

PS-525

Pitot-Static/Air Data Tester



OPERATION AND MAINTENANCE MANUAL

For Models PS-525 and PS-525A

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Revision 0, September 15, 2006

PRESTON PRODUCTS

PS-525/PS-525A

USER AND MAINTENANCE MANUAL

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WARRANTY AND LIABILITY STATEMENT

Preston Products warrants its products against defects in workmanship and material under normal, intended use for a period of two years from the date of purchase. The batteries are warranted for a period of 90 days from the date of purchase. Valves are warranted for a period of 180 days.

If the product was not purchased directly from Preston Products (i.e., through a distributor or other means), a proof of purchase and a warranty registration is required before any warranty will be honored. **Preston Products will not service any units without the proper documentation on file.**

Preston Products' limit of liability shall be to repair or replace the product at their discretion. Transportation shall be pre-paid to the Preston Products factory or authorized service facility. Preston Products shall not be liable for any consequential damage expense.

This warranty shall be void if the product has been repaired or altered in any way that adversely affects its performance or reliability. This warranty shall be void if the product has been subject to abuse, misuse, contamination, negligence, accident, shipping damage, or improper operation.

Preston Products reserves the right, at its own discretion, to make changes in materials, designs, finish, or specifications, without obligation to install or incorporate such changes in products previously manufactured.

This warranty shall, at Preston Products' option, become void if the ownership is changed, unless the prior owner or proposed owner obtains written approval of continuation of coverage prior to the change of ownership.

Preston Products reserves the right to revise this manual and to make changes to content from time to time in the content thereof, without obligation to notify any person of such revision.

CHAPTER 1

GENERAL INFORMATION

Description of the PS-525 Pitot-Static Test Box

The PS-525 Air Data, pitot-static test box is a digital display tester used to test aircraft altimeters, airspeed indicators, pitot-static systems, and other vacuum and low-pressure devices. This test box incorporates transducer sensor technology that is largely immune to the failures and costly repairs associated with analog instruments.

The PS-525 is battery powered, and portable. The vacuum and pressure sources are derived from independent internal pumps, and each has its own reservoir, thus eliminating the complexity and maintenance of an additional pressure/vacuum selector valve. The tester can simulate pressure and vacuum suitable for up to 35K ft (for the PS-525 models), (50K ft for the PS-525A models) and 500 Knots.

The PS-525 measures altitude in feet and meters. Airspeed is displayed in miles-per-hour and knots. Vacuum and pressure are also selectable in various units of measure, including inches Hg, milliBars, mm Hg, and Psia.

The PS-525 also includes an internal digital encoder reader. This reader can measure encoder outputs from -1200 feet to 62,700 feet. Inputs can be selected from either gray code or RS232.

- **Pressure Sensors**

The sensors used in the PS-525 test box are proprietary transducer sensors assembled by Preston Products. Both sensors are identical. The pitot sensor is not a differential pressure sensor as is most typically used. Instead, the pressure information from the static sensor is sent digitally to the airspeed's microprocessor, where it is subtracted mathematically from the pitot pressure, thus giving the differential pressure value. This design eliminates several components, with their associated costs and maintenance. The sensors are theoretically capable of giving altitude in 1.5 feet increments. An averaging algorithm is used to filter the sensed value, giving altitudes in increments of 5 feet, or 1 meter. This increment of 5 feet is four times the resolution of a standard mechanical altimeter.

A heating element is incorporated in each sensor. This element maintains the sensor at a stable temperature between 55 and 75 degrees Celsius for optimum stability. The numbers displayed while the unit is initializing upon powering up is the difference between the actual temperature of the sensor and 50 degrees C, multiplied by 100. The PS-525 will not begin to operate until the sensor reaches this operating temperature (50 degrees C). The delay is generally less than 1 minute, but will vary depending on the initial temperature of the sensor when it is powered.

The sensor has an overpressure rating of 10 times the normal range.

SPECIFICATIONS

Digital Altimeter:

Range – model PS-525: -1000 to 35,000 feet (-305 to 10,700 meters)

Range – model PS-525A: -1000 to 50,000 feet (-305 to 15,240 meters)

Resolution: 5 feet (1 meter) increments

Sensor Accuracy: approximately 0.025 %

Temperature range: 30 degrees F to 125 degrees F (-1 C to 51 C) limited by LCD display

Altitude units: Feet or Meters

Other Measurement Units:

inHg (inches of mercury): 0.295 to 32.48

mBar (milli bars): 10 – 1100

PSIA (pounds/square inch): 0.145 to 15.95

mm HG (millimeters of mercury): 7.5 - 825

Digital Airspeed:

Range: 18 – 500 Knots, 34 – 920 KPH, or 21 – 575 MPH

Resolution: 1 MPH, 1 KPH, or 1 Knot

Sensor Accuracy: approximately 0.025%

Temperature range: 30 degrees F to 125 degrees F (-1 C to 51 C) limited by LCD display

Other Measurement Units:

inHg (inches of mercury): 0.295 to 32.48

mBar (milli bars): 10 – 1100

PSI (pounds/square inch) 0.145 to 15.95

mm HG (millimeters of mercury): 7.5 – 825

E.P.R. (engine pressure ratio): 0.07-6.00

Display Type: LCD

Display Size:

Altimeter and Airspeed: 99 x 24 mm

Decoder display: 38 x 16 mm

Physical:

Dimensions: 10.5”D X 14.25”L X 10”H (27x35x25 cm)

Weight: approximately 20 lbs (9 Kg)

Power Source:

24 VDC (from a 110 VAC adaptor) 12/24 VDC (from internal rechargeable batteries)

Current draw: Display only: 275 mA initial, 125 mA after initial warm-up

370 mA with vacuum pumps operating

320 mA with pressure pump operating

540 mA with all systems operating

Other Features:

Leak test feature: 2 minutes, selectable down to 30 seconds

VSI (vertical speed indicator)

Note: The PS-525 does NOT have the precision required to test RVSM altimeter systems.

- **Power Supply**

The PS-525 power supply consists of an external transformer with an output of 24 volts DC. This supply is plugged into the round connector on the left-hand side of the tester. The transformer will charge the two 12-volt lead acid batteries that are internal to the PS-525. The batteries enable the test box to be used in a portable fashion, without a need for external power while the tester is in operation. The test box can be used while charging, if so desired.

The PS-525 incorporates a trickle-charge circuit that will maintain the batteries at optimum voltage if left charging continuously, and will not over-charge.

A battery monitoring circuit is also incorporated. This circuit disconnects the motors if the battery voltage drops below 18 VDC. This enables the display to continue working, and prevents the user from having the display suddenly blank out if the voltage goes too low when a motor is turned on. The decoder display will flash a “Low Battery” warning when the battery voltage is near 18.5 volts. The purpose behind this circuit is to protect the batteries from excessive discharges.

The “Select Code” button may be pressed to toggle the decoder display to a setting that will read the battery voltage (not the voltage going to the encoder). This enables the operator to maintain awareness of the battery voltage level.

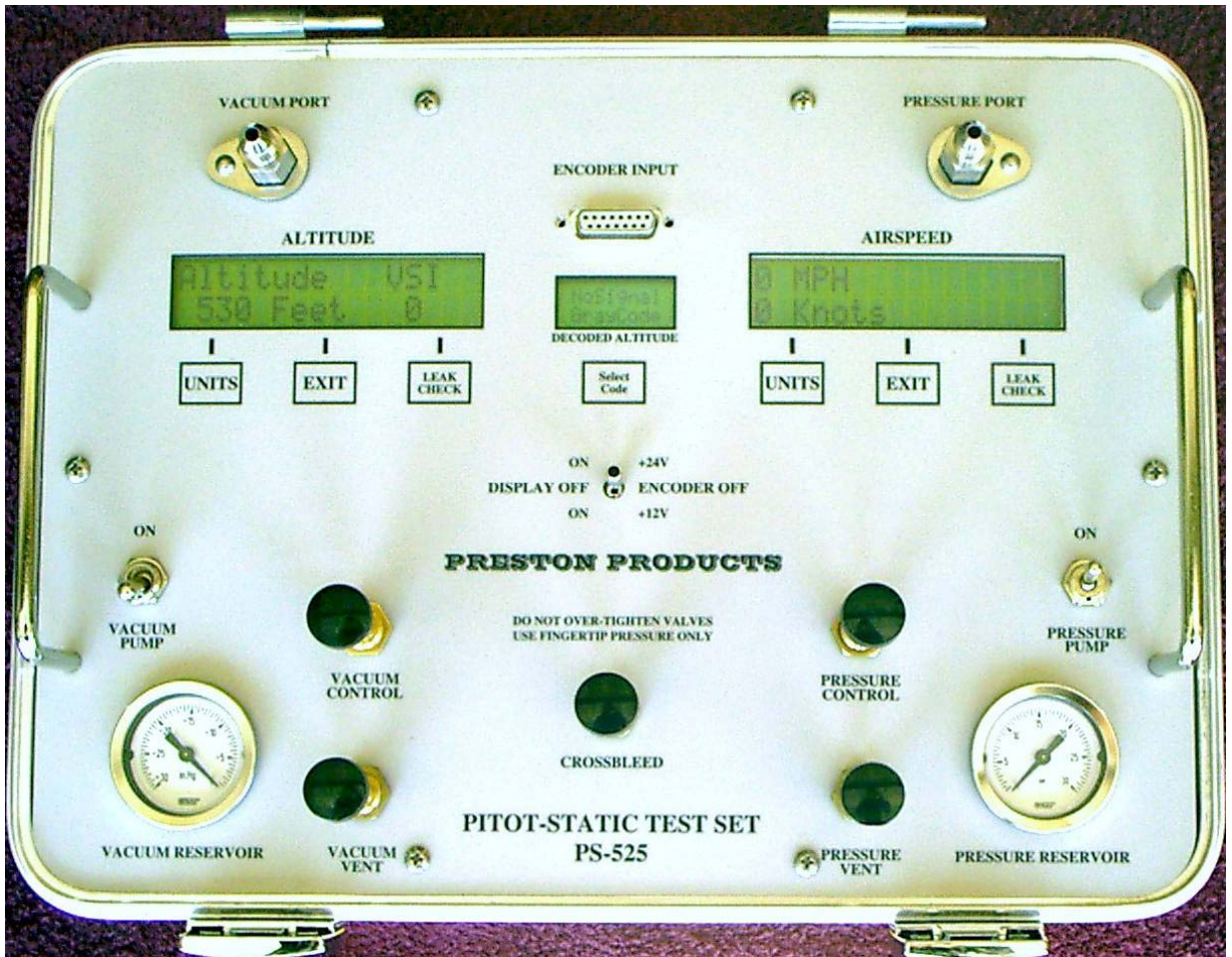
The useable charge duration of the batteries will vary, mostly depending on how long the vacuum and pressure pumps are left on. In order to obtain maximum charge durability, as well as longer pump and battery lives, it is recommended that the pumps be left on only for the amount of time needed to charge their respective reservoirs, as shown in the gauges. Then, the pumps can be cycled on and off as needed. When used properly, the user should be able to obtain several hours of operation directly from the batteries, before needing to re-charge. In factory tests, with fully charged batteries, the batteries lasted for about 18 hours when powering only the displays.

- **Vacuum and Pressure Pumps**

The vacuum side uses two pumps, connected in series to achieve a vacuum level equivalent of 35,000 feet. (The PS-525A model may have 3 pumps in series, or some other combination, to reach 50,000 feet.)

The pressure side uses one pump, which is sufficient to reach all the pressure necessary for normal tests.

FRONT PANEL LAYOUT



Front Panel Description

- The front panel's **Altimeter** buttons function as follows:

The **UNITS** button is used to toggle between the various units of measurement available from the vacuum/altimeter section. (Altitude – feet, Altitude – meters, inHg, mBar, mmHg, PSIA)

The **EXIT** button is used to exit out of the leak check mode.

The **LEAK CHECK** button is functional only when in the Altimeter mode. Pressing this button will begin a 120 second timer, and the display will also show the gain or loss of altitude experienced during the displayed time period. If the operator wishes to select a different length of time, the Leak Check button may be pressed repeatedly, which will cause a reduction in the timer counter in 30-second increments. The timer will not toggle above 120 seconds nor under 30 seconds.

- The front panel's **Airspeed** buttons function as follows:

The **UNITS** button is used to toggle between the various units of measurement available from the pressure/airspeed section. (Airspeed – MPH, knots, inHg, mBar, mmHg, PSIA, EPR)

The **EXIT** button is used to exit out of the leak check mode.

The **LEAK CHECK** button is functional only when in the Airspeed mode. Pressing this button will begin a 120 second timer, and the display will also show the gain or loss of airspeed experienced during the displayed time period. If the operator wishes to select a different length of time, the Leak Check button may be pressed repeatedly, which will cause a reduction in the timer counter in 30-second increments. The timer will not toggle above 120 seconds nor under 30 seconds.

- The front panel's **Select Code** functions as follows:

Upon initial power application, the decoder will always default to the Gray Code function. Pressing the Select Code button will cause the decoder to toggle through the following functions, after which it will return to the Gray Code function again:

- Battery voltage (used to monitor the voltage level of the tester's internal batteries). This is not necessarily the voltage going to the encoder, which is selected by the power switch.
- 1200 Baud rate, from Port A (pin 14 of front encoder connector)
- 1200 Baud rate, from Port B (pin 7 of front encoder connector)
- 2400 Baud rate, from Port A (pin 14 of front encoder connector)

- 2400 Baud rate, from Port B (pin 7 of front encoder connector)
- 9600 Baud rate, from Port A (pin 14 of front encoder connector)
- 9600 Baud rate, from Port B (pin 7 of front encoder connector)

Note: The **Power Switch** may be toggled up or down. Either position will turn on the test box. The only difference is that in the UP position the switch will transfer 24 VDC to the encoder connector (pin 8), and in the DOWN position the switch will transfer 12 VDC to the encoder connector (pin 8). The position of this switch does not change the voltage going to the display circuitry, which always operates at 24 VDC.

CHAPTER 2

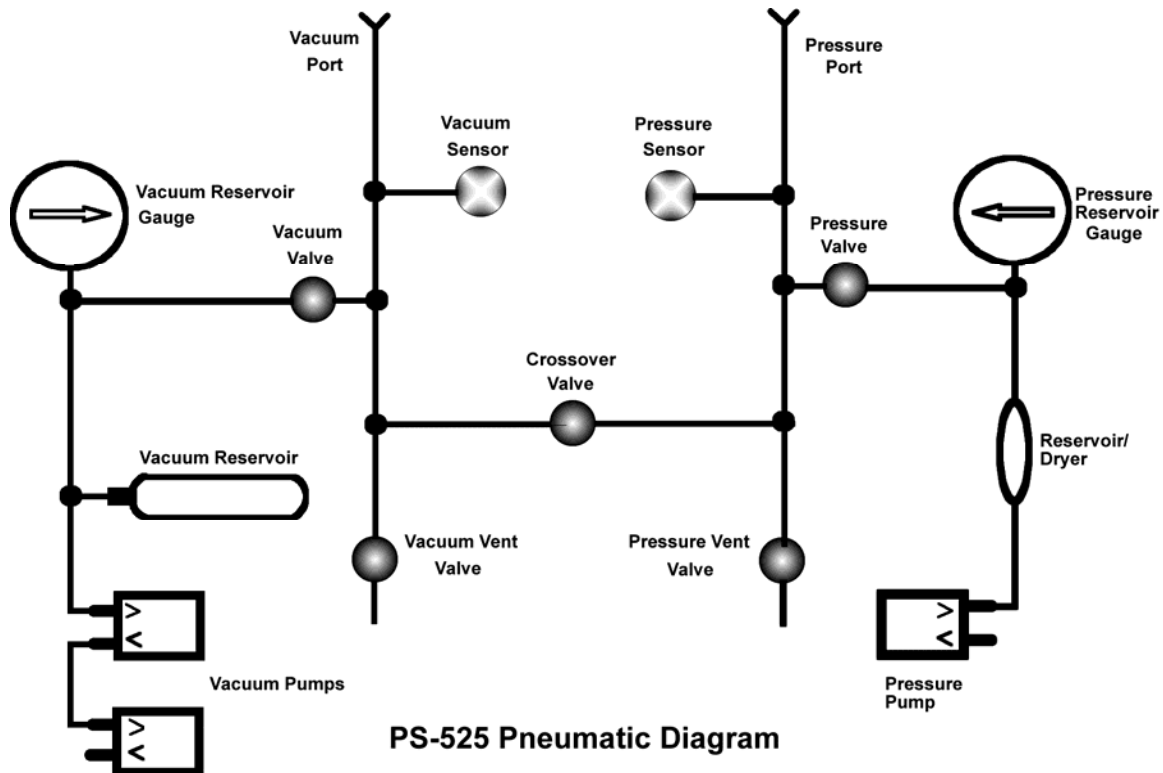
THEORY

The PS-525 test box consists of two vacuum pumps linked in series, one pressure pump, reservoirs for the pressure and vacuum, a system of metering valves, and digital displays for indicating altitude, airspeed, and various other pressure measurements, based on pressures sensed in the sensor transducers.

- **Pneumatic Theory**

Metering valves allow the operator to control the rate of flow of the air from the pressure or vacuum sources, exiting out through the vacuum and pressure ports. The vent valves allow for metering the produced vacuum or pressure back into the atmosphere. One crossover valve permits the operator to isolate the pressure and vacuum sides, or to allow the balancing of pressures, or even to reverse the normal flow of pressures.

The two round gauges allow the operator to monitor the level of pressure or vacuum that is stored in the tester's reservoirs. The switch corresponding to the pump for each reservoir can be toggled to increase the reservoir's level of vacuum or pressure.



When the operator wishes to simulate an altitude, the Crossover, Vacuum, and Vacuum Vent valves are gently closed. The vacuum pump is then energized until sufficient vacuum is in the reservoir, as indicated on the Vacuum Reservoir Gauge. How much

vacuum will be needed depends on the desired altitude, and is also affected by how long the tubing and lines are between the test box and the altimeter. **The vacuum and pressure reservoir gauges serve only as general references of reservoir vacuum and pressure; they are not used in the actual calibration of any instrumentation, and do not require calibration.** Once sufficient vacuum is obtained in the reservoir, the pump is turned off, and the Vacuum Valve is gently opened to allow air to be suctioned into the system. Once sufficient altitude simulation is obtained, the Vacuum Valve is gently closed. Reduction in altitude is accomplished by gently opening the Vacuum Vent Valve, and allowing atmospheric air pressure to enter into the lines.

If the operator needs to go to an altitude below atmospheric pressure, pressure must be introduced into the pressure reservoir. Opening the Crossover Valve will enable pressure to flow from the pressure reservoir to the altimeter. Open the Crossover valve, and then the Pressure valve to pressurize the vacuum side.

Similarly, when an airspeed is to be simulated, the Crossover, Pressure and Pressure Vent valves will first be closed, until the operator establishes a pressure build-up in the pressure reservoir by turning on the pressure pump. Then the Pressure Valve will be gently opened, allowing air pressure to flow to the airspeed indicator. To reduce pressure, the Pressure Vent valve is opened to leak the air pressure into the atmosphere.

- **Electronic Theory**

The main circuit board of the PS-525 incorporates all the electronics for the altimeter, decoder, and airspeed indicators. The switch on the top of the circuit board allows the operator to select encoder power as being either 12 or 24 Volts DC. Each of the three circuits utilizes its own microcontroller and power supply. The power for the altimeter, airspeed, and decoder circuits is regulated from the 24 VDC to 5 VDC and 3.3 VDC. Toggling the switch between 24 VDC and 12 VDC will have no effect on the power going to the altimeter, airspeed, and decoder circuits.

The sensors used in the PS-525 test box are proprietary transducer sensors assembled by Preston Products. Both sensors are identical. The pitot sensor is not a differential pressure sensor as is most typically used in airspeed measurements. Instead, the pressure information from the static sensor is sent digitally to the airspeed's microprocessor, where it is subtracted mathematically from the pitot pressure, thus giving the differential pressure value. This design eliminates several components, with their associated costs and maintenance. It also allows the Altimeter side to be used at any altitude, with the Crossover valve closed, without damaging the airspeed sensor.

Warning: Even though the independent pressure sensor will not be damaged due to a high differential pressure between the vacuum and pressure sides, damage can still occur in external instruments connected to the test box.

- **Electrical Theory**

Two lead-acid batteries provide the power to the PS-525 test box. These batteries are charged via the power connector on the side of the test box. Full charging time is about 10 hours, although the test box can be used while it is being charged.

The two batteries provide a voltage output of either +12 or +24 Volts DC. This allows the operator to switch between the voltages, depending on which type of encoder is being tested.

An electrical schematic of the test box and the power supply board is located in the Repairs and Troubleshooting chapter.

- **Decoder Reader Theory**

A front panel connector is available to allow the monitoring of encoded altitudes as reported from various types of encoders. This encoded altitude may be read simultaneously with the altimeter readings, in order to calibrate the two systems to read in unison. Various cables may be fabricated to enable the operator to connect any of the current encoders to be tested with the PS-525 test box.

The reader circuit will convert Gray Code and RS 232 in speeds of 1200, 2400, and 9600 baud, into alpha-numeric symbols for the operator to read. The operator may choose which code and which port to use by pressing the “Select Code” button beneath the decoder display. The power switch on the front of the test unit allows the operator to select either +12 or +24 volts for the encoder’s power.

The decoder defaults to Gray code upon powering up. Pressing the “Select Code” button once will change the display to read the battery voltage (not the voltage going to the encoder). This enables the operator to maintain awareness of the battery voltage level.

The pin-out of the connector is as follows:

Pin #	Function	Pin #	Function
1	D4	10	B4
2	A1	11	C1
3	A2	12	C4
4	A4	13	C2
5	B1	14	RS 232 input # A
6	strobe ground	15	power ground
7	RS 232 input # B		
8	+12 or +24 volts		
9	B2		
10	B4		

CHAPTER 3

OPERATION

- **Preliminary Information**

Prior to using the PS-525 tester, the user should familiarize himself with the unit by reading this manual and operating the tester independently of any other devices.

The test procedures described in this manual are general in nature, for reference use only. The operator may substitute these procedures with others, as applicable to the tests to be performed, or according to other specific documentation.

Upon powering up the test set, the Altimeter and Airspeed displays will indicate that the system is initializing, by showing a countdown as the heating elements of each sensor are reaching their intended temperature. These elements maintain the sensors at a stable temperature between 55 and 75 degrees Celsius for optimum stability. The numbers displayed while the unit is initializing upon powering up is the difference between the actual temperature of the sensor and 50 degrees C, multiplied by 100. The PS-525 will not begin to operate until the sensor reaches this operating temperature (50 degrees C). The delay is generally less than 1 minute, but will vary depending on the initial temperature of the sensor when it is powered.

Be very gentle with the precision metering valves. Do not close these valves with unnecessary force, or internal damage to valve seating will occur.

- **Pre-Testing**

Pre-test the static system of the PS-525 test box according to the following steps:

1. Ensure the PS-525 is not connected to any external hoses or devices.
2. Close the Vacuum Control, Vacuum Vent, Pressure Control, and Pressure Vent valves. Open the Crossover valve.
3. Cap the Vacuum Port and the Pressure Port. Turn on the power, and then turn on the Vacuum Pump switch until the Vacuum Reservoir gauge reads approximately -15 inHG.
4. Once the initialization is complete on the Altimeter display, gently open the Vacuum Control valve to make the Altimeter section climb. This climb may be done rapidly without damage to the sensor.
5. When the Altimeter reads at least 18,000 feet, gently close the Vacuum Control valve.
6. Wait for about 30 seconds for internal pressures to stabilize. Then press the Leak Check button three times (to count down for 60 seconds).
7. The leak check function will activate and begin to monitor the leak rate. Verify that the PS-525 does not leak exceeding 100 feet per minute. Write down the leak

rate for future reference. (Subtract this value from the leak rate when testing the aircraft, to arrive at the aircraft's leak rate.)

8. Gently open the Vacuum Vent valve to bring the test box back to ground (ambient) pressure.

Pre-test the pressure system of the PS-525 test box according to the following steps:

1. Ensure the PS-525 is not connected to any external hoses or devices.
2. Close the Vacuum Control, Vacuum Vent, Pressure Control, Crossover valve, and Pressure Vent valves.
3. Cap the Pressure Port. Turn on the power, and then turn on the Pressure Pump switch until the Pressure Reservoir gauge reads approximately 10 PSI.
4. Once the initialization is complete on the Airspeed display, gently open the Pressure Control valve to make the Airspeed section climb. This climb may be done rapidly without damage to the sensor.
5. When the Airspeed reads at least 300 knots, gently close the Pressure Control valve.
6. Wait for about 30 seconds for internal pressures to stabilize. Then press the Leak Check button three times (to count down for 60 seconds).
7. The leak check function will activate and begin to monitor the leak rate. Verify that the PS-525 does not leak exceeding 2 knots per minute. Write down the leak rate for future reference. (Subtract this value from the leak rate when testing the aircraft, to arrive at the aircraft's leak rate.)
8. Gently open the Pressure Vent valve to bring the test box back to ground (ambient) pressure.

Testing Aircraft Pitot System Only

1. Connect the Pressure Port to the aircraft Pitot system.
2. Close Pressure Control, Pressure Vent, and Crossover valves. Open Vacuum vent valve.
3. Turn power on for the PS-525 test box.
4. Turn Pressure Pump switch on until the Pressure Reservoir indicates 10 PSI or more.
5. Gently open Pressure Control valve until desired speed(s) are achieved.
6. Compare the airspeed of the PS-525 box to the airspeed indicated in the aircraft.
7. Go to approximately 75% of the maximum airspeed of aircraft indicator (or the speed specified by the manufacturer). Close the Pressure Control valve and after allowing a few seconds for stabilization, perform a leak check. The pitot system should not leak more than two knots per second, plus the leakage previously noted in the pressure system pre-test.
8. Gently open the Pressure Vent valve to return the pitot pressure to ambient pressure.

Testing Aircraft Static System

Note: If the previous pitot system test indicated an excessive leak, do not proceed until that leak is repaired. Damage to aircraft airspeed indicator could result.

1. Connect the Vacuum Port to the aircraft static port, and the Pressure port to the aircraft Pitot system.
2. Set the aircraft altimeter to 29.92 inHg (1013.3 mB).
3. Close Vacuum Control, Vacuum Vent, Pressure Control, and Pressure Vent valves. Open Crossover valve.
4. Turn power on for the PS-525 test box.
5. Operate the Vacuum Pump switch until a desired level of vacuum is seen on the Vacuum Reservoir gauge (generally -15 to -20 inHG).
6. Gently open the Vacuum Control valve to cause the altitude to climb.
7. **DO NOT** exceed the climb rate of the aircraft VSI indicator. It is a very delicate instrument.
8. Climb to the desired altitude(s) per the test to be performed.
9. Close the Vacuum Control valve, and after allowing a few seconds for stabilization, compare the aircraft altimeter with the test box.
10. When at the appropriate altitude (generally 18,000 feet) perform a leak check. If the static system shows leakage, be careful to not exceed the VSI rate. Be prepared to open the Vacuum Control valve if needed, to prevent excessive VSI indication.
11. Gently open the Pressure Vent valve to return the system pressure to ambient pressure.

Note: if an altitude lower than ambient pressure is desired, do steps 1-4 above. Then operate the Pressure Pump switch to charge the pressure reservoir. Gently open the Pressure Control valve to pressurize the system, thereby causing the altimeter to decrease in altitude. Open the Vacuum Vent valve to return to ambient pressure.

- **Using the E.P.R. function**

The EPR function is used to test engine pressure ratios. This ratio is the mathematic result of: High Pressure/Low Pressure. The PS-525 test box will display the low pressure, the high pressure (both in PSI), and the resulting EPR. To use the EPR function, proceed as follows:

1. Close all of the valves, including the Crossover valve.
2. Connect the Vacuum port to the low pressure to be tested.
3. Connect the Pressure port to the high pressure to be tested.
4. Turn on the test box and cycle through the Units on the Airspeed side until in the EPR mode. Read the EPR values displayed.

Note: Do not exceed 16.75 PSI on the high pressure side, to avoid sensor damage.

CHAPTER 4

CALIBRATION PROCEDURES

Calibration interval for the PS-525 test box is one year. If at any time during regular use the unit becomes unreliable or out of correct operating calibration, it must be repaired and/or re-calibrated before continuing its use.

The PS-525 test box is easy to calibrate. There are 7 set points used in the calibration. This enables the altimeter to have a greater degree of accuracy, allowing it to self-correct to the nearest calibrated set point.

The altimeter side should ALWAYS be calibrated first, as the airspeed side reads the static pressure through the altimeter circuitry.

Connect the battery charger during calibration for maximum voltage stability.

Altimeter Calibration Procedures

1. Apply power to the PS-525 display and allow unit to warm up for a *minimum* of 15 minutes.
2. Gently close the Vacuum Control valve, Vacuum Vent valve, and Crossover valve.
3. Connect a known altitude pressure standard to the Vacuum Port.
4. Set the PS-525 altimeter measurement units to read in mbar.
5. Press the Exit button. The display will change to:
Temp XX.X C
Calib? No Yes
6. Before proceeding, view the Temperature in the display. This is the sensor's temperature. It should be stable, fluctuating no more than +/- 0.1 degree C. There is no prescribed temperature where the heater will stabilize, but it will be between 55 and 75 degrees C. (The heater is self-regulating and is separate from the sensor. There will be some variation between sensor temperatures. The important thing is not to have the sensor at a specific ideal temperature, but rather that the temperature is stable when the calibration is done.)
7. Press the Leak Check button to proceed with calibration, or select the Exit button to exit out of the calibration mode without any changes being made.

8. At this point the display will read:

Goto 500 feet

Entr Cal Exit

9. Using the pneumatics of the PS-525 or the attached pressure standard, go to a pressure of 500 feet (referenced from 29.92 inHg), as read from the pressure standard. When the altitude is stable for approximately 15 seconds, press the Units button to enter the calibration value. After entering the value, the display will change to say **Goto 5500 feet**. (Or, the operator may exit the calibration by pressing the Leak Check button.)

10. Repeat the procedure in step 9 at each requested altitude: 5500, 10500, 15500, 20500, 25500, and 30500 feet. (PS-525A models will have additional altitudes of 35500, 40500, and 45500 feet.)

11. After the last calibration point has been entered, the display will briefly read **“Storing New Cal”** and then re-start from the very beginning of the program as if the unit had just been turned on.

12. While bringing the PS-525 box back down to ground level pressure, test each calibration point as specified in the chart. Enter the corrected value at each point. (The correction chart may be photocopied, cut out, and fixed to the test box for handy reference.)

Maximum allowable error at any altitude is 50 feet. (Generally, a maximum error of 25 feet should be expected.)

TEST ALTITUDE	DISPLAY ALTITUDE	TEST ALTITUDE	DISPLAY ALTITUDE
- 1000		10000	
0		12000	
500		14000	
1000		16000	
1500		18000	
2000		20000	
3000		22000	
4000		25000	
6000		30000	
8000		35000	

Calibrated by: _____ Date: _____
Next Calibration Due Date: _____

Airspeed Calibration Procedures

Note: *Ensure the altimeter side is calibrated first!*

1. Apply power to the PS-525 display and allow unit to warm up for a minimum of 15 minutes.
2. Gently close the Pressure Control valve, Pressure Vent valve, and Crossover valve.
3. Connect a known pressure standard to the Pressure Port. (The airspeed calibration is done by direct pressure measurement, and not in a differential pressure mode.)
4. Press the Units button to set the airspeed measurement units to read in mbar.
5. Press the Exit button. The display will change to:
Temp XX.X C
Calib? No Yes
6. Before proceeding, view the Temperature in the display. This is the sensor's temperature. It should be stable, fluctuating no more than +/- 0.1 degree C. There is no prescribed temperature where the heater will stabilize, but it will be between 55 and 75 degrees C. (The heater is self-regulating and is separate from the sensor. There will be some variation between sensor temperatures. The important thing is not to have the sensor at a specific ideal temperature, but rather that the temperature is stable when the calibration is done.)
7. Press the Leak Check button to proceed with calibration, or select the Exit button to exit out of the calibration mode without any changes being made.
8. At this point the display will read:
Goto 995.00 mBar
Entr Cal Exit
9. Using the pneumatics of the PS-525 or the attached pressure standard, go to a pressure of 995.00 mBar, as read from the pressure standard. When the pressure is stable for approximately 15 seconds, press the Units button to enter the calibration value. (Or, the operator may exit the calibration by pressing the Leak Check button.)
10. After the 995.00 calibration point has been entered, the display will briefly read "**Storing New Cal**" and then re-start from the very beginning of the program as if the unit had just been turned on.
11. Verify that the PS-525 returns to the same mBar reading as the standard.

13. When a satisfactory calibration is obtained at this test point, go through each test point in the following chart, and enter the corrected value at each point. (The correction chart may be photocopied, cut out, and fixed to the test box for handy reference.)

Maximum allowable error at any airspeed is 2 MPH. (Generally, a maximum error of 1 MPH should be expected.)

TEST AIRSPEED	DISPLAY AIRSPEED	TEST AIRSPEED	DISPLAY AIRSPEED
40 Kts		250 Kts	
60 Kts		275 Kts	
80 Kts		300 Kts	
100 Kts		325 Kts	
120 Kts		350 Kts	
140 Kts		375 Kts	
160 Kts		400 Kts	
180 Kts		425 Kts	
200 Kts		450 Kts	
225 Kts		500 Kts	

Calibrated by: _____ Date: _____
 Next Calibration Due Date: _____

Calibration Notes:

- Do not forget to wait the minimum of 15 minutes before calibrating.
- The calibration procedure can be entered only when the mbar mode is selected.
- Do not forget to check bead colors in the air pressure reservoir/dryer. If they are pink, it is time to change the unit in order to avoid a build-up of moisture in the pressure system.

Decoder Reader Calibration

There is no calibration necessary for the encoder reader circuitry. The Gray Code values are derived from look-down charts based on the input of the attached altitude encoder. Serial values are displayed based on the serial information that is sent from the altitude encoder to the decoder.

If proper operation needs to be verified, the following tests may be performed to show that each Gray Code input pin is working. Jumper each of the following pins, or combination of pins to ground (pin 15) and read the values as shown below:

Pin(s)	Display
11	-800 ft
12	-1200 ft
13	-1000 ft
1, 11	62300 ft
3, 11	14300 ft
4, 11	6300 ft

5, 11	2300 ft
2, 11	30300 ft

Warning: Do not jumper pin 8 to ground, as this pin is the 12 or 24 VDC output. This will blow the fuse on the internal circuit board, and possibly more fuses on the power supply board. This may also create enough heat to burn the operator.

To verify proper operation of the serial codes, an altitude encoder will need to be connected and configured to test the various speeds and inputs.

Calibration of Reservoir Gauges

The reservoir gauges are for reference only, and do not need calibration. The operator merely references these gauges as an indication of how much reserve pressure or vacuum there is in the reservoirs, and as a guide to know when to turn on the pump(s).

CHAPTER 5

MAINTENANCE REPAIRS AND TROUBLESHOOTING

Note: Refer to the Theory of Operation section as a reference on how the various systems function.

Annual Maintenance

The following annual maintenance is recommended:

1. Checking color of beads in air reservoir/dryer. Change if needed.
2. Feel fuses to verify tightness. If a fuse feels loose, remove the fuse, squeeze fuse clip slightly and re-install fuse. (There are 3 fuses on the power supply board and 1 on the main circuit board.)
3. Tug on motors to verify motors are mounted tightly. If play is noticed, disconnect batteries and connectors. Remove bottom assembly panel by removing the rubber feet on bottom of case. Tighten the motor mount screws and re-assemble bottom panel in case.
4. Verify rubber feet on bottom of case are tight (do not over-tighten).
5. Verify vacuum reservoir tank is mounted tightly.
6. Verify connectors are seated completely.
7. Verify battery holding clamp is tight.
8. Verify switches and valves on front panel are mounted tightly.
9. Test for leaks.
10. Perform calibration checks, and re-calibrate if necessary.

- **Troubleshooting**

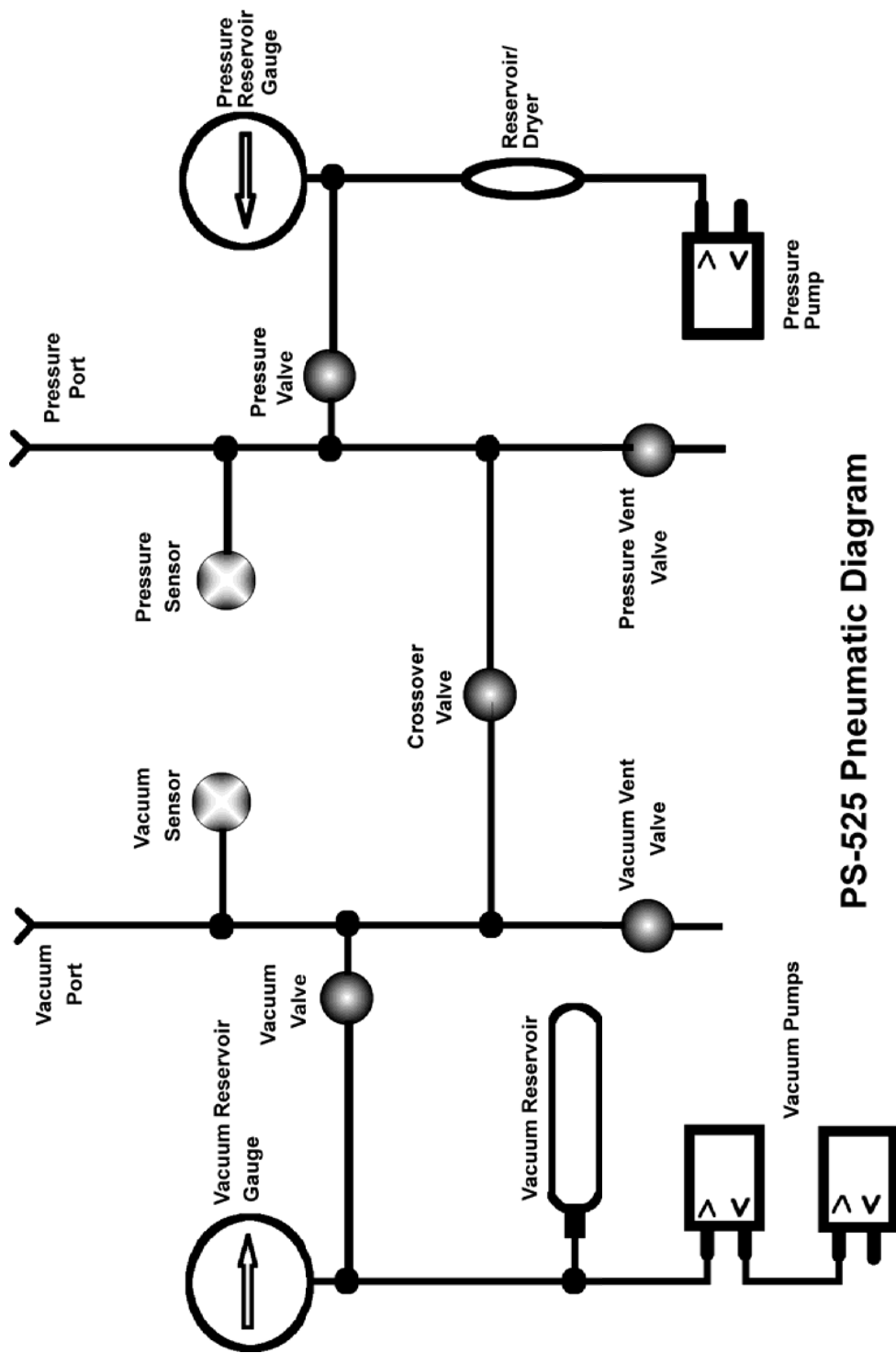
Refer to the following chart of symptoms, causes, and repair comments:

SYMPTOMS	POSSIBLE CAUSES	COMMENTARY
Display shows garbage	Microcontroller had a power brown-out	Re-cycle power switch. If problem occurs frequently, it may be caused by a loose or dirty internal connector.

		Check connectors to batteries and circuit boards. Also check for loose fuses.
Display never finishes initializing	<ol style="list-style-type: none"> 1. Bad heating element in sensor. (Not likely.) 2. Low battery 3. If occurring on airspeed side, it is not receiving static pressure from vacuum sensor. 	<ol style="list-style-type: none"> 1. The MTBF of the heating element used is 33 million hours. A heater solder joint, or the sensor's temperature sensor circuitry may have failed. 2. Re-charge battery. (The altimeter & airspeed circuits should function down to approximately 6 volts.) 3. A short delay is normal due to the individual speeds of heating rates of sensors upon initial power-up. Since airspeed is based on differential pressure, the airspeed side will not begin to display airspeed until it receives the static pressure values from the vacuum sensor. Press the Units button to display pressure in another measurement. Then cycle back to airspeed display. Or, just wait until warm-up is complete.
Display restarts when a pump switch is toggled	Electrical interference is affecting microcontroller	The capacitor across the pump switch terminals is defective or making poor contact. Replace or re-connect capacitor.
Decoder flashes "LOW BATTERY"	Battery voltage is low	<ol style="list-style-type: none"> 1. Connect charger. 2. If voltage is still low, or charge is rapidly lost, there is a defective battery. Test the voltage level across each battery and replace the battery with the lowest voltage. (Better still, replace both batteries.) 3. A fuse may be blown or loose on the power supply board.

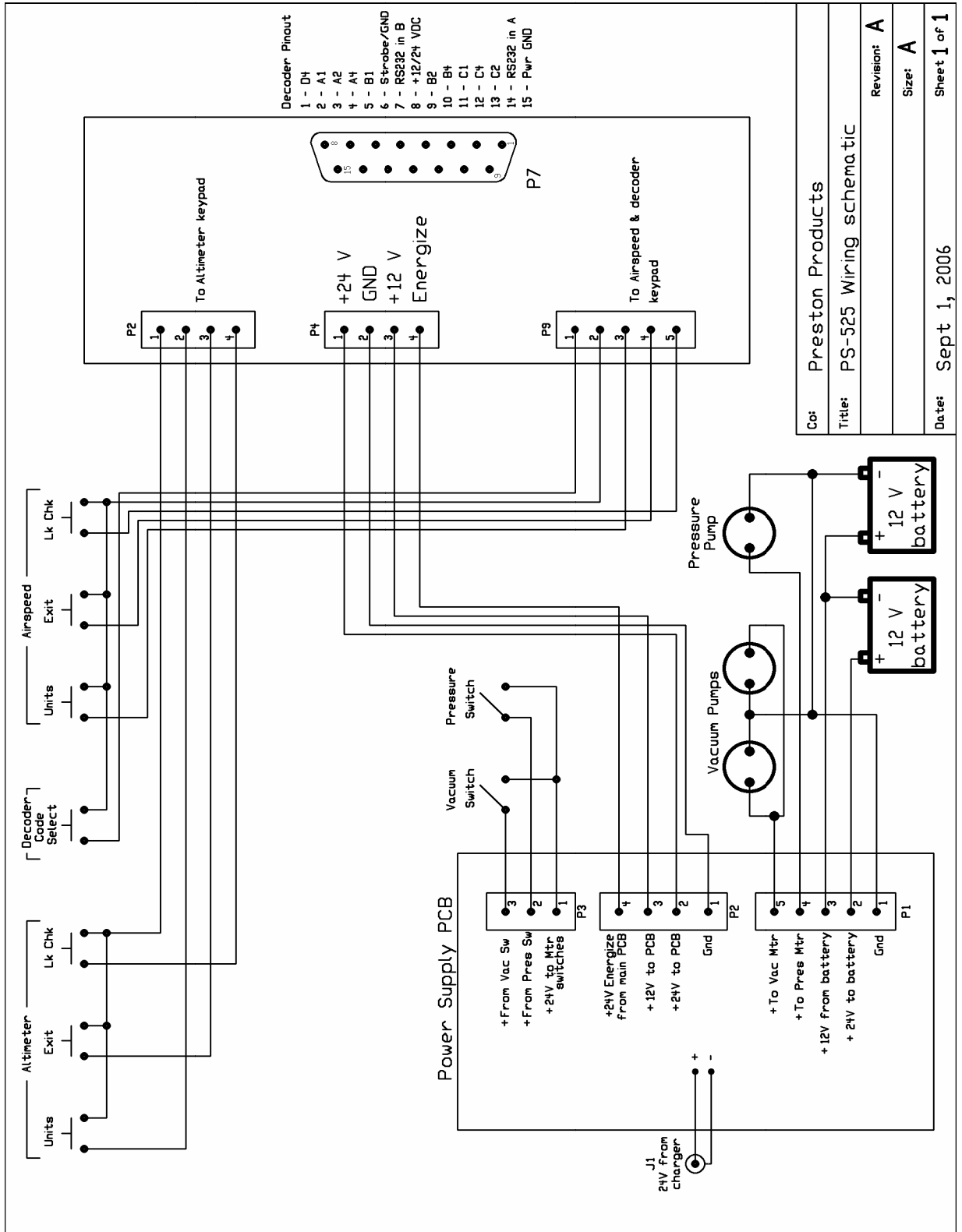
Motors do not work	<ol style="list-style-type: none"> 1. Low battery voltage 2. Bad fuse 3. Bad switch or connectors 4. Bad solder joint on motor 5. Bad motor(s) 6. Bad relay 	<ol style="list-style-type: none"> 1. The relay on the power supply board will disconnect power to the motors when voltage drops below 18 volts. This is to protect battery life. (See Chapter 1 – Power Supply) 2. Replace fuse(s) 3. Check switches and connectors. Replace as needed. 4. Repair bad solder joint 5. Replace bad motor(s) 6. Power supply board relay can be replaced.
Displays do not turn on	<ol style="list-style-type: none"> 1. Low voltage 2. Bad fuse(s) 3. Bad wiring or connector 4. Bad power switch 5. Bad voltage regulator 	<ol style="list-style-type: none"> 1. Connect charger. If battery voltage remains low, or charge is rapidly lost, there is a defective battery. Test the voltage level across each battery and replace the battery with the lowest voltage. (Better still, replace both batteries.) 2. Replace fuse(s) 3. Check and repair as needed. 4. Replace power switch. 5. Replace voltage regulator. Note: the Altimeter and Airspeed circuits each have their independent 3.3 volt regulators, and the decoder uses a 5 volt regulator. However, all of the displays operate at 5 volts, taken from the decoder regulator.
Batteries do not take a charge	<ol style="list-style-type: none"> 1. Bad battery(s) 	<ol style="list-style-type: none"> 1. If battery charge is rapidly lost, there is a defective battery. Test the voltage level across each battery and replace the battery with the lowest voltage. (Better still, replace both batteries.)

Batteries do not take a charge (cont'd)	<ul style="list-style-type: none"> 2. Bad power charger 3. Bad fuse 4. Bad power supply circuit 	<ul style="list-style-type: none"> 2. Replace power charger 3. Replace bad fuse 4. Repair power supply circuit (see schematic at end of this chapter).
Display contrasting needs adjustment	Adjust variable resistor behind display.	Each display is adjusted independently.
No signal from known good encoder	<ul style="list-style-type: none"> 1. Fuse is blown on main circuit board 2. Bad decoder circuitry 	<ul style="list-style-type: none"> 1. Replace blown fuse. Note: If encoder works on 24 volts, but not on 12, the problem may be caused by a bad connector, wiring, or the power switch. 2. Contact factory for further troubleshooting or repairs.
Unit will not vacuum up to 35,000 feet	<ul style="list-style-type: none"> 1. Leak in internal hoses or plumbing connectors 2. One motor is inoperative 	<ul style="list-style-type: none"> 1. Troubleshoot plumbing to find leak(s) 2. Replace defective motor

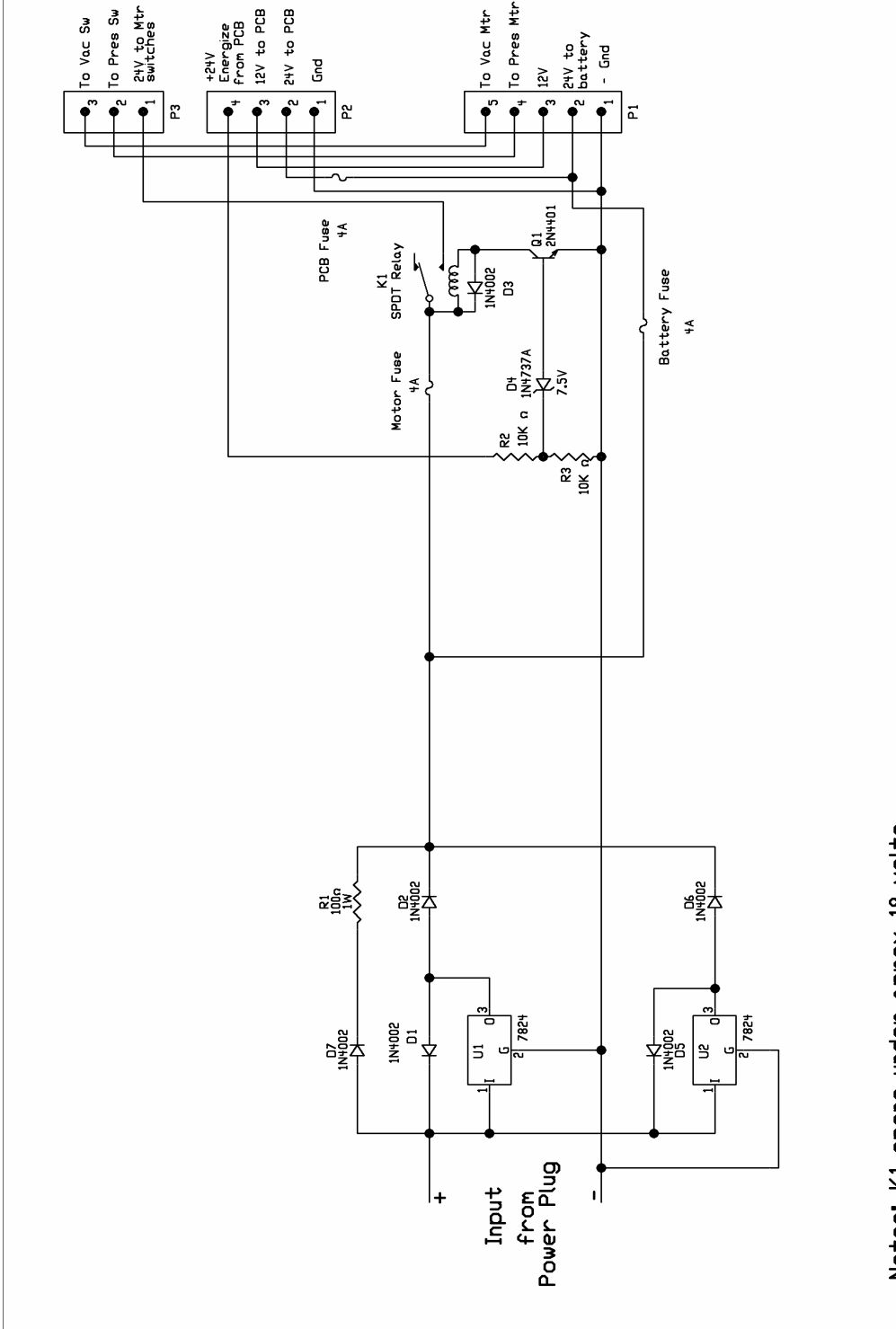


PS-525 Pneumatic Diagram

PS-525 Wiring Schematic



Co:	Preston Products
Title:	PS-525 Wiring schematic
Revision:	A
Size:	A
Date:	Sept 1, 2006
	Sheet 1 of 1



Co:	Preston Products		
Title:	Battery Charger and Protector		
Board:	525-004-01	Revision:	A
Author:	Kevin George		
Date:	May 25, 2005	Size:	A
			Sheet 1 of 1

Notes: K1 opens under approx 18 volts.

CHAPTER 6

SHIPPING AND STORAGE

Shipping Instructions

- Partially open all valves
- Cap the Vacuum and Pressure Ports
- Turn power switches off
- Package the test box inside another box, with at least 2 inches of packing material around the tester
- Do not forget to also enclose the battery charger/power supply

Storage Instructions

- Partially open all valves
- Place lid on tester
- Store the test set in a controlled environment
- If storage is to exceed 1 year, remove batteries from unit