

Newport Medical Instruments, Inc.

NEWPORT e500 WAVE VENTILATOR

Service Manual

**SER500US Rev. B
02-08**



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INTRODUCTION

It is very important to read and understand all of the information in this manual before attempting to service the e500 Ventilator.

Please review all warnings and cautions in this manual before attempting to service the ventilator.

DEFINITIONS

WARNING A WARNING describes a condition that can cause personal injury.

Caution A Caution describes a condition that can cause damage to equipment.

NOTE: A NOTE emphasizes information that is important or convenient.

Inspection: examination of actual condition.

Service: measures to maintain specified condition.

Repair: measures to restore to specified condition.

Maintenance: inspection, service, and repair where necessary.

Preventive Maintenance: maintenance performed at regular intervals.

Operational Verification: a routine verification procedure to ensure proper operation.

Overhaul Procedure: a procedure for replacing key components at regular intervals.

INTRODUCTION

GENERAL WARNINGS

Please review all warnings and cautions in this manual before attempting to service the ventilator.

Warnings and Cautions appear throughout this manual where they are relevant. The Warnings and Cautions listed here apply generally any time you work on the ventilator.

WARNING

To maintain grounding integrity, connect only to a hospital grade receptacle. Always disconnect power supply before servicing the ventilator.

DANGER: there is a risk of explosion if used in the presence of flammable anesthetics.

Before returning to patient use, the e500 ventilator must pass the operational verification procedure.

All ventilator service or repair must be performed by a technician authorized and trained by Newport Medical Instruments.

Use extreme caution when working inside the ventilator while it is connected to a power source.

GENERAL CAUTIONS

Caution

Use standard antistatic techniques when working inside the ventilator or handling any electronic parts.

Clean all external parts of the ventilator prior to service.

Use only dry, clean compressed air and medical grade oxygen. Water in the air or oxygen supply can cause equipment malfunction and damage.

Mains voltage must correspond to the voltage range selected on the power module of the ventilator. Always replace an open fuse with one of correct type and rating.

Do not place containers of liquids near the ventilator. Liquids that get into the ventilator can cause equipment malfunction or damage.

NOTE: Use the tools specified in the manual to perform specific procedures.

SYMBOLS

The following symbols may appear on the ventilator or in accompanying documentation. In some cases, these symbols may be accompanied by a text label.

Symbol	Labeling	Symbol	Labeling
	Alarm silence	P_{aw}	Airway pressure
	Battery	$P_{support}$	Pressure support
	Decelerating waveform	P_{base}	Base pressure
	Square waveform	P_{mean}	Mean pressure
	Equipotential	P_{peak}	Peak pressure
f	Respiratory rate	P_{plat}	Plateau pressure
\dot{V}	Flow	P_{limit}	Pressure limit
$F_{I}O_2$	Fraction of inspired oxygen	V_T	Tidal volume
	Fuse	f_{tot}	Total respiratory rate or total breath frequency
$I:E$	Inspiratory to expiratory ratio		Type B Device icon
t_I	Inspiratory time	\dot{V}_E	Expiratory minute volume
t_E	Expiratory time	V_{TE}	Expiratory tidal volume
	Lock		Alarm loudness adjustment
I	On (power)	\emptyset	Off or None
	Off/Standby (power)		Attention, consult accompanying documentation
	Patient icon	$VTP_{support}$	Volume target Pressure Support
	Pediatric or infant patient	$VTPC$	Volume Target Pressure Control
	Adult patient		
\dot{V}_{peakE}	Peak expiratory flow		
\dot{V}_{peakI}	Peak inspiratory flow		

INTRODUCTION

WARRANTY

The e500 comes with a one (1) year conditional warranty. The warranty covers any defect or malfunction that occurs due to normal use. The warranty does not cover any scheduled maintenance. See the e500 Ventilator Operating Manual for the conditions of this warranty.

Federal Law in the United States requires traceability of this equipment. Please fill out the self-addressed Warranty Registration Card included with the product and return it to Newport promptly. Or register online at www.newportnmi.com.

FACTORY SERVICE

Scheduled maintenance or repair services are available from the Newport Technical Service department. See Appendix B and D for instructions on returning your ventilator for service. Newport's annual price list includes current pricing for scheduled maintenance and labor rates. To obtain a copy of the price list, please contact your local Newport representative or contact our Customer Service department.

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Technical Service hours:	Monday through Friday, 7:00 am to 4:00 pm (USA Pacific Time)

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MAINTENANCE & OVERHAUL INTERVALS

The Preventive Maintenance procedure should be performed once a year or every 5000 hours, whichever comes first.

Perform the Overhaul Procedure every 5 years or 25,000 hours, whichever

GENERAL WARNINGS**WARNING**

All servicing or repair of the ventilator must be carried out off patient.

Hazardous voltages are present inside the ventilator. Use extreme caution if it is necessary to work inside the ventilator while it is connected to a power source. Disconnect electrical power, air and oxygen sources before attempting any disassembly. Failure to do so could result in injury to service personnel or equipment.

To maintain grounding integrity, the ventilator must be connected to a hospital grade receptacle when in use.

DANGER: there is a risk of explosion if the ventilator is used in the presence of flammable anesthetics.

Before returning to patient use, the e500 ventilator must pass the operational verification procedure.

All ventilator service repairs of the e500 ventilator must be performed by a service technician authorized and trained by Newport Medical Instruments.

To prevent damage from ESD and possible failure of the ventilator, use standard anti-static techniques when working inside the ventilator, handling circuit boards or other electronic components.

GENERAL CAUTIONS

Caution

Clean all external parts of the ventilator prior to service.

Use only dry, clean compressed air and medical grade oxygen. Water in the air or oxygen supply can cause ventilator malfunction or damage.

Mains voltage must correspond to the voltage range on the ventilator power module. Replace fuses with those of correct type and rating.

Keep all liquids away from the ventilator. Liquids in the ventilator can cause malfunction or damage.

Always use standard antistatic techniques when working inside the ventilator or handling any electronic parts.

TOOLS REQUIRED

NOTE: Use the tools specified in the manual to perform specific procedures.

- Small Phillips screwdriver
- Medium Phillips screwdriver
- Medium flat-blade screwdriver
- 5/16 in. nut driver

PARTS REQUIRED

Preventive Maintenance Kit

The Preventive Maintenance Kit (PMK500A) includes the following items:

Part Number	Quantity	Description
JFK100P	2	Inlet filter and O-ring
PPT1805A	1	Exhalation valve diaphragm and poppet assembly

Overhaul Kit

The Overhaul Kit (OVL500A) includes the following items:

Part Number	Quantity	Description
JFK100P	2	Inlet filter and O-ring
PPT1805A	1	Exhalation valve diaphragm and poppet assembly
RRK1800P	2	Air & Oxygen inlet regulator repair kit
SIL1801P	1	Exhaust muffler
BAT1800P	1	Battery

Exhalation Valve Diaphragm & Poppet Assembly

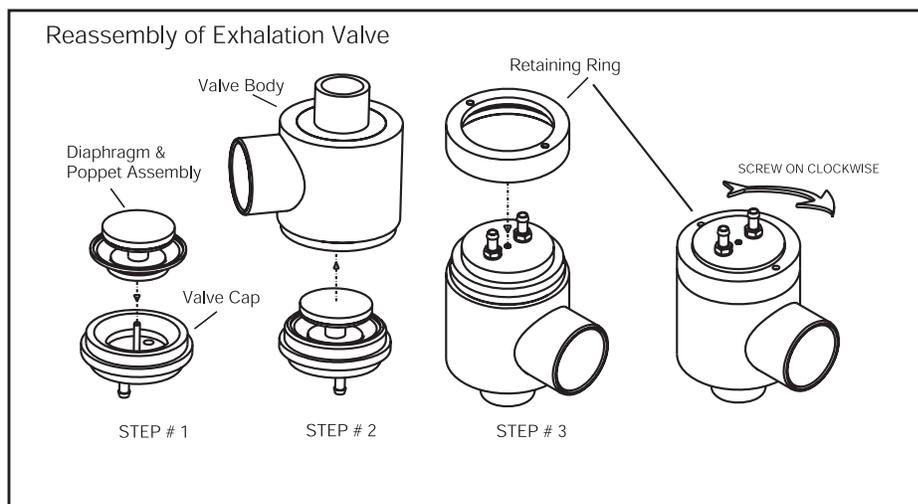
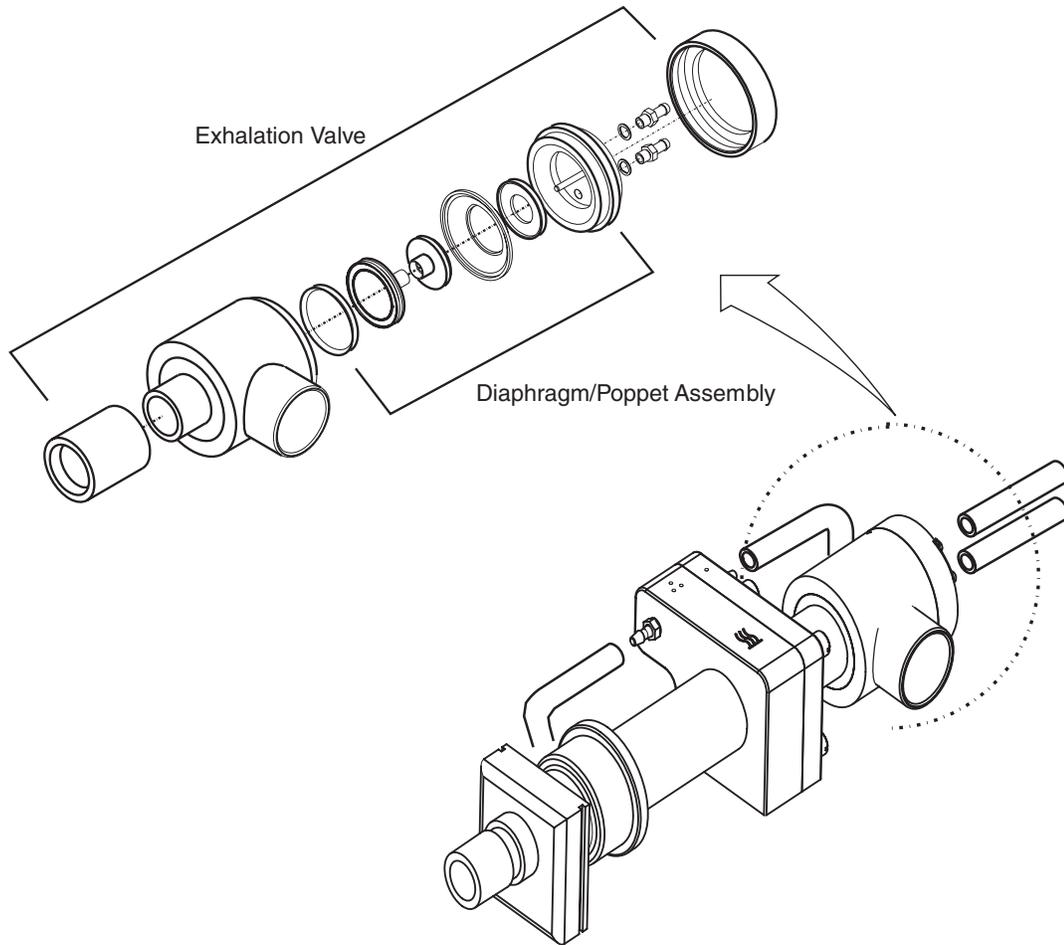


Figure 2-2

MAINTENANCE, OVERHAUL & SOFTWARE UPGRADE

Follow the procedures in Section 4 of this manual to remove the Top Cover and the Exhalation Module Assembly. Separate the exhalation valve from the module assembly (push fit) and detach the tubes from the assembly.

To replace the diaphragm and poppet assembly, refer to Figure 2-2 and do the following.

- 1 Hold the valve body securely with the retaining ring uppermost and twist the retaining ring counterclockwise to remove.
- 2 Lift the exhalation valve cap (the piece with two tube connectors) to remove it from the valve body.
- 3 Remove the diaphragm and poppet assembly from the valve cap. **Do NOT disassemble the diaphragm and poppet assembly, it is replaced as a single unit (P/N PPT1805A).**

To reassemble the exhalation valve, refer to Figure 2-2 and follow these steps.

- 1 Place the new diaphragm and poppet assembly (p/n PPT 1805A) onto the valve cap.
- 2 Hold exhalation valve body upside down and seat the valve cap with diaphragm and poppet assembly securely into valve body. **Make sure the pin on the valve cap lines up with the slot on the valve body when you bring them together (see Figure 2-3).**

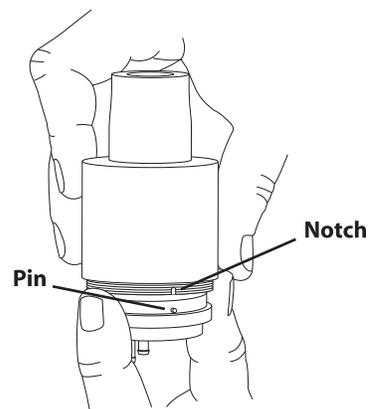


Figure 2-3

- 3 Hold the exhalation valve body securely together and turn it right side up. Re-attach the aluminum retaining ring to the valve body.

Exhalation Flow Sensor Screen

The flow sensor screen assembly is a precision instrument and must be handled carefully. The metal disc-screen is very fragile and may break if handled carelessly. Use a soft brush and mild soap solution to gently wash screen. Rinse with distilled water and air dry.

In the case of direct contact with patient exhaled gases, be certain to disassemble, clean, and sterilize the exhalation module between patients.

WARNING Always install a sterilized water collection system (with filter) between the expiratory limb of the breathing circuit and the expiratory (FROM PATIENT) connection leading into the exhalation module when installing a fresh breathing circuit.

WARNING Always put an additional bacteria filter at the expiratory side, as described above, before using a nebulizer. Failure to do so may cause severe exhaled flow screen contamination, resulting in exhaled flow/volume monitoring errors. For each nebulization treatment, use a fresh bacteria filter.

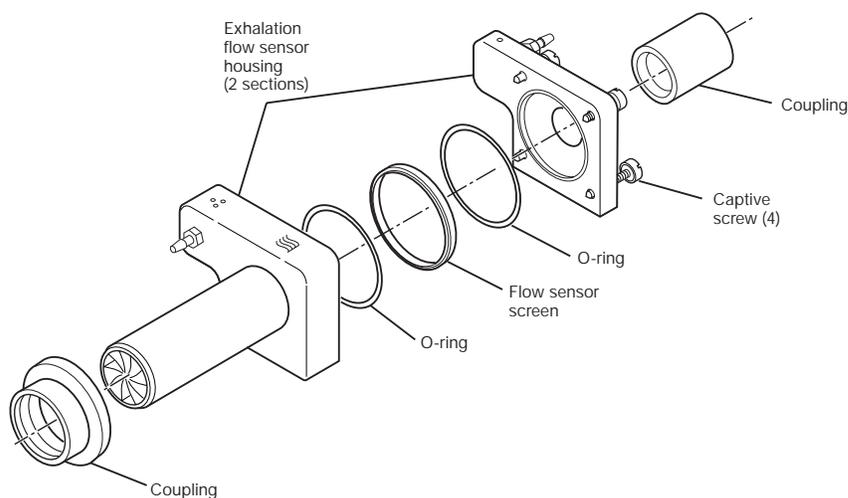


Figure 2-4. Removal of the Exhalation Flow Sensor

MAINTENANCE, OVERHAUL & SOFTWARE UPGRADE

Water Collection System (with Reusable Expiratory Filter)

See Section 4 for disassembly/assembly of the Water Collection System components.

NOTE: The reusable filter (FTR1800P) is supplied non-sterile, and should be sterilized before use.

Disassemble, clean and sterilize all components of the Water Collection System (except the circuit tubing) after each patient use.

During patient use: remove the water trap at the bottom of the water collection canister as necessary to drain excess water that forms due to condensation. Wipe down the outside of the filter and canister with a damp cloth moistened with a mild soap solution. Replace filter as needed if you suspect an increase in expiratory resistance.

Sterilization guidelines:

All components of the Water Collection System (except the circuit tubing) are designed for sterilization by steam autoclaving at temperatures not to exceed 135 °C (275 °F).

Filter, water collection canister and water trap:

Autoclave: 132 °C (270 °F) for 20 minutes for gravity-displacement cycles.

Wrap the reusable filter in muslin or equivalent paper before autoclaving.

WARNING To avoid damage to the filter do not immerse in liquid or attempt to scrub or touch the filter media. Soaking or rinsing of the filter may cause retention of harmful residues and/or increased air flow resistance. Damage to the filter media can reduce its filtration efficiency.

WARNING Do not use ETO (ethylene oxide) to sterilize this filter.

Caution If nebulized medication is used, monitor filters more frequently as nebulized medication build up can occlude filter medium.

Circuit Tubing:

The 12" section of reusable circuit tubing that connects the water collection manifold to the e500 GDU expiratory port must be cleaned, and sterilized if it malfunctions or is visibly contaminated while in use. See complete cleaning instructions for reusable circuits in the e500 Operating Manual.

Reusable Filter Maintenance

Remove and steam autoclave the filter after each patient use. To ensure proper installation, observe the flow direction markings on the filter.

Look to make sure the filter housing is in good condition with no cracks before use. Replace the filter if there is damage noted. If you suspect an increase in expiratory resistance due to water saturation or buildup of nebulized medication, sterilize filter or replace more frequently.

Reusable Filter Replacement

The filter is designed to withstand up to 100 repeated autoclave sterilization cycles at temperatures not exceeding 135 °C (275 °F). It is recommended to inspect the filter before each use and discarded if the filter housing is visibly damaged or if flow resistance is too high for your application. See Filter Pressure Drop Test.

It is recommended that the filter be replaced after a maximum of one year of service or after 100 steam autoclave cycles, whichever comes first. Make a note on the side of the filter housing of the anticipated retirement date.

Filter Pressure Drop Test

Check the flow resistance of the reusable filter before each reuse. Place a 0 to 10 cmH₂O pressure gage or TSI analyzer inline with a section of breathing circuit tubing connected to the filter. Run a 100 L/min continuous flow into the circuit.

The maximum allowable pressure drop across the filter is 4 cmH₂O (0.06 psig) at 100 L/min flow. If pressure drop is greater than 4 cmH₂O remove the filter from service.

MAINTENANCE, OVERHAUL & SOFTWARE UPGRADE

OVERHAUL PROCEDURES

To replace the Inlet Filters and O-rings and Exhalation Valve Diaphragm & Poppet assembly, follow the procedures given in the Preventive Maintenance at the beginning of this section.

Disengaging the Flow Sensors

Many service operations require the flow sensors to be disengaged from the Mixer/Manifold assembly and/or from the Servo valves. To avoid damage to the flow sensors, remove the Top Cover, the Exhalation Module and the Flow Sensor Cover as described in Section 4 then proceed as follows.

Remove the two screws and washers securing the mixer and manifold assembly (Figure 2-5)

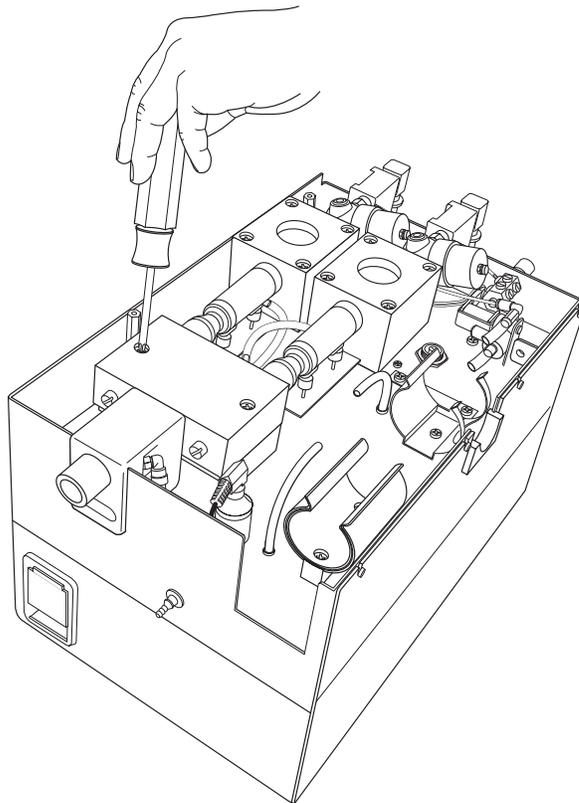


Figure 2-5 Detach mixer

Carefully slide the mixer/manifold assembly forward until the flow sensors disengage (Figure 2-6)

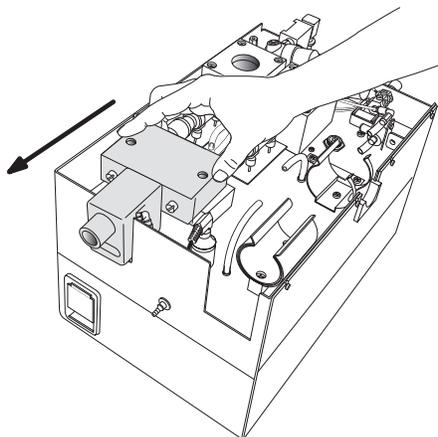


Figure 2-6 Slide mixer forward

Caution Do not bend or twist the sensors while attempting to free them as this could cause damage to the sensors.

To disconnect the flow sensors from the Servo valves, carefully pull each flow sensor in turn straight back from its socket (see Figure 2-7).

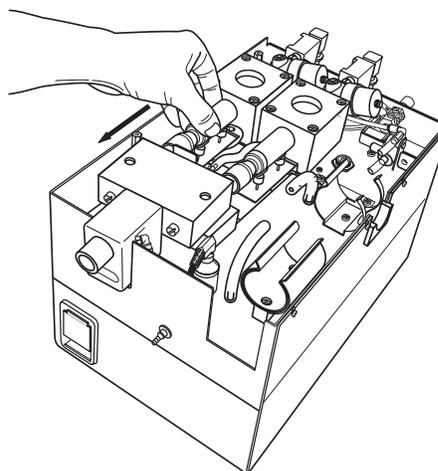


Figure 2-7 Flow sensors disengaged from servo valves

If you do not require the flow sensor cables to be disconnected, lay the sensors gently to one side while you proceed with the necessary service procedure.

Air and Oxygen Inlet Regulator Rebuild

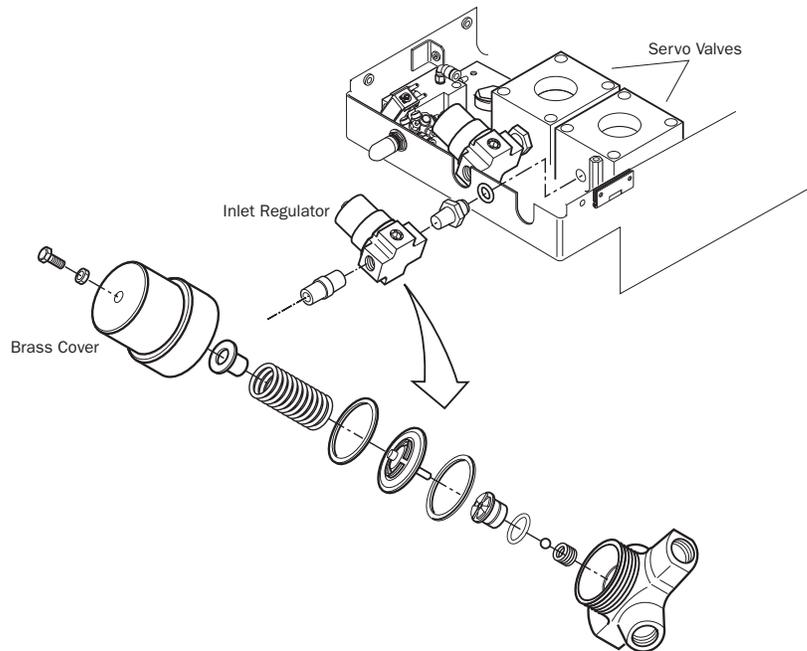


Figure 2-8

To install the Air and Oxygen Inlet Regulator Rebuild Kits, follow the procedures in Section 4 of this manual to remove the Top Cover, the Exhalation Module Assembly and the Flow Sensor Cover. Disengage the flow sensors (Figures 2-5, 2-6 and 2-7).

Refer to Figure, 2-8 and do the following:

NOTE: Retain all hardware for re-assembly.

- 1 Carefully lay the flow sensors to the side. It is not necessary to disconnect the flow sensor cables.
- 2 Loosen and remove the four (4) screws securing each of the two servo valves to the Pneumatic Box assembly.
- 3 Disconnect the small tube attached to each servo valve. One at a time, lift the regulator/servo valve assemblies out far enough to allow you to rotate the assembly until the air or oxygen regulator is pointing straight up.
- 4 Unscrew the brass cover from the regulator (no tool should be needed) and remove the spring, diaphragm, diaphragm washer, seat with O-ring, small spring, and ball (see Figure 2-8).

- 5 Replace these old parts, reversing the disassembly, with the parts from the Rebuild Kit (RRK1800P).
- 6 Replace the brass cover finger tight and realign each assembly, securing the servo valve to the mounting bracket with the four screws.
- 7 Re-attach the small tubes to the servo valves.
- 8 Carefully remount the flow sensors into both the servo valves and the mixer assembly.
- 9 Re-attach the mixer assembly with the two screws previously removed.
- 10 This procedure is the same for both the air and the oxygen regulators.

Remove/Replace the Muffler Filter

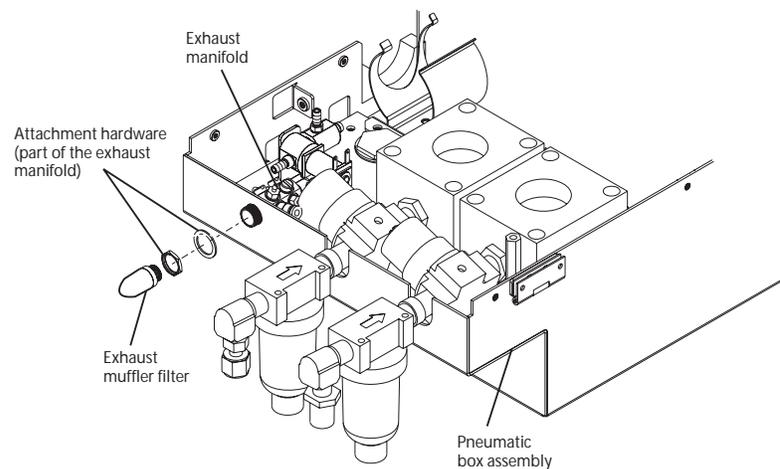


Figure 2-9

Refer to Figure 2-9 and follow these steps.

- 1 Unscrew the muffler filter from the rear of the GDU and discard. The filter is installed finger tight and needs no tools for removal.
- 2 Replace with the new muffler filter from the kit.

Remove/Replace the Internal Battery

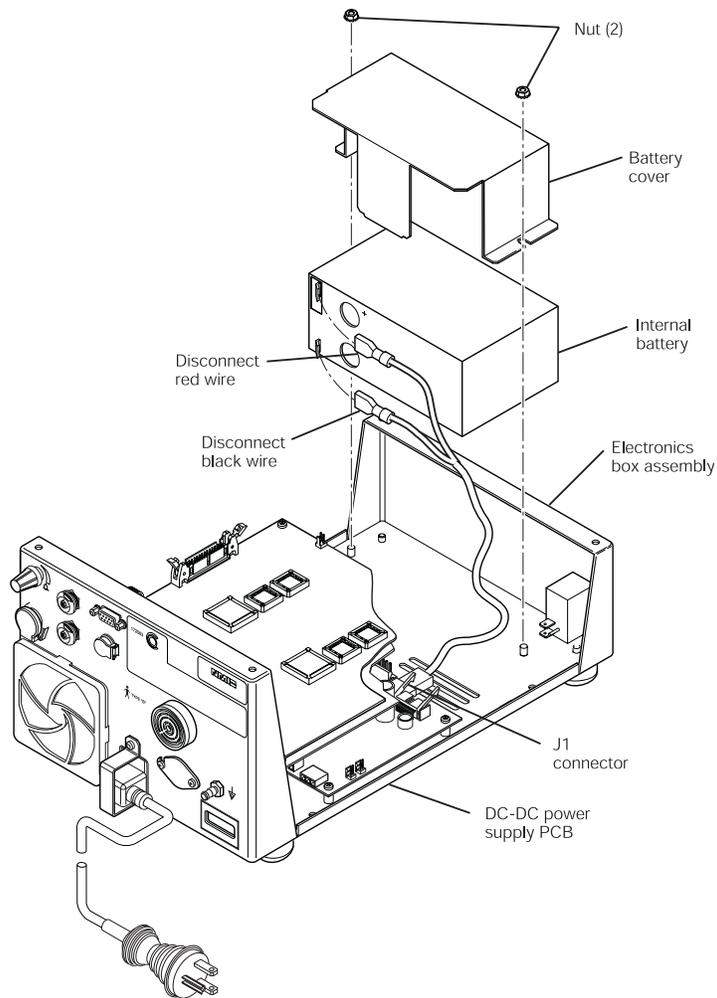


Figure 2-10 Battery removal

To replace the internal battery, follow the instructions in Section 4 to remove the Top Cover, Exhalation Module and Flow Sensor Cover. Also remove the Left Side Panel, Right Side Panel, and the Exhalation Manifold Support Bracket as shown in Section 4.

Refer to Figure 2-10 and follow these steps.

- 1 Remove the two screws (at the rear) and the two standoffs (at the front) securing the Pneumatics Box to the electronics box. Without removing any wires or cables, lift the pneumatics box and carefully lean it to the side to expose the battery assembly.

WARNING Connectors at J5 and J6 on the DC to DC board may become detached when the Pneumatics Box is moved to the side. Re-attach these connectors before re-installing the Pneumatics Box.

- 2 Remove the nuts securing the battery bracket to the electronics box. Remove the bracket.
- 3 Remove the red wire and black wire from the battery terminals. Remove the battery.
- 4 To install a new battery, reverse these removal steps.

Remove/Replace Tubing

The tubing inside the e500 does not need to be replaced at any predetermined time interval; however, Newport is aware that tubing may occasionally need replacing. During the overhaul procedure, carefully inspect all tubing for degradation, cracks, or brittleness. If the tubing indicates any of those symptoms, replacement is recommended.

Newport has put together a tube replacement kit P/N FSKTRK500. The Kit includes all the tubing for the e500. Refer to the System Pneumatic Diagram located in Appendix C to cut each tube to length and replace the worn tubing in the e500.

If tubing needs to be replaced, please contact Customer Service and order the tube replacement kit P/N FSKTRK500 separately from the overhaul kit.

After completing the overhaul, perform a complete electronic and pneumatic calibration as outlined in Section 5 of this manual and the OVP given in Section 6.

INSTALLATION OF THE e500 SOFTWARE UPGRADE KIT (ISW500-US)

NOTE: If you need to update the software in the Graphics Display Monitor GDM, see Appendix D Section 3.

Caution Always use standard antistatic techniques when working inside the ventilator or handling any electronic parts.

Warning Hazardous voltages are present inside the ventilator. Disconnect electrical power, air and oxygen sources before attempting any disassembly. Failure to do so could result in injury to service personnel or equipment.

Tools Required:

- Philips head screw driver (medium)
- Prom extractor tool (p/n TOL 1820P)
- EMI/RFI wrist strap and mat

Warning After replacing software EPROMS, before returning your e500 to patient use, you must perform a complete Operation Verification Procedure.

CONTROL PANEL MODULE (CPM) SOFTWARE

Refer to the Control Panel Module disassembly instructions in Section 4 of this manual and remove the CPM rear panel and the PC Board, PCB1810A.

- 1 Place the PCB on a non conductive surface, component side up.
- 2 Using a prom extraction tool (see Figure 2-10), remove the EPROM installed in U1 on the component side of PCB1810A. Discard the old EPROM.

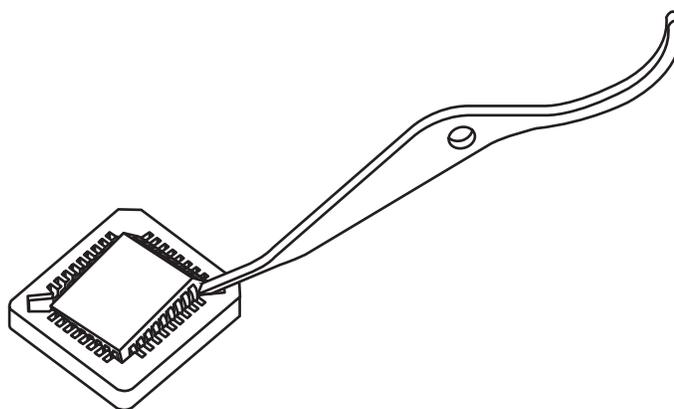


Figure 2-11 Extraction tool

- 3 From the kit, locate the new EPROM (P/N PRM1834A-X) and install it into the holder at U1.
- 4 Reinstall PCB1810A and secure with the eleven (11) screws and washers removed earlier.
- 5 Reconnect the nine (9) cables for the encoders at J1 through J9.
- 6 Reconnect the cable from PCB1810A to CN1 on the smaller Video PCB (message center display).
- 7 Reconnect the ribbon cable to JP2 on PCB1810A.
- 8 Replace the cables to JP1 and JP3.
- 9 Secure the rear panel with the twelve (12) screws previously removed.

GAS DELIVERY UNIT (GDU) SOFTWARE

Refer to the instructions in Section 4 of this manual and remove the Right Side Panel, the Left Side Panel, the Exhalation Module Assembly and the Flow Sensor Cover. Separate the Pneumatics Box assembly from the Electronics Box assembly and carefully position it so that it rests on its side.

NOTE: Retain all hardware for re-assembly.

To replace the old EPROMs.

- 1 Using the prom extraction tool, carefully remove the four (4) EPROMs located at U18, U19, U25, and U26 on the main board. Discard the old EPROMs.

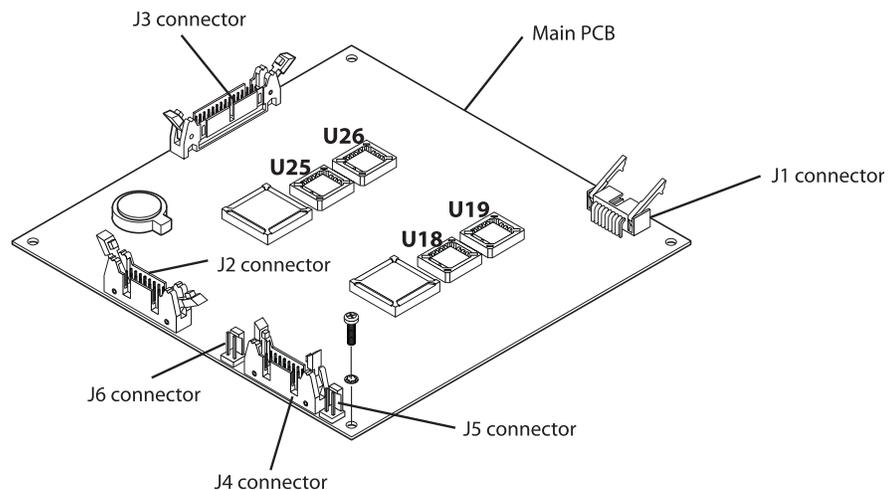


Figure 2-12 Main PCB showing EPROM locations

- 2 From the kit, install the four (4) EPROMS as indicated below;

PRM1830A-X	to U18
PRM1831A-X	to U19
PRM1832A-X	to U25
PRM1833A-X*	to U26

NOTE: EPROM part numbers may be subject to change. Refer to instructions provided in kit for most current part numbers.

*The "X" denotes the latest revision of the prom. The software kit contains the most current version.

- 3 Reassemble the GDU by reversing the disassembly procedure. Be sure to check all PCB connections as you re-assemble the pneumatics and electronics boxes as some may have become disconnected during the separation.
- 4 Complete Software Update Form.

Warning After replacing software EPROMS, before returning your e500 to patient use, you must perform a complete Operation Verification Procedure.

NOTE: Upon completion of software upgrade, you must complete the following form (with serial numbers and signature) and return it to Newport Regulatory Department.

NEWPORT e500 VENTILATOR SOFTWARE UPDATE FORM

**COMPLETED FORM MUST BE FAXED TO NEWPORT REGULATORY AFFAIRS
UPON COMPLETION OF UPGRADE.**

Fax completed form to: 1.949.645.5026 attention RA/QA
Or email requested information to: regulatory@NewportNMI.com

Facility Name: _____

Facility Address: _____

e500 Model: WW USA Language: _____

Current Hours: _____

Gas Delivery Unit (GDU) Serial Number: _____

GDU old software version: _____

GDU updated software version: _____

Control Panel Module (CPM) Serial Number: _____

CPM old software version: _____

CPM updated software version: _____

*Graphics Display Monitor (GDM) Serial Number: _____

GDM old software version: _____

GDM updated software version: _____

*if applicable

Company performing service: _____

Address of company performing service: _____

Installed by: (print name) _____ Date: _____

OVP performed by: _____ Date: _____

3. Troubleshooting Guide

Troubleshooting Guide 3-1
Error Messages 3-2

Table 3-1 may provide guidance in determining the cause and possible corrective action for ventilator problems. Newport does not guarantee that the suggested corrective action will solve the problem. Contact Newport Service Department, as shown in Appendix B, for additional assistance.

Table 3-1. Troubleshooting Guide

Problem	Potential Cause	Suggested Action
Ventilator cannot achieve or maintain correct tidal volume, plateau pressure, or baseline pressure.	Pressure relief valve regulator failure. Crossover solenoid valve (solenoid PCB) failure. Proximal zero solenoid (solenoid PCB) valve failure. Power down solenoid (solenoid PCB) failure.	Perform the Operational Verification Procedure to diagnose the problem.
No 8 L/min flow at power down.	Power down solenoid (solenoid PCB) failure.	Replace solenoid PCB.
Bar graph does not show pressure rise.	Proximal zero solenoid (solenoid PCB) valve failure.	Replace solenoid PCB. CPM PCB/Analog PCB
Zero monitored exhaled flow.	Flow zero solenoid (solenoid PCB) valve failure. Tube disconnected from exhalation flow sensor. Analog PCB failed.	Replace solenoid PCB. Reconnect tubing to exhalation flow sensor. Replace analog PCB.
Monitored values for exhaled flows or volumes differ from settings.	Occluded or missing bacteria filter. Dirty flow sensor screen. Exhalation heater failure.	Replace the bacteria filter. Disassemble and clean the Exhalation Module, including the flow sensor screen. Feel the bacteria filter. If it is not warm to the touch, replace the exhalation heater.
Automatic oxygen sensor calibration fails.	Defective oxygen sensor. Oxygen sensor restrictor occluded.	Replace the oxygen sensor. Clean or replace the oxygen sensor restrictor.
Monitored F _I O ₂ values differ from setting.	Defective oxygen sensor. Oxygen analyzer jet pump or restrictor occluded.	Replace the oxygen sensor. Clean or replace the oxygen analyzer jet pump or restrictor.
No audible alarm.	Defective alarm speaker or back panel PCB.	Replace alarm speaker or back panel PCB.
Internal battery does not charge.	Defective battery or battery charging hardware.	Replace internal battery or replace the DC-DC power supply PCB.
Loss of battery power.	Battery missing or discharged. Defective battery hardware.	Recharge or replace battery. Replace DC-DC power supply PCB.

Problem	Potential Cause	Suggested Action
Low supply gas alarm.	Supply pressure is not within specified range (30-90 psig).	Ensure that both gas supplies have a pressure of at least 30 psig.
No flow or low flow from inspiratory port during inspiratory phase of a mandatory breath.	Inlet regulator failure or servo valve failure.	Calibrate air and oxygen regulators; replace if calibration is not successful.
Ventilator cannot cycle, audible alarm on, and error message displayed in message window.	Based on error message.	Calibrate servo valves; replace if calibration is not successful. Refer to Table 3-2, Error Messages.

ERROR MESSAGES

Table 3-2 defines types of violations and messages that can be displayed in the message window. The first line in the message window displays the date and time of the error; the second line displays the error message.

Table 3-2. Error Messages (User Set Up Message Log)

MESSAGE	DEFINITION
Control RAM Failed	Random access memory that is used by the control processor on the main PCB is damaged.
Control ROM Failed	Read only memory that stores the code of the control processor has an incorrect checksum.
Control CPU Failed	The control processor on the main PCB is bad.
Monitor RAM Failed	Random access memory that is used by the monitor processor on the main PCB is damaged.
Monitor ROM Failed	Read only memory that stores the code of the monitor processor has an incorrect checksum.
Monitor CPU Failed	The monitor processor on the main PCB is bad.
Dual RAM Failed	Random access memory that is shared between the control and monitor processors is damaged.
Power Failure	DC power out of tolerance. Check +12 VDC, -12 VDC and +5 VDC.
Mon Task Failed	Monitor processor software tasks have operated out of sequence.
Control uP Failed	The control processor does not respond to a request from the monitor processor. The control processor is not running.
C Internal System	The control processor has detected an abnormal operation such as illegal instruction or division by zero that was generated by the control software.
Control Tasks Failed	Control processor software tasks have operated out of sequence.

4. Component Removal and Replacement

Removal of Gas Delivery Unit

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-
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Removal of Control Panel Module

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NOTE: For the e500 Graphics Display Monitor, please refer to the GDM Service Section, Appendix D.

REMOVAL OF GAS DELIVERY UNIT COMPONENTS

This section describes how to disassemble the replaceable components of the e500 Ventilator Gas Delivery Unit (GDU). Unless instructed otherwise, replace parts by reversing the disassembly.

Figure 4-1 shows the location of each major subassembly of the GDU. The Pneumatic Box Assembly includes the Inhalation System, Analog PCB and Solenoid PCB. The Electronic Box Assembly includes the Main PCB, Power Supply, DC-DC Power Supply PCB, Back Panel PCB and Back Panel Components.

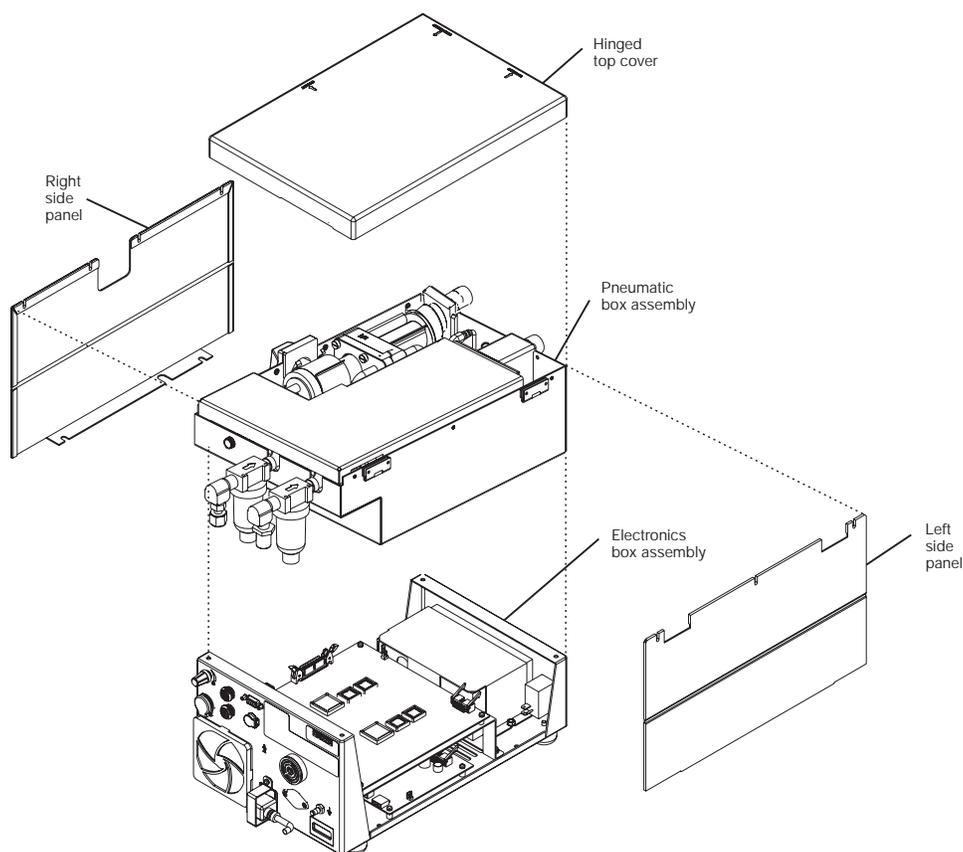


Figure 4-1. Sub-assemblies of the Gas Delivery Unit

Preparation

Before performing any repair or service on the e500 Ventilator GDU, do the following:

- 1 Toggle the GDU On/Standby switch to the Standby position, then disconnect gas and power supplies from the ventilator.
- 2 Disconnect the Control Panel and Graphic Display Monitor cables (if installed) from the GDU.

COMPONENT REMOVAL AND REPLACEMENT

- 3 Disconnect the water collection system and patient circuit from GDU.
- 4 Remove the GDU from the cart and place it carefully on a table or workbench.

Tools Required:

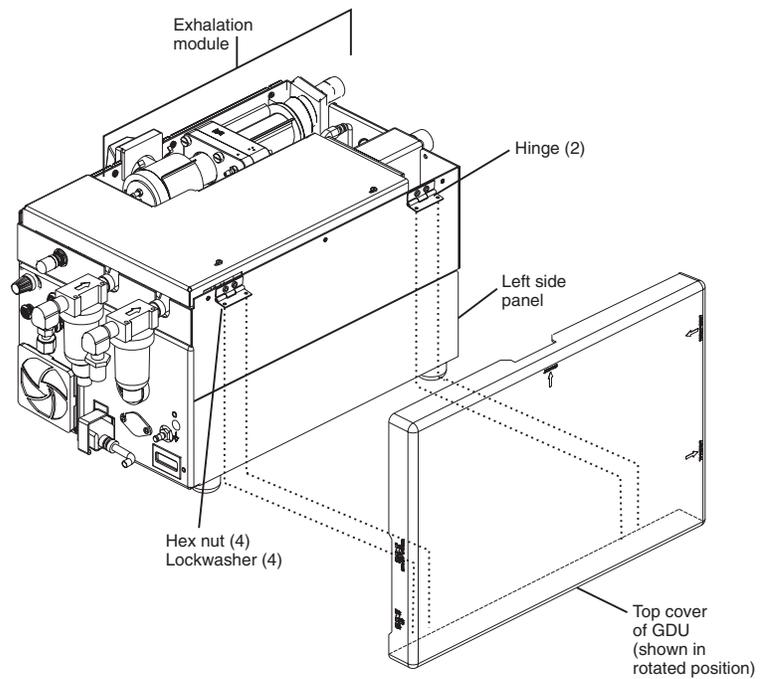
- 5/16" nut driver
- 7/32" nut driver
- 7mm nut driver
- Medium Philips screw driver
- Small Philips screw driver
- Anti static wrist strap and mat

WARNING To avoid possibility of electric shock, do not touch the power supply transformer when servicing the ventilator.

These instructions are intended for use only by a Newport Medical Instruments factory-trained technician. Do not perform any unauthorized modifications or repairs to the ventilator or its components.

Caution To avoid damaging equipment, always use standard electrostatic discharge (ESD) precautions, including an ESD wrist strap, when servicing the ventilator.

Top Cover

**Figure 4-2. Removal of the Top Cover**

Refer to Figure 4-2 and follow these steps.

- 1 Open the Top Cover.
- 2 Remove the four hex nuts and lock washers (two at each hinge) that secure the cover to the hinges on the left side of the Pneumatic Box.
- 3 Remove the cover and set aside. Retain hardware for re-assembly.

COMPONENT REMOVAL AND REPLACEMENT

Left Side Panel

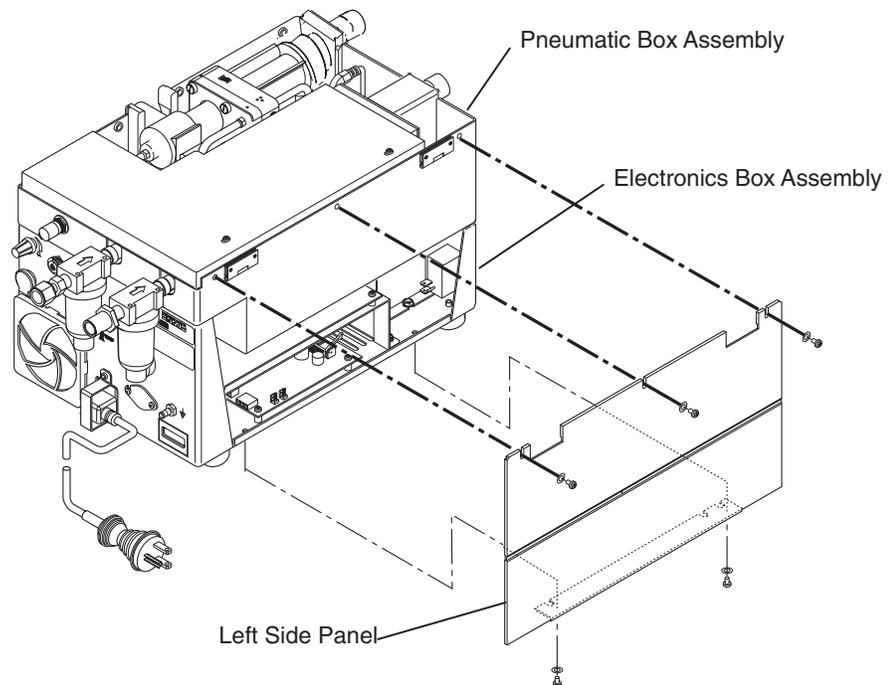
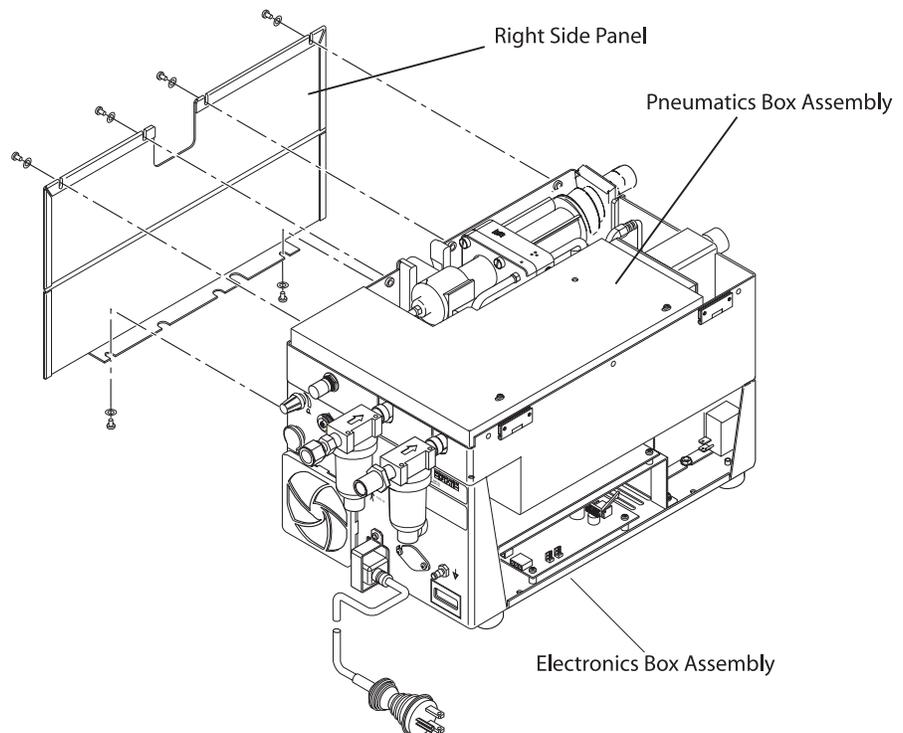


Figure 4-3. Removal of the Left Side Panel

Refer to Figure 4-3 and follow these steps.

- 1** Carefully place the GDU on its right side with the front of the GDU facing you.
- 2** Remove the three screws and washers at the top edge of the Left Side Panel.
- 3** Remove the two screws and washers from the underside of the Left Side Panel.
- 4** Remove the Left Side Panel. Retain hardware for re-assembly.

NOTE: When re-installing the Left Side Panel, fold the hinges up so that the reinstalled panel does not cover the hinges.

Right Side Panel**Figure 4-4. Removal of the Right Side Panel**

Open and remove the Top Cover (See Figure 4-2).

Refer to Figure 4-4 and follow these steps.

- 1 Carefully place the GDU on its left side.
- 2 Remove the four screws and washers at the top edge of the Right Side Panel.
- 3 Remove the two screws and washers from the underside of the Right Side Panel.
- 4 Remove the Right Side Panel. Retain hardware for re-assembly.

COMPONENT REMOVAL AND REPLACEMENT

Exhalation Module

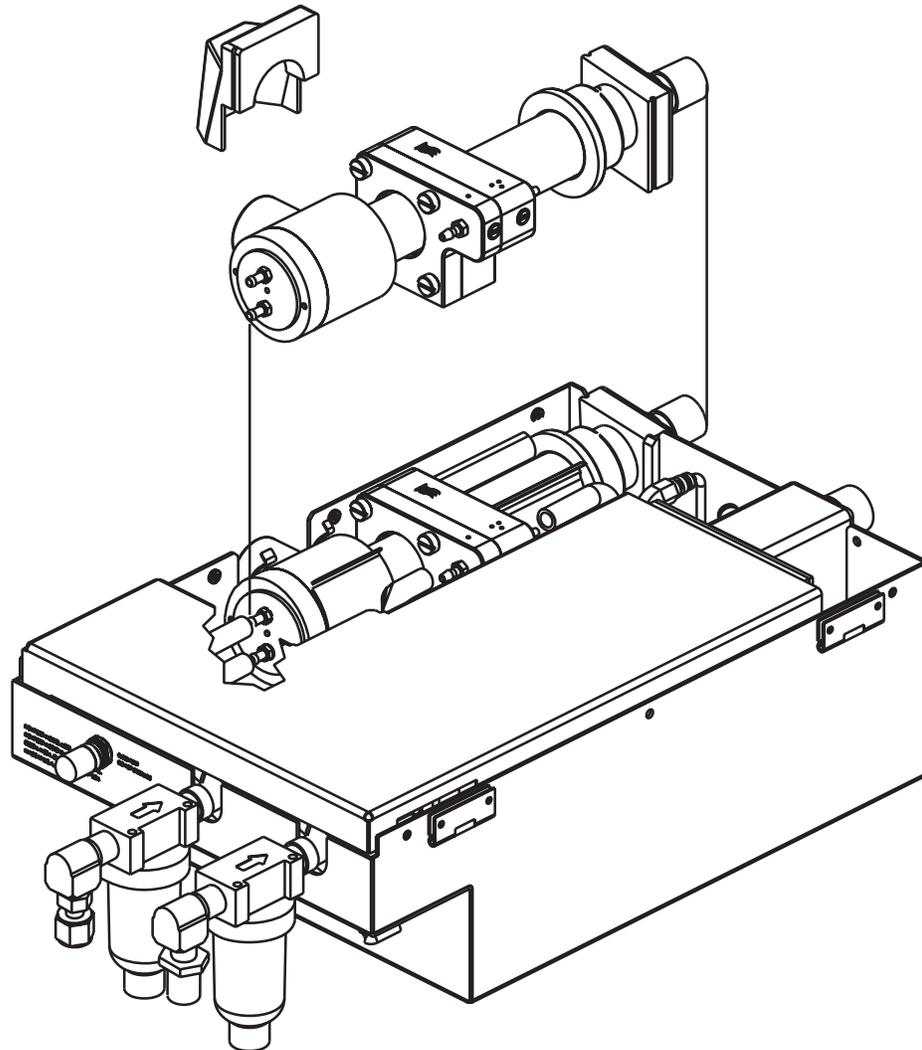


Figure 4-5. Removal of the Exhalation Module

Open the Top Cover (Figure 4-2) and locate the Exhalation Module.

Refer to Figure 4-5 and follow these steps.

- 1** Pull up and remove the flexible rubber exhalation outlet boot (push fit).
- 2** Disconnect the tubes from both sides of the flow sensor and the two tubes from the exhalation valve.
- 3** Pull the Exhalation Module straight up to remove it from the GDU.

Flow Sensor Cover

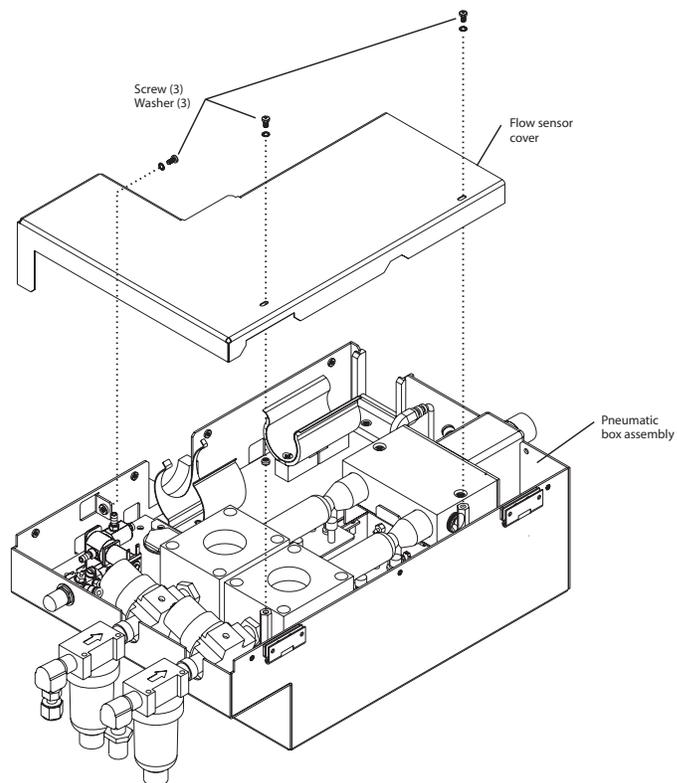


Figure 4-6. Removal of the Flow Sensor Cover

Open and remove the Top Cover (Figure 4-2).

Refer to Figure 4-6 and follow these steps.

- 1** Remove the three screws and washers that secure the Flow Sensor Cover to the Pneumatic Box assembly. Retain the hardware for re-assembly.
- 2** Remove the Flow Sensor Cover.

COMPONENT REMOVAL AND REPLACEMENT

Pneumatic Box Assembly

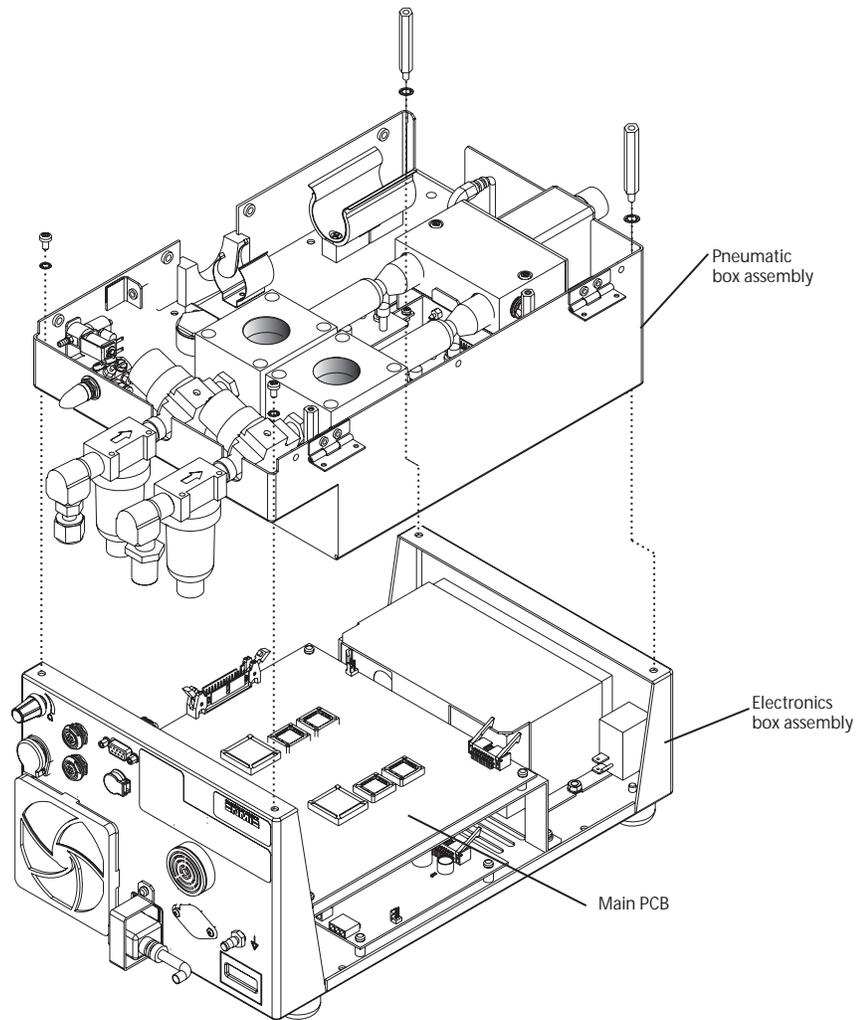


Figure 4-7. Removal of the Pneumatic Box Assembly

Open and remove the Top Cover (Figure 4-2), Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Flow Sensor Cover (Figure 4-6), and Exhalation Module (Figure 4-5).

Refer to Figure 4-7 and follow these steps.

- 1** Remove the two screws and washers (back corners), and two standoffs and washers (front corners) that secure the pneumatic (upper) box assembly to the electronic box assembly. Lift the Pneumatics Box and carefully tilt to one side.
- 2** Remove cables from connectors J1, J2, J3, J4, J5, and J6 on the main PCB. Note the position of these connectors for re-assembly.

- 3 If not already detached, remove the heater cables from J5 and J6 on the DC-DC power supply PCB.

NOTE: When reinstalling the Pneumatic Box assembly:

- Reinstall the (marked) servo valve cables to the main PCB (air to J5, oxygen to J6 on the main PCB) before setting the Pneumatic Box onto the electronic box assembly. If one of these servo valves is replaced, ALWAYS MARK THE CABLE AS AIR OR O2 WITH PERMANENT MARKER BEFORE INSTALLING. The assemblies are identical and are ordered with the same part number, they must be marked prior to installation.
- Tilt the pneumatics box to reattach all cables then carefully position onto the electronics box.
- Hold the analog PCB cable connector at the edge of the Pneumatic Box assembly to allow easy reinstallation into main PCB connector (J3 on main PCB).
- Take care to arrange all tubing so that it isn't kinked or pinched during the reassembly.
- Visually align the pneumatic and electronic box assemblies before reinstalling hardware.

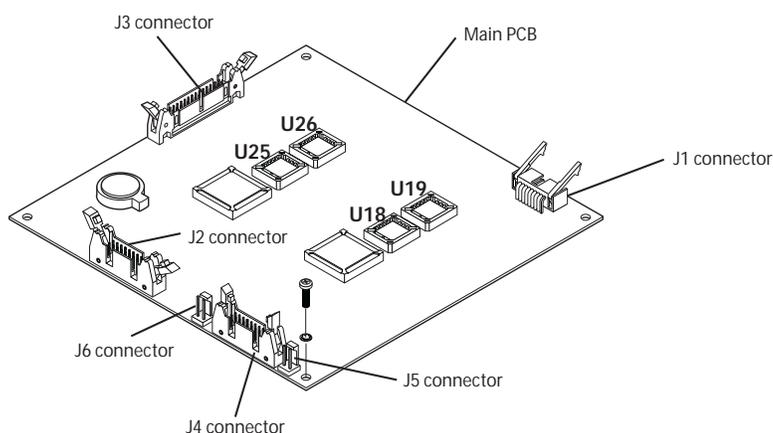


Figure 4-8 Main PCB Connections

COMPONENT REMOVAL AND REPLACEMENT

Water Trap, Expiratory Block & Exhalation Flow Sensor Housing

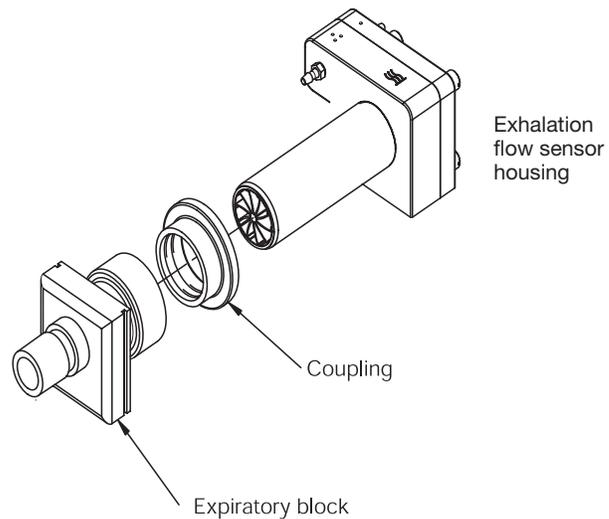


Figure 4-9. Removal of the Expiratory Block and Exhalation Flow Sensor Housing

Expiratory Block

Open the Top Cover (Figure 4-2) and remove the Exhalation Module (Figure 4-5).

The expiratory block press-fits onto the coupling and exhalation flow sensor housing. Refer to Figure 4-9 as you pull the expiratory block from the exhalation flow sensor housing.

Exhalation Flow Sensor Housing and Flow Sensor Screen

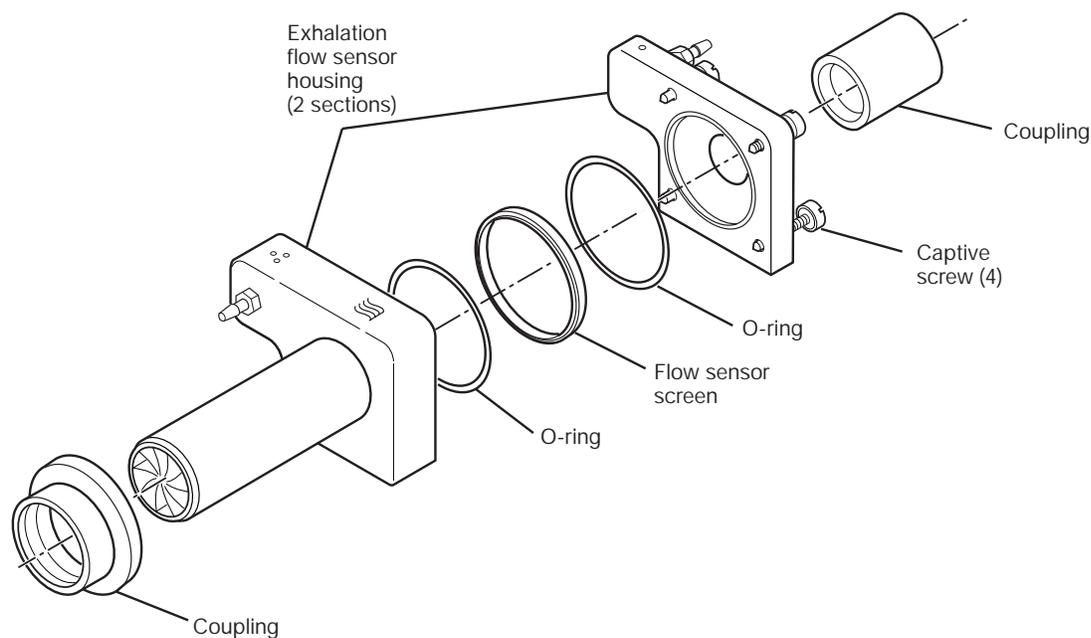


Figure 4-10. Removal of the Exhalation Flow Sensor Screen

Open the Top Cover (Figure 4-2) and remove the Exhalation Module (Figure 4-5). Remove the expiratory block (Figure 4-9).

The Exhalation Flow Sensor Housing press-fits into the couplings on either side (refer to Figure 4-10). To disassemble the Exhalation Flow Sensor Housing, loosen the captive screws to separate the housing sections and the Flow Sensor screen and O-rings.

NOTE: Once both o-rings are correctly fitted into the screen, one on each side, the flow sensor screen can be installed facing either direction. It is not directionally dependent.

NOTE: The flow sensor screen assembly is a precision instrument and must be handled carefully. The metal disc screen is very fragile and may break if handled carelessly.

COMPONENT REMOVAL AND REPLACEMENT

Exhalation Valve

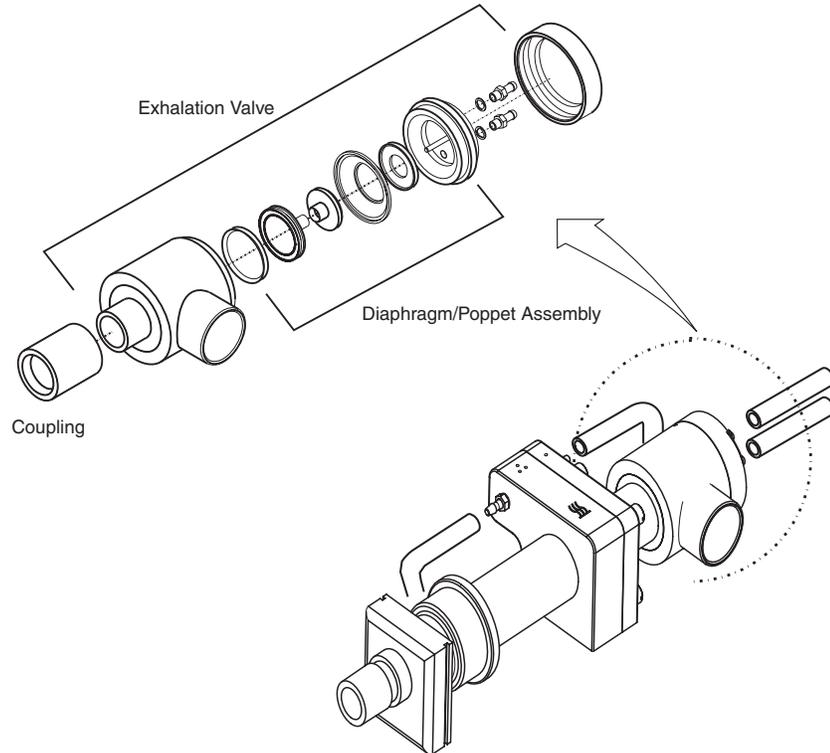


Figure 4-11 The Exhalation Valve

Open the Top Cover (Figure 4-2) and remove the Exhalation Module (Figure 4-5).

The exhalation valve assembly press-fits into the coupling at its inlet behind the exhalation flow sensor housing (refer to Figure 4-11).

Refer to Section 2, Preventive Maintenance, for details regarding Exhalation Valve Diaphragm/Poppet Assembly, removal/replacement.

Heater Assembly

Remove the Top Cover (Figure 4-2) and remove the Exhalation Module (Figure 4-5). It is not necessary to disassemble the Exhalation Module. Remove the Flow Sensor Cover (Figure 4-6).

- 1 Remove the two screws and washers securing the mixer assembly (see Figure 4-12).

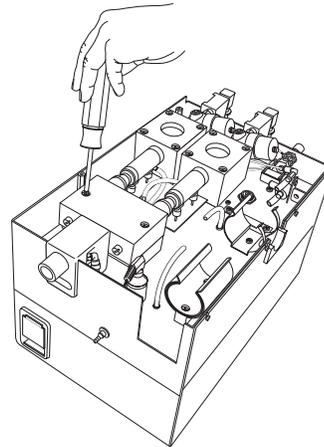


Figure 4-12

- 2 Carefully slide the mixer/manifold assembly forward to disengage the flow sensors from the mixer (see Figure 4-13).

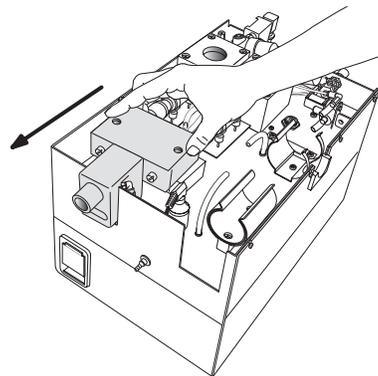


Figure 4-13

- 3 Lift the mixer/manifold assembly and release the compression fittings attaching the two tubes to the manifold (one on the side and one underneath). Set the assembly to one side (see figure 4-14).

COMPONENT REMOVAL AND REPLACEMENT

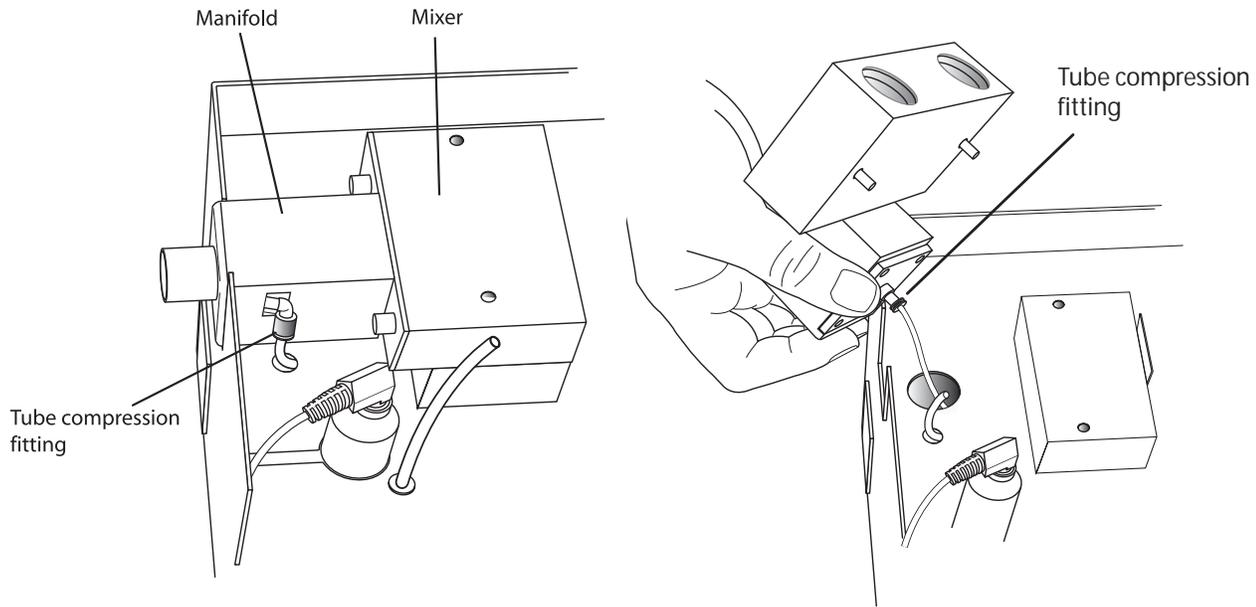
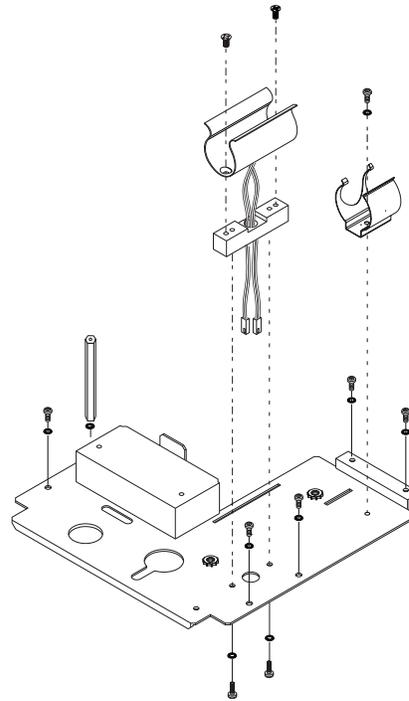


Figure 4-14 Detach manifold tubes

- 4 Remove the two screws attaching the heater assembly and the 5 screws and standoff securing the pneumatics panel (see Figure 4-15).

**Figure 4-15**

- 6** Gently pull the air and oxygen flow sensors straight out from the servo valves then carefully position them away from the pneumatics panel. It is not necessary to disconnect the flow sensor cables.
- 7** Lift out the heater assembly and the pneumatic panel together, exposing two quick release heater cable connectors.
- 8** Release the connectors and carefully pull the cables through the slot in the pneumatics panel to remove the heater assembly.

NOTE: Older units have only one heater cable and connector.

COMPONENT REMOVAL AND REPLACEMENT

Jet Pump and Exhalation Solenoid

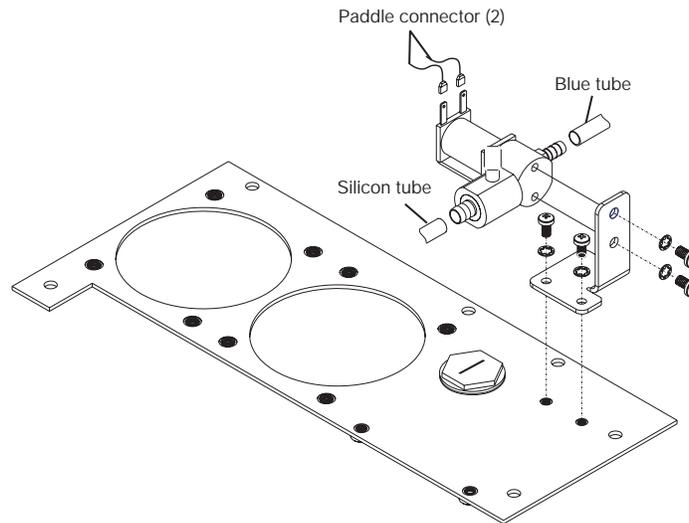


Figure 4-16 Removal of the Jet Pump and Exhalation Solenoid

Open the Top Cover (Figure 4-2) and remove the Exhalation Module (Figure 4-5) and the Flow Sensor Cover (Figure 4-6).

Refer to Figure 4-16 and follow these steps.

- 1** Remove the tubes from the jet pump.
- 2** Remove the two pan-head screws and washers securing the jet pump and exhalation solenoid to the mounting bracket. Remove the jet pump/exhalation solenoid assembly.
- 3** Remove the two screws and washers securing the Exhalation Solenoid to the jet pump.
- 4** Carefully pull the Exhalation Solenoid cable connectors from the Exhalation Solenoid.

Air and Oxygen Water Trap Assemblies

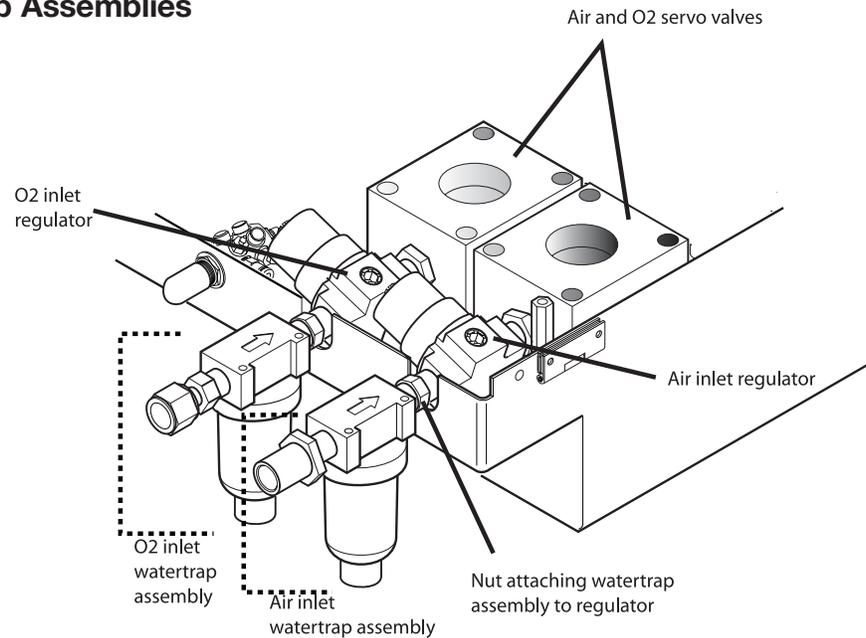


Figure 4-17 Removal of the Air and Oxygen Water Trap Assemblies

Open the Top Cover (Figure 4-2) and remove the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6).

Refer to Figure 4-17 as you follow these steps.

- 1** Use two adjustable wrenches: one to hold the water trap assembly, and the other to loosen the nut that fastens it to the inlet regulator.
- 2** After loosening the nuts, detach the air and oxygen water trap assemblies from the air and oxygen inlet regulators.

NOTE: Use an oxygen-safe thread sealant on the threads when reinstalling the water trap assemblies. Do not over-tighten.

COMPONENT REMOVAL AND REPLACEMENT

Air and Oxygen Inlet Regulators

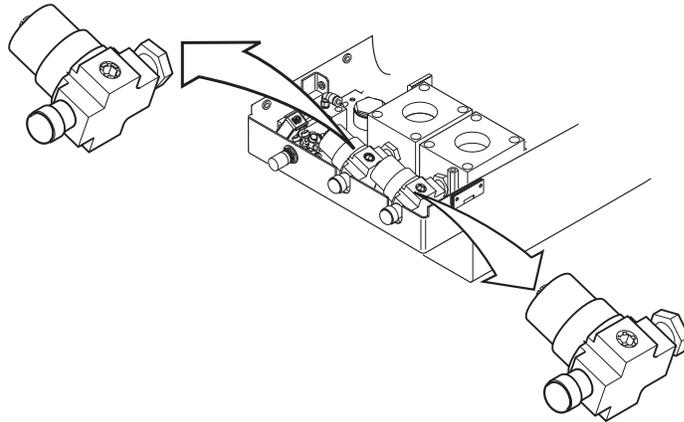


Figure 4-18 Removal of the Air and Oxygen Inlet Regulators

Open the Top Cover (Figure 4-2) and remove the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6). and Air and Oxygen Water Trap Assemblies (Figure 4-17).

- 1** Loosen the two screws holding the mixing chamber/inspiratory manifold assembly (Figure 4-12) and slide it forward to disengage the flow sensors from the mixing chamber (Figure 4-13).
- 2** Carefully pull out each of the flow sensors from the servo valves. Set the flow sensors to one side, it is not necessary to disconnect the flow sensor cables.
- 3** Loosen the four screws holding down each of the servo valves to allow them to be lifted.
- 4** Use an adjustable wrench to loosen the nuts that attach the regulators to the servo valves (see Figure 4-18). Detach and lift out the regulators.

NOTE: Use an oxygen-safe thread sealant on the filter threads when reinstalling the regulators.

Following a regulator replacement, ALWAYS perform an inlet regulator flow adjustment and Servo Valve Calibration (see Section 5, Calibration Procedures).

Inspiratory Manifold

Open the Top Cover (Figure 4-2) and remove the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6).

- 1 Disengage the tube compression fitting from the side of the manifold.
- 2 Refer to Figure 4-19 and remove the two thumbscrews and washers that hold the manifold to the mixing chamber.
- 3 Lift the manifold and depress the tube compression fitting to remove the tube connected underneath the manifold (Figure 4-20). Remove the manifold.

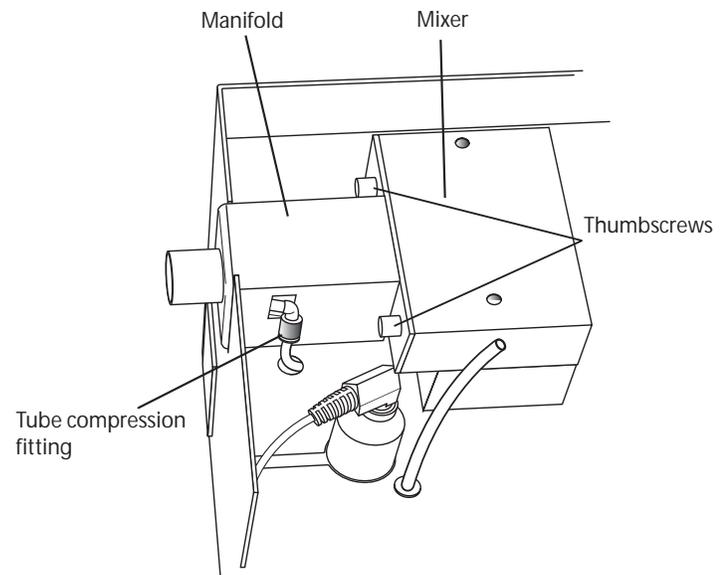


Figure 4-19

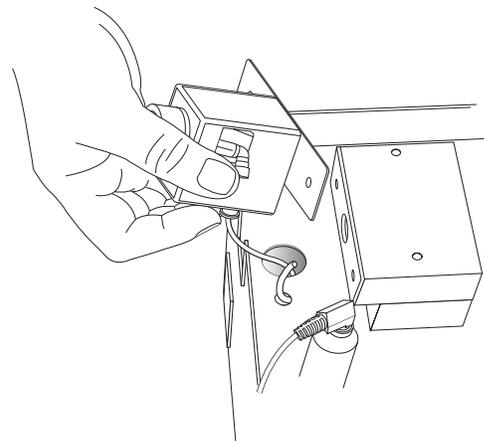


Figure 4-20

COMPONENT REMOVAL AND REPLACEMENT

Emergency Intake/Relief Valve Components

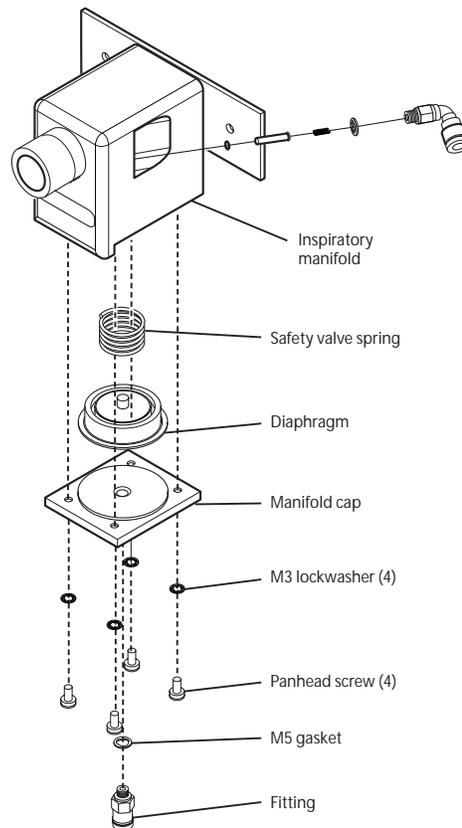


Figure 4-21. Removal of the Emergency Intake/Relief Valve Components

Open the Top Cover (Figure 4-2) and remove the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6). Remove the Inspiratory Manifold (see Figures 4-19 and 4-20 and associated text).

Refer to Figure 4-21 as you follow these steps.

- 1 Remove the four screws and washers at bottom of the inspiratory manifold.
- 2 Remove the cap, diaphragm, and spring.

Mixing Chamber

Remove the Top Cover (Figure 4-2) and the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6)

- 1 Remove the two screws and washers securing the mixing chamber (Figure 4-22).

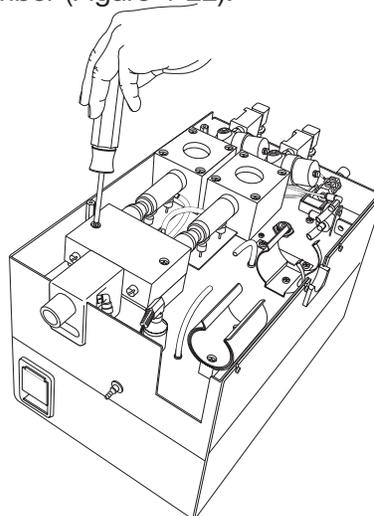


Figure 4-22

- 2 Slide the mixing chamber forward until the flow sensors disengage (Figure 4-23). Lift the mixing chamber/manifold assembly away from the flow sensors.

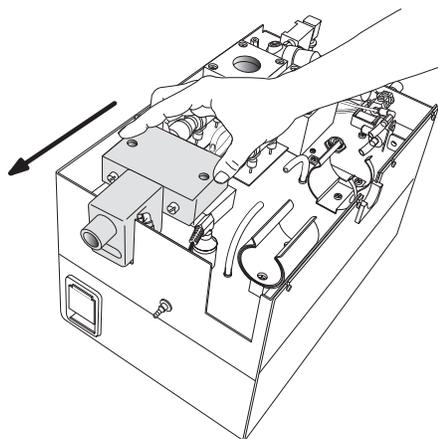


Figure 4-23

- 3 Release the compression fittings and detach the two tubes from the manifold.

COMPONENT REMOVAL AND REPLACEMENT

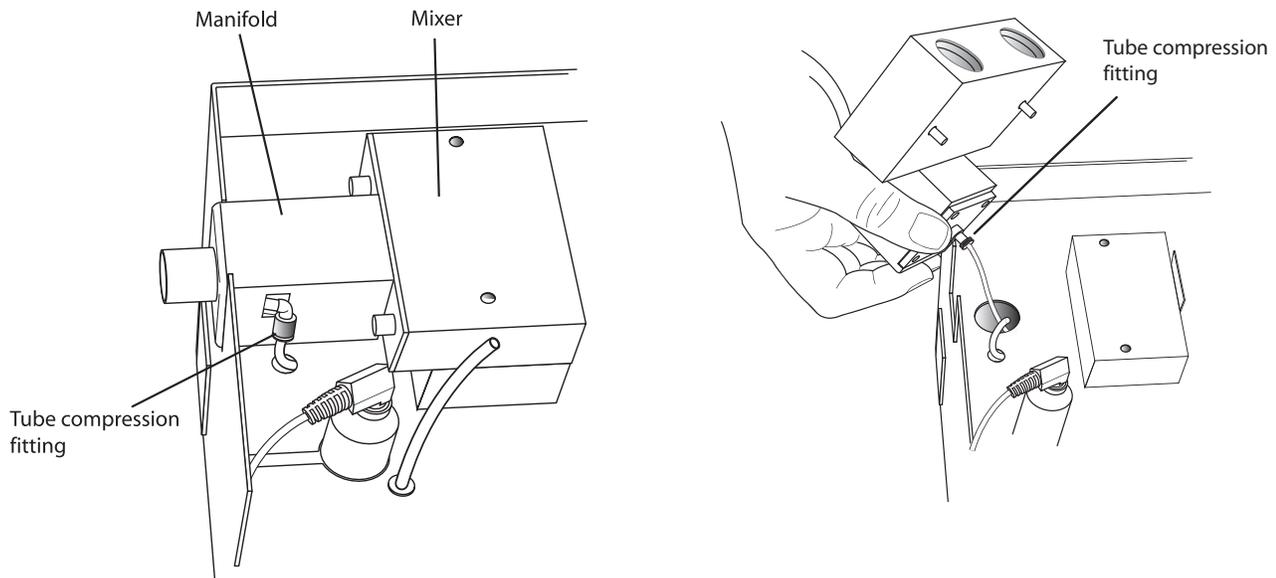


Figure 4-24

- 4 Loosen the two thumbscrews (see Figure 4-25) and detach the mixer from the manifold

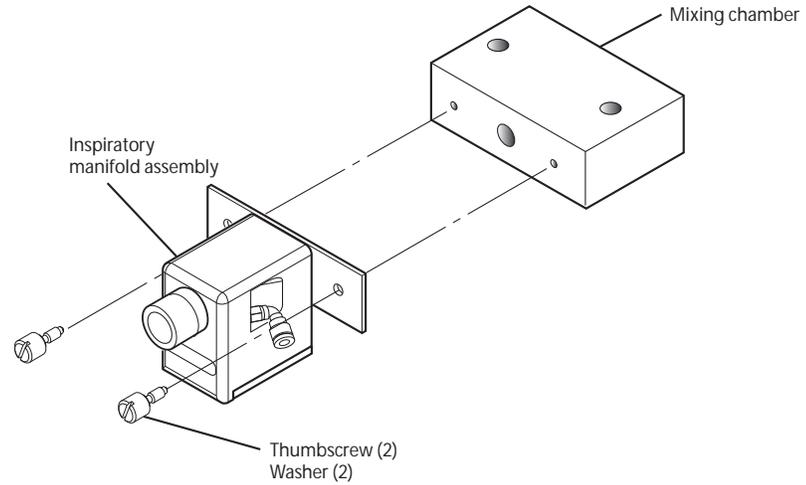


Figure 4-25

Air and Oxygen Flow Sensors

Open the Top Cover (Figure 4-2) and remove the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6).

- 1 Remove the 2 screws and washers securing the manifold/mixer assembly.

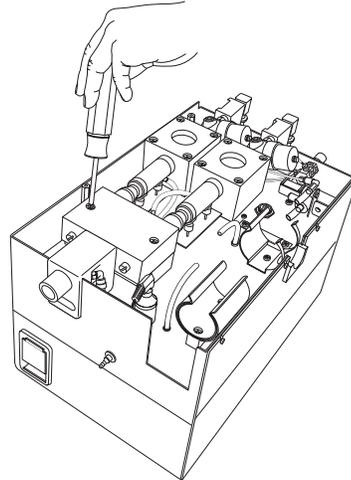


Figure 4-26 Release mixer assembly

- 2 Slide the manifold/mixer assembly forward to disengage the flow sensors.

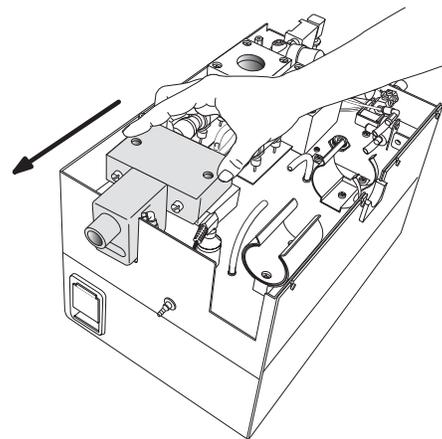


Figure 4-27 Slide mixer forward

- 3 Gently pull each flow sensor straight out from the servo valve, (the flow sensor push-fits into the servo valve port).

Caution Do not twist or pull the flow sensors to one side when disengaging. Damage to the flow sensors could result.

COMPONENT REMOVAL AND REPLACEMENT

- 4 Disconnect the flow sensor cable from its 10 pin connector at the underside of the flow sensor PCB and lift out the flow sensor.

NOTE: When reinstalling flow sensors, note whether the sensor is labeled for air or oxygen and be sure to install in the appropriate position.

Air and Oxygen Servo Valves

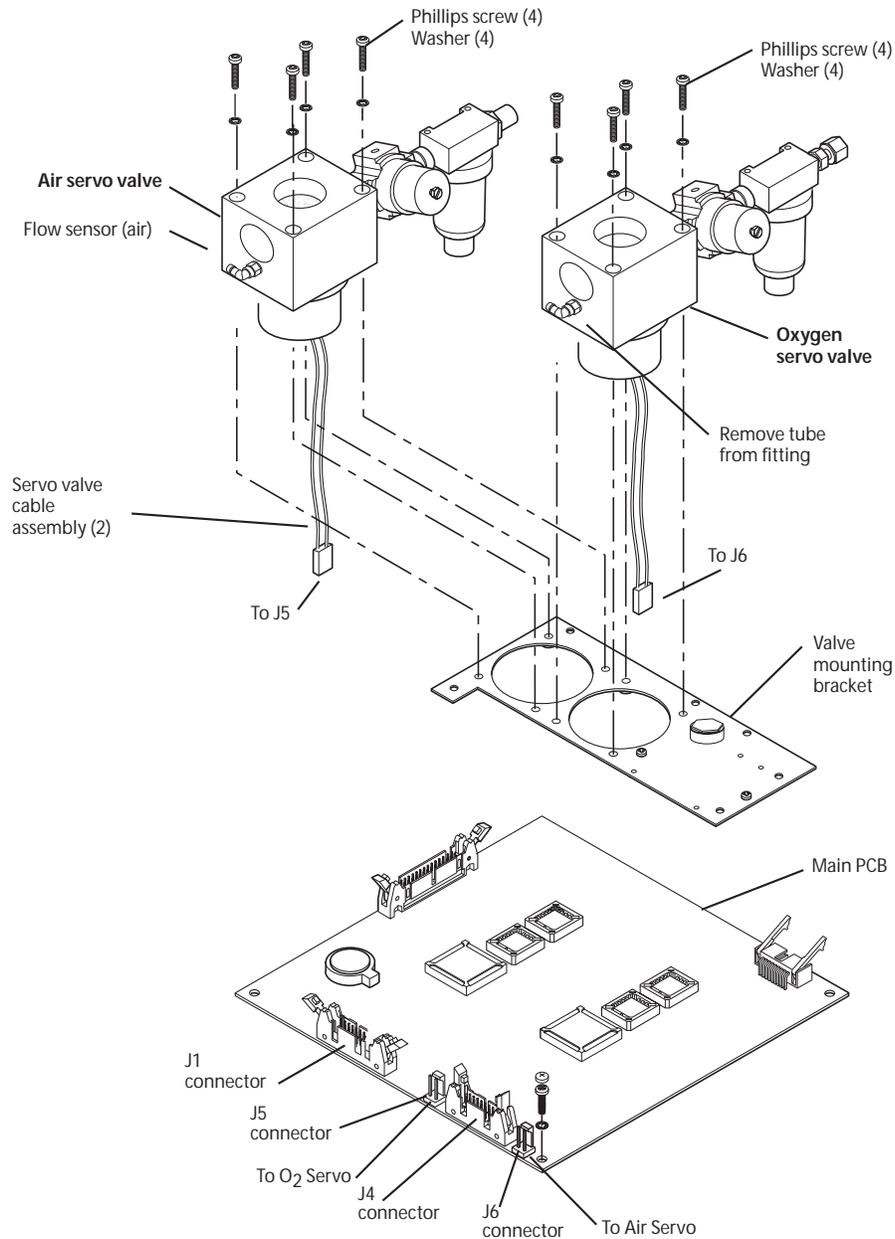


Figure 4-28

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), the Exhalation Module and Flow Sensor Cover (Figures 4-5 and 4-6).

Remove the two screws and washers from the back corners of the pneumatics (upper) box. Remove the one screw and washer from the Exhalation Manifold Support Bracket and remove the bracket. Remove the two standoffs and washers at the front corners of the pneumatics (upper) box securing it to the electronics (lower) box (see Figure 4-7). Remove the manifold/mixer assembly and the flow sensors and flow sensor cables (see Figures 4-26 and 4-27).

Refer to Figure 4-28 as you follow these steps.

- 1** Raise the Pneumatic Box to disconnect the cables from J3 through J6 on the main PCB and J5 and J6 on the DC/DC PCB. Remove the Pneumatics Box and carefully set on its side.
- 2** Remove the four screws and washers attaching the small plate and gasket on the underside of the Pneumatics Box and remove the plate. Save for re-assembly.
- 3** Remove the four screws and washers that secure each servo valve to the mounting bracket in the Pneumatic Box. Disconnect the tubing from each servo valve.
- 4** Lift servo valve/regulator/water trap assembly out of the pneumatics box.
- 5** Use a wrench to loosen the nut attaching the regulator and separate the valve from the rest of the assembly.

NOTES: When reinstalling the servo valves, arrange the tubes between the servo valves on top of each other without pinching or kinking the tubes.

Following a servo valve replacement ALWAYS perform a Servo Valve Calibration (see Section 5).

Always use a permanent marker to label the connectors of replacement servo valves as AIR or OXYGEN prior to reconnecting to the PCB.

COMPONENT REMOVAL AND REPLACEMENT

PNEUMATIC PANEL

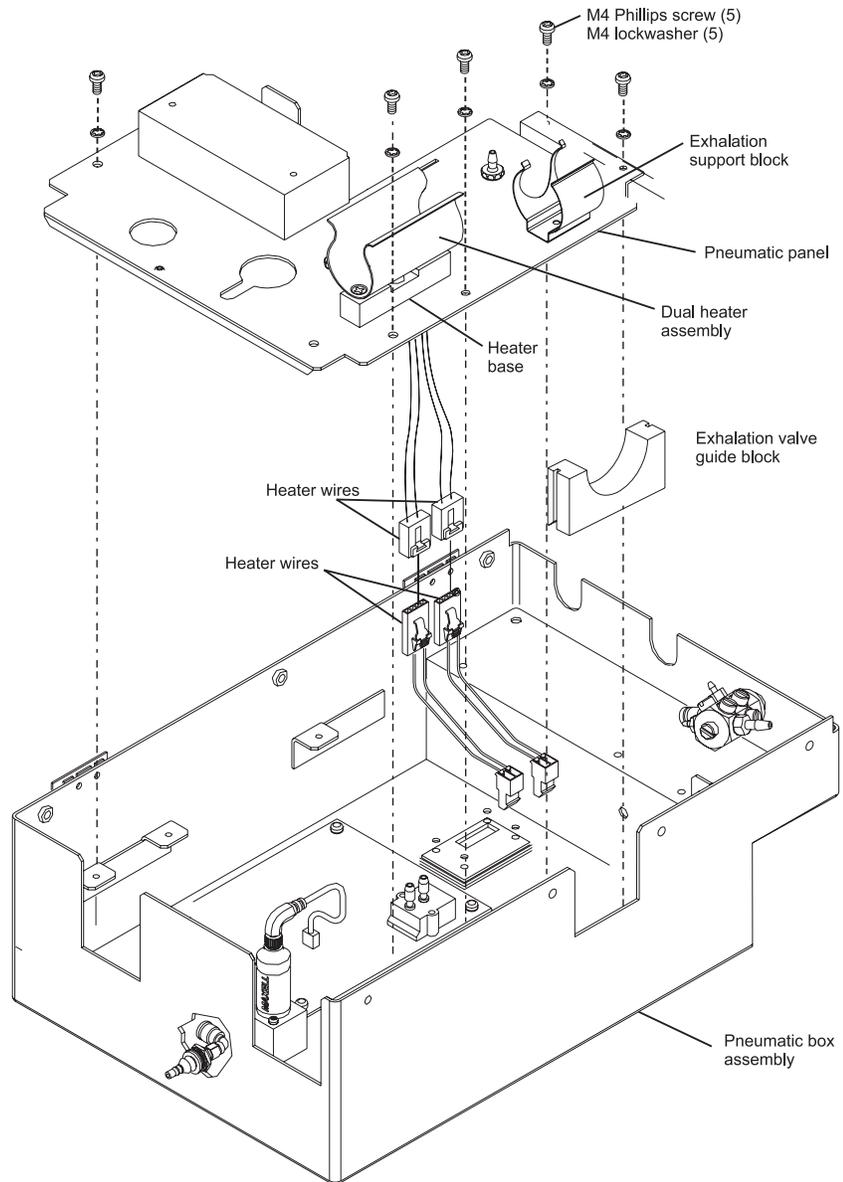


Figure 4-29 Removal of the Pneumatic Panel

Remove the Top Cover (Figure 4-2) and the Exhalation Module (Figure 4-5), Flow Sensor Cover (Figure 4-6), Inspiratory Manifold (Figure 4-19 and 4-20), Mixing Chamber (Figure 4-22 and 4-23), and Air and Oxygen Flow Sensors (Figure 4-26 and 4-27).

Refer to Figure 4-29 as you follow these steps.

- 1** Pull up on the exhalation valve guide block to remove it from the Pneumatic Box.
- 2** Remove the standoff and five screws and washers that secure the pneumatic panel to the Pneumatic Box.
- 3** Lift the pneumatic panel out of the box, and from the underside, detach all tubes and the heater wires that connect to the analog PCB.
- 4** The tubing connectors, heater assembly, heater base, and exhalation support block can also be disassembled from the pneumatic panel.

NOTES: To avoid stripping the nylon tubing connectors, loosen carefully and do not over tighten when reinstalling.

When reinstalling the pneumatic panel, align its corners with the Pneumatic Box assembly before refastening it to the box assembly.

COMPONENT REMOVAL AND REPLACEMENT

Analog PCB

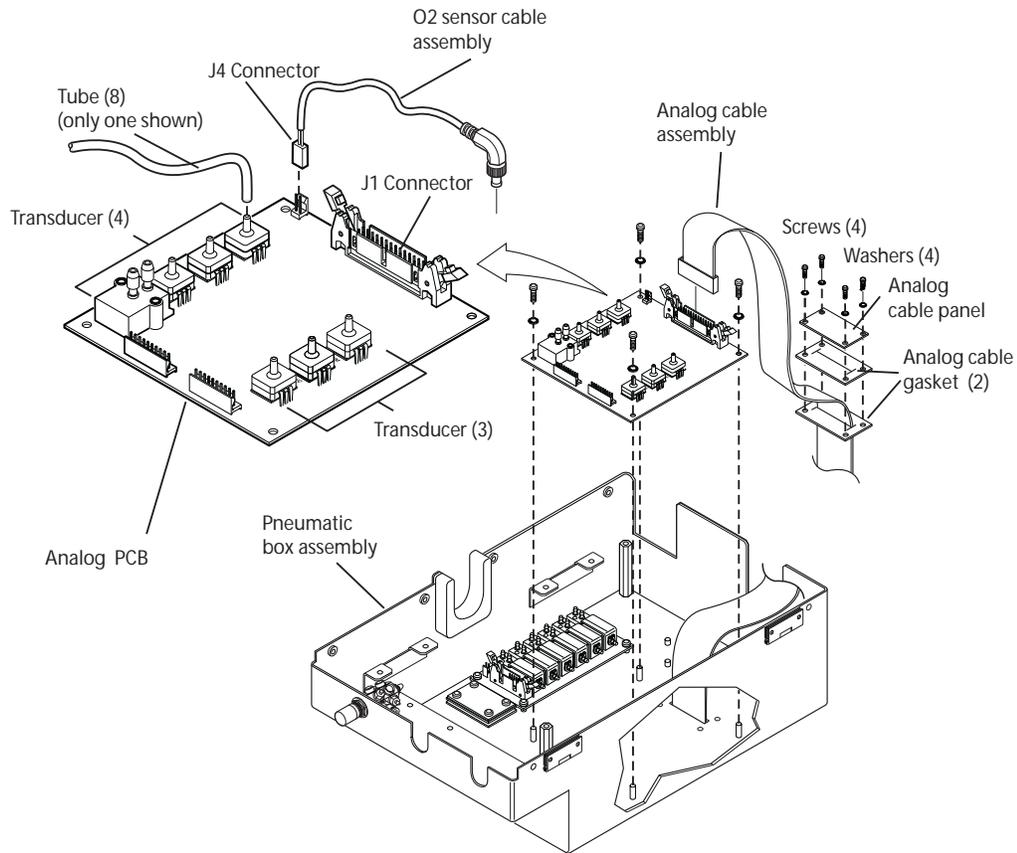


Figure 4-30 Removal of the Analog PCB

Open the Top Cover (Figure 4-2) and remove the Exhalation Module (Figure 4-5), Flow Sensor Cover (Figure 4-6), Inspiratory Manifold (Figure 4-19 and 4-20), Mixing Chamber (Figure 4-22 and 4-23), and Air and Oxygen Flow Sensors (Figure 4-26 and 4-27), and the Pneumatic Panel (Figure 4-29).

Refer to Figure 4-30 as you follow these steps.

- 1 Remove the cable from connector J1 on the analog PCB.
- 2 Carefully pull the tubes from each of the seven transducers on the analog PCB. Take note of the tubing connections for re-assembly.

Caution To avoid damaging the transducers during tube removal, gently press down on the transducer body when pulling off tube.

- 3 Disconnect the J4 connector from the analog PCB
- 4 Remove the four screws and washers that hold the analog PCB to the Pneumatic Box assembly.

- 5 Hold tubing aside and remove analog PCB from the box assembly.

NOTES: When replacing the analog PCB remove and save the flow sensor cables (J2 and J3 on the analog PCB) for reuse on the replacement PCB.

The Analog PCB P/N PCB1850A comes from the manufacturer pre-calibrated. No calibration is required.

Solenoid PCB

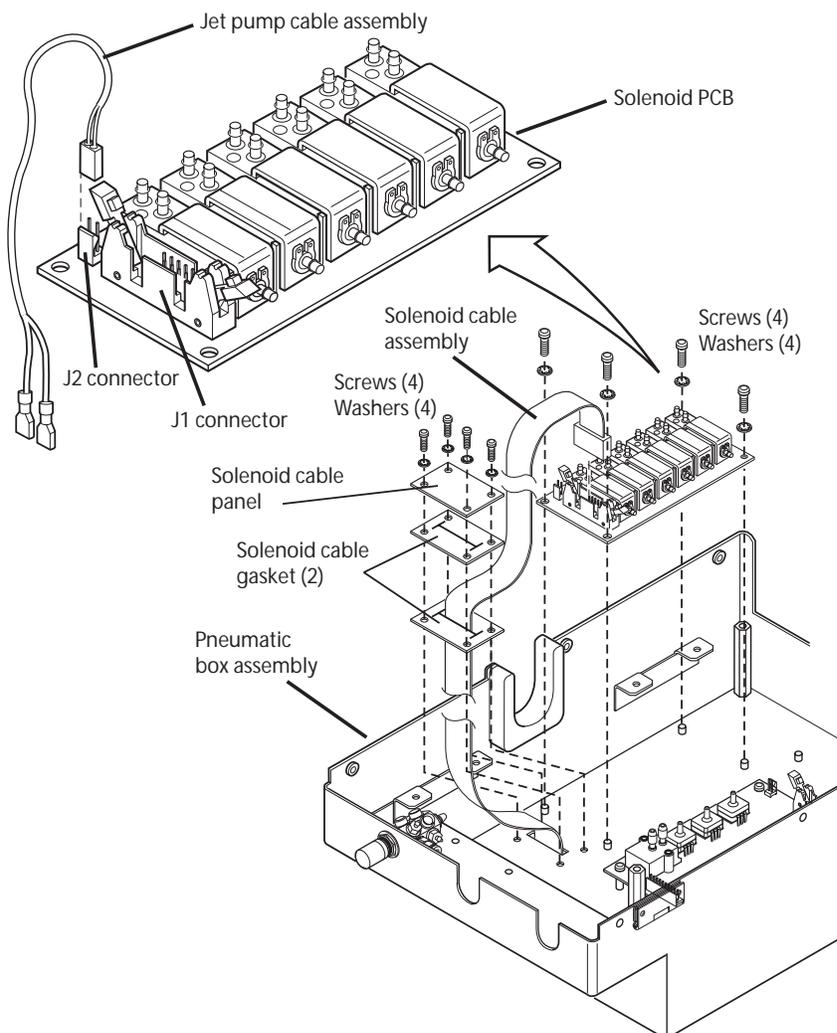


Figure 4-31 Removal of the Solenoid PCB

Remove the Top Cover (Figure 4-2) and the Exhalation Module (Figure 4-5), Flow Sensor Cover (Figure 4-6), inspiratory manifold (Figure 4-19 and 4-20), mixing chamber (Figure 4-22 and 4-23), and air and oxygen flow sensors (Figure 4-26 and 4-27), and the pneumatic panel (Figure 4-29).

COMPONENT REMOVAL AND REPLACEMENT

Refer to Figure 4-31 and follow these steps.

- 1 Carefully pull the tubes from their connections opposite the solenoid PCB (not directly from the solenoid PCB). Make note of the tubing connections for re-assembly.

Caution To avoid possible damage to the solenoid PCB and a lengthy replacement procedure, do not try to disconnect tubing from the solenoid PCB.

- 2 Remove the cables from J1 and J2 on the solenoid PCB.
- 3 Remove the four screws and washers that hold the solenoid PCB to the Pneumatic Box assembly.
- 4 Hold the tubing aside and remove the solenoid PCB from the box assembly.

Internal Battery

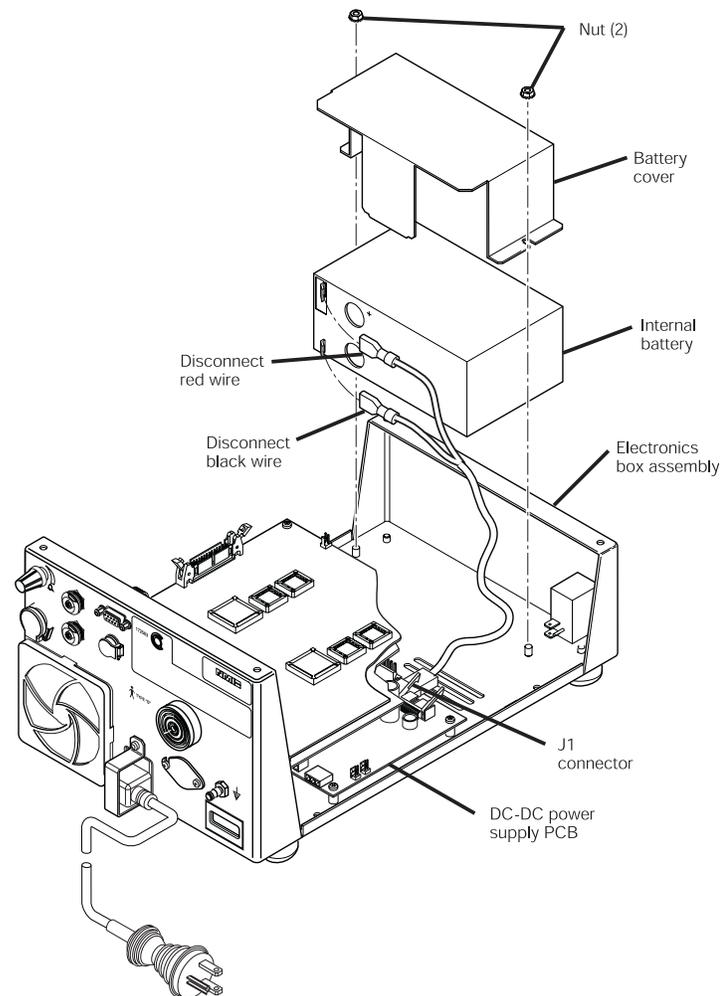


Figure 4-32. Removal of the Internal Battery

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-32 as you follow these steps.

- 1** Remove the two nuts that hold the battery cover to the electronics box assembly and remove the cover.
- 2** Disconnect the black and red wires from the battery terminals.
- 3** Pull the battery from the electronics box assembly.

Caution To avoid discharging battery voltage, do not allow any metal object (including tools) to touch battery terminals.

COMPONENT REMOVAL AND REPLACEMENT

Main PCB

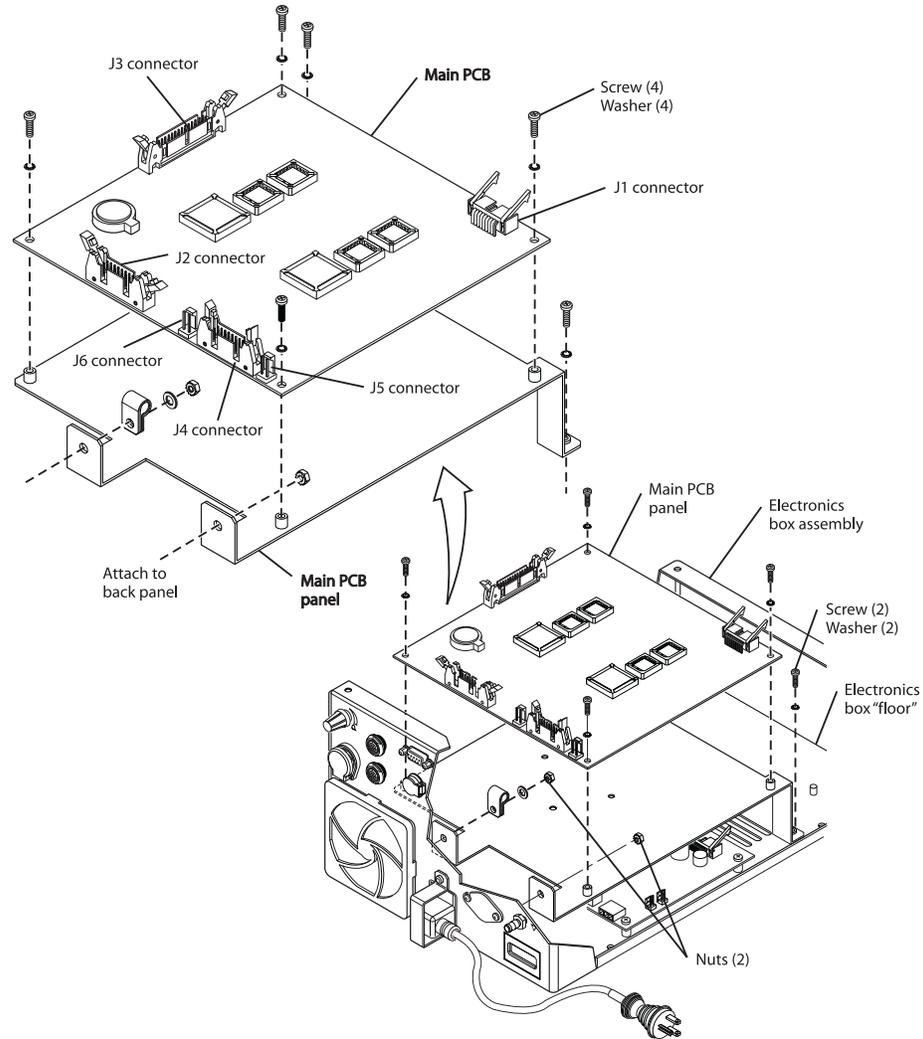


Figure 4-33 Removal of the Main PCB

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), Exhalation Manifold Support Bracket and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-33 as you follow these steps.

- 1 Disconnect cables from the J1, J2, J3, J4, J5, J6, J7 and J8 connectors on the main PCB.
- 2 To disassemble the main PCB from the main PCB panel, remove the four screws and washers that hold the PCB to the panel.
- 3 Lift the main PCB and panel from the electronics box.

DC-DC Power Supply PCB

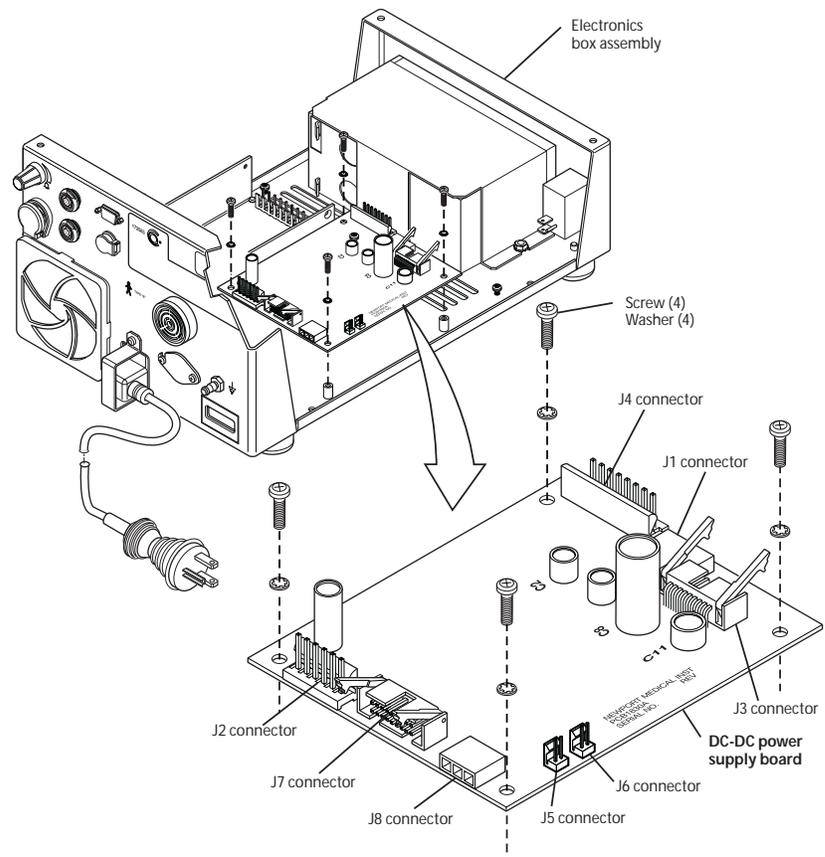


Figure 4-34 Removal of the DC-DC Power Supply PCB

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-34 as you follow these steps.

- 1** Disconnect cables from these connectors on the main PCB: J1, J2, J3, J4, J5, and J6.
- 2** Remove the two screws and washers that hold the main PCB panel to the “floor” of the electronics box assembly (see Figure 4-33).
- 3** Remove the two nuts that hold the main PCB panel to the back panel of the electronics box assembly.
- 4** Lift the main PCB and panel from the electronics box.
- 5** Disconnect cables from these connectors on the DC-DC power supply PCB: J1, J2, J3, J4, J5, J6, J7 and J8.

COMPONENT REMOVAL AND REPLACEMENT

- 6 Remove the four screws and washers that hold the DC-DC power supply PCB panel to the floor of the electronics box assembly.

Caution J2 on the DC/DC PCB is a 6 pin header. Pins 1-3 should connect to the hour meter and pins 4-6 to the fan assembly. These are separate connectors. Take appropriate precautions to avoid mis-connection on re-assembly. Reversing these connectors could result in damage to the e500.

Power Supply

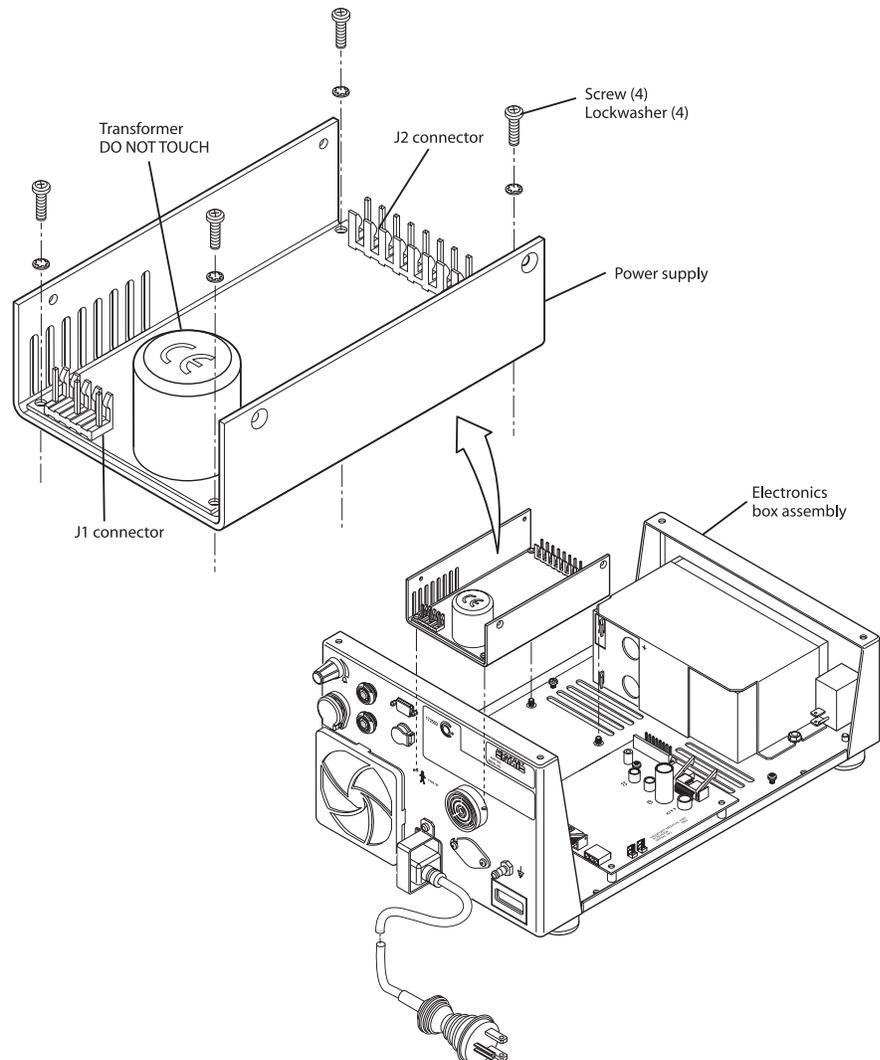


Figure 4-35 Removal of the Power Supply

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-35 as you follow these steps.

- 1 From the underside of the electronics box assembly, remove the four screws and lock washers that secure the power supply to the box assembly.
- 2 Disconnect cables from connectors J1 and J2 on the power supply.
- 3 Lift the power supply out of the electronics box assembly.

COMPONENT REMOVAL AND REPLACEMENT

WARNING To avoid personal injury DO NOT TOUCH TRANSFORMER on the power supply.

Back Panel PCB

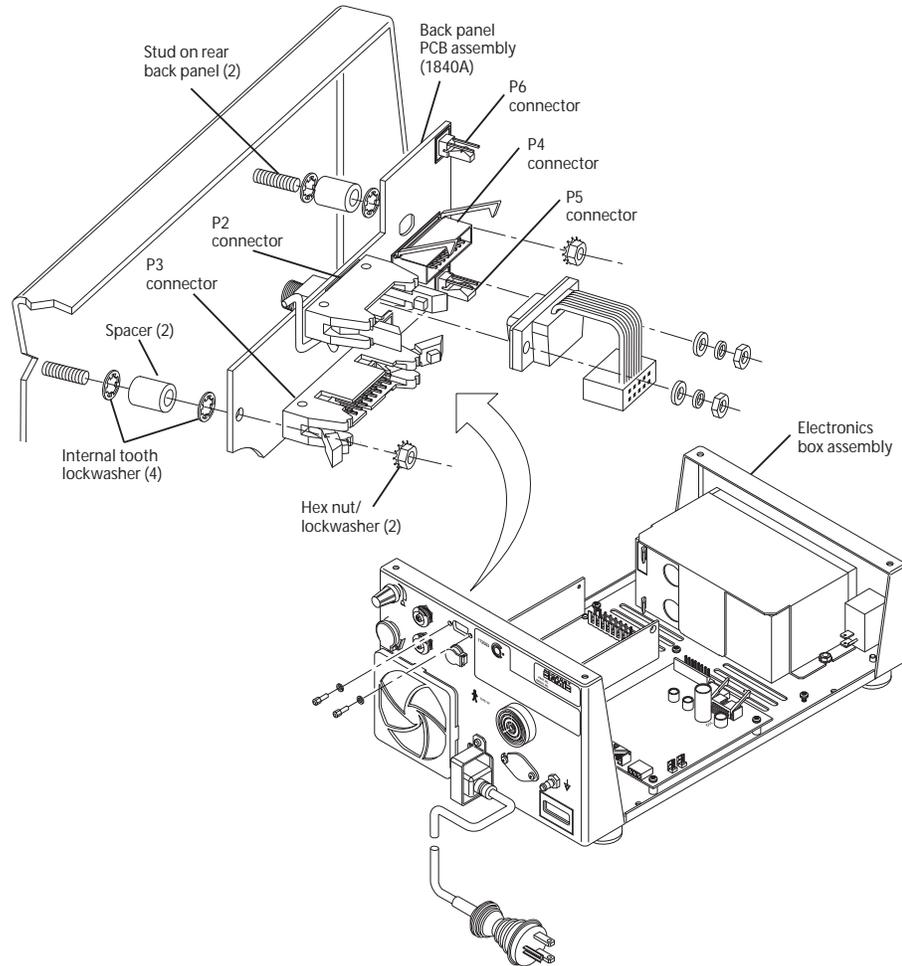


Figure 4-36 Back Panel PCB

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-36 as you follow these steps.

- 1 Disconnect cables at P2, P3, P4, P5, and P6 on the back panel PCB.

- 2 Remove the nut securing the ground wire and the screw securing the PCB to the back panel.
- 3 From the exterior of the back panel, unscrew the connector retaining nuts and gaskets securing the Graphics Display Module (GDM) connector and Control Panel Module (CPM) connector. Remove the connectors, nuts and retaining rings and save for re-assembly.

NOTE: When re-assembling these connectors, the grey gasket should be installed on the upper of the two connectors for connection to the GDM. The black gasket attaches to the lower connector for the CPM.

- 4 From the exterior of the back panel, unscrew the retaining nut and washer securing the external alarm silence connector. Remove and save the connector and hardware.
- 5 Lift the back panel PCB from the electronics box assembly.

COMPONENT REMOVAL AND REPLACEMENT

RS-232 Connector

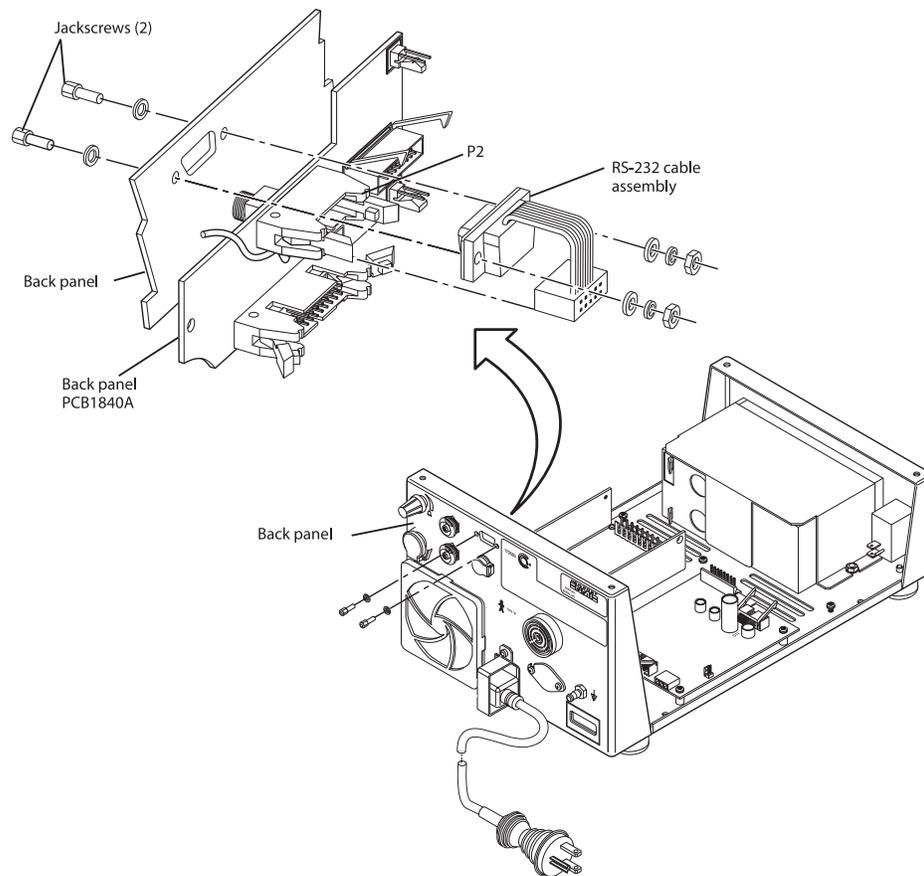


Figure 4-37 Removal of the RS-232 Connector

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-37 as you follow these steps.

- 1** Remove the two jackscrews that hold the RS-232 connector to the back panel of the electronics box assembly.
- 2** Disconnect the RS-232 cable assembly from P2 on the back panel PCB1840A.

Alarm Speaker

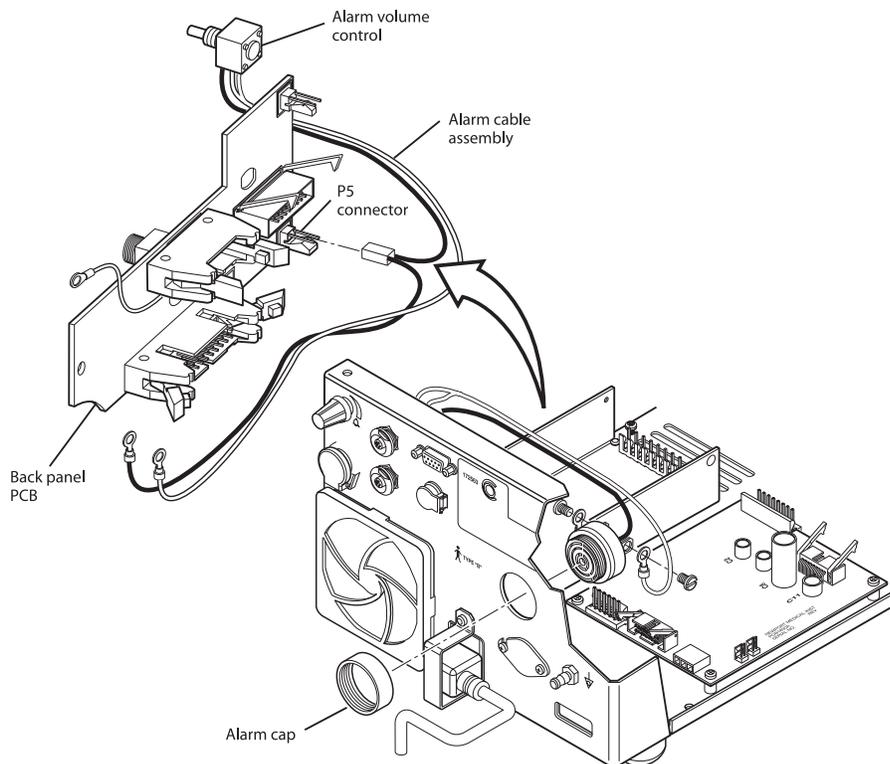


Figure 4-38 Removal of the Alarm Speaker

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

The alarm speaker is located on the back panel. Refer to Figure 4-38 as you follow these steps.

- 1** Unscrew the alarm retaining ring from the outside of the back panel; then pull the speaker from the inside of the back panel.
- 2** Disconnect the alarm cable assembly from P5 on the back panel PCB.

COMPONENT REMOVAL AND REPLACEMENT

Fan

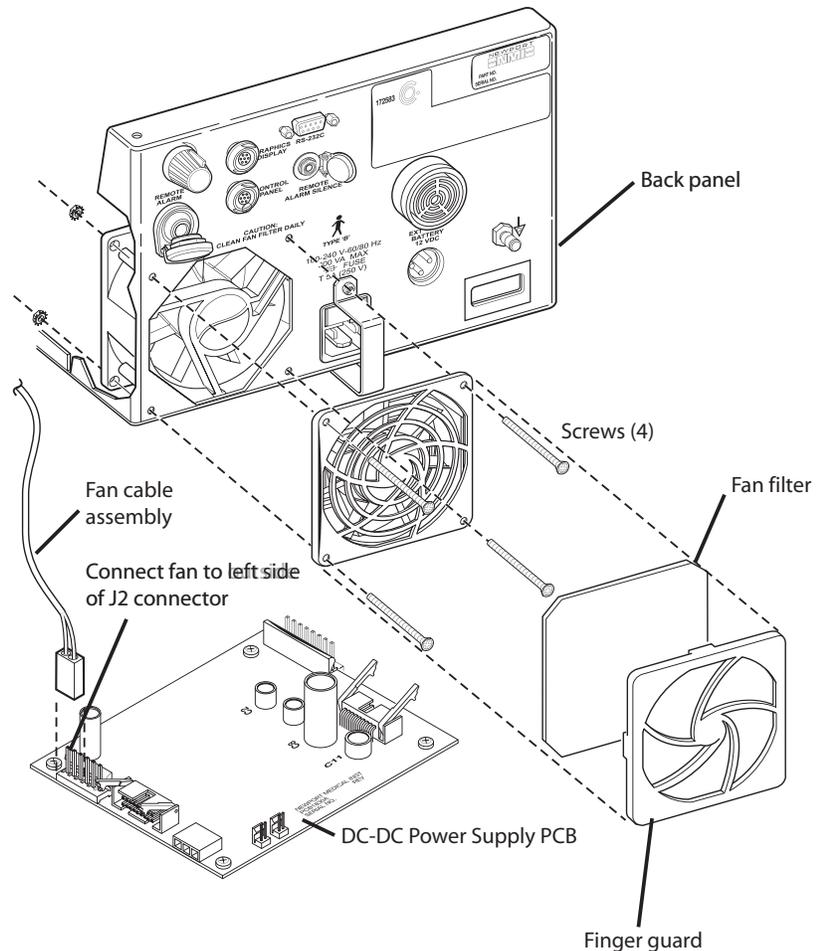


Figure 4-39 Removal of the Fan

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-39 as you follow these steps.

- 1** Pull the fan finger guard and filter from the back panel (no tools are required).
- 2** From inside the back panel, remove the four nuts that hold the fan to the back panel, then take out the long supporting screws. Retain all hardware for re-assembly.
- 3** Disconnect the fan cable assembly from J2 on the DC-DC power supply PCB (it may be convenient to use tweezers to remove the wires).

Caution Take note of correct position of fan and hour meter cable assemblies for reassembly into the J2 header on the DC-DC power supply PCB. Pins 1-3 connect the hour meter and pins 4-6 connect the fan.

To avoid cracking the fan housing, do not over-tighten screws during reinstallation.

COMPONENT REMOVAL AND REPLACEMENT

Hour Meter

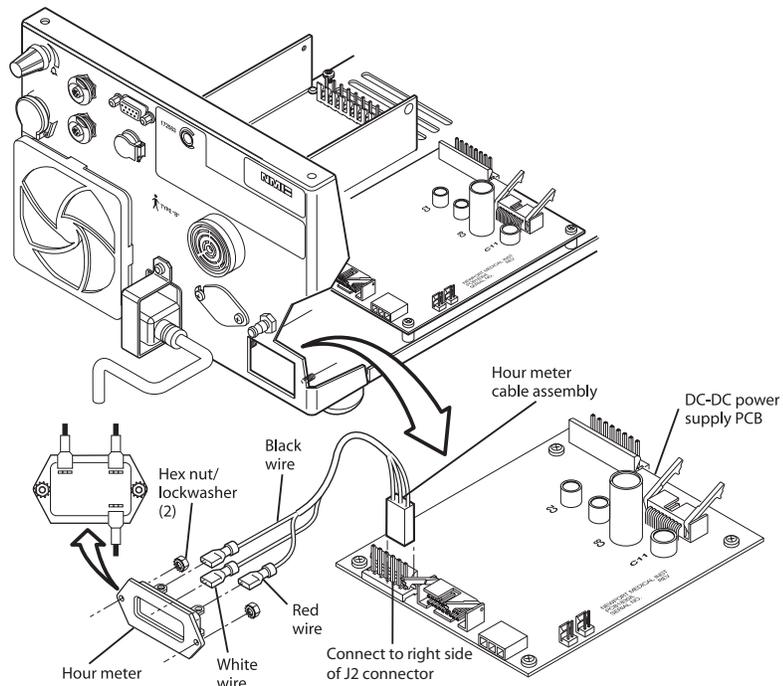


Figure 4-40 Removal of the Hour Meter

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-40 as you follow these steps.

- 1 From inside the back panel, remove the two nuts that hold the hour meter to studs on the back panel.
- 2 Disconnect hour meter cable assembly from J2 on the DC-DC power supply PCB (it may be convenient to use tweezers to remove the wires).

Caution Take note of correct position of fan and hour meter cable assemblies for reassembly into the J2 header on the DC-DC power supply PCB. Pins 1-3 connect the hour meter and pins 4-6 connect the fan.

AC Power Entry Module

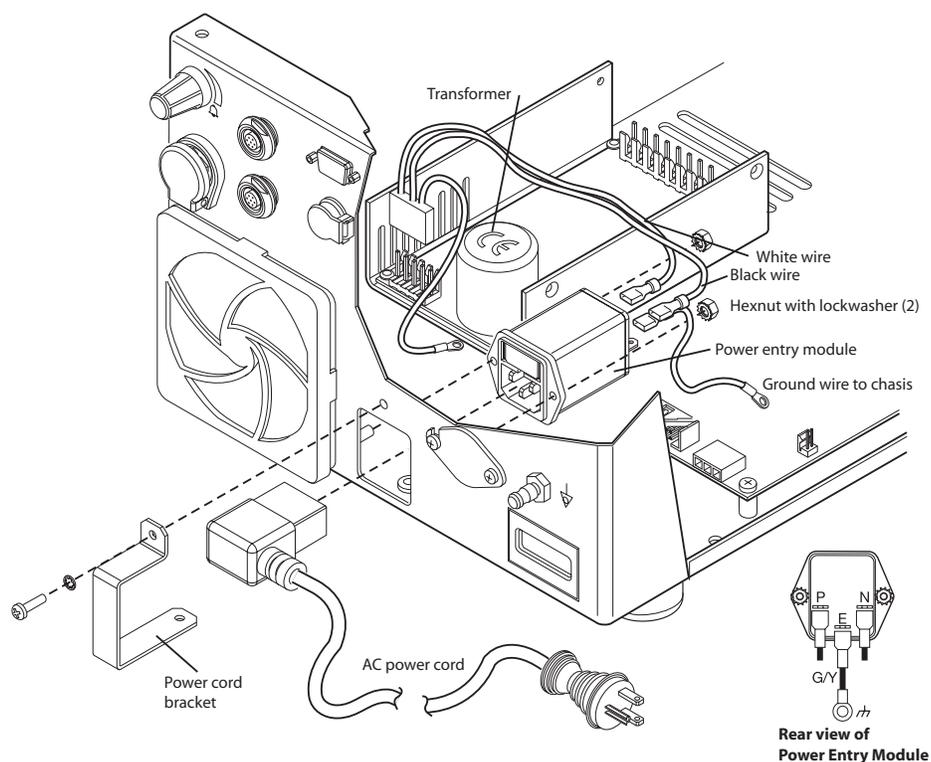


Figure 4-41 Removal of the AC power entry module

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-41 as you follow these steps.

- 1 Disconnect the 3 terminals from the power entry module.
- 2 Unscrew the screw holding the power cord safety bracket and remove bracket. Unplug and remove the AC power cord.
- 3 From inside the back panel, remove the two nuts that hold the AC power entry module to the back panel. Detach the AC power entry module.

WARNING To avoid personal injury **DO NOT TOUCH TRANSFORMER** on the power supply.

COMPONENT REMOVAL AND REPLACEMENT

External Battery Connector

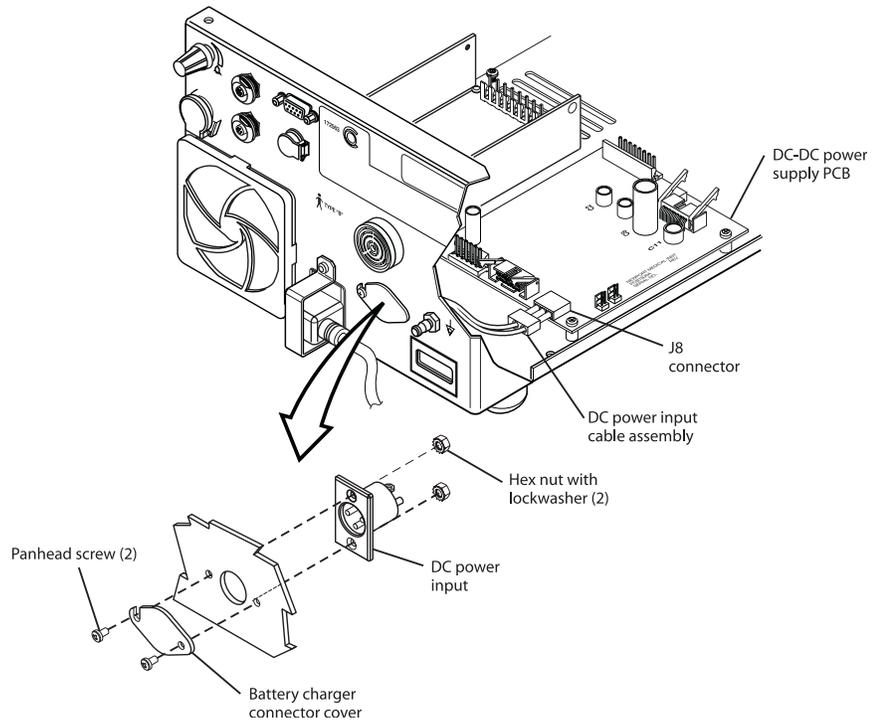


Figure 4-42 Removal of the External Battery Connector

Remove the Top Cover (Figure 4-2), the Left Side Panel (Figure 4-3), Right Side Panel (Figure 4-4), Exhalation Module (Figure 4-5), and Flow Sensor Cover (Figure 4-6). Remove the screws and standoffs securing the Pneumatic Box as previously described (Figure 4-7) and carefully lift out the Pneumatic Box.

Refer to Figure 4-42 as you follow these steps.

- 1 From inside the back panel, remove the two nuts that hold the external battery connector to the back panel.
- 2 Disconnect the DC power input cable assembly from J8 on the DC-DC power supply PCB.

Muffler Filter

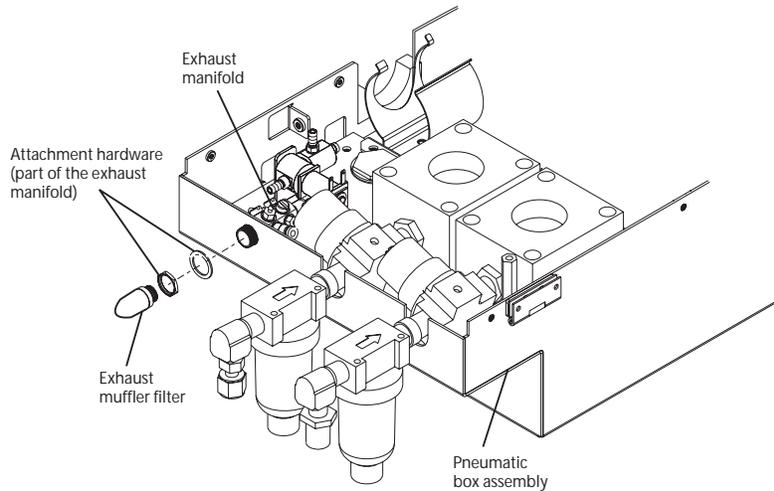


Figure 4-43 Removal of the Muffler Filter

Unscrew the muffler filter from the exhaust manifold (refer to Figure 4-43). No tools are required as the filter is installed finger tight.

Rubber Feet

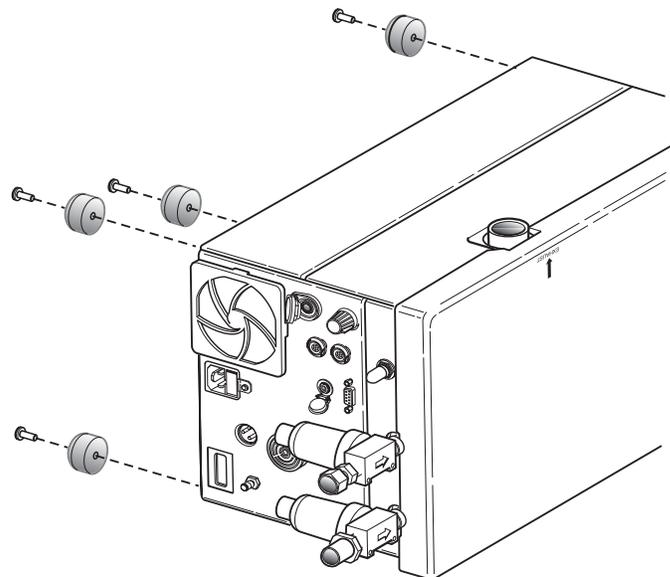


Figure 4-44 Removal of the Rubber Feet

Refer to Figure 4-44 and follow these steps.

- 1 Carefully set the GDU on its side.
- 2 Loosen the screw at the center of each foot and remove.

COMPONENT REMOVAL AND REPLACEMENT

Fuses

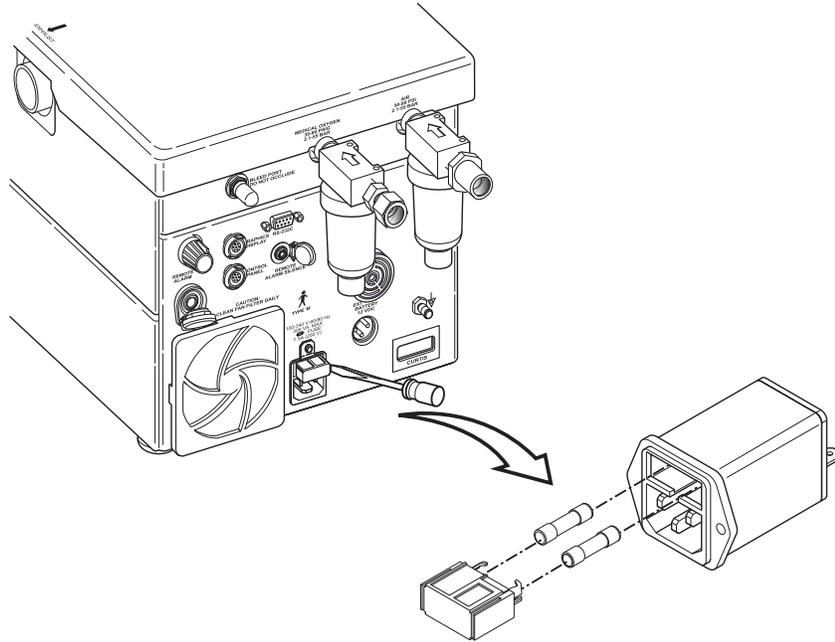


Figure 4-45 Removal of the Fuses

Refer to Figure 4-45 and follow these steps.

- 1 Unscrew the screw holding the power cord safety bracket and remove bracket. Unplug and remove the AC power cord.
- 2 To loosen the fuse drawer, use a small flathead screwdriver to squeeze the tabs on the fuse drawer.
- 3 Pull the fuse drawer from the AC power module.

NOTE: It is not necessary to remove the AC power module to remove the fuses.

- 4 Remove and replace the fuses.

WARNING To avoid fire hazard, only use a replacement fuse that is identical in type, voltage rating, and current rating to the existing fuse.

Water Collection System Attachment to e500 Cart

Figure 4-46 shows where to attach the Newport Water Collection System and a Fisher & Paykel-style humidifier to the e500 deluxe cart.

1. Using two screws provided, attach the mounting bracket to the mounting flange on the front of the cart.
2. Locate the dual mounting bar included in the Water Collection System. Position the dovetail mount on the back of dual mounting bar onto the mounting bracket at the front of the e500 cart and slide it into place.
3. Slide the water collection canister's dovetail mount onto the mounting bracket on the right side of the dual mounting bar.
4. Insert the reusable filter (FTR1800P) into the 22mm ID fitting on top of the water collection canister.
5. Install the Plunger Assembly and Water Trap cup onto the bottom of the water collection canister.
6. Connect the 12" breathing circuit tubing to the top of the filter and attach to the expiratory port on the gas delivery unit.
7. If used, slide the humidifier's dovetail mount onto the mounting bracket on the left side of the dual mounting bar.

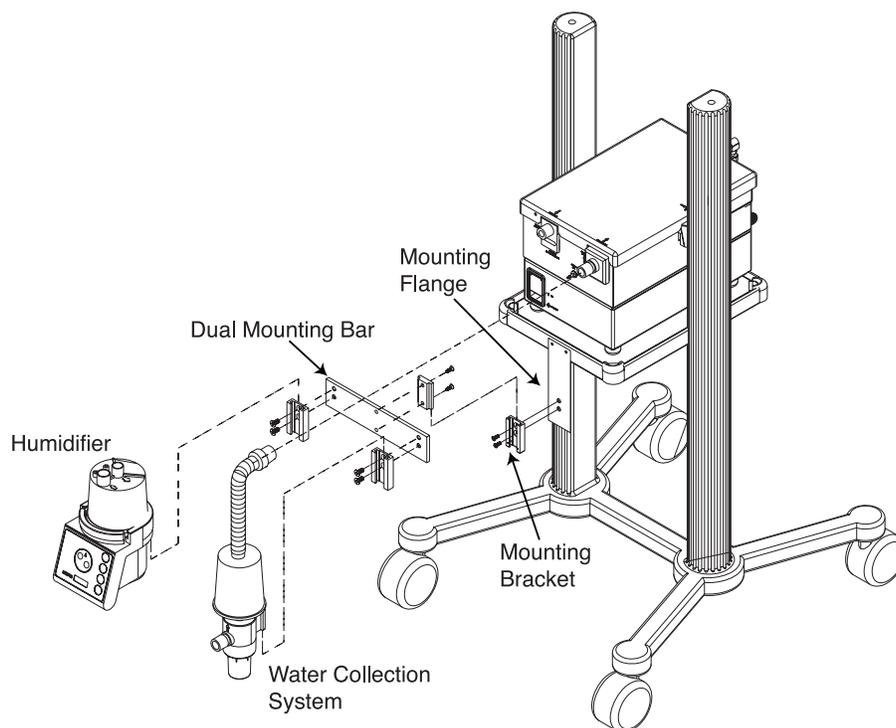


Figure 4-46 Attachment of Water collection System to Cart

COMPONENT REMOVAL AND REPLACEMENT

Disassembly of the Water Collection System

Follow these steps to remove/disassemble the Water Collection System with reusable expiratory filter.

1. Disconnect the corrugated tubing that connects the top of the filter to the expiratory port on the e500.
2. Disconnect the tubing from the filter.
3. Disconnect the filter from the water collection manifold.
4. Disconnect the water trap, and spring-loaded plunger from the water collection manifold.

Assembly of the Water Collection System

Reverse disassembly instructions listed above.

To ensure proper installation, observe the flow direction markings on the filter.

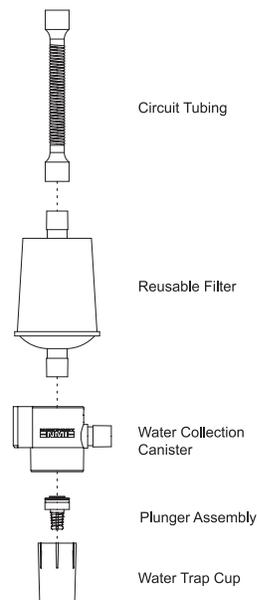


Figure 4-47 Water Collection System Components

REMOVAL OF CONTROL PANEL MODULE (CPM) PARTS

This section describes how to disassemble the replaceable components of the e500 ventilator Control Panel Module (CPM). Unless otherwise indicated, reassemble by reversing the disassembly instructions.

WARNING These instructions are intended for use only by a Newport Medical Instruments factory-trained technician. DO NOT perform any unauthorized modifications or repairs to the ventilator or its components.

Caution To avoid damaging equipment, always use standard electrostatic discharge (ESD) precautions, including an ESD wrist strap and mat, when servicing the ventilator.

Preparation

Before performing any repair or service on the e500 Ventilator CPM, do the following:

- 1 Toggle the GDU On/Standby switch to the Standby position, then disconnect gas and power supplies from the ventilator.
- 2 Disconnect the CPM interface cable from the back panel of the GDU. If installed on a cart, remove the CPM from the cart.
- 3 Carefully place the CPM face down on an anti static mat on a flat stable surface.

Tools required

- 7/16" torque driver set to 8 inch lbs of force
- Medium Philips screw driver
- Small Philips screw driver
- Anti static wrist strap and mat

COMPONENT REMOVAL AND REPLACEMENT

CPM Back Panel

- 1 Remove the 12 screws securing the back panel to the CPM.

NOTE: Retain all parts and hardware for re-assembly

- 2 Carefully separate the CPM back panel from the front panel. When you can access the connecting cables from the back panel to the CPM circuit board, disconnect them and gently lay the back panel to the side.

To re-install, reverse disassembly instructions.

Main CPM Circuit Board PCB1810A

Remove the CPM back panel as described above. Refer to Figure 4-48 and proceed as follows.

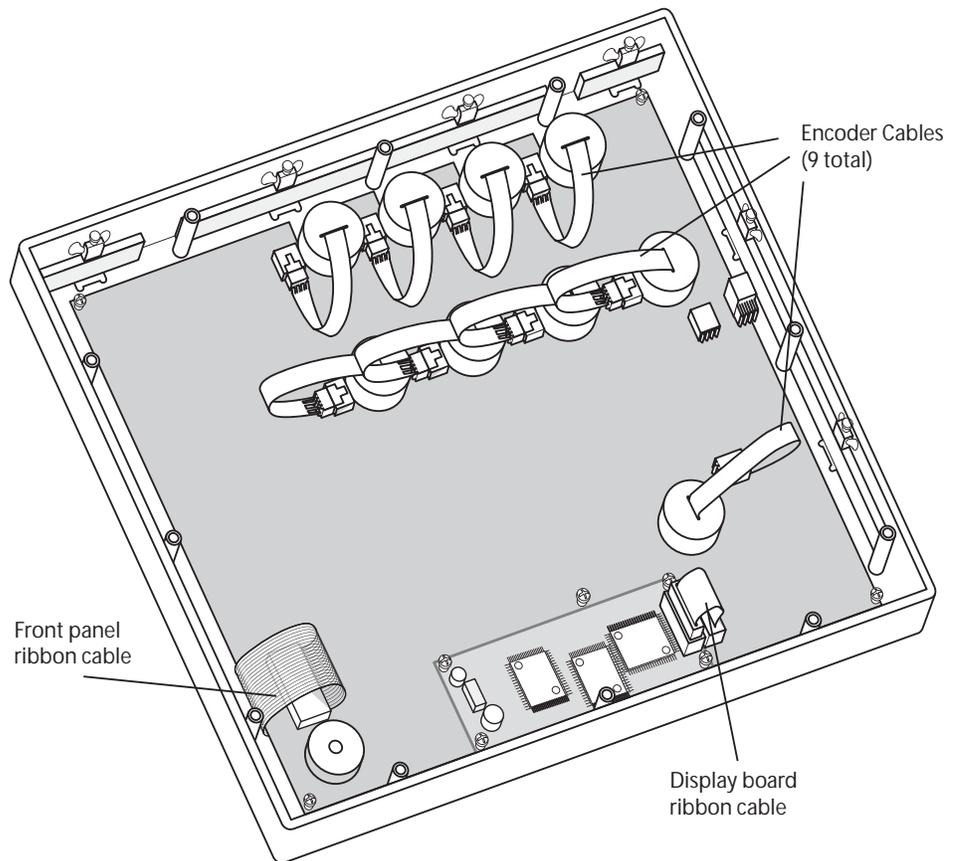


Figure 4-48 Main CPM Circuit Board

- 1 Disconnect the nine (9) cables connecting the encoders to the main CPM circuit board.
- 2 Disconnect the two ribbon cables connecting the main circuit board to the display circuit board and front cable.
- 3 Remove the 11 screws and washers securing the main circuit board to the front panel.
- 4 Carefully lift up on PCB1810A and remove.

To re-install, reverse disassembly instructions.

NOTE: After installation of PCB1810A the ROM must be initialized by powering on e500, and rotating the frequency control (*f*) knob at least 5 increments, in any direction.

Display Circuit Board

Remove the back panel. Refer to Figure 4-46 and proceed as follows.

- 1 Remove the ribbon cable connecting the main circuit board to the display circuit board.
- 2 Remove the 4 screws securing the message display circuit board to the front panel.
- 3 Carefully lift up on the message display circuit board and remove.

To re-install, reverse disassembly instructions.

Encoders

Remove the back panel and the nine (9) encoder cables then proceed as follows:

- 1 Working from the front of the CPM, detach the nine (9) control knobs from the encoders.
- 2 Using a 7/16 torque nut driver, remove the nut and washer securing the encoders to the front panel, 9 total.
- 3 Pull out the encoders from inside the CPM.

To re-install, reverse disassembly instructions.

Caution When installing the encoders, use a torque driver set to 8 inch lbs of force. If too much force is used, the encoder may become damaged.

COMPONENT REMOVAL AND REPLACEMENT

Front Panel

When replacing the front panel, remove the back panel, the main CPM circuit board, the display PCB and the encoders. To remove the front panel and reinstall the same panel, only the first 2 procedures need to be completed.

- 1** Remove the 10 screws and washers securing the brass wedges to the CPM. Remove the brass wedges.
- 2** Carefully lift the front panel and remove.

To reinstall reverse disassembly instructions.

5. Calibration Procedures

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CALIBRATION PROCEDURES

This section describes how to use the e500 Ventilator's diagnostic mode to calibrate the ventilator. The diagnostic mode can also be used for troubleshooting (see Section 3 for more information on troubleshooting).

The following procedures are included in this section:

- Air and O₂ Inlet Regulator adjustment
- Air/oxygen Servo Valve Calibration
- Patient Circuit Leak Test
- Exhalation Valve Calibration
- Pilot Pressure Transducer Accuracy and Maximum Pressure.
- Proximal Pressure Transducer Accuracy Test.
- Calibrating the Pressure Relief Regulator
- Insp/Exp Flow Sensor Accuracy Test
- Calibrating the Analog PCB

Calibration Equipment

To calibrate the e500 you will need:

- A Newport reusable breathing circuit (P/N PBC345A) or equivalent.
- A cap to plug the end of the breathing circuit (p/n CAP100P or equivalent)
- Clean, regulated medical air and oxygen supplies at 50 psi.

NOTE: To perform the calibration procedures correctly, the gas supply pressure must be regulated to 50 psig.

- A Certified TSI calibration analyzer or equivalent (acceptable substitute equipment would be a pressure meter with a full scale of less than 250 cmH₂O and an accuracy of +/- 2 cmH₂O of reading).
- A certified calibrated Multimeter (Voltmeter).

Caution The accuracy of all test equipment (electronic or pneumatic) used for verification or calibration procedures should be certified annually by a testing laboratory before use.

CALIBRATION PROCEDURES

SETUP

Connect the e500 to an AC power source. Connect both air and oxygen supply gas sources to the e500, verify supply gas sources are at 50 psig. Attach the water collection system and adult patient circuit.

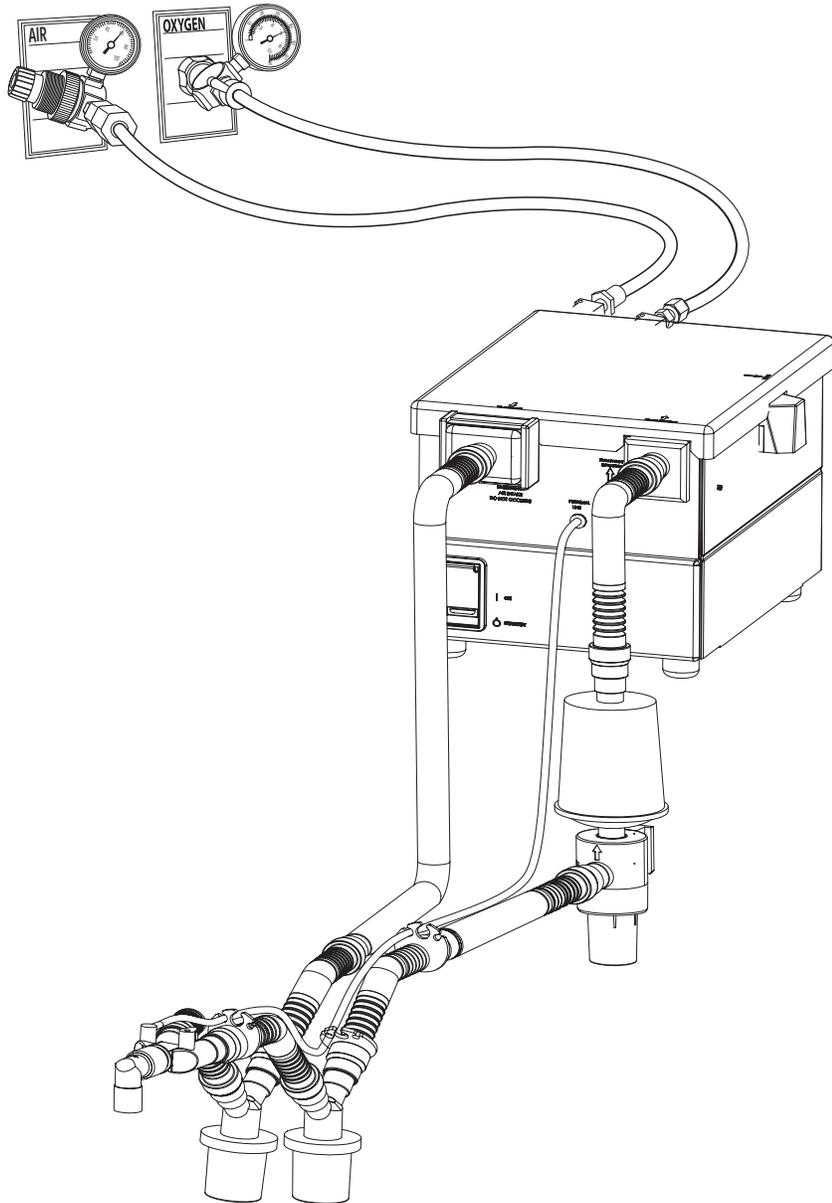


Figure 5-1 e500 with patient circuit attached

DIAGNOSTIC MODE

The e500 diagnostic mode enables you to perform Servo Valve Calibration, Exhalation Valve Calibration, Patient Circuit Leak Test, and Regulator Calibration.

Entering diagnostic mode

Most of the calibrations on the e500 are performed from within the Diagnostic Mode.

To enter diagnostic mode, press and hold the small button located on the rear of the e500 Control Panel (see Figure 5-2) while powering on the e500. When power-up is complete, release the button.

Begin diagnostics by choosing the test or calibration to perform as follows.

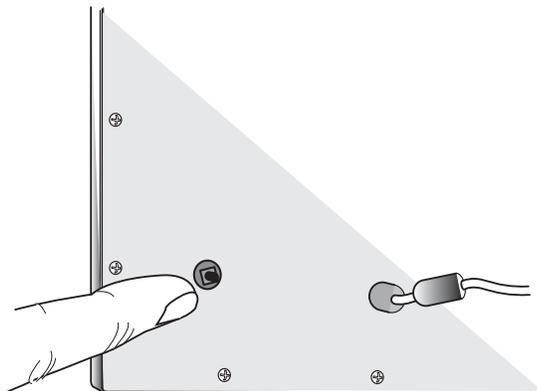


Figure 5-2 The Diagnostic mode button on the rear of the Control Panel

AIR AND OXYGEN INLET REGULATOR ADJUSTMENT (d3)

Performing Air/Oxygen inlet regulator adjustment from diagnostic mode d3 allows the technician to see the Air and Oxygen inlet regulator pressures to determine whether or not they are within specification. Both inlet regulator pressures must be set to 15.5 ± 0.3 psig with 3 L/min of flow passing through the regulator to perform the following e500 calibrations correctly.

Always make this adjustment after replacing the e500 air or oxygen inlet regulator and following the e500 overhaul procedure. This inlet pressure must be accurate before attempting to calibrate the Air & Oxygen Servo Valves.

CALIBRATION PROCEDURES

- 1 From within the Diagnostic Mode, rotate the **trig** knob to display d3 in the window. The message window will display:
FLOW MANUAL ADJUST
Hit Exp Hold.
- 2 Press Exp Hold Button. The message window displays:
FLOW MANUAL ADJUST
Adjust Flow Limit.
- 3 Set **F_IO₂** to 21%, **Ḃ (Flow)** to 3 L/min and set the pressure monitor to display **Ppeak**. The displayed value in the pressure monitor window is now the pressure for the Air Inlet Regulator. If the displayed value is not 15.5 ± 0.3 psig, you will need to adjust the regulator. If it is within specification, proceed to step 5.
- 4 To adjust the air inlet pressure regulator, use a 5/16" open ended wrench to loosen the bottom lock nut (see Figure 5-3). Using a 1/4" open ended wrench, rotate the top adjustment bolt to adjust the pressure (see Figure 5-3). Rotate the bolt clockwise to increase the pressure and counter clockwise to decrease the pressure. When the reading in the **Ppeak** window is 15.5 ± 0.3 psig secure the bottom lock nut.

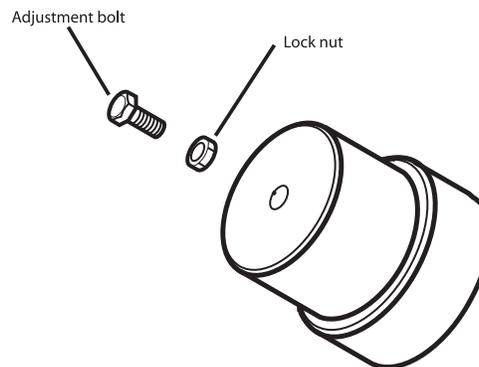


Figure 5-3 Lock nut and adjustment bolt on Air & Oxygen regulators

- 5 To check the oxygen inlet pressure regulator, set the **F_IO₂** to 100%, **Ḃ (Flow)** to 3 L/min and set the pressure monitor to display **Pplat**. The displayed pressure in the pressure monitor window is now the pressure for the oxygen regulator. If the displayed value is not 15.5 ± 0.3 psig, you will need to adjust the regulator. If it is within specification, proceed to step 7.

- 6 To adjust the oxygen inlet pressure use a 5/16" open ended wrench to loosen the bottom lock nut (see figure 5-3). Using a 1/4" open ended wrench rotate the top adjustment bolt to adjust the pressure. Rotate the bolt clockwise to increase the pressure and counter clockwise to decrease the pressure. When the reading in the **Pplat** window is 15.5 ± 0.3 psig secure the bottom lock nut.
- 7 Press **Exp Hold** button once to exit d3 and proceed to the next test.

NOTE: To perform the calibration successfully, it is very important that the air and oxygen gas supply is regulated to 50 psig and that the supply is capable of supporting a minimum of 180 L/min of constant flow.

AIR (d1) AND OXYGEN (d2) SERVO VALVE CALIBRATION

This calibration allows the ventilator software to create a lookup table which enables the e500 to properly control the servo valves throughout the full range of available flows.

Always perform this calibration after replacing the air or oxygen servo valves or regulators, or the main PCB.

To Calibrate the Air Servo Valve (d1)

With the e500 in Diagnostic mode, rotate the **trig** knob to display d1 in the **trig** window.

- 1 Ensure that the patient connection of the breathing circuit is open to ambient air (i.e. no test lung connected).
- 2 Press **Exp Hold** when the message window displays:
AIR VALVE CAL.
Hit Exp Hold
- 3 The message window changes to:
AIR VALVE CAL.
Calibrating.....

NOTE: This test may take up to 10 minutes to complete.

- 4 If the calibration is successful, the message window displays:
AIR VALVE CAL.
Test Completed

Press the **Insp Hold** button to save the calibration.

CALIBRATION PROCEDURES

- 5 If the ventilator detected a leak, the message window displays:
AIR VALVE CAL.
Valve Leaks > 50 cc

Re-run the d1 calibration. If same message is displayed the servo valve will need to be replaced. Refer to Section 4 for component removal instructions.

NOTE: During this calibration, flow measurement can be viewed by selecting **V peakI** in the Monitored Data Window. Maximum flow measured should be at least 180 L/min.

To Calibrate the Oxygen Servo Valve (d2)

Rotate the **trig** knob to display d2 in the trig window.

- 1 Ensure that the patient connection of the breathing circuit is open to ambient air (i.e. no test lung connected).
- 2 Press **Exp Hold** when the message window displays:
O₂ VALVE CAL
Hit Exp Hold
- 3 The message window changes to:
O₂ VALVE CAL
Calibrating.....

NOTE: This test may take up to 10 minutes to complete.

NOTE: During Calibration, flow measurement can be viewed by selecting **V peakI** in the monitoring window. Maximum flow measured should be at least 180 L/min.

- 4 If the calibration is successful, the message window displays:
O₂ VALVE CAL
Test Completed

Press the **Insp Hold** button to save the calibration.

- 5 If the ventilator detects a leak, the message window will display:
O₂ VALVE CAL
Valve Leaks > 50 cc

Re-run d2 calibration, if same message appears the servo valve will need to be replaced. Refer to Section 4 for component removal instructions.

PATIENT CIRCUIT LEAK TEST (d9)

Diagnostic d9 allows the technician to perform a leak test of the ventilator and breathing circuit. During this test, the system is closed then pressurized to approximately 30 cmH₂O to determine whether or not a leak is present. This test will verify that the existing breathing circuit and inspiratory and expiratory gas pathways have minimal leak. This is a similar test as the Leak Test found in User set-up.

NOTE: The Leak Test should be performed successfully prior to attempting to perform the Exhalation Valve calibration.

Test

To perform a leak test of the patient circuit, rotate the **trig** knob to display d9 in the trig window.

- 1 Press **Exp Hold** when the message window displays:
LEAK TEST
Hit Exp Hold
- 2 When the message window displays:
OCCLUDE CIRCUIT
Hit Exp Hold to Run

Completely block the patient wye using CAP100P or other suitable method (see Figure 5-4).

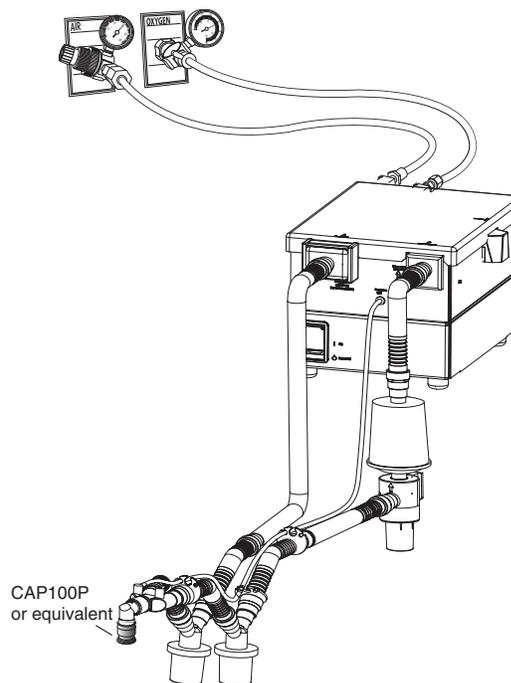


Figure 5-4 Setup for Leak Test and Exhalation Valve Calibration

CALIBRATION PROCEDURES

- 3 Press **Exp Hold**. The message window displays:
LEAK TEST
Testing.....

The breathing circuit will be briefly pressurized to approximately 30 cmH₂O.

- 4 If the ventilator detects no leak, the message window will display:
LEAK TEST
No Leak
- 5 If the ventilator detects a leak, the message window will display:
LEAK TEST
Leak Test Failed
- 6 Check patient circuit connections and exhalation module assembly for proper assembly and installation and correct the cause of any leaks. Re-run the d9 calibration.

If the test fails again, disassemble the exhalation valve and inspect the diaphragm to ensure it can seat/seal properly. Re-run the d9 calibration. If the test still fails, contact Newport Technical Service department.

EXHALATION VALVE CALIBRATION (d4)

This calibration allows ventilator software to create a lookup table which enables the e500 to properly control the exhalation solenoid so that a full range of PEEP can be achieved.

Perform this calibration after replacing the Exhalation Solenoid or as required.

NOTE: The e500 must pass the Leak Test (d9) prior to performing an exhalation valve calibration.

Rotate the **trig** knob to display d4 in the trig window.

- 1 Press **Exp. Hold** when the message window displays:
EXH VALVE CAL.
Hit Exp Hold
- 2 When the message window displays:
OCCLUDE CIRCUIT
Hit Exp Hold to run

Block the patient wye using CAP100P or other suitable method (see Figure 5-4).

- 3 Press **Exp. Hold**. The message window displays
EXH VALVE CAL.
Calibrating...

NOTE: This calibration may take several minutes to complete, keep the circuit closed until the message window indicates successful completion.

- 4 If the ventilator passes the test, the message window displays
EXH VALVE CAL.
Exh Valve Cal OK
- 5 Press **Insp Hold** to save the calibration. The message window reads
EXH VALVE CAL
Saving...
Completed
- 6 If the ventilator does not pass, the message window displays
EXH VALVE CAL
Failed xxxxxx

The failure message will correspond to one of the messages shown in Table 5-1. Take the appropriate corrective action.

CALIBRATION PROCEDURES

Displayed Message	Meaning	Corrective Actions
EXH.VALVE CAL Failed: Flow < "X"	Indicates a leak	<p>Perform Leak Test (d9)</p> <p>Check exhalation flow sensor.</p> <p>Check exhalation valve diaphragm for proper seating. Replace if necessary.</p> <p>Check exhalation valve body for cracks. Replace if necessary.</p> <p>Replace Analog PCB. DO NOT ATTEMPT TO RE-CALIBRATE.</p>
EXH.VALVE CAL Failed: Prox > 0.5	Valve is completely open but proximal pressure > 0.5	Check proximal pressure line for kinks.
EXH.VAVLE CAL Failed: Prox Low	Proximal pressure did not increase to the desired level	<p>Perform Leak Test (d9)</p> <p>Check calibration of analog PCB.</p> <p>Check for patient circuit leaks.</p> <p>Change exhalation valve solenoid.</p>
EXH.VALVE CAL Failed: Prox < 1	Exhalation valve is closed but proximal pressure < 1 cmH ₂ O	<p>Perform Leak Test (d9)</p> <p>Check exhalation valve & diaphragm.</p> <p>Check calibration of analog PCB.</p> <p>Check gas input.</p> <p>Check servo valves.</p> <p>Check exhalation valve solenoid.</p> <p>Check exhalation valve & diaphragm.</p> <p>Check proximal pressure line for leaks or kinks.</p>

Table 5-1: Troubleshooting exhalation valve calibration

PILOT PRESSURE TRANSDUCER ACCURACY & MAXIMUM PRESSURE TESTS (d5)

When the Pilot Pressure Transducer Accuracy Test is performed, the control system servos the pilot pressure going to the back of the exhalation valve to the same value as that set in the PEEP/CPAP window, confirming that throughout the test range the PEEP/CPAP setting and the displayed Pbase value is within $\pm 10\%$ or 3 cmH₂O/mbar, whichever is greater.

The purpose of the Maximum Pressure Test is to verify that at the highest flow condition, the pneumatic system is able to maintain pressure at the back of the exhalation valve to 75 cmH₂O/mbar or higher.

Pilot Pressure Transducer Accuracy Test

Tee in the calibration analyzer to either of the 1/8" silicone tubes attached at the rear of the exhalation valve (see Figure 5-6). Set the calibration analyzer to display either cmH₂O or mbar.

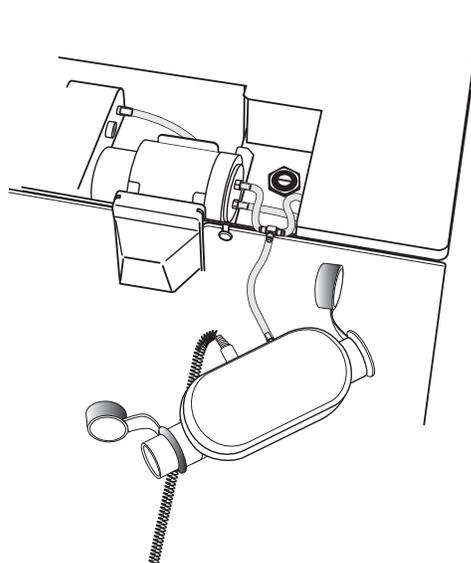


Figure 5-6 Pilot pressure calibration setup

- 1 Rotate the **trig** knob to display d5 in the **trig** window. The message window will display:
FLOW & P drive ADJUST
Hit Exp Hold

CALIBRATION PROCEDURES

- 2 Press the **Exp Hold** button. The message window will display:
FLOW & Pdrive ADJUST
Adjust Flow & Pbase
- 3 Select **Pbase** for display in the monitor window.
- 4 Rotate the **PEEP/CPAP** knob from 3 to 99, confirming that throughout the test range the **PEEP/CPAP** setting, the analyzer display and the displayed **Pbase** value is within $\pm 10\%$ or 3 cmH₂O/mbar, whichever is greater.
- 5 If the measurements are not within specification, the Analog PCB may need to be recalibrated.

Maximum Pressure Test

- 1 With the calibration analyzer still tee'd into the exhalation valve, repeat step 2 of Pilot Pressure Transducer Test.
- 2 Select the following settings
F_IO₂ = .21
 \dot{V} (Flow) = 180
PEEP/CPAP = 99
- 3 Select **\dot{V} peakI** for display in the monitor window. Verify that the measured flow equals 180 L/min (± 2 L/min). If not, then reduce the Flow control setting until the measured flow equals set flow.

NOTE: If measured flow is lower than set flow, this indicates that the gas supply to the ventilator is insufficient resulting in a limited inspiratory flow.

- 4 Verify that the calibration analyzer displays a pressure reading greater than 75.

NOTE: If the maximum pressure is less than 75, there are three primary items to check: gas supply pressure, the exhalation solenoid and the crossover solenoid.

- 5 Reset the **\dot{V} (Flow)** and **PEEP/CPAP** settings to zero. Remove the test setup.
- 6 Press the **Exp Hold** button to exit the test. The message window will display:
FLOW & Pdrive ADJUST
Test Completed

PROXIMAL PRESSURE TRANSDUCER ACCURACY TEST (d5)

This test checks the accuracy of the two transducers monitoring Proximal Pressure. The control system servos the pilot pressure to the exhalation valve to raise the circuit pressure. This enables you to compare the displayed value for pressure in the monitor window against the pressure shown on the e500 bar graph. You can also then check either or both of these two values with the external calibration analyzer reading.

Setup

With the calibration analyzer inserted into the expiratory limb of the patient circuit, tee into the 1/8" proximal pressure tubing (see Figure 5-7). Set the calibration analyzer to display pressure in either cmH₂O or mbar. Occlude the patient circuit wye using CAP100P or similar.

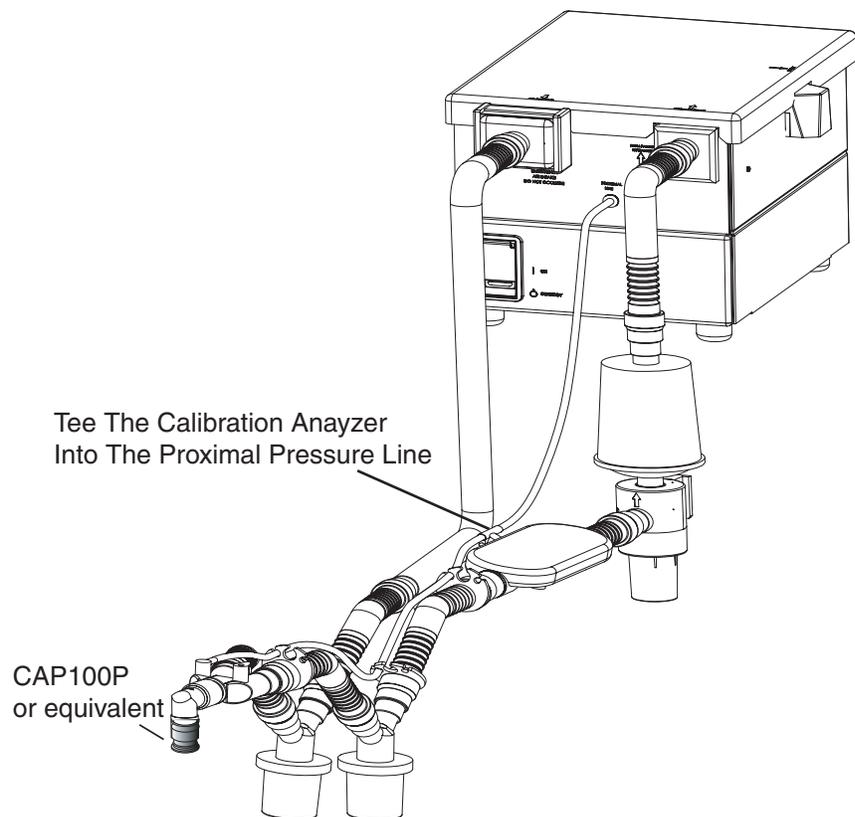


Figure 5-7 Proximal Pressure Transducer Accuracy Setup

CALIBRATION PROCEDURES

Test

- 1 Rotate the **trig** knob to display d5 in the **trig** window. The message window displays:
FLOW & Pdrive ADJUST
Hit Exp Hold
- 2 Press the **Exp Hold** button. The message window displays:
FLOW & Pdrive ADJUST
Adjust Flow & Pbase
- 3 Select **Pmean** to display in the monitor window.
- 4 Set \dot{V} (**Flow**) to 3 L/min.
- 5 Slowly rotate the **PEEP/CPAP** control from 0 to 99. As you do so, compare the pressure value displayed in the **Pmean** window against the pressure bar graph and the calibration analyzer. Confirm that throughout the test range, the three pressure measurements are within $\pm 10\%$ or 1 cmH₂O/mbar, whichever is greater. If pressures are within specification, proceed to step 7.
- 6 If the three pressure readings are not within specification, re-calibrate the Analog PCB and re-run this test.
- 7 Remove the test setup and re-connect the patient circuit. Press the **Exp Hold** button to exit. The message window will display:
FLOW & Pdrive ADJUST
Test Completed

CALIBRATING THE PRESSURE RELIEF REGULATOR (d3)

This calibration verifies that the Pressure Relief Regulator is adjusted to maintain a specified pressure throughout the full range of flows. You should perform this calibration after replacing the Pressure Relief Regulator or after completing the e500 overhaul procedure.

Setup

Remove the patient breathing circuit tube from the expiratory port (FROM PATIENT) on the e500 and re-connect it to the patient wye creating an inspiratory pressure loop. (see Figure 5-8). Insert the calibration analyzer into the breathing circuit as shown.

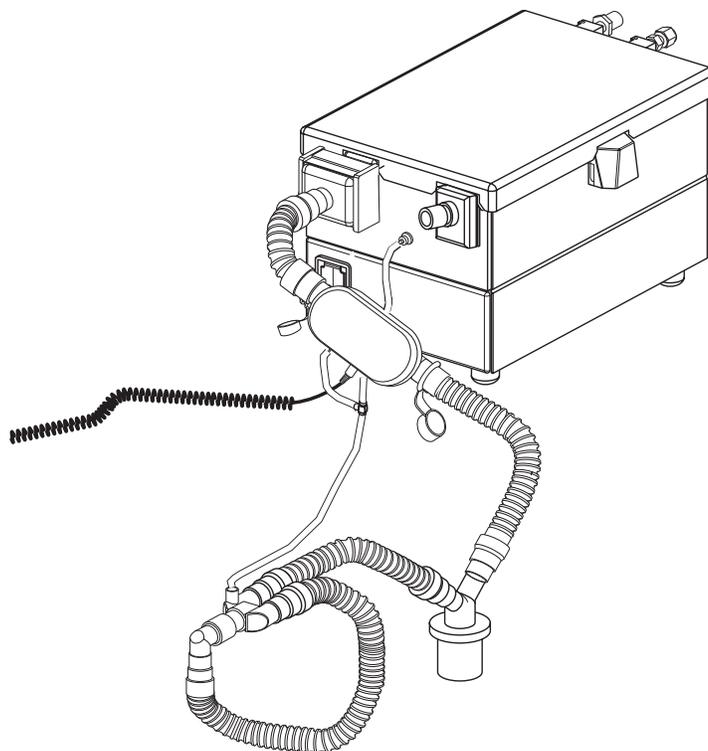


Figure 5-8 Pressure Relief Regulator calibration setup

CALIBRATION PROCEDURES

Test

- 1 Enter diagnostic mode and adjust the **trig** knob to display d3 in the **trig** window.
- 2 Press **Exp Hold**.
- 3 Set the e500 \dot{V} (Flow) to 3 L/min. This increases the airway pressure monitored by the e500 pressure bar graph and the calibration analyzer. When the emergency relief valve begins to open (you can hear the valve open and/or feel air escaping from the under the inspiratory port), verify that the calibration analyzer measures a pressure of 140 ± 5 cmH₂O (137 ± 5 mbar).
- 4 If the pressure is not within limits, calibrate the Pressure Relief Regulator as follows:
 - Remove the plastic cap from the top of the spring cap mechanism. Use a flat bladed screw driver to adjust the spring cap until the emergency valve opens at 140 ± 5 cmH₂O (137 ± 5 mbar) (see Figure 5-9).
 - Replace the cap so that it is snug, but not overly tight, and return the patient circuit to its original setup.

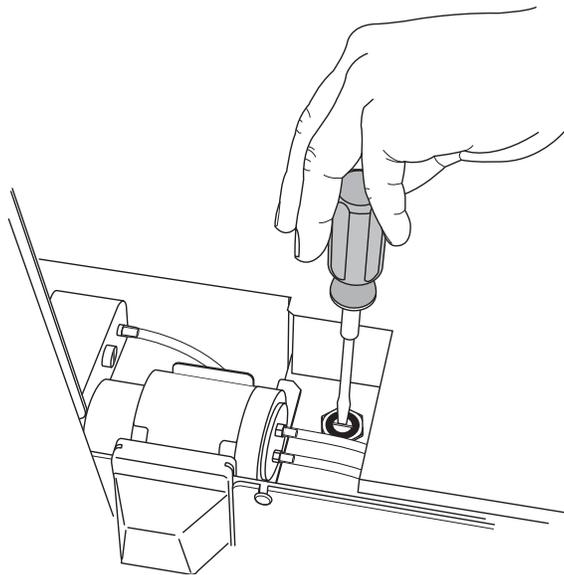


Figure 5-9 Adjusting the Pressure Relief Regulator

INSPIRATORY & EXPIRATORY FLOW SENSOR ACCURACY TEST (d3)

This test determines whether the two inspiratory flow sensors (TSI) and the expiratory flow sensor (screen pneumotach) are performing within specification, both at .21 (21%) and 1.00 (100%) oxygen settings.

Inspiratory Flow Sensor Test Setup

Insert the calibration analyzer into the inspiratory limb of the breathing circuit as shown in Figure 5-10. Occlude the patient circuit wye connector.

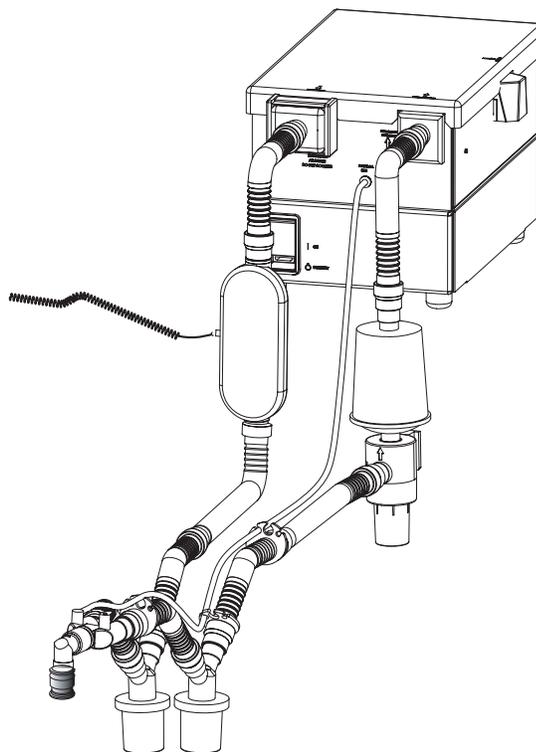


Figure 5-10 Inspiratory Flow Sensor accuracy test setup

Test

- 1 Rotate the **trig** knob to display d3 in the **trig** window. The message window will display:
FLOW MANUAL ADJUST
Hit Exp Hold
- 2 Press the **Exp Hold** button. The message window will display:
FLOW MANUAL ADJUST
Adjust Flow Limit
- 3 Set $F_{I}O_2$ to .21 and select **VpeakI** to display in the monitor window.

CALIBRATION PROCEDURES

- 4 Slowly adjust the \dot{V} (**Flow**) from 1 – 180 L/min, confirming that the monitored inspiratory flow is within $\pm 10\%$ of the flow setting. If flow is within specification, proceed to step 6.

NOTE: If monitored flow reading reaches a point where it no longer increases to match the flow setting, this means that the gas supply to the ventilator is insufficient, causing a flow delivery limitation. In this case, only test to the maximum possible flow delivery.

- 5 If flows are not within specifications, replace the Air TSI Flow sensor and re-run test.
- 6 Set $F_{I}O_2$ to 1.00 and repeat Step #4. If flow is within specification this concludes the test.
- 7 If flows are not within specification, replace oxygen TSI Flow Sensor and re-run test.

Expiratory Flow Sensor Test Setup

Remove the calibration analyzer from the inspiratory limb of the breathing circuit and place it in the expiratory limb instead. The patient circuit should still be occluded at the wye.

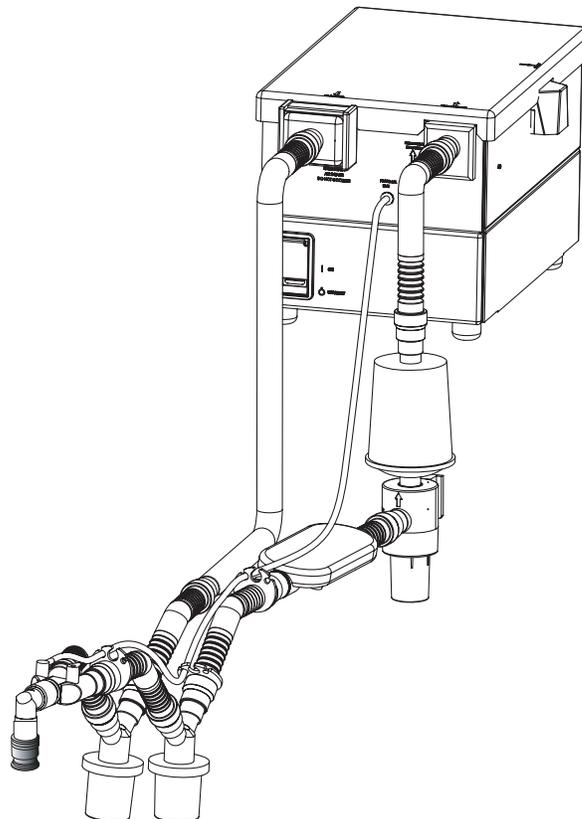


Figure 5-11 Expiratory flow sensor test setup

Test

- 1 With $F_{I}O_2$ still set to 1.00 (100%), select **\dot{V}_{peakE}** to display in the monitor window.
- 2 Adjust the **\dot{V} (Flow)** from 1 – 180 L/min, confirming that the measured expiratory flow is within $\pm 10\%$ of flow setting.

NOTE: If monitored flow reading reaches a point where it no longer increases to match the flow setting, this means that the gas supply to the ventilator is insufficient, causing a flow delivery limitation. In this case, only test to the maximum possible flow delivery.

- 3 Set $F_{I}O_2$ to .21 and repeat Step # 2.
- 4 If flows are not within specification, clean or replace the expiratory flow sensor screen and re-run the test. If flows remain out of specification replace the Analog PCB and re-run test.
- 5 Press the **Exp Hold** button to exit this test. The message window will display:
FLOW MANUAL ADJUST
Test Completed

Remove the test set up and reconnect the patient circuit.

EXIT THE DIAGNOSTIC MODE

To exit the diagnostic mode, save the calibration data, and resume normal ventilation.

- 1 Press the **Insp Hold** button once. The message window displays:
Saving.....
Save Completed
- 2 Power down the ventilator. For normal operation, power up the ventilator again without pressing the small button on the rear of the Control Panel.

CALIBRATION PROCEDURES

CALIBRATING THE ANALOG PCB

WARNING An authorized Newport Medical Instruments factory-trained service technician must perform all service and repairs on the e500 Ventilator.

WARNING

Hazardous voltages are present inside the ventilator. Disconnect electrical power, air, and oxygen sources before attempting any disassembly. Failure to do so could result in injury to service personnel or equipment.

To prevent damage from ESD and possible failure of the ventilator, ALWAYS use standard anti-static practices when working inside the ventilator, handling circuit boards or handling any other electronic components.

Tools Required

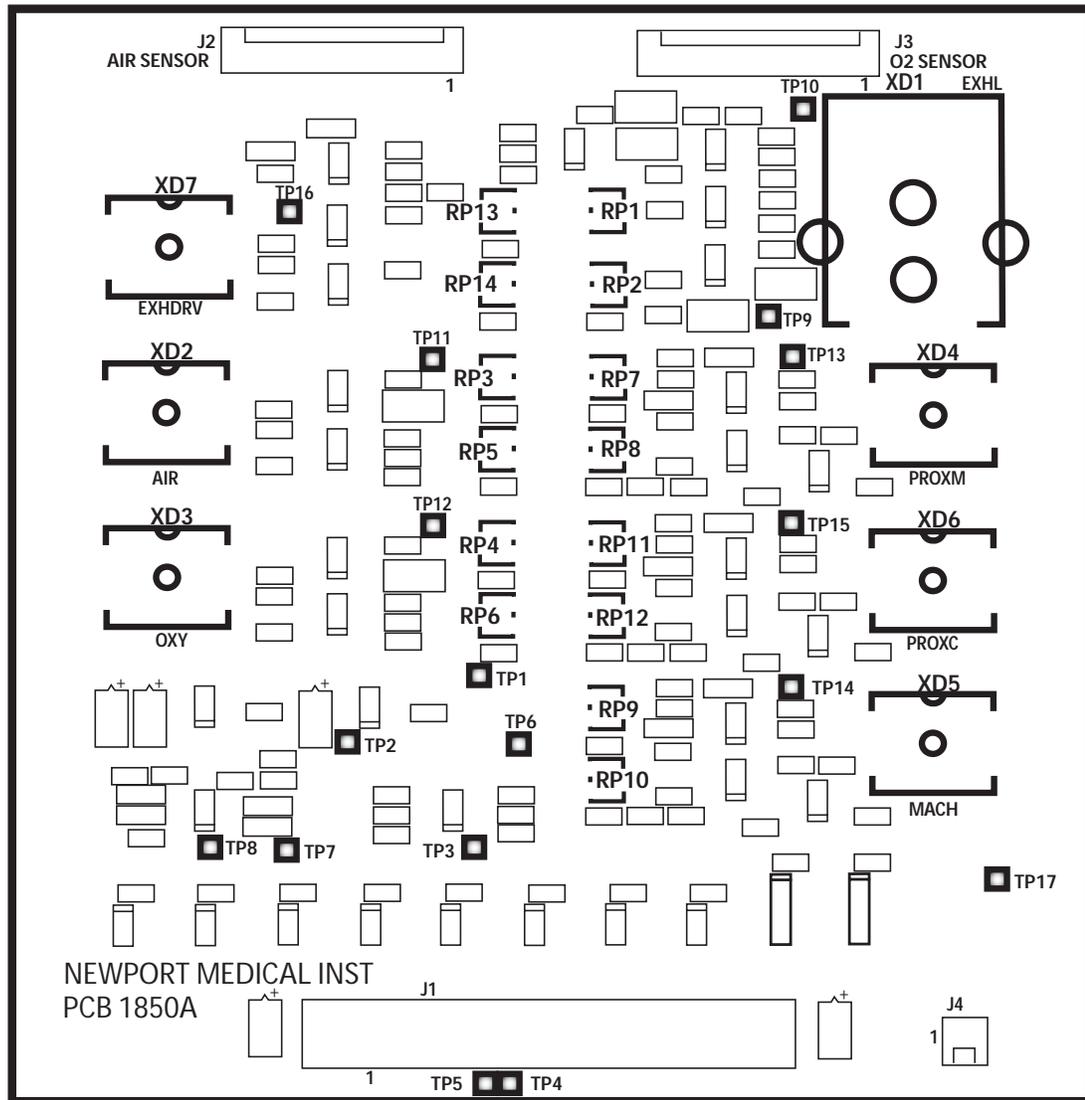
- 5/16" nut driver
- Medium size Phillips screwdriver
- Small flat-blade screwdriver
- 50 psig gas source for air and oxygen with adjustable regulators down to 30 psig
- Pressure gauge for readings from 0 to 60 psig
- Pressure gauge for reading 0 to 200 cmH₂O (0 to 196 mbar)
- Fluke 87 volt/ohmmeter or equivalent
- Pressure syringe

Setup

- 1 Disconnect the e500 Gas Delivery Unit (GDU) from AC power.
- 2 Disconnect the e500 Graphics Display Monitor (GDM).
- 3 Open the Top Cover and remove the Exhalation Module (Figure 4-6), Flow Sensor Cover (Figure 4-7), inspiratory manifold (Figure 4-16), mixing chamber (Figure 4-18), air and oxygen flow sensors (Figure 4-19), and the pneumatic panel (Figure 4-20) as described in Section 4.

- 4 Remove the tubing from transducers XD2 through XD7 on the Analog PCB.

NOTE: Do not remove the tubing from XD1; The XD1 transducer cannot be calibrated in the field.



DRAWING NOT TO SCALE

Figure 5-12 Diagram showing Analog PCB transducers, test points and potentiometers.

CALIBRATION PROCEDURES

Zero Pressure Calibration

- 1 Power-on the e500 GDU.
- 2 On the voltmeter, select the high accuracy DC function .
- 3 Refer to Figure 5-12 and connect the black voltmeter test lead (ground) to test point TP6 on the analog PCB.
- 4 Connect the red test lead to the following test points in turn and adjust the corresponding potentiometer to display the correct voltage on the voltmeter.

Analog PCB test point	Potentiometer to adjust	Displayed voltage
TP11	RP5	0.000 V +/- 0.001 V
TP12	RP6	0.000 V +/- 0.001 V
TP13	RP8	1.5000 V +/- 0.001 V
TP14	RP10	0.312 V +/- 0.001 V
TP15	RP12	1.500 V +/- 0.001 V
TP16	RP14	0.100 V +/- 0.001 V

Gain Pressure Calibration

- 1 Select the high accuracy DC function on the voltmeter.
- 2 Connect the black voltmeter test lead (ground) to test point TP6 on the analog PCB.
- 3 Connect the red test lead to the following test points in turn and adjust the corresponding potentiometer to display the correct voltage on the voltmeter.
- 4 Use the pressure syringe to apply pressure to each transducer. Tee in a pressure gauge 0 to 200 cmH₂O (0 to 196 mbar) to ensure accurate pressure delivery.

Analog PCB test point	Transducer & applied pressure	Potentiometer adjustment	Displayed voltage
TP11	XD2 @ 30psig	RP3	5.000 V +/- 0.01 V
TP12	XD3 @ 30psig	RP4	5.000 V +/- 0.01 V
TP13	XD4 @ 140 cmH ₂ O (137 mbar)	RP7	5.000 V +/- 0.01 V
TP14	XD5 @ 150 cmH ₂ O (147 mbar)	RP9	5.000 V +/- 0.01 V
TP15	XD6 @ 140 cmH ₂ O (137 mbar)	RP11	5.000 V +/- 0.01 V
TP16		RP13	5.000 V +/- 0.01 V

Calibration Complete

Power off the GDU and and disconnect from main power.
Reassemble the GDU.

Section 6. Operational Verification Procedure

Test Equipment	6-1
Set Up	6-2
Electrical Safety Checks	6-3
– Ground Resistance test	6-3
– Current Leakage test	6-3
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OPERATIONAL VERIFICATION PROCEDURE

The Operational Verification Procedure ensures that the Newport e500 Ventilator is in proper operating condition.

WARNING Do not use the e500 ventilator unless it passes the Operational Verification Procedure.

Test Equipment

- Electrical Safety Test (EST) Analyzer
- Certified calibration analyzer manufactured by TSI, Inc. (or equivalent)
- Newport reusable adult breathing circuit (p/n PCB345A or equivalent).
- Test resistor RP20 (p/n RP20)
- Adult test lung (p/n LNG600P)
- Adjustable (0-60 psig) air and oxygen supplies
- Analyzer adapter (p/n 900MR534)
- Analyzer tube adapter (p/n TUB06P)
- A device to occlude the patient circuit wye (p/n CAP100P or equivalent)

Caution The accuracy of all test equipment (electronic or pneumatic) used for verification or calibration procedures should be certified annually by a testing laboratory before use.

OPERATIONAL VERIFICATION PROCEDURE

SET UP

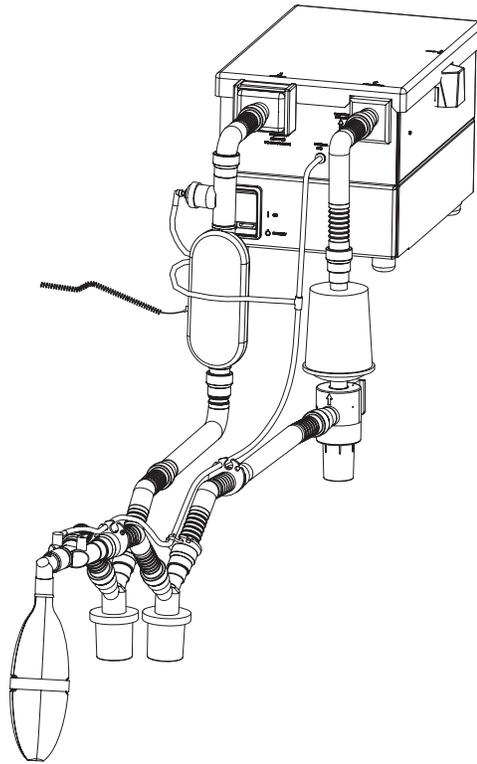


Figure 6-1 Analyzer set-up.

- 1** Connect reusable adult breathing circuit to the e500 ventilator to be tested. Attach a test lung to the patient wye.
- 2** Connect the calibration analyzer with oxygen sensor between the main flow outlet and the adult breathing circuit. Tee in the proximal line from the patient wye to the analyzer. (See Figure 6-1)
- 3** Connect regulated adjustable air and oxygen supplies to ventilator inlets on the rear of the ventilator. Set regulators to 50 psig.
- 4** Make a copy of the e500 Test Record sheets provided at the end of this section. Check the appropriate box or record appropriate data on the record sheet after each test is performed.

ELECTRICAL SAFETY CHECKS

Ground Resistance test

- 1 Connect the A.C. power cord to the EST analyzer.
- 2 Connect the ground lead of the EST analyzer to the labeled equipotential \downarrow connection on the rear of the ventilator.
- 3 Perform ground resistance check and record the results on the OVP record sheet. To pass, the ventilator ground resistance must be $\leq 0.1\Omega$.

Current Leakage test

- 1 Power the ventilator on.
- 2 Perform the current leakage check and record the result on the OVP record sheet. To pass, the measured current leakage must be $\leq 100 \mu\text{A}$.

OPERATIONAL CHECKS

Ensure the e500 front panel controls are adjusted to the settings shown in Table 6-1.

Table 6-1. Standard Test Settings

Control	Setting
Power	On
Breath Type	Volume Control
Mode	A/CMV
F _I O ₂	.60
\dot{V} (flow)	30 L/min
V _T (tidal volume)	600 mL
f (respiratory rate)	10 b/min
P _{limit}	5
P _{support}	0
PEEP	0
trig	Pressure
\dot{V}_E Alarm	Low at 1 L/min, High at 50 L/min
Pause	0 sec.
P _{aw} Alarm	Low at 10, High at 75

NOTE: Pressure readings should be set to either cmH₂O or mbar

OPERATIONAL VERIFICATION PROCEDURE

Front Panel LED Check

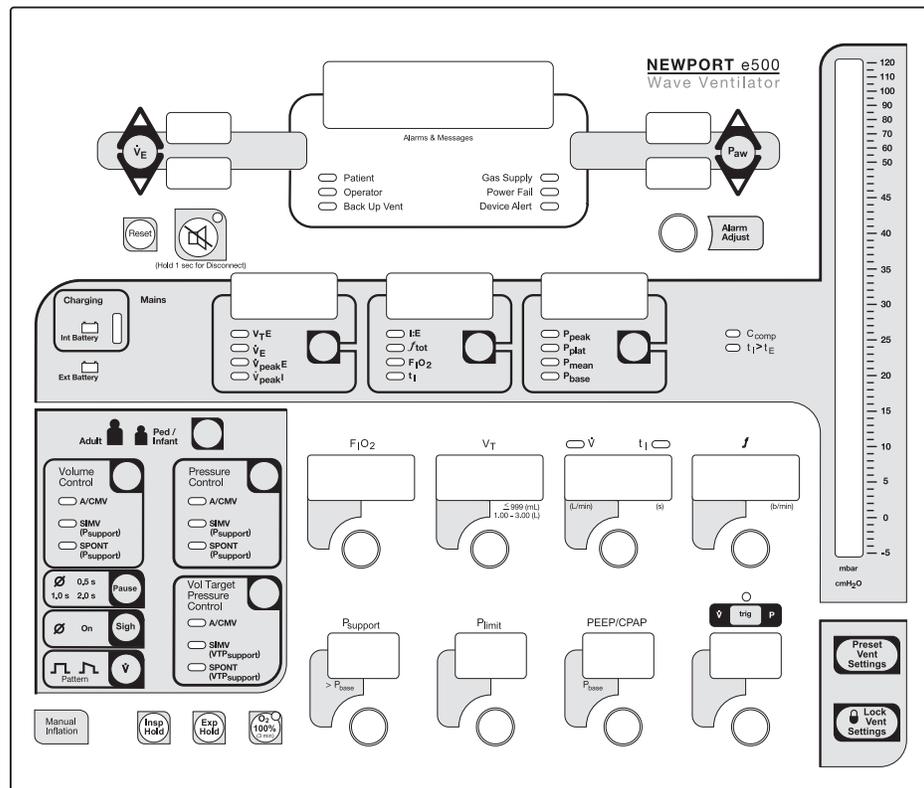
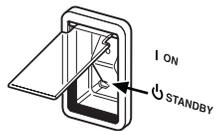
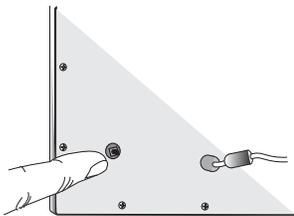


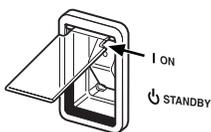
Figure 6-2 Front Panel Controls & Indicators



- 1 Toggle the power switch (shown here) on the front of the GDU to the Standby position.



- 2 Hold down the ok button on the rear of the Control Panel.



- 3 While you are pressing the button, toggle the power switch to the On position. This puts the e500 into diagnostic mode. Release small button.



- 4 Press the **Lock Vent Setting** button on the front of the Control Panel.

- 5 Verify that all the front panel displays light in the following sequence:
 - red** (alarms section at the top),
 - orange** (monitors section in the center),
 - and **green** (controls section at the bottom),
 - one section at a time.

- 6 Toggle the power switch back to the Standby position.

OPERATIONAL VERIFICATION PROCEDURE

Leak Self Test



- 1 Hold down the **Preset Vent Settings** button on the front panel, and toggle the power switch to the On position. This puts the e500 into User Setup mode.



- 2 Adjust the **trig** control until c1 appears in the trig window.



- 3 Remove test lung if present and occlude the end of the patient wye connector using CAP100P or similar.
- 4 Press the **Exp Hold** button twice. The ventilator will perform a Leak Self Test.
- 5 At the conclusion of the test, verify that the message display window reads **No Leak**. Check off the record sheet and re-install the test lung.
- 6 To exit User Setup, press and hold the **Preset Vent Settings** button for approximately 2 seconds until the unit starts to cycle.

F_IO₂ Test



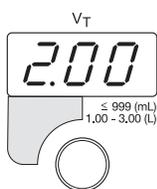
- 1 Set the **F_IO₂** control knob to 0.21. Verify and record the analyzer reading on the test record.
- 2 Repeat step 1 for **F_IO₂** settings of 0.40, 0.60, 0.80, and 1.0.
- 3 Set **F_IO₂** to 0.60.

NOTE: Allow sufficient time for the analyzer to stabilize at each setting before recording the analyzer reading.

Loss of Gas Alarm

- 1 Lower the air gas source regulator to 20 psig. Verify that there is no Loss of Gas alarm.
- 2 Lower the air gas source to 8 psig. Verify that the **Gas Supply** indicator lights, the audible alarm sounds and the message display reads Air Supply Loss.
- 3 Clear the alarms and set the air gas source back to 50 psig.
- 4 Repeat steps 1–3 for the O₂ gas source. Check off all results on the test record sheet.

Main Flow

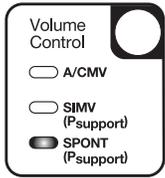


- 1 Set your calibration analyzer to record flow. Remove the test lung from the patient wye and set **V_T** to 2.00 L.
- 2 Set e500 **Ḃ (Flow)** to 5 L/min; verify and record the analyzer flow readings on the e500 Test Record.
- 3 Repeat for **Ḃ (Flow)** settings of 10, 20, 40, 60, 80, and 100 L/min.
- 4 Set **Ḃ (Flow)** to 30 L/min and **V_T** to 500; reattach the test lung.

NOTE: Because the e500 ventilator automatically compensates for use with a humidifier by lowering the flow by 11% (calibrated to BTPS) the calibration analyzer displays readings 11% lower than the ventilator's set flow rate.

OPERATIONAL VERIFICATION PROCEDURE

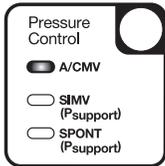
Bias Flow



- 1 Set the e500 to **Volume Control SPONT**.
- 2 Verify that the calibration analyzer measures a flow rate of 3 to 4 L/min, record the reading.

Inspiratory Time

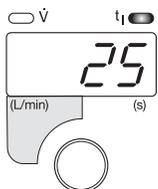
- 1 Remove the test lung.
- 2 Set your calibration analyzer to monitor inspiratory time.



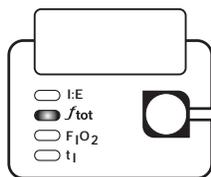
- 3 Set the e500 to **Pressure Control A/CMV**.



- 4 Set **P_{limit}** to 30.



- 5 Set **t_i** to 0.25 seconds. Verify calibration analyzer reading and record on test record.
- 6 Repeat step 5 for **t_i** settings of 0.50, 1.00, 2.00, and 3.00 seconds.

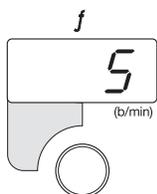
Respiratory Rate (f)

1 Set the e500 to display the monitored value for f_{tot} .

2 Set the calibration analyzer to monitor breaths per minute.



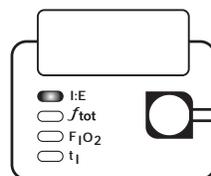
3 Set inspiratory time to 0.25 seconds and attach test lung to patient wye.



4 Set f to 5 b/min. Verify calibration analyzer reading and record on the e500 Test Record.

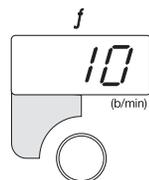
5 Repeat step 4 for f settings of 10, 20, 40, 60, and 80 b/min.

I:E Ratio

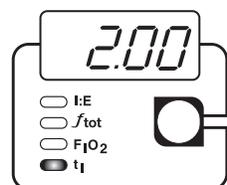


1 Set the calibration analyzer to monitor I:E ratio.

2 Set the e500 to display the monitored value for I:E.



3 Set f to 10 b/min.

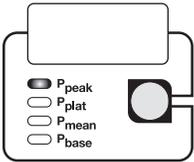


4 Set t_i to 2 seconds.

OPERATIONAL VERIFICATION PROCEDURE

- 5 Verify that the ventilator and calibration analyzer both display an I:E ratio of 1:1.9 to 1:2.10. Record the reading.

Pressure Control



- 1 Set the e500 to display the monitored value for **Ppeak**.
- 2 Set the calibration analyzer to measure peak pressure in cmH_2O .
- 3 Attach the RP20 test resistor between the test lung and the patient wye.

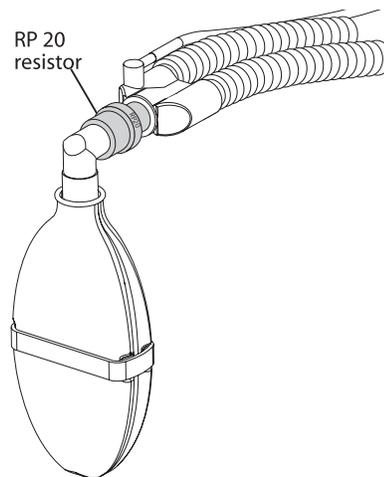
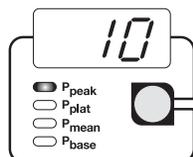


Figure 6-3 Test lung with RP20 attached



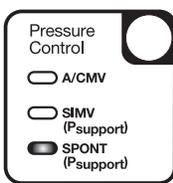
- 4 Set a **P_{limit}** setting of 10 on the e500.



- 5 Verify that the calibration analyzer and the ventilator both display a **P_{peak}** of 10. Record the reading on the e500 Test Record.

- 6 Repeat for **P_{limit}** settings of 20, 30, and 60.

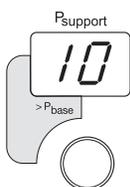
Pressure Support



- 1 Set the e500 to Pressure Control SPONT.



- 2 Select a pressure (**p**) **trig** setting of 0.5 on the e500.



- 3 Set the e500 to a **P_{support}** of 10.

- 4 Squeeze the test lung to trigger a breath. Verify that the calibration analyzer and ventilator both display a peak pressure of 10. Record the reading.

- 5 Repeat for settings of 20, 30, 50.

- 6 Set **P_{support}** to 0, and verify no pressure-supported breaths are delivered.

OPERATIONAL VERIFICATION PROCEDURE

Proximal Pressure Line Purge

- 1 Set the calibration analyzer to read pressure (not peak pressure).
- 2 Pinch the proximal pressure line just below the tee (see Figure 6-4)
- 3 Verify that the pressure reading on the calibration analyzer and the e500 pressure bar graph rise above 50 in ≤ 10 seconds. Record on the test record.
- 4 Release the pinch on the proximal pressure line.

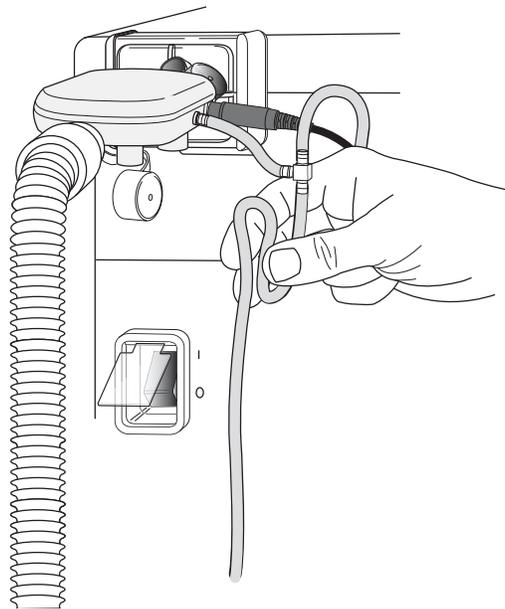
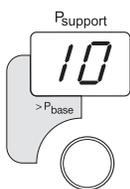
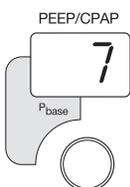


Figure 6-4 Pinch Proximal Pressure line

Pressure Trigger Sensitivity



- 1 Set e500 **Psupport** to 10.



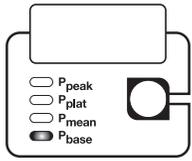
- 2 Set e500 **PEEP/CPAP** to 7.



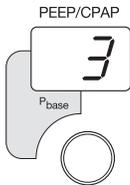
- 3 Set e500 pressure **Ptrig** to 1.0.
- 4 Manually squeeze and slowly release the test lung to create a dip in the pressure bar graph. Verify that the dip equals the **Ptrig** setting when the green trig LED lights and a pressure support breath is triggered. Record the reading.
- 5 Repeat step 4 for **Ptrig** settings of 3 and 5.
- 6 Re-set **Psupport** to 0. Leave the test lung connected, and proceed to the next test.

OPERATIONAL VERIFICATION PROCEDURE

PEEP/CPAP



- 1 Set the e500 to display the monitored value for **Pbase**.



- 2 Set e500 **PEEP/CPAP** to 3.

- 3 Verify that the calibration analyzer and the e500 pressure bar graph both display a pressure of 3. Record readings on the e500 Test Record.

- 4 Repeat step 3 with e500 **PEEP/CPAP** settings of 5, 10, 20, 30 and 45. Record the readings.

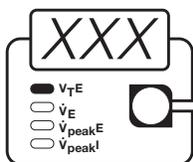
NOTE: Allow three to four breaths at each setting for pressure to stabilize.

- 5 Re-set **PEEP/CPAP** to 0.

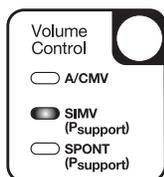
- 6 Remove the RP20 restrictor from the patient breathing circuit.

High and Low Minute Volume Alarms

- 1 Verify the e500 is at standard test settings (see Table 6-1).



- 2 Set display to monitor the value for expiratory minute volume.



- 3 Change the mode to **Volume Control SIMV**.

- 4 Allow 60 seconds for the minute volume value to stabilize.

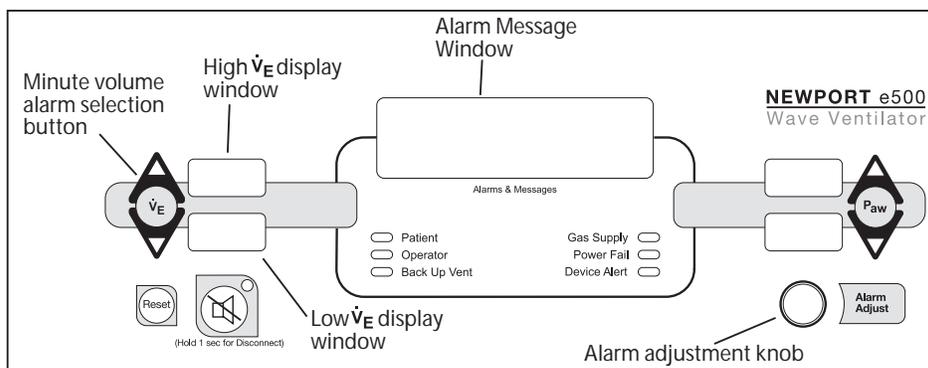


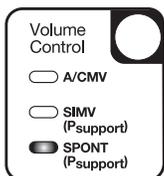
Figure 6-5 e500 Alarm section showing minute volume alarm controls.

- 5 Refer to Figure 6-5 and adjust the High Minute Volume Alarm limit to 2 L/min below the displayed monitored minute volume value. To do this, press the \dot{V}_E selection button until the “up” arrow LED lights, then rotate the Alarm Adjust knob until the desired value is displayed in the upper display window of the Minute Volume Alarm selection.
- 6 Verify that an audible alarm sounds, the minute volume monitor indicator flashes, and that High \dot{V}_E is displayed in the Alarm Message Window (shown in Figure 6-5).
- 7 Return the High Minute Volume Alarm limit setting to 50 L/min.

OPERATIONAL VERIFICATION PROCEDURE

- 8 Refer to Figure 6-5 and adjust the Low Minute Volume Alarm limit setting to 1 L/min above the monitored value.
- 9 Verify that an audible alarm sounds, the minute volume indicator flashes, and the Low \dot{V}_E and Back Up Ventilation messages are displayed.
- 10 Set the e500 to display the monitored value for **f_{tot}** .
- 11 Verify that:
 - the **f_{tot}** display = 15 b/min,
 - the Low \dot{V}_E alarm violation is canceled once the minute volume \dot{V}_E displayed value is greater than the Low \dot{V}_E alarm setting.
 - Back Up Ventilation is discontinued and the Back Up Vent indicator remains constant once the \dot{V}_E displayed value is at least 10% higher than the Low alarm setting.
- 12 Return the Low \dot{V}_E alarm limit setting to 1 L/min. After one minute, verify that the monitored value of **f_{tot}** is 10 b/min.
- 13 Press the Reset button and verify all visual alarm indicators are cleared.
- 14 Ensure that the e500 \dot{V} (**Flow**) is 30 L/min and the **V_T** is 500 mL.

Manual Inflation

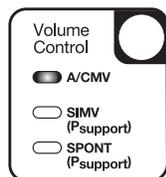


- 1 Set the e500 to **Volume Control SPONT**.



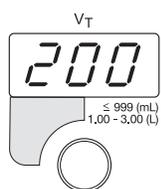
- 2 Press the **Manual Inflation** button.
- 3 Verify that a manual inflation is delivered while the button is pressed.

Inspiratory Tidal Volume

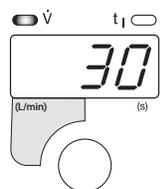


1 Set the e500 to **Volume Control A/CMV**.

2 Set the calibration analyzer to measure the volume in BTPS mode.



3 Set the e500 **V_T** (tidal volume) to 200 mL



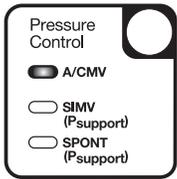
4 Set **\dot{V} (Flow)** to 30 L/min.

5 Record the calibration analyzer volume reading on the e500 Test Record.

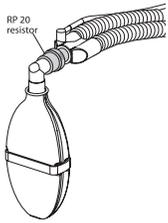
6 Repeat for **V_T** settings of 500 mL, 1 L, and 2 L.

OPERATIONAL VERIFICATION PROCEDURE

Proximal Line Disconnect



- 1 Set the e500 to **Pressure Control A/CMV**



- 2 Reconnect the RP20 restrictor between the test lung and the patient circuit.



- 3 Set the **P_{limit}** to 40.

- 4 Disconnect the proximal pressure line from GDU during the inspiratory phase (see Figure 6-6). Verify that the ventilator continues to deliver pressure control breaths and that the pressure is displayed on the pressure bar graph. Verify that the **Prox Line Disconnect** message is displayed, the audible alarm sounds, and the **Patient** alarm indicator flashes.

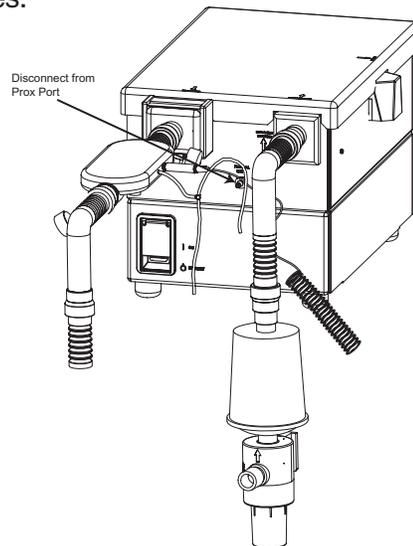


Figure 6-6 Proximal Pressure line disconnected

- 5 Reconnect the proximal pressure line and verify that the audible alarm is silenced, but that the **Prox Line Disconnect** message is still displayed and the **Patient** indicator is steadily lit. Check off on the record sheet.
- 6 Press the **Reset** button and verify that all visual alarm indicators are cleared.

Alarm Silence



(Hold 1 sec for Disconnect)

- 1 Create an alarm condition and wait for the alarm to sound.
- 2 Press the Alarm Silence button and verify that the indicator lights up. Using a stopwatch, verify that the audible alarm is silenced for 120 seconds.
- 3 Verify that the audible alarm resumes after 120 seconds. Check off on the record sheet.
- 4 Return e500 to standard test setting. Press reset to clear alarm indicators.

OPERATIONAL VERIFICATION PROCEDURE

High P_{aw} Alarm

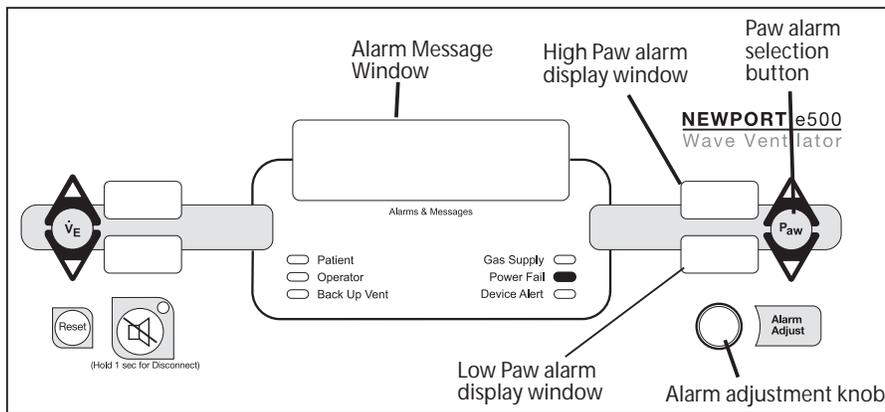
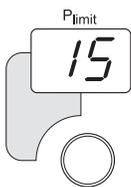


Figure 6-7 Alarm section showing P_{aw} alarm controls

- 1 Set e500 to display monitored **P_{peak}** value.
- 2 Refer to Figure 6-7. Decrease the **High P_{aw}** alarm limit below peak pressure (**P_{peak}**) to create a high pressure condition.
- 3 Verify that the message **High P_{aw}** is displayed, the High P_{aw} indicator flashes, and the audible alarm sounds when the pressure bar graph reaches the set High P_{aw} limit.
- 4 Verify that inspiration terminates when the alarm occurs.
- 5 Return the **High P_{aw}** alarm setting to 75. Check off on the record sheet.

Low P_{aw} Alarm

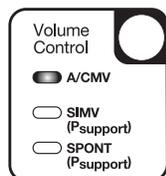


- 1 Set **P_{limit}** to 15.
- 2 Refer to Figure 6-7. Set the **Low P_{aw}** alarm setting above the P_{peak} value.
- 3 Verify that the message **Low P_{aw}** is displayed, and that the Low P_{aw} indicator flashes and audible alarm sounds at the end of the inspiration phase. Check off on the record sheet
- 4 Return the **Low P_{aw}** alarm setting to 10.

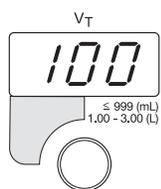
Sigh Function



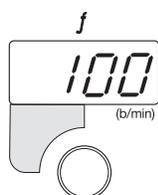
1 Set the e500 patient category to **Ped/Infant**.



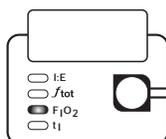
2 Set the e500 to **Volume Control A/CMV**.



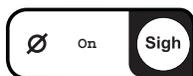
3 Set **VT** to 100 mL.



4 Set **f** to 100 b/min.



5 Set the e500 to display the monitored value for inspiratory time (**t_I**).



6 Press the **Sigh** button.

7 Verify after one minute (100 breaths) that monitored **t_I** becomes 0.30 seconds for one breath only and that this repeats for every 100th breath.

8 Return the e500 to standard setting per Table 6-1.

OPERATIONAL VERIFICATION PROCEDURE

Inspiratory and Expiratory Hold

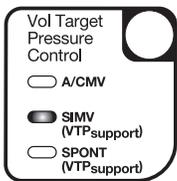


- 1 Press and hold the **Insp Hold** button for 2 seconds. Verify that the monitored **t_I** is approximately 2 seconds.



- 2 Press and hold the **Exp Hold** button for 2 seconds. Verify that the e500 does not deliver a breath for approximately 2 seconds.
- 3 Re-set the e500 to standard test settings (Table 6-1).

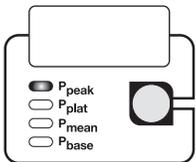
Volume Target Pressure Control (VTPC)



- 1 Set the e500 to **Vol Target Pressure Control SIMV**.



- 2 Set the **P_{limit}** to 40.



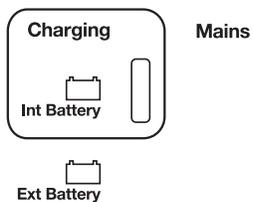
- 3 Set the pressure monitor to read **P_{peak}**.
- 4 Using a calibration analyzer, verify that the delivered inspiratory tidal volume is 500 mL \pm 10%.
- 5 Set **P_{limit}** to 5 cmH₂O (5 mbar) below the monitored **P_{peak}** value.
- 6 Verify that the alarm message **Volume Target Not Met** is displayed in the message window.



- 7 Set the **Plimit** to 40.
- 8 Verify that the alarm is cancelled and delivered inspiratory tidal volume is 500 mL \pm 10%.
- 9 Re-set the e500 to standard test settings (Table 6-1).

Loss of Power Alarm and Battery Operation

- 1 Disconnect the power cord from the AC power source.
- 2 Verify that the messages **AC Power Loss and Battery Back Up** are displayed in the message window. Verify that the audible alarm sounds, the **Power Fail** indicator flashes, and the **Internal Battery** indicator lights.



- 3 Verify that at least 3 bars of the charge bar graph are lit.
- 4 Reconnect the power cord to the AC power source.

OPERATIONAL VERIFICATION PROCEDURE

Expiratory Tidal Volume

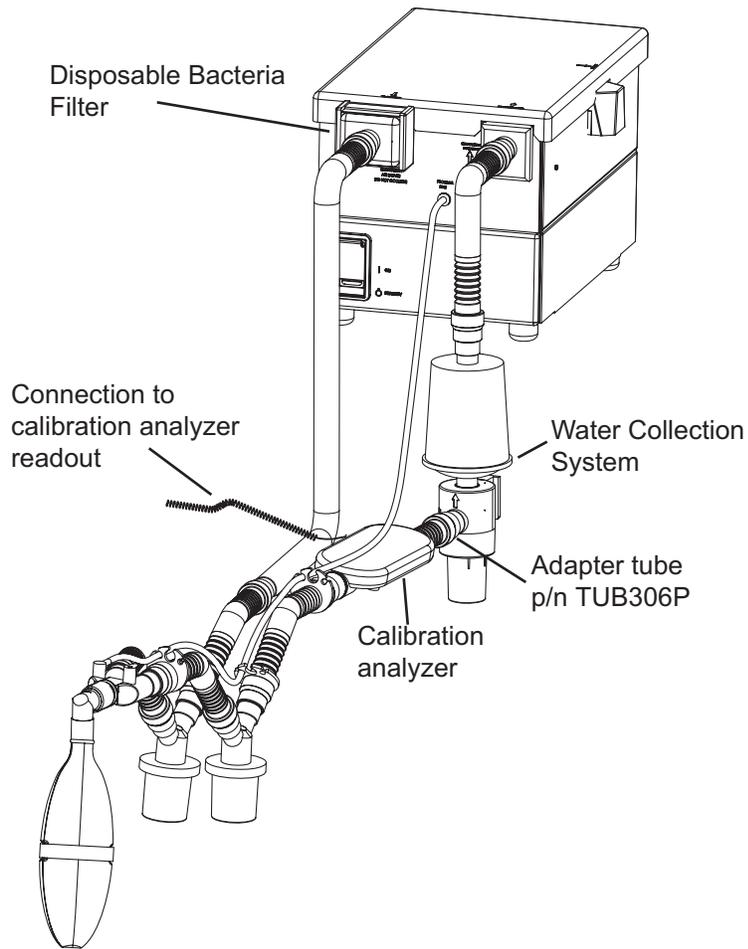
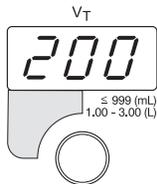


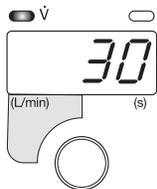
Figure 6-8 Expiratory tidal volume test setup

Expiratory tidal volume (cont)

- 1 Using an adapter tube, connect the calibration analyzer between the expiratory limb of the breathing circuit and the expiratory inlet of the ventilator and remove the RP20 resistor from the test lung (see Figure 6-8).
- 2 Set the calibration analyzer to measure the expiratory volume in ATP mode.



- 3 Set the e500 V_T to 200 mL



- 4 Set the e500 \dot{V} (Flow) to 30 L/min.
- 5 Record the monitored values shown on both the calibration analyzer and the e500 V_{TE} display on the e500 Test Record sheet. The two values must be within 20% of one another to pass this test.
- 6 Repeat the test with V_T settings for 500 mL, 1.0 L, and 2.0 L.

OPERATIONAL VERIFICATION PROCEDURE

e500 OVP TEST RECORD SHEET

Hospital or Organization _____	
GDU Serial Number _____	Hour Meter _____ Software Rev. _____
Control Panel Serial Number _____	Software Rev. _____
GDM Serial Number _____	Software Rev. _____
Service Technician _____	Date _____
Released by _____	Date _____

Test Equipment:	ID No.	Electrical Safety Test	Tol.	Value
Calibration Analyzer		Ground resistance	<0.1Ω	
Oxygen Analyzer		Max leakage current	<100μ A	
Electrical Safety Analyzer				
Digital Multimeter		Main Flow (L/min)		
		Set	Actual	TSI Certified analyzer BTPS compensated
Test	Pass	5		3-5 4-6
Front panel LED check		10		8-10 9-11
Pneumatic leak test		20		16-20 4-6
F _I O ₂		40		32-38 37-43
Loss of gas alarms (air/O ₂)		60		50-56 57-63
Main flow		80		66-76 75-85
Bias flow		100		84-94 95-105
Inspiratory time		Insp. Time (sec)		
Respiratory rate		Set		Tol. Range
I:E ratio		0.25		0.2-0.3
Pressure control		0.5		0.4-0.6
Pressure support		1.0		0.9-1.1
Prox line purge		2.0		1.9-2.1
P _{trig} sensitivity		3.0		2.9-3.1
PEEP/CPAP		Respiratory Rate (b/min)		
•VE alarms, high, low & BU _V		Set	Pass	Tol. Range
Manual inflation		5		4-6
Insp. Tidal volume		10		9-11
Prox. Line disconnect		20		19-21
Alarm silence		40		39-41
High Paw alarm		60		59-61
Low Paw alarm		80		79-81

e500 OVP TEST RECORD SHEET (CONTINUED)

External alarm silence (option)			Pressure Control (cmH ₂ O)		
Sigh function			Set	Actual	Tol. Range
Insp. and exp. hold			10		9-11
VTPC Vol. Targe Pressure Control			20		18-22
Loss of power/battery operation			30		27-33
Exp. Tidal volume (V _T E)			60		57-63
Pressure Support (cmH ₂ O)			F _I O ₂		
Set	Actual	Tol. Range	Set	Actual	Tol. Range
OFF		0	21		21-24
10		>10	40		37-43
20		>20	60		57-63
30		>30	80		77-83
50		>50	100		97-100
Pressure Support (cmH ₂ O)			Exp. Tidal Volume		
Set	Actual	Tol. Range	Set	V _T E Display	Analyzer Display
200mL		180-220	200		
500mL		450-550	500		
1.00L		900-1.1	1.00		
2.00L		1.8-2.2	2.00		
PEEP/CPAP					
Set	Actual	Tol. Range			
3		2-4			
5		4-6			
10		8-12			
20		18-22			
30		27-33			
45		42-48			

Appendix A. Theory of Operation

Inhalation System	A-1
Exhalation System	A-3
Electronics.	A-4
Safety Mechanisms	A-4

The e500 Gas Delivery Unit (GDU) includes these subsystems:

- Inhalation system
- Exhalation system
- Electronics
- Safety mechanisms

INHALATION SYSTEM

The inhalation system, shown in Figure A-1, supplies gas according to the user-selected breath delivery settings.

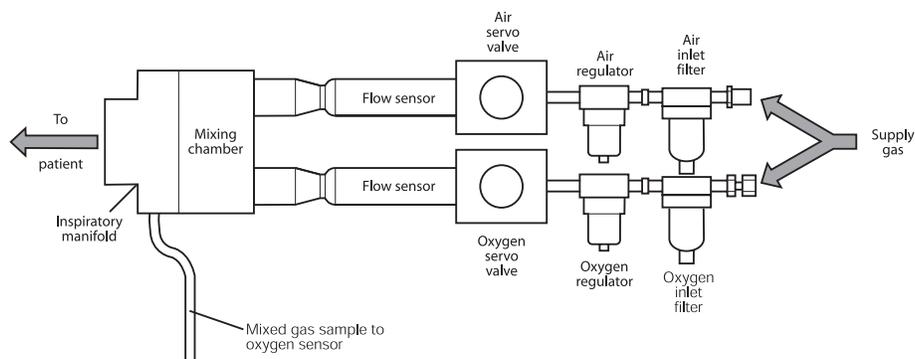


Figure A-1. Inhalation System

Supply gas enters the inlet filters (one for oxygen and one for air) at a pressure of 30 to 90 pounds per square inch gauge (psig). Each inlet filter traps particles as small as 40 microns and includes a water trap to collect any water in the supply gas.

The filtered supply gas then enters a regulator that regulates pressure from 30 to 90 psig down to 15 psig. Transducers monitor pressure at the regulators, and generate a low inlet pressure alarm in case of an excessive pressure drop at either regulator.

The regulated gas enters the servo valves, which control the flow of gas to the patient. A Servo Valve Calibration creates a lookup table of the currents required to generate a range of flows from the servo valve. The lookup table allows the ventilator to target the set flow as quickly as possible, and feedback from flow sensors every 10 milliseconds allows the ventilator to refine flow delivery. Because the lookup table is unique to each combination of regulator and servo valve, the Servo Valve Calibration must be re-run when either component is replaced. Most of the gas pressure drops across the servo valves, and gas exiting the servo valves is close to patient pressure.

Downstream of the air and oxygen servo valves are flow sensors. The microprocessor provides a closed loop control system between the sensors and the valves to regulate the flow output of the valves. Each flow sensor is a hot wire anemometer: as gas flows through the sensor, it cools the wire. The flow sensor adjusts power to keep wire temperature constant, and the power required relates to the flow across the wire. Each flow sensor is factory-calibrated for air or oxygen.

Air and oxygen then enter the mixing chamber, where they are combined using a static blender and a screen mesh. The blended gas exits to the patient circuit through the inspiratory manifold. The inspiratory manifold also includes the emergency intake/relief valve.

A small tube from the inspiratory manifold uses a venturi flow to sample a small amount of mixed gas for the oxygen sensor, where it is monitored and compared to the set $F_{I}O_2$. Because the oxygen sensor is sensitive to changes in atmospheric pressure and temperature, the ventilator calibrates the oxygen sensor at power up and periodically during normal operation. During calibration, the oxygen calibration solenoid is energized and sends 100% oxygen (from the oxygen inlet) to the oxygen sensor for about three minutes. Ventilator software assigns an $F_{I}O_2$ of 1.0 to the voltage read during calibration. If selected in the monitor window, the $F_{I}O_2$ display shows "---" until the calibration is complete.

During exhalation, the inhalation system supplies a bias flow of 3.0 L/min through the patient circuit to flush exhaled CO_2 and stabilize temperature, humidity, and baseline pressure. If bias flow exiting the exhalation system drops, the inhalation system increases flow output to compensate for a possible leak. Maximum leak compensation is determined by the patient type (Ped/Infant = 8.0 L/min, Adult = 15.0 L/min).

The ventilator uses proximal pressure tubing to sense pressure at the patient wye. A low flow of approximately 0.05 L/min of air through the proximal pressure tubing keeps moisture from collecting in the proximal line during normal ventilation. When the ventilator is powered down but still connected to gas (for example, when the power switch is toggled to Standby position or during a Device Alert), the proximal pressure tubing supplies 8.0 ± 2.0 L/min of air to the patient if possible.

A transducer monitors the pressure of the internal ventilator compartment, acting as a backup to the proximal pressure transducers. A proximal transducer rezero solenoid maintains an accurate zero point for the proximal pressure transducers by opening periodically to note the voltage that equals atmospheric (zero) pressure.

EXHALATION SYSTEM

The exhalation system, shown in Figure A-2, measures the flows and volumes of gas exhaled from the patient circuit and controls the exhalation valve to allow exhalation and maintain PEEP in the patient circuit.

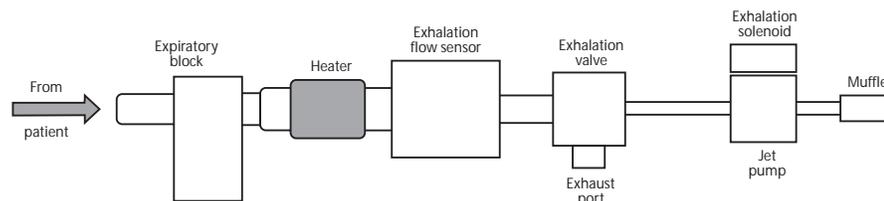


Figure A-2. Exhalation System

Because gas exhaled from the patient is humidified to 100% relative humidity, the water collection system includes a water trap to collect condensate that forms as the exhaled gas cools. The Plunger Assembly closes the water trap port when the cup is removed for emptying. This maintains a closed circuit and prevents circuit pressure loss.

The heater then heats gas from the expiratory block to prevent further condensation in the exhalation flow sensor. The exhalation flow sensor includes a screen that creates a known pressure drop (determined by the diameter of the screen wires) at various flow rates. By measuring the pressure before and after the screen, the ventilator determines the flow of the exhaled gas. The exhalation flow sensor is factory-tested, and does not require further calibration. A re-zero solenoid maintains an accurate zero point for the exhalation flow sensor transducer by opening at power up and periodically during normal operation to note the voltage that equals atmospheric (zero) pressure.

Gas from the exhalation flow sensor flows to the exhalation valve. The exhalation valve includes a flexible silicone exhalation diaphragm. Drive pressure from the jet pump opens and closes the diaphragm to allow inspiration, exhalation, and maintain PEEP.

The Exhalation Solenoid valve is a small servo valve that varies its current to control the outlet flow to the exhalation valve diaphragm. Gas from the Exhalation Solenoid valve enters the jet pump, where it flows through a jet nozzle to create drive pressure to the exhalation valve diaphragm.

THEORY OF OPERATION

A pressure transducer that monitors exhalation drive line pressure tells the Exhalation Solenoid to increase or decrease its output to achieve the correct drive pressure so that measured PEEP equals set PEEP. In case of a circuit disconnect or large breathing circuit leak, these reference pressures help avoid supplying excess pressure in an effort to compensate for a disconnect. Excess flow from the jet pump vents through the muffler.

ELECTRONICS

Power to the ventilator enters the AC inlet, which connects to the power supply. The power supply converts alternating current to direct current, and accepts any specified voltage or frequency without adjustment.

Direct current from the power supply enters the DC-DC power supply PCB, which supplies operating voltage to other PCBs, including charging for the internal battery. The DC-DC power supply PCB also powers the fan, hour meter, and heater.

The Main PCB accepts input from oxygen sensor, air and oxygen servo valves, and acts as motherboard for the ventilator. The Main PCB powers and receives signals from the Analog PCB.

The Back Panel PCB includes circuitry for the alarm volume control as well as the following connections: serial port, Control Panel cable, Graphics Display Module cable, Remote Alarm cable, External Alarm Silence cable, and External Battery cable.

The Analog PCB receives signals from the flow sensors and contains all ventilator pressure transducers.

The Solenoid PCB contains all valve controls (solenoids) except for the air, oxygen, and exhalation servo valves.

SAFETY MECHANISMS

The e500 ventilator provides the means to relieve excess pressure or allow patient access to ambient air, if necessary. In the case of a device alert, excess pressure, or power down with gas supplies connected, the software opens the exhalation valve and emergency intake/relief valve, and a power-down solenoid delivers 8.0 ± 2.0 L/min of air through the proximal pressure tubing.

Ventilator hardware safety mechanisms act as backups to the software safety mechanisms. If software cannot manage an excess pressure condition, the exhalation valve relieves pressure at about 135 cmH₂O (132 mbar) and the emergency intake/relief valve vents at about 140 cmH₂O (137 mbar).

Appendix B. Ordering and Contact Information

Ordering Parts and Kits from	
Customer Service.	B-1
To Contact Technical Support.	B-4
To Return Your e500 for Repair.	B-4

Ordering Parts and Kits from Customer Service

This section lists field-replaceable parts and maintenance kits for the e500 Ventilator. For more information about parts or ordering, contact Newport Customer Service:

Telephone (voice mail):

800.451.3111, extension 282 (only in USA)
949.642.3910, extension 282

Fax:

949.548.3091

Customer Service department hours:

Monday through Friday, 8:00 am to 5:00 pm (USA Pacific Time)

NOTE: For complete listing of the e500 parts, see Appendix C Diagrams and Schematics with Parts Lists.

Table B-1. Gas Delivery Unit Serviceable parts

Description	Part Number
Battery, internal, 12 VDC, 7.2 A	BAT1800P
Buzzer, alarm	BZR1001P
Check valves, crossover	VLV1805P
Diaphragm, exhalation valve assembly	PPT1805A
Flow sensor, air	FTD1800P
Flow sensor, oxygen	FTD1801P
Fuse, 2A slo-blo, 5 x 20 mm, two each (used in AC power unit)	FUS1802Q
Hour meter	MTR1800M
Oxygen sensor	R125P03-002
PCB, analog	PCB1850S
PCB, back panel	PCB1840A
PCB, DC-DC power supply	PCB1831A
PCB, main (does not include EPROMs)	PCB1800A
PCB, solenoid	PCB1820A
Water Collection Cannister Assembly	WCC1820A
Water Collection System with Filter Upgrade Kit	WCV1800A
Water Collection System without Filter Upgrade Kit	WCV1801A
Filter	FTR1800P
Canister	BDY1802A
Water trap cup	CUP1800P
Plunger Assembly	PLU1820A

ORDERING AND CONTACT INFORMATION

Table B-1. Gas Delivery Unit Serviceable parts cont.

Description	Part Number
Power cord, 120 VAC (AC wall supply to AC input)	PWR1500P
Power supply	PWR1800P
Regulator air/oxygen inlet (2 ea)	REG1800P
Regulator, safety valve	REG1802P
Switch, power	SWI1800P
Valve, servo, air	SVO1805P
Valve, servo, oxygen	SVO1805P
Water trap/filter, air/oxygen (2 ea)	WTR1800P
Finger guard and filter, fan assembly	GRD1800P
Exhalation Flow Sensor Kit	FSK1800A

Table B-2. Control Panel Module (CPM) Serviceable parts

Membrane switch assembly	PNL1819A-1
Message window	MOD1800P
Optical encoder	ENC1800P
PCB, control panel (does not include EPROM)	PCB1810A

Table B-3. Overhaul and preventive maintenance kits

Overhaul Kit (part number OVL500A) includes:		
Inlet filter and o-ring	JFK100P	2
Exhalation valve diaphragm	DIA1800M	1
Air and oxygen inlet regulator rebuild kit	RRK1800P	2
Exhaust muffler	SIL1801P	1
Battery	BAT1800P	1
Exhalation valve poppet assembly	PPT1805A	1
Preventive Maintenance Kit (PMK500A) includes:		
Inlet filter and o-ring	JFK100P	2
Exhalation valve poppet assembly	PPT1805A	1

Table B-4. Regulator rebuild kit

Regulator rebuild kit (RRK1800P) includes:		
Valve spring, 2.21 lb/in .56 long	N/A	1
Nitrile ball	N/A	1
O-ring, nitrile	N/A	1
Valve seat, acetal	N/A	1
Slip ring, acetal	N/A	2
Diaphragm	N/A	1

Table B-5. Exhalation Module Assembly

Exhalation Module Assembly (EXH1802A) includes:		
Mainfold, Exhalation Inlet	MFD1808M	1
Screw, captive panel, 6-32x25/32	SCC632P	4
Gasket, m5	GKT1800P	2
Plug vent jet hsg clippard	PLG400P	2
Fitting, 10-32 unf to 1/8id hose	FTG1813P	2
Screen assembly, Exhalation Flow	SCN1800A	1
O-ring silicone #32	ORGS032Q	2
Coupling, heat exchanger	CPL1800M	1
Coupling exhalation sensor	CPL1802M	1
Exhalation valve final assy	EXH1801A	1
Assy, heat exchanger tube sensor	HSG1801A	1
Housing Low Pressure	HSG1801M	1

ORDERING AND CONTACT INFORMATION

TO CONTACT TECHNICAL SUPPORT

Contact Newport Medical Instruments Technical Support using one of the contact information numbers below.

Phone: 800.451.3111, extension 500 (US only)
949.642.3910, extension 500

Fax: 949.645.2049 (technical service dept.)
email: techsupport@NewportNMI.com.

Email: TechService@newportnmi.com

For maintenance, warranty, or non-warranty repairs: dial extension 500 to reach the Technical Service department.

For other returns: dial extension 282 to reach the Customer Service department.

TO RETURN YOUR e500 FOR REPAIR

Follow these steps to return your e500 Ventilator for repair:

- 1 Obtain a returned goods authorization (RGA) number from Newport Technical Support at the numbers given above. The RGA number helps to identify your repair and avoid service delays.
- 2 Unless requested to do otherwise, remove all accessories from the ventilator except the inlet water traps. Do not send accessories to Newport.
- 3 Package the ventilator in the original packing material, if available. If the original packing material is not available, call the Technical Service department to order a replacement box. Package parts or accessories (if requested) for safe shipping (original packing materials are not required).
- 4 Address the shipping label to Newport's courier delivery address, including the RGA number:

Newport Medical Instruments
760 West 16th Street
Building B
Costa Mesa, CA 92627
USA

RGA Number: _____

Appendix C. Diagrams and Schematics

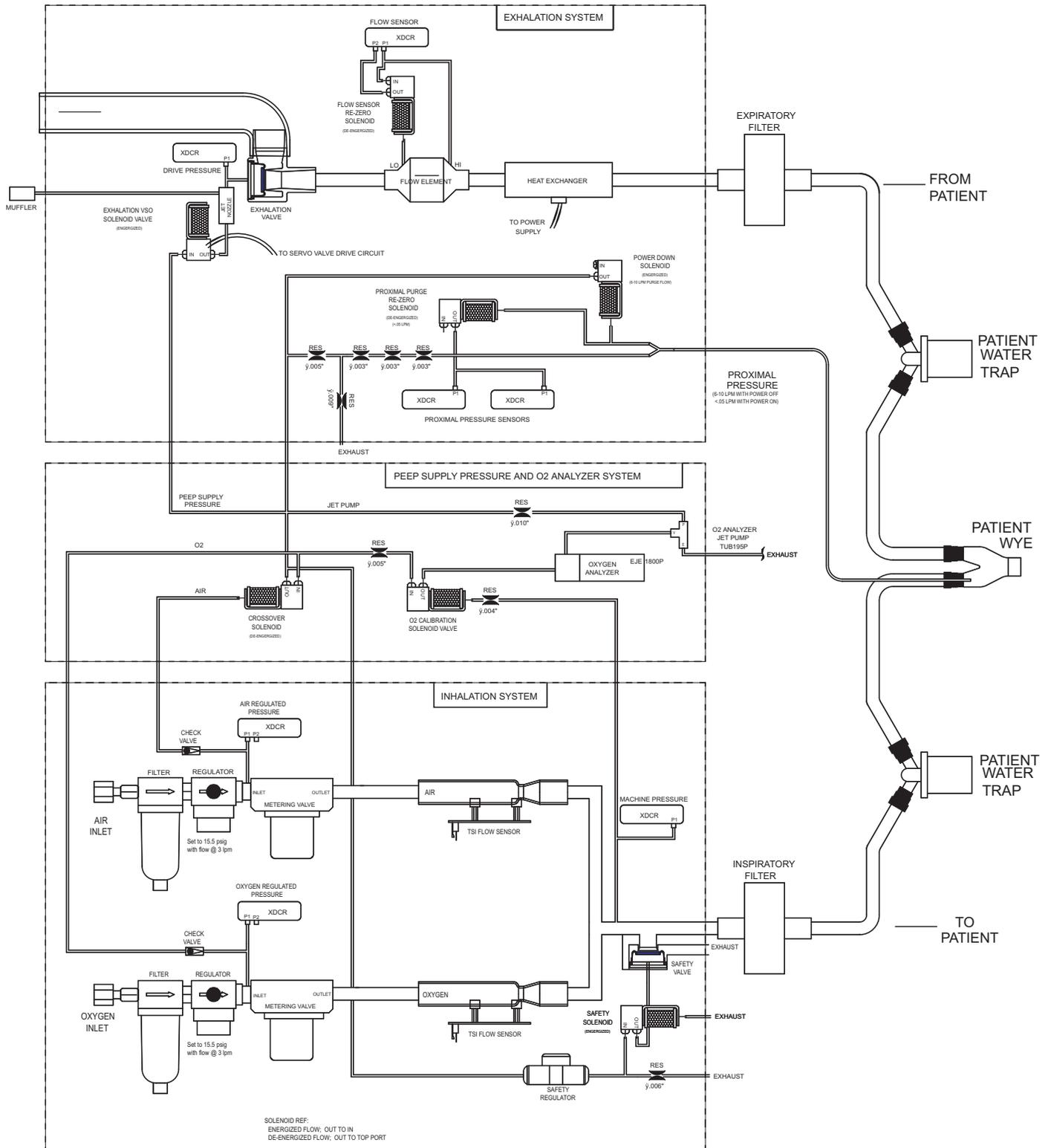
e500 Pneumatic Diagram	C-2
Pneumatic System	C-4
e500 GDU System Wiring	C-6
CPM System Wiring	C-7
Final Box Assembly	C-9
Control Panel Module	C-11
Electronic Box Assembly	C-14
Pneumatic Box Assembly	C-19
Exhalation Module Assembly	C-23

APPENDIX C DIAGRAMS AND SCHEMATICS

The drawings and schematics presented in this manual are for reference purposes only. It is possible that later versions of these documents may become available after this manual print date. Newport Medical Instruments will provide, upon request and to qualified persons, any and all diagrams, technical drawings and other information necessary to repair, maintain or service the e500 Ventilator systems. Contact Newport Medical Instruments Technical Support (see Appendix B) for information.

e500 Pneumatic Diagram**Pneumatic System Diagram****e500 GDU System Wiring Diagram, Gas Delivery Unit****e500 CPM System Wiring Diagram****Final Box Assembly****Control Panel Module Assembly****Electronics Box Assembly (2 sheets)****Pneumatic Box Assembly (3 sheets)****Exhalation Module Assembly**

NOTE: See Appendix D for e500 Graphics Display Monitor Service instructions and diagrams.

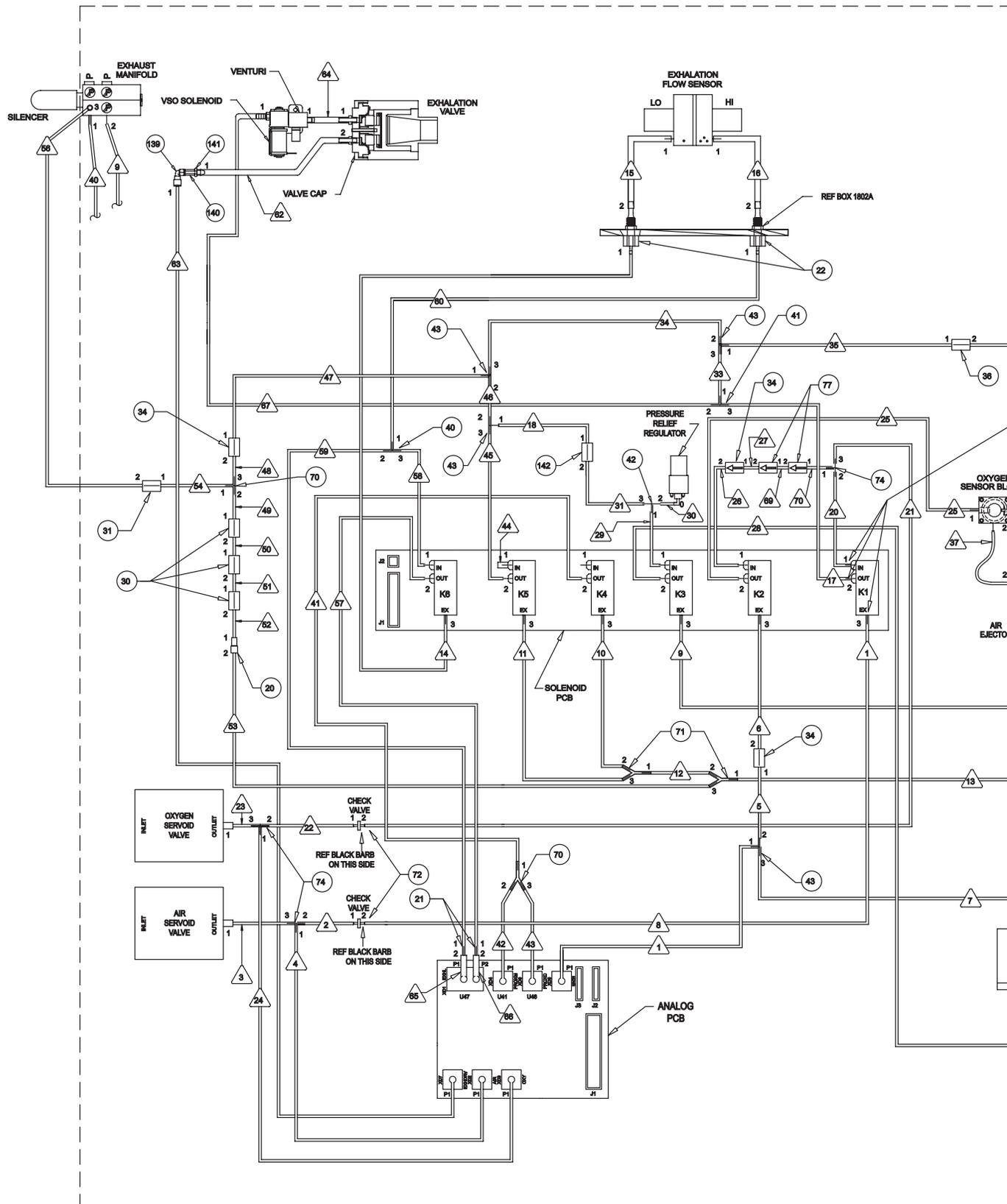


Pneumatic Diagram

PARTS LIST, PNEUMATIC SYSTEM

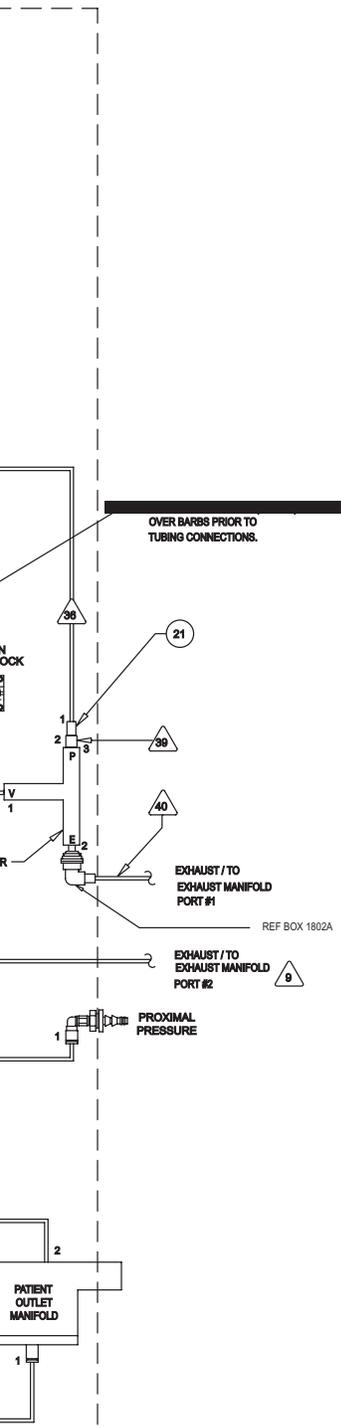
Part number	Description	Qty	Item No.
FTG1814P	FITTING, 3/32 ID TUBE TO 1/16 ID TUBE	1.00	20
FTG1815P	REDUCER, 1/8 X 1/16 WHITE, NYLON	4.00	21
FTG1817P	FITTING, MALE 1/16ID HOSE	2.00	22
RES15030P	RESTRICTOR, .003, INLINE 1/16" ID TUBE	3.00	30
RES1509P	RESTRICTOR, .009, INLINE, 1/16" ID TUBE	1.00	31
RES1805P	RESTRICTOR, .005 FILTERED ORIFICE	2.00	34
RES1810P	RESTRICTOR, .010 FILTERED ORIFICE	1.00	36
TEE1550P	TEE, 1/16 TUBE	1.00	40
TEE1553P	TEE, 1/16 TO 3/32 BARBS, WHITE, NYLON	2.00	42
TEE1554P	TEE, 3/32 TO 1/16 BARBS, WHITE, NYLON	5.00	43
TUB1200P	TUBING SILICONE 1/8 ID	1.20	50
TUB174P	TUBING, YELLOW POLY, 3.2MM 1/8" OD	6.34	51
TUB181P	TUBING, BLUE POLY,4MM 5/32" OD X 2.5MM ID	0.89	52
TUB184P	TUBING, YELLOW POLY,4MM 5/32" OD X 2.5MM ID	1.57	53
TUB195P	TUBING, 1/4OD GREEN	1.71	55
TUB105P	GREEN URE TUBING 1/16 X 1/8	0.46	56
TUB102P	RED URE TUBING 1/16 X 1/8	1.59	57
TUB106P	BLUE URE TUBING 1/16 X 1/8	0.21	58
TUB100P	CLEAR URE TUBING 1/16 X 1/8	1.27	59
TUB103P	ORANGE URE TUBING 1/16 X 1/8	0.13	60
YCN1800P	Y CONNECTOR 1/16" HOSE, WHITE, NYLON	2.00	70
YCN1801P	Y CONNECTOR, 3/32, WHITE, NYLON	2.00	71
ELB1802P	STEM ELBOW 1/4"OD X 1/4" OD	1.00	138
TUB301P	BLUE TRANS TUBING 1/8' X 1/4'	2.50	73
TEE1800Q	Tee, Reducer 1/8 x 1/16	3.00	74
TEE1801Q	Tee, Reducer	1.00	41
RES1804P	RESTRICTOR, .004 FILTERED ORIFICE	1.00	77
VLV1805P	Check Valve - 1/16" Barb	2.00	72
ELB1800P	ELBOW, 1/8"OD X 10-32 UNF MALE	1.00	139
CPL100P	COUPLER HEX	1.00	140
CON200P	CONNECTOR 1/8T X 10-32M	1.00	141
RES1811P	RESTRICTOR,.008, INLINE, 1/16 BARBED, NICKEL	1.00	142

DIAGRAMS AND SCHEMATICS



1. DENOTES TUBE. 
 NOTES: UNLESS OTHERWISE SPECIFIED

TUBING CONNECTIONS									
TUBE	FROM			TO			TUBE		
	LOCATION	ITEM NO.	PORT	LOCATION	ITEM NO.	PORT	I.D & LENGTH"	ITEM NO.	COLOR
1	SOL. VALVE K1	-	3	CHECK VALVE	72	2	1/8 X 2 1/2	73	BLUE
2	TEE	74	2	CHECK VALVE	72	1	1/8 X 2 1/4	73	BLUE
3	TEE	74	3	SERVOID VALVE /AIR	-	1	1/8 X 3 3/4	73	BLUE
4	TEE	74	1	ANALOG PCB	-	XD2 P1	1/16 X 2 1/2	58	BLUE
5	TEE	43	2	RESTRICTOR/.005"	34	1	3/32 X 1	53	YELLOW
6	SOL. VALVE K2	-	3	RESTRICTOR/.005"	34	2	3/32 X 1	53	YELLOW
7	TEE	43	1	MANIFOLD/PATIENT OUTLET	-	2	3/32 X 6	53	YELLOW
8	TEE	43	3	ANALOG PCB	-	XD5 P1	1/16 X 1	59	CLEAR
9	SOL. VALVE K3	-	3	EXHAUST MANIFOLD	-	2	1/16 X 14	51	YELLOW
10	SOL. VALVE K4	-	3	WYE	71	2	3/32 X 1	52	BLUE
11	SOL. VALVE K5	-	3	WYE	71	3	3/32 X 1 1/2	52	BLUE
12	WYE	71	1	WYE	71	2	3/32 X 1 1/2	52	BLUE
13	WYE	71	1	ELBOW FITTING/PROXIMAL	-	1	3/32 X 3 1/2	52	BLUE
14	SOL. VALVE K6	-	3	BKHD FITTING/LO PRESSURE	22	1	1/16 X 5 1/2	57	RED
15	BKHD FITTING/LO PRESSURE	-	2	EXHALATION FLOW SENSOR/LO	-	1	1/8 X 3	50	SILICONE
16	BKHD FITTING/HI PRESSURE	-	2	EXHALATION FLOW SENSOR/HI	-	1	1/8 X 3 1/2	50	SILICONE
17	SOL. VALVE K1	-	2	TEE	41	3	3/32 X 3 1/2	73	BLUE
18	TEE	43	1	RESTRICTOR/.008/NICKLE	142	1	1/16 X 3/4	51	YELLOW
19	TEE	43	3	TEE	41	3	3/32 X 3/4	53	YELLOW
20	SOL. VALVE K1	-	1	TEE	74	2	1/8 X 3 1/2	73	BLUE
21	TEE	74	3	CHECK VALVE	72	2	1/8 X 1 1/2	73	BLUE
22	CHECK VALVE	72	1	TEE	74	2	1/8 X 1 1/2	73	BLUE
23	TEE	74	3	SERVOID VALVE/OXYGEN	-	1	1/8 X 4 1/2	73	BLUE
24	TEE	43	1	ANALOG PCB	-	XD3 P1	1/16 X 2 3/4	56	GREEN
25	SOL. VALVE K2	-	2	O2 SENSOR BLOCK	-	1	3/32 X 1 1/2	53	YELLOW
26	SOL. VALVE K2	-	1	RESTRICTOR/.005" FILTERED/GREEN	34	2	1/16 X 1	56	GREEN
27	RESTRICTOR/.005" FILTERED/GREEN	34	1	RESTRICTOR/.004" FILTERED/PURPLE	77	2	1/16 X 2	56	GREEN
28	SOL. VALVE K3	-	2	MANIFOLD/PATIENT OUTLET	-	1	1/16 X 10	51	YELLOW
29	SOL. VALVE K3	-	1	TEE	42	1	3/32 X 5	53	YELLOW
30	TEE	42	2	PRESSURE RELIEF REGULATOR	-	0	1/16 X 4	51	YELLOW
31	RESTRICTOR/.008"/NICKLE	142	2	TEE	42	3	1/16 X 3/4	51	YELLOW
32	----	----	----	----	----	----	----	----	----
33	TEE	41	1	TEE	43	3	3/32 X 3/4	53	YELLOW
34	TEE	43	2	TEE	43	3	3/32 X 1	53	YELLOW
35	TEE	43	1	RESTRICTOR/.012" FILTERED/BLACK	36	1	1/16 X 3 1/4	51	YELLOW
36	RESTRICTOR/.012" FILTERED/BLACK	36	2	FITTING	21	1	1/16 X 3 1/4	51	YELLOW
37	O2 SENSOR BLOCK	-	2	AIR EJECTOR	-	1	1/8 X 3	73	BLUE
38	----	----	----	----	----	----	----	----	----
39	FITTING	21	2	AIR EJECTOR	-	3	1/4 X 1 1/2	55	GREEN
40	FITTING/ELBOW	-	2	EXHAUST MANIFOLD	-	1	1/4 X 16 1/2	55	GREEN
41	SOL. VALVE K4	-	2	WYE	70	1	1/16 X 3	59	CLEAR
42	WYE	70	3	ANALOG PCB	-	XD6 P1	1/16 X 1 3/4	59	CLEAR
43	WYE	70	2	ANALOG PCB	-	XD4 P1	1/16 X 1 3/4	59	CLEAR
44	SOL. VALVE K5	-	1	PLUG	-	-	1/16 X 1 1/2	60	ORANGE
45	SOL. VALVE K5	-	2	TEE	43	3	3/32 X 1	53	YELLOW
46	TEE	43	2	TEE	43	2	3/32 X 1	53	YELLOW
47	TEE	43	1	RESTRICTOR/.005" FILTERED/GREEN	34	1	1/16 X 3/4	51	YELLOW
48	RESTRICTOR/.005" FILT/GREEN	34	2	TEE	40	3	1/16 X 3/4	51	YELLOW
49	TEE	40	2	RESTRICTOR/.003"/ORANGE	30	1	1/16 X 3/4	51	YELLOW
50	RESTRICTOR/.003"/ORANGE	30	2	RESTRICTOR/.003"/ORANGE	30	1	1/16 X 3/4	51	YELLOW
51	RESTRICTOR/.003"/ORANGE	30	2	RESTRICTOR/.003"/ORANGE	30	1	1/16 X 3/4	51	YELLOW
52	RESTRICTOR/.003"/ORANGE	30	2	FITTING	20	1	1/16 X 3/4	51	YELLOW
53	FITTING	20	2	WYE	71	3	3/32 X 1	52	BLUE
54	TEE	40	1	RESTRICTOR/.009"/PURPLE	31	1	1/16 X 3/4	51	YELLOW
55	----	----	----	----	----	----	----	----	----
56	RESTRICTOR/.009"/PURPLE	31	2	EXHAUST MANIFOLD	-	3	1/16 X 11 1/2	51	YELLOW
57	SOL. VALVE K6	-	2	FITTING	21	1	1/16 X 3 1/2	57	RED
58	SOL. VALVE K6	-	1	TEE	40	3	1/16 X 3/4	57	RED
59	TEE	40	2	FITTING	21	1	1/16 X 3 1/8	57	RED
60	TEE	40	1	BKHD FITTING/HI PRESSURE	22	1	1/16 X 6 1/4	57	RED
61	----	----	----	----	----	----	----	----	----
62	CONNECTOR	141	1	VALVE CAP	-	2	1/8 X 1 3/4	50	SILICONE
63	ELBOW	139	1	ANALOG PCB	-	XD7 P1	1/16 X 12	51	YELLOW
64	VENTURI	-	1	VALVE CAP	-	1	1/8 X 1 3/4	50	SILICONE
65	FITTING	21	2	ANALOG PCB	-	XD1 P1	1/8 X 1	50	SILICONE
66	FITTING	21	2	ANALOG PCB	-	XD1 P2	1/8 X 1	50	SILICONE
67	TEE	41	2	VSO VALVE	-	1	1/8 X 16	73	BLUE
68	----	----	----	----	----	----	----	----	----
69	RESTRICTOR/.004" FILTERED/PURPLE	69	2	RESTRICTOR/.004" FILTERED/PURPLE	77	2	1/16 X 1	56	GREEN
70	RESTRICTOR/.004" FILTERED/PURPLE	70	1	TEE	74	1	1/16 X 1	56	GREEN

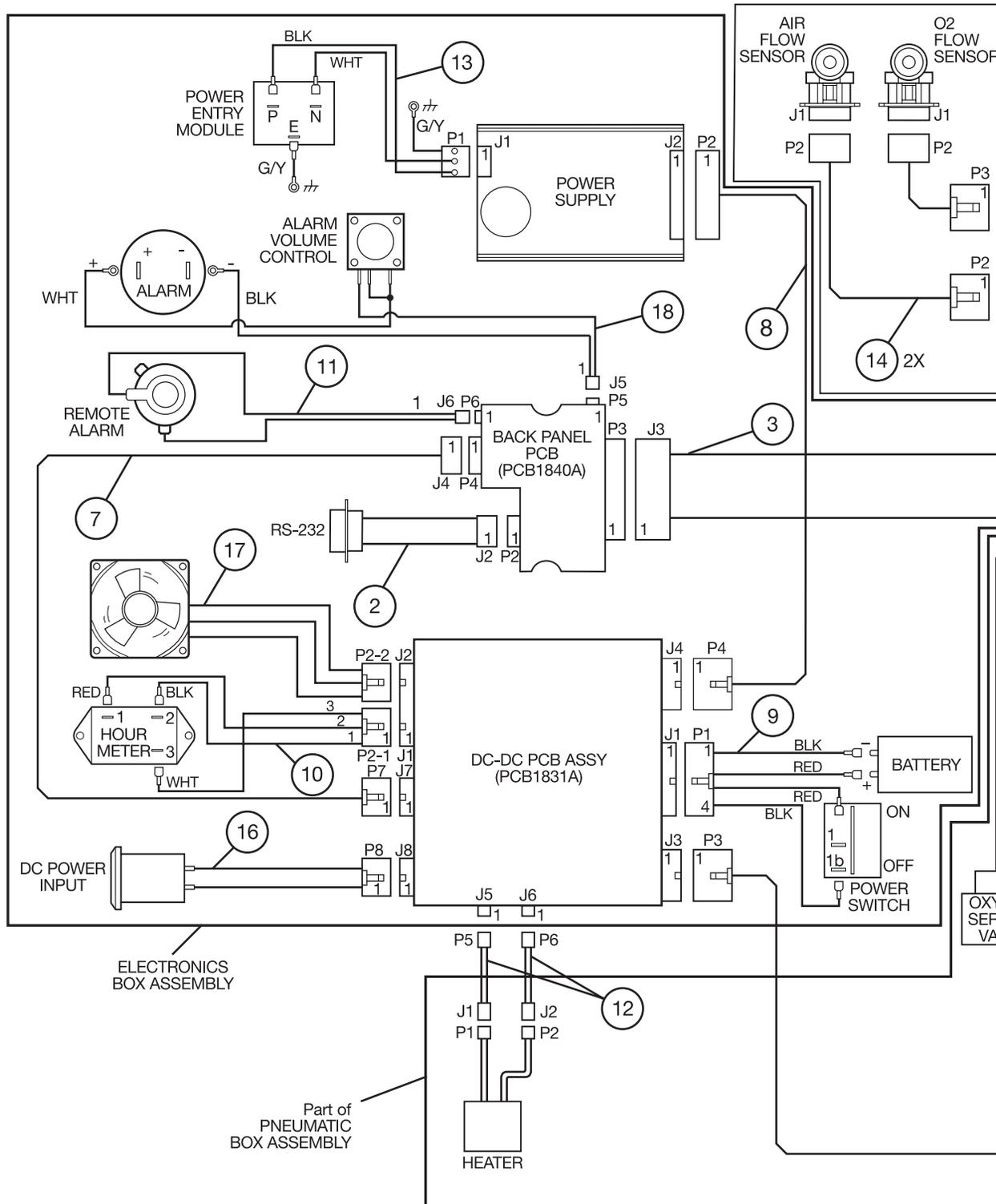


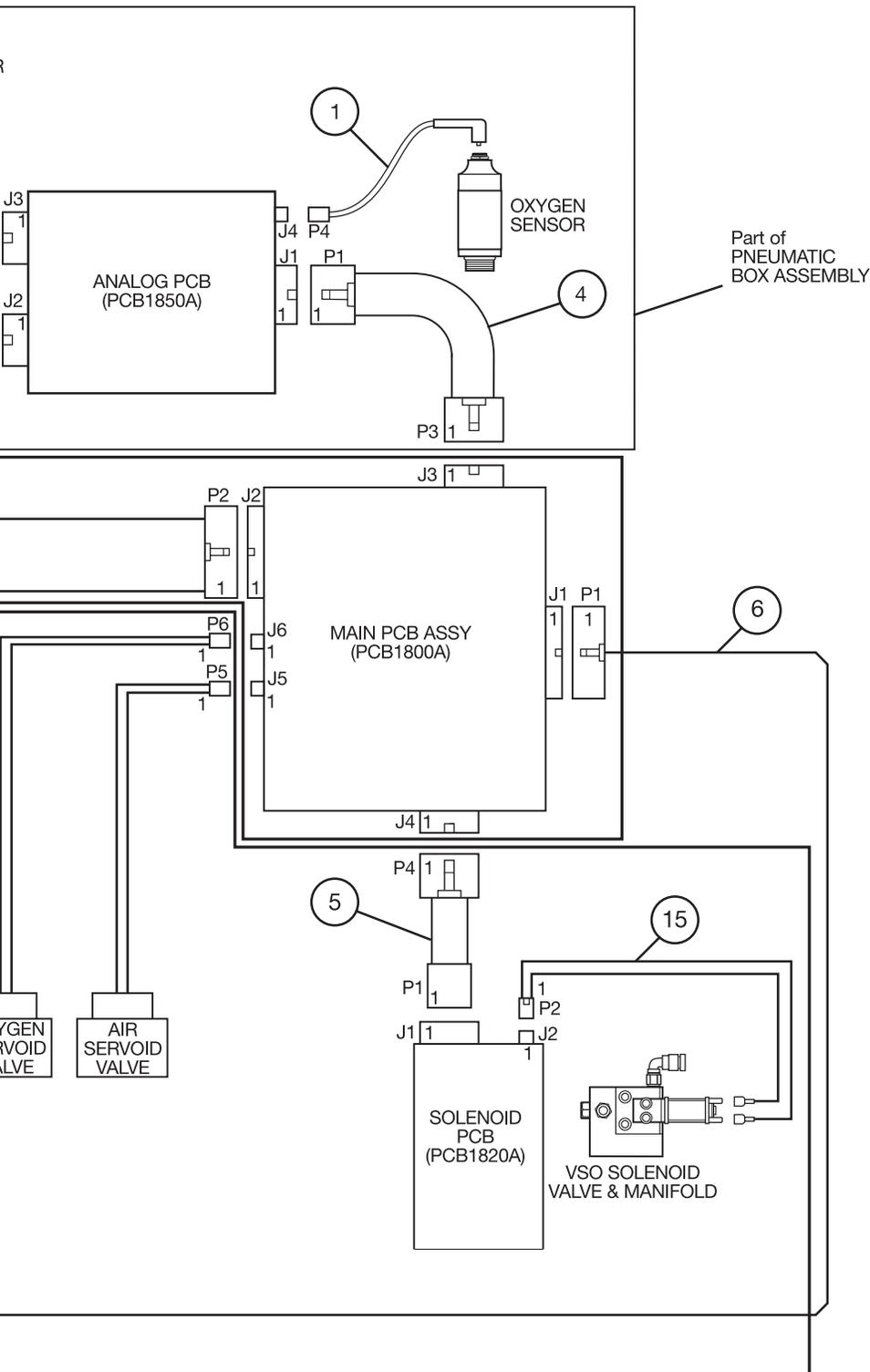
System Pneumatic Diagram
Sheet 1 of 1

PARTS LIST, e500 GDU SYSTEM WIRING DIAGRAM

Part number	Description	Qty	Item No.
CBL1803A	Cable Assy, Oxygen Sensor	1	1
CBL1804A	Cable Assy, RS-232 Back Panel	1	2
CBL1805A	Cable Assy, Main to Back Pane	1	3
CBL1806A	Cable Assy, Analog Board	1	4
CBL1807A	Cable Assy, Solenoid Valve	1	5
CBL1808A	Cable Assy, DC/DC to Main	1	6
CBL1809A	Cable Assy, DC/DC to Rear Panel	1	7
CBL1810A	Cable Assy, Power Supply to DC/DC	1	8
CBL1811A	Cable Assy, Battery & Switch	1	9
CBL1812A	Cable Assy, Hour Meter	1	10
CBL1813A	Cable Assy, Remote Alarm	1	11
CBL1814A	Cable Assy, Heater	1	12
CBL1817A	Cable Assy, AC Power Input	1	13
CBL1816A	Cable Assy, Flow Sensor	2	14
CBL1817A	Cable Assy, VSO Valve	1	16
CBL1818A	Cable Assy, DC Power Input	1	17
CBL1819A	Cable Assy, Fan	1	18
CBL1820A	Cable Assy, Alarm	1	19

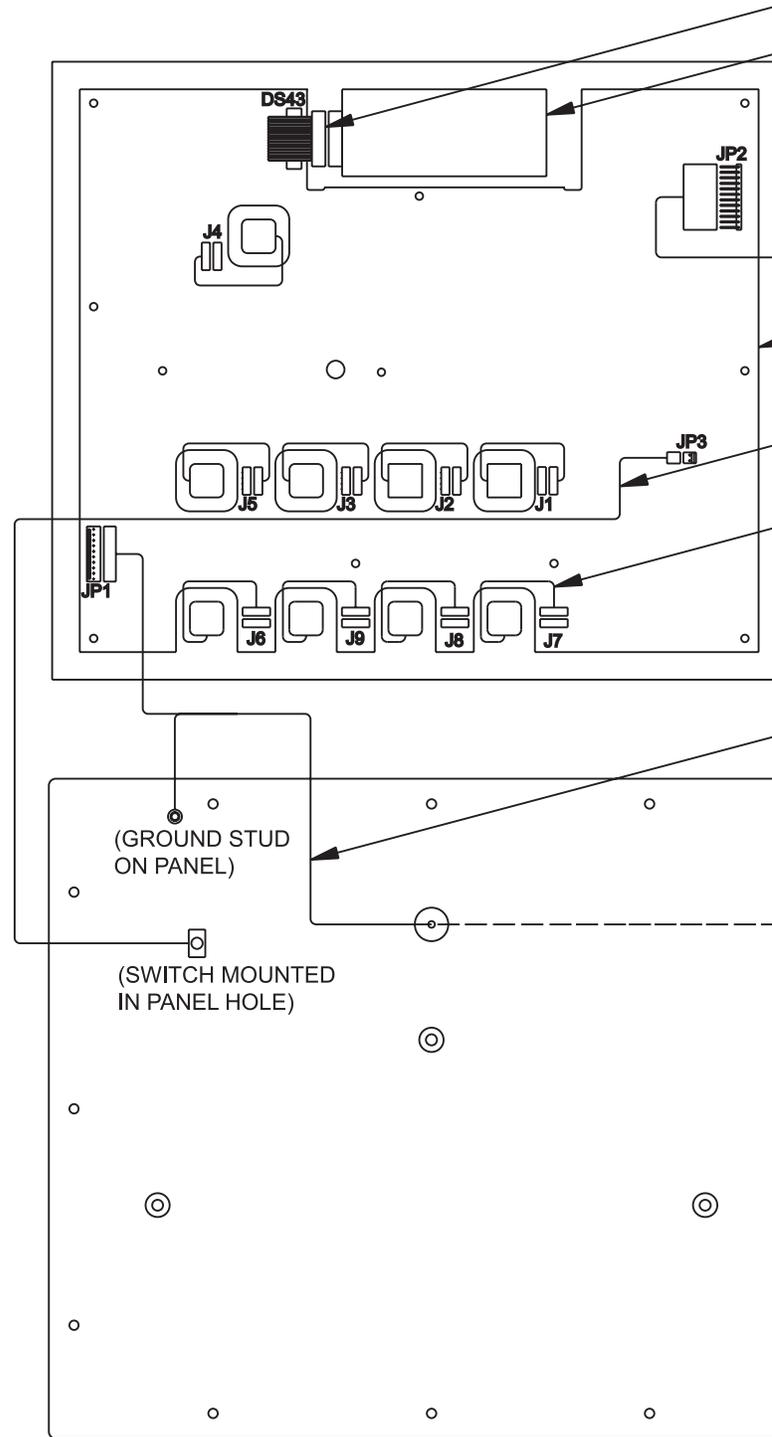
DIAGRAMS AND SCHEMATICS





e500 GDU
System Wiring Diagram
Sheet 1 of 1

DIAGRAMS AND SCHEMATICS

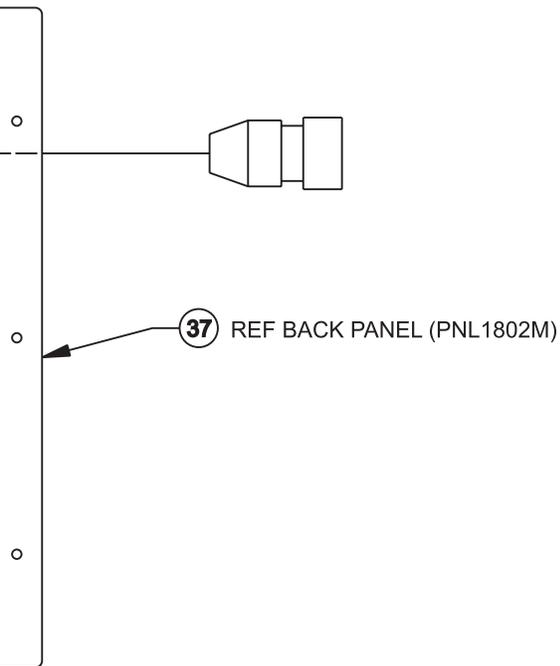
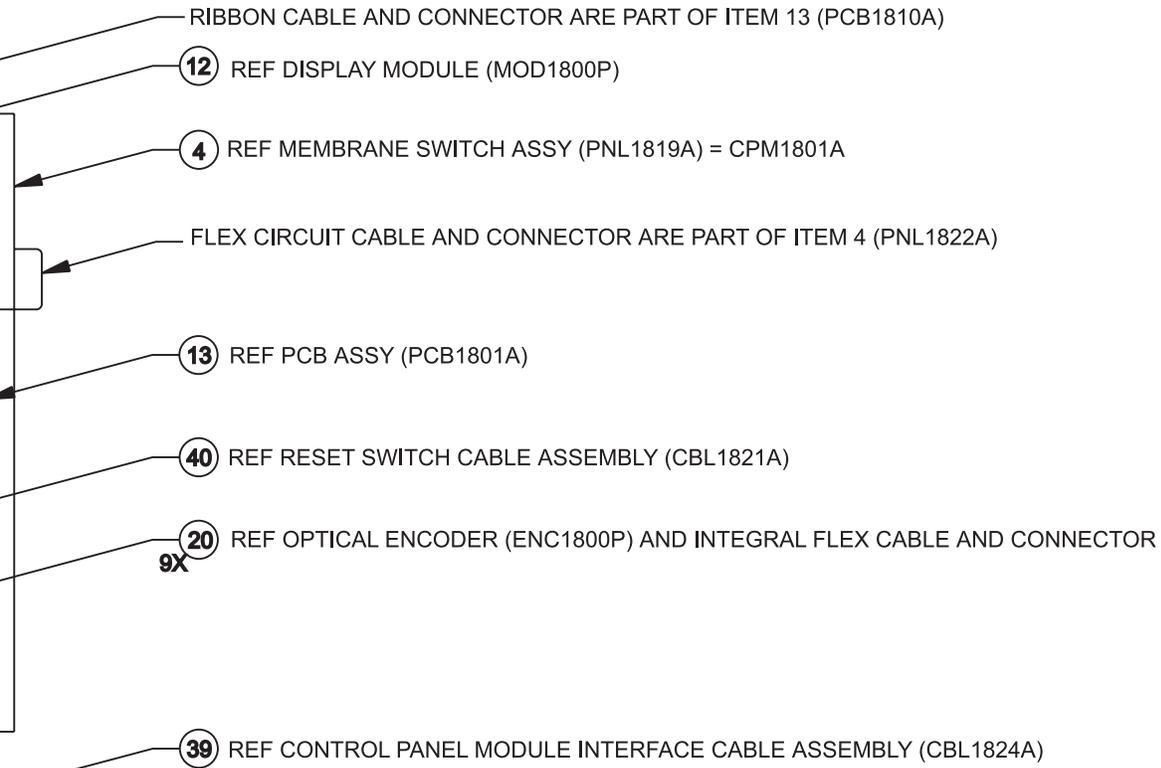


NOTES:

1. SEE CPM1801 & 1802A DRAWING FOR CABLE ROUTING AND ASSEMBLY DETAILS.

2. SEE CPM1801 & 1802A BOM FOR FASTENING HARDWARE PART NUMBERS.

3. (XX) REF DESIGNATES ITEM NUMBER ON CPM1801 & 1802A BOM.

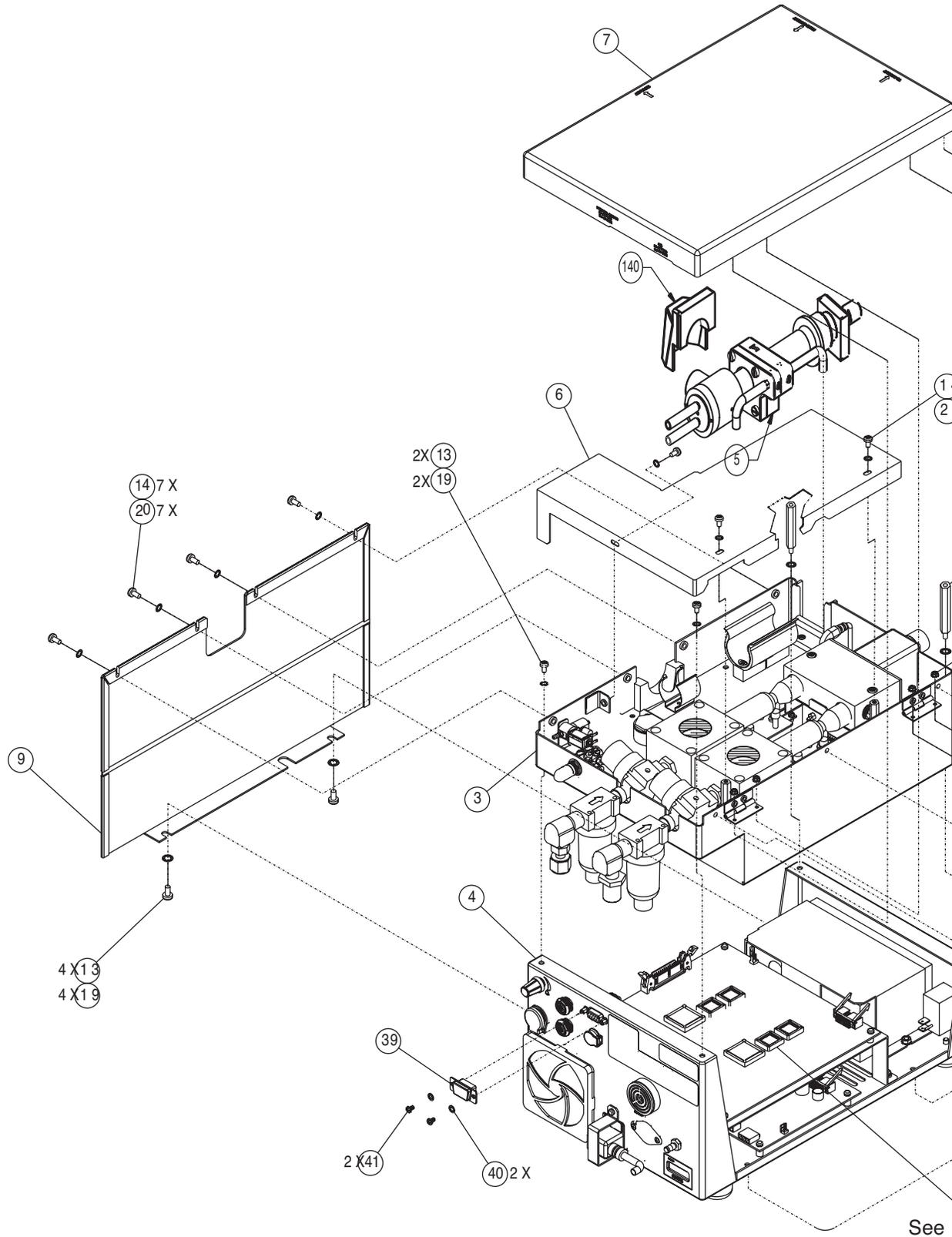


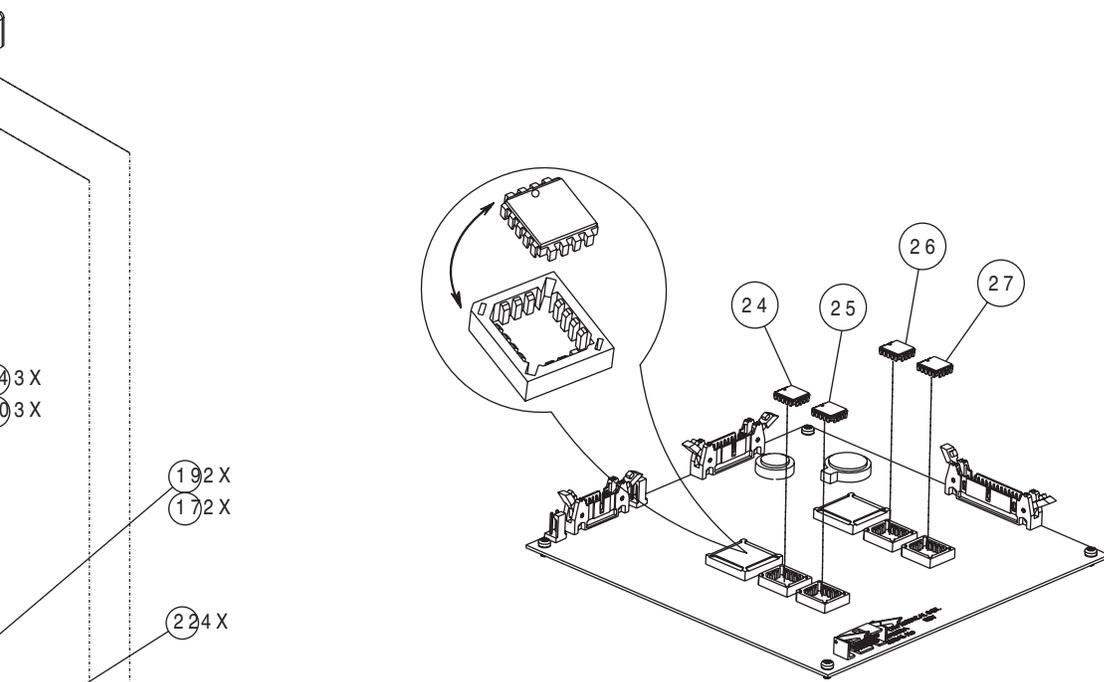
System Wiring Diagram,
Control Panel
Sheet 1 of 1

PARTS LIST, FINAL BOX ASSEMBLY

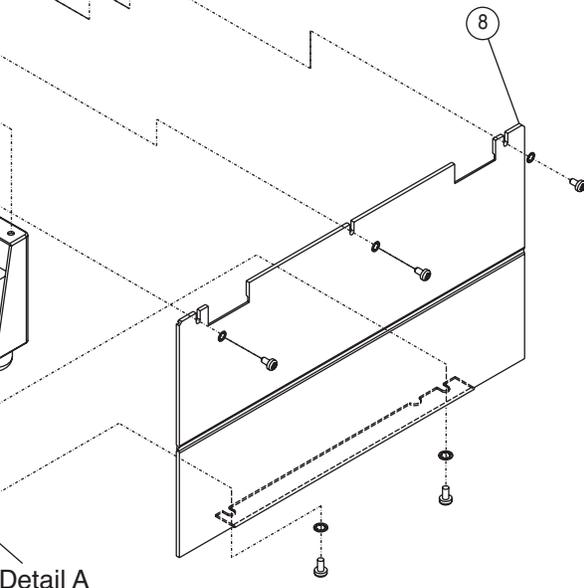
Part number	Description	Qty	Item No.
NUT1831P	Nut, hex w/lockwasher, m3x0.5	4	22
PNL1807M	Panel, left hand side	1	08
PNL1808M	Panel, right hand side	1	09
SCR1830P	Screw, pan hd, sst m3 x 0.5 x 6mm long	10	14
SCR1850P	Screw, pan hd ph, sst m5x0.8x8mm long	6	13
SPD1800A	Gas delivery unit tubing diagram	1	01
STO1850P	Standoff, m5 thrd, m&f, sst 8mm hex x 49mm	2	17
WSH1832P	Washer, internal tooth, m3	10	20
WSH1852P	Washer, internal tooth, m5	8	19
BPR1801Q	Bumper, square, gray	1	31
BPR1802	Bumper,round,grey	1	32
PAD1800M	Square bumper pad	1	33
PAD1801M	Round bumper pad	1	34
CVRDB9Q	Cap - 9 pin socket connector	1	39
SCP4019P	Screw, phillips pan head 440 x .187 long	2	41
WSH700P	#4 int tooth lockwasher	2	40
BOX1803A	Electronics box assembly	1	04
LBL1829P	Label, cover e500	1	43
BOX1804A	Pneumatic box assembly	1	03
EXH1802A	Exhalation assembly	1	05
OUT1803M	Top, outlet boot, exhalation valve	1	140
PRM1815A	Eprom assy, e500 control location # 1 (u18)	1	24
PRM1816A	Eprom assy, e500 control location #2 (u19)	1	25
PRM1817A	Eprom assy, e500 monitor location #1 (u25)	1	26
PRM1818A-X	Eprom assy, e500 monitor location	1	27
CVR1800M	Cover, Flow Sensor	1	06
CVR1801M	Cover, Top e500	1	07

DIAGRAMS AND SCHEMATICS





Detail A



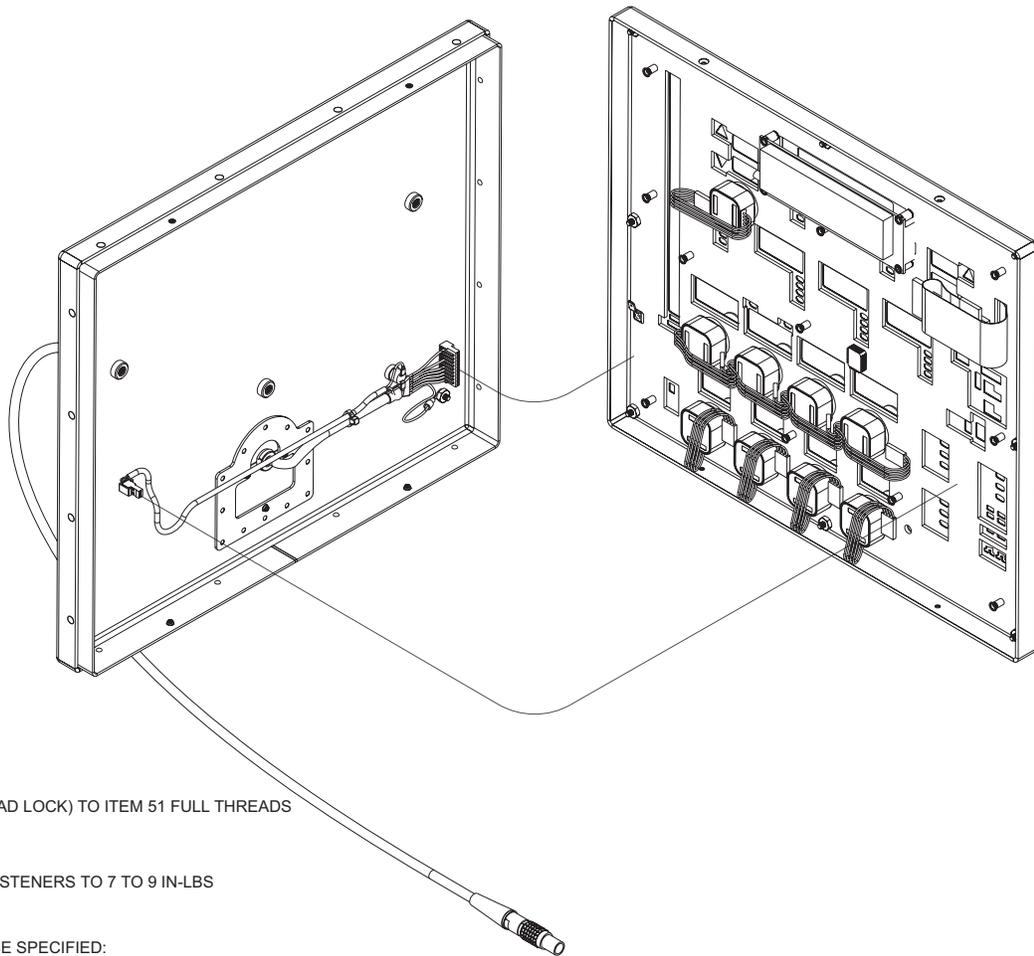
Detail A

Final Box Assembly
Sheet 1 of 1

PARTS LIST, CONTROL PANEL MODULE

Part Number	Description	Qty	Item No.
BZL1800M	Detailed assy, bezel,control module, e300	1	01
PNL1802M	Detailed assy, back panel	1	37
BAR1800M	4" panel clamp bar	8	08
BAR1801M	2" panel clamp bar	4	09
WSH1800M	Washer/seal opt. Enc.	9	19
ENC1800P	Optical encoder	9	20
KNB1800P	Knob	9	17
SCR1825P	Screw, pan hd, sst, m2.5x0.45x10mm lg	12	10
SCR1830P	Screw, pan hd, sst m3 x 0.5 x 6mm long	15	14
WSH500P	3/8 washer shakeproof	9	16
NUT1800P	Nut, panel 3/8"-32 hex	9	18
SCR1845P	Screw, flat head ph, sst m4x0.7x16mm long	12	38
PCB1810A	Assy, pcb	1	13
MOD1800P	Display module, vac. FI	1	12
NUT1841P	Nut, hex w/lockwasher (keps) m4 x 0.7, steel, zinc pltd	1	35
CBL1821A	Cable assy, reset switch, control panel	1	40
WSH1832P	Washer, internal tooth, m3	4	41
ADH1225P	Adhesive loctite 425	0	42
PNL1819A	Assembly, e500 control module membrane switch panel	1	04
CBL1824A	Cable assy, control module, e500	1	39
GKT1502P	Gasket, closed cell foam	0.20	49
WSH1900P	Washer,phenolic #4	11	51
PRM1834A-A	EPROM assy, e500 control panel module	1	43

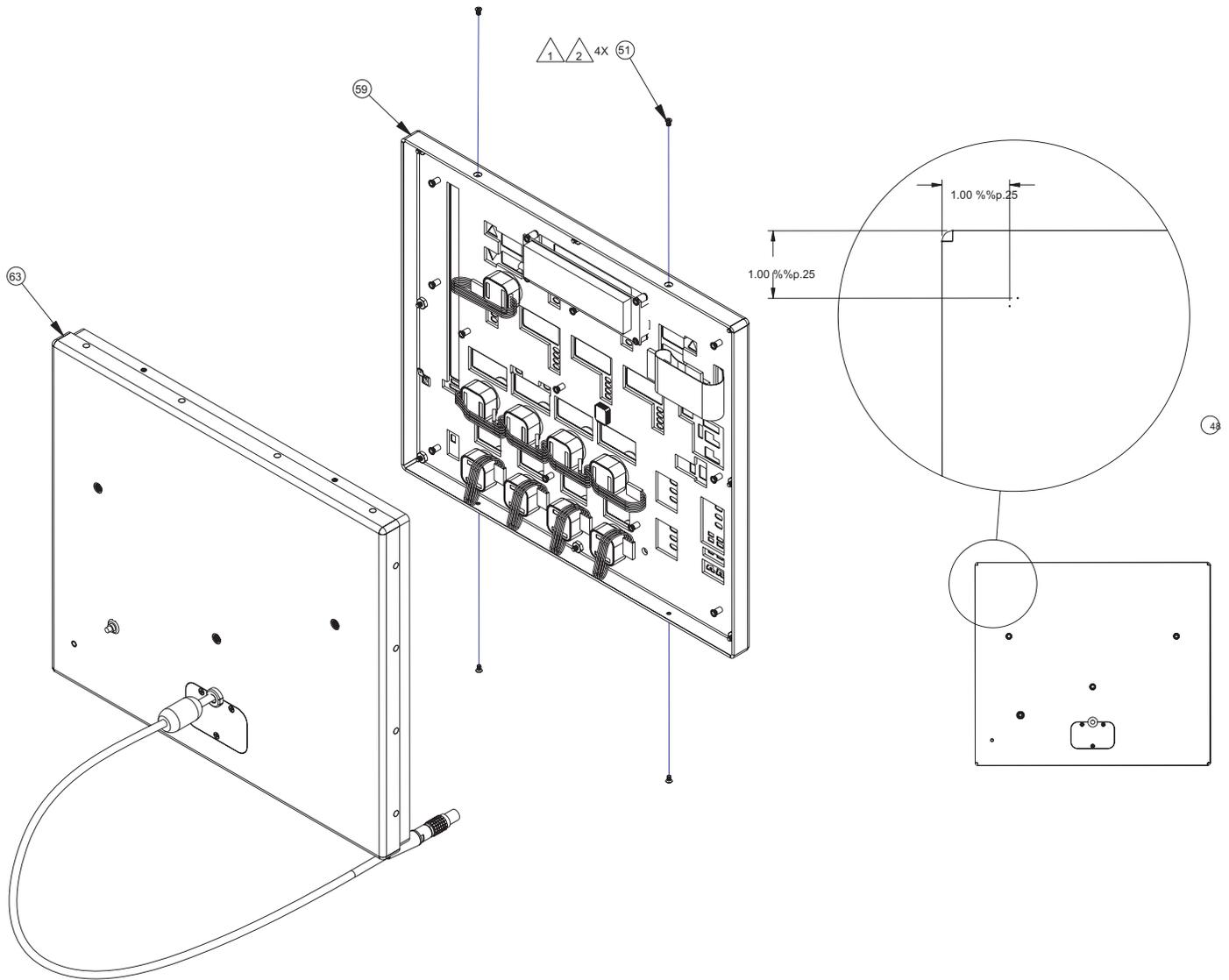
DIAGRAMS AND SCHEMATICS



△₂ APPLY ITEM 42 (THREAD LOCK) TO ITEM 51 FULL THREADS
REMOVE EXCESS

△₁ TIGHTEN TORQUE FASTENERS TO 7 TO 9 IN-LBS

NOTES: UNLESS OTHERWISE SPECIFIED:



Control Panel Module
Assembly

DIAGRAMS AND SCHEMATICS

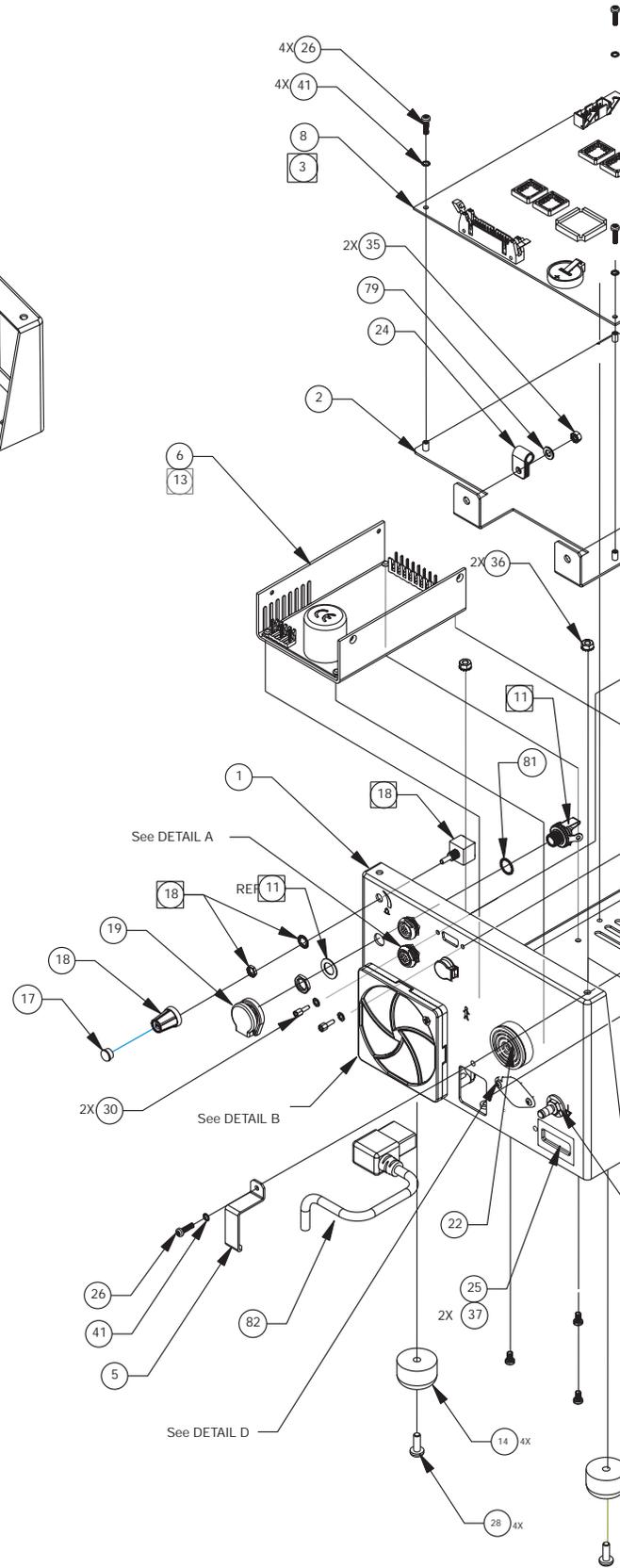
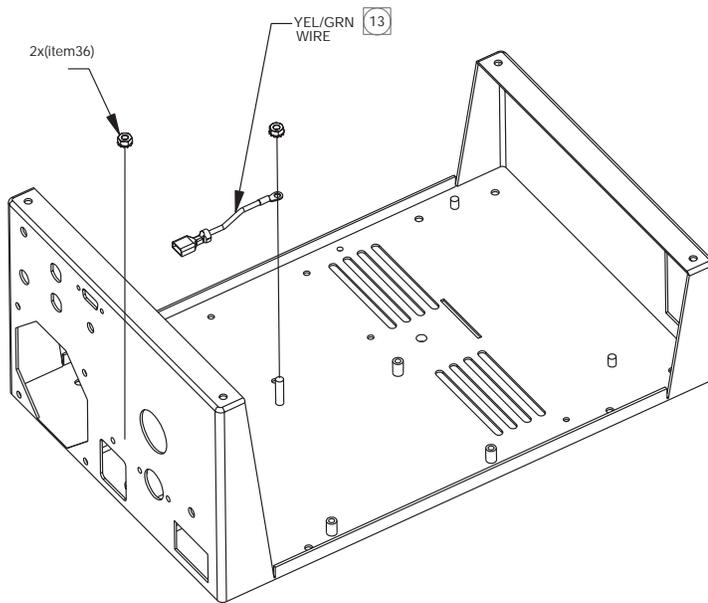
PARTS LIST, ELECTRONICS BOX ASSEMBLY

Part number	Description	Qty	Item No.
BOX1800M	Box, Electronics	1	1
PNL1805M	Panel, Main PCB	1	2
CVR1802M	Cover, Battery	1	3
PCB1840A	PCB Assembly, Back Panel	1	4
BKT1800M	Bracket, Power Cord	1	5
PWR1800P	Switching Power Supply	1	6
PCB1831A	DC-DC Power Supply Board	1	7
PCB1800A	Main Board	1	8
BAT1800P	Battery, 12V, 7.2A	1	9
FUH1800P	Module, Power Entry	1	11
FUS1802Q	Fuse, 2A Slo Blo	1	12
FUH1801P	Fuse, Drawer	1	13
BPR1800P	Foot, Rubber	1	14
CAP1200P	Knob Cap, Gray	1	17
KNB1200P	Knob, 1/8", Gray	1	18
CAP1501P	Cap, Nurse Call	1	19
GRD1800P	Finger Guard & Filter	1	21
BZR1001P	Buzzer	1	22
GND001P	Stud, Grounding	1	23
CLP1840P	Clamp, Cable, 1/4"	1	24
MTR1800P	Meter, Hour	1	25
SCR1830P	Screw, Panhead, SST M3 X 0.5 X 6mm long	8	26
SCR1849P	Screw, Phillips Pan Head, M5 X 0.8 X 14	4	28
SCR1855P	Screw, Jack, 4-40 X 5/16 X 3/16	2	30
SCR1839P	Screw, Phillips, M3 (.6) X 40 FH	4	31
NUT1841P	Nut, Hex w/Lockwasher, (KEPS) M4 X 0.7, Steel, Zinc Plated	2	35
NUT1851P	Nut, Hex w/Lockwasher, M5 X 0.8, SST	4	36
NUT1831P	Nut, Hex w/Lockwasher, M3 X 0.5	11	37
NUT006P	Nut, w/Lockwasher, 6mm	1	38
WSH1832P	Washer, Internal Tooth, M3	14	41
SWI1800P	Switch, Power	1	51
CAP1800P	Jack Cover	1	73

PARTS LIST, ELECTRONICS BOX ASSEMBLY cont.

Part number	Description	Qty	Item No.
CVR1803M	Cover, Battery Charger Connector	1	74
SPC1801Q	Spacer, 1/4" Hex	1	75
SCP6025P	Screw, Phillips Pan Head 632 X .25	4	76
LBL001P	Ground Label	1	78
WSH001P	Flatwasher #8, 174 X .375 X .032 S	1	79
SCR1834P	Screw, Phillips Cross Rec.	4	80
WSH500P	3/8 Washer, Shakeproof	1	81
PWR1500P	Power Cord	1	82
NUT1863P	Nut, Conical, M12 X 1.0	0	83
NUT1864P	Nut, Round, M8 X .75	0	84
WSH1870P	Washer, Internal Tooth, M12	0	85
BZL1801M	Bezel, e500 Power Switch	1	86
CVR1804M	Switch Cover, e500	1	87
COL1800P	Connector Collar - Gray	1	89
COL1801P	Connector Collar - Black	1	90
WSH1512P	Washer, Flat	2	91
SCR1833P	Screw	2	92

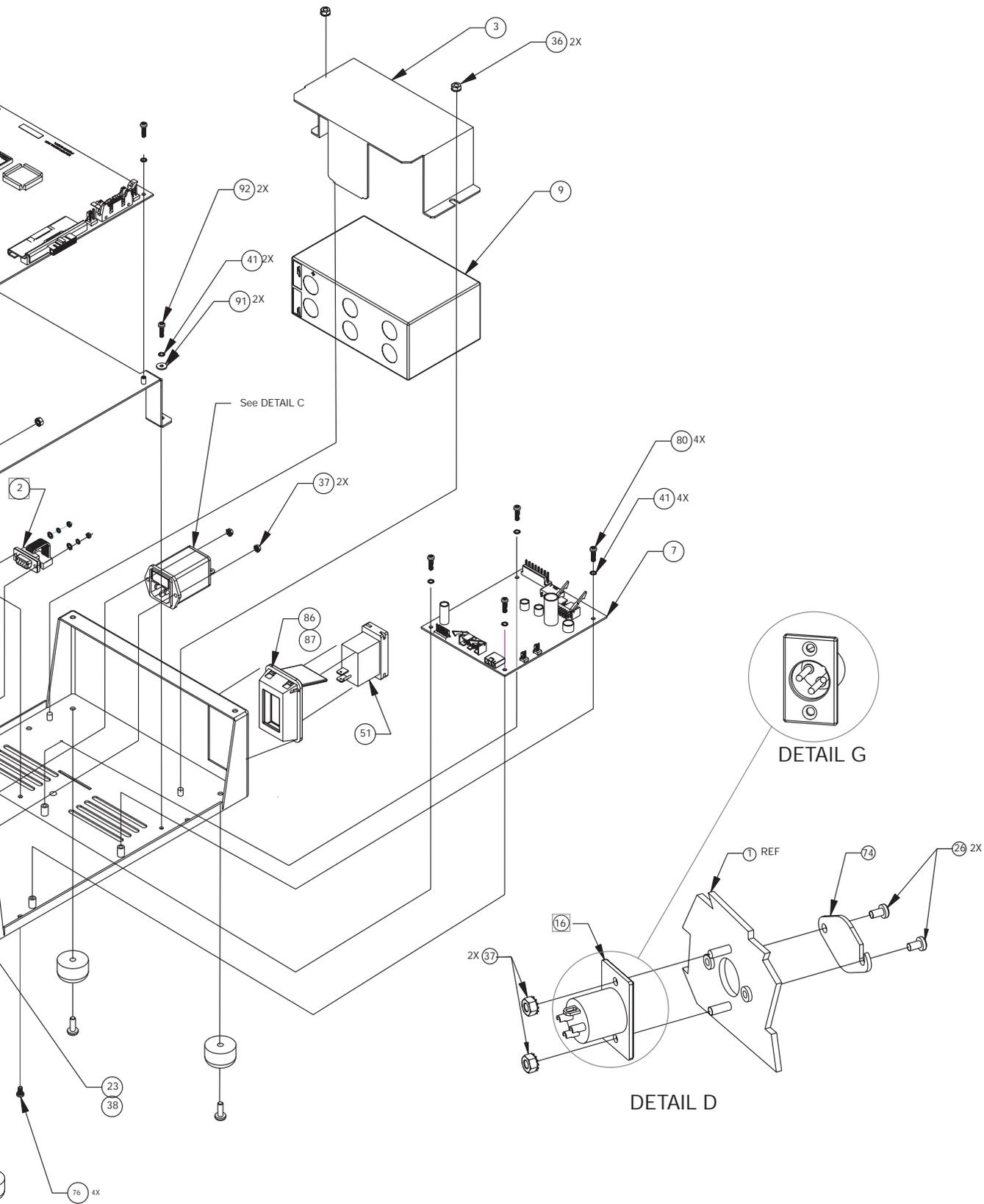
DIAGRAMS AND SCHEMATICS



1. THE NUMBER IN THE SYMBOL INDICATES CABLE ITEM NUMBER SHOWN ON THE SYSTEM WIRING DIAGRAM SWD1800A

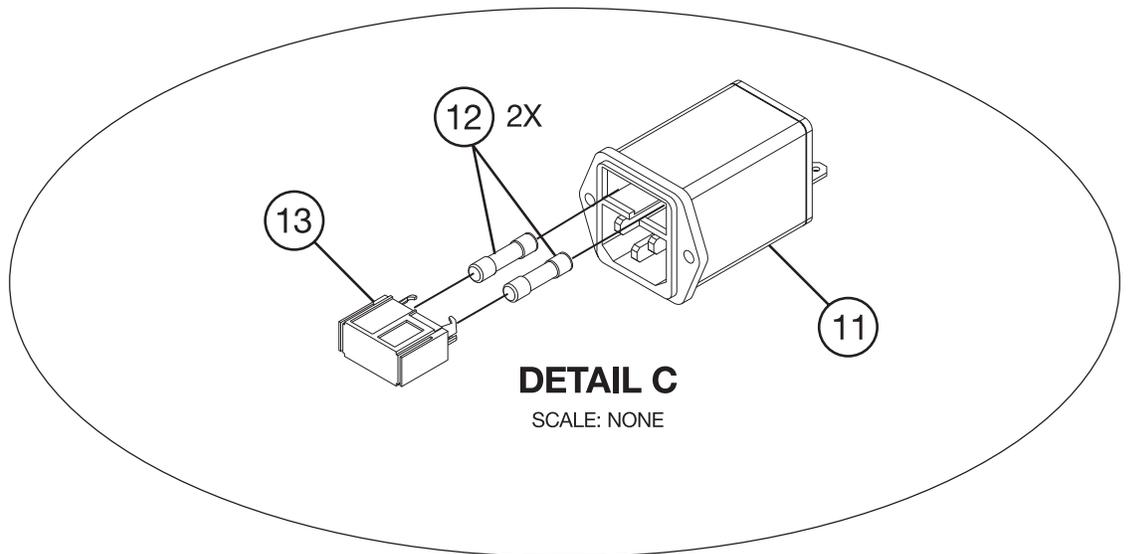
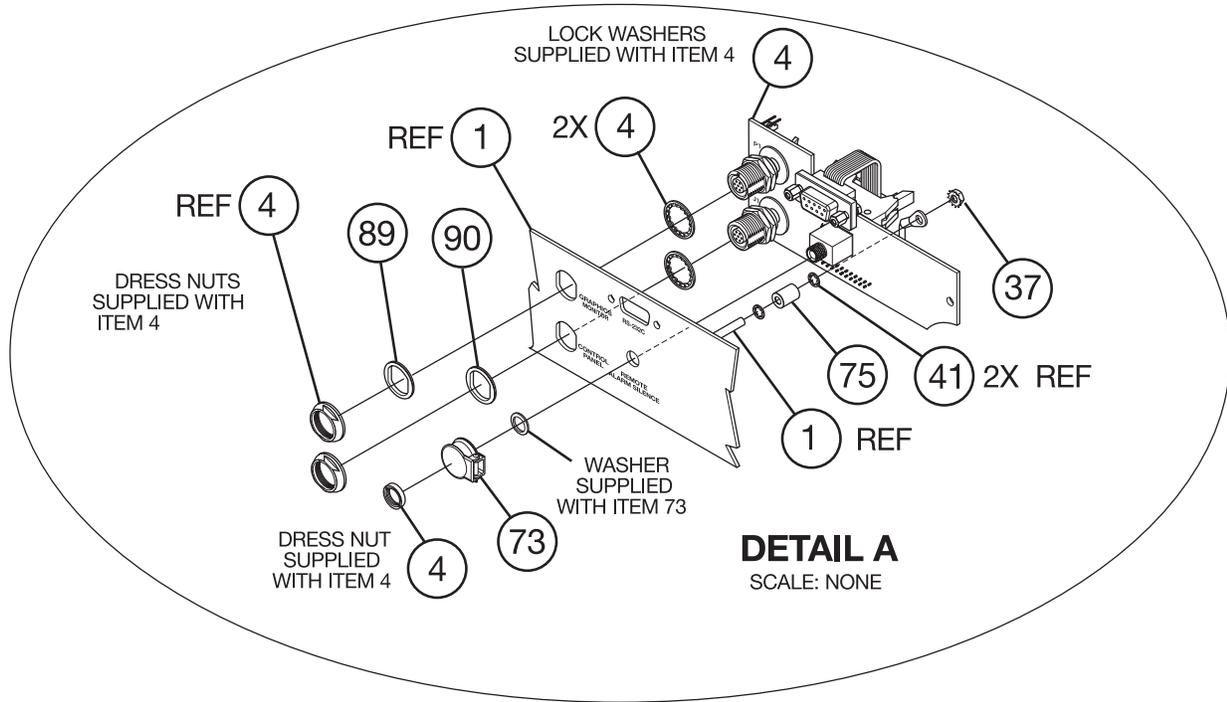
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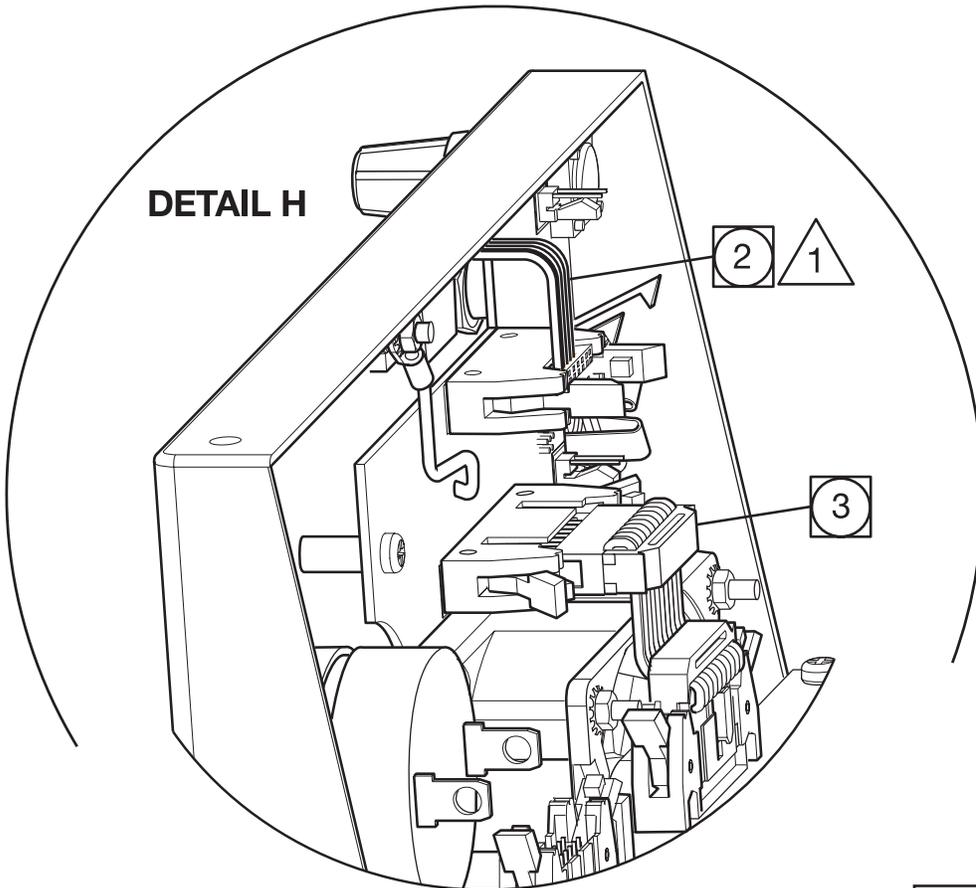
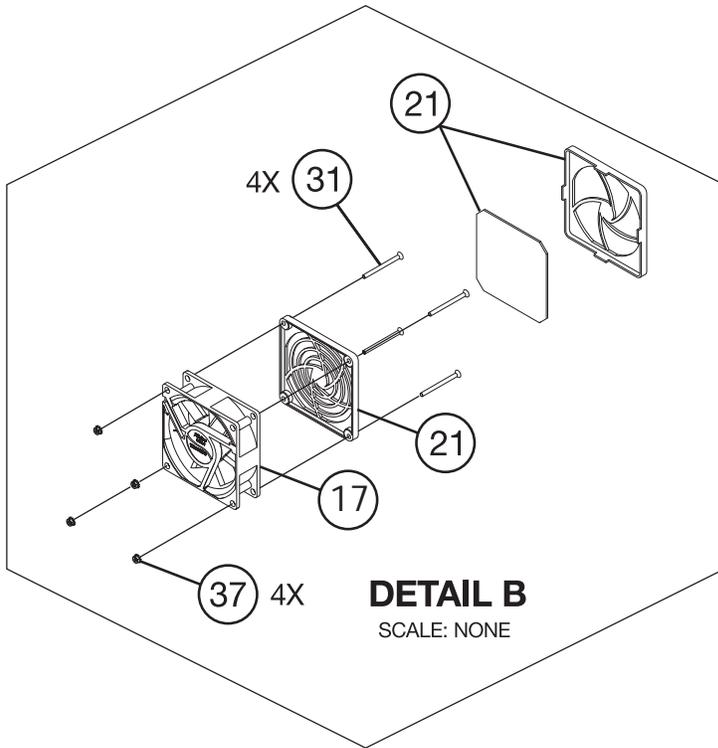
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Electronics Box Assembly
Sheet 1 of 2

DIAGRAMS AND SCHEMATICS





Electronics Box Assembly
Sheet 2 of 2

DIAGRAMS AND SCHEMATICS

PARTS LIST, PNEUMATIC BOX ASSEMBLY

Part Number	Description	Qty	Item No.
BOX1801M	Pneumatic box, weldment	1	01
PNL1806M	Panel, pneumatic	1	02
PLT1800M	Plate, adapter, mixing mfd	1	05
PNL1810M	Panel, analog cable	1	06
PNL1811M	Panel, solenoid cable	2	07
HIN1800M	Hinge, top cover	2	09
WTR1800P	Water trap/filter 1/4npt	2	15
REG1800P	Regulator, inlet	2	16
FTD1800P	TSI flow sensor - air	1	18
FTD1801P	TSI flow sensor - oxygen	1	19
BSE1800M	Base, heater	1	28
BLK1801M	Block, o2 sensor e300	1	31
MNF1800M	Manifold, flow sensor	1	32
DIA1800M	Exh diaphragm, e500	1	35
CAP1801M	Cap, manifold	1	36
ADP1800P	Ftg, diss 1160a, air to 1/4 mnpt	1	37
ADP1801P	Ftg, diss 1240, O2 fem to 1/4 mnpt	1	38
EJE1800P	Ejector, air	1	40
PCB1850A	Analog board	1	41
PCB1820A	Solenoid board	1	42
GKT1803M	Gasket, analog cable	2	44
GKT1802M	Gasket, solenoid cable	4	43
SCN1800P	Screen, TSI flow sensor	2	45
SCR1830P	Screw, pan hd, sst m3 x 0.5 x 6mm long	12	51
SCR1833P	Screw, ph cross rec.	18	52
SCR1845P	Screw, flat head ph, sst m4x0.7x16mm long	2	53
SCR1842P	Screw, m4x0.7x6, pan head phillips	10	54
SCR1832P	Screw, ph, cross rec.	2	56
SCR1802P	Screw, m4(.7) x 8 fh, phil	2	57
SCC716P	Screw, captive panel, 6-32x7/16	2	58
SCR1834P	Screw, ph cross rec.	4	60
STO1851M	Standoff, m4	1	70

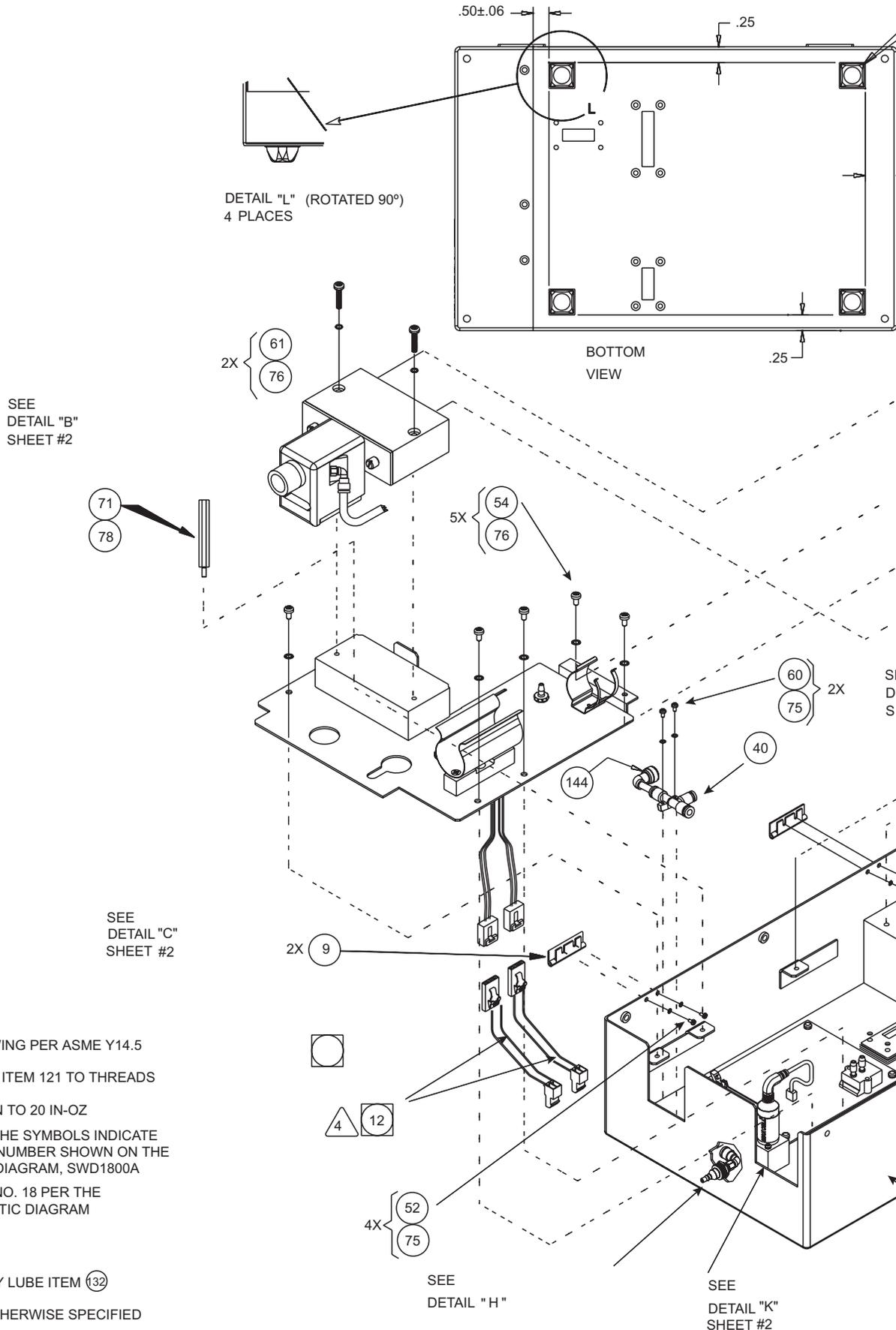
PARTS LIST, PNEUMATIC BOX ASSEMBLY cont.

Part Number	Description	Qty	Item No.
STO1852M	Standoff, m4	1	71
WSH1832P	Washer, internal tooth, m3	34	75
WSH1842P	Washer, int toothlock m4 sst	14	76
WSH1862P	Washer, internal tooth, m6	2	77
WSH1852P	Washer, internal tooth, m5	10	78
WSH500P	3/8 washer shakeproof	2	79
WSH611P	Washer, retaining, 6-32 sst (.112idx.171od.01)	2	80
NUT1801P	Nut, 1/4-28 unf, white, nylon	2	82
CON100P	Connector 1/16t x 10-32m	5	87
ELB1801P	Elbow, 5/32od tube x 10-32 unf male	2	90
PLG400P	Plug vent jet hsg clippard	6	93
GKT1800P	Gasket, m5	15	97
FTG1800P	Fitting, straight, 10-32x1/4" tube	1	102
FTG1805P	Fitting, straight, 10-32x1/8 tube	1	104
FTG1807P	Fitting, 1/4" npt hex nipple brass	2	107
OUT360M	Outlet prox	1	110
ORG1200P	O-ring- silicone- compass	4	113
PPS1000P	Pipe paste- lox 8	0	121
SCR1852P	Screw, m4 x 0.7 x 10, pan head, Phillips	1	55
SPR1803P	Spring, safety valve	1	118
TWS1801P	Mixer - inline 1/2" dia.	0	33
PLG375P	Plug, 3/8 npt hex countersunk	1	92
MNF1805P	Manifold, exhaust	1	20
FTG1808P	Fitting, barbed, m5, 10-32 to 3/32 id	1	101
NUT300P	Hex panel nuts 3/8-32	1	131
GRS111P	Grease - mcg111 christo lube	0	132
SIL1801P	Exhaust muffler, polyethylene one-piece	1	46
CON1805P	Connector, male to 1/8" kynar	2	86
RET1800P	Retainer, retains TWS1800p within mnf1800m	1	133
ORG1803P	O-ring, FIO2 sample tube .071" id x .032cs shore a "70" ethy	1	135
SPR1804P	Compression spring, sst with closed and ground ends	1	137
TUB1800M	Tubing	1	136

PARTS LIST, PNEUMATIC BOX ASSEMBLY cont.

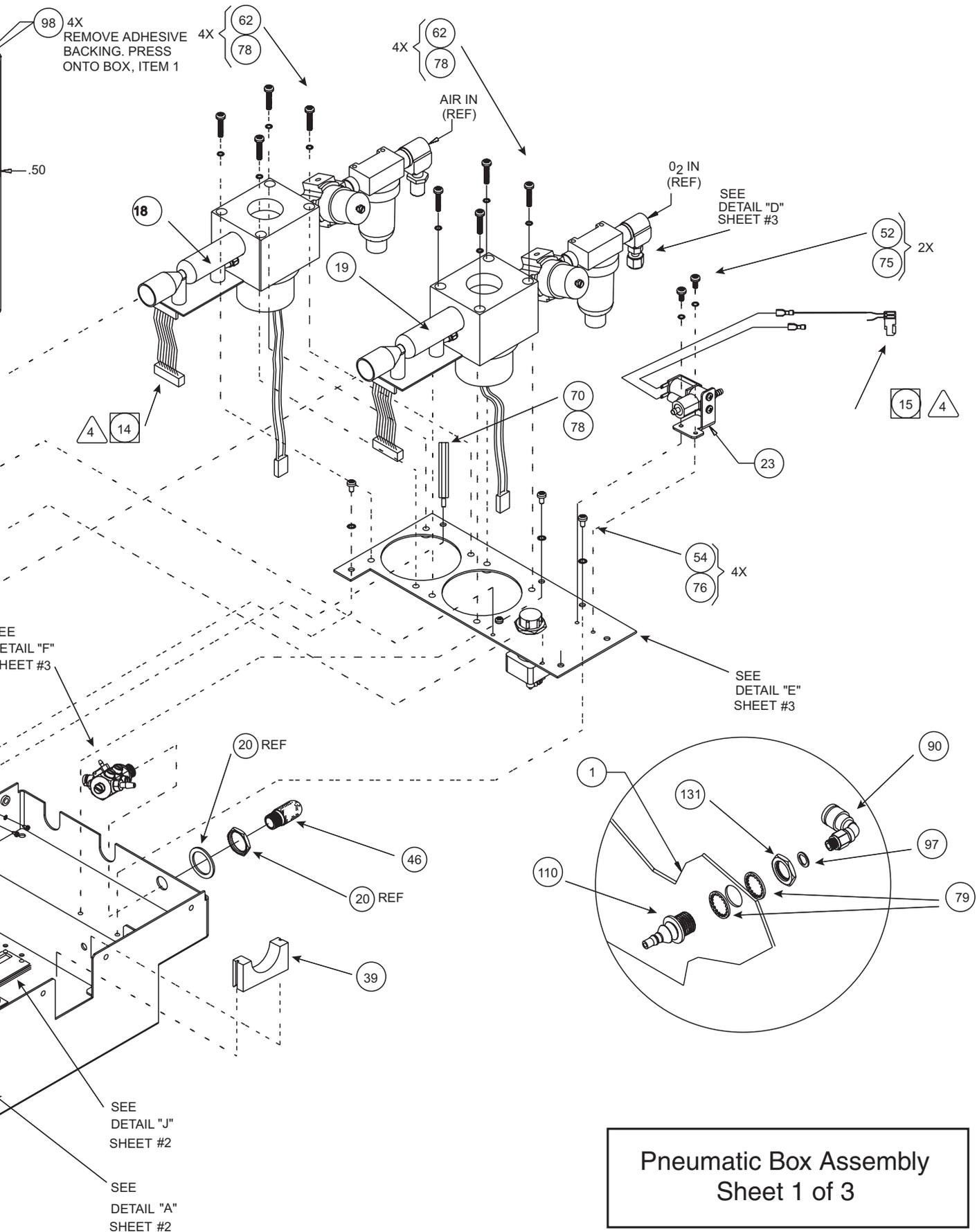
Part Number	Description	Qty	Item No.
SCN1801M	Screen	1	134
SCR1840P	Screw, pan hd ph, sst m4x0.7x35mm long	2	61
BPR1801Q	Bumper, square, gray	4	98
ELB1803Q	Elbow, 1/8 id tube to 10-32 thread	2	143
ELB1802P	Stem elbow 1/4"od x 1/4" od	1	144
ORG1802M	O-ring, manifold e300	1	116
HTR1801A	Assembly, dual heater	1	26
SCR1858P	Screw - m5 x 60mm phil pan	8	62
PLG100P	Plug- brass 1/8'	4	146
MNF1805A	Assy manifold patient outlet	1	34
ADP1800M	Adaptor, manifold	1	29
VEN1800A	Venturi assembly	1	23
RET1800M	Coupling, exhalation valve	1	27
ELB1804P	Elbow, 90 deg., 1/4 npt male x 1/4' npt female	2	99
OUT1802M	Bottom, outlet boot, exhalation valve	1	39
SVO1805P	Valve, servoid	2	17
R125P03-002	Max 250e oxygen sensor -002	1	30
BKT1805M	Bkt.valve mounting e500	1	03
REG1802P	Back pressure regulator	1	25
CAP1806P	Cap, 9/16-20, threaded	1	100

DIAGRAMS AND SCHEMATICS



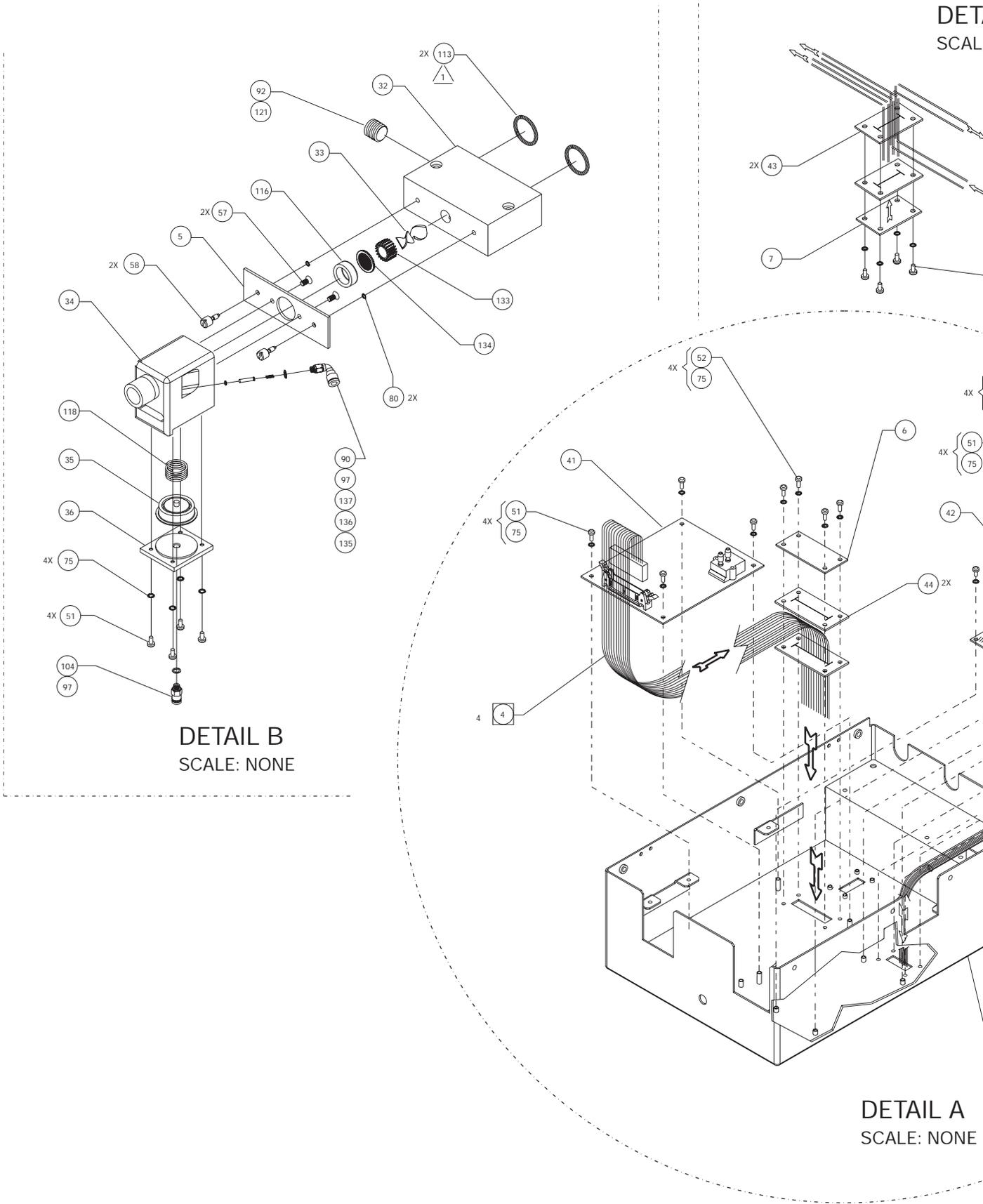
- 7. INTERPRET DRAWING PER ASME Y14.5
- 6. APPLY PIPE PAST ITEM 121 TO THREADS
- 5. TORQUE TIGHTEN TO 20 IN-OZ
- 4. THE NUMBER IN THE SYMBOLS INDICATE THE CABLE ITEM NUMBER SHOWN ON THE SYSTEM WIRING DIAGRAM, SWD1800A
- 3. ATTACH TUBING NO. 18 PER THE SYSTEM PNEUMATIC DIAGRAM
- 2. DELETED
- 1. SPARINGLY APPLY LUBE ITEM 132

NOTE: UNLESS OTHERWISE SPECIFIED



Pneumatic Box Assembly
Sheet 1 of 3

DIAGRAMS AND SCHEMATICS

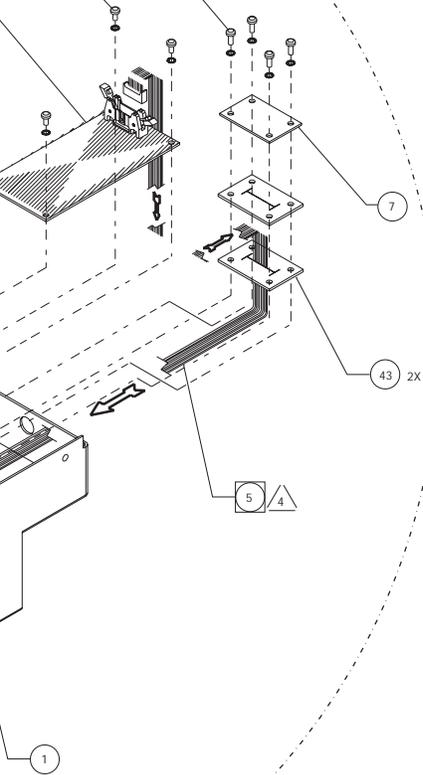


TAIL J
E: NONE

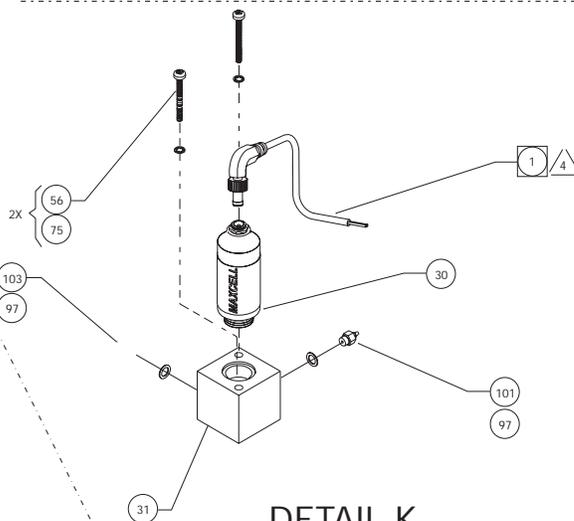
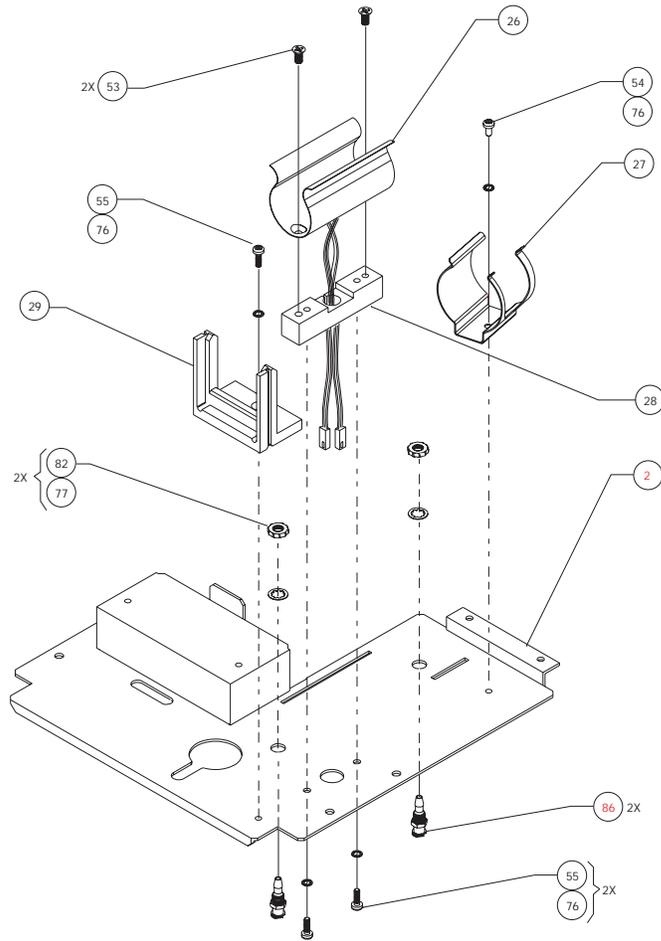
12 4

52 75 } 4X

52 75



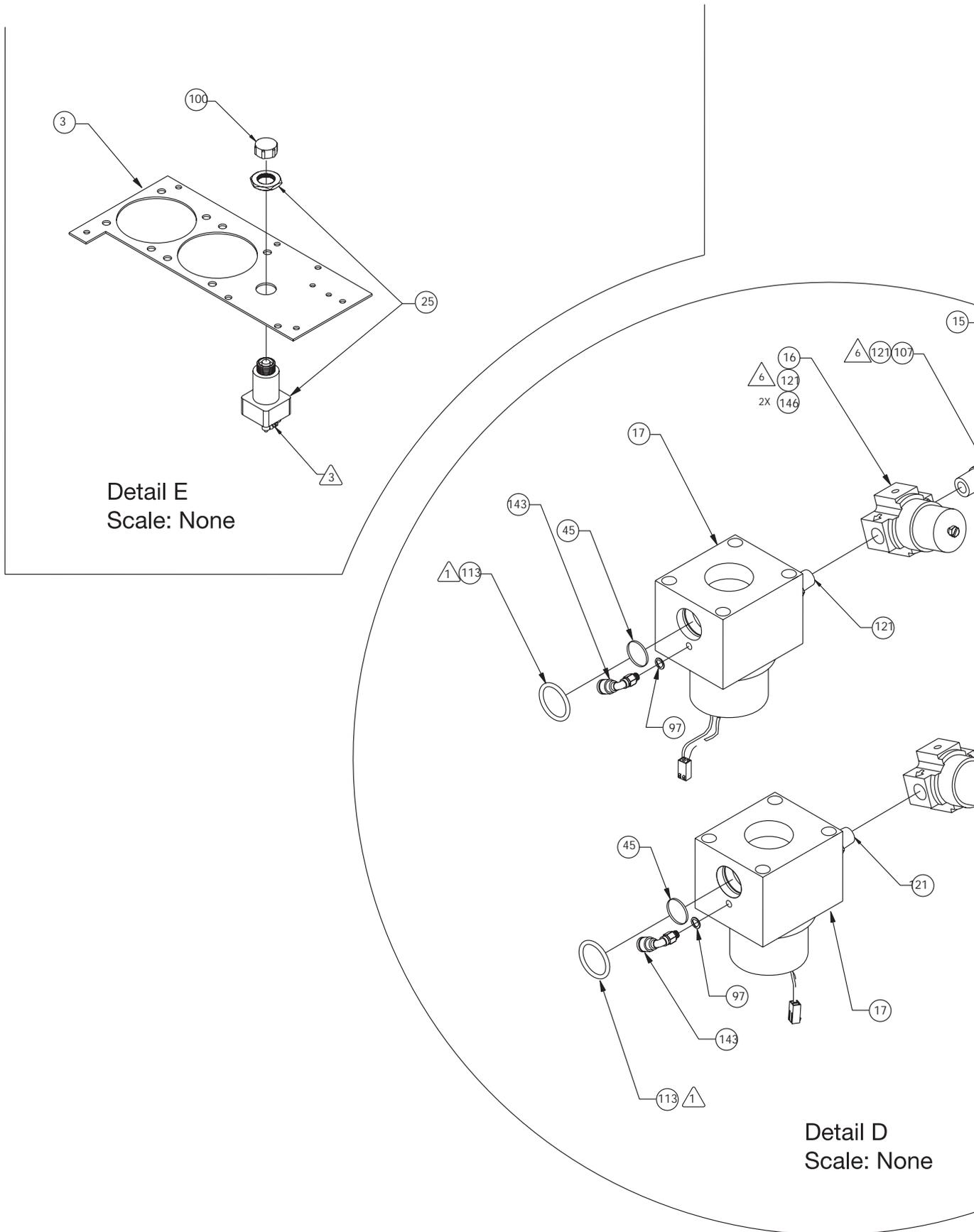
DETAIL C
SCALE: NONE



DETAIL K
SCALE: NONE

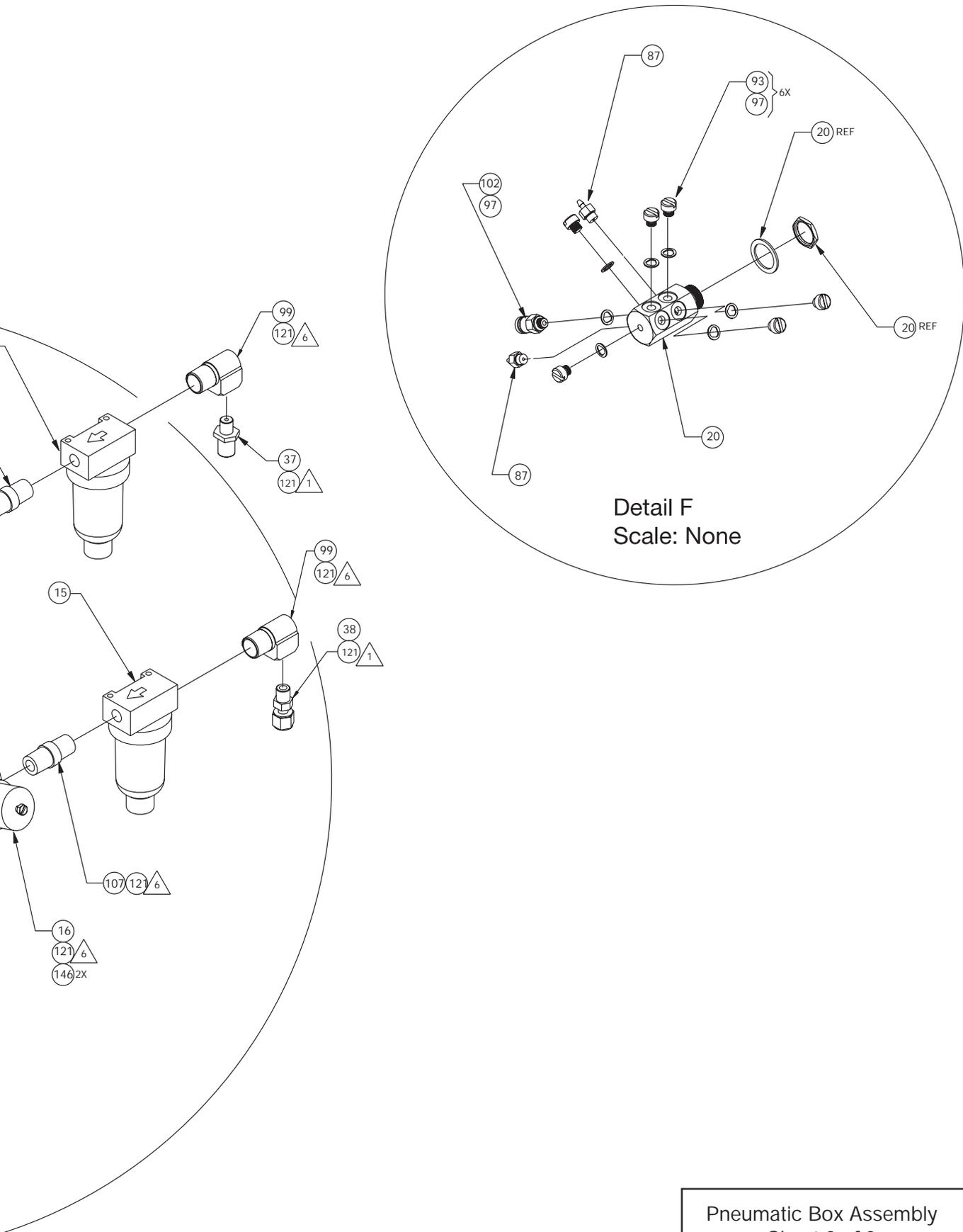
Pneumatic Box Assembly
Sheet 2 of 3

DIAGRAMS AND SCHEMATICS



Detail E
Scale: None

Detail D
Scale: None



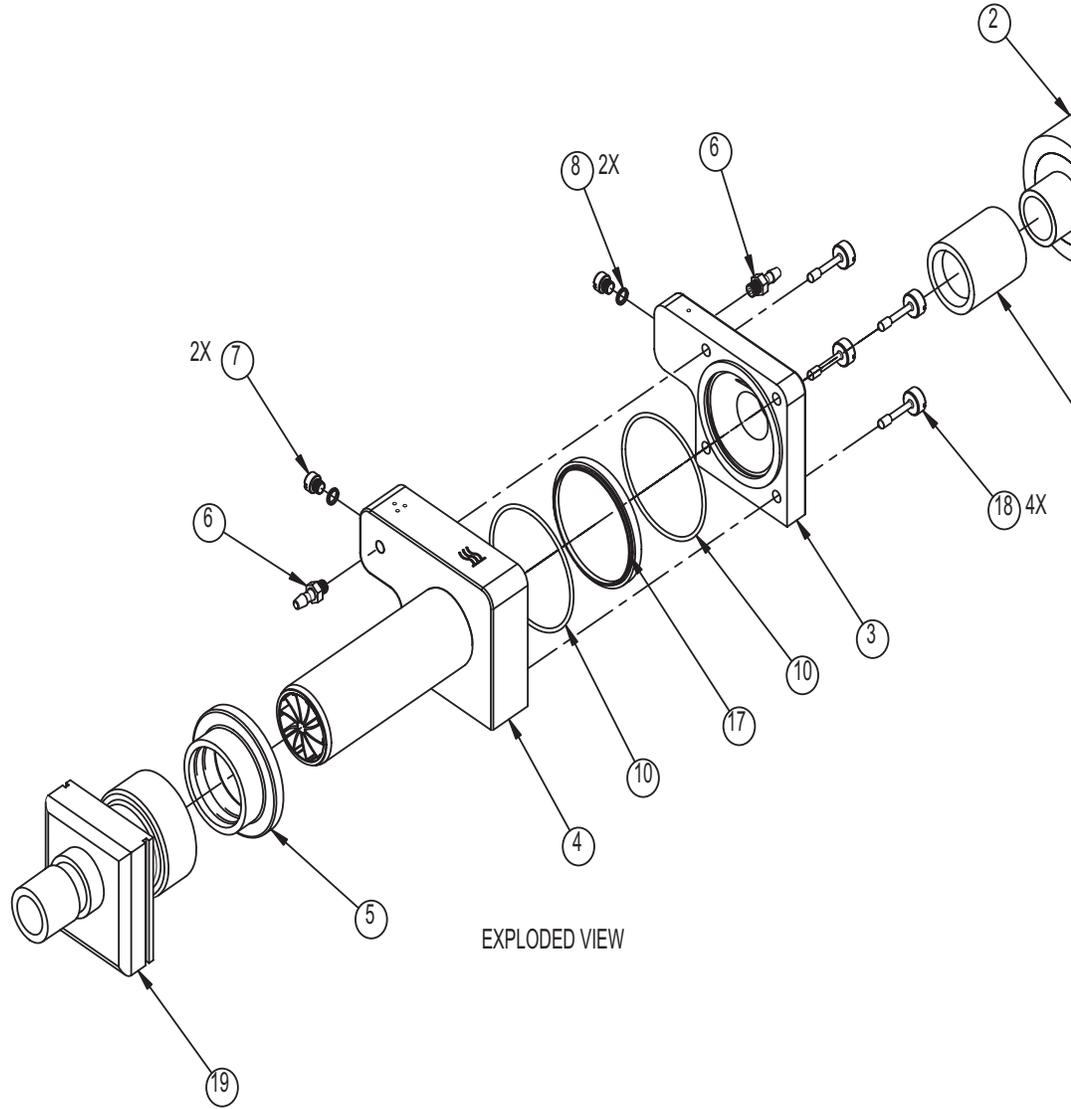
Detail F
Scale: None

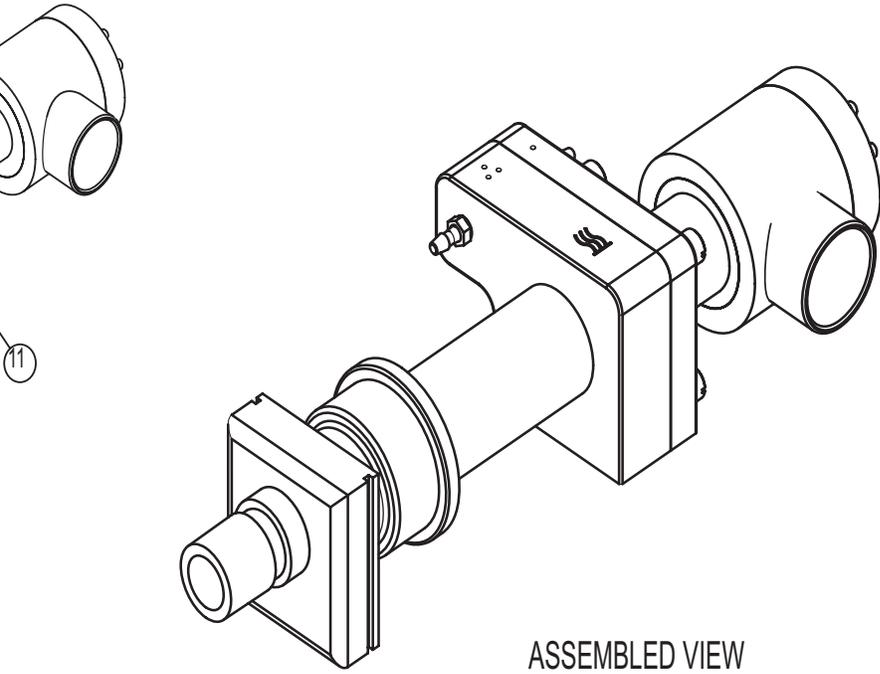
Pneumatic Box Assembly
Sheet 3 of 3

PARTS LIST, EXHALATION MODULE ASSEMBLY

Part number	Description	Qty	Item No.
MFD1808M	Manifold, patient inlet	1	19
HSG1801M	Housing, low pressure	1	3
HSG1800A	Assy, heat exchange tube/sensor	1	4
CPL1800M	Coupling, heat exchanger	1	5
SCC632P	Screw, captive panel, 6-32x25/32	4	18
GKT1800P	Gasket, m5	2	8
PLG400P	Plug vent jet hsg clippard	2	7
FTG1813P	Fitting, 10-32 unf to 1/8id hose	2	6
SCN1800A	Screen assembly	1	17
ORGS032Q	O-ring silicone #32	2	10
CPL1802M	Coupling exhalation valve	1	11
EXH1801A	Exhalation valve final assy	1	2

DIAGRAMS AND SCHEMATICS





Exhalation Module
Sheet 1 of 1

Appendix D.
e500 GRAPHICS DISPLAY MONITOR (GDM)
Service Instructions and Diagrams

Appendix D Contents

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- Accessories
- Warnings, Cautions, and Notes
- Warranty
- Factory Service
- Contact Information

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- Operational Overview
- Description of Operation
- Touch Screen Operation Concept

Section D-3 COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

- Warnings, Cautions, and Notes
- Rear Panel
- Updating Software
- Touchscreen Calibration
- Liquid Crystal Display (LCD)
- LCD Back-Light Bulb
- Fan and Cable Assembly
- PCBs
- Diagrams:
 - GDM1900A GDM Assembly Diagram
 - SWD1900A System Wiring Diagram
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- Contact Information
- Troubleshooting Guide Table

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- GDM Components Parts List
- GDM Accessories Parts List

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D-1. GENERAL INFORMATION

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Accessories	D-1-1
Warnings, Cautions, and Notes.	D-1-1
Warranty	D-1-3
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Contact Information	D-1-4

Please read and understand all of the information in this manual before servicing the e500 Graphic Display Monitor (GDM). Review the Operating Manual for additional product information.

ELECTROMAGNETIC INTERFERENCE

This equipment has been tested and found to comply with the EMC limits for the Medical Device Directive 93/42/EEC (EN 55011 Class A and EN 60601-1-2). These limits are designed to provide reasonable protection against harmful interference in a typical medical installation. The equipment generates, and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to other devices in the vicinity. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference with other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the other receiving device.
- Increase the separation between the equipment.
- Connect the equipment into an outlet on a circuit different from that to which the other device(s) is (are) connected.
- Consult the manufacturer or field service technician for help.

ACCESSORIES

Accessory equipment connected to the analog and digital interfaces must be certified according to the respective IEC standards (e.g. IEC 60950 for data processing equipment and EN 60601-1 for medical equipment). Furthermore, all configurations shall comply with the system standard EN 60601-1-1. Any person who connects additional equipment to the signal input part or signal output part configures a medical system, and is therefore responsible for ensuring that the system complies with the requirements of the system standard EN 60601-1-1. If in doubt, consult the technical service department or your local representative.

WARNINGS, CAUTIONS AND NOTES

Please review all warnings and cautions outlined in this manual before servicing the GDM. Strictly follow the instructions in this manual. Any use of the product requires full understanding and

GENERAL INFORMATION

strict observation of all sections of these instructions. Observe all WARNINGS and Cautions that appear in the operating and service manuals and on equipment labels.

■ **WARNING** A WARNING describes a condition that can cause personal injury.

■ **Caution** A Caution describes a condition that can cause damage to equipment.

NOTE: A note emphasizes information that is important or convenient.

Inspection: examination of actual condition.

Service: measures to maintain specified operational condition.

Repair: measures to restore to specified operational condition.

Maintenance: inspection, service, and/or repair where necessary or appropriate.

Preventive maintenance: maintenance performed at regular intervals.

WARNINGS

■ **WARNING** A patient connected to a ventilator requires the constant attention of medical staff.

■ **WARNING** The GDM displays information from the e500 Ventilator and its display integrity is dependent on the accuracy of the ventilator. In case of any discrepancy between the ventilator and GDM, information from the ventilator has the highest priority.

■ **WARNING** To ensure patient safety, accurate information processing and normal operation, connect the GDM to the e500 Ventilator only. Connect the GDM only to a NEWPORT-approved peripheral accessory (the Hewlett-Packard DeskJet 895 Cxi Printer or equivalent with the appropriate printer cable).

■ **WARNING** To maintain grounding integrity, connect the ventilator to a hospital grade receptacle only. Always disconnect the power cord from the power source and turn "OFF" the ventilator power switch before service.

Cautions

Caution Do not place liquids into or near the GDM, or allow sharp objects to damage or scratch the surface (especially the touchscreen/display surface).

Caution All GDM service or repair must be performed by a service technician authorized and trained by NEWPORT using authorized replacement parts.

Caution Use standard antistatic techniques when working inside the GDM enclosure or handling any GDM electronic parts.

Caution Clean all external parts of the GDM prior to service.

Caution To avoid damage to the GDM, do not block the air vents at the bottom of the GDM housing and avoid forceful impact to the touch screen.

Caution The function of the GDM may be adversely affected by the operation of high-frequency surgical (diathermy) equipment, defibrillators, or short-wave therapy equipment in the vicinity.

NOTE: Use the tools specified in the manual to perform specific procedures.

WARRANTY

The e500 GDM comes with a one (1) year conditional warranty. The warranty covers any defect or malfunction that occurs due to normal use. The warranty does not cover any scheduled maintenance. See the e500 Operating Manual for the conditions of this warranty.

FACTORY SERVICE

Scheduled maintenance or repair services are available from the NEWPORT Technical Service department. To return the GDM for service, see the instructions in Section 6 of this manual. NEWPORT's annual price list includes current pricing for scheduled maintenance and labor rates. To obtain a copy of the price list, please contact your local NEWPORT representative or call/fax our Customer Service department.

GENERAL INFORMATION

CONTACT INFORMATION

Address:

Newport Medical Instruments, Inc.
Post Office Box 2600
Newport Beach, California, USA 92658

Courier deliveries:

Newport Medical Instruments, Inc.
760 West 16th Street, Building B
Costa Mesa, California, USA 92627

Phone numbers:

Toll-free within the United States: 800.451.3111
Worldwide: 1.949.642.3910

Fax numbers:

Main fax: 1.949.548.3091
Technical Service department fax: 1.949.645.2049
Website: www.NewportNMI.com
email: info@NewportNMI.com

Department extensions:

Customer Service: 282
Technical Service: 500 (24-hour pager activated after hours)
Clinical Support: 123 (24-hour pager activated)

Corporate office hours:

Monday through Friday, 8:00 am to 5:00 pm (USA Pacific Time)

Technical Service department hours:

Monday through Friday, 7:00 am to 4:00 pm (USA Pacific Time)

D-2. ELECTRONIC THEORY OF OPERATION

Operational Overview	D-2-1
Description of Operation	D-2-2
Touch Screen Operation Concept.	D-2-3

OPERATIONAL OVERVIEW

The e500 Graphic Display Monitor (GDM) is a noninvasive patient monitor that displays real-time graphic and numeric data which is electronically fed to it from the e500 ventilator. Touch screen "buttons" (as pictorially displayed on the monitor screen) allow the user to select how the data information is displayed (waves, loops, trend waveforms, or numerics), change graph ranges, or print screen display hard-copy through the Hewlett-Packard DeskJet 895 Cxi printer or equivalent.

The GDM is powered by the e500 ventilator and runs continuously as long as the ventilator is powered-on and plugged into an appropriate AC power outlet source. When the ventilator is battery powered, the GDM will continue to function for a minimum of thirty minutes.

The major components of the GDM include:

- Rear Panel (PNL1900M) – includes cutouts for a printer cable port and the GDM Interface Cable. It is attached to the Front Bezel by 10 flat-head cross recess screws.
- GDM Interface (Power/Communications) Cable – passes through the cutout in the Rear Panel and connects to the e500 Ventilator Gas Delivery Unit Back Panel receptacle.
- Main Single Board Computer PCB (CPU1900A) – converts incoming digital data from the ventilator into intelligible graphical or numeric information that is displayed on the GDM screen. This PCB also interprets (and responds accordingly to) touch screen "button" touches. It includes a microprocessor (uP) cooling fan, that maintains proper Main Processor operating temperatures, and a cable used to provide +5 VDC and +13.5 VDC power to the circuit board.
- Touch Screen Interface PCB (PCB1911A) – manages electrical signal levels, which come from the touch screen panel, then feeds the end results to the Main Single Board Computer PCB for final analysis. Also, includes a DC-to-DC Power Converter/Regulator circuit that converts +13.5 VDC (from ventilator) to a regulated +5 VDC, to power other circuits of the GDM.
- Power Inverter PCB (PWR1900P) – converts low-voltage DC to high-voltage AC to power the Flat-Panel LCD display back-light CCF bulbs.
- Flat-Panel LCD Display (DSP1900P) – displays in multi-colors, based on the user selection, the graph axis with graphical waveforms/loops data, numeric parameter data, user-selectable "buttons", and all applicable textual information.

ELECTRONIC THEORY OF OPERATION

- Front Bezel/Touch Screen Panel assembly (PNL1901P) – The Touch Screen Panel is the surface that the user touches, with a finger or soft probe tool, to select GDM screen images, enter alpha/numeric data, or change graph ranges. The Front Bezel is the “window” to which the Touch Screen Panel is permanently attached, and is the Front Face of the GDM enclosure.
- Cables – cables are used to electrically connect the above listed major components together. (See Table 5-1, e500 GDM Components Parts List, for cable part numbers.)

DESCRIPTION OF OPERATION

The GDM Interface cable (which passes through a hole in the rear panel) connects to a receptacle on the Back Panel of the e500 ventilator gas delivery unit. This cable supplies +13.5 VDC (from the ventilator power supply) to the GDM circuitry as well as supplying digital data communication from the ventilator.

A DC-to-DC Power Converter/Regulator circuit, on the PCB1911A board, converts the incoming +13.5 VDC to a regulated +5.0 VDC source to power circuits on the CPU1900A and PCB1911A PCBs. The +13.5 VDC also powers other circuitry on the CPU1900A board and also powers the PWR1900P board. The PWR1900P board converts this +13.5 VDC into a high-voltage AC source to power the two back-light CCF bulbs inside the Flat-Panel LCD display. These back-light bulbs provide an overall white background illumination on the LCD display that is brightness-controlled by the R200 resistor (47K) located on PCB1911A board and is not adjustable.

The data communications from the ventilator is processed by the CPU1900A board, in accordance with the software programs stored in the "Disk-On-Chip" IC (installed in CPU1900A), to display on the LCD various real-time graphical or numeric parameter information (which are user-selectable, using the Touch Screen). The programs in the "Disk-On-Chip" IC are pre-programmed at NEWPORT, or vendor location, prior to installation into the CPU1900A board. These programs also control what type of overall screen detail is displayed (such as graph axis and applicable textual information, or table "cells" with parameter titles, under which any real-time parameter numeric data are displayed).

Included in each screen detail are "button" boundaries which, when pressed (touched) will cause a change in the type of screen display as defined by the software programs stored in the "Disk-On-Chip". In most of the screen displays such as all graphical, trends, or NUMERIC displays, a column of COMMAND "buttons" are along the right-hand side of the display. These "buttons" allow

the user to change screen display types or do a PRINT function. In other screens, such as SETUP, patient and general parameter settings, may be entered using various "buttons" located around the display area such as TIME, DATE, WEIGHT, etc. When touched these buttons will cause a display of alpha-numeric keypads, with "buttons", for the characters that can be touched for the user's selection of the respective values.

All of the final processed signals, both screen detail and structure, and real-time graphic and numeric data are then transferred to the LCD display which, in turn, converts these final signals into a visual display of same.

TOUCH SCREEN OPERATION CONCEPT

The Touch Screen Panel consists of a plate of glass (the "backing") with two sheets of dielectric plastic, each sheet coated with resistive material, placed in front of the glass, all being attached together as a complete unit. The surfaces of the two dielectric sheets are separated by a very small air-space gap (except when touched by a finger or probe). When installed on the Front-Bezel, the dielectric sheets will face the user, and the glass plate will face the LCD display, separated by spacing strips.

One of the dielectric sheets has an electrode material running along the upper and lower edges of the sheet. These electrodes are electrically separated from each other by the resistive coating material of the sheet, and are individually connected to the Touch Screen Panel cable connector via conductive etch strips along the cable. For purpose of explanation, this dielectric sheet, in combination with the electrodes, shall be referred to as the VERTICAL RESISTOR.

In a similar manner, the other dielectric sheet has an electrode material running along the left and right edges of sheet, each electrode being separated by the resistive coating material of this sheet, and likewise individually connected to the cable connector. This dielectric sheet shall be referred to as the HORIZONTAL RESISTOR. The cable connector has four conductors (from the above-mentioned electrodes) and terminals, which connect to the mating pins of J1 of PCB1911A Touch Screen Interface PCB.

Whenever a point on the Touch Screen surface is pressed, the two dielectric sheets are in contact with each other at that point (the glass acting as a "backstop" to facilitate contact). The exact point of contact, both horizontally and vertically, will determine the value of two analog signal levels, one each for horizontal and vertical position of contact that will be sampled by the PCB1911A processor circuitry, then converted to digital data.

The PCB1911A performs the sampling process by the following routine:

In each sampling cycle, there are two sections; one section is where the PCB1911A applies +5 VDC to the lower-edge electrode of the VERTICAL RESISTOR sheet, with respect to GROUND on the upper-edge electrode of same sheet. Simultaneously, the PCB1911A monitors one of the electrodes (left-edge or right-edge) of the HORIZONTAL RESISTOR sheet, using this electrode as a "receiving" path from which to measure the vertical analog value of the voltage at the point of contact between the two sheets. This value will range from about 0 VDC to about +5 VDC with the 0 VDC being measured if contact is made at the top edge of screen, and +5 VDC if contact is at the bottom edge. At the vertical center of screen, this value would be about +2.5 VDC.

This concept is similar to that of the center wiper terminal of a potentiometer (pot) "tapping" the voltage at the point of its setting, if +5 VDC is applied to one extreme terminal of the pot with respect to GROUND at the other extreme terminal.

During the other section of the sampling cycle, the roles of the two dielectric sheets are reversed. The PCB1911A applies +5 VDC to the right-edge electrode of the HORIZONTAL RESISTOR sheet, with respect to GROUND on the left-edge electrode of same sheet. Simultaneously, the PCB1911A monitors one of the electrodes (upper or lower-edge) of the VERTICAL RESISTOR sheet, in the same manner described above, to measure the horizontal analog voltage at the point of contact. This value will range from 0 VDC if contact is at the left edge, to +5 VDC if contact is at the right edge of screen, with +2.5 VDC at the horizontal center of screen.

During the sampling cycle, the pair of sampled vertical/horizontal analog voltage levels are converted into digital-code format by the processor chip on the PCB1911A board, which then serially transfers this digital-coded value to the CPU1900A board for further processing to determine what final display screen action will be performed.

The above described sampling cycle is initiated by the user touching the screen at any point. This cycle is completed within milliseconds duration (more than fast enough to complete before user removes the pressure point). Unless a point on the Touch Screen is touched, there will be no sampling cycle. If the user touches the screen at an invalid point (no "button" there, or "button" is grayed-out, meaning it is currently not applicable), the sampling cycle will still take place, but the "Disk-On-Chip" software will not recognize the horizontal/vertical coordinate values as valid, thus no screen change will occur.

Each time the Touch Screen is touched within a valid "button", a short audible beep sound shall be heard, signifying a successful "touch" operation. The actual duration of this beep is dependent on how long the user maintains pressure on the "button", with the sound terminating upon release of the "button". The buzzer and related circuitry that emits the audible sound is located on the CPU1900A board.

D-3. COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

Warnings, Cautions, and Notes	D-3-1
Rear Panel	D-3-1
Updating Software	D-3-3
Touch Screen Calibration	D-3-6
Liquid Crystal Display (LCD)	D-3-7
LCD Back-Light Bulb	D-3-8
Fan and Cable Assembly	D-3-9
PCBs	D-3-10
Diagrams:	
GDM1900A GDM Assembly Diagram	D-3-13
SWD1900A System Wiring Diagram	D-3-15
SCH1911 Touch Screen Schematic Diagram	D-3-16
Electronic Block Diagram	D-3-19

This section describes how to remove and replace the internal components of the e500 GDM.

Reference Drawings: Assembly Diagram, GDM1900A
System Wiring Diagram, SWD1900A

Before Any Service

Disconnect the e500 GDM from the e500 ventilator. It is not necessary to turn off the ventilator when connecting or disconnecting the GDM.

WARNING These instructions are intended for use only by a Newport Medical Instruments factory-trained technician. Do not perform any unauthorized modifications or repairs to the ventilator or its components.

Caution To avoid damaging equipment, use standard electrostatic discharge (ESD) precautions, including an ESD wrist strap, when servicing the GDM.

NOTE: Unless instructed otherwise, replace parts by reversing the removal steps.

REAR PANEL REMOVAL

Carefully set the GDM face down on a non-abrasive surface, oriented with bottom (vented) edge of GDM closest to technician.

1. Remove the 10 flat-head cross recess screws that hold the rear panel to the front bezel.
2. Lift the rear panel away and to the right of the monitor.
3. Remove cables from J2 and J4 on the touch screen interface PCB (PCB1911A).
4. Remove the cable from CN16 on the single board computer PCB (CPU1900A).

NOTE: When reinstalling the rear panel, reverse these steps and:

- Tighten these 10 screws per Assembly Drawing No. GDM1900A torque specifications.

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

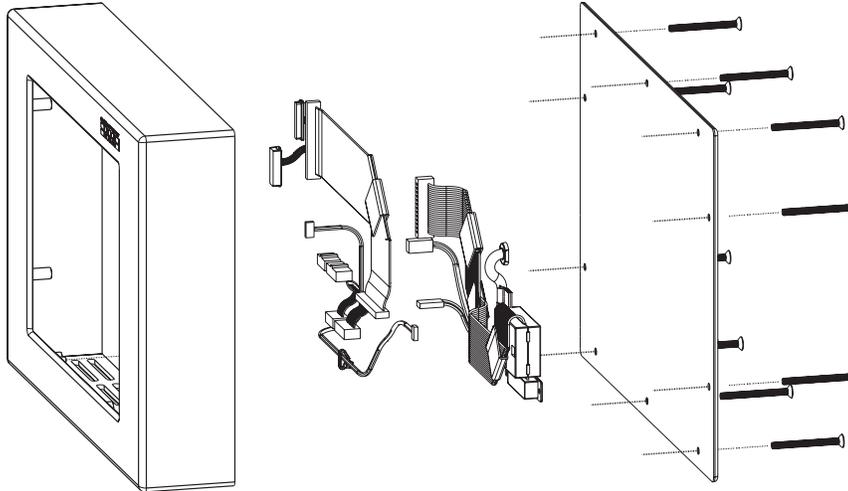


Figure 3-1. Rear Panel, Cables and Screw Positions

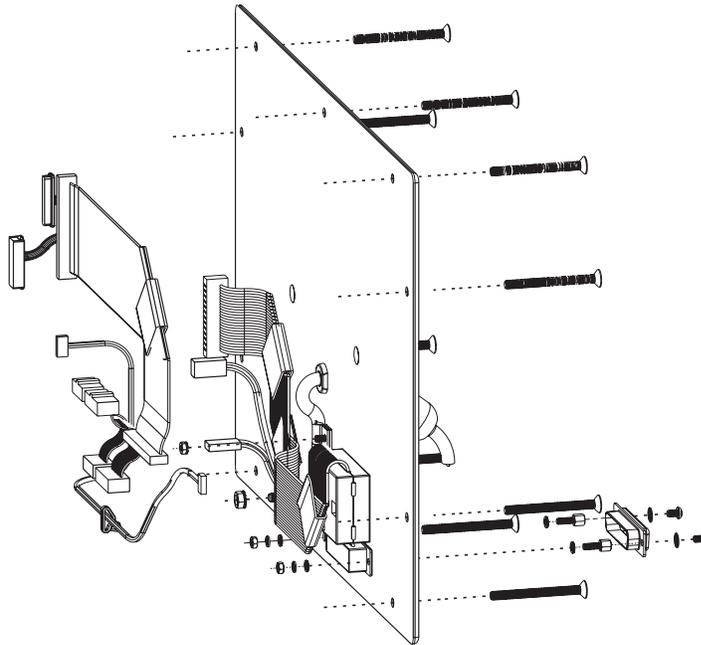


Figure 3-2. Rear Panel and Cables (details)

UPDATING SOFTWARE FOR THE GDM

Instructions for e500 GDM Disk-On-Chip Replacement

GENERAL INFORMATION

WARNING All service and repairs of the e500 Graphics Display Monitor (GDM) should be done by an authorized Newport Medical Instruments factory trained service technician.

Caution Hazardous voltages are present inside the e500 GDM. Disconnect electrical power before attempting any disassembly. Failure to do so could result in injury to service personnel or equipment.

To prevent damage from ESD and possible failure of the e500 GDM, please use standard anti-static technique when handling circuit boards or other electronic components.

FSK1900A Kit includes:
Disk on chip p/n DOC1901A*
Instructions FSK1900A
Packaging for chip p/n PKG1900P
*Or most current version p/n as included in kit.

Tools Needed:
Medium size Philips head screw driver
Small blade screw driver or chip extractor
EMI / RFI wrist strap and mat

1. Power on the e500 ventilator and make note of the current software version number in the Graphics Display Monitor (GDM) 'Set Up Screen'. Power the ventilator off. Disconnect from electrical power.
2. Disconnect the e500 Graphics Display Monitor (GDM) cable from the rear panel of the Gas Delivery Unit (GDU) of the e500 ventilator.
3. Dismount the e500 GDM from the cart by removing the 2 mounting nuts on the rear of the mounting bracket.
4. Remove all 10 holding screws to open the rear panel of the e500 GDM.
5. Disconnect ribbon cable CBL1904A at J5 on PCB1911A to expose SOLID STATE DISK.
6. Remove Disk-On-Chip from U27 socket.

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

7. Align the notch on the Disk-On-Chip with the outline on the board, and insert the new Disk-On-Chip into U27 (SOLID STATE DISK ROM 0) socket.
8. Reconnect ribbon cable CBL1904A to J5 on PCB1911A.
9. Close the rear panel of e500 GDM and secure with the 10 holding screws.
10. Remount the e500 GDM onto the cart and secure the 2 mounting nuts.
11. Reconnect the e500 GDM cable to the e500 GDU.
12. Power the e500 on, enter the GDM 'Set Up Screen' and verify that the software version number is an updated version number from previously installed release, i.e. US 4-8A to US 4-8B.

NOTE: Upon completion of software upgrade, you must complete the following form (with serial numbers and signature) and return it to Newport Regulatory Department.

**COMPLETED FORM MUST BE FAXED TO NEWPORT REGULATORY AFFAIRS
UPON COMPLETION OF UPGRADE.**

.Fax completed form to: 1.714.427.0489 attention RA/QA
or email requested information to: regulatory@NewportNMI.com

Facility Name: _____
Facility Address: _____

e500 Model: WW USA Language: _____

Current Hours: _____

Gas Delivery Unit (GDU) Serial Number: _____

GDU old software version: _____

GDU updated software version: _____

Control Panel Module (CPM) Serial Number: _____

CPM old software version: _____

CPM updated software version: _____

*Graphics Display Monitor (GDM) Serial Number: _____

GDM old software version: _____

GDM updated software version: _____

*if applicable

Company performing service: _____

Address of company performing service: _____

Installed by: (print name) _____ Date: _____

OVP performed by: _____ Date: _____

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

TOUCH SCREEN CALIBRATION

Calibrate the touch screen if:

- you have replaced the touch screen or the touch screen interface board, or
- you suspect that the touch screen is out of calibration (screen does not respond correctly to touch).

Caution Do not use any sharp object to touch the GDM screen as it may damage the screen surface.

Follow these steps to calibrate the touch screen:

1. Touch the SETUP button.
2. Touch the TOUCH SCREEN CAL button. A dialog box asks to confirm that you want to begin calibrating.

NOTE: Touch screen calibration takes from one to three minutes. Once calibration begins, the GDM cannot return to normal operation until the calibration is completed or the GDM is powered off, then back on.

3. Touch CANCEL to resume normal operation without calibrating, or touch CALIBRATE to begin calibration.
4. A message at the center of the screen repeatedly prompts you to touch a solid white dot displayed on the perimeter of the screen. The GDM confirms each touch with a beep, then displays a solid dot at a different location. The dot appears on the screen in this sequence:
 - the middle of the top edge,
 - the middle of the right edge,
 - the middle of the bottom edge, and
 - the middle of the left edge.

The sequence repeats 9 times for a complete calibration (40 touches total).

LCD REMOVAL

1. Follow above procedure for the removal of rear panel.
2. Remove cables from J1 and J6 on the touch screen interface PCB (PCB1911A).
3. Remove cables from CN2 and CN3 on the inverter PCB (PWR1900P).
4. Remove the four nut-and-washer assemblies that hold the mounting plate (to which all three PCBs are attached) to the front bezel.
5. Lift the mounting plate from the unit, and feed the two LCD cable connectors through the grommets in the plate.
6. Remove the four 4-40 mm cross recess pan-head screws that attach the LCD to the mounting place.

NOTE: If replacing the LCD with a new unit, also remove the attached cable from CN1 of the LCD and install this cable into CN1 of the new LCD.

NOTE: When reinstalling the LCD, reverse the above steps and:

- If installing a new LCD, fasten the gasket strips, part numbers GKT1904M and GKT1905M, (two each) around the metal surface of the front of the LCD so that the corners of the gasket strips meet.
- Align the mounting plate so that the LCD labeling is right side up relative to the front bezel, and so that the edges of the LCD are not visible through the bezel "window" before tightening the four nut-and-washer assemblies of the mounting plate. Tighten the mounting plate nut-and-washer assemblies as specified in the Assembly Drawing No. GDM1900A.

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

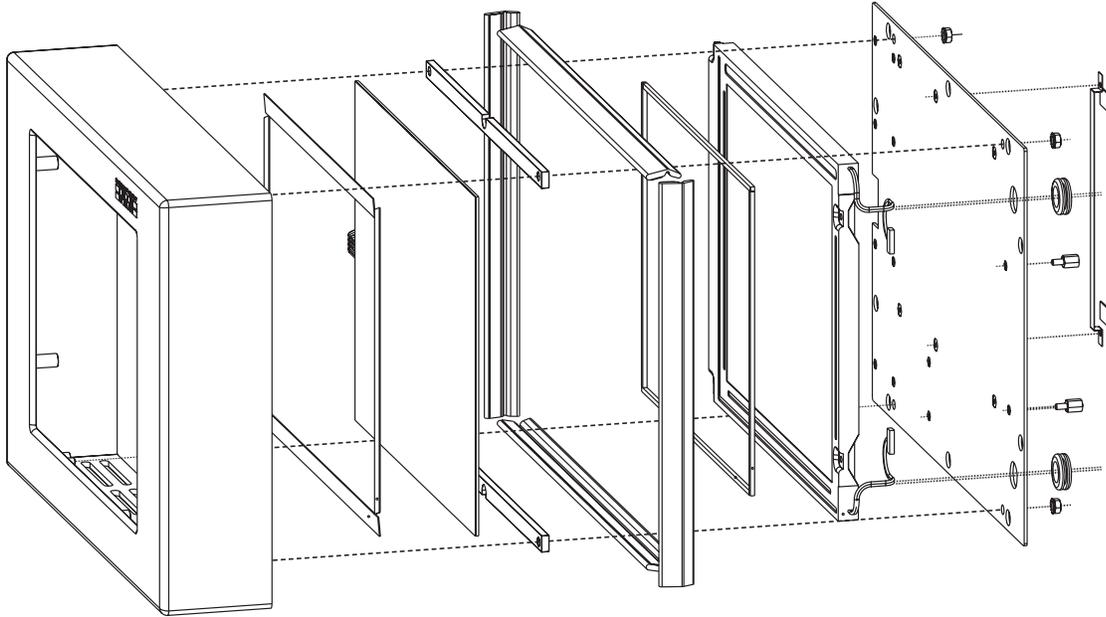


Figure 3-3. Liquid Crystal Display (LCD)

LCD BACK-LIGHT BULBS REMOVAL

1. Follow above procedures for the removal of rear panel and LCD.
2. Use the blade of a small flat screwdriver to push the tab that releases the upper or lower back-light bulb from the upper or lower edge, respectively of the LCD assembly.
3. Slide the back-light from the LCD.

When installing back-light bulbs, reverse these steps.

NOTE: The upper and lower back-lights are not interchangeable. A triangle symbol indicates an upper back-light, and no triangle indicates a lower back-light.

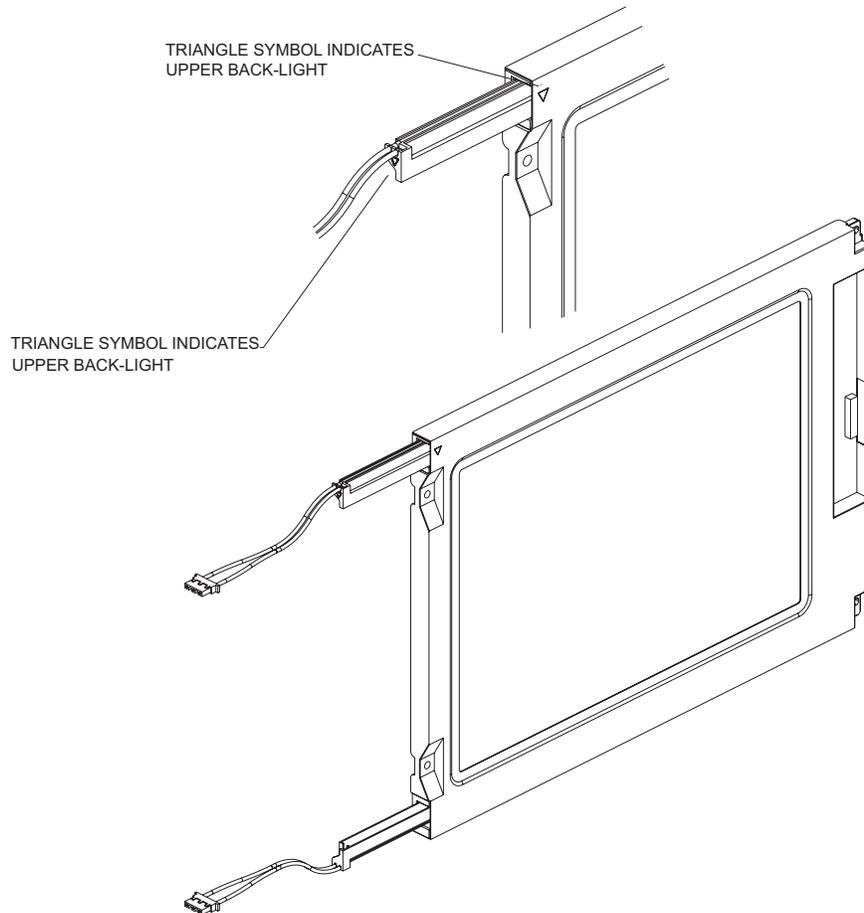


Figure 3-4. LCD Back-light

FAN AND CABLE ASSEMBLY REMOVAL

1. Follow above procedure for the removal of the rear panel.
2. Locate the fan on the single board computer PCB.
3. Remove the fan cable from CN11 of CPU1900A PCB and J10 of PCB1911A PCB.
4. Twist the fan housing and heat-sink assembly counter-clockwise to unscrew it from its mount.
5. Remove CPU Heat Sink mount by lifting slightly on locking tab and pulling straight up.

NOTE: When reinstalling the fan assembly, reverse steps in this order: Step 4, 5, 3-1.

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

Caution When screwing the fan and heat-sink assembly back into the CPU Heat Sink mount, make certain that the threads are properly engaged and aligned to avoid cross-threading. When tightening is completed, the heat-sink should make solid contact to the Intel chip surface and the CPU Heat Sink mount should not be able to slide along chip surface.

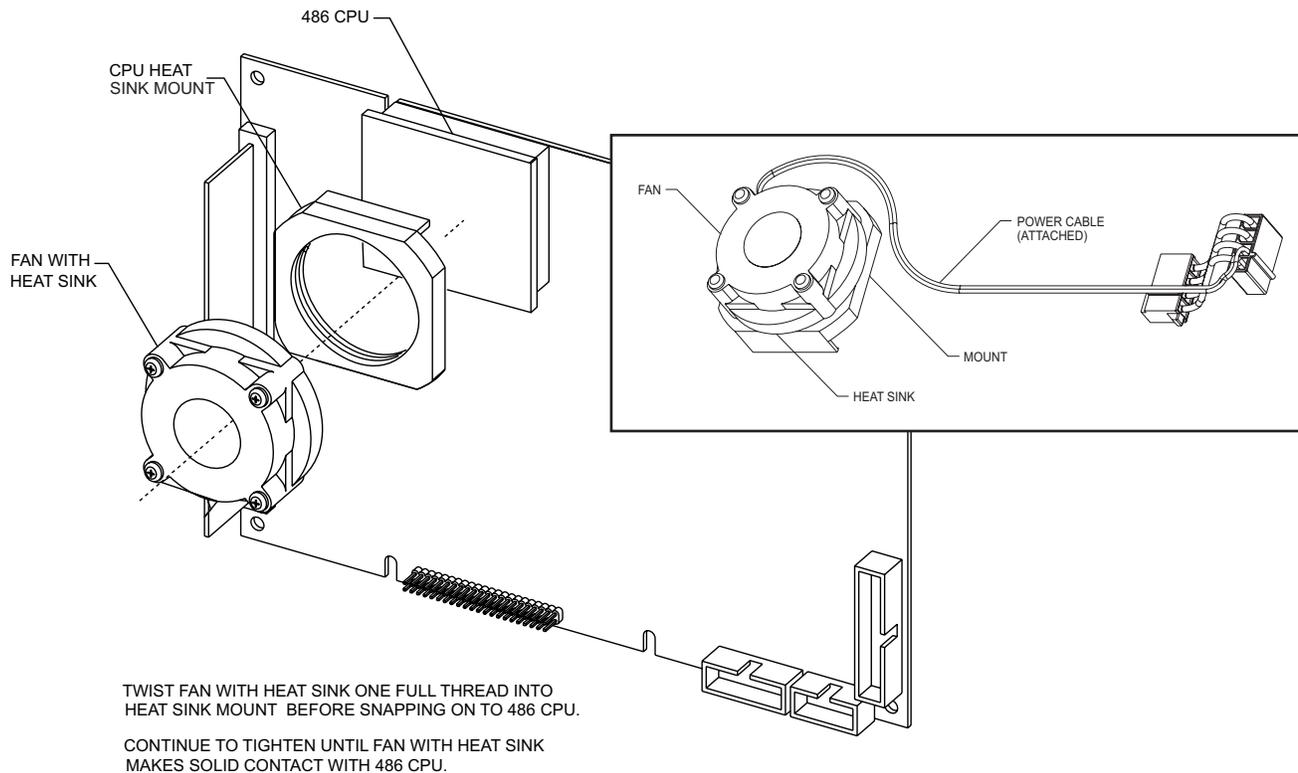


Figure 3-5. Fan and Cable Assembly

PCBs REMOVAL

1. Follow above procedure for the removal of the rear panel.
2. Remove these cables:
 - For the touch screen interface PCB (PCB1911A), remove cables from J1, J5, J6, J7, J10, J11, and J12.
 - For the single board computer PCB (PCB1900A), remove cables from CN2, CN8, CN11, and CN13.
 - For the inverter PCB (PWR1900P), remove cables from CN1, CN2, and CN3.
3. Remove the pan-head cross recess screws and internal-tooth lock washers that hold the respective PCB to the mounting plate as follows:
 - For the touch screen interface PCB, remove 10 metal screws and 10 lock washers.

- For the single board computer PCB, remove 4 metal screws, 2 plastic screws, and 6 lock washers.
- For the inverter PCB, remove 2 plastic screws and 2 lock washers.

NOTE: When reinstalling the PCBs, reverse these steps and tighten the PCB screws per Assembly Drawing No. GDM1900A torque specifications.

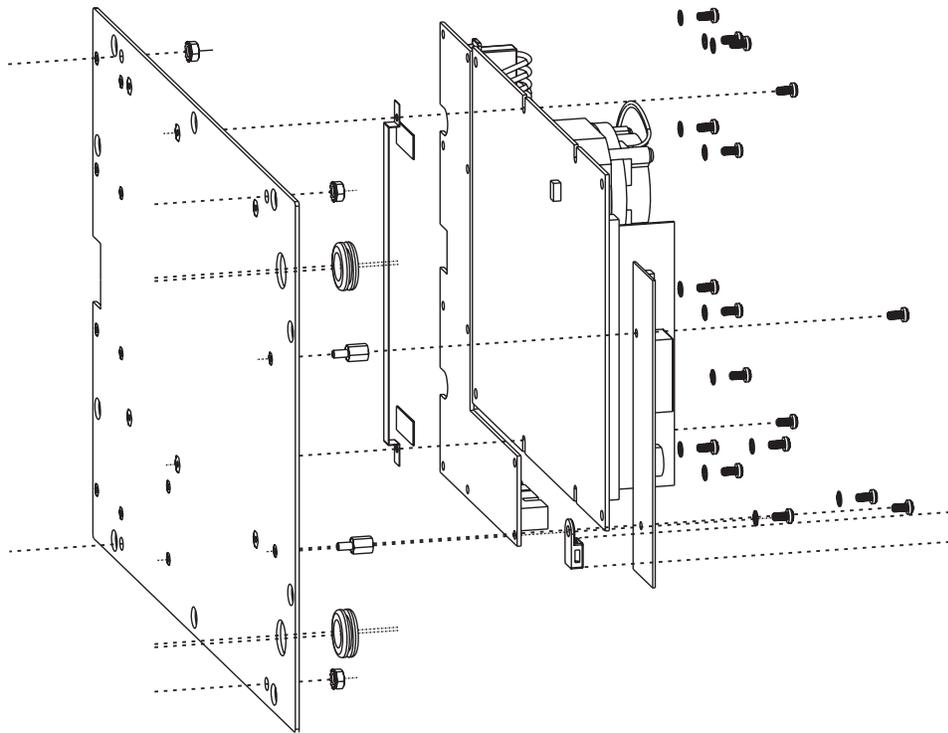


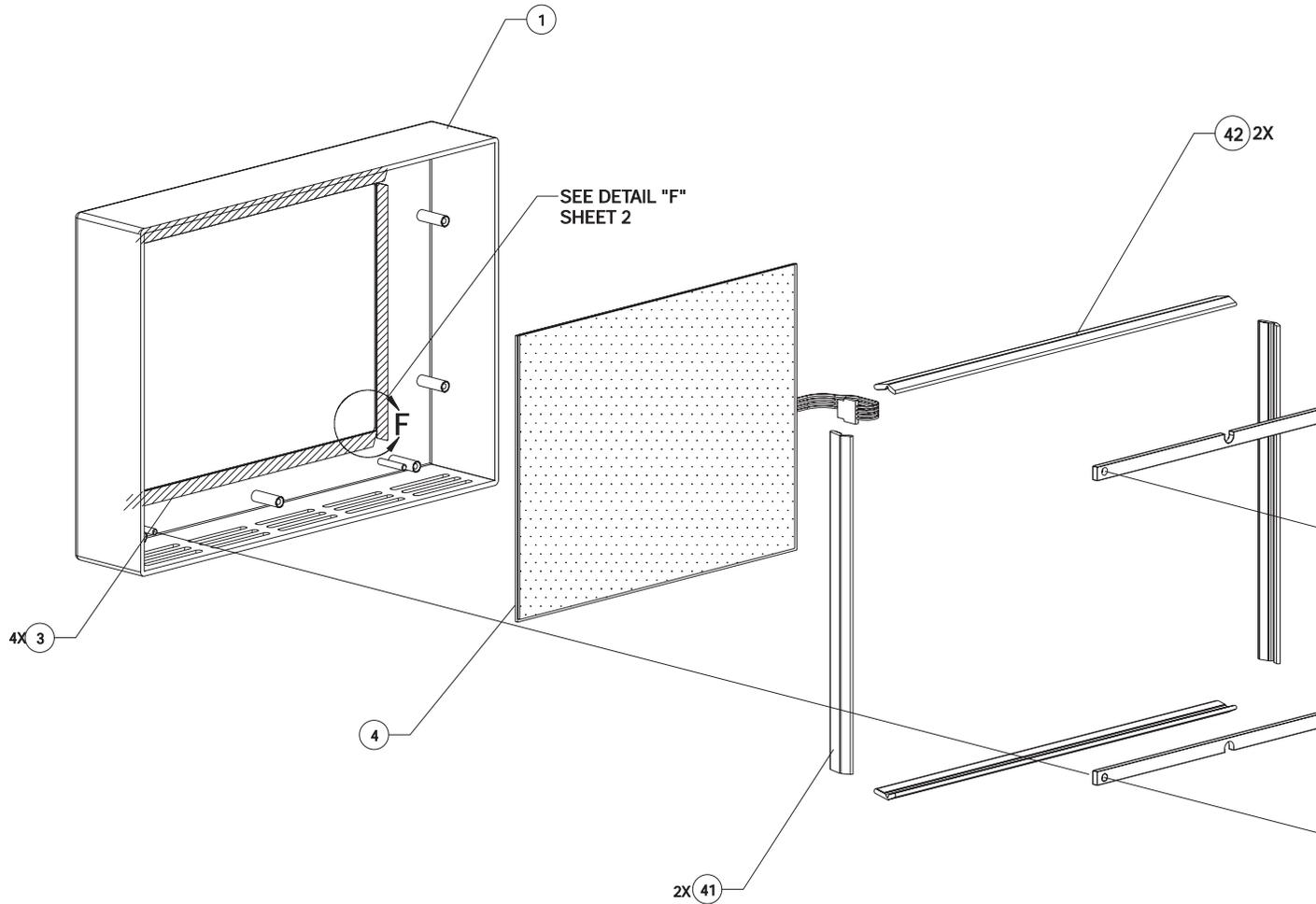
Figure 3-6. Touch Screen Interface, Single Board Computer and PCBs

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

GDM ASSEMBLY PARTS LIST

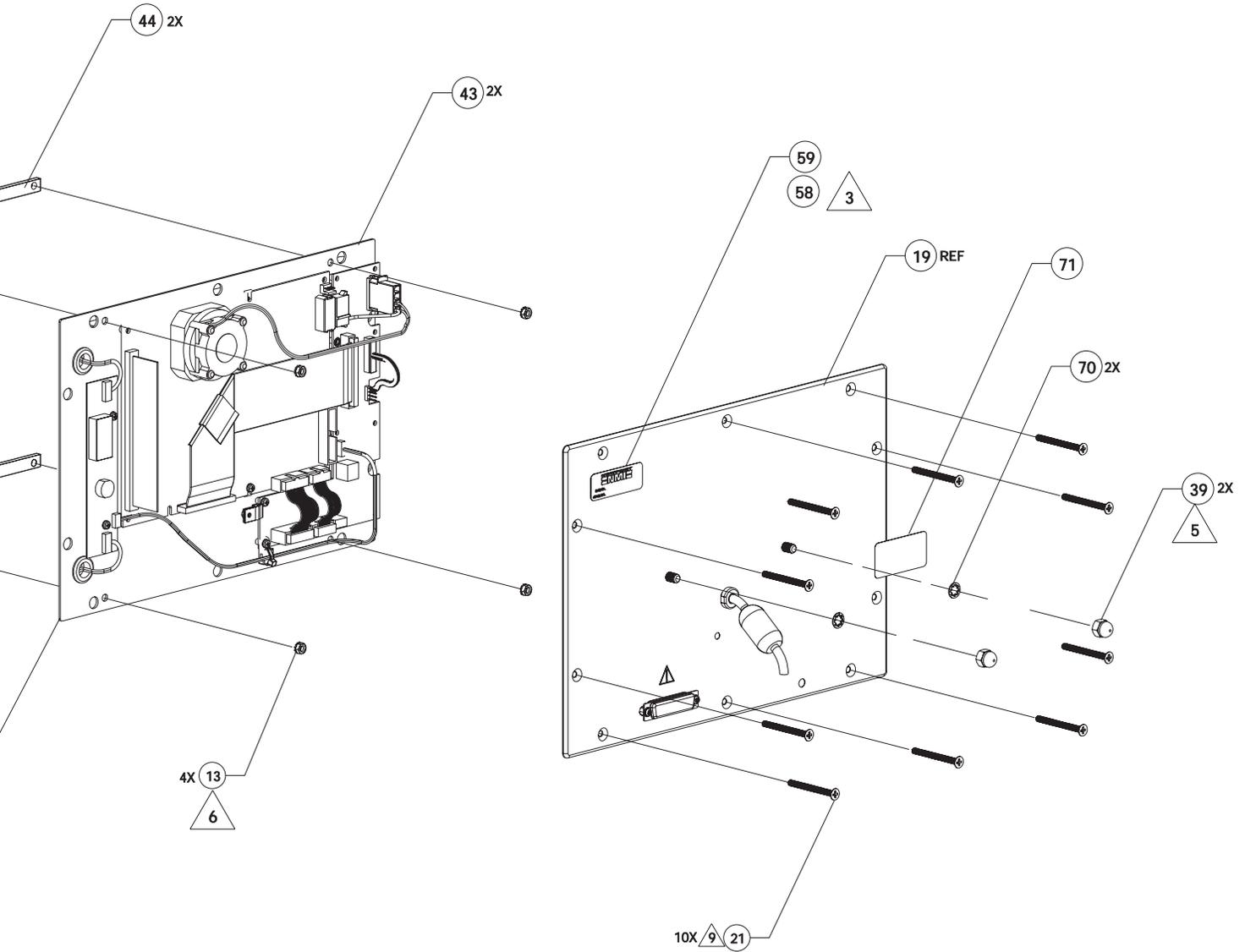
Part No.	Item No.	Quantity
BZL1900M	01	1.00
TAP1900P	03	2.72
PNL1901P	04	1.00
GKT1904M	05	2.00
GKT1905M	06	2.00
DSP1900P	07	1.00
PCB1911A	09	1.00
NUT1841P	13	5.00
CBL1903A	14	1.00
CPU1900A	16	1.00
SCR1830P	17	14.00
PNL1900M	19	1.00
BSH1800P	20	1.00
SCR1846P	21	10.00
SCR1855P	22	2.00
CBL1901A	23	1.00
CBL1825A	24	1.00
CBL1904A	31	1.00
PWR1900P	32	1.00
NUT1862P	39	2.00
GKT1902M	41	2.00
GKT1903M	42	2.00
PLT1900M	43	1.00
BAR1900M	44	2.00
GRM1900P	45	2.00
CBL1906A	46	1.00
CBL1907A	47	1.00
CBL1908A	48	1.00
WSH1832P	49	18.00
FER1901Q	50	1.00
NUT1831P	51	1.00
TYM1900Q	52	1.00
TYR100P	53	1.00
CLP1900Q	54	1.00
ADH1200P	58	0.00
LBL1807P	59	1.00
PPR1900M	60	1.00
SCR1901Q	61	4.00
STO1900P	62	2.00
CVRDB25Q	63	1.00
SCP4019P	64	2.00
WSH700P	65	2.00
FOM1801M	66	2.00
PKG1801P	67	1.00
LBL1815P	68	1.00
PAD1801M	69	1.00
WSH1862P	70	2.00
LBL1025P	71	1.00
FLP1900A	72	0.00
SCR448P	73	4.00
WSH638P	74	4.00
WSH1512P	75	4.00
SPC1901M	76	4.00
WSH1900P	77	4.00

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES



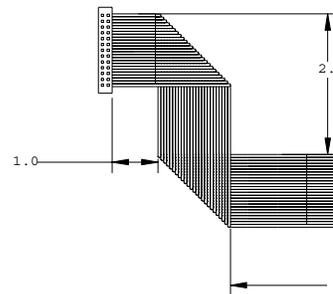
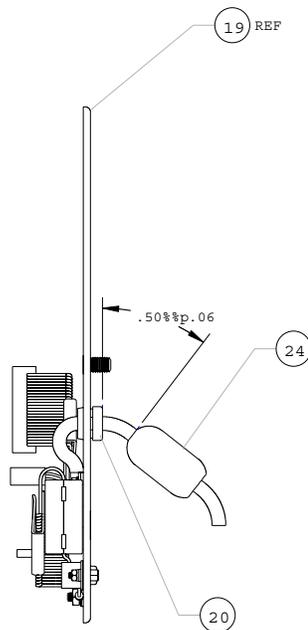
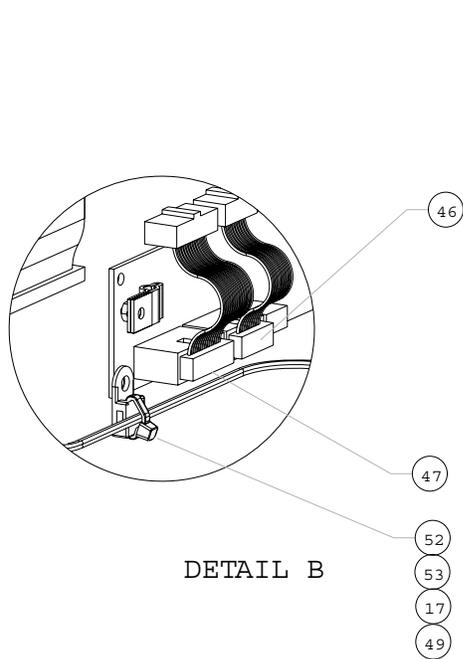
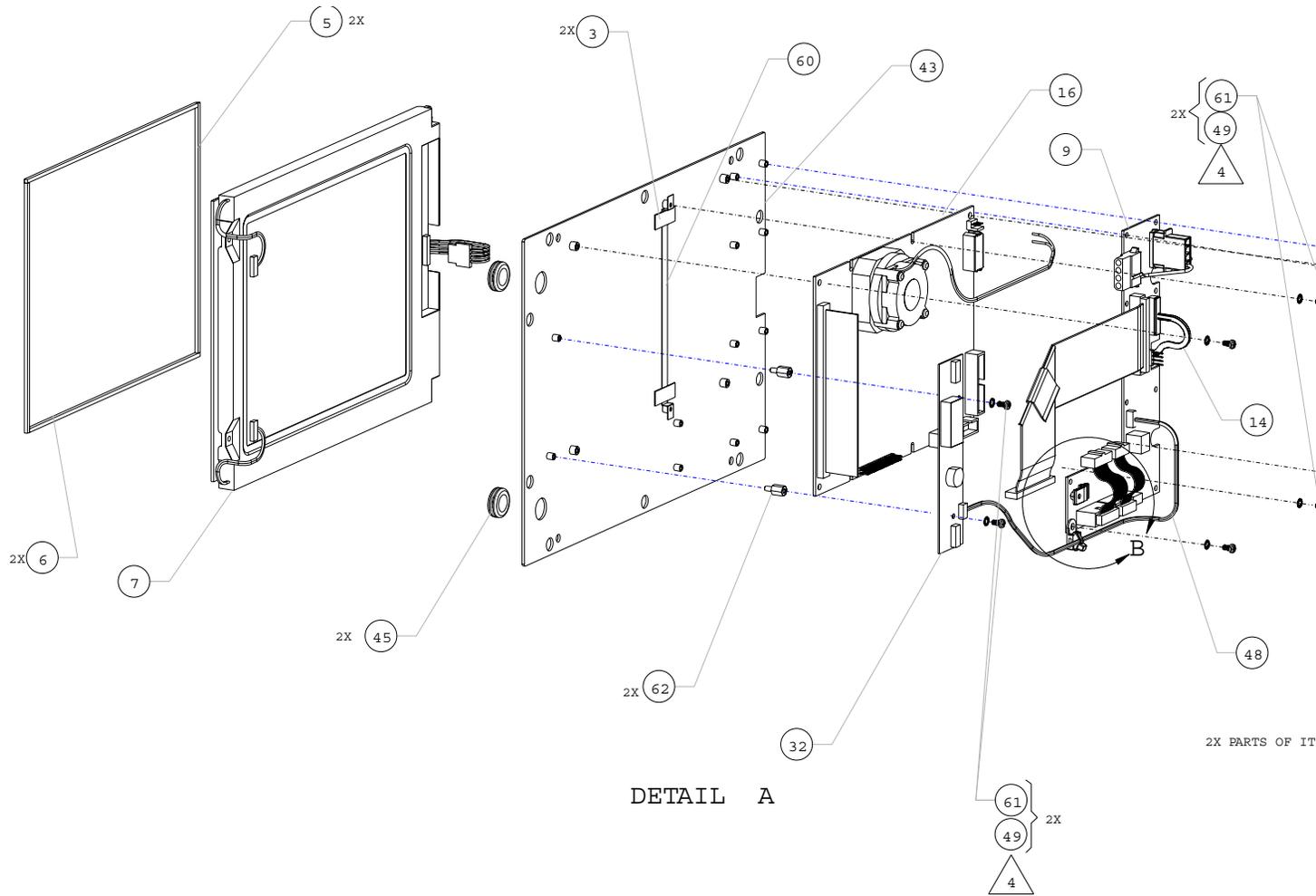
- ▲ 9 TORQUE TIGHTEN TO 9 – 12 IN.-LBS.
 - ▲ 8 TORQUE TIGHTEN TO 3 – 5 IN.-LBS.
 - ▲ 7 TORQUE TIGHTEN TO 10 ± 1 IN.-LBS.
 - ▲ 6 TORQUE TIGHTEN TO 6½ ± ½ IN.-LBS.
 - ▲ 5 TORQUE TIGHTEN TO 5 ± ½ IN.-LBS.
 - ▲ 4 TORQUE TIGHTEN TO 14 ± 02 IN.-LBS.
 - ▲ 3 APPLY LOCTITE ITEM 58 AS REQUIRED.
2. PROGRAM FINISHED UNIT WITH SOFTWARE FROM ITEM 7.
 1. FOR WIRING DIAGRAM SEE DRAWING SWD1900A.

NOTES: UNLESS OTHERWISE SPECIFIED.



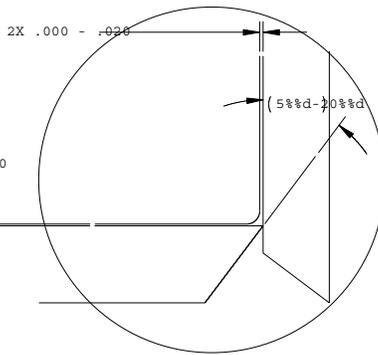
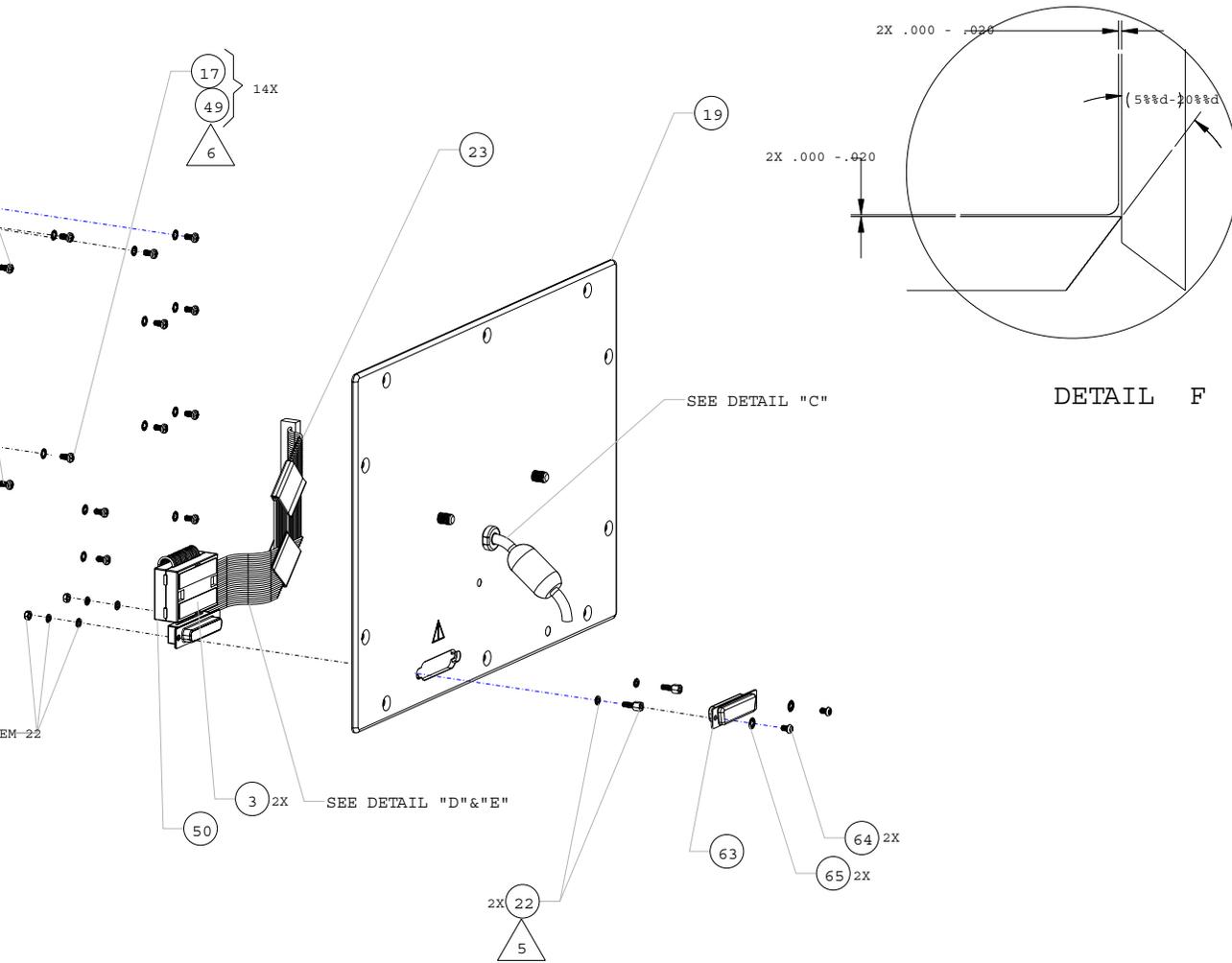
GDM Assembly Diagram
GDM1900A
Page 1 of 2

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

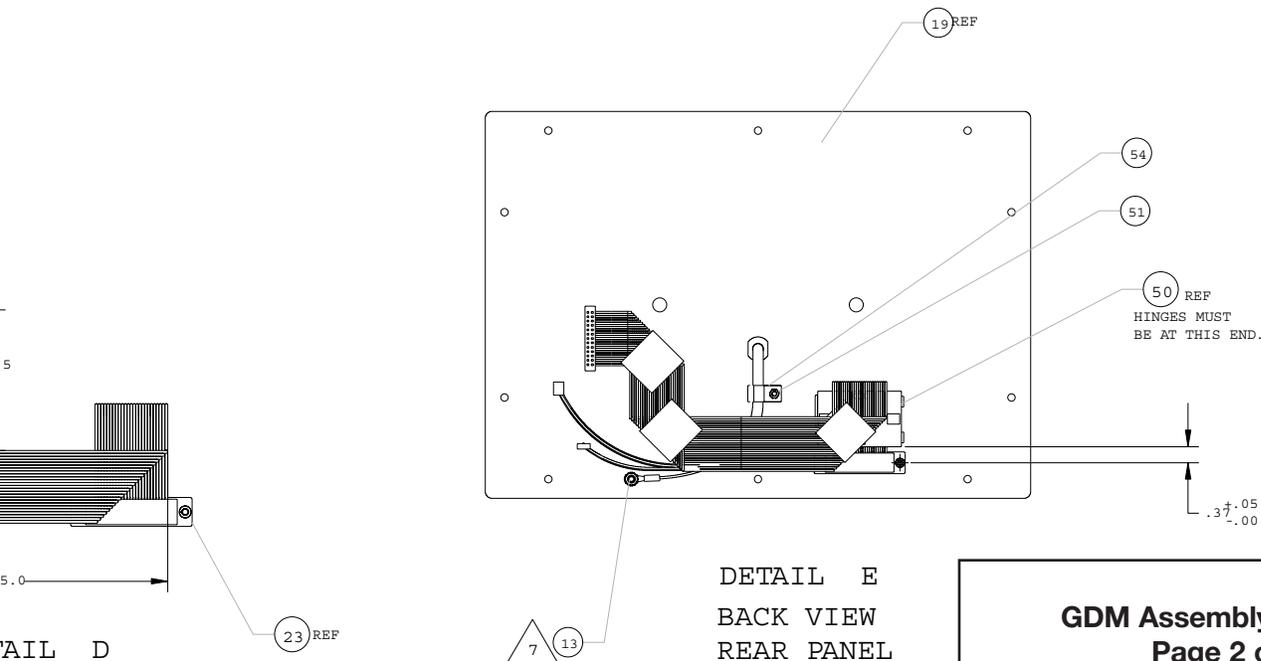


DETAIL C

DET



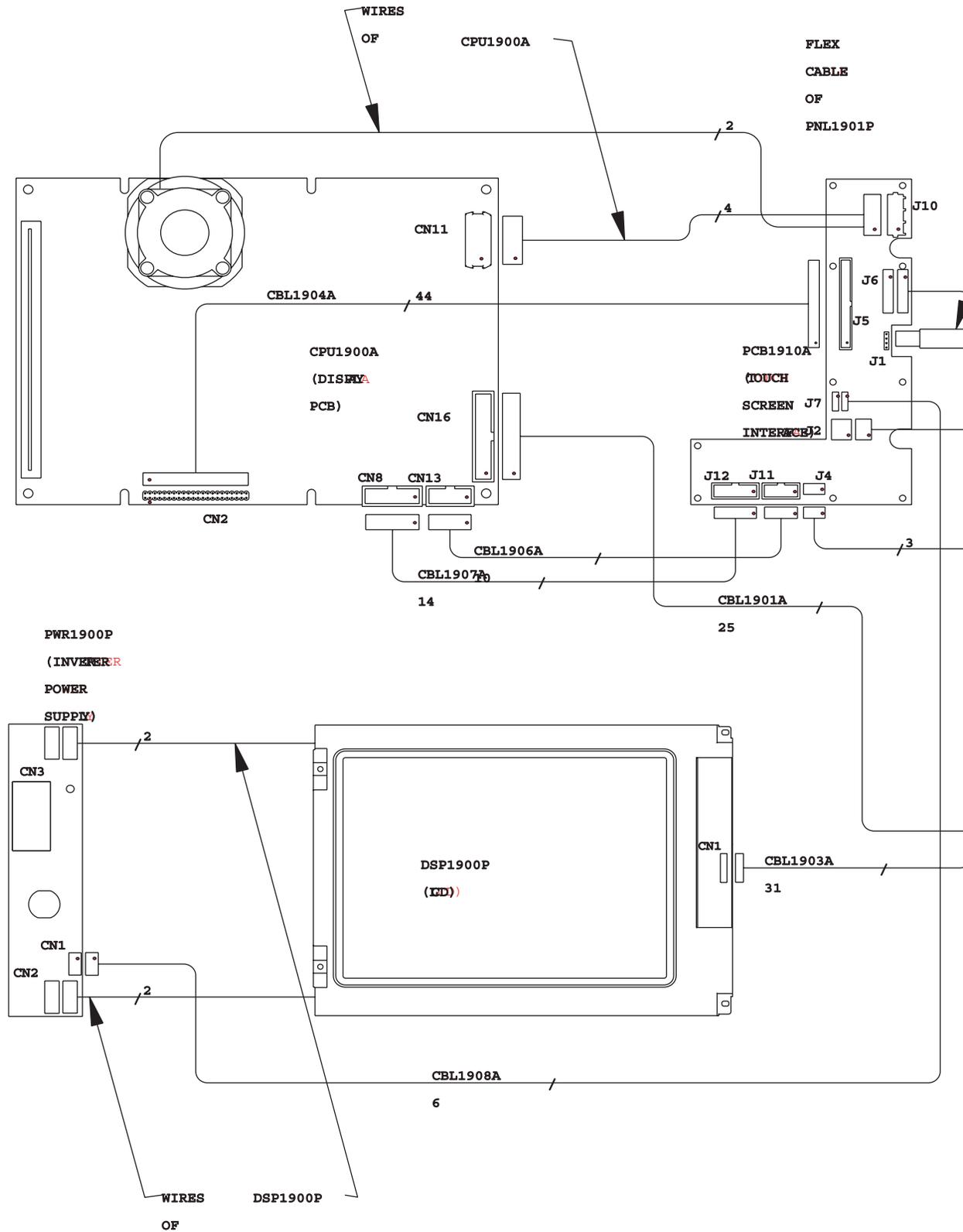
DETAIL F

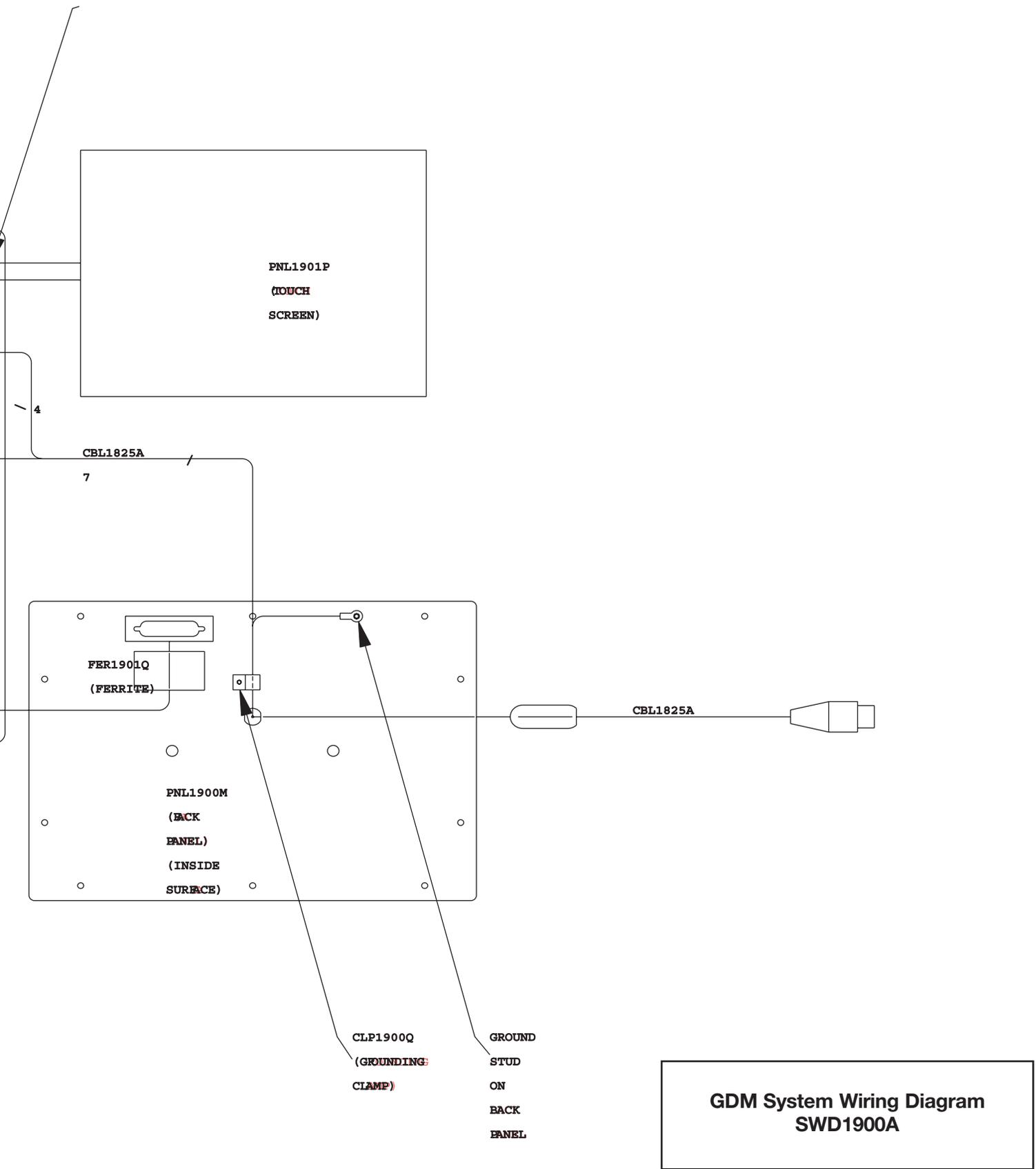


DETAIL E
BACK VIEW
REAR PANEL

GDM Assembly Diagram
Page 2 of 2

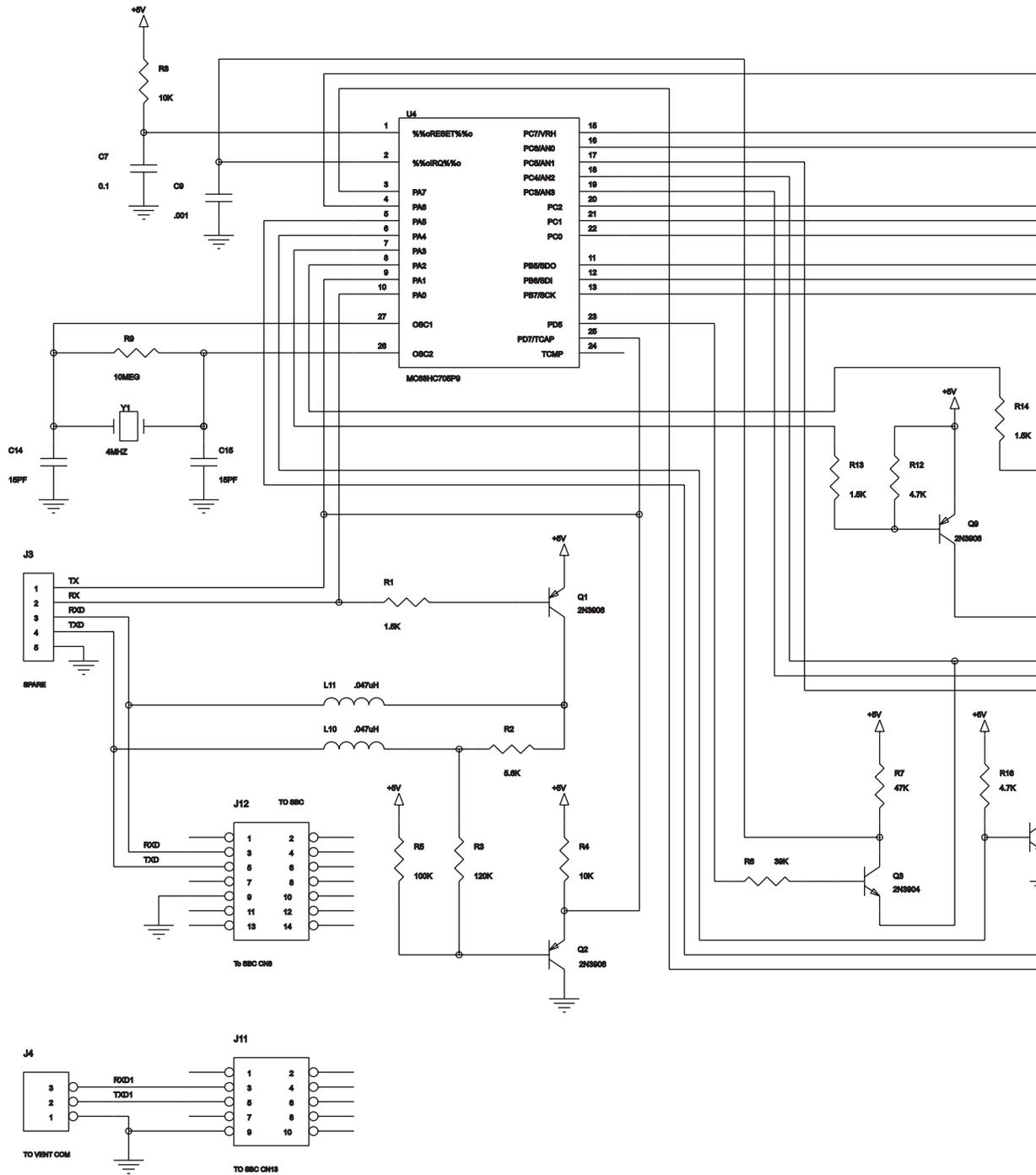
COMPONENT REMOVAL AND REPLACEMENT PROCEDURES



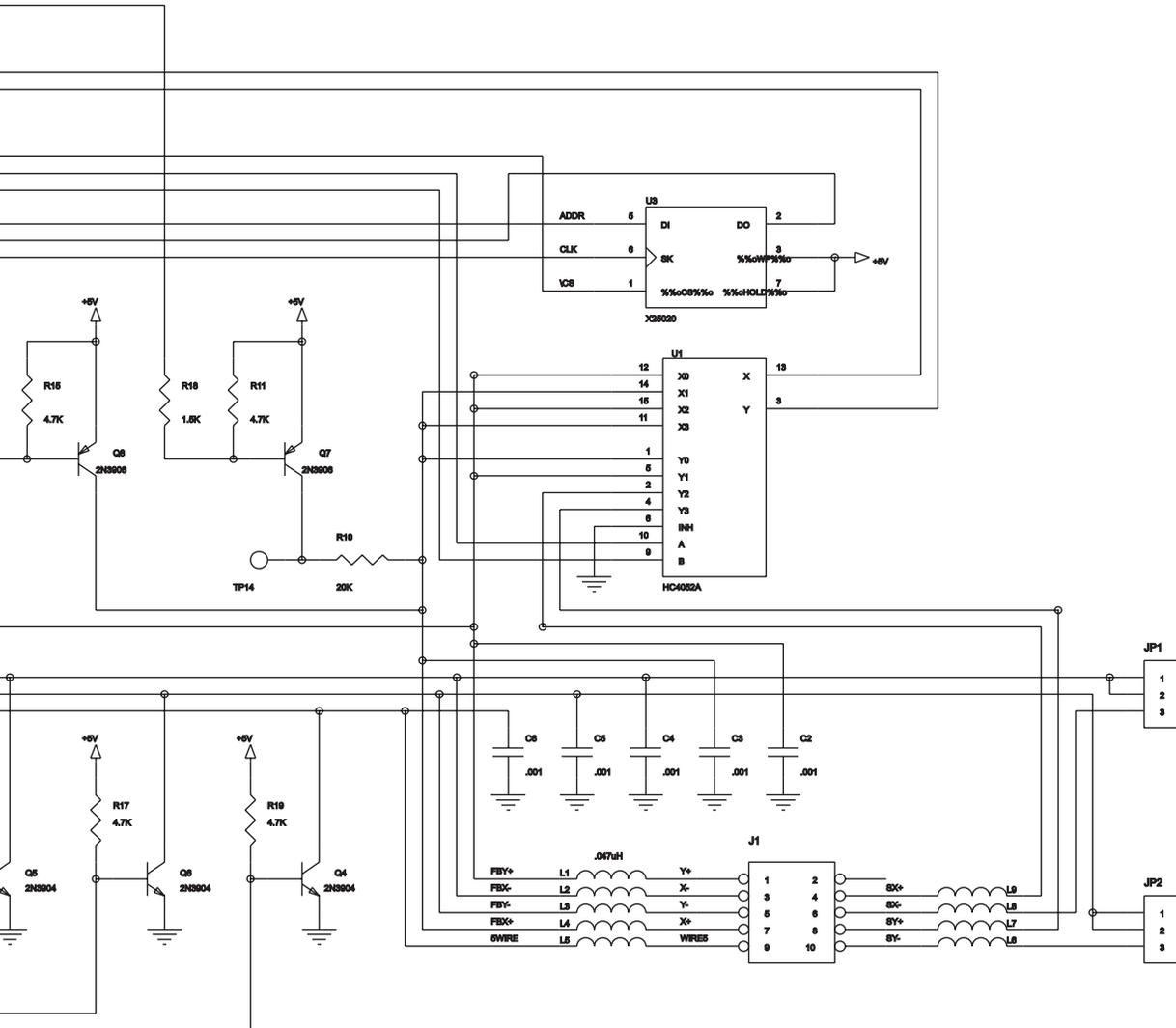


GDM System Wiring Diagram
SWD1900A

COMPONENT REMOVAL AND REPLACEMENT PROCEDURES



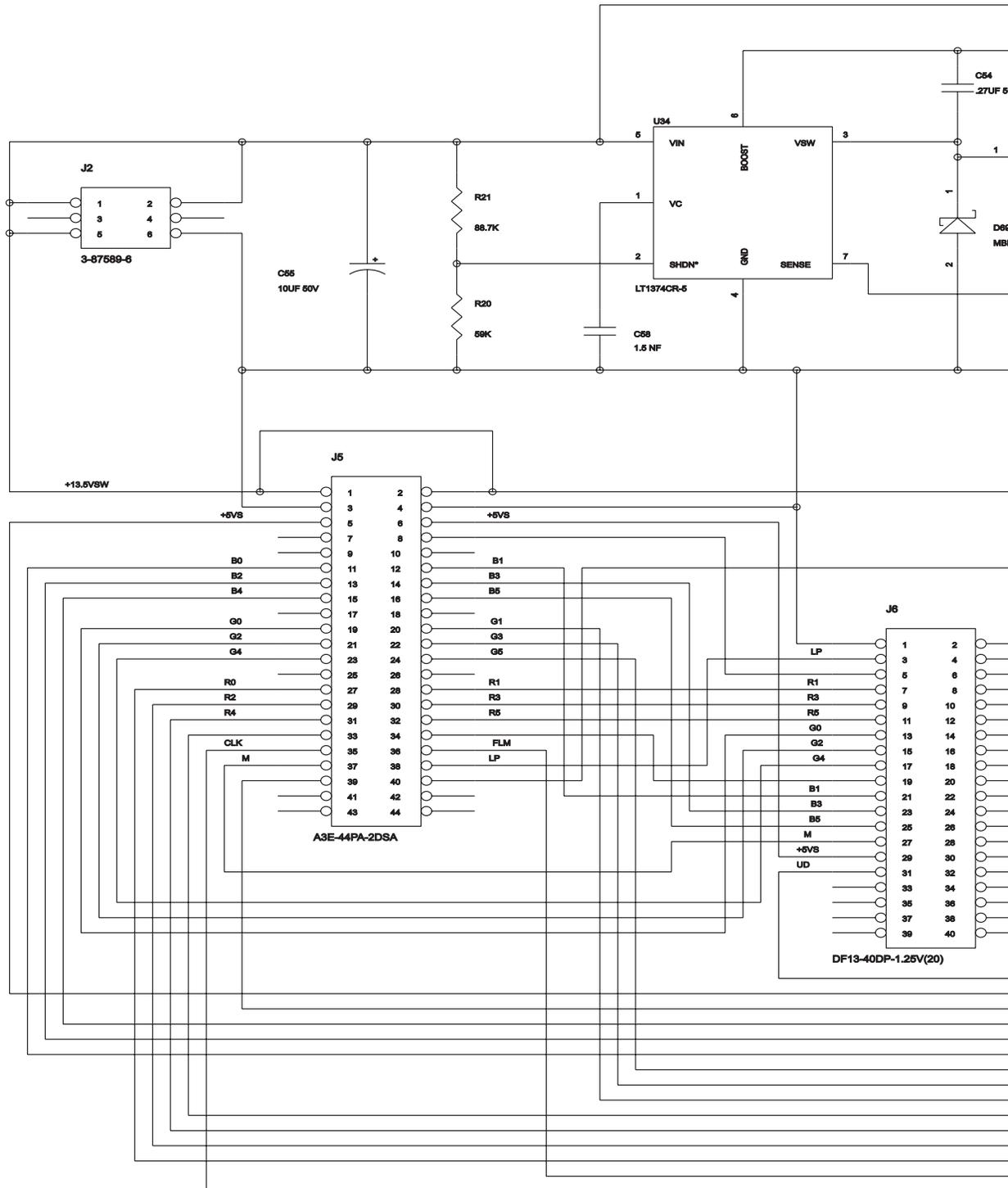
NOTICE: These schematics are provided for reference only. Only Newport factory trained service technicians are authorized to exchange or PCBs.



GDM Touch Screen Schematic
 Diagram SCH1911
 Page 1 of 3

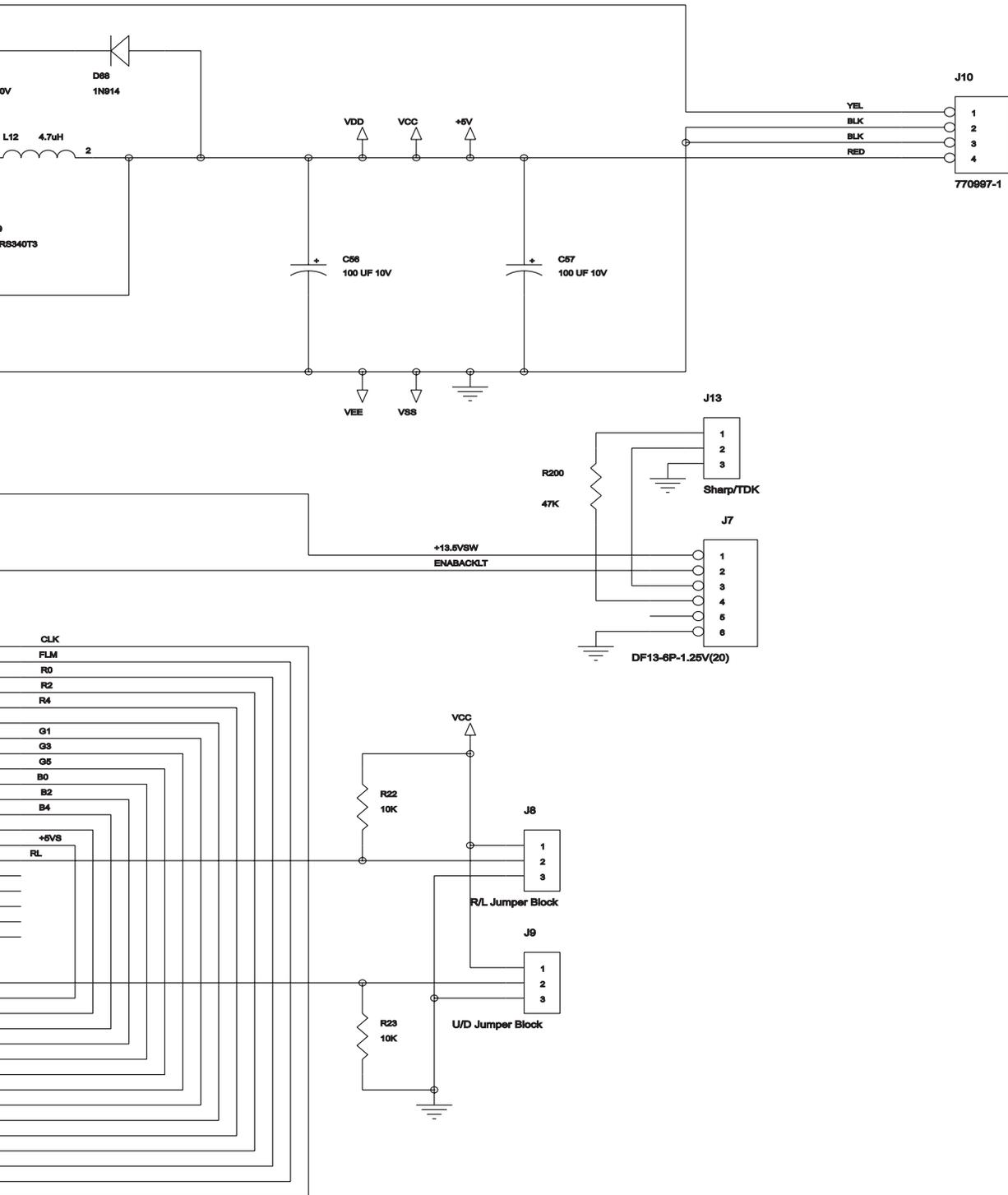
COMPONENT REMOVAL AND REPLACEMENT PROCEDURES

Trace routing is critical. Mount components over h

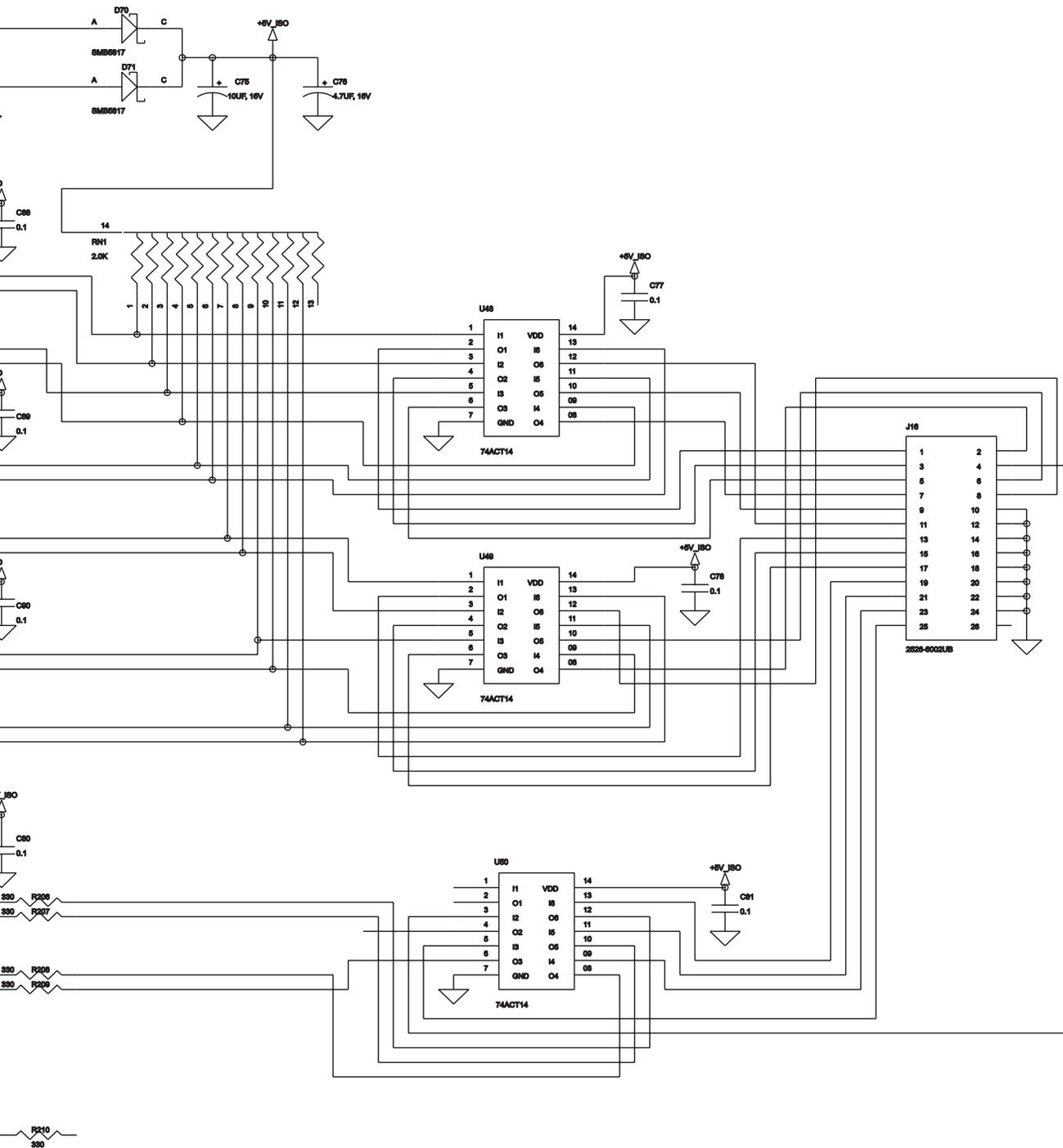


NOTICE: These schematics are provided for reference only. Only Newport factory trained service technicians are authorized to exchange PCBs.

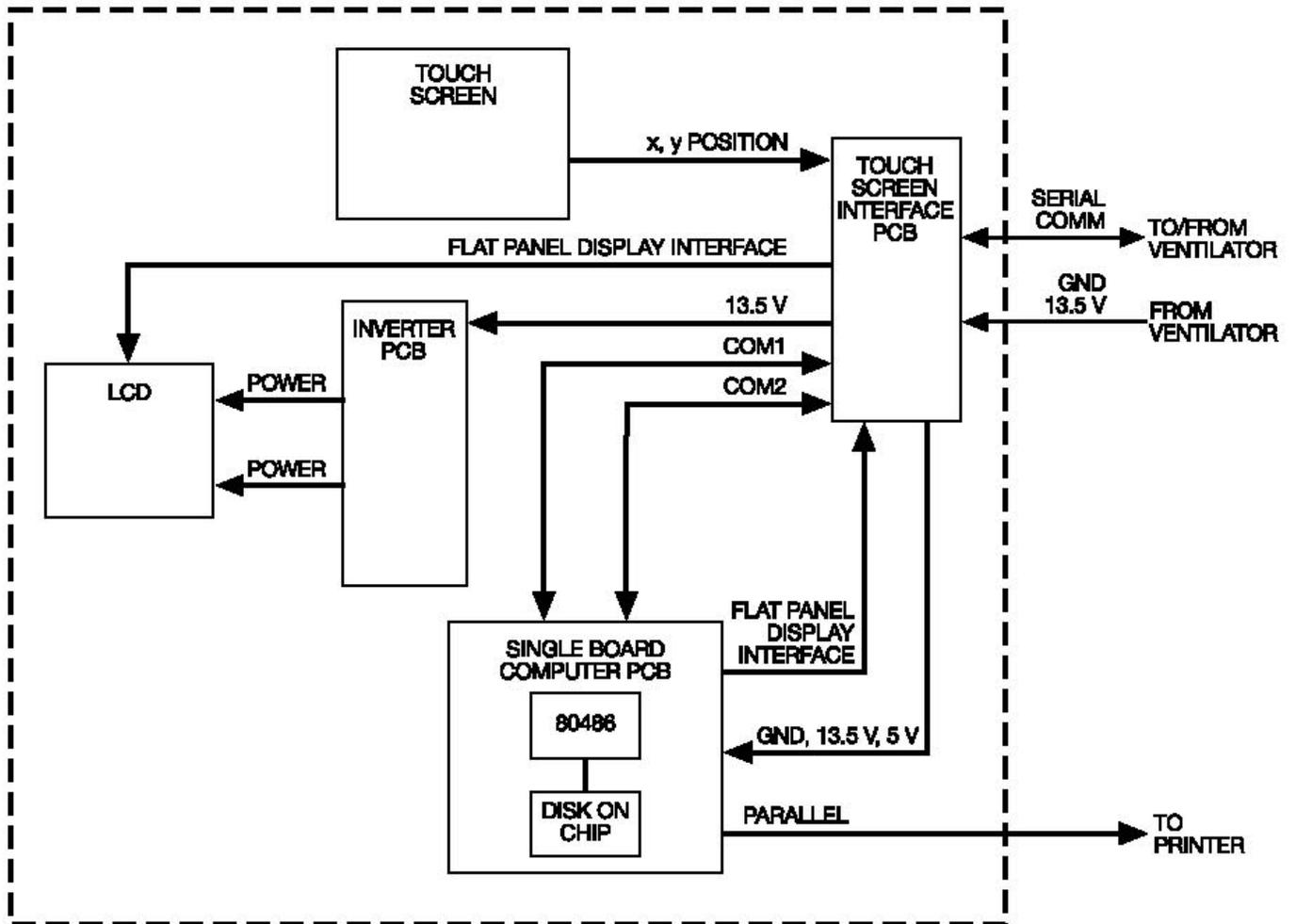
heat sink layer on PCB.



GDM Touch Screen Schematic
Diagram SCH1911
Page 2 of 3



GDM Touch Screen Schematic
 Diagram SCH1911
 Page 3 of 3



GDM Electronic Block Diagram

Electronic Block Diagram

D-4. TECHNICAL TROUBLESHOOTING

Contact Information	D-4-1
Troubleshooting Guide Table	D-4-2

CONTACT INFORMATION

Table 4-1 below summarizes the troubleshooting procedures for some problems that may occur during operation of the e500 GDM. For further information, contact the Technical Service Department at Newport Medical Instruments, Inc.:

Telephone:
 949.642.3910 extension 500, or
 800.451.3111 extension 500 (in the United States only)
 Fax: 949.548.3091
 Email: techsupport@NewportNMI.com

Reference Drawings:
 Assembly Diagram, Drawing GDM1900A
 System Wiring Diagram, Drawing SWD1900A

TROUBLESHOOTING GUIDE TABLE

Table 4-1. e500 GDM Troubleshooting Guide

NOTE: This guide assumes that the GDM is securely connected to a powered-up, properly-functioning e500 Ventilator.

PROBLEM	POSSIBLE CAUSE	SUGGESTED CORRECTIVE ACTION
GDM display is blank (no light emission); no audible beep sound heard upon power up.	<p>1. Ventilator is internal or external battery operated for longer than 30 minutes. (Control Panel "Int Battery" or "Ext Battery" indicator is lit.)</p> <p>Open GDM rear-panel for following checks:</p> <p>2. P2 of GDM power cable is loosened from J2 of PCB1911A.</p> <p>3. Fan/power cable is loosened from either J10 of PCB1911A or CN11 of CPU1900A.</p> <p>4. Cable CBL1904A is loosened from either CN2 of CPU1900A or J5 of PCB1911A.</p> <p>5. Cable CBL1908A is loosened from either J7 of PCB1911A or CN1 of PWR1900P.</p> <p>6. +5V Power Regulator section of PCB1911A is defective.</p> <p>7. PWR1900P is defective.</p>	<p>1. Power ventilator with appropriate AC power source, using appropriate power cord.</p> <p>2. Check (and reconnect if necessary) P2 of cable to J2 of PCB.</p> <p>3. Check (and reconnect if necessary) fan/power cable to CPU1900A and PCB1911A connectors.</p> <p>4. Check (and reconnect if necessary) CBL1904 to CPU1900A and PCB1911A connectors.</p> <p>5. Check (and reconnect if necessary) CBL1908A to PCB1911A and PWR1900P connectors.</p> <p>6. Replace PCB1911A with new PCB and return old PCB to NEWPORT..</p> <p>7. Replace PWR1900P with new PCB and return old PCB to NEWPORT.</p>

TECHNICAL TROUBLESHOOTING

Audible "boot-up" beep is heard, but GDM display is blank.

1. Above-listed Possible Causes #4, 5, and 7 apply.

1. Above-listed Corrective Action steps #4, 5, and 7 apply.

GDM display is half-lit (one back-light bulb is unlit).

1. Associated back-light cable is loosened from either CN2 or CN3 of PWR1900P.
2. Back-light bulb inside LCD flat-panel is defective.
3. Section of PWR1900P that powers unlit bulb is defective.

1. Check (and reconnect associated cable) to PWR1900P connector.
2. Replace bulb with new unit.
3. Replace PWR1900P with new PCB and return old PCB to NEWPORT.

GDM display is fully illuminated, but no text, graphs, or numerics data are displayed.

1. A Device Alert violation occurred on e500 ventilator.
2. Cable CBL1904A is loosened from either CN2 of CPU1900A or J5 of PCB1911A.
3. Cable CBL1903A is loosened from either J6 of PCB1911A or CN1 of DSP1900P (LCD).
4. +5V Power Regulator output is below required threshold to power logic circuits.
5. CPU1900A is defective.
6. DSP1900P is defective.

1. Check ventilator and resolve Device Alert.
2. Check (and reconnect if necessary) CBL1904 to CPU1900A and PCB1911A connectors.
3. Check (and reconnect if necessary) CBL1903A to PCB1911A and DSP1900P connectors.
4. Replace with a new PCB and return old PCB to NEWPORT.
5. Replace CPU1900P with new PCB and return old PCB to NEWPORT.
6. Replace DSP1900P with new Flat-Panel LCD and return old LCD to NEWPORT.

Graphs, numerics, and text are displayed, but inappropriate colors are displayed in some areas, or display may appear shifted vertically or horizontally, or otherwise abnormal.

1. One or more pins of cable CBL1904A or CBL1903A may not be making good contact to mating socket pins on PCBs, or one or more conductor wires of these cables may be broken.
2. CPU1900A is defective.
3. DSP1900P is defective.

1. Inspect both cables for bent pins, proper secure insertion into mating sockets, and for broken wires. Make corrections as appropriate.
2. Replace CPU1900P with new PCB and return old PCB to NEWPORT.
3. Replace DSP1900P with new Flat-Panel LCD and return old LCD to NEWPORT.

Normal full GDM display, but message "Check Cable and Unit" is superimposed on graph screen.

1. P4 of GDM power cable (CBL1825A) is loosened from J4 of PCB1911A.
2. Cable CBL1906A is loosened from either J11 of PCB1911A or CN13 of CPU1900A.
3. Bios chip on CPU1900A is defective.
4. CBL1825A is open or shorted out.

1. Check (and reconnect if necessary) P4 of cable to J4 of PCB.
2. Check (and reconnect if necessary) CBL1906A to PCB1911A and CPU1900A connectors.
3. Replace CPU1900A with new PCB and return old PCB to NEWPORT.
4. Replace CBL1825A cable.

GDM display is overall brighter or dimmer than normal, but otherwise normal functioning.

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| <ol style="list-style-type: none"> 1. R200 (47K resistor) on PCB1911A is open (defective) or has broken solder connection to mounting pads. 2. One or both back-light bulbs in LCD are dimmed from aging. 3. PWR1900P is defective. | <ol style="list-style-type: none"> 1. Check R200 value and solder connections, and replace and/or resolder R200 as appropriate or replace PCB1911A. 2. Check and replace one or both bulbs as needed. 3. Replace PWR1900P with new PCB and return old PCB to NEWPORT. |
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No response (change in screen display) when touchscreen is touched at appropriate "button" points. (Normal screen display otherwise)

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|---|--|
| <ol style="list-style-type: none"> 1. Touchscreen coordinates are out of calibration. 2. Jumper is loosened from J32 of CPU1900A. 3. Cable CBL1907A is loosened from either J12 of PCB1911A or CN8 of CPU1900A. 4. Touchscreen Panel flex-cable connector is bad or loosened from J1 of PCB1911A. 5. Touchscreen Interface section of PCB1911A is defective. 6. Touchscreen Panel is defective. 7. Bios chip on CPU1900A is defective. 8. Software locks-up or freezes. | <ol style="list-style-type: none"> 1. Perform a Touchscreen calibration procedure as described in Section D-3 of this Manual. (Use pencil eraser, or similar small, round tool, to touch the displayed dots on Calibration Screen as precisely as possible.) 2. Check (and install if necessary) jumper between pins 1 & 2 of J32 of CPU1900A. 3. Check (and reconnect if necessary) CBL1907A to PCB1911A and CPU1900A connectors. 4. Check (and reconnect if necessary) touchscreen cable to J1 of PCB1911A . 5. Diagnose PCB1911A and replace if defective with new PCB. Return old PCB to NEWPORT. 6. Replace touchscreen panel (with attached GDM bezel) with new assembly. 7. Replace CPU1900A with new PCB and return old PCB to NEWPORT. 8. Report problem to Newport Service Dept. |
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Incorrect change (or no change) in display response when a "button" is touched; response occurs only when "button" is touched on, or immediately outside of, its boundary

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Touchscreen coordinates are out of calibration.
(If repeated recalibrations do not improve touchscreen performance): 2. Touchscreen Interface section of PCB1911A is defective. 3. Touchscreen Panel is defective. 4. The CPU1900A is defective. | <ol style="list-style-type: none"> 1. Perform a Touchscreen calibration procedure as described in Section 2 of the Operating Manual. (Use pencil eraser, or similar small, round tool, to touch the displayed dots on Calibration Screen as precisely as possible.) 2. Diagnose PCB1911A and replace if defective with new PCB. Return old PCB to NEWPORT. 3. Replace touchscreen panel (with attached GDM bezel) with new assembly. 4. Replace the CPU1900A with a new PCB and return the old PCB to NEWPORT. |
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Numeric and/or graphical data is grossly inaccurate or missing in some areas (assumes that data fed from ventilator is known reliable).

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. GDM "Disk-On-Chip" software program is corrupted or the chip hardware, itself, is defective. 2. The CPU1900A is defective. | <ol style="list-style-type: none"> 1. Replace the "Disk-On-Chip" IC in the CPU1900A computer board with a properly programmed "Disk-On-Chip". 2. Replace the CPU1900A with a new PCB and return the old PCB to NEWPORT. |
|--|---|

TECHNICAL TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SUGGESTED CORRECTIVE ACTION
Print function is completely inoperative or prints-out erroneous data (assumes known good, correct model printer).	<ol style="list-style-type: none">1. Printer cable is not properly and securely connected to GDM port and printer port, or cable is defective (open conductor, bent pin, etc.) or wrong cable-design.2. Jumper is loosened from J16 of CPU1900A (inside GDM).3. Internal printer cable CBL1901A is loosened or ajar from CN16 of CPU1900A.4. The printer circuit section of CPU1900A is defective.	<ol style="list-style-type: none">1. Check-out printer cable for proper connection, open conductors, bent pins, and/or cable design. Make corrections as appropriate.2. Check (and install if necessary) jumper between pins 1 and 2 of J16 of CPU1900A.3. Check (and reconnect if necessary) CBL1901A to CN16 of CPU1900A.4. Replace the CPU1900A with a new PCB and return the old PCB to NEWPORT.
GDM functions in normal fashion in all areas for a period of time, but then begins manifesting abnormal behavior (random or unstable data, changing colors, screen goes fully or partially blank, touchscreen is intermittent, etc.).	<ol style="list-style-type: none">1. uP chip fan (mounted on the main Processor chip on CPU1900A board) is defective, fan blades are obstructed, or fan not connected to +13.5 volts power.2. If none of above is the cause, then either the CPU1900A, PCB1911A, or PWR1900P boards are heat-sensitive over time.	<ol style="list-style-type: none">1. Check that +13.5 volts \pm 5% is applied to the fan; if it is, then check that fan blades are not impeded by any obstacle. If both of above prove okay, then fan assembly (FAN1900Q) is defective and needs to be replaced.2. Replace, one-at-a-time, the CPU1900A, PCB1911A, and PWR1900P, then, after each change, allow GDM to operate for the time-duration required for it to originally fail. Once the GDM continues normal function well past that time-duration, then the PCB just previously changed is the defective unit. Replace as appropriate.
Audible "beep" sound is not heard shortly after GDM is powered-up and/or when a valid Touch Screen "button" is touched.	<ol style="list-style-type: none">1. Jumper is loosened from J21 of CPU1900A.2. Buzzer or buzzer controlling circuitry on CPU1900A board is defective.	<ol style="list-style-type: none">1. Check (and install if necessary) jumper between pins 1 and 2 of J21 of CPU1900A.2. Replace the CPU1900A with a new CPU1900A and return the old CPU to NEWPORT.

D-5. PARTS LIST AND ORDERING INFORMATION

GDM Components Parts List	D-5-1
GDM Accessories Parts List	D-5-2

This section lists the field-replaceable parts for the e500 GDM. For more information about parts or ordering, contact Newport Customer Service:

Telephone:
 949.642.3910 extension 282, or
 800.451.3111 extension 282 (in the United States only)
 Fax: 949.548.3091
 Email: customers@NewportNMI.com

Reference Drawing:
 Assembly Diagram, Drawing GDM1900A

Table 5-1. e500 GDM Components Parts List

Part Number	Description	Quantity
PCB1911A	Touch Screen Interface (TSI) PCB	1 EA.
CPU1900A	Single Board Computer (SBC) PCB (includes fan and power cable assembly)	1 EA.
FAN1900Q	Fan Assembly, replacement (installed on SBC PCB, includes cable assembly)	1 EA.
PWR1900P	Inverter Power Supply PCB	1 EA.
DSP1900P	TFT Liquid Crystal Display (LCD) (includes installed Back-Light bulbs)	1 EA.
GKT1904M	Gasket, 7 inch length, two each (for metal surface of the LCD, vertical edge)	2 EA.
GKT1905M	Gasket, 9 inch length, two each (for metal surface of the LCD, horizontal edge)	2 EA.
GKT1902M	Gasket, Front Bezel, conductive, 9 inch length, two each (for inside front bezel, vertical edges)	2 EA.
GKT1903M	Gasket, Front Bezel, conductive, 12 inch length, two each (for inside front bezel, horizontal edges)	2 EA.
BZL1901A	Bezel/Touch Screen Assembly (includes BZL1900M, TAP1900P, and PNL1901P)	1 EA.
CBL1903A	Cable Assembly, J6 of TS1 to CN1 of LCD	1 EA.
CBL1904A	Cable Assembly, J5 of TS1 to CN2 of SPC (LCD low-power)	1 EA.
CBL1901A	Cable Assembly, Printer Interface	1 EA.
CBL1825A	Cable Assembly, GDM Interface (connects e500 Gas Delivery Unit to J2 & J4 on TSI PCB). (Install with strain relief bushing BSH1800P)	1 EA.
BSH1800P	Bushing, Strain Relief (install on GDM Interface cable, CBL1802A)	1 EA.
CBL1906A	Cable Assembly, TSI PCB to SBC Vent. Comm. (connects CN13 on SBC PCB to J11 on TSI PCB)	1 EA.
CBL1907A	Cable Assembly, TSI PCB com to SBC (connects CN8 on SBC PCB to J12 on TSI PCB)	1 EA.
CBL1908A	Cable Assembly, TSI PCB to Inverter Power Supply (connects J7 on TSI PCB to CN1 on Inverter PCB)	1 EA.
LMP1900Q	Lamp Touch Screen	1 EA.

PARTS LIST AND ORDERING INFORMATION

Part Number	Description	Quantity
NUT1841P	Nut, hex w/lockwasher (KEPS) M4X 0	5 EA.
SCR1830P	Screw, Pan-head, SST M3 X 0.5 X 6MM L	14 EA.
PNL1900M	Back Panel	1 EA.
SCR1846P	Screw, M4 X 45MM, Flat-head Recess TY	10 EA.
SCR1855P	Screw, Jack 4 –40 X 5/16 X 3/16	2 EA.
NUT1862P	Nut, Hex-Domed, M6, Steel, Chrome	2 EA.
PLT1900M	Plate, Shield	1 EA.
BAR1900M	Bar, Spacer (Graphic Display Module)	2 EA.
GRM1900P	Grommet	2 EA.
WSH1832P	Washer, Internal Tooth, M3	14 EA.
FER1901Q	Ferrite, Flat Cable	1 EA.
NUT1831P	Nut, Hex w/lockwasher, M3X0.5	1 EA.
TYM1900Q	Cable Tie Mount	1 EA.
TYR100P	Tywrap, small	1 EA.
CLP1900Q	Clamp, Grounding	1 EA.
ADH1200P	Adhesive Loctite 411	AS REQ.
LBL1807P	Label, Serial Number	1 EA.
PPR1900M	Paper Insulation Strip	1 EA.
SCR1901Q	Screw, Pan head, Plastic M3 X 6MM L	4 EA.
STO1900P	Standoff, Plastic, M3 X 8MM	2 EA.
CVRDB25Q	Cover, Printer Port, metal, size DB25 (position)	1 EA.
SCP4019P	Screw, Pan head, 4 – 40 X 3/16 in. L	2 EA.
WSH700P	Washer, Internal Tooth Lock, #4	2 EA.
WSH1862A	Washer, Internal Tooth Lock, #6	2 EA.
WSH638 P	#6 Medium Lock washer SS	4 EA.
WSH1900P	Washer, Phenolic #4	4 EA.

Table 5-2. GDM Accessories Parts List

Part Number	Description	Quantity
CBL1900Q	Cable, Remote Printer, 25-conductor	
XFM1900Q	Isolation Transformer, Domestic, 120 VAC	

D-6. REPACKAGING AND SHIPPING INSTRUCTIONS

Repackaging and Shipping Instructions D-6-1

REPACKAGING AND SHIPPING INSTRUCTIONS

Follow these steps to return the e500 GDM to NEWPORT for service or repairs:

1. Call Newport Medical Instruments, Inc. (800.451.3111 or 949.642.3910) for a Returned Goods Authorization (RGA) number. The RGA number helps to identify your repair and avoid service delays.
 - Dial extension 500 to reach the Technical Service department (for maintenance, warranty, or non-warranty repairs)
 - Dial extension 282 to reach the Customer Service department (for other returns)
 - Or fax Customer Service at 949.548.3091 to request an RGA number.
2. Unless requested to do otherwise, disconnect all accessories from the GDM and do not include with return.
3. Package the GDM in the original packing material, if available. If the original packing material is not available, call the Technical Service department for instructions regarding the repackaging of parts or accessories for safe shipping.
4. Address the package shipping label to NEWPORT's courier delivery address, including the RGA number:

Newport Medical Instruments
760 West 16th Street
Building B
Costa Mesa, CA 92627
USA
RGA Number:

GLOSSARY

Term or Abbreviation	Definition
A/CMV	Assist control mandatory ventilation
Action	The response made by the ventilator to a given condition or set of conditions.
Active	An alarm condition where the alarm is in the defined alarm state
b/min	Breaths per minute (see respiratory rate)
BTPS	BTPS compensated: Body temperature pressure saturated. Body temperature 37 °C, steam saturated gas ambient pressure.
Compliance compensation	Allowance for patient breathing circuit compliance when calculating displayed parameters.
CmH₂O	Centimeters of water pressure; unit measure of pressure
CPAP	Continuous positive airway pressure
CPM	Control panel module of e500
Defaults	Pre-set ventilator control settings, usually in existence on power up.
Effective	Conditions under which an alarm or control is functional
ET Tube	Endotracheal tube
EtO	Ethylene Oxide
Expiratory	Portion of a breath which is not inspiratory; time during a breath cycle when gas flow is away from the patient and any additional time when patient flow is zero.
<i>f</i>	Respiratory rate, or breath frequency
GDU	Gas delivery unit of e500
GDM	Graphics display module of e500
I:E	Inspiratory time to expiratory time ratio
Inspiratory	Portion of the breath cycle which is not expiratory; the time during a breath when flow is towards the patient and any additional time when flow is zero before the next exhalation begins.

GLOSSARY

L	Liter; measurement of volume
L/min	Liters per minute; measurement of flow
Latched	Alarm state where the alarm condition has been resolved but the alarm has not yet been cleared or reset.
LED	Light emitting diode
Limitation	Exceptions or special conditions.
Mains	AC wall power
Message	Text displayed in the LCD window of the Control Panel.
mL	Milliliter (0.001 L)
mBar	Millibar
P_{aw}	Airway pressure
PEEP	Positive End Expiratory Pressure (baseline pressure); pressure maintained in the circuit at the end of exhalation
Plateau pressure	Pressure measured during and inspiratory hold maneuver or during zero flow in a pressure controlled breath.
psig	Pounds per square inch, gauge; pressure measure in psi above atmospheric pressure
$P_{support}$	Pressure support
Rate	See Respiratory rate
Range	Available settings of a control or an alarm between the pre-determined upper & lower limits.
Recovery	Conditions for an activated alarm to become inactive.
Resolution	The smallest numeric increment that can be observed.
Respiratory rate	The measured number of breaths delivered in a minute.
Retained	Saved in non-volatile memory
SIMV	Synchronized intermittent mandatory ventilation
SPONT	Spontaneous, patient initiated ventilation.
t_E	Expiratory Time

t_I	Inspiratory Time
$t_I > t_E$ time)	Inverse I:E Ratio (inspiratory time is greater than expiratory time)
\dot{V}	Flow
\dot{V}_E	Expiratory Minute Volume
Violated	An alarm limit threshold has been reached
\dot{V}_{peakE}	Peak Expiratory Flow
\dot{V}_{peakI}	Peak Inspiratory Flow
V_T	Tidal Volume
V_{TE}	Expiratory Tidal Volume
VTPC	Volume Target Pressure Control
VTP_{support}	Volume Target Pressure Support

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