

PrecisionTemp

RV500 & ShowerMate Water Heater

Service Manual

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**Models: RV500
 RV501
 M500**

PrecisionTemp

Authorized RV500 Service Schedule

Prior authorization is required for any warranty claim. The following figures are standard time requirements allowed for repair or replacement of components. Warranty service time charges exceeding these standards will not be paid unless prior approval is obtained from *PrecisionTemp*.

Service charges will be paid in tenths of an hour (six minute increments)

General Trouble-Shooting Maximum of 12 minutes (0.2 hour)

<u>Repair or replacement of components</u>			<u>Hours</u>
SM500-01	Circuit board (includes AutoCal)	(1841-RV)	0.3
SM500-02	DSI	(3158)	0.3
SM500-03	Electrical drawer		0.0
SM500-04	Hood		0.0
SM500-06	Heat exchanger assembly	(1435)	0.0
SM500-07	T-in	(1436)	0.3
SM500-08	T-mid	(2008)	0.3
SM500-09	T-out	(1437)	0.3
SM500-10	Burner		0.0
SM500-11	Igniter	(1411)	0.8
SM500-12	Flowmeter assembly	(1330)	0.5
SM500-13	Gas solenoid	(1073)	0.5
SM500-14	Modulating valve (incl. AutoCal)	(1076)	1.0
SM500-15	Automatic calibration (AutoCal)		0.3
SM500-16	Testing the RV500		0.2

Failure of the RV500 to work properly as a result of improper installation, or conditions caused by non-PrecisionTemp components is not covered by warranty.

In the event the estimated warranty time required to service the RV500 would exceed the authorized schedule it is necessary that PrecisionTemp Technical Support be contacted for approval. Without this approval service charges will be paid at the published rate.

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Section 1. Definition of Terms

AutoCal – A procedure by which the microprocessor in the heater accesses a stored calibration table to convert gas flow to voltage to control the gas valve.

DSI (Direct Spark Ignition) – The circuit board that controls the ignition process. Once supplied with 12 vdc by the main circuit board, it opens the gas solenoid, sparks the igniter, and senses the flame. Also, during operation it continues to monitor the flame and will fire the igniter if flame rectification is lost.

Ignition or minimum burn – The ignition gas flow and the lowest burn that the software will permit, which is normally 15,000 – 20,000 Btu.

Maximum burn – The highest burn that will pass through the unit, normally 53,000 Btu.

T-in – The temperature measured at the entrance to the heat exchanger 1436

T-mid – The temperature measured near the center of the heat exchanger 2008

T-out – The temperature measures at the exit of the heat exchanger 1437

T-set – The stabilization temperature set by the pot on the circuit board 1841-RV

Section 2. Description of Operation RV500

With gas and power supplied and no water flow, the RV500 will appear dormant except for the green LED flashing once each second. However, the microprocessor in the RV500 is actively monitoring the three temperature sensors, the set temperature request, and the water flow each half second in anticipation of a request for hot water.

When a hot water faucet is opened and flow is > 0.5 gpm, the microprocessor sends ignition voltage to the modulating valve and powers the ignition relay on the board which provides 12 vdc to the DSI board.

The (Direct Spark Ignition) DSI:

- Sends 12 vdc to the gas solenoid to open and supply gas to the burner
- Starts sparking the igniter
- Monitors the flame presence. When the DSI senses a flame it grounds the feedback to the circuit board. If the flame is not sensed during a 3.5 second ignition attempt the DSI will turn off gas and maintain the feedback signal to the circuit board open (12 vdc) for a 3.0 second purge and repeat the 3.5 second ignition attempt. If there is no flame sensed during the third attempt, the DSI will lockout and feedback will remain open until the software resets it 10 minutes later and the ignition process is repeated. If the flame is lost during normal burn, the DSI will attempt a re-ignition.
- When the feedback signal is grounded there is flame. Knowing T-in, T-set, and water flow, the software calculates the gas required for the desired set temperature. Stored in a chip on the circuit board is a calibration of the modulating valve (AutoCal). The microprocessor accesses the calibration to convert the gas flow to a voltage to send to the valve. Variations in the heat exchanger and the sensors cause the T-out to be slightly different in reality. To compensate for the variations the microprocessor adjusts the gas flow every 0.5 seconds based on the error between T-out and the T-set.
- Every 0.5 seconds the microprocessor reads the temperatures and water flow and recalculates the gas flow required. If the water flow changes the gas flow is reset within one second to a new value. Anytime water flow is turned off, the software will turn the gas off within 2 seconds.
- If you are operating within the capacity of the unit at steady state (see figure-1), you will see small changes in the flame height. These are the small automatic adjustments the software makes to maintain the set temperature. If you operate the RV500 above the capacity, you will see the burner at the maximum burn, however, the outlet water temperature will be below the T-set. Conversely, if you are operating below the capacity then the software cannot lower the burner lower than the minimum burn and the water will heat above T-set. The software will shut off the burner when T-out rises to 16°F greater than T-set. It will remain off until T-out $<$ T-set. At the faucet this is seen as fluctuating temperature from very hot to cold. The characteristics above and below the operating range are typical of all instantaneous water heaters.

Section 2.1 Description of Operation ShowerMate

Note: The next 8 steps take place in 3-5 seconds.

- The **flow meter** senses the water flow & sends a flow signal to the **green control board**.
- The **green control board** sends 12 VDC through the **orange wire** to the **pressure differential switch** and on to the **black relay** that powers the **power vent blower**.
- The **relay** closes the 12VDC contacts to start the **blower**.
- Fluing is proofed by the **vacuum tube** that runs from the **blower** to the **pressure differential switch**.
- The **pressure differential switch** contacts close, sending 12 VDC to the **spark ignition module** via the **orange wire**.
- The **ignition module** simultaneously affects a spark through the **heavy yellow wire** to the **spark ignition probe** over the **burner** and sends 12 VDC to the **combination gas valve** via the **blue wire**.
- Ignition of the burner's element is effected and the flame is proofed and monitored through the same **yellow wire** by the **spark ignition module**.
- The **green control board** sends DC voltage to the **modulating gas valve** for one second to effect flame cross-over to all burners.
- The micro-processor on the **green control board** monitors water flow with the **flow meter** and temperature with the three **thermistors** twice / second and varies voltage 0 – 12 VDC to the **gas modulating valve**, varying gas flow to burner in order to maintain constant temperature output.
- Burner remains lit as long as water flow continues, but if flame is extinguished for any reason, the **gas valve** will shut off in less than 1 second and re-ignition will be attempted.
- When water is turned off and the water heater no longer senses flow the heater shuts down to standby mode.

Section 3. Trouble-Shooting the RV500

3.1 Water Leak

- Identify the location. If a compression fitting or standard NPT fitting is the source, be sure the fitting is fully tightened. **CAUTION: 1) Use two wrenches so that no force is transferred to other parts, and 2) over-tightening fitting can damage the unit.**
- If tightening the compression fitting does not stop the leak, replace the flowmeter and tube assembly.
- If tightening the compression fitting does not stop the leak, replace the flowmeter and tube assembly.
- If there is still a leak from a NPT fitting then remove the fitting and try re-taping using plumber's Teflon tape. Otherwise, replace the component. To replace the leaking part, refer to appropriate location in service manual for change procedure, if necessary.

3.2 Gas Leak

Use leak tester to identify the specific location. Correct leak by either:

- Tightening the fitting
- Opening the fitting and re-applying thread sealer. The thread sealant must be an AGA-approved product for use with propane gas (LPG).
- Replacing the leaking parts.

CAUTION: When checking for gas leaks DO NOT use flame.

3.3 No Green LED flash or Green LED stays on, but does not flash

1. Be sure power is ON and panel breaker is not tripped. With power OFF detach the ¼ inch spade leads of the power supply (see figure 2). Attach a multi meter and turn power ON. If there is no power then trouble-shoot the coaches electrical system.
2. Be sure all electrical connectors are secure. Check polarity of the 12 vdc supply to the RV500. The positive (+) lead must be connected to the red (+) lead on the rear of the RV500. The negative (-) lead must be connected to the black (-) lead.
CAUTION: Supplying the RV500 with reverse polarity will damage the circuit boards.
3. Do you have a converter? If so, the 12 vdc supply to the RV500 must be from the filtered connection on the converter or connected directly to the battery. Refer to your converter manual to verify hookup. Also, check the AC content on the 12 vdc supply to the RV500. Normally, it should be less than ± 0.3 vac.
4. Open the electrical drawer and check for indications of water or moisture. If you find moisture turn power OFF and let the drawer dry (a hair dryer may be used if you only use warm air).
5. Check the power at the circuit board by placing the multimeter probes on the backside of the 2-pin connector (see figure -4). Voltage should be 10.8 – 14.4 vdc. If voltage is lower than the minimum the ignition board may not function. If voltage is above the maximum it is possible to damage either circuit board. If there is no voltage at the board then the fuse in the power supply cable is blown. Change the power supply cable 1331.
6. Examine the micro-controller EL 9049 (see figure -4). Be sure that all pins are in the socket and none appear bent (use thumb to gently press on the chip).

7. If the problem persists then change board 1841-RV. Refer to SM500-01 for the change procedure.

3.4 Green LED flashes, but no ignition attempt (no igniter, no gas)

1. Is the water ON and is the flow out of the faucet at least 0.5 gallons per minute (2.5 minutes to fill 1 gallon)? Flow must be greater than 0.5 GPM for the unit to turn on.
2. Check the T-in, T-mid, and T-out thermisters (see section 4.3 'T-in, T-mid, T-out Thermister and T-set readout').
3. Find the RV500 flowmeter (see figure -3) and verify that the black rotor, visible through the transparent cover, is rotating which indicates that there is flow going through the unit. If the flowmeter is not turning or turning slowly so that the rotor spokes are clearly visible there may be cold water leaking into the hot water lines somewhere in the coach. See the description under the problem Section 4.1 'Cold Water Bypass' to learn more about this condition. If the last letter on your micro-controller 9049 is 'D' or later, the flow through the RV500 can be read from the green LED as specified in section 4.3 'Reading flow using the green LED'.
4. Place a finger on the ignition relay on the circuit board (see figure -4) and turn on water. Do you feel or hear a click of the relay actuating?
5. If NO, inspect the micro-controller EL 9049 to confirm that it is pushed in fully and that no pins appear bent or out of the socket. If the micro-controller is okay then replace the circuit board 1841-RV per SM500-01.
6. If YES, check that 12 vdc goes to the DSI board 3158 (see figure -4) at the left white wire. If YES, check that the green (ground) wire on DSI cable 1829 is attached under the right-side screw at the burner bracket (see figure -3). If green ground wire is attached then replace the DSI 3158 per SM500-02. If NO, replace the DSI cable 1829.

3.5 Green LED flashes, but no ignition (igniter sparks, no gas)

1. Check the ECO for an open circuit by checking continuity on each connector. On older models check the pop-out button on the ECO 1293 and push in; newer models have auto reset (no button). The ECO is a bi-metal switch that opens when temperature goes above 165°F.
2. (see figure -3)
3. Check that the propane tank is ON and there is gas in the tank. Gas pressure to the RV500 while running should be 11.0–14.0 wci. Gas pressure may be too low due to improper gas line diameter (under ¼" diameter) or the gas line being too long (over 25 feet) or ON/OFF solenoid at tank, if you have a solenoid, may have an orifice that is too small (under 3/16" diameter).
4. Check that all four spade connectors are secure to the gas solenoid 1073 (see figure -3). Check that 12 vdc is getting to the gas solenoid 1073 (see figure -3). Removing the top and/or bottom spade connections at the gas solenoid and measuring voltage between the blue and white leads. If there is no voltage or the voltage is less than 10.0 vdc, replace the DSI cable 1829.
5. Use a wrench or similar tool to tap on the gas supply pipe to the right of the coil on the modulating valve 1076 (see figure -3). It is possible that the piston in the modulating valve has been forced out of its normal range and may stick. The tapping helps to free the valve.
6. Replace the gas solenoid 1073 per SM500-13.
7. Replace the modulating valve 1076 per SM500-14.

3.6 Green LED flashes, but no ignition (no igniter sparks, no gas flow, no gas odor)

1. Check that the ignition wire 1412 is connected to the igniter and then check the wire for continuity.
2. With gas OFF, check if the igniter is sparking to the burner (see figure -3). If not, find where the igniter is sparking. The likely places would be from the bottom of the igniter to the burner bracket and at the right side of the electrical drawer where the ignition wire can be forced against the case. If the spark is at the electrical drawer side then re-route the ignition wire. If the spark is going to the burner bracket, paint the burner bracket in that area with anti-rust paint, or else, cut away the burner bracket so there is about 0.5 inch clearance with the igniter wire.
3. Check that the green (ground) wire on DSI cable 1333 is attached under the right-side screw at the burner bracket (see figure -3).
4. Check the height of igniter electrode above the burner. This height should be 0.125 inch (see figure -8).
5. Disconnect the ignition wire from the DSI spade connector in the electrical drawer (see figure -4). During ignition a spark should be seen at the DSI spade connector. If there is none, replace the DSI board 3158 per SM500-02. If there is a spark, replace the ignition wire 1412 and, find where the spark is occurring along the ignition wire.

3.7 The unit ignites, but will not rise above minimum burn or water at the faucet is cool

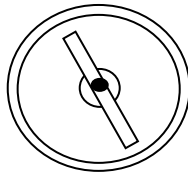
1. Check flow out of faucet by measuring the time it takes to fill a gallon container. Calculate water flow in gallons per minute (GPM) by dividing the number one by the time in minutes it takes to collect one gallon of water. Refer to figure -1 to be sure that you are in the normal operating range.
2. If the last letter on your micro-controller EL 9049 is 'D' or later then the flow through the RV500 can be read from the green LED as specified in section 4.3 'Reading flow using the green LED'. If the flow at the faucet is more than 0.25 GPM greater than the flow through the RV500, read about 'Cold Water Bypass'.
3. Check the voltage to the modulating valve 1076 by placing multimeter probes in the 2-pin connector (white and black wires) at the circuit board 1841-RV (see figure -4). If the voltage is greater than 2.0 vdc, the modulating valve likely has been forced out of normal range and needs to be returned.
4. While powered, tap on the gas pipe between the gas solenoid and the modulating valve. If this does not free the valve, try using a magnet, starting at the brass fitting on the right side of the coil lay the magnet on the pipe and move from right to left stopping at the wire coil and pulling straight off, or try running AutoCal. (See SM 500-15). (Call for tech assistance 800-934-9690).
5. Replace the modulating valve
6. If the voltage is less than 2.0 vdc:
7. The RV500 will not increase the flame above minimum until a flameproof signal is sent to the circuit board by grounding the red lead attached to the spade connector on the DSI board.

You can do this manually by touching the metal portion of the red wire to the RV500 steel case. The flame should increase.

8. Check thermisters per the section 4.5 'T-in, T-mid, T-out Thermister and T-set Readout'.
9. Check DSI harness 1829 red wire for continuity between the circuit board and the DSI spade connector (see figure -4).
10. Change the circuit board 1841-RV. (SM500-01).
11. Check the heater for airflow obstruction and clean.

3.8 Large fluctuations in temperature

1. Are you operating on the water pump? If yes, check if the flowmeter (or water flow) is pulsing at a low flow. If YES, then you may need an accumulator. See the section 4.4 'Using the water system pump'.
2. Are the inlet and outlet water supply lines hooked up properly? Check that all screen strainers and filters are clean and not obstructing water flow. The water inlet connection is the upper and the water outlet is the lower. This is the opposite of hot water tanks. You can also check the direction that the flowmeter rotor is turning. It should turn counter-clockwise.
3. There is a built in check/pressure reducing valve in most newer coaches. It is built into the hose hookup assembly. To locate it remove the water supply hose and the strainer/washer. Now, look into the water inlet. You typically will see a plastic spring retainer.



By putting a small screwdriver beside the spring retainer and turning it you can increase or decrease water flow. By turning adjust this check valve so that your showerhead, on full hot and no cold water running, makes the green LED on the water heater blink 12 to 16 times between interrupts during the summer and 8 to 12 blinks during winter operation or when on cold well water.

When moving from campground to campground you may need to readjust the pressure if you experience hot and cold cycles. This would be due to drastic changes in supply water temperature from campground to campground.

Do not make the above water pressure adjustments unless the showerhead flow-restricter has been removed!

To remove the showerhead flow-restricter, take the shower hose off the showerhead. Look into the water inlet of the showerhead. You will see a white or gray plastic part with a small hole in it. Turn a screw in to the hole and pull out the small plastic part with a pair of pliers.

4. Is the flame cycling between minimum burn and off? If yes, check the water flow through the unit as described in section 4.3 'Reading flow using the green LED'. Then refer to figure -1 to verify that the water flow is above the minimum normal operating line. You can do this step only if the last letter on the micro-controller chip EL 9049 is version 'D' or later.
5. Is unit changing between min burn and max burn? If yes, run AutoCal per SM500-15.

3.9 During a 'Navy' style shower water is cold for a short time after turning off and then back on

1. When water flow is turned off the RV500 will also turn off. Turning the water on again will result in a few seconds of over-heated water and then a few seconds of cold water. Our software minimizes the duration of the cold water, but it takes about three seconds to sense the flow and ignite the burner. The user can do the following:
 - If you are not dry-camping enjoy your shower and let the water run. The RV500 is designed to provide unlimited hot water.
 - The micro-controller should be EL 9049-E or later.

3.10 Pressure relief valve leaks

1. Check water supply pressure
2. Briefly, open valve to clear any debris that might be lodged in the seat.
3. If the valve continues to leak, replace pressure relief valve 1375.

3.11 During the AutoCal procedure the unit shuts down and restarts

Check T-out thermister as there may be a hot shift (typical problem found in production). Refer to the section 4.5 'T-in, T-mid, T-out Thermister and T-set readout'.
Check flow rate by counting flashes from green light. Must be 0.5 gpm or greater. (refer to 4.3)

3.12 Exhaust contains dark smoke

1. While the heater is operating check the burner manifold for any indication of a gas leak. This is observed as a localized, large flame or a flame located other than above the burner. All burners must have a flame.
2. Check for obstructions in the heat exchanger, vent or air intake.
3. Shutdown the unit and contact a factory representative at (800)934-9690.

Section 4.

4.1 Cold water bypass

A cold water crossover occurs when the cold water is connected to the hot water line and cold water is allowed to enter the hot water line between the water heater and the point of use (see figure -6). The places to look for this happening are outside wash down boxes or showers, water heater bypass kits, showers with a shutoff on the shower head, washing machines, dishwashers, and in the plumbing to water using appliances (usually in parallel instead of in series).

There can also be planned crossover in the shower since the Federal government has mandated that all shower mixing valves have anti-scald provisions built into them. If you turn the shower hot water valve on with the cold water valve off you cannot get 100% hot water from it.

The shower-mixing valve is designed to always bleed a little cold water in to the hot even when the cold water is off. With the RV-500 series water heater you may feel hotter water coming from your lavatory sink than the shower. This is normal.

4.2 Flowmeter checkout

Find the three-pin connector on the circuit board (see figure -4). Place the ground (-) probe of the multimeter in the back of the connector at the black wire and place the high (+) probe at the red wire. With power ON the multimeter should read 5 vdc. If it does not read properly then replace the flowmeter assembly 1330.

Now move the high (+) probe to the middle or white wire of the flowmeter. Turn water flow ON (greater than 0.5 GPM). You should see the multimeter jumping to values between 0 and 5 vdc. If you have a multimeter with frequency measurement go to that scale. The frequency is proportional to flow with 27 hertz \approx 1 GPM. If it does not read properly, replace the flowmeter assembly 1330 per SM500-12.

4.3 Reading flow using the green LED

Anytime the RV500 detects flow greater than 0.4 GPM it will flash a code on the green LED that corresponds to water flow. With power ON and water running through the unit watch the green LED. The LED will flash approximately once every second. Watch the green LED to find one longer delay between flashes (1.5 seconds versus 1.0 seconds). Begin counting the green LED flashes until the next longer delay. The flashes correspond to water flow. Each flash is 1/8 GPM so that water flow can be calculated: Water flow in GPM = number of green flashes divided by 8

4.4 Using the water system pump

When you see or feel pulsing of the water pressure through the showerhead or faucet you are seeing the movement of the diaphragm in the pump. With a diaphragm pump the water does not move in a steady flow like a rotary pump. The diaphragm moves up, pushing the water in that direction. When the diaphragm moves down a check valve opens and lets water in behind the water that was moved up on the up stroke. This causes a momentary hesitation of the water movement in the water line. Under normal circumstances this is no problem. However, with the RV500 series water heaters this can cause a problem.

The RV500 series water heaters use a water flow meter. The water heater should not come on if there is a leak in the hot water system. The flow meter is used so the computer can know when the water flow is four-tenths of a gallon per minute or higher before the water heater will come on. The computer also uses the water flow rate, the set temperature, and the incoming water temperature to calculate the BTU setting of the modulating gas valve. If the water pump system is pulsing, the flow meter will read the GPM on the high side of the pulse. The computer will set the gas valve to that BTU setting on the low side of the pulse it will read a new lower GPM setting and say to itself "they just reduced the water flow. Lower the BTU gas setting quickly". This condition will keep the RV500 series from controlling the water temperature and cause wide temperature fluctuations.

To solve this problem an accumulator or expansion tank needs to be installed after the pump. The accumulator tank must have a rubber bladder in it. If there is no bladder the water will absorb the head of air leaving nothing for the water to compress against, leaving the system as if no accumulator tank had been installed. A good accumulator tank will smooth the pulses and make the diaphragm pump a stream as smooth as if it were on city water.

4.5 T-in, T-mid, T-out Thermister and T-set readout

If the red LED is flashing, turn power OFF for 5 seconds and then turn power ON? If the red LED is flashing, there is a potential problem with a thermister.

To diagnose the problem, run water through the unit for at least 30 seconds with the power OFF then turn the water off. The output of the thermister should be checked with the power ON using a multimeter. Plug the ground (-) probe into the black test connector (TP1) on the circuit board 1841-RV and the high (+) probe into:

T-out	orange test connector (TP2)
T-mid	yellow test connector (TP3)
T-in	6 pin connector on 1841-RV at right (inboard) blue wire
T-set	blue test connector (TP4)

Compare the voltage reading of the three thermister outputs which should all be within .5 volts of each other.

Turn power OFF. Unplug the 2-pin connectors (figure -4) and, using a multimeter, check the resistance across the each thermister. If the suspect thermister is more than 75 ohms from the other thermisters, replace the thermister. Otherwise, replace the thermister cable (1329) first. If that does not fix the problem, replace the thermister.

T-set is set to 2.0 vdc (120°F) at the factory. The T-set pot output will change about 0.44 vdc (7°F) per turn of the pot. For example, to adjust T-set to 122°F turn the pot until the readout is 2.0 vdc.

Section 5. Service Code Diagnostics

Note: All red LED flashes can be reset by cycling the power OFF for 5 seconds and then ON.

Double red flash/second (two flashes per second)

Indicates that the T-mid thermister has failed. The heater will not operate without maintenance action. Check that the 2-pin and 6-pin connectors are all plugged in and inspect the wiring for any indications of a problem. Unplug the T-mid thermister 2008 at the 2-pin connector and check the thermister cable 1329 for continuity on the two yellow wires. If either wire shows a break, replace the cable 1329. Otherwise, replace the T-mid thermister 2008 per SM500-08.

Single Red flash

Indicates that the T-out thermister has failed. The heater will substitute a calculated (model) T-out, based on T-mid, and continue to operate. At a constant water flow the temperature output will remain constant. Over the operating water flow range, normally, this approximation will be within $\pm 3^{\circ}\text{F}$. If the variation is noticeable and improvement is needed, proceed with the checkout in section 4.3 and, if necessary, replace the T-out thermister per SM500-09. Otherwise, the unit can continue to operate.

Two Red flashes

Indicates that the T-in thermister has failed. The heater will assume 70°F for T-in and continue to operate. As long as incoming water temperature is near 70°F operation will be normal. However, as inlet water temperature deviates from 70°F the unit will be slower reaching the set temperature and eventually, the unit will be unable to reach the set temperature. If the variation is noticeable and improvement is needed, proceed with the checkout in section 4.3 and, if necessary, replace the T-in thermister per SM500-07. Otherwise, the unit can continue to operate.

Three Red flashes

T-mid is not in the operating range of $30 - 160^{\circ}\text{F}$. The unit continues to operate using the measured T-mid, however, the operation is likely affected since the T-out model will be much different and the unit will not be able to reach the set temperature at many or all water flows. If the variation is noticeable and improvement is needed then proceed with the checkout in section 4.3 and, if necessary, replace the T-mid thermister per SM500-08. Otherwise, the unit can continue to operate.

Four Red flashes

T-out is not in the operating range of $30 - 180^{\circ}\text{F}$. The unit continues to operate using the measured T-out, however, the operation is likely affected since the real heat exchanger outlet temperature will be much different and the unit will not be able to reach the set temperature at many or all water flows. If the variation is noticeable and improvement is needed then proceed with the checkout in section 4.3 and, if necessary, replace the T-out thermister per SM500-09. Otherwise, the unit can continue to operate. Temporary, improved operation may be obtained by disconnecting the T-out thermister at the 2-pin connector (see 'Single Red Flash').

Five Red flashes

T-in is not in the operating range of $30 - 110^{\circ}\text{F}$. The unit continues to operate using the measured T-in, however, the operation is likely affected since the real heat exchanger inlet temperature will be much different and the unit will not be able to reach the set temperature at many or all water flows. If the variation is noticeable and improvement is needed then proceed with the checkout in section 4.3 and, if necessary, replace the T-in thermister per SM500-07. Otherwise, the unit can continue to operate. Temporary, improved operation may be obtained by disconnecting the T-in thermister at the 2-pin connector (see '2 Red Flashes').

Six Red flashes

T-in is larger than T-mid and T-mid is larger than T-out. This indicates that the water is flowing through the unit backwards. Check the water inlet and outlet connections because they must be reversed. The water inlet is the upper connection and the water outlet is the lower connection. This is the opposite of RV hot water tanks.

Seven Red flashes

The direct spark ignition (DSI) has timed out (after two 3.5 second ignition attempts) and the DSI board 3158 has locked out. After 45 seconds the software on circuit board 1841-RV will reset the DSI board and the ignition sequence will be repeated. The DSI can also be reset by turning off water

a few seconds and then on. The red LED will continue to flash even though the unit is now operating. The red LED can be reset by cycling the power OFF, then ON. If the unit frequently locks out refer to section 3.6 'Green LED flashes, but no ignition (no igniter sparks, no gas flow, no odor).

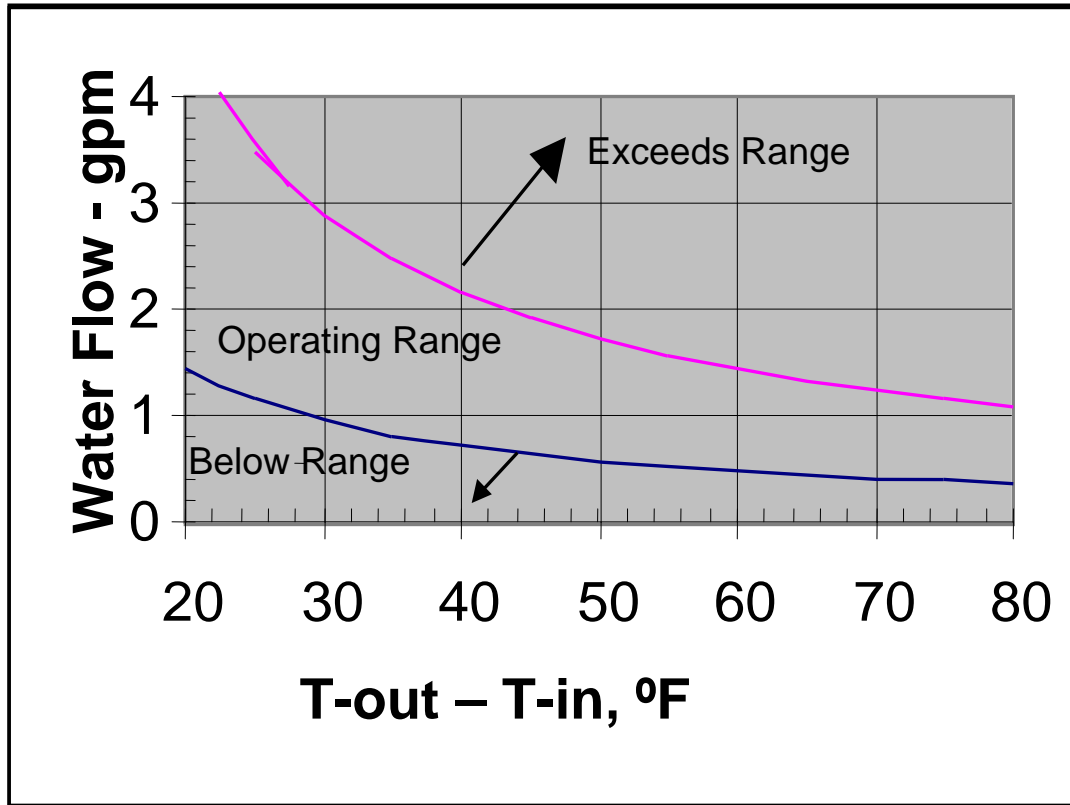


Figure 1. Operating Range of the RV500

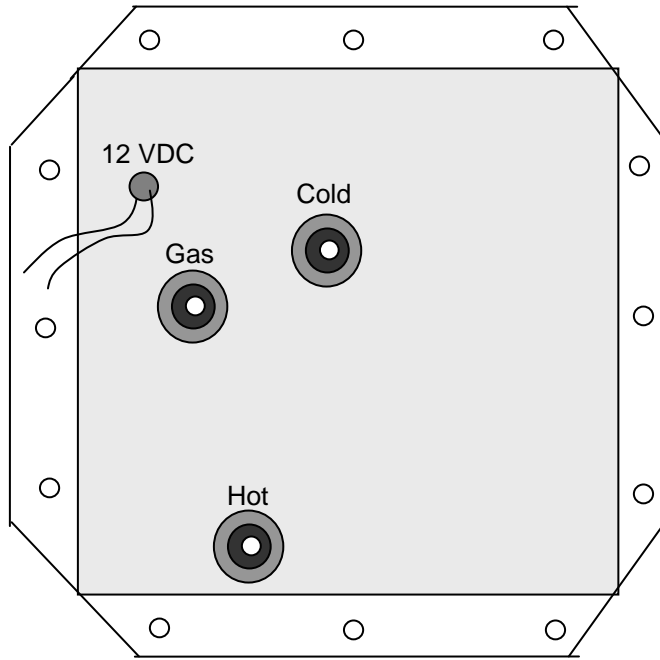
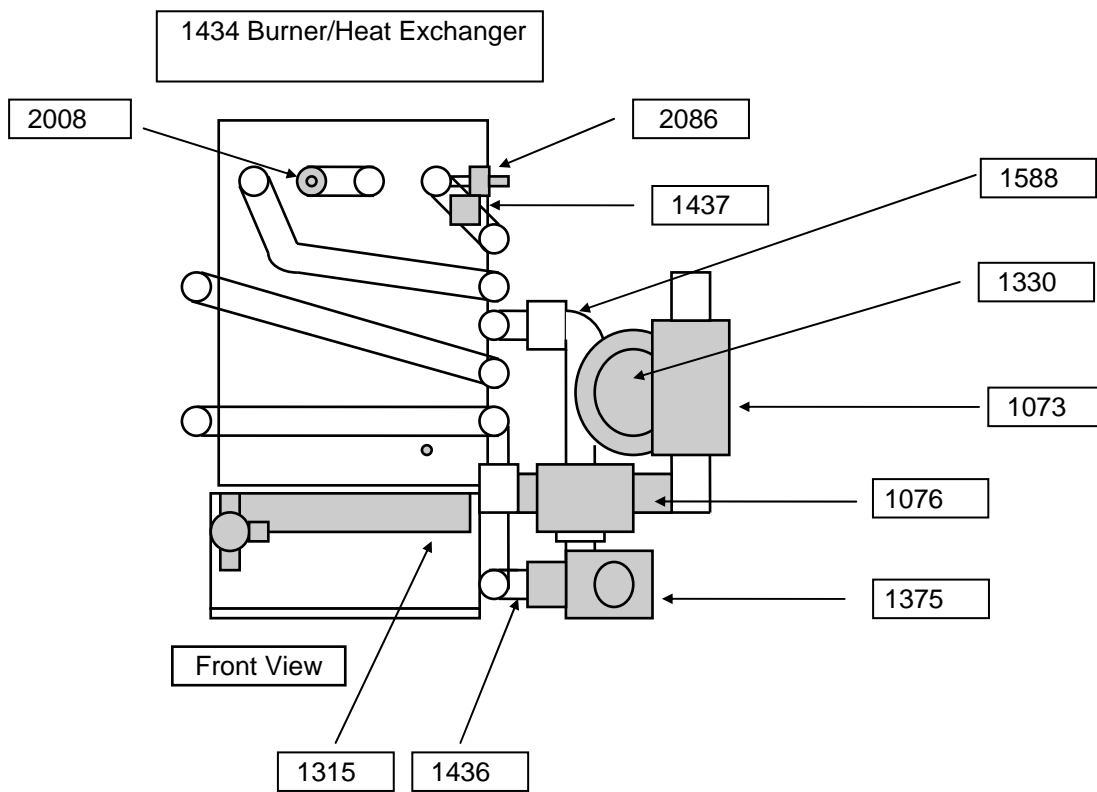


Figure 2. View of the back of the case of the RV500



- 1076 Modulating Gas Valve, LPG
- 2008 Heat Exchanger Core Temperature Sensor
- 1315 Burner Assembly
- 1434 Burner/Heat Exchanger Assembly
- 1436 Inlet Temperature Sensor
- 1437 Outlet Temperature Sensor
- 2086 ECO
- 1330 Flow Meter
- 1375 Pressure Relief Valve
- 1073 LPG Gas Solenoid

Figure 3. Frontal View of RV500 with Door Removed

Figure 5. Thermister Conversion from Volts & Ohms to °F



Thermister Calibration

Check @ colored test point

Yellow = T-Mid

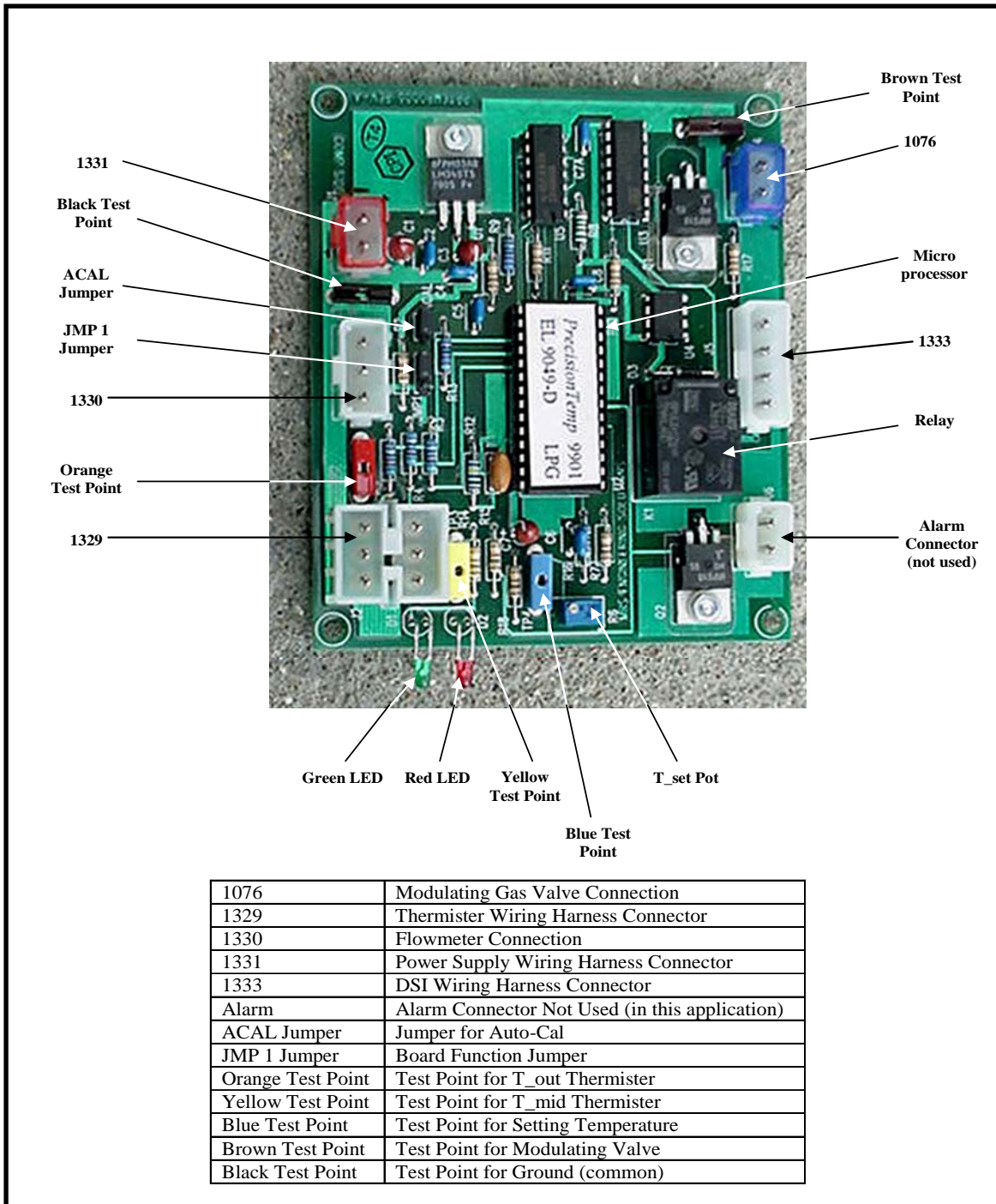
Black = Common

Orange = T-out

Inboard Blue wire = T-in

K-OHMS	°F	Volts	K-OHMS	°F	Volts	K-OHMS	°F	Volts	K-OHMS	°F	Volts
2.500	41.19	4.1514	0.273	135.06	1.7411	0.179	156.54	1.2971	0.107	184.70	0.8657
2.400	42.68	4.1223	0.271	135.42	1.7327	0.177	157.13	1.2863	0.106	185.24	0.8590
2.300	44.25	4.0911	0.269	135.79	1.7244	0.175	157.73	1.2755	0.105	185.78	0.8523
2.200	45.89	4.0575	0.267	136.16	1.7159	0.173	158.34	1.2646	0.104	186.33	0.8455
2.100	47.62	4.0214	0.265	136.53	1.7075	0.171	158.95	1.2537	0.103	186.88	0.8388
2.000	49.45	3.9825	0.263	136.91	1.6990	0.169	159.58	1.2426	0.102	187.44	0.8320
1.900	51.38	3.9403	0.261	137.28	1.6904	0.167	160.21	1.2316	0.101	188.01	0.8252
1.800	53.43	3.8944	0.259	137.67	1.6818	0.165	160.85	1.2204	0.100	188.58	0.8183
1.700	55.62	3.8444	0.257	138.05	1.6732	0.163	161.50	1.2092	0.099	189.16	0.8115
1.600	57.95	3.7897	0.255	138.44	1.6645	0.161	162.16	1.1979	0.098	189.75	0.8046
1.500	60.45	3.7295	0.253	138.83	1.6558	0.159	162.82	1.1866	0.097	190.34	0.7977
1.400	63.15	3.6630	0.251	139.23	1.6470	0.157	163.50	1.1751	0.096	190.95	0.7908
1.300	66.08	3.5892	0.249	139.63	1.6382	0.155	164.19	1.1637	0.095	191.55	0.7838
1.200	69.27	3.5067	0.247	140.03	1.6293	0.153	164.89	1.1521	0.094	192.17	0.7769
1.100	72.78	3.4140	0.245	140.44	1.6204	0.151	165.60	1.1405	0.093	192.79	0.7699
1.000	76.67	3.3091	0.243	140.85	1.6114	0.149	166.32	1.1288	0.092	193.42	0.7629
0.900	81.03	3.1892	0.241	141.26	1.6024	0.147	167.05	1.1170	0.091	194.06	0.7558
0.800	85.97	3.0511	0.239	141.68	1.5933	0.145	167.79	1.1052	0.090	194.71	0.7488
0.700	91.67	2.8902	0.237	142.11	1.5842	0.143	168.55	1.0933	0.089	195.37	0.7417
0.600	98.39	2.7003	0.235	142.53	1.5751	0.141	169.32	1.0813	0.088	196.03	0.7346
0.580	99.88	2.6581	0.233	142.96	1.5659	0.139	170.10	1.0692	0.087	196.71	0.7274
0.560	101.44	2.6144	0.231	143.40	1.5566	0.137	170.89	1.0571	0.086	197.39	0.7203
0.540	103.06	2.5690	0.229	143.84	1.5473	0.135	171.70	1.0449	0.085	198.08	0.7131
0.520	104.75	2.5218	0.227	144.28	1.5379	0.133	172.52	1.0326	0.084	198.78	0.7059
0.500	106.52	2.4728	0.225	144.73	1.5285	0.131	173.35	1.0202	0.083	199.49	0.6987
0.480	108.36	2.4218	0.223	145.18	1.5191	0.129	174.20	1.0078	0.082	200.21	0.6914
0.460	110.30	2.3687	0.221	145.64	1.5096	0.128	174.63	1.0016	0.081	200.95	0.6841
0.440	112.34	2.3134	0.219	146.11	1.5000	0.127	175.07	0.9953	0.080	201.69	0.6768
0.420	114.49	2.2556	0.217	146.57	1.4904	0.126	175.51	0.9890	0.079	202.44	0.6695
0.400	116.75	2.1954	0.215	147.05	1.4807	0.125	175.95	0.9827	0.078	203.21	0.6621
0.380	119.15	2.1324	0.213	147.52	1.4710	0.124	176.40	0.9764	0.077	203.98	0.6548
0.360	121.70	2.0666	0.211	148.01	1.4612	0.123	176.85	0.9700	0.076	204.77	0.6474
0.350	123.04	2.0325	0.209	148.50	1.4514	0.122	177.30	0.9637	0.075	205.57	0.6399
0.340	124.42	1.9976	0.207	148.99	1.4415	0.121	177.76	0.9573	0.074	206.38	0.6325
0.335	125.13	1.9799	0.205	149.49	1.4316	0.120	178.23	0.9509	0.073	207.21	0.6250
0.330	125.85	1.9620	0.203	149.99	1.4216	0.119	178.70	0.9444	0.072	208.05	0.6175
0.325	126.58	1.9438	0.201	150.50	1.4115	0.118	179.17	0.9380	0.071	208.90	0.6100
0.320	127.32	1.9254	0.199	151.02	1.4014	0.117	179.65	0.9315	0.070	209.77	0.6024
0.315	128.08	1.9068	0.197	151.54	1.3912	0.116	180.13	0.9250	0.069	210.65	0.5948
0.310	128.86	1.8879	0.195	152.07	1.3810	0.115	180.62	0.9185	0.068	211.54	0.5872
0.305	129.64	1.8689	0.193	152.61	1.3707	0.114	181.11	0.9120	0.067	212.46	0.5796
0.300	130.45	1.8496	0.191	153.15	1.3604	0.113	181.61	0.9054	0.066	213.38	0.5719
0.295	131.26	1.8300	0.189	153.70	1.3500	0.112	182.11	0.8989	0.065	214.33	0.5642
0.290	132.10	1.8102	0.187	154.25	1.3395	0.111	182.62	0.8923	0.064	215.29	0.5565
0.285	132.95	1.7902	0.185	154.81	1.3290	0.110	183.13	0.8857	0.063	216.27	0.5488
0.280	133.82	1.7699	0.183	155.38	1.3184	0.109	183.65	0.8790	0.062	217.27	0.5410
0.275	134.70	1.7494	0.181	155.96	1.3078	0.108	184.17	0.8724	0.061	218.29	0.5332

Electronic Control Board 200-14



1076	Modulating Gas Valve Connection
1329	Thermister Wiring Harness Connector
1330	Flowmeter Connection
1331	Power Supply Wiring Harness Connector
1333	DSI Wiring Harness Connector
Alarm	Alarm Connector Not Used (in this application)
ACAL Jumper	Jumper for Auto-Cal
JMP 1 Jumper	Board Function Jumper
Orange Test Point	Test Point for T _{out} Thermister
Yellow Test Point	Test Point for T _{mid} Thermister
Blue Test Point	Test Point for Setting Temperature
Brown Test Point	Test Point for Modulating Valve
Black Test Point	Test Point for Ground (common)

Revision 04/04

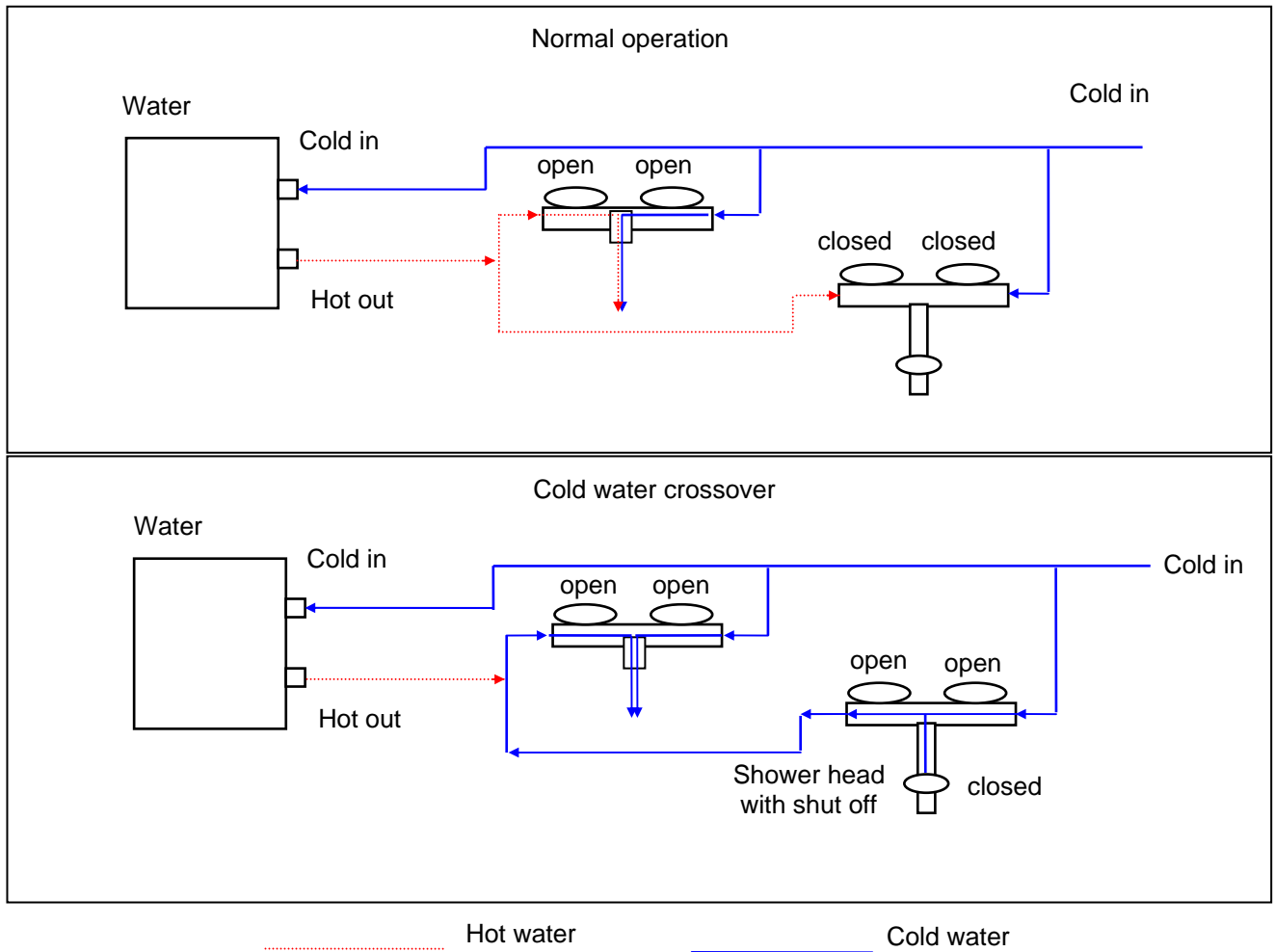


Figure 6. Cold Water Bypass

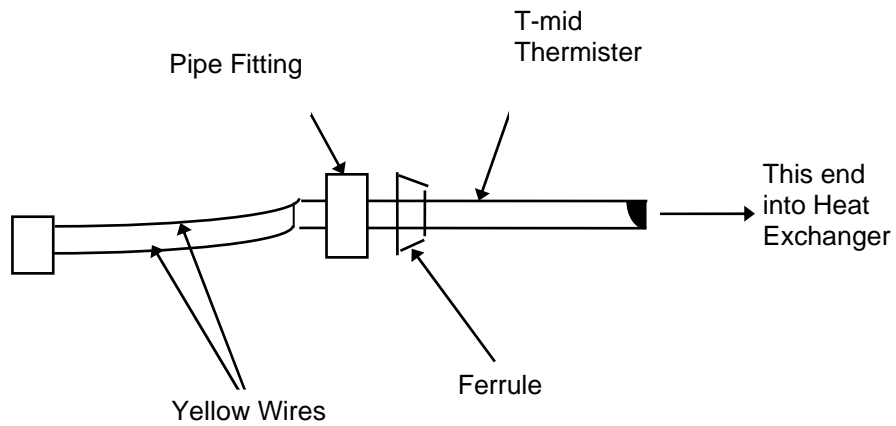
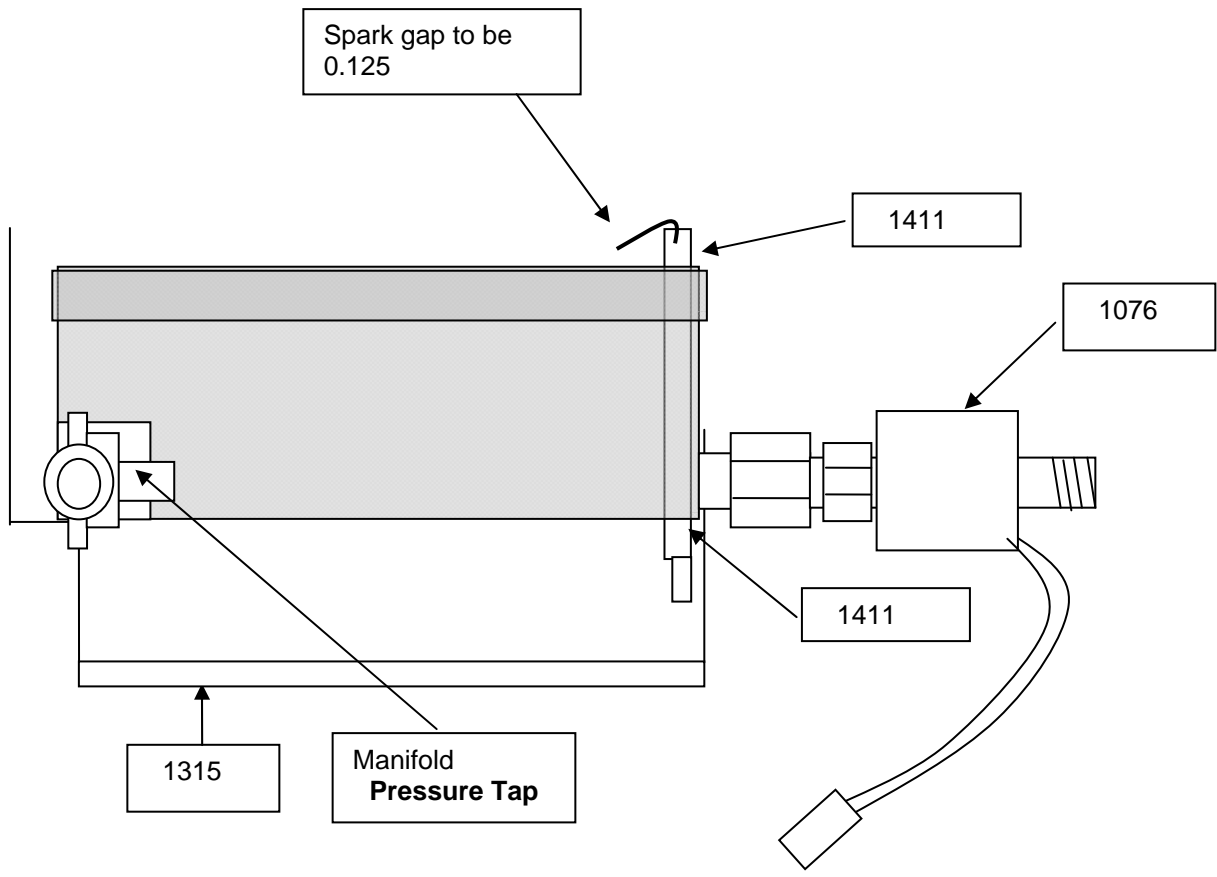
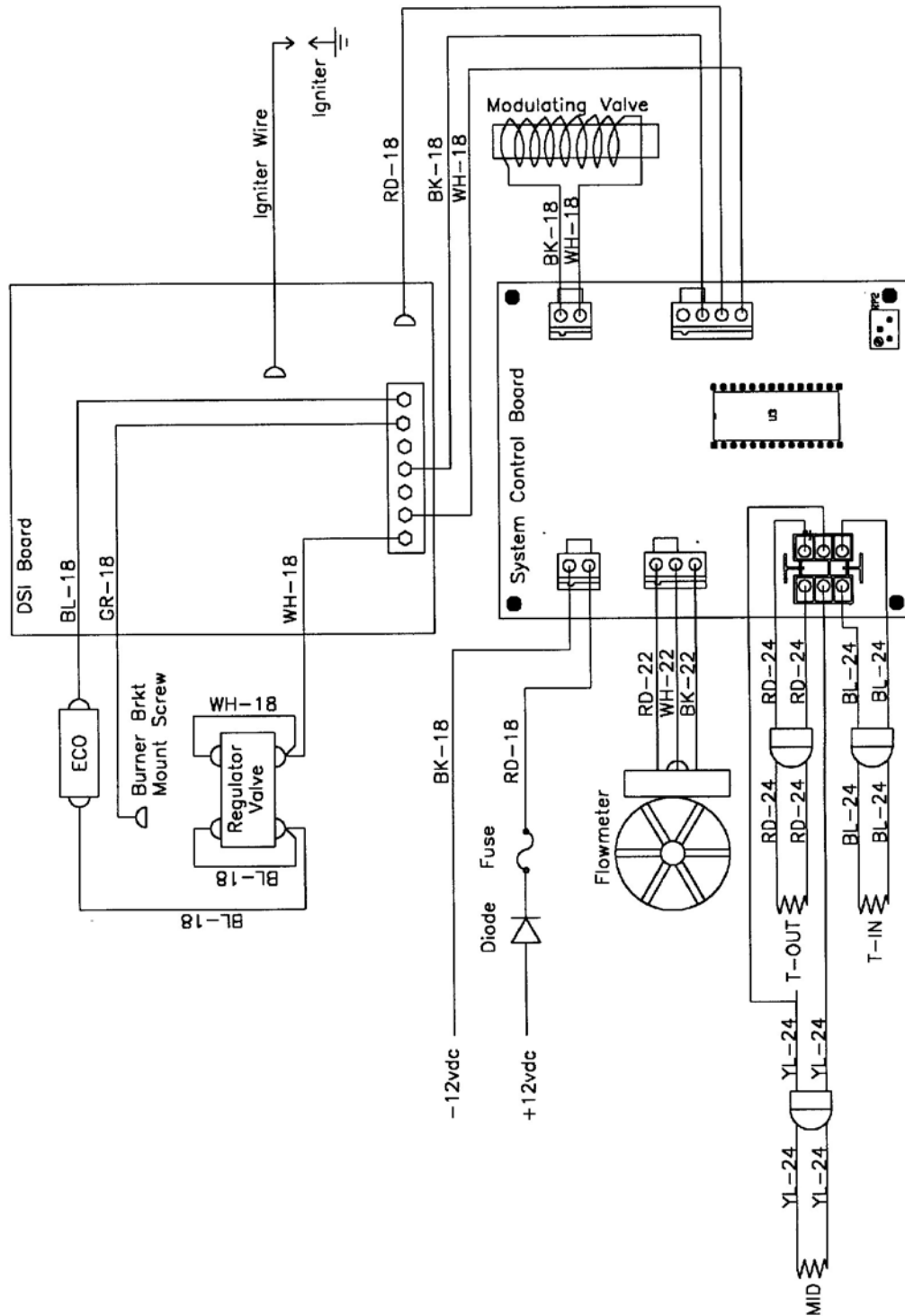


Figure 7. T-mid Ferrule Assembly

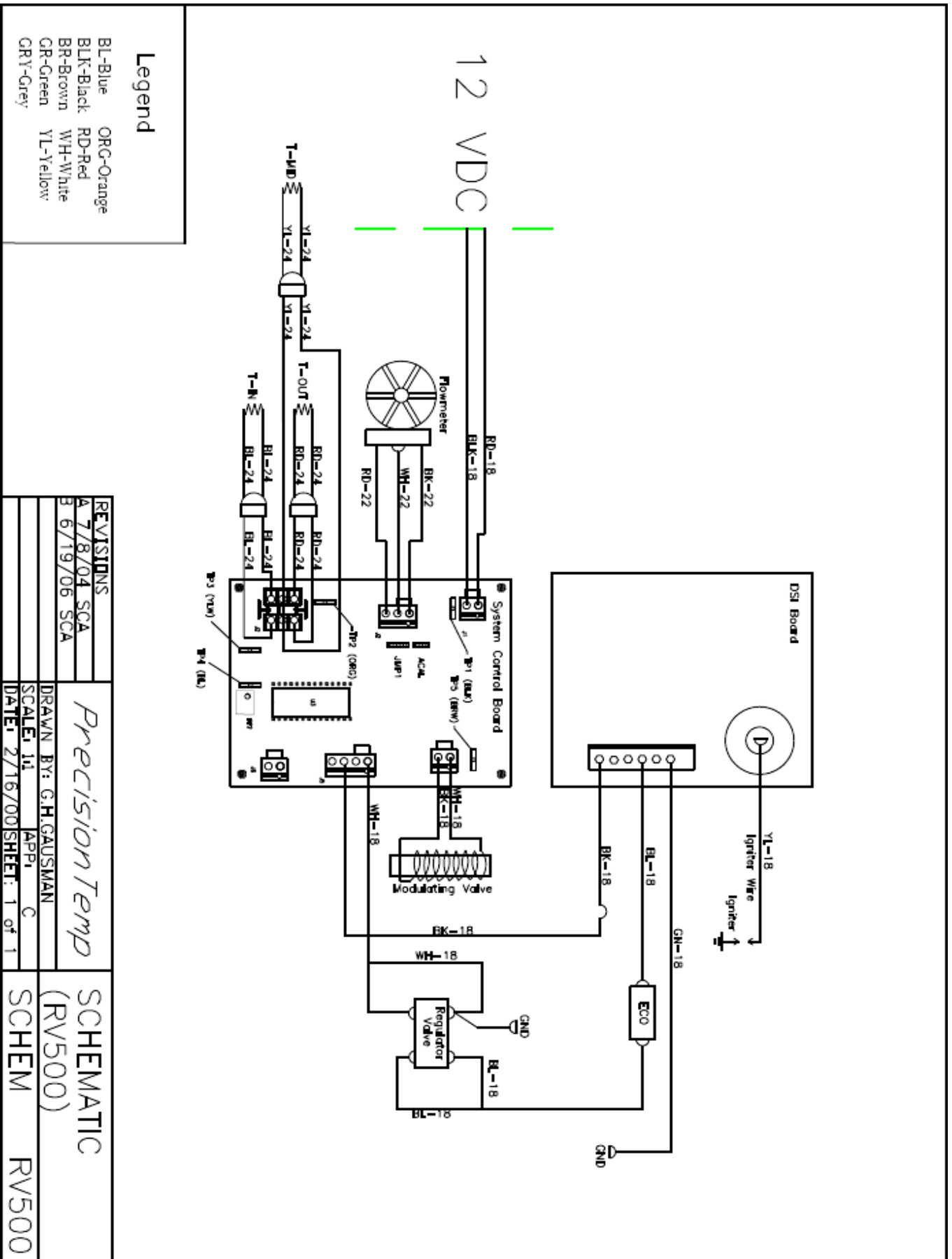


- 1076 Modulating Gas Valve LPG
- 1315 Burner Assembly
- 1411 Igniter

Figure 8. Burner Assembly - Gas Train Assembly



RV500 Wiring Schematic 2004 & prior years



Model: RV500-F-L / RV501-F-L
 Schematic RV500 2004 - present

SM500-01 Circuit Control Board Replacement

Other service documents required:

SM500-15 Automatic calibration (AutoCal)
SM500-16 Testing the RV500

Tools Required:

Needle-nose pliers

1. Turn off power. Disconnect all electrical connectors at the circuit board.
2. Remove the circuit board. A needle-nose plier can be used to remove the circuit board standoffs.
3. Remove the two black LED holders (if necessary) so they will not interfere with the installation of the new board.
4. Install the new board with the LEDs located at the front of the drawer. Reconnect all connectors to the board. **CAUTION:** there are two two-pin connectors. Be sure that the power supply connector (red and black wire) goes to upper left corner and the valve connector (white and black wire) goes to upper right (see figure -4).
5. Put the LED holders in.
6. The set temperature is already at 122°F. Refer to manual if a further adjustment is desired.
7. You must run AutoCal to complete the installation. Refer to SM500-15.
8. Perform a test of the unit. Refer to SM500-16 'Testing the RV500'.

Kit Parts List:

1841- RV Control Board

Figures:

Figure-4 View of the Electronic Drawer

Model: RV500-F-L / RV501-F-L

SM500-02 Direct Spark Ignition (DSI) Board Change

Other service documents required:

none

Tools Required:

¼" socket

5/16" wrench

Velcro strips

1. Turn off power. Disconnect all electrical connectors at the DSI board.
2. Remove the electronics drawer from cabinet.
- 3.
4. Removing the board may require a ¼" socket or a 5/16" wrench. Some models use Velcro.
5. Install the new DSI board using Velcro or screws and re-attach the wire harnesses plug. Be sure to route the ignition wire separate from the other control/wiring harnesses.

Kit Parts List:

3158 Direct Spark Ignition (DSI) board

3166 DSI Mounting Bracket

Figures:

none

Model: RV500-F-L / RV501-F-L

SM500-03 Electrical Drawer Assembly Change

Other service documents required:

SM500-16 Testing the RV500

Tools Required:

none

1. Turn power OFF.
2. Remove the door and locate the electrical drawer AS 1438 (see figure -3).
3. Slide the drawer forward to reveal the two circuit boards AS 1312 and EB 1378. Wire harnesses will not permit the drawer to be removed. Disconnect the one connection to EB 1378 and the five (5) connections to AS 1312. All electrical connectors in the drawer should now be disconnected and the drawer can slide out of the guides.
4. Route the wire harnesses through the grommets of the new drawer. Be sure to route the ignition harness separate from the other control harnesses. Then slide the drawer onto the guides.
5. Re-connect the nine (9) electrical connections.
6. Perform a test of the unit. Refer to SM500-16 'Testing the RV500'.

Kit Parts List:

1438 Assembly, Electrical Drawer

Figures:

Figure-3 Frontal view of RV500 without door

SM500-04 Hood Change Procedure

Other service documents required:

None

Tools Required:

Phillips screwdriver

1. Turn off power.
2. Open the electrical drawer and disconnect the two connectors on the DSI board EB 1378 and the five connectors on the circuit board AS 1312 (refer to figure -4). Route the cables out of the drawer and then slide the electrical drawer out.
3. Note: Model 500 with serial numbers prior to 97-07-xxxx.
Remove the four sheet metal screws located two on each side of the case. The head of the screw is accessed from the outside of the case. If the screws are not accessible then the case must be pulled from the RV sufficiently to access the screws.

Note: Model 500 with serial numbers after 97-07-xxxx and ALL MODEL 501

Using a Phillips screwdriver remove the 8-32 screw located at the middle rear of the hood (see figure -3). Then remove the two 8-32 screws located at the upper front of the hood. These screws are accessible through holes in the lower hood that have been covered with metal tape.

Note: Model 500 with serial numbers starting with 05-XX-XXXX remove the two 8-32 screws located at the upper front of the hood. These screws are accessible through holes in the lower hood that have been covered with metal tape

4. Lift the hood until it clears the heat exchanger and then bring the hood forward to remove it from the case.
5. Slide the electrical drawer into the new hood.
6. Install the new hood reversing steps 4, 3, and 2.

Kit Parts List:

Hood assembly 1327

Other service documents required:

none

Tools Required:

Phillips screwdriver

Figures:

Figure-3 Frontal View of RV500 with Door Removed
Figure-4 View of Electronic Drawer

Model: RV500-F-L / RV501-F-L

SM500-05 Heat Exchanger / Burner Assembly Replacement

Other service documents required:

SM500-16 Testing the RV500
SM500-04 Hood Change Procedure

Tools Required:

Phillips screwdriver
¼" socket
9mm open end wrench
Side cutters
2 adjustable wrenches
7/8 open end wrench

4. Turn power OFF, water OFF, and gas OFF.
5. Disconnect the gas line, water inlet, and water outlet.
6. Remove the hood assembly per SM500-04.
7. Remove the two 8-32 screws on the sides of the burner bracket using the ¼" socket and 9mm open end wrench. Refer to figure -3.
8. Slide the heat exchanger / burner assembly 1434 forward and out of the case.
9. Remove the thermister cable 1329 and DSI cable 1829.
10. Assemble the thermister cable 1329 and DSI cable 1829 from step 5 onto the new heat exchanger / burner assembly.
11. Reverse the procedure of steps 4, 3, and 2 to complete assembly.
12. Check the unit for normal operation per SM500-16 'Testing the RV500'

Kit Parts List:

1434 Heat exchanger / burner assembly

Figures:

Figure-3 Frontal View of RV500 with Door Removed
Figure-4 View of Electronic Drawer

Model: RV500-F-L / RV501-F-L

SM500-06 Heat Exchanger Assembly Replacement

Other service documents required:

SM500-04	Hood Change Procedure
SM500-05	Heat Exchanger / Burner Assembly Replacement
SM500-16	Testing the RV500

Tools Required:

- Phillips screwdriver
- ¼" socket
- 9mm open end wrench
- 3/8" socket
- level

13. Turn power OFF, water OFF, and gas OFF.
14. Remove the hood assembly per SM500-04.
15. Remove the heat exchanger / burner assembly 1434 per SM500-05.
16. Remove the two 8-32 machine nuts from the left side of the heat exchanger that attach the heat exchanger assembly 1435 from the burner assembly 1315.
17. Turn the new heat exchanger assembly 1435 upside down and place on a flat, level table. Position the burner assembly 1315 onto the burner so that the high side of the burner is on the outside of the heat exchanger and the other side of the heat exchanger is resting on the ledge of the burner assembly. See figure -8.
18. Be sure the table is level. Place a level on the burner bracket. Adjust the burner assembly until it is level and then mark the heat exchanger through the two mounting holes in the burner bracket.
19. Remove the burner assembly and drill ¼" holes at the two marked holes on the heat exchanger.
20. Again place the burner on the heat exchanger. From the inside of the heat exchanger assemble the heat exchanger backup plate through the two holes of the heat exchanger and burner. Use the two new 8-32 self-locking screws 1397 and a 3/8" socket to tighten the assembly. Recheck that the upside down assembly is still level as determined in step 6.
21. Reverse the procedure of steps 3, and 2 to complete assembly.
22. Check the unit for normal operation per SM500-16 'Testing the RV500'

Kit Parts List:

1435	Heat exchanger assembly
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Figures:

Figure-3	Frontal View of RV500 with Door Removed
Figure-4	View of Electronic Drawer
Figure-8	Burner Assembly

Model: RV500-F-L / RV501-F-L

SM500-07 T-in Thermister Change Procedure

Other service documents required:
SM500-16 Testing the RV500

Tools Required:
Scissors (or other cutting tool)

1. Remove the wire ties, metal tape, and old thermister. Clean off the old heat sink and be sure copper is wiped clean.
Note : T-in thermistor position changed on newer models. Current location is on the same tube forward of the PRV where the pipe makes a 90 degree vertical at the copper heat exchanger.
2. Apply heat sink compound to copper tube.
3. Place the thermister into the heat sink compound. Wrap metal tape around the tube and thermister.
4. Take the two wire ties. One goes around the wires as a strain relief. The other goes near the thermister (about 3/8" away from the head) to hold the thermister against the tube. **CAUTION: Do not place the tie wrap over the thermister tip as this may crack the thermister, and Do not over-tighten the wire ties.**
5. Check the resistance across the thermister leads. Under room temperature conditions the value should be between 700 - 1100 ohms. A further check may be to compare the resistance measurement to the other two thermisters. If all thermisters have been exposed to the same temperature they should be within 50 ohms.
6. Route the blue wire leads over the modulating valve keeping the wires away from the burner. Wrap the harness together and connect into the thermister harness that goes back to the control board.
7. Perform a test of the unit. Refer to SM500-16 'Testing the RV500'.

Kit Parts List:
1436 T-in thermister assembly kit

Figures:
none

Model: RV500-F-L / RV501-F-L

SM500-08 T-mid Thermister Change Procedure

Other service documents required:

SM500-16 Testing the RV500

Tools Required:

14 mm open end wrench

9/16" open end wrench

(or adjustable wrench)

1. Remove old thermister. CAUTION: Use two wrenches: one on the hex (9/16") of the thermister and one on the hex (14 mm) located on the heat exchanger fitting. Failure to do so may damage the heat exchanger.
2. Place the fitting and the ferrule on the thermister as shown in figure -7.
3. Insert the end of the thermister without electrical leads into the heat exchanger until the heat shrink (black) on the thermister touches the fitting and tighten the fitting finger-tight. Wiggle to locate center. The final tightening should be done using two wrenches as described in step 1.
4. Check the resistance across the thermister leads. Under room temperature conditions the value should be between 700 - 1100 ohms. A further check can be done by comparing this resistance to the other two thermisters. If all thermisters have been exposed to the same temperature they should be within 50 ohms.
5. Wire tie the harness together with the other two thermister harnesses and connect into the thermister harness that goes back to the control board.
6. You must run AutoCal to complete the installation. Refer to SM500-15.
7. Perform a test of the unit. Refer to SM500-16 'Testing the RV500'.

Kit Parts List:

2008 T-mid thermister assembly kit

Figures:

Figure-7 T-mid Ferrule Assembly

Model: RV500-F-L / RV501-F-L

SM500-09 T-out Thermister Change Procedure

Other service documents required:

SM500-16 Testing the RV500

Tools Required:

Scissors (or other cutting tool)

1. Remove the wire ties, metal tape, and old thermister. Clean off the old heat sink and be sure copper is wiped clean.
2. Place a large dab of heat sink compound on the pipe to replace the compound removed.
3. Place the thermister into the heat sink compound with the wire leads pointing down along the tube. Make sure the tip of the thermister is completely submerged in the compound.
4. Wrap metal tape around the tube and thermister.
5. Take the two wire ties. One goes around the wires as a strain relief. The other goes near the thermister (about 3/8" away from the head) to hold the thermister against the tube. **CAUTION: 1) Do not place the tie wrap over the thermister tip as this may crack the thermister, and 2) Do not over-tighten the wire ties.**
6. Check the resistance across the thermister leads. Under room temperature conditions the value should be between 700 - 1100 ohms. A further check may be to compare the resistance measurement to the other two thermisters. If all thermisters have been exposed to the same temperature they should be within 50 ohms.
7. Wire tie the thermister harnesses together and connect into the thermister harness that goes back to the control board.
8. Perform a test of the unit. Refer to SM500-16 'Testing the RV500'.

Kit Parts List:

1437 T-out thermister assembly kit

Figures:

none

Model: RV500-F-L / RV501-F-L

SM500-10 Burner Assembly Replacement

Other service documents required:
SM500-16 Testing the RV500

Tools Required:
Phillips screwdriver
¼" socket
9mm open end wrench
3/8" open end wrench
level

1. Turn power OFF, water OFF, and gas OFF.
2. Remove the hood assembly per SM500-04.
3. Remove the heat exchanger / burner assembly 1434 per SM500-05.
4. Remove the two 8-32 machine nuts from the left side of the heat exchanger that attach the heat exchanger assembly 1435 from the burner assembly 1315.
5. Turn the heat exchanger assembly 1435 upside down and place on a flat, level table. Assemble the new burner assembly 1315 onto the burner so that the high side of the burner is on the outside of the heat exchanger and the heat exchanger other side is resting on the ledge of the burner assembly. See figure -8.
6. Be sure the table is level. Place a level on the burner bracket. Adjust the burner assembly until it is level and mark the heat exchanger through the two mounting holes in the burner bracket.
7. Remove the burner assembly and drill ¼" holes at the two marked holes on the heat exchanger.
8. Again place the burner on the heat exchanger. From the inside of the heat exchanger assemble the heat exchanger backup plate through the two holes of the heat exchanger and burner. Use the two new 8-32 self-locking screws 1397 and a 3/8" open end wrench to tighten the assembly. Recheck that the upside down assembly is still level as determined in step 6.
9. Reverse the procedure of steps 3, and 2 to complete assembly.
10. Check the unit for normal operation per SM500-16 'Testing the RV500'

Kit Parts List:
1315 Burner assembly

Figures:
Figure-3 Frontal View of RV500 with Door Removed
Figure-4 View of Electronic Drawer
Figure-8 Heat Exchanger / Burner Assembly Method

Model: RV500-F-L / RV501-F-L

SM500-11 Igniter Replacement

Other service documents required:

SM500-04	Hood Change Procedure
SM500-05	Heat Exchanger / Burner Assembly Replacement
SM500-06	Heat Exchanger Assembly Replacement
SM500-10	Burner Assembly Replacement
SM500-16	Testing the RV500

Tools Required:

Phillips screwdriver
¼" socket
9mm open end wrench
3/8" open end wrench or socket
Level
Pliers
1/8" drill bit

1. Turn power OFF, water OFF, and gas OFF.
2. Remove the hood assembly per SM500-04.
3. Remove the heat exchanger / burner assembly 1434 per SM500-05.
4. Separate the heat exchanger assembly 1435 and burner assembly 1315 per SM500-06 or SM500-10.
5. Remove the one screw 1409 that attaches the igniter bracket 1410 and electrode 1411.
6. Replace the electrode and re-assemble onto the burner.
7. Using the 1/8" drill bit as a gage, bend the end of the electrode with the pliers until it is centered over the burner blade and 1/8" above the burner (see figure -8).
8. Re-assemble the heater reversing the procedure of steps 4, 3, and 2.
9. Check the unit for normal operation per SM500-16 'Testing the RV500'

Kit Parts List:

1411 Electrode

Figures:

Figure-3	Frontal View of RV500 with Door Removed
Figure-4	View of Electronic Drawer
Figure-8	Burner assembly/Electrode Adjustment

Model: RV500-F-L / RV501-F-L

SM500-12 Flowmeter Replacement

Other service documents required:

SM500-16 Testing the RV500

Tools Required:

Adjustable wrench
13/16 open end wrench
Teflon thread tape

1. Turn power OFF, water OFF, and gas OFF
2. Disconnect the flow meter connector from the control board (J3) and remove connector/wire from drawer. Remove drawer from shelf and let hang.
3. Loosen the upper compression fitting nut (see figure SM500-3). Carefully turn the flowmeter counter clockwise to release the bottom connection.
4. Reverse the above procedure and install the new flowmeter assembly, use Teflon pipe thread tape to seal the threaded connections.
5. Check the unit for normal operation per SM500-16 'Testing the RV500'

Kit Parts List:

1330 Flowmeter assembly

Figures:

Figure-3 Frontal View of RV500 with Door Removed
Figure-4 View of Electronic Drawer

Model: RV500-F-L / RV501-F-L

SM500-13 Gas Solenoid Replacement

Other service documents required:
SM500-16 Testing the RV500

Tools Required:
Basin wrench or crow foot wrench
Adjustable wrench

1. Turn power OFF, water OFF, and gas OFF.
2. Disconnect the gas supply.
3. Disconnect the four spade connectors at the gas solenoid.
4. Place an adjustable wrench on the modulating valve hex and unscrew the gas solenoid 1073 from the end of the piping and remove from the unit.
5. Remove the flare elbow from the gas solenoid.
6. USE AGA-APPROVED SEALANT ON ALL GAS THREAD CONNECTIONS. Assemble the flare elbow into the new gas solenoid.
7. Screw the gas solenoid 1073 onto the end of the piping in the case. Continue to tighten until the spade connections are to the rear of the unit.
8. Attach the four spade connections. Looking from the front, the two blue wires attach on the left and the two white wires on the right.
9. Connect the gas supply and test for leaks.
10. Check the unit for normal operation per SM500-16 'Testing the RV500'.

Kit Parts List:
1073 Gas Solenoid

Figures:
Figure-3 Frontal View of RV500 with Door Removed

Model: RV500-F-L / RV501-F-L

SM500-14 Modulating Valve & Coil Replacement

Other service documents required:

SM500-15 Automatic Calibration (AutoCal)
SM500-16 Testing the RV500

Tools Required:

Basin wrench or slip/channel pliers
2 Adjustable wrenches or
9mm open end wrench
7/8 wrench

1. Turn power OFF, water OFF, and gas OFF.
2. Unplug the Modulating valve connector from the control board (J4).
3. Disconnect the gas line from the gas solenoid and unplug wire connectors from gas solenoid.
4. Place an adjustable wrench on the modulating valve hex and unscrew the gas solenoid and piping from the end of the modulating valve.
5. Use the 7/8 wrench on the modulating valve hex to unscrew the valve and pipe nipple from the burner manifold. Then separate the pipe nipple from the valve.
6. To replace the coil only remove the C clip from the modulating valve tube, slide the coil off and install replacement coil. Make sure the direction arrow is pointed toward the manifold. Reinstall C clip.
7. USE AGA-APPROVED SEALANT ON ALL GAS THREAD CONNECTIONS. Assemble the pipe unto the new modulating valve and into the manifold. Take care not to get any thread sealant into the modulating valve because this will cause the valve to stick.
8. Re-assemble the heater reversing the procedure of steps 5, 4, 3, and 2.
9. Check for gas leaks.
10. Check the unit for normal operation per SM500-16 'Testing the RV500'. Note that the AutoCal procedure (SM500-15) must be run.

Kit Parts List:

1076 Modulating Valve assembly

Figures:

Figure-3 Frontal View of RV500 with Door Removed
Figure-4 View of Electronic Drawer

Model: RV500-F-L / RV501-F-L

SM500-15A Automatic Calibration (Auto Cal) Procedure

For auto calibration of all board units manufactured after April 25, 1999

Other service documents required:

SM500-16 Testing the RV500

Tools Required:

Needle-nose pliers

CAUTION: During this test the unit will not be controlling. It will increment the gas flow from minimum to maximum over 8 minutes. Be sure to monitor the unit for safe operation.

1. Turn off power. Open electronic drawer. From the front circuit board remove 2-pin jumper from **ACAL** (back jumper) using pliers or fingers (see figure -4).
2. Set water flow at about 1.5 gpm (flow is similar to shower flow) 12 flashes from green light between pauses.
3. Turn power ON. Green LED should flash and burner comes on to minimum burn. If red light flashes there is a problem with the temperature sensors and they must be corrected before continuing. Over the next 8 minutes the unit will be increasing the gas flow to calibrate the valve. The unit will run the test by itself and only requires monitoring for safety. When the test is ended the red LED will flash.
4. Turn power OFF and water can be turned off.
5. Replace the jumper on the board.
6. Turn on power.
6. Check the unit for normal operation (refer to SM500-16 'Testing the RV500'). If all operation appears normal the procedure is complete. If the unit does not control or gas flow varies excessively repeat the procedure.

Kit Parts List:

None.

Figures:

Figure-4 View of Electronic Drawer

Model: RV500-F-L / RV501-F-L

SM500-16 Testing the RV500

Other service documents required:

Section 4.5 T-in /T-mid/T-out Thermister and T-set Readout
SM500-15 Automatic Calibration (AutoCal)

Tools Required:

Small flat blade screwdriver
Basin wrench or crow's foot
9/16 open end wrench
3/16 hex key
regular flat blade screwdriver

Voltage Supply = 12 ± 0.5 vdc
Gas supply pressure (to regulator) = 11.0 14.0 wci
Water supply pressure = 25 - 60 psig

Instrumentation:

T-mid	Circuit board thermister reading (yellow test point)
T-out	Circuit board thermister reading (orange test point)
T-in	Inboard blue wire in 6 pin connector
T-set	Circuit board thermister reading (blue test point)
Water flow	Bucket or bench water meter (optional)
Manifold Pressure	0 - 10 wci (optional)
Regulator Pressure	0 - 15 wci (optional)
Modulating Valve	0 - 12 vdc (optional)

Test Data :

1. Turn power ON and verify that the green LED flashes.
2. On circuit board set T-set (blue test connector) to 2.0 volts (120°F).
3. Set water flow ≥ 0.5 gpm (gas OFF) and verify the DSI function: 2.5 sec fire, 3.0 sec purge, 2.5 sec fire, lockout.
4. Run AUTOCAL (SM500-15), if required.
5. Shutdown. Disconnect DSI flamesense feedback to board (see figure TS500-4)
Modulating valve voltage = (0.0 vdc)
Manifold pressure = (0.65 - 1.15 wci)
Verify gas stays at min.
6. Fail T-mid thermister.
Verify gas flow is shutoff.
System lockout (red LED double flashing).
7. Increase flow so that the burner is on maximum burn and T-out does not reach T-set. At this condition:
Modulating valve voltage = (> 10.0 vdc)
Manifold pressure = (> 7.25 wci)
8. Setup steady flow conditions verify that the steady state variation is always within $\pm 2^\circ\text{F}$.
9. Has the unit leaked water?

IMPORTANT

COLD WEATHER PROTECTION INFORMATION

WARNING: Do not disconnect the electrical supply, turn off the propane supply or disconnect the cold pack power when temperatures are near or below freezing. The RV500 freeze protection system will not work if the electrical power source or propane is disconnected.

Note: When driving in cold temperatures drain water from RV500 to avoid freezing. The freeze protection will not protect the unit from freezing while driving.

WINTERIZING

1. Turn off the power supply and gas supply to the RV500.
2. Turn off main water supply.
3. Open all hot water taps. (Bathroom, kitchen, laundry, etc.)
4. Drain water from plumbing lines.
5. Open pressure relief valve to drain remaining water from the heat exchanger and flowmeter.

WARNING: Always turn off the 12-volt power supply to the heater while the vehicle is moving and during any fueling operations. Operating this water heater or any other ignition source during fueling could cause a fire or explosion, which could result in serious injury or death. Trying to produce hot water while driving or moving may damage the RV500 electrical components and cause a fire.

REPLACEMENT PARTS RV 500 & ShowerMate	
P/N	COMPONENT DESCRIPTION
1073	Solenoid Valve LPG
1315	Assy-Burner
1411	Igniter
1076	Modulating Valve
1435	Heat Exchanger Assy
1330	Flowmeter Assy
2086	ECO
2008	Thermistor Assy T-Mid
1436	Thermistor Assy T-In
1437	Thermistor Assy T-Out
3158	DSI Ignition Board
1841-RV	Control Board w/chip
9049F	Programmed Chip for RV-500
1412	Ignition Cable
1375	Pressure Relief Valve
2000	six mag rotor for RV Flowmeter
2001	Plastic cover for RV Flowmeter
2002	O ring for RV Flowmeter
2003	Shaft for RV Flowmeter
1829	DSI Harness
1329	Thermistor Harness
2940	Pressure Switch ShowerMate only
2028	Relay ShowerMate only
2451	Exhaust Blower ShowerMate only
2984	10vdc Voltage Regulator ShowerMate
1103	Modulating Valve Coil
1703	RV 500 Wind Fan
1331	Power supply harness
3189	RV500 Wiring Harness Assy.
3190	ShowerMate Wiring Harness Assy.