Passport 2®/
Passport 2LT™

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Chapter

Foreword

This Service Manual is intended as a guide for technically qualified personnel durin repair and calibration procedures. The information has been divided into the eight ch: listed above. A detailed table of contents is provided on the first page of each chapt

This publication may have been updated to reflect product design changes and/or m: improvements. Any such changes to this manual would be accomplished by supplyi replacement pages and instructions for inserting or affixing them into the manual.

Note

Unauthorized servicing may void the remainder of the warranty. Check with the fact with a local authorized Datascope representative to determine the warranty status of particular instrument.

Warning

The **Passport 2** operates on line voltages. Therefore, an electric shock hazard may e: when the instrument covers are removed. Repair and calibration procedures should c be performed by qualified personnel who proceed with care and follow proper servic techniques. Warnings are given in Chapters 4 and 7, as well as in other appropriate locations.

NOTE: This product is year 2000 compliant.

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1.0 *Operation*

1.1 Introduction

Sections 1.2 and 1.3 are intentionally left blank, please refer to the Operating Instruc
for complete details.

OPERATING INSTRUCTIONS	PART NUMBER
Domestic	0070-00-0440-01
International	0070-00-0440-02

1.2   Controls, Indicators And Connectors

THIS SECTION LEFT INTENTIONALLY BLANK. REFER TO THE OPERATII
INSTRUCTIONS.

1.3   Operation

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INSTRUCTIONS.

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2.0 *Theory of Operation*

2.1   CPU Control Module

Overview

This board has the main program and system controller for the **Passport 2**. It also cont
the Communications Coprocessor, PCMCIA interface, RTC, Audio, CRT/LCD contro
Serial Channels and module bus interface connectors.

2.1.1   Microcontroller, U2

Device U2, is a MPC860T Microcontroller, which contains a PowerPC core, 32 bit
address and data bus, Memory Controller (8 banks), general purpose timers, System
Integration Unit (SIU), Multi-Level Interrupts, Communications Processor, SPI po
Mbit Ethernet Controller, and a Dual PCMCIA interface. Clock oscillator Y1, 5 M
multiplied by the MPC860T, PLL circuit to achieve the 45Mhz operating frequency
are five serial channels, which all are used. Two are full RS-232 compliant and are
for external communications. One is used for the Recorder module, one is used for
Audio Synthesizer and another is used for the Defib Interface.

2.1.2   Serial Communications Channels

There are four serial communications channels (SCC) that are part of the MPC860'
Communication Processor Module. The following describes the function of each o

SCC1 - This channel is assigned to external communication use. It is buffered (U4
RS-232 levels before connection to the external interface connector which is part o
base station or mini-port system. SCC1 will operate in the standard UART mode w
hardware control lines available.

SCC2 - This channel is assigned to external communication use. It is buffered (U5
RS-232 levels before connection to the external interface connector which is part o
base station or Comm-Port system. SCC2 will operate in the standard UART mode
all hardware control lines available.

SCC3 - Spare, not used.

SCC4 - This channel is assigned to the serial Recorder. It operates at 3V logic levels
connected to Recorder Connector J8. SCC4 will operate in the standard UART mod
all hardware control lines available.

There are two Serial management Channels (SMC) that are part of the MPC860T
Communication Processor Module. The following describes the function of each o

SMC1 - Not used. Pins used as general I/O. This channel is assigned to Defib Inter
operates at 3V logic levels and is connected to Defib Connector J24. SMC1 will ope
the standard UART mode with no hardware control lines available.

NOTE: **Applicable on CPU Board P/N 0670-00-0739-XX**

SMC2 - This channel is assigned to Audio. The audio circuit is composed of three
integrated circuits, CS9236 (Wave Table Music Synthesizer), CS4333, (a 24 Bit St
A Converter) and a LM4861 (one watt Power Amplifier).

2.1.3   Flash Memory

Program code is stored in eight flash memory devices configured as 2M x 32 bytes
banks for a total of 16 Mbytes. These devices allow for in circuit programming via
MPC860T background debug mode (BDM). There is a BDM header provided on th
Control module, 10 pin header J1. There are no special programming voltages,
programming is done using the existing 3.3Volts.

This is one way to allow for initial factory programming as well as software upgrad
Alternately a boot loader can be programmed in to the flash parts using the BDM, a
initial software and all upgrades can be programmed into the flash by the boot loade
a PCMCIA memory card.

The flash devices are configured and hooked to the processor in the byte mode.

The boot sectors can be protected by inserting jumper J4 and performing the sector p
algorithm. Remove jumper after protection is completed.

Upon reset, the MPC860T provides a boot chip select which is hard wired to the fla
memory to allow boot of the operating software. The board support software must e>
prior to any other hardware external or internal to function properly.

2.1.4   Dram Memory

This memory is made up of two 4M x 16 devices which form a 4M x 32 byte memo
array. These memories are volatile as well as requiring special timing and control si
RAS* and CAS* to operate. The type of DRAM is Fast Page Mode with an access ti
60nsec. The special timing signals require are generated by an internal timing circui
contained in the MPC860T. This timing generator is called Universal Programmabl
Machine A (UPMA). There is another one called Universal Programmable Machine
(UPMB) which is not required.

The universal programmable machines are flexible interfaces that connect to a wide
of memory devices, such as Fast Page Mode Dram=s. At the heart of the UPM is an
internal memory RAM that specifies the logical value driven on the external memor
controller pins for each clock cycle. Each word in the RAM array provides bits that :
a memory access to be controlled with a resolution of one quarter of the external bus
period on the byte-select and chip-select lines. The internal signal timing generator l
the RAM word from the RAM array to drive the general-purpose lines, byte-selects,
chip-selects.

The UPM RAM array is to be loaded by the board support software at power-on. Th
following is UPM RAM array values to support 60nsec Fast Page Mode DRAM wit
processor operating at 45Mhz.

2.1.5   RTC with CPU Supervisor

The Real Time Clock module, BQ4847, integrates a time of day clock, a 100 year
calendar, a CPU supervisor, a battery and a crystal in a 28 pin DIP module. There ar
registers which contain real-time clock and alarm functions. The clock has an accura
+/-1 minute per month. The duration of the power-on reset signal is 100ms min. The
MPC860T requires only 3us minimum.

Using the BQ4747's CE out and battery voltage out, Vout, static RAM U9 is made to
non-volatile. The internal battery powers the real time clock and maintains SRAM
information in the absence of system voltage. When an out of tolerance (4.3 to 4.5 v
condition is detected the BQ4747 generates an interrupt warning. The interrupt is fec
the IRQ0 NMI input on the MPC860T. This will allow 90us min. to save any data to
non-volatile SRAM.

2.1.6   SRAM

The SRAM is configured as 128K x 8 bits and is used to store system configuration settings. These settings are required to be non-volatile, therefore the SRAM is batte backed-up when system power is removed. This is achieved by the battery that is contained in RTC module, U7.

2.1.7   Dual Port RAM

The IDT71321 is a high speed 2K x 8 Dual Port RAM with internal logic for inter-processor communications. The device has two independent ports with separate coi address, and I/O pins that permit independent asynchronous access for reads or wri any location in memory.

The device is used for inter-communication between the main processor, MPC860T and the communication processor 68HC916X1 (U22).

2.1.8   Audio Generator Circuit

The audio circuit is composed of three integrated circuits, CS9236 Wave Table Mu: Synthesizer, CS4333, a 24 Bit Stereo D/A Converter and a LM4861, one watt Pow(Amplifier.

The CS9236 is a complete general MIDI wave table synthesizer on a single integra circuit. The MIDI interpreter, synthesis engine, effects processing, and all memory included on chip. The device receives a standard serial MIDI data stream at 31.25 -1 kbits/s, and outputs a stereo 16 bit digital audio stream at 44.1kHz.

The digital outputs LRCLK and SOUT from the CS9236 provide the clock and the audio data input to the CS4333 stereo D/A converter. The CS4333 is a complete ste digital to analog system including digital interpolation, 128X third order delta-sigm conversion, digital de-emphasis and analog filtering. The de-emphasis circuit is not in this application.

The stereo outputs from the CS4333 are summed together and the fed to the power amplifier LM4861. The LM4861 is a bridge connected audio power amplifier capal delivering 1watt of continuous average power to an 8 ohm speaker load.

2.1.9   Tone Generator

The tone generator is implemented using an AT90S1200 eight bit microprocessor. 1 device generates a tone signal of 1250Hz for a duration of 150ms. The tone is genera response to the following input conditions:

1. When the system is first turned on, the level of the MPC860T PORESET* sigr monitored. If this level is detected as low, the tone is generated.

2. When an active low status signal input is detected, the tone is generated. The st signal is generated by the MPC860T on Port A, bit 4 (PA4). The signal can be repeated in order to create a series of tones.

2.1.10 LCD/CRT VGA Controller

The LCD/VGA controller is a SPC8110 with an integrated RAMDAC, PLL Bit Blo Transfer engine and a VL Local Bus interface. It is capable of simultaneous displayi an external CRT and a color LCD. It is capable of display 256 colors at a resolution (x 640 on a TFT color LCD panel. The controller can interface to various display type only TFT color (single scan), EL (dual scan) and Passive (dual scan) will be used in Passport 2.

2.1.11 PCMCIA Interface

The PCMCIA interface is a dual interface called Socket A and Socket B. The PCM(cards plug into a dual stacked connector assembly, J14. The MPC860T PCMCIA hc adapter module provides all the control logic for each PCMCIA socket interface anc requires only power switching logic and buffering. The additional external bufferin̦ allows the PCMCIA host adapter module to support up to two PCMCIA sockets anc provide electrical isolation.

2.1.12 Serial EEPROM

There memory is made up of 256 bytes of non-volatile memory. U45 is a dip part an socketed to allow programming the memory with a external programmer. This devic used to store network settings. Communications to/from the device is done via the MPC860T SPI interface.

2.1.13 Recorder Interface

The recorder interface (J8) is a serial interface which is 8 bit, 1 stop bit, no parity an baud rate of 38.4K. The recorder interface is implemented using the MPC860T SCC

The recorder is controlled by sending a series of software commands along with data the serial interface. The recorders electronics process the incoming commands and d and send print information to the print head.

Hardware handshaking is provided using the RTS*/CTS* control lines. Handshakinḡ signals are used to control the transmission of data to the recorder and to ensure that MPC860T does not send another command until the current one has been processed.

The RECRST* signal is used to reset the recorder. This signal is an active low output PB(16) of the MPC860T and is a software control function.

There is an additional signal which is located on the connector, IRQ3*, which indica when data can be sent.

This connector also provides an interface to the fan for control and monitoring. Ther͏ control line from the MPC860T to turn the fan on or off and a status signal that indica its functioning.

2.1.14 CO_2 Interface Connector, J23

This connector connects the Communications processor module bus to the external C

2.1.15   NIBP Interface Connector, J25

This connector connects the Communications processor module bus to the external module. In addition power (+5 Vdc, +12V2) and ground are provided.

2.1.16   Defib Connector, J24

This connector provides the interface to an external Defibrillator. SMC1 is provide serial communications is necessary. There is a provision to accept a logic signal tha monitored by input PB(14) on the MPC860T. There is a provision for an analog inp signal that is fed to the 10 bit A/D converter that is contained with the Communicat processor (916X1). In addition there is a re-created analog output (ECG_OUT) of t ECG waveform and a ECG_SYNC signal which is the E trigger from the front end electronics. The ECG_SYNC signal which is the E trigger from the front end electri or ECG_SYNC created by the 12 lead communications data from the Mortara card the MPC860T. The source is controlled by the MPC860T. All signals are filtered w Pole filter devices.

2.1.17   SYNC Connector, J22

This connector provides the interface to an external device. There is a provision for analog input signal that is fed to the 10 bit A/D converter that is contained with the Communication processor (916X1). In addition there is a re-created analog output (ECG_OUT) of the ECG waveform and blood pressure (IBP_OUT).

2.1.18   Base Station Connector, J9

The base station interface connector provides the interface between the CPU Contr module and the base station or mini-port. The main purpose of the base station or C Port is to provide interface connectors and some interface circuitry that is not part c CPU Control module. It not feasible or practical to include all the connectors on the Control module itself.

2.1.19   3.3 Volt Power

The 3.3 Vdc is generated by Synchronous Step-Down Power Supply Controller U4 (MAX767) and associated discrete components. The input to the power supply con is +5 Vdc and its output is +3.3 Vdc +/-5% at 750ma. The controller operates a freq of 300 Khz. The current sense resistor (R32) is connected to the controller using a I connection (no current flow in sense lines). The current limit is controlled by current resistor R32.

2.1.20   -12 Volts DC

There is a limited requirement for -12 Vdc @ 30 ma max. The supply voltage was c by using power inverter U51 (LTC1144) operating at 10KHz. This device takes the + as an input and generates -12 Vdc +/- 10% as an output. The -12 Vdc is used by RS buffers U49 and U50 as well as Op-Amp U101.

2.1.21 Communications Processor & Support

The Communications Process is a high speed 16 bit, MC68H916X1 microcontrolle
incorporates a 16 bit CPU, single chip integration module (SCIM), a 8/10 bit 6 char
analog to digital converter (ADC), a queued serial module (QSM) a general purpose
(GPT), 2K bytes of SRAM, 48K bytes of Flash, and 2K bytes of EEPROM. The dev
clock is derived from a 4 Mhz external crystal and is multiplied to 16 MHz by the in
PLL.

The purpose of the Communications Processor is to communicate with Passport 2
measurement modules such as NIBP, Front End, etc. The communications is handlec
a RS-485 module bus, where the Communications Processor is the master and every
else is a slave. This processor also handles scanning the front panel keypad, rotary k
and updating its LEDS.

2.1.22 Analog Outputs

There are two analog outputs for recreation of the ECG waveform and IBP measure:
Both analog signal are created using a dual 12-bit D/A, U24 and Op-Amp, U101. Th
required 4.096 reference is supplied by U38.

The dual D/A converter is gets its data from the Communications Processor SPI por
qualified by PCS0. The data is recreated from measurement data received by the
Communications Processor over the module bus.

2.1.23 Analog Inputs

The communications Processor has a 6 channel A/D converter, only 4 channel are us
this time. The A/D converter is only for monitoring voltages and not for critical
measurements. AN0 and AN1 are assigned to external analog inputs. There is an
attenuator circuit provided to keep the input to the A/D within its limits. AN3 and AN
assigned to measure the internal battery voltages. They also have an attenuator circu:
which attenuates the battery voltage by 1/4, to stay within the limits of the A/D conv
(5 Vdc).

2.1.24 SRAM

There is 128K x 8 bytes SRAM which is used to store temporary variables and data
required by the Communications Processor.

2.1.25   **Keypad and Rotary Knob**

The front panel keypad is interfaced to the QSPI port qualified by PCS1. In order to key, keypad scanning is used. The actual scanning logic is contained on the Interco board, 0670-00-0686 and 0670-00-0714 in CPLD, U1. The keypad rows are exerci with a Awalking zero pattern. This means that three out of four lines will always be logic 1 with one line driven low. In a complete cycle, each line will sequentially go driving a different row on the keypad. This cycle is repeated continuously at a fast The eight columns are read, whenever a key is depressed, the coordinates of that ke be determined by knowing which column line. The Communications Processor sen scan pattern on the QSPI port transmit output (MOSI) and receives the keypressed response on the QSPI receive input (MISO). The QSPI signal are connected to the Interconnect board through connector J5. The keypad connects to mating connector the Interconnect Board.

The front panel rotary selector is quadrature encoder with an integral switch. The p of this device is for LCD menu scroll and selection. The quadrature signals CHA and are input from connector J5-70 and J5-71. The Communications Processor interpre serial data stream and sends it to the MPC860T through the Dual Port Ram, represe direction and speed as well as the status of the integral switch.

2.1.26   **Control Functions**

There is a DC/DC converter module, PS1 which provides isolated DC power to the end circuitry. The module can be turned on by a logic 1 on the Communications Pro port pin PGP7.The Communications Processor reset input is controlled by a signal the MPC860T, port pin PA(6). The signal required for reset is a logic 1. The signal inverted by FET Q1 before being connected to the Communications Processor RES pin.

2.1.27   **Module Bus**

Communications with all measurement modules in the ECM is through a RS-485 n bus. The Communications processor is the host and all modules are slave devices. Communications Processor UART connects to the module bus through RS-485 buf driver U20. The direction of the data flow through the RS-485 buffer driver is conti by two different signals from port pins on the Communications Processor. Receive controlled by an logic 0 on port pin PGP6 and logic 0 on PGP0 Transmit is controlle logic 1 on PGP0 and a logic 1 on PGP6.There is a module bus connection from the isolated front end through RS-485 buffer driver, U28. The isolation is provided by couplers. The front end transmit data is provided by opto coupler U230 and receive by opto coupler U231 along with Q2 and part of U100. The direction of data flow i controlled by opto coupler U232 along with part of U100.

2.2   Front End Module

Overview

This document describes the theory of operation of the ECM Frontend module. Thi
module is responsible for acquisition of most of the patient-safety isolated signals, n
the ECG, Respiration (by impedance), Temperature, and two channels of Invasive I
Pressure.

The Front End Module consists of a common isolated power supply, data isolation,
microcontroller, and A/D converter, shared between the various patient signals.

2.2.1   Power Supply

The power supply takes a raw +12v DC supply voltage and generates the highly isc
operating voltages required by the front end module. Since the input voltage varies
+/-5% range, some form of regulation is required. To preserve efficiency, a modula
switching supply is used.

This power supply requires sufficient isolation between the input and output to witl
the open circuit voltage of a defibrillator, up to 5 kV. Further, it requires low capaci
between the input and output, to minimize leakage currents which may flow should
patient accidently contact line voltage.

2.2.2   Communication Isolation

The communication between the front end module and the host must be isolated to
same degree as the power supply. The communications consist of an asynchronous
bidirectional serial data stream at 500 k baud. Since these signals are all digital, the
isolation is performed with optocouplers. All these devices are a special type which
feature very high isolation voltage.

2.2.3   Data Acquisition

The various signal processing blocks, such as ECG, IBP, etc., generate both analog
(waveform) and digital (status) signals. The purpose of the data acquisition system i
capture these signals and to format them into a data stream suitable for transmission
through the communication isolation circuits. The system consists of a multiplexed a
to digital converter, a single-chip microcontroller, and some digital level shifters. Tl
microcontroller serves the additional purpose of interpreting commands received fro
host.

2.2.4   Analog to Digital Converter

The MAX147 ADC is operated in the single ended bipolar mode, with external clo
control byte sent to the converter by the QSPI is %1mm, where mm is the ADC
multiplexer channel. Since the entire analog signal path is "floated" on the +2.5 vo
reference, the ADC analog common is referenced to this voltage also. The ADC th
produces signed output data for analog inputs corresponding to nominally ±1.25 v
around the +2.5 volt reference. The ADC results are read into the QSPI receive R/
words, and are left-justified. That is, the sign bit of the ADC data is the msb of the
and the 12 bit ADC data is padded with 4 trailing zeros. The ADC regards the leadi
in the command byte as a synchronization bit. Therefore, the output data justificati
controlled by the justification of the command byte within the word transmitted by
QSPI.

2.2.5   Microcontroller and Data Processing

The Passport 2 Front End is controlled by a Motorola 68HC916X1 microcontrolle
operating in the single-chip mode. The board holds BERR* low, which causes the
processor to enter this mode as it comes out of reset. The internal 16.0 MHz clock
generated by the internal synthesizer from a 4.000 MHz reference crystal. The crys
operates with roughly sinusoidal waveforms, and therefore generates less EMI that
square-wave oscillator module. To further minimize EMI, all unneeded dynamic o
pins are disabled, particularly CLKOUT. This also helps reduce power dissipation.

The processor lies on the patient isolated side of the barrier, and communicates wit
serial module bus via optocouplers. Power is supplied by a high-isolation DC-DC
converter.

2.2.6   Memory

Since the processor operates in the single chip mode, only internal memory is used
device contains 3 banks of internal Flash memory. The 16k bank is to be used for tl
bootloader code. The 2k block-erasable bank is used for the electronic serial numb
(ESN) and associated factory data. The 32k bank is used for the application code. I
intended that the bootloader and the ESN can be erased and changed only at the fac
while the application code can be reloaded in the field.

2.2.7   I/O Ports

The interfaces to the processor are through the parallel I/O ports, the QSPI, the SC
(UART), and the timer ports. The internal ADC is also used for status monitoring. .
I/O signals are routed to test connector J203.

2.2.8   Signal Acquisition

ECG

The ECG signal acquisition consists of three differential amplifier channels, which (
configured to support either 3 lead or 5 lead operation. These are connected to chan
through 2 of the MAX147 ADC. In the 5 lead mode, a dedicated electrode (RL) is us
patient drive. This allows all of the remaining electrodes (RA, LA, LL, and C) to be
for signal acquisition. There are 7 standard vectors ("leads") which can be obtained
simultaneously from these electrodes. However, these vectors contain much redund;
information. In fact, only 3 channels of data are required to allow derivation of any
of the 7 standard vectors. The ECM module bus therefore caries only lead I, Lead II
V as the requisite data channels. In three lead mode, only three electrodes are attach
the patient. Further, one of these electrodes must be used for the patient drive, prech
its use for signal acquisition. Therefore, only vectors Lead I, Lead II, and Lead III a:
available, with only a single vector being available at a time. Two of the 3 differenti
amplifiers are configured to acquire Lead I and Lead II. The third amplifier is
reconfigurable, by means of an analog switch, to acquire either the V lead or Lead III
configuration of the amplifiers and the driven lead is controlled by the two ECG lea;
select bits, LS0 and LS1.

2.2.9   Lead Fault Detection

Lead fault detection is performed by observing the voltage on the ECG amplifier inp
Due to the bias networks included in the lead buffers, an open circuited electrode wi
develop a strong negative voltage. The lead fault signal is then generated by the
microcontroller, which is actively monitoring the voltage via its A/D converter.

In leads I, II, and III, the operation of the lead fault detection is very simple. When a
leads are attached, both ECG amplifier inputs are approximately at the value of the c
amplifier bias voltage, which is about +2.5 volts nominal. This voltage is not suffici
negative, so no lead fault condition is indicated. If one of the active electrodes becon
detached, the voltage on the corresponding amplifier input swings to about -5 volts. '
is well beyond the threshold, so a lead fault condition is indicated. The effect is the sa
either active lead is detached. If the drive electrode becomes detached, this is equivalt
both active leads being open, so the operation is the same. Note that the margins betv
the common mode voltage established by the drive amplifier and the lead fault thresl
are large enough that the possibility of a 300 mV electrode polarization offset does n
affect lead fault detection. Note also that this lead fault detection scheme only tests tl
electrodes which are necessary to view a particular lead selection. Therefore, to view :
I, II, or III, only RA, LA, and LL are needed. The lead fault detection is indifferent t(
state of the unnecessary RL and C electrodes.

2.2.10   **Pacer Pulse/Electrosurgical Interference Detection**

It is necessary to detect pacer pulses so that the rate meter can be made unresponsi
them, and so that enhancement of the pacer pulse can be indicated on the monitor d
Electrosurgical interference is similar in nature to pacer pulses, but while a pacer p
occurs at a repetition rate related to the normal range of heart rates, electrosurgical
has much higher repetition rates, due to rapid sparking at the active electrode. There
single circuit can detect both types of signal, and categorize the detected event as a
or noise according to the repetition rate. The detection circuit processes the ECG si
present at the I, II, and III/V outputs.

The basis for detection of the pacer pulses is frequency - the frequency content of a
being assumed to be higher than any normal physiologic signal. The most difficult
to discriminate would therefore be one with the lowest slew rate, that is, the slowes
time and smallest amplitude. From the range of pacers defined in AAMI EC13-19S
is a pulse amplitude of 2 mV and a duration of 2 ms. The means of performing the
frequency discrimination is shown in the figure below.

In order to identify the pacer or noise spike, a window comparator, U214, is used to
when the output of U212 has a moderately high frequency content signal. U212 pr
rejection of the Respiration excitation carrier, but permits passage of pacer signals.
Positive and negative input pins of this comparator are biased near half of the +5 ra
voltages. The threshold of the window is approximately 0.4 volts wide. The compa
output network consisting of C246 and R261, provides stretching for narrow input
of variable width to output pulses having a wider width. Since the window compar
symmetrical, the system works equally well for pacer/noise pulses of either polarit
outputs (open collectors tied together) are used as the pacer flag connected to the
microcontroller.

2.2.11   **Respiration**

Respiration is obtained through the ECG electrodes by impedance pneumography,
which the AC impedance between a pair of the ECG electrodes is monitored. This
impedance varies with the chest motions associated with breathing. The respiration
consists of a small modulation on the order of 1 ohm, superimposed on a much larg
baseline impedance. The baseline impedance measured at the patient has a typical v:
500 ohms, and may reach 2000 ohms. However, when AAMI connector ECG cabl
used, the cable contains 1000 ohm resistors in series with each leadwire. Since the
respiration is measured through a pair of leadwires, 2000 ohms are added to the pai
impedance. When the connector board is equipped with additional defibrillation
protection provisions (series ECG resistors and high voltage respiration coupling
capacitors), the front end board can be used with resistor less ECG cables. Therefoi
total range of baseline impedance ranges from somewhat less than 500 to 4000 ohn

The respiration signal is isolated from the baseline by a fixed analog highpass filter
Hz, and a lowpass at about 3 Hz. The signal is amplified and acquired by channel 3
MAX147 ADC. Although the QSPI scans all channels every 2 ms, the respiration is
sampled at only 100 Hz. Therefore, the data processing software takes data from the
buffer in only 1 out of every 5 scans. The highpass filter is equipped with a reset fur
activated by a control line in Port A. The respiration reset is controlled in a manner s:
to the ECG reset, in that it is activated whenever the respiration signal appears stuck
offscale, and must remain asserted for a settling period after the signal is brought ba
range. The baseline impedance is also monitored, by a channel in the 68HC16 interr
ADC. When the baseline impedance exceeds about 4000 ohms (patient plus cable
resistors), a high impedance flag must be set by the software. This flag indicates tha
respiration signal is no longer reliable.

When monitoring neonatal patients, it is desirable to raise the highpass corner frequ
to 0.2 Hz. Since the analog filter is fixed, this is done by refiltering the signal with a d
filter in software. In the adult mode, this digital filter remains active, but is set to a v
low corner frequency, 0.0125 Hz. Therefore, the analog 0.1 Hz filter dominates the
response. This relaxes the design constraints on the respiration filter and DC amplifi
circuits, as any residual offset voltage present in these stages is now removed by the
digital filter, even in the adult mode. In the neonatal mode, the digital filter is set to (
Hz, which produces a 0.2 Hz 3 dB point when cascaded with the analog filter. A Ma:
document fully documents the digital filter. Note that these filters are based on the 1'
sampling rate. Whenever software resets the analog filter, the cascaded digital filter :
also be reset, or the baseline will not settle properly. The assembler code shows the
method of resetting the digital filter. Note also that the detection of an offscale condi
for reset generation must be done on the raw ADC data, before the digital filter.

The respiration can be configured to sense impedance in either a lead I (RA/LA) or le
(RA/LL) axis, by means of the Respiration Lead Select bit in Port A. The respiration
be disabled by the Respiration Enable bit in Port A. It is necessary to disable the
respiration when the carrier might cause interference with other electromedical devic
The table below summarizes the respiration control bits in Port A.

2.2.12 Invasive Blood Pressure

An interface is provided for two standard 5mV/mmHg/V transducers. This consists c
common excitation power source and a pair of differential amplifiers with lowpass fi:
one for each channel. The excitation source is monitored by the 68HC16 ADC, while
pressure waveforms are acquired by the MAX147. The frequency response can be
modified by digital filters processing the acquired signals.

The excitation voltage is nominally +5 volts, but tracks the ADC reference. In this w
the actual value of the ADC reference does not affect accuracy, since the transducer i
ratiometric device. The excitation source has current limiting, which prevents the mo
power supply from being disrupted if the transducer excitation becomes shorted. The
excitation regulator's error amplifier output is monitored by the 68HC16 internal AD
This signal will abruptly jump to almost zero when the excitation source begins to cur
limit.

2.2.13   Temperature

Patient temperature is monitored by a thermistor probe. Either YSI 400 series or 70(
probes can be used, with autodetection of probe type. When the 400 series is used,
temperature channel is accurate to 0.2 °C. Correct calibration is continuously verifi
is required by European standards.

The YSI 400 series probes contain a single thermistor, wired between the tip and sle
a two-circuit ¼ inch phone plug. The 700 series probes contain two thermistors, an(
three-circuit plug. The sleeve of the plug is connected to the common of the two
thermistors. The primary thermistor is connected to the tip contact, and a secondar
thermistor is connected to the ring contact. However, only the primary thermistor i:
for temperature measurement. The secondary thermistor is used as the basis for prol
autodetection. The ring contact of the probe socket is biased through a resistor from
volt supply, and has its voltage monitored by the 68HC16 internal ADC. When a se
400 probe is connected, the solid metal sleeve of the plug shorts the socket's ring c
to ground, so the ADC reads essentially zero. If no probe is connected, the ADC re
near full scale. However, if a series 700 probe is connected, a voltage divider is forr
the bias resistor and the secondary thermistor. Therefore, the ADC reads an interme
value which depends on the probe temperature, but is easily distinguished from the
readings obtained when a 400 series probe or no probe is present.

2.2.14   Timers

The only digital input to the processor is Timer Input Compare 1 (Port GP 0), whic
used for pacer detection. This line exhibits a falling edge each time a pacer is detec
Therefore, this input should be configured to generate an interrupt on falling edges,
invokes the pacer handling ISR. A timer channel, rather than interrupt input, has bee
so that the exact time of arrival of the pacer is logged; this may prove helpful in gene
some of the timing based on the pacer, although it is not necessary to use this featur
latency of the pacer ISR must be minimized, a consideration which must be remem
when assigning timer interrupt priorities. Timer Output Compare 1 (port GP 3) is the
blanking output. When the monitor is used with patients having conventional impla
pacemakers, this signal is not used, and is maintained at logic low. In the case of ex
pacemakers, a much stronger pacer overload signal results, and the pacer blanking
is used to activate a sample and hold of the ECG signal for the duration of the pace
overload. In external pacer mode, TOC 1 is used to generate the pacer blanking puls
Pacer ISR sets the TOC 1 output high, initiating the pulse. It further programs the T
register to terminate the pulse after the requisite duration. Therefore, the TOC 1 func
set to drive the pin low on timer match. Low ISR latency is necessary to ensure tha
pulse starts promptly upon pacer detection.

Timer Output Compare 2 (Port GP4) is used to define the E-trigger pulse sent to the
module bus. The E-trigger pulse is initiated by the R-wave detection software, whic
programs TOC 2 to terminate the pulse after the requisite width.

The other timer channel pins (Port GP 5..7) are unused, and should be configured a
outputs, to eliminate the need for termination. However, the associated internal tim
channels may be used for software purposes, such as the 2 ms data acquisition inter
flash programming timer, etc.

2.2.15   **Data Packets**

The data communications via the UART and communication isolation circuits are in form of bursts, or packets, of data.

The SCI is used to support the RS-485 module bus interface, operating at 500 kbaud SCI is operated in the 9 bit mode. In the module bus protocol, ninth bits are set only a module address is transmitted. Most of the time, the SCI is operated in the Address Wake-Up mode. In this mode, it ignores all characters without the ninth bit set. Each an address is sent on the module bus, the receiver will generate an interrupt on this character. Software must rapidly evaluate this character to determine if it matches the module address. If it does not match, the SCI mode remains unchanged, and the bus continues to be monitored for address characters only. However, if there is a match, SCI must immediately be placed in the normal receive mode, so that the rest of the packet can be received and buffered. The CRC is evaluated during reception. If the packet CRC is valid, the transmitter is enabled, and SCI is used to transmit a pre-bu response packet. Following this packet, the transmitter is disabled, and the SCI is ret to the Address Mark Wake-Up mode. Control of the transmitter is by means of peri select 3 (Port PQS 6), which is brought low to enable the RS-485 transmitter.

Because of the high data transmission speed, each of the phases of module bus communications is best handled through a separate ISR, with the interrupt vector be changed for each phase. This will result in faster response than could be achieved in single ISR with conditional code. The SCI must be the highest priority peripheral int in the system, due to the high communication speed.

2.3   TFT Display / Monochrome Interface Board And Keypad Board

P/N 0670-00-0686 or 0670-00-0726

Overview

This board provides interface and support for four different displays, an SPI interfa
X 8 matrix keypad, optical encoder and LED's. It provides connections for an exter
speaker and inverter for the display.

2.3.1   The EPLD Interface to the CPU Board VIA SPI

The purpose of the CPLD (U1) is to interface to and scan for key presses on the fro
panel keypad. The method of communicating with the CPLD is the SPI port of the
68HC916X1 communications processor on the CPU control board, 0670-00-0674.
SPI interface is a serial interface with separate serial data and clock. Data can flow
either direction using the common clock. The communications processor is set as th
master device and the CPLD can only be a slave.

The method used to scan the keypad, which is a 4 row (J11) with up to 8 columns (J
a "walking zero" pattern. This means that 3 of the 4 row/lines will always be a logi
with one line driven low. In a complete cycle, each line will sequentially be driven
driving a different row on the keypad.

2.3.2   Video display connections

The J5 connector is the decoded video for the TFT color LCD / monochrome displa
based on the board's configuration. The 3.3 VDC input power requires additional fil

2.3.3   TFT Inverter Connection

The inverter for the monochrome or TFT display is connected to J3. This inverter us
filtered +12V2 voltage and is controlled via a 5V CMOS compatible signal.

2.3.4   Speaker connection

The system speaker is connected to J2. The Interconnect Board functions as a pass th
for this signal.

2.3.5   Encoder connection

The optical encoder for the keypad is connected to J4. Phase signals (CHA/CHB) ar
switch contact signal (SW) are passed through the interconnect board to ADC on the
board.

2.4   NIBP Module P/N 0997-00-0501

Overview

The NIBP PCB utilizes a Motorola MC68HC16Z1 microcontroller. This processor responsible for controlling a pump and two valves in the generation of the patient pr signal. This pressure signal is generated non-invasively using an inflatable cuff. A Fujikura XFPM-050KPG-P2 pressure transducer converts the pressure signal in the (an analog voltage. The pressure signal is sampled by an AD7714 24-bit ADC whicl interfaces to the microcontroller's QSPI port. This data is processed by the HC16Z1 determine the blood pressure using the oscillometric principle. The results are then the host via a RS-485 interface through the processor's SCI port.

During a measurement, the HC16Z1 software inflates the cuff and then controls the pressure bleed rate using a linear valve. The linear valve control allows the software adjust the valve orifice to arrive at a nominal linear bleed rate of 6mmHg per secon(the conclusion of the measurement, a dump valve is opened by the software which a the cuff pressure to rapidly bleed down to atmosphere.

A separate Microchip PIC16C710 processor and Fujikura XFPM-050KPG-BP pres: transducer are used to monitor the cuff pressure redundantly for safety purposes.

This document describes the details of the actual design implementation developed meet the specifications set forth in the PCB specification document. It provides theo operation and internal specification of this implementation.

2.4.1   Pneumatic System Control

The pneumatic control consists of a pressure transducer, ADC, microcontroller, DAC drive circuitry. This circuitry controls a pump, a dump valve and a linear valve. The pneumatics can also be disengaged by the over-pressure detection circuitry. The pun used to inflate the cuff at the beginning of each measurement cycle. Inflation pressu regulated by the HC16Z1 software monitoring the pressure transducer signal from P1 the AD7714 ADC.

During the pump-up phase, the dump valve (V1) is closed and linear valve (V2) is modulated. At the onset of the actual measurement phase, the linear valve is controll provide a gradual reduction of the cuff pressure. The HC16Z1 software maintains th pressure bleed rate at a nominal 6 mmHg per second, regardless of the cuff pressure system volume. During the measurement phase, the pressure signal acquired by the transducer PT1 is digitized by the ADC (U2) and processed to extract the oscillomet: blood pressure data. At the conclusion of the measurement phase, the dump valve an linear valve are both fully opened to rapidly exhaust the residual cuff pressure.

2.4.2   **Pressure Transducer, PT1**

A Fujikura XFPM-050KPG-P2 transducer was selected for the measurement chanr provides a high level output signal which eliminates the need for an external ampli circuit. All that is required is a pull-up resistor and compensation capacitor. The -P: screened to maximize performance in designs which will perform a zero cal before measurement and a yearly span cal at 150mmHg near room temperature. It also pro· nonlinearity specification beyond the screening limits which enhances performance

Adjusting trim pot R81 changes the attenuation factor of the transducer output sign (span calibration). The nominal gain slope will correspond to the attenuation produ when the wiper is at the midpoint of its range. With a 28.7kW value for R80 and a value for R81, the nominal gain to be used by the software for the measurement cha 11.29mV per mmHg. The adjustment range is wide enough to cover the +/-50mV transducer set point tolerance at the 150mmHg calibration pressure.

2.4.3   **Pressure Transducer, PT2**

The Fujikura XFPM-050KPG-BP transducer was selected for the over-pressure chi Due to a transducer accuracy of ±5.625mmHg over the entire pressure range, the overpressure transducer must be zero calibrated at 0mmHg in order to operate the measurement duration timer. This zero calibration must be performed at the time of manufacture, any time a transducer is replaced, and as part of the yearly service rout the NIBP module. The -BP provides a high level output signal which eliminates the for an external amplifier circuit. All that is required is a pull-up resistor and comper capacitor.

Adjusting trim pot R31 effectively zeros the transducer error. With 0mmHg pressui applied to the transducer input port, R31 is adjusted until the output of the op-amp is 0.1V±1mV. With a 100kW value for R30, a 3.60kW value for R29, and a 10kW · for R31, the nominal gain to be used by the software for the over-pressure channel 12.44mV per mmHg. The adjustment range is wide enough to cover the +/-67.5mV transducer set point tolerance at the 0mmHg calibration pressure.

2.4.4   **Over-Pressure Detection**

There are two methods of keeping the pressure from getting too high. The first met the HC16Z1 software based monitoring of the pressure transducer, PT1. When the software monitors pressure higher than, 295mmHg in Adult mode, 195mmHg in Pe or 145mmHg in Neonate mode, the measurement cycle will halt and dump valve, \ bleed valve, V2 shall open to release the pressure in the cuff.

In the event of an over-pressure condition that is not corrected by the HC16Z1 soft and the measurement channel circuitry, the over-pressure channel serves as a fully redundant backup system to disable the pump and valves, thus relieving the pressure cuff. The hardware over pressure limit detect circuitry will deactivate the over pres: signal 12VEN*, cutting off power to the pump (M1) and valves (V1 and V2), rever them to their 'normally open' state, independent of software. This action places the PCB in a 'shutdown' state that can be exited only by cycling the system power.

To achieve this secondary over-pressure detection, the PCB uses a pressure transdu(
(PT2) separate from the measurement channel, a secondary microprocessor (U4), ar
power-cut circuitry (Q1, Q2). This circuit is also powered by a separate voltage (T5
than used by the AD7714 and measurement transducer.

2.4.5   Pump, M1

The pump control signal, M1EN, is provided via a PWM signal from the HC16Z1
microcontroller and is active high. This signal switches MOSFET Q3 (1/2), applyin
power to the pump motor. Power to the pump (12VSW) is supplied from 12V2 via (
This allows the pump to be disabled in case of a fault condition. (See section 1.1.1.:
Over-Pressure Detection).

2.4.6   Dump Valve, V1

The dump valve, V1, is controlled by the V1EN signal provided by an active high s:
from the HC16Z1 microcontroller. This signal drives MOSFET Q3 (1/2), which swi
power to the valve coil. Power to the valve (12VSW) is supplied from 12V2 via Q2
allows the valve to be opened in case of a fault condition. This valve is a 'normally
type, so coil current must be supplied to cause the valve to close.

2.4.7   Linear Valve, V2

The bleed valve, V2, provides bleed down of the cuff pressure. The HC16Z1 softwa
maintains the pressure bleed rate at a nominal 6mmHg per second, for product speci
volumes and pressure ranges. The linear valvecan also be used to control the pump u
when small volume cuffs are used in the neonatal mode.

Note that this valve is a 'normally open' type, so coil current must be supplied to cau:
valve to close.

The linear valve's bleed rate is current controlled by the HC16Z1 software by writin;
Maxim MAX5352 12-bit DAC (U12) connected to a Burr-Brown OPA336 CMOS
operational amplifier (U13), in turn connected to an International Rectifier IRF7303
Power MOSFET (Q6).

The DAC output voltage is divided by 5 (which results in a full-scale control voltage
0.5V nominal) which is applied to the opamp's, U13, non-inverting input. A current
sensing resistor, R95, is used to generate a low voltage proportional to the linear val
current. This voltage is fed back to the opamp's inverting input. The opamp controls
Q6 FET gate voltage to maintain the desired current setting and corresponding valve
orifice. A5V is used to generate a small offset voltage using R94 and R92 to insure t:
FET is fully off for a DAC code of 0.

R95 is chosen to guarantee the full-scale current fully closes the valve under worst c:
conditions, including coil winding tolerance.

The IRF7303 MOSFET part (Q6), was chosen due to its lead-frame design which off
superior power dissipation capabilities. As such, the maximum junction rise when dri
the 0.526W, 274 ohm linear valve coil under the worst case conditions, does not wan
any heat-sinking to achieve reasonable reliability.

2.4.8   Primary Microcontroller, U10

The NIBP PCB utilizes a Motorola MC68HC16Z1CPV16 microcontroller. This sp
a 5V, 16.78MHz, commercial temperature range part in a 144 pin TQFP package. T
processor is responsible for controlling a pump and two valves in the generation of
patient pressure signal. This data is processed by the HC16Z1 and fed to the host vi
RS-485 interface through the processor's SCI port.

A 32.768kHz crystal (Y1) is used for the HC16Z1 reference oscillator circuit. The
HC16Z1 SYNCR (clock synthesizer control) register will be set with X=1, W=0 an
Y=60. This produces a nominal system clock frequency of 15.99MHz. The 32.768k
crystal is specified with a load capacitance of 20pF. To present this load, C20 and C
set to 33pF. The load capacitance is calculated as the series combination of C21 and
plus the stray capacitance which is estimated to be less than 5pF.

At Power-On Reset, the state of the HC16Z1 pins controlling the pump and valves i
that they are disabled (pump off / valves open).

The HC16Z1 has an internal ADC which will be used to monitor both pressure tran:
outputs, a 2.5V reference source, A5V, 12V and the switched 12V voltage, 12VSW
Dividers are used where needed to insure the sampled voltage is within the usable /
input range. A filtered version of T5V is used as the ADC reference.

2.4.9   Secondary Microcontroller, U4

The PCB incorporates a Microchip Technologies PIC16LC710 to perform over-pre
sensing.

A 2.45MHz ceramic resonator (Y2) with built-in capacitors is used for the PIC16
oscillator.

The PIC16 is informed of the desired measurement mode by reading the MODE2:0
signals fed from the HC16Z1. It in turn sends back three signals, STATE2:0, to indi
that the PIC16 has not encountered any faults, has set its over-pressure and measur
duration limits to match the type of measurement indicated, and is ready for the
measurement of the type encoded on STATE2:0.

The over-pressure signal (PVO) is sampled by an ADC internal to the PIC16 at a ra
1.196kHz. If it detects an abnormal condition, the PIC16 goes into an emergency
shutdown state. In this state, the PIC16 turns off the 12VSW power feeding the pun
valves by toggling the 12VEN* signal line high. Since the valves are normally oper
turning off their power will vent any cuff pressure to atmosphere. The PIC16 then re
in the emergency shutdown state until the system's power is cycled. Note, a softwar
issued from the HC16Z1 and asserting RST* will have no effect on releasing the PI
from the shutdown state.

The ADC uses an external reference voltage (T5V). Since T5V is the same voltage :
that is powering the ratiometric transducer, direct ADC readings represent the press

In addition to the input signals MODE2:0 and PVO, the PIC16 also has the 2.5V ref
voltage (25VR) applied to its A/D inputs. This signal is used as an 'back-door'
verification of the T5V reference voltage. Since 25VR is generated from a separate s
than T5V, and since T5V is also used as the ADC reference voltage, if the T5V refe
voltage were to fail, the ADC would read full scale when comparing 25VR to the A
reference (T5V).

The PIC16 device includes a brown-out reset circuit which guarantees the device is
when VCC is below 3.7V. As long as the PIC16LC version is used, the device is
guaranteed to be reset if its minimum allowed supply voltage is not present. This br
out reset is required since the PIC16 is not connected to the HC16Z1 RST*.

To increase the reliability of the PIC16 device's function as an over-pressure detect
sleep mode will not be utilized. This prevents the possibility of the part becoming st
the sleep state.

2.4.10   Memory

Flash Memory

The program code will be stored in an Intel 28F400B5 4Mbit flash memory. The fla
device specified has the boot sector located at the bottom of the memory map at add
00000H where the HC16Z1 expects to find the reset vectors.

Although the flash device requires additional power with CE* tied low, this prevent:
need for decoding logic where board real estate is limited.

Besides storing program code, other unprotected sectors of the flash memory may be
to store less critical nonvolatile data if required. This would require dedicating an er
flash sector for that purpose. However, due to small 8K byte parameter blocks in the
this is not a gross waste of memory resources and prevents the need for an additiona
device.

2.4.11   CMOS Static RAM

The CMOS SRAM is composed of two Sony CXK58100AM 128k-word x 8-bit par
each with its own chip select signal, CSRAMLB* and CSRAMHB*, connected to th
CS1* pins. The HC16Z1 R/W* signal is used to activate the SRAM WE* pins while
OE* pins are held low and the CS2 pins are held high to default the part to the read n
Although this much memory is unlikely to be needed during normal operation, it will
when updating the flash in the field from the host. During this process, the HC16Z1
program code must reside in the SRAM with additional room available for buffering
received from the host.

2.4.12   CMOS EEPROM

The HC16Z1 also has access to a National Semiconductor NM25C020 2k-bit seria
EEPROM through its QSPI port. This EEPROM device may be used for storing P(
identification codes or any other non-volatile information. Although a potentiomet
currently included in the circuitry to allow span calibration of the measurement cha
the EEPROM could optionally be used to store span calibration values for a softwa
calibration scheme.

The HC16Z1 software can detect bad sector data in the serial EEPROM by storing
checksums which can be verified during initialization.

2.4.13   Voltage Sources

The PCB is fed 12V and 5V (VCC) from the host through connector J1. VCC is us
power the PCB's digital circuitry. It is also used to generate a 2.5V reference signal
(25VR) using a Maxim MAX6125 2.5V reference (U11).

VCC can alternately be applied through J7 during in-circuit programming or debug
procedures. VCC shall not be applied to both connectors simultaneously. VPP is ap
through J7 as the programming voltage for the PIC16.

A switched version of 12V2 (12VSW) is generated by Q2 and is used to drive the e
mechanical components. This switch allows these components to be de-energized b
PIC16 processor during an emergency shutdown. The 12V supply is also used to ge
separate, high tolerance 5 volt analog voltages, A5V and T5V, for powering the two
pressure transducer circuits. Each of these 5V voltages are generated using Maxim
MAX6250 5V references (U3 & U15).

A5V is used for the measurement channel pressure transducer and AD7714 ADC a
supply and a divided version is used for the device reference. A5V is also used to p
the linear valve opamp control circuit.

T5V is used as the PIC16 ADC and HC16Z1 ADC reference voltages and the over-
pressure transducer supply. In addition, T5V is used as the HC16Z1 analog supply v
(VDDA).

2.4.14   Host Reset

The MODRESET* signal from J1 allows the host to reset the main processor (HC1
on the PCB. A NOR gate (U14) inverts the signal and the Q7 FET pulls RST* low
MODRESET* is activated.

RST* is pulled up by R17. This resistor's value was chosen in order to meet the RS
timing requirements of the HC16Z1. If the RST* rise time is too slow, the HC16Z1
assume there is an external reset and repeatedly drive RST* low itself. This rise tim
governed by the capacitive loads on RST* as well.

VPP is pulled up to VCC by R44 during normal device operation which activates tI
PIC16 power-on-reset.

Note, RST* is not connected to the PIC16 MCLR* input (VPP) in order to prevent

2.5   Patient Connector Board AAMI

The ECM Patient Connector board is intended for use with cables having integral 1
resistors, which eliminate the possibility of harmful arc-over at the connector pins d
defibrillation.

2.5.1   Spark Gap Suppressor

The patient cable is attached to the patient connector board. The clamping of defibri
transients, consisting of a neon bulb with each electrode circuit which clamps the pe
voltage with respect to isolated ground in series with the coupling capacitors. The c;
resistors absorb the remaining defibrillator voltage.

2.5.2   Neon Bulbs

This board provides defibrillator overload protection in conjunction with the front-e
board. The neon bulbs has a breakdown voltage range 60 v to 75 Volts. The patient's
and Respiration signals pass through the neon bulbs, which suppresses the defibrilla
pulses.

2.5.3   Low-Pass Filter

The patient cable is attached to the patient connector board. The ECG signal and the
respiration signal pass through the AAMI connector J1. This board contains 3 LC L(
Pass Filters with a minimum roll-off frequency of 17 MHz. A cut-off frequency of 2
MHz
(-3dB)

2.5.4   EMI Suppressor

The temperature probe connects to a three-circuit phone jack connector on the Patier
Connector board. The temperature circuit provides high-precision measurements of t
thermistor resistance, while using a minimum of precise components. This module a
features electrosurgical interference suppression (ESIS) and EMI suppression. The
Connector cable is used to reduce Conducted Susceptibility and Radiated Susceptibi
induced by the high frequency fields. The module serves simply as a connector; the
signals pass through efficiently and with minimum loss.

2.5.5   Patient and Power Isolation

This power supply requires sufficient isolation between the input and output to withs
the voltage of a defibrillator, up to 2.5 kVrms. Further, it requires low capacitance betv
the input and output, to minimize leakage currents which may flow should the patien
accidentally contact line voltage. The patient's signals in the Patient Connector board
be isolated to the same degree as the power supply and the ground.

2.5.6   **Provide mating for ECG, Temperature and two IBP connectors**

The patient cable is attached to the monitor at the Patient Connector board. From th connector board, the signal flows to the Front-End module, where the bulk of the E processing is performed the transducers are plugged into the monitor via the Patien Connector board. The Connector board bridges the excitation and ground of the transducers together, then passes the signals to the main board.

2.5.7   **0670-00-0682-01**

This module is responsible for acquisition of most of the patient-safety-isolated sig namely the ECG, Temperature and two channels of Invasive Blood Pressure connec IBP1 and IBP2. The Connector board collects all of the individual patient cables in single ribbon cable, then passes the signals to the main board.

2.5.8   **0670-00-0682-02**

This module is responsible for acquisition of the patient-safety signals, namely the and the Temperature. This module is without the dual 6 pin connectors for the IBP. Connector board collects all of the individual patient cables into a single ribbon cab then passes the signals to the main board.

2.6   Patient Connector Board H.P.

The ECM Patient Connector board is intended for use with cables having integral 1]
resistors, which eliminate the possibility of harmful arc-over at the connector pins d
defibrillation.

2.6.1   Spark Gap Suppressor

The patient cable is attached to the patient connector board. The clamping of defibri
transients, consisting of a neon bulb with each electrode circuit which clamps the pe
voltage with respect to isolated ground in series with the coupling capacitors. The c;
resistors absorb the remaining defibrillator voltage.

2.6.2   Neon Bulbs

This board provides defibrillator overload protection in conjunction with the front-e
board. The neon bulbs have a breakdown voltage range 60 v to 75 Volts. The patient
ECG and Respiration signals pass through the neon bulbs, which suppresses the
defibrillation pulses.

2.6.3   Low-Pass Filter

The patient cable is attached to the patient connector board. The ECG signal and the
respiration signal pass through the HP connector J1. This board contains 3 LC Low ·
Filters with a minimum roll-off frequency of 17 MHz. A cut-off frequency of 23 MH
(-3dB).

2.6.4   EMI Suppressor

The temperature probe connects to a three-circuit phone jack connector on the Patiei
Connector board. The temperature circuit provides high-precision measurements of t
thermistor resistance, while using a minimum of precise components. This module a
features electrosurgical interference suppression (ESIS) and EMI suppression. The
Connector cable is used to reduce Conducted Susceptibility and Radiated Susceptibi
induced by the high frequency fields. The module serves simply as a connector; the
signals pass through efficiently and with minimum loss.

2.6.5   Patient and Power Isolation

This power supply requires sufficient isolation between the input and output to withs
the voltage of a defibrillator, up to 2.5 kVrms. Further, it requires low capacitance bet\
the input and output, to minimize leakage currents which may flow should the patien
accidentally contact line voltage. The patient's signals in the Patient Connector board
be isolated to the same degree as the power supply and the ground.

2.6.6   **Provide mating for ECG, Temperature and two IBP connectors**

The patient cable is attached to the monitor at the Patient Connector board. From th connector board, the signal flows to the Front-End module, where the bulk of the E processing is performed the transducers are plugged into the monitor via the Patien Connector board. The Connector board bridges the excitation and ground of the transducers together, then passes the signals to the main board.

2.6.7   **0670-00-0680-01**

This module is responsible for acquisition of most of the patient-safety-isolated sig namely the ECG, Temperature and two channels of Invasive Blood Pressure connec IBP1 and IBP2. The Connector board collects all of the individual patient cables in single ribbon cable, then passes the signals to the main board.

2.6.8   **0670-00-0680-02**

This module is responsible for acquisition of the patient-safety signals, namely the and the Temperature. This module is without the dual 12- pin connectors for the IB Connector board collects all of the individual patient cables into a single ribbon cal then passes the signals to the main board.

2.7 Nellcor SPO₂ Interface Board

Overview

The Nellcor SpO₂ Interface PCB provides the communication path for the two-way flow between the Nellcor MP-304 PCB and Passport 2 CPU Control Module. The M analyzes the analog input from the SpO₂ sensor and outputs the data in digital forma serial digital interface. The purpose of this PCB is to control the power supplied by control module as well as to reassign pins for two connectors, serving as an adapter between the two boards.

2.8 Recorder Interface Board (AR-42)

Overview

The function of this board is to provide power filtering for the recorder and suppres current spikes. The board also provide fan control and fan tach filtering and convers logic levels that the 860T can accept.

2.8.1 Detailed Description

2.8.1.1 Power Filtering

Power filtering of the recorder logic 5VDC is provided by C5 and C6. This circuit provides a low pass filter to reduce noise introduced into the system power. Since th is digital logic the current peaks are minimal.

The power filtering for the recorder motor and print head is provided by this board. this board that must suppress the high current peaks from affecting the power suppl power distribution within the system.

The suppression must reduce these peak loads to less than 1 Amp with a maximum voltage ripple of 0.5VDC.

2.8.1.2 Fan Controller

The digital control provided by the 860T I/O pin operating as a output is conditione R5 & C7. This signal is then applied to the gate of Q1 which provides the drive cont The fan is low line controlled with the fan return being connected to the FET source In series with the 12V2 is R1, 30 ohm resistor, that limits the fan voltage to approx. and reduces the fan noise. When fan operates on 12VDC it draws 100mA, typical.

2.8.1.3 Fan Sense

The Tach-generator, TG, generates two cycles of square wave per rotation of the fan motor. The square wave is then converted to a Digital logic level, which turns on Q (FET). Q2's output is driven to Digital Logic low. The 860T uses this level to sense fan is functional. If FTACH goes to Digital logic High The 860T will drive the FAN_CNTRL to Digital logic low turning off Q1 FET removing Digital Ground from Fan and turning it off.

2.9 XE-50 Recorder Interface Board

2.9.1 Cooling Fault

The Cooling Fault signal is driven by an FET (Q2), to the CPU to alert the CPU that cooling fault has occurred. A "Cooling Fan Failure" message will be displayed on unit. The fault can be cleared, if there is no obstruction in the fan, by cycling system power. In normal fan operation, a pulse train is present at the SENSE pin. A missing detector monitors this pin during fan operation. A stalled, open or unconnected fan the TC646 to trigger its startup timer once. If the fault persists, the FAULT output g low, and the device is latched in its shutdown mode. The Cooling Fault signal is als generated if there is an over-temperature condition. That is, a temperature rise abov point where the fan's PWM control signal is at 100%. A "Cooling Fan Failure" me will be displayed on the unit, but no action is necessary if the temperature normaliz

2.9.2 Fan-Fault Sense

The SENSE input (U2 pin 5) is connected to a resistor divider network (R5 & R30) scale down the tach pulses from the fan. During normal fan operation, a brief interr in the fan current generates pulses into the sense resistors network. If the device is r Shutdown mode, and pulses are not appearing at the SENSE input, a fault exists. Th Sense Network shall scale-down the pulses that will meet the requirements of the T of 90mV minimum at pin 5.

2.9.3 Power Filtering

Power filtering of the recorder logic 5VDC is provided by L1 together with C5 and This circuit provides a low pass filter to reduce noise introduced into the system po Since the load is digital logic, the current peaks are minimal. This board provides th power filtering for the recorder motor and print head. It must suppress the high curr peaks from affecting the power supply and power distribution within the system. Th suppression reduces these peak loads to less than the recorder in-rush current with a maximum voltage ripple of 0.5VDC.

Capacitor C7 is for the purpose of reducing induced PWM switching noise. The val this capacitor depends on the fan current consumption. Therefore, this capacitor val may be adjusted after lab measurements are analyzed. A provisional capacitor (C16 included as a placeholder with a different footprint to further aide in the elimination fan's acoustical noise, if required.

2.9.4   XE-50 Interface

J4 Interfaces the XE-50 Recorder to this Module. Data is transferred serially to and
the recorder when it gives the indication that it is ready to accept data. The signals
SINEN* and RDY* are ANDed together to produce the REC_CTS*, which is proce
by the CPU for data flow-control.

2.9.5   5V Regulator (U4)

The 5V Regulator circuit, comprised of the Micrel MIC2954 three terminal regulato
which derives +5V from the incoming +12V (+12V2). The regulated +5V is referen
the 12V-return in order to minimize the introduction motor noise generated by the fa

Q2, Q3 and Q5 isolate the boundary between the CPU Module's circuit ground pote
and the local ground potential. Since the two are referenced to different supply volta
they can be significantly different.

2.9.6   Fan Test

A 4.0 Kohms (typ) resistor along with a momentary pushbutton switch has been add
the PCB to facilitate testing of the fan after the unit has been assembled. The pushbu
switch is accessible through the Recorder door opening. Pressing the switch simulat
temperature, which will force the fan to operate (> 50°C typical).

2.10 Power Supply Assembly

The following specification describes a power supply/charger, which will be used a power source for the Passport 2.

The power supply can operate off an AC line, a DC source from the Docking Base S (DS-DC) or two sealed lead acid 12V batteries. The power supply will automatical select the available source of power, based on predetermined priority.

The power supply provides three regulated DC output voltages, +5V and two +12V outputs. The outputs can be turned On/Off via a logic signal REMOTE-ON*. Mom grounding of the REMOTE-ON* signal shall turn the outputs On/Off.

Two independent battery chargers will be included in the power supply to charge tv sealed lead acid batteries, Panasonic's LCS2312PC or equivalent. The chargers wil activated when AC. The chargers will continuously monitor the batteries' voltage a charge the batteries as required. The chargers can be turned off, by grounding an in logic signal, CHARGER-DISABLE*.

The power supply shall include a Microcontroller to control its functions with an e> Serial Peripheral Interface. In addition to the dedicated input control signals, the po supply can be controlled and send data over the Serial Peripheral Interface controll the ECM. The control functions to be determined by firmware residing in the Microcontroller.

2.11   El Display Interface Board

2.11.1   Overview

This board provides interface and support for the EL display, an SPI interface to a 4
matrix keypad, optical encoder and LED's. It also provides connection for a speaker

2.11.2   Detailed Description

CPLD Interface to the CPU Board Via SPI

The purpose of the CPLD (U1) is to interface to, and scan for, key presses on the fro
panel keypad. The method of communicating with the CPLD is the SPI port of the
68HC916X1 communications processor on the CPU control board (0670-00-0674).
SPI interface is a serial interface with separate serial data and clock. Data can flow e
direction using a common clock. The communications processor is set as the master
device and the CPLD can only be a slave.

Video Display Connections

The J5 connector is for the EL display. The EL display requires a 12V excitation vol
5V to power the logic circuitry, and can recognize the 3.3V logic levels. Data lines L
through LD7 are driven by 3.3V logic from the video processor, and filtered with 68
capacitors to 3.3V ground to prevent ringing.

Speaker Connection

The system speaker is connected to J2. The EL Display/Keypad Interface Board func
as a pass through for this signal.

Encoder Connection

The optical encoder for the keypad is connected to J4. Phase signals (CHA/CHB) and
switch contact signal (SW) are passed through the EL Display/Keypad Interface Boa
an ADC on the CPU board.

VDD Control Circuit

The board employs a P-Channel FET together with a NPN Transistor to provide pow
switching for the EL display's 12V excitation. The FET is controlled by the transistoi
which is switched on and off.

JTAG Connection

The board is equipped with JTAG Connector, J9, for in-circuit programming of the
Keypad Scanning CPLD.

2.12   Passport 2 Passive Display/keypad Interface Boar

2.12.1   Overview

This board provides interface and support for the Passive Display, an SPI interface t
8 matrix keypad, optical encoder and LED's. It also provides connection for a spea

2.12.2   Detailed Description

CPLD Interface to the CPU Board VIA SPI

The purpose of the CPLD (U1) is to interface to, and scan for, key presses on the fi
panel keypad. The method of communicating with the CPLD is the SPI port of the
68HC916X1 communications processor on the CPU control board (670-00-0674).
SPI interface is a serial interface with separate serial data and clock. Data can flow
either direction using the common clock. The communications processor is set as tl
master device and the CPLD can only be a slave.

Video Display Connections

Connectors J12, J13 and J14 are for the passive display. J12 and Jl3 are connectors
display data lines and power, J14 is for the inverter. Data Lines LD0 through LD7 ;
UD0 through UD7 originate from the video processor and are driven by 5V logic fr
FCT162373T buffer line driver. The data lines are terminated with 61.9 ohm resistc
filtered with 68pF capacitors to ground to prevent ringing.

Speaker Connection

The system speaker is connected to J2. The Passive Display/Keypad Interface Boaɪ
functions as a pass through for this signal.

Encoder Connection

The optical encoder for the keypad is connected to J4. Phase signals (CHA/CHB) a
switch contact signal (SW) are passed through the Passive Display/7Keypad Interfɑ
Board to an ADC on the CPU board.

VDD Control Circuit

The board employs a P-Channel FET together with a NPN Transistor to provide po
switching for the Passive Display's 12V excitation. The FET is controlled by the tra
which is switched on and off by the VIDPWR* signal from the CPU board. The ciɪ
also provides power filtering using an LC filter to reduce the in-rush current drawn
display.

JTAG Connection

The board is equipped with JTAG Connector, J9 for in-circuit programming of the Keypad Scanning CPLD.

LCDBIAS Control Circuit

In order to properly turn on the passive display, the board employs a N-Channel FE' which is switched on and off by the LCDBIAS signal from the CPU board. The LCD signal is connected to the CPLD for power sequencing. The contrast function is accomplished by varying a 10K potentiometer.

LCDADJ Control Circuit

The contrast function is accomplished by varying a 10K potentiometer.

2.13   NEC 10.4" Display/Keypad Interface Board

Overview

This board provides interface and support for the 10.4" NEC Display, an SPI interfa
4 X 8 matrix keypad, optical encoder and LED's. It provides connections for an ext
speaker and inverter for the display.

2.13.1   Video Display Interface

The video data, control signals, and display logic power are supplied to the display
J5 connector. The video data and control signals are generated by the video control
on the CPU board (0670-00-0674) and input to buffer/line driver ICs (U7 & U8). T
ICs have 3.3V/5V logic compatible.

inputs, and 5V logic compatible outputs. These buffer/line drivers provide the prope
levels to the display regardless of the setting of the video processor's LCD interfac
ensure proper drive capability. Each video data and control signal line then passes tl
an RC low pass filter designed to match line impedance and thus reduce ringing.

There are two display ID signals going to the CPU board connector, labeled VIDSE.
VIDSEL2. This generates the bit pattern for the NEC 10.4" display per the followii
chart:

TYPE	VIDSEL1	VIDSEL2
NEC 10.4" Display	1	0

The 3.3V supply power to the display is filtered by a LC low pass filter made up of l
C64. The goal of the low pass filter is to prevent the display's operating frequency
contaminating the 3.3V line. C59 was chosen for it's low ESR and Ripple Current
characteristics with the capacitance value being a secondary consideration. C61 wa
chosen for storing an amount of charge in order to maintain the voltage level for th
logic.

2.13.2   TFT Inverter Interface

The inverter for the TFT display is connected to connector J3. The inverter is powe
filtered +12V2 voltage and is turned on and off using the output of a monostable tir
driven from an astable timer. By varying the duty cycle of the monostable timer, th
brightness of the display is controlled. The higher the duty cycle, the brighter the d:
is, the lower the duty cycle, the dimmer the display is.

The +12V2 voltage to the inverter is filtered by a LC low pass filter made up of L3
C20. The goal of the low pass filter is to prevent the inverter's operating frequency
contaminating the +12V2 line. Capacitors C57 and C58 were chosen for their low l
and ripple current characteristics, with the capacitance value being a secondary
consideration.

Operation of both timers begins with both RESET lines held high. The first timer c
operates in an astable mode. The output of the first timer circuit is approximately 1.
with a 67% duty cycle. The period and the duty cycle are determined by R58, R56 a
C11. The output of the first timer circuit is fed into the trigger input of the second ti
circuit. The second timer circuit begins it's operation on the falling edge of the inpu
signal. The duty cycle is determined by the value of R59, R61 and C12. The amplitu
the output is approximately 1.55 volts less than the power supply.

To obtain a 100% duty cycle, J8 is unjumpered. This disconnects the output of the
monostable circuit from U9 and ties the input of U9 to the voltage across R63, whic
setup by the voltage divider of R60, R62 and R63. In this configuration J6 and J7 ar
unjumpered. To obtain a 50% duty cycle, J6 and J8 are jumpered, J7 is unjumpered.
combination of R59 and C12 produces the 50% duty cycle. To obtain a 75% duty cyc
and J8 are jumpered and J6 is unjumpered. The combination of R61 and C12 produc
75% duty cycle.

The output of the monostable timer is used to drive a buffer with a 3 state output wh
controlled by VIDPWR*. In order to satisfy the input requirements of the buffer, U9
output of the monostable timer is stepped down by R62 and R63 for 50% and 75% c
cycles. For the 100% duty cycle, the monostable timer is disabled and the input to U
stepped down by R60, R62, R63 and +12V2. When VIDPWR* is low, U9 is turned
providing the gate voltage to Q1. Q1 turns on essentially shorting the gate on Q2 to
ground. This turns on Q2, providing current to flow to the control pin of the inverter
VCONT. R34 and C66 were chosen to keep the Passport 2 CPU clock frequency (45
MHz) from contaminating the VCONT signal and to permit a return to +12V_RET f
inverter frequency (41 KHz). R34 also provides a ground loop between 3VGND
(VIDPWR*) and +12V_RET (VCONT). When VIDPWR* is high, there is no outpu
U9.

R64 and C65 sustain the supply voltage for U9 as the input on U9 changes from high
low and low to high.

CR1 provides ESD protection for the circuit from transients from the inverter.

2.13.3   Speaker Interface

The system speaker is connected to J2. The NEC 10.4" Display/Keypad Interface Bc
functions as a pass through for audio signals.

2.13.4   Encoder Interface

The optical encoder for the keypad is connected to J4. Phase signals (CHA/CHB) an
switch contact signal (SW) are passed through the NEC 10.4" Display/Keypad Interf
Board to an ADC on the CPU board.

2.13.5   The CPLD Interface to the CPU Board VIA SPI

The purpose of the CPLD (U1) is to interface to and scan for key presses on the fro
panel keypad. The method of communicating with the CPLD is the SPI port of the
68HC916X1 communications processor on the CPU control board, 0670-00-0674-
The SPI interface is a serial interface with separate serial data and clock. Data can l
either direction using the common clock. The communications processor is set as tl
master device and the CPLD can only be a slave.

The serial input provides the keypad poll data (D0, D1, D2, D3) and LED data (XLF
for the charger and mute LED's. This data is latched and is updated with each
communication packet and erased whenever the BRESET* is enabled. The output (
keypad Row Select is sent to the keypad. The column selection is edge latched whei
is pressed. This data is then serial encoded and transmitted to the Host.

The method used to scan the keypad, which is a matrix of 4 rows (J11, ROW1-4) w
to 8 columns (J10, COL1-8), is a "walking zero" pattern. This means that three out
four row lines will always be a logic "1" with one line driven low. In a complete cy
each line will sequentially be driven low, driving a different row on the keypad.

The CPLD has an 8-bit receive shift register with a latch to hold the row selection 1
(walking zero). This completes the first part of the cycle. The next 8 bit serial data
received provides the next pattern for the row selection (walking zero) and simultan
shifts back the previous column pattern. If a key were pressed there would be a log
in the data shifted back for one of the columns. Since the communications processc
knows which row was a logic "0" and now has the column location, it can determir
exactly which key was pressed.

Since there are only four rows allocated to the keypad and eight select lines availabl
have been assigned to the alarm LED's. The lines used are assigned to bits 4 and 5
input serial data. Lines assigned to bits [0:3] are for the keypad and bits 6 and 7 are
used. The LED's can be turned on or off as well as flashed by changing the pattern
bits assigned.

Passive components between the CPLD and top and bottom tail connectors are nee
follows: R15-22 are used to hold the signals high when the signal is low so that ther
confusion about signal information. Furthermore, R7-14 as well as R23-30 are curr
limiting resistors cleaning up the signal to the connectors.

The CPLD is programmed in-circuit by a cable connecting a computer to the 6 pin l
J9.

2.14   Passport 2 NIBP Module P/N 0670-00-0730/ 0670-00-0746-01

Overview

The NIBP PCB utilizes a Motorola MC68HC16Z1 microcontroller. This processor responsible for controlling a pump and two valves in the generation of the patient pre signal. This pressure signal is generated non-invasively using an inflatable cuff. A Fujikura XFPM-050KPG-P5 pressure transducer converts the pressure signal in the c an analog voltage. The pressure signal is sampled by an AD7714 24-bit ADC which interfaces to the microcontroller's QSPI port. This data is processed by the HC16Z1 determine the blood pressure using the oscillometric principle. The results are then the host via a RS-485 interface through the processor's SCI port.

During a measurement, the HC16Z1 software inflates the cuff and then controls the pressure bleed rate using a linear valve. The linear valve control allows the software adjust the valve orifice to arrive at a nominal linear bleed rate of 6mmHg per secon the conclusion of the measurement, a dump valve is opened by the software which a the cuff pressure to rapidly bleed down to atmosphere.

A separate Atmel AVR microcontroller (AT90S4433-8AC) and Fujikura XFPM-050 BP3 pressure transducer are used to monitor the cuff pressure redundantly for safety purposes.

This document describes the details of the actual design implementation developed t meet the requirements set forth in the module requirements document. It provides th of operation and internal specification of this implementation.

2.14.1   Pneumatic System Control

The pneumatic control consists of a pressure transducer, ADC, microcontroller, DAC drive circuitry. This circuitry controls a pump, a dump valve and a linear valve. The pneumatics can also be disengaged by the over-pressure detection circuitry. (See sec 2.14.8) The pump is used to inflate the cuff at the beginning of each measurement cy Inflation pressure is regulated by the HC16Z1 software monitoring the pressure transc signal from PT1 via the AD7714 ADC.

During the pump-up phase, the dump valve (V1) is closed and linear valve (V2) is modulated. At the onset of the actual measurement phase, the linear valve is controll provide a gradual reduction of the cuff pressure. The HC16Z1 software maintains the pressure bleed rate at a nominal 6mmHg per second, regardless of the cuff pressure c system volume. During the measurement phase, the pressure signal acquired by the transducer PT1 is digitized by the ADC (U2) and processed to extract the oscillometr blood pressure data. At the conclusion of the measurement phase, the dump valve an linear valve are both fully opened to rapidly exhaust the residual cuff pressure.

2.14.2   **Pressure Transducer, PT1**

A Fujikura XFPM-050KPG-P5 transducer was selected for the measurement chann
provides a high level output signal which eliminates the need for an external amplii
circuit. All that is required is a pull-up resistor and compensation capacitor. The PT
screened to maximize performance in designs which will perform a zero cal before
measurement and a yearly span cal at 150mmHg near room temperature. It also prov
nonlinearity specification beyond the screening limits which enhances performance

The transducer is not installed during the initial PCB manufacturing and cleaning
processes, avoiding exposure to moisture which may effect its performance, but wi
soldered in place during final module assembly.

The transducer has an output transfer characteristic of 11.667mV/mmHg. Adjustin{
pot R81 changes the attenuation factor of the transducer output signal (span calibra
and thus the slope of the transfer characteristic. The nominal slope will correspond
attenuation produced when the wiper is at the midpoint of its range. With a 28.7kW
for R80 and a 2kW value for R81, the nominal slope to be used by the software for
measurement channel is 11.29mV per mmHg. The adjustment range is wide enougl
cover the +/-50mV transducer set point tolerance at the 150mmHg calibration press

2.14.3   **ADC, U2**

The pressure signal is sampled by an Analog Devices AD7714 24-bit ADC which
interfaces to the microcontroller's QSPI port.

The device must first be configured by using the AD7714 zero-scale self-calibration
followed by the full-scale self-calibration mode. From this calibration process, offs
gain coefficients are determined that will be applied automatically by the AD7714
hardware.

NOTE: **Several samples must be read before the new
                coefficients are applied after a calibration.**

The system zero cal is then performed. If in the span calibration diagnostic mode th
system zero cal is followed by the span cal.

NOTE: **A 90 second warm-up period shall elapse prior to
                span calibration to account for transducer warm-
                up drift. It is also necessary to calibrate the ADC
                prior to system span cal., otherwise the gain
                coefficient in the ADC will not be taken into
                account during the span calibration.**

The ADC is used in the bipolar mode which causes the ADC gain error to be of op{
sign above and below the 2.5V nominal voltage appearing on AIN2. That is, the AD(
error pivots at 2.5V. The trim pot (R81), on the other hand, adjusts for gain error wl
pivots at 0V and will not correctly account for ADC gain error without a correspon(
change in the offset value. This leads to an iterative process for adjusting ADC gair
and offset.

The input buffer reduces the input range below what is required, so the BUFFER c(
pin is tied low to short out the internal buffer.

R15 and R27 are +/-0.1% tolerance, +/-25ppm/°C resistors which form a highly ac(
and stable voltage divider generating the AD7714 2.5V reference voltage from A5V.
the PT1 measurement channel transducer output is ratiometric with A5V, the AD77
readings are directly proportional to the applied pressure after subtracting the zero (

The DRDY* signal is used to indicate to the HC16Z1 software that the converted d
available. The AD7714's POL input is tied low, so the HC16Z1 QSPI shall be confi
in the master mode with its CPOL bit set to 0 and its CPHA bit set to 1 for ADC da
transfers.

The nominal ADC clock rate is 2MHz.

2.14.4　　　DAC

The linear valve's bleed rate is current controlled by the HC16Z1 software by writir
Maxim MAX5352 12-bit DAC (U12) connected to a Burr-Brown OPA336 CMOS
operational amplifier (U13), in turn connected to an International Rectifier IRF730:
Power MOSFET (Q6).

A DAC code of 0 will result in zero current flow in Q6, and a fully opened valve. A
scale DAC code results in the maximum DAC output voltage of 2.5V and thus max
current flow in Q6. This corresponds to a fully closed valve. Power-on-reset clears t
DAC's output to 0 thus fully opening the valve. The DAC's 2.5V reference voltage
derived from a Linear Technology part, LT1790-2.5.

2.14.5　　　Pump, M1

The pump control signal, M1EN, is provided via a PWM signal from the HC16Z1
microcontroller and is active high. This signal switches MOSFET Q3 (1/2), applyin;
power to the pump motor. Power to the pump (12VSW) is supplied from 12V2 via (
This allows the pump to be disabled in case of a fault condition.

2.14.6　　　Dump Valve, V1

The dump valve, V1, is controlled by the V1EN signal provided by an active high si
from the HC16Z1 microcontroller. This signal drives MOSFET Q3 (1/2), which swi
power to the valve coil. Power to the valve (12VSW) is supplied from 12V2 via Q2.
allows the valve to be opened in case of a fault condition. This valve is a 'normally (
type, so coil current must be supplied to cause the valve to close.

2.14.7　　　Linear Valve, V2

The linear valve, V2, provides bleed down of the cuff pressure. The HC16Z1 softwa
maintains the pressure bleed rate at a nominal 6mmHg per second, for product speci
volumes and pressure ranges. The linear valve can also be used to control the pump u
when small volume cuffs are used in the neonatal mode.

Note that this valve is a 'normally open' type, so coil current must be supplied to caus
valve to close.

The linear valve's bleed rate is current controlled by the HC16Z1 software by writi Maxim MAX5352 12-bit DAC (U12) connected to a Burr-Brown OPA336 CMOS operational amplifier (U13), in turn connected to an International Rectifier IRF730 Power MOSFET (Q6).

The DAC output voltage is divided by 5 (which results in a full-scale control volta; 0.5V nominal) which is applied to the opamp's, U13, non-inverting input. A curren sensing resistor, R95, is used to generate a low voltage proportional to the linear va current. This voltage is fed back to the opamp's inverting input. The opamp control Q6 FET gate voltage to maintain the desired current setting and corresponding val\ orifice. A5V is used to generate a small offset voltage using R94 and R92 to insure FET is fully off for a DAC code of 0.

R95 is chosen to guarantee the full-scale current fully closes the valve under worst conditions, including coil winding tolerance.

The IRF7303 MOSFET part (Q6), was chosen due to its lead-frame design which c superior power dissipation capabilities. As such, the maximum junction rise when c the 0.526W, 274 ohm linear valve coil under the worst case conditions, does not w; any heat-sinking to achieve reasonable reliability.

2.14.8   Over-Pressure Detection

There are two methods of keeping the pressure from getting too high. The first met the HC16Z1 software based monitoring of the pressure transducer, PT1. When the software monitors pressure higher than, 300mmHg in Adult mode, 200mmHg in Pe or 150mmHg in Neonate mode, the measurement cycle will halt and dump valve, \ bleed valve, V2 shall open to release the pressure in the cuff.

In the event of an over-pressure condition that is not corrected by the HC16Z1 soft and the measurement channel circuitry, the over-pressure channel serves as a fully redundant backup system to disable the pump and valves, thus relieving the pressure cuff. The hardware over pressure limit detect circuitry will deactivate the over pres; signal 12VEN*, cutting off power to the pump (M1) and valves (V1 and V2), rever them to their 'normally open' state, independent of software. This action places the PCB in a 'shutdown' state that can be exited only by cycling the system power.

To achieve this secondary over-pressure detection, the PCB uses a pressure transdu (PT2) separate from the measurement channel, a secondary microprocessor (U4), a; power-cut circuitry (Q1, Q2). This circuit is also powered by a separate voltage (T! than used by the AD7714 and measurement transducer.

An over-pressure test shall be performed yearly through service diagnostics to veri! circuit is operating within the prescribed parameters.

2.14.9   Pressure Transducer, PT2

The Fujikura XFPM-050KPG-BP3 transducer was selected for the over-pressure ch
Due to a transducer accuracy of ±5.625mmHg (+/-67.5mV set point tolerance at the
0mmHg) over the entire pressure range, the overpressure transducer must be zero
calibrated at 0mmHg in order to operate the measurement duration timer. This zero
calibration is automatically performed by the software resident in the secondary Atr
microcontroller (U4). The PT2 provides a high level output signal which eliminates
need for an external amplifier circuit. All that is required is a pull-up resistor and
compensation capacitor.

The transducer has an output transfer characteristic of 12mV/mmHg, but due to a sr
gain generated by a 100kW value for R30 and a 3.60kW value for R29 in the negati
feedback loop of the op-amp (U16), the transfer characteristic to be used by the soft
for the over-pressure channel is 12.44mV/mmHg. With 0mmHg pressure applied to
transducer input port, the output of the op-amp (U16) is approximately 100mV. Giv(
set point tolerance of +/-67.5mVat 0mmHg, the main processor (U10) software tracl
can be off as much as 67.5mV * 3.6% or 69.93mV (5.62mmHg).

The transducer is not inserted until the end of the manufacturing and cleaning proce:
avoiding exposure to moisture which may effect its performance, but will be solder(
place after final assembly.

2.14.10   12VSW Circuitry, Q1, Q2

Disabling the pump (M1) and valves (V1 and V2) is accomplished by cutting power
these devices using a switched version of 12V2, 12VSW. This is done via the secon(
microcontroller's 12VEN* signal which controls Q1. The 12VEN* signal turns the I
transistor Q1 on which allows current to flow through R36 and into the Q1 collector
voltage developed on R36 turns on Q2, a P-channel FET with high current capabilit)
supplying power to the pump and valves.

2.14.11   Primary Microcontroller, U10

The NIBP PCB utilizes a Motorola MC68HC16Z1CPV16 microcontroller. This spe(
a 5V, 16.78MHz, commercial temperature range part in a 144 pin TQFP package. Tl
processor is responsible for controlling a pump and two valves in the generation of tl
patient pressure signal. This data is processed by the HC16Z1 and fed to the host via
RS-485 interface through the processor's SCI port.

A 32.768kHz crystal (Y1) is used for the HC16Z1 reference oscillator circuit. The
HC16Z1 SYNCR (clock synthesizer control) register will be set with X=1, W=0 and
Y=60. This produces a nominal system clock frequency of 15.99MHz. The 32.768kI
crystal is specified with a load capacitance of 20pF. To present this load, C20 and C2
set to 33pF. The load capacitance is calculated as the series combination of C21 and (
plus the stray capacitance which is estimated to be less than 5pF.

At Power-On Reset, the state of the HC16Z1 pins controlling the pump and valves is
that they are disabled (pump off / valves open).

The HC16Z1 has an internal ADC which will be used to monitor both pressure tran
outputs, a 2.5V reference source, A5V, 12V and the switched 12V voltage, 12VSW
Dividers are used where needed to insure the sampled voltage is within the usable ⌐
input range. A filtered version of T5V is used as the ADC reference.

2.14.12   Secondary Microcontroller, U4

The PCB incorporates an Atmel AVR microcontroller to perform over-pressure sen
The Atmel AT90S4433-8AC is an 8-bit RISC architecture AVR microcontroller wi
4Kbytes of in-system programmable FLASH, 128 bytes of RAM and 256 bytes of
EEPROM. The device contains 32 byte-wide general-purpose registers, two timer/
counters, a 10-bit ADC with 6 input channels, programmable Watchdog, SPI Serial
interface and 20 individually programmable I/O lines. The device comes in a 32-pin
package and operates between 4 to 6 volts at speeds up to 8 MHz.

A 2.45MHz ceramic resonator (Y2) with built-in capacitors is used for the AVR's
oscillator.

The AT90S4433 is informed of the desired measurement mode by reading the
MODE_IN3:0 signals fed from the HC16Z1. It in turn sends back four signals,
STATE_OUT3:0, to indicate that the AT90S4433 has not encountered any faults, h₂
its over-pressure and measurement duration limits to match the type of measureme₁
indicated, has completed the offset reading (zero) and is ready for the measurement
type encoded on STATE_OUT3:0.

The over-pressure signal (PVO) is sampled by an ADC internal to the AT90S4433 a₁
of 153.125kHz. If it detects an over-pressure condition, the AT90S4433 goes into a
emergency shutdown state. In this state, the AT90S4433 turns off the 12VSW pow₤
feeding the pump and valves by toggling the 12VEN* signal line high. Since the va
are normally open, turning off their power will vent any cuff pressure to atmospher
AT90S4433 then remains in the emergency shutdown state until the system's powe₁
cycled. Note, a software reset issued from the HC16Z1 and asserting RST* will ha‑
effect on releasing the AT90S4433 from the shutdown state.

The ADC uses an external reference voltage (T5V). Since T5V is the same voltage ₤
that is powering the ratiometric transducer, direct ADC readings represent the pres₤

In addition to the input signals MODE_IN3:0 and PVO, the AT90S4433 also has th₤
reference voltage (25VR) applied to its A/D inputs. This signal is used as a 'back-d
verification of the T5V reference voltage. Since 25VR is generated from a separate ₤
than T5V, and since T5V is also used as the ADC reference voltage, if the T5V refₑ
voltage were to fail, the ADC would read full scale when comparing 25VR to the *A*
reference (T5V).

The AT90S4433 device includes a brown-out reset circuit which guarantees the deν
reset when VCC is below 4.0V +/-0.2V. This brown-out reset is required since the
AT90S4433 is not connected to the HC16Z1 RST*.

To increase the reliability of the AT90S4433 device's function as an over-pressure
detector, sleep mode will not be utilized. This prevents the possibility of the part bec
stuck in the sleep state.

2.14.13   Memory

Flash Memory, U7

The program code will be stored in an Atmel AT49F4096A 4Mbit memory. The fla
device specified has the boot sector located at the bottom of the memory map at ad(
00000H where the HC16Z1 expects to find the reset vectors.

Although the flash device requires additional power with CE* tied low, this prevent
need for decoding logic where board real estate is limited.

Besides storing program code, other unprotected sectors of the flash memory may b(
to store less critical nonvolatile data if required. This would require dedicating an e1
flash sector for that purpose. However, due to small 8K byte parameter blocks in the
this is not a gross waste of memory resources and prevents the need for an addition;
device.

Due to the fact that the flash reset input is held active low by the DS1811 until VCC
valid level, inadvertent flash writes are avoided during power cycling and brown-ou
addition, the flash WE* signal defaults to the high state after reset and it is virtually
impossible for the flash write protocol to be reproduced due to random levels.

The HC16Z1 software can detect bad sector data in the flash by storing checksums ʼ
can be verified during initialization.

2.14.14   CMOS Static RAM, U5

The SRAM is composed of one (U5) Samsung K6R1016C1C 64k-word x 16-bit par
two separate chip select signals, CSRAMLB* and CSRAMHB*, connected to the L
and UB* pins respectively. The HC16Z1 R/W* signal is used to activate the SRAM
pins while the OE* pin(s) are held low. The CS* signal is controlled by the UB* anc
signals. Although this much memory is unlikely to be needed during normal operati(
will help when updating the flash in the field from the host. During this process, the
HC16Z1 program code must reside in the SRAM with additional room available for
buffering data received from the host.

2.14.15   CMOS EEPROM, U9

The HC16Z1 also has access to an Atmel AT25C020 2k-bit serial EEPROM througl
QSPI port. This EEPROM device will be used for storing an electronic serial numbe
(ESN), NIBP hardware version, and byte checksum. The ESN is a 32-bit long word,
starting in memory location 0. The hardware version information is one byte and fol
immediately after the ESN, in memory location 5. The checksum is also one byte, a1
follows immediately after the hardware version info, in memory location 6. This
information can be programmed via J7 or off the board by removing the device from
socket.

This memory is hardware write protected by installing jumper J3 (JMODE*).

The EEPROM will be programmed using a PC based program script to download
hardware and software revision history.

The HC16Z1 software can detect bad sector data in the serial EEPROM using chec
which can be verified during initialization.

2.14.16   Hardware Locks

The EEPROM are hardware write protected by installing jumper J3 (JMODE* sign
line). Removing J3 will automatically remove the hardware write protection featur
allowing the device to be written while in one of the auxiliary modes.

2.14.17   Reset

Low Power Reset, U8

A Dallas Semiconductor DS1811 device monitors the PCB's VCC voltage and acti
RST* before it falls below 4.5V. Since the HC16Z1 timing characteristics are spec
with VCC at 5V+/-10%, a valid VCC voltage is guaranteed while the device is out
reset. The flash is also reset by RST*, which prevents spurious flash writes during
cycling.

2.14.18   Host Reset

The MODRESET* signal from J1 allows the host to reset the main processor (HC1
on the PCB. A NOR gate (U14) inverts the signal and the Q7 FET pulls RST* low
MODRESET* is activated.

RST* is pulled up by R17. This resistor's value was chosen in order to meet the RS
timing requirements of the HC16Z1. If the RST* rise time is too slow, the HC16Z1
assume there is an external reset and repeatedly drive RST* low itself. This rise tim
governed by the capacitive loads on RST* as well.

Note, RST* is not connected to the AT90S4433 reset (PROGRAM*) in order to pre
an HC16Z1 reset from bringing the PCB out of the emergency shutdown state.

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3.0   *Repair Information*

3.1   Introduction

This chapter of the Service Manual provides the necessary technical information to perform repairs to the instrument. The most important prerequisites for effective troubleshooting are through understanding of the instrument functions as well as understanding the theory of operation.

3.2   Safety Precautions

In the event the instrument covers are removed, observe the following warnings and guidelines.

1.   Do not short component leads together.

2.   The instrument covers must not be removed by other than qualified technical personnel who have received supplementary instructions regarding maintenanc(medical equipment or has equivalent experience in this area.

Stationary Mount,
Bedrail Hook Mount,
Visa / PatientNet
Radio & 608 Radio
Mount

Stationary Mounting
Bracket and (4) Screws
P/N: 0040-00-0299-02

Retainer Left
P/N 0226-00-0031

Retainer Right
P/N 0226-00-0030

608MHz
Radio Assembly
P/N 0040-00-0361-01

Bed Rail Hook Mount
and (4) Screws
P/N: 0040-00-0293

Bracket & Screws
P/N 0040-00-0296

PatientNet Mounting Kit
(P/N: 0020-00-0458-01)

Transmitter
(P/N: 0992-00-0130-01)

Transmitter
P/N 0992-00-0115 (Visa I)
P/N 0992-00-0116 (Visa II)

Comm Port
P/N 0998-00-0178-05 or
P/N 0998-00-0178-06

FIGURE 3-1 Stationary Mount, Bedrail Hook Mount, Visa/PatientNetRadio &
608 RadioMount

Rolling Stand and Wall Mount

**Rolling Stand Kit
Datascope P/N:
0040-00-0287-01**

Stationary Mounting Bracket
and Screws
P/N 0040-00-0299-02

Channel Plate Assembly
P/N 0386-00-0264

Swivel Head Assembly
P/N 0376-00-0011

Handle
P/N 0367-00-0068

**(Optional)
(Quick Release)
Deluxe Mounting Plate
P/N 0040-00-0299-01**

Basket Assembly
P/N 0426-00-0073

Column
P/N 0009-00-0004

Base
P/N 0441-00-0168

Caster Locking
P/N 0401-00-0027-02

Caster Non-Locking
P/N 0401-00-0027-01

Rolling Stand Dimensions		
Height	Width	Max Load
44"	24.5"	50 lb

**Wall Mount Kit
Datascope P/N:
0040-00-0287-02**

**(Optional)
(Quick Release)
Deluxe Mounting Plate
P/N 0040-00-0299-01**

Stationary Mounting Bracket
and Screws
P/N 0040-00-0299-02

Track and Arm Assembly
P/N 0436-00-0169

Cable Hook Assembly
P/N 0436-00-0132
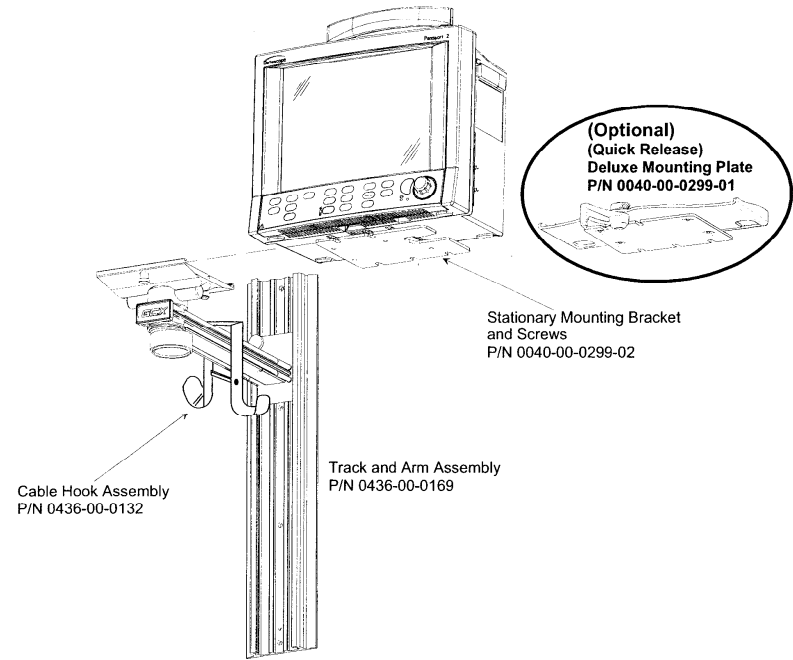
Single Wall Mount Dimensions				
Item	Height	Depth	Width	lbs.
Track	19"		3.5"	
Arm		12"	3.5"	
Max. Load per Arm				80 lbs

Passport 2 Specifications	
Height	9.5"
Depth	7.4"
Width	11.9"
lbs.	13.9 lbs
Watts Max.	72.0
BTU's	245

Notes:

1. It is recommended all AC Power be 120/.6amps,or 240/.3amps. Emergency power and a dedicated circuit be provided.
2. It is recommended minimum distance from finished floor to bottom of wall mount be 54 inches.
3. Location of wall mount is recommended to be to the left or right of the patients head for best visual.

Revised 12/01/00

RCD Wall Mount

CRT Mounting Plate
P/N 0386-00-0220

Arm Mounting Plate
P/N 0406-00-0631

Screws (4)
P/N 0212-00-0806

Note: Westbrook Engineering
Wall Mount is used for this kit
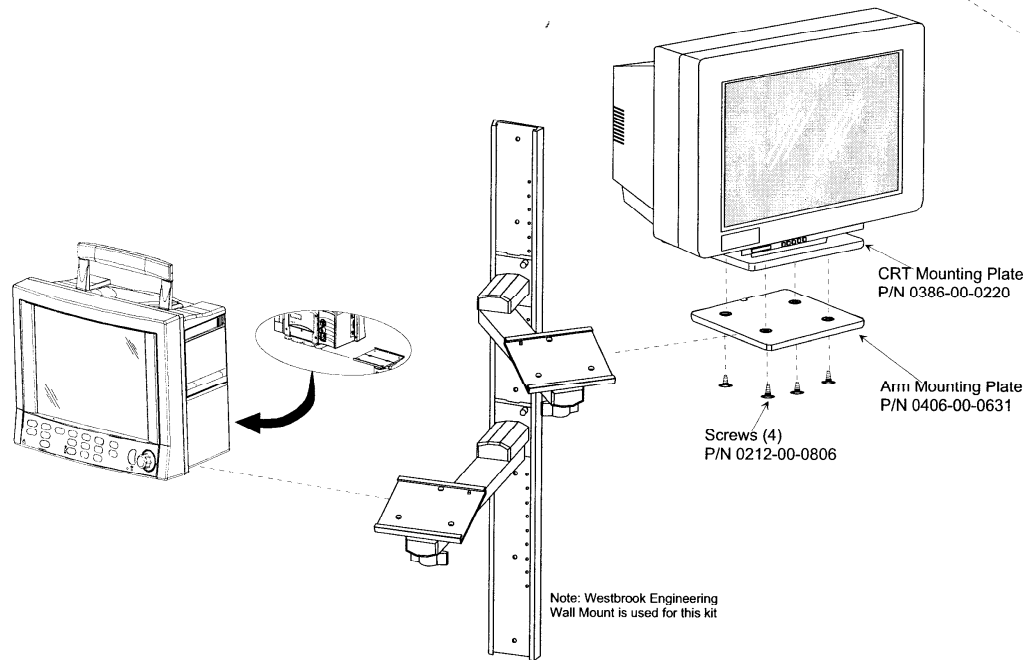
**Dual Remote Color Display
Wall Mount Kit
P/N 0020-00-0109**

**Note: This kit includes mounting accessories for
the Passport 3L, 5L and XG monitors.
See the wall mount kit on previous page for
accessories when used with a Passport 2.**

CRT Mounting Plate
P/N 0386-00-0220

Arm Mounting Plate
P/N 0406-00-0631

Screws (4)
P/N 0212-00-0806

Note: Westbrook Engineering
Wall Mount is used for this kit
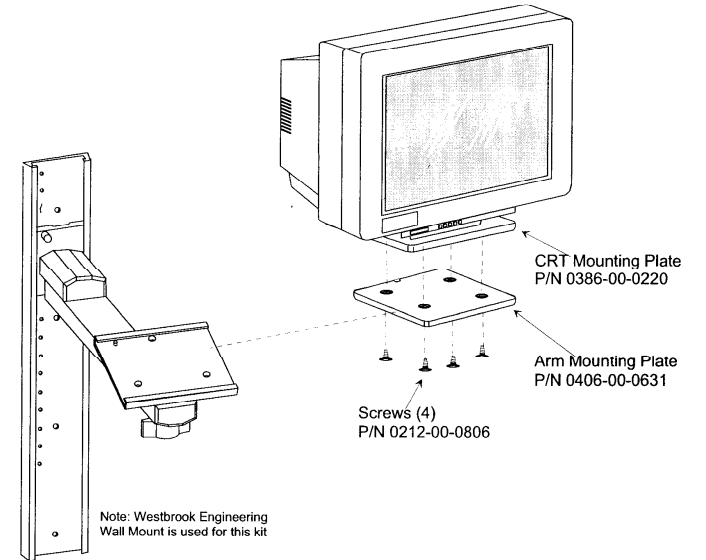
**Single Remote Color Display
Wall Mount Kit
P/N 0020-00-0108**

4-4

Basic Passport 2 Accessories

Filterline Nasal Canula (Adult)
P/N 0683-00-0467-10

Co2 Scavenging Assembly
P/N 0008-00-0332-01

Connects to
Co2 Exhaust Port

Connects to
Co2 Input Port

Filterline Set Short Term (Adult/Ped)
P/N 0683-00-0470-10

Recorder
Paper
P/N 0683-00-0422-02

400 Series Instrument cable
P/N 0012-00-0975

Connects to
Temperature
Input Port

Invasive Pressure
Ports 1 & 2

(See Note:)

400 Series Skin Temp Sensor
P/N 0206-03-0300-02

NIBP Adult Cuff
P/N 0998-00-0003-34

Connects to
Spo2 Input Port

Masimo Adult / Ped Spo2 Kit
P/N 0020-00-0130

ECG Cable Assembly 10'
P/N 0012-00-1255-01

Connects to
ECG Input Port

Connects to
NIBP Port

NIBP Hose 3.5 Meters
P/N 0683-04-0004

Battery

3 Lead Wire Set (USA)
(Snap 18")
P/N 0012-00-1261-07

5 Lead Wire Set (USA)
(Snap 18")
P/N 0012-00-1261-01

Battery
P/N 0146-00-0043
(2 required)

3 Lead Wire Set (International)
(Snap 18")
P/N 0012-00-1261-10

5 Lead Wire Set (International)
(Snap 18")
P/N 0012-00-1261-04

Passport 2
Installation Guide

**Note: Refer to the Pressure Transducer
Manufacturer for the proper IBP Instrument Cable**

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3.3	**Troubleshooting Guidelines**

1. **Identify the problem** - Due to the wide variety of potential symptoms certain problems may be more subtle than others. One approach to trouble shooting is t up the instrument as described in Chapter 7. Following the guidelines of the test help determine the problem if one exists.

2. **Avoid shorting component leads together** - During repair procedures, it can be tempting to make a series of quick measurements. Always turn the power off be connecting and disconnecting the test leads and probes. The accidental shorting leads can easily stress the components and cause a second failure (aside from th safety risk).

3. **Use the Proper equipment** - This equipment listed below is suggested to fulfil wide range of troubleshooting requirements. It is imperative to use the designate equipment in order to ensure proper results of any and all test procedures.

4. **Clean up the repair area** - After any repair especially after any soldering or desoldering clean off the repair area with alcohol and a stiff hairbrush. This will remove any residual solder flux inturn allowing the instrument to return to its ori neat appearance.

3.4	**Exchange Programs**

Datascope offers an exchange program for certain assemblies in the instrument. In m cases replacement of the complete assembly will result in the most expedient repairs

3.5	**Special Tools Required**

- DVM

- Digital Mercury Manometer - 0 to 300 mmHg

- Safety Analyzer - Dempsey model or Equivalent

- Patient Simulator

- Flow Meter

- Test Chamber / Dummy Cuff – Datascope P/N 0138-00-0001-01 (700 cc) or -03 (500 cc)

3.6   Disassembly Instructions

Before disassembling the unit, perform the following:

- Power down the unit and remove the line cord.
- Remove all cable assemblies from the left side, right side and rear of the unit
- Remove any batteries that were installed.
- Perform all work on a properly grounded station.

A. Removal of the Front Housing

1. Place the unit face down on a protective surface.

2. Loosen the screw from the Comm Port or filler Port. Remove the Comm Por filler port from the rear of the unit. Remove the eight screws from the rear of unit.

3. Turn the unit over and carefully remove the front housing assembly.

4. Disconnect the 80 pin ribbon cable from the J1 of the Display / Keypad boar mount in the front housing.

5. Disconnect the ground strap

B. Removal of the TFT Panel/EL Panel/Passive Panel/Keypad Panel Board

1. Remove the Encoder cable assembly from connector J4.

2. Unlatch the connectors and remove the Keypad Cable assemblies from conn J10 and J11 (EL or LCD), J11 and J12 (Passive).

3. Remove the Speaker cable assembly from connector J2.

4. Remove the inverter cable assembly from connector J8 (LCD only).

5. Remove the screw that secures the LCD cable assembly cover on J3 (LCD o

6. Remove the cable assembly from the connector J3 (LCD only).

7. Remove the EL Cable Assembly from connector J6 (EL only).

8. Remove the 5 screws that secure the panel board the front housing.

9. Remove the 2 screws that secure the ferrite clip to the Panel / Keypad Board

10. Lift the panel board up and out from the front housing.

C. Removal of the LCD Display / EL Display

1. Remove the TFT / EL Keypad Board as stated in Paragraph B.

2. Remove the high voltage cable assembly from the high voltage board at con CN2 (LCD only).

3. Remove the inverter cable assembly from the high voltage board at connect (LCD only).

4. Remove the two screws that secure the high voltage assembly to the left rail only).

5. Remove the two screws that secure the display driver cable bracket to the rig rail (LCD only).

6. Lift display driver cable assembly cable carefully from the LCD display / EI Display.

7. Remove the four screws that secure the LCD/EL display to the left and right 1

8. Lift the LCD/EL display up and out to remove.

D. Removal of the Passive Display

1. Remove the Passive Keyboard/Panel Board as stated in Paragraph B.

2. Remove the 2 screws that secure the Inverter bracket assembly.

3. Remove the 2 screws that secure the right mounting rail.

4. Remove the screw that secures the choke mounting bracket.

5. Remove the screw that secures the left mounting rail.

6. Remove the screw that secures the lower mounting bracket.

7. Lift the Passive display up and out and remove.

E. Removal of the Main CPU board (Main Frame).

1. Remove the front housing assembly as stated in Paragraph A.

2. Remove the NIBP Pump assembly and bracket as stated in Paragraph E.

3. Remove the 8 screws that secures the metal shield to the back housing.

4. Remove the Power Supply assembly from the rear of the unit as stated in Para¦ L. Once the Power Supply is removed carefully lift the Main CPU assembly u (about one inch).

5. Disconnect the Recorder cable from J8.

6. Disconnect the connector J13 (power switch).

7. Disconnect the CO_2 connector from J 23 (CO_2 module)

8. Disconnect the SpO_2 connector from the SpO_2 board assembly (Masimo® or Nellcor®).

9. Disconnect the connector J203. (Panel board).

10. Carefully lift the CPU board assembly from the back housing.

11. Carefully angle and lift the CPU board assembly from the back housing.

12. Disconnect the connector from J202 and remove the SpO_2 assembly.

13. Remove the ten screws that secure the CPU board to the metal frame.

F. Removal of the NIBP Pump.

1. Remove the Front housing assembly as stated in Paragraph A.

2. Disconnect the tubing from the inline pump filter.

3. Disconnect the connector from J8.

4. Remove Pump assembly from holding bracket.

G. Removal of the NIBP Module

    1. Remove the Front housing assembly as stated in Paragraph A.

    2. Remove the NIBP Pump as stated Paragraph E.

    3. Disconnect the cable from J1.

    4. Unfasten the NIBP fitting on the side of the back housing with a 1/4 inch nut

    5. Slide the NIBP module from the rear of the unit carefully and remove.

H. Removal of the Masimo SpO_2 Module

    1. Remove the Front Housing assembly as stated Paragraph A.

    2. Remove the Main frame assembly as stated Paragraph E.

    3. Remove the three screws that secure the Masimo SpO_2 module to the stando

    4. Remove the Cable assembly from J3 of the SpO_2 Module.

    5. Lift the Masimo SpO_2 Module up and remove.

I. Removal of the CO_2 Module

    1. Remove the front housing assembly as stated Paragraph A.

    2. Remove the Main frame assembly as stated Paragraph D.

    3. Remove the Patient Connector Panel as stated in Paragraph I.

    4. Remove the two screws that secure the CO_2 module to the back housing asse

    5. Slide the CO_2 Module to the left and lift the Module up and out of the back h

J. Removal of the Patient Connector Panel

    1. Remove the two screws that secure the Patient Connector Panel housing the
       housing.

    2. Slide the Patient Connector housing toward the back.

    3. Swing the housing open and remove the CO_2 exhaust tubing, connector and
       connector retainer clip. (optional).

    4. Disconnect the Ribbon cable assembly from the module.

    5. Remove the two screws that secure the SpO_2 connector to the Panel assembl

K. Removal of the Recorder Assembly

    1. Open the recorder door and locate the captive screws in the rear of the recor

    2. Slide the recorder from the opening and remove.

L. Removal of Recorder Interface Board

    1. Remove the Front Housing as stated in Paragraph A

    2. Remove the Main frame as stated in Paragraph D.

    3. Remove the recorder assembly as stated in Paragraph J.

    4. Remove the Cable assembly from J3.

    5. Remove the three screws and pull the board from the unit.

M. Removal of the Power Supply

1. Insert a narrow flat blade into each of the four slots and release each tab.

2. Ensure not to damage each tab. Remove the plastic cover.

3. Remove the four screws from the corners of the metal housing.

4. Slide the power supply out of the opening and remove.

N. Removal of the Battery Holder Assembly

1. Be sure the batteries are removed from the battery holder assembly.

2. Remove front housing assembly as stated in Paragraph A

3. Remove the main frame assembly as stated in Paragraph D.

4. Remove the five screws that secure the housing to the back housing. Be sure : bend the ground plate.

5. Lift and remove the battery holder assembly.

VGA Ext. Male 15 Pin D-Sub to Female 15 Pin D-Sub

PART NUMBER	LENGTH
0012-00-0852-01	6 feet
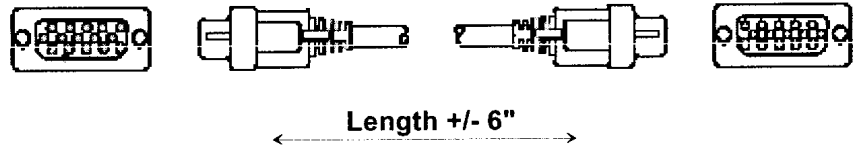
Length +/- 6"

Open Ended to Female 15 Pin D-Sub

PART NUMBER	LENGTH
0012-00-0852-02	25 feet
0012-00-0852-03	50 feet
0012-00-0852-04	100 feet
0012-00-0852-05	200 feet
0012-00-0852-06	300 feet
0012-00-0852-07	450 feet
0012-00-0852-08	600 feet
0012-00-0852-09	175 feet

HD-15S FEMALE CONNECTOR
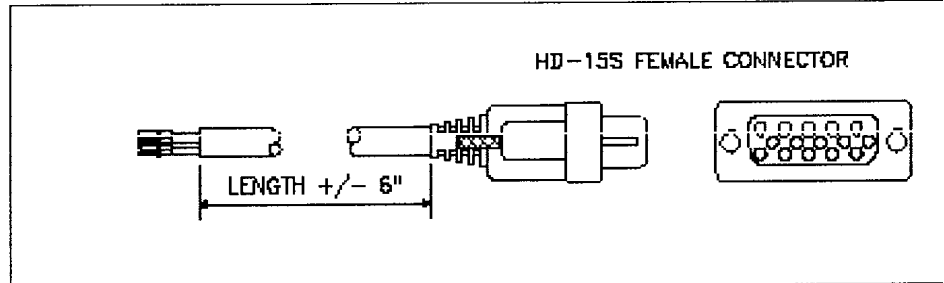
LENGTH +/- 6"

VGA Ext. Male 15 Pin D-Sub to Male 15 Pin D-Sub

PART NUMBER	LENGTH
0012-00-0994-01	10 feet
0012-00-0994-02	25 feet
0012-00-0994-03	50 feet
0012-00-0994-04	75 feet
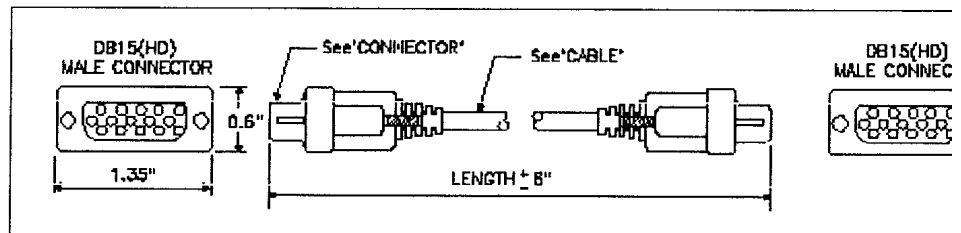
ECG Cable ESIS and Non ESIS

PART NUMBER	LENGTH AND DESCRIPTION
0012-00-1255-01	10 feet Straight Non ESIS
0012-00-1255-02	20 feet Straight Non ESIS
0012-00-1255-03	10 feet Rt Angle Non ESIS
0012-00-1255-04	20 feet Rt Angle Non ESIS
0012-00-1255-05	10 feet Straight ESIS
0012-00-1255-06	20 feet Straight ESIS
0012-00-1255-07	10 feet Rt Angle ESIS
0012-00-1255-08	20 feet Rt Angle ESIS

USE LUDLOW CONNECTOR #22 STRAIGHT FOR -01, -02, -05, -06

white brown
red white
green red
yellow black
black green

Opposite Side

USE LUDLOW CONNECTOR #95 RIGHT ANGLE FOR -03, -04, -0?

1.38"+/- .10"

.5"+/- .10"

ANSI/AAMI EC53-1996 STANDARD		IEC CONVENTIONAL STANDARD	
LEAD	COLOR	LEAD	COLOR
V	Brown	Chest (C)	White
Right Arm (RA)	White	Right Arm (R)	Red
Left Leg (LL)	Red	Left Leg (F)	Green
Left Arm (LA)	Black	Left Arm (L)	Yellow
Right Leg (RL)	Green	Right Leg (N)	Black

5 X 1k , 1W, 5%
Resistor in
Connector

brown V ———————————————— 4
white RA ——————————————— 1
red LL ——————————————— 3
black LA ——————————————— 2
black RL ——————————————— 5
green
SHIELD ——————————————— 6

Non ESIS

6 X 100mH Choke   5 X 1kΩ, 1W, 5%
in Yoke   Resistor in
       Connector

brown V ———————————————— 4
white RA ——————————————— 1
red LL ——————————————— 3
black LA ——————————————— 2
green RL ——————————————— 5

SHIELD ——————————————— 6

ESIS

ECG Shielded Lead Wires

PART NUMBER	LENGTH AND DESCRIPTION
0012-00-1261-01	18" snap lead set USA
0012-00-1261-02	24" snap lead set USA
0012-00-1261-03	40" snap lead set USA
0012-00-1261-04	18" snap lead set International
0012-00-1261-05	24" snap lead set International
0012-00-1261-06	40" snap lead set International
0012-00-1261-07	18" snap lead set USA
0012-00-1261-08	24" snap lead set USA
0012-00-1261-09	40" snap lead set USA
0012-00-1261-10	18" snap lead set International
0012-00-1261-11	24" snap lead set International
0012-00-1261-12	40" snap lead set International
0012-00-1261-13	3/40" 2/60" snap lead set USA
0012-00-1261-14	3/40" 2/60" snap lead set Internationa
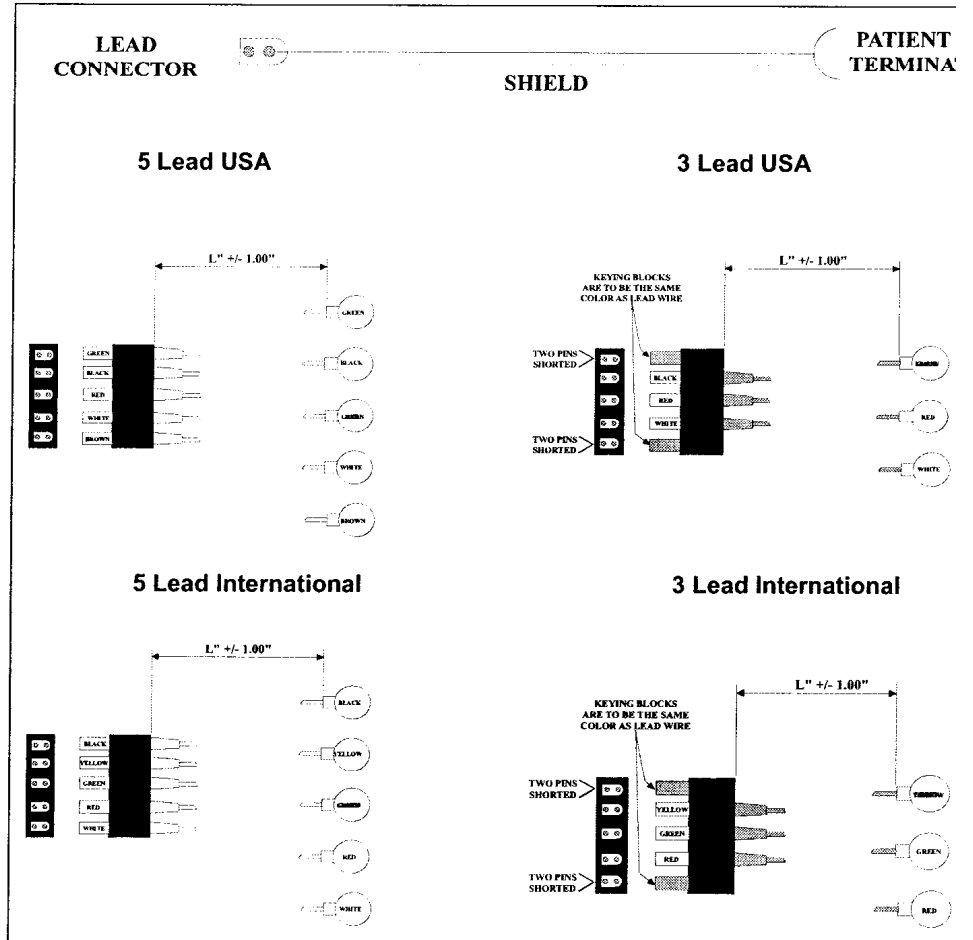
ECG Shielded Lead Wires

PART NUMBER	LENGTH AND DESCRIPTION
0012-00-1262-01	18" pinch 5 lead set USA
0012-00-1262-02	24" pinch 5 lead set USA
0012-00-1262-03	40" pinch 5 lead set USA
0012-00-1262-04	18" pinch 5 lead set International
0012-00-1262-05	24" pinch 5 lead set International
0012-00-1262-06	40" pinch 5 lead set International
0012-00-1262-07	18" pinch 3 lead set USA
0012-00-1262-08	24" pinch 3 lead set USA
0012-00-1262-09	40" pinch 3 lead set USA
0012-00-1262-10	18" pinch 3 lead set International
0012-00-1262-11	24" pinch 3 lead set International
0012-00-1262-12	40" pinch 3 lead set International
0012-00-1262-13	3/40" 2/60" pinch 5 lead set USA
0012-00-1262-14	3/40" 2/60" pinch 5 lead set Internatio
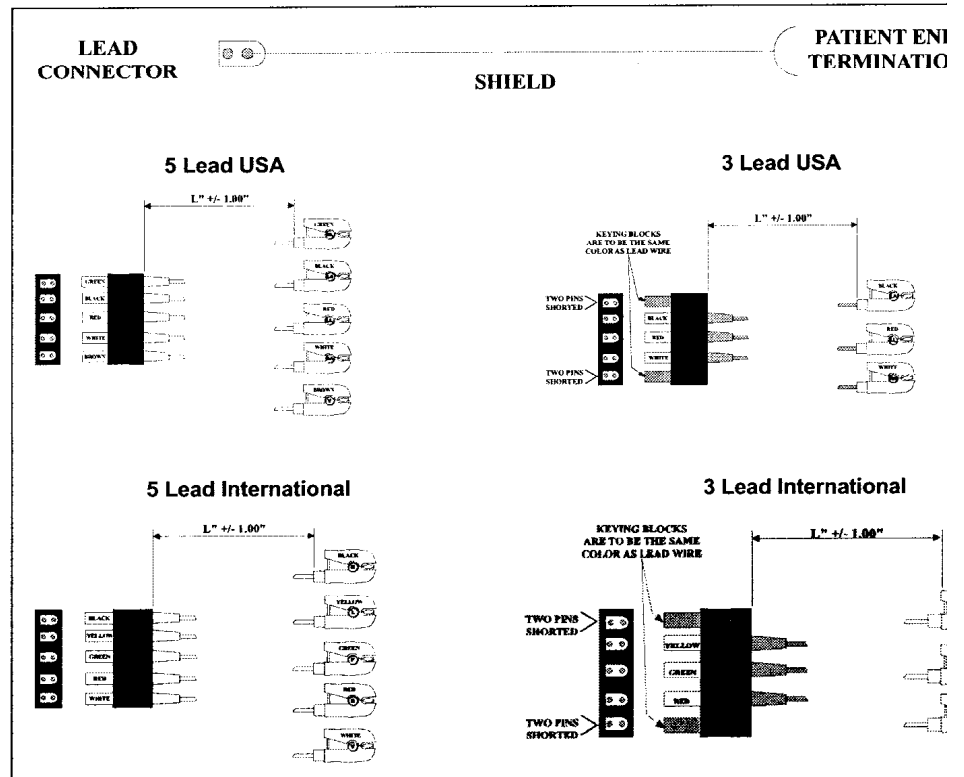
ECG Shielded Lead Wires

PART NUMBER	LENGTH AND DESCRIPTION
0012-00-1263-01	18" alligator 5 lead set USA
0012-00-1263-02	24" alligator 5 lead set USA
0012-00-1263-03	40" alligator 5 lead set USA
0012-00-1263-04	18" alligator 5 lead set International
0012-00-1263-05	24" alligator 5 lead set International
0012-00-1263-06	40" alligator 5 lead set International
0012-00-1263-07	18" alligator 3 lead set USA
0012-00-1263-08	24" alligator 3 lead set USA
0012-00-1263-09	40" alligator 3 lead set USA
0012-00-1263-10	18" alligator 3 lead set International
0012-00-1263-11	24" alligator 3 lead set International
0012-00-1263-12	40" alligator 3 lead set International
0012-00-1263-13	3/40" 2/60" alligator 5 lead set USA
0012-00-1263-14	3/40" 2/60" alligator 5 lead set International
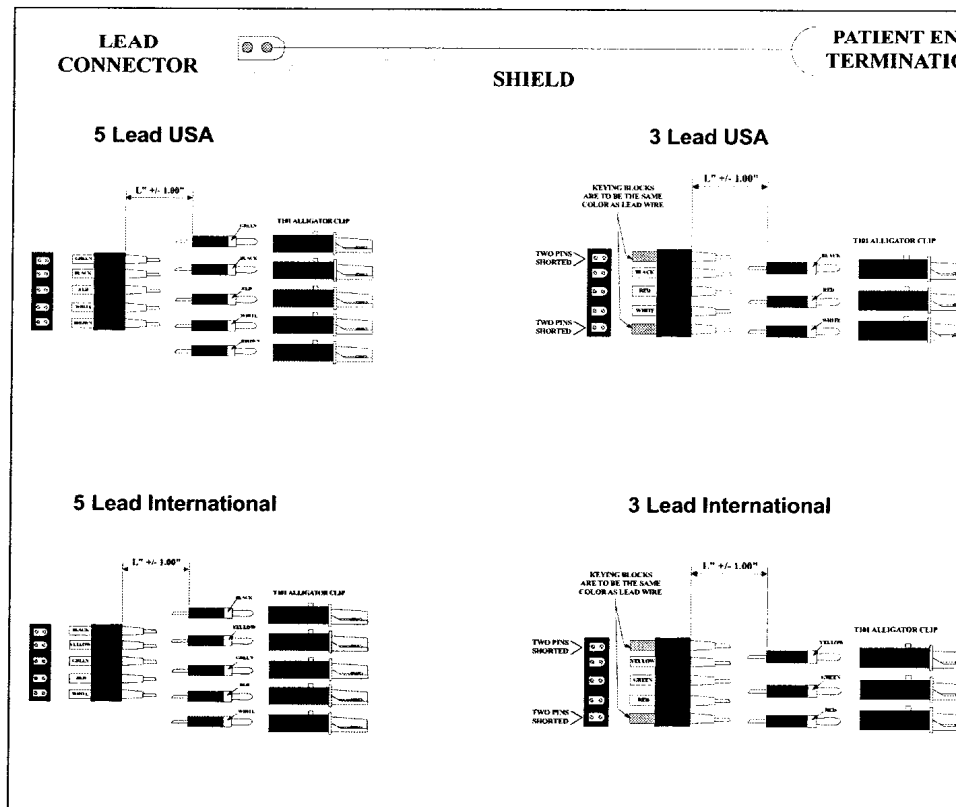
Category 5 Ethernet Cable

PART NUMBER	LENGTH AND DESCRIPTION
0012-00-1274-01	6 feet Cat 5 Ethernet Cable
0012-00-1274-02	25 feet Cat 5 Ethernet Cable
0012-00-1274-03	50 feet Cat 5 Ethernet Cable
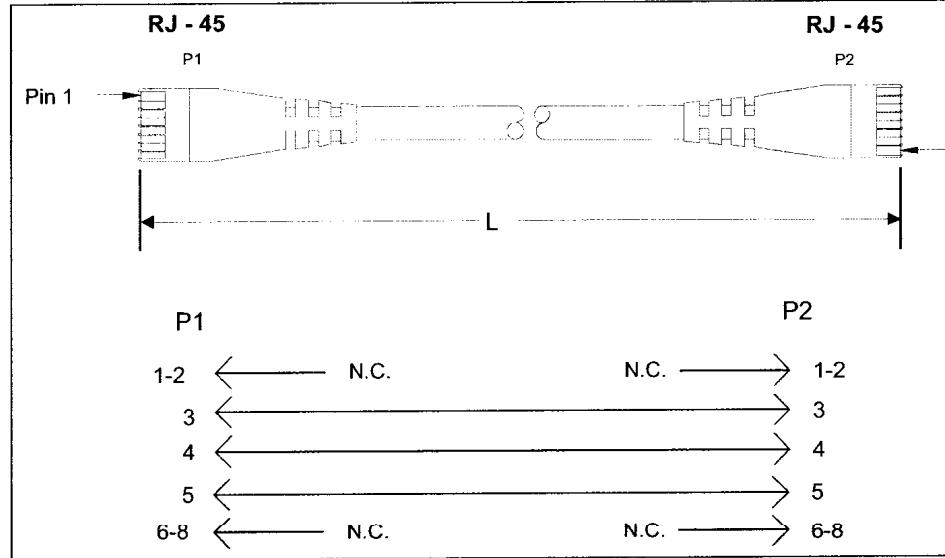
Serial Port to Serial Port Cable P/N 0012-00-1275-01
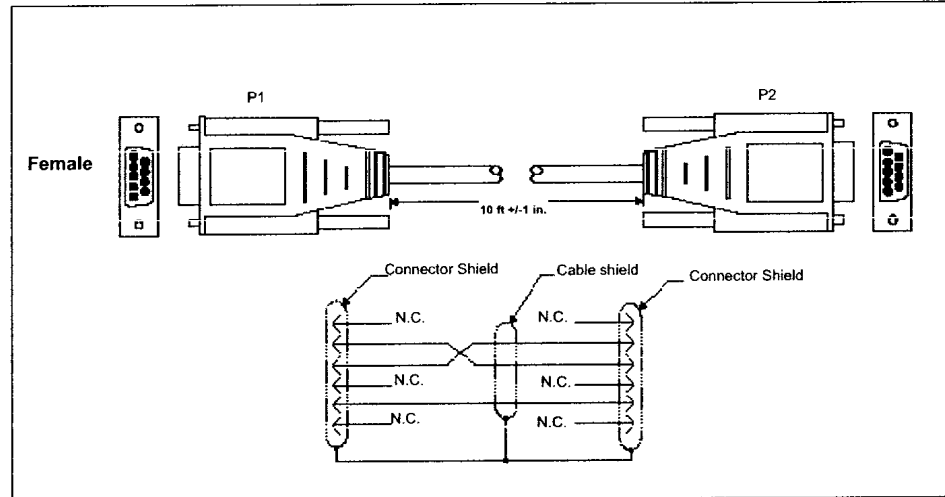
Serial Port to Gas Module Cable

PART NUMBER	LENGTH AND DESCRIPTION
0012-00-1276-01	12 inch 9 pin mini D serial to 25 pin D
0012-00-1276-02	72 inch 9 pin mini D serial to 25 pin D

DETAIL A

P1   P2

1	← NC	NC →	24-25
2	←	→	23
3	←	→	22
4	← NC	NC →	8-21
5	←	→	7
6-9	← NC	NC →	1-6
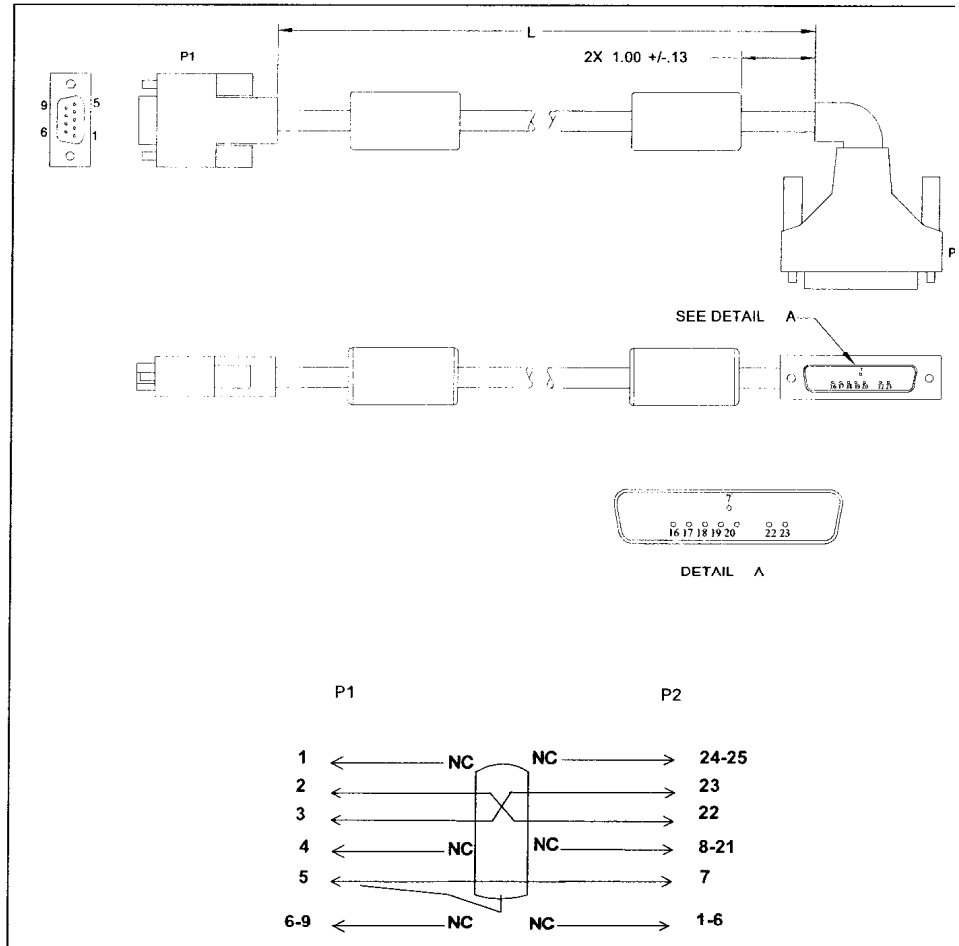
Nurse Call Cable (3 pin circular to unterminated) P/N 0012-00-12
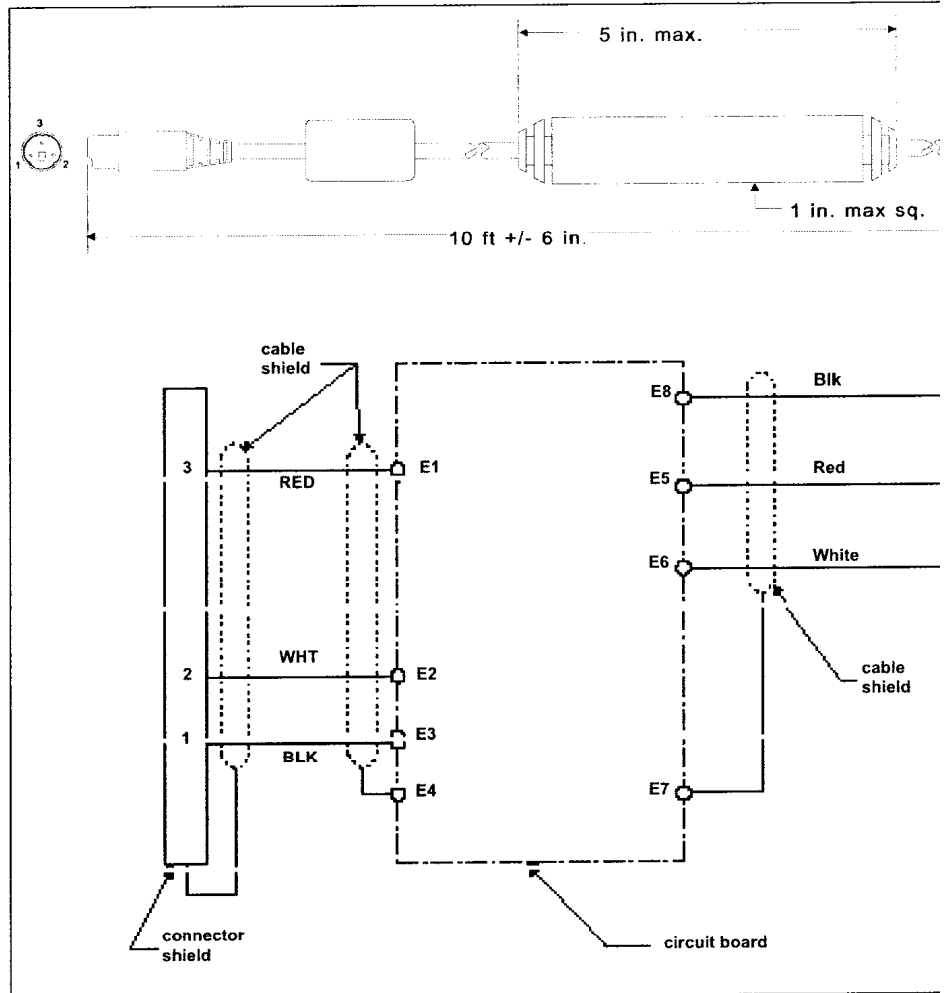
Serial Port to RJ 45 Cable (VISA) P/N 0012-00-1299-01
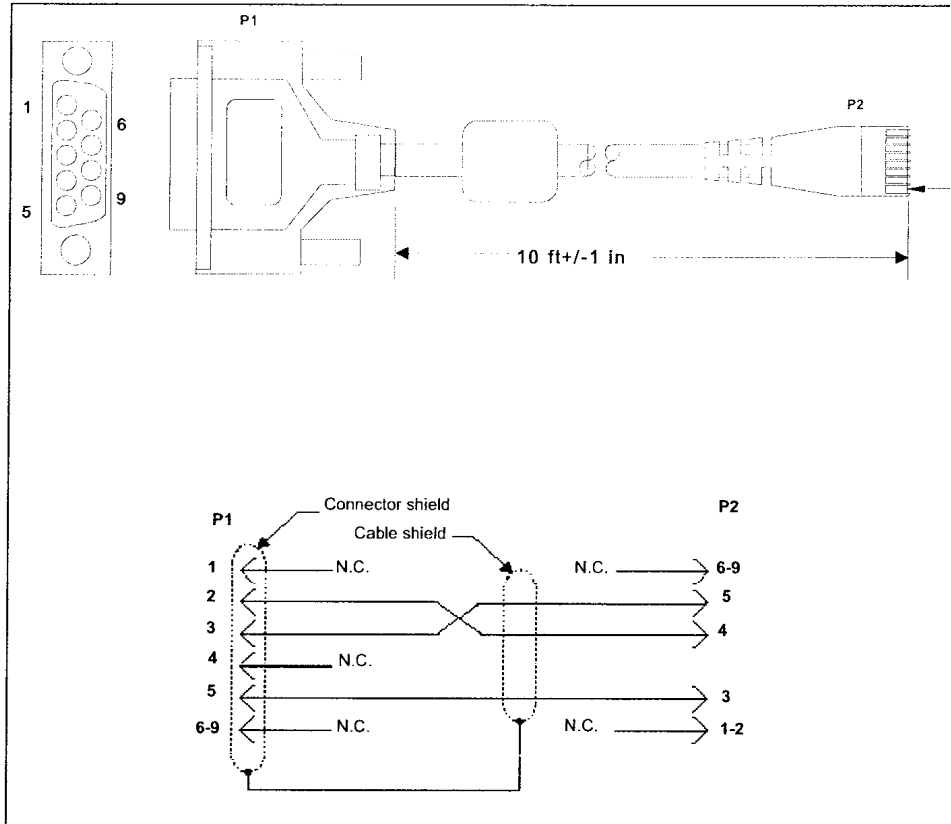
Serial Port to Corometrics Fetal Monitor Cable P/N 0012-00-1300-
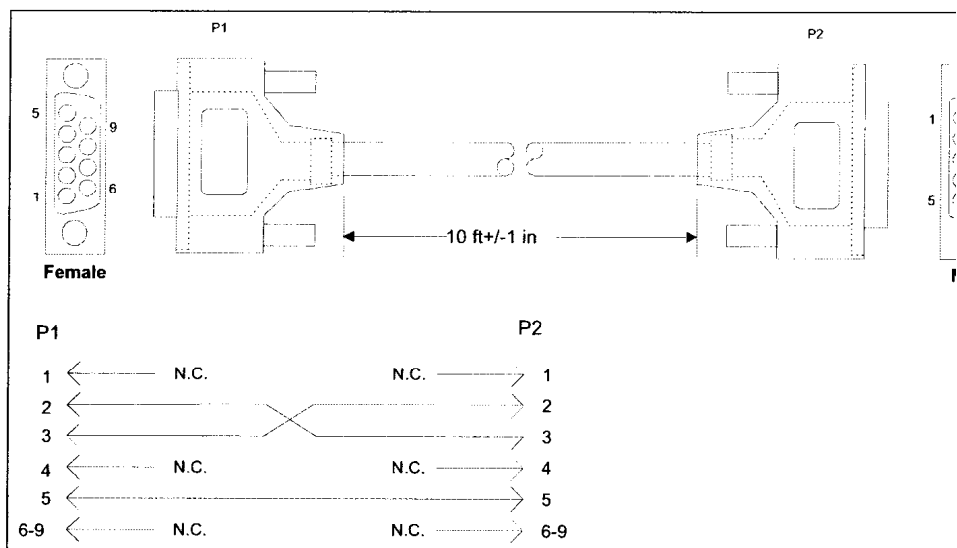
26 pin Molex to Mini Din Cable (DPD sync Cable)

PART NUMBER	LENGTH
0012-00-1301-01	8 inches ± 1 inch
0012-00-1301-02	10 feet ± 6 inches
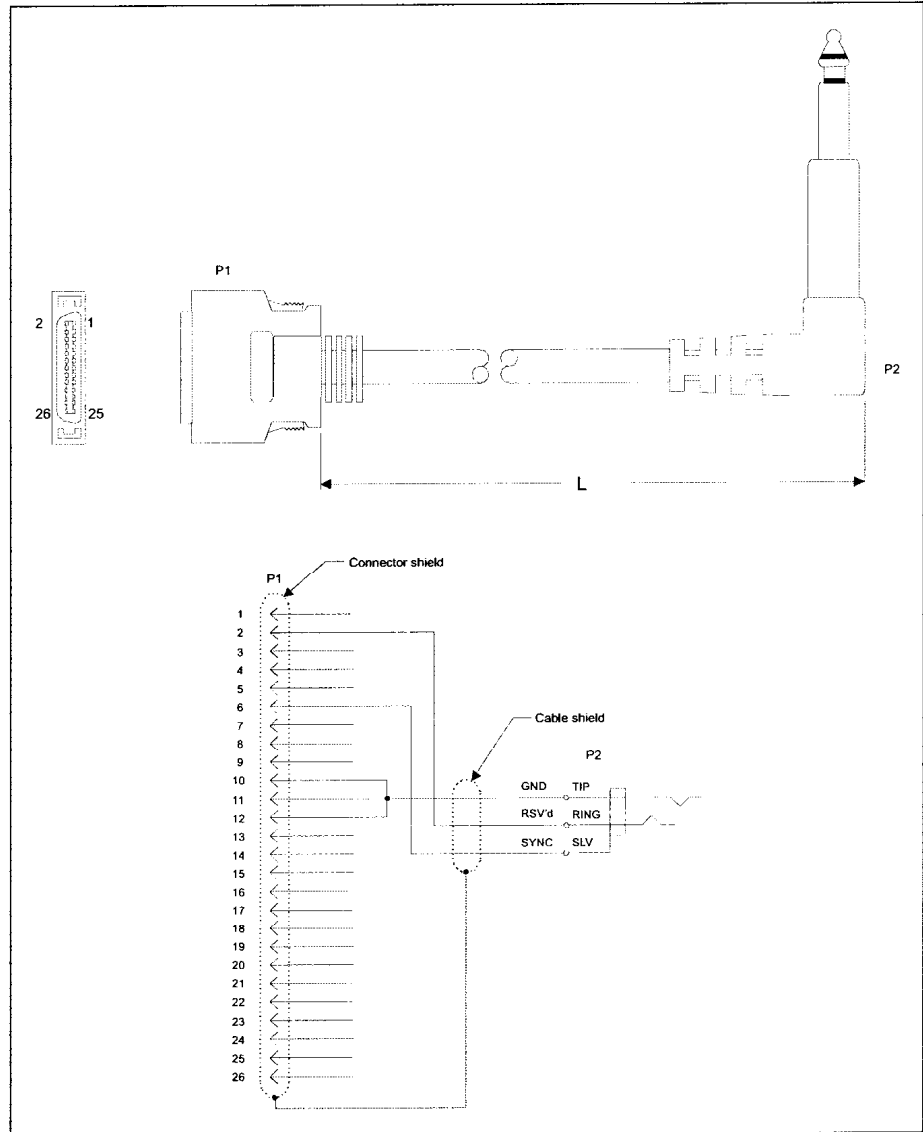
12 Lead PCMCIA Card and Cable Assembly P/N 0992-00-0155-01

P/N 0996-00-0065-01	12 Lead Processor Card

P/N 0040-00-0324	12 Lead Cable Assembly Kit

P/N 0012-00-1441-02	Cable Assembly Lead Set, 12 Lead AAMI/ ANSI

P/N 0012-00-1441-03	Cable Assembly Lead Set, 12 Lead IEC/ International

P/N 0380-00-0398	Cover Ecg Processor Card 12 Lead
P/N 0212-00-0203	Screws, Pan Head #2 x 3/16 (Quantity 2 req.)
P/N 0380-00-0397	Extender Cover Ecg Processor Card 12 Lead
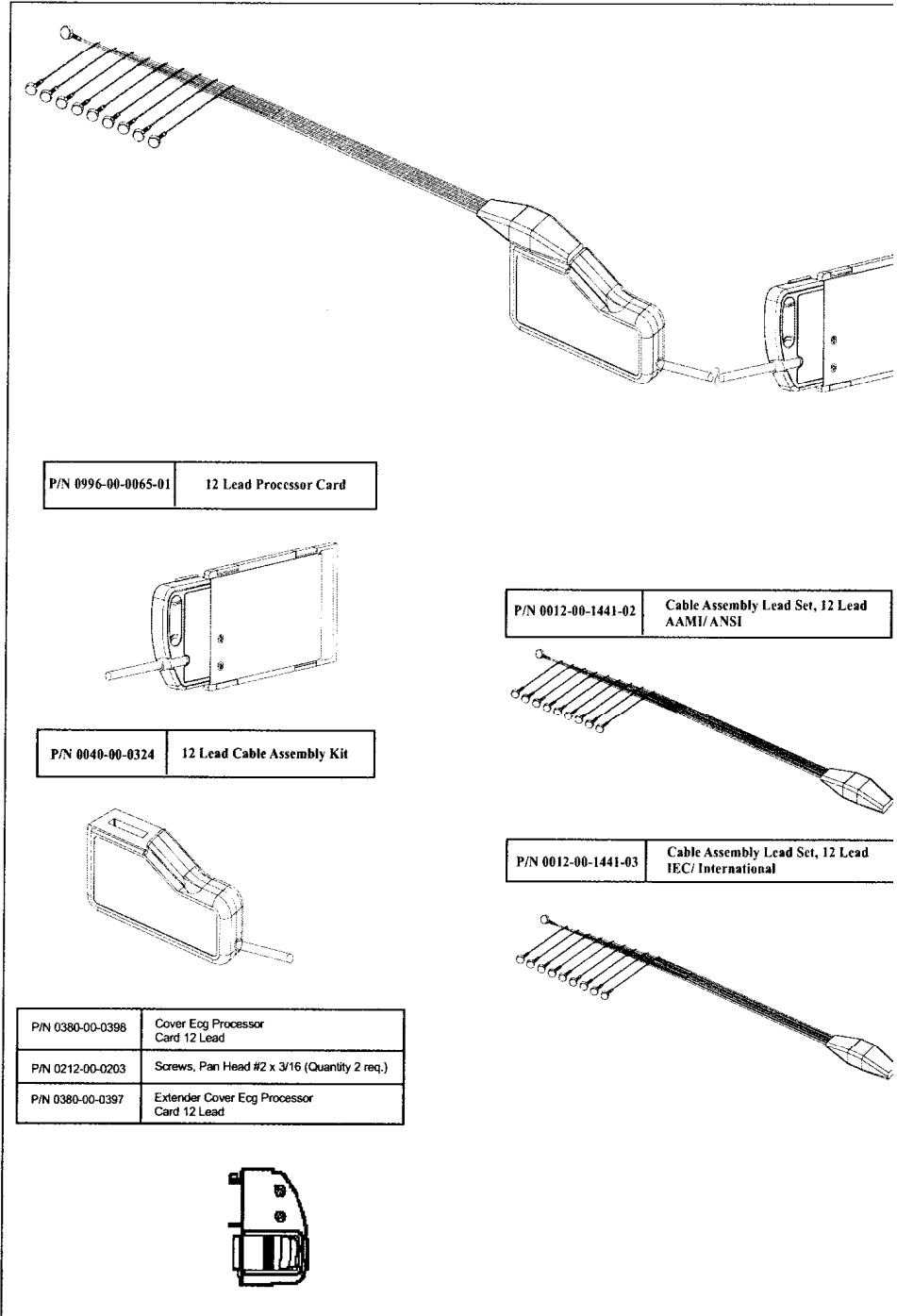
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4.0 Assembly and Schematic Diagrams

Detail Parts Lists, Assembly and Schematic Drawings are available upon request.

Contact:

Datascope Corporation
800 MacArthur Blvd.
Mahwah, New Jersey 07430-0619
1-800-288-2121 (x7130)

Detail Parts Lists, Assembly and Schematic Drawings Part Number 0070-00-0441-01.
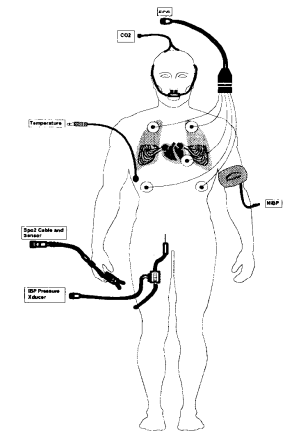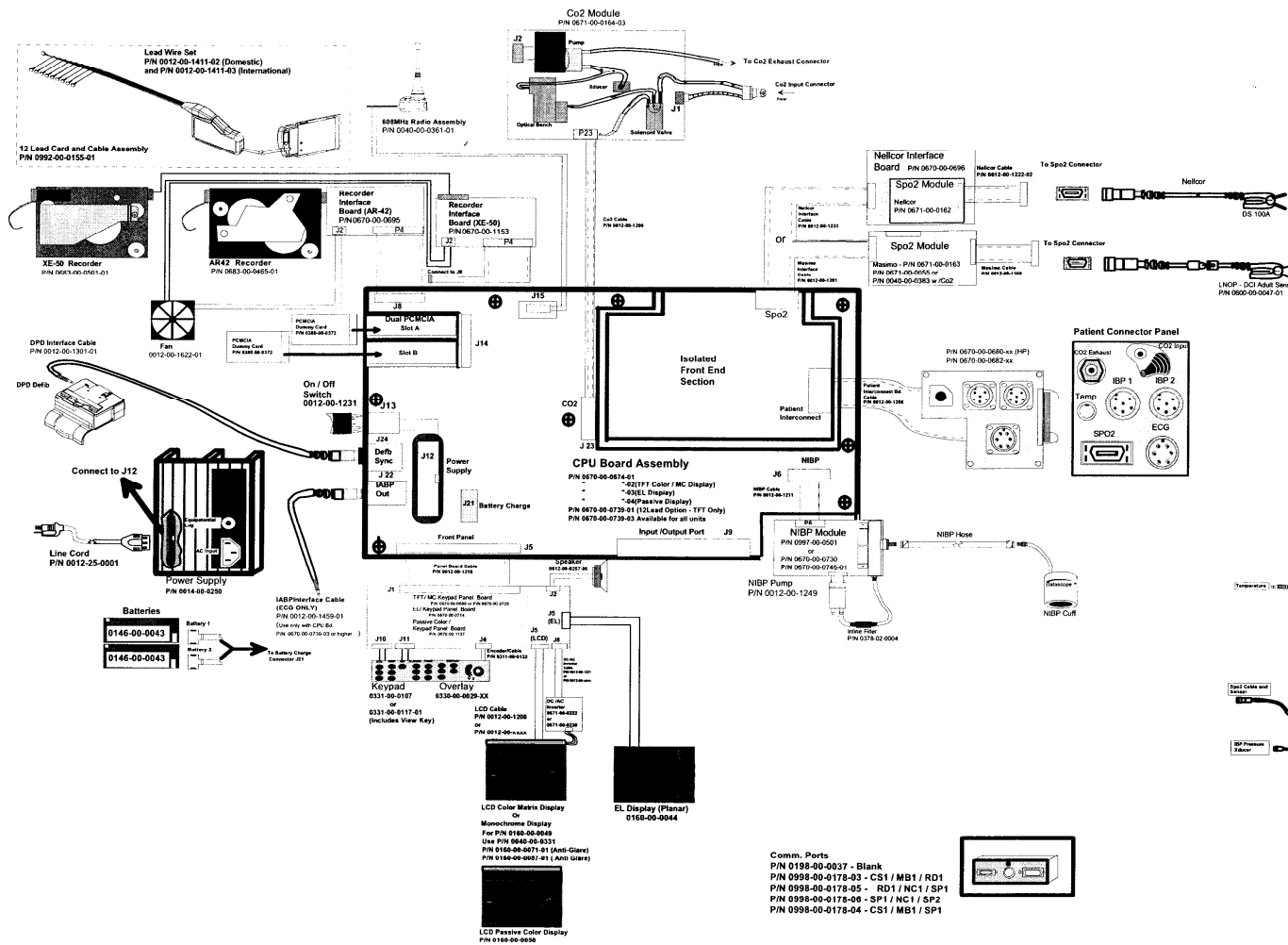
FIGURE 4-2 Detail Parts Lists and Assembly Schematic Drawing

5.0   *Replacement Parts*

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NEC TFT LCD Display Assembly
&
Monochrome Display

SURFACE MUST BE
CLEAN AND FREE OF
ALL DUST FINGER MARKS
SCRATCHES AND SCUFFS

SERIAL NUMBER LABEL,
LOCATE APPROX. AS
SHOWN

ATTACH GROUND STRAP
CONDUCTIVE SURFACE
IS TO CONTACT RAIL
GROUND STRAP IS PART OF
THE KEYPAD (ITEM 6)

(0212-12-0605)
4 PLACES

MOUNTING HARDWARE
(NUT & WASHER)
SUPPLIED WITH
ITEM 5

(0212-12-0404)
2 PLACES

(0212-12-0405)
2 PLACES

(0210-10-0004)
2 PLACES

SEE CABLE CLAMP
LOCATION V FW

(0212-12-0303)
2 PLACES

CLEAN HOUSING WITH
ISOPROPYL ALCOHOL AND
LET DRY THEN ASSEMBLE
THE KEYPAD IN THE
RECESSED AREA

MOUNTING HARDWARE
(LOCKWASHER AND NUT)
SUPPLIED WITH ITEM 5
TORQUE: 13 ±2 IN-LB

CLEAN HOUSING WITH
ISOPROPYL ALCOHOL AND
LET DRY THEN ASSEMBLE
THE FOOT IN THE
RECESSED AREA

(0212-14-0404)
2 PLACES

(0212-12-0404)

(0212-12-0403)

(0221-00-0004)
4 PLACES

(0212-12-0605)
REF

(0212-12-0404)
4 PLACES

FRONT ISO VIEW
EXPLODED

REAR ISO VIEW
EXPLODED

Isometric Drawing

(EL DISPLAY)

ATTACH GROUND STRAP
CONDUCTIVE SURFACE
IS TO CONTACT RAIL
GROUND STRAP IS PART OF
THE KEYPAD (ITEM 6)

SERIAL NUMBER LABEL
LOCATE APPROX AS
SHOWN

(6)

(6A)

(6B)

START KEYPAD INSTALLATION
AT ENCODER END

(8)

(7) 2 PLACES

(22)
REF

REF

(36)

2 PLACES

(4)

(17)

(14)

(15)

4 PLACES

(11)

(9)

(5)

(1)

(10)

(3)
2 PLACES

(32)
2 PLACES

(7) REF

MOUNTING HARDWARE
(LOCKWASHER AND NUT)
SUPPLIED WITH ITEM 5
TORQUE: 13IN - LB

2 PLACES

(40)

(13)

(35)

(2)

(33)
2 PLACES

(16)

DO NOT CREASE

(22)

(36)

(24)

(37)

(2)
6 PLACES

(42)

(4)
2 PLACES

(39)

Isometric Drawing
FRONT ASSEMBLY EL
Added 03/10/00

(Passive Display)

40 4 PLACES

33 2 PLACES

9

11

16

4 REF

(0212-12-0605)
4 PLACES

51

46

4

5

48

(0212-12-0403)
2 PLACES

2

(0212-10-0402)
2 PLACES

41

53

50

44

32 (0212-10-0004)
2 PLACES

1

3 (0212-12-0405)
2 PLACES

7 REF

2

(0212-12-0403)
4 PLACES

47

22 (0212-12-0404)
4 PLACES

25 (0221-00-0004)
4 PLACES

22

(0212-12-0404)

45

52

49

43 (0212-12-0402)
4 PLACES

2

(0212-12-0403)
2 PLACES

36

24

37

(0212-14-0408)

6A

6B

**START KEYPAD INSTALLATION
AT ENCODER END**

8

7 2 PLACES

6

10

Isometric Drawing
PASSIVE DISPLAY ASSEMBLY
Added 09/29/00

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5.1　　Parts List Front Housing

ITEM NO.	DESCRIPTION	DATASCOPE PART NO.
1.	Speaker w/ cable assembly	0012-00-0257-06
2.	Screw Pan Hd 4-40 x 3/16	0212-12-0403
3.	Screw Pan Hd 4-40 x 5/16	0212-12-0405
4.	Screw Pan Hd 6-32 x 5/16	0212-12-0605
5.	(Navigator) Encoder w / nut & washer	0311-00-0132
6.	Keypad Membrane	0331-00-0117-01
6a.	Keypad Overlay w/ IBP	0330-00-0029-XX
6b.	Keypad Overlay w/o IBP	0330-00-0029-XX (See Table 6-1)
7.	Foot (4 required)	0348-00-0190
8.	Knob, Rotary	0366-00-0101
9.	Front Housing	0380-00-0338-01
9.	Front Housing (LT)	0380-00-0338-02
10.	Speaker Holder	0380-00-0352
11.	Serial Number Label (Front Housing)	0334-00-1560
12.	PCB Interconnect Panel Bd. (LCD Display)	0670-00-0686
13.	Cable EL, (display to Interconnect Bd.)	0012-00-1005
14.	EL Display Assembly	0160-00-0044
15.	Screw Flat Head	0212-17-0807
16.	(EL) Gasket	0348-00-0189
17.	Mount Rail (EL Right Side)	0436-00-0138
18.	Cable LCD Color (display to Interconnect Bd)	0012-00-1208
19.	Cable LCD Color (DC/AC Inverter)	0012-00-1221
20.	LCD Color Display (P/N NL6448BC33-29)	0040-00-0331
20.	LCD Color Display P/N NL6448BC33-46)	0040-00-0331
20.	LCD Color Display with Anti-Glare	0160-00-0071-01
20.	LCD Color Display NEC Bonded/ Anti-Glare	0160-00-0087-01
21.	Screw Pan Hd 2-56 x 3/16	0212-12-0203
22.	Screw Pan Hd 4-40 x ¼	0212-12-0404
23.	Screw Flat Hd 4-40 x ¼	0212-14-0404
24.	Screw Flat Hd 4-40 x ½	0212-14-0408
25.	Washer flat #4	0221-00-0004
26.	Gasket	0348-00-0204
27.	N/A	
28.	Bracket	0406-00-0794
29.	Bracket Cable Retainer	0406-00-0795
30.	Mount Rail (LCD Left side)	0436-00-0178
31.	Mount Rail (LCD Right side)	0436-00-0177

ITEM NO.	DESCRIPTION	DATASCOPE PART NO.
32.	Washer flat large (2 required)	0210-10-0004
33.	Ferrite, Split Flat Cable	0108-00-0097-01
34.	Stand Off, Hex M/F 4-40 X 0.312 Long	0361-30-0312
35.	Screw, Flat Head 100° 4-40 X 0.187 Long	0212-17-0403
36.	Strap, Ground	0346-00-0046-01
37.	Retainer - Cable	0380-00-0375
38.	Clip, Ferrite	0344-00-0246
39.	Mount Rail (EL Left Side)	0436-00-0139
40.	Rubber Retainer	0354-00-0081
41.	Backlite Assembly	0149-00-0009
42.	PCB Interconnect Panel Bd. (EL)	0670-00-0714
43.	Screw, pan head, cross recessed, 4-40x 1/8	0212-12-0402
44.	PCB Interconnect Panel Bd. (Passive Display)	0670-00-1137
45.	Cable Assembly, 14 pin (Passive Display)	0012-00-1358
46.	Display, 10.4 Passive Color (Passive Display)	0160-00-0058
47.	Cable Assembly, 15 pin (Passive Display)	0012-00-1359
48.	Bracket Inverter Board (Passive Display)	0406-00-0790
49.	Bracket Choke Mounting (Passive Display)	0406-00-0791
50.	Mounting Rail, Left (Passive Display)	0436-00-0173
51.	Mounting Rail, Right (Passive Display)	0436-00-0174
52.	Mounting Block, Lower (Passive Display)	0436-00-0175
53.	PCB Inverter Bd., K2340, Kyocera (Passive Display)	0671-00-0222
54.	Bracket (TFT LCD 0160-00-0069)	0406-00-0820
55.	PCB Interconnect Panel Bd. (TFT LCD 0160-00-0069)	0670-00-0726
56.	Cable Inverter	0012-00-1423
57.	Cable Interconnect to LCD assembly	0012-00-1424
58.	PCB Inverter Bd. - 46 Display	0671-00-0230
59.	Clamp, Cable	0343-00-0108

Keypad Overlay Table P/N 0330-00-0029-XX

Languages

		ENGLISH	GERMAN	FRENCH	SPANISH	ITALIAN	DUTCH	*JAPANESE	DANISH
IBP	W/ IBP	01	03	05	07	09	11	13	15
	W/O IBP	02	04	06	08	10	12	14	16

*   *Options with an asterisk (*) are not released at this time.*

Languages w/ ECG View

		ENGLISH	GERMAN	FRENCH	SPANISH	ITALIAN	DUTCH	*JAPANESE	DANISH
IBP	W/ IBP	51	53	55	57	59	61	63	65
	W/O IBP	52	54	56	58	60	62	64	66

*   *Options with an asterisk (*) are not released at this time.*

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NOTE: Standoffs are only
required on units with
Nellcor SPO2. Use item
#24 screw to secure.

NOTE: Bracket is
only required on units
with Masimo SPO2

2 PLACES

2 PLACES

2 PLACES

2 PLACES

2 PLACES

5 PLACES

3 PLACES

4 PLACES

5 PLACES

6 PLACES

6 PLACES

2 PLACES

2 PLACES

4 PLACES

4 PLACES

SNAP FITTING
UNDER CLIP

XE-50 Recorder

Optional 12lead PCMCIA card
bracket and screws

Top View
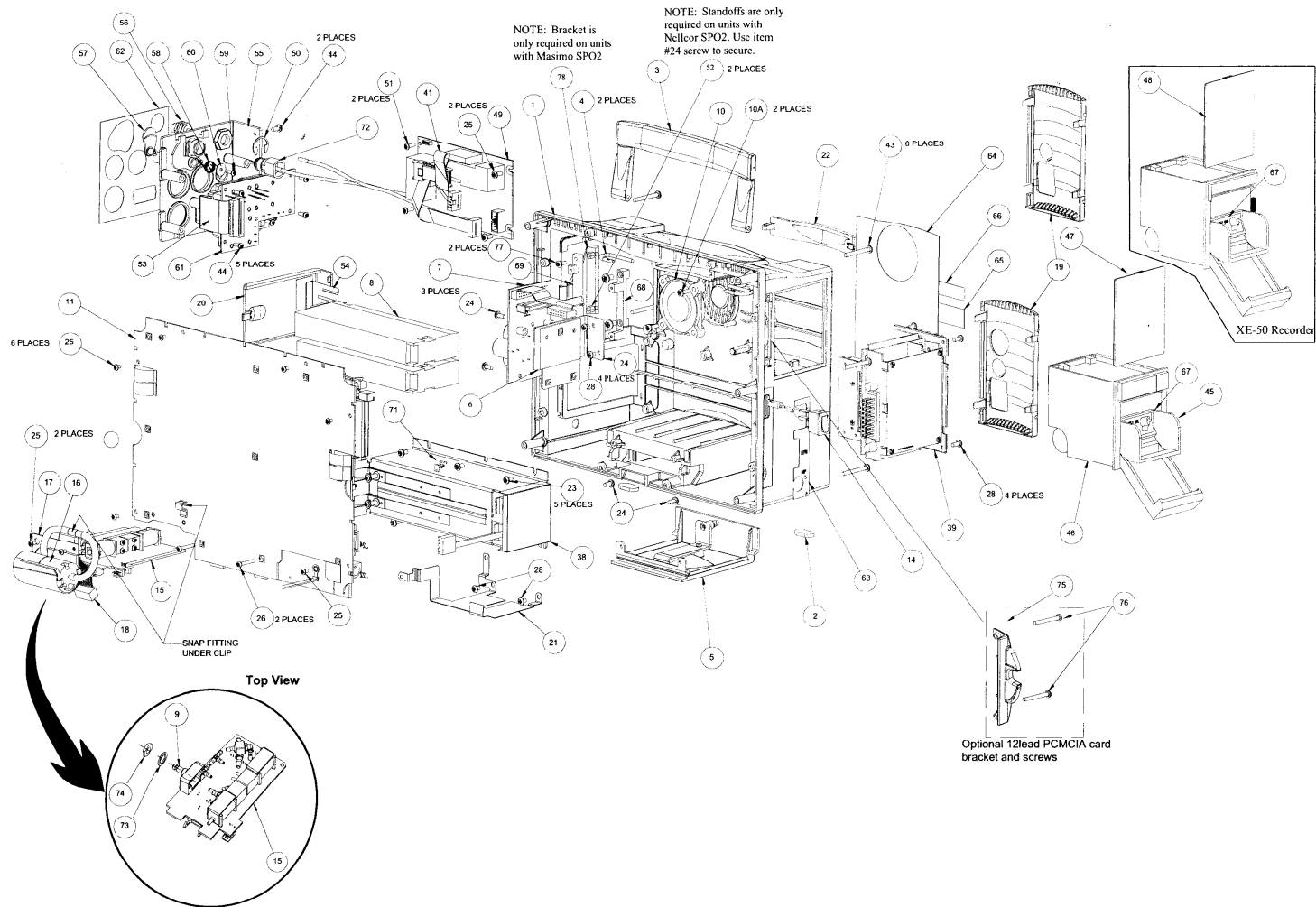
FIGURE 5-1 Rear Panel Assembly

(MASIMO SPO2)

ISO VIEW EXPLODED
SCALE 0.750

(NELLCOR SPO2)

ISO VIEW EXPLODED
SCALE 0.750
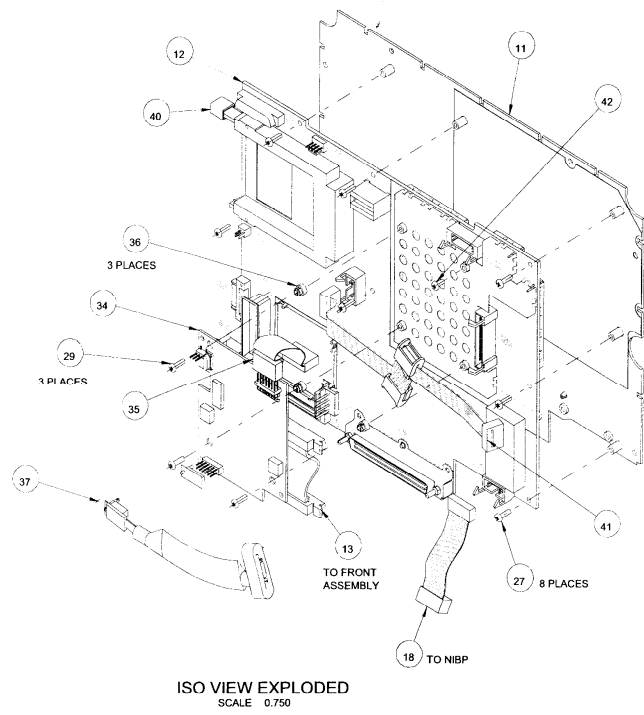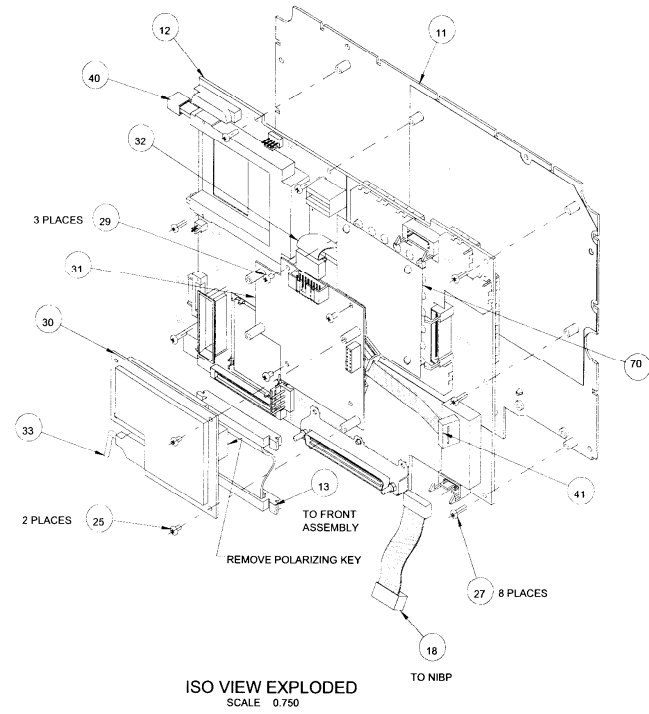
FIGURE 5-2 Main/Rear Assembly

5.2   Parts List Rear Housing

ITEM NO.	DESCRIPTION	DATASCOPE PART NUMBER
1.	Rear Housing Assembly (S/N - TM06075-G3 or higher)	0380-00-0339-01
1.	Rear Housing Assembly	0380-00-0339-02
2.	Foot	0348-00-0190
3.	Handle	0367-00-0061
4.	Pin, Handle (2 required)	0226-00-0017
5.	Cover/Docking Connector	0198-00-0037
6.	Recorder Mount Bracket (AR-42)	0406-00-0741
6.	Bracket Recorder Mount (XE-50)	0406-00-0745
7.	PCB Recorder Interface Board (AR-42)	0670-00-0695
7.	PCB Recorder Interface Board (XE-50)	0670-00-1153
8.	Batteries, 12 Volt Sealed Lead Acid	0146-00-0043
9.	Fitting NIBP Connector	0103-00-0503
10.	Fan w/ cable assembly 9.89 CFM	0012-00-1622-01
10a.	Screw Pan Hd 6-32 x 9/16	0212-12-0609
11.	Shield, Ground Plate	0386-00-0243
12.	PCB Main CPU Board	0670-00-0674EXX
12a.	PCB Main CPU Board (12 lead option) S/N CM 20000/TM1000-X or higher	0670-00-0739-01
12b.	PCB Main CPU Board (12 lead option) TFT only	0670-00-0739-03
13.	Cable Interconnect Panel Bd to Main CPU Bd	0012-00-1210
14.	Switch w/ cable assembly	0012-00-1231
15.	NIBP Module Assembly	0670-00-0746-01
16.	Pump Assembly w / cable (NIBP)	0012-00-1249
17.	NIBP Pump Bracket	0406-00-0750
18.	Cable Assembly NIBP to Main CPU Bd	0012-00-1211
19.	Cover, Power Supply (with DC connector)	0198-00-0028
19.	Cover, Power Supply (w/o DC connector)	0198-00-0050
20.	Battery Door	0380-00-0349
21.	Grounding bracket/ strap (metal)	0346-00-0044
21.	Grounding bracket/ strap (plastic)	0346-00-0049
22.	Snap Cover, Blank	0198-00-0027
23.	Screw Pan Hd 6-32 x 5/16	0212-12-0605
24.	Screw Pan Hd 6-32 x 7/16	0212-12-0607
25.	Screw Pan Hd 4-40 x 3/16	0212-12-0404
26.	Screw Pan Hd 4-40 x 11/16	0212-12-0412
27.	Screw Pan Hd 4-40 x 11/16	0212-12-0407
28.	Screw Pan Hd 4-40 x 3/16	0212-12-0603

ITEM NO.	DESCRIPTION	DATASCOPE PART NUMBER
29.	Screw Pan Hd 4-40 x 1/2	0212-10-0408
30.	PCB Nellcor SpO_2 Module with OxySmart	0671-00-0162
31.	PCB Nellcor Interface	0670-00-0696
32.	Cable, Nellcor Interface to Main CPU Board	0012-00-1233
33.	Cable Assembly Nellcor SpO_2	0012-00-1356
34.	PCB Masimo (MS-3) SpO_2 Module	0671-00-0055
35.	Cable Masimo Module to Main CPU	0012-00-1201
36.	Spacer	0361-45-0403
37.	Cable Assembly Masimo SpO_2	0012-00-1308
38.	Battery Holder Assembly (metal)	0997-00-0502
38.	Battery Holder Assembly (plastic)	0997-00-0972-01
39.	Power Supply/ Charger Assembly	0014-00-0190E
39.	Power Supply/ Charge Assembly	0014-00-0250
40.	Button/PCMCIA Slot B	
41.	Cable CO_2 Module to Main CPU Bd	0012-00-1200
NS	Double Sided Tape	0215-00-0115
42.	Screw Pan Hd Nylon 4-40 x ¼	0212-01-0404
43.	Screw Pan Hd # 6 x 1 ¼	0212-12-0620
44.	Screw Pan Hd # 6 x 5/16	0212-12-0405
45.	Paper Holder Recorder Door	0352-00-0051
46.	Recorder Assembly (AR-42 special)	0683-00-0465E01
46.	Recorder Assembly (XE-50)	0683-00-0501-01
47.	Recorder Plate, Blank	0370-00-0017-03
48.	Recorder Plate, Blank (XE-50)	0380-00-0427-01
49.	CO_2 Module Assembly (Oridion)	0671-00-0164-03
50.	Retainer C-Clip	0226-00-0018
51.	Screw Pan Head 6-32 x ¼	0212-12-0604
52.	Standoff Male / Female 6-32 x 0.250 long	0361-27-0250
53.	Cable, Patient Connector to Main CPU Bd	0012-00-1206-01
54.	Strap, Battery Door	0346-00-0047
55.	Connector Panel (Masimo w/ CO_2)	0380-00-0348-01
55.	Connector Panel (Masimo w/o CO_2)	0380-00-0348-02
55.	Connector Panel (Nellcor w/CO_2)	0380-00-0348-03
55.	Connector Panel (Nellcor w/o CO_2)	0380-00-0348-04
56.	CO_2 Exhaust Connector w/nut	0103-00-0489
57.	CO_2 Input Connector Door	0380-00-0355
58.	Spring	0214-00-0236
59.	Screw Self Tapping #4 x 3/16	0213-09-0403
60.	Washer Flat 0.470 OD 0.119 ID	0221-00-1014
61.	PCB Patient Connector Bd AAMI w/ IBP	0670-00-0682-01

ITEM NO.	DESCRIPTION	DATASCOPE PART NUMBER
61.	PCB Patient Connector Bd AAMI w/o IBP	0670-00-0682-02
61.	PCB Patient Connector Bd HP w/ IBP or w/o IBP	0670-00-0680-01
62.	Label, Patient Connector	0334-00-1501-XX (See Table 6-2)
63.	Label, Right Side	0334-00-1528
64.	Label, Information Passport2	0334-00-1500
65.	Label, Part Number / Serial Number	0334-00-1560
66.	Label, Software Part Number	0334-00-1561
67.	Label, Loading Recorder Paper (AR-42)	0334-00-1431
67.	Label, Loading Recorder Paper (XE-50)	0334-00-2674
68.	Bracket Plastic Slotted	0406-00-0805
69.	Bracket Plastic	0406-00-0783
NS	PCMCIA Extended Trend Card	0996-00-0052-01
NS	PCMCIA Transfer Card	0996-00-0051-01
NS	PCMCIA Filler Card (Blank)	0380-00-0372
70.	Insulator, Nellcor SpO$_2$ Interface Board	0349-00-0322
71.	Clamp, Cable	0343-00-0007
72.	CO$_2$ Input Assembly	0012-00-1400
73.	Nut, Hex 1/4 x 32 (use on NIBP fitting)	0220-00-0004
74.	Washer, Flat 0.473 OD - 0.260 ID use on NIBP fitting)	0221-00-1023
75.	Mounting Bracket, 12 Lead	0380-00-0399-01
76.	Screw Pan Head #6 - 32 x 1 1/2	0212-12-0624
77.	Screw Pan Head #6 - 32 x 3/4	0212-12-0612
78.	Bracket Magnetic Shield	0406-00-0833

Connector Panel Label
P/N 0334-00-1501-XXX

IBP	CO2	SPO2	English	German	French	Spanish	Italian	Dutch	Japanese	Dutch
w/ IBP	w/ CO2 *	NELLCOR	001	011	021	031	041	051	061	071
		MASIMO	002	012	022	032	042	052	062	072
	w/o CO2	NELLCOR	003	013	023	023	003	053	003	013
		MASIMO	004	014	024	024	004	054	004	014
w/o IBP	w/ CO2 *	NELLCOR	005	015	025	035	045	055	065	075
		MASIMO	006	016	026	036	046	056	066	076
	w/o CO2	NELLCOR	007	017	007	007	007	007	007	017
		MASIMO	008	018	008	008	008	008	008	018

* OPTIONS WITH AN ASTERISK (*) ARE NOT RELEASED AT THIS TIME

The following charts will help identify the proper hardware and software in each Passport 2.
These part numbers are required before an CPU exchange board (P/N 0670-00-0674EXX) or
(P/N 0670-00-0739EXX) can be ordered from the National Repair Center.

0670-00-0674E02 = CPU Bd. (TFT Active Color Display or Monochrome)
0670-00-0674E03 = CPU Bd. (EL Display)
0670-00-0674E04 = CPU Bd. (Passive Color Display- PP2 LT)
0670-00-0739E01 = CPU Bd. (12 Lead ECG capable unit - TFT Only)
0670-00-0739E03 = CPU Bd. (12 Lead ECG capable unit - TFT Only)

Example: Unit P/N - 0998-00-0170-0002A
         S/W P/N 0996-00-0045-002   = CPU P/N 0670-00-0674E02
         Serial Number - CM12233-K1

Passport 2 Part Number
0998-00-0170-XXXXL

					PASSPORT2								PASSPORT2 LT								PASSPORT2 WITH CO2 FOR VIEWPOINT TELEMETRY			
BATTERY				LEAD ACID				EXTENDED				LEAD ACID				EXTENDED				LEAD ACID						
RECORDER				w/ RECORDER		w/o RECORDER		w/ RECORDER		w/o RECORDER		w/ RECORDER		w/o RECORDER		w/ RECORDER		w/o RECORDER		w/ RECORDER		w/o RECORDER				
IBP	CO2	DISPLAY	CONN TYPE / SPO2	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP	AAMI	HP
w/ IBP	w/ CO2	COLOR	NELLCOR	0001	0017	0033	0049	0065	0081	0097	0113									4001	4017	4033	4049
			MASIMO	0002	0018	0034	0050	0066	0082	0098	0114									4002	4018	4034	4050
		EL	NELLCOR	0003	0019	0035	0051	0067	0083	0099	0115												
			MASIMO	0004	0020	0036	0052	0068	0084	0100	0116												
		MC	NELLCOR	0129	0137	0145	0153	0161	0169	0177	0185									4129	4137	4145	4153
			MASIMO	0130	0138	0146	0154	0162	0170	0178	0186									4130	4138	4146	4154
	w/o CO2	COLOR	NELLCOR	0005	0021	0037	0053	0069	0085	0101	0117	3005		3037		3069		3101					
			MASIMO	0006	0022	0038	0054	0070	0086	0102	0118	3006		3038		3070		3102					
		EL	NELLCOR	0007	0023	0039	0055	0071	0087	0103	0119	3007		3039		3071		3103					
			MASIMO	0008	0024	0040	0056	0072	0088	0104	0120	3008		3040		3072		3104					
		MC	NELLCOR	0131	0139	0147	0155	0163	0171	0179	0187	3131		3147		3163		3179					
			MASIMO	0132	0140	0148	0156	0164	0172	0180	0188	3132		3148		3164		3180					
w/o IBP	w/ CO2	COLOR	NELLCOR	0009	0025	0041	0057	0073	0089	0105	0121									4009	4025	4041	4057
			MASIMO	0010	0026	0042	0058	0074	0090	0106	0122									4010	4026	4042	4058
		EL	NELLCOR	0011	0027	0043	0059	0075	0091	0107	0123												
			MASIMO	0012	0028	0044	0060	0076	0092	0108	0124												
		MC	NELLCOR	0133	0141	0149	0157	0165	0173	0181	0189									4133	4141	4149	4157
			MASIMO	0134	0142	0150	0158	0166	0174	0182	0190									4134	4142	4150	4158
	w/o CO2	COLOR	NELLCOR	0013	0029	0045	0061	0077	0093	0109	0125	3013		3045		3077		3109					
			MASIMO	0014	0030	0046	0062	0078	0094	0110	0126	3014		3046		3078		3110					
		EL	NELLCOR	0015	0031	0047	0063	0079	0095	0111	0127	3015		3047		3079		3111					
			MASIMO	0016	0032	0048	0064	0080	0096	0112	0128	3016		3048		3080		3112					
		MC	NELLCOR	0135	0143	0151	0159	0167	0175	0183	0191	3135		3151		3167		3183					
			MASIMO	0136	0144	0152	0160	0168	0176	0184	0192	3136		3152		3168		3184					

Label on rear of Passport 2

0996-00-0045-XXX
0998-00-0170-XXXXL

CE 0044

0996-00-0045-XXX
SOFTWARE OPTIONS

0996-00-0045-XXX	DESCRIPTION	0996-00-0045-XXX	DESCRIPTION
-001	S/W, PP2, Default	-101	S/W, PP2 LT, USA, DEFAULT
-002	S/W, PP2, 3-Lead ST Analysis	-201	S/W, PP2 LT, INTERNATIONAL, DEFAULT
-003	S/W, PP2, Arrhythmia Analysis	-202	S/W, PP2 LT, INTERNATIONAL, 4-TRACE
-004	* S/W, PP2, Drug Calcs	-203	S/W, PP2 LT, INTERNATIONAL, 4-TRACE ST ANALYSIS W/MULTI-VECTOR ECG
-005	S/W, PP2, 3-Lead ST & Arrhythmia Analyses	-204	S/W, PP2 LT, INTERNATIONAL, ARRHYTHMIA ANALYSIS
-006	S/W, PP2, 3 Lead ST Analysis & Drug Calcs	-205	S/W, PP2 LT, INTERNATIONAL, 4-TRACE & ARRHYTHMIA ANALYSIS
-007	S/W, PP2, Arrhythmia Analysis & Drug Calcs	-206	S/W, PP2 LT, INTERNATIONAL, 4-TRACE ST ANALYSIS W/MULTI-VECTOR ECG & ARRHYTHMIA ANALYSIS
-008	S/W, PP2, Drug Calcs, 3 Lead ST & Arrhythmia Analyses		

NOTE: Passport2 (-0XXXL) units may be loaded with Software Packages -001 thru -008, Passport2 LT USA units may be loaded with Software Package -101 only, Passport 2 International units may be loaded with Software Packages -201 thru -206.
* OPTIONS WITH AN ASTERISK (*) ARE NOT RELEASED AT THIS TIME

L = LANGUAGE CODE	
A	= ENGLISH
G	= GERMAN
F	= FRENCH
P	= SPANISH
T	= ITALIAN
D	= DUTCH
N	= DANISH
J	= JAPANESE

Example:

0998-00-0170-0002A

With IBP
With CO2
LCD Display
Masimo SpO2
Lead Acid Batteries
With Recorder
AAMI Connector Type
English Language

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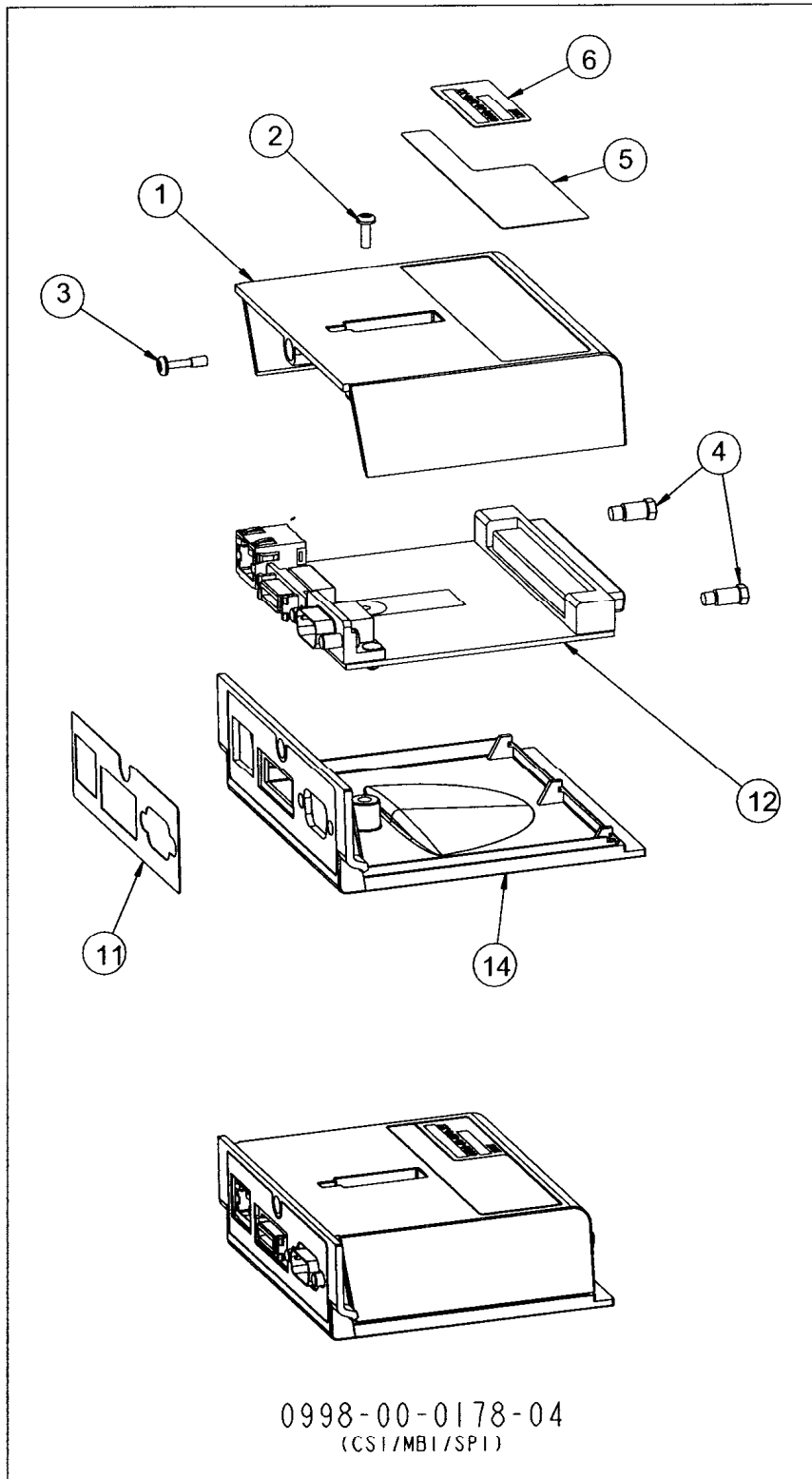
**0998-00-0178-05
(RD1/NC1/SP1)**

0998-00-0178-06
(SP1/NC1/SP2)

0998-00-0178-03
(CS1 / MB1 / RD1)

0998-00-0178-04
(CS1/MB1/SP1)

5.3 Communication Ports Parts List

ITEM NO.	DESCRIPTION	DATASCOPE P/ NUMBER
1.	Housing, Top	0380-00-0346
2.	Screw, Pan Head, #4.25 length	0212-12-0405
3.	Screw, Captive Pan Head	0217-02-0004
4.	Socket Guide, Docking Connector	0132-00-0077
5.	Label, Information	0334-00-1533
6.	Label	N/A
7.	TBD	
8.	TBD	
9.	TBD	
10.	TBD	
11.	Label, CS1, MB1, RD1, CommPort	0334-00-1541
12.	PCB Assy, CommPort, CS1, MB1, SP1	0670-00-0684-01
13.	PCB Assy CS1/MB1/RD1	0670-00-0690
14.	Housing, Bottom, CS1/MB1/RD1	0380-00-0347-0:
15.	Label, CS1/MB1/RD1	0334-00-1541
16.	PCB Assy, RD1/NC1/SP1	0670-00-0692
17.	Housing, Bottom, RD1/NC1/SP1	0380-00-0347-04
18.	Label, RD1/NC1/SP1	0334-00-1573
19.	PCB Assy. SPI/NCI/SP2	0670-00-1140
20.	Label, SP1/NC1/SP2	0334-00-2521

DETAIL A

NOTCH

SEE DETAIL A

FIGURE 5-4 Base Station Assembly

Detail B

ITEM NO	DESCRIPTION	PART NUMB
1	Housing Top Base Station	0380-00-0340
2	Housing Bottom Base Station	0380-00-0341
3	Latch Base Station	0380-00-0342
4	Lever Base Station	0380-00-0343
5	Carriage Base Station	0380-00-0344
6	Bezel Base Station	0380-00-0345
7	Connector Panel Rear	0386-00-0323
8	Slide Dashpot (Plastic Part)	0406-00-0737
9	PCB Assy Main Board	0670-00-0758
10	PCB Assy Daughter Board	0670-00-0759
11	Standoff Hex Male/Female (4-40 x .748 Lg)	0361-00-0182
12	Dashpot	0103-00-0466
13	Bracket Mounting Dashpot Base Station	0406-00-0738
14	Bracket Main Connector Ground	0406-00-0841
15	Pin Monitor Guide	0226-00-0016
16	Tubing Silicone Rubber 3/8 I.D. X 1/16 Wall	0008-00-0321
17	Spring Extension .375 Dia. 1.5 Length	0214-00-0235
18	Spring Compression .296 Dia. 1.281 Length	0214-00-0234
19	Socket Guide Docking Connector	0132-00-0077
20	Screw Pan Hd 4-40 x .25 Lg	0212-12-0404
21	Screw Pan Hd 4-40 x .75 Lg	0212-12-0412
22	Screw Pan Hd 6-32 x .50 Lg	0212-12-0608
23	Screw Pan Hd 6-32 x .31 Lg	0212-12-0605
24	Screw Shoulder #6 Thread .156 Dia x 0.187 Height	0217-00-0012
25	Nut Plain Hex #4 Small Pattern	0223-02-0004
26	Washer Snubbing Mylar	0221-00-1016
27	Washer Flat Large O.D. #4	0221-00-1010
28	Label Function Diagram Base Station	0334-00-1511
29	Label Information Base Station	0334-00-1497
30	Label Dashpot Adjustment	0334-00-1618
31	Label,Latch,Locked/Unlocked	0334-00-2514
32	Bumper (Feet Base Station)	0348-03-0001
33	Standoff Hex Male/Female With Lock Washer	0361-00-0164
34	Label Part Number Serial Number	N/A
35	Power Supply Assembly	0014-00-0070
36	Dashpot Assembly	0103-00-0465
NS	MB1 Connector Shroud	0334-00-1668

N.A. Not Available

6.0 *Calibration Procedure*

6.1   Calibration Introduction

The following procedures are provided to verify the proper operation of the **Passp(**
Monitor. Service Diagnostics provide the capabilities of diagnosing problems withi
Passport 2 hardware. A menu driven interface with the same "look and feel" as that
Passport 2 User Interface, is used to execute all tests.

**CAUTION: Calibration is not to be performed while
                monitoring a patient.**

6.2   Warning and Guidelines

In the event that the instrument covers are removed, observe these following warnin
general guidelines:

1. Do not short component leads together.

2. Perform all steps in the exact order given.

3. Use extreme care when reaching inside the opened instrument. Do not contact
    exposed metal parts which may become live.

4. Read through each step in the procedure so it is understood prior to beginning
    step.

6.3   Test Equipment and Special Tools Required

6.3.1   Description

*   Digital Mercury manometer w/bulb and valve 0-500 mmHg - Netech Digimano
    Accuracy 0.25% Full Range

*   Test Chamber/Dummy Cuff Datascope - P/N 0138-00-0001-01 (700cc) or -03 (

*   DVM

*   Patient Simulator

*   Digital Flow Meter

*   Calibration Gas - P/N 0075-00-0033

*   Calibration Gas Regulator - P/N 0119-00-0166

*   Safety Analyzer - Dempsy Model or equivalent

*   Flow Meter - Sierra Instruments or equivalent

6.4   Diagnostics

To enter the diagnostic mode:

1. Turn the power off.

2. Press and hold the "FREEZE' key and turn the unit on. The "Diagnostics Ma
Menu" will appear on screen. Release the "Freeze" key.

3. Rotate the Control Knob to move the cursor up and down to the "Diagnostics
Menu". Pressing the control knob will select the desired test and open the sec
menu for testing.
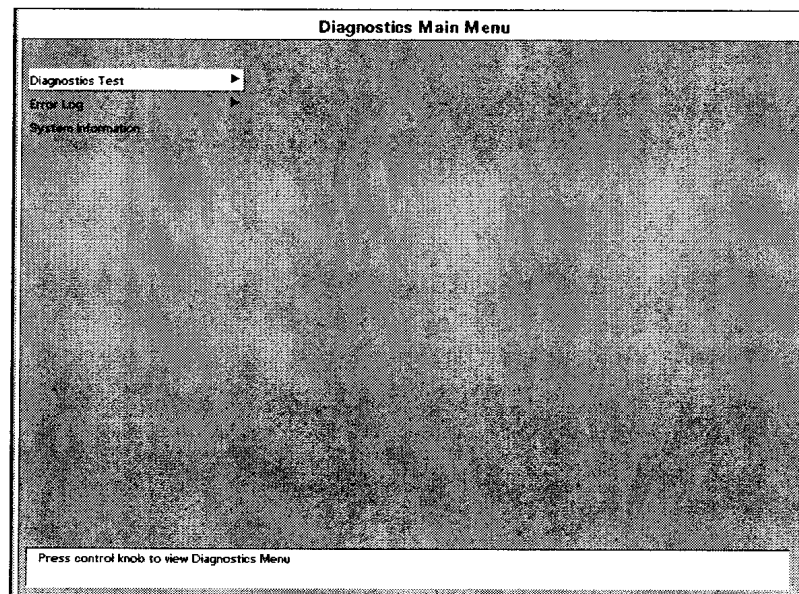
6.4.1   Diagnostic Test Menu
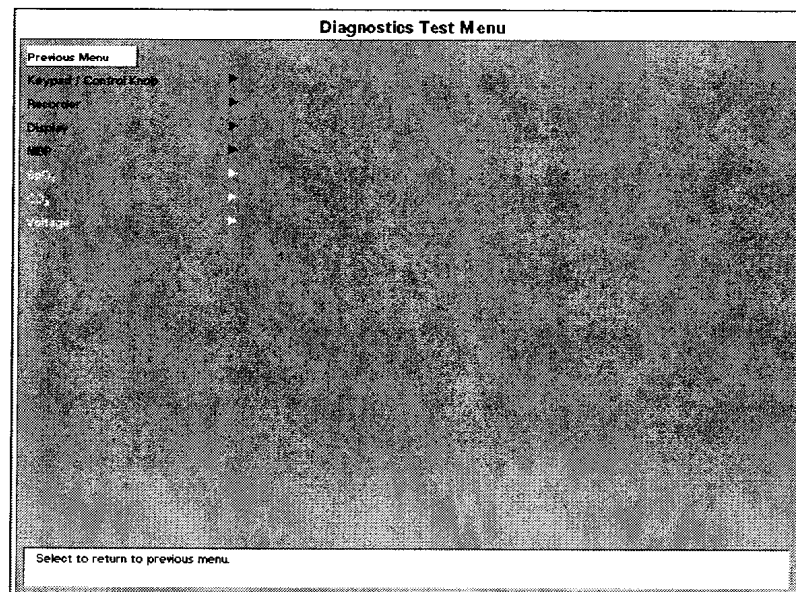
6.4.2   Keypad / Control Knob Test

When this menu is selected the unit will perform an echo test by displaying the nar the key that was pressed.

1. A blank key name will appear on screen

2. When a key is pressed the name of that key will be displayed in the key nam window.

3. Exercise each key to verify proper operation.

4. A second window with blank boxes will be displayed on screen.

5. When rotating the control knob the blank boxes will illuminate with each act detent.

6. Press the print key to print the test result on the local recorder.

7. Press the Normal Key and hold to return to the Diagnostics Test Menu.

Keypad / Control Knob Test

Control Knob Detent:

Key Pressed: None

Press keys and the text will appear on screen. Rotate the control knob to move the cursor. Press and hold the Normal Screen to exit

6.4.3   Recorder Test

Select the Chart Grid ASCII Characters menu. The printer will print the Recorder T
pattern as shown in Figure 1 or Figure 2.

FIGURE 6-1 AR-42 Test Strip

FIGURE 6-2 XE-50 Test Strip

6.4.4   Display Tests

The display test offers the choice of a Pixel test or a Color test. The color tests will ⟨
available on units with a color display.
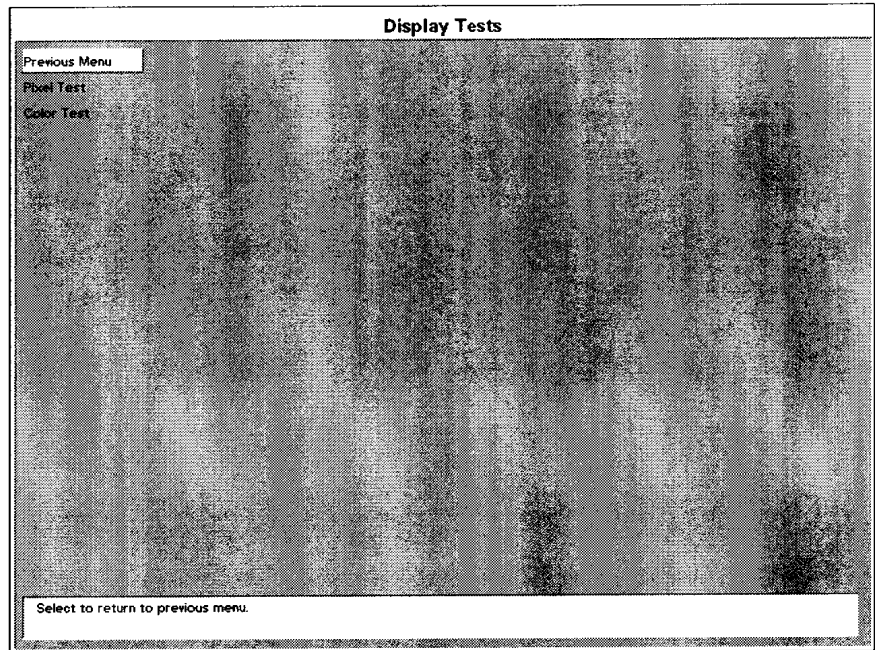
6.4.5   Pixel Test

The pixel test will verify the proper operation the display. On screen one half of the
will be illuminated while the second half is off. Pressing the control knob will illur
the second half of the screen while the first half is turned off. Pressing the control I
third time will activate the display test menu screen.
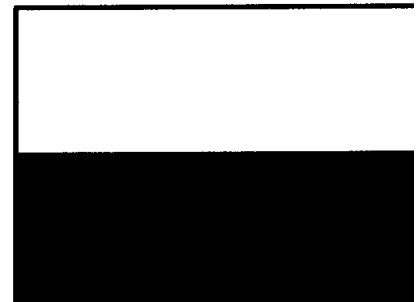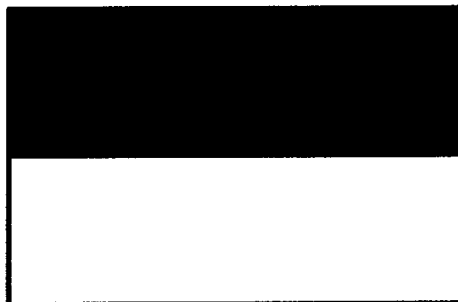
6.4.6   Color Test

The color test will verify the four basic colors of the display. Press the control knob
view the selected color screens in full illumination. The colors are Red, Blue, Green
White.
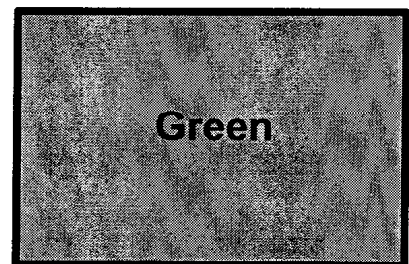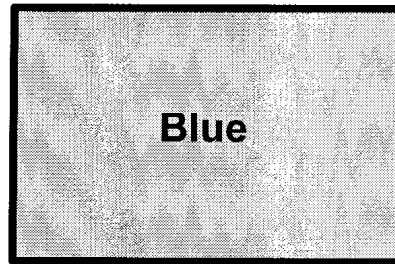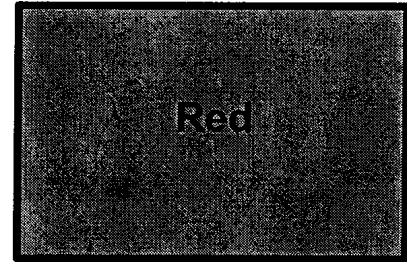
6.4.7   NIBP Tests

The following tests requires an approved 700 cc Test Chamber P/N 0138-00-0001-
500 cc Test Chamber P/N 0138-00-0001-03 to ensure proper test results.

6.4.7.1   Overpressure Voltage Test

A. Specification with P/N 0997-00-0501 only.

The purpose of this test is to verify the Zero Point of the Over Pressure Transducer i
0.100 ± 0.010 volts.

1. Verify on screen that the Overpressure zero point is 0.100 volts ± 0.010.
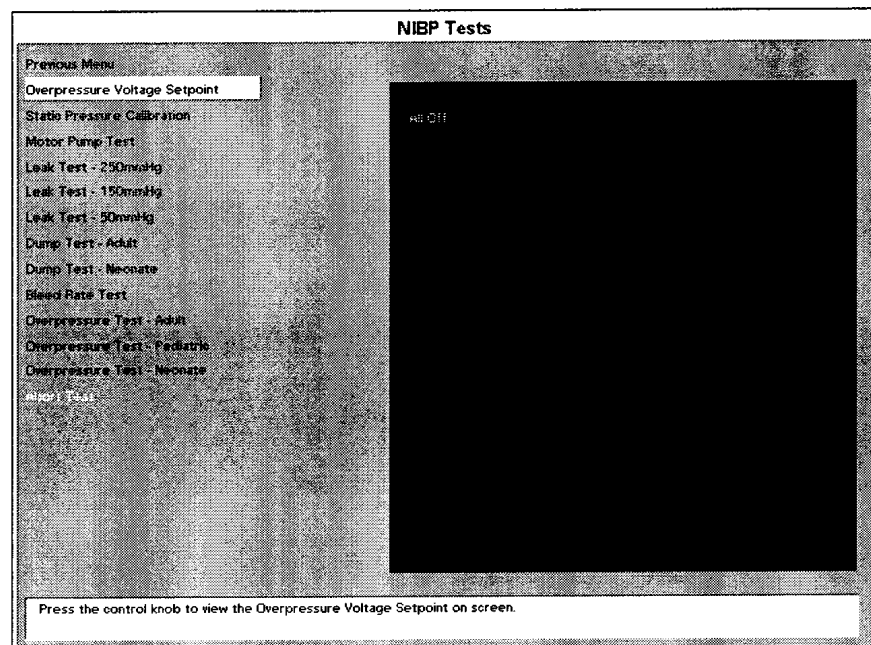
2. If the Overpressure zero point is out of specification follow the following proc

   a. Turn Unit off. Remove the eight screws that secure the front and rear housi
          together. Separate the front and rear housing. Disconnect the interconnect (
          from the TFT/display board and remove the ground strap.

   b. Place the front housing to the side for future use.

   c. Remove the NIBP Pump assembly and bracket from the Main Assembly k
          removing the two screws and placing the NIBP pump to the side.

   d. Remove the Rectus fitting from the left side of the monitor with a 0.25 hex
          driver.

   e. Remove the NIBP Cable assembly from the J1 connector of the NIBP mo(

   f. Slide NIBP Module from the rear of the unit.

   g. Reattach the NIBP Cable to connector of the NIBP module J1 and place it
          protective surface.

   h. Reattach the Front Housing Assembly via the Interconnect cable. Repower

i. Select down to NIBP Overpressure Voltage. Adjust potentiometer R 31 on
NIBP Module and verify on screen the Overpressure Voltage is 0.100 volts.

Overpressure Voltage Setup
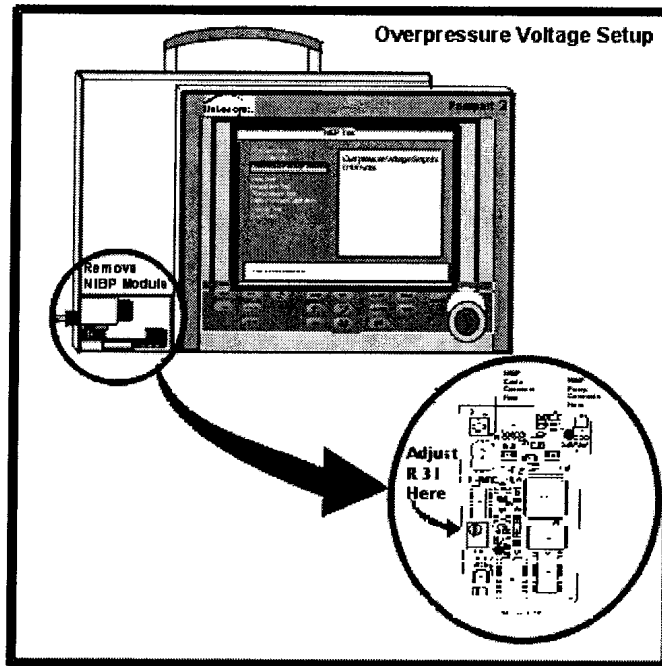
j. Reassemble unit and verify proper operation.

B. Specification with P/N 0670-00-0730/0670-00-0746-01

No manual adjustment is required. The voltage setpoint is controlled by software. If
"Check Calibration/Cuff Overpressure" appears on the screen in message area, replac
NIBP module accordingly.

C. Specification: .030 to .170 volts

6.4.7.2   Static Pressure Calibration

The purpose of this test is to verify the pressure transducer sensitivity for optimal accuracy.
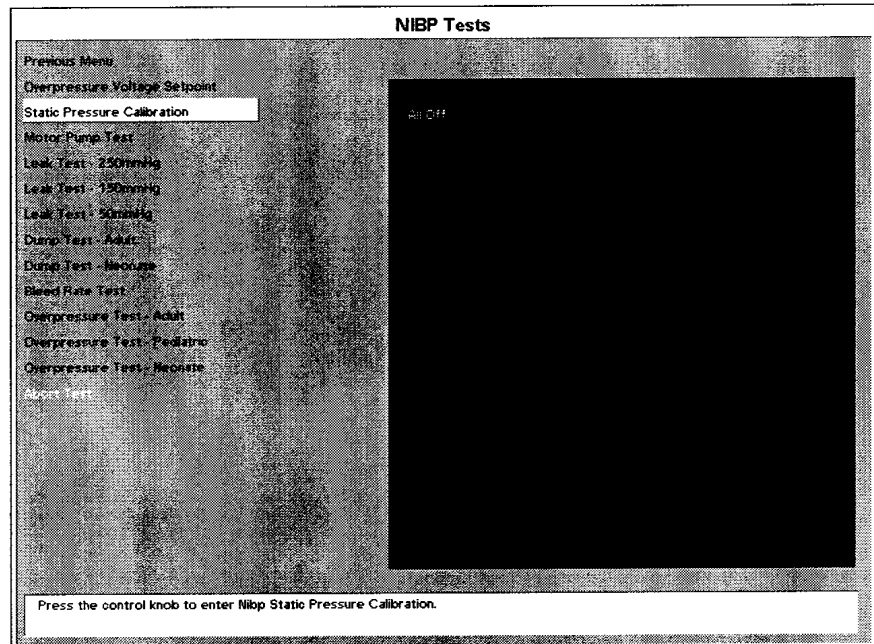
1. Connect the dummy cuff / test chamber to the side panel fitting.

2. Rotate the control knob to highlight the static pressure calibration. Once the st pressure calibration test is highlighted press the control knob to activate the te

3. Using a bulb and valve manually inflate the chamber to 150mmHg. (150mmH middle of the specified range)

4. Verify the pressure displayed on screen matches the pressure viewed on a Dig Mercury Manometer.

Specification: 0 to 300mmHg +/- 3mmHg

If the readings do not match follow the following procedure.

1. Turn unit off.

2. Remove the eight screws from the rear of the unit and separate the front and r housing.

3. Remove the NIBP Pump assembly and bracket from the Main Assembly. Be s reattach NIBP pump cable to module before next step.

4. Locate R81 on the NIBP Module. Turn unit on and enter the Diagnostics as st section 6.4. Reenter the diagnostics menu and select the Static Pressure Calibr menu.

5. Manually inflate the chamber to 150mmHg.

6. Adjust R81 potentiometer and verify the linearity accordingly. See figure belov

Static Calibration Setup
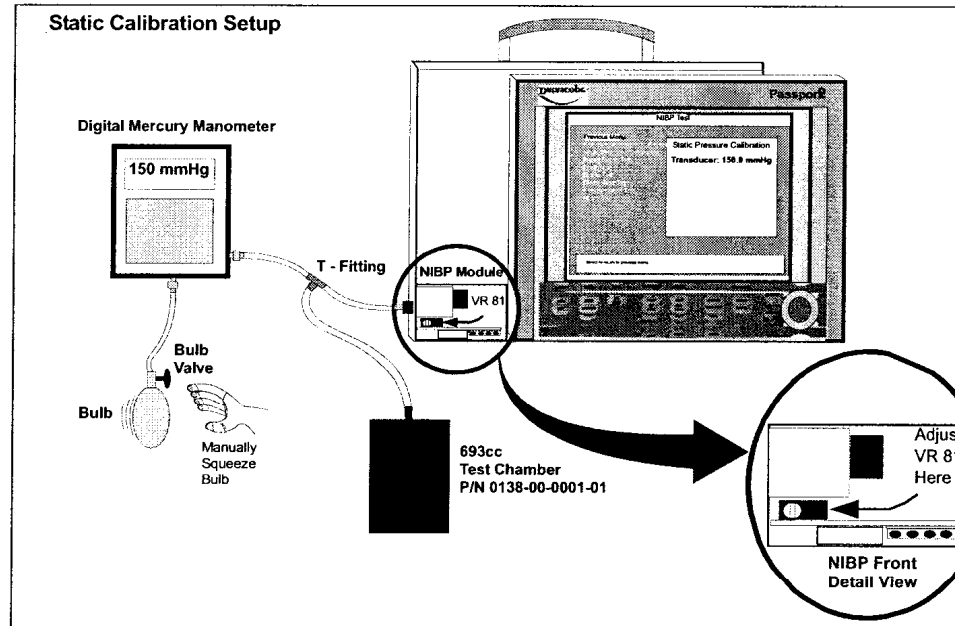
Specification: = 150mmHg +/- 0.1%

7. Reassemble unit and verify the following static pressure points to ensure proper calibration.

Specification: 30 mmHg, 100 mmHg, 150 mmHg, 190 mmHg and 250 mmHg. +
mmHg.

6.4.7.3 Motor Pump Test

1. Connect the dummy cuff / test chamber to the side panel fitting.

2. Rotate the control knob to highlight the motor pump test. Once the motor pump highlighted press the control knob to activate the test.

3. On screen the target pressure of 300mmHg will be view on screen. The time re to pump to 300mmHg will be viewed on screen.
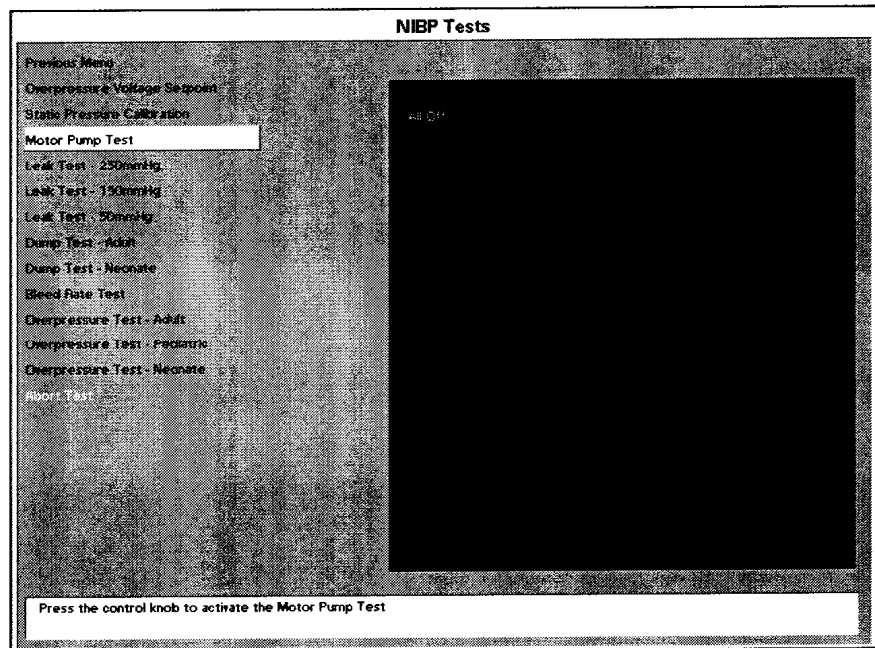
Specification: Pump to 300mmHg in < 35.0 seconds. – 500cc test chamber

Specification: Pump to 300mmHg in < 49.0 seconds – 700cc test chamber

6.4.7.4 Leak Test (250mmHg, 150mmHg, 50mmHg)

The purpose of the leak test is to verify the leak rate of the pneumatic components.

1. Connect the dummy cuff / test chamber to the side panel fitting.

2. Rotate the control knob to highlight the leak test. Once the leak test is highlight press the control knob to activate the test.

3. The chamber will inflated to 250, 150 or 50 mmHg of pressure. After ten secon pressure on screen the pressure is released. During this ten second period the m will determine the leak rate and display the total drop in pressure for that perioc
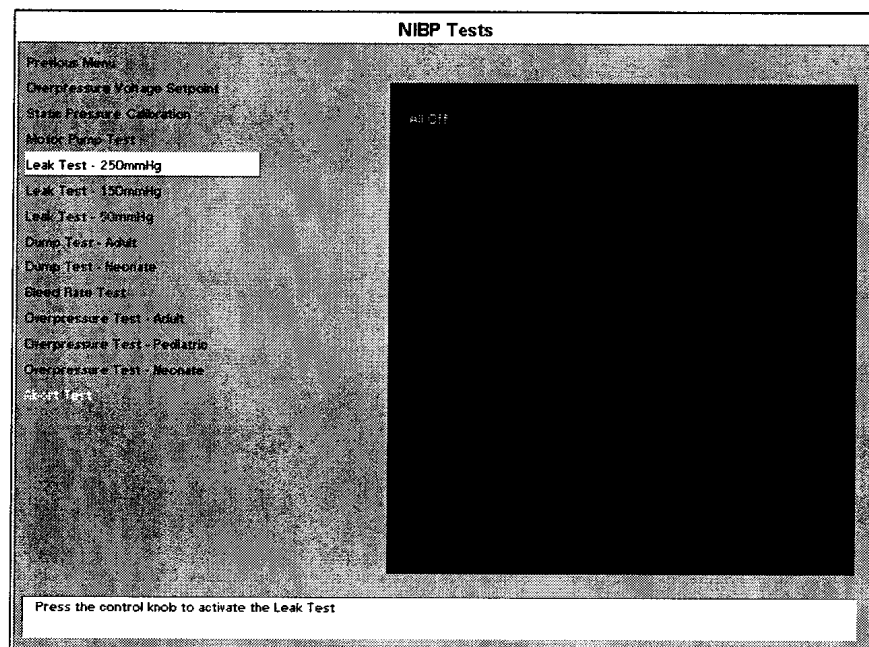
Specification: Leak rate should not exceed 10 mmHg / 10 seconds for the target values of 250, 150 and 50 mmHg. – 500 cc test chamber

Specification: Leak rate should not exceed 10 mmHg / 14 seconds for the target values of 250, 150 and 50 mmHg. – 700 cc test chamber

6.4.7.5   Dump Test (Adult, Neonate)

The purpose of this test is to verify the valve that control the and dump rate is funct properly.

1. Connect the dummy cuff / test chamber to the side panel fitting.

2. Rotate the control knob to highlight the dump test. Once the dump test is highl press the control knob to activate the test.

3. The chamber will inflate to 270mmHg of pressure (Adult) 170mmHg (Neonate dump valve will start to deflate at 260 (Adult) 150 (Neonate) after 10 seconds (5 seconds (Neonate) the unit will dump the pressure to approximately 15mmH (Adult) 5mmHg (Neonate). On screen the result of the test will be viewed.
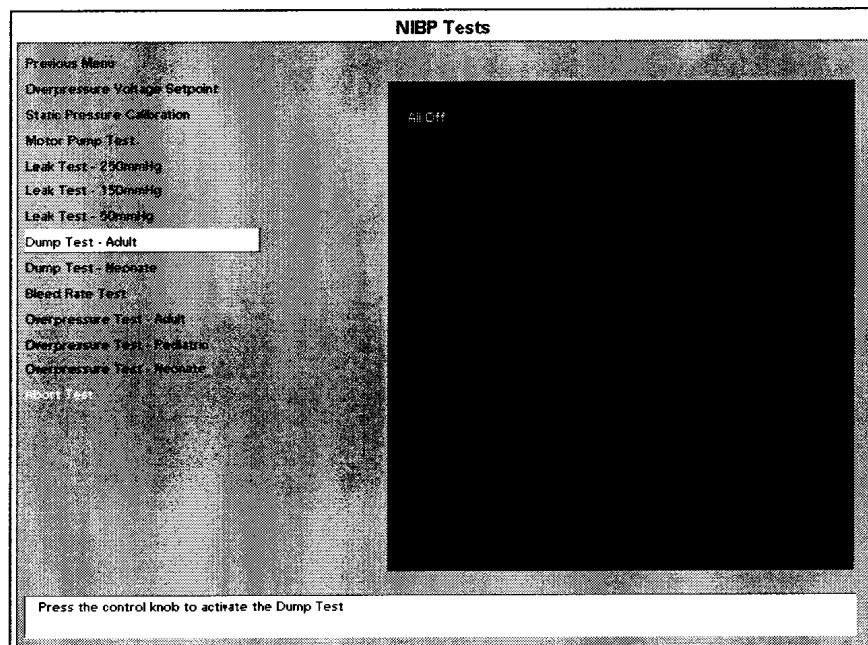
Specification: Dump Rate – 260 to 15mmHg / 10sec or less – Adult – 500cc test chamber
Dump Rate – 150 to 5mmHg / 5sec or less - Neonate – 500cc test chamber

Specification: Dump Rate – 260 to 15mmHg / 14sec or less – Adult – 700cc test chamber

Dump Rate – 150 to 5mmHg / 7sec or less - Neonate – 700cc test chamber

6.4.7.6   Bleed Rate Test

The purpose of this test is to verify the valves that control the bleed rate is functioni properly.

1.   Connect the dummy cuff / test chamber to the side panel fitting.

2.   Rotate the control knob to highlight the bleed rate. Once the bleed rate test is highlighted press the control knob to activate the test.

3.   The chamber will inflate to 220mmHg of pressure. The bleed rate valve will ope deflate the pressure for 10 seconds. On screen the result of the test will be view
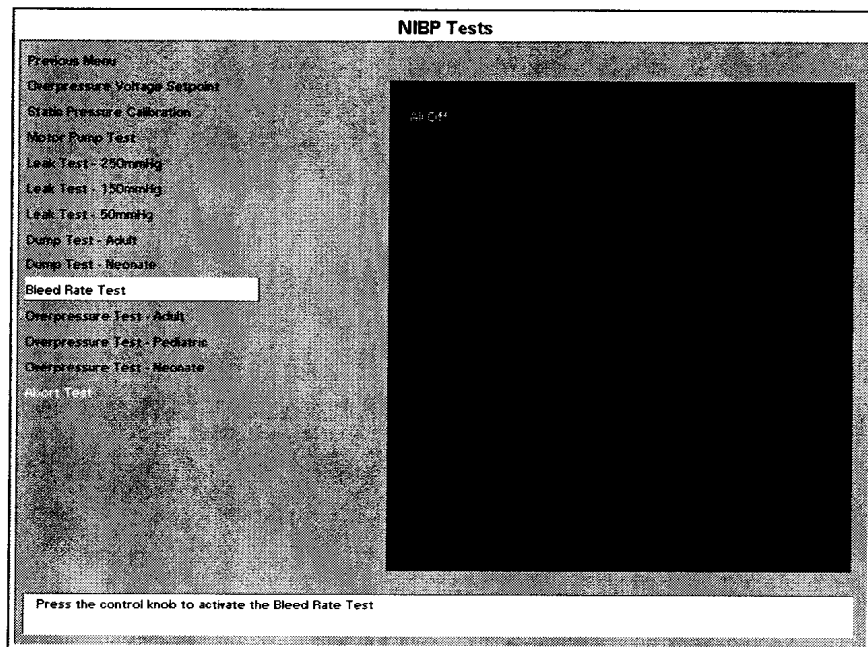
Specification: Bleed Rate = 6.0mmHg / sec ± 20% - 500cc test chamber

Specification: Bleed Rate = 6.0mmHg / sec ± 20% - 700cc test chamber

6.4.7.7 Overpressure Test (Adult, Pediatric, Neonate)

The purpose of this test is to verify the hardware overpressure sensor is functioning properly.

1. Connect the dummy cuff / test chamber to the side panel fitting.

2. Rotate the control knob to highlight the specified overpressure test. Once the overpressure test is highlighted press the control knob to activate the test.

NOTE: **Due to safety conditions the unit must be reset after each Overpressure Size as been tested.**
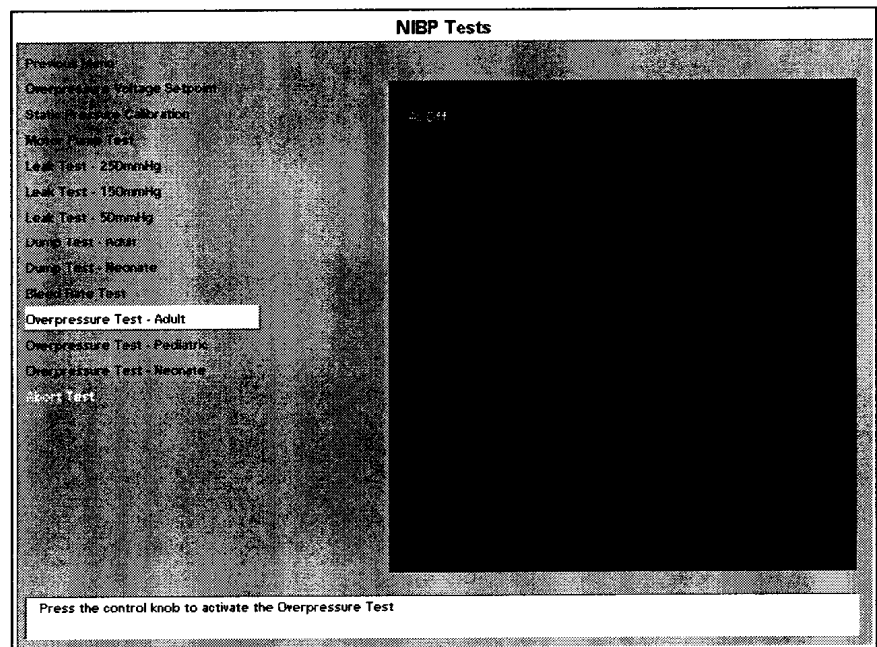
Software Trip points

Specifications: Adult < or = 300 mmHg
Pediatric < or = 200 mmHg
Neonate < or = 150.0 mmHg

Hardware Trip points

Specifications: Adult < or = 330 mmHg
Pediatric < or = 220 mmHg
Neonate < or = 165 mmHg

3. Press the print key to record the test result on the local printer.

6.4.8   Fan Test

The purpose of this test is to verify the operation of the fan at a simulated temperatu

6.4.8.1   Fan Test w/ Recorder Installed

1. Remove the recorder assembly by loosening the 2 captive screws inside the rec assembly.

2. Pull the recorder assembly from the rear housing and place to the side.

3. Locate the switch on the lower left and press with a plastic pen like tool. See fig below. Ensure the fan turns on and can draw air through the air vent. Check for messages on the front screen.

4. Place the recorder back into the rear housing assembly and secure with the 2 ca screws to the recorder interface board.

6.4.9   Fan Test without Recorder Installed

1. Remove the filler plate that covers the opening on the rear housing.

2. Locate the switch on the lower left and press with a plastic pen like tool. See fig below. Ensure the fan turns on and can draw air through the air vent. Check for messages on the front screen.

3. Place the recorder filler plate back onto the rear housing and snap in place.

6.5   Verification

6.5.1   Initial Set-up

1. Using a patient simulator, connect the ECG, IBP1, IBP2 and temperature cable: left side connector panel. Set the ECG simulator for 60 bpms, 1mv QRS signa

2. Set up the Passport 2 as follows:

- Patient Menu - Adult mode (patient size)

- Monitor Setup -

  a. Display Setup - 3 Waveforms / 6 Waveforms (12Leads)

  b. ECG Speed - 25 mm/sec

  c. IBP Speed - 25mm/sec (optional)

  d. Respiration / Gas Speed - 12.5 mm/sec

- Print Setup -

  a. Waveform 1 - ECG 1

  b. Waveform 2 - ECG 2

  c. Select Printer - Local

- Parameters -

  a. ECG

  ECG1 - II
  ECG 2 - I
  ECG 3 - III
  ECG 1 through 6 Size - 1cm/mV

  (12 Lead) Page 1
  ECG 1 - I
  ECG 2 - II
  ECG 3 - III
  ECG 4 - AVR
  ECG 5 - AVL
  ECG 6 - AVF

  (12 Lead) Page 2
  ECG 1 - V1
  ECG 2 - V2
  ECG 3 - V3
  ECG 4 - V4
  ECG 5 - V5
  ECG 6 - V6

b. NIBP -

Set Start Pressure - 180 mmHg
Interval - 5 minutes
IBP1 - Scale 0 to 160mmHg
IBP2 - Scale 0 to 80mmHg

c. SpO_2 -

Averaging mode - 2
Sensor Off Audio - off

d. CO_2 - (optional)

Apnea Delay - 30
Scale 40 mmHg

e. Respiration -

Resp lead - II
Apnea Delay - 30
Resp source - Auto
Scale - 3

f. Gases - (optional)
Select agent - Auto
O_2 scale - 100%
N_2O Scale - 10%

6.5.2 ECG Tests

6.5.2.1 Initialization

1. Observe that the trace display sweeps across the waveform 1 screen in five seco
There should be five complete ECG cycles. The same display and timing shoulc
seen in the Waveform 2 screen.

2. Check the following sweep speeds for the appropriate displays:
12.5 mm/sec – 10 second sweep/window.

6.5.2.2 Leads OFF

1. Disconnect one lead at a time RA, RL, LL, LA, and C from the simulator and ob:
that the message "Lead OFF" appears on the display.

2. Set the ECG simulator to Short Leads. Verify the resolution does not exceed one
resolution.

6.5.2.3 Pacer Detect

1. Set the Pacer Enhancement feature "on" in the ECG Setup menu.
2. Set the ECG simulator to Ventricular Pacer.
3. Verify the pacer pulse (yellow line) is displayed before the R wave of the QRS
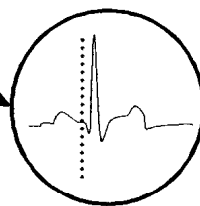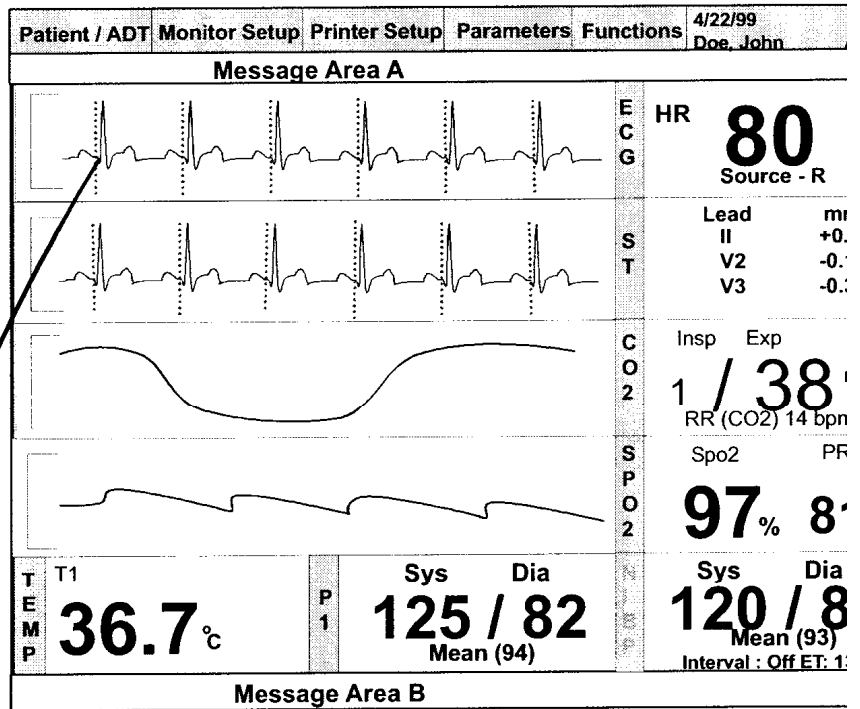
Expanded View with
Pacer Enhancement On

6.5.2.4 Heart Rate

1. Set the ECG simulator to ECG QRS waveform. Set the rate to 251 bpm.
2. Verify the Rate display is 251 ± 5 bpm.
3. Decrease the rate to 30 bpm and allow signal to stabilize. Verify that the rate d is 30 bpm ± 3 bpm.

6.5.2.5   Alarms

1. Set the simulator to 1mv ECG QRS signal, rate set to 60 bpm.

2. Set the **Passport 2** to Print on Alarm, install paper in the recorder, and set the L HR alarm to 50 bpm, and Hi alarm to 120 bpm.

3. Increase the HR to 125 and verify the following:

   - The high alarm violates with an audio tone and red led active on keypad
   - The recorder is initiated and prints the ECG strip showing the ECG informa

4. Measure the Grid and verify the overall width of 40 mm ± 2 cm.

5. Mute the alarm by pressing the Mute All key.

6. Verify that the mute alarms message is displayed in the Message Area "A" and alarm is silent.

7. Press the "Mark Event" key. Press the "Trend" Key and examine the trend data. high HR rate should be red (LCD) or normal brightness (EL) indicating the Hig was violated.

6.5.3   IBP 1 and IBP 2 Verification

1. Set the simulator to 0 mmHg for both IBP 1 and IBP2.

2. Press the Zero All key. Verify the Systolic, diastolic and mean displays "0" ± 1 mm /Hg.

3. Apply 50,150, and 300 mmHg and verify that the following parameters Sys/ Di: Mean agree.

4. Apply a 120/80/mmHg signal into IBP 1 and a 60 / 20/ mmHg signal into IBP 2 verify the correct waveforms are displayed in the window.

6.5.4   Temperature Verification

1. Set the Simulator to 37° C 400 series probe

2. Verify the temperature is 37° +/- 0.3°

3. Repeat same test for 700 series probe.

6.5.5   SpO$_2$ Verification

1. Set the **Passport 2** to display waveform 4 as pleth. Set the HR source to Auto.

2. Verify that the SpO$_2$ message is displaying SpO$_2$ No Sensor in Message area "B

3. Connect the SpO$_2$ sensor to the Panel connector. Verify the SpO$_2$ message chang Sensor off or SpO$_2$ initializing.

4. Apply sensor to finger.

5. Verify window 4 displays the pleth waveform, and the SpO$_2$ indicates a valid rea Verify the HR is from SpO$_2$ and a beep tone is present.

6.5.6   **NIBP Verification**

1.   Connect the Adult cuff connector to the NIBP hose. Attach the NIBP hose to th
     connection the left side on the monitor.

2.   Apply cuff and press the start key on the **Passport 2**.

3.   Verify the pump motor starts to pump and inflates the cuff to 180 mmhg (Adul
     cuff will begin to deflate and obtain a blood pressure reading of Sys/ Dia/ Mea
     about 20 to 30 seconds after peak pressure is obtained.

4.   Verify the reading on screen.

6.5.7   **Battery Operation Verification**

1.   If batteries are installed in the unit, remove them.

2.   Verify the unit functions on Line power correctly.

3.   Install the two batteries in the appropriate slots located on the left side of the n

4.   Remove the line cord from the unit. Verify the unit operation is not interrupted

5.   Remove one of the batteries and verify the unit still operates. Verify the secon
     battery operates in the same manner by reinstalling the first battery and remov
     second battery.

6.5.8   **CO$_2$ Operation Verification**

1.   Connect the Filterline Short Term assembly to the input port of the CO$_2$ conne
     the left side of the monitor.

2.   Attach a can of Calibration Gas P/N 0075-00-0033-01 to the Filterline Short T
     assembly. Feed gas into monitor and verify the ETCO$_2$, Inspired CO$_2$ and resp
     readings occur on the screen.

6.5.9   **Leakage Current Tests**

1.   Plug the line cord of the unit into the safety analyzer. Connect the case ground
     the analyzer to the equipotential lug of the monitor on the rear of the monitor.

2.   Perform the tests under the following conditions:

     a.   Case Grounded:

          Normal polarity
          Normal polarity with open neutral

     b.   Case ungrounded:

          Normal polarity
          Normal polarity with open neutral
          Reverse polarity

Specs: Verify the current reading of the test is less than 100 µA under normal oper
conditions.

Less than 300 µA under a single fault condition for 120 VAC and less than 500 µA
a single fault condition for 230 VAC.

6.5.9.1   Patient Leakage

1. Lead to ground: Sink Current Patient circuit (Test V Model 431 Dempsey; pati‹
    leakage with line voltage on leads).

2. Connect the ground wire from the safety analyzer to the equipotential lug of th‹
    monitor.

3. Connect the ECG cable from the Analyzer to the monitor.

4. On the safety analyzer depress the "Apply 115 VAC" button and note the readir

5. Repeat the test for normal and open ground polarity combinations.

Specs: Verify the current readings of the test are below 50uA under a single fault
condition.

NOTE: **Including 12 Lead.**

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7.0 *Preventive Maintenance*

7.1   Preventive Maintenance Schedule

The following is a list of activities required for periodic maintenance of the **Passpo** monitor. The physical inspection, replacement of consumable items and performan checks should be performed at the recommended intervals stated below. Datascope responsible for component failure or loss resulting from the use of stated consumat items beyond their recommended replacement interval.

7.2   Mechanical / Physical / Visual Inspection

7.2.1   Perform at Twelve Month Intervals

Suggested Inspections for Wear and Abuse:

1. Outer case, Line Cords, Rolling Stands, Wall Mounts, Modular Accessories ar Interconnecting Cables.
2. Patient Interface Connections (ECG, IBP, SpO_2, Temp, CO_2 and NIBP).

7.3   Preventive Maintenance Kit

1. N/A

7.4   Perform Verification and NIBP Calibration – Annua

1. See section 6.5., "Verification".

7.5   Perform Verification and CO_2 Calibration – Annual

1. See Test Outline in Service Manual.
2. Replace Pump and Scrubber after 20,000 Operating Hours or as Required.
3. Replace the CO_2 Sensor Assembly after 20,000 Operating Hours or as require

7.6   User Preventive Maintenance Introduction

This section of the manual outlines routine maintenance that should be performed b user.

The **Passport 2** Monitor is designed for stable operation over long periods of time a under normal circumstances should not require technical maintenance

beyond that described in this section. However, it is recommended that routine maintenance calibration and safety checks be performed at least once a year, or more as required by local statutory or hospital administration practice.

7.7   Care And Cleaning Of The Monitor

The monitor enclosure may be cleaned with a mild soap and water solution, isoprop alcohol, 10% bleach and water solution or ammoniated window cleaner. Apply clea solution to the cloth, not directly onto the monitor. DO NOT apply large amounts of liquid. DO NOT use abrasive cleaning agents or organic solvents.

WARNING: Do not clean the monitor while it is on and/or plugged in.

To prevent scratches on the front panel display screen, blow or carefully brush dust *z* dirt particles with a soft sponge moistened with cleaner solution or a fine, soft-hair b DO NOT use abrasive cleaning materials. Fingerprints and stains may be removed b using a liquid lens cleaner and a soft cloth. DO NOT wipe a dry screen or use alcoh chlorinated hydrocarbon solvents.

7.8   Care and Cleaning of SpO$_2$ Sensor

NOTE: Refer to the individual instruction sheets packaged with each sensor.

1. Check sensors and cables for wear or damage daily. Replace as required.

2. Check for proper operation of the spring mechanism on reusable adult sensors.

3. Sensors should be cleaned before and after use on each patient.

4. Clean and disinfect the sensors by wiping the patient contact area with a soft clo dampened with a mild soap and water solution or isopropyl alcohol. Hydrogen peroxide can be used to remove dried blood on all accessible surfaces.

5. DO NOT immerse sensors. Let sensors dry completely before using.

CAUTION: When cleaning sensors do not use excessive amounts of liquid. Wipe the sensor with a soft cloth, dampened with the cleaning solution.

7.9   Cleaning CO$_2$ Sensors, Adapters And Sampling Components

Oridion CO$_2$ patient monitoring accessories are designed for single patient use and ; not be cleaned or reused.

7.10   Sterilization and Cleaning of Reusable Cuffs

Remove the latex bladder from the cuff. The cuff and latex bladder may be cleaned isopropyl alcohol, a disinfectant wipe, or by sponging with a damp cloth. Both may sterilized with commercially available disinfectant soaks.

CAUTION: **Using dark colored soaks may stain the cuffs. Test a single cuff to ensure that no damage will occur.**

ETO sterilization may also be used.

Hand washing will enhance the service life of the cuff. Remove the latex bladder an wash the cuff in warm, soapy water; then rinse thoroughly. Allow the cuff to air dry insert the latex bladder.

CAUTION: **When ironing or pressing the cuffs, be aware that the velcro fasteners can melt at temperatures above 325 °F, 162 °C.**

7.11   Battery Replacement and Maintenance

7.11.1   Battery Replacement

1. Open the battery compartment door, located on the left side of the monitor.
2. Press the battery release tab to eject the battery. Slide out the old battery.
3. Slide replacement battery in until it clicks into place.
4. Close battery compartment door.
5. Use only Datascope Battery P/N 0146-00-0043.

7.11.2   Battery Maintenance

Due to the self-discharge characteristics of this type of battery, it is imperative that charged after 3 months of storage (or monitor not in use). If not charged, a permane of capacity may occur as a result of sulfation. Charge retention at 20 °C is 3 month 83%.

The batteries used in the **Passport 2** Monitor of sealed lead acid construction. This ! type may be subject to local regulations regarding disposal. At the end of the batter

7.12   Recorder Paper Replacement

The instructions below describe the replacement of recorder paper. For best results, only Datascope recorder paper, P/N 0683-00-0422-01, in your **Passport 2** Monitor.

1. Open the recorder door by pressing the door release button in the upper right cor the recorder.

    NOTE: **If the recorder's door does not open fully, carefully pull down on door until it is completely open.**

2. Remove the empty paper spool by pulling it out gently.

3. Insert a new roll of paper between the two rounded tabs of the paper holder witl coated (shiny) side of the paper facing the print head at the top of the recorder (paper should be feeding off of the bottom of the roll).

4. Unroll approximately 4 inches of paper.

5. Align the paper across the top the metal bar.

6. Holding the paper in place, close the recorder door.

7. To ensure that the paper is aligned properly and has not been pinched in the dooi the loose end of the paper out several inches. If the paper jams, open the door ai return to step 5.

7.13   Care and Storage of Thermal Chart Paper

Thermal Chart Paper is chemically treated and the permanency of a recording is affe by storage and handling conditions. These conditions are:

1. **Ultraviolet Light** - We recommend storing the recordings in a filing cabinet wit few days of printing. Long term exposure to natural or artificial U.V. sources ma detrimental.

2. **Storage Temperature and Humidity** - Keep the recordings in a cool and dry ar for a longer lasting image. Extreme temperature and humidity (above 80 °F and humidity) should be avoided.

3. **Solvent Reactions** - Do not store the recordings in plastic bags, acetate sheet protectors, or similar items made from petroleum products. These products emit small amount of vapor which will, over a period of time, deteriorate the image oi chart paper.

4. **Adhesive Tape** - Never place adhesive tape over recordings. The reaction betwe the adhesive compound and the Chemical/Thermal paper can destroy the image within hours.

5. **Archives** - We recommend that if long term archives are required, make a photoc of the recordings as back-up. Under normal office filing conditions, the recordin; should retain acceptable image quality for about five years.

7.14   How to Get Help

Datascope maintains a network of service representative and factory-trained distril
Prior to requesting service, perform a complete operational check of the instrumen
verify proper control settings. If operational problems continue to exist, contact th
Datascope Service Department (800) 288-2121 for assistance in determining the n
field service location.

Please include the instrument model number, software part numbers, the serial nur
and a description of the problem with all requests for service.

Any questions regarding the warranty should be directed to:

Service Manager
Datascope Corp., US, Canada
& Latin America
Patient Monitoring
Worldwide Headquarters
800 MacArthur Blvd.
Mahwah, NJ 07430 USA
US Customer Service: 1.800.288.2121
US Fax: 1.800.926.4275
Intl. Customer Service: 201.995.8000
Intl. Fax: 201.995.8659
E-Mail Address: pm_sales@datascope.com

Service Manager
Datascope GmbH
Fabrikstrasse 35
64625 Bensheim
Germany
Tel: 06251.17050
Fax: 06251.67877

Service Manager
Europe & Africa
Drs. W van Royenstraat 8
P.O. Box 26, 3870 CA Hoevelaken
The Netherlands
Tel: +31.33.2544911
Fax: +31.33.2537621

Service Manager
Datascope Medical Co., Ltd.
Lakeview Court
Ermine Business Park
Huntingdon
Cambs
United Kingdom
PE29 6XR
Tel: 01480.423600
Fax: 01480.423638

Service Manager
Datascope SARL
Z. I. Athelia 1
13705 La Ciotat
Cedex France
Tel: 04.42.08.77.50
Fax: 04.42.08.57.08

Service Manager
Datascope Middle East Office
37 Ahmed El-Sawy Street
Area No.6, Nasr City Cairo
Egypt
Tel: +20.2.274.8330
Fax: +20.2.274.7471

Service Manager
Datascope Corp Asia-Pacific Office
Unit A 30th Floor, Morrison Plaza
9 Morrison Hill Rd
Wan Chai, Hong Kong
Tel: 852.2793.5596
Fax: 852.2344.8824

Service Manager
Datascope Corp Belgium Office
Datascope Sprl/Bvba
Woluwe Garden C
Woluwedal 26
1932 St. Stevens-Woluwe, Belgium
Tel: +32.2.216.8000
Fax: +32.2.216.3333

Service Manager
Datascope Corp Brazil Office
Rua José Getúlio 579 - Cj. 92 e 93
CEP 01509-001 - São Paulo - SP, B
Tel: +5511+3346+5800
Fax: +5511+3346+5801

7.15   References

The following bibliography provides several articles and books of interest on pulse oximetry and issues affecting SpO_2 accuracy (carboxyhemoglobin, methemoglobir variation in calibration of algorithms between manufacturers, and excessive sensor pressure).

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7.16 Warranty

7.16.1 USA, Canada, Mexico, and Puerto Rico

Datascope Corp. warrants that its products will be free from defects in workmanshi
materials for a period of one (1) year from the date of purchase except that disposal
one-time use products are warranted to be free from defects in workmanship and ma
up to a date one year from the date of purchase or the date of first use, whichever is
sooner. This warranty does not cover consumable items such as, but not limited to,
batteries, external cables, sensors, cuffs, hoses, or mounts.

Datascope Corp. shall not be liable for any incidental, special, or consequential loss
damage, or expense directly or indirectly arising from the use of its products, liabil
under this warranty and the buyer's exclusive remedy under this warranty is limited
servicing or replacing at Datascope Corp's option at the factory or at an authorized
Datascope Distributor, any product which shall under normal use and service appear
Company to have been defective in material or workmanship.

No agent, employee, or representative of Datascope Corp. has any authority to bind
Datascope Corp. to any affirmation, representation, or warranty concerning its proc
and any affirmation, representation or warranty made by any agent, employee, or
representative shall not be enforceable by buyer.

This warranty is expressly in lieu of any other express or implied warranties, incluc
any implied warranty or merchantability or fitness, and of any other obligation on tl
of the seller.

Damage to any product or parts through misuse, neglect, accident, or by affixing ar
standard accessory attachments or by any customer modification voids this warrant
Datascope Corp. makes no warranty whatever in regard to trade accessories, such b
subject to the warranty of their respective manufacturers.

A condition of this warranty is that this equipment or any accessories which are clair
be defective be returned when authorized by Datascope, freight prepaid to Datascoj
Corp., Mahwah, New Jersey 07430. Datascope Corp. shall not have any responsibi
the event of loss or damage in transit.

Calibration may be performed without the need to disassemble the instrument. It is
responsibility of the purchaser to perform calibration as necessary, in accordance w
instructions provided in this manual.

7.16.2 International (excluding North America)

Datascope Corp. warrants that its products will be free from defects in workmanshi
materials for a period of two (2) years from the date of purchase except that disposa
one-time use products are warranted to be free from defects in workmanship and ma
up to a date one year from the date of purchase or the date of first use, whichever is
sooner. This warranty does not cover consumable items such as, but not limited to,
batteries, external cables, sensors, cuffs, hoses, or mounts.

Datascope Corp. shall not be liable for any incidental, special, or consequential loss
damage, or expense directly or indirectly arising from the use of its products, liabili
under this warranty and the buyer's exclusive remedy under this warranty is limited
servicing or replacing at Datascope Corp's option at the factory or at an authorized
Datascope Distributor, any product which shall under normal use and service appear
Company to have been defective in material or workmanship.

No agent, employee, or representative of Datascope Corp. has any authority to bind
Datascope Corp. to any affirmation, representation, or warranty concerning its prod
and any affirmation, representation or warranty made by any agent, employee, or
representative shall not be enforceable by buyer.

This warranty is expressly in lieu of any other express or implied warranties, includi
any implied warranty or merchantability or fitness, and of any other obligation on th
of the seller.

Damage to any product or parts through misuse, neglect, accident, or by affixing an
standard accessory attachments or by any customer modification voids this warrant
Datascope Corp. makes no warranty whatever in regard to trade accessories, such be
subject to the warranty of their respective manufacturers.

A condition of this warranty is that this equipment or any accessories which are clair
be defective be returned when authorized by Datascope, freight prepaid to Datascop
Corp., Mahwah, New Jersey 07430. Datascope Corp. shall not have any responsibili
the event of loss or damage in transit.

Calibration may be performed without the need to disassemble the instrument. It is t
responsibility of the purchaser to perform calibration as necessary, in accordance wit
instructions provided in this manual.

7.17   Datascope's Responsibility

Datascope is responsible for the effects on safety, reliability and performance of the equipment only if:

A. assembly operations, extensions, readjustments, modifications or repairs are ca out by persons authorized by Datascope; and

B. the electrical installation of the relevant room complies with the appropriate requirements; and

C. the equipment is used in accordance with the instructions for use.

7.18   Extended Warranty

Datascope Corp. warrants that components within the monitor unit will be free fror defects in workmanship and materials for the number of years shown on the Datasc invoice. Under this extended warranty, Datascope Corp. will repair or replace any defective component at no charge for labor and/or materials. This extended warrant not cover consumable items such as, but not limited to batteries, displays, external and sensors.

Recommended preventative maintenance, as prescribed in the service manual, is th responsibility of the user, and is not covered by this warranty.

Except as otherwise provided herein, the terms, conditions and limitations of Datas Corp.'s standard warranty shall remain in effect.

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To reorder the International English Passport 2 W.x Operation/Service Manual, use part number
0070-00-0652-02. See the following table for manual components.

PART NUMBER	DESCRIPTION	QUAI
0070-01-0513-02	Passport 2, Outside, Color Cover, International English, Combo	1
0070-02-0440-02	Passport 2, Black & White Cover, International English, Ops	1
0070-10-0649-02	Passport 2 W.x Operating Instructions Manual, Contents, International English	1
0070-02-0441	Passport 2, Black & White Cover, Service	1
0070-10-0441	Passport 2 Service Manual, Contents	1
0002-08-8918	Marketing Addresses (PM)	1
0070-03-0652-02	Passport 2 W.x, Inside, Back Page, International English, Combo	1
0071-00-0001-02	1.5", 3-Ring Binder, White Vinyl	1