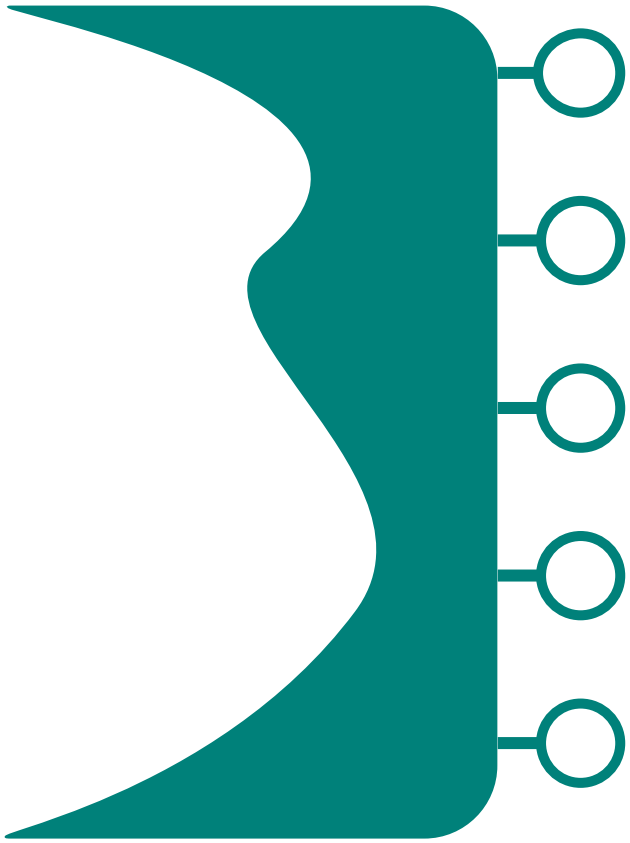
BiPAP® Vision™

Ventilatory Support System



Service Manual

RESPIRONICS INC.®

The BiPAP Vision Ventilatory Support System is the subject of U.S. patents #5148802, #5239995, #5313937, #5433193, and other pending U.S. and foreign patents. BiPAP is a registered trademark of Respironics.

Limited Warranty

Respironics warrants that the BiPAP® Vision™ Ventilatory Support System (BiPAP Vision) shall be free from defects of workmanship and materials and will perform in accordance with the product specifications for a period of one year from the date of sale by Respironics. If the product fails to perform in accordance with the product specifications, Respironics will repair or replace—at its option—the defective material or part. Respironics will pay customary freight charges from Respironics to the dealer location only. This warranty does not cover damage caused by accident, misuse, abuse, alteration, and other defects not related to materials or workmanship.

Respironics disclaims all liability for economic loss, loss of profits, overhead or consequential damages which may be claimed to arise from any sale or use of this product. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty is given in lieu of all other express warranties. In addition, any implied warranty, including any warranty of merchantability or fitness for the particular purpose, is limited to one year. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

The warranty for repairs is 90 days for labor and one year on the part(s) that was replaced.

To exercise your right under this warranty, contact your local authorized Respironics dealer or contact Respironics at:

RESPIRONICS®

1001 Murry Ridge Lane
Murrysville, PA 15668
www.respironics.com

Respironics Deutschland
Gewerbestrasse 17
82211 Herrsching, Germany

Visit Respironics Home Page on the World Wide Web at:

http://www.respironics.com

Table of Contents

Chapter 1: Introduction

Chapter 1: Introduction

1.1 BiPAP® Vision™ Ventilatory Support System Overview

The BiPAP Vision Ventilatory Support System (BiPAP Vision), shown in Figure 1-1, is a microprocessor-controlled, positive pressure ventilatory assist system. The BiPAP Vision incorporates a user interface with multi-function keys, real time graphic displays, and integral patient and system alarms.

The BiPAP Vision features a centrifugal blower to generate airflow, as well as hardware and software platforms that can be upgraded with an oxygen module and additional patient alarms. The system operates in the Continuous Positive Airway Pressure (CPAP), Pressure Support (S/T), and optional Proportional Assist Ventilation/Timed (PAV/T) modes.

The BiPAP Vision contains a variety of integrated safety and self-diagnostic features. All system functions are checked at start-up and during operation. Errors are reported by visual and/or audible indicators.

Pressure regulation is achieved by monitoring proximal airway pressure and adjusting flows accordingly to ensure that the proximal pressure equals the set pressure.

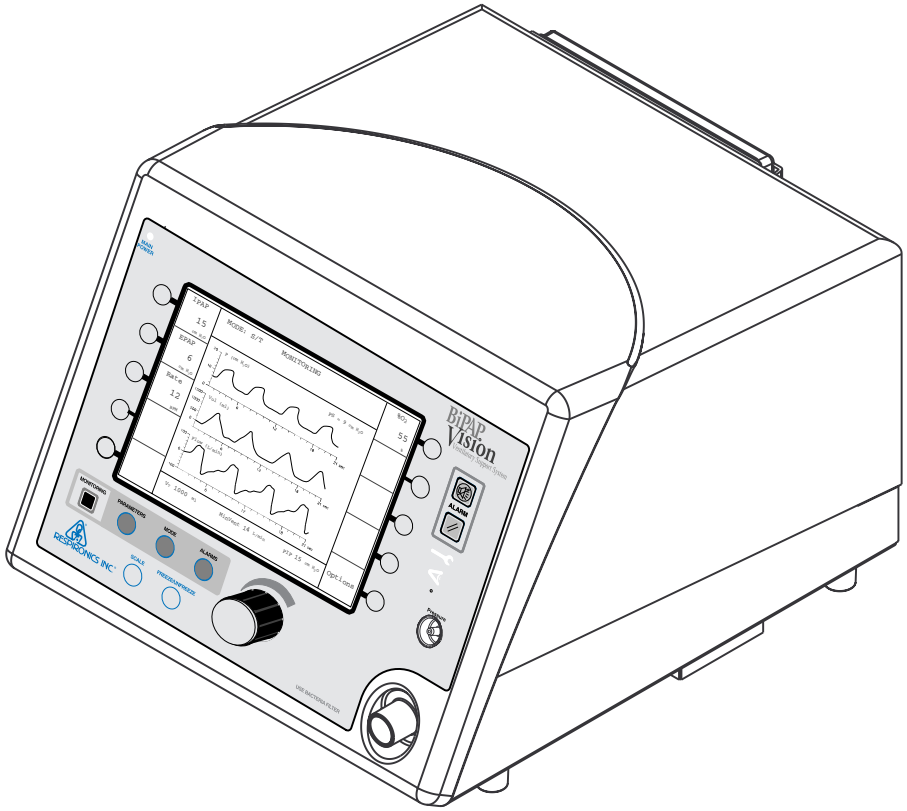


Figure 1-1
The BiPAP Vision Ventilator

1.2 Service Notice

This service manual was prepared by Respironics primarily for use by qualified technicians required to service the BiPAP Vision.

1.3 Technical Support

Respironics is committed to customer satisfaction, and may be contacted with any questions or for technical support at the following numbers:

U.S. and Canada

Phone: **1-800-345-6443**
Fax: **1-800-866-0245**

International

Phone: **1-724-387-4000**
Fax: **1-724-387-5012**

E-Mail **service@respironics.com**

Visit Respironics Home Page on the World Wide Web at:
http://www.respironics.com

Chapter 2: Warnings, Cautions, and Notes

Chapter 2: Warnings, Cautions, and Notes

WARNING: Indicates the possibility of injury.

CAUTION: Indicates the possibility of damage to the device.

NOTE: Places emphasis on an operating or procedural characteristic.

2.1 WARNINGS

2.1.1 Safety

- Do not use the BiPAP Vision in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.
- Oxygen supports combustion. Do not use oxygen while smoking or in the presence of an open flame.
- When using the optional oxygen module, the BiPAP Vision does not provide an oxygen sensor to monitor oxygen concentrations delivered to the patient circuit. Therefore, the use of oxygen with the BiPAP Vision should be monitored through oximetry.

NOTE: Refer to the Clinical Manual for guidelines on Applications and Operation.

2.1.2 Operational

- If the "Ventilator Inoperable" indicator illuminates, refer to Chapter 6 of this manual for troubleshooting guidelines.
- Never attach oxygen tubing or any positive pressure source to the pressure port on the front panel of the BiPAP Vision.

Warnings (Continued)

2.1.3 Service

CAUTION: Electronic components used in this device are subject to damage from static electricity. Repairs made to this device must be performed only in an antistatic, ESD-protected environment.

- Do not attempt to make connection to the diagnostic RS232 connector on the back panel of the BiPAP Vision to obtain repair information while the unit is operating on a patient.
- To assure the safety of the service technician and specified performance of the device, Respironics recommends that only qualified technicians perform repairs to the BiPAP Vision. Contact Respironics Technical Service for service training and authorization information.
- High voltages are present inside this device. To avoid electrical shock, disconnect the electrical supply before attempting any repairs on the device.
- For continued protection against risk of fire, replace fuses with those of the same type and rating only.

2.1.4 Cleaning

- To avoid electrical shock, unplug the BiPAP Vision unit before cleaning it.

2.2 CAUTIONS

- While cleaning the unit, do not allow any liquid to enter the cabinet or the inlet filter.
- Care should be taken to avoid exposing the BiPAP Vision to operating, storage, and transport temperatures near the extremes specified in Chapter 4. If exposed to such temperatures, allow the unit to cool or warm to room temperature before turning it on.
- The unit must be positioned on its base for proper operation.
- Always use an inlet filter when the BiPAP Vision is in use.
- If using the oxygen module, do not exceed 100 psig oxygen supply pressure.

2.3 NOTES

- This device contains a rechargeable nickel-cadmium (NiCAD) battery which is used by the alarms in the event of a power failure.
- Refer to the BiPAP Vision Clinical Manual for a complete list of operational Warnings, Cautions, and Notes.

Additional WARNINGS, CAUTIONS, and NOTES are located throughout this manual.

Chapter 3: Description and Theory of Operation

Chapter 3: Description and Theory of Operation

3.1 BiPAP Vision Ventilatory Support System

The BiPAP Vision is a microprocessor-controlled, positive pressure ventilatory assist system. The system's integral air intake filter draws in ambient air which is then pressurized by the system's centrifugal blower assembly. The In-Line Flow Restrictor (ILFR) valve and Pressure Regulation Valve (PRV), which are both located in the blower discharge airway, regulate total flow and pressure at the blower discharge system. An oxygen module can be installed to add a controlled source of supplemental oxygen, up to 100%, to the patient.

The Pressure Control (PC) board continuously monitors the readings from the Airflow Module (AFM) of total gas flow, temperature, generated pressure, and patient circuit pressure to ensure prescribed therapy to the patient. The PC board transmits process data to the Main Control (MC) board which then provides overall control of the BiPAP Vision, including conveying instructions to the PC board regarding required valve stem position and blower speed.

The unique design and operation of the ventilator makes it especially suited for mask applications. Designed with the BiPAP Auto-Trak Sensitivity™ feature that automatically adjusts to changing circuit conditions, the ventilator is capable of ensuring optimum patient-ventilator synchronicity despite changes in breathing patterns and circuit leaks. (Refer to the BiPAP Vision Clinical Manual.)

A liquid crystal display (LCD) screen is mounted on the front enclosure of the BiPAP Vision. The LCD and the Display Control (DC) board provide the primary user interface with the ventilator, including the visual presentation of data, control features, and visual and audible presentation of alarm conditions. The user interacts with the ventilator through the touch pad and rotation of the rotary encoder while observing the results of this input on the display. The information provided on the display varies depending on the state of the ventilator and / or the operations being performed.

The BiPAP Vision incorporates a number of safety features and self-diagnostic systems. System internal functions are checked automatically at start-up, and periodically throughout normal operation. An audible and visual alarm announces failures of principal subsystems. Integrated patient alarms are also provided and are announced on a visual message display area as well as with an audible tone.

The following sections of this chapter describe in more detail the major subsystems and components that make up the BiPAP Vision and its basic theory of operation.

Subsystem	Function
PSS	The Power Supply Subsystem (PSS) provides DC power to the BiPAP Vision from an AC source.
MC or MCS	The Main Control (MC) board or Main Control Subsystem (MCS) performs all control, data acquisition, and calculations required for the user-selected parameters. In addition, the MC performs the start-up test and reports all errors.
PC or PAS	The Pressure Control (PC) board or Pressure Airflow Subsystem (PAS) controls the blower and valves to generate and regulate the system pressure. The PAS senses the outlet pressure and the patient pressure and regulates the outlet pressure to the patient circuit.
DC or D/CS	Through the touch pad, the Display Control (DC) board or Display/Control Subsystem (D/CS) evaluates user inputs and passes valid parameters to the MC. The DC receives display data from the MC. The DC also has its own internal functions; the results of which are reported to the MC.
AFM	The Airflow Module (AFM), including the mass airflow sensor in the airstream, provides an airflow measurement interface to the PC, allowing the PC to measure total flow, temperature, and system pressure.
ILFR	The In-Line Flow Restrictor (ILFR) valve assembly regulates the total flow from the blower discharge.
PRV	The Pressure Regulation Valve (PRV) assembly is opened during exhalation to allow the patient flow to be exhausted.
OM	The Oxygen Module (OM) subassembly regulates and proportions the oxygen released into the air from the blower according to the oxygen concentration level set on the parameters screen.

BiPAP Vision Block Diagram

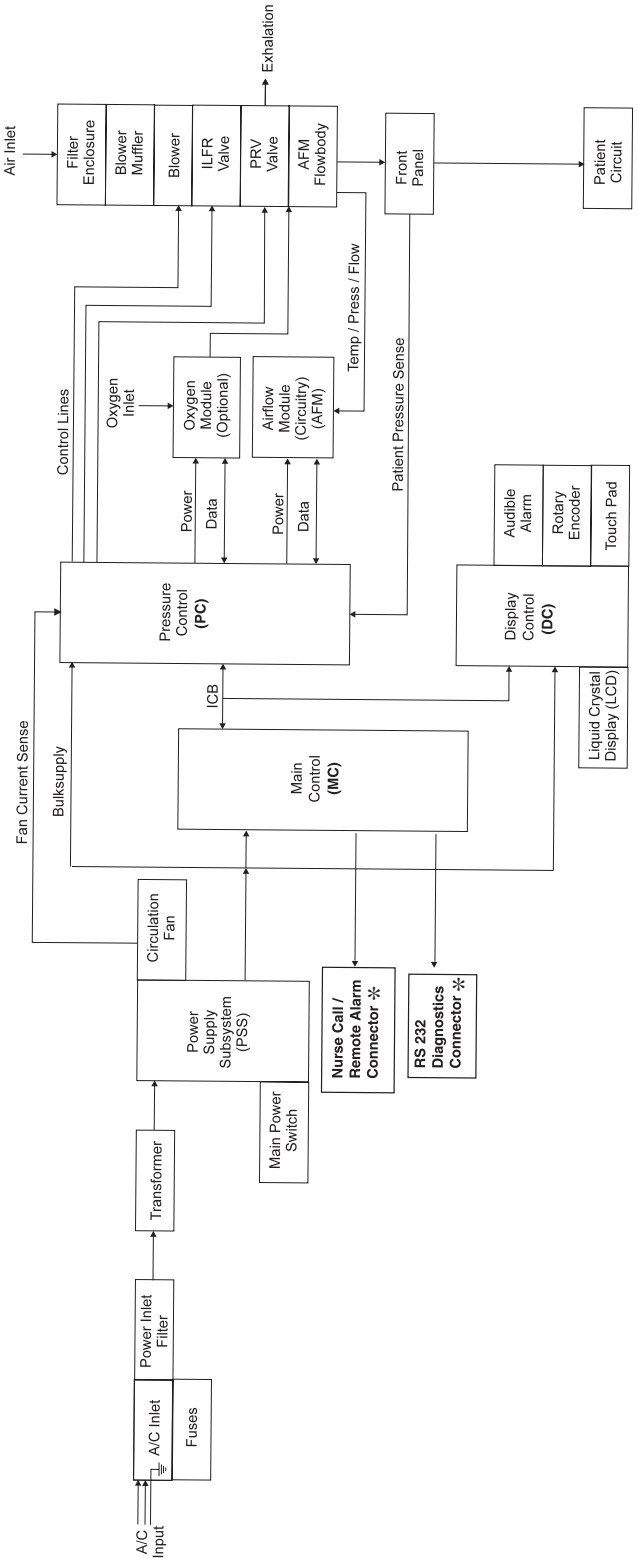
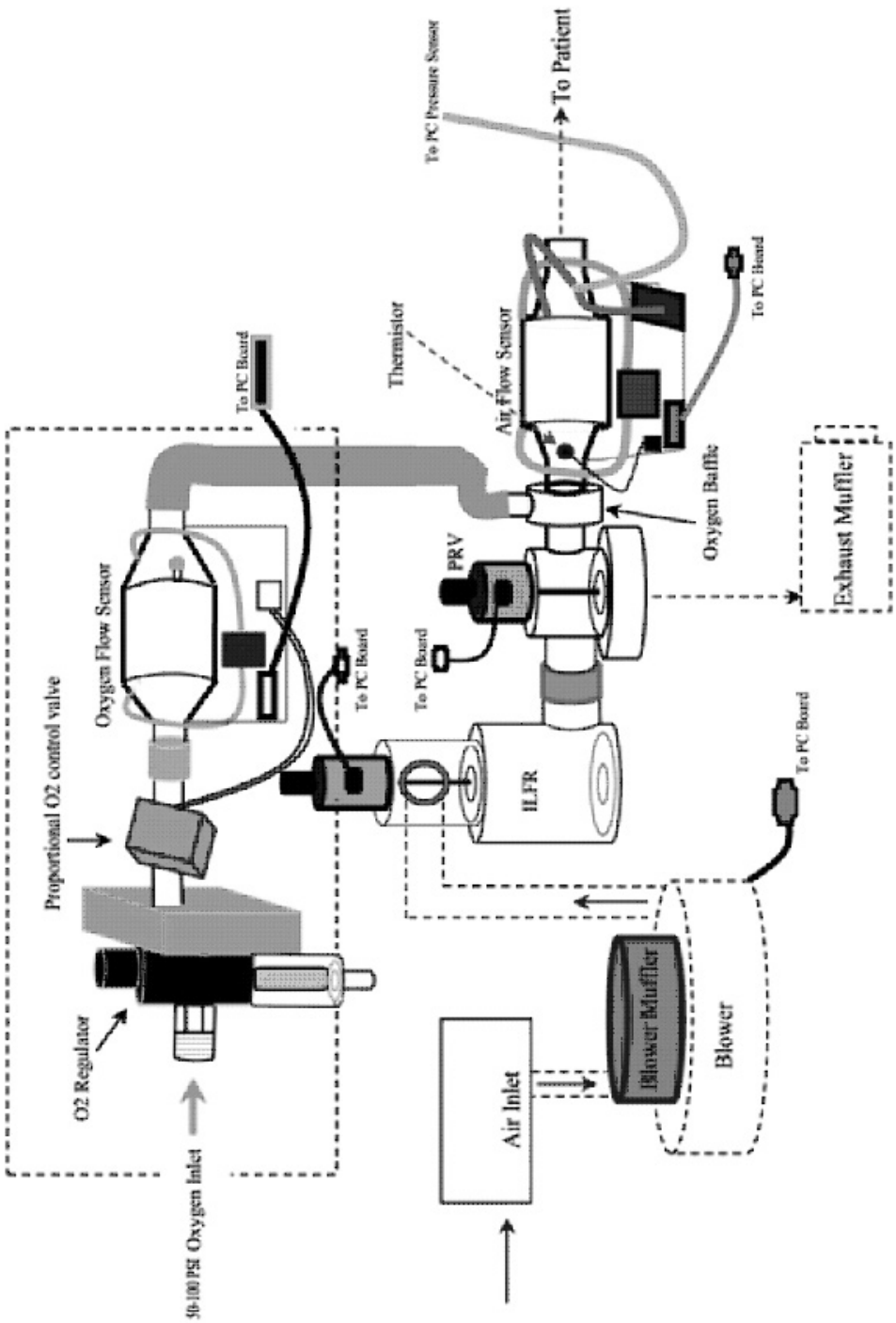


Figure 3-1
BiPAP Vision Block Diagram

* For S/N 106001 and greater

Pneumatics Block Diagram



3.2 Power Supply Subsystem (PSS)

The PSS supplies the Main Control (MC), Pressure Control (PC), and the Display Control (DC) with the proper DC supply voltage. Safety features designed into the circuitry include an overvoltage disconnect, low voltage supply detect, and line loss detect. Other features include "power-on" indicator voltage, circulation fan power, and an On/Off switch connection.

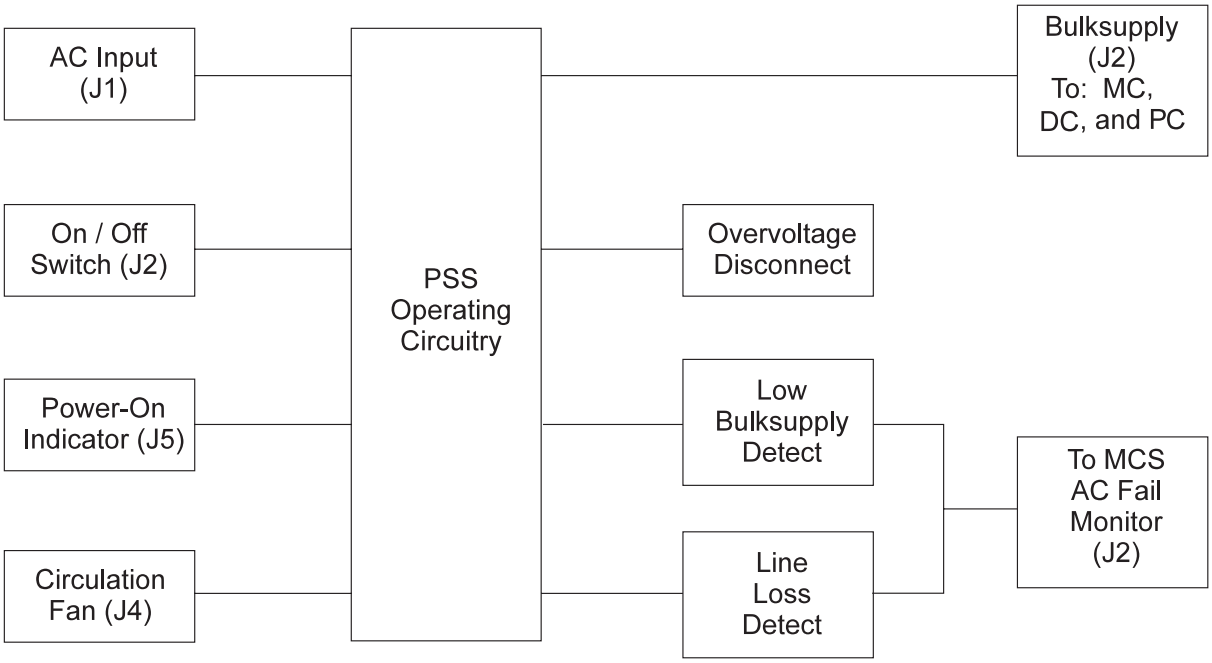


Figure 3-2
PSS Block Diagram

3.2.1 Input Range

The BiPAP Vision can operate with an AC input of 100, 120, 230, or 240 VAC (±10%) depending on the model.

3.2.2 DC Supply

The output DC supply is fused at 30 amps and delivers between 20.6 VDC and 35 VDC with a maximum ripple of 1 vpp (peak-to-peak voltage) to the MC, PC, and DC.

3.2.3 Overvoltage Disconnect

The overvoltage disconnect is used to remove the DC supply output when it exceeds 36 VDC and reconnects it when the level returns to an acceptable value.

3.2.4 AC Fail

The MC module monitors the level of DC supply voltage and the AC voltage output from the transformer supply winding to determine if an AC fail condition exists.

Low DC supply detect – If the DC supply voltage drops to 19.38 VDC or lower (nominal), an AC fail condition will be triggered.

Line loss detect – The AC voltage output from the transformer supply winding is monitored for a loss-of-cycle condition. Both legs of the winding are input to the monitoring circuitry. Whenever AC is lost, the AC fail signal is activated.

3.2.5 Outputs

The PSS module also includes the following:

a. Front panel “power-on” indicator voltage (J5)

b. Circulation fan power (J4)

c. On / Off switch (part of J2)

d. Circulation fan current sense information to (J12) on the PC subsystem.

3.3 Main Control Subsystem (MC)

The MC is microcontroller-based and provides overall system control and supervision by monitoring the activity of all the other system modules and providing commands to these modules based on user and system input. The MC also acts as the bus controller for all subsystem communications using the Intermodule Communications Bus (ICB).

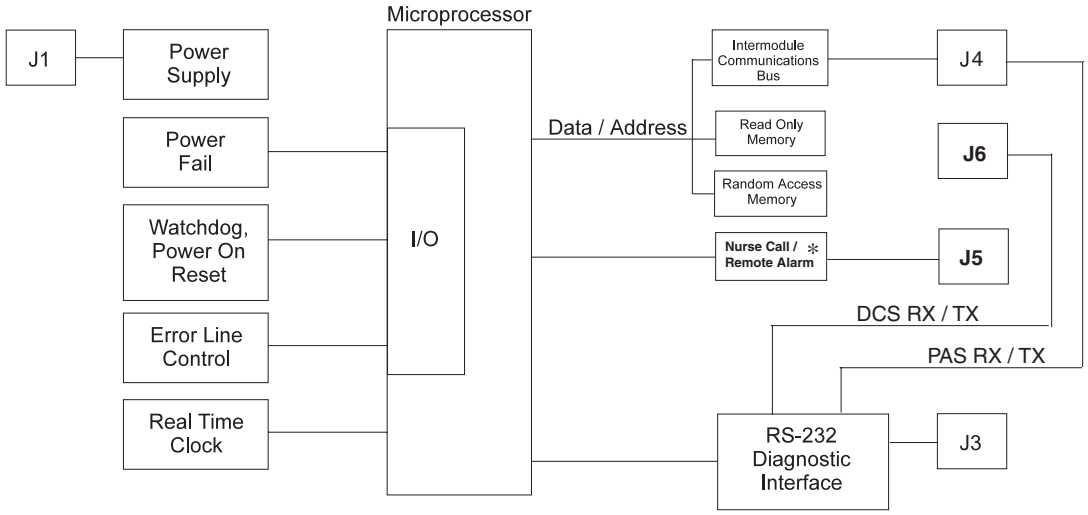


Figure 3-3
MC Block Diagram

* For S/N units >106K

3.4 Pressure Control Subsystem (PC)

The PC functions through a microcontroller to:

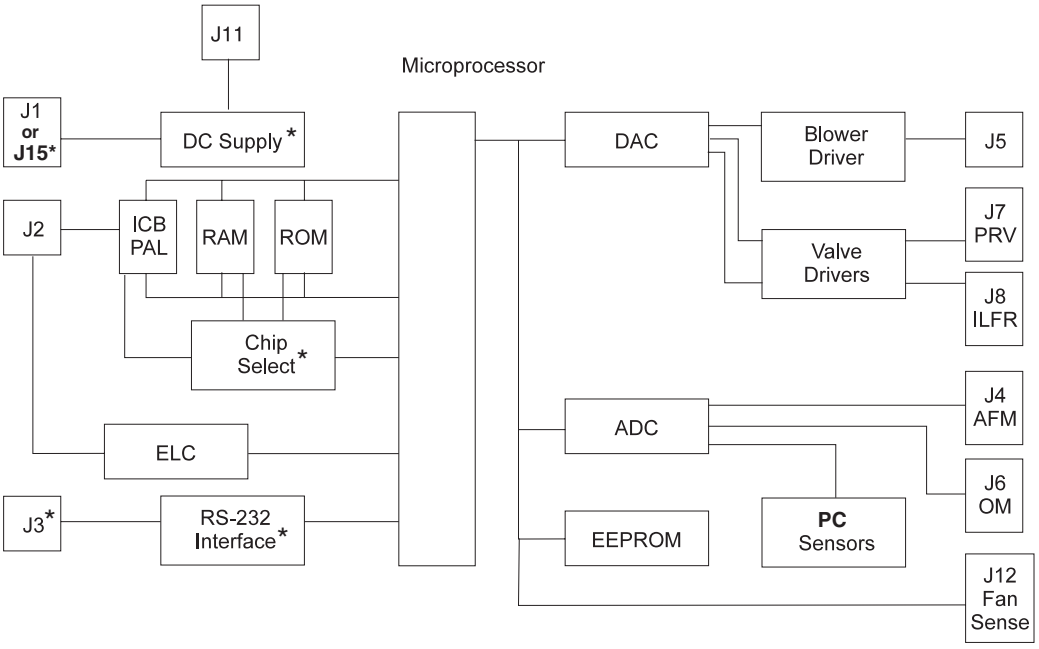
a. Communicate with the Main Controller Subsystem (MC)

b. Communicate to a terminal / PC for diagnostics

c. Acquire sensor data through an Analog-to-Digital Converters (ADC, A / D)

d. Control valves and the blower motor through a Digital-to-Analog Converter (DAC)

e. Respond to or invoke an error signal



*** For Units Serial Number <106K**

Figure 3-4
PC Block Diagram

3.4.1 Microcontroller Interface

Programmable Array Logic (PAL) memory device decodes the chip selects in such a way that the program code is retrieved from the EEPROM and data is retrieved from the RAM. An additional PAL provides the interface for the Intermodule Communications Bus (ICB). The microprocessor monitors: oxygen and gas temperatures; Airflow Module (AFM) and Oxygen Module (OM) detection; In-Line Flow Restrictor (ILFR), Pressure Regulation Valve (PRV), and oxygen valve DAC control voltage; blower DAC control voltage; and power supply and reference voltages.

3.4.2 Blower Motor Drive

The complete motor controller includes closed loop speed control via analog circuitry. When the desired speed and actual speed are known by the processor, the speed is adjusted by increasing or decreasing the DAC converter output to achieve proper pressure and flow.

3.4.3 Pressure Regulation Valve (PRV) and In-Line Flow Restrictor (ILFR) Drives

The valve drives have closed loop control via the microprocessor. The microprocessor reads seven pressure, flow, and temperature sensors through the PC hardware, and receives prescription parameters from the MC. The microprocessor then adjusts analog DAC voltages to control the PRV and ILFR valves as required to meet the prescription.

3.4.4 Pressure Sensors

The PC module has two dual pressure sensors (MT1 and MT2) and a single sensor (MT3). They measure patient pressure, unit outlet pressure, and barometric pressure. These sensors are subject to calibration with their calculated slope and intercept values stored in the on-board EEPROM. MT3 is a backup outlet pressure sensor that provides a redundant check of the primary outlet sensor located on the AFM.

NOTE: Calibration is factory programmed and field adjustment is not required.

3.4.5 Error Line Control (ELC) Circuit

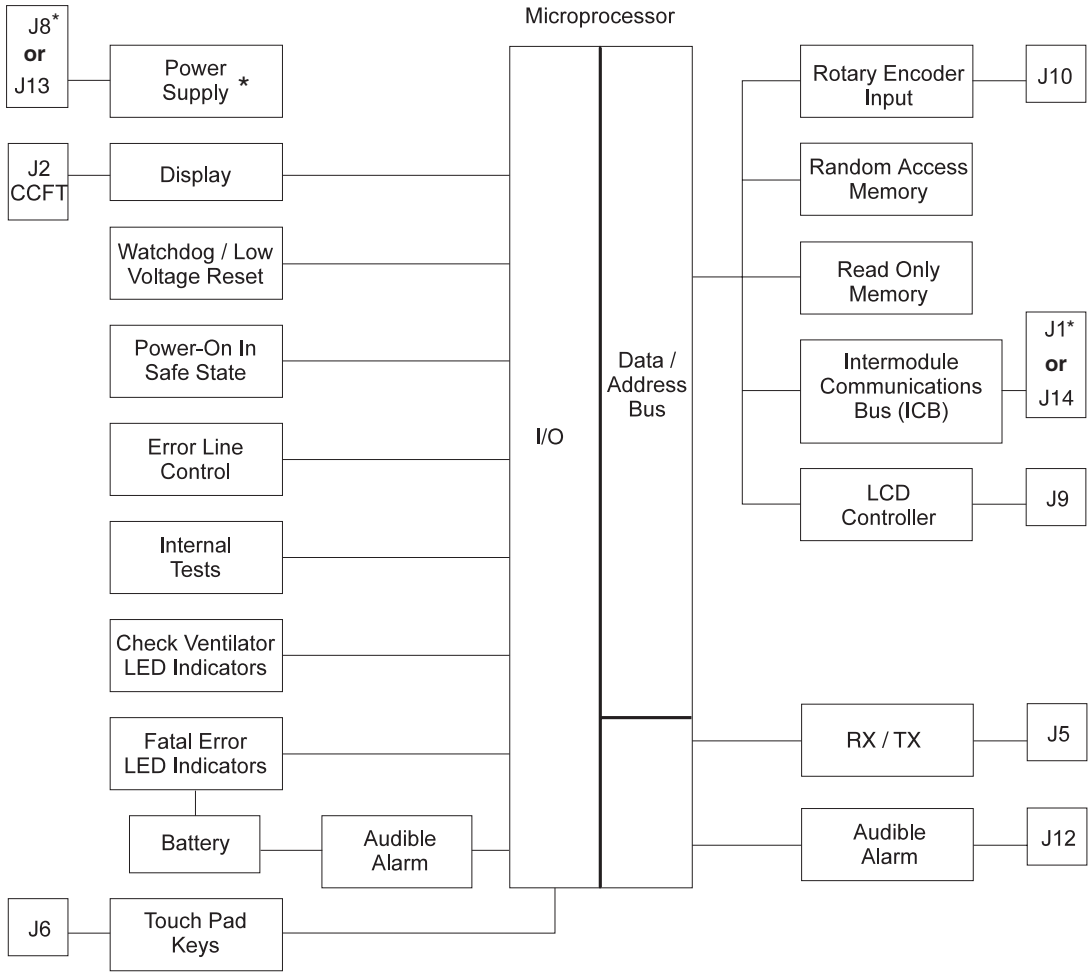
The ELC circuit is designed to simply detect a failure from, or signal a failure to, the MC and Display Control (DC) modules. If the ELC line activates, only a power On / Off of the ventilator can clear this latched circuit state.

3.4.6 Diagnostics Connector

The diagnostic connector (J3) interfaces with the microprocessor to view PC functions and system errors on units from serial number 100500 to 105999, unless upgraded. For units greater than this, the diagnostic connector is on the rear of the unit.

3.5 Display Control Subsystem (DC)

The DC provides a means of displaying the operating mode, measured and calculated operating parameters, parameter setpoints, alarm limits, real-time graphics, and general status information. The DC also provides the necessary user interface controls to modify the operating mode, parameter set points, alarm limits, and graphical scales; and to reset or silence the audible alarm, and freeze or unfreeze graphics. The displays and controls are described in more detail in the following subsections.



*** For Units Serial Number < 106K**

Figure 3-5
DC Block Diagram

3.5.1 DC/DC Converter

The DC/DC converter reduces the +24 VDC bulk supply to a +5 VDC logic level. (S/N <106K)

3.5.2 Display Backlight and Contrast Adjustment

A serial 8-bit D/A converter provides two, 0 to +5 VDC which originate in the MCU for these controls.

3.5.3 Display Voltage DC/DC Converter

This adjustable negative voltage converter reduces the level of bulk supply voltage needed to operate the Liquid Crystal Display (LCD) contrast control.

3.5.4 Cold Cathode Fluorescent Tube (CCFT) Inverter

The DC design has a DC to AC inverter that typically provides 390 VAC to the fluorescent tube in the display through (J2). The current varies to adjust the brightness of the fluorescent tube.

3.5.5 Reference Voltage Checks

This circuit compares reference voltages to determine if they are at the appropriate level.

3.5.6 Power Failure Alarm Battery Enable

This control detects a power failure from the DC supply.

3.5.7 Alarm Battery Voltage Cutout/Check

The battery voltage cutout /check monitors the battery voltage level and cuts it out if it drops to a level of approximately 3VDC.

3.5.8 Backup Battery/Charger

The DC contains a 3.6 V nickel cadmium rechargeable battery that operates the audible and visual alarm indicators for at least 20 minutes, when fully charged, when the Error Line Control (ELC) is active, and the DC supply has been removed. The battery output is compared to a reference voltage and the battery is recharged as required through a charging circuit. If necessary, refer to page 5-12 to recharge the battery.

3.5.9 Check Ventilator Light Emitting Diode (LED) Enable Current Check

An internal test is performed to verify that the Check Ventilator LED current is acceptable.

3.5.10 Vent Inop LED Current Check

An internal test is performed to verify the Ventilator Inoperative LED current is acceptable.

3.5.11 Error Line Control (ELC) Circuits

The DC contains redundant error signaling circuitry to communicate error conditions among the sub-systems. The circuitry's redundant and diverse nature minimizes the chance of communication failures.

3.5.12 Error LED

The error LED indicates that an error condition was detected, and it illuminates to make unit diagnosis easier.

3.5.13 Diagnostic Interface

The diagnostic connector interface (J5) interfaces with the MCU to provide a means for the DC to down-load diagnostic data to a terminal or PC.

3.5.14 EEPROM

A serial EEPROM stores the setpoints for the backlighting and contrast and also for the appropriate diagnostic data.

3.5.15 LCD Controller

The DC circuit contains an LCD controller that interfaces with the display.

3.5.16 Debouncing / Keypad Matrix

The matrix keys are debounced and then the microprocessor scans the matrix to determine what key was depressed.

3.5.17 Rotary Encoder Control

The rotary encoder control circuit detects relative position, direction, and speed of the rotary encoder, all within one detent of movement.

3.5.18 Audible Alarm Activation

The audible alarm is activated by either an input from the ELC, the power fail circuitry, or the test alarm signal from the MCU. It will also occur when the wrong key has been depressed, an adjustable parameter has reached its limit, or the error signal has been activated.

3.5.19 Audible Alarm Current Check

An internal test is performed to verify the audible alarm current is acceptable.

3.5.20 “Power-on“ in Safe State

The DC contains circuitry that causes the hardware to “power-on” in a safe state; which is when the backlight is off, the display is off, and the Intermodule Communications Bus (ICB) is terminated. When the MCU determines that no Vent Inop error exists, it lets the unit resume operation under normal operating conditions.

3.5.21 Watchdog and Low Voltage Reset

The watchdog function has to be periodically reset by the microprocessor if a time-out period has been exceeded. This function is designed to reset the processor if the software gets lost. When a low logic level is detected, the ELC will be activated resulting in a system shutdown.

3.6 Airflow Module (AFM)

The AFM is a submodule of the Pressure Control (PC). The AFM receives power from the PC and provides the following analog signals to the PAS:

a. Gas flow indication

b. Pressure indication

c. Temperature indication

To provide indications accurate enough for system requirements, the AFM must be calibrated. Calibration data is stored in a nonvolatile memory that is part of the AFM. The flow, pressure, and temperature indications are for the ventilator gas stream flowing through a "flow body" attached to the AFM circuit board.

3.6.1 Flow Body

The flow body, with laminar flow element, is added to the ventilator gas stream, creating a small pressure differential to short a fraction of the flow through the AFM sensor. Inlet, outlet, and pressure ports are part of the flow body for tubing attachment to the AFM electronic sensors. Also, a hole is molded into the flow body to position the temperature sensor. The body has molded feet for attaching it to the AFM circuit board assembly.

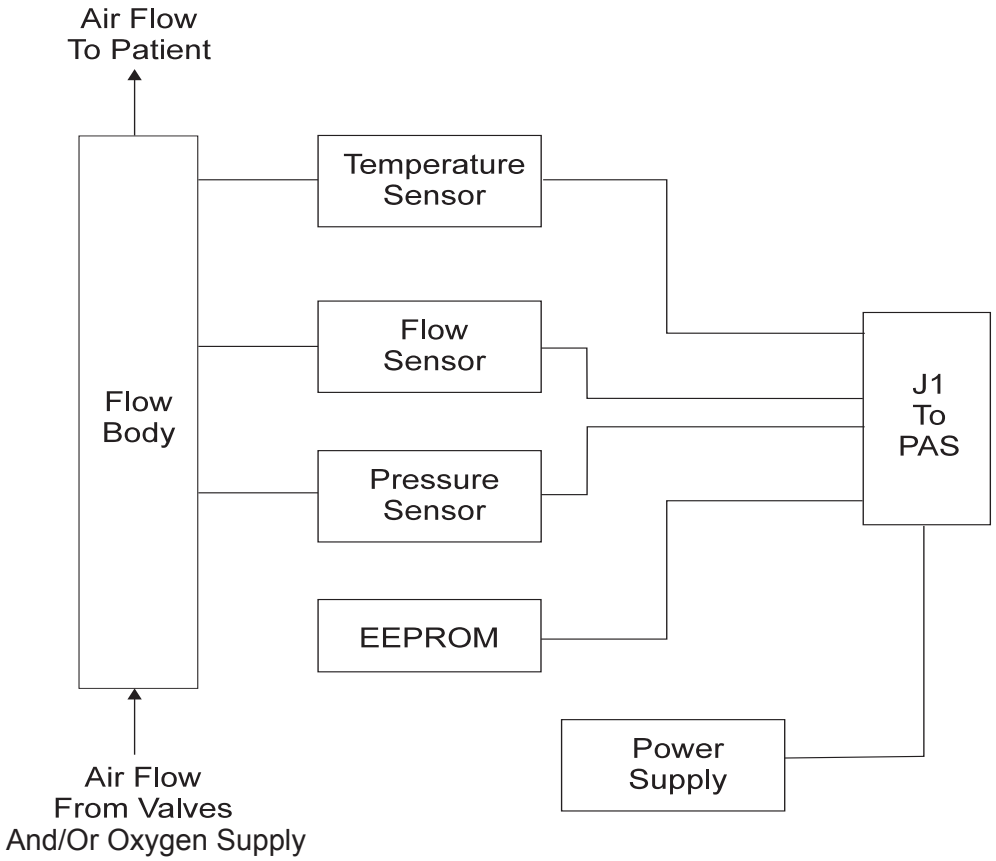


Figure 3-6
AFM Block Diagram

Airflow Module (AFM) (Continued)

3.6.2 Analog Reference

The PC provides the AFM with power in the form of +12 VDC, –12 VDC, analog ground, +5 VDC, and digital ground. An analog voltage reference supply is derived from the +12 VDC to power the pressure and flow sensors so their bridge outputs can be factory calibrated.

3.6.3 Flow Indication

Total gas flow indication is provided by MT1. It is then amplified by an instrumentation amplifier, low-pass filtered, and sent to the PC board for conversion.

3.6.4 Pressure Indication

MT2, a precision compensated pressure sensor, provides unit outlet pressure indication. The sensor is followed by a low-pass filter and a differential amplifier, and then sent to the PC board for conversion.

3.6.5 Temperature Measurement

The temperature is measured using a sensor inserted into a molded hole in the flow body. The BiPAP Vision requires temperature indication to correct air density and detect an undesirable temperature rise in the patient circuit.

3.6.6 Calibration

A data acquisition system, operating on a personal computer, is the control platform for AFM calibration of temperature, pressure, and flow. Correction factors are derived and stored in the AFM module in an EEPROM, with calibration accomplished by balancing the flow transducer bridge with an EEPOT. The PAS uses temperature, pressure, and flow to correct for actual operating conditions. Once calibrated, the AFM is interchangeable with other AFM assemblies.

NOTE: Calibration is factory programmed only.

3.6.7 Module Detection

The PC must know the AFM is connected, since it is required for normal operation of the ventilator. An extra line pulls a PC microcontroller line near zero volts. If the line is above two volts, the AFM is not connected, and the PC will transition to the error state.

3.7 Oxygen Module (OM)

The OM is an optional submodule of the Pressure Control (PC). It receives power from the PC and provides an analog signal to the PC for oxygen flow indication. To provide indications accurate enough for system requirements, the OM must be calibrated. Calibration data is stored in a nonvolatile memory that is part of the OM. The flow indication is for the ventilator pure oxygen stream flowing through a flow body attached to the OM circuit board.

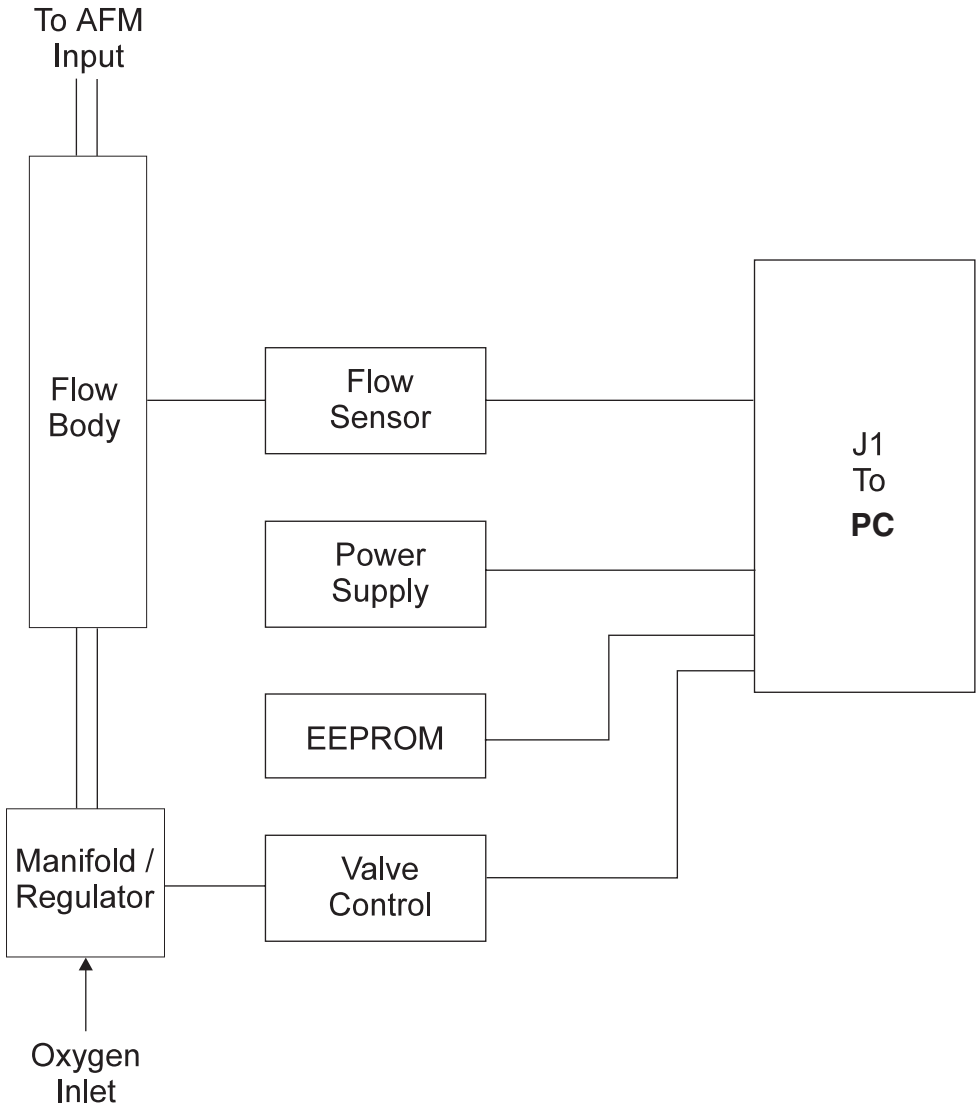


Figure 3-7
OM Block Diagram

3.8 Description of Ventilator Modes

The BiPAP Vision comes standard with two operating modes: Continuous Positive Airway Pressure (CPAP) and Spontaneous/Timed (S/T). A third, optional, Proportional Assist Ventilation/Timed (PAV/T) is also available.

3.8.1 Continuous Positive Airway Pressure (CPAP)

CPAP provides a constant pressure level delivered over the complete range of the patient's spontaneous breathing cycle. Pressure is controlled and maintained. Flow is available to meet changing patient demands and automatically compensate for leaks. The mode delivers the prescribed level of pressure that has been set with the CPAP control (Range: 4 to 20 cm H_2O).

3.8.2 Spontaneous/Timed (S/T)

The S/T mode provides either pressure support during spontaneous breaths or time-triggered, pressure-limited, time-cycled machine breaths.

Spontaneous Breaths

Two pressure levels are set: an EPAP level (range 4 to 20 cm H_2O) to establish a baseline pressure and an IPAP level (range 4 to 40 cm H_2O) that determines the amount of pressure support delivered with each breath (PS = IPAP– EPAP). During the inspiratory phase, the BiPAP Vision responds as necessary to satisfy the patient's flow requirements while maintaining the preset IPAP pressure. Under these conditions, the patient is active in determining inspiratory time and tidal volume. The delivered tidal volume will be dependent upon the pressure differential between the IPAP and EPAP levels, patient effort, and the combined resistance and compliance of the circuit and the patient. If the patient does not actively participate, the BiPAP Vision responds appropriately.

Timed Breaths

The S/T mode can also provide a time-triggered, pressure-limited, time-cycled machine breath, when the spontaneous respiratory rate drops below the Rate control setting. If the ventilator does not detect a spontaneous trigger within the interval determined by the Rate control setting, it will activate a time-triggered machine breath and deliver the IPAP level. Machine breaths are not synchronized with patient effort, and once triggered to IPAP, the balance of the cycle is determined by the Timed Insp. Control setting. A maximum Timed Inspiratory setting of 3.0 seconds can be set, as long as the I:E Ratio does not exceed 1:1, as determined by the Rate setting. For example, see Figure 3-12. If the Rate control is set at 10 BPM, the total respiratory cycle is six seconds. If a spontaneous trigger occurs before the six-second cycle time has elapsed, a spontaneously-triggered, pressure support breath occurs, a timed trigger will not occur, and the timer is reset for a new six second interval. If a six second interval passes without a spontaneous trigger, a timed trigger will be initiated and IPAP will be delivered for the duration of time set by the Timed Inspiration setting.

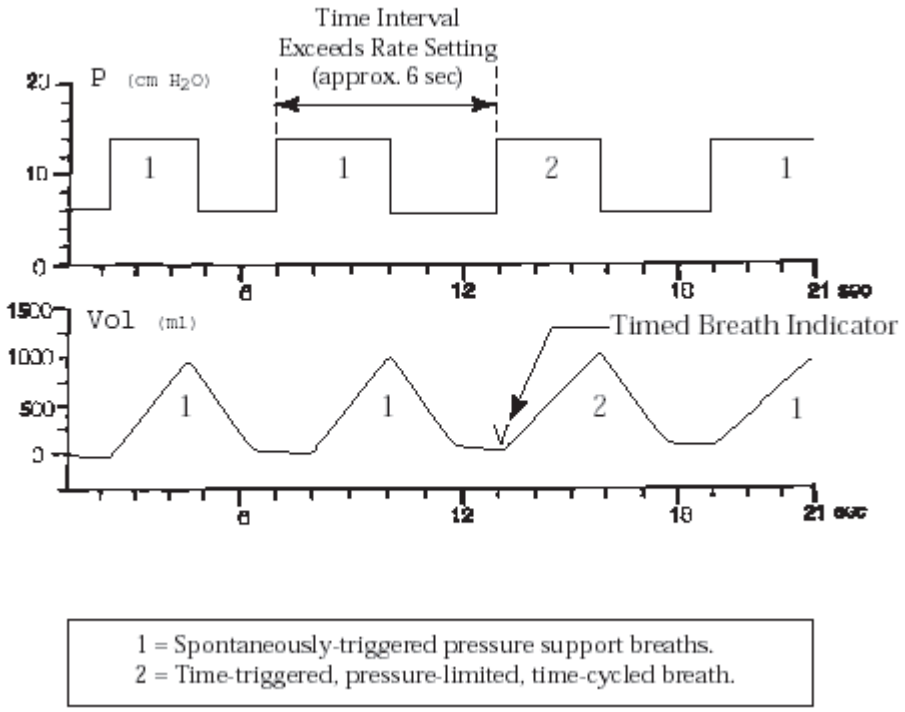


Figure 3-12
Timed Breath Example

3.8.3 Proportional Assist Ventilation / Timed Mode (PAV/T)

For a detailed description of functioning of the Proportional Assist Ventilation/Timed (PAV/T) Mode, refer to the appropriate BiPAP Vision Clinical manual. This mode utilizes the design features of S/T mode and is a software enhancement only.

3.9 Nurse Call/Remote Alarm Feature Operation (for s/n units greater than 106000 only)

The unit will activate a remote signal for system shutdowns, patient alarms, and Loss of AC Power conditions which inhibit therapy. Note that a Check Vent condition does not activate the nurse call signal. The nurse call signal can be silenced via the Alarm Silence key for the same amount of time that the audible alarm on the Vision is silenced (two minutes). The signal can also be cleared by selection of the Alarm Reset key. The nurse call signal will automatically terminate when a patient alarm self-cancels.

The Nurse Call/Remote Alarm feature is meant to be a backup with the main Vision alarm system being the primary alarm/alert mechanism.

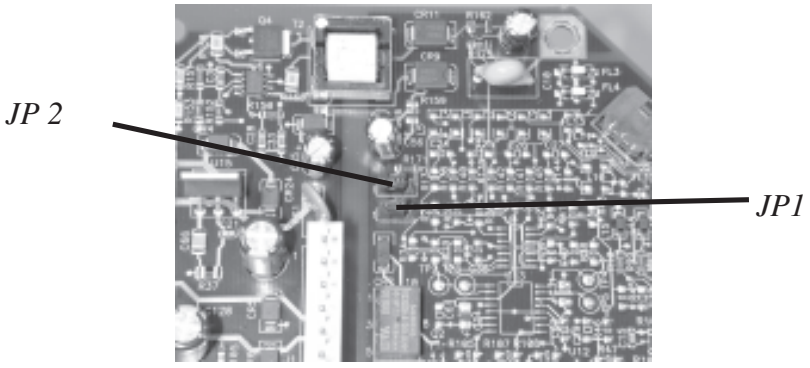
The Nurse Call or Remote Alarm signal is generated on the MC board and then can be connected to a hospital nursing station. This signal is opto-isolated and used to switch a relay to provide open or closed contacts to the remote station circuit. The arrangement of the two jumpers (JP1 and JP2) on the MC determine the output configuration that is utilized by a common connector on the rear panel of the Vision.

The Nurse Call Adapter (RI P/N 1014280) along with the Nurse Call Cable (RI P/N 1003742) can be used to connect the Vision to a Nurse Call station.

The jumper configuration on the MC circuit board can be selected to meet requirements according to the following table. Refer to the photo for jumper location.

Option	JP1	JP2	No Alarm Output	Alarm Option	System Requiring
1	2,3	2,3	51.1K	Open	Respironics Remote Alarm
2	2,3	1,2	Closed	Open	Central Alarm System
3	1,2	1,2	Open	Closed	Central Alarm System

NOTE: Option 2 is the original factory set configuration for S/N 106001 to 106368.
Option 3 is the original factory set configuration for S/N 106369 and greater.



Nurse Call / Remote Alarm (Continued)

Details of option selections:

Option 1:

For use with Respironics Remote Alarm (RI p/n 34003, or equivalent).

Option 2:

For use with alarm systems requiring NORMALLY OPEN contacts for an “alarm” condition and CLOSED contacts for a “no alarm” condition.

Option 3:

For use with alarm systems requiring NORMALLY CLOSED contacts for an “alarm” condition and OPEN contacts for a “no alarm” condition.

Caution: The Vision Nurse Call/Remote Alarm port shall be connected to nurse call systems that meet the relevant local safety standards. Secondly, the nurse call port shall be connected to a low voltage circuit (less or equal to 42.4V peak ac or 50V dc). The leakage currents from the low voltage circuit shall not cause the Vision leakage currents to exceed acceptable levels. Lastly, the rated output current of the low voltage circuit shall not exceed 1A.

3.10 BiPAP Vision Patient Disconnect Alarm Description of Operation

The patient disconnect alarm ("Disconnect") is based on the flow limit control algorithm in the Vision. The mitigation for the Disconnect alarm is to put the unit into flow limit control. This same action is done when the user selects the Standby key.

3.10.1 Detection

The unit determines that a patient is not connected to the circuit anymore based on flow for the given pressure. This is implemented via a look-up table, with a flow entry for every generated pressure. The range of flows is 95 to 180 LPM, with 180 LPM being the low limit for any pressure above 9 cmH_2O. If the unit detects flow greater than the threshold at any given pressure for more than 10 seconds (3 seconds in for software earlier than 13.2), the unit puts itself into the Flow Limit Control state. In this state, the unit attempts to limit the flow coming out of the mask in order to make putting the mask back on the patient easier and more comfortable for the patient.

Also, for safety concerns, the oxygen valve closes to discontinue oxygen delivery during this condition.

When the Standby key is selected by the user, the unit automatically enters the FLC state, regardless of the flow at the time the Standby key is selected.

In order to limit the flow, the unit drops the pressure to 4 cmH_2O. The algorithm was enhanced to work with the Full Face Mask a while ago. The Full Face Mask has a flap that will close the patient circuit and open the mask to atmosphere upon loss of flow and pressure. This flap must be kept in a position during FLC so that the patient circuit is not occluded. This allows the unit to detect when the patient is reconnected. The enhancement to the algorithm consists of the pressure being slowly increased to keep the flow at 160-170 LPM. The pressure level is limited to 10 cmH_2O for software 11.2 and 11.3 (15 cmH_2O for software 11.3a and higher), regardless of how much flow is being generated. Therefore, the unit will either output 160-170 LPM at some pressure or will be limited to some lesser flow at 10 cmH_2O for software 11.2 and 11.3 (15 cmH_2O for software 11.3a and higher).

3.10.2 Termination

There are two termination stages to FLC. During the first stage, as the pressure is being increased from 4 cmH_2O to its maximum of 10 cmH_2O for software 11.2 and 11.3 (15 cmH_2O for software 11.3a and higher), FLC will be automatically terminated if the unit detects negative flow (i.e., the patient breaths back into the unit). This pressure increase takes about 10 – 12 seconds for software versions earlier than 13.2, depending on how soon the flow set point is reached. There have been two enhancements in software version 13.2 in this area. The first is that the pressure is increased faster (1 cmH_2O per 40 ms instead of the previous ¼ cmH_2O per 40 ms) to shorten the amount of time in stage one. The second change concerns the flow range processing. In software versions earlier than 13.2, when the pressure is dropped to 4 cmH_2O and the flow is greater than the desired flow range (160-170 LPM), the flow limit algorithm attempts to decrement the pressure to get the flow into that desired range. In software version 13.2, that was changed to immediately enter stage 2 under that condition.

Once either the flow set point or the maximum pressure is reached, the unit will automatically terminate FLC for either the detection of negative flow or if flow varies from the current flow by more than 40 LPM in software versions prior to 13.2 and 20 LPM for software version 13.2. For instance, if the 160-170 LPM set point has been reached, the unit will terminate FLC if the flow drops below 120 LPM or goes above 210 LPM in older software and 140-190 LPM in the new software.
If the flow set point has not been reached, the current flow at 10 cmH2O for software 11.3 and 11.3 (15 cmH_2O for software 11.3a and higher) is used as the set point. For instance, if only 80 LPM can be reached at 10 cmH_2O for software 11.3 and 11.3 (15 cmH_2O for software 11.3a and higher), the thresholds for automatic termination of FLC will be 40 LPM and 120 LPM in older software and 60-100 LPM in new software.

This allows FLC to be terminated without the patient necessarily breathing back into the machine but by the simple act of refitting the mask to the patient.

The Standby condition, besides being terminated automatically by the above methods, can also be manually terminated by reselecting the highlighted Standby soft key on the Monitoring screen.

When FLC is terminated during a “Disconnect” alarm period, the alarm is self-cancelled. That means that the audible component of the alarm is silenced but the visual component of the alarm remains displayed on the screen. That can be cleared by selecting the Alarm Reset key.

Note: During FLC, the oxygen parameter setting reduces to 21%, regardless of the setting.

Chapter 4: Specifications and Control Ranges

Chapter 4: Specifications and Control Ranges

4.1 Specifications

ENVIRONMENTAL:

Temperature	Operating: 40° F to 104° F (4.4° C to 40° C) Transport / Storage: –4° F to 140°F (–20°C to 60°C)
Humidity	Storage and Operating: 0 to 95% Relative Humidity

PHYSICAL:

Dimensions	At the base: 16" (L) × 14 3/8" (W) × 10 5/8" (H) (40.6 cm x 36.5 cm x 27cm)
Weight	34 lbs (15.4 kg)

ELECTRICAL:

AC Input Voltage (VAC)	100/120/230/ 240 VAC Single Phase ±10%
Fuses	100 – 120 VAC ~ T 3.5 A, 5 × 20 mm, Time Lag (×2) (For serial no.'s 100500 and higher – Respironics Reorder # 1000749) 115 VAC ~ T 3.0 A, 250 V, ¼" × 1¼" (For serial no.'s 100499 and lower – Respironics Recorder # 582100) 220 VAC, 230 VAC and 240 VAC ~ T 1.6 A, 250 V, 5 × 20 mm (For all serial no.'s – Respironics Recorder # 1000750)
Power Consumption	300 VA max.
AC Current	3.0 A maximum
AC Frequency	50/60 Hz
Class	Protection Against Electrical Shock: Class I

Specifications (Continued)

Type	BF Degree of Protection Against Harmful Ingress of Water: Ordinary Equipment, IPX0
Electromagnetic Compatibility	The BiPAP Vision meets the requirements of IEC 601-1-2
Earth Resistance	Less than 0.10 ohms
Earth Leakage Current	
Normal Pole, No Earth, L2	Less than 300 µA
Reverse Pole, No Earth, L2	Less than 300 µA
Reverse Pole, No Earth, No L2	Less than 1000 µA
Normal Pole, No Earth, No L2	Less than 1000 µA
Insulation Resistance	Greater than 2 megaohms
Noise Level	No specification is given because various test instruments, test procedures, and unit operating conditions produce varying results.
Alarm Sound Level	Between 70 and 85 dBA peak at a distance of 1 meter.

PRESSURE:

Output	4 to 40 cm H_2O
Dynamic Regulation	± 2 cm H_2O at sinusoidal flow @ ± 100 L/min
Static Regulation	± 2 cm H_2O from –60 to 120 L/min
Elevation	0 to 5000 ft above sea level

CONTROL ACCURACY:

Timed Inspiration	± 0.2 sec of the set point
Rate	± 1 BPM of the set point
Oxygen Concentration	The greater of ± 3% or ±10% of the set point

DISPLAY ACCURACY:

Pressure	± 1 cm H_2O
Volume	± 10% (during stable conditions)
Flow	± 10% (during stable conditions)

Specifications (Continued)

TRIGGER SENSITIVITY:
(Refer to BiPAP Vision Clinical Manual Auto-Trak section for more details)

Spontaneous Trigger	Shape Trigger $\dot{V}_{leak}$ Volume 6 cc above
Spontaneous Cycle	Spontaneous Expiratory Threshold (SET) Shape Cycle IPAP maximum of 3.0 sec Flow Reversal

OXYGEN MODULE INLET:

Pressure Range	50 to 100 psig
Inlet Fitting	DISS male oxygen connector

INTERNAL BATTERIES:

Alarm Battery	NiCAD Location: D/C 3.6 VDC, 110 mAh Rechargeable (See Section 5.9.3 for details) (RI P/N 1012819)

Data Retention Battery (for original MCS board)	Type:	Lithium Cell Location: MCS +3 VDC, 300 mAh Not Rechargeable (RI P/N 1001988)
Data Retention Battery (for current MC Board)	Type:	Lithium Cell Location: MCS +3 VDC, 300 mAh Not Rechargeable (RI P/N 1006005)

4.2 Control Ranges and Increments

NOTE: Refer to the applicable BiPAP Vision Clinical Manual for PAV/T information.

4.2.1 Parameters

Parameter	Control Range	Control Increments
IPAP	4 to 40 cm H_2O	1 cm H_2O
EPAP	4 to 20 cm H_2O	1 cm H_2O
CPAP	4 to 20 cm H_2O	1 cm H_2O
Rate	4 to 40 BPM	1 BPM
Timed Inspiration	0.5 to 3.0 sec	0.1 sec
IPAP Rise Time	0.05 to 0.4 sec	4 set points: .05, 0.1, 0.2, 0.4 sec
Oxygen Concentration (%O_2)*	21 to 100%	4% from 21 to 25% 5% from 25 to 100%

*With optional Oxygen Module

4.2.2 Alarms (Adjustable)

Alarm	Control Range	Control Increments
High Pressure	5 to 50 cm H_20	1 cm H_20
Low Pressure	Disabled to 40 cm H_20	1 cm H_20
Low Pressure Delay	0 to 60 sec.	1 cm H_20
Apnea	Disabled; 20 to 40 sec.	4 set points; Disabled, 20, 30, 40 sec.
Low Minute Ventilation*	Disabled to 99 L/min.	1 L/min.
High Rate*	4 to 120 BPM	1 BPM
Low Rate*	4 to 120 BPM	1 BPM

*With optional Alarm Module

4.2.3 Display Ranges & Increments

PARAMETER	DISPLAY RANGE	DISPLAY RESOLUTION
IPAP	0 TO 50 CM H_2O	1 CM H_2O
EPAP	0 TO 50 CM H_2O	1 CM H_2O
CPAP	0 TO 50 CM H_2O	1 CM H_2O
RATE	0 TO 150 BPM	1 BPM
EXHALED TIDAL VOLUME (VT)	0 TO 4000 ML	1 ML
MINUTE VENTILATION (MIN VENT)	0 TO 99 L /MIN	1 L / MIN
TOTAL LEAK (TOT LEAK)	0 TO 300 L/MIN	1 L / MIN
PATIENT LEAK (PT. LEAK)	0 TO 300 L /MIN	1 L /MIN
PEAK INSPIRATORY PRESSURE (PIP)	0 TO 50 CM H_2O	1 CM H_2O
PERCENT OF PATIENT TRIGGERED BREATHS (PT.TRIG)	0 TO 100%	1%
TI/TTOT	0 TO 100%	1%

Chapter 5: Routine Maintenance

5.1 Cleaning the BiPAP Vision

CAUTION: Do not immerse the BiPAP Vision in water or allow any liquid to enter the cabinet or the inlet filter.

NOTE: The following guidelines for cleaning refer to the BiPAP Vision only. Refer to the individual instructions for cleaning accessories.

5.1.1 Cleaning the Front Panel

Clean the front panel as needed by wiping with water or 70% isopropyl alcohol only.

5.1.2 Cleaning the Enclosure

Clean the exterior of the enclosure as needed by wiping with any anti-bacterial agent.

CAUTION: Do not allow any liquid to enter the cabinet or the inlet filter.

NOTE: Do not clean the Auto-Trak sticker with anything except mild soap and water.

5.2 Replacing the Inlet Filter

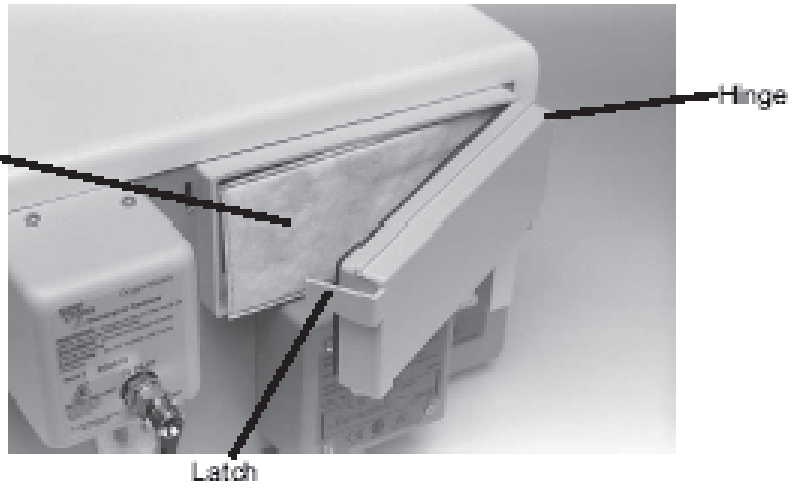
CAUTION: A dirty inlet filter may cause high operating temperatures, and may affect ventilator performance. Examine the inlet filter for integrity and cleanliness before each use, and as required during operation.

Step 1 Turn the BiPAP Vision OFF and unplug the electrical cord from the wall outlet and from the back of the unit.

Removing the Filter

Step 2 Remove the inlet filter cap by pinching the latch, then rotate the cap until the hinge is free from its slot.

NOTE: The inlet filter is disposable. Do not attempt to clean the inlet filter. When the filter is dirty replace it with a new filter. Use only Respironics filters; see Chapter 7 for the filter reorder number.



(P/N 582101 x6)

Figure 5-1
Removing the Filter Cap
(P/N1003444)

Installing the Filter

Step 3 Place the filter inside the cap, then reverse Step 2 to reinstall the filter cap.

NOTE: To clean any of the accessories, refer to each accessory's instruction sheet.

5.3 Cleaning/Replacing the Nylon Mesh Inlet Filter

CAUTION: A dirty nylon mesh inlet filter may cause high operating temperatures and may affect ventilator performance.

Step 1 Turn the BiPAP Vision off and unplug the electrical cord from the wall outlet and from the back of the unit.

Step 2 Remove the filter cap and inlet filter. (See Section 5.2 for more detailed instructions on removing the filter cap and inlet filter.)

Step 3 Using a medium Phillips screwdriver, remove the two screws that secure the nylon mesh inlet filter to the filter enclosure. Remove the nylon mesh inlet filter.

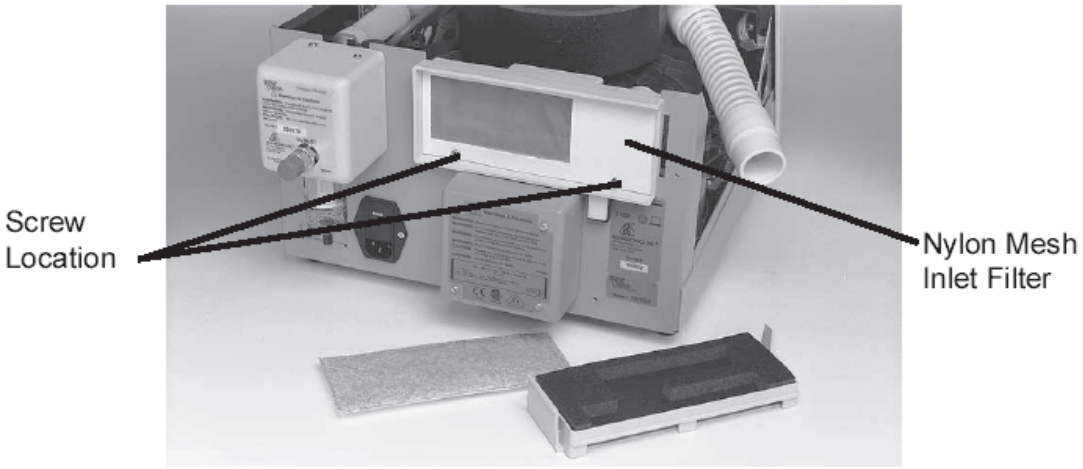


Figure 5-2
Removing the Nylon Mesh Filter

NOTE: Depending on the condition of the nylon mesh inlet filter, it may be cleaned and reused. If the filter is in good shape, follow the cleaning instructions in Step 4. If the filter must be replaced, proceed to Step 5.

NOTE: If the nylon mesh inlet filter is to be cleaned, care should be taken to protect the adhesive on the edges of the filter. If the adhesive is damaged, the filter may not correctly seal when reinstalled.

Step 4 Using a solution of mild soap and water, carefully clean then thoroughly rinse the nylon mesh inlet filter. Insure that the filter is completely dry before reinstalling it in the unit.

Step 5 If necessary, remove the protective backing from the nylon mesh inlet filter. Align the new cleaned nylon mesh inlet filter with the filter enclosure. Press the edges of the filter firmly in place. Secure the filter to the filter enclosure using the two Phillips screws.

5.4 Replacing the Oxygen Regulator Filter

CAUTION: A dirty Oxygen Regulator filter may reduce system performance. Examine the filter for integrity and cleanliness before each use.

NOTE: Replace the filter as necessary to ensure normal operation.

Step 1 Position the BiPAP Vision so that the back is easily accessible.

Step 2 Disconnect the Oxygen Module (OM) input line.

Step 3 Firmly grasp the plastic body of the regulator bowl and rotate it counterclockwise to remove it. (Direction is referenced from the bottom of the unit.)

NOTE: The regulator bowl has a standard right-hand thread.

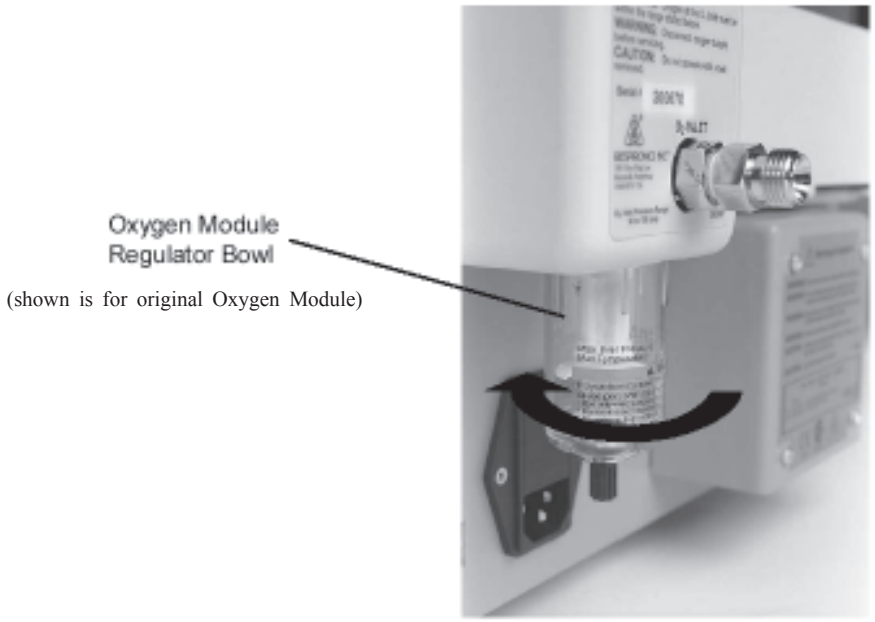


Figure 5-3
Removing the OM Regulator Bowl

Step 4 Remove the original filter.

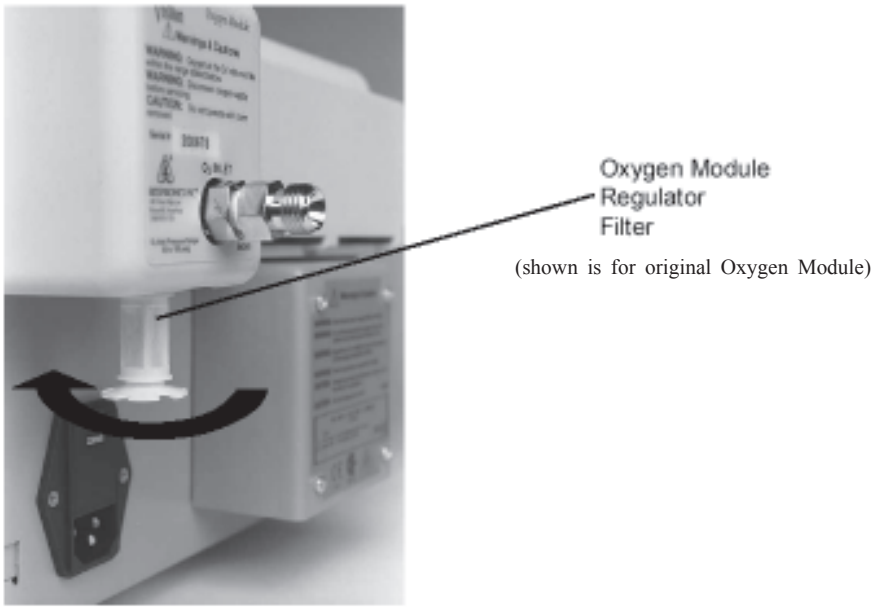


Figure 5-4
Removing the OM Filter

Step 5 Insert the new filter.

Step 6 If necessary, clean the regulator bowl with mild soap and water and dry completely.

Step 7 Put the regulator bowl in place and rotate it clockwise until securely tightened.

Step 8 Connect the oxygen input line to the OM.

BiPAP Vision Oxygen Module Regulator Filter and Regulator Bowl Compatibility

Note: Refer to the information below for compatibility when ordering Oxygen bowl and filter replacements.

Oxygen Module (OM) Manifold / Regulator Bowl	For Oxygen Module S/N < 300000, use part number 582154 For Oxygen Module S/N > 299999, use part number 1007546*
Oxygen Module (OM) Manifold / Regulator Bowl filter (x5)	For Oxygen Module S/N < 300000, use part number 582153 For Oxygen Module S/N > 299999, use part number 1007547*

* This part is also for the Oxygen Modules that do not have a serial number on the Oxygen Module cover.

5.5 Changing the System Fuses

WARNING: Unplug the BiPAP Vision before changing the fuses.

NOTE: This procedure applies to Vision S/N's 100500 and greater.

Step 1 Unplug the AC power cord from the wall outlet and from the power entry module on the rear of the BiPAP Vision.

Step 2 With a small, flat-blade screwdriver, gently pry open the fuse holder door from the top. The door hinges downward.

Figure 5-5
Opening the Fuse Door

Step 3 Pry the fuse drawers loose and slide them out of the power entry module.

Step 4 Pull the fuses out of the fuse drawers.

Figure 5-6
Replacing the Fuses

Step 5 Replace both fuses.

Step 6 Place the new fuses in the fuse drawers and slide the fuse drawers back into the power entry module with the arrows on the front of the drawers pointing to the right.

Step 7 Select the proper operating voltage by removing the drum and reinserting it with the desired voltage displayed.

NOTE: Use only Respironics approved fuses. See Section 5.6 for fuse part numbers.

Step 8 Swing the fuse drawer door shut and snap it into place.

Step 9 Plug the AC power cord into the BiPAP Vision and the wall outlet.

5.6 Voltage and Fuse Selection

The voltage selection is originally set at the factory. If you wish to use the BiPAP Vision with a different operating voltage, refer to Section 5.5.

NOTE 1: Vision S / N's 100500 and greater:
- For operating voltages of 100 and 120 VAC, use RI P/N 1000749 fuses.
- For operating voltages of 230 and 240 VAC, use RI P/N 1000750 fuses.

NOTE 2: Visions S / N's 100499 and less:
- For operating voltage of 115 VAC, use RI P/N 582100 fuses.
- For operating voltage of 220 and 240 VAC, use RI P/N 1000750 fuses.

5.7 Power Cord Inspection

Inspect the power cord and replace if damaged or shows signs of wear.

5.8 Internal Alarm Battery

5.8.1 Battery Function

The BiPAP Vision contains an internal NiCAD battery located on the DC (P/N 1012819) to activate the Ventilator Inoperative visual and audible alarm indicators if an error occurs. A fully charged battery can maintain the audible alarm for up to 20 minutes.

5.8.2 Low Battery Condition

The NiCAD battery can lose its charge if the BiPAP Vision is not used for an extended time. In a typical environment, a fully charged battery can be stored approximately six months before losing its charge, but the discharge rate depends heavily on temperature.

NOTE: The BiPAP Vision internal alarm battery should be charged prior to use if it has been stored for longer than three months.

If the battery voltage is too low to support the alarm indicators, the Check Ventilator visual (Eye icon) and audible alarm indicators will activate. **The time that the audible alarm operates may be short due to the low voltage of the battery.** The BiPAP Vision also generates error code 205.

To check the error code:

Step 1 Silence the audible alarm component by pressing the Alarm Reset key.
The audible component will not sound again.

Step 2 Press the Monitoring hard key if you are not already in the Monitoring screen.

Step 3 Press the Options soft key.

Step 4 In the Options screen, press the Error soft key.
Check vent error codes are displayed in the top line of the Options/Message area.

5.8.3 Charging the Internal Battery

There are two methods used to recharge the NiCAD battery on the DCS circuit board that is used to sound the audible alarm, fast charge and normal.

1. Fast Charge Method (Check Vent/Error 205 Being Displayed)

A fast charge will be initiated at first time initialization and when a low internal battery error is detected. Fast charging is available when the unit is in the Setup Screen and when it is providing therapy (i.e., the unit can sit in the diagnostic mode and still fast charge). Fast charge time is 6 hours to sufficiently charge the battery to support the audible alarm for 20 minutes.

If the unit is powered off during a fast charge sequence, the sequence will pick up where it left off when the unit is powered back on unless a low battery error is detected during the start-up testing (i.e., the unit was off long enough to discharge the battery). In that case, a new 6-hour fast charge sequence will be initiated. The functionality of the Check Ventilator error 205 remains unchanged - the error code will be able to be cleared approximately 1 minute after the status indicates a good battery.

Note: If the status never indicates a good battery (i.e., the battery is actually bad and will not take a charge), the fast charge sequence will run continuously. The user will be able to detect this by not being able to clear the 205 error even after a full fast charge cycle.

Charging Process:

1. Remove the unit from patient use.
2. Plug the unit into an AC source and start the unit. The Self Diagnostics will begin.
3. Allow the unit to remain in the Exhalation Port/Language Screen.
4. Or, allow the unit to be in therapy or Standby mode. Press the alarm reset to silence the audible alarm.
5. Leave in one of these conditions for approximately 6 hours to fully charge the battery.

2. Normal Method (No Check Vent/Error 205)

If there is no Check Vent error 205, the charging circuit will continue to charge the battery on a regular basis while in the Test Exhalation/Language screen or during therapy use. It will take approximately 24 hours to fully charge the battery to support the audible alarm for up to twenty minutes.

Charging Process:

1. Remove the unit from patient use.
2. Plug the unit into an AC source and start the unit. The Self Diagnostics will begin.
3. Allow the unit to remain in the Exhalation Port/Language selection screen.
4. Or, allow the unit to be in therapy or Standby mode.
5. Leave in one of these conditions for approximately 24 hours to fully charge the battery.

Charging Verification:

1. A minimum of two hours is required to charge a fully discharged battery to a voltage at which the alarm will not be activated. At this time, the unit can be operated and will continue to trickle charge the battery while it is in operation.
2. Press Monitoring to begin operation.
3. Wait two minutes to determine if the Check Vent alarm activates with an error 205 in the Error Message screen. If not, then the unit is ready for use.

CAUTION: Prolonged storage of the BiPAP Vision at high temperatures, above 80 ºF (27 ºC) can result in premature battery failure. Failure to recharge a battery when it is being stored for long periods will cause a loss of battery life, activate the Check Ventilator alarm, and generate error code 205.

5.9 Preventive Maintenance Schedule

The Maintenance Schedule lists the items that are recommended to be periodically inspected or tested. The service interval may be decreased as internal protocol specifies. The user should be aware of any local or national regulations that may deviate from the schedule as described below. Use the log to record the dates the maintenance items are performed.

5.9.1 Vision Preventive Maintenance Schedule (Factory Recommended)

Model # _____ Serial # _____

Maintenance Item	Verification Reference	Service Interval	Date
Record hours of operation	Displayed on Options Screen	1 Year	
Replace inlet filter	Section 5.2	As required	
Replace oxygen regulator filter	Section 5.4	As required	
Audible Alarm	Visual, verify by activating Test Alarms.	1 Year	
Run Blower Valve Calibration	Section 8.5	1 Year	
Perform "System Final Test"	Section 8.8	1 Year	
Inspect Power Cord	Section 5.7	As required	
Cleaning	Section 5.1	As required	

Tested by: _____ **Date:** _____

Chapter 6: Troubleshooting

Chapter 6: Troubleshooting

6.1 Overview

Purpose

This chapter outlines a general procedure for troubleshooting the BiPAP Vision. Problems shall be investigated to the major component or subassembly as indicated on the specific error code charts found in this chapter.

Process

Step 1 If a **Patient Alarm** activates and it is not possible to eliminate it, refer to the Alarm Descriptions beginning on page 6-8 for detailed descriptions, possible causes, and corrective action.

Step 2 If the **Check Ventilator** icon illuminates along with the audible alarm, refer to the Check Vent Error Flow Chart on page 6-12 for the recommended troubleshooting sequence to follow. Refer to the "Check Vent" Error Codes chart on page 6-13 for descriptions and possible corrective actions.

Step 3 If the **Ventilator Inoperative** icon illuminates along with the audible alarm, refer to the Vent Inop Errors Flow Charts on pages 6-14 and 6-15 for the recommended troubleshooting sequence to follow. Refer to the Common System (page 6-16), PC Specific (page 6-18), MC Specific (page 6-22), and the DC Specific (page 6-24) Error Codes Charts for descriptions and possible corrective actions.

Step 4 Use the chart on page 6-3 to diagnose Common System Level Problems.

Step 5 Use the "Error Codes Chart Abbreviation Definitions" on pages 6-25 and 6-26 for the definition of terms used throughout all of the Error Code Charts.

Step 6 Follow the PC/Laptop Setup Procedures in section 8.9 for the suggested method to check the error code for each subsystem. The procedure includes PC/Laptop setup guidelines.

Common System Level Problems

Symptom	Possible Cause	Corrective Action
The unit will not power on.	Power cord Fuses PSS Main power switch AC Inlet Transformer	Inspect power cord insertion or damage, replace. Inspect fuses, replace if blown. Replace PSS. Continuity test switch, replace. Replace AC Inlet. Replace transformer.
Intermittent On / Off condition. Main Power indicator blinks sporadically.	Power cord Main power switch Loose connections	Verify proper input voltage setting. Inspect power cord insertion or damage, replace. Continuity test, replace. Remove top cover, verify all wiring connections are properly inserted.
Display blank, power On.	LCD DC	Replace the LCD. Replace the DC.
Fuses failing.	Fuses Transformer PSS	Replace if failed. Disconnect transformer from the PSS, if fuses still failing, replace the transformer. If the fuses and transformer are operational, replace the PSS.

Common System Level Problems

Symptom	Possible Cause	Corrective Action
Outlet air temperature too warm.	High ambient temperature Inlet filter Blower Transformer PC	Reduce ambient temperature, re-locate unit. Replace the inlet filter (See Chapter 5).
Noise	PC ILFR PRV Blower	Perform the Blower / Valve Calibration Procedure (See Section 8.5). Replace PC. Replace the ILFR. Replace the PRV. Replace the Blower.
Touch pad not responding to selection.	Touch pad DC	Check Connections Replace touch pad. Replace DC.
Rotary encoder does not adjust selection.	Rotary encoder DC	Replace rotary encoder. Replace DC.
Ventilator Inoperative icon (wrench) illuminated, and the audible alarm.		See Section 6.3.
Check Ventilator icon (eye) illuminated, and the audible alarm.		See Section 6.3.

6.2 Description of System Alarms

The BiPAP Vision incorporates self-diagnostic testing capabilities and a number of safety features. All system internal functions are checked automatically at start up and periodically throughout operation. The microprocessors continuously obtain readings from internal sensors to monitor machine functions and operating conditions. Device malfunctions or abnormal operating conditions are analyzed and reported according to the level of severity. Two primary alarm functions, **Check Ventilator** and **Ventilator Inoperative**, are available to identify a system malfunction. Patient Alarms are displayed on screen when activated.

6.2.1 Patient Alarm Indications

All alarms contain an audible and visual element. In the event of an alarm condition, the audible alarm sounds and the screen changes to show the alarm condition in the Mode/Message Area. See Figure 6-1.

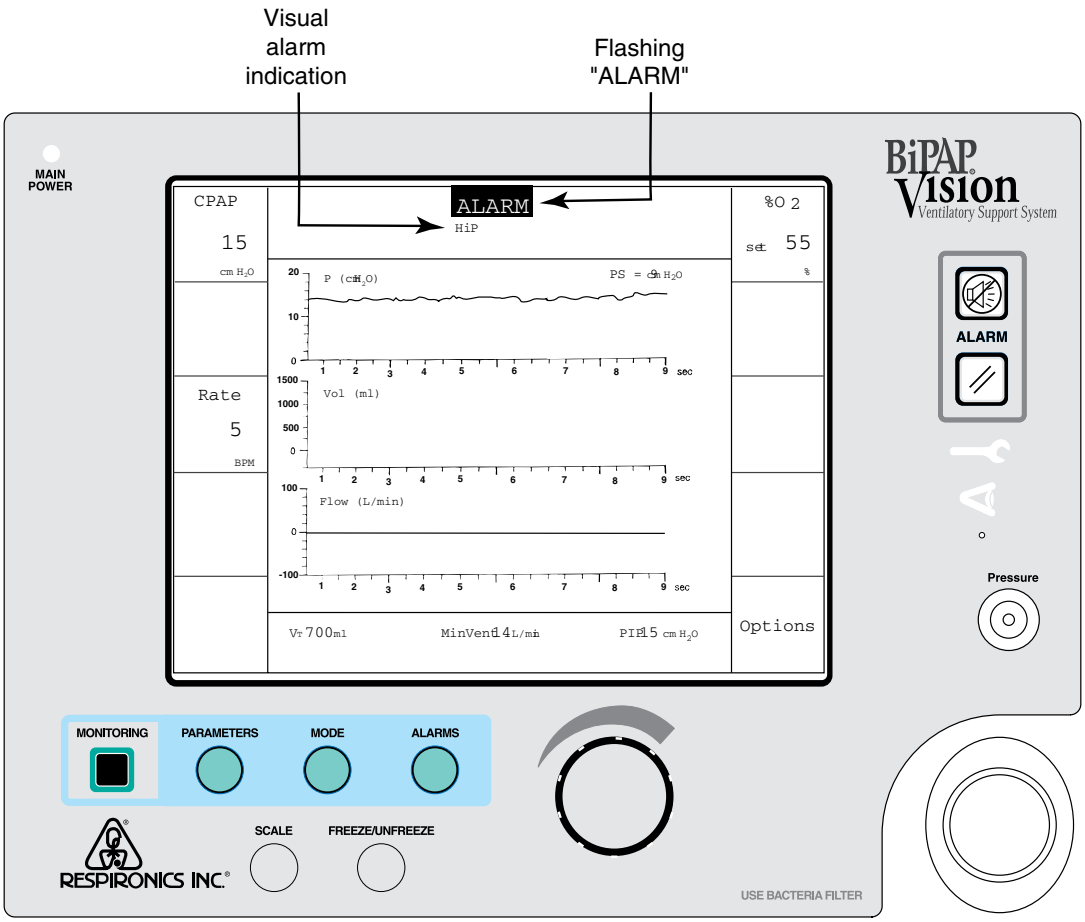


Figure 6-1
Patient Alarm Shown in Mode / Message Area

6.2.2 Patient Alarm Silence and Reset

The audible indicator of most alarms is self-cancellable if the patient alarm condition is corrected. The user can silence the audible indicator by pressing the **ALARM SILENCE** hard key. The **ALARM SILENCE** hard key turns off the audible alarm for two minutes. Additional pressing of the **ALARM SILENCE** hard key has no effect on the alarm. When the alarm silence is active, the message "**Alarm Silenced**" appears in the Mode / Message Area for the duration of the silence period. Any new alarm condition that occurs, except for an Apnea alarm, during the silence period will provide a visual alert, but **will not** trigger the audible alarm.

The visual patient alarm indicator in the Mode / Message Area is cancelled only when the **ALARM RESET** hard key is pressed. The **ALARM RESET** hard key cancels the alarm silence period and resets the visual indicators. The alarm immediately reactivates if the condition causing the alarm has not been corrected.

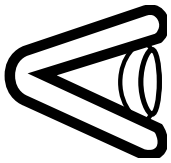
6.3 Alarm Indicators

6.3.1 Vision Ventilator Inoperative Indicator

Purpose: Alerts the user to a machine malfunction by illuminating the red "**Wrench**" icon on the display panel and activating an audible alarm. The ventilator immediately powers down and opens the internal valves allowing ambient air to be drawn through the ventilator for unimpeded spontaneous breathing. The audible and visual alerts remain active and cannot be silenced until the On / Off Switch is placed in the OFF position.

Active: At all times.

6.3.2 Check Ventilator Indicator



Purpose: Alerts the user of a potential abnormal operating condition by illuminating the yellow "**Eye**" icon on the display panel and activating an audible alarm. The audible alarm can be temporarily silenced with the **ALARM SILENCE** hard key. However, the visual indicator cannot be reset and remains illuminated until the error is corrected. The ventilator continues to operate during a "Check Ventilator" condition.

Active: At all times.

6.4 Troubleshooting

Alarm Display	Meaning	Description	Possible Cause	Corrective Action
	Ventilator Inoperative	System Failure – A system malfunction that results in machine shutdown. The system valves open to the atmosphere to permit unimpeded spontaneous breathing through the system. Audible and visual indicators are activated; once activated, the audible alarm cannot be silenced.	System level failure that impairs performance of the unit.	Refer to the Vent Inop Troubleshooting Flow Charts on pages 6-14 and 6-15 for diagnostic information.
		AC Power Failure – Power to the device is lost while the power switch is in the Start position. The system valves open to the atmosphere to permit unimpeded spontaneous breathing through the system. Audible and visual indicators are activated; once activated, the audible alarm cannot be silenced.	AC power failure	Verify input power. Check fuses.
			Temperature overload fuse activated (Non-resetable).	Replace Transformer.
			No bulk supply voltage.	Replace PSS.
	Check Ventilator	Audible and visual indicators are activated. A system error has occurred. The Vision ventilator continues to operate.	System error.	Refer to the Check Vent Error Troubleshooting Chart on page 6-12 for diagnostic information.
Hi P	High Pressure	Audible and visual indicator in proximal airway pressure setting exceeds the high pressure setting for more than 0.5 seconds. The inspiration is terminated. Audible alarm indication cancels if the subsequent breath is below the high pressure setting.	Improper Alarm setting; alarm limit set below set pressure.	Review high pressure alarm setting.
			Patient coughing during inspiratory cycle.	Observe patient.

Troubleshooting Chart

Lo P	Low Pressure	Audible and visual alarm indicators if the proximal airway pressure remains below the low pressure setting for the time set with the Low Pressure Delay control. The audible alarm indicator cancels if the pressure rises above the low pressure setting.	Patient disconnect or large leak. Patient inspiratory demand exceeds machine-delivered flow. Low Pressure Delay set incorrectly. Improper alarm setting; alarm limit set above set pressure.	Check circuit and patient connection. Check the patient circuit for obstructions. Check inlet filter. Review Low Pressure Alarm Delay setting. Review Low Pressure alarm setting.
Apnea	No spontaneous triggered breath detected within set apnea interval	Monitors spontaneous triggered breaths within user-selectable time interval. Time interval resets with each spontaneous trigger. If a spontaneous trigger is not detected within the selected apnea time interval, there is an audible and visual alarm indicator. The audible alarm indicator cancels when two consecutive spontaneous triggers are detected. The apnea alarm can be disabled. Audible and visual indicators if the minute	Patient not breathing or unable to trigger ventilator.	Reevaluate the patient and check the patient circuit. Reevaluate the patient and alarm setting.
Exh. **Port**	Low leak during exhalation	Activated when the leak, during exhalation, falls 50% or 5 LPM, whichever is greater, below a limit for a period of one minute.	Block or restriction in the air flow pathway.	Check air flow pathway.
LoMin Vent	Low minute ventilation	Ventilation is below the alarm setting. The audible alarm indicator cancels if the patient minute ventilation increases above the alarm setting. Alarm can be disabled.	Patient disconnect or large leak. Decrease in patient rate or tidal volume. Improperly set alarm limit.	Check circuit and patient connection. Reevaluate the patient and alarm settings. Reevaluate the patient and alarm settings.

Troubleshooting Chart

Alarm Display	Meaning	Description	Possible Cause	Corrective Action
Hi Rate	High total breathing rate	Continuously compares the total breathing rate (machine + spontaneous) with the **Hi Rate** alarm setting. Audible and visual indicator if the measured value is higher than the alarm setting. The audible alarm self-cancels if the total breathing rate drops below the alarm setting.	Increase in patient breathing rate. Improperly set alarm limit.	Reevaluate the patient and alarm settings. Reevaluate the patient and alarm setting.
Lo Rate	Low total breathing rate	Continuously compares the total breathing rate (machine + spontaneous) with the Lo Rate alarm setting. Audible and visual indicator if the measured value is lower than the alarm setting. The audible alarm self-cancels if the total breathing rate increases above the alarm setting.	Decrease in patient breathing rate. Patient unable to trigger ventilator. Improperly set alarm limit.	Reevaluate the patient and alarm settings. Reevaluate the patient and alarm settings. Reevaluate the patient and alarm settings.
P Regulation	Loss of pressure regulation	Audible and visual indicators if the measured proximal pressure differs more than ± 5 cm H_2O of the set pressure for greater than 5 seconds. Audible self-cancels if the proximal pressure returns to within ± 5 cm H_2O of the set value. Alarm is automatically disabled when the unit goes into flow limit control.	Large leak Occluded patient circuit	Check the patient circuit. Check the patient circuit.

Troubleshooting Chart

Alarm Display	Meaning	Description	Possible Cause	Corrective Action
ProxLine Disc	Proximal pressure line disconnect	Audible and visual indicators if proximal pressure measures less than 1.0 cm H_2O for greater than 1.0 second. Audible alarm self-cancels if the measured proximal pressure is increased above 1.0 cm H_2O. Alarm is automatically disabled when the unit goes into flow limit control.	Proximal pressure line disconnection or obstruction.	Check the proximal pressure line.
O_2 Flow	Incorrect O_2 flow	System alarm that activates audible and visual indicators if the oxygen supply is lots. The audible alarm does not self-cancel after correction. During the alarm condition, the ventilator continues to function.	Insufficient oxygen supply pressure. Obstructed O_2 inlet filter.	Check the oxygen supply. Check the oxygen regulator inlet filter; replace if necessary.
Disconnect	Mask has been removed or excessive leak.	Audible and visual indicator if mask is removed or becomes dislodged enough to cause excessive leak. (see section 3.10) Audible self-cancels if leak is resolved.	Mask removed or dislodged.	Reapply mask.

6.5 Check Vent Error Codes

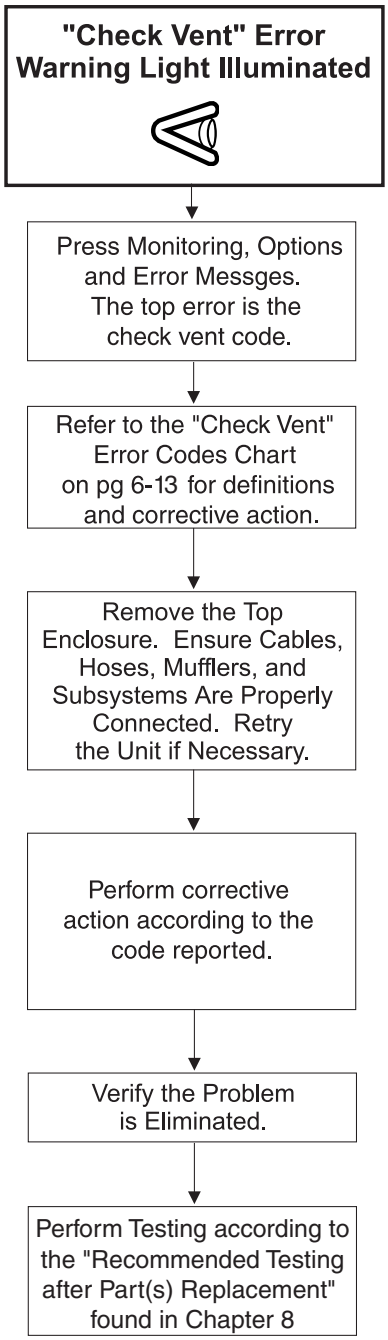


Figure 6-3
Check Vent Error Flow Chart

"Check Vent" Error Codes

Code	Error Definition	Description	Corrective Action (Replace in order until the problem is corrected.)
100	RTC failure on the MC	Real Time Clock failure on the MC	MC
101	MC NVRAM CRC error	MC Non-Volatile Random Access Memory Cyclic Redundancy Check error	MC
102	Backup battery failure on the MC	Backup battery for the NVRAM and RTC failure on the MC	MC
103	V ref failure on the MC	Reference voltage failure on the MC	MC
200	DC display voltage	Error detected in the display voltage on the DC	DC
201	DC audible alarm	Audible alarm current error detected on the DC	DC
202	DC Check Vent indicator	Check Vent indicator current error detected on the DC	DC
203	DC Vent Inop indicator	Vent Inop indicator current error detected on the DC	DC
204	DC backlight error	Backlight voltage error detected on the D C	DC
205	DC alarm battery	Alarm battery voltage low on the DC	Recharge battery (See Section 5.8.3) DC
206	Keypad Error	Key is held down too long (30 seconds)	Keypad, DC
300	Circulation fan	Circulation fan is not operational	Circulation fan
301	Invalid PC Calibration Data	Data not read successfully during installation	Blower Valve Cal, PC
303	Blower speed	Blower speed exceeds 16500 RPM	Blower PC
306	OM detection	PC detects OM originally present, but became disconnected during operation	OM cable OM PC

6.6 Vent Inop Errors

(Use when Vent Inop occurs and the unit operates afterwards)

Error Indicated on Vision Display

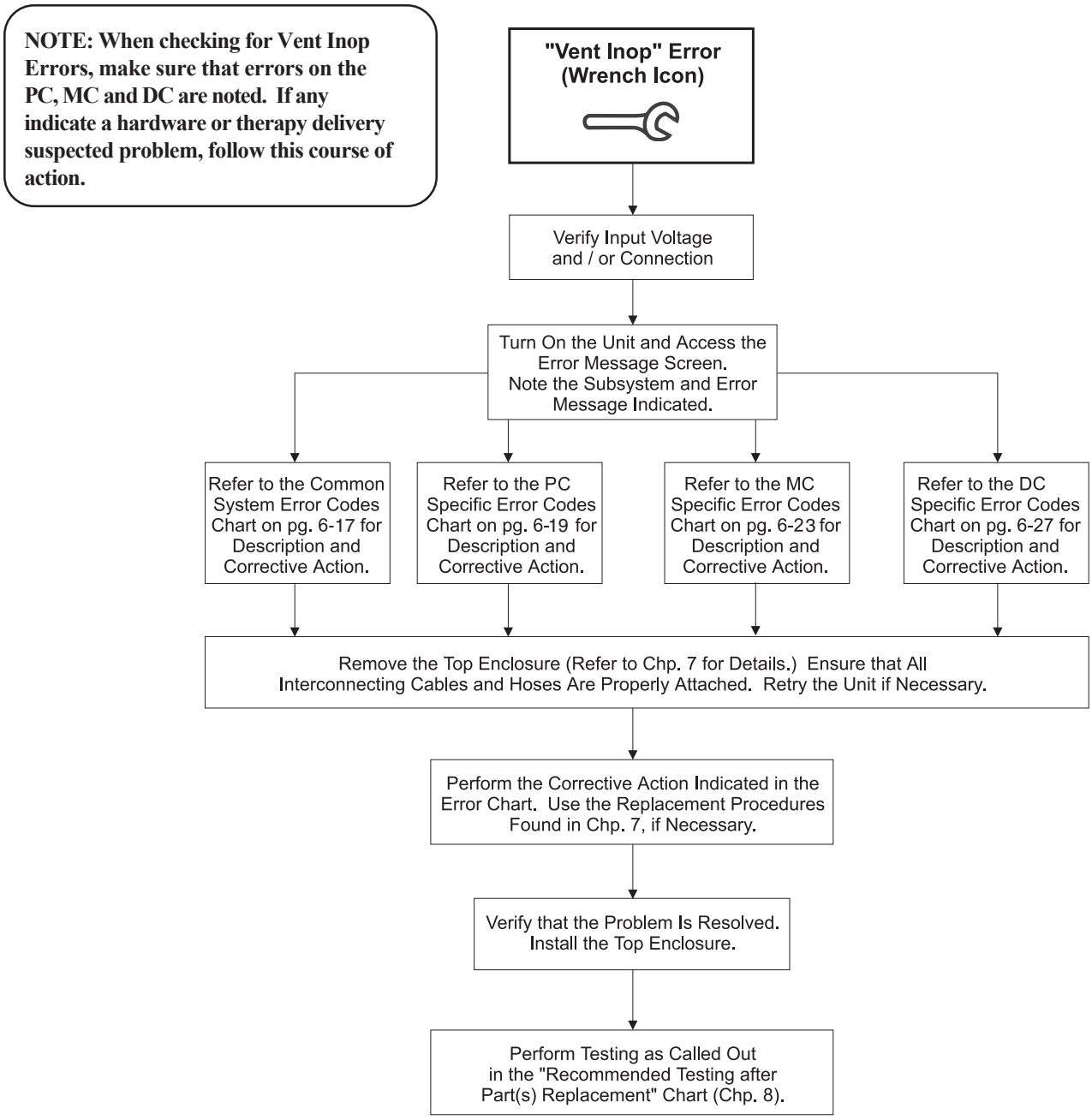


Figure 6-4
Vent Inop Indicator Troubleshooting Flow Chart

Error Indicated PC/Laptop
(use when "Ventilator Inoperative" is continuously activated)

NOTE: When checking for Vent Inop Errors, make sure that errors on the PC, MC and DC are noted. If any indicate a hardware or therapy delivery suspected problem, follow this course of action.

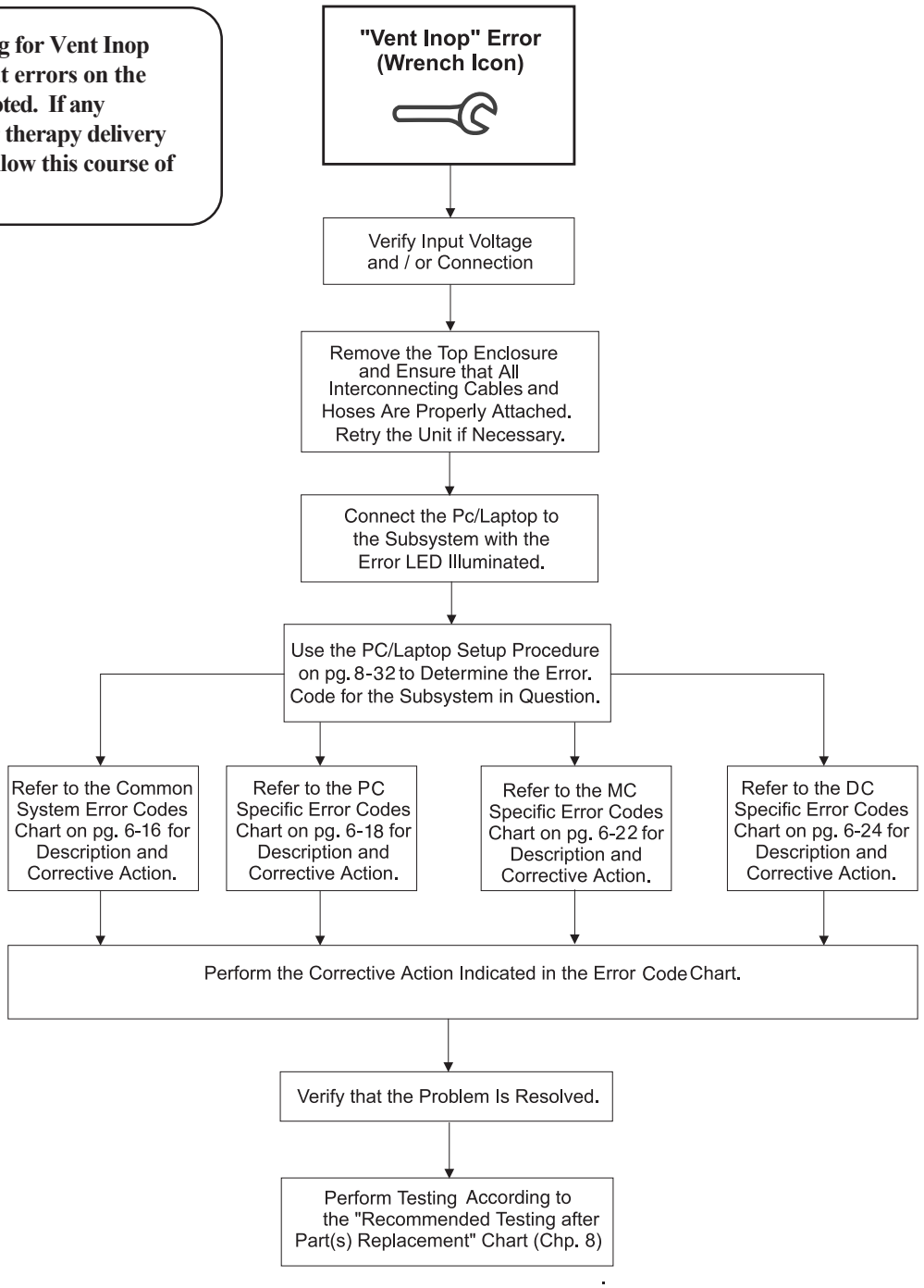


Figure 6-5
Vent Inop Indicator Troubleshooting Flow Chart

Vent Inop Errors (Continued)

Common System "Vent Inop" Errors

MC	DC	PC	Error Definition	Description	Corrective Action (Replace in order until the problem is corrected.)
0	0	0	Hardware Failure	Subsystem detects a hardware failure	Refer to error reported on other subsystem
601	E01	1601	Spurious interrupt	MCU detects spurious interrupt	Subsystem with LED lit
602	E02	1602	Unassigned interrupt	MCU detects unassigned interrupt	Subsystem with LED lit
603	E03	1603	Bus interrupt	MCU detects bus interrupt	Subsystem with LED lit
604	E04	1604	Illegal instruction	MCU detects illegal instruction executed	Subsystem with LED lit
605	E05	1605	Breakpoint error	MCU detects breakpoint error	Subsystem with LED lit
606	E06	1606	Divide by zero	MCU detects divide by zero	Subsystem with LED lit
607	E07	1607	Uninitialized interrupt	MCU detects uninitialized interrupt	Subsystem with LED lit
608	E08	1608	Software interrupt	MCU detects software interrupt executed	Subsystem with LED lit
609	E09	1609	Unused interrupt	MCU detects unused interrupt executed	Subsystem with LED lit
60A	E0A	160A	ROM CRC error	EPROM corrupted (stored CRC does not match calculated CRC)	Subsystem with LED lit
60C	N/A	N/A	Bad MC state	Invalid data on "MC state" signal	Subsystem with LED lit
60E	E0E	160E	Watchdog failure	Watchdog circuitry failure (software continues after long delay in watchdog timer test)	Subsystem with LED lit
614	E14	1614	Walking RAM test error	Pattern read from RAM doesn't match pattern written (RAM hardware problem)	Subsystem with LED lit
616	E16	1616	Watchdog reset after Watchdog	Power-on reset occurred after Watchdog test	Subsystem with LED lit Alarm PAL on MC
617	E17	1617	test SCI failed	completed SCI register not ready for a character to be output	Subsystem with LED lit
700	F00	1700	CRC error on third send to DC – MC	after a delay loop of one flip-flop iterations Calculated CRC does not match transmitted CRC on third try	ICB cable DC MC PC
701	F01	1701	NAK received on third send to DC-MC	Negative Acknowledgment message received on third try	ICB cable DC MC PC
702	F02	1702	Tack timeout on third send to DC-MC	Tack not received on last byte sent within 750 usecs	ICB cable DC MC PC

Common System "Vent Inop" Errors

703	F03	1703	Trply timeout on third send to DC-MC	Slave did not start responding within one msec of last byte sent from MC	ICB cable DC MC PC
N/A	F04	1704	MC timeout from slave	MC did not request data from slave within 15 msecs	MC/PC (if code exist)
705	F05	1705	Packet does not fit in message	Buffer in "Move Packet To Message" is out of room	Subsystem with LED lit
706	F06	1706	Invalid timer value	Timers not initialized before this call or invalid data on the timer parameter	Subsystem with LED lit
707	F07	1707	Invalid delay value	Timers not initialized before this call or requested delay is greater than one minute (prevents rollover)	Subsystem with LED lit
708	F08	1708	Invalid delay (usec)	Timers not initialized before this call or requested delay is greater than 85 usecs (use "Delay" for larger delays)	Subsystem with LED lit
709	F09	1709	GPT not initialized	GPT not initialized before call to Initiate Timers is made	Subsystem with LED lit
70A	F0A	170A	Invalid usec ticks	Timers not initialized before this call or PCsed parameter to large (greater than 62499 prevents rollover)	Subsystem with LED lit
70B	F0B	170B	Invalid priority level	PCsed priority level value has invalid data	Subsystem with LED lit
70C	N/A	N/A	CRC error on third send to PC	Calculated CRC does not match transmitted CRC on third try	ICB cable PC DC MC
70D	N/A	N/A	NAK received on third send to PC	NAK received on third try	ICB cable PC DC MC
70E	N/A	N/A	Tack timeout on third send to PC	Tack not received on last byte sent to PC within 750 usecs	ICB cable PC DC MC
70F	N/A	N/A	Trply timeout on third to PC	PC did not start responding within one msec of last byte sent from MC	ICB cable PC DC MC
FFFF	FFFF	FFFF	Illegal Error Report	Software recognzed an extra data bit	No Action Required

Vent Inop Errors (Continued)

PC Specific "Vent Inop" Error Codes

Code	Error	Description	Corrective Action (Replace in order until the problem is solved.)
1201	ADC timeout	After read of internal ADC, incomplete conversion occurred after a 173 usec delay. (ILFR, PRV, O_2, ANA ground, Vref)	PC
1202	Blower speed test fail	Invalid data in the "blower test status" signal	PC
1203	Error controlling operational tests	Invalid data in the "test case primary" and "test case secondary" signals	PC
1204	MUX voltage error	Invalid data in the "MUX channel" parameter	PC
1205	Other voltage error	Invalid data in the "channel" parameter	PC
1206	IADC failed	Internal ADC did not complete sequence before background sensors are read	PC
1207	MC did not communicate within start-up time	MC did not request status within 30 seconds of PC starting	ICB cable MC, PC, DC
1208	12 volts voltage reference test failed - operational	12 volt signal read from MUX is less than 11 volts or greater than 13 volts	PC
120A	Bulk supply voltage reference test failed - operational	Bulk supply signal read from MUX is less than 20 volts or greater than 38.88 volts	PC
120B	–12 volts voltage reference test failed - operational	–12 volt signal read from MUX is less than –13 volts or greater than –11 volts	PC
120C	–5 volts voltage reference test failed - operational	– 5 volt signal read from MUX is less than –5.425 volts or greater than -4.547	PC
120D	Reference Voltage test	Voltage reference signal read from MUX is less than 3.749 volts or	PC
120E	failed - operational QSM failed	greater than 4.445 volts Queued Serial Module failed	PC
120F	Error in rise rate processing	The Rise Rate information in the MC to PC message not within range (0-4)	ICB cable PC, MC, DC
1210	Blower voltage bad in safe state	Blower drive voltage read from MUX is greater than 15 mV	PC
1211	PRV voltage bad in safe state	PRV drive voltage read from internal ADC is greater than 15 mV	PC
1212	ILFR voltage bad in safe state	ILFR drive voltage read from internal ADC is greater than 15 mV	PC
1213	O_2 valve voltage bad in safe state	Oxygen module drive voltage read from Internal ADC is greater than15 mV	PC
1214	Failure controlling start-up tests	Invalid data in "test case"	PC
1215	12 volts voltage reference test failed - start-up	12 volt signal read from MUX is less than 10.12 volts or greater than 14.04 volts	PC
1216	ANA ground voltage reference test failed - start-up	ANA and signal read from MUX is less than 0 mV or greater than 500 mV	PC
1217	Bulk supply voltage reference test failed - start-up	Bulk supply signal read from MUX is less than 18.4 V or greater than 38.88 V	PC

PC Specific "Vent Inop" Error Codes

1218	–12 volts voltage reference test failed - start-up	–12 volt signal read from MUX is less than –14.04 V or greater than –10.12 V	PC
1219	– 5 volts voltage reference test failed - start-up	–5 volt signal read from MUX is less than –5.833 V or greater than – 4.467	PC
121A	Reference Voltage test failed - start-up	Voltage reference signal read from MUX is less than 3.749 V or greater than 4.445 V	PC
121B	Blower voltage reference bad - start-up	Blower drive voltage read from MUX is greater than 100 mV	PC
121C	ILFR voltage reference bad - start-up	ILFR drive voltage read from internal ADC is greater than 100 mV	PC
121D	O_2 valve voltage reference bad - start-up	Oxygen Module drive voltage read from Internal ADC is greater than 100 mV	PC
121E	PRV voltage reference bad - operational	PRV drive voltage read from internal ADC is greater than 100 mV	PC
121F	Blower voltage reference bad - operational	Blower drive voltage read from MUX is greater than 40 mV on the second try immediately after first try	PC
122A	Corrupted Resistance Table	Invalid data in the resistance table - Software Error	PC
122B	Invalid Mode	Selected mode not supported in software - Software Error	PC needs PAV / T EPROM
122C	Blower Failure	Blower Bad (overcurrent, undervoltage, shut down)	PC, Blower
122D	Bad Backup unit outlet pressure sensor	Data can not be read from backup unit outlet pressor sensor	PC
122E	Unit outlet difference	Unit outlet and backup unit outlet sensor readings differ too much	PC,AFM,PSS
122F	Stuck backup unit outlet pressure sensor	Bad backup unit outlet pressure sensor or ADC	PC
1220	ILFR voltage reference bad - operational	ILFR drive voltage read from the internal ADC is greater than 40 mV on the second try immediately after the first try	PC
1221	O_2 valve voltage reference bad - operational	Oxygen Module drive voltage read from the internal ADC is greater than 40 mV on the second try immediately after the first try	PC
1222	PRV voltage reference bad - operational	PRV drive voltage read from the internal ADC is greater than 40 mV on the second try immediately after the first try	PC
1225	Internal ADC calibration divide by zero	Analog Vref signal = analog ground	PC
1226	Bad O_2 temperature sensor	Oxygen Module temperature out of range (40-160° F), for 2500 counts, conversion did not complete	OM
1227	Blower out of calibration / stuck motor	Blower speed ± 750 RPM from desired setting for 12 seconds	Blower PC
1228	Bad pressure setpoint calculated	LPF of pressure setpoint in the rise rate calculation not in range of the unit outlet pressure - error in LPF calculation	PC
1229	Patient pressure sensor drift error	LPF of change in pressure average is greater than 10 cm H_2O if the flow is less than 5 LPM	PC
1230	Voltage Failure	Voltage reference test failed	PC

PC Specific "Vent Inop" Error Codes

Code	Error	Description	Corrective Action (Replace in order until the problem is solved.)
1300	Bad AFM calibration	AFM calibration data all zeroes or CRC bad data CRC	AFM
1301	Bad O_2 Module calibration data CRC	OM calibration all zeroes or CRC bad	OM
1302	Bad PC calibration data CRC	PC calibration data all zeroes or CRC bad	PC
1304	QSM timeout	QSPI not finished after 100 usecs after selection of EEPROM for reading of actual read	PC
1305	No AFM	AFM detection signal, supplied by hardware, is greater than 300 mV (cut off for AFM being present)	AFM cable AFM PC
1308	Bad pressure setpoint message from MC	MC commanded pressure in message is greater than 40 cm H_2O	ICB cable MC PC DC
1309	Bad rise rate message from MC	Rise rate setpoint in MC message is greater than four (4)	ICB cable MC PC DC
130A	Bad IPAP setpoint message from MC	IPAP pressure setpoint in the MC message is greater than 40 cm H_2O (non-PAV) or 50 cm H_2O (PAV)	ICB cable MC PC DC
130B	Bad O_2 concentration setpoint message from MC	Oxygen concentration in the MC message is less than 21 or greater than 100	ICB cable MC PC DC
130C	Invalid MC message	Byte count in message not equal to expected byte count	ICB cable MC PC DC
1312	AFM detect conversion cannot be done	Read of ADC not completed in time for the AFM detection read	AFM cable AFM PC

PC Specific "Vent Inop" Error Codes

1313	OM detect conversion cannot be done	Read of ADC not completed in time for OM detection read	OM cable OM, PC, AM
1316	Stuck absolute atmospheric pressure sensor	Sensor reading is less than 20 in. HG or greater than 40 in. HG for 2.5 seconds	PC
1317	Stuck unit outlet pressure	Sensor reading is less than –5 cm H_2O or greater than 70 cm H_2O for 2.5 seconds	AFM cable AFM
1318	Stuck patient pressure sensor	Sensor reading is less than –5 cm H_2O or greater than 50 cm H_2O for 2.5 seconds	PC
1319	Stuck total flow sensor	Sensor reading is less than –200 LPM or greater than 300 LPM	AFM cable AFM
131A	Stuck O_2 flow sensor	Sensor reading is greater than 120 LPM for 2.5 seconds	OM cable OM
131B	Bad air temperature sensor	Air temperature out of range (40 - 160° F) for 2500 counts, conversion not complete	AFM cable AFM PC
131C	ATM detected bad unit outlet pressure sensor	(High ATM - Low ATM) × 100 is greater than or equal to (5 × High ATM)	PC
131D	Bad calibration data 2 CRC	PC calibration data 2 CRC is bad after filling with either default values or calculated data and reading them back out	PC
131E	Bad PC calibration data 3 CRC	PC calibration data 3 CRC is bad after filling with default values and read them back out	PC
131F	Error in drift tests	Invalid data in "drift test case"	PC
1320	Bad AFM drift calibration data CRC	AFM calibration data 1 CRC is bad after filling with either default values or calculated values and read them back out	AFM cable AFM PC
1321	Bad PC calibration	PC calibration data 4 CRC is bad after filling with either default values or calculated data and read them back	PC
1322	Sensor drift failure	Unit outlet or pressure sensor out of range (Tolerance + 2 cm H_2O around nominal)	AFM cable AFM PC
1323	Bad Calibration data 6 CRC	Drift Data could not be updated.	PC
1324	Bad OM drift calibration data CRC	OM calibration data 1 CRC is bad after filling with either default values or calculated data and reading them back	OM cable, OM, PAS
1325	Total Flow Sensor Drift	Total Flow sensor drifted too much	AFM cable, AFM, PAS
1326	Oxygen Flow Sensor Drift	Oxygen Flow sensor drifted too much	OM cable OM,PAS

MC Specific "Vent Inop" Error Codes

Code	Error Definition	Description	Corrective Action (Replace in order until the problem is corrected.)
206	RTC test error	Invalid data on the "RTC case" signal or SPI time-out when attempting to get time	MC
207	Illegal Operational Test	Requested test does not exist	MC
209	+12 volt out of range	ADC voltage test	MC
20A	-12 volt out of range	ADC voltage test	MC
20B	+24 volt value out of range	ACC voltage test	MC
20C	Reference voltage value out of range	ADC voltage test	MC
20D	ADC could not return +12 volt value	ADC voltage test	MC
20E	ADC could not return-12 volt range	ADC voltage test	MC
20F	ADC could not return +24 volt value	ADC voltage test	MC
210	ADC could not return Reference Voltage Value	ADC voltage test	MC
211	Power Fail without AC Fail	Loss of bulk supply without loss of AC input caused by PS1 trip	MC PSS PC
301	Invalid byte count in DCS message	Byte count from DCS not within range (greater than 0)	ICB cable DC MC
304	Divide by zero in sum total breaths calculation	Calculation error	MC
305	Divide by zero in baseline error calculation	Clock cycle times per breath = 0	MC
306	Divide by zero in calc. BPM / Min Vent calc.	Sum total time = 0	MC

MC Specific "Vent Inop" Error Codes

Code	Error Definition	Description	Corrective Action (Replace in order until the problem is corrected.)
307	Divide by zero in Ti / Ttot calculation	Clock cycles time per breath = 0	MC
30A	MC scan cannot be performed (overflow of 10 msecs process)	Response task did not complete processing before 10 msecs interrupt occurred again	ICB cable DC PC
30B	Invalid command for CPAP mode	Received command ID from DC for some S/T or PAV/T specific message	D C MC
30C	Invalid command for S/T mode	Received command ID from DC for some CPAP or PAV/T specific message	DC MC
30D	Invalid command for PAV / T mode	Received command ID from DC for some CPAP or S/T	DC
30E	No dispatch function	Command ID from DC not recognized	DC
310	Invalid mode update	Invalid mode update	MC
311	Illegal alarm module	Hardware returns something other than built-in Module B	MC
312	MC Scan Overruns	Response task did not complete processing before 10 msecs interrupt occurred again, 3 times in 1 hour.	ICB cable DC PC MC
313	PAV/T Security failure	PAV/T Software implementation not accessible	Contact Respironics Technical Service
332	Pressure regulation	Cannot regulate to 2 cm H_2O in Pressure Out or Flow Limit Control	ILFR valve PRV valve Blower PC AFM MC
333	Invalid S / T state	Invalid data on "system status state" signal (not BPM, IPAP, or EPAP)	MC
334	Invalid PAV state	Invalid data on "system status state" signal (not BPM, IPAP, EPAP, or To Inspiratory)	MC
335	Invalid mode	Invalid data on "active mode" signal (not Standby, CPAP, or PAV/T)	MC

DC Specific "Vent Inop" Error Codes

Code	Error Definition	Description	Corrective Action (Replace in order until the problem is corrected.)
B00	Bad ICB message from MC	Status in self-test message not valid, Byte count in message greater than 125, command ID not recognized.	ICB cable DC MC PC
B01	Bad download sequence from MC	DC received download message when not expecting it	ICB cable DC MC PC
B02	Bad mode	Invalid data in "test mode" and "test mode" signals. Mode-specific messages received in the wrong mode	DC
B03	Error decoding hard key table	ICB message corresponding to selected hard key not valid	DC
B04	Bad screen state	Receive soft key selection for mode when impossible (illegal entry into process key stroke function)	DC
B09	Simultaneous failure of audible	Simultaneous failure of Vent Inop LED and Audible Alarm as alarm and system error LED indicated by hardware	DC
B0A	MC did not start communication within start-up time	MC did not send status request within 30 seconds of the DCS starting up	MC D C
B0B	Bad font type	Invalid data on the "G screen font type" signal	D C
B0C	Bad video memory address	Calculated screen pixel to which to begin writing is to large (off the screen)	D C
B0D	DC queue overflow	No room in the display queue for incoming MC message (background not running often enough)	D C
B0E	Bad graph size	X length or Y length is less than or equal to zero (invalid memory data)	D C
B0F	No graph structure available	An attempt is being made to initialize a fourth graph	D C
B10	Spurious keypad interrupts	More than ten keypad interrupts in a row with no key depressed	Touch pad D C
11D7	Invalid start-up test	Invalid "test case" data	D C
11D8	Invalid BIST test	Invalid "Built-In Self Test" case data	D C
11D1	Keypad Error	Key is pressed during start-up tests or held down too long (10 sec.)	Touchpad DC

Error Codes Chart Abbreviation Definitions

Abbreviation	Definition
ADC	Analog to Digital Converter
AFM	Air Flow Module
ANA	Analog
ATM	Atmospheric
BIST	Built-In Self Test
CRC	Cyclic Redundancy Check
D C	Display Control
EPROM	Electrically Programmable Read Only Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
GPT	General Purpose Timer
IADC	Internal Analog to Digital Converter
ICB	Intermodule Communications Bus
ILFR	In-Line Flow Restrictor
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LPF	Low PCs Filter
MC	Main Control
MCU	Microcontroller Unit
MP	Microprocessor
MUX	Multiplexer
NAK	Negative Acknowledgment
NVRAM	Non-Volatile Random Access Memory
O_2	Oxygen
OM	Oxygen Module

Error Codes Chart Abbreviation Definitions (Continued)

Abbreviation	Definition
PC	Pressure Control
PAV	Proportional Assist Ventilation
PAV/T	Proportional Assist Ventilation / Timed
PRV	Pressure Release Valve
QSM	Queued Serial Module
QSP	Queued Serial Peripheral Interface
RAM	Random Access Memory
ROM	Read Only Memory
RPM	Revolutions Per Minute
RTC	Real Time Clock
SCI	Serial Interface
SPI	Serial Peripheral Interface
Tack	Acknowledge Timer
Trply	Reply Timer
Vref	Voltage Reference

Chapter 7: Repair and Replacement

Chapter 7: Repair and Replacement

7.1 Contact Information

Figures 7-1 and 7-2 list the names and identify the locations of major replaceable components in the BiPAP Vision. These drawings provide a quick reference and overview of the unit.

Note: Refer to Section 8.2 for testing that is required after items are replaced.

For replacement part ordering information, technical or clinical assistance contact Respironics Customer Service at:

U.S. and Canada

Parts Ordering: **1-800-345-6443**
Fax: **1-800-886-0245**

Technical Support: **1-800-345-6443**
Fax: **1-724-387-5236**

International (Parts or Technical Assistance)

Phone: **1-724-387-4000**
Fax: **1-724-387-5012**

E-Mail Technical Assistance **service@respironics.com**

Visit Respironics Home Page on the World Wide Web at:

http://www.respironics.com

7.2 Exploded View

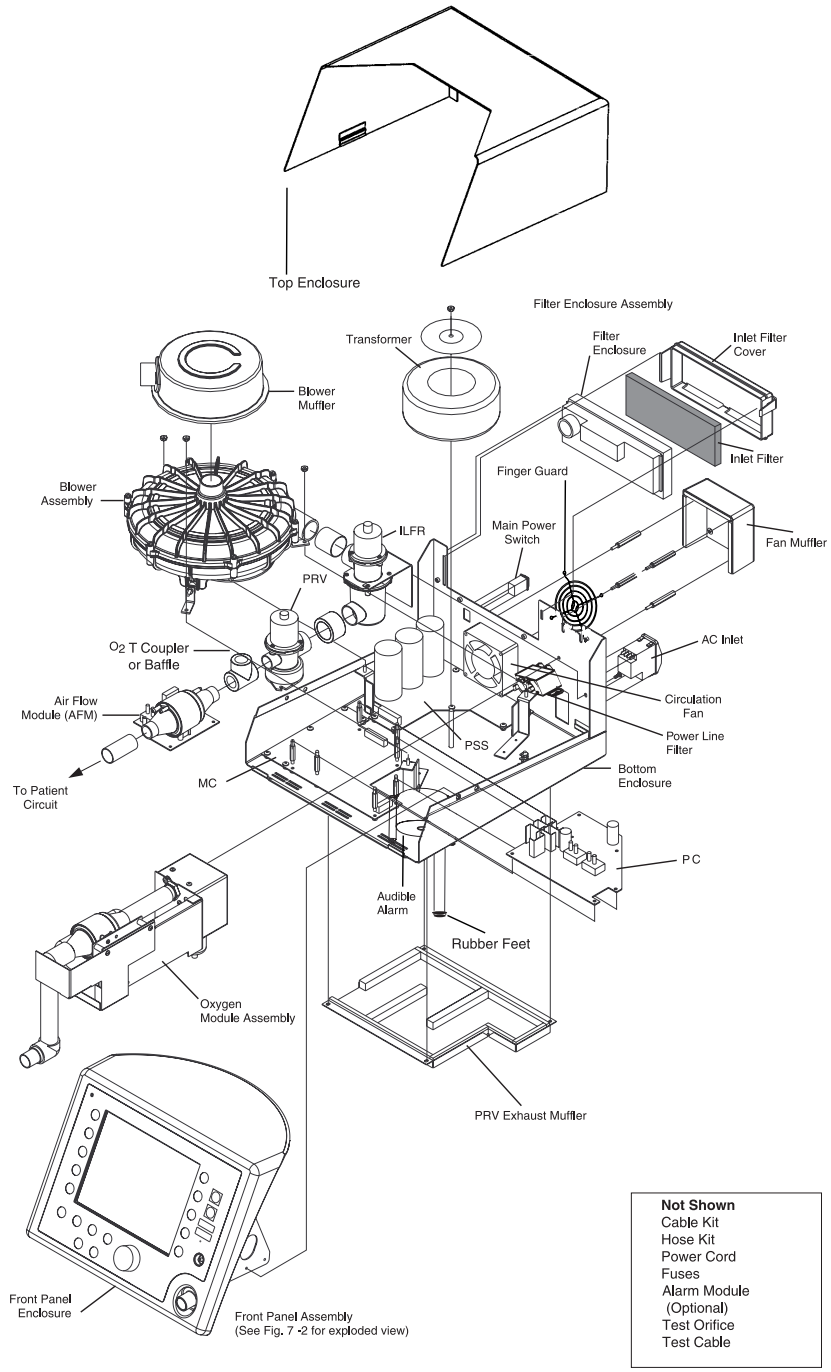


Figure 7-1
BiPAP Vision Ventilator Component Location and Identification

Exploded View (Continued)

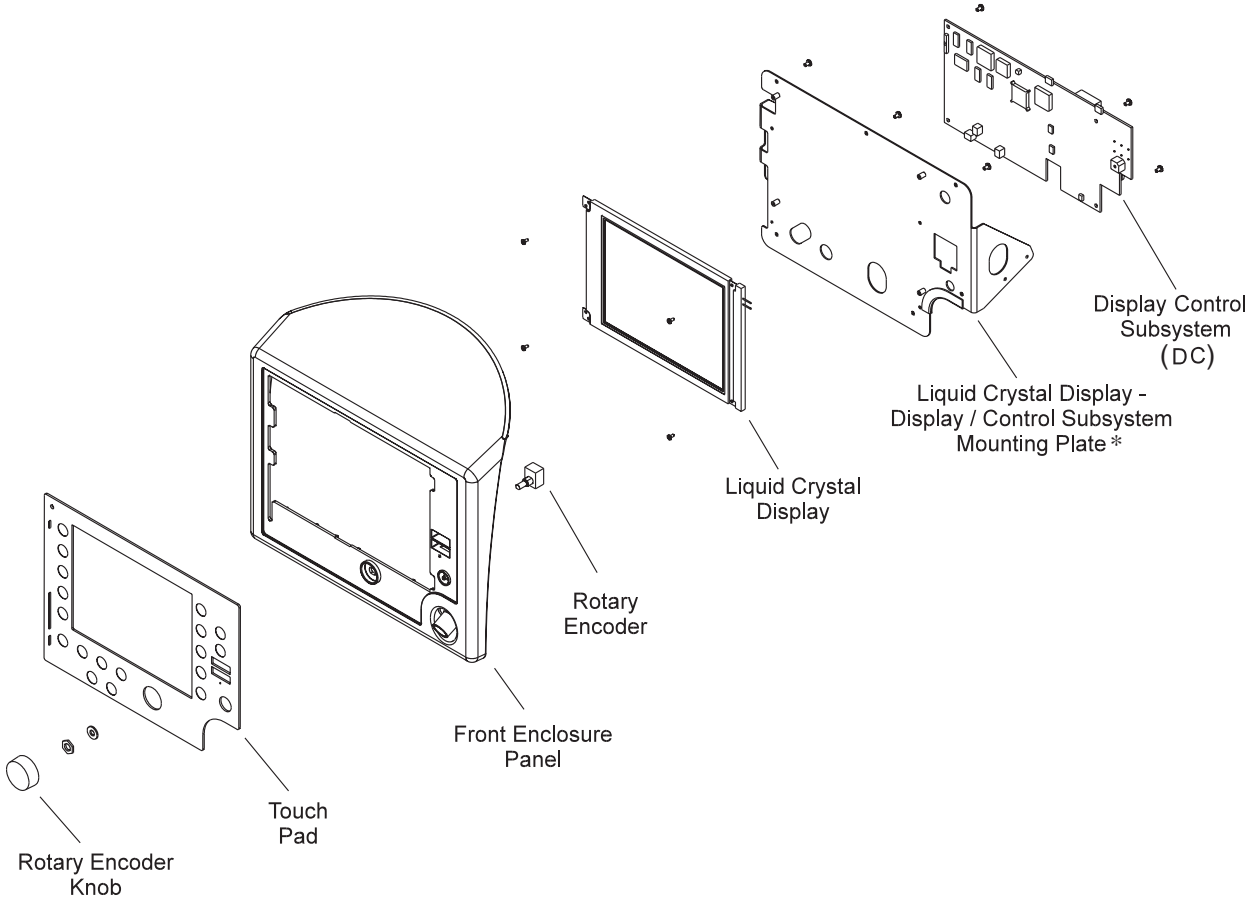


Figure 7-2
Front Panel Assembly Exploded View

* Not available as a repair kit, contact Technical Support for assistance.

7.3 BiPAP Vision Repair Kits

Replacement Kit	Replacement Part No.	Photo Page No.
AC Inlet (includes power inlet filter)	582138	7-13,7-14
AC Power Cord (North American) (See Note 2)	362435	Not Shown
AC Power Cord Clamp	1000751	7-13,7-43
Airflow Module (AFM)	582127	7-19,7-31,7-37
Alarm Module (Optional)	582158	7-36
Audible Alarm	1000743	7-19,7-30,7-31
Backlight	1014432	7-56
Battery, (MC board) S/N >106K (See Note 8)	1006005	7-36
Battery, Lithium (MC board) S/N<106K (See Note 8)	1001988	7-53
Battery (DC, Alarm)	1012819	7-17
Blower Assembly	582128	7-20,7-21
Blower Muffler	582129	7-20
Blower Valve Coupler	1003728	7-26,7-57
Blower Vibration Isolator (x3)	1003893	7-21
Bottom Enclosure S/N < 106K	582130	7-43,7-55
Bottom Enclosure S/N > 106K	1004700	7-13,7-55
Cable Kit (all interconnecting)	582131	Not Shown
Circulation Fan	582132	7-26,7-27
Circulation Fan Muffler	English – 582155 International - 1005618	7-16,7-43
Coiled Pressure Tube 28"	1000752	7-19,7-30,7-31
DC Subsystem S/N >106K (see note 4)	1004709	7-17
DC/LCD Ribbon Cable	1016457	7-56
DCS Connector	1007206	Not Shown
DC/MC/PC Upgrade with PAV S/N<106K	1004707	7-24,7-25
DC/MC/PC Upgrade S/N<106K	1004714	7-24,7-25
Display Control (D/CS)	582133	7-24, 7-25, 7-45, 7-46
EPROM V11 S/N<106K	1000286	7-47
EPROMS V11 S/N<106K W/PAV	1003524	7-47
EPROM V12 S/N<106K	1000351	Not Shown
EPROMS PAV 12 S/N<106K	1000349	Not Shown
EPROMS V13 S/N>106K	1000353	7-11,7-36
EPROMS PAV V13 S/N>106K	1000354	7-11,7-36

BiPAP Vision Repair Kits (Continued)

Replacement Kit	Replacement Part No.	Photo Page No.
EPROM Extraction Tool Kit	1006874	Not Shown
Front Panel Enclosure	582135	7-54
Fuses, 115VAC, S/N <100500	582100	Not Shown
Fuses, 100-120 Volt, S/N >100499 (Also part of upgrade kit 1004713)	1000749	7-14
Fuses, 230-240 Volt, all S/N's (Also part of upgrade kit 1000356)	1000750	7-14
Grounding Post	1002902	7-13,7-26
Grounding Post Hand Punch	1002991	Not Shown
Keypad, English Keypad, German Keypad, Universal	582151 582221 1004712	7-54
Hose Kit (All internal Tubing)	582136	Not Shown
ICB Cable S/N <106K	582159	7-49
ICB Cable S/N >106K	1004695	7-18,7-19,7-28,7-30
In-Line Flow Restrictor (ILFR) Valve Assembly	582137	7-29,7-35,7-39
Inlet Filter Cover	1003444	7-13,7-15,7-43
Inlet Filter Enclosure Assembly (see note 7)	582134	7-13,7-15,7-20
Inlet Filter Foam Strip	1004493	7-52
Inlet Filter Replacement (×6) Inlet Mesh Filter (Nylon)	582101 1000747	7-15 7-15
Label, Diagnostic/Nurse S/N>106K	1004703	7-16
Liquid Crystal Display (LCD) Assembly	582139	7-17,7-56
Main Power Switch	582141	7-13,7-26,7-38

Replacement Kit	Replacement Part No.	Photo Page No.
MC/DC Cable S/N>106K	1004698	7-28
MC Board S/N>106K (see note3,4)	1004711	7-34,7-36
Mobile Stand III Shipper	1009410	Not Shown
Mobile Stand III drawer feet	1009745	Not Shown
Ni-Cad Alarm Battery for DC (all)	1012819	7-17, 7-22, 7-25
Nurse Call Adapter (Executon/Hill-Rom connector)	1014280	Not Shown
Nurse Call Cable	1003742	Not Shown
Nurse Call Harness S/N >106K	1004697	7-26,7-27,7-36
Oxygen Baffle	1004705	7-26,7-31,7-35
Oxygen Module (OM) Assembly	English- 582142 Int'l - 1004977	7-13,7-20,7-29, 7-32
Oxygen Module (OM) Manifold / Regulator Filters (x5)	582153 1007547	7-13
Oxygen Module (OM) Manifold/Regulator Bowl	582154 1007546	7-13
Oxygen Regulator/Manifold	1014434	7-32
Oxygen Flowbody/PCA	1014433	7-32
Oxygen Inlet Fitting (DISS)	1014805	7-32
PC Board S/N>106K (see notes 3,4)	1004710	7-11
PC/MC Upgrade PAV S/N<106K	1000356	7-33
PC/MC Upgrade S/N<106K (see notes 3,4)	1004713	7-33
Power Harness PC/DC S/N>106K	1004696	7-28
Power Harness PSS/PC S/N>106K	1004706	7-27,7-30
Power Supply Subsystem (PSS)	582145	7-26,7-27,7-30,7-38
Pressure Regulation Valve (PRV) Assembly	582147	7-29,7-35,7-39
Pressure Regulation Valve (PRV) Muffler	582156	7-55
Rotary Encoder	582148	7-23
Rotary Encoder Knob	582157	7-17,7-54
Rubber Feet	582149	7-43,7-55
Service Manual	582160	Not Shown

BiPAP Vision Repair Kits (Continued)

Replacement Kit	Replacement Part No.	Photo Page No.
Shipping Container (includes all necessary inner packaging)	1002424	Not Shown
Test Cable(S/N <106K) (see section 8.10)	582161	7-58
Test Cable (Ribbon) **(or RS232 Ribbon Harness for S/N >106k)**	1004699	7-17,7-19,7-27, 7-36,7-42
Test Cable S/N >106K (see section 8.10) **(or for upgraded units)**	1004823	7-58
Test Orifice (0.25”)	332353	Not Shown
Top Enclosure	582150	7-13,7-43
Transformer Assembly	582152	7-26,7-27, 7-40

NOTE 1: All items have a quantity of one unless otherwise specified.

NOTE 2: For specific country AC power cord ordering information, please contact Respironics Customer Service.

NOTE 3: The original EPROM must be removed from the circuit board and installed into the new circuit board, unless performing an upgrade to units S/N<106K. EPROMS are included.

NOTE 4: This item is either a Replacement Part or an Optional Upgrade for the unit.

NOTE 5: For units from S/N 100500 to 100999, the PSS (582145) and power wiring harness (part of 582131) must also be replaced if not already done.

NOTE 6: For units from S/N 100500 to 100999, the PSS (582145), main power switch (582141) and the power wire harness (part of 582131) must also be replaced.

NOTE 7: The Inlet filter foam strip (1004493) should also be ordered with this kit.

NOTE 8: **CAUTION:** Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

7.4 BiPAP Mobile Stand Repair Parts

Mobile Stand II	
Replacement Kit	**Replacement Part No.**
Mobile Stand II Caster (locking)	1001921
Mobile Stand II Casters (x3) (non-locking)	1001922
Mobile Stand II Circuit Arm Mount	1002310
Mobile Stand II Plexiglass Door	1001920
Mobile Stand II Pole	1001923
Mobile Stand II Shipping Container	1002425
Mobile Stand II Strike / Catch Kit	1002151
Circuit Support Arm Handle	1006501
Mobile Stand III	
Replacement Kit	**Replacement Part No.**
Humidifier Bracket	1005101
O2 Hose Hanger Assembly	1007903
Oxygen Analyzer Pole	1011515
Storage Compartment	1007904
Mobile Stand III Storage Tray	1007905
Mobile Stand III Shipper	1009410
Mobile Stand III Storage Tray Feet	1009745

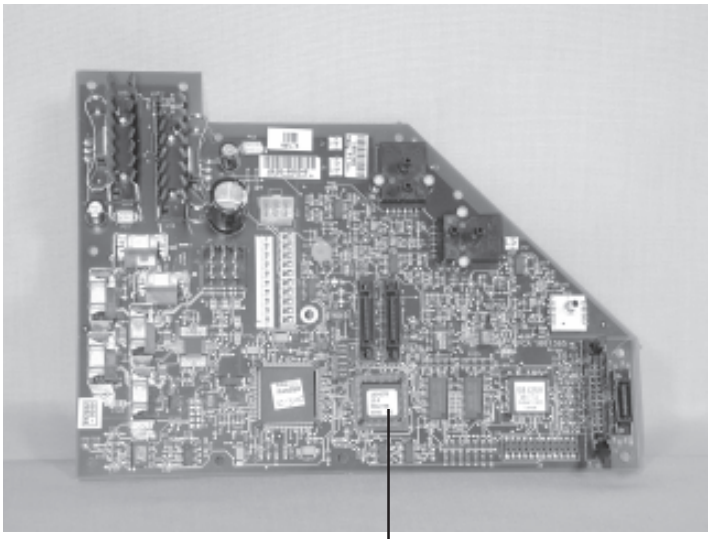
7.5 Replacement Identification Photos

Overview

The following identification photos are to be used as repair guidelines. Items have been identified for all serial number units beginning with 100500 to present.

Pressure Control Board S/N >106K

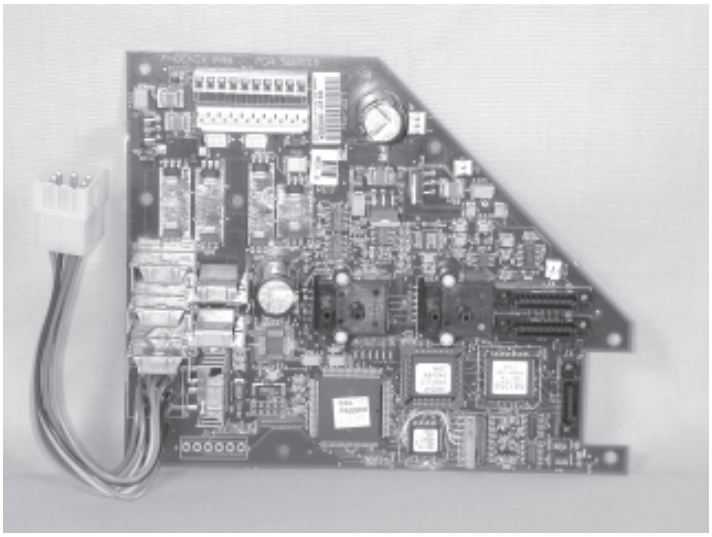
(1004710)



EPROM S/N >106K
(1000353)
(W / PAV 1000354)

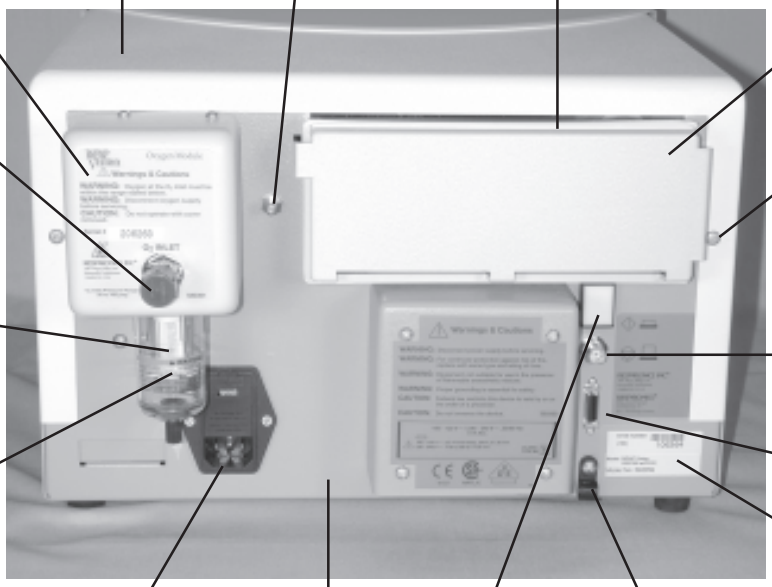
Pressure Air Flow Subsystem

Note: This item is obsolete, originally P/N 582146. Replaced by 1004713 for units S/N <106001.



Rear View

S/N >106000

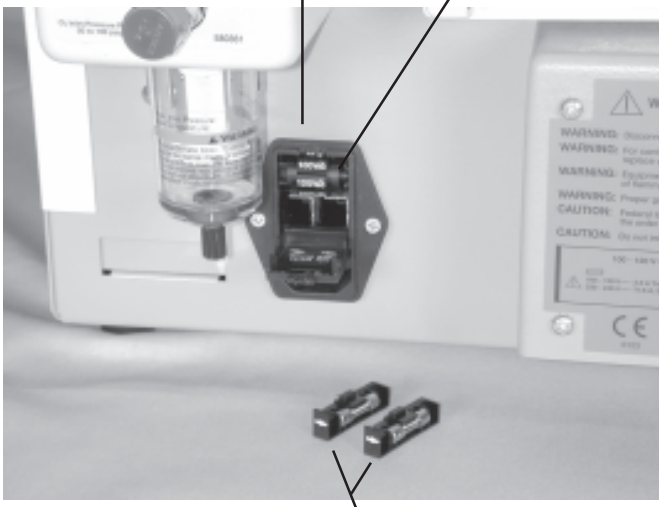


Fuses and Voltage Selector

Fuse Location

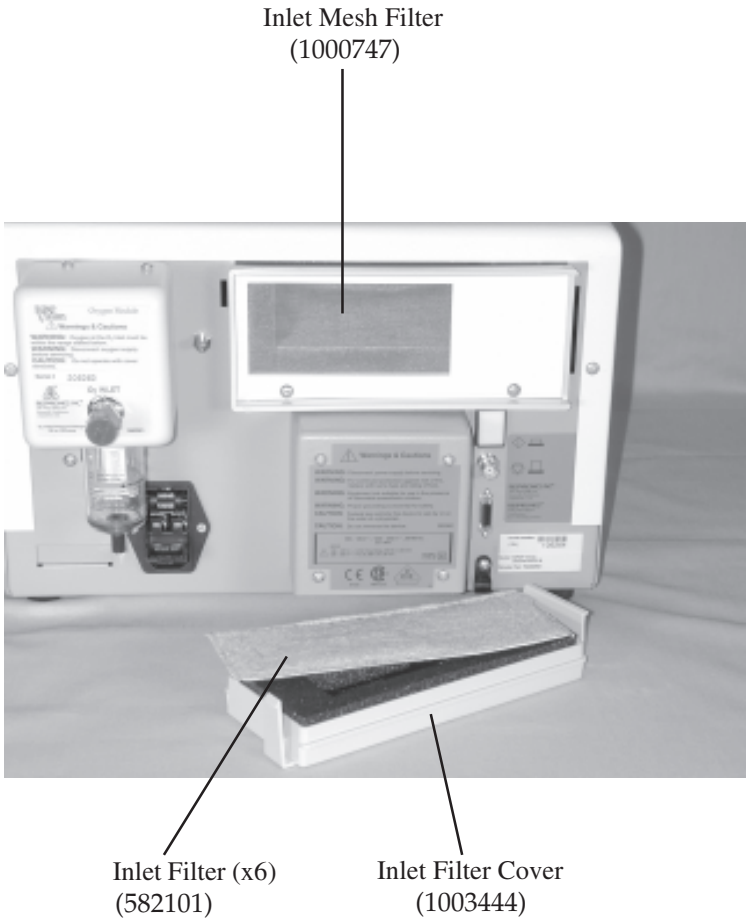
AC Inlet
(582138)

Voltage Setting



Fuses
(1000749 for 100 and 120 VAC operation
1000750 for 230 and 240 VAC operation)

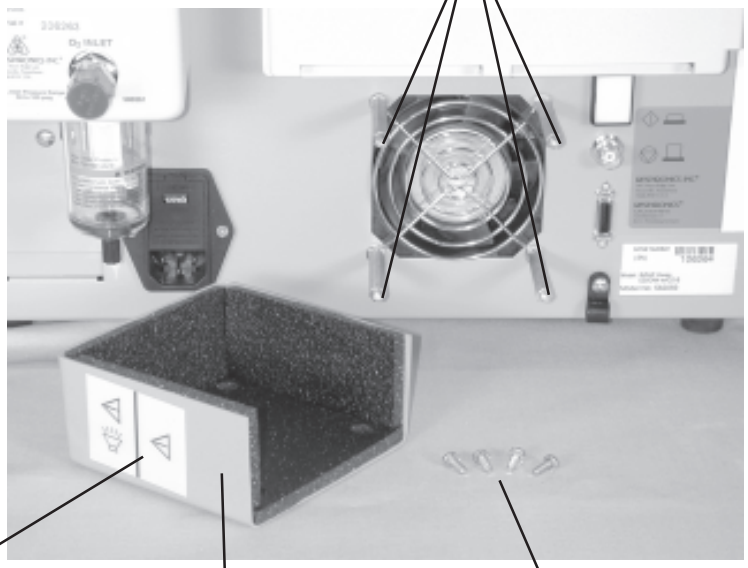
Inlet Filter Enclosure (582134)



Exploded View (Continued)

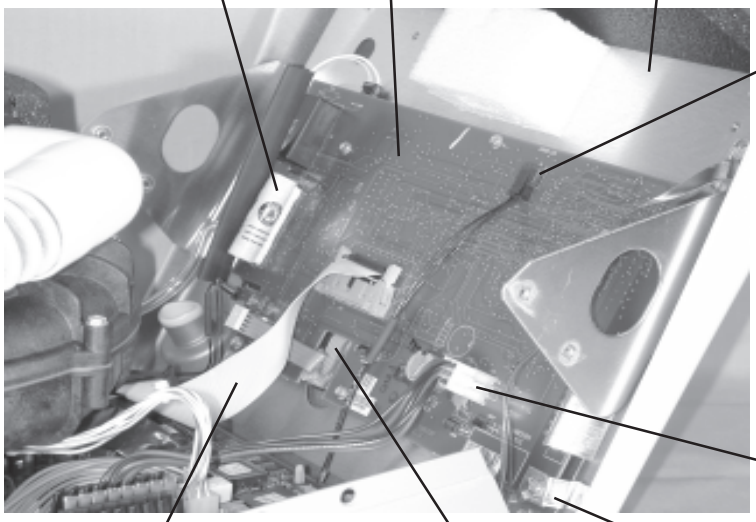
Circulation Fan Muffler

(English 582155)
(Int'l 1005618)

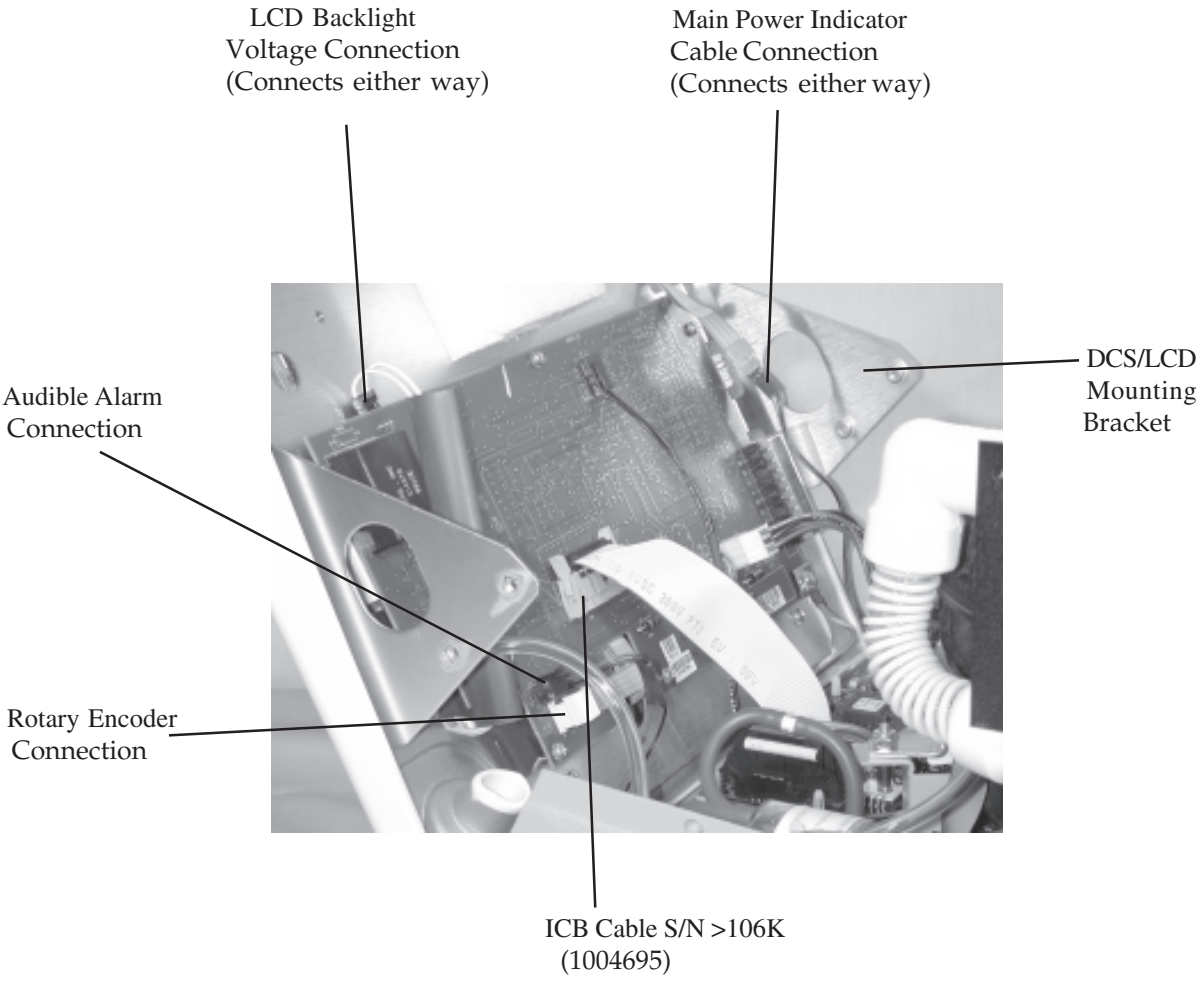


* Included

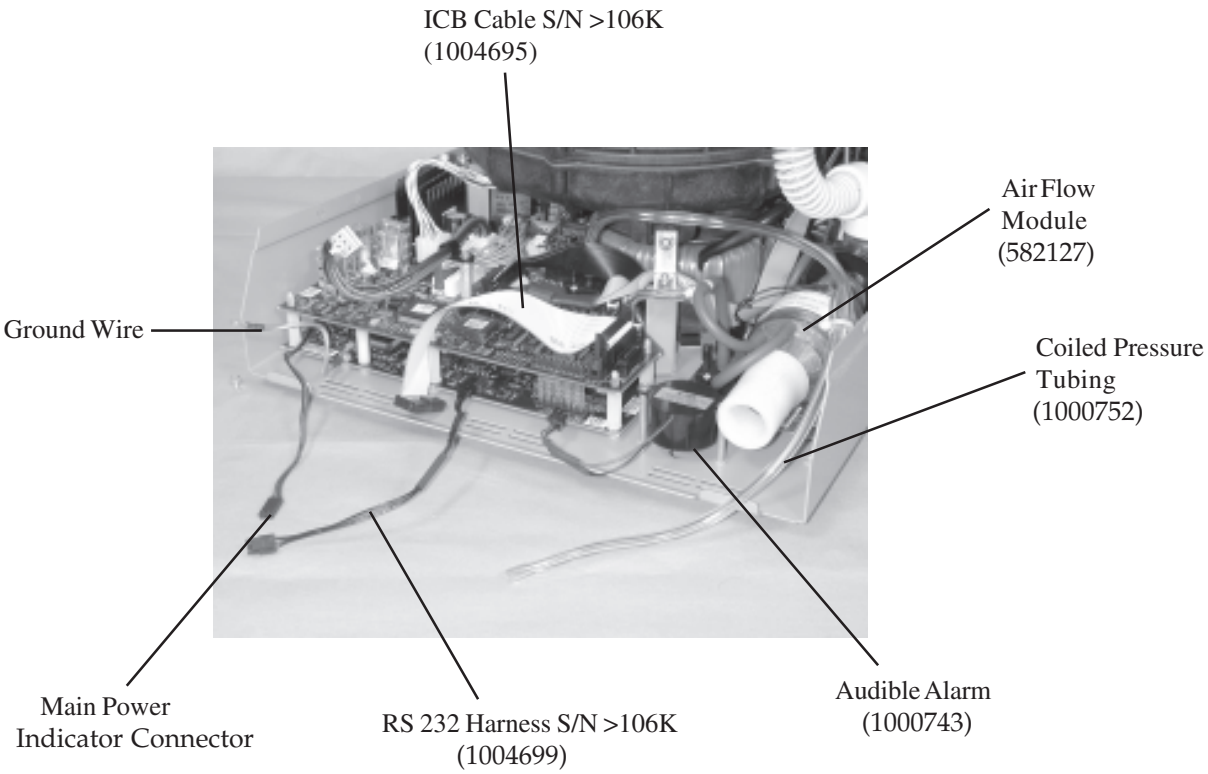
DC View #1 S/N >106K



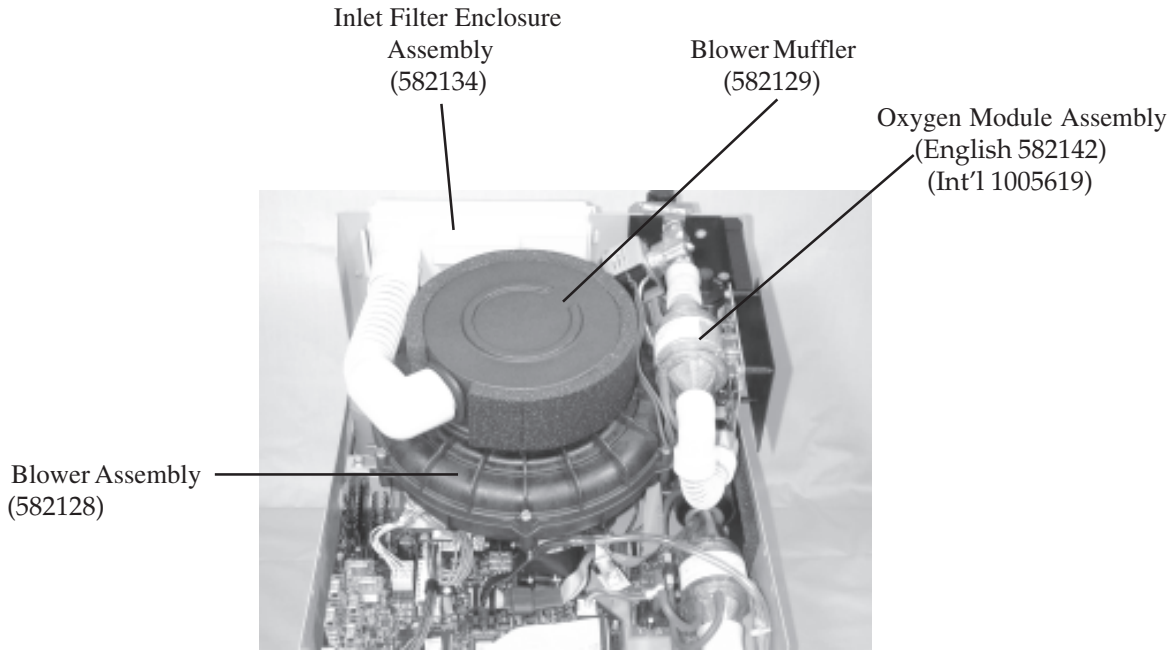
DC View #2
S/N >106K



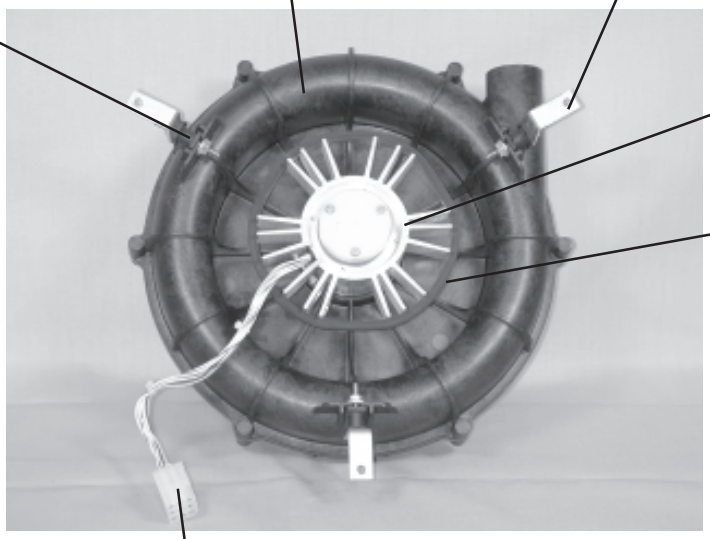
Component Identification



Component Identification

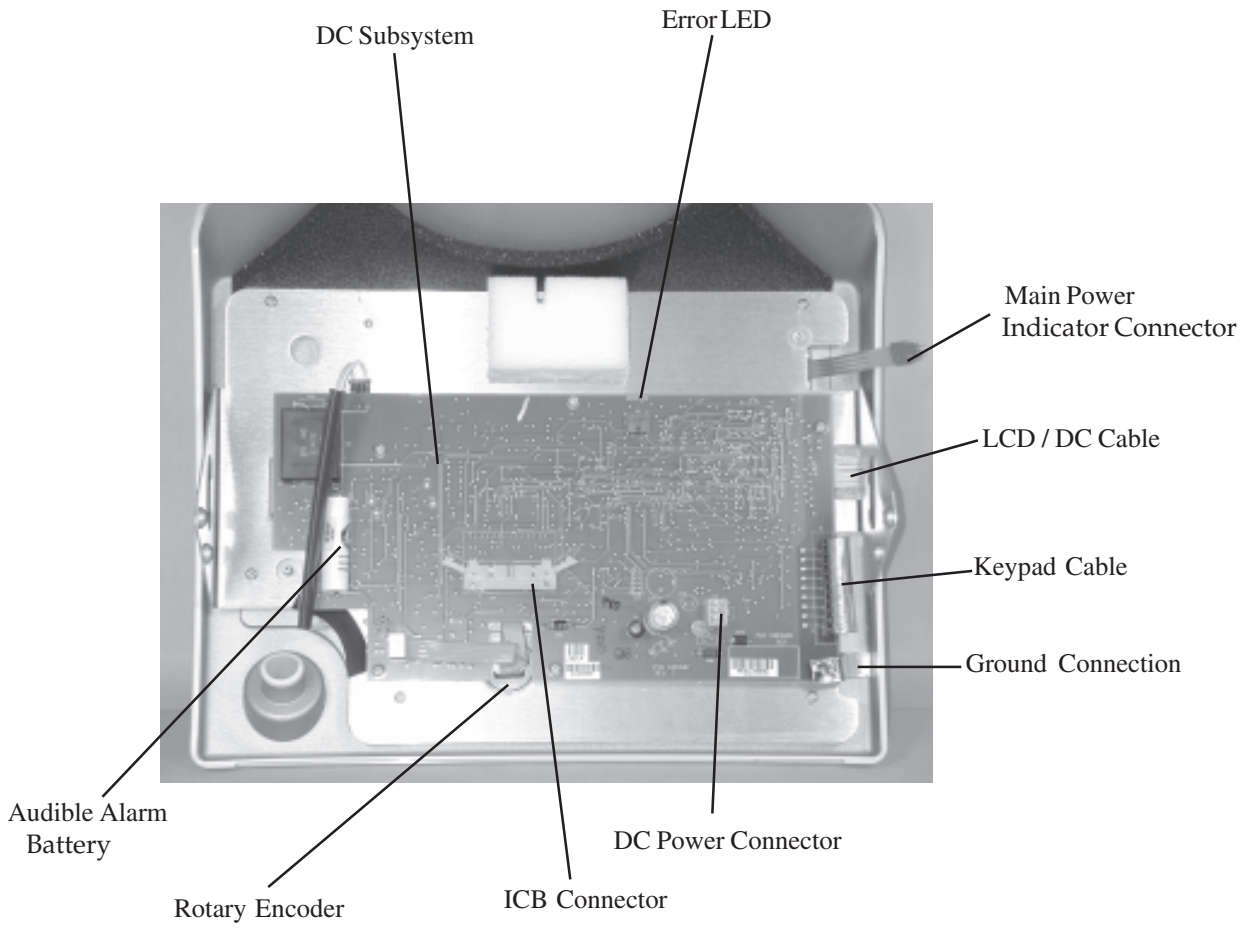


Blower Assembly
(582128)

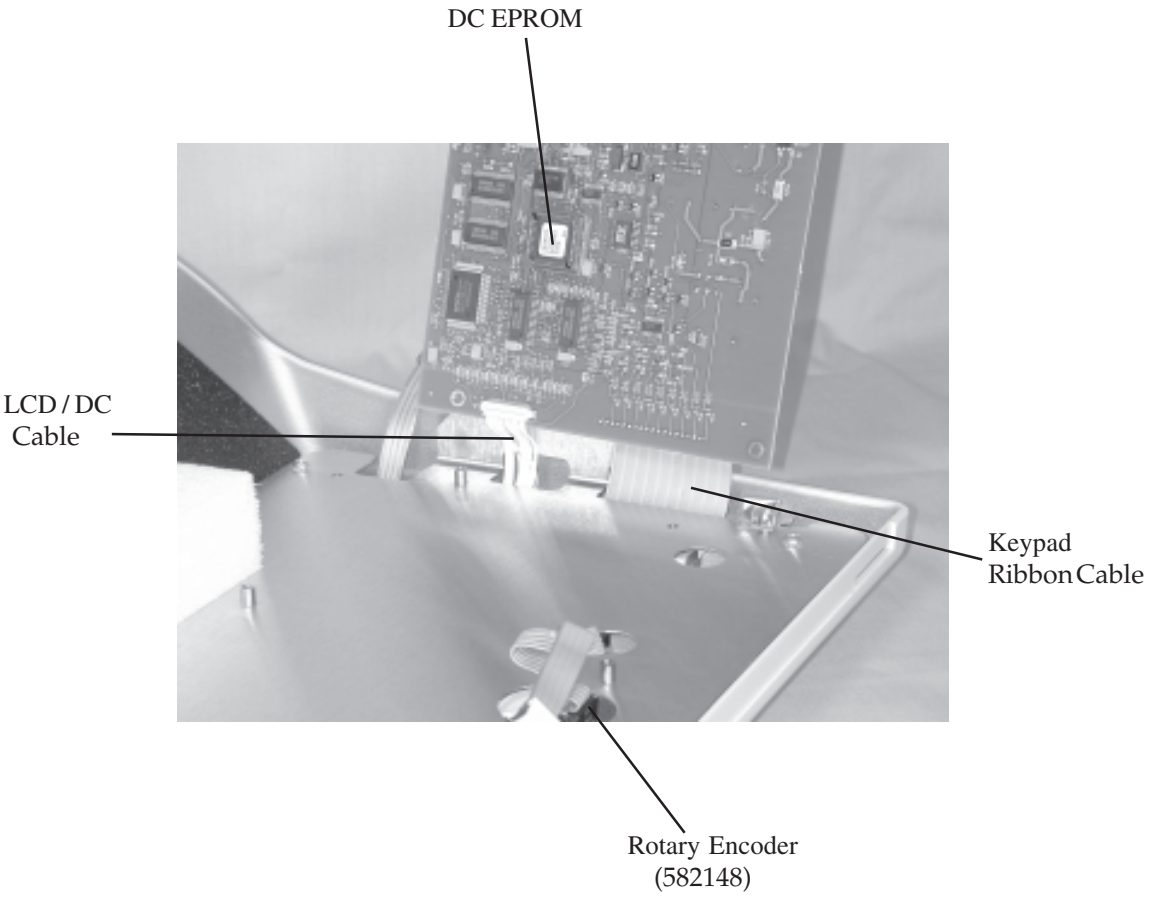


* Not sold seperately

Front Panel Assembly

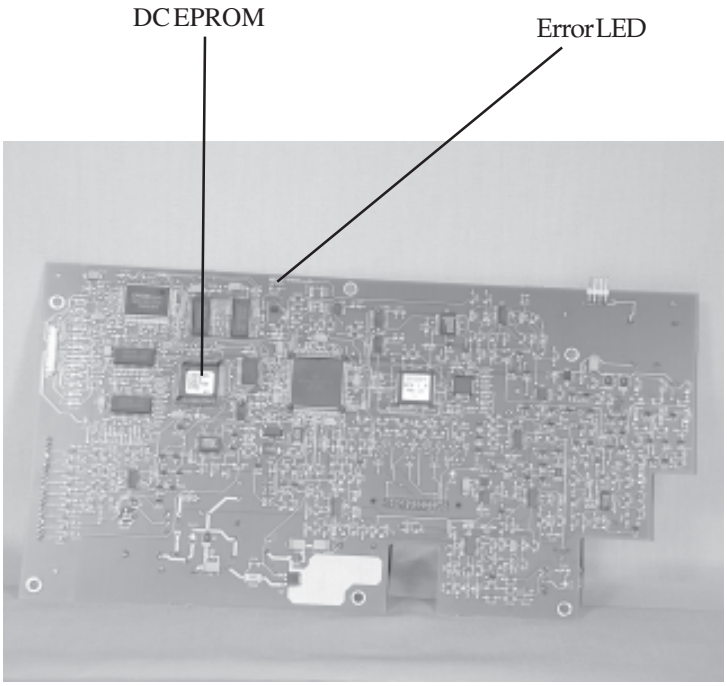


DC Cable Connections



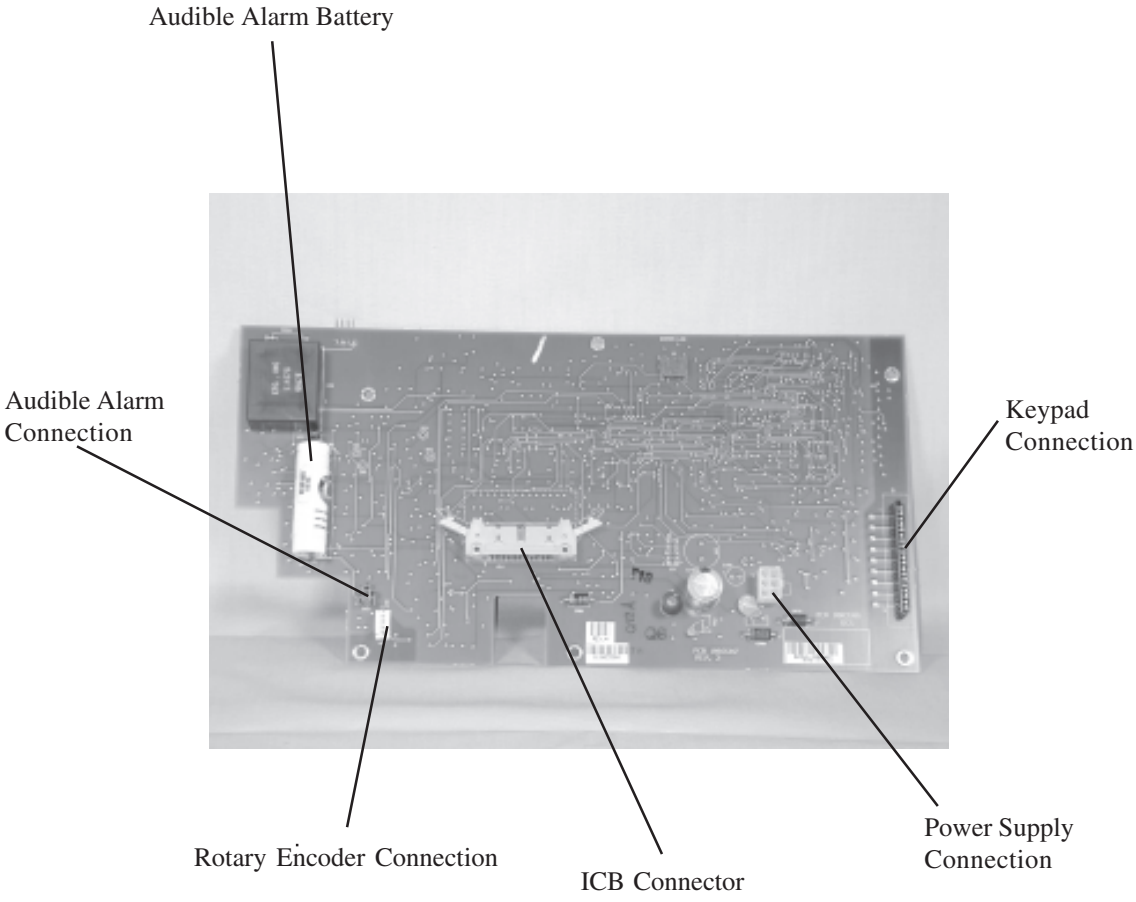
Front View DC Subsystem

(1004709, or part of 1004707, 1004714)

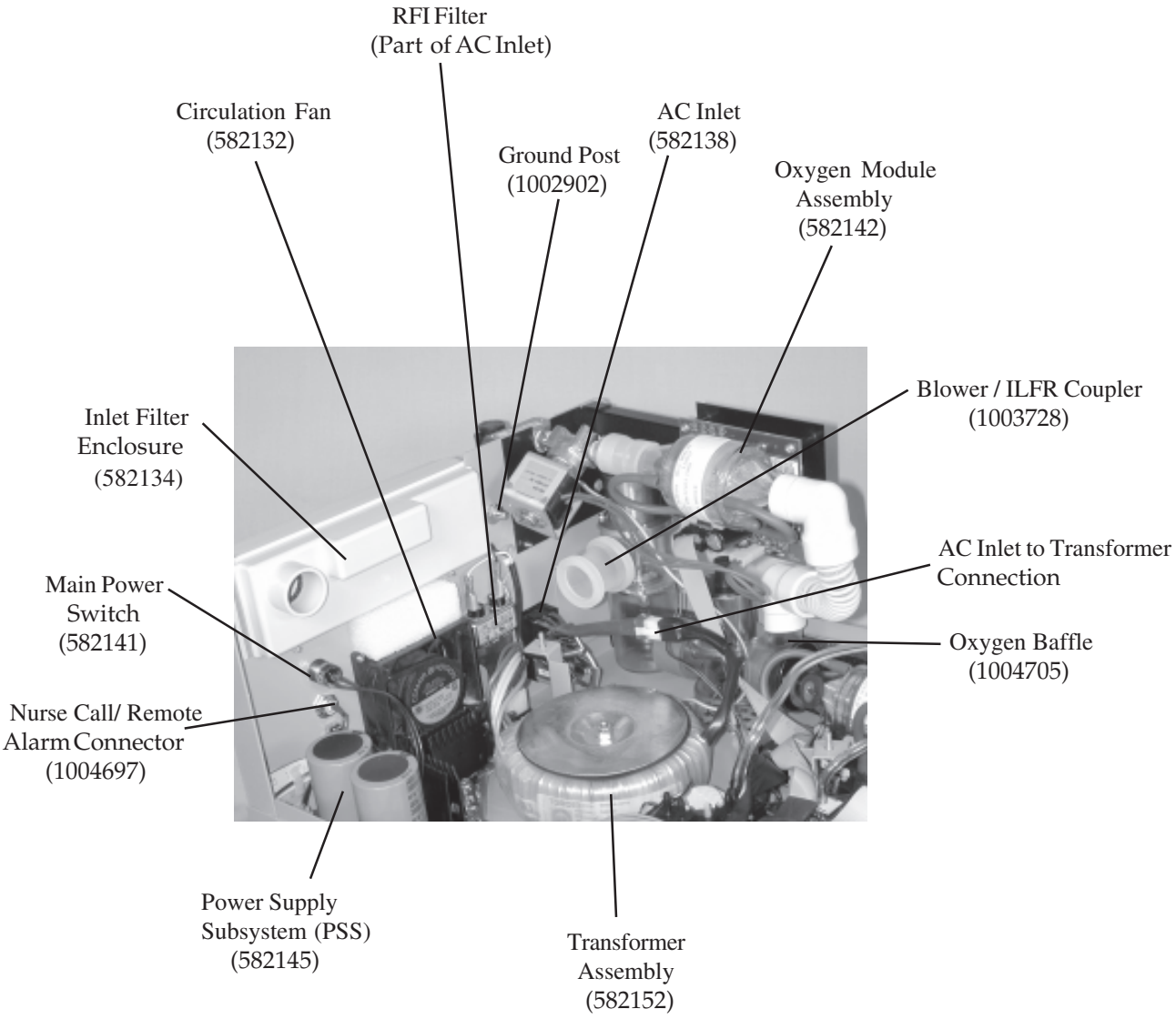


Back View DC Subsystem

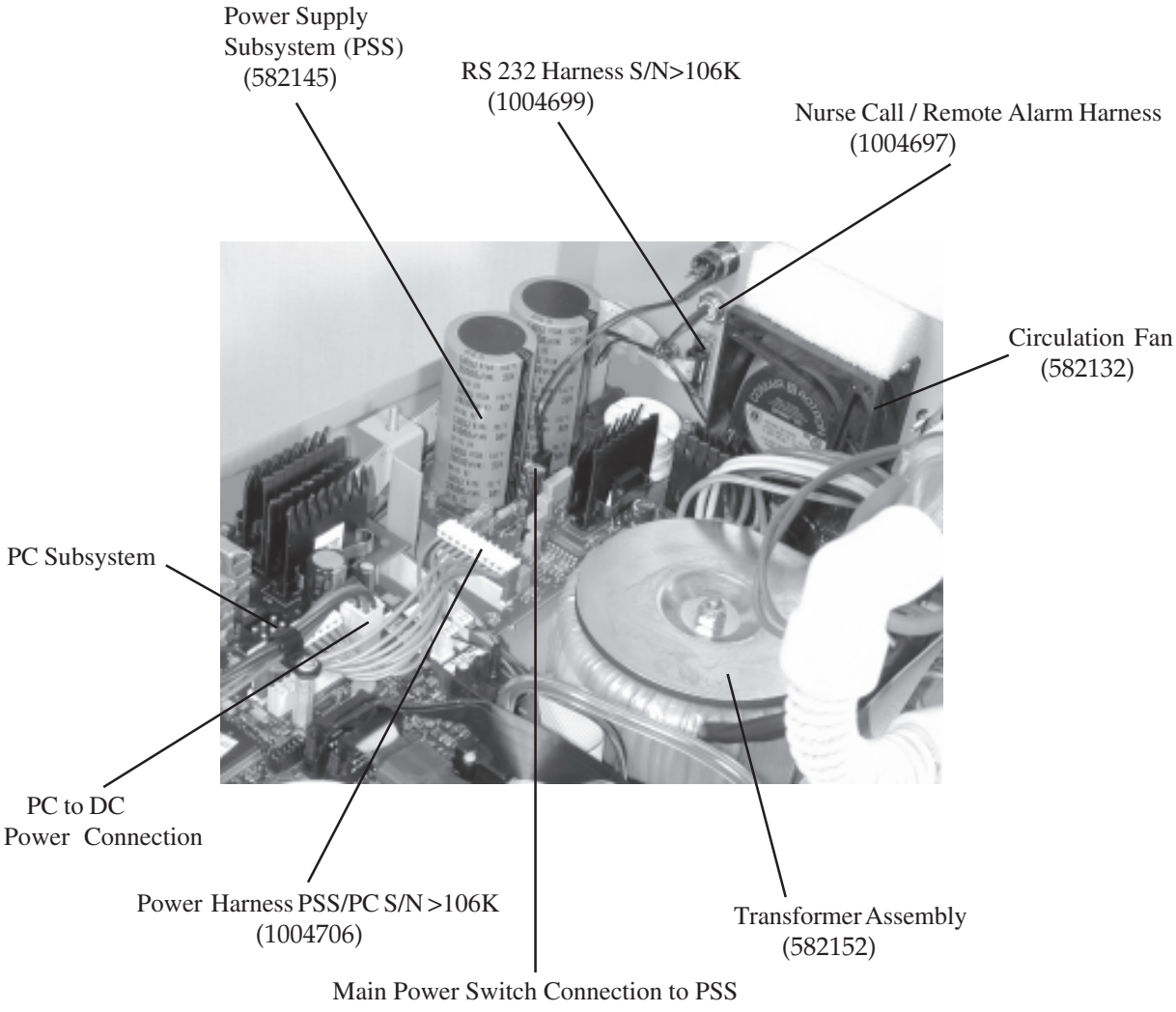
(1004709, or part of 1004707, 1004714)



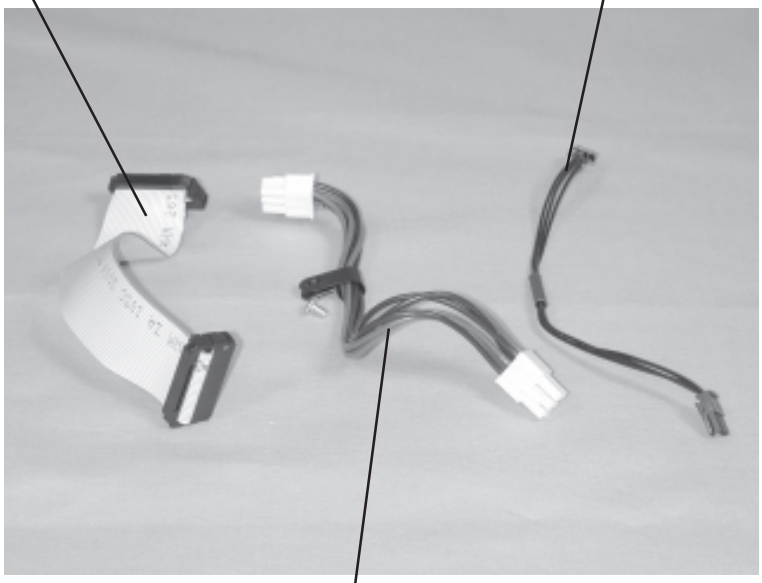
Component Identification



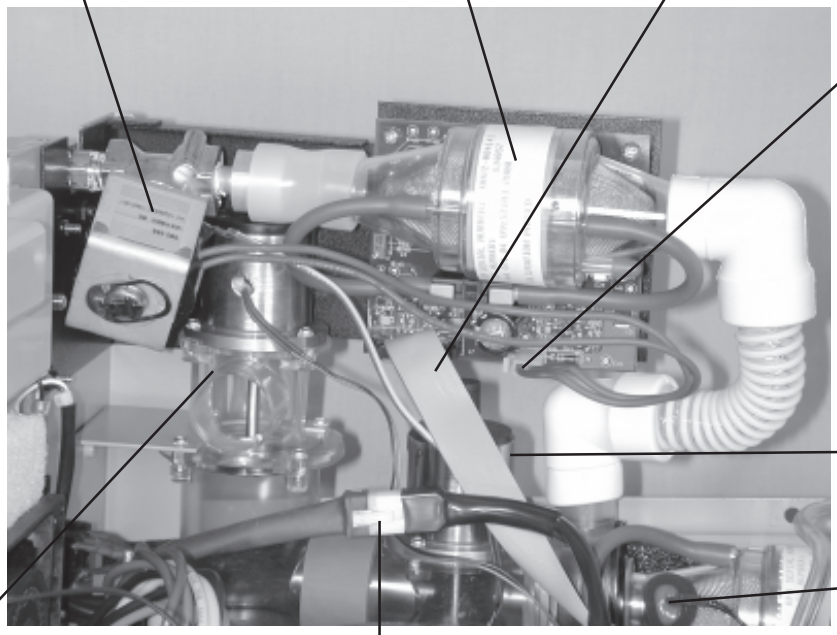
Component Identification



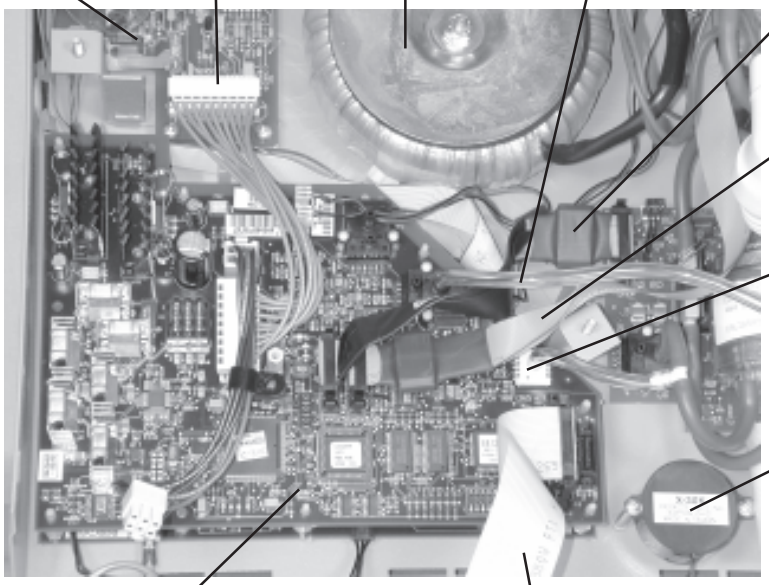
DC Cables


ICB Cable S/N >106K
(1004695)
RS 232 Cable S/N >106K
(1004698)
Power Harness PC / DC S/N >106K
(1004696)

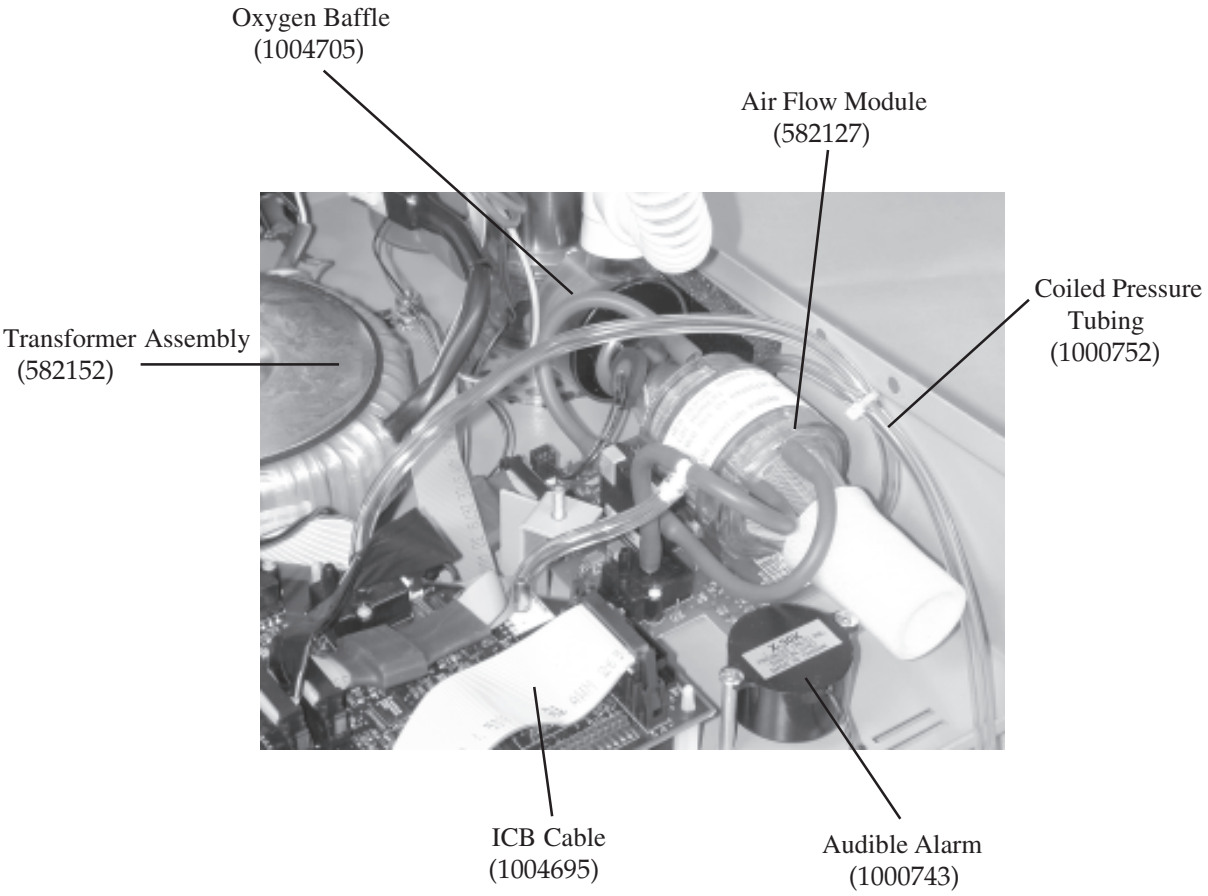
Component Identification



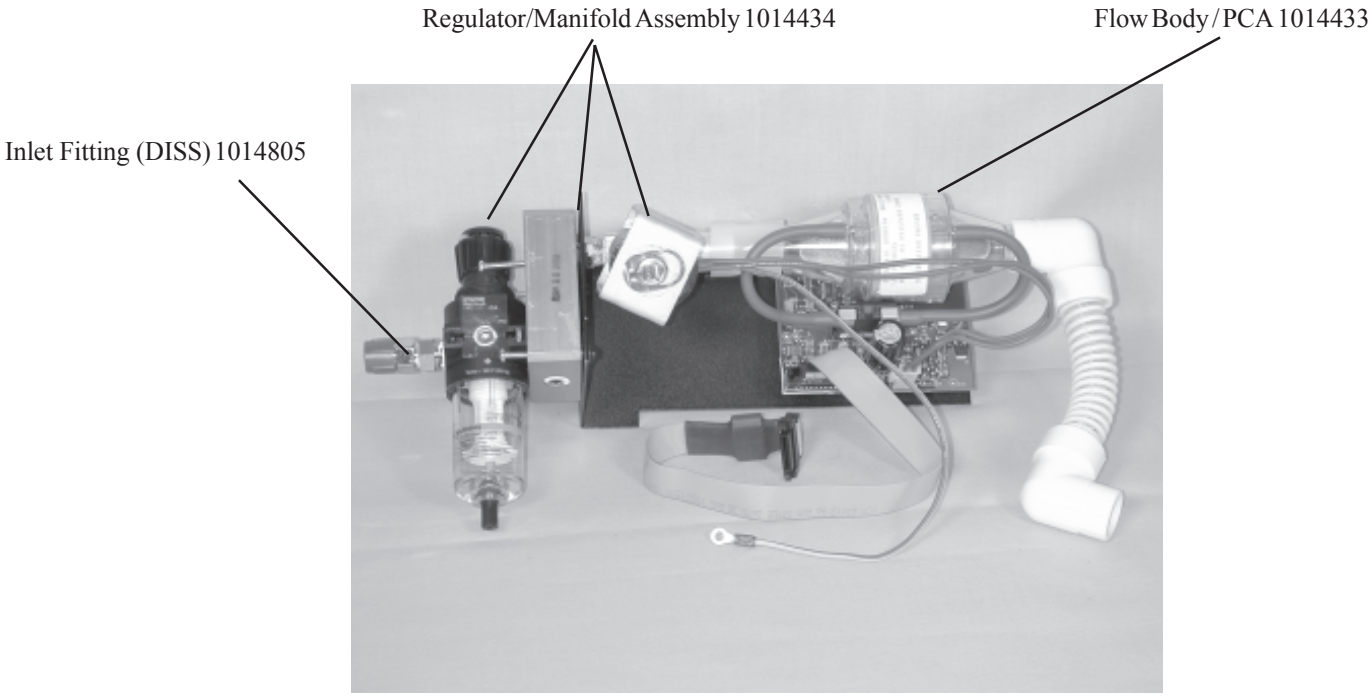
Component Identification



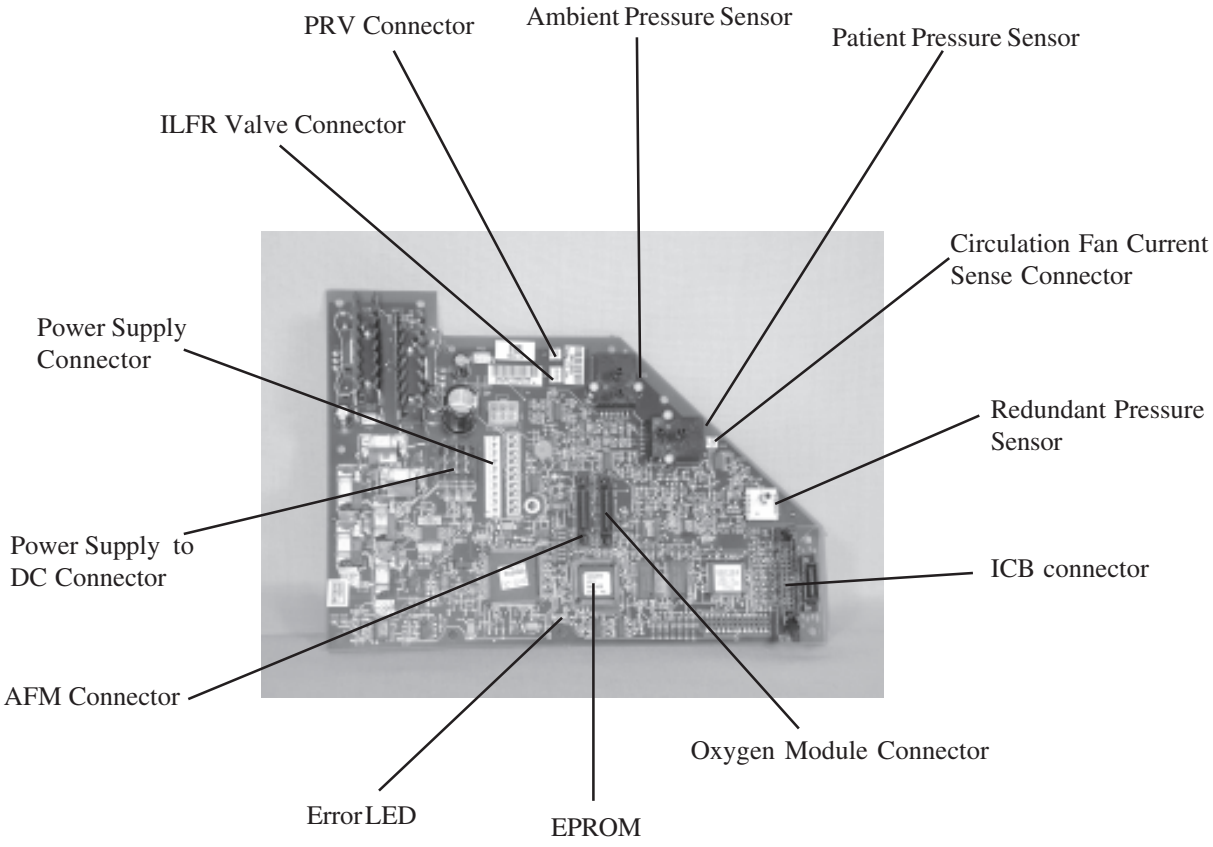
Component Identification



Oxygen Module Assembly
(English, 582142)
(Int'l 1005619)

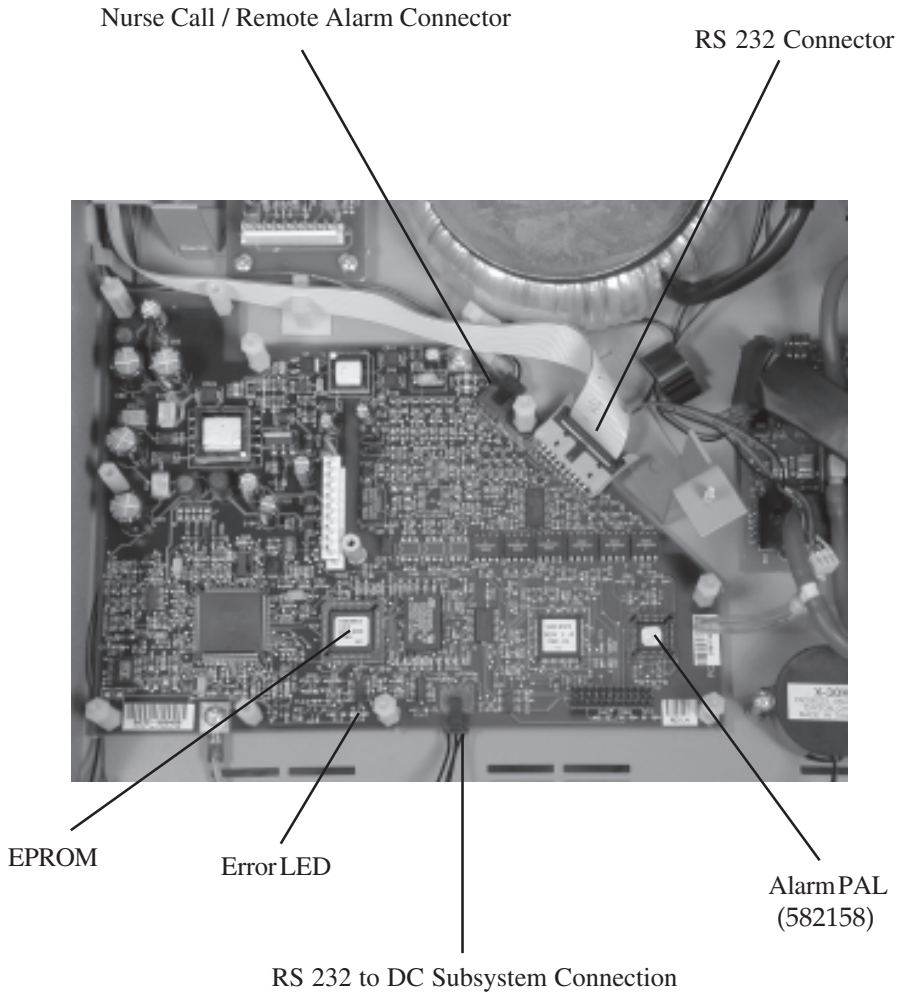


Pressure Control (PC) Subsystem*
(1004710)



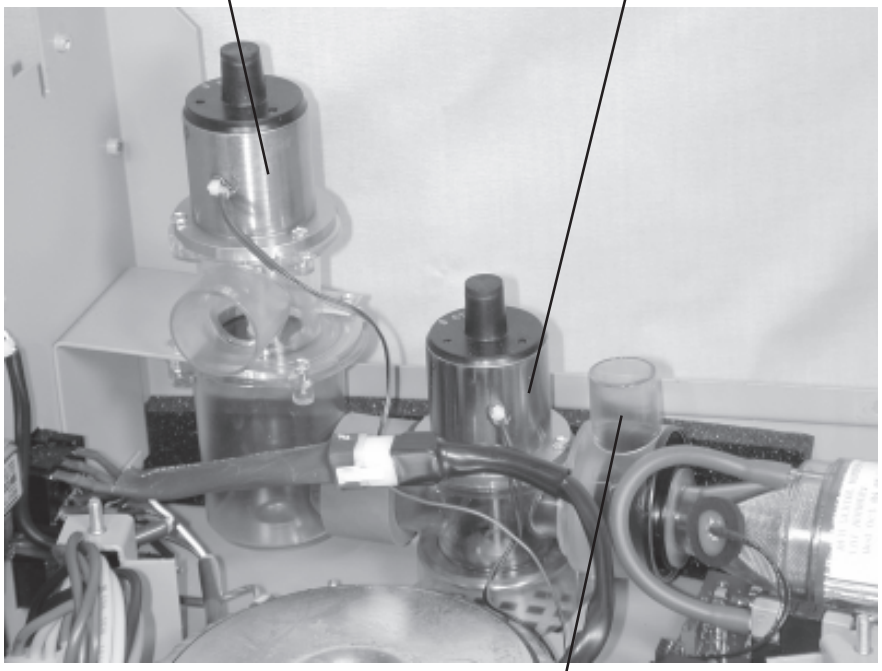
* Also part of 1004713, used to upgrade units S/N<106K 1000356, 1004714 and 1004707

Main Control (MC) Subsystem*
(1004711)

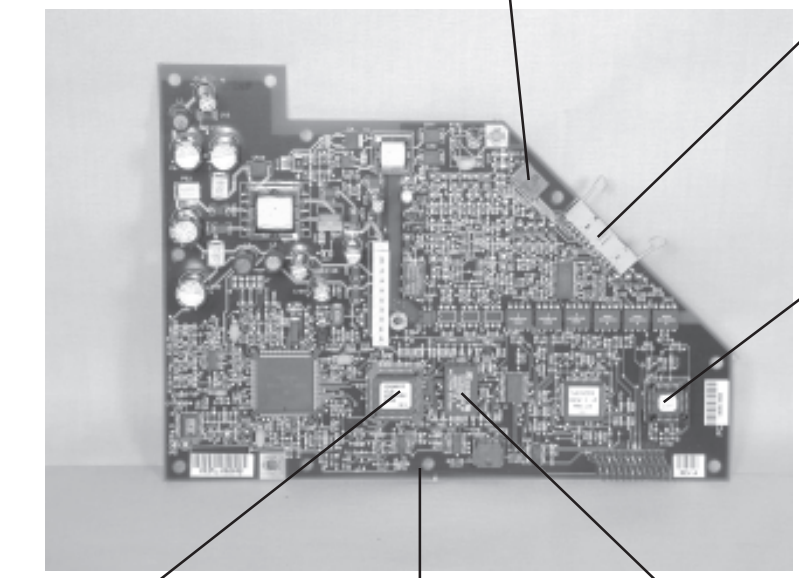


* Also part of 1004713, 1000356, 1004714 and 1004707

Component Identification

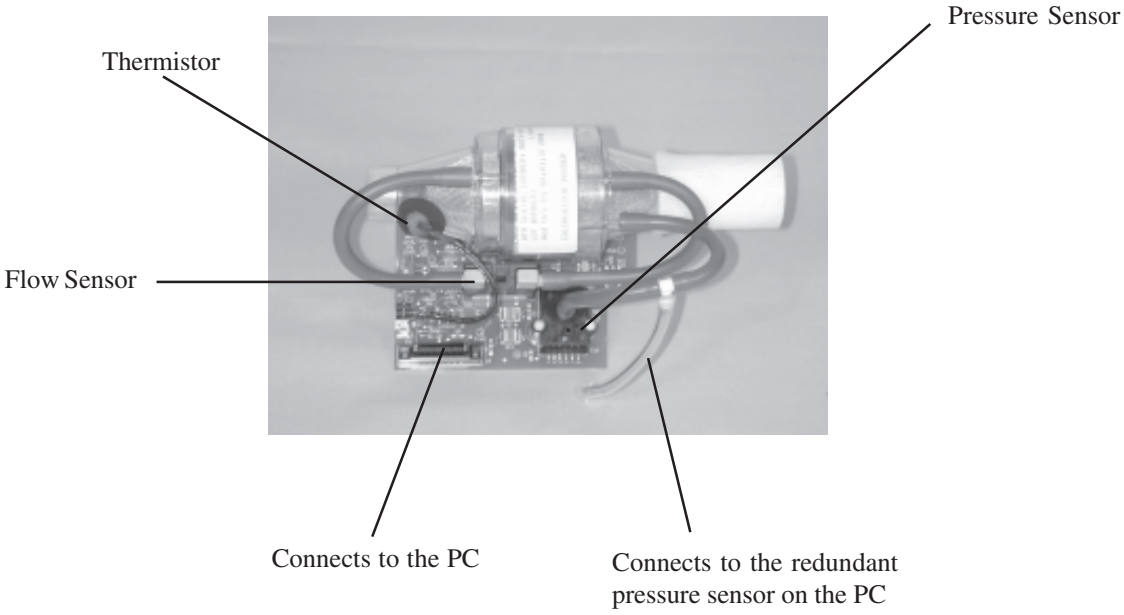


Main Control (MC) Subsystem*
(1004711)

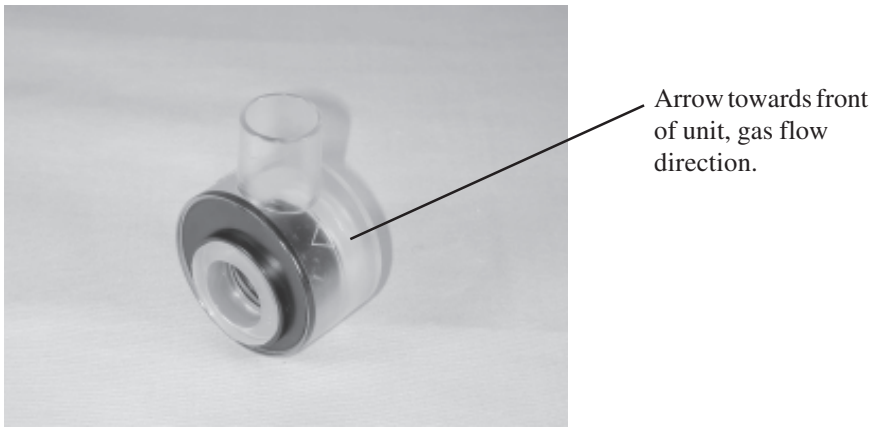


* Also part of 1004713, 1000356, 1004714 and 1004707 used to upgrade units S/N<106K

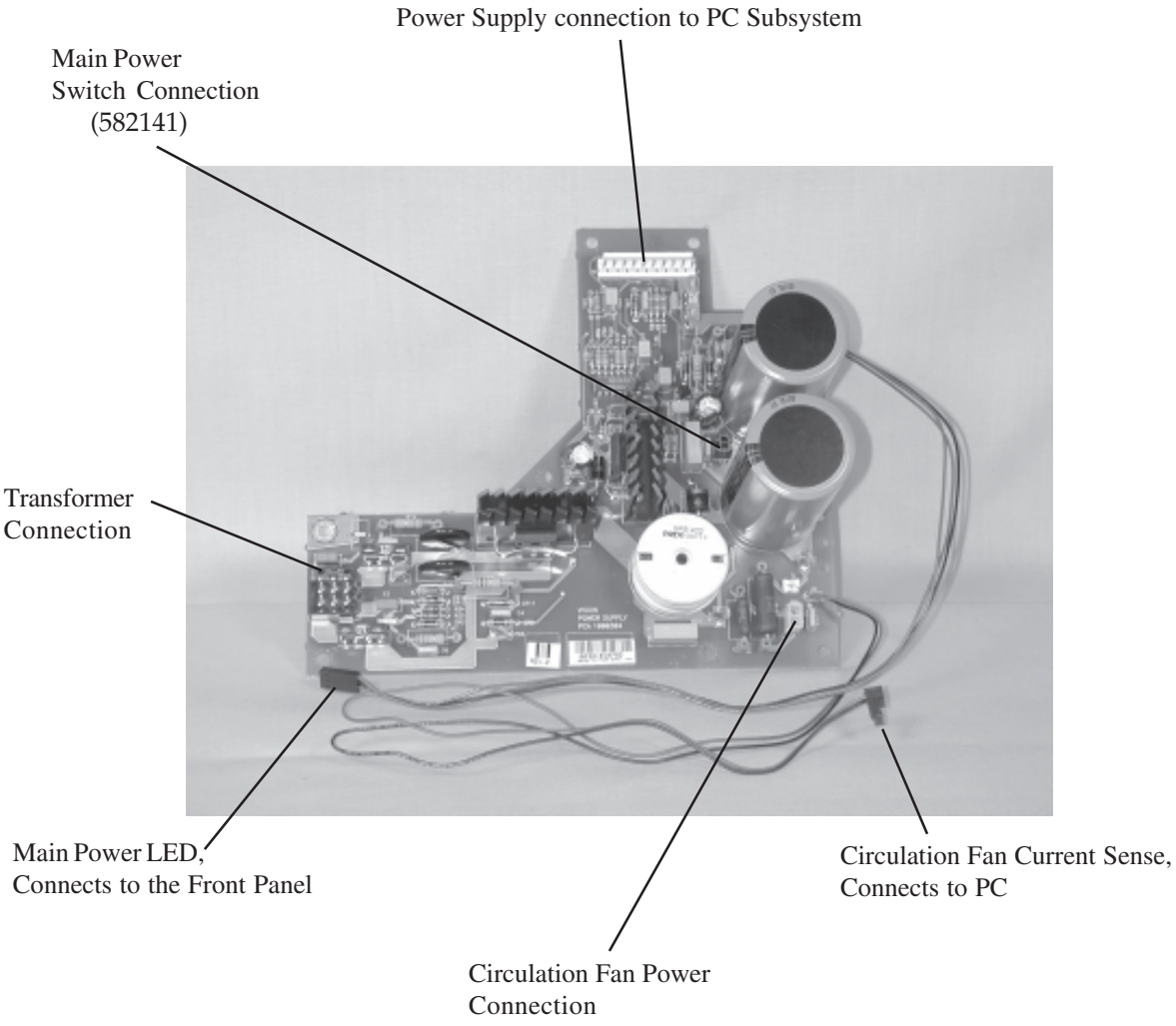
Air Flow Module (AFM) (582127)



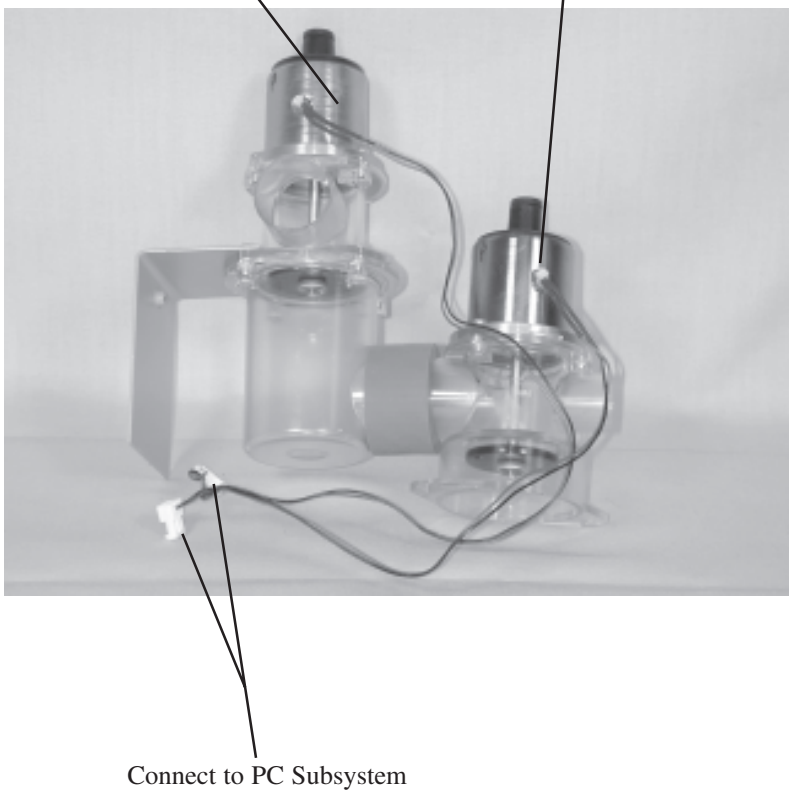
Oxygen Baffle (1004705)



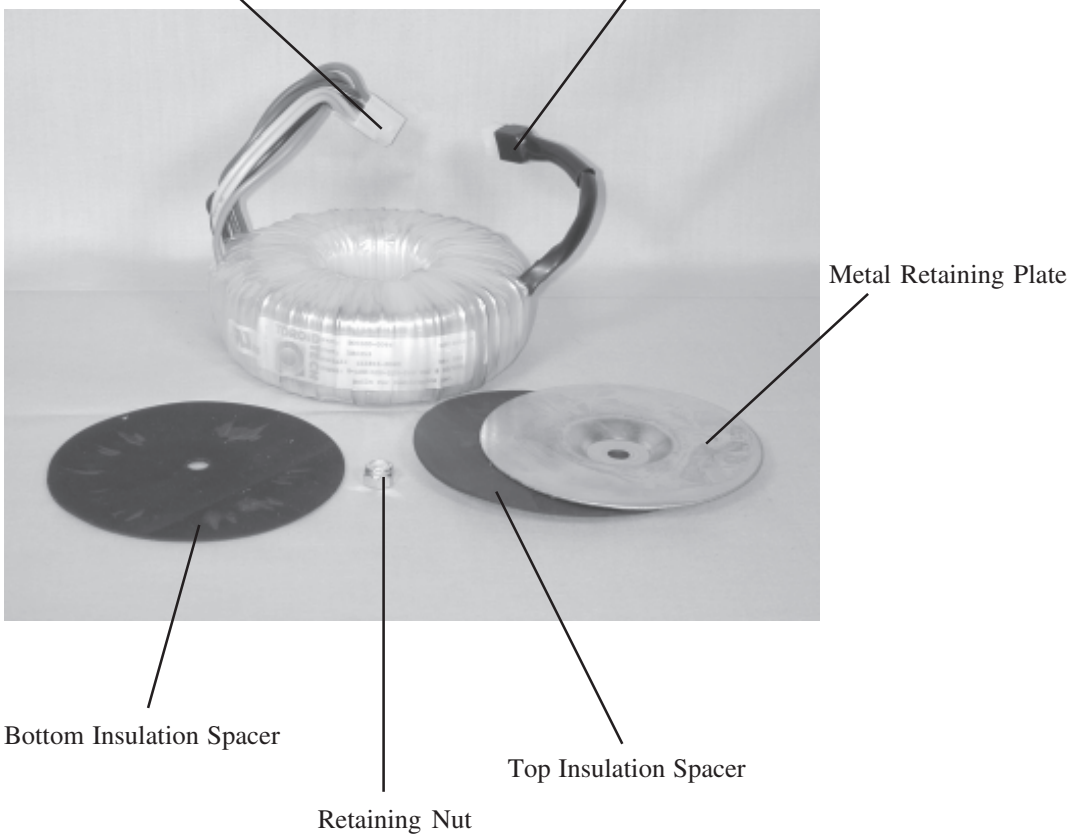
Power Supply Subsystem (PSS) (582145)



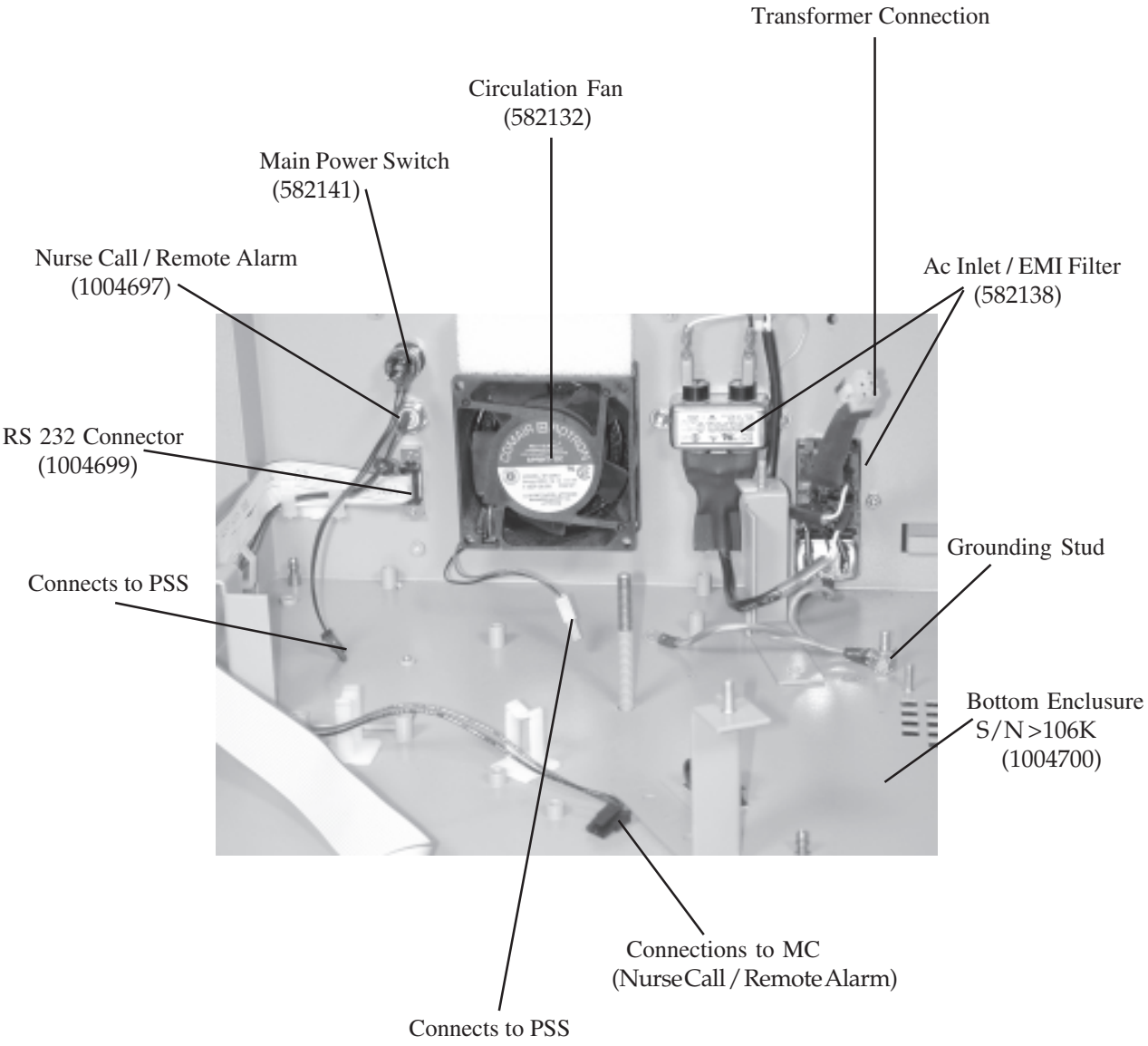
Valve Identification



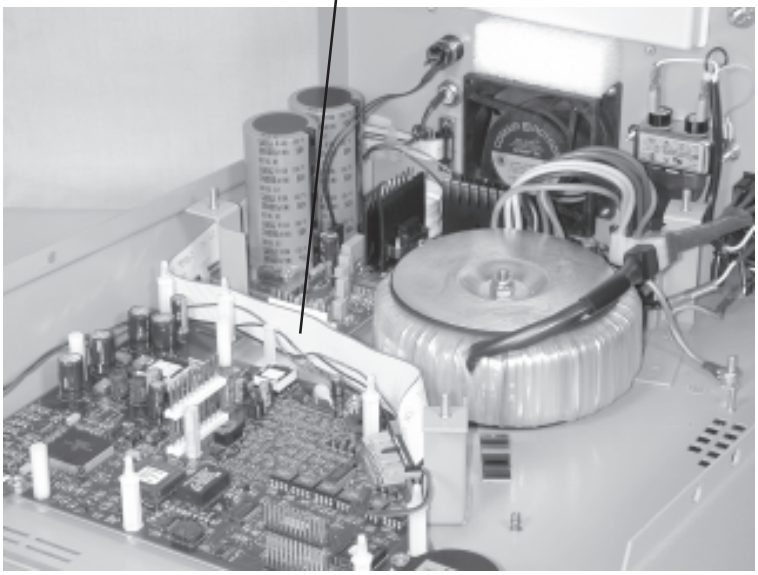
Transformer Assembly (582152)



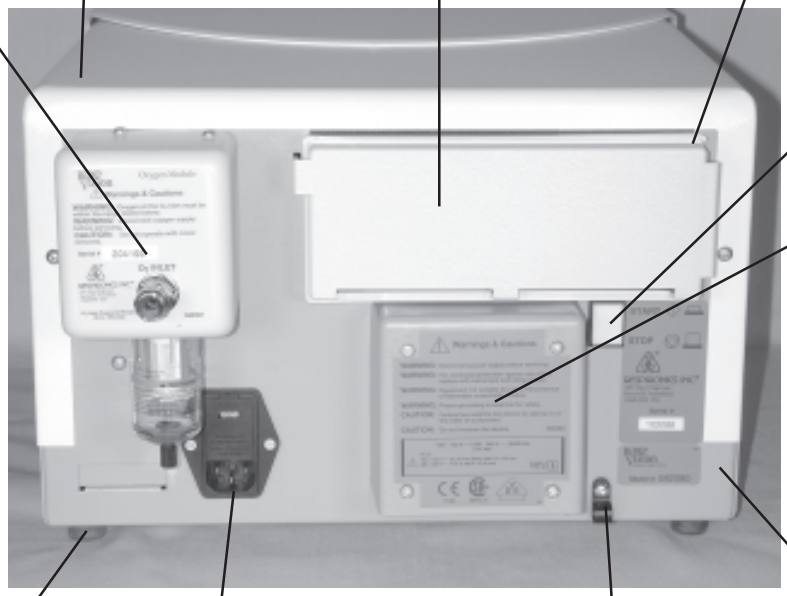
Component Identification



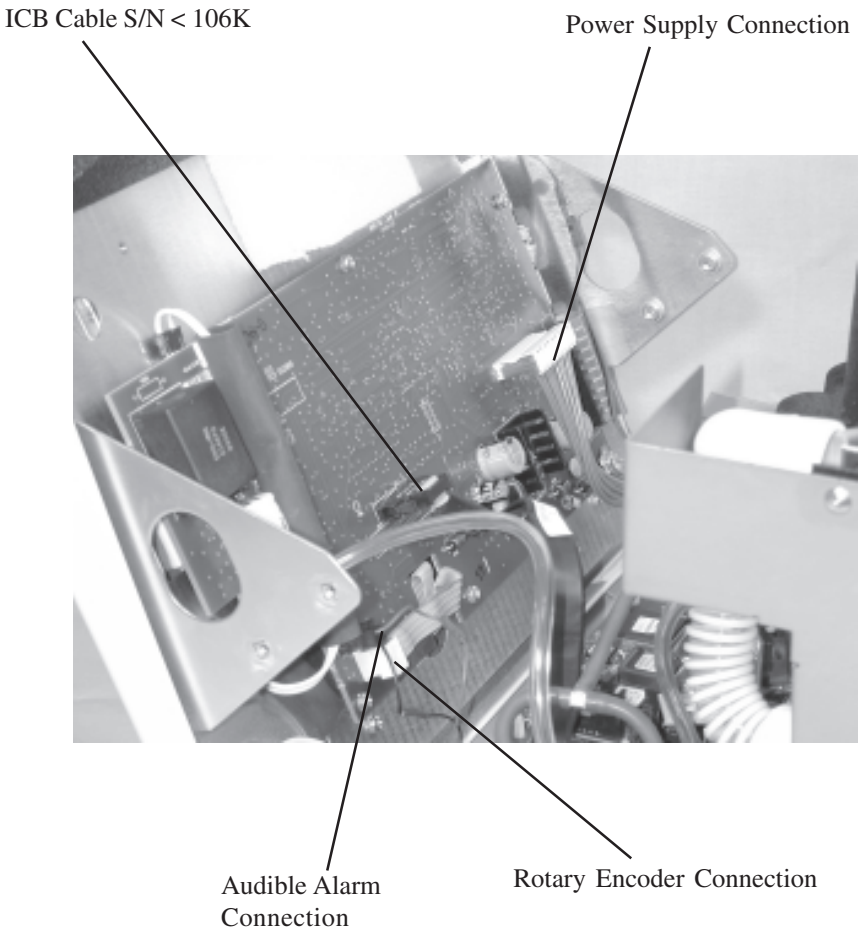
Nurse Call / Remote Alarm,
RS 232 Cable routing



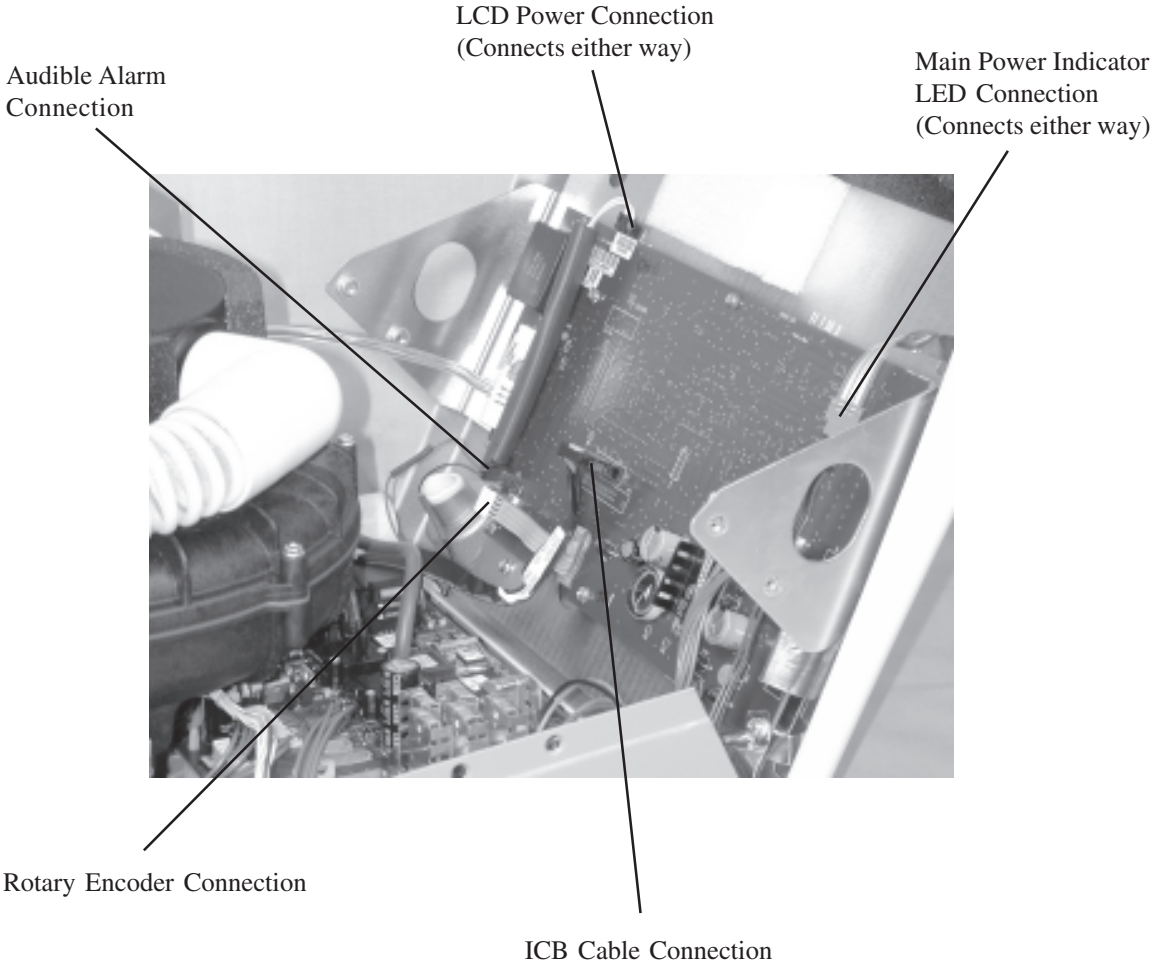
Back Panel, Units S/N <106001



Display Control Subsystem (D/CS) Connections for S/N <106001 (582133)

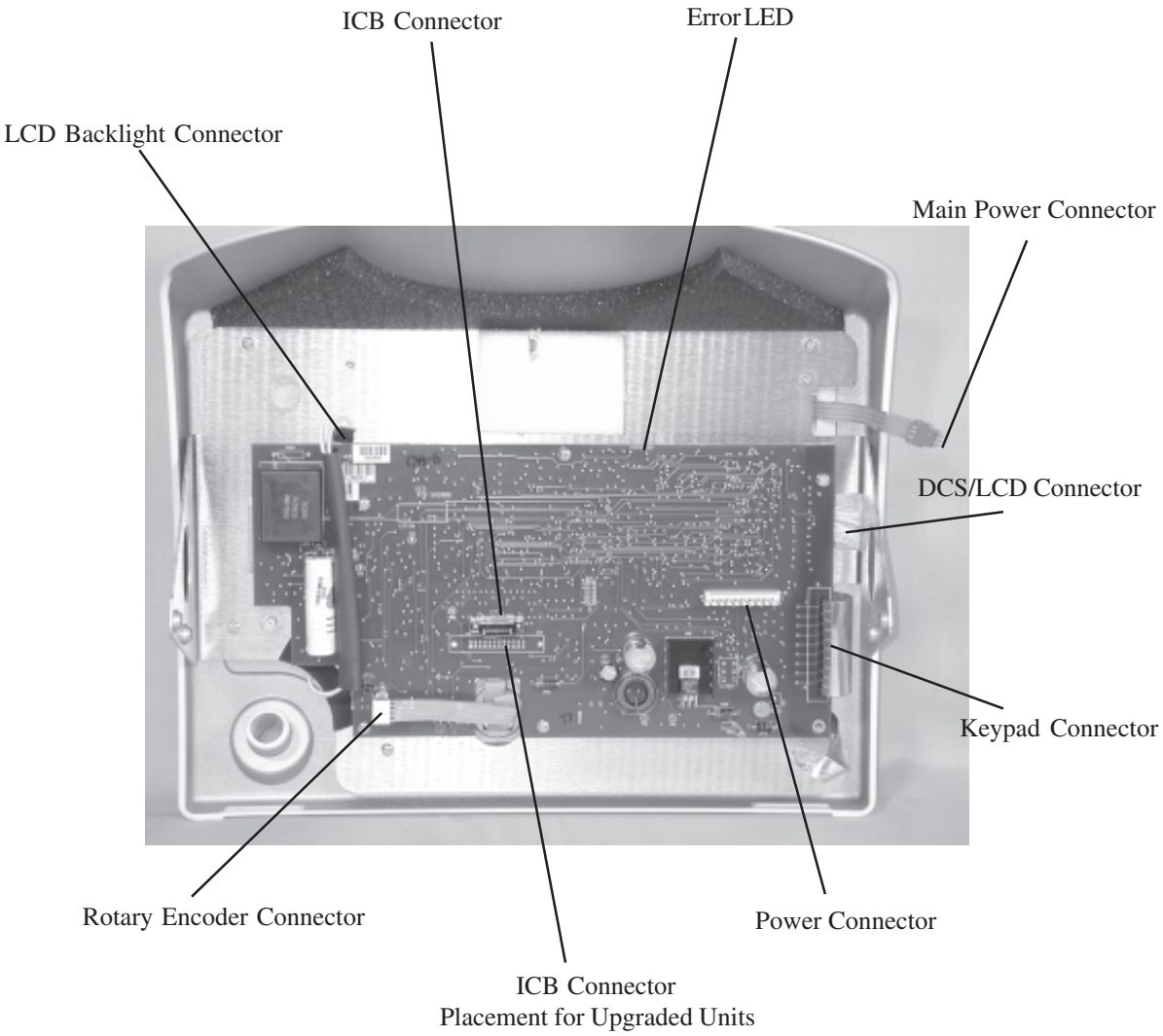


Display Control Subsystem (D/CS) Connections for S/N <106001 (582133) *

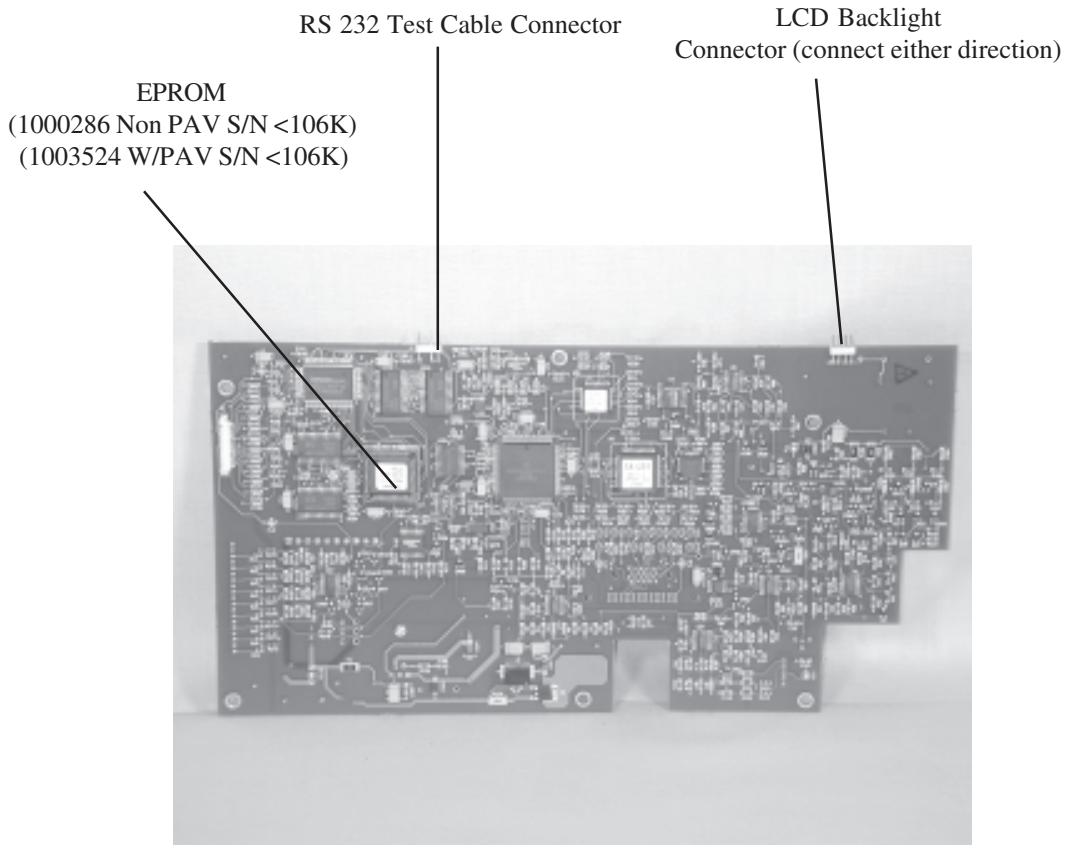


* Also could be for upgrade units S/N <106K using 1004714 or 1004707

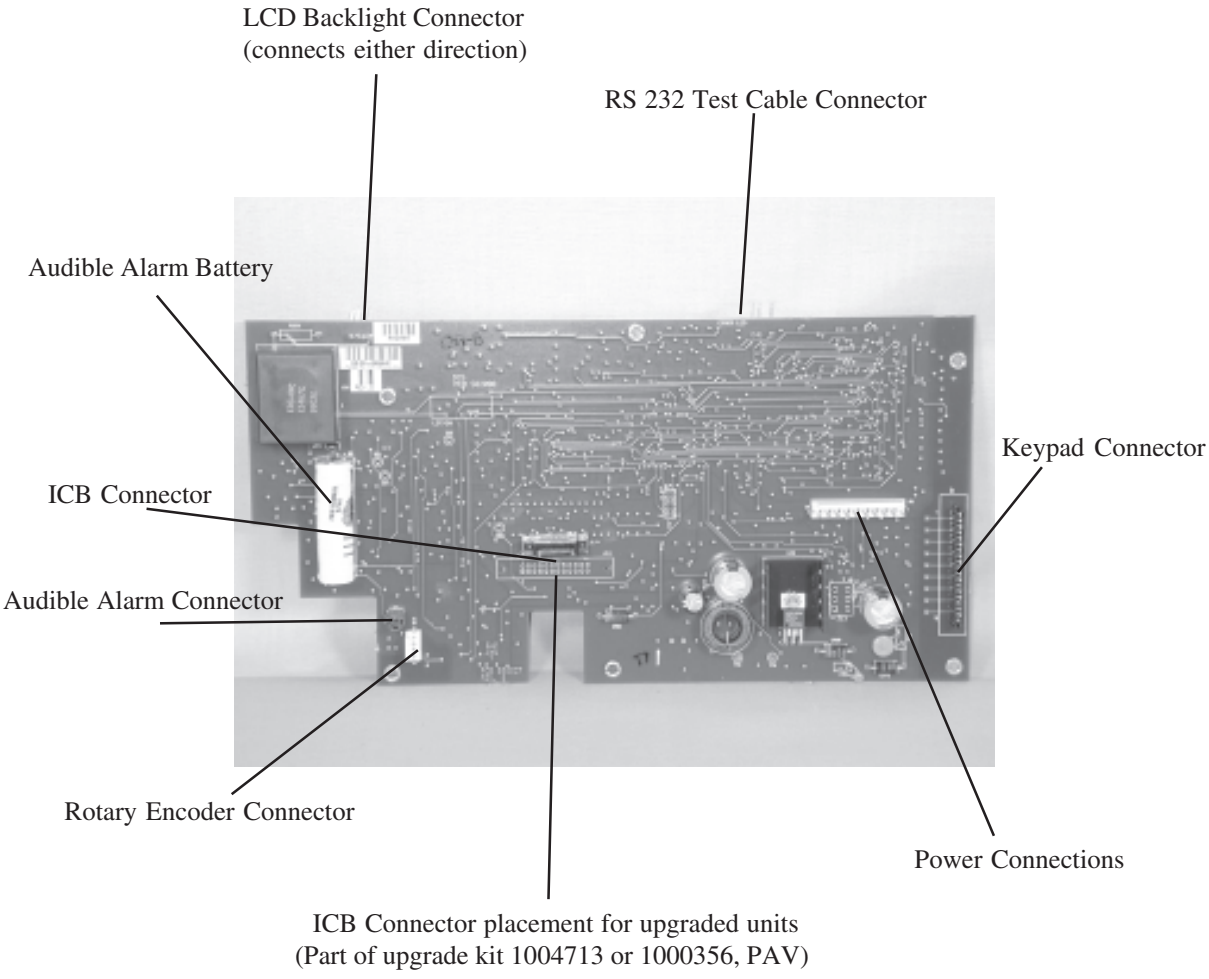
Display Control Subsystem (D/CS) (582133)



Display Control Subsystem (D/CS) (582133)

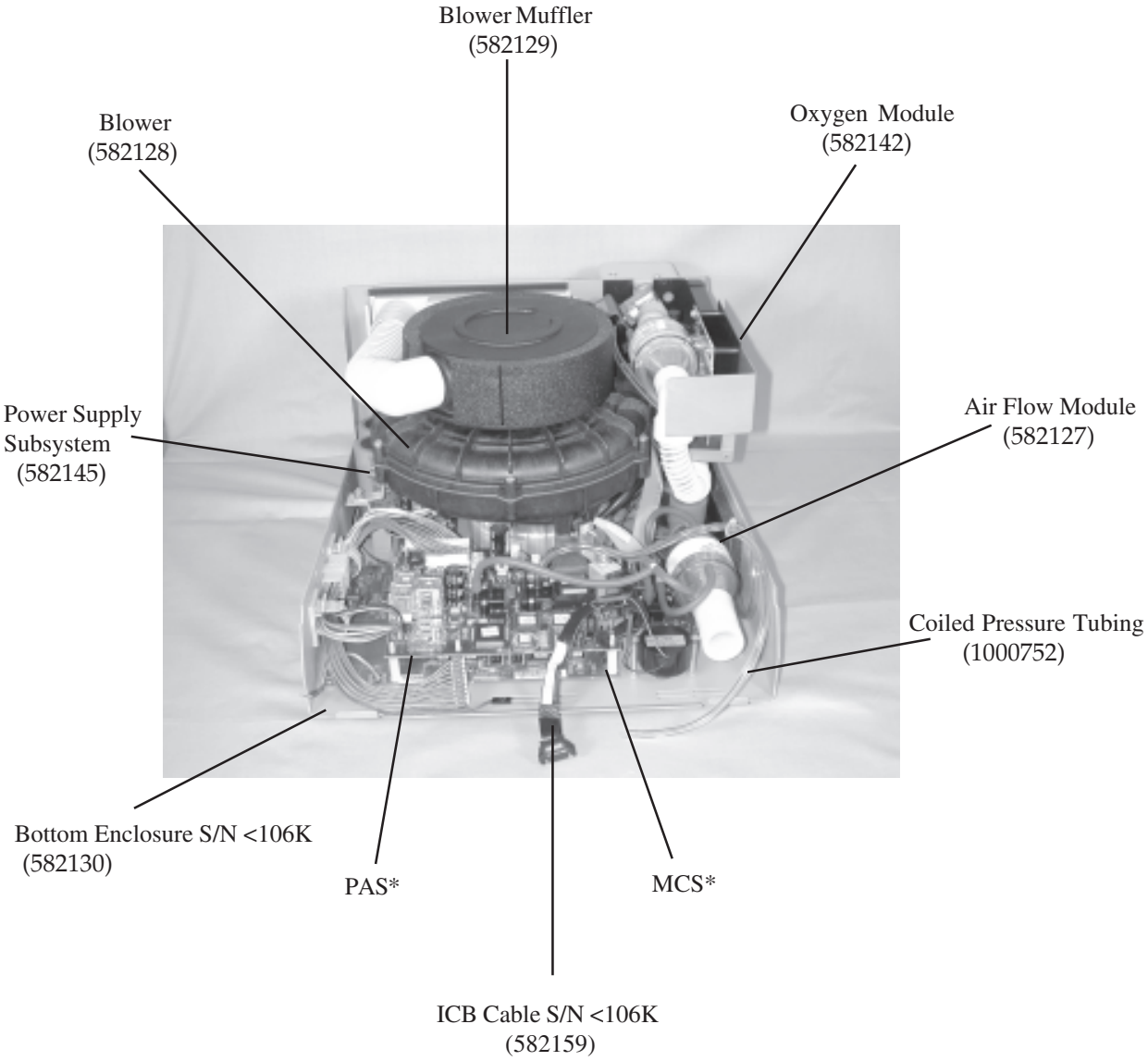


Display Control Subsystem (D/CS) (582133)



Component Identification *

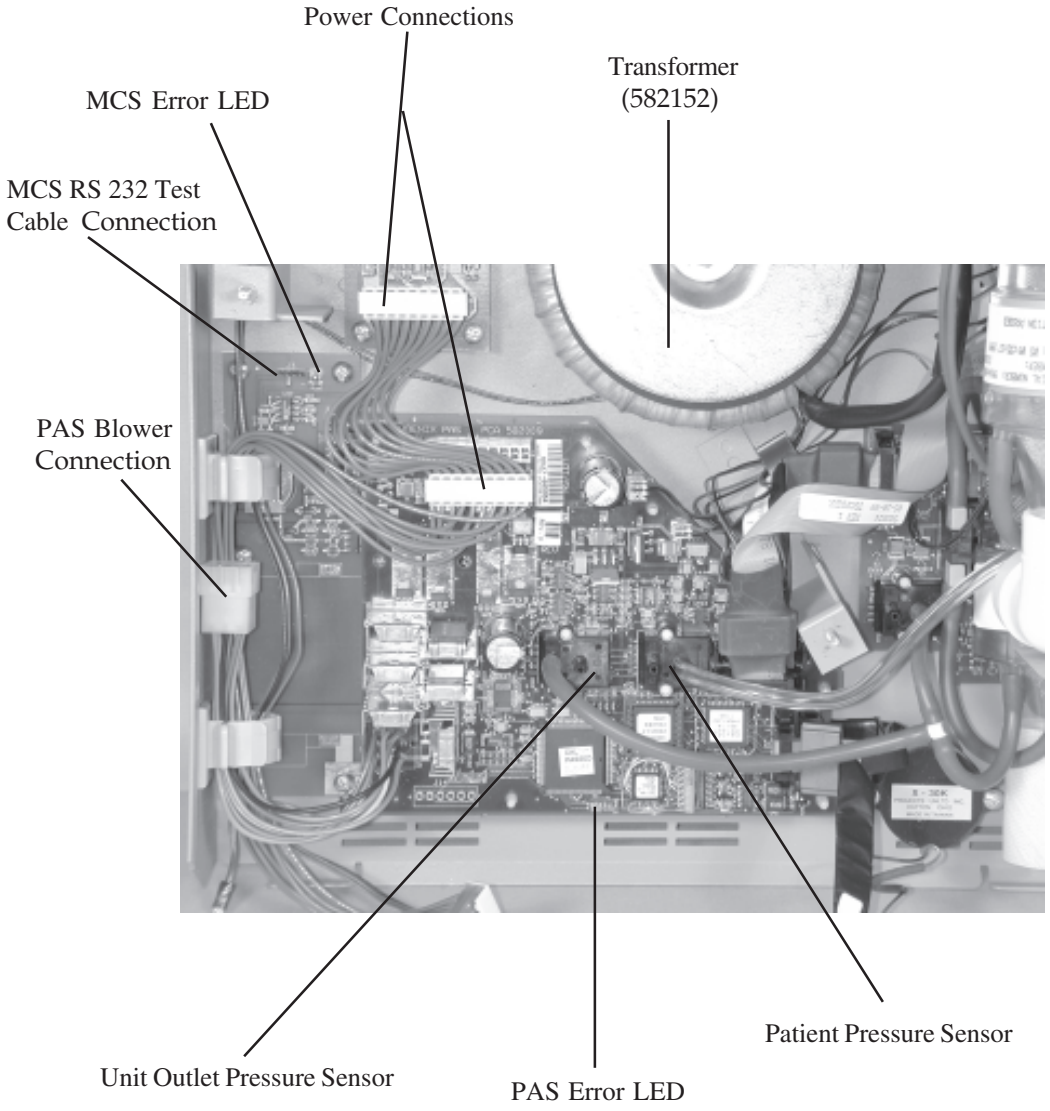
(S/N <106K)



* Replaced using upgrade kit 1004713, or 1000356 (PAV)

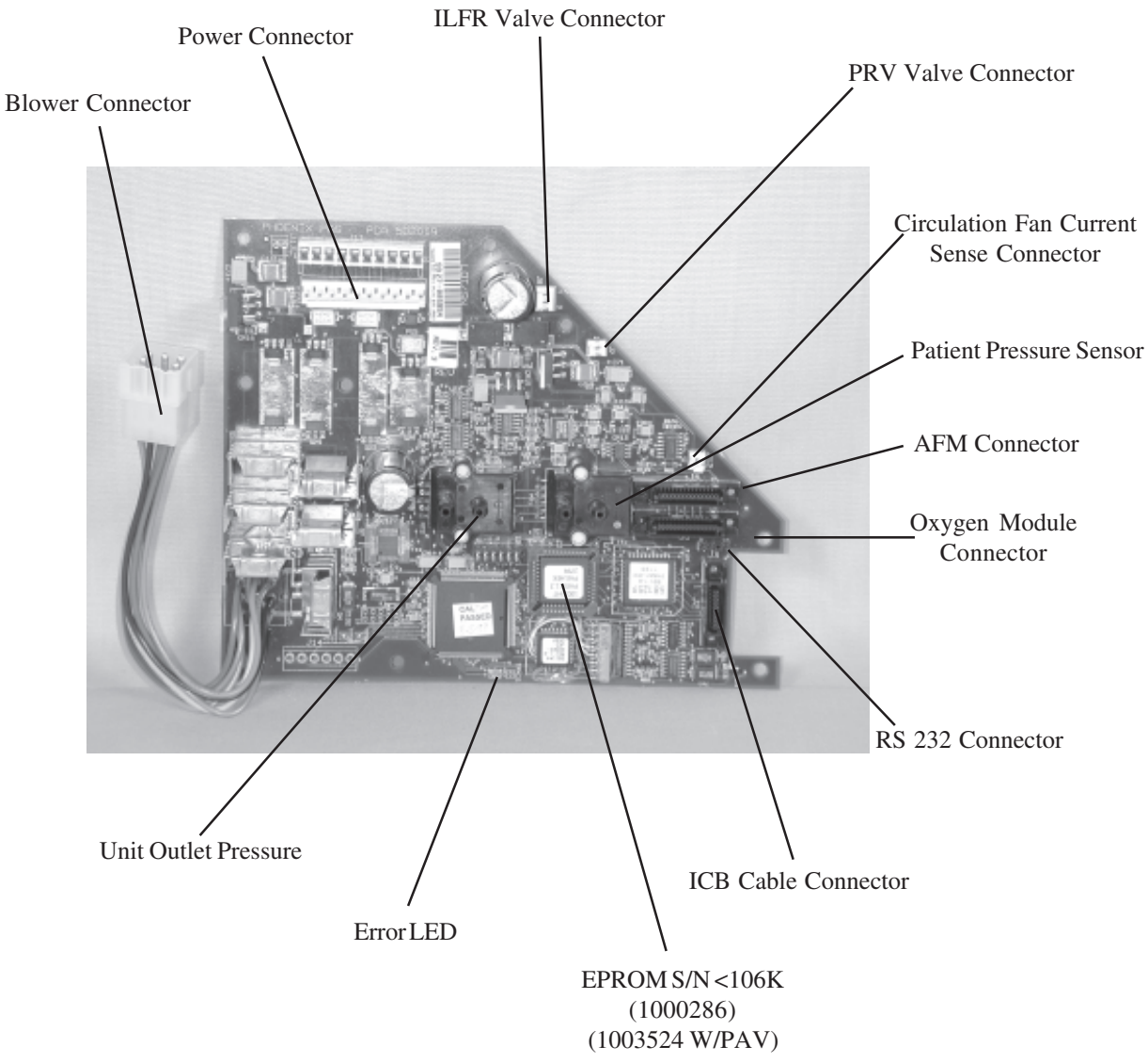
Component Identification

(S/N<106K)

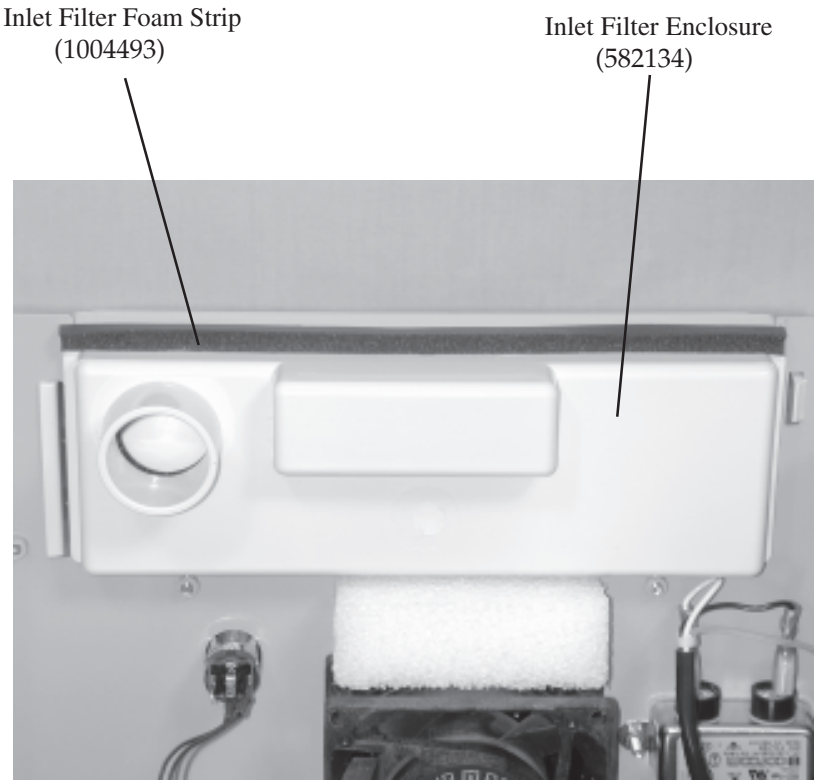


Pressure Airflow Subsystem (PAS)

(No longer manufactured, now part of upgrade kit 1004713 or 1000356,PAV)

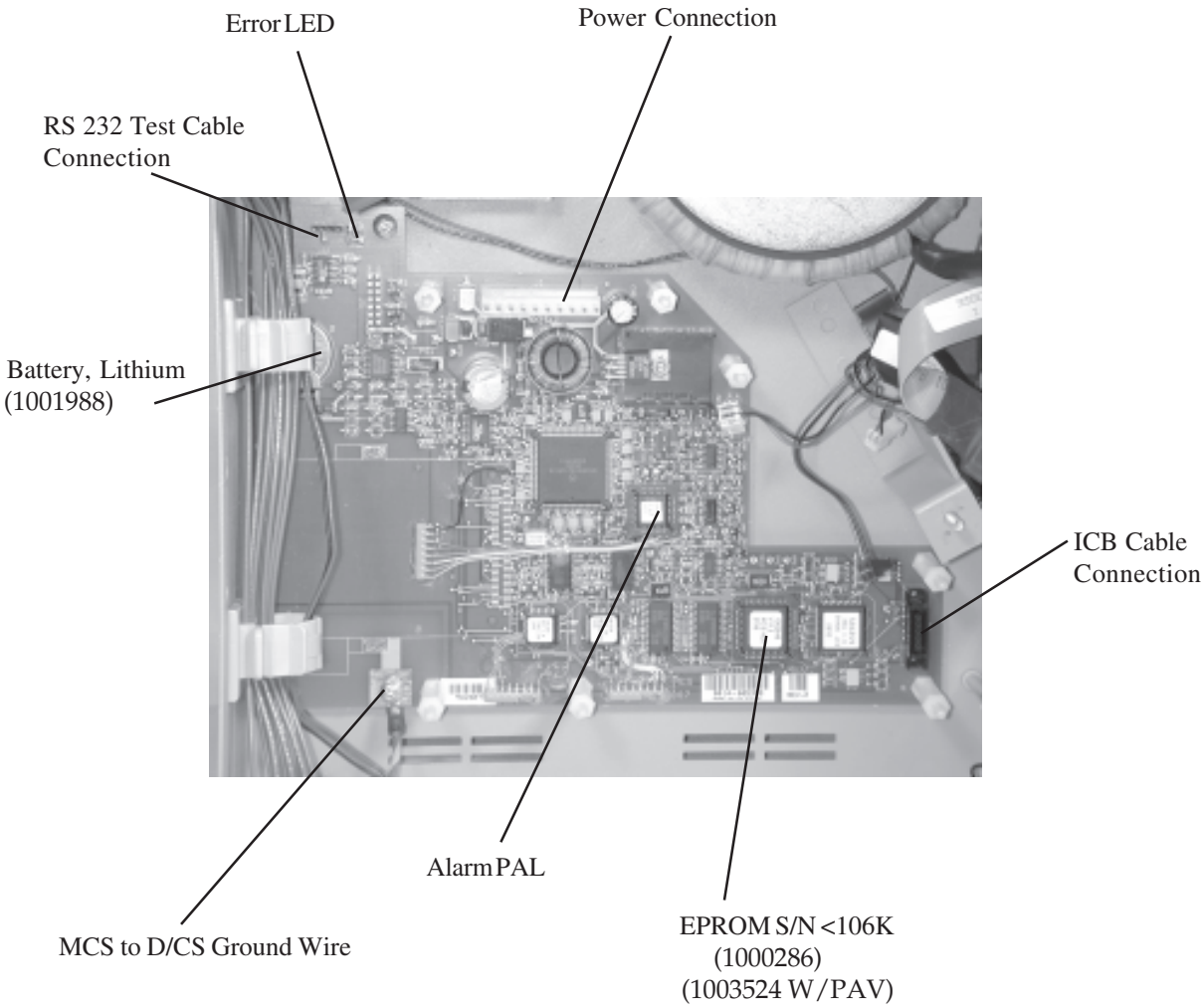


Inlet Foam Strip Location



Main Control Subsystem (MCS)

(No longer manufactured, now part of upgrade kit 1004713 or 100356, PAV for S/N<106K)



Component Identification

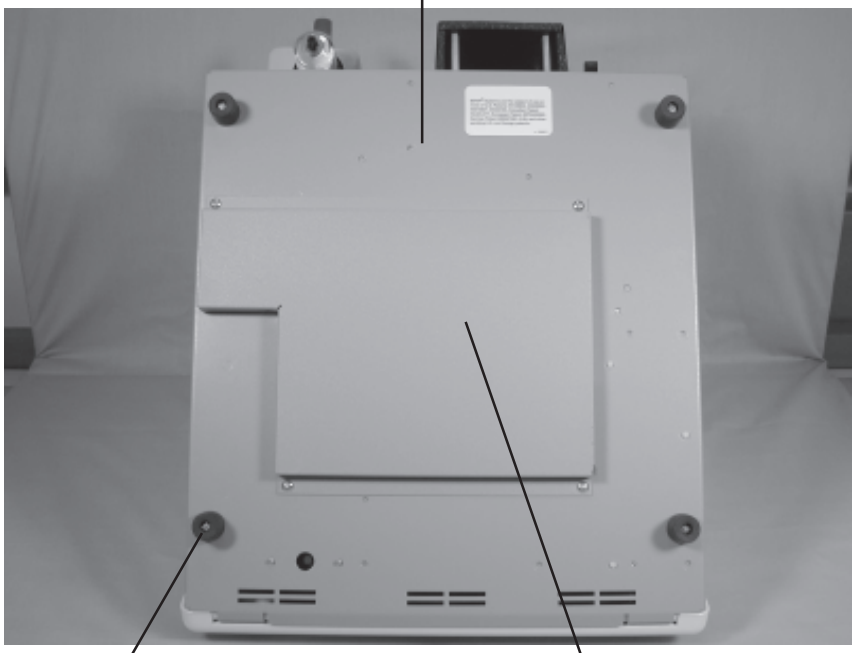
Front Enclosusre
(582135)

Rotary Encoder Knob
(582157)

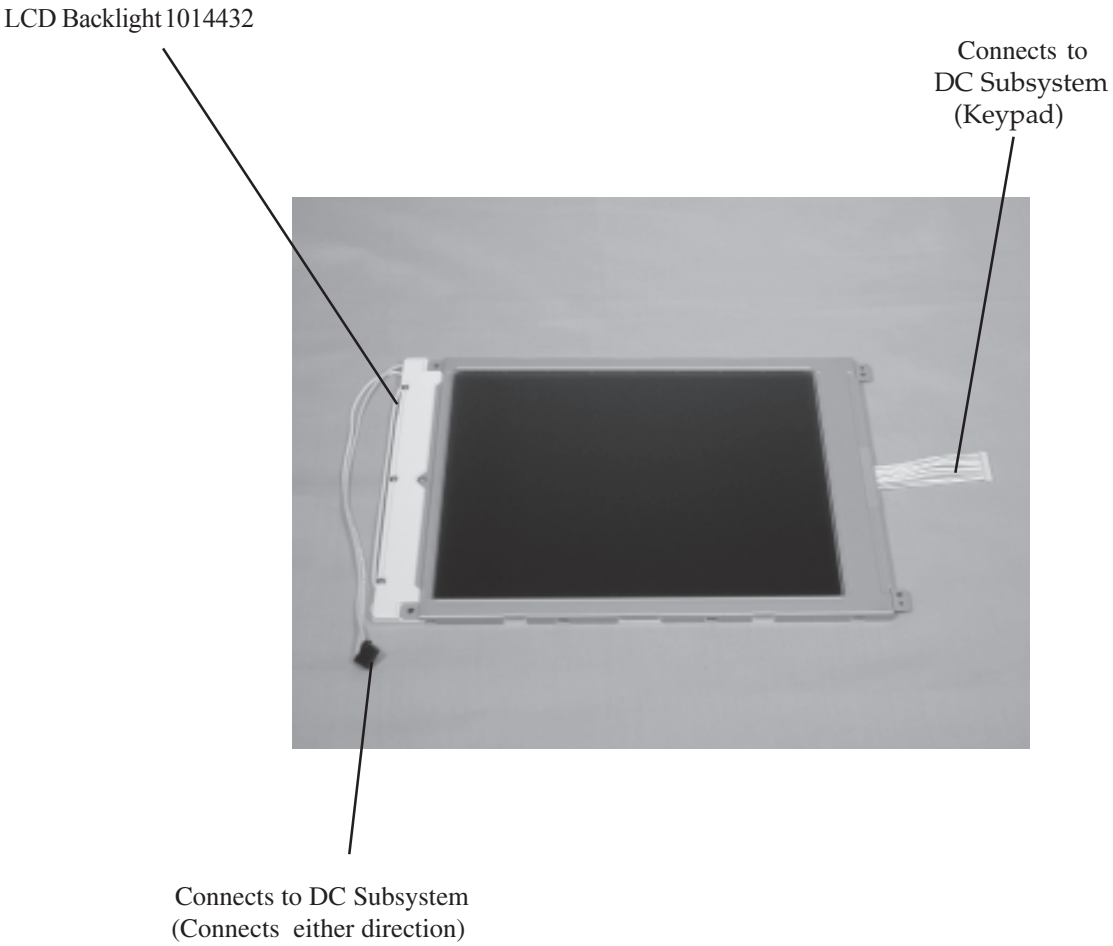
Keypad
(English, 582151)
(Universal Symbols, 1004712)
(German, 582221)

Note: See "Touchpad Replacement Instructions" at end of chapter, section 7.6

Component Identification

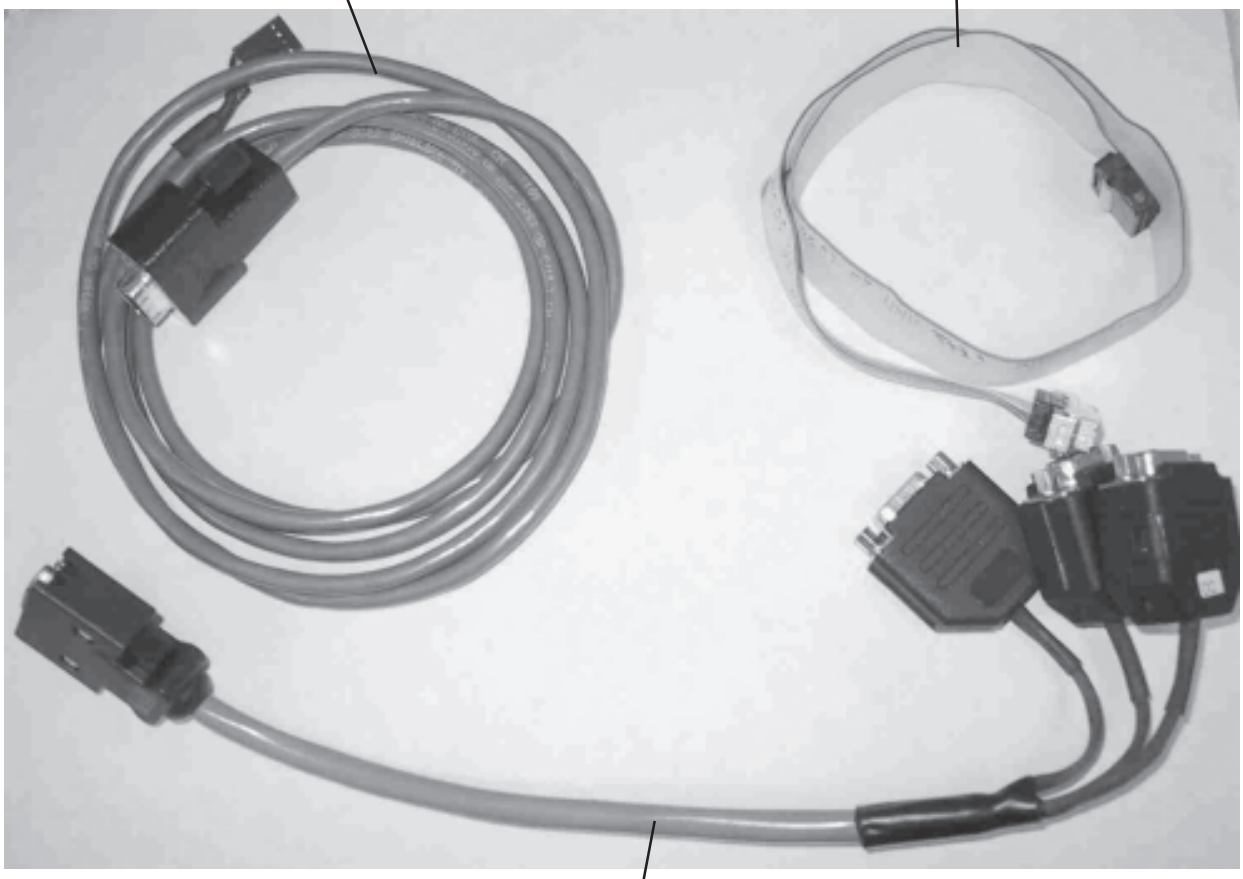


LCD Assembly (582139)



Blower Valve Coupler
(1003728)

Test Cable Identification *

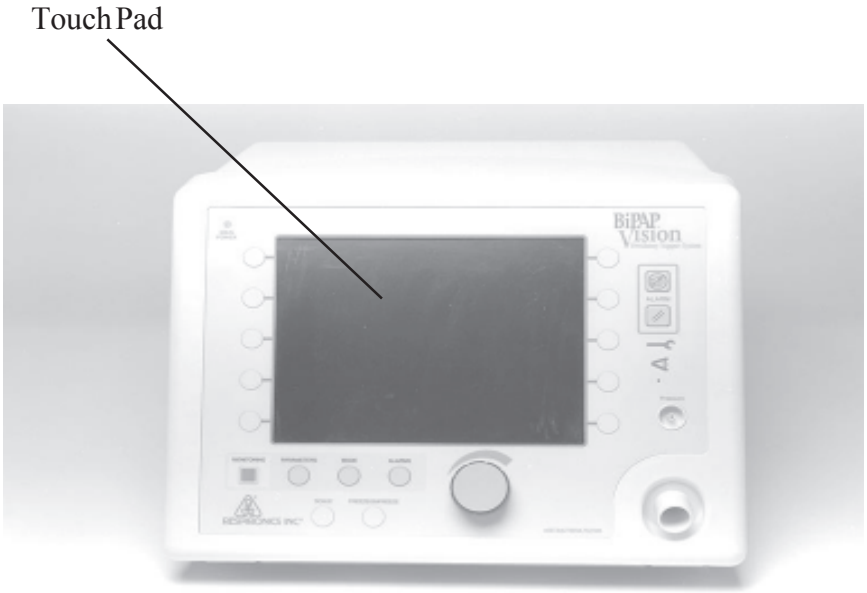


* See Section 8.10, Test Cable Usage Definitions, for further information.

7.6 Touch Pad Replacement Instructions

Replacement Part Number: 582151
Procedure
Removed / Installed During Process:
- Top enclosure
- Front panel enclosure
- Rotary encoder
- Display / Control Subsystem-Liquid Crystal Display (D / CS - LCD) mounting plate assembly
- Touch pad

Included in Kit: Touch pad
Tools Required: Phillips screwdriver, 7/16" nut driver, Isopropyl alcohol, Cleaning cloth

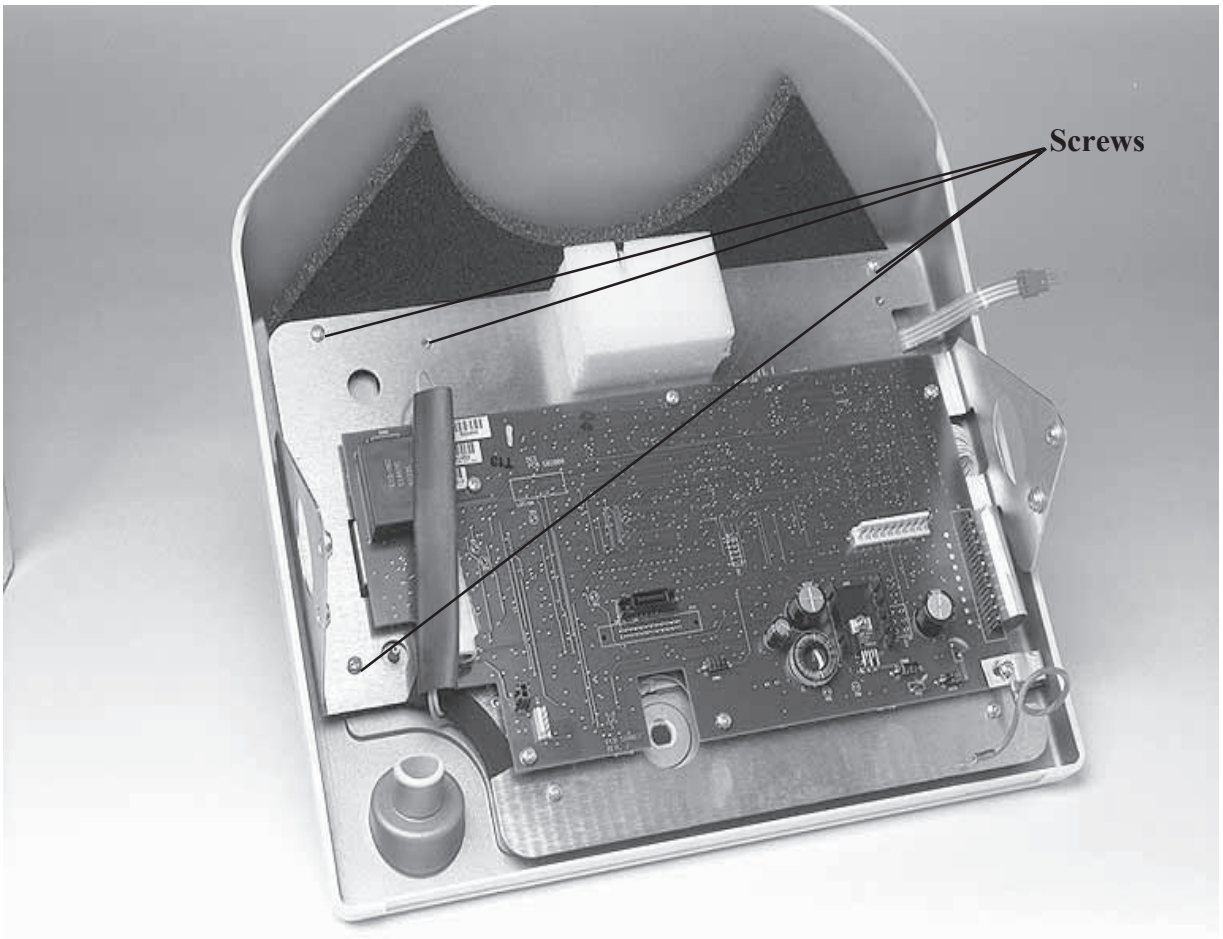


WARNING: Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the device.

CAUTION:
Electronic components used in this device are subject to damage from static electricity.
Repairs made to this device must be performed only in an antistatic, ESD-protected environment.

Step 1
Removing the D / CS Touch Pad Ribbon Cable and Shielding Foil

a. Making sure the front enclosure is protected, place it face down on the work surface with the D / CS upwards.
b. Gently remove the ribbon cable from (J6).
c. Remove the one D / CS mounting screw that has touch pad shielding foil and ground wire under it. Locate the foil away from this connection.

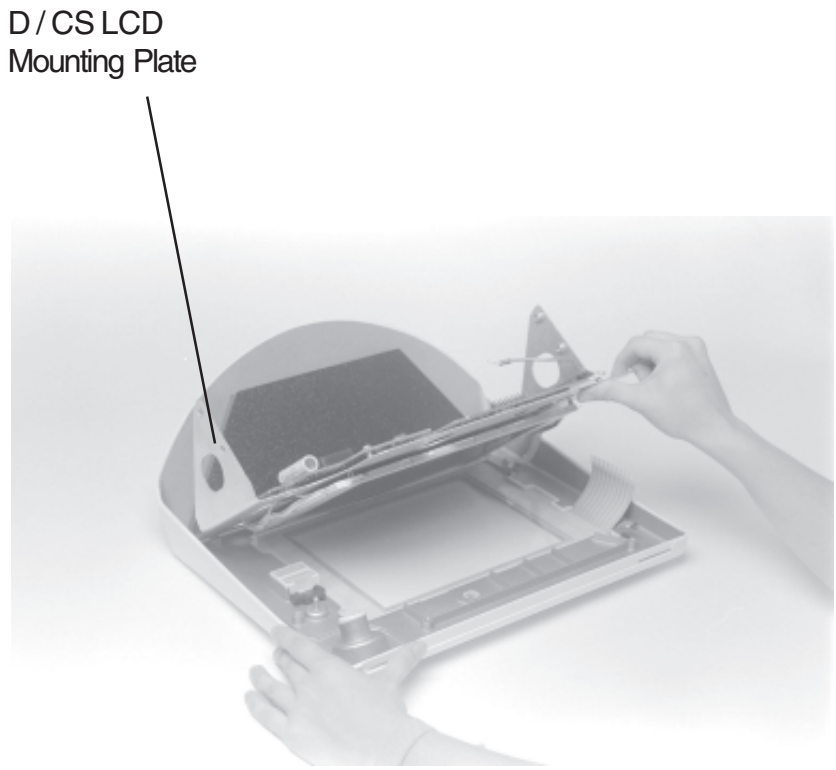


Touch Pad Replacement (Continued)

Step 2
Removing the D / CS - LCD Mounting Plate

a. Remove the six screws securing the D / CS - LCD mounting plate to the front enclosure.
b. Hold down on the front panel enclosure, and slowly lift upwards on one of the mounting plate to begin releasing the LCD from the touch pad. Continue until the plate can be removed.

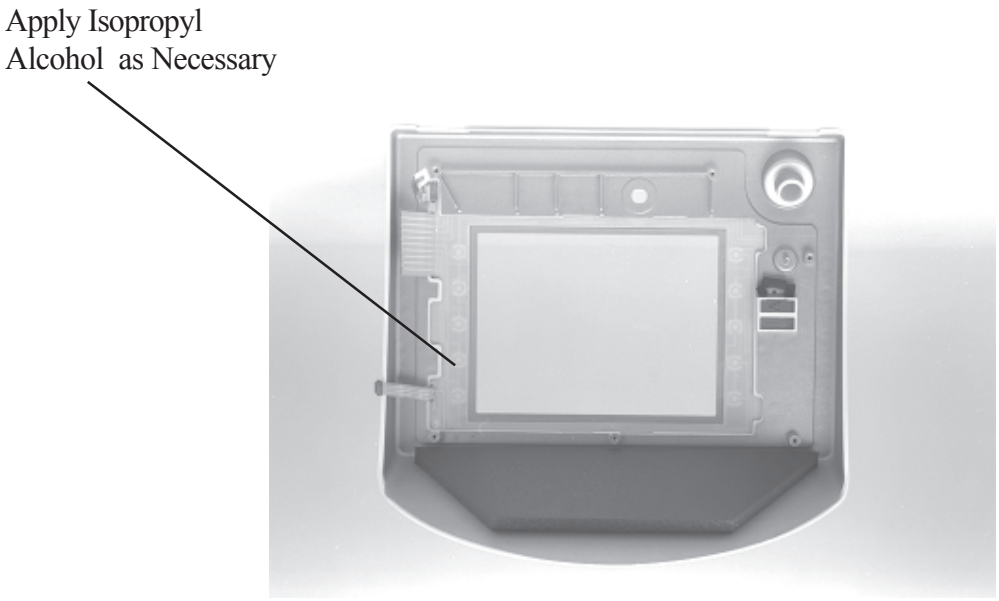
NOTE: It may be necessary to use a small amount of isopropyl alcohol to assist with the touch pad removal.



NOTE: Place this assembly in a protected area.

Step 3
Removing the Touch Pad

a. With the touch pad facing down, place a small amount of isopropyl alcohol between the touch pad lens and the front panel enclosure at its smallest width (near the top). Tilt the front panel enclosure slightly, and allow it to sit for approximately 10 to 15 seconds.



Apply Alcohol to Front Panel enclosure

b. Gently push the touch pad away from the front panel enclosure, while adding small amounts of alcohol as required, to loosen the bonding glue. Continue slowly and carefully around the panel opening until entire touch pad is removable.

c. Using isopropyl alcohol, clean any remaining glue from the front panel enclosure touch pad mounting surface.

Step 4
Installing the Touch Pad

a. Lay the front panel enclosure face up. With respect to the front of the unit, place the left side of the front panel enclosure slightly over the edge of the work surface.

b. After assuring that all glue from the original touch pad has been removed from the front panel enclosure, remove the protective paper backing from the new touch pad, including the clear protective coating on the LCD side of the touch pad lens.

c. Place the ribbon cables and ground shields through their appropriate slots in the front panel enclosure. Make sure no wiring is pinched. Slide the cables and shields through until the left side of the touch pad rests (but is not secured) on the left side of the front panel enclosure.

d. Align the touch pad, top to bottom, and rest it in place. Observe alignment as the touch pad becomes secured to the front panel enclosure.

NOTE:
Place one hand underneath the front panel enclosure while applying any pressure, so that the curve in the front panel is not damaged. Once on and aligned properly, apply a rotating, rubbing pressure to secure the touch pad.

NOTE:
If an alignment problem occurs, use a small amount of isopropyl alcohol to remove the touch pad. Allow to dry before trying again.

Step 5
Installing the D / CS - LCD Mounting Plate

a. While placing the D / CS - LCD mounting plate on the front enclosure, ensure that the cables are properly routed. Secure the plate into position using the six mounting screws

Step 6
Installing the D / CS - Touch Pad Ribbon Cable

a. With the tabs fully extended on (J6), place the ribbon cable completely into the connector. While applying slight inward pressure on the ribbon cable, lock the tabs on both sides of (J6).

Chapter 8: Testing and Calibration

Chapter 8: Testing and Calibration

8.1 Overview

The following is a summary of the testing and calibration procedures detailed in this chapter.

8.2 Recommended Testing after Part(s) Replacement

Defines the recommended testing to perform on the unit after removal and installation of a replacement part. The testing reflects the minimum required to verify system performance.

8.3 Exhalation Port Test

Characterizes the circuit by analyzing the leak rate of the exhalation port.

8.4 Total Operating Hours Transfer Procedure

Transfers the current Total Operating Hours for a unit when replacing the Main Control Subsystem (MC), or the memory battery.

8.5 Blower/Valve Calibration Procedure

Provides instructions for calibrating the Blower and Valves of the unit after major component replacement.

8.6 Performance Verification

Verifies that the BiPAP Vision user interface is functioning properly. It is not intended to verify specifications, only the operational features are tested.

8.7 Run-In Cycle Procedure

This procedure is to be used after servicing the BiPAP Vision as called out in the Testing after Part(s) Replacement on page 8-3 and 8-4. The unit will cycle for one half hour with specified operating parameters to qualify the repair after a component has been replaced.

8.8 System Final Test

Verifies that the Vision unit operates within specifications. The intent of this procedure is to ensure that the unit functions against performance specifications by verification of the internal sensor measurement's accuracy and the unit's capability to generate and control the required pressures and flow rates of the various operating modes. User controls and alarm functions are also tested.

8.9 PC or Laptop Setup Procedures

Necessary steps to set up a PC/Laptop for testing or Vent Inop error code extraction.

8.10 Test Cable Usage Definitions

8.11 Oxygen Flow Module Test

8.2 Recommended Testing after Part(s) Replacement

Purpose

This chart defines the recommended testing to perform on the unit after removal and installation of a replacement part. The testing reflects the minimum required to verify system performance.

Replacement Item	Blower/ Valve Cal.	Run-In Cycle	Performance Verification	System Final Test
1. Air Flow Module (AFM)	YES	YES	NO	YES
2. Alarm "B" Option	NO	YES	YES	NO
3. Blower	YES	YES	NO	YES
4. Blower Muffler	YES	NO	NO	NO
5. Bottom Enclosure	YES	YES	NO	YES
6. Cables (any internal)	NO	NO	YES	NO
7. Circulation Fan	YES	YES	NO	YES
8. Display Control (DC)	NO	YES	NO	YES
9. AC Power Cord (any)	NO	YES	YES	NO
10. Fan Muffler	NO	NO	NO	NO
11. Filter Enclosure	YES	YES	YES	NO
12. Filter	NO	NO	NO	NO
13. Front Panel Enclosure	NO	YES	YES	NO
14. Fuses, Domestic	NO	NO	YES	NO
15. Fuses, International	NO	NO	YES	NO
16. Hoses (any internal)	YES	YES	YES	NO
17. ICB Ribbon Cable	NO	NO	YES	NO
18. In-Line Flow Restrictor (ILFR)	YES	YES	NO	YES
19. AC Inlet	YES	YES	NO	YES
20. Liquid Crystal Display (LCD)	NO	NO	YES	NO
21. Main Control (MC)	YES	YES	NO	YES
22. Oxygen Module Assembly (OM)	YES	YES	NO	YES
23. OM Regulator Bowl	NO	NO	NO	NO
24. OM Regulator Filter	NO	NO	NO	NO
25. Main Power Switch	NO	NO	YES	NO
26. Power Supply Subsystem (PSS)	YES	YES	NO	YES
27. Pressure Control (PC)	YES	YES	NO	YES
28. Pressure Relief Valve (PRV)	YES	YES	NO	YES
29. PRV Muffler	YES	NO	YES	NO
30. Rotary Encoder	NO	YES	YES	NO

Recommended Testing after Part(s) Replacement (Continued)

Replacement Item	Blower/ Valve Cal.	Run-in Cycle	Performance Verification	System Final Test
31. Rotary Encoder Knob	NO	NO	NO	NO
32. Rubber Feet	NO	NO	NO	NO
33. Top Enclosure	NO	NO	NO	NO
34. Touch Pad	NO	YES	YES	NO
35. Transformer	YES	YES	NO	YES
36. Power Line Filter	NO	YES	NO	YES
37. Audible Alarm	NO	YES	YES	NO
38. EPROM	NO	YES	NO	YES
39. PAV / T	NO	YES	NO	YES
40. Oxygen Manifold/Regulator	YES	YES	NO	YES
41. Oxygen PCA/Flowbody	YES	YES	NO	YES

8.3 Exhalation Port Test

Figure 8-1

8.3 Exhalation Port Test

Purpose

The Exhalation Port Test characterizes the circuit by analyzing the leak rate of the exhalation port. During the test, the system learns the intentional exhalation port leak over the complete pressure range. The learned leak value is then stored in system memory and is used to perform leak calculations and provide an accurate display of patient leak, minute ventilation, and tidal volume in the Data Display Area. When a test is performed successfully, the Data Display shows the unintentional leak. The display will appear as "Pt. Leak" in the Data Display Area. If the test is not performed or cannot be completed successfully, the system is unable to accurately know the intentional leak and will display the total leak value (intentional + unintentional). The display will appear as "Tot. Leak" in the Data Display Area.

NOTE: The Exhalation Port Test should be performed after servicing to ensure the accuracy of estimated tidal volume and minute ventilation readings. Accurate minute ventilation readings are necessary to ensure the accuracy of the low minute ventilation alarm when it is set below 3 L/min.

NOTE: The Exhalation Port Test is recommended before each use, with circuit changes, with changes in the exhalation port, or after servicing. Completing the test ensures the accuracy of some displays and alarms.

Equipment Set-up

- First Install a 6' smooth inner lumen tubing, then a whisper swivel, and then a pressure pick-off port onto the unit outlet.
- Connect a pressure line from the pick-off port to the pressure connection on the Vision unit.
- Occlude the outlet.

Procedure

Step 1 Plug in the power cord. The **Main Power** indicator will illuminate.

Step 2 Turn the main power switch to the On position and wait for the unit to complete the **SYSTEM SELF TEST** (internal system check). This will take approximately 5 to 15 seconds. The **TEST EXHALATION PORT** screen will then be displayed.

Exhalation Port Test (Continued)

Step 3 Press the **Test Exh Port** (Test Exhalation Port) soft key. Follow the instructions that appear on the screen, then press **Start Test**.

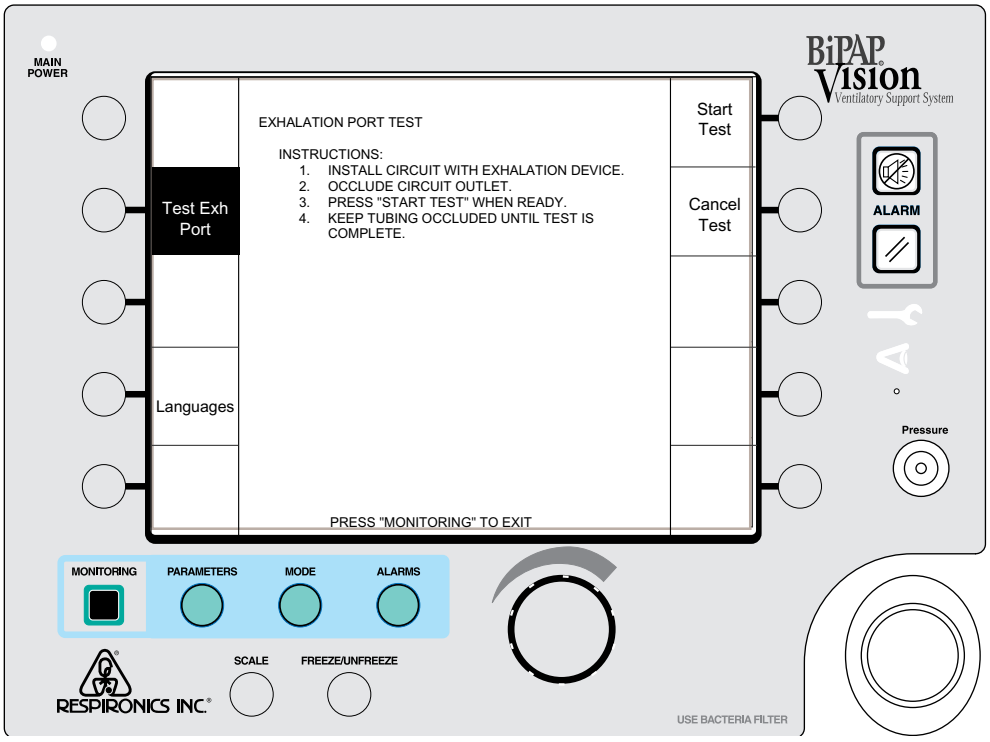


Figure 8-2
Exhalation Port Test Instructions

NOTE: This test can be canceled at anytime by pressing the **Cancel Test** soft key.

Step 4 There are seven possible status messages that can appear depending on the outcome of the **SYSTEM SELF TEST**. Follow the instructions for the condition that appears.

a. **TEST COMPLETE**
The circuit displays normal leak conditions at the exhalation (user interface) port.

b. **LOW FLOW, CHECK CIRCUIT, REPEAT TEST**
The circuit displays a lower than normal leak rate at the exhalation port. Check that the vents on the exhalation port are not blocked and that the circuit is sound. Replace, in order, the PC, AFM, PRV, and ILFR. Repeat the Exhalation Port Test.

c. **EXCESSIVE FLOW, CHECK CIRCUIT, REPEAT TEST**
The circuit displays a higher than normal leak rate at the exhalation port. Assure that the internal circuit is properly assembled. Replace, in order, the PC, PRV, and ILFR. Repeat the Exhalation Port Test between each replacement.

d. **OCCLUDED EXHALATION PORT, CHECK CIRCUIT, REPEAT TEST**
The leak rate was less than predicted. Check that the exhalation port is not blocked. Replace, in order, the PC, AFM, PRV, and ILFR. Repeat the Exhalation Port Test between each replacement.

e. **PROXLINE DISCONNECTED, CHECK CIRCUIT, REPEAT TEST**
The proximal pressure line is disconnected. Check that the internal and external proximal pressure line is connected and is not obstructed. Repeat the Exhalation Port Test.

f. **PRESSURE REGULATION ERROR, CHECK CIRCUIT, REPEAT TEST**
Leak test pressures cannot be attained. Check that the internal pressure line is connected and not obstructed. Replace, in order, the AFM and PC. Repeat the Exhalation Port Test between each replacement.

g. **INTERMITTENT EXCESSIVE FLOW, CHECK CIRCUIT, REPEAT TEST**
The leak rate was intermittently high during the test. Check that the internal and external circuit is occluded and properly sealed. Replace, in order, the PRV valve and PC. Repeat the Exhalation Port Test between each replacement.

8.4 Total Operating Hours Transfer Procedure*

Purpose

The following steps must be done to transfer the current Total Operating Hours for a unit.

Equipment

- PC / Laptop
- Test Cable (RI P/N 582161) for S/N < 106000
- Test Cable (RI P/N 1004823) for S/N > 106000 and upgraded units for S/N <106000.

Note: See Figure 8-3 and 8-4 for cable connections.

Procedure

Step 1 Power on the unit.

Note: If powering on is not possible, then an approximation will have to be made based on previous documented hours and additional running time.

Step 2 Write down the Total Operating Hours for the unit from either the Set Up Screen or the Options Screen.

Step 3 Using the test cable, connect a PC/Laptop to the MC. If necessary, follow the Terminal Setup guidelines in Section 8.9

Step 4 Power on and leave the unit in the Set Up Screen.

Step 5 Enter "**S J O**" on the terminal keyboard. This will display the "Operating Time Modify" screen.

Step 6 Follow the instructions on the screen to modify the Total Operating Time value displayed to match the hours written down from the unit in Step 2.

Step 7 After the time is correctly set, turn the power switch off, remove the terminal from the MC, reassemble the unit, or continue with testing process.

* This is used primarily when a Main Control Subsystem or Lithium battery is replaced.

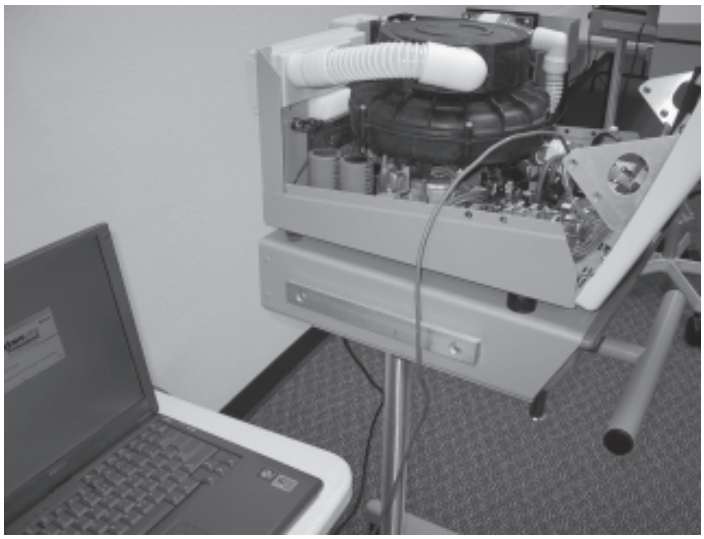


Figure 8-3

For Visions with S/N < 106K

Figure 8-4

For Visions with S/N > 106K

8.5 Blower / Valve Calibration Procedure

Purpose

This procedure provides instructions for calibrating the Blower and Valves for the BiPAP Vision system. This test will take about 10 minutes or less depending on the software version.

Note: Unit must be a minimum software revision of 11.8 / 12.4 / 13.4 to successfully pass this test. If necessary, upgrade unit.

Equipment (See Figure 8-3 and 8-4 for cable connections)

- Test Cable (Respironics P/N 582161) for S/N < 106K
- Test Cable (RI P/N 1004823) for S/N >106K and upgraded for units for S/N <106K
- PC / Laptop (Terminal mode)
- 0.25" test orifice (Respironics P/N 332353)
- Phillips screwdriver

CAUTION: Electronic components used in this device are subject to damage from static electricity. Use and follow appropriate electro-static discharge (ESD) procedures.

Procedure

Step 1 Verify that the power to the BiPAP Vision is turned Off.

Step 2 For S/N<106000, remove the top enclosure.

Step 3 Depending on the test cable needed, connect one side to the (J3) connector on the Pressure Control Subsystem (PC), or a standard serial cable to the PC connector, and the other side to the PC or Laptop.

Step 4 Install the test orifice and pressure line to the Vision outlet. Plug in and turn on the unit. Turn on the PC/Laptop.

NOTE: It may be necessary to refer to the "PC/Lap Setup Procedure" found in Chapter 8 to properly set the parameters on the PC or Laptop for Hyperterminal application.

Blower / Valve Calibration Procedure (Continued)

Step 5 Wait for the Test Exhalation Port/Language screen to appear. Do not press Monitoring.

Step 6 Assure that the test orifice and the PRV exhaust are not obstructed.

Step 7 Type the calibration start code: **SJB,** on the terminal with no carriage return.

NOTE: Insure that the calibration start codes are in all capital letters. These will not display on the PC or PC/Laptop.

Step 8 Wait for the calibration process to complete. The terminal will stop updating information and the cursor will blink when the process is finished. "Valve Calibration Successful" will be displayed. (See below for a description of the Calibration Sequence Summary.)

NOTE: If calibration is unsuccessful, try the test again. If it fails a second time, follow the guide lines on the screen for suggested failure information.

Step 9 Turn the unit Off and remove the power cord.

Step 10 Unplug the test cable from unit unless further testing is required.

Step 11 Remove the test orifice.

Step 12 Install the top enclosure, unless further testing is required.

Step 13 If necessary, carefully position the unit on its side and install the PRV muffler enclosure

Step 14 If necessary, set the unit upright.

Step 15 Test complete.

Calibration Sequence Summary

The first four states are for blower calibration. The blower DAC voltage is increased while the pressure and blower speed are monitored to determine the slope and intercept.

The next two states independently "warm up" the ILFR and PRV valves and then collect four sets of operating data on each to use to determine an average value.

All of this information is stored in memory and is used to ensure that the blower and the valves are able to meet the specified requirements.

8.6 Performance Verification

Purpose

This procedure confirms that the ventilator is functioning properly. It is not intended to verify specifications; only operational features are tested.

Equipment

- Test orifice (P/N 332353)
- Pressure tubing
- Smooth inner lumen tubing
- Whisper swivel II (P/N 332113)

Procedure

Step 1 First connect the smooth inner lumen tubing to the unit outlet then the whisper swivel and finally the test orifice. Connect the pressure tubing from the BiPAP Vision to the test orifice.

NOTE: If the Vision unit loses power, and power is restored in less than 10 seconds, the unit will return to operation at the same settings that were in effect before power was lost.

Step 2 Turn the unit on. When the Test Exhalation Port/Language Screen is displayed, remove the AC power cord from the rear of the unit. Verify that the Ventilator Inoperative visual (wrench icon) and the audible alarm is activated. Turn the unit off. Verify that the audible and visual alarms are no longer active.

Step 3 After 15 seconds or more, reinstall the AC power cord, and switch the unit on.

NOTE: For software versions 11.2 and higher, the "Loss of AC Power" symbol will begin flashing in the display area. Press the Alarm Reset to clear and continue.

Perform the Exhalation Port Test as described in Section 8.3. (After successful completion of the test, press the **MONITORING** hard key to proceed to the Monitoring Screen.)

Step 4 Press the **OPTIONS** soft key to access the Options Screen. If an alarm is active, press the Reset Hard Key.

Step 5 Press the **TEST ALARMS** soft key to verify that both the audible tone and the alarm messages activate for all available alarms. The Ventilator Inoperative and Check Ventilator icons should illuminate during the test. The Vision front panel should look like Figure 8-2 (O_2 Flow, Lo MinVent, Hi Rate, and Lo Rate appear if the oxygen module and optional alarms are installed).

NOTE: Each alarm function has both an audible and visual component. Verify that both components are active during the alarm test. If either component is not active, have the unit serviced.

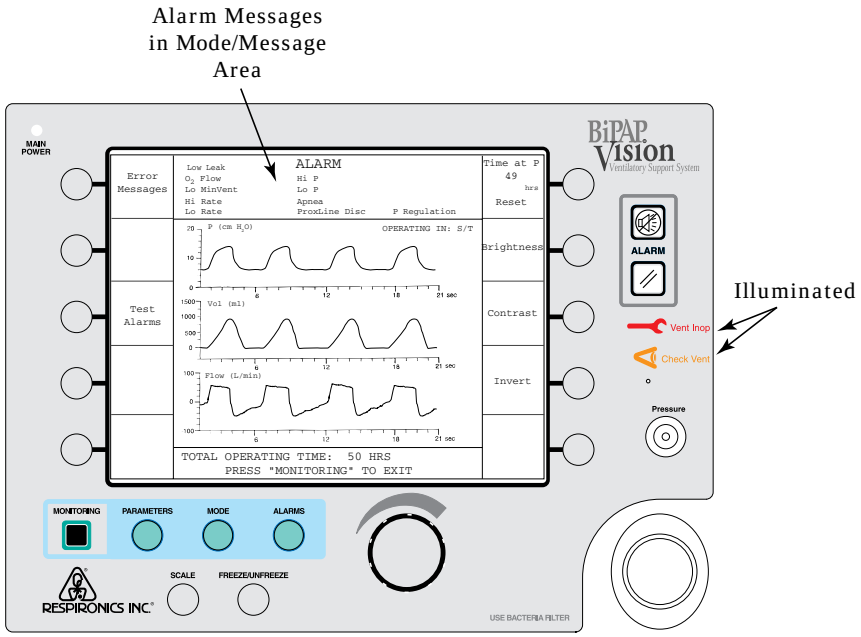


Figure 8-5
Alarm Test Screen
(Oxygen and Optional Alarm Module Installed)

Step 6 Press Monitoring. If the CPAP or PAV/T mode is active, press the **MODE** hard key, select the **S/T** soft key, and set the parameters as shown below. Activate the new mode. If the S/T Mode is active, press the **MONITORING** hard key then press the **PARAMETERS** hard key. In either case, set the parameters as follows:

IPAP = 15 cm H_2O

EPAP = 5 cm H_2O

Rate = 15 BPM

Timed Insp = 1.0 sec

IPAP Rise Time = 0.1 sec

Performance Verification (Continued)

Step 7 Press the **ALARMS** hard key and set the following alarm parameters.

Hi P = 20 cm H_2O

Lo P = 10 cm H_2O

Lo P Delay = 20 sec

Apnea = Disabled

If you have the optional Alarm Module, set the following additional alarm parameters.

Lo MinVent = Disabled

Hi Rate = 40 BPM

Lo Rate = 10 BPM

Step 8 Press the **MONITORING** hard key to return to the Monitoring Screen. Verify the following parameters from the Monitoring Screen. (visual inspection)

- The **Rate** soft key indicator flashes when each timed breath is activated.
- The timed breath is approximately 1 second in duration.
- The IPAP during a timed breath is 15 cm H_2O.
- The EPAP during a timed breath is 5 cm H_2O.
- The Timed Breath Rate is 15 BPM as indicated in the Timed Breath Indicator display.

Step 9 Occlude the test orifice for a few seconds. While viewing the Vision Pressure waveform, create a small leak at the test orifice to simulate a spontaneous trigger. This process may have to be repeated a few times. Verify that the unit cycles to IPAP and that the Rate Indicator did not flash. After the breath is triggered, unocclude the test orifice.

Step 10 Press the **ALARMS** hard key to display the Alarms Screen.

Step 11 Select the **Hi P** soft key and adjust the parameter to 10 cm H_2O. Wait for the audible and visual alarms indicating a High Pressure alarm. Return the Hi P parameter to 20 cm H_2O and press the **Alarm Reset** hard key to remove the alarm message.

Step 12 Open the circuit to atmosphere for approximately 20 seconds to verify the following audible and visual alarms.

- The disconnect alarm is activated after a few seconds. Press the alarm silence button and continue.
- The Lo P Alarm is activated.

Occlude the patient outlet on the circuit and press the **Alarm Reset** hard key to clear both the audible and the visual alarms.

Step 13 Select the **Apnea** soft key and adjust the parameter to 20 sec. Maintain the occlusion of the patient connection for a minimum of 20 seconds to verify that the audible tone and the Apnea Alarm Message are activated. Adjust the Apnea setting to the Disabled setting. Press the **Alarm Reset** key to clear the visual alarms.

Step 14 Test complete.

BiPAP Vision Performance Verification/Screening Data Sheet

Serial Number		Service Notification (Respironics use only)	
Model Number		Total Operating Time	

Purpose:

This data sheet is to be used in conjunction with the BiPAP Vision Performance Verification. It should also be used whenever a screening procedure is required on the BiPAP Vision.

Results:

Test	Step	Pass	Fail
Ventilator Inoperative Alarm	2		
Exhalation Port Test	3		
Test Alarms	5		
Parameters From Monitoring Screen	8		
Spontaneous Breath	9		
High Pressure Alarm	11		
Low Pressure Alarm	12		
Apnea Alarm	13		

Tested By: (print)	Tested By: (signature)	Date

8.7 Run-In Cycle Procedure

Purpose

This procedure is to be used after servicing the BiPAP Vision as called out in the Recommended Testing after Part(s) Replacement Chart in section 8.2. The unit will cycle for one half hour, with specified operating parameters, to qualify the repair after a component has been replaced.

Equipment / Materials

- 0.25″ test orifice (Respironics P/N 332353)
- pressure tubing

Procedure

Step 1 Connect the 0.25″ test orifice (Respironics P/N 332353) to the outlet port, and the pressure tubing from its port to the pressure input on the BiPAP Vision.

Step 2 Connect the power, turn the unit On, and set up the following parameters in the **S/T** Mode.

IPAP = 40 cm H_2O

EPAP = 4 cm H_2O

Rate = 20 BPM

Timed Insp = 0.5 sec.

IPAP Rise Time = 0.1 sec.

Step 3 Set the following alarm parameters:

Hi P = 50 cm H_2O

Lo P = Disabled

Lo P Delay = 60 sec.

Apnea = Disabled

If the unit has the optional Alarm Module, and/or optional Oxygen Module set the following additional parameters:

Lo MinVent = Disabled

Hi Rate = 50 BPM

Lo Rate = 4 BPM

%O_2 = 21%

Run-In Cycle Procedure (Continued)

Step 4 Return to the Monitoring screen and observe that the display values match the set values.

Step 5 Run the unit for one half hour with the above settings.

Step 6 Verify that the display values match the set values and that no alarms occurred during this time period. If a problem exists, follow the appropriate Troubleshooting Flow Chart in Chapter 6 and perform the Run-In Cycle Procedure again before proceeding.

Step 7 Test Complete.

8.8 System Final Test

Purpose

This procedure will verify that the Vision unit operates to specifications. The intent is to ensure that the unit functions against performance specifications by verification of the internal sensor measurement's accuracy, and the unit's capability to generate and control the required pressures and flow rates of the various operating modes. User controls and alarm functions are also tested. Below are the major activities performed within this test procedure.

- Set up the Unit for Test
- Measure Flow Accuracy
- Measure S/T Performance
- Verify Options, Controls, and Alarms
- Nurse Call/Remote Alarm (if installed)
- Verify Pressure Accuracy
- Measure Dynamic Pressure Regulation
- Verify Oxygen Module Operation (if installed)
- Verify PAV/T Mode (if installed)
- Earth Restance and Leakage Current (Optional)

Data and other various information is to be recorded on the System Final Test Data Sheet.

Equipment

- Flexible, smooth inner lumen tubing (P/N 301016)
- Flowmeter (Appendix A)
- Manometer (Appendix A)
- PC/Laptop (Appendix A)
- Mechanical lung (Appendix A)
- Medical grade Oxygen and regulator (for testing of optional oxygen module only)
- Oxygen analyzer (for testing of optional oxygen module only - Appendix A)
- Variable flow restrictor (adjustable valve) (P/N 1006120)
- Whisper swivel (P/N 332113)
- Phillips screwdriver
- Pressure tubing
- Safety analyzer (Appendix A)
- Test cable (P/N 582161 for serial numbers 105999 and less, P/N 1004823 for serial numbers 106000 and higher or upgraded units).
- Multiple outlet power strip
- Plug, cap, or stopper
- Pressure pick-off port (0_2 port, P/N 312710)

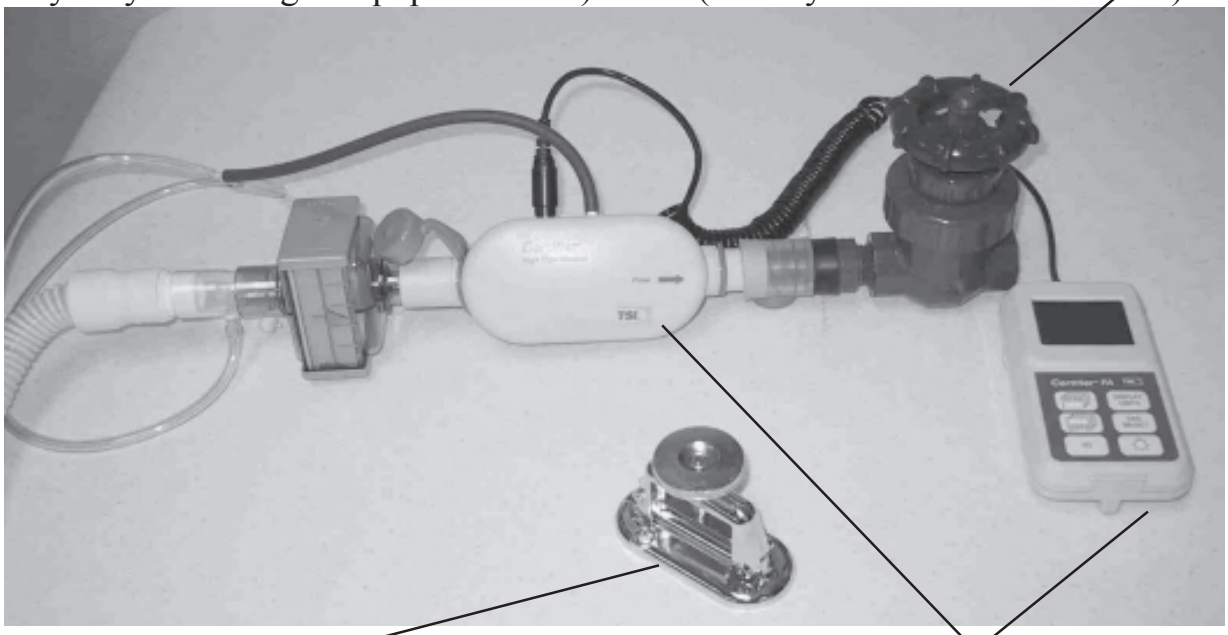
System Final Test (Continued)

CAUTION: Static sensitive components. This procedure must be performed at an ESD approved workstation.

NOTE: Only properly trained service personnel are permitted to perform this procedure.

Initial Equipment Setup

(May vary according to equipment used) (Locally sourced flow restrictor)



Flow Restrictor (1006120) Certifier Flow Analyzer (1012598)

Figure 8-6
Initial Equipment Setup

Procedure

A. Connect Unit to Test Equipment

Step 1 Remove the top enclosure.

Step 2 Connect the Test Cable from the PC board (J3), or the Test Cable connector labeled PC, to the PC/ laptop com port.

Step 3 Plug in the AC power cord and verify the **MAIN POWER** indicator is lit.

Step 4 Connect the patient tubing to the outlet of the unit. Place a pressure pickoff port on the other end and then connect this to the Flowmeter. Using another piece of patient tubing, connect the outlet of the flowmeter to the restrictor valve. Adjust restrictor valve to allow for a small amount of circuit leak. Refer to figure 8-3.

Step 5 Using a Tee fitting, connect the Manometer, the pressure pickoff port, and the Vision pressure port together.

B. Turn on Unit

Step 1 After the System Self Test is complete, record the **Total Operating Time** shown on the display shown at the bottom of the Test Exhalation Port/Language screen.

Step 2 Press **MONITORING**, then press **Options**.

Step 3 Verify that **Brightness** and **Contrast** can be controlled by pressing the appropriate key and turning the adjustment knob. Then adjust both of these for an acceptable display. (The Brightness has a small control range, it will not have much affect on the screen).

Step 4 Press **MONITORING** to exit.

C. Set Up Alarms and Scales

Step 1 Press **ALARMS**.

Step 2 After selecting the desired alarm, rotate the adjustment knob, and set each alarm according to the following:

ALARM	VALUE
Hi P	50
Lo P	Disabled
Lo P Delay	60
Apnea	Disabled

Step 3 If ALARM MODULE B is installed, set the alarms as listed below (they will be displayed on the right side of the alarms screen).

ALARM	VALUE
Lo Min Vent	Disabled
High Rate	50
Low Rate	4

System Final Test (Continued)

Step 4 Press **SCALE.** Select the desired scale then rotate the adjust knob . Set each to the following:

SCALE	VALUE
P	45 cm H_2O
Vol	1500 ml
Flow	100 L/min.
Time Base	9 sec.

Step 5 Press **MONITORING** to exit.

D. Set CPAP Pressure

If the unit is in CPAP mode:

- Press **PARAMETERS**
- Press **Set CPAP** and adjust the pressure to 5 cm H_2O

If the unit is in S/T mode:

- Press **MODE** then **CPAP**.
- Press **Set CPAP** and adjust the pressure to 5 cm H_2O.
- Press **Activate New Mode** to enable.

If the unit is in PAV/T mode:

- Press **MODE** then **CPAP**.
- Press **Set CPAP** and adjust the pressure to 5 cm H_2O.
- Press **Activate New Mode** to enable.

Step 1 On the PC/Laptop type, in sequence, the capital letters **SJL** to view the system parameters of the Vision unit being tested. Note that only the blinking cursor will be displayed.

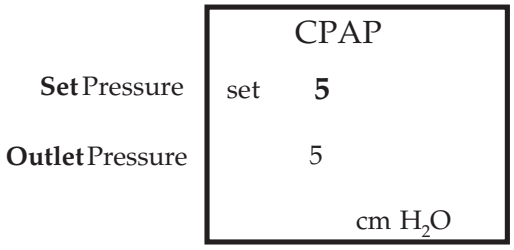
(If required, use the PC/Laptop Setup Procedure found in Chapter 8)

NOTE:	Lo Rate alarm will sound during this test. Press **ALARM SILENCE** to temporarily cancel.
NOTE:	Unit may oscillate when no flow is present. Open the flow restrictor slightly until it stops, then slowly close the valve.
NOTE:	After a period of time, the unit will automatically switch to **MONITORING**. Press **PARAMETERS** to return to the parameters screen for making unit adjustments and viewing the displays listed below.

E. Pressure Accuracy

Step 1 Adjust the flow restrictor for 0 (+0.5) LPM on the flowmeter.

Step 2 Record the following unit values on the data sheet:
a) **Set** pressure value from **Vision display**.
b) **Outlet** pressure value from **Vision display** (Bottom number while in parameter)
c) "**Unit Outlet Pressure**" on **PC/Laptop**.
d) "**Patient Pressure**" on **PC/Laptop**.
e) **Manometer** pressure



Step 3 Verify all pressure readings are within specification (i.e. ± 2 cm H_2O of the Manometer reading).

Step 4 Set the unit pressure for 10 cm H_2O and repeat steps 2-4.

Step 5 Set the unit for a pressure of 20 cm H_2O, adjust the flow restrictor to 30 (± 3) LPM and repeat steps 2-4.

F. Flow Accuracy

Step 1 Leave the **CPAP** pressure set to 20 cm H_2O.

Step 2 Set the flow restrictor for 0 LPM (+0.5) flow rate.

Step 3 Record the flow meter reading.

Step 4 Record the **COMPENSATED TOTAL FLOW** from the PC/Laptop.

System Final Test (Continued)

Step 5 Verify the compensated total flow values are within specification.

Step 6 Set the flow restrictor for 10, 60, and 120 LPM (± 1 LPM) and repeat steps 3-5.

Step 7 While at 120 LPM, verify the pressure is 20 cm H_2O ± 2 cm H_2O.

G. Dynamic Pressure Regulation

Step 1 Turn the unit Off.

Step 2 Disconnect the flow restrictor from the flow meter.

NOTE: The test lung should not be connected at this time.

Step 3 Connect a whisper swivel to the patient tubing at the output of the flow meter and plug the end. Turn the unit On. Wait for the Test Exhalation Port Screen to appear.

Step 4 Press **Test Exh Port** then **Start Test**. Follow the on screen instructions as appropriate until **"TEST COMPLETE"** is displayed.

NOTE: Do not block the slots on the Whisper Swivel while the Exhalation Port Test is in progress.

Step 5 Press **MONITORING** to exit then press **PARAMETERS**.

Step 6 Ensure that the unit is still in **CPAP** mode, set at 20 cm H_2O.

Step 7 Remove the plug and connect the test lung. (Compliance set to 0.05, Parabolic Resistor RP 20). **See Figure 8-7 for setup instructions.**

Step 8 Press **MONITORING** and verify that the unit is in "**Waveform**" display.

Step 9 Manually operate the test lung to create a uniform waveform on the Vision flow display with peaks approaching 100 L/Min and a rate of approximately 30 BPM (one every two seconds). While doing this, observe the manometer reading.

Step 10 Verify the manometer reading to be within ± 2 cm H_2O of the unit's set value.

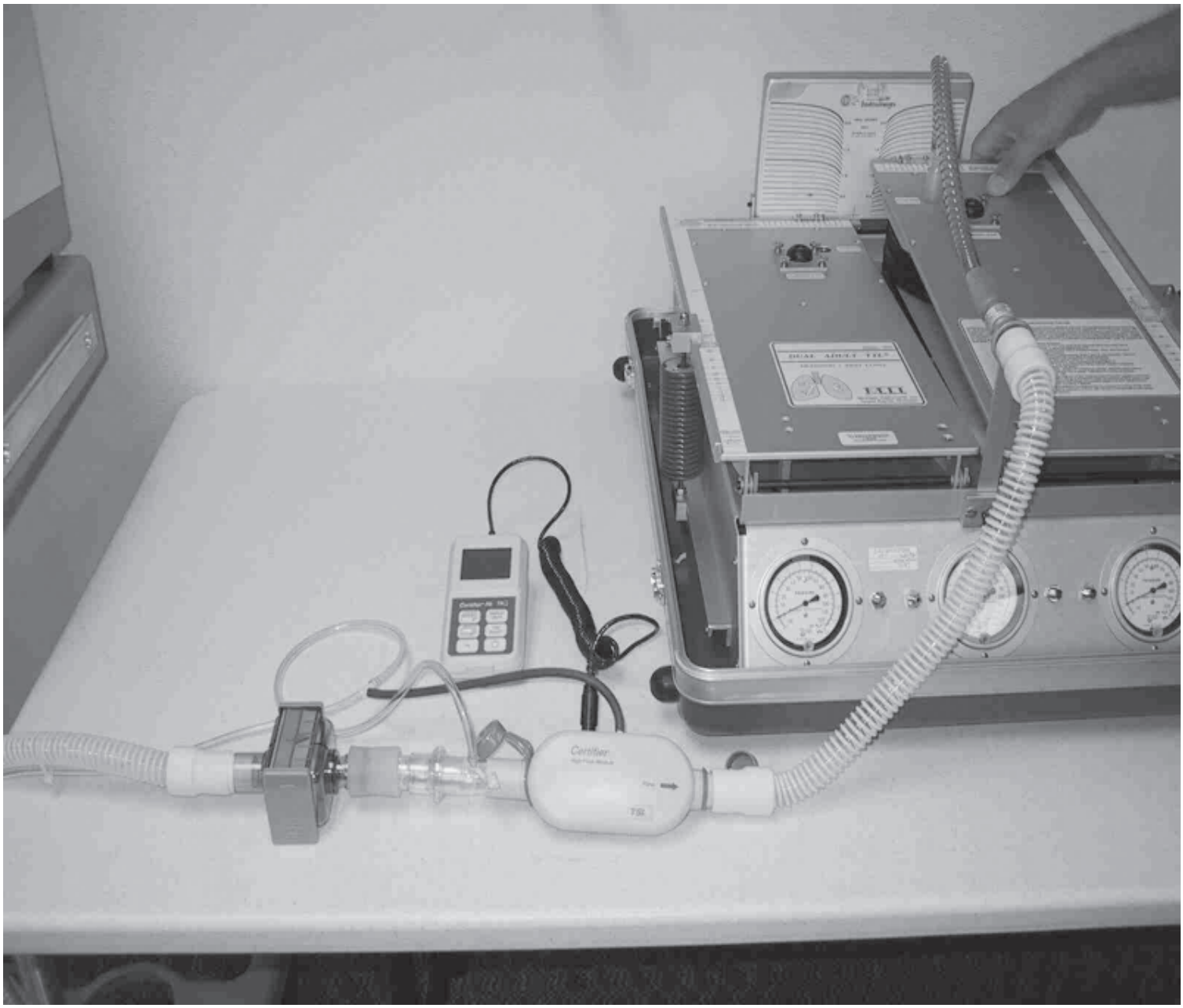


Figure 8-7

H. S/T Performance

Step 1 Press **MODE,** then **S/T**. Leave the test lung connected.

Step 2 Select and set the following.

- **IPAP** = 35 cm H_2O
- **EPAP** = 5 cm H_2O
- **Rate** = 10 BPM
- **Timed Insp** = 2.5 sec
- **IPAP Risetime** = .05 sec

Step 3 Press **Activate New Mode** when ready to continue. Allow the unit to cycle a few times.

Step 4 Verify that the unit is cycling between low and high pressure by observing the waveforms on the Vision pressure display.

Step 5 Verify the Manometer readings for **IPAP** pressure and **EPAP** pressure are within ± 2 cm H_2O of their settings.

Step 6 Record the BPM. Acceptance range is 9.3 to 10.8 BPM.

I. Options and Controls

Step 1 Press **MONITORING** then press **Options**.

Step 2 Press **Invert**. Verify function, and press again to return.

Step 3 Press **Bar Graph**. Verify that the screen displays bar graphs. Press again to return to waveform.

Step 4 Press **Test Alarms**. An audible tone should occur along with alarm messages displayed briefly at the top of the screen. The Check Vent and Vent Inop symbols will light.

Step 5 Press **Error Messages**. Observe and record any displayed messages. Then press **Clear Error Messages**.

Step 6 If desired, press the key for **Time at P** to reset.

Step 7 Press **System Info** and record the software version, if the Oxygen Module is installed, and which Alarm Module is installed.

System Final Test (Continued)

Step 8 Press **MONITORING**.

Step 9 Press **FREEZE/UNFREEZE** and observe that the graphic displays have stopped updating. Press **FREEZE/UNFREEZE** again to resume.

Step 10 Press **SCALE**. Press **P** and change the scale by rotating the knob and observe a change in the displayed waveform. Set back to 45 cm H_2O. Press **MONITORING** to exit.

J. Alarms

Step 1 Disconnect the manometer tubing from the Vision Pressure Port. In a few seconds, an alarm will sound and **ProxLine** and / or **Lo P Disc** will be displayed in the Alarm message window at the top of the screen.

Step 2 Replace the tubing and the alarm will be silenced. Press **ALARM RESET** and the alarm will reset.

Step 3 Pull the AC power cord from the unit. An alarm should sound and the "wrench" icon will light.

Step 4 Turn the unit Off, wait for the alarm to stop and then wait 10 seconds minimum.

Step 5 Plug the AC power cord into the unit and turn the unit On.

Step 6 Verify that the unit powers up without alarming.

NOTE: For software versions 11.2 and higher, the "Loss of AC Power" indication will be flashing in the display area. Press the Alarm Reset to clear and continue.

Step 7 Turn off the unit.

BiPAP Vision Oxygen Module Testing for S/N 1007401-108343

Note: This test should only be performed once for affected units. If the Oxygen Module has been replaced with a new type, or if your unit does not have a serial number on the oxygen module label, this test does not need to be performed.

Purpose:

1. To perform an additional test on BiPAP Vision units from serial number 107401 to 108343 (inclusive). This procedure must be done the first time a Vision that falls within the above listed serial number range is returned for service for any reason. This procedure is to be performed after the unit passes system final test found in the service manual.

2. This procedure must also be performed on any Oxygen Module repair kit from serial number 300000 to 301249 (inclusive) that has been installed into any unit. The serial number is located on the cover. Repair parts 582142 and 1004977 are made up of these serial numbers, along with the production units listed above.

This test will verify the ability of the oxygen delivery subassembly to adequately supply the required flow needed to yield a specified oxygen concentration at the maximum unit flow rate. Some of these may have had a vendor assembly problem. Any faults will require the replacement of the Oxygen Module assembly.

Test Equipment:
Same as used with oxygen testing found in step K of the System Final Test.

Test Setup:
See figure 8-8, except substitute the flow restrictor in the circuit for the test lung. Begin with a small leak.

Procedure:
1.) Turn the unit on.
2.) After the System Self Test completes, press **MONITORING**.
3.) Press **PARAMETERS** button and set the following unit parameters:

IPAP = 40 cm H2O
EPAP = 20 cm H2O
RATE = 10 BPM
TIMED INSP. = 3.0 sec
IPAP RISETIME = .05 sec
O2% = 21%

4.) Slowly open the flow restrictor and verify the flowmeter reads a minimum of 130 LPM for four consecutive breaths during the IPAP portion of the cycle. If the unit activates the "Disconnect" alarm, it may be necessary to adjust the flow restrictor valve to a lower flow and slowly re-open to reach this flow rate.

5.) Set the O2% parameter to 100% and wait for oxygen analyzer reading to stabilize.

6.) For the unit to pass, the oxygen analyzer reading must remain between 90% and 109% inclusive for four consecutive breaths. If any unit fails, the Oxygen Module subassembly must be replaced and the unit retested.

7.) When complete, set the unit parameters as follows:

IPAP = 15 cm H2O
EPAP = 5 cm H2O
RATE = 10 BPM
TIMED INSP. = 1.0 sec
IPAP RISETIME = .05 sec
O2% = 21%

8.) Press **MONITORING** button.

9.) Close the oxygen tank valve.

10.) Turn power off and disconnect test equipment.

11.) Test Complete.

K. Oxygen Module Operation

Note: To perform this test it is necessary that the Vision unit being tested have at least 11.8 / 12.4 / 13.4 software. If your Vision unit has earlier software, it is mandatory that it be upgraded before performing this test.

Note: See Figure 8-8 for assistance in connecting oxygen analyzer.

WARNING: Oxygen supports combustion. Do not use oxygen while smoking or in the presence of an open flame.

WARNING: Never use the analyzer to measure gas with a high oxygen content following use on air with an oil vapor content. The oil vapor will contaminate the tubing and may result in a fire on contact with high oxygen levels.

Oxygen Module Test Procedure

Step 1

Prior to performing this test, a visual inspection should be made of the internal components of the oxygen delivery system including tubing, to ensure that there are no faulty items.

Step 1A Connect the 6 foot smooth inner lumen tubing from the outlet of the Vision, to the Whisper Swivel, then to a pressure pick-off port (O_2 port) and then to the TTL Lung (or equivalent). A small length of tubing (approximately 6 inches) may be needed between the pressure pick-off port and the test lung.

Connect the oxygen analyzer cell in the patient circuit.
Put the pressure tubing from the pick-off port to the unit's patient pressure connection.

Or, Using a "T" connector, connect the pressure pick-off port, the unit's patient pressure connection and the oxygen analyzer inlet together, whichever applies.

Set the test lung to have a compliance of 0.04 and a parabolic resistance of 20.

Step 2 Turn on the Vision unit.

Step 3 On the unit, press **Parameters** and set the following unit parameters.

IPAP = 20 cm H_2O
EPAP = 4 cm H_2O
RATE = 15 BPM
Timed Insp. = 1.0 sec
IPAP Risetime = .05 sec
O_2% = 21%

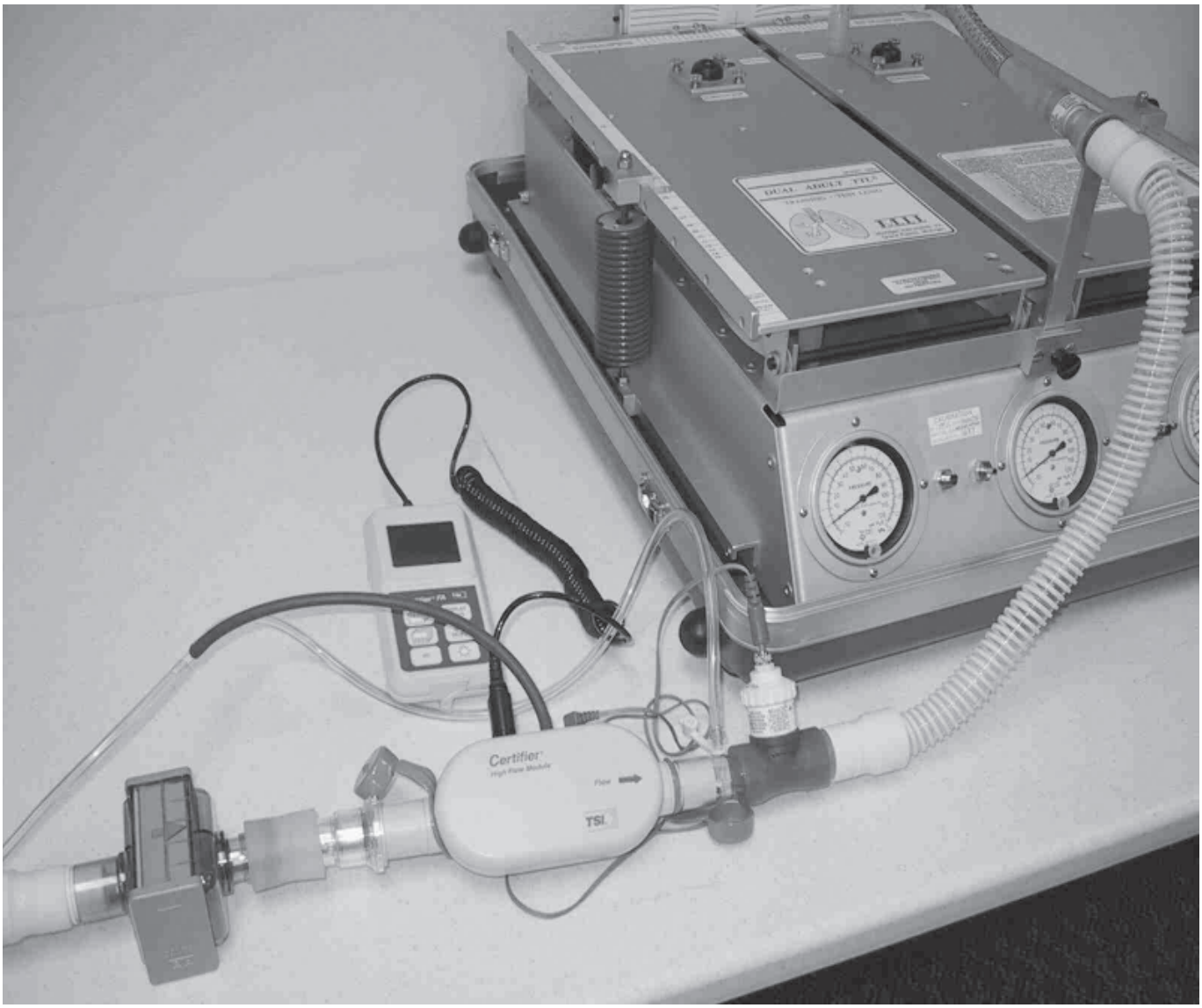


Figure 8-8

Step 4 Press **Monitoring**. Ensure that the tidal volume reading on the Vision (Vt) is at 500 ml, +/- 20 ml (480 to 520 ml). If not raise or lower the IPAP pressure until the proper tidal volume reading is obtained.

Step 5 Connect the O_2 line to the Oxygen Module. Open the O_2 cylinder valve. Ensure that the O_2 regulator is set at 50 psi.

Step 6 Wait for the Oxygen Analyzer to stabilize and verify that the reading is 18% to 24%.

Note: Readings should be stable after 8 to 10 breaths. Some variance in the reading may occur, depending on the quality of the analyzer being used.

Step 7 Press **Parameters** then set % O_2 and adjust for 30% O_2 level. Wait for the Oxygen Analyzer to stabilize and verify that the reading is between 27% and 33% (inclusive). If the tidal volume reading on the Vision falls out of the acceptable range, adjust the IPAP pressure until the tidal volume falls within the acceptable range before taking the reading.

Step 8 Set the O_2 to 100%.

Step 9 Close the O_2 cylinder valve. Disconnect the Oxygen hose from the back of the Vision.

Step 10 The unit should alarm for no O_2 Flow at 15 Breaths or less.

Step 11 Reconnect the Oxygen hose to the back of the Vision and Open the O_2 cylinder valve, set the O_2 to 40% and press **Alarm** reset. Verify that no alarms exist after 8 breath cycles.

Step 12 Wait for the Oxygen Analyzer to stabilize and verify that the reading is between 36% and 44% (inclusive). If the tidal volume reading on the Vision falls out of the acceptable range, adjust the IPAP pressure until the tidal volume falls within the acceptable range before taking the reading.

Step 13 Set the unit for 60% O_2. Wait for the Oxygen Analyzer to stabilize and verify that the reading is between 54% and 66% (inclusive). If the tidal volume reading on the Vision falls out of the acceptable range, adjust the IPAP pressure until the tidal volume falls within the acceptable range before taking the reading.

Step 14 Set the unit for 80% O_2. Wait for the Oxygen Analyzer to stabilize and verify that the reading is between 72% and 88% (inclusive). If the tidal volume reading on the Vision falls out of the acceptable range, adjust the IPAP pressure until the tidal volume falls within the acceptable range before taking the reading.

Step 15 Set the unit for 100% O_2. Wait for the Oxygen Analyzer to stabilize and verify that the reading is between 90% and 109% (inclusive). If the tidal volume reading on the Vision falls out of the acceptable range, adjust the IPAP pressure until the tidal volume falls within the acceptable range before taking the reading.

Step 16 Close the O_2 cylinder valve. Disconnect the O_2 input line.

NOTE: If O_2 Module Test Fails, perform the "Oxygen Flow Module Test" found in section 8.11. Then re-run step K above.

System Final Test (Continued)

L. PAV / T mode (if installed)

Step 1 Select **Mode**.

Step 2 Select **PAV/T**.

Step 3 Activate the PAV/T mode and verify the mode features are displayed on the screen and that no errors or alarms occur.

NOTE: No further testing of the PAV/T mode is needed since the functioning of the PAV/T mode is directly linked to the S/T mode through software. The S/T specifications were verified earlier in the system final test.

Step 4 Turn off the unit, disconnect the test circuit, and remove the power.

Step 5 Install the top enclosure.

M. Earth Resistance

Step 1 Measure and record the earth resistance value. Test current is 25 amps. The value must be less than 0.10 Ohms (W) to pass.

N. Earth Leakage Current

Step 1 Measure and record the Normal Pole, No Earth, L2 earth leakage current. The value must be less than 300 microamps to pass.

Step 2 Measure and record the Reverse Pole, No Earth, L2 earth leakage current. The value must be less than 300 microamps to pass.

Step 3 Measure and record the Reverse Pole, No Earth, No L2 earth leakage current. The value must be less than 1,000 microamps to pass.

Step 4 Measure and record the Normal Pole, No Earth, No L2 earth leakage current. The value must be less than 1,000 microcamps amps.

O. BiPAP Vision Nurse Call / Remote Alarm Feature Testing (for units s/n greater than 106000 only). (optional test)

Note: Refer to chapter 3 of this manual for details of the operation of this feature.

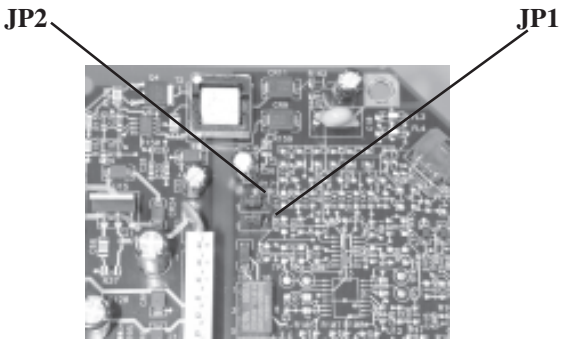
Purpose:

This test verifies the operation of the Nurse Call/Remote Alarm output connector on the rear panel of the BiPAP Vision unit. This is an optional test and is provided to use as specified by internal protocol. The option 1,2 and 3 tests can be performed independently or as a whole, depending on requirements. The unit is shipped from the factory set at the option 2 setting.

Equipment:

Fluke DVM, or equivalent
0.25" Test Orifice (p/n 332353), or occluded patient circuit

Jumper Location Photo:



Option 1 Test (Remote Alarm)

1. JP1 and JP2 on the MC board are set at 2,3.
2. Using a DVM and the unit turned off, measure the continuity across the High and Low of the Nurse Call/ Remote Alarm output connector. Value should be approximately 48.6K to 53.7K.
3. Place the test orifice on the unit. Turn the Vision on and activate any patient alarm. (For example, the Apnea alarm could be set to 20 seconds)
4. Measure the continuity on the same connector and it now should be an open circuit.
5. Turn unit off.

Option 2 Test (Nurse Call, normally closed setting)

1. JP1 on the MC board is set at 2,3. JP2 is set at 1,2.
2. Using a DVM and the unit turned off, measure the continuity across the High and Low of the Nurse Call/ Remote Alarm output connector. A closed circuit should be measured.
3. Place the test orifice on the unit. Turn the Vision on and activate any patient alarm (For example, the Apnea alarm could be set to 20 seconds).
4. Measure the continuity on the same connector and it now should be an open circuit.
5. Turn unit off.

Option 3 Test (Nurse Call, normally open setting)

1. JP1 and JP2 on the MC board are set to 1,2.
2. Using a DVM and the unit turned off, measure the continuity across the High and Low of the Nurse Call/ Remote Alarm output connector. An open circuit should be measured.
3. Place the test orifice on the unit. Turn the Vision on and activate any patient alarm (For example, the Apnea alarm could be set to 20 seconds).
4. Measure the continuity on the same connector and it now should be a closed circuit.
5. Turn unit off.

Upon completion, set the unit to the desired option.

Q. Final Test Data Sheet

Step 1 Sign and date completed Final Test Data Sheet.

BiPAP Vision Final Test Data Sheet

Serial Number _____ Model Number _____
Total Operating Time _____ Service Notification _____

Power Indicator and LCD Controls

Step	Control	Pass	Fail
A-3	Power Indicator		
B-3	Brightness		
B-3	Contrast		

Pressure Accuracy (see step E-3 for guidlines)

Step	Pressure	Set	Outlet	Unit	Patient	Manometer	Spec	Pass	Fail
E-2	5 cm H_2O						+/- 2 cmH_2O		
E-4	10 cm H_2O						+/- 2 cmH_2O		
E-5	20 cm H_2O						+/- 2 cmH_2O		

Flow Accuracy

Step	Flow Setting	Flowmeter	Compensated Total Flow	Pressure	Specification	Pass	Fail
F-2 to F-5	0 LPM				-5 to 5 LPM		
F-6	10 LPM				4.2 to 15.8 LPM		
F-6	60 LPM				50.2 to 69.8 LPM		
F-6	120 LPM				105.6 to 134.4 LPM		
F-7	120 LPM				18.0 to 22.0 cm H_2O		

Dynamic Pressure Regulation

Step	Test	Pass	Fail
G-4	Exhalation Port		
G-9	Flow Waveforms		
G-10	Manometer Reading (Spec = +/- 2 cm H_2O)		

S/T Performance

Step	Test	Reading	Specification	Pass	Fail
H-4	Cycling		Visual		
H-5	IPAP/EPAP		+/- 2 cm H_2O		
H-6	BPM		9.3 to 10.8 BPM		

Options and Controls

Step	Pass	Fail
I-2 to I-10		

Alarms

Step	Pass	Fail
J-1 to J-6		

Error Messages

Step	Type	Codes
I-5	Error	
I-5	MCS	
I-5	PAS	
I-5	DCS	

System Information

Step	Item	Info.
I-7	Software Version	
I-7	Oxygen Module	
I-7	Alarm Module	

Oxygen Module (if installed)

Step	Oxygen Set Point	Oxygen Analyzer	Specification	Pass	Fail
K-6	21%		18.0 to 24%		
K-7	30%		27.0 to 33%		
K-10			Alarm Activates		
K-12	40%		36 to 44%		
K-13	60%		54 to 66%		
K-14	80%		72 to 88%		
K-15	100%		> 90%		

PAV/T Mode (if installed)

Step	Pass	Fail
L-3		

Earth Resistance and Leakage Current (Optional)

Step	Test	Reading	Specification	Pass	Fail
M-1	Earth Resistance		< 0.100 Ohms		
N-1	Norm. Pol, No Earth, L2		< 300 microamps		
N-2	Rev. Pol, No Earth, L2		< 300 microamps		
N-3	Rev. Pol, No Earth, L2		< 1,000 microamps		
N-4	Norm Pol, No Earth, No L2		< 1,000 microamps		

Nurse Call/Remote Alarm (optional test for S/N > 106000)

Step	Pass	Fail
P		

Testing Verification

Tested By: (Full Signature)	Date

8.9 PC / Laptop Setup Procedure

Purpose

This procedure is to be used to set up the PC / Laptop required for testing and troubleshooting of the BiPAP Vision.

Note: The Vision requires no special data acquisition software. All necessary software is contained within the unit.

Equipment

PC/Laptop Computer

Serial Cable

Test Cable for serial number 105999 and lower (RI P/N 582161)

Test cable for serial numbers 106000 and higher (RI P/N 1004823), or upgraded hybrid units.

Test cable for upgraded hybrid units also required (RI P/N 1004699)

Note: For any unit 105999 and lower that has had a new MC board installed, test cable 1004823 will be used. Test cable 582161 will still need to be used on the DC board.

Equipment Setup

Step 1 Connect one end of the test cable to the RS-232 communications port on the PC/laptop.

Note: When connecting to a PC/Laptop, the 9 pin to 25 pin connector supplied with the test cable 582161 is not required.

Step 2 For S/N **105999** and lower: Connect the proper end of the test cable (582161) to the desired subsystem: (J3) on the Pressure Control (PC) and Main Control (MC) or (J5) on the Display Control (DC).

For S/N **106001** and higher: Connect the other end of the test cable (1004823) to the rear panel of the Vision and connect a standard computer cable to the desired selection.

For **upgraded hybrid** units connect ribbon cable (1004699) to the desired selection of test cable (1004823) .

Step 3 Turn on the PC / Laptop.

Operating System Setup

A. Microsoft Windows® with Hyperterminal.

Step 1 Open the following:
Start
Programs
Accessories
Hyperterminal
Hyperterminal

Step 2 From **Connection Description**, name the file if it is to be saved, select the umbrella with phone icon, then click OK.

Step 3 In **Connect To**, select **COM1** in **Connect Using**, then click OK.

Step 4 In **COM1 Properties**, **Port Settings**, set the following:

Bits per Second; 19,200
Data Bits; 8
Parity; None
Stop Bits; 1
Flow Control; Xon / Xoff.

Step 5 Click OK to activate the settings. At this point, a blinking cursor will appear on the screen.

Step 6 If necessary, check the ASCII settings. Go to File, Properties, Settings, ASCII Setup.

Step 7 Enter the appropriate command for the desired selection below. No typed letters will appear on the PC or Laptop. Data will appear after the code is entered.

Step 8 If screen rolling go to: File, Properties, Settings, Emulation, VT52, OK

Note: For an existing Vent Inop condition, the MC and DC will output full screens of information. The PC only outputs one line of error code information. No command and needs to be entered. During normal operation, the full command needs to be entered.

B. Microsoft Windows® V. 3.1

Step 1 From **Program Manager**, open Accessories.

Step 2 From **Accessories**, open Terminal.

Step 3 Under **Settings**, open **Terminal Emulation** then select **DEC VT-52**, and click OK.

Step 4 Again under **Settings**, open **Terminal Preferences** then set the following:

Line Wrap; On
Columns; 80
Cursor; Block, Blink
Show Scroll Bars
Use function arrows and control (Ctrl) keys for Windows.

Step 5 Click OK

Step 6 Again under Settings, open Communications then set the following:

Baud Rate; 19,200
Data Bits; 8
Stop Bits; 1
Parity; None
Flow Control; Xon / Xoff
Connector; COM 1 or COM 2 (which ever is being used).

Step 7 Click OK

Step 8 Turn on the Caps Lock.

Step 9 Enter the appropriate command for the test being performed. See the list of commands on the next page.

Commands Options:

SJO **Transfer of total operating hours (MC subsystem connection).**

SJB **Blower/valve calibration (PC subsystem connection).**

SJL **System final test and limited PC function (PC subsystem connection).**

SJP **PC error code info, including operating parameters (PC subsystem connection).***

SJM **MC error code information (MC subsystem connection).***

SJD **DC error code information (DC subsystem connection).***

SJE **Check Vent error code history (MC subsystem connection).**

SJC **For determining type of breath triggering (MC subsystem connection).**

* If the unit is in a Vent Inop condition, the current error will automatically appear.

8.10 Test Cable Usage Definitions

For Vision units serial number <106K

Test Cable 582161 is to be used to test/calibrate BiPAP Vision units with serial numbers <106K

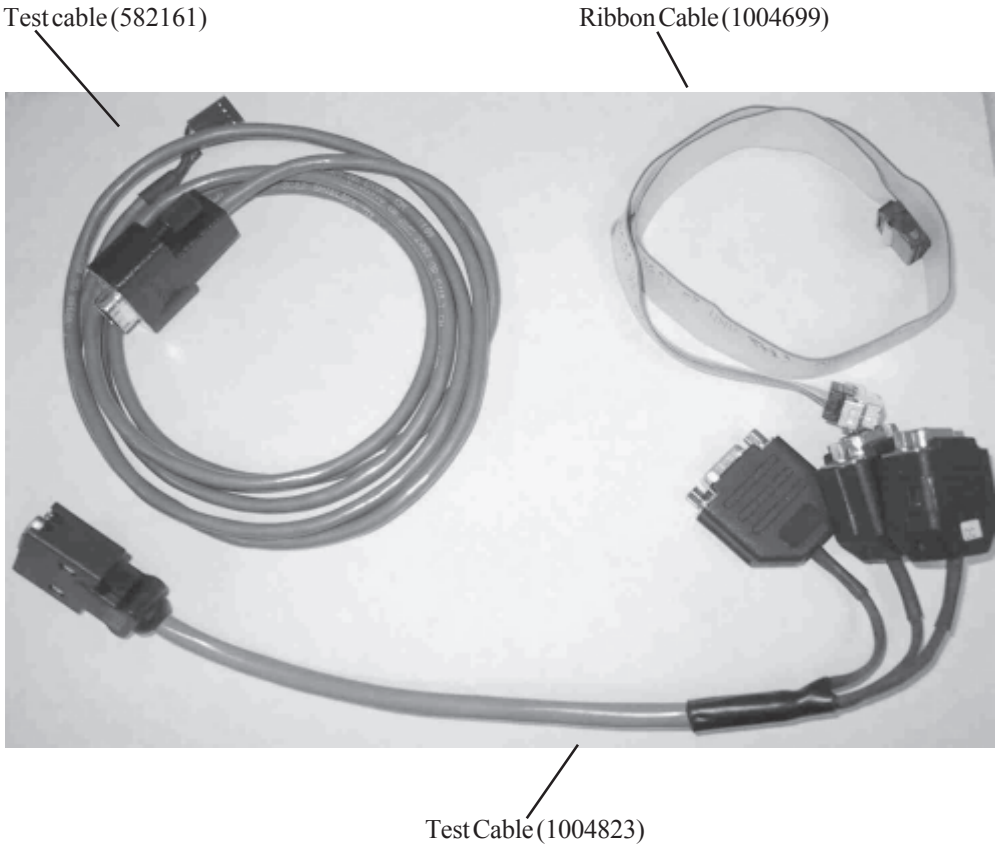
For Vision units serial number <106K that are upgraded hybrid units (new PC/MC installed)

Test Cable 1004823, along with the Ribbon Cable 1004699 (see note below), is to be used to test/calibrate BiPAP Vision units with serial numbers <106K that are upgraded hybrid units (repaired using the new PC/MC circuit boards). A standard serial I/O cable is used in conjunction with this to connect to the PC/laptop.
Any unit still having the original Display Control Subsystem will still need Test Cable 582161 connected to the DCS to test the unit.

Note: The Ribbon cable will be temporarily installed and then removed after testing. Make sure that the metal connector housing does not make contact with any components within the Vision unit during use.

For Vision units serial number >106K

Test Cable 1004823 is to be used to test/calibrate BiPAP Vision units with serial numbers >106K. A standard serial I/O cable is used in conjunction with this to connect to the PC/laptop.



8.11 Oxygen Flow Module Calibration

Purpose:
To field adjust the zero flow voltage on the main circuit board of the Oxygen Module Assembly. This test can be performed on any Oxygen Module that is suspected to be out of tolerance. The Oxygen Module testing in the System Final Test should be performed after this test is completed to confirm this module is now operational. If acceptable, the complete System Final Test needs to be performed.

Equipment:
Digital Multimeter, Fluke 87 or equivalent (3 ½ digit)

Equipment Set Up:

1. Remove the complete oxygen module assembly (except the ground wire and ribbon cable) to be able to easily perform this test. The assembly can then set on the table next to the Vision unit.

2. Connect the DVM to TP 9 with respect to TP 13 (ground).

Procedure:

1. Turn the Vision unit on.

2. Allow the unit to complete the "System Self Test In Progress". **Do not put the unit into Monitoring mode.**

3. Adjust R41 for a value of 0.225 to 0.235 volts DC.

4. Re-assemble unit (if necessary)

NOTE: If the measured Oxygen concentration is still not in specification after completion of this test, follow standard repair practices to obtain acceptable results.

Chapter 9: PAV/T or EPROM Upgrade Installation Instructions

9.1 BiPAP Vision PAV / T Mode or EPROM Upgrade Installation

Included in Upgrade Kits	Tools Required
EPROM (DC or DCS) EPROM (PC or PAS) EPROM (MC or MCS) Alarm B PAL (For PAV/T only)	Phillips screwdriver Long-shaft, small, flat-blade Extraction Tool

NOTE: For PAV/T mode, the Alarm B PAL on the MC board will also need to be changed.

CAUTION: To ensure proper operation of the unit, the MC, PC, and DC EPROM's **MUST** be the same revision.

Procedure

Removed / Installed During Process

- Top enclosure
- Front panel enclosure
- Display Control Subsystem (DC), partially
- Pressure Control Subsystem (PC)
- EPROM (DC)
- EPROM (PC)
- EPROM (MC)
- Alarm B PAL (install only if not already a PAV/T unit)

WARNING: Electrical shock hazard: Disconnect the electrical supply before attempting to make any repairs to the device.

CAUTION: Electrical components used in this device are subject to damage from static electricity. Repairs made to this device must be performed only in an antistatic, ESD-protected environment.

EPROM Upgrade or PAV / T Installation (Continued)

Step 1 Installing the EPROM Upgrade or PAV/T Mode

NOTE: Each EPROM in the RP kit is labeled for identification purposes. During this procedure, ensure that the correct EPROM has been identified for each installation.

a. Locate the new EPROM for the DC.

b. Remove the DC. Using an appropriate extraction tool, remove the existing EPROM.

NOTE: It may be possible to replace this EPROM by partially removing the DC Board. Leave the keypad and LCD connections attached and remove the retaining screws to be able to carefully rotate the board upwards to expose the EPROM side.

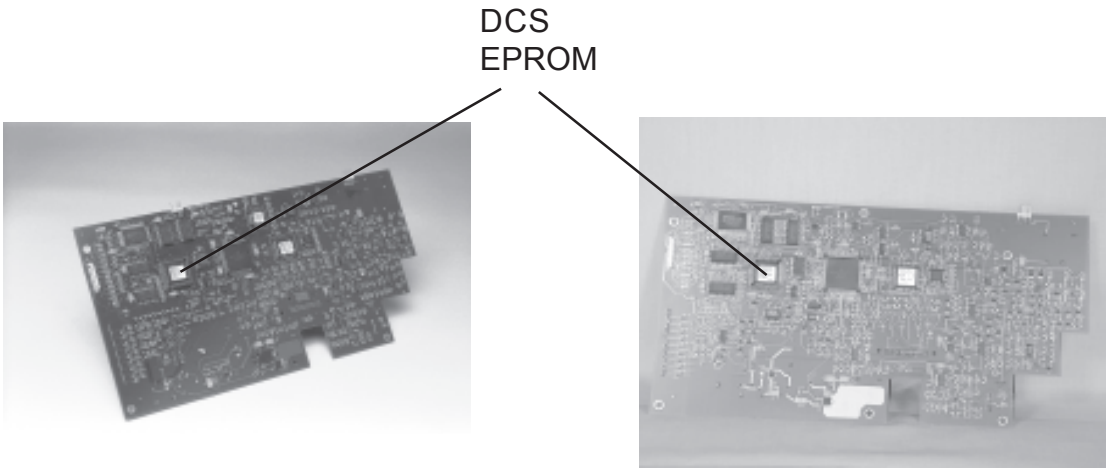


Figure 9-1
Location of the DC EPROM

NOTE: If necessary, store the removed EPROM in an approved anti-static bag or box.

c. Carefully insert the new DC EPROM.

NOTE: Ensure proper orientation before insertion. Flat edge of EPROM to the flat edge of the socket.

d. Re-secure the DC to the front panel.

e. Locate the new EPROM for the PC.

f. Place the PC on an appropriate work surface. Using an appropriate extraction tool, remove the existing EPROM.

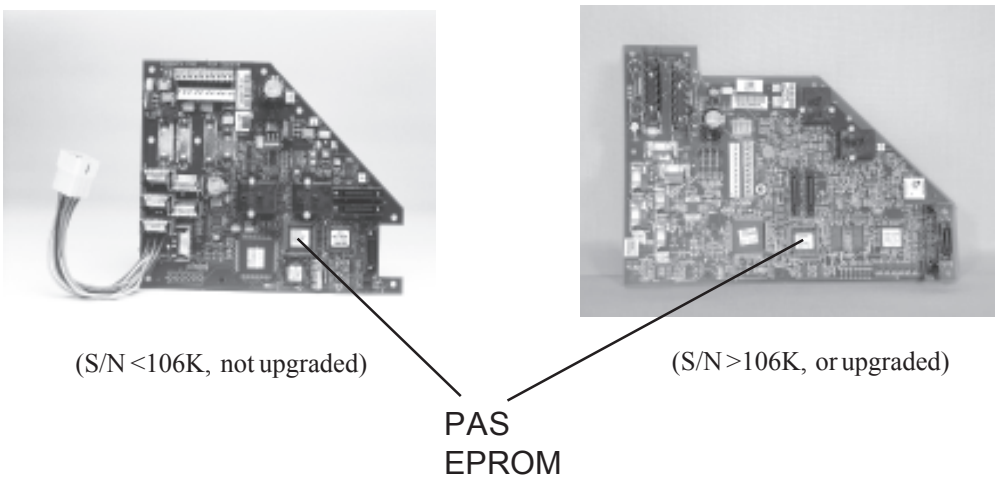


Figure 9-2
Location of the PC EPROM

NOTE: If necessary, store the removed EPROM in an approved antistatic bag or box.

g. Carefully insert the new PC EPROM.

NOTE: Ensure proper orientation before insertion. Flat edge of EPROM to the flat edge of the socket.

h. Set the PC aside for installation later in this procedure.

i. Locate the new EPROM and Alarm B PAL (PAV/T mode only) for the MC.

j. Using an appropriate extraction tool, remove the existing EPROM from U46.

EPROM Upgrade or PAV / T Installation (Continued)

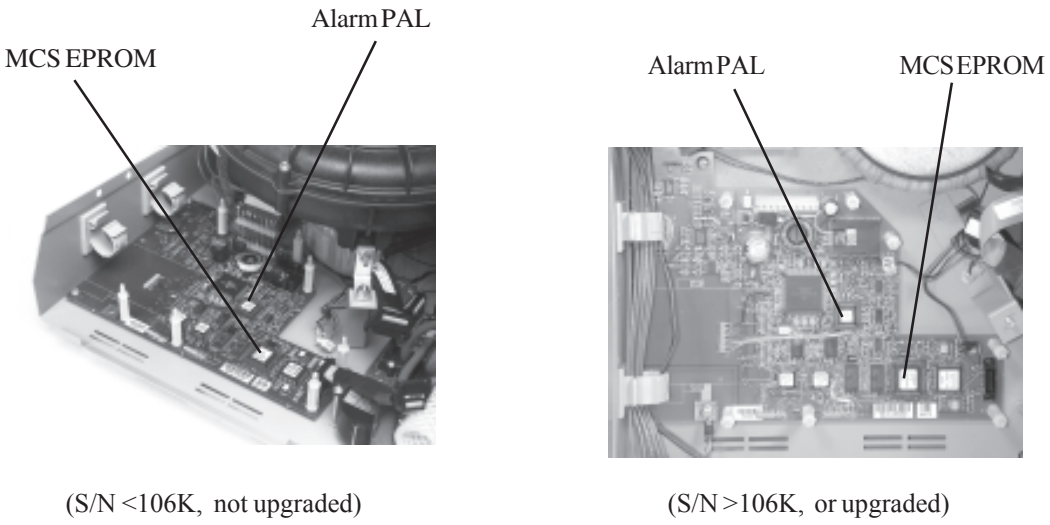


Figure 9-3
Location of the MC EPROM

NOTE: If necessary, store the removed EPROM in an approved antistatic bag or box.

k. Carefully insert the new MC EPROM.

l. If necessary, remove the Alarm PAL (PAV/T mode installation only).

m. Carefully insert the new Alarm B PAL (PAV/T mode installation only).

NOTE: Ensure proper orientation before insertion. Flat edge of EPROM to the flat edge of the socket.

Step 2 Testing

To ensure the integrity of the unit, the Run-In Cycle and the System Final Test found in Chapter 8 must be performed.

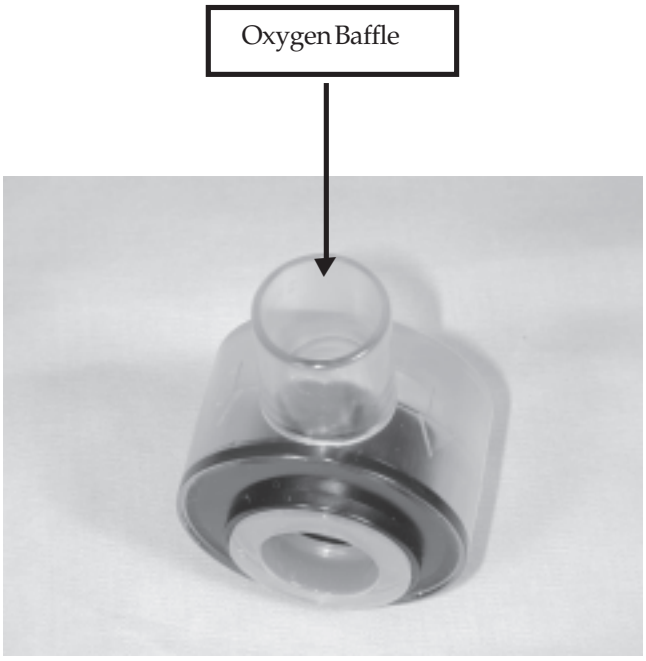
9.2 BiPAP Vision Oxygen Baffle Installation Instructions (P/N 1004705)

Purpose

To provide the necessary information to install the Oxygen Baffle into BiPAP Vision units less than serial number 1006001.

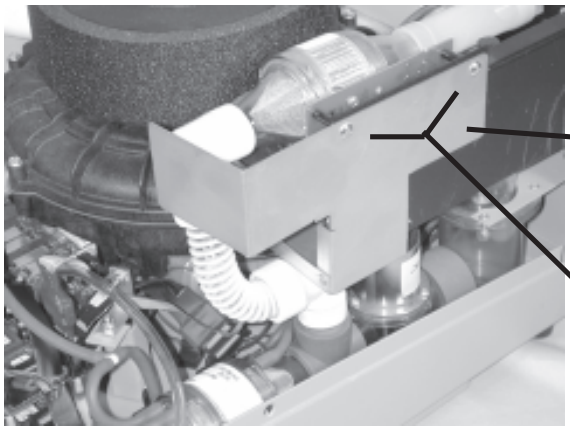
Oxygen Baffle Description

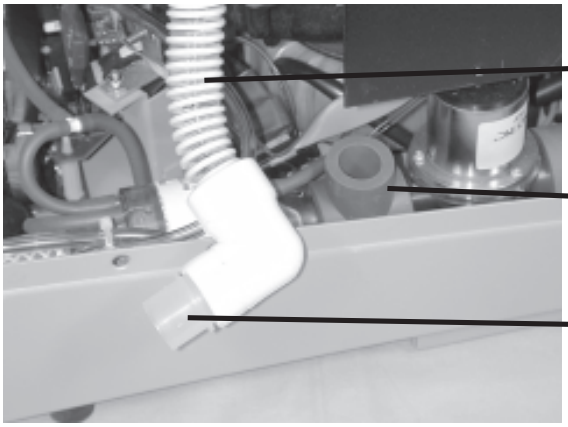
The oxygen baffle provides a better mix of oxygen and air to improve the Air Flow Module (AFM) flow measurements.



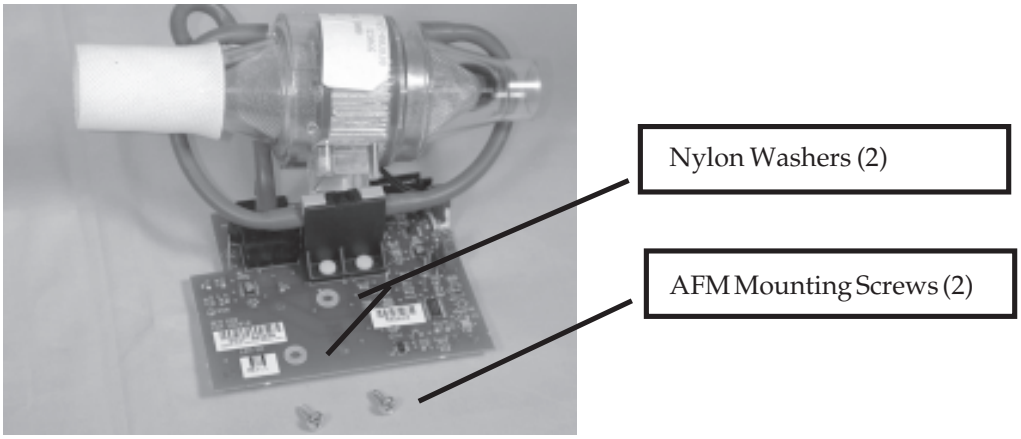
Procedure

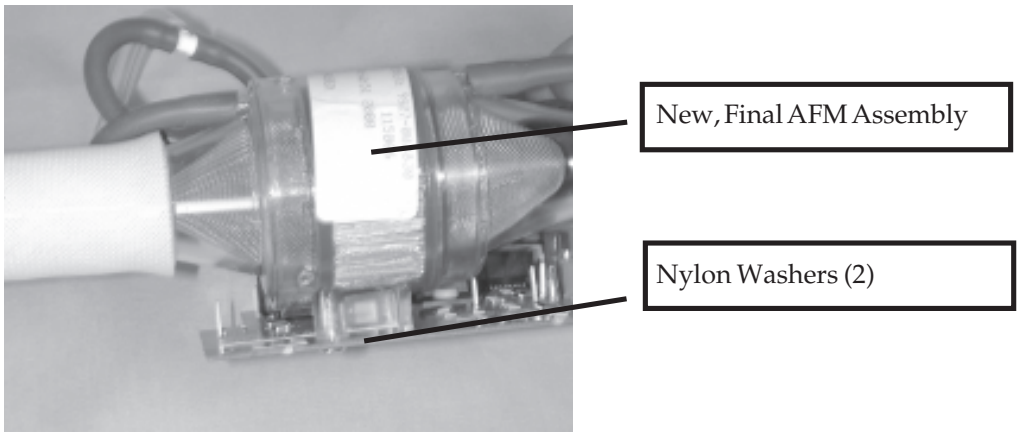
1. Remove:
    - Top Enclosure
    - Front Panel
    - AFM
    - Oxygen module outlet tubing support bracket (no longer needed)
    - "T" tubing (no longer needed)
    - 22mm coupling at the Oxygen Module outlet (no longer needed)



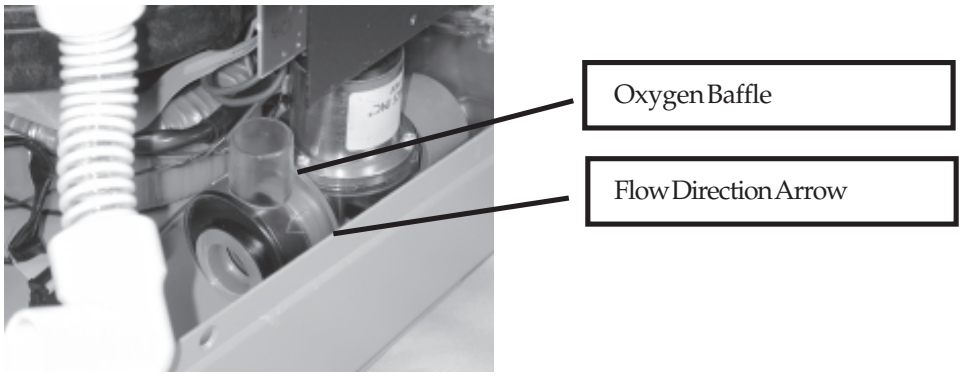


2. On the AFM assembly, install the two nylon washers provided in the kit under the two mounting screws for the AFM flowbody to allow proper clearance for the new Oxygen Baffle.
   - Remove the two Phillips screws that hold the flow body to the circuit board. Be careful not to cause any damage to the thermistor wiring connection.
   - Place the two nylon washers between the AFM flowbody and the circuit board.
   - Install the screws and securely tighten.

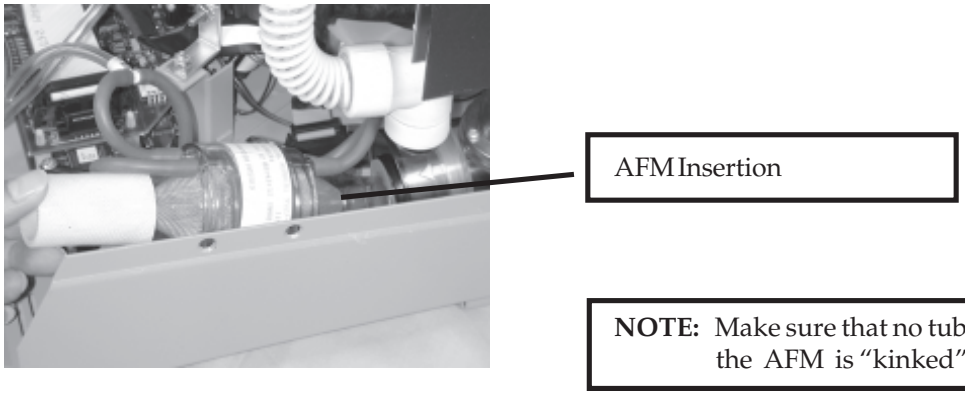




3. Place the Oxygen Baffle, as far as possible, onto the ILFR with the oxygen inlet port pointing directly upwards and the flow direction arrow towards the front of the unit.



4. While keeping the AFM lifted slightly upwards, gently insert it into the Oxygen Baffle outlet until the AFM is aligned with its three mounting posts on the bottom enclosure. A back and forth motion may be required. Push down on the AFM circuit board at the 3 mounting post locations to secure it into place.



5. Re-install:
   - Remaining AFM connections
   - Oxygen tubing to baffle
   - Front enclosure
   - Top enclosure

6. Perform the BiPAP Vision System Final Testing from Chapter 8 of the service manual.

Chapter 10: Summary of Upgrades for Repairs of Vision units with Serial Numbers 100500 to 106000

10.1 Summary of upgrades for repairs of Vision units with serial numbers 100500 to 106000

Note: For any of the following upgrades, the new Nurse Call/Remote, RS-232, Oxygen Baffle, and Ground Stud will not be implemented. Existing Keypad and labeling will remain the same. Language additions are only available in version 13.0 and higher. A non-PAV and PAV kits will be available.

10.1.1 Upgrade #1 – P/N 1004713, RP-Vision PC/MC Upgrade (without PAV) (2 Board Upgrade)

For replacement of the PC (582146) or MC (582140) in s/n's 100500 to 105999 without PAV option. The following items will be included in this kit:

a) MC board and version 12 EPROM
b) PC board and version 12 EPROM
c) DC version 12 EPROM
d) DC ICB connector (must be soldered onto DC board)
e) New ICB cable
f) Revised longer AFM harness
g) Revised longer Power harness
h) PC/MC board spacers
i) Nut for MC center board spacer
j) Pressure tubing
k) Cable clamps
l) Screw for center cable clamp
m) MC ground screw
n) Top cover screws

10.1.2 Upgrade #1A – P/N 1000356, RP-Vision PC/MC Upgrade (with PAV)

For replacement of the PC (582146) or MC (582140) in s/n's 100500 to 105999 with PAV option. The following items will be included in the this kit:

a) MC board and version 12 PAV EPROM
b) PC board and version 12 PAV EPROM
c) DC version 12 PAV EPROM
d) DC ICB connector
e) New ICB cable
f) Revised longer AFM harness
g) Revised longer Power harness
h) PC/MC board spacers
i) Nut for MC center board spacer
j) Pressure tubing

k) Cable clamps
l) Screw for center cable clamp
m) MC ground screw
n) Top cover screws

10.1.3 Upgrade #2 – P/N 1004714, RP-Vision DC Upgrade (without PAV) (3 board upgrade)

For replacement of the DC (582133) to add the additional languages in s/n's 100500 to 105999 without PAV, the following items must be installed and will be included in this kit (note that new PC and MC boards are also installed). If necessary, a new test cable (1004823) and RS-232 cable (1004699) will also have to be ordered (refer to Section 8.10 for further details).

a) DC board and 13 EPROM
b) PC board and version 13 EPROM
c) MC board and version 13 EPROM
d) Revised longer AFM cable
e) Power cable, PSS to PC
f) Power cable, PC to DC
g) ICB cable
h) PC/MC board spacers
i) Nut for MC center board spacer
j) Pressure tubing
k) Cable clamps
l) Screw for center cable clamp
m) MC ground screw
n) Top cover screws

10.1.4 Upgrade #2A – P/N 104707, RP-Vision DC Upgrade (with PAV)

For replacement of the DC (582133) to add the additional languages in s/n's 100500 to 105999 with PAV, the following items must be installed and will be included in this kit (note that new PC and MC boards are also installed). If necessary, a new test cable (1004823) and RS-232 cable (1004699) will also have to be ordered.

a) DC board and 13 PAV EPROM
b) PC board and version 13 PAV EPROM
c) MC board and version 13 PAV EPROM
d) Revised longer AFM cable
e) Power cable, PSS to PC
f) Power cable, PC to DC

g) ICB cable
h) PC/MC board spacers
i) Nut for MC center board spacer
j) Pressure tubing
k) Cable clamps
l) Screw to center cable clamp
m) MC ground screw
n) Top cover screws

10.1.5 Upgrade #3 – P/N 1000286, RP-EPROM Upgrade Kit (without PAV)

This kit provides a software only update to provide new features to units s/n's 100500 to 105999. The O_2% parameter will be retained when switching between modes of operation, pressure increase from 10cm H_20 to 15cm H_20 during dis connect alarm conditions, and the revised alarm sounds for different alarms will be implemented.*
The following items are included in this kit:

a) MC version 11 EPROM
b) PC version 11 EPROM
c) DC version 11 EPROM

10.1.6 Upgrade #3A – P/N 1003524, RP-EPROM Upgrade Kit (with PAV)

This kit provides a software only update to provide new features to units s/n's 100500 to 105999 along with the PAV option. The O_2% parameter will be retained when switching between modes of operation, pressure increase from 10cm H_20 to 15cm H_20 during disconnect alarm conditions, and the revised alarm sounds for different alarms will be implemented.*

The following items are included in this kit:

d) MC version 11 PAV EPROM
e) PC version 11 PAV EPROM
f) DC version 11 PAV EPROM
g) Alarm B option PAL (not used for units already having PAV)

* 5 beep tone sequence for Patient Alarms
3 beep tone sequence for Check Vent Alarms
Soft click for an attempt to change a selection that is out of range.
Original solid tone for Vent Inop Alarms

10.2 Repair Kits No Longer Manufactured

The following table is a listing of the repair kits that will no longer be available. It also gives a description to the reasoning behind the decision and the replacement kit to be used as a new substitute.

RP Kit No Longer Manufactured	Reasoning	Replacement Kit to be Used in Place of This
Circulation Fan Muffler, French (1000741) Spanish (1000738) German (1000729)	Replaced language specific items with the international symbols style.	1005618, Circulation Fan Muffler International.
EPROM Upgrade (582180)	New Kit created to avoid confusion.	1000286, Vision EPROM Kit (non PAV) for S/N <106K that have not been upgraded already.
Fuse, International (582099)	Existing RP kit already replaces this.	1000750
Mail Control Subsystem, MC (582140)	Design improvements have made this item obsolete.	Upgrade kit 1004713 (non PAV) or 1000356 (PAV). See Section B for details.
Oxygen Module Assembly, French (582254) Spanish (582255) Italian (1003547) German (582220)	Replaced language specific items with the international symbols style.	1004977, Oxygen Module International.
PAV/T Option (1000747)	New kit created to avoid confusion.	1003524, Vision EPROM Kit (with PAV) for S/N <106K that have not been upgraded already.
Power Line Filter (1000745)	Engineering has included this item into the AC inlet design.	582138
Pressure Airflow Subsystem, PC (582146)	Design improvements have made this item obsolete.	Upgrade kit 1004713 (non PAV) or 1000356 (PAV) See Section 10.1 for details.
Touchpad, Spanish (582256) French (582257)	Replaced language specific items with the international symbols style.	1004712, Universal Keyp ad.

10.3 Installation/Upgrade Instructions for Repair Parts 1004713 and 1000356 (PC/MC Upgrade, with and without PAV, for serial number units less than 106000)

Caution: All work is to be done following proper ESD guidelines.

Note: The original Total Operating Hours should be recorded, if possible, to enter onto the new unit when this upgrade is complete.

Additional Items Required:

- Ribbon Cable used for testing (RI # 1004699)
- BiPAP Vision Service Manual (RI # 582160)
- Test Cables (RI # 582161, and 1004823)
- Other miscellaneous items as called out in the service manual to support testing after this upgrade is performed as defined in this procedure.

Remove the following from the existing unit with serial number less than 106000:

1. Top cover.
2. Front Panel.
3. DCS.
4. Inlet tubing, Blower Muffler and Blower* (may need to partially remove the Oxygen assembly to access the back blower mounting screw).
5. All connections to the PAS.
6. PAS.
7. MCS.
8. The two cable clamps from the left side of the unit that hold the blower, power supply, and main power indicator wiring.

* It is possible to just remove the front two blower mounting screws and then when required, partially lift upwards on the front of the blower assembly to perform this upgrade.

The following will no longer be needed:

1. Power cable (gray) that originally connected to the PSS, PAS, and DCS.
2. ICB cable.
3. AFM to PC ribbon cable.
4. 4 of the 5 screws that held the MCS in place.
5. PAS (including software).
6. MCS (including software).
7. DCS software.
8. Two top cover screws.

From the repair kit 1004713 or 1000356 (PAV):

1. Locate the EPROMs (version 12) and place them into their respective locations on the MC and PC boards.

2. For non-PAV/T units, remove the original Alarm PAL located in U41 in the MCS and place it in the new MC board. For PAV/T units, install the PAL provided with upgrade kit 1000356 into U41 in the MC board.

3. Remove the DCS from the front panel. Install the DCS EPROM into its respective location.

4. Locate the independent connector supplied with the kit. Insert it into the DCS next to the original ICB connector that is in the center of the board. It should be placed so that the keying (single open slot in the plastic body of the connector) is facing downwards. Solder in place. This will allow for the new ICB cable to be located so that the ribbon cable is downwards towards the bottom of the unit.

5. Re-install the original DCS back onto the front enclosure.

6. Install the 6-32 nut and one of the aluminum spacers onto the MC board with the spacer located on the component side of the board and the nut on the other side. The mounting hole is located by the power cable connection near the center of the board.

7. Install the MC board into the bottom enclosure. Use the existing nylon "snap" standoffs to be placed where the original ones were removed, except put the new 8-32 x 3/8 screw in the mounting hole with the ground plane around it, which is located along the transformer edge of the MC board.

8. Also for the MC, install new nylon "snap" standoffs in the front left and back left MC mounting holes. Put one of the three nylon standoffs between these two. Put one of the other two nylon standoffs in the rear behind the power supply connector and the third one opposite of this in the front of the MC board.

9. Place the original DC ground wire and screw is to put into the mounting hole with the ground plane around it on the front left side of the MC board.

10. Temporarily install the Ribbon cable, 1004699. This is not part of the kit, but should be kept on hand as part of the service tools needed to repair upgraded BiPAP Vision units s/n<106K. It will be left in only for testing purposes and must be removed afterwards.

Installation/Upgrade (continued)

11. Install the PC board onto the MC board standoffs making sure that the power connection near the center of the board, and the other similar connector (testing and error data) located in the front right of the board are fully seated. Also make sure that all of the nylon "snap" locks are fully engaged.

12. Mount the second aluminum standoff onto the location near the center of the PC board where the first aluminum standoff from the MC board can be seen.

13. Connect the blower, valves, circulation fan current sense, Oxygen Module ribbon cable, and the new ICB cable to the appropriate PC connection points.

14. Locate the new AFM to PC ribbon cable and install it in place. Put this on the PC connection J4 to the AFM. The other is connected to J6 for the OM ribbon connection.

15. Connect the new power supply cable to the PSS connection. Note that the new cable has 6 inches between the one end connector and the one in the middle. Connect this middle connector to the power connection on the PC board. Make a counterclockwise loop in the remaining part of the cable that will connect to the DCS board. Using the 6-32 x ¼ inch screw and cable clamp from the kit, attach the power supply cable to the center aluminum standoff in the center of the PC board. This will allow the cable to be secured, but also allow some movement of the cable during front panel removal.

16. Remove the 7 inch piece of pressure tubing that connects from the "T" fitting on the AFM that originally connected to the pressure sensor on the PAS board.

17. Locate the 3 inch piece of pressure tubing in the kit and place one end on the AFM "T" connection and the other end to the redundant pressure sensor. This is the sensor located nearest to the AFM module.

18. Re-install the blower, blower muffler and inlet tubing (if all or any of these were removed). Connect the blower connector to the PC board.

19. Re-install the front enclosure, making sure that all the proper connections are secured in place. The patient pressure tubing will go from the front enclosure to the middle pressure sensor, port on the right side.

20. Make sure all required connections are correctly made. Just a reminder to double check your work.

Installation/Upgrade (continued)

21. When the upgraded unit is first turned on, a Check Vent Error 301 may occur. This will clear after the Blower/Valve Calibration is performed on the unit and the unit is cycled off and then on again.

22. Using the Total Operating Hours Transfer found in chapter 8 of the BiPAP Vision service manual, put the original operating hours into the unit.

23. Perform Blower/Valve Calibration found in chapter 8 of the BiPAP Vision service manual.

> **Note: The PRV muffler DOES NOT get removed once this upgrade is installed into a unit.**

24. Perform the Run-In Test and then the System Final Test found in chapter 8 of the BiPAP Vision service manual.

25. When complete, remove the Ribbon (1004699) cable that was temporarily installed into the MC board.

26. Install the top enclosure using the two 6-32 x ½ screws supplied with the kit.

Appendix A: Tools and Equipment

A.1 Service Tools and Supplies

You should have the following hand tools and supplies available for troubleshooting, testing, and repair of the BiPAP Vision.

- Common hand tools:

  Flat-blade screwdrivers – small (long shaft) and medium

  Phillips screwdriver – medium

  Nut drivers – 1/4", 5/16", 11/32", and 7/16"

  1/4" wrench

  Needle-nose pliers, medium

- Antistatic work station – minimum requirement is a grounded mat and wrist strap
- Digital manometer - see section A.2, A.3
- Flowmeter - see section A.2, A.3
- Digital Multimeter – see section A.2
- PC/Laptop – see section A.2
- O_2 Analyzer - see section A.2, A.3
- Oxygen tank, medical grade oxygen and regulator
- Mechanical test lung – see section A.2
- Test Cable – Respironics P/N 582161 or 1004823 (see test cable description, Chapter 8)
- Pressure tubing – 6 in., 6 ft., other misc. lengths as required
- Tubing, 6 ft. smooth inner lumen – Respironics P/N 301016, other misc. lengths as required.
- Variable flow restrictor - Respironics P/N 1006120
- Pressure Pick-Off Port – Respironics P/N 312710
- Test orifice – 0.25" – Respironics P/N 332353
- Isopropyl alcohol
- Cleaner (i.e. Fantastik®, 409®.)
- Cleaning cloth
- Bacteria filter
- Mild Detergent

A.2 Acceptable Test Equipment

A.2.1 Digital Manometer

Specifications:

0-40 cm H_2O minimum

± 1.0% cm H_2O of reading

Acceptable Options:

- Certifier Flow Analyzer, RI p/n 1012598 (High flow module) (see A.3 for details)
- Any commercially available digital manometer that meets the above specifications

A.2.2 Flowmeter

Specifications:

0-150L/minimum

±1% of reading

Acceptable Options:

- Certifier Flow Analyzer, RI p/n 1012598 (High flow module) (see A.3 for details)
- Any commercially available flowmeter that meets the above specifications

A.2.3 Digital Multimeter

Specifications:

3 1/2 digit readout

Acceptable Options:

- Fluke 87 or better model.
- Any commercially available digital multimeter that meets the above specifications

A.2.4 PC/Laptop

Acceptable Options:

- Any commercially available PC or laptop with Windows operating system and hyperterminal.

A.2.5 Mechanical Lung (Adult)

Specifications:

Variable Compliance includes 0.05

Parabolic Resistor value RP-20

Lung capacity of at least 100L

Acceptable Options:

- Michigan Instruments, Inc. Model 1601 Test Lung
- Any commercially available test lung that meets the above specifications

A.2.6 Electrical Safety Analyzer

Specifications:

Earth Resistance

Range – 0 to 19.99 Ohms

Resolution – 0.01 Ohms

Accuracy – ±5%, ±1 digit

Leakage Current

Range – 0 to 19.99 µA

Resolution – 1µA

Accuracy – 2.5 to 1k Hz: ±1%, ± 1 digit

1k Hz to 100 k Hz: ± 1 digit

100 k Hz to 1M Hz: ± 1 digit

Acceptable Options:

- Dale model 544L
- Any commercially available safety analyzer that meets the above specifications.

Acceptable Test Equipment (Continued)

A.2.7 Oxygen Analyzer

Specifications:

Range: 0.0% to 100.0% O_2

Display Resolution: 0.1% O_2 increments

Accuracy: ± 2% of full scale

Acceptable Options:

- Certifier Flow Analyzer, RI p/n 1012598 (High flow module) (see A.3 for details)
- MSA Mini OX1 (or better)
- Servomex 570A Oxygen Analyzer
- Any commercially available Oxygen Analyzer that meets the above specifications

A.3. TSI, Inc. Certifier Test System

The Certifier FA Test System manufactured by TSI Inc. and will be distributed worldwide by Respironics Inc. This test system, currently being used by the Respironics mobile technicians, is ideal for biomedical testing applications, including ventilators. The system as configured can measure air, O_2 and nitrous gases. The following are the measurement capabilities of this device:

- **Flow**
- **Peak Flow**
- **Volume**
- **Stacked Volume**
- **Minute Volume**
- **Inspiratory Time**
- **I:E Ratio**
- **Respiratory Rate**
- **Pressure**
- **Peak and PEEP Pressure**
- **Barometric Pressure**

This small battery powered unit is ideal for use in the field, in any medical facility or laboratory. It comes equipped with all the filters and connectors to install in-line for testing purposes. There are two versions being offered. The first version is the portable unit with a high flow and O2 module. This is the version used currently by the Respironics Mobile Technicians for test of the Esprit, Vision and the PLV. The second version includes the high flow and O2 module but adds a low flow module and is designed to handle low flow and volume measurements when a high degree of accuracy is required. The following is the ordering information for both versions:

P/N 1012598 - Kit, Certifier, High Flow Module
P/N 1012599 - Kit, Certifier, High and Low Flow

These kits can be ordered through Respironics Customer Service.

Appendix B: Schematics

B.1 Schematic Statement

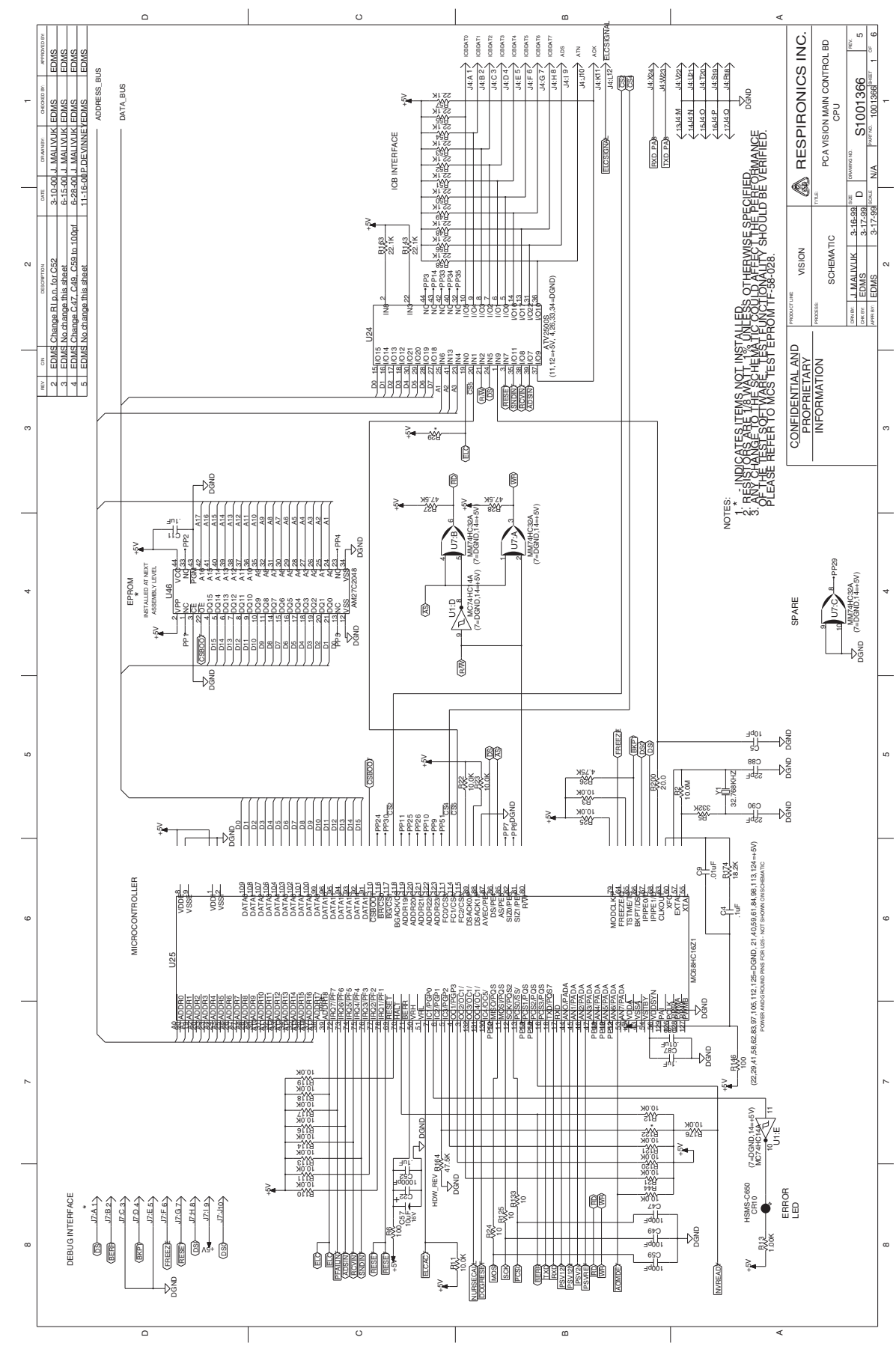
Schematics are supplied with this manual in direct support of the sale and purchase of this product.

The schematics are proprietary and confidential. Do not copy the schematics or disclose them to third parties beyond the purpose for which they are intended. Patents are pending.

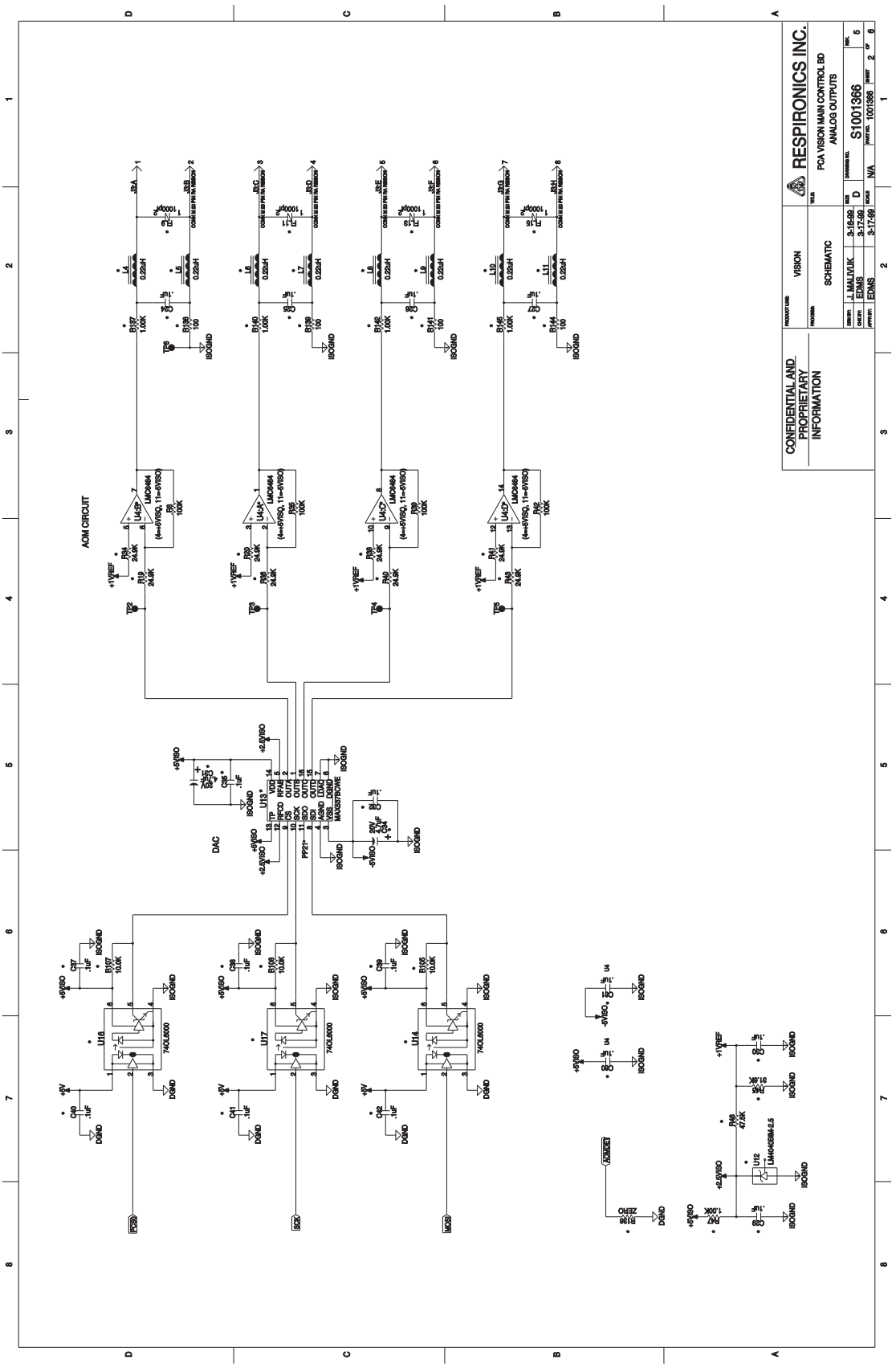
The schematics are intended to satisfy administrative requirements only. They are not intended to be used for component level testing and repair. Repairs and testing are supported only at the complete board level.

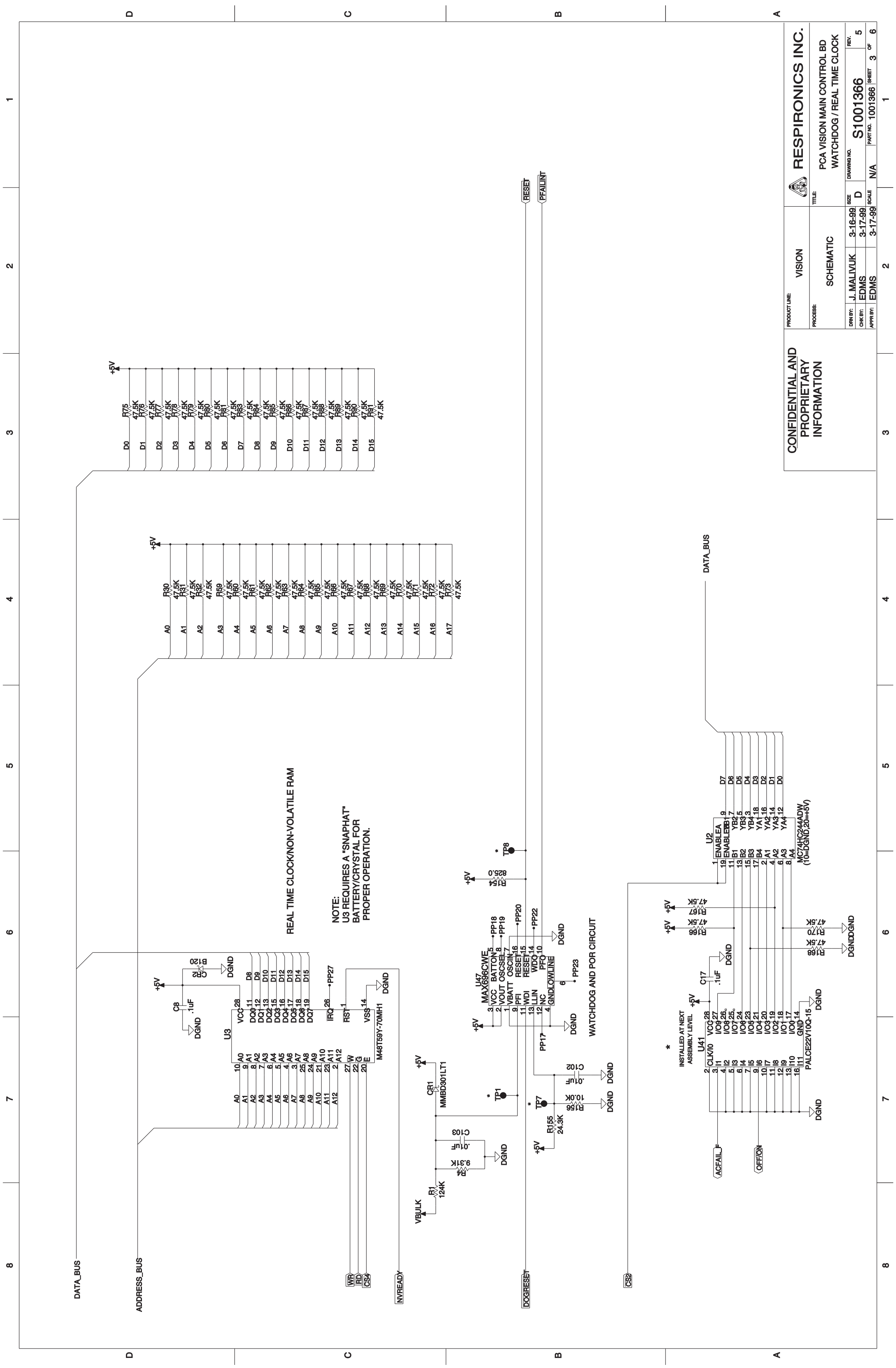
Respironics does not recommend component repair of the BiPAP Vision. The circuit boards in the BiPAP Vision are multilayer boards. Due to the very small trace size, extreme care must be used when replacing components to prevent permanent nonrepairable damage to the circuit board. Components are surface mounted and require special hot air jet soldering and desoldering equipment. Most of the work should be done under a microscope set at 25 times magnification. Use of regular soldering equipment will damage the board and void any applicable warranty.

The schematics are of the revision level in effect at the time that this manual was last revised. Prior revisions may be obtained upon request.

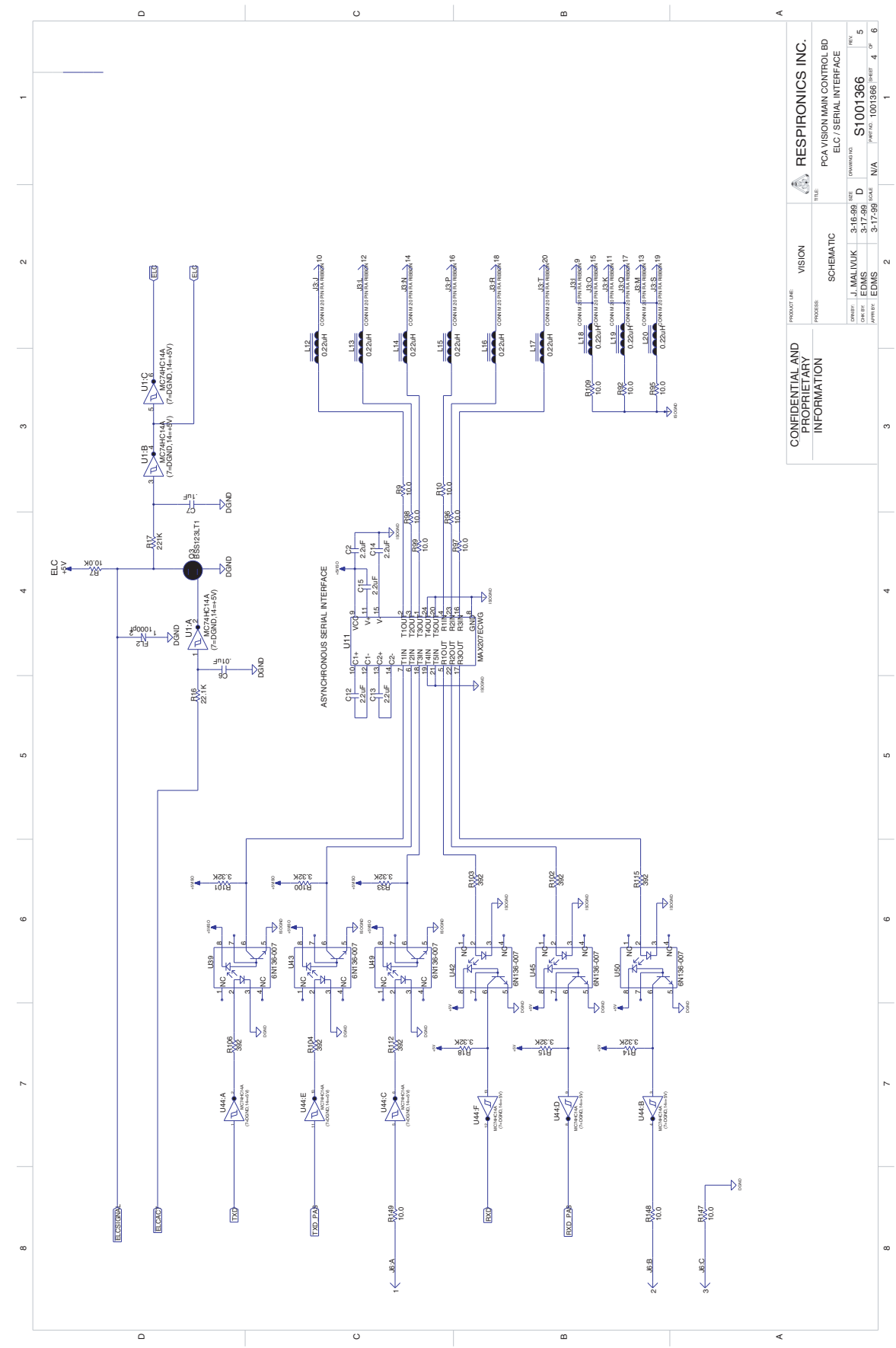


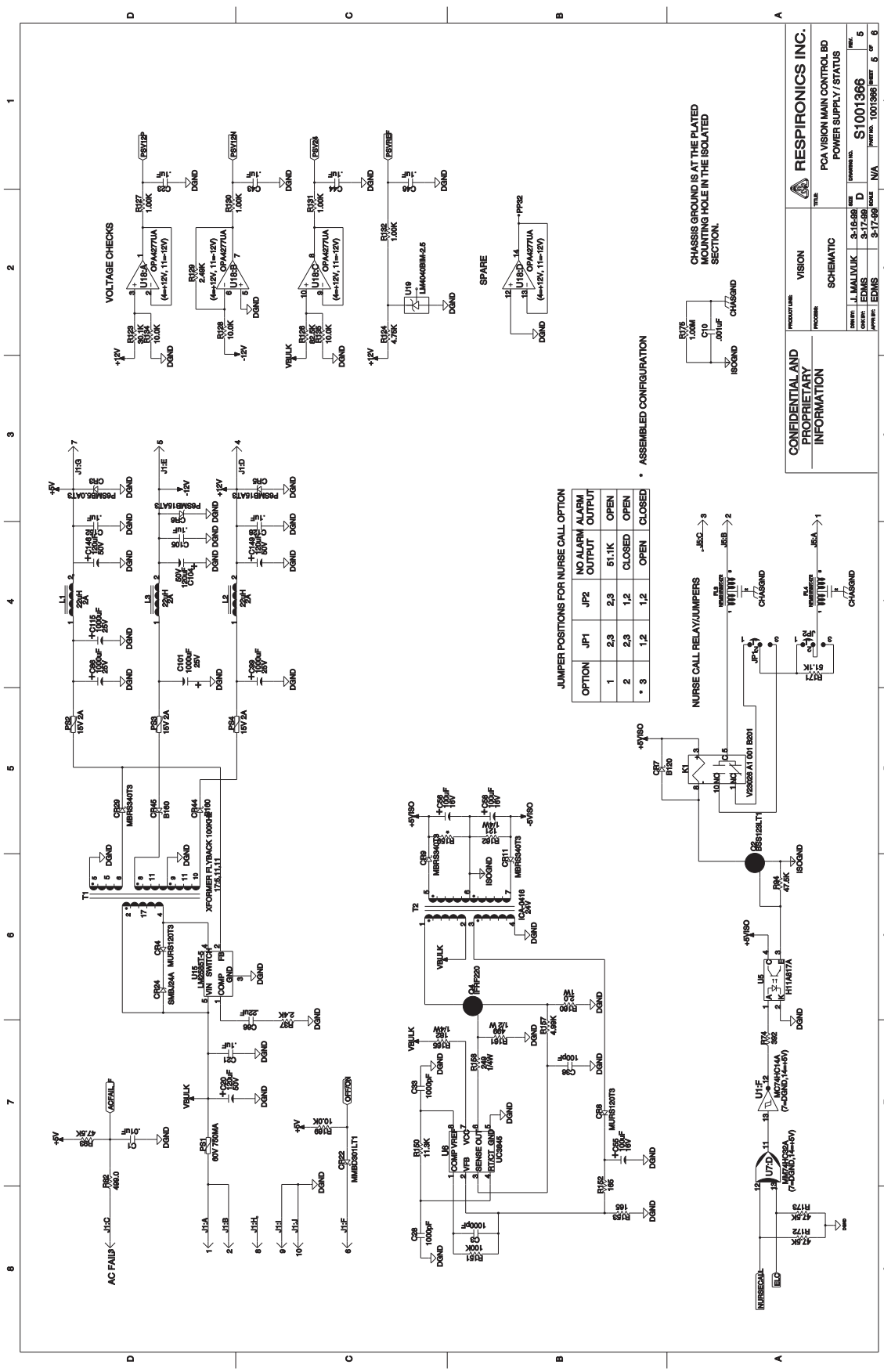
Main Control Microcontroller Interface


RESPIRONICS INC.
PCA VISION MAIN CONTROL BD
ANALOG OUTPUTS
S10013666
SCHEMATIC
VISION
CONFIDENTIAL AND PROPRIETARY INFORMATION
AOM CIRCUIT
DAC
MAX5876CWE
74OL8000
LM4040BIM-2.5

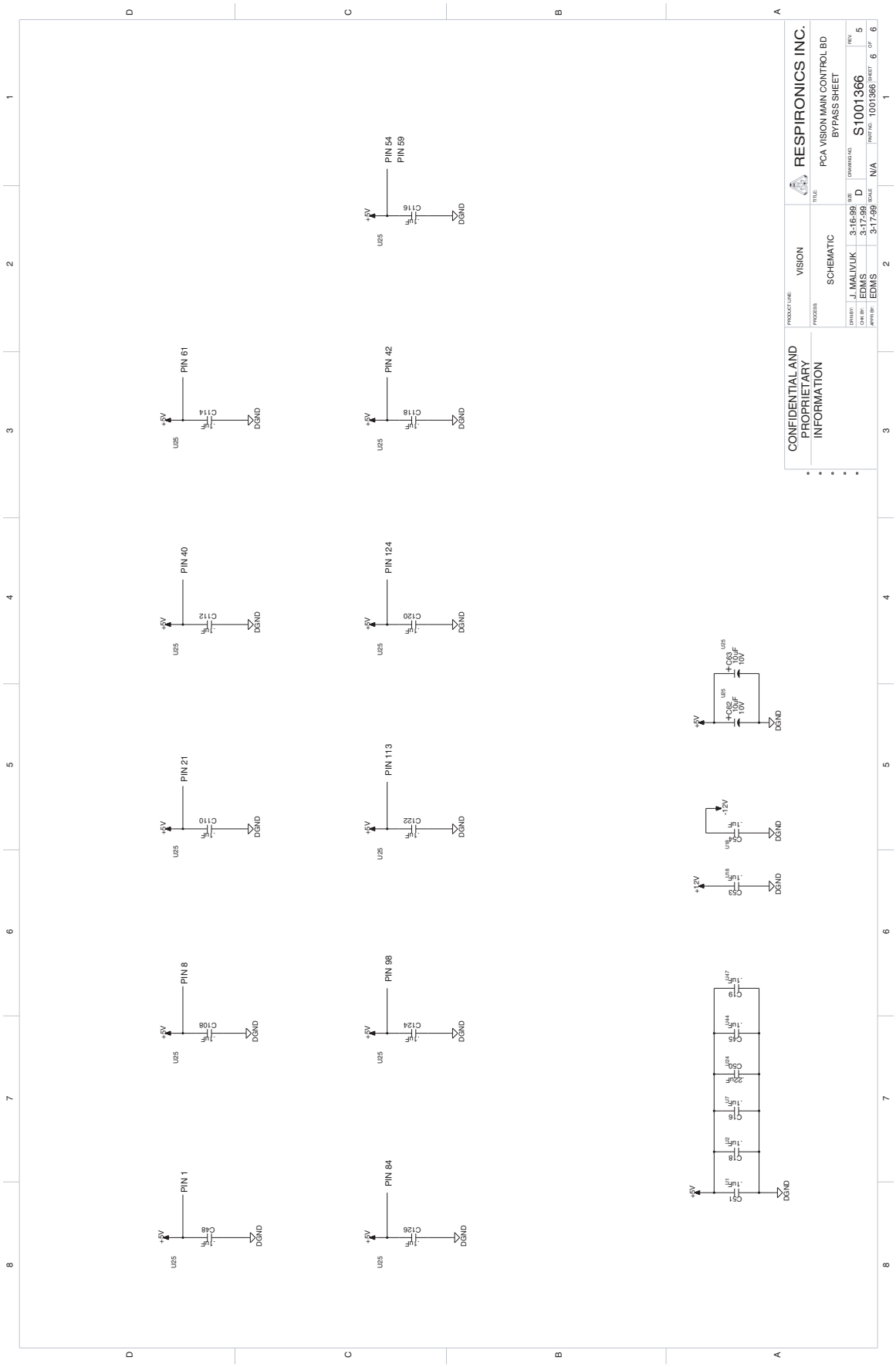


Main Control I / O Interface 2

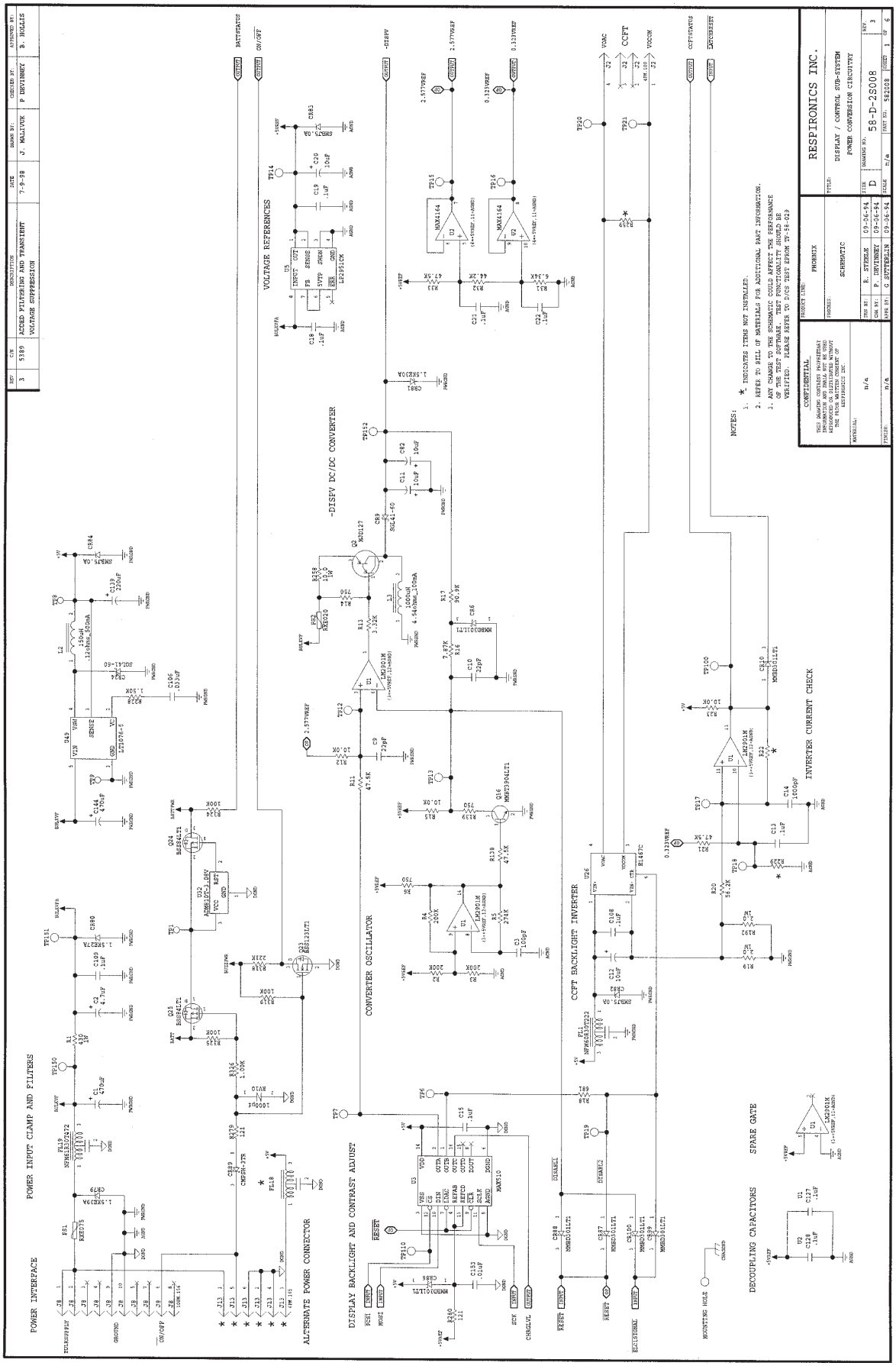

RESPIRONICS INC.
PCA VISION MAIN CONTROL BD
ELC / SERIAL INTERFACE
S1001366
CONFIDENTIAL AND PROPRIETARY INFORMATION
SCHEMATIC
ASYNCHRONOUS SERIAL INTERFACE
MAX207EEWG
6N136-007
MC74HC14A



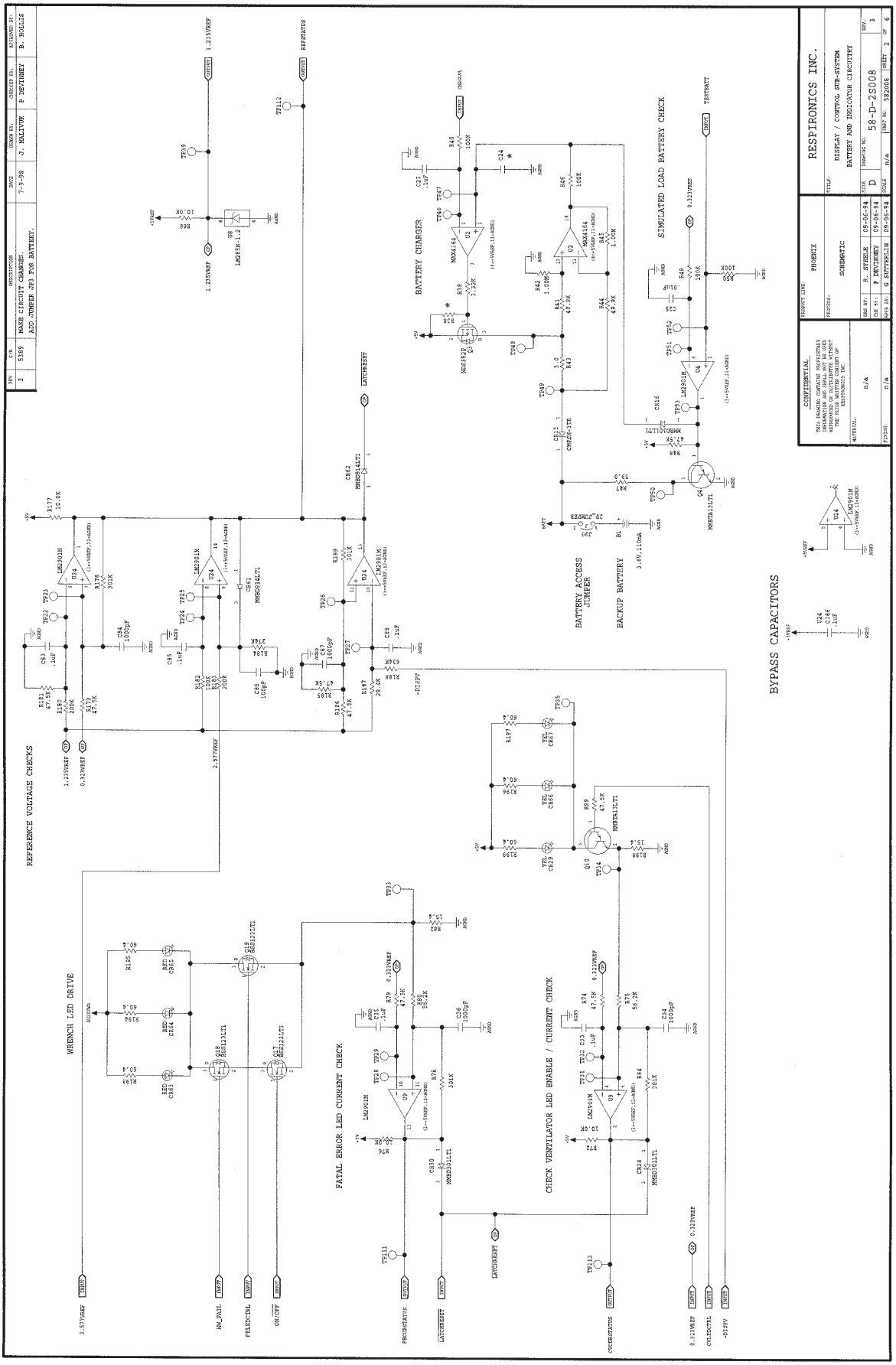
Main Controller Error Line Control Circuit



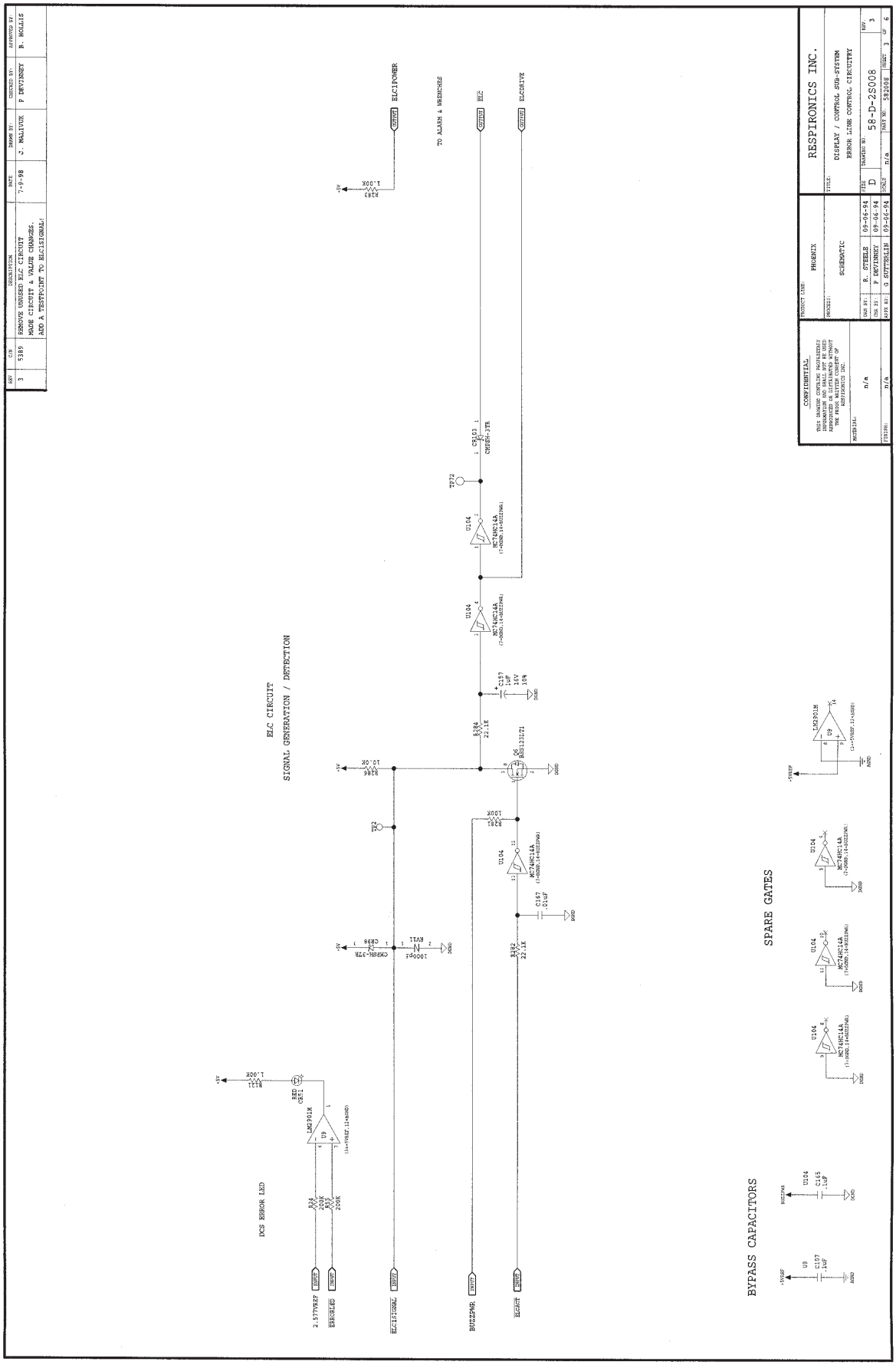
Main Controller Decoupling Caps



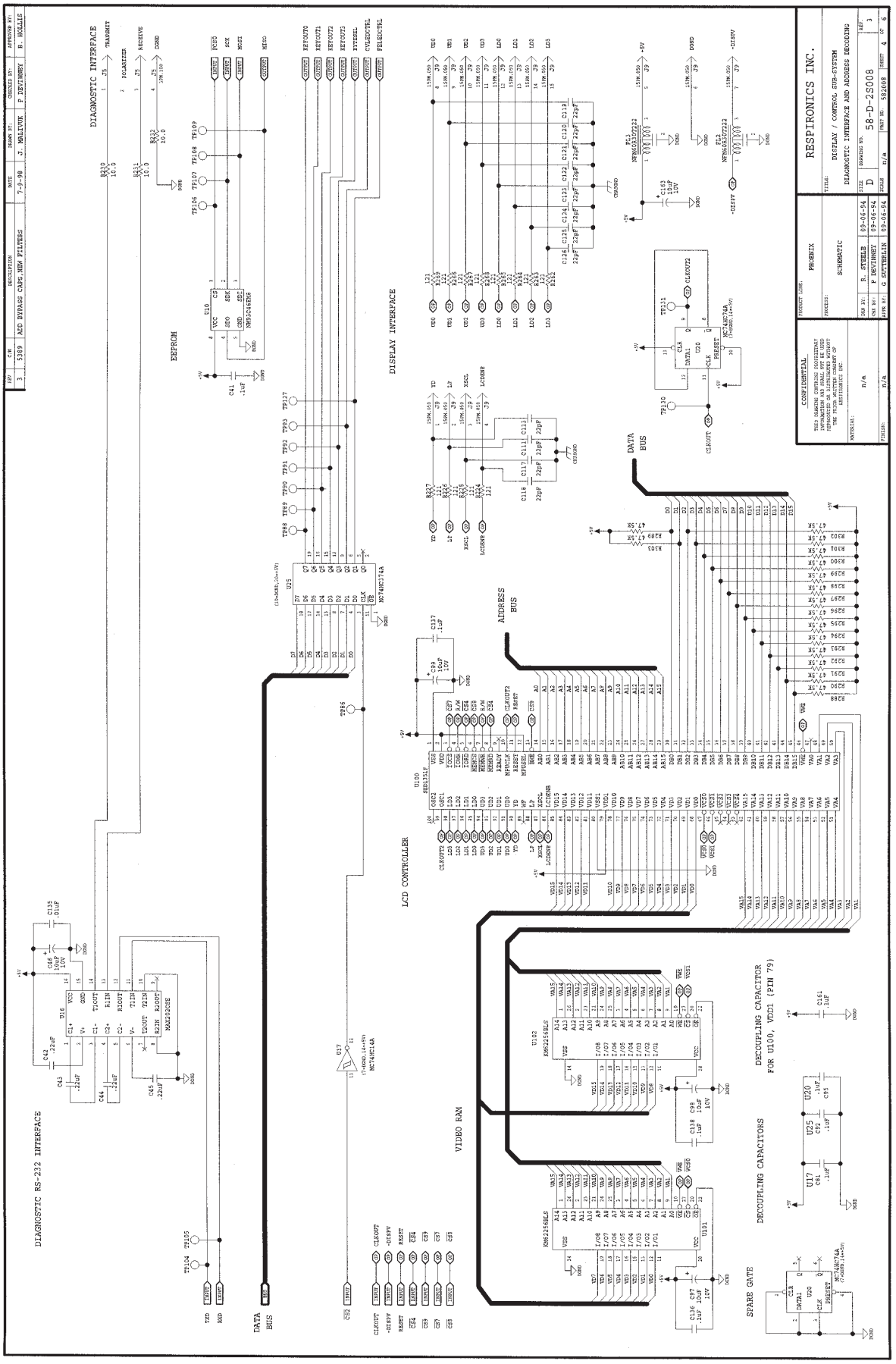
Display Control Power Conversion Circuitry



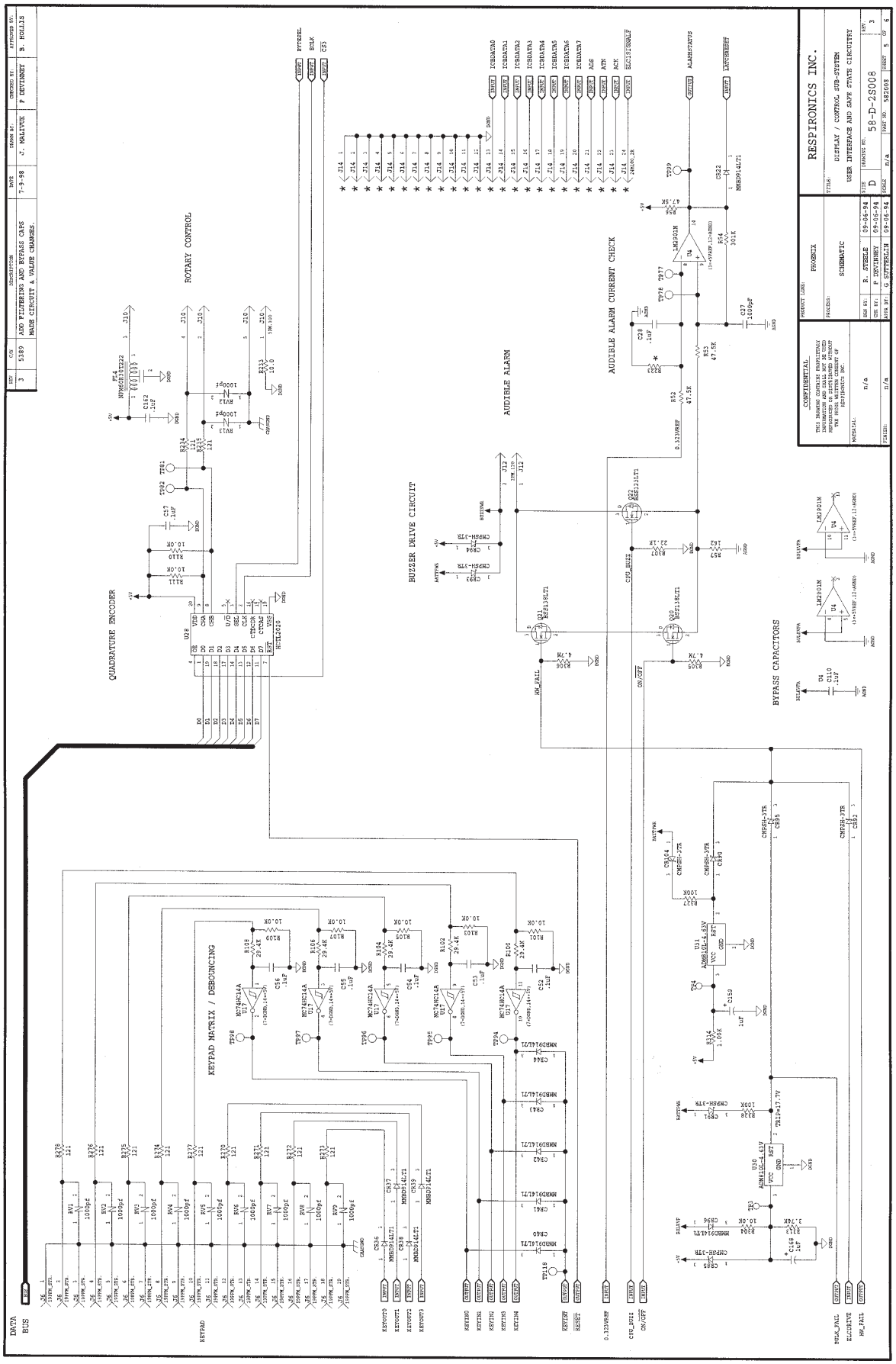
Display Control Battery and Indicator Circuitry



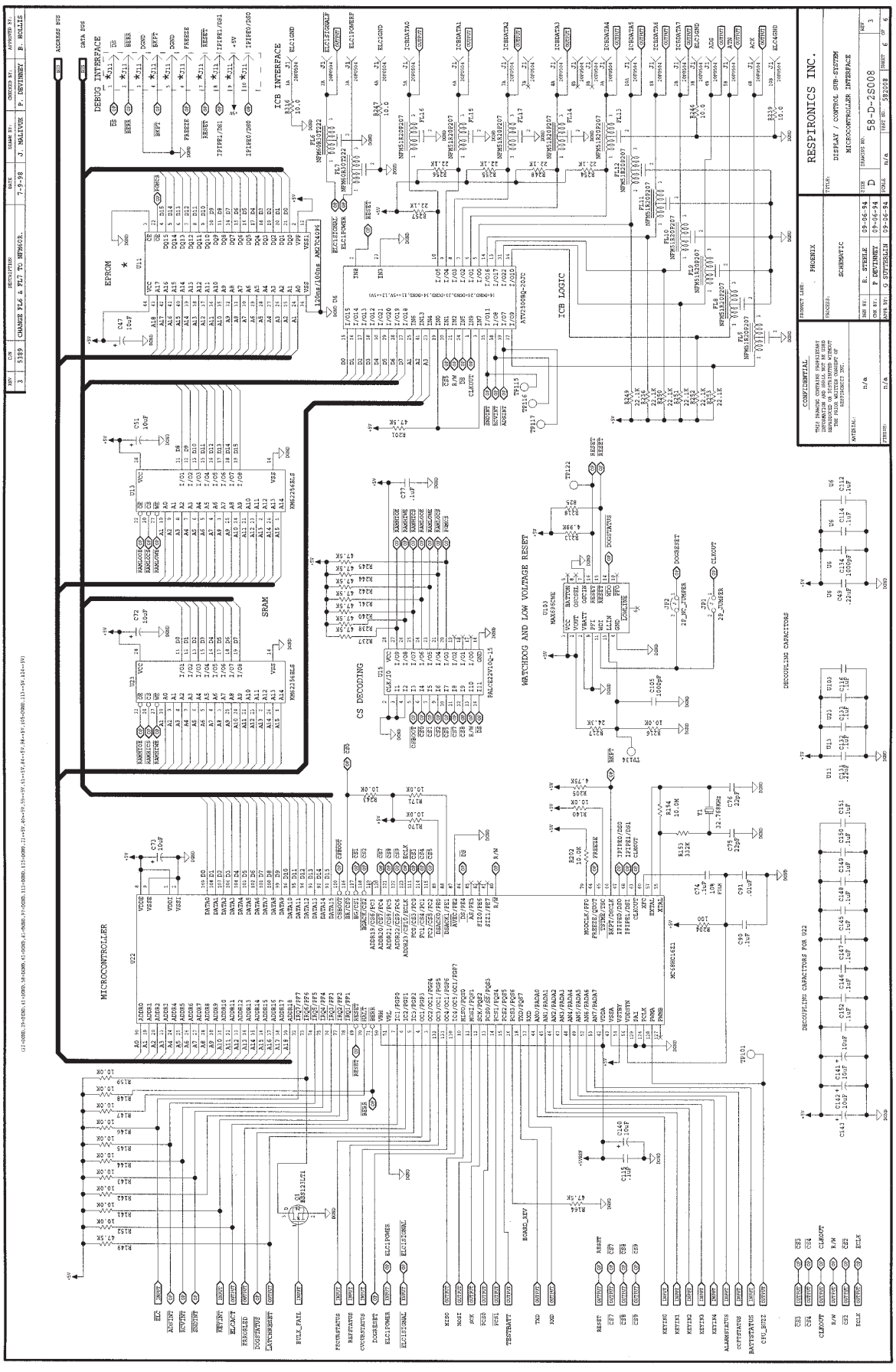
Display Control Error Line Control Circuitry



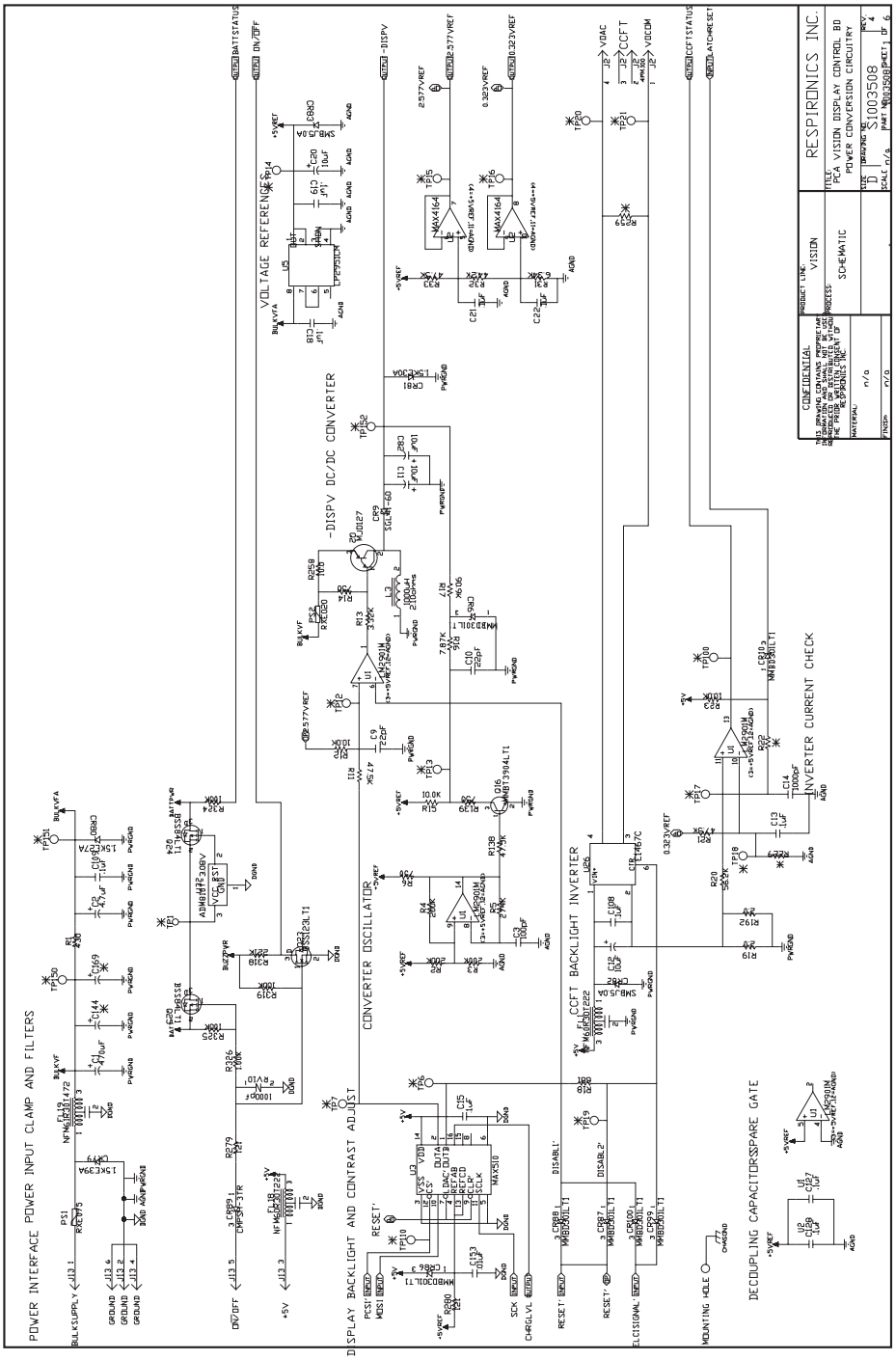
Display Control Diagnostic Interface and Address Decoding



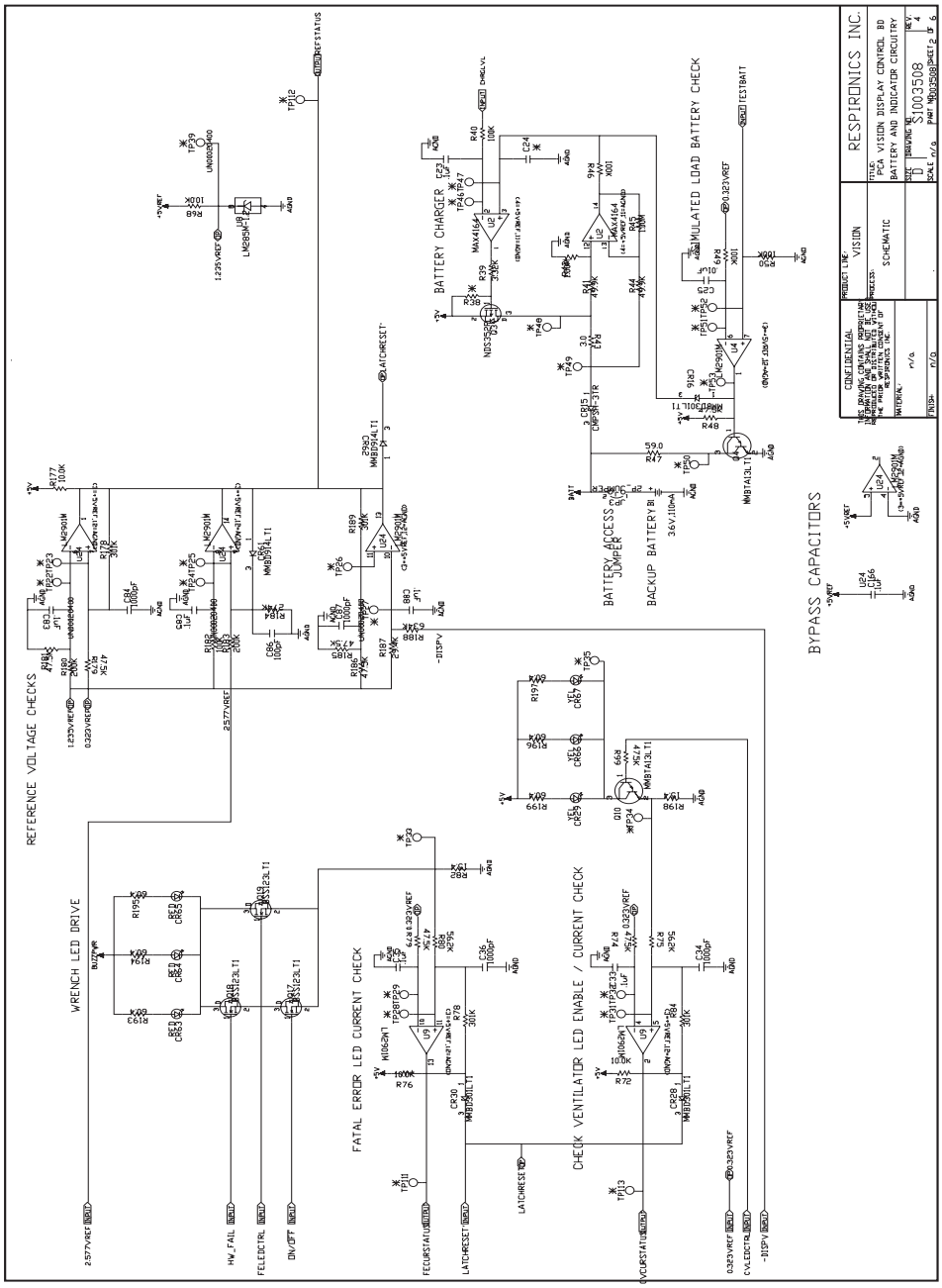
Display Control User Interface and Safe State Circuitry



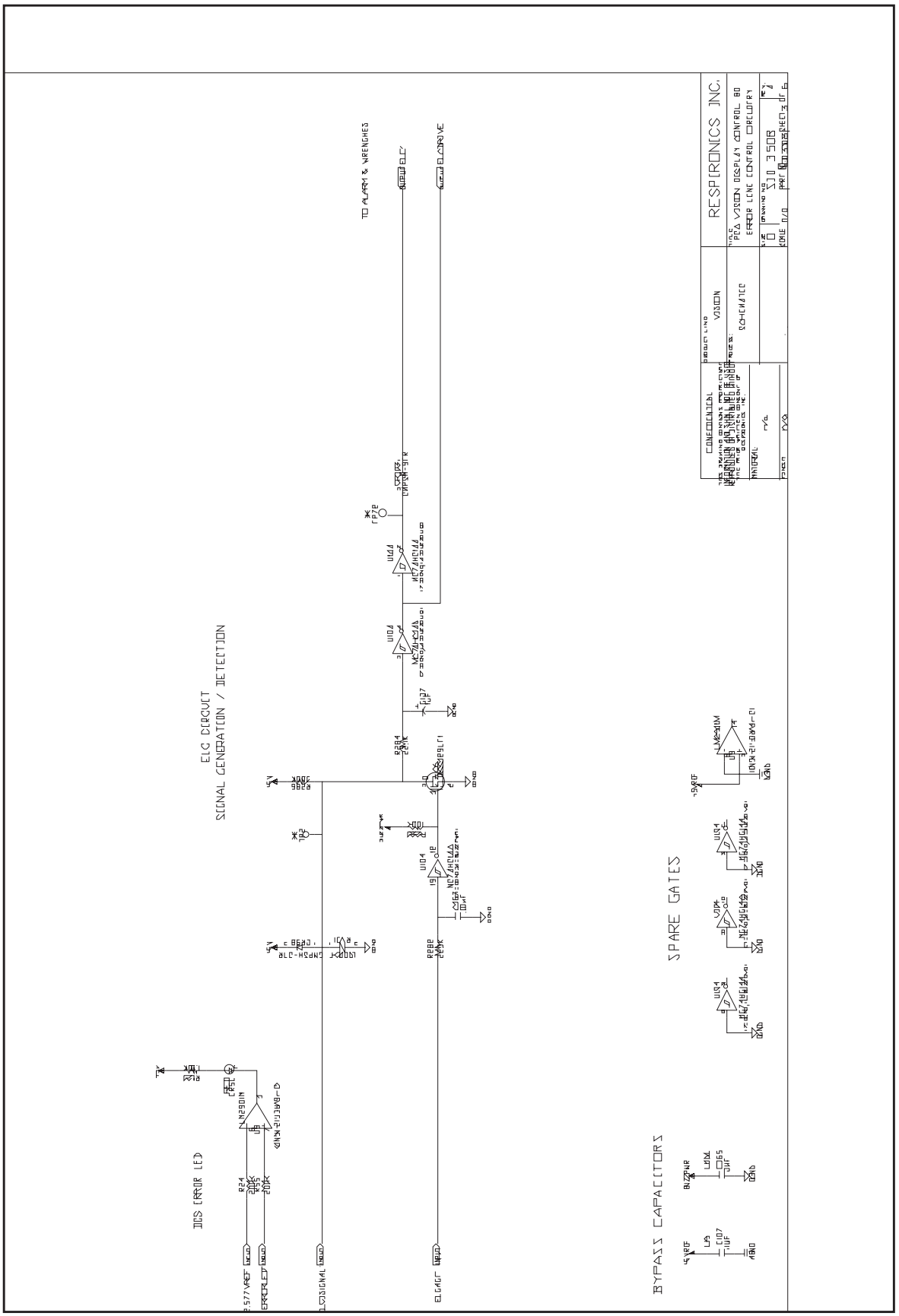
Display Control Microcontroller Interface



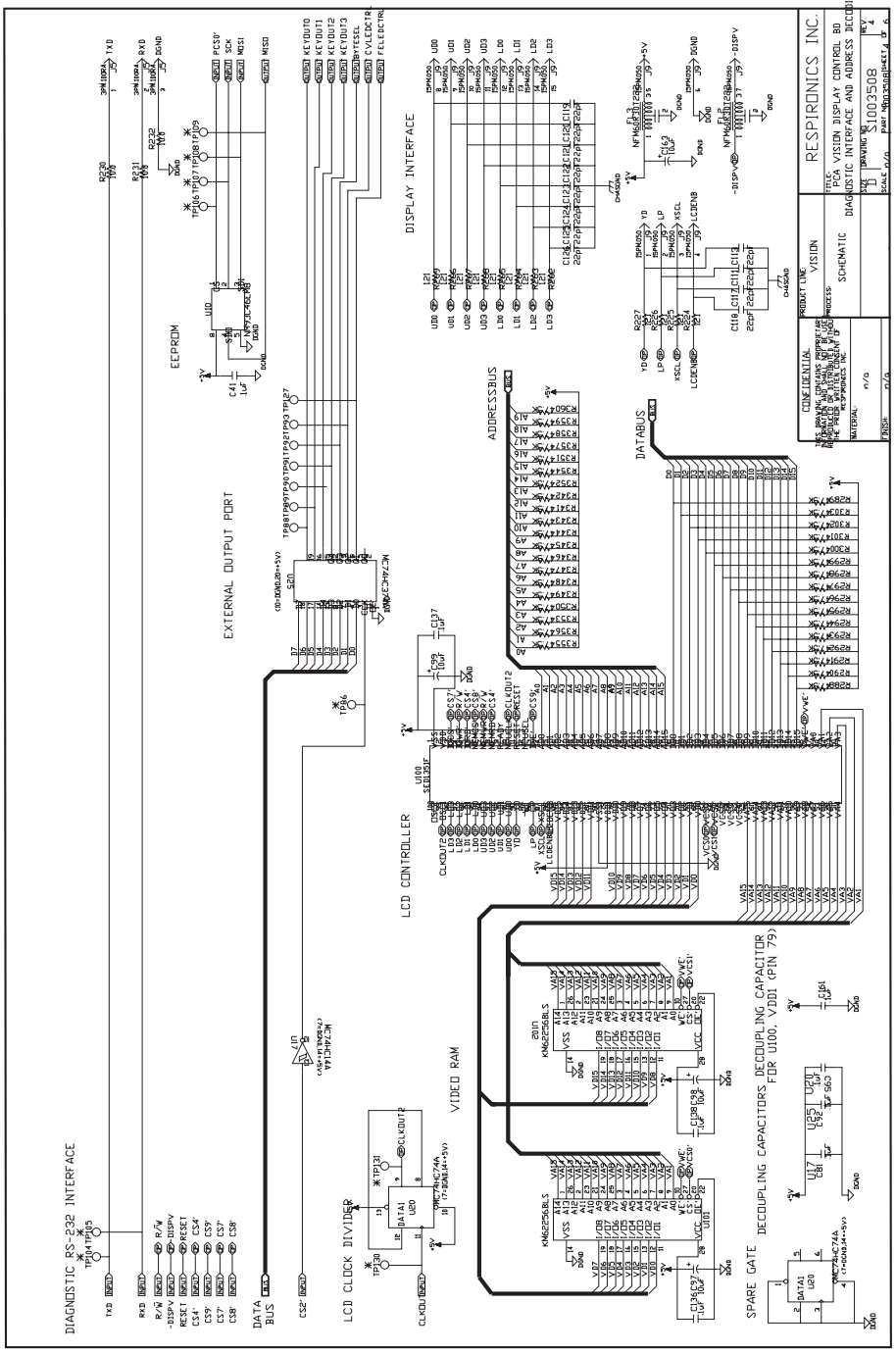
PCA Display Control Board - Power Conversion Circuitry



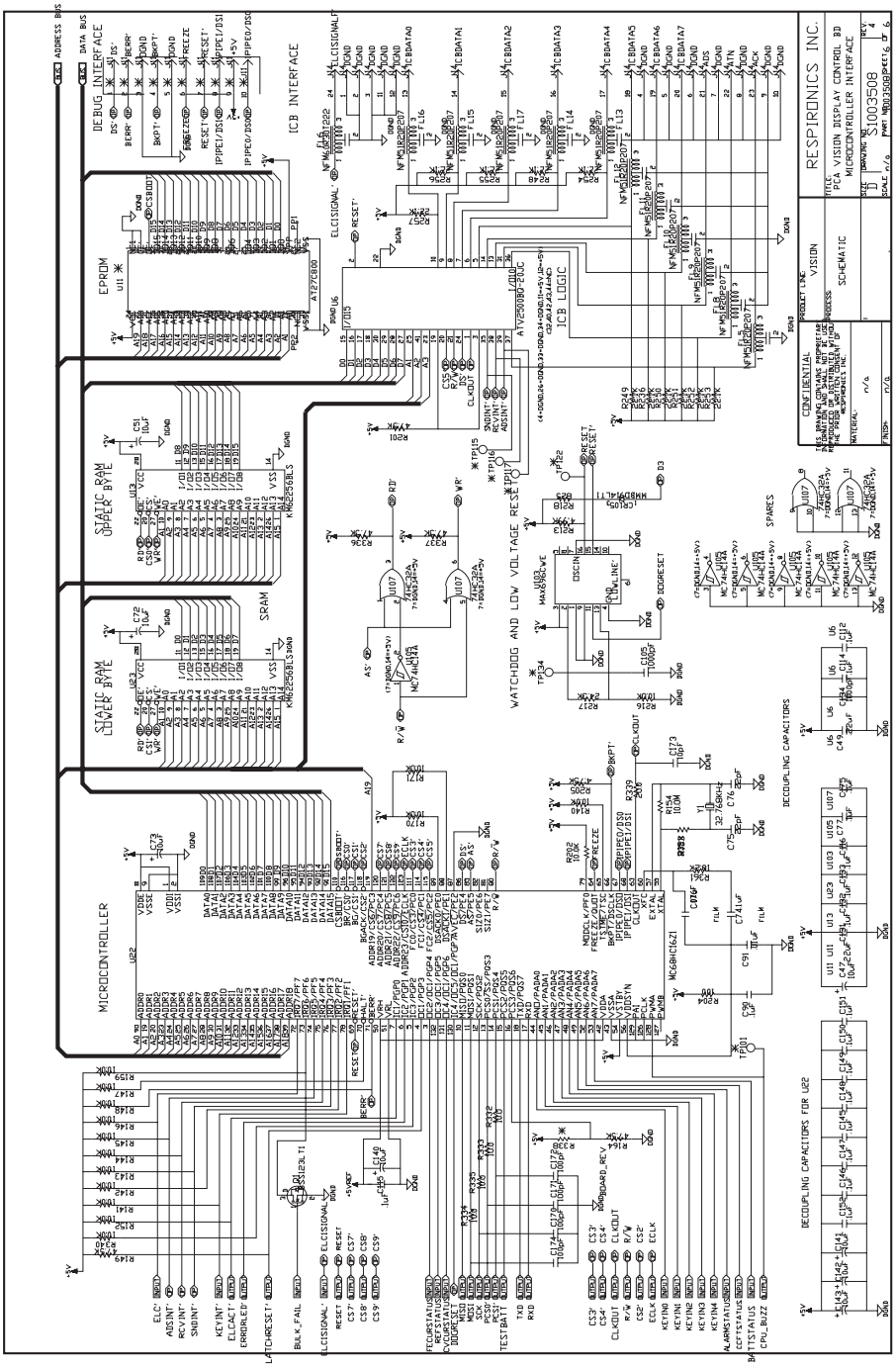
PCA Display Control Board - Battery and Indicator Circuitry



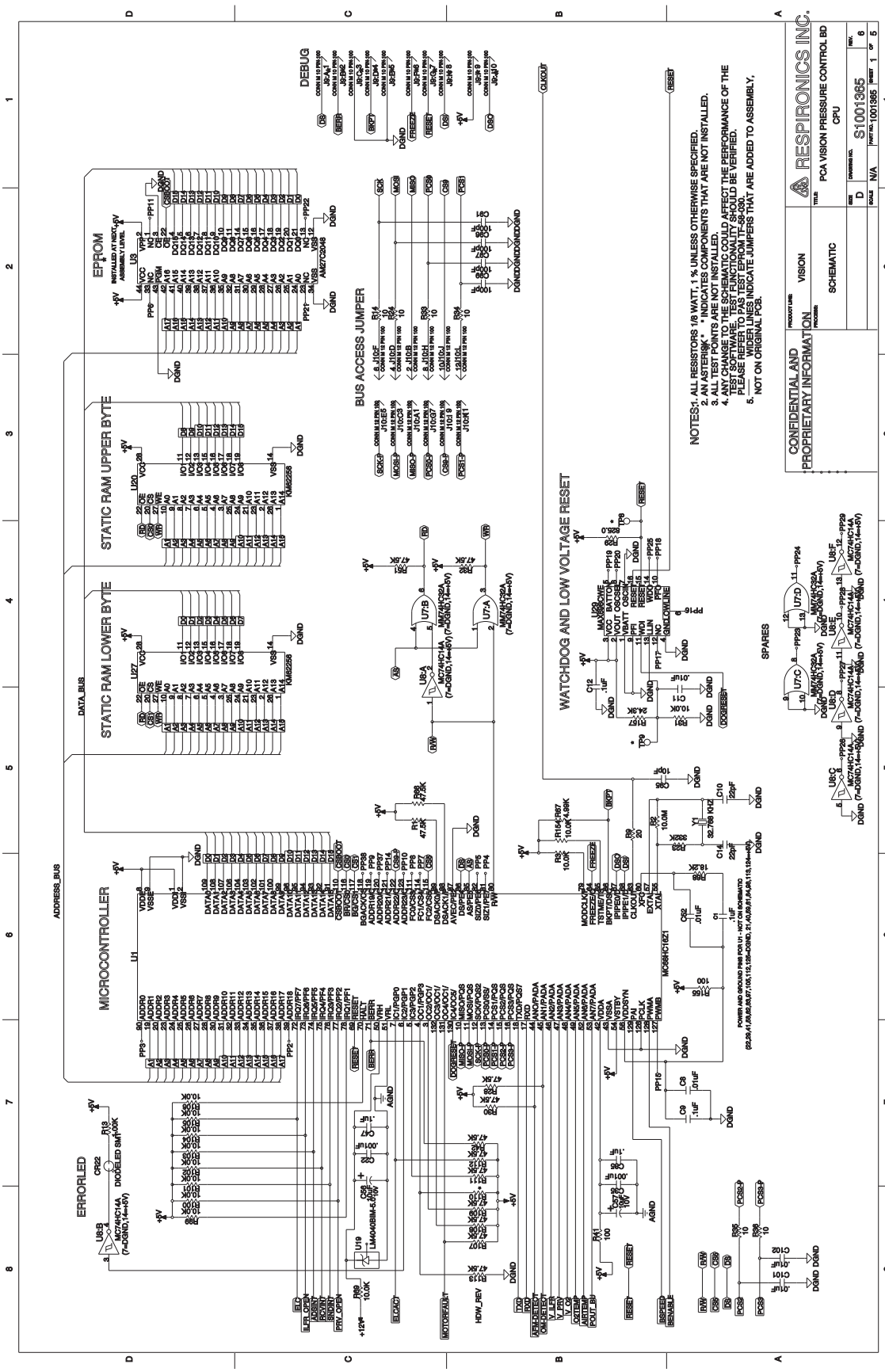
PCA Display Control Board - Error Line Control



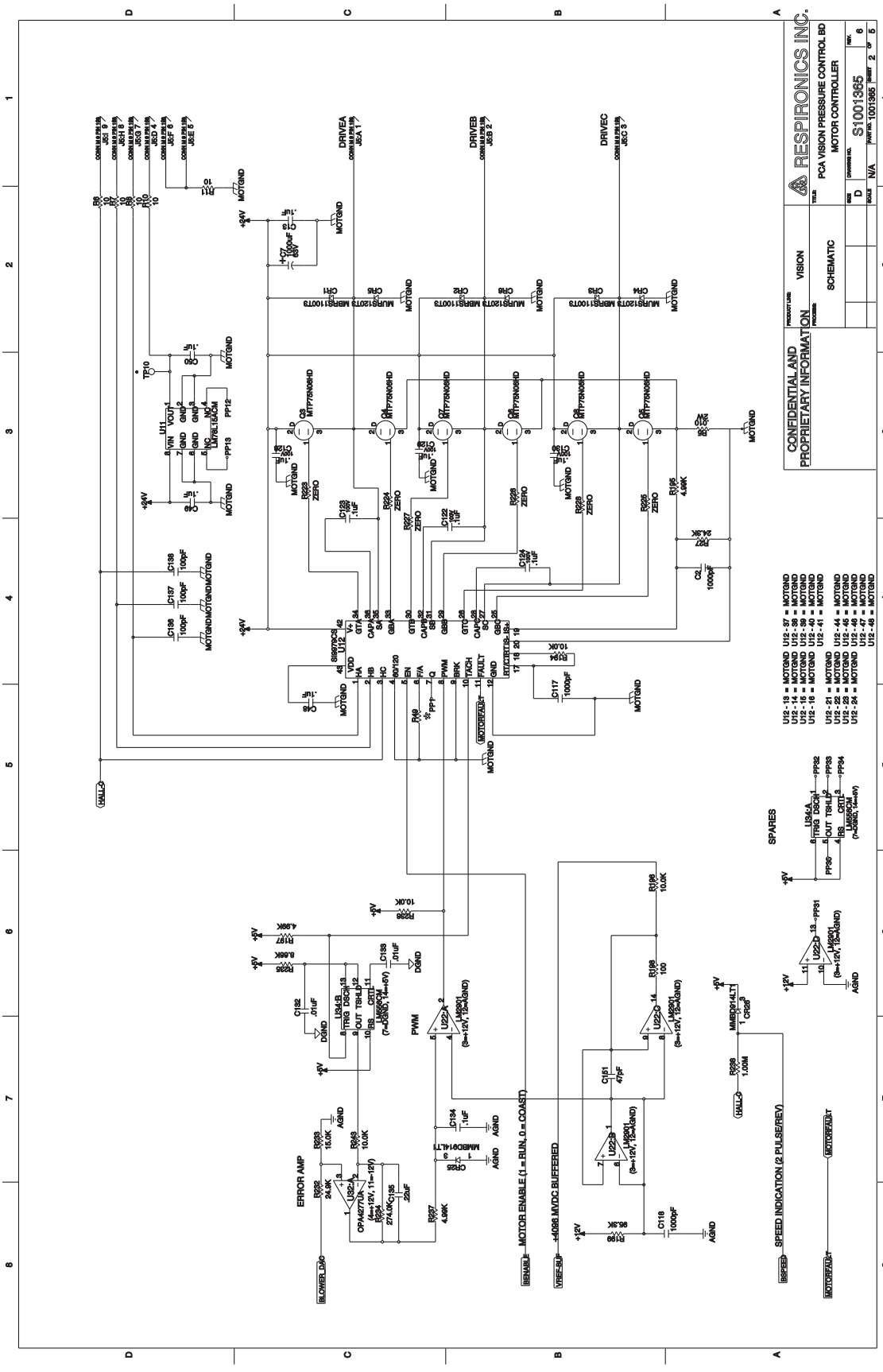
PCA Display Control Board - Diagnostic Interface & Address Decoding



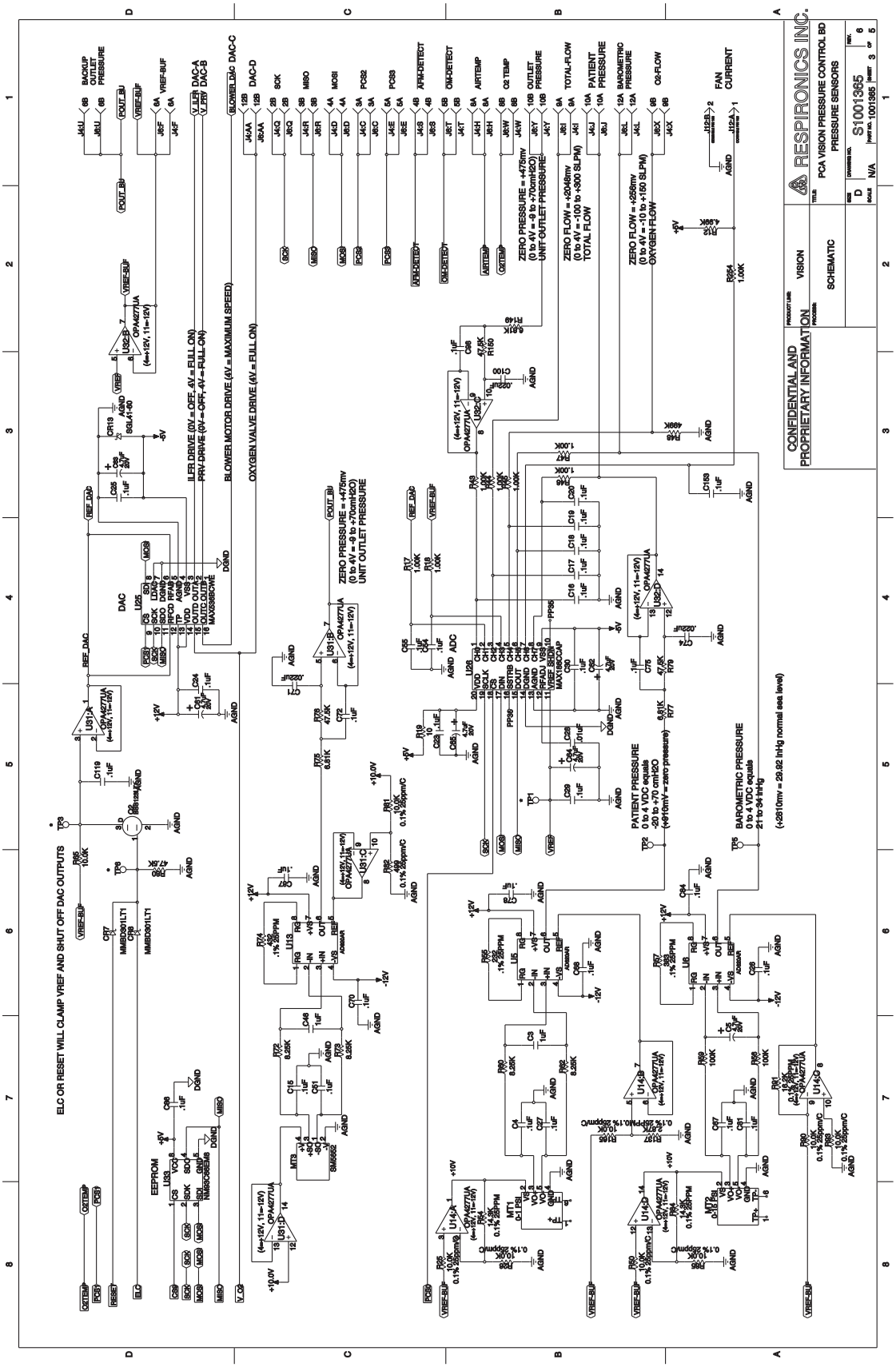
PCA Display Control Board - Microcoltroller Interface



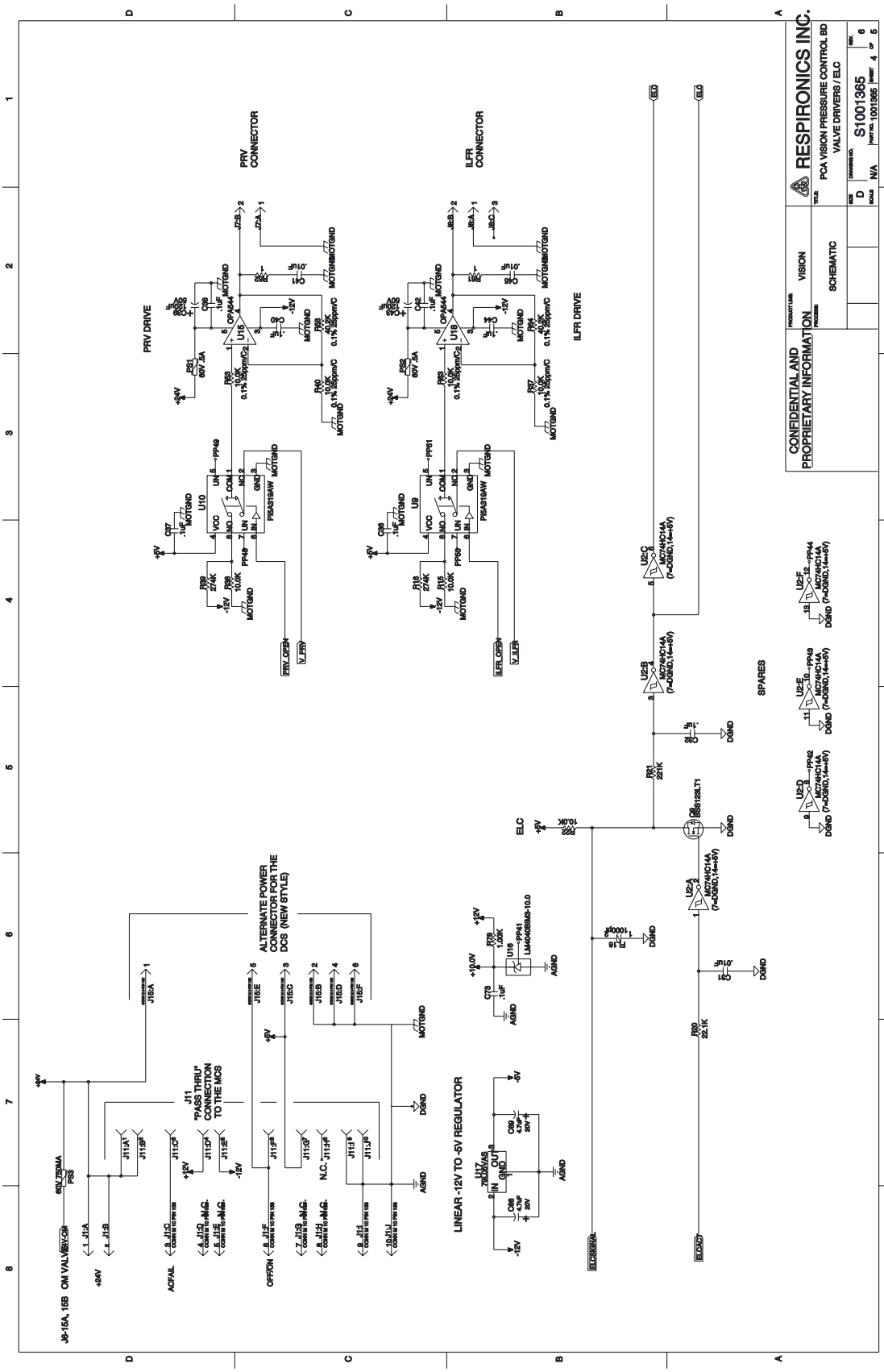
PCA Pressure Control Board CPU



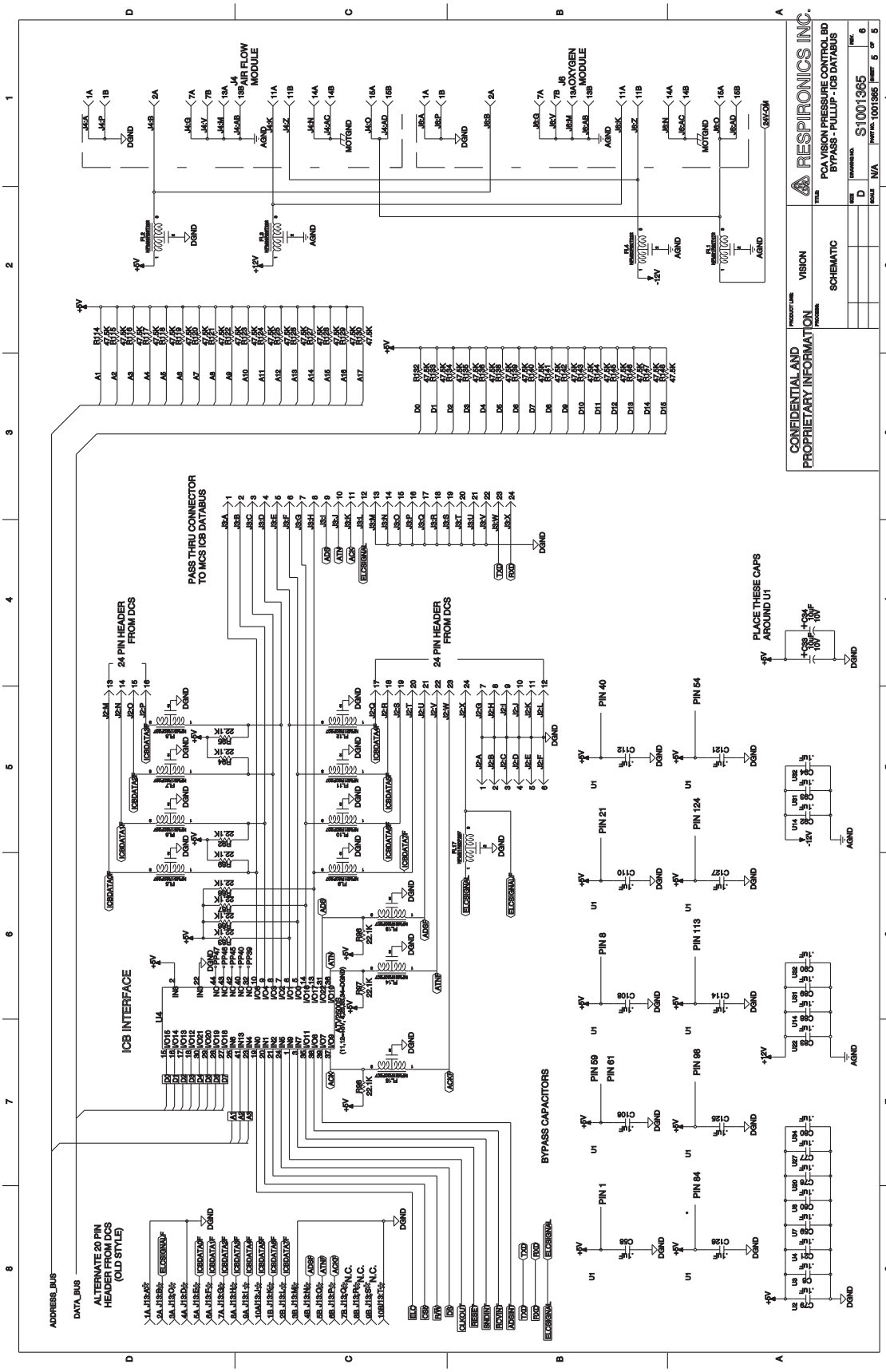
PCA Pressure Control Board - Motor Controller



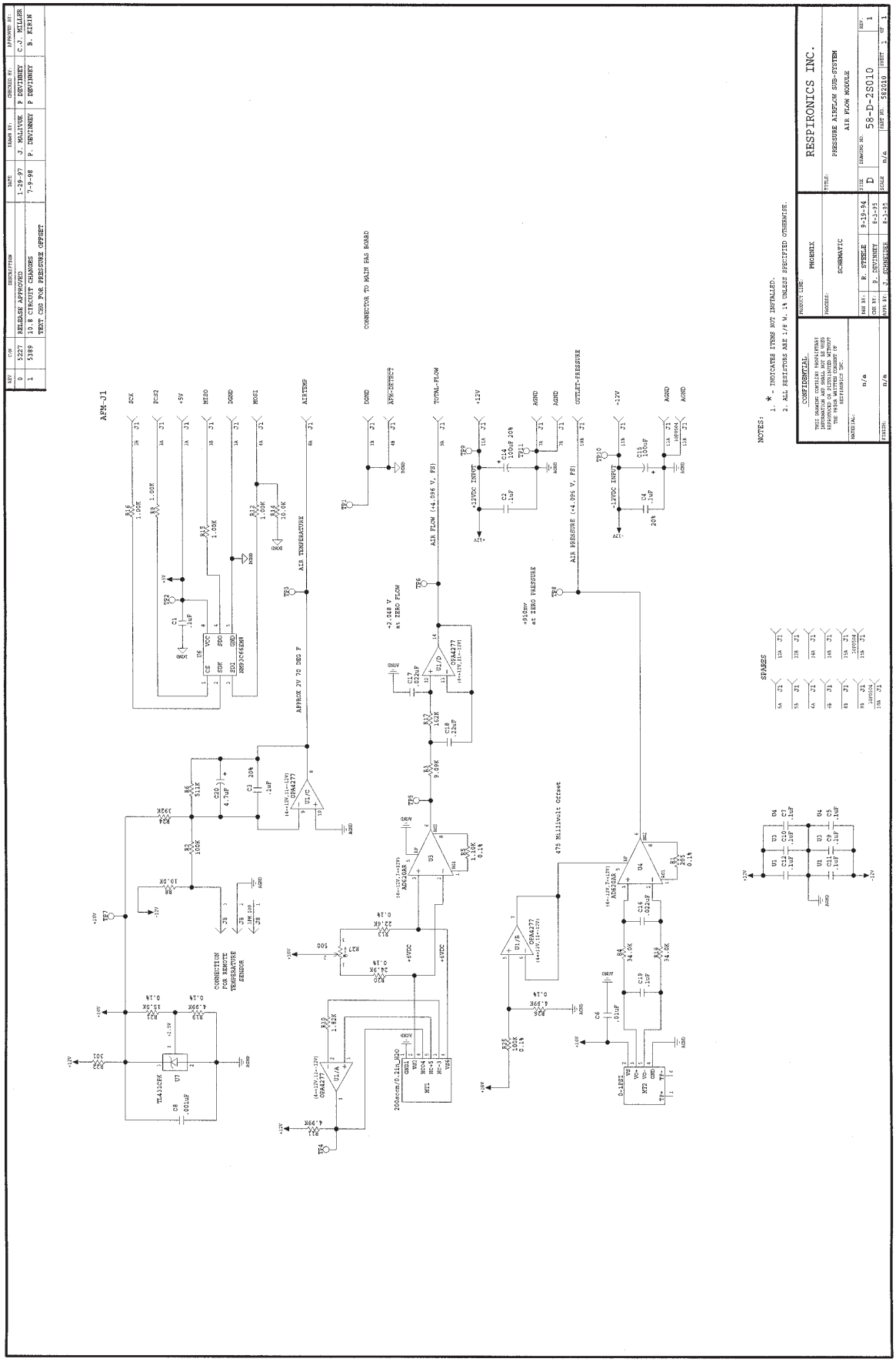
PCA Pressure Control Board - Pressure Sensors



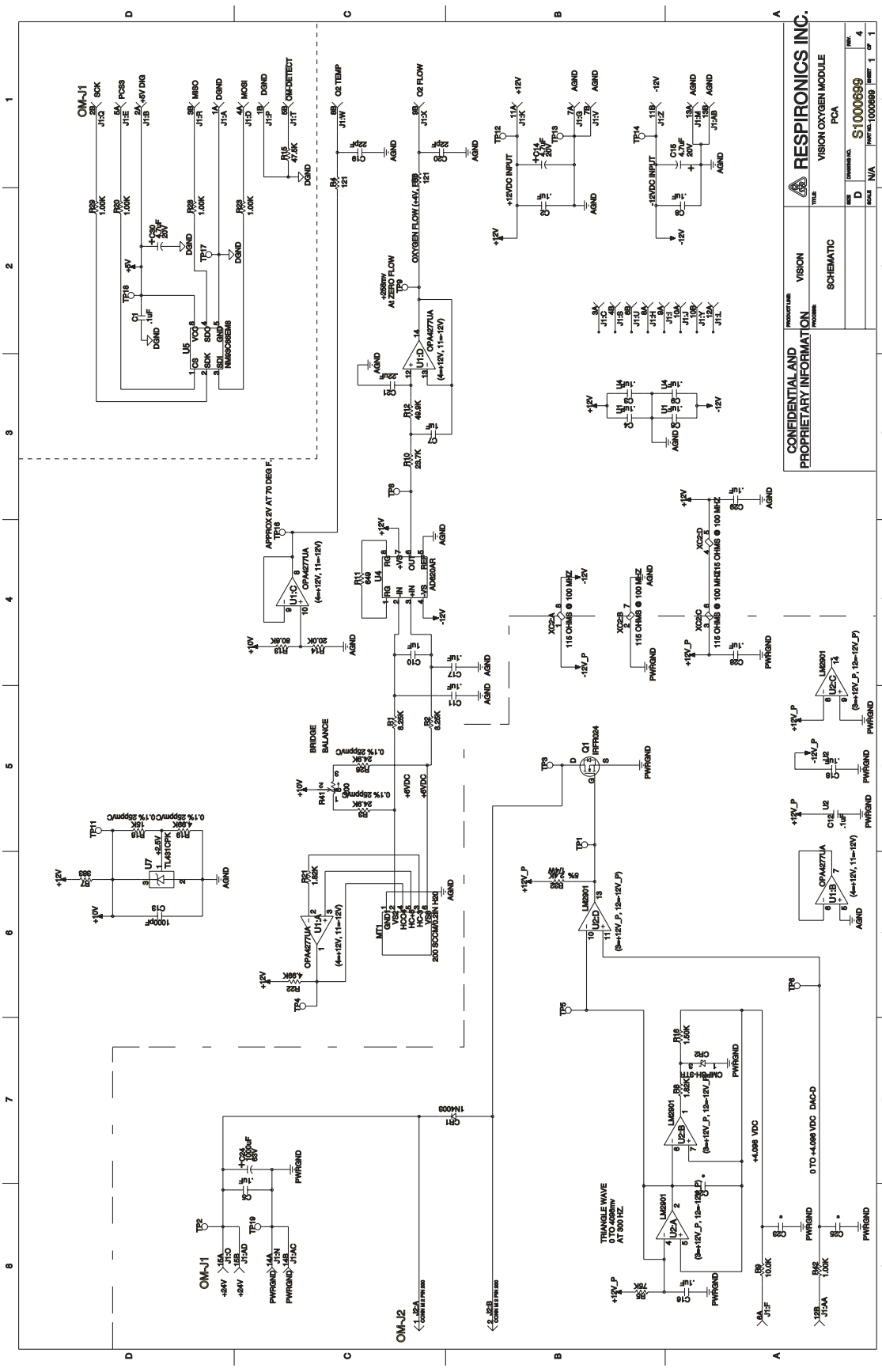
PCA Pressure Control Board - Valve Drivers / ELC

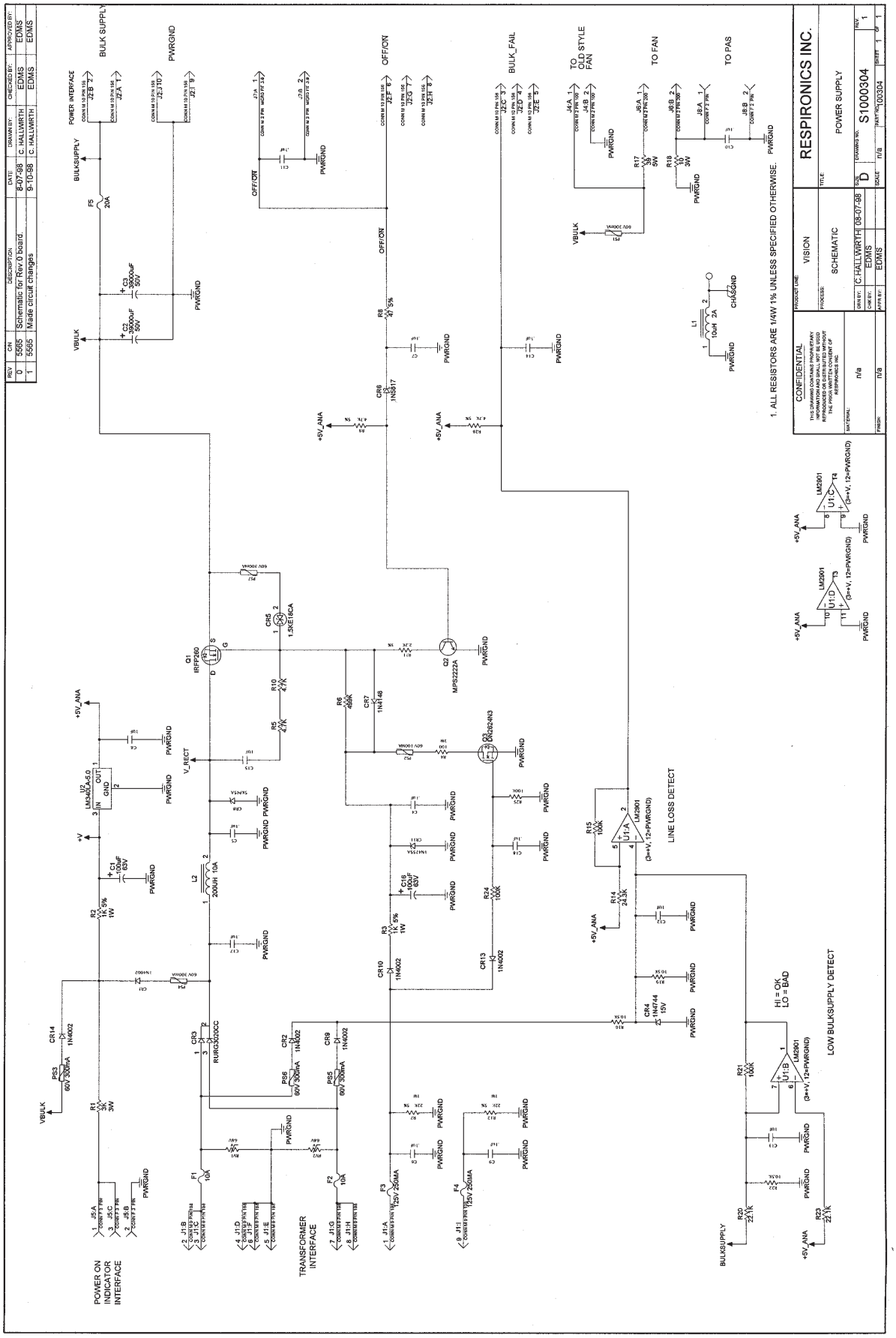


PCA Pressure Control Board - Bypass-Pullup-ICB Databus



Air Flow Module


RESPIRONICS INC.
CONFIDENTIAL AND PROPRIETARY INFORMATION
VISION
SCHEMATIC
VISION OXYGEN MODULE
PCA
S1000699
N/A
1000699
OM-J1
OM-J2
O2 TEMP
O2 FLOW
OXYGEN FLOW (±4V, ±5V)
+12VDC INPUT
-12VDC INPUT
BRIDGE BALANCE
TRIANGLE WAVE
0 TO +4.096 VDC DAC-D
+4.096 VDC
APPROX 2V AT 70 DEG F.
+200mV AT ZERO FLOW
OPA4277UA
LM2901
AD620AR
TLV431CPK
IRFR024
1N4003
200 SCCM/LEM HZ02



Power Supply Subsystem

RESPIRONICS INC.®
1001 Murry Ridge Lane
Murrysville, Pennsylvania
15668-8550 USA

RESPIRONICS®
Deutschland
Gewerbestrasse 17
D-82211 Herrsching Germany

1045049
LH /RICT 05/31/07