Life Scope EC
BEDSIDE MONITOR

BSM-1101/1102

0634-001334B

Contents

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to the possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.

On panel

Symbol	Description	Symbol	Description
	"On" only for a part of the equipment		Alternating current
	"Off" only for a part of the equipment		Equipotential terminal
	Attention, consult operator's manual		Serial number
	Output terminal		Year of manufacture

Symbol	Description	Symbol	Description
	Defibrillation-proof type CF applied part		Home key
	Defibrillation-proof type BF applied part		Other key
	Type CF applied part		NIBP key
	Type BF applied part		ECG key
	Power lamp		Record key
	Battery		Record setup key
	Battery charging		Intensity control
	Alarm off/suspend		Brightness
	List/trend key		Alarm sound volume
	NIBP start		QRS sync sound volume
	NIBP stop		

On screen

Symbol	Description	Symbol	Description
	Alarm recording off		Out of paper
	Alarm suspend with remaining minutes		Paper magazine open
	Alarm recording		Manual recording
	QRS sync mark		Periodic recording
PR	Pulse sync mark		Calibration
	Network communicating		

Other

Symbol	Description
	Recycle
	The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.

Section 1 General

Introduction

This service manual is intended for use by qualified service personnel only. It provides the information required to understand, troubleshoot, service, maintain, and repair the BSM-1101 or BSM-1102 Bedside Monitor (referred to as the "instrument" in this service manual).

All replaceable parts or subassemblies of this instrument and its optional units are clearly listed and illustrated with exploded parts views to aid you in parts location and repair.

Section 6, "Maintenance," describes the maintenance that should be performed by qualified service personnel only. The maintenance section in the operator's manual describes the maintenance that can be performed by the user.

Although the operator's manual is written primarily for the user, it is important for service personnel to thoroughly read both the service manual and the operator's manual before attempting to troubleshoot, service, or maintain the instrument.

Service Policy and Patient Safety Checks

Service Policy

Nihon Kohden Corporation's basic policy for technical service is to replace any faulty printed circuit board (board), part, or unit with a new one. This is because most of the boards are multilayer boards with surface-mounted electrical devices. We do not recommend the repair or replacement of electrical devices on these multilayered boards outside the factory.

NOTE

When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please provide the name or model of the device and the NK part number and part name listed in this service manual. This helps us attend to your needs promptly. Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to ensure the maximum performance of your instrument.

Patient Safety Checks

Periodic maintenance procedures and self-check procedures are provided in this manual to ensure that the instrument is operating in accordance with its design and production specifications. To verify that the instrument is operating safely, patient safety checks should be performed on the instrument before initial installation, periodically after that, and after a repair is made on the instrument.

For patient safety checks, perform the following checks as described in the International Electrotechnical Commission's standard, IEC 60601-1 (1988):

- Ground impedance check
- Earth leakage current check
- Enclosure leakage current check
- Patient leakage current check
- Withstanding voltage check

Specifications

Display

Display size	5.5 inches, TFT type LCD
Waveform display method	Non-fade moving or non-fade fixed method
Screen size	111 × 83 mm
Resolution	320 × 240 dots
Number of waveform traces	2
Sweep speed	12.5 mm/s or 25 mm/s
Waveform display time	4.45 s (at 25 mm/s)
Waveform display colors	7
Numeric display colors	6
Waveform freeze	Not provided
Display waveforms	ECG and Pulse (SpO_2)
Numerical data display	Heart rate (or pulse rate), SpO_2, NIBP (systolic, diastolic, mean)

Trendgraph

Trend parameters	Heart rate (or pulse rate), SpO_2, NIBP (systolic, diastolic, mean)
Trend period	1, 2, 4, 8, or 24 hours

Alarm

Alarm items	Heart rate (or pulse rate), SpO_2, NIBP (systolic, diastolic, mean)
Alarm indication	Highlighted message, alarm sound, alarm bar LED
Alarm suspend	Provided (for a specified period)

ECG Measurement

ECG leads	3-electrode lead: I, II, III
Defibrillation discharge protection	Provided
ESU interference filter	Provided
Pacing pulse count elimination	Provided
Filter	Diagnosis/Monitoring filter selection
Frequency response	Diagnosis: 0.05 to 115 Hz (>–3 dB)
	Monitoring: 0.4 to 25 Hz (>–3 dB)
Heart rate counting range	12 to 300 bpm
Measuring accuracy	± 2 bpm
Alarm limits	Upper: 20 to 300 bpm, in 5 bpm steps
	Lower: 15 to 295 bpm, in 5 bpm steps

SpO_2 Measurement

BSM-1101:

Measuring range	50% to 100%, in 1% steps
Measuring accuracy	± 2 digits ($80 \leq SpO_2 \leq 100$)
	± 3 digits ($50 \leq SpO_2 < 80$)
Alarm limits	Upper: 51 to 100%, in 1% steps
	Lower: 50 to 99%, in 1% steps

BSM-1102:

Measuring range	1% to 100%

Alarm limits	Upper:	51 to 100%, in 1% steps
	Lower:	50 to 99%, in 1% steps
Measuring range:	SpO_2:	1 to 100%, in 1% steps
	Pulse rate:	20 to 250 bpm
Measuring accuracy:	70 to 100%:	D-25/D-25L: ±2 digits
		DS-100A: ±3 digits
		N-25: ±2 digits
		D-YS: ±3 digits
		I-20: ±2 digits
		D-20: ±2 digits
		OXICLIQ I: ±2.5 digits
		OXICLIQ P: ±2.5 digits
		OXICLIQ A: ±2.5 digits
		OXICLIQ N: ±2.5 digits
		RS-10: ±3.5 digits
		D-YSE: ±3.5 digits
		D-YSPD: ±3.5 digits
		OXIBAND A/N: ±3 digits
		OXIBAND P/I: ±3 digits
		OXI1-2-3 A/N: ±2.5 digits
		OXI1-2-3 P/I: ±2.5 digits
	80 to 100%:	R-15: ±3.5 digits
Alarm limits:	Upper:	51 to 100%
	Lower:	50 to 99%

Non-invasive Blood Pressure Measurement

Measuring method	Oscillometric	
Display value	Systolic, diastolic, and mean pressures	
Pressure display range	0 to 300 mmHg	
Accuracy	± 3 mm Hg (< 200 mmHg)	
	± 4 mm Hg (≥200 mmHg)	
Measuring range	Adults/children	
	Systolic:	50 to 260 mmHg
	Mean:	40 to 240 mmHg
	Diastolic:	30 to 220 mmHg
	Neonates	
	Systolic:	40 to 120 mmHg
	Mean:	30 to 100 mmHg
	Diastolic:	20 to 90 mmHg
Measurement modes	Manual	
	Continuous:	15 min
	Automatic:	2, 2.5, 5, 10, 15, 30, 6 min interval, OFF
Safety	Cuff pressure limiter:	> 300 mmHg (adults/children)
		>150 mmHg (neonates)
	Cuff inflation time limiter:	>161 s (adults/children)
		>81 s (neonates)
	Rapid deflation in case of power failure	
Alarm limits	Upper:	15 to 260 mmHg, in 5 mmHg steps
	Lower:	10 to 255 mmHg, in 5 mmHg steps

Vital Signs List

Parameters	Heart rate, pulse rate NIBP (systolic, diastolic, mean) and SpO_2
Total number of measurement times in list	120 for periodic vital signs list 120 for NIBP list

External Output

ZB-800PA interface
ZB-800PG interface
ZB-800PK interface

Recorder WS-120P (option)

Paper speed	12.5 mm/s, 25 mm/s
Recording mode	Waveform recording, trend recording, list recording
Number of channels	2 max
Annotation printing	Date and time, reason for recording, parameter data, ECG lead, filter on/off, sensitivity, recording speed
Effective printing width	48 mm

Battery

Type of battery:	NKB-101, NiCd, 1.7 AH
Operation time:	Approx. 2 hours (no recording, no alarm occurrence, no NIBP measurement and the POWER SAVE MODE set to on) with fully charged new battery
Charging mode:	Standard and trickle charging mode, automatic selection
Battery life:	Approx. 200 charge/discharge cycles

Transmitter ZB-800PG/PK (optional)

Transmission frequency	CH1001 to 1080:	420.0500 to 421.0375 MHz, 12.5 kHz steps
	CH2001 to 2120:	424.4875 to 425.9750 MHz, 12.5 kHz steps
	CH3001 to 3040:	429.2500 to 429.7375 MHz, 12.5 kHz steps
	CH4001 to 4080:	440.5625 to 441.5500 MHz, 12.5 kHz steps
	CH5001 to 5080:	444.5125 to 445.5000 MHz, 12.5 kHz steps
	CH6001 to 6080:	448.6750 to 449.6625 MHz, 12.5 kHz steps
	CH8001 to 8009:	450.930 to 451.090 MHz, 20 kHz steps
	CH8011 to 8020:	439.700 to 439.925 MHz, 25 kHz steps
	CH8021 to 8024:	457.525 to 457.600 MHz, 25 kHz steps
	CH8025 to 8032:	467.750 to 467.925 MHz, 25 kHz steps
	CH8037 to 8046:	448.000 to 448.275 MHz, 25 kHz steps
	CH8047 to 8069:	458.5125 to 458.7875 MHz, 12.5 kHz steps
	CH8070 to 8136:	433.100 to 434.750 MHz, 25 kHz steps
	CHA000 to C0FF:	420.000 to 472.79375 MHz, 6.25 kHz steps
Transmission power	0.4 mW	
Modulation method	FSK (Frequency-Shift-Keying)	
Bandwidth	8.5 kHz max.	
Frequency deviation	±1.75 kHz	

Transmitter ZB-800PA (optional)

Transmission frequency	CH7001 to 7997:	457.5125 to 469.9625 MHz, 12.5 kHz steps
Transmission power	0.4 mW	
Modulation method	FSK (Frequency-Shift-Keying)	

Bandwidth	8.5 kHz max.
Frequency deviation	±1.75 kHz

Power Requirements

Line voltage	BSM-1101/1102J: 100 to 127 V±10% AC, 50/60 Hz
	BSM-1101/1102K: 220 to 240 V±10% AC, 50/60 Hz
	BSM-1102: 117 V±10% AC, 60 Hz
Power consumption	AC operation: 70 VA
	Battery operation: 40 W

Environment

Operating temperature	10 to 40°C (50 to 104°F)
Storage temperature	–20 to 60°C (–4 to 140° F)
Operating humidity	30 to 90% RH, non-condensing
Storage humidity	15 to 90% RH
Operating atmospheric pressure	68 to 106 kPa
Storage atmospheric pressure	68 to 106 kPa

Dimensions and Weight

Dimensions	180 W × 206 H × 197 D mm
Weight	3.5 kg (excluding battery)

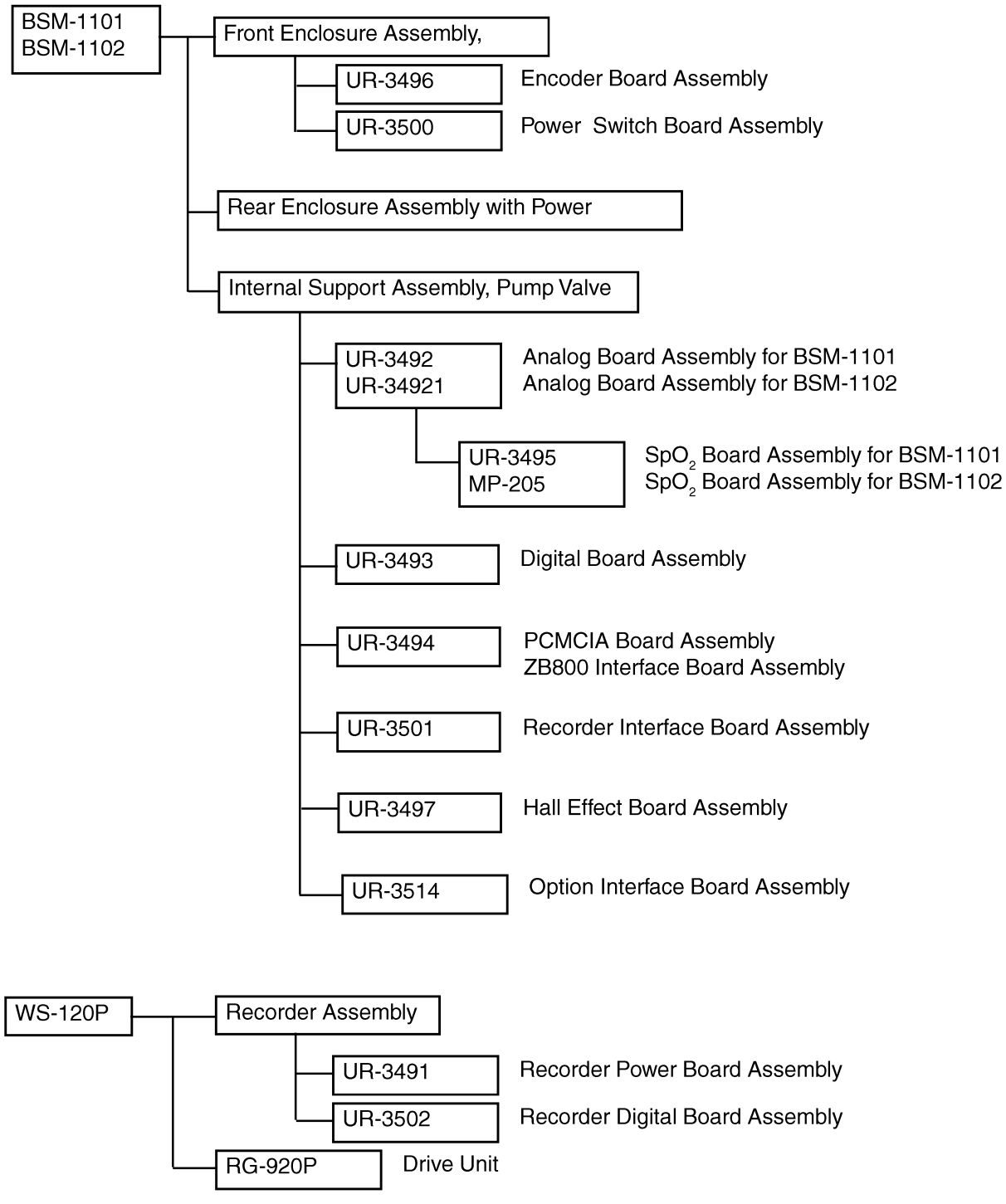
Safety Standards

Safety standard	IEC 60601-1 (1988) - Collateral Standard Amendment 1 (1991-11), Amendment 2 (1995-03) IEC 60601-1-2 (1993-04) - Collateral Standard: Electromagnetic compatability IEC 60601-2-27 (1994-03) - Particular requirements for the safety of electrocardiographic monitoring equipment IEC 60601-2-30 (1995-03) - Particular requirements for the safety of automatic cycling in direct blood pressure monitoring equipment
According to the type of protection against electrical shock	AC power: CLASS I EQUIPMENT Battery power: INTERNALLY POWERED EQUIPMENT
According to the degree of protection against electrical shock	DEFIBRILLATION-PROOF TYPE CF APPLIED PART (ECG) DEFIBRILLATION-PROOF TYPE BF APPLIED PART (NIBP) TYPE BF APPLIED PART (SpO_2)
According to the degree of protection against harmful ingress of water	Ordinary EQUIPMENT
According to the degree of safety of application in the presence of a FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:	EQUIPMENT not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE.
According to the mode of operation	CONTINUOUS OPERATION

Torque Specifications (N-m equivalents)

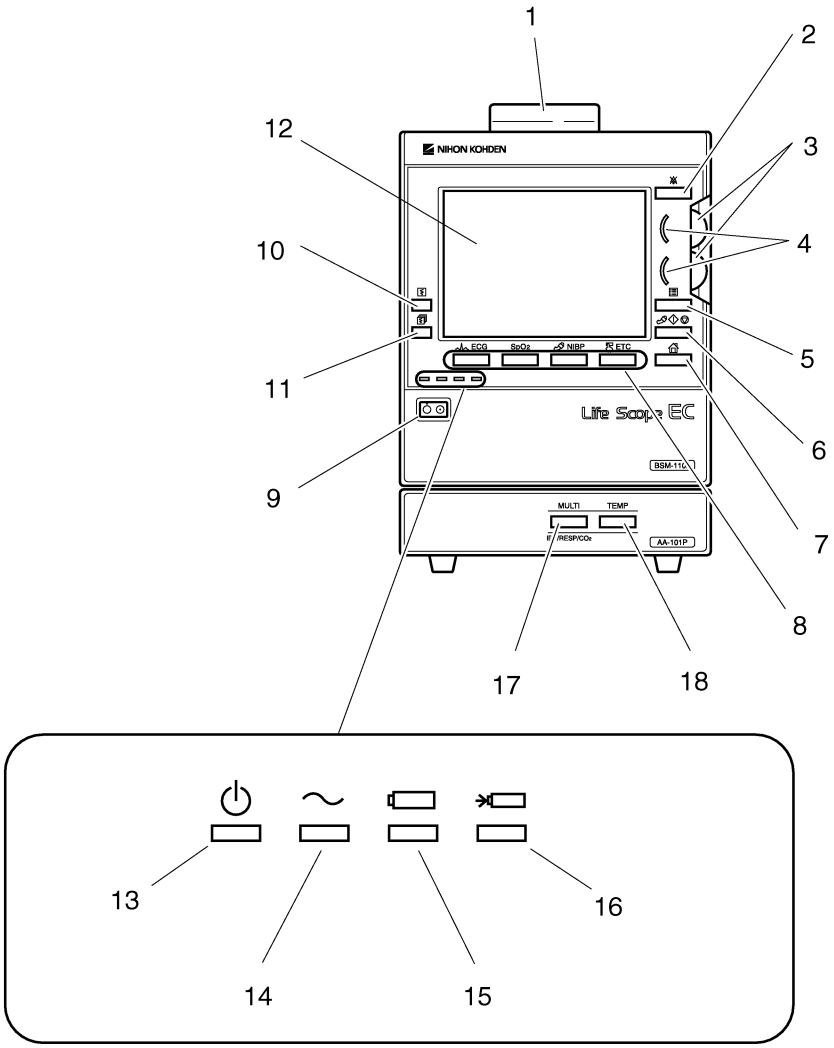
Handle Shoulder Screws	1 N•m
Bezel Bosses: Hand Tighten Max	0.3 N•m
Machine Screws into metal inserts	0.9 - 1.1 N•m
Self-tapping Screws into plastic	0.3 - 0.6 N•m
	* 1 N•m = approx. 10 kg•cm = approx. 8.68 lb•inch

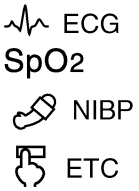
Composition



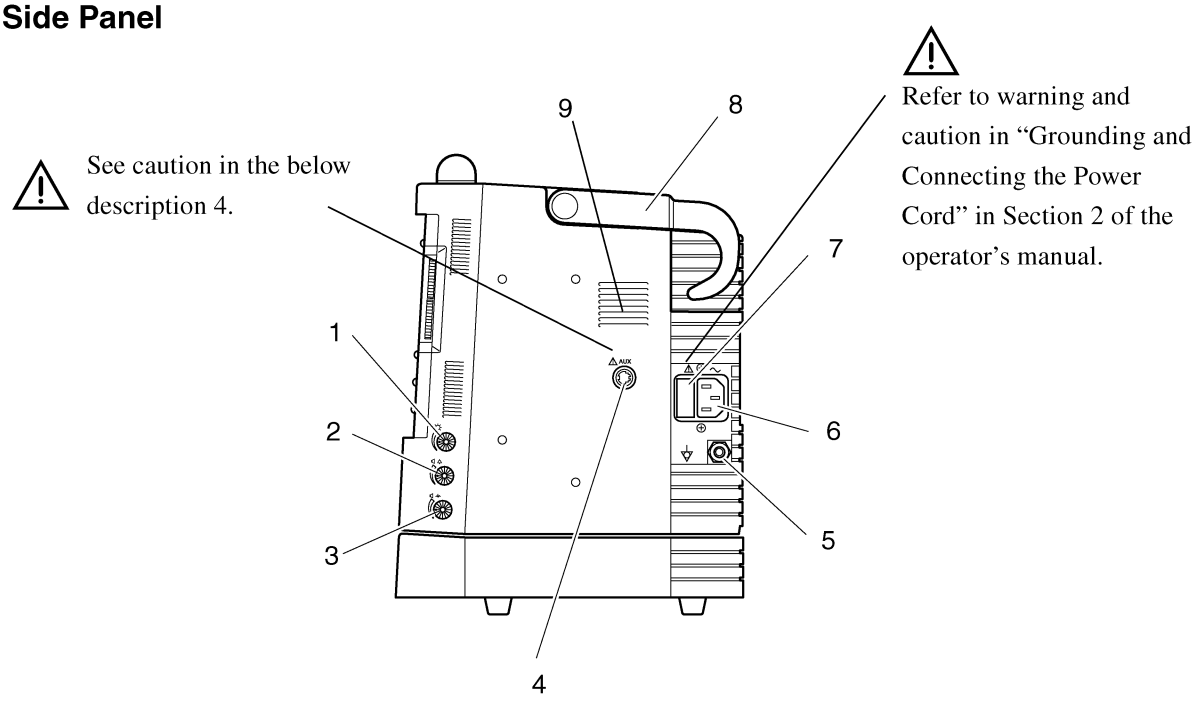
Panels and Controls

Front Panel



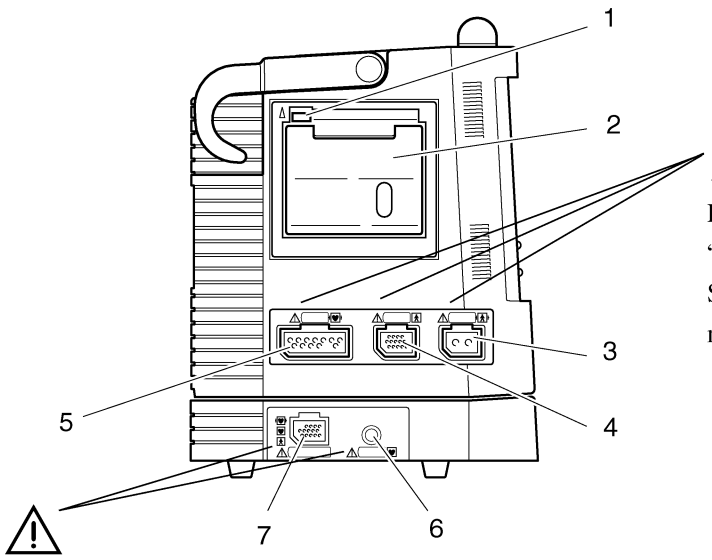
Name	Description
1. Alarm bar	Red or orange lamp blinks according to the alarm settings. Green lamp blinks in synchronization with the QRS.
2. Suspend key 	Press to temporarily suspend the alarm function alarm sound, alarm detection, alarm recording and screen messages.
3. Function Dial 1 and 2	Used for setting alarm limits and scrolling a list or trendgraph.
4. Function Dial lamp 1 and 2	Lights when the function dials are available.
5. Review key 	Press to display the List screen, Trend screen and Arrhythmia Recall screen.
6. NIBP start/stop key 	Starts or stops NIBP measurement.
7. Home key 	Press to display a monitoring screen.
8. ECG, SpO_2, NIBP and ETC hard/soft (function) keys 	When soft keys are displayed on the screen, these keys function as the displayed function keys. When soft keys are not displayed on the screen, these keys function as hard keys which call up the ECG, SpO_2, NIBP setting screens and ETC screen, respectively.
9. Power switch	Push to turn the monitor power on or off. When turning the power off, press and hold the switch for at least one second.
10. Record key 	Press to start or stop recording when using the optional recorder.
11. Record setup key 	Press to select a combination (pattern) of recording waveform(s) when using the optional recorder.
12. Display	5.5 inch color LCD.
13. AC power lamp	Lights when monitor power is on.
14. AC operation lamp	Lights when operating on AC power.
15. Battery operation lamp	Lights when operating on battery power.
16. Battery charging lamp	Lights or slowly blinks when charging.
17. MULTI key	Press to call up the setting screen of the parameter connected to the MULTI socket. (Refer to the Appendix.)
18. TEMP key	Press to call up the TEMP SETUP screen. (Refer to the Appendix.)

Right Side Panel



Name	Description
1. Brightness control	Turn clockwise to increase the screen brightness.
2. Alarm sound volume control	Turn clockwise to increase the alarm sound volume.
3. Synchronous sound volume control	Turn clockwise to increase the synchronous sound volume.
4. AUX socket	For the ZB-800PG/PK transmitter. **CAUTION** **Connect only the ZB-800PA/PG/PK transmitter to the connector marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.**
5. Equipotential grounding terminal	For an equipotential grounding lead.
6. AC SOURCE power cord socket	For the AC power cord.
7. Fuse holders	For two fuses: T2A/250 V.
8. Hook handle	Use to carry the monitor or hook it onto a bedside rail.
9. Speaker	For alarm and QRS synchronous sounds.

Left Side Panel

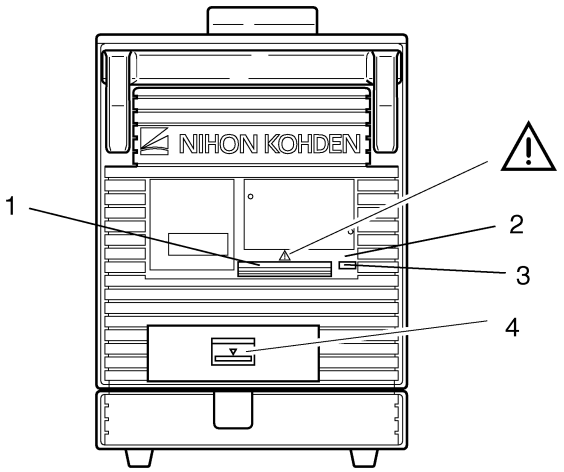


Refer to warning and caution in "General Safety Information" in Section 1 of the operator's manual.

Refer to warning and caution in "General Safety Information" in Section 1 of the operator's manual.

Name	Description
1. Paper magazine release lever	Push to open the paper magazine.
2. Recorder (option)	2-channel thermal array recorder.
3. Cuff socket	Connects to the NIBP air hoses.
4. SpO_2 socket	Connects to the SpO_2 connection cord.
5. ECG socket	Connects to the ECG connection cord for measuring ECG.
6. Temp socket	Connects to the temperature probe cable. (Refer to the Appendix.)
7. MULTI socket	Connects to the parameter to be measured from invasive blood pressure, respiration or CO_2. (Refer to the Appendix.)

Rear Panel



Name	Description
1. PC card slot	For a QI-101P network card. **CAUTION** • **Use only the Nihon Kohden card.** • **Do not press the PC card eject button while the PC card lamp is lit. This may damage the PC card and monitor.**
2. PC card lamp	Lights while data is read from or written to the PC card.
3. PC card eject button	Press to eject the PC card.
4. Battery pack holder	Remove the cover and insert the battery pack.

Storage and Transport

Follow these procedures when storing or transporting the instrument.

Storage

Before storing the instrument for a long time, perform the following steps:

1. Disconnect the power cord from the instrument.
2. Remove the battery from the instrument.
3. Cover the instrument with a dust cover.
4. If possible, store the instrument in its original shipping container.
5. Make sure the storage place meets the following storage conditions for the duration of the storage:
   Storage temperature –20 to 60°C (–4 to 130°F)
   Storage humidity 15 to 90% RH, non-condensing

Transport

To transport the instrument, perform the following steps:

1. Disconnect the power cord from the instrument.
2. Remove the battery from the instrument.
3. Cover the instrument with a dust cover.
4. If possible, transport the instrument in its original shipping container.

Hard Keys and Soft Keys

The four keys on the front panel below the screen function as either hard keys or soft keys, depending on the screen display.

When the normal monitoring screen is displayed, the four keys function as the ECG, SpO_2, NIBP, and ETC hard keys, and call up the ECG, SpO_2, NIBP, and ETC screens, respectively.

When any screen other than the normal monitoring screen appears, a soft key display appears at the bottom of the screen and the four keys correspond to the soft key functions. For example, when the ECG key is pressed at the normal monitoring screen, the ECG setting screen displays and the ECG key function changes to LEAD NAME (ECG waveform lead selector soft key).

In this manual, soft keys are indicated by brackets (for example, the [LEAD NAME] key).

Upgrading System Software/Changing Language on Screen

CAUTION

Upgrading the system software and changing the language on screen erases all system and individual bed settings. Write down these settings so they can be re-entered after the software upgrade.

The instrument uses a program card for upgrading its system software and changing a language on screen. When the instrument detects that a program card is inserted into its memory card slot during the booting stage after it is turned on, it checks the program card for a system program or language. If the program card contains a newer version of the system program or language, the instrument automatically replaces its current system program or language information with the new one. If the program card contains a system program whose version number is the same or older than the one in the instrument, however, a replacement confirmation message appears on the screen. If the program card does not contain a system program, the instrument continues the boot-up process.

In the system software upgrading or language changing process, the instrument first deletes the old system software or language stored in its system ROM. Then it checks whether the data in the system ROM is completely deleted. When the data is completely deleted, it copies the new version of the system program or language information from the program card to the system ROM and then checks the copy process. After the data is successfully copied, it performs the self-check programs to check the instrument.

How to Upgrade the Instrument System Software and Change a Language on Screen

1. Write down the system settings and individual bed settings of the instrument.
2. Insert the program card into the PC card slot of the instrument.
3. Turn on the instrument. The instrument performs the upgrading process and self-check programs. The Diagnostic Check and System Setup screen appears.
4. Confirm that the new system software version number appears.

Section 2 Troubleshooting

General Information

Use this section to locate, identify, and solve an instrument problem. The troubleshooting tables in this section are divided into 8 general problem areas:

- Power-related
- Display
- Sound
- Key operation
- Recording
- ECG
- SpO_2
- NIBP

How to Troubleshoot

1. Determine which troubleshooting table to use.
2. In the “Problem” column, find the item that matches the problem.
3. Do the action recommended in the “Action” column.
4. If the problem is not solved, do the action for the next possible cause or criteria.
5. If none of the actions solve the problem, contact your nearest Nihon Kohden Corporation dealer.

NOTE

Before contacting Nihon Kohden Corporation or your distributor for technical support, please complete a copy of the Maintenance Check Sheet (the original is provided at the end of Section 6, “Maintenance,” of this manual), and if possible, provide additional detailed information on the problem. Send the completed copy of the Maintenance Check Sheet to Nihon Kohden Corporation or your distributor. This helps Nihon Kohden Corporation or your distributor provide you with the best support.

Power-Related Problems

Problem	Possible Cause/Criteria	Action
No beep sound and the AC power lamp does not light in AC power.	1. No AC power input. 2. One or both of the AC inlet fuses is blown. 3. Faulty connection to J007 on the Analog borad. 4. Faulty connection to J010 on the Digital board.	1. Check the AC power input. 2. Determine and correct the cause of the blown fuse, then replace the fuse. 3. Check the connection. 4. Check the connection.
No beep sound and the battery power lamp does not light in DC power operation.	1. The battery is discharged. 2. The battery is damaged. 3. Faulty connection to J020 on the Analog board. 4. Faulty connection to J010 on the Digital board.	1. Charge the battery before using. 2. Replace the battery. 3. Check the connection. 4. Check the connection.
No beep sound and the AC power lamp and battery power lamp do not light.	1. The fuse on the instrument is blown. 2. Faulty power supply unit. 3. Faulty Power Switch board.	1. Determine and correct the cause of the blown fuse, then replace the fuse. 2. Replace the power supply unit. 3. Replace the Power Switch board.
DC power operation time is shorter than expected.	1. The battery is near the end its life (about 1 year). 2. Poor contact between the battery and its contact points in the battery compartment. 3. The battery is experiencing “memory effect” in which its charge capacity is diminished by frequent incomplete charging.	1. Replace the battery. 2. Clean the contact points between the battery and its compartment terminals. 3. To clear this “memory effect”, fully discharge and then fully charge the battery a few times or replace the battery.

Display Problems

Problem	Possible Cause/Criteria	Action
No display and the backlight does not light up.	1. Faulty connection between J312 on the Power Switch board and J212 on the Encoder board or faulty connection between CN1 on the LCD unit and J013 on the Digital board. 2. Faulty LCD unit.	1. Check the connection. 2. Replace the LCD unit.
No display, but the backlight lights and the NIBP START/STOP key is operational.	1. Faulty connection between CN1 on the LCD unit and J013 on the Digital board. 2. Faulty LCD unit. 3. Faulty Digital board.	1. Check the connection. 2. Replace the LCD unit. 3. Replace the Digital board.
No display, the backlight lights, and the NIBP START/STOP key is not operational.	Faulty Digital board.	Replace the Digital board.
Fine vertical or horizontal lines on the LCD.	Faulty LCD unit.	Replace the LCD unit.
Some randomly scattered pixels on the LCD do not light. Up to 6 pixels not lighting when brightness is set to maximum is considered normal.*	Faulty LCD unit if the number of pixels that do not light when the brightness is set to maximum is more than 6.	Replace the LCD unit.
Some randomly scattered pixels on the LCD have abnormal color. Up to 6 with abnormal color when brightness is set to maximum is considered normal.*	Faulty LCD unit if the number of pixels that have abnormal color when the brightness is set to maximum is more than 6.	Replace the LCD unit.
The characters are garbled or waveforms are distorted.	Faulty Digital board.	Replace the Digital board.
The display is dim and turning the brightness control knob does not make it brighter.	1. Faulty connection between Encoder board and Digital board. 2. The display is dimmer during DC operation than during AC operation. 3. The backlight unit is near the end of its useful life (10,000 hours of continuous operation). 4. Faulty Digital board.	1. Check the connection. 2. Use AC power for a brighter display. 3. Replace the LCD unit. 4. Replace the Digital board.
The instrument repeatedly displays the system error messages and resets itself.	Faulty Digital board.	Replace the Digital board.
No waveform is displayed.	1. Faulty connection between J009 on the Analog board and J109 on the Digital board. 2. Faulty Analog board. 3. Faulty Digital board.	1. Check the connection. 2. Replace the Analog board. 3. Replace the Digital board.
Waveforms of some parameters are not displayed.	1. Faulty sensor or input cable/electrode cable for that parameter. 2. Faulty connection between J009 on the Analog board and J109 on the Digital board. 3. Faulty Analog board or SpO_2 board. 4. Faulty Digital board.	1. Check and, if necessary, replace the sensor or cable/electrode cable for that parameter. 2. Check the connection. 3. Replace the Analog board and/or SpO_2 board. 4. Replace the Digital board.

* For TFT LCD screen, it is considered normal if some pixels have abnormal color or do not light.

Sound Problems

Problem	Possible Cause/Criteria	Action
No sound.	1. Faulty connection between J014 on the Digital board and J114 on the speaker. 2. Faulty speaker. 3. Faulty Digital board.	1. Check the connection. 2. Replace the speaker. 3. Replace the Digital board.
No sound, except for a hissing sound.	Faulty connection between J014 on the Digital board and J114 on the speaker.	Check the connection.
The sound is muffled.	1. The speaker on the right side of the instrument is blocked. 2. The volume control is not turned up all the way.	1. Remove the object blocking the speaker. 2. Adjust the volume.
The alarm sound volume control **and/or** synchronous sound volume control are not operational.	1. Faulty Digital board. 2. Faulty Encoder board.	1. Replace the Digital board. 2. Replace the Encoder board.

Key Operation Problems

Problem	Possible Cause/Criteria	Action
No keys, except the Power switch, are operational.	1. Faulty connection between the key panel and J017 on the Digital board. 2. Faulty Digital board. 3. Faulty membrane switch assembly.	1. Check the connection. 2. Replace the Digital board. 3. Replace the membrane assembly.
Some keys are not operational (excluding keys on the connector panel and Power switch).	1. Faulty membrane switch assembly. 2. Faulty Digital board.	1. Replace the membrane switch assembly. 2. Replace the Digital board.
Power switch is not operational.	1. Faulty Power Switch board. 2. Faulty Digital board.	1. Replace the Power Switch board. 2. Replace the Digital board.
Function dials are not operational.	1. Faulty connection between the key panel and J018 on the Digital board. 2. Faulty Encoder board. 3. Faulty Digital board.	1. Check the connection. 2. Replace the Encoder board. 3. Replace the Digital board.

Recording Problems

Problem	Possible Cause/Criteria	Action
Missing dots in the recording.	1. Dirty thermal head. 2. Faulty thermal head.	1. Clean the thermal head. 2. Replace the thermal head.
Fixed lengthwise straight lines along the recording.	Faulty thermal head.	Replace the thermal head.
Paper does not feed properly, causing skewing.	1. Dirty gear. 2. Faulty gear. 3. Dirty platen roller. 4. Damaged platen roller. 5. If the recorder unit motor rotates at a constant speed, there is a faulty connection between: • the recorder unit and J615 on the Recorder Power board • J515 on the Recorder Power board and J415 on the Recorder Digital board • J315 on the Recorder Digital board and J215 on the Recorder Interface board • J115 on the Recorder Interface board and J015 on the Digital board	1. Clean the gear. 2. Replace the gear. 3. Clean the platen roller. 4. Replace the platen roller. 5. Check the connections.
Abnormally loud rotating sound of recorder unit motor.	Faulty platen roller or gear.	Replace the platen roller or the recorder unit.
No recording on the paper.	1. The heat-sensitive side of the recording paper is facing the wrong way. 2. Faulty thermal head. 3. Faulty recorder unit, Recorder Power board, Recorder Digital board, Recorder Interface board or Digital board. 4. Faulty +24 V output from J015 on the Digital board. 5. Faulty connection between: • the recorder unit and J615 on the Recorder Power board • J515 on the Recorder Power board and J415 on the Recorder Digital board • J315 on the Recorder Digital board and J215 on the Recorder Interface board • J115 on the Recorder Interface board and J015 on the Digital board	1. Make sure the side with the black detection mark faces up when inserting the paper. 2. Replace the thermal head. 3. Replace the recorder unit or faulty board. 4. Check the +24 V output and, if necessary, replace the Digital board. 5. Check the connections.

Problem	Possible Cause/Criteria	Action
Out of paper icon blinks when there is still paper in the paper tray and the paper does not feed during recording.	1. Dirty sensor. 2. Faulty connection to the sensor. 3. Faulty recorder unit, Recorder Power board, Recorder Digital board, Recorder Interface board or Digital board.	1. Clean the sensor. 2. Check the connection. 3. Replace the recorder unit or faulty board.
Paper does not feed automatically, but recording can be made when the recording paper is manually pulled out after the RECORD key is pressed.	Faulty recorder unit, Recorder Power board, Recorder Digital board, Recorder Interface board or Digital board.	Replace the recorder unit or faulty board.
Paper does not feed automatically, and recording cannot be made even when the recording paper is manually pulled out after the RECORD key is pressed.	Faulty +24 V output from the Digital board.	Replace the Digital board.
For page-dependent recording, such as trendgraph, the recording does not start at the top of the page.	1. The recommended recording paper is not being used. 2. Dirty sensor. 3. Incorrect adjustment of the mark detection. 4. Faulty recorder unit.	1. Use only the recommended paper. 2. Clean the sensor. 3. Adjust the mark detection. 4. Replace the recorder unit.

ECG Problems

Problem	Possible Cause/Criteria	Action
ECG baseline is out of its normal position.	1. If the baseline is not normal even when ECG is not input, the Analog board is faulty. 2. If the baseline does not change even when the ECG lead is changed, the Analog board is faulty.	1. Replace the Analog board. 2. Replace the Analog board.
AC noise-like interference on the waveform.	1. Poor electrode to skin contact or bad electrode position. 2. Faulty electrode leads or electrode cable. 3. Electrical interference emitting source, such as an electric blanket, near the instrument. 4. If the trouble persists when the ECG setup setting is set to monitoring mode, the Analog board is faulty. 5. If the trouble persists after the electrode leads are disconnected, the Analog board is faulty.	1. Refer to the Operator's Manual to correct this problem. 2. Replace the electrode leads or electrode cable. 3. If possible, place the patient and the instrument away from such source. 4. Replace the Analog board. 5. Replace the Analog board.
CHECK LEADS message appears and the recommendations in the Operator's Manual do not correct the problem.	If the message does not disappear when the electrode leads are short-circuited: 1. Faulty electrode leads or electrode cable. 2. Faulty ECG input connector on the connector panel. 3. Faulty connection between J009 on the Analog board and J109 on the Digital board. 4. Faulty Analog board. 5. Faulty Digital board.	1. Check and, if necessary, replace the electrode leads or electrode cable. 2. Replace the ECG input connector. 3. Check the connection. 4. Replace the Analog board. 5. Replace the Digital board.
PACING message appears and the recommendations in the Operator's Manual do not correct the problem.	1. Spike or narrow QRS complex on the ECG waveform. 2. If the message still appears when a normal ECG signal from the AX-800P Vital Sign Simulator is input, the Analog board is faulty.	1. Turn pacing mode off. 2. Replace the Analog board.

SpO_2 Problems

Problem	Possible Cause/Criteria	Action
PROBE OFF message is continuously displayed.	1. The SpO2 probe is not correctly attached to the patient. 2. The external light is too bright.	1. Refer to the Operator's Manual for the correct probe attachment procedure. 2. Cover the probe to reduce the effect of external light.
PROBE OFF message is continuously displayed, even when other SpO2 probes are used.	1. Faulty SpO2 probe. 2. Faulty SpO2 input connector on the connector panel. 3. Faulty connection between J009 on the Analog board and J109 on the Digital board. 4. Faulty connection between the SpO2 board and the Analog board. 5. Faulty SpO2 board. 6. Faulty Analog board. 7. Faulty Digital board.	1. Replace the SpO2 probe. 2. Replace the SpO2 input connector. 3. Check the connection. 4. Check the connection. 5. Replace the SpO2 board. 6. Replace the Analog board. 7. Replace the Digital board.
PULSE SEARCH message is continuously displayed.	1. The patient's pulse is too weak to be picked up by the SpO2 probe. 2. If the same message appears when other SpO2 probes are used, the SpO2 board is faulty.	1. Refer to the Operator's Manual to correct this problem. 2. Replace the SpO2 board.
INSERT CONNECTOR message is continuously displayed.	1. If this message appears immediately after the power is turned on, the SpO2 board is faulty. If this message is continuously displayed even when the SpO2 connector from the probe is inserted into the SpO2 input connector on the connector panel, then there is a: 2. Faulty SpO2 probe. 3. Faulty SpO2 input connector on the connector panel. 4. Faulty connection between J009 on the Analog board and J109 on the Digital board. 5. Faulty connection between the SpO2 board and the Analog board. 6. Faulty SpO2 board. 7. Faulty Analog board. 8. Faulty Digital board.	1. Replace the SpO2 board. 2. Replace the SpO2 probe. 3. Replace the SpO2 input connector. 4. Check the connection. 5. Check the connection. 6. Replace the SpO2 board. 7. Replace the Analog board. 8. Replace the Digital board.
SpO2 MODULE ERROR message appears. (BSM-1102 only)	SpO2 hardware malfunction.	Replace the SpO2 board.

Non-Invasive Blood Pressure Problems

Problem	Possible Cause/Criteria	Action
The measured NIBP value is suspicious.	1. Cuff is not properly wrapped around the patient's limb. 2. Cuff is wrong size. 3. Patient moves during measurement. 4. Accuracy of the Calibration (1) item of the NIBP self check is out of the specified range. 5. Air leak in the NIBP module.	1. Refer to the Operator's Manual to wrap the cuff correctly around the patient's limb. 2. Use the correct cuff size. Refer to the Operator's Manual to determine the correct cuff size for the patient. 3. Stop the patient from moving. 4. Replace the Analog board. 5. Check the internal air tube connections of the instrument and, if necessary, replace the air tubes or Analog board.
Cuff does not inflate and the error message does not appear.	1. Loose connection between hose and cuff or internal air tube. 2. Blocked connection between hose and cuff or internal air tube. 3. Hose, cuff, or internal air tube is punctured. If the pump motor rotates and the recorder unit is operational, there is a: 4. Faulty connection between J009 on the Analog board and J109 on the Digital board. 5. Faulty connection between J019 on the Analog board and J119 on the Digital board. 6. Faulty Analog board. 7. Faulty Digital board.	1. Check the connection. 2. Check the connection. 3. Replace the damaged part. 4. Check the connection. 5. Check the connection. 6. Replace the Analog board. 7. Replace the Digital board.
CHECK CUFF AND HOSE message during measurement.	If the other monitored parameters are normal: 1. Faulty connection between J009 on the Analog board and J109 on the Digital board. 2. Faulty connection between J019 on the Analog board and J119 on the Digital board. 3. Faulty Analog board. If the other monitored parameters are incorrect: 4. Faulty connection between J009 on the Analog board and J109 on the Digital board. 5. Faulty Digital board. 6. Faulty Analog board.	1. Check the connection. 2. Check the connection. 3. Replace the Analog board. 4. Check the connection. 5. Replace the Digital board. 6. Replace the Analog board.
NIBP AMP ERROR message during measurement.	The offset value of the NIBP item of the self check is out of the specified range.	Replace the Analog board.

Problem	Possible Cause/Criteria	Action
CHECK CUFF AND HOSE message during measurement.	1. Blocked connection between hose and cuff or internal air tube. 2. Accuracy of the Calibration (2) item of the NIBP self check is out of the specified range.	1. Check the connection. 2. Replace the Analog board.
CHECK CUFF AND HOSE message during measurement.	Accuracy of the Calibration (2) item of the NIBP self check is out of the specified range.	Replace the Analog board.
CHECK CUFF AND HOSE message during measurement.	If the results of the Deflation Speed and Step Deflation items of the NIBP self check are OK, the valve operation or the pump and valve driving circuit is faulty.	Replace the Analog board.
CHECK CUFF AND HOSE message during measurement.	If the results of the Inflation Speed item of the NIBP self check is ERROR: 1. Loose connection between hose and cuff or internal air tube. 2. Blocked connection between hose and cuff or internal air tube. 3. Hose, cuff or internal air tube is punctured. 4. If the pump motor rotates but the recorder unit is not operational, the +24 V supply from the power supply unit is faulty. If the pump motor rotates and the recorder unit is operational, there is a: 5. Faulty connection between J009 on the Analog board and J109 on the Digital board. 6. Faulty connection between J019 on the Analog board and J119 on the Digital board. 7. Faulty pump. 8. Faulty Analog board. 9. Faulty Digital board.	1. Check the connection. 2. Check the connection. 3. Replace the damaged part. 4. Replace the power supply unit. 5. Check the connection. 6. Check the connection. 7. Replace the pump. 8. Replace the Analog board. 9. Replace the Digital board.
CHECK CUFF AND HOSE message during measurement.	If the pressure displayed on the Calibration (1) screen of the NIBP self check is not stable after the instrument is inflated by an external pressure generator: 1. Loose connection between hose and cuff or internal air tube. 2. Blocked connection between hose and cuff or internal air tube. 3. Hose, cuff or internal air tube is punctured. 4. Faulty Analog board.	1. Check the connection. 2. Check the connection. 3. Replace the damaged part. 4. Replace the Analog board.

Problem	Possible Cause/Criteria	Action
Usually long zeroing period.	1. Sudden change in operating environment temperature can cause the sensor temperature to drift and the hose or air tubes to expand/contract. 2. If the instrument did not experience a sudden change in environment temperature, the power supply unit, Analog board or Digital board is faulty.	1. After a sudden change in temperature, wait about 30 minutes before using the instrument. 2. Replace the power supply unit or faulty board.
Usually long measurement period.	1. Patient moves during measurement. 2. Loose connection between hose and cuff or internal air tube. 3. Hose to cuff or internal air tube connection is blocked. 4. Hose, cuff or internal air tube is punctured. 5. Faulty Analog board.	1. Stop the patient from moving. 2. Check the connection. 3. Check the connection. 4. Replace the damaged part. 5. Replace the Analog board.

Signal Noise Problems

Electrical noise can resemble a problem caused by a faulty input circuit in a low-level signal measuring instrument. This noise can be caused by:

- Line frequency
- Power supply ripple/surge
- Electromagnetic interference
- High radio frequency emitter
- Static electricity
- Poor electrode-to-skin contact
- High skin-to-electrode impedance
- Bad electrode placement
- Patient conditions, such as anxiety and body movement

To suppress this noise, you need to identify its source and then take the necessary action, such as:

- Using a dedicated power supply line for the instrument
- Grounding the instrument
- Installing a surge protector
- Turning off or removing any high frequency or electromagnetic energy emitters around the instrument, such as televisions, mobile phones, and electronic games
- Making sure there is no loose or bad contact from the electrode to the input connector
- Decreasing the skin-to-electrode impedance
- Using correct electrode placement
- Establishing patient conditions that are favorable to measurement

Section 3 Self Check, Errors, System Set Up, Initialization and Diagnostics

Power On Self Check

Introduction

The instrument has an automatic power on self check as well as a complete set of diagnostic checks that you can perform at any time.

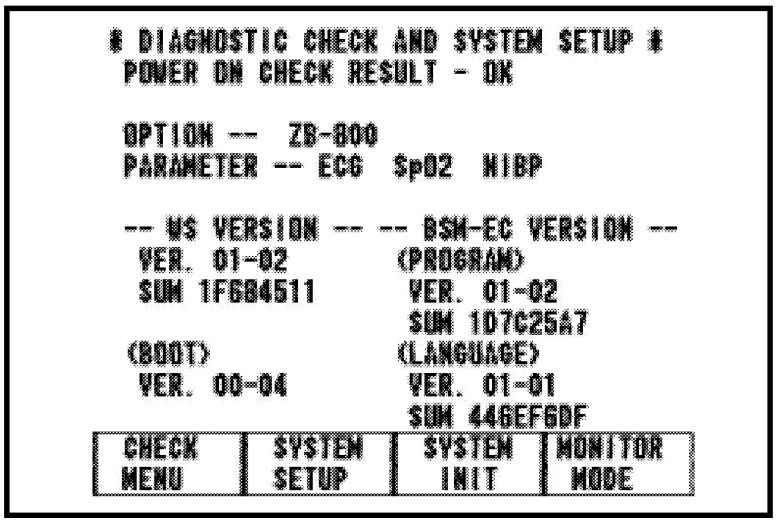
All errors detected during the power on self check, diagnostic checks, and any time during operation are stored in an error history table that you can view.

The diagnostic checks, error history, and system setup and initialization are accessed from the Diagnostic Check and System Setup screen.

Calling Up the Error History

Use this screen to view the error history or perform diagnostic or system setup and initialization.

1. With the power off, press the Power switch while pressing the SUSPEND key. Continue pressing the SUSPEND key until the Diagnostic Check and System Setup screen appears.



2. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

Power On Self Check

This self check is performed every time the Power switch is turned on. The CHECK PROGRAM RUNNING message appears during the power on self check. If no error is detected, the normal operating mode begins and the patient monitoring display appears. If an error is detected, the Diagnostic Check and System Setup screen appears.

The following items are checked during the power on self check:

System RAM. The memory in the RAM is checked by comparing the test patterns that are written on the RAM to the test patterns that were read out from it. If there is a difference, an error occurs and the screen display may be abnormal.

If an error message appears, the Digital board is faulty.

Boot ROM. The program stored in the boot ROM of the Digital board is checked by the check sum technique. This technique compares the sum value of the stored data with the exception of the value of the last address, with the prestored check sum at the last address. If the values are not the same, an error occurs and the screen display may be abnormal.

If an error message appears, the Digital board is faulty.

Program ROM. The program stored in the program ROM of the Digital board is checked by the check sum technique. This technique compares the sum value of the stored data with the exception of the value of the last address, with the prestored check sum at the last address. If the values are not the same, an error occurs and the recorder may not work.

If an error message appears, the Digital board is faulty.

Clock. The accuracy of the real-time clock of the Digital board is checked by comparing the time interval of the periodic interrupt to the value counted by the software counter. If the values are not the same, an error occurs and the date and time of the instrument return to their default values.

If an error message appears, the Digital board or PCMCIA board is faulty.

A/D–D/A. The accuracy and conversion speed of the A/D–D/A converter is checked and compared with their prestored values. If the values are not the same, an error occurs and the instrument may not output waveform signals.

If an error message appears, the Digital board is faulty.

EEPROM. The program stored in the EEPROM of the Digital board is checked by the check sum technique. This technique compares the sum value of the stored data with the exception of the value of the last address, with the prestored check sum at the last address. If the values are not the same, an error occurs and the instrument automatically performs system initialization.

If an error message appears, the Digital board is faulty.

Optional Interface. If installed, the optional interface is checked. If the optional interface is not installed, the optional interface default setting is used.

Backed Up Data. The parity of the backed up data is checked. If an error occurs, the backed up data is cleared and the default data is used.

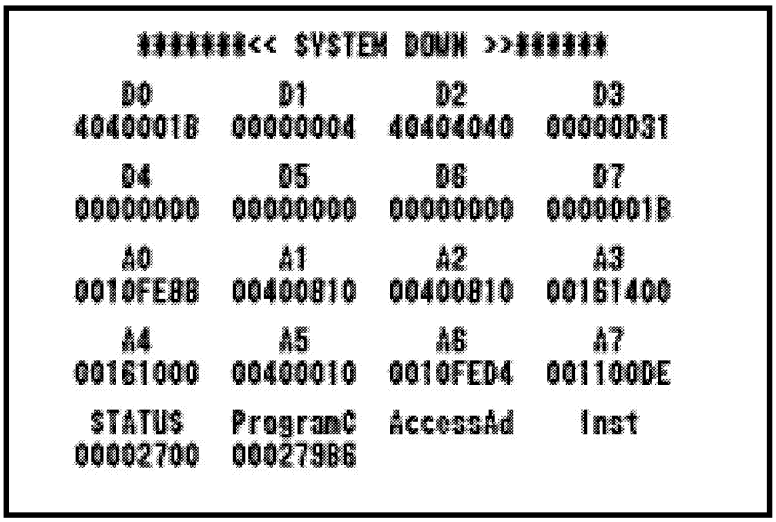
Version. The version of the instrument is checked. If an error occurs, system initialization is automatically performed.

Errors and Displaying the Error History

The instrument has a continuous self check function that detects errors causing faults during operation.

System Errors

A system error occurs when a fatal fault is detected in the CPU operation. If this happens, all operation of the instrument is halted and the system error messages appear. These error messages are not stored in the error history and cannot be used for troubleshooting.



Error Codes

When a fault is detected during operation or during the power on self check, the error is stored in the error history table. The error codes stored in the error history are only deleted when system initialization is performed. If the memory space for the error history is filled up, however, the oldest error code is deleted when a new error code is added.

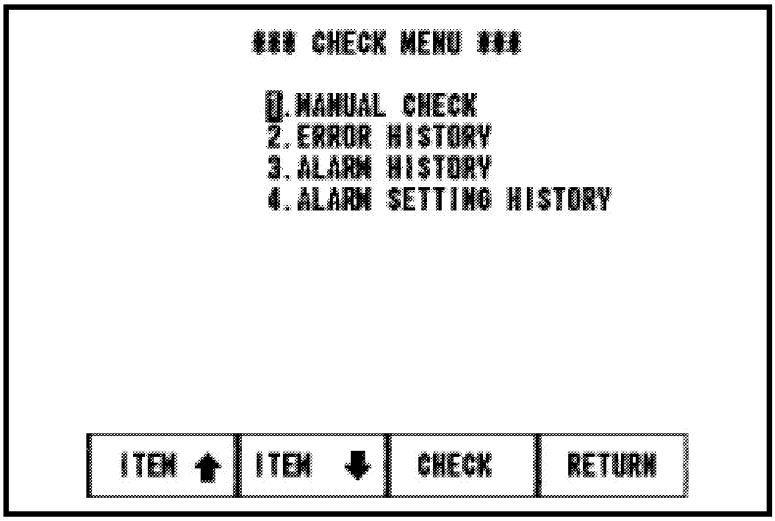
The message and description of each error code are described in the following table:

Error Code	Message	Description
110	WATCH DOG	Interrupt from the watch dog timer
210	BUS	Bus error occurred when empty address is selected
220	ADDRES	Address error when word accessing the odd address
230	ILLEGAL	Illegal command is executed
240	ZERO	Zero division error
250	CHK	Check command error occurring during check
260	TRAP	Trap command error
270	PRIVIEGE	Privilege error occurring
280	SPRIOUS	Undefined interrupt error
290	UNDEFIND	Not used
2A0	UNDEFIND	Not used
2B0	UNDEFIND	Not used
2C0	OTHER	Error from faults other than ones described above
310	OS	Error detected by the OS
410	CPU (ROM)	Error detected by CPU ROM check
411	WS (ROM)	Error detected by WS ROM check
420	CPU (RAM)	Error detected by CPU RAM check
430	A/D, D/A	Error detected by A/D and D/A check
470	CLOCK	Error detected by the real time clock
472	CLK DATA	Error detected by CLOCK DATA check
480	E2PROM	Error detected by EEPROM check
400	OTHER	Error from faults other than those described above

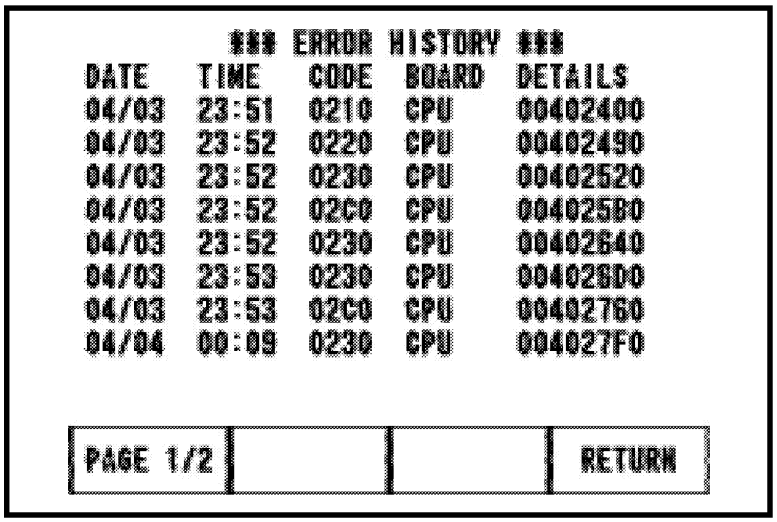
Calling Up the Error History

The Error History screen shows the error history of the instrument. The error code, board name, time, and date the error occurred are listed on this screen. For an explanation of error codes, see the previous section, “Error Codes.” The error history data is deleted whenever system initialization is performed.

1. From the Diagnostic Check and System Setup screen, press the [CHECK MENU] key. The Check Menu screen appears.



2. From the Check Menu screen, press the [ITEM ⬇] key to select Error History and press the [CHECK] key. The Error History screen appears.



3. To view other pages of the error history, press the [PAGE] key.

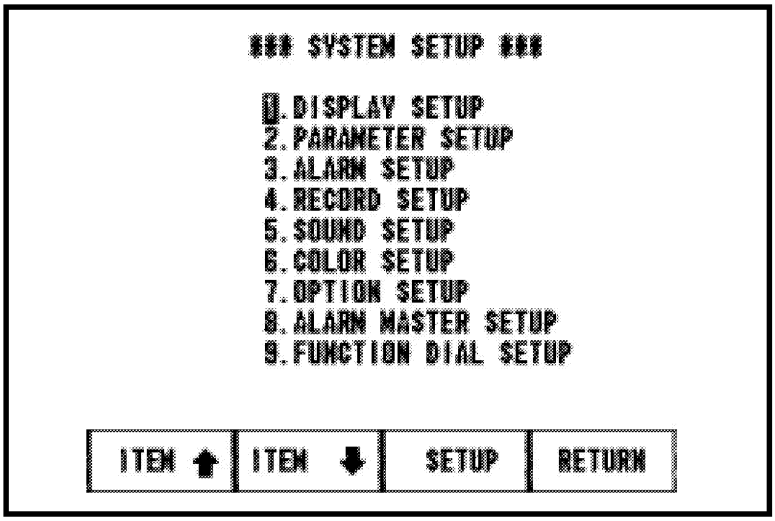
4. To return to the Check Menu screen, press the [RETURN] key.

5. To return to the Diagnostic Check and System Setup screen, press the [RETURN] key.

6. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

Changing System Settings

The following system settings can be changed. See the Operator's Manual for an explanation of each item.



1. From the Diagnostic Check and System Setup screen, press the [SYSTEM SETUP] key. The System Setup screen appears.

2. On the System Setup screen, press the [ITEM ⬆] or [ITEM ⬇] key to select an item.

3. Press the [SETUP] key to go to the setup screen for that item.

4. Rotate the lighted jog dial to change the setting for the selected item.

5. To return to the System Setup screen, press the [RETURN] key.

6. To return to the Diagnostic Check and System Setup screen, press the [RETURN] key.

7. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

Initializing the System

You can delete all stored waveforms and data and the error history and return all settings to the factory defaults.

CAUTION

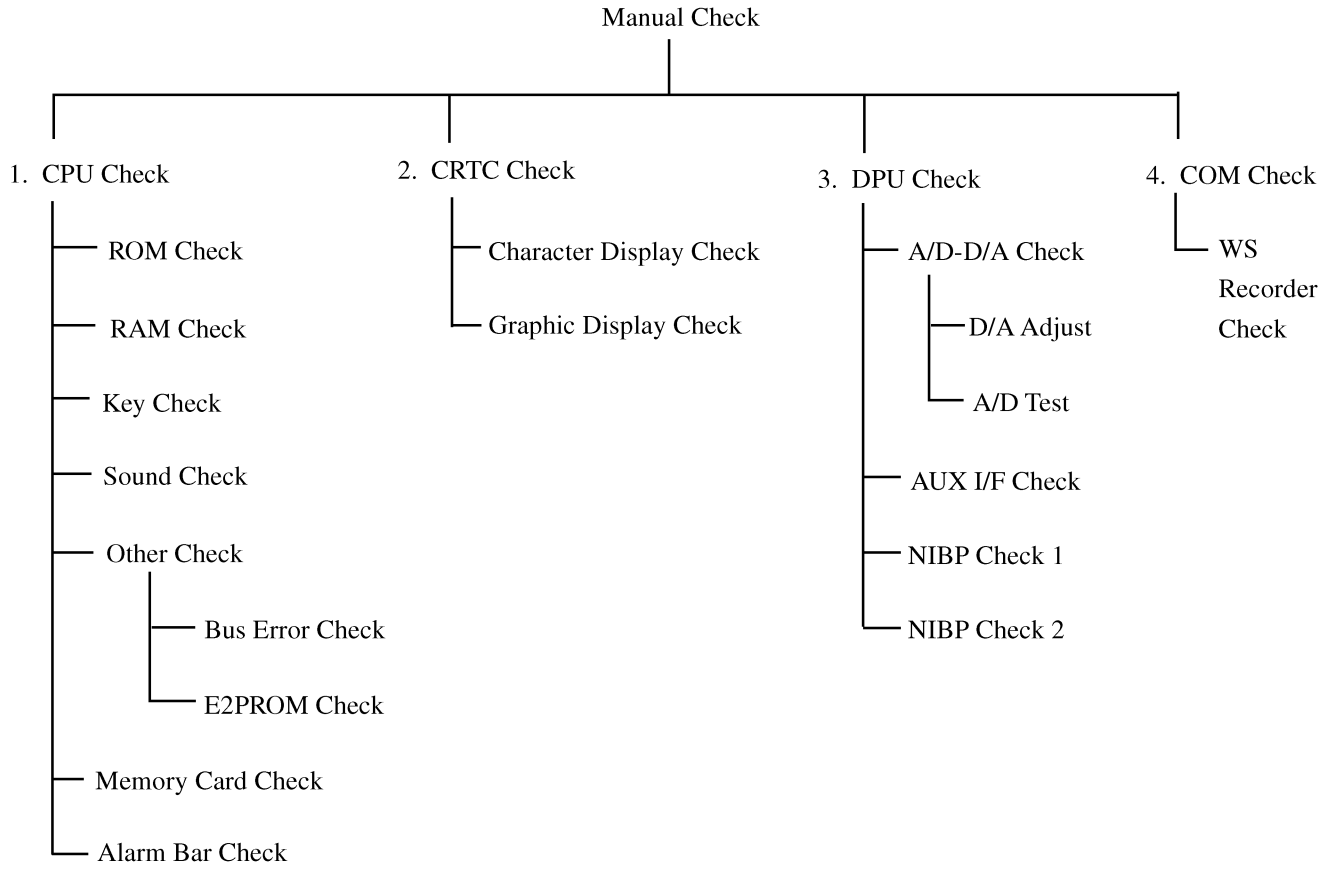
Initializing the system deletes all the patient data and error history, and returns the setting conditions to their default settings.

1. From the Diagnostic Check and System Setup screen, press the [SYSTEM INIT] key until a SYSTEM INITIALIZE confirmation message appears. All data and user settings are deleted.

2. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

Performing Diagnostic Checks

The following diagnostic checks are available. The available check items depend on the optional units installed in the instrument.

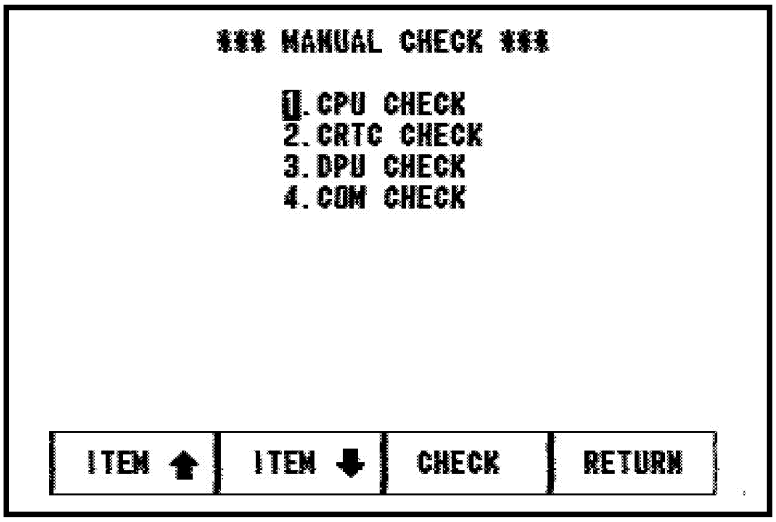


In most of these diagnostic checks, if an error is detected during the check, the operating system hangs. When the system hangs, switch off the main power supply and fix the faulty parts or units.

Calling Up the Check Menu Screen

1. From the Diagnostic Check and System Setup screen, press the [CHECK MENU] key. The Check Menu screen appears.

2. From the Check Menu screen, press the [CHECK] key. The Manual Check screen appears.



3. From the Manual Check screen, press the [ITEM ⬆] or [ITEM ⬇] key to select the check item.

4. Press the [CHECK] key to go to the check screen for that item.

5. To return to the Manual Check screen, press the [RETURN] key.

6. To return to the Check Menu screen, press the [RETURN] key.

7. To return to the Diagnostic Check and System Setup screen, press the [RETURN] key.

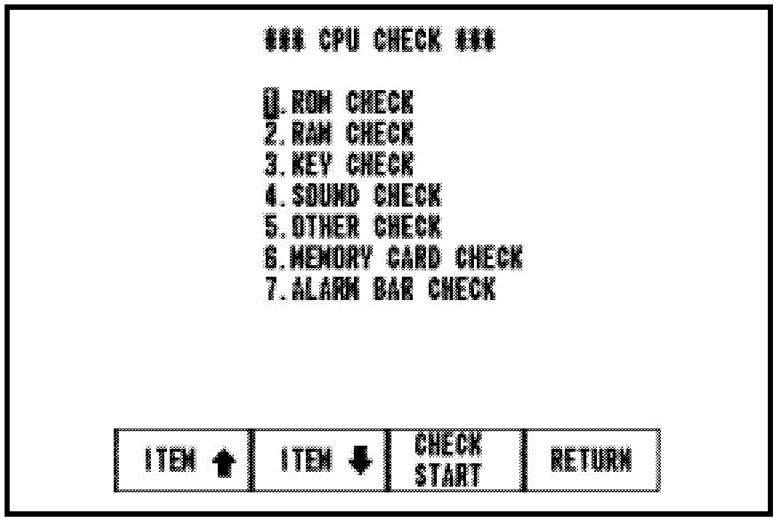
8. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

Procedure to Return to the Previous Screen
To return to the previous screen, press the [RETURN] key.

CPU Check Menu Items

The following CPU check menu items are explained in the following pages.

1. From the Manual Check screen, select CPU Check and press the [CHECK] key. The CPU Check screen appears.

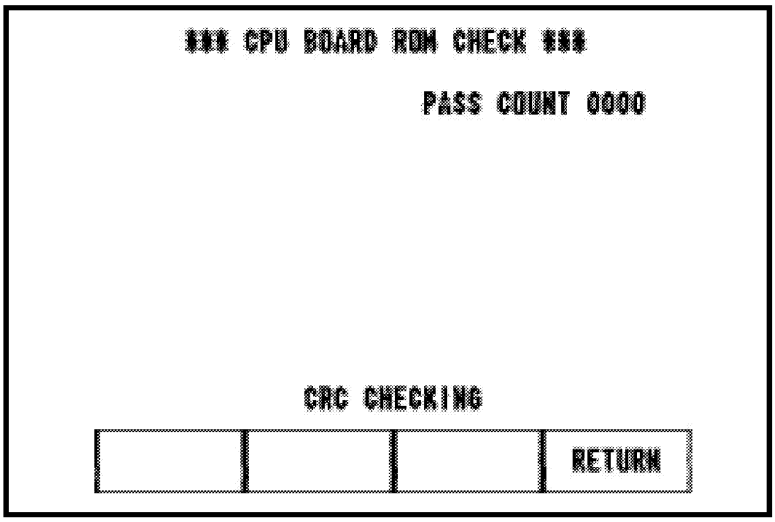


2. From the CPU Check screen, press the [ITEM ⬆] or [ITEM ⬇] key to select the check item.

3. Press the [CHECK START] key to start the selected check item. The selected check item screen appears. Some check items run automatically.

4. To return to the CPU Check screen, press the [RETURN] key.

ROM Check



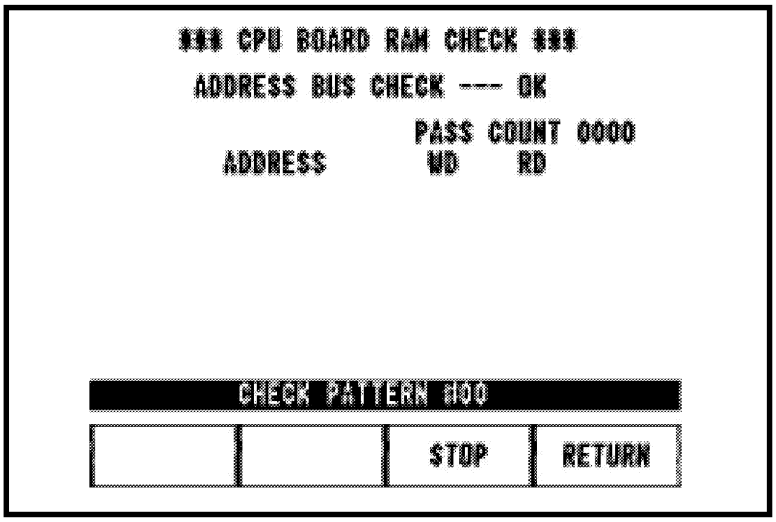
This item checks the ROMs on the Digital board by the cyclic-redundancy-check (CRC) technique. This check assigns a count number when one set of checks is successfully completed. A set of checks takes about 1 minute and 30 seconds.

If an error message appears, the Digital board might be faulty.

Procedure to Exit the ROM Check program

To return to the CPU Check screen, press the [RETURN] key.

RAM Check



This item checks the RAM on the Digital board by comparing the test patterns it first wrote on the RAM with the test patterns it later read from the RAM. This test uses 14 test patterns and assigns a count number when a comparison of the 14 test patterns is successfully completed. The comparison of all the test patterns in this check takes about 4 minutes and 10 seconds.

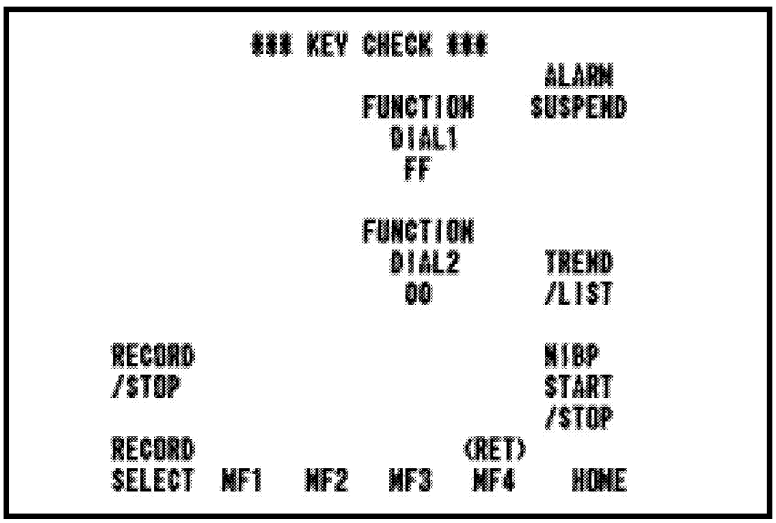
The patient data is destroyed. If an error message appears, the Digital board might be faulty.

Procedure to Restart, Stop, and Exit the RAM Check Program

1. To stop the check temporarily, press the [STOP] key. The [STOP] key name changes to [CONT]. To continue the check, press the [CONT] key.

2. To return to the CPU Check screen, press the [RETURN] key.

Key Check



This item checks the key operation and multifunction dials of the instrument. A diagram of the key location on the instrument appears. Pressing the key on the instrument or rotating the multifunction dials usually highlights the pressed key representation on the screen. The only exception to this case is the ETC key on the instrument. When this key is pressed, the Key Check screen disappears and the CPU Check screen appears.

If the pressed key is not highlighted, the key may be faulty. If more than one key has this symptom, however, the membrane switch assembly or Digital board might be faulty.

NOTE

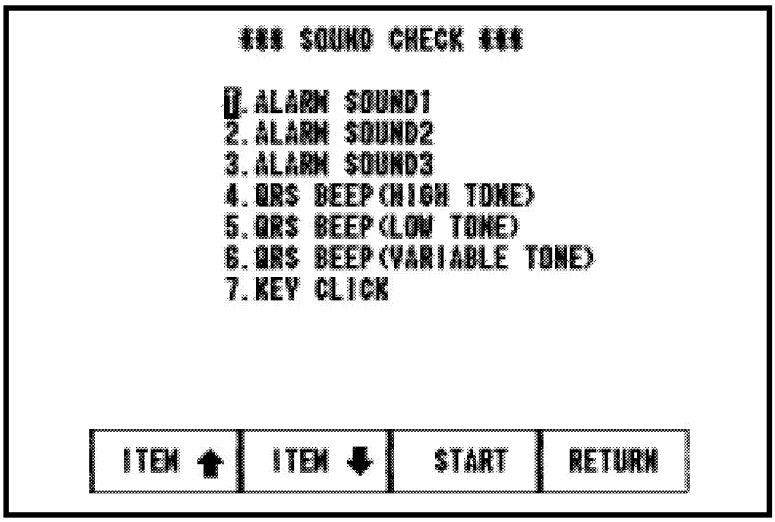
The key does not give a key click sound when it is pressed in this check.

Procedure to Check the Keys or to Exit the Key Check Program

1. To check the key, press the key and confirm that the corresponding pressed key is highlighted on the screen.

2. To return to the CPU Check screen, press the ETC key.

Sound Check



This item checks the 7 types of sounds generated by the instrument. This check also can be used to check the alarm circuit and the QRS beep circuit.

If there is no sound, the speaker or Digital board might be faulty.

Procedure to Check the Sound Circuit

1. Press the [ITEM ↑] or [ITEM ↓] key to select the sound.

2. Press the [START] key to generate the selected sound. The key name changes from [START] to [STOP].

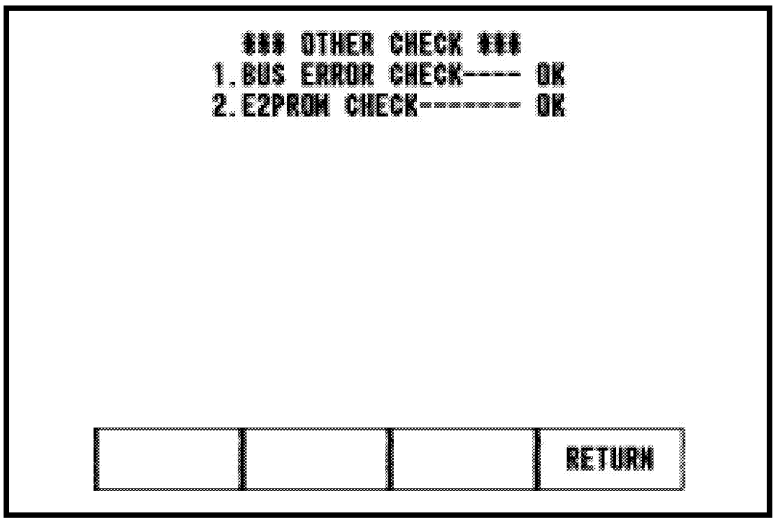
3. To check the alarm volume control circuit, select any alarm sound check and turn the alarm volume knob clockwise and counterclockwise.

4. To check the QRS beep tone volume control circuit, select any QRS beep check and turn the QRS beep tone volume knob clockwise and counterclockwise.

5. To stop the sound check, press the [STOP] key. The key name changes from [STOP] to [START]. To continue the sound check, press the [START] key.

6. To return to the CPU Check screen, press the [RETURN] key.

Other Check



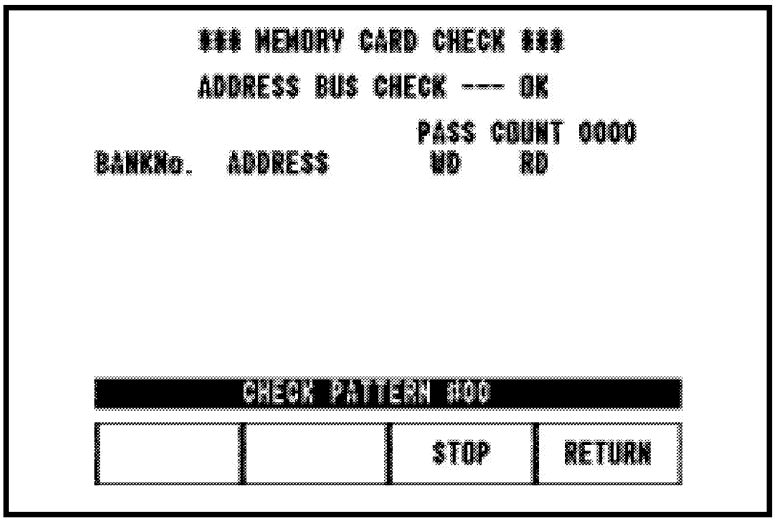
This item checks the system bus and system EEPROM. The system EEPROM contains the system setting data. This check has the same check program as the ROM check. The check program checks the system bus by accessing an address at which the memory area does not exist and detecting the bus error signal.

If an error message appears, the Digital board might be faulty.

Procedure to Exit the EEPROM Check Program

To return to the CPU Check screen, press the [RETURN] key.

Memory Card Check



This item checks the memory card inserted into the instrument by comparing the test patterns it first wrote on the RAM with the test patterns it later read from the RAM. This test uses 14 test patterns and assigns a count number when a comparison of the 14 test patterns was successfully completed. The comparison of all the test patterns in this check takes about 11 minutes and 15 seconds.

When this check displays an error, replace the memory card or the Digital board. If the memory card interface on the PCMCIA board is faulty, an error occurs during the software upgrading procedure.

If an error message appears, the memory card, the PCMCIA board, or the Digital board might be faulty.

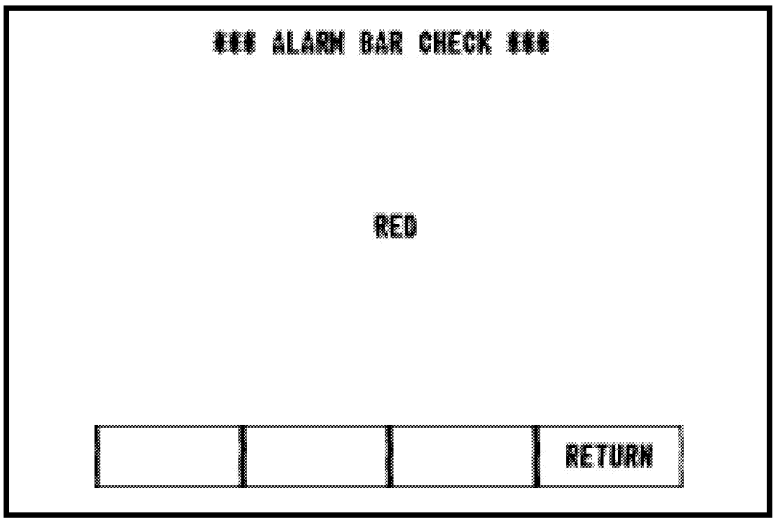
Procedure to Restart, Stop and Exit the Memory Card Check Program

1. To stop the check temporarily, press the [STOP] key. The [STOP] key name changes to [CONT]. To continue the check, press the [CONT] key.

2. To return to the CPU Check screen, press the [RETURN] key.

3. To return to the Manual Check screen, press the [RETURN] key.

Alarm Bar Check



This item checks the operation of the red, yellow, and green LEDs in the alarm bar. In this check program the red, yellow, and green lights are lit according to the color displayed on the screen.

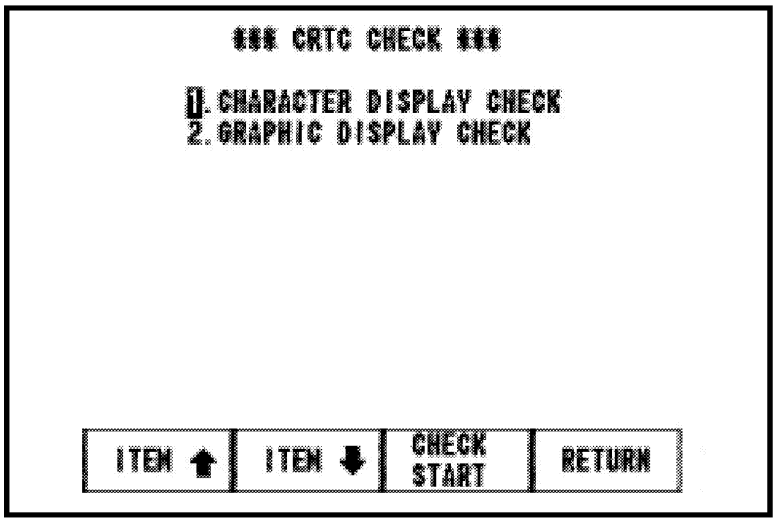
If the lights do not light according to the color displayed on the screen, or do not light up at all, the alarm bar, the Encoder board, or the Digital board might be faulty.

Procedure to Exit the Alarm Bar Check Program
To return to the CPU Check screen, press the [RETURN] key.

CRTC Check Menu Items

The following CRTC check menu items are explained in the following pages.

1. From the Manual Check screen, select CRTC Check and press the [CHECK] key. The CRTC Check screen appears.



2. From the CRTC Check screen, press the [ITEM ⬆] or [ITEM ⬇] key to select the check item.

3. Press the [CHECK START] key to start the selected check item. The selected check item screen appears. Some check items run automatically.

4. To return to the CRTC Check screen, press the ETC key.

5. To return to the Manual Check screen, press the [RETURN] key.

6. To return to the Check Menu screen, press the [RETURN] key.

7. To return to the Diagnostic Check and System Setup screen, press the [RETURN] key.

8. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

Character Display Check

This item checks the display format of the alphanumeric and domestic characters.

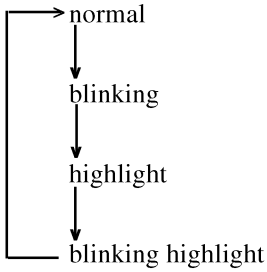
If the displayed alphanumeric character set is not readable, the Digital board or the LCD unit might be faulty.

Procedure to Check Character Display

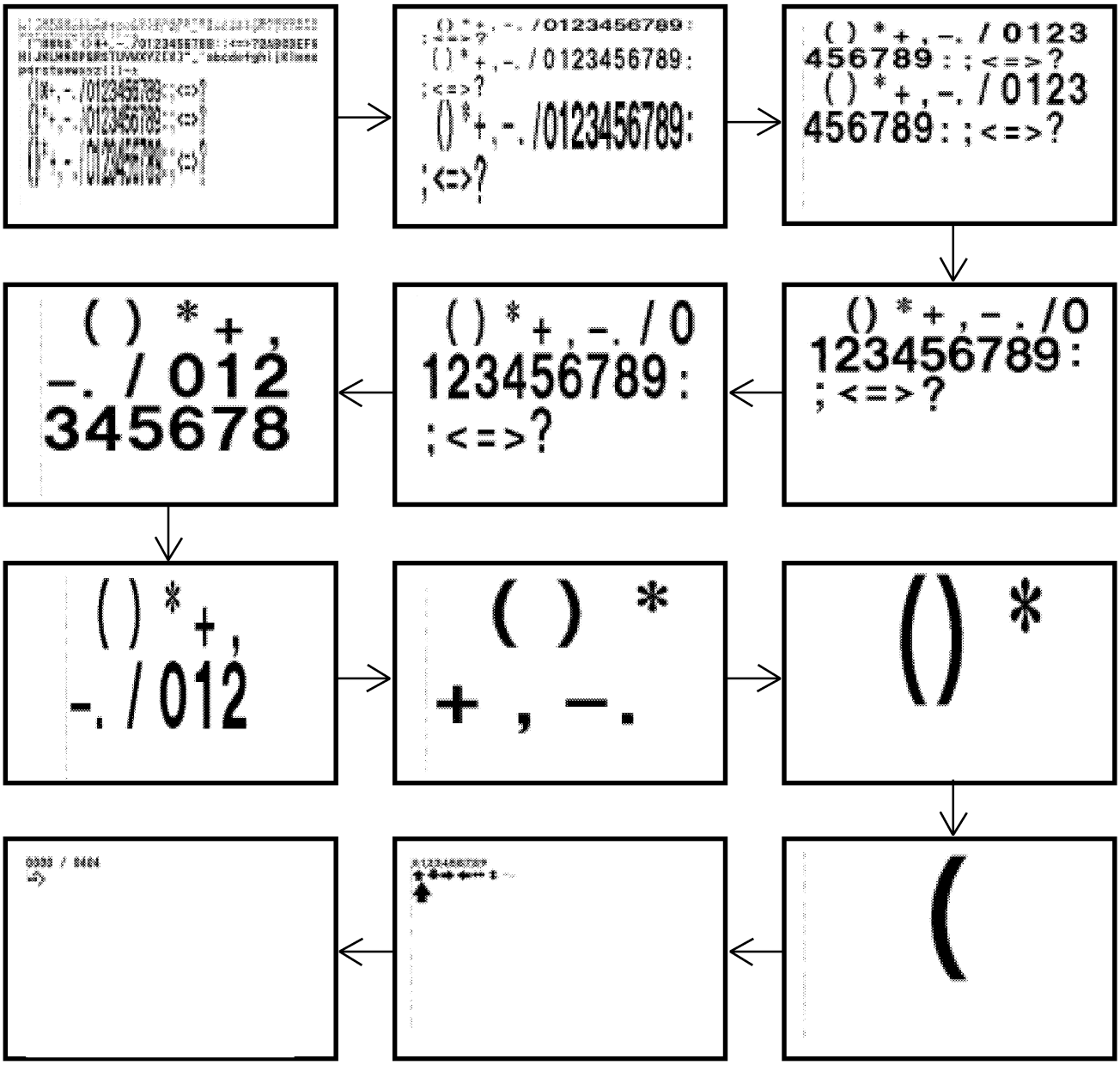
1. From the CRTC Check screen, select Character Display Check and press the [CHECK START] key. The Character Display Check screen appears.

2. From the Character Display Check screen, press the [ITEM ⬆] or [ITEM ⬇] key to select the check item.

3. Press the ECG key repeatedly to change the character display format as follows:



4. Press the SpO_2 key repeatedly to change the character display as follows:



5. To return to the Character Display Check screen, press the [ETC] key.

6. To return to the CRTC Check screen, press the [RETURN] key.

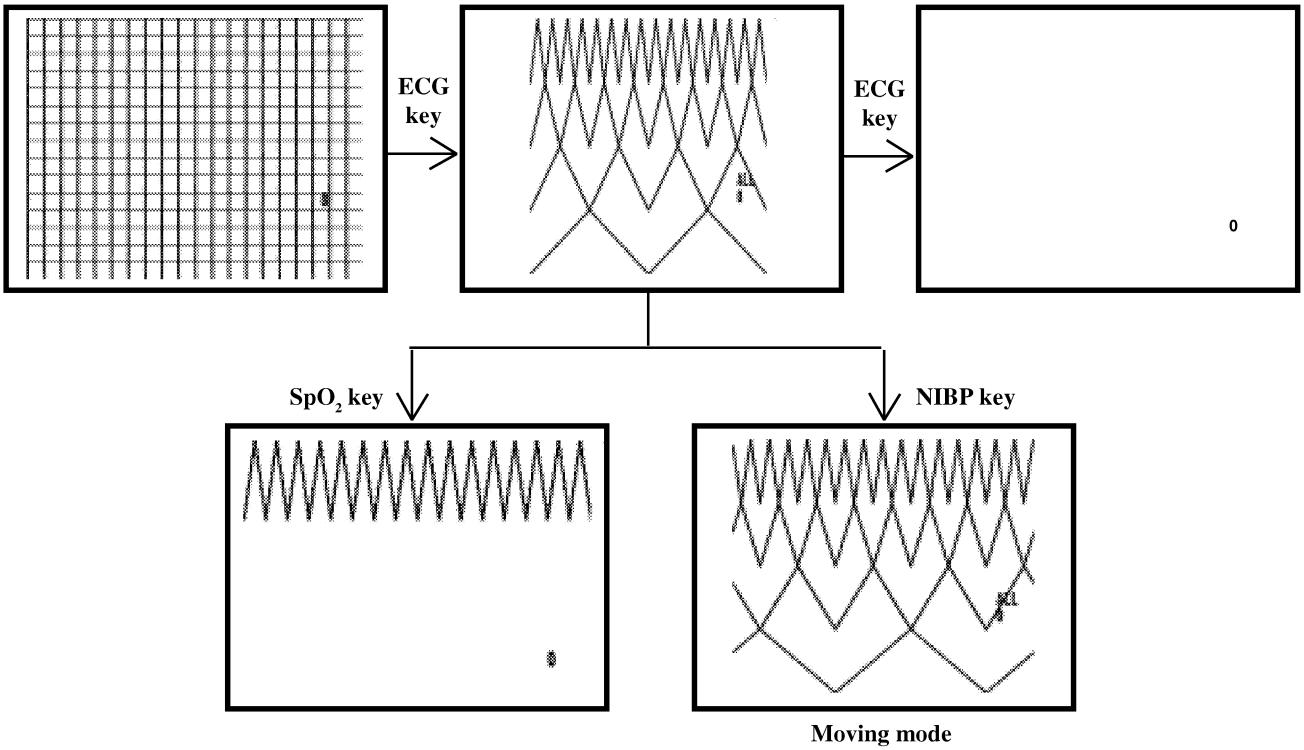
Graphic Display Check

This item checks the linearity of the graphic display as well as the four triangular waveform displays.

If the displayed screen is different from that shown below, the Digital board or the LCD unit might be faulty.

Procedure to Check the Graphic Display 1

1. Press the ECG, NIBP, or SpO_2 key to change the four triangular waveforms display as shown below.

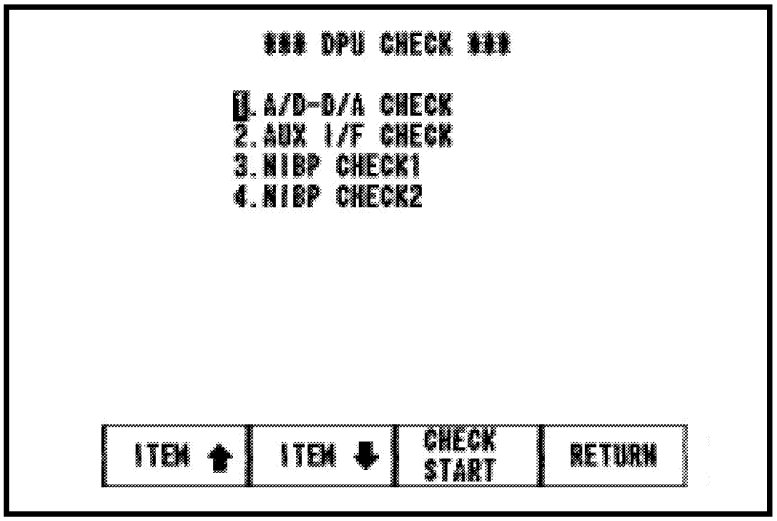


2. To return to the CRTC Check screen, press the [ETC] key.

DPU Check Menu Items

The following DPU check menu items are explained in the following pages.

1. From the Manual Check screen, select DPU Check and press the [CHECK] key. The DPU Check screen appears.



2. From the DPU Check screen, press the [ITEM ⬆] or [ITEM ⬇] key to select the check item.

3. Press the [CHECK START] key to start the selected check item. The selected check item screen appears. Some check items run automatically.

4. To return to the DPU Check screen, press the [ETC] key.

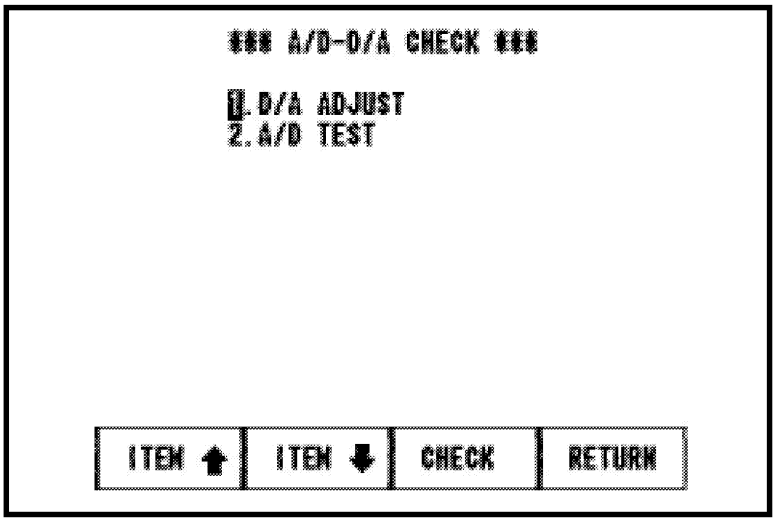
5. To return to the Manual Check screen, press the [RETURN] key.

6. To return to the Check Menu screen, press the [RETURN] key.

7. To return to the Diagnostic Check and System Setup screen, press the [RETURN] key.

8. To exit the Diagnostic Check and System Setup screen and return to the patient monitoring mode, press the [MONITOR MODE] key.

A/D–D/A Check



This item checks the following items. Each item is explained on the following pages.

Procedure to Select and Start the Check Item

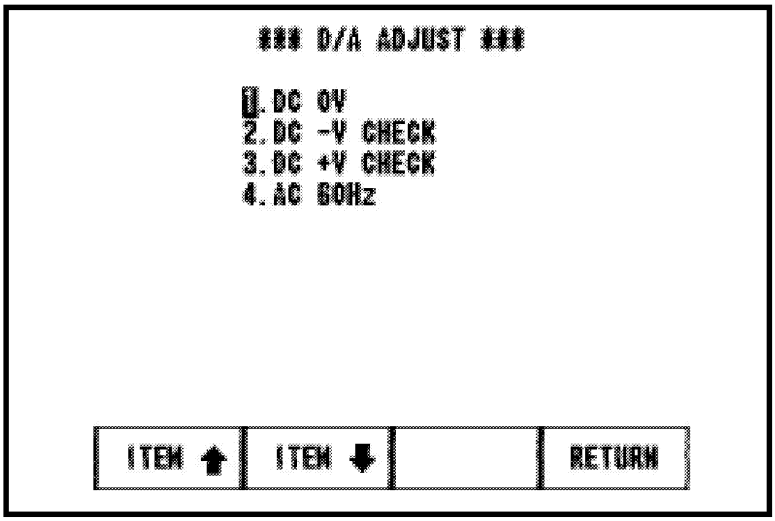
1. Press the [ITEM ↑] or [ITEM ↓] key to select a check item from the A/D–D/A Check screen.

2. Press the [CHECK] key to start the check program for the selected item.

3. Repeat steps 1 and 2 for each item.

4. To return to the DPU Check screen, press the [RETURN] key.

D/A Adjust



This check item checks the D/A output voltage level of the D/A converter. A digital voltmeter or oscilloscope is necessary for this check.

Procedure to Carry Out the D/A Adjust Check

1. Connect the digital voltmeter or oscilloscope to the ZB-800P connector. See Section 8, “Connector Pin Assignment,” for the pin assignments of the ZB-800P connector.

2. From the A/D–D/A Check screen, select D/A Adjust and press the [CHECK] key. The D/A Adjust screen appears.

3. Press the [ITEM ↑] or [ITEM ↓] key to select the item. When the check item is selected, the signal is output to the oscilloscope.

4. Check the display of the oscilloscope and compare the result with the following table:

Check	**ECG Output Voltage**
DC 0V	0 V ±5 mV
DC –V	–5.12V ±1%
DC +V	+5.1175V ±1%
AC 60 Hz	60 Hz sine wave

5. To return to the A/D–D/A Check screen, press the [RETURN] key.

6. To return to the DPU Check screen, press the [RETURN] key.

A/D Test

This is not a check. The A/D Test table shows the A/D converted values of all the parameters. Even if the parameter is not available in the instrument, the A/D converted value of the disabled signal is shown in the table.

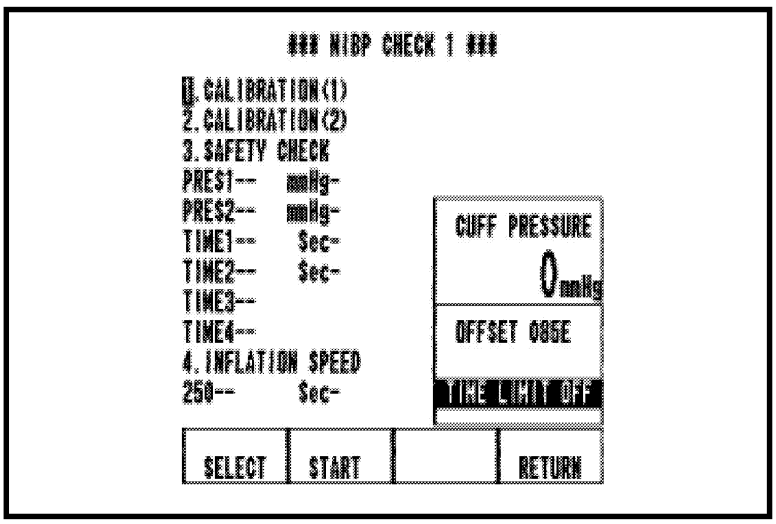
AUX I/F Check

When the optional ZB-800P Transmitter is installed, this item checks the waveform signal output by the transmitter to the radio telemetry receiver. The check program outputs a sawtooth waveform to the transmitter. The radio telemetry receiver, such as a cardiac telemetry system, receives the transmitted sawtooth waveform signal.

NIBP Checks 1 and 2

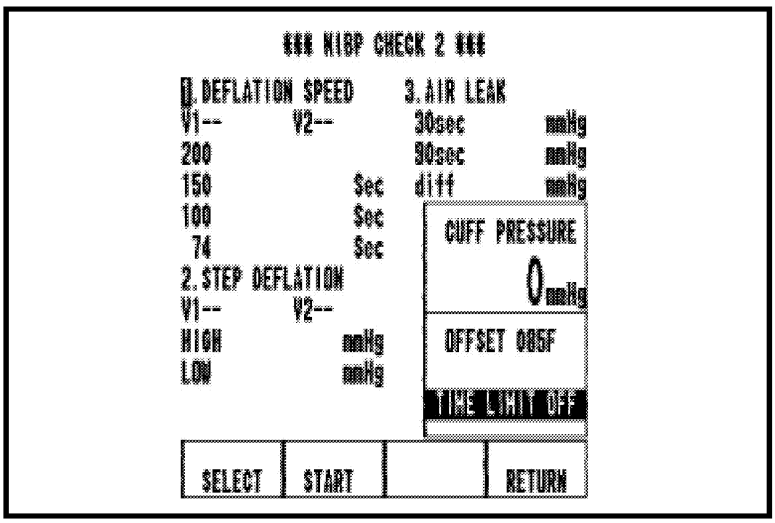
This item checks the function and safety aspect of the NIBP circuit and pump unit. The NIBP check consists of the following check items:

NIBP Check 1



1) Calibration (1)
2) Calibration (2)
3) Safety Check
4) Inflation Speed

NIBP Check 2



1) Deflation Speed
2) Step Deflation
3) Air Leak

Required Tools

- Hand bulb pump
- Manometer
- Y-shape hose connector (Used so that the two NIBP sockets on the instrument can be connected to the hand bulb pump and manometer)
- 700 ml dummy cuff (A solid container that withstands high pressure; the inner volume of this container must be 700 ml, YS-558R9)
- 250 ml dummy cuff (A solid container that withstands high pressure; the inner volume of this container must be 250 ml, YS-564R2)
- Two 3.5 m air hoses: 1 for adults and 1 for neonatals (dual hose type)

Selecting and Starting NIBP Check

1. Press the [SELECT] key to select the check item number.

2. Press the [START] key to start the check for the selected check item.

NOTE

Make sure there is no pressure on the pump unit before turning the power on and entering the NIBP check. The check program considers the pressure of the pump unit as 0 mmHg at the start of the check.

3. To return to the DPU Check screen, press the [RETURN] key.

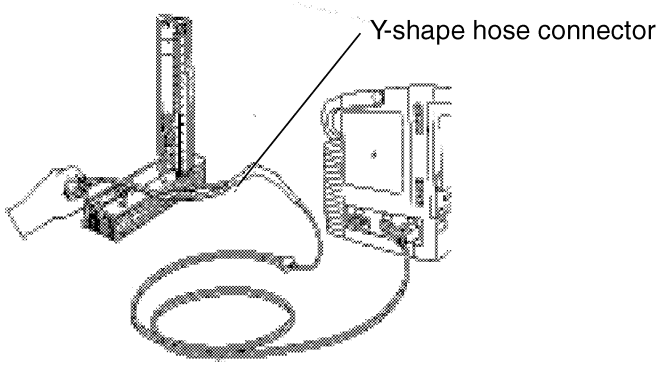
Calibration (1)

The Calibration (1) Check program is used not for calibration but to display the accuracy of the Pressure Sensor 1. The accuracy of the sensor changes with the measuring pressure. The following table shows the acceptable accuracy range of the Pressure Sensor 1 at different pressure ranges.

Pressure Range	Acceptable Accuracy Range
0 to 200 mmHg	±3 mmHg (The displayed value is always 0 mmHg)
201 to 300 mmHg	±4 mmHg

Checking the Accuracy of Pressure Sensor 1

1. Connect the manometer and hand bulb pump to the two NIBP sockets on the instrument using the Y-shape hose connectors as shown below.



2. Press the [SELECT] key to select item number 1.

3. Press the [START] key to start the check.

4. Immediately start pumping the hand bulb pump. Stop pumping the hand bulb pump when the pressure reading displayed on the NIBP Check display of the instrument is within one of the two pressure ranges (0–200 or 201–300 mmHg).

5. Compare the pressure reading displayed on the NIBP Check display with the pressure reading on the manometer.

6. Repeat steps 4 and 5 for a reading in the other pressure range.

7. If the accuracy of the pressure sensor for either of the two pressure ranges is out of the acceptable accuracy range, replace the Analog board.

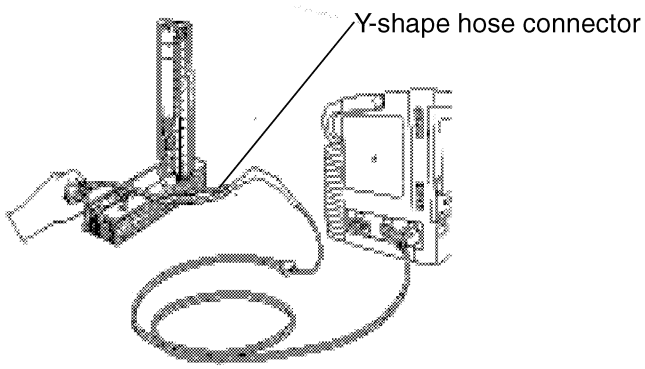
Calibration (2)

The Calibration (2) Check program is used not for calibration but to display the accuracy of the Pressure Sensor 2. The accuracy of the sensor changes with the measuring pressure. The following table shows the acceptable accuracy range of the Pressure Sensor 2 at different pressure ranges.

Pressure Range	Acceptable Accuracy Range
0–15 mmHg	–2 mmHg to +3 mmHg (The displayed value is always 0 mmHg)
16–200 mmHg	±4 mmHg
201–300 mmHg	±8 mmHg

Procedure to Check Accuracy of Pressure Sensor 2

1. Connect the manometer and hand bulb pump to the two NIBP sockets on the instrument using the Y-shape hose connector as shown below.



2. Press the [SELECT] key to select item number 2.

3. Press the [START] key to start the check.

4. Immediately start pumping the hand bulb pump. Stop pumping the hand bulb pump when the pressure reading displayed on the NIBP Check display of the instrument is within one of the three pressure ranges (0–15, 16–200, or 201–300 mmHg).

5. Compare the pressure reading displayed on the NIBP Check display with the pressure reading on the manometer.

6. Repeat steps 4 and 5 for a reading in the other pressure ranges.

7. If the accuracy of the pressure sensor for any of the three pressure ranges is out of the acceptable accuracy range, replace the Analog board.

Safety Check

This checks the 6 items monitored by the NIBP safety circuit.

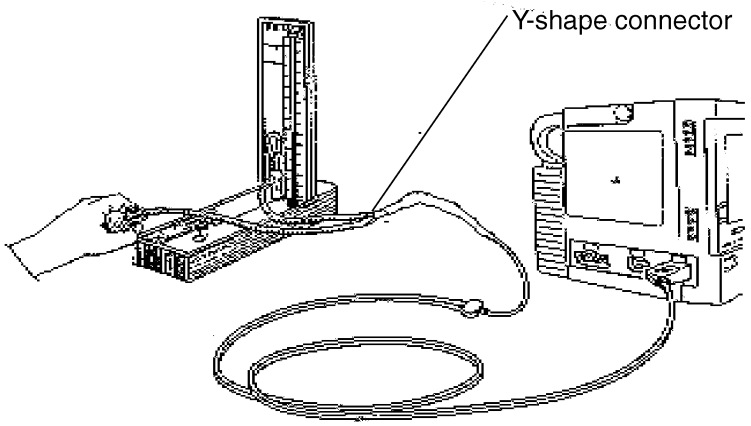
Check Item	Description	Acceptable Range
PRESS 1	Pressure limiter in the adult mode	315 ±15 mmHg
PRESS 2	Pressure limiter in the neonatal mode	157.5 ±7.5 mmHg
TIME 1	Time limiter in the adult mode	161 to165 sec (15 mmHg)
TIME 2	Time limiter in the neonatal mode	81to85 sec (5 mmHg)
TIME 3	Interval error in the adult mode	≥31 sec (20 mmHg)
TIME 4	Interval error in the neonatal mode	≥31 sec (10 mmHg)

NOTE

The TIME 1 to TIME 4 check items are only used in the factory. Because these items require a sensitive mechanical pressure generator that can quickly provide the right pressure at the right time interval. If a manometer and hand bulb pump are used, accuracy cannot be guaranteed.

Pre-check Preparation

Connect the manometer and hand bulb pump to the NIBP sockets on the instrument using the Y-shape hose connector as shown below.



NOTE

Start pumping the hand bulb pump as soon as the CHECK message appears next to these safety check items. A delay in inflation causes the solenoid valve to open. Inflation cannot continue with an open solenoid valve.

Checking the PRESS 1 Safety Check Item

1. Connect a 3.5m air hose for adults to the instrument.

2. Press the [SELECT] key to select item number 3.

3. Press the [START] key to start the check.

4. Start pumping the hand bulb pump as soon as the CHECK message appears.

5. Quickly increase the pressure until the manometer reads 300 mmHg. From the 300 mmHg pressure point, slowly increase the pressure further. The OK or ERROR message appears after the inflated pressure reaches a certain value in the 300 to 330 mmHg range. When the OK message appears, the SAFETY ON message also appears in the cuff pressure window.

NOTES

- **If the pressure is increased too quickly to a value above 330 mmHg, the ERROR message appears.**
- **Slowly increasing the pressure after the 300 mmHg pressure point triggers the safety circuit to display the OK or ERROR message in less than 15 seconds.**

When the OK or ERROR message appears, the WAIT message also appears in the next safety check item, TIME 1. This waiting period is about 33 seconds.

6. Open the valve in the hand bulb pump until the manometer reads 0 mmHg, then close the valve to prepare the hand bulb pump for the next check. This must be done within 33 seconds.

Checking the PRESS 2 Safety Check Item

1. Connect a 3.5 m air hose for neonatals to the instrument.

2. Press the [SELECT] key to select item number 3.

3. Press the [START] key to start the check.

4. Start pumping the hand bulb pump as soon as the CHECK message replaces the WAIT message.

5. Quickly increase the pressure until the manometer reads 150 mmHg. From the 150 mmHg pressure point, slowly increase the pressure further. The OK or ERROR message appears after the inflated pressure reaches a certain value in the 150 to165 mmHg range. When the OK message appears, the SAFETY ON message also appears in the cuff pressure window.

NOTES

- **If the pressure is increased too quickly to a value above 165 mmHg, the ERROR message appears.**
- **Slowly increasing the pressure after the 150 mmHg pressure point triggers the safety circuit to display the OK or ERROR message in less than 7.5 seconds.**

When the OK or ERROR message appears, the WAIT message also appears in the next safety check item, TIME 2. This waiting period is about 33 seconds.

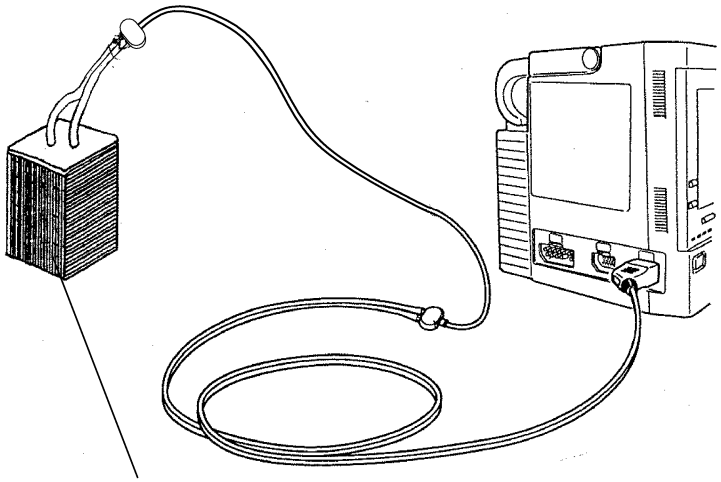
6. Open the valve in the hand bulb pump until the manometer reads 0 mmHg, then close the valve to prepare the hand bulb pump for the next check. This must be done within 33 seconds.

Inflation Speed

This checks the inflation speed of the pressure pumps. The specifications state that the cuff pressure must be able to reach 250 mmHg in less than 7 seconds.

Procedure to Check the Inflation Speed

1. Connect the 700 ml dummy cuff to the NIBP socket with the 3.5 m dual air hose as shown below.



2. Press the [SELECT] key to select check item number 4.

3. Press the [START] key to start the check.

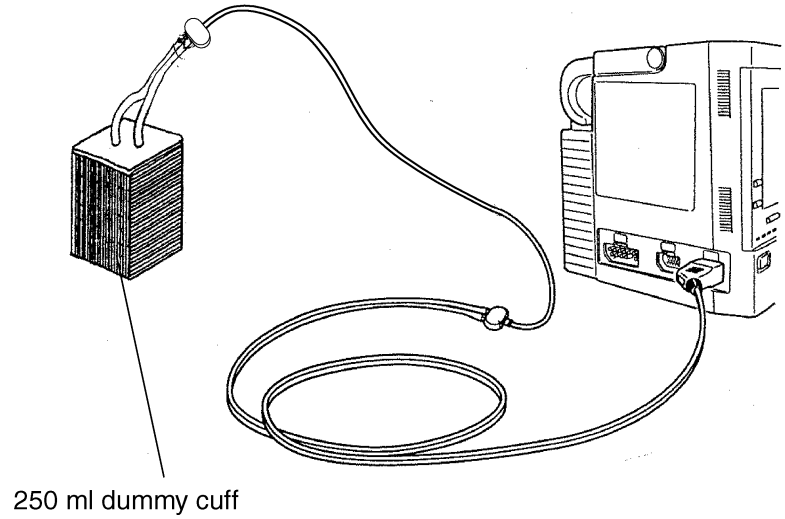
If the inflation speed is less than 7 seconds, an OK message appears.

Step Deflation

This checks the step deflation of the cuff at given pressures. At the LOW pressure, Valve 1 opens for 60 ms and Valve 2 opens for 80 ms at 20 mmHg. At the HIGH pressure, Valve 1 opens for 40 ms and Valve 2 opens for 70 ms at 250 mmHg.

Procedure to Check the Step Deflation Speed

1. Connect the 250 ml dummy cuff to the NIBP socket with the 3.5 m air hose as shown below.



2. Press the [SELECT] key to select check item number 5.

3. Press the [START] key to start the check.

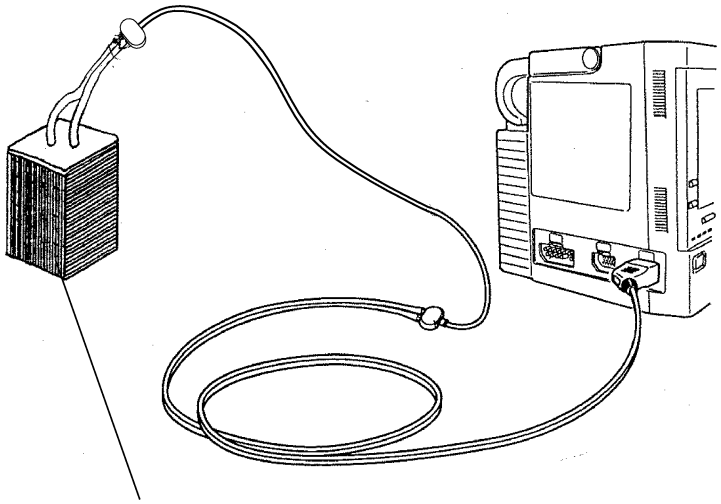
Depending on the result of the check, an OK or ERROR message appears.

Air Leak

This checks for air leakage in the air compartment of the NIBP module. In this check, the air pressure of the dummy cuff is increased to 250 mmHg. It then compares the pressure readings of the dummy cuff taken at 30 seconds and 90 seconds after the pressure of the dummy cuff has reached 250 mmHg. If the pressure readings differ by less than 5 mmHg, an OK message appears. If not, an ERROR message appears.

Procedure to Check the Air Leak

1. Connect the 700 ml dummy cuff to the NIBP socket with the 3.5 m air hose as shown below.



700 ml dummy cuff

2. Press the [SELECT] key to select check item number 7.

3. Press the [START] key to start the check.

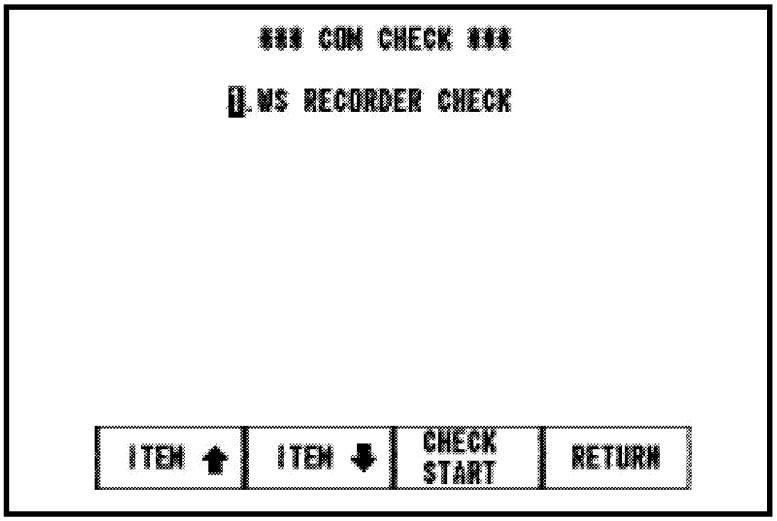
Depending on the result of the check, an OK or ERROR message appears.

COM Check Menu Items

The following COM Check Menu items are explained on the following pages.

1. From the Check Menu screen, press the [MANUAL CHECK] key. The Manual Check screen appears.

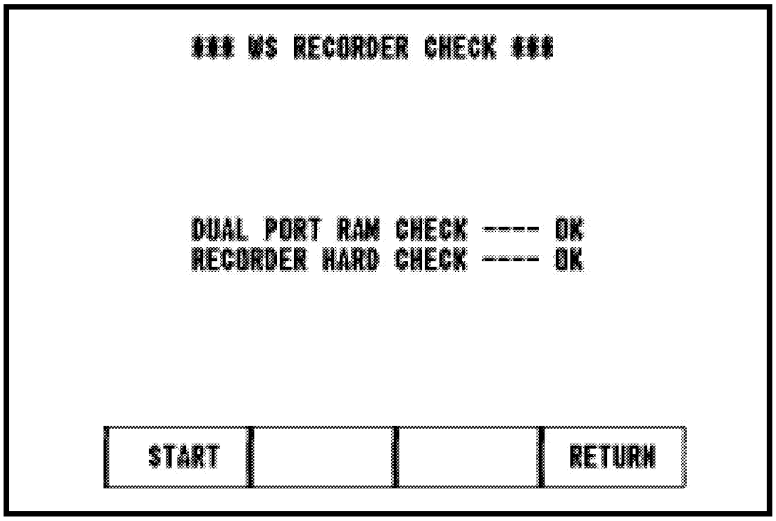
2. From the Manual Check screen, select COM Check and press the [CHECK] key. The COM Check screen appears.



3. Press the [CHECK START] key to start the WS Recorder check, which runs automatically.

4. To return to the COM Check screen, press the [RETURN] key.

WS Recorder Check

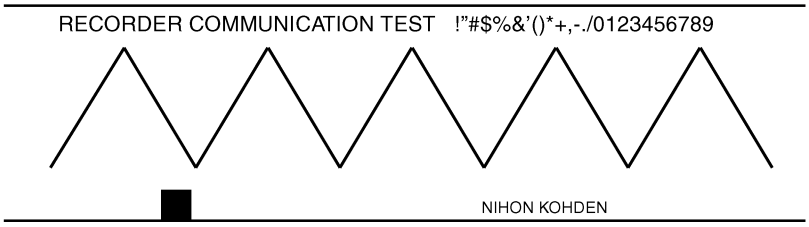


This item checks the communication between the recorder unit and the Digital board by printing a test printout.

If an error message appears, the Digital board or the recorder unit might be faulty.

Procedure to Start, Stop, and Exit the WS Recorder Check Program

1. Press the [START/STOP] key to start the check. The start or stop key name is highlighted when the [START/STOP] key is pressed. The recorder unit prints the test printout.

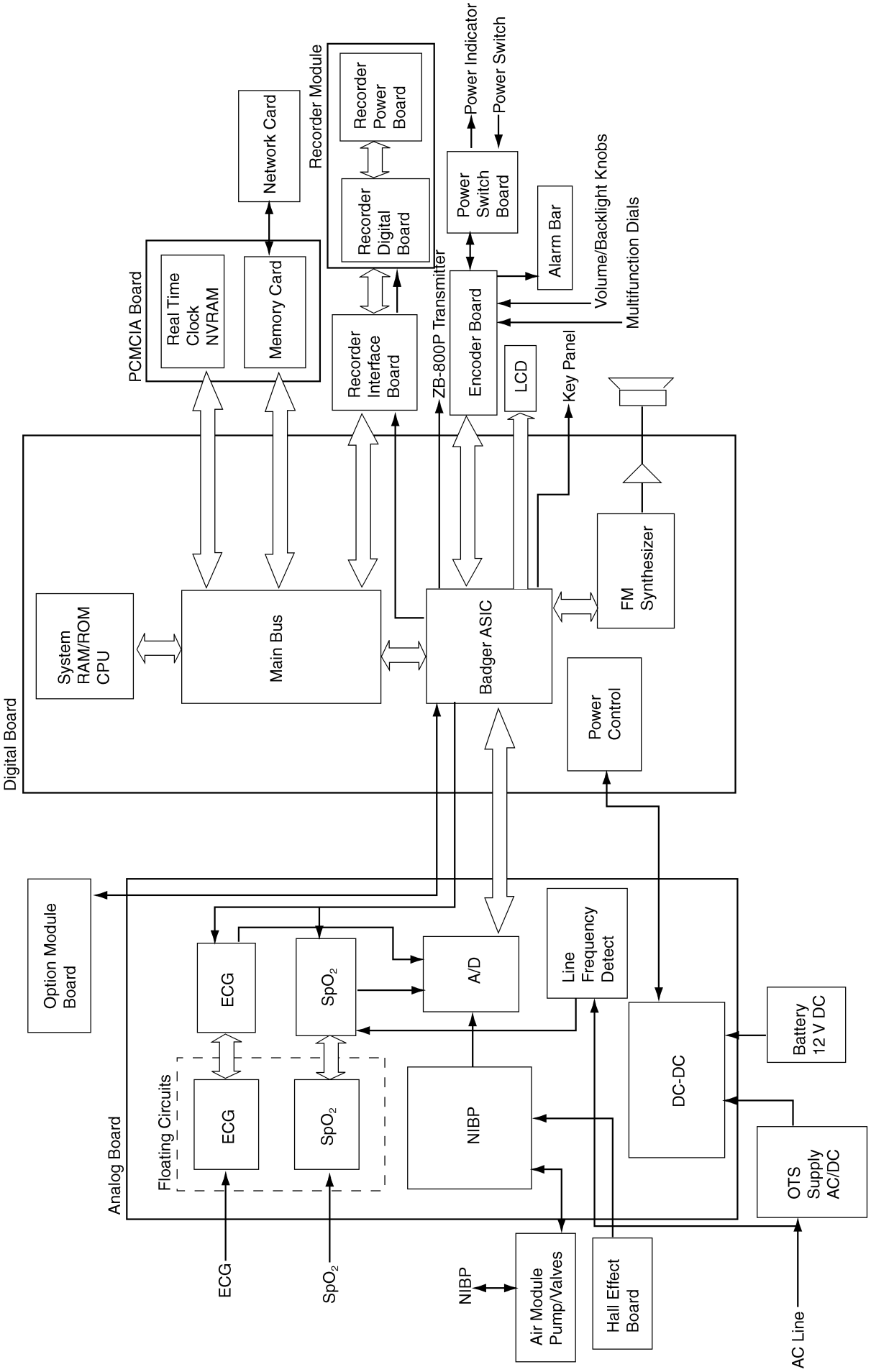


2. To stop the check, press the [START/STOP] key again.

3. To return to the COM Check screen, press the [RETURN] key.

Section 4 Board/Unit Descriptions

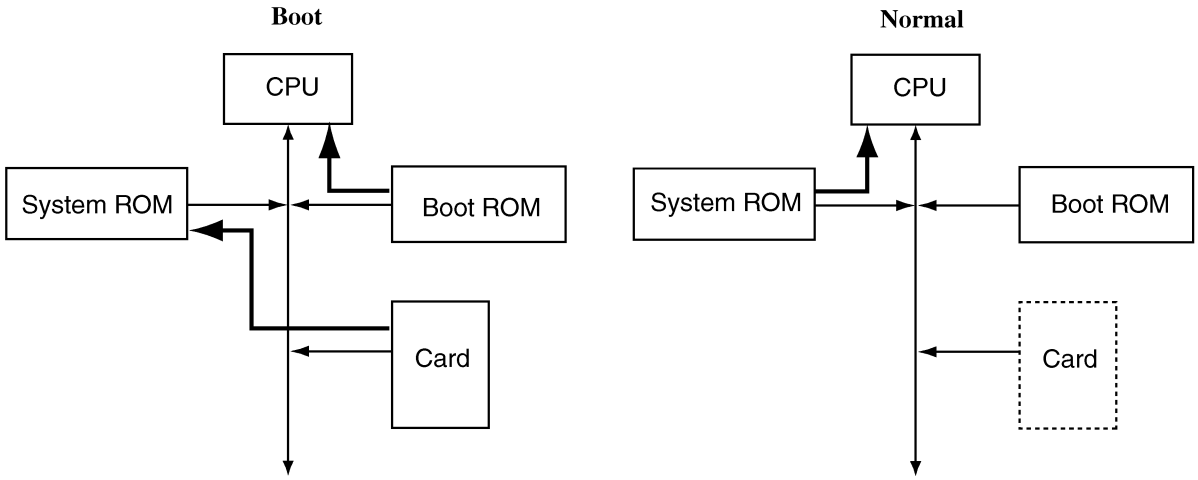
Overall Function Block Diagram



Digital Board

The Digital board provides the processing to run the instrument and supplies a central interconnection for other parts of the instrument. The Digital board is based on a 68000 microprocessor with some on-board memory. The Digital board performs a variety of individual functions that fall into six major functional blocks. Other minor functions of the Digital board include periodically reading the status of the switches and controlling the recorder unit when it is performing a self check.

Boot and Memory Block



When the instrument is turned on, the CPU performs a hardware check before running the boot program. The boot ROM (128 KB) tells the CPU to read from the memory card or system ROM (1 MB). If the program memory card is inserted into the memory card slot when the instrument is turned on, the boot ROM tells the CPU to read the system software from the program memory card and write it into the system ROM. This allows the system software to be easily upgraded with a program memory card. If a program memory card is not inserted in the memory card slot when the power is turned on, the boot ROM tells the CPU to read the system software from the system ROM, where the program is executed.

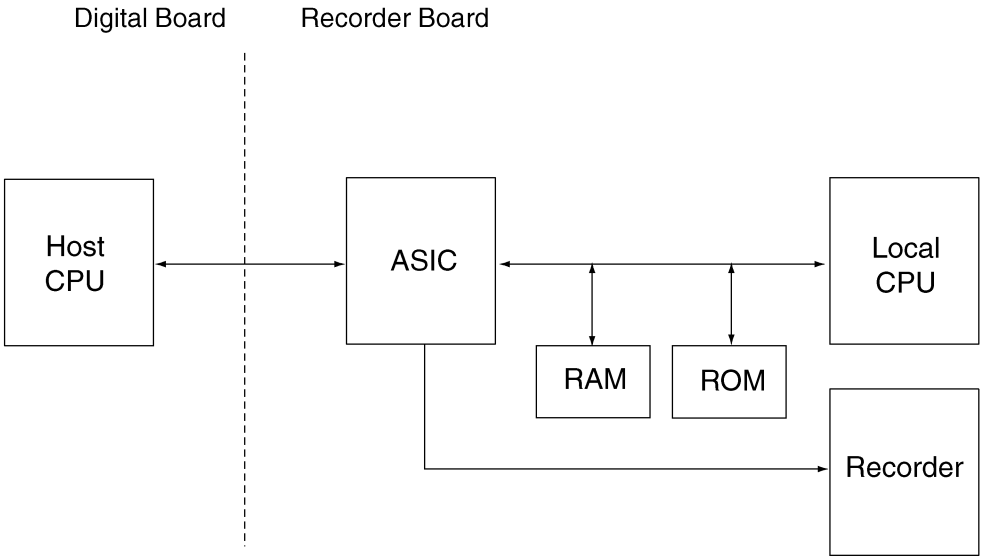
The system RAM not only holds the tentative data of the system software when the instrument is running, but also stores the following data:

- Trend data and settings
- Numerical data
- Saved waveforms in 8-second files
- ECG settings
- SpO_2 settings
- NIBP settings
- Alarm settings

A capacitor is used to back up the above data in the RAM for approximately 1 hour after the instrument is turned off. System software, however, erases the stored data after 30 minutes of power off due to unreliability of data.

The system and alarm master settings data are stored in a non-volatile static RAM. Therefore, this data is not lost when the instrument is turned off. The only way to clear this RAM data is to initialize the system.

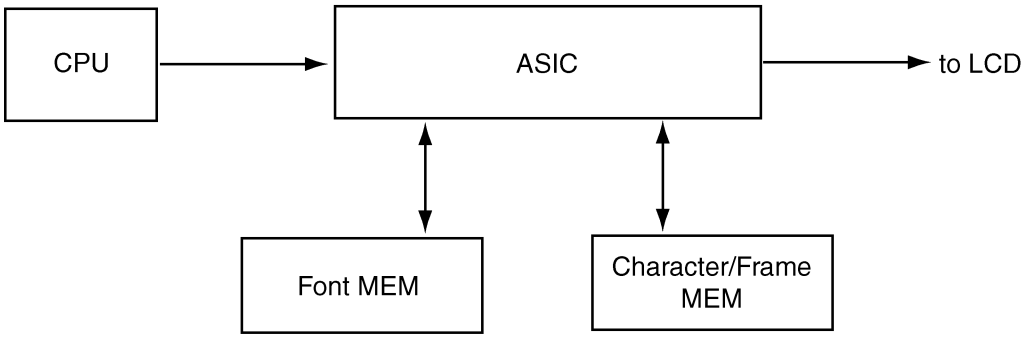
Recording Block



This block is controlled by a local CPU with its own ROM and RAM. This CPU is controlled by the system CPU on the Digital board via ASIC on the Recorder board. Similar to the ROM in the Digital board, the program stored in this ROM can also be upgraded through a program card.

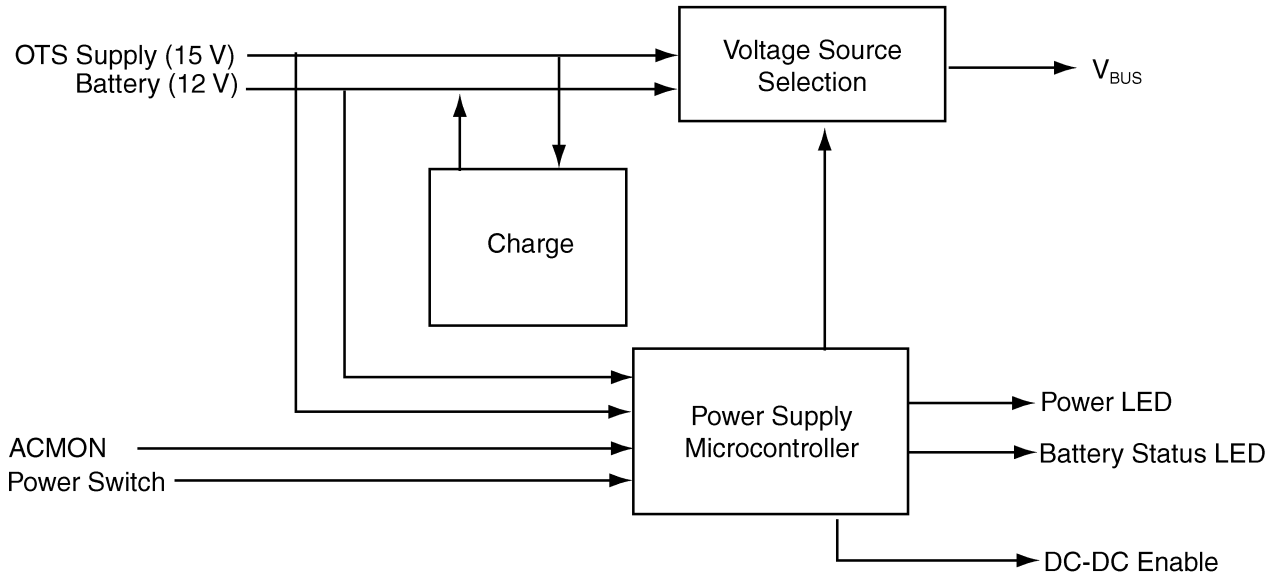
Although the recording block is controlled by the host CPU, most of the CPU processing is performed by ASIC on the Recorder board. In the recording process, the system CPU on the Digital board outputs the record command to the local CPU on the Recorder board via its ASIC. The local CPU processes the recording data, such as the waveform data, trendgraph data, or list data, and outputs thermal head command signals to the recorder unit for the recording operation. The temperature of the thermal head in the recorder unit is also controlled by the local CPU on the Recorder board.

Display Block



This block is responsible for displaying the waveforms, graphics, and numerical data on the LCD's 320 dots × 240 lines screen. For the waveforms and graphics, an advanced graphics controller (Badger ASIC) is used to draw the waveforms and graphics in the frame memory before the final picture is output to the LCD screen. For the numerical data, the system CPU of the Digital board issues the command to the Badger ASIC to write certain information. The Badger ASIC, using the character RAM, outputs the recording information to the character and font memories. The information drawn in these memories is output to the LCD screen.

Power Control Block



The functions of the Power Control Block are to read the switch status of the power switch, control the DC/DC converter on the power supply unit, monitor the battery voltage and control the battery charging. These functions are controlled by a single-chip microcontroller in the Power Control Block.

Standby Mode

The power supply microcontroller receives its power either from the 15 V DC OTS power supply unit or from the battery. This means that the power supply microcontroller is in operation even before the power switch is turned on. This is known as the standby mode and its main advantage is that it allows the power supply microcontroller to control the battery charging operation when the power is not turned on.

System On Control

When the power is not turned on, the power supply microcontroller enables the DC/DC signal when it detects that the power switch is pressed. The enabled DC/DC signal is output to the power supply unit to drive its DC/DC converter. If the power is already turned on, the power supply microcontroller disables the DC/DC signal when it detects that the power switch is pressed for about 1 second.

Power Source Supply

The power control microcontroller controls the display of the AC power LED and battery power LED by monitoring the status of the ACMON signal from the power supply unit when the power switch is pressed. If the ACMON signal is enabled, the power supply microcontroller lights the AC power LED. If the ACMON signal is not enabled, the power supply microcontroller CPU lights the battery power LED.

Battery Charge Level Display

The power supply microcontroller monitors the battery charge level of the battery and displays its level on the battery charge level indicator located on the left side of the front panel of the instrument.

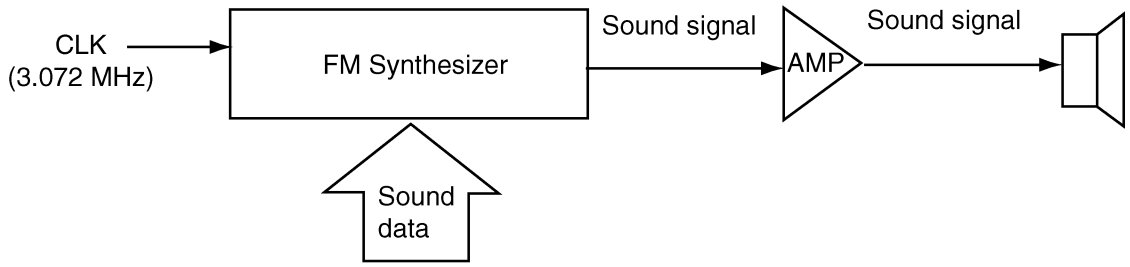
Battery Charging and Discharging

The power supply microcontroller monitors the battery charge level of the inserted battery. Depending on the battery charge level, if AC power is available to the instrument, the power supply microcontroller activates the battery charging circuit. The charging power supply is provided by the 15 V DC OTS power supply unit.

Power Input Load Check

The Digital board checks the power input load for abnormality when AC or battery power is introduced to the instrument. If a low input voltage or other abnormality is detected, a buzzer generates a continuous sound. When the power input load is normal, a single beep sound is generated when AC power is introduced or the battery is inserted.

Sound Synthesizer Block



This block is based on an FM synthesizer that, under the control of the CPU, generates the QRS sync and alarm sound signals. These sound signals are then amplified and output to the speaker connected to the Digital board. The volume of these sounds is controlled by the CPU.

Key Panel

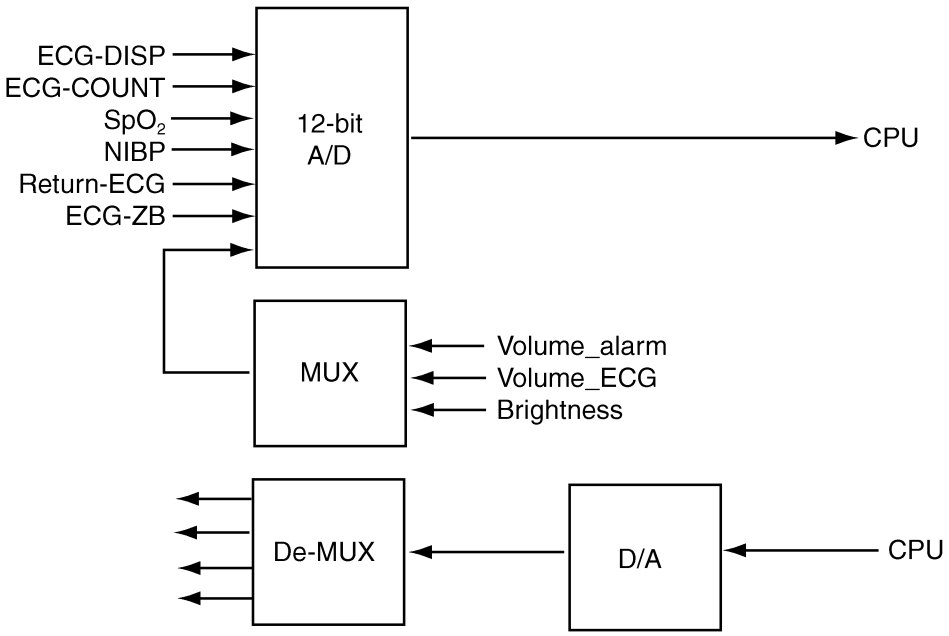
The Digital board monitors the status of the membrane switches on the key panel of the instrument. The membrane switches are: SUSPEND ALARM key, REVIEW key, NIBP START/STOP key, HOME key, ETC key, NIBP key, SpO_2 key, ECG key, RECORDER START/STOP key, and RECORDING PATTERN SELECT key.

ZB Interface

This interface is available for the instrument to connect to a ZB-800P Transmitter for telemetry capability. With this transmitter, the instrument can transmit certain patient information to a telemetry monitor such as a cardiac telemetry system.

Analog Board

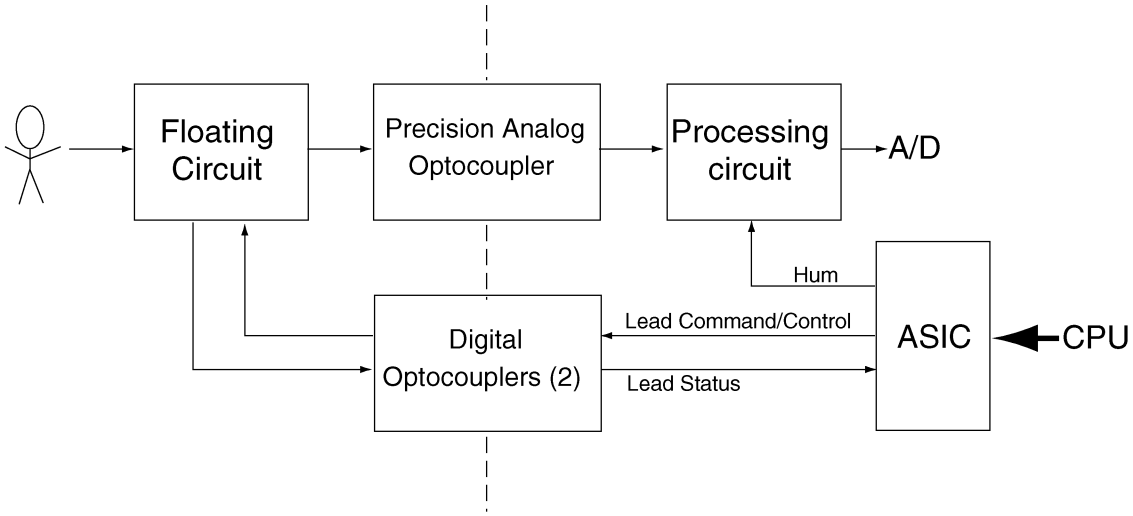
Analog Processing Block



The analog processing block consists of an A/D converter, a D/A converter, multiplexer, and demultiplexer. The A/D converter converts the following analog signals into corresponding digital signals:

- Patient measured parameters such as ECG, non-invasive blood pressures, and SpO_2
- Sound volume
- Brightness volume

Input Control Block

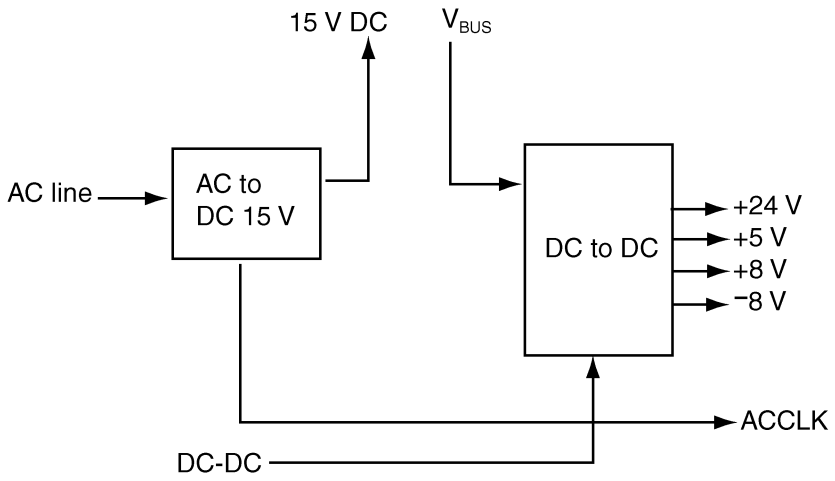


This block controls the non-floating circuits of the ECG board and SpO_2 board by switching on or off the hum filter control signal.

This block also generates another type of control signals for the floating circuit of the ECG board and SpO_2 board. This second type of control signals include the leads selection signal, the 3 leads measuring mode signal, and the lead status signal. These are output to or input from the floating circuit via digital optocoupler.

Apart from the above control signals, this block also generates the timing signal for serial communication between the floating and non-floating circuits of the ECG circuit and SpO_2 circuit.

Power Supply Unit



The AC power switch is on the front of the instrument. The AC inlet with fuse line filter is located at the rear panel of the instrument. The output of these components is input into the OTS power supply unit, which converts the AC power to 15 V DC power. The Power Control circuit then converts the 15 V DC power to the various power supplies required by the instrument.

AC/DC Converter

The power supply unit uses an AC/DC converter to convert the AC power source into 15 V DC power. At the same time, the ACMON signal is enabled to inform the Power Control Block that AC power supply is available to the instrument.

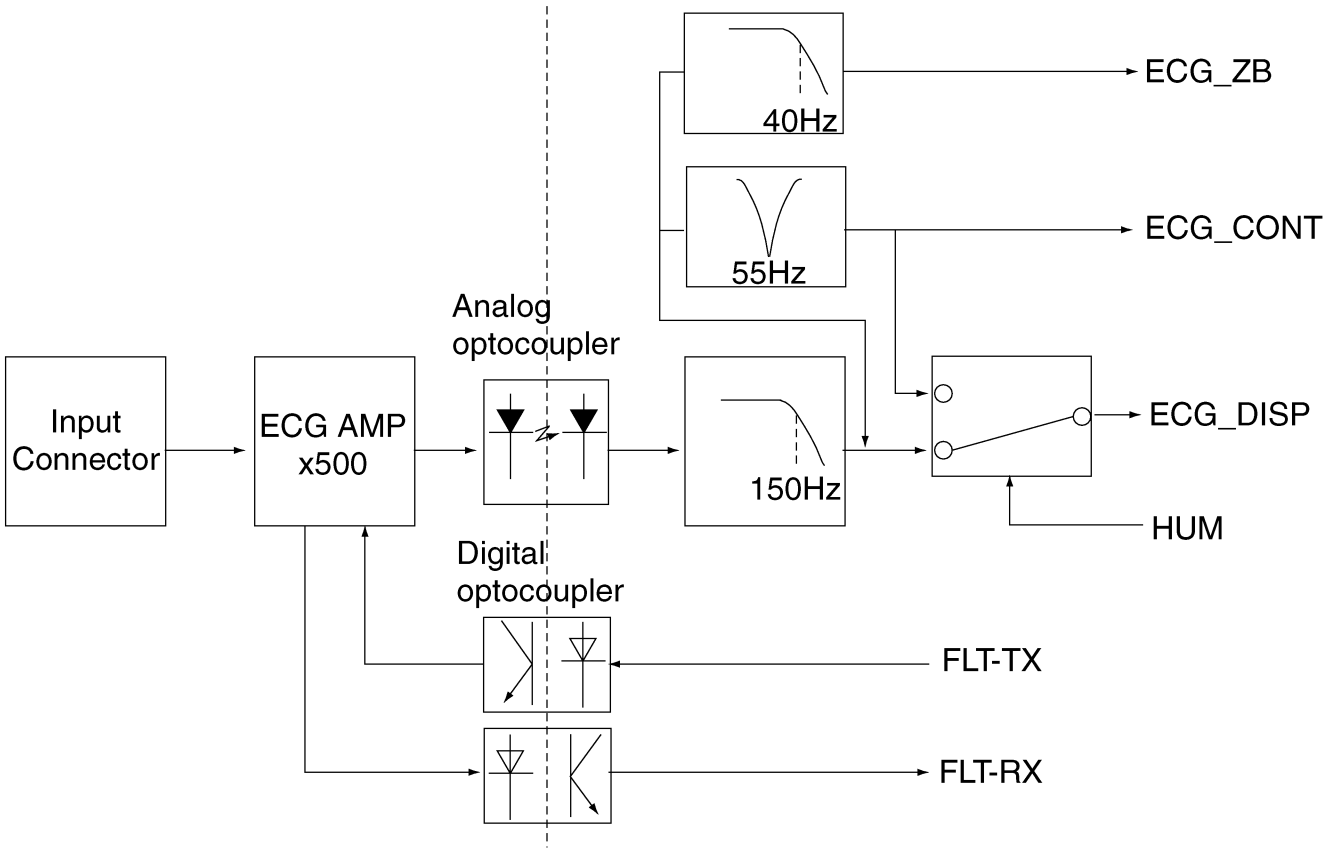
DC/DC Converter

The DC/DC converter changes the 15 V DC power into +3.3 V, +5 V, +8 V, −5 V, and −8 V when it receives the command signal from the Power Control Block.

AC Line Frequency Detector

The AC line frequency detector outputs a pulse signal that is synchronized with the AC line frequency to the SpO_2 circuit on the Analog board.

ECG Circuit



The input circuits in the ECG board are equipped with high impedance components to protect the input amplifiers from defibrillation and high-frequency interference input signals from the patient lead electrodes. For further patient protection, this input circuit is isolated from the other circuits by photocouplers and isolation transformers.

For ECG signal processing, the operational amplifiers in the input circuits of the ECG circuit amplify the signal before it goes to the non-isolated circuits through an analog optocoupler. The ECG signal from the analog optocoupler is processed for hum filtering. The FLT_RX signal from the digital optocouplers carries the lead status, connector connection and excessive polarization voltage information. The input circuit performs the lead selection, time constant switching, INST control and CAL control when it receives the FLT_TX lead select command signal from the non-isolated side through another digital optocoupler.

The output connector to the Analog board is located on this printed circuit board. Therefore, the finally processed and A/D converted ECG signal is output to the Digital board via the Analog module through this output connector.

NIBP System

The NIBP system consists of the NIBP circuitry on the Analog board and the pump and valve components. These components contain 1 air compressor pump and 2 solenoid valves. The NIBP system is also equipped with 2 sensors, 1 for measuring the change in blood pressure in the cuff and the other for monitoring the cuff pressure for any abnormality. The NIBP system performs the following functions:

- Inflates the cuff during NIBP measurement by controlling the pump
- Deflates the cuff during NIBP measurement by controlling the valves
- Monitors the change in the cuff pressure through a sensor on the NIBP circuitry
- Prevents the cuff from over-inflating
- Monitors the inflation and deflation time of cuff
- Monitors the total measuring time
- Monitors the power supply in the NIBP circuit
- Zero calibrates the cuff pressure in both measurement and safety circuits
- Processes the NIBP signal and outputs the processed NIBP signal to the CPU through the 12-bit A/D
- Informs the system CPU on the Digital board if it detects any abnormality

Under normal conditions, the system CPU on the Digital board controls the pump and valves in the NIBP system. Under abnormal conditions, however, the NIBP safety circuit takes control of the operations of the pump and valves by immediately stopping the pump and opening the valves. The abnormal conditions are:

- When a power down situation is detected
- When the pressure of the inflated cuff is over its preset limits
- When the inflation time is over its preset limits
- When the deflation time is over its preset limits
- When the interval between measurements is different from its preset value

PCMCIA Board

Memory Card Interface Block

The memory card interface is based on the JEIDA Version 4.0 protocol. Its switchability among its seven memory banks of 512 KB each lets the interface switch from attribute memory mode to common memory mode. This means the instrument can read from a program memory card and also read from, or write to, a data memory card.

LCD Unit

The LCD unit has a resolution of 320 dots × 240 lines and a visible display diagonal size of 5.5 inches (139.7 mm). Although the LCD unit can display up to 16 M colors, this instrument only allows 4096 selectable colors for the waveforms and numerical data display.

The polarization filter on the surface of the LCD screen is sensitive to shock and high pressure. A resin protects this polarization filter from shock and rough handling of the LCD screen. The resin is sensitive to strong alcohol, so if the surface of the LCD must be cleaned with alcohol, use diluted alcohol on a cloth and clean the LCD screen quickly.

The LCD is illuminated from behind (backlight) by 2 cold cathode electrodes. The life span of the backlight is 10,000 hours (approximately 14 months). The life span is the number of hours for the intensity to reach 50% of its original value when the backlight is continuously on at maximum brightness. Depending on the operating environment of the instrument, the LCD may need to be replaced after 10,000 hours of continuous use.

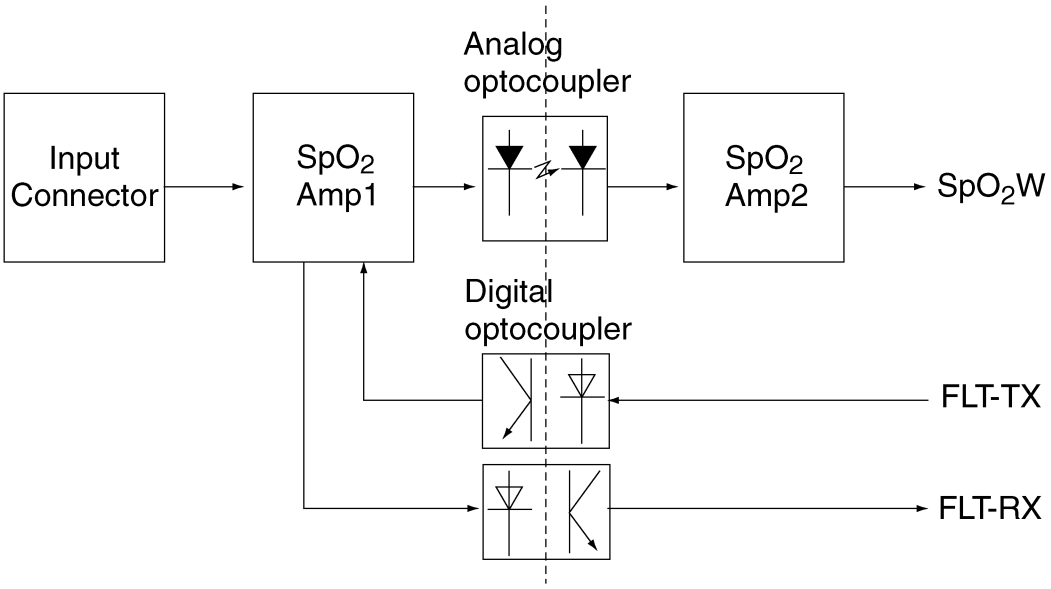
SpO_2 System

The following circuits process the SpO_2 signals. Different SpO_2 processing circuits are used for BSM-1101 and BSM-1102.

SpO_2 Processing Circuit (BSM-1101)

The input circuits in the SpO_2 system are isolated from the non-floating circuits by optotocouplers and isolation transformers for patient protection.

The processed signals from the SpO_2 processing circuit pass across the isolation barrier through analog optocouplers. The SpO_2 circuit then outputs the processed SpO_2 to the Digital board via the Analog board.



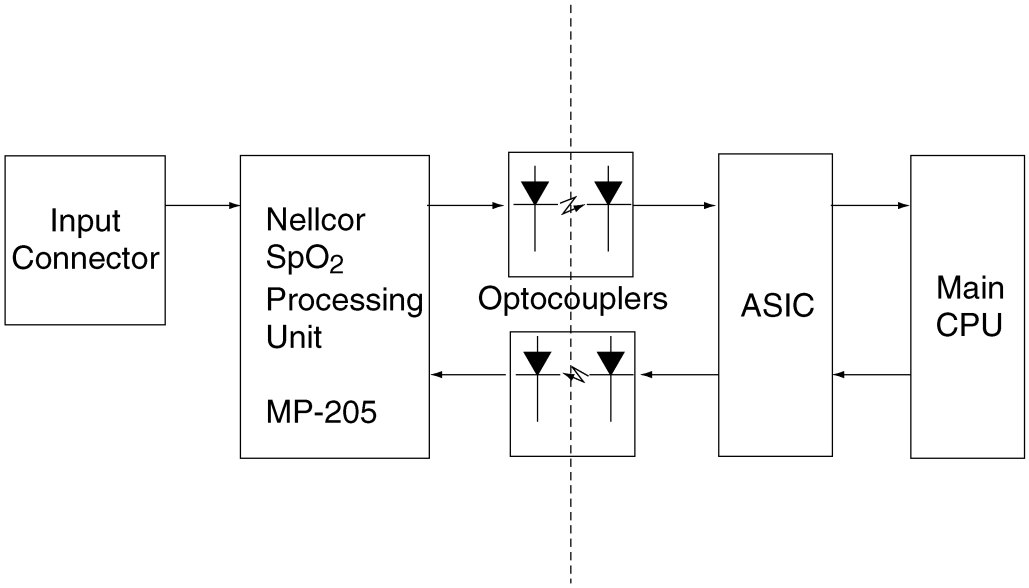
The SpO_2 processing circuit consists of three smaller circuits: LED control circuit, probe ID detection circuit, and input processing circuit.

The LED control circuit also controls the timing signal that is used to drive the LEDs in the probe. The source timing signal used by this circuit is previously synchronized with the AC line frequency in the power supply unit using the line frequency detection circuit. This source timing can be set to 50 or 60 Hz by using the AC Line Frequency Setting system setup screen.

The function of the probe ID detection circuit is to identify the probe ID of the sensor of the SpO_2 probe.

This input processing circuit later uses this ID information to correct the values from the sensor. In the input processing circuit, the input signal from the photodiode is amplified and filtered by a low-pass filter. In this process, the offset signal detected with no LED light is used as the baseline signal.

SpO_2 Processing Circuit (BSM-1102)



The MP-205 Nellcor SpO_2 processing unit controls the LED of the sensor in the probe. The MP-205 also processes the signals from the sensor and calculates SpO_2 value and pulse rate. These calculated data are sent to the main CPU via serial communication.

Section 5 Disassembly/Assembly

General Information

The procedures in this section tell how to disassemble, replace, and reassemble the major components of this instrument.

Warnings and Cautions

The procedures in this section should be attempted only by qualified service personnel.

Read the following precautionary information and be sure you understand it before proceeding. This information is presented to prevent injury to personnel and/or damage to the instrument.

WARNING

Avoid electrical shock.
Always disconnect the input power and battery from the instrument before opening the enclosure.

CAUTION

Avoid damage to circuit boards caused by static discharge.
Always use a grounded static bench mat and grounded wrist strap when working on internal components.

CAUTION

Avoid damage caused by improper fuses.
Always find the cause of a blown fuse and correct it before replacing the fuse.
Always use the correct rating for replacement fuses.

Before You Begin

Always take the following steps before servicing the instrument:

1. Remove the input power cable.
2. Remove the battery.
3. Remove all other connectors and cables from the outside of the instrument.
4. Remove the PCMCIA card.

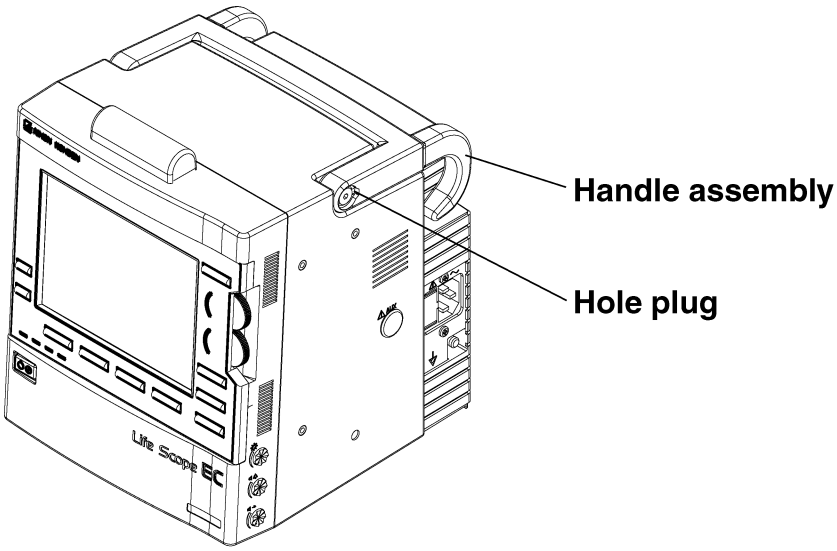
When servicing the instrument, please remember:

1. To retain all hardware for use during reassembly.
2. Connectors, cables, hose, and wire connections are referenced in the body of the instructions. These parts can be replaced by disassembling to the extent necessary and replacing the defective part.

Required Tools

- Long-bladed Phillips (plus +) screwdriver (insulated) with magnetized tip
- Long-bladed flat (minus –) screwdriver (insulated) with magnetized tip
- 3 mm hex key (torque controllable type)
- Anti-static bench mat connected to appropriate ground
- Anti-static wrist strap connected to appropriate ground

Opening the Instrument Chassis



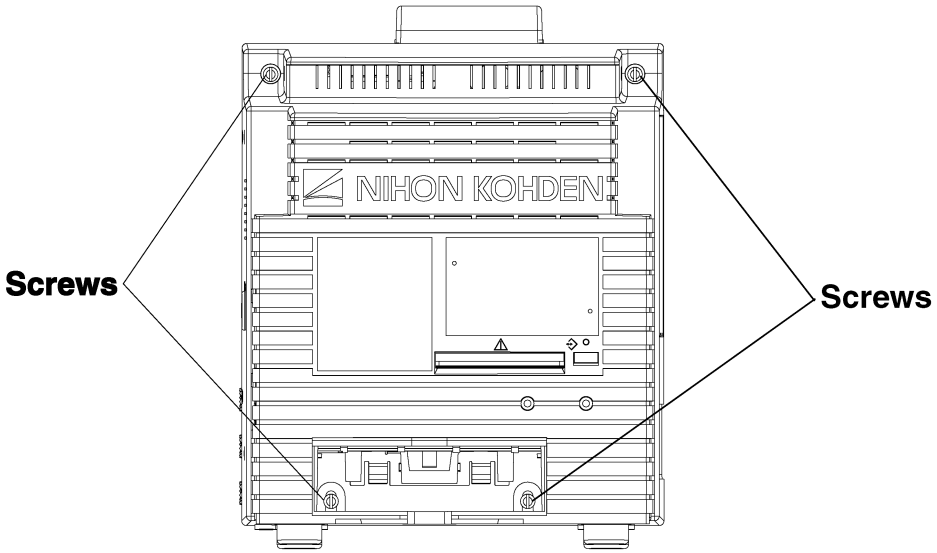
1. Remove the hole plugs from the ends of the handle assembly by popping them out using a screwdriver in the slots.

2. Use a 3 mm hex key to remove the shoulder screws that secure the handle. Remove the handle.

3. Use a long-bladed Phillips screwdriver to remove the 2 screws recessed in the front cover. These screws are accessed in the handle mounting.

4. Remove the battery door.

5. Use a long-bladed Phillips screwdriver to remove the 2 screws in the slots located at the back of the battery compartment.



6. Swing the front enclosure to the right (the side with the knobs) to reveal the 3 cables that are connected to the Digital board.

7. Disconnect all 3 cables at the Digital board. The shielded cable is from the Digital board to the LCD; the 12-pin connector is from the Digital board to the key panel; the 28-pin connector is from the Digital board to the Encoder board.

8. Set the front enclosure on a smooth, soft surface to avoid scratching the screen.

Reassembly

NOTE

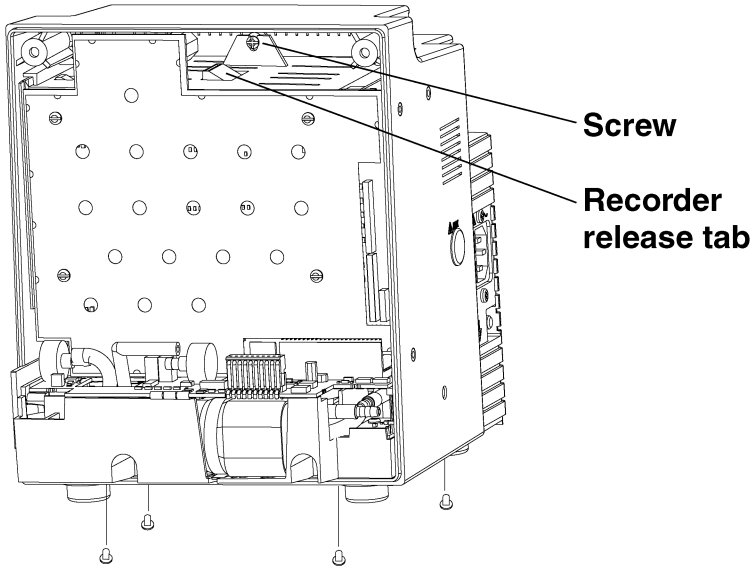
When attaching the handle to the instrument, use a 3 mm hex key to fasten the shoulder screws that secure the handle. Use 1 N•m force.

Reassemble by reversing the above procedure.

Be careful not to pinch or bend the wires or cables.

Accessing Internal Components

1. Follow the instructions in the “Opening the Instrument Chassis” section.

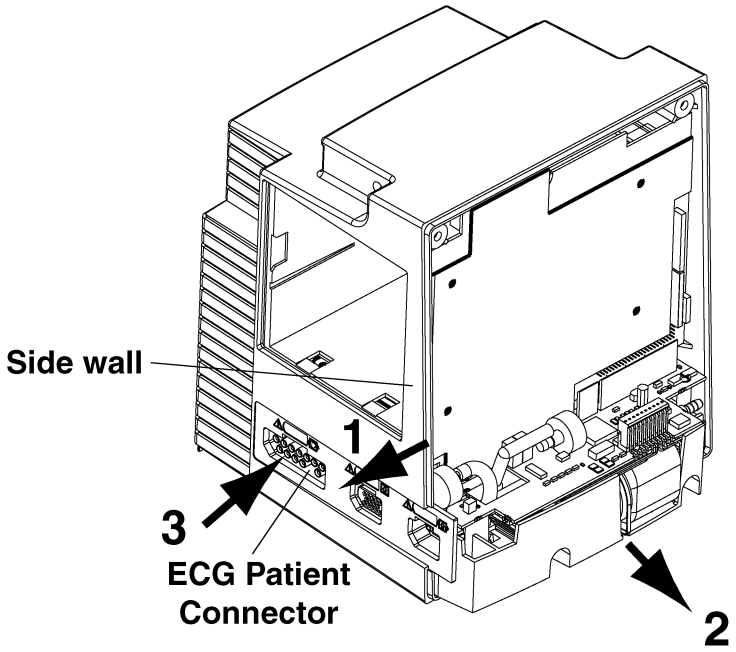


2. If the recorder cover is installed, use a flat-blade screwdriver to press the 2 bottom tabs and remove the cover. If the recorder is installed, press down on the tab at the top of the recorder and slide the recorder out of its enclosure.

3. Remove the screw that secures the top of the internal support assembly to the chassis.

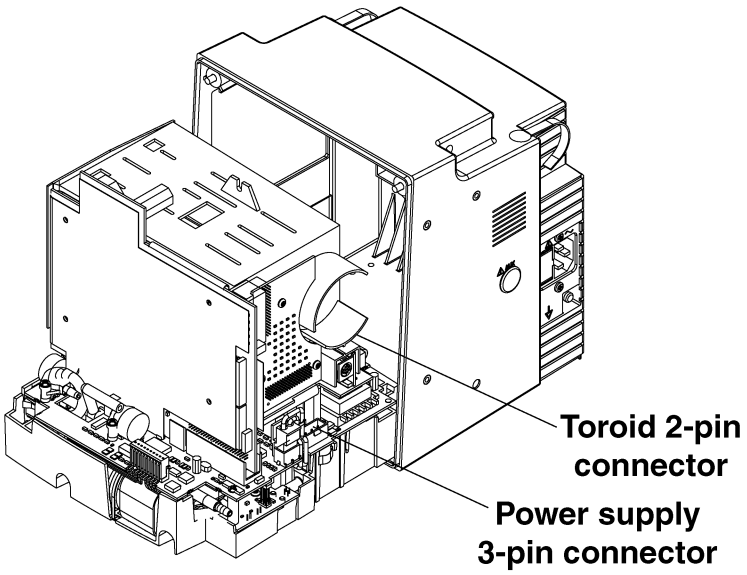
4. Remove the 4 screws and the 4 rubber feet on the bottom of the instrument.

5. While pulling out the side wall in the direction of the arrow 1, carefully pull the lower tray and internal support assembly out of the chassis in the direction of the arrow 2. Do not pull hard because the tray is still attached by the wiring.



NOTE

The green ECG patient connector can catch on the rear enclosure wall. If this occurs while pulling out the side wall, push this green connector inward in the direction of the arrow 3 as the internal support assembly is removed.

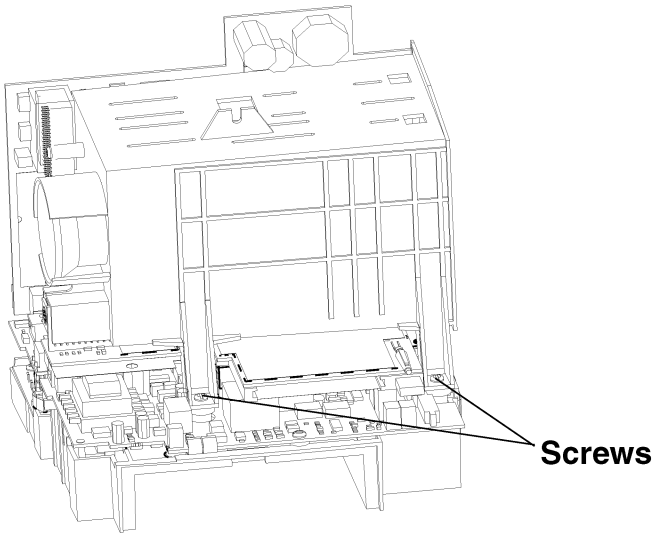


6. Disconnect the 3-pin connector at the right side of the unit that goes from the power supply board to the Analog board.

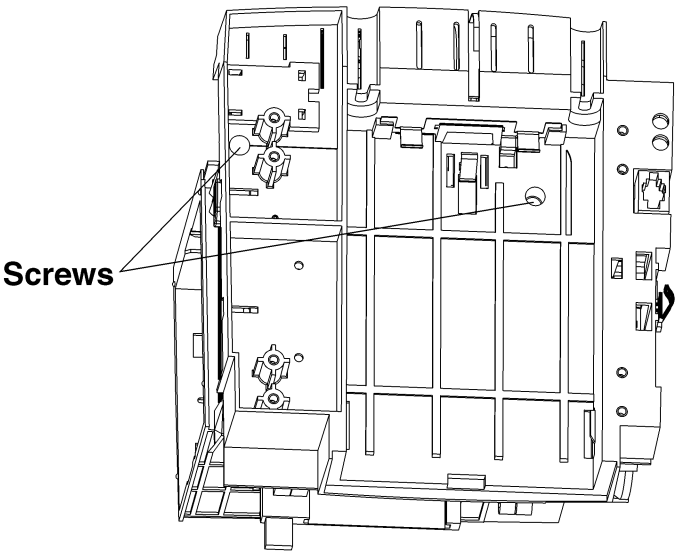
7. Reach through the large recorder opening at the side of the instrument and disconnect the 2-pin connector that goes from the back of the Analog board to the toroid.

8. Pull the tray the rest of the way out.

9. Remove the 2 screws from the rear of the internal support assembly. These screws secure the internal support assembly to the tray.



10. Remove the 2 deeply recessed screws from the bottom of the tray.



11. Lift the upper part of the internal support assembly off the Analog board.

Reassembly

Reassemble by reversing the above procedure.

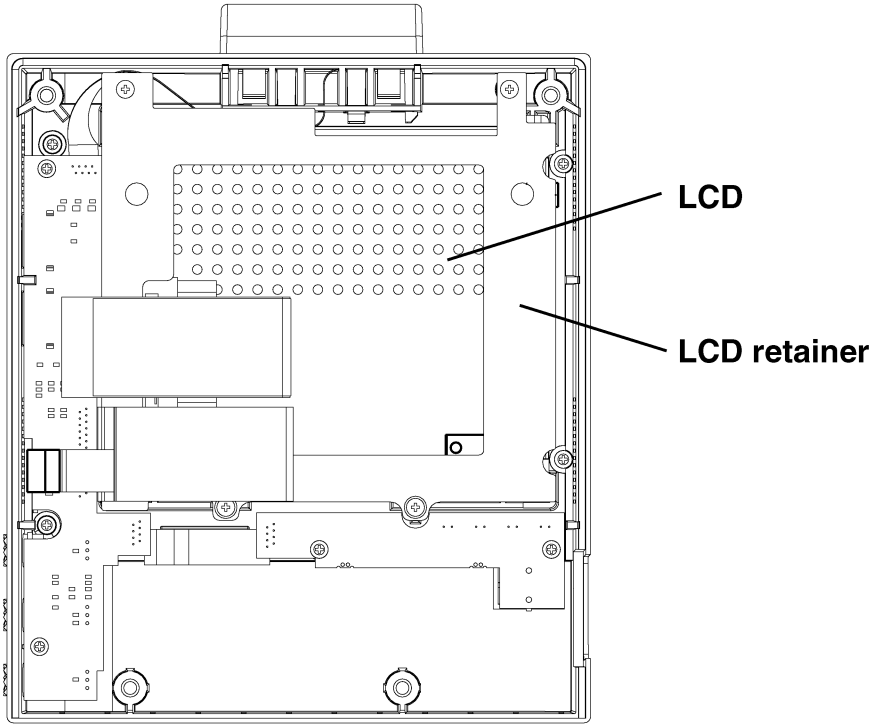
Be careful not to strain the wires from the power supply or toroid when reattaching them.

NOTE

During reassembly of the internal support assembly into the rear enclosure, the black toroid cable must be pulled toward the recorder opening and be positioned between the Analog board and the PCMCIA board. The power/ground cables must be positioned in the slot below the speaker. Pull the wire harness forward as you slide the internal support assembly into the rear enclosure.

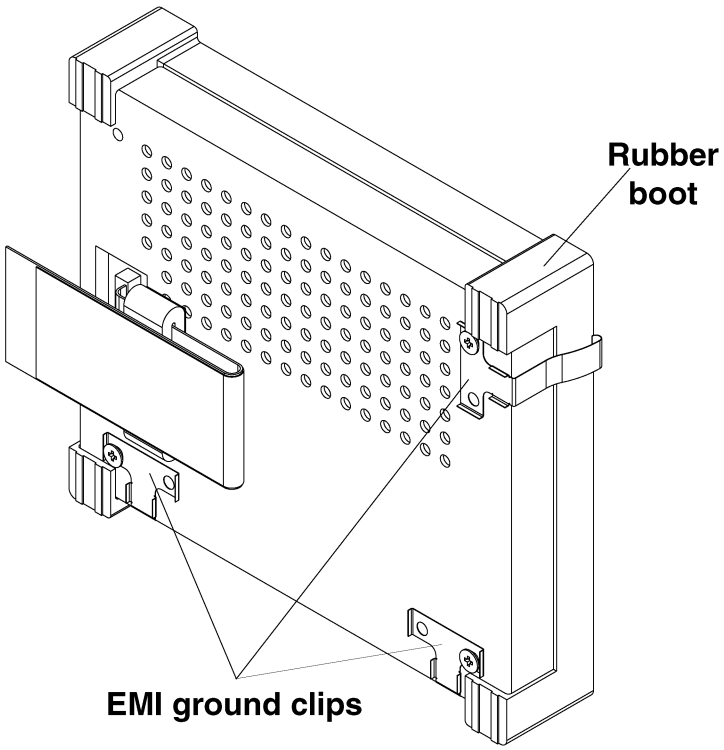
Replacing the LCD

1. Follow the instructions in the “Opening the Instrument Chassis” section.



2. Remove the 4 screws that secure the LCD retainer and remove the retainer.

3. Remove the 3 screws that secure the EMI ground clips.



4. Lift out the LCD unit and disconnect the ribbon cable. Remove and save the rubber boot around the LCD. (Note the orientation of the rubber boot around the LCD. One side of the LCD case is wider than the other.)

Reassembly

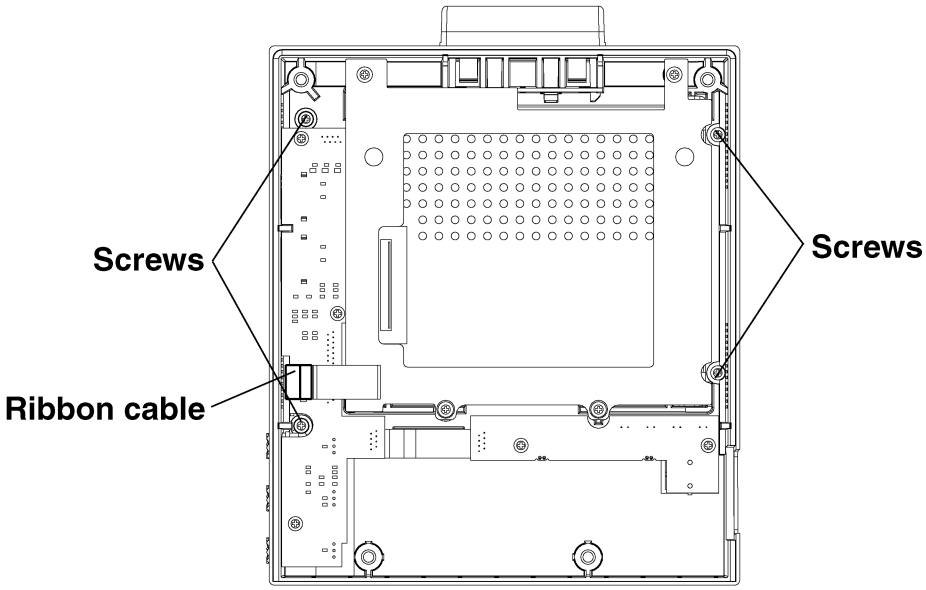
Replace the LCD, place the rubber boot on the new LCD, reassemble the 3 EMI ground clips, and reassemble by reversing the above procedure.

NOTE

Handle the LCD carefully so that it does not become marked by fingerprints or scratches. Also, be sure that no dust gets in the space between the LCD and its lens.

Replacing the Membrane Switch

1. Follow the instructions in the “Opening the Instrument Chassis” section.

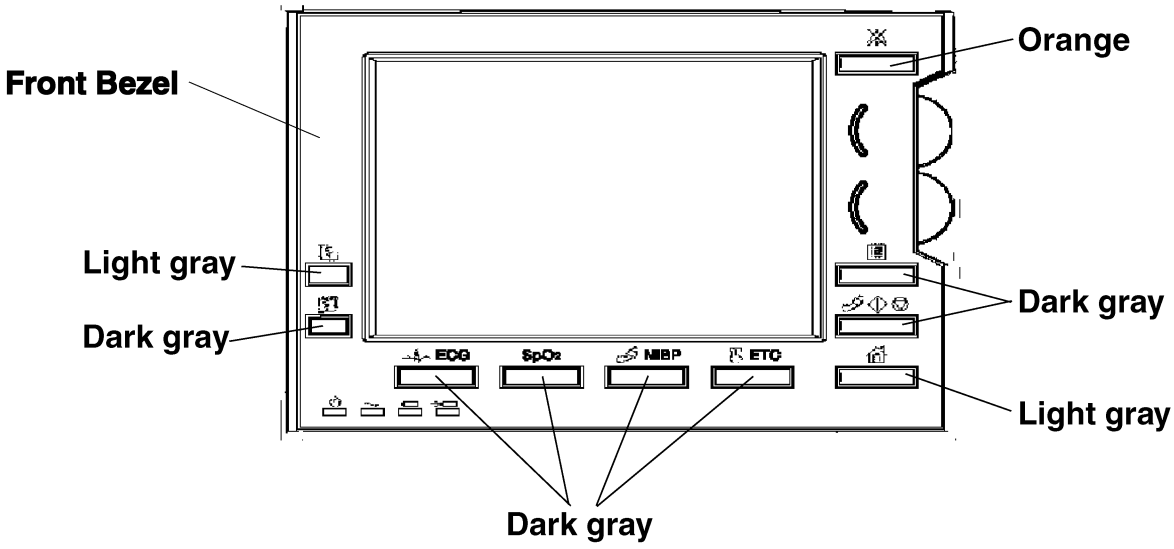


2. Remove the 4 screws that secure the front bezel.

3. Guide the ribbon cable through the slot in the front bezel. Remove the bezel from the front assembly.

4. Carefully peel the old membrane switch assembly off the rear of the bezel.

5. Reposition the buttons through the appropriate openings in the bezel.



6. Peel the backing from the new membrane switch assembly.

7. Carefully position the new membrane switch assembly.

NOTE

To prevent decreased reliability of the new membrane switch assembly, avoid peeling off the assembly and repositioning.

8. Press the switch evenly to the inside of the front panel.

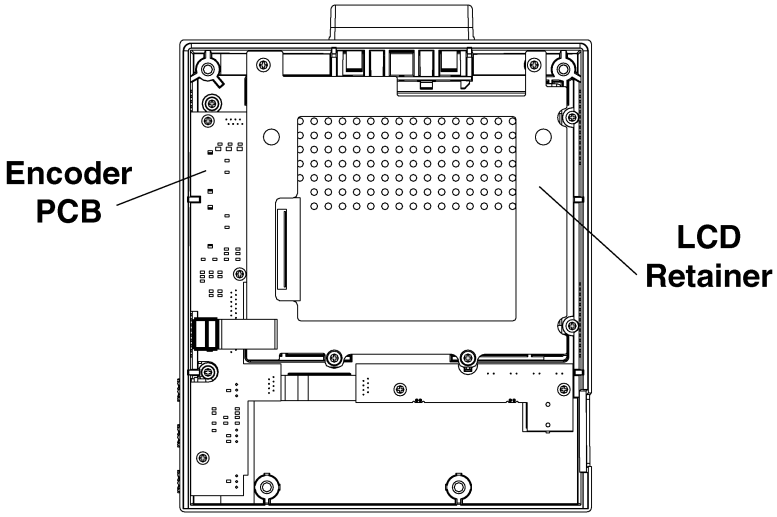
Reassembly

1. Feed the ribbon cable through the slot in the front bezel and then to the left of the Encoder board.

2. Reassemble by reversing the above procedure.

Replacing the Encoder Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.



2. Remove the 4 screws that secure the front bezel.

3. Guide the ribbon cable through the slot in the front bezel. Remove the bezel from the front assembly.

4. Remove the 4 screws that secure the LCD retainer and set the retainer aside. Remove the LCD assembly.

5. At the Encoder board, disconnect the 2 small flat flex cables that go from the Encoder board to the light bar assembly and from the Encoder board to the Power Switch board.

6. Use a flat-blade screwdriver to loosen the upper and lower multifunction dials from their mounting shafts and remove the dials.

7. Remove the 3 screws that secure the Encoder board.

8. Slide and pivot the Encoder board to the right until the 3 volume control knobs have cleared their openings. Lift the Encoder board out of the enclosure.

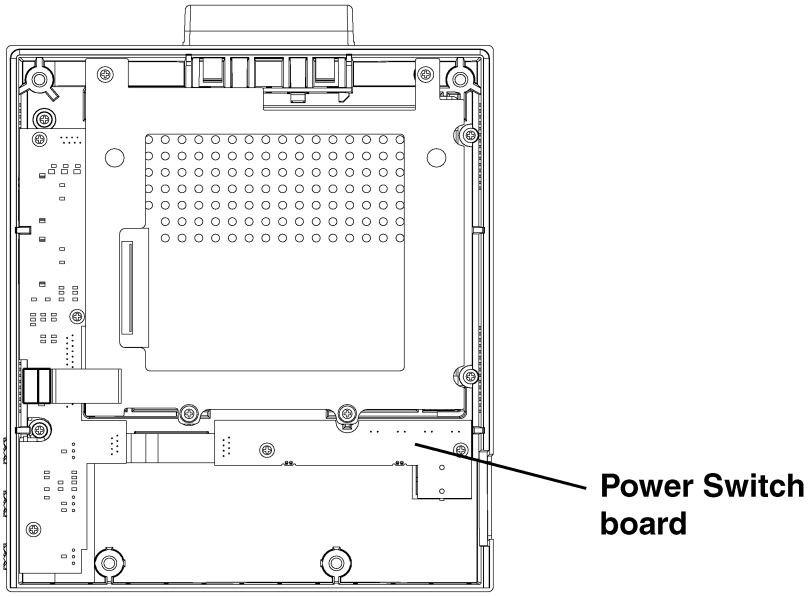
Reassembly

1. Reconnect the flat flex cables before positioning the Encoder board.

2. Replace the Encoder board and reassemble by reversing the above procedure.

Replacing the Power Switch Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.



2. At the Power Switch board, disconnect the flat flex cable that goes from the Power Switch board to the Encoder board.

3. Remove the 2 screws that secure the Power Switch board.

4. Lift out the Power Switch board.

5. Remove the plastic Power switch and place it on the new Power Switch board.

Reassembly

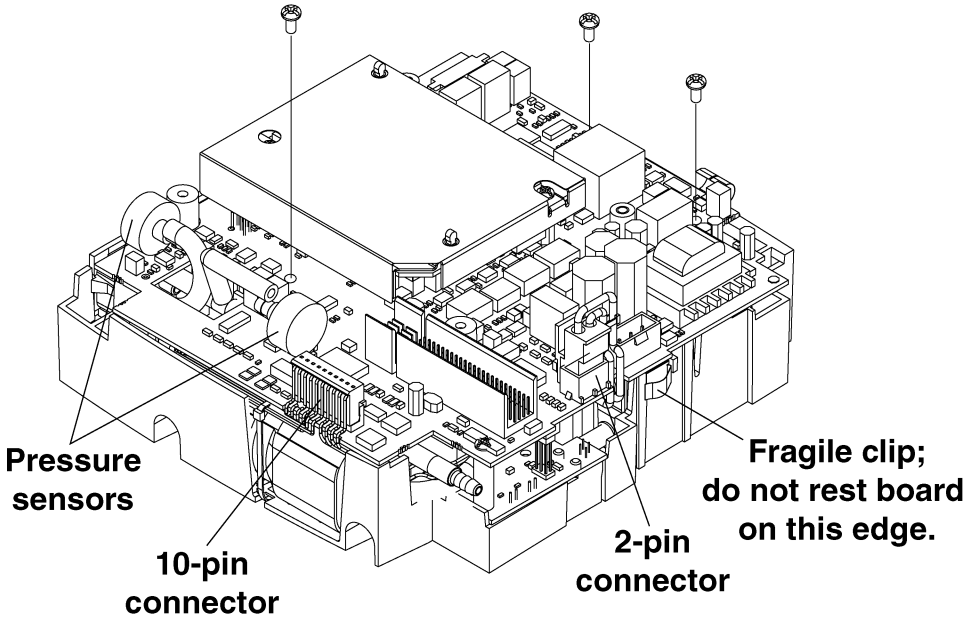
Install the new Power Switch board and reassemble by reversing the above procedure.

Replacing the Analog Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing Internal Components” section.

3. At the front of the Analog board, disconnect the 10-pin connector that goes from the Analog board to the NIBP components.



4. At the side of the Analog board, disconnect the 2-pin connector that goes from the Analog board to the battery contacts.

5. Disconnect the 2 hoses from the pressure sensors on the Analog board. Be careful not to bend the pressure sensor leads.

6. Remove the 3 screws that secure the Analog board to the tray.

7. Pull the connector cover for the patient inlets out of the tray.

8. Carefully lift the Analog board to remove it from the tray.

Reassembly

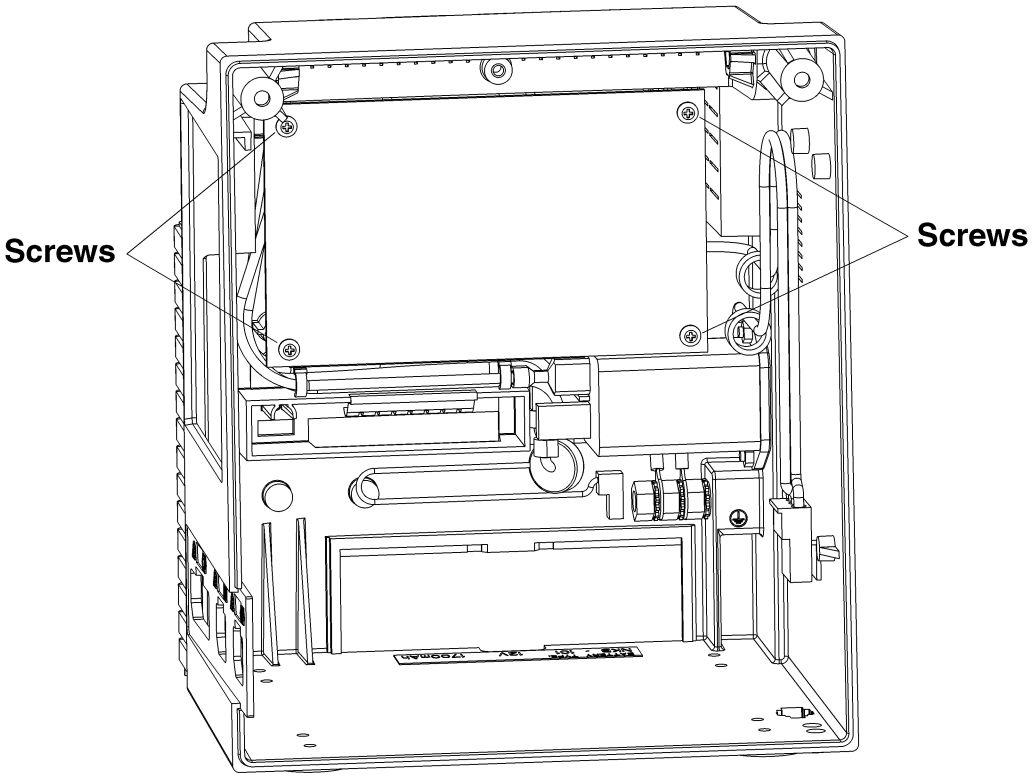
Replace the Analog board and reassemble by reversing the above procedure.

Replacing the Power Supply Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing Internal Components” section.

3. Remove the 4 screws that secure the Power Supply board to the rear of the chassis.



4. Lift the Power Supply board.

5. At the front of the Power Supply board, disconnect the 3-wire connector that goes from the Power Supply board to the AC inlet.

6. At the front of the Power Supply board, disconnect the 2-wire connector that goes from the Power Supply board to the ground.

7. Remove the Power Supply board.

Reassembly

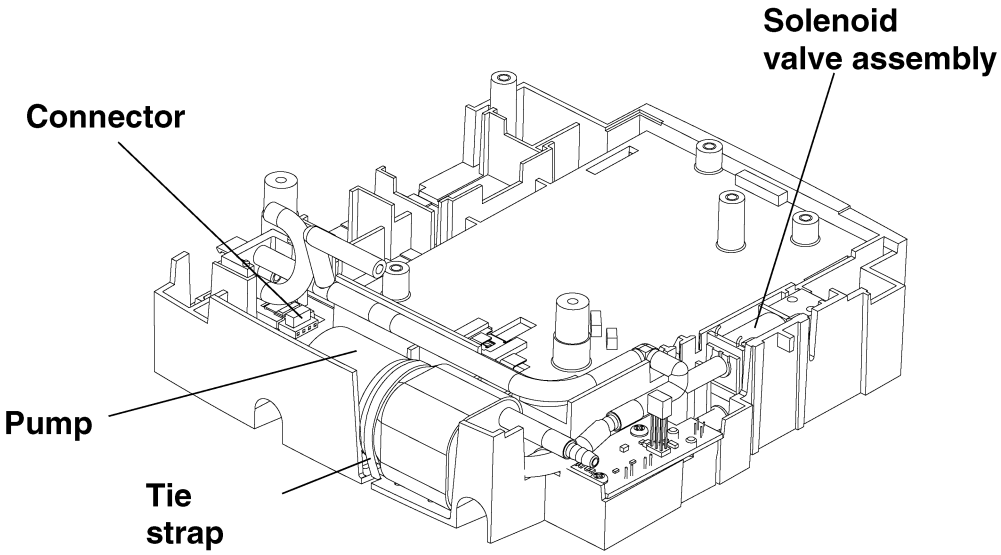
Replace the Power Supply board and reassemble by reversing the above procedure.

Replacing the Pump and/or Solenoid Valve Assembly

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing Internal Components” section.

3. Follow the instructions in the “Replacing the Analog board” section. The components located in the tray should be all that remain.



4. Lift out and unclip the 2 spade connectors from the pump.

5. To remove the pump, clip the tie strap and disconnect the air filter hose and intake manifold hose. Note the orientation of all components. Lift the pump out of the tray.

6. To remove the solenoid valve assembly, press out on the snap next to the assembly and lift the valve assembly out of the tray. Note the orientation of all components. Disconnect the 4-joint manifold tubing from the valve orifice.

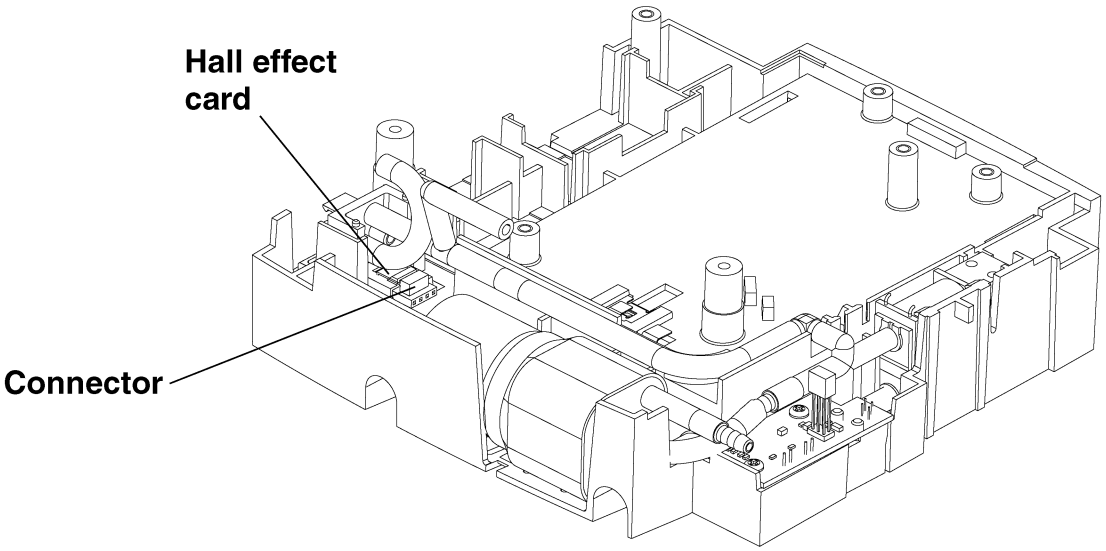
Reassembly

Replace the pump and/or solenoid valve assembly and reassemble by reversing the above procedure.

Be sure to route the hoses carefully.

Replacing the Hall Effect Card

1. Follow the instructions in the “Opening the Instrument Chassis” section.
2. Follow the instructions in the “Accessing Internal Components” section.
3. Follow the instructions in the “Replacing the Analog board” section. The components located in the tray should be all that remain.



4. Lift out the red NIBP connector.
5. Unclip the connector from the hall effect card that goes to the Analog board.
6. Press the plastic snaps and lift out the hall effect card without disturbing the pump or solenoid valve assembly.

Reassembly

Replace the hall effect card and reassemble by reversing the above procedure.

Be sure the card is seated properly in its compartment.

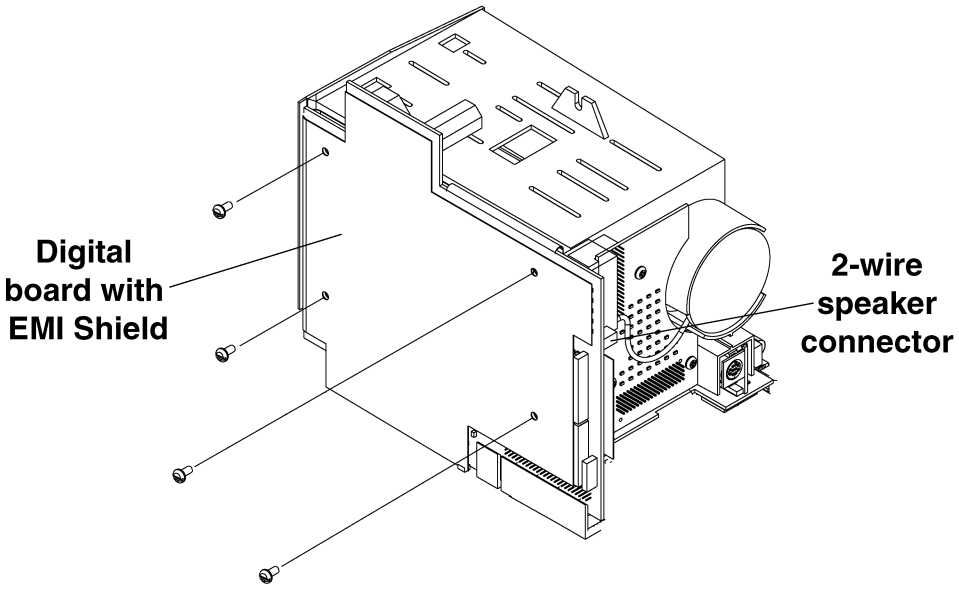
Replacing the Digital Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing Internal Components” section.

3. Disconnect the 2-wire speaker connector from the Digital board.

4. Remove the 4 screws that secure the Digital board to the internal support assembly and unfold the flexible EMI shield.



5. Firmly pull the board away from the assembly, being careful not to damage the two large connectors on the edges.

Reassembly

Replace the Digital board and reassemble by reversing the above procedure.

NOTE

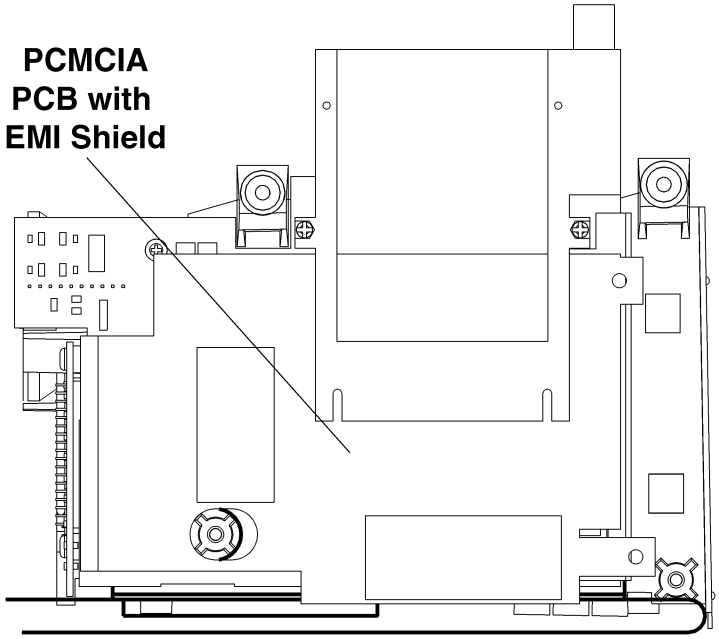
When refolding the EMI shield, be sure that the exposed copper surfaces are refolded so that they touch one another.

Replacing the PCMCIA Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing Internal Components” section.

3. Follow the instructions in the “Replacing the Digital board” section. This removes the Digital board so you can have access to the PCMCIA board.



4. Remove the 4 screws that secure the PCMCIA board to the internal support assembly and unfold the flexible EMI shield.

5. Remove the PCMCIA board.

Reassembly

Replace the PCMCIA board and reassemble by reversing the above procedure.

NOTE

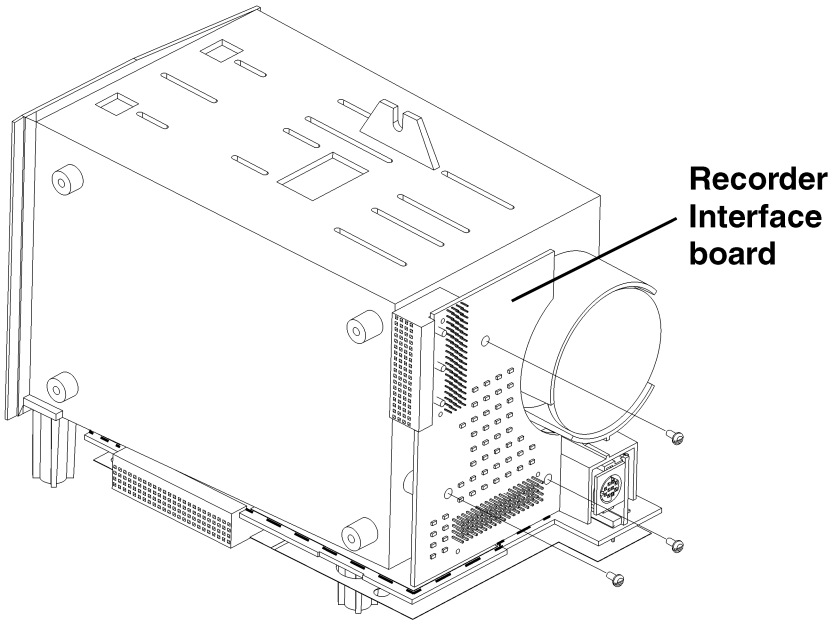
When refolding the EMI shield, be sure that the exposed copper surfaces are refolded so that they touch one another.

Replacing the Recorder Interface Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing Internal Components” section.

3. Follow the instructions in the “Replacing the Digital board” section to remove the Digital board.



4. Remove the 3 screws that secure the Recorder Interface board to the internal support assembly.

5. Carefully lift out the Recorder Interface board.

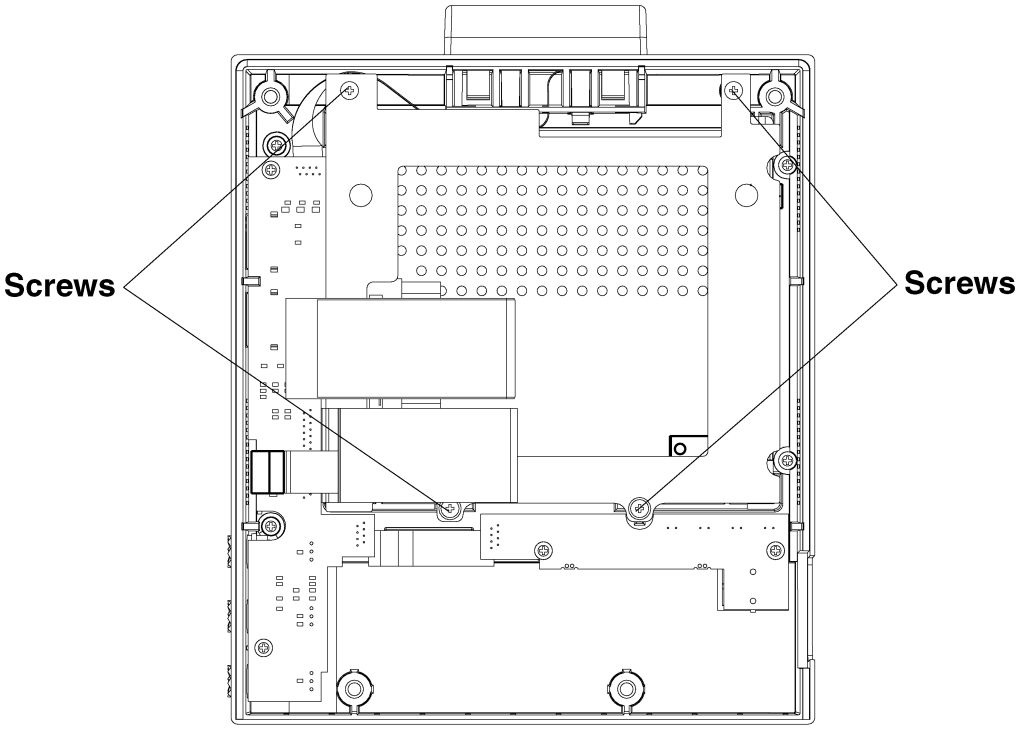
Reassembly

Replace the Recorder Interface board and reassemble by reversing the above procedure.

Replacing the Light Bar

1. Follow the instructions in the “Opening the Instrument Chassis” section.

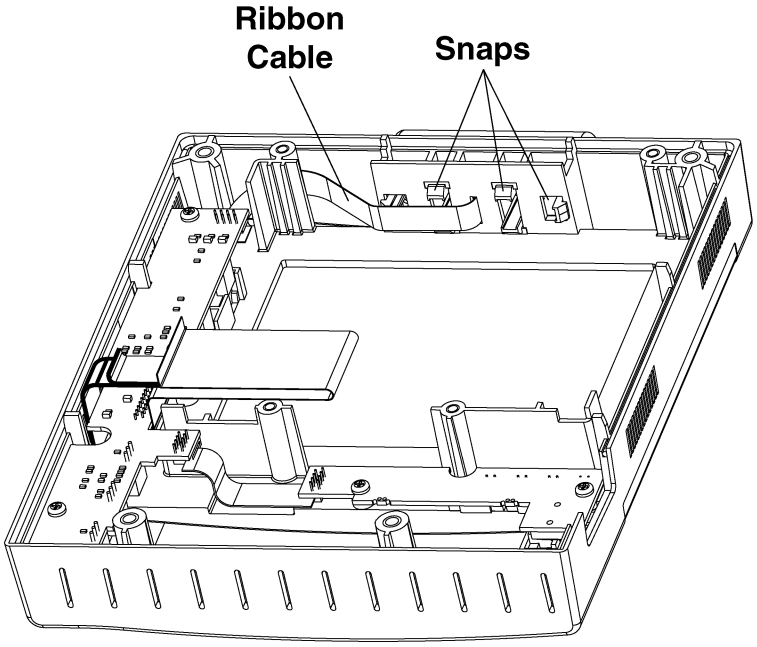
2. Remove the 4 screws that secure the LCD retainer and remove the retainer.



3. Lift out the LCD unit.

4. Gently pull out the ribbon cable from the light bar assembly.

5. Press the three snaps on both ends of the light bar assembly to release the unit. Discard the old light bar.



6. Pull the ribbon cable through the slot and, using a needle-nose pliers, insert the connector into the slot of the new light bar.

7. Carefully press the light bar back into place, ensuring that snaps into position.

8. Replace the LCD unit, making sure that the ribbon cable is not bent or folded.

Reassembly

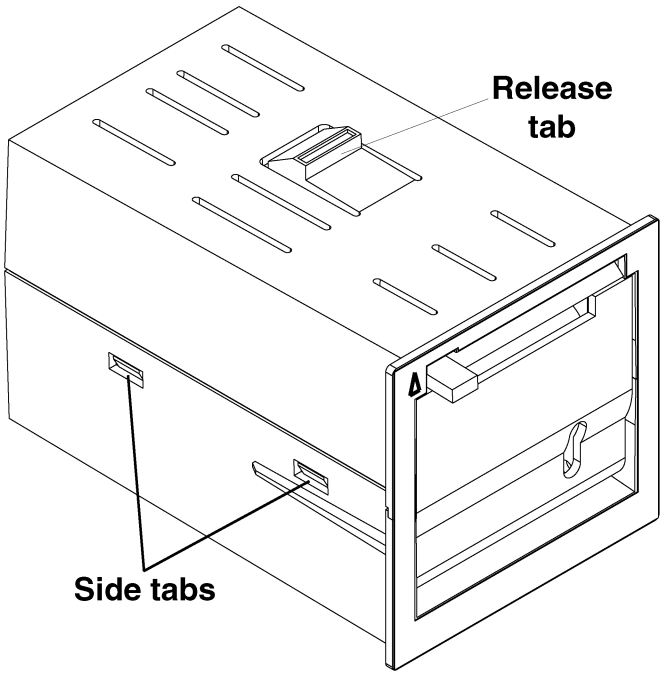
Reassemble the unit by reversing steps 1-2, above.

Replacing the Recorder Module Board

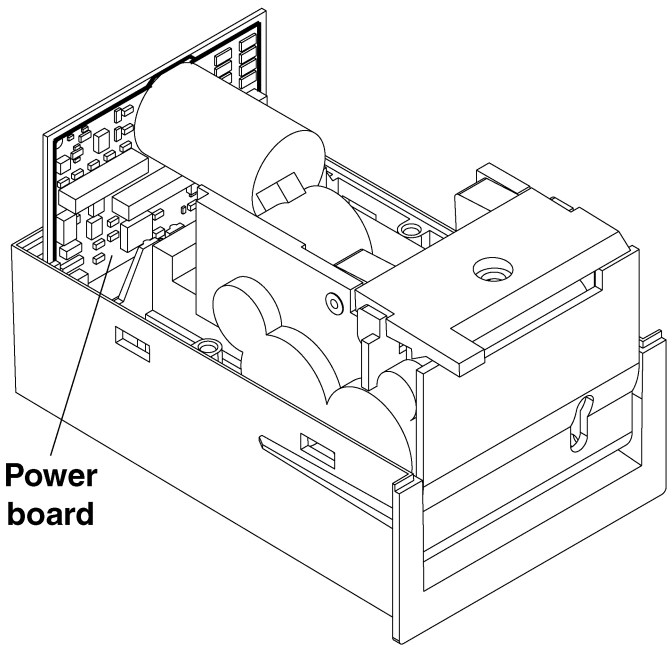
1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. If the recorder is installed, press down on the tab at the top of the recorder and slide the recorder out of its enclosure.

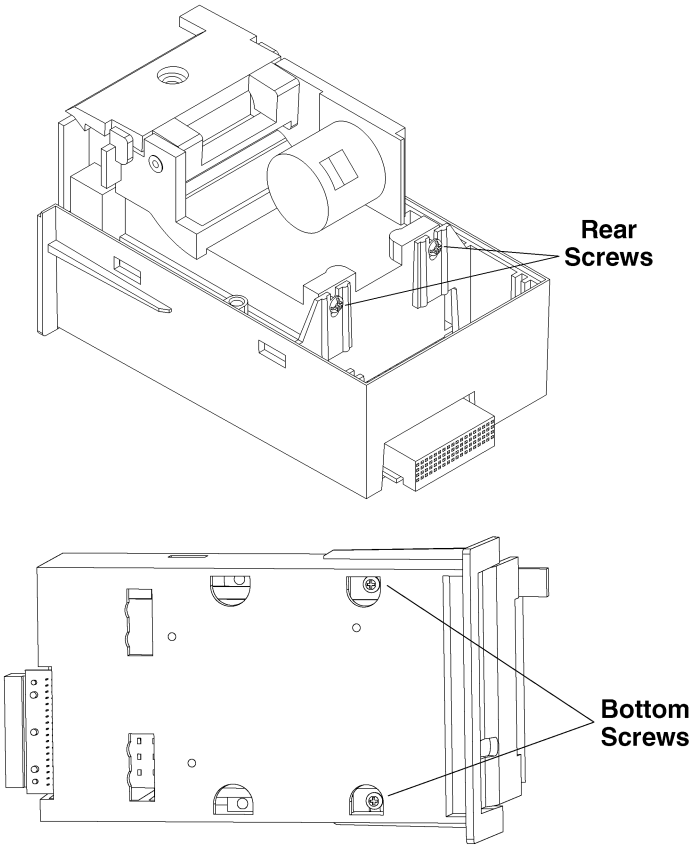
3. Push in the side tabs to release the recorder cover.



4. Remove the power board and disconnect the 3 connectors from the board.

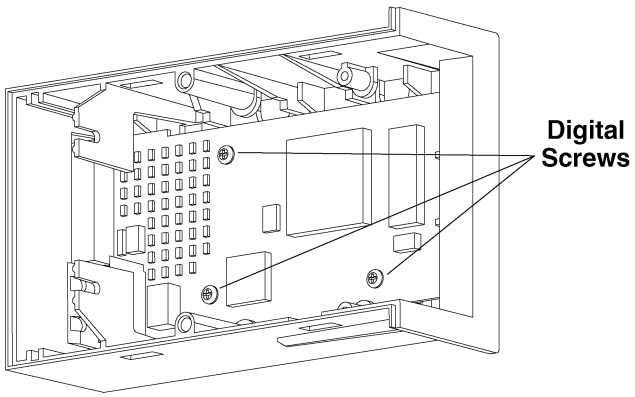


5. Remove the 2 rear screws and 2 bottom screws to release the recorder unit.



6. Slide out the recorder unit.

7. Remove the 3 digital screws and lift out the board.



Reassembly

Reassemble the recorder module by reversing the above procedure.

Replacing the Option Module Interface Board

1. Follow the instructions in the “Opening the Instrument Chassis” section.

2. Follow the instructions in the “Accessing the Internal Components” section.

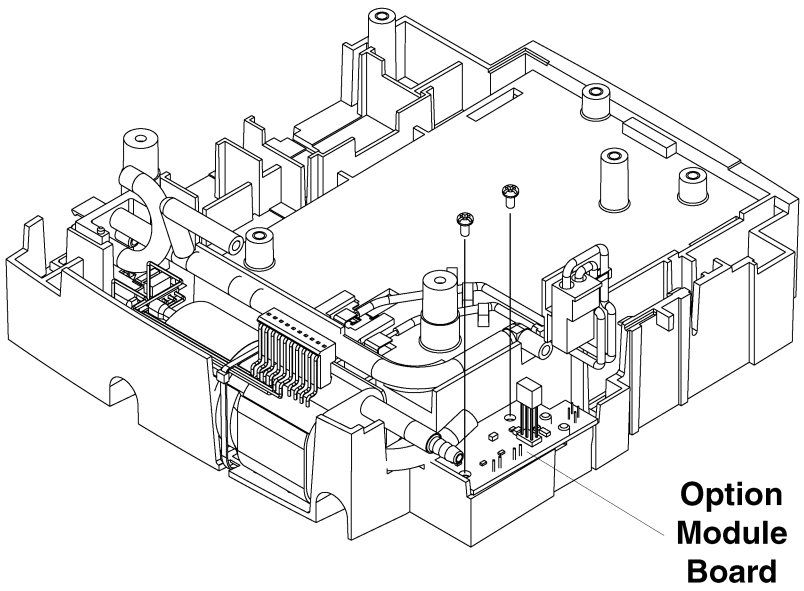
3. Follow steps 3 to 8 in the “Replacing the Analog Board” section.

4. Pull back on the valve assembly snap to release the assembly.

NOTE

The valve assembly does not detach completely. You must hold the assembly to one side to complete this procedure.

5. Remove the 2 screws from the option module interface and lift out the board.



Reassembly

Reassemble by reversing the above procedure.

Section 6 Maintenance

Required Tools

- Long-bladed Phillips screwdriver (insulated) with magnetized tip
- Long-bladed flat screwdriver (insulated) with magnetized tip
- 3 mm hex key (torque controllable type)
- Anti-static bench mat connected to appropriate ground
- Anti-static wrist strap connected to appropriate ground

Measuring and Test Equipment

Digital Voltmeter

A digital tester with at least 3-1/2 digits LCD display that can measure voltage, current, and resistance.

Cathode-ray Oscilloscope

An oscilloscope with a bandwidth of more than 1 MHz and a sensitivity of more than 10 mV/cm.

Function Generator

A function generator with a range of 1 Hz to at least 1 kHz with 1% or better frequency accuracy.

AX-800P Vital Sign Simulator

A simulator that outputs ECG, respiration, temperature, blood pressure, and cardiac output data.

YS-545R6 NIBP Dummy Cuff

A 700 ml container that is needed for some NIBP diagnostic check items.

AX-110G SpO_2 Simulator (for BSM-1101)

A simulator that outputs fixed SpO_2 data.

N1290 Nellcor SpO_2 Pulse Simulator with RCAL Adapter Model RA-1 (for BSM-1102)

A simulator that outputs fixed SpO_2 data.

Pocket Tester Model PT-2500

Maintenance Check Items and Schedule

Perform this maintenance check once every six months.

A maintenance check sheet is provided at the end of this section. Make a copy of this check sheet before using it. The check items are grouped as follows:

- External
- Safety
- Power
- Input circuit
- Display screen
- Measuring parameters
- Recorder

Following are the procedures for each check item.

External

Item	Check Procedure	Action
Dirt	Check the outside of the instrument for dirt.	Clean with a cloth moistened with neutral soap or alcohol.
Loose screws	Check all screws for tightness.	Tighten loose screws.
Damaged or bent parts	Check the instrument, including cable, cord and pins on the connector or socket for damaged or bent parts.	Replace damaged or bent parts.
Warning and caution labels	Check the labels for readability.	Replace damaged or worn labels.

Safety

Item		Check Procedure	Action
Protective earth impedance (refer to IEC 60601-1 18.(f).)		Check that the impedance between the protective earth contact and any accessible metal part does not exceed 0.1 Ω.	Remove the cause if the impedance exceeds 0.1 Ω.
Earth leakage current (refer to IEC 60601-1 19.)		Check that the earth leakage current does not exceed 0.5 mArms under normal condition and 1.0 mArms under each single fault condition.	Remove the cause if the earth leakage current exceeds one of the maximum values.
Enclosure leakage current (refer to IEC 60601-1 19.)		Check that the enclosure leakage current does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition.	Remove the cause if the enclosure leakage current exceeds one of the maximum values.
Patient leakage current (refer to IEC 60601-1 19.)	Patient leakage current	Check that the patient leakage current to type CF or defibrillation-proof CF applied part does not exceed 0.01 mArms under normal condition and 0.05 mArms under each single fault condition.	Remove the cause if the patient leakage current exceeds one of the maximum values.
		Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition.	
	Patient leakage current (mains voltage on the applied part)	Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.05 mArms under each single fault condition.	
		Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 5 mArms under each single fault condition.	
Dielectric strength (refer to IEC 60601-1 20.)		Check that the instrument has the following withstand voltage. • A-a1: 1500 V AC for one minute • A-f: 1500 V AC for one minute • B-a: 4000 V AC for one minute • B-d: 1500 V AC for one minute	Remove the cause if the instrument does not have one of the withstand voltages.

Power

Item	Check Procedure	Action
Power cord	Check the power cord for damage.	Replace the power cord if damaged.
Grounding	Verify that the instrument is grounded to the dedicated facility grounding terminal.	Properly ground the instrument to a dedicated facility grounding terminal.
Fuse	Verify that the fuse holder contains a workable fuse with no signs of breakage or burning.	Find and correct the cause of any blown fuse, then replace the fuse with the recommended fuse type
Fuse type	Verify that the fuse in the fuse holder is the correct type.	Replace any incorrect fuse with the recommended type fuse.
AC power	Verify that the AC input power is within the correct range.	Only use AC power within the correct range.

Fuse Type

All models of BSM-1101/BSM-1102: 2 A/250 V Time-lag (Fuse type does not depend on the line voltages.)

Input Circuit

Item	Check Procedure	Action
Electrode leads	Check for loose electrode lead input jack/socket connection in the instrument.	Replace loose electrode leads.
Recommended ECG electrodes	Verify that the ECG electrodes are of the recommended type.	Use only recommended ECG electrodes.

Display Screen

Item	Check Procedure	Action
LCD brightness	Check the brightness of the LCD by turning the brightness control knob.	If the brightness of the LCD does not respond, check the Digital board or the Encoder board and replace the faulty board as required. In case of battery operating, make sure the instrument is set to Power Saving Mode in the System Setup.
Heart rate trend	Check the heart rate trending function.	If the heart rate trending function does not work, replace the Digital board.
QRS and alarm bar synchronization	Verify that the QRS complex is synchronized with the alarm.	If it is not synchronized, replace the Digital board and/or alarm bar.
QRS and QRS sound synchronization	Verify that the QRS complex is synchronized with the QRS sound.	If it is not synchronized, replace the Digital board.
Alarm operation	Check the alarm operation by changing the alarm limit settings.	If the alarm does not function properly, replace the Digital board.
Alarm sound	Verify that the alarm sounds when an alarm occurs. Turn the volume knob to check alarm audibility.	If the alarm does not sound or is not audible, replace the Digital board or speaker.
Measurement settings	Verify that the measurement settings do not return to their default settings 30 minutes after the instrument is switched off.	If the measurement settings return to their default settings, replace the Digital board.
Self check	Perform the diagnostic checks.	Perform the necessary corrective action as suggested by the test.

Measuring Parameters

Item	Check Procedure	Action
ECG HR display (80 ±2 bpm)	Use the AX-800P Vital Sign Simulator to input normal ECG signal to the instrument and verify that the displayed heart rate of the input ECG signal is within 80 ±2 bpm.	If the displayed heart rate is not within the range, replace the Analog board.
SpO_2 (97 ±2%) (BSM-1101)	Use the AX-110G SpO_2 Simulator to input normal SpO_2 signal to the instrument and verify that the displayed SpO_2 is within 97 ±2%.	If the displayed SpO_2 is not within the range, replace the SpO_2 board.
SpO_2 (97 ±X*%) (BSM-1102)	Use the N1290 Nellcor SpO_2 Pulse Simulator to input normal SpO_2 signal to the instrument and verify that the displayed SpO_2 is within 97 ±X*%.	If the displayed SpO_2 is not within the range, replace the SpO_2 board.
NIBP	Check the NIBP operation of the instrument according to the procedures in Section 3 of this manual.	If an error occurs, replace the Analog board.

*The SpO_2 measuring accuracy on the BSM-1102 depends on the probe as described below:

70 to 100%

- D-25/D-25L: ±2 digits
- DS-100A: ±3 digits
- N-25: ±2 digits
- D-YS: ±3 digits
- I-20: ±2 digits
- D-20: ±2 digits
- OXICLIQ I: ±2.5 digits
- OXICLIQ P: ±2.5 digits
- OXICLIQ A: ±2.5 digits
- OXICLIQ N: ±2.5 digits
- RS-10: ±3.5 digits
- D-YSE: ±3.5 digits
- D-YSPD: ±3.5 digits
- OXIBAND A/N: ±3 digits
- OXIBAND P/I: ±3 digits
- OXI1-2-3 A/N: ±2.5 digits
- OXI1-2-3 P/I: ±2.5 digits

80 to 100%

- R-15: ±3.5 digits

Recorder

Item	Check Procedure	Action
Recording	Verify that the recorder prints at the correct speed, without skewing or abnormal sounds.	If the recorder skews, makes abnormal sounds, or records at an incorrect speed, clean the recorder unit. If this does not correct the problem, replace the recorder unit.
Waveform recording	Verify that the waveform is clearly printed on the paper.	If the waveform is not clearly printed, clean the thermal head. If this does not correct the problem, replace the thermal head.
Alphanumeric recording	1. Verify that the alphanumerics are clearly printed on the paper. 2. Check that the alphanumerics begin recording at the start of the page, beginning at the paper detection mark.	1. If the alphanumerics are not clearly printed, clean the thermal head. If this does not correct the problem, replace the thermal head. 2. If the alphanumerics do not begin recording at the start of the page, clean the paper detection mark sensor.
Recorded time	Verify that the correct time prints on the paper.	If the correct time is not printed, replace the PCMCIA board.
Recommended recording paper	Verify that the recording paper used is the recommended type.	Use only recommended recording paper.

Recommended Recording Paper

Evertrace Heat Sensitive Paper, model: FQW50-3-100

Maintenance Check Sheet

(Refer to the Maintenance section of the service manual for details.)

Customer: _____ Customer Address: _____

Service Personnel: _____ Service Company: _____

Instrument Name: _____ Instrument Model: _____

Instrument Serial Number: _____ Hardware Revision: _____

Software Revision: _____

		Result
1. External	Dirt	
	Loose screws	
	Damaged or bent parts	
	Warning and caution labels	
2. Safety	Protective earth resistance is within prescribed range.	
	Earth leakage current is within prescribed range.	
	Enclosure leakage current is within prescribed range.	
	Patient leakage current is within prescribed range.	
	Instrument can withstand prescribed withstand voltage.	
3. Power	Power cord	
	Grounding	
	Fuse	
	Fuse type	
	AC source type	
4. Input Circuit	Electrode leads	
	Recommended ECG electrodes	
5. Display Screen	LCD brightness	
	Waveform sweep/freeze	
	Heart rate trend	
	QRS and alarm bar synchronization	
	QRS and QRS sound synchronization	
	Alarm operation	
	Alarm sound	
	Measurement settings	
	Self check	
6. Measuring Parameters	ECG HR display (80 ±2 bpm)	
	SpO_2 (97 ±X)	
	NIBP	
7. Recorder	Recording	
	Waveform recording	
	Alphanumeric recording	
	Recorded time	
	Recommended recording paper	
8. Other	Electrical noise generating source	

Section 7 Replaceable Parts List

Periodically Replaceable Parts

Index	NKC P/N	Qty	Description	Expected Life Span/Description
1		1	Module with integral backlight	More than 10,000 hours or 14 months of continuous operation
2	NKB-101	1	Battery	About 1 year
3	UR-3494*	1	PCMCIA board with real-time clock	More than 3 years
4	6114-053114C	1	Platen roller	More than 6 years
5	107002	1	E-ring for platen roller	Replaced with platen roller
6	445074	1	Thermal head for RJ048-8S81	More than 250 stacks of paper during continuous recording

* When replacing the UR-3494 PCMCIA board with a new one, note the following because the new UR-3494 does not have the insulation coating shield sheet and light pipe (transparent plastic rod for memory card lamp) which are attached to the old UR-3494.

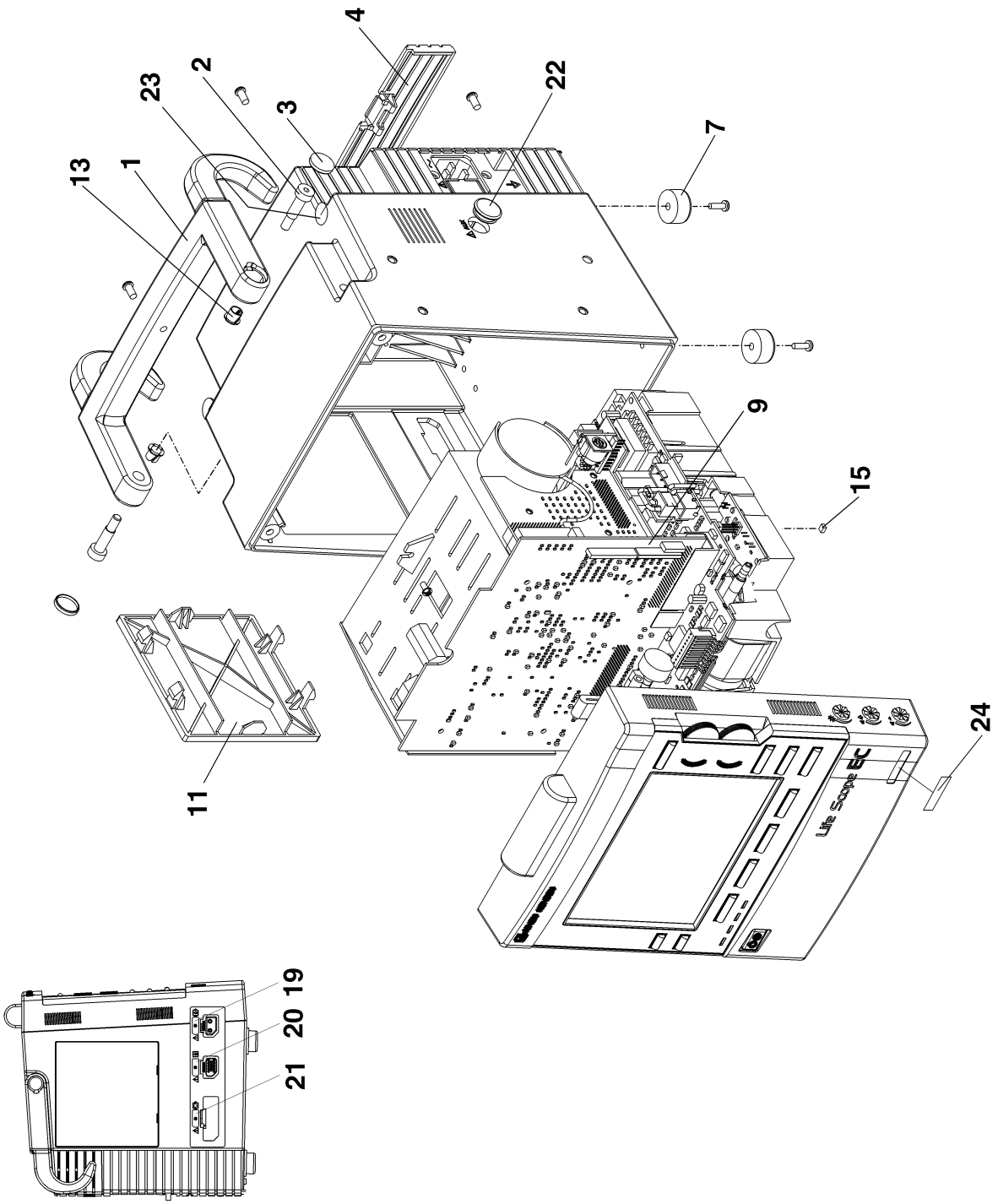
- If the shield sheet on the old UR-3494 has no damage:
  1. Remove the shield sheet and attach it to the new UR-3494.
  2. Remove the light pipe and attach it to the new UR-3494 with the adhesive.

- If the shield sheet on the old UR-3494 has a damage:
  1. Attach the parts as shown below to the new UR-3494 instead of the shield sheet because the shield sheet is not available.
     Shield (top): 6112-012403
     Shield (bottom): 6113-033824A
     Insulation sheet (top): 6113-033833A
     Insulation sheet (bottom): 6114-100278
     EMI gasket: 6114-100287
     Earth spring (to be attached to the power inlet module as the addition): 6114-097503
  2. Remove the light pipe and attach it to the new UR-3494 with the adhesive.
     If replacing the rear enclosure with a new one in addition to the UR-3494 replacement, removing the light pipe from the old UR-3494 is not required because the new rear enclosure has the light pipe.

Main Unit Parts

BSM-1101 Final Assembly

Index	NKC P/N	Qty	Description
1	6113-029125	1	Handle
2	551387	2	Hardware, Shoulder Screw - Metric hex socket head: Zinc Plated with clear chromate, m5 × 6 × 16 (.8 pitch)
3	6113-029134	2	Plastic Handle Cap
4	6113-029143	1	Battery Cover
7	551422	4	Rubber Bumpers, Grey, SBR 60 +/– 5 Durometer
11	6113-029152	1	Recorder Cover
13	551431	2	Nyliner
15	558825	1	Option Module Interface Cover
19	6124-027579	1	Sticker - NIBP
20	6124-027588A	1	Sticker - SpO_2 (for BSM-1101)
	6124-028943A	1	Sticker - SpO_2 (for BSM-1102)
21	6124-027597A	1	Sticker - ECG
22	6113-029179A	1	Cover - ZB-800P Connector
23	551413	2	Bumpers, Handle: Clear with adhesive on one side
24	6124-027605	1	Sticker - Model Number (for BSM-1101)
	6124-027855	1	Sticker - Model Number (for BSM-1102)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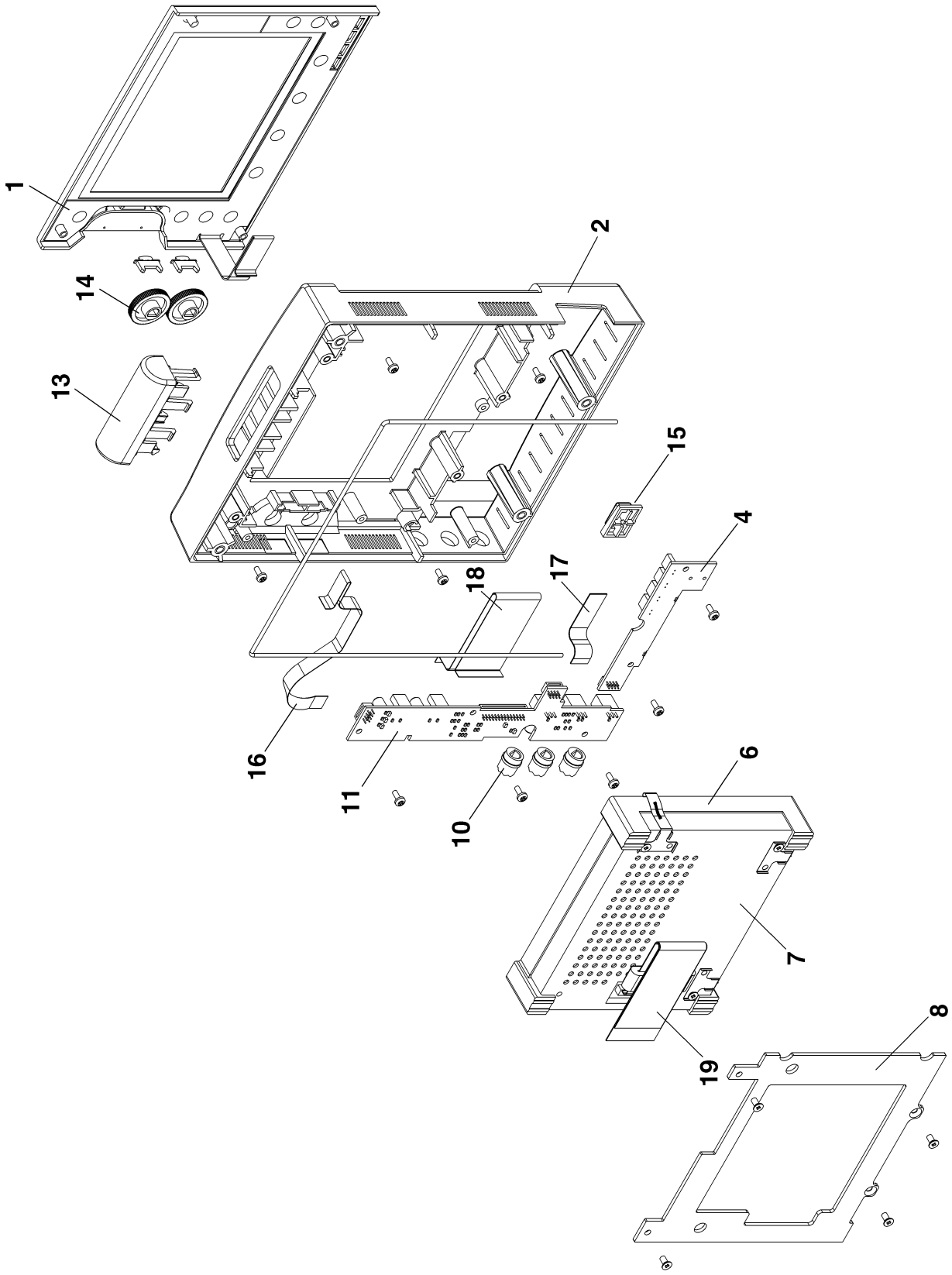
ASSY-Front Enclosure Assembly

Index	NKC P/N	Qty	Description
1	6143-009206*	1	ASSY - Key Panel Assembly
2	6113-029188	1	Front Enclosure
4	UR-3500 (549621)	1	ASSY - Power Switch Board Assembly
6	6113-029232	1	LCD Rubber Boot
7	550004	1	LCD Module
8	6113-029259A	1	LCD Support Bracket
10	6113-029205	3	Volume Knob
11	UR-3496 (549603)*	1	ASSY - Encoder Board Assembly
13	6143-009198	1	Light Bar Assy
14	6113-029214*	2	Jog Dial
15	6113-029223	1	Main Power Button
16	550022	1	Flat Flex Cable, 8 Conductor-long, Length
17	550031	1	Flat Flex Cable, 8 Conductor-short, Length
18	550049	1	Flat Flex Cable, 28 Conductor, Length
19	550058	1	Flat Flex Cable, 30 Conductor, Shielded, Length

* When replacing the parts with new ones, other parts replacement is required as shown below.

Key panel assembly:	Requires front enclosure replacement.
Encoder board:	Requires replacement of the front enclosure, key panel assembly, and jog dial.
Jog dial:	Requires replacement of the front enclosure and key panel assembly.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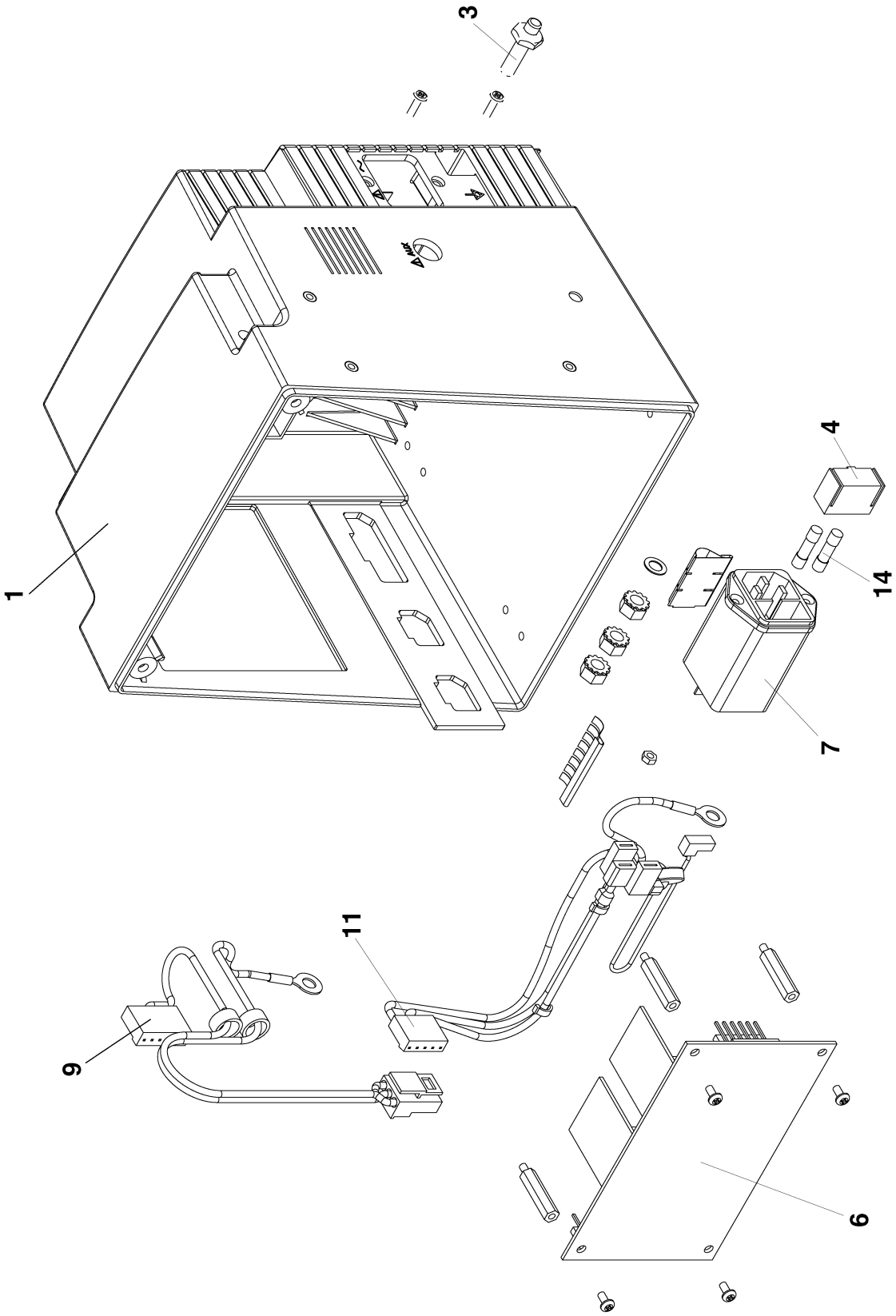
ASSY-Rear Enclosure Assembly

Index	NKC P/N	Qty	Description
1	6113-029277*	1	Rear Enclosure
3	551734	1	Ground Pin (POAG Equipotential Connector)
4	550076	1	Fuse Drawer
6	550013	1	Power Supply
7	550067	1	Power Inlet Module
9	549461	1	ASSY - Wire Harness: Power Supply Output
11	549452	1	ASSY - Wire Harness: Power Supply Input
14	104522	2	Fuse

* When replacing the rear enclosure with a new one, remove the light pipe (transparent plastic rod for LED indicator) from the UR-3494 PCMCIA board because the new rear enclosure has the light pipe.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ASSY-Internal Support Assembly

Index	NKC P/N	Qty	Description
1	6113-029286	1	Internal Support Top
2	6113-029295*[1]	1	Internal Support Tray
3	6113-029303	1	Connector Cover
4	515542A	1	NIBP Connector
5	532149	1	Pump P-22D
5’	6114-097013	1	Single Adhesive-backed Foam/Rubber for Pumps (#33)
6	Tube set		
Ⓐ	6114-096995A	2	Silicon tube 3 × 5 L35
Ⓑ	6114-096977A	2	Silicon tube 3 × 5 L55
Ⓒ	6114-097004A	2	Silicon tube 3 × 5 L16
Ⓓ	6114-096959A	1	Silicon tube 3 × 5 L80
Ⓔ	6113-029312	1	Four-Joint Rubber Manifold
Ⓕ	6113-029321	1	Rubber Elbow
Ⓖ	551396	1	Plastic Barbed Tee
Ⓗ	531337	2	Plastic Barbed Elbow
Ⓘ	531355	1	Check Valve
Ⓙ	531346	2	Air Filter
18	6113-029339	1	Battery Contact, Negative
19	6113-029348	1	Battery Contact, Positive
20	6113-029357	1	Shield - Analog Board, Top
21	6113-029366	1	Shield - Analog Board, Bottom
22	549488	1	ASSY - Speaker and Wire Harness Assembly
23	UR-3492*[1]	1	ASSY - Analog Board Assembly
24	UR-3514	1	Option Interface Board
25	UR-3493*[2]	1	ASSY - Main Digital Board Assembly
26	UR-3494*[3]	1	ASSY - PCMCIA Board Assembly
27	UR-3497	1	ASSY - Hall Effect Board Assembly
28	UR-3501	1	ASSY - Recorder Interface Board Assembly
29	UR-3495	1	ASSY - SpO_2 Nihon Kohden Daughter Board Assembly (for BSM-1101)
	UR-3495	1	SpO_2 Nellcor Daughter Board Assembly (for BSM-1102)
30	549497	1	ASSY - Wire Harness: Non-Invasive Blood Pressure
31	549479	1	ASSY - Wire Harness: Battery
32	6113-032674	1	Shield Analog
40	551378	2	Plastic Standoffs for top shield

*1 When replacing the internal support tray with a new one, note the following.

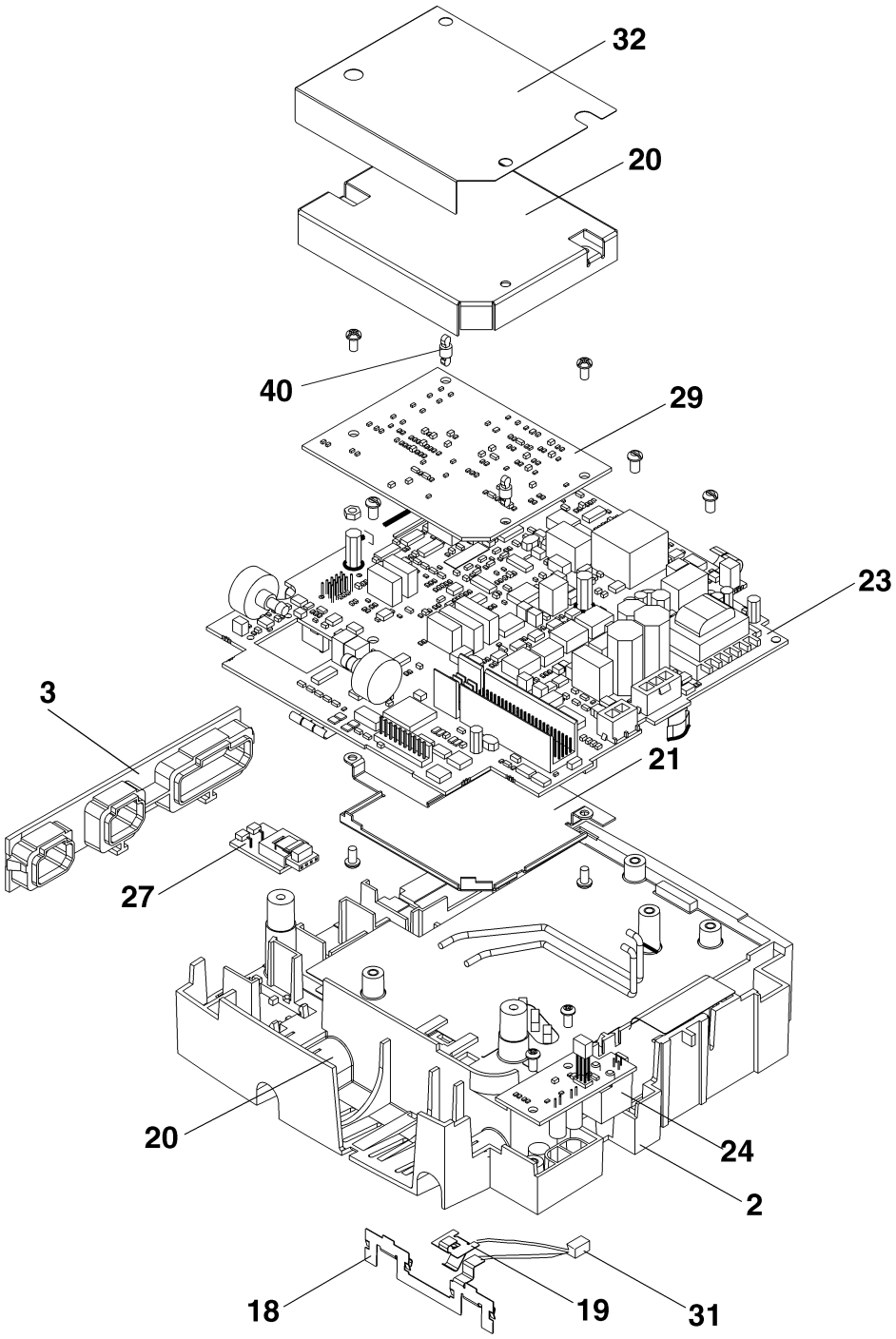
- Remove the spacer behind the NIBP socket.
- If replacing the UR-3492 Analog board with a new one in addition to the internal support tray replacement, attach the spacer bolt (128354) between the UR-3514 Option Interface board and internal support tray.
- If the insulation sheet between the UR-3492 and internal support tray is damaged, attach the following parts to the internal support tray instead of the insulation sheet because the insulation sheet is not available.
  Solenoid shield: 6114-097495A
  Protection sheet: 6114-102623

*2 When replacing the UR-3493 Main Digital board with a new one, perform the following.

1. Remove the insulation coating shield sheet from the UR-3493.
2. Attach the parts as shown below to the new UR-3493 instead of the shield sheet because it is not available.
   Shield (top): 6112-012403
   Shield (bottom): 6113-033824A
   Insulation sheet (top): 6113-033833A
   Insulation sheet (bottom): 6114-100278
   EMI gasket: 6114-100287
3. Remove the spring from the internal support top.

*3 When replacing the UR-3494 PCMCIA board with a new one, note the following because the new UR-3494 does not have the insulation coating shield sheet and light pipe (transparent plastic rod for memory card lamp) which are attached to the old UR-3494.

- If the shield sheet on the old UR-3494 has no damage:
  1. Remove the shield sheet and attach it to the new UR-3494.
  2. Remove the light pipe and attach it to the new UR-3494 with the adhesive.
- If the shield sheet on the old UR-3494 has a damage:
  1. Attach the parts as shown below to the new UR-3494 instead of the shield sheet because the shield sheet is not available.
     Shield (top): 6112-012403
     Shield (bottom): 6113-033824A
     Insulation sheet (top): 6113-033833A
     Insulation sheet (bottom): 6114-100278
     EMI gasket: 6114-100287
     Earth spring (to be attached to the power inlet module as the addition): 6114-097503
  2. Remove the light pipe and attach it to the new UR-3494 with the adhesive.
- If replacing the rear enclosure with a new one in addition to the UR-3494 replacement, removing the light pipe from the old UR-3494 is not required because the new rear enclosure has the light pipe.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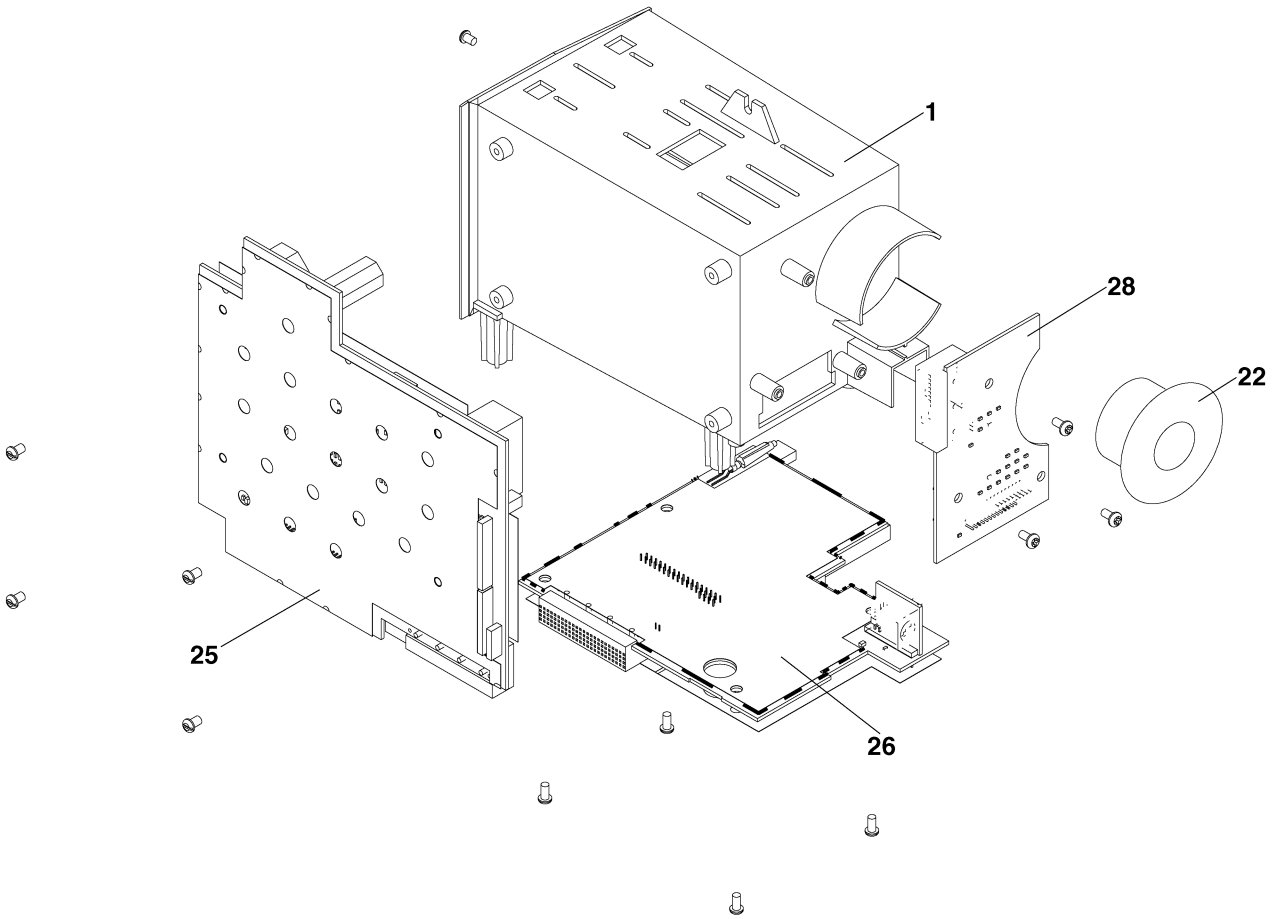
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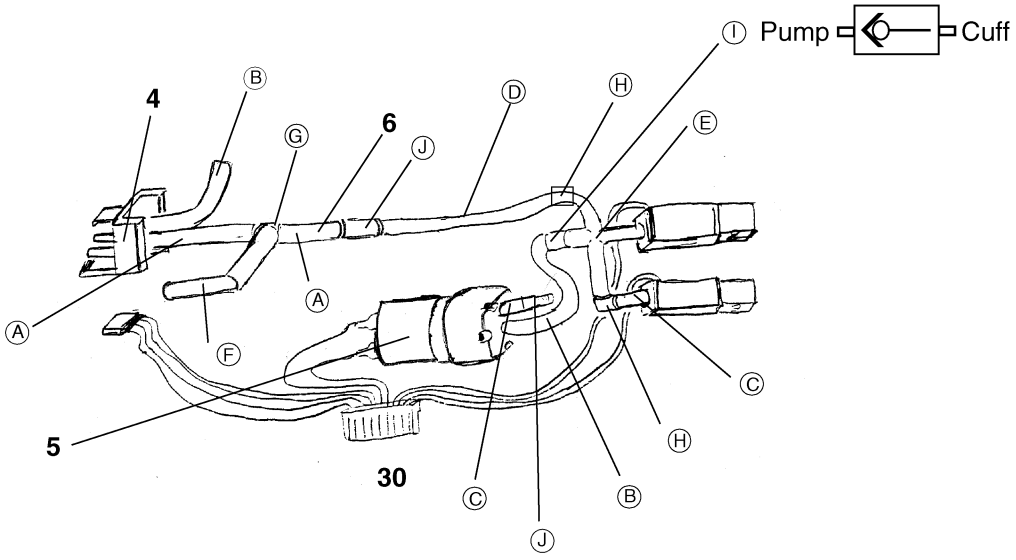
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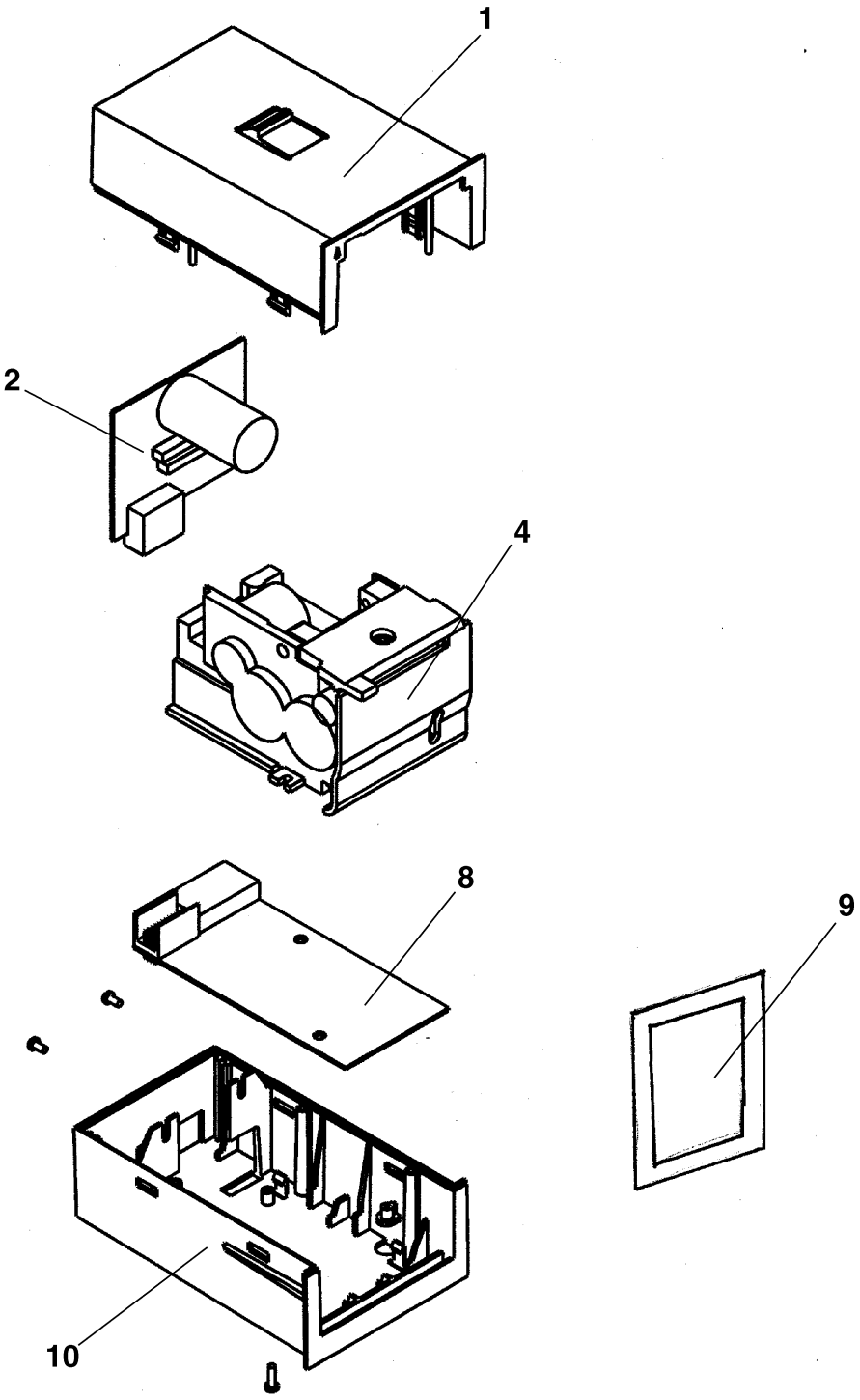
Recorder Assembly

Index	NKC P/N	Qty	Description
1	6113-029375	1	Recorder Shell Top
2	UR-3491	1	ASSY - Recorder Power Board Assembly
4	RG-920P	1	Recorder Module including Motor, Printhead, and ESD Wire Harness
8	UR-3502	1	ASSY - Recorder Digital Board Assembly
9	6123-010082	1	Recorder Overlay
10	6113-029384	1	Recorder Shell Bottom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Section 8 Connector Pin Assignment

Analog Board to Option Module

Analog Board	Pin Number		Signal Name	Signal Description	Pin Number		Option Module
	J001	—			J301	J401	
	1	–	+5V	+5 V Supply Voltage	1	1	
	2	–	DGND	Digital Ground	2	3	
	3	–	OPT_TX	Transmit Signal	3	–	
	4	–	OPT_RST	Reset	4	2	
	5	–	DGND	Digital Ground	5	4	
	6	–	OPT_RX	Receive Signal	6	–	

Analog Board to ECG Connector

Analog Board	Pin Number		Signal Name	Signal Description	Pin Number		ECG Connector
	J002	—			J102	—	
	1	–	IMP_R	Impedance Detect/Right Electrode	1	–	
	2	–	NC	Not Connected	2	–	
	3	–	C3	Chest #2 Electrode	3	–	
	4	–	GND	Ground	4	–	
	5	–	SEL	Electrode Select	5	–	
	6	–	NC	Not Connected	6	–	
	7	–	L	Left Electrode	7	–	
	8	–	NC	Not Connected	8	–	
	9	–	C6	Chest #6 Electrode	9	–	
	10	–	NC	Not Connected	10	–	
	11	–	F	Foot Electrode	11	–	
	12	–	GND	Ground	12	–	
	13	–	SH	Shield	13	–	
	14	–	NC	Not Connected	14	–	

Analog Board to NIBP Hall Effect Sensors, Pump, Valve 1 & Valve 2

	Pin Number		Signal Name	Signal Description	Pin Number		
	J003	J103			J203	J306	
Analog Board	10	10	+5 V	+5 V to Hall Effect Sensors	1	1	NIBP Hall Effect
	9	9	CUFF0	Cuff Detect 0	2	2	
	8	8	CUFF1	Cuff Detect 1	3	3	
	7	7	DGND	Digital Ground	4	4	
	J003	**J103**	**Signal Name**	**Signal Description**			Pump
	6	6	IMOTOR	Pump Motor Positive			
	5	5	IMOTOR_RET	Pump Motor Negative			
	J003	**J103**	**Signal Name**	**Signal Description**			Valve 1
	3	3	VALVE1_POS	Solenoid Valve 1 Positive			
	4	4	VALVE1_RET	Solenoid Valve 1 Negative			
	J003	**J103**	**Signal Name**	**Signal Description**			Valve 2
	1	1	VALVE2_POS	Solenoid Valve 2 Positive			
	2	2	VALVE2_RET	Solenoid Valve 2 Negative			

Analog Board to OTS Power Supply, Ground Pin & Toroid

	Pin Number		Signal Name	Signal Description	Pin Number		
	J007	J107			J207	TB2	
Analog Board	1	1	15 V	15 V from OTS Power Supply	1	1	OTS
	2	2	DGND	Digital Ground			Ground
	3	3	DGND	Digital Ground	3	6	OTS
	J008	**—**	**Signal Name**	**Signal Description**	**—**		Toroid
	1	-	LF_DET	Line Frequency Detect	-		
	2	-	AGND	Analog Ground	-		
OTS	**TB1**	**J507**	**Signal Name**	**Signal Description**	**—**	**—**	AC Inlet/Ground
	1	1	L	Line			
	2	2	N	Neutral			
	3		PE	Protective Ground			

Analog Board to Nellcor or NK SpO_2 Card

Analog Board							SpO2 Card
Pin Number		Signal Name	Signal Description	Pin Number		
J030	—			—	JP1	
1	–	NL_PD_A	Nellcor Photo Diode, Anode	–	1	
2	–	NC	Not Connected	–	2	
3	–	NC	Not Connected	–	3	
4	–	NL_PD_K	Nellcor Photo Diode, Kathode	–	4	
5	–	RCAL_RET	Probe Calibration Resistor Return	–	5	
6	–	RCAL	Probe Calibration, Resistor	–	6	
7	–	LED_–_IR	Infrared LED –	–	7	
8	–	NK_+6F	NK +6 V Supply (floated)	–	8	
9	–	LED_+_R	Red LED +	–	9	
10	–	GND	Ground	–	10	
J031	**—**	**Signal Name**	**Signal Description**	**—**	**JP5**	
1	–	ECG_SYNC	ECG Synchronization	–	1	
2	–	EF	Ground (Floated)	–	2	
3	–	EF	Ground (Floated)	–	3	
4	–	N_RESET	Nellcor SpO2 Reset	–	4	
5	–	DEF	Digital Ground (Floated)	–	5	
6	–	NC	Not Connected	–	6	
7	–	–5F	–5 V Supply (Floated)	–	7	
8	–	NEL_TXD	Transmit Data for Nellcor	–	8	
9	–	NEL_RXD	Rcvd Data for Nellcor	–	9	
10	–	+5F	+5 V Supply (Floated)	–	10	
11	–	NEL_CTS_F	CTS for Nellcor	–	11	
12	–	DEF	Digital Ground (Floated)	–	12	
13	–	+5DF	+5 V Digital Supply (Floated)	–	13	
14	–	XNEL	Nellcor Identification	–	14	
J032	**—**	**Signal Name**	**Signal Description**	**—**	**J132**	
1	–	EF	Grounded (Floated)	–	1	
2	–	EF	Grounded (Floated)	–	2	
3	–	NK_PD_K	NK Photo Diode Kathode	–	3	
4	–	NK_PD_A	NK Photo Diode Anode	–	4	
5	–	EF	Ground (Floated)	–	5	
6	–	EF	Ground (Floated)	–	6	
7	–	RCAL_RET_2	Probe Calibration Return	–	7	
8	–	RCAL_2	Probe Calibration	–	8	
9	–	PID	Probe ID	–	9	
10	–	SPNG_IN		–	10	

Analog Board							SpO2 Card
	Pin Number		Signal Name	Signal Description	Pin Number		
	J033	—			—	J133	
	1	–	SW_GAIN_A	SpO2 GAIN CONTROL A	–	1	
	2	–	SW_GAIN_B	SpO2 GAIN CONTROL B	–	2	
	3	–	SW_GAIN_C	SpO2 GAIN CONTROL C	–	3	
	4	–	LIGHT_SEL	LIGHT/GAIN Select	–	4	
	5	–	LIGHT_A	LIGHT Intensity Control A	–	5	
	6	–	LIGHT_B	LIGHT Intensity Control B	–	6	
	7	–	LIGHT_C	LIGHT Intensity Control C	–	7	
	8	–	DEF	Digital Ground (Floated)	–	8	
	9	–	SYNC_F	SYNC (Floated)	–	9	
	10	–	FCLK_F	FCLK (Floated)	–	10	
	11	–	+6F	+6 V Supply (Floated)	–	11	
	12	–	EF	Ground (Floated)	–	12	
	13	–	–2.5F	–2.5 V Supply (Floated)	–	13	
	14	–	+2.5F	+2.5 V Supply (Floated)	–	14	
	J034	—	Signal Name	Signal Description	—	J134	
	1	–	DEF	Digital Ground	–	1	
	2	–	1000HZ_F	1000 Hz Clock (Floated)	–	2	
	3	–	250HZ_F	250 Hz Clock (Floated)	–	3	
	4	–	125HZ_F	125 Hz Clock (Floated)	–	4	
	5	–	62.5HZ_F	62.5 Hz Clock (Floated)	–	5	
	6	–	CHECK_F	CHECK Control (Floated)	–	6	
	7	–	GAIN_S	SpO2 Pulse Gain	–	7	
	8	–	+10UF	+10 V Supply Unregulated (Floated)	–	8	
	9	–	EF	Ground (Floated)	–	9	
	10	–	S_CHECK_W_F	SpO2 CHECK Waveform (Floated)	–	10	

Digital Board to Analog Board

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Analog Board
	J109	—			—	J009	
	A1	–	NIBP_PULSE_CHECK	NIBP Pulse Check Waveform	–	A1	
	A2	–	AGND	Analog Ground	–	A2	
	A3	–	DGND	Digital Ground	–	A3	
	A4	–	NIBP_CHECK	NIBP Check Control	–	A4	
	A5	–	CANCEL	Pressure Limiter Cancel	–	A5	
	A6	–	INT	Internal Measurement Mode	–	A6	
	A7	–	ZREQ	Zero Request	–	A7	
	A8	–	DGND	Digital Ground	–	A8	
	A9	–	INT_RET	Interval Measurement Mode Return	–	A9	
	A10	–	NIBPSS	NIBP Start/Stop Key	–	A10	
	A11	–	PUMP	Pump Drive	–	A11	
	A12	–	VALVE1	Valve1 Drive	–	A12	
	A13	–	VALVE2	Valve2 Drive	–	A13	
	A14	–	CUFF0_RET	Cuff Status 0	–	A14	
	A15	–	CUFF1_RET	Cuff Status 1	–	A15	
	A16	–	IEC_ERR	IEC Error Status	–	A16	
	A17	–	DGND	Digital Ground	–	A17	
	A18	–	NEL_XRTS	RTS for Nellcor	–	A18	
	A19	–	DGND	Digital Ground	–	A19	
	A20	–	CHARGER_EN	Battery Charge Enable	–	A20	
	A21	–	QUICK_CHARGE_EN	Battery Quick Charge Enable	–	A21	
	A22	–	DGND	Digital Ground	–	A22	
	A23	–	OPT_RX	Option Module Receive	–	A23	
	A24	–	OPT_RST	Option Module Reset	–	A24	
	B1	–	NIBP_PRESS_CHECK	NIBP Pressure Check Waveform	–	B1	
	B2	–	AGND	Analog Ground	–	B2	
	B3	–	DGND	Digital Ground	–	B3	
	B4	–	–8VA	–8 V Supply Voltage	–	B4	
	B5	–	+8VA	+8 V Supply Voltage	–	B5	
	B6	–	DGND	Digital Ground	–	B6	
	B7	–	CLK_250	250 Hz Clock	–	B7	
	B8	–	DGND	Digital Ground	–	B8	
	B9	–	INST	Instantaneous Baseline Reset	–	B9	
	B10	–	DGND	Digital Ground	–	B10	
	B11	–	BRAKE	Brake	–	B11	
	B12	–	DGND	Digital Ground	–	B12	
	B13	–	ZEROEND	Zero End Status	–	B13	
	B14	–	CANCEL_RET	Pressure Limiter Cancel Return	–	B14	
	B15	–	DGND	Digital Ground	–	B15	
	B16	–	HW_ERR	Hardware Error	–	B16	
	B17	–	XNEL_GA	Nellcor Cont/G-A Clock	–	B17	
	B18	–	NEL_TX	Nellcor Transmit	–	B18	

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Analog Board
	J109	—			—	J009	
	B19	–	DGND	Digital Ground	–	B19	
	B20	–	DGND	Digital Ground	–	B20	
	B21	–	LB2_EN	Load Block 2 Enable	–	B21	
	B22	–	DGND	Digital Ground	–	B22	
	B23	–	OPT_TX	Option Module Transmit	–	B23	
	B24	–	DGND	Digital Ground	–	B24	
	C1	–	NEL_RX	Nellcor Receive	–	C1	
	C2	–	AGND	Analog Ground	–	C2	
	C3	–	AGND	Analog Ground	–	C3	
	C4	–	AGND	Analog Ground	–	C4	
	C5	–	AGND	Analog Ground	–	C5	
	C6	–	AGND	Analog Ground	–	C6	
	C7	–	NHT	Nellcor Heart Beat Trigger	–	C7	
	C8	–	DGND	Digital Ground	–	C8	
	C9	–	CLK_125	125 Hz Clock	–	C9	
	C10	–	DGND	Digital Ground	–	C10	
	C11	–	GAIN	NIBP Pulse Gain	–	C11	
	C12	–	DGND	Digital Ground	–	C12	
	C13	–	NIBP_SRET	NIBP Safety Return	–	C13	
	C14	–	DGND	Digital Ground	–	C14	
	C15	–	DGND	Digital Ground	–	C15	
	C16	–	DGND	Digital Ground	–	C16	
	C17	–	CHECK	Analog Self Check Control	–	C17	
	C18	–	DGND	Digital Ground	–	C18	
	C19	–	PS_SENSE_RET	Power Supply Sens Return	–	C19	
	C20	–	HUM	HUM Filter	–	C20	
	C21	–	DGND	Digital Ground	–	C21	
	C22	–	SYNC	Synchronization for Floating	–	C22	
	C23	–	DGND	Digital Ground	–	C23	
	C24	–	FLT_TX	Floating Circuitry Data Transmit	–	C24	
	D1	–	S_CHECK_W	SpO_2 Check Waveform	–	D1	
	D2	–	ADC_CH2	A/D Channel 2 Input	–	D2	
	D3	–	ADC_CH3	A/D Channel 3 Input	–	D3	
	D4	–	ADC_CH6	A/D Channel 6 Input	–	D4	
	D5	–	ECG_DISP		–	D5	
	D6	–	AGND	Analog Ground	–	D6	
	D7	–	DGND	Digital Ground	–	D7	
	D8	–	X50_OUT	50 Hz Detect	–	D8	
	D9	–	NADC_CS	A/D Chip Select	–	D9	
	D10	–	ADC_CLK	A/D 2 MHz Clock	–	D10	
	D11	–	ADC_OUT	A/D Output	–	D11	
	D12	–	X50_IN	50 Hz Select	–	D12	
	D13	–	XAC	AC Operation	–	D13	
	D14	–	XAU	Auto Frequency Select	–	D14	
	D15	–	DGND	Digital Ground	–	D15	
	D16	–	ADC_IN	A/D Converter Input	–	D16	

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Analog Board
	J109	—			—	J009	
	D17	–	DGND	Digital Ground	–	D17	
	D18	–	DGND	Digital Ground	–	D18	
	D19	–	PS_BATT_SENSE	Power Supply Battery Sensitivity	–	D19	
	D20	–	PS_OTS_SENSE	Power Supply OTS Sensitivity	–	D20	
	D21	–	DGND	Digital Ground	–	D21	
	D22	–	FLT_RX	Floating Circuitry Data Receive	–	D22	
	D23	–	XPACE	Pacemaker Input	–	D23	
	D24	–	CLK_80K	80 KHz Clock	–	D24	
	J119	**–**	**Signal Name**	**Signal Description**	**–**	**J019**	
	A1	–			–	A1	

Digital Board to Encoder Board

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Encoder Board
	J010	—			—	J110	
	1	–	DGND	Digital Ground	–	1	
	2	–	JOGUA	Jog Dial Upper A	–	2	
	3	–	JOGUB	Jog Dial Upper B	–	3	
	4	–	JOGLA	Jog Dial Lower A	–	4	
	5	–	JOGLB	Jog Dial Lower B	–	5	
	6	–	LED_JOGU	Enable for Upper Jog Dial LED	–	6	
	7	–	LED_JOGL	Enable for Lower Jog Dial LED	–	7	
	8	–	DGND	Digital Ground	–	8	
	9	–	DGND	Digital Ground	–	9	
	10	–	DGND	Digital Ground	–	10	
	11	–	LED_GR	Enable for Green LED on Light Bar	–	11	
	12	–	VBUS		–	12	
	13	–	LED_YL	Enable for Yellow LED on Light Bar	–	13	
	14	–	VBUS		–	14	
	15	–	LED_RD	Enable for Red LED on Light Bar	–	15	
	16	–	+5V	+5 V Supply Voltage	–	16	
	17	–	FRONT_SWITCH	Signal From Front Switch	–	17	
	18	–	LED_DC_OP	Enable for Battery Powered LED	–	18	
	19	–	DGND	Digital Ground	–	19	
	20	–	LED_BATT_STAT	Enable for Battery Status LED	–	20	
	21	–	LED_DC_PULSE	Blink Control for Battery LEDs	–	21	
	22	–	OTS_SENSE	Enable for AC Line Power Present	–	22	
	23	–	LB2_EN	Enable for Load Block 2	–	23	
	24	–	BRIGHT	Brightness Control	–	24	
	25	–	VOL_ECG	ECG Volume Control	–	25	
	26	–	VOL_ALARM	Alarm Volume Control	–	26	
	27	–	DGND	Digital Ground	–	27	
	28	–	DGND	Digital Ground	–	28	

Encoder Board to Light Bar Board

Encoder Board	Pin Number		Signal Name	Signal Description	Pin Number		Light Bar Board
	J211	—			—	J311	
	1	–	YELLOW	Turn on/off Yellow LED Cluster	–	1	
	2	–	RED	Turn on/off Red LED Cluster	–	2	
	3	–	GREEN	Turn on/off Green LED Cluster	–	3	
	4	–	LED_RETURN	Power Supply Bus	–	4	
	5	–	LED_RETURN	Power Supply Bus	–	5	
	6	–	GREEN	Turn on/off Green LED Cluster	–	6	
	7	–	RED	Turn on/off Red LED Cluster	–	7	
	8	–	YELLOW	Turn on/off Yellow LED Cluster	–	8	

NOTE

Signals will be repeated symmetrically so that you cannot accidentally insert the FCC "backwards" into the connector.

Encoder Board to Power Switch Board

Encoder Board	Pin Number		Signal Name	Signal Description	Pin Number		Power Switch Board
	J212	—			—	J312	
	1	–	VBUS	Power Supply Bus	–	1	
	2	–	DGND	Digital Ground	–	2	
	3	–	DGND	Digital Ground	–	3	
	4	–	AC_PRESENT	Enable for AC Line Power Present LED	–	4	
	5	–	AC_OP	Enable for AC Line Operation LED	–	5	
	6	–	BATT_STAT	Enable for Battery Status LED	–	6	
	7	–	DC_OP	Enable for Battery Powered LED	–	7	
	8	–	FRONT_SWITCH	Power on Switch on Front Panel	–	8	

Digital Board to LCD

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		LCD
	J013	—			—	CN1	
	1	–	GNDD	Ground for Logic and Backlight	–	1	
	2	–	ExtClk	External Clock	–	2	
	3	–	GNDD	Ground for Logic and Backlight	–	3	
	4	–	HS	Horizontal Synchronous Signal	–	4	
	5	–	VS	Vertical Synchronous Signal	–	5	
	6	–	Hout	Horizontal Synchronous Signal Output	–	6	
	7	–	Vout	Vertical Synchrnous Signal Output	–	7	
	8	–	Bpls	Luminance Control Signal	–	8	
	9	–	GNDD	Ground for Logic and Backlight	–	9	
	10	–	GNDD	Ground for Logic and Backlight	–	10	
	11	–	ExtCsl	External Clock Select	–	11	
	12	–	GNDD	Ground for Logic and Backlight	–	12	
	13	–	N/P	Display Mode Select	–	13	
	14	–	MTSL	Vertical Display Area Select	–	14	
	15	–	U/D	Vertical Scanning Select Signal	–	15	
	16	–	R/L	Horizontal Scanning Select Signal	–	16	
	17	–	GNDD	Ground for Logic and Backlight	–	17	
	18	–	V_{DCB}	9.5 V Power Supply for Backlight	–	18	
	19	–	V_{DCB}	9.5 V Power Supply for Backlight	–	19	
	20	–	V_{DC}	9.5 V Power Supply for Processor, Controller and Driver	–	20	
	21	–	GNDD	Ground for Logic and Backlight	–	21	
	22	–	GNDD	Ground for Logic and Backlight	–	22	
	23	–	GNDD	Ground for Logic and Backlight	–	23	
	24	–	GNDA	Ground for Analog RGB	–	24	
	25	–	R	Analog Red Signal	–	25	
	26	–	GNDA	Ground for Analog RGB	–	26	
	27	–	G	Analog Green Signal	–	27	
	28	–	GNDA	Ground for Analog RGB	–	28	
	29	–	B	Analog Blue Signal	–	29	
	30	–	GNDA	Ground for Analog RGB	–	30	

Digital Board to Speaker

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Speaker
	J111	J114			—	—	
	1	1	Positive	Speaker Positive	–	–	
	2	2	Negative	Speaker Negative	–	–	

Digital Board to Recorder Interface Board

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Recorder Interface Board
	J015	—			—	J115	
	D18	–	+24V	+24 V Supply Voltage	–	D18	
	D17	–	24_GND	+24 V Ground Return	–	D17	
	D16	–	SNS_EN	Sensor Enable, Active Low	–	D16	
	D15	–	INT_REC	Recorder Interrupt to the Host, Active Low	–	D15	
	D14	–	A17	Address Bit 17	–	D14	
	D13	–	DGND	Digital Ground	–	D13	
	D12	–	+3.3V	+3.3 V Supply Voltage	–	D12	
	D11	–	A16	Address Bit 16	–	D11	
	D10	–	A15	Address Bit 15	–	D10	
	D9	–	A14	Address Bit 14	–	D9	
	D8	–	NRES_24	Boost Disable	–	D8	
	D7	–	D3	Data Bit 3	–	D7	
	D6	–	D2	Data Bit 2	–	D6	
	D5	–	+3.3V	+3.3 V Supply Voltage	–	D5	
	D4	–	GND	Ground Return	–	D4	
	D3	–	D1	Data Bit 1	–	D3	
	D2	–	D0	Data Bit 0	–	D2	
	D1	–	GND	Ground Return	–	D1	
	C18	–	+24V	+24 V Supply Voltage	–	C18	
	C17	–	24_GND	+24 V Ground Return	–	C17	
	C16	–	NRES_24V	24V Inactive Reset, Active Low	–	C16	
	C15	–	MDO	Magazine Open, Active Low	–	C15	
	C14	–	A9	Address Bit 9	–	C14	
	C13	–	A7	Address Bit 7	–	C13	
	C12	–	A6	Address Bit 6	–	C12	
	C11	–	A4	Address Bit 4	–	C11	
	C10	–	GND	Ground Return	–	C10	
	C9	–	A1	Address Bit 1	–	C9	
	C8	–	DTACK	Data Acknowledge, Active Low	–	C8	
	C7	–	80_SLH	Chip Select, Active Low	–	C7	
	C6	–	GND	Ground Return	–	C6	
	C5	–	D14	Data Bit 14	–	C5	
	C4	–	D12	Data Bit 12	–	C4	
	C3	–	D10	Data Bit 10	–	C3	
	C2	–	D4	Data Bit 4	–	C2	
	C1	–	+5V	+5 V Supply Voltage	–	C1	
	B18	–	+24V	+24 V Supply Voltage	–	B18	
	B17	–	24_GND	+24 V Ground Return	–	B17	
	B16	–	NC	Not Connected	–	B16	
	B15	–	RST_SYS	System Reset, Active Low	–	B15	
	B14	–	A10	Address Bit 10	–	B14	
	B13	–	A8	Address Bit 8	–	B13	

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Recorder Interface Board
	J015	—			—	J115	
	B12	–	GND	Ground Return	–	B12	
	B11	–	A5	Address Bit 5	–	B11	
	B10	–	A3	Address Bit 3	–	B10	
	B9	–	A2	Address Bit 2	–	B9	
	B8	–	GND	Ground Return	–	B8	
	B7	–	R/W	Host System Read/Write	–	B7	
	B6	–	D15	Data Bit 15	–	B6	
	B5	–	D13	Data Bit 13	–	B5	
	B4	–	D11	Data Bit 11	–	B4	
	B3	–	D9	Data Bit 9	–	B3	
	B2	–	D5	Data Bit 5	–	B2	
	B1	–	5V	5 V Supply Voltage	–	B1	
	A18	–	24V	24 V Supply Voltage	–	A18	
	A17	–	24_GND	24 V Ground Return	–	A17	
	A16	–	REC_PRES		–	A16	
	A15	–	REC_SET	Recorder Setting	–	A15	
	A14	–	GND	Ground Return	–	A14	
	A13	–	A13	Address Bit 13	–	A13	
	A12	–	A12	Address Bit 12	–	A12	
	A11	–	A11	Address Bit 11	–	A11	
	A10	–	GND	Ground Return	–	A10	
	A9	–	3.3V	3.3 V Supply Voltage	–	A9	
	A8	–	PE	Paper Empty, Active Low	–	A8	
	A7	–	REC_ON	Recorder Start/Stop	–	A7	
	A6	–	RST_PRO	Download Reset, Active Low	–	A6	
	A5	–	D8	Data Bit 8	–	A5	
	A4	–	GND	Ground Return	–	A4	
	A3	–	D7	Data Bit 7	–	A3	
	A2	–	D6	Data Bit 6	–	A2	
	A1	–	GND	Ground Return	–	A1	

Digital Board to Memory Card Interface Board

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Memory Card Interface Board
	J016	—			—	J116	
	A1	–	+8V	+8 V Supply Voltage	–	A1	
	A2	–	ZB_CLK	64 KHz ZB-800P Clock	–	A2	
	A3	–	B0	Mcbank Bit 0	–	A3	
	A4	–	B2	Mcbank Bit 2	–	A4	
	A5	–	A2	Address Bit 2	–	A5	
	A6	–	A4	Address Bit 4	–	A6	
	A7	–	DGND	Digital Ground	–	A7	
	A8	–	A17	Address Bit 17	–	A8	
	A9	–	A6	Address Bit 6	–	A9	
	A10	–	A16	Address Bit 16	–	A10	
	A11	–	LED_MC	Memory Card LED	–	A11	
	A12	–	DGND	Digital Ground	–	A12	
	A13	–	+5V	+5 V Supply Voltage	–	A13	
	A14	–	DGND	Digital Ground	–	A14	
	A15	–	DGND	Digital Ground	–	A15	
	A16	–	+3.3V	+3.3 V Supply Voltage	–	A16	
	A17	–	RST_MC	Memory Card Reset	–	A17	
	A18	–	LDS	Data (7:0) Strobe, Active Low	–	A18	
	A19	–	MC_OE	Memory Card Output Enable	–	A19	
	A20	–	D1	Data Bit 1	–	A20	
	A21	–	DGND	Digital Ground	–	A21	
	A22	–	D9	Data Bit 9	–	A22	
	A23	–	D5	Data Bit 5	–	A23	
	A24	–	D3	Data Bit 3	–	A24	
	B1	–	AGND	Analog Ground	–	B1	
	B2	–	ZB_XRST	ZB-800P Reset	–	B2	
	B3	–	B5	Mcbank Bit 5	–	B3	
	B4	–	B4	Mcbank Bit 4	–	B4	
	B5	–	A12	Address Bit 12	–	B5	
	B6	–	A5	Address Bit 5	–	B6	
	B7	–	A7	Address Bit 7	–	B7	
	B8	–	A9	Address Bit 9	–	B8	
	B9	–	DGND	Digital Ground	–	B9	
	B10	–	DGND	Digital Ground	–	B10	
	B11	–	DGND	Digital Ground	–	B11	
	B12	–	DGND	Digital Ground	–	B12	
	B13	–	+5V	+5 V Supply Voltage	–	B13	
	B14	–	DGND	Digital Ground	–	B14	
	B15	–	DGND	Digital Ground	–	B15	
	B16	–	+3.3V	+3.3 V Supply Voltage	–	B16	
	B17	–	MC_WP	Memory Card Write Protect	–	B17	
	B18	–	DGND	Digital Ground	–	B18	

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Memory Card Interface Board
	J016	—			—	J116	
	B19	–	MC_CD2	Memory Card Detect Bit 2	–	B19	
	B20	–	D13	Data Bit 13	–	B20	
	B21	–	D7	Data Bit 7	–	B21	
	B22	–	D11	Data Bit 11	–	B22	
	B23	–	D12	Data Bit 12	–	B23	
	B24	–	DGND	Digital Ground	–	B24	
	C1	–	ZB_ECG	ZB-800P ECG Signal	–	C1	
	C2	–	ZB_RX	ZB-800P Receive Data Signal	–	C2	
	C3	–	B3	Mcbank Bit 3	–	C3	
	C4	–	DGND	Digital Ground	–	C4	
	C5	–	A1	Address Bit 1	–	C5	
	C6	–	A3	Address Bit 3	–	C6	
	C7	–	A18	Address Bit 18	–	C7	
	C8	–	A8	Address Bit 8	–	C8	
	C9	–	A15	Address Bit 15	–	C9	
	C10	–	DGND	Digital Ground	–	C10	
	C11	–	DGND	Digital Ground	–	C11	
	C12	–	RST_STS	Reset System	–	C12	
	C13	–	DGND	Digital Ground	–	C13	
	C14	–	NVRAM_RTC_WE	NVRAM Write Enable	–	C14	
	C15	–	NVRAM_RTC_OE	NVRAM Output Enable	–	C15	
	C16	–	MC_TR	Read (Active High)/Write (Active Low) Signal	–	C16	
	C17	–	MC_WE	Memory Card Write Enable	–	C17	
	C18	–	MC_SEL	Memory Card Select	–	C18	
	C19	–	MC_BAT2	Memory Card Battery Status Bit 2	–	C19	
	C20	–	D0	Data Bit 0	–	C20	
	C21	–	DGND	Digital Ground	–	C21	
	C22	–	D10	Data Bit 10	–	C22	
	C23	–	D4	Data Bit 4	–	C23	
	C24	–	D2	Data Bit 2	–	C24	
	D1	–	DGND	Digital Ground	–	D1	
	D2	–	ZB_TX	ZB-800P Transmit Data Signal	–	D2	
	D3	–	B6	Mcbank Bit 6	–	D3	
	D4	–	B1	Mcbank Bit 1	–	D4	
	D5	–	A11	Address Bit 11	–	D5	
	D6	–	A13	Address Bit 13	–	D6	
	D7	–	A10	Address Bit 10	–	D7	
	D8	–	A14	Address Bit 14	–	D8	
	D9	–	AGND	Analog Ground	–	D9	
	D10	–	RETURN_ECG	ECG Return	–	D10	
	D11	–	DGND	Digital Ground	–	D11	
	D12	–	DGND	Digital Ground	–	D12	
	D13	–	DGND	Digital Ground	–	D13	
	D14	–	NVRAM_RTC_CS	NVRAM Real-time Clock Chip Select	–	D14	
	D15	–	MC_BS_INT	Memory Card Busy/Interrupt	–	D15	

Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Memory Card Interface Board
	J016	—			—	J116	
	D16	–	MC_REG	Memory Card Memory Type	–	D16	
	D17	–	UDS	Data (15:8) Strobe, Active Low	–	D17	
	D18	–	MC_BAT1	Memory Card Battery Status Bit 1	–	D18	
	D19	–	MC_CD1	Memory Card Detect Bit 1	–	D19	
	D20	–	D15	Data Bit 15	–	D20	
	D21	–	D6	Data Bit 6	–	D21	
	D22	–	D8	Data Bit 8	–	D22	
	D23	–	D14	Data Bit 14	–	D23	
	D24		DGND	Digital Ground		D24	

Memory Card Interface Board to ZB-800P Module Connector Board

Memory Card Interface Board	Pin Number		Signal Name	Signal Description	Pin Number		ZB-800P Module Connector Board
	J216	—			—	J316	
	1	–	+5V TX	5 V Supply Voltage	–	1	
	2	–	GND	Ground Return	–	2	
	3	–	+8V CLK	8 V Supply Voltage	–	3	
	4	–	GND	Ground Return	–	4	
	5	–	ZBECG	ECG Output for ZB-800P	–	5	
	6	–	ECG_RETURN	ECG Return	–	6	
	7	–	ZBRX	Receive Data	–	7	
	8	–	ZBTX	Transmit Data	–	8	
	9	–	ZBCLK	Clock from ZB-800P	–	9	
	10	–	ZBRXT	Reset for ZB-800P	–	10	

Recorder Interface Board to Recorder Digital Board

Recorder Interface Board	Pin Number		Signal Name	Signal Description	Pin Number		Recorder Digital Board
	J215	—			—	J315	
	A1	–	VBOOST	Boosted Supply	–	A1	
	A2	–	VBOOST_DG	Boosted Return	–	A2	
	A3	–	SNS_ON	Sensor Enable	–	A3	
	A4	–	HST_NIRQ	Interrupt for MAIN	–	A4	
	A5	–	HST_ADR17	Host Address Bit 17	–	A5	
	A6	–	DGND	Digital Ground	–	A6	
	A7	–	+3.3V	+3.3 V Supply Voltage	–	A7	
	A8	–	HST_ADR16	Host Address Bit 16	–	A8	
	A9	–	HST_ADR15	Host Address Bit 15	–	A9	
	A10	–	HST_ADR14	Host Address Bit 14	–	A10	
	A11	–	BST_EN	Boost Enable	–	A11	
	A12	–	HST_DAT3	Host Data Bit 3	–	A12	
	A13	–	HST_DAT2	Host Data Bit 2	–	A13	
	A14	–	+3.3V	+3.3 V Supply Voltage	–	A14	
	A15	–	DGND	Digital Ground	–	A15	
	A16	–	HST_DAT1	Host Data Bit 1	–	A16	
	A17	–	HST_DAT0	Host Data Bit 0	–	A17	
	A18	–	DGND	Digital Ground	–	A18	
	B1	–	VBOOST	Boosted Supply	–	B1	
	B2	–	VBOOST_DG	Boosted Return	–	B2	
	B3	–	NRES_24V	24 V Inactive Reset	–	B3	
	B4	–	HST_DAT0	Host Data Bit 15	–	B4	
	B5	–	HST_ADR9	Host Address Bit 9	–	B5	
	B6	–	HST_ADR7	Host Address Bit 7	–	B6	
	B7	–	HST_ADR6	Host Address Bit 6	–	B7	
	B8	–	HST_ADR4	Host Address Bit 4	–	B8	
	B9	–	DGND	Digital Ground	–	B9	
	B10	–	HST_ADR1	Host Address Bit 1	–	B10	
	B11	–	HST_NDTACK	Host DTACK Signal	–	B11	
	B12	–	N80SLH	Chip Select	–	B12	
	B13	–	DGND	Digital Ground	–	B13	
	B14	–	HST_DAT14	Host Data Bit 14	–	B14	
	B15	–	HST_DAT12	Host Data Bit 12	–	B15	
	B16	–	HST_DAT10	Host Data Bit 10	–	B16	
	B17	–	HST_DAT4	Host Data Bit 4	–	B17	
	B18	–	+5V	+5 V Supply Voltage	–	B18	
	C1	–	VBOOST	24 V Inactive Reset	–	C1	
	C2	–	VBOOST_DG	24 V Inactive Reset	–	C2	
	C3	–	MST_PW_FL	Master Power Fail	–	C3	
	C4	–	NRES_SYS	System Reset	–	C4	
	C5	–	HST_ADR10	Host Address Bit 10	–	C5	
	C6	–	HST_ADR8	Host Address Bit 8	–	C6	

Recorder Interface Board	Pin Number		Signal Name	Signal Description	Pin Number		Recorder Digital Board
	J215	—			—	J315	
	C7	–	DGND	Digital Ground	–	C7	
	C8	–	HST_ADR5	Host Address Bit 5	–	C8	
	C9	–	HST_ADR3	Host Address Bit 3	–	C9	
	C10	–	HST_ADR2	Host Address Bit 2	–	C10	
	C11	–	DGND	Digital Ground	–	C11	
	C12	–	HST_RW	Host Read/Write	–	C12	
	C13	–	HST_DAT15	Host Data Bit 15	–	C13	
	C14	–	HST_DAT13	Host Data Bit 13	–	C14	
	C15	–	HST_DAT11	Host Data Bit 11	–	C15	
	C16	–	HST_DAT9	Host Data Bit 9	–	C16	
	C17	–	HST_DAT5	Host Data Bit 5	–	C17	
	C18	–	+5V	+5V Supply Voltage	–	C18	
	D1	–	VBOOST	24 V Inactive	–	D1	
	D2	–	VBOOST_DG		–	D2	
	D3	–	G_REC_PRES	Digital Ground	–	D3	
	D4	–	NREC_SET	Recorder Set	–	D4	
	D5	–	DGND	Digital Ground	–	D5	
	D6	–	HST_ADR13	Host Address Bit 13	–	D6	
	D7	–	HST_ADR12	Host Address Bit 12	–	D7	
	D8	–	HST_ADR11	Host Address Bit 11	–	D8	
	D9	–	DGND	Digital Ground	–	D9	
	D10	–	+3.3V	+3.3 V Supply Voltage	–	D10	
	D11	–	PE	Paper Empty	–	D11	
	D12	–	NREC_ON	Recorder Start/Stop	–	D12	
	D13	–	NRES_PRO	Recorder Programming	–	D13	
	D14	–	HST_DAT8	Host Data Bit 8	–	D14	
	D15	–	DGND	Digital Ground	–	D15	
	D16	–	HST_DAT7	Host Data Bit 7	–	D16	
	D17	–	HST_DAT6	Host Data Bit 6	–	D17	
	D18	–	DGND	Digital Ground	–	D18	

Recorder Digital Board to Recorder Power Board

Recorder Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Recorder Power Board
	J415	—			—	J515	
	A1	–	VBOOST	+24 V Supply Voltage	–	A1	
	A2	–	VBOOST_DG	+24 V Ground	–	A2	
	A3	–	DGND	Digital Ground	–	A3	
	A4	–	DGND	Digital Ground	–	A4	
	A5	–	+3.3V	+3.3 V Supply Voltage	–	A5	
	A6	–	DGND	Digital Ground	–	A6	
	A7	–	NPEMP	Paper Detected Signal	–	A7	
	A8	–	+3.3V	+3.3 V Supply Voltage	–	A8	
	A9	–	MOT_EN	Motor Enable Signal	–	A9	
	A10	–	DGND	Digital Ground	–	A10	
	A11	–	DGND	Digital Ground	–	A11	
	A12	–	DGND	Digital Ground	–	A12	
	B1	–	VBOOST	+24 V Supply Voltage	–	B1	
	B2	–	VBOOST_DG	+24 V Ground	–	B2	
	B3	–	MST_PWR_FAIL	Not Used	–	B3	
	B4	–	DGND	Digital Ground	–	B4	
	B5	–	AD_DAT	Thermistor A/D Data	–	B5	
	B6	–	AD_NCS	A/D Chip Select Signal	–	B6	
	B7	–	AD_CLK	A/D Clock	–	B7	
	B8	–	DGND	Digital Ground	–	B8	
	B9	–	THDATA	Thermal Head Serial Data	–	B9	
	B10	–	THSTB	Serial Data Latch Signal	–	B10	
	B11	–	DGND	Digital Ground	–	B11	
	B12	–	+5V	+5 V Supply Voltage	–	B12	
	C1	–	VBOOST	+24 V Supply Voltage	–	C1	
	C2	–	VBOOST_DG	+24 V Ground	–	C2	
	C3	–	BOOST_EN	Thermal Head Strobe Signal	–	C3	
	C4	–	VR1	Motor Voltage Reference 1	–	C4	
	C5	–	VR0	Motor Voltage Reference 0	–	C5	
	C6	–	DGND	Digital Ground	–	C6	
	C7	–	PH1	Motor Phase 1	–	C7	
	C8	–	PH0	Motor Phase 0	–	C8	
	C9	–	TH_CLK	Serial Data Transfer Clock	–	C9	
	C10	–	DGND	Digital Ground	–	C10	
	C11	–	NTHEN		–	C11	
	C12	–	+5V	+5 V Supply Voltage	–	C12	
	D1	–	VBOOST	+24 V Supply Voltage	–	D1	
	D2	–	VBOOST_DG	+24 V Ground	–	D2	
	D3	–	DGND	Digital Ground	–	D3	
	D4	–	DGND	Digital Ground	–	D4	
	D5	–	DGND	Digital Ground	–	D5	
	D6	–	NMOPEN	Magazine Detected Signal	–	D6	

Recorder Digital Board	Pin Number		Signal Name	Signal Description	Pin Number		Recorder Power Board
	J415	—			—	J515	
	D7	–	+3.3V	+3.3 V Supply Voltage	–	D7	
	D8	–	DGND	Digital Ground	–	D8	
	D9	–	NPMRK	Paper Mark Detected Signal	–	D9	
	D10	–	SENS_ON	Optical Sensors Enable Signal	–	D10	
	D11	–	DGND	Digital Ground	–	D11	
	D12	–	DGND	Digital Ground	–	D12	

Recorder Power Board to Recorder

Recorder Power Board	Pin Number		Signal Name	Signal Description	Recorder
	J615	—			
	1	–	MA1	Motor Phase A	
	2	–	MB1	Motor Phase $\overline{A}$	
	3	–	MA2	Motor Phase B	
	4	–	MB2	Motor Phase $\overline{B}$	
	5	–	+3.3V	+3.3 V Supply Voltage	
	6	–	NMOPEN_P	Magazine Detected Signal	
	7		+5V	+5 V Supply Voltage	
	8		DGND	Digital Ground	
	9		SNS_ON_P	Paper Sensor Enable Signal	
	10		NPEMP_P	Paper Detected Signal	
	11		SNS_ON_P	Mark Sensor Enable Signal	
	12		NPMRK_P	Mark Detected Signal	

Digital Board to Key Panel

Digital Board	Pin Number		Signal Name	Signal Description	Key Panel
	J017	—			
	1	–	KEY_SU	SUSPEND Key	
	2	–	KEY_TL	REVIEW Key	
	3	–	KEY_NIBP	NIBP Key	
	4	–	DGND	Digital Ground	
	5	–	KEY_F4	Function 4 Key	
	6	–	KEY_F3	Function 3 Key	
	7	–	KEY_F2	Function 2 Key	
	8	–	KEY_F1	Function 1 Key	
	9	–	DGND	Digital Ground	
	10	–	KEY_HOME	Home Key	
	11	–	KEY_R1	Recorder 1 Key	
	12	–	KEY_R0	Recorder 0 Key	

Analog Board to Battery

Analog Board	Pin Number		Signal Name	Signal Description	Pin Number		Battery
	J020	—			—	J120	
	1	–	DGND	Digital Ground	–	1	
	2	–	12V	12 V from Battery	–	2	

Appendix

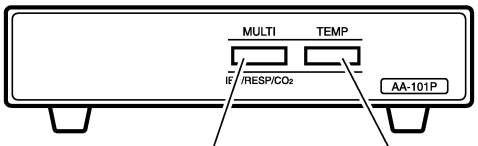
AA-101P Universal Unit

General

With the optional AA-101P Universal Unit connected to the bedside monitor, temperature and one parameter from invasive blood pressure, respiration and CO_2 can be monitored. When the parameter cable is connected to the MULTI socket, the measuring parameter is automatically identified. The monitoring screen is automatically layed out for easy viewing of all measuring parameters.

Panel Description

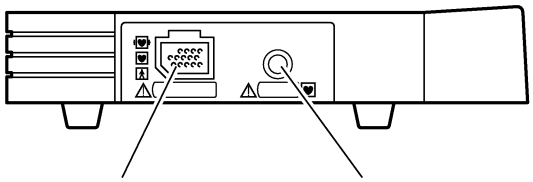
Front Panel



MULTI key
Press to call up the setting screen of the parameter connected to the MULTI socket.

TEMP key
Press to call up the TEMP SETUP screen.

Side Panel



MULTI socket
Connects to the parameter to be measured: invasive blood pressure, respiration or CO_2.

TEMP jack
Connects to the temperature probe cable.

Troubleshooting

Parameter Recognition Problems

Problem	Possible Cause/Criteria			Action
The parameter connection cord or the temperature probe cord is not recognized.	No parameter connection cord, including temperature, is recognized.	No communication between the main unit and AA-101P is performed on the communication check screen.	Faulty BSM-1101/1102 main unit.	Repair the main unit.
			Faulty connection cable between the main unit and AA-101P	Replace the connection cable between main unit and AA-101P.
			Faulty AA-101P.	Replace the MAIN board.
		Communication between the main unit and AA-101P is performed on the communication check screen.	Faulty AA-101P.	Replace the MAIN board.
			Faulty connector of the parameter connection cord.	Replace the parameter connection cord with a new one.
	Only the temperature probe cord is recognized.	Faulty AA-101P.		Replace the MAIN board.
		Faulty connector of the parameter connection cord.		Replace the parameter connection cord with a new one.
The parameter connection cord is erroneously recognized.	Faulty connector of the parameter connection cord.			Replace the parameter connection cord.

Key Operation Problem

Problem	Possible Cause/Criteria	Action
The MULTI key and TEMP key have no function even though the respective parameter connection cord and temperature probe cord are recognized correctly.	Faulty AA-101P.	Replace the MAIN board. Replace the SWITCH board.

Temperature Problems

Problem	Possible Cause/Criteria	Action
No display of temperature data.	Faulty temperature probe.	Replace the temperature probe with a new one.
	The temperature is out of measurement range.	Use a dedicated temperature measurement instrument which covers the temperature range.
	Poor contact between the plug and jack.	Clean the plug of the temperature probe cord.
	Faulty AA-101P.	Replace the MAIN board.
Abnormal temperature data display.	Poor contact between the plug and jack.	Clean the plug of the temperature probe cord.
	Faulty AA-101P.	Replace the MAIN board.

IBP (Invasive Blood Pressure) Problems

Problem	Possible Cause/Criteria	Action
No display of IBP data.	Faulty IBP connection cord.	Replace the IBP connection cord with a new one.
	Faulty BP transducer.	Replace the BP transducer with a new one.
	Faulty AA-101P.	Replace the MAIN board.
No zeroing.	Excessive pressure (out of ±200 mmHg zero balancing range) is at the BP transducer.	Remove the cause.
	There is unstable pressure.	Remove the cause.
	Faulty BP transducer.	Replace the BP transducer.
	Faulty AA-101P.	Replace the MAIN board.

Thermistor Probe Respiration Problems

Problem	Possible Cause/Criteria	Action
No display of respiration rate.	Faulty thermistor probe.	Replace the thermistor probe.
	Faulty AA-101P.	Replace the MAIN board.
No display of respiration waveform.	Faulty thermistor probe.	Replace the thermistor probe.
	There is no difference in temperature between the expired and inspired gas.	Set the inspired gas temperature to a lower temperature than expired gas.
	Thermistor probe contacts the skin.	Float the thermistor probe away from the skin.
Abnormal display of respiration waveform.	Expiration and inspiration curves are inverted.	Set the inspired gas temperature to a lower temperature than expired gas.
	Thermistor probe contacts the skin.	Float the thermistor probe away from the skin.

CO_2 Problems

Problem	Possible Cause/Criteria	Action
No display of CO_2 data.	Faulty CO_2 sensor.	Replace the CO_2 sensor with a new one.
	Faulty AA-101P.	Replace the MAIN board with a new one.
No display of CO_2 waveform.	Faulty CO_2 sensor.	Replace the CO_2 sensor with a new one.
	Infrared path is dirty.	Clean the CO_2 sensor and airway adapter.
Abnormal display of CO_2 waveform.	Vertical line on CO_2 waveform shows automatic zero compensation mark which is normal.	No action necessary.
	Baseline of CO_2 waveform moves upward during inspiration.	Remove the cause of CO_2 mixing in the inspired gas.
	End tidal CO_2 is lower than the actual CO_2 value.	Remove the cause of CO_2 mixing in the inspired gas.

Diagnostic Check

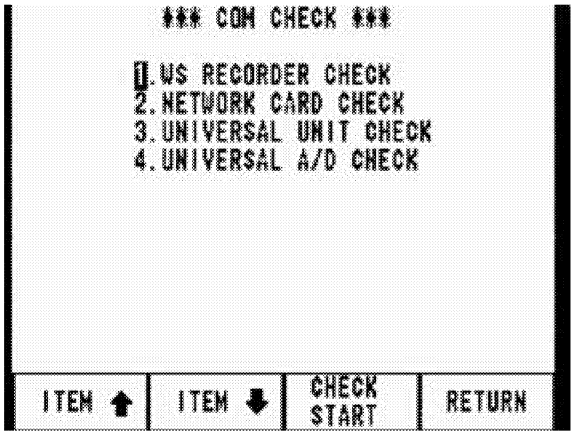
Power on Self Check

This self check is performed every time the power switch on the front panel of BSM-1101/1102 is turned on. If no error is detected, the normal operating mode begins and the patient monitoring display appears. If a serious error is detected, all operation is halted and the Diagnostic Check and System Setup screen appears. The following items are checked in addition to the BSM-1101/1102 check items during the power on self check.

1) ROM Check
   ROM is checked. If there is an error, the AA-101P operation is halted.
2) RAM Check
   RAM is checked. If there is an error, the AA-101P operation is halted.
3) A/D Check
   12-bit A/D converter is checked. If there is an error, no AA-101P parameters can be monitored.
4) VREF Check
   The reference voltage for the 12-bit A/D converter is checked. If there is an error, the numeric data of all parameters is not reliable.
5) Communication Check
   The internal communication of AA-101P and communication between AA-101P and BSM-1101/1102 are checked. The following four statuses are possible.
   - ERROR: Communication error between the AA-101P and BSM-1101/1102
   - NORMAL: Normal communication between the AA-101P and BSM-1101/1102.
   - LOOP: Data transmitted by AA-101P is received by itself.
   - REQUEST: AA-101P receives the communication test request signal from BSM-1101/1102.

Manual Check

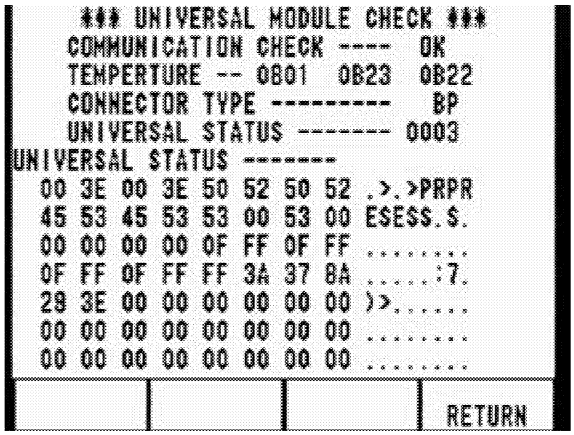
Refer to Section 3-5 “Performing Diagnostic Checks” to display the COM CHECK screen.



On the COM CHECK screen, the NETWORK CARD CHECK (for future use), UNIVERSAL UNIT CHECK, and UNIVERSAL A/D CHECK items are added.

1. Press the “ITEM ↑” or “ITEM ↓” key to select the UNIVERSAL UNIT CHECK item.

2. Press the “CHECK START” key to perform the UNIVERSAL UNIT CHECK. BSM-1101/1102 transmits the reset signal to AA-101P and displays all the AA-101P communication status in real time as shown below.



COMMUNICATION CHECK

Shows the check result of the communication between the AA-101P and BSM-1101/1102. If the communication works normally, “OK” appears on the screen.

If the communication has trouble, “ERROR” appears on the screen.

TEMPERATURE

Shows the digitized temperature data in real time in addition to the reference temperatures 27°C (0800±2) and 37°C (0B24±2) while the temperature probe is connected to the TEMP jack.

CONNECTOR TYPE

Shows the connector, BP, TH-RESP, CO_2, (CO, FiO_2)* which is connected to the MULTI socket.

*CO and FiO_2 are not supported but recognized.

UNIVERSAL STATUS

Shows the following status information.

The status data from AA-101P to BSM-1101/1102 is 3 byte data. The lower 8 bit of the first byte data is used for this status information stored in the status buffer. The status information is updated at every 2 msec that the 3-byte data transfer to BSM-1101/1102 is complete.

	D7							D0
Status Buffer	ERR	COM	Temp	MP2	MP1	MP0	SWT	SWM

ERR:	1	AA-101P is abnormal.
	0	AA-101P is normal.
COM:	1	AA-101P is disabled to receive a command.
	0	AA-101P is enabled to receive a command.
TEMP:	1	Temperature probe is not connected.
	0	Temperature probe is connected.
MP2, MP1, MP0:	111	No connection cord is connected.
	000	IBP connection cord is connected.
	100	CO_2 connection cord is connected.
	010	RESP (TH) connection cord is connected.
	110	The connection cord connector has a failure.
SWT:	1	The TEMP key is not pressed.
	0	The TEMP key is pressed.
SWM:	1	The MULTI key is not pressed.
	0	The MULTI key is pressed.

The example screen shows 0003. The lower 8 bit data is 03 in hexadecimal code, 00000011 in binary code. It means the following information according to the above status buffer data.

- The AA-101P is normal
- The AA-101P is ready for receiving a command.
- Temperature connection cord plug is connected to the TEMP jack.
- IBP connection cord is connected to the MULTI socket.
- The TEMP key is not pressed.
- The MULTI key is not pressed.

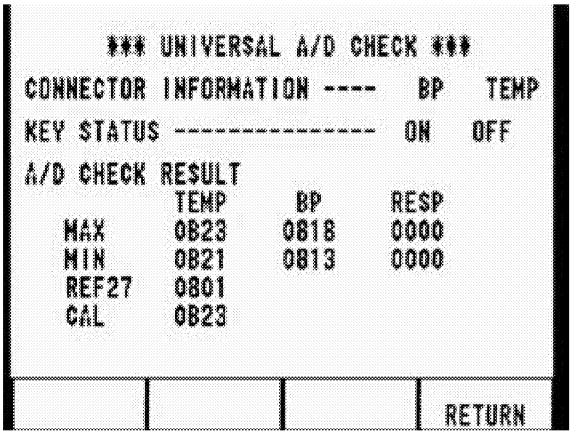
The second and third byte data are used in the damp list.

UNIVERSAL STATUS

Shows the detailed AA-101P status information, damp list, which is source of the above four status information.

1. Press the "ITEM ↑" or "ITEM ↓" key to select the UNIVERSAL A/D CHECK item.

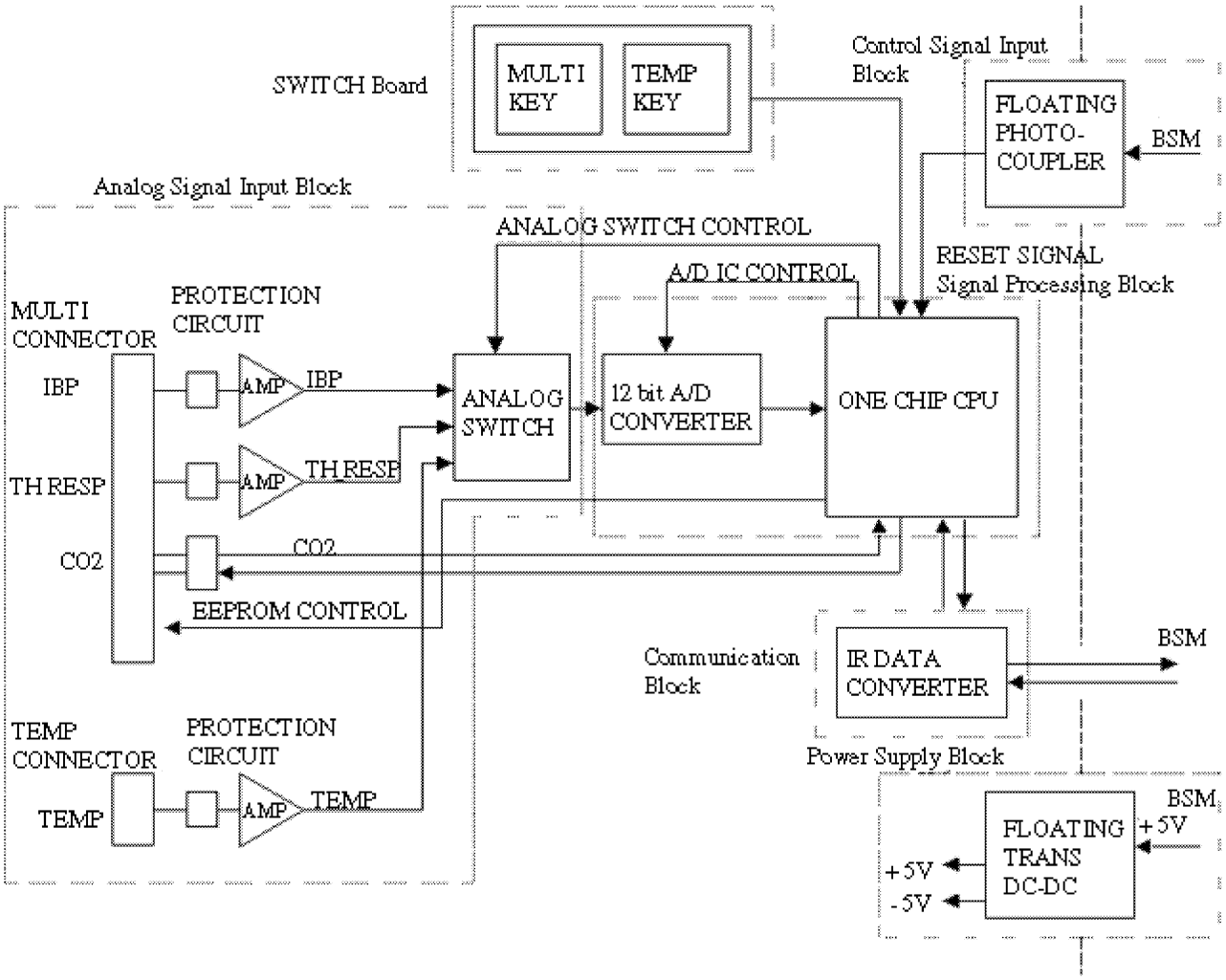
2. Press the "CHECK START" key to perform the UNIVERSAL A/D CHECK. BSM-1101/1102 transmits the reset signal to AA-101P and displays the A to D converted data of the parameters connected to AA-101P in real time as shown below.



- CONNECTOR INFORMATION: Shows the information of the connector/ plug connected to the MULTI socket and TEMP jack. The example screen shows that the BP connection cord is connected to the MULTI socket and temperature probe is connected to the TEMP jack.
- KEY STATUS: Shows the status of the TEMP key (at the left on the screen) and the MULTI key (at the right on the screen). The example screen shows that the TEMP key is pressed and MULTI key is not pressed.
- A/D CHECK RESULT: Shows the digitized data in hexadecimal code of temperature, blood pressure, and respiration when they are connected. The data display is updated at every 3 sec. The peak and bottom data in the data sampled for 3 sec are displayed at the MAX and MIN on the screen. The REF27 (27°C reference data) and CAL (37°C reference data) which are displayed for temperature only are sampled just before every display update.

Board/Unit Descriptions

Functional Block Diagram



Digital Circuit

The digital circuit consists of the following blocks.

Signal processing block: Consists of CPU (microprocessor unit H8/3003), ROM, RAM, and 12-bit A/D converter. This block is the major part of AA-101P.

Communication block: Communicates with the BSM-1101/1102 and uses two way communication with infrared rays. This isolates the AA-101P from the BSM-1101/1102 for safety.

Control signal input block: Receives the reset signal from the BSM-1101/1102 through the photo coupler and sends the reset signal to the CPU. The reset signal is active high. When the connection cable is disconnected from the BSM-1101/1102, the AA-101P is in the reset status.

Power supply block: Generates +5V (for digital circuit) and ±5V (for analog circuit) from +5V of BSM-1101/1102 using a DC-DC converter so that the necessary voltages are supplied to the isolated circuit.

SWITCH board: Has the two key switches. The switch status is directly monitored by the CPU which informs the BSM-1101/1102 of the switch status at the AA-101P.

Analog Circuit

The analog circuit (Analog Signal Input Block shown on the block diagram) consists of the amplifier of each parameter (temperature and universal parameter blocks) and its reference voltage generator.

Temperature block:

Amplifies the analog signals which come from the temperature probe and reference voltage generated from the highly accurate resistor network. Its resistor network, circuit design, and automatic compensation program allow the sensitivity to be compensation free. The A to D converted data of the reference voltage for 27°C and 37°C are 0800±2 and 0B23±2 in hexadecimal code, respectively.

Universal parameter block:

- Blood pressure: Amplifies the analog signal which comes from the blood pressure transducer. The highly accurate amplifier allows the sensitivity to be compensation free. When 100 mmHg is applied to the transducer, approx. 1 V is output there.
- Thermistor method respiration: Amplifies the analog signal which comes from the respiration thermistor probe. The DC component of the analog signal is cut off in the amplifier. Since the resistance of the thermistor varies according to the temperature change during breathing (expiration and inspiration) and the constant voltage (exciter voltage) is applied to the thermistor circuit, the voltage across the thermistor is proportionally output.

- CO_2: Receives the CO_2 data in serial communication from the CO_2 sensor in real time. The CO_2 data is transferred to the serial port of the CPU through the buffer.

Disassembly and Assembly

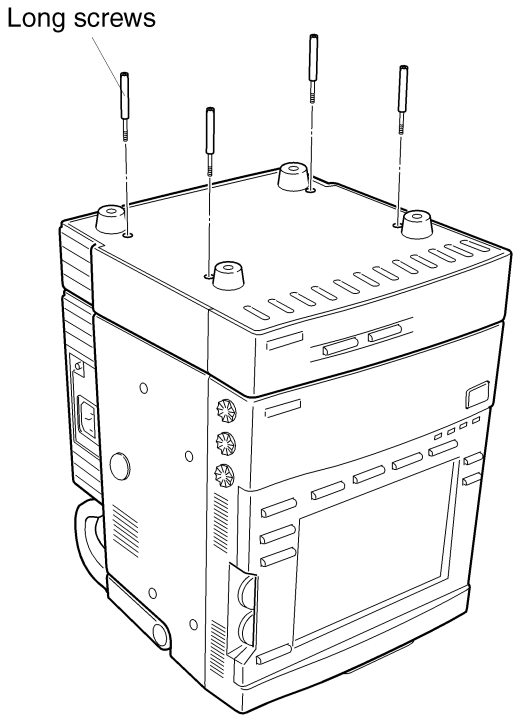
General Information

Refer to Section 5-1 "General Information".

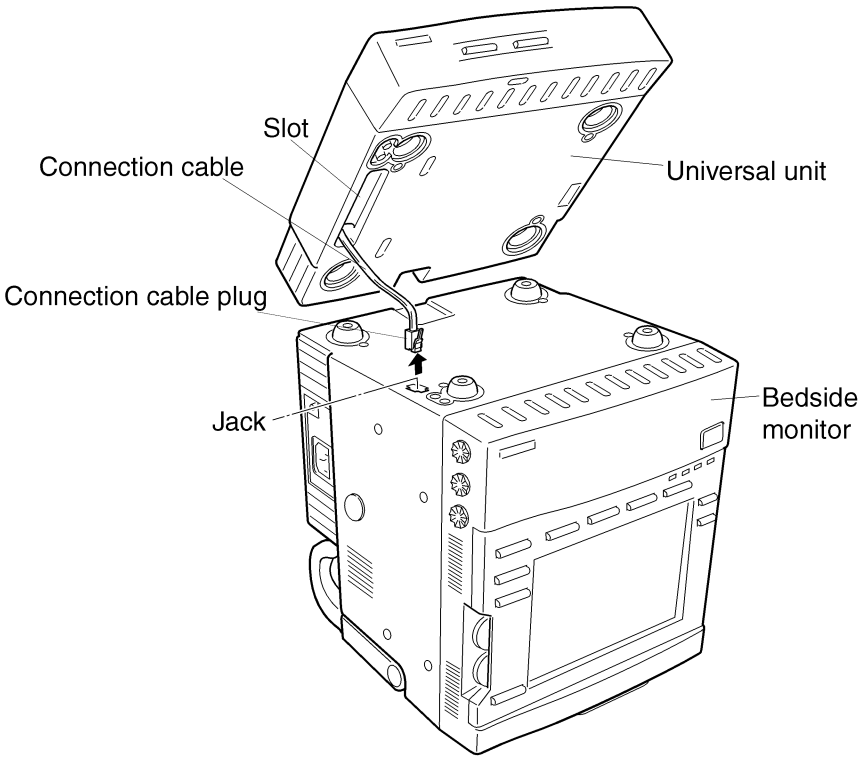
Removing AA-101P from BSM-1101/1102

1. Turn the BSM-1101/1102 with AA-101P upside down.

2. Remove the four long screws which hold the AA-101P to the BSM-1101/1102.



3. Slightly pull up the AA-101P and disconnect the connection cable plug from the jack using tweezers.



4. Remove the AA-101P from the BSM-1101/1102.

Disassembling AA-101P

For the following steps, refer to the exploded view in the Replaceable Parts List.

1. Remove the four rubber feet from the AA-101P and remove the bottom panel.

2. Remove the insulation sheet. Remove the two screws which hold the MAIN board to the top casing assy. Release the MAIN board from the hook of the top casing assy.

CAUTION

When assembling the AA-101P, do not put the insulation sheet upside down because it has different front and back sides.

3. Remove the MAIN board together with the two shield covers from the top casing assy while not a straining the connection cable connected to the MAIN board.

CAUTION

Do not bend the infrared emitting element and detecting element on the MAIN board.

4. Remove the 2 screws which hold the two shield covers to the MAIN board so that you can check it or replace it with a new one.

Assembling AA-101P

Assemble the AA-101P by reversing the above procedure.

CAUTION

- **Be careful not to pinch or strain the cables.**
- **Do not bend the infrared emitting element and detecting element on the MAIN board.**
- **Be sure that the two infrared elements are fitted into the two holes of the top casing assy.**

Maintenance

Measuring and Test Equipment

- Digital voltmeter
- Leakage current measuring device
- Dielectric strength measuring device
- Protective earth impedance measuring device
- AX-800P Vital Sign Simulator
- Respiration thermistor probe
- CO_2 sensor

External Check

Perform the following checks. If an abnormal part is found, replace it with a new one.

- Check that there is neither strain nor physically damaged or bent parts on the instrument. Also check the pins of the jack/socket.
- Check that there are no loose screws and no damaged screws.
- Check that the labels on the instrument panel are clearly readable and have no damage.

Safety Check

Perform the following checks to maintain the safety of the patient and medical staff. For the maintenance interval, refer to Section 6-3.

- Leakage current
  Measure the leakage currents according to the IEC60601-1. Check that the leakage currents do not exceed the specified limits.

- Dielectric strength
  Apply the corresponding test voltage between an F-type Applied Part (Patient Circuit: TEMP jack and MULTI socket) and Enclosure according to the IEC60601-1. Check that there is no breakdown or flashover.
- Protective earth impedance
  Measure the protective earth impedance according to the IEC60601-1. Check that the impedance between the equipotential terminal and protective earth contact of the power cord plug is 0.2 Ω or less and the impedance between the protective earth terminal and any accessible metal part is 0.1 Ω or less.

Check of Measuring Parameters

Perform the following checks when they are required, e.g. after the MAIN board replacement.

- Temperature
  1. Connect the temperature plug of the AX-800P to the TEMP jack.
  2. Check that the temperature value within the tolerable range is displayed on the UNIVERSAL UNIT CHECK screen. Refer to the Manual Check section in this appendix.

- Blood pressure
  1. Connect one of the four blood pressure connectors of the AX-800P to the MULTI socket.
  2. Check that the zeroing works and the blood pressure values selected on the AX-800P are displayed on the screen within the tolerable range.

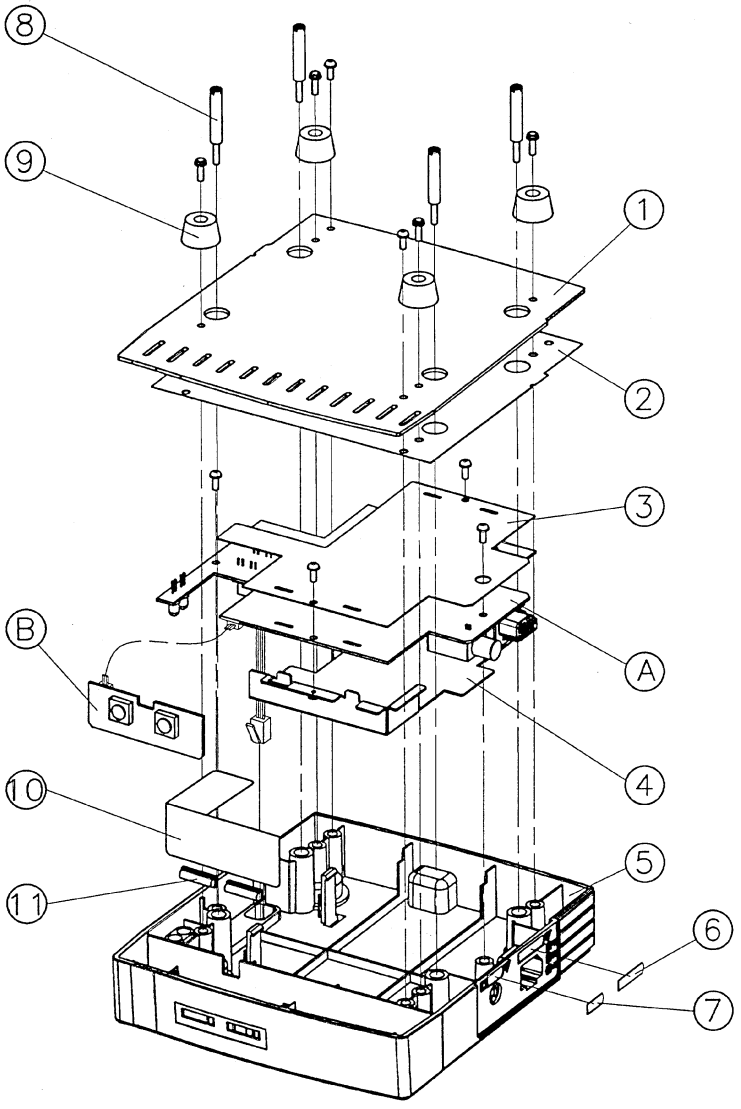
- Respiration (thermistor method)
  1. Connect the respiration thermistor probe connector to the MULTI socket.
  2. Apply the probe to yourself.
  3. Check that the respiration waveform appears according to your breath (expiration and inspiration).

- CO_2
  1. Connect the CO_2 sensor connector to the MULTI socket.
  2. Apply the CO_2 sensor to yourself. Refer to the BSM-1101/1102 operator's manual for more details.

  Check that the CO_2 curve appears according to your breath and $EtCO_2$ is from 35 to 45 mmHg.

Replaceable Parts List

Index	NK Code No.	Qty	Description	
1	6113-033842B	1	Bottom panel	ソコイタ
2	6113-034672	1	Insulation sheet	ゼツエンシート
3	6113-033869B	1	Shield cover 2	シールド2
4	6113-033851A	1	Shield cover 1	シールド1
5	6143-009483	1	Top casing assy	ジョウブケースASSY
6	6124-029425A	1	IBP/RESP/CO_2 label	IBP/RESP/CO_2コネクタヒョウジラベル
7	6124-029434A	1	TEMP label	TEMPコネクタヒョウジラベル
8	6114-100322	4	Long screw	カンカクシチュウ L=30.5
9	111327B	4	Rubber foot	ゴムアシK-20（ワッシャイリ）
10	6114-100331	1	Key top cover suspension sheet	キートップオサエシート
11	6113-032852	2	Key top cover	LARGE KEYPAD BUTTON (721) 1
A	UR-3529	1	MAIN board	メインボード
B	UR-3530	1	SWITCH board	スイッチボード



AA-101P

QI-101P Network Card

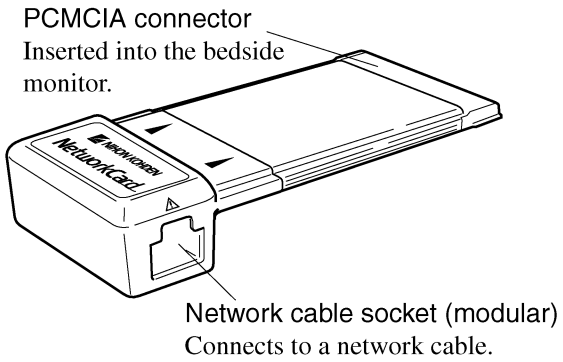
General

The QI-101P Network Card is inserted into a bedside monitor to connect the bedside monitor to the central monitor in the network. The vital sign data from the monitor can be sent to a central monitor and an interbed alarm of any patient in the same network can be displayed on the bedside monitor.

CAUTION

Never disassemble nor repair the network card. For any problem, contact your Nihon Kohden distributor.

Parts Description



Troubleshooting

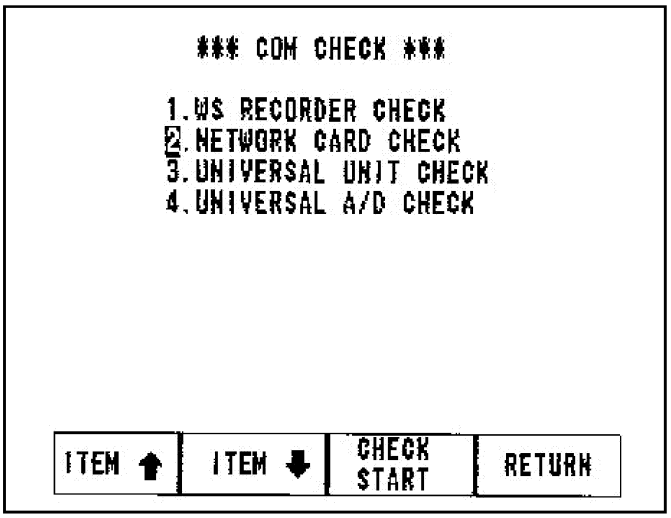
Problem	Possible Cause/Criteria	Action
No data from a bedside monitor appears on the central monitor.	The network card is not inserted into the bedside monitor properly.	Properly insert the network card.
	The network cable is disconnected.	Properly connect the network cable to the network card and hub.
	The network cable is damaged.	Replace the network cable with a new one.
	The central monitor, bedside monitors, other instruments and hub are not connected to the network properly.	Connect the instruments to the network properly by referring to the operator's manual and network installation guide.
	Other problems.	Contact your Nihon Kohden distributor.

Manual Check

Refer to Section 3-5 “Performing Diagnostic Checks” to display the MANUAL CHECK screen.

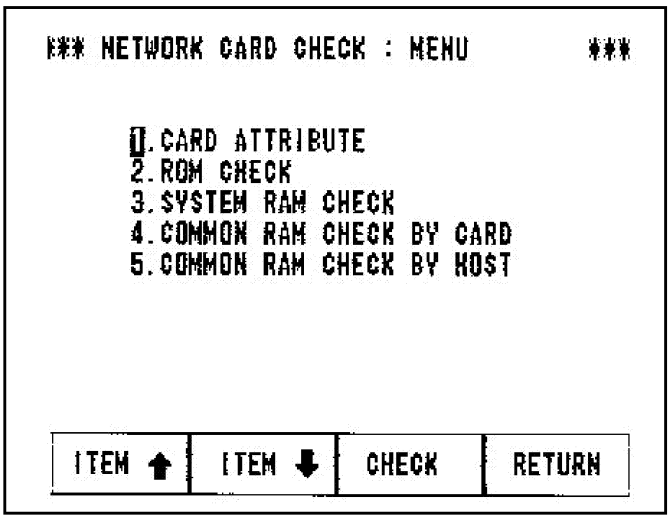
1. From the MANUAL CHECK screen, press the [ITEM ↑] or [ITEM ↓] key to select “4. COM CHECK”.

2. Press the [CHECK] key to display the COM CHECK screen.



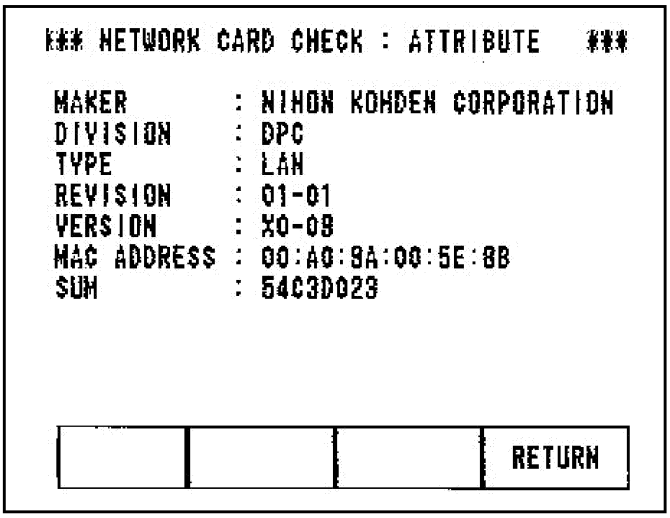
3. Press the [ITEM ↑] or [ITEM ↓] key to select “2. NETWORK CARD CHECK”.

4. Press the [CHECK START] key to display the NETWORK CARD CHECK: MENU screen.



5. Press the [ITEM ↑] or [ITEM ↓] key to select “1. CARD ATTRIBUTE”.

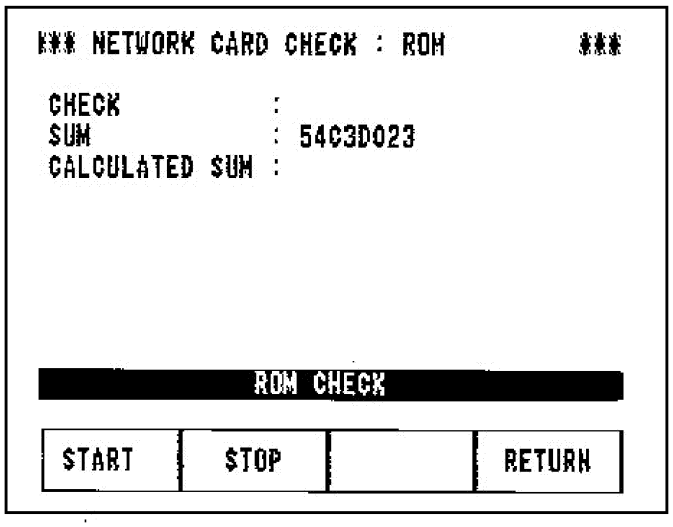
6. Press the [CHECK] key to display the NETWORK CARD CHECK: ATTRIBUTE screen.



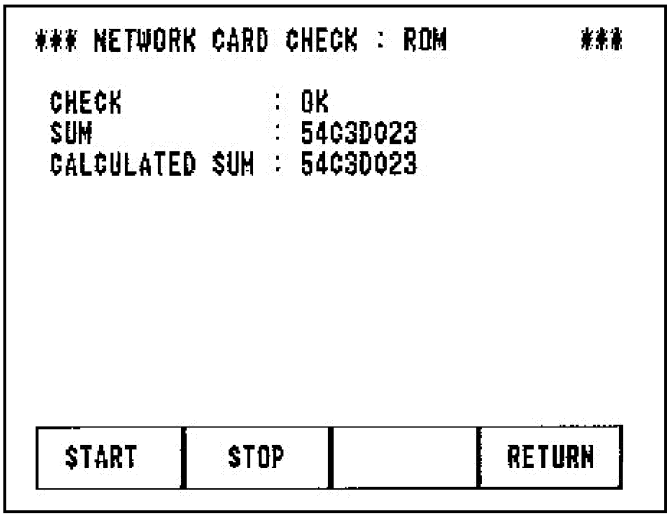
7. Be sure that the following items are displayed on the screen.
   1) MAKER: Indicates NIHON KOHDEN CORPORATION.
   2) DIVISION: Indicates DPC.
   3) TYPE: Indicates LAN.
   4) REVISION: Indicates the hardware revision of the network card inserted into the instrument.
   5) VERSION: Indicates the software version of the network card inserted into the instrument.
   6) MAC ADDRESS: Indicates the MAC address of the network card inserted into the instrument.
   7) SUM: Indicates the check sum of the network card software.

8. Press the [RETURN] key to return to the NETWORK CARD CHECK: MENU screen.

9. Press the [ITEM ↑] or [ITEM ↓] key to select "2. ROM CHECK" and press the [CHECK] key to display the NETWORK CARD CHECK: ROM screen. The following screen appears. This screen allows checking the flash ROM of the network card QI-101P.

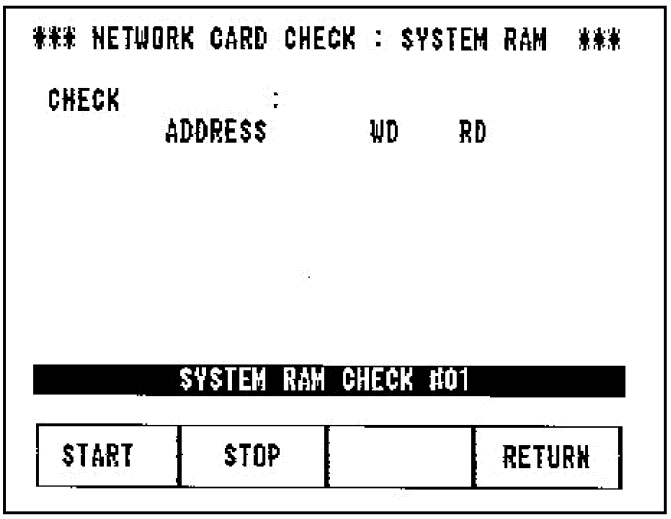


10. Press the [START] key to start the flash ROM check. When the Sum data written in the flash ROM matches the calculated Sum data at the end of this check, an “OK” message appears on the screen. If it is wrong, an “ERROR” message appears.

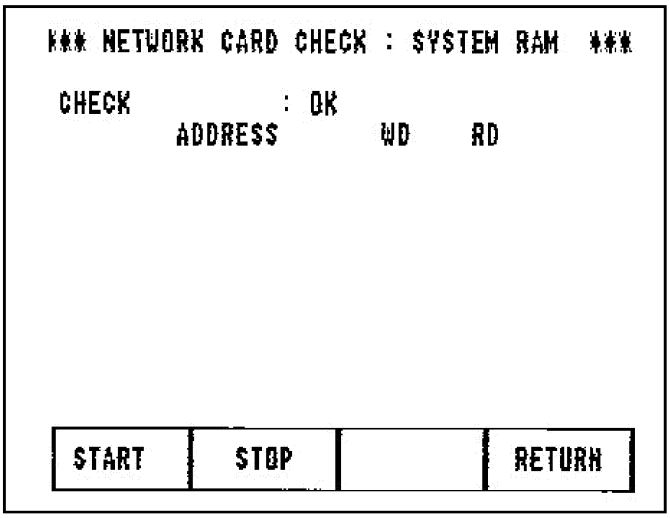


11. Press the [RETURN] key to return to the NETWORK CARD CHECK: MENU screen.

12. Press the [ITEM ↑] or [ITEM ↓] key to select “3. SYSTEM RAM CHECK” and press the [CHECK] key to display the NETWORK CARD CHECK: SYSTEM RAM screen. The following screen appears. This screen allows checking the DRAM of the QI-101P.

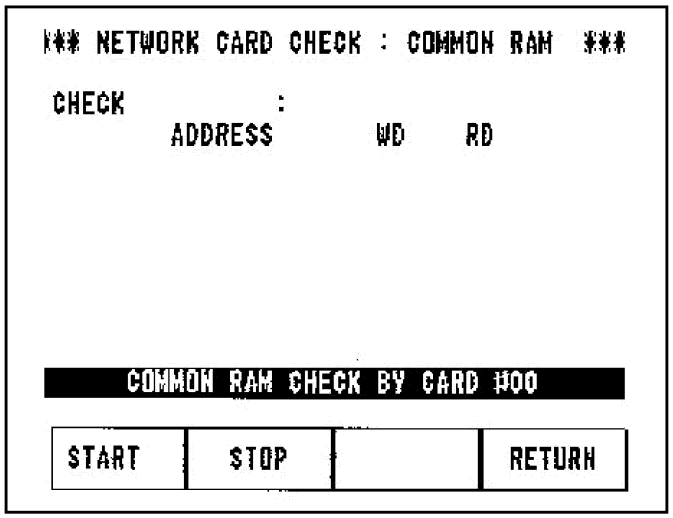


13. Press the [START] key to start the DRAM check. When the data written in all the data storage area of the DRAM matches the data read from the DRAM at the end of this check, an "OK" message appears on the screen. If an error is found, the address, written data, and read data appear on the screen. Up to 7 errors can be displayed on the screen.

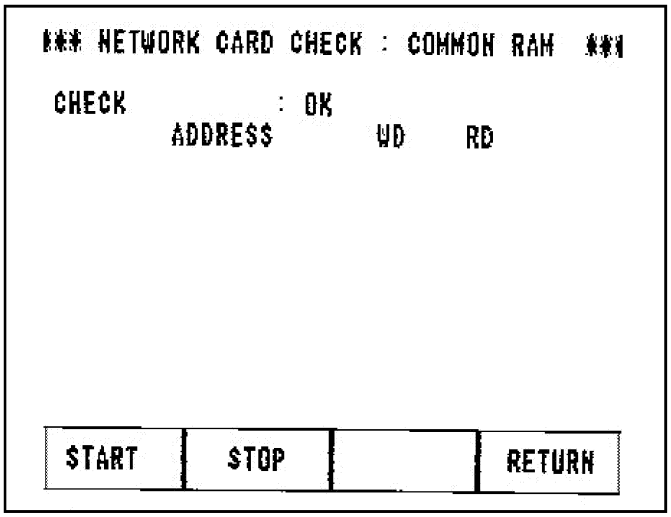


14. Press the [RETURN] key to return to the NETWORK CARD CHECK: MENU screen.

15. Press the [ITEM ↑] or [ITEM ↓] key to select "4. COMMON RAM CHECK BY CARD" and press the [CHECK] key to display the NETWORK CARD CHECK: COMMON RAM (by Card) screen. The following screen appears. This screen allows the CPU in the QI-101P to check the dual port RAM in the QI-101P.

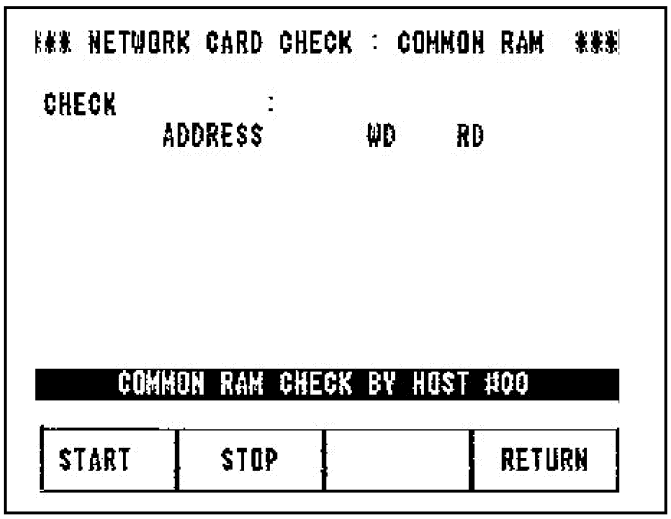


16. Press the [START] key to start the dual port RAM check. When the data written in all the data storage area of the dual port RAM matches the data read from the dual port RAM at the end of this check, an "OK" message appears on the screen. If an error is found, the address, written data, and read data appear on the screen. Up to 7 errors can be displayed on the screen.

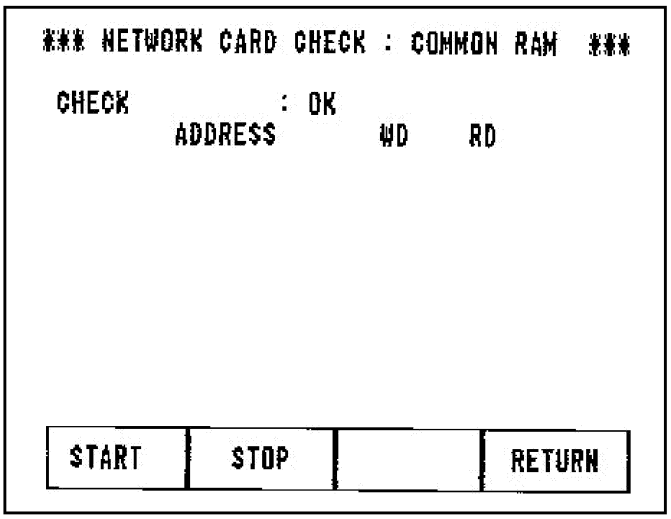


17. Press the [RETURN] key to return to the NETWORK CARD CHECK: MENU screen.

18. Press the [ITEM ↑] or [ITEM ↓] key to select "5. COMMON RAM CHECK BY HOST" and press the [CHECK] key to display the NETWORK CARD CHECK: COMMON RAM (by Host) screen. The following screen appears. This screen allows the CPU of the BSM-1100 to check the dual port RAM in the QI-101P.

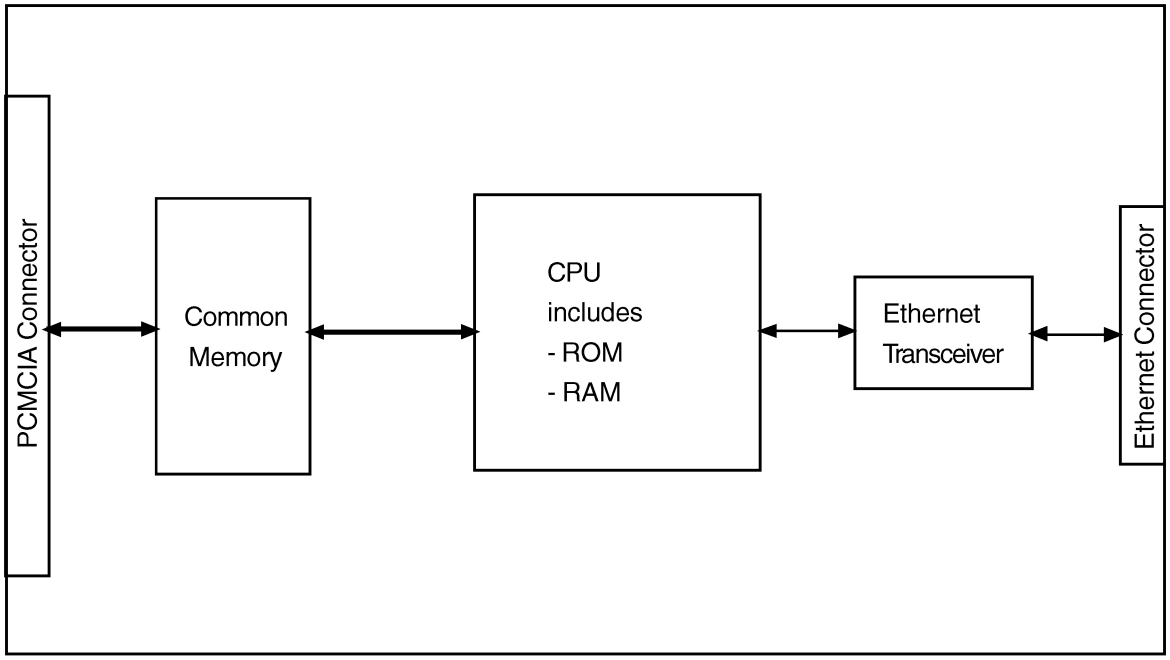


19. Press the [START] key to start the dual port RAM check. When the data written in all the data storage areas of the dual port RAM matches the data read from the dual port RAM at the end of this check, an “OK” message appears on the screen. If an error is found, the address, written data, and read data appear on the screen. Up to 7 errors can be displayed on the screen.



Functional Block Diagram

The following diagram shows the QI-101P functional block diagram.



Common Memory (dual port RAM):
This memory has dual ports, one for the CPU of the BSM-1100 and one for the CPU of the QI-101P. The CPU of the BSM-1100 writes a command and data to the common memory to transfer the data to the Ethernet line. The CPU of the QI-101P reads the command and data from the common memory and transfers the data to the Ethernet line.

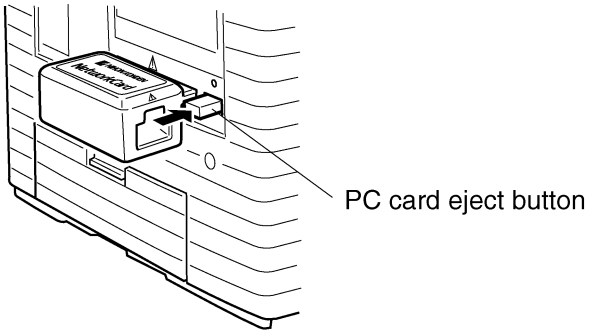
When the BSM-1100 receives alarm information from the other monitors through the Ethernet line, the CPU of the QI-101P writes the command and alarm message to the common memory. The CPU of the BSM-1100 reads the command and alarm message from the common memory and displays the alarm message on the screen.

CPU:
Controls the Ethernet line and receives the command from the CPU of the BSM-1100 through the common memory so that the CPU of the QI-101P can transfer or receive the data through the Ethernet.

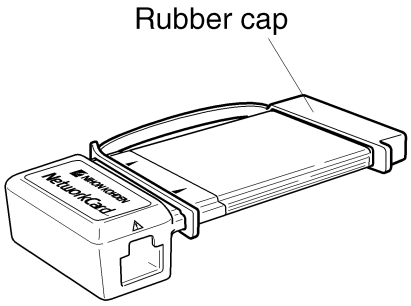
Ethernet Transceiver:
Drives the Ethernet line.

Removing the Network Card from the Bedside Monitor

When removing the network card from the bedside monitor, remove the network cable from the socket on the network card and press the PC card eject button on the bedside monitor.



Check that there is no scratches, dirt or damage to the network card, attach the rubber cap to the PCMCIA connector as shown below and store the card in an appropriate place.



Maintenance

Measuring and Test Equipment

- Digital voltmeter
- Leakage current measuring device
- Dielectric strength measuring device
- Protective earth impedance measuring device

External Check

Perform the following checks. If there is any problem on the network card, contact your Nihon Kohden distributor.

- Check that there is neither strain nor physically damaged or bent parts on the instrument. Also check the pins of the connector/socket.

Safety Check

Perform the following checks to maintain the safety of the patient and medical staff. For the maintenance interval, refer to Section 6-3.

- Leakage current
  Measure the leakage currents according to the IEC60601-1. Check that the leakage currents do not exceed the specified limits.
- Dielectric strength
  Apply the corresponding test voltage between the network cable socket and enclosure according to the IEC60601-1. Check that there is no breakdown or flashover.
- Protective earth impedance
  Measure the protective earth impedance according to the IEC60601-1. Check that the impedance between the equipotential terminal and protective earth contact of the power cord plug is 0.2 Ω or less and the impedance between the protective earth terminal and any accessible metal part is 0.1 Ω or less.

Check of Communication

When the network card and the network cable are connected properly, the waveforms and data of the bedside monitor appear on the central monitor screen and the communicating icon appears on the bedside monitor screen to indicate that the bedside monitor is properly connected to the central monitor system.

 Communicating icon

If the communicating icon does not appear and an error message is displayed on the monitor screen, check the following items, then install the network card again.

- The network card is inserted into the bedside monitor properly.
- The network cable is connected to the network card and hub properly.
- The network cable is not pulled.
- The network cable is not damaged.
- The bedside monitor, hub and central monitor are connected properly.