Model 512/513

Service Manual

April 23, 2001

Part Number 9100-90-02

For Catalog No. 9100-00 & 9300-00 monitors

Novametrix Medical Systems Inc.
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Wallingford, Connecticut, U.S.A. 06492.

CE
0086

Revision History

7-Dec-99	Release
7-Sep-00	Revision 01. R-N795
23-Apr-01	Revision 02. R-N893

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1 Contents

2 Introduction

2.1 About this manual

This manual is written for technical personnel servicing the Novametrix Handheld Pulse Oximeter, Model 513.

2.2 Model 513 Technical Description

Per requirements of IEC 601-1, the Model 513 is classified as class II equipment, internally powered, with type BF applied part, and an enclosure protection rating of IPX0. The Model 513 is Year 2000 compliant.

Transport/Storage: -10 to +55° C (14-131° F), 10-95% R.H. non-condensing
Operating Conditions: 10 to +40° C (50 to 104° F), 10-90% R.H. non-condensing

2.3 Manufacturing Quality & Safety

The Novametrix Medical Systems Inc. manufacturing facility is certified to both ISO 9001 and EN46001 (MDD93/42/EEC Annex II). Novametrix' products bear the "CE 0086" mark. The product is certified by Underwriter's Laboratories (UL) to bear the UL mark; and tested by TÜV Rheinland to IEC 601-1/EN60601-1.

2.4 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 SN6 8TD
United Kingdom

2.5 Warranty

Equipment manufactured or distributed by Novametrix 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. Novametrix reserves the right to perform guarantee service(s) at its factory, at an authorized repair station, or at the customer's installation.

Novametrix' obligations under this guarantee are limited to repairs, or at Novametrix' 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 Novametrix from any further guarantee obligations.

Service Department

For factory repair service:
Call toll free: 1-800-243-3444
To Call Direct: (203) 265-7701
Facsimile (203) 284-0753
http://www.novametrix.com
techline@novametrix.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.

2.6 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.

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3 General Description

The Novametrix Model 512/513 is an easy-to-operate handheld pulse oximeter. It determines functional oxygen saturation (SpO_2) and pulse rate values and displays them to the user on a bright easy-to see display. A bargraph, indicative of the plethysmogram signal, is also displayed. The monitor is powered from two “AA” batteries. An optional external power adapter is available.

3.1 Indications for Use

The Model 512/513 Handheld Pulse Oximeter is indicated for use by technically skilled clinical personnel for the monitoring of oxygen saturation and pulse rate in patient areas including adult, pediatric and neonatal.

3.2 Patient Safety

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

- Care should be exercised to assure continued peripheral perfusion distal to the SpO_2 sensor site after application.
- Do *NOT* attach an SpO_2 sensor distal to a blood pressure cuff. Valid data *CANNOT* be processed when the cuff is inflated. Attach the sensor to the limb opposite to the site used for the blood pressure cuff.
- Keep the Model 512/513 and its accessories clean. Do not operate the Model 512/513 when it is wet due to spills or condensation.
- Where electromagnetic devices (i.e., electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electromagnetic fields up to 3 V/m will not adversely affect system performance.
- The Model 512/513 contains no user serviceable parts. Refer servicing to qualified service personnel.

3.3 Warnings

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

- **Explosion Hazard:** Do NOT use the Model 512/513 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 512/513 off before cleaning it. Do NOT use a damaged sensor or one with exposed electrical contacts. Do not use with a damaged external power source. Refer servicing to qualified service personnel.

- **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 SpO_2 sensor site after application.
- Do not position the sensor cable in any manner that may cause entanglement or strangulation.

3.4 Cautions

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

- Do not operate the Model 512/513 when it is wet due to spills or condensation.
- Do not operate the product 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.
- Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.
- Operate at temperatures between 10 to +40° C (50 to 104° F), 10-95% R.H. non-condensing.
- Avoid storing the monitor at temperatures less than -10° C or greater than +55° C (<14° F or >131° F) 10-95% R.H. non-condensing

3.5 Notes

NOTE:
Indicates points of particular interest or emphasis and intended to provide for more efficient or convenient operation.

- Use only Novametrix approved sensors and accessories with the Model 512/513.
- This product and its accessories which have patient contact are free of latex.
- The Model 512/513 is Year 2000 compliant.
- **Data Validity:** As with all pulse oximeters, inaccurate SpO_2 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

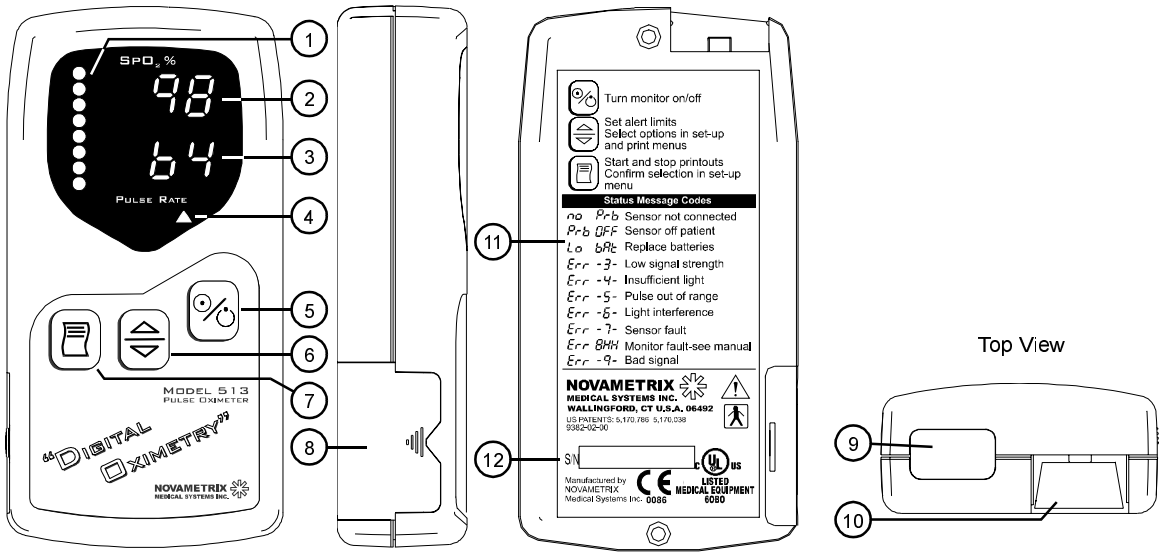
3.6 Symbols

	**Patient Isolation** Identifies patient isolation connection as type BF.
	**Attention** Consult manual for detailed information.

3.7 Preparation for Use

3.7.1 Getting Acquainted

The Model 513 Handheld Pulse Oximeter Monitor is shown below.

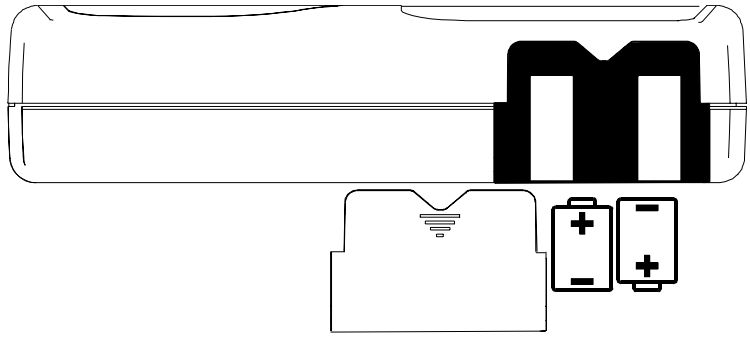


1	**Activity Bar** indicates pulsatile activity (plethysmogram signal).	7	**Print Key** Start/stop printouts. Confirm selections in setup menu.
2	**SpO_2 %** displays oxygen saturation value. Also error and setup messages.	8	**Battery Cover** slides from monitor to access batteries.
3	**Pulse Rate** display value in beats/ min. Also error and setup messages.	9	**IR Link** Infrared communications link to external devices.
4	**Alerts Enabled** icon illuminates when alert limits are active.	10	**Sensor Input** Connect only approved Novametrix sensors.
5	**Power Key** turns monitor on/off.	11	**Quick Guide** Basic reference.
6	**Select Key** selects alert limits. Also options in setup and print menus.	12	**Serial Number** and other information.

3.7.2 Power supply options

Batteries. Fresh disposable “AA” alkaline batteries (Panasonic AM3X or equivalent) provide approximately 16 hours of operation. Battery capacity may be reduced in colder temperatures or with excessive power cycling.

To install or remove the batteries;



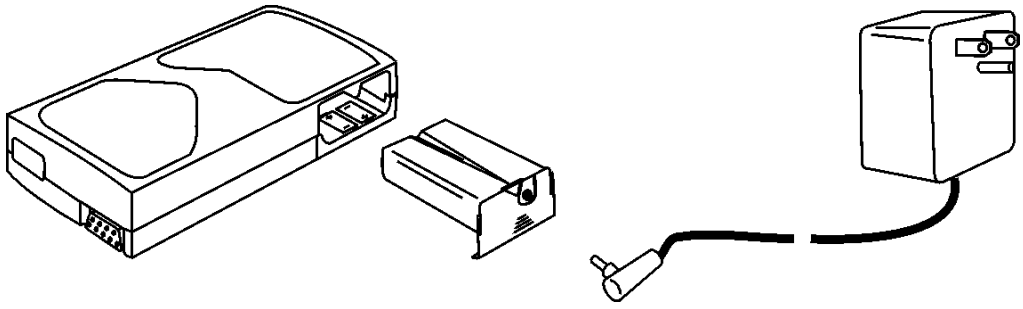
1. Turn the monitor off and then slide the battery cover from the unit. Remove the old batteries from the battery compartment.
2. Install fresh batteries according to the polarity diagram. Slide the battery compartment cover back into place and turn the monitor on.

Dispose of batteries in accordance with local laws. Do not mix battery types (e.g. disposable and rechargeable AA batteries). The Model 512/513 may not power up if the batteries are nearly depleted.

WARNING:

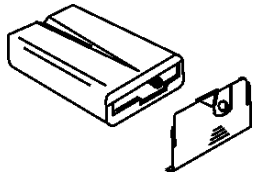
Do not recharge or incinerate alkaline batteries. Attempting to do so may cause the batteries to leak or explode.

Battery Eliminator. Use in place of batteries for AC operation, use only with Novametrix Cat. No. 9278-10 or 9421-10 AC Adapters.



1. With the monitor OFF, remove the battery cover and any batteries installed in the monitor.
2. Install the Battery Eliminator, ensure it ‘snaps’ into place.
3. Plug the AC Adapter into the Battery Eliminator then into a grounded hosital-grade AC outlet. The adapter should be connected to the same electrical circuit as other equipment in use on the patient.
4. Turn the monitor ON.

- Turn the monitor OFF before disconnecting the adapter from power or removing the Battery Eliminator. Failure to do so may result in loss of trend data.
- The hinged door will disengage if subjected to excessive force. Simply reattach by snapping back into place.



WARNING:
Use only Novametrix Cat. No. 9278-10 or 9421-10 AC Adapters with the Battery Eliminator.

3.7.3 Power On/Off

To turn the pulse oximeter on, press the POWER key.

Press the power key

- All displays are briefly illuminated and an audible tone sounds. Next, the model number (SpO_2 display) and software revision level (Pulse Rate display) are briefly indicated.

To turn the pulse oximeter off, press the POWER key.

3.7.4 Auto Power Off

A battery power saving feature allows the pulse oximeter to shut itself off after waiting three and one-half minutes without detecting any pulsatile activity.

- If three minutes elapse without any detected pulsatile activity, the oximeter emits a two-tone audible signal once each 5 seconds for 30 seconds. If still no pulsatile activity is detected, the pulse oximeter shuts itself off.
- If at any time pulsatile activity is detected, the power off counter is reset.

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4 Theory of Operation

The Model 512/513 measures oxygen saturation and pulse rate with sensors that contain red and infrared light sources—light emitting diodes, or LEDs. Since oxygen saturated blood absorbs different amounts of light at each wavelength (red and infrared) as compared to unsaturated blood, the amount of light absorbed by the blood in each pulse can be used to calculate oxygen saturation.

The light energy from red (660 nm) and infrared (940 nm) LEDs is beamed through a sample cell—a pulsating vascular bed, the patient's finger or toe for example. The remaining light energy not absorbed by the sample cell reaches a light receptor, called a photodiode, on the opposing side of the sensor. The data received at the photodiode is sent back to the monitor where it is split into its red and infrared components, digitized, processed by a microprocessor chip, and finally displayed as a numerical value for oxygen saturation. The moment to moment changes in this signal are reflected on the bargraph display.

The Model 512/513 is calibrated to display "functional" saturation. This differs from the "fractional" saturation value displayed by most co-oximeters. Functional saturation represents the amount of oxyhemoglobin as a percentage of the hemoglobin that can be oxygenated. Dysfunctional hemoglobins, (COHb and METHb) are not included in the measurement of functional saturation.

Functional Saturation = HbO_2/100-(COHb+METHb);

- HbO_2 is fractional hemoglobin,
- COHb is carboxyhemoglobin,
- METHb is methemoglobin.

Pulse Rate is calculated by measuring the time interval between the peaks of the infrared light waveform. The inverse of this measurement is displayed as pulse rate.

4.1 On/Off Switch

Refer to page 1 on 2578-03 schematic.

When the monitor is turned ON (pressing the POWER key) a positive pulse will appear at PWRSW, this will turn on Q3A which turns on Q3B, Q8 and finally Q6. With Q6 ON the V_SW voltage is now powered. When the PWRSW pulse goes low Q3A is still biased on by R15, R16 and R19 through V_SW. When Q6 is first turned on the system power will not be up, it is turned ON by Q8 which biases the gate to ground through D8. When both positive and negative supplies reach full potential, the gate of Q6 will be biased at the -5V (anode of D8), this will guarantee that Q6 is completely on (saturated) which is important for low battery conditions.

4.2 3.3V Digital Supply

Refer to page 1 on 2578-03 schematic.

A switch-mode boost regulator IC5 is used to generate the 3.3 volt digital supply (VDD) from the battery voltage. It is designed to operate over an input voltage range of 1.6V - 3.3V.

The switch-mode controller IC5 includes a low battery output pin (LBO), which is driven by an internal comparator. When the voltage applied to the low battery input pin (LBI) is less than the internal reference voltage, the comparator's output (LBO) is driven low. By connecting LBI capacitor C18, which is charged relatively slowly through resistor R35 from the digital supply (VDD), LBO will remain low for some time after power is applied, thereby generating the Power On Reset signal (POR).

4.3 ±5V Analog Supply

Refer to page 1 on 2578-03 schematic.

A switch-mode boost regulator IC5 is used to generate the positive 5 volt supplies (+5V and +VA) from the battery voltage. The negative 5 volt supplies (-5V and -VA) are generated by a charge pump voltage converter IC12, from the positive supply.

4.4 Reference voltage

Refer to page 1 on 2578-03 schematic.

The 20 bit analog to digital converters, and the micro controller's internal 8 bit A/D and D/A converters all require a 2.5 volt reference voltage. This is supplied by a single chip voltage reference IC10.

4.5 Reverse Battery Protection

Refer to page 1 on 2578-03 schematic.

A P channel MOSFET Q2 is used to provide protection against the batteries being improperly installed (reverse polarity). The gate of the transistor is driven from the negative 5 volt supply. This is because, in worst case conditions, the battery voltage can drop to 1.6 volts, which is not enough to turn the MOSFET fully on, leading to unwanted power losses in the device.

Although the MOSFET has a parasitic diode between its drain and source, (which is forward biased when the batteries are inserted correctly), an additional Schottky diode D3 is included to minimize the forward voltage drop, and ensure that the unit can start up at low battery voltages.

4.6 Micro controller

Refer to page 2 on 2578-03 schematic.

The micro controller chosen for the Model 512/513 pulse oximeters is the Hitachi HD64F3048 (H8/3048). The core is a 16 bit processor, capable of running off a 3.3V supply, at up to 12.5 Mhz. Combined with it is ample internal program memory (128k bytes Flash ROM) and 4k bytes of internal RAM.

This device also includes a number of integrated peripherals, which make it ideal for this application. There are several timers, and a timing pattern generator, which will be used to generate the front end timing signals; an 8 bit A/D converter, which will be used to monitor the front-end and battery status; an 8 bit D/A converter, which will be used to generate the sensor LED control voltage; two serial ports, one of which will be used to interface with the 20 bit A/D converters, the trend memory and the real time clock, the other of which will be configured as an asynchronous serial interface for communications with the "outside world". Finally,

because the external data and address busses are not required, there are enough uncommitted I/O pins to drive the LED displays and monitor the control keys.

CPU Pin Functions

	Pin #	Sig	1/0	Active State	Description
Port 1:	Pin 36	$P1_0$	Output	Active Low	Drives the lowest (least significant) LED in the pulse amplitude bargraph.
	Pin 37	$P1_1$	Output	Active Low	Drives the second LED in the pulse amplitude bargraph.
	Pin 38	$P1_2$	Output	Active Low	Drives the third LED in the pulse amplitude bargraph.
	Pin 39	$P1_3$	Output	Active Low	Drives the fourth LED in the pulse amplitude bargraph.
	Pin 40	$P1_4$	Output	Active Low	Drives the fifth LED in the pulse amplitude bargraph.
	Pin 41	$P1_5$	Output	Active Low	Drives the sixth LED in the pulse amplitude bargraph.
	Pin 42	$P1_6$	Output	Active Low	Drives the seventh LED in the pulse amplitude bargraph.
	Pin 43	$P1_7$	Output	Active Low	Drives the top (most significant) LED in the pulse amplitude bargraph.
Port 2:	Pin *45*	$P2_0$	Output	Active Low	“A” segment driver, for multiplexed 7 segment LED display.
	Pin 46	$P2_1$	Output	Active Low	“B” segment driver, for multiplexed 7 segment LED display.
	Pin 47	$P2_2$	Output	Active Low	“C” segment driver, for multiplexed 7 segment LED display.
	Pin 48	$P2_3$	Output	Active Low	“D” segment driver, for multiplexed 7 segment LED display.
	Pin 49	$P2_4$	Output	Active Low	“E” segment driver, for multiplexed 7 segment LED display.
	Pin 50	$P2_5$	Output	Active Low	“F” segment driver, for multiplexed 7 segment LED display.
	Pin 51	$P2_6$	Output	Active Low	“G” segment driver, for multiplexed 7 segment LED display.
	Pin 52	$P2_7$	Output	Active Low	Decimal point driver, for multiplexed 7 segment LED display.

	Pin #	Sig	1/0	Active State	Description
Port 3:	Pin 27	$P3_0$	Input	Active Low	This pin goes low when the “Print” key is pressed.
	Pin 28	$P3_1$	Input	Active Low	This pin goes low when the “Clock Set” key is pressed.
	Pin 29	$P3_2$	Input	Active Low	This pin will only be used if an additional key is required. It goes low when the “Spare” key is pressed.
	Pin 30	$P3_3$	Not Used		
	Pin 31	$P3_4$	Not Used.		
	Pin 32	$P3_5$	Not Used.		
	Pin 33	$P3_6$	Not Used.		
	Pin 34	$P3_7$	Output	Active Low	Disables the Non-Maskable Interrupt, that is generated when the Power On/Off switch is pressed.
Port 4:	Pin 18	$P4_0$	Output	Active Low	Signal IRDARST resets the IrDa Encoder/ Decoder. This signal should be asserted before attempting to transmit or receive serial data over the IrDa interface.
	Pin 19	$P4_1$	Output	Active Low	Signal IRDASDN places the IrDa transceiver in standby mode, to conserve power.
	Pin 20	$P4_2$	Output	Active Low	Signal RAMHLD. Normally high. Asserting this signal while writing to the serial RAM allows the communication to be temporarily interrupted.
	Pin 21 $P4_3$		Output Active Low		Signal RAMCS is the chip select for the serial Flash RAM.
	Pin 23	$P4_4$	Output Active High		Signal RTCCS is the chip select for the real time clock.
	Pin 24	$P4_5$	Output Active Low		Signal ADCSLP places both the 20 bit A/D converters in standby mode, to conserve power. (This can be done whenever a probe fault is detected).
	Pin 25	$P4_6$	Output Active Low		Signal ADOIRCS is the chip select for the A/D converter that digitizes the infra-red plethysmogram.
	Pin 26	$P4_7$	Output Active Low		Signal ‘ADO RDCS is the chip select for the *AID* converter that digitizes the red plethysmogram.

	Pin #	Sig	1/0	Active State	Description
Port 5:	Pin 53	$P5_0$	Output Active High		When signal PWROFF is asserted, the power supply is turned off.
	Pin 54	PS_1	Input Active High		In normal operation the TRIP signal is low. It goes high to indicate that the sensor LED current limit has tripped.
	Pin *55* PS_2		Output Active High		Pulsing the ADOCAL signal high (for a minimum of 4 ADC clock cycles) initiates an ADC calibration cycle.
	Pin 56 PS_3		Output Both		The logic level on the ADOSCI signal when an ADC calibration is initiated, determines the type of calibration that is performed: Low = Self calibration, High = System offset calibration.
Port 6:	Pin 58	$P6_0$	Output	Active Low	“Hundreds” digit driver for SP02, 7 segment LED display.
	Pin 59	$P6_1$	Output	Active Low	“Tens” digit driver for SP02, 7 segment LED display.
	Pin 60	$P6_2$	Output	Active Low	“Units” digit driver for SP02, 7 segment LED display.
	Pin 69	$P6_3$	Output	Active Low	“Hundreds” digit driver for pulse rate, 7 segment LED display.
	Pin 70	$P6_4$	Output	Active Low	“Tens” digit driver for pulse rate, 7 segment LED display.
	Pin 71	$P6_5$	Output	Active Low	“Units” digit driver for pulse rate, 7 segment LED display.
	Pin 72	$P6_6$	Not Used		
Port 7:	Pin 78	AN_0	Input	Analog	ADOFEDO- Scaled voltage level at the output of the photo-diode amplifier.
	Pin 79	AN_1	Input	Analog	PROBID . Probe identification.
	Pin 80	AN_2	Input	Analog	ADCBATT . Scaled battery voltage.
	Pin 81	AN_3	Input	Analog	ADORDLED . Scaled voltage at the drain of the red sensor LED drive transistor.
	Pin 82	AN_4	Input	Analog	ADO IRLED . Scaled voltage at the drain of the infra-red sensor LED drive transistor.
	Pin 83	$P7_5$	Not Used		
	Pin 84	$P7_5$	Not Used		
	Pin 85	DA_1	Output Analog	VLED . Sensor LED intensity control voltage.	

	Pin #	Sig	1/0	Active State	Description
Port 8:	Pin 87	$P8_0$	Not Used		
	Pin 88	IRQI	Input	Active Low	The interrupt signal, PFIRQ, is pulled low when the real time clock detects a power failure (ie: the supply voltage is less than the back-up voltage). Probably not needed.
	Pin 89	IRQ_2	Input	Active Low	The interrupt signal, RTCRQ, is pulled low by a pre-programmed real time clock alarm. Probably not needed.
	Pin 90	IRQ_3	Input	Active Low	The interrupt signal, KEYRQ, is pulled low when one of the control keys (print, clock set or spare) is pressed. Not needed if keys are polled.
	Pin 91	$P8_4$	Not Used		
Port 9:	Pin 12	TxD_0	Output Both		Synchronous serial data output to RTC and RAM.
	Pin 13	TxD_1	Output Both		Asynchronous serial data output to IrDa encoder and programming interface.
	Pin 14	RxD_0	Input	Both	Synchronous serial data input from RTC, RAM and ADCs.
	Pin 15	RxD_1	Input	Both	Asynchronous serial data input from IrDa decoder and programming interface.
	Pin 16	SCK_0	Output Both		Synchronous serial interface clock.
	Pin 17	SCK_1	Input	Both	Asynchronous serial interface clock (at 1 6x data rate).
Port A:	Pin 93	PA_0	Not Used		
	Pin 94	PA_1	Not Used		
	Pin 95	PA_2	Not Used		
	Pin 96	TIOC B_0	Output Active High		When the peizo-beeper is inactive, this line is held low. To generate an audio output, this line is driven by Timer 0, in “Toggle output” mode, to produce a square wave. The frequency of the tone depends on the value written to the timer. (Optimum frequency is 4096 Hz).
	Pin 97	PA_4	Not Used		
	Pin 98	TIOC B_1	Output Both		16x data rate, asynchronous serial interface clock generated by Timer 1, in “Toggle output” mode. Should be disabled when IrDa interface is inactive.
	Pin 99	PA_6	Not Used		
	Pin 100	TIOC B_2	Output Both		4.096 Mhz, A/D converter clock generated by Timer 2, in “Toggle output’ mode. Should be disabled when ADCs are in standby mode.

	Pin #	Sig	1/0	Active State	Description
Port B:	Pin 2	PB_0	Output Active High		Normally low. When asserted, SIGGND grounds the analog signal input path, directly after the photo-diode amplifier. It is used for calibration purposes. Note: This signal should only be asserted if INSIG has already been asserted.
	Pin 3	PB_1	Output Active Low		Normally high. When asserted, INSIG isolates the photo-diode amplifier from the remainder of the analog signal input path. It is used for calibration purposes.
	Pin 4	PB_2	Not Used		
	Pin *5*	TP_{11}	Output Active Low		The signal IRSAMP is derived from the timing pattern controller. When low, it places the infra-red channel, sample and hold in sample mode. See timing diagram, Fig 4.
	Pin 6	TP_{12}	Output Active Low		The signal IRLED is derived from the timing pattern controller. When low, it turns oh the infra-red LED in the sensor. See timing diagram, Fig 4.
	Pin *7*	TP_{13}	Output Active Low		The signal ASAMP is derived from the timing pattern controller. When low, the signal is allowed to pass. When high, the signal path is grounded, to discharge the HP filter capacitor. See timing diagram, Fig 4.
	Pin 8	TP_{14}	Output Active Low		The signal RDSAMP is derived from the timing pattern controller. When low, it places the red channel, sample and hold in sample mode. See timing diagram, Fig 4.
	Pin 9	TP_{15}	Output Active Low		The signal RDLED is derived from the timing pattern controller. When low, it turns oh the red LED in the sensor. See timing diagram, Fig 4.

	Pin #	Sig	1/0	Active State	Description
Misc:	Pin 10	VPP	Input	Power	When programming the internal Flash ROM, 12V is applied to this pin.
	Pin 61	CLK	Not Used		
	Pin 62	STBY	Input	Active Low	Places CPU in standby mode. Pulled high, as this facility is not required.
	Pin 63	RES	Input	Active Low	Power on reset.
	Pin 64	NMI	Input	Active High	Non-maskable interrupt, generated when power switch is pressed. Can be disabled by $P3_7$ (see above).
	Pin 66	EXTAL	Input		Connected to external crystal.
	Pin 67	XTAL	Output		Connect to external crystal.
	Pin 73	MD_0	Input	Both	Mode control, pulled high for mode 7.
	Pin 74	MD_1	Input	Both	Mode control, pulled high for mode 7.
	Pin *75*	MD_2	Input	Both	Mode control, pulled high for mode 7. Taken to programming voltage (12V), for bootstrap programming mode.
	Pin 76	AVcc	Input	Power	Power supply (+5V) for on-chip ADC and DAC.
	Pin 77	VREF	Input	Analog	Reference voltage (+2.5V) for on-chip ADC and DAC.
	Pin 86	Avss	Input	Power	Power supply ground for on-chip ADC and DAC.
	Pins 1, 35 & 68			Power	Digital power supply (+3.3V).
	Pins 11, 22,44, *57, 65* & 92			Power	Digital ground.

4.7 Sensor LED drive

Refer to page 1 on 2578-03 schematic.

The red LED drive circuitry is explained here, the infrared circuitry operates in a similar manner with the corresponding components listed in parenthesis. Op-amp IC7A (IC7B) and Q7 (Q9) are configured as a constant current source. The current flowing through the transistor (and hence through the LED) is set by the value of R42 (R50), and by the LEDSRC Voltage. The VLED voltage from IC19 (page 2 on schematic) allows IC7A (IC7B) to drive transistor Q7 (Q9) ON, this draws current through the sensor LED.

The LED is turned off by MOSFET Q12 (Q14) via the RDLED (IRLED) line, which shorts the Control Voltage VLED to ground through R55 (R63). This in effect brings the input to amplifier IC7A (IC7B) to ground which results in turning Q7 (Q9) OFF.

4.8 Plethysmogram Acquisition

Refer to page 1 on 2578-03 schematic.

The signal (both red and infrared) from the photodiode is amplified by differential amplifier IC2B. The output of the amplifier is fed to electronic switch IC4, controlled by the INSIG line. The INSIG line will close switch IC4 (signal will flow through) except in the case of “Probe Off Patient” or during a power up self test.

The signal is then, ac coupled by C24 and buffered by IC2A, before being fed to the sample and hold circuits which extract the infra-red (IC9, IC11A) and red (IC8, IC11B) signals from the IC2B output. The ASAMP line controls Q13, which when ON will discharge any residual voltage on C24 before the next signal level is read. The SIGGND line controls Q10, which when ON will short the input of the sample and hold circuit (IC4, IC2 and C24) to enable the system to compensate for circuit offsets during system calibration.

When the red signal is present at the output of IC2A the RDSAMP line will close switch IC8 and allow the red signal to reach amplifier IC11B. At this time the IRSAMP line keeps switch IC9 open, preventing any red signal from reaching IC11A. When the infrared signal is present at the output of IC2A the IRSAMP line will close switch IC9 and allow the infrared signal to reach amplifier IC11A. At this time the RDSAMP line keeps switch IC8 open, preventing any infrared signal from reaching IC11B. The red LED signal, amplified by IC11B is fed to the analog to digital converter IC14. The infrared signal, amplified by IC11A is fed to the analog to digital converter IC15.

4.9 A/D converters

Refer to page 1 on 2578-03 schematic.

Data from the red and infrared channels is sampled by the 20-bit measurement ADCs, IC14 and IC15 respectively. The analog input at pin 9 is converted to a digital representation with 20-bit resolution based on the input magnitude.

The analog to digital 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 clock signal at the ADC pin 3 (ADCCLK) input.

The microprocessor starts a read cycle of the infrared channel by bringing the ADCIRCS or ADCRDCS low. A red channel read starts when IC14 pin 16 (chip select red channel) is brought low.

On the falling edge of the ADC’s CS*, the output word’s MSB (most significant bit) appears at the 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 (SCLK) 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 Serial Clock speed 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 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 CS* to return high, and the ADC resumes its sample/convert/overwrite-buffer cycle.

4.10 Sensor Over-current Protection

Refer to page 1 on 2578-03 schematic.

The average current drawn by the sensor LEDs must be limited to less than 50 mA, in a fault condition. This will prevent any possibility of burns caused by excessive power dissipation in the sensor LEDs. Therefore a current limiting circuit is set in place. This circuit monitors the current passing through R52 via IC3A. If it exceeds 50 mA, the thyristor (SCR 1) is triggered by IC3B and its associated circuitry, this turns OFF the pass transistor, Q5 which controls the LEDSRC voltage. The circuit latches in this state, because the thyristor continues to draw current through R2, so it will not turn OFF. In order to reset the circuit, the whole monitor must be turned off, then back on again.

4.11 Front End Timing Signals

The front end requires a number of timing signals; “RDLED” & “IRLED” to turn the sensor LEDs on and off, “RDSAMP” & “IRSAMP” to sample and hold the red and infra-red signals, and “ASAMP” to clamp the analog signal path to ground in between the signal pulses.

These timing signals will be generated by the micro controller’s Timing Pattern Controller (bits 3 -7 of port B will be configured as TPC outputs; TP11 - TP15), which will be programmed to produce the signals shown.

The front-end requires two additional signals, to enable a front end offset calibration to be performed. These signals are: “INSIG”, which isolates the photodiode amplifier stage from the rest of the signal chain, and “SIGGND”, which grounds the signal path. As these signals are only required for calibration, and subsequently remain static during normal operation, they will be derived from bits 0 and 1 of port B, configured as standard outputs.

4.12 20 Bit ADC Interface

The micro controller communicates with the 20 bit ADCs via channel 0 of its Serial Communications Interface, configured for synchronous operation (SCK0 and RxD0).

The “infrared” ADC is addressed by the chip select signal “ADCIRCS”, which is derived directly from Port 4, bit 6, configured as a standard output. The “red” ADC is addressed by the chip select signal “ADCRDCS”, which is derived directly from Port 4, bit 7, configured as a standard output.

A 4.096MHz clock signal (ADCCLK) is derived from the micro controller’s internal timer, channel 2 (TIOCB2).

Three additional control signals are provided. “ADCCAL” and “ADCSC 1” are used to perform an internal calibration. They are derived from port 5, bits 2 and 3. “ADCSLP” allows the software to place the ADC in standby mode, when it is not used to conserve power. It is derived from port 4, bit 5.

4.13 Front End Status Lines

The micro controller monitors the status of different circuits within the front end. The following subsections describe these lines and the interaction with the system.

4.13.1 Front End DC

The output of the photodiode amplifier ADCFEDC is scaled down by R21, R11, C5 and fed to channel 0 of the micro controller’s internal 8 bit A/D converter. This signal is used by the software to determine if the ambient light level at the sensor is too high.

4.13.2 Sensor LED voltage

The voltage appearing at the cathodes of the red (ADCRDLED) and infra-red (ADCIRLED) sensor LEDs is scaled down by R12, R18, C6 (red) and R13, R7, C3 (infrared) and fed to channels 3 and 4 of the micro controller's internal 8 bit A/D converter, respectively.

Normally, the voltage at these points would be around 3 volts (5V supply less 2V LED voltage drop). If this is not the case, it indicates that either there is a sensor fault, or that there is no sensor connected.

4.13.3 Sensor LED over-current protection status

In a fault condition, the sensor current pass transistor Q5 is latched off. The voltage applied to the gate of this transistor is fed to bit 1 of port 5 as ADCLPWR, which is configured as an input. This enables the software to determine if an over-current fault has occurred.

4.13.4 Battery Status

The raw battery voltage (after the on/off switch) is scaled by R40, R74, C49 and fed to channel 2 of the micro controller's internal 8 bit A/D converter (ADCBATT). This enables the software to estimate the remaining capacity in the batteries.

4.14 Trend Storage

Refer to page 2 on 2578-03 schematic.

SpO_2 and Pulse Rate trend data is stored in a 16 kByte serial Flash RAM IC18, which allows 24 hours of data to be stored at 12 second resolution.

The micro controller communicates with the RAM via channel 0 of its Serial Communications Interface, configured for synchronous operation (SCK0, TxD0 and RxD0).

The RAM is addressed by the chip select signal "RAMCS", which is derived directly from Port 4, bit 3, configured as a standard output. Trend data is buffered by the micro controller, and written to the RAM in blocks of 32 bytes (or multiples thereof).

The "HOLD" pin on the RAM is driven by the signal "RAMHLD", which is derived from port 4, bit 2, configured as a standard output. Although it is probably not required, this allows communications with the RAM to be temporarily interrupted, whilst another device connected to the serial interface is serviced. Normally, this line would remain high.

The Program Protect (PP) pin on the RAM is connected to the Power On Reset (POR), so that programming is disabled during power up.

4.15 Real-time Clock

Refer to page 2 on 2578-03 schematic.

The micro controller communicates with the RTC IC16 via channel 0 of its Serial Communications Interface, configured for synchronous operation (SCK0, TxD0 and RxD0).

The RTC is addressed by the chip select signal "RTCCS", which is derived directly from Port 4, bit 4, configured as a standard output.

A backup supply for the clock is provided by a 0.1 Farad capacitor C51, which is normally kept charged by either the main 3.3V supply VDD, (when the unit is switched on), or the raw battery voltage VBATT, (when the unit is switched off). This will allow the clock to maintain timekeeping for up to 24 hours after the primary batteries are removed.

If the supply voltage falls below the backup voltage, indicating a power failure, the RTC drives its “PF” pin low. This signal (PFIRQ) is connected to the micro controller’s IRQ1 input, so that an interrupt can be generated under these conditions.

4.16 External Programming

The Flash ROM, inside the micro controller can be re-programmed up to 100 times. This is achieved by applying a 12V programming voltage to the VPP pin on the micro controller, from an external power source. The new program is then downloaded via the Serial Communications interface, channel 1, under the control of an external device, such as a PC.

4.17 $Sp0_2$ and Pulse Rate Displays

The SpO_2 and Pulse Rate are each displayed on a 3 digit, 7 segment red LED display. Each digit is 0.3” (7.6mm) high.

The displays used are low current devices, operating at 2 mA per segment, to conserve power. Port 2 of the micro controller are used to drive the segments of the displays, each pin is capable of sinking 10 mA. The common anodes of each digit will be driven from port 6, via P-MOSFETs, as none of the micro controller’s outputs is capable of sourcing enough current.

4.18 Pulse Amplitude Bar-graph

The pulse amplitude bar-graph will consist of 8, 3mm diameter, red LEDs. The LEDs are low current devices, designed to operate at around 2 mA. They are driven directly from the port 1 of the micro controller, which is capable of sinking 10 mA into each pin.

4.19 Battery Status

A “Lo bAt” message will briefly be displayed once a minute (with triple beep tone) when less than 30 minutes of battery capacity remains, and once each 5 seconds (with triple beep tone) when less than 15 minutes of power remain.

4.20 IrDa Interface

The micro controller communicates with the IrDa Encoder/decoder IC6 via channel 1 of its Serial Communications Interface, configured for asynchronous operation (TxD1 & RxD1). The IrDa encoder/decoder interfaces directly with the IrDa receiver/transmitter IC1. This interface is designed specifically for the Infrared Reader Module (Cat. No. 9342-00) and the Hewlett-Packard Infrared Printer (Cat. No. 330088) and does not conform to standard IrDa protocol.

The IrDa encoder/decoder requires a clock signal that is 16 times the data rate. Unfortunately, this is not available from the serial interface clock output (SCK1). Consequently, the baud clock is derived from timer channel 1 (TIOCB1) in the micro controller. This is fed to both the IrDa encoder/decoder and SCK1, which is configured as an external clock input.

Two additional control signals are implemented. The first of these is IRDARST, which is used to reset the encoder/decoder’s internal state machine. It is derived from the micro controller’s port 4, bit 0, configured as an output. The second control signal is IRDASDN, which is used to put the receiver/transmitter into standby mode, thereby conserving power. It is derived from the micro controller’s port 4, bit 1, configured as an output.

4.21 Audio

The micro controller's internal timer, channel 0, (TIOCB0) is used to generate a suitable audio frequency square wave. This drives a peizo-electric transducer located on the display board, via a buffer transistor Q20.

4.22 Control Keys

Three user operated, control keys are provided (Print, Set Clock and a spare). The state of these keys can be read by the software via port 3, bits 0- 3, which are configured as inputs. The switch lines are normally pulled high, until a key is pressed.

The keys can either be polled by the software or, if required, serviced by an interrupt. The state of the key lines is "ORed" (inverse logic) to generate the signal KEYIRQ, which is fed to the micro controller's IRQ3 input.

4.23 Battery Eliminator

Refer to the 2580-03 schematic.

The Battery Eliminator accessory is powered by an AC Adapter (Cat. No. 9278-10 or 9421-10 use *only* these adapters) that supplies a DC input at J1. This is filtered by L1, C1 and C2. Fuse F1 and Diode D2 protect against overcurrent (short) and reverse bias respectively. IC1 is a low power 3.3 volt regulator with R2 and R3 serving as feedback resistors to control the output voltage, C3 and C4 filter the regulator's output. Zener diode D1 protects the inout of the monitor against any over voltage condition.

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5 Functional Testing

The Functional Testing verifies overall functional integrity of the monitor and sensor. If the Model 512/513 does not pass these tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance. Refer to the Accuracy Tests for testing the rear panel connectors.

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

5.1 Equipment Required

1. SpO_2 Finger Sensor, PN: 9168-00 or 9768-00
2. (2) “AA” batteries (fully charged), PN: 400038
3. Additional Equipment for Model 513 Testing:
   - Hewlett-Packard Infrared Printer, PN: 330088
   - Seiko DPU-414 Thermal Printer PN: 9140-00 and 9452-00 interface cable
   - Infrared Reader Module PN: 9342-00

5.2 Model 512 Procedure

1. Visually inspect the monitor and verify that there are no cosmetic defects.
2. Verify all labels are properly placed.
3. Install two AA batteries into the battery compartment. Be careful to follow polarity markings. Close battery door.
4. Turn on the unit by pressing the power button. Verify the following power up sequence occurs: Monitor will beep on power on, display all LED segments, then display monitor type “512” in the saturation field and the current software revision in the pulse rate field.
5. Connect the 9168-00 finger sensor to the unit and place the sensor over your finger.
6. Verify saturation and pulse rate values are displayed with no error messages displayed.
7. Remove your finger from the sensor. Verify a “Prb OFF” message is displayed.
8. Leave the unit running in this state for approximately 3 minutes. Verify after 3 minutes that an audio alert sounds for approximately 30 seconds, after which time the unit shuts off automatically.
9. The procedure is complete remove the batteries and disconnect the finger sensor from the unit.

5.3 Model 513 Procedure

1. Install the two “AA” batteries into the battery compartment. Be careful to follow polarity markings. Close battery door.
2. Turn on the unit by pressing the power key. Verify the following power-up sequence occurs: Monitor will beep on power on, display all digits, then display monitor type “513” in the saturation field and the current software revision in the pulse rate field. Then "no Prb" will be displayed.
3. Power the unit down by pressing the power key, then power the unit back up while holding down the Select key. Verify the display indicates “Set Up”.
4. Press the Select key twice. Display should indicate “U2 nO”, press the Print key to select “YES” for pulse beep.
5. Press the Select key, verify "U3 nO" appears. If not use the Print key to set it to "nO".
6. Press the Select key, verify "U4 YES" appears on the display. If not use the Print key to set it to "YES".
7. Press the Select key and verify the correct time / date is properly set in the following sections: (U6 - year), (U7 - Month), (U8 - Day), (U9 - Hour), (U10 - Minute). If a parameter within any of these menus is set incorrectly enter the correct parameter using the Print key. Wait until the unit comes out of the “Set Up” mode then proceed.
8. Wait for the "no Prb" message to appear. Connect the 9168-00 finger sensor to the unit and verify a "Prb OFF" message.
9. Place the sensor on your finger.
10. Verify saturation and pulse rate values are displayed with no error massages displayed.
11. Verify a pulse beep and pulse bar (LEDs).
12. Remove your finger from the sensor. Verify a “Prb OFF” message is displayed and an alert tone sounds. Press the Select key, verify the alert tone stops and "Aud OFF" appears on the display.
13. Leave the unit running in this state for approximately 3 minutes. Verify after 3 minutes that an audio alert sounds for approximately 30 seconds, after which time the unit shuts off automatically.
14. The procedure is complete.

5.3.1 Checking with Hewlett Packard 82240B Infrared Printer

1. Refer to the Hewlett Packard 82240B Infrared Printer User’s Manual for setup and operation. Power the printer on and ensure the paper is properly loaded. Set the Model 513 so that the infrared window is positioned properly for communication with the printer.
2. Power the Model 513 up while holding down the Select key. Verify the display indicates “Set Up”.
3. Press the Select key until "U5" appears in the SpO_2 display, if the Pulse Rate display is not set to "Pt1" then use the Print key to set the it to "U5 Pt1".
4. Wait for the "no Prb" message to appear. Connect the 9168-00 finger sensor to the unit and verify a "Prb OFF" message.
5. Place the sensor on your finger.

6. Verify saturation and pulse rate values are displayed with no error massages displayed.
7. Verify a pulse beep and pulse bar (LEDs).
8. Press and hold the Print key on the 513 for 5 seconds, then press the Select key until “Set P 2” is displayed. Once “Set P2” is displayed, press the Print key again to activate the IR interface.
9. Verify real time text printout from the printer. The printout should update every thirty seconds.

5.3.2 Checking with Seiko DPU-414 Thermal Printer

1. Connect the 9452-00 interface cable from the 9342-00 Infrared Reader Module to the 9 pin connector on Seiko DPU-414 Thermal Printer.
2. Refer to the Model 513 User’s Manual for instructions on configuring the Seiko to operate with the Model 513.
3. Turn the Seiko DPU-414 on.
4. Power the Model 513 up while holding down the Select key. Verify the display indicates “Set Up”.
5. Press the Select key until "U5" appears in the SpO_2 display, if the Pulse Rate display is not set to "Pt1" then use the Print key to set it to "U5 Pt1".
6. Wait for the "no Prb" message to appear. Verify a printout similar to the following:
   HandHeld Pulse Oximeter Model 513
   Software Version **#.##**
   Session Started HH:MM:SS DD/MMM/YY
   Auto shut off is ON
   Pulse Limits are OFF
   Pulse Beep is OFF
   Printer Type is SIEKO
7. Connect the 9168-00 finger sensor to the unit and verify a "Prb OFF" message.
8. Place the sensor on your finger.
9. Verify saturation and pulse rate values are displayed on the monitor with no error massages displayed.
10. Verify a pulse beep (if enabled) and pulse bar (LEDs).
11. Press and hold the Print key on the 513 for 5 seconds, then press the Select key until “Set P 1” is displayed, if the Pulse Rate display is not set to "P 1" then use the Select key to set it to "P 1". Press the Print key.
12. Press the Print key (P1 Off displayed), followed by the Select key (P1 On displayed), then press the Print key again. Verify a header is printed, then the time, $\%SpO_2$ and pulse rate are printed every thirty seconds.

5.3.3 Checking with PC and Infrared Reader Module

1. Connect the 9342-00 to one of the communications ports on the PC. Run the terminal emulation software with the following settings:

Baud Rate	9600
Bits	8
Stop Bits	1
Parity	None
Flow/Control	Xon/Xoff

   Note: Set the Com Port setting to the Com Port the 9342-00 is connected to.

2. Place the 9342-00 so it is two feet away from the units IRDA window. The IRDA fixture must be facing the unit with nothing interrupting it's viewing path.
3. Power the unit up while holding down the Select key. Verify the display indicates "Set Up".
4. Press the Select key until "U5" appears in the SpO_2 display, if the Pulse Rate display is not set to "PC1" then use the Print key to set the it to "U5 PC1".
5. Wait for the "no Prb" message to appear. Connect the 9168-00 finger sensor to the unit and verify a "Prb OFF" message.
6. Verify the terminal emulation program is displaying a message similar to the following:

   HandHeld Pulse Oximeter Model 513
   Software Version **#.##**
   Session Started HH:MM:SS DD/MMM/YY
   Auto shut off is ON
   Pulse Limits are OFF
   Pulse Beep is OFF
   Printer Type is SIEKO

7. Connect the 9168-00 finger sensor to the unit and verify a "Prb OFF" message.
8. Place the sensor on your finger.
9. Verify saturation and pulse rate values are displayed on the monitor with no error massages displayed.
10. Verify a pulse beep (if enabled) and pulse bar (LEDs).
11. Press the Print key (P1 Off displayed), followed by the Select key (P1 On displayed), then press the Print key again. Verify a header is printed, then the time, %SpO_2 and pulse rate are printed every thirty seconds.

6 Accuracy Tests

The Accuracy Tests verifies the performance accuracy of the Model 512/513. This test is typically performed in conjunction with (after) the Functional Tests. If the monitor does not pass the Accuracy Tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

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

6.1 Equipment Required

1. (2) “AA” batteries (fully charged), PN: 400038
2. TB500B Saturation Sensor Simulator, PN: 5530-00
   This is the same device used by the factory technicians to check calibration of the monitor prior to shipping. The TB500B is an updated version of the TB500A Test Box. The TB500A, used in conjunction with adapter cable (Cat. No. 5453-00), may be substituted for the TB500B in most parts of this test.
3. Adapter Cable, DB9 to Hypertronics, PN: 9180-00
4. Current Limit Test Fixture, PN: 5693-48
5. Finger Sensor, PN: 9168-00

6.2 Procedure

1. Plug the two fully charged AA Batteries into the battery compartment. Be sure to follow the correct polarity. Connect the battery door.
2. Press the power button. Verify the proper power up sequence is displayed. The monitor will beep with all segments on. The Display then shows “512” or "513" and the software revision.
3. Verify the display shows “NO PRB”.

4. Connect the TB500B to the adapter cable and turn it ON. Set the TB500B to the settings listed in the chart below. Verify the saturation values are within the specified tolerance:

TB500 Settings		Monitor	
Saturation	Attenuation	Saturation	Pulse Rate
100	3	98 - 100	60 ± 1
92	3	90 - 94	60 ± 1
82	3	80 - 84	60 ± 1
72	3	70 - 74	60 ± 1
62	3	60 - 64	60 ± 1
72	7	68 - 76	60 ± 1
82	7	78 - 86	60 ± 1
92	7	88 - 96	60 ± 1
100	7	98 - 100	60 ± 1

5. Change the TB500B power switch to OFF. Verify an “ERR 4” is displayed.
6. Change the TB500B power switch to ON. Verify the error message clears and a saturation and pulse value are displayed.
7. Set the TB500B Signal Attenuation to “1”. Verify a “PRB OFF” message is displayed.
8. Set the TB500B Signal Attenuation to “3”. Verify the error message clears and a saturation and pulse value are displayed.
9. Set the TB500B Saturation to “0”. Verify an “ERR 3” message is displayed.
10. Set the TB500B Saturation to “100”. Verify the error message clears and a saturation and pulse value are displayed.
11. Press the TB500B RED OPEN button. Verify an “ERR 7” is displayed.
12. Release the RED OPEN button. Verify the error message clears and a saturation and pulse value are displayed.
13. Press the TB500B INFRARED OPEN button. Verify an “ERR 7” is displayed.
14. Release the INFRARED OPEN button. Verify the error message clears and a saturation and pulse value are displayed.
15. Disconnect the test box from the adapter cable.
16. Connect the current limit test fixture to the adapter cable. Verify the fixture LED is on.
17. Press and release the switch on the current limit test fixture. Verify the LED shuts off and stays off.
18. Disconnect the current limit test fixture.
19. Power down the monitor by pressing the power button.
20. Connect the TB500B to the monitor using the adapter cable. Set the ATTENUATION to 3 and the SATURATION to 100.
21. Power up the monitor by pressing the power button.
22. Verify the a displayed saturation of 98-100 and a pulse of 60.

23. Connect the 9168-00 finger sensor to the monitor. Verify a “Prb OFF” message is displayed.
24. Place the finger sensor on your finger. Verify the monitor is displaying a saturation and pulse value with no error messages.
25. Verify the pulse bar is moving up and down smoothly.
26. Disconnect the finger sensor from the monitor. Verify the monitor delivers two short audio beeps every 5 seconds approximately 3 minutes after the finger sensor is disconnected. Verify the monitor shuts off approximately 30 seconds after the beeping starts.
27. The Accuracy Test is complete.

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7 Electronic Tests

The Electronic Tests verify the calibration and operation of the electronic circuits within the Model 512/513. 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 Accuracy Tests or the Functional Tests. 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 the Maintenance section for disassembly instructions.

CAUTION: The Model 512/513 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

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.

7.1 Equipment Required

1. TB500B Saturation Sensor Simulator, PN: 5530-00
   This is the same device used by the factory technicians to check calibration of the monitor prior to shipping. The TB500B is an updated version of the TB500A Test Box. The TB500A, used in conjunction with adapter cable (Cat. No. 5453-00), may be substituted for the TB500B in most parts of this test.
2. Adapter Cable, DB9 to Hypertronics, PN: 9180-00
3. Saturation Test Jack, PN: 5942-00
4. Current Limit Test Fixture, PN: 5693-48
5. Adjustable DC Power Supply
6. DMM, Fluke Model 8840A or equivalent

7.2 Setup

1. Remove the battery door and any batteries. Disassemble the monitor to expose the internal circuit boards but do not remove the top cover/keypanel from the display board.
2. Set the adjustable DC Power Supply to 3.0Vdc.
3. Connect the adjustable power supply to the battery terminals. Observe polarity, J3 - positive and J5 - negative (ground).

7.3 Procedure

1. Apply power to the monitor by pressing the POWER key.
2. Verify a proper power up sequence. The display board will beep with all segments on. The Display then shows “512” or "513" and the software revision. Then the display shows “NO PRB”.
   Note: On initial power up the display may show "Set Up" before showing the “NO PRB” message. This is due to the software parameters being set to their factory default values.
3. Measure the following voltages:

Location	Signal Name	Voltage
TP4	V_SW	3.000V ± 100mV
TP14	VDD	3.295V ± 100mV
TP1	LEDSRC	5.00V ± 250mV
TP7	+VA	5.000V ± 250mV
TP11	-VA	-4.50V ± 500mV
TP10	VREF	2.500V ± 10mV
TP16 (Model 512)	ADCIN	2.500V ± 100mV
TP16 (Model 513)	ADCIN	0.00V ± 100mV

   ** Use the negative battery terminal for ground reference

4. Short C24 by jumping Test Point 5 to Test Point 6.
   Note: Do not try to attach to C24, part is susceptable to damage.
5. Connect the 9180-00 Adapter Cable to the monitor.
6. Connect the One Volt Test Jack to the adapter cable.
7. Monitor IC2 pin 7. Verify 1.00V DC ± 50mV.
8. Monitor Test Point 12. Verify 2.00VDC ± 75mV.
9. Monitor Test Point 13. Verify 2.00VDC ± 75mV.
10. Remove the Jumper and disconnect the Test Jack from the adapter cable.
11. Connect the TB500B to the adapter cable. Set the TB500B to the settings list in the chart. Verify the saturation values are within the specified tolerance:

TB500B Settings		Monitor	
Saturation	Attenuation	Saturation	Pulse Rate
100	3	98 - 100	60 ± 1
92	3	90 - 94	60 ± 1
82	3	80 - 84	60 ± 1
72	3	70 - 74	60 ± 1
62	3	60 - 64	60 ± 1
72	7	68 - 76	60 ± 1
82	7	78 - 86	60 ± 1
92	7	88 - 96	60 ± 1
100	7	98 - 100	60 ± 1

12. Change the TB500B power switch to OFF. Verify an “ERR 4” is displayed.

13. Change the TB500B power switch to ON. Verify the error message clears and a saturation and pulse value are displayed.
14. Set the TB500B Signal Attenuation to “1”. Verify a “PRB OFF” message is displayed.
15. Set the TB500B Signal Attenuation to “3”. Verify the error message clears and a saturation and pulse value are displayed.
16. Set the TB500B Saturation to “0”. Verify an “ERR 3” message is displayed.
17. Set the TB500B Saturation to “100”. Verify the error message clears and a saturation and pulse value are displayed.
18. Press the TB500B RED OPEN button. Verify an “ERR 7” is displayed.
19. Release the RED OPEN button. Verify the error message clears and a saturation and pulse value are displayed.
20. Press the TB500B INFRARED OPEN button. Verify an “ERR 7” is displayed.
21. Release the INFRARED OPEN button. Verify the error message clears and a saturation and pulse value are displayed.
22. Connect the current limit test fixture to the adapter cable. Verify the LED is on.
23. Press the switch on the current limit test fixture. Verify the LED turns off and remains off after the switch is released.
24. Monitor the positive battery terminal. Slowly adjust the power supply until the voltage is less than 1.9V. Verify a “LOW BAT” message with three accompanied beeps occurs every six seconds.
25. Slowly adjust the power supply until the board shuts off. Verify the voltage at the battery terminal is between 1.5V and 1.8V.
26. Adjust the power supply until the voltage at the battery terminal is 3.0V.
27. The Electronic Tests are complete.

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8 Serial Communication

The Model 513 has RS232 communications capabilities through a built-in infrared port that is used in conjunction with the Infrared Reader Module. This section documents the NovaCOMM interface and the Debug Menu protocols.

8.1 NovaCOMM Interface

The NovaCOMM interface is designed to output data in formats easily read by a computer or data logging device. The computer interface provides the user the ability to “dump” trend information to a computer file for later analysis. The communication format is 9600 baud, 8 bits, no parity, 1 stop bit and XON/XOFF handshaking.

The Model 513 must be set for NovaCOMM, refer to the User’s Manual "System Setup Options" for configuring the Model 513 for NovaCOMM.

8.1.1 Trend Dump

Trend data is transmitted as a succession of records. The record size for Model 513 is 16 bytes of ASCII Hexadecimal data. A record can be one of two types, an INFO record or a DATA record. The INFO record contains monitor information such as time of day, date, limit settings, and units. The DATA record contains event marker, audio disable, SpO_2, and pulse rate values.

The first record sent is always an INFO record. This record reflects the oldest data in the buffer, then records would continue being sent in chronological order from the oldest record to the newest record. In normal monitoring use, an INFO record would be followed by 15 data records, followed by another INFO record and then another 15 data records, etc. Turning the monitor off, or changing the limits will disrupt this sequence. When this occurs a new INFO record will be sent and indicate the time and date, along with the current limits. At this point, unless another exception occurs, the next INFO record will be followed by 15 DATA records.

An INFO record can be distinguished from a DATA record by the first byte. The first byte of an INFO record is FF, the first byte of a DATA record is 00-C8 (0-200 decimal), or FB (pen lift or no data available). Any other values are not applicable. The DATA record uses 8 data points per parameter, at 8 second resolution, for a total of 64 seconds of trend data per data record.

To request trend dump, the computer must send an ASCII “6” character. The monitor echoes back the “6” character and transmits the first INFO record.

The Mode 6 data format is;

INFO record;

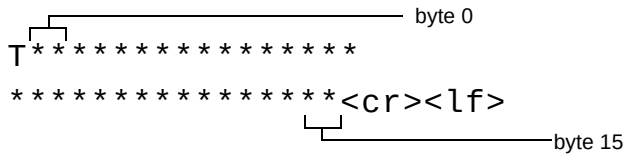
where;
T- Trend mode identifier
**-INFO byte, starting at byte 0 and ending at byte 15 (see below)

INFO record byte assignment

byte -0	flag byte = FF for INFO record
byte-1	information type (FE-power on, FD-limit change, FC-time stamp)
byte-2	model code = 2
byte-3	compression ratio = 12 (i.e. 1 point/12 seconds)
byte-4	seconds (0-59)
byte-5	minute (0-59)
byte-6	hour (0-23)
byte-7	day (1-31)
byte-8	month (1-12)
byte-9	year (0-99)
byte-10	unused
byte-11	unused
byte-12	unused
byte-13	unused
byte-14	unused
byte-15	unused

<cr> - carriage return
<lf> - line feed

DATA record;



T - Trend mode identifier
**-DATA byte, starting at byte 0 and ending at byte 39 (see below)

DATA record byte assignments

byte 0-7	8 byte SpO2 data, range: 01-28 Hex (1-40 decimal) (corresponds to 60-100%, i.e. a value of 1E Hex that corresponds to 30 decimal will indicate an SpO2 value of 90%), 00-no data available. The MSB and second MSB (bits 7 & 6) of the SpO2 bytes are not used in this monitor and should be masked out.
byte 8-15	8 byte pulse rate data, range: 00-FA Hex (0-250 decimal), FB Hex (251 decimal) - no data available over period.

<cr> - carriage return
<lf> - line feed

8.1.2 Date and Time

Date and Time mode causes the Model 513 to transmit, on request, the date and time as calculated by the monitor's internal calendar clock.

To request the date and time, the computer must send an ASCII "d" character. The monitor echoes back the "d" character and sends the date and time on the same line. The Mode d data format is;

d•MMM/DD/YY•hh:mm:ss<cr><lf>

where;
d - the echoed command character
• - is an ASCII space character
MMM - a 3-character month (Jan, Dec),
DD - a 2-digit ASCII day (01, 31),
YY - the last 2-digits of the year (1990 is 90),
hh - a 2-digit hour based on a 24 hour clock (00, 23),
mm - a 2-digit minute,
ss - a 2-digit second,
<cr><lf> is a carriage return, line-feed sequence.

8.1.3 Setting Date and Time

To set the date and time the computer must send the ASCII "s" character. The "s" is the command to set the time. The mode of the data format is;

sMM/DD/YY•hh:mm:ss

where;
• - is an ASCII space character
s - the echoed command character
MM - a 2-digit month number (01, 12),
DD - a 2-digit ASCII day (01, 31),
YY - the last 2-digits of the year (1990 is 90),
hh - a 2-digit hour based on a 24 hour clock (00, 23),
mm - a 2-digit minute,
ss - a 2-digit second.

There must be a delay of at least 20 msec between bytes so the data receive buffer will not overflow. When the monitor has received the complete command it will echo the date in the format described in the section above.

8.1.4 Clear Trends

Clear Trends mode allows the user to remotely clear the Model 513 trend memory This action has the same result as the monitor's Clear Trend function in that trend memory and the Trend Page displays are cleared.

Use this remote Clear Trends function with care as there is no way to undo the clear command once issued.

To clear the Model 513 trend memory, the computer must send an ASCII "c" character. The Model 513 will echo the "c" followed by a <cr><lf> and then the trend memory will be cleared.

8.1.5 Exit Command

To exit the NovaCOMM mode, the computer must send an “x” or “X” character. The *Model 513* will echo the “x” and then stop communication. Sending a new valid command character will start communication again.

8.2 Debug Menu

The Model 513 Debug Menu has various commands that can be accessed through the IRDA RS232 communications. Most of these commands were used for development purposes and are not intended for normal testing purposes.

8.2.1 Equipment Required

1. (2) AA Battery
2. IRDA to RS232 Converter, 9342-00
3. Personal Computer
   Minimum Requirements:
   Microprocessor486 or better
   Processor Speed100MHZ or better
   Memory (RAM)8MB or better
   Hard Drive Space100MB or better
   Com Ports1 Serial port, 1 Parallel port
4. Terminal Emulation Software, Qmodem or equivalent

8.2.2 Setup

1. Power up the PC.
   Run the terminal emulation software with the following settings:
   Baud Rate9600
   Bits 8
   Stop Bits1
   Parity None
   Handshaking XON/XOFF
   Note: Set the Com Port setting to the Com Port the 9342-00 is connected to.
2. Connect the 9342-00 to the appropriate communications port (COM) on the PC. Place the 9342-00 so it is two feet away from the units IRDA window. The IRDA fixture must be facing the unit with nothing interrupting the infrared path.

8.2.3 Procedure

1. Plug the two AA Batteries into the battery compartment. Be sure to follow the correct polarity. Connect the battery door.
2. Press the power button. Verify the proper power up sequence is displayed. The monitor will beep with all segments on. The Display then shows “513” and the software revision.
3. Verify the terminal emulation program is displaying a message similar to the following:
   HandHeld Pulse Oximeter Model 513
   Software Version **#.##**
   Session Started HH:MM:SS DD/MMM/YY
   Auto shut off is ON
   Pulse Limits are OFF

Pulse Beep is OFF
Printer Type is SIEKO

4. Verify the display shows “NO PRB” (no probe should be connected).
5. Press the “c” key on the PC. Verify the terminal emulation program displays the command menu.
6. Press the “d” key on the PC. Verify the terminal emulation program displays the debug menu.

```
***** DEBUG MENU *****
A = Toggle Autoshutoff
B = Toggle beeper ON/OFF
C = Command Menu
D = Debug Menu
E = External Flash Test
F = Log Bat Level
G = Auto Re-cal ADCs
g = Manual Re-cal ADCs
H = Get Raw RED 20bit ADC Val
I = Get Raw IR  20bit ADC Val
J = Display segment test (AUTO)
j = Display segment test
K = Key Panel Test
L = List System Errors
M = MSM Debug
S = Set SYSERR
R = RTC Menu
T = Trend Header Info
V = Enable/Disable VENUS
W = Watchdog Timeout Test
0 - 5 = Display SYSADC Channel
6 = Inc DAC
7 = Dec DAC
```

Not all of the items are implemented, some are case sensative and others are for development purposes only. Enter the letter for the appropriate item to start. A brief explanation is listed below:

Option	Description
Toggle Autoshutoff	Enables/disables Auto Power Off feature
Toggle beeper	Not implemented
Command Menu	Displays COMMAND MENU
Debug Menu	Displays DEBUG MENU
External Flash Test	Performs test on the memory that stores trend and setup information. This test will erase any stored data when executed.
Log Bat Level	Transmitts battery value (HEX) with time and date stamp every minute.
Auto Re-cal ADCs	Not implemented
Manual Re-cal ADCs	ADCs are recalibrated (automatically done on power up).
Get Raw RED 20bit ADC Val	Displays the RED channel ADC value in hex.

Get Raw IR 20bit ADC Val	Displays the IR channel ADC value in hex.
Display segment test (AUTO)	Illuminates each display segment in sequence.
Display segment test	Illuminates each display segment in sequence by manually pressing the "n" key.
Key Panel Test	Tests "Select" and "Print" keys, press and hold the key during the test to check the scroll function.
List System Errors	Lists system errors with thier appropriate code.
MSM Debug	Development purpose
Set SYSERR	Development purpose
RTC Menu	Real Time Clock options
Trend Header Info	
Enable/Disable VENUS	Development tool
Watchdog Timeout Test	Performs watchdog timeout test, this will reset the monitor.
Display SYS ADC Channel	Displays the current value of the chosen ADC channel (0-5) in hex.
Inc DAC	Development purpose
Dec DAC	Development purpose

9 Maintenance

9.1 General

This section presents information on general maintenance such as cleaning and sterilization, battery replacement, and disassembly and assembly instructions.

9.2 Maintenance Schedules

The electronic circuits within the Novametrix Model 512 and Model 513 monitors do not require scheduled calibration or service.[1]

The pulse oximeter performs a diagnostic self-test at power-up that checks the internal electronics. If this self-test fails the normal monitoring display will not appear. Remove the oximeter from use and contact qualified service personnel

9.3 Cleaning and Sterilization

To clean and/or sterilize the oximeter and its accessories:

9.3.1 Pulse Oximeter

- Do not immerse the oximeter. Do not sterilize the oximeter.
- Turn the oximeter off and unplug the external adapter (if used) from the AC power source before cleaning.
- The oximeter can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutaraldehyde, or 10% bleach solution. Then wipe down with a water dampened clean cloth to rinse. Dry before use.

9.3.2 SpO_2 Finger Sensor

- Do not immerse the finger sensor. Do not sterilize the finger sensor.
- The sensor can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutaraldehyde, or 10% bleach solution. Then wipe down with a water-dampened clean cloth to rinse. Dry before use.
- Make certain that the finger sensor windows are clean and dry before reuse.
- After cleaning the finger sensor, perform a Quick Check to verify the sensor is functional.

9.3.3 SpO_2 Y-Sensor

- The Y-Sensor may be immersed—up to, but not including, the connector, in a 2% glutaraldehyde solution, or 10% bleach solution. Refer to manufacturer's instructions

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

and standard hospital protocols to determine recommended times for disinfection and sterilization.

- Rinse thoroughly with water and dry before use (do not rinse the connector).
- After cleaning or sterilizing the Y-Sensor, perform a Quick Check to verify the sensor is functional.

9.3.4 SpO_2 Y-Strip Tapes and Foam Wraps

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

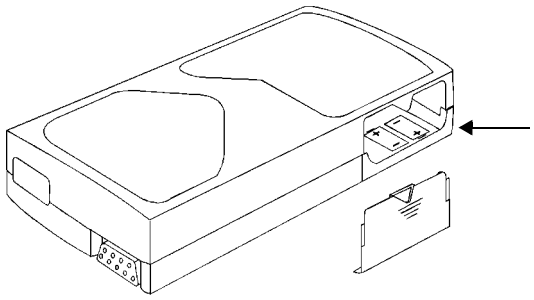
9.3.5 Ear Clip

- Clean the ear clip with a cloth dampened with 70% isopropyl alcohol. After cleaning, wipe the ear clip with a clean water-dampened cloth.

9.4 Battery Replacement

To replace the batteries: slide the battery compartment cover off, remove the old batteries and replace with (2) 1.5V AA size batteries, aligned according to the polarity diagram inside the monitor cover. Replace the battery compartment cover.

Fresh disposable “AA” alkaline batteries (Panasonic AM3X or equivalent) provide approximately 16 hours of operation.



WARNING: Do not recharge or incinerate alkaline batteries. Attempting to do so may cause the batteries to leak or explode.

Dispose of batteries in accordance with local laws. Do not mix battery types (e.g. disposable and rechargeable AA batteries). The monitor may not power up if the batteries are nearly depleted.

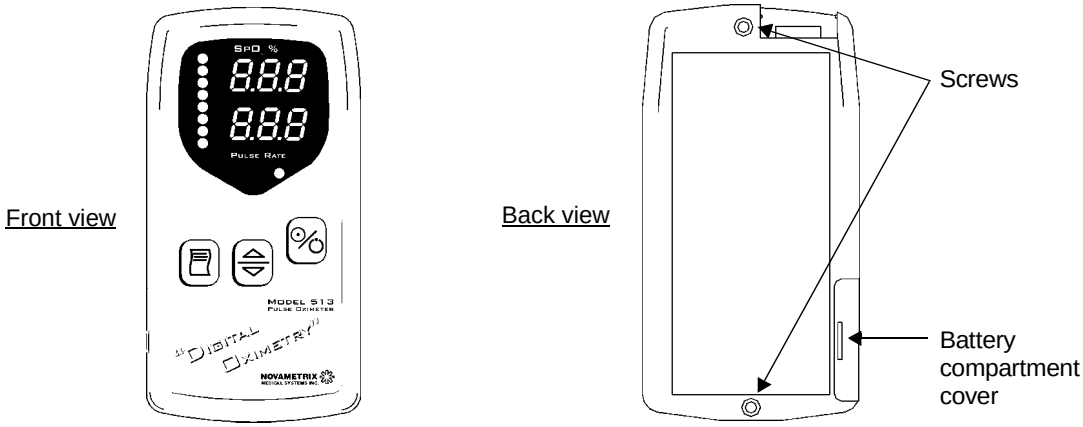
9.5 Assembly Exchanges

Disassembly should be performed by qualified service personnel only.

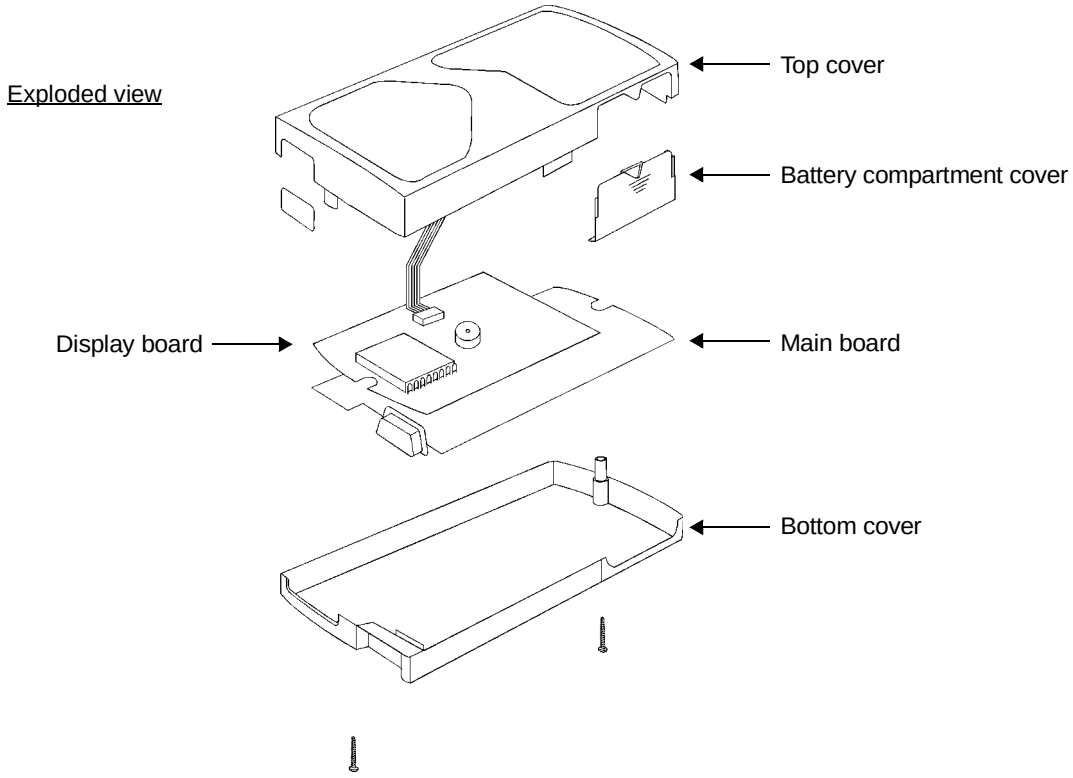
9.5.1 Internal Assemblies

1. Ensure that the monitor is OFF. Remove the battery compartment cover and place aside, remove batteries.

2. Turn the monitor over and remove the two screws from the back cover.



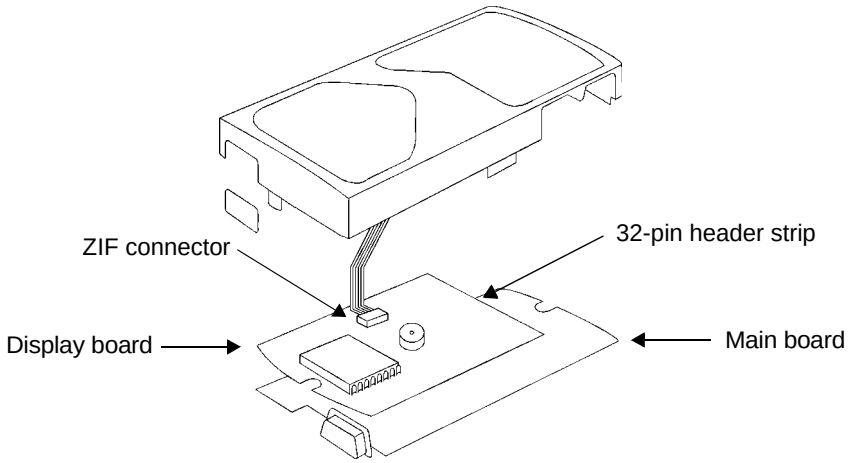
3. Carefully lift the back cover from the monitor (tilt the cover to clear the 9-pin D connector).
4. The separate assemblies of the monitor can now be accessed.



CAUTION: The Model 512/513 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

9.5.2 Main Board and CPU Interface/Top Cover Assembly

1. Disconnect the ZIF (zero insertion force) connector from the main board by sliding the connector open and removing the flex cable.
2. Remove the Display board from the Main board by disconnecting the 32-pin header strip.



9.5.3 Reassembling the monitor

1. Reconnect the Display board and Main board via the 32-pin header strip.
2. Insert the flex cable into the ZIF connector, hold, and slide the connector closed.
3. Seat the Display/Main board assembly into the top cover, replace the infrared lens if necessary, and lay the monitor face down.
4. Replace the back cover on the monitor, being careful to clear the 9-pin D connector. The back cover will “click” when seated properly.
5. Replace the two cover screws, batteries and battery compartment cover.

10 Specifications

The Novametrix Model 512/513 Handheld Pulse Oximeter specifications are listed here for informational purposes only, and are subject to change without notice.

Principle of Operation

- Red/Infrared Absorption

SpO_2 (Oxygen Saturation)

- Range:0-100%
- Accuracy:80-100% ±2%, 0-79% unspecified, ±1 standard deviation
- Resolution:1%
- Averaging:8 seconds

Pulse Rate

- Range: 30-250 bpm
- Accuracy: ±2 bpm
- Resolution: 1 bpm
- Averaging: 8 seconds

General

- Size: 4.25 x 2.25 x 1.0 inches (10.8 x 5.7 x 2.5 cm)
- Weight: 5.7 ounces (162 g) (with batteries)
- Display: Numerics - 7 segment LED's, Pulse Bar - 8 LEDs
- Electrical: Battery - 2 AA alkaline, Capacity - 16 hours
- Operating Conditions: 10 to +40° C (50 to 104° F), 10-90% R.H. non-condensing
- Transport/Storage Conditions: -10 to +55° C (14 to 131° F), 10-95% R.H. non-condensing

Additional Features

- Auto Shut Off: Monitor automatically shuts itself off after 3.5 minutes if no data is being received.
- Low Battery Indicator: Illuminates when approximately 15 minutes of battery life remain.
- Monitor Status Messages: Error codes displayed for various monitoring related conditions.

Model 513 Additional Features

- Alerts: Automatic and adjustable SpO_2 & Pulse Rate limits.
- Pulse Beep: User selectable on/off.
- Communications: Infrared link allows downloading of up to 24 hours of patient data to a computer or printer.

11 Accessories

Cat. No.	Description
Monitor	
9100-00	Model 512, Handheld Pulse Oximeter
9300-00	Model 513, Handheld Pulse Oximeter
9100-23	User's Manual, Model 512
9300-23	User's Manual, Model 513
315134	Transport Pouch
9276-00	Protective Rubber Boot
400038	Alkaline Battery, 1.5 vdc, AA Size (Panasonic AM3X or equiv.)
SuperBright™ Oximeter Sensors	
9169-00	Y-Sensor™ (use with DB-9 Sensors) 90 day warranty
9168-00	Finger Sensor (use with DB-9 Sensors) 1 yr. warranty
9768-00	Finger Sensor 6 ft. cable (use with DB-9 Sensors) 1 yr. warranty
9769-00	Y-Sensor™ 6 ft. cable (use with DB-9 Sensors) 90 day warranty
6455-00	Single Patient Use Pediatric/Adult Sensor (10 per box)
6455-25	Single Patient Use Pediatric/Adult Sensor (25 per box)
6480-00	Single Patient Use Neonatal/Pediatric Sensor (10 per box)
6480-25	Single Patient Use Neonatal/Pediatric Sensor (25 per box)
8828-00	20mm Wrap Style Y-Strip Taping System (100 per box)
8829-00	25mm Wrap Style Y-Strip Taping System (100 per box
8831-00	20mm Finger Style Y-Strip Taping System (100 per box)
8832-00	25mm Finger Style Y-Strip Taping System (100 per box)
8836-00	Non-Adhesive Foam Wraps - Large (25 per box)
8943-00	Non-Adhesive Foam Wraps - Small (25 per box)
6929-00	Large Adhesive Foam Wrap, (25 per box)
6968-00	Neonatal/Pediatric Adhesive Foam Wrap, (25 per box)
6131-50	Ear Clips (5 per box)
6131-25	Ear Clips (25 per box)
8700-00	Re-Flex Sensor Application Dots
9174-00	Extension Cable, DB-9 to DB-9, 3 feet
8936-00	Adapter Cable, DB9 to OxySnap, 6 inch
9180-00	Adapter Cable, DB-9 to Hypertronic, 6 inch
Options	
9278-00	Battery Eliminator Kit
9278-10	AC Adapter for Battery Eliminator 120 VAC
9421-10	AC Adapter for Battery Eliminator 220-240 VAC
9342-00	Infrared Reader Module
6065-00	*NovaCARD for Windows* Data Archive Software (3½" diskette)
330088	Hewlett-Packard Infrared Printer (HP82240P)
300020	Thermal Printer Paper for Hewlett-Packard Infrared Printer
9140-00	Seiko DPU-414 Thermal Printer (with battery pack)
400052	AC Adapter for Seiko DPU-414 Printer, 120 VAC
400053	AC Adapter for Seiko DPU-414 Printer, 100 VAC
400054	AC Adapter for Seiko DPU-414 Printer, 230 VAC
300017	Printer Paper for Seiko DPU-414 Printer (5 rolls per box)

12 Parts Lists

12.1 9100-00 PULSE OXIMETER, 512

Seq	Item	Description	Quantity
001	9026-32	LABEL, MANUFACTURED IN US	1
002	9100-01	MAIN ASSY, MODEL 512	1
004	9100-09	OVERALL WIRING DIAGRAM	0
005	9100-23	USER'S MANUAL, 512	0
010	9100-90	SERVICE MANUAL, MODEL 512	0
011	9317-32	LABEL, SN, 512 & 513	1
012	9480-32	INSTRUCTIONS LABEL	1
019	400038	BATTERY, 1.5V DC, AA SIZE	2
020	315141	SHIPPING CTN	1

12.2 9100-01 MAIN ASSY, MODEL 512

Seq	Item Nbr	Description	Quantity
001	2578-01	MAIN BD ASSY, 512	1
002	2579-01	DISPLAY BD ASSY, 512 513	1
003	9249-27	MEMBRANE KEYPANEL, 512	1
004	9310-16	TOP COVER, 512 & 513	1
005	9311-16	BOTTOM COVER, 512 & 513	1
006	9312-01	BATTERY DOOR ASSY, 512 &	1
007	9313-16	WINDOW, RED TRANSLUCENT,	1
008	9316-13	DISPLAY WITH PAD PRNT, 512	1
015	284267	SCR, 4-40 X 1/2L, PHILIPS	0

12.3 9300-00 PULSE OXIM W SER OUT, 513

Seq	Item Nbr	Description	Quantity
001	9026-32	LABEL, "MANUFACTURED IN US"	1
002	9300-01	MAIN ASSY, MODEL 513	1
004	9300-09	OVERALL WIRING DIAGRAM, M	0

Seq	Item Nbr	Description	Quantity
005	9300-23	USER'S MANUAL, 513	0
010	9300-90	SERVICE MANUAL, MODEL 513	0
011	9317-32	LABEL, SN, 512 & 513	1
012	9382-32	INSTRUCTIONS LABEL, 513	1
019	400038	BATTERY, 1.5V DC, AA SIZE	2
020	315141	SHIPPING CTN	1

12.4 9300-01 MAIN ASSY, MODEL 513

Seq	Item Nbr	Description	Quantity
001	2577-01	MAIN BD W IR ASSY, 513	1
002	2579-01	DISPLAY BD ASSY, 512 513	1
003	9250-27	MEMBRANE KEYPANEL, 513	1
004	9310-16	TOP COVER, 512 & 513	1
005	9311-16	BOTTOM COVER, 512 & 513	1
006	9312-01	BATTERY DOOR ASSY,	1
007	9313-16	WINDOW, RED TRANSLUCENT,	1
008	9316-13	DISPLAY WITH PAD PRNT	1
015	284267	SCR, 4-40 X 1/2L, PHILIPS	0

12.5 2576-01 IR INTERFACE BD ASSY

Seq	Item Nbr	Description	Quantity
000	474233	RESISTOR, 10K OHM, 1/16W,	1
000	481554	DIODE, BAV70LT1, DUAL	1
000	486337	IC, LT1181AC5, R5232 DUAL	1
000	474247	RESISTOR, 10M OHM, 1/16W	1
000	474240	RESISTOR, 100K OHM, 1/16W	3
000	481546	DIODE, SWITCHING, SURF MT	1
000	474138	RESISTOR, 100 OHM, 1/8W	1
000	154125	CAPACITOR, IUF, 16V, 10%	3
000	154129	CAPACITOR, .1UF, 50V, 10%	4
000	154132	CAPACITOR, I5PF, 50V, 5%	2
000	487144	IC, INFRARED IRDA TRANS	1
000	487143	IC, INFRARED SERIAL ENCOD	1
000	154133	CAPACITOR, 47uF, 6.3VDC	1
000	2576-02	FAB, IR INTERFACE BD	1
000	154140	CAPACITOR, 100uF, 20%	2
000	487149	IC, IR SER ENCDR/DCDR, 16	1
000	472292	RESISTOR, 22.1 OHM, 1/4 W	1

Seq	Item Nbr	Description	Quantity
000	154141	CAPACITOR, 22uF, 20%, 6.3	1
000	484577	VOLT RGLTR, 5 V OUT, 50mA	1
000	230033	CRYSTAL, 3.6864MHz, S MNT	1
000	211644	CONNECTOR, 6 PIN, HEADER	1
000	153066	CAPACITOR, .0luF, 50V, 12	1
000	486372	IC, LINE DRVR/RCVR, RS232	1
000	211520	CONN, 5 PIN, HDR, VERT MT	1

12.6 2577-01 MAIN BD W IR ASSY, 513

Seq	Item Nbr	Description	Quantity
000	230030	CRYSTAL, 32.768KHZ	1
000	485553	TRANSISTOR, N-CH ENH FET,	3
000	486485	IC, QUAD BUS BUFFER, 3-ST	1
000	487140	IC, REAL TIME CLOCK, SER	1
000	486834	IC, VOLTAGE CONVERTER, +5	1
000	486053	IC, 16K X 8 BIT FLASH RAM	1
000	474334	RESISTOR, 4.7K OHM, 1%	3
000	474335	RESISTOR, 3.92k OHM, 1/16	2
000	230031	CRYSTAL, 8.000MHz, .433 L	1
000	487141	IC, STEP-UP DC-DC CONTROL	1
000	487142	IC, ANALOG SWITCH, SPST	3
000	487144	IC, INFRARED IRDA TRANSCE	1
000	487143	IC, INFRARED SERIAL ENCOD	1
000	154127	CAPACITOR, 150uF, 6.3V	1
000	154126	CAPACITOR, 47uF, 6.3V	2
000	485602	THYRISTOR, SCR, SENSITIVE	1
000	481560	DIODE, SWITCHING, HIGH SP	2
000	486837	IC, OP AMP, MICROPOWER	1
000	472291	RESISTOR, 33 OHM, 1/4W	1
000	472290	RESISTOR, 68 OHM, 1/4W	1
000	154133	CAPACITOR, 47uF, 6.3VDC	1
000	472532	RESISTOR, .51 OHMS, 1/4W	1
000	213105	CONN, 32 PIN, RCPT, DIL	1
000	472500	RESISTOR, 10K OHM, 1/8W	2
001	2578-02	FAB, MAIN BD, 512 & 513	1
003	9149-10	CONNECTOR, 9 PIN, RECEPTA	1
004	9777-10	PCB BTRY CONTACT, 512 513	2
004	9777-10	BATTERY CONTACT & SPRING	2

Seq	Item Nbr	Description	Quantity
007	9388-32	BTRY ALIGN LBL, 512 & 513	1
008	161039	FOAM TAPE	0
008	180060	FERRITE BEAD, 600 OHMS	3
009	474241	RESISTOR, 150K OHM, 1/16W	4
010	474256	RESISTOR, 0 OHM, 0603 STY	1
011	474317	RESISTOR, 47.5K OHM, 1/16	7
012	474318	RESISTOR, 470K OHM, 1/16W	4
013	474330	RESISTOR, 3/4 OHM, .25W,	1
014	485554	TRANSISTOR, P-CM ENM FET,	10
015	474240	RESISTOR, 100K OHM, 1/16W	30
016	606812	WIRE, 30AWG, SOLID, PVC	0
000	474245	RESISTOR, 1M OHM, 1/16w,	3
000	474233	RESISTOR, 10K OHM	4
000	474222	RESISTOR, 10 OHM, 1/16w,	8
000	481554	DIODE, BAV70LT1, DUAL	1
000	484061	TRANSISTOR, MMBT2222ALT1	4
000	180030	INDUCTOR-CAP, 4700PF, 50V	1
000	481555	DIODE, MMBD7000LT1, DUAL	2
000	474227	RESISTOR, 1K OHM, 1/15w	5
000	486808	IC, AD680JR, 2.5 VOLTAGE	1
000	474259	RESISTOR, 15K OHM, 1/16w	1
000	474249	RESISTOR, 215 OHMS, 1/16w	1
000	515082	FUSE W FUSEHOLDER, 1/2A	1
000	515077	FUSE, 1/16A, 125V, VERY FAST	1
000	481558	DIODE, MBR0520LT1, SCHOTTY	3
000	481546	DIODE, SWITCHING, SURF MT	5
000	486332	IC, AD7703BR, 20-BIT A TO D	2
000	154108	CAPACITOR, 100PF, 50VDC	2
000	486781	IC, TLO72CD, OP AMP, JFET	1
000	474224	RESISTOR, 100 OHM, 1/16w	7
000	180020	INDUCTOR, 100UH, 10%, SUR	1
000	487084	IC, OP-282GS, DUAL JFET	3
000	154119	CAPACITOR, 6.8PF 50V 5%	1
000	474228	RESISTOR, 1.21KOHM	1
000	474301	RESISTOR, 36.5KOHM	1
000	474319	RESISTOR, 560K OHM, 1/16w	1
000	474320	RESISTOR, 221K OHM, 1/16w	1
000	474322	RESISTOR, 3.92 OHM	1
000	474323	RESISTOR, 110K OHM, 1/16w	1
000	474324	RESISTOR, 182K OHM, 1/16w	1
000	474325	RESISTOR, 2.2 OHM, 1/10w	2

Seq	Item Nbr	Description	Quantity
000	474328	RESISTOR, 330K OHM, 1/16w	3
000	474329	RESISTOR, 39.2K OHM, 1/16	1
000	474331	RESISTOR, 332 OHM, 1/16w,	18
000	154121	CAPACITOR, .1F, 5.5VDC, +	1
000	154122	CAPACITOR, .1UF, 25V, +80	38
000	154123	CAPACITOR, 2.2UF, 10V, 10	1
000	154124	CAPACITOR, 10UF, 6V, 10%,	3
000	154125	CAPACITOR, 1UF, 16V, 10%,	3
000	154120	CAPACITOR, 6.8PF, 100V, 5	1
000	154128	CAP, .1UF, 50VDC, 2%, S M	3
000	154129	CAPACITOR, .1UF, 50V, 10%	5
000	154130	CAPACITOR, .01UF, 50V, 10	2
000	154131	CAPACITOR, 47PF, 100V, 5%	2
000	154132	CAPACITOR, 15PF, 50V, 5%,	2
000	180058	INDUCTOR, 68UH, 20%, .5A,	1
000	180059	INDUCTOR, 100UH, 20%, .41	1
000	180061	FERRITE BEAD, 80 OHMS	2
000	180062	FERRITE BEAD, 1K OHMS	9
000	481048	DIODE, ZENER, 6.8V, 3 PIN	1
000	481559	DIODE, DUAL SWITCHING,	1
000	180063	INDUCTOR, 10UH, 10%	3
000	152098	CAPACITOR, 22UF, 16V, 20%	2
000	152099	CAPACITOR, 100UF, 16V	3
000	213105	CONNECTOR, 32 PIN, RECEPT	1
000	485552	TRANSISTOR, DUAL, PNP & NPN	1
000	485555	TRANSISTOR, N-CH ENH FET	6

12.7 2578-01 MAIN BD ASSY, 512

Seq	Item Nbr	Description	Quantity
000	474335	RESISTOR, 3.92k OHM	2
000	230031	CRYSTAL, 8.000MHz, .433 L	1
000	487141	IC, STEP-UP DC-DC CONTROL	1
000	487142	IC, ANALOG SWITCH, SPST,	3
000	154127	CAPACITOR, 150uF, 6.3V	1
000	154126	CAPACITOR, 47uF, 6.3V	2
000	485602	THYRISTOR, SCR, SENSITIVE	1
000	481560	DIODE, SWITCHING, HIGH SP	2
000	486837	IC, OP AMP, MICROPOWER	1

Seq	Item Nbr	Description	Quantity
000	472532	RESISTOR, .51 OHMS, 1/4W,	1
000	213105	CONN, 32 PIN, RCPT, DIL,	1
000	472500	RESISTOR, 10K OHM, 1/8W,	2
001	2578-02	FAB, MAIN BD, 512 & 513	1
004	9149-10	CONNECTOR, 9 PIN, RECEPT	1
005	9777-10	BATTERY CONTACT & SPRING	2
007	9388-32	BTRY ALIGN LBL, 512 & 513	1
008	180060	FERRITE BEAD, 600 OHMS	2
009	474241	RESISTOR, 150K OHM, 1/16W	4
010	474256	RESISTOR, 0 OHM	1
011	474317	RESISTOR, 47.5K OHM	7
012	474318	RESISTOR, 470K OHM, 1/16W	4
013	474330	RESISTOR, 3/4 OHM, .25W,	1
014	485554	TRANSISTOR, P-CM ENH FET,	10
015	474240	RESISTOR, 100K OHM, 1/16W	30
016	606812	WIRE, 3OAWG, SOLID, PVC	0
000	474245	RESISTOR, 1M OHM, 1/16w,	3
000	474233	RESISTOR, 10K OHM, 1/16w,	4
000	474222	RESISTOR, 10 OHM, 1/16w,	8
000	474228	RESISTOR, 1.21KOHM	1
000	474301	RESISTOR, 36.5KOHM	1
000	484061	TRANSISTOR, MMBT2222ALT1,	4
000	180030	INDUCTOR-CAP, 4700PF, 50V	1
000	481555	DIODE, MMBD7000LT1	2
000	474227	RESISTOR, 1K OHM, 1/16w,	5
000	486808	IC, AD680JR, 2.5 VOLTAGE	1
000	474259	RESISTOR, 15K OHM, 1/16w,	1
000	474249	RESISTOR, 215 OHMS, 1/16w	1
000	515082	FUSE W FUSEHOLDER, 1/2A,	1
000	515077	FUSE, 1/IEA, 125V, VERY FAST	1
000	481558	DIODE, MBR0520LT1, SCHOTTY	3
000	481546	DIODE, SWITCHING, SURF MT	6
000	486332	IC, AD7703BR, 20-BIT A TO D	2
000	154108	CAPACITOR, 100PF, 50VDC,	2
000	486781	IC, TLO72CD, OP AMP, JFET	1
000	474224	RESISTOR, 100 OHM, 1/16w,	7
000	180020	INDUCTOR, 100UH, 10%, SUR	1
000	487084	IC, OP-282GS, DUAL JFET 0	3
000	474319	RESISTOR, 560K OHM, 1/16w	1
000	474320	RESISTOR, 221K OHM, 1/16w	1
000	474321	RESISTOR, 36K OHM, 1/16W,	1

Seq	Item Nbr	Description	Quantity
000	474322	RESISTOR, 3.92 OHM, 1/low	1
000	474323	RESISTOR, 110K OHM, 1/16w	1
000	474325	RESISTOR, 2.2 OHM, 1/10w,	2
000	474328	RESISTOR, 330K OHM, 1/16w	3
000	474329	RESISTOR, 39.2K OHM, 1/16	1
000	474331	RESISTOR, 332 OHM, 1/16W,	18
000	154122	CAPACITOR, 1UF, 25V, +80	36
000	154123	CAPACITOR, 2.2UF, 10V, 10	1
000	154124	CAPACITOR, 10UF, 6V, 10%,	3
000	154125	CAPACITOR, 1UF, 16V, 10%,	3
000	154128	CAP, 1UF, 50VDC, 2%, S M	3
000	154129	CAPACITOR, .1UF, 50V, 10%	5
000	154130	CAPACITOR, .01UF, 50V, 10	2
000	154131	CAPACITOR, 47PF, 100V, 5%	2
000	154132	CAPACITOR, 15PF, 50V, 5%,	2
000	180058	INDUCTOR, 68UH, 20%, .5A,	1
000	180059	INDUCTOR, 100UH, 20%, .41	1
000	180061	FERRITE BEAD, 80 OHMS	2
000	180062	FERRITE BEAD, 1K OHMS	6
000	481048	DIODE, ZENER, 6.8V, 3 PIN	1
000	180063	INDUCTOR, 10UM, 10%, 1206	3
000	152098	CAPACITOR, 22UF, 16V, 20%	2
000	152099	CAPACITOR, 100UF, 1EV, 20	3
000	213105	CONNECTOR, 32 PIN, RECEPT	1
000	485552	TRANSISTOR, DUAL, PNP & NPN	1
000	485555	TRANSISTOR, N-CH ENH FET,	6
000	485553	TRANSISTOR, N-CH ENH PET,	3
000	486485	IC, QUAD BUS BUFFER, 3-ST	1
000	486834	IC, VOLTAGE CONVERTER, +5	1
000	474334	RESISTOR, 4.7K OHM, 1%	3

12.8 2579-01 DISPLAY BD ASSY, 512 513

Seq	Item Nbr	Description	Quantity
000	481501	DIODE, 1N4148, SIGNAL	7
000	154016	CAPACITOR, .1UF, 50V, 10%	1
000	481026	DIODE, ZENER, BZY88C-4V7,	1
000	482609	LED, RED, 3MM DIA, 2 PIN,	9
000	130019	TRANSDUCER, AUDIO	1
000	482608	LED DISPLAY, 7-SEG, RED,	6
000	213102	CONNECTOR, 32 PIN, HEADER	1

Seq	Item Nbr	Description	Quantity
000	211643	CONN, 6 PIN, RCPT, ZIF	1
000	213104	CONN, 32 PIN, HDR, DIL	1
001	2579-02	FAS, DISPLAY SD,	1

12.9 2580-01 BATTERY ELIMINATOR BD ASSY

Seq	Item Nbr	Description	Quantity
000	474165	RESISTOR, 10K OHM, 1/8w,	1
000	474182	RESISTOR, 150K OHM, 1/8w,	1
000	481547	DIODE, BAT54, HOT CARRIER	1
000	481045	DIODE, ZENER, EZT52-C5VI,	1
000	474166	RESISTOR, 100K OHM, 1/8w,	1
000	180054	INDUCTOR, 1.5K OHMS	1
000	154072	CAPACITOR, .1UF, 50V, 10%	2
000	474186	RESISTOR, 15K OHM, 1/8w	1
000	484579	V RGLTR, 1.23V-29V OUT	1
000	154144	CAPACITOR, 150uF, 10V,	1
000	216080	TERMINAL, STRY, SIZE AAA	2
000	515097	FUSE, 200mA, 30VDC, S MNT	1
000	154147	CAPACITOR, 15uF, 25V, 20%	1
000	210160	CONNECTOR, DC PWR, RCPT	1
000	9485-10	BRACKET, ADAPTER CONTACT,	2
001	2580-02	FAB, BTRY ELIMINATOR SD	1

12.10 9278-00 BATTERY ELIMINATOR

Seq	Item Nbr	Description	Quantity
001	2580-01	BTRY ELIMINATOR BD ASSY	1
006	9732-16	BOTTOM HOUSING, BATTERY E	1
007	9733-16	TOP HOUSING, BATTERY ELIM	1
008	9734-16	DOOR, BATTERY ELIMINATOR	1
009	9759-32	ID LABEL, BATTERY ELIMIN	1
010	9763-32	INSTR SH, BATTERY ELIMIN	1
018	315063	POUCH, PLASTIC, ZIP LOCK,	1

12.11 9316-13 DSPL WDO W PAD PRNT, 512

Seq	Item Nbr	Description	Quantity
001	9316-02	ARTWORK, DISPLAY WINDOW W	0
002	9316-14	PAD PRINT NEST, DISPLAY	0

Seq	Item Nbr	Description	Quantity
003	9316-16	DISPLAY WINDOW, RED, 51	1
009	163018	INK, WHITE	0

12.12 9342-00 IR INTERFACE BOX

Seq	Item Nbr	Description	Quantity
001	2576-01	IR INTERFACE BD ASSY	1
003	9342-11	IR BOX MODIFICATION	1
004	9342-32	LABEL, IR INTERFACE BOX	1
006	9532-01	CABLE ASSY, IR BOARD	1
007	9607-32	INSTR SHEET, IR INTFC BOX	1
00$	6070-32	LABEL, SERIAL NDMBER, 1.6	1
012	140055	VELCRO, HOOK, 1" W, WHITE	0
013	140056	VELCRO, LOOP, 1" W, WHITE	0
014	140090	IR WINDOW, RED, ACRYLIC	1
015	160044	ALCOHOL, ISOPROPYL, TECHN	0
016	281211	SCREW, NO. 2 X 1/4 L, EEL	0
017	285013	NYL WASH, #4 NATURAL COLO	0
017	285028	WASHER, NYLON, NO. 5, .14	0
018	315063	POUCH, PLASTIC, ZIP LOCK,	1

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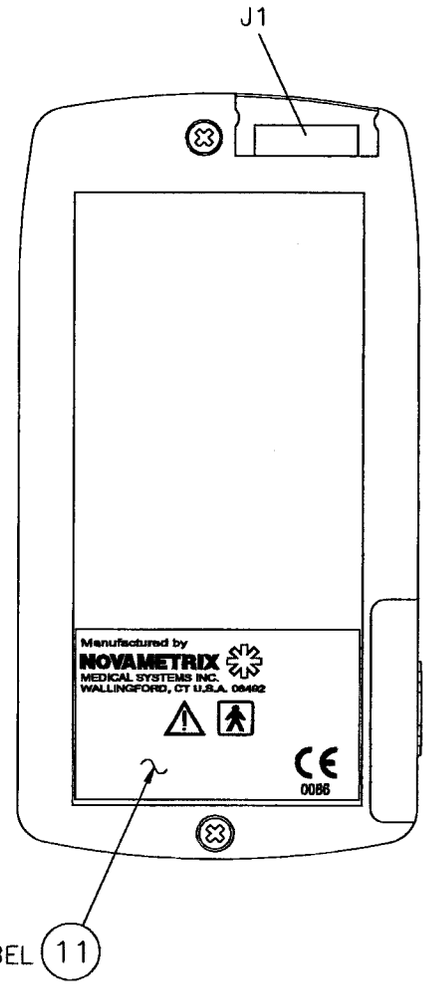
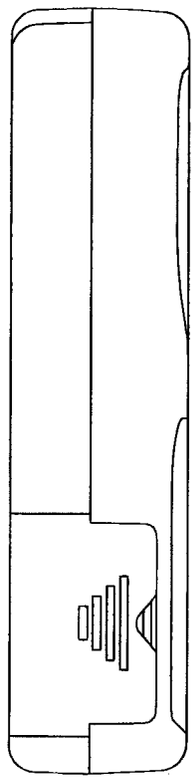
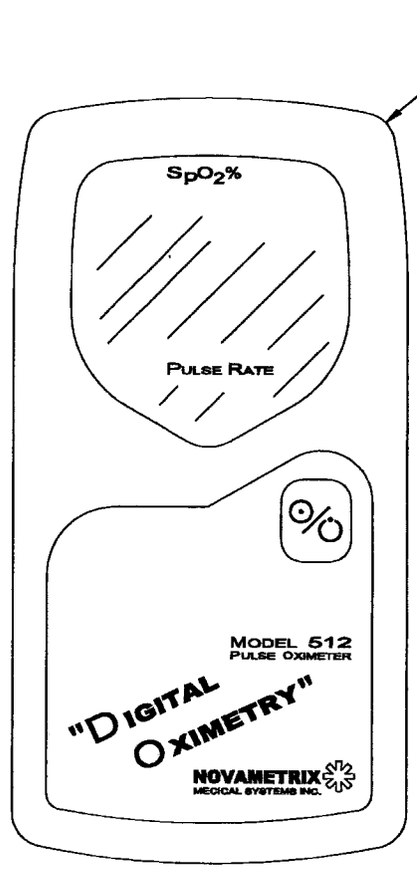
13 Drawings

Drawing No.	Description
9100-00	PULSE OXIMETER, 512
9100-09	OVERALL WIRING DIAGRAM, 512
9100-01	MAIN ASSY, MODEL 512
9300-00	PULSE OXIMETER WITH SERIAL OUTPUT, 513
9300-09	OVERALL WIRING DIAGRAM, 513
9300-01	MAIN ASSY, MODEL 513
2576-01	IR INTERFACE BOARD ASSY
2576-03	SCHEMATIC, IR INTERFACE BOARD
2577-01	MAIN BOARD WITH IR ASSY, 513 (2 sheets)
2578-01	MAIN BOARD ASSY, 512 (2 sheets)
2577-03/ 2578-03	512/513 Hand-held Pulse Oximeter - Front End (2 sheets)
2579-01	DISPLAY BOARD ASSY, 512 & 513
2579-03	SCHEMATIC DISPLAY BOARD, 512 & 513
2580-01	BATTERY ELIMINATOR BOARD ASSY
2580-03	SCHEMATIC, BATTERY ELIMINATOR BOARD







SERIAL NUMBER LABEL (11)
SEE NOTE 4

NOTES:

1. FOR SYSTEM TEST PROCEDURE SEE A9100-04.
2. FOR OVERALL WIRING DIAGRAM SEE D9100-09.
3. FOR QA INSPECTION PROCEDURE SEE A9100-70.
4. WIPE UNIT CLEAN WITH IPA, ITEM 18 AND LOCATE LABELS APPROX AS SHOWN.
5. INCLUDE THE FOLLOWING ITEMS WITH MONITOR:
   A. ITEM 19: TWO AA SIZE BATTERIES. DO NOT INSTALL.
   B. ITEM 5: USERS MANUAL
   C. ITEM 12: INSTRUCTIONS LABEL, SHEET OF 10, MULTILANGUAGE. DO NOT ATTACH TO UNIT.

REV	R NO.	DATE
10	N879	3Apr01
09	N834	28Dec00
08	N805	18Oct00

REV	R NO.	DATE
07	N792	8Sep00
06	N752	20Apr00
05	N696	28Sep99
04	N667	11May99
03	N658	22Apr99
02	N656	15Apr99
01	N643	2Mar99

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

☐ SOLID MODEL ON FILE

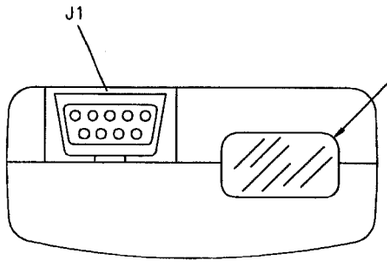
DRAWN	RGG	DATE 1Dec98
CHECK	MRL	DATE
MFG ENGR	TJC	DATE 15Jan99
ENGR	~	DATE
PROJ ENGR	A. Kersey	DATE 15Jan99
NEXT ASSY: ~		

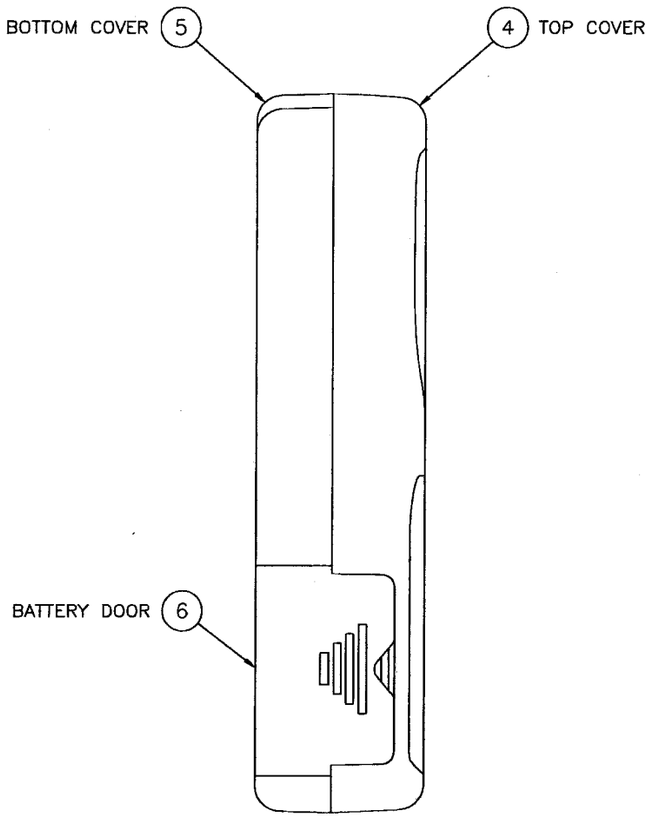
NOVAMETRIX
MEDICAL SYSTEMS INC.

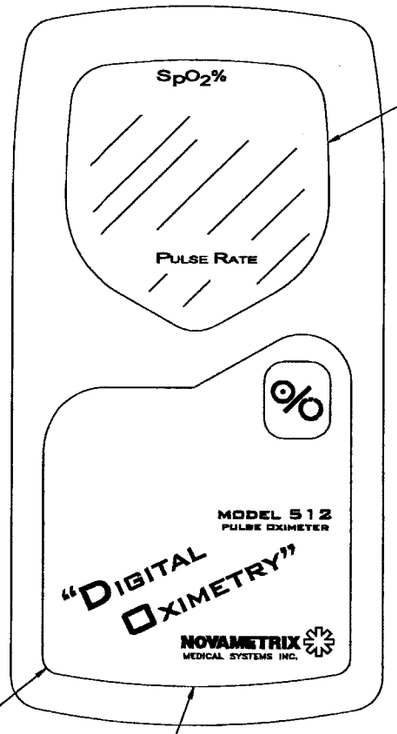
TITLE
PULSE OXIMETER, 512

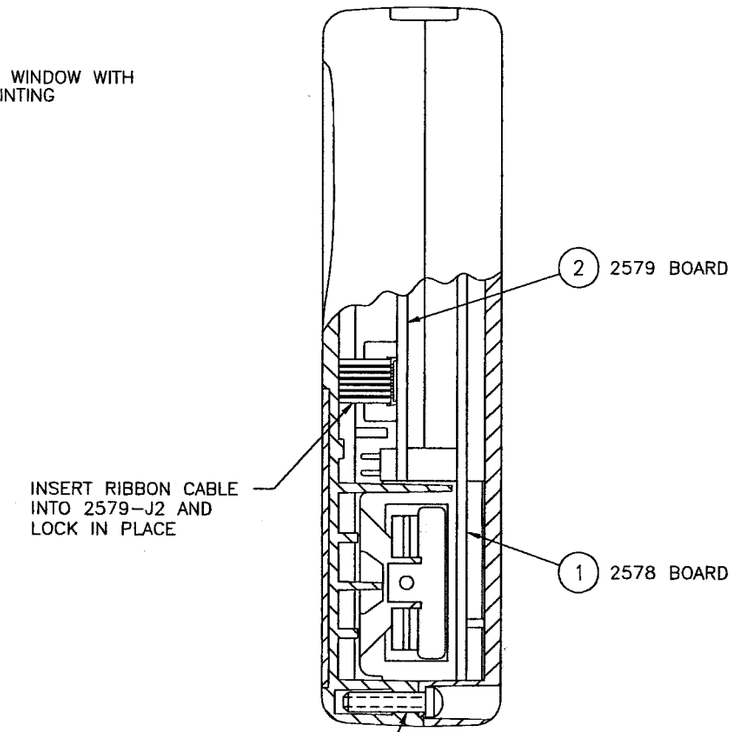
SIZE	DRAWING NO.	CODE	REV
C	9100	00	10

SCALE: NONE SHEET 1 OF 1









			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES BREAK ALL SHARP EDGES	TITLE: MAIN ASSY, MODEL 512	NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492	
			.X ±.02 .XX ±.01 .XXX ±.005 .XXXX ±.0025 TOLERANCES FRAC ±1/64 ANG ±1/4°			
			MATERIAL ~	DRAWN RGG 1Dec98 / CHECKED MRL	SIZE D / DRAWING NO. 9100 / CODE 01 / REV 01	
01	N879	3Apr01	FINISH ~	MFG ENGR TJC 15Jan99 / APPROVED AK 15Jan99		
REV	R NO.	DATE		USED ON: 09100-00	SCALE: 2/1	SHEET 1 OF 1

DISPLAY BOARD
B2579-03

J1 J2

J2
P2

MEMBRANE KEYPANEL
D9249-27

MAIN BOARD
B2578-03

F1
1/2A 125V
V FAST-ACT

F2
1/16A 125V
V FAST-ACT

J1

J3 J5

+
BT
1.5V DC

BT
1.5V DC
+

E1

REV	R NO.	DATE

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]

TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

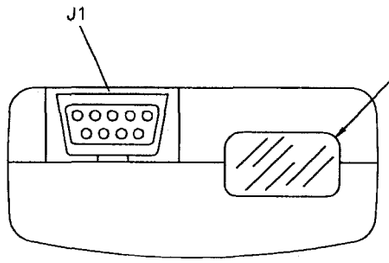
DRAWN	Russell G. Griffith	DATE 2Feb99
CHECK	MRL	DATE
MFG ENGR		DATE 10 Feb 99
ENGR		DATE
PROJ ENGR		DATE 10Feb99
NEXT ASSY: D9100-00		

NOVAMETRIX MEDICAL SYSTEMS INC.

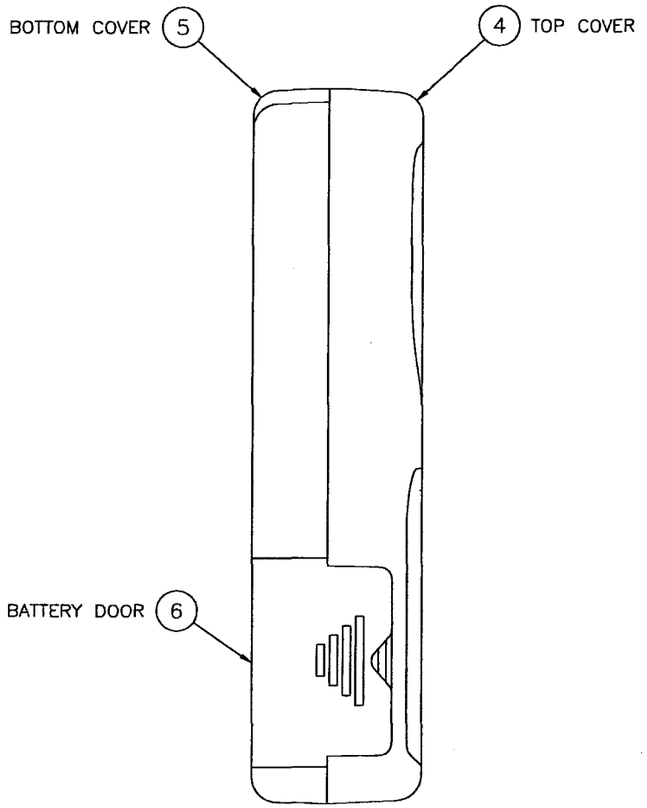
TITLE
OVERALL WIRING DIAGRAM, 512

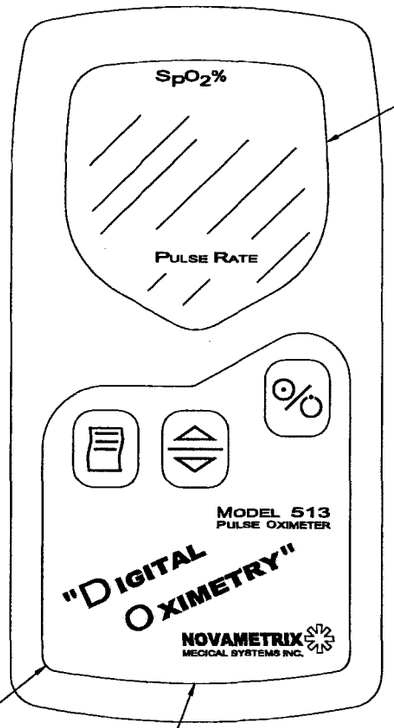
SIZE	DRAWING NO.	CODE	REV
C	9100	09	00

SCALE: NONE SHEET 1 OF 1



7 SLIDE IR WINDOW INTO BOTTOM COVER OPENING WITH GATE MARK FACING UP BEFORE INSTALLING TOP COVER

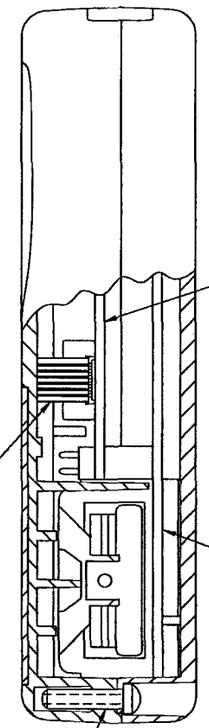




8 DISPLAY WINDOW WITH PAD PRINTING

CLEAN KEYPANEL RECESS WITH ISOPROPYL ALCOHOL AND ALLOW TO DRY 14

REMOVE ADHESIVE LINER, GUIDE RIBBON CABLE THRU SLOT AND ATTACH MEMBRANE KEYPANEL TO TOP COVER USING ADHESIVE BACKING 3



2 2579 BOARD

INSERT RIBBON CABLE INTO 2579-J2 AND LOCK IN PLACE

1 2577 BOARD

SECURE TOP AND BOTTOM COVER TOGETHER 2 PL 15

			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES BREAK ALL SHARP EDGES .X ±.02 .XX ±.01 .XXX ±.005 .XXXX ±.0025 TOLERANCES FRAC ±1/64 ANG ±1/4°	TITLE: MAIN ASSY, MODEL 513	NOVAMETRIX MEDICAL SYSTEMS INC. WALLINGFORD, CT U.S.A. 06492	
			MATERIAL ~	DRAWN RGG 12Nov98	CHECKED MRL	SIZE D / DRAWING NO. 9300 / CODE 01 / REV 01
			FINISH ~	MFG ENGR TJC 15Jan99	APPROVED AK 15Jan99	
01	N879	3Apr01		USED ON: 09300-00	SCALE: 2/1	SHEET 1 OF 1
REV	R NO.	DATE				

DISPLAY BOARD
B2579-03

J1

J2

J2

P2

MEMBRANE KEYPANEL
D9250-27

MAIN BOARD
B2577-03

F1

1/2A 125V
V FAST-ACT

F2

1/16A 125V
V FAST-ACT

J1

J3

J5

+

BT
1.5V DC

BT
1.5V DC

+

E1

REV	R NO.	DATE

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]

TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

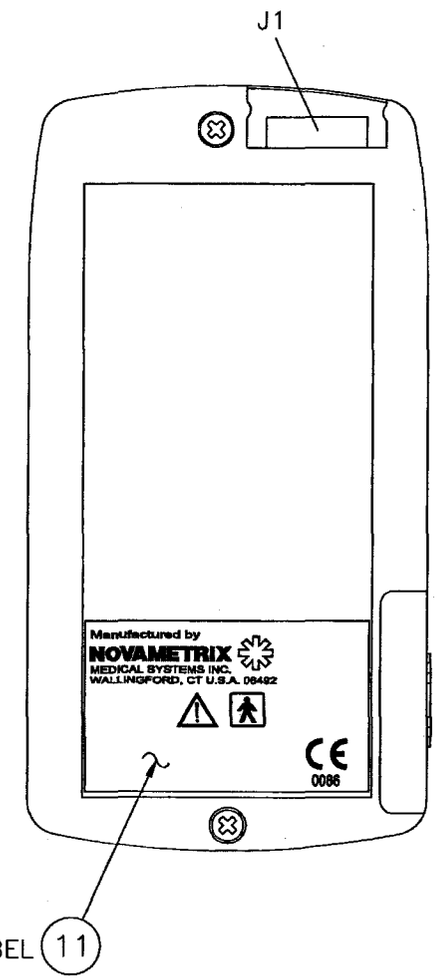
DRAWN	Russell G. Griffith 2Feb99
CHECK	MRL DATE
MFG ENGR	DATE
ENGR	DATE 18APR99
PROJ ENGR	DATE 18APR99
NEXT ASSY: D9300-00	

NOVAMETRIX MEDICAL SYSTEMS INC.

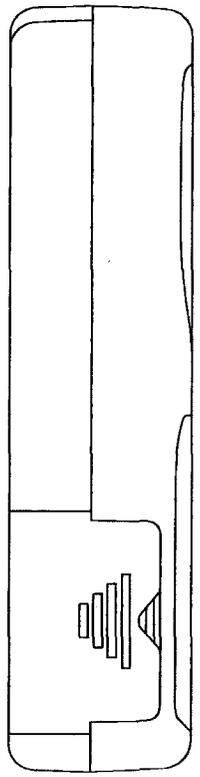
TITLE
OVERALL WIRING DIAGRAM,
513

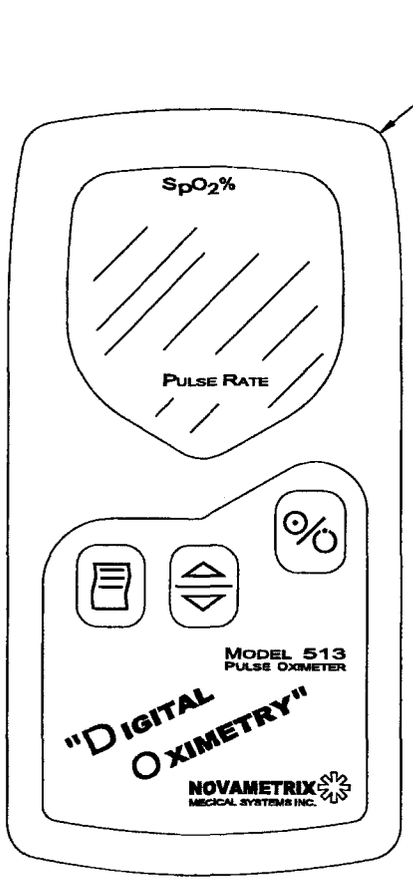
SIZE	DRAWING NO.	CODE	REV
C	9300	09	00

SCALE: NONE SHEET 1 OF 1



SERIAL NUMBER LABEL (11)
SEE NOTE 4





NOTES:

1. FOR SYSTEM TEST PROCEDURE SEE A9300–04.
2. FOR OVERALL WIRING DIAGRAM SEE D9300–09.
3. FOR QA INSPECTION PROCEDURE SEE A9300–70.
4. WIPE UNIT CLEAN WITH IPA, ITEM 18 AND LOCATE LABELS APPROX AS SHOWN.
5. INCLUDE THE FOLLOWING ITEMS WITH MONITOR:
   A. ITEM 19: TWO AA SIZE BATTERIES. DO NOT INSTALL.
   B. ITEM 5: USERS MANUAL
   C. ITEM 12: INSTRUCTIONS LABEL, SHEET OF 10, MULTILANGUAGE. DO NOT ATTACH TO UNIT.

REV	R NO.	DATE
10	N879	3Apr01
09	N834	28Dec00
08	N805	18Oct00

REV	R NO.	DATE
07	N792	8Sep00
06	N752	20Apr00
05	N696	28Sep99
04	N667	11May99
03	N658	22Apr99
02	N656	15Apr99
01	N643	2Mar99

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

☐ SOLID MODEL ON FILE

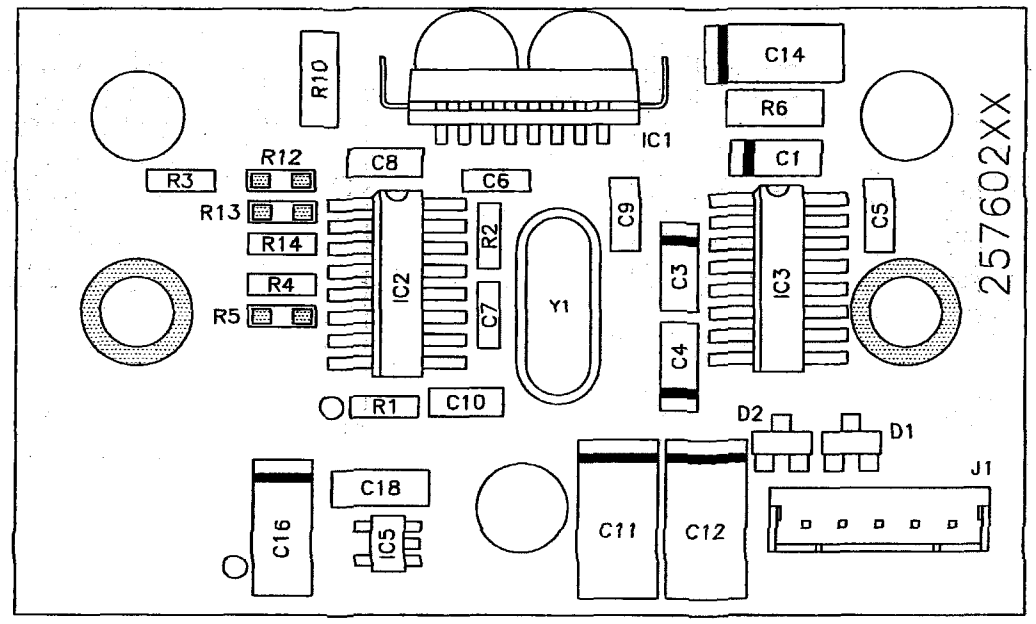
DRAWN	RGG	DATE 24Nov98
CHECK	MRL	DATE
MFG ENGR	TJC	DATE 15Jan99
ENGR	~	DATE
PROJ ENGR	A. Kersey	DATE 15Jan99
NEXT ASSY: ~		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE
PULSE OXIMETER WITH SERIAL OUTPUT, 513

SIZE	DRAWING NO.	CODE	REV
C	9300	00	10

SCALE: NONE | SHEET 1 OF 1



PN	DESCRIPTION	REF DES
2576-02	FAB, IR INTERFACE BOARD	~
B2576-03	SCHEMATIC, IR INTERFACE BOARD	~
A2576-04	TEST PROCEDURE, IR INTERFACE BOARD	~
153066	CAPACITOR, .01uF, 50V, 1206 STYLE	C18
154125	CAPACITOR, 1uF, 16V, 10%, 3216, TANTALUM	C1, C3, C4
154129	CAPACITOR, .1uF, 50V, 10%, X7R, 0805	C5, C8, C9, C10
154132	CAPACITOR, 15pF, 50V, 5%, COG, 0603, CERAMIC	C6, C7
154133	CAPACITOR, 47uF, 6.3VDC, 20%, TANTALUM	C16
154140	CAPACITOR, 100uF, 20%, 16V, 7343H STYLE	C11, C12
154141	CAPACITOR, 22uF, 20%, 6.3V, 6032 STYLE	C14
☆ 211520	CONNECTOR, 5 PIN, HEADER, VERT MT, .079 SP	J1
230033	CRYSTAL, 3.6864MHz	Y1
472292	RESISTOR, 22.1 OHM, 1/4W, 1%, 1206 STYLE	R6
474138	*RESISTOR, 100 OHM, 1/8W, 1%*	*R10*
474233	RESISTOR, 10k OHM, 1/16W, 1%, 0603 STYLE	R1
474240	RESISTOR, 100k OHM, 1/6W, 1%, 0603 STYLE	R3, R4, R14
474247	RESISTOR, 10M OHM, 1/6W, 5%, 0603 STYLE	R2
481554	DIODE, DUAL, COMMON CATHODE, 70V	D1
481546	DIODE, SWITCHING	D2
484577	VOLTAGE RGLTR, 5 V OUT, 50mA, SOT-23, 5 PIN	IC5
486372	IC, LINE DRVR/RCVR, RS232, 5V, 16 PIN	IC3
487144	IC, INFRARED IRDA TRANSCEIVER	IC1
487149	IC, INFRARED SERIAL ENCODER/DECODER, 16 PIN	IC2

NOTES:
1. COMPONENTS NOT FITTED: R5, R12, R13
2. FOR TEST PROCEDURE SEE A2576-04.
3. ☆ DENOTES THRU HOLE COMPONENTS.

REV	R NO.	DATE
01	N658	22Apr99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES
.X ±.02 TOLERANCES
.XX ±.01
.XXX ±.005 FRAC ±1/64
.XXXX ±.0025 ANG ±1/4°

MATERIAL ~

FINISH ~

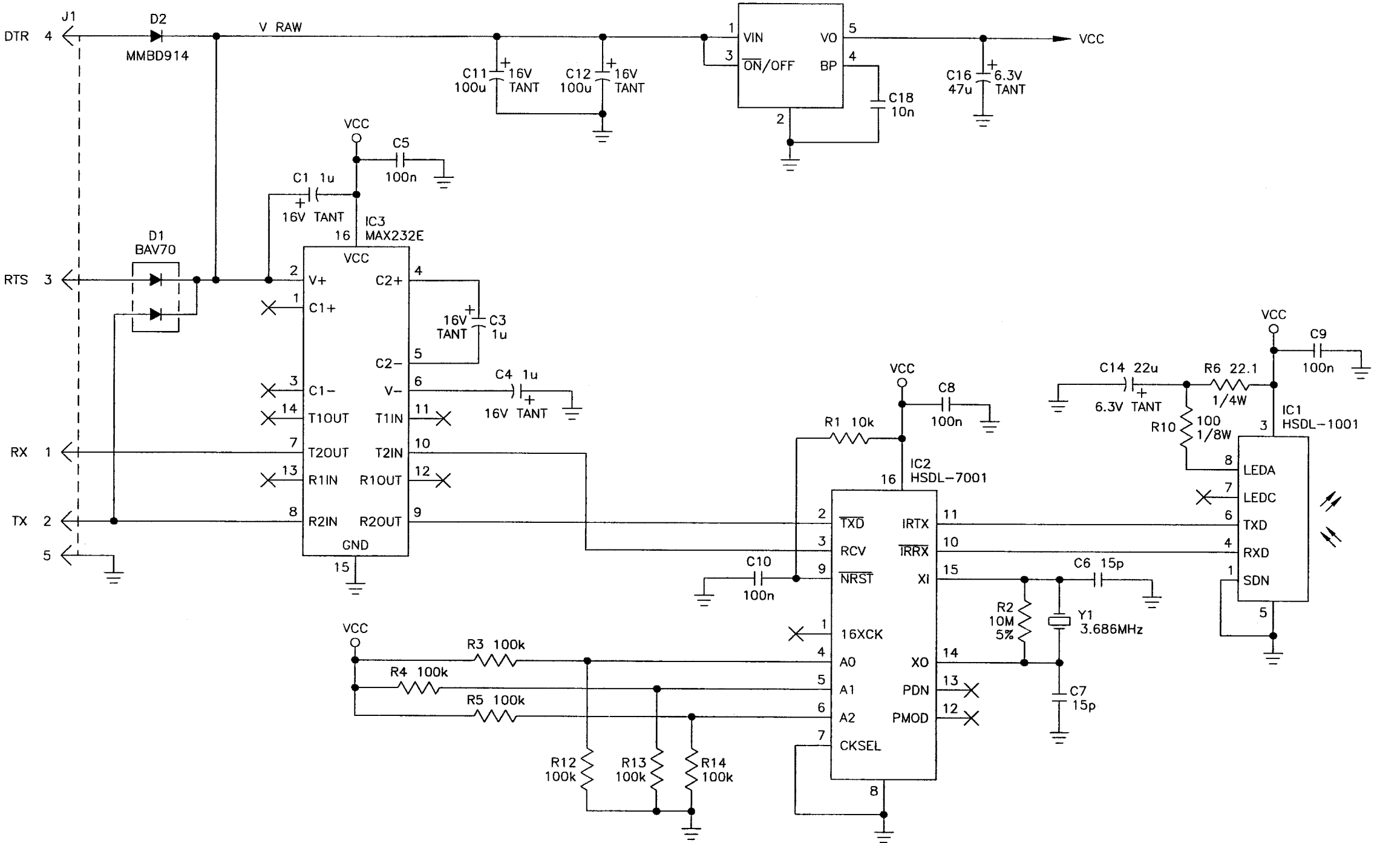
DRAWN	Russell G. Griffith	11Mar99
CHECK	MRL	
MFG ENGR	T. Carroll	25Mar99
ENGR	~	
PROJ ENGR	A. Kersey	25Mar99
NEXT ASSY: D9342-00		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: IR INTERFACE BOARD ASSY

SIZE	DRAWING NO.	CODE	REV
C	2576	01	01

SCALE: 4/1 SHEET 1 OF 1



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 1/16W, 1%
   CAPACITANCE VALUES ARE IN FARADS
2. LAST REF DES USED: C18, D2, IC5, J1, R14, Y1
3. REF DES NOT USED: C2, C13, C15, C17, IC4, R7, R8, R9, R11
4. FOR 9600 BAUD RATE DO NOT USE R5, R12 & R14
5. COMPONENTS NOT FITTED TO THIS ASSEMBLY: R5, R12, R13

REV	R NO.	DATE
01	N658	5May99

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

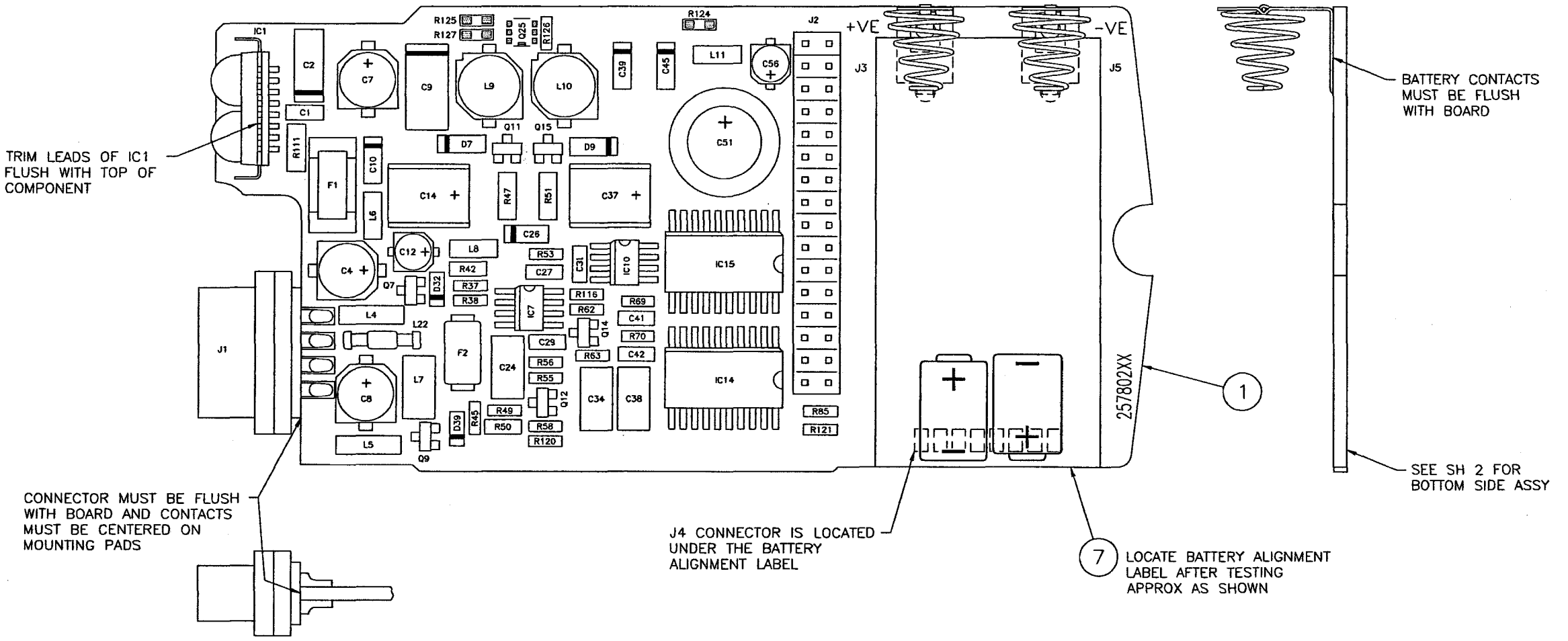
DRAWN	Mike Polson	DATE 14Sep98
CHECK	RL	DATE
MFG ENGR	Bob Narciso	DATE
ENGR	~	DATE
PROJ ENGR	AE Kersey	DATE 27Apr99
NEXT ASSY: ~		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: SCHEMATIC, IR INTERFACE BOARD

SIZE	DRAWING NO.	CODE	REV
C	2576	03	01

SCALE: NONE SHEET 1 OF 1



NOTES:

1. COMPONENTS NOT FITTED: C59, D13, L21, Q25, R9, R14, R108, R122, R123, R124, R125, R127
2. FOR TEST PROCEDURE SEE A2578-04.
3. FOR IC17 PROGRAMMING PROCEDURE SEE A9373-33.

REV	R NO.	DATE
07	N834	29Dec00
06	N787	25Aug00
05	N715	21Jan00
04	N696	28Sep99
03	N667	11May99
02	N656	19Apr99
01	N643	2Mar99

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

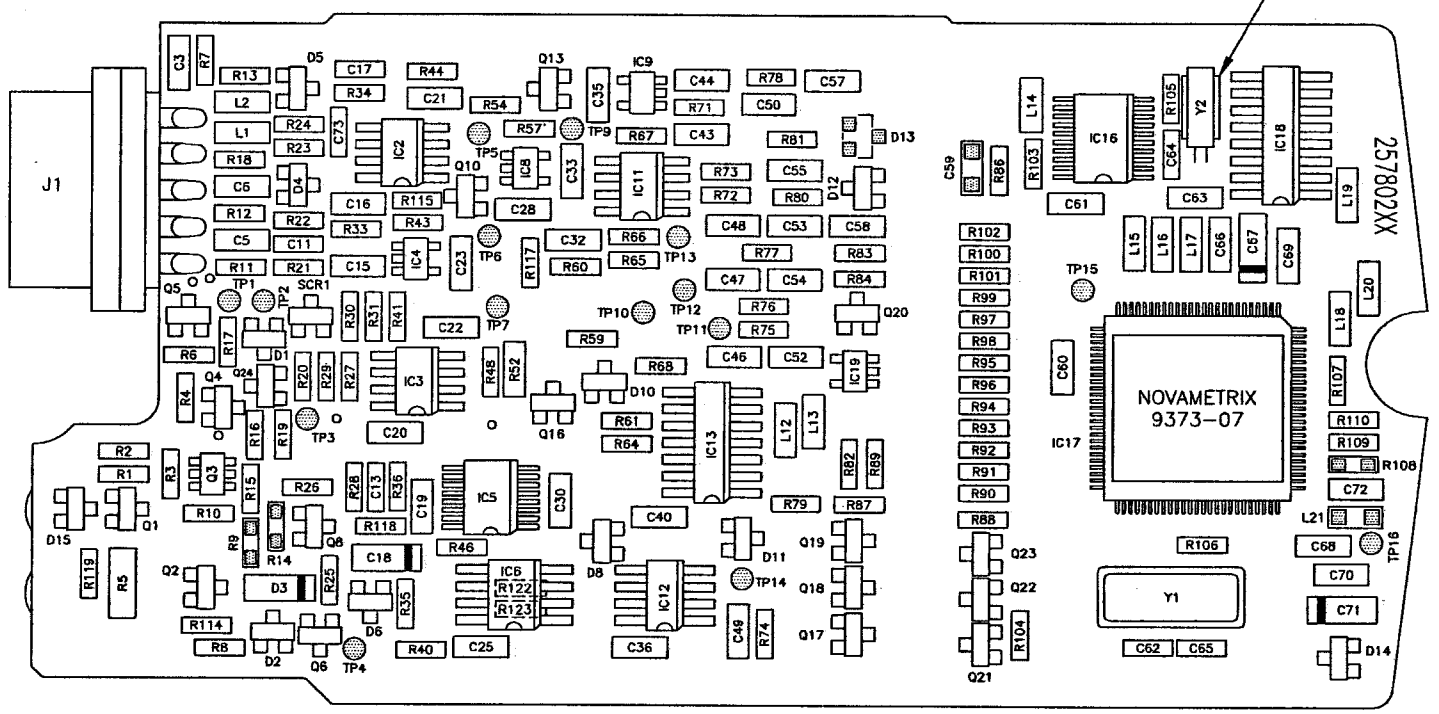
DRAWN	RGG	DATE 26Oct98
CHECK	MRL	DATE 24Nov98
MFG ENGR	MJC	DATE 11/23/98
ENGR	~	DATE
PROJ ENGR	AEK	DATE 23Nov98
NEXT ASSY: D9300-01		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD WITH IR ASSY, 513

SIZE	DRAWING NO.	CODE	REV
C	2577	01	07

SCALE: NONE SHEET 1 OF 2



REV	R NO.	DATE
07	N834	29Dec00
06	N787	25Aug00
05	N715	21Jan00
04	N696	28Sep99
03	N667	11May99
02	N656	19Apr99
01	N643	2Mar99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]

TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

DRAWN	RGG	26Oct98
CHECK	MRL	24Nov98
MFG ENGR	MJC	11/23/98
ENGR	~	
PROJ ENGR	AEK	23Nov98

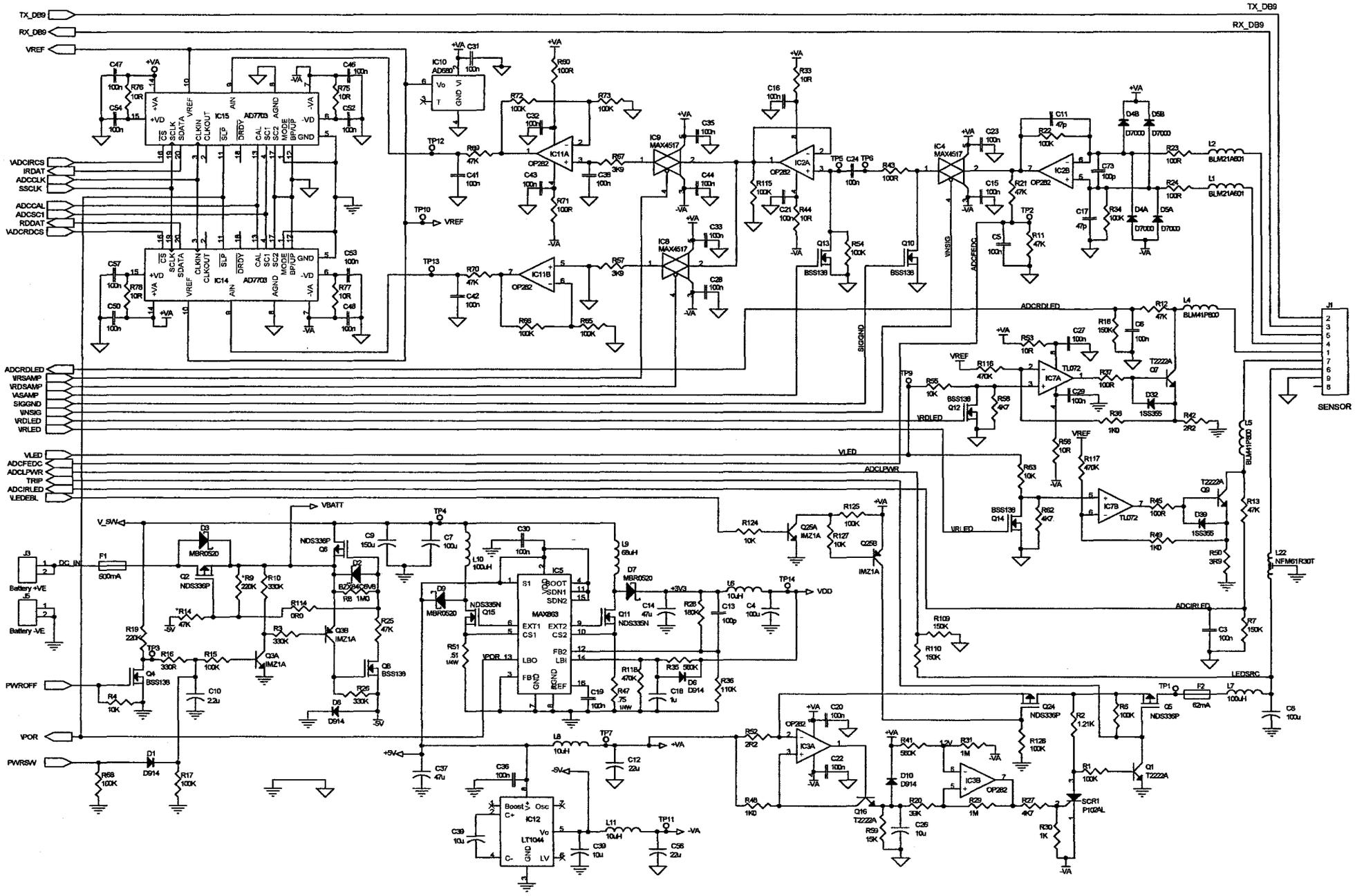
NEXT ASSY: D9300-01

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD WITH IR ASSY, 513

SIZE	DRAWING NO.	CODE	REV
C	2577	01	07

SCALE: NONE | SHEET 2 OF 2



DRAWING TABULATION		
DWG. NO	REV	TITLE
C2577-03	07 N834	SCHEMATIC, MAIN BOARD WITH IR, 513
C2578-03	07 N834	SCHEMATIC, MAIN BOARD, 512

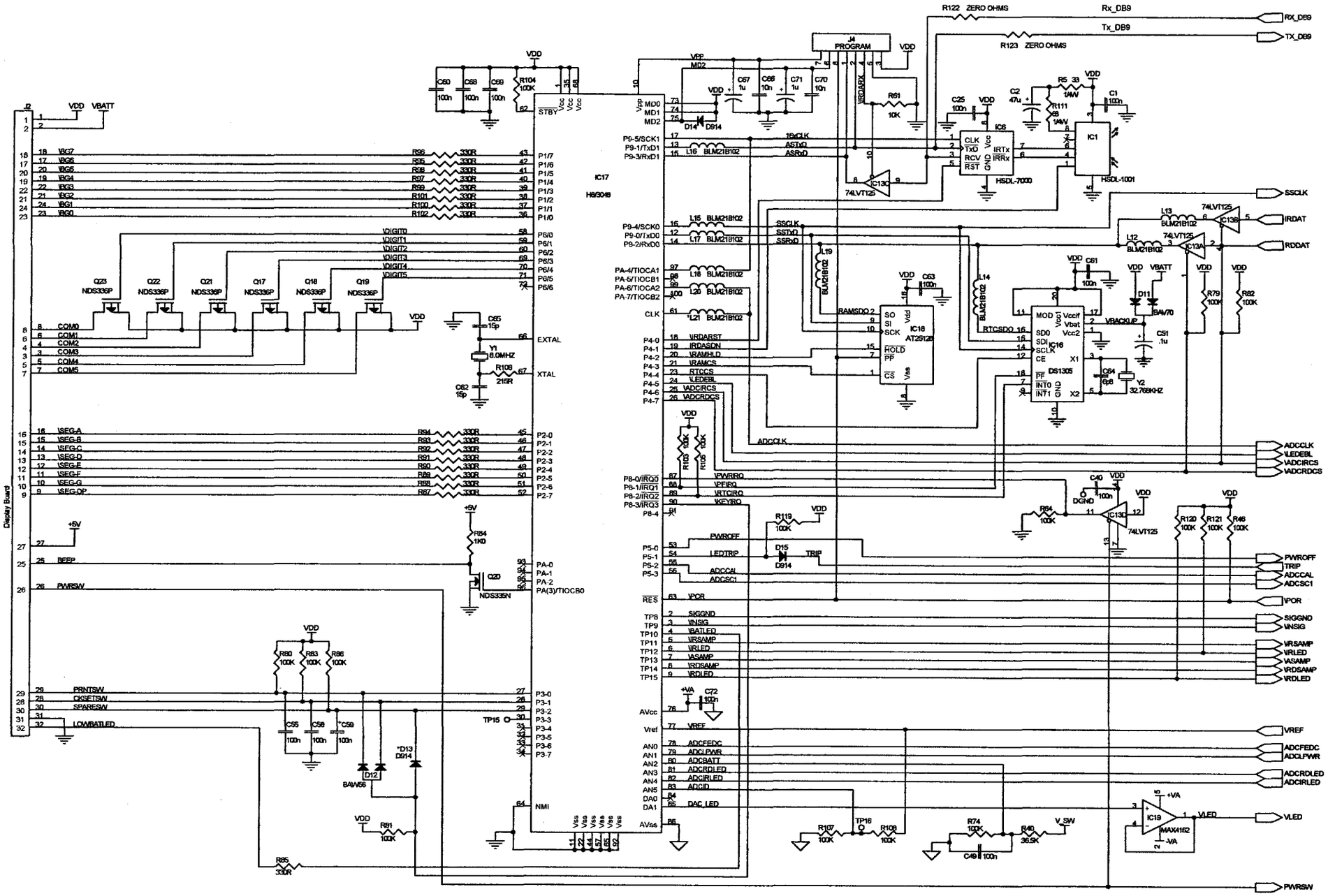
Rev.	"R" No.	By Date
07	NE34	28Dec00
06	N787	26Aug00
05	N715	10Feb00
04	N696	28Sep99
03	N667	11May99
02	N656	19Apr99
01	N643	1Mar99

SCHEMATIC, MAIN BOARD
512 & 513

Drawn: Mike Poleon — Checked: —
15-May-98
Mfg Eng: M. Casazarino 3/31/99 — Approved: AEKersey 31-Mar-99
File: 2577-780507
Date: Thursday, December 28, 2000

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

Size C — Document Number 2577 & 2578 — Code 03 — Rev. SEE TAB
Sheet 1 of 2



NOTES:

1. LAST REF DES USED: C73, D39, F2, IC19, J5, L22, Q25, R127, SCR1, Y2
2. REF DES NOT USED: D16-D31, D33-D38, L3, R32, R39, R112, R113
3. 2578 COMPONENTS NOT FITTED: C1, C2, C51, C59, C61, C64, D11, D12, D13, IC1, IC6, IC16, IC18, L14, L18, L19, L21, Q25, R5, R9, R14, R107, R111, R122, R123, R124, R125, R127, Y2
4. 2577 COMPONENTS NOT FITTED: C59, D13, L21, Q25, R9, R14, R108, R122, R123, R124, R125, R127
5. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS, 1/16W, 1%
   CAPACITANCE VALUES ARE IN FARADS

DRAWING TABULATION

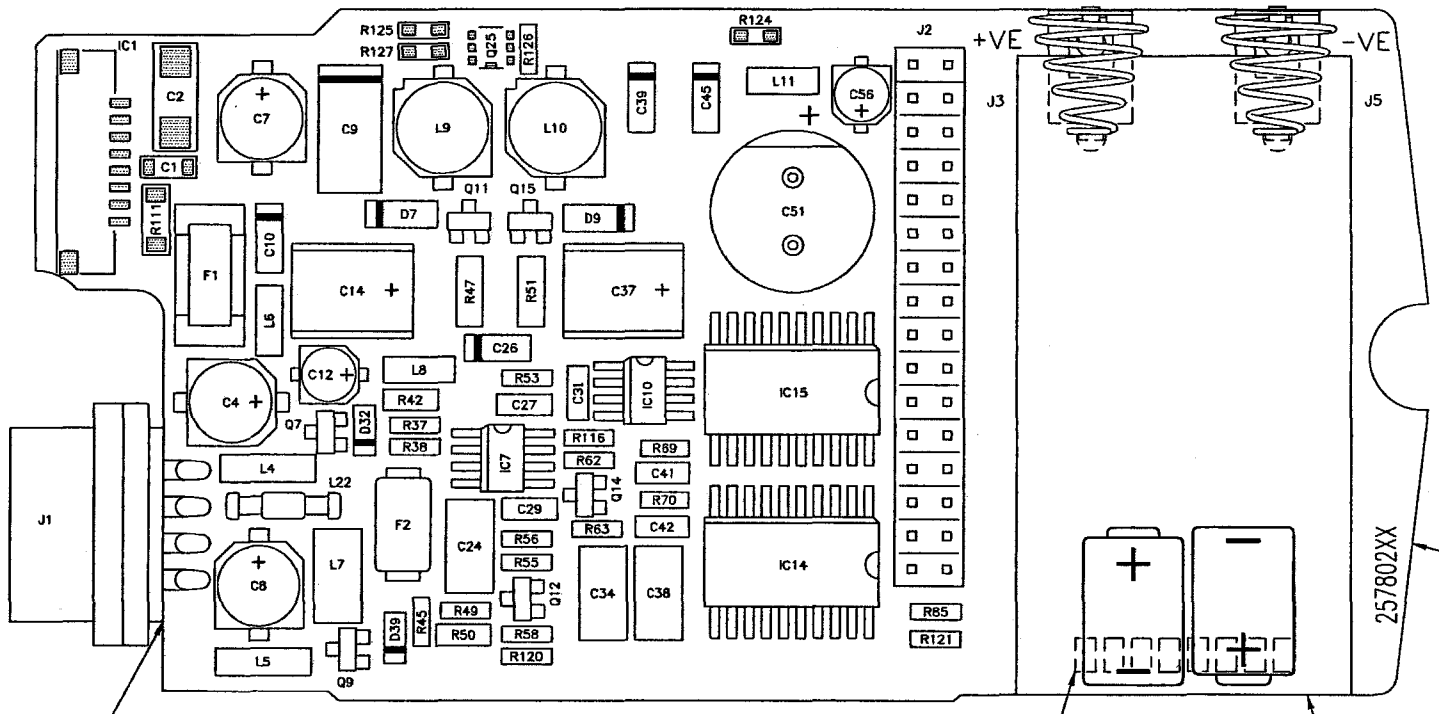
DWG. NO	REV	TITLE
C2577-03	07 N834	SCHEMATIC, MAIN BOARD WITH IR, 513
C2578-03	07 N834	SCHEMATIC, MAIN BOARD, 512

Rev.	"R" No.	By	Date
07	N834		28Dec00
06	N787		23Aug00
05	N715		10Feb00
04	N696		28Sep99
03	N687		11May99
02	N655		19Apr99
01	N643		1Mar99

SCHEMATIC, MAIN BOARD
512 & 513

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

Drawn: Mike Polson 15-May-98
Checked: –
Mfg Eng: M. Cassarino 3/31/99
Approved: AEKersey 31-Mar-99
File: 2577-780307
Date: Wednesday, January 03, 2001
Size: C
Document Number: 2577 & 2578
Code: 03
Rev: SEE TAB
Sheet 2 of 2



NOTES:

1. COMPONENTS NOT FITTED: C1, C2, C51, C59, C61, C64, D11, D12, D13, IC1, IC6, IC16, IC18, L14, L18, L19, L21, Q25, R5, R9, R14, R107, R111, R122, R123, R124, R125, R127, Y2
2. FOR TEST PROCEDURE SEE A2578-04.
3. FOR IC17 PROGRAMMING PROCEDURE SEE A9373-33.

REV	R NO.	DATE
07	N834	29Dec00
06	N787	25Aug00
05	N715	24Jan00
04	N696	28Sep99
03	N667	11May99
02	N656	19Apr99
01	N643	1Mar99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]

TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

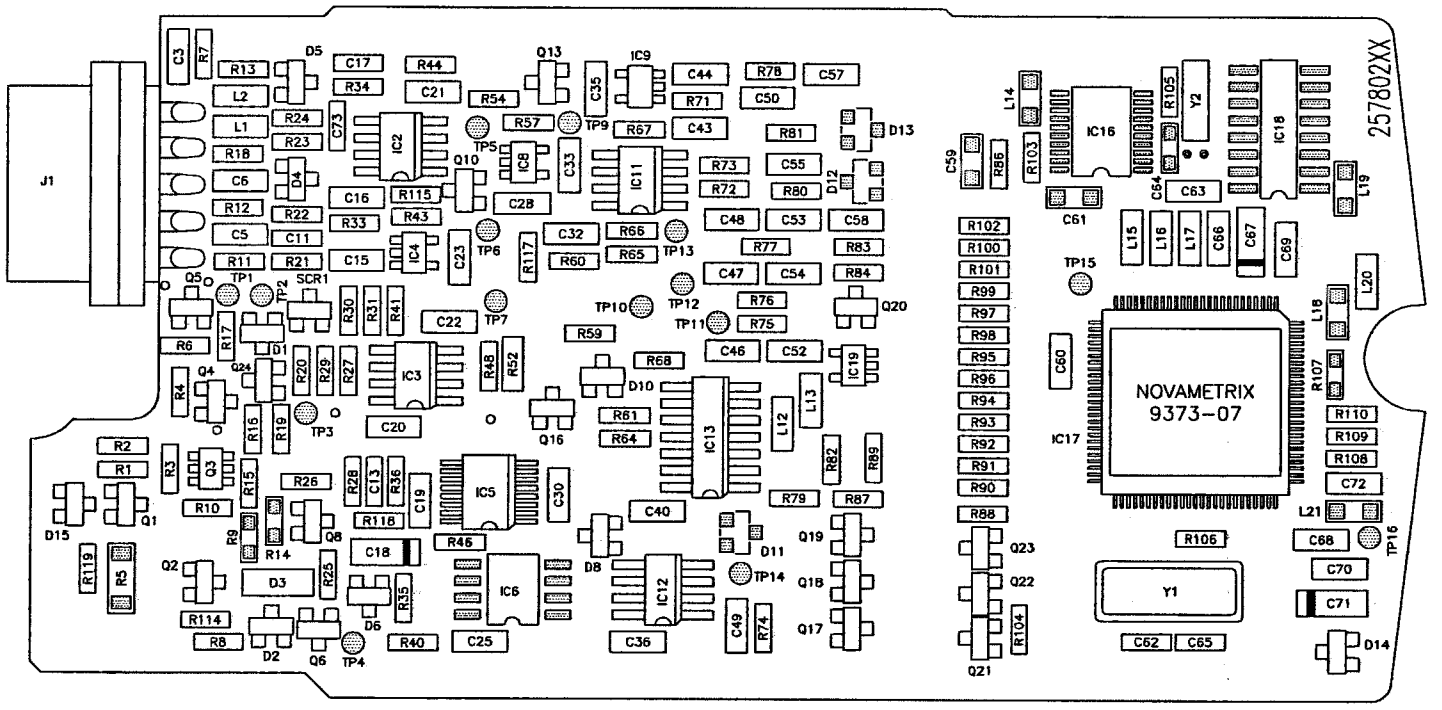
DRAWN RGG	DATE 14Oct98
CHECK MRL	DATE
MFG ENGR MJC	DATE 12/15/98
ENGR ~	DATE
PROJ ENGR EM	DATE 12/15/98
NEXT ASSY: D9100-01	

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD ASSY, 512

SIZE	DRAWING NO.	CODE	REV
C	2578	01	07

SCALE: NONE | SHEET 1 OF 2



REV	R NO.	DATE
07	N834	9Jan01
06	N787	25Aug00
05	N715	24Jan00
04	N696	28Sep99
03	N667	11May99
02	N656	19Apr99
01	N643	1Mar99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]

TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

DRAWN RGG	DATE 14Oct98
CHECK MRL	DATE
MFG ENGR MJC	DATE 12/15/98
ENGR ~	DATE
PROJ ENGR EM	DATE 12/15/98
NEXT ASSY: D9100-01	

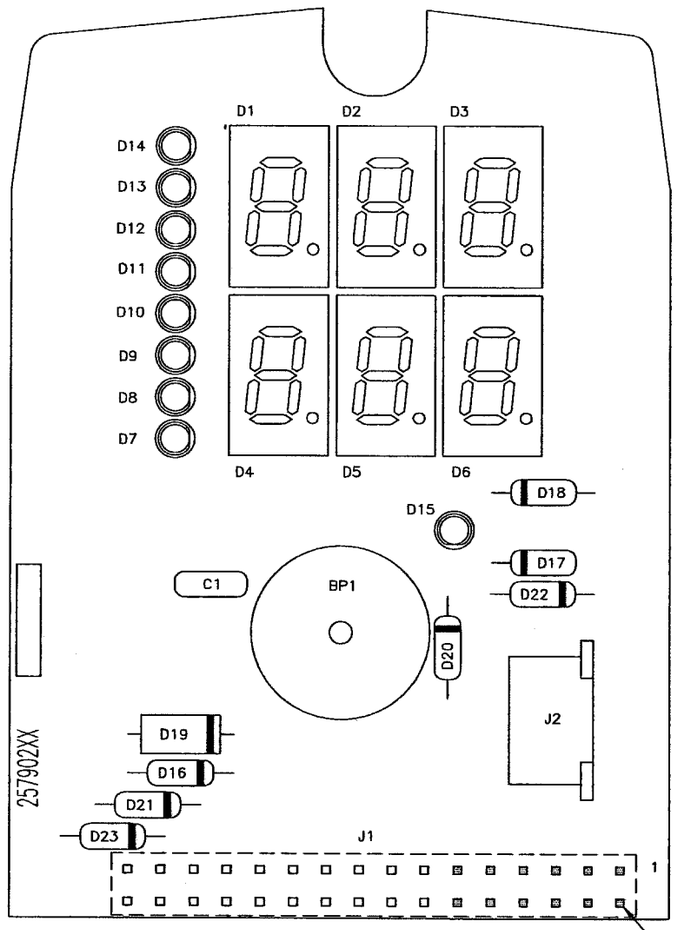
NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: MAIN BOARD ASSY, 512

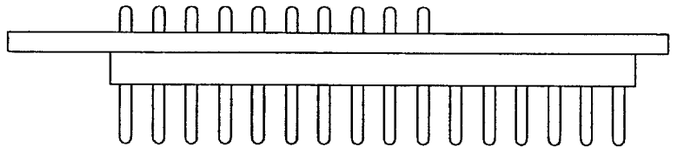
SIZE	DRAWING NO.	CODE	REV
C	2578	01	07

SCALE: NONE | SHEET 2 OF 2

PN	DESCRIPTION	REF DES
2579-02	FAB, DISPLAY BOARD, MODEL 512 & 513	~
D2579-03	SCHEMATIC, DISPLAY BOARD, MODEL 512 & 513	~
A2579-04	TEST PROCEDURE, DISPLAY BOARD, 512 & 513	~
☆ 130019	TRANSDUCER, AUDIO, 3800Hz, 1-20VDC, 1MA	BP1
☆ 154016	CAPACITOR, .1uF, 50V, 10%, .1 SPACING	C1
☆ 211643	CONNECTOR, 6 PIN, RCPT, RT ANGLE, .05 SP	J2
☆ 213104	CONNECTOR, 32 PIN, HEADER, DIL, .1 SP STR	J1
☆ 481026	DIODE, ZENER, 4.7V, 500MW	D19
☆ 481501	DIODE, SIGNAL SILICON, HIGH SPEED	D16-D18, D20-D23
☆ 482608	LED, DISPLAY, 7-SEG, RED, 10 PIN, .1 SPACING	D1-D6
☆ 482609	LED, RED, 3MM DIA, 2 PIN	D7-D15



TRIM J1-1 THRU J1-12
FLUSH WITH BOARD



NOTES:
1. FOR TEST PROCEDURE SEE A2579-04.
2. ☆ DENOTES THRU HOLE COMPONENTS.

REV	R NO.	DATE
01	N667	10May99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
BREAK ALL SHARP EDGES
.X ±.02
.XX ±.01
.XXX ±.005
.XXXX ±.0025
TOLERANCES
FRAC ±1/64
ANG ±1/4°

MATERIAL ~

FINISH ~

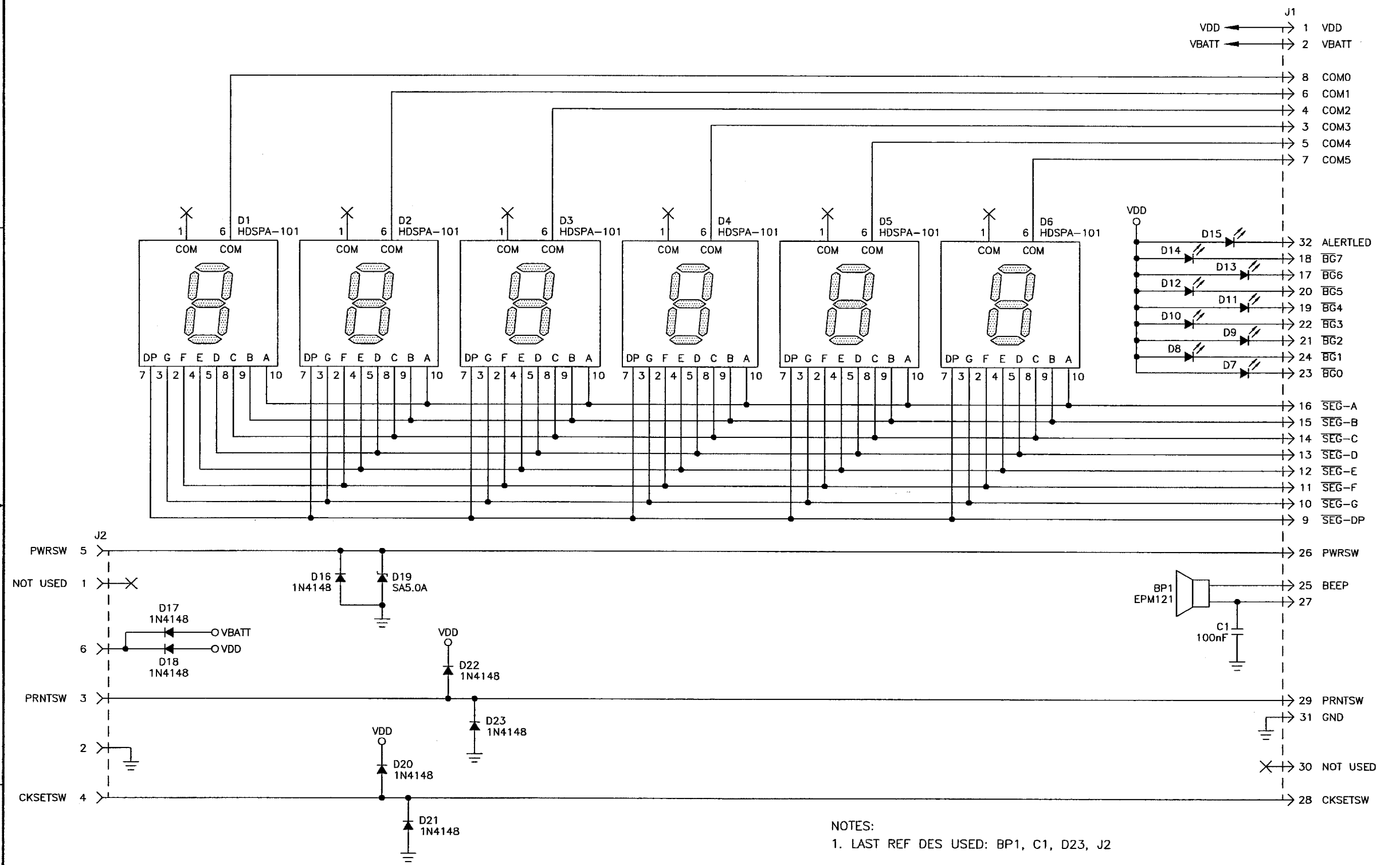
TITLE: DISPLAY BOARD ASSY, 512 & 513

DRAWN RGG 27Oct98 | CHECKED ~
MFG ENGR TJC 30Nov98 | APPROVED AK 30Nov98
USED ON: 9100-01 & 9300-01

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

SIZE	DRAWING NO.	CODE	REV
D	2579	01	01

SCALE: 4/1 | SHEET 1 OF 1



NOTES:

1. LAST REF DES USED: BP1, C1, D23, J2

REV	R NO.	DATE
01	N667	2Jun99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]

TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

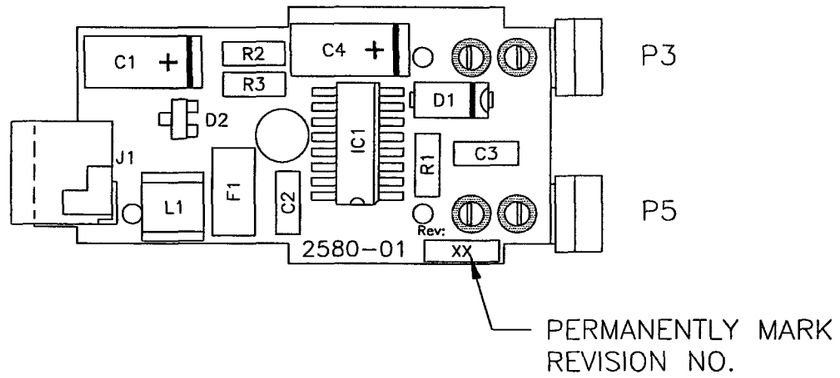
DRAWN	Mike Polson	DATE 15May98
CHECK	BL	DATE 1Jun99
MFG ENGR	T. Carroll	DATE 1Jun99
ENGR	~	DATE
PROJ ENGR	A. Kersey	DATE 1Jun99
NEXT ASSY: ~		

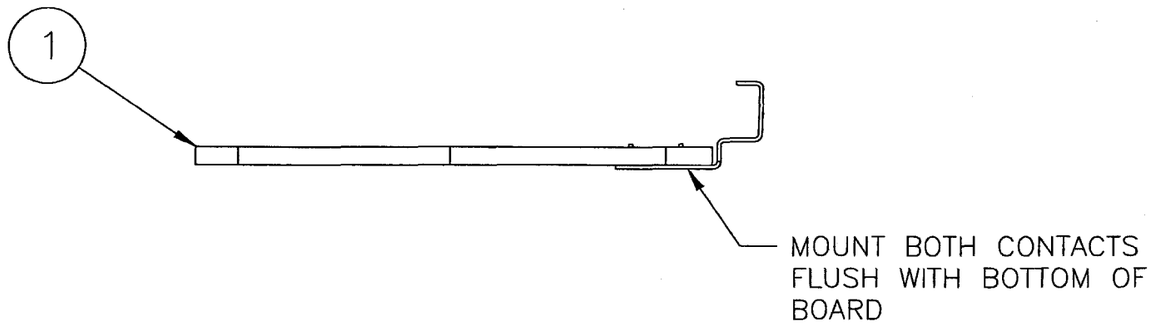
NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE: SCHEMATIC, DISPLAY BOARD, 512 & 513

SIZE	DRAWING NO.	CODE	REV
C	2579	03	01

SCALE: NONE SHEET 1 OF 1





NOTES:

1. FOR TEST PROCEDURE SEE A2580-04.

REV	R NO.	DATE
01	N743	12Apr00

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]

TOLERANCES

.XX	±.01	[.254]
.XXX	±.005	[.127]
.XXXX	±.0025	[.064]
FRAC	±1/64	
ANG	±1/4°	

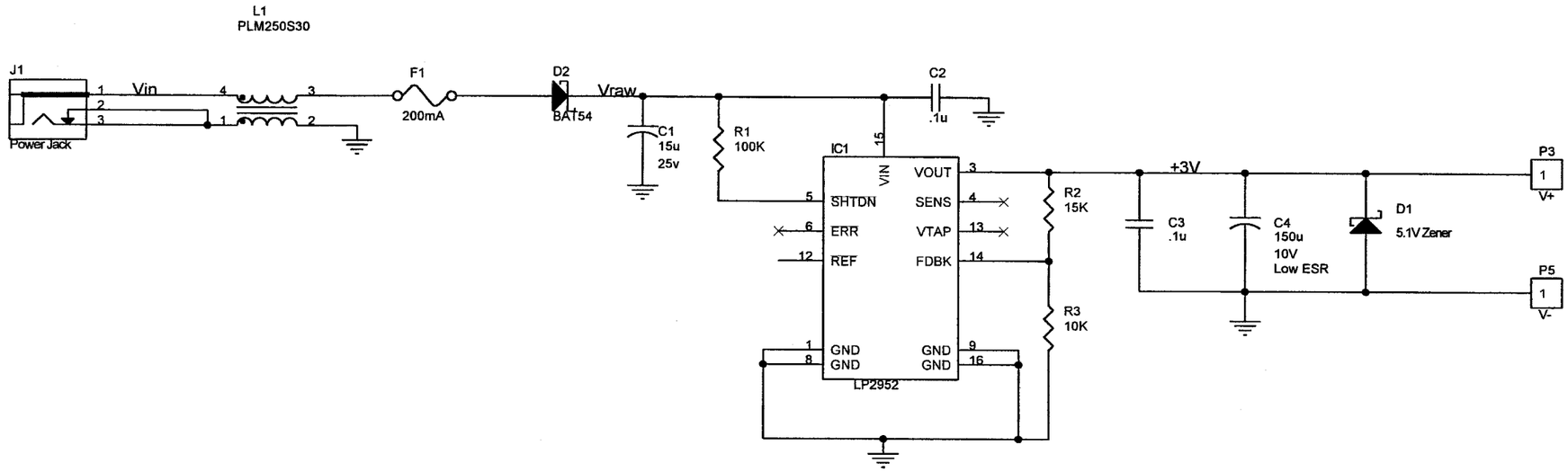
DRAWN	Russell G. Griffith	DATE 20Sep99
CHECK	B. Lancaster	DATE 11Nov99
MFG ENGR	T. Carroll	DATE 11Nov99
ENGR	~	DATE
PROJ ENGR	A. Kersey	DATE 11Nov99
NEXT ASSY: C9278-00		

NOVAMETRIX MEDICAL SYSTEMS INC.

TITLE
BATTERY ELIMINATOR BOARD ASSY

SIZE	DRAWING NO.	CODE	REV
B	2580	01	01

SCALE: 2/1 SHEET 1 OF 1



Notes:

1. Unless otherwise specified:
   Resistance values are in ohms, 1/8W, 1%
   Capacitance values are in farads
2. Last Ref Des used: C4, D2, F1, IC1, J1, L1, P5, R3
3. Ref Des not used: P1, P2, P4

			Schematic, Battery Eliminator Board, 512/513		Novametrix Medical Systems, Inc. 1 Barnes Industrial Park Road Wallingford, CT USA 06492		
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