	Common supply terminals – selectable per circuit. Fuse per circuit - 80mA, time lag type
	Shunt Resistor	Selectable per circuit 250 Ohms, 0.05% - 15ppm
Relay Output RTP	Relay Output Module	Relay common disconnect per circuit Fuse per circuit – 6.3A, time lag type 24A maximum per RTP

Remote Terminal Panel Specifications		
DI, DO, AO RTP	Discrete Input Module DC Type Discrete input module AC type Discrete output module DC type Discrete output module AC type Analog Output module	Jumper selectable configuration
Cables	Construction	Pre-wired cable with mating plugs for RTP panels and HC900 Controller I/O modules.
	Lengths	1.0M, (3.28ft), 2.5M (8.2ft), 5M, (16.4ft)
	High voltage type	10 twisted pair, 20AWG with shield and drain, PVC insulation – 300Volt, -20 to 80 deg. C Used with Relay and AC I/O modules.
	Low voltage type	10 twisted pair, 24 AWG with shield and drain, PVC insulation – 300Volt, -20 to 80 deg. C Used with Analog Input, Analog output and DC I/O modules.

Operator Interface

Models 559 and 1042, See Specification: 51-52-03-32.

Hybrid Control Designer and Hybrid Control Utilities Software

TABLE 3 – HC900 Hybrid Control Designer & Hybrid Control Utilities Software Specifications

Design	
PC Requirements	Software runs on Windows NT, 2000, Me, Minimum—Pentium 200 MHz with 64 MB of RAM Screen resolution – SVGA (1024x768 recommended) CD ROM drive (for loading software)
Configuration (HC Designer only)	Off-line configuration with optional on-line (Run mode) configuration download.
Monitoring	On-line monitoring allows user to test the developed configuration.
System Interconnection	Connected to controller through its dedicated RS232 port or Ethernet 10Base-T host port. <i>Maximum Distance Between Controller File dedicated RS232 port and PC Configurator: 50 feet</i> <i>Cable Type: Standard 9-pin RS232</i> <i>Cable termination: 9-pin "D" connector</i> <i>Maximum Distance for Ethernet Connection: Not limited, per user network topology</i> <i>Cable termination: RJ-45</i>

TABLE 3 – HC900 Hybrid Control Designer & Hybrid Control Utilities Software Specifications

Modem	<p>PC Interface: Supports Microsoft Windows Telephony API (TAPI) device independent modem communications. Baud rate = 9600, 19.2KB, 38.4KB selectable</p> <p>Controller Interface: Connects to the controller RS-232 configuration port. <i>Most commercially available modems with equivalent specifications to those validated should function with the HC900 controller.</i> The following modems have been validated: 3COM US Robotics 56K Data/Fax External Modem, Zoom 56K Dualmode External Modem, Best Data 56SX Data Fax External Modem</p> <p>The modem must have the following capabilities:</p> <ul style="list-style-type: none"> RS232 interface Auto answer Can operate at 9600 baud, 8 data bits, 1 stop bit, and no parity Hardware handshaking can be disabled Software handshaking can be disabled Data Terminal Ready (DTR) input can be disabled Result codes can be suppressed Echo can be disabled Must be equipped with non-volatile memory (NVRAM) so that settings that are configured using command strings can be retained during a power-outage Must be able to load the NVRAM settings automatically on power-up
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TABLE 4 – Summary of HC900 Hybrid Control Designer & Hybrid Control Utilities Software Main Window Menu Selections

Main Menu Selection	Description
File	<ul style="list-style-type: none"> • New: Provides dialog box • Open: Opens an existing Hybrid Control Designer configuration. • Close: Closes the active window. • Save: Saves the active configuration. • Save As: Can name the active configuration, select the target CPU type and revision, C30, 1.1, C50, 1.0 and select the directory where file is to be stored. • Download: Alternate selection for download of saved configuration • Upload: Alternate selection for upload of complete configuration in controller including graphic pages, text annotations, stored recipes/profiles/schedules/sequences, OI display assignments, OI data storage setup • Upload Recipes: Uploads individual recipe files for variables, setpoint profiles, setpoint schedules and sequences. (Allows print, save, edit or download.) • Properties: File properties, statistics (capacity usage), file read protection, worksheet protection (password access to individual worksheets) • Write Protect File: Can enter and confirm a password for the selected file. • Print Report: Provides report printout selections for documentation including configured I/O list, worksheets, block parameters, tag list, display listing, recipes, SP profiles, SP schedules, sequences, alarms and event list. • Print Report Preview: Provides print preview of report selection plus print selection • Printer Setup: Can select printer, paper type, and orientation. • Exit: Exits the Hybrid Control Designer application.
Edit (HC Designer only)	<ul style="list-style-type: none"> • Cut, Copy, Paste: Editing functions for function block diagram items. • Delete: Deletes the currently selected item on the function block diagram. • Append FBD (Function Block Diagram) Worksheet: Adds a worksheet • Delete FBD Worksheet: Deletes a worksheet and its contents <ul style="list-style-type: none"> ▪ Reorder FBD: Allows the sequence of worksheets to be changed. • Worksheet properties: Adds title and description for worksheet • Unlock Worksheet: Allows entry of password to unlock protected worksheet • Block and Tag Order: Shows list for ordering block sequence (fast and normal scan rates), ordering of major blocks such as control loops for display purposes • Alarms: Displays alarm groups for setup or changes • Events: Shows tag listing for assignment and annunciation as reportable events • Find: Directs to area of diagram for tagged variables and blocks. • Go To: Can enter the page number of Worksheet to which you want to go. • Options: Warning Level: Can enable or disable the Open Input and Unassigned I/O warnings on download. Default Annotation Attributes: Sets the default text attributes for annotation entries.

TABLE 4 – Summary of HC900 Hybrid Control Designer & Hybrid Control Utilities Software Main Window Menu Selections

Main Menu Selection	Description
View	<ul style="list-style-type: none"> • <i>Toolbar</i>: Displays or hides the toolbar in the top of the Main window. • <i>Status Bar</i>: Displays or hides the status bar at the bottom of the Main window. • <i>File Browser</i>: Displays all open files (configurations, recipes, data storage) • <i>Worksheet Toolbox</i>: Enables function block diagram tool category listing • <i>Trace Window</i>: Shows listing of connection routing for selected input pin to function block • <i>Phone Book</i>: Shows editable list of phone numbers • <i>Grid</i>: Can place a grid in the function block diagram. • <i>Zoom Out</i>: Can zoom out to see more of a document, (5 levels). • <i>Zoom Normal</i>: Returns object to normal size (Zoom In).
Monitor	<ul style="list-style-type: none"> • <i>Monitor Mode</i>: Enables monitor mode Enables toolbar for monitoring selections • <i>Monitor Toolbar</i>: Disables/Enables monitoring toolbar • <i>Set Update Rate</i>: Provides monitoring update rate selection – ¼ sec., ½ sec., 1 sec., 5 sec. • <i>Watch Summary Window</i>: Enables watch window with tabbed selection of I/O, Signal Tags, Variables (write-capable), and display groups (write-capable) • <i>Controller Diagnostics</i>: Displays controller diagnostics. • <i>Controller Ports Diagnostics</i>: Provides menu selection of all ports for displaying diagnostic status including Ethernet port, RS-232 port, RS-485 OI port, Host connections, Expansion Rack port, Peer to peer connections • <i>Rack Diagnostics</i>: Displays rack and I/O diagnostics. • <i>Monitor Function Block</i>: Alternate selection for enabling function block monitoring • <i>Show Forces</i>: Displays all blocks with force conditions • <i>Toggles Function Block Windows</i>: Allows monitored blocks to be disabled/enabled for viewing • <i>Toggles All Monitor Windows</i>: Allows all monitoring windows to be disabled/enabled for viewing
Recipes	<ul style="list-style-type: none"> • <i>Recipes</i>: Displays recipe pool, allows stored recipe review, supports recipe development, recipe printout is selectable • <i>Setpoint Profiles</i>: Displays setpoint profile pool, allows stored profile review, supports profile development, profile printout is selectable • <i>Setpoint Schedules</i>: Displays setpoint schedules, allows stored schedule review, supports schedule development, schedule printout is selectable • <i>Sequences</i>: Displays sequence pool, allows stored sequencer review, supports sequencer development, sequence printout is selectable
Window	<ul style="list-style-type: none"> • <i>Cascade</i>: Arranges windows so that they overlap. • <i>Tile Horizontally</i>: Arranges windows over and under each other. Each window is visible and none overlap. • <i>Tile Vertically</i>: Arranges windows side by side. Each window is visible and none overlap. • <i>Arrange All</i>:
Help	<ul style="list-style-type: none"> • <i>Help Topics</i>: Calls up the top level Help Contents page. • <i>About Help</i>: Displays copyright and software version information.

TABLE 5 – HC900 Hybrid Control Designer Functional Tabs

Controller Function Tab	<p>Displays the I/O used in configuration by rack, module, channel</p> <p>Supports configuration of:</p> <ul style="list-style-type: none"> • Controller name (for network peer addressing) • E-mail alarm setup
Display Function Tab	<p>Displays the operator interface display setup by display button</p> <p>Supports configuration of:</p> <p>Operator interface displays, alarms, events, operator interface security, filenames, Help displays, and startup display</p>
Function Blocks Tab	<p>Supports configuration of control and data acquisition strategy using function blocks available from category tree. Up to 20 named worksheets with 20 pages each can be assigned.</p>

TABLE 5 – HC900 Hybrid Control Designer Functional Tabs

Utilities Tab	<p>Supports configuration of:</p> <ul style="list-style-type: none">• PC communications ports (Com1 – Com8), selectable controller IP addresses• Controller communications ports and IP address setup with auto-detect/verification selection• Real-time clock, controller mode <p>Other functions:</p> <ul style="list-style-type: none">• Controller, I/O, controller communications port, peer controller diagnostics• Analog I/O calibration• Slidewire calibration (Position Proportional Output)• Show I/O force conditions (HC Designer only)• Upload, Download and Loop-back check functions
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Dimensions

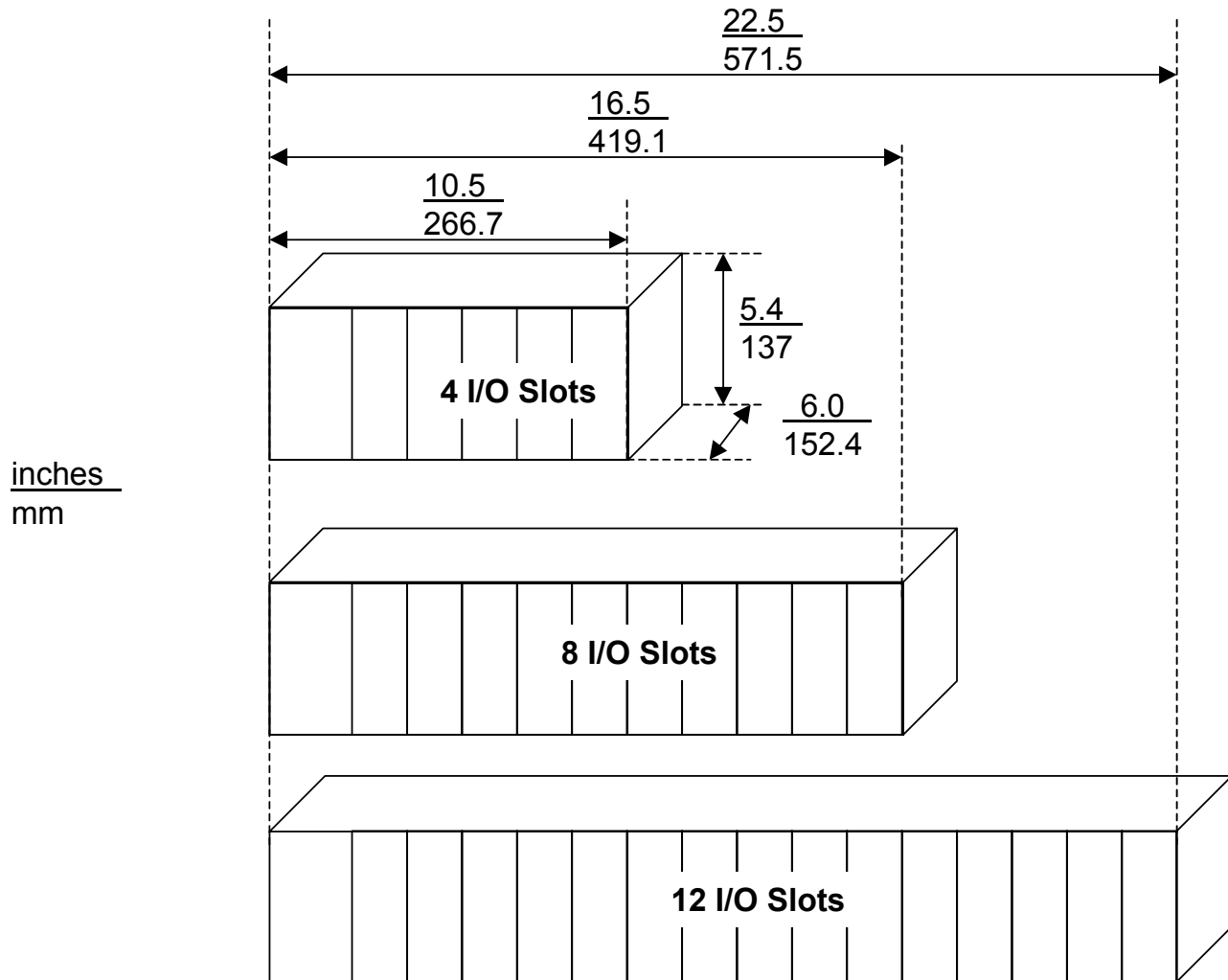


Figure 2—HC900 Hybrid Controller Dimensions

HC900 Power Supply Calculation

To determine if the 900P02 power supply will support the needs of the specific rack, use the table and limit tests below to calculate power requirements.

Enter quantity of each module type in column A and calculate the 5V and 24V maximum current in columns D and E. Sum the maximum current for all module types and determine if the 900P02 power supply is appropriate.

	A	B	C	D	E
		Max Current	Max Current	5V	24V
Module type	Quantity	@ 5 V in mA	@ 24 V in mA	mA Sub. Tot	mA Sub. Tot
				(D = A * B)	(E = A * C)
Controller	()	600	0	()	()
Scanner	()	600	0	()	()
Analog Input (8 pts)	()	40	25	()	()
Analog Output (4 pts)	()	40	200	()	()
AC Digital Input (16 pts)	()	230	0	()	()
DC Digital Input (16 pts)	()	230	0	()	()
Contact Input (16 pts)	()	230	40	()	()
AC Digital Output (8 pts)	()	220	0	()	()
DC Digital Output (16 pts)	()	430	0	()	()
Relay Output (8 pts)	()	140	100	()	()
Total mA				Total 5V= ()	Total 24V= ()

1. Is total 5V less than 2000? Yes/No
2. Is total 24V less than 900? Yes/No
3. If the answer to 1 and 2 are YES, go to 4. **If the answer to 1 or 2 is NO, use power supply 900P01-0001.**
4. Multiply 5V total by 5.1. ()
5. Multiply 24V total by 24.5. ()
6. Sum results of 4 and 5. ()
7. Divide results of 6 by 1000 ()
8. Is the result of 7 less than 28? Yes/No
9. **If the answer to 8 is Yes, Use power supply 900P02-0001**
If the answer to 8 is No, use power supply 900P01-0001

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