

Model 509

Service Manual

Jan 26, 2000

Part Number 6900-90-00

Novamatrix Medical Systems Inc.
P.O. Box 690
5 Technology Drive
Wallingford, Connecticut, U.S.A. 06492.

CE
0086

Revision History

26-Jan-00 Preliminary

Guarantee

Equipment manufactured or distributed by Novamatrix Medical Systems Inc., is fully guaranteed, covering materials and workmanship, for a period of one year from the date of shipment, except for certain disposable products and products with stated guarantees other than one year. Novamatrix reserves the right to perform guarantee service(s) at its factory, at an authorized repair station, or at the customer's installation.

Novamatrix' obligations under this guarantee are limited to repairs, or at Novamatrix' option, replacement of any defective parts of our equipment, except fuses, batteries, and calibration gasses, without charge, if said defects occur during normal service.

Claims for damages during shipment must be filed promptly with the transportation company. All correspondence concerning the equipment must specify both the model name and number, and the serial number as it appears on the equipment.

Improper use, mishandling, tampering with, or operation of the equipment without following specific operating instructions will void this guarantee and release Novamatrix from any further guarantee obligations.

Service Department
For factory repair service, call toll free
1-800-243-3444
In Connecticut, call Collect (203) 265-7701
Facsimile (203) 284-0753
World Wide Web: <http://www.novamatrix.com>
Internet: techline@novamatrix.com

Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

Copyright 2000, Novamatrix Medical Systems Inc. This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc., and may not be reproduced, stored in a retrieval system, translated, transcribed, or transmitted, in any form, or by any means, without prior explicit written permission from Novamatrix Medical Systems Inc.

Service Policy

Novametrix Medical Systems Inc. provides 24-hour a day access to technical support through its Technical Support Department in Wallingford, Connecticut, and company Service Representatives located throughout the United States. (Outside the U.S., primary technical support is handled through our qualified international sales and service distributors.

Novametrix will provide Warranty Service support within 48 hours of receiving a request for assistance. Contact the Technical Support Department by telephone toll free at 800-243-3444, or 203-265-7701; by facsimile at 203-284-0753; or, by e-mail at techline@novametrix.com. After hours telephone 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. After hours facsimile and e-mail requests will be answered the next business day. It is suggested that any person calling in for technical support have the equipment available for product identification and preliminary troubleshooting.

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. Replaced or exchanged materials are expected to be returned to Novametrix within 10 days in order to avoid (additional) charges. Return materials should be cleaned as necessary and sent directly to Novametrix using the return paperwork and shipping label(s) provided (Transferring return materials to a local sales or dealer representatives does not absolve you of your return responsibility.).

Novametrix manufactures equipment that is generally field serviceable. When repair parts are provided, the recipient can call Technical Support for parts replacement assistance and repair assurance. In the event a replacement part requires increased technical capability, Technical Support may request Biomedical assistance, provide on-site technical support or complete replacement equipment. If the customer requires the return of their original product, the exchange material will be considered "loaner material" and exchanged again after the customer equipment is repaired.

Novametrix promotes customer participation in warranty repairs, should they become necessary. A longer useful product life, and quicker, more cost-effective maintenance and repair cycles—both during and after the warranty period, are benefits of a smooth transition into self-maintenance. The Technical Support Department can provide technical product support at a level appropriate to your protocol and budget requirements.

Please contact Technical Support for information on these additional programs and services:

- Focus Series Technical Training Seminars
- Test Equipment and Test Kits
- Service Contract / Parts Insurance Plans
- On-Site Technical Support
- "Demand Services" including:
 - Flat rate parts exchange
 - Flat rate return for repair
 - Time and material,
 - Full warranty, discounted replacement sensors.

Declaration of Conformity with European Union Directive

The authorized representative for Novametrix Equipment is:

D.R.M. Green
European Compliance Services Limited,
Oakdene House,
Oak Road,
Watchfield
Swindon, Wilts SN 6 8TD
United Kingdom



1

Table of Contents

Patient Safety	1
Indications and Usage	2
Front and Rear Panel Illustrations	5
Front Panel Illustration	5
Rear Panel Illustration	6
Electronic Theory of Operation	7
2543 Main Board	7
2581 Power Board	13
2542 Display Board	14
Functional Tests	15
Equipment Required	15
Procedure	15
Accuracy Tests	17
Equipment Required	17
Procedure	17
Electronic Tests	19
Equipment Required	19
Procedure	20
Safety Testing	22
Maintenance	23
Maintenance Schedules	23
Cleaning and Sterilization	23
Assembly Exchanges	25
Battery Replacement	26
Software Update Instructions	27
Troubleshooting	29
Status Messages	29
Specifications	31
SpO2 (Oxygen Saturation)	31
Pulse Rate	31
General Specifications	31
Parts Lists	33
6900-00 Pulse Oximetry Interface	33
6900-01 Main Assy Model 509	33

2542-01 Display Board Assy, Front	33
2543-01 Main Board Assy,	34
2581-01 Power Board Assy,	36
Schematics and Assembly Drawings	37

2

Patient Safety

Pulse oximetry is a non-invasive method of monitoring the oxygen saturation of arterial blood. Pulse oximeters display oxygen saturation of functional hemoglobin and therefore the accuracy may be interfered with by carboxyhemoglobin or other dysfunctional hemoglobins present in significant concentrations. Oxygen saturation monitoring is intended to be used in a variety of clinical situations, including, but not limited to respiratory therapy, anesthesia, intensive care, and emergency.

The *Model 509* Pulse Oximetry Interface Module SpO₂ input is electrically isolated. Patient leakage current flowing from the instrument to ground is limited to less than 50 µA at 120 VAC, 60 Hz. Patient isolation is tested at 2500 VAC rms at 60 Hz.

For maximum patient and operator safety, the following are recommended:

- **Failure of Operation:** If the module fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- Keep the *Model 509* and its accessories clean.
- Do not operate the *Model 509* when it is wet due to spills or condensation.
- Do not operate the *Model 509* if it appears to have been dropped or damaged.
- Connect the *Model 509* only to Novamatrix approved power supply.
- Connect the external supply only to a grounded hospital grade outlet. It should be connected to the same electrical circuit as the equipment it is used with. Outlets on the same electrical circuit can be identified by the hospital's engineering department.
- Care should be exercised to assure continued peripheral perfusion distal to the SpO₂ sensor site after application.
- Do *NOT* attach an SpO₂ 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.
- Do *NOT* wrap the sensor tape around the limb so tightly that circulation is restricted. Inspect the site often for adequate circulation - at least once every four hours. When applying sensors take note of the 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.
- Connect the *Model 509* external interface cable (Cat. No. 6905-00) to VueLink modules only.

2.1 Indications and Usage

The *Model 509* Pulse Oximetry Interface Module is intended to be used in conjunction with Hewlett Packard VueLink Gas Analyzer modules (Cat. # M1032A with option A03) and supported patient monitoring systems. The *Model 509* is intended to be used for monitoring oxygen saturation and pulse rate in all critical monitoring environments in all patient areas including adult, pediatric and neonatal.

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



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

- **Explosion Hazard:** Do NOT use the *Model 509* in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- **Electrical Shock Hazard:** Always turn the *Model 509* off and disconnect it from any equipment before cleaning it. Do NOT use a damaged sensor or one with exposed electrical contacts. Refer servicing to qualified service personnel.
- Do not operate the *Model 509* when it is wet due to spills or condensation.
- Do not operate the *Model 509* 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.
- **Patient Safety:** Care should be exercised to assure continued peripheral perfusion distal to the SpO₂ sensor site after application.
- **Data Validity:** As with all pulse oximeters, inaccurate SpO₂ and Pulse Rate values may be caused by
 - Incorrect application or use of a 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 ones with a xenon light source, or direct sunlight
 - Excessive patient movement
 - Venous pulsations
 - Electrosurgical interference
- **Data Validity:** Do NOT attach a 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.
- **Do Not** apply Y-Sensor tapes or wraps so tightly that circulation is restricted. Inspect 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.
- Electric shock hazard. Do NOT remove covers or panels. Refer servicing to qualified service personnel.

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

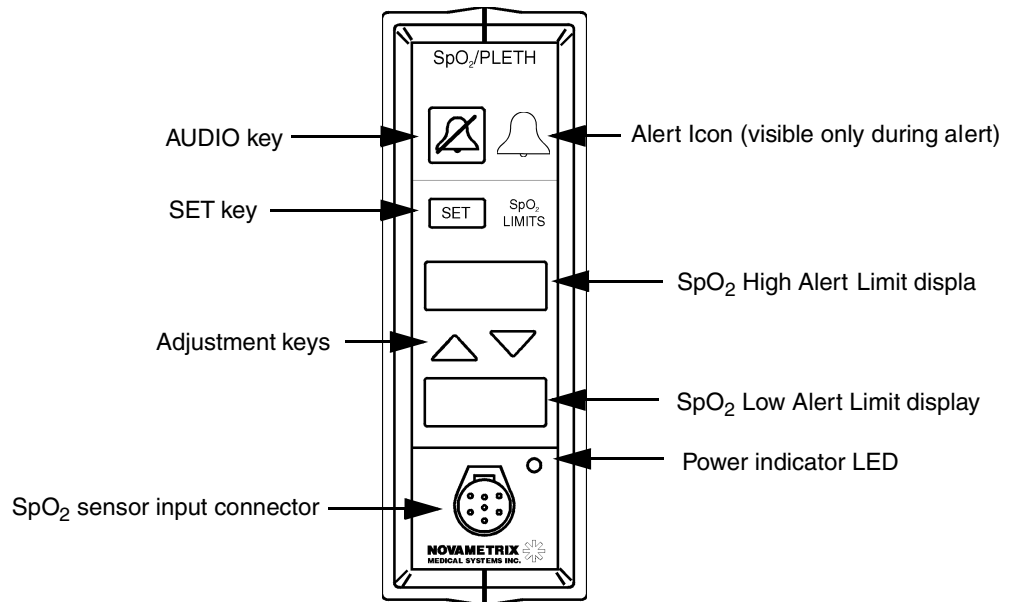
- Do not operate *Model 509* when it is wet due to spills or condensation.
- Do not operate *Model 509* if it appears to have been dropped or damaged.
- Never sterilize or immerse the monitor in liquids.
- Do not sterilize or immerse sensors except as directed in this manual.
- No tension should be applied to any sensor cable.
- Do not store the monitor or sensors at temperatures less than 14 °F (-10 °C) or greater than 131 °F (55 °C).
- Do not operate the monitor or sensors at temperatures less than 50 °F (10 °C) or greater than 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.
- Overstretching the pulse oximeter finger sensor can damage the sensor and potentially affect pulse oximeter readings. Do not stretch the finger sensor open beyond the limit for which it was designed. Overstretching can be prevented: avoid opening the sensor by any means other than squeezing the grips; *DO NOT* force the sensor onto large objects such as a bed rail.
- Electric shock hazard. Do NOT remove covers or panels. Refer servicing to qualified service personnel.
- For continued protection against fire hazard, replace fuse only with those of the same type and rating.


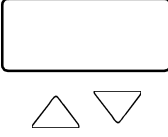


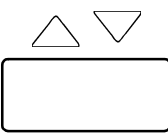



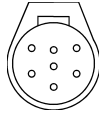

[This page intentionally blank.]

3

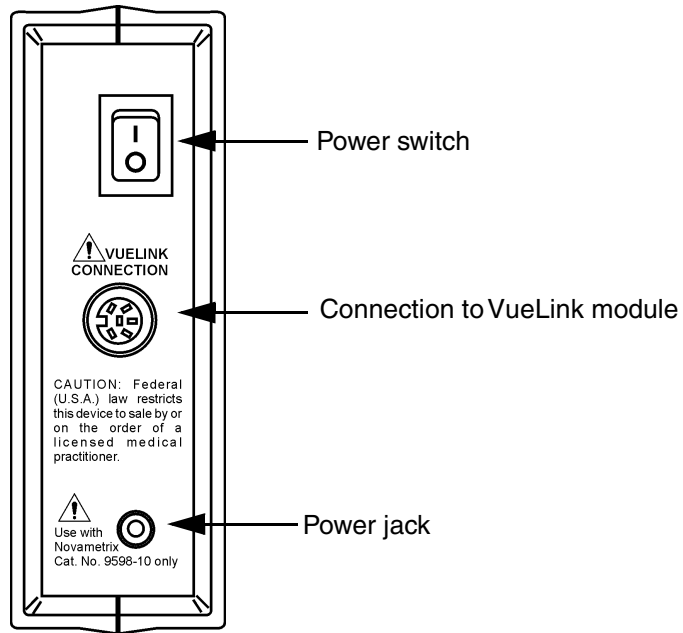
Front and Rear Panel Illustrations

3.1 Front Panel Illustration



	<p>AUDIO key-Press for two minute silence. Press and hold to permanently mute audible alert. Press again to cancel two minute silence or audible alert mute.</p>		<p>SpO₂ High Limit display-Upper limit value displayed during normal monitoring. Displays "▲", "VOL", "BEEP" or "AUTO" depending upon the function selected by the  key.</p>
	<p>SET key-Use to select between alert limits, pulse beep volume and alert volume.</p>		<p>SpO₂ Low Limit display-Lower limit value during normal monitoring. Displays "▼", volume setting value, pulse beep value, or "LMTS" depending upon the function selected by the  key.</p>
	<p>ADJUSTMENT keys-Use to adjust selected option's value.</p>		<p>Power indicator LED-Lights green when the <i>Model 509</i> is powered.</p>
	<p>SpO₂ sensor input connector-For connection of Novametric SuperBright series sensors.</p>		<p>Alert Icon- Flashes red when an alert condition is detected. This icon is visible only when indicating an alert.</p>

3.2 Rear Panel Illustration



	Power switch- "I" - ON turns module on, "O" - OFF turns module off.		Power jack-Connect only to Novamatrix power supply catalog number 9598-10.
	VUELINK connection- Connects to the "black" end of the VueLink interface cable.		Attention symbol-Consult manual for detailed information.

4

Electronic Theory of Operation

The electronic theory of operation of the Model 509 Pulse Oximeter monitor is detailed in the subsections below. See *Schematics and Assembly Drawings* on page 37. for accompanying information.

4.1 2543 Main Board

4.1.1 Power Supplies and Voltage Reference

Refer to schematic sheet 3. Power for the monitor enters at J101 when SW1 is closed (switched ON), the power is routed to the 2581 Power board through J102. Power then returns to the board as an analog (V8.1) and a digital (VDD) supply. Diode D1 protects against reverse bias, fuse F1 protects against over current conditions.

The LEDSRC supply which supplies the sensor's LEDs is current regulated by IC2 and further filtered by L3, C8 and C9. It is supplied by the analog supply V8.1 from the 2581 board. The VDD digital supply from the 2581 board is filtered by L2 which creates the +VA supply. The -VA supply is created by IC3 which is a charge pump inverter. The +VA and -VA supplies are needed by the bipolar analog circuits in the monitor.

Refer to schematic sheet 2. A positive reference voltage VREF2.5 is developed by IC8, which is a +2.5 volts DC reference derived from the +VA supply. A negative reference voltage is developed by IC23A (pin1) by inverting the +2.5 volt supply (schematic sheet 3). This negative reference is -VREF at TP6. The analog to digital converters IC9, IC10 and IC11 use the VREF2.5, the -VREF (-2.5V DC) is used by the digital to analog converter IC22.

4.1.2 Sensor LED Drive Circuits

See schematic sheet 2. When the $\overline{\text{RDLED}}$ signal goes low (logic 0), Q3 turns off and the VLED signal is divided down by R23 and R25, at IC7A (pin 3). FET Q2 is in turn driven on by IC7A (pin 1). Current will flow from LEDSRC (J200 pin 7) through the red LED in the sensor, through Q2, then through R20 to ground.

When $\overline{\text{RDLED}}$ returns high (logic 1), Q3 is biased on, forcing IC7A pin3 to ground potential, this results in 0 volts at the output of IC7A (pin 1). FET Q2 is biased off, and as a result, the Red LED in the sensor is off.

The Infrared LED drive circuit operates in the same manner as the Red LED drive discussed above. The $\overline{\text{IRLED}}$ signal activates Q4 which controls IC7B, this in turn controls Q8. The source of Q8 will control the Infrared LED of the sensor.

Refer to schematic sheet 3. The VLED line voltage is derived from IC23B pin 7 which is controlled by the Digital to Analog Converter IC22. When the $\overline{\text{DACCS}}$ line is brought Low IC22 is enabled. The data on lines D0-D7 now control the output of IC22 which in turn control IC23Bs output on pin 7(VLED).

4.1.3 **Photodiode Return Path**

Refer to schematic sheet 2. 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. IC4B pins 5-7 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 IC4B pin 7¹.

The voltage at IC4B pin 7 is presented to an analog switch IC5B pin 6. This switch is controlled at pin8 by $\overline{\text{INSIG}}$ (Input Signal), and will be closed (IC5B pins 6 and 7 connected) except if the monitor is in a probe off patient condition or is undergoing its self-test at system power up. The switch IC5C pins 9-11, controlled from $\overline{\text{SIGND}}$ (Signal Ground) will be open (no connection between IC5C pins 10 and 11) except as noted above for the switch at IC5B pins 6-8. As a result, the IC4B pin 7 voltage passes undisturbed to the high pass filter consisting of R14 and C15.

The ASAMP signal is active whenever either sensor LED is turned on. This causes Q5 to turn off and the charge at C15 passes through to IC4A pin 3. The ASAMP line returns to a logic high when neither LED is being driven, causing Q5 to turn on. With Q5 conducting, any charge at C15 is discharged to ground and the next pulse will charge C15 from a known level. If it were not for Q5, any charge remaining on C15 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 IC4A pin 1 is the product of the Red LED being turned on, then $\overline{\text{RDSAMP}}$ will go low and close the switch at IC5A pins 2-3, thereby presenting the signal to a sample and hold circuit consisting of R29 and C26 (that maintains the signal until next sample pulse arrives), a gain stage, (IC6A), a filter network (C34 and R34), and finally, to the red channel Analog-to-Digital Converter (ADC) IC10.

If the signal at IC4A pin 1 is the product of the Infrared LED being turned on, then $\overline{\text{IRSAMP}}$ will go low and close the switch at IC5D pins 14-15, thereby presenting the signal to a sample and hold circuit consisting of R28 and C25 (that maintains the signal until next sample pulse arrives), a gain stage, (IC6B), a filter network (C29 and R38), and finally, to the infrared channel Analog-to-Digital Converter IC9.

4.1.4 **Calibrating the 20-Bit Analog to Digital Converters (ADCs)**

The 20-bit ADCs are calibrated as part of the system self-test which occurs each time the monitor is turned on. At power up, the microprocessor sets the CAL line high. The system calibrations input SC1 is set high. The CS5503 ADC will not operate while the CAL line is high. On the falling edge of the CAL signal, the ADC will initiate a calibration cycle. The type of calibration is determined by the state of the SC1.

The high at SC1 causes $\overline{\text{INSIG}}$ to go high and reset $\overline{\text{SIGND}}$ to a logic low. The high $\overline{\text{INSIG}}$ opens the switch at IC5B pin8 so that IC5B pins 6 and 7 are no longer connected—disconnecting the returning photodiode signal from the rest of the circuitry. The low $\overline{\text{SIGND}}$ signal closes the switch at IC5C pin9 and as a result, the input to the C15-R14 high pass filter (and thus the entire ADC input circuitry) is brought to ground potential.

The CAL line (which went high at power up) is reset low and ADCs IC9 and IC10 begin their calibration cycles. Because the analog input circuitry is grounded via $\overline{\text{SIGND}}$, only circuit offset voltages can be present at the (pin 9 AIN) inputs. The calibration cycle sets

1. The Model 509 uses SuperBright™ sensors. If a non-SuperBright™ sensor is connected, IC4b pin 7 will go negative.

the ADC “zero” point to equal this voltage, thus compensating for any circuitry offsets. The ADC then sets its “full scale” point to equal the voltage at its VREF (pin 10) input. This completes the calibration cycle.

The ADC can now start sampling its input and converting it to a 20-bit digital word. The processor resets SC1 to a logic low, causing IC5C pin9 to open and IC5B pin8 to close. The photodiode signal can now reach the ADCs.

4.1.5 20-Bit Analog to Digital Conversion

Refer to sheet 2 on schematic. Data from the red and infrared channels is sampled by the 20-bit measurement ADCs, IC10 and IC9 respectively. The analog input at pin 9 is converted to a digital representation with 20-bit resolution based on the input magnitude.

The CS5503 converter continuously samples its input, converts the value to a digital word, puts the word in its output buffer (overwriting previous buffer contents), then repeats the process by again sampling its input. The frequency of the sample/convert/overwrite-buffer sequence is based on the 3.072 MHz clock signal at the ADC pin 3 (F_ADCCLK) input.

The microprocessor starts a read cycle of the Infrared channel by bringing $\overline{\text{ADCIRCS}}$ low. A Red channel read starts when $\overline{\text{ADCREDCS}}$ is brought low. On the falling edge of these signals ($\overline{\text{CS}}$ lines), the output word's MSB (most significant bit) appears at pin-20 SDATA (Serial Data) output. The SDATA line connects directly to the microprocessor's serial input (RXS) pin. The remaining bits (in descending order) are output from SDATA with subsequent falling edges of the Serial Clock (CLKS) input at pin 19. The SDATA output automatically goes to a 3-state (high impedance) condition after completing a word transmission, thus freeing the data line for other uses (i.e., the other ADC channel).

The CLKS rate is significantly slower than the ADC sampling rate. As a result, the ADC rewrites its output buffer with new information at a faster rate than the data can be read from the buffer. No conflict occurs, however, because while $\overline{\text{CS}}$ is low (during the read cycle), the ADC does not update its output buffer—the current word is not overwritten. After the processor receives the entire word, it allows the convertor's $\overline{\text{CS}}$ to return high, and the ADC resumes its sample/convert/overwrite-buffer cycle.

4.1.6 Sensor Status

The microprocessor monitors several sensor parameters in addition to the red and infrared data channels. These parameters allow the software to determine when certain error conditions are present in order to display the proper error code.

Refer to schematic sheet 2. The 8-to-1 multiplexor, IC12, decodes the A0MUX-A2MUX input address lines and connects one of eight status parameter inputs to the multiplexer output at IC12 pin 3. Resistor R47 and diode D13 prevent negative voltages from reaching the input of IC11.

IC11 is an 8-bit serial analog-to-digital convertor. While the IC11 Chip Select ($\overline{\text{ADC3CS}}$) input is high, the CLK input and DOUT output are in 3-state mode. When $\overline{\text{ADC3CS}}$ is brought low (under processor control), the most significant bit (D7) of the previous data conversion becomes available at the DOUT pin. The remaining bits (D6-D0) are shifted out on subsequent falling edges of the CLK input. On the clock pulse following the one that shifts out the least significant bit (D0), the CLK and DOUT lines are returned to 3-state and IC11 performs a new conversion based on the input it receives from the IC12 channel selected by the A0MUX-A2MUX input address lines.

The IC11 sample/convert/store-result cycle is based on internal chip timing and not the CLKS input which (along with $\overline{\text{ADC3CS}}$) only controls serial data output. Thus the $\overline{\text{CS}}$ line is free to return high once the IC11 cycle begins.

4.1.7 **Sensor Status Parameters**

The sensor status parameters input to the multiplexor IC12 are described below.

ADCVRD: This signal is not used as of this writing.

ADCVIR: This signal is not used as of this writing.

ADCFEDC: Photodiode DC Level.

Resistors R11, R12 and capacitor C14 form a voltage divider and low pass filter that provide a measure of the mean DC level at the output of the photodiode amplifier IC4B pin 7. This signal (IC12 pin 15) is used in determining ambient light interference. If this line is examined while the sensor's red and infrared LEDs are turned off, then any DC level at IC4B pin 7 must be the result of ambient light impinging on the photodiode. If the DC shift is in excess of limits set in the software, a Light Interference message appears on the monitor's display.

ADCLPWR: Sensor LED Supply Voltage.

This channel, at IC12 pin 12, monitors the sensor LED supply voltage through a voltage divider consisting of R2 and R3 (sheet 3 on schematic). If a fault occurs that causes the LED supply fuse F2 to blow, or if the sensor wires are shorted, this channel reports the condition and the monitor will indicate the appropriate error condition.

ADCIRLED: Infrared LED Cathode Voltage.

A low pass filter/divider consisting of R17, R18 and C24 provides a means to measure the cathode voltage of the sensor's Infrared LED. When the channel at IC12 pin 5 is sampled the monitor can determine if the LED is open circuit (zero volts at IC12 pin 5) or operational (approximately 2.5 volts at IC12 pin 5).

ADCRDLED: Red LED Cathode Voltage.

A low pass filter/divider consisting of R15, R16, and C23 provides a means to measure the cathode voltage of the sensor's Red LED. When the channel at IC12 pin 4 is sampled the monitor can determine if the LED is open circuit (zero volts at IC12 pin 4) or operational (approximately 2.5 volts at IC12 pin 4).

4.1.8 **Processor and Memory**

Refer to page 1 on schematic. The Model 509 is controlled by IC14, an 8 bit microprocessor running at 6.144 MHz. Crystal Y1 (12.288 MHz) controls the operating frequency, system address lines are labelled as A0-A17, and system data lines are labelled D0-D7.

The system program is contained in IC18, a 27C101 (1 MB) EPROM. When $\overline{\text{ROMCS}}$ is brought low a read operation is performed on IC18. The $\overline{\text{ROMCS}}$ line is controlled by the $\overline{\text{ME}}$ line (Memory Enable) and address line A17. When both the $\overline{\text{ME}}$ line and address line A17 are low the $\overline{\text{ROMCS}}$ line will go low (IC20A pin 6), this enables the data to be read from IC18.

System RAM is contained in IC17, a 256k SRAM. When both the $\overline{\text{RD}}$ and $\overline{\text{RAMCS}}$ lines are brought low a read operation is performed on IC17. With both $\overline{\text{WR}}$ and $\overline{\text{RAMCS}}$ low a write operation will be performed. The $\overline{\text{RAMCS}}$ line is controlled by the $\overline{\text{ME}}$ (Memory Enable) line and address line A17. When address line A17 is brought high, and the $\overline{\text{ME}}$ line brought low, IC20B pin 3 will go low activating the $\overline{\text{RAMCS}}$ line.

Refer to sheet 3 on schematic. The processor communicates to the Vuelink through serial channel 0 on the microprocessor. The TX0 and RX0 lines from the processor are converted to RS232 levels by IC13 as TXD0 and RXDI.

4.1.9 Decoding

Refer to page 1 on schematic. A three to eight line decoder IC19, is used for decoding various address, write, and I/O lines for the system. Address lines A4, A5, A6, and A7 along with the IOE and LIR lines will enable one of the Q outputs of IC19.

Name	Function
DACCS Digital to Analog Converter Chip Select	This line will enable writing to IC22.
DISPC Display Chip Select	This line enables the displays to be written to.
KEYLATCH	This line enables the input latch that reads the keypad.
DAC2CS	This line enables the D/A converter which controls the audio output level.
PORT1WR Port #1 Write	This line enables writing to IC16, which controls the multiplexor lines, SC1 and CAL lines for the 20 bit A/D Converters, and all data converter chip selects.
PORT2WR Port #2 Write	This line enables writing to IC15 which controls the 20 bit A/D converter sleep line ADCSLP and the ALERT line

4.1.10 Processor Superviso

Refer to page 1 on schematic. A microprocessor supervisory integrated circuit, IC29 monitors the power supply, generates the Reset signals, and switches the power supply to the SRAM over to battery on power down. The WDOG line under control of the processor must be toggled before a specific time-out occurs (1.6 seconds) otherwise the RESET line is brought low resulting in the system resetting itself. Therefore, the processor toggles the WDOG line periodically to avoid the reset which ensures that the processor is working and not lost in a loop or task. If the VDD supply drops below a certain level (4.65V) the RESET line will also be brought low to reset the system.

4.1.11 Front End Timing Signals

Refer to page 3 on schematic. A 14 stage divider IC27, acts as a timing sequencer. The ADCCLK input is the clock input, the RESET line is the clear input, used for clearing the chip at power up. The Q4-Q11 outputs of IC27 are divided down from the clock input and feed IC28, the data sampling controller. The Q14 output of IC27 is used as an interrupt that is generated roughly every 5 milliseconds (INT5MS).

The data sampling controller IC28 is a Programmable Electrically Erasable Logic device (PEEL). The PEEL uses the outputs from IC27 and generates the front end timing signals. These signals control the sensor LED drive and the photodiode's return path circuitry during normal operation and calibration.

The RESET and SC1 lines control when the outputs of IC28 are active, both these lines must be low in order for IC28 to operate normally. The RESET line controls IC28 during

power up, while the SC1 line is under processor control and will toggle when a probe off patient alert exists and during the power up self test.

Signal	Description
INSIG Input Signal	This line will enable signals from the photodiode, or prevent signals from the photodiode from reaching the detection circuitry.
RDLED Red LED	Controls the signals for the Red LED in the sensor.
IRLED Infrared LED	Controls the signals for the Infrared LED in the sensor.
SIGND Signal Ground	This is used to short out the inputs of the detection circuitry so that the system can compensate for offsets.
ASAMP Analog Sample	This line is used to short out the capacitor used in the sample and hold circuitry to avoid having residual charge interfere with data sampling.
SYNC Synchronization	Synchronization signal, not used in this system.
IRSAMP Infrared Sampling	Used for sampling the Infrared signal response from the photodiode.
RDSAMP Red Sampling	Used for sampling the Red signal response from the photodiode.

4.1.12 System Output Ports

Refer to page 1 on schematic. There are two output latch chips IC15 and IC16, these control various lines for system control. The first port IC16, enabled when PORT1WR is high, controls the CSIO PEEL IC26, the analog multiplexor IC12, and selection of the A/D converters. The second port IC15, enabled by the PORT2WR line, handles control line ADCSLP and the ALERT line.

The output ports are selected by the decoding performed by IC19, IC20 & IC21 and the WR line. The signals controlled by the ports are listed below with a brief description of their function.

Signal	Description
AA0-AA1	Decode line for selecting ADCs.
SC1	Used for 20 bit ADC calibration.
CAL	De-activates the 20 bit ADCs prior to calibration.
A0MUX-A1MUX	Selects one of six sensor status channels that will be switched to the serial A/D converter for conversion.
NEXT	Used in decoding selection of ADCs.
ADCSLP	ADC sleep line.
ALERT	Alert line.

4.1.13 Serial I/O Controller

Refer to page 1 on schematic. Digital data from the three Analog-To-Digital Convertors SDATA is read by the CPU through its clocked serial data input (RXS) at IC14 pin 56. The PEEL IC26 acts as the Clocked Serial Input/Output (CSI/O) Controller.

Except during power up or watchdog timer reset, IC27 pin 3 (sheet 3 on schematic) provides an interrupt to the CSI/O controller in the form of a 5 millisecond period square-wave input to IC26 pin 7 (INT5MS).

On the rising edge of INT5MS, a CPU interrupt request is generated when IC26 pin 18 (CPUINIT) goes low. The CPU responds by sending the clock input to CSI/O controller (CKS) at IC26 pin 6 low. (This CKS line is inactive (high) unless a serial receive operation is in progress.) The CPU also sets up the ADC decode lines AA1 and AA0 at IC26 pins 5 and 4, and as a result, one of the ADC chip select lines (ADCIRCS, ADCREDCS, ADC3CS) is brought low, and the CPUINIT line is disabled.

On the rising CKS signal a CLKS output pulse at IC26 pin 14 is sent as a serial clock input to the ADC selected by the decode lines. Decode results are shown below.

AA1	AA0	Decode
0	0	Red LED 20-bit ADC
0	1	Infrared LED 20-bit ADC
1	1	Sensor Status 8-bit ADC
1	0	Internal CSI/O signal (TEND)

Successive CKS/CLKS pulses cause the ADC data to be shifted out of the ADC (most significant bit first) along the serial data line (SDATA) to the CPU serial input (RXS) at IC14 pin 56.

After receiving the correct number of bits for the ADC being read, the CPU changes the AA1 and AA0 decode lines and exerts the Next line (NEXT) at IC16 pin 12 low. This restarts the serial data shifting out of the newly selected ADC.

After all three ADCs have been read, the CPU sets the AA1 and AA0 decode lines to exert the internal TEND signal and set the 8-bit ADC to the next channel (so that it has time to settle before the next read of the ADC). This re-enables the CPUINIT line. At this point the CSI/O controller is reset awaiting an INT5MS pulse to begin the cycle again.

4.1.14 Audio Drive Circuitry

Refer to page 3 on schematic. Audible tones are generated by the Digital to Analog Converter IC24 when both the WR and DAC2CS are low. The output of IC24 drives non-inverting amplifier IC25B which in turn drives Q7. Transistor Q7 boosts the current of IC25B in order to drive transducer LS1.

4.2 2581 Power Board

Power from the external supply enters the board as VRAW through J1 and is converted to a digital supply (VCC) by voltage regulator IC2 and an analog supply (V8.1) by voltage regulator IC1. The analog supply is used as the supply for the LEDs in the sensor (LEDSRC) and is also used by the audio circuitry. The digital supply, in addition to supplying the digital circuitry is converted to bipolar supplies for some of the analog circuitry in the monitor

4.3 2542 Display Board

The display board contains two three digit LED displays and the keypad latch. The front keypad connects to J203 and the main board connects through J202. Two LEDs, one for power indication and the other for the alert icon are also located on the display board.

Address line A2 controls which of the two displays is currently selected while address lines A0 and A1 determine which digit of the selected display is being written to by the processor's data lines D0-D7. The \overline{WR} and \overline{DISPCS} lines also control the selection of the displays (IC2 and IC3). The combination of RP1 pins 1 and 6, R3 and Q1 inverts the A2 signal for IC3, this enables A2 to either select IC2 or IC3 by changing states (this is in accordance with the \overline{WR} , \overline{DISPCS} and \overline{RESET} lines).

The \overline{ALERT} line draws current through LED D1 when low, this illuminates the display's alert icon (red). When power is applied to the monitor LED D2 illuminates green.

The membrane keypad is decoded by IC1. The $\overline{KEYLATCH}$ line enables IC1 by polling it to check if any of the four front panel keys has been depressed. The appropriate output from IC1 is read by data lines D0-D3 (remaining lines are not necessary and are tied to ground).

5

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 Novamatrix Service Department for repair/replacement assistance.

5.1 Equipment Required

1. HP Merlin System
2. 6904-00 HP Vuelink Module - Programmed for Novamatrix Model 509
3. 6905-00 HP Adapter Cable
4. 8776-00 Novamatrix Finger Sensor
5. 9598-10 Power Supply

5.2 Procedure

1. Connect the HP Merlin System to AC power and press the power on button.
2. Plug the HP Vuelink Module into one of the HP Merlin System bays.
3. Plug the HP Adapter Cable into the HP Vuelink Module.
4. Apply power to the Model 509 by switching the power switch from "O" to "I"
5. Verify a proper power up sequence. The alert limit displays "NMTX" and "509" followed by the software revision. The alert led flashes and the high and low alert limits are shown.
6. Press the Set key. Verify the high alert limit has an arrow beside it.
7. Using the Up Arrow and Down Arrow key's change the high alert limit. Set the high alert limit to 100.
8. Press the Set key again. Verify the low alert limit has an arrow beside it.
9. Using the Up Arrow and Down Arrow key's change the low alert limit. Set the low alert limit to 85.
10. Press the Set key again. Verify ALRM appears in the upper display. Set the Volume to VOL4 (can be set from VOL1 to VOL7).
11. Press the Set key again. Verify BEEP appears in the upper display.
12. Press the Up Arrow key to set the Beep to VOL3 (can be set OFF or from VOL1 to VOL7).
13. Connect the HP Adapter Cable to the Model 509.

14. Press the HP Vuelink Module button.
15. Verify the Open Interface Saturation Information Page is displayed. Press the MAIN SCREEN button on the HP Merlin System to display the full Merlin screen.
16. Connect the Finger Sensor to the Model 509. Place the Finger Sensor on your finger and verify a Saturation and Pulse values are displayed on the HP Merlin screen along with a Plethysmogram waveform.
17. Verify the HP Merlin displays a Plethysmogram waveform that is clean and free of any drop out.
18. Remove your finger from the Finger Sensor. Verify “SPO2 Probe Off PT” message on HP Merlin display, alert tone and flashing alert icon on Model 509.
19. Press the AUDIO key (Model 509) to silence the alert for two minutes (a beep will sound). Verify the alert tone returns after two minutes. Press and hold the AUDIO key for three seconds to permanently mute the alert one (two beeps will sound).
20. Disconnect the Model 509 from the HP Merlin system. Verify the Model 509 displays a “Chk Com” and the Alert LED is flashing.
21. The test is complete. Power down the Model 509 by disconnecting the power supply from the AC outlet. Disconnect the Model 509 from the HP Merlin system.

6

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” on page 15. If the monitor does not pass the accuracy test, contact the Novamatrix 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.

6.1 Equipment Required

1. HP Merlin System
2. 6904-00 HP Vuelink Module - Programmed for Novamatrix Model 509
3. 6905-00 HP Adapter Cable
4. TB500B Saturation Sensor Simulator (calibrated)
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.
5. 9598-10 Power Supply

6.2 Procedure

1. Connect the HP Merlin System to AC power and press the power on button.
2. Plug the HP Vuelink Module into one of the HP Merlin System bays.
3. Plug the HP Adapter Cable into the HP Vuelink Module
4. Apply power to the Model 509 by switching the power switch from “O” to “I”
5. Verify a proper power up sequence. The alert limit displays “NMTX” and “509” followed by the software revision. The alert led flashes and the high and low alert limits are shown.
6. Press the Set key. Verify the high alert limit has an arrow beside it.
7. Using the Up Arrow and Down Arrow key’s change the high alert limit. Set the high alert limit back to 100.
8. Press the Set key again. Verify the low alert limit has an arrow beside it.

9. Using the Up Arrow and Down Arrow key's change the low alert limit. Set the low alert limit back to 85.
10. Press the Set key again. Set the Volume to VOL4.
11. Press the Set key again.
12. Press the Up Arrow key to set the Beep to VOL3.
13. Connect the HP Adapter Cable to the Model 509.
14. Connect the TB500B to the Model 509. Set the Signal Attenuation to "3" and the Saturation to "100".
15. Apply power to the Model 509 by switching the power switch from "O" to "I"
16. Press the HP Vuelink Module button.
17. Verify the Open Interface Saturation Information Page is displayed. Press the MAIN SCREEN button on the HP Merlin System to display the full Merlin screen.
18. Press and hold the Audio Off key until a double beep is heard.
19. Set the TB500B Attenuation to "3".
20. Verify the following Saturation values. For each setting verify a Pulse Rate of 60 ± 1 . Verify an audio beep consistent with the Pulse beat.

<u>Saturation Setting</u>	<u>Attenuation</u>	<u>Tolerance Range</u>
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

21. Disconnect the TB500B from the Model 509.
22. Disconnect the Model 509 from the HP Merlin system. Verify the Model 509 displays a "CHK COM" and the Alert LED is flashing.
23. The test is complete. Power down the Model 509 by disconnecting the power supply from the AC outlet. Disconnect the Model 509 from the HP Merlin system.

7

Electronic Tests

The Electronic Tests verify the calibration and operation of the electronic circuits within the Model 509. 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 page 15 and/or “Accuracy Tests” on page 17. 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 25 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 Novamatrix 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.

7.1 Equipment Required

1. HP Merlin System
2. 6904-00 HP Vuelink Module - Programmed for Novamatrix Model 509
3. 6905-00 HP Adapter Cable
4. 9598-10 Power Supply
5. 5530-00 TB500B Saturation Sensor Simulator*
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.
6. 5942-00 Saturation Test Jack
7. 6573-48 Shorted Saturation Test Jack (safety checks)
8. 8776-00 Novamatrix Finger Sensor
9. Hipot Tester*
10. DMM*
*Calibrated

7.2 Procedure

1. Connect the HP Merlin System to AC power and press the power on button.
2. Plug the HP Vuelink Module into one of the HP Merlin System bays.
3. Plug the HP Adapter Cable into the HP Vuelink Module.
4. Apply power to the Model 509 by switching the power switch from "O" to "I"
5. Verify a proper power up sequence. The alert limit displays "NMTX" and "509" followed by the software revision. The alert led flashes and the high and low alert limits are shown.
6. Measuring the following voltages:

<u>Location</u>	<u>Signal Name</u>	<u>Voltage</u>
TP1	VDD	5.00 V \pm 0.2 V
TP2	+VA	5.00 V \pm 0.2 V
TP3	-VA	- 4.75 V \pm 0.25 V
TP4	LEDSRC	7.00V \pm 0.5 V
TP9	VREF 2.5	2.50 V \pm 0.05 V
TP6	VREF -2.5	-2.50V \pm 0.05 V
IC29-1	VBACK	5.00 V \pm 0.2 V

** Use Test Point 5 (TP5) for ground reference

7. Jumper Test Point 12 to Test Point 13.
8. Connect the Saturation Test Jack to the Model 509 input connector.
9. Monitor IC4 pin 7. Verify 1.00VDC \pm 50mV.
10. Monitor Test Point 10. Verify 2.00VDC \pm 0.1V.
11. Monitor Test Point 11. Verify 2.00VDC \pm 0.1V.
12. Remove the jumper and disconnect the Saturation Test Jack.
13. Press the Set key. Verify the high alert limit has an arrow beside it.
14. Using the Up Arrow and Down Arrow key's change the high alert limit. Set the high alert limit back to 100.
15. Press the Set key again. Verify the low alert limit has an arrow beside it.
16. Using the Up Arrow and Down Arrow key's change the low alert limit. Set the low alert limit back to 85.
17. Press the Set key again. Verify the Alert Volume setting is displayed.
18. Using the up and down arrow keys, set the alert volume to "VOL7".
19. Press the Set key again. Verify the Beep Volume setting is displayed.
20. Using the up and down arrow keys, set the Beep Volume to "VOL5".
21. Power down the main board by switching the power from "I" to "O".
22. Measure IC17-28. Verify 2.50V to 3.50VDC.

23. Connect the HP Adapter Cable to the Model 509.
24. Connect the TB500B to the Model 509. Set the Signal Attenuation to “3”, the Saturation to “100” and turn it ON.
25. Apply power to the Model 509 by switching the power switch from “O” to “I”
26. Press the HP Vuelink Module button.
27. Verify the HP Merlin displays a “Preparing Operation Screen” followed by the “Gas Analyzer Information Page”. Press the MAIN SCREEN button on the HP Merlin System to display the full Merlin screen.
28. Set the TB500B Saturation to “62”. Verify the Model 509 Alert LED is flashing and an audible alert is present.
29. Press the Audio Off key and verify the audible alert is gone. Verify a “2 min” message is displayed on the left side of the HP Merlin waveform.
30. Wait approximately two minutes. Verify the audible alert returns and the “2 min” message clears.
31. Press and hold the Audio Off key until a double beep is heard. Verify the audible alert is gone. Verify a “Mute” message is displayed on the left side of the HP Merlin waveform.
32. Return the TB500B Saturation to “100”.
33. Verify the following alert conditions. Verify the error message displayed in the upper left hand corner of the HP Merlin display. Verify the Model 509 Alert LED is flashing and no audible alert is heard. Verify any Saturation and Pulse values displayed on the HP Merlin screen clear. Return the TB500B to the original setting after each error check and verify the error condition clears and the Saturation and Pulse values return.

<u>Atten</u>	<u>Sat</u>	<u>Switches</u>	<u>Error Message</u>	<u>After 10 seconds</u>
3	100		None	
3	0		SPO2 Low Signal	SpO2 REPOS PROBE
3	100	Red Open	SPO2 Probe Failed	no change
3	100	IR Open	SPO2 Probe Failed	no change
3	100	Pwr Off	SPO2 Insuf. Light	SpO2 REPOS PROBE
3	100	TB Not Connected	SPO2 Probe Discon	no change

34. Verify the following Saturation values. For each setting verify a Pulse Rate of 60 ± 1 . Verify an audio beep consistent with the Pulse beat.

<u>Saturation Setting</u>	<u>Attenuation</u>	<u>Tolerance Range</u>
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

35. Disconnect the TB500B from the Model 509.

36. Disconnect the Model 509 from the HP Merlin system. Verify the Model 509 displays a “Chk Com” and the Alert LED is flashing.
37. The test is complete. Power down the Model 509 by disconnecting the power supply from the AC outlet. Disconnect the Model 509 from the HP Merlin system.

7.3 *Safety Testing*

1. Connect the 6573-48 Shorted Saturation Test Jack to the Model 509 input.
2. Using the Hipot apply 2.5KV from the shorted hot / neutral to earth ground on the power supply. Wait approximately one minute. Verify there is no arcing or leakage during the test period.
3. Using the Hipot apply 2.5KV from the shorted hot / neutral on the power supply to the 6573-48 Shorted Saturation Test Jack. Wait approximately one minute. Verify there is no arcing or leakage during the test period.
4. Using the Hipot apply 500V from earth ground on the power supply to the 6573-48 Shorted Saturation Test Jack. Wait approximately one minute. Verify there is no arcing or leakage during the test period.
5. Measure the AC leakage from the 6573-48 Shorted Saturation Test Jack to the hot side of the AC line. Verify the leakage current is < 50 uA.

8

Maintenance

8.1 Maintenance Schedules

The electronic circuits within the Model 509 do not require scheduled calibration or service¹.

8.2 Cleaning and Sterilization

Follow the cleaning and sterilization instructions listed below to clean and/or sterilize the *Model 509* and its accessories.

8.2.1 Model 509 Module

- Turn the module off and unplug the DC supply from the AC Mains before cleaning.
- The module can be cleaned and disinfected by wiping 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 module.
- Do not attempt to sterilize the module.

8.2.2 Finger Sensor

- The sensor can be cleaned and disinfected by wiping 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.
- Ensure the Finger Sensor is 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.
- Perform a Quick Check to verify the integrity of the sensor.

8.2.3 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 the manufacturer's instructions and standard hospital protocols to determine recommended times for disinfection and sterilization.

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

- Rinse thoroughly with water and dry before use (do not rinse connector).
- Do not attempt to sterilize the Y-Sensor except as stated above.
- Do not immerse connector on the Y-Sensor.
- 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.
- Perform a Quick Check to verify the integrity of the sensor

8.2.4 Y-Strip Tapes

- Treat Y-Strip Tapes in accordance with hospital protocol for single-patient use.

8.2.5 Single Patient Use Sensors

- Treat Single Patient Use sensors in accordance with hospital protocol for single patient use.

8.2.6 Ear Clip

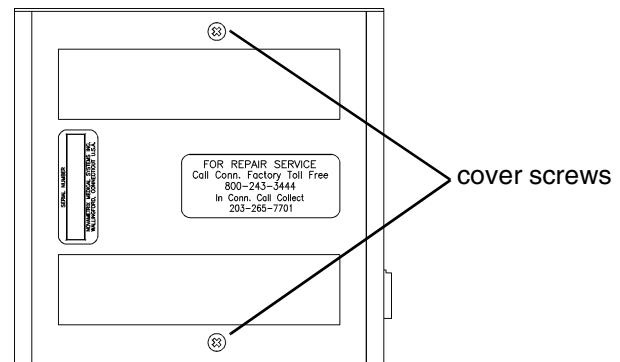
- Clean the ear clip with a cloth dampened with 70% isopropyl alcohol. After cleaning wipe the ear clip down thoroughly with a clean water dampened cloth to rinse.
- Do not immerse the ear clip.

8.3 Assembly Exchanges

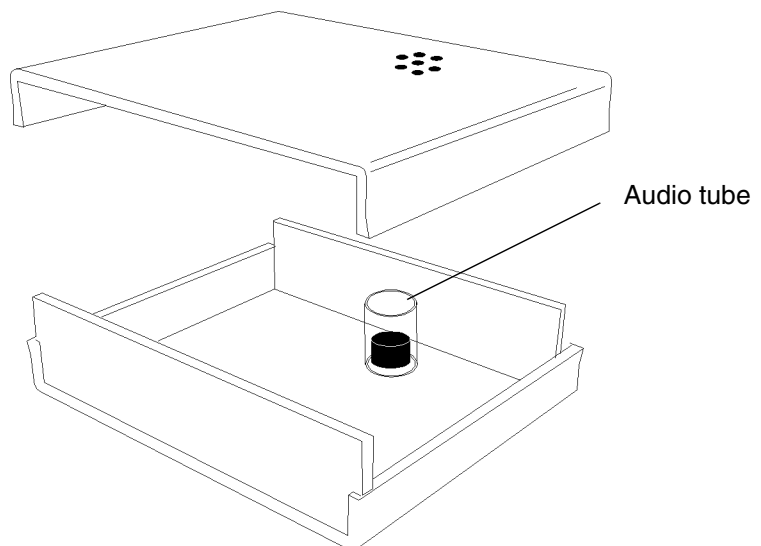
The disassembly instructions below are intended as a guide to enable assembly exchanges if necessary. There are no user serviceable parts inside. Disassembly should be performed by qualified service personnel only.

CAUTION: The Model 509 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

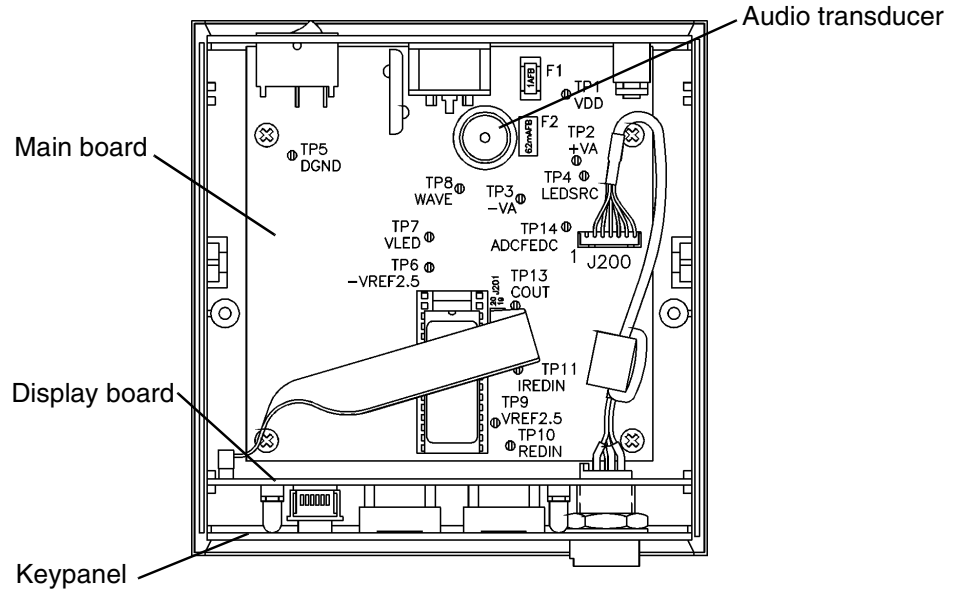
1. Disconnect any sensor and external supply from the Model 509. Remove the two (2) cover screws and set aside.



2. Turn unit over to rest on the Velcro side. Carefully pull the cover side that contains the instructions (and speaker holes) out. Be careful not to lose the audio tube.



- The 2581 Power Board, which is attached to the cover, is connected to the Main Board by a cable. The internal circuit boards can now be accessed. The display board and keypad assembly can be removed and the main board is secured to the cover by four (4) screws.

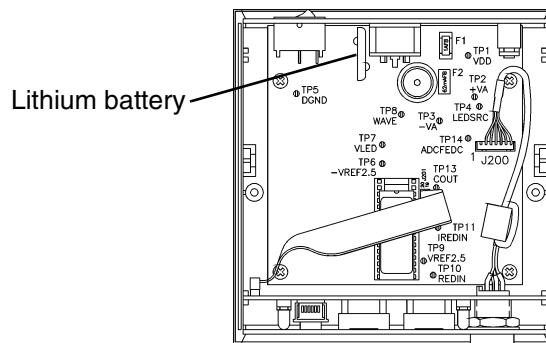


- When reassembling the Model 509 be sure that the audio tube is set in place over the transducer and that the top cover is aligned to the tube before securing. Ensure there are no loose objects inside and that all cables are secure when reassembling.

8.4 Battery Replacement

The main board in the Model 509 contains a 3 volt 190mAH Lithium battery (PN: 400047) that is used to store the user settings when the monitor is turned off. If the monitor fails to retain any user settings (when turned off) then this internal battery may need replacement. Replace the main board Lithium battery only with same type and rating.

- The Model 509 must be disassembled, the main board removed, then the battery desoldered from the main board.
- Solder the new battery in place, be sure to observe proper polarity when replacing the new battery.

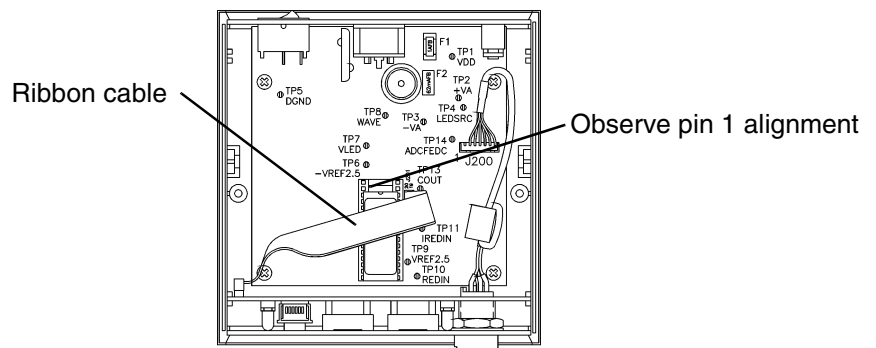


3. Refer to Assembly Exchanges on page 25 for instructions on reassembling the monitor.

8.5 Software Update Instructions

The following instructions are for updating the Model 509's software. Refer to any additional instructions that may accompany the software update package for changes in the procedure or other pertinent information.

1. Disconnect any sensor, cable and external supply from the Model 509.
2. Disassemble the monitor to expose the main board.
3. Carefully remove EPROM IC18 from its' socket. Disconnecting the ribbon cable from J201 will allow easier access to the chip.



4. Install the new EPROM into the socket, be sure to observe proper pin 1 alignment with 28 pin DIP packages. The Model 509 will not operate unless the chip is properly installed.
5. Reconnect the ribbon cable to J201, then reassemble the monitor.

[This page intentionally blank.]



9

Troubleshooting

Conditions may occur that require certain status messages to be displayed. These status messages that will appear on the Hewlett Packard Patient monitor's display are listed below. All these messages relate to operation of the *Model 509* Pulse Oximetry Interface Module and its sensors.

9.1 Status Messages

9.1.1

<u>Status Message</u>	<u>Condition/correction</u>
SpO ₂ PROBE OFF PT	Sensor disconnected from patient, improperly applied, or placed on an area too translucent for proper sensor operation. Reposition sensor.
SpO ₂ REPOS. PROBE SpO ₂ NOISY SIGNAL	1. Reposition probe. Monitor not receiving valid signals from sensor. May be caused by excessive motion, cardiac arrhythmia or other situations leading to poor signal. Check patient status, reposition sensor. 2. Sensor is placed on too thick of a site. Reposition the sensor on a thinner (less opaque) section of tissue.
SpO ₂ PROBE DISCON	1. Sensor is disconnected from the monitor. 2. Sensor is faulty. Remove sensor from use and contact qualified service personnel.
SpO ₂ PROBE FAILED	Sensor faulty. Remove sensor from use and contact qualified service personnel.
SpO ₂ INSUF. LIGHT	1. Insufficient Light. Sensor placed on a site too thick (or opaque) for adequate light transmission. Reposition sensor. 2. Incompatible sensor. Connect only Novamatrix SuperBright™ sensors to the <i>Model 509</i> .
SpO ₂ LIGHT INT	Light Interference. Ambient light sources (sunlight, warming lights, etc.) are interfering with sensor light sources. Shield the sensor from ambient light sources.
SpO ₂ LOW SIGNAL	Low Signal Strength. Pulse strength as detected by sensor is too weak for proper monitor operation. Reposition sensor.
MUTE	Displayed in the left corner of the pleth window when user enables Audio Off mode by pressing and holding the  .
2 MIN	Displayed in the left corner of the pleth window if user enables 2 minute silence mode by pressing the  key.

Chk Co
(displayed on *Model 509*)

Connection between the VueLink module and the *Model 509* has been disturbed. Reconnect cables, if condition is not corrected remove the module from use and contact qualified service personnel.

NOTE: If the *Model 509* had previously been connected to a VueLink module and then disconnected, or a communications error has occurred, this message will be displayed on the *Model 509*. Push the button on the front of the VueLink module to reset and proceed with monitoring.

If the *Model 509* detects an internal error, then a numerical code will be displayed in the PULSE RATE display. The numerical codes with the error detected are listed below.

Code	Problem
1	RAM Self Test Failed
3	ROM Self Test Failed
10	Stack pointer error-not at top of stack
11	MMU error-not at base page
12	250 ms interrupt-illegal task
13	Stack error-stack overflow
14	Display buffer overflow
15	Front end offset error
20	10 ms overrun

Code	Problem
21	250 ms overrun
22	illegal int1 interrupt
23	illegal int2 interrupt
24	illegal prt1 interrupt
25	illegal dma0 interrupt
26	illegal asc0 interrupt
27	illegal nmi interrupt
28	Trap error-illegal command executed
40	Unknown error

10

Specifications

Specifications for the *Model 509 Pulse Oximetry Interface Module* are listed for informational purposes only, and are subject to change without notice.

10.1 *SpO₂ (Oxygen Saturation)*



- Range: 0-100%.
- Accuracy: (1 standard deviation) 80-100% \pm 2%, 0-79% unspecified.
- Averaging Time: fixed at 8 seconds.
- Audio: Pitch of pulse tone varies with SpO₂ value and high alert limit setting.
- Continuous numerical display of SpO₂ value on the Hewlett Packard Patient Monitor Display.

10.2 *Pulse Rate*

- Range: 30-250 beats/min.
- Accuracy: (1 standard deviation) \pm 1% of full scale.
- Averaging Time: 8 seconds, fixed.
- Continuous numerical display of pulse rate value on Hewlett Packard Patient Monitor Display.

10.3 *General Specifications*

10.3.1 *Alerts*

- SpO₂ Alert Limits: Displayed on *Model 509* module. Automatic or manually selectable for high and low SpO₂.
- 2 Minute Silence: When  key is pressed, alarms are deactivated for two minutes.
- Audio Off: Press and hold the  key for three seconds to deactivate audible alerts.
- Status Messages: Displayed on the Hewlett Packard Patient Monitor.
- Alert and Pulse Beep Volume: Operator selectable.

10.3.2 *Display*

- Numerics: Green Alpha Numeric LED's on *Model 509* front panel.
- Plethysmogram: Continuously displayed on the Hewlett Packard Patient Monitor.

10.3.3 **EMC Emissions**

- EN55011:1991, Class A. Classification for Radiated and Conducted Emissions

10.3.4 **EMC Immunity**

- EN60601-1-2:1993. Collateral standard: Electromagnetic compatibility - requirements and test. Includes; IEC801-2 Electrostatic Discharge Requirements, IEC801-3 Radiated Electromagnetic Fields, IEC801-4 Electrical Fast Transient Burst.
- Electomagnetic fields up to 3 V/m will not adversely affect system performance.

10.3.5 **Physical**

- Operating Environment: 50 °F - 104 °F (10 °C - 40 °C), 0-90% relative humidity (non-condensing).
- Size: Height 5 in. (12.7 cm), width 1.5 in, (3.81 cm), depth 5.25 in. (13.34 cm).
- Weight: 12 ounces (0.34 kg).

10.3.6 **Electrical**

- Power: 100-120 VAC, 60 Hz, 8 VA.

11

Parts Lists

6900-00 Pulse Oximetry Interface

LINE	PART NO	REV	QPA	DESCRIPTION
001	1217-32	03	1	REPAIR LABEL
002	6070-32	03	1	LABEL, SERIAL NUMBER
003	6900-01	03	1	MAIN ASSY, MODEL 509
005	6900-09	03	0	OVERALL WIRING DIAGRAM
011	9598-10	06	1	120V AC ADAPTOR
013	6926-32	03	1	LABEL, QUICK START GUIDE
015	140055	03	1	VELCRO, HOOK, 1" W, WHITE
016	140056	03	1	VELCRO, LOOP, 1" W, WHITE
017	9026-32	03	1	LABEL, "MANUFACTURED IN US"

6900-01 Main Assy Model 509

LINE	PART NO	REV	QPA	DESCRIPTION
001	2542-01	01	1	DISPLAY BOARD ASSY, FRONT
002	2543-01	01	1	MAIN BOARD ASSY, MODEL 509
003	6711-27	01	1	MEMBRANE KEY PANEL
004	6884-32	01	1	FACEPLATE, REAR PANEL
005	6921-01	01	1	CABLE ASSY, SPO2 INPUT
006	6933-32	01	1	LABEL, BATTERY REPLACEMENT
007	6955-01	01	1	BOTTOM COVER WITH 4 SCREWS
008	6959-10	01	1	TUBE, AUDIO, MODEL 509
009	2581-01	02	1	POWER BOARD ASSY
010	9513-01	02	1	CABLE ASSY, POWER, 509
012	6955-11	01	1	TOP COVER MODIFICATION
013	284003	01	0	SCREW, NO. 4 x 1/4L
014	285039	01	0	WASHER, STAR, .594 ID
015	600071	01	1	RIBBON CABLE ASSY, 20 COND

2542-01 Display Board Assy, Front

PART NO	REV	QPA	DESCRIPTION
212542	00	1	CONNECTOR, 20 PIN, HEADER
485510	00	1	VN10LM VMOS F.E.T.

PART NO	REV	QPA	DESCRIPTION
486680	00	1	IC, MM74HC573AN-
2542-02	00	1	FAB, DISPLAY BOARD, FRONT
472205	00	1	RESISTOR, 1.21K OHM, 1/4W
482596	00	1	LED, HLMP-C100, RED
2542-03	00	0	SCHEMATIC, DISPLAY BOARD
482518	00	1	LED, HLMP-3502, GREEN, PC
474107	00	1	RESISTORPACK, 1K, 2%
211921	00	4	CONNECTOR, 9 PIN, RECEPTACLE
474113	00	1	RESISTORPACK, 10K, 5%
280233	00	0	SPACER, LED, FOR 2 LEADS
154016	00	3	CAPACITOR, .1UF,50V,10%
211635	00	1	CONNECTOR, 6 PIN, RECEPTACLE
470030	00	1	RESISTOR, 330 OHM, 1/4W
482606	00	2	DISPLAY, DOT MATRIX
470034	02	1	RESISTOR, 680 OHM, 1/4W

2543-01 Main Board Assy,

LINE	PART NO	REV	QPA	DESCRIPTION
000	472200	03	1	RESISTOR, 5.6 OHM, 1/4W
000	154111	03	3	CAPACITOR, .1UF,16VDC
000	154074	03	1	CAPACITOR, 1.5UF,25VDC
000	212542	03	1	CONNECTOR, 20 PIN, HEADER
000	484546	03	1	VOLTAGE CONVERTER, LTC104
000	180034	03	1	FERRITE FILTER, 4 LIN
000	484060	03	1	TRANSISTOR, MMBT3904T
000	211721	03	1	CONNECTOR, 7 PIN, HEADER
000	180029	03	3	INDUCTOR, 50MHZ CUT-OFF F
000	486333	03	1	IC, HD64180RCP-6X, 8-BIT
000	486334	03	1	IC, MC14051BD, 8-CH
000	2543-02	03	1	FAB, MAIN BOARD, 509
000	474165	03	8	RESISTOR, 10K OHM, 1/8W
000	474220	03	1	RESISTOR, ZERO OHM, 1/4W
000	230023	03	1	CRYSTAL, 12.288 MHZ
000	485546	03	4	TRANSISTOR, VN0605T
000	486337	03	1	IC, LT1181ACS, RS232 DUAL
000	484541	03	1	VOLTAGE REGULATOR, LM317L
000	486329	03	1	IC, SN74HC32D, QUAD 2-IN.
000	211640	03	1	CONNECTOR, 6 PIN, RECEPTACLE
000	486776	03	1	IC, AD7528JP, 8-BIT D-A C
000	474175	03	5	RESISTOR, 3.92K OHM, 1/8W
000	512006	03	1	SWITCH, ROCKER, 3 POSITION
000	515082	03	1	FUSE W FUSEHOLDER, 1/2A
000	154085	03	4	CAPACITOR, 47PF, 100VDC
000	472274	03	1	RESISTOR, 26.7 OHM, 1/4W
000	474160	03	1	RESISTOR, 5.11K OHM, 1/8W

LINE	PART NO	REV	QPA	DESCRIPTION
000	481035	03	1	DIODE, ZENER, BZX84C7V5L
000	486320	03	1	IC, SN74HC14D, HEX SCHMITT
000	515077	03	1	FUSE, 1/16A, 125V, VERY FAST
000	486324	03	1	IC, DG444DY,QUAD SPST CM
000	486319	03	1	IC, MC14020BD, 14-BIT BIN
000	154078	03	1	CAPACITOR, 1000PF, 50VDC
000	486794	03	1	IC, PM7524FS
000	481546	03	7	DIODE, SWITCHING, SURF MT
000	481547	03	5	DIODE, BAT54, HOT CARRIER
000	474166	03	19	RESISTOR, 100K OHM, 1/8W
000	180022	03	1	INDUCTOR, 10UH, 10%, SURF
000	472198	03	1	RESISTOR, 3.3 OHM, 1/4W
000	484522	03	1	VOLTAGE REGULATOR, LM2940
000	486332	03	2	IC, AD7703BR
000	215059	03	1	SOCKET, 32 PIN, LOW PROFILE
000	474169	03	1	RESISTOR, 7.5K OHM, 1/8W
000	210141	03	1	CONNECTOR, DC PWR JACK
000	154082	03	3	CAPACITOR, 22PF, 100V
000	481552	03	1	DIODE, MBRS340T3, SCHOTTKEY
000	154072	03	49	CAPACITOR, .1UF,50V,10%
000	486788	03	1	IC, LT1019CS8-2.5, PREC V
000	180019	03	1	INDUCTOR, 100UH, 10%, SURF
000	474186	03	1	RESISTOR, 15K OHM, 1/8W
000	474153	03	16	RESISTOR, 42.2K OHM, 1/8W
000	487084	03	4	IC, OP-282GS, DUAL JFET
000	474138	03	12	RESISTOR, 100 OHM, 1/8W
000	130016	03	1	TRANSDUCER, AUDIO
000	486795	03	1	IC, TLC549ID
000	486321	03	1	IC, SN74HC138D
000	154080	03	7	CAPACITOR, 47UF, 10VDC
000	216029	03	0	TEST POINT, SPRING LOADED
000	5965-07	03	1	PROGRAM, PEEL ASSY, CSIO
000	400047	03	1	BATTERY, 3V, 190M AH, LITH
000	5966-07	03	1	PROGRAM, PEEL ASSY, TIMING
000	487086	03	1	IC, LTC694C58, UPROCESSOR
000	485532	03	2	TRANSISTOR, 2N7002T1
000	180011	03	1	FERRITE BEAD, 22 AWG TCW
000	486323	03	2	IC, SN74HC573DW
000	281211	01	0	SCREW, 2-56 X 1/4L, SELF
000	2543-03	01	0	SCHEMATIC, MAIN BOARD
000	6923-07	01	1	PROGRAM, EPROMASSY, SYST
000	2543-04	01	0	TEST PROCEDURE, MAIN BOARD
000	2543-17	01	1	MAIN BOARD SUBASSY
000	211414	03	1	CONNECTOR, 4 PIN, PLUG
000	474184	03	1	RESISTOR, 39.2 OHM, 1/8W
001	486790	03	1	IC, TLE2022CD, DUAL OP AMP
002	180030	03	1	INDUCTOR-CAP, 4700PF, 50V

LINE	PART NO	REV	QPA	DESCRIPTION
003	474172	03	10	RESISTOR, 10 OHM, 1/8W, 1
004	154081	03	3	CAPACITOR, 100PF, 100V, 1
005	154079	03	1	CAPACITOR, 10UF, 25V, 10%
006	474136	03	4	RESISTOR, 1K OHM, 1/8W, 1

2581-01 Power Board Assy,

LINE	PART NO	REV	QPA	DESCRIPTION
001	2581-02		1	FAB, POWER BOARD
007	152065	01	2	CAPACITOR, 10UF, 20%, 25V
007	154079		2	CAPACITOR, 10UF, 25V, 10%
008	154016	01	2	CAPACITOR, .1UF, 50V, 10%
008	154072		2	CAPACITOR, .1UF, 50V, 10%
009	154142	01	2	CAPACITOR, 47UF, 20%, 16V
009	154080		1	CAPACITOR, 47UF, 10VDC
010	211414		1	CONNECTOR, 4 PIN, PLUG
012	281500	01	0	NUT, HEX, NO. 4-40, STEEL
013	284200	01	0	#4-40 X 1/4 SLOTTED BINDING
014	285000	01	0	LOCK WASHER, NO. 4, INTER
015	472058	01	2	RESISTOR, 100K OHM, 1/4W
015	474166		2	RESISTOR, 100K OHM, 1/8W
016	472137	01	1	RESISTOR, 562K OHM, 1/4W
016	472294		1	RESISTOR, 562k OHM, 1/4W
017	474005	01	2	RESISTOR, 5 OHM, 1W, 5%
017	474340		2	RESISTOR, 4.7 OHM, 1W, 1%
018	484522	01	1	VOLTAGE REGULATOR
018	484578		1	V RGLTR, 5V OUT
019	484580	01	1	V RGLTR, ADJ MICROPWR
019	484579		1	V RGLTR, 1.23V-29V OUT
020	606401	01	0	#24 BUSS WIRE
021	152096		1	CAPACITOR, 220UF, 35V

12

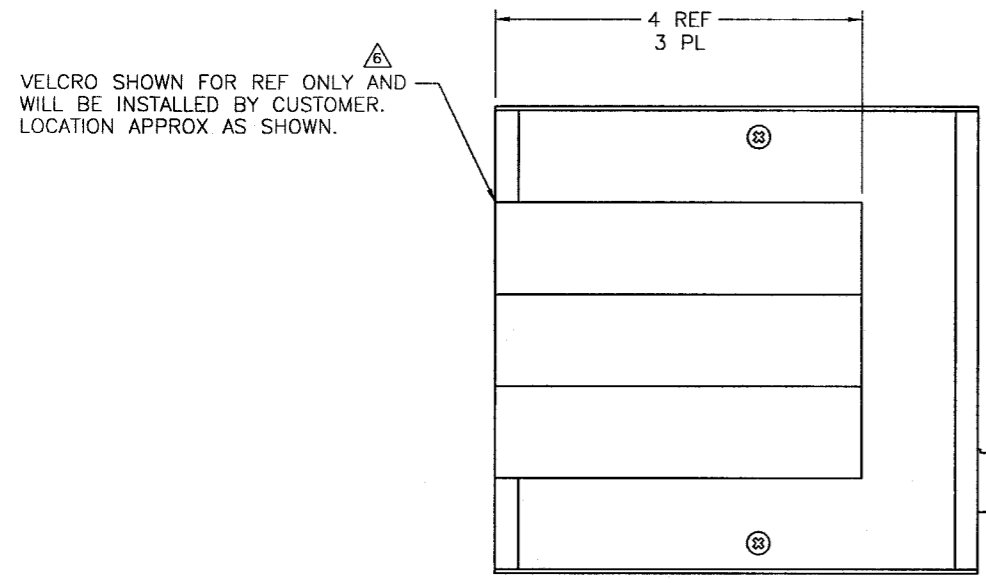
Schematics and Assembly Drawings

<u>Drawing</u>	<u>Description</u>
6900-00	Pulse Oximetry Interface Module, Model 509
6900-01	Main Assy, Model 509
6900-09	Overall Wiring Diagram, Model 509
6921-01	Cable Assy, SpO ₂ Input, Model 509
2543-01	Main Board Assy, Model 509 (2 sheets)
2543-03	Schematic, Main Board, Model 509 (3 sheets)
2542-01	Display Board Assy, Front Panel, Model 509
2542-03	Schematic, Display Board, Front Panel, Model 509
2581-01	Power Board Assy, 509
2581-03	Schematic, Power Board, 509
6711-27	Membrane Keypanel, Model 509 (2 sheets)

12 *Schematics and Assembly Drawings*

[This page intentionally blank.]

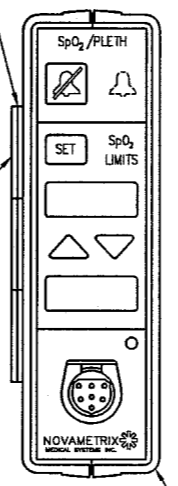
This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.



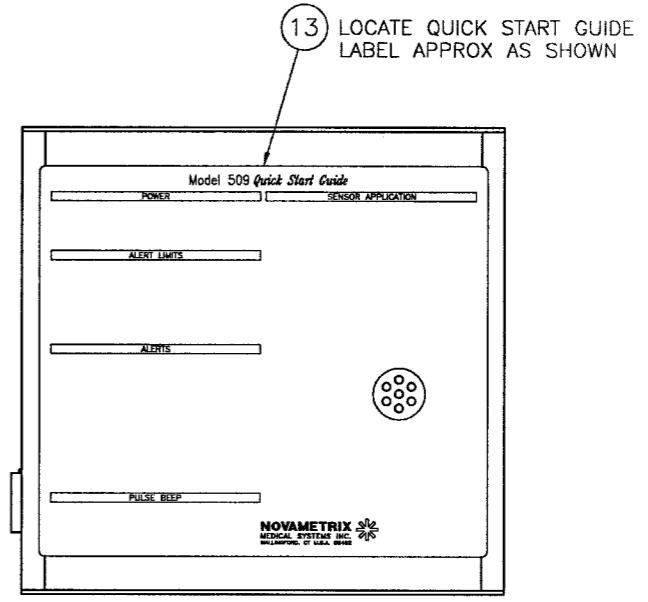
VELCRO SHOWN FOR REF ONLY AND WILL BE INSTALLED BY CUSTOMER. LOCATION APPROX AS SHOWN.

VELCRO "LOOP" REF ITEM 16 MOUNTS FIRST ON BOTTOM

VELCRO "HOOK" REF ITEM 15 MOUNTS SECOND ON BOTTOM



3 MAIN ASSY

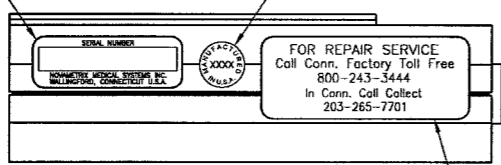


13 LOCATE QUICK START GUIDE LABEL APPROX AS SHOWN

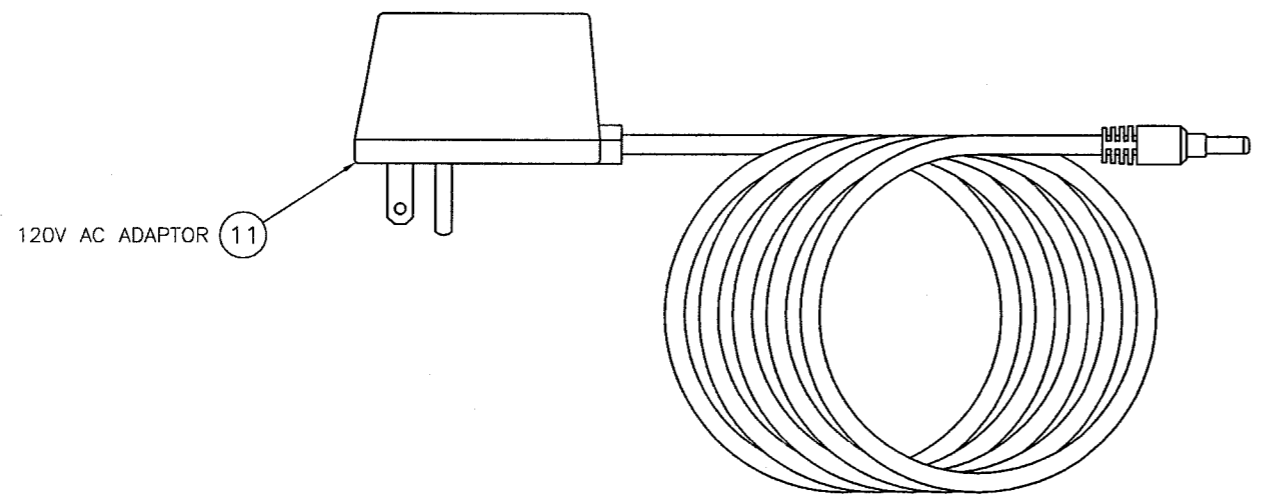
LOCATE SN LABEL APPROX AS SHOWN

2

17 LOCATE "MANUFACTURED IN USA" LABEL APPROX AS SHOWN



1 LOCATE REPAIR LABEL APPROX AS SHOWN



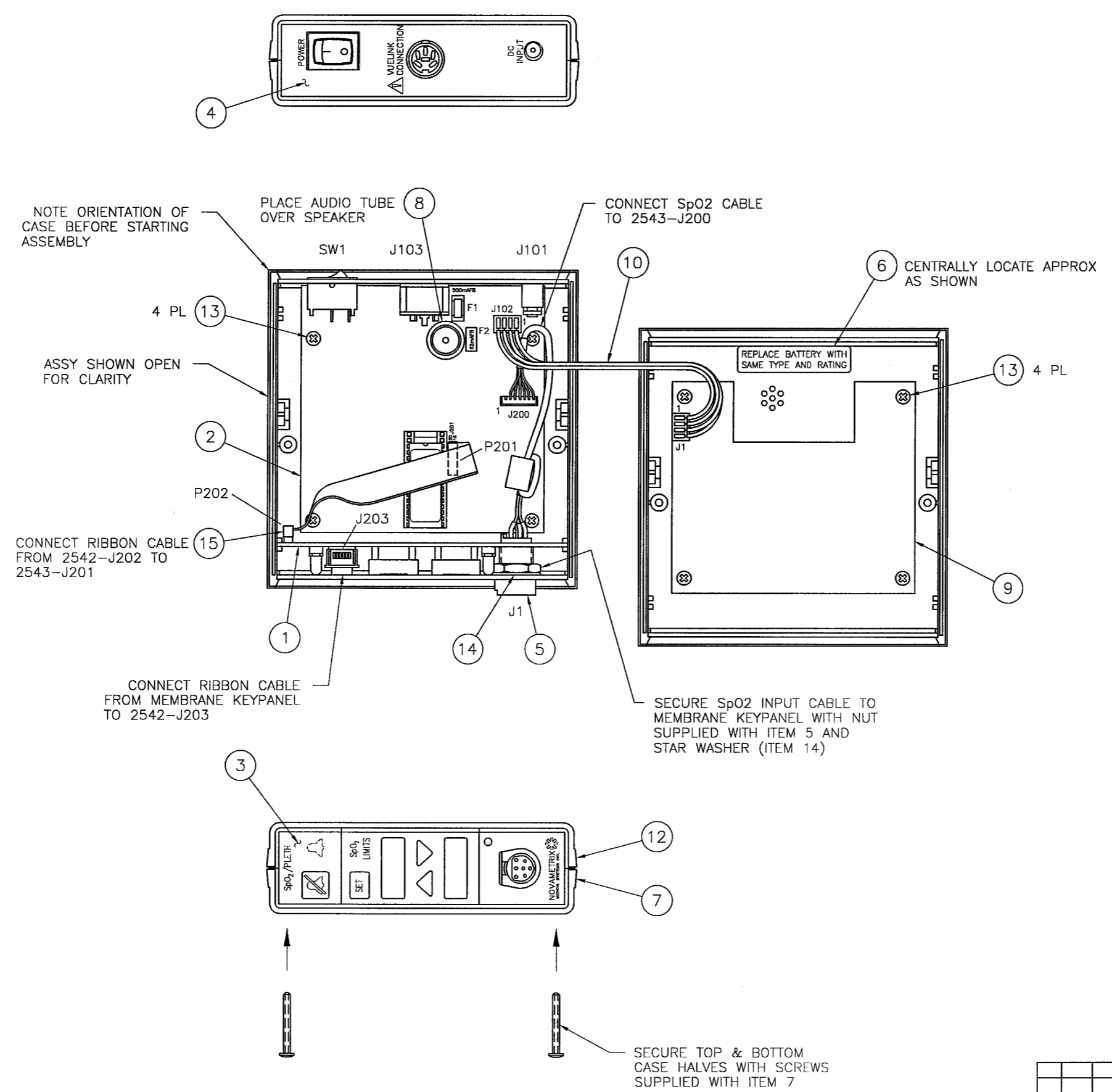
120V AC ADAPTOR 11

NOTES:

1. FOR OVERALL WIRING DIAGRAM SEE D6900-09.
 2. FOR SYSTEM TEST PROCEDURE SEE A6900-04.
 3. FOR QA TEST PROCEDURE SEE A6900-70.
 4. WIPE UNIT CLEAN WITH ISOPROPYL ALCOHOL BEFORE APPLYING LABELS.
 5. INCLUDE USERS MANUAL, ITEM 6 WITH MONITOR.
- ⚠️ VELCRO HOOK, ITEM 15 AND VELCRO LOOP, ITEM 16 TO BE CUT INTO 3 PIECES @ 4 IN. LONG EACH. DO NOT ATTACH VELCRO AND INCLUDE VELCRO LOOSE WITH MONITOR.

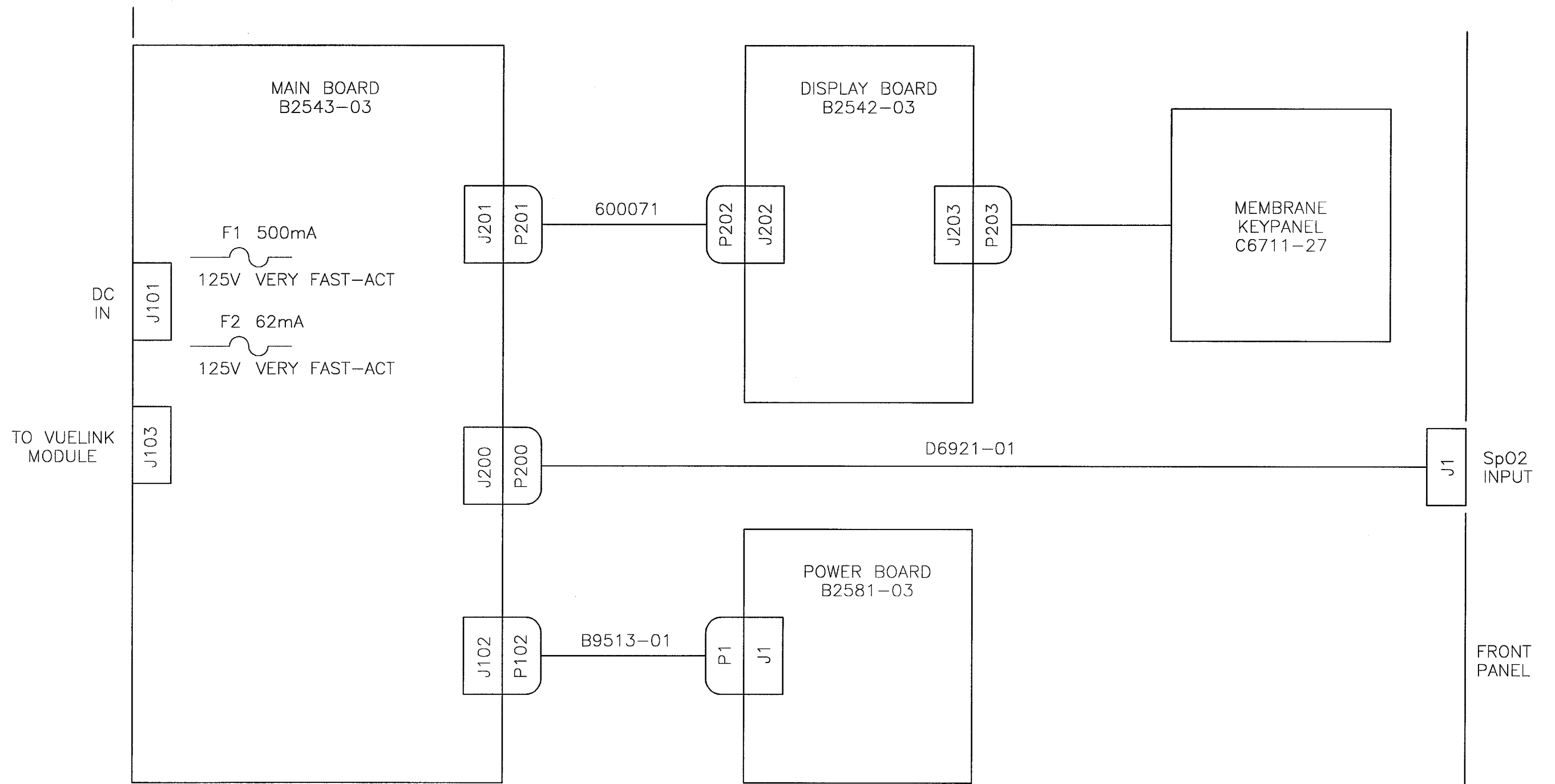
07	N647	5Apr99	DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES	TITLE	NOVAMATRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06482
06	N647	24Mar99	TOLERANCES	PULSE OXIMETRY INTERFACE MODULE, MODEL 509	
05	N634	15Jan99	DEC ± .001 (mm) (± .001)		
04	N596	16Sep98	FRACTION ± .001 (mm) (± .001)		
03	N569	16Apr98	HOLES +.007 - .003 (mm) (± .001)		
02	N558	11Mar98	AND ± .001 (mm) (± .001)		
01	N485	17Jun97	MATERIAL	DRAWN L1Mar97 M.R. Itoaback 4/10/97	CHECKED HP 4/10/97
REV	R NO.	DATE	FINISH	MFG ENGR MJC 4/10/97	APPROVED HS 4/10/97
				USED ON: ~	SCALE: 1/1 SHEET 1 OF 1

This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.



DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES			TITLE MAIN ASSY. MODEL 509		NOVAMATRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492	
TOLERANCES DEC ± ~ (mm) (± ~) FRG ± ~ (mm) (± ~) HOLES +.007 - .003 (mm) (± ~) ANG ± ~			DRAWN 13Mar97 M.R. Lineback	CHECKED HP 4/10/97	SIZE D	DRAWING NO. 6900
02	N647	25Mar99	MFG ENGR MJC 4/10/97		APPROVED HS 4/10/97	CODE 01
01	N485	29Jul97	FINISH ~		USED ON: D6900-00	REV 02
REV	R NO.	DATE	SCALE: 1/1		SHEET 1 OF 1	

This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.

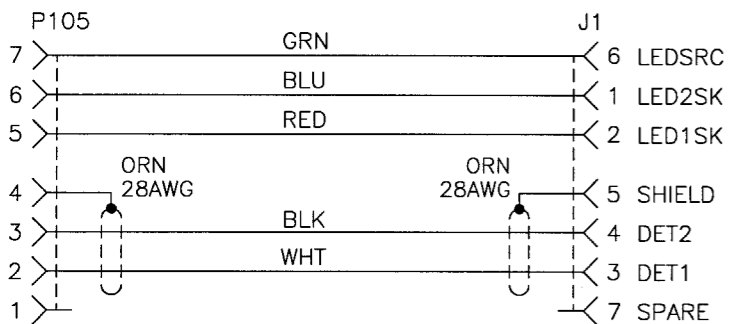
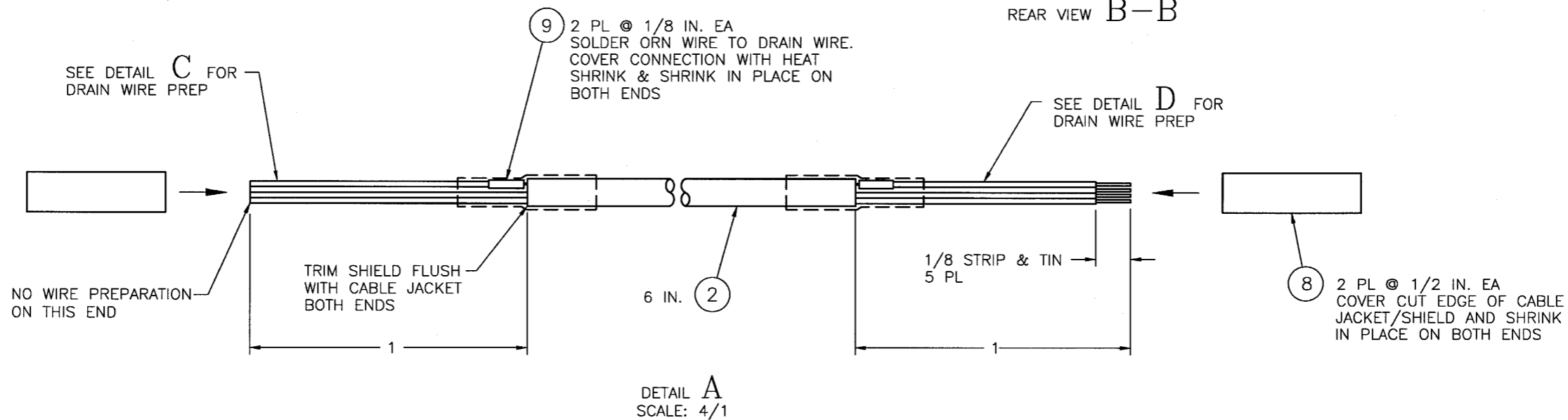
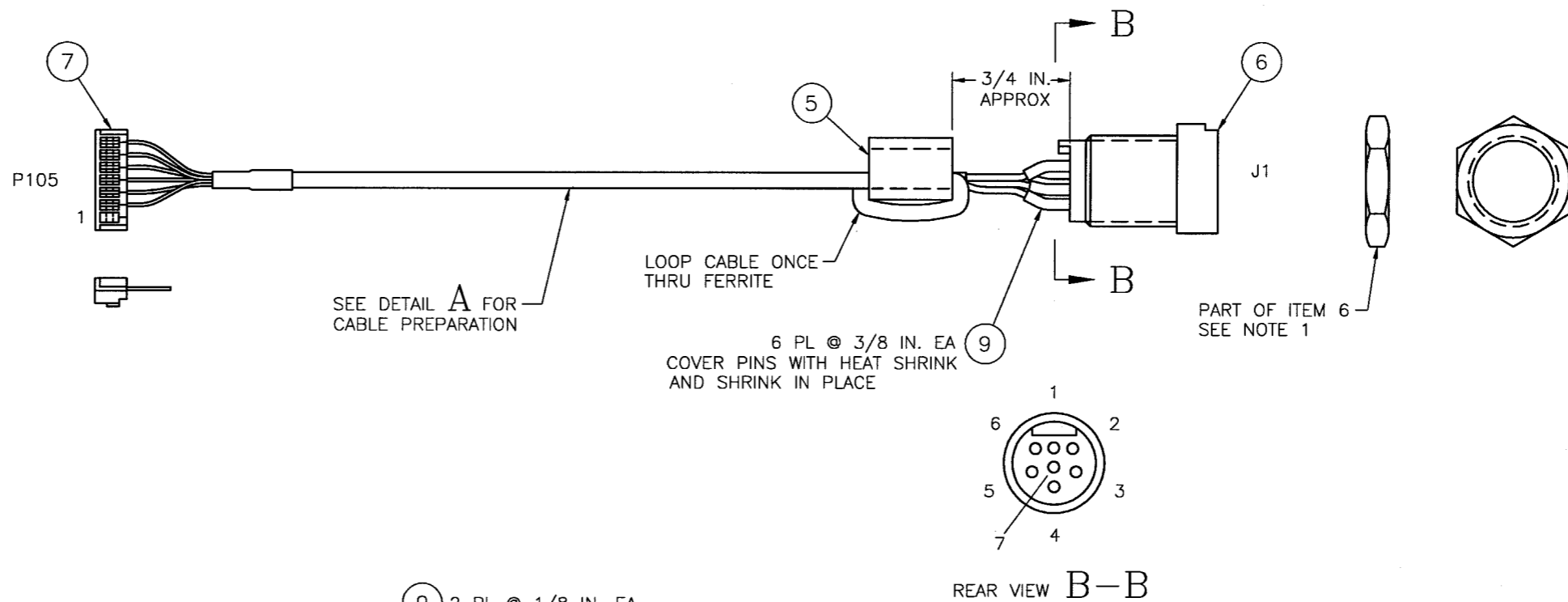


REAR PANEL

FRONT PANEL

			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES		TITLE OVERALL WIRING DIAGRAM, MODEL 509							
			TOLERANCES		DRAWN BL 27Mar97				CHECKED MRL 27Mar97			
			DEC ± - (mm) ± -		MFG ENGR MJC 4/10/97		APPROVED HP 3/31/97		SIZE C	DRAWING NO. 6900	CODE 09	REV 02
			FRAC ± - (mm) ± -		FINISH		USED ON: D6900-00		SCALE: NONE		SHEET 1 OF 1	
			HOLES +.007 -.003 (mm) (+.18 -.08)									
			ANG ± -									
			MATERIAL									
02	N685	15Jul99										
01	N485	25Jul97										
REV	R NO.	DATE										

This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.



SCHEMATIC DIAGRAM

NOTES:

1. THE HEX NUT (PART OF ITEM 6) USED TO MOUNT THE CONNECTOR IS SUPPLIED LOOSE AND SHOULD NOT BE INSTALLED ON THE CONNECTOR. KEEP HEX NUT WITH THE ASSEMBLY UNTIL REQUIRED AT THE NEXT ASSY LEVEL.

DO NOT SCALE UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES (mm). BREAK ALL SHARP EDGES.		TITLE		NOVAMATRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492				
DEC ± .005 (mm) (± .001)		CABLE ASSY, Sp02 INPUT, MODEL 509						
FRAC ± 1/32 (mm) (± .008)		DRAWN BL 28Feb87		CHECKED MRL 1Apr87	SIZE	DRAWING NO.	CODE	REV
HOLES ± .007 - .003 (mm) (± .001)		MFG ENGR MJC 4/2/87		APPROVED HP 4/2/87	D	6921	01	00
AND ± .005 (mm) (± .001)		FINISH		USED ON: D8900-01		SCALE: 2/1		SHEET 1 OF 1
REV	R NO.	DATE						

This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.


PN	DESCRIPTION	REF DES
D2543-03	SCHEMATIC, MAIN BOARD, MODEL 509	~
A2543-04	TEST PROCEDURE, MAIN BOARD, MODEL 509	~
D2543-17	MAIN BOARD SUBASSY, MODEL 509	~
A6923-07	PROGRAM, EPROM ASSY, SYSTEM, MODEL 509	IC18
281211	SCREW, 2-56 X 1/4 L, SELF TAPPING, BINDING HD	(FOR J103)

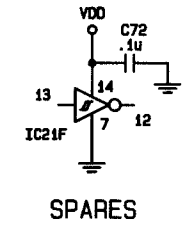
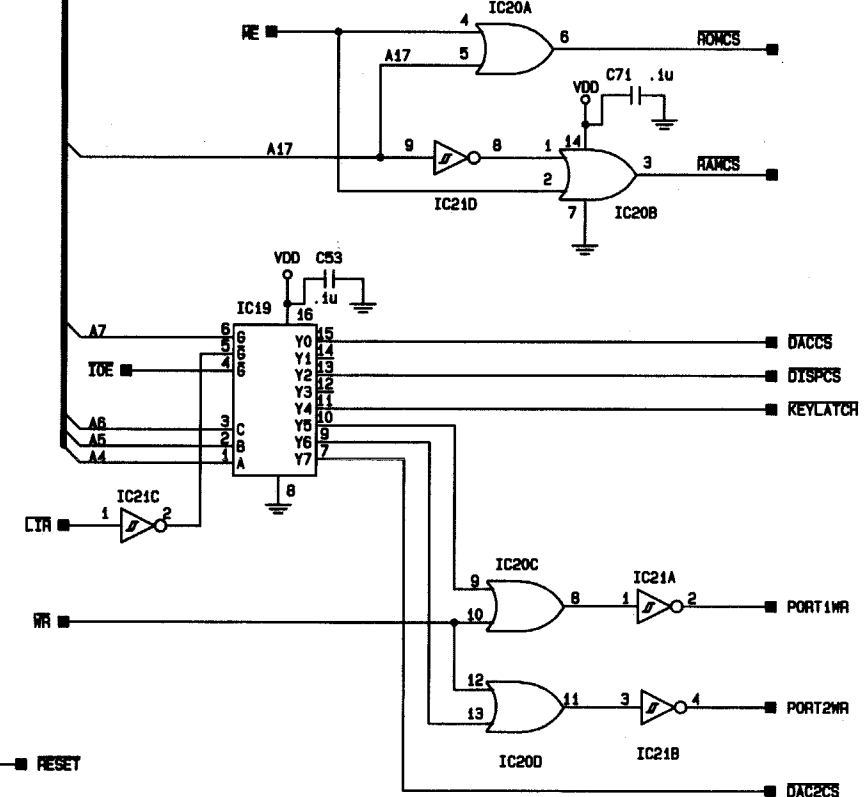
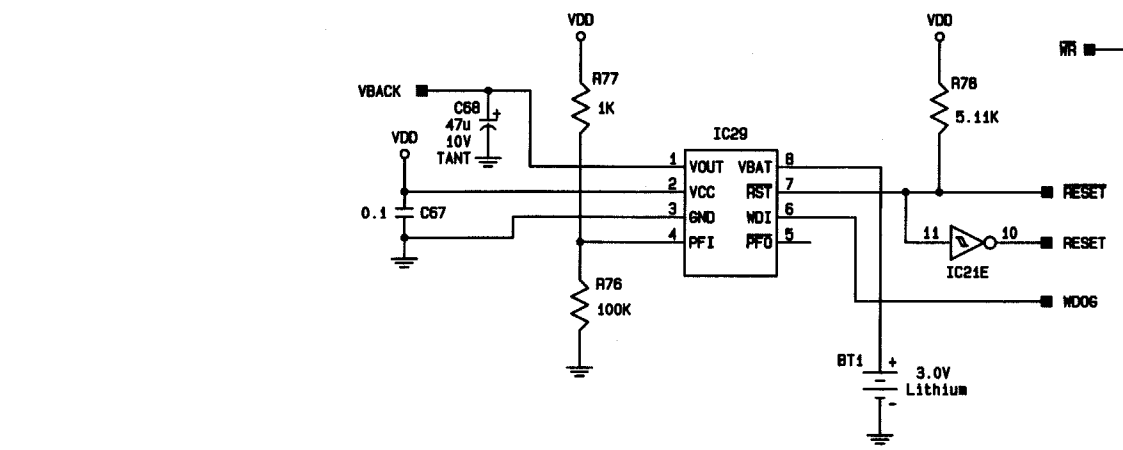
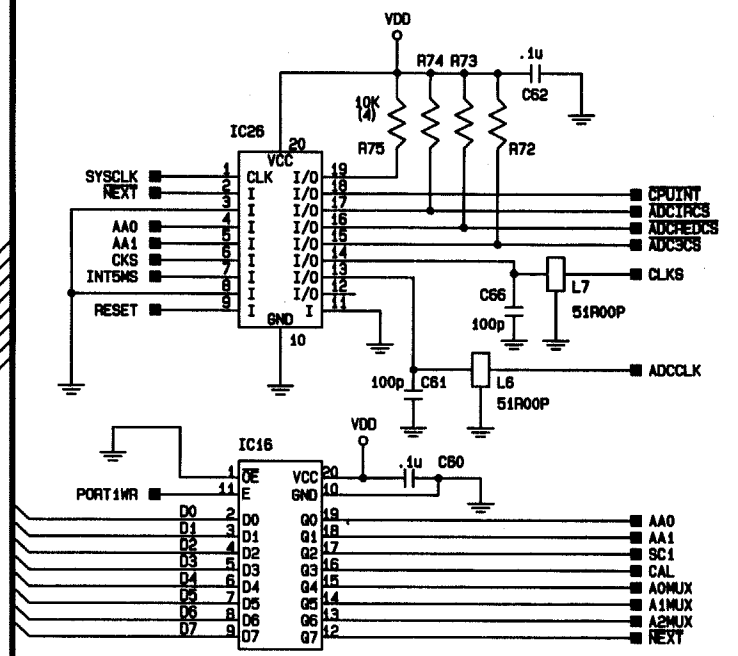
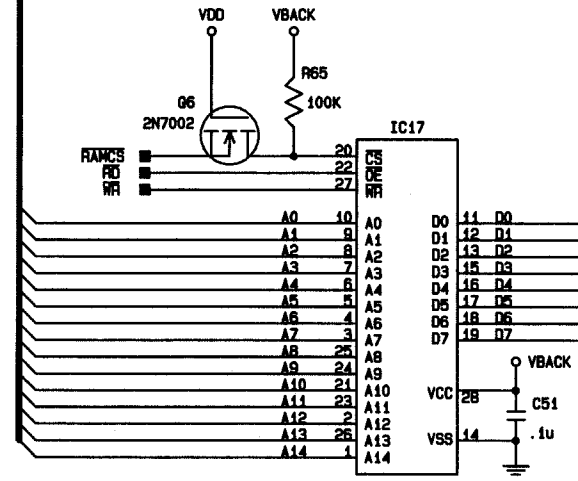
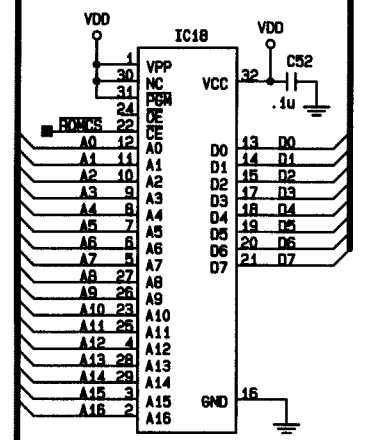
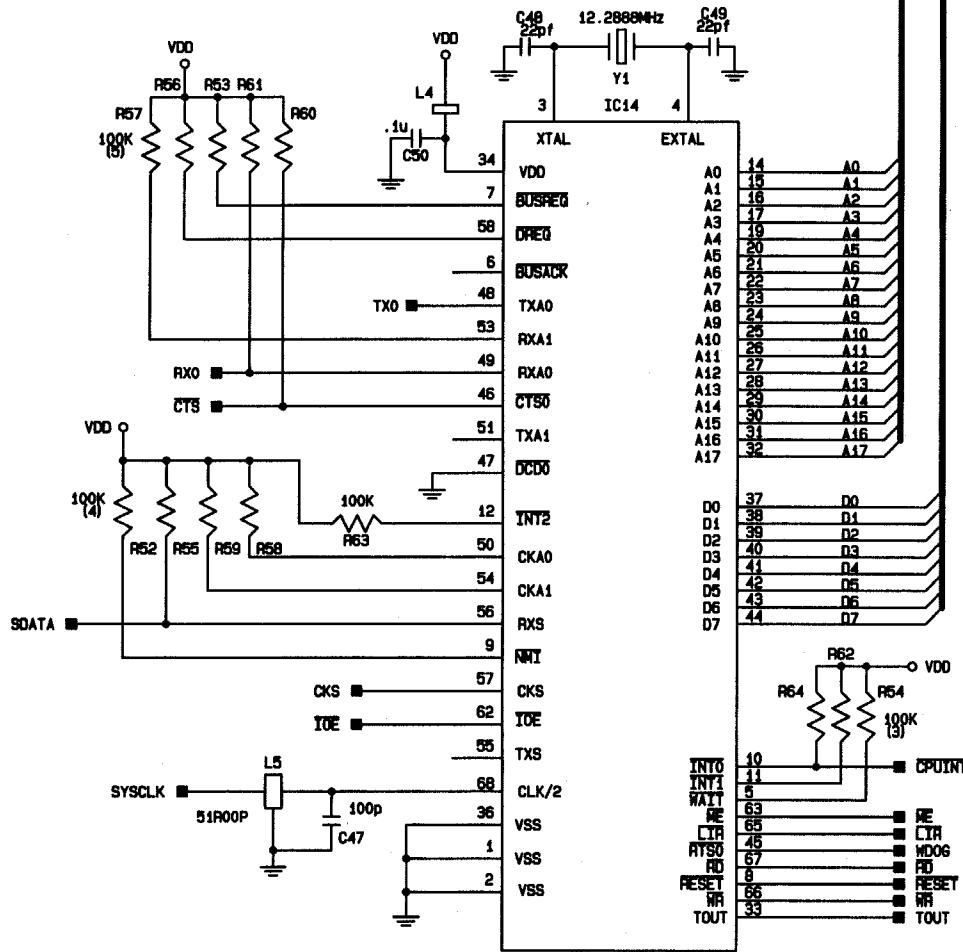
PN	DESCRIPTION	REF DES
2543-02	FAB, MAIN BOARD, MODEL 509	~
A5965-07	PROGRAM, PEEL ASSY, CSIO CONTROLLER, 510	IC26
A5966-07	PROGRAM, PEEL ASSY, TIMING SEQUENCER, 510	IC28
☆130016	TRANSDUCER, AUDIO, 2400 Hz, 5V, 40mA	LS1
154072	CAPACITOR, .1uF, 50V, 10%, X7R	C7, C12-C14, C16-C18, C21-C24, C27-C46, C50-C55, C57-C60, C62, C63, C65, C67, C69-C72
154078	CAPACITOR, 1000pF, 50VDC, 10%	C56
154074	CAPACITOR, 1.5uF, 25VDC, 10%, TANTALUM	C1
154116	CAPACITOR, 10uF, 35V, 10%, LOW ESR	C4
154080	CAPACITOR, 47uF, 10VDC, 10%, TANTALUM	C2, C3, C5, C6, C8, C9, C68
154081	CAPACITOR, 100pF, 100V, 10%, NPO	C47, C61, C66, C73
154082	CAPACITOR, 22pF, 100V, 10%, NPO	C48, C49, C64
154085	CAPACITOR, 47pF, 100VDC, 5%	C10, C11, C19, C20
154111	CAPACITOR, .1uF, 16VDC, 5%, 1210 CASE	C15, C25, C26
☆180011	FERRITE BEAD, 22 AWG TCW WIRE THRU CORE	L4
180019	INDUCTOR, 100uH, 10%	L3
180022	INDUCTOR, 10uH, 10%	L2
180029	INDUCTOR, 50MHz CUT-OFF FREQUENCY	L5, L6, L7
180030	INDUCTOR-CAP, 4700pF, 50VDC, 2A, 3 TERMINAL	L1, L9
180034	FERRITE FILTER, 4 LINE, EMI SUPPRESSION	L8
☆210141	CONNECTOR, DC POWER JACK, SOLDER TERMINAL	J101
☆211414	CONNECTOR, 4 PIN, PLUG, FRICTION LOCK	J102
☆211640	CONNECTOR, 6 PIN, RECEPTACLE, RIGHT ANGLE	J103
☆211721	CONNECTOR, 7 PIN, HEADER, .079 SPACING	J200
☆212542	CONNECTOR, 20 PIN, HEADER, STRAIGHT, .05 SP	J201
☆215059	SOCKET, 32 PIN, LOW PROFILE, .6 SPACING	(FOR IC3)
☆216029	TEST POINT, SPRING LOADED, 475' C MAX	TP1-TP14
☆230023	CRYSTAL, 12.288 MHz, HC49S CASE	Y1
☆400047	BATTERY, 3V, 190 MAH, LITHIUM, VERTICAL	BT1

PN	DESCRIPTION	REF DES
☆472198	RESISTOR, 3.3 OHM, 1/4W, 1%	R20
☆472200	RESISTOR, 5.6 OHM, 1/4W, 1%	R19
☆472274	RESISTOR, 26.7 OHM, 1/4W, 1%	R1
474136	RESISTOR, 1k OHM, 1/8W, 1%	R49-R51, R77, R85-R88
474138	RESISTOR, 100 OHM, 1/8W, 1%	R5, R6, R13, R14, R30, R31, R66, R67, R70, R79, R80, R83
474153	RESISTOR, 42.2k OHM, 1/8W, 1%	R2, R3, R11, R12, R15-R18, R32-R34, R36-R38, R81, R82
474160	RESISTOR, 5.11k OHM, 1/8W, 1%	R78
474165	RESISTOR, 10k OHM, 1/8W, 1%	R8, R25, R26, R48, R72, R73-R75
474169	RESISTOR, 7.5k OHM, 1/8W, 1%	R68
474166	RESISTOR, 100k OHM, 1/8W, 1%	R4, R7, R27, R42, R52-R65, R76
474172	RESISTOR, 10 OHM, 1/8W, 1%	R9, R10, R21, R22, R40, R41, R43-R45
474175	RESISTOR, 3.92k OHM, 1/8W, 1%	R23, R24, R28, R29, R47
474184	RESISTOR, 39.2k OHM, 1/8W, 1%	R71
474186	RESISTOR, 15k OHM, 1/8W, 1%	R69
474220	RESISTOR, ZERO OHM, 1/4W, 5%, 1206 STYLE	R84

PN	DESCRIPTION	REF DES
481035	DIODE, ZENER, 7.5V	D15
481546	DIODE, SWITCHING	D2-D7, D14
481547	DIODE, HOT CARRIER SCHOTTKY	D8-D11, D13
481552	DIODE, SCHOTTKY, 40V, 3A	D1
484060	TRANSISTOR, NPN	Q7
484541	VOLTAGE REGULATOR, +1.2V - +37V	IC2
484546	VOLTAGE CONVERTER, SWITCH CAP	IC3
485532	TRANSISTOR, N-CHAN ENHAN MODE	Q5, Q6
485546	TRANSISTOR, N-CHAN ENHAN MODE	Q2-Q4, Q8
486306	IC, 32K X 8 BIT CMOS RAM, 100ns	IC17
486319	IC, 14-BIT BINARY COUNTER	IC27
486320	IC, HEX SCHMITT-TRIGGER INVERTER	IC21
486321	IC, 3-LINE TO 8-LINE DECODER	IC19
486323	IC, OCTAL D-TYPE LATCH	IC15, IC16
486324	IC, QUAD SPST CMOS ANALOG SWITCH	IC5
486329	IC, QUAD 2-INPUT POS OR GATE	IC20
486332	IC, 20-BIT A TO D CONVERTER	IC9, IC10
486333	IC, 8-BIT MPU	IC14
486334	IC, 8-CHAN ANALOG MUX/DEMUX	IC12
486337	IC, RS232 DUAL DRVR/RCVR, L PWR	IC13
486776	IC, 8-BIT D-A CONVERTER	IC22
486781	IC, OP AMP, JFET INPUT, LOW NOISE	IC7
486788	IC, PREC VOLTAGE REF, 2.5V	IC8
486794	IC, 8-BIT D TO A CONVERTER	IC24
486795	IC, 8-BIT A TO D CONVERTER	IC11
487084	IC, DUAL JFET OP AMP	IC4, IC6, IC23, IC25
487086	IC, MICROPROCESSOR SUPERVISORY CKT	IC29
☆512006	SWITCH, ROCKER, 3 POSITION, 4 AMP	SW1
515077	FUSE, 1/16A, 125V, VERY FAST-ACTING	F2
515082	FUSE W FUSEHOLDER, 1/2A, 125V, V FAST-ACT	F1

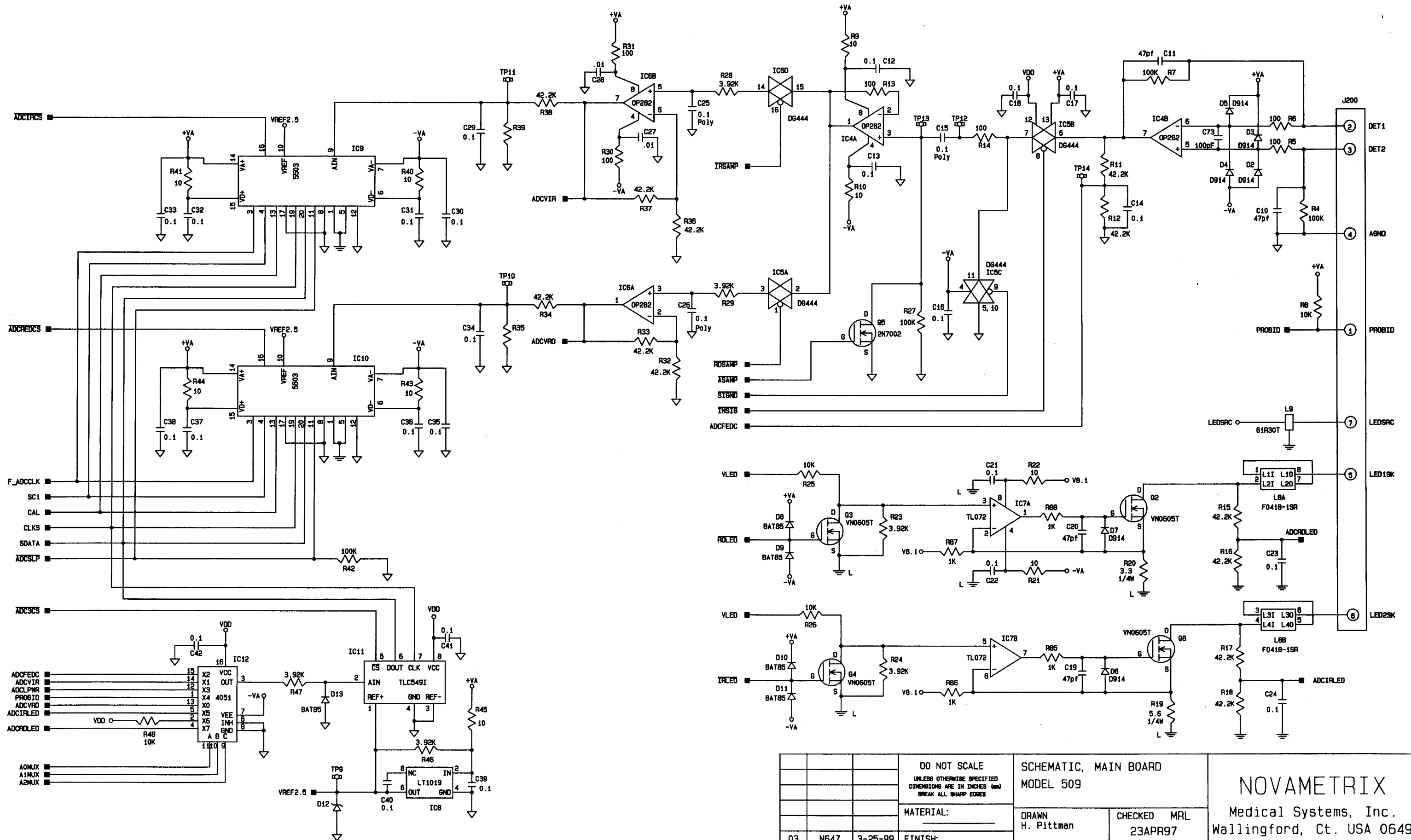
NOTES:
 ☆ DENOTES THRU HOLE COMPONENTS.

DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES			TITLE MAIN BOARD ASSY, MODEL 509		 NOVAMATRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492
TOLERANCES DEC ± .005 (mm) (± ~) FRACTION ± .0005 (mm) (± ~) HOLES +.007 - .003 (mm) (± ~) ANG ± .005			DRAWN BL 5Mar97	CHECKED HP 4/10/97	
03	N647	31Mar99	MATERIAL ~		SIZE D
02	N596	17Sep98	FINISH ~		DRAWING NO. 2543
01	N558	9Mar98	MFG ENGR N/A/C 4/10/97		CODE 01
REV	R NO.	DATE	APPROVED HS 4/10/97		REV 03
USED ON: ~			SCALE: NONE		SHEET 2 OF 2

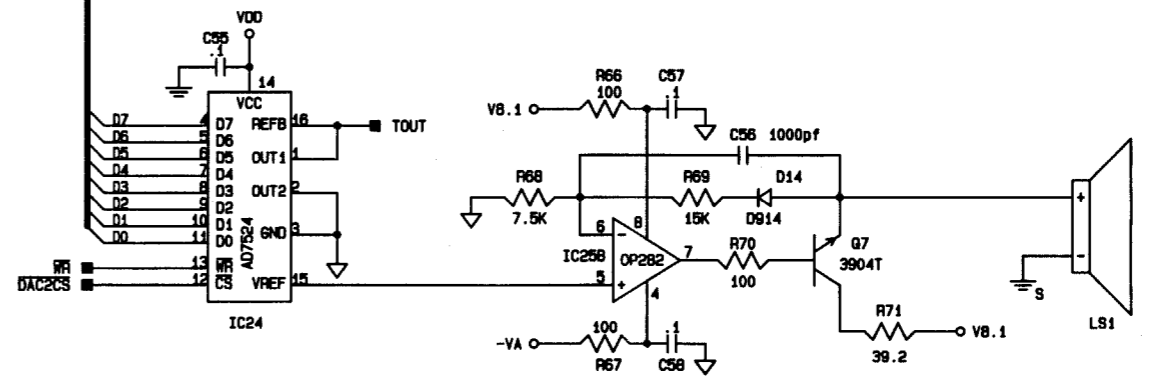
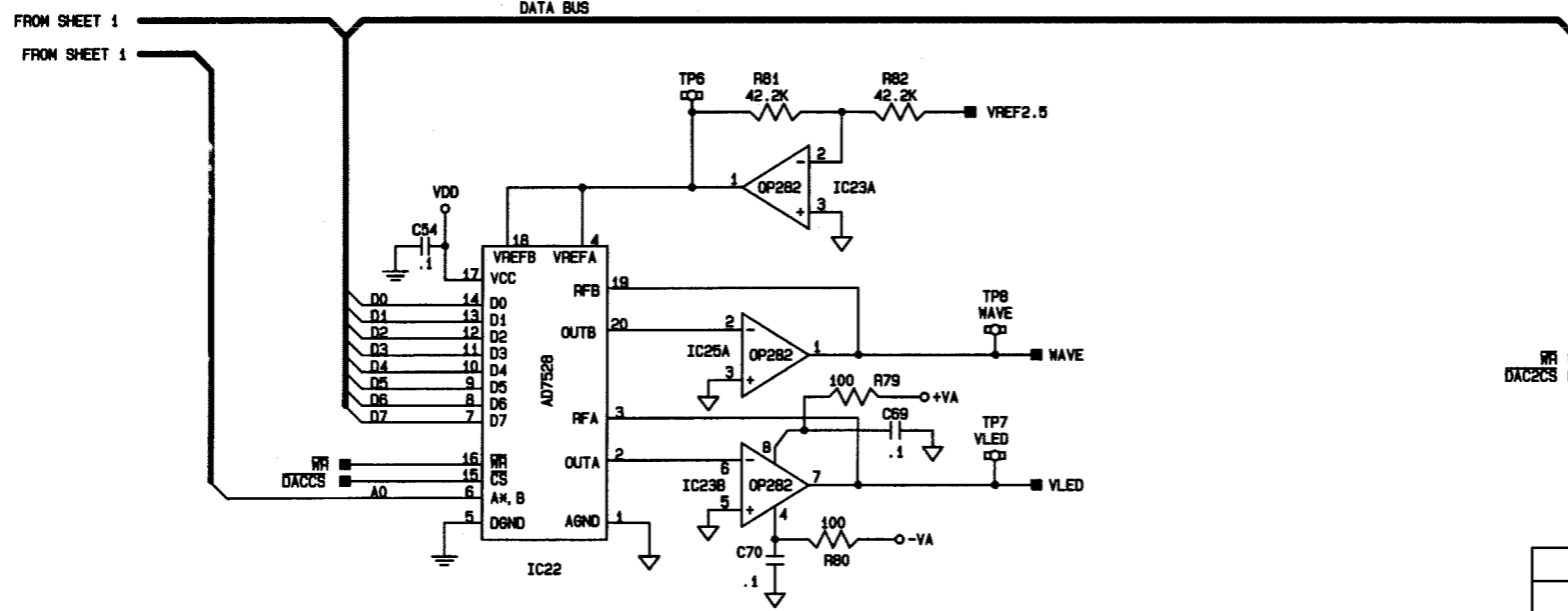
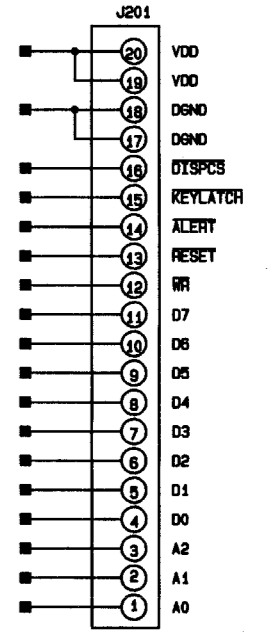
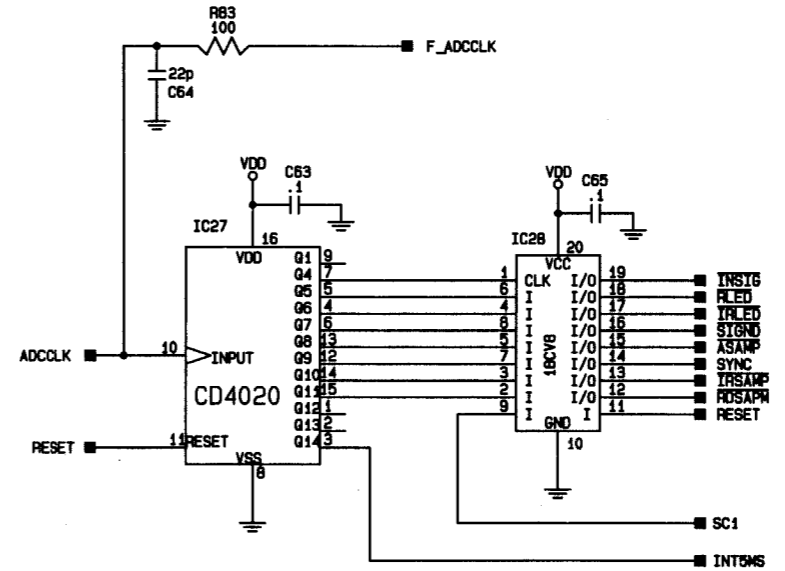
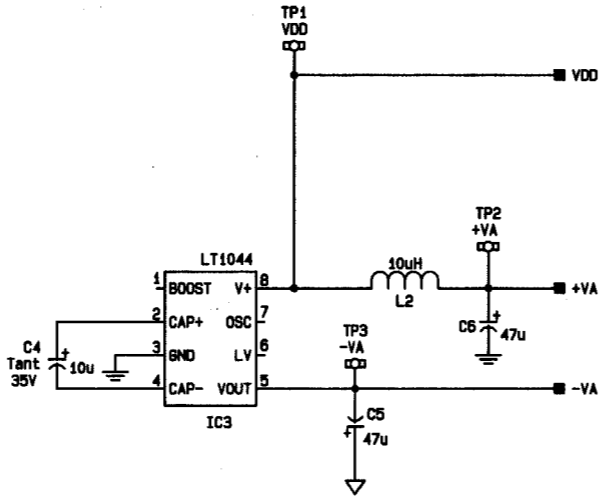
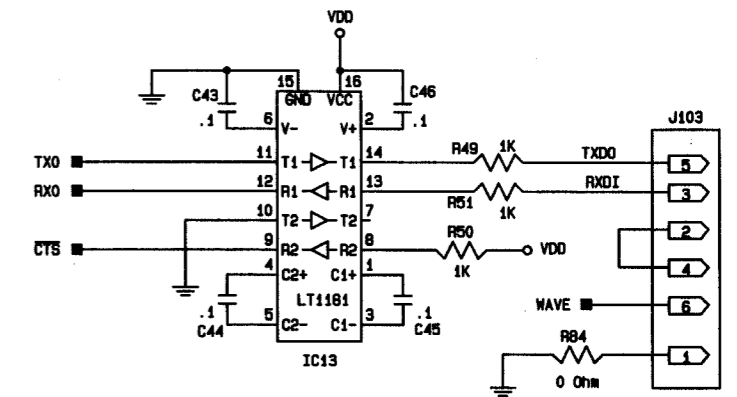
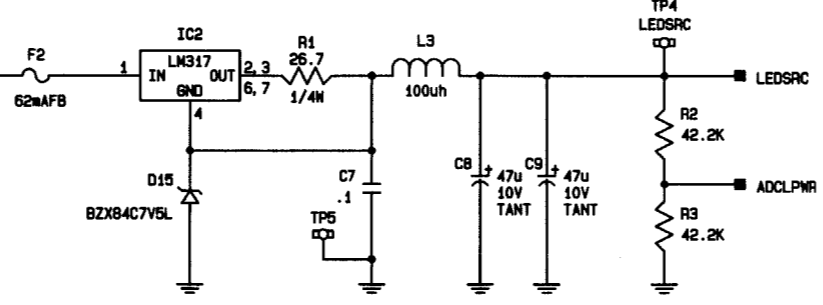
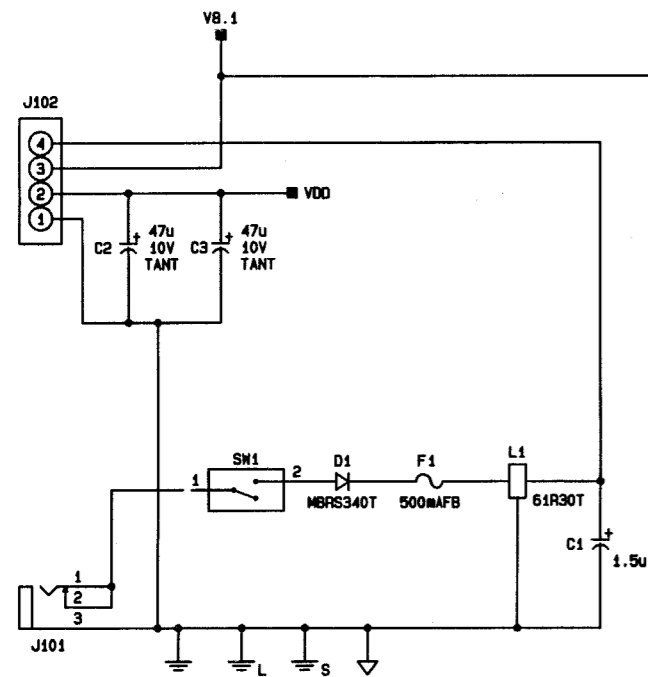


- NOTES:
- UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, 1/8W, 1% CAPACITANCE VALUES ARE IN FARADS INDUCTANCE VALUES ARE IN HENRYS
 - LAST REF DES USED: BT1, C72, D15, F2, IC29, J201, L8, LS1, Q8, R88, SW1, TP14, Y1
 - REF DES NOT USED: IC1, Q1
 - COMPONENTS NOT FITTED TO THIS ASSY: R35, R39, R46, D12

DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES		SCHEMATIC, MAIN BOARD MODEL 509		NOVAMETRIX Medical Systems, Inc. Wallingford, Ct. USA 06492				
MATERIAL:		DRAWN H Pittman	CHECKED MRL					
03	N647	3-25-99	DATE 5Feb97	23APR97	SIZE B	DRAWING NO. 2543	CODE 03	REV. 03
02	N596	9/17/98	MFG. ENGR. MJC	APPROVED HS	23APR97	23APR97		
01	N558	03/11/98	FILE: 254303S1.SCH	DATE: 4-1-99				
REV	"R" NO.	BY DATE	TIME:		USED ON: D2543-01	SCALE: NONE	SHEET 1 OF 3	



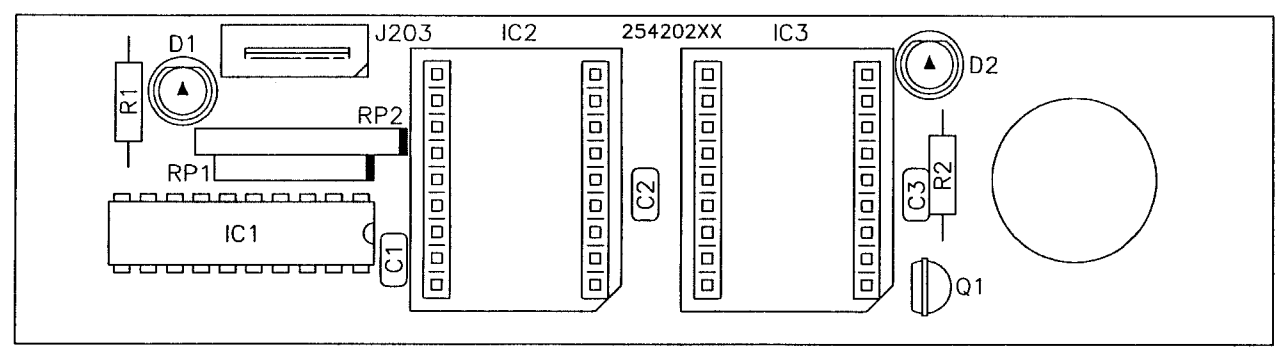
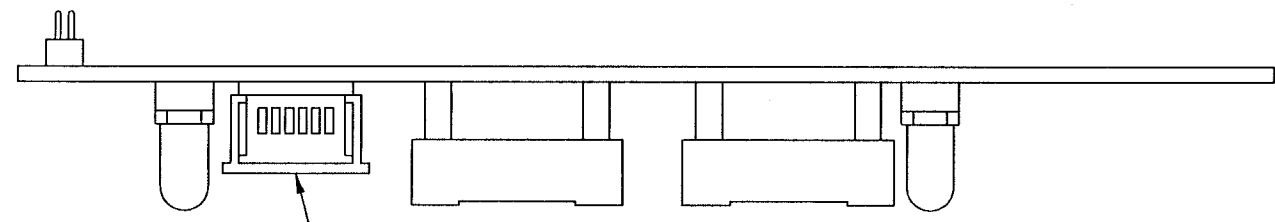
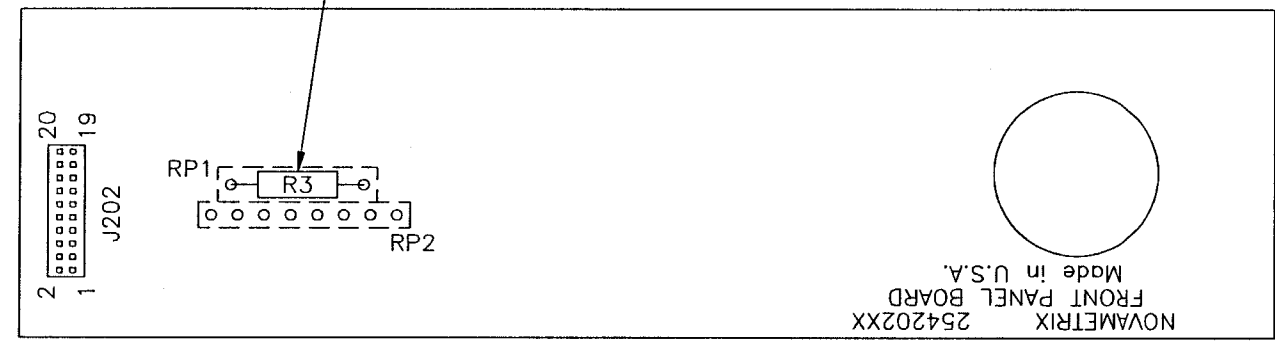
DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES			SCHEMATIC, MAIN BOARD MODEL 509		NOVAMETRIX Medical Systems, Inc. Wallingford, Ct. USA 06492					
MATERIAL:			DRAWN H. Pittman	CHECKED MRL 23APR97						
03	N647	3-25-99	FINISH:		MFG. ENGR. MJC 23APR97	APPROVED HS 23APR97	SIZE	DRAWING NO.	CODE	REV.
02	N596	9/17/98	FILE: 254303S2.sch DATE: 3-29-99				B	2543	03	03
01	N558	03/11/98	TIME:		USED ON: D2543-01	SCALE: NONE	SHEET 2 OF 3			
REV	"R" NO.	BY DATE								



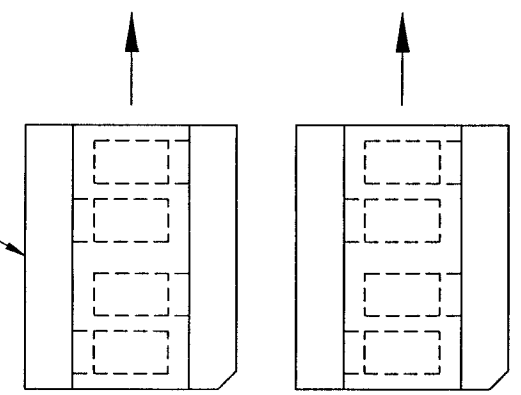
			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES		SCHEMATIC, MAIN BOARD MODEL 509		NOVAMETRIX Medical Systems, Inc. Wallingford, Ct. USA 06492									
			MATERIAL:		DRAWN H. Pittman						CHECKED MRL 16APR97					
			FINISH:		MFG. ENGR. MJC 23APR97		APPROVED HS 23APR97		SIZE B		DRAWING NO. 2543		CODE 03		REV. 03	
03			N647		3-25-99		FILE: 254303S1.SCH DATE: 3-29-99		TIME:		USED ON: D2543-01		SCALE: NONE		SHEET 3 OF 3	
02			N596		9/17/98											
01			N558		03/11/98											
REV			"R" NO.		BY DATE											

This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.

MOUNT R3 BETWEEN RP1-1 AND RP1-6. RESISTOR CAN NOT TOUCH PINS.

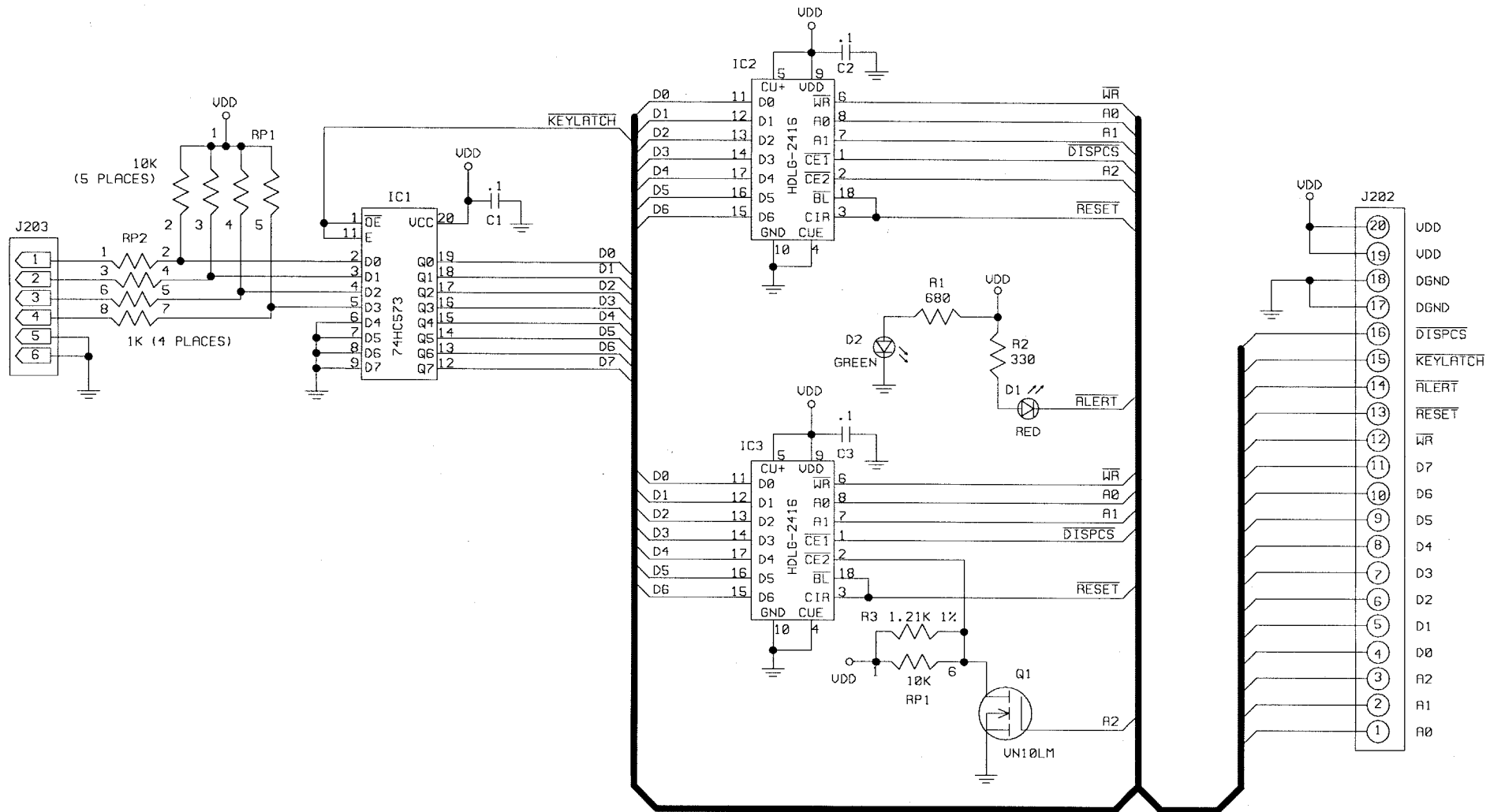


NOTE ORIENTATION WHEN INSTALLING IC2 & IC3



PN	DESCRIPTION	REF DES
2542-02	FAB, DISPLAY BOARD, FRONT PANEL, MODEL 509	~
B2542-03	SCHEMATIC, DISPLAY BOARD, FRONT PANEL, 509	~
154016	CAPACITOR, .1uF, 50V, 10%, .1 SP, X7R	C1-C3
211635	CONNECTOR, 6 PIN, RECEPTACLE, ZIF	J203
211921	CONNECTOR, 9 PIN, RECEPTACLE, .1 SP, STR	(FOR IC2, IC3)
212542	CONNECTOR, 20 PIN, HEADER, STR, .05 SP	J202
280233	SPACER, LED, FOR TWO LEADS, .2 DIA, BLACK	(FOR D1, D2)
470030	RESISTOR, 330 OHM, 1/4W, 10%	R2
470034	RESISTOR, 680 OHM, 1/4W, 10%	R1
472205	RESISTOR, 1.21k OHM, 1/4W, 1%	R3
474107	RESISTOR PACK, 1k OHM, 2%, 4 RES, 8 PIN	RP2
474113	RESISTOR PACK, 10k OHM, 5%, 5 RES, 6 PIN	RP1
482518	LED, GREEN, PC MOUNT	D2
482596	LED, RED, PC MOUNT	D1
482606	DISPLAY, DOT MATRIX, 4 CHARACTER, GREEN	IC2, IC3
485510	TRANSISTOR, FET	Q1
486680	IC, OCTAL D-TYPE LATCH, 3 ST	IC1

			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES		TITLE		NOVAMATRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492	
			TOLERANCES		DISPLAY BOARD ASSY, FRONT PANEL, MODEL 509			
			DEC ± ~ (mm) (± ~)		DRAWN 4Mar97		CHECKED HP	
			FRAC ± ~ (mm) (± ~)		M.R. Lineback		4/10/97	
			HOLES +.007 -.003 (mm) (± ~)		MFG ENGR MJC		APPROVED HS	
			ANG ± ~		4/10/97		4/10/97	
			MATERIAL		~		SIZE	
02	N647	23Mar99			~		C	
01	N596	21Sep98	FINISH		~		DRAWING NO.	
REV	R NO.	DATE					2542	
							CODE	
							01	
							REV	
							02	
							USED ON: D6900-01	
							SCALE: 2/1	
							SHEET 1 OF 1	



NOTES:

- UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS, 1/4W, 10%
CAPACITANCE VALUES ARE IN FARADS
- LAST REF DES USED: C3,D2,IC3,J203,
Q1,R3,RP2
- REF DES NOT USED: J201

			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES	SCHEMATIC, DISPLAY BOARD FRONT PANEL, MODEL 509		NOVAMETRIX Medical Systems, Inc. Wallingford, Ct. USA 06492			
			MATERIAL: _____	DRAWN H. Pittman	CHECKED MRL 16APR97				
			FINISH: _____	MFG. ENGR. MJC 4/23/97	APPROVED HS 4/23/97	SIZE B	DRAWING NO. 2542	CODE 03	REV. 02
02	N647	3/23/99	FILE: 254202.sch DATE: 23-Mar-99 TIME:	USED ON: C2542-01	SCALE: NONE	SHEET 1 OF 1			
01	N596	9/17/98							
REV	"R" NO.	BY DATE							

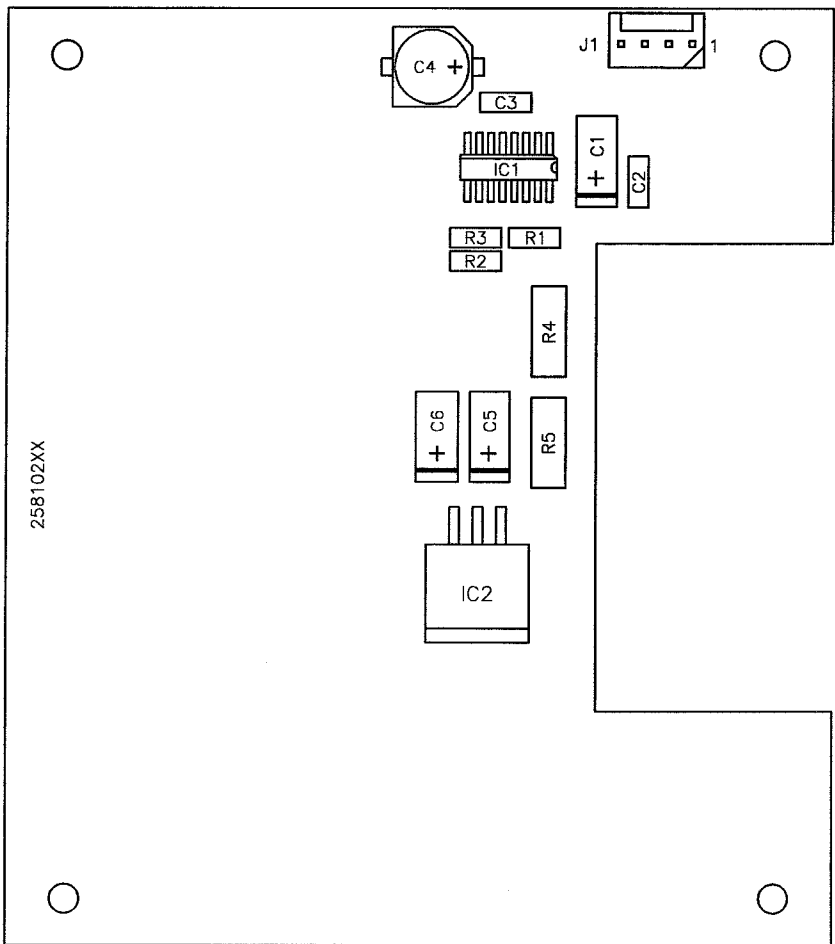
4

3

2

1

PN	DESCRIPTION	REF DES
2581-02	FAB, POWER BOARD	~
B2581-03	SCHEMATIC, POWER BOARD	~
152096	CAPACITOR, 220uF, 35V, 20%	C4
154072	CAPACITOR, .1uF, 50V, 10%	C2, C3
154079	CAPACITOR, 10uF, 25V, 10%	C1, C5
154080	CAPACITOR, 47uF, 10V, 10%	C6
☆ 211414	CONNECTOR, 4 PIN, PLUG, FRICTION LOCK	J1
472294	RESISTOR, 562kΩ, 1/4W, 1%	R2
474166	RESISTOR, 100kΩ, 1/8W, 1%	R1, R3
474340	RESISTOR, 4.7Ω, 1W, 1%	R4, R5
484578	VOLTAGE REGULATOR, 5V OUTPUT, 3 PIN	IC2
484579	VOLTAGE REGULATOR, ADJ OUTPUT, 16 PIN	IC1



NOTES:
 1. ☆ DENOTES THRU HOLE COMPONENTS.

This document contains information which is proprietary and the property of Novamatrix Medical Systems Inc. and may not be reproduced, used or disclosed in whole or in part without the written consent of Novamatrix Medical Systems Inc.

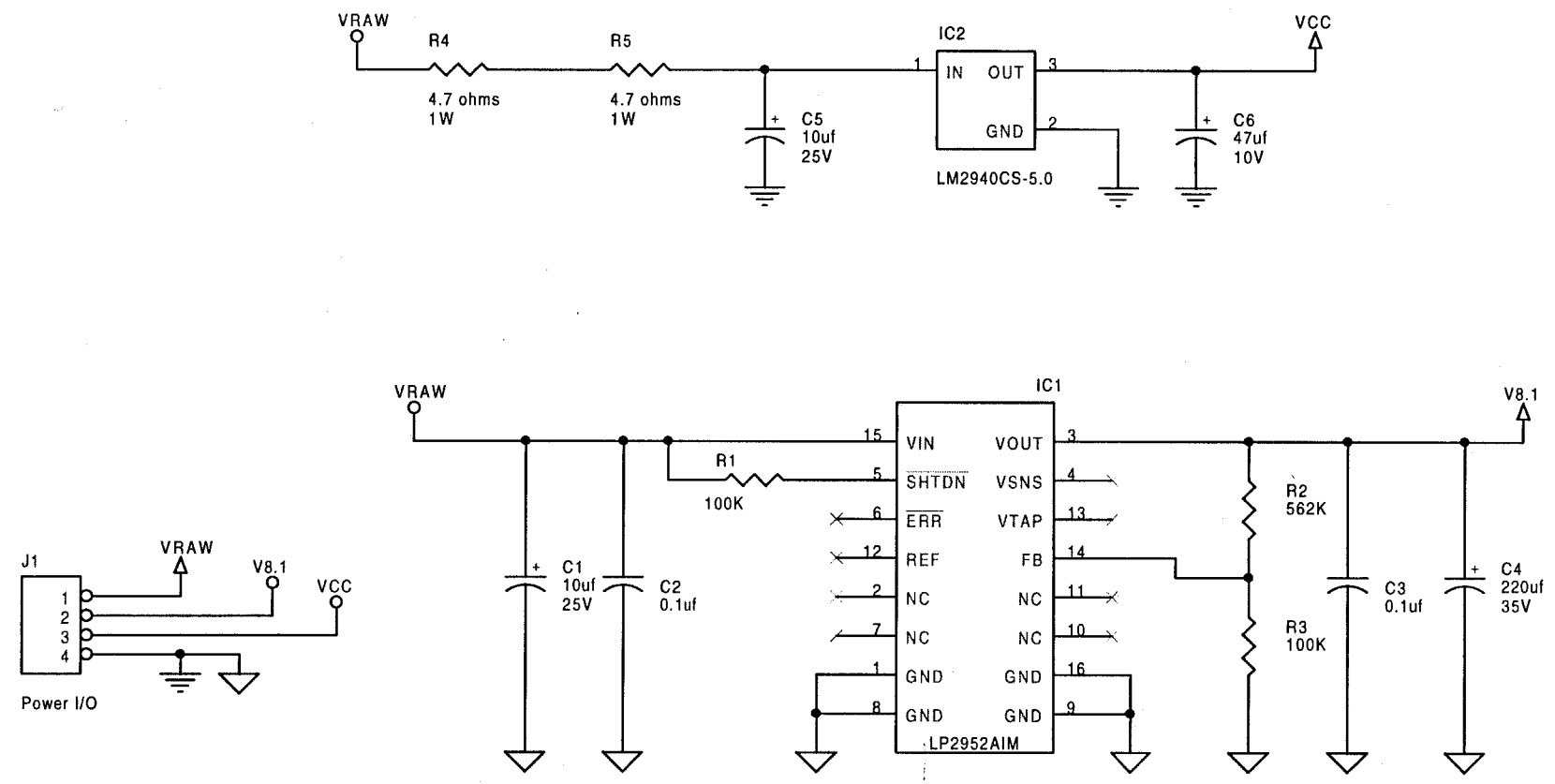
DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]			DRAWN B. Lancaster	DATE 11Mar99	NOVAMATRIX MEDICAL SYSTEMS INC.
TOLERANCES			CHECK	DATE	
.XX	±.01	[.254]	MFG ENGR	DATE	TITLE POWER BOARD ASSY, 509
.XXX	±.005	[.127]	ENGR	DATE	
.XXXX	±.0025	[.064]	PROJ ENGR	DATE	SIZE C
FRAC	±1/64		NEXT ASSY: ~		DRAWING NO. 2581
ANG	±1/4°				CODE 01
01	N646	17Mar99			REV 01
REV	R NO.	DATE			SCALE: 2/1
					SHEET 1 OF 1

4

3

2

1



- NOTE:
- 1.) UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS, 1/8W, 1%
CAPACITANCE VALUES ARE IN FARADS
INDUCTANCE VALUES ARE IN HENRY'S
 - 2.) LAST REF DES USED: C6, IC2, J1, R5
 - 3.) COMPONENTS NOT USED:

		Model 509 Power Board		Novamatrix	
		Medical Systems, Inc.		*	
		56 Carpenter La.		Wallingford, CT 06492	
Drawn: A. Esposito		Checked: <i>MR</i>		Size B	
Date: 10 Mar 99		Approved: <i>WJE</i>		Document Number 2581	
Eng: <i>WJE</i>		Date: 17 Mar 99		Code 03	
01		N646		Rev 01	
17 Mar 99		File: 2581 Schematics		Sheet 1	
Rev. *R* No.		By Date		Date: Friday, March 12, 1999	
				of 1	