



FUTUREDESIGN
C O N T R O L S

Orion-M

Watlow PM Controller System Guide



Safety Information in this Manual

Notes, cautions and warnings appear throughout this book to draw your attention to important operational and safety information.

A “**NOTE**” marks a short message to alert you to an important detail.

A “**CAUTION**” safety alert appears with information that is important for protecting your equipment and performance.

A “**WARNING**” safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.



This symbol (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.



This symbol (a lightning bolt in a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.

Technical Assistance

If you encounter a problem with your Orion-M controller, review all of your configuration information to verify that your selections are consistent with your application: inputs; outputs; alarms; limits; etc. If the problem persists after checking the above, you can get technical assistance by dialing +1 (866) 342-5332 or by faxing your request to +1 (866) 332-8014, Monday thru Friday, 8:00 a.m. to 5:00 p.m. Eastern Standard Time. You can also email your request to support@futuredesigncontrols.com.

An applications engineer will discuss your application with you.

Please have the following information available:

- Complete Model #'s and/or Serial #'s for Component(s) in Question
- Complete Software Version #'s
- All Configuration Information
- All User Manuals

Warranty and return information is on the back cover of this manual.

Your Comments

Your comments or suggestions on this manual are welcome. Please send them to:
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1 What is the Orion-M?

The Orion-M is a multi-loop process control system combined with an embedded SCADA color touch interface. The Orion-M provides a configurable control platform for a variety of OEM applications requiring up to 15 separate loops of control. In addition to 15 loops of control, the Orion-M can also provide up to an additional 15 inputs for process monitoring, for a total of 30 process inputs.

The system is provided with eight 24Vdc digital inputs, two 24Vdc outputs and 6 relay outputs standard. The Orion-M can be expanded to a total of 16 digital inputs and 32 digital outputs. The Orion-M also provides the capability of accepting analog inputs for remote set point control and analog outputs capable of retransmitting system variables (PV, SP or %Out) to other devices such as a chart recorder. The 0-10Vdc or 4-20mA user selectable signals are provided through the addition of optional analog expander cards.

The Orion-M complements its versatile hardware platform by providing a host of standard features and configuration capabilities, all through its visual, touch interface. The touch screen interface is an embedded, industrial PC with all software included. No external PC software is required for setup or configuration of the Orion-M. All of the setup and configuration data is saved to the Orion-M's internal memory.

Individual process controllers, one for each loop in the system, provide reliable, consistent and accurate control by distributing the process control requirements of the system among multiple processors. Each loop controller provides full auto tune functionality with high resolution, universal process inputs. When coupled with the built in ramping profiler of the Orion-M, it allows for automatic, timed control of all processes and outputs of the system. No other control system on the market provides the flexibility, functionality and configurability of the Orion-M.

1.1 Features

The digital inputs of the Orion-M can be configured as alarm inputs with adjustable delay timers, as control inputs for controlling profile operation or for direct control of the system's digital outputs.

The digital outputs of the Orion-M can be used as direct outputs for controlling external equipment related to the application through software switches, called events, or be programmed to act as system alarm or status outputs. All outputs have adjustable delay times for on, off and cycle times.

The Orion-M can be operated in single set point or automatic profile control mode. Profile entry is made easy through the use of copy, paste and delete menu selections. Profiles can be copied to the external 'USB' memory stick and then imported to another Orion-M controller which eliminates the need to enter duplicate profiles into multiple Orion-M systems. When running in automatic profile mode, the operator can place the system into hold and change any control parameter without modifying the saved profile. This gives the operator maximum flexibility over the controlled process.

Data file analysis tools (auto-trend) make looking at historical data a simple task. Any control variable saved to the Orion-M flash memory can be plotted on the historical data trend, for any time frame within the data file's total time range. Full 'USB' print capabilities from the Orion-M interface to a standard HP inkjet printer Model 6540, 6940, 6980 (or compatible printer), eliminates the need for a PC, strip or circular chart-recording device. Graphics trends, historical and report print functions are standard.

The built in Ethernet functionality includes a 'Web Server' to provides access to all Orion-M data (view only), a VNC interface for remote control and monitoring and an NTS clock, all available via a local Intranet connection (wired or wireless), or the World Wide Web using standard software like Microsoft's Internet Explorer.

The Orion-M provides a rich set of tools for control interaction and data analysis. Views include system overviews, trends, alarms, profiles as well as historical data, alarm history and audit trail views. The menu driven interface eliminates screen 'clutter' by providing an easy to use 'Windows' interface for interaction between the user and the Orion-M system.

The Orion-M can store more than one year of data on its internal compact flash card. Data logging can be enabled manually or automatically during automatic profile run. Data backup is provided with the 'USB I-Stick' for plug and play transfer of files to any PC running Microsoft Windows XP operating systems.

The Orion-M security module provides full system security with three levels of access. Each of the three access levels allow for independent user rights. Up to 30 users can be entered into the system while the audit trail tracks all operator actions and records them.

The Orion-M control system includes the following interface features:

- Overview screen that displays all "runtime" information.
- Profile run and monitor views.
- Profile entry, open, save and download interface screens.
- Current alarm and alarm history views (alarm history for up to 1 year).
- Real time trends (with adjustable X,Y limits) for all inputs.
- System and application setup (control loops, monitors, inputs/outputs, alarms, etc.).
- Data logging interface screens include log point selection and historical viewing.
- 'Plug and Play' memory stick functionality for data transfer/backup.
- Full USB print capabilities and on-line help screens
- Web server for intranet/internet access (view only).
- VNC server for intranet/internet access (control/view).
- FTP data back-up for automatic data file transfer over intranet/internet.
- Integrated email server for alarm notification and file transfer.
- NTS clock with daylight savings time insures that the system is up to date.
- Full security with audit trail for tracking user actions.
- Maintenance counters for output cycles and on times.
- Helps screens are available for most screen views; configurable in English, Spanish and French
- Voice assisted help in English, Spanish and French (external speakers required – not included).

2 Getting Started

The Orion-M requires one Watlow PM PID control or PM Integrated (PM with built in limit controller) for each control loop required in the system. Since the Orion-M is capable of interfacing to more than one brand of controller, refer to the Orion-M part number matrix for the operating system to be sure that the WTPM, CM application software has been provided. The Orion-M will not operate correctly if any other version of CM application software is used with a Watlow PM controller.

2.1 Installing the Watlow PM Controller

For applications requiring several loops of control or more, proper planning and arrangement of the Watlow PM controllers prior to mounting is critical for optimum routing of the controller wiring. For applications requiring frequent access to the controllers, panel mounting provides direct access. For applications where operator access to the controllers is not required, or is desired to be kept at a minimum, the controllers can be mounted directly inside of an enclosure. This also reduces wiring concerns by eliminating the need to run the sensor, communication and control wiring for each controller to and from an enclosure door.

Refer to the Watlow PM User’s Manual for the control being used for dimensions, appropriate mounting and operating conditions, including proper electrical connections. Connect sensor and control wiring as required, paying close attention to all wiring precautions and guidelines as noted in the controller manual. It is recommended that all sensor and communication wiring, to and from the Watlow PM controllers, be routed away from all high voltage and/or output control wiring. This will minimize the chances of electrical transients or spikes in the power/control wiring from causing communications or sensor reading errors.

2.1.1 Communications Wiring

Each Watlow PM control used in the Orion-M system is its own independent loop control. However, in order for the controllers to work as part of the system, they must communicate with the Orion-M control module using RS485 serial communications. Therefore, each Watlow PM used must be equipped with the RS485 communications option or they will not operate as part of the Orion-M system:

PM X X X X X - **1** X X X X X X

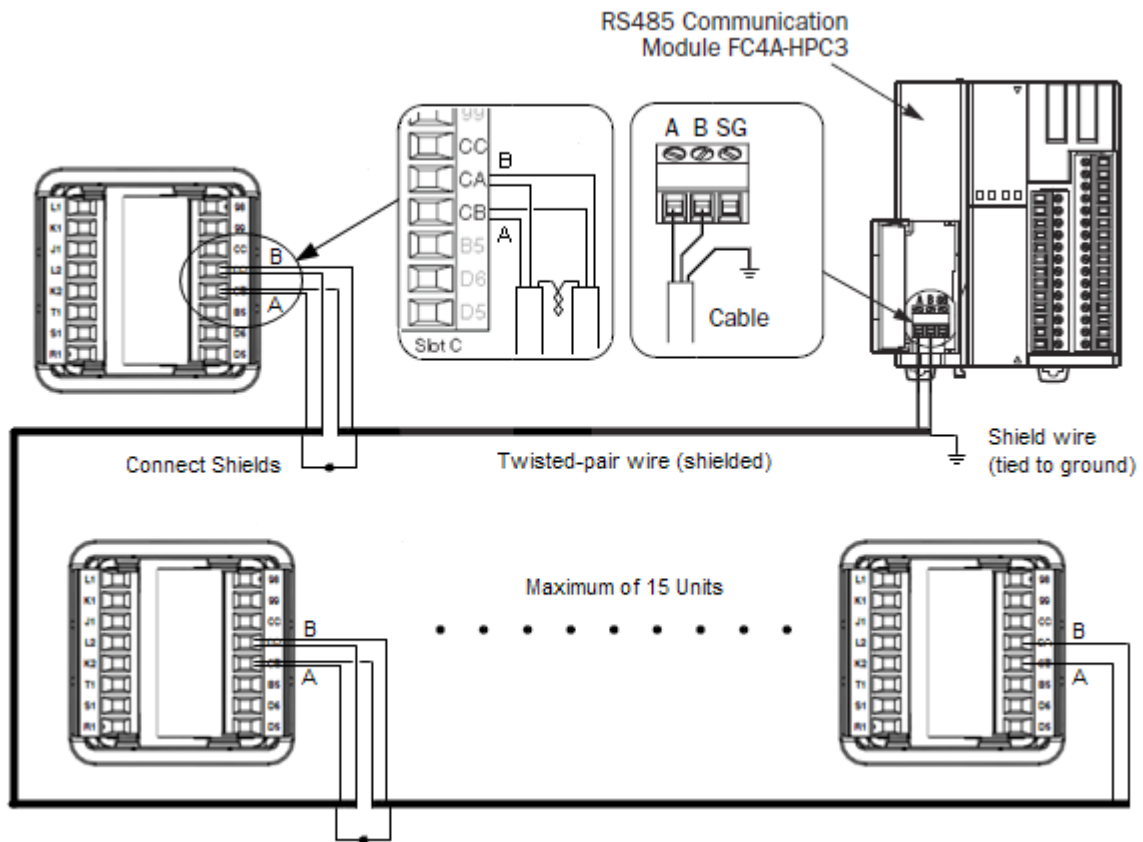
└── Order code **1** designates RS-485 Modbus RTU serial communications
(see Watlow PM User’s Manual for order code descriptions)

NOTE: Order codes “D” and “2” also provide the RS485 Modbus RTU communications option and are also acceptable for use with the Orion-M.

Communications wiring must be run using a minimum of 24 AWG twisted-pair, copper conductors. For short runs (< 50 feet total), non-shielded wiring can be used as long as proper separation from power/control conductors is maintained. For communications wiring where the total length will exceed 50 feet, up to the maximum allowed length of 650 feet, shielded twisted-pair must be used.

NOTE: FDC recommends the use of shielded wire for all installations regardless of the total length in order to maintain optimum performance and minimize the possibility of communications errors.

When using shielded twisted-pair, be sure to ground the shield at only one end, preferably at the Orion-M control module. Allowing any other portion of the cable shield to come in contact with ground, or grounding both ends, will allow ground loop currents to flow in that section of the cable shield which can disrupt communications.



Communications Wiring Example (1/16th DIN Watlow PM Shown)

NOTE: The “A” and “B” terminal connections between the Orion-M control module and the Watlow PM control are reversed. Terminal “A” of the Orion-M CM will connect to terminal “B” of the Watlow PM and terminal “B” of the CM will connect to terminal “A” of the Watlow PM.

Refer to the Watlow PM User’s Manual for all other connections including power, sensor and control wiring. Since no two applications are the same, it is up to the system designer to insure that the controllers are properly installed and wired to meet design specifications.

3 Configuring the Watlow PM Controller

The unique and inherently flexible design of the Orion-M system allows the OEM to tailor each component of the system to the application. By using independent loop controls, each one can be configured for various input and output types, control algorithms, etc., based on the requirements of the application. It also allows control loops to be added or replaced on the system at any time, simply by connecting the controller to the Orion-M's control module, RS-485 communication link.

If the application requirements change and a different input or output type is required, or if the controller were to fail, it can be replaced quickly, and at a lower cost as compared to having to repair or replace larger, integrated multi-loop controllers. The Orion-M only requires that the communications settings for each loop control be properly assigned, and that the input type of the controller is set in the Orion-M Configurator, so that the control loop input and set point can be displayed and set properly through the Orion-M interface.

3.1 Assigning the Proper Communications Settings

The Orion-M can support up to 15 Watlow PM controls. They can be mixed and matched as required, but each one must have its own communication address. The allowable address range is 1 – 15 corresponding to Loop Input #1 – 15 in the Orion-M Configurator. Communication addresses must be assigned to all controllers on the communications link beginning with 1, up to the total number of controllers.

As control loops are enabled in the Orion-M Configurator, the Orion-M will automatically use the Loop Input # as the corresponding controller address. If more than one Watlow PM has the same address, or a loop input is enabled but a controller is not assigned to that address, the Orion-M will report a communications alarm for that loop input when the runtime application is started.

NOTE: *The order of the loop controls on the communication link is not important. The communications address for a controller can be assigned regardless of its position on the link.*

In addition to the communications address, the baud rate, parity and several other important communications settings must also be set properly in order for the Watlow PM to communicate with the control module of the Orion-M.

*Required Watlow PM Controller Settings for Proper Communications:

- | | |
|-----------------------------|---|
| • Protocol (PCoL): | Mod |
| • Address Modbus (Ad.M): | 1 - 15 (based on system design) |
| • Baud Rate Modbus (bAUd): | 9600 |
| • Parity Modbus (PAr): | nonE |
| • Modbus Word Order (M.hL): | hiLo |
| • Data Map (Map): | 1 or 2 (see following section 3.1.1 Modbus Mapping) |

***See chapter 6, Setup Page, in the Watlow PM User's Manual for instructions on changing parameter values as required.**

Modbus Data Mapping *The Watlow PM series are equipped with a block of addresses that must be configured by the user to provide direct access to specific parameters in the PM control. The parameter assignment is required in order for the Orion-M to properly monitor and control the Watlow PM. This must be done prior to connecting the Watlow PM to the Orion-M's communications link. See the following section for information on properly setting this programmable memory block area.*



3.1.1 Modbus Data Mapping

Due to features added in later model Watlow PM controllers, Watlow reassigned the Modbus data registers. The “Data Map” selection for the communications settings is used to select legacy mapping (1) or the new mapping (2) which is required if any of the new additional features of the PM control are to be used.

Since the requirement for these additional features are determined by the system designer, Watlow added a block of addresses that could be configured by the user and assigned to specific parameters in the PM. This allows other devices communicating with the Watlow PM to do so and not be affected by the data mapping selection. However, in order for the remote devices communicating with the PM to be “blind” to the data mapping selection, the user must configure this block of addresses accordingly.

The Orion-M takes advantage of this design by communicating only with the programmable memory block of addresses. This allows the system designer to take full advantage of the functionality of the Watlow PM control, without being restricted to legacy Modbus mapping. However, this requires that the proper addresses are pre-programmed into the PM in order for the Orion-M to communicate with it. The following table provides the Modbus (Assembly Definition) Addresses that must be programmed into the PM based on the communications data mapping selection.

NOTE: *This programmable memory area can only be set via the Modbus communications port on the Watlow PM. Thus, the Watlow PM must be programmed directly via a PC prior to being connected to the Orion-M’s communications link.*

Watlow PM Assembly Definition Address	Data Map 1 Value	Data Map 2 Value	Parameter
40, 41	1880, 1881	2360, 2361	LOOP CONTROL MODE
42, 43	2160, 2161	2640, 2641	CLOSED LOOP SETPOINT
44, 45	2162, 2163	2642, 2643	OPEN LOOP SETPOINT
46, 47	2164, 2165	2644, 2645	LOW LIMIT SETPOINT
48, 49	2166, 2167	2646, 2647	HIGH LIMIT SETPOINT
50, 51	2490, 2491	2970, 2971	COMMUNICATIONS TEMPERATURE UNITS
52, 53	2494, 2495	2974, 2975	NONVOLTAILE MEMORY WRITE
80, 81	360, 361	360, 361	LOOP PROCESS VALUE
82, 83	362, 363	362, 363	PV1 ERROR STATUS
84, 85	440, 441	450, 451	LIMIT PROCE SS VALUE
86, 87	442, 443	452, 453	PV2 ERROR STATUS
88, 89	2172, 2173	2652, 2653	CLOSED LOOP WORKING SETPOINT
90, 91	1904, 1905	2384, 2385	HEAT OUTPUT POWER
92, 93	1906, 1907	2386, 2387	COOL OUTPUT POWER
94, 95	2174, 2175	2654, 2655	OPEN LOOP WORKING SETPOINT
96, 97	1882, 1883	2362, 2363	LOOP MODE ACTIVE
98, 99	1884, 1885	2364, 2365	HEAT ALGORITHM
100, 101	1886, 1887	2366, 2367	COOL ALGORITHM
102, 103	1920, 1921	2400, 2401	TUNE STATUS
INDICATES DEFAULT PM ASSEMBLY STRUCTURE SETTINGS			

**Watlow PM Assembly Definition Addresses are listed in relative values.
To convert to absolute values, add 4001.**

The “Assembly Definition Addresses” are used to store the memory addresses (or pointer values) for the parameters that the Orion-M requires access to. These addresses must be set to the values in the Data Map 1 or Data Map 2 column based on the communications setting made in the Watlow PM.

As an example, by default, assembly data addresses 42 and 43 contain the values 2160 and 2161 respectively. When using data map 1, these values point to the closed loop set point of the PM. This allows the Orion-M to set the loop set point. However, if data map 2 is selected for the communications setting, assembly data addresses 42 and 43 must be set to 2640 and 2641 respectively. These values are the new pointer values associated with the second data map that point to the closed loop set point of the Watlow PM.

If the values in assembly addresses 42 and 43 were left at 2160 and 2161 with the communications data map setting at 2, the Orion-M would be unable to set the loop set point. The Watlow PM provides a total of 40 programmable addresses; however, only those noted in the table must be configured accordingly for use with the Orion-M. For more information on how the Watlow PM uses this programmable memory block, see chapter 2 of the Watlow, EZ-ZONE PM Controller Communications Manual.

3.2 Input Type Assignments

The Watlow PM controls offer a universal input for input 1 and can provide an optional second input for use as a back-up control sensor, heater current monitor or built in limit control available on integrated models. The Loop Input # for the corresponding control in the Orion-M Configurator is set to match the selected input type for input 1 of the PM control. Based on this selection, the Orion-M assumes control of certain parameters related to the input and automatically assigns them based on settings made in the Orion-M.

3.2.1 Input 1 Operation

When input 1 of the Watlow PM control is set for a temperature input type, i.e., RTD or thermocouple, the corresponding Loop Input # in Orion-M Configurator must also be set to temperature. When this selection is made, the temperature units of the Watlow PM communications interface is set by the Orion-M to match the selection on the Degrees C/F screen. However, the temperature units for the Watlow PM display are a different setting which the Orion-M can not change. Therefore, if the Watlow PM controls are visible to the operator, the display units of the PM controls should be set to match the temperature units of the Orion-M.

NOTE: *It is recommended that the Degrees C/F selection screen be disabled in the Orion-M Configurator once the proper temperature units selection has been made to prevent it from being accessed. This will prevent the temperature units from being accidentally changed and causing operator confusion when the units do not match between the PM Series control and the Orion-M. See section 3.6 Orion Functions/Startup View, in the Orion-M Configuration Manual for information on enabling and disabling this item.*

When input 1 of the PM control is set for an analog input type, i.e., voltage or current, the corresponding Loop Input # in Orion-M Configurator must be set to process even if the input is from a temperature transmitter. The range and units of the temperature transmitter are unknown to the Orion-M so they must be manually set at the PM control. If the Orion-M loop input type is set to temperature in the Configurator for an analog input type, the Orion-M will change engineering units for the input; however, the measurement will not change. Therefore, the Orion-M may display units in degrees Fahrenheit while the reading is in degrees Centigrade or vice versa.

For either temperature or process (voltage/current) input types, the Orion-M provides lower and upper set point limits and a decimal point selection for the loop input in the Configurator. The lower and upper set points will be automatically set in the Watlow PM by the Orion-M. However, the decimal point selection for the Loop Input in the Orion-M is independent of that set in the Watlow PM for its display resolution.

Loop Inputs set as temperature in the Orion-M Configurator allow a decimal point selection of 0 or 1. Process type loop inputs can be displayed on the Orion-M with a resolution of 0 to 3 decimal points. Note that the Orion-M has a display range of -32768 to 32767, -3276.8 to 3276.7, -327.68 to 327.67 or -32.768 to 32.767 depending upon decimal point selection. When selecting the decimal point resolution for the Loop Input in the Orion-M Configurator, make sure that range of the PM control input does not exceed the range selected in the Orion-M or the value may not be displayed correctly.

IMPORTANT: *The temperature units and lower and upper set point limits are set once, each time the Orion-M enters the runtime application. Do not alter the values in the Watlow PM control once they have been set or the Orion-M will not display the correct process value or set the correct set point to the loop control which could result in a runaway condition leading to property damage or injury to personnel.*



3.2.2 Input 2 Operation

Input 2 of the PM controller (if equipped) can be used as a monitor input to the Orion-M. When Loop 2 Input is selected as the monitor input type in the Orion-M Configurator, the Orion-M will display the second input of selected loop controls as monitor inputs.

The Loop Input 2 monitor point selection allows inputs to be displayed on the Orion-M with a resolution of 0 to 3 decimal points. The Orion-M has a display range of -32768 to 32767, -3276.8 to 3276.7, -327.68 to 327.67 or -32.768 to 32.767 depending upon decimal point selection. When selecting the decimal point resolution for the monitor point input in the Orion-M Configurator, make sure that range of the PM input does not exceed the range selected in the Orion-M or the value may not be displayed correctly.

When using the second input of control loops for monitor points, it is important to note that the controller itself, provides range, calibration and input bias settings for the input. The 'Monitor Input Offset' screen in the Orion-M runtime application allows an offset to be applied to the monitor points when input 2 of the loop controls are used. However, the input offset of the Orion-M only corrects the value shown on the Orion-M display and does not offset the reading in the loop control.

If the loop control is visible to the operator, it is recommended that the 'Monitor Input Offset' screen be hidden (see Section 3.6 Orion Functions/Startup View in the Orion-M Configuration Manual) or even password protected in the runtime application to prevent an offset from being applied to the monitor point in the Orion-M. Rather, use the input bias setting of the loop control so that both the reading on the loop control and the Orion-M will match to avoid operator confusion.

3.3 Control Output Assignments

The Watlow PM controls can be equipped with different types of control outputs that can be assigned to operate as heat/cool (indirect/direct). If only a single control output is used for heating or cooling operation, the Orion-M will display a percentage of output of 0.0 – 100.0% for the output if heating is selected for the output mode or 0.0 to -100.0% for the output if cooling is selected for the output mode.

If both outputs are used in a heat/cool application, the Orion-M will display a value of -100.0% to 100.0% for the percentage of output. In this case, 0.0% represents both heat and cool outputs are off. Values from 0.0 to 100.0% represent the percentage of heat output from off to full on and values from 0.0 to -100.0% represent the percentage of cool output from off to full on.

3.3.1 Auto-Tune and Auto/Manual Operation

The Orion-M provides the ability to switch each PM control in the system between auto and manual output operation as well as initiating the controller's auto-tune function. These functions are accessed from the Orion-M runtime, Single Loop View screen via the 'AM' and 'AT' control buttons.

NOTE: *If both the heating and cooling control algorithms in the PM are programmed for a mode other than PID, pressing the 'AT' button on the Single Loop View screen in the Orion-M runtime will provide the appearance that it will activate the auto-tune on the control, but once initiated, it will immediately turn off. This is due to the fact that the PM Series auto-tune function can only be initiated when at least one of the heating or cooling control algorithms is programmed for proportional control (PID).*

3.4 Loop Permissions

The Orion-M iSeries configuration provides permissions which can be set to allow the control loop set point, auto/manual and auto tune operations to be performed at the loop control itself as well as through the Orion-M. These can allow an operator to make changes at the loop control in cases where the Orion-M interface is located in a remote location.

3.4.1 Set Point Permission Exception

If the control loop is configured to operate under cascade control or is configured as an RH wet bulb loop type, the set point for the loop is generated by logic within the Orion-M. The loop will not function as configured unless the set point is constantly set by the Orion-M. Thus, any change made at the loop control will be overridden by the Orion-M. If local adjustment at the loop control may be required for any reason, loop set point communications must be interrupted via a digital input to the Orion-M configured as 'loop SP comms disable'.

Appendix

Software Usage Note:

The selection, application or use of Future Design Control products or software is the purchaser or user's responsibility. No claims will be allowed for any damages or losses, whether direct, indirect, incidental, special or consequential.

In addition, Future Design reserves the right to make changes without notification to purchaser or user to materials or processing that do not affect compliance with any applicable specification. Future Design makes no warranties when using the Orion-M system.

Warranty:

Future Design Controls products described in this book are warranted to be free from functional defects in material and workmanship at the time the products shipped from Future Design Controls facilities and to conform at that time to the specifications set forth in the relevant Future Design Controls manual, sheet or sheets for a period of one year after delivery to the first purchaser.

Future Design Controls products are warranted to be free from functional defects in materials and workmanship at the time the products shipped from Future Design Controls facilities and to conform at that time to the specifications set forth in the relevant Future Design Controls manual, sheet or sheets for a period of one year after delivery to the first purchaser for use.

There are no expressed or implied Warranties extending beyond the Warranties herein and above set forth. Limitations: Future Design Controls provides no warranty or representations of any sort regarding the fitness of use or application of its products by the purchaser. Users are responsible for the selection, suitability of the products for their application or use of Future Design Controls products.

Future Design Controls shall not be liable for any damages or losses, whether direct, indirect, incidental, special, consequential or any other damages, costs or expenses excepting only the cost or expense of repair or replacement of Future Design Control products as described below.

Future Design Controls sole responsibility under the warranty, at Future Design Controls option, is limited to replacement or repair, free of charge, or refund of purchase price within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse or abuse.

Future Design Controls reserves the right to make changes without notification to purchaser to materials or processing that do not affect compliance with any applicable specifications.

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