

# ***SILENCER***®

## **S12V Series**

### **Service Manual**



Proudly designed and manufactured in the great United States

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S12V Service Manual v1.0.0

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## Chapter 1

# Getting Started

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## SCOPE

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This manual contains information with regards to application, installation, and operation of the Silencer<sup>®</sup> S12V table-top centrifuge, and must be read prior to setup or operation of the centrifuge.

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## UNPACKING AND INSPECTION

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Your new Silencer<sup>®</sup> centrifuge is packed in a specially designed shipping carton. Upon arrival please check the condition of carton and note any damage. Keep all packing materials for the warranty period of the centrifuge.

After unpacking your Silencer<sup>®</sup> carefully inspect it for damage. It is your responsibility to report all damages to the transportation company and filing, if necessary, any damage claims.

At this point take a moment to ensure you have received the correct rotor, tube adapters, etc. If not or if you have any questions regarding compatibility with your tubes, please contact GFMD, Ltd. at 800-323-4306 before proceeding.



## **WARNING**

Do not operate this equipment in a combustible atmosphere!

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## SETUP

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For your own safety and to prevent damage to the centrifuge, be sure to read this manual before continuing with setup or operation of this centrifuge.

For smooth operation and long equipment life, choose a stable, level bench top.

Avoid sources of heat and/or moisture such as sinks, water baths, heating ducts, and direct sunlight. A suitable environment is 10° to 30° C (50° to 86° F) with a relative humidity range of 40% to 70%. The minimum clearance is 6" on all sides. A cooler ventilated location and leaving the lid open between cycles will allow longer and/or more frequent cycles without overheating of samples. The maximum number of cycles that may be run consecutively will depend upon operating speed, set time, ventilation around the centrifuge, and ambient temperature. Samples that may be adversely affected by being warmed to 39°C during centrifugation should be centrifuged in a refrigerated centrifuge such as the Silencer<sup>®</sup> S2510R.

Plug the power cord into a properly grounded outlet and turn on main power interrupt (on back of unit next to power cord). For safety, equipment life, and proper performance, your Silencer<sup>®</sup> S12V's power requirements are 115V AC, 5 amperes, 60Hz. The power cord must be UL listed or CSA certified, 18 AWG, and 6' 7" or less in length.

# Getting Started

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## **WARNING**

Operating the centrifuge without proper grounding can cause dangerous electrical conditions and could result in serious operator injury!

## **CAUTION**

Operation of centrifuge on an emergency power circuit can cause damage to electronic circuits.

## **CAUTION**

Operation of centrifuge on a power strip increases ground resistance and can cause damage to electronic circuits.

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## **ROTOR INSTALLATION**

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Insert the rotor onto the motor shaft ensuring the alignment pins in the motor shaft adapter fit correctly into the alignment groove in the bottom of the rotor. The rotor must be installed correctly for proper operation.

Replace the rotor securing hex screw. The screw must be securely tightened.

## Chapter 2

# About The S12V

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## PURPOSE

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The Silencer<sup>®</sup> S12V is a quiet, general purpose centrifuge designed to be used to accelerate sample separation through the application of relative centrifugal force (RCF). This product is not intended to diagnose, treat, cure or prevent any disease.

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## DESCRIPTION

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The direct drive system employs a powerful, specially designed, balanced, brushless motor ensuring a smooth quiet operation spanning the full speed range of the instrument. This design also promotes long bearing life and eliminates brush maintenance, thereby reducing operating costs.

Excellent stability against imbalance is achieved due to special vibration absorbing drive assembly mounts.

The operator and the S12V are protected by several safety features:

- The centrifuge cannot be started with the lid open.
- The centrifuge will not run if the lidlock fails to securely lock.
- Once the rotor is in motion the lid cannot be opened until the rotor has stopped.
- The see-through high-strength lid allows the operator to view the rotor chamber without opening the lid.
- The rotor chamber is strong and easy to clean.

For complete equipment specifications see Appendix A.



## Chapter 3

# Using The S12V

## ORIENTATION

Take time now to acquaint yourself with the S12V's displays and controls. The basic operation is very simple and the controls are mostly self-explanatory.



Figure 3.1



## WARNING

Turning the power off does not remove power to the centrifuge. Remove all power to the unit by unplugging the power cord.

## CONTROLS

### START

If pressed when the unit is in the STANDBY mode, the START button will start the run cycle.

Pressing the START button during a run cycle stops the cycle.

### SPEED

Press the SPEED button to increment the speed to the desired RPM / RCF setting.

### TIME

Press the TIME button to increment the time to the desired time setting.

## DISPLAYS

### RPM/RCF

# Using The S12V

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There are four LEDs to indicate the selected speed. A blinking LED is an indication that an error has occurred.

## MINUTES

There are four LEDs to indicate the selected time in minutes. A blinking LED normally indicates that the unit has reached set speed. If the RPM / RCF LED is also blinking an error has occurred.



## WARNING

Do not operate this equipment in a combustible atmosphere!

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## OPERATION

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Chapter 1 must be read and the S12V must be setup accordingly before continuing.

The set speed and time defaults to the last used speed and time setting. The settings can be changed using the SPEED and TIME buttons.

Open the lid and load your samples, taking care to maintain a balanced load.

Close the lid and press the START button. The lidlock will engage, and the centrifuge will accelerate to the set speed. Upon reaching the set speed the time LED will start blinking.

When the set time has elapsed the time LED will stop blinking and the centrifuge will decelerate to a stop.

When the rotor has come to a complete stop the lidlock will release.

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## OPERATION TIPS

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- Do not drop or slam the lid!
- Use the emergency lid lock release only for emergencies.
- Only use the supplied emergency lid lock release tool.
- Unplug the centrifuge before using the emergency lid lock release tool.
- Leave the lid open between cycles.

If there are any questions regarding operation please contact GFMD, Ltd. at 800-323-4306.

# Cleaning

---

## **⚠ WARNING**

Turning the power off does not remove power to the centrifuge. Remove all power to the unit by unplugging the power cord.

## **⚠ WARNING**

Standard safety precautions for handling of biological hazards must be followed!

## **CAUTION**

Do not get any liquids into the top of the motor. Many disinfectants are extremely corrosive and may damage the motor.

## **CAUTION**

Allowing liquid levels in the rotor chamber to rise to the bottom of the motor seal may result in serious damage to the centrifuge.

- The rotor must be removed from the centrifuge for disinfecting.
- Clean tube breakages and spills immediately and thoroughly. The interior can be disinfected with disinfectants such as bleach, followed by a clear water rinse and wipe. The interior must be rinsed and dried thoroughly before using the centrifuge. Use water sparingly when rinsing, as the motor seal is not watertight.
- The exterior should be kept clean with the use of a mild soap and a damp (not wet) lint-free cloth. The centrifuge must be dried thoroughly before using.

## Chapter 5

# Troubleshooting

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## STATUS CODES

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The numbering is based on counting up from the lowest RPM / MINUTES setting LED to the highest. The RPM setting LED represents the most significant digit and the MINUTES setting LED represents the least significant digit. The LEDs will blink to indicate an error has occurred.

This is a list of error codes and the brief description that the centrifuge displays when an error is encountered. Check under symptoms for more details.

ERROR: 1.1	Check the lid safety interlock switch for proper alignment and continuity.
ERROR: 1.2	Check the lid safety interlock switch for proper alignment and continuity.
ERROR: 1.3	Do not attempt to open the lid until the unit has stopped.
ERROR: 2.1	Indicates no power is getting to the motor.
ERROR: 2.2	Indicative of a momentary drop or loss of line voltage.
ERROR: 2.3	Indicative of low line voltage or a momentary sag.
ERROR: 3.1	Indicates an over current error.
ERROR: 3.2	Motor Drive Hardware Fault
ERROR: 3.3	Motor Drive Transistor Over Temp
ERROR: 4.1	Over Speed
ERROR: 4.2	Under Speed

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## ERROR RESET

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Pressing the front panel START button resets error messages.

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## TROUBLESHOOTING TABLE

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<b>SYMPTOM</b>	<b>The lid remains locked and the LEDs are not illuminated when the main power switch is turned on.</b>	
	<b>POSSIBLE CAUSES</b>	<b>POSSIBLE SOLUTIONS</b>
	No power to the S12V.	Ensure the S12V is plugged in, and there is power to the receptacle.
	The fuses are blown.	Replace the fuses with 5A, 250V, time delay fuses. If the fuses blow again contact GFMD, Ltd. at 800-323-4306 for assistance.

# Troubleshooting

---

<b>SYMPTOM</b>	<b>Will not start when the START button is pressed and “ERROR: 1.1” is displayed.</b>	
	<b>POSSIBLE CAUSES</b>	<b>POSSIBLE SOLUTIONS</b>
	The lid safety interlock switch is defective or misaligned.	Check the lid safety interlock switch for proper alignment and continuity.
	Lid is not closed completely preventing the lid from locking.	Make sure the lid is completely closed.
	Locking mechanism is mechanically binding.	Check for proper lid lock solenoid movement.
	Lid lock safety interlock switch is defective or misaligned.	Check the lid lock safety interlock switch for proper alignment and continuity.

<b>SYMPTOM</b>	<b>Will not start when the START button is pressed and “ERROR: 2.1” is displayed.</b>	
	<b>POSSIBLE CAUSES</b>	<b>POSSIBLE SOLUTIONS</b>
	Indicates no power is getting to motor.	Ensure the motor wires are properly connected to MOTA1, MOTB1, and MOTC1 on the Power PCB.
	The motor tachometer cable is unplugged.	Ensure the motor tachometer cable is connected to MOTOR1 on the Power PCB.
	The power sagged so the unit did not start before the bootstrap capacitors discharged.	Check electrical outlet for stable line voltage, and ensure that the circuit isn't overloaded.  Reset the unit by turning the main power switch off for approximately 20 seconds and then back on.

# Troubleshooting

<b>SYMPTOM</b>	<b>Shuts down and a status code is displayed.</b>	
	<b>POSSIBLE CAUSES</b>	<b>POSSIBLE SOLUTIONS</b>
	<b>ERROR: 1.2</b> - Indicates the lid safety interlock switch failed during a run cycle or an attempt was made to open the lid during the run cycle	<p>If there was not an attempt to open the lid before the unit came to a complete stop, see suggestions for the centrifuge not starting and giving an “ERROR: 1.1” error.</p> <p>If someone attempted to open the lid during the run cycle, please wait until the unit has come to a complete stop before opening the lid. Manually releasing the lid during the cycle creates a hazardous condition and is an OSHA safety violation.</p>
	<b>ERROR: 1.3</b> - Indicates the lid safety interlock switch failed during deceleration or an attempt was made to open the lid before the unit came to a complete stop.	<p>If there was not an attempt to open the lid before the unit came to a complete stop, see suggestions for the centrifuge not starting and giving an “ERROR: 1.1” error.</p> <p>If someone attempted to open the lid during the run cycle, please wait until the unit has come to a complete stop before opening the lid. Manually releasing the lid during the cycle creates a hazardous condition and is an OSHA safety violation.</p>
	<b>ERROR: 2.2</b> - Indicative of a momentary drop in line voltage or loss of line voltage.	Check for a loose power cord connection to the outlet, an overloaded circuit, or line voltage below 110 VAC.
	<b>ERROR: 2.3</b> - Indicative of low line voltage or a momentary sag in line voltage.	Check for a loose power cord connection to the outlet, an overloaded circuit, or line voltage below 110 VAC.
	<b>ERROR: 3.1</b> - Indicative of excess motor current or a current spike.	Ensure the plug to outlet connection is secure and the unit is not plugged into a power strip.
	<b>ERROR: 3.2</b> - Motor driver shutdown due to current spike or driver temperature.	Ensure the plug to outlet connection is secure, the unit is not plugged into a power strip, the vent fan is running, and there is adequate space around the centrifuge.

# Troubleshooting

	<b>ERROR: 3.3</b> - The motor drive MOSFETs are too warm.	Ensure the vent fan is running and there is adequate space around the centrifuge.
	<b>ERROR: 4.1</b> - The speed is not stable and exceeded the allowable maximum speed.	Ensure the plug to outlet connection is secure, the unit is not plugged into a power strip, and the power circuit is not overloaded.
	<b>ERROR: 4.2</b> - The speed is not stable and dropped too low.	Ensure the plug to outlet connection is secure, the unit is not plugged into a power strip, and the power circuit is not overloaded.

<b>SYMPTOM</b>	<b>The sample temperature is exceeding 39°C.</b>	
	<b>POSSIBLE CAUSES</b>	<b>POSSIBLE SOLUTIONS</b>
	The rotor chamber heat extraction fan isn't running.	Verify that the fan is running.
	Cycle times are too long, operating speed is too high, and /or cycles are too frequent.	Lower the operating speed, shorten spin time, and/or allow more cooling time between cycles with the lid open.
	Centrifuge is under a heat vent.	Relocate the centrifuge away from heat vents.
Centrifuge's immediate ambient environment is warm due to other equipment.	Relocate unit away from heat producing equipment.	

## Chapter 6

# Functional Description

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The S12V consists of the following interactive circuits:

- AC Power Distribution
- DC Power Distribution
- Operator Interface Circuits
- Lid Interlock Circuit
- Lid Unlocking Circuit
- Tach Feedback Circuit
- Motor Control Circuit
- Motor Current Sense Circuit
- Motor Drive Temperature Circuit

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## AC POWER DISTRIBUTION

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Power for the S12V is 115 VAC and is supplied through a CSA approved line cord with a three prong grounding plug and power entry module which contains the 5 ampere fuses, and a double pole power interrupt switch. The output of the power entry module is applied to the +24VDC Power Supply and the vent fan.

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## DC POWER DISTRIBUTION

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The output of the +24VDC Power Supply is applied to the Display / Control PCB. The positive output goes to PLUS1 (VIN) and negative output goes to NEG1 (VSS). The common for all DC power supplies is VSS.

VIN is applied to U4 pin 26, drain pin of Q3, Q5, & Q7, and pin 1 of the +5VDC regulator (U3). Input of U3 is delayed by relay RX, R38, and R39 to give the +24VDC time to stabilize.

The output of U3 (VCC) is used for all logic circuits.

---

## OPERATOR INTERFACE CIRCUITS

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The Display / Control PCB handles setting and visual status of run activation, time, speed, and displaying error messages.

The START push button switch is applied to U1 pin 17. The START button is used to start and stop the run mode, and to reset errors.

The SPEED push button switch is applied to U1 pin 16. The SPEED button is used to increment the speed selection.



# Functional Description

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The TIME push button switch is applied to U1 pin 15. The TIME button is used to increment the time selection.

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## LID INTERLOCK CIRCUIT

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The lidlock assembly has two switches wired in series. One indicates if the lid is open or closed and the other indicates if the lock is engaged or disengaged. If either switch is open pin 1 of LID1 will be high. This signal is applied to pin 23 of U1. This input is used to verify the switches status prior to starting and to generate an error if either switch opens after the unit starts. The default status assumes the lid is open in the event the lidlock assembly is unplugged or there is a break in the circuit.

---

## LID UNLOCKING CIRCUIT

---

The default condition of the lidlock assembly is locked. Unlocking of the lid is handled by energizing a solenoid. Initially full voltage is applied to the solenoid to energize it. The unlocking voltage is controlled from pin 24 of U1. This signal is applied to the gate of Q2 and through C7 to pins 12 and 13 of U2. The output of U2 at pin 10 is applied to the gate of Q1. Q1 applies VSS to the solenoid.

After a time delay set by C7 and R28 the unlocking voltage turns off. The solenoid holding voltage is supplied by Q2. Q2 applies VSS to the solenoid through the dropping resistors R24, R25, R26, and R27.

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## TACH FEEDBACK CIRCUIT

---

There are three Hall Effect sensors in the motor. The sensor outputs are supplied to U4 on the through HALL1. U4 uses this input to determine motor rotor position. The motor rotor position information is used to control the three-phase motor driver U4. The output of one Hall Effect sensor (HC) is also applied to U2 pins 1 and 2. The output of U2 at pin 4 (TAK) is supplied to U1 pin10.

There are 4 TAK pulses per revolution so RPM can be calculated by measuring duration of a tachometer pulse with an oscilloscope and applying the formula  $((1/\text{duration in seconds}) * 60) / 4$ . The speed can also be checked using a frequency counter and applying the formula  $((\text{tachometer frequency in seconds}) * 60) / 4$ .

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## MOTOR CONTROL CIRCUIT

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When a run cycle is started a signal from pin 14 of U1 is applied to U4 pin 22 to enable the run mode.

A PWM signal from U1 pin 10 is applied to pin 19 of U4. The PWM pulse is at a constant frequency and a duty cycle that is adjusted based upon the TAK feedback to control motor speed.

# Functional Description

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## **MOTOR CURRENT SENSE CIRCUIT**

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The voltage drop across R18, R19, R20 and R21 is proportional to the current through the drive motor. This voltage is applied to U4 pin14. This is a negative feedback that counteracts the PWM pulse to limit current draw of the motor. This voltage is also applied to ADC pin 22 of U1 to supply current draw feedback. This feedback is used to control the PWM ramp during acceleration.

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## **MOTOR DRIVE TEMPERATURE CIRCUIT**

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The voltage drop across temperature sensor TH1 is applied to ADC pin 19 of U1 to supply temperature feedback for the motor drive MOSFETs. If the temperature exceeds safe limits for the MOSFETs the PWM drive is shutdown.

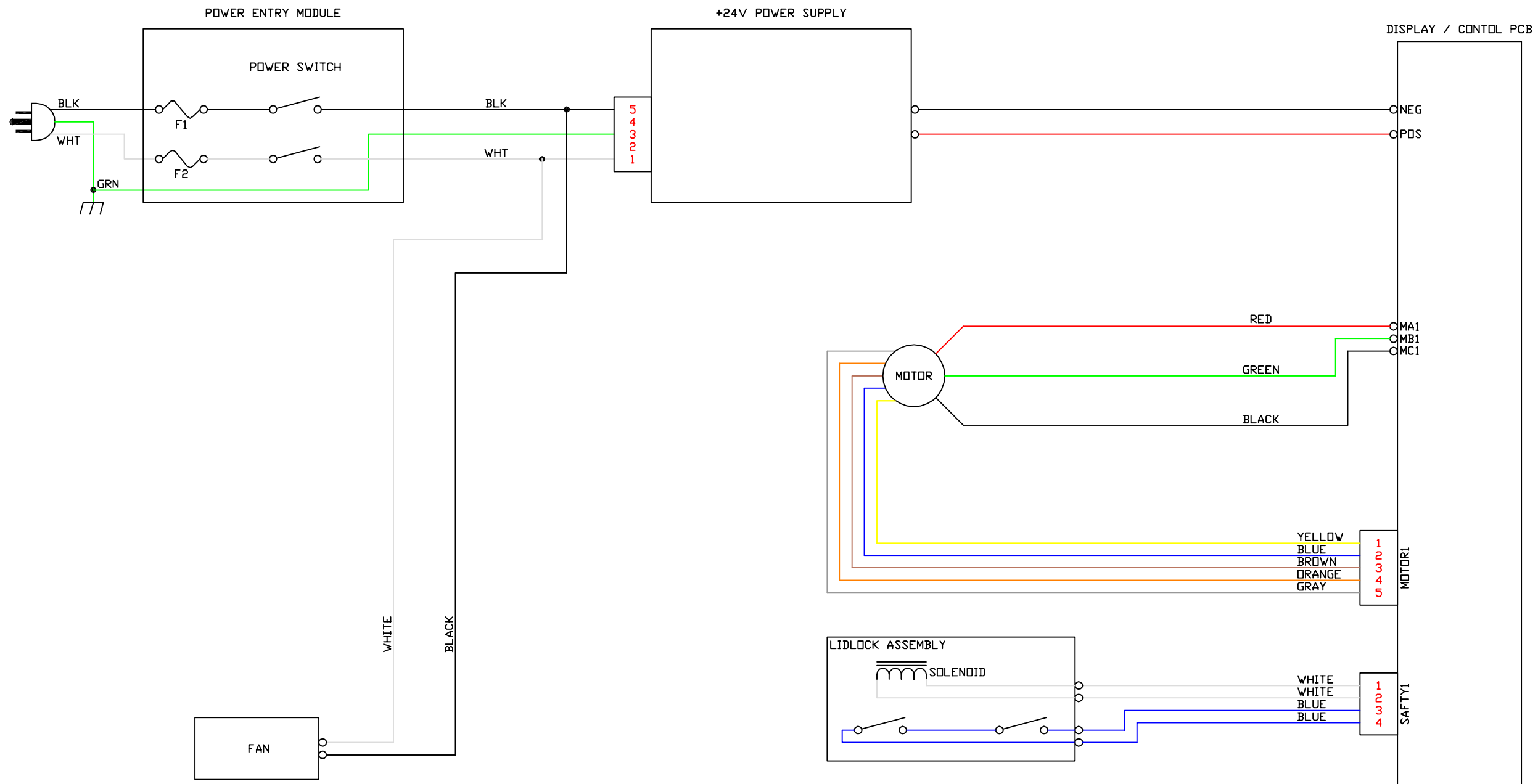


Figure 7.1  
S12V Wiring Diagram

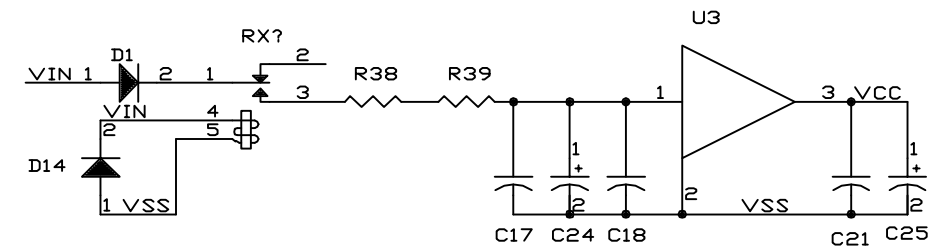
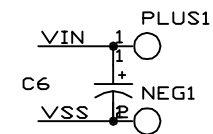
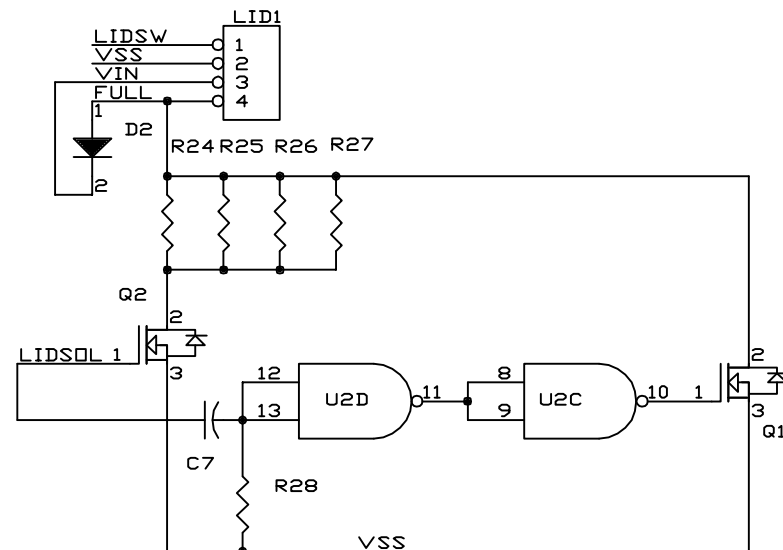
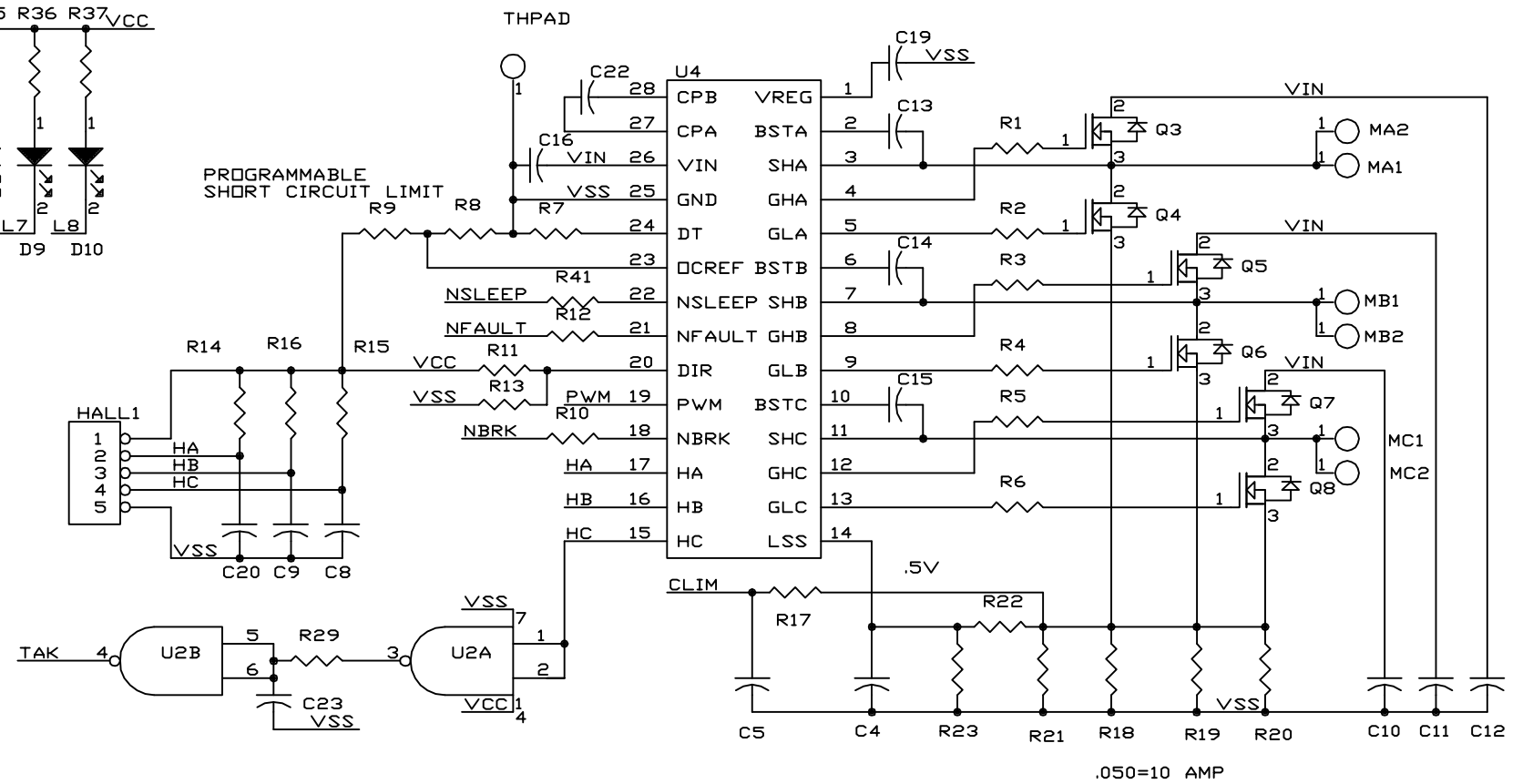
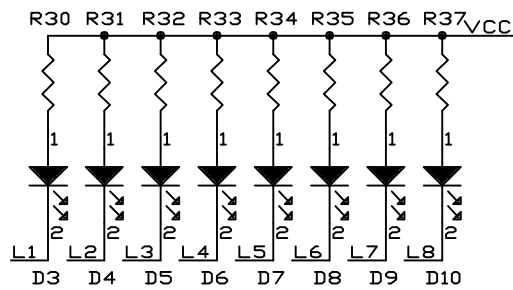
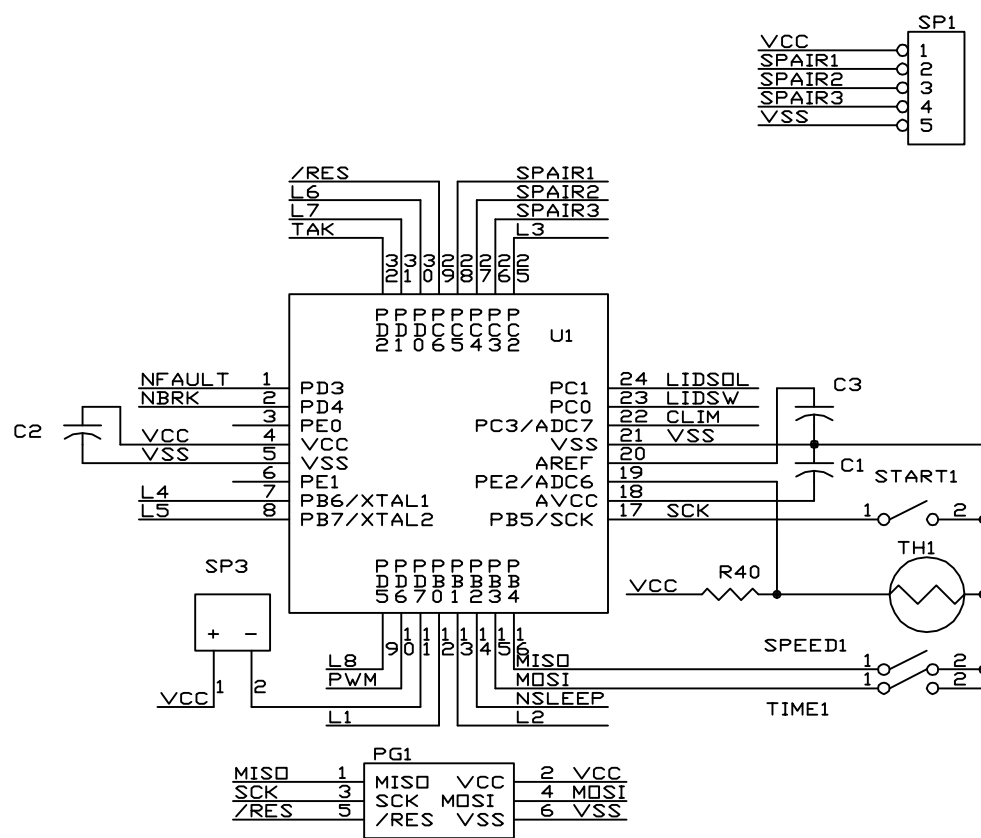


Figure 7.2  
Display / Control PCB Schematic  
Page 7-2

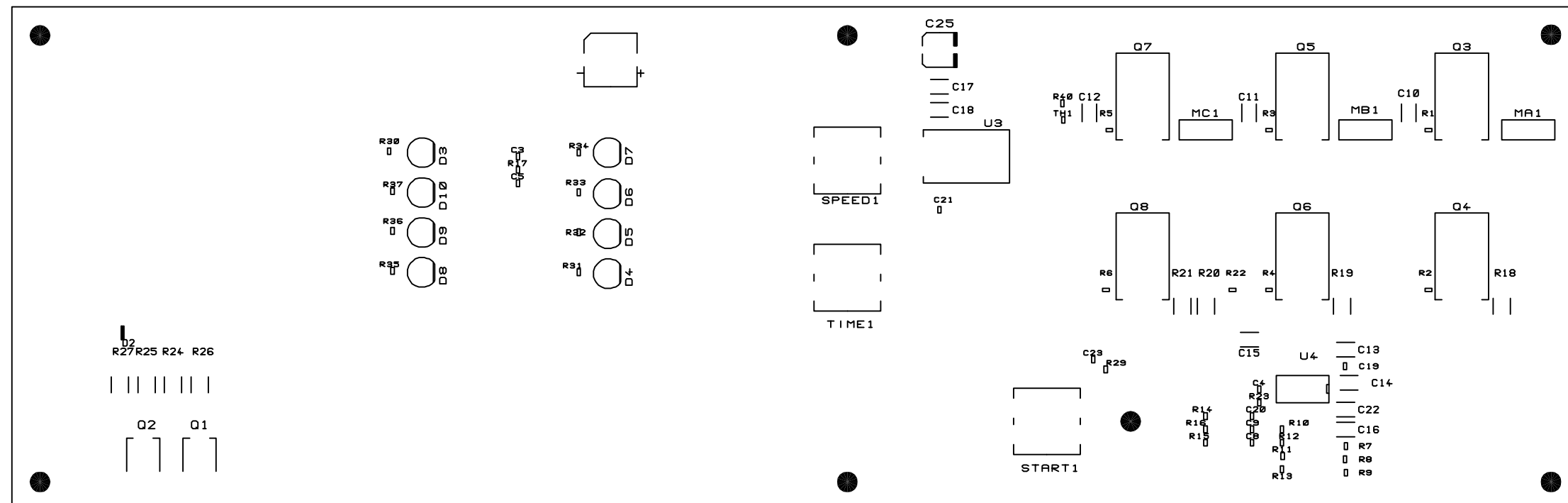


Figure 7.3  
 Display / Control PCB Layout  
 Page 7-3

## Chapter 8

# Parts Replacement Procedures

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## PRECAUTIONS

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This section describes procedures for replacement of parts which may not be obvious to complete. **Remove power and read the entire procedure carefully prior to beginning any procedure! Pay particular heed to all WARNINGS and CAUTIONS.**



## WARNING

Turning the power off does not remove power to the centrifuge. Remove all power to the unit by unplugging the power cord.

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## EQUIPMENT

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The following equipment is useful or necessary in the repair of the S12V centrifuge.

- A Test Equipment
  1. Tachometer
  2. Multimeter
  3. Ammeter (capacity to 10 amps)
- B. Tools
  1. Screwdrivers (assorted slotted and Phillips)
  2. Nut Drivers (5/16" minimum requirement)
  3. Combination Wrenches

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## MOTOR

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Turn on power to the S12V. Open the lid, turn the power off, and **unplug the power cord.**

Remove the four Phillips front panel retaining screws (see Figure 8.1) taking care not to drop the front panel.

Unplug the lid lock assembly and tach sensor connectors.

Remove the door cable retaining screw and disconnect the door cable from the side panel.

Lower the front panel.

Remove the 5/16" hex rotor retaining screw, and gently lift the rotor off.

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## CAUTION

Take care not to drop anything onto the PCB's or into the unit to prevent possible damage to the unit.

# Parts Replacement Procedures

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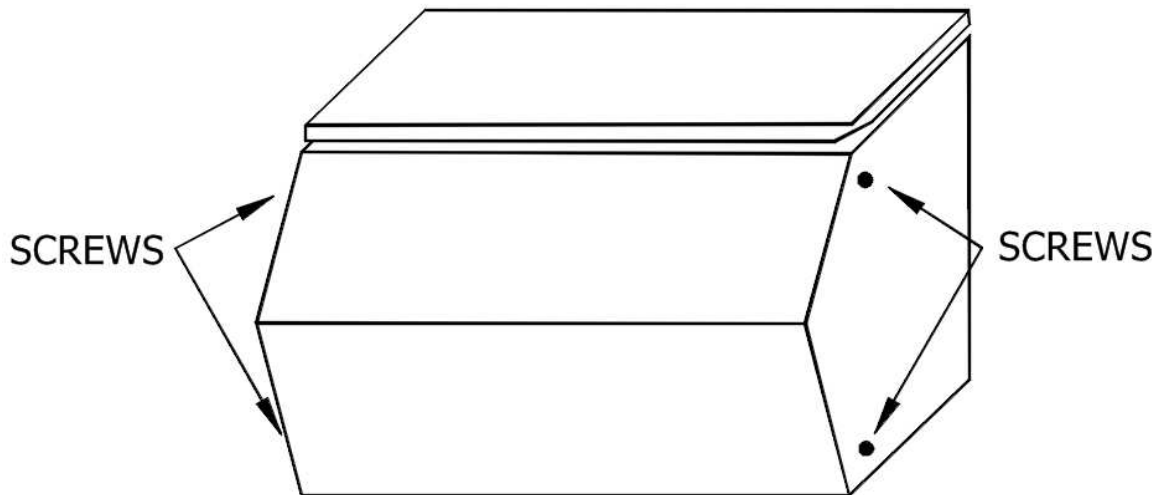


Figure 8.1

Remove the four motor gasket Phillips screws and plate.

Remove the rubber motor gasket by rolling the outer edge back, unhook it from the rotor chamber (see Figure 8.2), and then pull it from around the motor.

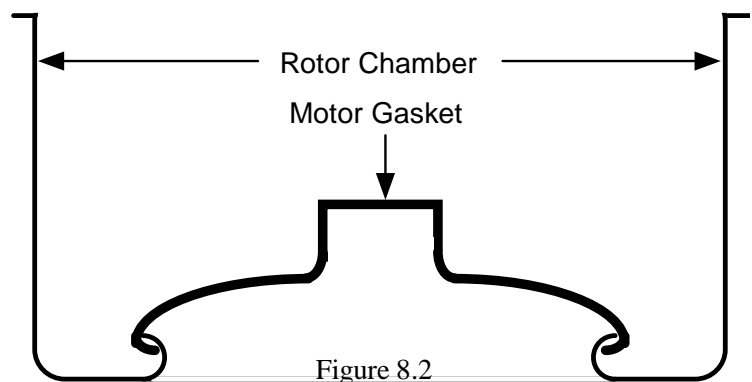


Figure 8.2

Unplug the red, green, and black motor power wires.

Remove the four 5/16" hex motor securing nuts from the bottom of the motor mount plate and lift the motor out.

Reverse procedure to re-install the motor.

Lightly grease the motor shaft before reinstalling the rotor.

---

## DISPLAY / CONTROL PCB

---

**Unplug the power cord.**

Remove the four Phillips front panel retaining screws (see Figure 8.1) taking care not to drop the control panel.

### **CAUTION**

Take care not to drop anything onto the PCB's or into the unit to prevent possible damage to the unit.

# Parts Replacement Procedures

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Unplug the lid lock assembly and tach sensor connectors.

Remove the door cable retaining screw and disconnect the door cable from the side panel.

Lower the front panel.

Remove all plug connections, and mounting screws.

Remove the Display / Control P.C.B.

Install replacement Display / Control P.C.B. by reversing the removal procedure.

---

## LIDLOCK ASSEMBLY

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**Unplug the power cord.**

Remove the four Phillips front panel retaining screws (see Figure 8.1) taking care not to drop the control panel.

Unplug the lid lock assembly and tach sensor connectors.

Remove the door cable retaining screw and disconnect the door cable from the side panel.

Lower the front panel.

Remove the two 5/16" hex nuts securing the Lidlock Assembly.

Install replacement Lidlock Assembly by reversing the removal procedure.

### **CAUTION**

Take care not to drop anything onto the PCB's or into the unit to prevent possible damage to the unit.



## Chapter 9

# Limited Warranty Statement

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The Silencer<sup>®</sup> S12V is warranted to be free from defects in material and workmanship for a period of one year from the date of delivery. GFMD, Ltd., or its agent, will repair or replace and return free of charge any part that is returned, transportation prepaid by user, to GFMD, Ltd., or its agent, within said period, and that is found upon inspection to have been defective in materials or workmanship.

These warranties do not include normal wear from use, or operator maintenance. It does not apply to any instrument or part that has been altered by anyone other than an employee of the manufacturer or its agent nor to any instrument that has been damaged through accident, negligence, failure to follow operating Services, natural disaster, the use of electric currents of circuits other than those specified on the plate affixed to the instrument, insufficient or excessive electrical supply, operation on emergency or backup generators, abnormal mechanical or environmental conditions, misuse or abuse.

GFMD, Ltd. reserves the right to change, alter, modify or improve any of its instruments without any obligation whatsoever to make corresponding changes to any instrument previously sold or shipped.

The foregoing obligations are in lieu of all other obligations including negligence and all warranties of merchantability or otherwise, expressed or implied in fact or by law and state our entire and exclusive liability and buyer's exclusive remedy for any claim or damages in connection with the sale or furnishing of goods or parts, their design, suitability for use, installation or operation. GFMD, Ltd., or its agent, will in no event be liable for any special or consequential damages whatsoever, and our liability under no circumstances will exceed the contract price for the goods for that liability is claimed.

## Appendix A

# Specifications

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### PERFORMANCE SPECIFICATIONS

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- Maximum speed:
  - S12V-HZ w/ 8 x 10ml Horizontal Rotor 4,000 RPM
  - S12V-FA w/ 10 x 10ml FA Rotor 4,500 RPM
- Maximum RCF:
  - S12V-HZ w/ 8 x 10ml Horizontal Rotor 2,418 x g
  - S12V-FA w/ 10 x 10ml FA Rotor 2,802 x g
- Approximate acceleration rate (0 - Max. RPM): 15 seconds
- Approximate deceleration rate (Max. - 0 RPM):
  - S12V-HZ w/ 8 x 10ml Horizontal Rotor 45 seconds
  - S12V-FA w/ 10 x 10ml FA Rotor 60 seconds
- Maximum noise level: 58 dBA
- Speed Control +/- 2%
- Timer +/- 5%
- Power requirements: 115 volts, 5 amperes

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## UNIT SPECIFICATIONS

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- Dimensions 13”w x 16.5”d x 11.5”h
- Spill resistant control panel
- Completely enclosed rotor chamber
- High-strength alloy rotor chamber
- See-through high-strength lid
- Dual safety interlock to ensure lid is closed and locked
- Direct drive system
- Brushless D.C. motor
- Microprocessor control



## Appendix C

# Replacement Parts List

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<b>Description</b>	<b>Qty Needed</b>	<b>Part No.</b>
Gasket, Lid	1 ea.	SIL00476
Gasket, Motor, S12V	1 ea.	SIL00456B
Hinge, Lid, S12V	2 ea.	SIL00512
Latch, Lidlock	1 ea.	SIL00642B
Lid, S12V	1 ea.	SIL00661
Lidlock Assembly	1 ea.	SIL00672
Switch, Lid Interlock (part of SIL00672)	1 ea.	SIL02456
Switch, Lock Interlock (part of SIL00672)	1 ea.	SIL02457
Motor Assembly, S12V	1 ea.	SIL00731
P.C.B., Display / Control, S12V	1 ea.	SIL00814

Parts are sold individually. The quantity listed is the quantity used per unit.

# Lid Release Tool

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 **WARNING**

The lid release tool is provided for emergency access to samples only. Unplug the centrifuge before attempting this procedure!

The correct tool must be used for your unit or the lid safety interlock switch may become damaged. If the interlock switch is damaged the unit can't detect the lid being closed and therefore won't start.

To use the release tool:

1. Unplug the centrifuge.
2. Insert the tool completely into the release access port on the left side of the unit (just below the lid locking bracket).
3. Push the handle towards the back of the unit and lift the centrifuge lid.