

Controller

In Use Indicator

Indicates that hot water is being supplied.

Temperature Display

Indicates temperature setting or flashes error code.

Thermostat

Priority Indicator

Indicates that the controller is setting the water temperature.

Priority Button

When no water is being supplied, pressing this button allows this controller to set the water temperature.

ON/OFF Button

WARNING

The MC-91-1 controller is not compatible with Alternate Temperature Settings are for commercial applications only. DO NOT use the MC-91-1 controller when dip switches 2 and 3 (white switches) are in the ON position.

Diagnostic Use of the Controller

1. To display the most recent diagnostic codes press and hold the "On/Off" button for 2 seconds on the MC-91 controller.

2. To enter or exit the maintenance monitor information mode press and hold the down button for 2 seconds and without releasing it press the ON/OFF button.

No.	Data	Unit
01	Water flow rate	0.1 gal/min
02	Outgoing water temperature	Degrees Fahrenheit

To Change the Temperature Scale (°F / °C)

With the water heater turned off, press and hold the ON/OFF button until the display changes to the other temperature scale (about 5 seconds).

To Turn Off the Controller Sound (Mute)

To turn the sound off (mute), press and hold both the ▲ and ▼ thermostat buttons until a "beep" is heard (about 5 seconds).

Locking the Controller

The MC-91-2 controller can be locked or unlocked by pressing the Priority button and the up button together for 5 seconds. A beep will sound confirming that the controller is locked. The display will alternately show "LOC", the temperature setting, and a diagnostic code if one has been activated. All of the controllers in the system are also locked.

To unlock the controller press the Priority button and the up button together for 5 seconds.

Gas Pressure Setting

Ensure gas pressure check under Commissioning has been completed first! The regulator is electrically coded and factory pre-set. Under normal circumstances it does not require adjustment during installation. Make adjustments only if the unit is not operating correctly and all other possible causes for incorrect operation have been eliminated.

1. Turn OFF the gas supply.

2. Turn OFF the water supply.

3. Remove the front panel (four screws).

4. Check the gas type using the data plate on the side of the unit. Confirm that the gas type switch is in the correct position (switch 1 of SW2 is ON for natural gas, NG, and OFF for propane gas, LPG.) Figure 1.

5. Remove the screw and attach the manometer to the burner test point located on the gas control. Figure 2.

6. Turn on the gas supply and the power supply.

7. Flow water through the water heater at the maximum flow rate obtainable. (At least 3 gallons per minute is recommended. If there is not enough water flowing, the water heater could shut off or sustain damage due to overheating.)

8. Move switch 8 of SW1 to ON. Figure 3.

9. Push the PC board switch A for one second. Figure 4.

10. Calibrate "Forced Low" combustion using switch A (up) and switch B (down).

11. Move switch 8 of SW1 to OFF and then back to ON. Figure 6.

12. Push the PC board switch B for one second. Figure 4.

13. Calibrate "Forced High" combustion using switch A (up) and switch B (down).

14. Move switch 8 of SW1 to OFF. Figure 5.

15. Close hot water taps.

16. Turn off gas supply and 120 V power supply.

17. Remove manometer and re-install allen head plug.

18. Turn on the gas supply and 120 V power supply.

19. Operate the unit and check for gas leaks.

20. Install the front panel using four screws.

Gas Pressure Setting

NOTE: For additional installation and commissioning information refer to the Operation and Installation Manual.

WARNING

This appliance must be installed, serviced and removed by a trained and qualified person. During pressure testing of the consumer piping, ensure gas valve is turned off before unit is shut off. Failure to do so may result in serious injury to yourself or damage to the unit.

APPLIANCE OPERATING PRESSURES

Table 1						
Water Inlet Min./Max.	Gas Inlet Min./Max.		Forced Low		Forced High	
	NAT.G.	LPG	NAT.G.	LPG	NAT.G.	LPG
UGTC-199	Short flue length	150 PSI	4" W.C. (10.5" W.C.)	8" W.C. (13.5" W.C.)	0.51" W.C. (0.52" W.C.)	3.1" W.C. (3.7" W.C.)
	Long flue length				0.53" W.C. (0.55" W.C.)	3.3" W.C. (3.9" W.C.)
UGTC-152	Short flue length	150 PSI	4" W.C. (10.5" W.C.)	8" W.C. (13.5" W.C.)	0.51" W.C. (0.52" W.C.)	1.9" W.C. (2.3" W.C.)
	Long flue length				0.53" W.C. (0.55" W.C.)	2.0" W.C. (2.4" W.C.)

Commissiioning

With all gas appliances in operation at maximum gas rate, the flowing inlet pressure at the incoming test point on the water heater should read 4" W.C. - 10.5" W.C. on natural gas and 8" W.C. - 13.5 W.C. on propane gas. If the pressure is lower, the gas supply is inadequate and the unit will not operate to specification. Check the gas meter regulator and pipework for correct operation/sizing and correct as required.

Troubleshooting

Important Safety Notes

There are a number of (live) tests that are required when fault finding this product. Extreme care should be used at all times to avoid contact with energized components inside the water heater. Only trained and qualified service technicians should attempt to repair this product. Before checking for resistance readings, disconnect the power source to the unit and isolate the item from the circuit (unplug it).

(SV1, SV2, SV3 and POV) Gas valve and Modulating solenoids: (Set meter above 2K)

Wire color	Voltage	Resistance	Connector #	Pin #fs
Main Black - Pink	11 ~ 13 VDC	24 ~ 28 ohms	B1	3-4
(SV1) Black - Blue	11 ~ 13 VDC	35 ~ 41 ohms	B3	4-6
(SV2) Black - Yellow	11 ~ 13 VDC	35 ~ 41 ohms	B2	4-7
(SV3) Black - Red	11 ~ 13 VDC	39 ~ 42 ohms	B4	4-5
(POV) Yellow - Yellow	2 ~ 15 VDC	67 ~ 81 ohms	D1	1-2

(M) Water Flow Control Device Servo or Geared Motor:

Red - Pink	5 ~ 8 VDC	44 ~ 52 ohms	G2	3-4
White - Blue	5 ~ 8 VDC	44 ~ 52 ohms	G2	1-2
Grey - Brown	N/A	N/A	G2	5-7
Grey - Orange	N/A	N/A	G2	6-7

NOTE: The grey wire listed above turns to black at G connector on the PCB.

(QS) Water Flow Sensor:

Black - Red	11 ~ 13 VDC	5.5 ~ 6.2 K ohms	L3	E10 - G7
Yellow - Black	4 ~ 7 VDC	1.1 ~ 1.4 Mega ohms	L3	E1 - G7

By-pass Flow Control:

Red - Pink	2 ~ 6 VDC	44 ~ 52 ohms	G1	12-13
White - Blue			G1	10-11

(IG) Ignition System:

Grey - Grey	90 ~ 110 VAC	N/A	C1	1-3
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(FM) Combustion Fan Motor:

Red - Black	6 ~ 45 VDC	N/A	L2	5-6
White - Black	5 ~ 10 VDC	9.72 ~ 9.75 K ohms	L2	3-5
Yellow - Black	1.1 ~ 1.3 VDC	4.02 ~ 4.05 K ohms	L2	4-5

Set your meter to the hertz scale. Reading across the white and black wires at terminals 3 and 5 you should read between 60 and 420 hertz.

Thermal Fuse / Overheat Switch:

Red - White	11 ~ 13 VDC	Below 1 ohms	B8	B1-G8
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Wire Diagram

Example:

59°F = 11.4 ~ 14KΩ

140°F = 2.2 ~ 2.7KΩ

88°F = 6.4 ~ 7.8KΩ

221°F = 0.6 ~ 0.8KΩ

113°F = 3.6 ~ 5.4KΩ

Outgoing Water Thermostat:

White - White

N/A

See example above

E6

2-3

Heat Exchanger Temperature Thermostat:

Pink - Pink

N/A

See example above

E5

4-7

Inlet Thermostat:

White - White

N/A

See example above

E9

4-9

Remote Controls:

Terminals J

10 ~ 13 VDC

1.5 ~ 3.0 K ohms

J

1-2

Frost Protection:

This unit has frost protection heaters mounted at different points to protect the water heater from freezing. All of them should show a positive resistance reading.

Amp Fuses:

This unit has one inline (10) amp glass fuse. Remove the fuse and check continuity through it. If you have continuity through the fuse then it is good. Otherwise the fuse is blown and must be replaced.

Dip Switches Settings

Adjust switches 2 and 3 in the tan switches depending on your altitude according to the table below.

SW1

SW2

SW1

High Altitude

WARNING

DO NOT adjust the other dip switches unless specifically instructed to do so. Incorrect Dip Switch Settings can cause the water heater to operate in an unsafe condition and may damage the water heater and void the warranty.

SW No.	NOTES
2	High Altitude
3	High Altitude

Diagnostic Codes

03 Power interruption during Bath fill (Water will not flow when power returns)

• Turn off all hot water taps. Press ON/OFF twice.

05 Bypass Servo

• Replace bypass servo

10 Air Supply or Exhaust Blockage

• Ensure approved venting materials are being used.

• Check that nothing is blocking the flue inlet or exhaust.

• Check all vent components for proper connections.

• Ensure vent length is within limits.

• Verify dip switches are set properly.

• Check fan for blockage.

• Burner Sensor (see code 31)

11 No Ignition

• Check that the gas is turned on at the water heater, meter, or cylinder.

• If the system is propane, make sure that gas is in the tank.

• Ensure appliance is properly grounded.

• Ensure gas type and pressure is correct.

• Ensure gas line, meter, and/or regulator is sized properly.

• Verify dip switches are set properly.

• Ensure igniter is operational.

• Check igniter wiring harness for damage.

• Check gas solenoid valves for open or short circuits.

• Remove burner cover and ensure burners are properly seated.

• Remove burner plate; inspect burner surface for condensation/debris.

• Check the ground wire for the PC board.

12 No Flame

• Check that the gas is turned on at the water heater, meter, or cylinder.

• Check for obstructions in the flue outlet.

• If the system is propane, make sure that gas is in the tank.

• Ensure gas line, meter, and/or regulator is sized properly.

• Ensure gas type and pressure is correct.

• Bleed all air from gas lines.

• Ensure proper venting material was installed.

• Ensure condensation collar was installed properly.

• Ensure vent length is within limits.

• Verify dip switches are set properly.

• Check power supply for loose connections.

• Check power supply for proper voltage and voltage drops.

• Ensure flame rod wire is connected.

• Check flame rod for carbon build-up.

• Disconnect and reconnect all wiring harnesses on unit and PC board.

• Check for DC shorts at components.

• Check gas solenoid valves for open or short circuits.

• Remove burner plate; inspect burner surface for condensation/debris.

14 Thermal Fuse

• Check for restrictions in air flow around unit and vent terminal.

• Check gas type of unit and ensure it matches gas type being used.

• Check for low water flow in a circulating system causing short-cycling.

• Ensure dip switches are set to the proper position.

• If switch #5 in the SW2 bank is in the OFF position, turn it to the ON position.

• Check for foreign materials in combustion chamber and exhaust piping.

• Check heat exchanger for cracks or separations.

• Check heat exchanger surface for hot spots which indicate blockage due to scale build-up. Refer to instructions in manual for flushing heat exchanger. Hard water must be treated to prevent scale build up/damage.

• Measure resistance of safety circuit.

• Ensure high fire and low fire manifold pressure is correct.

• Check for improper conversion of product.

16 Over Temperature Warning

• Check for restrictions in air flow around unit and vent terminal.

• Check for low water flow in a circulating system causing short-cycling.

• Check for foreign materials in combustion chamber and exhaust piping.

• Check for blockage in the heat exchanger.

19 Electrical Grounding

• Check all components for electrical short.

25 Condensate Trap

• Condensate trap is full. Check condensate trap and drain pipe for blockage.

• Replace condensate trap.

31 Burner Sensor

• Measure resistance of sensor.

• Replace sensor.

32 Outgoing Water Temperature Sensor

33 Heat Exchanger Outgoing Temperature Sensor

41 Outside Temperature Sensor

51 Inlet Water Temperature Sensor

• Check sensor wiring for damage.

• Measure resistance of sensor.

• Clean sensor of scale build-up.

• Replace sensor.

52 Modulating Solenoid Valve Signal

• Check modulating gas solenoid valve wiring harness for loose or damaged terminals.

• Measure resistance of valve coil.

57 Burner

• Contact a service provider.

58 Secondary Heat Exchanger

• There is scale build up in the secondary heat exchanger and it needs to be flushed to prevent damage. Refer to the flushing instructions in the manual. Hard water must be treated to prevent scale build up or damage to the heat exchanger.

61 Combustion Fan

• Ensure fan will turn freely.

• Check wiring harness to motor for damaged and/or loose connections.

• Measure resistance of motor winding.

65 Water Flow Servo

• The water flow control valve has failed to close during the bath fill function. Immediately turn off the water and discontinue the bath fill function. Contact a licensed professional.

70 PC Board

• Check PC board DIP switches for correct positions.

• Check the connection harness at the connection on the PC board.

• Replace PC board.

71 Solenoid Valve Circuit

• Replace the PC Board.

72 Flame Sensing Device

• Verify flame rod is touching flame when unit fires.

• Check all wiring to flame rod.

• Remove flame rod;check for carbon build-up; clean with sand paper.

• Check inside burner chamber for any foreign material blocking flame at flame rod.

• Measure micro amp output of sensor circuit with flame present.

• Replace flame rod.

73 Burner Sensor Circuit

• Check sensor wiring and PC board for damage.

• Replace sensor.

79 Water leakage detected

• Turn off water supply and contact licenced professional.

LC# Scale Build-up in Heat Exchanger

(when checking maintenance code history "00" is substituted for "LC")

• LC0~LC9 indicates that there is scale build up in the heat exchanger and that the heat exchanger needs to be flushed to prevent damage. Refer to the flushing instructions in the manual. Hard water must be treated to prevent scale build up or damage to the heat exchanger.

• To operate the water heater temporarily until the heat exchanger can be flushed, push the On/Off button on the temperature controller 5 times. Repeated LC# codes will eventually lock out the water heater.

FF Maintenance Performed

• Indicates a service provider performed maintenance or repair. Enter this code by pressing up, down, and ON/OFF simultaneously.

No Code

(Nothing happens when water flow is activated.)

• Clean inlet water supply filter.

• On new installations ensure hot and cold water lines are not reversed.

• Verify you have at least the minimum flow rate required to fire unit.

• Check for cold to hot cross over. Isolate circulating system if present.

• Turn off cold water to the unit, open pressure relief valve; if water continues to flow, there is bleed over in your plumbing.

• Verify turbine spins freely.

• Measure the resistance of the water flow control sensor.

• If the display is blank and clicking is coming from the unit, disconnect the water flow servo motor (GY, BR, O, W, P, BL, R). If the display comes on then replace the water flow servo motor.

Item	Description	Part Number	Qty
001	Main Body	109000362	1
002	Wall Bracket	109000143	2
003	Rubber Bushing-A	CF79-41020-A	1
004	Connection Reinforcement Panel	1090000225	1
005	Reinforcement Panel	1090000226	1
006	Front Panel UGTC-199	109000363	1
006	Front Panel UGTC-152	109000366	1
007	Gasket - Top and Bottom	109000120	2
008	Gasket - Side	109000121	1
009	Controller Assembly (FFU)	105000144	1
010	Controller Panel	1090000229	2
011	Screw Cover	1090000230	1
014	Rubber Bushing	U245-125	2
022	Attachment Bracket	1090000274	1
030	Gasket	1090000231	1
100	Gas Controller Assembly	1060000064	1
101	Test Port Set Screw	C10D-5	2
102	Gas Connection 3/4" NPT	1060000065	1
103	Burner Unit Assembly	1060000070	1
110	Manifold Assembly-LPG	1060000066	1
110	Manifold Assembly-NG	1060000067	1
111	Gasket	1090000232	1
112	Gasket	1090000233	2
113	Gasket	1090000234	2
114	Gasket	1090000235	1
116	Electrode	105000145	1
117	Flame Rod	105000146	1
118	Electrode Packing	1090000236	1
119	Electrode Holder	1090000237	1
120	Gas Pipe Assy	1060000084	1
125	Fan Motor All Assembly	1080000052	1
126	Fan Bracket	1080000053	1
131	Noise Filter A	1080000054	1
132	Noise Filter B	1080000055	1
138	Gasket	1090000238	1
139	Exhaust Duct Assembly	1080000056	1
143	Heat Exchanger Assembly	1070000098	1
144	Flue Connection Assembly	1080000058	1
145	O-ring	1090000239	1

Item	Description	Part Number	Qty
149	Gasket	1090000240	1
153	Burner Sensor Gasket	1090000241	1
154	Burner Thermistor	105000147	1
160	Secondary Heat Exchanger	1070000089	1
161	Outlet Pipe Packing	109000161	1
162	Outlet Pipe	1070000064	1
163	O-ring	1080000018	2
164	Secondary Heat Exchanger Bracket	109000242	1
400	Water Inlet 3/4" NPT	H73-501-2	1
401	Water Flow Servo & Sensor Assem	1070000090	1
402	Rectifier	107000105	1
403	Bypass Flow Assembly	1070000091	1
404	Stop Bracket	AH69-310	2
405	Plug Band	1090000018	1
408	Hot Water Outlet 3/4" NPT	1070000092	1
409	Stop Bracket	U211-322X01	1
412	Water Filter Assembly	H98-510-S	1
413	Servo Cover	1070000093	2
422	Drain Plug	1070000058	2
423	Clip	1050000090	2
426	Packing	1090000243	1
431	Connecting Pipe - Inlet	1070000094	1
432	Connecting Pipe - HEX	1070000095	1
433	Clip	109000132	1
434	Clip	1090000244	2
440	Condensate Trap	1090000245	1
443	Condensate Drain Tube	1090000246	1
444	Band	109000137	1
445	Band	109000138	1
446	Screw	109000155	2
447	Connection Harness	105000105	1
460	Water Detection Unit	1070000096	1
461	Water Flow Turbine	1070000088	1
700	PC Board	105000148	1
701	Anti Frost Unit	BU195-1873-2	1
702	PC Board Cover Side	109000247	1
703	PC Board Cover Front	109000248	1
705	Electric Installation Board	U245-257	1
706	Ignitor	106000068	1

UGTC-199

UGTC-152

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