S-3
Solvent Saver System

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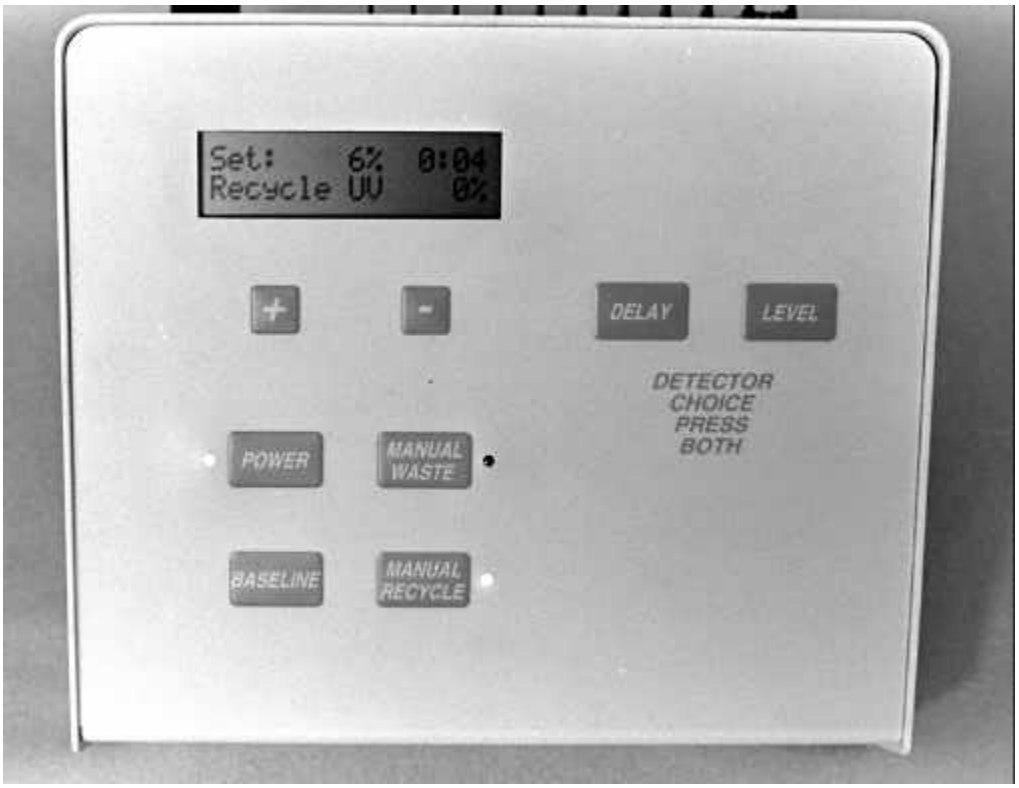
CE

The S-3 Solvent Saver System has been tested and found to comply with:

IEC 801-2:1991
IEC 801-3:1988
IEC 801-4:1990
EN 55011, Group 1, Class A:1991
EN 50082:1992


Set: 6% 0:04
Recycle UV 0%
+
-
DELAY
LEVEL
DETECTOR
CHOICE
PRESS
BOTH
POWER
MANUAL
WASTE
BASELINE
MANUAL
RECYCLE

Contents

1 Quick Start

1.1 Introduction

This section of the manual provides sufficient information to use the Solvent Saver System in most typical applications. (The typical application is using a UV detector with a 1 volt full-scale output.) Additional technical details are provided later in this manual.

1.2 Setup

Unpack the Solvent Saver System. You should receive the following items:

1. Solenoid valve
2. Wall mount transformer (AC adapter)
3. Solvent Saver console
4. This manual
5. Cable for detector
6. Package of fittings

Make sure that you do not discard any of the smaller items with the packing material.

Connect the valve to the valve terminals on the back of the Solvent Saver console. It does not matter which lead you connect to the + terminal and which you connect to the – terminal.

Connect the signal terminals on the back of the Solvent Saver console to your detector. If you are able to use the detector cable included with the Solvent Saver, the black lead should go to the + terminal and the clear or white lead to the – terminal; at the detector end the side of the plug with the extra hump should go into the black, common, or – jack. If your detector does not provide banana plug outputs you will need to construct a suitable cable.

Connect the fluid lines to the solenoid valve using the fittings provided. Connect the outlet from your detector to the valve inlet, your old waste container to the Waste port on the valve, and a new line from the Recycle port of the valve to your solvent reservoir. Do not connect the Recycle port directly to your pump.

After checking to make sure that the AC adapter provided is suitable for your mains voltage, use it to apply power to the Solvent Saver console. Press the POWER key to turn on the Solvent Saver. When the Solvent Saver is not on, the valve is always set to direct fluid to the waste container.

Start your pump and allow fluid to begin flowing through the valve. Press the MANUAL WASTE key; the red light next to it should flash and fluid should be directed to the waste container. Press the MANUAL RECYCLE key; the red light next to it should begin flashing and fluid should be directed back to the solvent reservoir. Press the MANUAL RECYCLE key a second time and the Solvent Saver will resume automatic operation.

Finally, press the LEVEL key to set the minimum peak level. Use the + and – keys to adjust this to the level you feel comfortable with and then press the LEVEL key again to return to the normal display. A higher level will increase the amount of fluid recycled as well as the possibility of contamination, while a lower level will increase solvent consumption and decrease the possibility of contamination. In most instances a threshold of 25% to 50% is satisfactory.

Your solvent saver is now ready for use. After you adjust the baseline on your detector, just press the BASELINE key on the Solvent Saver and it will automatically recycle the pure solvent which you previously discarded.

2 Introduction

2.1 Description

The microprocessor controlled S-3 Solvent Saver System is used to reduce solvent consumption when doing chromatography. This both saves money for the operator and reduces the impact on the environment.

In most isocratic liquid chromatographic separations (this applies to both HPLC and low-pressure liquid chromatography), most of the mobile phase pumped through the column emerges as pure as when it entered the column. (Generally there is more baseline area than peak area.) This is especially true when the time between runs is included. Without the use of an intelligent solvent saver one must either dispose of all of the mobile phase consumed or recycle all of the solvent and have an ever-increasing baseline and the risk of interferences.

The S-3 Solvent Saver System connects to both the system detector and the flow stream of a liquid chromatograph. It then uses the output from the detector to determine when clean solvent is leaving the column. The clean solvent is recycled by being directed back to the original solvent reservoir. Whenever the sample components are eluting from the column, this fluid is directed to either a waste container or a fraction collector. Thus, you need only dispose of small fraction of the total volume of solvent used in a chromatographic run.

The S-3 Solvent Saver System works equally well with almost any detector (UV, RI, EC, etc.) since it may be set to either recycle or discard negative peaks. It provides a great deal of versatility, the only requirements are that the detector have either a 1 V or 10 mV output and that the operating flow rate be less than 200 ml/min. The S-3 Solvent Saver comes complete with a valve, fittings for both 1/16” OD and 1/8” OD tubing, and a cable for connection to many popular detectors.

Special features of the Spectra/Chrom® Solvent Saver System are:

- Works with either 1 V or 10 mV detectors.
- All wetted parts are made of Teflon® or Tefzel®.
- Remote inputs for forced waste and forced recycle.
- Auto-zero input.
- Verify output to confirm valve operation.
- Works with UV or RI detectors.
- Programmable delay for allows for synchronization with the detector.
- Programmable hysteresis eases work with noisy signals.
- Recycle threshold may be set in 1% increments.
- Operates in coldrooms down to 0 °C.

2.2 Technical Specifications

Table 2-1 details the technical specifications of the Spectra/Chrom® Solvent Saver System. Table 2-2 in conjunction with Figure 2-1 explains the controls on the Solvent Saver System; table 2-3 in conjunction with Figure 2-2 explains the external connections of the Solvent Saver System.

TABLE 2-1. TECHNICAL SPECIFICATIONS

Power Requirements	115±25VAC, 14VA 230±50VAC, 14VA
Line Frequency	45 to 64 Hz
Dimensions (without valve)	21 cm x 10 cm x 17 cm 8.3" x 4" x 6.7" w x h x l
Weight	1 kg (2.2 lb.)
Hysteresis	0 to 9.9% full-scale in 0.1% steps
Set Point	0 to 0.5 V in .01 V steps or 0 to 5 mV in .1 mV steps
Signal Input	1 V or 10 mV full-scale (user selectable)
Remote Inputs	Contact closure or TTL low inputs for forced waste, forced recycle, or auto-zero
Remote Output	Open collector output to verify valve operation
Operating Temperature	0 to 40 °C non-condensing when left connected to mains

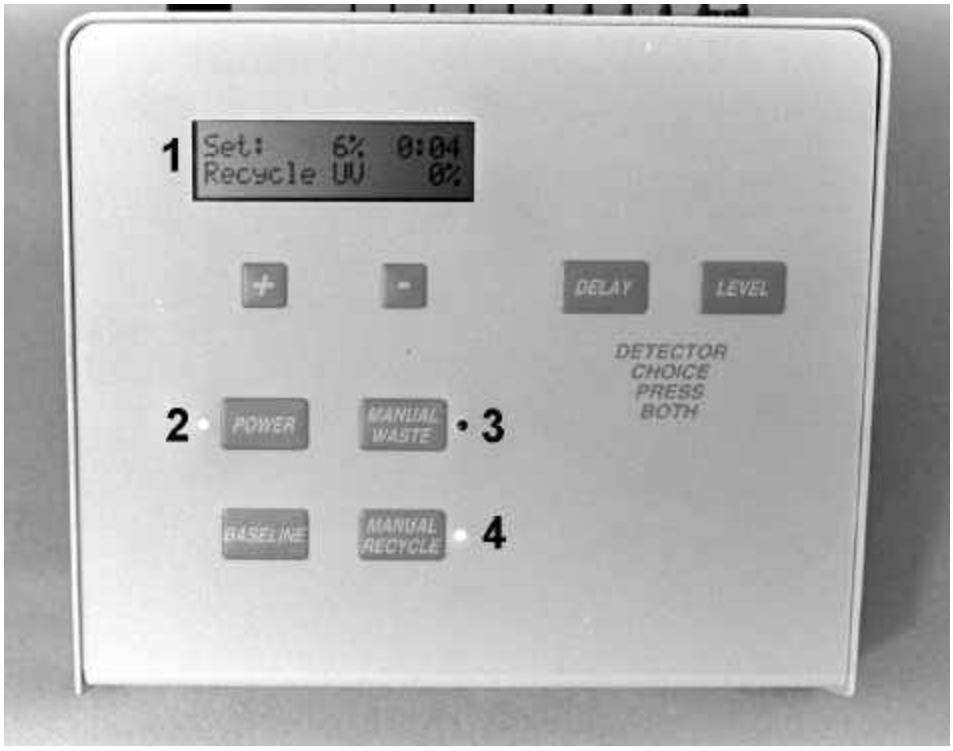


Figure 2-1 Spectra/Chrom® Solvent Saver System, Front View

Table 2-2. Front Panel Controls and Indicators

Item in Fig 2-1.	Description	Purpose
1	LCD Display	Displays prompts and results to the operator.
2	Power Indicator	Lights when the Solvent Saver is operating.
3	Waste Indicator	Lights when the recycle valve is set to the waste position.
4	Recycle Indicator	Lights when the recycle valve is set to the recycle position.

Figure 2-2 Spectra/Chrom® Solvent Saver System, Rear View

Table 2-3. Rear Panel Connections.

Item in Fig 2-2.	Description	Purpose
1	Connection for Valve	Connect the valve to these terminals.
2	Auto-Zero Input	Auto-zero input for the Solvent Saver.
3	Waste Input	Force waste input for the Solvent Saver.
4	Verify Output	Output low when valve is set to recycle.
5	Signal Input	Signal input for Solvent Saver.
6	Power Connector	14 VAC power input to Solvent Saver.

3 Installation

3.1 Unpacking

Save all packing materials until you are sure that the solvent saver is operational and that there is no concealed damage. Most carriers will not honor claims for concealed damage without inspecting the packing materials.

Your solvent saver should include the following items:

1. Solenoid valve
2. Wall mount transformer (AC adapter)
3. Solvent Saver console
4. This manual
5. Cable for detector
6. Package of fittings

Make sure that you do not discard any of the smaller items with the packing material.

3.2 Electrical Connections

The barrier strip on the rear of the solvent saver console provides all of the electrical connections necessary to operate your solvent saver.

First, connect the leads from the solenoid valve to the two terminals labeled valve. It does not matter which of the valve leads is + and which is –. The valve will work with either way.

Next, connect the cable for detector to the two terminals labeled signal. The black wire should be connected to the + terminal and the white (or clear) wire to the – terminal. The other end of the cable supplied has a dual stackable banana plug. This end of the cable will be plugged into your detector. You need not connect your detector at this time, but when you do connect your detector be sure that the side of the plug with the hump is connect to the black, common, or – terminal of the detector. If your detector does not have banana jacks at its output, you will need to construct a suitable cable.

After checking that the transformer supplied is sutiable for your power mains, plug it into the power connector on the solvent saver console and then into the wall. When you press and release the POWER button, the red light next to it should illuminate and the display should show a copyright message. After a few seconds the copyright message should be replaced by the normal display.

You should now press the POWER key again to place the solvent saver in standby mode. Then proceed with either section 3.3 Plumbing Connections or 3.4 First Time Set Up. These steps may be done in either order.

3.3 Plumbing Connections

The S-3 Solvent Saver System is complete with fittings for both 1/8” and 1/6” OD tubing. It uses standard 1/4”-28 flat bottomed fittings. A replacement set of fittings is available as part 142105.

To plumb the solenoid valve, first select the fittings for your tubing size. Use the blue nuts and ferrules for 1/16” OD tubing and the cream colored nuts and ferrules for 1/8” OD tubing. The ferrules are made of Tefzel and the nuts are made of Delrin®. The Tefzel ferrules have excellent resistance to most organic and aqueous solvents. The Delrin nut, not normally a wetted part, may be attacked by organic solvents. Spills or leaks of organic solvents may necessitate replacing these nuts.

It is important to cut the tubing ends square when using these fittings. For polymer tubing we recommend using a Spectra/Chrom® tubing cutter. Many other commercially available tubing cutters are suitable for use with stainless steel tubing.

To use these fittings to connect to the Solvent Saver's valve, first remove the rubber dust boots from the fitting ports of the valve. These are used to prevent contamination during shipping.

Once the port is clear, slide the nut and then the ferrule over the end of the tubing. The narrow end of the ferrule should be away from the end of the tubing and nearest the nut as shown in Figure 3-1.

Connect the outlet of your chromatography system, normally the outlet of the detector's flow cell, to the input of the solenoid valve. Connect the waste port of the valve to your old waste container and the recycle port of the valve back to your solvent reservoir for your pump. Do not connect it directly to the pump inlet.

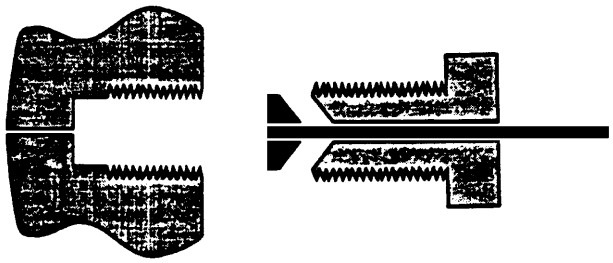


Figure 3-1. Assembling Flangless Fittings.

3.4 First-Time Setup

As previously described, connect the Solvent Saver console to mains power using the AC adapter provided. Be sure that the adapter provided is appropriate for your power mains. Turn the Solvent Saver on by pressing the POWER button and the red light next to it should illuminate. The display should then briefly display a copyright message and then the normal operating display.

Simultaneously depress both the DELAY and LEVEL keys so that you may configure the Solvent Saver to correctly interact with your detector.

After simultaneously pressing both the DELAY and LEVEL keys, the display will prompt you to select the detector type. Press the + key if you will be using a UV or other unipolar detector. (Press the + key if only positive-going peaks will be associated with impurities or sample components.) Press the − key if you will be using a refractive index or other bipolar detector. (Press the − key if both positive- and negative-going peaks will be associated with impurities or sample components.)

After the detector type is set you will need to tell the Solvent Saver what full-scale output voltage to expect. Press the + if your detector has a 1 volt full-scale output; press the − if your detector has a 10 millivolt full-scale output.

Finally, you may set the hysteresis level. Normally the factory set value of 1.5% is satisfactory. The hysteresis level is discussed more thoroughly in section 4. Press either the DELAY or the LEVEL key to return to the normal display.

This completes the first-time setup and the Solvent Saver should be ready to use.

4 Operation

4.1 Introduction

The Solvent Saver can be used to reduce the solvent consumption associated with most liquid chromatographic separations. It is most useful in isocratic analytical separations.

The Solvent Saver acts in conjunction with your existing detector. When a the detector "sees" a peak the Solvent Saver quickly switched to valve to the waste position, sending the column output to your waste container. Between peaks, the valve is set to recycle your solvent, sending the pure solvent coming off of the column back to your reservoir for use again and again.

4.2 General Information

The keys and indicators on the front of the Solvent Saver are designed to be easy to understand. Their normal functions are:

LCD Display	The LCD display provides prompts for the user when setting the instrument and also displays the current operating information.
⊕ and ⊖	The ⊕ and ⊖ keys are used to set numbers and to select choices shown on the LCD display.
POWER	The POWER key is used to change between the on and standby modes. The Solvent Saver continues to draw power even when not operating. This allows it to be used in humid coldrooms by minimizing internal condensation.
BASELINE	The BASELINE key is used to set the zero level. When this key is pressed the detector output is read and remembered as being the baseline level. All subsequent peak readings are referenced to this level.
MANUAL RECYCLE	The MANUAL RECYCLE key is used to force the valve to the recycle position. This is useful during instrument setup and troubleshooting. Pressing this key once sets the valve to the recycle position and causes the red light next to it to begin flashing. Pressing this key a second time returns the Solvent Saver to automatic mode. In automatic mode the green light next to this key is on when the valve is in the recycle position.
MANUAL WASTE	The MANUAL WASTE key is used to force the valve to the waste position. This is useful during instrument setup and troubleshooting. Pressing this key once sets the valve to the waste position and causes the red light next to it to begin flashing. Pressing this key a second time returns the Solvent Saver to automatic mode. In automatic mode the green light next to this key is on when the valve is in the waste position.
DELAY	The DELAY key is used to set the flow delay. Pressing this key once allows you to set the flow delay (the time required for fluid to travel from the detector to the valve) using the ⊕ and ⊖ keys. When the desired flow delay is shown, press the DELAY key again to return to the normal display.
LEVEL	The LEVEL key is used to set the peak level. Pressing this key once allows you to set the peak level (the detector response at which you want the fluid to no longer be recycled) using the ⊕ and ⊖ keys. When the desired peak level is shown, press the LEVEL key again to return to the normal display.

4.3 Concept of Operation

The Spectra/Chrom® Solvent Saver System is used to reduce solvent consumption in liquid chromatography applications. It operates by monitoring the detector output and controlling a calve based upon the detector signal.

When the BASELINE key is pressed the Solvent Saver reads the detector signal and remember this level. This is used as the reference for all subsequent readings. This will probably not be 0 volts output by the detector unless it has been automatically zeroed as well. You will need to press the BASELINE key after each injection or manual baseline adjustment.

As the chromatography progresses and sample components come off of the column, the detector signal will begin to increase at the start of each peak. As soon as the detector signal exceeds the level set in the Solvent Saver, its valve will switch from the recycle to the waste position. This is done immediately, rather than waiting for the eluant to travel from the detector to the valve in order to reduce any risk of contamination of the solvent reservoir. As long as the detector signal exceeds the level set the valve will remain in the waste position.

As the peak passes the detector signal will decline, eventually to below the set level. After the detector signal has dropped below the set level, the Solvent Saver will wait for it to drop the additional amount set by the hysteresis level. This is done to reduce the contamination from any trailing peaks. Generally an additional 1% to 2% is allowed for the hysteresis.

Finally, after the detector signal has fallen sufficiently, the flow delay time is allowed to elapse so that the material in the detector's flow cell has had time to move through the valve. (For most HPLC work this flow delay time will be relatively short and of no concern.)

Only after the flow delay time has elapsed with no new peak will the valve be allowed to return to the recycle position.

This method of operation was designed to allow considerable fluid to be recycled and yet minimize any risk of contamination.

4.4 Keypad Operation

Normally, the Solvent Saver System will be operated from its keypad rather than through the remote connectors on its back. The only exception to this general rule is the auto-zero connection. If you are using an automatic injector and your detector does not auto-zero, you may connect your injection output to the Zero connectors to facilitate operation.

The following steps are used to operate the Solvent Saver from the keypad:

1. If you have not already done so, set up the instrument as described in section 3. Pay particular attention to completing section 3.4 so that the Solvent Saver correctly interacts with your detector.
2. Press the LEVEL key to set the minimum peak level. Use the + and − keys to adjust this to a level with which you feel comfortable and then press the LEVEL key again to return to the normal display. A higher level will increase the amount of fluid recycled as well as the possibility of contamination, while a lower level will increase solvent consumption and decrease the possibility of contamination. In most instances a threshold of 25% to 50% is satisfactory.
3. If necessary, press the DELAY key to set the flow delay. Use the + and − keys to adjust this to a time with which you feel comfortable and then press the DELAY key again to return to the normal display. This is used to represent the time required for fluid to travel from the detector to the Solvent Saver's valve. For HPLC work, this time may generally be neglected since it is usually rather short. For some low-pressure work this time may be significant and need to be calculated as described in section 4.7.
4. If either the waste or recycle indicators are flashing red, press the key next to the flashing indicator to return the Solvent Saver to automatic operation.

5. There are 2 cases to consider with regard to the operation of the BASELINE key. If your detector does not provide its own autozero, press the BASELINE key after each injection and after each time you manually adjust the detector's baseline. If your detector has its own autozero, use it to zero the detector once and then press the BASELINE key. After each injection you will then only need to zero the detector and not the Solvent Saver.
6. Finally, inject your sample and then, as selected in 5 above, either press or don't press the BASELINE key.

If you are using an automatic injector or data system and your detector does not automatically zero, you may wish to have the Solvent Saver be automatically zeroed at each injection. To do this connect the Zero terminals on the back of the Solvent Saver to the inject mark output on your injector or data system. Again, if your detector auto-zeros you should not make this connection, but you should zero the Solvent Saver once as described in step 5 above.

4.5 Remote Control

If you have an automated chromatography system, you will probably operate the Solvent Saver System chiefly through the remote connector on its rear panel. These connectors all share a common ground. All output are open collector outputs; all inputs are for use with open collector outputs, contact closure outputs, or TTL outputs. The inputs and outputs have the following functions:

Zero The zero input is for automatically zeroing the Solvent Saver. The zero input continuously zero's the Solvent Saver when the + terminal is connected to the – terminal. This is usually done at immediately prior to or immediately following the sample injection. If you are simultaneously zeroing a detector, you will probably not use this terminal as it is chiefly intended for use with detectors lacking this feature.

Waste The Waste input is for forcing the valve to the waste position. This is normally desired when washing the column with a second solvent so that the wash solvent is not recycled into the solvent reservoir. This will be connected to an output of your data system which signals when a column wash is in progress.

Verify The Verify output is for use by a data system to monitor the performance of the Solvent Saver. The + terminal is connected to the - terminal with an open collector whenever the valve is in the recycle position. If desired this may be collected to an input to your data system to record the valve operation.

Special consideration must be given to the Zero connections. If you a using a detector that is automatically zeroed at the start of a run, you will probably not want to use the remote Zero connections on the Solvent Saver. Instead, zero the detector once and then press the BASELINE key to zero the Solvent Saver. This will prevent conflicts which may arise if the detector is changing its signal to zero while the Solvent Saver is recording it. If your detector is not automatically zeroed, you will want to use the Zero connections on the Solvent Saver. Have a momentary output on your data system trigger the Zero signal at the start of each run.

4.6 Verify Output

Some special consideration must be used when connecting the verify output. This output is active whenever the valve is set to the recycle position. If the valve is disconnected or burned out this output will never be active. This allows a data system to verify connection of the valve.

4.7 Flow Delay

In some situations, the Solvent Saver may be located a considerable distance from the detector. This can create an error in selecting the clean and dirty eluant for recycling, since only the composition at the detector is known. Under most normal circumstances, for HPLC the flow delay can be set to 0 and ignored.

If you are doing low Pressure chromatographic work it is possible that you may want the Solvent Saver to account for the delay between its valve and the detector.

The flow delay programmed into the Solvent Saver should be the amount of time required for fluid to travel between the detector and its valve.

To calculate the flow delay time you must know the approximate flow rate and the inner diameter and length of the tubing connecting the detector to the valve. Once you have this information use the formula:

$$5.07\ d^2\ l\ /\ f$$

where d is the ID of the tubing (inches), l is the length of the tubing (cm), and f is the flow rate (ml/min). The time derived from this formula will be in minutes.

If you have the tubing ID in millimeters use the constant 0.007854 in lieu of the 5.07 used with inches.

5 Theory of Operation

5.1 Introduction

The S-3 Solvent Saver System is a microprocessor controlled device. This allows it to provide the flexibility needed in a modern laboratory; it also can make any operation problems difficult to troubleshoot by ordinary means. The description of the electronic circuitry is to provide a general outline. It assumes the you have some experience with electronic circuits but not a great deal if experience with microprocessors.

Please refer to Figure 5-1 for the schematic diagram the solvent saver. This is a representative schematic diagram, in the interest of improving performance changes may have been made to the design so that this schematic may not exactly match your solvent saver.

5.2 Electronics

The power supply in the S-3 Solvent Saver System generates 3 different voltages for use by the remainder of the circuitry. A full-wave bridge rectifier, D4, rectifies the AC supplied by the wall mounted transformer. This provides a peak-rectified voltage of about 19 V. This is the voltage source used to drive the solenoid valve. This unregulated 19 V supply is reduced and regulated to 5 V by U10 for use by most of the rest of the circuitry. A low-voltage detector in U10 provides a clean start for the processor when power is applied. A charge pump supply is used to provide the -6 V used by the analog circuitry.

The S-3 Solvent Saver System uses an 80C31 processor, U1, as the principle control element. Since this processor uses a multiplexed address and data bus, an 8 bit latch, U2, is used to generate a non-multiplexed address bus for use by the other components. The processor directly connects to the switches in the keyboard. The instructions used by the processor are stored by the factory in a non-volatile memory, U3.

The user entered parameters, delay time, threshold, hysteresis, etc., are stored in an low-volatility memory, U12. This memory chip will remember these settings for in excess of 10 years with or without applied power. It also is interfaced directly to the 80C31 processor.

The analog input has a 1 megohm input impedance, set principally by R6. The input amplifier, U6, provides a gain of either 2.65 or 265. The value is determined by multiplexor U11. When the user has selected a 10 mV full-scale input, the input is multiplied by 265 prior to reaching the A/D converter. When a 1 V input is selected, the input is only multiplied by 2.65. This provides a sufficient signal to the A/D converter so that its internal noise does not significantly contribute to the operation of the solvent saver. The input amplifier also acts to remove any high frequency noise from the signal.

The A/D converter receives the signal from the input amplifier. This is a signal that is about 2.65 V for 100% of detector output. The dual-slope A/D converter further smoothes the signal and converts the analog input into a number. The smoothing done by the input amplifier and A/D converter are not a concern to most chromatographers, they will have little effect on peaks which are more than 1 second wide. By contrast, many noise pulses are less than 1 second wide and this allows these short noise blasts to be eliminated. A gain control is not required on either the input amplifier or the A/D converter since the value determined is processed by the software to obtain the percentage level.

All of the outputs generated by the solvent saver, the valve control, the LED drive, and the beeper, are handled by a single 8 bit latch, U8, and a high current driver, U9. The lowest order bit provides the basic valve drive. Driver U9A, in series with resistor R16, provides drive for the valve when it is on. Resistor R16 drops about 1/2 of the supply voltage, so that only about 9 volts is applied to the valve. This is sufficient to keep the valve in the recycle position and minimize its heat dissipation but not sufficient to change the valve from waste to recycle. The highest order bit and driver U9H are used for this task. Each time the valve is energized driver U9H is activated for 2 seconds to apply the full 16 volts across the valve. This minimizes the switching time of the valve.

Transistors Q3, Q2, and the associated diodes and resistors are used to generate the verify output. Whenever more than about 0.5 ma is flowing through the valve (normally about 180 ma flows when the valve is operating and 0 ma when the valve is at the waste position or disconnected), Q3 will turn on. This is happens whenever the voltage drop across resistor R4A exceeds about 1.2 V. As Q3 turns on, current source by the valve will begin to flow through resistor R8F. As soon as the voltage across R8F exceeds about 1.2 V Q2 will also turn on providing a positive indication that the valve is now drawing current and should be in the recycle position.

The second lowest order bit from latch U8 is used to control both the power LED and the display drive. When the solvent saver in on, driver U9B provides drive voltage to the LCD display and also illuminates the power LED. When the solvent saver is in standby the LCD and LED drive is removed yet the processor continues to operate. This allows the solvent saver to by used in a cold room. The constant power consumption maintains the inside of the case at a slightly high temperature than the surrounding air, minimizing internal condensation.

The third lowest order but from latch U8 is used to control the beeper.

The remaining bits of latch U8 are used to control the waste and recycle LEDs. These are bipolar LEDs. If they are biased with one polarity the emit red light; if biased with the opposite polarity they emit green light. Each LED has two associated drivers and ballast resistors. One driver is used when the LED should be green and the other for red.

A simple buffer, U13, is used to read the waste and zero inputs from the rear panel. This same buffer is also used to evaluate the progress of each A/D conversion. These waste and zero input are fitted with 10 K ohm pull up resistors. They can be driven with contact closures, open collectors, or TTL devices.

6 TROUBLESHOOTING

6.1 Introduction

The Spectra/Chrom® Solvent Saver System has been designed to provide a long life with minimum trouble. As with any instrument, however, there are technical details which may confuse an unfamiliar user. These symptoms and solutions are discussed in the first tips section. More detailed troubleshooting information may be found in Table 6-1.

6.2 First Tips

1. Pressing the BASELINE key (or using the remote auto-zero connection) sets the baseline to the current detector output. For normal operation this should be at less than 1/2 of the detector's maximum output voltage (between 50% and -50% of full-scale). If you re-zero your detector or your baseline has drifted appreciably, you may need to press the BASELINE key again to reset the Solvent Savers baseline.

2. If you are using a UV detector make sure that the signal connections are of the proper polarity. The red or (+) connection from your UV monitor should go to the Signal + terminal, the black, common, or (–) connection from your UV monitor should go to the Signal – terminal.

3. If you are using an RI detector make sure the hysteresis is at least 1% less than the level setpoint. If the hysteresis is greater than the level setpoint the Solvent Saver will never return to the recycle position.

4. Make sure that the detector output voltage range is the same as the Solvent Saver's range. See section 3.4 for instructions on how to change from 1 V full-scale to 10 mV full-scale.

5. Pressing the MANUAL WASTE or MANUAL RECYCLE key overrides the automatic operation of the Solvent Saver. To return to normal operation press the key next to the flashing red light.

6. The remote inputs override the keys as well as the automatic operation of the Solvent Saver. You must remove the connection or stop the input to return to normal operation.

7. The Solvent Saver contain an internal fuse. If you accidentally short the valve terminals on the console while power is applied it may blow this fuse. If you cannot get any response from your Solvent Saver see section 6.3 for instructions on checking and replacing this fuse.

6.3 Fuse Replacement

The Solvent Saver console has an internal protective fuse. If the Valve output terminals become shorted while power is applied to the Solvent Saver, this fuse may blow necessitating its replacement. The following procedure may be used to replace this fuse:

1. Disconnect the AC adapter from the wall socket and then disconnect it from the Solvent Saver console.
2. Using a Phillips screwdriver, remove the 2 screws from the bottom side of the Solvent Saver console and then the 2 screws on the back of the console below the terminal strip. You should then be able to remove the bottom of the console.
3. Do not remove the circuit board from the case!
4. On the circuit board near the 2 connectors you should find a 5 mm cartridge fuse. Rmove the blown fuse. Be careful not to break the glass since broken glass can be dangerous.
5. Replace the fuse with a 2 ampere 250 volt 5 mm cartridge fuse. Suitable fuses are Littelfuse® part number 217.002.
6. Replace the case bottom on the Solvent Saver. Use the screws removed in Step 2 above to secure it in place.

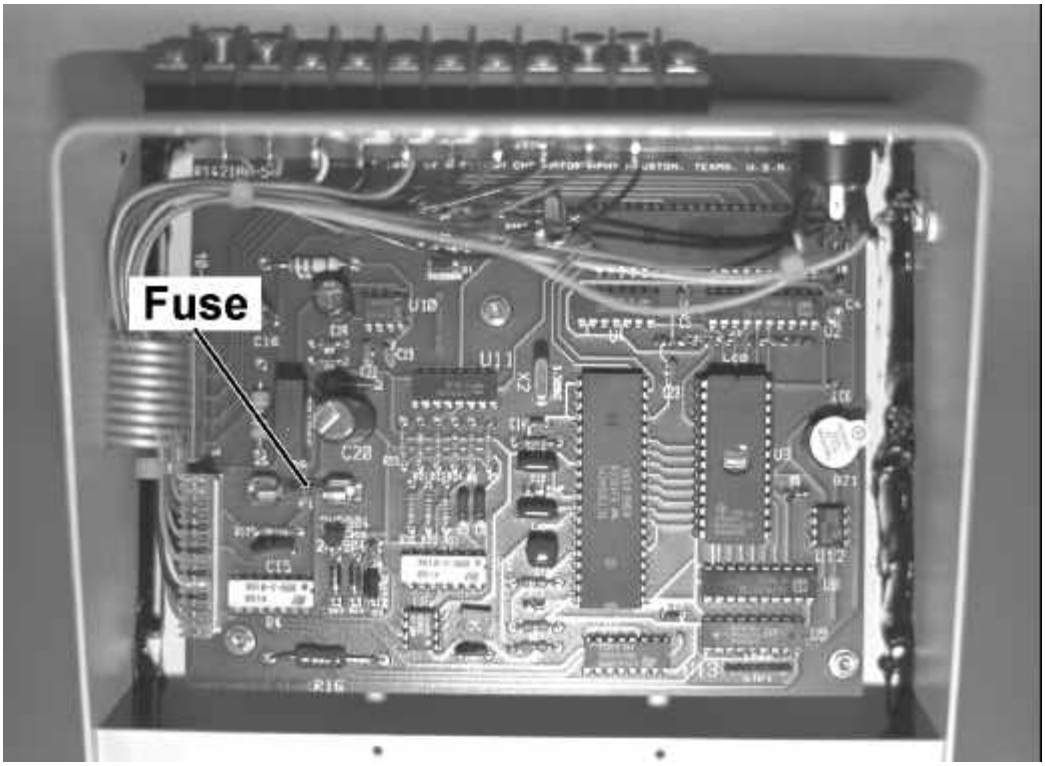


Figure 6-1 Internal Layout

Table 6-1 Troubleshooting

1. No response to POWER key.	A. Not plugged in.	A. Use the AC adapter supplied to connect the Solvent Saver's console to mains power.
	B. No Mains power.	B. Check the power outlet to be sure that electricity is available.
	C. Defective transformer.	C. Have an experienced technician measure the output of the transformer. It should be about 14 VAC.
	D. Blown fuse.	D. See section 6.3 for instructions on replacing the fuse inside the Solvent Saver's Console.
2. Valve does not operate. All material goes to waste.	A. Valve not connected.	A. Connect valve to valve terminals on back of console.
	B. Excessive backpressure.	B. If you are using a backpressure regulator it should be connected between the detector and the Solvent Saver's valve. The fluid lines from the valve to the waste container and the solvent reservoir should be free of obstructions.
	C. Defective valve.	C. If possible, check the valve's operation using a power supply. When 12 volts DC is applied across the valve it should switch from the waste to the recycle port.
	D. Defective console.	D. Press the MANUAL RECYCLE key on the console to select the recycle position. Then use a voltmeter to measure the voltage at the valve terminals. It should be 15 V for 1 second as the valve changes position and then about 6 V.
3. Valve does not operate. All material goes to recycle.	A. Excessive backpressure.	A. If you are using a backpressure regulator it should be connected between the detector and the Solvent Saver's valve. The fluid lines from the valve to the waste container and the solvent reservoir should be free of obstructions.
	B. Defective valve.	B. Disconnect the valve leads from the valve terminal on the console. All material should no go to waste.
	C. Defective console.	C. Press the MANUAL WASTE key on the console to select the waste position. Then use a voltmeter to measure the voltage the valve terminals. With the valve connected it should read less than 1 volt.
4. Displayed detector signal does not match chart recorder.	A. Bad connection.	A. Check the connection from the Signal terminals to the detector.
	B. Solvent Saver improperly set up.	B. If the Solvent Saver always shows close to 0 or always over 100% then check to be sure you have set the correct voltage range. The procedure for entering the voltage range is described in section 3.4.
	C. Baseline not set properly.	C. Unless you are using a detector with an automatic zero, you will need to press the BASELINE key every time you adjust the baseline on the recorder or the detector. If you detector has an automatic zero you will still need to set the baseline once as described in section 4.4.

7 ORDERING INFORMATION

Orders may be placed:

by phone at (800) 459-9700 (US & Canada)
+1-281-443-2900 (everywhere).

by fax at +1-281-443-3100.

by email at sales@spectra-chrom.com.

by mail at:

Spectrum Chromatography
Attn: Sales
PO Box 672026
Houston, TX 77267-2026
USA

7.1 Trademarks

Spectra/Chrom® is a registered trademark of Spectrum Medical Industries.
Teflon® is a registered trademark of E.I. du Pont de Nemours & Co., Inc.
Tefzel® is a registered trademark of
Delrin® is a registered trademark of E.I. du Pont de Nemours & Co., Inc.

Table 7-1. Available Products

Description	Part No.
S-3 Solvent Saver System, 115V	142100
S-3 Solvent Saver System, 230V	142102
Replacement Fittings, pk	152105