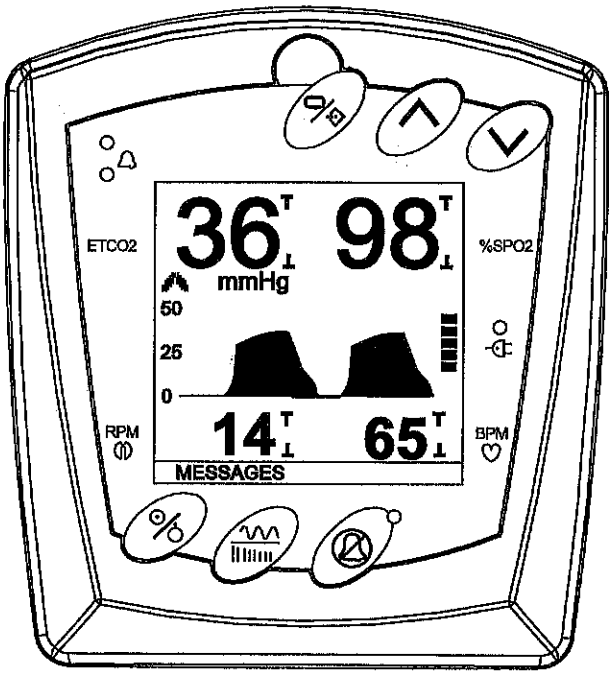
Capnograph

Service Manual

MODEL: 8400 MDD



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Catalog Number 1895
Version 2 September 2000

CAPNOGRAPH SERVICE MANUAL

Conditions of Warranty

This warranty is void if the Product has been altered, misused, damaged by neglect or accident, not properly maintained or recharged, or repaired by persons not authorized by Seller. Misuse includes, but is not limited to, use not in compliance with the labeling or use with accessories not manufactured by Seller. This warranty does not cover normal wear and tear and maintenance items.

Limitation of Remedies

The original purchaser's exclusive remedy shall be, at Seller's sole option, the repair or replacement of the Product. **THIS IS THE EXCLUSIVE REMEDY. In no event will Seller's liability arising out of any cause whatsoever (whether such cause is based in contract, negligence, strict liability, tort or otherwise) exceed the price of the Product and in no event shall Seller be responsible for consequential, incidental or special damages of any kind or nature whatsoever, including but not limited to, lost business, revenues and profits.**

Warranty Procedure

To obtain warranty service in the USA, you must request a Customer Service Report (CSR) number from Technical Service. Reference the CSR number when returning your Product, freight and insurance prepaid, to: SIMS BCI, Inc., N7 W22025 Johnson Road, Waukesha, WI 53186-1856. Telephone: 1-800-558-2345. Facsimile: 262-542-3325. Seller will not be responsible for unauthorized returns or for loss or damage to the Product during the return shipment. The repaired or replaced Product will be shipped, freight prepaid, to Purchaser.

CE Notice

Marking by the symbol CE 0473 indicates compliance of this device to the Medical Device Directive 93/42/EEC.

Authorized Representative (as defined by the Medical Device Directive):

SIMS Graseby Limited
Colonial Way, Watford, Herts,
UK, WD2 4LG

Phone: (44) 1923 246434
Fax: (44) 1923 240273

Proprietary Notice

WARRANTY

Limited Warranty

Seller warrants to the original purchaser that the Product, not including accessories, shall be free from defects in materials and workmanship under normal use, if used in accordance with its labeling for two years from the date of shipment to the original purchaser.

Seller warrants to the original purchaser that the reusable oximeter sensors supplied as accessories, shall be free from defects in materials and workmanship under normal use, if used in accordance with its labeling for one year from the date of shipment to the original purchaser (USA).

Disclaimer of Warranties

THE FOREGOING EXPRESS WARRANTY, AS CONDITIONED AND LIMITED, IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Seller disclaims responsibility for the suitability of the Product for any particular medical treatment or for any medical complications resulting from the use of the Product. This disclaimer is dictated by the many elements which are beyond Seller's control, such as diagnosis of patient, conditions under which the Product may be used, handling of the Product after it leaves Seller's possession, execution of recommended instructions for use and others.

Chapter 1: Introduction

Intended Use:

The Capnograph is a low cost CO_2 monitor with oximetry and optional external printer. It may be used in the hospital or clinical environment, and during emergency land transport. It is not intended for use in the home. It is intended to be used in all critical environments, including ventilatory applications, patient ground transport, EMS (Emergency Medical Services) and anesthesia. The capnography parameter provides end tidal CO_2 (ET CO_2) inspired CO_2 (in CO_2) and respiration rate measurements on all patients from pediatric to adult. The oximetry parameter works with all SIMS BCI, Inc. oximetry sensors, providing %SpO_2 and pulse rate on all patients from pediatric to adult. The Capnograph permits continuous patient monitoring with adjustable alarm limits as well as visual and auditory alarm signals. It is not intended nor designed to be used as an apnea monitor.

Symbol Definitions

SYMBOL	DEFINITION
	Type CF equipment.
	Attention, consult accompanying documents.
	Refer servicing to qualified service personnel.
	Input voltage
	Printer output
	Direct Current
	Alarm Silence
	On/Off
	Waveform/Trend or Menu Exit
	Menu/Enter
	Up or Down arrows
	Battery Power
	External Power/Battery Eliminator
	Non AP Device
	Breath Indicator
	Date of Manufacture
IPX1	Drip Proof
	High Alarm Limit Indicator
	Low Alarm Limit Indicator
	Pulse Rate
	Respiration Rate
	Use By
	Alarm

⚠ Warnings, Cautions, and Notes

KEYWORD	DEFINITION
WARNING	Tells you about something that could hurt the patient or hurt the operator.
CAUTION	Tells you about something that could damage the monitor.
NOTE	Tells you other important information.

Warnings

WARNING: Federal law (USA) restricts the use or sale of this device by, or on the order of, a physician.

WARNING: Do not use this device in the presence of flammable anesthetics.

WARNING: Do not autoclave, ethylene oxide sterilize, or immerse in liquid. Unplug before cleaning or disinfecting.

WARNING: ELECTRICAL SHOCK HAZARD when cover is removed. Do not remove covers. Refer servicing to qualified personnel.

WARNING: Use only SpO_2 sensors supplied with, or specifically intended for use with, this device.

WARNING: Do not use this device in the presence of magnetic resonance imaging (MR or MRI) equipment.

WARNING: Do not plug the monitor into an outlet controlled by a wall switch.

WARNING: This device must be used in conjunction with clinical signs and symptoms. This device is only intended to be an adjunct in patient assessment.

WARNING: In the event that earth ground integrity is lost, the performance of this device and/or other devices nearby may be affected due to excessive RF emissions.

WARNING: Prolonged use or the patient's condition may require changing the SpO_2 sensor site periodically. Change sensor site and check skin integrity, circulatory status, and correct alignment at least every 4 hours.

WARNING: When attaching SpO_2 sensors with Microfoam® [1] tape, do not stretch the tape or attach the tape too tightly. Tape applied too tightly may cause inaccurate readings and blisters on the patient's skin (lack of skin respiration, not heat, causes the blisters).

[1] Microfoam® is a registered trademark of the 3M Company.

WARNING: Any monitor that has been dropped or damaged, should be inspected by qualified service personnel, prior to use, to insure proper operation.

WARNING: The capnography parameter of this monitor is not for use on Neonates.

WARNING: This monitor is not for use as an apnea monitor.

WARNING: This monitor is not intended for use in Sleep Study environments.

WARNING: This monitor is not for home use.

WARNING: Remove device batteries prior to long term storage.

WARNING: When connecting to or communicating with this monitor, verify proper operation before clinical use. Refer to the instrument's user manual for full instructions. Accessory equipment connecting to or communicating to the monitor's data interface must be certified according to the respective IEC standards, i.e. IEC 950 for data processing equipment or IEC 601-1 for electromedical equipment. All combinations of equipment must be in compliance with IEC 601-1-1 systems requirements.

WARNING: IEC 950 approved equipment including the HP82240B printer must be placed outside of the "patient environment". The patient environment is defined as an area 1.5m (4.92 feet) from the patient. See *Chapter 10: Printer Output* illustration 10.3.

WARNING: Patient safety can be comprimised by the use of a power supply not be supplied by SIMS BCI, Inc. Use only the power supply included with your monitor, or approved by SIMS BCI, Inc.

Cautions

CAUTION: Ensure the device's AC rating is correct for the AC voltage at your installation site before using the monitor. The monitor's AC rating is shown on the external power supply. If the rating is not correct, do not use the monitor; contact SIMS BCI, Inc. service department for help.

CAUTION: This device is intended for use by persons trained in professional health care. The operator must be thoroughly familiar with the information in this manual before using the monitor.

CAUTION: Do not allow water or any other liquid to spill onto the monitor. Unplug the external power supply from the monitor before cleaning or disinfecting the monitor.

CAUTION: Should the device become wet, wipe off all moisture and allow sufficient time for drying before operating.

CAUTION: Do not use the device without the appropriate filter attached. Use of any other filter will cause degradation in performance, and/or permanently damage the device.

CAUTION: It is the operator's responsibility to set alarm limits appropriately for each individual patient.

CAUTION: If the accuracy of any measurement is in question, verify the patient's vital sign(s) by an alternative method and then check the monitor for proper functioning.

CAUTION: Pump motors in the $C0_2$ monitor may adversely affect other medical equipment, e.g. ECG tracings.

CAUTION: The monitor should be operated from its internal power source if the integrity of the protective earth conductor is in doubt.

CAUTION: Follow local governing ordinances and recycling instructions regarding disposal and recycling of device components.

CAUTION: The monitor contains a 6-hour Lithium Ion (LI+) battery. If the battery fails to hold a charge or otherwise becomes inoperable, the battery should be replaced and the old battery should be disposed of properly. Consult local officials for information about the proper disposal of the Lithium Ion battery. SIMS BCI, Inc. cannot dispose of monitor batteries.

CAUTION: Pressing front panel keys with sharp or pointed instruments may permanently damage the keypad. Press front panel keys only with your finger.

CAUTION: Do not disassemble unit, it contains no user serviceable parts. Refer to qualified service personnel.

Notes

NOTE: Dyes introduced into the bloodstream, such as methylene blue, indocyanine green, indigo carmine, and fluorescein, may cause an inability to determine accurate SpO_2 readings.

NOTE: Any condition that restricts blood flow, such as use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate pulse and SpO_2 readings.

NOTE: Operation of this device may be adversely affected in the presence of conducted transients or strong EM or RF sources, such as electrosurgery and electrocaudery equipment, x-rays, and high intensity infrared radiation.

NOTE: Significant levels of dysfunctional hemoglobins, such as carboxyhemoglobin or methemoglobin, will affect the accuracy of the SpO_2 measurement.

NOTE: SpO_2 measurements may be adversely affected in the presence of high ambient light. If necessary, shield the sensor area (with a surgical towel, for example).

NOTE: Remove fingernail polish or false fingernails before applying SpO_2 sensors. Fingernail polish or false fingernails may cause inaccurate SpO_2 readings.

NOTE: All user and patient accessible materials are non-toxic.

NOTE: Hazards arising from software errors have been minimized. Hazard analysis was performed to meet EN1441: 1997.

NOTE: Each input and output connection of the monitor is electrically isolated.

NOTE: Performance and safety test data are available upon request.

NOTE: To comply with government requirements for patient monitoring, the indefinite high priority alarm, medium priority alarm and low priority alarm tone silence feature may not be available in monitors shipped to your country.

NOTE: Capnograph patient attachments, sample lines, and filters are disposable, single-patient use items. Use a new patient attachment, filter and sample line for each new patient.

NOTE: Discard and replace the patient attachment if it becomes occluded. If an air leak is noted, check all patient connections. If the air leak persists, discard and replace the patient attachment.

NOTE: When using the AC battery eliminator, the Capnograph is a class II device with functional earth. This earth connection is for device electromagnetic compatibility and does not provide protection to the patient or user.

NOTE: $InC0_2$ is only displayed in the message line if it has exceeded its alarm limit.

NOTE: The presence of anesthetic agents may cause CO_2 readings to deviate beyond specified tolerances.

NOTE: Do not use monitor while nebulized medications are being administered.

NOTE: The low SpO_2 alarm limit minimum test value is 80. If an operator changes the low SpO_2 alarm limit to a value less than 80, and a power down - power up sequence takes place, a minimum value of 85 takes the place of the operator entered value.

NOTE: Alarm settings are maintained when power is turned off. If the low SpO2 setting is less than 80, the setting is changed to 85 at power up.

NOTE: Optical cross-talk can occur when two or more sensors are placed in close proximity. It can be eliminated by covering each site with an opaque material.

Chapter 2: Product Description

The Capnograph is a portable handheld monitoring device. It provides side stream end tidal CO2 and SpO2 measurement capability. CO2 is measured with a self-contained low power CO2 sensor provided by CPT Inc. SpO2 measurements are made using the standard SIMS BCI, Inc. business card oximeter board. The parameters can be displayed in numerical and graphical format on a 160 x 160 pixel LCD display. Control of the unit is provided through a front panel keyboard. The unit is powered by a single 7.4V lithium-ion rechargeable battery.

The Capnograph circuitry is located on four assemblies: the main processor board (20652B1), the SpO2 daughter board (71552B1), and the LCD display board (20653B1), and the front panel keyboard (20683B1). The main processor board operation is the subject of this document.

The main processor board is the most fundamental component in the system. All other circuit boards and components are considered peripherals to the main processor board. One of the design goals of the Capnograph was to incorporate as much on the main board as possible. The main board contains the CPU and memory for program execution, the drive circuitry for the display, pump, valve, and speaker, the interfaces for the SpO2 daughter board, the CO2 bench, ambient light detector, and external RS232 communications. The front panel interface circuitry is located on the main board. A series of power supply circuits to power all the above systems also reside on the board.

The 71552B1 oximetry board provides complete SpO2 capability including the probe interface, signal detection, SpO2 and peripheral pulse rate calculation, waveform data and error and status codes. It is the same board that is used in the 9200 Advisor to provide SpO2 functionality. The 71552B1 requires that the host system provide patient isolation. For a more detailed description of the operation of this assembly refer to the 71552B1 theory of operation.

The LCD display board (SIMS BCI, Inc. p/n 20653B1) provides the main display for the user interface. It is a 160x160 pixel LCD dot matrix display. Circuitry on the main processor board interface to the display board and control the display on a pixel by pixel basis. The 20651 provides an AC voltage signal for the EL backlight that is included in the PicView assembly. For more information refer to the 20653B1 PicView display documentation.

The front panel keypad provides pushbuttons used for user input and the front panel LED indicators. It is comprised of a combination of membrane switches and LED indicators fabricated on a flex circuit assembly. The membrane switches are a series of normally open, momentary switches. The main processor board responds to the closure of each switch. The LEDs located on the keypad assembly are driven by circuitry on the main processor board. For more information on the front panel keypad assembly, refer to the 20683B1 documentation.

20652B1 Main Processor Board

The main processor board is the main circuit board in the Capnograph system. It consists of the following sections:

Power Supplies	Battery voltage, +5V switching power supply, +5Vbench linear supply, -V adjustable LCD bias voltage, -5VA.
Microprocessor and Memory	68HC812A4 μC, 128Kx16 Flash memory, 32Kx16 Static RAM.
External Timer Circuitry	μPD71054L three channel timer chip.
Printer Interface	PIC12C508 μC, IR LED drive.
Front Panel Interface	Switch input, LED drive, protection circuitry.
Ambient Light Interface	OPT101 light to voltage converter.
Bench	CPT COMET bench.
Analog Acquisition Circuitry	CO2 signal amplifier, voltage reference, 4 channel A/D converter.
Display Interface	SED1335 display controller, 8Kx8 SRAM, high voltage EL drive.
Speaker drive circuitry	Tone, volume, slew rate control.
Pump Control	High current drive.
Valve Control	High, low current drive.
Serial Interface	Printer channel, SpO2 interface, data logging.

Power Supplies

The Capnograph is powered by a single 7.4V Lithium Ion battery. A high efficiency step down DC-DC converter is used to generate +5V from the battery voltage. The +5V powers all of the digital circuitry, the display, the pump, valve and speaker drive circuitry, and the SpO2 daughter board.

The +5V provides the input for an adjustable negative power supply. The range of the negative supply is –5V to –15V. This voltage is required for the LCD display and the voltage controls the contrast of the LCD display. The output voltage of this switching regulator is controlled by the LCDCK and LDIR signals.

This negative voltage is linearly regulated to –5V with a linear voltage regulator. This voltage is required by the SpO2 board.

Microprocessor and Memory

The Motorola 68HC812A4 processor provides a low power, fully integrated solution to the overall design of the Capnograph. The 68HC812A4 is run in 16 bit wide mode which means that instructions are fetched 16 bits at a time. A single 16 bit wide Flash memory device (E28F200BV_T) is used to store program code, trend data, and non-volatile setup information. A single 16 bit wide static RAM (KM164000B) is used for program data space. The 68HC812A4 generates its own chip selects and bus timing signals.

An on board 8 bit A/D converter is used to convert ambient light and battery voltages.

The 68HC812A4 has an on chip background debugger capability that is used for code development and test. The background debug pins are located on connector J7.

External Timer Circuitry

Three channels of digital timer functionality are provided with the μPD71054L timer chip. The timer chip clock input is driven by the 68HC812A4 E clock.

One timer channel is used to generate the Microchip PIC clock. The second channel is used to generate the speaker tone. The third channel is used to generate the display synchronization signal to the processor.

Printer Interface

The interface to the HP thermal printer is provided by the PIC12C508 microcontroller. The PIC receives serial characters from the 68HC812A4 and converts them into the communications format that the HP printer requires. The output of the PIC drives a transistor that boosts the current drive for the IR LED.

Front Panel Interface

The front panel keyboard assembly connects to the main circuit board via J4 and J14. The keyboard includes switches for ON/OFF, Waveform Select, Alarm Silence, Menu/Enter, Up and Down keys. Each of the keys on the keypad are normally open momentary single pole switches.

The assembly also contains 3 LEDs for displaying ETCO2 alarm, SpO2 alarm, and external power connection. The circuitry on the main circuit board drives the LEDs at the proper current levels. P-channel FETs are used to drive the LEDs. The control signals that drive the FET gates are active low signals.

The circuitry surrounding the switch and LED drive connections protect the main board from potential static discharge that is possible through the keyboard.

COMET CO2 Sensor (Bench)

The main CO2 sensor for the Capnograph is the COMET CO2 bench manufactured by CPT Inc. The bench produces an output voltage that is proportional to the concentration of CO2 in the sample cell. Sample cell barometric pressure is provided with an on bench pressure sensor. Sample cell temperature is provided with an on bench temperature sensor.

The CO2 bench also includes an on bench EEPROM that contains factory calibration values. These values are read by the Capnograph at power up. The EECS, EECLK, EEDAT signals are used to communicate with the bench EEPROM. Raw CO2, pressure and temperature values are manipulated with the EEPROM constants to provide calibrated CO2 Pressure and temperature values.

Analog Acquisition Circuitry

The raw CO2 signal that is provided by the COMET bench is amplified with a non-inverting amplifier stage with a gain of 6.2. The temperature and pressure signals do not have any gain circuitry in the signal path.

The analog signals produced by the bench and amplifier circuitry are converted to digital codes with a 12 bit 4 channel A/D converter. The converter is also driven with a 4.096V voltage reference. This combination provides a conversion factor of 1 bit/mV of input signal for each channel.

Display Interface

The display controller circuitry utilizes the S-MOS SED1335 Display controller. This controller uses an 8-bit data bus along with several control signals and an address line from the processor. The controller uses a 10 MHz crystal to generate its system clock. This provides the maximum throughput to the display.

The graphics controller uses a 32Kx8 SRAM chip for its display memory. This memory is separate from the RAM used by the 68HC812A4. This configuration allows refresh of the display without affecting main processor bandwidth.

The host interface to the graphics RAM is through the display controller. The host sends a command to the controller for accessing the display RAM. The controller then writes/reads the data to/from the host processor. This graphics access reading/writing process is tightly controlled in software to avoid pixel flicker on the display.

The following signals make up the display controller interface to the LCD panel connections:

XD0 to XD3 are the 4-bit X-driver (column drive) data outputs. These outputs are connected to the inputs of the X-driver chips.

XSCL latches the data on XD0 to XD3 into the input shift registers of the X-drivers on its falling edge. To conserve power, this clock halts between LP and the start of the following display line.

LP latches the signal in the X-driver shift registers into the output data latches. LP is a falling-edge triggered signal and it pulses once every display line. The LP is connected to the external interrupts through a logical NAND gate. The NAND gate's other input is used to mask off/on the interrupt when used in conjunction with the processors /NMI input.

WF is the LCD panel AC drive output. The WF period is selected to be one of two values with SYSTEM SET command.

YD is the data pulse output for the Y drivers. It is active during the last line of each frame. Data is shifted through the Y drivers be YSCL one by one to scan the display's common connections.

YDIS is the display power-down output signal. YDIS is HIGH while the display drive outputs are active.

Speaker Drive Circuitry

The speaker drive circuitry drives the speaker with a fundamental tone and harmonics. The circuitry has the capability of controlling the on/off slew rate of the tone as well as the volume.

The fundamental frequency is determined by the frequency of the TONE signal generated by the timer chip. SPKRON controls the on/off action of the speaker. /FSLEW controls the slew rate of the on/off ramp. CLICK is used to provide a key click sound when a key is pressed. The signal VOL_PWM is ended with the TONE signal to provide a PWM style volume control.

Pump Control

The pneumatic pump used to pull gas through the CO2 bench is a +5VDC pump. It is turned on and off with a P channel MOSFET. When the PUMPON signal generated by the 68HC812A4 goes to its active state, the MOSFET is turned on and 5V is applied across the pump terminals and the pump runs.

Valve Control

The pneumatic valve used to switch the flow of CO2 scrubbed ambient gas or sample line gas to the CO2 bench. The valve is normally in the sample position. Energizing the valve selects the CO2 scrubbed ambient gas to pass to the sample chamber in the CO2 bench.

The control circuitry is similar to the pump drive circuitry. However the valve drive circuitry has a two stage drive circuit configuration. The first stage is made up of a high current P channel MOSFET. When the VALVON signal is sent active low, the high current drive MOSFET is turned on and the valve is connected directly to the 5V supply. This gets the valve to the energized state quickly. At the same time that the high current MOSFET is turned on, the lower current P channel MOSFET is turned on. This circuit also connects the valve to the +5V supply. In this circuit path there is a 50 ohm resistance. This resistance limits the current through the valve and therefore the power dissipated by the valve. The valve need less current to keep it in the on state and the lower current MOSFET channel is all that is needed.

Serial interface

The main processor board provides two channels of asynchronous serial communications capability. One channel is used for bi-directional communication between the 68HC812A4 and the SpO2 daughter board. The second serial channel is used for unidirectional communication to the PIC12C507. Data is transferred from the 68HC812A4 to the PIC. The PIC converts the serial data into the HP printer format.

An additional feature of the serial communication circuitry is that through the selection of the DIP switches, the second serial channel can be routed to provide data logging through the serial channel.

Chapter 3: Pulse Oximetry

Product Description

The SIMS BCI, Inc. 71552B1 Pulse Oximeter Board enables easy OEM integration for fast, reliable SpO_2 and Pulse Rate measurements on any patient, from neonates to adults. Serial communication at 4800, 9600, 19,200 Baud provides the host system with $\%SpO_2$, Pulse Rate, Signal Strength, Bargraph, Plethysmogram, and Status Bits data. The host system can send commands to control the averaging rates, synchronize the Plethysmogram waveform, and request the Oximeter software revision level. The 71552B1 Pulse Oximeter has a compact size of 3.5 inches wide by 2.0 inches deep by 0.5 inch high. An assortment of compatible Oximeter probes and patient attachments are available through SIMS BCI, Inc.

Theory of Operation

The Oximeter determines SpO_2 and pulse rate by passing two wavelengths of light, one red and one infrared, through body tissue to a photodetector. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the probe placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues. The Oximeter processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SpO_2) to identify the pulse rate and calculate oxygen saturation. Oxygen saturation calculations can be performed because oxygen saturated blood predictably absorbs less red light than oxygen depleted blood.

Product Specifications

Data Provided to the Host System

SpO_2	Range:	0 - 100%
	Accuracy:	± 2 % at 70 - 100% SpO_2 ± 3 % at 50 - 69% SpO_2
Pulse Rate	Range:	30 - 250 BPM
	Accuracy:	± 2BPM at 30 - 250 BPM
Signal Strength		0 - 8 (Protocol #1 and Protocol #2)
Bargraph		0 - 15 (0 - 16 for Protocol #3)
Plethysmogram		0 - 100, auto-gained for highest resolution. 8-bit and 16-bit waveforms available.
Flags		Pulse Beep No Finger in Probe Probe Unplugged Searching for Pulse Searching Too Long
Software Revision		transmitted upon request
Serial Communication Logic Levels		TTL voltage levels

Data Provided From the Host System (Protocol #1 and Protocol #2)

SpO_2 Averaging Value	4, 8, or 16 beat averaging (default: 8 beat)
Pulse Rate Averaging Value	8 or 16 second averaging (default: 8 second)
Plethysmogram scale and offset	Synchronized by Host or Performed Automatically

Data Provided From the Host System (Protocol #3)

Set Waveform Rate	Can be set from 10msec to 247.5msec in 2.5msec increments.
Waveform Rate Request	Ranges from 10msec to 247.5msec in 2.5msec increments.
Set Response Mode	Normal (default), fast, or slow mode.
Response Mode Request	Normal, fast, or slow mode.
Restart Oximeter	Restores all default values (same as power on reset)
Version Request	Responds with version string.
Primary Status Request	Probe/No Probe attached, pulse search
Secondary Status Request	Waveform On/Off, 8-bit/16-bit waveform
Enable 16 bit Waveform	Must restart Oximeter to disable

Power Requirements

Power Supply Input Voltage (typical)	+5 VDC Digital @ 35mA electrically isolated
	+5 VDC Analog @ 16mA electrically isolated
	-5 VDC Analog @ 5mA electrically isolated

Dimensions

Width	3.5 inches (8.9 cm)
Depth	2.0 inches (5.1 cm)
Height	0.5 inches (1.3 cm)

Serial Communications Specifications

The 71552B1 Pulse Oximeter board communicates with the host computer through a single, high-speed asynchronous serial channel at TTL voltage levels. Data provided to the host includes $\%SpO_2$, Pulse Rate, Signal Strength, Bargraph, Plethysmogram, and Status Bits data. The host can send commands to control the averaging rates, synchronize the Plethysmogram Waveform, and request the Oximeter software revision level. Three protocol options are provided for system flexibility. These protocols are hardware jumper selected.

Communication Protocols

There are 3 protocols available on the 71552B1 Pulse Oximeter Board which support the SIMS BCI, Inc. Communications Protocol. Jumper settings for each protocol and available baud rates are shown in the table below.

	Baud	Serial Port Settings Parity - Data - Stop	Bytes per Packet	Packets per Sec	Jumper J3 - 1	Jumper J3 - 2	Jumper J3 - 3
Protocol #1	4800	O-8-1	5	60	OFF	OFF	OFF
Protocol #1	9600	O-8-1	5	60	ON	OFF	OFF
Protocol #2	19,200	E-8-1	8	120	OFF	ON	OFF
Protocol #3	9600	E-8-1	Variable	Variable	OFF	OFF	ON
Protocol #3	19,200	E-8-1	Variable	Variable	ON	OFF	ON

Communication Protocol #1

Data is transmitted from the Oximeter board to the host at a rate of **60** packages per second. Data is formatted in 5 byte packets. Data packages transmitted from the Oximeter to the host can be synchronized by using bit 7. The communication settings are **4800** or **9600** Baud, One Start Bit, Eight Data Bits, **Odd** Parity, One Stop Bit.

Communication Protocol #2

Data is transmitted from the Oximeter board to the host at a rate of **120** packages per second. Data is formatted in 8 byte packets. Data packages transmitted from the Oximeter to the host can be synchronized by using bit 7. The communication settings are **19,200** Baud, One Start Bit, Eight Data Bits, **Even** Parity, One Stop Bit.

Communication Protocol #3

Data is transmitted from the Oximeter board to the host at a rate defined by the host system. Fast data is formatted in 4 byte packets. Slow data packets will vary in length. The communication settings are **9,600 and 19200** Baud, One Start Bit, Eight Data Bits, **Even** Parity, One Stop Bit. This communication protocol available upon request.

Serial Communication Notes - Protocol #1 and Protocol #2

Start up averaging is:

SpO2 - 8 pulses
HR - 8 seconds

To synchronize Plethysmogram level and offset algorithm, the 'A' command is used. After start up, auto pleth size/offset is enabled, and the board periodically adjusts Plethysmogram level to keep the waveform in range using the processor's internal timer. If command 'G' is sent, the internal timer is disabled, and the Master can adjust the Plethysmogram by sending the 'A' command. This command makes the board run an adjustment algorithm once, to make sure that during the next time interval the Plethysmogram will stay in range. For example, one could send this command between the Master's screen "frames" to make sure that during the display of any given frame there will not appear to be any "jumps" on the waveform.

Commands can be sent any time asynchronously with the output data.

Commands can be sent "back-to-back", except 'E' after 'E' (send revision level). If Master has not received revision information yet from previous 'E' command, the next 'E' command will be lost. "Revision level" response interrupts normal data stream at any place. It is assumed that 'E' command will be sent once during power up, hence no significant amount of data will be lost.

When data packets are sent from the Oximeter to the Host, there may be times when there is invalid data (for example, when finger is removed from probe). Invalid data can be interpreted as:

invalid Rate = 0xFF
invalid SpO2 = 0x7F
invalid Pleth = 0x7F
invalid Signal Strength = 0xF

Oximeter Transmitted Data – Protocol #1

Data is transmitted from the Oximeter board to the Host in 5 byte packets. Baud rate is jumper selectable for 4800 or 9600 baud.

Byte	Bit	Description
1	0	Signal Strength 0
	1	Signal Strength 1
	2	Signal Strength 2
	3	Signal Strength 3
	4	1 = searching too long
	5	1 = probe unplugged
	6	1 = pulse beep
	7	1 (sync. bit)
2	0	Plethysmogram 0
	1	Plethysmogram 1
	2	Plethysmogram 2
	3	Plethysmogram 3
	4	Plethysmogram 4
	5	Plethysmogram 5
	6	Plethysmogram 6
	7	0 (sync. bit)
3	0	Bargraph 0
	1	Bargraph 1
	2	Bargraph 2
	3	Bargraph 3
	4	1 = no finger in probe or probe unplugged
	5	1 = searching for pulse
	6	Rate 7 (see byte 4)
	7	0 (sync. bit)

Byte	Bit	Description
4	0	Rate 0
	1	Rate 1
	2	Rate 2
	3	Rate 3
	4	Rate 4
	5	Rate 5
	6	Rate 6
	7	0 (sync. bit)
5	0	SpO_2 0
	1	SpO_2 1
	2	SpO_2 2
	3	SpO_2 3
	4	SpO_2 4
	5	SpO_2 5
	6	SpO_2 6
	7	0 (sync. bit)

Oximeter Transmitted Data – Protocol #2

Data is transmitted from the Oximeter board to the Host in 8 byte packets. The baud rate is 19,200 baud. The checksum is a 14 bit number specified as a 2's complement of the sum of the first 6 bytes of the data packet.

Byte	Bit	Description
1	0	Signal Strength 0
	1	Signal Strength 1
	2	Signal Strength 2
	3	Signal Strength 3
	4	1 = searching too long
	5	1 = probe unplugged
	6	1 = pulse beep
	7	1 (sync. bit)
2	0	Plethysmogram 0
	1	Plethysmogram 1
	2	Plethysmogram 2
	3	Plethysmogram 3
	4	Plethysmogram 4
	5	Plethysmogram 5
	6	Plethysmogram 6
	7	0 (sync. bit)
3	0	Bargraph 0
	1	Bargraph 1
	2	Bargraph 2
	3	Bargraph 3
	4	1 = no finger in probe or probe unplugged
	5	1 = searching for pulse
	6	Rate 7 (see byte 4)
	7	0 (sync. bit)
4	0	Rate 0
	1	Rate 1
	2	Rate 2
	3	Rate 3
	4	Rate 4
	5	Rate 5
	6	Rate 6
	7	0 (sync. bit)

Byte	Bit	Description
5	0	SpO_2 0
	1	SpO_2 1
	2	SpO_2 2
	3	SpO_2 3
	4	SpO_2 4
	5	SpO_2 5
	6	SpO_2 6
	7	0 (sync. bit)
6	0 - 1	00 = 4 beat average SPO2,
		8 beat average Pulse Rate
		01 = 8 beat average SPO2,
		8 beat average Pulse Rate
		10 = 16 beat average SPO2,
		16 beat average Pulse Rate
		11 = 16 beat average SPO2,
		8 beat average Pulse Rate
	2	Unused
	3	Unused
	4	1 = Revision Level Reply
	5	Unused
	6	1 = Disable Auto Pleth Scaling
	7	0 (sync. bit)
7	0-6	Check sum Bits 0 – 6
	7	0 (sync. bit)
8	0-6	Checksum Bits 7-13
	7	0 (sync. bit)

Oximeter Received Data – Protocol #1 and Protocol #2

The host system can send single character commands to the Oximeter to change the averaging values, synchronize the Plethysmogram scale and offset, and force the Oximeter to send the software revision level.

ASCII	Description
A	Synchronizes the Plethysmogram scale and offset to the next sample. Subsequent offset adjustments will also occur when the Plethysmogram value exceeds the range 0 - 99. The Plethysmogram scale and offset is automatically adjusted every 256 samples.
B	Sets SpO_2 to 4-beat average and pulse rate to an 8-second average.
C	Sets SpO_2 to 8-beat average and pulse rate to an 8-second average (default).
D	Sets SpO_2 to 16-beat average and pulse rate to a 16-second average.
E	Forces Oximeter to send software revision level (x.xx) in a 5-byte format: Byte 1: 80H Byte 2: (00H for protocol #2) (FFH for protocol #1) Byte 3: Ones digit (ASCII) Byte 4: Tenths digit (ASCII) Byte 5: Hundredths digit (ASCII)
F	Sets SpO_2 to 16-beat average and pulse rate to an 8-second average.
G	Disable auto Plethysmogram scale and offset

Serial Communication Notes – Protocol #3

Protocol #3 communicates with a method that combines two message types; slow and fast. Slow data packets are used to communicate commands and status messages in a bi-directional manner between the module and the host system. Fast data packets are used to send pulse and waveform data in a timely manner from the module to the host. Slow data packets can contain more than one message. Fast data packets always contain only one message.

Slow Data Packet Format

Every slow data packet is transmitted with the following format:

{STX}	(0x02)
Message Length	(2 ASCII characters)
Reserved Byte	(0x20)
Slow Data Messages Checksum	(2 ASCII characters)

The message length is in hex notation and has a max value of FF (255). The length is just the length of the data messages. It does not include the reserved byte or the checksum. The checksum is determined from the message length bytes, reserved byte and data message bytes. It is the 2's complement of the modulo-256 sum of the bytes expressed in hex form.

Slow Data Message Format

The contents of the slow data packet is made up of multiple slow messages. The slow message format is:

Message Identifier	(1 byte)
Data Length Message Data	(2 ASCII characters)

The following messages are supported in the SIMS BCI, Inc. 71552B1 Oximeter:

From the Oximeter:

P00	Pulse Searching, transmitted every ¼ second when active.	
T00	Pulse Searching Too Long, transmitted every 10 seconds when active	
X00	Probe Off, transmitted every ¼ second when active	
W02xx	Waveform Rate, W00 command response. xx is the current waveform rate and ranges from 0 to 99.	
M01x	Response Mode, M00 command response. X = 1, 2 or 3 for Normal, Fast and Slow mode, respectively.	
VLLxxx...	Version, V00 command response. LL = message length, xxx... = version string; *SIMS BCI, Inc. Oximeter v1.0 10/20/97.*	
S02xx	Primary Status, S00 command response. xx is decimal ASCII representation of a bitmapped value where:	
	bit 0-	0=no probe, 1=probe attached
	bit 1-	0
	bit 2-	0=no pulse search, 1=pulse search
	bit 3-	1
	bit 4-	0
	bit 5-	0
	bit 6-	0
	bit 7-	0
s02xx	Secondary Status, s00 command response. xx is decimal ASCII representation of a bitmapped value where:	
	bit 0-	0=waveform on (default), 1=waveform off
	bit 1-	0=8-bit waveform (default), 1=16 bit waveform
	bit 2-	0
	bit 3-	0
	bit 4-	0
	bit 5-	0
	bit 6-	0
	bit 7-	0
E01x	Error, sent in response to various messages. x is defined as follows:	
	1-	RAM error (Oximeter stops)
	2-	ROM Checksum Error (Oximeter stops)
	3-	Last Message had Checksum Error (message ignored)
	5-	Command value out of range (command ignored)
	9-	Command syntax error (command ignored)

To the Oximeter:

W02xx	Set Waveform Rate. xx is the current waveform rate and ranges from 4 to 99. Rate is 2.5ms per sample times xx. 4=10ms, 99=247.5ms. The default rate is 4 (10ms). A W010 command causes waveform output to stop.
W00	Waveform Rate Request.
M01x	Set Response Mode. x = 1, 2 or 3 for Normal, Fast and Slow mode, respectively. The default mode is Normal.
M00	Response Mode Request.
A00	Restart Oximeter.
V00	Version Request.
S00	Primary Status Request.
s00	Secondary Status Request.
w00	Enable 16 bit waveform output (there is no disable command other than a restart)

Fast Data Message Format

Fast data messages are always four bytes in length. Every fast data message is transmitted with the following format:

{DLE}	(0x10)
Message Identifier	(1 ASCII character)
Message Data	(2 bytes)

Fast messages can occur at any time including during the transmission of slow data packets. When sent during a slow packet transmission they do not effect the length of checksum of the slow packet.

There are three valid fast data messages:

!-	SpO2 and Pulse Rate Values are sent once per pulse. 1st data byte is SpO2 value, 2nd data byte is pulse rate value.
~-	Pulse waveform and pulse bargraph values are sent at the programmed waveform rate. 1st data byte is pulse waveform from 0 to 255. 2nd data byte is pulse bargraph from 0 to 16.
+-	Full scale (16 bit) pulse waveform values are sent at the programmed waveform rate. 1st byte is the LSB, 2nd byte is the MSB. Data values range from 0 to 65535.

Pin Description

J1 - Power and Communication Connector

Pin	Description
1	No Connect
2	GND
3	GND
4	/RESET Input
5	GND
6	No Connect
7	-5VDC Analog Input
8	TX Output
9	RX Input
10	+5VDC Analog Input
11	/CTS Input
12	GND
13	+5VDC Digital Input
14	GND

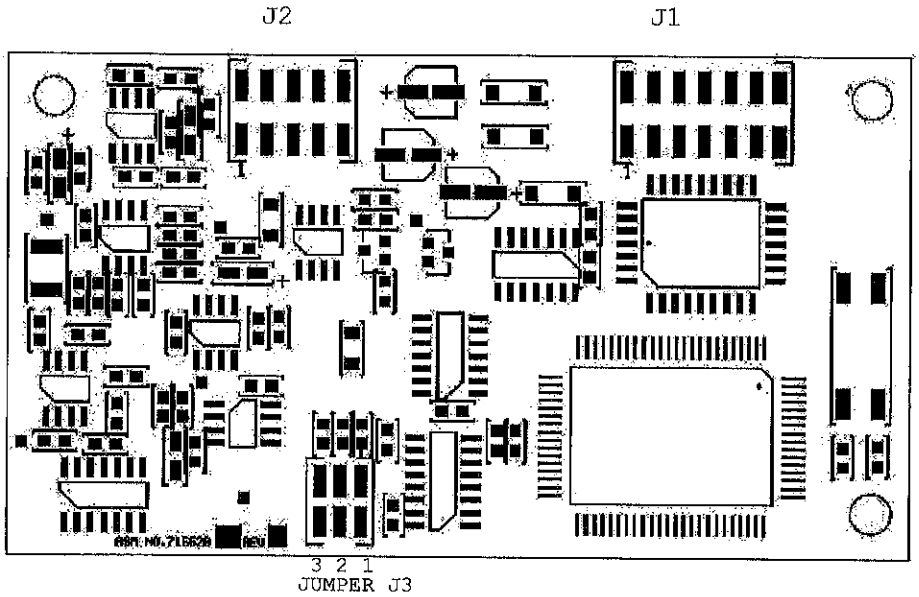
J2 - Oximeter Probe Connector

J2 Pin	SIMS BCI, Inc. Cable Color Code	DB9 Pin
1	White	5
2	No Connect	
3	No Connect	
4	Black	9
5	Yellow	6
6	Green	1
7	Orange	3
8	No Connect	
9	Red	2
10	Shield	7

Jumper Settings

Jumper Settings are used to select communication modes.

	Baud	Jumper J3 - 1	Jumper J3 - 2	Jumper J3 - 3
Protocol #1	4800	OFF	OFF	OFF
Protocol #1	9600	ON	OFF	OFF
Protocol #2	19,200	OFF	ON	OFF
Protocol #3	9600	OFF	OFF	ON
Protocol #3	19,200	ON	OFF	ON
Factory Test	19,200	ON	ON	ON



Probes

Choose the appropriate probe from the following chart.

Patient	Site	Description
Adult > 45 Kg	Finger Finger or Toe Ear	3044: Probe, Adult 3444: Sensor Comfort Clip 3043: Probe, Universal "Y" 1300: Probe, Disp., Adult Finger 3078: Probe, Ear
Pediatric 15-45 Kg	Finger Finger or Toe Ear	3044: Probe, Adult 3444: Sensor Comfort Clip 3043: Probe, Universal "Y" 1301: Probe, Disp., Ped. Finger 3078: Probe, Ear
Infant 3-15 Kg	Hand or Foot Toe Finger or Toe	3043: Probe, Universal "Y" 3025: Probe, Wrap, Infant 1303: Probe, Disp., Infant
Neonate < 3 Kg	Hand or Foot Foot	1302: Probe, Disp., Neonate 3026: Probe, Wrap, Neonate

Checking Pulse Oximeter Performance

Pulse Oximeters do not require user calibration. To check the function of the device, an optional Oximeter/ECG Patient Simulator is available as an accessory (SIMS BCI, Inc. Cat# 1606HH). The simulator attaches to the Oximeter in place of the probe or patient cable. It provides a known SpO_2 and pulse rate signal to the Oximeter, allowing the Oximeter's performance to be checked.

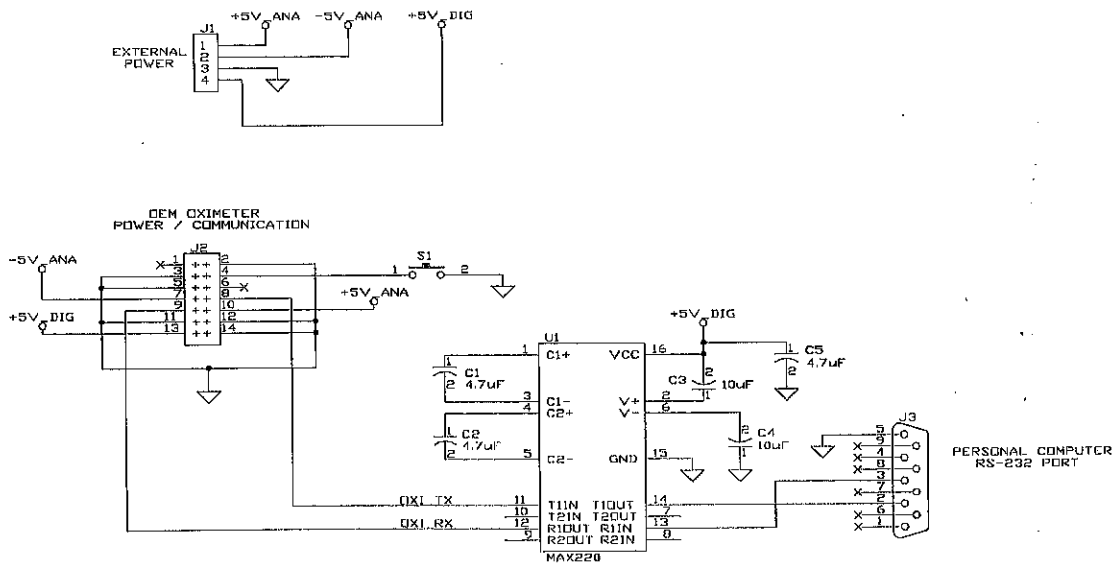
Follow the instructions included with the Oximeter/ECG Patient Simulator.

Demonstration Software

SIMS BCI, Inc. provides PC software for demonstration purposes only. The intent is to allow the OEM customer to quickly become familiar with the operation of the Oximeter board. **This software is NOT be used in any product for sale. This circuit shown below, for interface to a PC for demonstration purposes, is for evaluation only and is to be used with a SPO2 simulator. Do not connect directly to a patient without proper patient isolation.** Command line help is given if no command line options are used for OEM.EXE or ADV.EXE. PROT3.EXE is a "Windows" based program with a menu driven user interface.

	Demonstration Software
Protocol #1	OEM.EXE
Protocol #2	ADV.EXE
Protocol #3	PROT3.EXE

The 71552 Oximeter board can be connected to your PC through a custom power/communication interface board. A **sample schematic which could be used for the PC interface** is shown below.



Chapter 4: $C0_2$ Theory of Operation

Theory of Operation

Measuring CO_2

The device draws a sample of gas through the sample chamber. A light source shines infrared (IR) light through an optical bandpass filter and then through the sample chamber. An IR detector responds to the amount of IR light that passes through the sample chamber.

Because CO_2 absorbs IR light at a specific wavelength, the amount of light passing through the sample chamber varies according to the concentration of CO_2 in the sample chamber. When there is a high concentration of CO_2 in the sample chamber, the detector senses a smaller amount of light than when there is a low concentration of CO_2.

The device computes the partial pressure of CO_2 STPD (standard temperature, pressure, dry) based on measured levels of IR light intensity. The $ETCO_2$ measurement is shown as an average of 4 breaths.

CAUTION: Pump motors in the CO_2 monitor may adversely affect other medical equipment, e.g. ECG tracings.

Measuring Respiration Rate

The device uses the continuous CO_2 waveform to detect each breath cycle. It uses an adaptive algorithm to recognize each breath in the waveform, even in the presence of an elevated baseline (rebreathing) and higher frequencies in the CO_2 waveform (cardiogenic oscillations).

The device computes respiration rate (RPM) from the total number of seconds for the last four breaths according to this formula:

$$RPM = \frac{60 \text{ seconds} * \text{breaths}}{\text{Number of seconds for 4 breaths}}$$

N_2O Compensation

The interfering effect of N_2O results in inaccurate CO_2 readings, however the device has the ability to compensate for this.

With the N_2O compensation ENABLED, the device adjusts the CO_2 reading by an algorithm that assumes the concentration of N_2O is 40% and compensates accordingly. If N_2O compensation is enabled and the concentration of N_2O is not 40%, the displayed value must be adjusted by the following equation to get the actual CO_2 concentration.

$$\text{Actual } CO_2 = \frac{CO_2 \text{ reading} * 1.0625}{1 + \left(\frac{0.0625 * N_2O\%}{40\%} \right)}$$

With the N_2O compensation DISABLED, the device adjusts the CO_2 reading by an algorithm that assumes the concentration of N_2O is 0%. If N_2O compensation is disabled and the concentration of N_2O is not 0%, the displayed value must be adjusted by the following equation to get the actual CO_2 concentration.

$$\text{Actual } CO_2 = \frac{CO_2 \text{ reading}}{1 + \left(\frac{0.0625 * N_2O\%}{40\%} \right)}$$

NOTE: The presence of other anesthetic agents may cause CO_2 readings to deviate beyond specified tolerances.

Chapter 5: Pneumatics and CO_2 Calibration

Connecting a Non-Recirculating Scavenging System

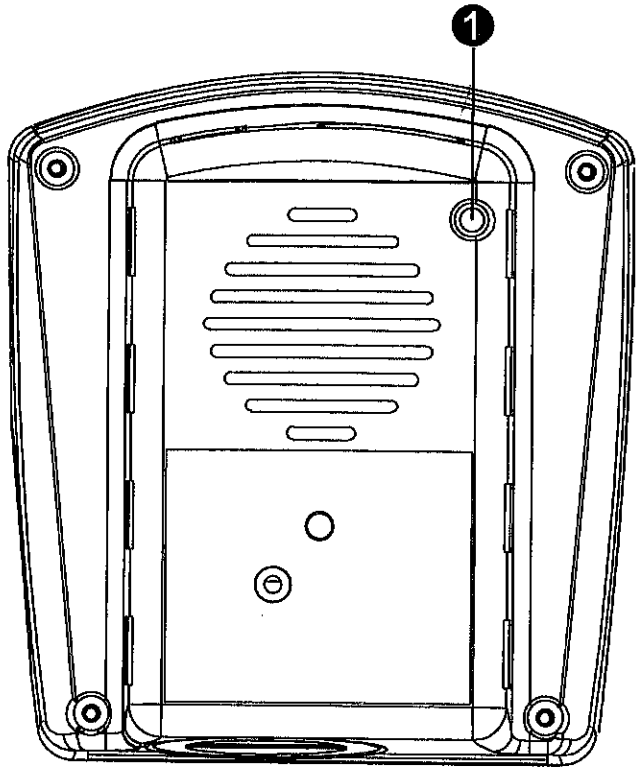


FIGURE 5.1: CONNECTING A NON-RECIRCULATING SCAVENGING SYSTEM

❶ Connect tubing to exhaust port.

If desired, connect a non-recirculating scavenging system to the exhaust port on the monitor's rear panel as shown.

⚠ **CAUTION: When connecting a non-recirculating scavenging system, only use an exhaust line approved by SIMS BCI, Inc. Failure to comply may result in damage to the monitor.**

Checking for Leaks

1. Pinch the sample line near the moisture filter connection.
2. Make sure the "OCCLUSION" message appears in the lower left of the display. If no message appears, go to the *Chapter 12: Troubleshooting* section.

Calibrating the Capnograph

Calibration ensures that the $ETCO_2$ and Inspired CO_2 measurements are accurate. Calibrate the device every 30 days.

NOTE: Use only the calibration gas canister and flow regulator supplied with or specifically intended for use with this device. See *Appendix A: Supplies and Accessories* for information on ordering calibration gas.

The device has two calibration modes: Low Calibration (LO CAL) and Low/High Calibration (LO/HI CAL). The LO CAL process is required if a significant change in altitude occurs. It is not necessary to remove the device from the patient while performing a LO CAL procedure because a three-way valve closes the patient inlet and opens to room air. The LO/HI CAL procedure requires the delivery of a gas mixture from a canister.

NOTE: Remove the device from the patient before performing a Low/High Calibration procedure.

Low Calibration

To perform a LO CAL, do the following:

1. Turn on the device.
2. Depress the **MENU/ENTER** (%) key. Select Capnograph. Select Low Cal.
3. A menu screen appears with the message: "CO2 LOW CAL IN PROGRESS".
4. When the unit is finished, a "CALIBRATION COMPLETE" message will appear.
5. Press the **MENU/ENTER** (%) key to return to the Capnograph menu, or press the **WAVE/TREND** key to exit all menus.

Low/High Calibration

NOTE: Remove the device from the patient before performing a Low/High Calibration.

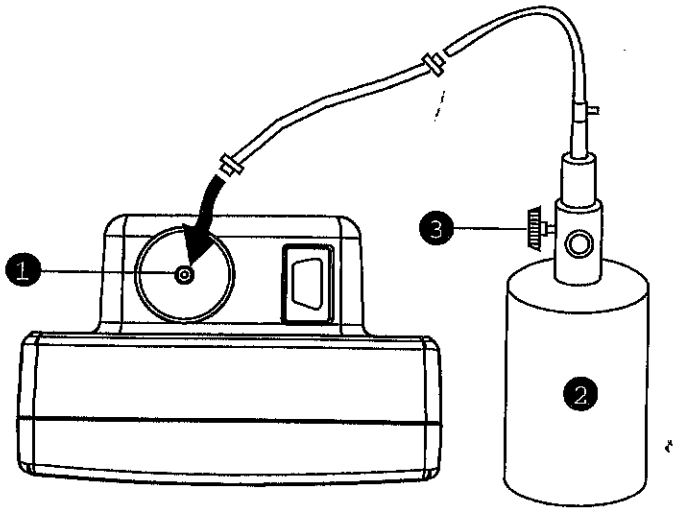


FIGURE 5.2: CONNECTING THE CALIBRATION GAS

1. Gas Inlet
2. Calibration Gas
3. Flow Control Valve

To perform a Low/High Cal do the following:

1. Disconnect the patient attachment from the luer-lock adapter.
2. Turn on the device.
3. Locate the calibration gas canister.
4. Press the **MENU/ENTER** (%) key. Select Capnograph. Select Low/High Cal and follow the directions on the display.
5. After the message "PLEASE TURN ON CAL GAS" appears, quickly open the flow control valve on the calibration gas canister. The valve must be fully opened in less than 30 seconds.
6. When the message "CALIBRATION COMPLETE" appears, close the flow control valve of the calibration gas canister, disconnect the calibration test fixture and exit all menus.
7. Turn the device off, by pressing the **OFF/ON** key twice, to ensure the calibration data is saved.

An unsuccessful calibration procedure causes an error message to appear. Operation resumes using the old calibration data. Refer to *Capnograph Messages* in *Chapter 7* for further instructions.

Chapter 6: Printer Output

Printer Setup

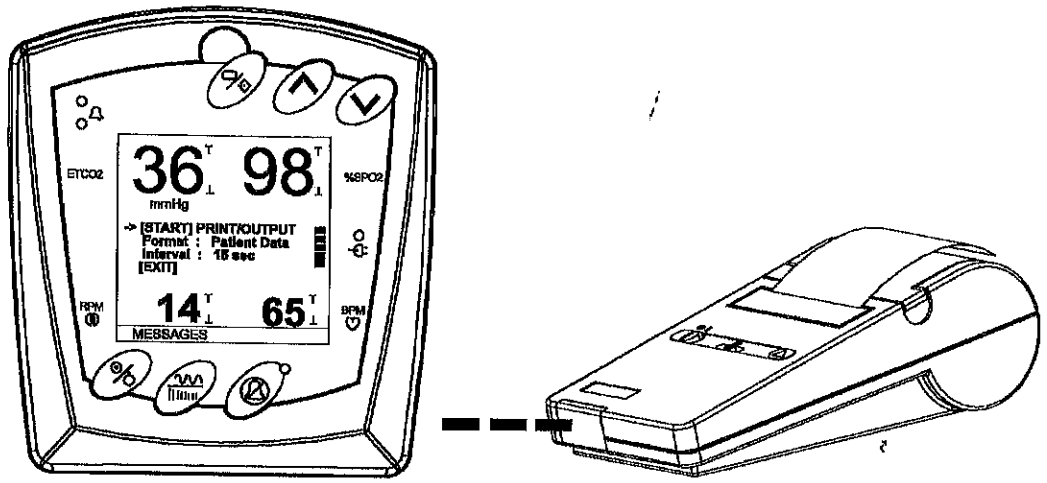


FIGURE 6.1 PRINTER SETUP

The Capnograph communicates to the HP 82240B printer through the infrared serial port. Align the infrared serial ports as shown in the above illustration. Optimal distance from port to port is 4 – 6 inches. When Capnograph and printer are properly aligned proceed to the Printer menu on the Capnograph.

⚠ **WARNING: When connecting to or communicating with this monitor, verify proper operation before clinical use. Refer to the instrument's user manual for full instructions. Accessory equipment connecting to or communicating to the monitor's data interface must be certified according to the respective IEC standards, i.e., IEC 950 for data-processing equipment or IEC 601-1 for electromedical equipment. All combinations of equipment must be in compliance with IEC 601-1-1 systems requirements.**

⚠ **WARNING: IEC 950 approved equipment including the HP82240B printer must be placed outside of the "patient environment." The patient environment is defined as an area 1.5m (4.92 feet) from the patient.**

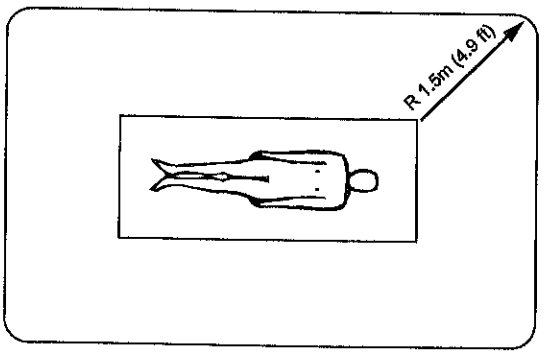


FIGURE 6.2: PATIENT ENVIRONMENT

Printer Menu

The Printer menu allows the user to select a data format for output to the infrared serial port, as well as select the output interval and/or the amount of data to send. This data can be output to a compatible printer.

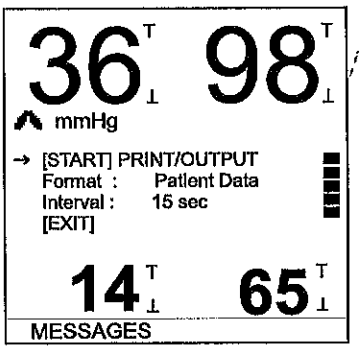


FIGURE 6.3: PRINTER OUTPUT MENU, PATIENT DATA

START/STOP Select this to enable/disable serial output. If no output is currently in progress, this shows START. If output is in progress, this shows STOP.

Data Format Shows data output format, PATIENT DATA or TREND DATA.

Interval Shows the amount of time between data log outputs.

Printer/Output

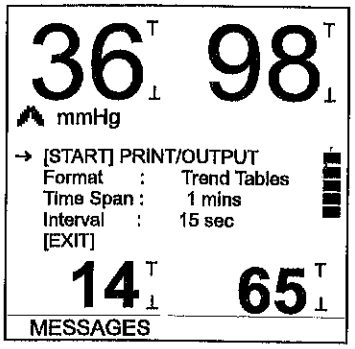


FIGURE 6.4: PRINTER OUTPUT MENU TREND TABLES

The serial output data format and output interval or amount can be changed only if no print output is in progress. To change the data format selection:

1. Select Printer from the Main Menu. If [START] is displayed, then no print output is currently in progress, so proceed with step 2. Otherwise, [STOP] is shown and you must select STOP to halt the current output before the serial output data settings can be changed.

To change the data format (Patient Data or Trend Tables):

2. Use the **ARROW** (∧ or ∨) keys to point to the Format item, then press **MENU/ENTER** (⅋).

3. Use the **ARROW** (∧ or ∨) keys to switch between formats. When the format changes, the menu item below it changes.

   If Patient Data is selected, the menu item displayed below it is: Interval.

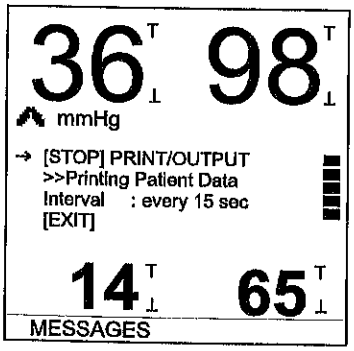


FIGURE 6.5: PRINTING PATIENT DATA STATUS MENU

If Trend Tables is selected, the menu items below are: Time Span and Interval.

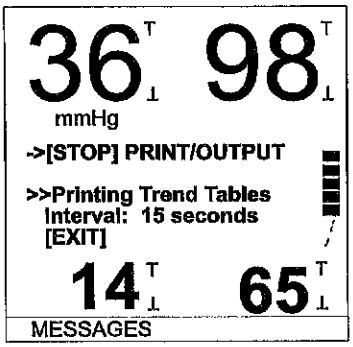


FIGURE 6.6: PRIORITY TREND TABLE STATUS

4. Press **MENU/ENTER** (⟲) to accept the selection.

To change the output interval or trend time span:

5. Use the **ARROW** (∧ or ∨) keys to point to `Interval` (for Patient Data Format) or `Time Span` (for Trend Tables format), then press **MENU/ENTER** (⟲).
6. Use the **ARROW** (∧ or ∨) keys to change the value.
7. Press **MENU/ENTER** (⟲) to accept the selection.
8. When the output format has been set, select `[START]` to enable the serial output. At this point, the `[START]` field will change to `[STOP]`, and the message "`Printing...`" will be displayed in the menu area.
9. Select `[EXIT]` or press **WAVE/TREND** (〰) to exit menus. If serial output is in progress, exiting menus will not stop it.

To STOP serial output:

1. Select `Printer` from the main menu.
2. Select `[STOP]` (if it is shown.)

Output Examples:

Patient Data

A real-time Patient Data sample is output through the infrared port, one table per output interval. The time interval between tables is selected in the Printer menu. Each line of text in the patient data table ends with a carriage return, line feed.

Sample Output

```
        PATIENT DATA
Sample Interval:  15 secs
Relative Time   00:00:15
ETC02           28  mmHg
inC02           03  mmHg
Resp Rate       16  rpm
Sp02            98  %Sp02
Pulse           74  bpm
40% N20 /Comp:  No
```

Trend Table Data

Trend data is output in tabular text format, one table per trend data record, starting at the oldest record. The number of records printed depends on the time span selected in the Printer menu. For example, if Time Span = 2 hours, then two hours of accumulated trend data records will be printed. Every time the monitor is turned off, then on again, a new block of trend data is started in trend memory and the relative time clock is set to 0:00.

Each line of text in the trend tables ends with a carriage return, line feed.

Each new block of many trend data records has the following title information:

Sample Output

```
        TREND DATA
Sample Interval:  15 secs
Time Span          1 mins
Relative Time   00:50:15
ETC02           28  mmHg
inC02           03  mmHg
Resp Rate       16  rpm
Sp02            98  %Sp02
Pulse           74  bpm
```

NOTE: Changing the units of measure for a parameter will clear the trend data.

Chapter 7: Routine Maintenance

Charging the Battery

Charge the battery after the monitor is used under battery operation, when the "LOW BATTERY" message is displayed, or after long term storage. Remove the battery from the device. Place the battery in the external charger unit. Verify the green "CHARGING" LED is lit.

After 2.5 hours, the battery is fully charged, indicated by the "CHARGE COMPLETE" LED. To ensure continous use of the Capnograph, with battery power, the purchase of a second battery is recommended. Please refer to *Appenix A: Supplies and Accessories*, for more information.

⚠ **CAUTION: The monitor contains a 4 hour Lithium-Ion battery. If the battery fails to hold a charge or otherwise becomes inoperable, the battery should be replaced and the old battery should be disposed of properly. Consult local officials for information about the proper disposal of the Lithium-Ion battery. SIMS BCI, Inc. cannot dispose of monitor batteries.**

Cleaning and Disinfecting

⚠ **CAUTION: Do not immerse the monitor or any of its accessories in liquid. Do not autoclave or ethylene oxide sterilize the monitor or any of its accessories. Unplug the external charger before cleaning or disinfecting the monitor or its accessories.**

⚠ **CAUTION: Before cleaning or disinfecting the HP82240B printer, unplug the AC adapter, remove the batteries, and remove the paper.**

⚠ **CAUTION: Should the device become wet, wipe off all moisture and allow sufficient time for drying before operating.**

Clean the surfaces of the monitor and the accessories with a soft cloth moistened in a mild soap solution. If disinfecting is required, wipe the surfaces with isopropyl alcohol then wipe with a water moistened soft cloth.

Maintenance Chart

Item	Action	Interval
Battery	Charge	When LOW BATTERY message is displayed After continuous use under battery power.
The monitor's surfaces.	Clean or disinfect.	As required.
SpO_2 sensors.	Inspect and change patient site. Clean or disinfect.	Every 4 hours When attaching a new patient.
Capnograph patient attachment.	Discard the capnograph patient attachment.	When finished monitoring the patient. The capnograph patient attachments are disposable, single-use items. When the patient attachment becomes occluded or has an air leak.
Moisture filter.	Discard and replace the moisture filter.	The moisture filter occludes when it is full.
Capnograph calibration.	Perform a Low/High calibration.	Once every month.
Pneumatic system.	Check pneumatic system for leaks.	After replacing the moisture filter and Capnograph patient attachment. At least once every two weeks.
Calibration gas canister.	Discard and replace the calibration gas canister.	When the gas pressure reading is 20 psi or less as shown on the flow control valve's pressure gauge.

⚠ **CAUTION: Follow local governing ordinances and recycling instructions regarding disposal and recycling of device components.**

Long Term Storage

⚠ **WARNING: Remove the device batteries prior to long term storage.**

Storage Facility:	Indoor
Temperature:	-40 - 75° C (-40 - 167° F)
Relative Humidity:	10-95%, non-condensing
Periodic Inspection:	None required.
Special Procedures:	Store the monitor and accessories in the original packing materials and shipping carton.

General Cleaning

The LCD and all external surfaces may be cleaned with a mild diluted soap solution and a damp soft cloth. Do no use solutions which contain chlorine, ammonia, fluoro-carbons, or hydro-carbons. Do not us abrasive cleaners or high fiber wipes that may scratch the surface. Do not allow cleaners to remain on the system surfaces, wipe off immediately.

NOTE: Before cleaning the unit, ensure the monitor is off and the mains power cord is disconnected.

NOTE: Do not allow liquid to enter the case or submerge any part of the system. Allow components to dry thoroughly before reconnecting system to AC power.

Performance and Safety Checks

Recommended Maintenance	Frequency
General Cleaning	As Needed
Inspect the system, cables, and cords	Before Use
Safety Checks (In Acc. with IEC 601-1)	Annually

Inspecting the System

Examine the exterior for cleanliness and general physical condition. Ensure the housing is intact, hardware is present and secure, and labeling is legible.

Cables and Cords

Examine the power cord for damage/abuse. Ensure that the prongs of the plug are secure in the casing, and no damage is present in the cord itself.

Inspect all patient cables, leads, and sensors, for general condition.

Chapter 8: Troubleshooting

Problem	Possible Cause	Corrective Action
SPO_2 SENSOR is displayed.	a. Sensor not connected to monitor or patient.	a. Connect the sensor to the patient cable and connect the patient cable to the monitor. Attach the sensor to the patient.
	b. Sensor improperly positioned on patient.	b. Reposition the sensor on the patient.
	c. Incorrect sensor for application.	c. Choose the correct sensor for the application.
	d. Defective sensor or patient cable.	d. Change the sensor or contact SIMS BCI, Inc. service department or recharge battery.
Unit operates when connected to external charger, but not on battery power.	a. Battery shelf life exceeded or battery not charged.	a. Contact SIMS BCI, Inc. service department.
Display does not light.	a. If operating on battery, battery may need charging.	a. Recharge battery.
Green External Power LED not lit.	a. Battery eliminator not properly seated in the unit.	a. Reseat battery eliminator in unit.
No pulse registering on bargraph.	a. Sensor or patient cable disconnected from monitor.	a. Check connections to patient cable and sensor.
	b. Sensor incorrectly positioned.	b. Reposition sensor on patient.
	c. Poor patient perfusion.	c. Reposition sensor on patient.
	d. Defective sensor or patient cable.	d. Try a new sensor or contact SIMS BCI, Inc. service department.
Pulse rate erratic, intermittent, or incorrect.	a. Sensor incorrectly positioned.	a. Reposition sensor on patient.
	b. Poor patient perfusion.	b. Reposition sensor on patient.
	c. Patient motion.	c. Patient must be still for monitor to function properly. Place extremity on a pillow that acts as a "buffer" to motion.
	d. Ambient light.	d. Shield with towel.
HIGH CALIBRATION REQUIRED, appears at startup	a. Monitor needs calibration	a. Contact SIMS BCI, Inc. Service representative.
NEW CO2 SENSOR, appears at startup	a. New CO2 sensor or new software installed	a. Contact SIMS BCI, Inc. Service representative.
C02 BENCH ERROR, appears at startup	a. The C02 Bench is not working.	a. Contact SIMS BCI, Inc. Service representative.
SP02 ERROR, appears at startup	a. The Oximeter board has failed.	a. Contact SIMS BCI, Inc. Service representative.
User settings lost, reset to default	a. User data has been corrupted and reset to factory defaults.	a. Update any applicable user setting through the menu structure.

CAUTION: The monitor should be operated from its internal power source if the integrity of the protective earth conductor is in doubt.

Troubleshooting the Occlusion Low Priority Alarm

Most occlusions are automatically cleared within a minute. If occlusion cycles occur frequently or the occlusion low priority alarm persists, use the following chart to find and repair the problem.

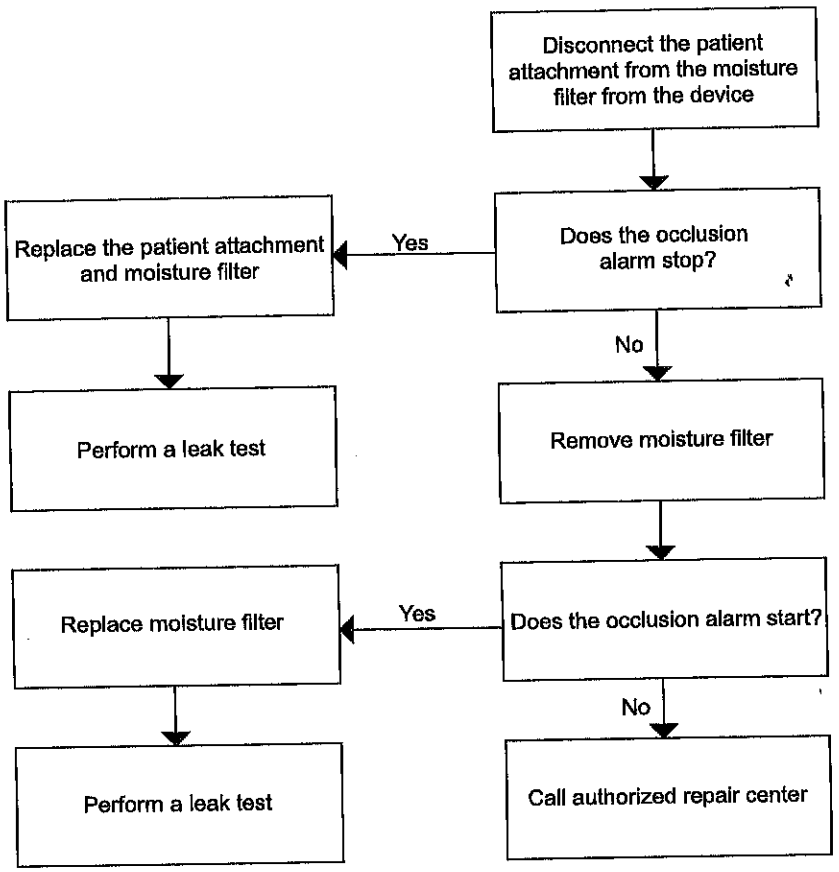


FIGURE 14.1: OCCLUSION LOW PRIORITY ALARM TROUBLESHOOTING CHART

Repairs of SIMS BCI, Inc. devices under warranty must be made at authorized repair centers. If the device needs repair, contact your local distributor or SIMS BCI, Inc. service department. When calling, have the device's model and serial number ready.

SIMS BCI, Inc.
N7 W22025 Johnson Road
Waukesha, WI USA 53186-1856

Phone: (262) 542-3100
Toll-Free: (800) 558-2345
Fax: (262) 542-0718

E-Mail address: info@sims-bci.com

Chapter 9: Supplies, Accessories & Specifications

Supplies and Accessories

CAT NO.	DESCRIPTION	QTY.
1100	Adapter, Airway, Straight, 12.7 ID x 15 OD (mm)	10/pkg
1101	Cannula, Oral/Nasal O_2/CO_2, Adult	10/pkg
1102	Cannula, Oral/Nasal O_2/CO_2, Ped	10/pkg
1105	Adapter, Airway, Straight, 12.7 ID x 15 OD (mm), w/filter	10/pkg
1110	Adapter, Return Flow "T"	each
1114	Adapter, Airway, Dual Port, Straight	10/pkg
1121	Cannula, Oral/Nasal O_2/CO_2 + Sample Line, Adult	10/pkg
1123	Sample Line, Oral/Nasal CO_2, Adult	10/pkg
1124	Sample Line, Oral/Nasal CO_2, Ped	10/pkg
1129	Sample Line, Nasal CO_2, Adult	10/pkg
1130	Sample Line, Nasal CO_2, Pediatric	10/pkg
1131	Sample Line, Nasal CO_2, Infant	10/pkg
1140	Sample Line, Extension, 15 ft.	10/pkg
1151	Adapter, Airway, 12.7 ID x 15 OD (mm), Ped	10/pkg
1152	Adapter, Airway, 12.7 ID x 15 OD (mm), w/filter, Ped	10/pkg
1300	Sensor, Oximetry, Disposable, Adult Finger	10/box
1301	Sensor, Oximetry, Disposable, Ped Finger, 15-45 kg.	10/box
1302	Sensor: Oximetry, Disposable, Neonate < 3 Kg.	10/box
1303	Sensor, Oximetry, Disp., Infant Finger, 3-15 kg.	10/box
1606	Simulator, Oximeter/ECG	each
1894	Manual, Operation, (Capnograph)	each
1895	Manual, Service, (Capnograph)	each
3025	Sensor, Oximetry, Wrap, Infant, 3-15 Kg	each
3026	Sensor, Oximetry, Wrap, Neonate, <3Kg	each
3043	Sensor, Oximetry, Universal "Y"	each
3044	Sensor, Oximetry, Finger	each
3049	Strips, Adhesive	40/pkg
3078	Sensor, Oximetry, Ear	each
3134	Tape Attachment Neonatal	50/pkg
3135	Tape Attachment Infant	50/pkg
3136	Tape Attachment Neonatal	100/pkg
3137	Infant Attachment Tape	100/pkg
3138	Universal "Y" Posey Wrap	10/pkg
3143	Attachment, OxiLink small finger	100/ctn
3143B	Small finger OxiLink	10/box
3144	Attachment, OxiLink medium finger	100/ctn
3144B	Medium Finger OxiLink	10/box

CAT NO.	DESCRIPTION	QTY.
3145	Attachment, OxiLink large finger	100/ctn
3145B	Large Finger OxiLink	10/box
3311	Cable, Oximetry, 5 ft	each
3444	Sensor, Oximetry Comfort Clip finger	each
5093	Gas, $ETCO_2$ Cal, (10% CO_2, 21% O_2, bal N_2)	each
8030	Adapter, Airway, Elbow, 15ID/22OD x 15OD (mm)	10/pkg
8044	Sample Line, 8 ft.	10/pkg
8061	Regulator, Cal. Gas Flow	each
8208	Gas Manifold filter	10/pkg
8211	Sample Line 4 ft.	10/pkg
8214	Capnograph Patient Attachment kit (1100, 8211, 8208)	10/pkg
8217	Kit: Calibration Capnograph (5093, 8061, 8223, 8211)	each
8400	Capnograph and Oximetry	each
8403	Battery Eliminator, 105-125 VAC, 60 Hz, 100-240 VAC, 50/60 Hz	each
8404	Battery Charger Kit	each
8405	Extended Life Moisture Trap System	each
8406	Battery Eliminator, 208-252 VAC 50/60 Hz	each
8407	Battery Eliminator, 90-110 VAC 60 Hz	each
8408	Battery, 7.4 V Lithium-Ion Rechargeable	each
8409	Pole Mount	each
8411	Infrared Printer, HP 82240B	each
8412	Carrying Case	each

* The SIMS BCI, Inc. 1302 and 3026 oximetry sensors should not be used on neonatal patients with the Capnograph monitor. Testing has not been conducted for the Capnograph for patients less than 30 days old. These sensors may, however, be used on older patients.

Ordering Information

For ordering information, contact your local distributor or the SIMS BCI, Inc. customer service department.

SIMS BCI, Inc.
N7 W22025 Johnson Road
Waukesha, WI USA 53186-1856

Phone: (262) 542-3100
Toll-Free: (800) 558-2345
Fax: (262) 542-0718

E-Mail address: info@sims-bci.com

Specifications

Capnograph

Display	LCD, with electrolumnescent (EL) back light 160 X 160 pixels; 38.4 cm2, 62 x 62 mm
Measurement	Non-Dispersive IR absorption
Calibration	Manual 2 point.
Measurement Range	0-10% CO_2 STPD (standard temperature and pressure dry)
Display Range	0-100 mmHg; 0-13.3 kPa; 0-10% CO_2
Display Update Rate	Waveform data updates at 24 Hz using a sliding erase bar to provide sweep speeds. Numerical data and messages are updated at 1 Hz. Sp02 pulse strength bar and the breath indicator update at 60 Hz.
Accuracy*	± 2mmHg or 4% of reading, whichever is greater
Stability	∠ 0.3% (vol) CO_2 /24hrs
Rise Time	325ms (average)
Delay Time	2.140s (average)
System Response Time	2.465s (average)
Time from power on to accurate readings:	3 minutes (typical)
N2O Compensation	selectable 40% (default = OFF)
Averaging	4 breath average
Flow Rate	120 ± 20 ml/min

* Accuracy specification for respiration rates less than 50 breaths per minute. ETCO2 specification for 51-80 breaths per minute is –10% of reading and for 81-150 breaths per minute is –20% of the reading.

Respiration Rate

Range	0-150 breaths/min
Accuracy	± 1 bpm
Averaging	4 breath average
Display Update Rate	1 Hz for Respiration value

SpO_2

Range	0-100% SpO_2 (functional)
Accuracy	± 2 at 70-100% SpO_2 ± 3 at 50-69% SpO_2
Averaging	8 beats
Pulse Tone	Pitch corresponds to SpO_2 value. Value adjustable or OFF.
Display Update Rate	1Hz for SpO_2 value, 60Hz for waveform
Sensor	Red 660nm, 2.0 mW Infrared 905 nm, 2.0 - 2.4 mW
Calibration:	Factory calibrated over 50% to 100% using human blood samples to functional saturation. Test methods available upon request. No in-service calibration required.

Peripheral Pulse Rate

Range	30-254 bpm
Accuracy	±2 bpm or 2%, whichever is greater, at 30 to 254 bpm
Averaging	8 seconds
Display Update Rate	1Hz

Pulse Strength

NOT proportional to pulse volume!

Range	30-254 bpm, indicates logarithmic strength of patient's pulse
Display	8 segment bargraph
Display Update Rate	60Hz

Alarm Limits Ranges

$ETCO_2$	
High:	0-100 mmHg (1 mmHg steps), and OFF
	0-13.3 kPa (0.1 kPa steps), and OFF
	0-10.0% CO_2 (0.1% steps), and OFF
Low:	0-100 mmHg (1 mmHg steps), and OFF
Factory Defaults:	High = 60 mmHg
	Low = 20 mmHg
Resp Rate	
High:	5-150 bpm (1 bpm steps), and OFF
Low:	5-150 bpm (1 bpm steps), and OFF
Factory Defaults:	High = 35 bpm
	Low = 5 bpm
Inspired CO_2	
High:	0-100 mmHg (1 mmHg steps), and OFF
	0-13.3 kPa, 0.1 kPa steps, and OFF
	0-10.0% CO_2, 0.1% steps, and OFF
Factory Default:	High = 8 mmHg
Pulse Rate	
High:	30-254 bpm (1 bpm steps), and OFF
Low:	30-254 bpm (1 bpm steps), and OFF
Factory Defaults:	High = 150 bpm
	Low = 45 bpm
SpO_2	
High:	50-100% (1% steps), and OFF
Low:	50-100% (1% steps), and OFF
Factory Defaults:	High = OFF
	Low = 85%

NOTE: User set alarm limits will be retained through power cycles.

Serial Output

Infrared Port compatible with HP82240B Printer or similar device.

Data Format:	Non-standard format ~ 500 baud
Options:	Text only, no graphics. Patient data log or trend tables

Power

AC Power (Optional)	See Appendix A: Supplies and Accessories
Battery Charger	MoliEnergy Agency Approvals pending
Battery	LI+ (lithium-Ion) ,7.4 VDC Replaceable internal rechargeable. Fully charged continuous use life of approximately 6 hours. Maximum full-capacity charging time is 2.5 hours
Battery Disposal	The battery must be disposed of properly. For more information contact your local authorities.

Physical

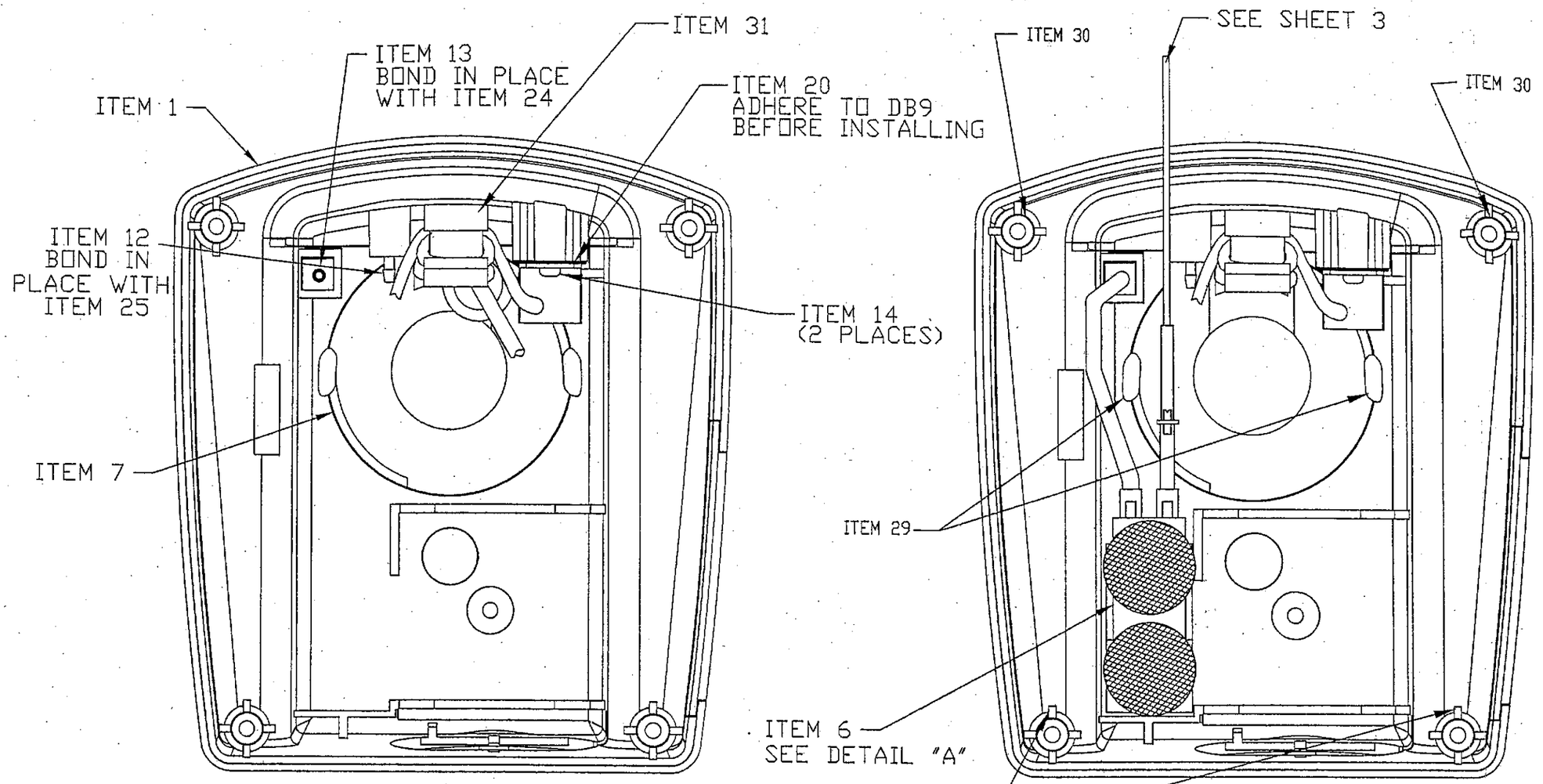
Dimensions:	Width: 4.38" (111 mm) Height: 5.0" (127 mm) Depth: 2.90" (73.7 mm)
Weight:	22 ounces (0.63 Kg)

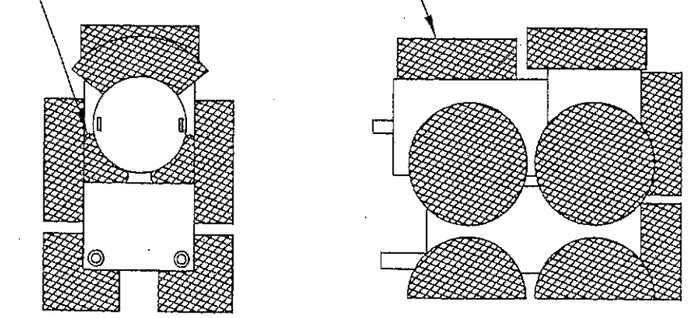
Environment

Temperature:	Operation: 0-50° C (32-122° F) Storage: -40-75° C (-40-167° F)
Relative Humidity	Operation: 15-95% (non-condensing) Storage: 10-95% (non-condensing)
EMC:	As per the most recent FDA guidelines for Respiratory and Oximetry devices, and EN60601-1-2.

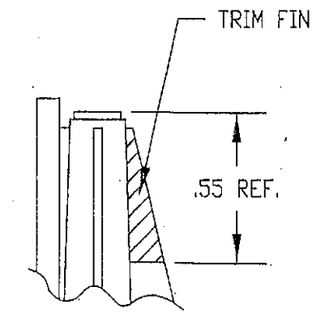
Appendix: Parts Lists, Assembly Drawings

Assemblies, drawings, schematics, and component information not contained in this manual, is available upon request to SIMS BCI, Inc.





DETAIL "A"



DETAIL "B"

DWG NO: 20650A	
REV.	DESCRIPTION
B	UPDATED PER LATEST ASSEMBLY PROCEDURES EAR# 3184 CLL 9-9-99
0	PRODUCTION RELEASE. C/N 4301 CLL 9-9-99
1	SEE SHEET 2 C/N 5910 RPA 02-02-00
2	SEE SHEET 2 C/N 5950 RPA 02-29-00
3	UPDATE ILLUSTRATION TO CURRENT ASSY. PROCEDURE C/N 6149 RPA 08-30-00
4	ITEM 11 AMOUNT WAS 15, ADDED ITEM 29 & 30 C/N 6207 RPA 10-03-00
5	ADDED A2 (OEM VERSION) C/N 6334 CLL 10-18-00
6	ADDED ASSY. A3 C/N 1148-01 RPA 04-18-01
7	SHOWED CUT OUT OF FIN C/N 1204-01 RPA 05-11-01
8	ADDED ITEM 31 UPDATED ILLUSTRATION C/N 1240-01 RPA 06-27-01

ORIGINAL

SIMS BCI, Inc.

DRN BY: RJR	CHK. BY: C. LANGE	ENG.: P. ROPELLA
DATE: 10-12-98	DATE: 12-14-99	DATE: 12-14-99
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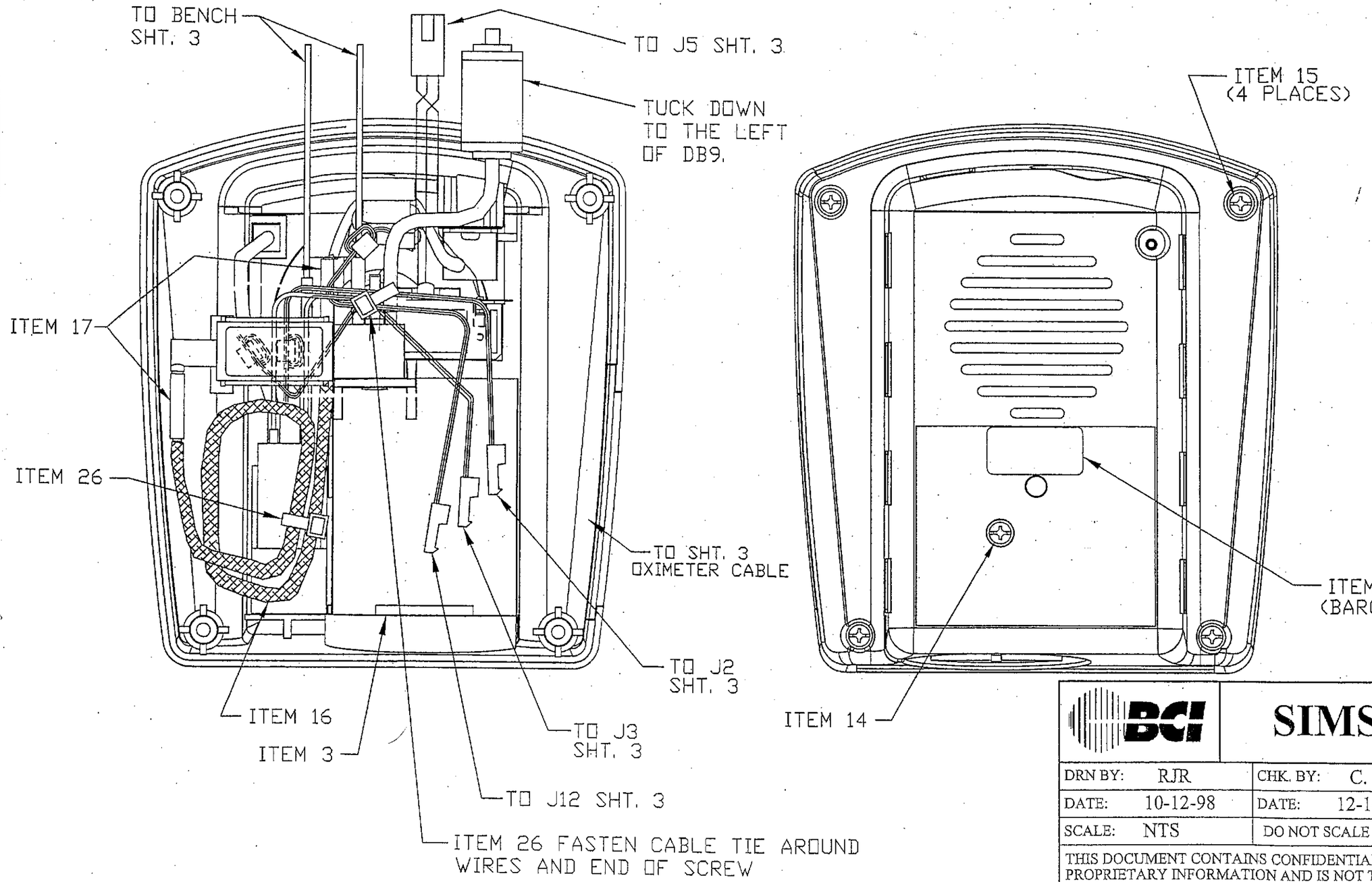
		MFG.: SANDERSON
		DATE: 12-14-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: GENERIC ASM CAPNOCHECK II 8400 A1=BCI, A2=OEM, A3=W/DIG. OXIMETRY BRD.		DWG NO: 20650A REV. 8 SHT. 1 OF 4

A-2



DWG NO: 20650A	
REV.	DESCRIPTION
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0	PRODUCTION RELEASE C/N 4301 CLL 9-9-99
1	ADDED TAPE ITEM 28 C/N 5910 RPA 02-02-00
2	ITEM 28 WAS 56239B1 C/N 5950 RPA 02-29-00
3	UPDATE ILLUSTRATION TO CURRENT ASSY. PROCEDURE C/N 6149 RPA 08-30-00
4	SEE SHEET 1 C/N 6207 RPA 10-03-00
5	SEE SHEET 1 C/N 6334 CLL 10-18-00
6	ADDED ASSY. A3 C/N 1148-01 RPA 04-18-01
7	SEE SHEET 1 C/N 1204-01 RPA 05-11-01
8	SEE SHEET 1 C/N 1240-01 RPA 06-27-01

NOTES:

1. ITEM 14 IS USED TO HOLD ITEM 3 IN PLACE.
2. ITEM 15 IS USED TO HOLD THE CASE TOGETHER UPON COMPLETION OF ASSEMBLY.

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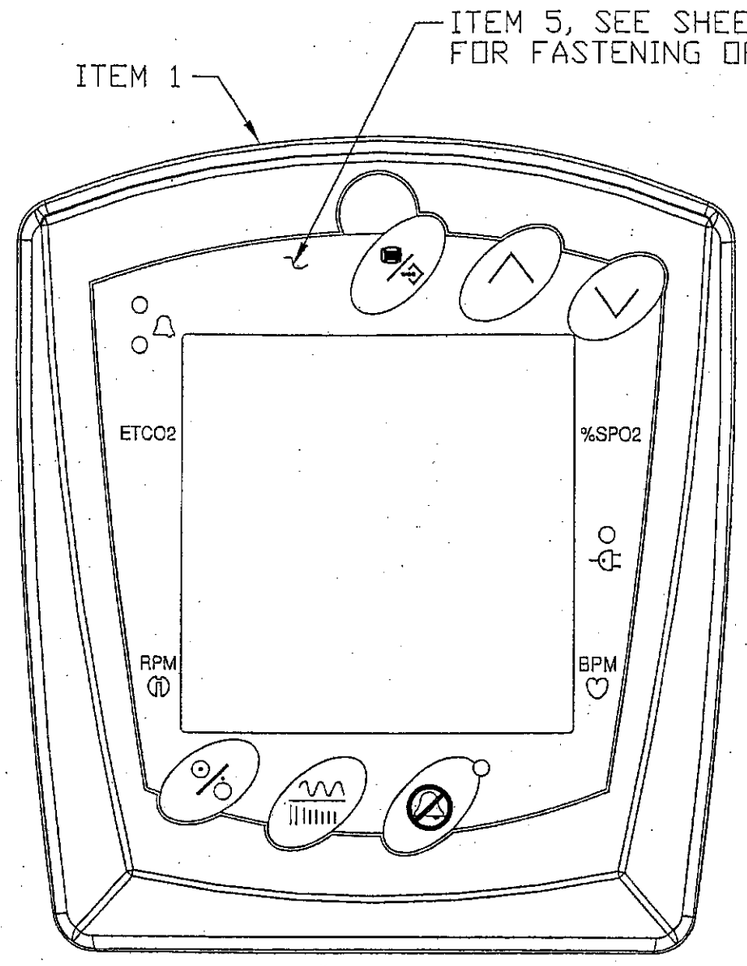
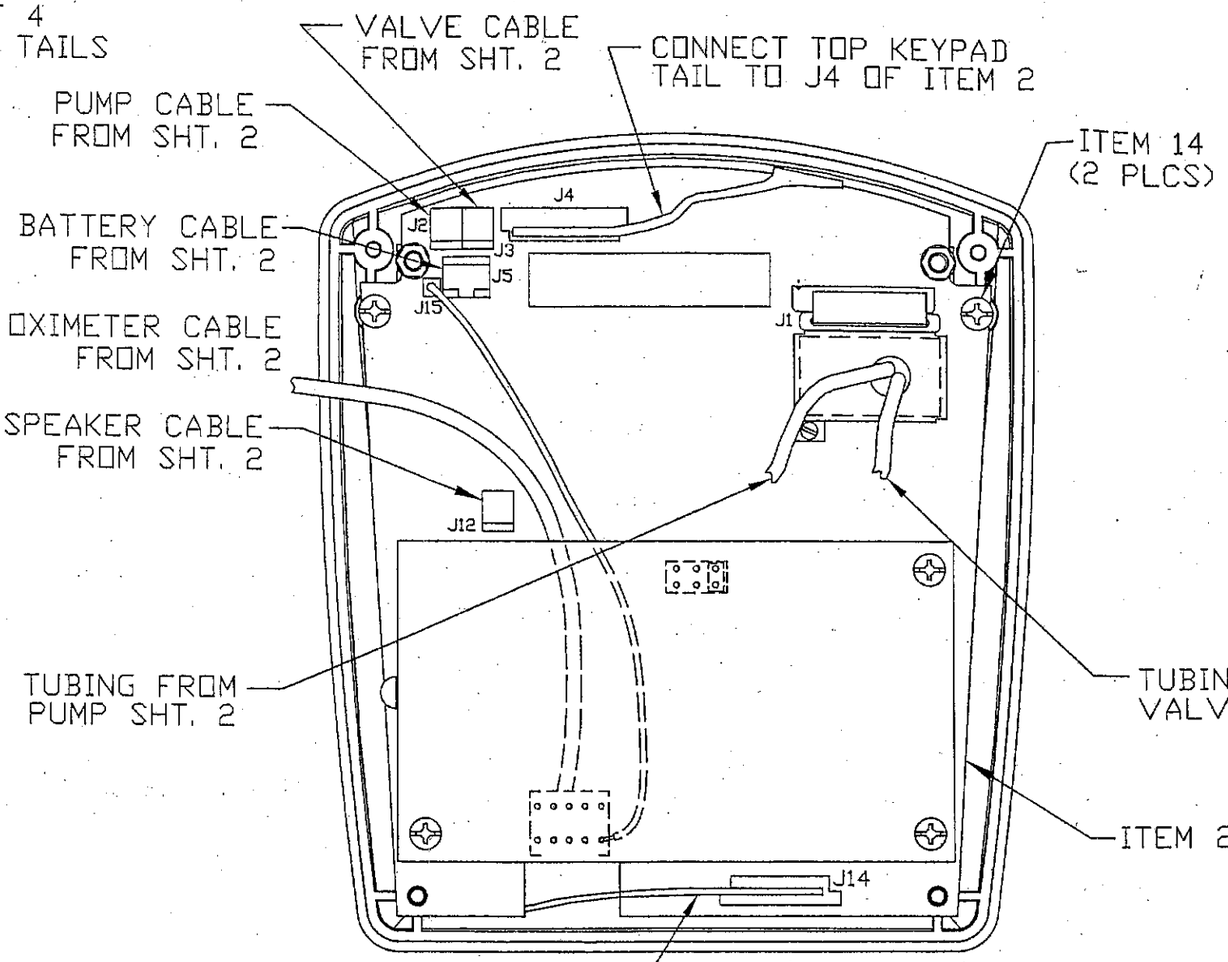
		REV. 8

A-3





CONNECT BOTTOM KEYPAD
TAIL TO J14 OF ITEM 2

DWG NO: 20650A	
REV.	DESCRIPTION
B	SEE SHEET 1 EAR# 3184 CLL 9-9-99
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1	SEE SHEET 2 C/N 5910 RPA 02-02-00
2	SEE SHEET 2 C/N 5950 RPA 02-29-00
3	SEE SHEETS 1 AND 2 C/N 6149 RPA 08-30-00
4	SEE SHEET 1 C/N 6207 RPA 10-03-00
5	SEE SHEET 1 C/N 6334 CLL 10-18-00
6	ADDED ASSY. A3 C/N 1148-01 RPA 04-18-01
7	SEE SHEET 1 C/N 1204-01 RPA 05-11-01
8	SEE SHEET 1 C/N 1240-01 RPA 06-26-01

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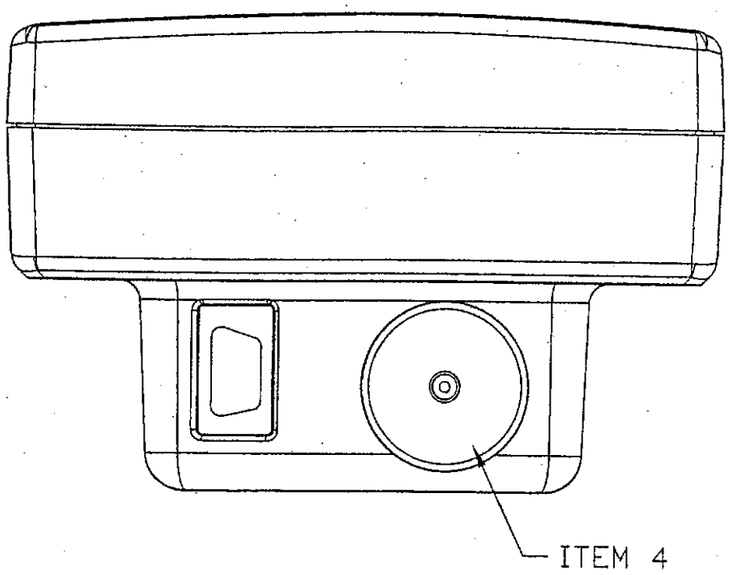
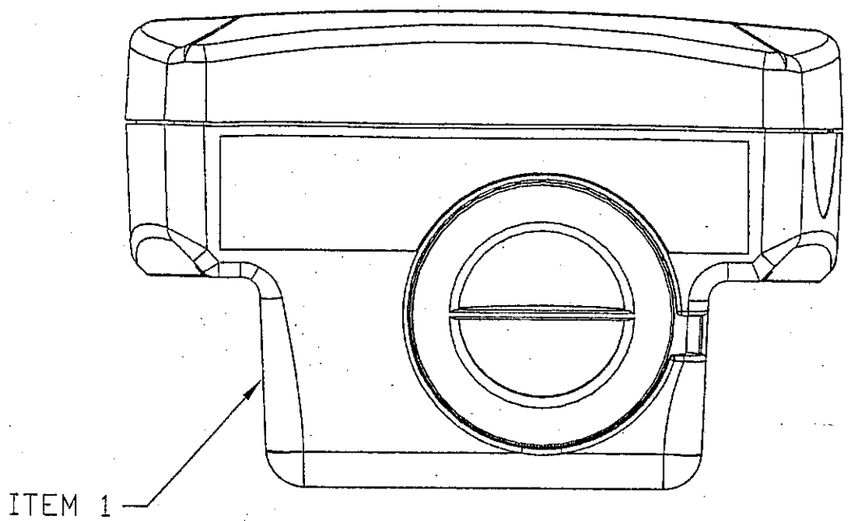
A-4





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REV.	DESCRIPTION
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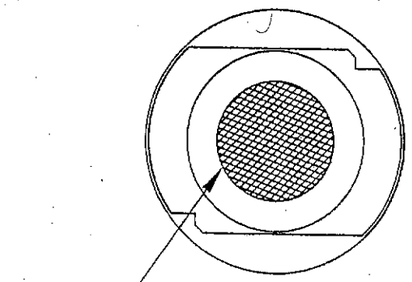
0	PRODUCTION RELEASE C/N 4301 CLL 9-9-99
1	SEE SHEET 2 C/N 5910 RPA 02-02-00
2	SEE SHEET 2 C/N 5950 RPA 02-29-00
3	SEE SHEETS 1 AND 2 C/N 6149 RPA 08-30-00
4	SEE SHEET 1 C/N 6207 RPA 10-03-00
5	SEE SHEET 1 C/N 6334 CLL 10-18-00
6	ADDED ASSY. A3 C/N 1148-01 RPA 04-18-01
7	SEE SHEET 1 C/N 1204-01 RPA 05-11-01
8	SEE SHEET 1 C/N 1240-01 RPA 06-26-01



APPLY ONE OF ITEM 11 TO THE INSIDE OF THE BATTERY DOOR AS SHOWN.

ORIGINAL

SIMS BCI, Inc.

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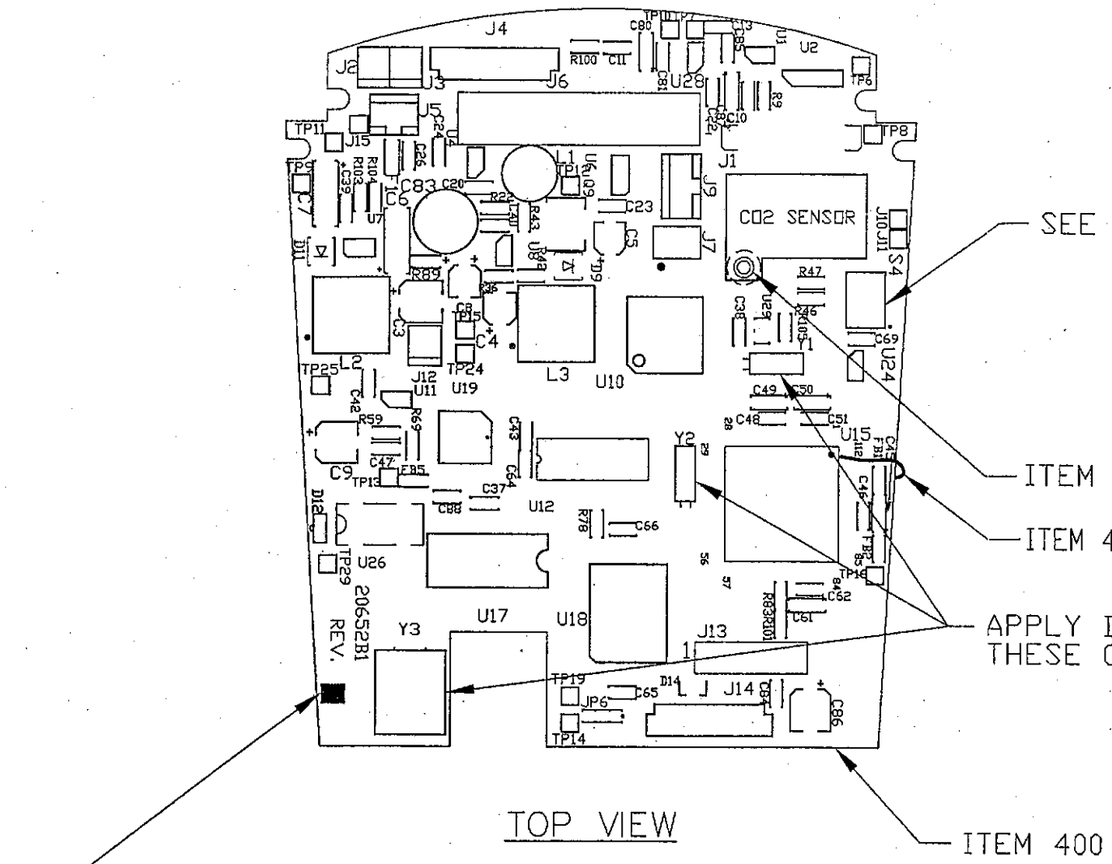
TITLE: GENERIC ASM CAPNOCHECK II 8400 A1=BCI, A2=OEM, A3=W/DIG. OXIMETRY BRD.		DWG NO: 20650A REV. 8
		SHT. 4 OF 4

A-5

Date : 09-12-01 [10:46]
SIMS BCI, Inc.

SINGLE-LEVEL PRODUCTION BOMS (1)

Pos.	Item Code	Description	Effect. Date	Expiry Date	Length [IN]	Width [IN]	No.of Units	Net Quantity	Un.	Scpf [%]	Wrl
Manufactured Item : 20650A1			GENERIC ASM CPNCK II 8400 BCI BOM Rev: 6								BC
1	20663B1	CASE COMPLETE 8400	09-30-98					1.0000	EA		MI
2	20681A1	ASM MAIN/DISP/SPO2 P	06-16-98					1.0000	EA		MI
3	20686A1	COMPARTMENT ASM BATT	06-16-98					1.0000	EA		MI
4	70825C2	FLTR 17MM CAPCHK MOD	10-14-98					1.0000	EA		MI
5	20683B1	KYPD 8400 BCI CAPNOC	06-16-98					1.0000	EA		MI
6	20674B1	PUMP ASM 8400	06-16-98					1.0000	EA		MI
7	20672A1	SPEAKER ASM 8400	12-01-99					1.0000	EA		MI
11	20176B1	PAD FOAM .75 DIA X .	09-29-98					11.0000	EA		MI
12	20677B1	FITTING 1/16" BONDAB	09-29-98					1.0000	EA		MI
13	20678B1	FITTING 1/16" TB TO	09-29-98					1.0000	EA		MI
14	12026B3	SCREW TAP 4X1/4 TYPE	12-01-99					5.0000	EA		MI
15	12026B4	SCREW TAP 4X7/8 TYPE	09-29-98					4.0000	EA		MI
16	70875B1	SMPLN ASM NAF 1'	09-29-98					1.0000	EA		MI
17	68061B1	TB TYGON B-44-3 .125	09-29-98					0.1000	FT		MI
18	31168A1	CBL ASM OVERMOLDED 5	10-14-98					1.0000	EA		MI
20	31017B5	GSKT DB9 RUBBER W/AD	12-01-99					1.0000	EA		MI
22	45082B	TAPE DOUBLE-BACK CLO	12-01-99					0.0100	RL		MI
23	57217B1	ADHSV NON-COROSIVE D	12-01-99					0.0000	EA		MI
24	57836B1	EPOXY 5 MINUTE DEV-T	12-01-99					0.0000	TB		MI
25	20553B1	ADHESIVE LOCTITE PRI	12-01-99					0.0000	BT		MI
26	54068B2	TIE CBL MICROMINI	12-01-99					2.0000	EA		MI
27	20542B5	LBL THT-5-423-10 WHT	12-14-99					0.0100	RL		MI
28	56239B1	TAPE DBL-SD FOAM 1/2	02-03-00					0.0400	FT		MI
29	58326B1	GLUE HOT MELT *SH*	09-05-00					0.0000	CS		MI
30	20166B1	O-RING .037 ID X .08	10-03-00					2.0000	EA		MI
31	31007B1	CLAMP CBL	06-08-01					1.0000	EA		MI



TOP VIEW

SWITCH CHART
FOR S1

SWITCH	ON	OFF
1		X
2	X	
3	X	
4		X
5		X
6	X	

NOTES:

1. MANUFACTURER TO PLACE A "MFD BY" IDENTIFICATION MARK ON BOARD.
2. IF MANUFACTURER TESTS BOARDS, A TEST STAMP MUST BE PLACED ON THE BOARD INDICATING IT PASSED ALL TESTS.
3. THIS ASSEMBLY MUST MEET ALL REQUIREMENTS OF IPC-A-610, CLASS 1 (CURRENT REVISION) SPECIFICATION, UNLESS OTHERWISE SPECIFIED.
4. VENDOR IS TO INSTALL SOFTWARE ASSEMBLIES ITEM 402 AT U18, ITEM 403 AT U21 AND ITEM 404 AT U15.
5. DESOLDER AND LIFT PINS #2 AND #7 FROM U25. SOLDER WIRE FROM U25 PIN #7 TO U15 PIN #112.

DWG NO: 20652B1	
REV.	DESCRIPTION
C	UPDATED PER LATEST DESIGN CHANGES, SEE SHEETS 2 THRU 6 EAR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	UNPOPULATED DESIGNATORS C85, R90, U23, P/N FOR C83 WAS ECEVDJA102UP, ADDED ALTERNATE P/N KM6161000BLT-7L TO U17, CORRECTED P/N FOR U26 WAS SG-531P-2000MC, ADDED ITEM 405 (RTV) C/N 4301 CLL 9-10-99
2	ADDED ITEM 406 AND NOTE #5 C/N 5827 RPA 02-21-00
3	UPDATED P/N FOR DESIGNATOR U12 WAS P/N KM62256CLGI-7 C/N 6114 JBK 6-8-00

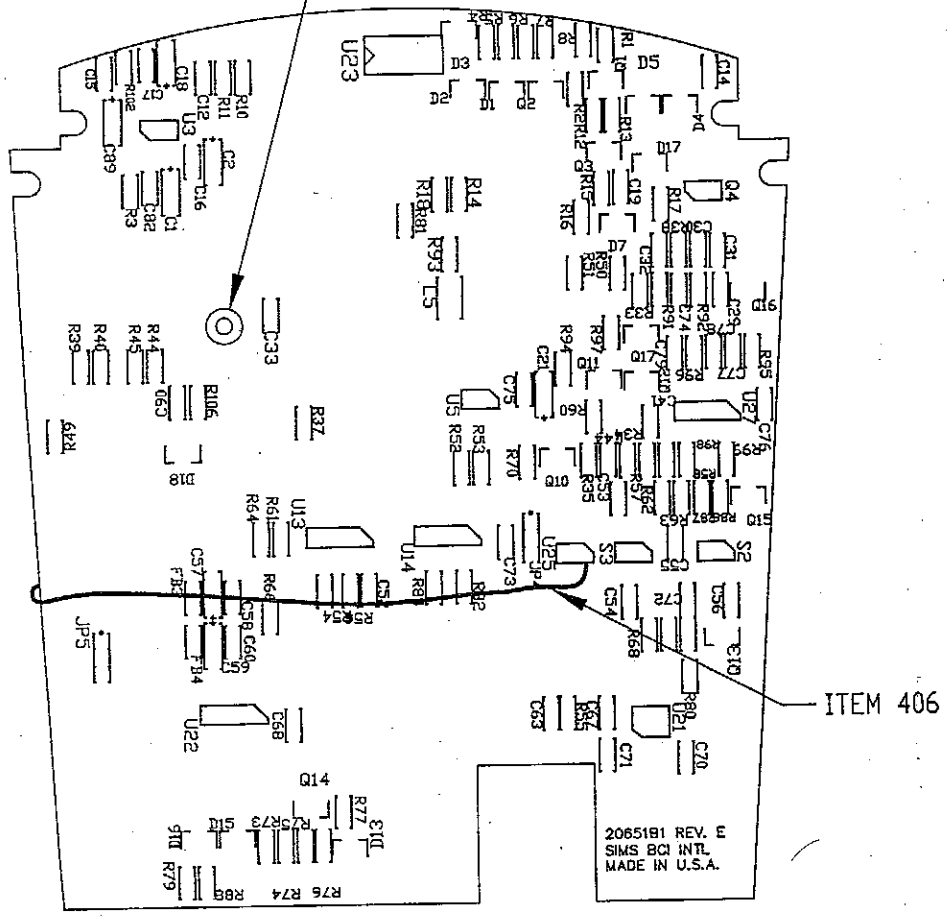
ORIGINAL

SHT. 2 IS "A" SIZE, SHTS. 3 THRU 6 ARE "V" SIZE.

SIMS BCI, Inc.

DRN BY: MER	CHK. BY: C.L. Lange	ENG.: M. Moritz
DATE: 8-19-98	DATE: 7-16-99	DATE: 7-15-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A.: Sue Seib
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, Inc. OR ITS DESIGNATED AGENT.		DATE: 7-16-99
		MFG.: M.S.
		DATE: 7-15-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: PWB ASM A/T MAIN BOARD 8400		DWG NO: 20652B1 REV. 3
		SHT. 1 OF 6

INSERT ITEM 401 (PRESS IN FASTENER) FROM THE BOTTOM SIDE OF THE BOARD INTO THIS "0.154" HOLE. THE FASTENER SHALL BE INSERTED FROM THE BOTTOM SO THAT IT IS FLUSH WITH THE TOP SIDE OF THE BOARD AFTER INSERTION.



BOTTOM VIEW

DWG NO:	20652B1
REV.	DESCRIPTION
C	UPDATED PER LATEST DESIGN CHANGES, SEE SHEETS 1 & 3 THRU 6 EAR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	SEE SHEET 1 C/N 4301 CLL 9-10-99
2	SEE SHEET 1 C/N 5827 RPA 02-21-00
3	SEE SHEET 1 C/N 6114 JBK 6-8-00

ORIGINAL

SHT. 1 "B" SIZE. SHTS. 3–6 "V" SIZE.

SIMS BCI, Inc.

DRN BY: MER	CHK. BY: C.L.Lange	ENG.: M. Moritz	
DATE: 8-24-98	DATE: 7-16-99	DATE: 7-15-99	
SCALE: NTS	DO NOT SCALE PRINT	Q.A.: Sue Seib	
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, Inc. OR ITS DESIGNATED AGENT.		DATE: 7-16-99	
		MFG.: M.S.	
		DATE: 7-15-99	
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°	
FINISH:			
TITLE: PWB ASM A/T MAIN BOARD 8400		DWG NO: 20652B1	REV. 3
		SHT. 2 OF 6	

ORIGINAL

QTY	DESIGNATION(S)	DESCRIPTION	PACKAGE	MANUFACTURER /	PART NUMBER	
6	C1,C2,C18,C21,C87,C89	10uF 6.3V TANT	3216	PANASONIC	ECS-TOJY106R	
3	C3,C9,C86	100uF 6.3V ALUM-ELEC	6.3x5.7	PANASONIC	ECE-VOJA101SP	
3	C4,C5,C8	22uF 35V ALUM-ELEC	5x6.3	NIC	NACZ220M35V5X6.3TR13	
2	C6,C7	100uF 16V LOW ESR TANT	D7343	AVX	TPSE107M016R0100	
46	C10,C11,C13,C15,C16,C17, C22,C23,C24,C26,C29,C33, C37,C38,C39,C40,C42,C43, C44,C46,C48,C51,C52,C53, C54,C55,C56,C58,C60,C62, C63,C64,C65,C66,C67,C68, C69,C73,C75,C76,C77,C78, C79,C81,C82,C84	.1uF 50V Y5V	0805	KEMET	C0805104K5RAC	Or eq.
2	C12,C31	56pF 50V NPO 5%	0805	PANASONIC	ECU-V1H560JCG	Or eq.
1	C14	.047uF 50V X7R 10%	0805	KEMET	C0805C473K5RAC	Or eq.
2	C19,C47	.22uF 16V X7R 10%	0805	AVX/KYOCERA	0805YC224KAT2A	Or eq.
1	C20	82pF 50V NPO 5%	0805	AVX/KYOCERA	08055A820JAT2A	Or eq.
1	C30	680pF 50V X7R 10%	0805	AVX/KYOCERA	08053C681KAT2A	Or eq.
1	C32	6800pF 50V X7R 10%	0805	AVX/KYOCERA	08055C682KAT2A	Or eq.
2	C41,C72	.01uF 50V X7R 10%	0805	PANASONIC	ECU-V1H103KBG	Or eq.
6	C45,C49,C50,C57,C59,C61	1.0uF 16V TANT	3216	KEMET	T491A105K016AS-TR	Or eq.
2	C70,C71	10pF 50V NPO 5%	0805	PANASONIC	ECU-V1H100DCN	Or eq.
3	C74,C88,C90	100pF 50V NPO 5%	0805	PANASONIC	ECU-V1H101JCG	Or eq.
1	C80	4.7uF 16V TANT	3216	PANASONIC	ECS-T1CY475R	Or eq.
1	C83	2200uF 6.3V ALUM-ELEC	THROUGH HOLE	PANASONIC	ECA-OJM222	
9	D1,D2,D3,D13,D14,D15, D16,D17,D18	BAV99	SOT23	VISHAY	BAV99TR	Or eq.
3	D4,D5,D7	BAS16	SOT23	VISHAY	BAS16	Or eq.
2	D9,D11	SK13	SMB	VISHAY	SK13	
1	D12	IRLED	THROUGH HOLE	LITEON	LTE-302	
5	FB1,FB2,FB3,FB4,FB5	BEAD	0805	MURATA ERIE	BLM21A121SPT	
1	F1	2AMP FUSE	1206	Littelfuse	429002	
1	J1	CONNECTOR FLEX	SMT	MOLEX	52610-1690	

SIMS BCI, INC.	Dwg No. 20652B1	
Pwb Asm A/T Main Board 8400		Page 4 of 6
	Rev Date: 06-08-00	Rev 3

ORIGINAL

QTY	DESIGNATION(S)	DESCRIPTION	PACKAGE	MANUFACTURER /	PART NUMBER	
3	J2,J3,J12	CONNECTOR 2 POS	THROUGH HOLE	MOLEX	22-11-2022	
2	J4,J14	CONNECTOR KEYPAD	THROUGH HOLE	AMP	520315-6	
1	J5	CONNECTOR 3 POS	THROUGH HOLE	BERG	69167-103	
1	J6	CONNECTOR 15 POS	THROUGH HOLE	MOLEX	22-17-2152	
1	J7	CONNECTOR 6 POS	THROUGH HOLE	AMP	103240-3	
1	J9	CONNECTOR 4 POS	THROUGH HOLE	BERG	69167-104	
2	J11,J10	CONNECTOR 1 POS	THROUGH HOLE	AMP	103321-1	
1	J13	CONNECTOR 2x7 POS	THROUGH HOLE	BERG	68683-307	
1	L1	15mH	THROUGH HOLE	TOKO	187LY-153J	
1	L2	50uH	SMT	COILTRONICS	CTX50-2	
1	L3	100uH	SMT	COILTRONICS	CTX100-1P	
1	L5	3.3uH	1210	COILTRONICS	CTX32T-3R3	
4	Q1,Q2,Q14,Q15	BSS84ZX	SOT23	ZETEX	BSS84ZXTR	Or eq.
4	Q3,Q10,Q16,Q17	2N7002	SOT23	MOTOROLA	2N7002LT1	Or eq.
1	Q4	SI9956DY	SO8	TEMIC	Si9956DY	
1	Q9	FZT790A	SOT223	ZETEX	FZT790A	Or eq.
3	Q11,Q12,Q13	FMMTA06	SOT23	MOTOROLA	MMBTA06LT1	Or eq.
19	R1,R2,R39,R40,R44,R45, R56,R57,R58,R61,R64,R70, R77,R86,R95,R100,R101, R104,R105	100K 1%	0805	DALE	CRCW0805-1003FRT1	Or eq.
13	R3,R4,R5,R6,R10,R37,R60, R67,R68,R73,R74,R76,R87	2.21K 1%	0805	DALE	CRCW0805-2211FRT1	Or eq.
4	R7,R8,R42,R75	475 1%	0805	DALE	CRCW0805-4750FRT1	Or eq.
9	R9,R78,R80,R81,R82,R83, R84,R98,R99	1.00K 1%	0805	DALE	CRCW0805-1001FRT1	Or eq.
1	R11	11.5K 1%	0805	DALE	CRCW0805-1152FRT1	Or eq.
7	R12,R13,R14,R54,R55,R66 R102	100 1%	0805	DALE	CRCW0805-1000FRT1	Or eq.
3	R15,R92,R106	20.0K 1%	0805	DALE	CRCW0805-2002FRT1	Or eq.
1	R16	499K 1%	0805	DALE	CRCW0805-4993FRT1	Or eq.
5	R17,R22,R38,R50,R51	5.11K 1%	0805	DALE	CRCW0805-5111FRT1	Or eq.
2	R18,R97	825K 1%	0805	DALE	CRCW0805-8253FRT1	Or eq.

QTY	DESIGNATION(S)	DESCRIPTION	PACKAGE	MANUFACTURER /	PART NUMBER	
2	R33,R96	249K 1%	0805	DALE	CRCW0805-2493FRT1	Or eq.
1	R34	604K 1%	0805	DALE	CRCW0805-6043FRT1	Or eq.
1	R35	402K 1%	0805	DALE	CRCW0805-4023FRT1	Or eq.
1	R36	750K 1%	0805	DALE	CRCW0805-7503FRT1	Or eq.
1	R43	0.27 OHM 5%	0805	PANASONIC	ERJ-6RQJ27V	Or eq.
5	R46,R47,R49,R53,R69	10.0K 1%	0805	DALE	CRCW0805-1002FRT1	Or eq.
4	R52,R89,R93,R94	0 Ohm	0805	KOA-SPEER	RM73Z2A000Z	Or eq.
1	R59	10M 1%	0805	DALE	CRCW0805-1005FRT1	Or eq.
1	R62	69.8K 1%	0805	DALE	CRCW0805-6982FRT1	Or eq.
1	R63	150K 1%	0805	DALE	CRCW0805-1503FRT1	Or eq.
1	R65	61.9 1%	0805	DALE		Or eq.
1	R79	40.2K 1%	0805	DALE	CRCW0805-4022FRT1	Or eq.
1	R88	1.50K 1%	0805	DALE	CRCW0805-1501FRT1	Or eq.
1	R91	66.5K 1%	0805	DALE	CRCW0805-6652FRT1	Or eq.
1	R103	348K 1%	0805	DALE	CRCW0805-3483FRT1	Or eq.
2	S2,S3	ADG419	SO8	ANALOG DEVICES	ADG419BR	
1	S4	SWITCH SMT 6 POS	SMT	C&K COMP.	TD06H0SK1	
15	TP6,TP7,TP8,TP9,TP10,TP11, TP12,TP13,TP14,TP15,TP16,TP19, TP24,TP25,TP29	TESTPOINT	THROUGH HOLE	COMPONENTS CORP	TP-103-03	
1	U1	OP184	SO8	ANALOG DEVICES	OP184ES	
1	U2	LTC1594	SO16	LINEAR TECHNOLOGY	LTC1594CS	
1	U3	ADR292GR	SO8	ANALOG DEVICES	ADR292GR	
1	U4	SP4422A	SO8	SIPEX	SP4422ACN	
1	U5	MC79L05AC	SO8	MOTOROLA	MC79L05ACD	
1	U6	74VHC541	SO20W	FAIRCHILD	74VHC541MTC	Or eq.
1	U7	LTC1433	SSOP16	LINEAR TECHNOLOGY	LTC1433GN	
1	U8	MAX749	SO8	MAXIM	MAX749CSA	
1	U10	SED1335F	QFP60	S-MOS	SED1335FOB	
1	U11	AD822	SO8	ANALOG DEVICES	AD822AR	
1	U12	KM62256A	SOP28	SAMSUNG	KM62256DLGI-7	
1	U13	74HC00	SO14	FAIRCHILD	MM74HC00M	Or eq.

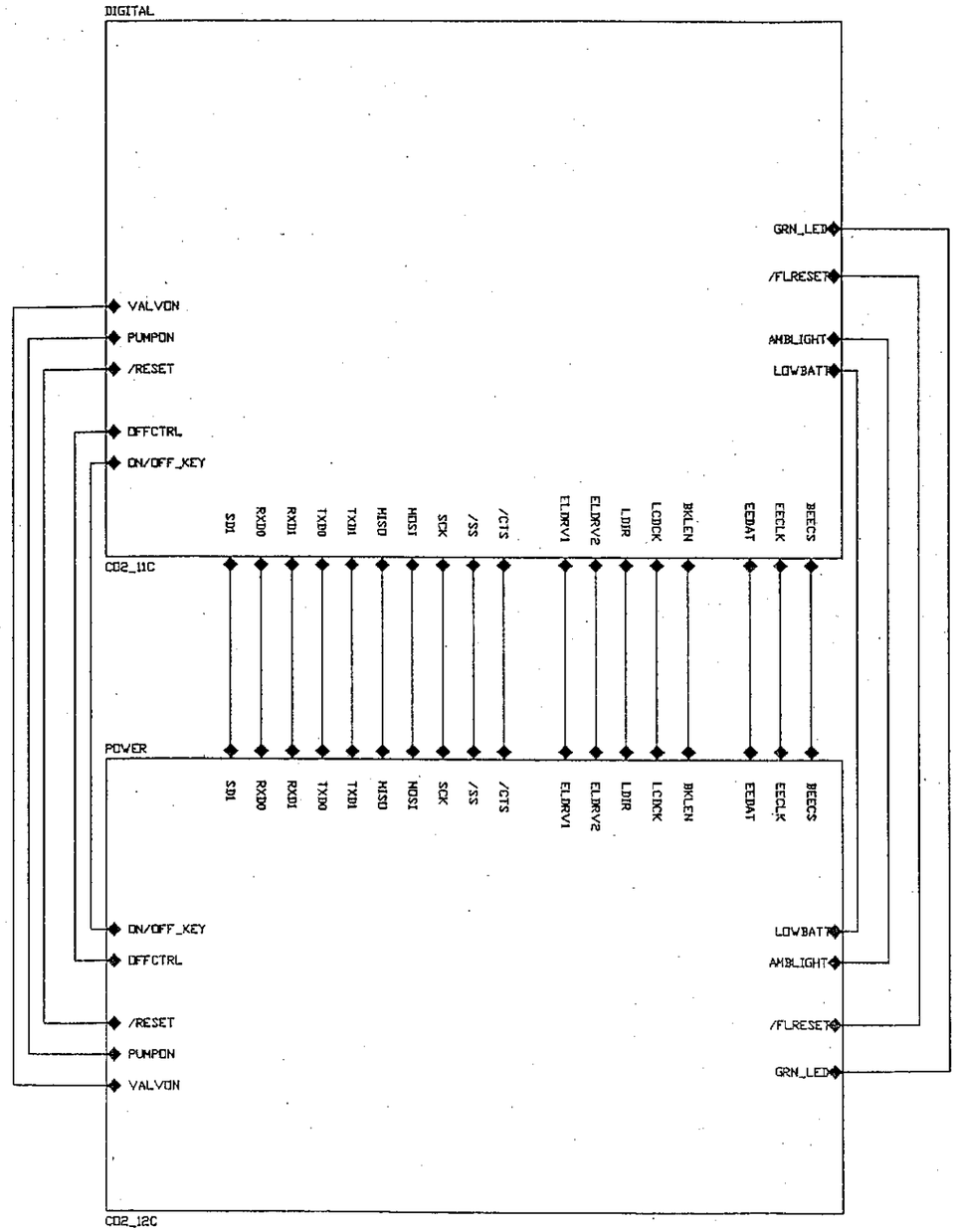
ORIGINAL

A-11

SIMS BCI, INC.	Dwg No. 20652B1	
Pwb Asm A/T Main Board 8400		Page 6 of 6
	Rev Date: 06-08-00	Rev 3

QTY	DESIGNATION(S)	DESCRIPTION	PACKAGE	MANUFACTURER /	PART NUMBER	
1	U14	74HC08	SO14	FAIRCHILD	MM74HC08M	Or eq.
1	U15	MC68HC812A4	TQFP112	MOTOROLA	MC68HC812A4PV8	
1	U17	KM6164000B	TSOP44	SAMSUMG	KM6164000BLT-7L or KM6161000BLT-7L	
1	U18	28F200B5B_TSOP	TSOP48	INTEL	E28F200B5-B60	
1	U19	uPD71054L	PLCC-28	NEC	uPD71054L-8	
1	U21	PIC12C508A	SO8W	MICROCHIP	PIC12C508A-04/SM	
1	U22	74HC32	SO14	FAIRCHILD	MM74HC32M	Or eq.
1	U24	NM93C66M8	SO8	FAIRCHILD	NM93C66M8	Or eq.
1	U25	ADM1232	SO8	ANALOG DEVICES	ADM1232ARN	
1	U26	OSCILLATOR 2.000MHz	THROUGH HOLE	EPSON	SG-531P-2.000MC	
1	U27	4093BM	SO14	FAIRCHILD	CD4093BCM	Or eq.
1	U28	ADP3301AR-5	SO8	ANALOG DEVICES	ADP3301AR-5	
1	U29	INVERTER SCHMITT TRIG	SMV-5 (SSOP5-P-0.95)	TOSHIBA	TC4S584F-TE85L	
1	Y1	CRYSTAL 10.000MHz	THROUGH HOLE	EPSON	CA-301 10.000M-C	
1	Y2	CRYSTAL 8.3886MHz	THROUGH HOLE	EPSON	CA-301 8.388608M-C	
1	Y3	CRYSTAL 2.097152MHz	THROUGH HOLE	FOX	FOX021S	
1	400	PWB FAB		ANY	20651B1	Or eq.
1	401	FASTNER, PRESS-IN NUT		PENN ENG & MANUF CORP	KFS2-256	
1	402	SOFTWARE ASSEMBLY	INSTALL AT U18	SIMS BCI, INC.	BCI P/N 20684A1	
1	403	SOFTWARE ASSEMBLY	INSTALL AT U21	SIMS BCI, INC.	BCI P/N 20688A1	
1	404	SOFTWARE ASSEMBLY	INSTALL AT U15	SIMS BCI, INC.	BCI P/N 20691A1	
A/R	405	ADHESIVE LOCTITE PRISM 406		SIMS BCI, INC	BCI P/N 20553B1	
A/R	406	WIRE, STRANDED OR SOLID 30AWG 300V BLACK		SIMS BCI, INC.	BCI P/N 47952B1 (SOLID)	OR EQ.

ORIGINAL



DRWG NO: 20652S1	
REV.	DESCRIPTION
C	UPDATED PER LATEST DESIGN CHANGES, ALSO SEE SHEETS 2 & 3 EAR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	ADDED DO NOT POPULATE THIS AREA IN 2 PLACES ON SHEET 3 C/N 4301 CLL 9-21-99
2	SEE SHEET 2 C/N 5827 RPA 02-21-00
3	ADDED SHEETS 4 & 5 C/N 1108-01 MAM 3-22-01

ORIGINAL

SIMS BCI, INC.

DRAWN BY: MER	CHK. BY: C.L.Lange	ENG. APPR.: M.Moritz
DATE: 8-18-98	DATE: 7-16-99	DATE: 7-15-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: Sue Selb
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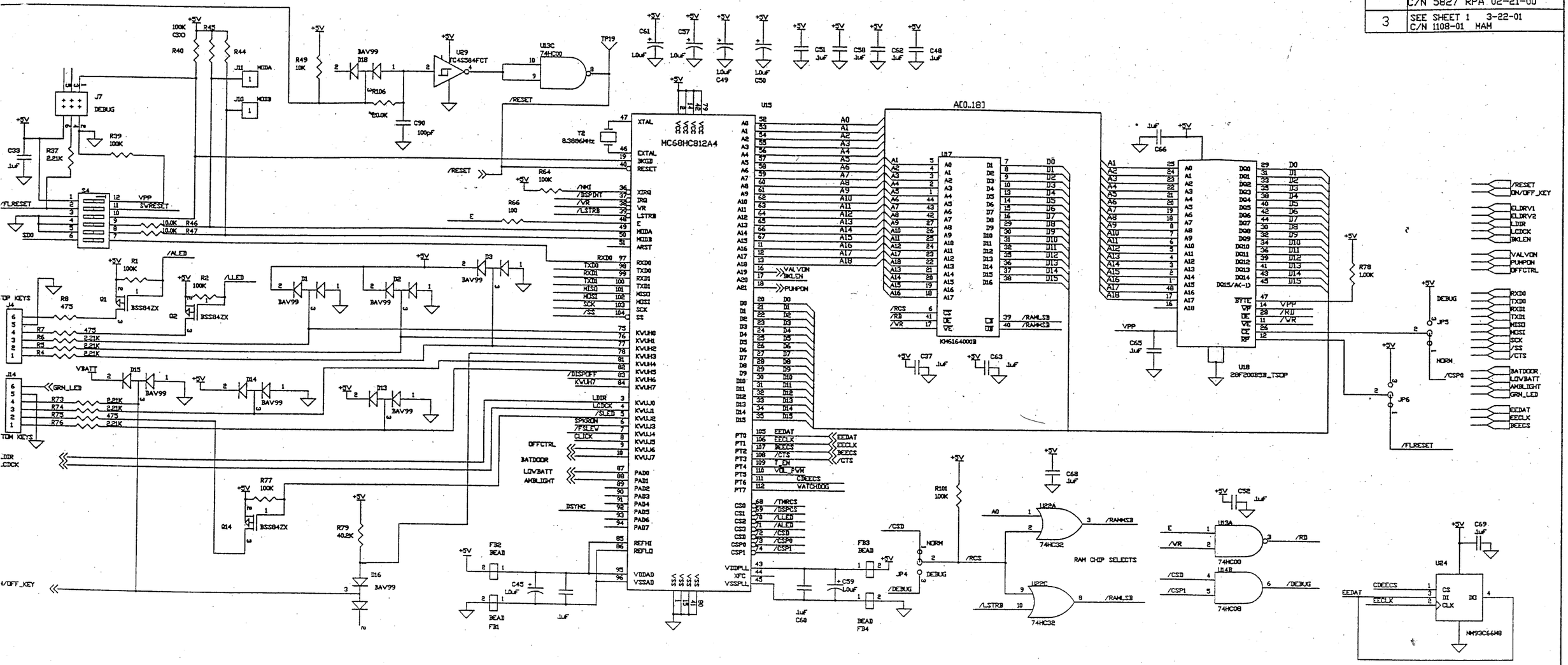
		MFG. APPR.: M.S.
		DATE: 7-15-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC 8400 MAIN BOARD	DRWG NO: 20652S1	REV.: 3
	SHT. 1 OF 5	

DRWG NO: 20652S1	
REV.	DESCRIPTION
C	SEE SHEET 1 EAR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	SEE SHEET 3 C/N 4301 CLL 9-21-99
2	U25 REMOVE PIN #2 FROM GRD., AND REMOVE PIN #7 FROM U19 PIN #12 AND CONNECT TO U15 PIN #112 C/N 5827 RPA 02-21-00
3	SEE SHEET 1 3-22-01 C/N 1108-01 MAM



ORIGINAL

SIMS BCI, INC.		
DRAWN BY: MER	CHK. BY: C.L.Lange	ENG. APPR.: M.Moritz
DATE: 8-24-98	DATE: 7-16-99	DATE: 7-15-99
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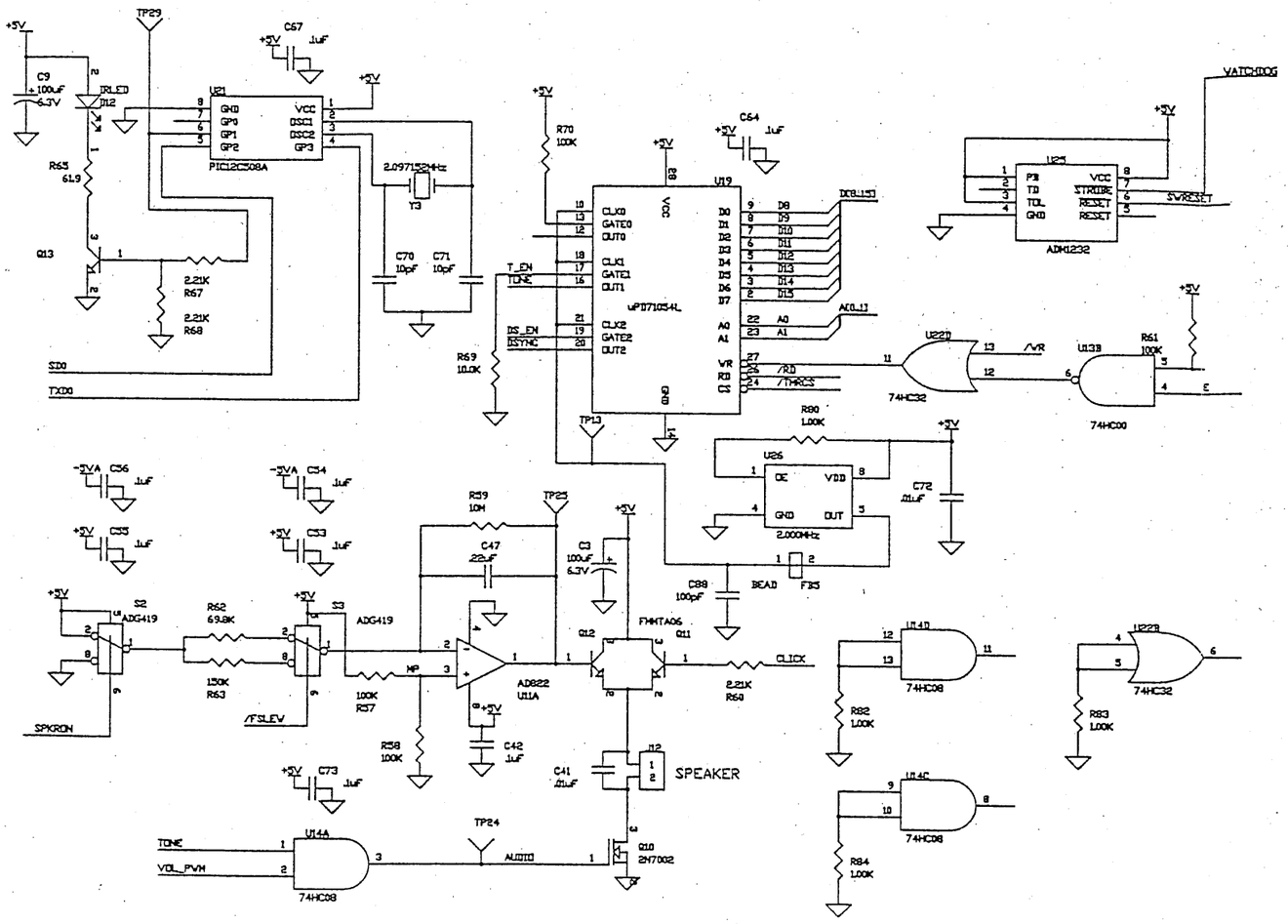
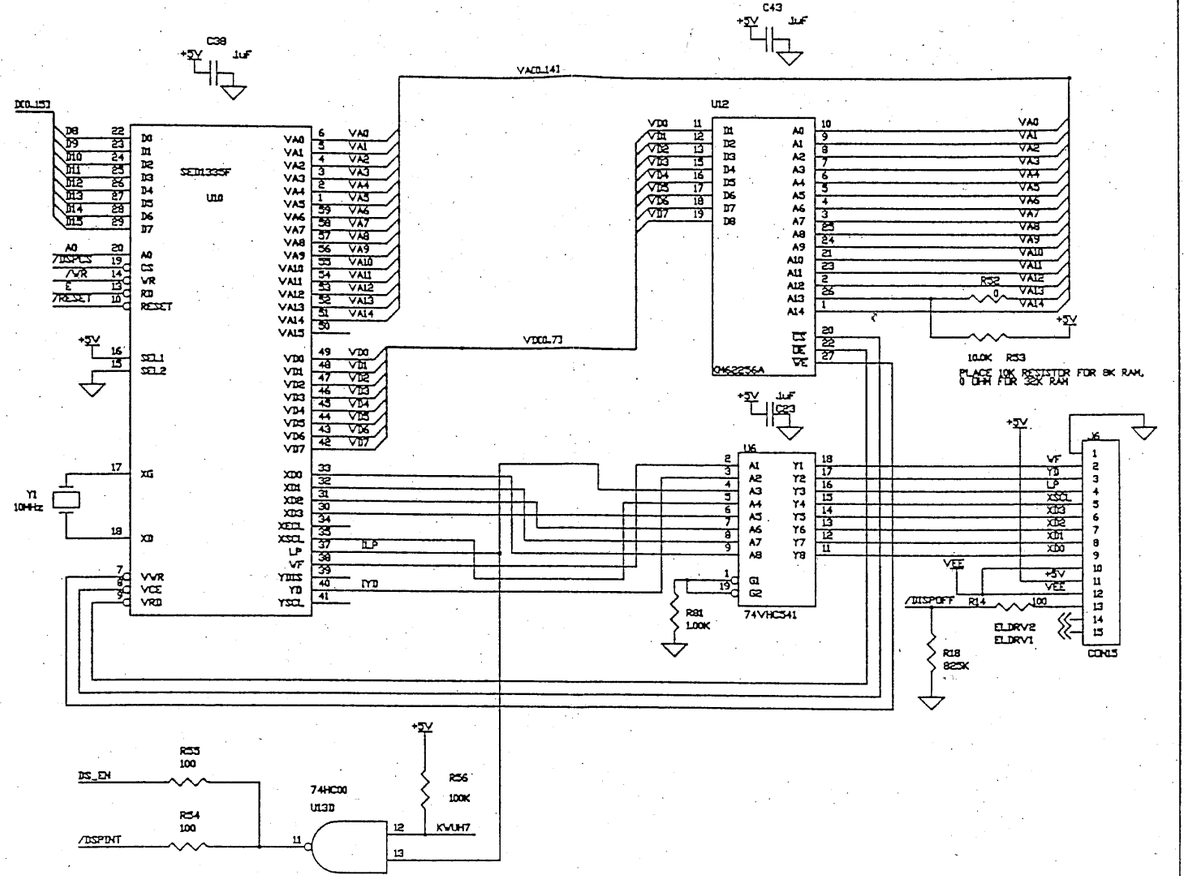
		MFG. APPR.: M.S.
		DATE: 7-15-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC 8400 MAIN BOARD		DRWG NO: 20652S1 REV: 3
		SHT. 2 OF 5

DRWG NO: 20652S1	
REV.	DESCRIPTION
C	SEE SHEET 1 EAR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	SEE SHEET 3 C/N 4301 CLL 9-21-99
2	U25 REMOVE PIN #2 FROM GRD. AND REMOVE PIN #7 FROM U19 PIN #12 AND CONNECT TO U15 PIN #112 C/N 5827 RPA 02-21-00
3	SEE SHEET 1 3-22-01 C/N 1108-01 MAW





ORIGINAL

SIMS BCI, INC.		
DRAWN BY: MER	CHK. BY: C.L.Lange	ENG. APPR.: M.Moritz
DATE: 8-24-98	DATE: 7-16-99	DATE: 7-15-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: Sue Selb
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, INC. OR ITS DESIGNATED AGENT.		DATE: 7-16-99
		MFG. APPR.: M.S.
		DATE: 7-15-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC 8400 MAIN BOARD		DRWG NO: 20652S1 REV. 3
		SHT. 3 OF 5

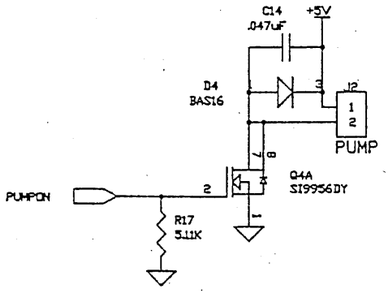
DRWG NO: 20652S1	
REV.	DESCRIPTION
C	SEE SHEET 1 CAR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	SEE SHEET 3 C/N 4301 CLL 9-21-99
2	U25 REMOVE PIN #2 FROM GRD. AND REMOVE PIN #7 FROM U19 PIN #12 AND CONNECT TO U15 PIN #112 C/N 5827 RPA 02-21-00
3	SEE SHEET 1 3-22-01 C/N 1108-01 MAM

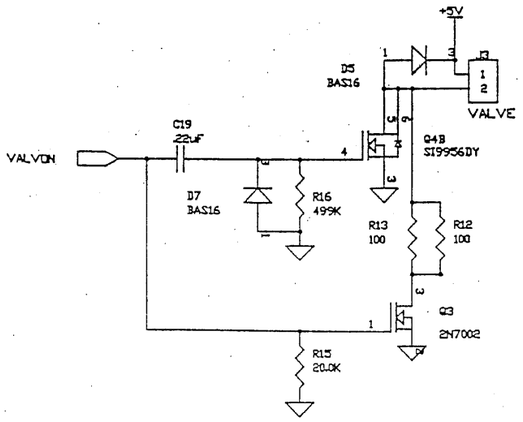
-15V to -5V
Usable voltage range for
-5VA series pass regulator
Is -8 to -15.

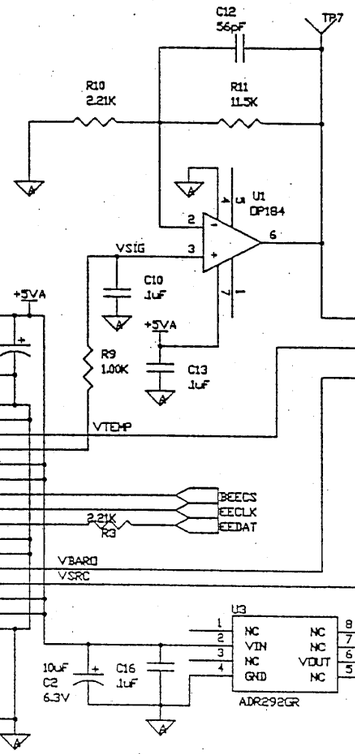
ORIGINAL

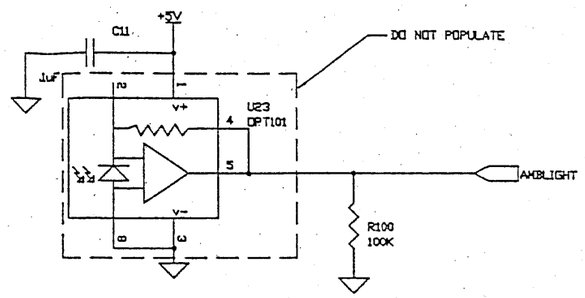
SIMS BCI, INC.		
DRAWN BY: MER	CHK. BY: C.L.Lange	ENG. APPR.: M.Moritz
DATE: 8-24-98	DATE: 7-16-99	DATE: 7-15-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: Sue Selb
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, INC. OR ITS DESIGNATED AGENT.		DATE: 7-16-99 MFG. APPR.: M.S. DATE: 7-15-99
MATERIAL: FINISH:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
TITLE: SCHEMATIC 8400 MAIN BOARD		DRWG NO: 20652S1 REV. 3 SHT. 4 OF 5

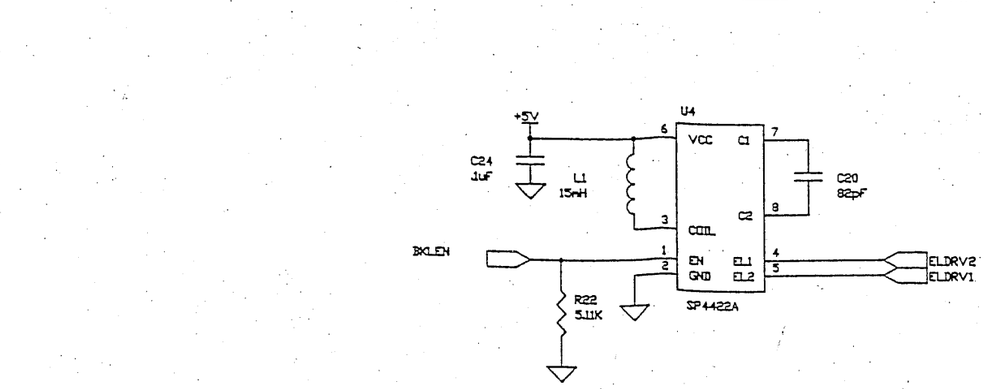
DRWG NO: 20652S1	
REV.	DESCRIPTION
C	SEE SHEET 1 ECR 4131 CLL 7-8-99
0	PRODUCTION RELEASE C/N 5111 CLL 7-8-99
1	SEE SHEET 3 C/N 4301 CLL 9-21-99
2	U25 REMOVE PIN #2 FROM GRD. AND REMOVE PIN #7 FROM U19 PIN #12 AND CONNECT TO U15 PIN #112 C/N 5827 RPA 02-21-00
3	SEE SHEET 1 3-22-01 C/N 1108-01 MAM

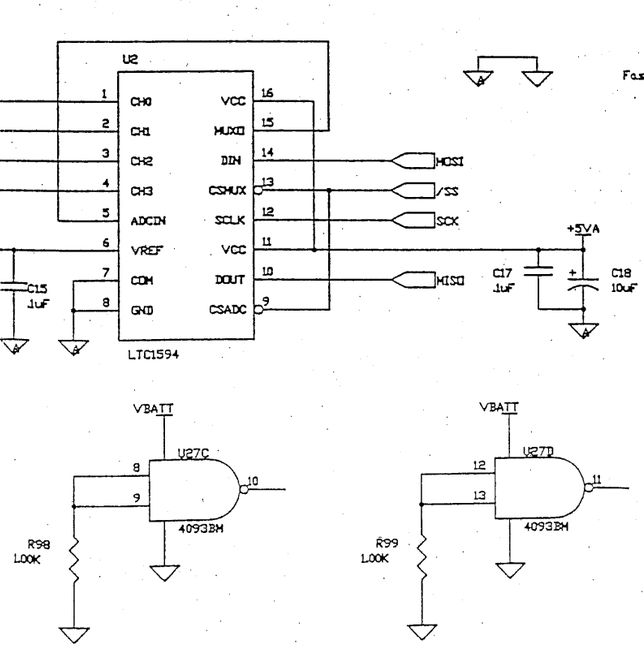


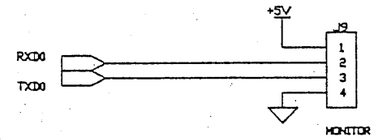


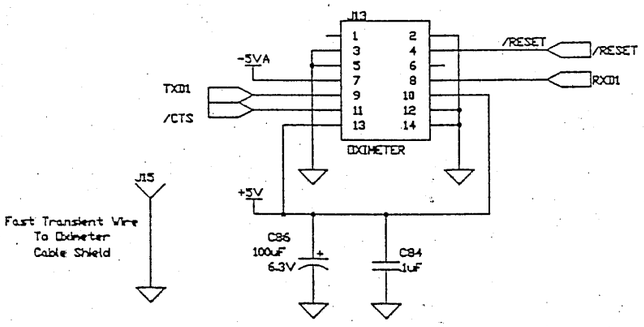








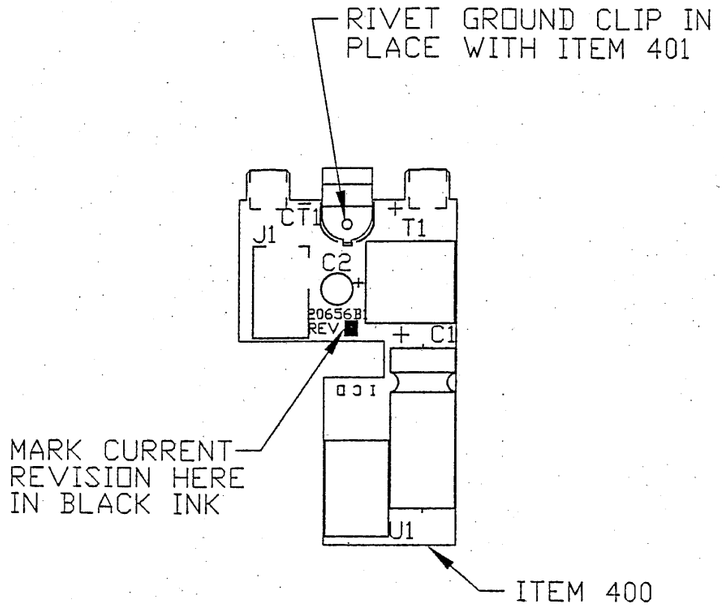


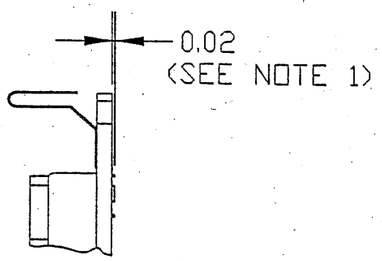


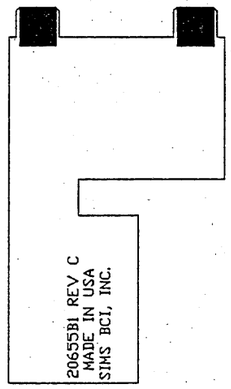
ORIGINAL

SIMS BCI, INC.		
DRAWN BY: MER	CHK. BY: C.L.Lange	ENG. APPR.: M.Moritz
DATE: 8-24-98	DATE: 7-16-99	DATE: 7-15-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: Sue Selb
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, INC. OR ITS DESIGNATED AGENT.		DATE: 7-16-99
		MFG. APPR.: M.S.
		DATE: 7-15-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC 8400 MAIN BOARD	DRWG NO: 20652S1	REV. 3
	SHT. 5 OF 5	

DRWG NO: 20656B1	
REV.	DESCRIPTION
C	REDESIGNED & REDRAWN ON 'B' SIZE C.L.LANGE 7-14-99
0	PRODUCTION RELEASE C/N 4301 CLL 9-21-99







COMPONENT SIDE

SOLDER SIDE

ORIGINAL

NOTES:

1. LEADS CAN NOT PROTRUDE PAST .020 DIM. ON SOLDER SIDE OF BOARD.
2. THIS ASSEMBLY MUST MEET ALL REQUIREMENTS OF IPC-A-610, CLASS 1 (CURRENT REVISION) SPECIFICATION, UNLESS OTHERWISE SPECIFIED.

SHEET 2 IS "V" SIZE

SIMS BCI, INC.

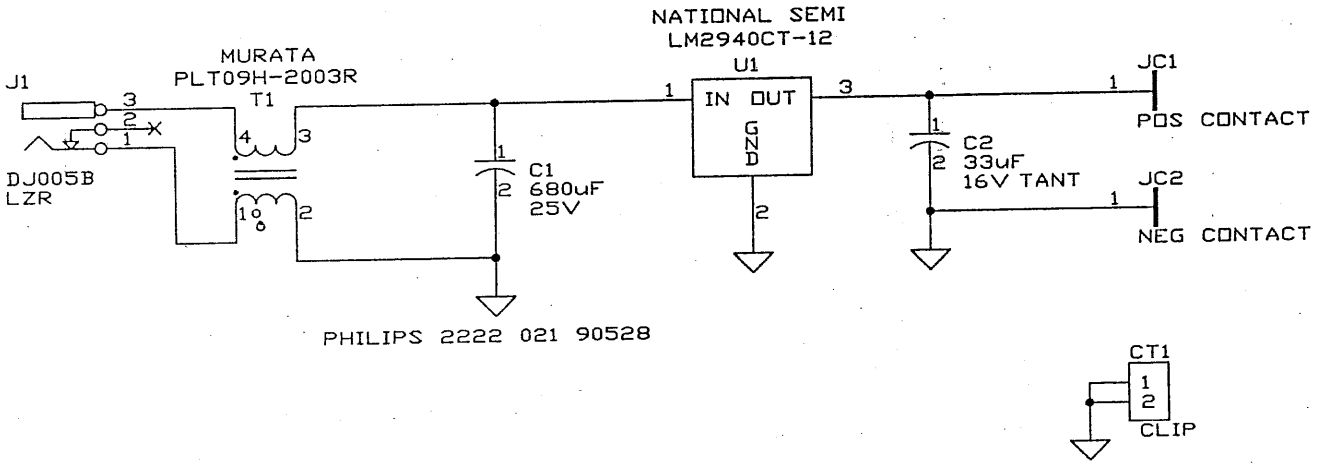
DRAWN BY: C.L.Lange	CHK. BY: Dave Ehn	ENG. APPR: Paul Ryall
DATE: 7-13-99	DATE: 12-9-99	DATE: 10-26-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR: J Seeb
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, INC. OR ITS DESIGNATED AGENT.		DATE: 12-9-99
		MFG. APPR: [illegible]
		DATE: 10-11-99
MATERIAL: ———		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH: ———		
TITLE: PWB ASM BATTERY ELIMINATOR 8400 CAPNOCHECK II		DRWG NO: 20656B1 REV. 0
		SHT. 1 OF 2

SIMS BCI, INC.	Dwg No. 20656B1	
PWB ASM Battery Eliminator 8400 Capnocheck II		Page 2 of 2
	Rev Date: 9-21-99	Rev 0

QTY	DESIGNATION(S)	DESCRIPTION	PACKAGE	MANUFACTURER / PART NUMBER		
1	C1	680uF 25V	THROUGH HOLE AXIAL	PHILLIPS	2222 021 90528	
1	C2	33uF 16V TANT	THROUGH HOLE RADIAL	PANASONIC	ECS-F1CE336K	Or eq.
1	CT1	GROUND CLIP	THROUGH HOLE	BCI (SOLAR SPRING)	BCI P/N 71067B2	
1	J1	CONNECTOR JACK	THROUGH HOLE	LZR	DJ005B	
1	T1	COMMON MODE CHOKE	THROUGH HOLE	MURATA	PLT09H-2003R	
1	U1	REGULATOR, +12V	TO-220	NATIONAL	LM2940CT-12	
1	400	PWB FAB		ANY	BCI P/N 20655B1	Or eq.
1	401	WIDE ROLL EYELET	RIVET	KEYSTONE	#24	Or eq.

ORIGINAL

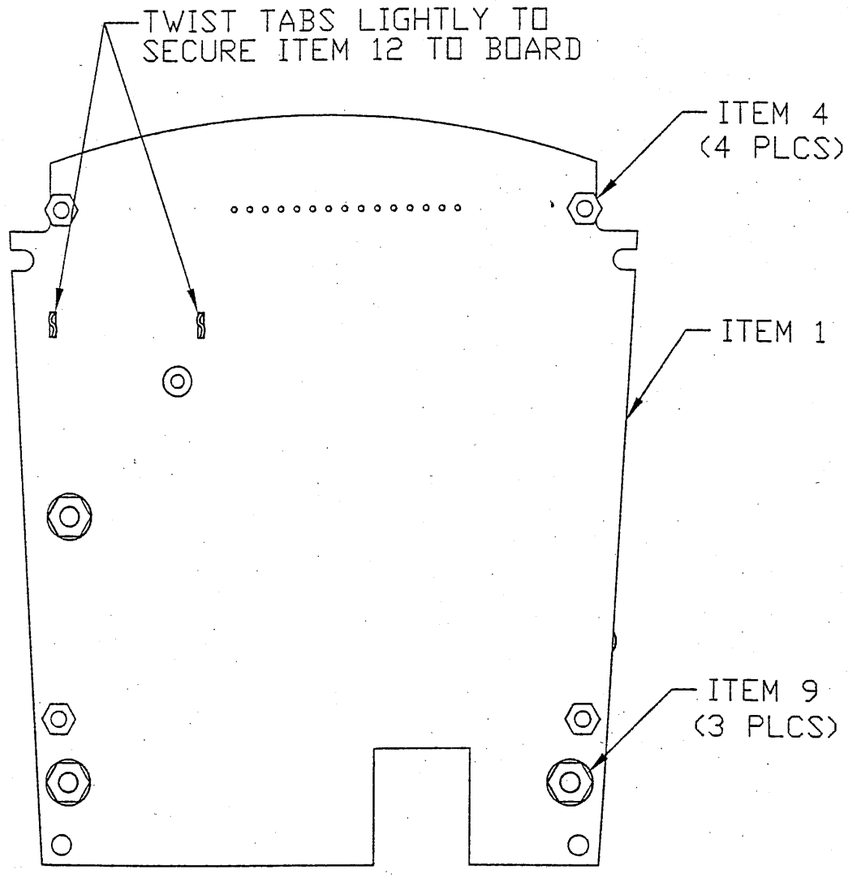
DRWG NO:	20656S1
REV.	DESCRIPTION
B	REDESIGNED AND RE-DRAWN ON "A" SIZE CLL 7-10-99
0	PRODUCTION RELEASE C/N 4301 CLL 9-21-99

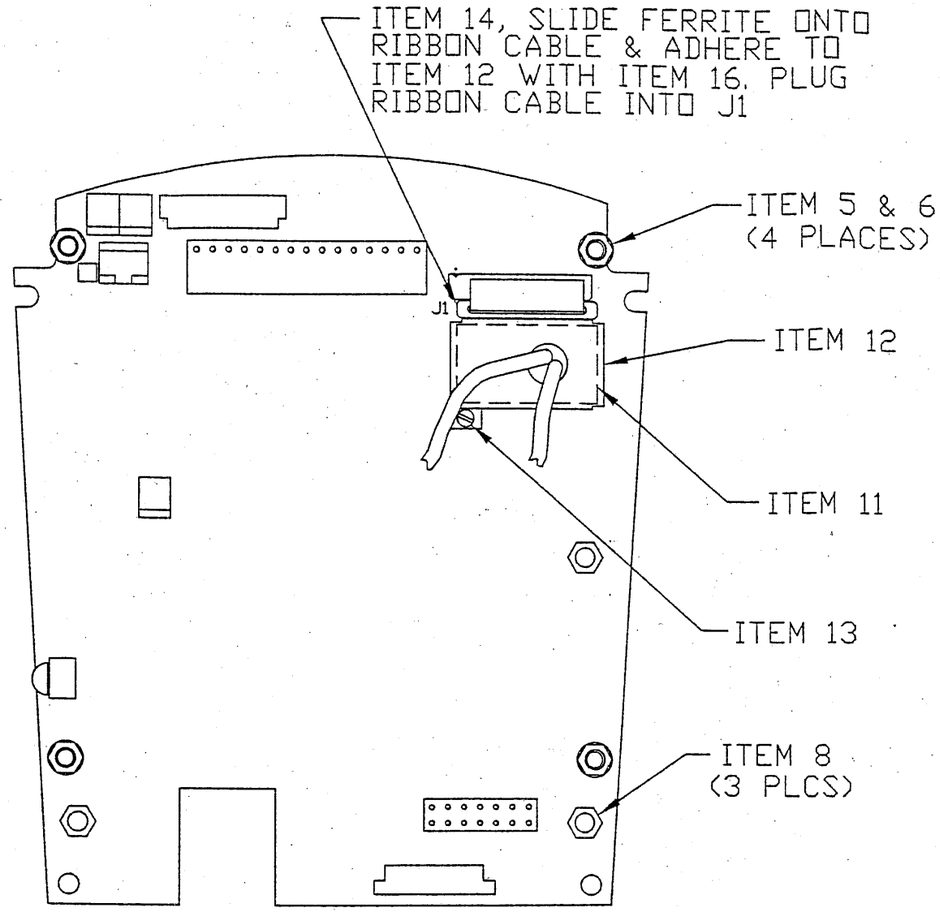


ORIGINAL

SIMS BCI, INC.

DRAWN BY: C.L.Lange	CHK. BY: Chris R. Lange	ENG. APPR.: Paul Ryall
DATE: 7-10-99	DATE: 12-9-99	DATE: 10-26-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: Jsenb
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, INC. OR ITS DESIGNATED AGENT.		DATE: 10-22-99
		MFG. APPR.: M
		DATE: 10-11-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC BATTERY ELIMINATOR BOARD CAPNOCHECK II 8400		DRWG NO: 20656S1 REV. 0
		SHT. 1 OF 1





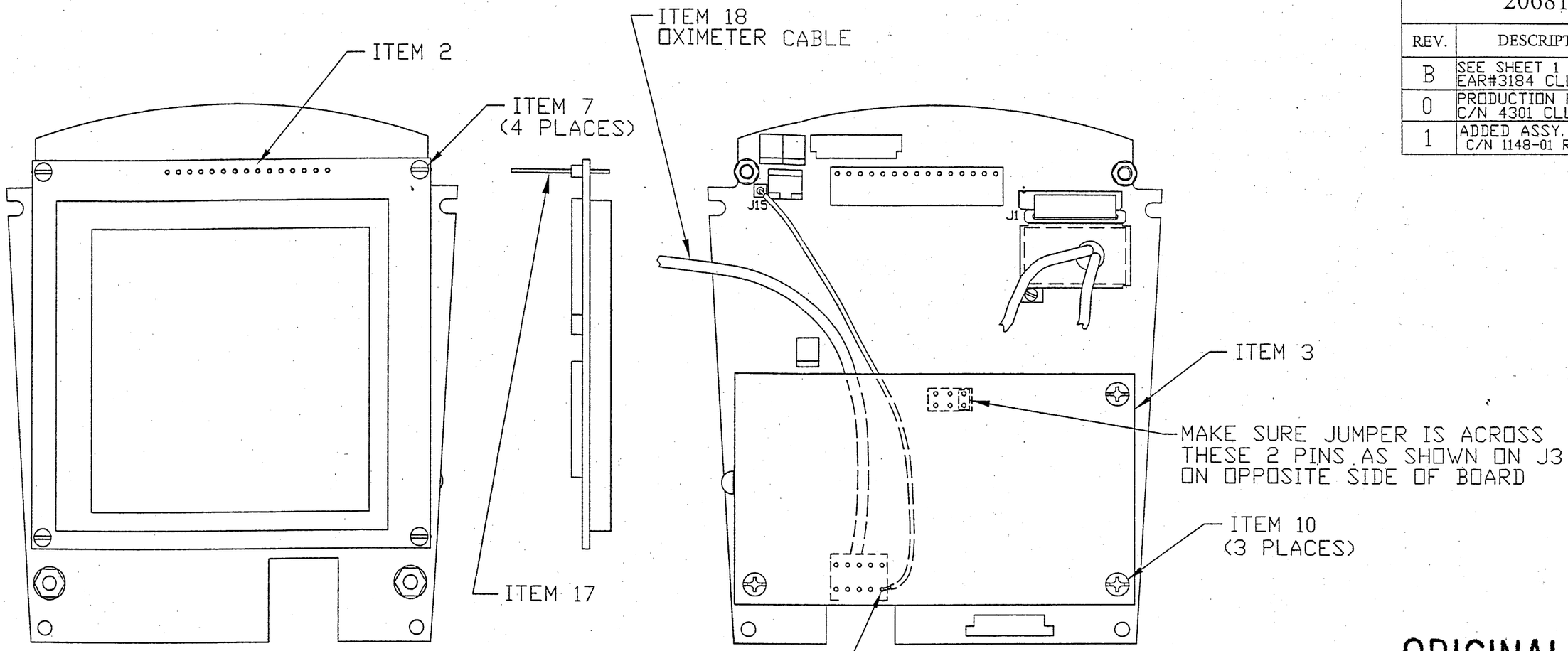
DWG NO: 20681A	
REV.	DESCRIPTION
B	ADDED ITEMS 12 THRU 18 EAR#3184 CLL 9-14-99
0	PRODUCTION RELEASE C/N 4301 CLL 9-14-99
1	ADDED ASSY. A2 C/N 1148-01 RPA 04-18-01

ORIGINAL

SIMS BCI, Inc.

DRN BY:	RJR	CHK. BY:	EHLEN	ENG.:	ROPELLA
DATE:	5-14-98	DATE:	12-9-99	DATE:	10-26-99
SCALE:	NTS	DO NOT SCALE PRINT		Q.A.:	SEIB
				DATE:	12-9-99
				MFG.:	SANDERSON
				DATE:	10-22-99
MATERIAL:				TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°	
FINISH:					
TITLE: PWB ASM MAIN/DISPLAY/SPO2 CAPNOCHECK II 8400 A1=BCI, A2=W/DIG. OXIMETRY BRD.				DWG NO: 20681A	REV. 1
				SHT. 1 OF 2	

DWG NO:	20681A
REV.	DESCRIPTION
B	SEE SHEET 1 EAR#3184 CLL 9-14-99
0	PRODUCTION RELEASE C/N 4301 CLL 9-14-99
1	ADDED ASSY. A2 C/N 1148-01 RPA 04-18-01



ORIGINAL

SIMS BCI, Inc.

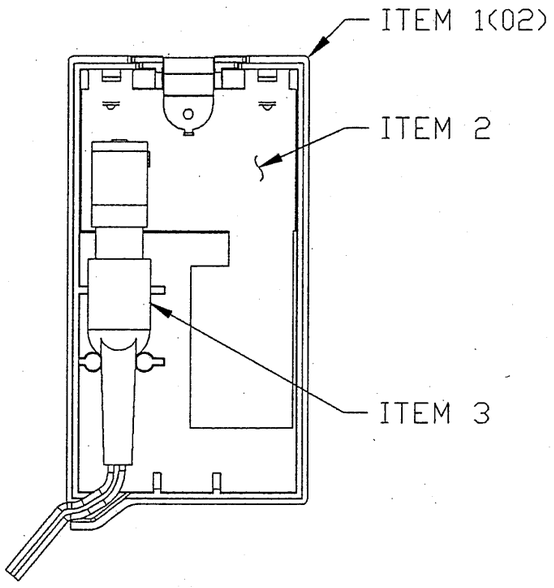
DRN BY: RJR	CHK. BY: EHLEN	ENG.: ROPELLA
DATE: 5-14-98	DATE: 12-9-99	DATE: 10-26-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A.: SEIB
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF SIMS BCI, Inc. OR ITS DESIGNATED AGENT.		DATE: 12-9-99
		MFG.: SANDERSON
		DATE: 10-22-99
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .010 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: PWB ASM MAIN/DISPLAY/SPO2 CAPNOCHECK II 8400 A1=BCI, A2=W/DIG. OXIMETRY BRD.		DWG NO: 20681A SHT. 2 OF 2 REV. 1

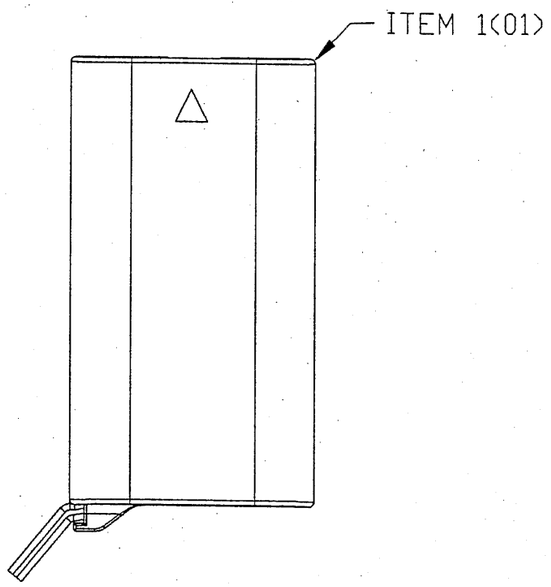
Date : 03-20-01 [12:47]
SIMS BCI, Inc.

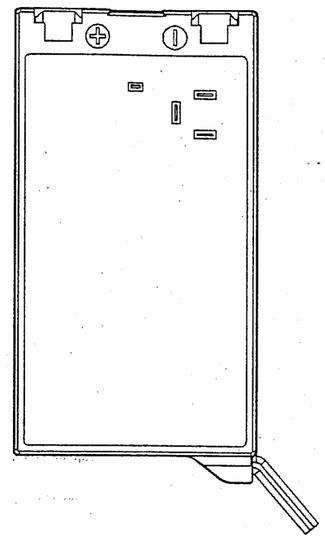
SINGLE-LEVEL PRODUCTION BOMS (1)

Pos.	Item Code	Description	Effect. Date	Expiry Date	Length [IN]	Width [IN]	No.of Units	Net Quantity	Un.	Scpf [%]	Wrk
Manufactured Item	**: 20681A1**	**ASM MAIN/DISP/SPO2 PWBS 8400**					**BOM Rev: 1**				BC
1	20652B1	PWB ASM A/T MAIN BRD	09-25-98					1.0000	EA		MN
2	20653B1	DISP EL MOD LCD FSTN	12-06-99					1.0000	EA		MN
3	71552B1	PWB ASM A/T MAIN BC	09-25-98					1.0000	EA		MN
4	57121B1	SPCR M-F 3/16 HEX 2-	09-25-98					4.0000	EA		MN
5	12010B7	WASHER LOCK NO.2 INT	09-25-98					4.0000	EA		MN
6	70639B1	NUT 2-56 SM PATTERN	09-25-98					4.0000	EA		MN
7	12000B9	SCREW 2-56 X 3/16 BH	09-25-98					4.0000	EA		MN
8	12023B7	SPCR MF 3/16 HX 4-40	09-25-98					3.0000	EA		MN
9	12009B1	NUT KEPS 4-40	09-25-98					3.0000	EA		MN
10	12005B1	SCREW 4-40 X 1/4 PHM	09-25-98					3.0000	EA		MN
11	20577B1	CO2 BENCH 8400/9004	10-15-98					1.0000	EA		MN
12	20696B1	BKT BENCH 8400	12-06-99					1.0000	EA		MN
13	12006B20	SCREW 2-56 X 1/8 RHM	12-06-99					1.0000	EA		MN
14	31027B2	FERRITE OVAL 40 OHMS	12-06-99					1.0000	EA		MN
15	48151B3	WIRE STRAN 22AWG BLK	12-06-99					0.4000	FT		MN
16	58326B1	GLUE HOT MELT *SH*	12-06-99					0.0100	CS		MN
17	58476B3	TERMINAL STRIP 3M 92	12-06-99					1.0000	EA		MN
18	71233B2	CBL OXI 8400	12-06-99					1.0000	EA		MN

DWG NO:	20682A
REV.	DESCRIPTION
B	ADDED B2 & B3 CLL 3-15-99
0	PRODUCTION RELEASE C/N 4301 CLL 9-10-99
1	ADDED NOTE 2 C/N 5855 EJP 1-04-00







NOTE:

1. ITEM 1(01) IS BONDED TO ITEM 1(02) WITH LOCTITE ITEM 4.
2. REPLACE LABEL 20542C132 FROM THE SIDE OF ITEM 3 , WITH THE FOLLOWING LABELS:

   FOR A1 APPLY LABEL P/N 20542C219
   FOR A2 APPLY LABEL P/N 20542C220
   FOR A3 APPLY LABEL P/N 20542C221

ORIGINAL

SIMS BCI, Inc.

DRN BY: RJR	CHK. BY: C.L.LANGE	ENG.: P. ROPELLA
DATE: 7-1-98	DATE: 12-09-99	DATE: 10-26-99
SCALE: NTS	DO NOT SCALE PRINT	Q.A.: S. SEIB

DATE: 12-09-99
MFG.: M.SANDERSON
DATE: 10-11-99

MATERIAL:

FINISH:

TOLERANCE UNLESS OTHERWISE SPECIFIED:
XX: ± .010
XXX: ± .005
ANGLES: ± 1°

TITLE: ASM BATTERY INTERFACE 8400
A1 = 110V A2 = 220V A3 = 90V

DWG NO: 20682A
REV. 1
SHT. 1 OF 1

Date : 06-08-00 [10:16]
SIMS BCI, Inc.

SINGLE-LEVEL PRODUCTION BOMS (1)

Pos.	Item Code	Description	Effect. Date	Expiry Date	Length [IN]	Width [IN]	No.of Units	Net Quantity	Un.	Scpf [%]
Manufactured Item	**: 20682A1**		**ASM BATT IFACE 110V 8400**			**BOM Rev: 1**				
1	20664B1	HSG BATT IFACE TOP/B	10-13-98					1.0000	EA	
2	20656B1	PWB ASM BAT ELIM BRD	10-13-98					1.0000	EA	
3	71202B1	CHGR AC 105V-125V 60	10-13-98					1.0000	EA	
4	20553B1	ADHESIVE LOCTITE PRI	10-13-98					0.0010	BT	
5	20542C219	LBL MOD FOR USE W 84	01-05-00					1.0000	EA	

Date : 06-08-00 [10:22]
SIMS BCI, Inc.

SINGLE-LEVEL PRODUCTION BOMS (1)

Pos.	Item Code	Description	Effect. Date	Expiry Date	Length [IN]	Width [IN]	No.of Units	Net Quantity	Un.	Scpf [%]
Manufactured Item	**: 20682A2**		**ASM BATT IFACE 220V 8400**			**BOM Rev: 1**				
1	20664B1	HSG BATT IFACE TOP/B	10-13-98					1.0000	EA	
2	20656B1	PWB ASM BAT ELIM BRD	10-13-98					1.0000	EA	
3	71202B2	CHGR 208-252V 50/60H	03-15-99					1.0000	EA	
4	20553B1	ADHESIVE LOCTITE PRI	10-13-98					0.0010	BT	
5	20542C220	LBL MOD FOE USE W 84	01-05-00					1.0000	EA	

Date : 06-08-00 [10:22]
SIMS BCI, Inc.

SINGLE-LEVEL PRODUCTION BOMS (1)

Pos.	Item Code	Description	Effect. Date	Expiry Date	Length [IN]	Width [IN]	No.of Units	Net Quantity	Un.	Scpf [%]
Manufactured Item	**: 20682A3**		**ASM BATT IFACE 90V 8400**			**BOM Rev: 1**				
1	20664B1	HSG BATT IFACE TOP/B	10-13-98					1.0000	EA	
2	20656B1	PWB ASM BAT ELIM BRD	10-13-98					1.0000	EA	
3	71202B3	CHGR 90V NEWOX4	03-15-99					1.0000	EA	
4	20553B1	ADHESIVE LOCTITE PRI	10-13-98					0.0010	BT	
5	20542C221	LBL MOD FOR USE W 84	01-05-00					1.0000	EA	

BCI INTERNATIONAL

DRAWING NO. 71202B1

TITLE: CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/105-125VAC INPUT

DWG. CODE: B

SHEET 1 OF 2

REV. NO. 5

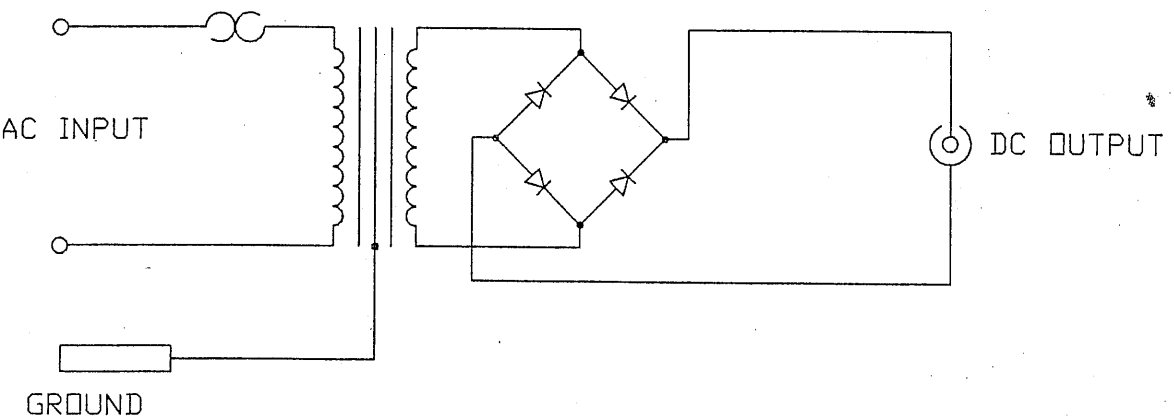
I. SPECIFICATIONS:

A. Input Voltage	105 - 125 VAC w/U.S. Standard Ground Pin
B. Frequency	60 Hz
C. Output Voltage	12VDC @ 120VAC Input
D. Output Current	340mA
E. Isolation Requirements	
Primary to ground pin	1500V RMS
Primary to Secondary	2500V RMS
Secondary to ground pin	2500V RMS
F. Output Cord	18AWG, 6 ft. Lg. with 5.5mm X 2.5mm Plug
G. Construction	Per UL-544 and CSA C22.2 NO. 125
H. Charger Markings	See Sheet 2
I. Max. Temperature Rise	50° C
J. Thermal Cutout	130° C, UL Rec. Component in series with primary. Elcut #U-23 or equiv.

II. HIPOT TESTING

To be performed on each unit by the manufacturer.

A. 4000 VAC primary to secondary, 1 sec.



Revisions

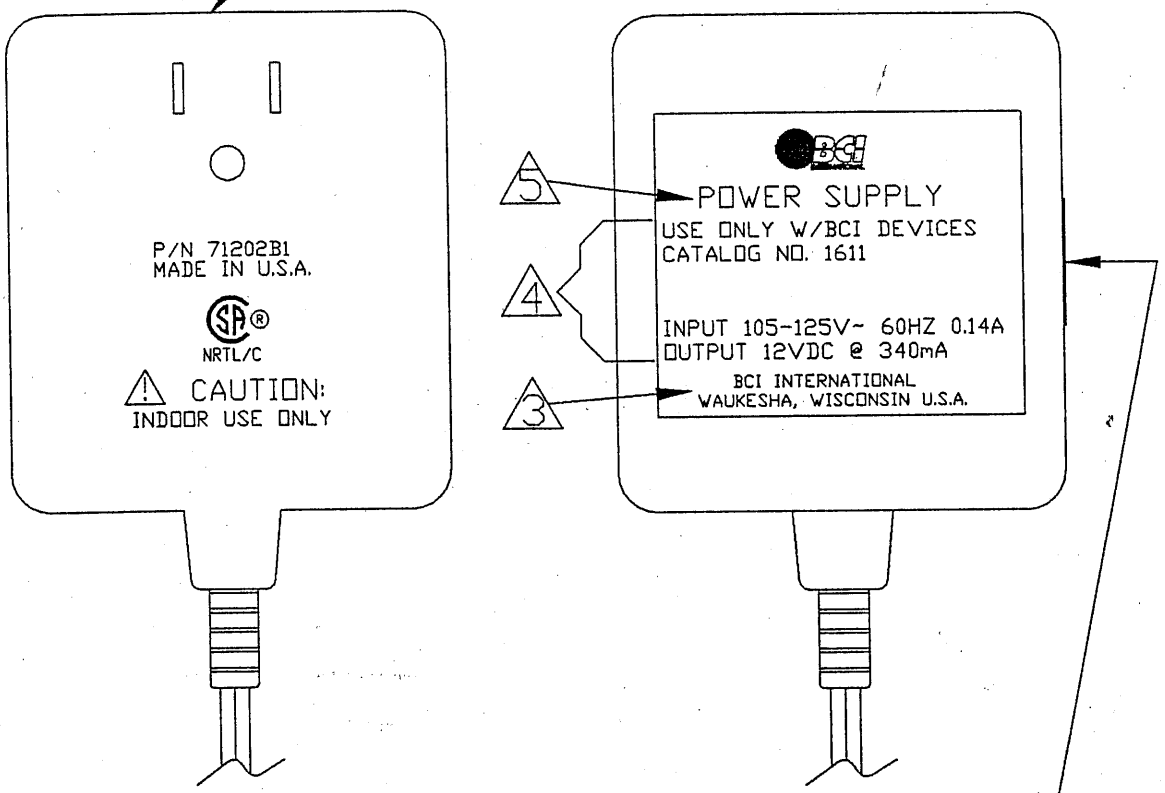
1	SDP 2-28-96	SEE SHEET 2	3	MER 6-3-97	SEE SHEET 2
2	KMK 1-14-97	SEE SHEET 2	4	MER 5-13-98	SEE SHEET 2
			5	EJP 3-21-00	SEE SHEET 2

ORIGINAL

DRAWN BY RJR	APPROVALS E. PALATNIK	J.M. PETER 1-26-96	DWG. NO. 71202B1	
ISSUED 01-25-96	1-25-96	D. SIEFERT 1-30-96	SHEET 1 OF 2	

BCI INTERNATIONAL		DRAWING NO. 71202B1
TITLE: CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/105-125VAC INPUT	DWG. CODE B	SHEET 2 OF 2
		REV. NO. 5

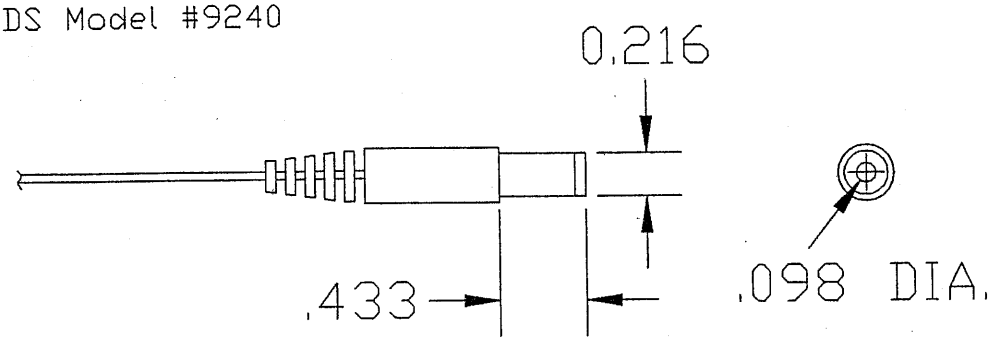
ENCLOSURE SERIES UNIVERSAL



NOTES:
1. CHARGER TO BE HOT STAMPED ON BOTH SIDES WITH INFORMATION SHOWN. INK MUST BE ALCOHOL RESISTANT.
2. CORD TO BE TERMINATED WITH PLUG SHOWN BELOW.
3. LETTERING TO BE 6PT HELVETICA MEDIUM.
4. LETTERING TO BE 10PT HELVETICA MEDIUM.
5. LETTERING TO BE 14PT HELVETICA MEDIUM.
6. BCI SUPPLIED LABEL (P/N 20542C132).

6 ⚠ FOR USE WITH: **3304** AND **3402**

III. APPROVED MANUFACTURER:
EDS Model #9240



Revisions					
1	SDP 2-28-96	REMOVED CSA NRTL/C C/N 2399	3	MER 6-3-97	REMOVED LOT NO. BOX & NOTE 2. RENUMBERED NOTES. C/N 4024
2	KMK 1-14-97	ADDED CSA NRTL/C C/N 2695	4	MER 5-13-98	ADDED LABEL (FOR USE WITH: 3304). C/N 4421
			5	EJP 3-21-00	ADDED 3402 TO LABEL 20542C132. C/N 4770

ORIGINAL

DRAWN BY RJR	APPROVALS E. PALATNIK	J.M. PETER 1-26-96	DWG. NO. 71202B1
ISSUED 01-25-96	1-25-96	D. SIEFERT 1-30-96	SHEET 2 OF 2

BCI INTERNATIONAL	DRAWING NO. 71202B2
TITLE: CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/208-252V~ INPUT	DWG. CODE: B
	SHEET 1 OF 3
	REV. NO. 3

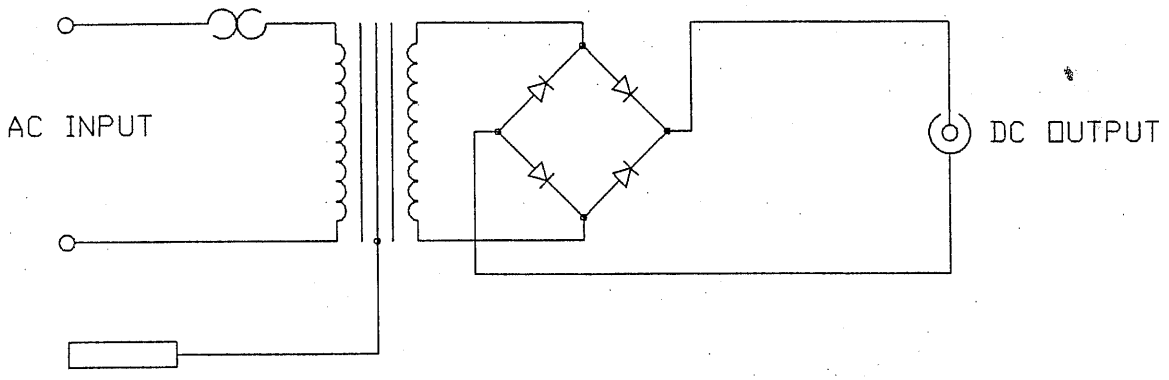
I. SPECIFICATIONS:

A. Input Voltage	208-252V~ w/European Style Plug with Ground Pin
B. Frequency	50/60 Hz
C. Output Voltage	12VDC @ 230VAC Input
D. Output Current	340mA
E. Isolation Requirements	
Primary to secondary	4000V RMS
Primary to ground pin and shield	1500V RMS
Secondary to ground pin and shield	500V RMS
Shield construnction to meet IEC-601 (57.9.4 a&d) requirements	
F. Output Cord	18AWG, 6 ft. Lg. with 5.5mm X 2.5mm Plug
G. Input Cord	18AWG, 6 ft. Lg. w/European Style Plug with Ground Pin Per IEC-601
H. Construction	See Drawing (Sheet 2)
I. Charger Markings	50° C
J. Max. Temperature Rise	130° C, UL Rec. Component in series with primary. Elcut #U-23 or Elmwood Sensors #WA128
K. Thermal Cutout	

II. HIPOT TESTING

To be performed on each unit by the manufacturer

A. 4800 VAC primary to secondary, 1 sec.



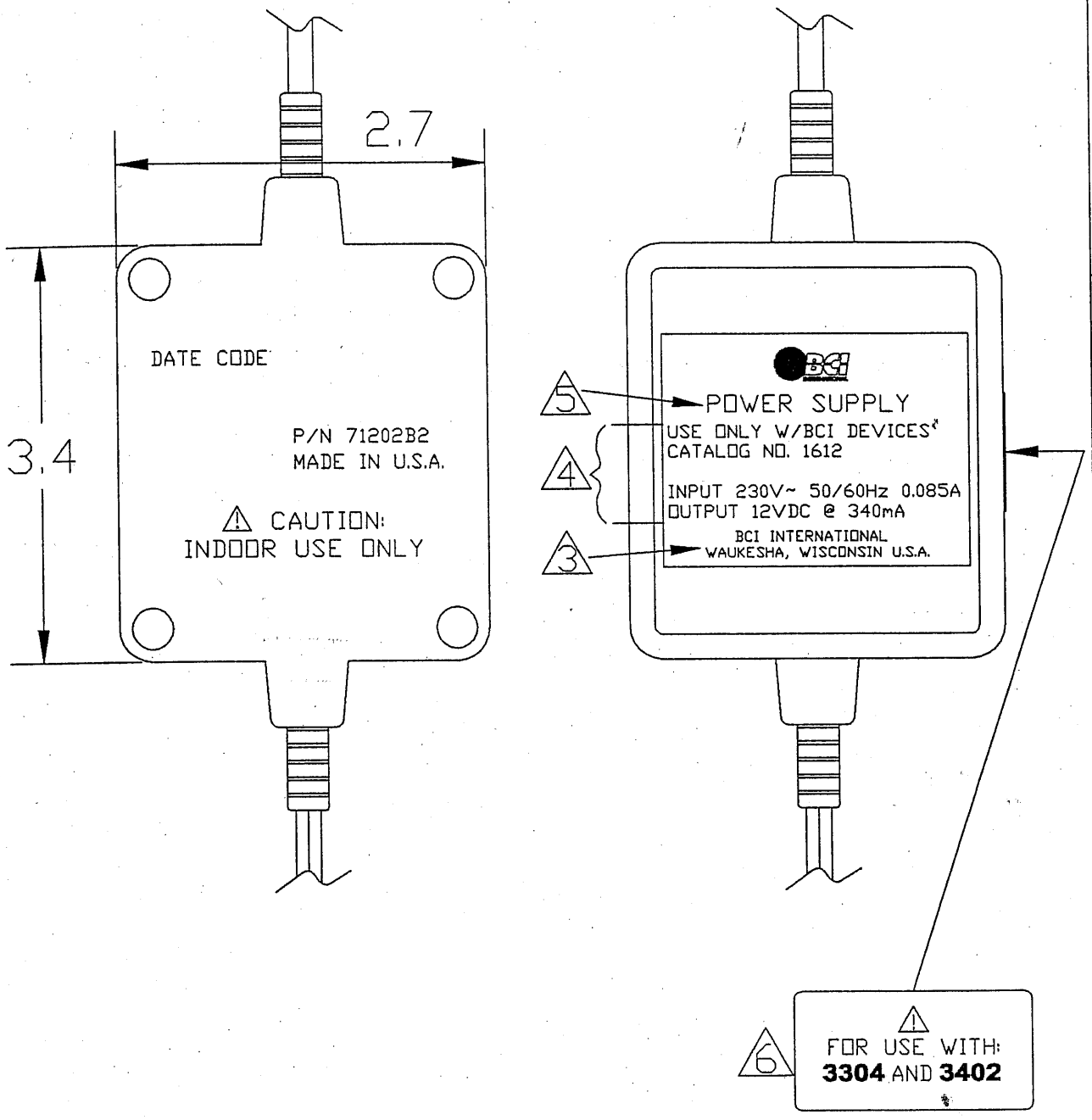
Revisions

1	MER 6-3-97	SEE SHEET 2. C/N 4024
2	MER 5-13-98	SEE SHEET 2. C/N 4421
3	EJP 3-21-00	SEE SHEET 2. C/N 4770

ORIGINAL

DRAWN BY RJR	APPROVALS E. PALATNIK 1-25-96	J.M. PETER 1-26-96	DWG. NO. 71202B2
ISSUED 01-25-96		M. GEISLER 2-1-96	SHEET 1 OF 3

BCI INTERNATIONAL	DRAWING NO. 71202B2
TITLE: CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/208-252V~ INPUT	DWG. CODE: B
	SHEET 2 OF 3
	REV. NO. 3



NOTES:
1. CHARGER TO BE HOT STAMPED ON BOTH SIDES WITH INFORMATION SHOWN. INK MUST BE ALCOHOL RESISTANT.
2. CORD TO BE TERMINATED WITH PLUGS PER SHEET 3.
3. LETTERING TO BE 6PT HELVETICA MEDIUM.
4. LETTERING TO BE 10PT HELVETICA MEDIUM.
5. LETTERING TO BE 14PT HELVETICA MEDIUM.
6. BCI SUPPLIED LABEL (P/N 20542C132).

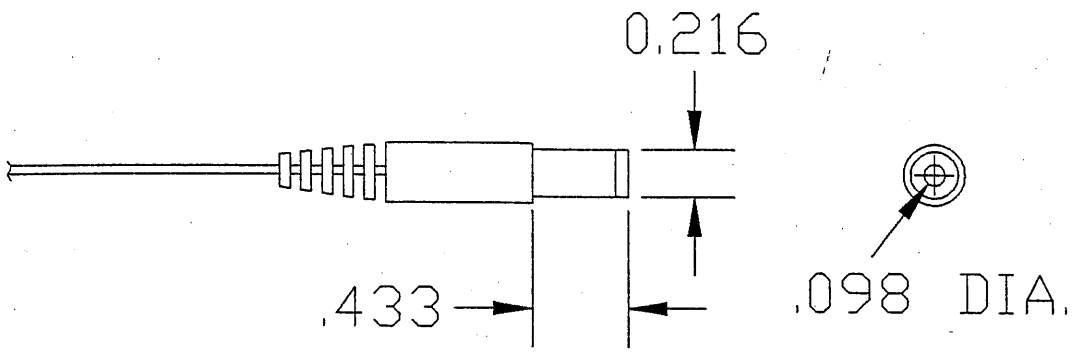
Revisions

1	MER 6-3-97	REMOVED LOT NO. BOX & NOTE 2, RENUMBERED NOTES. C/N 4024	
2	MER 5-13-98	ADDED LABEL (FOR USE WITH: 3304. C/N 4421	
3	EJP 3-21-00	ADDED 3402 TO LABEL 20542C132. C/N 4770	

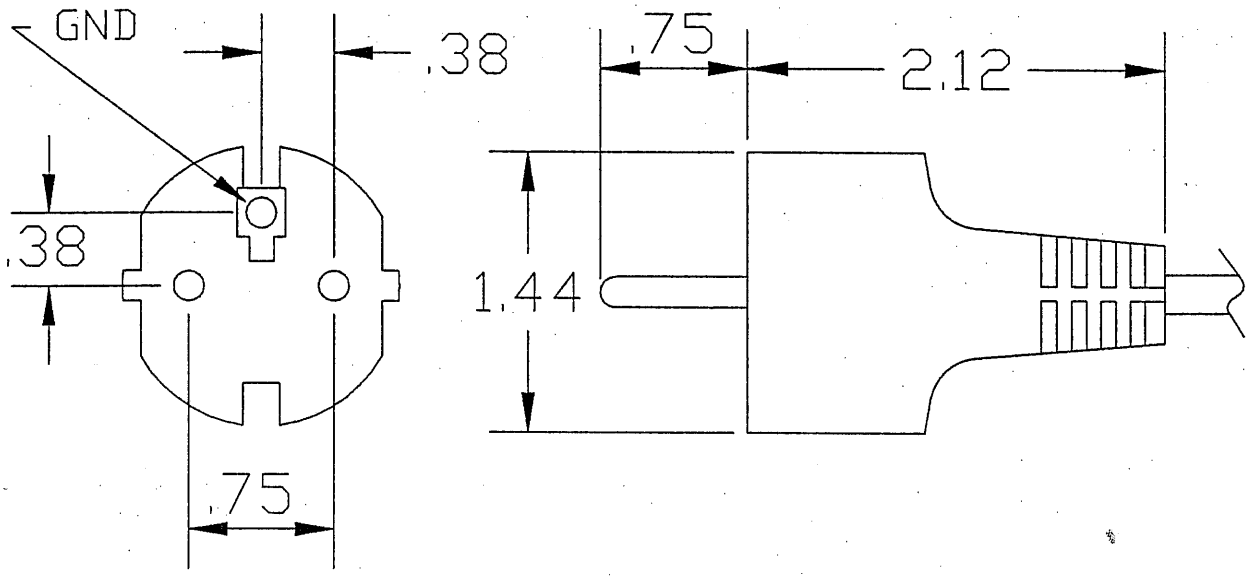
ORIGINAL

DRAWN BY RJR	APPROVALS E. PALATNIK 1-25-96	J.M. PETER 1-26-96	DWG. NO. 71202B2
ISSUED 01-25-96		M. GEISLER 2-1-96	SHEET 2 OF 3

BCI INTERNATIONAL	DRAWING NO. 71202B2
TITLE: CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/208-252V~ INPUT	DWG. CODE B; SHEET 3 OF 3; REV. NO. 3



Output Plug



Wall Plug

III. APPROVED MANUFACTURER:
EDS Model #9241

Revisions			
1	MER 6-3-97	SEE SHEET 2.	C/N 4024
2	MER 5-13-98	SEE SHEET 2.	C/N 4421
3	EJP 3-21-00	SEE SHEET 2.	C/N 4770

DRAWN BY RJR	APPROVALS E. PALATNIK 1-25-96	J.M. PETER 1-26-96	DWG. NO. 71202B2
ISSUED 01-25-96		M. GEISLER 2-1-96	SHEET 3 OF 3

A-30

ORIGINAL

BCI INTERNATIONAL	DRAWING NO. 71202B3
TLE: CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/90-110VAC INPUT	DWG. CODE B; SHEET 1 OF 2; REV. NO. 4

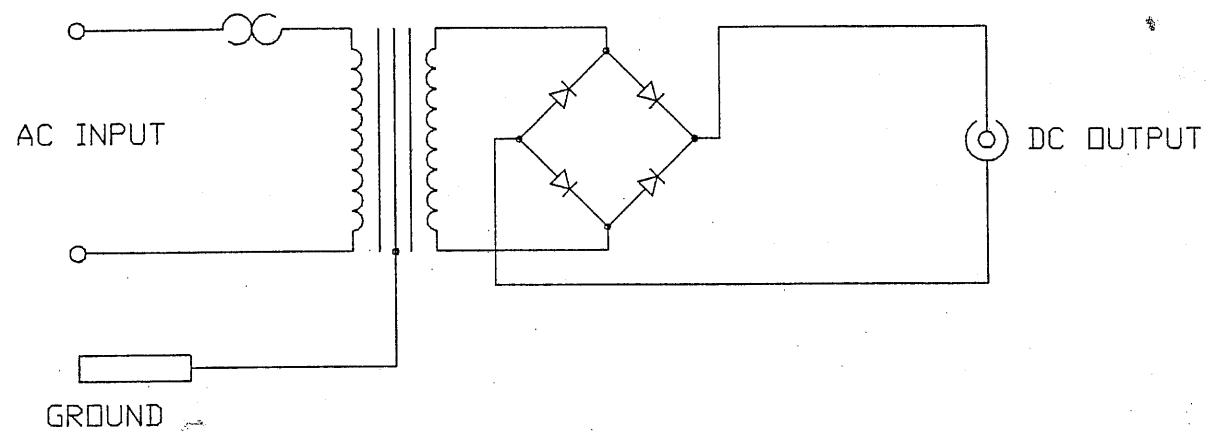
I. SPECIFICATIONS:

A. Input Voltage	90 - 110 VAC w/U.S. Standard Ground Pin
B. Frequency	60 Hz
C. Output Voltage	12VDC @ 120VAC Input
D. Output Current	340mA
E. Isolation Requirements	
Primary to ground pin	1500V RMS
Primary to Secondary	2500V RMS
Secondary to ground pin	2500V RMS
F. Output Cord	18AWG, 6 ft. Lg. with 5.5mm X 2.5mm Plug
G. Construction	Per UL-544 and CSA C22.2 NO. 125
H. Charger Markings	See Sheet 2
I. Max. Temperature Rise	50° C
J. Thermal Cutout	130° C, UL Rec. Component in series with primary. Elcut #U-23 or equiv.

II. HIPOT TESTING

To be performed on each unit by the manufacturer.

A. 4000 VAC primary to secondary, 1 sec.



Revisions		
1	SDP 2-28-96	SEE SHEET 2
2	MER 6-3-97	SEE SHEET 2
3	MER 5-13-98	SEE SHEET 2
4	EJP 3-21-00	SEE SHEET 2

ORIGINAL

DRAWN BY RJR	APPROVALS E. PALATNIK	J.M. PETER 1-26-96	DWG. NO. 71202B3
ISSUED 01-25-96	1-25-96	D. SIEFERT 1-30-96	SHEET 1 OF 2

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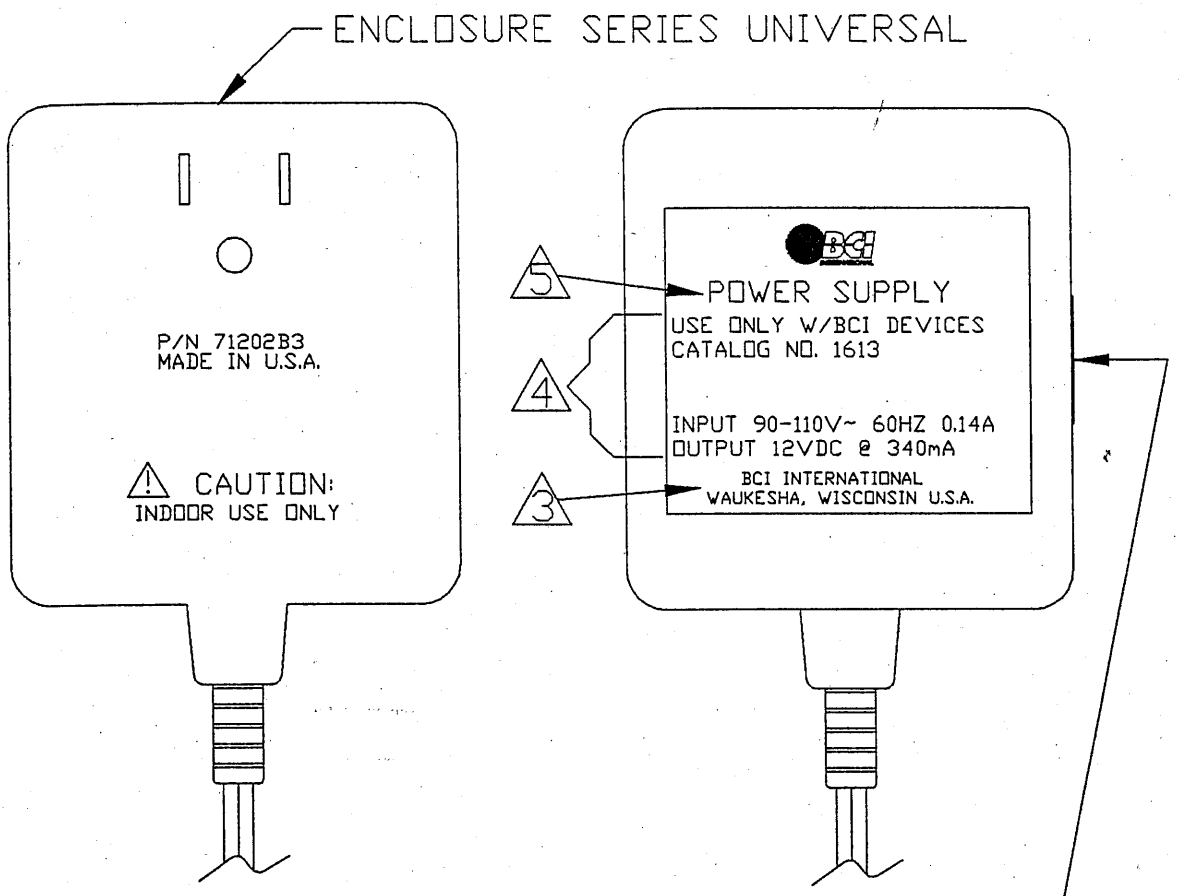
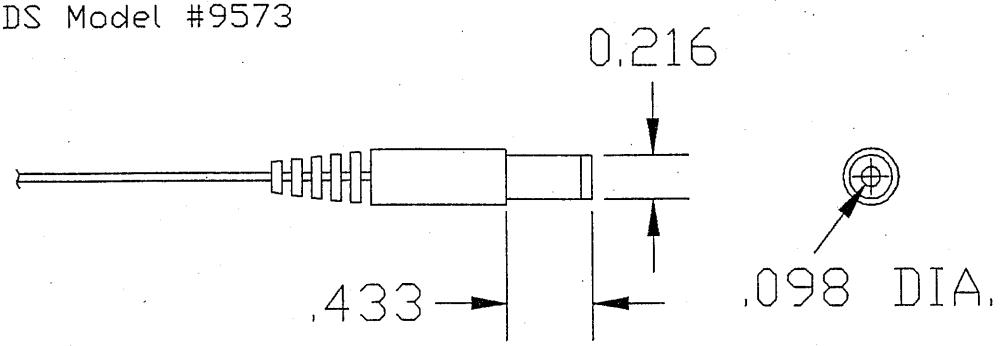
BCI INTERNATIONAL

DRAWING NO.	71202B3
TITLE	CHARGER/POWER SUPPLY ISOLATED 12VDC OUTPUT/90-110VAC INPUT
DWG. CODE	B
SHEET	2 OF 2
REV. NO.	4



NOTES:
1. CHARGER TO BE HOT STAMPED ON BOTH SIDES WITH INFORMATION SHOWN. INK MUST BE ALCOHOL RESISTANT.
2. CORD TO BE TERMINATED WITH PLUG SHOWN BELOW.
3. LETTERING TO BE 6PT HELVETICA MEDIUM.
4. LETTERING TO BE 10PT HELVETICA MEDIUM.
5. LETTERING TO BE 14PT HELVETICA MEDIUM.
6. BCI SUPPLIED LABEL (P/N 20542C132).

III. APPROVED MANUFACTURER:
EDS Model #9573



Revisions

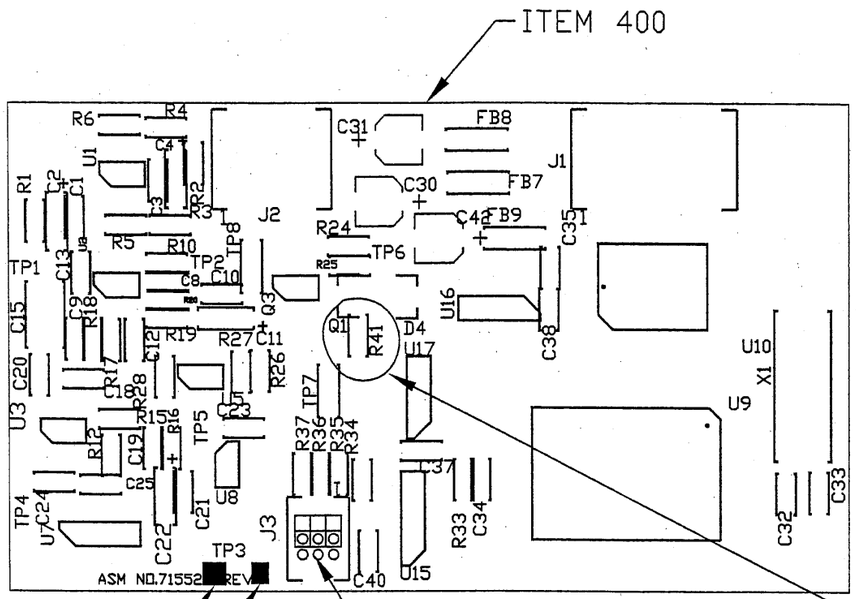
1	SDP 2-28-96	REMOVED CSA NRTL/C C/N 2399	
2	MER 6-3-97	REMOVED LOT NO. BOX & NOTE 2. RENUMBERED NOTES. C/N 4024	
3	MER 5-13-98	ADDED LABEL (FOR USE WITH: 3304). C/N 4421	
4	EJP 3-21-00	ADD 3402 TO LABEL 20542C132 C/N 4770	

ORIGINAL

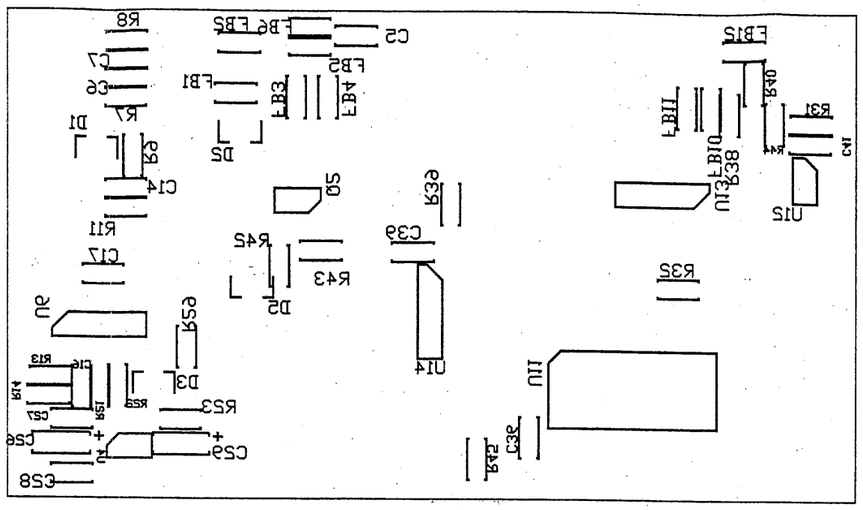
DRAWN BY	RJR	APPROVALS	E. PALATNIK	J.M. PETER 1-26-96	DWG. NO. 71202B3
ISSUED	01-25-96		1-25-96	D. SIEFERT 1-30-96	SHEET 2 OF 2

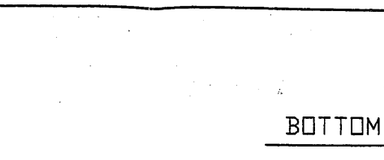
A-32

TOP COMPONENT ASSEMBLY



BOTTOM COMPONENT ASSEMBLY





SOLDER C200 ON TOP OF R41

NOTES:

1. MANUFACTURER TO PLACE A "MFD BY" IDENTIFICATION MARK ON THE BOARD.
2. IF MANUFACTURER TESTS BOARDS, A TEST STAMP MUST BE PLACED ON THE BOARD INDICATING IT PASSED ALL TESTS.
3. VENDOR IS TO BUY, PROGRAM, & INSTALL E-PROM PER SOFTWARE ASSEMBLY ITEM 401.
4. THIS ASSEMBLY MUST MEET ALL REQUIREMENTS OF IPC-A-610, CLASS 1 (CURRENT REVISION) SPECIFICATION, UNLESS OTHERWISE SPECIFIED.

DRWG NO: 71552B1

REV.	DESCRIPTION
C	ADDED THIS SHEET. C/N 4136 MER 8-13-97
0	PRODUCTION RELEASE. C/N 4136 MER 8-13-97
1	REMVD 'TO BE INSTALLED BY BCI' FROM IT. 402 NOTE. C/N 4954 MER 4-26-99
2	ADDED HYUNDAI PART TO U11 C/N 5850 RPA 01-04-00
3	ADDED C200, R12 WAS 249K ADDED DETAIL OF C200 ON TOP OF R41 C/N 6174 RPA 07-18-00
4	U2 WAS TEXAS INST. P/N TLC2272CD ADDED ALT. P/N TO U2 C/N 6227 JBK 8-16-00
5	ADDED TEXAS INSTRUMENTS P/N TLC2272ACD AS AN APPROVED SOURCE FOR U3 C/N 6338 JBK 10-24-00
6	CREATE PREFERRED AND ALTERNATE PART FOR U3 C/N 1062-01 RPA 02-15-01
7	SOCKET FOR 32PLCC WAS 821977-1 C/N 1024-02 RPA 01-23-01

ORIGINAL

SHEETS 2-4 "V" SIZE

BCI INTERNATIONAL

DRAWN BY: MER	CHK. BY: Paul Ropella	ENG. APPR.: M. S. Gelsler
DATE: 8-8-97	DATE: 8-14-97	DATE: 8-14-97
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: D. Schoeffel
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 8-14-97
		MFG. APPR.: M. Sanderson
		DATE: 8-14-97
MATERIAL: -------		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH: --------		
TITLE: PWB ASM MAIN BC SP02		DRWG NO: 71552B1 REV.: 7
		SHT. 1 of 4

A-33

QTY	DESIGNATORS	DESCRIPTION	PKG	MANUFACTURER/PART NUMBER
23	C1,C3,C5,C9, C10,C12,C13, C16,C17,C20, C21,C23,C25, C27,C28,C34, C35,C36,C37, C38,C39,C40, C41	.1uF 50V +80%-20% Y5V	0805	Any
5	C2,C4,C11, C22,C26	1uF 16V TANTALUM	3216	Panasonic ECS-T1CY105R *or* ANY
2	C6,C7	68pF NPO 50V 5%	0805	Any
3	C8,C14,C200	220pF NPO 50V 5%	0805	Any
1	C15	.12uF FILM 16V 5% or .12uF FILM 16V 5% or .1uF FILM 16V 5%	1913 1913 1913	Panasonic ECW-U1C124JB9 *or* NIC NSFC124J16TRD2 *or* NIC NSFC104J50TRD2
1	C18	.001uF FILM 50V 5%	0805	Panasonic ECH-U1H102JB5 *or* NIC NSPC102J50TRA1
1	C19	1000pF NPO 50V 5%	0805	ANY
3	C24,C32,C33	10pF NPO 50V +/-0.5pF	0805	ANY
1	C29	4.7uF TANTALUM 16V	3216	Panasonic ECS-T1CY475R *or* ANY
3	C30,C31,C42	47uF ELECTROLYTIC 6.3V	5x5.5	NIC NACE470M6.3V5x5.5
4	D1,D2,D4,D5	DUAL-DIODE BAV99LT1	SOT-23	Motorola or ANY
1	D3	VREF LM4040DIM3-2.5	SOT-23	National Semi LM4040DIM3-2.5
9	FB1,FB2,FB3, FB4,FB5,FB6, FB10,FB11, FB12	EMI-FILTER BLM21B222SPT	0805	Murata Erie BLM21B222SPT
3	FB7,FB8,FB9	EMI-FILTER BLM41A01	1806	Murata Erie BLM41A800SPT
1	J1	14POS DUAL-ROW .1x.1 HEADER	SMT	Samtec TSM-107-01-L-DV-A
1	J2	10POS DUAL-ROW .1x.1 HEADER	SMT	Samtec TSM-105-01-L-DV-A
1	J3	6POS DUAL-ROW 2MM HEADER	SMT	Samtec TMM-103-01-G-D-SM *or* ANY
1	Q1	MMBT05LT1 NPN	SOT-23	Motorola MMBT05LT1 *or* ANY
1	Q2	DUAL N-CHANNEL	SO-8	Siliconix SI9955DY *or* Samsung SI9956DY *or* International Rect. IRF7101 or IRF7103 *or* Diodes Inc. DID2009 or DID2003

ORIGINAL

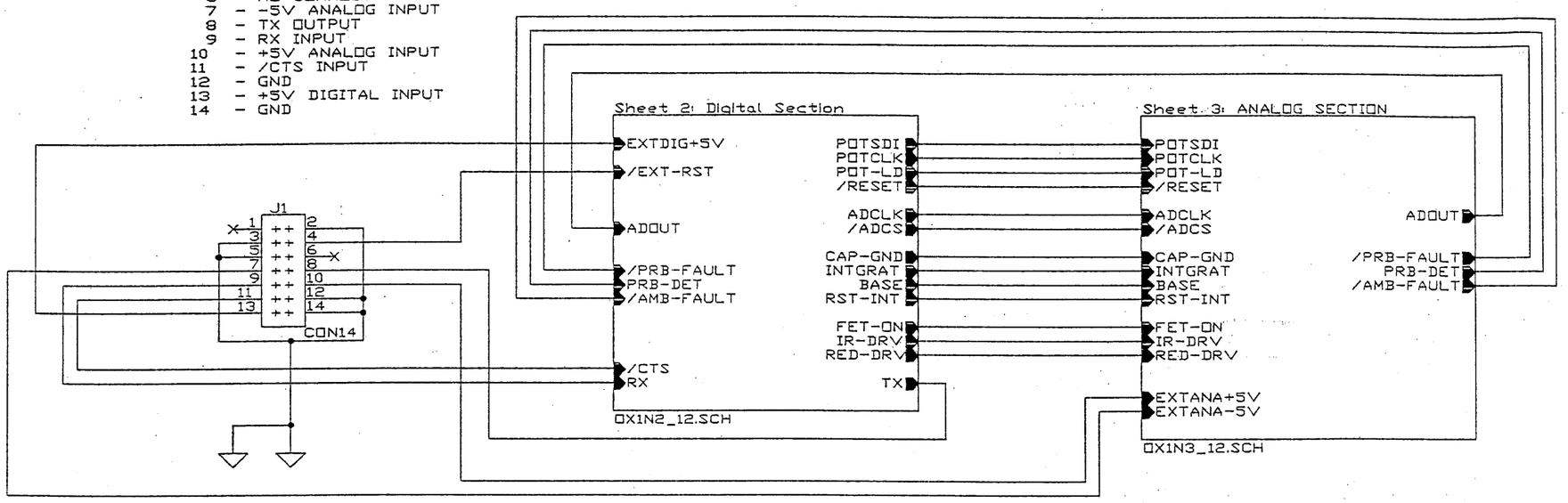
QTY	DESIGNATORS	DESCRIPTION	PKG	MANUFACTURER/PART NUMBER
1	Q3	DUAL P-CHANNEL	SO-8	Siliconix SI9953DY *or* Samsung SSD2005 *or* Texas Instruments TPS1120 *or* Diodes Inc. DID2005 *or* International Rect.IRF7104
4	R1,R2,R16, R23	47 5%	0805	Any
5	R3,R4,R22, R42,R43	2.15K 1%	0805	Any
7	R5,R6,R9,R10 R11,R20,R21	11K 1%	0805	Any
7	R7,R8, R14,R17,R18, R27,R29	249K 1%	0805	Any
1	R12	499K 1%	0805	Any
1	R13	24.9K 1%	0805	Any
1	R15	49.9K 1%	0805	Any
2	R19,R31	270 5%	0805	Any
2	R25,R24	15 1%	0805	Any
7	R26,R32,R33, R34,R35,R36, R37	180K 5%	0805	Any
1	R28	200K 1%	0805	Any
3	R38,R39,R41	1K 5%	0805	Any
1	R40	10 5%	0805	Any
2	R44, R45	820K 5%	0805	Any
2	TP7,TP8	TESTPOINT CHIP	1206	KOA Speer Electronics RCW
1	U1	TLC2272CD DUAL OP-AMP	SO-8	Texas Instruments TLC2272CD
1	U2	OP-AMP	SO-8	(Preferred) National Semiconductor LM6132BIM, or Analog Devices AD822AR
1	U3	AD822AR DUAL OP-AMP	SO-8	Analog Devices AD822AR Preferred TEXAS INST TLC2272ACD Alternate
1	U4	TLC272CD DUAL OP-AMP	SO-8	Texas Instruments TLC272CD
1	U5	LM393M DUAL COMPARATOR	SO-8	National Semiconductor LM393M
1	U6	DG308ACY QUAD SPST SWITCH	SO-16	Siliconix *or* Maxim DG308ACY
1	U7	AD8402AR10 DIGITAL POT	SO-14	Analog Devices AD8402AR10
1	U8	LTC1286CS8 12-BIT ADC	SO-8	Linear Technology LTC1286CS8
1	U9	HD64180RF8X PROCESSOR	FP-80	Hitachi HD64180RF8X
1	U10	SOCKET 32POS PLCC	32PLCC	AMP 822498-1
1		27C256-20/L EPROM	32PLCC	Microchip 27C256-20/L *or* ANY
1	U11	6264 8Kx8 SRAM	SO-28	Hitachi HM6264ALFP-15T or HYUNDAI HY6264ALJ-10 or any
1	U12	ADM705AR uP-SUPERVISOR	SO-8	Analog Devices ADM705AR
1	U13	74HC139D DUAL 1OF4 DECODER	SO-16	Motorola MC74HC139D *or* Any
1	U14	74HC259D 8-BIT ADDR-LATCH	SO-16	Motorola MC74HC259D *or* Any

ORIGINAL

DRWG NO: 71552S1	
REV.	DESCRIPTION
0	PRODUCTION RELEASE. C/N 4136 MER 8-13-97
1	SEE SHEET 3 C/N 6174 RPA 07-18-00
2	SEE SHEET 3 C/N 6227 JBK 8-17-00

CONNECTOR J1
POWER AND COMMUNICATION

1 - NO CONNECT
2 - GND
3 - GND
4 - /RESET INPUT
5 - GND
6 - NO CONNECT
7 - -5V ANALOG INPUT
8 - TX OUTPUT
9 - RX INPUT
10 - +5V ANALOG INPUT
11 - /CTS INPUT
12 - GND
13 - +5V DIGITAL INPUT
14 - GND



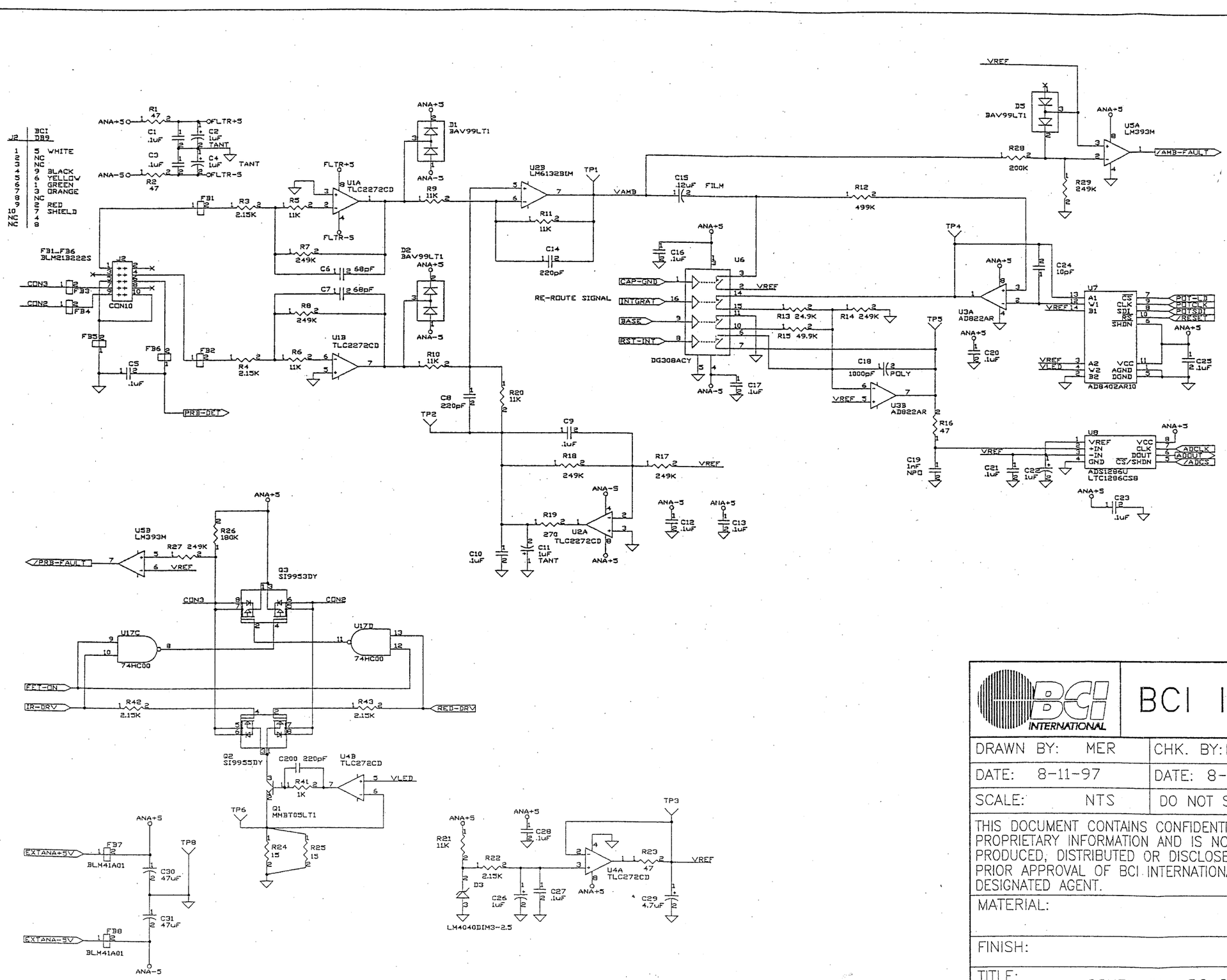
ORIGINAL

BCI INTERNATIONAL		
DRAWN BY: MER	CHK. BY: P. ROPELLA	ENG. APPR.: GEISLER
DATE: 8-11-97	DATE: 8-14-97	DATE: 8-14-97
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: DAS
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 8-14-97
		MFG. APPR.: M.S.
		DATE: 8-14-97
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC, BC SP02 MAIN BOARD		DRWG NO: 71552S1 REV.: 2
		SHT 1 OF 3

DRWG NO: 71552S1	
REV.	DESCRIPTION
0	PRODUCTION RELEASE. C/N 4136 MER 8-13-97
1	SEE SHEET 3 C/N 6174 RPA 07-18-00
2	SEE SHEET 3 C/N 6227 JBK 8-17-00

ORIGINAL

BCI INTERNATIONAL		
DRAWN BY: MER	CHK. BY: P. ROPELLA	ENG. APPR.: GEISLER
DATE: 8-11-97	DATE: 8-14-97	DATE: 8-14-97
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: DAS
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 8-14-97
		MFG. APPR.: M.S.
		DATE: 8-14-97
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC, BC SP02 DIGITAL SECTION		DRWG NO: 71552S1 REV.: 2
		SHT 2 OF 3



DRWG NO: 71552S1	
REV.	DESCRIPTION
0	PRODUCTION RELEASE. C/N 4136 MER 8-13-97
1	ADDED C200, R12 WAS 249K C/N 6174 RPA 07-18-00
2	P/N FOR U2 WAS TLC2272CD C/N 6227 JBK 8-17-00

ORIGINAL

BCI INTERNATIONAL

DRAWN BY: MER	CHK. BY: P. ROPELLA	ENG. APPR.: GEISLER
DATE: 8-11-97	DATE: 8-14-97	DATE: 8-14-97
SCALE: NTS	DO NOT SCALE PRINT	Q.A. APPR.: DAS
THIS DOCUMENT CONTAINS CONFIDENTIAL AND/OR PROPRIETARY INFORMATION AND IS NOT TO BE RE-PRODUCED, DISTRIBUTED OR DISCLOSED WITHOUT PRIOR APPROVAL OF BCI INTERNATIONAL OR ITS DESIGNATED AGENT.		DATE: 8-14-97
		MFG. APPR.: M.S.
		DATE: 8-14-97
MATERIAL:		TOLERANCE UNLESS OTHERWISE SPECIFIED: XX: ± .020 XXX: ± .005 ANGLES: ± 1°
FINISH:		
TITLE: SCHEMATIC, BC SP02 ANALOG SECTION		DRWG NO: 71552S1 REV.: 2
		SHT 3 OF 3

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