Athena® Series RMC
Hot Runner Controller
Operator's Manual

CE

Precautions

Warning

Use of this equipment in a manner not specified by the manufacturer may impair protection provided by the equipment.

In addition to presenting a potential fire hazard, high voltage and high temperature can damage equipment and cause severe injury or death. When installing or using this instrument, follow all instructions carefully and use approved safety controls.

Hazardous potentials exist on components inside the mainframe and controller. Always disconnect AC power to the mainframe when servicing the controllers or the mainframe.

Because these temperature controls or associated equipment may not always fail safe, an approved temperature and/or pressure safety control should be used for safe operation.

Turn off power to the controller before cleaning the exterior of the controller.

Failure to observe these precautions can result in exposure to a potentially lethal shock hazard.

The controller power switch must be in the "OFF" position before you put a controller into an energized mainframe, or remove a controller from an energized mainframe. Failure to observe these precautions can result in damage to the connectors and printed circuit boards.

Changing jumper settings and all wiring should be done by an experienced technician. The controller and wiring should be installed in accordance with national and local electrical codes. To avoid serious personal injury and damage to equipment, follow all warnings and cautions provided in the manual supplied with the mainframe.

Caution

If a controller shows signs of having been damaged during shipping, do not power up or install the controller. Save all packing materials and report any damage to the carrier immediately.

When the controller is powered up, the output may be activated. Consider the effects on your process before powering up the controller.

We recommend placing the controller in standby mode until you have configured the controller for your application. By default, the output is off in standby mode. However, the standby output is configurable.

Do not locate this instrument where it may be subjected to excessive shock, vibration, dirt, moisture, oil, or other liquids.

This is a Class A product. In domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Specified operating ambient temperature is 32 to 131 °F (0 to 55 °C).

Table of Contents

1.Introduction

1.1 About This Manual

This manual contains the information needed to operate the RMC Hot Runner controller after it has been configured as described in the *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*.

1.2 About the Control

Each RMC controller has one output, which is used for PID (proportional-integral-derivative) control. When PID control is used, you can take advantage of the controllers' Autotune feature for easy tuning of the proportional, integral, and derivative components of the control algorithm. Instructions for Autotuning are in Section 10 of this manual.

The controller can operate in normal (auto) mode, in which the controller calculates the output based on the setpoint (closed loop control). The controller can also be operated in manual mode, in which you set the output percentage (open loop control). Transfer from PID to manual is "bumpless" when the process value is within 9 °F (5 °C) of the setpoint.

- Instructions for changing the mode are in 3.3.
- Instructions for changing the setpoint are in 5.4.
- Instructions for changing the manual mode output percentage are in 5.5.

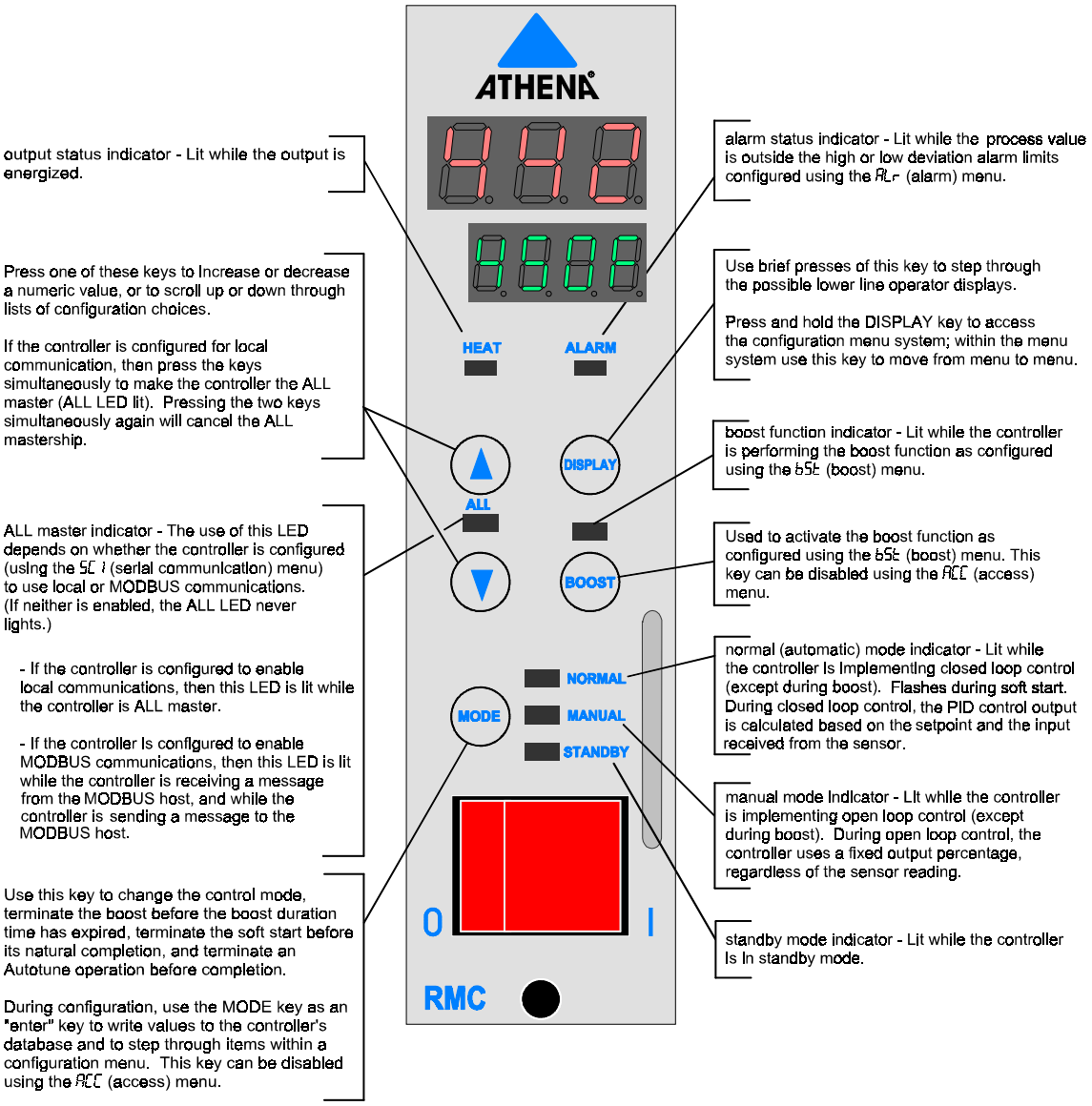
The controllers can be configured to alert you to process alarm conditions; see Section 8.

If you cannot use all the keys, or cannot do all the functions described in this manual, the process engineer has used the controller's firmware to limit functions that can be accessed using the keypad.

2. LEDs and Keys

The RMC front panel contains seven LEDs that light under specific circumstances. See the illustration below for the function of each LED.

The key functions are also described below. The displays available are described in Section 3.



3. Modes of Operation and Controller Displays

3.1 Control Modes

The Series RMC Hot Runner controllers support several modes of operation for control, as well as a special mode used to tune the unit automatically for PID control.

The table below summarizes the control modes and their effects on the controller output.

Use the **MODE** key to step through these modes in the sequence in which they are listed in the table. The LEDs to the right of the **MODE** key signal the controller's present mode. The operational display for each mode is in 3.4.3.

Control Mode	Description
normal (closed loop)	When the controller is in normal mode (closed loop control), the output is based on the controller's calculations of the output action needed to achieve or maintain the currently active setpoint, in accordance with the configured control strategy. In closed loop control, the controller is dependent on the input received.
manual (open loop)	When the controller is in manual mode (open loop control) the output percentage used is not influenced by the input value. In manual mode you can change the output percentage using the front panel of the controller (see 5.5.2) except under special circumstances (see 5.5.3). Transfer from normal (auto) to manual is bumpless (if the PV is within 9 °F (5 °C) of the SV).
standby	When the controller is in standby mode, the behavior of the output depends on how the standby menu parameters have been configured. • If the standby type is configured as closed loop, the configured standby setpoint will be used. • If the standby type is open loop, the configured standby fixed output percentage will be used.

A special automatic control mode is provided for automatic tuning of the controller (that is, automatically determining the proportional and derivative values to be used by the PID control algorithm)[1]. When Autotune is active, the output is under the control of the Autotune algorithm, and is dependent on the input received. By default, the Autotune operation is executed once. If the Autotune is successful, then Autotune is disabled. You can terminate the Autotune operation prematurely by pressing the **MODE** key.

[1] In the Series RMC controllers the integral value is automatically set to five times the derivative (rate) value.

This does not disable the Autotune feature. If Autotune operation is set to “once”, then the controller will attempt to perform the Autotune operation again the next time it is powered up.

Autotune can also be disabled entirely or enabled for every power up. More information about Autotune is in Section 10.

3.2 Configuration

In addition to the operating displays associated with the control modes described above, an RMC controller can display configuration parameters. The parameters are grouped by purpose and organized in menus. Instructions for viewing and changing configuration parameter values are in the *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*.

Attention

Before accessing the menu system (or changing a parameter value using a remote host), we recommend putting the controller in standby mode by pressing the MODE key until the STANDBY LED lights (or using a MODBUS host). By default, the output is off in standby mode. However, the controller’s behavior in standby mode is configurable.

3.3 Changing the Mode

Unless the **MODE** key has been disabled, you can put the controller in normal (auto) mode for closed loop control, manual mode for open loop control, or standby mode.[2]

To change the controller’s mode, press the **MODE** key until the LED corresponding to the desired mode is lit.

Pressing the **MODE** key while a soft start or Autotune operation is active will stop the operation. If the controller is going through the sequence of startup actions described in 4.2, the processing will move on to the next action in the startup sequence.

[2] Whether the controller performs closed loop control using the configured standby setpoint or performs open loop control using the configured standby fixed output percentage depends on the configuration of the StB (standby) menu parameters.

3.4 Display

3.4.1 Introduction

What is displayed on the front panel of the controller depends on the mode of operation (see 3.1), and whether the controller detects any problems with the input or with its own operation.

3.4.2 Cycling Through Available Displayed Values

Unless the configuration menus have been accessed or the controller has detected an error, the top line of the display will always show the process value. At any time, you can press the **DISPLAY** key repeatedly to cycle through the other values available for display on the lower line. The available values always include the output (in percent) and the heater current (in 0.1 amp increments).

3.4.3 Control Displays

The control displays (when no problems are detected) are summarized in the table below. The error messages that can be displayed when the controller detects a problem with the input, the output, or its own operation are explained in Section 11.

Information about the controller's behavior, and error codes displayed if the controller detects a problem during Autotune are in Section 10.

Circumstance	What's Displayed Top Line Lower Line	Example Top Line Lower Line
normal mode (closed loop control) NORMAL LED is lit.	process value	407
	display cycle includes:	
	setpoint and unit of measure	450F
	and	*and*
	output (in percent)	100P
	and	*and*
	measured heater current (in amps)	15.0A
manual mode (open loop control) MANUAL LED is lit.	process value	407
	display cycle includes:	
	output percent value	90P
	and	*and*
	measured heater current (in amps)	13.5A

Circumstance	What's Displayed Top Line Lower Line	Example Top Line Lower Line
standby mode STANDBY LED is lit.	process value	407
	display cycle includes:	
	output percent value	90P
	and	*and*
	measured heater current (in amps)	13.5A
	If standby type is configured as closed loop, then the display cycle also includes:	
	configured standby setpoint and unit of measure	450F
boost function active BOOST LED is lit.	process value	407
	display cycle includes:	
	output percent value	90P
	and	*and*
	measured heater current (in amps)	13.5A
	If boost type is configured as closed loop, then the display cycle also includes:	
	configured boost setpoint and unit of measure	450F
Autotune active	process value alternating with tun	tun
	setpoint value	450F

4. What Happens When You Power Up the Controller

4.1 Introduction

All Series RMC Hot Runner controllers support the CompuStep soft start feature, which allows slow dissipation of moisture in heaters, by gradually applying power to the heaters. Using this feature helps extend the life of the heaters and the molds. When a soft start is executed, phase angle firing starts at 5% output power and steps up the output 5% every 30 seconds.

- The soft start when the controller is in normal (automatic) mode lasts five minutes or until the process temperature reaches 200 °F (93 °C).
- The soft start when the controller is in manual mode continues until the output is 50% or until the output is less than 5% of the last output percentage stored in non-volatile memory (EEPROM) before the controller was powered down.[3]

The green NORMAL LED flashes during soft start in normal mode. You can stop the soft start by pressing the **MODE** key.

Unless a jumper setting was changed when the controller was set up, by default a soft start will be executed:

- every time the controller starts and the process value is less than 200 °F (93 °C), and
- every time the controller is returned to normal (automatic) operation and the PV is less than 200°F (93 °C).

However, if a jumper was changed from the default as described in the *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*, the controller will execute a soft start only in response to detection of a ground fault interruption; see 11.3. More information about the start up sequence of events is in 4.2.

4.2 Power Up Sequence

The sequence of controller actions and the state of the controller output following power up depend on jumper settings and configuration choices made when the controller was set up.

- Unless a default jumper setting has been changed, the controller does a CompuStep soft start if in normal (auto) mode and the process value is less than

[3] While the controller is in manual mode, the processor periodically compares the output percentage in use with the manual mode output percentage stored on the EEPROM. If the output has been changed since the last time the output was stored, the new output percentage is written to the EEPROM.

or equal to 200 °F (93 °C) (or if in manual mode and the last output used in manual mode was greater than or equal to 5%). During soft start in normal (auto) mode the NORMAL LED flashes. You can stop the soft start by pressing the **MODE** key.

- Unless a default jumper setting has been changed, the controller starts up in normal (auto) mode. If the jumper setting was changed, the controller starts up in the mode it was in when it was powered down.

- Unless the default value for a supervisor menu parameter was changed, if the controller is starting in normal (auto) mode, Autotune will be attempted. You can stop the Autotune operation by pressing the **MODE** key. See Section 10 for more information about Autotuning.

5. Normal Mode Setpoint and Manual Mode Output Percentage

5.1 Introduction

Every Series RMC controller can operate in normal (auto) mode, in which the controller calculates the output based on the setpoint. The NORMAL LED is lit while the controller is in normal (auto) mode. See 5.2 for the sources of setpoints and 5.4 for instructions for changing the setpoint using the front panel of the controller.

The controller can also be operated in manual mode (MANUAL LED lit), in which you set the output percentage. Transfer from PID to manual is "bumpless" when the process value is within 9 °F (5 °C) of the setpoint. See 5.5 for instructions for displaying and changing the output percentage while the controller is in manual mode.

To change the mode, press the **MODE** key. Each time you press the key, the controller steps to the next mode in the sequence, as shown by the mode LEDs. (If nothing happens when you press the **MODE** key, the process engineer disabled it during configuration.)

5.2 Where Setpoints Come From

The value of the PV and the setpoint currently being used ("active setpoint") are always displayed when an RMC controller is operating in normal (automatic) mode.

The setpoint used (and displayed) is not always the one you enter using the front panel as described in 5.4.

- If the controller has been configured to use closed loop boost, then when you push the **BOOST** key, the boost setpoint will be used; see Section 6.
- If the controller has been configured to do closed loop control while in standby, then when you use the **MODE** key to put the controller in standby, the standby setpoint will be used.[4]
- If the controller has been configured to use MODBUS communication, the setpoint can be written to the controller by a MODBUS host; see 7.2.
- If the controller has been configured to use local communication, the setpoint can be changed using another controller that is temporarily the ALL master; see 7.3.

For the algorithm used by the controller to determine which setpoint is the "active" setpoint, that is, the setpoint being used now, see 5.3.

[4] If the controller has been configured to do open loop control in standby, then the standby fixed output percentage will be used; see 5.5.3.

5.3 What Determines Which is the Active Setpoint

The active setpoint is the setpoint value currently being used for control. This is also the setpoint currently being displayed. As described above, this setpoint can come from one of several sources. The logic flow that determines which setpoint value is used is shown below.

If boost is active and the boost control type is closed loop,

then the active setpoint equals the boost setpoint.

Else if standby mode is active and the standby control type is closed loop,

then the active setpoint equals the standby setpoint.

Else active setpoint equals the setpoint entered using the controller front panel or written by a MODBUS host.

5.4 Displaying and Changing the Setpoint

The setpoint can be changed only when the controller is in normal (automatic) mode (NORMAL LED lit) and a CompuStep soft start is not in progress.

To display the setpoint, if the setpoint is not on display in the lower line while the controller is in normal mode, press the **DISPLAY** key until the setpoint and unit of measure are displayed.

To change the setpoint, use the ▲ and ▼ keys to change the displayed setpoint value.

The setpoint values that can be entered using the controller's front panel are limited by the configured setpoint range.

If the controller is using a configured boost (closed loop) setpoint or a standby mode (closed loop) setpoint, then that setpoint can be changed only in configuration.

5.5 Displaying and Changing the Output in Manual Mode

5.5.1 Displaying the Output Percentage in Use

If you switch the controller from normal (automatic) mode to manual mode using the **MODE** key, then the fixed output used when the switchover occurs depends on whether the process value was within 9 °F (5 °C) of the setpoint when you switched to manual.

- If the process value is within 9 °F (5 °C) of the setpoint, bumpless transfer will occur. That means that the fixed output percentage will be set to a calculated value that typically maintained this setpoint in the past in normal mode. You can change the output as described below.

- If the process value is <u>not</u> within 9 °F (5 °C) of the setpoint when the switchover occurs, the fixed output percentage will be set to 0% until you change it as described below.

To display the output percentage being used when the controller is in manual mode, if the output percentage is not on display in the lower line while the controller is in manual mode, press the **DISPLAY** key until the output percentage is displayed.

5.5.2 Changing the Output Percentage

To change the manual mode output percentage, use the ▲ and ▼ keys to change the displayed output percentage value.

5.5.3 Special Cases When a Fixed Output is Used

If using a fixed output percentage is the configured failsafe action, that special failsafe fixed output percentage can be changed as described above. However, the change will not affect the value stored for the supervisor menu's failsafe output percentage parameter. The failsafe output percentage parameter's value can be changed only in configuration (that is, using the supervisor menu).

If the controller is using a fixed output percentage because open loop boost is active, or because the controller is in open loop standby mode, the output percentage used is the configured boost fixed output percentage or standby fixed output percentage. You cannot change the output percentage as described in 5.5.2. The boost output percentage and the standby output percentage can be changed only in configuration mode (that is, using the boost or standby menu).

6. Boost Function

6.1 Introduction

Every Series RMC Hot Runner controller supports a boost function. During configuration the process engineer specified a boost setpoint (closed loop boost) or a boost fixed output percentage (open loop boost) to be used when you press the **BOOST** key.

While the special boost setpoint or boost fixed output percentage is being used, the green LED above the **BOOST** key will be lit. During closed loop boost, the boost setpoint is included in the display cycle for the lower line. During open loop boost, the configured boost fixed output percentage is included in the lower line display cycle (see 3.4.3).

6.2 Using the Boost Function

Unless the **BOOST** key has been disabled during configuration, the **BOOST** key can be used any time that the controller is in normal mode, and is not Autotuning or displaying an error message.

To start the boost function, press the **BOOST** key.

The boost function will remain active (and the BOOST LED on) until:

- the configured boost duration time has expired, or
- you press the **BOOST** key again before the expiration of the boost duration.

This boost function can be started simultaneously on all controllers in a usage group if you press the **BOOST** key on a local communication ALL master (see 7.3). The boost duration on the various controllers in a usage group can be configured to expire normally at different times. However, if you terminate the boost before the expiration of the boost duration on the ALL master, the boost will be stopped on all the other controllers in that usage group, too.

7. Communication

7.1 Introduction

Every Series RMC Hot Runner controller supports RS-485 serial communications. During configuration, the controller is set to use MODBUS, local communication, or no communication.

7.2 MODBUS Communication

If MODBUS communication was selected during configuration, the RMC controllers can be networked to a MODBUS host. You can use this host to read and write to every configuration parameter in a RMC controller's database. The host can also be used to read every status value available in the database, including which LEDs are lit. Guidelines for using a MODBUS host to communicate with the controllers are in *Using the MODBUS Protocol with Athena Series RMC Hot Runner Controllers*.

7.3 Local Communication with ALL Mastership

If local communication was selected during configuration, then each controller was assigned to a usage group. The front panel of any controller in a usage group can be used to activate the boost, change the mode, change the setpoint, or change the manual mode output in every controller in the usage group.

This is accomplished by making any one of the controllers in the usage group the ALL master temporarily.

To make a controller the ALL master, press ▲ and ▼ simultaneously. The ALL master's green ALL LED will light.

While the ALL LED is lit, you can use the ALL master to activate the boost, change the mode, change the setpoint, or change the manual mode output in other RMC controllers. An ALL master can communicate with all the other RMC controllers in the same usage group as the master, if the controllers are in mainframes that are linked via an RS-485 network with the ALL master's mainframe.[5]

[5] Series RMB controllers can be installed in the same mainframe with Series RMC controllers. However, the RMB controllers do not support communication. Therefore, changes to RMB controllers cannot be implemented using an RMC ALL master.

To make a change to all the controllers in the ALL master's usage group in networked mainframes, use the keypad of the ALL master as you ordinarily would.

- Mode changes and the activation of the boost are transmitted immediately to all the other controllers in the ALL master's group.
- Setpoint and output changes are transmitted to the other controllers when you have completed changing the value on the ALL master.

If you do not press another key within 5 seconds of pressing ▲ and ▼ simultaneously (or during any 5 second interval while the ALL LED is lit), ALL mastership will be cancelled automatically. You can cancel ALL mastership manually before 5 seconds have passed by pressing ▲ and ▼ again simultaneously.

If the ALL master experiences a problem, such as a ground fault error or a short in the TRIAC output, ALL mastership is automatically cancelled.

Caution

Each controller can be assigned to only one usage group. However, up to three usage groups can co-exist in a single mainframe (or networked mainframes). Enable ALL mastership on only one controller at a time in a mainframe (or networked mainframes). If more than one ALL master is active at the same time, network collisions can occur. The results will be unpredictable and may be undesirable.

8. Alarms

8.1 How You Are Alerted to Alarm Conditions

Each Series RMC Hot Runner controller supports two configurable deviation alarms. If the process value falls below the setpoint minus the deviation low setpoint, or if the process value exceeds the setpoint plus the deviation high setpoint, the red ALARM LED on the front panel of the controller will light.

The alarm status indicator will remain lit as long as the process value is below or above the deviation setpoints.

8.2 Automatic Shutoff if Process Temperature Exceeds Programmable Safety High

If the process engineer used the supervisor menu to specify a high-temperature safety value to be applied to the process, then when the process value exceeds this value:

- controller processing and output activity is halted, and
- the ALARM LED is lit, and
- the message H.SF alternating with Err will be displayed on the lower line.

Once the high-temperature safety value has been exceeded by the PV, the controller will not resume processing and output activity until you cycle power to the controller.

9. Access Levels

9.1 Introduction

The Series RMC Hot Runner controller can be configured to limit the functions that you can access and the values you can change using the keypad.

The **BOOST** and/or **MODE** key can be disabled using configuration parameters in the access menu.

9.2 Access Levels Available

A controller can be set to any of the access levels in the table below. The sequence of levels in the table is from most restrictive to least restrictive.

Access Level	Description
keypad lockout	**Highest security level; no access.** While the access level is "keypad lockout", you cannot change any controller values, not even the setpoint. Pressing the **MODE** and **BOOST** keys will have no effect.
setpoint only	**Setpoint or manual output can be adjusted; no access to menus.** When the access level is "setpoint only", you can use the keypad to change the setpoint or the manual mode output percentage. Whether you will be able to change the controller from normal (automatic closed loop control) to manual (open loop control) mode (or vice versa) depends on whether the **MODE** key was enabled during configuration. Availability of the boost function depends on whether the **BOOST** key was enabled during configuration.
configuration	**Setpoint and manual output can be adjusted. Access to all available menus is permitted.** When the access level is "configuration", you can use the keypad to change the setpoint, change the output percentage in manual mode, and to view and change all configuration parameter values in accessible menus. Not all menus are accessible all the time.

10. Tuning the Controller for PID Control

10.1 Introduction

The Series RMC Hot Runner controllers use Proportional-Integral-Derivative (PID) control to modulate the output power by adjusting the output power percentage within a proportional band. Power is proportionally reduced as the process temperature gets closer to the setpoint temperature. The integral action affects the output based on the duration of the process value's variation from the setpoint, and the derivative action affects the output based on the rate of change of the process value.

The proportional band and derivative action (rate) are automatically adjusted by the Autotune operation. The integral (reset) action used by an RMC controller is always equal to five times the configured derivative (rate) action.

If your process experiences extremely long lag time, Autotuning may be unsuccessful. If this is the case, an error message will be displayed to alert you to that fact (see 10.4). If Autotuning is not possible, you can tune the controller manually as described in *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*.

10.2 Configuration Sequence and Autotune

By default, every Series RMC controller is configured to execute the Autotune operation the first time it is powered up, then to disable the Autotune feature after a successful Autotune has been completed. When the Autotune feature is disabled, the PID control menu Autotune operation parameter is set to disabled. If the Autotune is not successfully completed, either because you interrupt it by pressing the **MODE** key or because an Autotune error condition is detected, the Autotune feature will not be disabled automatically.

The controller must be configured before it is tuned. When you first power up the controller, it will attempt to go through the normal startup procedure described in Section 4. Press the **MODE** key until the controller is in standby mode and configure the controller as described in *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*. Once all the parameters described in that manual have been configured, perform Autotune as described in 10.3.

10.3 Autotuning

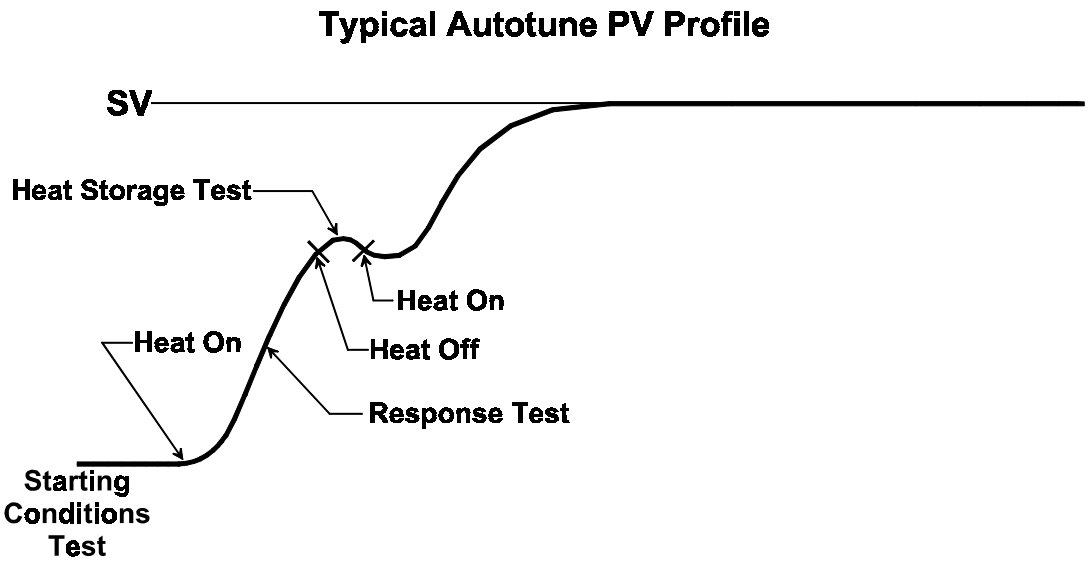
10.3.1 Introduction

By default, every Series RMC controller is configured to execute the Autotune operation the first time it is powered up, then to disable the Autotune feature after a successful Autotune has been completed. If the Autotune is not successfully completed, the Autotune feature will not be disabled automatically.

The Autotune operation overwrites any existing proportional band and derivative (rate) parameter values that were previously configured.

The controller must be configured before Autotune is used.

All RMC controllers in a single process should be Autotuned simultaneously, so that interactions between zones during tuning parallel the interactions expected while the controllers are in use.



10.3.2 Procedure for Autotuning

The procedure below is used to start Autotune using the front panel of the controller. You can also use a MODBUS master to change the mode, view and change parameter values, and to start Autotuning.

To Autotune:

1. After the controller has been configured as described in *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*, exit configuration by pressing and holding the **DISPLAY** key until the PV is displayed on the top line of the display in place of the menu name.

2. Use the ▲ and ▼ keys to enter a setpoint that is representative of the setpoint you expect to use when the controller is in normal operation.

3. Cycle the power to the controller.

4. At this point the controller may execute a CompuStep soft start (NORMAL LED flashing). (See Section 4 for an explanation of the factors that affect whether a soft start occurs when you power up the controller.)

   - If you want to terminate the soft start, press the **MODE** key once.

   - If you want the soft start to continue to its normal conclusion (recommended), do not press any keys.

5. When the Autotune operation begins, the process value on the top line of the display will alternate with tun. Unless you want to terminate the Autotune by pressing the **MODE** key, do not press any keys during the Autotune operation. The lower line will continue to display the setpoint your entered in Step 2.

6. When the controller has completed Autotuning successfully, the flashing tun will disappear. The display will revert to the normal mode operating display, with the process value on the top line and the setpoint on the lower line. The controller will save the tuning parameter values in the proportional band and rate parameters. (The new tuning values can be viewed in the PId menu.)

   If the Autotune was unsuccessful, the top line will display Er plus a one-digit error code (alternating with tun). Refer to 10.4 for the Autotune error codes. If the controller detects an Autotune error condition, the controller will go to the configured failsafe state automatically. (The effect on the output depends on how the failsafe action was configured.)

7. To clear the error display and put the controller in standby mode, press the **MODE** key once. (The effect on the output depends on the configuration selections made with the standby menu.)

8. Fix the problem and try tuning again. (If Er9 was displayed, your process is not responsive enough for the Autotune algorithm to work successfully. Tune the controller manually as described in the *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*).

9. Once Autotune has been completed successfully, and the PV and SV are on display, the controller is controlling the process in normal (auto) mode.

10.4 Autotune Error Codes

If an Autotune error occurs, the top line of the display will alternately show tun and an error code (which will be displayed until you press the **MODE** key). If the Autotune operation is terminated by the controller because of an error condition, the controller is placed in the failsafe state configured using the SUP (supervisor) menu. The Autotune error codes are in the table below.

Error Code	Description
Er3	Setpoint is higher than the process value. Look at the setpoint. If it is realistic for your process, then check the thermocouple leads; maybe they are reversed.
Er5	There is not enough difference between initial PV and the setpoint. For Autotune to work, the difference must be at least 9 °F (5 °C).
Er8	The startup curve (change in PV) was not acceptable to the Autotune algorithm. This could be caused by a process upset that occurred during tuning. Try Autotuning again when the process is stable. If the error recurs, your process is not suitable for Autotuning. Use manual tuning as described in *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*.
Er9	The Autotuning timed out, because the process was unresponsive (or extremely slow). Your process is not suitable for Autotuning. Use manual tuning as described in *Athena Series RMC Hot Runner Controller Configuration and Operation Manual*.

11. Error Messages and Codes

11.1 Introduction

As described in Section 3, usually the controller displays the process variable on the top line and the setpoint on the lower line of the display. You can see other values on the lower line by pressing the **DISPLAY** key. However, when the controller detects a problem with the process (other than a deviation alarm) or with its own operation, messages and codes are displayed to alert you to conditions that require your immediate attention.

11.2 Problem with Process Temperature

During configuration, the supervisor menu can be used to specify a high-temperature safety value to be applied to the process. If the process value exceeds this value:

- controller processing and output activity is halted, and
- the ALARM LED is lit, and
- the message H.SF alternating with Err will be displayed on the lower line.

Once the high-temperature safety value has been exceeded by the PV, the controller will not resume processing and output activity until you cycle power to the controller.

11.3 Ground Fault in Controller Output Wiring

The RMC controller is capable of detecting ground faults in the controller output wiring. When a ground fault is detected, the controller will attempt to perform a normal soft start. As usual in the case of a soft start, if the process value is less than or equal to 200 °F (93 °C), the standard CompuStep soft start described in 4.1 will be executed. In this special case, the soft start will be executed up to three times. If the ground fault is still detected, the controller will consider this a “hard” ground fault. The effect on the controller will be the same as when the PV is greater than 200 °F (93 °C) when the ground fault is detected as described below.

If the process value is greater than 200 °F (93 °C) when the ground fault is detected, the controller will consider this a “hard” ground fault. The controller will:

- interrupt the signal to its own output, in effect “turning off” the output (even if the controller output was already at the configured failsafe output state), and
- an error message GF 1 will be displayed on the lower line, and
- the red ALARM LED will also be lit (all other LEDs will be turned off).

Following the interrupt in response to a “hard” ground fault, the controller’s output will remain off until you cycle power to the controller.

If the controller is the ALL master for local communication at the time that the ground fault is detected, the mastership will be cancelled automatically. (See 7.3 for more information about local communication and ALL mastership.)

11.4 Loop Break in Sensor Wiring

During configuration the supervisor menu can be used to specify a loop break time, that is, the time period within which the input value should increase at least 1% of supported sensor span (9.67 °F or 5.37 °C) if the sensor is working properly and the input wiring is intact. If the input value does not change within the specified time period while the controller is operating in normal (automatic) mode or in closed loop standby mode (or while a closed loop boost is in progress), and a "bad heater" error has not been detected (see 11.6), then:

- the controller output will be turned off, and
- the ALARM LED will be lit (all other LEDs turned off), and
- the message LPbr will be displayed on the lower line.

The controller will remain in this alarm and output off state until you cycle power to the controller.

11.5 Failsafe Operation if a Sensor Error is Detected

During configuration the supervisor menu can be used to specify a failsafe action, that is, what should happen to the output if the controller detects a reversed or open sensor.[6] The possible failsafe action are:

- output off, or
- use a calculated output value based on output values that have typically successfully maintained the current setpoint for your process in the past, or
- use a special configurable failsafe fixed output percentage.

If the controller detects an open or reversed sensor:

- the controller output goes to the configured failsafe state, and
- the ALARM LED will be lit (all other LEDs turned off), and
- the upper display will alternate tC and rEu (reversed sensor), or tC and oPn (open sensor).

The controller will remain in this alarm and failsafe state until the condition clears or you cycle power to the controller.

[6] When an Autotune error condition is detected, the controller goes to the failsafe state automatically. In this case, an Autotune error message will be displayed; see 10.4.

11.6 Heater Current Monitoring

The present current output to the heater, expressed to the closest tenth of an amp, is always displayable in the lower line. Cycle through the available lower line display items using the **DISPLAY** key. The controller constantly checks heater current readings to ensure that they correlate with output activity.

- If the output is off and a current flow greater than 0.1 amp is detected, then the controller will post a “TRIAC short” error.
- If the output is on, but no controller current output flow is detected, then the processor will post a “bad heater” error. (This condition is checked only if loop break detection is enabled, the PV has not changed 1% of supported sensor span during the configured loop break time period while the controller is in normal (auto) mode, and the PV is not within the proportional band.[7])

If either of these error conditions is detected:

- the output failure interruption relay will break the connection between the controller’s TRIAC output and the heater, and
- controller processing will cease, and
- the red ALARM LED will be lit (all other LEDs turned off), and
- an alarm message will be displayed on the lower line:
  - if a short was detected, Out will alternate with SHrt
  - if a heater problem is detected, bAd will alternate with Htr

The controller will remain in this halted state until you cycle power to the controller.

If the controller is the ALL master for local communication at the time that the output failure is detected, the mastership will be cancelled automatically. (See 7.3 for more information about local communication and ALL mastership.)

[7] If the input has not changed 1% during the loop break period, but the current output flow is OK, then the loop break error will be displayed; see 11.4.

11.7 Problem with Controller

11.7.1 Introduction

If the controller detects a problem with its own operation, it displays Err on the top line instead of the process value and displays an error code on the lower line instead of the setpoint. For example, if the controller detects a checksum error, the display will show:

Err
0 100

11.7.2 Controller Error Codes

The table below lists the error messages and codes that the RMC controllers display in place of the setpoint value when a self-diagnostic test has failed.

All errors of this type will shutdown controller activity (except for display of error message). Output will go off. A host computer cannot communicate with a controller that is displaying one of these messages.

Display	Error Condition	Operator Action
HErd alternating with Err (See Note 1)	Heater conversion error *There is a problem getting a reading from the analog to digital converter.*	Cycle power to clear the message. *Note the error code and call for service.*
0 100	PROM checksum error *This message is usually displayed only at startup, before any outputs are calculated.*	Cycle power to clear the message. *Note the error code and call for service.*
0 101	RAM error *This message is usually displayed only at startup, before any outputs are calculated.*	Cycle power to clear the message. *Note the error code and call for service.*
0202	Default parameter values were loaded automatically, because the controller found corrupted values stored on the EEPROM. *This message is usually displayed only at startup, before any outputs are calculated.*	Cycle power to clear the message. Re-configure all configuration parameter values.
0249	Calibration value corrupted.	Cycle power to clear the message. *Note the error code and call for service.*

Display	Error Condition	Operator Action
0303	EEPROM write failure *This message is usually displayed when a configuration value is written.*	Cycle power to clear the message. Try the write operation again. If the message recurs and persists, the EEPROM may be worn out. Call for service. (See Note 2 below.)
2436	Line frequency determination error. *The controller was unable to determine whether the line frequency was 50 Hz or 60 Hz.*	Cycle power to clear the message. Check the line frequency. If it is OK, but the message recurs and persists, call for service.
3923 through 3543	interrupt-related problem *While one of these messages is on display, the controller output is off*.	Cycle the power to the controller. If the message recurs and persists, call for service.

Note1: In this case, the PV is displayed on the top line.

Note 2: A host computer can wear out the EEPROM by writing to it too many times. Do not write the setpoint to the EEPROM when you are writing a temporary setpoint to the controller, such as when you are ramping to a final setpoint under the direction of a MODBUS master.

11.8 Error Display Priority and Summary

If more than one error occurs simultaneously, only the highest priority error will be displayed. The following table shows the priority of the RMC error codes and messages.

Displayed Code or Message	Description	Output State	Where to Find More Information
Highest Priority – No communication with MODBUS host possible			
Err 0 100 or *other 4-digit code*	controller has detected a problem with its own operation	off	11.7
High Priority – Communication with MODBUS host still possible. PV is displayed on top line, unless an input error (medium priority) occurs simultaneously. In that case, the top line is blank; no valid PV is available. If two high priority error states are detected, the one ranked highest will be displayed on the lower line (see numbers below).			
1) GFI	hard ground fault detected	off	11.3
2) bAd Htr	heater problem detected	off (output failure relay will interrupt output)	11.6
3) Out SHrt	output is off, but current flow is detected	off (output failure relay will interrupt output)	11.6
4) H.SF Err	configured high temperature safety value has been exceeded	off	11.2
5) LPbr	PV has not increased at least 1% of supported sensor span in the configured loop break time	off	11.4
6) Ht.rd Err	heater conversion error	off	11.7
Medium Priority – Communication with MODBUS host still possible. SV is displayed on lower line. These conditions cannot occur simultaneously.			
tC oPn	thermocouple open	goes to configured failsafe state	11.5
tC rEu	thermocouple leads reversed	goes to configured failsafe state	11.5
Low Priority – Communication with MODBUS host still possible. SV is displayed on lower line. Only one Autotune error will be displayed.			
tun Er3	initial SV is less than PV	goes to configured failsafe state	10.4
tun Er5	not enough difference between initial SV and PV	goes to configured failsafe state	10.4
tun Er8	change in PV not acceptable to Autotune algorithm; possible process upset during tuning	goes to configured failsafe state	10.4
tun Er9	Autotune timed out; process unresponsive or very slow	goes to configured failsafe state	10.4

12. Maintenance

12.1 Introduction

This section contains instructions for cleaning the front panel of the controller and instructions for replacing the fuses.

Except for fuses, the controller contains no user-serviceable parts.

12.2 Cleaning the Front Panel

Warning

Do not attempt to clean any part of a controller other than the front panel.

If you want to clean the front panel of a single controller, use the power switch on the front of the controller to turn it off, then remove the controller from the mainframe.

If you want to clean the front panel of several controllers, turn off power to the mainframe before cleaning the controllers while they are installed in the mainframe.

While cleaning a controller's front panel, do not allow alcohol to enter the switch.

Allow controllers and mainframes to dry thoroughly before restoring power. Do not use a heater or compressed air to dry the units.

Failure to observe these precautions can result in exposure to a potentially lethal shock hazard.

The controller power switch must be in the "OFF" position before you put a controller into an energized mainframe, or remove a controller from an energized mainframe. Failure to observe these precautions can result in damage to the connectors and printed circuit boards.

To clean an RMC controller:

1. Read the safety warnings on the previous page before you start cleaning a controller.

2. To clean the front panel of a single controller, put the controller power switch in the "OFF" position, and then remove the controller from the energized mainframe by removing the locking pin or locking screw, and pulling on the handle on the front of the controller.

   Alternatively, if you plan to clean the front panel of several controllers, put the power switch of every controller in the mainframe in the "OFF" position, and then turn off power to the entire mainframe. After the mainframe has been de-energized, you can clean the controllers while they are in the mainframe.

3. Use a cotton cloth to gently and sparingly apply isopropyl alcohol to the front panel of the controller. Do not use cleaning solutions or other solvents. Use of anything other than isopropyl alcohol can result in damage to the controller.

   Do not allow alcohol to enter the power switch on the controller's front panel.

4. Allow the controller to air-dry thoroughly. Do not use a heater or compressed air to dry the unit.

5. Inspect all surfaces to make sure that they are completely dry.

6. When the controller is completely dry, re-install it and return it to service.

12.3 Replacing the Fuses

Each RMC controller contains two fuses, located on the main printed circuit board.

To replace the fuses in an RMC controller:

1. Make sure that you have appropriate replacement fuses. The fuses used in an RMC controller are Type F fast-acting 250 Vac fuses rated at 15 amps. Suitable fuses are Littlefuse Inc. p/n 314015 and Athena p/n 210B001U01.

2. Put the power switch of the controller in the "OFF" position.

3. Remove the locking pin or locking screw.

4. Use the handle on the front of the controller to pull it out of the mainframe.

5. Replace the fuses.

6. Re-install the controller and return it to service.

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Athena Series RMC Hot Runner Controllers

Parameter List

Please note the numbers or selections used in your controller for these key parameters.
(Not all parameters apply to every controller or to every control strategy.)

Write down the values after the controller has been Autotuned and is working well. Save this sheet for future reference. If someone accidentally changes the configuration or you must replace the controller (with the same model controller), you can re-enter these values and minimize downtime.

Model Number (on controller label) _____

Firmware Version Number (displayed when the controller is powered up after all segments on both lines of the display have been tested) _____

PId (PID control)	bSt (boost)	Stb (standby)	InP (input)	AIr (alarm)
Pb _____	tYPE _____	tYPE _____	b IAS _____	AL.OP _____
rAtE _____	dUr _____	S.SP _____	SP.LL _____	dE.H _____
At.OP _____	b.SP _____	S.Pct _____	SP.HL _____	dE.L _____
	b.Pct _____			InH _____