Semitool

"S" model
w/
102 controller

Operations Manual

Semitool

Installation Section

SECTION 2: INSTALLATION

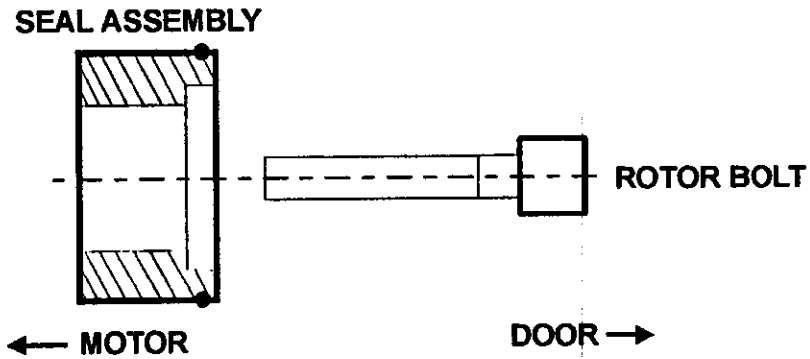
Power Requirements

PSC-101		BRUSHED MOTOR		BRUSHLESS MOTOR	
BOWL SIZE	COUNTRY	Volts	Breaker	Volts	Breaker
(240 - 280)	USA	120, 1 phase	15 Amp	120, 1 phase	15 Amp
	Japan	120, 1 phase	15 Amp	100, 1 phase	15 Amp
	Europe	220, 1 phase	13 Amp	220, 1 phase	13 Amp
(2300)	Europe	220, 1 phase	16 Amp	220, 1 phase	16 Amp
	USA	208, 3 phase 240, 2 phase	20 Amp 20 Amp		
(2400-2600)	USA			208, 3 phase 208, 1 phase	15 Amp 15 Amp
	Europe				
	Japan				

2.2 UNPACKING THE RINSER / DRYER

FOLLOW CLEANROOM PROCEDURES TO PREVENT CHAMBER CONTAMINATION.

- Before operation, remove all red plugs located in facility lines and drain tubes.
- Remove the shipping block and tie strap located between the bowl and front bearing support.
- Install the filter in the N2 supply line before connecting the N2 supply to the Semitool SRD.
- The rotor bolt must be removed before the rotor can be installed. (See illustration below).



ROTOR BOLT REMOVAL

2.3 FACILITY REQUIREMENT SPECIFICATIONS

2.3.1 Processing Fluid Requirements

The following table gives the fluid requirements for one machine. It should be noted that a Stacker model is two machines and the flow values need to be doubled.

Machine Size	Nitrogen			DI Water			Second Process Solution (3 stage option)		
	Tubing Size	Flow		Tubing Size	Flow		Tubing Size	Flow	
	O.D.	CFM	PSIG	O.D.	GPM	PSIG	O.D.	GPM	PSIG
240/60/70	3/8"	4-6	30-35	3/8"	1.5-2.0	25-30	3/8"	1.5-2.0	25-30
280	3/8"	4-6	30-35	3/8"	2.5-3.0	25-30	3/8"	2.5-3.0	25-30
2300	1/2"	8-10	30-35	3/4"	3.5-4.5	30-40	3/4"	3.5-4.5	30-40
2400	3/4"	8-10	30-35	3/4"	3.5-4.5	30-40	3/8"	3.0-4.0	25-30

a. Regulators and pressure gauges for 3/8 inch supply lines must have an inside diameter of at least 1/4 inch.

b. Regulators and pressure gauges of 1/2 inch supply lines must have an inside diameter of at least 5/16 inch.

c. DI water facility pressures must be maintained during the rinse cycle.

d. Nitrogen facility pressures must be maintained during the dry cycle.

e. Water recirculation options:

- WR20 (Teflon) - 3/8" tube outlet, plumb to facility reclaim.
- WR20A (Gray PVC) - connect 1/8" ID tube to barb on drain box.

2.3.2 Drain Requirements

For easy installation, all bench and console models are provided with 1 inch Schedule 40 PVC drain box fittings. Stacker models use 1-1/4 inch Schedule 40 PVC drain pipe (Exception: 2300 - 2400 models use 1-1/2 inch PVC). Console and stacker models are plumbed with drain traps and atmospheric vents.

Semitool recommends that every bench model Rinser/Dryer be installed with a drain trap to prevent contaminants from migrating back into the bowl. See the recommended drain configuration for more details.

2.3.3 Cabinet Exhaust Requirements

All Semitool Rinser/Dryers are provided with a 1-1/2 inch Schedule 40 PVC exhaust fitting. Semitool recommends that an equivalent mass flow rate of 7 CFM be maintained during all processing.

2.3.4 Power Requirements

PSC-102		BRUSHED MOTOR		BRUSHLESS MOTOR	
Bowl Size	Country	Volts	Breaker	Volts	Breaker
240 - 280	USA	120, 1 phase	15 Amp	120, 1 phase 100, 1 phase	15 Amp 15 Amp
	Europe	220, 1 phase	10 Amp	220, 1 phase	15 Amp
	Japan	120, 1 phase	15 Amp	120, 1 phase 100, 1 phase	15 Amp 15 Amp
2300	USA	208, 3 phase 240, 2 phase	20 Amp 20 Amp	N.A.	N.A.
2400 - 2600	USA	N.A.	N.A.	208, 3 phase	20 Amp
	Europe	N.A.	N.A.	380, 3 phase	16 Amp
	Japan	N.A.	N.A.	200, 3 phase	16 Amp

2.4 FACILITY AND HANDLING RECOMMENDATIONS FOR BEST PERFORMANCE

2.4.1 DI Water Quality

a. Resistivity: 17 megohms or better.

b. Bacteria: _2 colonies/100 ml sample.

c. Particles: <1000/L sample.

d. Point of use filtration: 0.2 µm or better, made of approved material (PVDF, Teflon, Polysulfone etc.)

Note: The high flow cone nozzles used by Semitool are designed to operate at relatively low pressures to minimize particulate generation. Refer to facility requirements for specific flow recommendations.

2.4.2 N_2 Quality

Nitrogen should be filtered to 0.05µm or better.

2.4.3 Recognized Process Recipe for Bowl Sizes 240 to 2300

1.	Rinse	60 -120 seconds	600 - 1000 rpm
2.	Dry 1	30 - 60 seconds	1200 - 2000 rpm
3.	Dry 2	180 seconds	600 rpm

2.4.4 Recognized Process Recipe for Bowl Sizes 2400 to 2600

1.	Rinse	60 -120 sec.	400-600 rpm
2.	Dry 1	30 - 60 sec.	1000-1200 rpm
3.	Dry 2	180 sec.	400-600 rpm

2.4.5 Test Wafer Cleanliness

_10 particles (0.3µm and larger)

2.4.6 Process Carrier (Boat)

The process carrier must be clean and uncontaminated (pure plastic - no pigment, preferably PFA Teflon).

2.4.7 Wafer Handling and Transportation

Recognized methods in Class 100 or better clean room environments (clean room garments, gloves, boat handles, etc.).

2.5 FACILITY CAUTION:

CAUTION: Removing pilot valve control air (CDA or N2) without DI shut-off may allow DI leakage past pneumatically controlled valves. This would result in excessive DI usage, N2 line/filter backfilling, and possible chemical tank overflows. Remove DI pressure prior to control air shut-off.

2.6 GENERAL WIRING PRACTICES

These guidelines should be followed in the installation of Semitool equipment in industrial locations. Each installation will differ and more care should be taken as installations become longer. Special attention should be given to wires that transmit data. For all installations, the following practices should be observed:

1. Locate electrical equipment, controls and components away from water, humidity, heat and dust or provide a suitable enclosure to protect equipment from these elements.

2. Locate equipment, controls and components away from SCRs, Triacs, buzzers, heavy motors, contactors, heavy current relays or other electrical noise generating equipment.

3. Use a metal enclosure to protect the electronic components from radiated electrical noise or other electrostatic or magnetic noise.

4. Low level signal and control wiring should be separate from wiring for switching and power. Cabinet and panel wiring should be planned with the power and relay wiring dressed to one side and low level signals dressed to the other side. Wiring to barrier strips, connectors and relay contacts should be planned for maximum separation.

5. Signal and control wiring should be at minimum run (shortest length) in twisted pairs. Lines from tachometers and other pulse or frequency devices should be run in separate 2-wire shielded cables.

6. Shield connections for shielded cables should be connected so that no current flows in the shield. Care should be taken not to ground the shield at any point except where it is connected to the equipment or instrument ground. The case of the equipment or instrument should be connected to earth ground.

7. Provide power that is noise-free and free of power interruption. In some cases this may require constant voltage sources, isolation transformers and/or noise filters.

8. DC power busses should operate within the limits provided in the equipment specifications. Special care should be taken to isolate DC relay contact wiring from signal and control wiring.

9. Electrical noise may be most easily reduced at its source. The installation of snubber networks or noise suppressers across relay contacts, relays, and switches may be helpful.

2.7 ROTOR BALANCING AND OPERATING REQUIREMENTS

1. Each rotor Semitool builds is spin balanced with a load (cassette and wafers) to ensure smooth, vibration-free operation over the specified (RPM) operating range. Any excess vibration of the Semitool is related to an unbalanced operating condition of the rotor. Several factors are important in maintaining balance and should be carefully observed by the operator.

2. Each rotor is balanced and operated for a specific cassette. Do not spin the rotor without a properly loaded cassette inserted. The rotor and/or bowl may be damaged. The cassette type is etched on the front plate of the rotor. Be aware of the cassette fit. It is possible that carriers of the same type (number) have different dimensions due to variations in their manufacturers' molds. Contact Semitool if you should encounter problems.

3. All rotors are balanced and operated with a full cassette of wafers unless specifically requested by the customer. Some rotors will have a minimum load specification etched on the front plate of the rotor. This offers a minimum/maximum loading window to the operator. Any rotors balanced for less than a full cassette will have the specific balance criteria etched on the front plate of the rotor.

4. All rotors are balanced with the cassette "H" bar, or in the case of symmetrical cassettes, wafer slot one, to the inside of the rotor unless otherwise stated on the front plate of the rotor.

5. Rotors are balanced to operate across the full RPM range unless otherwise stated. Rotors with RPM limitations will have specific RPM criteria etched on the front plate of the rotor.

6. Prolonged operation of an unbalanced rotor, a rotor with an incorrect cassette, or an improperly loaded cassette, will cause premature stress related failures of the rotor, rotor plate, shaft assembly and drive motor. Prolonged operation of an improperly loaded rotor will cause the rotor itself to become unbalanced.

7. Semitool offers a rotor rebalancing service at the manufacturing facility in Kalispell, Montana. Contact the Service Department at (406)752-2107 for details.

CAUTION: Do not spin the rotor without a properly loaded cassette inserted. The rotor and/or bowl may be damaged.

2.8 RINSER / DRYER START-UP

1. Do not perform the initial start-up procedures until the Operations Section of this manual has been carefully read and understood.

2. Verify that the main power cord is disconnected.

3. Verify that all control cables are connected between the Rinser/Dryer and controller.

4. Verify that N_2 and DI pressures are set to factory recommendations.

5. Visually check all tubing connections for leaks.

   Note: Tubing connections have been loosened and removed during pre-ship sanitation procedures. After reconnection, the unit has not been checked for leaks using fluids. When installing the Rinser/Dryer, always use clean DI water in all liquid processing functions to verify leak-free operation prior to chemical loading or usage.

6. Turn the controller Power switch to the Off position.

7. Connect the main power cord to an appropriately rated receptacle.

8. Push the Power switch, located on the controller front panel, to the On position. Check for rotor or N2 error indications on the controller.

9. Open the door to the Rinser / Dryer and install the rotor. To install the Standard 4-Bolt Rotor, start all four rotor bolts before tightening. Tighten the rotor bolts in a cross-type pattern, making sure caution is taken not to over-tighten or gall the bolts. To install the Quick Disconnect Rotor, refer to the Options Section of this manual for installation instructions.

10. Insert the cassette into the rotor.

> **CAUTION:** Each rotor is balanced for partially or fully loaded cassettes per the customer's specifications. Always spin up the rotor with the proper load. Failure to do so will unbalance the rotor and may cause damage to the rotor and/or bowl.

11. Press the Start switch on the operator control panel.

2.9 CHECK RECIPE PROCEDURE

After performing the Rinser/Dryer start-up, select recipe "b" to complete the following Check Recipe procedure.

Note: Step 1 in the Check Recipe procedure is a rinse cycle. When pressing the Start switch, the recipe always begins at step 1 even though any of the eight other steps may be shown on the display.

2.9.1 Step 1 - Rinse Cycle Operation

Check for the following sequence:

a. The rotor is spinning counter-clockwise.

b. DI water is flowing over the wafers and RINSE LED is illuminated.

c. The Power switch is illuminated.

d. The DOOR SEAL LED is illuminated.

e. The MOTOR ON LED is illuminated.

f. The ROTOR UP LED is Off.

g. The PURGE BOWL LED is illuminated.

h. The displayed RPM readout is the programmed RPM.

i. The displayed time readout is counting down.

j. The displayed Resistivity readout is the programmed Resistivity (if Resistivity Monitor option is present).

Note: When 5 seconds remain in the rinse cycle, listen for the momentary purge. When the Rinser/Dryer transitions to the dry cycle, this permits the DI manifold to blow out all existing fluids.

2.9.2 Step 2 - Dry Cycle Operation

Check for the following conditions:

a. Ensure there is no excessive vibration.

b. The N2 DRY LED is lit.

c. The RINSE LED is Off.

d. Verify that Step 2 in the Check Recipe is operating at maximum RPM for 30 seconds.

Note: If excessive vibration occurs, contact your maintenance department or Semitool service department.

2.9.3 Step 3 - Secondary Dry Cycle

Check for the following conditions:

a. The DOOR SEAL, POWER, N2 OK, MOTOR ON, PURGE BOWL and (Optional) ANTI-STAT LEDs are illuminated.

b. Verify that the RPM readout is reading the programmed RPM for 155 seconds.

c. The HEAT and AT TEMP LEDs are illuminated before the end of 155 seconds.

d. Check for rapid rotor deceleration (spin-down) after the dry cycle is finished. There is a delay timing device inside the controller for activating the RSP and de-energizing the door seal.

e. After the door seal deflates, you can open the door. Feel the inside of the bowl (using a gloved hand) to ensure that the Rinser/Dryer was heating.

f. Verify that the IDLE STATUS LED is illuminated. With the door open, listen and feel for a low pressure purge. This is used to pressurize the chamber while the machine is sitting idle. This purge decreases the amount of particulates entering the chamber. During the rinse cycle, the low pressure purge ensures a more accurate resistivity reading.

2.10 RECOMMENDED PRE-CLEAN RINSE

Before shipment, each machine has a hydrogen peroxide purge to reduce the bacterial build-up in the Rinser/Dryer. Unpacking and set-up procedures may contaminate the Rinser/Dryer and produce poor particle counts. A pre-clean rinse is recommended before a product is introduced to the Rinser/Dryer for processing. Should you require additional information or assistance, please contact your local Semitool Customer Service Office.

2.10.1 Pre-Operation Cleaning Rinse

The Rinser/Dryer should be rinsed thoroughly before any production material is introduced into the chamber. The following procedure provides guidelines for performing a pre-operation cleaning rinse.

a. Program a recipe of nine steps, with each step having a time period of 6000 seconds.

b. Push the Start button and let the Rinser/Dryer rinse for 4 to 8 hours.

Semitool

Operation Section

SECTION 3: OPERATION

3.1 GENERAL DESCRIPTION

1. The model PSC-102 allows the programming of nine recipes which can consist of up to nine steps. Each step can consist of any combination of functions supported by the tool, such as rinse, dry, purge bowl, heat, or additional optional features. The RPM, time, and resistivity (if applicable) for each step must be programmed.

2. A 16K E prom, 2K RAM and 2K battery backed-up RAM allows the system to retain its recipe memory with the power OFF.

3. The 16-character display allows for easy programming and status information. Error codes and prompts are presented on this display. Also standard is a Program/Operate Keyswitch to prevent unauthorized personnel from accidentally changing the recipe.

3.2 MODULES

1. Control Panel - Located on the front, contains four programming soft keys, a power switch, the Program/Operate Keyswitch, and a status display which indicates individual recipe steps, system errors, diagnostic tests, etc.

2. Master Power On/Off Switch - Illuminated when power is ON.

3. Main Logic Board - Contains microprocessor, serial communications chips, bit input/output and RAM/ROM memory.

   - Power Supervisor Chip - Supervises the power supply voltage and inhibits operation if it should drop below a predetermined level. Also ensures that the microprocessor starts up in a known manner.

   - Seven sets of Dip Switches - Sets SECS communication parameters.

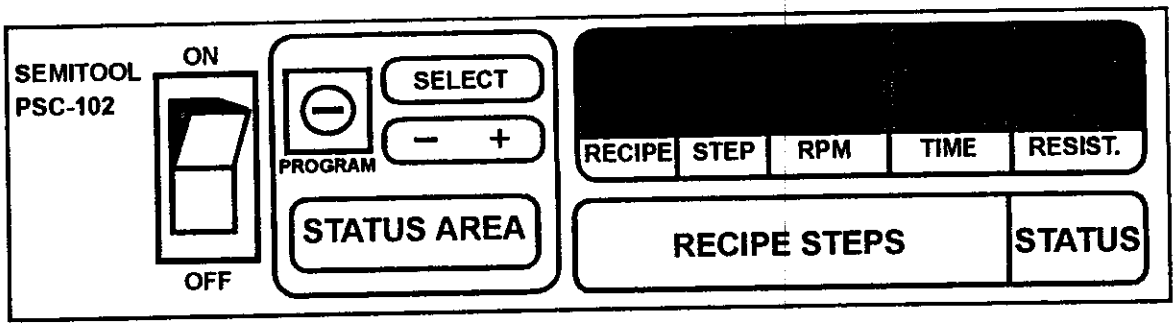
4. Power Supply - +5 at 1 Amp, +5 at 1 Amp and +24 at 1 Amp.

5. Motor Control Board - Regulates rotor speed. For Rinser/Dryers equipped with a brushless motor, see the AUTOMOTION Brushless Motor Control User's Guide in the Options Section of this manual.

6. Robotics Interface Relays (4) - Provide AC to motor control board, a return on the motor drive, access main logic board, and provide AC power to entire System. The right hand connector contains heater, AC power and Anti-stat.

7. Relay Board - Contains AC power distribution and fuses. The large relays control the heaters and the motor. The 14 Pin DIP Relay is located next to the Motor Relay and is used for the Anti-static On/Off.

3.3 PSC-102 CONTROLLER PANEL



3.3.1 Program/Operate Keyswitch

This keyswitch is located to the right of Power switch and allows the user to lockout recipe programming. When the keyswitch is turned to Program (the key is in the vertical position), the LED, located below the keyswitch, will be illuminated and the user allowed to program and edit recipes. When the keyswitch is turned to Operate (the key is positioned horizontally), the Program LED will not be illuminated. This mode allows the user to initiate and stop recipes, but locks out any recipe modifications.

3.3.2 Select (← and →)

The **Left** and **Right Select** soft keys are located to the right of the Keyswitch and are used to position the cursor for editing purposes. When the cursor is positioned, the alphanumeric will blink. Each digit must be changed individually and the Select key used to move to the next digit.

3.3.3 Digit Change (- and +)

The **DIGIT CHANGE** soft keys are located below the Select keys and are used to increment or decrement the field where the cursor is positioned. On numeric fields, the cursor is positioned on each digit and then the **DIGIT CHANGE** keys are used to edit the current value. On non-numeric fields, such as the recipe steps (RINSE, DRY, CHEM, PURGE BOWL, HEAT, PURGE MANIFOLD, and ANTISTAT), the plus and minus soft keys are used to activate and deactivate the process.

3.3.4 Recipe

A total of nine recipes (one through nine on the display) are available for programming. Auto Cycle (A), Idle Status (idle), and Check Recipe (b) are additional resident recipes. Check Recipe is a preprogrammed standard recipe that may be altered. If recipes are cleared from memory (see Section 3.5), Check Recipe will revert to it's previous values.

3.3.5 Step

A total of nine steps per recipe are available. Each step has a programmable time, RPM, resistivity (for rinse cycles), and function.

3.3.6 RPM

By positioning the cursor to the RPM field, a range of 0 to 2800 may be entered. However, the RPM stamped on the rotor should not be exceeded.

3.3.7 Time

This field displays step time, measured in seconds, and ranges from 0 to 9999 (almost 3 hours).

3.3.8 Resistivity (RM-20 Option)

When editing this field, enter the desired resistivity in megohms for the rinse cycle. In Operate mode, this field displays the current resistivity from 0 to 20 megohms. If a displayed resistivity is over this range, this might indicate a dry or disconnected probe.

3.3.9 Recipe Steps

The following processes are available for selection in any given recipe step. When a process is selected for a step, the LED will be lit. When the cursor is positioned on a selected process, the LED remains lit most of the time. When the cursor is positioned on an unselected process, the indicator blinks rapidly.

a. Rinse -Indicates a rinse cycle is in process.

b. Dry - Indicates a dry cycle is in process.

c. Chem - Indicates a chemical is being supplied to the chamber.

d. Purge Bowl - Low pressure purge to reduce particulates in the bowl.

e. Heat - Indicates bowl heaters are activated.

f. Purge Manifold - Indicates H2O manifold is being purged.

g. Anti-Stat - Indicates the optional CY-20 Antistat cell is energized.

h. A - Spare indicator normally used to reverse motor on 2400 - 2600 Rinser/Dryer.

i. B - Spare Indicator.

3.3.10 Status Indicators

A blinking status LED indicates an error condition (see Section 3.12 for a full list and description of error conditions). The following status categories are maintained:

a. Auto Load (Optional) - Located on the lower right side of the panel and indicates Auto Load is activated.

b. Auto-Cycle (Optional) - Located on the lower right side of the panel and is illuminated when the machine has been programmed for a cleaning process at some interval when the machine has been sitting idle. The lamp will flash when an Auto Cycle is scheduled to run, but an existing condition prevents it's occurrence, e.g. an interlock error, or the door is open and needs to be closed, etc.

c. Idle Status - Located on the lower right side of the panel and indicates one or a combination of functions are programmed to run while the machine is sitting idle, e.g. bowl purge, bowl heaters, etc.

d. N2 OK - Located on the lower left side of the panel and indicates an adequate nitrogen pressure has been achieved.

e. At Temp - Located on the lower left side of the panel and indicates the bowl heat is at the correct temperature.

f. Motor ON - Located on the lower left side of the panel and indicates the motor is running.

g. Rotor Up - Located on the lower left side of the panel and indicates the rotor is in the correct upright position.

h. Door Seal - Located on the lower left side of the panel and indicates the door is sealed.

i. Heat - Located on the lower center of the panel and when illuminated indicates blanket heaters are on. The lamp will flash when there is a malfunction of the blanket heaters.

3.4 RINSER / DRYER CONTROLS

The following buttons/switches are located on the front of the Rinser/Dryer.

3.4.1 Start

a. Initiates the displayed recipe beginning with step one.

3.4.2 Stop - Performs a dual function:

a. Stops the current process.

b. Clears error messages after the error conditions have been corrected.

3.4.3 Door Toggle or Kick Switch

a. Opens the door if the door is currently closed, closes the door if it is currently open.

3.5 INITIALIZATION

To initialize the PSC-102 controller, select the **POWER** switch located on the left hand side of the controller. When this occurs the following messages should be seen:

1. The display check appears, with all "8"s showing on the display panel and all LED indicators illuminated.
2. The ROM resident program check occurs and displays **"CPU PASS 1"**.
3. The RAM memory check takes place and displays **"CPU PASS 2"**.
4. Parameters (recipe, timers, SECS, etc.) are verified and **"CPU PASS 3"** is displayed.

3.6 RECIPE PROGRAMMING

1. Turn the keyswitch to the **Program** position (key vertical). The LED under the key illuminates to indicate Program mode. Press the **SELECT** (← or →)soft key to move to the RECIPE field. The current recipe number is blinking to indicate that the cursor is positioned her. Use the **DIGIT CHANGE** keys (+ and -) to choose the desired recipe.

2. Press the right arrow key once to move to the STEP field. RPM, time and resistivity show 0's and all the programmable functions (rinse, dry, etc.) are all deactivated. Recipes 1 through 8 all contain steps that are initialized to zero. Recipe 9 is initialized to a standard recipe that may be modified by the user.

3. Press the right arrow key once to move to the RPM field for step one. Use the **DIGIT CHANGE** keys to modify the value digit by digit. For example, to enter an RPM of 550, depress the right arrow key once to move the blinking cursor to the 100's place of RPM. Depress the + key five times to increase RPM from 0 to 500. Press the right arrow key once to position the cursor on the 10's place of RPM, and select the + key five times to increase the RPM from 500 to 550.

4. To program the step time, depress the right arrow soft key twice to position on the first digit of the time field and use the **DIGIT CHANGE** keys to enter the desired value in seconds. For example, to enter a step time of three minutes, depress the right arrow key until the 100's place of the time display is blinking. Since three minutes is equal to 180 seconds, depress the + key once to program a one in the 100's position. To program the tens place, depress the right arrow key once. Then depress the + key until the display counts up to eight. If you have gone too far, the - key can be used to count backward.

5. Position the cursor to the resistivity field to program the resistivity setpoint for the rinse step and enter the desired value in megohms. For example, to enter 10.0 megohms, press the right arrow key to the tens place and press the + key once.

   NOTE: If a resistivity setpoint is programmed, the rinse function is automatically activated and the machine will hold in the rinse cycle until the resistivity setpoint is reached.

6. To program a rinse, move the cursor to the right until the end of the numerical display is reached. Notice that depressing the right arrow key again causes the rinse indicator (located in the lower area of the display) to blink. Press the + key to select the rinse function for step one. Combinations of processes may be selected. For example, to select a rinse with bowl purge, press the right arrow key two times to move to Purge Bowl and press the + key. Rinse and Bowl Purge have now been programmed. A minimum of 20 seconds must be programmed to ensure that the probe is moistened for an accurate reading.

3.6.7 To program the next step, step two, press the right arrow key to move the cursor to the step position. Since this step has not been programmed, all the fields and functions display zero or off default values. To enter a high speed drying process for step two, press the + key to advance the step from one to two. Select 1500 RPM for three minutes (180 seconds). To select "Dry", move the cursor to the Dry indicator and turn it on by depressing the + key.

8. Each recipe can have up to nine steps and any function may be programmed into each step. In this recipe, steps three through nine are blank. Any steps having zero times are skipped and blank steps can be interspersed with normal steps. This would allow the process engineer to add an additional step between existing steps without having to reprogram the entire recipe.

3.7 OPERATION MODE

When all desired recipes have been programmed on the SRD, the OPERATION mode provides security from modification. To enter OPERATION mode, turn the Program Keyswitch to the left and remove the key from the controller until the next recipe programming session. In this mode, the user may only observe status indicators and initiate process runs; recipe programming is not available in this mode. The Program LED goes out and the display now indicates the current selected recipe, Idle status, current rotor RPM (0), time and resistivity. The user may position on the RECIPE field and cycle through all the recipes, using the **DIGIT CHANGE** keys, but individual recipe steps are not visible in the idle state. When the Auto Cycle timer is activated and the SRD is idle, the Auto Cycle time interval may be observed counting down in the TIME field.

3.8 RUNNING RECIPES

After a recipe has been programmed, the Rinser/Dryer is ready to run. Open the door and insert a loaded cassette of wafers. If the cassette is not full, the wafers should be evenly spaced throughout the boat.

> **CAUTION:** Engraved on the front of the rotor is the minimum wafer load required for a balanced run. Placing a smaller load than this minimum risks damage to the rotor. Refer to the Balancing and Operating Requirements for Semitool Rotors in the Installation Section of this manual.

The recipe may be started in any controller mode, e.g. Recipe Programming, Service/Diagnostics, etc. However, to observe the recipe cycle through each step, the active recipe must be selected. To begin wafer processing, close the door and press the **START** button on the front of the tool.

While the Rinser/Dryer is operating, the following conditions may be observed.

- When the active recipe is selected, the current recipe step is displayed along with the time remaining in that step, the actual RPM, and the actual resistivity reading (when applicable).
- Observe that the rotor is spinning counter-clockwise.
- During rinse cycles, DI water should be flowing over the wafer.
- Verify that the (manually operated) door is properly sealed. Applying light pressure, pull on the door. It should not open.
- Check that the SRD switched to the dry cycle. The water manifold is purged for approximately ten seconds. After ten seconds have elapsed, the purge valve will close with a high N2 flow continuing in the dry cycle.
- Make sure there is no excessive vibration.
- Verify that rapid rotor deceleration (spin-down) occurs after the Dry cycle.
- Check that the Rotor Stop Positioner (RSP) has stopped the rotor in the correct upright position at the end of the cycle.
- When the door seal is de-energized, open the door. Using a gloved hand, feel inside the bowl to ensure the SRD was heating.

3.9 AUTO CYCLE OPTIONS (AC-10 and AC-20)

The Auto Cycle function instructs the Rinser/Dryer to clean the bowl if a recipe has not been run for some interval (usually an hour). Auto cycle does not close the door. The machine will not start an auto cycle if the door is open or the controller is interlocked. If the programmed time interval has expired, the tool will continue to attempt starting the auto cycle, so as soon as the door is closed or interlocks are cleared, the auto cycle will begin.

The AC-10 option gives the PSC-102 controller an additional programmable recipe which may only be used for auto cycles. To program an auto cycle recipe, move the cursor to the recipe field and use the **DIGIT CHANGE** keys to select recipe A. This is the auto cycle recipe and is programmed exactly as a normal recipe (see Section 3.6 for recipe programming instructions). It should be noted that the maximum RPM for an auto cycle recipe is 300 and no greater value will be accepted in this field. To schedule the auto cycle (after the recipe has been programmed), move the cursor to the recipe field and continue to press one of the **DIGIT CHANGE** keys until **"ACY dLY"** is displayed. Select the RIGHT CURSOR key once to move to the time field. This is the time interval between the last recipe run and the scheduled auto cycle. Enter the desired interval and use the RIGHT CURSOR to move to the ON/OFF field, located where the resistivity is usually entered. Set this field to ON, using the + key (the - key is used to turn the function off). When this is done, the auto cycle status indicator (located on the lower right side of the panel) will be illuminated.

3.9 AUTO CYCLE OPTIONS (continued)

The AC-20 option has the same capabilities as the AC-10, plus two additional features.

1. By positioning on the recipe field and using the **DIGIT CHANGE** soft keys, **"ACY RUNS"** allows the user to specify a certain number of runs to occur prior to starting the auto cycle. Enter the number of occurrences (between 0 and 99) and activate this function by selecting ON.

2. By positioning on the recipe field and using the **DIGIT CHANGE** soft keys, **"ACY DOOR"** allows the user to specify an auto cycle delay time based on door closure. This feature requires a programmed delay time (from 0 to 99 seconds) to be entered. When this function is enabled, the program waits for all of the following to occur: a regular recipe (non-auto cycle) runs to completion; the door opens and closes; and the programmed door delay time elapses. The auto cycle door delay is meant to be used with either the auto cycle delay or runs command.

   NOTE: An Auto Cycle will not run with the door open. If the set time interval has expired, the Auto Cycle will begin immediately when the door is closed. The operator may press the Stop button to abort the process. If Stop is used to abort the process, the operator must wait until Idle status has been achieved before clearing the interlocks.

   The auto cycle function may be equipped (by customer request) to run at higher RPMs. However, Semitool recommends running auto cycle recipes at a maximum of 300 RPM to avoid damage to the Rinser/Dryer.

3.10 RESISTIVITY DELAY ALARM (for RM-20 Option)

When a resistivity is entered for a rinse cycle, the possibility exists that this value may never be reached and the recipe step will not advance. For this reason, it is recommended that the Resistivity Delay Alarm be activated. It instructs the machine to hold in Rinse for a certain number of seconds, waiting for the machine to reach the Resistivity Setpoint. If at the end of the programmed time the machine has not reached Setpoint, the Rinser/Dryer will advance to the next step. The Resistivity Display will flash to indicate that this product run did not reach Setpoint. This error is reset by pressing the Stop button. To activate this alarm, position the cursor at the recipe field and press the **DIGIT CHANGE** soft keys until **"RES dLY"** appears. Move the cursor to the time field and enter the desired maximum rinse cycle time. A value between 0 and 9999 seconds may be entered (with a default value of 600 seconds). Move the cursor to the ON/OFF field and use the **DIGIT CHANGE** keys to activate the alarm.

3.11 IDLE STATUS FUNCTION

The Idle Status function allows the user to specify one or more functions to run while the Rinser/Dryer is idle. To program this feature, position the cursor on the recipe field and press the **DIGIT CHANGE** keys until **"IDLE"** is displayed. Use the Right and Left arrow keys to select the desired functions. These functions are limited to Bowl Heat, Purge Bowl, and "Anti Stat" (if this option is installed).

3.12 ERROR CONDITIONS

3.12.1 N2 Pressure Low

When a N2 failure occurs, the process will abort and the N2 OK LED will blink to indicate that an error occurred. The N2 error can be cleared by pressing the **STOP** key or sending the equivalent command via RI-25 or SECS II. It will also be cleared automatically if a Start command is issued. If the N2 is still low, however, another error is generated immediately.

3.12.2 Bowl Heater Not at Temp

If the Controller is unable to reach the snap switch temperature (160 +/- 15 degrees F) within 170 seconds, the HEAT LED will blink to indicate that an error occurred. This would normally indicate an open heater. When the temperature is too low, selecting **STOP** clears this error. However, when the temperature is too high, this indicator is cleared five seconds after closure of the switch.

3.12.3 High Bowl Temp Error

If the bowl heater is unable to cool down within 3 minutes of reaching temperature (160 +/- 15 degrees F), the HEAT LED will blink to indicate the error. This indicator is cleared five seconds after closure of the switch.

3.12.4 Door Failure

When one of the four door valves remains in the wrong position for ten seconds after opening/closing the door, the DOOR SEAL LED will blink to indicate that an error occurred. Any active recipe is aborted and if the Autoload option is on, this is also deactivated. The door valves are all turned Off when a Door error is sensed and the door will assume whatever position gravity takes it. Selecting **STOP** clears the indicator.

3.12.5 Rotor Upright Failure

The Controller allows 15 seconds to spin-down and upright the rotor. If the motor board is unable to accomplish this within 15 seconds, the ROTOR UP LED will blink to indicate that an error occurred. Selecting **STOP** clears this indicator.

3.12.6 User Stop While in Process

When **STOP** is selected while a process is running, the process will be aborted and the IDLE STATUS LED will blink to indicate the occurrence. Selecting **STOP** again clears the indicator.

3.12.7 User Hold While in Process

When a hold is initiated (via a SECS-II command) while a process is running, the process will hold indefinitely and the IDLE STATUS LED will blink to indicate the occurrence. Selecting **STOP** clears the indicator.

3.12.8 User Step Advance

When a step advance is initiated (via a SECS-II command) while a process is running, the process will advance to the next step and the IDLE STATUS LED will blink to indicate the occurrence. Selecting **STOP** clears the indicator.

3.12.9 Carrier Not Present (when Carrier Present Option is installed)

When a recipe is initiated and a wafer carrier is not loaded in the Rinser/Dryer, the process will be aborted and the IDLE STATUS LED will blink to indicate the occurrence. Selecting **STOP** clears the indicator.

3.12.10 Resistivity Out of Range (when RM-20 Option is installed)

When the Resistivity Timeout Alarm is set and the entered resistivity for the current recipe is not achieved, the step will automatically advance and the Resistivity display will blink to indicate the error. Selecting **STOP** clears the indicator.

3.12.11 High Vibration

This problem may occur when the cassette load or rotor is unbalanced and the result is the MOTOR ON LED will blink to indicate the error. The process will be automatically shut down. Selecting **STOP** clears the indicator.

3.12.12 Motor Overtemp

When the motor overheats, the MOTOR ON LED will blink to indicate the error and the motor will be automatically shut down. Selecting **STOP** clears the indicator.

3.12.13 Motor/Tach Failure

When the motor or tachometer is not operating correctly, the MOTOR ON LED will blink to indicate the error and the motor will be automatically shut down. Selecting **STOP** clears the indicator.

3.12.14 Low DI Flow

If the DI flow is not adequate within five seconds, the process is aborted and the RINSE LED will blink to indicate the error. Selecting **STOP** clears the indicator.

3.12.15 Low or High N2 Flow

If the N2 flow is too high or low during the drying process, the process is aborted and the DRY LED will blink to indicate the error. Selecting **STOP** clears the indicator.

3.12.16 Auto Cycle Pending (AC-10 and AC-20 Option)

When the auto cycle function is ready to run, but for some reason cannot (such as the door is open), the AUTO CYCLE LED will blink to indicate the error. Selecting **STOP** or allowing the auto cycle to function clears the indicator.

3.12.17 Bottle Level is Low (Optional)

When the Rinser/Dryer is configured to accommodate a bottle (such as a surfactant system), and the contents of the bottle is running low, the B LED will blink to indicate this status. The current process will run to completion, but no new recipe may be initiated until the bottle is refilled. The indicator will be cleared when the bottle is refilled.

3.13 SIGNAL TOWER

The following table lists conditions that activate each of the signal tower lamps.

Lamp Color	Lamp State	Condition
RED	Steady	An Alarm has occurred.
YELLOW	Steady	Recipe is In Process.
GREEN	Steady	Tool is idle.
GREEN	Flashing	Process is finished but door has not yet been opened.

Semitool

Options Section

4.1 RINSER/DRYER OPTIONS INCLUDED IN THIS SECTION

IN MANUAL	AVAILABLE OPTIONS
✓	CY-20 ANTISTAT OPTION
	FN-10/FW-10 FACILITY QUICK CONNECTIONS
✓	FN-40/FW-40 FACILITY QUICK CONNECTIONS
✓	WR-20 WATER RECIRCULATION VALVE
	QD QUICK DISCONNECT ROTOR
✓	BRUSHLESS MOTOR
	SECS-II INTERFACE GUIDE
	VS-10 VIBRATION SENSOR
	DS-50 DISPENSING SYSTEM

CY-20 ANTISTAT OPTION

The CY-20 Antistat is a self-contained pulsing, direct current static control system with the ionizing needles introduced directly into the process chamber. The CY-20 is a true point of use system, ionizing the actual production environment. The unit is only energized while the Rinser/Dryer is operating. Review your electrical schematic set to determine when your CY-20 is energized. The CY-20 requires no maintenance and may be quickly replaced in the event of failure.

Testing the CY-20 Antistat Unit

The CY-20 produces a high voltage, low current output. A high voltage probe, such as the Beckman HV-211 (22 megohm input impedance) is required to measure the CY-20 output. Output voltage should be checked by a qualified service technician at least every six months.

Using safety ground as a reference, carefully touch the meter probe to each needle of the CY-20. A properly functioning unit will read 3.5 KV to 4.6 KV on each needle. One tip will indicate a positive reading and the other tip a negative reading when the CY-20 is operating (typically enabled during the dry cycle).

If the inspection tag on the antistatic unit indicates a factory test value greater than 3.5 KV, replacement is indicated by a reading lower than 3.0 KV.

NOTE: Early CY-20 units had factory test readings of approximately 2.5 KV. If your unit is so marked, replacement is indicated by a reading of less than 2.0 KV.

CY-20 Parts List

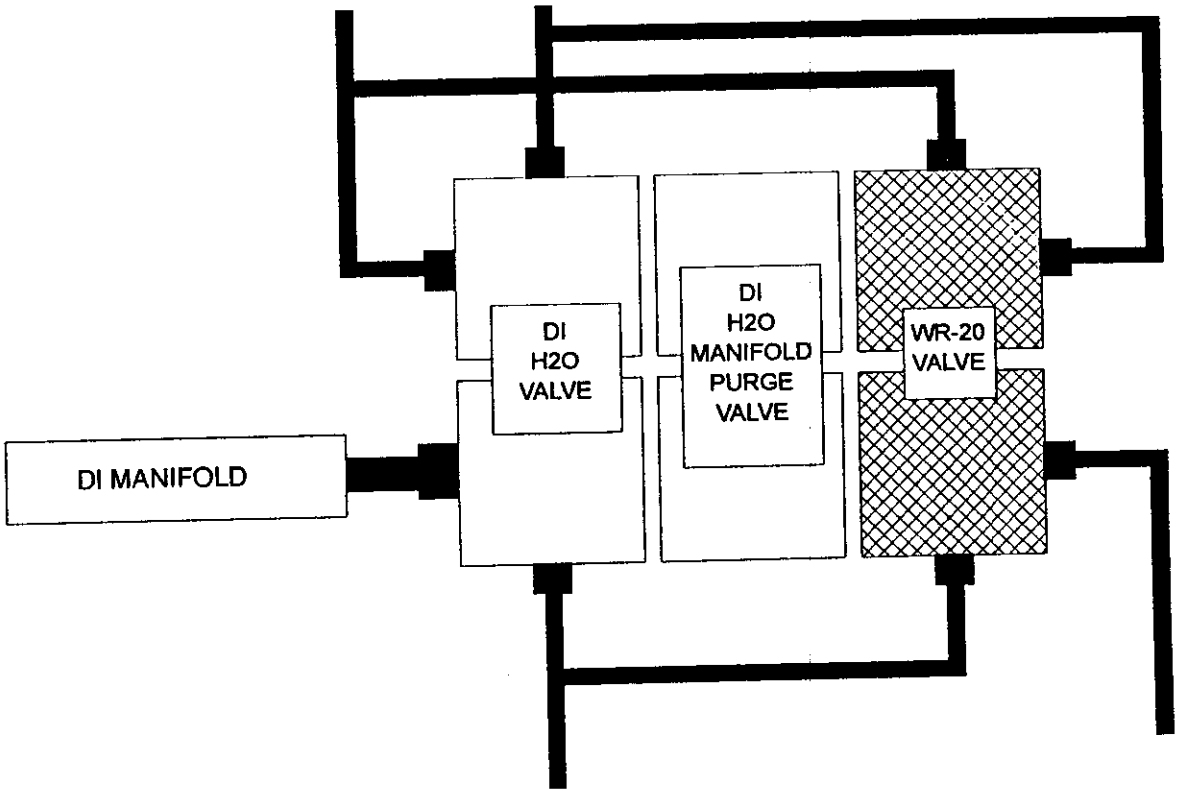
DESCRIPTION	PART NUMBER
CY-20 Antistat Assembly (110 V)	115R0004-01
CY-20 Antistat Assembly (220 V)	115R0004-501
O-Ring Seals	62723-06

WR-20 OPTION

The WR-20 option provides for recirculation of DI water. When the water spray manifold is not in use (closed), the DI water supply is diverted through the water valve to the facility DI water recovery system by virtue of an additional Semitool valve. This circulation through the water valve reduces bacterial build-up in both the valve and the DI water tubing.

WR-20A OPTION

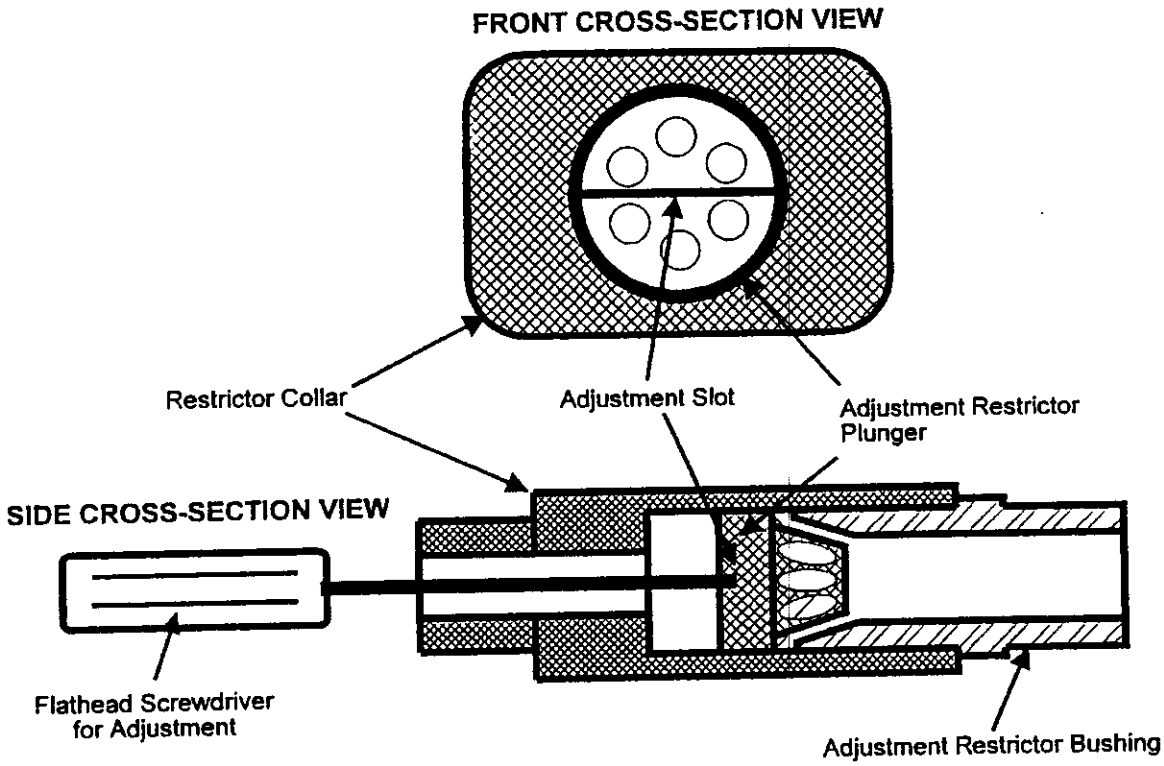
The WR-20A option provides a low flow recirculation of DI water. When the water spray manifold is not in use (closed), the DI water supply is diverted back through the water valve to the drain box by virtue of an additional Semitool valve. This low flow circulation through the water valve reduces bacterial build-up in both the valve and DI water tubing. The WR-20A option is used when there is no facility DI water recovery system.



WR-20A FLOW ADJUSTMENT PROCEDURE

The adjustable restrictor controlling the flow of DI water through the WR-20A option is factory set to flow at approximately 0.1 gallons per minute (GPM).

Special flow adjustment modifications may be made by first removing the connecting elbow. Insert a small screwdriver, and turn the plunger adjustment restrictor counter-clockwise to increase the flow rate or clockwise to decrease the flow rate.



FW-40 / FW-40R / FN-40 OPTIONS

These control panels allow for simple and quick connections between the facility supplies and the Semitool Rinser/Dryer. The DI line is connected by means of 3/4 inch Galtek fittings and the Nitrogen line is connected by 1/2 inch Galtek fittings. Any of these options can easily be mounted to a wall or the side of the Rinser/Dryer.

FW-40

DI water flow rates can be monitored using the float gauge provided with this option. Flow rates in gallons per minute are read directly from the top of the stainless steel float. Specified facility requirements can be achieved by adjusting the restrictor valve.

FW-40R

DI water pressure and flows can be monitored using the pressure gauge and flow meter provided with this option. Flow rates in gallons per minute are read directly from the top of the stainless steel float, while pressures in PSIG can be read from the pressure gauge. Specified facility requirements can be achieved by adjusting the regulator valve.

FN-40

Nitrogen pressure and flow rates can be monitored with the pressure gauge and flow meter provided with this option. Flow rates are measured in cubic feet per hour (CFH); dividing by sixty will convert this reading to cubic feet per minute (CFM). The pressure, in PSIG, is read directly from the pressure gauge. Specified facility requirements can be achieved by adjusting the regulator valve. This system is capable of delivering pressures from 0 to 60 PSIG for flows from 0 to 25 CFM.

AUTOMOTION

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MODEL LC-5

USER'S MANUAL

This manual covers the use and maintenance of the model LC-5 DC Brushless Motor Control product family. Included in this are the following model numbers:

LC-5A-(P)
LC-5B-(P)

This document applies to serial numbers beginning after 110351188.

If you require further assistance please call or write:

AUTOMOTION INCORPORATED
P.O. Box 7746
Ann Arbor, Michigan, U.S.A. 48107
(313) 662-7771

DO NOT RETURN PRODUCTS WITHOUT PRIOR AUTHORIZATION DIRECT FROM AUTOMOTION.

DOCUMENT CREATION DATE: February 20, 1990
Rev. 5.0
File: LC-5 User's Manual
LC-5 Safety
LC-5 Notes

SAFETY PRECAUTIONS

Read this page and section 1.0 before using the LC-5

To operate Your control successfully, these minimum safety precautions MUST be followed to insure proper performance without injury to the operator and damage to motor or control. **FAILURE TO OBSERVE THESE SAFETY PRECAUTIONS COULD RESULT IN SERIOUS BODILY INJURY, INCLUDING DEATH IN EXTREME CASES.**

1. DO NOT touch any of the output terminals numbered 16, 17, 18, 19 or 20 when power is applied. The voltages at these terminals are dangerous and can produce an electric shock. Bare wires from adjacent terminals must never be allowed to touch one another. Terminal 15 must be connected to an external earth ground.
2. Always operate the control within the prescribed voltage limits.
3. Each model has dangerous voltages on the circuit boards and stores a high voltage charge after being disconnected. DO NOT REMOVE THE COVER OR ATTEMPT TO SERVICE THESE UNITS IF A PROBLEM OCCURS.
4. Be cautious when using the control in a 4 Quadrant mode as instant direction changes can damage the amplifier. Read manual carefully for 4 quadrant limitations.
5. Do not parallel more than one motor off of the same control.
6. Under no circumstances must a phase output from the control be connected to anything other than a passive inductive load, such as a motor.
7. The packaged control is designed for use in a NEMA type 1 service. Direct contact with liquids or corrosive chemicals should be avoided.
8. Excessive speed can destroy some DC brushless motors. Check the motor manufacturer's specifications to ensure the maximum current and voltage output for your control model.does not exceed their limitations.
9. Do not remove the connectors P1 and P2 from the control while the motor is operating. DO NOT plug connector P2 into the control when wired to live AC power.
10. Read Automotion's Life support Policy Section 21 for application limitations.

TABLE OF CONTENTS

PLEASE NOTE !

Read this manual entirely. Particularly -- "SAFETY PRECAUTIONS" – BEFORE attempting to use the LC-5 Brushless Motor Control

1.0 Safety Precautions:

READ THIS ENTIRE SECTION BEFORE ATTEMPTING TO USE THE LC-5!

To operate the LC-5 successfully, these minimum safety precautions MUST be followed to insure proper performance without injury to the operator and damage to motor or LC-5 control. **Failure to observe these safety precautions could result in serious bodily injury, including death in extreme cases.**

Automotion's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President of Automotion Incorporated.

1. Do not touch any of the output terminals numbered 16, 17, 18, 19, or 20 when power is applied. The voltages at these terminals are dangerous and can produce an electrical shock and cause lethal personal injury. The wires connected there should never have too much insulation removed allowing bare wire to be exposed beyond the terminal block. Bare wires from adjacent terminals must never be allowed to touch one another when power is applied to the LC-5 control. Ground terminal number 15 MUST always be connected to an appropriate external power ground during use of the LC-5 control.

2. Always operate the LC-5 control within the prescribed voltage limits. To attempt to operate outside these bounds may result in damage to the LC-5 control. See section 3.3

3. All LC-5 models have dangerous voltages present on the internal circuit boards and use large electrolytic capacitors which store a high voltage charge after the unit is disconnected from the power supply. **Do not attempt to service these units if a problem occurs or remove the cover!!** First consult section 17.0, "In Case of Trouble." If this fails to solve the problem, call AUTOMOTION.

4. Care must be exercised when using the LC-5 control in a 4 Quadrant mode. Instant direction changes under these conditions can cause electrical damage to the amplifier. Before using the LC-5 in this mode, read section 13.0, "Reversing the Motor, 4 Quadrant Operation."

5. The LC-5 will control only one brushless DC motor at a time. Do not parallel additional motors off of the same LC-5 control.

6. Under no circumstances must a phase output from the LC-5 control be connected to anything other than a passive inductive load, such as a motor. This could cause immediate damage to the LC-5 control. The LC-5 integral current limiting control will NOT protect the unit from damage due to a direct short circuit to ground, a short to the 220 VAC power supply rails, or a phase-to-phase short.

7. The LC-5 packaged control is designed for use in a NEMA type 1 service. Direct contact with liquids, or corrosive chemicals should be avoided. If it is necessary to operate the LC-5 in an area where it may violate these conditions, contact AUTOMOTION for special packaging recommendations.

8. Check the motor's peak RPM rating. Excessive speed can destroy some DC brushless motors. In addition, check the motor manufacturer's specifications to make certain the maximum current limited output for your LC-5 model will not risk permanent demagnetization of the motor. If the current is too high, see Section 16.0, "Setting the Maximum Current Limited Output," for details on how the upper limit on the LC-5 may be reduced to a safe level to match the motor's limits.

9. Do not remove the connectors P1 and P2 from the LC-5 while the motor is operating. This can cause electrical arcing which can damage the connector pins. DO NOT plug connector P2 into the LC-5 frame when live AC power is wired into the mating connector body.

2.0 Unpacking and Repacking:

When your package arrives, inspect the shipping box carefully, and save ALL packing materials. Contact the carrier promptly if damage is discovered. Your LC-5 has arrived carefully packaged from AUTOMOTION in a static proof bag. As you unseal this bag inspect the contents carefully. There should not be any loose or damaged parts in this bag. While unpacking, if you discover any loose or damaged parts, notify AUTOMOTION within two working days.

Compare the packing slip against all items included in the box. Any shortages or other inspection problems should be reported immediately. Never attempt to operate or power-up the LC-5 if there is any visible external damage or if it sounds as though there are loose materials inside the chassis. AUTOMOTION recommends that all packing materials be saved in case the LC-5 ever needs to be shipped again. Always place the LC-5 in the same static proof bag used in the original shipment. Abundant filler material should always be placed around the LC-5 bag so that it cannot shift inside the box.

Always insure your shipment for the proper replacement value of its contents. AUTOMOTION will not assume responsibility for any returned goods which have been damaged outside of our factory because of improper packaging or handling. All goods shipped to AUTOMOTION must have prior return authorization and be shipped FREIGHT PREPAID.

3.0 LC-5 Product Family Specifications:

3.1 Drive type:

4 Quadrant, six step, 3 Phase, Full Wave PWM controlled output.

3.2 Maximum Current Limited Output:

LC-5A	3.25	Amps RMS continuous.
	4.5	Amps RMS peak* limited.
LC-5B	7.2	Amps RMS continuous.
	10.0	Amps peak* limited.

*See "Reversing the Motor, 4 Quadrant Operation" for precautionary details.

3.3 Operational Voltage Supply Range:

200 to 245 volts AC-RMS, single phase, 50/60 Hz. 260 VAC peak for 1 sec. Automatic over/under voltage shutdown employed. AC line inputs are MOV protected.

3.4 PWM Operating Frequency:

Approximately 18 KHz.

3.5 Operating Temperature Range:

-20 to +50 degrees Celsius. Automatic over temperature shutdown employed at +50 degrees Celsius on heat sink.

3.6 Storage Temperature Range:

-20 to +85 degrees Celsius.

3.7 Operating Humidity Range:

5 to 95% RH non-condensing.

3.8 Output Voltage to Motor:

Nominally +320 volts chopped DC, phase-to-phase. This is based upon a supply voltage of 220 volts AC-RMS, at full-rated continuous output amps.

3.9 Product Size:

Packaged Unit:

Height	9.25	inches (23.5 cm)
Width	5.4	inches (13.7 cm)
Depth	8.5	inches (21.6 cm)
Weight	6.25	lb. max (2.81 Kg)

Open Frame Unit:

Height	10.5	inches (26.7 cm)
Width	3.0	inches (7.6 cm)
Depth	6.25	inches (15.9 cm)
Weight	3.0	lb. max (1.36 Kg)

3.10 Heat Sink Cooling:

External forced air cooling may be necessary when prolonged high amperage duty cycles are used and/or high ambient air temperature exists. The LC-5 will automatically shutdown whenever the heat sink temperature reaches approximately 50 degrees Celsius. To restart the motor, toggle the Start/Stop input after the heat sink has cooled.

3.11 Speed Control:

Stock model is equipped for both external 4 quadrant speed control or Closed Loop 2 quadrant internal speed regulation. The external speed control may be provided by means of either an analog signal from 0 to +10 volts, or an external PWM source. See the appropriate sections in this manual for further details on each of these capabilities. An optional +/- 10 volt analog signal input card is available. See Section 18.0, "Optional Equipment."

3.12 Commutation Control:

Normally provided by three rotor positional sensors located within the brushless DC motor. These sensors may be either of the Hall variety or optical in nature. See section 7.0, "Motor Requirements."

3.13 Commutation Code:

User selectable for either 60 or 120 electrical degrees of signal phase displacement. See section 7.0, "Motor Requirements."

3.14 Additional Controls:

Start/stop, forward/reverse, dynamic brake, variable soft start, external current limit trip input, external signal input for closed loop speed control. An optional current signal output is available, but must be configured at the factory. See the Table of Contents for further information.

3.15 Motor Compatibility:

Any three phase WYE or DELTA wound brushless DC motor designed to operate with 320 volts DC power and possessing a minimum winding inductance of 300 micro Henries or greater and a minimum winding electrical time constant of 0.5 msec. See Section 7.0, "Motor Requirements" for more information.

3.16 Logic Control:

All logic I/O terminals numbered 1 through 14 are electrically isolated from the AC power. External logic interfacing should be implemented using TTL outputs. Simple toggle switches may also be used. The maximum input voltage should not exceed +24 volts DC. See appendix for suggested wiring hook-ups.

3.17 Dynamic Braking Limitations:

Some limitations exist in the use of the dynamic brake. Dynamic Brake Limitations: Maximum 4% Duty Cycle. 10 watts continuous/650Watts intermittent. Please read Section 14.0, "Dynamic Braking the Motor," if you intend to use this feature.

3.18 Packaging:

Models with the subscript "P" are packaged in a NEMA 1 type ventilated enclosure. All others are open frame. **DO NOT PLACE ANY LC-5 IN CONTACT WITH LIQUIDS, ELECTRICALLY CONDUCTIVE MATERIALS, OR CORROSIVE CHEMICALS OR ALLOW FOREIGN MATERIALS TO FALL INTO THE LC-5.** If the LC-5 must be used in an environment which violates these conditions, contact AUTOMOTION for special packaging recommendations.

3.19 Fuse Sizes:

When replacing a fuse, always use properly rated devices. For the LC-5A, use only a BUSS type ABC-10 or equivalent. For the LC-5B, use only a BUSS type, ABC-15 or equivalent. If the LC-5 is subject to frequent power-up conditions, a different fuse may need to be specified.

4.0 Quick-Start Set up:

The following steps should be followed in the order shown to complete the proper electrical installation. Always cut and strip only enough insulation off of connecting wires to mate with the LC-5 terminals. Do not leave bare wires exposed beyond the edge of the terminal block. This would create a potential hazard to the operator and the system from short circuits between adjacent terminals. **NEVER MAKE ELECTRICAL CONNECTIONS OR WIRING ADJUSTMENTS WITH LIVE POWER APPLIED TO THE LC-5 CONTROL.** Please refer to FIGURE 1 for information when performing the following installation steps.

4.1 Step One:

Wire motor phases to proper terminals on the LC-5 control. Use the wire sizes recommended in Section 6.0, "Power Supply Requirements." The three phase wires should be twisted together with approximately six twists per foot (0.3 meters).

4.2 Step Two:

Wire the rotor positional sensors into the control. In a typical installation, there will be 5 wires serving the sensor assembly. They are: S1, S2, S3, + low voltage DC power (i.e., Terminal #4, +12 volt DC), and LOGIC GROUND (i.e., Terminal #5).

Light gauge wire may be used, such as 24 AWG. When the distance between the motor and the control exceeds 6 feet (1.8 meters), AUTOMOTION recommends using a shielded cable for the sensor wires. A single shield covering the entire bundle should be sufficient with the shield terminated

Basic wiring installation details:

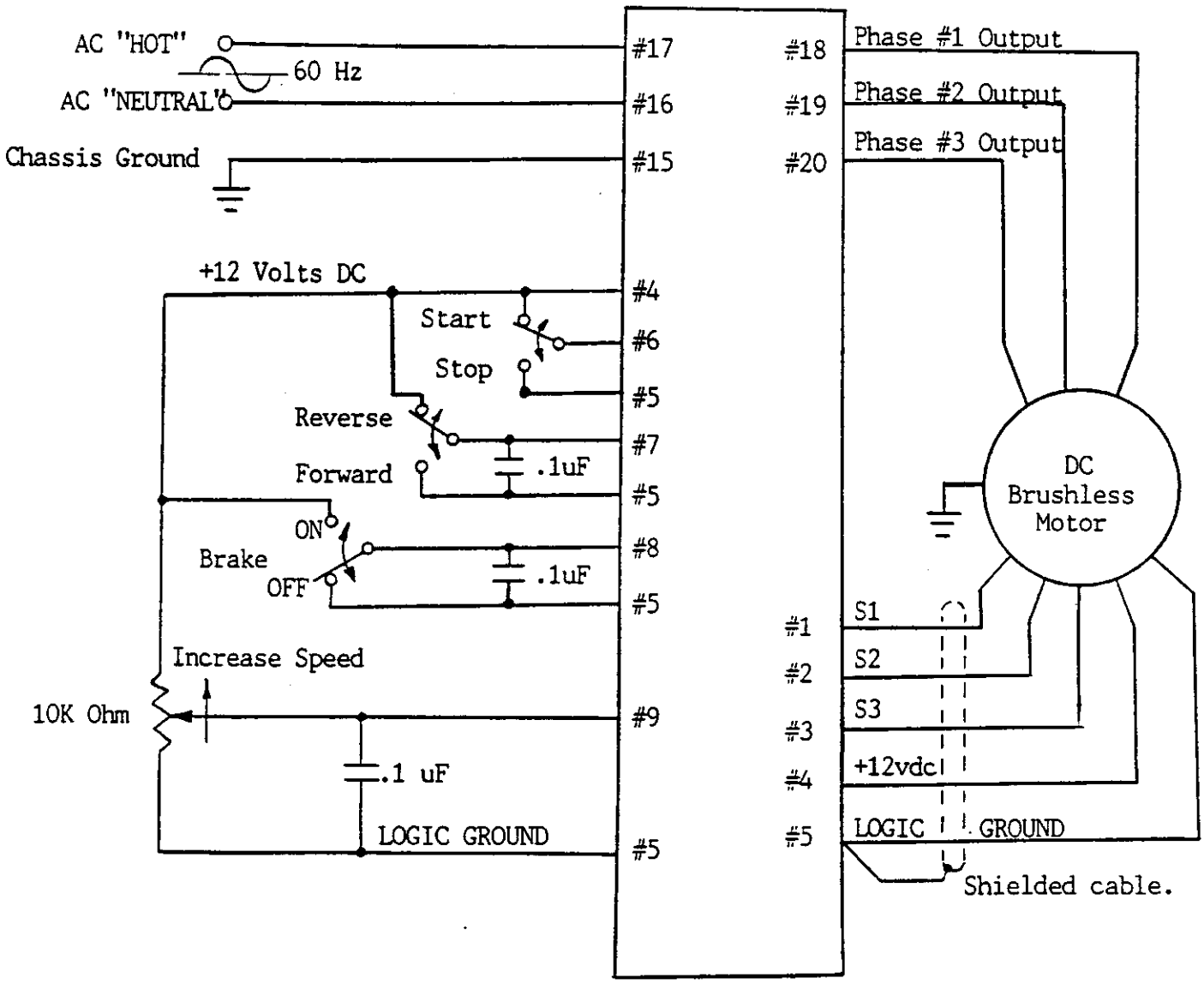


FIGURE 1

NOTE ! LOGIC GROUND and chassis ground are **NOT** common with each other and normally are kept separate from each other externally as well. Also, be aware of restrictions involving the use of the Forward/Reverse at high RPM's. SEE THE MANUAL FOR ADDITIONAL DETAILS!!

Shown above is a simple open loop speed control installation.

ONLY at Terminal #5 of the LC-5 control. The motor end of the shield should be left open. If unshielded wire is used, twist these five wires together with approximately six twists per foot (0.3 meters).

4.3 Step Three:

Determine the proper commutation signal phase shift required for your motor (i.e., 60 or 120 electrical degrees) and place the jumper located on the bottom of the LC-5 in the proper position as described below. See FIGURE 3 for placement details. Units are shipped in the 120 degree mode, unless otherwise indicated. Reference Section 7.0, "Motor Requirements" for more information.

4.4 Step Four:

Decide whether you will be using either open or closed loop speed control. If open loop is required, use Terminal #9 as the input for this 0 to +10 volt analog signal, which is referenced to LOGIC GROUND (i.e., Terminal #5). A +10 volt DC signal at Terminal #9 will run the motor at maximum current limited RPMs. Please note that for open loop speed control a simple external potentiometer with a minimum resistance of 10K ohms may be used to control your motor RPM's. See section 10.0, "Running the Motor With the LC-5 Control: OPEN LOOP" and Section 11.0, "Running the Motor With the LC-5 Control: CLOSED LOOP" for details.

Your LC-5 is designed to operate in several different speed control modes. These include: Open loop, 1, 2 or 4 quadrant speed control using a 0 to +10 volt analog signal; optional +/-10 volt input; internal single quadrant closed loop speed control with the tach signal provided by the commutation sensors; internal single quadrant closed loop speed control with the tach signal provided by an external encoder input; external PWM control.

4.5 Step Five:

If you use Forward/Reverse or Dynamic Brake controls, these ports may be toggled by either a simple SPDT switch, or by TTl signal outputs from an external electronic based control. If external TTL signals are used, the common return path must be connected to terminal #5 (LOGIC GROUND).

A note of caution: The standard LC-5 is designed to be used as a 4 quadrant drive under controlled conditions. The energy dissipated in the control during a direction change can be excessive and damaging to the LC-5 if certain precautionary measures are not followed. See Section 13.0, "Reversing the Motor, 4 Quadrant Operation."

4.6 Step Six:

With the 220 volt AC 50/60 Hz, feed power temporarily DISCONNECTED, wire the feeder block or the power cord into the LC-5 control. Use the wire sizes recommended in Section 6.0, "Power Supply Requirements." **NEVER MAKE POWER CONNECTIONS TO THE LC-5 WITH LIVE 220 VOLT AC POWER.**

4.7 Step Seven:

Before operating the LC-5 control for the first time, make sure that all logic control inputs are wired correctly and that the current drain out of Terminal #4 will be no more than 50 mA. Whenever AC power is first applied after a brownout or after a momentary power interruption, the LC-5 will require a power-up reset. This is done by toggling the Start/Stop input port (i.e., Terminal #6) from OFF to ON. Please note that it is normal for the "Power/OT Fault" LED to be lit at power-up of after a power interruption.

Always check the setting of the front panel trim pots. Improper adjustment can cause needless delays and trouble. Review Section 5.0, "Last Minute Check List" before operating the LC-5 for the first time.

5.0 Last Minute Check List:

(read before operating the LC-5 for the first time)

Have you connected your AC power cables correctly?

_____ yes _____ no

Are all connectors snapped into place?

_____ yes _____ no

Have you checked your motor phase output connections and all other wiring to make certain there are no shorts?

_____ yes _____ no

Will your power source supply the correct AC voltage?

_____ yes _____ no

(Remember to bring the motor speed up gradually the first time you operate the LC-5).

Have you adjusted the user accessible trim pots correctly?

_____ yes _____ no

If you are NOT using input Terminals #10 and/or #11, have you connected them to Terminal #5 (LOGIC GROUND)?

_____ yes _____ no

Have you read through this manual entirely including the SAFETY PRECAUTIONS?

_____ yes _____ no

If you answer "NO" to any of the above questions, make the necessary corrections before proceeding.

Please note, upon power up, the default condition for Terminals #6 start/stop is "Stop". Start/stop inputs must be toggled to its alternate state to start the motor.

6.0 Power Supply Requirements:

6.1 Power Source:

The power source used with the LC-5 product family must be a nominal 220 volts single phase AC service with a nominal line frequency of 50/60 Hz, +/- 3%, and the amperage capacity for the supply circuit must be rated at least 10 amperes above the continuous output rating for your particular LC-5 model. The voltage range must be between 200 and 245 VAC-RMS or an automatic shutdown of the control will occur. Any continuous supplied voltage over 245 VAC-RMS may cause damage to the control. The AC line inputs for the LC-5 are MOV protected for very short "soft" line transients above 260 VAC. Consult AUTOMOTION for limitations.

6.2 AC Voltage Fluctuation:

Voltage fluctuations on the AC supply line may adversely affect the maximum RPM level attainable by your motor and speed stability, especially when operating in an open loop mode.

6.3 Wire Size:

AUTOMOTION recommends that a minimum wire size of 18 AWG be used for connecting the LC-5 to both the AC power source and to the three phases of the motor. Use 16 AWG wire for the motor phase connections and the AC power connections if the individual wire lengths exceed 6 feet (1.8 meters).

6.4 Fuses:

The LC-5 product line is internally fused. Should the fuse blow, always determine why this occurred before attempting to operate the LC-5 again. See Section 3.19 for fuse sizes.

6.5 Line Filter:

In some noisy systems, it may be desirable to place a line filter between the LC-5 AC power input terminals and AC power source. Such devices are commercially available. Ask AUTOMOTION for recommendations.

7.0 Motor Requirements:

7.1 Commutation Feedback:

The LC-5 control is designed to operate with a three phase brushless DC motor. This motor must employ either three Hall or optical sensors for rotor positional feedback. These sensors must be capable of operation off of the +12VDC supply provided by the LC-5. The signal outputs of these sensors may use either passive or active pull-ups. The LC-5 DOES provide internal pull-ups. So, if the sensors used by your motor do not provide active pull-ups, then passive external pull-ups of three 10K Ohm, 1/4 Watt resistors are optional, though recommended. See FIGURE 2 for details.

For distances less than six feet (1.8 meters), twist the sensor wires and sensor power wires together with approximately six twists per foot (0.3 Meter). If the distance between the motor and control exceeds six feet (1.8 meters), use shielded wire for the commutation sensor signal lines and the commutation sensor power lines.

7.2 Electrical Characteristics:

The brushless DC motor should be three phase with either a WYE or DELTA wound stator. The motor inductance should not be less than 150 micro Henries phase-to-phase at full amperage. The total number of poles on the rotor assembly does not affect the performance of the LC-5 control except at very high RPM's.

The motor should operate with a DC voltage power source at a minimum of +400 volts, and pass a Highpot test of 1KV or higher.

7.3 Phase Shift Selection:

Before operating, configure the LC-5 control to match the phase shift between the signals supplied by the three rotor positional sensors. You can use the LC-5 with either 60 or 120 electrical degree phase shift. See FIGURE 3.

To program the LC-5, see FIGURE 4 for an illustration of where to locate the proper jumper pins on the bottom of the chassis. All units are shipped from the factory set for 120 electrical degrees unless otherwise noted.

* **To use the LC-5 control with 60 electrical degree signal phase shift, place the Group 2 jumper in position "B".**

* **To use the LC-5 control with 120 electrical degree signal phase shift, place the Group 2 jumper in position "A".**

Please note that the three rotor positional sensor signals coming into the LC-5 from your motor must be square waves. When the motor is running at a constant velocity, these signals should exhibit a 50% duty cycle.

Typical Hall Sensor Interface

(Must be duplicated for each of the three signal inputs).

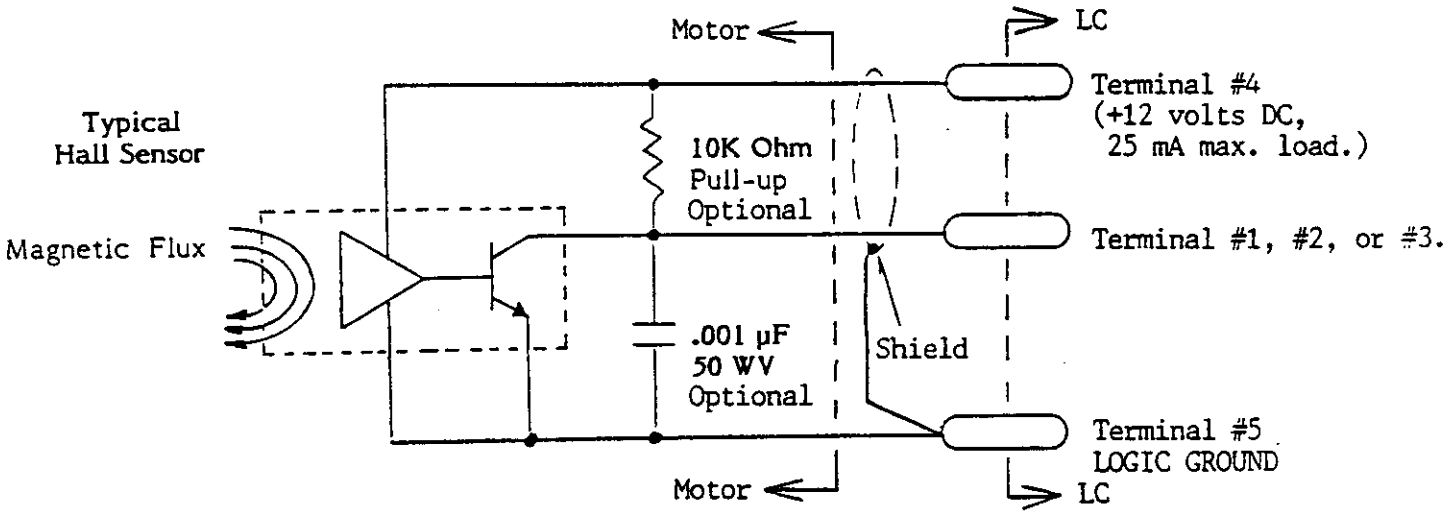
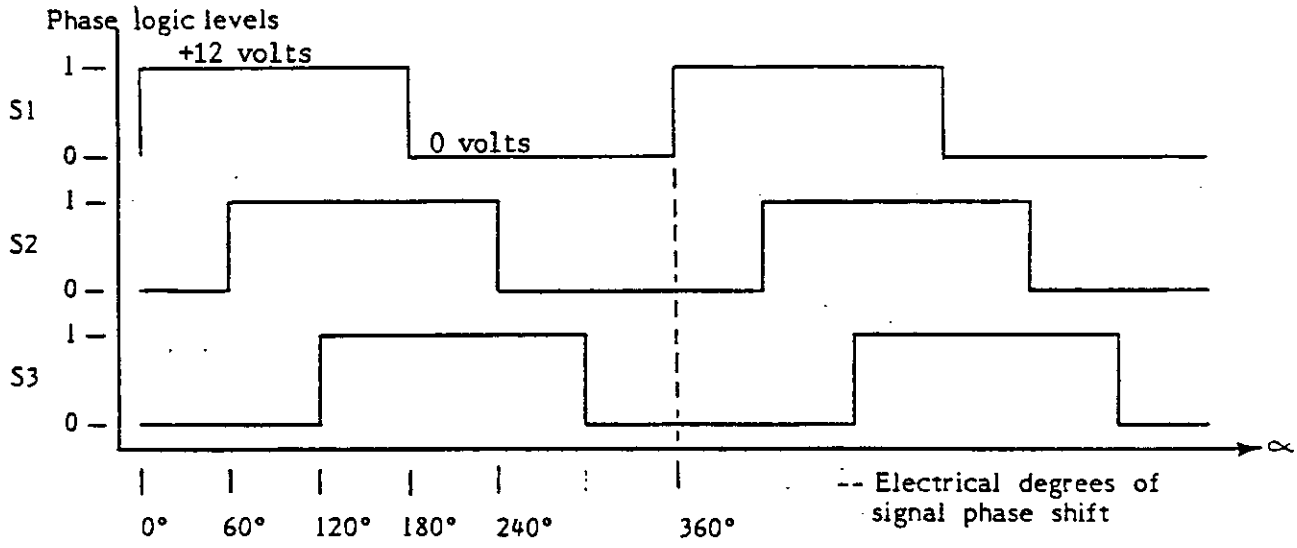
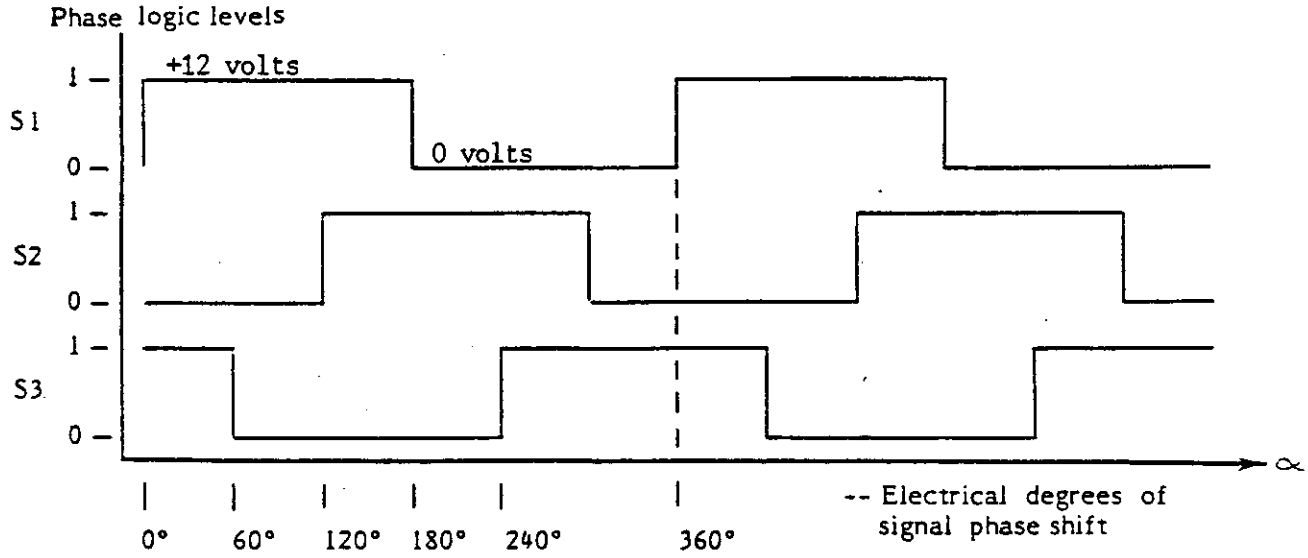


FIGURE 2

OPTIONS FOR COMMUTATION SIGNAL PHASE RELATIONSHIPS



60° ELECTRICAL SIGNAL PHASE SHIFT



120° ELECTRICAL SIGNAL PHASE SHIFT

FIGURE 3

Note: Each commutation signal has a balanced 50% duty cycle when the motor is running at a constant velocity.

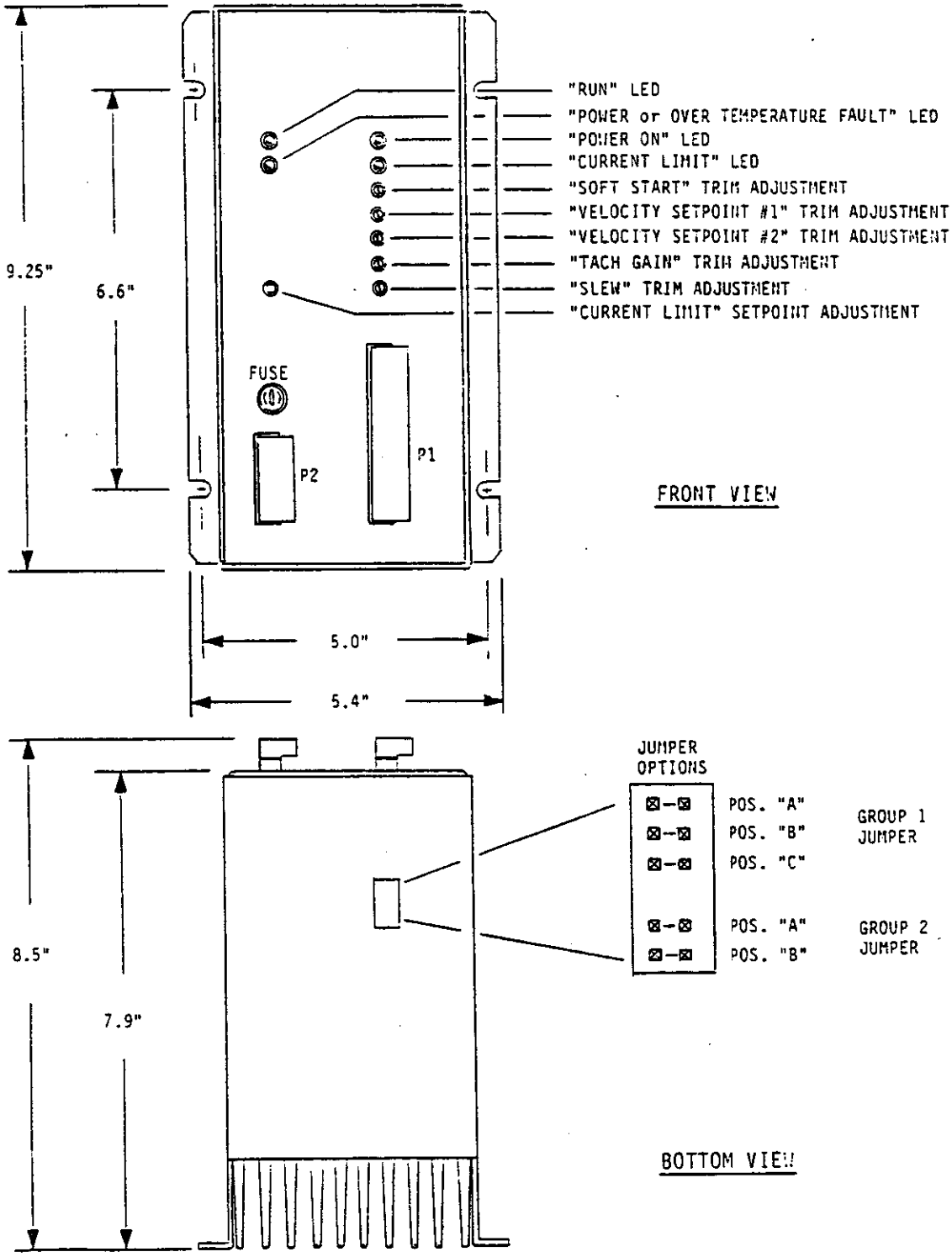

"RUN" LED
"POWER or OVER TEMPERATURE FAULT" LED
"POWER ON" LED
"CURRENT LIMIT" LED
"SOFT START" TRIM ADJUSTMENT
"VELOCITY SETPOINT #1" TRIM ADJUSTMENT
"VELOCITY SETPOINT #2" TRIM ADJUSTMENT
"TACH GAIN" TRIM ADJUSTMENT
"SLEW" TRIM ADJUSTMENT
"CURRENT LIMIT" SETPOINT ADJUSTMENT
9.25"
6.6"
FUSE
P2
P1
FRONT VIEW
5.0"
5.4"
JUMPER OPTIONS
POS. "A"
POS. "B"
POS. "C"
GROUP 1 JUMPER
POS. "A"
POS. "B"
GROUP 2 JUMPER
8.5"
7.9"
BOTTOM VIEW

FIGURE 4

8.0 Input/Output Terminal Identification:

Terminal Number	Function Description
1	COMMUTATION SIGNAL S1, INPUT PORT. Digital signal required from motor. A 10K ohm pull-up resistor is provided internally.
2	COMMUTATION SIGNAL S2, INPUT PORT. Digital signal required from motor. A 10K ohm pull-up resistor is provided internally.
3	COMMUTATION SIGNAL S3, INPUT PORT Digital signal required from motor. A 10K ohm pull-up resistor is provided internally.
4	+12 VOLT DC REGULATED OUTPUT PORT. 25 mA maximum load. This may be the power source for the commutation sensors in motor and some external logic.
5	LOGIC GROUND. All external logic should be referenced here. This port is isolated from chassis ground and from the AC power lines.
6	START/STOP CONTROL INPUT PORT. Approximately 4.7K ohm input Z. This port is TTL compatible. The maximum applied voltage here must not exceed +24 VDC. 0 volts stops the control. The default condition is STOP.
7	FORWARD/REVERSE DIRECTION CONTROL, INPUT PORT. This port is TTL compatible. The maximum applied voltage here must not exceed +24 VDC. O volts enables "forward" motor rotation. Default condition is FORWARD.
8	DYNAMIC BRAKE CONTROL, INPUT PORT. This port is TTL compatible. 0 volts turns off the brake. The default condition is brake "OFF".
9	OPEN LOOP SPEED CONTROL INPUT PORT. Requires a 0 to +10 volt signal to set the open loop motor speed. +10 volts produces maximum motor RPM's and 100% PWM amplifier output. 0 volts produces zero motor speed and 0% PWM amplifier output. The input Z is approximately 22K ohm. The default condition is zero speed. (+/- volt input optional.)
10	DUAL SPEED SELECT CONTROL, INPUT PORT. A TTL compatible port for selecting one of two Closed Loop speed settings. This uses the internal single quadrant Closed Loop speed control. Both speed settings are controlled through built-in pots. The default condition selects Velocity Setpoint #1.
11	EXTERNAL CLOSED LOOP SPEED CONTROL, INPUT PORT. This port allows for an external signal source to control the internal single quadrant Closed Loop speed. The input Z is approximately 10K ohm.

Terminal Number	Function Description
12	EXTERNAL ENCODER/ EXTERNAL PWM INPUT PORT. This port is TTL compatible. The maximum applied voltage here must not exceed +24 VDC. See Section 11, 12, and Appendix A & B for configuration details.
13	CURRENT SIGNAL OUTPUT PORT. (Optional). Approximately +.05 volts/Ampere. See Section 18.1 for details.
14	EXTERNAL CURRENT TRIP, INPUT PORT. Whenever a digital signal is applied here of +12 volts in amplitude, the LC-5 stops sourcing current to the motor. Input Z is approximately 22K ohms. See Section 16.0 for details.
15	CHASSIS GROUND (i.e., heat sink)
16	220 VOLTS AC NEUTRAL POWER INPUT PORT. 50/60 Hz.
17	220 VOLTS AC HOT POWER INPUT PORT. 50/60 Hz.
18	MOTOR PHASE #1 OUTPUT.
19	MOTOR PHASE #2 OUTPUT.
20	MOTOR PHASE #3 OUTPUT.

9.0 Installation: Mechanical:

Mount on a clean and flat vertical surface. This will provide natural convection air cooling. Notches in the side brackets are provided for mounting the unit. Never drill holes into or mount brackets on the case.

Whenever the heat sink temperature reaches approximately 50 degrees Celsius (122 degrees Fahrenheit), the LC-5 will automatically shut down. If the surface temperature of the mounting base of heat sink is around or above 50 degrees Celsius, additional forced air cooling will be required.

Do not place the LC-5 in an environment subject to high vibrational stress. If this is necessary, contact AUTOMOTION.

The LC-5 model "P" unit is a packaged device designed to conform to NEMA type 1 standards.

10.0 Running the Motor With the LC-5 Control - OPEN LOOP:

10.1 Set Up:

To operate the LC-5 control in an open loop mode means that there is not any built-in means of speed regulation. Rather, the speed will be governed based upon the analog signal supplied on Terminal #9. Other factors influencing speed stability in an open loop mode are the load applied to the motor, the AC line voltage stability, and the maximum current delivery of the LC-5 model being used.

To set up the control for open loop operation, examine FIGURE 4. Locate and adjust the Velocity Set #1, Velocity Set #2 and the Tach Gain pots fully counter-clockwise. These three pots are approximately 17 turn devices and to adjust them will produce a noticeable "click" when they are at the fully CCW or CW extremes. Also decide how much, if any, "Soft Start" time is needed, and how much current limited output is required. Refer to Section 16.0, "Setting the Maximum Current

Limited Output" and Section 15.0, "Using Soft Start."

10.2 Speed Control:

To control the speed a 0 to +10 volt signal must be applied to terminal #9. This variable analog voltage should be referenced to Terminal #5 (LOGIC GROUND). The amplitude of the analog voltage applied to Terminal #9 linearly modulates the duty cycle of the PWM controlled output voltage to the motor windings.

At 100% duty cycle modulation the motor will rotate at maximum speed. If the motor is unloaded, the speed will only be limited by the peak-to-peak voltage applied to the motor which is a nominal +320 volts. If the load upon the motor increases enough to cause excessive current to be drawn, the PWM duty cycle will automatically be reduced to limit the peak current level, causing the speed to fall off.

The Appendix shows several examples of how an external speed control may be provided in the open loop mode.

Before running the motor, pre-select the commutation phase code, set the motor drive direction by using Terminal #7, and disable the Dynamic Brake by applying 0 volts to Terminal #8. Limitations apply for rapid direction changes at rotational speeds above 1000 RPM. See Section 13.0, "Reversing the Motor, 4 Quadrant Operation."

Remember, upon initial power up, the LC-5 default condition is start/stop control in the stop condition, and the dynamic brake is off. The start/stop input must be toggled to its alternate state to start the motor.

To start the control, Terminal #6 must be activated by a +5 volt TTL signal. Now the analog voltage may be increased on Terminal #9. If the motor is wired correctly, it should begin to turn slowly, but smoothly, as the analog voltage increases at Terminal #9. Also wire Terminals #10 and #11 to Terminal #5 (LOGIC GROUND) if the internal closed loop speed control is not to be used. When running in the open loop mode, the signal applied to Terminal #9 proportionally controls the amount of modulation applied to the motor. However, the speed of the motor in the open loop mode will NOT necessarily vary in direct proportion to the voltage applied to terminal #9.

11.0 Running the Motor With the LC-5 Control - CLOSED LOOP:

11.1 Set up:

To operate in a closed loop mode the speed is regulated through a means of feedback control. This feedback system will automatically try to compensate for fluctuations in either the motor load or the supply voltage, which would otherwise change the speed.

The built-in closed loop speed control system on the LC-5 is 2 quadrant only. If the motor speed should overshoot the setpoint or if there is an overriding load, the control will not produce a negative torque on the motor to slow it down. Rather, the LC-5 will simply stop sourcing power to the motor until the speed drops. More elaborate 4 quadrant performance may be achieved with the Forward/Reverse and Dynamic Brake functions, however, certain limitations apply. AUTOMOTION does not recommend toggling the Forward/Reverse line while under closed loop control unless the Current Limit pot setting is set midway. (i.e., 8 turns off fully CCW). The built-in closed loop speed control system on the LC-5 is designed for 2 quadrant velocity loop control only.

The built-in closed loop speed control system on the LC-5 allows two options for creating a tachometer signal necessary for speed regulation. They are:

1. Hall Signal feedback
2. External encoder feedback

The Hall signal feedback is provided by the motor. It is not as effective as a high resolution encoder at low speeds or where tight speed regulation is required (< +/- 1%).

In general, the Hall signal approach is suitable for speeds above 350 RPM. To select the Hall signal feedback mode, place the jumper in Group 1 in position "A". Place it in position "B" to select the external encoder feedback mode. Speed stability with either approach is influenced by the setting of the Tach Gain pot, the Slew pot, the load, and the total dynamic speed range of the motor. To control the closed loop speed, the LC-5 allows two options. They are:

1. Internal speed pots
2. Externally supplied voltage reference

11.2 Use of Internal Speed Pots:

To use the internal speed pots, note the front panel layout in FIGURE 4. There are two on-board pots used for setting the closed loop speed. They are designated "Vel. Set #1" and "Vel. Set #2." With a TTL logic level "0" input on Terminal #10, pot #1 is automatically selected as the primary speed control pot. "Vel. Set #2" is your secondary speed control pot selected by a TTL logic level "1" input on Terminal #10. Both pots are 17 turn devices with full CW producing maximum speed. The maximum allowable voltage input on Terminal #10 is +24 volts DC and the minimum voltage input is -0.3 volts DC.

The maximum speed level using pot #2 can never exceed the speed setting for pot #1. These two pots can be used for dual RPM level shifting while under closed loop speed control. Just remember to select the desired pot using Terminal #10 as described above.

11.3 Use of an External Voltage Reference:

To supply an external reference voltage to set the closed loop speed, adjust both pot #1 and pot #2 to their fully CCW positions. A noticeable "click" will be heard. Use Terminal #11 as the input port for this externally supplied signal. The signal amplitude applied to Terminal #11 should range from 0 to +10 volts for full range control. The maximum voltage should not exceed +12 volts or be less than -0.3 volts. When Terminal #11 is not in use it should be left disconnected or strapped to Terminal #5 (LOGIC GROUND). After the Tach Gain Pot is adjusted, the voltage span to attain full speed may become very narrow. External scaling may be effected through the use of a series resistor with terminal #11.

11.4 Tach Gain and Slew Adjustments:

When using closed loop control, the proper adjustment of the tach gain pot will impact the performance of the motor under changing load conditions. AUTOMOTION recommends that, initially, the tach gain pot, which is a 17 turn device, be set approximately halfway. This establishes a moderate tach gain. Higher or lower gain may be needed later, depending upon the desired system response and stiffness. In general, a higher tach gain setting will provide for a lower speed drop as the motor load increases.

If the motor vibrates, or the speed is erratic, the LC-5 could be in a current limit mode or there could be too much system gain, or poor loop compensation. One possible solution is to adjust the slew pot to reduce the loop response (i.e., CCW). If the LC-5 is in a current

limit mode the "Current Limit" red LED will glow.

The slew pot helps produce a lag in overall loop response when operating under closed loop conditions. This pot should be left in the fully CW position for the fastest loop response. Before operating the LC-5 under internal closed loop control disconnect any input connection to Terminal #9. It could prevent proper performance of the internal closed loop system. Please refer to Appendices for additional information and suggested wiring connections

12.0 External PWM Speed Control:

An external digital PWM signal can be used to control the output modulation to the motor. If one is used, AUTOMOTION recommends that the base frequency be no higher than 20 KHz.

To set-up external PWM, place the LC-5 in the Stop mode. Next, strap Terminal #9 to Terminal #4. Examine FIGURE 4 to locate and place the Group 1 jumper in position "C". The external PWM signal source must be fed into the LC-5 via Terminal #12. This signal source should be TTL compatible.

The logic inside the LC-5 is positive true. A logic high level for the PWM signal translates into an ON condition in the output amplifier. The external PWM source will have complete speed control over the motor except when the output is in a current limited state. Whenever the motor goes into current limit the LC-5 will automatically limit the output modulation and override the external PWM source.

If the motor goes into a current limit mode, the Current Limit LED on the front panel will glow. The brighter the glow, the higher the peak current draw. Precise speed may be difficult to maintain when operating in a current limit mode.

13.0 Reversing the Motor, 4 Quadrant Operation:

The LC-5 control permits the reversal of the motor while in motion. However, some discretion is required when under closed loop or operating above the 1000 RPM level. Please refer to Appendix for additional information and suggested wiring connections.

A 4 quadrant drive means the motor and control can produce a negative torque which opposes the direction of shaft rotation. This negative torque is limited by the maximum output current and the torque constant of the motor. This operation is different than dynamic braking since the effects of negative torque by dynamic braking decrease with lower shaft speeds.

Under closed loop control, if the motor is to be subject to direction reversals AUTOMOTION requires that the Current Limit setpoint be reduced, unless the heavy duty 4 quadrant +/- 10 VDC Analog Input option has been installed. Looking at the front panel find the Current Limit pot. This pot should be adjusted for a halfway position (approximately 6 turns off the fully CCW position).

14.0 Dynamic Braking the Motor:

When it is desirable to dynamically brake the motor, Terminal #8 should be toggled to a TTL logic "1" level. The maximum signal amplitude allowed here is +24 volts.

To release the dynamic brake pull Terminal #8 down to LOGIC GROUND potential as found on Terminal #5 or apply a TTL logic "0" level signal. Do not take the voltage on Terminal #8 below LOGIC GROUND potential, which is 0 volts.

In order for the dynamic brake to be fully effective, the voltage on Terminal #9 during the braking cycle must be +10 volts DC. Any voltage less than +10 volts DC will begin to diminish the effectiveness of the dynamic brake. This has the benefit in allowing the deceleration rate to be controlled. However, the effect of the brake drops off rapidly with voltage levels much below +9 volts DC on Terminal #9 during a dynamic brake cycle.

The standard dynamic brake feature can absorb energy at a rate of 10 Watts continuously and 650 Watts intermittently. This translates into a maximum duty cycle rate 4% ON and 98% OFF, or 6 Seconds ON and 150 Seconds OFF. If higher rates are required, consult AUTOMOTION.

15.0 Using Soft Start:

The LC-5 control has a built-in Soft Start feature. This permits the acceleration rate for the motor to be controlled. To locate the Soft Start pot, refer to FIGURE 4. When adjusted to the maximum setting clockwise, the motor will accelerate at the slowest rate. Acceleration at this rate may take 60 seconds or more to reach setpoint speed. When the Soft Start pot is set for the minimum setting (i.e., maximum acceleration) it must be in the fully counter-clockwise position. This pot is a 12 turn device.

The Soft Start feature is useful in accelerating delicate loads up to running speeds. The Soft Start feature is only in effect after the Start/Stop input signal on Terminal #6 is toggled. Once the Soft Start cycle times out, it cannot be repeated until the Start/Stop input is again toggled OFF and back ON.

16.0 Setting the Maximum Current Limited Output:

The Current Limit pot located on the front panel of the LC-5 (See FIGURE 4) is used to set the maximum current limited delivery from the LC-5 control. The peak current output will reach a maximum level after approximately 17 full CW turns on the Current Limit pot. The relationship between the actual current limit and the pot setting is linear. When the LC-5 is in a current limit mode, the "Current Limit" red LED will glow. Should the rotor of the motor ever become firmly locked during a run condition, the LC-5 will automatically shut down after a few seconds and the "Current Limit" red LED will glow brightly. To restart the LC-5, the Start/Stop input must be toggled from OFF to ON.

You can remotely control the trip level of current limit by feeding a digital pulse signal, between 2 and 10 uSec. in duration, into Terminal #14. This signal must be +12 volts in amplitude as referenced to Terminal #5 (LOGIC GROUND). When a +12 volt digital pulse with a fast leading edge is applied to Terminal #14, the LC-5 will turn off output amperage to the motor until the next cycle begins on the internal 18 KHz PWM oscillator.

This is useful when used in conjunction with the Current Signal Output Option which can be ordered with the LC-5. The combination of this option and a simple comparator circuit will allow the user to remotely control the current limit setpoint.

17.0 In Case of Trouble:

Should your motor and LC-5 control not perform properly after following the installation and operation procedures, read through this list of symptoms.

17.1 Symptom 1:

Running the motor in the open loop mode nothing happens (i.e., the rotor does not move at all once power is applied).

* SOLUTION *

Check that only the Green LEDs are lit. If all LEDs are off, check that the AC power supply connections are correct and that 220 volt AC power is applied. Check the fuse.

If the fuse is blown check each output connection for shorts or otherwise improper wiring. If the fuse blows a second time contact AUTOMOTION immediately.

Should any red LEDs be lit, see the LED diagnostics chart for advice. The motor will not run in the open loop speed control mode without a voltage above LOGIC GROUND up to +10 volts being applied to Terminal #9. Try toggling the Start/Stop input port, Terminal #6, first to 0 volts DC and then to +5 volts DC. Remember that a 0 volt DC signal is required at the Dynamic Brake input port, Terminal #8. Both closed loop speed control pots, Vel. Set #1 and #2, must be set FULLY CCW and the Tach Gain pot must be set FULLY CCW in order to attain full open loop rotor speed. Note that all external logic control signals applied to the LC-5 must be referenced to Terminal #5 (LOGIC GROUND).

Are the three motor phase output connections connected?

Are all of the LC-5 wiring connections placed into their respective terminals securely?

Are the front panel connectors snapped into place securely?

Check your three rotor positional sensors for proper electrical connections and check that you have properly selected your sensor signal phase angle. Are the three rotor position sensor signals, designated S1, S2 and S3, of proper amplitude? (i.e., +12 volts DC for a "1" state and 0 volts for a "0" state. See FIGURE 3). The Appendix contains suggested wiring connections for several popular brushless motor manufacturers.

17.2 Symptom 2:

When running the motor without a load, the operating current seems to be excessive, or the motor vibrates at low RPM. Alternatively, the motor must be hand-turned to start rotation.

* SOLUTION *

Check the position of your commutation sensors located within or upon the motor frame. They must be adjusted for optimum commutation efficiency. Rotate the sensor assembly a few degrees both CW and CCW relative to the stator and again try running the motor. If the current begins to increase or decrease, the sensor assembly may be misaligned. Adjust it accordingly to reduce the unloaded current drawn and improve commutation efficiency.

When the commutation is properly "NEUTRALIZED," the motor will run at the same RPM in both directions while unloaded using a constant speed control signal into Terminal #9.

Has jumper Group 2 (See FIGURE 4) been properly programmed to select either 120 or 60 degree phase shift for the commutation signals?

LED Diagnostics Chart

For use in conjunction with Figure 4.

LED Status				
RUN	POWER ON	CURRENT LIMIT	POWER/OT FAULT	Condition
off	ON	off	off	AC power applied. Unit on standby.
ON	ON	off	off	Output power applied to motor. Unit in a "RUN" mode.
ON	ON	ON dimly	off	Motor running in a current limited state. Peak current excessive.
ON	ON	ON bright	off	Locked rotor shutdown state. The LC5 has automatically shutdown.
ON	ON	off	ON	The LC5 has experienced a brownout, a sustained overvoltage, or high temp.
off	off	off	off	Either no 115 Volt AC power is applied or there is a logic power fault.

IT IS NORMAL FOR THE "POWER/OT" FAULT LED TO BE ON UPON INITIAL POWER-UP.

FIGURE 5

NOTE! See the manual for additional details on each individual condition listed in the chart above.

17.3 Symptom 3:

The rotor jerks erratically back and forth, or the motor vibrates while in motion.

* SOLUTION *

Are motor output phase connections connected and in the correct order? Also perform the same check upon the three rotor positional sensor connections.

Has jumper Group 2 (See FIGURE 4) been properly programmed to select either 120 to 60 degree phase shift for the commutation signals?

Check the dynamic balance of your motor and load.

If you are using internal closed loop speed control, try reducing the slew pot setting or reducing the tach gain setting. See Section 11.4 for details.

17.4 Symptom 4:

When running the motor, the rotor hums and moves very little or not at all.

* SOLUTION *

Check status of all LEDs. If they are all OFF, read symptom #1 carefully or compare status with the LED Diagnostics Chart.

Disconnect all power from the LC-5 control and try to free spin the rotor. Does it bind or feel excessively stiff? Investigate for possible motor bearing misalignment or damage.

Is the load which is coupled to the rotor shaft excessive or binding? Check this carefully. Try running the motor without the load.

Are there any commutation dead spots? Monitor the signals from the three rotor positional sensors, designated S1, S2 and S3 one at a time. Use a voltmeter with power applied to the drive then slowly rotate the motor shaft by hand through one complete revolution. Each transition to a "1" state should produce a +12 volt DC signal into the appropriate LC-5 input terminal. Each transition to a "0" state should produce a near 0 volt signal into the appropriate LC-5 input terminal. Contact AUTOMOTION for details. Check solution for Symptom 3.

17.5 Symptom 5:

When the motor begins to accelerate the control shuts down and the motor coasts to a stop. The "Power/OT Fault" red LED comes one.

* SOLUTION *

The AC line voltage may be low. Check this carefully.

17.6 Symptom 6:

When attempting to run the motor, the "Power/OT Fault" red LED comes on and/or the motor shuts down.

* SOLUTION *

Check your supply line voltage. If it is below 200 volts AC or above 260 volts AC the control will shutdown automatically. Check the temperature of the LC-5 chassis. If it is near or above 50 degrees Celsius (122 degrees Fahrenheit) the control is too hot and will shutdown automatically.

Check your 220 VAC supply line for severe line transients or surges with high peak voltages. It may be necessary to add an external line filter. Contact AUTOMOTION for suggestions.

17.7 Symptom 7:

When dynamically braking the motor, the "Power/OT Fault" red LED comes on and the motor shuts down.

* SOLUTION *

The duty cycle of the dynamic brake may be excessive. Reduce the frequency of braking if possible. Otherwise an auxiliary braking resistor may need to be installed. Contact AUTOMOTION for assistance.

17.8 Symptom 8:

The dynamic brake has little effect in slowing the motor.

* SOLUTION *

When the dynamic brake is applied, check the voltage at Terminal #9. This voltage needs to be +10 volts DC. See Section 14.0 for details.

17.9 Symptom 9:

When running motor under closed loop control, the speed is not stable.

* SOLUTION *

Check the "Current Limit" red LED. If it is glowing then the motor is drawing enough current while spinning to force the drive into a current limit mode. This can adversely affect speed stability because the motor is being starved for sufficient current to operate. Set the Current Limit pot at its maximum CW limit.

Check the load upon the motor. Is it excessive or binding? Does the motor shaft spin freely when the external load is removed? The load upon the motor shaft may be excessive and more power may be required than either the LC-5 or the motor can deliver. Check the solutions for Symptoms 2 and 4.

If the above steps fail to correct the problem, contact AUTOMOTION. **DO NOT** attempt to service the LC-5 control. To do so will immediately void the warranty.

18.0 Optional Equipment:

18.1 Current Signal Output Option:

The optional current signal output feature must be configured at the time of purchase and cannot be added in the field. This option produces an analog signal output which is proportional to the delivered amperage through the motor.

The calibration factor for this analog signal is approximately +.05 volts per Amp. There is a built-in offset voltage of approximately +6 volts DC. The amperage signal will ride on top of this offset voltage. Some low pass filtration may be needed for this signal because the drive's 18 KHz chopping rate will cause this signal to have some high frequency ringing upon it. The appropriate time constant for this filter will vary depending upon the application. AUTOMOTION will be pleased to provide application support if needed.

The maximum load impedence on Terminal #13 should be no less than 10K ohms.

Refer to Section 8.0, "Input/Output Terminal Identification," and FIGURE 6 for additional information.

18.2 +/- 10 Volt Analog Control Option:

The LC-5 may be purchased with an option to permit the user to use an external +/- 10 Volt signal to control the motor velocity. If your drive is equipped with this option, your +/- 10 Volt control signal must be coupled into Terminal #9 on the LC-5. Please note that Terminal #9 is the open loop input.

Use of the optional current signal output feature.

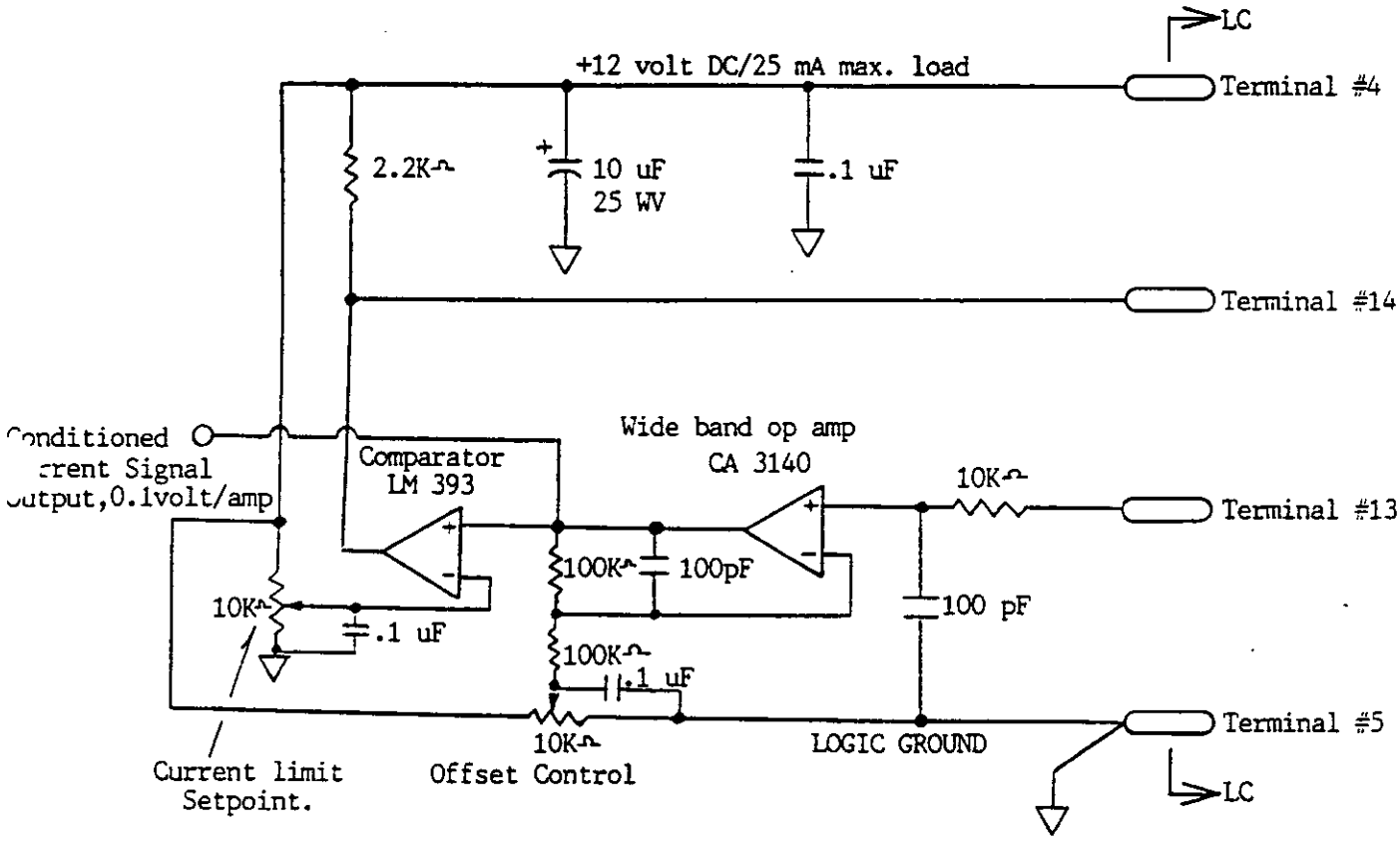


FIGURE 6

Suggested method for current loop feedback.

port for the LC-5. The speed may then be throttled and the direction of rotation controlled by using a singular bipolar analog signal into Terminal #9 when using this option. However, the LC-5 will NOT regulate speed under varying load conditions when using this option. The user must provide for the closed loop speed regulation in their external system hardware. When the LC-5 is equipped with this option the following pots are disabled permanently:

VEL. SET #1
VEL. SET #2
TACH GAIN
SLEW

This means that the LC-5's on board 2 quadrant speed control system is non-functional.

To use the LC-5 when equipped with this option, the absolute amplitude of the applied signal on Terminal #9 controls in direct proportion the amount of applied voltage modulation to the motor. This means 0 Volts translates into 0% PWM output, 5 Volts absolute translates into approximately 50% PWM output and 10 Volts absolute translates into approximately 100% PWM output to the motor.

The level of applied modulation may or may not vary the speed of the motor in a linear fashion. Linearity is a function of a number of factors, such as motor design and motor load. This is why if precise speed control is needed, an external speed regulator system is required.

The input impedance looking into Terminal #9 on the LC-5 equipped with this option is approximately 4.7 Ohms. The polarity of the applied signal into Terminal #9 controls the direction of shaft rotation. The relative direction of shaft rotation for positive or negative signal polarity may be programmed into the LC-5 by the user if a jumper wire is connected between Terminal #7 and either Terminal #4 or Terminal #5. Do NOT ever short Terminals #4 and #5 together.

19.0 Custom Features Section

If your unit included any non-standard, custom features; they would be listed here.

20.0 Warranty:

AUTOMOTION INCORPORATED hereinafter referred to as the "Company," warrants its products for a period of 1 year from date of shipment to be free of defects caused by faulty material or inferior workmanship. The liability of the Company under this warranty extends to the replacement, repair, or issuance of credit, at the Company's option, for any of its products which are returned by the initial Purchaser during such period, provided:

The Company is promptly notified in writing upon discovery of such defects by Purchaser.

The defective product(s) is returned to the Company after the Company has issued a Return Authorization Number, with all return transportation charges prepaid by Purchaser.

The Company's examination of such product(s) shall disclose to its satisfaction that such defects exist and have not been caused by improper installation, neglect, repair, alteration, misapplication, or accident caused by the Purchaser.

Under no circumstances shall the Company be liable for collateral or consequential damages of any nature incurred through the use of our products.

21.0 Life Support Policy:

AUTOMOTION'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF AUTOMOTION INCORPORATED.

As described herein:

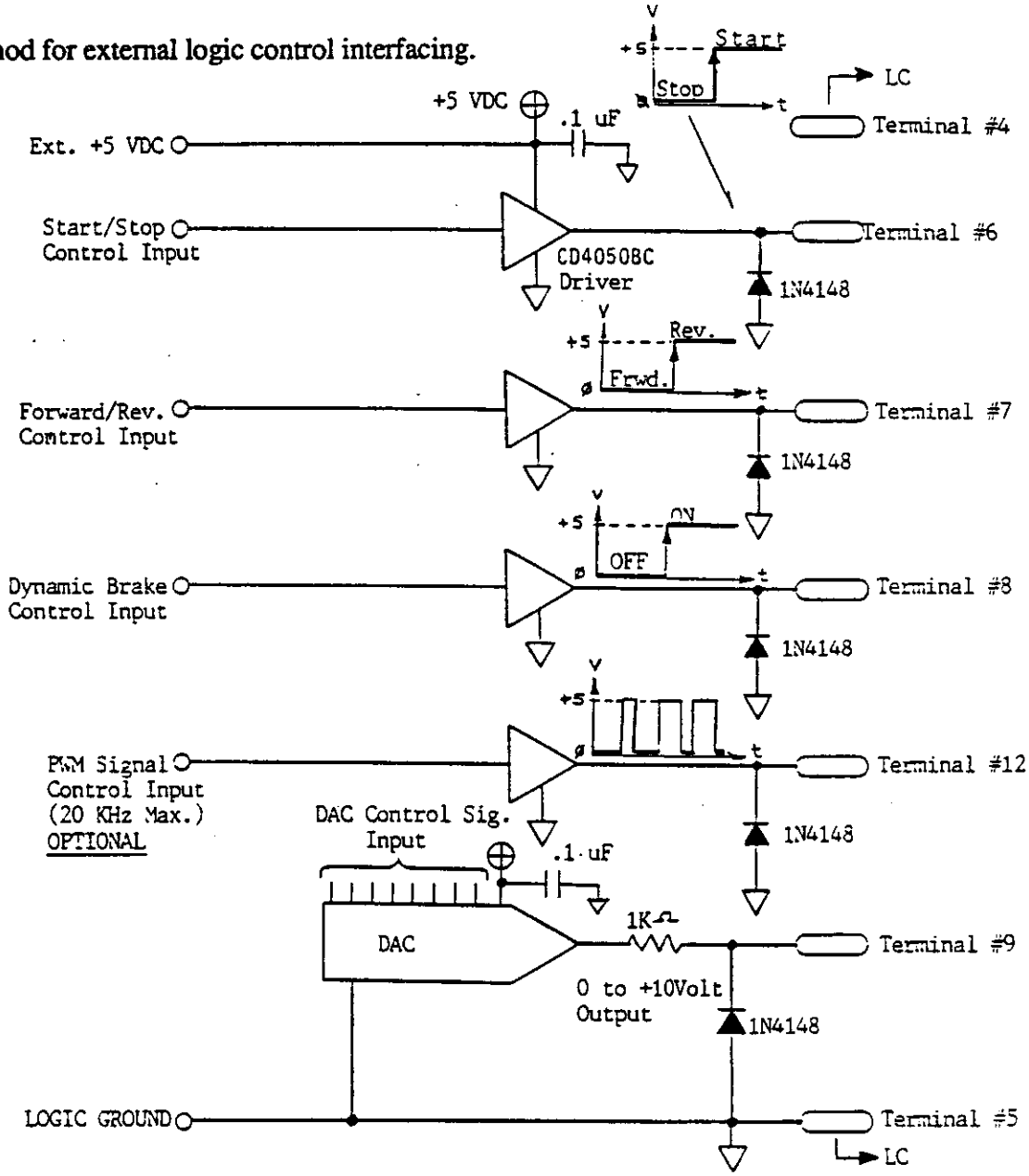
Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the User's Manual and in the labeling, can be reasonable expected to result in a significant injury to the user.

A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

22.0 Appendices:

Appendix A:

Suggested method for external logic control interfacing.

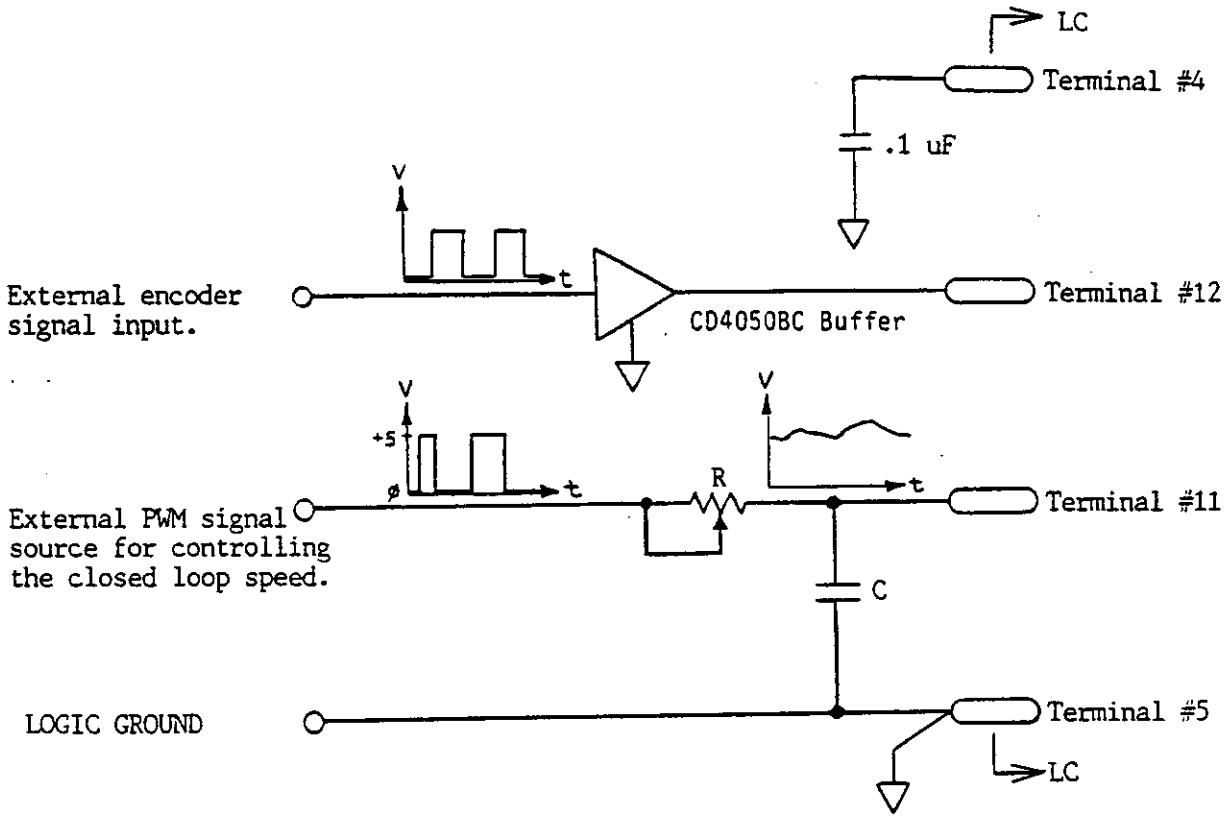


NOTES: Use of the PWM signal input for speed control is optional. If this input is to be used Terminal #9 should be connected to Terminal #4. See the manual for additional details.

All logic input/output signals on the LC-5 are electrically isolated from the motor drive output power.

Appendix B:

Use of an external input signal with an external closed loop speed reference signal input.



The signal input at Terminal #12 may be TTL. A buffer such as the CD4050BC is recommended but not mandatory. The maximum signal amplitude that can be applied to Terminal #12 is +12 Volts.

NOTES: The input impedence of Terminal #11 is 10K ohm. Therefore, both the low pass filter time constant required to smooth the incoming PWM signal and the peak signal required. A buffer amplifier between the RC filter and Terminal #11 may be needed. The signal source coming into Terminal #11 need not be just from a PWM generator. An analog source may be used directly.

Check the Group 1 jumper setting if an external encoder signal is to be used. See Section 11.0 for details.

APPENDIX C:

Motor Phase Commutation Sequence and Input/Output State Tables:

The following tables may be used to understand how the feedback signals from the three rotor positional sensors are decoded and subsequently energize the output phases of the LC-5 control.

In each table a "1" designates a + or "high" logic signal level. Conversely, a "0" designates a "low" logic signal level. For correct signal transition recognition, all + or "high" logic signal levels must match, but not exceed, the amplitude of the voltage available on Terminal #4 of the LC-5 control. AUTOMOTION recommends that the output voltage source available at Terminal #4 be used to power your external rotor positional sensors.

APPENDIX C: Continued

I/O State Table; 60 Electrical Degree Commutation Signal Phase Shift:

			Forward Motion		Reverse Motion	
			Current Source	-Current Sink	+Current Source	-Current Sink
S1	S2	S3	Output Enabled	Output Enabled	Output Enabled	Output Enabled
0	0	0	Phase 2	Phase 1	Phase 1	Phase 2
1	0	0	Phase 2	Phase 3	Phase 3	Phase 2
1	1	0	Phase 1	Phase 3	Phase 3	Phase 1
1	1	1	Phase 1	Phase 2	Phase 2	Phase 1
0	1	1	Phase 3	Phase 2	Phase 2	Phase 3
0	0	1	Phase 3	Phase 1	Phase 1	Phase 3

I/O State Table; 120 Electrical Degree Commutation Signal Phase Shift Mode:

			Forward Motion		Reverse Motion	
			Current Source	-Current Sink	+Current Source	-Current Sink
S1	S2	S3	Output Enabled	Output Enabled	Output Enabled	Output Enabled
0	0	1	Phase 2	Phase 1	Phase 1	Phase 2
1	0	1	Phase 2	Phase 3	Phase 3	Phase 2
1	0	0	Phase 1	Phase 3	Phase 3	Phase 1
1	1	0	Phase 1	Phase 2	Phase 2	Phase 1
0	1	0	Phase 3	Phase 2	Phase 2	Phase 3
0	1	1	Phase 3	Phase 1	Phase 1	Phase 3

Please Note: The Dynamic Brake input port, when enabled, will activate current sink outputs and disable all current source outputs. By applying a 0 to +10 volt DC analog signal to Terminal #9, the rate of braking may be throttled. See Section 14.0, "Dynamic Braking the Motor," for additional details.

23.0 Addendum

23.1 Cable Requirements

The phase output cable should have a maximum distributed capacitance of 100 pF/ft (328 pF/meter) up to a total of 1000 pF.
Total capacitance being the sum of phase to phase and phase to ground (shield) capacitance. If cable losses are higher, compensating line inductor's may be required. Contact Automotion for application assistance.

LC Application Note #100

Using the Automotion AUTOPAC DC Brushless Motors with the Automotion LC Control

The following table may be used to properly mate the wiring connections between Automotion AUTOPAC DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control

Automotion Terminal Label	Motor Lead Label
Phase 1	Heavy gauge ORANGE wire
Phase 2	Heavy gauge RED wire
Phase 3	Heavy gauge BROWN wire
S1	Light gauge BLUE wire
S2	Light gauge BLACK wire
S3	Light gauge YELLOW wire
Regulated voltage out put port	Light gauge VIOLET wire
Logic Ground	Light gauge GRAY wire

Note: The additional two (2) heavy gauge white wires are the built-in thermal protector. The light gauge red wire is for the thermal protector pull up

LC Application Note #102

Using the Pacific Scientific BL series of DC Brushless Motors with the Automotion LC Control

The following table may be used to properly mate the wiring connections between a BL series Pacific Scientific DC brushless motor and an Automotion type LC brushless motor control.

If there is any question regarding this connection, please contact the factory prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase T
Phase 2	Phase S
Phase 3	Phase R
S1	Sensor 1
S2	Sensor 2
S3	Sensor 3
Regulate voltage Output port	+12 V
Logic Ground	GND

LC Application Note #103

Using the Motronics DC Brushless Motors with the Automotion LC Control

The following table may be used to properly mate the wiring connections between a Motronics DC brushless motor and an Automotion type LC brushless motor control

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control

Automotion Terminal Label	Motor Lead Label
For DELTA wound, 4 pole motors:	
Phase 1	Heavy gauge RED wire
Phase 2	Heavy gauge BLUE wire
Phase 3	Heavy gauge WHITE wire
For WYE wound, 4 pole motors:	
Phase 1	Heavy gauge ORANGE wire
Phase 2	Heavy gauge RED wire
Phase 3	Heavy gauge BROWN wire
S1	Light gauge BLUE wire
S2	Light gauge BLACK wire
S3	Light gauge YELLOW wire
Regulated voltage out put port	Light gauge VIOLET wire
Logic Ground	Light gauge GRAY wire

LC Application Note #104

Using the BEI/Kimco Brushless Motor with the Automotion LC Control

The following table may be used to properly mate the wiring connections between a BEI/Kimco DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase A RED wire
Phase 2	Phase C GREEN wire
Phase 3	Phase B BLACK wire
S1	Sensor 1 BROWN wire
S2	Sensor 2 BLUE wire
S3	Sensor 3 ORANGE wire
Regulate voltage Output port	Sensor Supply (+) YELLOW wire
Logic Ground	Sensor return (GND) GRAY wire

LC Application Note #105

Using the Bowmar - Harowe DC Brushless Motor with the Automotion LC Control

The following table may be used to properly mate the wiring connections between a Bowmar - Harowe DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase C VIOLET wire
Phase 2	Phase B BROWN wire
Phase 3	Phase A BLUE wire
Chassis Ground	Case Ground
S1	S1 Yellow Wire
S2	S2 ORANGE wire
S3	S3 WHITE wire
Regulate voltage Output port	+12 V RED wire
Logic Ground	GROUND BLACK wire

LC Application Note #106

Using the Electro-Craft ES 2002 series of DC Brushless Motors with the Automotion LC Control

The following table may be used to properly mate the wiring connections between an ES 2002 Electro-Craft DC brushless motor and an Automotion type LC brushless motor control.

If there is any questions regarding this connection, please contact the factory prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase C VIOLET wire
Phase 2	Phase B BROWN wire
Phase 3	Phase A BLUE wire
S1	CHANNEL 3 WHITE wire
S2	CHANNEL 2 BLUE wire
S3	CHANNEL 1 YELLOW wire
Regulate voltage Output port	+5 VDC RED wire (Note: Automotion applies +12 VDC)
Logic Ground	GROUND BLACK wire

LC Application Note #107

Using the Robbins-Myers BDC series 36xx DC Brushless Motors with the Automotion LC Control

The following table may be used to properly mate the wiring connection between a Robbins-Myers BDC series 36xx DC brushless motor and an Automotion type LC brushless motor control.

If there is any question regarding this connection, please contact the factory prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase T VIOLET wire
Phase 2	Phase S BROWN wire
Phase 3	Phase R BLUE wire
S1	HALL A YELLOW wire
S2	HALL B WHITE wire
S3	HALL C ORANGE wire
Regulate voltage Output port	+5 VDC RED wire (Note: Automotion applies +12 VDC)
Logic Ground	GROUND BLACK wire

LC Application Note #108

Using the Pittman Brushless DC Motor with the Automotion LC Control

The following table may be used to properly mate the wiring connections between a Pittman DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase A BROWN wire
Phase 2	Phase B RED wire
Phase 3	Phase C ORANGE wire
S1	Sensor 3 WHITE wire
S2	Sensor 2 BLUE wire
S3	Sensor 1 GRAY wire
Regulate voltage Output port	Sensor Supply (+) VIOLET wire
Logic Ground	Sensor Return (GND) BLACK wire
Commutation Selection	120 Degrees

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LC Application Note #109

Using the Inland Motor Corp. Brushless DC Motor with the Automotion LC Control

The following table may be used to properly mate the wiring connections between an Inland DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	A (Red)
Phase 2	B (Wht)
Phase 3	C (Blk)
S1	C (Yel)
S2	B (Org)
S3	A (Brn)
Regulated Voltage Output Port	Blue
Logic Ground	Green
Commutation Selectation	120º

LC Application Note #110

Using the Baldor BSM4F Series Brushless DC Motor with the Automotion LC Control

The following table may be used to properly mate the wiring connections between a Baldor BSM4F DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	T1 (Phase A)
Phase 2	T3 (Phase C)
Phase 3	T2 (Phase B)
S1	S1 (White)
S2	S2 (Yellow)
S3	S3 (Orange)
Regulated Voltage Output Port	Vcc (Red)
Logic Ground	GND (Black)
Commutation Selection	60º

LC Application Note #111

Using the Eastern Air Devices BLDC Motor with the Automotion LC Control

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The following table may be used to properly mate the wiring connections between an Eastern Air BLDC motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Brown
Phase 2	Blue
Phase 3	White
S1	Yellow
S2	Green
S3	Gray
Regulated Voltage Output Port	Orange
Logic Ground	Black
Commutation Selection	120°

LC Application Note #112

Using the Bodine Brushless DC Motor with the Automotion LC Control

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The following table may be used to properly mate the wiring connections between a BodineDC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label	Bodine Cable Model 3991	Bodine Cable Model 3981
Phase 1	Phase A (Brown)	—	—
Phase 2	Phase B (Red)	—	—
Phase 3	Phase C (Orange)	—	—
S1	Hall A D Connector, Pin 3	Brown	Brown (5 Conductor)
S2	Hall B D Connector, Pin 8	White	White (5 Conductor)
S3	Hall C D Connector, Pin 5	Green	Green (5 Conductor)
Regulated Voltage Output Port	Commutation Vcc D Connector, Pin 4	Red	Red (5 Conductor)
Logic Ground	Commutation Common D Connector, Pin 9	Black	Black (5 Conductor)

Optional Encoder Feedback

Note: Place the Group 1 Jumper in position "B" if the motor is equipped with the 30 ppr encoder and make the following connections

External Encoder Input	Channel 1 or 2 D Connector Pin 1 or Pin 2	Yellow or Orange	White or Green (4 Conductor)
Regulated Voltage Output Port	Encoder Vcc D Connector, Pin 7	Not Applicable	Red (4 Conductor)
Logic Ground	Encoder Common D Connector, Pin 6	Not Applicable	Black (4 Conductor)
Commutation Selection:	60°		

LC Application Note #113

Using the MFM Technology DC Brushless Motors with the Automotion LC Control

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The following table may be used to properly mate the wiring connections between MFM Technology DC brushless motor and an Automotion type LC brushless motor control.

If the color code listed below does not correspond with that available on the motor, please contact Automotion prior to applying power to the control

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase B BLACK wire
Phase 2	PHASE C WHITE wire
Phase 3	Phase A RED wire
S1	Sensor 3 BROWN wire
S2	Sensor 1 GREEN wire
S3	Sensor 2 WHITE wire
Regulated voltage out put port	+ 5 VDC RED wire (Note: Automotion applies + 12 VDC)
Logic Ground	GND Black wire

LC Application Note #114

Using the EG&G Torque Systems Brushless Motors with the Automotion LC Control

The following table may be used to properly mate the wiring connections between Automotion's LC4 brushless DC motor control and the EG&G Torque Systems motor.

If there is any question regarding this connection, or if the color code listed does not match that on your motor, please contact Automotion for assistance prior to applying power to the control.

Automotion Terminal Label	Motor Lead Label
Phase 1	Phase B Black 22 AWG
Phase 2	Phase C Red 22 AWG
Phase 3	Phase A White 22 AWG
S1	S3 green 26 AWG
S2	S1 brown 26 AWG
S3	S2 yellow 26 AWG
Regulated voltage output port	(+) red 26 AWG
Logic Ground	(-) black 26 AWG
Chassis Ground	(External Frame Gnd) Green 22 AWG

Semitool

Maintenance Section

SECTION 5.0 MAINTENANCE

5.1 GENERAL NOTES ON MAINTENANCE

1. Good performance can only be achieved if the Semitool Rinser/Dryer and surrounding areas are kept clean. Most regular machine cleaning procedures can be performed using DI water and peroxide. For components that are excessively dirty, the following sequence of baths or wipe-downs can be performed.

   - DI water and peroxide for removal of residue build-up.
   - Peroxide for bacteriological decontamination.
   - Deionized (DI) Water for a final rinse.
   - Blow dry with a Nitrogen (N2) or Clean Dry Air (CDA) supply.

2. The use of ultrasonic or agitated bath cleaning methods is preferred over scrubbing. To eliminate the need for valve disassembly, purge and flush with cleaning fluids (H2O2, DI Water, etc.). Some components are damaged by certain cleaning fluids. The table below lists these components and presents the cleaning fluids which may be used.

Component	Acceptable Cleaning Fluid
Manifold Gasket	DI Water Only
Optical Sensor Reflective Surface	DI Water Only
Resistivity Monitor Probe	DI Water Only
N2 Cartridge Heater	DI Water Only
Electrical Components	Blow Clean with N2 CDA

3. Any personnel servicing Semitool equipment should be skilled in maintenance practices. Use clean tools, wear adequate protective gear, and be conscious of maintaining a clean environment. Work should be performed in a clean, well ventilated area with adequate space and facilities.

5.2 WEEKLY PREVENTATIVE MAINTENANCE

5.2.1 Rotor Removal

a. For the standard four bolt rotor, remove the four retaining bolts and the rotor from the bowl (see the Options Section of this manual for QD Rotor removal). Take care when removing the rotor from the bowl to prevent scratching or scraping the coating of bowl.

b. Inspect the rotor for signs of staining or corrosion. Clean with a cleanroom wipe and peroxide/DI water solution. Inspect wafer retainer rods for excessive wear.

Note: Stains can be an indication that a change in process might be necessary; i.e., increased retention time in "Dump Rinse" after acid process.

5.2.2 Bowl Inspection

a. Inspect Bowl for scratches, scrapes, dents and other signs of damage. Damage of this sort can contribute to increased particle counts. If damage is severe, repassivation may be necessary. Contact Semitool for instructions.

b. Inspect the area around N2/DI water nozzles, and CY-20 port for signs of contamination. Clean with peroxide and/or DI water if necessary.

c. Inspect the surface of the drive plate, if standard, or the QD drive. If unit has a QD type rotor, inspect the exterior of the motor/bowl seal.

5.2.3 Drain Tube Inspection

a. With the rotor removed, visual inspection of the Drain Tube can be carried out using a flashlight. The tube should be clean and smooth with no signs of wafer breakage. If the tube is contaminated, remove it and clean with peroxide/DI Water solution.

b. To remove Drain Tube, unfasten screws from shroud and remove shroud. With shroud Off, loosen hose clamp on drain tube. Twist tubing to remove. Clean tubing with peroxide/DI Water solution.

c. Reassembly of tube is the reverse of disassembly.

Note: Older tools are equipped with Tygon drain tubes. Semitool recommends replacing these tubes with PFA Teflon Drain Tube, Semitool P/N 12494-11.

5.2.4 Drain Box Inspection

a. Located at the rear of the tool, remove the drain box cover from the top of the drain box and remove the screen (trap) from inside the drain box.

b. Inspect the drain box for foreign material. Remove any material from the box. If the inside of the box is discolored or dirty, clean with a lint free cloth soaked with peroxide/DI Water solution.

c. If the drain box shows signs of recent wafer breakage, the Resistivity Monitor Probe (if present) may have become fouled. Remove the Probe by disconnecting the patch cord from the controller and unscrewing the probe from the drain box. Bits of broken wafer can become lodged in the probe. Use the N2 blow off gun to remove this type of contamination. If the probe requires more cleaning, proceed to the next step.

5.2.5 Cleaning Resistivity Monitor Probe

a. Inspect the probe and drain box for sources of contamination, e.g.; broken wafers, scale and/or blocked DI Water path. Remove foreign material from the drain box. Any object in contact with the probe can affect the resistivity reading. Any obstruction of water flow to the probe can cause erratic resistivity readings.

b. Conditions can exist that can contaminate the resistivity monitor probe, e.g. organic contamination from fouled DI Water sources, mishandling of the probe during inspections, etc. If resistivity indications are erratic or unusually low, when compared to another probe, cleaning of the probe may be necessary. A tentative schedule for cleaning the electrodes should be established. The time interval between cleanings can be increased or decreased depending on the nature of the process liquid or the difference between resistivity readings before and after cleaning. To clean the probe, remove the probe from the drain box (See 5.2.5.c). The following procedure is from Foxboro and should be satisfactory to clean most contamination:

1. Remove the sensor from the process chamber.

2. Soak the sensor (immersed to the bushing) in 2% Micro-soap/DI Water for thirty minutes. Solution should be stirred with a magnetic stirrer. Solution temperature should be approximately 55° C.

3. With fresh solution, immerse electrodes to the bushing in an ultrasonic bath, at approximately 55°C, for four minutes.

4. Repeat step three.

5. Rinse electrodes in DI Water.

6. With a fresh solution of DI Water, immerse electrodes to the bushing in the ultrasonic bath for four minutes minimum.

7. Repeat step six above.

Note: Micro-soap is a product of International Products Corp., Trenton, New Jersey, 08601

5.2.6 Window and Door Seal Inspection

a. Open the door and examine the seal area for foreign material.

b. Remove the seal if the area appears contaminated with broken wafer chips or residue from processing. Clean the seal with peroxide/DI Water solution and a lint free cloth.

c. With the seal removed, clean the seal channel with peroxide/DI Water solution and a lint free swab.

d. Reinstall the seal in the channel and wipe the exterior of the seal and window surfaces with the peroxide/DI Water solution.

5.2.7 N2 Filter Inspection

The filter life depends on several factors, such as the quality of N2 being supplied and machine usage. Until the user develops a time schedule for their replacement, the filter should be inspected regularly.

5.2.8 Tubing and Fittings Inspection

a. With shroud removed, inspect surfaces and plumbing connections. Check for abrasion of tubing that is in close proximity to metal edges.

b. Inspect pneumatic lines for tightness of connection and/or crimped hoses.

c. Reinstall shroud and wipe down surface with lint free cloth and peroxide/DI Water solution. (If you are performing a Monthly or Quarterly PM, do not reinstall shroud at this time.)

5.2.9 Facilities Inspection

a. Clean the machine shroud and all areas surrounding the SRD.

b. Run the SRD through four cycles to verify correct operation.

c. Check for leaks at tool connections.

d. Verify that pressures and flows are in specification for this particular tool. (See installation section of manual for tool specifications.)

Note: After any cleaning or maintenance is performed, an extended rinse cycle should be run at a high RPM (1000 - 1800, **DO NOT EXCEED MAXIMUM RPM STAMPED ON ROTOR**). This should ensure that the machine is free of any possible contaminants before it is used for processing.

5.3 MONTHLY PREVENTATIVE MAINTENANCE

The following steps should be performed in addition to the weekly maintenance procedures.

5.3.1 Rear Bowl Seal Inspection

a. Remove the Quick Disconnect Rotor, if present, following the instructions located in the Options Section of this manual. If the standard four bolt rotor is present see Section 5.2.1 for instructions.

b. Remove the motor/bowl seal spacer.

c. Visually inspect all surfaces on the rear bowl seal.

d. Clean the cap seal and shaft spacer thoroughly with peroxide/DI Water.

e. Reinstall the shaft spacer.

f. Check the inside of the bowl for scratches or staining. Clean as needed.

g. Remove the cover from the bowl drain.

5.3.2 Rotor Drive Plate/Shaft Inspection

a. Clean the shaft and plate assembly with a solution of peroxide/DI Water.

b. Inspect surfaces for signs of wear or corrosion. If the drive shaft/plate assembly is severely pitted or stained, repolishing may be necessary. Contact Semitool for instructions.

c. Reinstall the shaft/plate assembly by inserting the drive shaft into the motor shaft. Please note the alignment pin at the junction of the drive plate and the shaft. The pin goes in a slot cut in the motor drive shaft to align the rotor in an upright position in relation to the RSP.

d. Reposition the spacer/washer, cam (and optical encoder if equipped) on the motor drive shaft.

e. Tighten the nut on the rear of the motor drive to 30 in/lbs torque. This assures proper compression of the motor drive shaft and the rotor drive shaft/drive assembly.

5.3.3 Rotor Stop Positioner (RSP) Inspection

a. Inspect the rotor stop positioner for damage, especially the cam and follower.

b. Clean all pivot points, linkage and bearings.

c. Reinstall the RSP and align according to the cam.

d. Check the rotor stop positioner for correct operation.

e. Reinstall the shroud.

5.3.4 Door Alignment Inspection

a. Open and close the door to check for any dragging of the window or door seal on the bowl ring.

b. If a noticeable drag exists or the window appears to hit the edge of the bowl ring on closing, adjustment may be necessary.

c. The height of the door can be changed by unlocking the jam nut on the lower hinge pin. Then the hinge pin may be raised or lowered by turning it with an Allen wrench.

d. Be sure to lock the jam nut on the lower hinge pin when finished with this adjustment.

5.3.5 Inspect All Bowl Attachments

a. Verify proper tightness of all attachments to the bowl: CY-20, if present; H2O Manifold; N2 Manifold

b. Verify the integrity of O-rings and gaskets.

5.3.6 Check for Loose Electrical Connections

a. Check for any loose components inside the controller and tighten as required.

b. Visually inspect all wiring.

5.3.7 Power Supply Voltage Inspection

a. Check the five volt power supply inside the Rinser/Dryer controller unit. The power supply unit should provide 5.1 ± 0.5 volts.

b. This voltage should be measured on the CPU board. Consult schematics in the back of this manual to locate test points on the CPU card on your particular controller.

c. Check other voltages at the power supply wiring connections. Some controllers use 12 VDC relays, others use 24 VDC.

5.3.8 DI Water Recirculation Inspection (WR-20 Option)

a. Check the flow of DI water recirculation. The flow rate can be set by adjusting the restrictor in the external valve.

b. The flow rate through the recirculation loop should be sufficient to prevent the growth of algae in the manifolds.

5.4 QUARTERLY PREVENTATIVE MAINTENANCE

The following steps should be added to the weekly and monthly maintenance procedures.

1. To eliminate the need for disassembling valves, they can be cleaned by back-flushing.

2. Remove and clean the DI water manifolds.

3. Remove, disassemble and clean all nozzles. Before disassembling the nozzles, note the original spray angles. Try to achieve the same angle when the spray systems are reassembled. Examine the nozzles under bright light. Foreign material can be removed by use of CDA blown back through the nozzle. Foreign material that is particularly stuck can be removed with a small pointed object similar to a dentists probing tool. Nozzles can also be immersed in an ultrasonic bath for cleaning in a peroxide/DI Water solution.

4. Remove and clean all tubes and fittings. Empty DI Water from the DI Water filter housing. Fill the filter housing with DI water and hydrogen peroxide (check chemical compatibility). Program the tool for a modified recipe. A long rinse step will be needed to allow proper rinsing of the filter, tubing and fittings. Complete the recipe with normal dry times and RPMs. Place the tool into a sixty-minute rinse at the maximum allowable RPM. Verify the resistivity has returned to normal at the end of the hour. If not, repeat the rinse in smaller increments until resistivity meets specifications. Return the controller to normal process recipe configuration.

5. Remove, inspect and clean the N2 cartridge heater. Some tools may not be equipped with this option. To remove the heater, disconnect the power connector and unscrew the heater from the manifold. Examination of the heater should reveal a golden brown color with a slight tint of blue. If the heater is black or appears to be charred, this condition can contribute to high particle counts. Replace the heater if necessary. On reassembly look inside the nitrogen manifold for pieces of Teflon tape and other possible sources of foreign material.

6. Inspect the shock mounts for deterioration or damage and replace them if necessary.

7. Check the N2 pressure switches.

8. Verify tachometer readings.

5.6 PARTICLE CONTROL AND TROUBLESHOOTING (continued)

7. If particle counts are still high, rinse a cassette with three wafers in a SRD with acceptable particle counts. Remove the cassette and dry in the tool with high counts.

8. If particles remain high, check the N2 line for sources of contamination.

   - Remove the cartridge heater and check for deep bluing or blackening of the heater. Either clean the heater with Scotch-Brite™, IPA and DI water or replace it with a new cartridge heater.

   - Repeat the process in Step 7. If counts are still high, replace the P.O.U. N2 filter.

9. After the tool qualifies for the dry only process, run a standard recipe. If the tool does not qualify, proceed to the next step. Otherwise, particle troubleshooting is complete.

10. Remove the rotor. Check the rear bowl seal for tears. Thoroughly spray the inside of the chamber with H2O2. Clean the rotor and drive plate, if the four bolt is present, with H2O2. Reinstall the rotor and run a one hour high speed rinse (approximately 2400 RPM). Check particle counts.

11. If the tool is still not in spec, the following are additional tips that could cause high particles.

    - Unplug the CY20, if present. If the probes are badly deteriorated, they may shed particles.

    - Check the tightness of the mounting bolts for the N2 and DI manifold and CY20.

    - If none of the above recommendations work, it is possible the bowl needs new electropolishing.

The above procedures should solve particle problems in the majority of circumstances. Should all steps be performed and the tool still does not qualify, consult Semitool Customer Service at 406-752-2107 in Kalispell, Montana.

5.5 FUNDAMENTALS OF ACCURATE PARTICLE COUNTING

All particle count results should be verified using the following steps:

1. A known clean carrier must be used; either just cleaned (boil off) or just unpacked from a sealed bag.

2. Use known good wafers of relatively low counts (less than 20). If wafers are too dirty, the Rinser/Dryer will take off some particles but they will be left in the bowl.

3. Check the wafers to see if they are hydrophilic or hydrophobic. This can be done by immersing the wafer in a weir. If water runs off the wafer, they are hydrophobic. If water is retained on the wafer, it is hydrophilic. Hydrophilic wafers are the desired wafer type.

4. Check the measuring machine (Surfscan, Euronka, etc.) for erratic counts by putting the same wafer through it again. The counts should not vary by more than two or three.

5. Use a control wafer in all experiments in order to verify that an increase in particles resulted from the process in question. Use the same number of slots and keep an accurate log of the results, noting which parameters changed.

6. If you follow the recorded steps for particle control, you will achieve counts of less than 10 for 1 microns. Please note that if the machines are in a bad state (counts greater than 200), an overnight rinse through manifolds may be required.

7. The more aware you are of how to check particle counts, the more likely you are to achieve good results with the Rinser/Dryer.

5.6 PARTICLE CONTROL AND TROUBLESHOOTING

Preventive maintenance and proper cleaning is essential for particle control. However, a well maintained Rinser/Dryer may unexpectedly become a source of particulate. In most cases, following these steps will solve or isolate the problem.

1. Verify the recipe sequence. Contact Semitool for recipe guidelines.

2. Check the facility pressures to ensure that the N2 and DI are set at the proper levels. Check if any other equipment in the vicinity of the SRD is experiencing high particle counts. Look for indicators of N2 or DI problems in that section of the fab.

3. Check the tool for any obvious particle sources. Typical sources are broken wafers inside the chamber, drain tube, or drain box. If excessive amounts of silicon dust are present in any of these areas, perform the following steps.

   - Check the DI manifold gasket for silicon dust.

   - Remove the rotor and drive plate (if drive is present). Check the rear bowl seal for silicon dust and/or tears in the seal.

   - If the Rinser Dryer has a Brushed Motor, check the ferrofluidic seal. If it appears dry, charge it, using sixty microliters of ferrofluid (one glass pipette full). Overcharging will result in even higher particle counts and extended cleanup time for the bowl. If ferrofluid is found in the back of the bowl, use either lighter fluid or heptane to clean the bowl. Pull the drain tube and clean ferrofluid residue from inside the tube. Reinstall the rotor and run a thirty minute high speed rinse (approximately 2400 RPM). Check the particle count. If the unit is not in spec in a dry only process, continue high speed rinses until the unit qualifies.

4. Perform the following steps to verify correct door operation.

   - Check for door leaks while running a rinse in the chamber.

   - Reduce the N2 pressure to approximately 15 PSI. With the door open, use the port display to inflate the seal (see the Port/Bit Map in the Schematics Section of this manual). Verify there are no pinhole leaks in the seal.

   - Clean the door seal and window with DI water.

5. Using a new or slightly used cassette, run a thirty minute rinse at 2400 RPM, followed by a standard purge and dry. Run three standard recipes, then check particle counts.

6. If particles are reduced but not within specifications, repeat Step 5. Continue repeating this step as long as particle counts decrease.

5.7.4 Bowl Surface Oxidation Procedure

When drying problems are encountered on electropolished bowl surfaces, perform the following steps until a hydrophillic bowl surface is attained.

a. Charge the point-of-use filter with 400 ml of 30% solution H2O2. Run the following extended rinse recipe.

Rinse: 1500 RPM for 999 seconds

Dry 1: 2000 RPM for 60 seconds

Dry 2: 600 RPM for 180 seconds

Note: If the SRD is equipped with the water recirculation option (WR-20), turn the water supply on when the machine is in the rinse cycle.

b. Repeat the extended rinse recipe.

c. Completely douse the bowl interior, rotor and carrier with 30% solution H2O2. Run the following "dry only" recipe.

Dry 1: 2800 RPM for 60 seconds

Dry 2: 600 RPM for 300 seconds

d. Repeat the extended rinse recipe, from the first step.

e. Repeat steps c and d, with the "dry only" recipe times increased to 120 and 600 seconds respectively.

Note: Extended "dry only" cycles (drying times greater than twelve minutes) and/or successive dry only cycles may cause excessive oxidation of the heater cartridge. If a hydrophillic bowl surface is not attained, contact Semitool for further instruction.

5.7.5 Door Seal Replacement Procedure (**VAD-DOWN ONLY**)

The following steps are required to insure that the vertical auto door seal is replaced properly.

a. Door Position - The auto door should be in the closed position.

b. Shroud Removal - The shroud is fastened to the frame with six screws, three on each side of the tool. Once the screws have been removed, the shroud can be removed from the tool to expose the door mounting brackets. It is not necessary to remove the back panel from the tool.

5.7 GENERAL MAINTENANCE PROCEDURES

5.7.1 Drive Motor/Process Chamber Seal

a. Ferrofluid Seal Cartridge Assembly -- **(Brushless Motors)**

> **CAUTION:** Attempts to service this assembly by other than qualified Semitool personnel may cause seal failure. Machine damage and product contamination is possible. Never use IPA around the seal assembly area.

The Rinser/Dryer comes equipped with a pre-charged ferrofluid seal cartridge assembly. The unit has been assembled at the Semitool facility by qualified technicians and has no user-serviceable parts. No maintenance is necessary and service life should exceed 5 years under normal operating conditions. Should service to this unit be necessary, contact your Semitool service representative for assistance.

b. Seal Adapter Assembly -- **(Brushed Motor Only)**

Charging of the Ferrofluidic is unnecessary on all Direct Drive units unless the Seal Adapter assembly is removed. The following parts are required to charge the Ferrofluidic Seal:

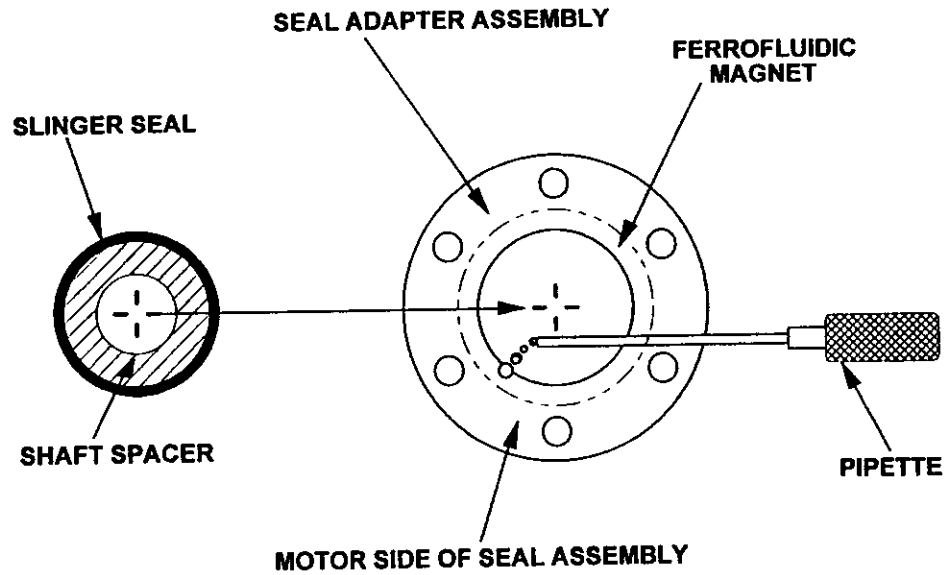
- Ferrofluidic - Part # 70738-F (1cc bottle, enough for 16 changes)
- 75µl Pipettes - Part # 70738-D (100pk, includes bulb)

> **CAUTION:** Do not exceed 75µl of fluid in the Ferrofluidic Seal assembly. Excessive fluid will leak from the seal and cause contamination of the chamber and product.
>
> Certain solvents will adversely affect the Ferrofluid. Do not use any solvents directly in contact with the Ferrofluid or near completed assemblies.

5.7.1.b Seal Adapter Assembly -- (Brushed Motor Only -- continued)

The following procedure should be performed outside the Rinser/Dryer.

1. The seal adapter assembly should be wiped clean using only a dry cloth. All excess ferrofluid should be removed from the magnet area, as shown in the following display.



Ferrofluidic Seal Maintenance

2. To charge the pipette with Ferrofluid, carefully inset a glass pipe into the bulb. Covering the hole in the bulb, squeeze and draw fluid from the vial until the pipette is almost filled. The glass pipette capacity is 75 microliters (µl).

3. Apply fresh ferrofluid directly to the interior of the magnetic seal from the flat side of the seal adapter assembly (faces motor). An amount of 60 µl should be applied at four points (3, 6, 9, and 12 o'clock) on the seal. Touching the magnet will draw fluid from the pipette. Do not squeeze the pipette until the last touch point. At the last point, gently squeeze the pipette to dispense the remaining 60 µl. Spinning the rotor drive after reassembly will distribute the fluid evenly and create an airtight seal.

4. After applying ferrofluid to the seal, it is recommended that the seal be reassembled within fifteen minutes of charging. Increased exposure of the ferrofluid to an open environment could degrade the seal.

5.7.2 KBIC Motor Control Calibration Procedures (**Brushed Motors Only**)

KBIC Motor Controllers are used to drive Rinser/Dryer motors. It is important that the horsepower resistor (R21) located on the KBIC be valued appropriately (refer to the table defining values). Prolonged operation of a KBIC motor combination with incorrect R21 values will result in premature failure of these components.

CAUTION: The following procedures involve operations on electrically live equipment and should be performed only by authorized, trained maintenance personnel.

a. Tools Required :

- Insulated alligator jumper leads
- DC ammeter (0 - 10 amp)
- Plastic hex adjustment tool

b. Ensure primary power is deactivated on the tool prior to making any preliminary adjustments/connections.

c. After locating the appropriate KBIC motor control within the electronics enclosure, set the four controls as follows (refer to the KBIC Motor Control Drawing):

Max = fully CW	IR = fully CCW, then 1/4 turn CW
Min = fully CCW	CL = fully CCW, then 1/4 turn CW

d. Refer to the KBIC motor control drawing (see next page). Locate the terminal marked **A+**. Carefully remove the push-on wire connector attached to the **A+** terminal. Using the insulated alligator clip, connect the wire removed from the **A+** terminal to the negative ammeter lead.

e. Using the second alligator clip lead, connect the positive ammeter terminal to the **A-** terminal on the KBIC. Use caution to ensure no connections are contacting metal or shorting to other components.

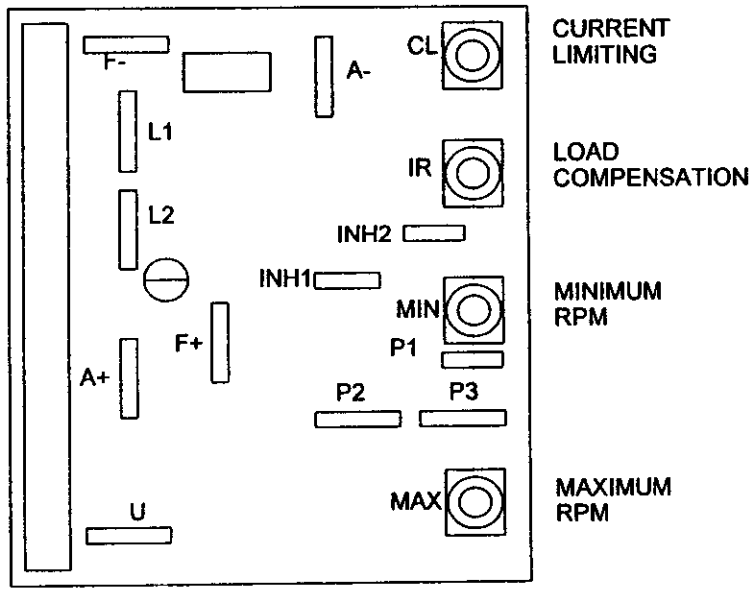
f. The next step is to set the CL (Current Limiting) pot on the KBIC. Apply power to the tool. If an ammeter is not available, adjust the pot to the twelve o'clock position. If an ammeter is to be used, observe the ammeter and turn on the motor. Adjust the CL pot on the KBIC until the maximum startup current is limited to five amps. This process may take several starts and stops of the motor to accomplish.

5.7.2 KBIC Motor Control Calibration Procedures (continued)

g. The maximum RPM will need to be set once the Current Limiting is adjusted. Due to the variety of products, the following assumes knowledge of user RPM selection procedures. Caution should be taken to ensure that the rotor is removed for the Max RPM calibration. Operation of the empty rotor at full RPM can cause the rotor to be knocked out of balance.

h. Using the diagnostic tests, run the motor without feedback at maximum RPM (stamped on the rotor). Adjust RV1 of the duty cycle to the voltage converter (P/N 14861) until the requested and actual RPM displays are equal. Set the maximum RPM limitation by adjusting the **Max RPM** potentiometer on the KBIC motor controller as follows:

240-270	=	2800 RPM
Any 280/300mm	=	2100 RPM
2400/2600	=	1300 RPM



KBIC MOTOR CONTROL DRAWING

HORSEPOWER	RESISTOR VALUE	RESISTOR P/N
1/12 HP	.18 OHM	P/N 76001
1/3 HP	.035 OHM	P/N 60701-15
1/2 HP	.025 OHM	P/N 60701-20

5.7.3 Brushless Motor Failure Checkout Procedure

To troubleshoot a Brushless Motor Failure, check all voltages at the Automotion Controller.

a. General Maintenance Notes

- Automotion does not recommend grounding the motor to safety ground. This induces noise in the motor controller.
- When using an AC powered oscilloscope, you should NOT connect the scope probe ground clips to Automotion pin 5. Instead, use two channels of a dual trace scope to make a differential measurement.
- Use 10x probes and set both channels to 10 VOLTS/DIV. A lower setting may overload the scope's pre-amps.
- Select DC on both channels and set TIME/DIV control to 5 ms.
- Set channel B to INVERT mode and vertical mode to ADD with channels A and B OFF.
- Put both channel probes on Automotion pin 5 (motor ground). The probe grounds may be connected to safety ground or left floating.
- If the two probes are matched you will see a flat line (channel A - channel B). If the signal is not a flat line you will need to adjust the variable gain of one of the channels to match the probes as closely as possible.
- Leave the channel B probe on Automotion pin 5 as reference.
- Use the channel A probe to measure the signals you need to see.

b. The voltage measured between pins 4 (+) and 5 (-) should be 12 VDC. This is supplied from the motor controller.

c. Check the three hall sensors. They should switch between +12 VDC and ground during one rotation of the motor. Measure this by using pin 5 as ground; pins 1, 2, and 3 are the hall sensors. Use a DVM or an oscilloscope. When you rotate the motor slowly you should see a square wave.

d. Check the motor drive voltage at pin 11 (pin 5 is reference ground). On drive systems configured for analog control (typical SRD), 1 VDC should be close to 3000 RPM.

5.7.3 Brushless Motor Failure Checkout Procedure (continued)

e. Check the control bits. These are +12 VDC signals that tell the controller what to do.

- Pin 5 is ground.
- Pin 6 is start/stop. It is at 0 VDC when stopped and 12 VDC when start is pressed.
- Pin 7 is the reverse bit. It is 12 VDC for forward or counter clockwise rotation and 0 VDC for reverse or clockwise rotation.
- Pin 8 is the brake. It is 0 VDC until the end of a cycle, then it momentarily switches to +12 VDC when the brake is applied.

Note: On Rinser Dryers with limited RPM, the start/stop bits run through the motor speed limiter. If there is a problem getting the controller to start/stop, the motor speed limit may be bad. These signals originate at the Output Board, go through the Opto Isolator Board, then through the Motor Speed Limiter, to the Automotion Controller.

f. If the voltages on the controller check out, there is possibly a problem with the field windings in the motor. To check the windings:

- Unplug the short connector from the Automotion Controller and measure the resistance of the windings.
- Measure between pins 18 & 19, 18 & 20, and 19 & 20. There should be 3 ohms for a LC4 120 VAC, or 12 ohms for a LC5 220 VAC unit on each of the 3 windings.
- Measure between pin 15 (ground) and pins 18, 19, and 20 for any continuity. This should be an open circuit.

5.7.5 Door Seal Replacement Procedure (continued)

c. Door Removal - The auto door is attached to the pneumatic cylinder assembly by two stainless steel brackets. Each bracket (see figure 1), attaches to the door with four screws. After removal of the eight screws, pull the door away from the tool. Extreme caution should be taken to ensure that the pneumatic cylinder bracket assemblies are not turned outward on the tool. When the door is closed, the door photo sensor interlocks are engaged, and if the assemblies are forced outward, the photo sensor may be damaged.

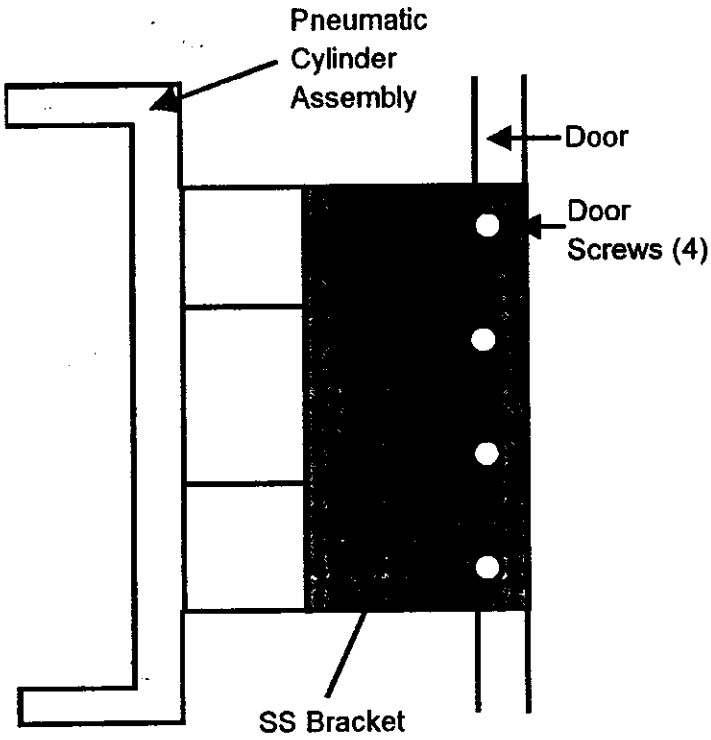


FIGURE 1

d. Door Seal - Remove the door seal from the channel in the window. Insert the new seal in the channel, making sure it is in the correct position (see figure 2 on the next page). When replacing the door, replace the rubber O-Ring (Grommet, see figure 3 on the next page), if it is damaged or worn. To replace the door, reverse the door removal procedure.

5.7.5 Door Seal Replacement Procedure (continued)

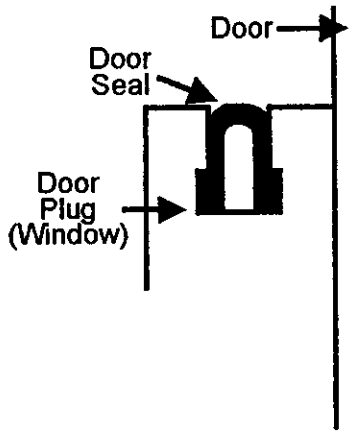


FIGURE 2

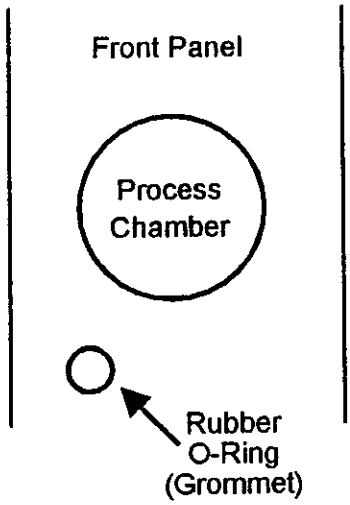


FIGURE 3

5.8 PSC-102 DIAGNOSTIC TESTING ROUTINE

The PSC-102 software contains diagnostic tests that can be accessed by the user to aid in troubleshooting. These diagnostic tests are accessed via the dip switches within the controller.

CAUTION: The safety interlocks are disabled when the PSC-102 controller is in the PROGRAM mode diagnostic routine.

5.8.1 Common Hazards to Avoid

a. The door can be opened when the rotor is turning, or when the rotor is not upright.

b. The motor can be started while the door is open.

c. The door-close time-out feature is not active. The door will continue to close, even if an obstruction is present, until the processor is told otherwise.

d. The water and microsoap spray features can be activated while the door is open.

5.8.2 Accessing the PSC-102 Diagnostic Routine

To access the PSC-102 diagnostic routine, follow the procedure outlined below:

a. Begin with the PSC-102 powered down.

b. Pull the PSC-102 out of the housing to access the DIP switches.

c. Set DIP switch 7, position 8, to the On position (see the Main Logic Board Assembly in the Schematic Section for the location of this switch).

d. Power up the PSC-102 controller.

e. Select the diagnostic test number by positioning the cursor in the RECIPE field and using the **DIGIT CHANGE** keys (+ and -) to enter the desired value. To enter the port number, position the cursor in the RESISTIVITY field. The bit information is located in the RPM and TIME fields.

f. When completed with diagnostic testing, turn the PSC-102 Off.

g. Return the DIP switch 7, position 8, to the Off position.

h. Push the PSC-102 back into the housing.

5.8.3 Test 1: Port Input/Output

The intended purpose of this test is to provide a means to exercise the valves and relays. This test allows the user to read from or write to a selected port. The operator may continuously execute the function, or execute it only on keystroke command. The data sent or received is entered and displayed in binary. The port address selected is entered in hex. To use this test:

a. The port location is entered in the field normally reserved for resistivity (see the Port Map in the Schematics Section).

b. The bit string is entered in the field normally reserved for RPM and TIME and is entered digit by digit like all other fields.

c. There are two methods of running this test. The first method is called the repetition mode. The port location should first be entered and then position the cursor in the right-hand character of the step field and enter an "r" by pressing the + key. This deactivates all previously active bits. With "r" selected, move the cursor to the bit field and set the desired bit(s), i.e. set the bit to "1" by pressing the + key. By setting the bit, the function controlled by this bit is immediately executed. To terminate the function, reset the bit to "0".

d. The second method of running this test is called the port setting mode. The port location should first be entered and then the desired bit string should be set. When this data has been set, select the port setting mode by positioning the cursor in the right-hand character of the step field and enter a "1". Pressing the - key will then execute the command. After this test is terminated, it is important to reset the bits before proceeding. This is done by moving the cursor back to the bit fields and resetting all the bits to "0". Then position the cursor to the right-hand character of the step field and press the - key.

e. Select the next port address to be tested and repeat the above procedure.

5.8.4 Test 2: LED Selectable Function

This test allows the operator to turn on selected recipe processes using the panel lights instead of programming a recipe. To use this test;

a. Select Test 2 by positioning the cursor to the RECIPE field and selecting 2. Move the cursor to the desired LED. Pressing the + key will turn on the associated process, while pressing the - key will turn it Off.

b. The active LEDs and the function associated with each are given below:

Motor On:	Turns on the motor control relay.
Door Seal:	Turns on door seal valve.
Rinse:	Turns on the rinse valve.
Dry:	Turns on the dry valve.
Purge Bowl:	Turns on low pressure purge.
Bowl Heat:	Turns on the heater relay.
Antistat:	Turns on the antistat relay.

c. Before terminating the test, deactivate all the selected processes.

5.8.5 Test 3: Multiplexed Input Read

The user switches, program switches, status inputs, and SECS switches are multiplexed. The multiplexed inputs and their bit patterns are shown in the Port Map located in the Schematics Section. "1" indicates that the switch is closed. Test 3 allows the user to select the following sets of inputs and observe the current bit settings for those switches.

P = Program switches	S2 = SECS switch 2	S5 = SECS switch 5
O = Operator panel	S3 = SECS switch 3	S6 = SECS switch 6
S = Status inputs	S4 = SECS switch 4	S7 = SECS switch 7
S1 = SECS switch 1		

5.8.6 Test 4: Memory Read/Write Function

This test allows the user to test the recipe checksum feature by writing a different byte somewhere in the recipe memory area, and verifying that the Recipe Fail message is displayed. The primary utility of this test would be in debugging partial memory failures after power up. A secondary use for this test is to assist in debugging address decoding problems. However, the processor may not be able to execute the diagnostic program if faulty address problems exist.

5.8.7 Test 5: Motor Control Test

The STEP field displays "Sr" which represent STOP and RUN. Pressing either the + or - keys in the "S" field will execute the motor stop routine, which automatically opens the motor enable relay and extends the RSP. Pressing the + key in the "r" field will execute the motor start routine, which automatically closes the motor enable relay, retracts the RSP, and sets the drive RPM value. Pressing the - key in the "r" field will execute the start routine and also enable the feedback routine. The user sets the desired RPM and is able to view the actual RPM (displayed in the TIME field), as well as the motor control status returned by the motor control board. The status code displayed can have the following meanings:

- 00 = Idle with rotor up
- 01 = Rotating under power without feedback control
- 02 = Rotating under power with feedback control
- 03 = Braking rotor
- 04 = RSP firing

5.8.8 Test 6: Serial Port Test

This test requires that the serial communications transmit and receive ports be joined. The left step field shows which serial port is being tested (the default is the first port). The right step field allows the technician to select either 1 for a single character test, or r for a repeating test. If the single test is selected, pressing the - key will transmit a character.

The test automatically sends a series of characters, starting with hex 20, resulting in a "barber pole" pattern if connected to an external terminal. The RPM field displays the last character which was sent, but is blank upon entering the test. The time field displays the last character received. Both are displayed as hex values. If the same character sent is received within 0.3 seconds, a pair of equals signs are displayed on the display between the send and received character displays. Connecting pins 2 and 3 of the DB-25 connector, the user can test both transmit and receive sections. The resistivity field shows the current status of the 8251 chip as a hex value, which is 81 for normal status.

5.8.9 Test 7: Analog-to-Digital Converter Test

The RPM field displays the instantaneous hex A/D converter value. The time field displays the averaged A/D value.

5.8.10 Test 8: System Recovery Test

If for some reason the processor should fail to service the 74LS123 timer within the expected time, the recovery software will sense the error and attempt a recovery. If the recovery were to fail, the controller would "lock up." To execute the test, move the <GO> indicator to the step field and press either the + or - keys.

5.9 RINSER / DRYER TROUBLE-SHOOTING TIPS

5.9.1 Machine won't advance to dry cycle with the resistivity monitor activated.

a. Check the resistivity of the facility DI water. Provide cleaner DI water or reduce the setpoint of the resistivity monitor.

b. Check for contaminants being leached out of old carriers. Clean the Rinser/Dryer and carrier following the instructions described in this section.

c. Check and clean the monitor probe.

d. Check for lack of N_2 purge during the rinse cycle.

e. Clean the drain tube, box and trap and check for foreign matter or possible sources of contamination.

5.9.2 Door will not seal

a. Remove the door seal and clean. Reassemble seal and verify proper fit.

b. Check the door hinge and adjust if necessary.

c. Set the facilities N_2 supply for factory specifications. See the installation section.

d. Check and replace any damaged tubing and barbs.

5.9.3 Rotor Stop Positioner won't upright

a. Verify correct facility pressure. Set correct pressure if necessary.

b. Check the Humphrey valve labeled "RSP" for proper operation.

c. Check the tubing and barbs. See Flow Diagram (Schematic Section) for N_2 routing. Replace any punctured or damaged tubing or barbs.

d. Replace the RSP unit, if required.

5.9.4 Rotor positioner out of position

a. Check rotor orientation on shaft and rotate.

5.9.5 No heat

a. Test the continuity of blanket heater wires. Blanket heaters normally have approximately 50 ohms resistance. Replace heater if necessary.

b. Check the heater relay in the power module.

5.9.6 Machine stays in holding mode

a. Verify thermostat closure, and check the relay. Replace if necessary.

5.9.7 Rotor appears to be out of balance

a. Check the rotor at high RPM for excessive vibration with a properly loaded cassette of wafers. Return unbalanced rotor to factory for rebalancing.

5.9.8 Water overflows

a. Check for blocked drain or atmospheric vent. Clean drain or vent.

5.9.9 Water continues to spray when in dry cycle

a. Check the DI water valve for proper operation. Replace if necessary.

b. The DI water pressure may be too high. Set to factory specifications.

c. Check solenoid valve operation. Replace if necessary.

5.9.10 Machine won't start

a. Check for interlock failures, e.g. low N_2 pressure, open door, etc. Correct any failure condition.

b. Check start/stop switches. Replace if necessary.

5.9.11 Display on controller stops counting or shows erratic display

a. Check the CPU board and replace if necessary.

5.10 PSC-102 CONTROLLER TROUBLESHOOTING GUIDE

5.10.1 Display is blank/No Response to Input.

a. Check the power supply voltage. Regulator CR1 should have + 5 volt output with only minor ripple.

b. Check the reset line to the CPU. The power supply supervisor chip (TL7705) will hold the reset line low when the power supply dips below about 4.75 volts. If always low, check the power supply, TL7705, and the reset switch.

c. The chip selects to RAM, ROM, and 8253 timer chips should pulse low. If they do not, check the 74LS138 address decoders and the various address lines for "stuck low or high" conditions. Visually inspect the chips in the ROM and RAM sockets for bent pins, etc. Try a known good ROM chip. Try a known good CPU chip. Check strapping options on the chips.

d. The interrupt line to the CPU (INT) should be low about 50% of the time with about a 2 msec repetition rate.

- If the interrupt line is always low, check on the input side of the 74LS05 to see which input is high and causing the interrupt. An 8251 is required in the first position (not optional) for proper operation.

- If the interrupt line is always high, check the 8253. It should generate an interrupt about every 2 msec. Experience has shown that the Mitsubishi brand 8253 chips don't initialize reliably. We have since specified Intel or NEC brands. Check the chip select of the 8253 and look for a 2 msec. short pulse at the "timer pulse" line. The 74LS123 is used like a flip-flop and is set and cleared by the timer pulse and timer clear lines.

e. The NMI line should not be low. In normal operation the CPU toggles the WD RETRIG line periodically. If the processor stops running, the 74LS123 will time out, pull the NMI line low, and actuate the error recovery software. A failure in the 74LS123 or the 8255, which controls the WD RETRIG output, could cause the processor to get stuck handling the NMI. If removing X8 allows the CPU to work correctly, check this circuitry.

5.10.2 CPU FAIL message is displayed on the controller.

This message indicates a recipe checksum error has occurred. The following procedure ERASES ALL RECIPES.

1. Turn off the power.
2. Open the drawer and depress the Memory Clear button (SW 9 on the Main Logic Board Assembly Drawing in the Schematics Section) located behind the Program key switch.
3. Turn on the power while holding the button. **"CLEARING RECIPES"** will be displayed, followed by the four messages described above.

5.11 SECS CONFIGURATION SWITCHES

The following switch settings refer to the Main Logic Board Assembly drawing in the Schematics Section of this manual. Serial communications protocol is eight bit, no parity as per the SECS standard, and Switch 1 is the least significant digit.

SWITCH	POSITION	FUNCTION	NORMAL SWITCH SETTING
1	8	Master/Slave (On = Master)	On - Master
1	1 - 7	SECS ID address high, in binary	All switches OFF
2	1 - 8	SECS ID address low, in binary	All switches OFF - SECS ID 0
3	1 - 5	Retries, in binary	Switch 2 ON = 2 Retries
3	6 - 8	The BAUD rate is varied by setting switch positions 6, 7, and 8 as follows: OFF, OFF, OFF ⇒ Baud Rate 150 ON, OFF, OFF ⇒ Baud Rate 300 OFF, ON, OFF ⇒ Baud Rate 600 ON, ON, OFF ⇒ Baud Rate 1200 OFF, ON, OFF ⇒ Baud Rate 2400 ON, OFF, ON ⇒ Baud Rate 4800	Switches 7 and 8 ON = 9600 BAUD
4	1 - 8	TIMER 1 (in 1/10 of a second)	Switches 2 and 4 ON
5	1 - 8	TIMER 2 (in 2/10 of a second)	Switches 1, 4, and 5 ON
5*	8	Resistivity Select (functions when Switch 6 position 8 is in resistivity position) ON = Raw Resistivity Readout OFF = Adjusted Resistivity	Off = Display Adjusted Resistivity Readout
6	1 - 7	TIMER 3 (in seconds)	Switches 1, and 3 ON
6*	8	Run Mode Display Select ON = Temperature	OFF = Resistivity
7	1 - 7	TIMER 4 (in seconds, in binary)	Switches 1 and 3 ON = 5 seconds
7	8	Diagnostic Switch ON = Service mode	OFF

*** Used with the Semitool RM-20 Resistivity Monitor option**

5.13 CALLING FOR TECHNICAL SERVICE

When calling the factory for help, it is suggested that a person with machine maintenance responsibilities be present with a copy of the manual to receive instructions.

If data is furnished by letter or telephone, it is essential that the data furnished be complete and accurate in order to avoid unnecessary delays.

Listed below is the information that should be provided with your request for help:

- Date, Customer name, and address.
- Person to contact (name, title, telephone and extension).
- Person writing/calling (name and title).
- Machine model and serial number.
- Description and part number of replacement parts.
- Urgency of request, e.g. machine is down.
- Nature of problem, e.g. broken part, won't respond, etc.
- Components inoperative (description and part number, if available).
- Additional information or comments that might be helpful.

5.13.1 Return of Goods Policy / Special Shipping Requirements:

a. Notify Semitool Customer Service prior to return, and request a Return Material Authorization (RMA) number. Please give the machine model and serial number when requesting a RMA.

Semitool, Inc.
Customer Service Department
655 W. Reserve Dr.
Kalispell, Montana 59901
(406) - 752-2107

Note: Return shipments will not be accepted by the Semitool Receiving Department without a RMA number.

b. Secure goods so that they cannot be damaged in transit. Package in original container if possible.

c. Include reason for returning the machine, along with original purchase order and RMA number.

Semitool

Part List Section

SECTION 6 — PARTS LIST

6.1 PSC-102 CONTROLLER SPARE PARTS LIST

TYPE	DESCRIPTION	PART NUMBER
General	Board, Display PSC-102 Assy.	14841-01
	Board, Converter Assy.	14861-501
	Fuse, 7 Amp Slow Blow 3AG	61640-10
	Fuse, 8 Amp Slow Blow 3AG	61640-11
	Board Assy. Power Supply +24 +5/120V	16710-505
Brushless Type Motor	Board, PSC-102 Logic Assy.	14843-515
	Board, Relay Assy. 102	14880-01
	Board, Relay Assy. (for Resistivity Monitor)	14884-01
Brush Type Motor	Board, PSC-102 Logic (with Resistivity Monitor RM-20)	14843-511
	Board, Relay Assy. PSC-102 220V	14876-01
IC For Logic Board	8255 I.C.	60316
	I.C. Z80 CMOS 4 Mhz	60320-01
	DS 1220 RAM	60324
	8253 I.C.	60325
Remote Autodoor Option Only	PSC-102 Controller Cable Assembly (DB50 Signal) 4 Ft.	14169-01
	Remote Operator Control Assy. 102	17135-01
Controller Front Panel	PSC-102 Front Panel Assembly	PSC-102FP

TYPE	DESCRIPTION	PART NUMBER
Additional Parts	Bezel, Front PSC-102	12923-01
	Nut, 4-40 Nylon	95069
	Panel, Membrane PSC-102	12777-11
	Screw, 6-32 CPTV w/Knob	95046-19
	CNTR 2 Pin Recpt Ribbon Cable	73206
	Standoff, 0.25 x 0.2 Nylon	95061
	Stud, 4-40 x 1/2 PEM	91262-01
	Switch, Rocker SPST LGTD	60900
	Switch, Key Lock DPDT	73083

6.2 RINSER / DRYER SPARE PARTS LIST

TYPE	DESCRIPTION	PART NUMBER
General - Electrical	Board, Optical Sensor Assembly Tach	16730-01
	Heater, Cartridge (375W /120V)	61501
	Heater, Cartridge (375W /220V)	61501-04
	Heater,Blanket (2 Thermodiscs 120V) 6 x 7-3/4	60270-04
	Heater, Blanket (2 Thermodiscs 220V) 290W 6 x 7-3/4	60270-220
	Heater,Blanket (No Thermodiscs 120V) 290W 6 x 7-3/4	60270
	Heater, Blanket (No Thermodiscs 220V) 290W 6 x 7-3/4	60270-221
	Switch, Pressure Non Adj.	61510
	Switch, Micro w/ 2-1/2 Arm	61567-01
	Switch, Reed 3W 120V	60709
	Switch, Magnetic Actuating Reed	60709-01
	Switch, 1 PL MOM Round Panel Mount	73029
	Valve, Solenoid (Humphrey 24V)	61591
General - Mechanical	Actuator Valve Assembly Slow Act 1/4 VLV	17329-01
	Actuator Valve Assembly, 1/4" VLV	12675-01
	Adapter, 1/4" Valve 3/8 Tube FLRTK	324C0006-01
	Filter, Cartridge (Disposable Plastic .2 Micron)	70003
	Filter, Cartridge (Stainless Steel .01 Micron Disposable)	70886-10 (Pall)
	Filter, Cartridge 0.05U Disposable SS	70886-02 (Millipore)
	Gasket, H2O 8 POS 240-70 Silicon	10968-01

TYPE	DESCRIPTION	PART NUMBER
General - Mechanical	Gasket, H2O 12 POS 2300	10968-13
	Grommet Panel Front 1/4	61206
	Nozzle, 80 CONE (PVDF) Spray 8 ea.	17425-01
	Rotor Stop Positioner (240,260,270) Slow Act	17143-01
	Rotor Stop Positioner (280,300) Slow Act	17143-501
	Seal, Viton Door 240	10771-01
	Seal, White Viton Locking Door 260, 270, 280, 2300	17438-01, 03, 05, 07
	Window, 240LH, 240RH w/o Flange	10892-511, 512
	Window, 260LH, 260RH, 270LH, 270RH	17446-501, 502, 503, 504
	Window, 280LH, 280RH, 300LH, 300RH	17446-505, 506, 507, 508
Brushless Type Motor	Cartridge, SRD Ferrofluid	240R0001-01
	Motor, Brushless 1/2 HP (120V)	17410-01
	Motor, Brushless 1/2 HP (230V)	17410-03
	Seal, Bowl Viton (240 - 300)	17448-01
	Controller (110V) Motor 1/2 HP Brushless	60710-27
	Controller (230V) Motor 1/2 HP Brushless	60710-28

TYPE	DESCRIPTION	PART NUMBER
Brush Type Motor	Motor, 1/2 HP Brushed 90 VDC	17359-01
	Motor, 1/2 HP Brushed 90 VDC, Thermal Protection	17359-02
	Motor Controller Rinser Dryer(120V)	60701-10
	Controller, 1/2 HP Brushed Motor (220V)	60701-05
	Resistor 0.025 Ohm SW	60701-20
	Seal Adapter 316SS (240, 260, 270)	13444-05
	Seal Adapter ST (280, 300)	12497-03
	Seal, Bowl Viton (240 - 300)	10777-01
	Seal, Ferrofluidic	70738

6.3 PSC-102 CONSUMABLE PARTS LIST

The following list consists of parts which Semitool considers to be consumable.

TYPE	DESCRIPTION	PART NUMBER
PSC-102 Controller, General	Fuse, 7 Amp Slow Blow 3AG	61640-10
	Fuse, 8 Amp Slow Blow 3AG	61640-11
Rinser/Dryer, General - Mechanical	Filter, Cartridge (Disposable Plastic .2 Micron)	70003
	Filter, Cartridge (Stainless Steel .01 Micron Disposable)	70886-10 (Pall)
	Filter, Cartridge 0.05U Disposable SS	70886-02 (Millipore)
	Seal, Viton Door 240	10771-01
	Seal, White Viton Locking Door 260, 270, 280, 2300	17438-01, 03, 05, 07
	Gasket, H2O 8 POS 240-70 Silicon	10968-01
Brushless Type Motor	Cartridge, SRD Ferrofluid	240R0001-01
	Seal, Bowl Viton (240 - 300)	17448-01
Brush Type Motor	Seal, Bowl Viton (240 - 280)	10777-01

FLUID FLOW SYMBOL LEGEND

RINSER DRYER FLUID FLOW

PSC-102 PORT MAP

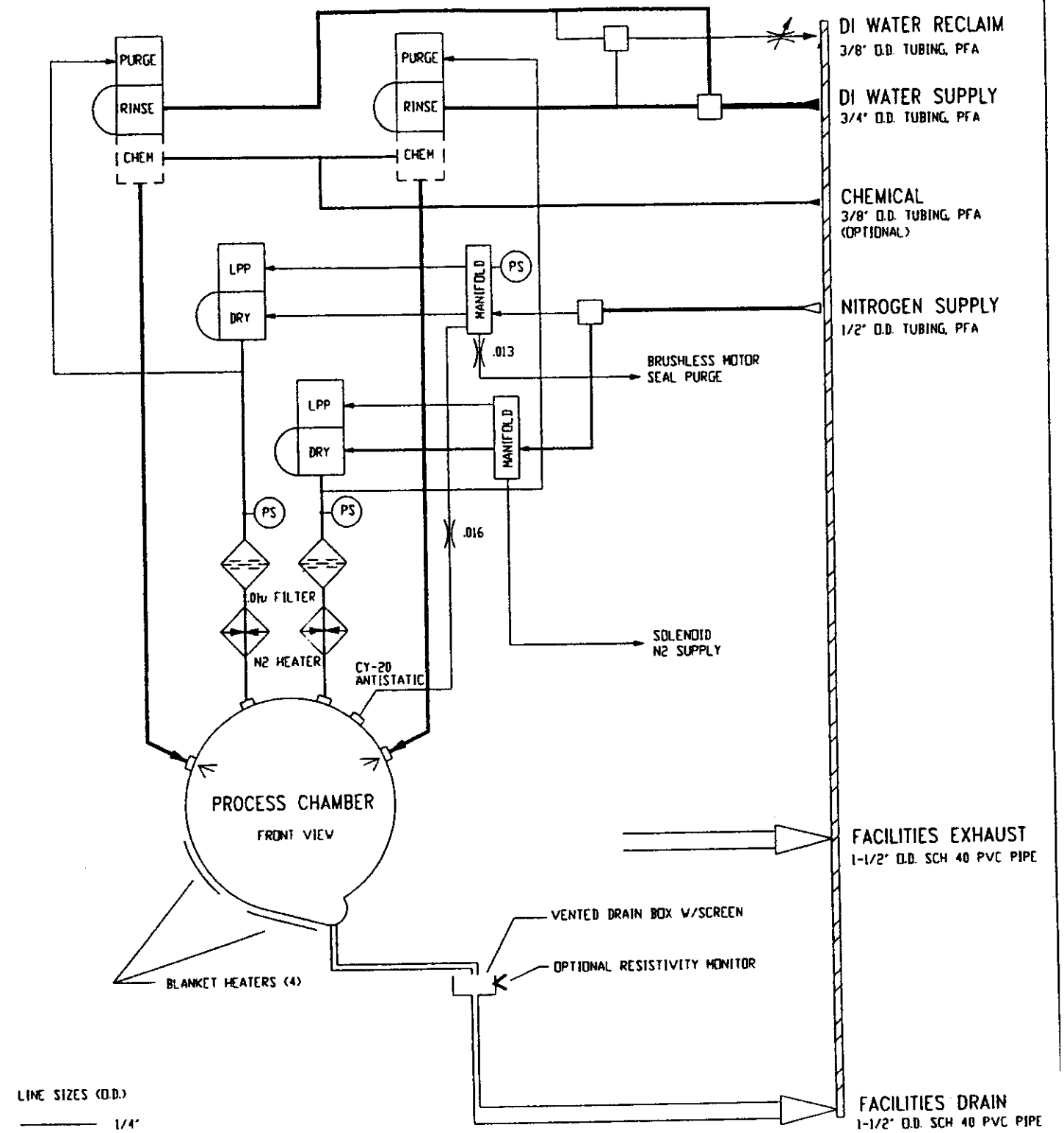
ELECTRICAL DRAWING LIST

ELECTRICAL SCHEMATICS

LEGEND OF SYMBOLS

SEMITOOL FLUID FLOW SCHEMATICS

SYMBOL	DESCRIPTION	PURPOSE
	Directional Flow – Gas	
	Directional Flow – Liquid	
	Pressure Regulator	Reduce and control pressure of a gas or liquid.
	Pressure Gauge	Visual indication of line pressure.
	Pressure Switch	Provide electrical signal of pressure change past setpoint.
	Check Valve	Allow flow in one direction only.
	Pressure Relief Valve	Limit line pressure to a maximum preset value.
	Inline Filter	Filtration of chemical, DI water, or nitrogen.
	Inline Heater	Typical N2 heater.
	Heater	Chemical or DI tank heater: immerion or external.
	Restricted Orifice – Fixed	Reduce pressure/volume to a fixed level.
	Restricted Orifice – Adjustable	Mechanical adjust flow rate for chem, DI recirc line, etc.
	Semitool Pneumatic Valve	Supply, drain, or diverter functions for liquids or gases.
	Slow–acting Pneumatic Valve	Delayed open/close for liquids or gases.
	2–Way Manual Ball Valve	Used to drain tanks, filters, or provide manual shutoff.
	or	Angle pattern of above.
	3–Way Manual Ball Valve	Used to select one of two paths of fluid flow.
Px	Pump (Pneumatic or Electric)	Chemical delivery to process chamber.
MPx	Metering Pump	Controlled pumping for mixing chemicals.
	Sensor (Switch Type)	Liquid level indicator on tanks, vessels, fluid lines, flowmeters, etc.
	Flowmeter (Rotameter)	Indicate visual rate of flow in liquid or gas line.
	Flowsensor (Turbine type)	Provides analog input of flow rate to controller.
	Parallel–Plumbed Valve	One electric solenoid controls more than one pneumatic valve, in parallel operation (all open/all close).
	Cross–Plumbed Valve	One solenoid operates more than one pneumatic valve, in opposing operation (one opens, other closes).

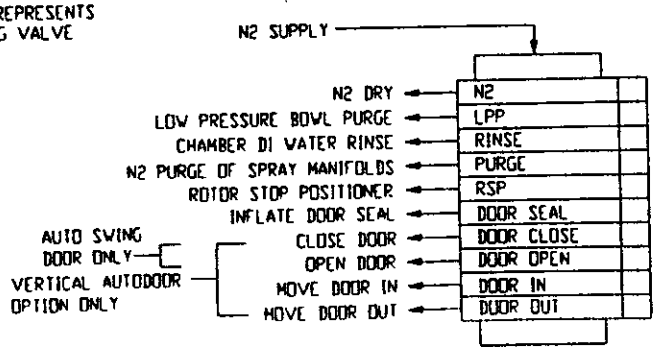


LINE SIZES (O.D.)

- 1/4"
- 3/8"
- 1/2"
- 3/4"

THIS SYMBOL REPRESENTS A SLOW-ACTING VALVE

SOLENOIDS



OPTIONS:

1) CY-20 ANTI-STATIC DEVICE
2) RESISTIVITY MONITOR
3) VERTICAL AUTODOOR
4) AUTO SWING DOOR

SEMITOOL KALISPELL, MT

FLUID FLOW, RINSER DRYER
300 CHAMBER

BY	DATE	DRAWING NUMBER:	REV
DRAWN R. ENGLISHBEE	1-10-95		
ENGR		SPEC. NO.	SHEET 1 OF 1
APPROVED			

****

PORT MAP FOR PSC-102

****

Address	
20	Inputs (Multiplexed)
22	Robot Interface Inputs/Outputs
40	Tach Counter
41	Output Solenoid Valves
42	Output Relays
60	SECS Parameter Switches (Multiplexed)
61	Door Valves
80	Serial Channel A
A0	A/D Converter

Signals shown in ( ) are not used in all machines.

INPUTS (MULTIPLEXED)

Port	Bit	Signal	Display True	Connector Pin	Connects To
		BIT 0, PROGRAM SWITCHES	("True" describes button pressed state)		
	0	PGM Left Switch	1	J2-7	N.O. Switch
	1	PGM Right Switch	1	J2-7	N.O. Switch
	2	PGM Less Switch	1	J2-7	N.O. Switch
	3	PGM More Switch	1	J2-7	N.O. Switch
20 0	4	Key in Program Mode	1	J2-7	N.O. Switch
	5	N/C			
	6	N/C			
	7	N/C			
		BIT 1, OPERATOR SWITCHES	("True" describes button pressed state)		
	0	Start Switch	1	J4-31	N.O. Switch
	1	Stop Switch	1	J4-32	N.O. Switch
	2	(Open Door Switch)***	1	J4-29	N.O. Switch
	3	(Close Door Switch)	1	J4-30	N.O. Switch
20 1	4	(Door Safety Swtch)****	1	J4-27	N.O. Switch
	5	DI flow is above low)	1	J4-28	N.O. Flow switch
	6	(Vibration not excessive)	1	J4-25	N.O. relaycontact **
	7	Alarm Silence Switch	X	J4-26	N.O. Switch
		Opr Common	X	J4-33	
		BIT 2, STATUS SWITCHES			
	0	N2 Pressure is Good	1	J4-42	N.O. Switch
	1	(Bowl is not at Temp)	1	J4-39	N.C. Switch
	2	(Door is Closed [2,3]*)	1	J4-40	N.O. Switch
	3	(Door is Open [2,3] *)	1	J4-37	N.O. Switch
20 2	4	Door is In [1,3] *	1	J4-38	N.O. Switch
	5	(Motor is not Overtemp)	1	J4-35	N.C. Switch
	6	(N2 Flow is above low)	1	J4-36	N.O. Flow Switch
	7	(N2 Flow is below high)	1	J4-34	N.C. Flow Switch
		Status Common	X	J4-41	
3		Rotor is upright	0	J4-1	open col. transistor
4		Outputs Are Disabled	0	X	X
20 5		(Carrier is present)*****	0	J4-44	open col. transistor
6		Timer Not Timed Out	0	X	X
7		Clear Memory	0	X	N.O. Switch

Switch closures will multiplex a low voltage onto the 8255 inputs which the diagnostic routine displays as a "1".

* [1] = used in manual door design, [2] = used in 2 sensor autodoor design, [3] = used in 3 sensor standard autodoor design.

** Sensor holds N.O. contacts closed unless excessive vibration is present.

*** Used as door toggle input for KS-10 option.

**** Previously used as "Autoload" switch.

***** Used for bottle low level if bottle present, no cps.

Port Map, PSC-102 master
Based on STI P/N 14843 H board

8/18/95

SERIAL PORTS

Port	Signal	Connector/Pin	Direction	Destination
80	Channel A RS232			
	RX	J3-2	<=	DB25,3
	TX	J3-1	=>	DB25,2
	GND	J3-3	=	DB25,7

ANALOG PORT

Port	Signal	Connector/Pin	Destination
A0-A3	A/D Converter	J1 pins 1-40	RM-20 Resistivity Monitor (Internal)

INPUTS (MULTIPLEXED)

Port	Bit Sel	Signal	True
		BIT 0 SECS ID HI	
	0	Device ID Bit 8 (SW1-1)	1
	1	Device ID Bit 9	1
	2	Device ID Bit 10	1
60	0 3	Device ID Bit 11	1
	4	Device ID Bit 12	1
	5	Device ID Bit 13	1
	6	Device ID Bit 14	1
	7	Master Bit (SW1-8)	1
		BIT 1 SECS ID LO	
	0	Device ID Bit 0 (SW2-1)	1
	1	Device ID Bit 1	1
	2	Device ID Bit 2	1
60	1 3	Device ID Bit 3	1
	4	Device ID Bit 4	1
	5	Device ID Bit 5	1
	6	Device ID Bit 6	1
	7	Device ID Bit 7 (SW2-8)	1
		BIT 2 SECS BAUD/RETRY	
	0	Retry Count 0 (SW3-1)	1
	1	Retry Count Bit 1	1
	2	Retry Count Bit 2	1
60	2 3	Retry Count Bit 3	1
	4	Retry Count Bit 4	1
	5	Baud Code Bit 0	1
	6	Baud Code Bit 1	1
	7	Baud Code Bit 2 (SW3-8)	1
		BIT 3 SECS TIMER 1	
	0	Timer 1 Bit 0 (SW4-1)	1
	1	Timer 1 Bit 1	1
	2	Timer 1 Bit 2	1
60	3 3	Timer 1 Bit 3	1
	4	Timer 1 Bit 4	1
	5	Timer 1 Bit 5	1
	6	Timer 1 Bit 6	1
	7	Allow parameter clear	1

Port	Bit Sel	Signal	True
		BIT 4 SECS TIMER 2	
	0	Timer 2 Bit 0 (SW5-1)	1
	1	Timer 2 Bit 1	1
	2	Timer 2 Bit 2	1
60	4 3	Timer 2 Bit 3	1
	4	Timer 2 Bit 4	1
	5	Timer 2 Bit 5	1
	6	Timer 2 Bit 6	1
	7	Display Unadj. resist.	1
		BIT 5 SECS TIMER 3	
	0	Timer 3 Bit 0 (SW6-1)	1
	1	Timer 3 Bit 1	1
	2	Timer 3 Bit 2	1
60	5 3	Timer 3 Bit 3	1
	4	Timer 3 Bit 4	1
	5	Timer 3 Bit 5	1
	6	Timer 3 Bit 6	1
	7	Display Resmon temp.	1
		BIT 6 SECS TIMER 4	
	0	Timer 4 Bit 0 (SW7-1)	1
	1	Timer 4 Bit 1	1
	2	Timer 4 Bit 2	1
60	6 3	Timer 4 Bit 3	1
	4	Timer 4 Bit 4	1
	5	Timer 4 Bit 5	1
	6	Timer 4 Bit 6	1
	7	Allow Diagnostics SW7-8	1
		BIT 7 N.C.	
	0		X
	1		X
	2		X
60	7 3		X
	4		X
	5		X
	6		X
	7		X

Note: Based on Semitool P/N 14843 board. A switch closure is read as "1" at the input port.

INPUTS

Port	Bit	Signal	True	Connector Pin	Connects To	Destination
		RI-25 INPUT				
	0	RI Bit 0	1	J6-2	opto coupler	DB15,9 OR N/C
	1	RI Bit 1	1	J6-3	opto coupler	DB15,2 OR N/C
22	2	RI Bit 2	1	J6-4	opto coupler	DB15,10 OR N/C
	3	RI Bit 3	1	J6-5	opto coupler	DB15,3 OR N/C
Note:		A 12-24VDC signal applied to the interface input will put a low voltage at the 8255 input which the diagnostic routine displays as a "1".				
40		Tach Counter		J4-2	tach input sensor	

OUTPUTS

Port	Bit	Signal	True	Connector Pin	Connects To
		INTERFACE OUTPUTS (Brushed/Brushless)			(Brushed/Brushless)
	4	(Spare/Enable Rotor [Start])	1	J5-3	relay coil/optocoupler
	5	(Spare/Enable Rotor Brake)	1	J5-4	relay coil/optocoupler
22	6	(Spare/Enable Rotor CCW)	1	J5-5	relay coil/optocoupler
	7	(Enable Process Lamp)	1	J5-6	signal tower relay coil
	0	Door Seal	1	J4-9	solenoid
	1	(Chem)	1	J4-10	solenoid
	2	(N2 Heat On)	1	J4-7****	relay coil
	3	Manifold Purge	1	J4-12	solenoid
41	4	Extend RSP **	1	J4-11	solenoid
	5	Low Pressure N2	1	J4-14	solenoid
	6	Rinse	1	J4-13	solenoid
	7	Dry	1	J4-16	solenoid
	0	(Heater On)	1	J5-16	relay coil
	1	(Brushed Motor Enable)	1	J5-15	relay coil
42	2	(Anti Stat)	1	J5-14	relay coil
	3	N.C.	X	X	X
	0	N.C.			
	1	(Enable Unload Lamp)***	1	J3-4	signal tower relay coil***
	2	(Enable Alarm Lamp)	1	J3-5	signal tower relay coil
	3	(Enable Ready Lamp)	1	J3-7	signal tower relay coil
61	4	(Move Door Open *)	1	J4-20	solenoid
	5	(Move Door Closed)	1	J4-19	solenoid
	6	(Move Door Out)	1	J4-22	solenoid
	7	(Move Door In)	1	J4-21	solenoid

Note: When a "1" is written to the port, the open collector output conducts.

* This valve is used for single valve door designs.

** with X16 connected.

*** If Output "A" is utilized (hot DI, 2nd Chem, enable chem reclaim), signal tower option is not available. Output connects to J4-18 and it operates a solenoid rather than a relay coil.

**** This output also appears at J5-7 with 14843 rev E board.

Port Map, PSC-102 master
Based on STI P/N 14843 H board

8/18/95

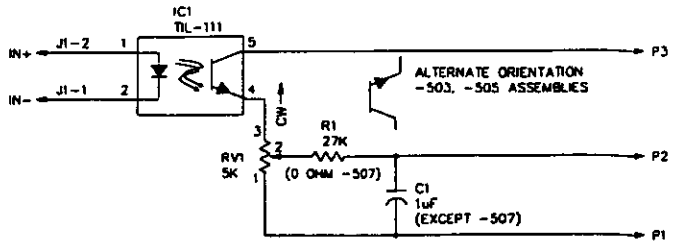
REVISION HISTORY

2/26/88	Changed " MOTOR REVERSE" bit to 611. Add audio alarm bit 612.
ER880075	Showed "CARRIER IS PRESENT" transistor connection only, 205. Added verb to several bit names.
10/31/88	Added notes to vibration excessive input. Added switch identifiers to SECS switches. Added RM-20 A/D option. Removed optical door switch option.
11/17/88	Changed "Motor Reverse" bit to "Output A".
1/18/89	Added "Output B" to 613.
4/11/90	Removed motor reverse from port 42 bit 2. Port 20 bit 1 SS 2 is door toggle input on KS-10 option.
10/15/90	Removed the A/D Converter signal at port A0 for the external TC-40 Resistivity Monitor. Added the signal tower option by using bit 7 of port 22 and bits 1, 2, and 3 of port 61 as the enable lamp signals.
10/31/90	Changed Port 20 bit 1 SS 4 to Door Safety Switch. It was previously used as the "Autoload" Switch.
11/7/90	Changed Port 20 Bit 1 SS 4 From "Autoload" To "Door Safety" switch.
11/12/90	Consolidated PSC-102 port maps -3 through -12, and -14 through -19 into one single port map. Added operator and status bit commons. Removed channel B serial port. Removed address A0 A/D converter. Added brushed/brushless note for interface outputs.
9/12/91	Added note to indicate that usage of output "A" excludes use of signal tower option. ER 910031-1.
3/29/93	Added "Enable Chem Reclaim" bit. First used on S/O 46346.
6/7/93	Added alarm silence input on 20 1 7. Added functions of 60 4 7, 60 5 7, and 60 3 7. Added drain toggle to output A.
12/15/93	Added Bottle Level Low input on 20 bit 5. If bottle is present, no cps allowed. First done for S/O 52788.
8/18/95	M950105 Release revs' 3/29/93, 6/7/93, and 12/15/93. Removed "The rinse valve will be used for IPA delivery on IPA tools only" from port 41 bit 6.

PSC-102 Electrical Drawing List

Dwg Set (102-21)

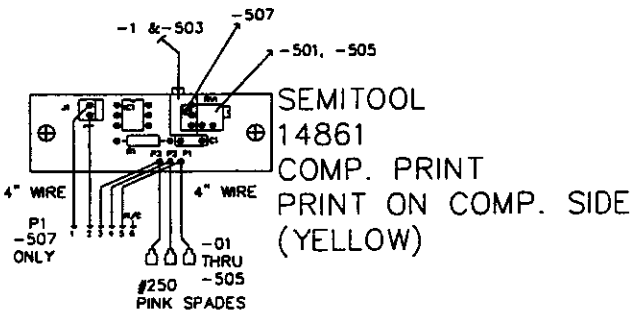
Drawing Number	Rev	Description
16068	E	PSC-102 WIRING SCHEMATIC
16034	D	MAIN LOGIC BOARD, SCHEMATIC
14843	X	MAIN LOGIC BOARD, ASSEMBLY
14157		DISPLAY BOARD, SCHEMATIC
14841	D	DISPLAY PANEL, ASSEMBLY
14861	M	DUTY CYCLE TO VOLTAGE CONVERTER
14169	A	PSC-102 CONTROLLER CABLE ASSEMBLY (DB50)
16730	G	OPTICAL SWITCH MOUNTING BOARD
16696		OPTOISOLATOR INTERFACE, SCHEMATIC
16728	F	OPTOISOLATOR INTERFACE, ASSEMBLY
14190		PSC-102 POWER CABLE ASSEMBLY
16049	C	AUTOMOTION MOTOR CONTROL TUNING ANALOG INPUT
16901	C	MOTOR SPEED LIMITER, SCHEMATIC
16737	H	MOTOR SPEED LIMITER, ASSEMBLY
AUTODOOR OPTION		
17135		PSC-102 OPERATOR CONTROL PANEL
14862	A	OPERATOR KEYPAD BOARD
RM-20 RESISTIVITY MONITOR OPTION		
14884	F	RESISTIVITY MONITOR ADAPTOR, ASSEMBLY
14188	B	RESISTIVITY MONITOR ADAPTOR, SCHEMATIC
SIGNAL TOWER OPTION		
16739	B	SIGNAL TOWER INTERFACE, ASSEMBLY
16055	H	SIGNAL TOWER INTERFACE BOX, SCHEMATIC
EA-10 END ALARM OPTION		
16064	B	EA-10 SRD END ALARM WIRING DIAGRAM
OPTICAL LEAK DETECTOR OPTION		
16755		+24VDC LEAK DETECTOR ASSEMBLY & SCHEMATIC
CARRIER DETECT OPTION		
14186	C	CARRIER PRESENT DETECTOR
23736		PSC-102 POWER CABLE ASSEMBLY



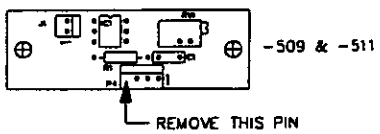
SCHEMATIC

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DA
A		CHANGE J1 PART	CAC	CAC	12/8
B		CHANGED RV1 OUTLINE TO SHOW SIDE ADJUSTMENT.	CAC	CAC	4/2
C		ADDED HOLES FOR MOUNTING RV1 IN EITHER OF TWO POSITIONS. BOARD BECOMES REV. A.	CAM	CAC	9/11
D	ER87238-1	ADDED ASSEMBLIES -503 & -505.	CAC	CAC	12/1
E	ER890299	ADDED -507 ASSEMBLY	RLF	CAC	7/14
F	ER890299-1	CHANGED P1 TO A 6 PIN CONNECTOR ON -507.	CAC	CAC	8/14
G	ER890248-4	MODIFIED NOTE 4.	CAC	CAC	10/2
H	ER890503	REVISED ARTWORK TO AUTOCAD. CHANGED TO A DOUBLE SIDED BOARD. BOARD BECOMES REV. B.	KAH	CAC	11/1
I	ER890503-1	CHANGED RV1 ON -507 ASSY TO TOP ADJUST.	CAC	CAC	4/11
J	ER910017	ADDED -509 ASSY WITH FRICTION LOCK HEADER.	RAC	CAC	3/5
K	ER910017-1	RV1 CCW DIRECTION CORRECTED TO CW.	TA	CAC	9/4
L	ER920047	ADDED -511 ASSY.	RAC	TA	4/
M	ER920047-1	CHANGED WIRE SIZE ON -1, -501, -503, -505, & -507 ASSY FROM 20AWG TO 22 AWG.	RAC	CAC	12/

ASSEMBLY



SEMITOOL
14861
COMP. PRINT
PRINT ON COMP. SIDE
(YELLOW)



SHEET	SIZE	DESCRIPTION
1.	C	ASSEMBLY
2.	A	PARTS LIST
3.	C	DRILL AND TRIM
* 4.	C	ASSEMBLY (EARLIER REV.'S)
5.	DISK "APCB"	COMP. SIDE ARTWORK
6.	DISK "APCB"	CIRC. SIDE ARTWORK
7.	DISK "APCB"	SOLDER SIDE ARTWORK
8.	DISK "APCB"	SILKSCREEN ARTWORK
* 9.	DISK "APCB"	POWER PLANE ARTWORK
* 10.	DISK "APCB"	GROUND PLANE ARTWORK

* THESE DO NOT APPLY TO THIS PC. BOARD *

CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY	
PRELIMINARY	
AS BUILT	

SEMITOOL KALISPELL, MT

ASSEMBLY, DUTY CYCL
TO VOLTAGE CONVERTER BRD.

BY	DATE
DRAWN KARI HERZOG	10/31/89
ENGR	
APPROVED	

DRAWING NUMBER: 14861

SCALE: 1 — 1

SHEET 1 OF

SEMITOOL	Kalispell, MT	
TACH OPT. SW. MOUNTING BD		
BY DATE	DRAWING NUMBER	REV
DRAWN KAH 9/13/89	16730	G
CHECKED		
APPROVED CAC 3/18/93	SHEET 2A OF 8	

REF	DESCRIPTION	PART NO.	PARTS LIST #1	#2
OP1	SWITCH, OPTICAL 5 PIN, GE # H22L2	60293-03	1	0
OP1	SWITCH, OPTICAL 5 PIN, MOTOROLA MOC75U2	60293-08	0	1
P1	CONNECTOR, 4 PIN POST HDR FRCTLK	60617-05	1	1
R1	RESISTOR, 220 OHM, 1/4 WATT	60105-03	1	1
C1	CAPACITOR, MONO 1.0uF 50V	60253-1	1	1
	BRACKET, OPT SW MOUNTING	21162	1	1
	STANDOFF, 1/2" CLEARANCE SS	95005-06	2	2
	NUT, #6/32	91214	2	2
	WASHER, #6/32 STAR	91256	2	2
	SCREW, #6/32 X 7/8" PAN HEAD	91247-04	2	2
	PRINTED CIRCUIT BOARD	16730	1	1
	ELECTRIAL SCHEMATIC	16730 SHT 1	1	1
	ASSEMBLY DRAWING	16730 SHT 1	1	1

ASSY USAGE NOTE:
BRD #16730-1 + BRKT #21162 = 14878-1 (5V, 220 OHM TACH)

NOTE ON ALL REV. BOARDS:
MOUNT OP1 ON CIRCUIT SIDE OF P.C. BOARD.

ON REV E BOARDS:
On alternate -1 assembly, cut trace on circuit side from hole labeled 1 to 2 install wire from 1 to 4. Cut trace on component side from hole labeled 3 and install wire from 3 to 2.

ASSEMBLE BRACKET & PC BOARD AS SHOWN ON ASSEMBLY DWG #16730 SHT 1.

-1 Assembly use parts list #1, for H22L2 optical switch.
Alternate -1 Assembly use parts list #2, for MOC75U2 optical switch.

END OF PARTS LIST

SEMITOOL	Kalispell, MT	
DUTY CYCLE TO VOLTAGE CONVERTER BD		
BY DATE	DRAWING NUMBER	REV
DRAWN KAH 11/1/89	14861	M
CHECKED		
APPROVED CAC 12/21/92	SHEET 2A OF 8	

REF	DESCRIPTION	PART NO.	ASSY -1	ASSY -501	ASSY -503	ASSY -505	ASSY -507	ASSY -509	ASSY -511
C1	CAPACITOR, 1uF 50V MONOLYTHIC	60253-01	1	1	1	1	0	1	0
IC1	I.C., TIL111	60451	1	1	1	1	1	1	1
J1	CONNECTOR, 2 PIN FRICTION LOCK HEADER	73203	1	1	1	1	0	1	1
P1	CONNECTOR, 6 PIN PLUG	73092	0	0	0	0	1	0	0
R1	RESISTOR, 27K OHM, 1/4W, 5%	60114	1	1	1	1	0	1	0
R1	RESISTOR, 0 OHM JUMPER	76001-01	0	0	0	0	1	0	1
RV1	POT, 5K PC MNT SIDE ADJ	73166-05	1	1	1	1	0	1	1
RV1	POT, 5K PC MNT TOP ADJ	73166-06	0	0	0	0	1	0	0
	SPADES, #250 FEMALE INSULATED	61753	3	3	3	3	0	0	0
	WIRE, 22 AWG VIOLET	73189-51	12"	12"	12"	12"	24"	0	0
	PINS, SM. SILVER MALE	73066	0	0	0	0	5	0	0
P4	CONNECTOR, 4 PIN FRICTION LOCK HEADER	60617-5	0	0	0	0	0	1	1
	I.C. SOCKET, 6 PIN	60505-6	1	1	1	1	1	1	1
	PRINTED CIRCUIT BOARD	14861	1	1	1	1	1	1	1
	ELECTRIAL SCHEMATIC	14861 SHT 1	1	1	1	1	1	1	1
	ASSEMBLY DRAWING	14861 SHT 1	1	1	1	1	1	1	1
	MATING CONNECTOR								
J1	CONNECTOR, 2 PIN FRICTION LOCK	73183-50	1	1	1	1	0	1	1
J4	CONNECTOR, 4 PIN FRICTION LOCK	73183-51	0	0	0	0	0	1	1

ASSY USAGE NOTE:

-1 & -501 BRUSHED MOTOR (KBIC MOTOR CONTROL)
-1 & -501 ARE THE SAME EXCEPT THE ORIENTATION OF RV1.
-503 & -505 BRUSHED MOTOR (SABINA'S REVERSING MOTOR CONTROL)
-503 & -505 ARE THE SAME EXCEPT THE ORIENTATION OF RV1.
-507 BRUSHLESS MOTOR (DIRECT PULSE WIDTH MODULATION CONTROL)
-509 BRUSHLESS MOTOR PSC-102-20 IPA SRD
-511 PSS/PAT 302 PWM WITH HEADER.

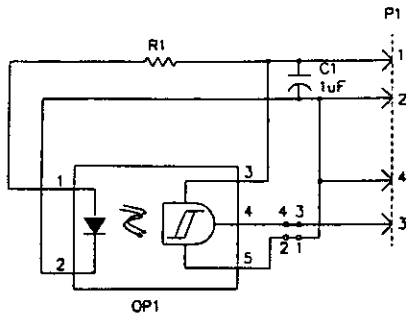
NOTE ON ALL REV. BOARDS:

1. -01 THRU -505 SOLDER 4" 22 AWG VIOLET WIRES DIRECTLY INTO P1-P3, TERMINATE WITH #250 FEMALE PINK SPADES.

2. -503 & -505 ONLY
CUT IC1 PINS 4 & 5. JUMPER IC1 PIN 4 TO P3 & JUMPER IC1 PIN 5 TO RV1 PIN 3.
3. -507 SOLDER 4" 22 AWG VIOLET WIRES DIRECTLY INTO J1 & P1-P3, TERMINATE WITH SM. SILVER MALE PINS, PIN OUT ACCORDING TO DWG #14861 SHT 1.
4. -509 & -511 REMOVE PIN ON P4 HEADER AND INSTALL AS SHOWN ON SHT 1.

END OF PARTS LIST

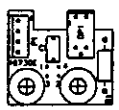
SCHEMATIC



LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DA
A	890435	CHANGED ARTWORK FOR OP1. RELEASED WITH REV. A BOARDS. RESCALED DRAWING.	KAH	CAC	9/1
B	890435-1	CHANGED R1 FROM 390 OHM TO 220 OHM.	RLF	CAC	12/
C	890435-2	CHANGED BOARD OUTLINE. BOARD BECOMES REV.B.	KAH	CAC	2/1
D	890435-3	IMPROVED TRACE CLEARANCE ON P1. BOARDS BECOME REV. C.	JEA	CAC	6/1
E	910056	ADDED C1. CHANGED P1 HOLES TO .045. BOARD BECOMES REV.D	RAC	CAC	7/1
F	930015	ADDED JUMPER OPTION TO CONFIGURE BOARD FOR MOC75U2 OPTICAL SWITCH. BOARD BECOMES REV E.	MB	TA	3/
G	930015-1	CHANGED -501 ASSEMBLY TO ALTERNATE -1 ASSEMBLY.	MB		

ASSEMBLY

NOTE: OP1 MOUNTS ON CIRCUIT SIDE.



SEMITOOL
16730E
COMP. PRINT
PRINT ON COMP. SIDE
(YELLOW)

SHEET	SIZE	DESCRIPTION
1.	A	ASSEMBLY
2.	A	PARTS LIST
3.	A	DRILL AND TRIM
* 4.	C	ASSEMBLY (EARLIER REV.'S)
5.	DISK "APCB"	COMP. SIDE ARTWORK
6.	DISK "APCB"	CIRC. SIDE ARTWORK
7.	DISK "APCB"	SOLDER SIDE ARTWORK
8.	DISK "APCB"	SILKSCREEN ARTWORK
* 9.	DISK "APCB"	POWER PLANE ARTWORK
* 10.	DISK "APCB"	GROUND PLANE ARTWORK

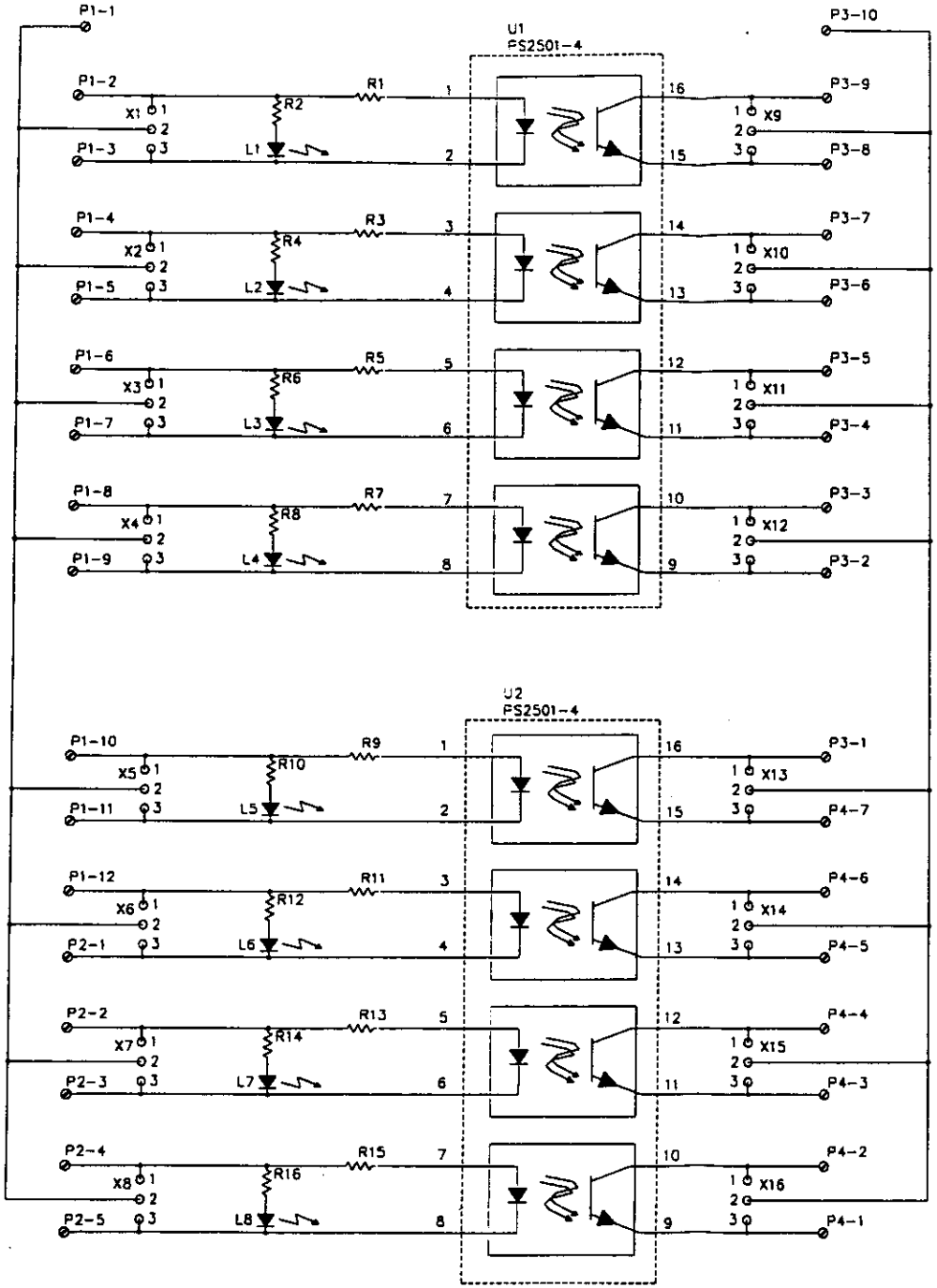
* THESE DO NOT APPLY TO THIS PC. BOARD *

NOTE:

BRD# 16730-1 + BRKT# 21162 = 14878-1 (5V, 390 OHM TACH)

BRD# 16731-1 + BRKT# 21161 = 14878-501 (5V, 390 OHM OPEN COLLECTOR UPRIGHT)

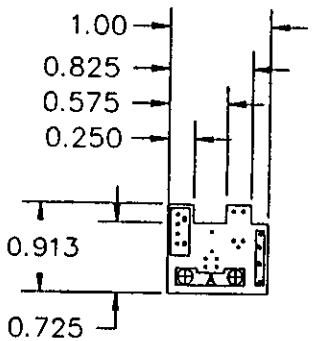
CUSTOMER	SEMITOOL KALISPELL, MT
S/O	
REF MASTER	TACH OPTICAL SWITCH MOUNTING BOARD ASSEMBLY, SCHEMATIC
REF SCHEMATIC	
REF ASSEMBLY	BY DATE
PRELIMINARY	DRAWN KARI HERZOG 8-21-89
AS BUILT	ENGR
	DRAWING NUMBER: 16730
	SCALE:



LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DA

CUSTOMER	SEMITOOL™ KALISPELL, MT		
S/O			
REF MASTER	OPTOISOLATOR INTERFACE BOARD SCHEMATIC		
REF SCHEMATIC			
REF ASSEMBLY 16728	BY DATE	DRAWING NUMBER:	R
PRELIMINARY	DRAWN TA 10/25/89	16696	
AS BUILT	ENGR	SCALE:	SHEET 1 OF

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	890435	CHANGED ARTWORK FOR OP1. RELEASED WITH REV. A BOARDS. RESCALED DRAWING.	KAH	CAC	9/12/
B	890435-1	CHANGED R1 FROM 390 OHM TO 220 OHM.	RLF	CAC	12/12/
C	890435-2	CHANGED BOARD OUTLINE. BOARD BECOMES REV.B.	KAH	CAC	2/13/
D	890435-3	IMPROVED TRACE CLEARANCE ON P1. BOARDS BECOME REV. C.	JEA	CAC	6/1/9
E	910056	ADDED C1. CHANGED P1 HOLES TO .045. BOARD BECOMES REV.D	RAC	CAC	7/15/
F	930015	ADDED JUMPER OPTION TO CONFIGURE BOARD FOR MOC75U2 OPTICAL SWITCH. BOARD BECOMES REV E.	MB	TA	3/7/
G	930015-1	CHANGED -501 ASSEMBLY TO ALTERNATE -1 ASSEMBLY.	MB	ck.	3/18/



DRILL CHART		
DRILL CODE	FINISHED HOLE SIZE	QTY
A	.157"	2
B	.045"	6
ALL OTHERS	.035"	11
	TOTAL:	19

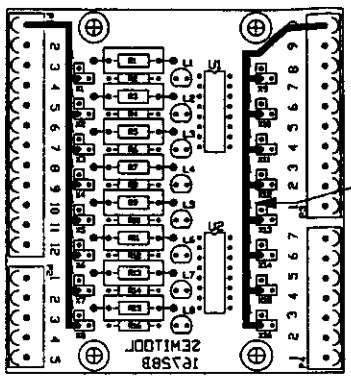
FABRICATION NOTES
1. DOUBLE SIDED BOARD. TWO OZ. COPPER BOTH SIDES.
2. BASE MATERIAL G10FR.
3. DO NOT PLATE THROUGH "A" DIMENSION (.157") HOLES.
4. PLATE THROUGH ALL HOLES (EXCEPT AS NOTED ABOVE) WITH A MINIMUM OF .002 INCH THICK COPPER, INCLUDING PLATING. HOLE DIMENSIONS APPLY AFTER PLATE THROUGH.
5. APPLY SOLDER MASK BOTH SIDES (SR1000).
6. FINAL BOARD THICKNESS .062" ±.005".
7. PRINT COMPONENT ID (YELLOW).
8. SCALE 1=1.

CUSTOMER	SEMITOOL KALISPELL, MT
S/O	TACH OPTICAL SWITCH MOUNTING BOARD DRILL AND TRIM
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY	
PRELIMINARY	BY DATE
AS BUILT	DRAWN KARI HERZOG 8-21-89
REF E.R.	ENGR
	APPROVED 3/17/97
	DRAWING NUMBER: 16730 REV G
	SCALE: 1=1 SHEET 3 OF 8

	-1	-501	-503	-505	-507	-509
X1	1 to 2	1 to 2	1 to 2			
X2	1 to 2	1 to 2	1 to 2			
X3	1 to 2	1 to 2	1 to 2			
X4	1 to 2	N	1 to 2			
X5	1 to 2	N	1 to 2			
X6	1 to 2	N	1 to 2			
X7	N	N	1 to 2			
X8	N	N	1 to 2			
X9	N	1 to 2	N			
X10	N	1 to 2	N			
X11	N	1 to 2	N			
X12	N	N	N			
X13	N	2 to 3	N			
X14	N	2 to 3	N			
X15	N	2 to 3	N			
X16	N	2 to 3	N			

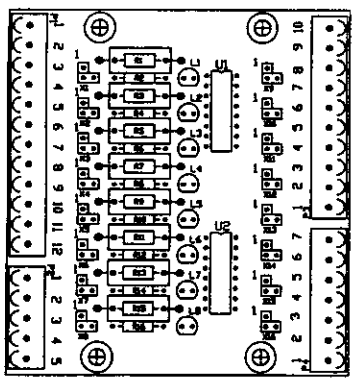
N MEANS NOT INSTALLED

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DAT
A	890431-1	CORRECTED PART NUMBERS FOR LED'S 1 THRU 8.	RLF	CAC	12/7/
B	890431-2	ADDED -501 ASSEMBLY.	TA	CAC	2/13/
C	890431-3	ADDED -503 ASSEMBLY.	JWD	CAC	4/20/
D	890431-4	CHANGED CONNECTORS P1-P4. BOARDS BECOME REV. A.	JEA	CAC	8/7/
E	890431-5	CORRECTED HOLE SPACING ON P1-P4. BOARD BECOMES REV. B.	RAC	CAC	11/14/
F	M950130	MODIFIED -501 ASSEMBLY.	ASC	ASC	8/24/



CUT TRACE ON -501 ASSEMBLY ONLY.

(USAGE NOTE: PRESENT ON PSC-120-14,21 CONTROLLERS IN >2300 SIZE SRDs AFTER 8/95.

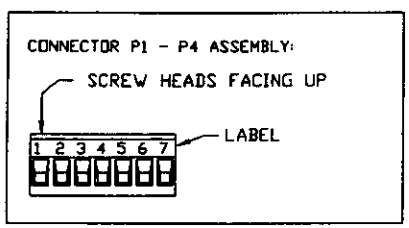


SEMITOOL
16728
COMP. PRINT
(YELLOW)

SHEET	SIZE	DESCRIPTION
1.	C	ASSEMBLY
2.	A	PARTS LIST
3.	C	DRILL AND TRIM
* 4.	C	ASSEMBLY (EARLIER REV.'S)
5.	DISK "APCB"	COMP. SIDE ARTWORK
6.	DISK "APCB"	CIRC. SIDE ARTWORK
7.	DISK "APCB"	SOLDER SIDE ARTWORK
8.	DISK "APCB"	SILKSCREEN ARTWORK
* 9.	DISK "APCB"	POWER PLANE ARTWORK
* 10.	DISK "APCB"	GROUND PLANE ARTWORK

* THESE DO NOT APPLY TO THIS PC. BOARD *

ASSEMBLY NOTES:



CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC 16696	
REF ASSEMBLY	
PRELIMINARY	
AS BUILT	
REF E.R.	

SEMITOOL KALISPELL, MT

OPTOISOLATOR INTERFACE BD
,ASSEMBLY

	BY	DATE
DRAWN	KARI HERZOG	8/11/89
ENGR	ASC	8/24/95
APPROVED	ASC	8/24/95

DRAWING NUMBER: 16728 RE F

SCALE:

SHEET 1 OF 8

SEMITOOL Kalispell, MT BY DATE
DWG# 16728 REV F SHEET 2A OF 8 ASC 8/24/95
OPTOISOLATOR INTERFACE BRD., ASSEMBLY

REF	DESCRIPTION	PART NO.	ASSY -1	ASSY -501	ASSY -503
L1	LED, T-1 RED 1.2V.	73099-01	1	1	1
L2	LED, T-1 RED 1.2V.	73099-01	1	1	1
L3	LED, T-1 RED 1.2V.	73099-01	1	1	1
L4	LED, T-1 RED 1.2V.	73099-01	1	0	1
L5	LED, T-1 RED 1.2V.	73099-01	1	0	1
L6	LED, T-1 RED 1.2V.	73099-01	1	0	1
L7	LED, T-1 RED 1.2V.	73099-01	1	0	1
L8	LED, T-1 RED 1.2V.	73099-01	1	0	1
P1	CONNECTOR, 12 PIN HEADER PC MOUNT	60516-10	1	1	1
P1	CONNECTOR, 12 PIN PLUG	60516-9	1	1	1
P1	LABEL, 1-10	61403-15	1	1	1
P2	CONNECTOR, 5 PIN HEADER PC MOUNT	60516-8	1	0	1
P2	CONNECTOR, 5 PIN PLUG	60516-7	1	0	1
P2	LABEL, 1-10	61403-15	1	0	1
P3	CONNECTOR, 10 PIN HEADER PC MOUNT	60516	1	1	1
P3	CONNECTOR, 10 PIN PLUG	60516-01	1	1	1
P3	LABEL, 1-10	61403-15	1	1	1
P4	CONNECTOR, 7 PIN HEADER PC MOUNT	60516-4	1	1	1
P4	CONNECTOR, 7 PIN PLUG	60516-5	1	1	1
P4	LABEL, 1-10	61403-15	1	1	1
R1	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	1	1
R1	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R1	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R2	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	1	1
R2	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R2	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R3	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	1	1
R3	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R3	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R4	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	1	1
R4	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R4	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R5	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	1	1
R5	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R5	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R6	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	1	1
R6	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R6	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R7	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	0	1
R7	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R7	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R8	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	0	1
R8	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R8	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R8	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0

SEMITOOL Kalispell, MT BY DATE
DWG# 16728 REV F SHEET 2B OF 8 ASC 8/24/95
OPTOISOLATOR INTERFACE BRD., ASSEMBLY

R8	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R9	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	0	1
R9	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R9	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R10	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	0	1
R10	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R10	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R11	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	0	1
R11	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R11	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R12	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	0	1
R12	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R12	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R13	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	0	1
R13	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R13	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R14	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	0	1
R14	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R14	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
R15	RESISTOR, 2.2K OHM, 1/2 W, 5%	60108-01	1	0	1
R15	RESISTOR, 1.2K OHM, 1/4 W, 5%	60131	0	0	0
R15	RESISTOR, 330 OHM, 1/4 W, 5%	60115-08	0	0	0
R16	RESISTOR, 4.7K OHM, 1/4 W, 5%	60107-01	1	0	1
R16	RESISTOR, 2.2K OHM, 1/4 W, 5%	60103	0	0	0
R16	RESISTOR, 750 OHM, 1/4 W, 5%	60125-3	0	0	0
U1	I.C., PS 2501-4	60455-3	1	1	1
U2	I.C., PS 2501-4	60455-3	1	0	1
X1	CONNECTOR, 3 PIN POST HDR	60283	3	3	3
X2	CONNECTOR, 3 PIN POST HDR	60283	3	3	3
X3	CONNECTOR, 3 PIN POST HDR	60283	3	3	3
X4	CONNECTOR, 3 PIN POST HDR	60283	3	0	3
X5	CONNECTOR, 3 PIN POST HDR	60283	3	0	3
X6	CONNECTOR, 3 PIN POST HDR	60283	3	0	3
X7	CONNECTOR, 3 PIN POST HDR	60283	3	0	3
X8	CONNECTOR, 3 PIN POST HDR	60283	3	0	3
X9	CONNECTOR, 3 PIN POST HDR	60283	3	3	0
X10	CONNECTOR, 3 PIN POST HDR	60283	3	3	0
X11	CONNECTOR, 3 PIN POST HDR	60283	3	3	0
X12	CONNECTOR, 3 PIN POST HDR	60283	3	0	0
X13	CONNECTOR, 3 PIN POST HDR	60283	3	2	0
X14	CONNECTOR, 3 PIN POST HDR	60283	3	2	0
X15	CONNECTOR, 3 PIN POST HDR	60283	3	2	0
X16	CONNECTOR, 3 PIN POST HDR	60283	3	2	0
	SHORTING JUMPERS	60282	5	10	8
	PRINTED CIRCUIT BOARD	16728	1	1	1
	ASSEMBLY DRAWING	16728 SHT	1	1	1
	ELECTRICAL SCHEMATIC	16696	1	1	1

-1 ASSY IS +24VDC

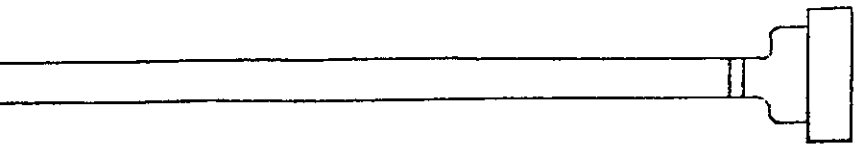
-501 IS FOR USE WITH 2400 AND 2600 SIZE BOWL SRD's.
CUT (1) TRACE ACCORDING TO ASSEMBLY 16728. INSTALL JUMPER BETWEEN PINS 15 AND 16 ON U2.

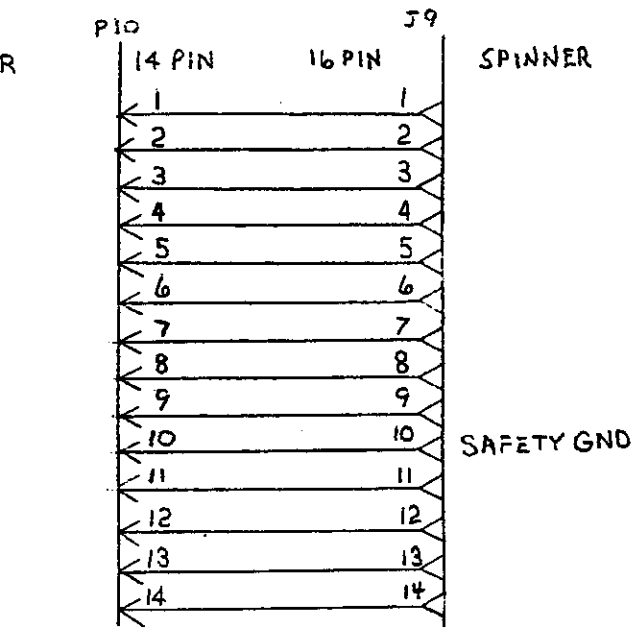
-503 IS USED ON PAT-202 TOOLS

CUT LABELS FOR P2 AND P4 BETWEEN NUMBERS 5-6, AND 7-8 RESPECTIVELY.
APPLY LABEL FOR P1-P4 AS SHOWN ON ASSY DRAWING NOTES.

END OF PARTS LIST

LTR.	REVISION	BY	APP'D.	DATE





QTY. PER ASSY.	PART NO.	DESCRIPTION	SPECIFICATION
16.5'	73179	CABLE, ROUND 20 COND., 18GA.	
1	73051-15	EXTENDED GROUND PIN, MALE	
2	61714	STRAIN RELIEF	
1	61712	CONNECTOR 16 PIN CPC	
1	73189	CONNECTOR, 14PIN CPC	
1	73051-30	EXTENDED GROUND PIN, FEMALE	
-1			

TOLERANCES UNLESS NOTED
.XX = ± .02
.XXX = ± .010
ANGULARITY = ± ½°
BREAK CORNERS-.010 MAX.
FILLET RADII-.015 MAX.
125√ MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

NEXT ASSEMBLY

SEMITOOL™ KALISPELL, MT.

PSC-102
POWER CABLE ASSEMBLY

	BY	DATE
DRAWN	RTW	1/15/8
CHECKED		
APPROVED	CAC	1/19/88

DRAWING NUMBER 14190

RE

SCALE

SHEET 1 OF

A	900044	FOR ADDITION OF P/N 16740 BOARD	TA	CAC	[illegible]
B		SOFT START WAS 1 TURN, NOW 2	CAC	CAC	5/4/9
C	920077	ADDED TUNING NOTES FOR SMALL BOWL MACHINES.	TA	TA	8/24/

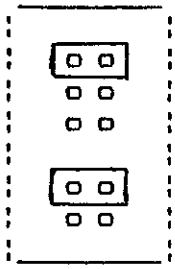
SEMITOOL™ Kalispell, MT		
AUTOMOTION MOTOR CONTROL TUNING, ANALOG INPUT		
BY DATE	DRAWING NUMBER	REV
DRAWN TA 8/24/92	16049	C
CHECKED		
APPROVED TA 8/24/92	SHEET 1 OF 2	

) THE SOFT START POTENTIOMETER SHOULD BE ADJUSTED COUNTER CLOCKWISE UNTIL AN AUDIABLE CLICK IS HEARD AND THEN ADJUSTED TWO FULL TURN CLOCK WISE.

) THE VELOCITY SETPOINT 1 & 2 POTENTIOMETERS SHOULD BE TURNED COUNTER CLOCKWISE UNTIL AN AUDIBLE CLICK IS HEARD.

) THE TACH GAIN, SLEW, AND CURRENT LIMIT POTENTIOMETERS SHOULD BE TURNED CLOCKWISE UNTIL AN AUDIBLE CLICK IS HEARD.

) THE JUMPERS ON THE AUTOMOTION CONTROLLER SHOULD BE CONFIGURED AS SHOWN;



)

PSC-101:
AFTER THE ABOVE STEPS HAVE BEEN COMPLETED, LOCATE THE POTENTIOMETER (RV3) ON THE PSC 101 MAIN LOGIC BOARD. ENTER THE MOTOR TEST PORTION OF SERVICE MODE AND PROGRAM THE SETPOINT RPM TO EQUAL THE MAXIMUM ROTOR RPM. WITH THE MOTOR RUNNING OPEN LOOP (MOTOR N), ADJUST RV3 SO THAT THE ACTUAL RPM EQUALS THE SETPOINT RPM. THIS COMPLETES THE TUNING PROCEDURE.

PSC-102:
AFTER THE ABOVE STEPS HAVE BEEN COMPLETED, LOCATE THE POTENTIOMETER (RV1) ON THE DUTY CYCLE CONVERTER BOARD (P/N 14861) (OR OPTOCOUPLER/RELAY BOARD P/N 16740 IF IT IS BEING USED). ENTER THE MOTOR TEST PORTION OF SERVICE MODE AND PROGRAM THE SETPOINT RPM TO EQUAL THE MAXIMUM ROTOR RPM. WITH THE MOTOR RUNNING OPEN LOOP, ADJUST RV1 SO THAT THE ACTUAL RPM EQUALS THE SETPOINT RPM. THIS COMPLETES THE TUNING PROCEDURE.

SEMITOOL Kalispell, MT		
AUTOMOTION MOTOR CONTROL TUNING, ANALOG INPUT		
BY DATE	DRAWING NUMBER	REV
DRAWN TA 8/19/92	16049	C
CHECKED		
APPROVED TA 8/24/92	SHEET 2 OF 2	

ON SOME SMALL DIAMETER BOWL MACHINES, RPM VALUES SEEN DURING ACCELERATION MAY NOT INCREASE TO THE SETPOINT RPM SMOOTHLY. TO CORRECT THIS PROBLEM, DO THE FOLLOWING:

1) ENTER THE MOTOR TEST PORTION OF SERVICE MODE AND SET THE RPM FOR 500 RPM.

2) START AND STOP THE MOTOR RUNNING (IN OPEN LOOP MODE) AND OBSERVE WHETHER THE MOTOR'S FINAL SPEED IS SUBSTANTIALLY LOWER THAN IT'S PEAK SPEED. IF SO, REDUCE THE CURRENT LIMIT POTENTIOMETER SETTING (COUNTER CLOCKWISE) APPROXIMATELY 10 TURNS OR UNTIL THE MOTOR ACCELERATES SMOOTHLY TO IT'S FINAL RPM.

3) THIS COMPLETES THE TUNING PROCEDURE.

SEMITOOL Kalispell, MT

MOTOR SPEED LIMITER

	BY	DATE	DRAWING NUMBER	REV
DRAWN	MB	7/21/93	16737	H
CHECKED				
APPROVED	CAC	8/1/93	SHEET 2A of 10	

REF	DESCRIPTION	PART NO.	PARTS LIST #1	#2	#3	#4	#5
C1	CAPACITOR, 10uF, 50V ELECTROLYTIC	60260	1	1	1	1	1
C2	CAPACITOR, 0.01uF 25V. CERAMIC	60201	1	1	1	1	1
C3	CAPACITOR, 0.1uF 25V. METAL FILM	60240-03	0	0	1	0	0
C3	CAPACITOR, 0.047uF 50V. METAL FILM	60240-05	1	0	0	0	1
C3	CAPACITOR, 0.01uF 50V. METAL FILM	60240-02	0	1	0	1	0
C4	CAPACITOR, 1uF 50V. MONOLYTHIC	60253-01	1	1	1	1	1
C5	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C6	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C7	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C8	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C9	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C10	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C11	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C12	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C13	CAPACITOR, 0.1MF 35V, TANT.	60202	1	1	1	1	1
P1	CONNECTOR, 7 PIN HEADER PC MOUNT	60516-4	1	1	1	1	1
P1	CONNECTOR, 7 PIN PLUG	60516-5	1	1	1	1	1
P1	LABEL, 1-10	61403-15	1	1	1	1	1
R1	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	0	0
R1	RESISTOR, 750 OHM, 1/4W 5%	60125-03	0	0	0	1	1
R2	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	0	0
R2	RESISTOR, 750 OHM, 1/4W 5%	60125-03	0	0	0	1	1
R3	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	0	0
R3	RESISTOR, 750 OHM, 1/4W 5%	60125-03	0	0	0	1	1
R4	RESISTOR, 22K OHM, 1/4W 5%	60105	1	1	1	1	1
R5	RESISTOR, 30K OHM, 1/4W 5%	60115-02	1	0	1	0	1
R5	RESISTOR, 22K OHM, 1/4W 5%	60105	0	1	0	1	0
R6	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	1	1
R7	RESISTOR, 180K OHM, 1/4W 5%	60101-05	1	0	1	0	0
R7	RESISTOR, 150K OHM, 1/4W 5%	60268	0	1	0	1	1
R8	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	1	1
R9	RESISTOR, 10M OHM, 1/4W 5%	60107-05	1	1	1	1	1
R10	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	1	1
R11	RESISTOR, 15K OHM, 1/4W 5%	60105-39	1	1	1	1	1
R12	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	0	0
R12	RESISTOR, 100 OHM, 1/4W 5%	60105-38	0	0	0	1	1
R13	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	0	0
R13	RESISTOR, 100 OHM, 1/4W 5%	60105-38	0	0	0	1	1
R14	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	0	0
R14	RESISTOR, 100 OHM, 1/4W 5%	60105-38	0	0	0	1	1
R15	POT, 100K OHM PC MNT SIDE ADJ.	73166-36	1	1	1	1	1
R16	RESISTOR, 4.7K OHM, 1/4W 5%	60107-01	1	1	1	1	1
R17	RESISTOR, 7.5K OHM, 1/4W 5%	60125-01	1	1	1	1	1
R18	RESISTOR, 7.5K OHM, 1/4W 5%	60125-01	1	1	1	1	1

SEMITOOL	Kalispell, MT		
MOTOR SPEED LIMITER			
	BY / DATE	DRAWING NUMBER	REV
DRAWN	MB 7/21/93	16737	H
CHECKED			
APPROVED	CAC 8/6/93	SHEET 2C of 10	

USAGE NOTES:

-1 ASSEMBLY OBSOLETE, SEE BELOW. WAS USED WITH LC4 AND LC5 MOTOR CONTROLS.

-501 ASSEMBLY USE PARTS LIST #2: USED WITH LC1 MOTOR CONTROL, SWP MAX 2000 RPM BEI 8 POLE MOTOR.

-503 ASSEMBLY USE PARTS LIST #1: USED WITH 50 WAFER CARRIERLESS, MFM K127 12 POLE MOTOR 1300 RPM MAX.

-505 ASSEMBLY USE PARTS LIST #1: REPLACES -1 ASSY FOR LC4, LC5 MOTOR CONTROLS.
USED FOR SRD, BOX WASHER WITH STD MOTOR CNTRL BRD, SYSTEMS <= 2300 SIZE (2000RPM OR GREATER

-507 ASSEMBLY USE PARTS LIST #3: REPLACES -1 ASSY. USED WITH LC4, LC5 MOTOR CONTROLS.
USED FOR SYSTEMS 2400/2600 SIZE (1300RPM), AND FOR ALL SATS EXCEPT SATS WITH
750 PAC-SCI MOTOR CONTROLLER.

-509 ASSEMBLY USE PARTS LIST #4: USED ON SATS WITH 750 PAC-SCI MOTOR CONTROLLER (SPEED LIMITER INPUT FROM 60 SLOT DISK).

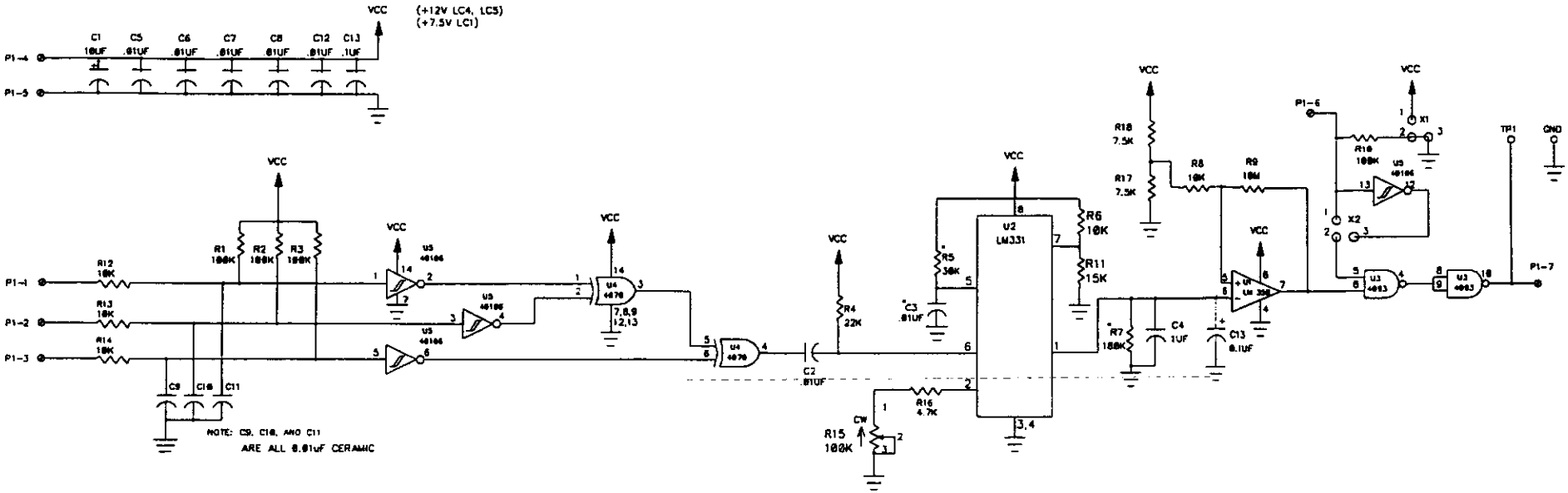
-511 ASSEMBLY USE PARTS LIST #5: USED ON BOX WASHERS WITHOUT STD MOTOR CNTRL BRD.

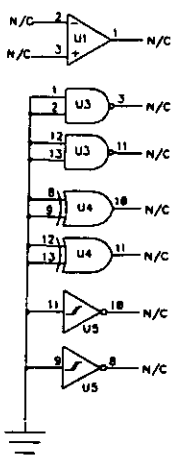
CALIBRATION PROCEDURE:
TURN R15 FULLY CW, SET SPEED TO RECIPE+10%.
ADJUST R15 CCW UNTIL TRIP POINT IS REACHED.

END OF PARTS LIST

ASSEMBLY	COMPONENT	VALUE
<=220Hz	R5	39K OHM
	R7	180K OHM
	C3	0.1uF
220-510Hz	R5	39K OHM
	R7	180K OHM
	C3	0.047uF
>510 HZ	R5	22K OHM
	R7	150K OHM
	C3	0.01uF

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DAT
A	900071-1	ADDED C9-C12, R12-R14, U5, X1, AND X2. BOARD BECOMES REV. A.	JEA	CAC	7/
B	900071-2	CORRECTED COMPONENT VALUES: C9-C11 WERE .001uF, R1-3 WERE 10K, R12-14 WERE 100 OHM, C4 WAS .01uF, R18 WAS 10K. ADDED -503 ASSY.	TA	CAC	8/
C	930043	CHANGED F-V CONVERTER FROM 4047 TO LM 331. BOCRD BECOMES REV. C.	MB		





CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY 16737	
PRELIMINARY	
AS BUILT	
REF F.R.	

SEMITOOL™ KALISPELL, MT

MOTOR SPEED LIMITER BOARD SCHEMATIC

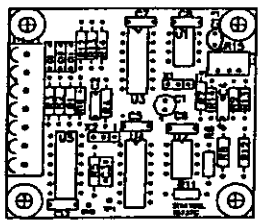
	BY	DATE
DRAWN	MB	5/6/93
ENGR		
APPROVED		

DRAWING NUMBER: 16901

SCALE: NONE

SHEET 1 OF 1

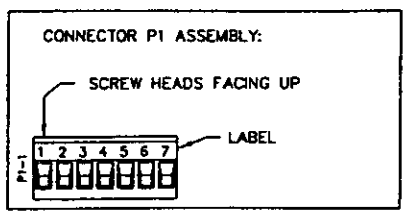
LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	900070	OBSOLETE CAP 50201-01. CHANGED C3 TO METAL FILM.	JWD	CAC	3/28/90
B	900070-1	CHANGED P1. ADDED C9-C12, R12-R14, U5, X1 AND X2. BOARDS BECOME REV A.	JEA	CAC	7/19/90
C	900070-2	ADDED -501 ASSY	JWD	CAC	8/7/90
D	910016	-501 ASSY X2 WAS 2-3, ADDED CUT.	CAC	CAC	3/11/91
E	910016-1	CORRECTED HOLE SPACING ON P1 TO 5MM. CORRECTED TRACE FROM R18, REVISED RV1 OUTLINE. BOARD BECOMES REV. B.	RAC	CAC	7/18/91
F	910016-2	ADDED -503 ASS'Y TO PARTS LIST. C8 WAS SHOWN ON PARTS LIST TWICE.	RAC	CAC	9/3/91
G	930043	CHANGED F-V CONVERTER FROM 4047 TO LM 331. BOARD BECOMES REV. C.	MB	CAC	5/7/93
H	930043-1	CREATED -509 ASSEMBLY, CORRECTED CALIBRATION PROCEDURE ON PARTS LIST.	MB	[illegible]	[illegible]



SEMITOOL
16737
COMP. PRINT
PRINT ON COMP. SIDE
(YELLOW)

ASSEMBLY NOTES:

CONFIGURATION TABLE		
ASSY	X1	X2
-1,-503-505,-507,-509 (LC4 AND LC5)	2 TO 3 (IN ARTWORK)	1 TO 2
-501 (LC1)	CUT TRACE FROM 2 TO 3 INSTALL JUMPER 1 TO 2	1 TO 2



SHEET	SIZE	DESCRIPTION
1.	B	ASSEMBLY
2.	A	PARTS LIST
3.	B	DRILL AND TRIM
* 4.	C	ASSEMBLY (EARLIER REV.'S)
5.	DISK "APCB"	COMP. SIDE ARTWORK
6.	DISK "APCB"	CIRC. SIDE ARTWORK
7.	DISK "APCB"	SOLDER SIDE ARTWORK
8.	DISK "APCB"	SILKSCREEN ARTWORK
* 9.	DISK "APCB"	POWER PLANE ARTWORK
* 10.	DISK "APCB"	GROUND PLANE ARTWORK

* THESE DO NOT APPLY TO THIS PC. BOARD *

CUSTOMER	SEMITOOL™ KALISPELL, MT	
S/O	MOTOR SPEED LIMITER BRD. ASSEMBLY,	
REF MASTER		
REF SCHEMATIC 16981		
REF ASSEMBLY	BY DATE	DRAWING NUMBER: 16737 REV H
PRELIMINARY	DRAWN MB 7/21/93	
AS BUILT	ENGR	SCALE: 1=1
REF E.R. 890489	APPROVED [illegible]	SHEET 1 OF 8

SEMITOOL Kalispell, MT

MOTOR SPEED LIMITER

	BY	DATE	DRAWING NUMBER	REV
DRAWN	MB	7/21/93	16737	H
CHECKED				
APPROVED	CAC	8/1/93	SHEET 2A of 10	

REF	DESCRIPTION	PART NO.	PARTS LIST #1	#2	#3	#4	#5
C1	CAPACITOR, 10uF, 50V ELECTROLYTIC	60260	1	1	1	1	1
C2	CAPACITOR, 0.01uF 25V. CERAMIC	60201	1	1	1	1	1
C3	CAPACITOR, 0.1uF 25V. METAL FILM	60240-03	0	0	1	0	0
C3	CAPACITOR, 0.047uF 50V. METAL FILM	60240-05	1	0	0	0	1
C3	CAPACITOR, 0.01uF 50V. METAL FILM	60240-02	0	1	0	1	0
C4	CAPACITOR, 1uF 50V. MONOLYTHIC	60253-01	1	1	1	1	1
C5	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C6	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C7	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C8	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C9	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C10	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C11	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C12	CAPACITOR, 0.01MF 25V. CERAMIC	60201	1	1	1	1	1
C13	CAPACITOR, 0.1MF 35V, TANT.	60202	1	1	1	1	1
P1	CONNECTOR, 7 PIN HEADER PC MOUNT	60516-4	1	1	1	1	1
P1	CONNECTOR, 7 PIN PLUG	60516-5	1	1	1	1	1
P1	LABEL, 1-10	61403-15	1	1	1	1	1
R1	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	0	0
R1	RESISTOR, 750 OHM, 1/4W 5%	60125-03	0	0	0	1	1
R2	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	0	0
R2	RESISTOR, 750 OHM, 1/4W 5%	60125-03	0	0	0	1	1
R3	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	0	0
R3	RESISTOR, 750 OHM, 1/4W 5%	60125-03	0	0	0	1	1
R4	RESISTOR, 22K OHM, 1/4W 5%	60105	1	1	1	1	1
R5	RESISTOR, 30K OHM, 1/4W 5%	60115-02	1	0	1	0	1
R5	RESISTOR, 22K OHM, 1/4W 5%	60105	0	1	0	1	0
R6	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	1	1
R7	RESISTOR, 180K OHM, 1/4W 5%	60101-05	1	0	1	0	0
R7	RESISTOR, 150K OHM, 1/4W 5%	60268	0	1	0	1	1
R8	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	1	1
R9	RESISTOR, 10M OHM, 1/4W 5%	60107-05	1	1	1	1	1
R10	RESISTOR, 100K OHM, 1/4W 5%	60106	1	1	1	1	1
R11	RESISTOR, 15K OHM, 1/4W 5%	60105-39	1	1	1	1	1
R12	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	0	0
R12	RESISTOR, 100 OHM, 1/4W 5%	60105-38	0	0	0	1	1
R13	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	0	0
R13	RESISTOR, 100 OHM, 1/4W 5%	60105-38	0	0	0	1	1
R14	RESISTOR, 10K OHM, 1/4W 5%	60104	1	1	1	0	0
R14	RESISTOR, 100 OHM, 1/4W 5%	60105-38	0	0	0	1	1
R15	POT, 100K OHM PC MNT SIDE ADJ.	73166-36	1	1	1	1	1
R16	RESISTOR, 4.7K OHM, 1/4W 5%	60107-01	1	1	1	1	1
R17	RESISTOR, 7.5K OHM, 1/4W 5%	60125-01	1	1	1	1	1
R18	RESISTOR, 7.5K OHM, 1/4W 5%	60125-01	1	1	1	1	1

SEMITOOL	Kalispell, MT	
MOTOR SPEED LIMITER		
BY DATE	DRAWING NUMBER	REV
DRAWN MB 7/21/93	16737	H
CHECKED		
APPROVED CAC 8/4/93	SHEET 2B 40	

			PARTS LIST #1	#2	#3	#4	#5
U1	I.C., LM358A	73159	1	1	1	1	1
U2	I.C., LM331	60309-03	1	1	1	1	1
U3	I.C., 4093 QUAD NAND GATE	60308-01	1	1	1	1	1
U4	I.C., 4070	73156-01	1	1	1	1	1
U5	I.C., 40106B	60306	1	1	1	1	1
	PINS, J (TEST POINTS, GND & TP1)	73066-02	2	2	2	2	2
X1	CONNECTOR, 3 PIN POST HEADER	60283	1	1	1	1	1
X1	JUMPER, SHORTING	60282	1	1	1	1	1
X2	CONNECTOR, 3 PIN POST HEADER	60283	1	1	1	1	1
X2	JUMPER, SHORTING	60282	1	1	1	1	1
	SOCKETS:						
	IC SOCKET, 14 PIN	60503-1	3	3	3	3	3
	IC SOCKET, 8 PIN	60511-3	2	2	2	2	2
	PRINTED CIRCUIT BOARD	16737 C	1	1	1	1	1
	ASSEMBLY DRAWING	16737 SHT 1	1	1	1	1	1
	ELECTRICAL SCHEMATIC	16901	1	1	1	1	1

SSEMBLY NOTES:

ALL ASSEMBLIES:
CUT LABEL FOR P1 CONNECTOR PLUG BETWEEN
NUMBERS 7 AND 8. ATTACH AS SHOWN ON ASSEMBLY DRAWING SHEET 1.
INSTALL JUMPERS AS SHOWN ON ASSEMBLY DRAWING SHEET 1.

REV A BOARDS:

ALL ASSEMBLIES:
CUT TRACE BETWEEN PAD OF R10 AND THE "2" OF C2.
-501 ASSEMBLY:
CUT TRACE BETWEEN PINS 2 & 3 OF X1.

REV B BOARDS:

-501 ASSEMBLY:
CUT TRACE BETWEEN PINS 2 & 3 OF X1.

REV C BOARDS:
-1,-503,-505,-511 ASSY. INSTALL SHORTING JUMPER X2 PIN 1 TO 2.
-501 ASSY. CUT TRACE X1 PIN 2 TO X1 PIN 3. INSTALL SHORTING JUMPER X1 PIN 1 TO 2.

REV C BOARDS ALL ASSEMBLIES:
A SILK SCREEN ERROR HAS OCCURED. THE RESISTOR LABELED R14 NEXT TO R7
SHOULD BE R16. THE RESISTOR LABELED R13 NEAR R9 SHOULD BE R17. THE RESISTOR
LABELED R12 NEAR R8 SHOULD BE R18.

SEMITOOL Kalispell, MT			
MOTOR SPEED LIMITER			
	BY DATE	DRAWING NUMBER	REV
DRAWN	MB 7/21/93	16737	H
CHECKED			
APPROVED	CAC 8/6/93	SHEET 2C of 10	

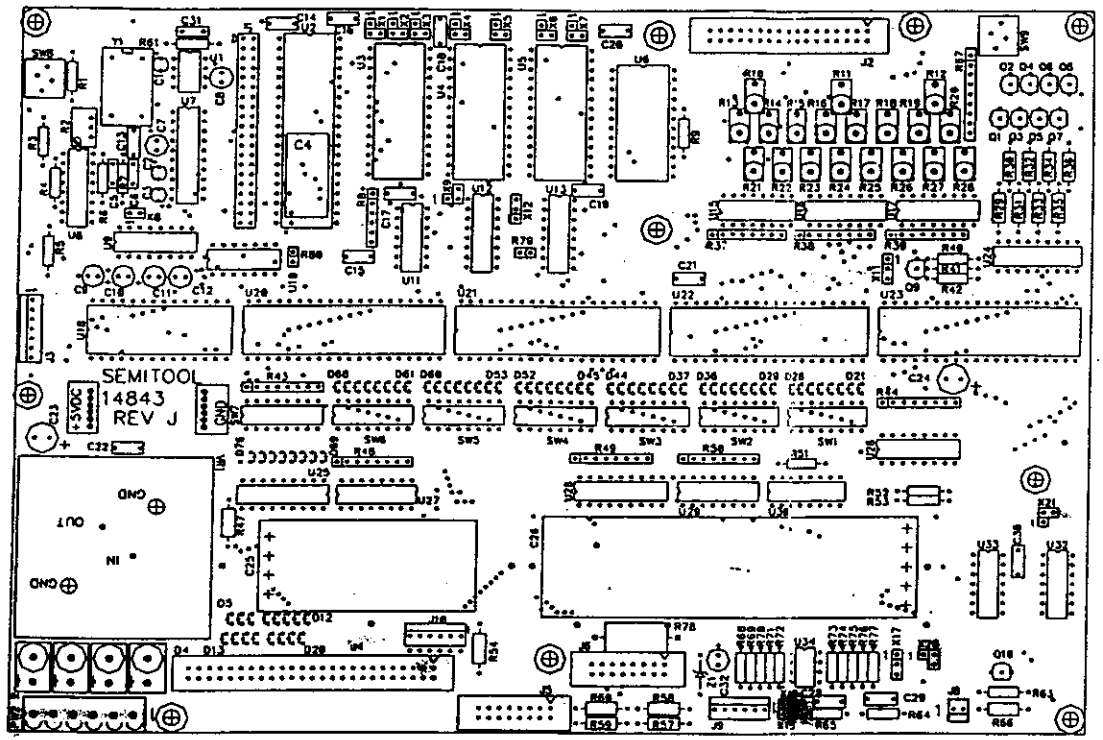
USAGE NOTES:

-1 ASSEMBLY OBSOLETE, SEE BELOW. WAS USED WITH LC4 AND LC5 MOTOR CONTROLS.
-501 ASSEMBLY USE PARTS LIST #2: USED WITH LC1 MOTOR CONTROL, SWP MAX 2000 RPM BEI 8 POLE MOTOR.
-503 ASSEMBLY USE PARTS LIST #1: USED WITH 50 WAFER CARRIERLESS, MFM K127 12 POLE MOTOR 1300 RPM MAX.
-505 ASSEMBLY USE PARTS LIST #1: REPLACES -1 ASSY FOR LC4, LC5 MOTOR CONTROLS.
USED FOR SRD, BOX WASHER WITH STD MOTOR CNTRL BRD, SYSTEMS <= 2300 SIZE (2000RPM OR
-507 ASSEMBLY USE PARTS LIST #3: REPLACES -1 ASSY. USED WITH LC4, LC5 MOTOR CONTROLS.
USED FOR SYSTEMS 2400/2600 SIZE (1300RPM), AND FOR ALL SATS EXCEPT SATS WITH
750 PAC-SCI MOTOR CONTROLLER.
-509 ASSEMBLY USE PARTS LIST #4: USED ON SATS WITH 750 PAC-SCI MOTOR CONTROLLER (SPEED LIMITER INPUT FROM 60 SLOT DI
-511 ASSEMBLY USE PARTS LIST #5: USED ON BOX WASHERS WITHOUT STD MOTOR CNTRL BRD.

CALIBRATION PROCEDURE:
TURN R15 FULLY CW, SET SPEED TO RECIPE+10%.
ADJUST R15 CCW UNTIL TRIP POINT IS REACHED.

END OF PARTS LIST

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DA
L	ER880178	CHANGED TO ACAD DRAWING. ADDED -509 AND -511 ASSY'S FOR INTERNAL RPM SENSOR, 14569.	BT RTW	CAC	4-16
M	ER880202	REMOVED ASSY NOTES FROM THIS DWG AND ADDED TO PARTS LIST.	CAC	CAC	8-15
N	ER880202-1	CHANGED U22-35 JUMPER TO U20-35 ON ASSY NOTE 4 PAGE 2F OF 6.	SL	CAC	8-29
O	ER890050	ADDED ASSEMBLY NOTE 9 ON SHEET 2F OF 6.	CAC	CAC	2-15
P	ER890248	CHANGED ARTWORK TO A FOUR LAYER BOARD. BOARD BECOMES REV.F	CAM	CAC	3-17
Q	ER890389	JUMPERED U27-11 TO J4-18. BOARD BECOMES REV. G. REV E ASSY PRINT CHANGED TO SHEET4	KAH	CAC	5-5-
R	ER890504	PLATED THROUGH VR1 GND. PADS, AND JUMPERED TO GND. TEST POINTS. JUMPERED U12-6 TO R8-2. CHANGED R37, R38 & R39 TO 4.7K OHM SIPS ON THE PARTS LIST. BOARD BECOMES REV. H.	KAH	CAC	8-31
S	ER890504-1	ADD -515 ASS'Y FOR PSC-102-14 & PSC-102-15	TA	CAC	6/96
T	ER900113	MODIFIED -515 ASS'Y TO INCLUDE SIGNAL TOWER OPTION	AJW	CAC	10/8/
U	ER900127	ADDED -517 ASS'Y FOR IPA TOOLS. CORRECTED -515 JUMPS.	TA	CAC	11/5/
V	ER900131	ADDED TRACES U27-11 TO J3-4, U27-10 TO J3-5, U27-12 TO J3-7. ADDED J10 WITH SOLDER PADS. CORRECTED PW2 OUTLINE AND LEAD SPACING. REMOVED INCORRECT U12-6 TIE TO +5. MOVED J4-45-46-48-50 TRACE TO SOLDER SIDE. CORRECTED U18 PART NUMBER. BOARD BECOMES REV L	RAC	CAC	2/1/
W	ER930022	ADDED R79, R80, AND REVISED ASSEMBLY NOTES TO ADD 2 GATE DELAYS TO IORQ.	RAC	CAC	2/22/
X	ER930022-1	REVISED BOARD ARTWORK TO ADD R79, R80, AND 2 GATE DELAYS TO IORQ. BOARD BECOMES REV J.	RAC	CAC	6/15/



SEMITOOL 14843
COMPONENT PRINT

SHEET	SIZE	DESCRIPTION
1.	C	ASSEMBLY
2.	A	PARTS LIST
3.	C	DRILL AND TRIM
4.	C	ASSEMBLY (REV E & EARLIER)
5.	DISK"APCB"	COMP. SIDE ARTWORK
6.	DISK"APCB"	CIRC. SIDE ARTWORK
7.	DISK"APCB"	SOLDER MASK ARTWORK
8.	DISK"APCB"	SILKSCREEN ARTWORK
9.	DISK"APCB"	GROUND PLANE ARTWORK
10.	DISK"APCB"	POWER PLANE ARTWORK

	-1	-501	-503	-505	-507	-509	-511	-513 -515 -517
X8	I	I	I	I	I	I	I	I
X11	1TO2	1 TO 2	1 TO 2	1 TO 2	1 TO 2	1 TO 2	1 TO 2	1 TO 2
X13	NO LONGER PRESENT							
X14	NO LONGER PRESENT							
X16	NO LONGER PRESENT							
X17	N	2 TO 3	1 TO 2	2 TO 3	N	2 TO 3	2 TO 3	N
X18	N	N	N	N	N	N	N	N
X19	N	N	N	N	N	N	N	N
X20	N	2 TO 3	2 TO 3	2 TO 3	2 TO 3	2 TO 3	2 TO 3	N
X21	N	2 TO 3	2 TO 3	2 TO 3	2 TO 3	2 TO 3	2 TO 3	N

NOTE:
I= INSTALLED
N= NOT INSTALLED

CUSTOMER		SEMITOOL KALISPELL, MT	
S/O		PSC-102 MAIN LOGIC BOARD ASSEMBLY	
REF MASTER		BY DATE	DRAWING NUMBER: 14843 REV X
REF SCHEMATIC	16034	DRAWN C. McCARLEY 3-17-89	
REF ASSEMBLY		ENGR	SCALE: NONE SHEET 1 OF 1
REF E.R.		APPROVED CAC 6/15/93	

LAYER ID: 9 13 17 24 36 SEMITOOL PROPRIETARY

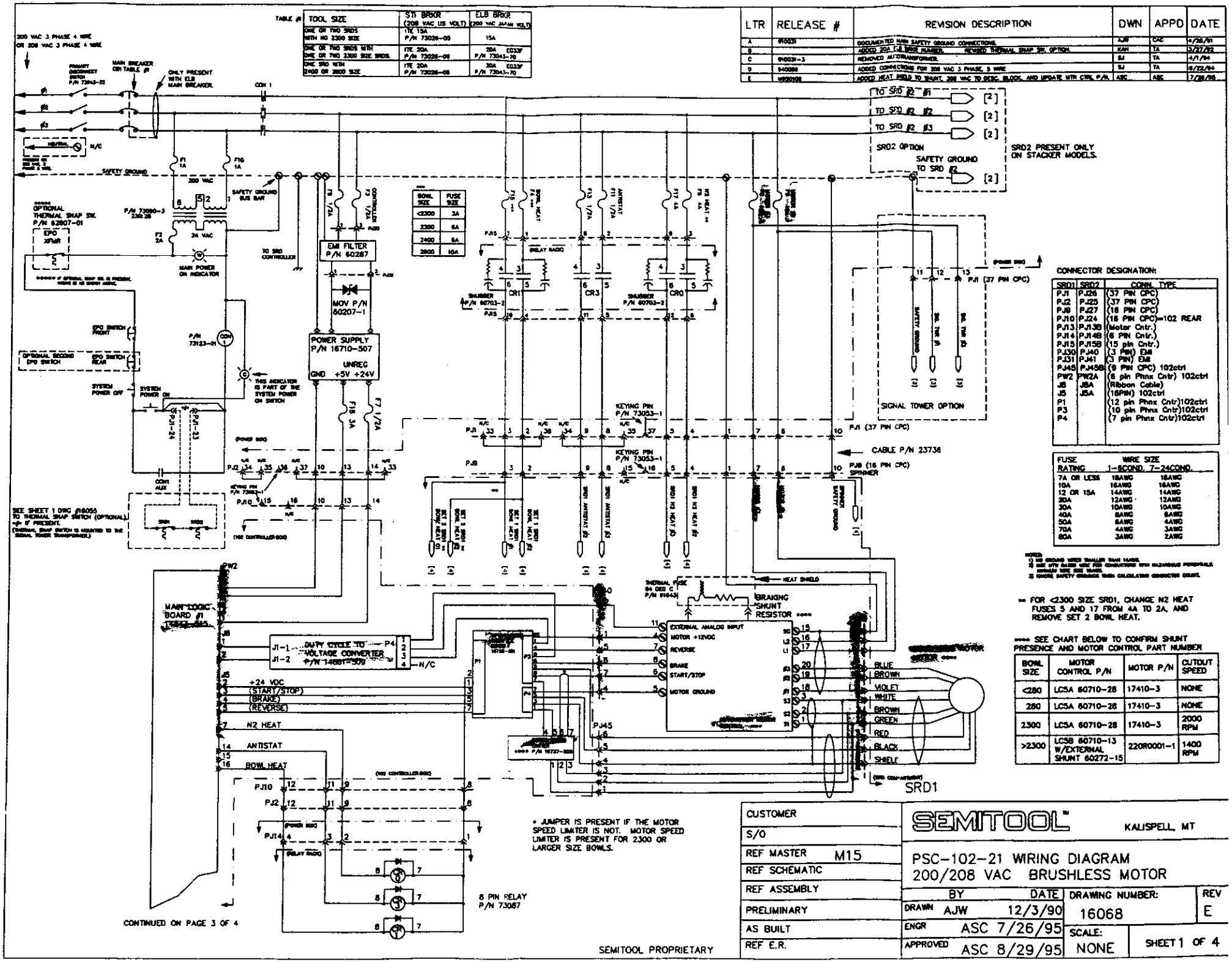


TABLE #1 TOOL SIZE	STD BRKR (208 VAC US VOLT)	ELB BRKR (200 VAC JAPAN VOLT)
ONE OR TWO SRDS WITH NO 2300 SIZE	ITE 15A P/N 73026-05	15A
ONE OR TWO SRDS WITH ONE OR TWO 2300 SIZE SRDS.	ITE 20A P/N 73026-06	20A EG33F P/N 73043-20
ONE SRD WITH 2400 OR 2800 SIZE	ITE 20A P/N 73026-06	20A EG33F P/N 73043-20

BOWL SIZE	FUSE SIZE
<2300	3A
2300	6A
2400	6A
2800	10A

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	910031	DOCUMENTED MAIN SAFETY GROUND CONNECTIONS.	AJW	CAC	4/28/91
B		ADDED 10A 1-4 BOWL HEATER. REVISED THERMAL SNAP SW. OPTION.	KAH	TA	3/27/92
C	910031-3	REMOVED AUTOTRANSFORMER.	SJ	TA	4/1/94
D	940089	ADDED CONNECTIONS FOR 208 VAC 3 PHASE, 3 WIRE	SJ	TA	8/22/94
E	W939109	ADDED HEAT PROD TO SHUNT, 208 VAC TO DESC. BLOCK, AND UPDATE MTR CTRL P/N.	ASC	ASC	7/28/95

CUSTOMER	
S/O	
REF MASTER	M15
REF SCHEMATIC	
REF ASSEMBLY	
PRELIMINARY	
AS BUILT	
REF E.R.	

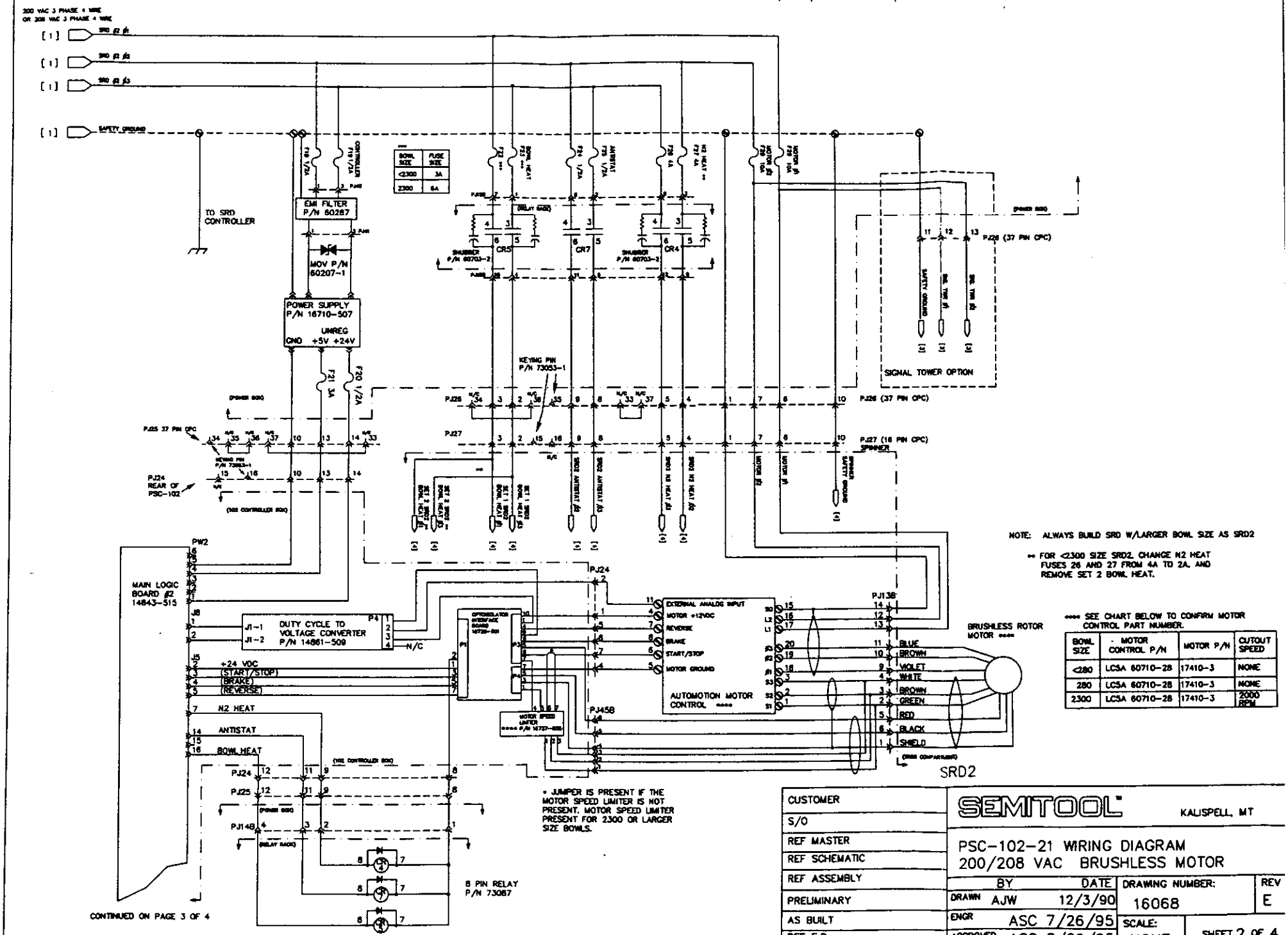
SEMITOOL™ KALISPELL, MT

PSC-102-21 WIRING DIAGRAM
200/208 VAC BRUSHLESS MOTOR

	BY	DATE
DRAWN	AJW	12/3/90
ENGR	ASC	7/26/95
APPROVED	ASC	8/29/95

DRAWING NUMBER: 16068 REV E
SCALE: NONE
SHEET 1 OF 4

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE



NOTE: ALWAYS BUILD SRD W/LARGER BOWL SIZE AS SRD2

** FOR <2300 SIZE SRD2, CHANGE N2 HEAT FUSES 26 AND 27 FROM 4A TO 2A, AND REMOVE SET 2 BOWL HEAT.

**** SEE CHART BELOW TO CONFIRM MOTOR CONTROL PART NUMBER.

BOWL SIZE	MOTOR CONTROL P/N	MOTOR P/N	CUTOUT SPEED
<280	LC5A 60710-28	17410-3	NONE
280	LC5A 60710-28	17410-3	NONE
2300	LC5A 60710-28	17410-3	2000 RPM

* JUMPER IS PRESENT IF THE MOTOR SPEED LIMITER IS NOT PRESENT. MOTOR SPEED LIMITER PRESENT FOR 2300 OR LARGER SIZE BOWLS.

CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY	
PRELIMINARY	
AS BUILT	
REF E.R.	

SEMITOOL KALISPELL, MT

PSC-102-21 WIRING DIAGRAM
200/208 VAC BRUSHLESS MOTOR

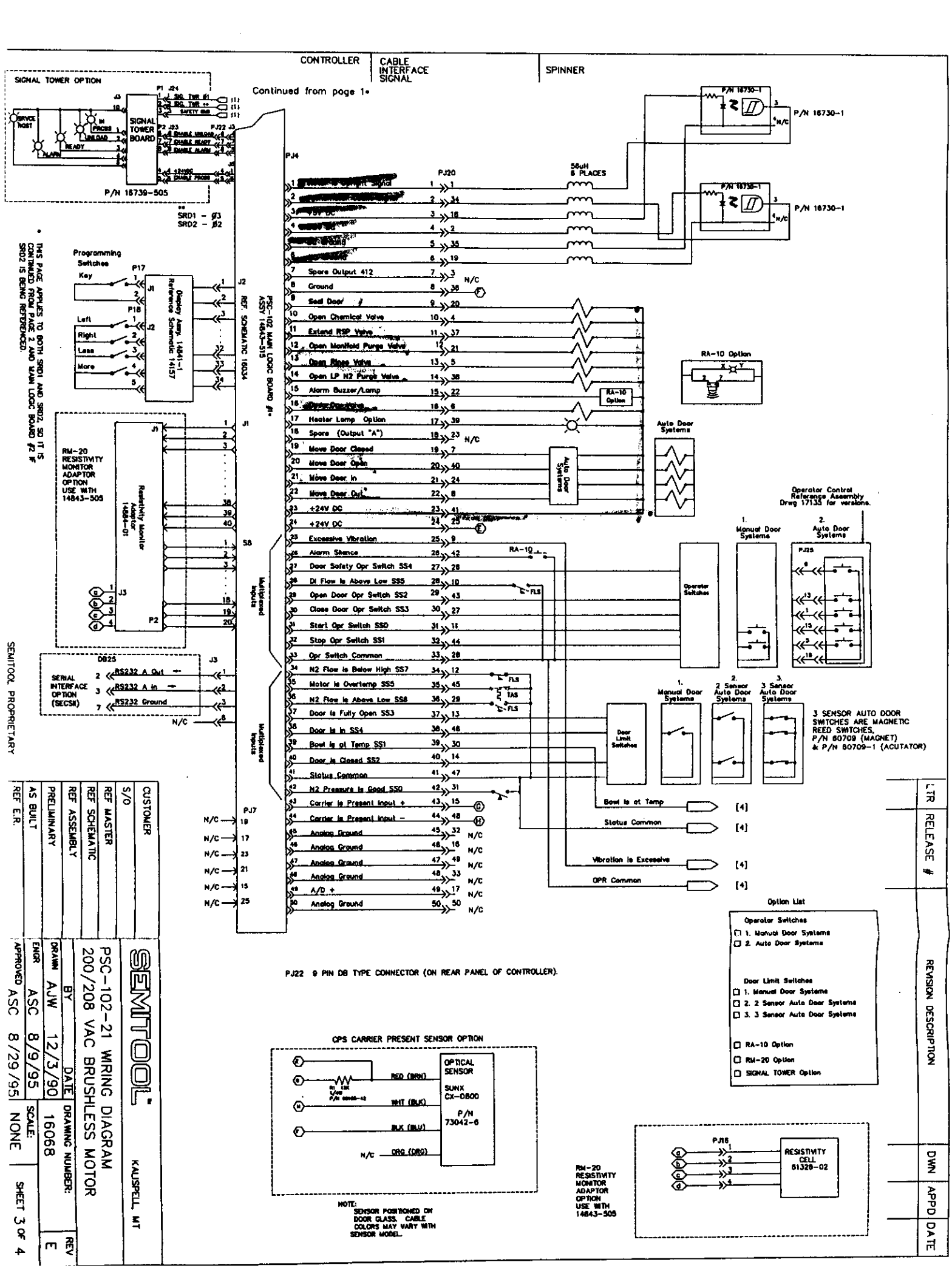
	BY	DATE
DRAWN	AJW	12/3/90
ENGR	ASC	7/26/95
APPROVED	ASC	8/29/95

DRAWING NUMBER: 16068

REV: E

SCALE: NONE

SHEET 2 OF 4



SEMITOOL PROPRIETARY

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE

CUSTOMER
S/O
REF MASTER
REF SCHEMATIC
REF ASSEMBLY
PRELIMINARY
AS BUILT
REF E.R.

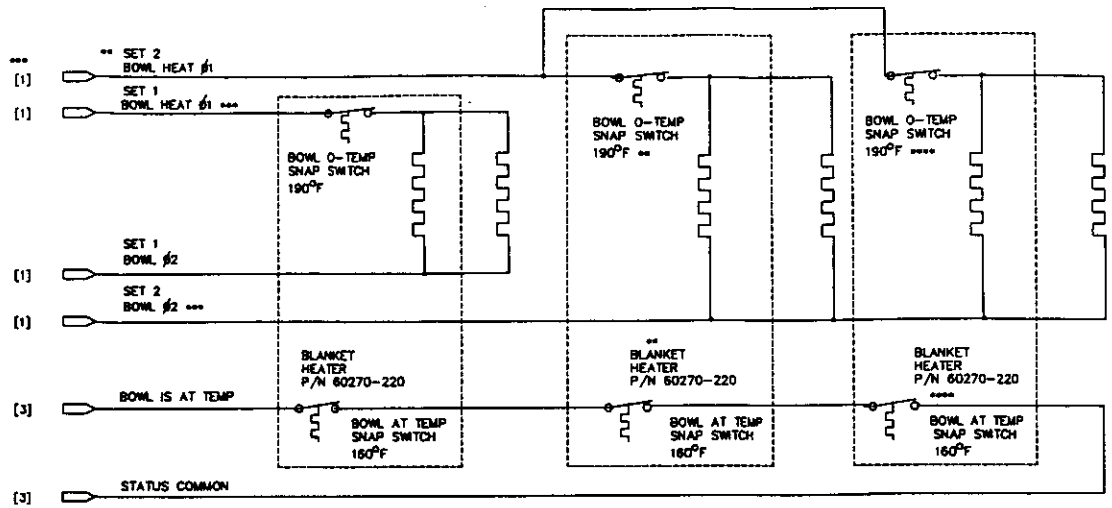
SEMITOOL
KALISPELL, MT

PSC-102-21 WIRING DIAGRAM
200/208 VAC BRUSHLESS MOTOR

	BY	DATE
DRAWN	AJW	12/3/90
ENGR	ASC	8/9/95
APPROVED	ASC	8/29/95

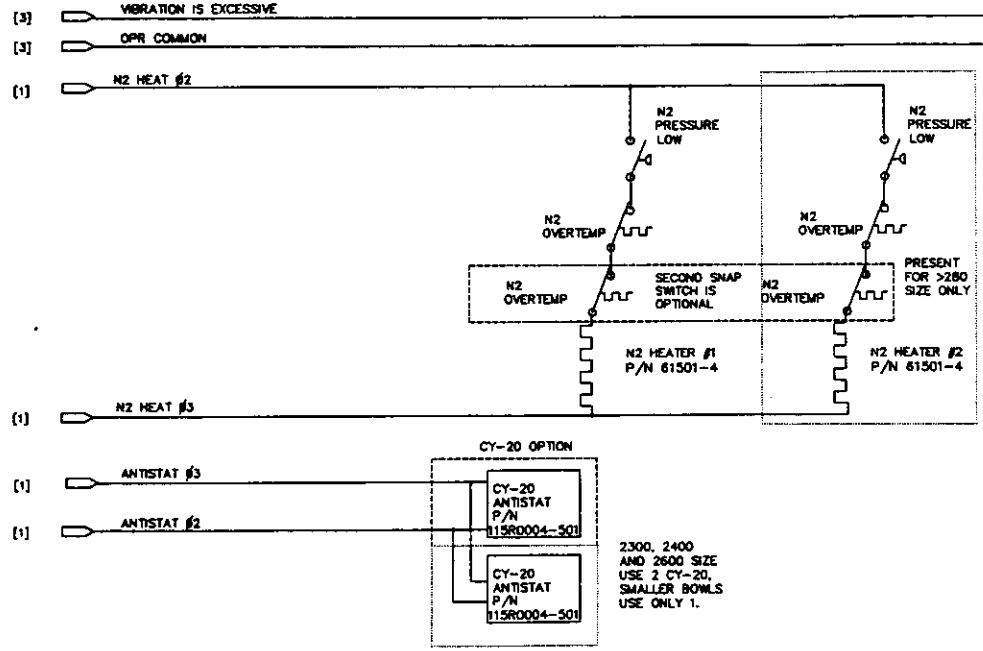
DRAWING NUMBER: 16068
REV: E
SCALE: NONE
SHEET 3 OF 4

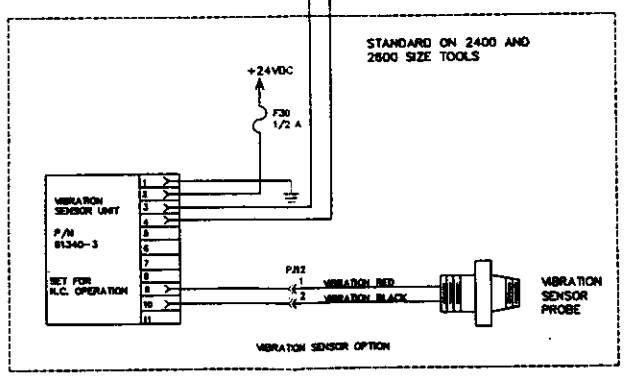
LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE



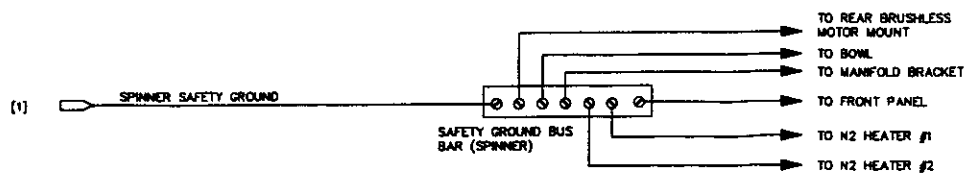
** SET 2 BOWL HEAT IS PRESENT ON 2300 SIZE OR LARGER SRDS..

**** THESE BLANKET HEATERS AND SNAP SWITCHES ARE ONLY PRESENT ON THE 2600 SERIES MACHINES.





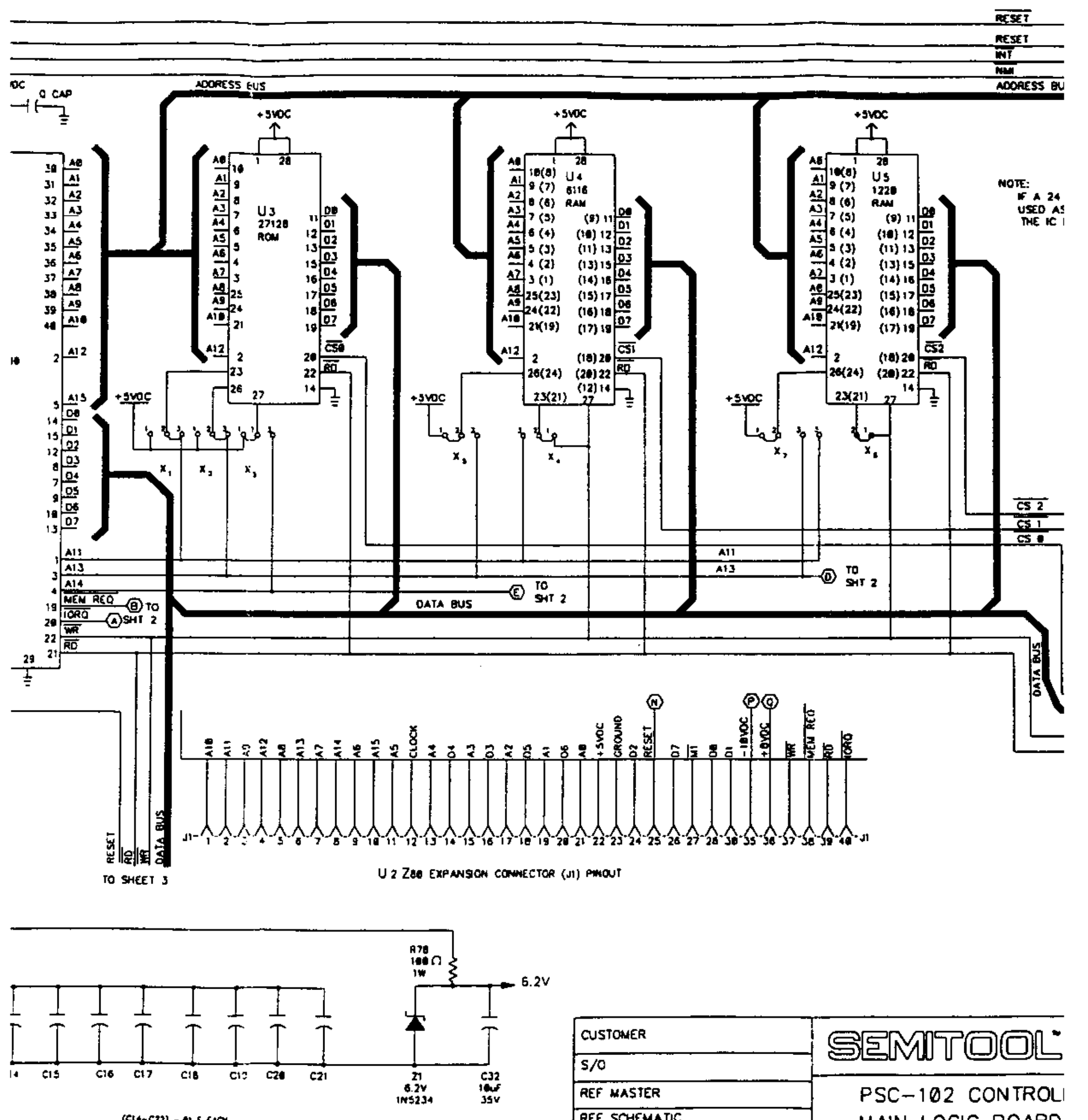
*** THIS PAGE APPLIES TO BOTH SRD1 AND SRD2. OFF PAGE REFERENCES GIVEN ARE FOR SRD1, FOR SRD2, SUBSTITUTE PAGE 2 FOR ALL PAGE 1 REFERENCES, AND CHANGE BOWL HEAT PHASE ϕ2 TO PHASE ϕ3.



CUSTOMER	SEMITOOL	KALISPELL, MT		
S/O	PSC-102-21 WIRING DIAGRAM 200/208 VAC BRUSHLESS MOTOR			
REF MASTER		BY	DATE	DRAWING NUMBER: 16068 REV E
REF SCHEMATIC	DRAWN	AJW	12/3/90	
REF ASSEMBLY	ENGR	AJW		SCALE: NONE
PRELIMINARY	APPROVED	TA	8/22/94	SHEET 4 OF 4
AS BUILT				
REF E.R.				

PART NO.	ASSY -501	ASSY -503	ASSY -505	ASSY -507	ASSY -509	ASSY -511	ASSY -513	ASSY -515	ASSY -517
60202	1	1	1	1	1	1	1	1	1
60202	1	1	1	1	1	1	1	1	1
60202	1	1	1	1	1	1	1	1	1
60297	1	1	1	1	1	1	1	1	1
60253-01	1	1	1	1	1	1	1	1	1
60253-01	1	1	1	1	1	1	1	1	1
60260	1	1	1	1	1	1	1	1	1
60260	1	1	1	1	1	1	1	1	1
60249	1	1	1	1	1	1	1	1	1
60249	1	1	1	1	1	1	1	1	1
60249	1	1	1	1	1	1	1	1	1
60249	1	1	1	1	1	1	1	1	1
60201	1	1	1	1	1	1	1	1	1
60201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0252	1	1	1	1	1	1	1	1	1
0252	1	1	1	1	1	1	1	1	1
0248	1	1	1	1	1	1	1	1	1
0252-04	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
0201	1	1	1	1	1	1	1	1	1
3009-07	1	1	1	1	1	1	1	1	1
0260	1	1	1	1	1	1	1	1	1
0404	1	1	1	1	1	1	1	1	1
0404	1	1	1	1	1	1	1	1	1
0404	1	1	1	0	1	1	1	1	1
0404	1	1	1	0	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1
0401	1	1	1	1	1	1	1	1	1

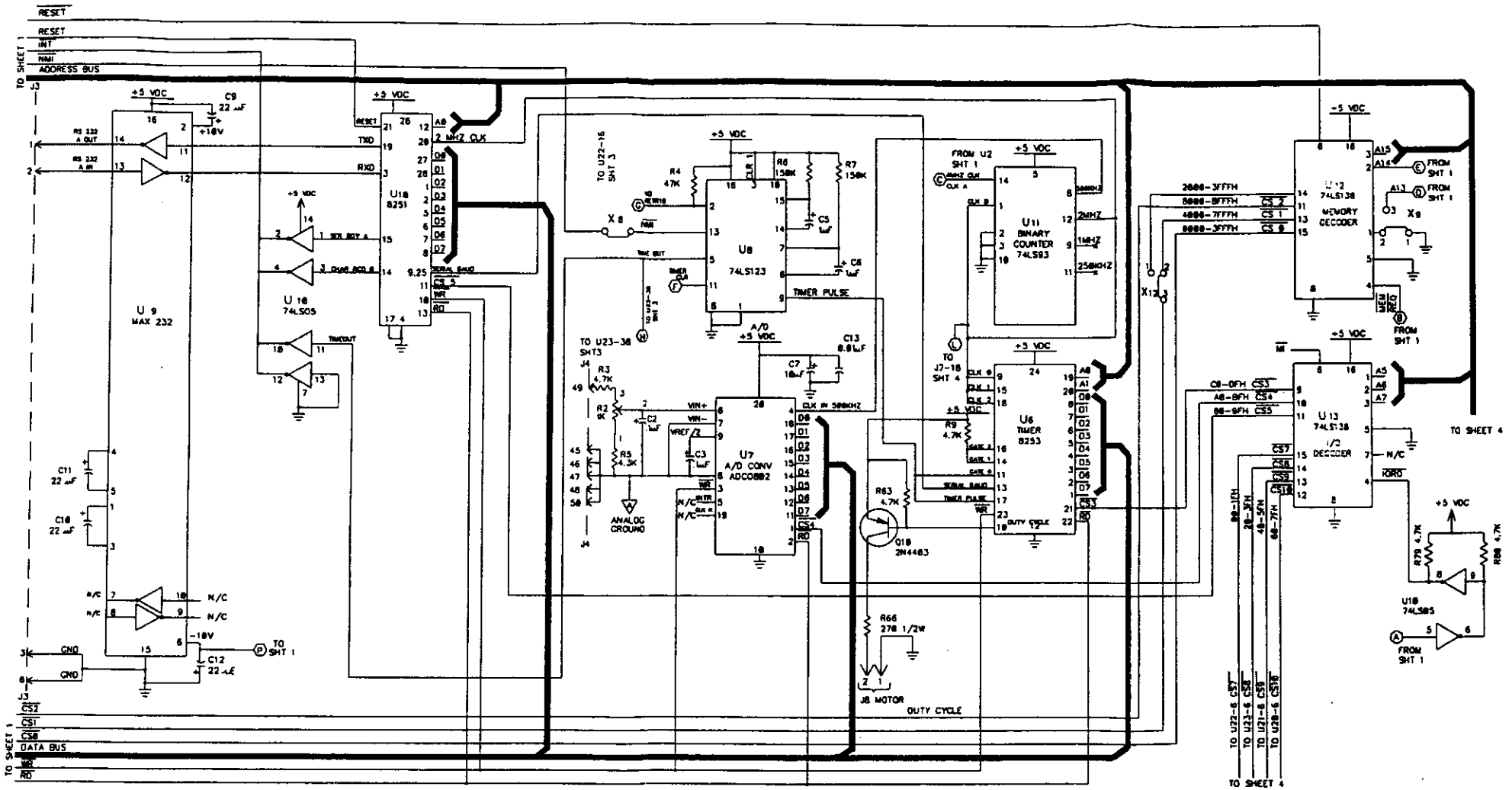
LTR	RELEASE #	REVISION DESCRIPTION
B	900113	ADDED JUMPERS FOR -515 ASSY (SIGNAL TWR OPTION) TO ON SHT 4. CHANGED U9-7, U9-8 TO N/C ON SHT 2.
C	900113-1	REMOVED CS6 SIGNAL FROM U13 PIN 7 AND MADE PIN 7 A ON SHT 2. ULN2003 IS ULN2003 AND MOVED U27 PIN 9 R ABOVE THE LINE FOR U27 PIN 9 ON SHT 4.
D	930022	ADDED TWO GATE DELAYS TO IORQ.



CUSTOMER	SEMITOOL
S/O	PSC-102 CONTROL
REF MASTER	MAIN LOGIC BOARD
REF SCHEMATIC	
REF ASSEMBLY 14843	BY / DATE
PRELIMINARY	DRAWN TA 6/1/89
AS BUILT	ENGR
REF E.R. 890248	APPROVED

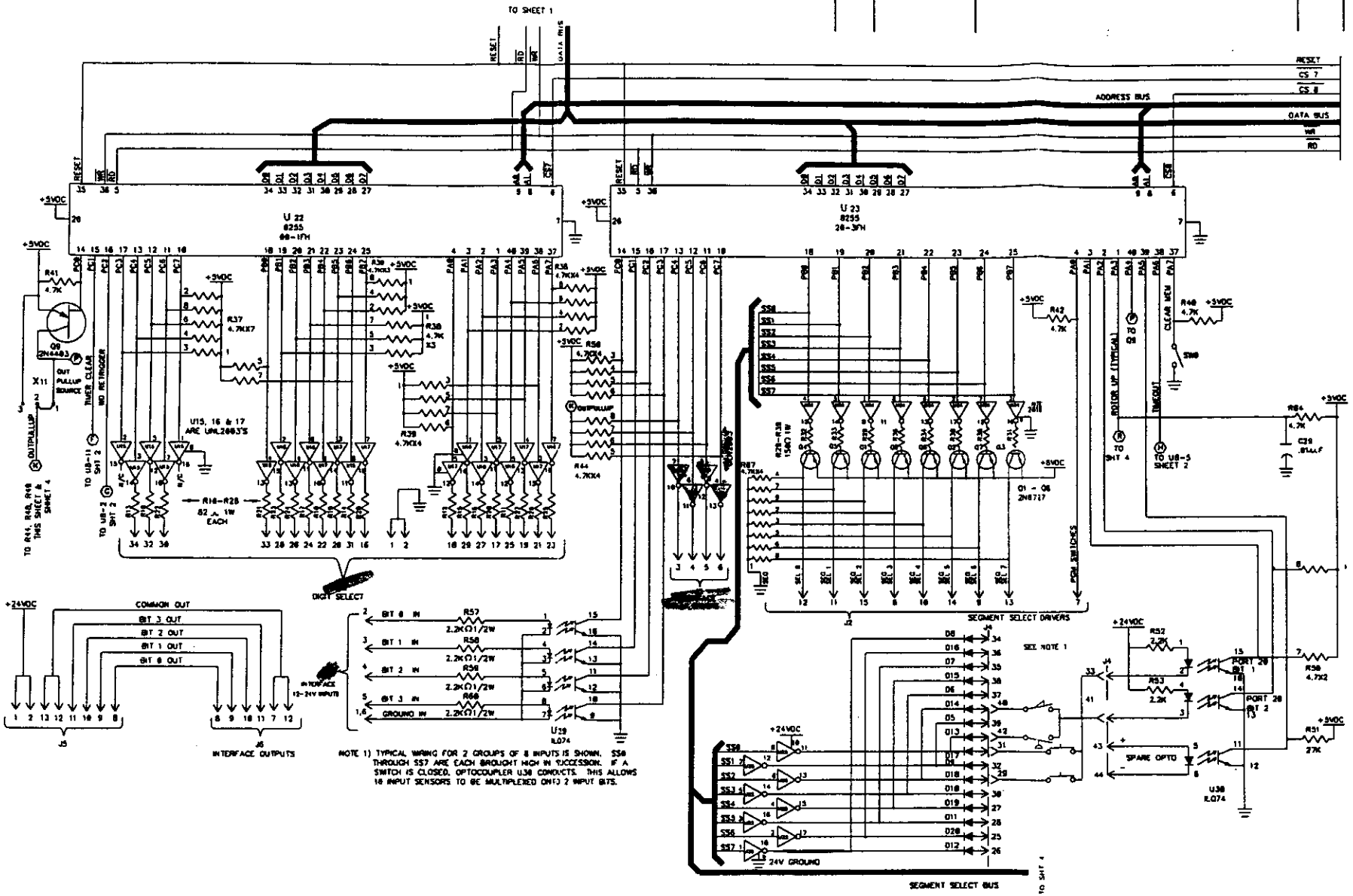
SEMITOOL PROPRIETARY

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE



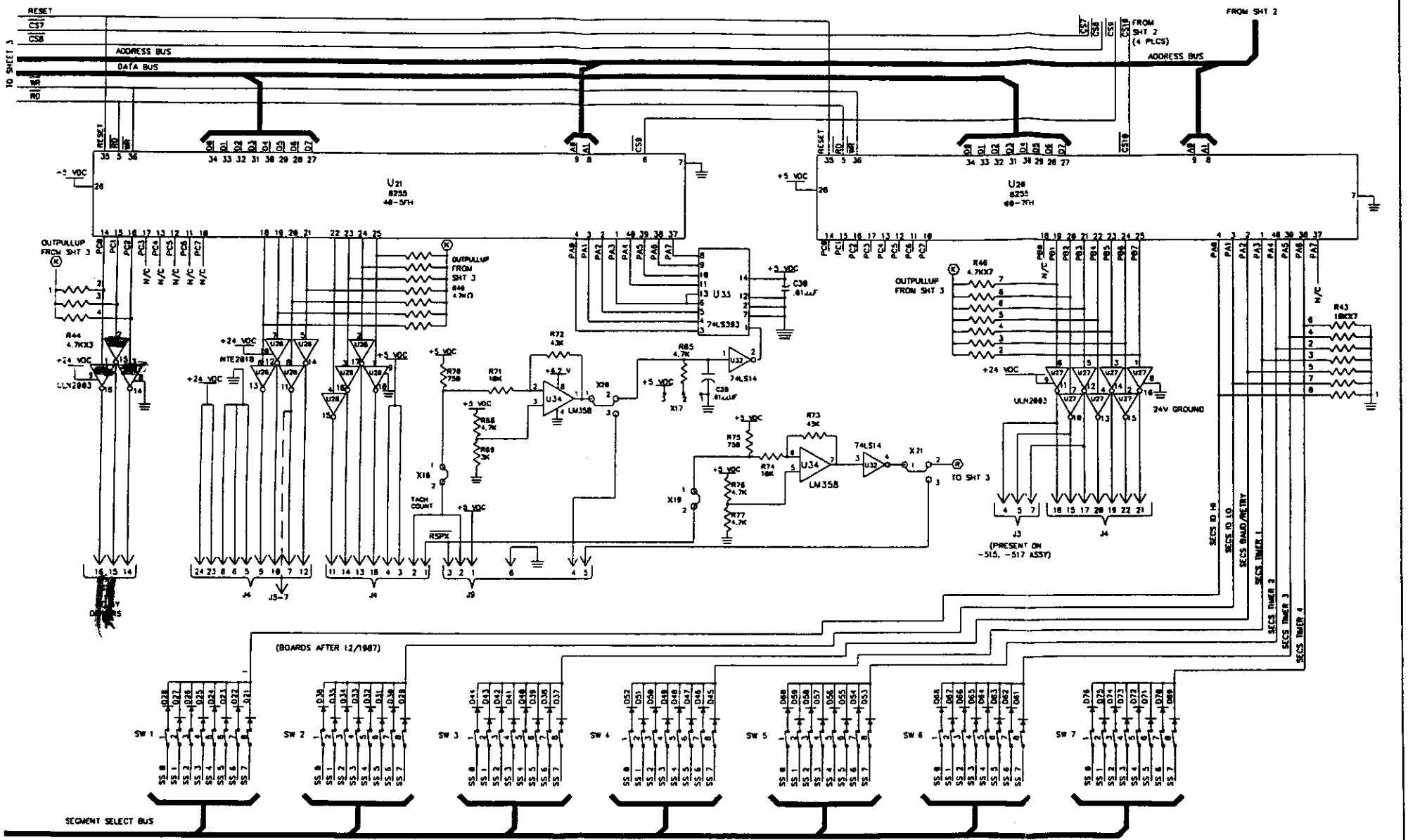
CUSTOMER	SEMITOOL	KALISPELL, MT	
S/O	PSC-102 CONTROLLER		
REF MASTER	MAIN LOGIC BOARD SCHEMATIC		
REF SCHEMATIC	BY	DATE	DRAWING NUMBER: REV
REF ASSEMBLY	DRAWN TA	6/1/89	16034 0
PRELIMINARY	ENGR		SCALE:
AS BUILT	APPROVED		SHEET 2 OF 4

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE



CUSTOMER	SEMITOOL™	KALISPELL, MT	
S/O	PSC-102 CONTROLLER		
REF MASTER	MAIN LOGIC BOARD SCHEMATIC		
REF SCHEMATIC			
REF ASSEMBLY	BY	DATE	DRAWING NUMBER: 16034 REV D
PRELIMINARY	DRAWN TA	6/1/89	
AS BUILT	ENGR		SCALE: NONE
REF E.R.	APPROVED		SHEET 3 OF 4

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE



CUSTOMER	SEMITOOL KALISPELL, MT
S/O	PSC-102 CONTROLLER
REF MASTER	MAIN LOGIC BOARD SCHEMATIC
REF SCHEMATIC	
REF ASSEMBLY	BY DATE — DRAWN TA 6/1/89 — ENGR
PRELIMINARY	DRAWING NUMBER: 16034 — REV D
AS BUILT	SCALE:

SEMITOOL™ Kalispell, MT

PSC-102 MAIN LOGIC BOARD ASSY

	BY	DATE	DRAWING NUMBER	REV
DRAWN	CAM	3/25/87	14843	X
CHECKED				
APPROVED	CAC	2/22/93	SHEET 28 OF 10	

D13	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D14	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D15	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D16	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D17	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D18	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D19	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D20	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D21	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D22	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D23	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D24	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D25	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D26	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D27	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D28	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D29	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D30	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D31	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D32	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D33	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
[illegible]	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
[illegible]	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D36	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D37	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D38	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D39	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D40	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D41	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D42	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D43	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D44	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D45	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D46	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D47	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D48	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D49	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D50	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D51	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1

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D52	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D53	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D54	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D55	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D56	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D57	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D58	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D59	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D60	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D61	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D62	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D63	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D64	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D65	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D66	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D67	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D68	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D69	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D70	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D71	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D72	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
[illegible]	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
[illegible]	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D75	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
D76	DIODE, 1N4148	60401	1	1	1	1	1	1	1	1	1
HS1	HEATSINK-WAKEFIELD	73037-01	1	1	1	1	1	1	1	1	1
J1	40 PIN, MALE HDR, STRT, PC MNT	73184-50	1	1	1	1	1	1	1	1	1
J2	34 PIN, EJCTR HDR, STRT, PC MN	73184-28	1	1	1	1	1	1	1	1	1
J3	7 PIN HEADER, FRICTION LOCK	60617-10	1	1	1	1	1	1	1	1	1
J4	50 PIN, EJCTR HDR, STRT, PC MN	73184-40	1	1	1	1	1	1	1	1	1
J5	16 PIN, EJCTR HDR, STRT, PC MN	73184-17	1	1	1	1	1	1	1	0	0
J5	16 PIN, EJCTR HDR TO DISCR WIR	73184-57	0	0	0	0	0	0	0	1	1
J6	16 PIN, EJCTR HDR, STRT, PC MN	73184-17	1	1	1	1	1	1	1	1	1
J8	2 PIN HEADER, FRICTION LOCK	73203	1	1	1	1	1	1	1	1	1
J9	6 PIN HEADER, FRICTION LOCK ST	73183-04	0	0	0	0	1	1	1	1	1
J10	6 PIN HEADER, FRICTION LOCK	73183-04	0	0	0	0	0	0	0	0	0
PW2	6 PIN HEADER, PHOENIX CONN.	60515	1	1	1	1	1	1	1	1	1
Q1	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q2	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q3	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q4	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q5	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q6	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q7	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1

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Q8	TRANSISTOR, 2N6727	60411	1	1	1	1	1	1	1	1	1
Q9	TRANSISTOR, 2N4403	60298	1	1	1	1	1	1	1	1	1
Q10	TRANSISTOR, 2N4403	60298	1	1	1	1	1	1	1	1	1
R1	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R2	RESISTOR, POTENTIOMETER, 1K OH	73166-04	1	1	1	1	1	1	1	1	1
R3	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R4	RESISTOR, 47K OHM, 1/4W, 5%	60110	1	1	1	1	1	1	1	1	1
R5	RESISTOR, 4.3K OHM, 1/4W, 5%	60106-02	1	1	1	1	1	1	1	1	1
R6	RESISTOR, 150K OHM, 1/4W, 5%	60268	1	1	1	1	1	1	1	1	1
R7	RESISTOR, 150K OHM, 1/4W, 5%	60268	1	1	1	1	1	1	1	1	1
R8	RESISTOR, SIP, 4.7K OHM, 6 PIN	60119-01	1	1	1	1	1	1	1	1	1
R9	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R10	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R11	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R12	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R13	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R14	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R15	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R16	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R17	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R18	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
[illegible]	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
[illegible]0	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R21	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R22	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R23	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R24	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R25	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R26	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R27	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R28	RESISTOR, 82 OHM, 1W	60104-02	1	1	1	1	1	1	1	1	1
R29	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R30	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R31	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R32	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R33	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R34	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R35	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R36	RESISTOR, 150 OHM, 1/2W	60113-01	1	1	1	1	1	1	1	1	1
R37	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R38	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R39	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R40	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1

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R41	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R42	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R43	RESISTOR, SIP, 10K OHM, 8 PIN	60120	1	1	1	1	1	1	1	1	1
R44	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R47	RESISTOR, 390 OHM, 1/2W, 5%	60115-04	1	1	1	1	1	1	1	1	1
R48	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R49	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R50	RESISTOR, SIP, 4.7K OHM, 8 PIN	60119-02	1	1	1	1	1	1	1	1	1
R51	RESISTOR, 27K OHM, 1/4W, 5%	60114	1	1	1	1	1	1	1	1	1
R52	RESISTOR, 2.2K OHM, 1/4W, 5%	60103	1	1	1	1	1	1	1	1	1
R53	RESISTOR, 2.2K OHM, 1/4W, 5%	60103	1	1	1	1	1	1	1	1	1
R54	RESISTOR, 4.7K OHM, 1/2W	60108-05	1	1	1	1	1	1	1	1	1
R57	RESISTOR, 2.2K OHM, 1/2W, 5%	60108-01	1	1	1	1	1	1	1	1	1
R58	RESISTOR, 2.2K OHM, 1/2W, 5%	60108-01	1	1	1	1	1	1	1	1	1
R59	RESISTOR, 2.2K OHM, 1/2W, 5%	60108-01	1	1	1	1	1	1	1	1	1
R60	RESISTOR, 2.2K OHM, 1/2W, 5%	60108-01	1	1	1	1	1	1	1	1	1
R61	RESISTOR, 430 OHM, 1/4W, 5%	60105-36	1	1	1	1	1	1	1	1	1
R63	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R64	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R65	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R65	RESISTOR, 510 OHM, 1/4W, 5%	60105-44	0	0	0	0	0	0	0	0	0
	RESISTOR, 270 OHM, 1/2W	60111	1	1	1	1	1	1	1	1	1
	RESISTOR, SIP, 4.7K OHM, 9 PIN	60119-05*	1	1	1	1	1	1	1	1	1
R68	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R69	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R70	RESISTOR, 750 OHM, 1/4W, 5%	60125-03	1	1	1	1	1	1	1	1	1
R71	RESISTOR, 10K OHM, 1/4W, 5%	60104	1	1	1	1	1	1	1	1	1
R72	RESISTOR, 43K OHM, 1/4W, 5%	60107-03	1	1	1	1	1	1	1	1	1
R73	RESISTOR, 43K OHM, 1/4W, 5%	60107-03	1	1	1	1	1	1	1	1	1
R74	RESISTOR, 10K OHM, 1/4W, 5%	60104	1	1	1	1	1	1	1	1	1
R75	RESISTOR, 750 OHM, 1/4W, 5%	60125-03	1	1	1	1	1	1	1	1	1
R76	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R77	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R78	RESISTOR, 100 OHM, 1W, 5%	60104-03	1	1	1	1	1	1	1	1	1
R79	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
R80	RESISTOR, 4.7K OHM, 1/4W, 5%	60107-01	1	1	1	1	1	1	1	1	1
	SOCKET, 40 PIN DIP	60513-01	5	5	5	5	5	5	5	5	5
	SOCKET, 28 PIN DIP	60506-01	4	4	4	4	4	4	4	4	4
	SOCKET, 24 PIN DIP	60511-04	1	1	1	1	1	1	1	1	1
	SOCKET, 16 PIN DIP	60504-01	11	11	11	11	11	11	11	11	11
	SOCKET, 20 PIN DIP	60510-02	1	1	1	1	1	1	1	1	1
	SOCKET, 8 PIN DIP	60511-03	2	2	2	2	2	2	2	2	2
	SOCKET, 14 PIN DIP	60503-01	4	4	4	4	4	4	4	4	4
	SOCKET, 18 PIN DIP	60510-01	3	3	3	3	3	3	3	3	3
SW1	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1
SW2	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1

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SW3	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1
SW4	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1
SW5	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1
SW6	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1
SW7	SWITCH, DIP, 8 POSITION	73029-05	1	1	1	1	1	1	1	1	1
SW8	SWITCH, MOMENTARY, SPST	61319	1	1	1	1	1	1	1	1	1
SW9	SWITCH, MOMENTARY, SPST	61319	1	1	1	1	1	1	1	1	1
U1	TL7705A	73157-11	1	1	1	1	1	1	1	1	1
U2	TMPZ 84COOP (CPU)	60320-01	1	1	1	1	1	1	1	1	1
U3	27128 EPROM	73202-10	1	1	1	1	1	1	1	1	1
U4	6116 RAM	60274	1	1	1	1	1	1	1	1	1
U5	DS 1220 NON-VOLATILE RAM	60324	1	1	1	1	1	1	1	1	1
U6	8253	60325	1	1	1	1	1	1	1	1	1
U7	ADC 0804	60330	1	1	0	1	1	0	0	0	0
U8	74LS123	60327	1	1	1	1	1	1	1	1	1
U9	MAX 232	60330-01	1	1	1	1	1	1	1	1	1
U10	74LS05	60328	1	1	1	1	1	1	1	1	1
U11	74LS93	60326	1	1	1	1	1	1	1	1	1
U12	74LS138	60318	1	1	1	1	1	1	1	1	1
U13	74LS138	60318	1	1	1	1	1	1	1	1	1
U15	ULN2003	60313	1	1	1	1	1	1	1	1	1
	ULN2003	60313	1	1	1	1	1	1	1	1	1
	ULN2003	60313	1	1	1	1	1	1	1	1	1
U18	8251A	60135-01	1	1	1	1	1	1	1	1	1
U20	8255	60316	1	1	1	1	1	1	1	1	1
U21	8255	60316	1	1	1	1	1	1	1	1	1
U22	8255	60316	1	1	1	1	1	1	1	1	1
U23	8255	60316	1	1	1	1	1	1	1	1	1
U24	NTE2018	60313-01	1	1	1	1	1	1	1	1	1
U25	NTE2018	60313-01	1	1	1	1	1	1	1	1	1
U26	ULN2003	60313	1	1	1	1	1	1	1	1	1
U27	ULN2003	60313	1	1	1	1	1	1	1	1	1
U28	NTE2018	60313-01	1	1	1	1	1	1	1	1	1
U29	ILQ74	60265	1	1	1	1	1	1	1	1	1
U30	ILQ74	60265	1	1	1	1	1	1	1	1	1
U32	74LS14	60288	1	1	1	1	1	1	1	1	1
U33	74LS393	73156-21	1	1	1	1	1	1	1	1	1
U34	LM358A	73159	1	1	1	1	1	1	1	1	1
VR1	LM323K REGULATOR	60329	1	1	1	1	1	1	1	1	1

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	BY	DATE	DRAWING NUMBER	REV
DRAWN	CAM	3/25/87	14843	X
CHECKED				
APPROVED	CAC	2/22/93	SHEET 26 OF 10	

X8	2 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
X11	3 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
X17	3 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
X18	2 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
X19	2 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
X20	3 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
X21	3 PIN HEADER	60283	1	1	1	1	1	1	1	1	1
Y1	4 MHZ OSCILLATOR	73211	1	1	1	1	1	1	1	1	1
Z1	ZENER DIODE, 6.2V, 1N5234	60453	1	1	1	1	1	1	1	1	1
	J PINS	73066-02	2	2	2	2	2	2	2	2	2
	PC BOARD	14843	1	1	1	1	1	1	1	1	1
	SCHEMATIC	16034	0	0	0	0	0	0	1	1	1

SEMITOOL™ Kalispell, MT			
PSC-102 MAIN LOGIC BOARD ASSY			
	BY / DATE	DRAWING NUMBER	REV
DRAWN	CAM 3/25/87	14843	X
CHECKED			
APPROVED	CAC 2/22/93	SHEET 10 OF 2H	

NOTE:

THE -1 ASSEMBLY IS FOR MICRODESIGN MOTOR CONTROLS
THE -501 ASSEMBLY IS FOR KBIC MOTOR CONTROL WITH OPTICAL TACHOMETER SENSOR (SLOTTED DISK)
THE -503 ASSEMBLY IS FOR KBIC MOTOR CONTROL AND REFLECTIVE TACHOMETER SENSOR.
THE -505 ASSEMBLY IS FOR KBIC, OPTICAL TACH, RESISTIVITY MONITOR ADAPTOR.
THE -507 ASSEMBLY IS FOR EXTERNAL 24VDC SUPPLY (USED IN SANDIA RFT/W).
THE -509 ASSEMBLY IS FOR INTERNAL TACH BUFFER BOARD (14869)
THE -511 ASSEMBLY IS FOR INTERNAL TACH BUFFER BOARD (14869) WITH RESISTIVITY MONITOR.
THE -513 ASSEMBLY IS FOR BRUSHED OR BRUSHLESS MOTORS WITH TACH BUFFER INTEGRATED ON BOARD. TYPICAL PRODUCTION PRIOR TO 10/2/90.
THE -515 ASSEMBLY HAS THE LONG LATCH ON J5 AND ADDITIONAL JUMPERS FOR THE SIGNAL TOWER OPTION AND IS TYPICAL FOR ALL PSC-102 CONTROLLERS AFTER 10/2/90.
THE -517 ASSEMBLY TO BE USED FOR IPA SRD ONLY, (SAME AS -515 EXCEPT JUMPERS) (NO WATER, LTD 5VDC FOR TACH, ROTOR UP)

NOTES: 1. THE -1 ASSEMBLY OF THE 14843 PCB CAN NOT BE MADE WITH A REV F OR LATER BOARD.

2. ON ASSEMBLIES -501 TO -511, CUT TRACE BETWEEN X18 PIN 1 AND PIN 2. CUT TRACE BETWEEN X19 PIN 1 AND PIN 2. CUT TRACE BETWEEN X20 PIN 1 AND PIN 2. CUT TRACE BETWEEN X21 PIN 1 AND PIN 2.

3. INSTALL J PIN IN +5VDC TEST POINT & ONE IN GND TEST POINT.

4. INSTALL Q-CAP (C4) UNDER U2-11 & U2-29.

REV F BOARD NOTES;

1. ON ALL ASSEMBLIES; ADD 18AWG JUMPER BETWEEN THE SCREW MOUNTING PAD OF VR1 AND THE GROUND TEST POINT. USING A #50 DRILL DRILL OUT THE PAD ON U12 PIN 6. PLACE A PIECE OF INSULATION ON THE LEG OF THE IC U12 PIN 6 BEFORE INSTALLING ON THE PCB. JUMPER U12 PIN 6 TO R8 PIN 2. ALSO, DRILL OUT THE VIA THAT IS DIRECTLY ABOVE R44 PIN 1. JUMPER X21 PIN 2 TO U23 PIN 1. JUMPER U27 PIN 11 TO J4 PIN 18.

REV G BOARD NOTES;

1. ON ALL ASSEMBLIES; ADD 18AWG JUMPER BETWEEN THE SCREW MOUNTING PAD OF VR1 AND THE GROUND TEST POINT. JUMPER U12 PIN 6 TO R8 PIN 2.

REV H BOARD NOTES;

1. ON ALL ASEMBLIES USE A #50 DRILL BIT, DRILL OUT THE PAD ON U12 PIN 6.

2. PLACE A PIECE OF INSULATION ON THE LEG OF I.C. U12 PIN 6 BEFORE INSTALLING ON THE PCB.

REV H BOARD NOTES CONTINUED;

3. JUMPER U12 PIN 6 TO R8 PIN 2.

4. ON THE -515,-517 ASSEMBLIES, ADD THE FOLLOWING JUMPERS:
   U27-11 TO J3-4
   U27-10 TO J3-5
   U27-12 TO J3-7

4. ON THE -517 ASSEMBLY
   CUT THE TRACE BETWEEN J4-48 AND J4-50
   JUMPER C25 (+) TO J4-50

REV I BOARD NOTES;

ALL ASSEMBLIES:

1. INSTALL SOCKETS FOR ALL I.C.s.
2. MAKE THE FOLLOWING MODIFICATIONS TO ADD TWO GATE DELAYS TO THE IORQ:
   2.1. CUT THE TRACE ON THE TOP SIDE OF THE BOARD, BETWEEN THE VIA FROM U13-4 AND THE VIA FROM U2-20.
   2.2. JUMP BETWEEN THE VIA FROM U2-20, AND U10-5.
   2.3. JUMP BETWEEN U10-6 AND U10-9.
   2.4. ON THE BOTTOM OF THE BOARD SOLDER ONE END OF R80 TO U10-6 AND THE OTHER END TO +5 VDC AT U10-14.
   2.5. ON THE BOTTOM OF THE BOARD SOLDER ONE END OF R79 TO U10-8 AND THE OTHER END TO +5 VDC AT U10-14.
   2.6. CONNECT U10-8 TO THE VIA FROM U13-4.

ON THE -517 ASSEMBLY:

1. CUT THE TRACE BETWEEN J4-48 AND J4-50.
2. JUMPER C25 (+) TO J4-50.

REV J BOARD NOTES:

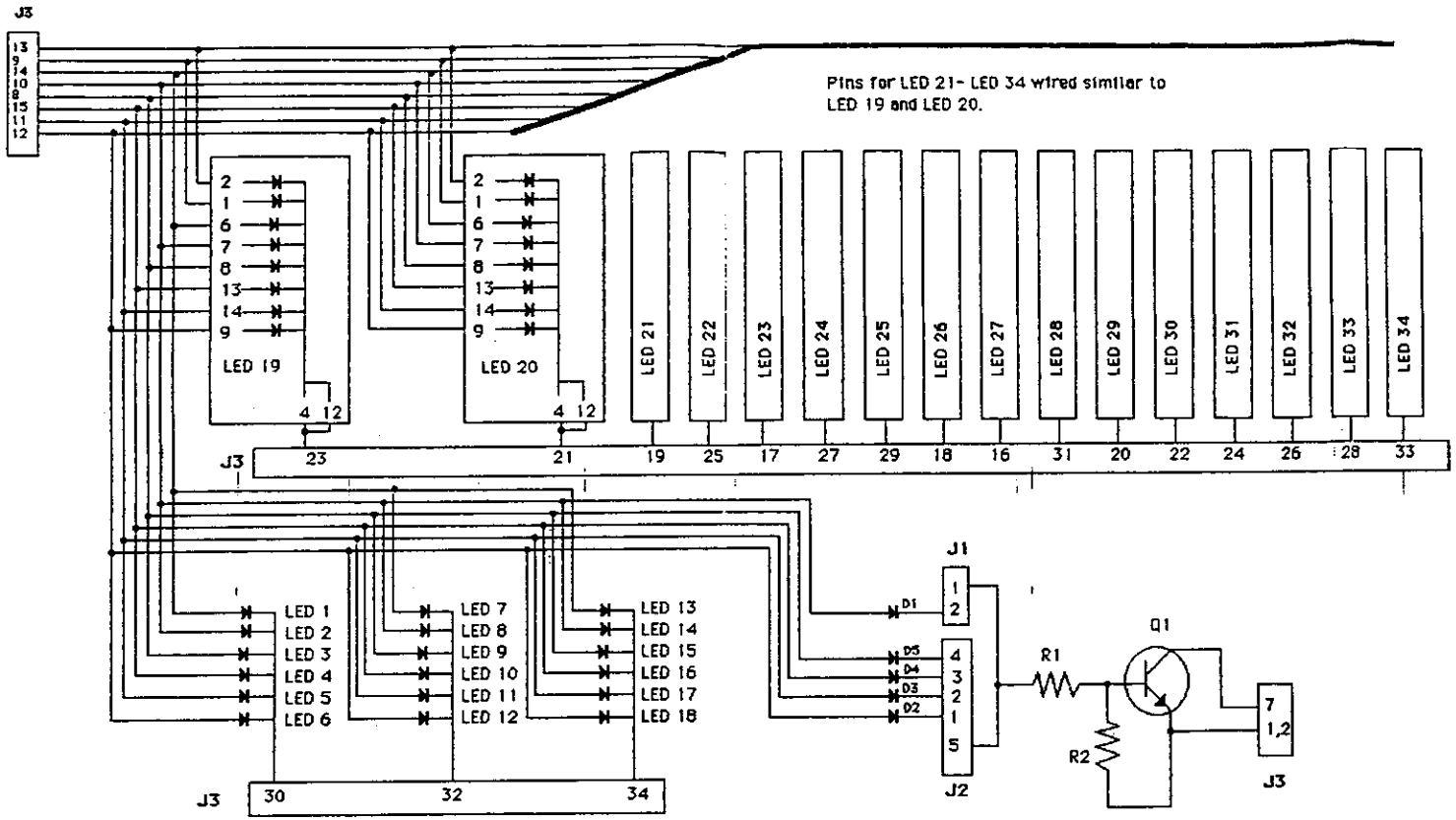
1) INSTALL SOCKETS FOR ALL I.C.s.
2) THE BOARD ARTWORK HAS BEEN REVISED, AND THE ABOVE CUTS AND JUMPS ARE NO LONGER REQUIRED.

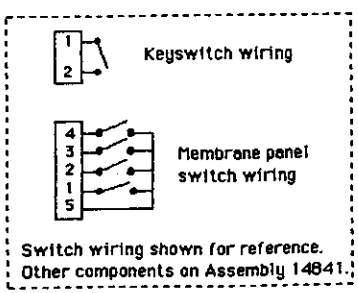
ON THE -517 ASSEMBLY:

1. CUT THE TRACE BETWEEN J4-48 AND J4-50.
2. JUMPER C25 (+) TO J4-50.

END OF PARTS LIST

LTR	REVISION	BY	APP'D





SEMITOOL CONFIDENTIAL

-1	PART NO.	DESCRIPTION	SPECIFICATION
QTY. PER ASSY.			

TOLERANCES UNLESS NOTED
.XX = ± .02
.XXX = ± .010
ANGULARITY = ± ½°
BREAK CORNERS-.010 MAX.
FILLET RADII-.015 MAX.
125√ MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

NEXT ASSEMBLY

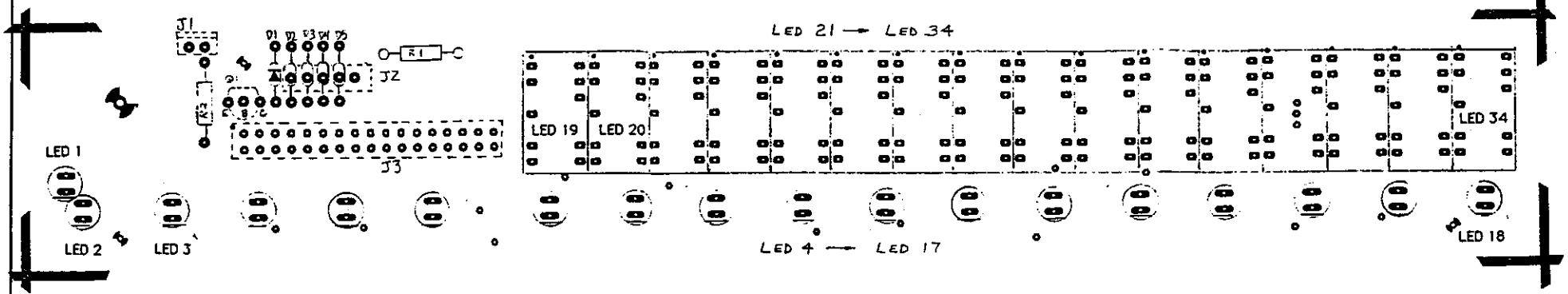
SEMITOOL KALISPELL, M

SRD DISPLAY PANEL - SCHEMATIC
PSC-102

	BY	DATE
DRAWN	CAC	5-21-86
CHECKED		
APPROVED	CAC	5-21-86

DRAWING NUMBER 14157
SCALE
SHEET

LTR.	REVISION	BY	APP'D
A	Moved R1 Enlarged Key switch hole	CAC	CAC
B	Request solder mask	CAC	CAC
C	CORRECT Q1	CAC	CAC
D	ROTTED Q1, J1-J3. CORRECTED Q1 ORIENTATION ER#10025	AJW	CAC



NOTES: 1. Install J3, then diodes (D1-D5, then J1, J2, J3, and Q1 are installed on the circuit side of the bd.
2. LED's 1-18 are oriented as shown.

(Long lead is this side)

QTY. PER ASSY.	PART NO.	DESCRIPTION	SPECIFICATION
16	60457	LED19-LED 34	LTS 315AHR 7 Segment Display
18	60459	LED 1-LED 18	T-1 Red LED
2	60107-01	R1-R2	4.7K 1/4W resistor
5	60401	D1-D5	1N4148 Diode
1	73083	J1	Connector, 2 pin header
1	60624-6	J2	Connector, 5 pin header
1	73184-30	J3	Connector, 34 pin IDC PC mount
1	73189-30		2" piece 34 conductor ribbon (attached to J3)
1	73184-21		34 pin female connector (attached to end of cable)
1	73041-10	Q1	2N4401 Transistor
			PC BOARD MOUNTING HARDWARE
3	95061		standoff spacers
3	91245-3		Insulating washers
3	91214		6-32 nuts
1	14841B	Circuit Board	
1	14157	Schematic	

Sheet 1	Assembly drawing
Sheet 2	Hole Legend
Sheet 3	Component side art
Sheet 4	Circuit side art
Sheet 5	Pad master art

TOLERANCES UNLESS NOTED
.XX = ± .02
.XXX = ± .010
ANGULARITY = ± ½°
BREAK CORNERS-.010 MAX.
FILLET RADII-.015 MAX.
125√ MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

NEXT ASSEMBLY

SEMITOOL CONFIDENTIAL

SEMITOOL KALISPELL,

SRD PC Board PSC-102

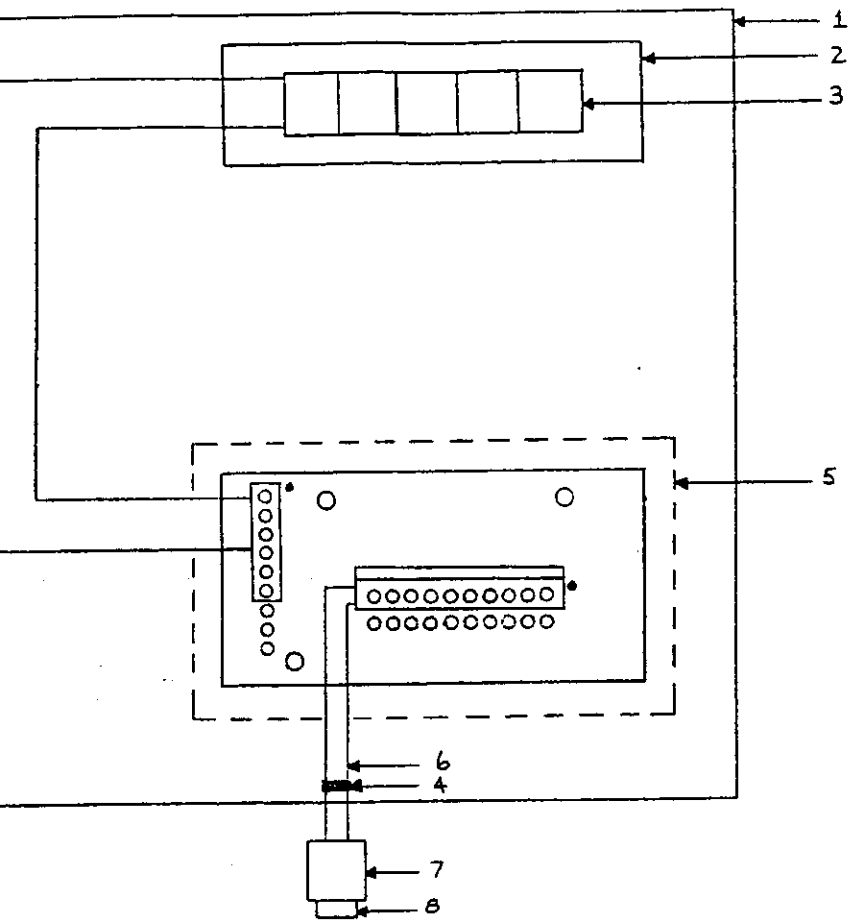
	BY	DATE
DRAWN	CAC	5/24/96
CHECKED		
APPROVED		5/24/96

DRAWING NUMBER 14841

SCALE

SHEET

LTR.	REVISION	BY	APP'



#	QTY. PER ASSY.		PART NO.	DESCRIPTION	SPECIFICATION
	1	1	12821-1	OVERLAY ASSY., OPERATOR CONTROL PAN	
	3	3	91256	LOCKWASHER, INTERNAL TOOTH, #6	
	3	3	91262	PRESS STUD, 6-32 x 1/2"	
	3	3	91214	6-32 NUTS	
	3	3	95061	SPACERS, 1/4" x .2, NYLON	
8	1	1	73174-2	DB9 CONNECTOR PLUG	
7	1	1	73171-3	DB9 CABLE CLAMP	
6	4'	10'	73189-28	10 CONDUCTOR ROUND CABLE	
5	1	1	14862-501	SWITCH PAD INTERCONNECT BOARD ASSY.	
4	-	1	61710	PLASTIC TIE WRAP (STRAIN RELIEF)	
3	1	1	73153-01	CONTROL SWITCHES, MEMBRANE, 6 POS	
2	1	1	12823-03	METAL PLATE	
1	-	1	17137-501	REMOTE OPERATOR CONTROL BOX	
		•	-1 DEL	OPERATOR CONTROL PANEL	
	-501	-1			

S:

he -1 assembly is used on PSC-102's with autodoors and emote electronics

he -501 assembly is used on PSC-102's with autodoors nd no remote electronics

his assembly is used on all PSC-102's built after 7/8/87

TOLERANCES UNLESS NOTED
.XX = ± .02
.XXX = ± .010
ANGULARITY = ± 1/2°
BREAK CORNERS-.010 MAX.
FILLET RADII-.015 MAX.
125√ MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

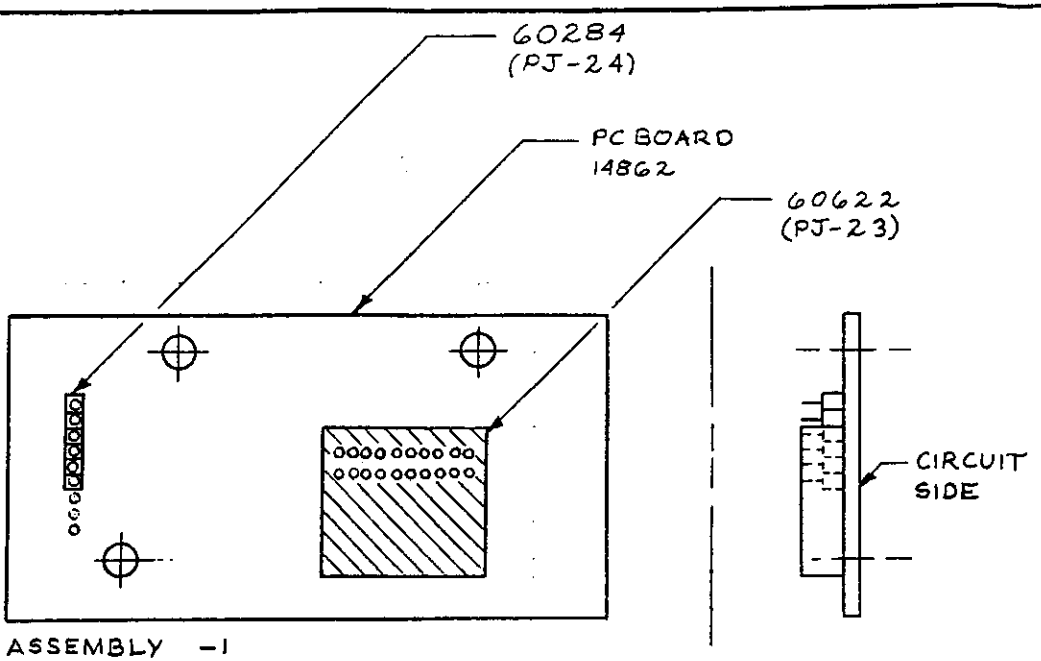
NEXT ASSEMBLY

SEMITOOL™ KALISPELL

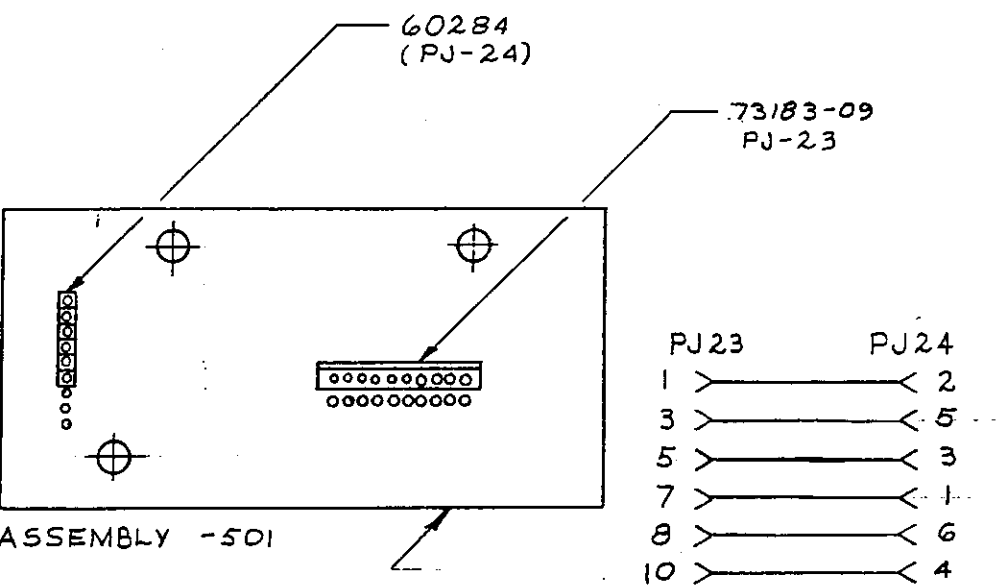
PSC-102 OPERATOR CONTROL PANEL (

	BY	DATE	DRAWING NUMBER
DRAWN	RLF	7/8/87	17135
CHECKED			SCALE
APPROVED	CAC	7/21/87	SHEET

LTR.	REVISION	BY	APP'D.
A	ADDED THE -501 ASSY. REDRAW	BTH	CAC



ASSEMBLY -1



ASSEMBLY -501

QTY. PER ASSY.		PART NO.	DESCRIPTION	SPECIFICATION
	-501	-1		
		1	73183-49	CONNECTOR, 10 PIN, FRICTION LOCK SOCKET
1		1	73153-1	CONNECTOR ON 6 POSITION SWITCH MEMBR
	1		60623-04	CONNECTOR, 20 PIN, FEMALE FLAT CABLE

MATCHING CONNECTORS

1/2		73204	CONNECTOR, 10 PIN, FRICTION LOCK 90°
•		-501	SWITCH-PAD INTERCONNECT BOARD ASS
	1	14160	SCHEMATIC, PSC-102
1	1	60284	CONNECTOR, 6PIN, STRAIGHT(.025"SQ POSTS, 1/8 CE
	1	60622	CONNECTOR, RIGHT ANG., 20 PIN, PCB, LOCK & EJE
1	1	14862	PC BOARD, SWITCH-PAD INTERCONNECT
	•	-1	SWITCH-PAD INTERCONNECT BOARD ASS

OF 3 IS "DRILL AND TAP" INFO.
OF 3 IS "CIRCUIT SIDE" ART WORK.
ASSY IS USED ON ALL PSC-102's W/AUTODOORS BUILT BEFORE 7/8/87.
01 ASSY IS USED ON ALL PSC-102's W/AUTO DOORS AFTER 7/8/87.

TOLERANCES UNLESS NOTED
.XX = ± .02
.XXX = ± .010
ANGULARITY = ± 1/2°
BREAK CORNERS-.010 MAX.
FILLET RADII-.015 MAX.
125 MACHINED SURFACES
DIMENSIONS ARE IN INCHES UNLESS NOTED

NEXT ASSEMBLY 12823

SEMITOOL™ KALISPELL,

SWITCH-PAD INTERCONNECT BOARD

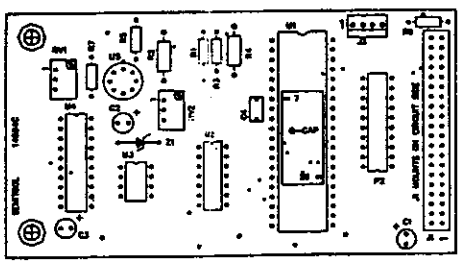
	BY	DATE
DRAWN	BT HANSEN	7-7-87
CHECKED		
APPROVED	CAC	7/27/87

DRAWING NUMBER 14862

SCALE NONE

SHEET

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	———	CORRECTED SHORTED TRACE ON ARTWORK, REDRAWN. BOARD BECOMES REV A. ECN#880039	CAM	CAC	2/8/88
B	888629-1	ADDED C4 AND C5 TO ASSY. NOTES 2 AND 3 PAGE 2.	RTW	CAC	4/5/88
C	888629-2	FIXED SHORT, ADDED C4 TO BOARD. BOARD IS REV B.	CAM	CAC	9/15/1
D	888629-3	MOVED MOUNTING HOLES.	JEA	CAC	6/4/9
E	938622-2	ADDED RV1, RV2, R7, CHANGED R2 TO 13.3K 1% REDRAWN ON ACAD BOARD BECOMES REV C.	RAC	CAC	8/25/1
F	938825-2	CORRECTED +5VDC CALIBRATION TO READ +/-0.001 VOLTS.	RAC	CAC	10/27



COMPONENT PRINT
ON COMPONENT SIDE (YELLOW)

SHEET	SIZE	DESCRIPTION
1.	C	ASSEMBLY
2.	A	PARTS LIST
3.	C	DRILL AND TRIM
* 4.	C	ASSEMBLY (EARLIER REV.'S)
5.	DISK "APCB"	COMP. SIDE ARTWORK
6.	DISK "APCB"	CIRC. SIDE ARTWORK
7.	DISK "APCB"	SOLDER SIDE ARTWORK
8.	DISK "APCB"	SILKSCREEN ARTWORK
* 9.	DISK "APCB"	POWER PLANE ARTWORK
* 10.	DISK "APCB"	GROUND PLANE ARTWORK

* THESE DO NOT APPLY TO THIS PC. BOARD *

CUSTOMER	SEMITOOL™ KALISPELL, MT		
S/O	PSC-102 RESISTIVITY MONITOR ADAPTOR ASSEMBLY		
REF MASTER	BY	DATE	DRAWING NUMBER: 14884
REF SCHEMATIC 14188	DRAWN CM	1/27/88	RE F
REF ASSEMBLY	ENGR		
PRELIMINARY	APPROVED CAC	10/24/93	SCALE: NONE
AS BUILT			SHEET 1 OF
REF E.R. 880029			

LAYER ID 9 13 17 24 30

SEMITOOL	Kalispell, MT	
RESISTIVITY MONITOR ADAPTOR		
BY / DATE	DRAWING NUMBER	REV
DRAWN CAM 12/16/87	14884	F
CHECKED		
APPROVED CAM 10/28/93	SHEET 2A OF 8	

REF	DESCRIPTION	PART NO.	ASSY -1
C1	Capacitor, Elect., 10mF, 35 VDC	60260	1
C2	Capacitor, Elect., 10mF, 35 VDC	60260	1
C3	Capacitor, Elect., 10mF, 35 VDC	60260	1
C4	Capacitor, NPO, 120pF, 1000 V	73009-5	1
C5	Capacitor, Decoupling QCap	60296	1
J1	Conn, 40 pin Fem., Dual Row, PC Mnt	73184-51	1
J3	Conn, 4 pin post hdr FRCTLK	60617-05	1
P2	Conn, 20 pin DIP Rbn	6022-01	1
	Conn, 20 pin DIP Rbn	6022-01	1
	Cable, Ribbon, 20 conductor, 2.5"	60613	2.5"
R1	Res 470, 1/4W, 5%	60108	1
R2	Res 13.7K, 1/2W, 0.1%	60130-13	(USED ON REV B AND EARLIER BOARDS)
R2	Res 13.3K, 1/2 W, 1%	60130-14	1
R3	Res 470, 1/4W, 5%	60108	1
R4	Res 499K, 1/2W, 0.1%	60130-499	1
R5	Res 220, 1/4W, 5%	60105-03	1
R6	Res 1K, 1/4W, 5%	60112	1
R7	Res 330K, 1/4W, 5%	60115-14	1
RV1	Pot, 10K PCMNT, TOP ADJ	61523-01	1
RV2	Pot, 1K PCMNT, TOP ADJ	73166-04	1
U1	I.C. 8255	60316	1
U2	I.C. 4066	60305	1
U3	I.C. LM358	73159	1
U4	I.C. TLC1541IN	60313-10	1
U5	I.C. AD584LH, Precision Volt. Ref.	60330-05	1
Z1	Zener, 6.2V	60453	1
	Standoffs, 3/4", Fem/Male, 4-40	91288-01	1
	I.C. SOCKETS		
	Socket, I.C., 8 pin	60511-03	1
	Socket, I.C., 14 pin	60503-01	1
	Socket, I.C., 20 pin	60510-02	2
	Socket, I.C., 40 pin	60513-01	1

SEMITOOL Kalispell, MT			
RESISTIVITY MONITOR ADAPTOR			
	BY DATE	DRAWING NUMBER	REV
DRAWN	CAM 12/16/87	14884	F
CHECKED			
APPROVED	CAC 10/5/93	SHEET 2A OF 8	

REF	DESCRIPTION	PART NO.	ASSY -1
	Printed Circuit Board	14884	1
	Assembly Drawing	14884 Sht 1	1
	Electrical Schematic	14188	1

NOTES:

ALL BOARDS:

1. C5 is placed under U1 connected to pins 7 and 26.
2. Install sockets under all I.C.s.

NO REV BOARDS:

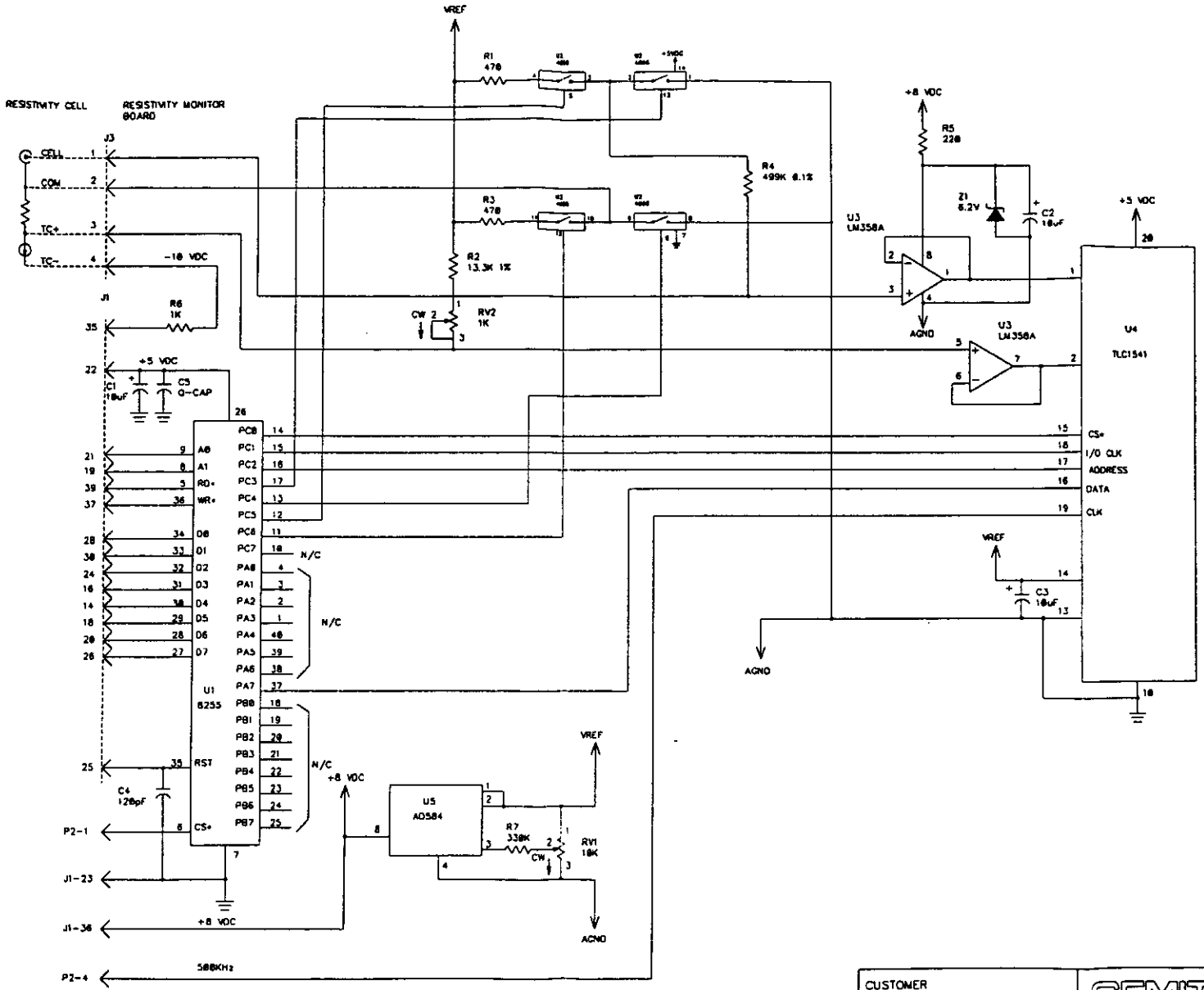
1. After installing J1, Trim trace that leads from J1-39 to R6 away from J1-37 and J1-39 (leave J1-35 connencted to R6).
2. Place C4 on the circuit side between pins 7 and 35 of U1.

REV C BOARDS:

1. RESISTANCE CALIBRATION:
With the power off, connect one lead of a Fluke 8050A DVM set to the 20K OHM range to U4-14, and the other lead to U3-5. Adjust RV2 (1K) pot to read 13.71 OHMS, and lock the adjusting screw.
2. PRECISION +5 VDC CALIBRATION:
Connect the NEG lead of a Fluke 8050A DVM to U4-13. Connect the POS lead to U4-14. Adjust RV5 (10K) pot to read 5.00 VDC (+/- 0.001 VDC), and lock the adjusting screw.

END OF PARTS LIST

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	880829-1	ADDED C4 AND C5 ON U1.	RTW	CAC	4/5/88
B	930822-2	ADDED RV1, RV2, R7, CHANGED R2 TO 13.3K 1% REDRAWN ON ACAD.	RAC	CAC	8/25/93



CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY	14884
PRELIMINARY	
AS BUILT	
REF E.R.	

SEMITOOL KALISPELL, MT

RM-20 RESISTIVITY MONITOR ADAPTOR
SCHEMATIC (PSC-102)

	BY	DATE
DRAWN	RTW	1/27/88
ENGR		
APPROVED		

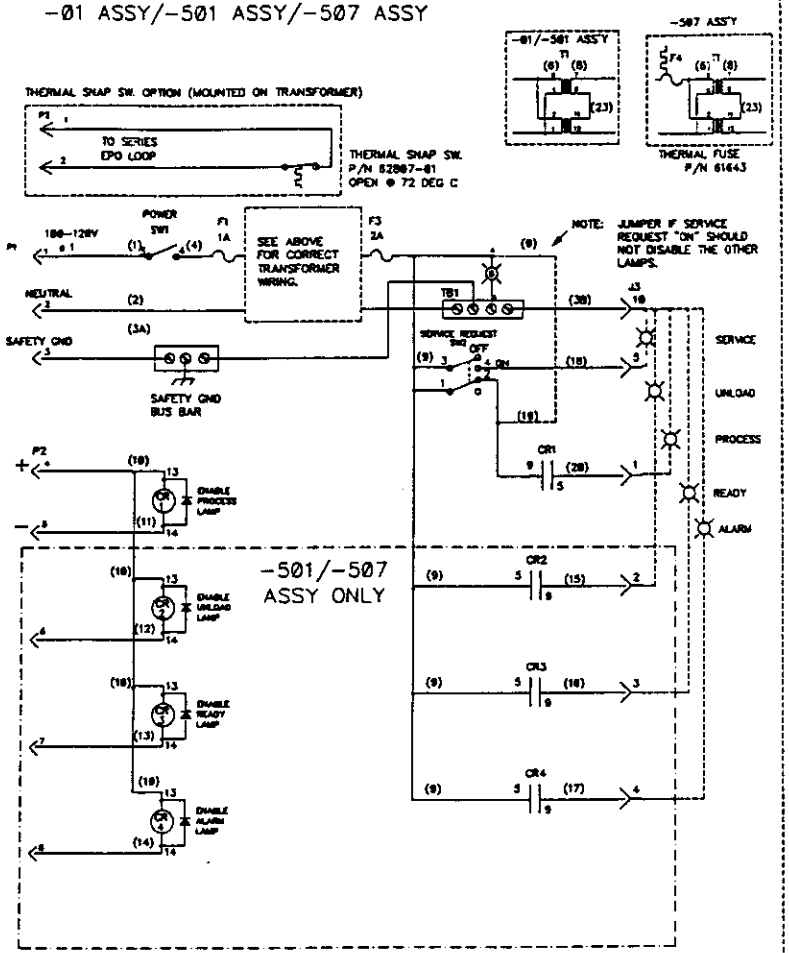
DRAWING NUMBER: 14188

REV: B

SCALE: NONE

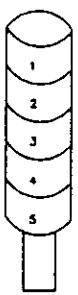
SHEET 1 OF 1

-01 ASSY/-501 ASSY/-507 ASSY



SHOP ORDER	TOWER ASS'Y	TOWER TYPE	LAMP POSITION 1	2	3	4	5
33778	-501	1	R S	A S	B S	N/A	N/A
STYLE 1 34969, 35753	-501	1	R S	G S	A S	N/A	N/A
38178 *THESE USE CR1 W/SPECIAL SOFTWARE.	-501	1	R S	A S	G 2 3 S F *	N/A	N/A

COLOR CODE
FUNCTION CODE
LIGHT TYPE CODE



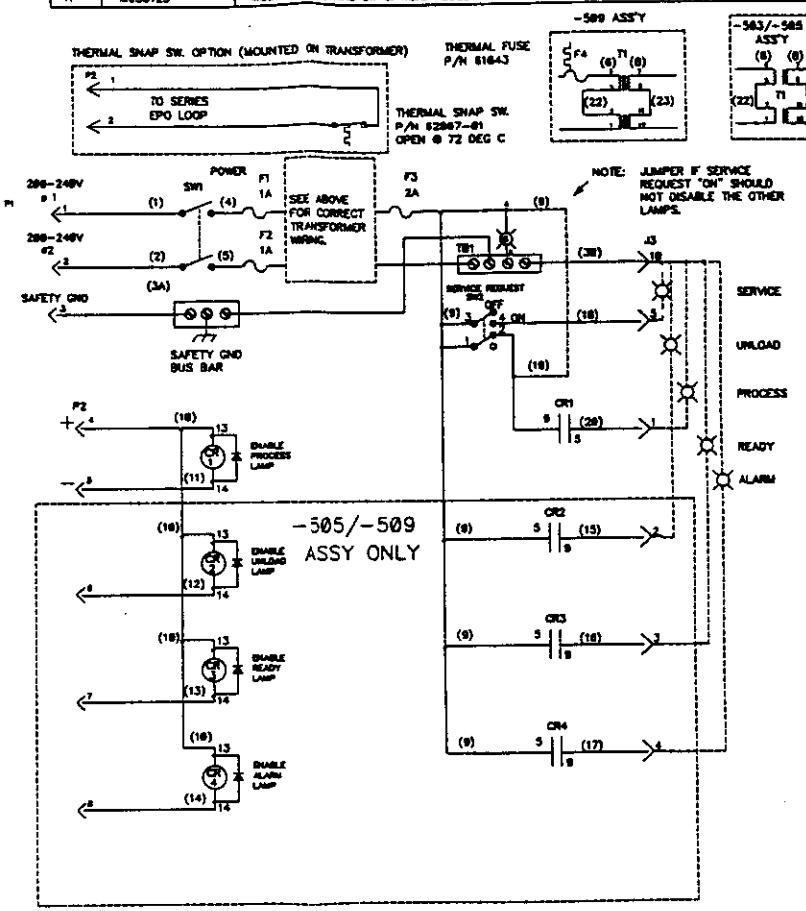
CODE	COLOR
R	RED
A	AMBER
G	GREEN
C	CLEAR
B	BLUE

CODE	FUNCTION
1	ALARM
2	IN PROCESS
3	UNLOAD
4	READY
5	SERVICE

CODE	LIGHT TYPE
F	FLASHING
S	STEADY

CODE	TOWER TYPE
1	ST-382V STANDARD SIZE 3 LAMP NO AUDIO ALARM
2	STF-382V STANDARD SIZE 3 LAMP NO AUDIO ALARM WITH BLINKING OPTION
3	ST-482V STANDARD SIZE 4 LAMP NO AUDIO ALARM
4	STF-482V STANDARD SIZE 4 LAMP NO AUDIO ALARM WITH BLINKING OPTION

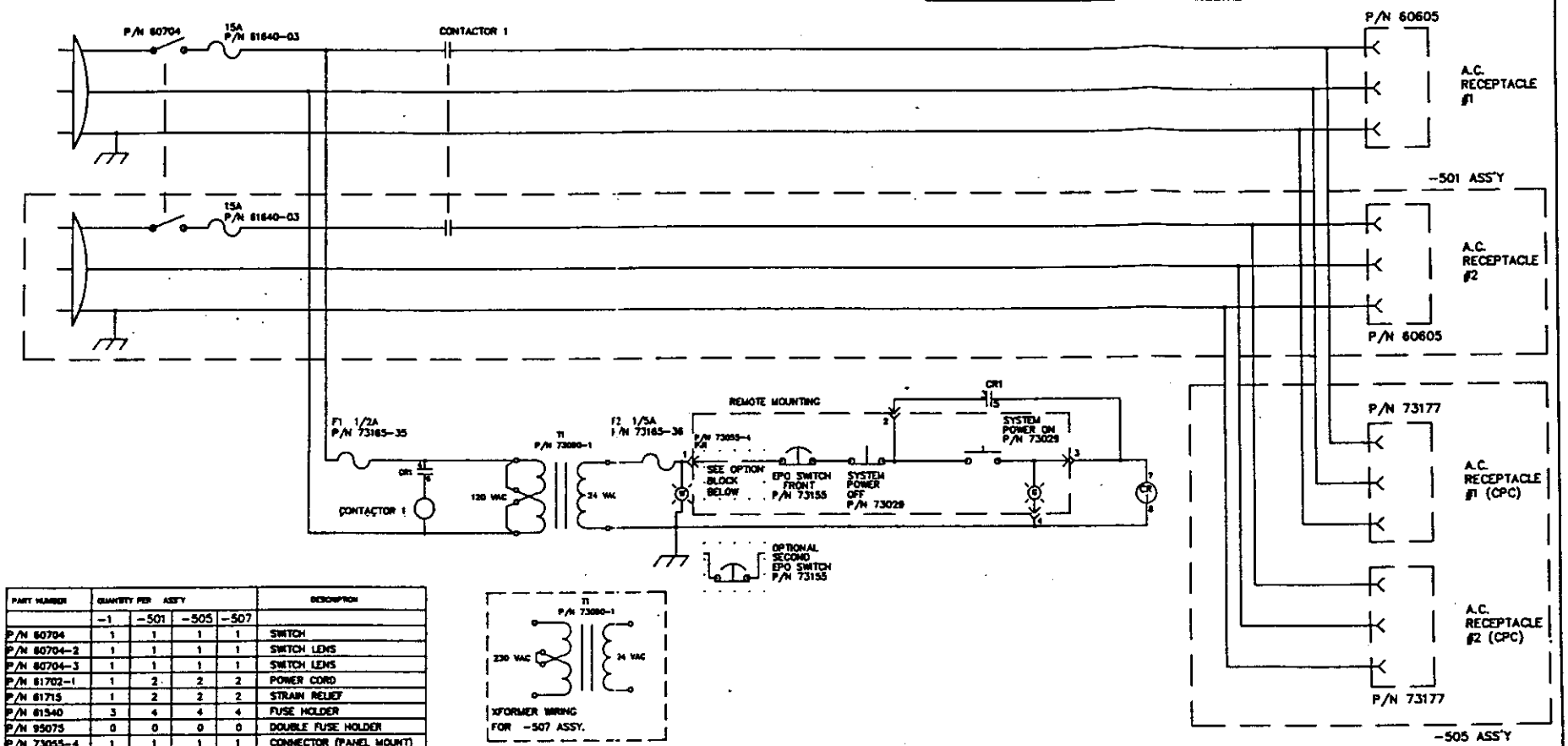
LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	980111	ADDED JUMPER BETWEEN TB1-9 AND TB1-11. CHANGED LAMP CONFIGURATION TO ALLOW A FOUR LAMP SIGNAL TOWER.	AJW	CAC	9/28/94
B	980111-1	ADDED OPTIONAL TRANSFORMER THERMAL FUSES.	AJW	CAC	12/14/9
C	980111-2	ADDED S/O 34969.	TA	CAC	2/27/91
D	980111-3	CREATED -507, -509 ASSEMBLIES FOR OPTIONAL THERMAL FUSES. CREATED ST-38 STYLE 1.	AJW	CAC	3/8/91
E	910874	ADDED S/O 38178, CHANGED LIGHT TYPE X BLINKING TO F FLASHING. ADDED LAMP FUNCTION LABELS TO SCHEMATIC.	RAC	CAC	8/30/9
F	910831-1	ADDED THERMAL SNAP SW. OPTION.	KAH	TA	4/1/92
G	910831-2	REMOVED TB1.	RAC		
H	M950125	MODIFIED THERMAL SW OPTION. ADDED TB1 & SAFETY GND BUS BAR.	ASC	ASC	8/23/9



-503 ASSY/-505 ASSY/-509 ASSY

CUSTOMER	SEMITOOL	KALISPELL, MT	
S/O 28715	SIGNAL TOWER INTERFACE BOX, SCHEMATIC		
REF MASTER			
REF SCHEMATIC			
REF ASSEMBLY 16739	BY	DATE	DRAWING NUMBER: 16055
PRELIMINARY	DRAWN KARI HERZOG	1/31/96	
AS BUILT	ENGR ASC	8/23/95	SCALE:
REF F.R.	APPROVED		SHEET 1 OF

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	890031-1	CHANGED CR1 AND REVISED PARTS LIST	RLF	RLF	5/12/89
B	890031-2	CHANGED LAMP WIRING AND REVISED PARTS LIST.	RLF	CAC	6/6/89
C	890031-3	ADDED OPTIONAL SECOND EPO SWITCH	AJW	CAC	5/14/91
D	890031-4	ADDED -507 ASSY (EUROPEAN 230VAC)	JWD	CAC	1/16/92
E	890031-5	ADDED 220VAC CONTACTOR TO -507 ASSY.	JWD	CAC	1/16/92



PART NUMBER	QUANTITY PER ASS'Y				DESCRIPTION
	-1	-501	-505	-507	
P/N 60704	1	1	1	1	SWITCH
P/N 60704-2	1	1	1	1	SWITCH LENS
P/N 60704-3	1	1	1	1	SWITCH LENS
P/N 61702-1	1	2	2	2	POWER CORD
P/N 61715	1	2	2	2	STRAIN RELIEF
P/N 61540	3	4	4	4	FUSE HOLDER
P/N 95075	0	0	0	0	DOUBLE FUSE HOLDER
P/N 73055-4	1	1	1	1	CONNECTOR (PANEL MOUNT)
P/N 73055-3	1	1	1	1	CONNECTOR
P/N 60605	1	2	0	2	AC RECEPTACLE
P/N 73048-3	1	1	1	1	RELAY, 24VAC, 8 PIN
P/N 73048-1	1	1	1	0	CONTACTOR
P/N 73080-1	1	1	1	1	TRANSFORMER
P/N 73165-35	1	1	1	1	FUSE .5A
P/N 73165-36	1	1	1	1	FUSE .2A
P/N 61640-03	1	2	2	2	FUSE 15A
P/N 73177	0	0	2	0	CPC CONNECTOR
P/N 73029	2	2	2	2	SWITCH
P/N 73155	1	1	1	1	SWITCH
P/N 73155-1	1	1	1	1	ACTUATOR
P/N 73155-2	1	1	1	1	MOUNT
P/N 73031	2	2	2	2	SWITCH BEZEL
P/N 73032	2	2	2	2	SWITCH DIFFUSER
P/N 73033	1	1	1	1	SWITCH RED LENS
P/N 73035	1	1	1	1	SWITCH GREEN LENS
P/N 73111-10	1	1	1	1	SWITCH 24V LAMP
P/N 12175-1	1	1	1	1	RELAY BACK 1 POSITION
P/N 60852	1	1	1	1	RELAY SOCKET, 8 PIN
P/N 61768-1	0	0	0	2	AC PLUG (EUROPEAN TYPE)
P/N 73048-5	0	0	0	1	CONTACTOR (220VAC COIL)

NOTE:
-1 ASS'Y: SINGLE RINSER DRYER EPO CIRCUIT
-501 ASS'Y: STACKER (TWO) RINSER DRYER EPO CIRCUIT
-505 ASS'Y: STACKER (TWO) RINSER DRYER EPO CIRCUIT (W/ CPC A.C. RECEPTACLES)
-507 ASSY: SAME AS -501 ASSY. EXCEPT XFORMER WIRED FOR 230 VAC INPUT AND EUROPEAN TYPE AC LINE CORD PLUGS INSTALLED

CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY	
PRELIMINARY	890031
AS BUILT	890031-2
REF E.R.	890031

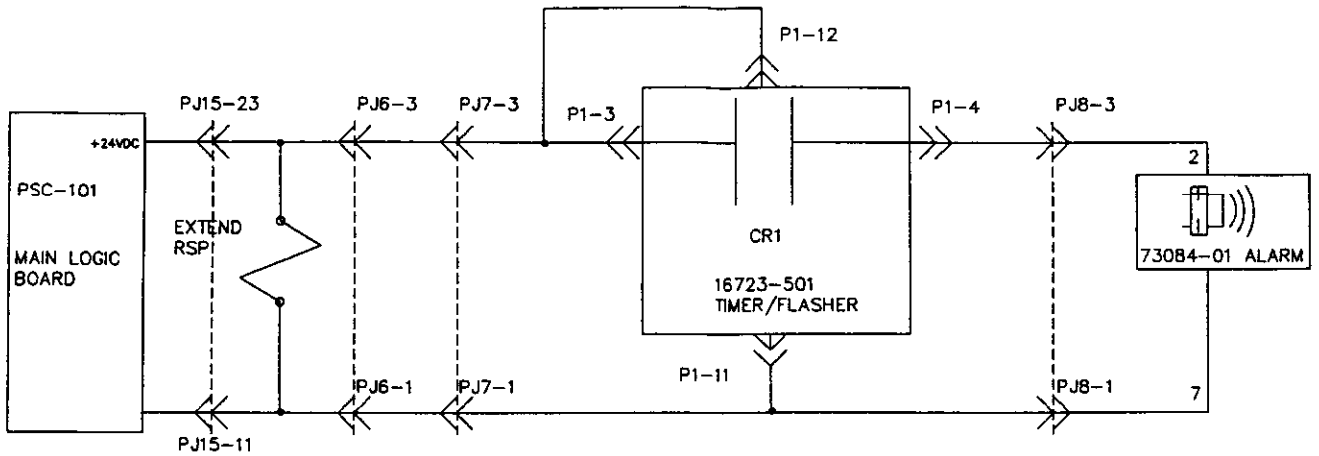
SEMITOOL KALISPELL, MT

SRD
EPO WIRING DIAGRAM

	BY	DATE
DRAWN	TA	1/25/89
ENGR		
APPROVED	CAC	1/16/92

DRAWING NUMBER: 16020
REV: E
SCALE: NONE
SHEET 1 OF 1

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	890247-4	CORRECT P1 PINOUT ON PSC-102 SECTION OF DRAWING.	TA	CAC	8/91
B	M950140	ADDED CONNECTORS PJ6, PJ7 PJ8 TO BOTH SCHEMATICS	ASC	ASC	9/7/95

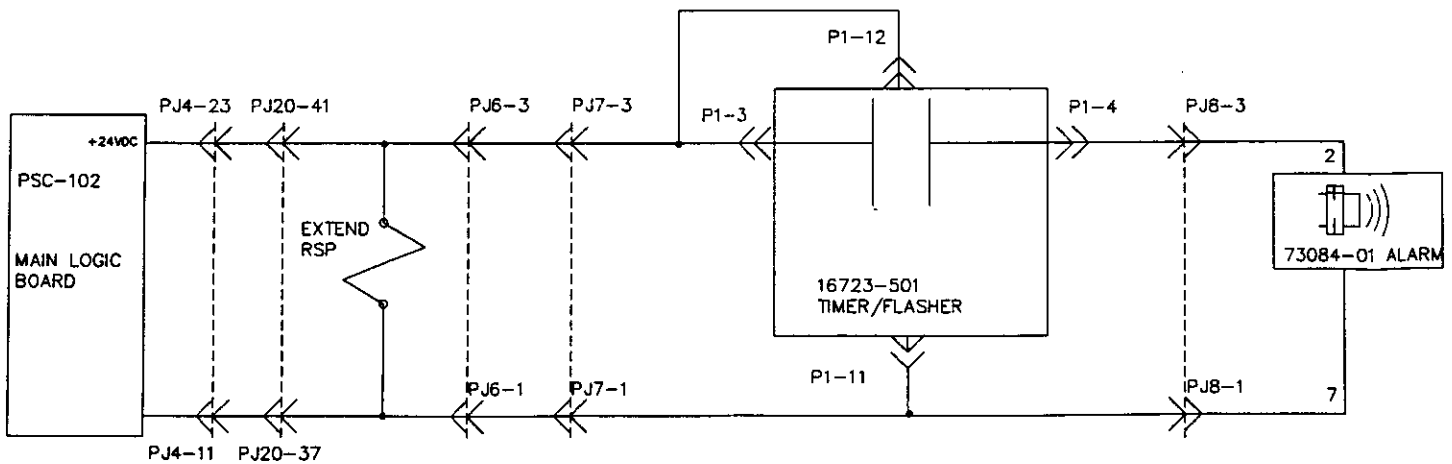


16723-501 SWITCH SETTINGS

S1	S2	S3	S4	S5	S6	S7	S8
0	0	0	1	1	0	1	0

0 = SWITCH OFF

FOR 3 SECOND ALARM, SET RV2 TO 2.0.



NOTE: MATING CONNECTIONS DIFFER IN NUMBERING CONVENTION "D" CONNECTOR.

CUSTOMER	
S/O	
REF MASTER	
REF SCHEMATIC	
REF ASSEMBLY	
PRELIMINARY	
AS BUILT	
REF E.R.	900108

SEMITOOL™ KALISPELL, MT

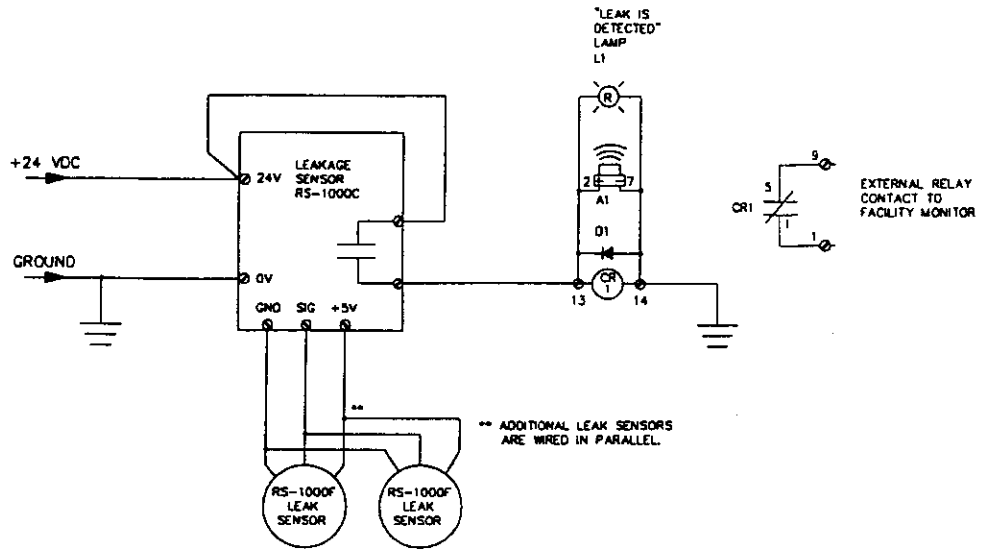
SRD END ALARM WIRING DIAGRAM

	BY	DATE
DRAWN	AJW	8/8/90
ENGR	ASC	9/7/95
APPROVED	ASC	9/7/95

DRAWING NUMBER: 16064 REV B

SCALE: NONE SHEET 1 OF 1

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE

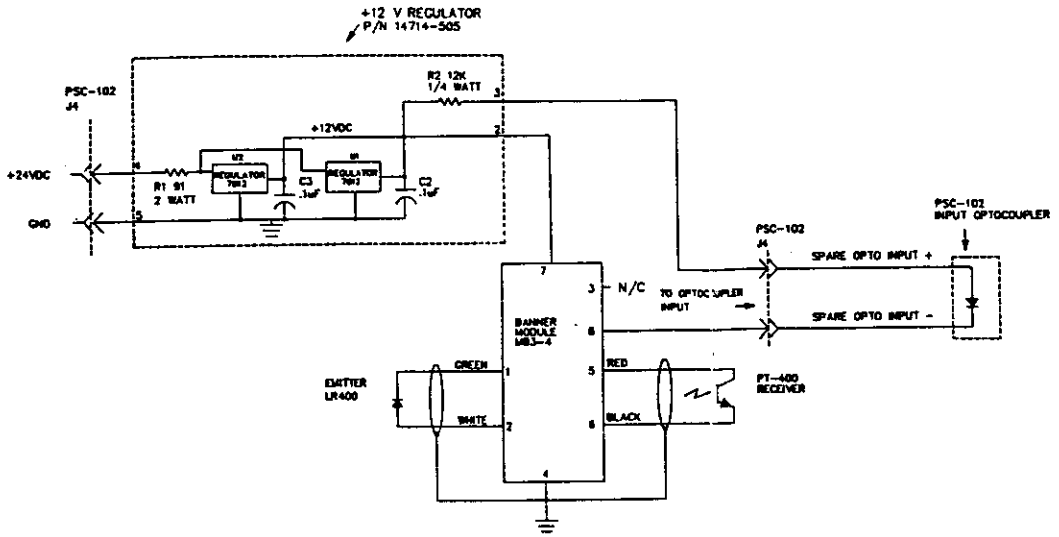


PARTS LIST

REF	DESCRIPTION	PART NO.	-1 ASSY
A1	ALARM BUZZER	73084-01	1
CR1	RELAY 24V DPDT 8 PIN 10A	73048-3	1
CR1	SOCKET RELAY 8 PIN SURFC MNT	60658	1
D1	DIODE 1N4002	60402	1
L1	INDICATOR LIGHT, SQUARE	73152-02	1
L1	LENS SQUARE, RED	73152-04	1
L1	LAMP T 1 3/4 CRVE BASE	73111-15	1

CUSTOMER	SEMITOOL™ KALISPELL, MT		
S/O	+24VDC LEAK DETECTOR ASSEMBLY AND SCHEMATIC		
REF MASTER			
REF SCHEMATIC			
REF ASSEMBLY	BY / DATE	DRAWING NUMBER: 16755	REV
PRELIMINARY	DRAWN AJW 4/25/91		
AS BUILT	ENGR AJW	SCALE: NONE	SHEET 1 OF 1
REF E.R. 010075	APPROVED		

LTR	RELEASE #	REVISION DESCRIPTION	DWN	APPD	DATE
A	910006	ADDED MA3-4 MODULE PORTION OF SCHEMATIC (PSC-102 SECTION)	TA	CAC	1/91
B	910006-1	ADDED PSS-202A/PAT-202 PORTION OF SCHEMATIC	TA	CAC	2/91
C	910043-1	REMOVED CONNECTOR NUMBER DESIGNATIONS	TA	CAC	5/91

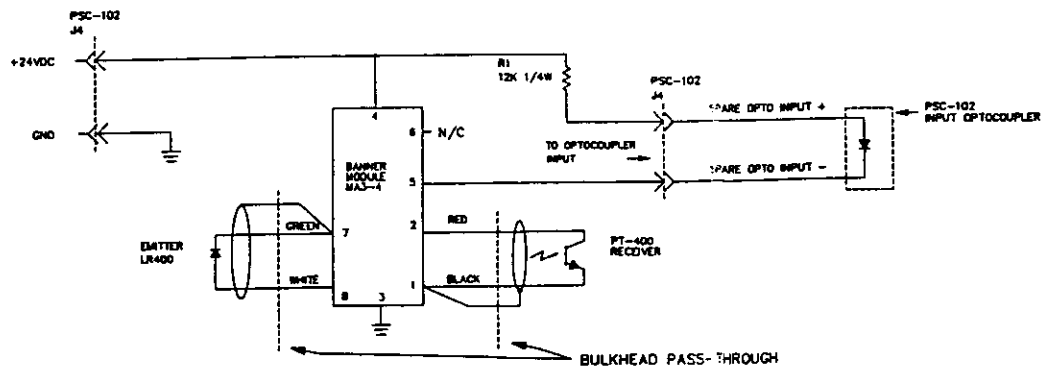


NOTE: PSC-102 CONTROLLER CONNECTIONS PRIOR TO 1/20/91. THE MB3-4 OPTICAL AMPLIFIER WAS USED.

QTY	P/N	DESCRIPTION
1	60456-3	BANNER LR400 EMITTER
1	60456-2	BANNER PT400 RECEIVER
1	74002	BANNER MB3-4 AMPLIFIER
1	74002-1	RB08 SOCKET (MINARIK)
1	14714B-505	POWER SUPPLY ASSEMBLY

NOTE: PSC-102 CONTROLLER CONNECTIONS AFTER 1/20/91. THE MA3-4 OPTICAL AMPLIFIER IS USED.

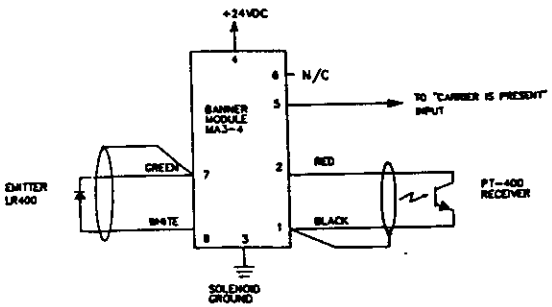
QTY	P/N	DESCRIPTION
1	60456-3	BANNER LR400 EMITTER
1	60456-2	BANNER PT400 RECEIVER
1	74002-3	BANNER MA3-4 AMPLIFIER
1	74002-4	RS8 SOCKET
1	60105-42	12K 1/4W RESISTOR



NOTE: ON IPA TYPE SRD's, THE PT-400 AND LR-400 (RECEIVER AND EMITTER CABLES) PASS THROUGH A BULKHEAD GROMMET/SEAL. THE MA3-4 MODULE WILL BE PLACED IN THE POWER ENCLOSURE RATHER THAN IN THE SPINNER AREA.

NOTE: PSS-202A OR PAT-202 CONTROLLER CONNECTIONS AFTER 1/20/91. THE MA3-4 OPTICAL AMPLIFIER IS USED.

QTY	P/N	DESCRIPTION
1	60456-3	BANNER LR400 EMITTER
1	60456-2	BANNER PT400 RECEIVER
1	74002-3	BANNER MA3-4 AMPLIFIER
1	74002-4	RS8 SOCKET



CUSTOMER	SEMITOOL	KALISPELL, MT	
S/O 16879	CARRIER PRESENT DETECTOR		
REF MASTER			
REF SCHEMATIC			
REF ASSEMBLY	BY	DATE	DRAWING NUMBER: 14186 C
PRELIMINARY	DRAWN TA	12/14/87	
AS BUILT	ENGR		SCALE: NONE
REF E.R.	APPROVED		SHEET 1 OF 1