CO_2SMO PLUS!

RESPIRATORY PROFILE MONITOR

Service Manual

Model 8100

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Declaration of Conformity with European Union Directives

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The COSMO Plus!® monitor and its sensors and accessories are covered by the following USA patents: 4,859,858, 4,859,859, 4,914,720, 4,958,075, 5,146,092, 5,153,436, 5,190,038, 5,206,511, 5,251,121, 5,347,843, 5,369,277, 5,379,650, 5,398,680, 5,448,991, 5,535,633, 5,616,923, 5,693,944, 5,789,660, 5,793,044, 5,820,550, 5,891,026, 5,999,834, 6,073,038, 6,099,481, 6,126,610, 6,149,481, 6,179,784, 6,312,389. Other patents pending.

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Novametrix provides 24 hour a day technical support accessibility via telephone numbers (800) 243-3444 or (203) 265-7701. After hours technical support requests (before 8:00 AM and after 5:00 PM Eastern Time) will be responded to promptly by the Technical Support On-Call staff. It is suggested that any person calling in for technical support have the inoperative equipment available for preliminary troubleshooting as well as product identification. Novametrix reserves the right to repair or replace any product found to be defective during the warranty period. Repair may be provided in the form of replacement exchange parts or accessories, on-site technical repair assistance or complete system exchanges. Repairs provided due to product abuse or misuse will be considered “non-warranty” and invoiced at the prevailing service rate. Any replaced defective material is expected to be returned to Novametrix within 10 days of being provided in order to avoid additional charges. Exchanged material should be returned promptly and directly to Novametrix using the return paperwork and shipping label(s) provided. Transferring return materials to local sales or dealer representatives does not absolve return responsibility.

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Table of Contents

Safety 1

Introduction 5
- Indication for use 5
- Operational Overview 5
  - Controls 5
  - Indicators 8
  - Miscellaneous 8
- Rear Panel Connections and Labeling 9

Theory of Operation 11
- 2726 Power Supply Board 11
  - AC Mains and Battery Operation Overview 11
  - AC Mains Operation 11
  - Battery Operation 12
- Digital Control System 13
  - Background Mode Debugging 16
  - System Memory 16
  - Serial Communications UART 16
  - User Interface Control Circuitry 18
  - Real Time Clock, Power on RESET Generation and Glue Logic 18
- CO2 System Analog Subsections 19
  - CO2 Pulser Source Drive 19
  - Capnostat® Case and Detector Heater Control 20
  - CO2 Input Signal Path 21
  - Capnostat® Interface 21
  - Sampling Pump 21
- Saturation Analog Subsections 22
  - LED Power Generation and LED Drive 22
  - Saturation Input Signal Path and Signal Conversion 22
- Flow System Analog Subsections 23
  - Flow Zeroing and Patient Line Back-flushing 23
  - Flow Circuitry 24
  - Barometric and Airway Pressure 25
  - Patient Airway Adapter Type Sensing 25
  - Power Supply and Voltage Reference Generation 25
- Digital Logic List 27

Functional Tests 41
- Equipment Required 41
- Functional Testing 41
  - Start up 41
- Determining Torr Value 44

Accuracy Tests 49
- Equipment Required 49
- Test Procedure 50
  - Start up 50

SpO2 Test 50
CO_2 Test 51
Flow Test 52

Electronic Tests 55
General 55
Equipment Required 55
Power Supply Testing 56
CO2 Testing 57
Saturation Testing 60
Flow Testing 61
Barometric Pressure 62
Isolation and Leakage Checks 62
Test Fixtures 63
Test Fixture Construction 63
Sampling Cannula Modification: 63
Test Fixture Assembly 63

Maintenance 65
General 65
Maintenance Schedules 65
Cleaning and Sterilization 66
Monitor 66
SpO_2 Finger Sensor 66
SpO_2 Y-Sensor 66
SpO_2 Y-Strip Tapes and Foam Wraps 66
Ear Clip 66
Flow Sensors and Combined CO_2/Flow Sensors 66
CAPNOSTAT® CO_2 Sensor 67
Reusable Adult Airway Adapter 67
Reusable Neonatal Airway Adapter 67
External Sampling System Components 67
Single Patient Use Airway Adapters 67
Internal Sampling System Components 68
Mains Voltage Configuration 69
Fuse Replacement 69
Changing the Mains Voltage Setting 70
Battery Maintenance 71
Assembly Exchanges 72
Internal Assemblies 72
Main Board and CPU - Interface/Keypanel Assembly 72
Replacing the internal battery 74
Reassembling the monitor 74
Software Update Instructions 75
Equipment Required 75
Setup 75
Procedure 76

Specifications 79
General 79
Capnograph 79
Pulse Oximeter 80
Flow Sensor Specifications 80

Monitor Specifications 81
Additional Features 81

Accessories 83

Parts Lists 87
6758-00 Model 8100 87
6758-01 Main Assembly Model 8100 87
6765-01 Top Cover Assembly, Model 8100 88
6868-01 Bottom Cover Assembly, Model 8100 88
6660-01 Front Panel Assembly, Model 8100 89
6692-01 Rear Panel Assembly, Model 8100 89
6693-01 Flow Connector Assembly, Model 8100 90
6699-01 Chassis Assembly, Model 8100 90
2731-01 Main Board Assembly, Model 8100 90
2726-01 Power Supply Board Assembly, Model 8100 94
2748-01 Power Supply Board Assembly, Japan 95
2732-01 EtCO2 Board Assembly, Model 8100 96

Drawings 97

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Section 1 Safety

The *CO_2SMO Plus!®* monitor is electrically isolated. Patient leakage current flowing from the instrument to ground is limited to less than 100 uA at 120/220 VAC, 50-60Hz.

For maximum patient and operator safety, you must follow the following warnings and cautions.

WARNINGS

Indicates a potentially harmful condition that can lead to personal injury.

- Explosion Hazard: *DO NOT* use *CO_2SMO Plus!®* in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- Electrical Shock Hazard: Always turn *CO_2SMO Plus!®* off and remove the line cord before cleaning it. Refer servicing to qualified service personnel.
- Never sterilize or immerse the monitor in liquids.
- Do not operate *CO_2SMO Plus!®* when it is wet due to spills or condensation.
- Do not operate *CO_2SMO Plus!®* if it appears to have been dropped or damaged.
- Failure of Operation: If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- The *CO_2SMO Plus!®* is not intended to be used as a primary diagnostic apnea monitor and/or recording device.
- Patient Safety: Care should be exercised to assure continued peripheral perfusion distal to the SpO_2 sensor site after application.
- Inspect the SpO_2 sensor site often for adequate circulation - at least once every four hours. When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.
- Data Validity: As with all pulse oximeters, inaccurate SpO_2 and Pulse Rate values may be caused by:
    - Incorrect application or use of sensor;
    - Significant levels of dysfunctional hemoglobin; carboxyhemoglobin or methemoglobin;
    - Significant levels of indocyanine green, methylene blue, or other intravascular dyes;
    - Exposure to excessive illumination such as surgical lamps-especially those with a xenon light source, or direct sunlight;
    - Excessive patient movement;
    - Venous pulsations;
    - Electrosurgical interference.
- A "NO RESPIRATION" alert is not generated when both the CAPNOSTAT® CO_2 sensor and the CO_2/flow or flow sensor are disconnected from the *CO_2SMO Plus!®*.
- The *CO_2SMO Plus!®* automatically identifies the type of CO_2/flow sensor (neonatal, pediatric or pediatric/adult) or flow sensor (neonatal or pediatric/adult) when it is connected. If a flow sensor identification message is not displayed when a flow or CO_2/flow sensor is first connected, DO NOT use the sensor. If the condition persists, refer the monitor to qualified service personnel.

- Periodically check the CO_2/flow sensor and tubing for excessive moisture or secretion build up. Although the *CO_2SMO Plus!®* automatically purges the lines, excessive moisture or secretions may still remain.
- While using the CO_2/flow sensor, a system leak, such as that caused by uncuffed endotracheal tubes or a damaged CO_2/flow sensor may significantly effect flow related readings. These include flow, volume, pressure, deadspace, CO_2 production and other respiratory mechanics parameters.
- Connect the line cord to a grounded hospital-grade outlet. *CO_2SMO Plus!®* should be connected to the same electrical circuit as other equipment in use on the patient. Outlets of the same circuit can be identified by the hospital's engineering department.
- The *CO_2SMO Plus!®* has no protection against the ingress of water.

CAUTIONS

Indicates a condition that may lead to equipment damage or malfunction.

- Do not operate *CO_2SMO Plus®!* when it is wet due to spills or condensation.
- Do not operate *CO_2SMO Plus!®* if it appears to have been dropped or damaged.
- Keep *CO_2SMO Plus!®* and its accessories clean.
- Never sterilize or immerse the monitor in liquids.
- Do not sterilize or immerse sensors except as directed in this manual.
- Do not apply excessive tension to any sensor cable or pneumatic tubing.
- Do not store the monitor or sensors at temperatures less than 14°F (-10°C) or above 131°F (55°C).
- Do not operate the monitor or sensors at temperatures below 50°F (10°C) or above 104°F (40°C).
- Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.
- DO NOT attach an SpO_2 sensor distal to a blood pressure cuff. Valid data CANNOT be processed when the cuff is inflated. Attach the sensor to the limb opposite to the site used for the blood pressure cuff.
- Excessive moisture in the CO_2/flow sensor may affect the accuracy of the flow measurement.
- To avoid the effects of excessive moisture in the measurement circuit, insert the CO_2/flow sensor in the ventilator circuit with the tubes upright (as shown by arrows). The striped tube is positioned closest to the patient. Improper placement will result in erroneous data.
- It is recommended that the CO_2/flow sensor be removed from the circuit whenever an aerosolized medication is delivered. This is due to the increased viscosity of the medications which may contaminate the sensor windows, causing the sensor to fail prematurely.
- In case of interference with our equipment or another manufacturer's equipment, notify your Novametrix representative.

NOTES

Indicates points of particular interest or emphasis for more efficient or convenient operation.

- Components of this product and its associated accessories which have patient contact are free of latex.
- As with all flow measuring devices, adverse conditions may affect the accuracy of the flow measurement.
- If CO_2 is being measured while not using a CO_2/flow sensor, certain rebreathing circuits, or the presence of artifacts such as cardiogenic oscillations, may cause *CO_2SMO Plus!®* to react to non-respiratory CO_2 fluctuations as if they were breaths. This condition affects only the numerical displays; the capnogram display continues to provide an accurate picture of the CO_2 waveform.

- When a new CAPNOSTAT® CO_2 sensor is attached to the monitor, or is moved from one monitor to another, it must be initialized before use. The CAPNOSTAT® CO_2 sensor does not have to be initialized again as long as it is used with the same monitor.
- The Sample Pump will not turn on if a combined CO_2/flow or flow sensor is connected to the *CO_2SMO Plus!®*. If the Sample Pump is already on and a combined CO_2/flow or flow sensor is connected, the Sample Pump will turn off.
- If you use the *CO_2SMO Plus!®* for transport or if you drastically change the orientation of the *CO_2SMO Plus!®*, the CO_2/flow sensor must be manually re-zeroed.
- After the life cycle of our equipment and all accessories has been met, disposal of the equipment should be accomplished following the national requirements. Contact the local Novametrix representative for questions concerning disposal.

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Section 2 *Introduction*

2.1 Indication for use

The *CO_2SMO Plus!®* is intended to be used for monitoring end tidal CO_2, respiration rate, functional oxygen saturation, pulse rate and respiratory mechanics in monitoring environments such as ventilatory support, emergency and anesthesia. *CO_2SMO Plus!®* is designed to monitor adult, pediatric and neonatal patients. *CO_2SMO Plus!®* is not intended for any other purposes.

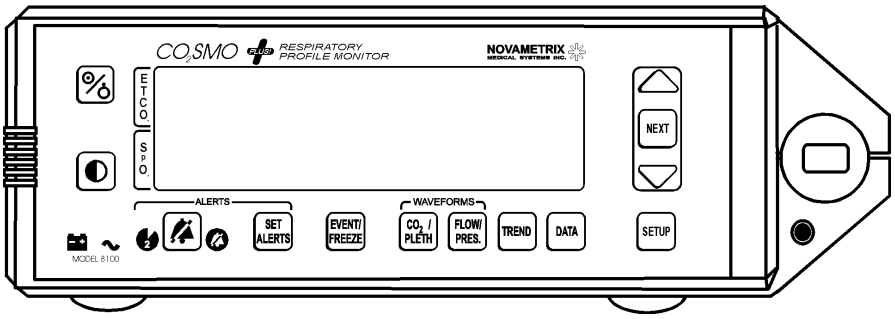
NOTE

Components of this product and its associated accessories which have patient contact are free of latex.

Gas compositions other than those selected in the SETUP screen can influence CO_2 and flow measurement.

2.2 Operational Overview

Front Panel Controls and Indicators



2.2.1 Controls

Power Key

Press the POWER key to place the unit into operate mode (ON) or to place the unit into standby (OFF). There are four states of the unit:

- No AC Power, power icon ∿ off, not in operate mode

  In this condition the AC switch is off, or the power cord is not plugged into an AC outlet, or the outlet is not powered. No monitoring may occur in this state. Battery is not being charged.

- AC Power, power icon ∿ on, not in operate mode (standby)[1]

  In this condition the unit may be placed into operate mode by pressing the %0 key. Battery is charging in this mode.

- AC Power, power icon ∿ on, in operate mode

  In this condition the unit is in operating mode and the battery is being charged.

- Battery power, power icon ∿ off, battery is not being charged

  In this condition the unit is in the operating mode and the battery is not being charged.

When the monitor powers up a self test is performed in which all indicators will temporarily illuminate and the monitor will emit a short beep. Following the self test the monitor will display:

"ERASE STORED TRENDS?
YES: △ NO: ▽"

If the △ or ▽ key is not pressed within five seconds, trends will be retained. The monitor is now ready for operation.

Contrast

Press or hold to adjust the display's contrast for different up/down viewing angles.

Alert Silence

Press for 2 minute silence (audible alerts muted for two minutes). The 2 icon will illuminate for the duration of the two minute silence. Press again to cancel.

Press and hold for 3 seconds to disable audible alerts, and the icon will flash. Press and hold again to cancel.

Press to acknowledge a latched alert.

If preconfigured not to allow the audio off function, the key will not disable the audible alerts when pressed (the two minute silence is still active).

Set Alert Limits

Press to set alert limits manually, or hold to set automatically. Press again to accept the displayed limits and return to the previous screen.

Event/Freeze

Press the EVENT/ FREEZE key to freeze the waveforms and loops for sixty seconds. An EVENT MARKER with time and date will appear in the message center for three seconds followed by "WAVEFORM FROZEN

1. The monitor must be in "stand-by" mode in order for the CAPNOSTAT CO_2 sensor to remain heated when the monitor is off.

UNFREEZE: PRESS EVENT KEY". To resume normal display press EVENT/FREEZE again, otherwise the waveform will resume again in 60 seconds.

Pressing this key when viewing the DATA entry screen allows you to enter the patient's $PaCO_2$ for calculation of Vd/Vt phy, Vd phy and Vd alv.

CO_2 Waveform/Plethysmogram

Press to switch waveform display between capnogram and capnogram with plethysmogram.

Flow/Pressure Waveforms

Press to switch waveform display between flow and pressure waveforms, or flow and volume waveforms, or flow vs. volume and volume vs. pressure loops.

Trend

Press to switch between trend screens.

Data Screen

Press to switch between data screens (numeric values only), and data entry screen (to enter weight and $PaCO_2$).

Setup/Configuration

Press to display SETUP screen, or hold for three seconds to display CONFIGURATION screen (for advanced settings). Press again to accept the displayed settings and return to the previous screen.

Adjustment Keys

Press NEXT to select different parameters in SETUP, CONFIGURATION, SET ALERTS or DATA ENTRY screen. Press △ and ▽ to change value or state of the currently selected parameter.

The NEXT key is also used to:

- Select different time bases on the Trend screens
- Rescale various waveforms if scaling is set to manual.

The △ and ▽ keys are also used to respond to monitor prompts such as "ERASE STORED TRENDS? YES: △ NO: ▽."

From the FLOW/PAW screen, use the △▽ keys to adjust the spontaneous threshold line.

2.2.2 Indicators

Battery Alert Icon

Illuminates when the unit is on battery power and the battery charge is critically low. When battery is near exhaustion an audible alert will sound and “BATTERY VERY LOW PLUG IN AC POWER” will appear in the display screen. Refer to Battery Maintenance on page 71 for information on connecting AC power and charging the battery.

AC Power Indicator Icon

Illuminates when the monitor is connected to an AC power source and the rear panel power switch is ON “|”. In this condition the internal battery is charging.

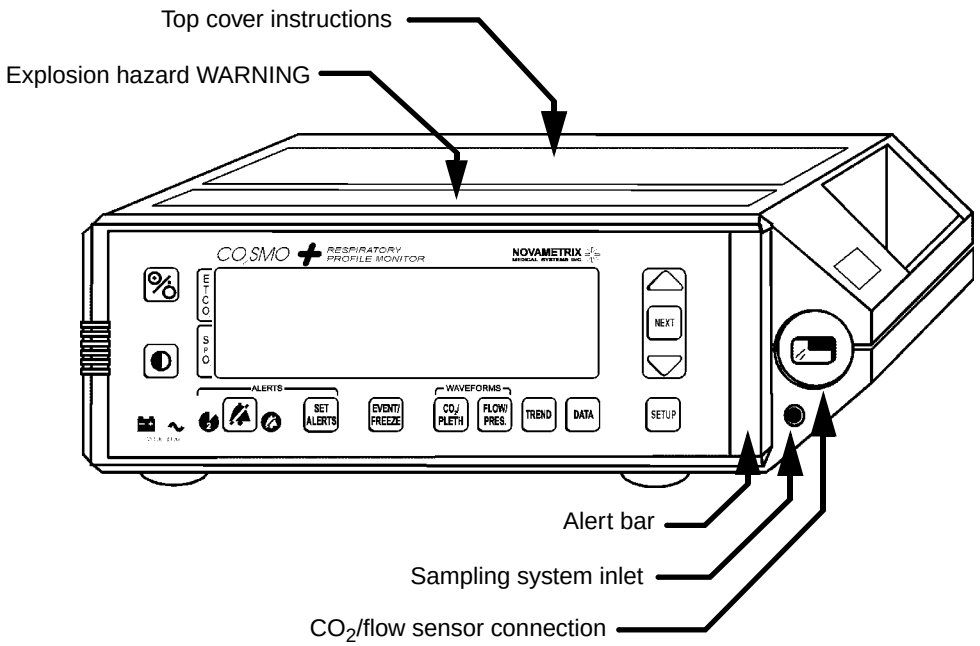
Two Minute Silence Icon

Illuminates when the two minute silence is active.

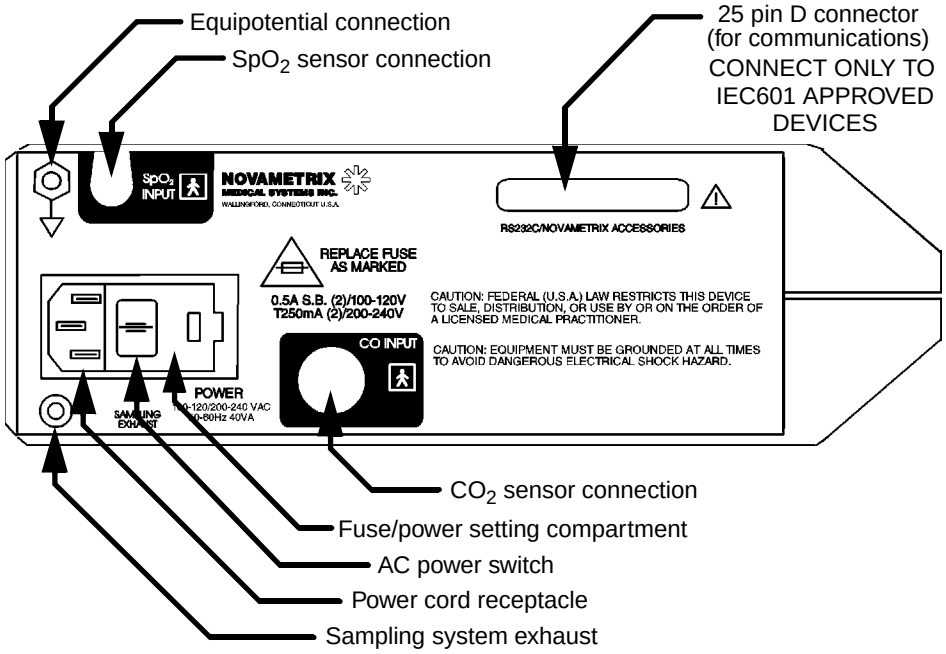
Audible Alert Disabled Icon

Flashes when audible alerts have been disabled.

2.2.3 Miscellaneous



2.3 Rear Panel Connections and Labeling



	Equipotential: Connection to monitor's chassis
	Patient isolation: Identifies connection as type BF
	Attention: Consult manual for detailed information
250V	Mains fuse rating for replacement fuses
| ○	AC mains switch "|" ON-connection to mains; "O" OFF-disconnection from mains
	Recyclable item. This symbol is found on the internal battery and should not concern the common user. Refer to qualified service personnel when battery replacement is required.
	Separate collection. Appropriate steps must be taken to ensure that spent batteries are collected separately when disposed of. This symbol is found on the internal battery and should not concern the common user. Refer to qualified service personnel when battery replacement is required.
Pb	Indicates heavy metal content, specifically lead. This symbol is found on the internal battery and the monitor enclosure and should not concern the common user. Refer to qualified service personnel when battery replacement is required.

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Section 3 Theory of Operation

The *CO_2SMO Plus!®* monitor measures the primary parameters of CO_2 production, blood oxygen saturation, pulse rate, respiration rate, airway pressure and flow. Other parameters are derivative of these primary properties. The system contains all the circuitry necessary for controlling, collecting, conditioning and displaying patient information gathered from the CAPNOSTAT®, Saturation and FloTrak® sensors. The *CO_2SMO Plus!®* monitor's theory of operation is explained in detail in the subsections that follow.

3.1 2726 Power Supply Board

The 2726 Power Supply Board contains the circuitry needed to power the monitor from the AC Mains (line voltage). The power supply board also connects to the battery and contains the battery charging circuitry.

Model 8100 units shipped to Japan have an alternate power supply board assembly (2748-01) installed. These boards are identical to the 2726-01 board with the exception of the power transformer T301. The transformer in the Japan version board (2748-01) is rated for operation at slightly lower line voltage (down to 90 VAC). The operation and testing are identical and the manual text that applies to the 2726-01 board also applies to the 2748-01 board.

3.1.1 AC Mains and Battery Operation Overview

The Model 8100 can be powered from its internal 12 volt battery or from the AC Mains. The green ∿ (sine wave shaped) front panel indicator illuminates when the line cord is connected and the rear panel power switch is in the "|" (On) position. This indicates that AC Mains power is reaching the power supply, that the battery is being charged, and that if the monitor is turned on, it is being powered from the line voltage.

If AC Mains power is removed by unplugging the line cord or setting the rear panel power switch to the "0" (Off) position, the monitor will operate for up to two hours from its internal 12 volt lead-acid battery. As the battery voltage runs low (≈11.5 volts), the red 🔋 (battery indicator) on the front panel illuminates. At this point, the AC Mains should be reconnected to power the monitor and charge the battery.

If the monitor continues to be powered from a battery in a low voltage situation, at approximately 11 volts, a continuous alarm sounds for thirty seconds while an alert message is displayed. If this alarm/message is ignored, the monitor displays will shut down and the battery indicator will flash on and off about every 5 seconds. If AC power is now restored, the monitor will re-initialize (go through the power up and self-test routines) and resume normal operation. However, continued battery operation will eventually activate a hardware low voltage circuit (≈10.0 volts) that shuts the monitor off to prevent damage to the battery. Once the unit is shut down with the hardware circuit, the AC Mains must be connected and the front panel power key pressed before the monitor will turn back on.

3.1.2 AC Mains Operation

The AC Mains voltage enters the monitor at the rear panel Power Entry Module (PEM). This device contains a built in RFI power line filter, a double-pole single-throw switch that opens and closes both AC input lines, fuses, and an input voltage selection card.

The filtered, switched and fused output of the Power Entry Module is fed to the primary coils of the rear panel mounted system transformer, T301, this is mounted on the 2726 Power Supply Board. The secondary output from T301 is fed to the Power Supply Board and is rectified by D1 (bridge rectifier) and filtered by C1. The (loaded) DC voltage at this point is approximately 20 volts.

The 20 VDC is fed to the 2731 Main Board through fuse F301 to connector P102, and is switched to the battery charging regulator IC1 (pin 5) through Q1. Biasing for Q1 is accomplished by D2, R1 and R2 when AC power is applied. When running on battery power Q1 is biased off by R1, R2 and D3, this prevents the battery from trying to power the battery charger regulator IC1. Power to IC2 is also removed, this informs the monitor of the loss of AC via the LINEST line.

The output of switching regulator IC1 pin4 is rectified and filtered by D4, C4 and L1 then fed to the battery through current sense resistor R3 and fuse F302 to J302 pin 1 (VBAT+). The battery float charge voltage is maintained at 13.2 volts except for fast charge which is regulated at 14.4 volts. The output is also monitored for over current conditions. These parameters are controlled by IC3 and associated circuitry. When the battery charge current exceeds 120mA of current IC3 pin 7 goes high which biases Q2 on, this in turn shorts out R12 which affects the feedback control (FB) to IC1 (pin 1). With R12 shorted out the control resistors R14 and R13 set the output voltage to 14.4 volts. When the charge current lowers IC3 pin 7 goes low which biases Q2 off, this puts R12 back into the feedback control which now consists of R12, R13 and R14 setting the voltage to 13.2 volts. When too much current flows through R3, IC3 pin 1 shorts IC1 pin 2 to ground which shuts IC1 off until its next switching cycle, when the current reaches a safe level IC3 pin 1 allows IC1 to remain on.

The voltage switched by Q1 is also fed to IC2 as VCH (Voltage Charge). The output of this 5 volt regulator provides the LINEST (Line Status) signal to the main board at E302 pin 3. With AC applied, LINEST is high. LINEST goes low when the AC is disconnected. The LINEST line is also routed to the power on/off circuitry.

3.1.3 Battery Operation

Without AC power there will be no secondary voltage rectified by D1. Power for the monitor will be supplied from the battery at J102 pins 1 (VBAT+) and 2 (VBAT-). The battery power will conduct through D3 and F301 to the 2731 Main Board. The arrangement of R1, R2 and D2 bias Q1 off in this condition which prevents power from reaching IC1, IC2 and IC3. The output of IC1 is also protected by D5 which is now reverse biased, the bridge D1 is also reverse biased and prevents T301 from discharging the battery. With no voltage at IC2 the LINEST will be low which indicates to the main board that there is no AC power, and the front panel ∿ LED will be off.

3.2 Digital Control System

For circuit diagrams of the digital section described below, refer to schematic 2731-03, sheet 1, of the schematic. Embedded control for the system is provided by IC1, a Motorola MC68332 integrated microcontroller. In addition to a full 32-bit Central Processing Unit (CPU), this device also contains circuitry for system clock generation, peripheral chip select generation, data control, interrupt generation, a sophisticated timing co-processor, synchronous and asynchronous serial communication. In general, functional signals are grouped together into ports, and each signal can be independently programmed by software to be its pre-defined port function or as discrete I/O. Additionally, the functionality for several ports (Port C, E and F) can be pre-defined by the state of the data bus on system power-up. A special "background mode" port allows the device to be controlled by an external source for system debugging and testing. Also integrated on-chip are several activity monitors, as well as a software watchdog to ensure proper device and system operation. Refer to Table 1.

Table 1. CPU / Digital Control System

Port	Defined Function	Functionality Control , Data Bus Control (Alt Functions: D pulled low)
TPU 16 Channels	Timing Signal Generation	Each channel independently user programmable as TPU function or as Discrete I/O
QSM 4 Synchronous Serial Chip Selects & one asynchronous serial channel	Serial Communications Port: QSPI: Queued Serial Peripheral Interface SCI: Serial Communications Interface	QSPI chip selects independently user programmable, can be used as Discrete I/O or decoded to create up to 16 chip selects. SCI transmit can be programmed as Discrete I/O
Background Mode	System debugging	Allows an appropriate external device to control the microprocessor and system
C	Chip Selects	D0: CSBOOT* Data Width, 8 or 16-bit D1: CS1*-CS3* or BR*,BG*,BGACK* D2: CS3*-CS5* or FC0-FC2 D3-D7: CS6*-CS10* or A19-A23
E	Bus Control	D8: Control Signals or Discrete I/O
F	MODCK and Interrupts	D9: MODCK & IRQ or Discrete I/O

The maximum operating frequency of the integrated processor is 20.97 MHz. The operating frequency is software selectable and generated by an internal VCO operating from Y2, a 32.768KHz watch crystal. The Timing Processor Unit (TPU) co-processor of the MC68332 provides timing generation derived from the system clock. This feature is utilized to control the precise timing required for the acquisition of the End Tidal Carbon Dioxide ($etCO_2$) and saturation (SpO_2) signals. The TPU is also used to generate the PWM (Pulse Width Modulation) control for the CAPNOSTAT® case and detector heaters, as well as provide the frequency generation for the audio tones. See Tables 2 and 3.

Table 2. TPU Timing Generation for the etCO$_2$ subsystem

Signal	Name	Function / Timing
CO2AZ	Auto Zero	Clears the Sample/Hold circuitry prior to data acquisition. Active High, 90 us
CO2PWENB	Pulse Width Enable	Defines the active time for both phases of the bipolar source pulse, used for pulse width protection circuitry. Active High, 810 us
SRCDRV0	Source Drive 0	First source drive signal. Active High, 405 us
CS*/H	Current Sample/Hold	Enables circuitry for source current measurement. Sample is taken when SRCDRV0 is active. Low = Sample, 90 us, High = Hold
SRCDRV1	Source Drive 1	Second source drive signal delayed for 10 microseconds after SRCDRV0 ends. Active High, 395 us
SS*/H	Signal Sample/Hold	Enables circuitry for CO_2 and Reference channel data acquisition. Low = Sample, 90 us, High = Hold
CASEPWM	Case Heater PWM	PWM control for the case heater servo
DETPWM	Detector Heater PWM	PWM control for the detector heater servo
TOUT1, TOUT2, TOUT3	Tone Generation	Variable frequency outputs to generate system audio

Table 3. TPU Timing Generation for the SpO$_2$ subsystem

Signal	Name	Function / Timing
ASAMP*	Auto Zero	Clears the Sample/Hold circuitry prior to data acquisition. Active Low
RDLED*	Red Channel LED control pulse	Defines the active time for the Red LED
IRLED*	Infra-Red Channel LED control pulse	Defines the active time for the Infra-Red LED
RSAMP*	Red Channel Sample/Hold	Enables circuitry for the Red Channel signal measurement. Sample is taken when SRCDRV0 is active. Low = Sample, 90 us, High = Hold
ISAMP*	Infra-Red Channel Sample/Hold	Enables circuitry for the Infra-Red Channel signal measurement. Sample is taken when SRCDRV0 is active. Low = Sample, 90 us, High = Hold

Ferrite filters have been placed on the microprocessor signals with fast rise and fall times (including timing, clock, data and address lines) in order to help reduce and suppress the radiation of electromagnetic interference (L1-L14). In addition, good EMI/EMC design techniques have been incorporated in the component layout and printed circuit board manufacture.

Table 4 lists the chip select, control and discrete I/O functions for the *CO_2SMO Plus!®* system module. On power-up, Ports E and F are programmed as discrete inputs by pulling down their controlling data lines, DB8 and DB9. After power-up, the software sets up each pin function individually and performs a series of self tests to check the integrity of the system. During this initialization period, the MPU holds the SYSUP line low which keeps the system in an idle state. The state of configuration inputs on Port E (TST*, CNFG0*, CNFG1* and JP0*) are read. These inputs allow the software to identify different operating states such as Test Mode, or different hardware configurations. After the initialization period is complete and all system functions have been set, the MPU brings SYSUP high, indicating that the system is ready for operation.

Table 4. Chip Select, Control and Discrete I/O

Pot	Pin Functions	System Signal Name	I/O	Comments
C				D0-D7 pulled high, Pins are Chip Select on power-up
	CSBOOT**	BOOTCS*	O	Program PROM Chip Select Word (16-bits) wide mode, D0 = HIGH
	CS0* / PC0 / BR*	UBRAMWR*	O	Upper Byte SRAM Write Enable Allows for byte (8-bit) or word writes
	CS1*/ PC1 / BG*	LBRAMWR*	O	Lower Byte SRAM Write Enable Allows for byte (8-bit) or word writes
	CS2* / PC2 / BGACK*	RAMRD*	O	SRAM Read Enable, Word
	CS3* / PC3 / FC0	ROMWR*	O	FLASH PROM Write Enable, Word
	CS4* / PC4 / FC1	IORW*	O	Control for external System and CO_2 input buffer and output latch
	CS5* / PC5 / FC2	ROMWREN	O	Port C Discrete Output, prevents unintentional writes to FLASH EPROM. This signal must be asserted before ROMWR* in order to overwrite the FLASH
	CS6* / PC6 / A19	UARTCS*	O	High Speed UART Chip Select
	CS7* / PC7 / A20	PROFILE*	O	Enables profiling data output latch
	CS8* / PC8 / A21	DISPCS*	O	Display Chip Select for LCD control
	CS9* / PC9 / A22	FLOWIO*	O	Control for external Flow sub-system input buffer and output latch
	CS10* / ECLK / A23	RTCCS*	O	Real Time Clock Chip Select
E				D8 pulled low, Discrete I/O on power-up
	DSACK0* / Port E0	TST*	I	Initiate System TEST if Low
	DSACK1* / Port E1	DS1*	I	Data and Size Acknowledge 1*
	AVC* / Port E2	CNFG0*	I	Configuration Switch 0
	RMC* / Port E3	CNFG1*	I	Configuration Switch 1
	DS* / Port E4	DS*	O	Data Strobe
	AS* / Port E5	AS*	O	Address Strobe

Pot	Pin Functions	System Signal Name	I/O	Comments
	SIZ0* / Port E6	JP0*	I	Configuration Switch 2, Hardware Jumper Mode Select 0
	SIZ1* / Port E7	JP1*	I	Hardware Jumper Mode Select 1
	R/W*	RD*	O	Data Read Strode
		WR*	O	Data Write Strobe
F				D9 pulled low, Discrete I/O on power-up
	MODCK / Port F0	LED	O	LED CPU Activity Indicator
	IRQ1* / Port F1	SYSUP	O	System Initialization Complete
	IRQ2* / Port F2	CASEOT	O	Case Heater Over Temperature Shut Down
	IRQ3* / Port F3	DETOT	O	Detector Heater Over Temperature Shut Down
	IRQ4* / Port F4	EXTDCIN	I	Indicates external AC Mains power operation
	IRQ5* / Port F5	UARTIRQ*	I	External UART Interrupt
	IRQ6* / Port F6	PWRDWN*	O	System power down enable
	IRQ7* / Port F7	NMI	I	Non-Maskable Interrupt

3.2.1 Background Mode Debugging

External system debugging is possible by connecting an appropriate device (emulator or debugger) to header J400 then momentarily bringing the BERR* on J400 low. This halts the bus activity and turns control of the system over to the external device. In this mode, internal MPU registers can be viewed and altered, special test features can be invoked, and system memory can be read and written to.

3.2.2 System Memory

A 16-bit wide data path is used for FLASH PROM and SRAM transfers to maximize system throughput. Program code storage is contained in two 2-Meg 5V FLASH or EPROM (IC3 and IC5) devices. The FLASH PROMs are protected from unintentional over-writes of the program code by transistor Q1 and the ROMWREN signal. The ROMWREN line must be high prior to writing new code into the FLASH devices. Volatile data storage is contained in two 1-Meg SRAM (IC4 and IC6). The SRAMs can also be backed-up to retain their contents by applying a 2.5 Volt level on VBACK when main power is removed from the system. During the battery back-up state, transistor Q2 keeps the CS1* control of the SRAMs in the inactive state. This forces the data bus to a high impedance state, isolating the SRAMs from the rest of the system. True non-volatile storage for system parameters is provided by a serial EEPROM (IC8).

3.2.3 Serial Communications UART

In addition to the on-chip asynchronous serial communications interface (SCI) channel contained in the MC68332, a single channel UART (Universal Asynchronous Receiver/Transmitter), IC2, is provided for buffered high speed data communication to an external computer. The serial connection to external, non-patient, contact devices is electrically isolated from the patient applied sections by optical data couplers (IC68, IC71, IC73, IC74) and isolated power supply (see page 9 of schematic). This connector is located on the rear panel. The data Input/Output pins 15-22 of the UART are bi-directional and their direction is controlled by the RDN and WRN when CEN is held Low. The bus is put into tri-state condition when

CEN is High. Crystal Y1 is required for driving the internal baud rate generator and other clocking circuitry in the chip. The A0-A2 lines select the UART's registers for read/write operations. The data signals URxD and UTxD are diode protected against over voltage by D1 and D2. Refer to schematic 2731-03, sheet 9 and Table 5 for the pinout and signals of serial interface connector J100.

Table 5: Serial Connector, 25-pin D-subminiature connector (located on rear panel)

Pin Number	Signal	Function
1	NC	
2	RC1IN	Internal MC68332 UART Receive, RS232 Signal Level
3	TR1OUT	Internal MC68332 UART Transmit, RS232 Signal Level
4	TR2OUT	External UART Transmit, RS232 Signal Level
5	V-	Non-Patient RS232 Level Minus Supply Out
6	RC2IN	External UART Receive, RS232 Signal Level
7	IGND	Non-Patient Signal Ground
8	NC	
9	NC	
10	NC	
11	NC	
12	NC	
13	NC	
14	IRAW	Unregulated Power Supply Output
15	NC	
16	NC	
17	NC	
18	NC	
19	ASTxD	Internal MC68332 UART Transmit, TTL Signal Level
20	V+	Non-Patient RS232 Level Positive Supply Out
21	NC	
22	NC	
23	NC	
24	NC	
25	IVDD	Non-Patient 5V Logic Supply Out

3.2.4 User Interface Control Circuitry

Refer to schematic 2731-03, sheet 2.

The user interface features a 64 row by 240 column Liquid Crystal Display (LCD) module with a cold cathode florescent backlight. Patient and system information is presented in both graphical and textual formats organized into several screen configurations. A 13-switch membrane keypanel is provided for operator entry of screen selection, data entry and user input. The membrane panel also contains several LEDs which represent various system conditions, such as input power status (AC or Battery) and alarm state. Control of the user interface is provided by the IORW* chip select signal together with the RD* and WR* signals from the microprocessor. IC13 and IC15 are input buffers which read in the present state of the membrane keys. Depressing a key causes the signal line to be pulled low in contrast to its normally high state. Also located on the input buffer IC13 are the CAPNOSTAT® CO2XDISC, CO2ZERO* and CO2SPAN* signals, which inform the system that a CAPNOSTAT® sensor is disconnected, if it is connected and currently on the Zero Cell, or if it is connected and currently on the Reference Cell. IC17 provides a latched output for controlling the membrane and Alert LEDs and the LCD backlight. When the BACKLITE signal is pulled high (IC17 pin 13), transistor Q5A turns on allowing maximum display brightness. Otherwise, the current through the display must also pass through fixed resistor R103, causing the display to dim. Contrast control for the LCD is provided by DAC IC78 and amplifier IC77B (schematic 2731-03, sheet 9). When the CPU detects the closure of the contrast membrane key, the CPU sends a digital ramp input to the DAC which causes the its output to change accordingly. Inverting amplifier IC77B controls the base current into transistor Q31, which changes the output of the display contrast voltage, VDISP.

(See page 7) To supplement the visual indicators associated with the membrane keypanel and display, an audio output signal is generated to provide an additional mode to convey information to the user. Up to three tone frequencies are generated by the TPU processor of the MC68332 (DTOUT1, DTOUT2, DTOUT3). These signals are fed into separate reference inputs of the 8-bit DAC IC53, providing a means for independently attenuating each signal under CPU control. From the DAC, the individual signals are summed together by IC79A and filtered by L33 and C220 (see page 9). Audio amplifier IC76 drives the system speaker to produce system audio.

3.2.5 Real Time Clock, Power on RESET Generation and Glue Logic

Time-keeping for date and time stamping of patient trend information is provided by IC16 (see schematic 2731-03, sheet 2). This device contains a built in crystal for precise time and date measurement. In the absence of digital power, the time keeping function is maintained by the battery backed-up supply, VBACK.

On power-up, the system is forced into a RESET state by IC9 (schematic 2731-03, sheet 1). This chip creates the master active low system reset signal SRST*. An inverter is used to generate the active high RESET signal.

Chip selection for the serial peripherals are provided by decoders IC10 and IC14 and by the inverter IC11 (schematic 2731-03, sheet 2). IC18 and IC20 are used to determine CPU utilization during system development, latching various status bits out on connector J404. Latch IC19 is used to control the saturation analog signal processing and to drive the optical reflectors on the auxiliary pressure connector J411. On schematic 2731-03, sheet 8, input buffer IC62 is used to input the decoded output from the flow and auxiliary reflectors, while latch IC66 is used to control the flow pneumatics and provide the drive signals for the flow optical reflectors.

3.3 CO_2 System Analog Subsections

3.3.1 CO_2 Pulser Source Drive

Refer to schematic 2731-03, sheet 3.

The source drive circuitry is designed to drive the source with a bipolar signal to prevent the migration of charges within the source that may result from unidirectional electrical fields. The resistance of the source is monitored constantly to ensure the integrity of the system by sampling the current through the source while it is active.

The signals for source drive are generated by the TPU co-processor in the MC68332, IC1. The SRCDRV0 and SRCDRV1 lines are used to control the bipolar signal that drives the source. The SRCDRV0 signal goes High as soon as the CO2AZ (Auto Zero) line goes Low and the CO2PWENB (Pulse Width Enable) line goes High. The duration of SRCDRV0 is 405 us (micro-seconds), and drives the source in the positive direction. The SRCDRV1 line drives the source with an opposite polarity signal when High. There is a 20 us delay from when the SRCDRV0 line goes Low and the SCRDRV1 line goes High. This delay is to prevent the possibility of both SRCDRV0 and SRCDRV1 being active at the same time, thus creating a low impedance path between the two supplies. SRCDRV1 steers current through the source in the opposite direction from SRCDRV0.

When SRCDRV0 and CO2INH (Inhibit) are High the output of MOSFET Driver IC23A pin 7 will go Low. This turns the P-Channel half of MOSFET Q6 on. At the same time the output of MOSFET Driver IC24B pin 6 will be High biasing on the N-Channel half of MOSFET Q7 on. With both Q6B P-Channel and Q7A N-Channel on current will flow from +VSRC through Q6B to the positive source terminal, then back from the source negative terminal through Q7A, through R118 to -VSRC. When SRCDRV0 returns Low both Q6B and Q7A are turned off and no current flows through the source. After the 20 us delay, SRCDRV1 will go High. The output of IC24A pin 8 will go High biasing the N-Channel section of MOSFET Q6 on. The output of IC23B pin 5 will go Low turning the P-Channel of Q7 on. Current will now flow from +VSRC through Q7B to the source negative terminal, back from the source positive terminal through Q6A and R118 to -VSRC. Current will cease to flow when SRCDRV1 goes Low. The bridge circuit of Q6 and Q7 in effect switches the polarity of the drive signal of the source between +VSRC and -VSRC. CO2PWENB also falls with the falling edge of SCRDRV1, signaling the end of source activity.

When current flows through the source, it will also flow through current sensing resistor R118, creating a differential voltage proportional to the source current:

$$V_{SRC} = (V_{SR} / R_{SR}) * R_S * A_{V(DA)} \text{ where}$$

V_{SRC} = voltage out of difference amplifier proportional to current through the source element = 24V +/- 0.625V

V_{SR} = differential voltage across the source element

R_{SR} = resistance of the source element

R_S= resistance of the current sensing resistor = 1 ohm

$A_{V(DA)}$ = difference amplifier gain = 5

V_{SRC} = [120 (Volts*Ohms) / R_{SR}]

The voltage signal out of difference amplifier IC25A is level shifted through C36 and fed to the sample and hold IC26A. A low level on the CS*/H (Current Sample and Hold) signal allows the source current signal to be sampled. On the rising edge of CS*/H, the present voltage level of the source current signal is held and appears at the input to the Analog to Digital Converter IC12 (on page 2) for processing by the MPU. When CO2AZ is High the input to the sample and hold of IC26A is grounded to discharge any residual charge that may be on C36.

In order to prevent the source from being driven until the system is up and ready there is protection circuitry that inhibits the source drive until enabled. During system power-up, the RESET line keeps Q8

on. This causes the CO2INH line to be brought Low, preventing source pulses by pulling down SRCDRV0 and SCRDRV1 through D5. Protection circuitry also guards against extended pulse width as well as shortened duty cycle. On the rising edge of CO2PWENB, the trip point of IC27B is exceeded, allowing C39 to charge through R122. If the SRCDRV signals do not turn the Source Pulser off within 200 us after the 810 us pulse period, the trip point for IC27A will be exceeded, pulling the CO2INH line low turning the Pulser off. After the CO2PWENB signal returns Low, capacitor C41 discharges through R123, keeping the output of comparator IC27B at the voltage acquired by C39. After approximately 10.4 ms, C41 will have discharged below the comparator trip point. The comparator output goes low, discharging C39 and the circuit is ready for the next source pulse cycle.

3.3.2 CAPNOSTAT® Case and Detector Heater Control

Refer to schematic 2731-03, sheet 4.

The temperature of the system directly affects its ability to accurately measure CO_2 and therefore must be precisely maintained at a controlled value. Two separate heaters and control circuitry are used; one regulates the temperature of the detectors for the CO_2 Input and Reference channels; the other regulates the temperature of the transducer case (and loosely maintains the temperature of the airway adapter). While the purpose of the Detector heater is to keep the detectors' sensitivity to infrared radiation constant, the function of the Case heater is to keep condensation from forming on the airway windows by elevating the window temperature above the ambient airway temperature. Both heaters use an efficient Pulse-Width Modulation scheme designed to decrease power consumption, with the PWM timing generated by the TPU under microprocessor control. For the purpose of describing the regulation loop, the case heater circuitry will be considered. The detector and case heater circuitry are identical.

Inside the CAPNOSTAT®, a sensing thermistor is thermally connected to the heater module. Initially, the CAPNOSTAT® is at the ambient temperature and the resistance of the thermistor is large. A small current flows through the signal path CASETHERM and only a small voltage is developed across R139. The microprocessor programs the TPU to allow a maximum duty cycle of 30% to power the PWM heater circuitry. This causes the heater control MOSFET Q13A to be pulsed on and off with a duty cycle that is under direct control of the program software. As the heater warms up the case, the thermistor's resistance decreases, raising the voltage appearing at the input of the control loop. As described below, the MPU looks at this output voltage and decreases the duty cycle of the PWM control circuitry, gradually reducing the power output into the heater. When the desired temperature set point is reached, a balance is struck between the energy delivered into the system and the heat flow out of the system.

The case thermistor is sensed by amplifier IC29B pin 5. The difference between the signal at the non-inverting input and the reference appearing at the inverting terminal generates an error voltage proportional to the sensed temperature at the amplifier's output:

$$e_o\ (V) = [83.133V / (R_{th}+3.32K)] - 10.2V$$ where e_o = amplifier output voltage

R_{th} = resistance of the thermistor

= 4.36933K at 45°C

$$\text{Temp (°C)} = 4.1288\ ((C/V) * e_{o\ (T)}\ V + 41.7321°C$$

where e_o = amplifier output voltage at temperature T

This error voltage is low pass filtered by amplifier IC28A, sent to the ADC and processed by the CPU to regulate the output pulses from the TPU. The TPU PWM signal is buffered by MOSFET Driver IC31 and capacitively coupled to the gate of the heater drive MOSFET, Q13A. Capacitive coupling the signal prevents a system fault that would allow the PWM to be stuck at a level that would cause a high heater output. In the absence of a pulse, the gate drive will be pulled high, disabling the output to the heater. The pulsed voltage signal out of the MOSFET is filtered by D12, L15, C53 and C54 to produce a DC output level for the heater. Since the TPU generated PWM signal is based on the system clock, it is synchronized

with the generation of the source pulse timing. This minimizes the effect of any random disturbance caused by the heater circuit on the detection of the CO_2 Data and Reference signals.

The error voltage out of amplifier IC29B also appears at the temperature watchdog comparator IC30B. If the error voltage reaches approximately 56 degrees Celsius, the comparator trips, turning Q11 off. The gate of MOSFET Q10A is pulled high by R138, which turns it off and VHTR is prevented from reaching the Source of transistor Q13A. The temperature of the sensor is also monitored by the MPU which will disable the heater when a temperature of 50 degrees Celsius is exceeded. To shut off the heater, the MPU asserts the CASEOT signal, turning Q12 on which turns Q11 and Q10A off.

3.3.3 CO_2 Input Signal Path

Refer to schematic 2731-03, sheet 5.

The signals from the sensor CO2DATAIN (CO_2 Data) and CO2REFIN (CO_2 Reference Signal) have similar signal paths. The CO2DATAIN passes through a high pass filter with a gain of 3.8 consisting of C68, R173 and buffer amplifier IC34B. The signal is fed to a Butterworth low pass filter IC33A and associated components. This filter has a gain of 2 with a corner frequency of 1.5 KHz. The output from the low pass filter is fed to a 12-bit digital to analog converter IC78 (refer to schematic 2731-03, sheet 9). The signal, CO2DIN comes into the reference of the DAC, which acts as a programmable gain stage followed internally by an amplifier with a fixed gain of 2. Here under processor control the signal's gain is adjusted to an acceptable level for conversion. The gain setting is adjusted using the digitized signal out of IC12 (page 2) as part of the feedback loop. Similarly, CO2REFIN is conditioned by high pass filter IC34A with a gain of 1.75 and low pass filter IC33B with a gain of 2. The equivalent fixed gains for the two input signals are not equal in order to compensate for differences in the output signal levels of the infra-red detectors in the CAPNOSTAT®.

The output from IC78 (page 9), CO2DOUT, is buffered by IC35B (page 5) and AC coupled through C270 to IC94B. The CO2DATA signal received from the CAPNOSTAT® is AC coupled by C68 prior to the high pass filter to remove any DC bias. Prior to sampling the CO_2 signal, the CO2AZ (Auto Zero) pulse biases Q16 on causing any residual charge on C270 to discharge to ground. At the start of the source pulse, the CO2AZ pulse goes Low and the CO_2 signal from the sensor is attained, and appears at the input of the sample and hold amplifier, IC26B. Near the end of the source pulse, the SS*/H (Signal Sample and Hold) goes Low and the peak signal is acquired on the internal sample and hold capacitor. SS*/H returns high at the end of the cycle, and the CO_2 signal on the sample capacitor is held at the peak value. The signal then passes through a low pass filter of R191 and C80 before being converted by the ADC into digital data and analyzed by the processor. The signal CO2REF follows an identical zeroing and acquisition path.

3.3.4 CAPNOSTAT® Interface

A twenty pin connector, J408, interfaces the CAPNOSTAT® with the system electronics. Ferrite filters have been placed on all lines to suppress radiated EMI and reduce susceptibility from high frequency external sources of interference.

3.3.5 Sampling Pump

To enable the monitoring of non-intubated patients, a single tapered sampling port is provided below the Flow connector. Regulator IC36 adjusts the pump motor speed and the flow rate of air through the tubing system via VR1. Pump motor current is sensed by measuring the voltage developed across resistor R207 using amplifier IC37B which provides a gain of 125. This provides an output of 8mA per Volt $\{V_o = (I_{pump}*R) / Gain\}$ into the 12-bit ADC IC12 (page 2), or approximately 5 uA per bit resolution $\{Vref_{(ADC)} / (2^{12}*Gain)\}* \{8mA/V\}$. A two-pole 31 Hz filter composed of IC37A provides high frequency attenuation.

3.4 Saturation Analog Subsections

3.4.1 LED Power Generation and LED Drive

Refer to schematic 2731-03, sheet 6.

Adjustable voltage regulator IC38 is configured as a constant current supply for the Red and Infra-Red (IR) sensor LEDs. R210 limits the current to Vref/R {1.25V/26.7 ohms} or 50mA, while D31 sets the maximum output voltage at 7.5 Volts. Capacitors C90 and C119 provide a reservoir for providing the instantaneous current demanded when the LEDs are turned on. Transistor Q19 allows shutting down the power to the sensor LEDs by the microprocessor.

Refer to schematic 2731-03, sheet 9.

The SPO2VLED voltage is used by both channels' drive circuitry. The DAC output portion "C" from IC78 is programmed by the processor and is buffered by amplifier IC67B. This voltage appears at the output of IC67B pin 7 and is labelled as SPO2VLED.

Refer to schematic 2731-03, sheet 6.

Connector J102 couples the saturation sensor to the monitor. Each sensor LED is controlled by an amplifier configured as a constant current driver. IC39A and IC39B are non-inverting amplifiers. The voltage appearing at the positive terminal will also appear at the negative terminal, and across current programming resistors R222 and R231. This voltage creates a current through R222 of 225mA {0.74V/ 3.3 ohms} when the RDLED* signal is asserted and Red LED is turned on. The driver for the IR LED creates a constant current source of 111mA across R231 and is controlled by asserting the IRLED* signal. The two control signals operate at 33 Khz with a 10% duty cycle and are staggered so that one LED is active during the middle of the other LED's off period.

Each LED (one red and one infrared) in the sensor is driven separately. Since the circuitry is similar, only one channel will be discussed; the corresponding components for the other channel will appear in brackets.

When the REDLED* [IRLED*] line is low Q21 [Q22] will turn off, this allows the SPO2VLED voltage, divided by R212 [R223] and R215 [R226], to drive the non-inverting input of IC39A [IC39B]. When IC39A [IC39B] output is high, Q20 [Q35] will turn on, this pulls current through the sensor LED from the IC38 supply (fed to the sensor from J102 pin 6). When the REDLED* [IRLED*] line is high, the input of IC39A [IC39B] is brought to ground potential because Q21 [Q22] is biased on. This shuts Q20 [Q35] off resulting in no current flow through the LED.

3.4.2 Saturation Input Signal Path and Signal Conversion

Refer to schematic 2731-03, sheet 6.

Light from the sensor's Red or Infrared LED shines through the pulsating vascular bed (the patient's finger, toe, etc.), placed between the LEDs and the photodiode. Some of this light emerges from the tissue and impinges on the photodiode, causing the photodiode to conduct current. IC44A pins 2-3 are set up as a differential amplifier that converts this input current to a voltage at the amplifier output. The sensors are wired such that photodiode current produces a positive voltage at IC44A pin 1[1].

The voltage at IC44A pin 1 is presented to an analog switch IC43A. This switch is controlled at pin 1 by INSIG* (Input Signal), and will be closed (IC43A pins 2 and 3 connected) except if the monitor is in a Probe Off Patient condition or is undergoing its self-test at system power up. The switch IC43B, controlled from SIGND* (Signal Ground), will be open (no connection between IC43B pins 6 and 7) except as noted above for the switch at IC43A. As a result, the IC44A output voltage passes undisturbed to the high pass filter consisting of R239 and C108.

1. This is true for SuperBright™ sensors. If a non-SuperBright™ (Novametrix part number 86xx series) sensor is connected, IC44A pin 1 will go negative.

The ASAMP* signal is active low whenever either sensor LED is turned on. This causes Q23 to turn off and the signal at C108 passes through to IC44B. The ASAMP* line returns to a logic high when neither LED is being driven, causing Q23 to turn on. With Q23 conducting, any voltage at C108 is discharged to ground and the next pulse will charge C108 from a known level. If it were not for Q23, any charge remaining on C108 from the previous pulse, or from ambient light reaching the photodiode, would be added to the charge from a new pulse—creating measurement errors.

If the signal at IC44B is the product of the Red LED being turned on, then RDSAMP* will go low and close the switch at IC43D. This sends the signal to a sample and hold circuit consisting of R247 and C124 (that maintains the signal until next sample pulse arrives), a gain stage (IC42A), a filter/divider network (C120, R218 and R409), and finally, to the Red channel Analog-to-Digital Convertor (ADC) IC45.

If the signal at IC44B is the product of the Infrared LED being turned on, then IRSAMP* will go low and close the switch at IC43C. This sends the signal to a sample and hold circuit consisting of R236 and C111 (that maintains the signal until next sample pulse arrives), a gain stage (IC42B), a filter/divider network (C103, R214 and R408), and finally, to the Infrared channel Analog-to-Digital Convertor IC41.

On power up, the system performs a self-calibration cycle to establish the level of background circuit offset. Calibration is performed by coordinating the control signals SPO2CAL, SPO2SC1, ASAMP*, RSAMP*, ISAMP*, SIGND* and INSIG*. Once the system baseline has been acquired, the Red and Infra-Red ADCs, IC41 and IC45, adjust their output to compensate for any system offsets found.

The main timing signal generation for saturation signal acquisition is generated by the TPU. Auxiliary signals for calibration and signal acquisition (SPO2CAL, SPO2SC1, SIGND* and INSIG*) are generated by the MPU control of output latch IC19 (reference page 2 on schematic).

3.5 Flow System Analog Subsections

3.5.1 Flow Zeroing and Patient Line Back-flushing

Refer to schematic 2731-03, sheets 7 and 8.

The zero process begins when the CPU brings the VALVE1, VALVE2, VALVE3 and VALVE4 lines high, energizing valves V1, V2, V3 and V4. This disconnects the differential pressure transducer IC50/IC95 (via V1 and V2) and the absolute pressure transducer IC59/IC96 (via V2) from the patient airway, shunts the differential pressure sensor ports (V4) and opens all pressure transducer ports to atmosphere through V3. Note that there are two possible installations for IC50/IC95 and IC59/IC96, depending upon the model configuration.

The pressure transducers are “zeroed” by adjusting the amplified and conditioned pressure output signals into the 12-bit Analog to Digital Converter (ADC, IC46) so that each reading reads approximately mid-scale (2048 counts) using a successive approximation algorithm. With a reference voltage of 2.5 Volts, each count returned by the ADC is equal to 0.6103 mV. Centering the no flow (ambient) signal to the ADC's mid-scale allows the sensor to report both positive and negative airway pressures. IC53, an octal 8-bit Digital to Analog Converter (DAC) provides the adjustment under microprocessor control. The DAC maintains each adjustment voltage obtained during the zeroing process until a new zero cycle is initiated.

The patient airway pressure transducer is "zeroed" first by adjusting the AUXTRIM output of the DAC until the Airway Pressure signal into the ADC, IC46, reads mid-scale. The barometric (ambient) pressure as sensed by IC59/IC96 is recorded after the airway pressure zero is completed. Next the flow channels are zeroed. A non-inverting summing amplifier (IC52B) combines two of the DAC's outputs and a constant voltage from IC52A equal to the mid-scale of the ADC. The output voltage produced by the summer is fed into IC49, a monolithic instrumentation amplifier, which takes the differential output of the pressure transducer, IC50/IC95, and adds an offset equal to the reference voltage input. DAC outputs VOUTA and VOUTB serve to provide the flow channels with a fine and a course adjustment. VOUTB,

the course adjustment, is altered until the X10 Flow gain channel input into the ADC, FLOW10, reads mid-scale. VOUTA, whose ratio is 1/256 that of VOUTB, is then used to fine tune the system by bringing the x100 Flow gain channel, FLOW100, to mid-scale. Finally, the x1000 gain channel is adjusted if required by changing the value of DAC output VOUTA. Once the x1000 gain channel is set, a reading is taken from all four flow gain channels. The result from each channel is stored in SRAM and used as an offset in the flow calculations. Valves V1, V2, V3 and V4 are then de-energized, reconnecting the pressure transducers with the patient airway.

If patient line purging is set, the system turns on the pump by bringing the PURGE line high after the zero values are recorded. A slight pressure is allowed to build in the pump tubing line that will aid in flushing out the patient airway tubing. To purge patient line 1, the CPU brings the VALVE1 and VALVE4 signals high, energizing Valves V1 and V4. V1 connects the pump with the P1 patient line, flushing out the patient P1 line while V4 shunts across the differential pressure transducer, preventing a differential pressure from appearing across the transducer. During purging, the system is able to monitor the pressure that is present in the selected patient line by reading the AWPRESS signal. VALVE1 is brought low and V1 is then de-energized, once again isolating the pump from the patient airway and allowing a pressure head to build once more. The VALVE2 line is then brought high and valve V2 is then energized, flushing out the patient P2 line. After all lines have been flushed out, V1 and V3 are re-energized allowing any residual pressure to be vented to atmosphere. All valves are then de-energized and the PURGE signal is brought low, turning the pump off. The purging-process is complete and normal patient monitoring continues.

A hardware watchdog, consisting of IC32B and the surrounding circuitry, limits the maximum pump on time, preventing overpressure from building in the patient lines.

3.5.2 Flow Circuitry

Differential Pressure Transducer, IC50/IC95, is a silicon-based, piezoresistive bridge with four active elements. When pressure is applied between transducer ports P1 and P2, a differential output voltage proportional to the applied pressure is produced. The full-scale output range for the transducer is 0 to 10 inches of water (P1>P2). By setting the 0 differential pressure (no-flow) point to mid-scale (during the zeroing process described earlier), negative pressure readings (P2>P1) are also available. The transducer is temperature compensated at 25 degrees Celsius and designed to be driven by a constant voltage source (IC54A, B).

In the normal system operating mode, all valves are de-energized and the pump is inactive. Transducer ports P1 and P2 are connected to the patient airway. As air flows through the flow sensor, a pressure difference between P1 and P2 is created. This signal is dependent on both the magnitude and the direction on the airflow. The greater the flow volume, the larger the pressure difference created between the two transducer ports. The transducer senses an inspired flow as a positive pressure difference (P1>P2), while an expiratory flow is seen as a negative pressure (P2>P1). With a source voltage of 5.0V, the sensor transforms this pressure difference into an electrical signal with a nominal absolute magnitude of 16.67 mV Full-scale Output. This signal is conditioned and amplified by IC49, which is a monolithic Instrumentation Amplifier (IA). The flow IA IC49 also offsets the signal to the mid-range of the ADC obtained during the zeroing process. A positive pressure difference (inspiratory flow) creates a signal above the offset (approximately 1.25 to 2.5V). A negative pressure difference (expiratory flow) becomes a 1.25 to 0V signal. The nominal gain of IC49 is set by fixed resistor R260 and variable resistor VR2. The output for the transducer is adjusted using VR2 and a known pressure input as a calibration reference. With an input differential pressure of 10 inH_2O, the gain of the amplifier is set to give an ADC count of 3498.

The signal out of the flow IC49 is taken through a two-pole low pass filter IC47B with a 31Hz cutoff frequency to remove unwanted high frequency electronic noise before it is passed on to the four gain stages (IC48 and IC51). The four flow differential gain amplifiers provide signal gains of 1 (Flow 1), 10 (Flow 10), 100 (Flow 100) and 1000 (Flow 1000). The gain of 1 amplifier is used to buffer the flow signal

and provide signal conditioning consistent with the other channels. The x10, x100 and x1000 channels amplify the flow signal according to the following equation:

V_{out} = $(V_{flow}\text{-}Vrefo/2)(A_v) + (Vrefo/2)$

where A_v is the amplifier gain, R_{fb}/R_v (1, 10, 100 or 1000)

R_{fb} is the feedback resistor (R258, R269, R274)

R_v is the reference resistor (R257, R268, R273)

The circuit is designed to amplify the difference between the flow signal into each gain stage and the reference voltage so the zero point of each stage remains at mid-scale.

The output from each gain stage appears at the 12-bit analog to digital converter IC46, where it is transformed from an analog voltage into a digital code for processing by the CPU, IC1.

3.5.3 Barometric and Airway Pressure

IC59/IC96 is a piezoresistive differential pressure transducer with port P2 held at zero psi. It measures the absolute pressure difference at port P1 relative to the vacuum at port P2. The transducer is calibrated for a full scale output of 0 to 15 psi, has internal temperature compensation and is designed to be driven by a constant current source. An on-board calibration resistor is trimmed by the manufacturer and is used to set the current through the sensing bridge by amplifier IC57B. Instrumentation amplifier (IA) IC58 conditions this signal to correspond to the current barometric pressure, which is set by adjusting VR4. The nominal gain of this amplifier is 93.56, which corresponds to an ADC count of 3800 at 760 mmHg. The output signal from IC58 is low pass filtered by IC57A and appears as an input to both the 12-bit ADC and a second IA, IC56. IC56 provides gain adjustment via VR3 and offsets the output signal from the barometric amplifier to mid-scale during the zeroing state. This is handled by the VOUTC line from IC53, the output is then fed to the low pass filter circuit of IC55A. The nominal gain of the airway pressure amplifier is 5. This signal connects to the P1 (proximal to the patient) side of the differential pressure transducer during monitoring and provides patient airway pressure sensing (AWPRESS).

3.5.4 Patient Airway Adapter Type Sensing

Given a specific flow sensor type (i.e., Adult), the physical characteristics of the sensor will be consistent from one adapter to another. However, due to the differences in the physical size and geometry of the various flow sensor types (i.e., Adult, Neonatal), each type requires different coefficients be used in the calculation of flow. Each flow sensor type has a unique 3-bit code associated with it. This pattern molded into the connector body can be optically reflective or non-reflective and is read by the system. A pulse is generated by the CPU that turns on the LED component of a opto-coupler mounted directly beneath each pattern segment. If the pattern segment associated with that opto-coupler is reflective, the LED's light will cause its photodetector mate to be turned on, which generates a signal that is sensed by the system and relayed back to the CPU. If the segment is non-reflective, no signal is returned to the sensing circuitry. A three-bit code can generate 8 unique pattern combinations. One code condition, all zeros (no reflection), is reserved for detecting when the sensor unplugged. The circuitry to decode the flow sensor type is located on schematic 2731-03, sheet 8, and consists chiefly of connector J410, comparator IC60, Schmitt trigger IC61 and input buffer IC62. A separate connector (J411) and circuitry are provided to decode an auxiliary pressure port, which is currently not implemented.

3.5.5 Power Supply and Voltage Reference Generation

Refer to schematic 2731-03, sheets 9 and 10.

The monitor operates either on isolated AC Mains power or on the internal 12 Volt Lead-Acid Battery. A separate power supply board provides the AC rectification and filtering, battery charging and DC Input Voltage, VDCIN, for the Main 2731 PCB on J414. The heart of the power supply design for the system is a 100 KHz switching regulator, IC86, which utilizes a flyback transformer configuration to generate the DC supply voltages and provide the required isolation between the primary, secondary and isolated power planes. The primary of the transformer is designed to accept 10 to 24 V DC input and provides

secondary outputs of nominally 5VDC, +13.5VDC, and -13.5VDC. An additional winding pair is isolated (2KV rating) from the other transformer windings to provides 9VDC output for the earth connected serial output circuitry. The 5VDC supply (VDD) provides feedback to the switching regulator by resistor divider R379/R385. The other windings are loosely regulated to the 5VDC supply by the ratio of the transformer windings, creating unregulated secondary voltages for the analog supplies of approximately +\-13VDC. The 5V supply is L-C filtered to provide clean logic supplies for the analog sections of the CO_2 and Saturation (CVDD) and Flow (FVDD) sub-systems. Another filter isolates the 5 Volt supply for the Flow valves from the rest of the system. Analog supplies of +/-12VDC (+12V, +AVCC, -12v, -AVCC) are created by regulators IC85 and IC90.

These supplies are also filtered to provide a degree of power isolation between the Flow sub-system and the remainder of the system. IC87 and IC89 are designed as a tracking regulator pair to provide a 24VDC differential voltage for powering the CAPNOSTAT® source (+VSRC, -VSRC). Linear regulator IC82 provides the logic and analog supply for the patient-isolated circuits. Power for the CAPNOSTAT® Heaters, Display Backlight and Pumps are designed to run off of the battery for maximum efficiency. Linear regulator (IC91) provides the supply when the unit is plugged into MAINS power, since the DC input voltage can be 24VDC under high line conditions (refer to Table 6).

Table 6: Power Supply and Reference Outputs

Signal	Supply	
VDCIN	+10 - +24VDC	Main DC input generated from external MAINS or internal battery
VBATT	+10 - +12.5VDC	Internal Battery DC input
VBACK	+2.5VDC or +5VDC	Supply for SRAMs, either VDD or 2.5V to maintain SRAM data during power down
VHTR	+12V or VBATT	Supply for the CAPNOSTAT® Case and Detector heaters, regulated at 12V when MAINS power available or from VBATT when unit is on battery power
VBKLITE	+12V or VBATT	Supply for the LCD Display Backlight and Pumps, regulated at 12V when MAINS power available or from VBATT when unit is on battery power
VDD	+5VDC	Regulated digital logic supply
VVDD	+5VDC	Regulated and filtered supply for the valves
CVDD	+5VDC	Regulated and filtered logic supply for CO_2 and Saturation analog sub-systems
FVDD	+5VDC	Regulated and filtered logic supply for the Flow analog sub-system
+VA	+13.5VDC (nominal)	Loosely regulated off of the 5VDC feedback line
+12V	+12VDC	Linearly Regulated and filtered positive analog supply for the CO_2 and Saturation sub-systems
+AVCC	+12VDC	Linearly Regulated and filtered positive analog supply for the Flow sub-system
+VSRC	+12VDC	Linearly Regulated and filtered positive supply for the CAPNOSTAT® Source. Tracks -VSRC to provide a 24V +/- 2.5% differential voltage across the source
-VSRC	-12VDC	Linearly Regulated and filtered negative supply for the CAPNOSTAT® Source. Tracked by +VSRC to provide a 24V +/- 2.5% differential voltage across the source
-AVCC	-12VDC	Linearly Regulated and filtered negative analog supply for the Flow sub-system
-12V	-12VDC	Linearly Regulated and filtered negative analog supply for the CO_2 and Saturation sub-systems
-VA	-13.5VDC (nominal)	Loosely regulated off of the 5VDC feedback line
IRAW	+7.5VDC (nominal)	Loosely regulated off of the 5VDC feedback line, isolated from the other transformer windings
IVDD	+5VDC	Linearly Regulated to provide an isolated digital and analog power source

Stable reference voltages for the sensors and analog circuitry are derived from IC70, a precision 2.5V with low drift. Five (5) and 2.5 Volt references for the CO_2 and Saturation circuits are generated by IC72, while a separate 5, 2.5 and 1.25 Volts are generated directly from IC70 and from IC75.

When the monitor is operated from an AC Mains power source, the green AC ON indicator on the front panel is lit. Pressing the Power or key on the front membrane keypanel will not turn the monitor off. Instead, the monitor is placed in a standby operating mode. The display, backlight and other non-essential control functions are inactivated by the software, giving the monitor the appearance of power down. While in standby however, the core system continues to operate, keeping the CAPNOSTAT® heaters within temperature regulation. This reduces the time required to bring the system up to full operating specifications during the following power-up cycle.

If AC power is lost or is not available, the monitor automatically operates from its internal battery without interruption. The AC ON indicator is extinguished and a BATTERY ICON appears on the display, indicating the current power level of the battery. While on internal DC power, the current state of the battery is monitored by both software and hardware (IC80B and IC88B, schematic 2731-03, sheet 10). Should the battery power level become low, the monitor software alerts the user. If the monitor is not placed on AC Mains power, the software will turn the unit off. Should the software fail to turn the monitor off, the hardware cutoff (IC88B) activates, turning the unit off. While on battery operation, depressing the Power key on the front keypanel will turn the monitor off; stand-by mode is disabled and power to the system is turned off.

3.6 Digital Logic List

The tables below lists the signals in the Model 8100, including a brief description. Information not explicitly covered in the previous sections may be found here.

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
SIM/EBI/Chip Selects	CSBOOT	CSBOOT	BOOTCS*	O	flash rom chip select
	BR/CS0*	CS0*	UBRAMWR*	O	upper byte sram write
	BG/CS1*	CS1*	LBRAMWE*	O	lower byte sram write
	BGACK/CS2*	CS2*	RAMRD*	O	sram read
	PC0/FC0/CS3*	CS3*	ROMWR*	O	flash rom write
	PC1/FC1/CS4*	CS4*	IORW*	O	input buffer read / output latch write
	PC2/FC2/CS5*	PC5	ROMWREN	O	flash rom write enable, uart autovector
	PC3/A19/CS6*	CS6*	UARTCS*	O	parallel uart chip select
	PC4/A20/CS7*	CS7*	PROFILE*	O	16-bit profile output latch
	PC5/A21/CS8*	CS8*	DISPCS*	O	lcd display chip select
	PC6/A22/CS9*	CS9*	FLOWIO*	O	flow input/output enable
	A23/CS10*	CS10*	RTCCS*	O	real time clock chip select

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
SIM/EBI/Bus Control	R/W*	R/W*	R/W*	O	read/write control
	RESET*	RESET*	RESET*	I/O	system reset
	HALT*	HALT*	HALT*	O	system halt
	BERR*	BERR*	BERR*	I	bus error
SIM/EBI/ Port E	PE0/DSACK0*	DSACK0*	TST*	I	enables system test function
	PE1/DSACK1*	DSACK1*	DS1*	I	data and size acknowledge 1
	PE2/AVEC*	PE2	CNFG0*	I	configuration switch #1
	PF3/RMC*	PE3	CNFG1*	I	configuration switch #2
	PF4/DS*	DS*	DS*	O	68K data strobe
	PF5/AS*	AS*	AS*	O	68k address strobe
	PF6/SIZ0	PE6	CNFG3*/JP0*	I	config switch #3, hardwire jumper 1
	PF7/SIZ1	PE7	JP1*	I	hardwire configuration jumper 2
SIM/EBI/ Port F	PF0/MODCLK	PF0/MODCLK	LED	O	mpu activity led
	PF1/IRQ1*	PF1	SYSUP	O	system initialization complete
	PF2/IRQ2*	PF2	CASEOT	O	case heater over temp shut down
	PF3/IRQ3*	PF3	DETOT	O	detector over temp shut down
	PF4/IRQ4*	PF4	EXTDCIN	I	external ac input active
	PF5/IRQ5*	IRQ5*	UARTIRQ*	I	uart interrupt input
	PF6/IRQ6*	PF6	PWRDWN*	O	power down signal
	PF7/IRQ7*	IRQ7*	NMI*	I	non maskable interrupt

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
TPU	T2CLK	T2CLK		I	external TPU clock source
	TP0		CO2AZ	O	etCO2 autozero
	TP1		CO2PWENB	O	etCO2 source pulse width enable
	TP2		SRCDRV0	O	etCO2 source drive phase 0
	TP3		CS/H*	O	etCO2 current sample and hold control
	TP4		SRCDRV1	O	etCO2 source drive phase 1
	TP5		SS*/H	O	etCO2 signal sample and hold control
	TP6		CASEPWM	O	etCO2 case heater pwm
	TP7		DETPWM	O	etCO2 detector heater pwm
	TP8		ASAMP*	O	SpO2 auto zero sample
	TP9		RSAMP*	O	SpO2 red channel sample
	TP10		RDLED*	O	SpO2 red led control
	TP11		ISAMP*	O	SpO2 infra-red channel sample
	TP12		IRLED*	O	SpO2 infra-red led control
	TP13		TOUT1	O	tone output channel 1
	TP14		TOUT2	O	tone output channel 2
	TP15		TOUT3	O	tone output channel 3
QSM/QSPI	MISO		SSDI	I	qspi master mode serial input
	MOSI		SSDO	O	qspi master mode serial output
	SCLK		SCLK	O	qspi master mode serial clock
	PCS0/SS*		PCS0	O	serial chip select 0
	PCS1		PCS1	O	serial chip select 1
	PCS2		PCS2	O	serial chip select 2
	PCS3		PCS3	O	serial chip select 3
QSM/SCI	TxD		ASTxD	O	sci transmit data
	RxD		ASRxD	I	sci receive data
TEST	IPIPE*/DSO	IPIPE*	IPIPE*	O	instruction pipe
	IFETCH*/DSI	IFETCH*	IFETCH*	O	instruction fetch
	BKPT*/DSCLK	BKPT*	BKPT*	I	hardware breakpoint
	FREEZE/QUOT	FREEZE	FREEZE	O	freeze, initiate background mode
	TSTME*/TSC	TSTME*	TSTME*	I	test mode enable

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
CLK	XTAL	XTAL	XTAL	I	crystal oscillator
	EXTAL	EXTAL	EXTAL	I	crystal oscillator
	CLKOUT	CLKOUT	SYSCLK	O	system clock
	XFC	XFC	XFC	I	external filter capacitor
	VDDSYN	VDDSYN	VDDSYN	I	power supply to vco
12-bit ADC #1		0	CO2DATA	I	etCO2 data channel
		1	CO2REF	I	etCO2 reference channel
		2	CO2ISRC	I	etCO2 source current
		3	CO2CASE	I	etCO2 case heater temp
		4	CO2DET	I	etCO2 detector heater temp
		5	SPO2FEDC	I	SpO2 front end dc
		6	SPO2RDLED	I	SpO2 red led power
		7	SPO2IRLED	I	SpO2 infra-red power
		8	ABPRESS	I	barometric pressure
		9	VSUMP	I	sampling pump motor current
		10	VBATTADC	I	battery voltage
12-bit ADC #2		0	FLOW1	I	flow x1 gain channel
		1	FLOW10	I	flow x10 gain channel
		2	FLOW100	I	flow x100 gain channel
		3	FLOW1000	I	flow x1000 gain channel
		4	AWPRESS	I	airway pressure
		5	SPO2PROB	I	SpO2 probe signal
		6		I	
		7		I	
		8		I	
		9		I	
		10		I	
12-bit Quad DAC #1		0	CO2DOUT	O	etCO2 data gain adjust
		1	CO2ROUT	O	etCO2 reference gain adjust
		2	SPO2VLED	O	SpO2 led control voltage
		3	VDISP	O	display contrast control voltage

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
8-bit Octal DAC #2		0	FLOWFINE	O	flow offset fine adjust
		1	FLOWCRSE	O	flow offset coarse adjust
		2	AWTRIM	O	airway pressure trim adjust
		3	AUXTRIM	O	auxiliary pressure trim adjust
		4	TOUT1	O	tone output channel 1
		5	TOUT2	O	tone output channel 2
		6	TOUT3	O	tone output channel 3
		7		O	
CONFIGURATION SWITCH FUNCTIONS	S1 PIN	1	TST*	O	enables system TEST function
		2	CNFG0*	O	configuration switch #1
		3	CNFG1*	O	configuration switch #2
		4	CNFG2*/JP0*	O	config switch #3, hardwire jumper 1
System Input Buffer	IORW* & RD*	D0	CO2XDISC	I	etCO2 CAPNOSTAT® disconnected
		D1	CO2ZERO*	I	etCO2 zero switch
		D2	CO2SPAN*	I	etCO2 span switch
		D3	S13 (ADJUP)	I	keypanel switch 13, adjust setting up
		D4	S11 (ADJDWN)	I	keypanel switch 11, adjust setting down
		D5	S12 (NEXTITEM)	I	keypanel switch 12, next item select
		D6	S1 (POWER)	I	keypanel switch 1, power toggle
		D7	S2 (CONTRAST)	I	keypanel switch 2, display contrast
		D8	S3 (AUDIOSW)	I	keypanel switch 3, audio switch
		D9	S4 (ALERTSW)	I	keypanel switch 4, alert reset switch
		D10	S5 (EVNTFRZ)	I	keypanel switch 5, event / freeze key
		D11	S6 (CO2PLETH)	I	keypanel switch 6, co2 / pleth screen
		D12	S7 (FLOWPRES)	I	keypanel switch 7, flow / pressure scrn
		D13	S8 (TREND)	I	keypanel switch 8, trend screen
		D14	S9 (DATA)	I	keypanel switch 9, data screen
		D15	S10 (SETUP)	I	keypanel switch 10, setup screen

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
System Output Latch	IORW* & WR*	D0	2MINLED	O	2 minute procedure led
		D1	AOFFLED	O	audio off led
		D2	SPARELED	O	spare led control
		D3	BATTLED	O	battery on led
		D4		O	
		D5	ALERTS	O	alerts "kojak" leds
		D6	BACKLITE	O	display backlight dim
		D7	SAMPLE	O	co2 sampling pump control
		D8	SPO2CAL	O	SpO2 adc calibrate
		D9	SPO2SC1	O	SpO2 adc calibration mode
		D10	SPO2LPON	O	SpO2 led power on
		D11	INSIG*	O	SpO2 input signal enable
		D12	SIGND*	O	SpO2 signal ground control
		D13	OCDRV3	O	flow aux optical encoder drive 3
		D14	OCDRV4	O	flow aux optical encoder drive 4
		D15	OCDRV5	O	flow aux optical encoder drive 5
Profile Output Latch	PROFILE*	D0	PROBIT0	O	profiling bit 0
		D1	PROBIT1	O	profiling bit 1
		D2	PROBIT2	O	profiling bit 2
		D3	PROBIT3	O	profiling bit 3
		D4	PROBIT4	O	profiling bit 4
		D5	PROBIT5	O	profiling bit 5
		D6	PROBIT6	O	profiling bit 6
		D7	PROBIT7	O	profiling bit 7
		D8	PROBIT8	O	profiling bit 8
		D9	PROBIT9	O	profiling bit 9
		D10	PROBIT10	O	profiling bit 10
		D11	PROBIT11	O	profiling bit 11
		D12	PROBIT12	O	profiling bit 12
		D13	PROBIT13	O	profiling bit 13
		D14	PROBIT14	O	profiling bit 14
		D15	PROBIT15	O	profiling bit 15

GROUP	SIGNAL	SYSTEM FUNCTION	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
Flow Input Buffer	FLOWIO* & RD*	D0		I	flow optical encoder read bit 0
		D1		I	flow optical encoder read bit 1
		D2		I	flow optical encoder read bit 2
		D3		I	flow optical encoder read bit 3
		D4		I	flow optical encoder read bit 4
		D5		I	flow optical encoder read bit 5
		D6		I	
		D7		I	
Flow Output Latch	FLOWIO* & WR*	D0		O	valve 1 control
		D1		O	valve 2 control
		D2		O	valve 3 control
		D3		O	valve 4 control
		D4		O	purge pump control
		D5		O	flow aux optical encoder drive 0
		D6		O	flow aux optical encoder drive 1
		D7		O	flow aux optical encoder drive 2
QSPI Decoder	PCS3*-PCS0*	0000	ns	O	no select
		0001	ADCCS1*	O	co2 & spo2 adc #1 chip select
		0010	DACCS1*	O	co2 & spo2 dac #1 chip select
		0011	CALEECS	O	calibrator eeprom chip select
		0100	OBEECS	O	on board eeprom chip select
		0101	SPO2RDADC*	O	spo2 red 20-bit adc chip select
		0110	SPO2IRADC*	O	spo2 infra-red 20-bit adc chip select
		0111	DACLD1*	O	co2 & spo2 dac #1 load enable
		1000	ns	O	no select
		1001	ADCCS2*	O	flow adc #2 chip select
		1010	DACLD2	O	flow dac #2 load enable
		1011	nc	O	no connect
		1100	nc	O	no connect
		1101	nc	O	no connect
		1110	nc	O	no connect
		1111	nc	O	no connect

CONNECTOR	DESIGNATOR	PIN	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
Background Mode Connector	J400	1	DS*	O	sram read
		2	BERR*	I	hardware breakpoint
		3	DGND		digital ground
		4	BKPT*	O	hardware breakpoint
		5	DGND		digital ground
		6	FREEZE	O	freeze, initiate background mode
		7	SRST*	I	system reset
		8	IFETCH*	O	instruction fetch
		9	MVDD		mpu power plane
		10	IPIPE*	O	instruction pipe
Boot Block Device Select	J401	1	RAMRD*	O	sram read
		2	SRAMOE*	I	sram output enable
		3	BOOTCS*	I	program rom chip select
		4	ROMOE*	O	rom output enable
AUX Serial TTL	J402	1	UMPI	I	ttl level uart multi purpose input
		2	RxDIN1	I	ttl level serial receive
		3	TxDOUT1	O	ttl level serial transmit
		4	VDD		+5V supply output
		5	DGND		digital ground return

CONNECTOR	DESIGNATOR	PIN	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
Keypanel Connector	J403	1	DGND		digital return path
		2	S8	I	membrane keypanel switch 8
		3	S2	I	membrane keypanel switch 2
		4	S11	I	membrane keypanel switch 11
		5	S3	I	membrane keypanel switch 3
		6	S9	I	membrane keypanel switch 9
		7	S4	I	membrane keypanel switch 4
		8	2MINLED	O	2 min procedure led
		9	S5	I	membrane keypanel switch 5
		10	AOFFLED	O	alert off led
		11	S6	I	membrane keypanel switch 6
		12	ALRTLED	O	alert led
		13	S7	I	membrane keypanel switch 7
		14	BATTLED	O	internal battery power led
		15	S1	I	membrane keypanel switch 1
		16	EXTONLED	O	external ac power on led
		17	DGND		digital return path
		18	S12	I	membrane keypanel switch 12
		19	S13	I	membrane keypanel switch 13
		20	S10	I	membrane keypanel switch 10

CONNECTOR	DESIGNATOR	PIN	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
Profiling Connector	J404	1	PROBIT0	O	profiling bit 0
		2	PROBIT1	O	profiling bit 1
		3	PROBIT2	O	profiling bit 2
		4	PROBIT3	O	profiling bit 3
		5	PROBIT4	O	profiling bit 4
		6	PROBIT5	O	profiling bit 5
		7	PROBIT6	O	profiling bit 6
		8	PROBIT7	O	profiling bit 7
		9	PROBIT8	O	profiling bit 8
		10	PROBIT9	O	profiling bit 9
		11	PROBIT10	O	profiling bit 10
		12	PROBIT11	O	profiling bit 11
		13	PROBIT12	O	profiling bit 12
		14	PROBIT13	O	profiling bit 13
		15	PROBIT14	O	profiling bit 14
		16	PROBIT15	O	profiling bit 15
Alert Connector	J405	1	VDD	I	digital power supply rail
		2	ALERTS	I	alerts led bar
Flow Decoder	J410	1	VVDD		+5V, flow valve supply rail
		2	VVDD		+5V, flow valve supply rail
		3	OCDRV0	O	optical decoder control 0
		4	OCDOUT0	I	optical decoder output 0
		5	OCDRV1	O	optical decoder control 1
		6	OCDOUT1	I	optical decoder output 1
		7	OCDRV2	O	optical decoder control 2
		8	OCDOUT2	I	optical decoder output 2
		9	VGND		return path for valve supply
		10	VGND		return path for valve supply
Sampling Pump Connector	J409	1	PUMP+		buffered data line 9
		2	PUMP-		buffered data line 10

CONNECTOR	DESIGNATOR	PIN	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
Display Connector	J406	1	DGND		digital return path
		2	DGND		digital return path
		3	VDD		digital power supply rail
		4	VDISP		display contrast control
		5	WR*	I	i/o write
		6	RD*	I	i/o read
		7	DISPCS*	I	display chip select
		8	A1	I	address line a1
		9	NC		no connect
		10	SRST*	I	system reset
		11	D8	I/O	data line lsb, 8-bit port
		12	D9	I/O	data line
		13	D10	I/O	data line
		14	D11	I/O	data line
		15	D12	I/O	data line
		16	D13	I/O	data line
		17	D14	I/O	data line
		18	D15	I/O	data line msb, 8-bit port
		19	VDD		digital power supply rail
		20	NC		digital return path
Backlight Connector	J407	1	VO1		dc-ac inverter output 1
		2	NC		no connect
		3	NC		no connect
		4	VO2		dc-ac inverter output 2
Speaker Connector	J413	1	VOUT1		speaker +
		2	VOUT2		speaker -
Power Input Connector	J414	1	VDCIN		dc input voltage
		2	VBATT		internal battery input
		3	LINEST	I	ac line state input
		4	GND		power return path

CONNECTOR	DESIGNATOR	PIN	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
CAPNOSTAT® Connector	J408	1	CO2REFIN	I	co2 reference chnl detector output
		2	CO2DATAIN	I	co2 data channel detector output
		3	-12V		-12V, analog positive supply rail
		4	AGND		analog return path
		5	CASETHERM	I	case heater thermistor
		6	+12V		+12V, analog positive supply rail
		7	CVDD		+5V, co2 power supply rail
		8	DETTHERM	I	detector heater thermistor
		9	SSCLK	O	qspi master mode serial clock
		10	CALEECS	O	calibrator eeprom chip select
		11	SSDO	O	qspi master mode serial output
		12	SSDI	I	qspi master mode serial input
		13	ZEROSW*	I	zero cell switch
		14	SPANSW*	I	span cell switch
		15	DETHTR	O	detector heater power
		16	HTR RTN		return path for heaters
		17	SRCSHIELD		CAPNOSTAT® outer shield
		18	CASEHTR	O	case heater power
		19	CO2SRC+	O	source pulser phase +
		20	CO2SRC-	O	source pulser phase -
AUX Pressure Decoder	J411	1	VVDD		+5V, flow valve supply rail
		2	VVDD		+5V, flow valve supply rail
		3	OCDRV3	O	optical decoder control 3
		4	OCDOUT3	I	optical decoder output 3
		5	OCDRV4	O	optical decoder control 4
		6	OCDOUT4	I	optical decoder output 4
		7	OCDRV5	O	optical decoder control 5
		8	OCDOUT5	I	optical decoder output 5
		9	VGND		return path for valve supply
		10	VGND		return path for valve supply
Purge Pump	J412	1	VPUMP		+12V pump supply rail
		2	NC		no connect
		3	PUMP-		purge pump supply return

CONNECTOR	DESIGNATOR	PIN	SYSTEM SIGNAL	I/O	SIGNAL FUNCTION
Serial Output Connector	J100	1	NC		no connect
		2	RxDIN1	I	serial receive, channel 1 (QSM)
		3	TxDOUT1	O	serial transmit, channel 1 (QSM)
		4	TxDOUT2	O	serial transmit, channel 2 (UART)
		5	BUFFV-		buffered voltage, neg RS232 level
		6	RxDIN2	I	serial receive, channel 2 (UART)
		7	IGND		patient isolated ground return
		8	NC		no connect
		9	NC		no connect
		10	NC		no connect
		11	NC		no connect
		12	NC		no connect
		13	NC		no connect
		14	IRAW		raw switcher voltage, fused
		15	NC		no connect
		16	NC		no connect
		17	NC		no connect
		18	NC		no connect
		19	TTLTxD1	O	ttl level serial transmit chnl 1 (QSM)
		20	BUFFV+		buffered voltage, pos RS232 level
		21	NC		no connect
		22	NC		no connect
		23	NC		no connect
		24	NC		no connect
		25	IVDD		+5V supply output, fused
SpO_2 Sensor Connector	J102	1	IRLED	I	IR led current control
		2	RDLED	I	red led current control
		3	DET+	I	photodetector +
		4	DET-	I	photodetector -
		5	AGND		analog ground return
		6	LEDPWR		led supply voltage
		7	NC		no connect

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Section 4 *Functional Tests*

The Functional Test described below verifies overall functional integrity of the monitor and sensors. If the monitor or sensors do not pass these tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

4.1 Equipment Required

1. CAPNOSTAT® CO_2 Sensor, Catalog No. 7167-00
2. Pediatric/adult airway adapter, Catalog No. 7007-01
3. SpO_2 Finger Sensor, Catalog No. 8776-00
4. Pediatric/adult Flow Sensor, Catalog No. 6717-01
5. 1 Liter (1000 ml) Calibration Syringe, Catalog No. 550020
6. Model 1298 Gas Calibrator, Catalog No. 6081-00
   Low point calibration gas, Catalog No. 8364
   This device is used for gas flow control in checking the CAPNOSTAT® CO_2 sensor and monitor. Use only Novametrix supplied Calibration Gas with this device.

4.2 Functional Testing

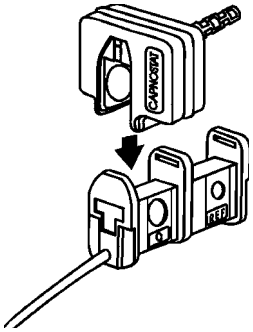
4.2.1 Start up

1. Visually inspect the monitor and verify there is no external damage.
2. Verify proper fuses and voltage setting on the rear panel. See “Mains Voltage Configuration” on page 69.
3. Attach the line cord and set the rear panel power switch to “|”.
4. Verify the green ∿ AC ON on the front panel illuminates. Press the  or  (power) key.
5. When the monitor powers up, a self test is performed in which all indicators will temporarily illuminate and the monitor will emit two short beeps. Following the self test the monitor will display:

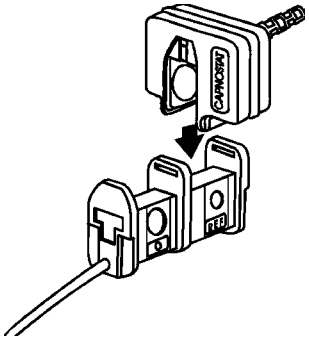
   “ERASE STORED TRENDS?
   YES: △ NO: ▽”

   If the △ or ▽ key is not pressed within five seconds, trends will be retained. The monitor is now ready for operation.

6. Press the CO2/PLETH key and verify both CO_2 and SpO_2 waveform screens are displayed.
7. Connect a CAPNOSTAT® CO_2 sensor to the *CO_2SMO Plus!*®.
8. Verify a “CO2 Warm-Up” message is displayed in the $ETCO_2$ window. Verify the “CO2 Warm-Up” message is replaced by a “Please Wait For Sensor” message within one minute.
9. Verify the “Please Wait For Sensor” message is replaced by a “Put on -0- Cell” message within two minutes.
10. Place the CAPNOSTAT® sensor on its Zero cell. Verify a “Zeroing CO2 on -0- Cell” message is displayed with a counter that is counting down beside it.

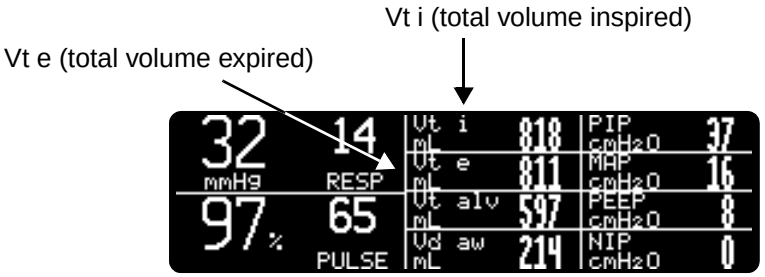


11. Verify a “PUT CO_2 SENSOR ON REFERENCE CELL” message is displayed.
12. Place the CAPNOSTAT® CO_2 sensor on the Reference cell.



13. Verify a “CHECKING ON CELL” message is displayed.
14. Verify a “SENSOR PASSED” message and 38 ± 2 mmHg are displayed.
15. Verify a “Put CO2 Sensor on Adapter in Room Air” message is displayed.
16. Place the CAPNOSTAT® on an adult airway adapter.
17. Press the ↑ key. Verify a “Zeroing CO2 on Airway Adapter” message is displayed with a counter that is counting down beside it.
18. Connect the low point calibration gas to the Model 1298 Gas Calibrator. Refer to the instructions supplied with the gas calibrator for further instructions.
19. Connect the Model 1298 Gas Calibrator with low point calibration gas to the adult airway adapter.
20. Press and hold the SETUP key for five seconds.
21. Verify the CONFIGURATION screen comes up.

22. Press the NEXT key to select CO_2 AVG.
23. Press the △ key to select “INST”.
24. Press the CO2/PLETH key. Verify the *CO_2SMO Plus!*® returns to the main screen.
25. Flow the calibration gas from the Model 1298.
26. Flow gas for thirty seconds. Verify the CO_2 value as determined from "Determining Torr Value" on page 44.
    Gas accuracy is dependent upon factors such as barometric pressure, gas temperature and monitor compensations. The expected gas reading is the ideal value and may differ from the actual gas value because of these factors.
27. Turn the calibration gas off.
28. Connect a Saturation Finger sensor to the *CO_2SMO Plus!*®.
29. Connect the finger sensor to any of your fingers.
30. Press the CO_2/PLETH waveform key until the PLETH waveform is displayed.
31. Verify the *CO_2SMO Plus!*® is displaying a saturation and pulse value.
32. Take the finger sensor off your finger.
33. Verify a “PROBE OFF” message is displayed in the SPO_2 window.
34. Connect a 6717-01 Adult Flow Sensor to the *CO_2SMO Plus!*®.
35. Connect the flow sensor to the 1000 ml calibration syringe.
36. Press the DATA key until the TOTAL VOLUME screen is displayed.



37. Pump the syringe back at a rate of 15 cycles per minute.
38. Verify a Vt i and Vt e of 1000 ml ± 50 ml.
39. Press the CO_2/PLETH waveform key. Verify the *CO_2SMO Plus!*® returns to the main screen.
40. Press and hold the ◐ key and verify that the display contrast is fully adjustable.
41. Power the unit down by pressing the ⏻ (power) key and unplug the unit from AC power.
42. Power the unit up on battery and verify that it functions properly.
43. Power the unit down by pressing the ⏻ (power) key.
44. This completes the Functional Tests for the *CO_2SMO Plus!*®.

4.3 Determining Torr Value

Use the attached tables to determine the nominal torr value for the calibration gas in use. The gas temperature and the barometric pressure affect the nominal torr value.

1. Get the current barometric pressure from a calibrated barometer.
2. Get the current gas temperature (room temperature is adequate provided the gas has had time to acclimate).
3. Use the look up table for the calibration gas being used.
4. Find the nominal torr value by locating the current barometric pressure in the first column then go across until the correct temperature column intersects. The corresponding number is the nominal torr value. The “SIM” column is the column used if a TB1265 Sensor Simulator, PN: 5776-00 is used in place of gas.
5. Use the nominal torr value as the base number when performing CO2 gas measurements. The tolerance for the CO2 gas value is the base number ± 2 for 5% gas.
   Monitor default O2 compensation % = 17
   Test gas O2 concentration percentage = 0

Baro. Press.	5% Gas Temperature (×C)							
	21	22	23	24	25	26	27	Sim
735	39.5	39.4	39.3	39.2	39.1	38.9	38.8	38.1
736	39.6	39.4	39.3	39.2	39.1	39.0	38.8	38.1
737	39.6	39.5	39.3	39.2	39.1	39.0	38.9	38.2
738	39.6	39.5	39.4	39.2	39.1	39.0	38.9	38.2
739	39.6	39.5	39.4	39.3	39.1	39.0	38.9	38.2
740	39.6	39.5	39.4	39.3	39.2	39.0	38.9	38.2
741	39.7	39.5	39.4	39.3	39.2	39.1	38.9	38.2
742	39.7	39.6	39.4	39.3	39.2	39.1	38.9	38.2
743	39.7	39.6	39.5	39.3	39.2	39.1	39.0	38.3
744	39.7	39.6	39.5	39.3	39.2	39.1	39.0	38.3
745	39.7	39.6	39.5	39.4	39.2	39.1	39.0	38.3
746	39.8	39.6	39.5	39.4	39.3	39.1	39.0	38.3
747	39.8	39.6	39.5	39.4	39.3	39.2	39.0	38.3
748	39.8	39.7	39.5	39.4	39.3	39.2	39.1	38.4
749	39.8	39.7	39.6	39.4	39.3	39.2	39.1	38.4
750	39.8	39.7	39.6	39.5	39.3	39.2	39.1	38.4
751	39.8	39.7	39.6	39.5	39.4	39.2	39.1	38.4
752	39.9	39.7	39.6	39.5	39.4	39.2	39.1	38.4
753	39.9	39.8	39.6	39.5	39.4	39.3	39.1	38.4
754	39.9	39.8	39.6	39.5	39.4	39.3	39.2	38.5
755	39.9	39.8	39.7	39.5	39.4	39.3	39.2	38.5
756	39.9	39.8	39.7	39.6	39.4	39.3	39.2	38.5
757	39.9	39.8	39.7	39.6	39.5	39.3	39.2	38.5
758	40.0	39.8	39.7	39.6	39.5	39.4	39.2	38.5
759	40.0	39.9	39.7	39.6	39.5	39.4	39.2	38.5

Baro. Press.	5% Gas Temperature (×C)							
	21	22	23	24	25	26	27	Sim
760	40.0	39.9	39.8	39.6	39.5	39.4	39.3	38.6
761	40.0	39.9	39.8	39.6	39.5	39.4	39.3	38.6
762	40.0	39.9	39.8	39.7	39.5	39.4	39.3	38.6
763	40.1	39.9	39.8	39.7	39.6	39.4	39.3	38.6
764	40.1	40.0	39.8	39.7	39.6	39.5	39.3	38.6
765	40.1	40.0	39.9	39.7	39.6	39.5	39.4	38.7
766	40.1	40.0	39.9	39.7	39.6	39.5	39.4	38.7
767	40.1	40.0	39.9	39.8	39.6	39.5	39.4	38.7
768	40.2	40.0	39.9	39.8	39.7	39.5	39.4	38.7
769	40.2	40.1	39.9	39.8	39.7	39.6	39.4	38.7
770	40.2	40.1	40.0	39.8	39.7	39.6	39.5	38.8
771	40.2	40.1	40.0	39.8	39.7	39.6	39.5	38.8
772	40.2	40.1	40.0	39.9	39.7	39.6	39.5	38.8
773	40.3	40.1	40.0	39.9	39.8	39.6	39.5	38.8
774	40.3	40.2	40.0	39.9	39.8	39.7	39.5	38.8
775	40.3	40.2	40.0	39.9	39.8	39.7	39.6	38.8
776	40.3	40.2	40.1	39.9	39.8	39.7	39.6	38.9
777	40.3	40.2	40.1	40.0	39.8	39.7	39.6	38.9
778	40.4	40.2	40.1	40.0	39.9	39.7	39.6	38.9
779	40.4	40.3	40.1	40.0	39.9	39.8	39.6	38.9

Monitor default O2 compensation % = 17
Test gas O2 concentration percentage = 12

Baro. Press.	10% Gas Temperature (×C)							
	21	22	23	24	25	26	27	Sim
735	78.3	78.0	77.8	77.6	77.3	77.1	76.8	75.5
736	78.3	78.1	77.8	77.6	77.4	77.1	76.9	75.5
737	78.4	78.1	77.9	77.6	77.4	77.2	76.9	75.5
738	78.4	78.1	77.9	77.7	77.4	77.2	77.0	75.6
739	78.4	78.2	77.9	77.7	77.5	77.2	77.0	75.6
740	78.5	78.2	78.0	77.7	77.5	77.3	77.0	75.6
741	78.5	78.3	78.0	77.8	77.5	77.3	77.1	75.7
742	78.5	78.3	78.1	77.8	77.6	77.3	77.1	75.7
743	78.6	78.3	78.1	77.9	77.6	77.4	77.1	75.8
744	78.6	78.4	78.1	77.9	77.6	77.4	77.2	75.8
745	78.7	78.4	78.2	77.9	77.7	77.4	77.2	75.8
746	78.7	78.4	78.2	78.0	77.7	77.5	77.2	75.9
747	78.7	78.5	78.2	78.0	77.8	77.5	77.3	75.9
748	78.8	78.5	78.3	78.0	77.8	77.6	77.3	75.9
749	78.8	78.6	78.3	78.1	77.8	77.6	77.4	76.0
750	78.8	78.6	78.3	78.1	77.9	77.6	77.4	76.0
751	78.9	78.6	78.4	78.1	77.9	77.7	77.4	76.0

Baro. Press.	10% Gas Temperature (×C)							
	21	22	23	24	25	26	27	Sim
752	78.9	78.7	78.4	78.2	77.9	77.7	77.5	76.1
753	78.9	78.7	78.5	78.2	78.0	77.7	77.5	76.1
754	79.0	78.7	78.5	78.2	78.0	77.8	77.5	76.1
755	79.0	78.8	78.5	78.3	78.0	77.8	77.6	76.2
756	79.0	78.8	78.6	78.3	78.1	77.8	77.6	76.2
757	79.1	78.8	78.6	78.3	78.1	77.9	77.6	76.2
758	79.1	78.9	78.6	78.4	78.1	77.9	77.7	76.3
759	79.1	78.9	78.7	78.4	78.2	77.9	77.7	76.3
760	79.2	78.9	78.7	78.4	78.2	78.0	77.7	76.3
761	79.2	79.0	78.7	78.5	78.2	78.0	77.8	76.4
762	79.3	79.0	78.8	78.5	78.3	78.0	77.8	76.4
763	79.3	79.1	78.8	78.6	78.3	78.1	77.8	76.4
764	79.3	79.1	78.9	78.6	78.4	78.1	77.9	76.5
765	79.4	79.1	78.9	78.6	78.4	78.2	77.9	76.5
766	79.4	79.2	78.9	78.7	78.4	78.2	78.0	76.6
767	79.5	79.2	79.0	78.7	78.5	78.2	78.0	76.6
768	79.5	79.3	79.0	78.8	78.5	78.3	78.0	76.6
769	79.5	79.3	79.0	78.8	78.6	78.3	78.1	76.7
770	79.6	79.3	79.1	78.8	78.6	78.4	78.1	76.7
771	79.6	79.4	79.1	78.9	78.6	78.4	78.2	76.8
772	79.7	79.4	79.2	78.9	78.7	78.4	78.2	76.8
773	79.7	79.4	79.2	79.0	78.7	78.5	78.2	76.8
774	79.7	79.5	79.2	79.0	78.8	78.5	78.3	76.9
775	79.8	79.5	79.3	79.0	78.8	78.6	78.3	76.9
776	79.8	79.6	79.3	79.1	78.8	78.6	78.3	76.9
777	79.8	79.6	79.4	79.1	78.9	78.6	78.4	77.0
778	79.9	79.6	79.4	79.1	78.9	78.7	78.4	77.0
779	79.9	79.7	79.4	79.2	78.9	78.7	78.5	77.0

If the barometric pressure, gas temperature, monitor default compensations, or the O2 concentration in the test gas differs from the values listed in the table then use the formula below to calculate the nominal torr value.

(CO2 Gas %) * (Barometric Pressure) * (Gas Compensation) * (Pressure Compensation) / 1 - (0.003 * (33 - Gas Temperature))

The *gas compensation* factor if only O2 gas is present:

0.000865 * (Default O2 Compensation - Gas O2 Concentration) + 1

The *gas compensation* factor if O2 and N2O gas is present:

0.00249133 * (Default O2 Compensation - Gas O2 Concentration) + 1

If a TB1265 Sensor Simulator, PN: 5776-00 is used, the temperature compensation portion of the formula is not used. Divide the numerator by one.

The pressure compensation factor is calculated by linear interpolation into the PBCV table below. Take the current barometric pressure and locate the high and low values from the Pressure column in the table below (e.g. a barometric pressure of 752 would

give a *Pressure Max* of 760 and a *Pressure Min* of 720). Calculate the rise over run or slope (m) for the range that the barometric pressure falls under. Determine the difference between the barometric pressure and the lesser pressure value and multiply that by the slope then add one.

The formula for pressure compensation is:

PBCV for pressure min + (m * (Barometric Pressure - Pressure Min)) + 1

Where:

$$m = \frac{\text{PBCV for pressure max - PBCV for pressure min}}{\text{(Pressure Max - Pressure Min)}}$$

Pressure Table:

Pressure (mmHg)	PBCV
800	-0.0321
760	0.0000
720	0.0356
680	0.0754
640	0.1202
600	0.1710
560	0.2290
520	0.2959
480	0.3741
440	0.4662
400	0.5770

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Section 5 Accuracy Tests

The Accuracy Test verifies the performance accuracy of the Model 8100. This test is typically performed in conjunction with (after) the Functional Tests described on Functional Testing on page 41. If the monitor does not pass the accuracy test, contact the Novametrix Service Department for repair/ replacement assistance.

This procedure assumes the technician performs each step as indicated—leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

5.1 Equipment Required

1. Mercury Barometer
2. CAPNOSTAT® CO_2 Sensor, Catalog No. 7167-00
3. Nasal Cannula Tubing Set, Catalog No. 8781-00
4. Pediatric/adult Airway Adapter, Catalog No. 7007-01
5. Model 1298 Gas Regulator, Catalog No. 6081-00*
   Low point calibration gas, Catalog No. 8364
   This device is used for gas flow control in checking the CAPNOSTAT® CO_2 sensor and monitor. Use only Novametrix supplied Calibration Gas with this device.
6. TB500B Test Box, Catalog No. 5330-00*
   This is the same device used by the factory technicians to calibrate the monitor prior to shipping. The TB500B is an updated version of the TB500A Test Box. The TB500A, used in conjunction with adapter cable (Catalog No. 5453-00), may be substituted for the TB500B in most parts of this test.
7. SpO_2 Finger Sensor, Catalog No. 8776-00
8. Pediatric/adult Flow Sensor, Catalog No. 6717-01
9. Neonatal Flow Sensor, Catalog No. 6718-01
10. 1 Liter (1000 ml) Calibration Syringe, Catalog No. 550020
11. Adult Combined CO_2/Flow Sensor, Catalog No. 6719-01
    *Calibrated

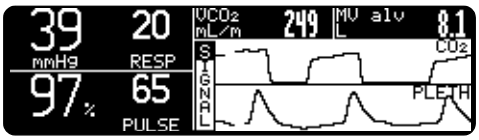
5.2 Test Procedure

5.2.1 Start up

1. Visually inspect the monitor and verify there are no cosmetic defects.
2. Verify proper fuses and voltage setting on the rear panel. See “Mains Voltage Configuration” on page 69.
3. Attach the line cord and set the rear panel power switch to “|”.
4. Verify the green ∿ AC ON symbol on the front panel illuminates. Press the (power) key.
5. When the monitor powers up, a self-test is performed in which all indicators will temporarily illuminate and the monitor will emit two short beeps. Following the self-test the monitor will display:

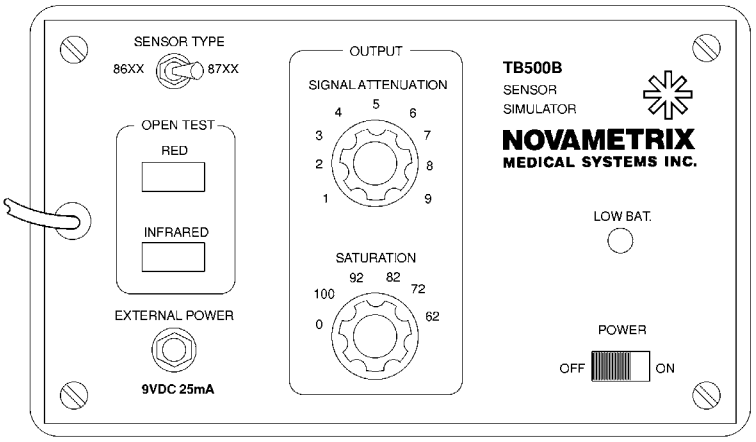
   “ERASE STORED TRENDS?
   YES: △ NO: ▽”

   If the △ or ▽ key is not pressed within five seconds, trends will be retained. The monitor is now ready for operation.
6. Press the CO₂/PLETH key until the CO_2 / PLETH waveform screen is displayed.



5.2.2 SpO_2 Test

7. Set the controls on the TB500B as follows:
   - SENSOR TYPE: 87XX
   - SIGNAL ATTENUATION: 1
   - SATURATION SETTING: 100
   - POWER: ON



8. Connect the TB500B to the rear panel SpO_2 INPUT. Verify the saturation values listed below:

*SATURATION SETTING on TB500B:	SIGNAL ATTEN on TB500B:	SATURATION % on monitor DISPLAY:
100	3	98-100
92	3	90-94
82	3	80-84
72	3	70-74
62	3	60-64
72	7	68-76
82	7	78-86
92	7	88-96
100	7	98-100

* Verify the pulse rate is 60 ± 1 bpm for each Saturation Setting.

Note: When a parameter limit is passed an alert should occur. Reset the alert for that specific parameter by first pressing the SET ALERTS key then the NEXT key in conjunction with the △ ▽ keys to adjust the limit beyond the alerted value.

9. Set the TB500B **SIGNAL ATTENUATION** to **1**, verify "PROBE OFF" appears on the display and an alert condition occurs. Reset the TB500B **SIGNAL ATTENUATION** to **3** and verify the alert resets.
10. Press and hold the **INFRARED** button on the TB500B and verify an alert occurs with the message "FAULTY PROBE 1" displayed. Release the button to reset the alert.
11. Press the **RED** button on the TB500B and verify an alert occurs with the message "FAULTY PROBE 2" displayed. Release the button to reset the alert.
12. Remove the TB500B from the monitor and verify an alert condition.
13. Connect a finger sensor to the rear panel SpO_2 INPUT and place the sensor over your finger. Verify a reasonable reading for both SpO_2 and pulse rate.
14. Remove your finger from the sensor and verify an alert condition with "PROBE OFF" displayed. Press the silence key and verify the alert is reset. Unplug the sensor from the unit.

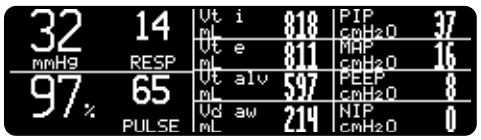
5.2.3 CO_2 Test

15. Connect the CAPNOSTAT® CO_2 sensor to the monitor. After it has warmed up, follow the display prompts and calibrate the CAPNOSTAT®. Verify it passes calibration.
16. Place the airway adapter on the CAPNOSTAT®. Verify the monitor displays "PUT CO2 SENSOR ON ADAPTER IN ROOM AIR OK: △ CANCEL ▽ ". Press △ to continue.
17. Press and hold the SETUP key until the CONFIGURATION screen appears. Press NEXT to select CO2 AVG:, use the arrow keys to select INST. Press the CO2/PLETH key.
18. Connect the low point calibration gas to the Model 1298 Gas Regulator then connect to the adult airway adapter, refer to the instruction supplied with the Model 1298 for more information.

19. Flow gas for thirty seconds. Verify the CO_2 value as determined from Determining Torr Value on page 44.
    Gas accuracy is dependent upon factors such as barometric pressure, gas temperature and monitor compensations. The expected gas reading is the ideal value and may differ from the actual gas value because of these factors.
20. Press the SETUP key and turn the CO_2 SAMPLE PUMP on using the NEXT and △▽ keys. Press the NEXT key to "CO_2 ZERO NOW": then press the △ key and follow the prompts to calibrate the CAPNOSTAT® on the nasal cannula.
21. Breathe into the nasal cannula and verify reasonable values and waveform for $ETCO_2$. Press the EVENT/FREEZE key, verify the waveform is frozen and the event is marked with the correct time. Press the EVENT/FREEZE key again.
22. Block first the intake tubing and then the exhaust port of the sampling system, in both cases verify an "OCCLUSION?" message appears when blocked.
23. Discontinue breathing into the cannula and verify that an alert condition occurs and a "NO RESP X:XX" message is displayed (X:XX = time).
24. Press and hold the audio key, verify the audio is off and the alert has not been reset.
25. Remove the CAPNOSTAT® and cannula tubing from the unit.
26. Press the SETUP key and shut off the sample pump using the △ key. Press the SETUP key to return to the main menu.

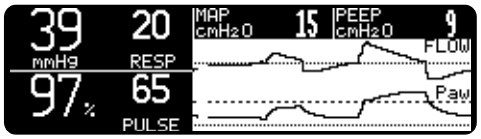
5.2.4 Flow Test

27. Connect the 6717-01 Adult Flow Sensor to the unit and verify that the adult flow sensor is identified. Connect the flow sensor to the 1000ml calibration syringe.
28. Press the DATA key until the Vt i / Vt e screen appears:



29. Pump the syringe fully back and forth with a steady motion at a rate of 20 cycles per minute for each of the following tests:
    - Verify a Vti and Vte of 1000ml (± 50ml).
    - Press the FLOW/PRES key and verify the Flow/Pressure waveforms are appropriately displayed:

Flow/Pressure Waveforms

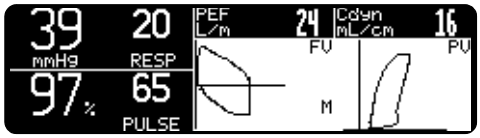


- Press FLOW/ PRES again and verify the Flow/Volume waveforms are appropriately displayed:

Flow/Volume Waveforms

- Press FLOW/ PRES once more and verify the Flow/ Pressure Volume Loop waveforms are appropriately displayed:

Flow/Pressure Volume Loops



30. Remove the flow sensor and syringe from the unit and verify “FLOW SENSOR DISCONNECTED” is displayed.
31. Install the Neonatal Flow Sensor (Cat. No.: 6718-01) and verify “NEONATAL FLOW SENSOR IDENTIFIED” is displayed. Remove the sensor from the unit.
32. Install the Combined CO_2/Flow Sensor (Cat. No.: 6719-01) and verify “ADULT CO2/FLOW SENSOR IDENTIFIED” is displayed. Remove the sensor from the unit.
33. Press and hold the key and verify that the contrast of the display is fully adjustable.
34. Power the unit down by pressing the key and unplugging the unit from AC power.
35. Power the unit up on battery and verify that it functions properly.
36. Power the unit down by pressing the key.

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Section 6 Electronic Tests

The Electronic Tests verify the calibration and operation of the electronic circuits within the *CO_2SMO Plus!*® Model 8100. These tests DO NOT need to be performed on a regular (preventative) basis. Perform these tests only if the monitor fails to operate as expected or fails the Functional Tests on Functional Tests on page 41 and/or Accuracy Tests on Accuracy Tests on page 49. The Electronic Tests should be performed only by qualified service personnel.

The Electronic Tests require access to the internal components of the monitor. Refer to Assembly Exchanges on page 72 for disassembly instructions.

CAUTION

The Model 8100 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

If the monitor does not pass an Electronic Test, remove it from use and contact the Novametrix Service Department for repair/replacement assistance.

This procedure assumes the technician performs each step as indicated—leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure the monitor is set to the correct state before continuing.

6.1 General

The Model 8100 must have the top cover removed to expose the internal electronic circuit boards. Refer to Assembly Exchanges on page 72 for disassembly instructions.

6.1.1 Equipment Required

1. Mercury barometer*
2. TB1265 Sensor Simulator* (Cat. No. 5778-00):
   The Novametrix TB1265 Sensor Simulator emulates a functioning CAPNOSTAT® CO_2 sensor, and can be used in place of the (PN: 7167) CAPNOSTAT® for *CO_2SMO Plus!*® $ETCO_2$ monitor test purposes. The TB1265 will verify the functionality of the monitor's CO_2 front end circuitry. Certain error conditions can be simulated by the sensor simulator to verify responses from the monitor under test.
   The TB1265 is an optional test device and is not mandatory for testing the *CO_2SMO Plus!*®. Its purpose is to increase test efficiency by simulating a working CAPNOSTAT®. The TB1265 Sensor Simulator is available from the Novametrix Service Department.
3. Flow meter / Sampling Cannula test fixture, see Test Fixtures on page 63.

4. TB500B Saturation simulator* (Cat. No. 5330-00)
   This is the same device used by the factory technicians to calibrate the monitor prior to shipping. The TB500B is an updated version of the TB500A Test Box. The TB500A, used in conjunction with adapter cable (Cat. No. 5453-00), may be substituted for the TB500B for most parts of this test.
5. 6717-48 Adult flow sensor test jack or sensor
   - 6718-48 Neonatal flow sensor test jack or sensor
   - 6719-48 Combined sensor test jack or sensor
   - Pennwalt pneumatic calibrator* or equivalent
   - D.V.M.*
     *Calibrated

6.2 Power Supply Testing

1. Connect the line cord to the monitor and plug into the AC line. Switch the rear panel power switch to "|". Verify the green AC ON ∿ symbol on the front panel illuminates.
2. Measure the following voltages (use TP19 as ground reference for all measurements unless otherwise specified):

Supply Name	Location	Voltage Range
VDCIN	IC86 PIN 5	25.00 V ± 5.0V
VHTR	L51	12.00 V ± 0.6V
VBACK	IC4 PIN 32	2.20 V ± 0.2V

3. Press the front panel power button ⏻ to turn the monitor on.
4. Measure the following power supply voltages (use TP19 as ground reference for all measurements unless otherwise specified):

Supply Name	Location	Voltage Range
VDD	IC62 PIN 20	5.00 V ± 0.15V
VBACK	IC4 PIN 32	4.70 V ± 0.2V
+VA	IC85 PIN 3	15.00 V ± 2.0V
+12V	IC85 PIN 2 (Tab)	12.00 V ± 0.5V
+VSRC	IC87 PIN 2 (Tab)	12.00 V ± 0.5V
-VA	IC90 PIN 2	-15.00 V ± 2.0V
-12V	IC90 PIN 3	-12.00 V ± 0.5V
-VSRC	IC89 PIN 3	-12.00 V ± 0.5V

5. Measure the following reference voltages (use TP19 as ground reference for all measurements unless otherwise specified):

Supply Name	Location	Voltage Range
VREF0	IC70 PIN 6	2.50 V ± 25mV
2CVREF	C207 POSITIVE	5.00 V ± 50mV

-2CVREF	C253 NEGATIVE	-5.00 V ± 50mV
CVREF	C209 POSITIVE	2.50 V ± 25mV
2VREF0	C212 POSITIVE	5.00 V ± 50mV
VREF0/2	IC53 PIN 4	1.25 V ± 25mV

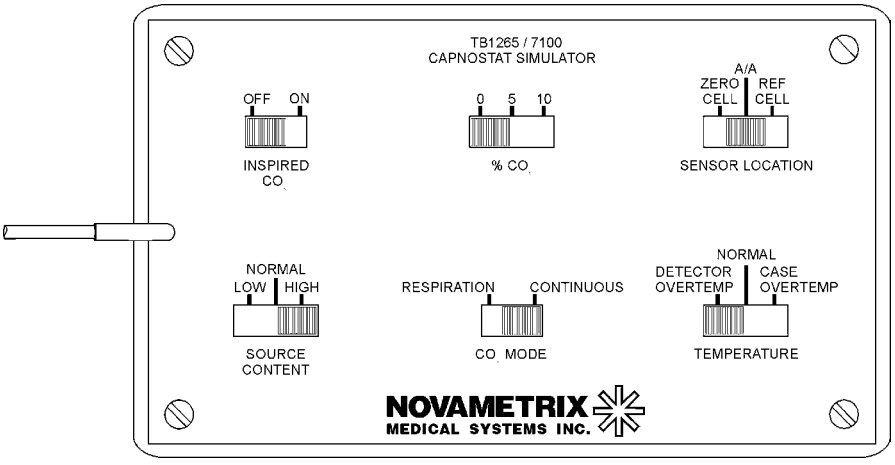
6. Measure the following isolated voltages: * Use TP18 as ground reference

Supply Name	Location	Voltage Range
IRAW	IC82 PIN 3	9.00 V ± 1V
IVDD	IC82 PIN 2 (Tab)	5.00 V ± 0.2V

7. Switch the rear panel mains switch to “O”. Verify the AC ON symbol turns off and the battery icon is displayed.
8. Switch the rear panel mains switch to “|”. Verify the AC ON symbol turns on and the battery icon disappears.
9. Press and hold the contrast key. Verify the display intensity changes from light to dark. Set the intensity to a normal level.

6.3 CO_2 Testing

10. Set the TB1265 switches as follows:
    - Inspired CO2: OFF
    - % CO2: 0
    - Sensor Location: ZERO CELL
    - Source Current: NORMAL
    - CO2 Mode: CONTINUOUS
    - Temperature: NORMAL



11. Verify “CO_2 SENSOR ?” is displayed in the $ETCO_2$ window.
12. Connect the TB1265 to the *CO_2SMO Plus!*®. Verify a “CO2 Warm-Up” message is initially displayed in the $ETCO_2$ window. Verify the “CO2 Warm-Up” message is replaced by a “Please Wait For Sensor” message within one minute.

Depending on the temperature status of the TB1265, the “CO2 Warm-Up” message might be shown for a brief instant before the “Please Wait For Sensor” message is displayed.

13. Display the $ETCO_2$ engineering screens by simultaneously pressing and holding the SETUP key and the DATA key for five seconds. Press the NEXT key until Screen 2 (# in lower right corner) appears.
14. Verify the CASET and DETT slowly rise and stabilize at 45.00 °C within 2 minutes.
15. Verify the SRCCUR is between 250 and 300.
16. Change the TEMPERATURE switch on the TB1265 to CASE OVER TEMP. Verify the following:
    - CASET > 50.00
    - C30 pin 7 is low
    - TP3 is low
17. Change the TEMPERATURE switch on the TB1265 back to NORMAL.
18. Verify the CASET stabilizes to 45.00 °C within 2 minutes.
19. Change the TEMPERATURE switch on the TB1265 to DETECTOR OVER TEMP. Verify the following:
    - DET TEMP > 50.00
    - C30 pin 1 is low
    - TP5 is low
    - An audible alarm with the alert bar flashing
20. Press the AUDIO OFF key.
21. Change the TEMPERATURE switch on the TB1265 back to NORMAL.
22. Verify the DETT stabilizes to 45.00 °C within 2 minutes. Verify the alert bar turns off.
23. Read the current barometric pressure from the calibrated barometer.
24. Using the NEXT key display the Flow engineering screen (Screen 3).
25. Adjust VR4 until the TOTALP equals the recorded barometric pressure.
26. Press the ▽ key to zero the *CO_2SMO Plus!*®.
27. Using the NEXT key change back to the $ETCO_2$ engineering screen (Screen 2).
28. Verify the BAROP equals the TOTALP ± 1 set in the previous step.
29. Zero calibrate the TB1265 by pressing the ▽ key.
30. Verify the DATACH and REFCH are 3400 ± 100.
31. Change the SENSOR LOCATION switch on the TB1265 to REF CELL.
32. Verify the CO_2 equals 38.0 ± 2.0.
33. Change the SENSOR LOCATION switch on the TB1265 to A/A.
34. Connect the Flow Meter / Sampling Cannula test fixture to the *CO_2SMO Plus!*®.
35. Press the SETUP key to access the SETUP screen.

36. Press the NEXT key until the selection arrow is beside SAMPLE PUMP.
37. Press the ⌃ key to turn the sample pump on.
38. Verify the sampling pump turns on.
39. Adjust VR1 for a flow rate of 180 ccm ± 1 ccm. Record the flow rate.
40. Press the NEXT key until the selection arrow is beside CO_2 ZERO NOW.
41. Press the ⌃ key.
42. Verify the *CO_2SMO Plus!*® screen changes back to the main screen. Verify an "ATTACH CANNULA AND SAMPLE ROOM AIR" message is displayed in the $ETCO_2$ window.
43. Press the ⌃ key again to start an airway calibration. Verify the adapter calibration completes.
44. Change the % CO_2 switch on the TB1265 to 5.
45. Change the CO_2 MODE switch on the TB1265 to RESPIRATION.
46. Verify the CO_2 value as determined from Determining Torr Value on page 44 and a respiration rate of 20 ± 2. Record the values.
    Gas accuracy is dependent upon factors such as barometric pressure, gas temperature and monitor compensations. The expected gas reading is the ideal value and may differ from the actual gas value because of these factors.
47. Change the INSPIRED CO_2 switch on the TB1265 to ON.
48. Verify an inspired CO_2 value of 5 ± 2. Record the value.
49. Change the INSPIRED CO_2 switch on the TB1265 to OFF.
50. Change the % CO_2 switch on the TB1265 to 10.
51. Verify the CO_2 value as determined from Determining Torr Value on page 44 and a respiration rate of 20 ± 2. Record the values.
    Gas accuracy is dependent upon factors such as barometric pressure, gas temperature and monitor compensations. The expected gas reading is the ideal value and may differ from the actual gas value because of these factors.
52. Block the *CO_2SMO Plus!*® flow output port.
53. Verify an "OCCLUSION?" message is flashing in the $ETCO_2$ window.
54. Remove the blockage from the *CO_2SMO Plus!*®.
55. Verify the "OCCLUSION?" message clears.
56. Kink the Cannula line.
57. Verify an "OCCLUSION?" message is flashing in the $ETCO_2$ window.
58. Remove the blockage from the Cannula line.
59. Verify the "OCCLUSION?" message clears.
60. Press the SETUP key.
61. Press the NEXT key until the selection arrow is beside SAMPLE PUMP.
62. Press the ⌃ key.
63. Verify the sampling pump turns off.

64. Disconnect the TB1265 and the Flow Meter / Sampling Cannula test fixture.

6.4 Saturation Testing

** An audible alarm with the alert bar flashing will occur when the saturation setting drops below certain preset limits or when any of the sensor error tests are done. Press and hold the AUDIO OFF key. The audible alert should shut off while the alert bar continues flashing.

65. Press the CO2/PLETH waveform key until the PLETH waveform screen is displayed.
66. Connect the TB500B to the *CO_2SMO Plus!*®.
67. Verify the Saturation and Pulse value for the following TB500B Saturation and Pulse settings:

Test Box Switch Settings		Displayed Saturation
Saturation Setting	Signal Attenuation	Tolerance Range
100	3	98 - 100
82	3	80 - 84
62	3	60 - 64
72	7	68 - 76
92	7	88 - 96

Verify Pulse rate is 60 ± 1 for all settings

68. Set the SIGNAL ATTENUATION switch on the TB500B to “1”
69. Verify a “PROBE OFF” message is displayed in the SPO_2 window.
70. Set the SIGNAL ATTENUATION switch on the TB500B to “3”.
71. Verify the “PROBE OFF” message clears.
72. Set the SATURATION switch on the TB500B to “0”.
73. Verify a “LOW SPO_2 SIGNAL, CHANGE SITE” message is displayed in the SPO_2 window.
74. Set the SATURATION switch on the TB500B to “100”.
75. Verify the “LOW SPO_2 SIGNAL, CHANGE SITE” message clears.
76. Turn the TB500B off.
77. Verify a “LOW LIGHT, CHANGE SITE” message is displayed in the SPO_2 window.
78. Turn the TB500B on.
79. Verify the “LOW LIGHT, CHANGE SITE” message clears.
80. Press and hold the RED open test button on the TB500B.
81. Verify a “FAULTY PROBE 2” message is displayed in the SPO_2 window.
82. Release the RED open test button.
83. Verify the “FAULTY PROBE 2” message clears.
84. Press and hold the INFRARED open test button on the TB500B.
85. Verify a “FAULTY PROBE 1” message is displayed in the SPO_2 window.

86. Release the INFRARED open test button.
87. Verify the “FAULTY PROBE 1” message clears.
88. Disconnect the TB500B.

6.5 Flow Testing

89. Display the FLOW engineering screen (Screen 3) by simultaneously pressing and holding the SETUP and DATA key for five seconds. Use the NEXT key to advance to the Flow screen.
90. Verify “(0) NONE” is displayed next to SENSOR.
91. Connect the 6717-48 test jack to the flow sensor input on the *CO_2SMO Plus!*®.
92. Verify “(6) 6717” is displayed next to SENSOR.
93. Connect the 6718-48 test jack to the *CO_2SMO Plus!*®.
94. Verify “(3) 6718” is displayed next to SENSOR.
95. Connect the 6719-48 test jack to the *CO_2SMO Plus!*®.
96. Verify “(5) 6719” is displayed next to SENSOR.
97. Disconnect the test jack.
98. Connect the 6935-48 leak test adapter to the *CO_2SMO Plus!*®.
99. With the stop cock on the leak test fixture open set an AIRP reading of 100 - 110 cmH_2O.
100. Close the stop cock.
101. Verify the AIRP remains the same for at least 30 seconds.
102. Disconnect the leak test adapter.
103. Connect the 6936-48 test fixture to the *CO_2SMO Plus!*®.
104. Connect the pneumatic calibrator output to the left port of the 6936-48 test fixture.
105. Set the pneumatic calibrator (Pennwalt) for an output pressure of 20 cmH_2O.
106. Adjust VR2 for a “X1” value of 1610 ± 5.
107. Press the ↓ key to zero the *CO_2SMO Plus!*®
108. At the conclusion of the zero, verify the “X1” value remains 1610 ± 5.
The source pressure must stabilize to it’s initial value before verifying the “X1” reading.
109. Switch the pneumatic calibrator output from the left port of the 6936-48 test fixture to the right port.
110. Verify a “X1” value of -1610 ± 50.
111. Press the ↓ key to zero the *CO_2SMO Plus!*®
112. At the conclusion of the zero, verify the “X1” value remains -1610 ± 5.
The source pressure must stabilize to it’s initial value before verifying the “X1” reading.

113. Disconnect the 6936-48 test fixture.
114. Connect the 6937-48 test fixture to the *CO_2SMO Plus!*®.
115. Connect the pneumatic calibrator output to the 6937-48 test fixture.
116. Set the pneumatic calibrator (Pennwalt) for an output pressure of 80 cmH_2O.
117. Adjust VR3 for a AIRP reading of 80.00 cmH_2O ± 0.1 cmH_2O.
118. Disconnect the pneumatic calibrator from the 6937-48 fixture.
119. Press the △ key to purge the *CO_2SMO Plus!*®. Verify the purge pump turns on.
120. Disconnect the 6937-48 test fixture.

6.6 Barometric Pressure

The monitor determines the barometric pressure from an internal sensor. This sensor has been calibrated at the factory and should not need readjustment with normal use. To verify the barometric pressure or to adjust the barometric pressure if necessary, perform the following steps; otherwise proceed to the next section.

1. With the monitor on, simultaneously press and hold the DATA and SETUP keys until the engineering menu appears. Press the NEXT key to advance to the $ETCO_2$ screen (2).
2. Check the current barometric pressure using a calibrated barometer. Verify the “BAROP” value corresponds to the barometric pressure within one count. If not, adjustment of VR4 on the CPU-Interface board may be necessary. Refer to Adjust VR4 until the TOTALP equals the recorded barometric pressure. on page 58.

6.7 Isolation and Leakage Checks

1. Assemble the unit completely. Attach the line cord to the rear panel of the monitor.
2. Apply 2.5KVAC for sixty seconds between earth ground and the shorted hot and neutral of the linecord. Verify there is no arcing or leakage.
3. Apply 4.0KVAC for sixty seconds between the shorted SpO_2 INPUT connections and the shorted hot and neutral of the linecord. Verify there is no arcing or leakage.
4. Apply 1.5KVAC for sixty seconds between the shorted SpO_2 INPUT connections and earth ground. Verify there is no arcing or leakage.
5. Measure the monitor’s leakage current as listed. Verify a leakage current less than 25uA
   - Monitor grounded
   - Monitor ungrounded
   - Monitor ungrounded with polarity reversed
6. Measure the monitor’s AC leakage from the shorted SpO_2 INPUT connections (located on rear panel) to the hot side of the AC line.
7. Verify a leakage current less than 25uA.

6.8 Test Fixtures

Flow Meter/Sampling Cannula test fixture, parts list:

Qty	Part Number	Description
1		Mass flow meter, Aalborg GFM17 or equivalent
1	5843-01	Sampling Airway Adapter with tubing
1	8781-02	Nasal CO_2 Sampling Cannula - Adult
1	160038	50/50 mix of THF and Cyclohexanone (solvent)
1	250110	1/8” Y-fitting
1	315062	Dehumidification tubing
1	608106	1/8” ID PVC tubing (1 1/2” length)
2	608114	3/32” ID PVC tubing (1” length)

6.9 Test Fixture Construction

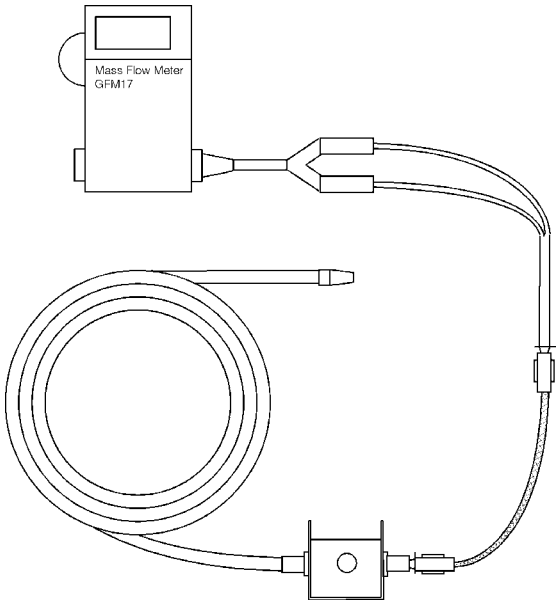
6.9.1 Sampling Cannula Modification:

1. Cut the right and left side tubing from the nasal prong portion of the 8781-01 Nasal CO_2 Sampling Cannula. Make the cut as close as possible to the nasal prong assembly.
2. Using the following procedure, solvent bond each of the cut tubes to one of the 3/32” I.D. PVC tubes.
   - Dip the left side tube into the 50/50 mix of THF and Cyclohexanone solvent for *one* second.
   - Blot the end of the tube on a piece of paper to remove any excess solvent that might be inside the tube.
   - Insert the tube about 1/4” into the end of the 3/32” I.D. PVC tubing.
   - Allow to bond for five minutes. Verify that both tubes are not occluded in any way.
   - Repeat steps a-d for the right side tube.
3. Connect both free ends of the 3/32” I.D. PVC tubing to the 1/8” Y-fitting.
4. Connect the 1/8” I.D. PVC Tubing to the output end of the Y-fitting.

6.9.2 Test Fixture Assembly

1. Insert the male end of the Dehumidification Tube into the female end of the Sampling Adapter (note: the Sampling Adapter is part of 5843-01).
2. Insert the male end of the modified Nasal CO_2 Sampling Cannula into the female end of the Dehumidification Tube.

3. Slide the 1/8” I.D. PVC tubing from the modified Nasal CO_2 Sampling Cannula onto the outlet port barb on the Mass Flow Meter.



Section 7 Maintenance

7.1 General

This section presents recommended maintenance schedules for the *CO_2SMO Plus®!* Model 8100, and information on general maintenance, such as battery and fuse replacement, disassembly and assembly instructions, and system software updates.

7.2 Maintenance Schedules

The electronic circuits within the Novametrix Model 8100 monitor do not require scheduled calibration or service. However, in order to maximize battery life, the monitor's internal battery should be tested monthly. Novametrix recommends the following maintenance schedules.[1]

- Cleaning and Sterilization:
  Perform as required. See Cleaning and Sterilization on page 66.
- Battery Maintenance:
  Contains information on charging the internal battery. See Battery Maintenance on page 71.
- Functional Tests:
  The test verifies overall functional integrity of the monitor and sensors. See Functional Testing on page 41.
- Accuracy Tests:
  The test verifies the calibration accuracy of the monitor using specified test apparatus. See Accuracy Tests on page 49.
- Electronic Tests:
  These tests contain information on calibrating the electronic circuits within the Model 8100 and should only be performed if the monitor fails to pass the Functional Tests. Only qualified service personnel should attempt to perform the Electronic Tests. See Electronic Tests on page 55.
- Barometric Pressure:
  This procedure enables verifying the automatic barometric pressure reading of the monitor. See Barometric Pressure on page 62.
- Safety Checks:
  These tests contain information on hipot and leakage testing of the monitor. See Isolation and Leakage Checks on page 62.

1. At the customer's request, Novametrix will provide repair and calibration services under terms of a Service Contract. Contact the Novametrix Service Department for contract details.

7.3 Cleaning and Sterilization

Follow the cleaning and sterilization instructions listed below to clean and/or sterilize the monitor and its accessories.

7.3.1 Monitor

- Turn the monitor off and unplug the line cord from the AC line before cleaning.
- The monitor can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutaraldehyde, or 10% bleach solution. Then wipe down with a water-dampened clean cloth to rinse. Dry before use.
- Do not immerse the monitor.
- Do not attempt to sterilize the monitor.

7.3.2 SpO_2 Finger Sensor

- The sensor can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutaraldehyde, or 10% bleach solution. Then wipe down with a water-dampened clean cloth to rinse. Dry before use.
- Make certain that the finger sensor windows are clean and dry before reuse.
- Do not immerse the finger sensor.
- Do not attempt to sterilize the finger sensor.
- After cleaning the finger sensor, verify that the sensor is physically intact, with no broken or frayed wires or damaged parts. Make certain that the connectors are clean and dry, with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated or corroded connectors.

7.3.3 SpO_2 Y-Sensor

- Do not immerse connector on the Y-Sensor.
- The Y-Sensor may be immersed—up to, but not including, the connector, in a 2% glutaraldehyde solution, or 10% bleach solution. Refer to manufacturer's instructions and standard hospital protocols to determine recommended times for disinfection and sterilization.
- Rinse thoroughly with water and dry before use (do not rinse the connector).
- Do not attempt to sterilize Y-Sensor except as stated above.
- After cleaning or sterilizing the Y-Sensor, verify that the sensor is physically intact, with no broken or frayed wires or damaged parts. Make certain that the connectors are clean and dry, with no signs of contamination or corrosion. Do not use a broken or damaged sensor or one with wet, contaminated, or corroded connectors.

7.3.4 SpO_2 Y-Strip Tapes and Foam Wraps

- Treat Y-Strip Tapes and foam wraps in accordance with hospital protocol for single-patient use items.

7.3.5 Ear Clip

- Do not immerse the ear clip.
- Clean the ear clip with a cloth dampened with 70% isopropyl alcohol. After cleaning, wipe the ear clip down thoroughly with a clean water-dampened cloth to rinse.

7.3.6 Flow Sensors and Combined CO_2/Flow Sensors

- Treat all flow and CO_2/flow sensors in accordance with hospital protocol for single-patient use items.

7.3.7 CAPNOSTAT® CO_2 Sensor

- Clean the sensor surface with a damp cloth.
- Make certain that the sensor windows are clean and dry.
- Do not immerse the CAPNOSTAT® CO_2 sensor.
- Do not attempt to sterilize the CAPNOSTAT® CO_2 sensor.

7.3.8 Reusable Adult Airway Adapter

- The Pediatric/adult Airway Adapter (Cat. No. 7007) may be cleaned by rinsing in a warm soapy solution, followed by soaking in a liquid disinfectant, pasteurized, or sterilized by soaking in glutaraldehyde. It should then be rinsed with sterile water and dried.
- The Pediatric/adult Airway Adapter (Cat. No. 7007) may be sterilized using either steam autoclave or ETO (ethylene oxide) gas methods. Be sure to use appropriate aeration times.
- Before reusing the adapter, ensure that the windows are dry and residue-free, and that the adapter has not been damaged during handling or by the cleaning/sterilization process.

7.3.9 Reusable Neonatal Airway Adapter

- The Neonatal Airway Adapter (Cat. No. 7053) may be cleaned by rinsing in a warm soapy solution, followed by soaking in a liquid disinfectant, pasteurized, or sterilized by soaking in glutaraldehyde. It should then be rinsed with sterile water and dried.
- The Neonatal Airway Adapter (Cat. No. 7053) may be sterilized using ETO (ethylene oxide) gas. Be sure to use appropriate aeration times.
- Before reusing the adapter, ensure that the windows are dry and residue-free, and that the adapter has not been damaged during handling or by the cleaning/sterilization process.

7.3.10 External Sampling System Components

- The Nasal Sampling Cannulas are for single-patient use.
- The Sampling Adapter with tubing (Cat. No. 5843) may be cleaned by rinsing in a warm soapy solution, followed by soaking in a liquid disinfectant. It should then be rinsed with sterile water and dried.

7.3.11 Single Patient Use Airway Adapters

- Treat all single patient use airway adapters in accordance with hospital protocol for single-patient use items.

7.3.12 Internal Sampling System Components

Acceptable fluids for cleaning and sterilizing the internal pneumatic parts of the Sampling System include isopropyl alcohol, Cidex[2] or equivalent, or a 5.25% water solution by weight of sodium hypochlorite (bleach).

CAUTION

Do not attempt to pump cleaning/sterilizing liquid with the sampling pump. This may cause accelerated wear on the pump bearings. Always flush liquids with a syringe as described in the following instructions.

To clean and disinfect the pumping system:

1. Turn the monitor off and disconnect the AC line cord.
2. Remove both the sampling inlet tubing set and the sampling exhaust tubing (if any).
3. Attach an exhaust port line (1/8 inch or 3/16 inch I.D. tubing) from the Sampling Exhaust port to a suitable container located below the bottom level of the monitor.
4. Use a 60 cc catheter tip syringe. Fit it to the SAMPLING SYSTEM INLET connector. Flush the sterilizing solution slowly through the pumping system. Push the entire 60 cc of solution through the SAMPLING INLET. Repeat this process two more times to use a total of 180 cc of solution.
5. Remove the syringe and leave the cleaning/sterilizing fluid within the sampling pump system for 30 minutes to disinfect the system. Follow sterilant manufacturer's instructions for disinfection.
6. After 30 minutes, fill the syringe with distilled water and flush the system three times. Allow the cleaning/disinfection solution and distilled water to drain through the SAMPLING EXHAUST output.
7. Push several syringes of air slowly through the system to ensure that most of the liquid has been drained.
8. Follow this with at least three more syringes of distilled water, followed by at least two more syringes of air to make sure that most of the distilled water has been drained.
9. Remove the syringe from the unit. Do not connect the sampling inlet tubing. Connect the AC line cord and turn the monitor on. Allow the sampling pump to operate for several minutes. This will help to remove any trapped water.
10. Connect a sampling tubing set to the SAMPLING SYSTEM INLET.
11. Block the open end of the tubing with your finger. Alternate blocking and unblocking the tubing end at least ten times. Use a quick, brisk motion when blocking and unblocking the tubing. Keep the tubing blocked and unblocked for several seconds at a time.
12. Repeat the same blocking and unblocking action with your finger on the sampling exhaust port.
13. Allow the sampling system to run for at least 30 minutes without the sampling assembly tubing and the sampling exhaust tubing connected. This will speed dry the system pneumatics.
14. Once these cleaning and disinfection instructions have been completed, normal sampling system operation can be resumed. See "Sampling Airway Adapter."

2. Cidex is a trademark of Arbook, Inc.

7.4 Mains Voltage Configuration

The rear panel power entry module indicates the Mains voltage setting for the monitor. Check that the voltage is correct before attaching the AC line cord and powering the monitor. The *CO_2SMO Plus!®* can be set to operate from 100-120 VAC 50/60Hz or 200-240VAC 50/60Hz.

Instructions for fuse replacement and changing the Mains voltage setting follow.

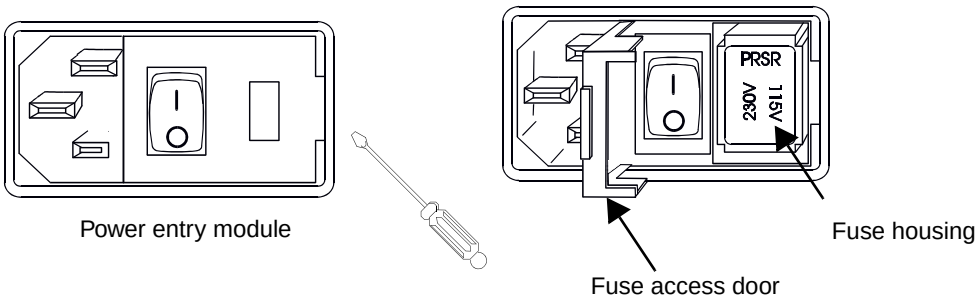
CAUTION

Replace fuses with same type and rating. Verify proper fuse value for Mains voltage setting (see table below).

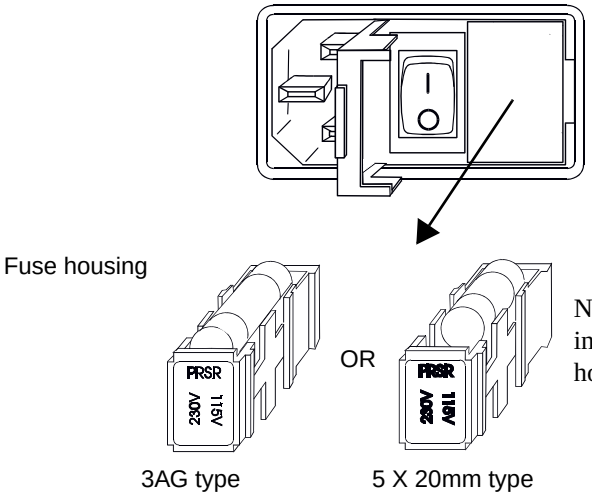
7.4.1 Fuse Replacement

1. Check that the monitor is OFF.
2. Set the rear panel power entry module switch to OFF (“O”). Remove the AC line cord from the power entry module.
3. Using a flat blade screwdriver, pry the fuse access door open to expose the fuse housing. Note the orientation of the fuse housing (this determines the Mains operating voltage).

Mains Voltage	Fuses (Slo Blo)
100-120 VAC	0.5 A 250V
200-240 VAC	250mA 250V

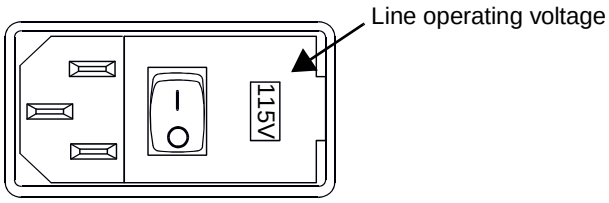


4. Pry the fuse housing out from the power entry module.



NOTE: 5 mm X 20 mm fuses are installed toward the “back” of the fuse housing as shown

5. Replace the blown fuse(s) with the proper type and rating.
6. Reinstall the fuse housing. When positioning the housing into the power entry module make sure that it is oriented correctly. Press the fuse housing back into the power entry module.
7. Close the fuse access door and verify that the proper Mains operating voltage is displayed.



7.4.2 Changing the Mains Voltage Setting

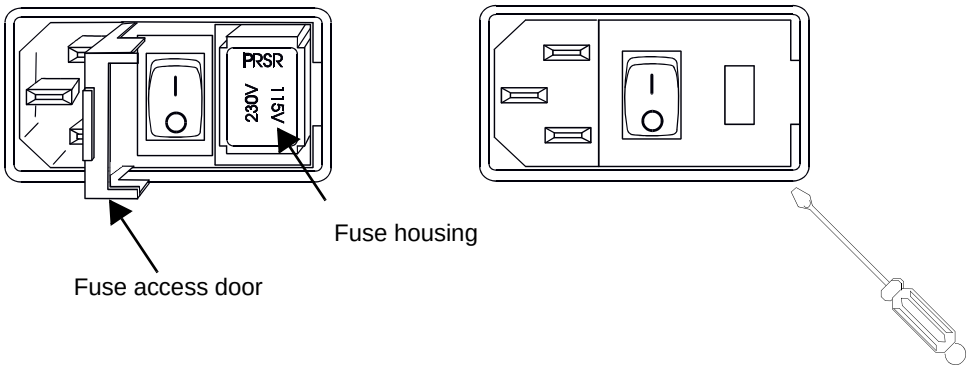
1. Check that the monitor is OFF.
2. Set the rear panel power entry module switch to OFF (“O”). Remove the line cord from the power entry module.

CAUTION

Replace fuses with same type and rating. Verify proper fuse value for Mains voltage setting (see table below).

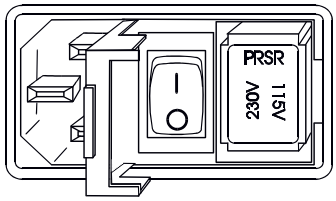
Mains Voltage	Fuses (Slo Blo)
100-120 VAC	0.5 A 250V
200-240 VAC	250mA 250V

3. Using a flat blade screwdriver, pry the fuse access door open to expose the fuse housing. Pry the fuse housing out from the power entry module.

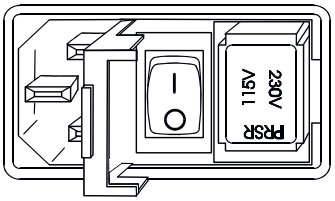


4. Install the proper type and rating fuse for the Mains voltage setting required.

5. Position the housing into the power entry module so that the desired voltage is furthest away from the switch (see below).

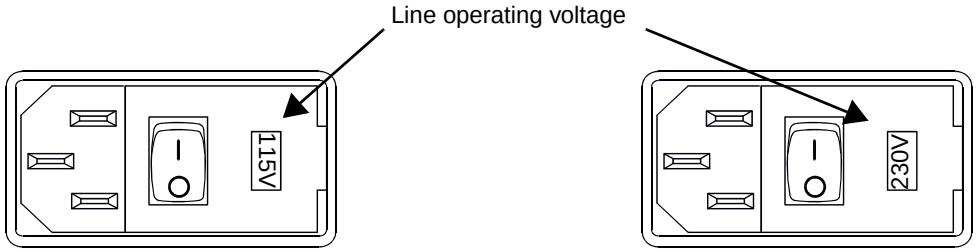


Set for 100-120V operation



Set for 200-240V Operation

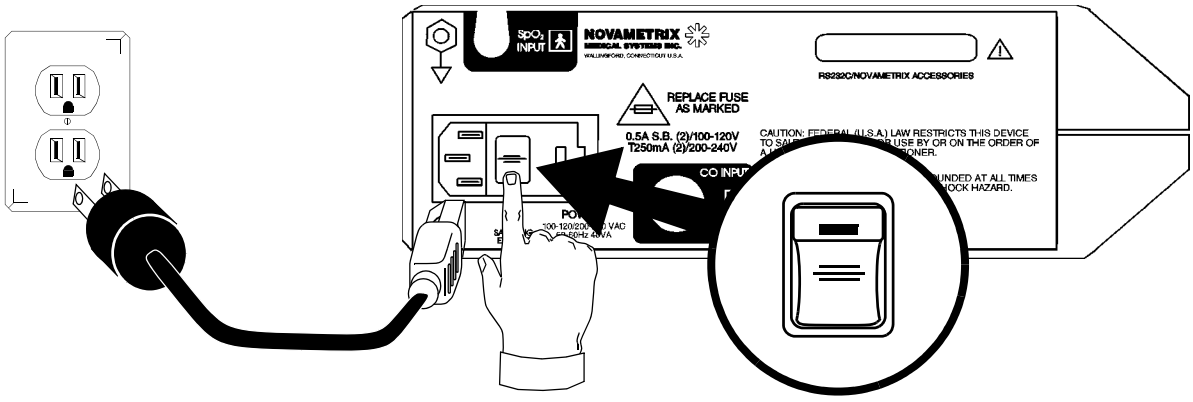
6. Close the fuse access door and verify that the proper Mains operating voltage is displayed.



7.5 Battery Maintenance

If the monitor has not been used or powered by AC for an extended time[3] (3 months or more) allow the battery to charge for 12 hours before use. The monitor may not power up on battery power if the battery is not sufficiently charged.

To charge the battery, connect the power cord (see below) and set the rear panel power switch ON ("|"). Check that the front panel ∿ icon is green. Allow the battery to charge for 12 hours to ensure a fully charged battery in the event that battery power is required.



The AC power line cord shipped with monitors for North America is a Hospital Grade, SJT style cord with a 120 VAC plug. All power line cords shipped with monitors for Europe are the European style with

3. The internal battery will slowly discharge over long periods of non-use.

a 220-240 VAC plug. All other style power line cords, as required by the country of destination, are provided by the distributor of that country.

7.6 Assembly Exchanges

Disassembly should be performed by qualified service personnel only..

CAUTION

The Model 8100 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

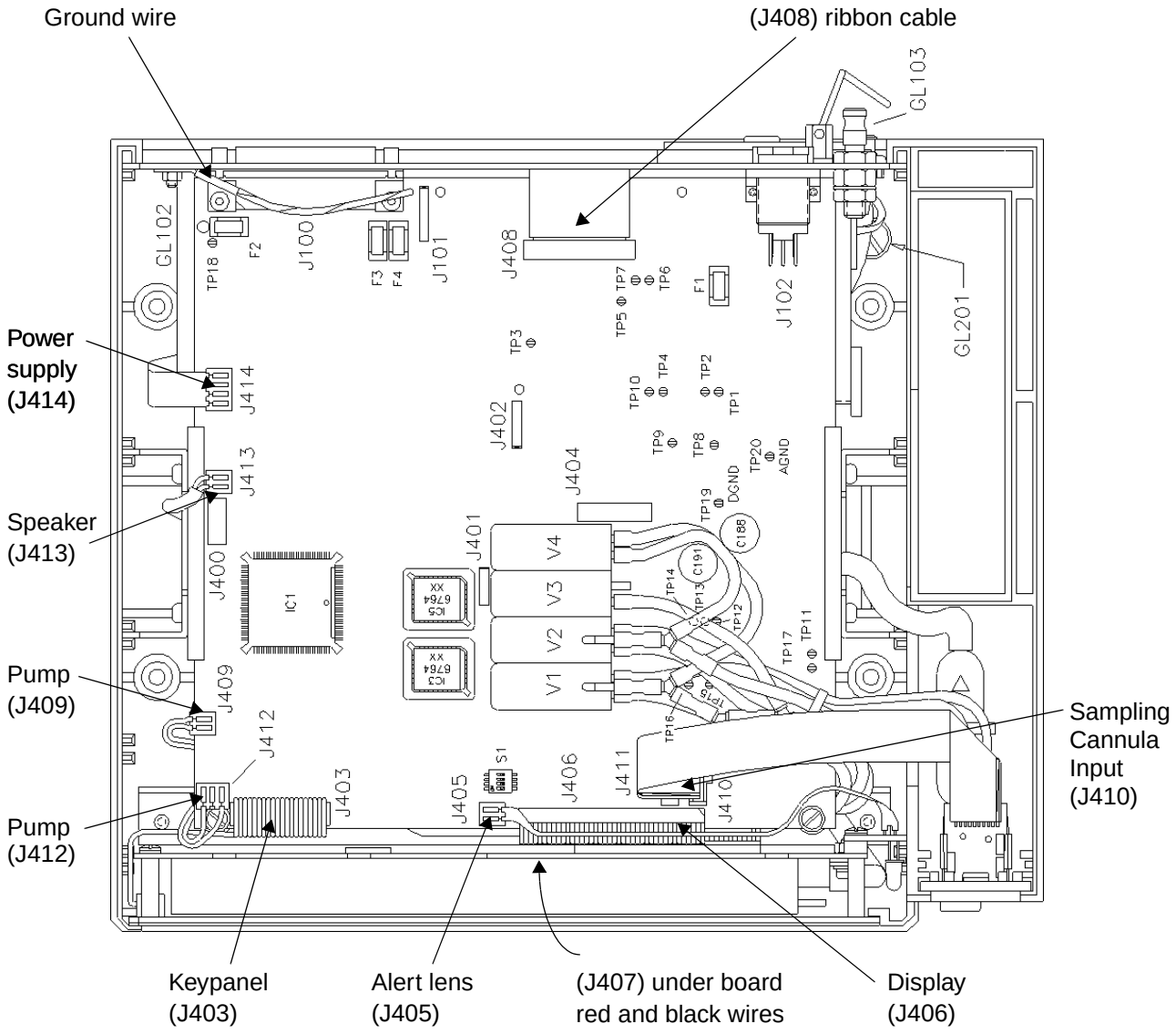
7.6.1 Internal Assemblies

1. Ensure that the monitor is OFF. Disconnect the line cord and any sensors. Turn the monitor upside down and remove the four cover screws from the bottom cover. Holding both case halves together, flip the monitor right-side up.
2. Carefully lift the top cover from the monitor (use a gentle rocking motion to lift first one side and then the other side, a little at a time). Set the red alert lens aside along with the top cover for safe keeping.
3. The separate assemblies of the monitor can now be removed.

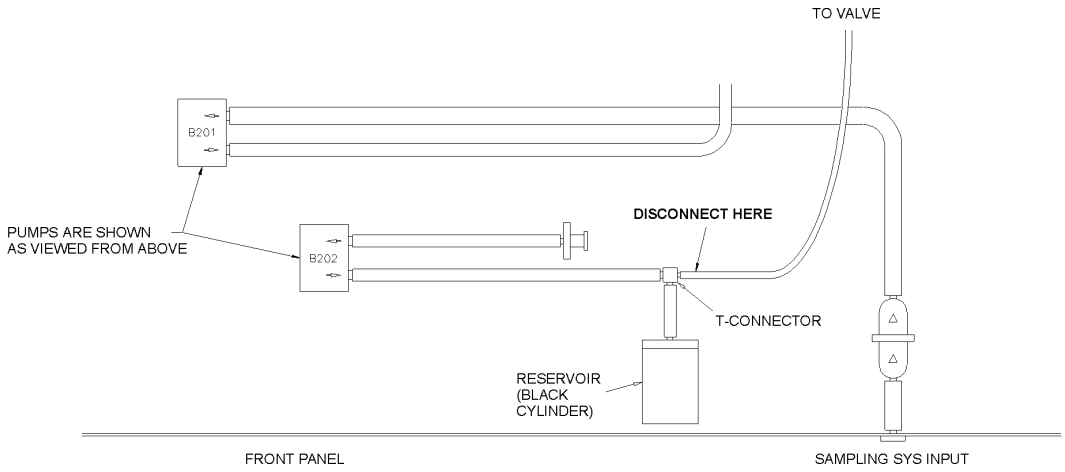
7.6.2 Main Board and CPU - Interface/Keypanel Assembly

1. Disconnect the power supply connector (J414) from the main board.
2. Remove the display/keypanel assembly and lay face down without pulling wires. Gently unplug the connector from J405, then the two ribbon cables, J403 and J406. The J407 connector under the main board (with red and black wires) is disconnected by pressing the small release button on the connector end. Pull gently out and slightly down to clear the header strip pins from above.
3. The main board is secured to the chassis via two (2) screws with tooth washers. Loosen and remove the two screws and washers. Place aside with the monitor top cover and other parts.

4. The main board is also secured to the rear panel by a nut that also secures the chassis ground connection. Remove the nut. Next disconnect J408, J409, J410, J412, and J413.



5. Only one pneumatic line must be removed to free the main board. Find the black pump reservoir under the main board. Remove either line from the T-connector on top of the reservoir.



6. Gently slide the board out, toward the front of the unit, taking care that the clear pneumatic lines clear the standoffs (lift corner slightly). Lay the main board face down.
7. Lift the plastic shield to access the nut. Remove the nut and the shield.
8. The rear panel and power supply assembly, and the battery can now be accessed.

7.6.3 Replacing the internal battery

1. Disassemble the monitor to expose the battery (see Assembly Exchanges on page 72, Assembly Exchanges).
2. Slide the battery bracket assembly UP from the bottom cover assembly, being careful not to disconnect the pneumatic lines. Turn the bracket over and lay it along the right rear corner of the monitor, out of the work area.
3. Disconnect J302 from the power supply board. Remove the old battery. Remove the wire harness from the old battery and install on the new one; red is positive, black is negative. Place the new battery in the battery bracket. Connect the harness to J302 on the power supply board.

4. Replace the battery bracket.
5. Dispose of the old battery in accordance with local laws. It may be illegal to dispose of this battery into the municipal waste stream. Never dispose of batteries in a fire.

7.6.4 Reassembling the monitor

1. Check that all pneumatic lines are still connected and the speaker assembly is between posts, face down on the unshielded grill. When properly in place, the power supply board will contact the foam and hold the speaker in place.
2. Replace the plastic shield and the nut.
3. Turn the main board face up, place between guides, and slide to the rear of the unit. LIft corner of board slightly to allow the pneumatic lines to clear the standoff. Reconnect pump reservoir.

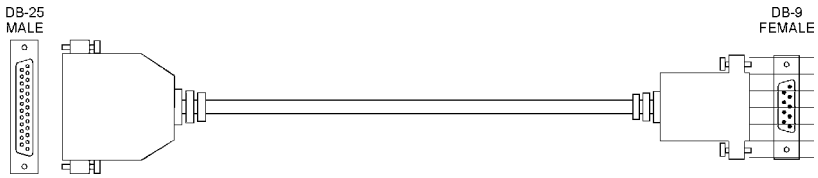
4. Reconnect J408, J409, 410, J412, J413 and the chassis ground wire. Resecure the main board with two screws.
5. LIft the display/keypanel assembly. Reconnect the J407 black and red connector until it “clicks”. Reconnect J403 and J406 ribbon connectors. Slide the assembly into the bottom cover. Reconnect J405.
6. Replace the red alert lens. Reconnect the power supply connector (J414) to the main board.
7. Replace the top cover. Holding both halves together, turn the monitor upside-down and replace the four cover screws.

7.7 Software Update Instructions

The following procedure is for updating the monitor’s software from the supplied *COSMO Plus!*® Software Update Kit using an IBM compatible computer.

7.7.1 Equipment Required

1. IBM compatible computer with an unused serial port (COM1 or COM2)
2. DB-25 male to DB-9 female serial communications cable (Cat. No. 600073)



Pin-out	
9 pin	25-pin
1	8
3	2
4	20
5	7
6	6
8	5
9	22
shell	shell

3. Update diskette (XX = new firmware version): Model 8100; PN: 6764-57-XX and/or 6895-57-XX
   Model 8000; PN: 9080-57-XX and/or 9077-57-XX
4. Reply card

7.7.2 Setup

1. Connect the serial cable to the rear panel 25 pin connector on the *COSMO Plus!*® (see FIG. A).
2. Connect the other end of the cable to the computer’s COM[4] (serial) port (see FIG. A). The update software allows use of either COM1 or COM2. When connecting the

4. The location and availability of the COM ports (COM1, COM2) will vary from computer to computer. Refer to the computer’s documentation for more information. The update software can only communicate with the *COSMO Plus!*® through either COM1 or COM2.

cable be sure to record which COM port is used, the program will prompt the user for this information before updating the software.

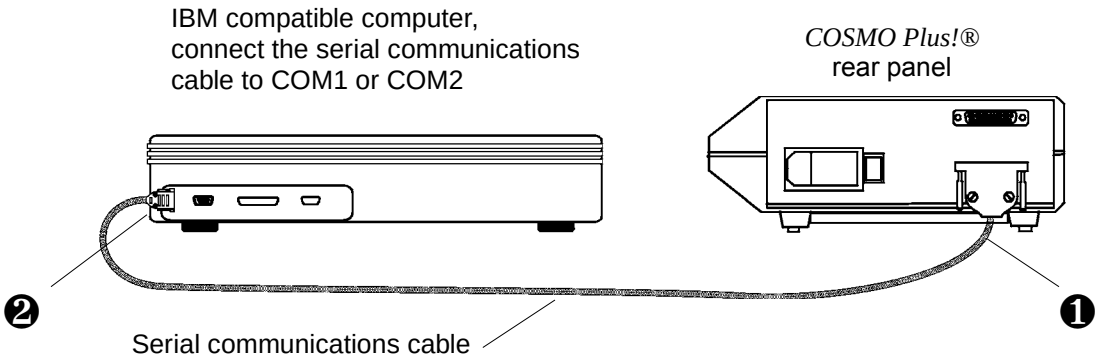
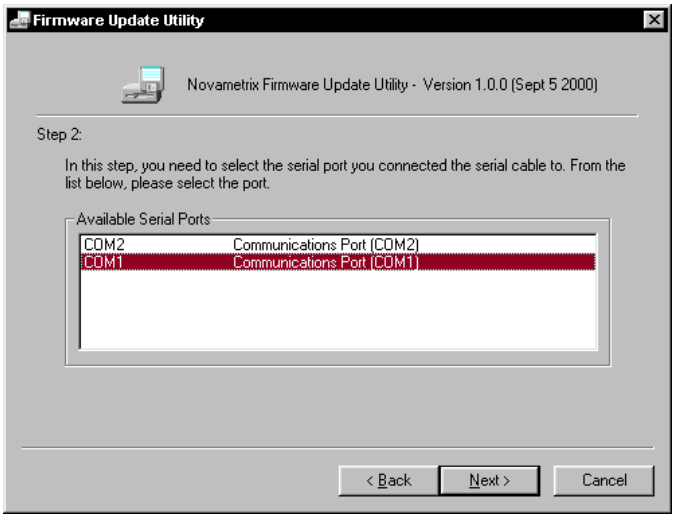


FIG. A

3. Turn the *COSMO Plus!®* on. From the main menu press and hold the SETUP key until the CONFIGURATION screen appears. Check that the SERIAL is set to NOVACOM3, otherwise use the NEXT ITEM and arrow keys to select it.

7.7.3 Procedure

1. Insert the update diskette into the computer's floppy drive (typically drive A).
2. Run the executable on the diskette.
   - Double click the "My Computer" icon on the Desktop, then on the floppy icon "3½ Floppy (A:)" in the "My Computer" window.
   - Double click on the update icon in the "3½ Floppy (A:)" window.
3. Follow the Firmware Update Utility screen instructions.
   - Select the proper COM port in step 2. View the "Connection Status" for any instructions, "Ready to Download" should be displayed to continue. If the download does not start, try selecting the other COM port.



If you are not sure of the process, press any other key and call service or Novametrix Service Department at 1-800-243-3444, in Connecticut call collect (203) 265-7701.

- When the download starts, the *COSMO Plus!*® screen will blank and "DOWNLOADING FIRMWARE TO INSTRUMENT DO NOT INTERRUPT!" will appear on the Firmware Update Utility screen. The Download Status will display the progress of the download.
- The procedure is complete when "DOWNLOAD COMPLETE" is displayed. Click on "Finish" to exit the Firmware Update Utility.

4. Check that the *COSMO Plus!*® restarts and returns to normal operation; if not, perform the update procedure again or call Novametrix Service Department at 1-800-243-3444, in Connecticut call collect (203) 265-7701.

5. Remove the serial communications cable from the PC and the *COSMO Plus!*®. Store the update diskette in a safe place. Record the serial number from the *COSMO Plus!*® on the reply card. Fill in the remaining information and return the postage paid card to Novametrix.

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Section 8 Specifications

8.1 General

Specifications for the Novametrix *CO_2SMO Plus!*® Monitor, Model 8100, are listed for informational purposes only, and are subject to change without notice.

8.2 Capnograph

- Principle of Operation: Non-Dispersive Infrared (NDIR) absorption, dual wavelength ratiometric-single beam optics
- Sensor Type: “Mainstream” (no gas sample drawn from breathing circuit)
- Initialization Time: Capnogram in 15 seconds, full specifications in 60 seconds.
- Response Time: Less than 60 ms
- N_2O/O_2, Air, Heliox, O_2 > 60%, Anesthetic Agent Compensation: Operator selectable
- Barometric Pressure Compensation: Automatic (range 400-800 mmHg)
- CAPNOSTAT® CO_2 Sensor and Airway Adapter:
  Weight: 18 g without cable
  Sensor Size: 1.30” x 1.67” x .85” inches (3.3 x 4.2 x 2.2 cm), 8 foot cable (2.44 m)
  Construction: Durable high performance plastic, ultra-flexible cable
  Shock Resistant: Sensor will withstand a 6 foot drop to a tile floor
- Airway Adapter: Single Patient Use or reusable, less than 5 cc deadspace, Neonatal less than 0.5 cc deadspace, meets ANSI Z-79
- End Tidal CO_2:
  Range: 0-150 mmHg, 0-19.7 % or 0-20 kPa at 760 mmHg Pb
  Accuracy: ± 2 mmHg for 0-40 mmHg, ± 5% of reading for 41-70 mmHg, ± 8% of reading for 71-150 mmHg
  Display Resolution: 0-50 mmHg scale, 0-75 mmHg scale, 0-100 mmHg scale, 0-150 mmHg scale.
- Respiratory Rate:
  Range: 0-150[1] breaths/min
  Accuracy: ± 1 breath/min

1. Range 0-70 when used with sampling airway adapter.

8.3 Pulse Oximeter

- Oxygen Saturation
  Range: 0-100%
  Accuracy: ± 2% for 80-100% (1 standard deviation or approximately 68% of readings are within the accuracy claim), unspecified for 0-79%
  Display Resolution: 1%
  Averaging Time: Menu selectable 2 or 8 seconds
- Pulse Rate:
  Range: 30-250 beats per minute
  Accuracy: ± 1% of full scale
  Display Resolution: 1 beat per minute
  Averaging Time: fixed at 8 seconds

8.4 Flow Sensor Specifications

- **Flow Range (L/min):**
  Neonatal Flow - 0.25 to 25
  Neonatal CO_2/Flow - 0.25 to 25
  Pediatric CO_2/Flow - 0.5 to 120
  Pediatric/Adult Flow - 2 to 180
  Pediatric/Adult CO_2/Flow - 2 to 180
- **Flow Accuracy:**
  Neonatal Flow - Greater of ± 3% reading or .125 L/min
  Neonatal CO_2/Flow - Greater of ± 3% reading or .125 L/min
  Pediatric CO_2/Flow - Greater of ± 3% reading or .25 L/min
  Pediatric/Adult Flow - Greater of ± 3% reading or .5 L/min
  Pediatric/Adult CO_2/Flow - Greater of ± 3% reading or .5 L/min
- **Minute Volume Range (L/min):**
  Neonatal Flow 0.1 to 15
  Neonatal CO_2/Flow 0.1 to 15
  Pediatric CO_2/Flow 0.5 to 30
  Pediatric/Adult Flow 2 to 60
  Pediatric/Adult CO_2/Flow 2 to 60
- **Tidal Volume Range (ml):**
  Neonatal Flow - 1 to 100
  Neonatal CO_2/Flow - 1 to 100
  Pediatric CO_2/Flow - 30 to 400
  Pediatric/Adult Flow - 200 to 3000
  Pediatric/Adult CO_2/Flow - 200 to 3000
- **Airway Pressure Range (cm H_2O):**
  Neonatal Flow -120 to 120
  Neonatal CO_2/Flow -120 to 120
  Pediatric CO_2/Flow -120 to 120
  Pediatric/Adult Flow -120 to 120
  Pediatric/Adult CO_2/Flow -120 to 120
- **Added Dead Space (ml):**
  Neonatal Flow - less than 1 ml
  Neonatal CO_2/Flow - less than 1 ml
  Pediatric CO_2/Flow - less than 4 ml
  Pediatric/Adult Flow - 6.5
  Pediatric/Adult CO_2/Flow - 8

8.5 Monitor Specifications

- Classification (IEC601-1): Class I/internal power source, type BF, continuous operating mode
- Operating Environment: 50-104° F (10-40° C), 0-90% relative humidity (non-condensing)
- Size: Height 3.3 in. (8.38 cm), Width 9 in. (22.86 cm), Depth 8 in. (20.32 cm)
- Weight: 8 pounds (3.63 kg)
- Power: 100-120/200-240 VAC, 50-60 Hz, 40VA
- Fuse Rating: 100-120/200-240 VAC, 0.5 A 250 V Slo-Blo (x2); 200-240 VAC, T 250 mA/250 V (x2)
- Battery: Sealed lead-acid gel-cell, not externally removable, rechargeable, 2 hour life on full charge (on-screen life indicator), 12 hours recharge time, non-standard, 178mm x 34mm x 64mm (L x W x H).
- Display: 1.5 x 5 inch (3.81 x 12.7 cm) Cold Cathode Display (CCD)
- Electromagnetic Emissions: Conforms to EMC Directive 89/336/EEC, CISPR Class A. Tested to EN55011 (1991) and CISPR11 (1990).
- Electromagnetic Immunity: Conforms to EMC Directive 89/336/EEC, EN50082-1 (1992). Tested to IEC801-3 (1984) Radiated Immunity. Conforms to Medical Device Directive 93/42/EEC EN60601-1 (1992). Tested to IEC801-2 (1991) ESD, IEC801-4 (1988) EFT, and IEC1000-4-5 (1995) Surge Immunity.

8.6 Additional Features

- Audible SpO_2 Trend Feature: Pitch of Pulse Rate “beep” tracks the SpO_2 value, user selectable volume.
- Alert Limits: Automatic or menu selected high and low limits for $ETCO_2$, Respiratory Rate, SpO_2 and Pulse Rate. No respiration alert selectable between 20 and 60 seconds. Visible alert is immediate; audible alert can be delayed until 10 seconds after set limit is exceeded.
- 2-Minute Silence: When key is pressed, audible alerts are deactivated for two minutes. Indicated by illuminated (2 minute LED)
- Audio Off: Press and hold key for 3 seconds to deactivate audible alerts. Indicated by flashing (Audio Off LED)
- Trend Memory: 24 hour trend memory capacity, battery backed. On-screen trends for VCO_2, mechanical and spontaneous alveolar minute ventilation, mechanical and spontaneous alveolar tidal volume, and airway deadspace. Other parameters are stored internally and can be downloaded to a PC.
- Digital Data Output: Serial (RS232), connect only to IEC601 approved devices.
- Sampling System: Standard. Allows gas sampling of non-intubated patients
- Internal Real Time Clock
- Red Alert Bar

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Section 9 *Accessories*

Catalog No.	Description
	***CO_2SMO Plus!*® RESPIRATORY PROFILE MONITOR**
	***CO_2SMO Plus!*®** is a continuous, non-invasive monitor specifically designed for the management of mechanically ventilated patients—from neonatal to adult. Airway flow, pressure, $ETCO_2$ and Pulse Oximetry (Model 8100 only) measurements present a respiratory profile allowing efficient ventilator management.
6758-00	***CO_2SMO Plus!*® Respiratory Profile Monitor**, Model 8100 includes: CAPNOSTAT® CO_2 Sensor (7167-00), Series 3 Pediatric/Adult Combined CO_2/Flow Sensor (6719-01), choice of SpO_2 sensor.
9758-00	***CO_2SMO Plus!*® Respiratory Profile Monitor**, Model 8000 includes: CAPNOSTAT® CO_2 Sensor (7167-00), Series 3 Pediatric/Adult Combined CO_2/Flow Sensor (6719-01)
	Analysis Plus! for Windows
	Analysis Plus! for Windows is a PC Software program that interfaces to the *CO_2SMO Plus!* and may be used continuously at the bedside for enhanced waveform and data review and storage, or may be connected to the *CO_2SMO Plus!* for intermittent download of patient files.
9864-00	***Analysis Plus!* for Windows** includes Software, Interface Cable (600073), User's Manual & Respiratory Monitoring Tutorial
	CAPNOSTAT® CO_2 SENSOR
7167-00	**CAPNOSTAT® CO_2 Sensor**
	COMBINED CO_2/FLOW SENSORS
6719-00	**Series 3 Pediatric/Adult Combined CO_2/Flow Sensors** (10 per box)
6716-00	**Series 3 Pediatric Combined CO_2/Flow Sensors** (10 per box)
6720-00	**Series 3 Neonatal Combined CO_2/Flow Sensors** (10 per box)
	FLOW SENSORS
6717-00	**Series 3 Pediatric/Adult Flow Sensors** (10 per box)
6718-00	**Series 3 Neonatal Flow Sensors** (10 per box)
	SINGLE-PATIENT USE CO_2 AIRWAY ADAPTERS
6063-00	**Single-Patient Use Adult Airway Adapters** (10 per box)
6421-00	**Single-Patient Use Adult Airway Adapters** with mouthpiece (10 per box)
6312-00	**Single-Patient Use Neonatal Airway Adapters** (10 per box)
	REUSABLE CO_2 AIRWAY ADAPTERS
7007-01	**Adult Airway Adapters** (1 per box)
7007-00	**Adult Airway Adapters** (10 per box)
7053-01	**Neonatal Airway Adapters** (1 per box)
7053-00	**Neonatal Airway Adapters** (10 per box)
5953-00	**Neonatal Airway Adapters for Low Deadspace ET Tubes** (10 per box)

Catalog No.	Description
	CO_2 SAMPLING ADAPTER AND ACCESSORIES
5843-01	**Sampling Airway Adapters** with tubing (1 per box)
5843-00	**Sampling Airway Adapters** with tubing (10 per box)
8781-00	**Nasal CO_2 Sampling Cannula—Adult**, Single Patient Use (10 per box)
8780-00	**Nasal CO_2 Sampling Cannula—Pediatric**, Single Patient Use (10 per box)
8906-00	**Nasal CO_2 Sampling and O_2 Delivery Cannula—Adult**, Single Patient Use (10 per box)
8907-00	**Nasal CO_2 Sampling and O_2 Delivery Cannula—Pediatric**, Single Patient Use (10 per box)
5816-34	**Nasal CO_2 Sampling Starter Kit,** includes one each Sampling Airway Adapter with Tubing (5843), Nasal CO_2 Sampling Cannula—Adult (8781), & Dehumidification Tubing (8908)
8908-00	**Dehumidification Tubing** (10 per box)
	SuperBright™ SpO_2 SENSORS
8793-00	***OxySnap*™ Y-Sensor™** (use with *OxySnap*™ Extension Cable), 90 day warranty
8744-00	***OxySnap*™ Finger Sensor** (use with *OxySnap*™ Extension Cable), 1 yr. warranty
8853-00	***OxySnap*™ Extension Cable**, (use with *OxySnap*™ sensors), 8 feet, 1 yr. warranty
8898-00	***OxySnap*™ Extension Cable**, (use with *OxySnap*™ sensors), 12 feet, 1 yr.warranty
8776-00	**SuperBright™ Finger Sensor** (10 ft sensor cable), 1 yr. warranty
8791-00	**SuperBright™ Y-Sensor**™ (10 ft sensor cable), 90 day warranty
	SENSOR MANAGEMENT PLANS
	Select a Finger Sensor or Y-Sensor™ Management Plan for each SuperBright™ Pulse Oximeter. The plan you select determines the length of coverage—36 or 60 months. **How the Plans Work:** Included in each Plan are TWO sensors—one for immediate use, the other one for back-up. If a sensor becomes inoperative, place the backup sensor into use and return the inoperative sensor in the convenient prepaid mailer. A replacement sensor will be shipped within two business days of receipt of the inoperative sensor. This simple return/replacement method will be used for the entire warranty period, thereby, guaranteeing your costs and virtually eliminating sensor tracking hassles. **Warranty:** For each Pulse Oximeter a plan is purchased for, the warranty on the monitor is also extended to the length of the Plan (a pre-contract inspection may be required). Replacement sensors provided under terms of the Plan shall carry the remaining Plan warranty—replacements do not extend the warranty.
8791-36	**Y-36 Plan** The Plan length is 36 months. Includes 9 boxes of any Y-Strip Taping Systems
8791-60	**Y-60 Plan** The Plan length is 60 months. Includes 15 boxes of any Y-Strip Taping Systems
8776-36	**Finger-36 Plan** The Plan length is 36 months
8776-60	**Finger-60 Plan** The Plan length is 60 months
	Y-SENSOR™ APPLICATORS
8828-00	**20mm Wrap Style Taping System** (100 per box) Use on neonatal foot and hand, or on pediatric toe or finger, color coded blue
8829-00	**25mm Wrap Style Taping System** (100 per box) Use on neonatal foot and hand, color coded green
8831-00	**20mm Finger Style Taping System** (100 per box) Use on pediatric finger or on small adult finger, color coded blue
8832-00	**25mm Finger Style Taping System** (100 per box) Use on adult finger, color coded green
6929-00	**Adhesive Foam Wraps**, Large (25 per box)
6968-00	**Adhesive Foam Wraps**, Small (25 per box)
8836-00	**Non-Adhesive Foam Wraps**, Large (25 per box)
8943-00	**Non-Adhesive Foam Wraps**, Small (25 per box)
6131-00	**Ear Clips** (5 per box)
8700-00	**Adhesive Dots** (200 per box)
	ACCESSORIES
9960PED-00	***CAPNO$_2$mask*™** - Pediatric O_2 Delivery/CO_2 Mainstream Monitoring Mask (10 per bag)
9960STD-00	***CAPNO$_2$mask*™** - Adult Standard O_2 Delivery/CO_2 Mainstream Monitoring Mask (10 per bag)
9960LGE-00	***CAPNO$_2$mask*™** - Adult Large O_2 Delivery/CO_2 Mainstream Monitoring Mask (10 per bag)

Catalog No.	Description
420031	***CO_2SMO Plus!*® Model 8100** Inservice Video, VHS video tape (NTSC format)
5963-00	**Analog Output Module** for *CAPNOGARD®*, *CO_2SMO®* and *CO_2SMO PLUS!®*
6045-00	**Cable**, for 5963-00 Analog Output Module (open ended, 6 ft)
600073	**Cable**, *CO_2SMO Plus!®* to Personal Computer (PC with 9-pin connector)
550034	***CO_2SMO Plus!*® to HP Vuelink Interface Adapter** Used to connect *CO_2SMO Plus!®* to Hewlett-Packard Vuelink Module
8935-25	**15 mm Male/Female Adapter** (package of 25) Use to connect Novametrix neonatal airway adapters to neonatal flow sensors.
8937-25	**15 mm Male/Female Adapter, Low Deadspace** (package of 25) Use to connect Novametrix neonatal airway adapters to low deadspace ET tube connectors.
9860-00	**2 Port Connector Cap** (package of 25)
7104-10	**Side Accessory Pouch**, (included with monitor)
6934-00	**Cable Management Straps**, for use with the CAPNOSTAT® CO_2 Sensor. Organizes and holds multiple cables and tubings. (package of 5)
8751-00	**CAPNOSTAT® CO_2 Sensor Cable Holding Clips** (50 per box)
600026	**Power Cord**, (included with monitor)
4941-00	**Saturation Sensor Extension Cable** (4 feet)
4942-00	**Saturation Sensor Extension Cable** (6 feet)
4943-00	**Saturation Sensor Extension Cable** (10 feet)
5266-00	**Saturation Sensor Extension Cable** (25 feet)
6147-00	**Saturation Sensor Extension Cable** (50 feet)
600081	**TrendCare Interface Cable**
600082	**Serial Cable**, Dual Port
600083	**IRMA Interface Cable**
600084	**VIA Interface Cable**
	EXTENDED WARRANTY
	Normal warranty: Monitor & CAPNOSTAT®—2 years
6758-81	***CO_2SMO Plus!*®** warranty extended an additional 1 year at time of purchase, monitor only
6758-82	***CO_2SMO Plus!*® & CAPNOSTAT®** warranty extended an additional 1 year at time of purchase

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Section 10 *Parts Lists*

6758-00 Model 8100

Seq	Item Nbr	Description	Qty
021	315032	LABEL, 12OVAC	1
006	6758-01	MAIN ASSY, MODEL 810	1
016	7104-10	SIDE POUCH, ACCESSORIES	1
017	6642-32	INSTR SH, BATTERY CH	1
022	600026	LINECORD, AC	1
013	6765-01	TOP COVER ASSY	1
023	9026-32	LABEL, MANUFACTURED	1
003	4470-32	LABEL, CAUTION	1
002	1217-32	REPAIR LABEL	1
015	9621-16	LENS, ALERT	1
001	1003-32	LABEL, SERIAL NUMBER	1
027	280022	CHAIN, 13 LONG SPLI	1
020	286205	SCR, 6-32 X 3/4, PHI	0
024	6986-32	BATTERY LABEL, LEAD	1
018	6965-32	REGULATORY LABEL, UL	1
019	6966-32	LABEL, REGULATORY	1
026	9685-32	INSTR CARD, FL SNSR	1
001	9824G-32	SN LABEL	1

6758-01 Main Assembly Model 8100

Seq	Item Nbr	Description	Qty
038	160038	SOLVENT, 50~ CYCLOHEX	0
006	6692-01	REAR PANEL ASSY, MOD	1
024	286215	SCREW, 6-32 X 3/8 S.	0
028	280189	STANDOFF, 5/16 DIA X	2
003	5815-01	SPEAKER ASSY, MODEL	1
018	250143	FITTING, REDUCING EL	1
019	250144	FITTING, TEE, FOR 3/	1
034	250164	FITTING, PRESS-IN PL	1
020	250161	RESERVOIR, POLYCARBO	1
001	2731-01	MAIN BOARD ASSY, 810	1
032	285000	LOCK WASHER, NO. 4,	0
030	608117	U-CLIP, WIRE ROUTER,	2
007	6693-01	FLOW CONNECTOR ASSY,	1
025	286220	SCR, 6-32 X 3/16, PH	0
036	608129	TUBING, ESTER-BASED	0

017	250134	FITTING, Y, FOR 1/16	1
008	6699-01	CHASSIS ASSY, MODEL	1
022	284207	#4-40 X 3/8 BINDING	0
002	5714-01	BATTERY HARNESS ASSY	1
014	9024-10	PNEUMATIC JUNCTION B	2
015	250056	FILTER, IN-LINE, 3 M	1
033	250109	FITTING, TEE, FOR 1/	1
026	400024	BATTERY, 12VDC, 2.3A	1
037	608130	TUBING, POLYURETHANE	0
012	160030	TUBING, .062 ID X .1	0
005	6660-01	FRONT PANEL ASSY, MO	1
035	250165	FITTING, TRANSITION,	1
010	6868-01	BOTTOM COVER ASSY, B	1
027	608114	TUBING, TYGON, 3/32	0
004	5842-01	INPUT TUBING ASSY, S	1
021	281500	HEX NUT, 4-40, STEEL	0
015	250169	FILTER, INLINE, 25 M	1
15A	250169	FILTER, INLINE, 25 M	3

6765-01 Top Cover Assembly, Model 8100

Seq	Item Nbr	Description	Qty
004	6765-32	INSTRUCTIONS LABEL,	1
003	5862-10	MYLAR SHIELD, T CVR	1
001	6427-32	USA-FRE WARN LBL, EX	1
005	6867-13	T CVR, PAINT & SHLD,	1
002	5828-32	ISOLATION LABEL	1
006	161100	TAPE, FOAM, 3/4W X .	0

6868-01 Bottom Cover Assembly, Model 8100

Seq	Item Nbr	Description	Qty
020	161007	ADHESIVE, 414, HIGH	0
003	6868-11	BOT CVR MOD, 8100	1
014	281519	NUT, HEX, 1/4-32UNEF	0
010	284261	SCR, 4-40 X 5/8	0
009	4727-10	KICKSTAND, BEDRAIL	1
005	5826-10	FOOT PAD, BOT CVR	4
019	284264	SCR, 4-40 X 1/4, SL	0
011	161064	TAPE, 3/4 X 60 YDS,	0
012	5405-10	SHLD, BATTERY, 520A	1
015	5835-10	FEMALE LUER W 1/8 BARB	1
013	284262	SCREW, 4-40 X 7/8 L,	0
007	5760-16	WHT L FOOT, KCKSTND	2
008	5761-16	WHT R FOOT, KICKSTND	2
017	5849-10	BRKT, SUPPORT, 520A	1
002	5409-32	WARN LBL, POLE MOUNT	1
006	315052	LABEL, EARTHING SYMBOL	1

015	9889-10	FEMALE LUER	1
IEA	5835-10	FEMALE LUER W 1/8 BARB	1

6660-01 Front Panel Assembly, Model 8100

Seq	Item Nbr	Description	Qty
006	280033	SPACER, 1/8 L, NO. 4	0
003	6660-27	MEMBRANE KEYPANEL	1
002	5720-01	DISPLAY ASSY, COMMON	1
001	2473-01	ALERT BD ASSY	1
010	285000	LOCK WASHER, NO. 4,	0
008	284200	SCR, 4-40 X 1/4, PHI	0
007	280187	STANDOFF, .187 DIA	0
009	284204	SCR, 4-40 X 1/2, PHI	0
O2A	5720-01	DISPLAY ASSY	0
02A	482614	LCD W RIBBON CABLE	1

6692-01 Rear Panel Assembly, Model 8100

Seq	Item Nbr	Description	Qty
008	6692-17	REAR PANEL SUBASSY,	1
027	285012	LOCK WASHER, NO. 2,	0
025	285001	LOCK WASHER, NO. 6,	0
026	285005	FLAT WASHER, NO. 8,	0
003	5812-10	SPCR, SUPPORT	2
020	250081	FITTING, 1/4-28 LOCK	1
006	9090-01	POWER CABLE ASSY WIT	1
001	2726-01	POWER SUPPLY SD ASSY	1
024	281509	NUT, HEX, NO. 2-56,	0
022	280188	STANDOFF, 3/8 DIA X	0
035	285009	#4 WASHER FLAT STL	0
004	5820-01	5 1/2 GND WIRE ASSY	1
017	210149	POWER ENTRY MODULE,	1
028	285013	FL WASHER, NYLON, *4	0
009	6870-10	INSULATING SHIELD	1
034	285000	LOCK WASHER, NO. 4,	0
031	608033	WIRE CLIP & BUSHING	1
021	250082	FITTING, QUICK DISC	1
018	216059	CONNECTOR, PLUG, POT	1
030	515023	FUSE, 1/2A, 25OV, SL	2
029	286219	SCR, 6-32 X 1 1/4, P	0
007	6549-01	GROUND WIRE ASSY	1
019	250080	FITTING, LOCK RING	1
023	281501	HEX NUT, 6-32, STEEL	0
002	2732-01	ETCO2 INPUT BOARD	1
033	281500	HEX NUT, 4-40, STEEL	0

6693-01 Flow Connector Assembly, Model 8100

Seq	Item Nbr	Description	Qty
005	6939-10	BONDING SOLUTION	0
001	2733-01	DECODER BOARD ASSY	1
002	6643-16	PNEUMATIC SEAL, FLOW	1
003	6652-16	PNEUMATIC CONNECTOR,	1
004	6784-16	SUPPORT BLOCK, FLOW	1
006	160030	TUBING, .062 ID X .1	0

6699-01 Chassis Assembly, Model 8100

Seq	Item Nbr	Description	Qty
008	140002	CARD GUIDE, 2.5 L	2
001	5886-10	BRACKET, PUMP	2
009	161067	TAPE, CL CELL	0
013	284202	SCR, 4-40 X 5/8, PHI	0
002	5920-01	SAMPLING PUMP ASSY,	1
014	285000	LOCK WASHER, NO. 4,	0
003	6699-10	CHASSIS, MODEL 8100	1
015	285045	WASHER, .375 DIA	0
004	6762-01	PURGE PUMP ASSY, MOD	1
010	280192	GROMMET, RIBBED	0
011	6885-16	FERRULE, PUMP MOUNTING	4
012	281500	HEX NUT, 4-40, STEEL	0
004	9333-01	PURGE PUMP ASSY	1

2731-01 Main Board Assembly, Model 8100

Seq	Item Nbr	Description	Qty
000	487100	IC, TC1426C0A, DUAL	1
000	474245	RESISTOR, 1M OHM, 1/	12
000	481557	DIODB, MBRS1100T3, S	2
000	484557	VOLT RGLR, LT1117CST	1
000	474032	RESISTOR, 10 OHM, 1/	1
000	154106	CAPACITOR, 22PF, 50V	5
000	474241	RESISTOR, 150K OHM,	11
000	486325	IC, MC14O93BD, QUAD	1
000	486037	IC, HM628128LFP-12SL	2
000	472200	RESISTOR, 5.6 OHM, 1	1
000	154111	CAPACITOR, .1UF, i6V	9
000	211414	CONNECTOR, 4 PIN, PL	1
000	487108	IC, TL77S7CD, VOLTAG	1
000	487064	IC, CNY17-III, OPTOC	4
000	152085	CAPACITOR, BLCTLT, 1	2
000	180048	EMI FILTER, W FERRIT	3
000	180034	FERRITE FILTER, 4 LI	4
000	474222	RESISTOR, 10 OHM, 1/	12
010	281211	SCREW, NO. 2 X 1/4 L	0

000	481554	DIODE, BAV7OLT1, DUA	7
000	154093	CAPACITOR, 68UF, 16V	5
000	481549	DIODE, SCHOTTKY RECT	7
000	152096	CAPACITOR, 220UF, 35	14
000	486790	IC, TLE2O22CD, DUAL	8
000	486340	IC, TLC2S43CDW, 12 B	2
000	486049	IC, MC68332GCFC20, 2	1
000	515088	FUSE W FUSEHOLDBR, 1	1
000	487115	IC, INSTR AMP, LOW P	3
000	2731-03	SCHEMATIC, MAIN BD,	0
000	180029	INDUCTOR, 50MHZ CUT-	7
000	515089	FUSE W FUSEHOLDER, 1	2
000	484061	TRANSISTOR, MMBT2222	5
000	180030	INDUCTOR-CAP, 4700PF	21
000	6948-07	PRGM SET, FL PBROM,	1
000	475042	POTENTIOMETER, 50K 0	1
000	474265	RESISTOR, 1 OHM, 1/4	2
000	481555	DIODE, MMBD7000LT1,	27
000	486314	IC, MC74HCS41DW, OCT	3
000	475046	POTENTIOMETER, 5K OH	1
000	474232	RESISTOR, 5.11K OHM,	1
000	486348	IC, MM74HC4O4OM, 12-	1
000	474227	RESISTOR, 1K OHM, 1/	45
000	474229	RESISTOR, 2.05K OHM,	5
000	484565	IC, LT117OCQ, VOLTAG	1
000	474260	RESISTOR, 121K OHM,	2
000	154081	CAPACITOR, 100PF, 10	1
000	486808	IC, AD68OJR, 2.5 VOL	2
000	154105	CAPACITOR, 47PF, SOy	7
000	486326	IC, MC14O13BD, DUAL	1
000	471400	RESISTOR, lOOM OHM,	1
000	474238	RESISTOR, 37.4K OHM,	2
000	474259	RESISTOR, 15K OHM, 1	4
000	486042	IC, AT93C66-1OSC, SE	1
000	154103	CAPACITOR, .OO1UF, S	7
000	250146	VALVE, SOLENOID, SV,	2
000	486341	IC, DAC-8841FS, D TO	1
000	486819	IC, AD7S64BR, 12-BIT	1
000	154112	CAPACITOR, .O47UF, 1	17
000	486337	IC, LT1181ACS, RS232	1
000	483019	TRANSISTOR, MMBT29O7	6
000	487104	IC, TC44O4COA, DUAL	1
000	484541	VOLTAGE REGULATOR, L	1
000	485541	TRANSISTOR, S14947DY	3
000	180045	INDUCTOR, 220UH, 20%	3
000	484542	VOLTAGE REGULATOR, M	1
000	474228	RESISTOR, 1.21K OHM,	3
000	486796	IC, TLC2272CD, DUAL	7
000	152084	CAPACITOR, 470UF, 25	2

000	486312	IC, SCC2691ACD1D24,	1
000	487110	IC, 122OA-015A-3S, P	1
000	474247	RESISTOR, 1OM OHM, 1	2
000	484571	VOLTAGE RGLTR, LM259	1
000	486805	IC, LM393M, DUAL VOL	4
000	481501	DIODE, 1N4148, SWITC	1
000	515082	FUSE W FUSEHOLDER, 1	1
000	472274	RESISTOR, 26.7 OHM,	1
000	482551	LBD, RED, WITH LENS,	1
000	474250	RESISTOR, 43.2K OHM,	1
000	486785	IC, LP339M, QUAD VOL	1
004	2731-02	FAD, MAIN BOARD, MOD	1
000	470109	RBSISTOR, 470K OHM,	1
000	474284	RESISTOR, 115 OHM, 1	1
000	230024	CRYSTAL, 32.768 KHZ,	1
000	486320	IC, SN74HC14D, HEX S	3
000	515085	FUSE W FUSEHOLDER, 2	1
000	481046	DIODB, ZENER, MMSZ52	1
000	212501	CONNECTOR, 20 PIN, H	2
000	474231	RESISTOR, 4.99K OHM,	7
000	486324	IC, DG444DY, QUAD SP	1
000	474240	RESISTOR, lOOK OHM,	55
000	474261	RESISTOR, 7.5K OHM,	5
000	154086	CAPACITOR, 4.7UF, 10	3
000	481546	DIODE, SWITCH, BD914	11
000	487094	IC, RTC-62423, REAL	1
000	6799-01	GROUND WIRE ASSY, 3	1
000	481547	DIODE, SCHOTTKY, BAT	7
000	474194	RESISTOR, 2.2M OHM,	2
000	180035	FERRITE FILTER, 8 LI	11
000	212133	CONNECTOR, 10 PIN, H	1
000	474197	RESISTOR, 49.9K OHM,	14
000	484062	TRANSISTOR, MMBT2369	1
000	484562	IC, LT1175CS8-ADJ, M	2
000	215073	SOCKET, 32 PIN, PLCC	2
000	484563	VOLT RGLTR, LT1117CS	2
000	180022	INDUCTOR, 1OUH, 10%,	6
000	486821	IC, AD822AR, FET-IN	7
000	486807	IC, SMPO4ES, QUAD SA	1
000	180047	INDUCTOR, SO OHMS @	3
000	487114	IC, MC34119D, AUDIO	1
000	486322	IC, SN74HCO2D, QUAD	1
000	474230	RESISTOR, 3.32K OHM,	6
000	211412	CONNECTOR, 4 PIN, HE	1
000	48SS43	TRANSISTOR, MOSFET,	3
000	472198	RESISTOR, 3.3 OHM, 1	1
000	153045	CAPACITOR, .47UF, 50	1
000	474239	RESISTOR, 7SK OHM, 1	8
000	486332	IC, AD7703BR, 20-BIT	2

000	474198	RESISTOR, 2.49K OHM,	S
000	154108	CAPACITOR, 100PF, 50	6
000	487122	IC, SLPOO4DD4, L PRB	1
000	250151	VALVE, SOLENOID, SV,	2
000	211213	CONNECTOR, 2 PIN, HE	3
000	481SS2	DIODE, MBRS340T3, SC	1
000	6756-10	TRANSFORMER, MAIN BO	1
000	474224	RESISTOR, 100 OHM, 1	44
000	154072	CAPACITOR, .1UF, SOV	15
000	474223	RESISTOR, 49.9 OHM,	2
000	180019	INDUCTOR, lOOuH, 10%	1
000	475050	POTENTIOMETER, 20K 0	1
000	230025	CRYSTAL, 3.6864 MHZ,	1
000	1S3063	CAPACITOR, 220PF, 3K	2
000	1S4104	CAPACITOR, .O1UF, 50	171
000	481S48	DIODE, EGL41B, RECTI	7
000	474008	RESISTOR, 470 OHM, 1	2
000	484540	VOLTAGE REGULATOR, L	1
000	485540	MOSFET, SI9945D, DUA	3
000	212529	CONNECTOR, 20 PIN, H	1
000	486321	IC, SN74HC138D, 3-LI	2
000	216029	TEST POINT, SPRING L	20
000	154116	CAPACITOR, 1OUF, 3SV	11
000	474234	RESISTOR, 20.5K OHM,	3
000	211327	CONNECTOR, 3 PIN, HE	1
000	474225	RESISTOR, 499 OHM, 1	11
000	400042	INVERTER, DC TO AC I	1
000	487103	IC, TC44OSCOA, DUAL	1
000	5844-01	CONNECTOR & BRACKET	1
000	513010	SWITCH, SLIDE, SPDT,	1
000	481036	DIODE, ZENER, 1NS366	1
000	474243	RESISTOR, 324K OHM,	3
000	474195	RESISTOR, 511K OHM,	3
000	485532	TRANSISTOR, 2N7002T1	20
000	210051	CONNECTOR, 2S PIN, R	1
000	487078	IC, AD712JR, DUAL BI	2
000	474236	RESISTOR, 33.2K OHM,	10
000	474292	RESISTOR, 13K OHM, 1	1
000	47423S	RESISTOR, 24.9K OHM,	12
000	2731-17	MAIN BOARD SUBASSY,	1
000	486323	IC, SN74HCS73DW, OCT	5
000	486838	IC, OP AMP, DUAL, *V*	1
000	486839	IC, VOLT COMPTR, DUA	1
000	475053	POTENTIOMETER, 200 0	1
000	474345	RESISTOR, 953 OHM, 1	1
O9A	1S4079	CAP, 1OUF, 25V, 20%,	12
O9B	1S4079	CAP, 1OUF, 25V, 20%,	5
000	154159	CAPACITOR, lOuF, 16V	7
hA	474233	RESISTOR, 10K OHM, 1	115

11B	474233	RESISTOR, 10K OHM, 1	119
12A	474242	RESISTOR, 249K OHM,	12
12B	474242	RESISTOR, 249K OHM,	8

2726-01 Power Supply Board Assembly, Model 8100

Seq	Item Nbr	Description	Qty
000	211505	CONNECTOR, 5 PIN, SQ	1
000	474145	RESISTOR, 215 OHM, 1	1
000	481S3O	DIODE, KBU4G, 4 AMP,	1
000	474214	RESISTOR, 332K OHM,	1
000	474137	RESISTOR, 1M OHM, 1/	1
000	481549	DIODE, SCHOTTKY RBCT	1
000	152096	CAPACITOR, 22OUF, 35	1
000	484S29	V REGULTR, 78LOSAC	1
000	180014	INDUCTOR, 25UH, .25	1
000	474165	RESISTOR, 10K OHM, 1	1
000	152081	CAPACITOR, 6800UF, 3	1
000	474162	RESISTOR, 61.9K OHM,	1
000	5918-10	XFMR, MAINS, PWR SPL	1
000	470026	RESISTOR, 150 OHM, 1	1
000	474215	RESISTOR, 2.21K OHM,	1
000	486805	IC, LM393M, DUAL VOL	1
000	2725-02	FAD, POWER SUPPLY BO	1
000	S1508S	FUSE W FUSBHOLDER, 2	1
000	474141	RESISTOR, 249K OHM,	1
000	600034	RIBBON CABLE ASSY, 4	1
000	474181	RESISTOR, 4.3 OHM, 1	1
000	474166	RESISTOR, lOOK OHM,	4
000	474216	RESISTOR, 4.99K OHM,	1
000	48S543	TRANSISTOR, MOSFET,	1
000	211213	CONNECTOR, 2 PIN, HE	1
000	481552	DIODE, MERS34OT3, SC	3
000	154072	CAPACITOR, .1UF, SOV	4
000	474151	RESISTOR, 37.4K OHM,	1
000	484SS9	VOLT RGLR, LT1O76CT	1
000	515083	FUSE W FUSEHOLDER, 1	1
000	2726-17	POWER SUPPLY BOARD S	1
000	154079	CAP, 1OUF, 25V, 20%,	1
000	474218	RESISTOR, 47.5K OHM,	1
000	280114	SNAP RIVET, .118- .15	0
000	1S2029	CAPACITOR, ELCTLT, 2	1
000	485532	TRANSISTOR, 2N7002T1	1
000	474211	RESISTOR, 49.9K OHM,	1
000	481561	DIODE, ULTRAFAST, 3A	1
000	474341	RESISTOR, 4.3 OHM, 3	1
000	481563	DIODE, SCHOTTKY, SA,	2
000	320012	TAPE, POLYETHELBNE,	0

000	481542	DIODE, UF5400, 50V,	1

2748-01 Power Supply Board Assembly, Japan

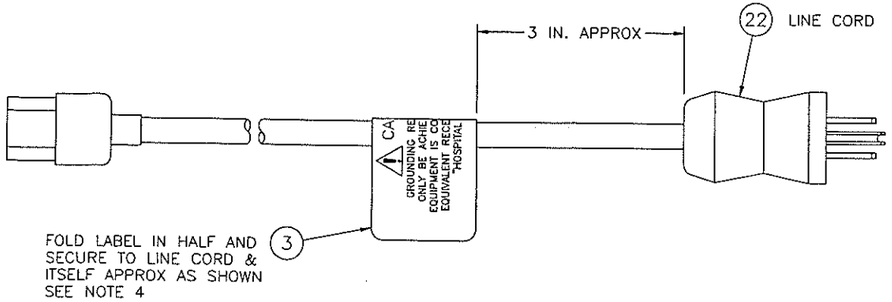
Seq	Item Nbr	Description	Qty
000	211505	CONNECTOR, 5 PIN, SQ	1
000	474145	RESISTOR, 215 OHM, 1	1
000	481530	DIODE, KBU4G, 4 AMP,	1
000	474214	RESISTOR, 332K OHM,	1
000	474137	RESISTOR, 1M OHM, 1/	1
000	481549	DIODE, SCHOTTKY RECT	1
000	152096	CAPACITOR, 220UF, 35	1
000	484529	V REGULTR, 78L05AC	1
000	180014	INDUCTOR, 25uH, .25	1
000	474165	RESISTOR, 10K OHM, 1	1
000	152081	CAPACITOR, 6800UF, 3	1
000	6977-10	TRANSFORMER, MAINS,	1
000	2748-17	POWER SUPPLY BOARD S	1
000	474162	RESISTOR, 61.9K OHM,	1
000	470026	RESISTOR, 150 OHM, 1	1
000	474215	RESISTOR, 2.21K OHM,	1
000	486805	IC, LM393M, DUAL VOL	1
000	2725-02	FAB, POWER SUPPLY BD	1
000	515085	FUSE W FUSEHOLDER, 2	1
000	474141	RESISTOR, 249K OHM,	1
000	600034	RIBBON CABLE ASSY, 4	1
000	474181	RESISTOR, 4.3 OHM, 1	1
000	474166	RESISTOR, IOOK OHM,	4
000	474216	RESISTOR, 4.99K OHM,	1
000	485543	TRANSISTOR, MOSFET,	1
000	211213	CONNECTOR, 2 PIN, HE	1
000	481552	DIODE, MBRS340T3, SC	3
000	154072	CAPACITOR, .1UF, 50V	4
000	474151	RESISTOR, 37.4K OHM,	1
000	484559	VOLT RGLR, LT1O76CT	1
000	515083	FUSE W FUSEHOLDER, 1	1
000	154079	CAP, 1OUF, 25V, 2O%,	1
000	474218	RESISTOR, 47.5K OHM,	1
000	280114	SNAP RIVET, .118-.15	0
000	152029	CAPACITOR, ELCTLT, 2	1
000	485532	TRANSISTOR, 2N7002T1	1
000	474211	RESISTOR, 49.9K OHM,	1
000	481561	DIODE, ULTRAFAST, 3A	1
000	474341	RESISTOR, 4.3 OHM, 3	1
000	481563	DIODE, SCHOTTKY, SA,	2
000	320012	TAPE, POLYETHELENE,	0
000	481542	DIODE, UF5400, 50V,	1

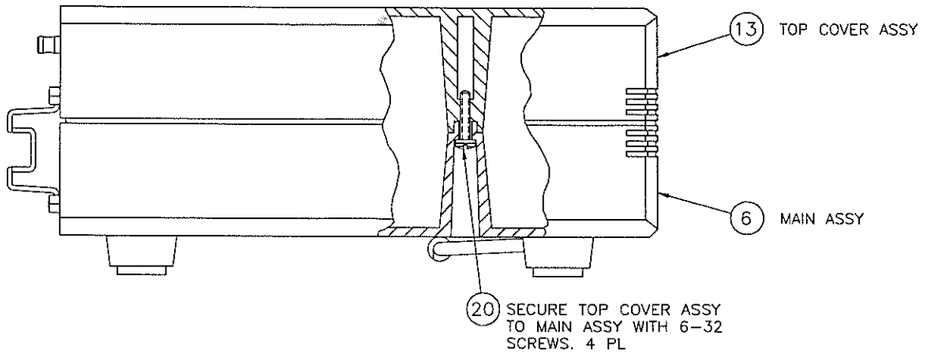
2732-01 EtCO2 Board Assembly, Model 8100

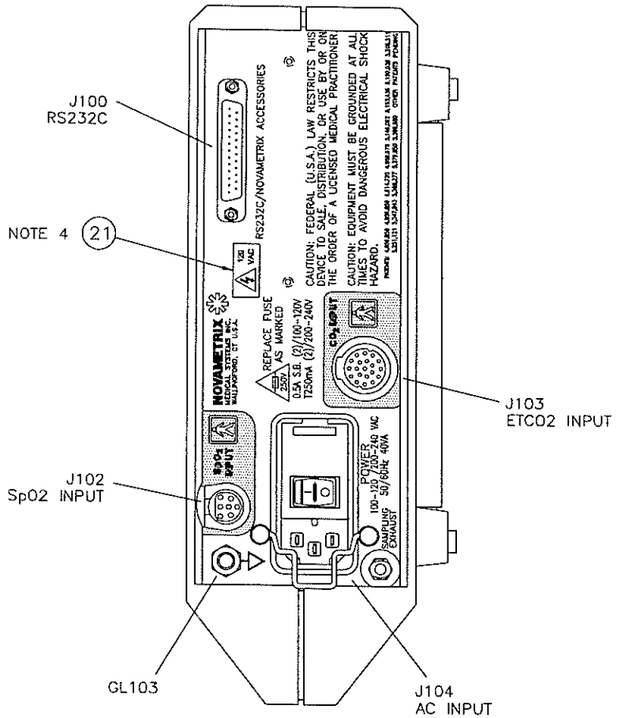
Seq	Item Nbr	Description	Qty
001	2732-02	ETCO2 INPUT BOARD	1
006	600055	RIBBON CABLE ASSY, 2	1
005	212527	CONNECTOR, 20 PIN	1
000	608126	TUBING, HEAT SHRINK,	0
000	608014	TUBING, HT SHR, .750	0

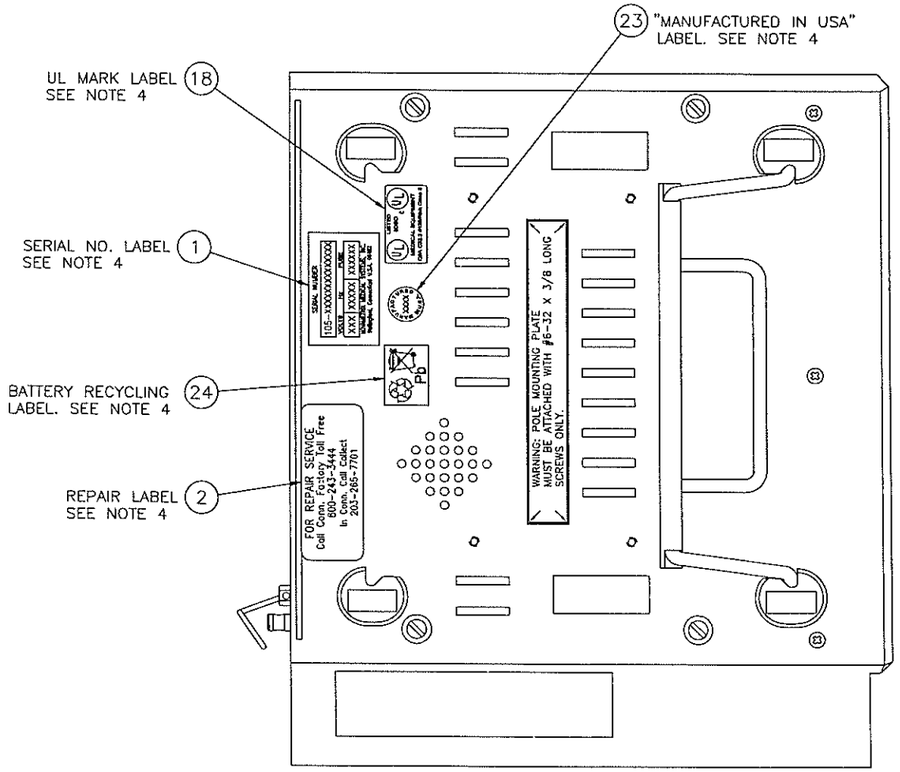
Section 11 *Drawings*

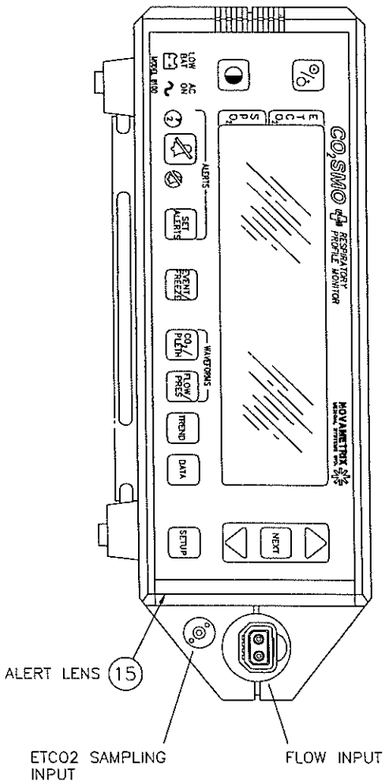
Drawing	Description
6758-00	Flow, ETCO2 & SpO2 Monitor, Model 8100 - CO2SMO Plus!®
6758-09	Overall Wiring Diagram, Model 8100 - CO2SMO Plus!®
6758-01	Main Assembly, Model 8100 - CO2SMO Plus!® (4 sheets)
2732-01	ETCO2 Input Board Assembly, Model 8100
2732-03	CO2 Interface PCB, Schematic
2733-01	Decoder Board, Flow Connector, Model 8100
2726-01	Power Supply Board
2726-03	Schematic, Power Supply Board
2748-01	Power Supply Board, Japan
2748-03	Schematic, Power Supply Board, Japan
2731-01	Main Board Assembly, Model 8100 - CO2SMO Plus!® (2 sheets)
2731-03	Schematic, Main Board, Model 8100 (10 sheets)











NOTES:

1. FOR SYSTEM TEST PROCEDURE SEE A6758-04.
2. FOR QA INSPECTION PROCEDURE SEE A6758-70.
3. FOR OVERALL WIRING DIAGRAM SEE D6758-09.
4. WIPE UNIT & LINE CORD CLEAN WITH IPA, ITEM 25 AND LOCATE LABELS APPROX AS SHOWN.
5. INCLUDE THE FOLLOWING ITEMS WITH MONITOR:
   A. ITEM 9: USERS MANUAL
   B. ITEM 16: ACCESSORY SIDE POUCH. DO NOT ATTACH.
6. ATTACH INSTRUCTION CARD, ITEM 26 WITH CHAIN, ITEM 27 TO THE HANDLE OF MONITOR.
7. PLACE BATTERY CHARGING INSTRUCTION SHEET, ITEM 17 ON TOP OF UNIT WITH NOMENCLATURE UP PRIOR TO WRAPPING UNIT IN PLASTIC.

REV	R NO.	DATE
0C	R-N1010	6Mar02
RC	CR-N3342	16Jan02
0B	R-N939	27Sep01
0A	R-N922	25Jul01
22	N861	1Mar01

DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°
☐ SOLID MODEL ON FILE

DRAWN	PL	DATE 20Nov96
CHECK	MRL	DATE 10Apr97
MFG ENGR	MJC	DATE 4/10/97
ENGR	~	DATE
PROJ ENGR	RHD	DATE 10Apr97
NEXT ASSY: ~		

novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE: RESPIRATORY PROFILE MONITOR, MODEL 8100 - COSMO+

SIZE	DRAWING NO.	CODE	REV
B	6758	00	0C

SCALE: NONE | SHEET 1 OF 1

PM101
POWER ENTRY MODULE
CONFIGURED FOR 120V AC

J104
L
PE
N
POWER INPUT
100/120V AC
50/60 Hz

S101
G
H
F101
1/2A 250V
SLO-BLO
F102
1/2A 250V
SLO-BLO
VOLTAGE
SELECTOR
(A) J305 P305
(B) J306 P306
(C) J307 P307
(D) J308 P308
BRN
BRN
BLU
BLU
5
4
2
1
P301 J301
6
2
5
1
T301
8
11
POWER SUPPLY BD
D2726-03
F302 1A
125V
V FAST-ACT
J302 P302
B5714-01
P306 J306
P305 J305
BT301
12V DC
F301
2A
125V
SLO-BLO
E302
(GND)
REAR
PANEL
GRN/YEL
GL101
(INTERIOR)
GRN/YEL
GL201
BOTTOM COVER
GRN/YEL
GL103
(EXTERIOR)
GRN/YEL
GL102
(INTERIOR)
E1
J101
SPARE
NEONATAL
HEATER
F2 125mA
125V V FAST-ACT
F3 1/2A
125V V FAST-ACT
F4
125mA
125V
V FAST-ACT
RS232C/
NOVAMETRIX
ACCESSORIES
J100
SpO2
INPUT
J102
F1 62mA
125V V FAST-ACT
F5 2A
125V SLO-BLO
ETCO2
INPUT
J103
ETCO2 INPUT BOARD
C2732-03
J301
J408
P408
ISOLATION BARRIER
SAMPLING
SYS PUMP
B201
B5920-01
P409 J409
PURGE PUMP
B202
B9333-01
P412 J412
LS201
B5815-01
P413 J413
P414
J414
BACKGROUND
MODE
J400
BOOT
SELECT
J401
AUXILIARY
SERIAL
J402
PROFILING
J404
AUXILIARY
DECODE
J411
MAIN BOARD
D2731-03
J403 P403
J405 P405
J407 P407
J406 P406
J410 P410
FRONT PANEL
C6660-01
EMI/RFI SHIELDING
MEMBRANE
KEYPANEL
D6660-27
ALERT BOARD
C2473-03
DISPLAY ASSY
C5720-01
DECODER BOARD,
FLOW CONNECTOR
C2733-03
J301
FRONT
PANEL
EMI/RFI SHIELDING

REV	R NO.	DATE
03	N615	25Nov98
02	N528	21Nov97
01	N501	4Aug97

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES
TOLERANCES
DEC ± ~ (mm) (± ~)
FRAC ± ~ (mm) (± ~)
HOLES +.007 -.003 (mm) (± ~)
ANG ± ~
MATERIAL ~
FINISH ~

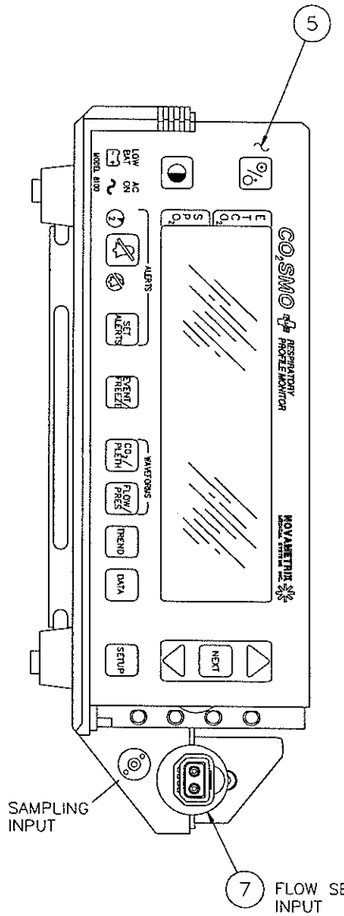
TITLE
OVERALL WIRING
DIAGRAM, MODEL
8100 - COSMO+

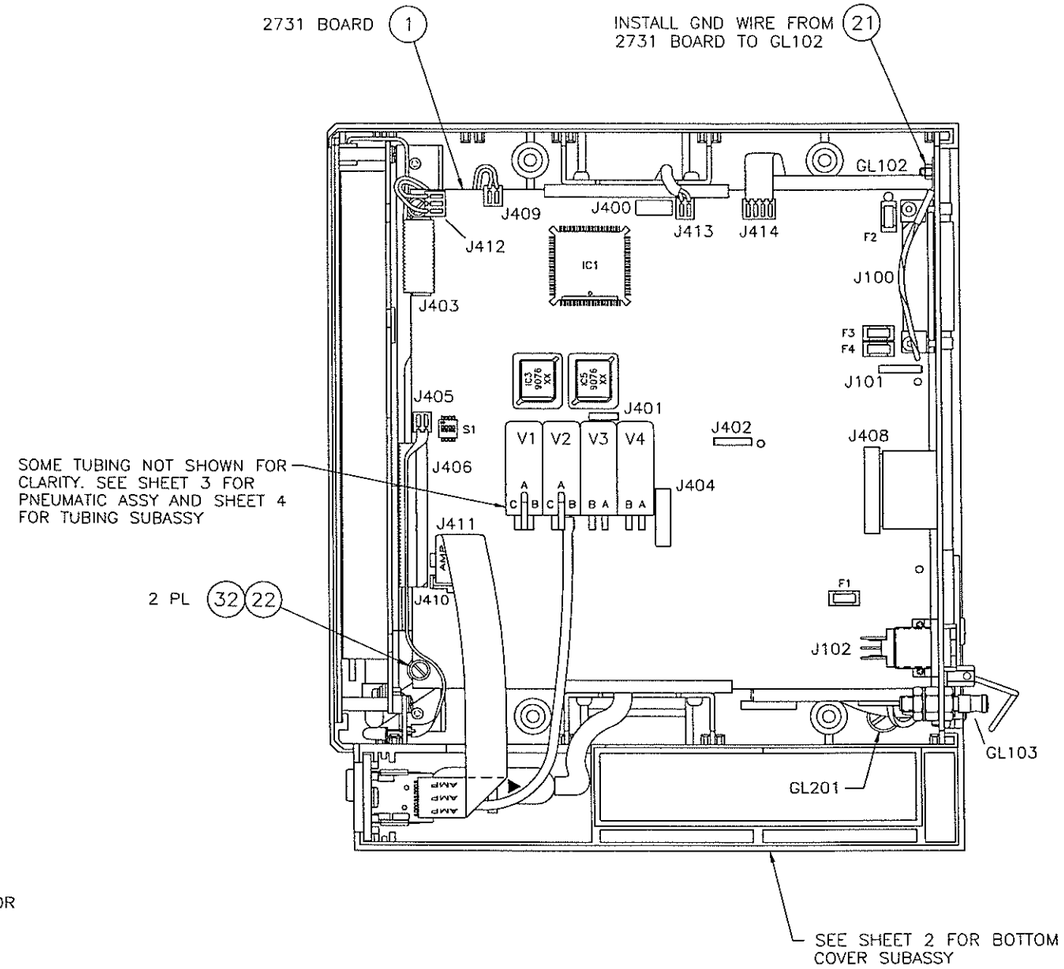
DRAWN 14Aug98 M.R. Lineback
CHECKED MRL
MFG ENGR MJC 4/2/97
APPROVED RHD 4/2/97
USED ON: D6758-00

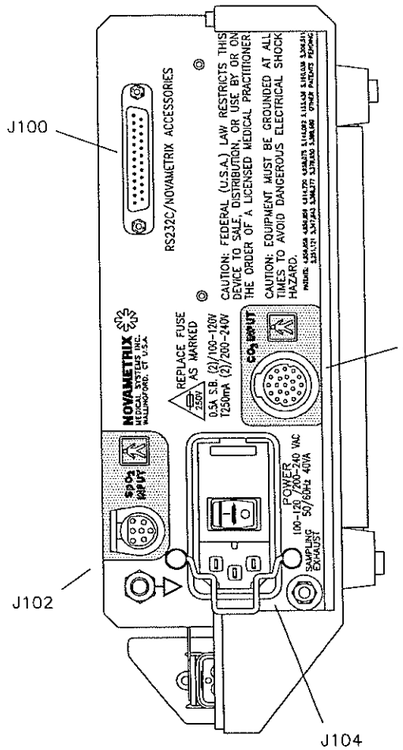
NOVAMETRIX
MEDICAL SYSTEMS INC.
WALLINGFORD, CT U.S.A. 06492

SIZE	DRAWING NO.	CODE	REV
D	6758	09	03

SCALE: NONE
SHEET 1 OF 1







REV	R NO.	DATE
07	N668	17May99
06	N615	30Nov98
05	N566	17Apr98
04	N550	19Feb98
03	N528	24Nov97
02	N475	27May97
01	N462	14Apr97

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES
TOLERANCES
DEC ± ~ (mm) ± ~
FRAC ± ~ (mm) ± ~
HOLES +.007 −.003 (mm) (+.18 −.08)
ANG ± ~
MATERIAL ~
FINISH ~

TITLE
MAIN ASSEMBLY, MODEL 8100 – COSMO+

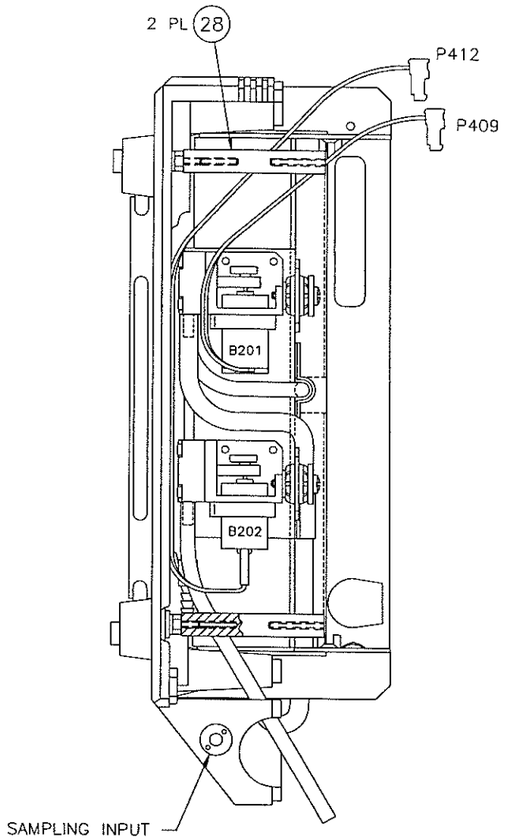
DRAWN	CHECKED
RGG 15Jan97	MRL 21Mar97
MFG ENGR MJC 4/2/97	APPROVED RHD 4/2/97

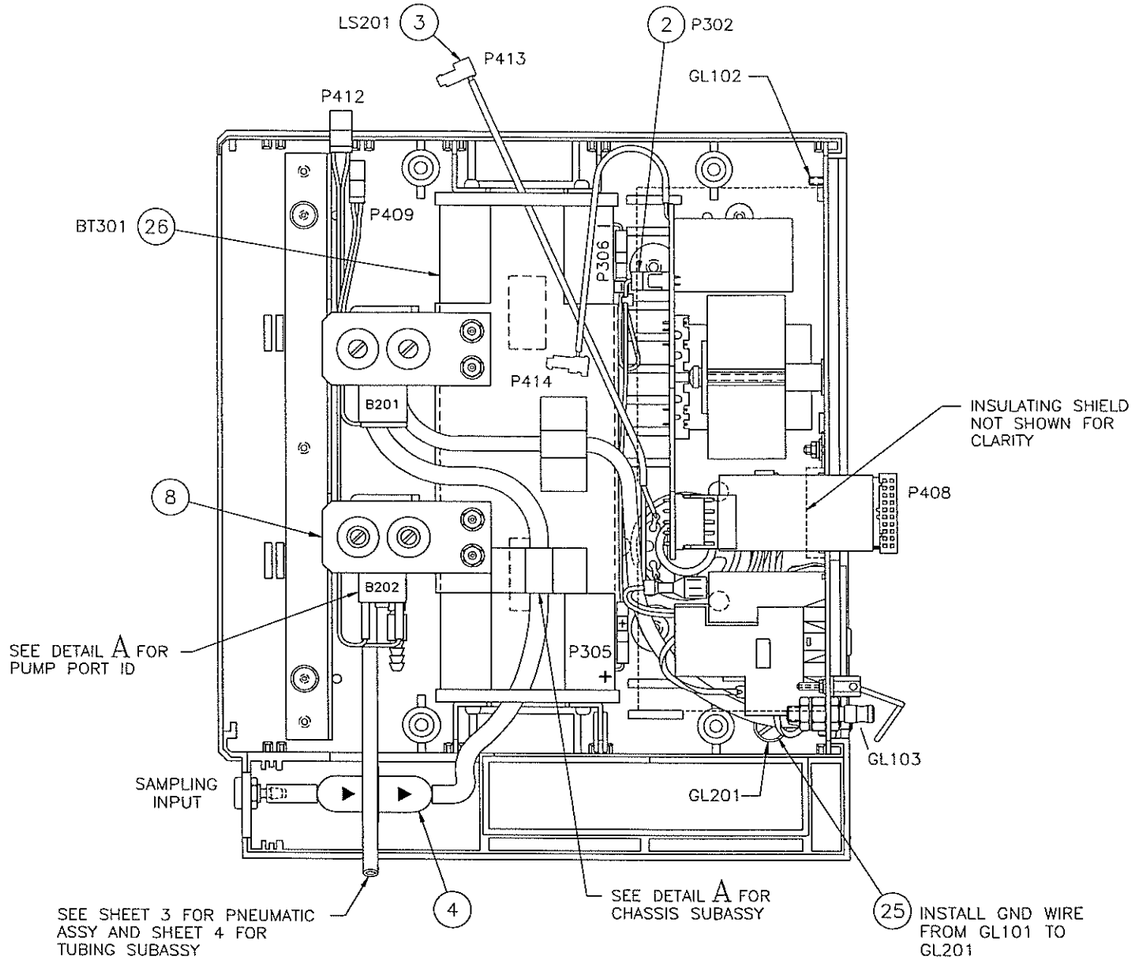
USED ON: D6758-00

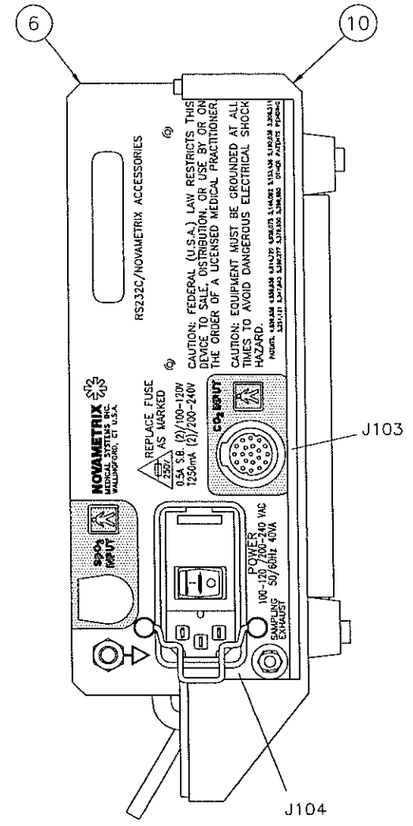
NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492

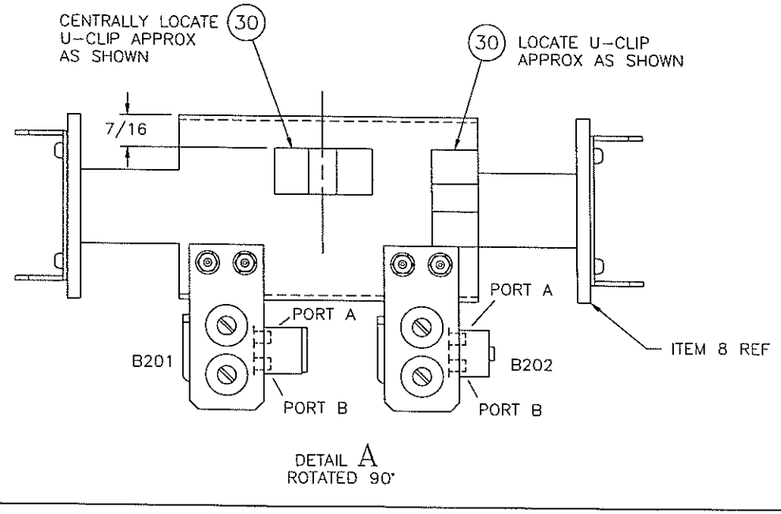
SIZE	DRAWING NO.	CODE	REV
D	6758	01	07

SCALE: 1/1 SHEET 1 OF 4









REV	R NO.	DATE	DESCRIPTION
07	N668	17May99	
06	N615	30Nov98	
05	N566	17Apr98	
04	N550	20Feb98	
03	N528	24Nov97	
02	N475	27May97	
01	N462	14Apr97	

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES
TOLERANCES
DEC ± ~ (mm) ± ~
FRAC ± 1/32 (mm) ± ~
HOLES +.007 −.003 (mm) (+.18 −.08)
ANG ± ~
MATERIAL ~
FINISH ~

TITLE: MAIN ASSEMBLY, MODEL 8100 – COSMO+

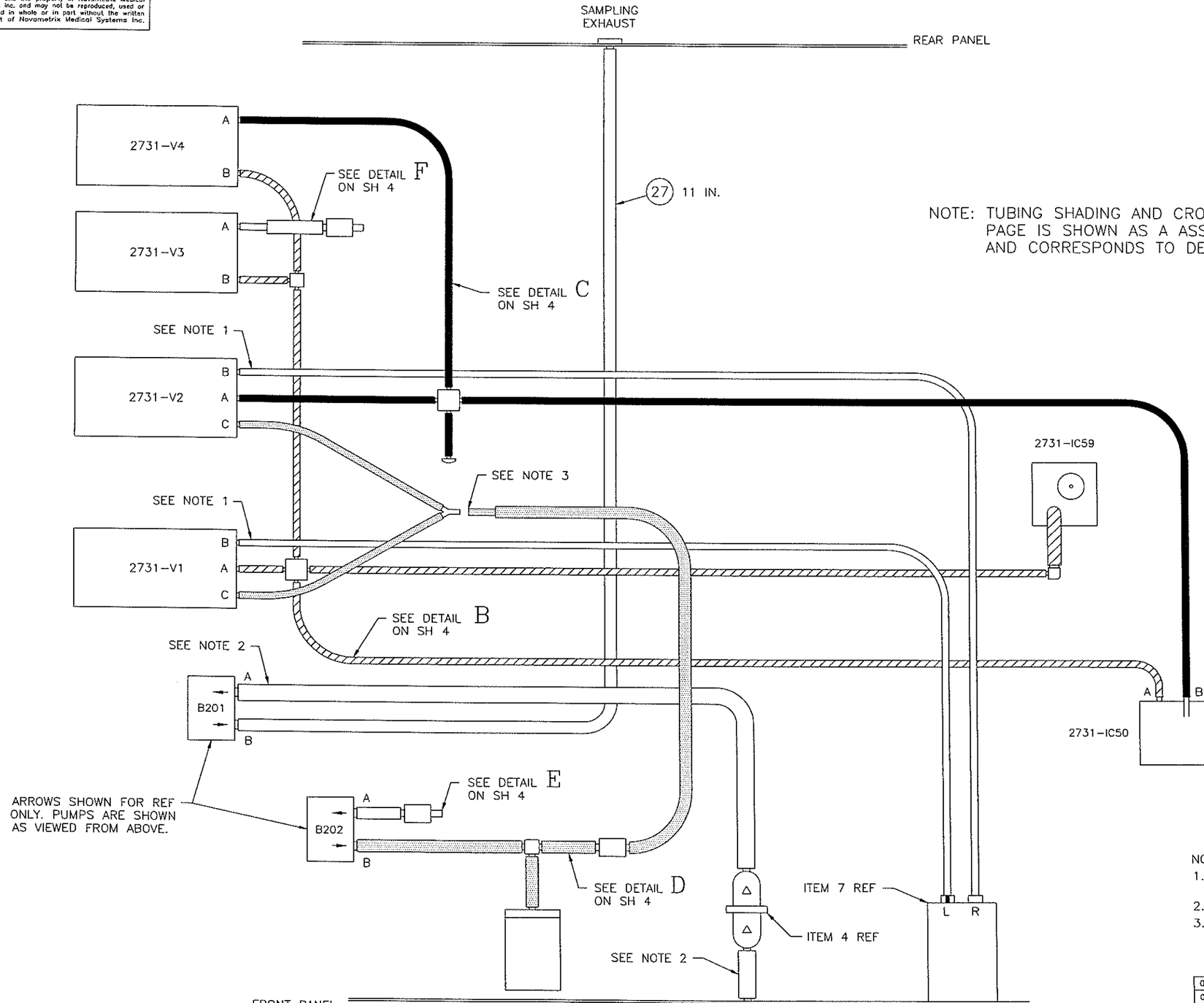
NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492

DRAWN	CHECKED
RGG 15Jan97	MR 5May97
MFG ENGR	APPROVED
MJC 4/2/97	RHO 4/2/97

USED ON: 06758-00

SIZE	DRAWING NO.	CODE	REV
D	6758	01	07

SCALE: 1/1 SHEET 2 OF 4



NOTE: TUBING SHADING AND CROSS HATCHING ON THIS PAGE IS SHOWN AS A ASSEMBLY & CONNECTION GUIDE AND CORRESPONDS TO DETAILS SHOWN ON SHEET 4.

NOTES:

1. CONNECT TUBING FROM FLOW CONNECTOR ASSY (ITEM 7) AS SHOWN.
2. CONNECT TUBING FROM INPUT TUBING ASSY (ITEM 4) AS SHOWN.
3. DO NOT CONNECT TUBING FROM THE RESERVOIR TO THE Y FITTING. THIS CONNECTION WILL BE MADE AT INSTALLATION.

PNEUMATIC ASSY - SCHEMATIC

REV	R NO.	DATE
07	N668	17May99
06	N615	1Dec98
05	N566	17Apr98
04	N550	20Feb98
03	N528	24Nov97
02	N475	27May97
01	N462	14Apr97

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES
TOLERANCES
DEC ± ~ (mm) (± ~)
FRAC ± 1/16 (mm) (± ~)
HOLES +.007 -.003 (mm) (+.18 -.08)
ANG ± ~
MATERIAL ~
FINISH ~

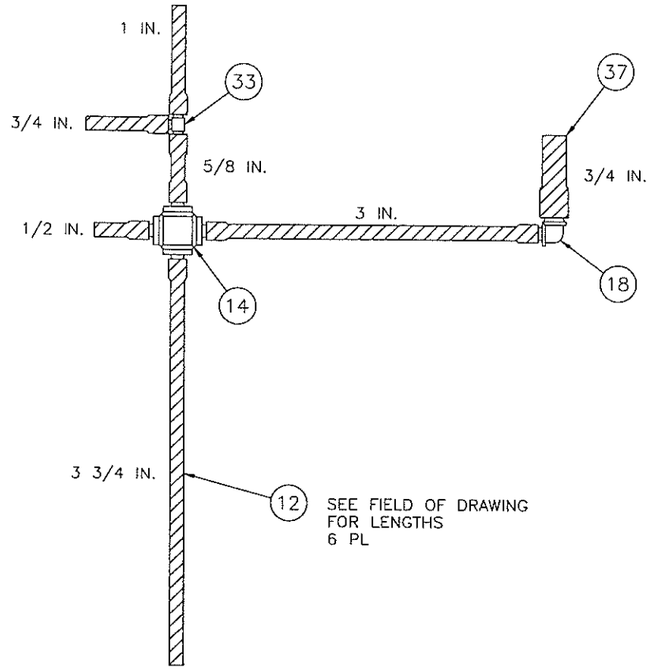
TITLE: MAIN ASSEMBLY, MODEL 8100 - COSMO+

DRAWN BL 17Feb97 | CHECKED MRL 31Mar97
MFG ENGR MJC 4/2/97 | APPROVED RHD 4/2/97
USED ON: 08758-00

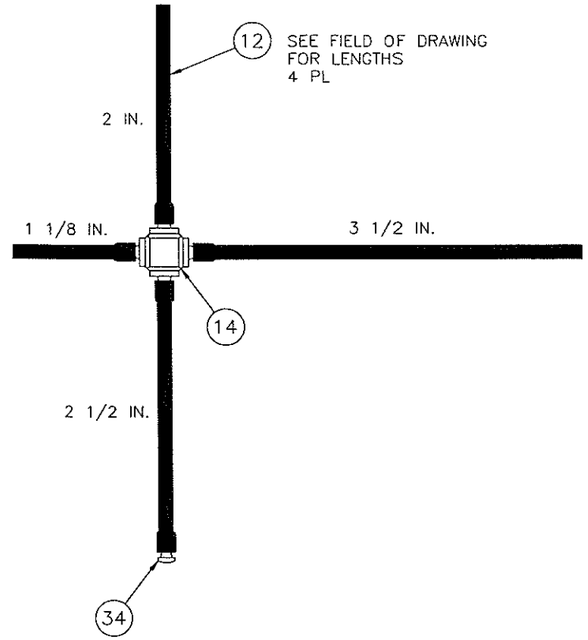
NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492

SIZE	DRAWING NO.	CODE	REV
D	6758	01	07

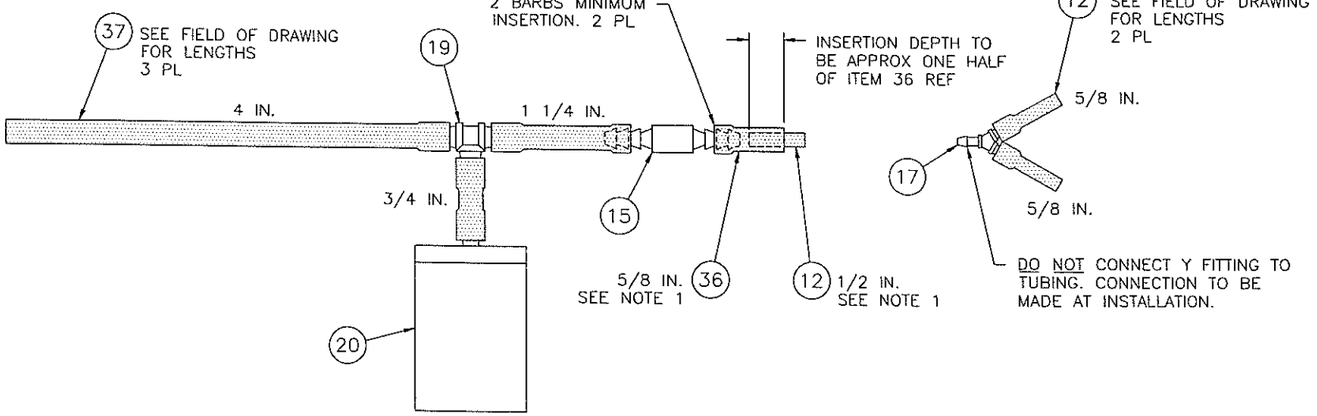
SCALE: NONE | SHEET 3 OF 4



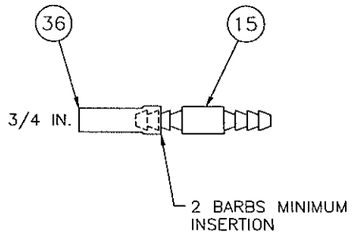
DETAIL B



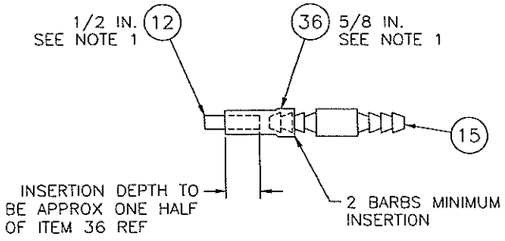
DETAIL C



DETAIL D



DETAIL E



DETAIL F

NOTES:

1. DIP END OF TUBING (ITEM 12) IN 50/50 MIX OF THF/CYCLOHEXANONE (ITEM 38) FOR ONE SECOND. BLOT END OF TUBING ON ABSORBENT TOWEL TO DRAW SOLVENT OUT OF TUBING. INSERT APPROX HALF WAY INTO THE LARGER DIAMETER TUBING (ITEM 36). ALLOW TO DRY FOR 10 MINUTES.

REV	R NO.	DATE
07	N668	17May99
06	N615	1Dec98
05	N566	17Apr98
04	N550	19Feb98
03	N528	24Nov97
02	N475	27May97
01	N462	14Apr97

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
BREAK ALL SHARP EDGES
.X ±.02 .XX ±.01 .XXX ±.005 .XXXX ±.0010
TOLERANCES
FRAC ±1/16 ANG ±1/4°
MATERIAL ~
FINISH ~

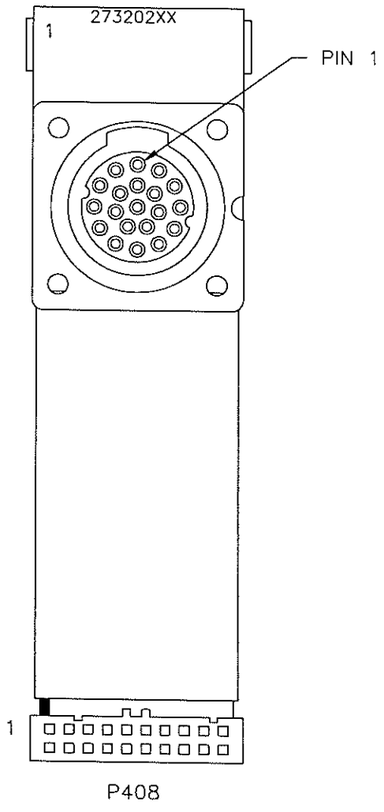
TITLE
MAIN ASSEMBLY,
MODEL 8100 -
COSMO+

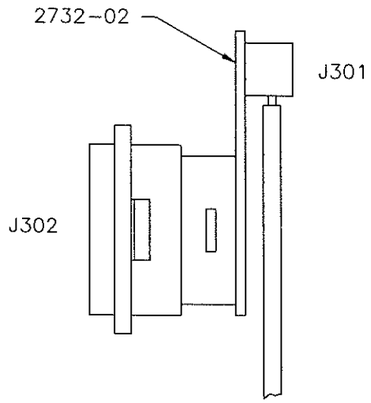
DRAWN RGC 15Apr97 | CHECKED MRL 31Mar97
MFG ENGR MJC 4/2/97 | APPROVED RHD 4/2/97
USED ON: D6758-00

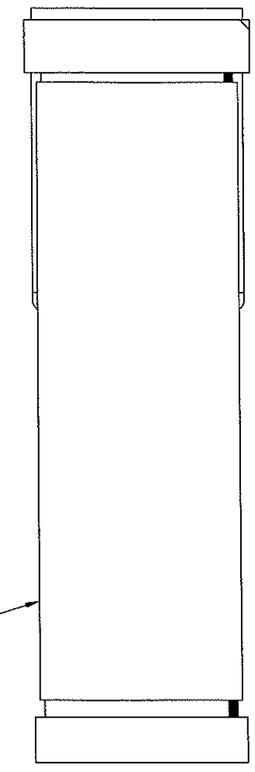
NOVAMETRIX
MEDICAL SYSTEMS INC.
WALLINGFORD, CT U.S.A. 06492

SIZE	DRAWING NO.	CODE	REV
D	6758	01	07

SCALE: 1.5/1 | SHEET 4 OF 4







REV	R NO.	DATE
01	R-N961	4Dec01
R1	CR-N3317	9Nov01

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/32
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	BL	22Oct96
CHECK	MRL	7Jan97
MFG ENGR	MJC	1/7/97
ENGR	~	
PROJ ENGR	RHD	7Jan97

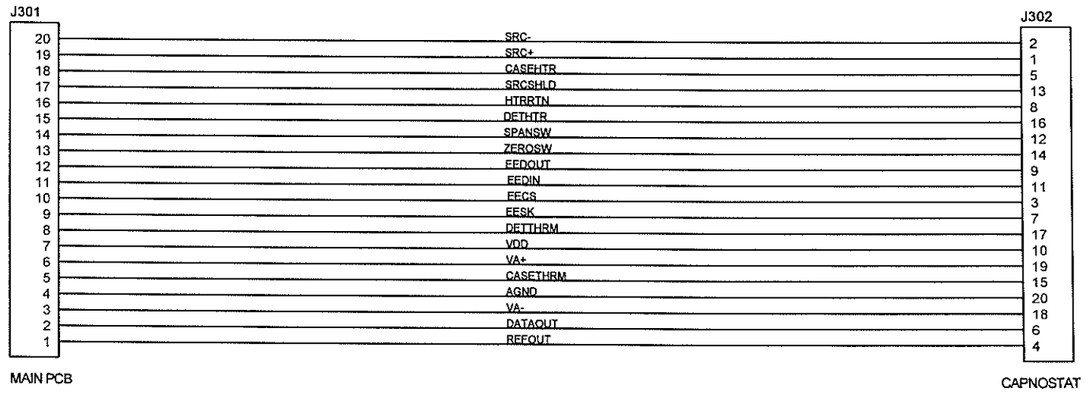
NEXT ASSY: 6692-01

novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
ETCO2 INPUT BOARD ASSY, MODEL 8100

SIZE	DRAWING NO.	CODE	REV
B	2732	01	01

SCALE: NONE | SHEET 1 OF 1

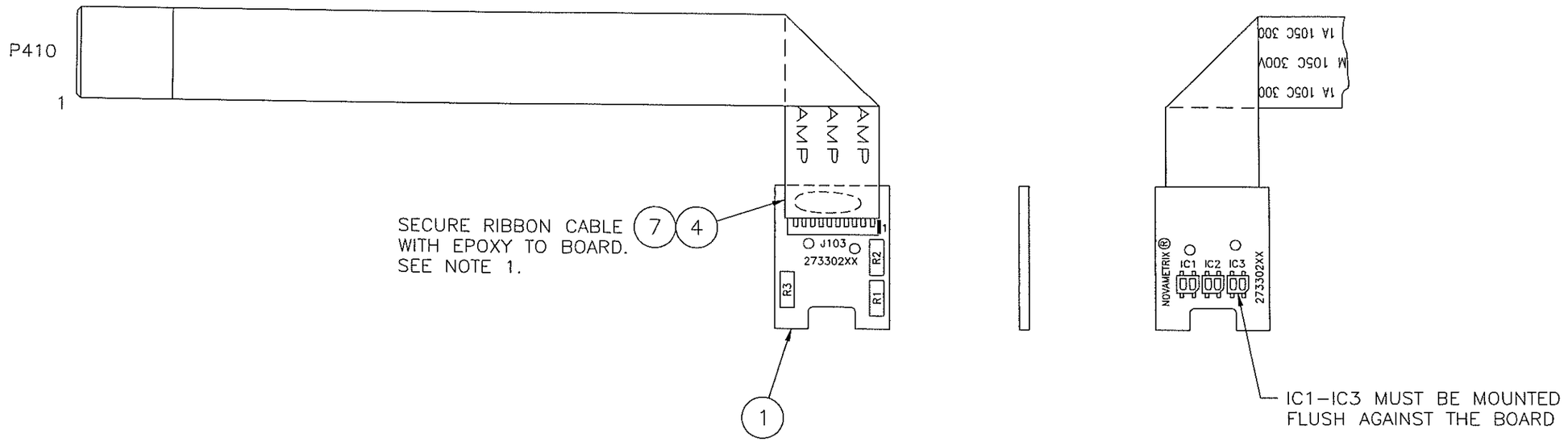


MAIN PCB

CAPNOSTAT

NOTES:
1. LAST REF DES USED: J302

			SCHEMATIC, EtCO2 INPUT BD, MODEL 8100	Novametrix Medical Systems, Inc. 5 Technology Drive Wallingford, CT USA 06492	*
			Drawn: RHD BL 28Jan97	Checked: MRL	
			Mfg Eng: MJC 4/12/97	Approved: RHD 30May97	Size B / Document Number 2732 / Code 03 / Rev 01
01	R-N961	5Dec01	File: 27320301		Sheet 1 of 1
R1	CR-N3317	9Nov01	Date: Wednesday, December 05, 2001		
Rev.	"R" No.	By Date			



NOTES:

1. FOR EPOXY MIXING ASSY PROCEDURE SEE A9779–33.

REV	R NO.	DATE
06	N831	15Dec00
05	N718	25Jan00
04	N528	24Nov97
03	N512	25Sep97
02	N468	29Apr97
01	Prod	Release

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES
TOLERANCES
DEC ± ~ (mm) ± ~
FRAC ± ~ (mm) ± ~
HOLES +.007 −.003 (mm) (+.18 −.08)
ANG ± ~
MATERIAL ~
FINISH ~

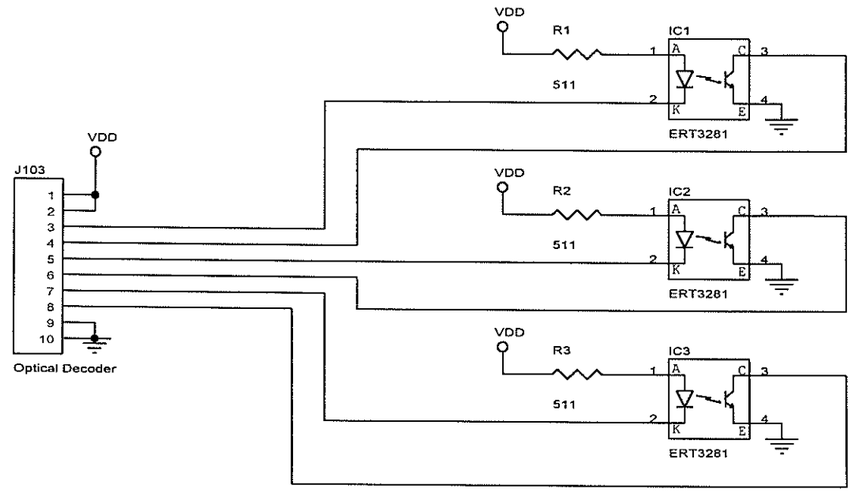
TITLE: DECODER BD ASSY, FLOW CONNECTOR, MODEL 8100

DRAWN BL 24Oct96 | CHECKED MRL 22Jan97
MFG ENGR MJC 1/23/97 | APPROVED RHD 21Jan97
USED ON: C6693–01

NOVAMETRIX MEDICAL SYSTEMS INC.
WALLINGFORD, CT U.S.A. 06492

SIZE	DRAWING NO.	CODE	REV
C	2733	01	06

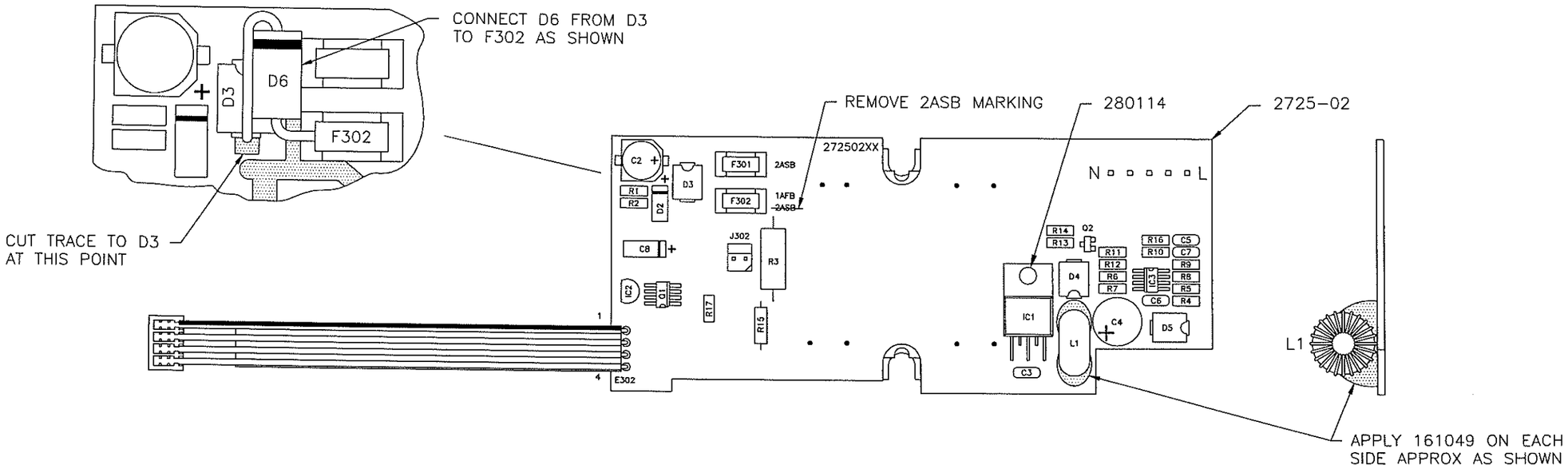
SCALE: 2/1 | SHEET 1 OF 1

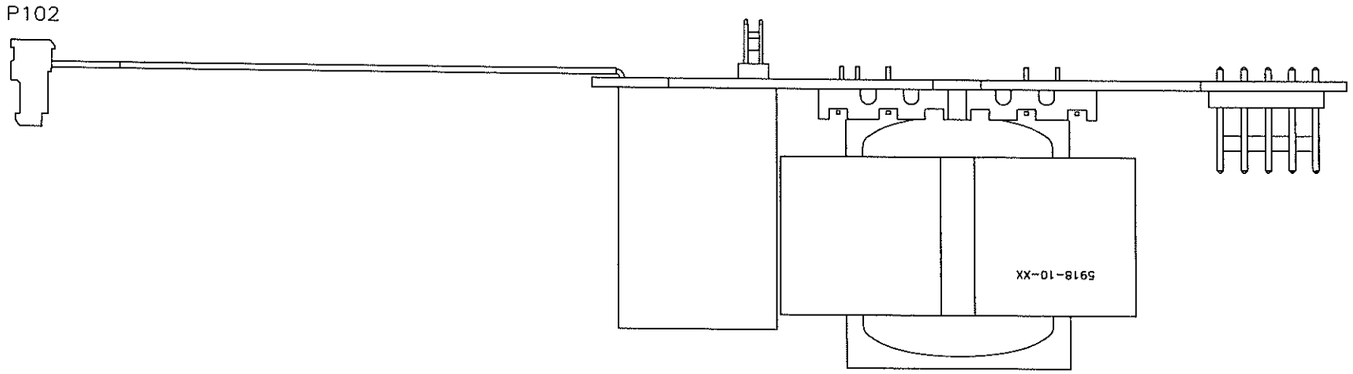


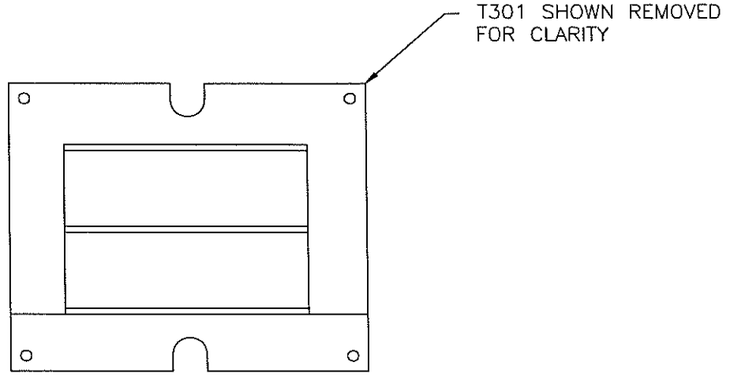
NOTES:

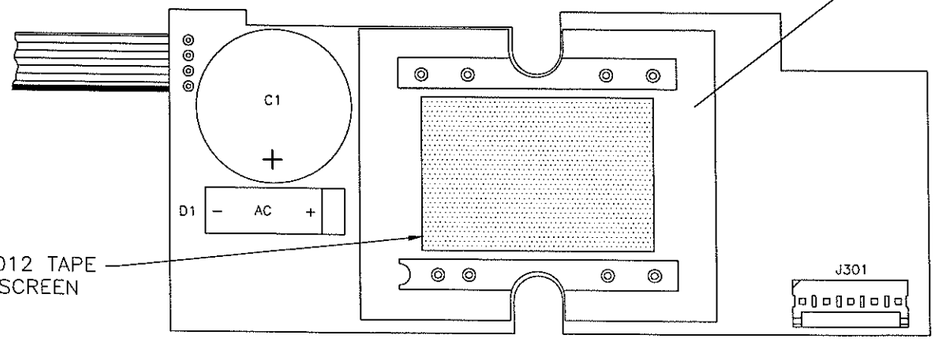
1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, 1/8W, 1%
2. LAST REF DES USED: IC3, J103, R3
3. REF DES NOT USED: J101, J102

Rev.	"R" No.	By Date	SCHEMATIC, OPTICAL DECODER BD, FLOW SENSOR, 8100		Novametrix Medical Systems, Inc. 1 Barnes Industrial Park Road Wallingford, CT USA 06492			
06	N831	15Dec00						
05	N718	25Jan00	Drawn: R. Daniels 5May97	Checked: MRL				
04	N528	4Dec97						
03	N512	30Sep97	Mfg Eng: MJC 4/12/97	Approved: RHD 5/1/97	Size B	Document Number 2733	Code 03	Rev 06
02	N468	5May97						
01	Prod	Release	File: 27330306				Sheet 1 of 1	
			Date: Friday, December 15, 2000					









NOTES:

1. FOR TEST PROCEDURE SEE 2726-04.

REV	R NO.	DATE
07	R-N960	4Dec01
R7	CR-N3316	9Nov01
06	N675	28Jun99
05	N671	1Jun99
04	N616	3Nov98
03	N508	29Aug97
02	N433	29Jan97

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	RGG	DATE 7Aug95
CHECK	BL	DATE 7Nov95
MFG ENGR	EH	DATE 11-8-95
ENGR	~	DATE
PROJ ENGR	AJE	DATE 9Nov95

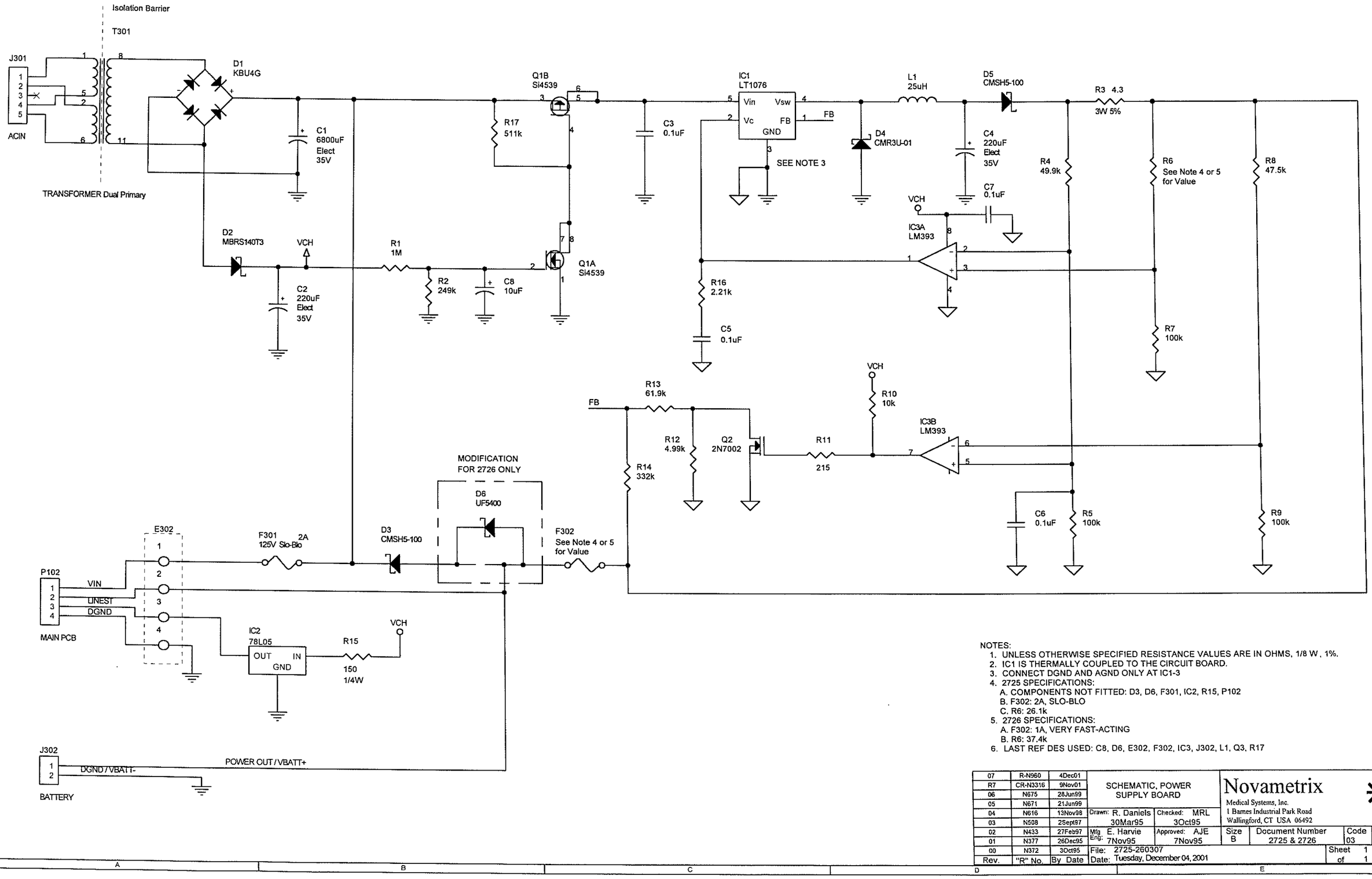
NEXT ASSY: 6487-01

novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
POWER SUPPLY BOARD ASSY,
MODEL 515A SB, 520A,
1265 & 7100

SIZE	DRAWING NO.	CODE	REV
B	2726	01	07

SCALE: 1/1 SHEET 1 OF 1



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, 1/8 W , 1%.
2. IC1 IS THERMALLY COUPLED TO THE CIRCUIT BOARD.
3. CONNECT DGND AND AGND ONLY AT IC1-3
4. 2725 SPECIFICATIONS:
   A. COMPONENTS NOT FITTED: D3, D6, F301, IC2, R15, P102
   B. F302: 2A, SLO-BLO
   C. R6: 26.1k
5. 2726 SPECIFICATIONS:
   A. F302: 1A, VERY FAST-ACTING
   B. R6: 37.4k
6. LAST REF DES USED: C8, D6, E302, F302, IC3, J302, L1, Q3, R17

Rev.	"R" No.	By Date
07	R-N960	4Dec01
R7	CR-N3316	9Nov01
06	N675	28Jun99
05	N671	21Jun99
04	N616	13Nov98
03	N508	2Sept97
02	N433	27Feb97
01	N377	26Dec95
00	N372	3Oct95

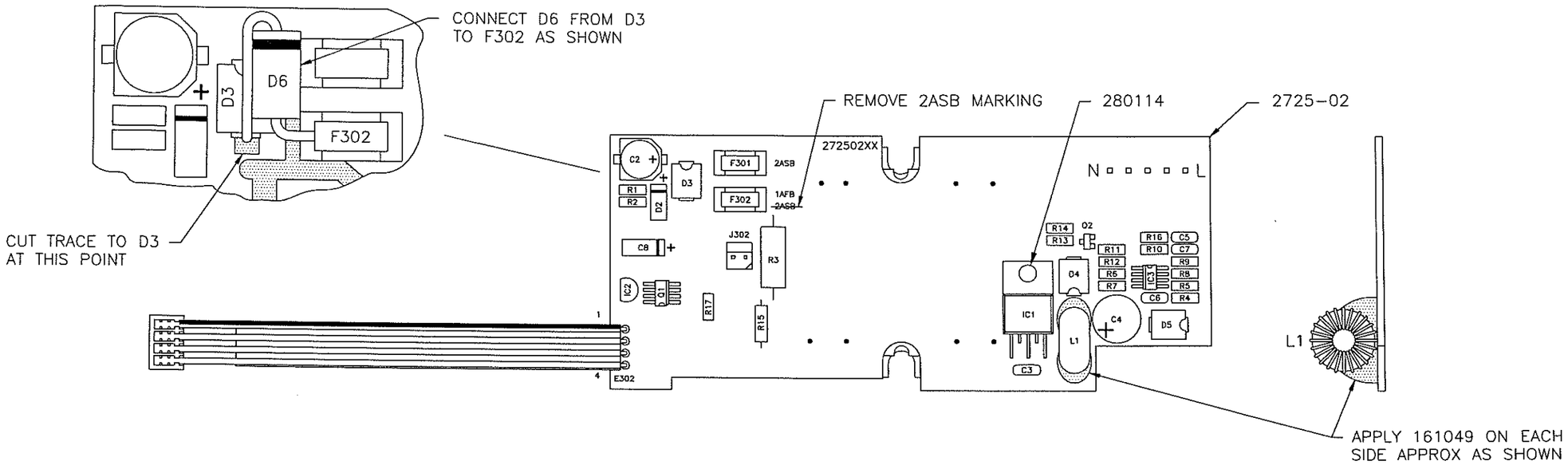
SCHEMATIC, POWER SUPPLY BOARD

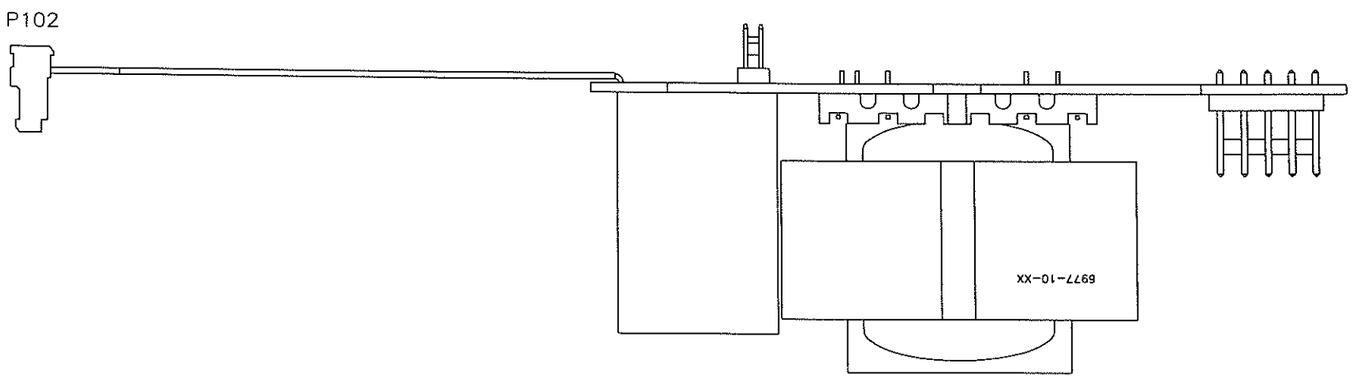
Drawn: R. Daniels 30Mar95 | Checked: MRL 3Oct95
Mfg Eng: E. Harvie 7Nov95 | Approved: AJE 7Nov95
File: 2725-260307
Date: Tuesday, December 04, 2001

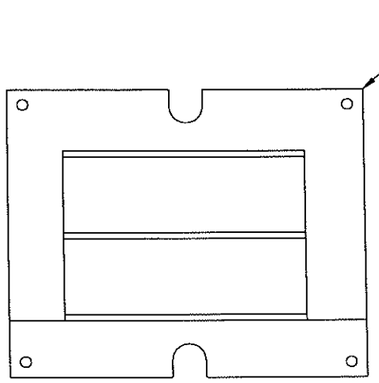
Novametrix
Medical Systems, Inc.
1 Barnes Industrial Park Road
Wallingford, CT USA 06492

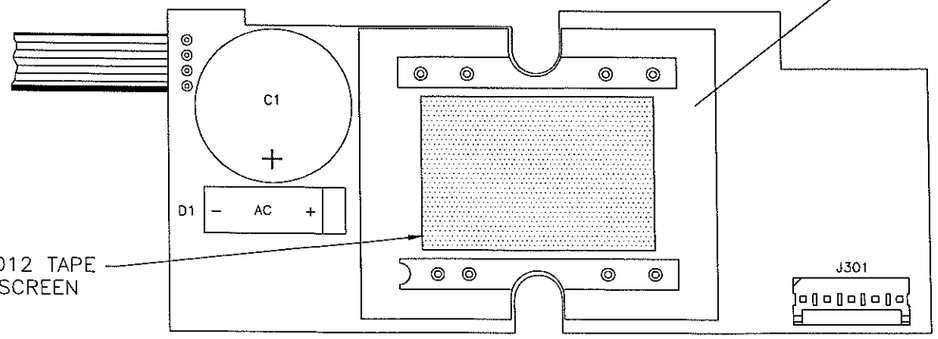
Size	Document Number	Code	Rev
B	2725 & 2726	03	07

Sheet 1 of 1









NOTES:

1. FOR TEST PROCEDURE SEE 2748-04.

REV	R NO.	DATE
04	R-N960	10Dec01
03	N675	28Jun99
02	N671	23Jun99
01	N616	3Nov98

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	BL	19Aug97
CHECK	MRL	21Aug97
MFG ENGR	BN	21Aug97
ENGR	~	
PROJ ENGR	RHD	21Aug97
NEXT ASSY: 6496-01		

novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
POWER SUPPLY BOARD ASSY,
JAPAN, MODEL 8100

SIZE	DRAWING NO.	CODE	REV
B	2748	01	04

SCALE: 1/1 SHEET 1 OF 1

MODIFICATION

Isolation Barrier

T301

J301

ACIN

TRANSFORMER Dual Primary

D1
KBU4G

C1
6800uF
Elect
35V

D2
MBRS140T3

VCH

C2
220uF
Elect
35V

R1
1M

R2
249k

C8
10uF

Q1B
Si4539

Q1A
Si4539

R17
511k

C3
0.1uF

IC1
LT1076
Vin
Vsw
Vc
FB
GND
FB
SEE NOTE 3

L1
25uH

D5
CMSH5-100

D4
CMR3U-01

C4
220uF
Elect
35V

R3 4.3
3W 5%

R4
49.9k

R6
37.4k

R8
47.5k

C7
0.1uF

VCH

IC3A
LM393

R16
2.21k

C5
0.1uF

R7
100k

VCH

R10
10k

R13
61.9k

FB

R12
4.99k

Q2
2N7002

R11
215

IC3B
LM393

R14
332k

MODIFICATION

D6
UF5400

C6
0.1uF

R5
100k

R9
100k

E302

F301 2A
125V Slo-Blo

D3
CMSH5-100

F302
1A 125V
V Fast-Acting

P102
VIN
LINEST
DGND
MAIN PCB

IC2
78L05
OUT
IN
GND

R15
150
1/4W

VCH

J302
DGND / VBATT-
POWER OUT / VBATT+
BATTERY

NOTES:
1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, 1/8W, 1%.
2. IC1 IS THERMALLY COUPLED TO THE CIRCUIT BOARD.
3. CONNECT DGND AND AGND ONLY AT IC1-3.
4. LAST REF DES USED: C8, D6, R17, F302, T301, IC3, Q2, L1, P102, J302, E4

Rev.	"R" No.	By Date
04	R-N960	7Dec01
03	N675	28Jun99
02	N671	22Jun99
01	N616	16Nov98

SCHEMATIC, POWER SUPPLY BOARD, JAPAN, MODEL 8100

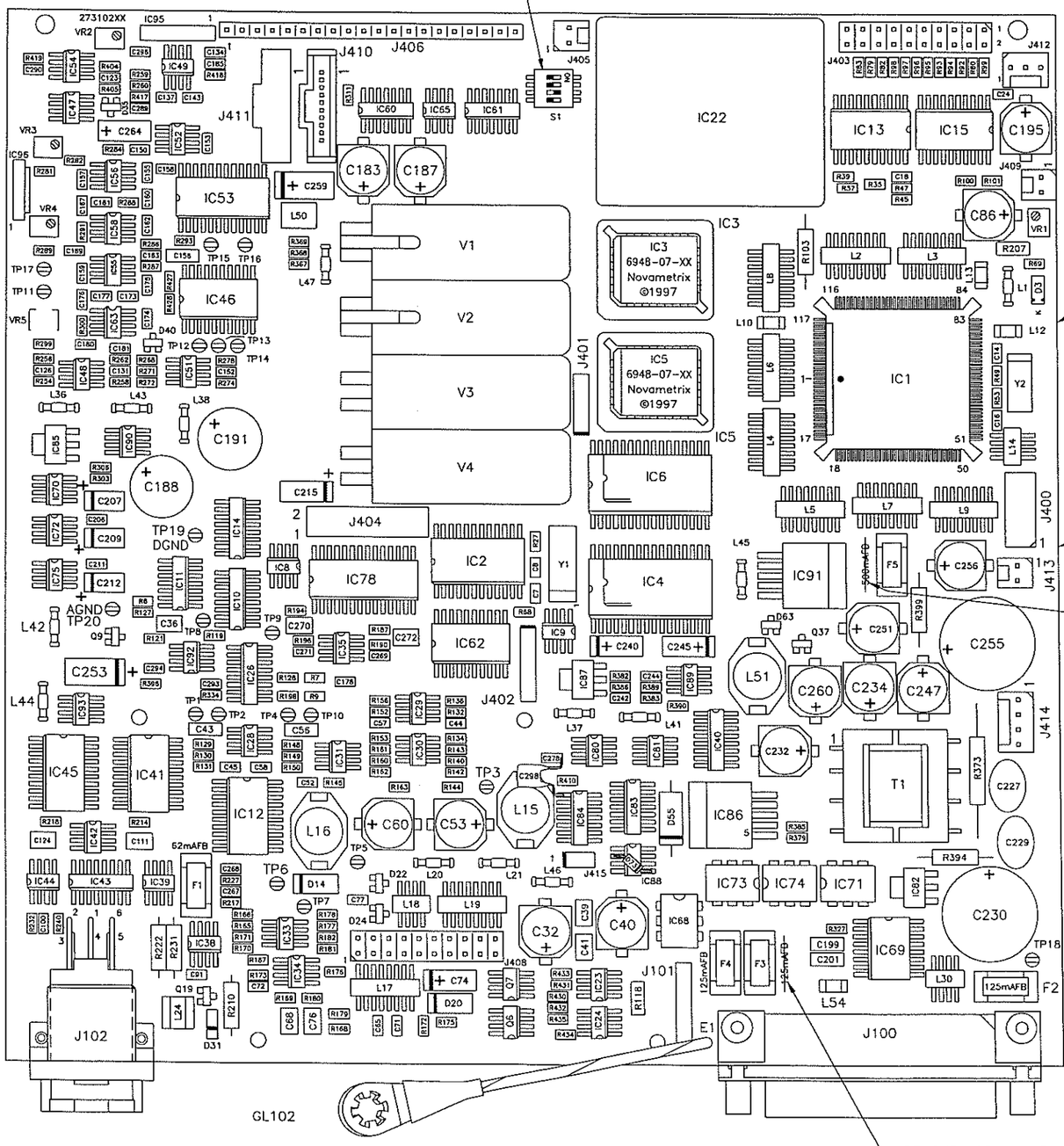
Drawn: B.Lancaster 19Aug97 | Checked: MRL 21Aug97
Mfg Eng: BW 21Aug97 | Approved: RHD 21Aug97

File: 27480304
Date: Friday, December 07, 2001

Novametrix
Medical Systems, Inc.
1 Barnes Industrial Park Road
Wallingford, CT USA 06492

Size	Document Number	Code	Rev
B	2748	03	04

Sheet 1 of 1



NOTES:

1. D2731-01 SPECIFICATIONS:
   A. SET S1 AS SHOWN.
   B. FOR TEST PROCEDURE SEE A2731-04.
2. COMPONENTS NOT FITTED: C33, C34, C175, C177, C181, C264, C266, C278, IC63, IC64, IC95, IC96, J101, J400-J402, J404, J411, J415, R20, R104, R105, R228, R299, R310, R396, R411, R414, VR5
3. SEE DETAIL A FOR COMPONENT SIDE MODIFICATIONS.

REV	R NO.	DATE
10	N785	7Aug00
09	N735	21Feb00
08	N712	24Nov99
07	N688	18May99
06	N615	30Nov98
05	N528	20Nov97
04	N512	25Sep97
03	N501	8Aug97
02	N475	28May97
01	Prod	Release

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

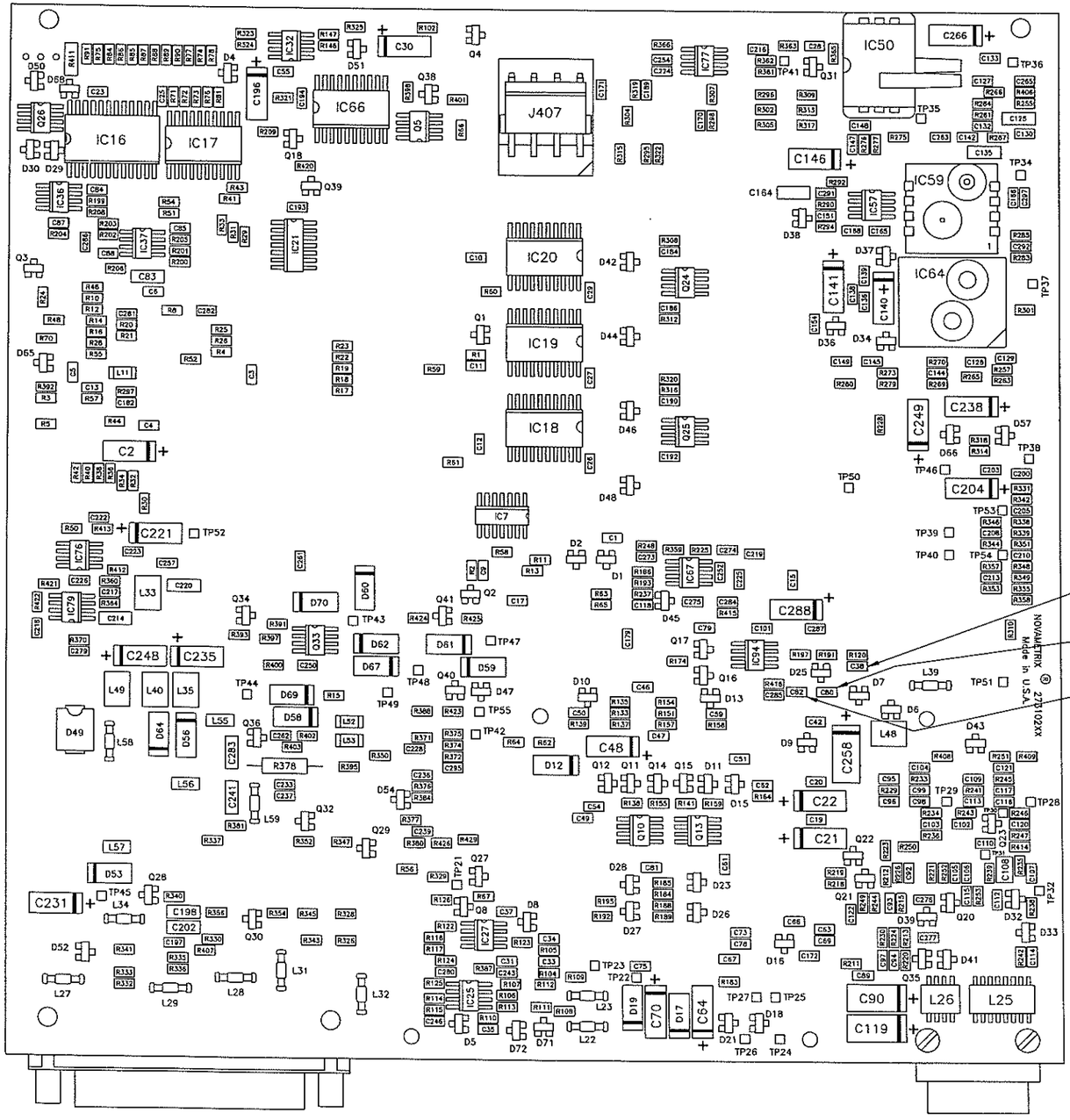
DRAWN	PL	DATE 8Oct96
CHECK	M/RL	DATE 15Apr97
MFG ENGR	MJC	DATE 5/13/97
ENGR	~	DATE
PROJ ENGR	RHD	DATE 28May97
NEXT ASSY: D6758-01		

NOVAMETRIX MEDICAL SYSTEMS INC.

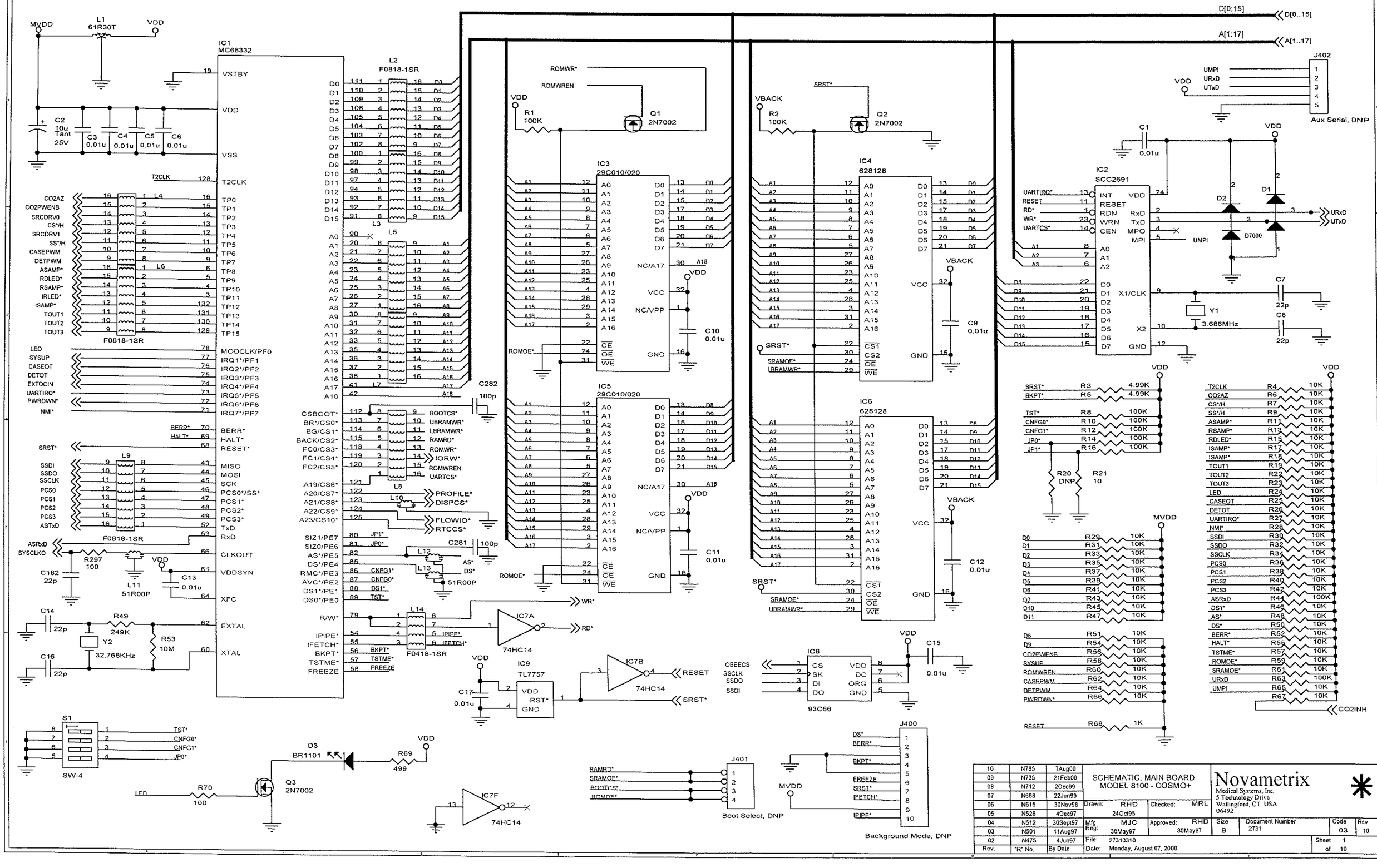
TITLE: MAIN BOARD ASSY, MODEL 8100 - COSMO+

SIZE	DRAWING NO.	CODE	REV
D	2731	01	10

SCALE: NONE SHEET 1 OF 2



				07	N668	18May99	DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm] TOLERANCES .XX ±.01 [.254] .XXX ±.005 [.127] .XXXX ±.0025 [.064] FRAC ±1/64 ANG ±1/4°	DRAWN DL DATE 10Jul96	NOVAMETRIX MEDICAL SYSTEMS INC.
				06	N615	30Nov98		CHECK MRL DATE 15Apr97	TITLE MAIN BOARD ASSY, MODEL 8100 – COSMO+
				05	N528	20Nov97		MFG ENGR MJC DATE 5/13/97	
				04	N512	25Sep97		ENGR ~ DATE	
10	N785	7Aug00		03	N501	8Aug97		PROJ ENGR RHD DATE 28May97	SIZE D DRAWING NO. 2731 CODE 01 REV 10
09	N735	21Feb00		02	N475	28May97		NEXT ASSY: D6758-01	SCALE: NONE SHEET 2 OF 2
08	N712	24Nov99		01	Prod	Release			
REV	R NO.	DATE		REV	R NO.	DATE			



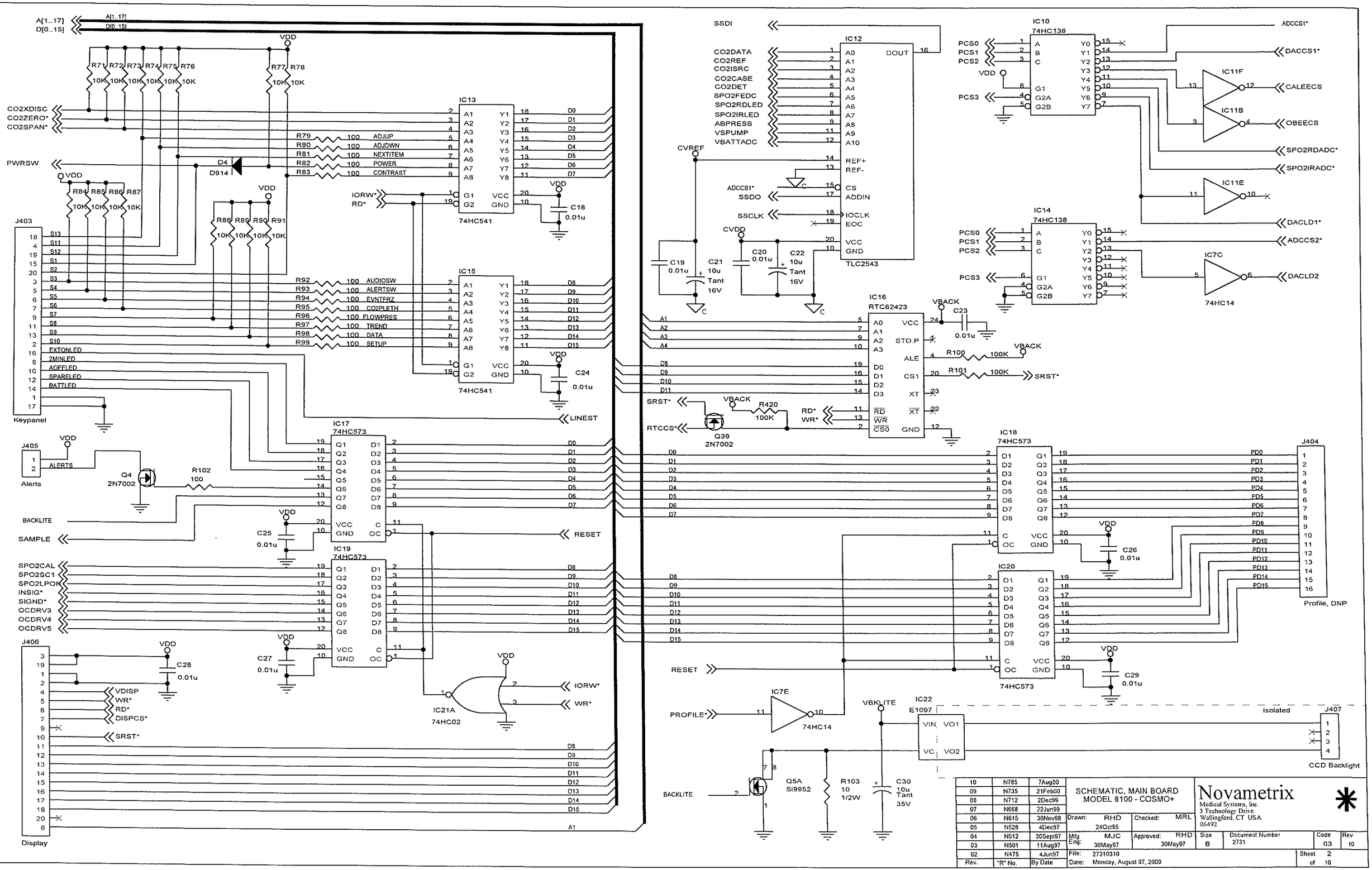
Rev.	"R" No.	By Date
10	N785	7Aug00
09	N735	21Feb00
08	N712	2Dec99
07	N668	22Jun99
06	N615	30Nov98
05	N528	4Dec97
04	N512	30Sept97
03	N501	11Aug97
02	N475	4Jun97

SCHEMATIC, MAIN BOARD
MODEL 8100 - COSMO+

Drawn: RHD 24Oct95 | Checked: MRL
Mfg Eng: MJC 30May97 | Approved: RHD 30May97
File: 27310310 | Date: Monday, August 07, 2000

Size: B | Document Number: 2731 | Code: 03 | Rev: 10 | Sheet 1 of 10

Novametrix
Medical Systems, Inc.
5 Technology Drive
Wallingford, CT USA
06492

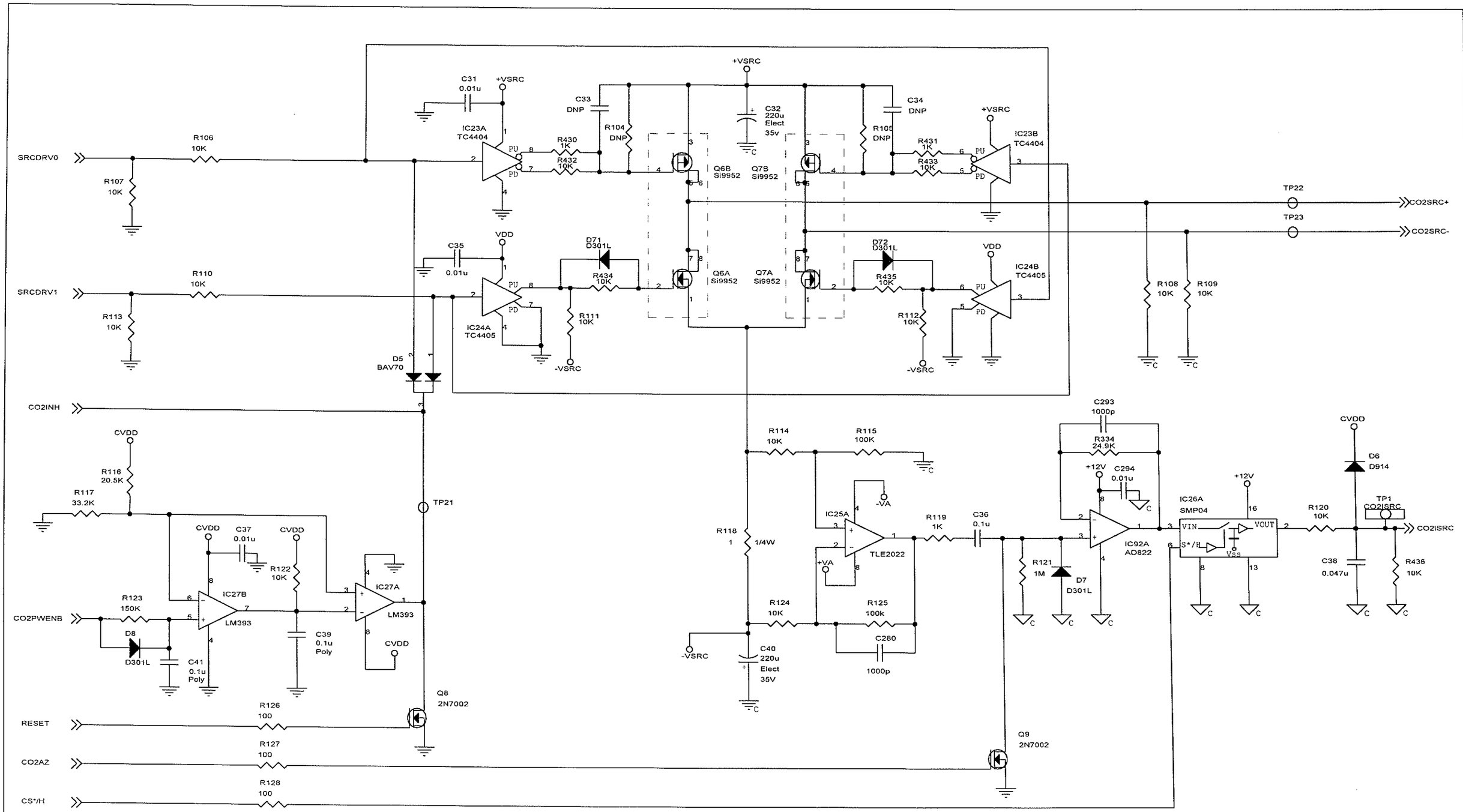


Rev.	"R" No.	By Date
10	N785	7Aug00
09	N735	21Feb00
08	N712	2Dec99
07	N668	22Jun99
06	N615	30Nov98
05	N528	4Dec97
04	N512	30Sept97
03	N501	11Aug97
02	N475	4Jun97

SCHEMATIC, MAIN BOARD
MODEL 8100 - COSMO+

Novametrix
Medical Systems, Inc.
5 Technology Drive
Wallingford, CT USA
06492

Drawn:	RHD 24Oct95	Checked:	MRL		
Mfg Eng:	MJC 30May97	Approved:	RHD 30May97	Size: B	Document Number: 2731
File:	27310310			Code: 03	Rev: 10
Date:	Monday, August 07, 2000			Sheet 2 of 10	

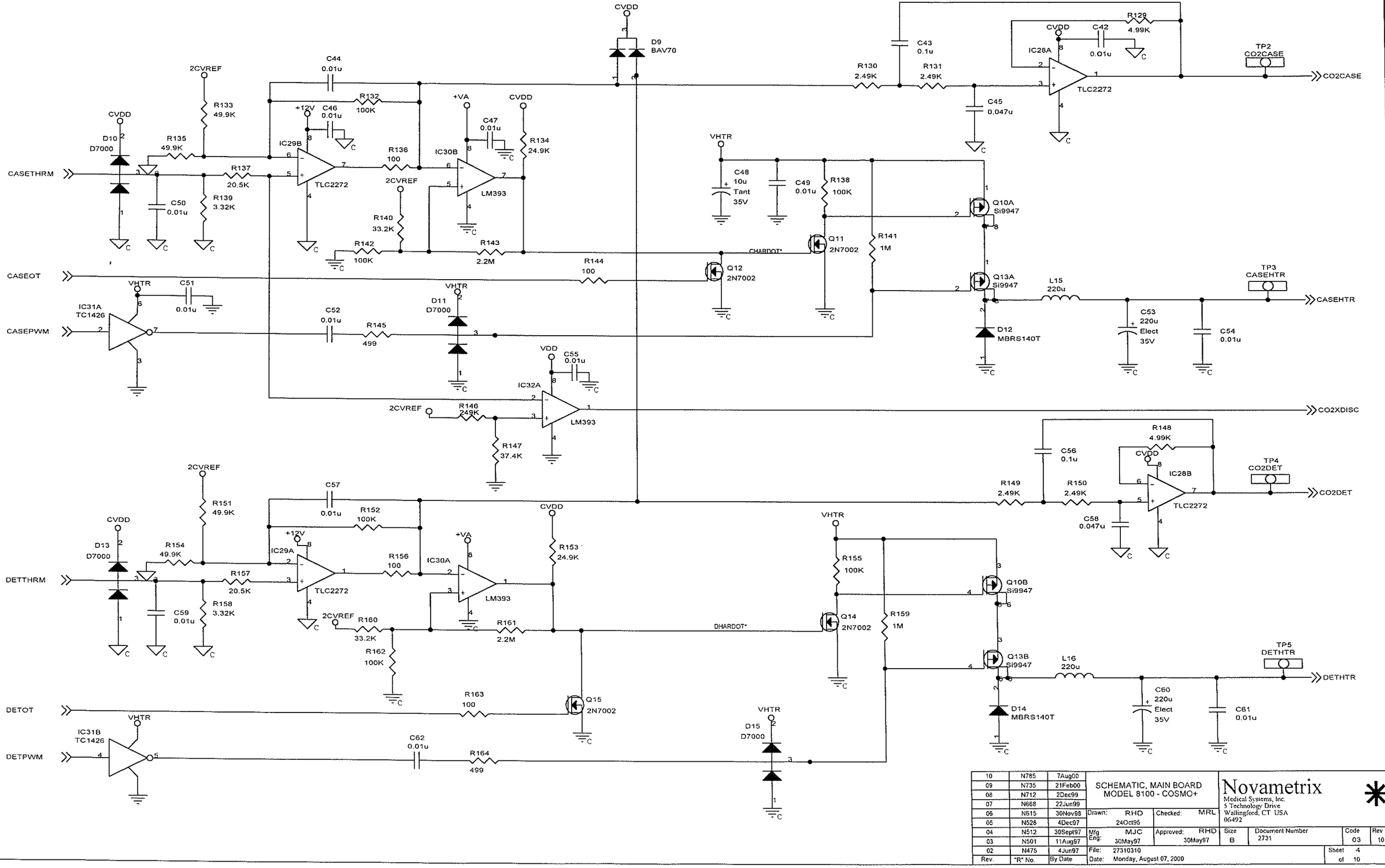


Rev.	"R" No.	By Date
10	N785	7Aug00
09	N735	21Feb00
08	N712	2Dec99
07	N668	22Jun99
06	N615	30Nov98
05	N528	4Dec97
04	N512	30Sept97
03	N501	11Aug97
02	N475	4Jun97

SCHEMATIC, MAIN BOARD
MODEL 8100 - COSMO+

Novametrix
Medical Systems, Inc.
5 Technology Drive
Wallingford, CT USA
06492

Drawn: RHD 24Oct95	Checked: MRL				
Mfg Eng: MJC 30May97	Approved: RHD 30May97	Size B	Document Number 2731	Code 03	Rev 10
File: 27310310				Sheet 3 of 10	
Date: Monday, August 07, 2000					



Rev.	"R" No.	By Date
10	N785	7Aug00
09	N735	21Feb00
08	N712	2Dec99
07	N668	22Jun99
06	N615	30Nov98
05	N528	4Dec97
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02	N475	4Jun97

SCHEMATIC, MAIN BOARD
MODEL 8100 - COSMO+

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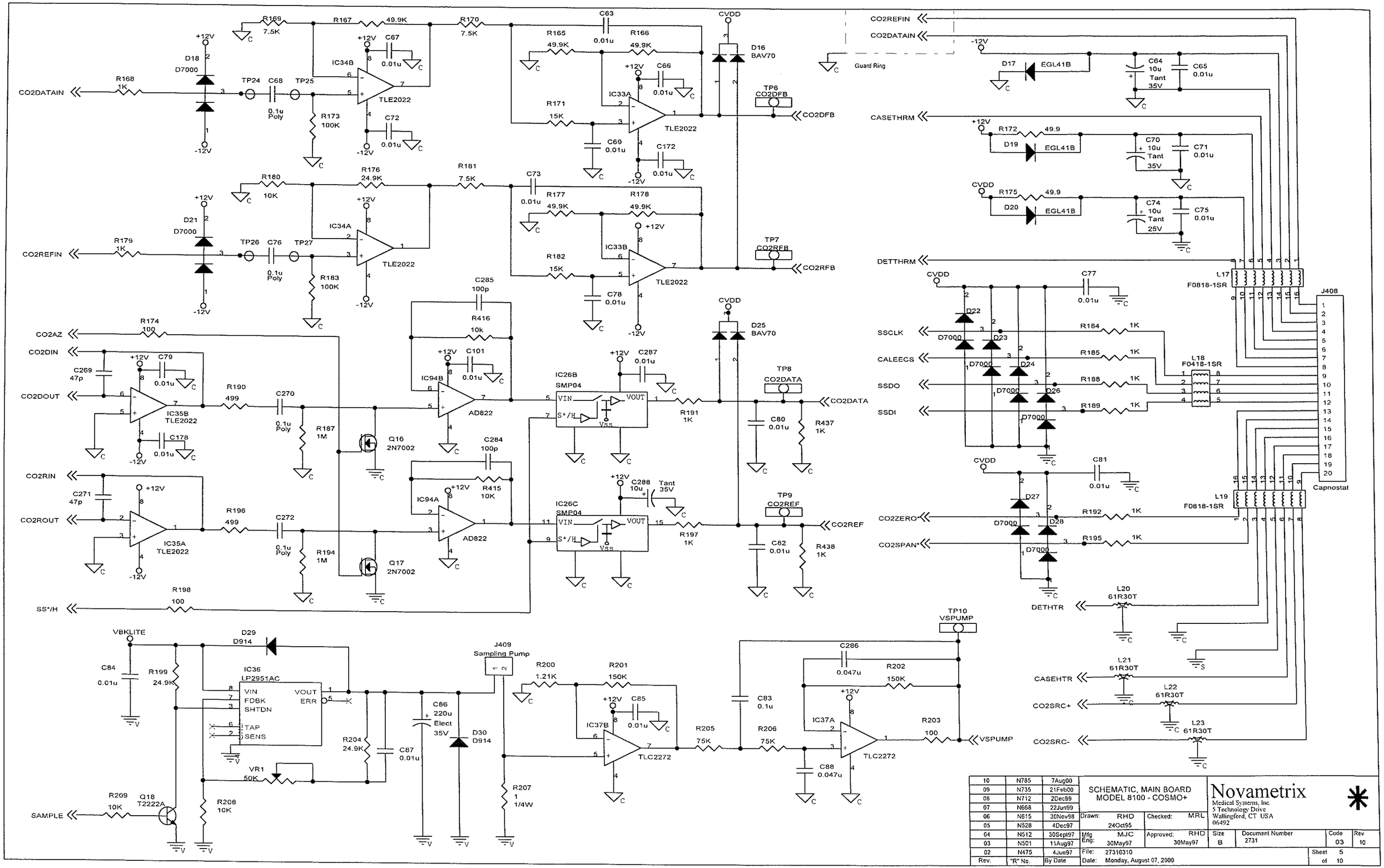
Size	Document Number	Code	Rev
B	2731	03	10

Sheet 4 of 10



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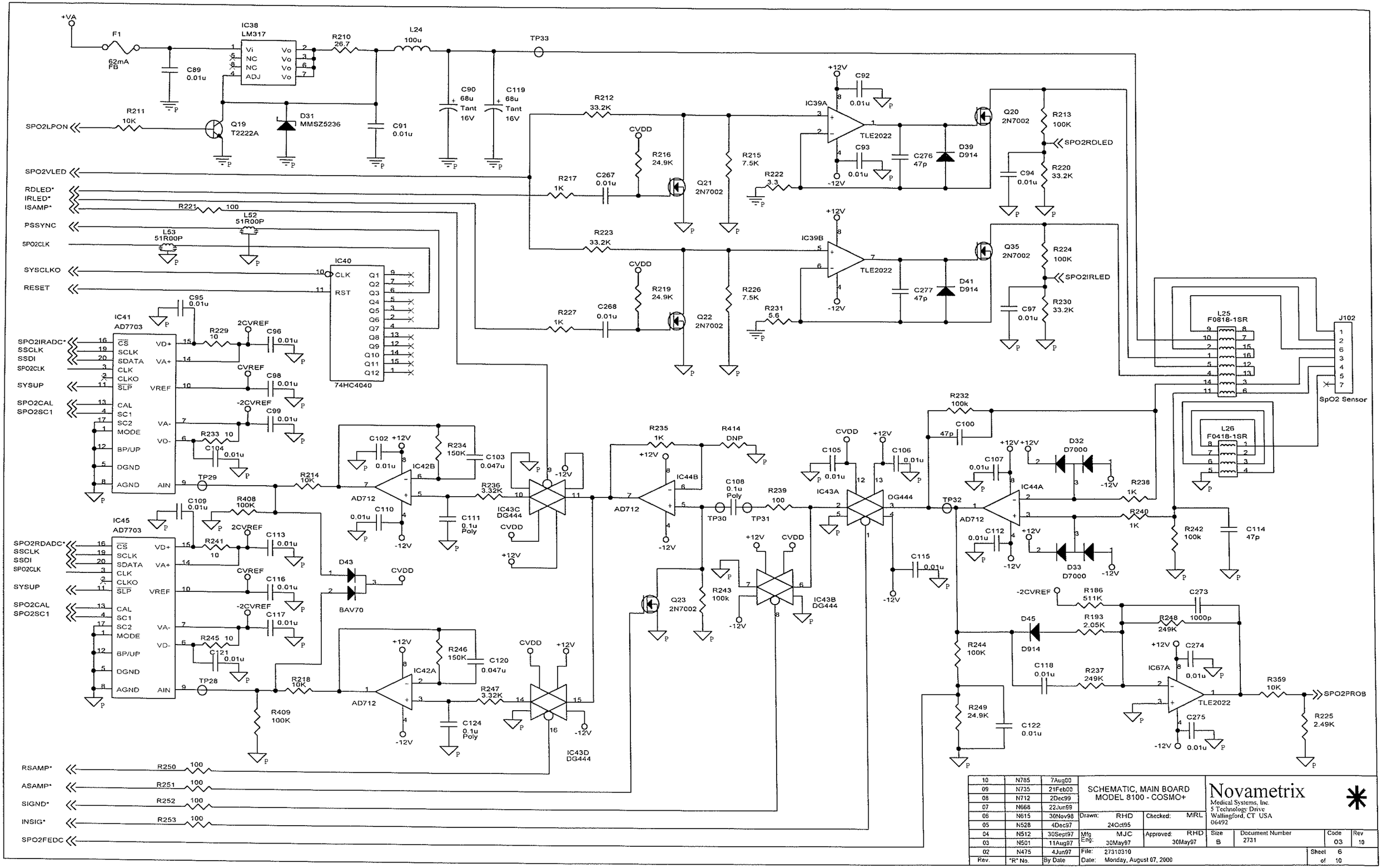
File: 27310310				Sheet 5	
Date: Monday, August 07, 2000				of 10	



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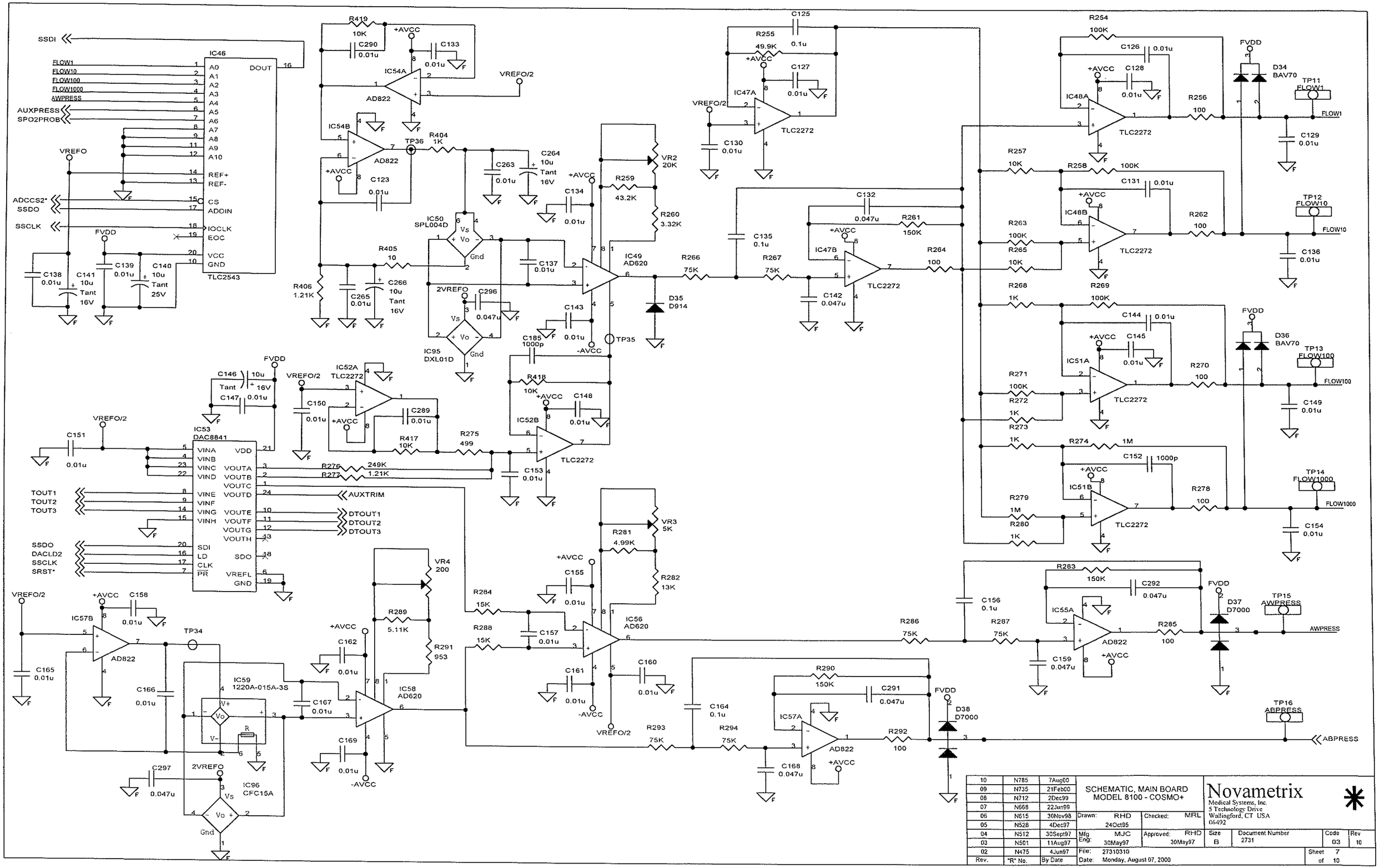

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02	N475	4Jun97	File: 27310310					Sheet 7 of 10	
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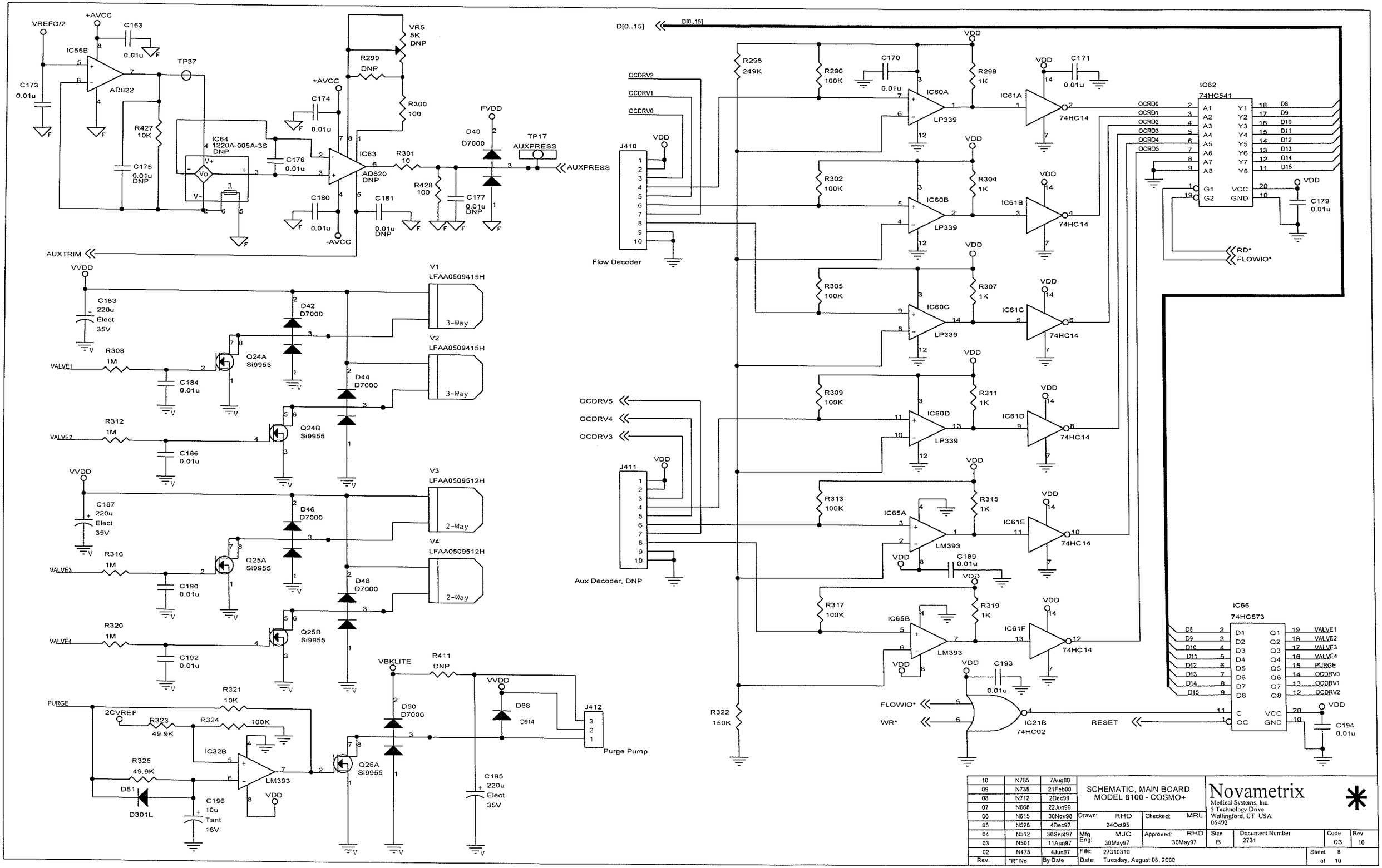

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Size	Document Number	Code	Rev
B	2731	03	10

Sheet 8 of 10

ASTxD
ASRxD
UTxD
URxD

IC70 AD680 — TP38 — R331 10 — C203 0.01u — C204 10u Tant 16V — +VA — C200 0.01u — VREFO

R338 10K — R339 10K — TP53 — 2CVREF
C205 0.01u — +12V — C206 0.01u — IC72A AD822 — R342 10 — C207 4.7u Tant 10V
R344 10K — TP39 — CVREF
C208 0.01u — +12V — IC72B AD822 — R346 10 — C209 4.7u Tant 10V

R348 10K — R349 10K — TP54 — 2VREFO
C210 0.01u — +AVCC — C211 0.01u — IC75A AD822 — R351 10 — C212 4.7u Tant 10V
R353 4.99K — TP40 — VREFO/2
C213 0.01u — +AVCC — IC75B AD822 — R357 10
R355 10K — R358 10K

R429 1K — IC68 CNY17-3 — R328 100K — R329 499 — Q27 T2907A
R337 100K — IC71 CNY17-3 — R340 499 — Q28 T2907A — R341 1K
R347 499 — IC73 CNY17-3 — R345 100K — Q29 T2907A
R350 1K
R352 100K — IC74 CNY17-3 — R354 499 — Q30 T2907A — R356 1K

Isolation Barrier

VDD — IVDD — R326 100K

IC69 LT1181 — C199 0.1u — C201 0.1u — C197 0.01u — C198 0.1u — C202 0.1u
IRAW — F2 125mA FB — L27 61R30T — R327 1K FB — L28 61R30T — R330 1K — L29 61R30T
L30 F0418-1SR — R332 1K — R333 1K — R335 1K — R336 1K
R407 1K — L54 51R00P
J100 Serial Comm

IVDD — F3 500mA FB — L31 61R30T — E1 GRN/YEL to REAR PANEL

IRAW — F4 125mA FB — L32 61R30T — J101 — Neonatal Heater, DNP

CVDD — C219 0.01u — C215 10u Tant 16V — IC78 AD7564
VDD DGND SDOUT CLR LDAC FSIN SDIN CLKIN A1 A0 RFBA RFBB VREFC VREFD AGND
VREFA IOUT1A IOUT2A VREFB IOUT1B IOUT2B RFBC IOUT1C IOUT2C RFBD IOUT1D IOUT2D
SRST* DACLD1* DACCS1* SSDO SSCLK
CO2DIN CO2DOUT CO2RIN CO2ROUT
CO2DFB CO2RFB -2CVREF
C225 0.01u

C252 100p — +12V — IC67B TLE2022 — -12V
C254 100p — +12V — IC77A TLE2022 — -12V

DTOUT1 DTOUT2 DTOUT3 — R367 10K — R368 24.9K — R369 49.9K — SPO2VLED

CVDD — R361 24.9K — R362 33.2K — R366 33.2K — IC77B TLE2022 — C216 0.01u — C224 0.01u — -12V
R363 10K — TP41 — Q31 T2907A — VDISP — R365 100

SYSUP — IC7D 74HC14

R370 10K — C279 0.01u — +12V — C218 0.01u — IC79A TLE2022 — R364 1K — C226 0.01u — -12V
C214 0.1u — L33 10u — C217 0.01u — R360 100 — C220 0.1u
R412 10K — R413 10K — IC76 MC34119 — C221 10u Tant 25V — C223 0.01u — C222 0.01u — J413 Speaker

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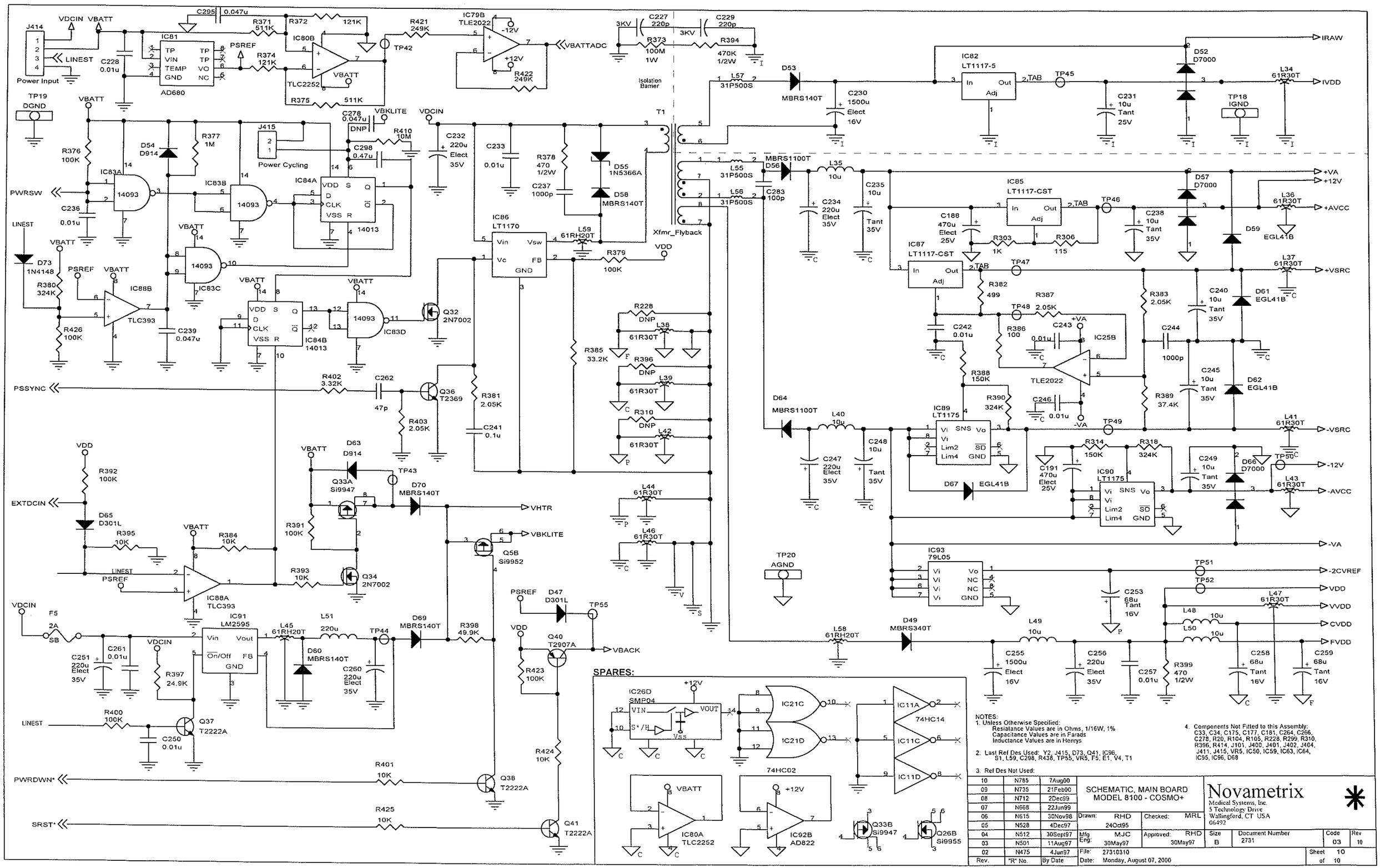

NOTES:
1. Unless Otherwise Specified:
   Resistance Values are in Ohms, 1/16W, 1%
   Capacitance Values are in Farads
   Inductance Values are in Henrys
2. Last Ref Des Used: Y2, J415, D73, Q41, IC96, S1, L59, C298, R438, TP55, VR5, F5, E1, V4, T1
3. Ref Des Not Used:
4. Components Not Fitted to this Assembly: C33, C34, C175, C177, C181, C264, C266, C278, R20, R104, R105, R228, R299, R310, R396, R414, J101, J400, J401, J402, J404, J411, J415, VR5, IC50, IC59, IC63, IC64, IC95, IC96, D68

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