VERSATILE BOILER CONTROL

MP2™ SEQUENCER FOR POWER-FIN® COPPER-FIN®, COPPER-FIN II® AND EFFICIENCY+®

INCREASING SYSTEM EFFICIENCY

Lochinvar's MP^2 sequencer can control the supply water temperature for up to nine On / Off stages based on outdoor temperature, a setpoint requirement, or an external input signal (0 - 10V DC). The large, easy to read display provides current system temperature and operating status. The control has outputs for a primary pump and either a combustion air damper or alarm. It is extremely versatile, allowing many different combinations of boiler stages and pumps.

STANDARD FEATURES

· Indoor / Outdoor Reset
· Night Setback
· Warm Weather Shutdown
· Boiler Minimum Supply
· PID Staging
· Equal Run Time Rotation
· Fixed Lead

· Fixed Last
· Setpoint Boiler Reset Override
· Combustion Air or Alarm Contacts
· 0 - 10V DC input

VERSATILE IN APPLICATION

The MP^2 Sequencing Control is extremely versatile in its application, allowing for up to nine on/off stages and eight modes of operation. The following describes each mode of operation.

Mode 1: 9 Single Stage Boilers and a Primary Pump
Mode 2: 4 Single Stage Boilers with individual pumps and a primary pump
Mode 3: 4 Two Stage Boilers and a Primary Pump
Mode 4: 3 Two Stage Boilers with individual pumps and a primary pump
Mode 5: 3 Three Stage Boilers and a Primary Pump
Mode 6: 2 Three Stage Boilers with individual pumps and a primary pump
Mode 7: 2 Four Stage Boilers and a Primary Pump
Mode 8: 1 Four Stage Boiler with pump and a primary pump

	RELAY 1	RELAY 2	RELAY 3	RELAY 4	RELAY 5	RELAY 6	RELAY 7	RELAY 8	RELAY 9
MODE 1	Boiler 1	Boiler 2	Boiler 3	Boiler 4	Boiler 5	Boiler 6	Boiler 7	Boiler 8	Boiler 9
MODE 2	Boiler 1 ———	Boiler 1 Pump	Boiler 2 ———	Boiler 2 Pump	Boiler 3 ———	Boiler 3 Pump	Boiler 4 ———	Boiler 4 Pump	——— ———
MODE 3	Boiler 1 Stage 1	Boiler 1 Stage 2	Boiler 2 Stage 1	Boiler 2 Stage 2	Boiler 3 Stage 1	Boiler 3 Stage 2	Boiler 4 Stage 1	Boiler 4 Stage 2	——— ———
MODE 4	Boiler 1 Stage 1	Boiler 1 Stage 2	Boiler 1 Pump	Boiler 2 Stage 1	Boiler 2 Stage 2	Boiler 2 Pump	Boiler 3 Stage 1	Boiler 3 Stage 2	Boiler 3 Pump
MODE 5	Boiler 1 Stage 1	Boiler 1 Stage 2	Boiler 1 Stage 3	Boiler 2 Stage 1	Boiler 2 Stage 2	Boiler 2 Stage 3	Boiler 3 Stage 1	Boiler 3 Stage 2	Boiler 3 Stage 3
MODE 6	Boiler 1 Stage 1	Boiler 1 Stage 2	Boiler 1 Stage 3	Boiler 1 Pump	Boiler 2 Stage 1	Boiler 2 Stage 2	Boiler 2 Stage 3	Boiler 2 Pump	——— ———
MODE 7	Boiler 1 Stage 1	Boiler 1 Stage 2	Boiler 1 Stage 3	Boiler 1 Stage 4	Boiler 2 Stage 1	Boiler 2 Stage 2	Boiler 2 Stage 3	Boiler 2 Stage 4	——— ———
MODE 8	Boiler 1 Stage 1	Boiler 1 Stage 2	Boiler 1 Stage 3	Boiler 1 Stage 4	Boiler 1 Pump	——— ———	——— ———	——— ———	——— ———

CONTROL FUNCTIONS AND BENEFITS

INDOOR / OUTDOOR RESET

To properly control a heating system, the heat supplied to a building must equal the heat lost from the building. Heat loss is dependent on the outdoor temperature, and it is necessary to reset the supply water temperature based on the outdoor temperature. Indoor / Outdoor Reset improves comfort by limiting temperature swings, and increases energy savings by providing heat only when needed.
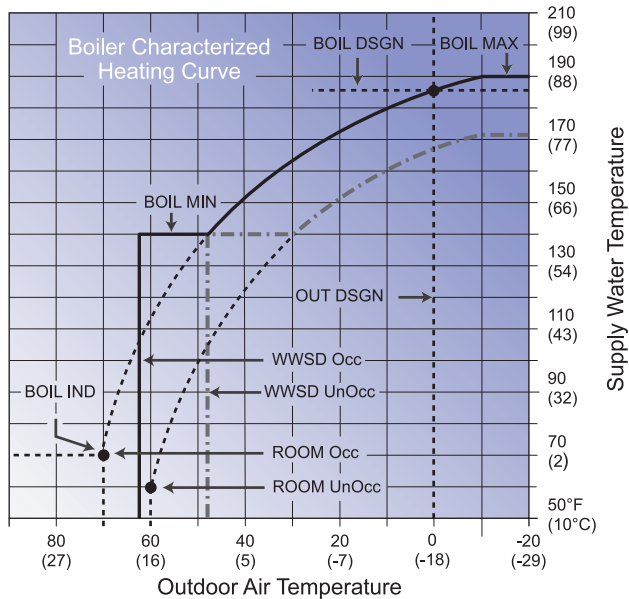
BOIL DSGN - Design temperature
BOIL MIN - Min. boiler target supply water temp.
BOIL MAX - Maximum boiler target supply water temp.
BOIL IND - Design indoor air temp for heat loss calculation
OUT DSGN - Design outdoor temp. for heat loss calculation
ROOM Occ - Target room temp. while occupied
ROOM UnOcc - Target room temp while unoccupied
WWSD Occ - System warm weather shutdown while occupied
WWSD UnOcc - System warm weather shutdown while unoccupied

WARM WEATHER SHUTDOWN

When the outdoor air temperature rises above the indoor temperature, no heat is required in the building and the system can be shut down, increasing system efficiency.

BOILER MASS SETTING

The heat up and cool down rate of a boiler depends on how much thermal mass the boiler contains. By knowing the boiler mass, the control can more accurately determine the correct number of stages to turn on.

PID STAGING

The MP^2 control uses proportional, integral and derivative logic for boiler control. Proportional determines how far the boiler temperature is below setpoint. The colder the supply water temperature, the faster the next stage is turned on. Integral evaluates how long the temperature has been below setpoint. The Derivative function compares how fast or slow the supply water temperature is changing.

FIXED LEAD ROTATION

In some applications, such as a front end loaded system, it may be desirable to have the first boiler fire first at all times, while firing the remaining boilers in Equal Run Time Rotation to maximize the efficiency of the system.

FIXED LAST ROTATION

In other applications, it may be desirable to have the last boiler fire last at all times, while firing the remaining boilers in Equal Run Time Rotation.

EQUAL RUN TIME ROTATION

To minimize the wear and tear on individual boilers, the run time rotation feature changes the firing order of the boilers after one boiler accumulates 48 hours more run time than any other boiler. After each rotation, the boiler with the least run time is the first to fire and the boiler with the most run time is the last to fire. This function ensures that all the boilers receive equal amounts of use.

720 hours   690 hours   672 hours

672 hours   690 hours   720 hours

SETPOINT BOILER RESET OVERRIDE

The control setpoint temperature will override the outdoor reset temperature and the warm weather shutdown temperature settings in order to provide heat to the setpoint load. This allows the boilers to operate only at the temperature required to satisfy the currently load, saving energy over those systems maintaining a constant temperature to satisfy the highest load.
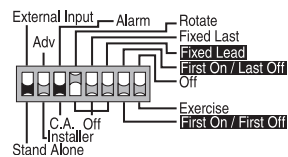
COMBUSTION AIR OR ALARM CONTACTS

An isolated contact is provided on the MP^2 control that can be used as either a combustion air damper contact or alarm contact.
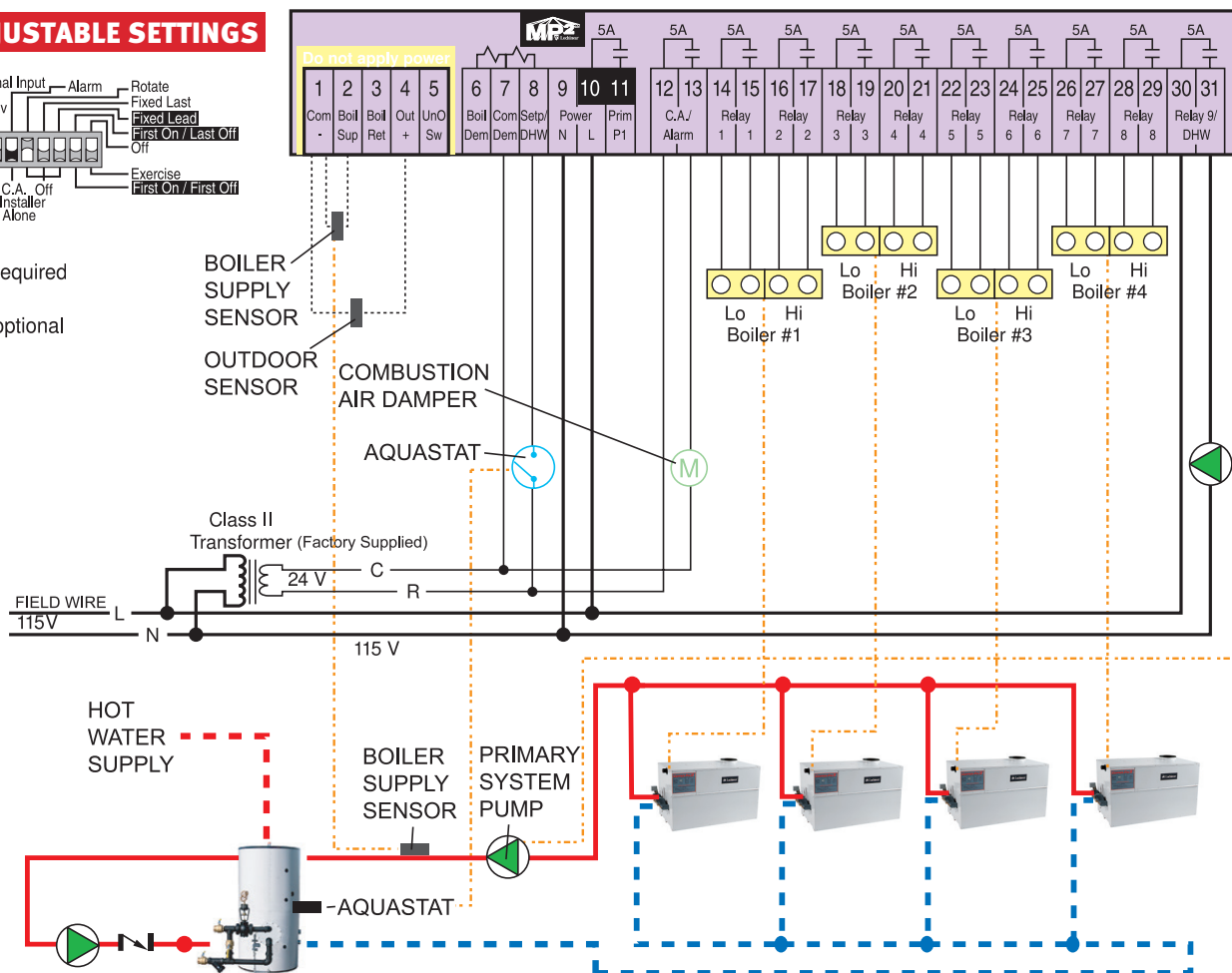
EXTERNAL INPUT

The MP^2 control can accept an external (0 - 10V) DC signal in place of the outdoor air sensor to control heating system input.

MP²™ TYPICAL APPLICATION (MODE 3)

TYPICAL SYSTEM APPLICATION

The MP² provides domestic hot water operation to a single Lochinvar Hot Water Generator. The MP² provides staging rotation and purging four two-stage Copper-Fin II® boilers. The boilers are piped in reverse return with a single pump. A combustion air damper is also controlled by the MP².

CONSIDERATIONS

Proper control of low mass copper-tube boilers, such as the Copper-Fin and Copper-Fin II, is critical for system efficiency. Proper boiler control and increased system efficiency can be obtained by utilizing the MP² sequencing control. To prevent system temperature overshooting and droop, which is commonly seen in basic boiler sequencing controls, this control utilizes PID control logic. With PID logic controls like the MP², the number of boiler(s) or stage(s) of boiler(s) fired depends on how far the system temperature is below setpoint, the time system temperature has been below setpoint, and how fast the temperature is changing.

Another important factor of overall system efficiency is boiler run time. To ensure maximum system efficiency, boiler run time must be limited to a minimum of 6 cycles per hour. With the MP² sequencing control, this is done through the adjustable mass setting. The adjustable mass setting reduces unnecessary staging by knowing how fast the boiler heats up and cools down.

DIMENSIONS & SPECIFICATIONS


13"

13-1/2"

3-1/2"
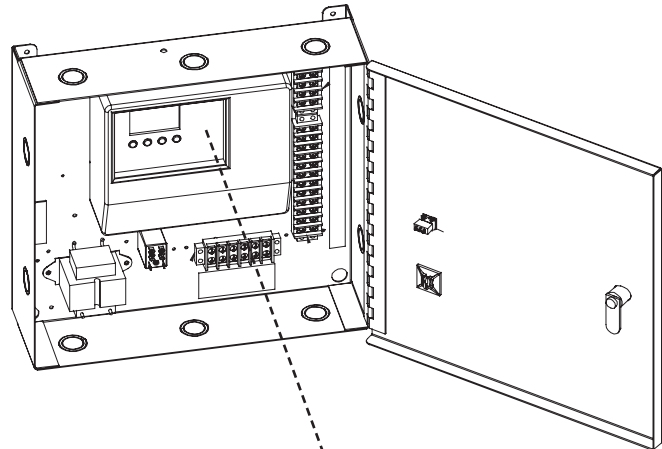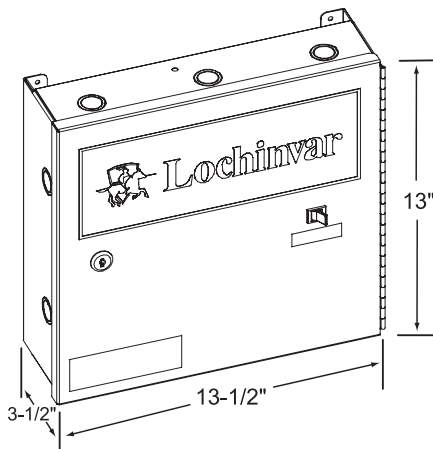
MP² sequencer part numbers:

PAN3815 - *Boiler Operation*

PAN3816 - *Boiler Operation w/ Domestic Hot Water Prioritization/Outdoor Sensor*

PAN3817 - *Water Heater Operation*

ADJUSTABLE SETTINGS

- Room Temperature
- Range of External Input Signal
- Temperature Offset
- Mode of Operation
- Number of Stages of Control
- Outdoor Design Temperature
- Design Indoor Air Temperature
- Design Supply Water Temperature
- Maximum Boiler Temperature
- Minimum Boiler Temperature
- Stage Delay (Differential)
- Boiler Differential
- Setpoint Temperature
- Warm Weather Shutdown Temperature
- Units of Measure - U.S. or Metric
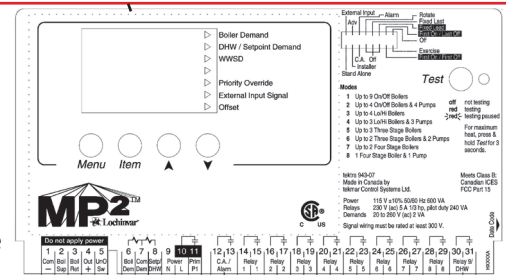
SPECIFICATION

The SEQUENCER shall be a LOCHINVAR MP²™ electronic control. Model PAN_____ having a capacity for up to _____ stages of operation to control _____ boilers. The MP² Sequencer shall carry a one (1) year limited warranty.

The MP² shall use a microprocessor based sequencing control with an advanced Proportional plus Integral plus Derivative (PID) control algorithm to minimize temperature droop and overshoot. It shall be able to operate up to a total of 9 on/off stages of boilers with one, two, three or four independent on/off stages. Soft start function shall be provided to minimize rapid cycling during system start up. The microprocessor shall provide a minimum two minute time between stages and a one minute minimum "on time" to reduce rapid cycling and increase efficiency. The microprocessor control board shall be an Underwriters Laboratories Inc. recognized component and Canadian Standards Association certified. The microprocessor may be field set to cycle with a First-On/First-Off (lead/lag) sequence or with a First-On Last-Off sequence as required. Continuous monitoring of water temperature shall be used. Water temperature input shall be provided by an immersion type platinum thermistor with a positive temperature coefficient. The control shall have the ability to calculate the boilers' target temperature based on outdoor reset. It shall have an adjustable warm weather shut down when in outdoor reset operation. A primary pump contact is operational during a call for space heating. 120 VAC power shall be supplied to the sequencer. An internally mounted and wired 24 VAC transformer shall be provided for operation of the internal microprocessor control board.

The sequencer shall have the ability to rotate the firing sequence of the boilers and an option for rotating the boiler firing sequence based on the boilers' accumulated run time. To prevent short cycling of boiler stages, the control shall have an automatic differential calculation. Based on the mode of operation selected, the MP² shall have the ability to operate a system pump and individual boiler pumps. It shall have the option of staging multistage boilers in either a Low - High sequence or a Low - Low sequence. It shall have the option for a fixed lead rotation or first on/first off, or first on/last off firing sequence, or fixed last rotation.

The MP² sequencer shall have terminal strip connections for all field wiring of remote temperature controls, control interlocks to cycle individual units connected to the sequencer and 120 VAC power supply. It will accept a 0 - 10V (dc) input signal from an energy management system.

The assembled MP² sequencer shall be enclosed in a NEMA-1 enclosure. The enclosure shall be constructed with heavy gauge galvanized steel. All steel used in the enclosure shall be galvanized on both sides. The exterior and interior surfaces of the enclosure assembly shall be coated in a 3 coat acrylic enamel finish. The enclosure shall be provided with a hinged, key locking door for security. The enclosure shall be provided with integral mounting brackets for ease of field installation in the equipment room. An externally mounted and lighted main power switch shall be provided on the enclosure. The manufacturer shall verify proper operation of the microprocessor control by electrically testing of all functions prior to shipping. A quality test report shall be shipped with each unit.

LOCHINVAR®
HIGH EFFICIENCY BOILERS & WATER HEATERS