Service Manual

NEPTUNE
Portable
Patient Monitor

Contents

Chapter 1. Introduction

1.1 About this manual

Service manual only contains additional technical information about system
This manual contains information about servicing and maintenance of **NEPTUNE** monitors.
When you want to service these systems you should refer to this manual but if you want to know about systems setting and get more information about using those you should consult the operator's manual.
This manual is intended to help diagnosing, servicing and trouble shooting the monitor to the board level.
Board's schematics in this manual are only to describe how the system operates.
It is not permitted to service the printed circuit boards of system.

1.2 Warnings

1. Bedside **NEPTUNE** patient monitors are intended for clinical monitoring application with operation only granted to appropriate medical staff.

2. There could be hazard of electrical shock by the monitor casing.

3. Do not touch patient, table near by or the equipment during defibrillation.

4. Alarm must be set up according to different situation of individual patient.
Make sure that audio sounds can be activated when alarm occurs.

5. Every servicing or changing internal parts of system must be performed by qualified technicians of **SIARE**

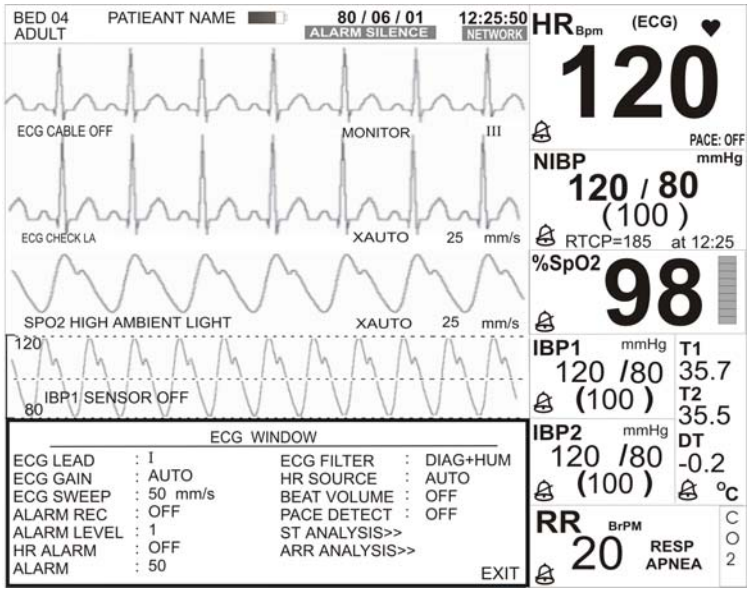
6. These systems are not suitable for use in environments containing combined flammable anesthetic gases with air, oxygen or nitrogen oxide.

1.3 General information of system

The **NEPTUNE** monitors are adaptable to adult and neonatal usage.
Depend on model of system, modules are fixed in it and system can monitor vital signs as ECG, RR, SpO_2, NIBP, Dual-TEMP, Dual-IBP and Co_2. It integrates parameters measured by modules and displays them on screen, featuring compactness, lightweight and portability.
Internal-battery facilitates transportation of patient.
The internal battery can automatically be charged when connected to AC-power. In this case, turning on or off the system does not have any effect on the process of battery charging.
The connectors of cables, sensors and cuff are at the left side of system.
Other sockets like as network connector, DC-in and power plug-in are at the back of system.

1.3.1 General information

On/off key, fixed function keys, Rotary switch, Alarm and Power indicators are placed on the right side of system's front panel.
Display of **NEPTUNE** monitor is color TFT
When you rotate Rotary switch, the selected parameters boarder will be bolded and if press it, the related menus will be displayed on the bottom of screen. In the parameter menus you can trace between parameters and select them by pressing rotary switch knob and apply proper setting. You can close setting menus by pressing Home/menu key or selecting Exit. This facility makes more user-friendly and easy to use.



Fixed function keys are:

Alarm silence: pressing this key, you can mute the alarm temporarily for 120 seconds.

Freeze: pressing this key, you can fix waveforms. Pressing the key again, waveforms restart.

Rec/stop: pressing this key, you can run fixed recorder on system/central.

Home/menu: pressing this key, you will be back to previous menu or screen.

Start/Stop: pressing this key, you can start or stop blood pressure measurement manually.

Power: pressing this key, you can turn on and off system.

Notice: you should hold this key for 1 second.

1.3.4 General information of monitors

In depend on system model; there could be any of following modules fixed in the system:

ECG: ECG waveform in three leads, heart rate (HR) and pace detection and rejection.

RESP: RESP waveform in two leads, respiration rate (RR)

TEMP: Two channel (T_1, T_2) temperature for two sensors.

SpO_2: Pleth waveform and SpO_2 percentage and PR.

NIBP: Pressure of systolic, diastolic and mean.

IBP: Bp_1, Bp_2 waveforms and sys/ dia/ mean pressures for two channels.

Co_2: Capnogram and Fico2, Etco2, AWRR

The patient parameters, waveforms, alarm message, bed number, date; system status and error message can be displayed from the screen.

There are sockets at the left side of system.
These sockets are fixed for connection of patient probes.

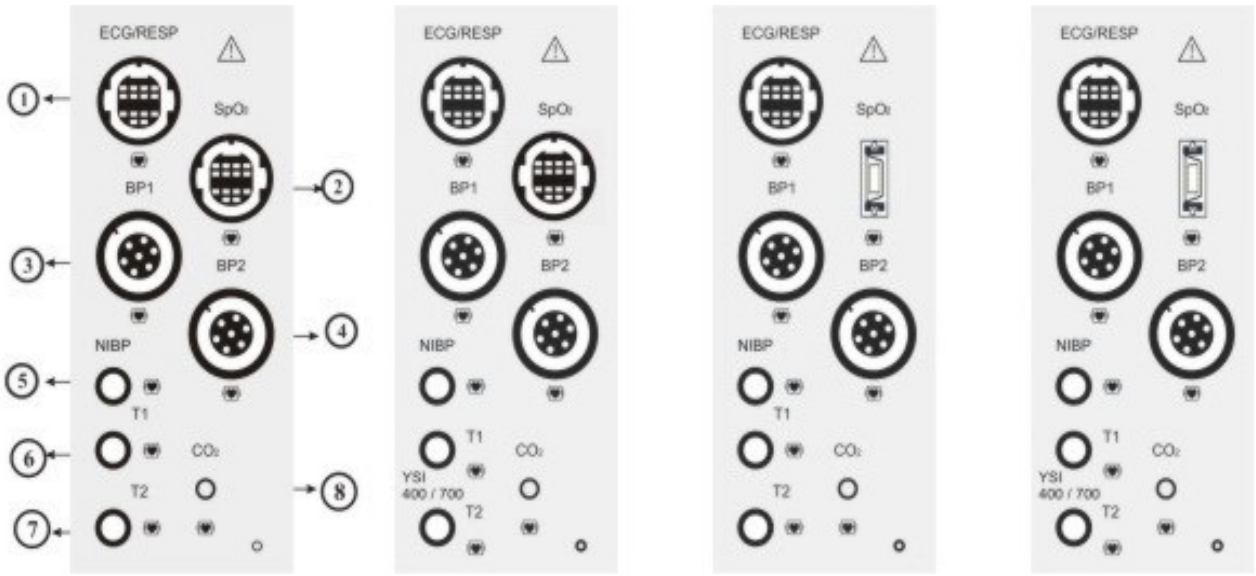
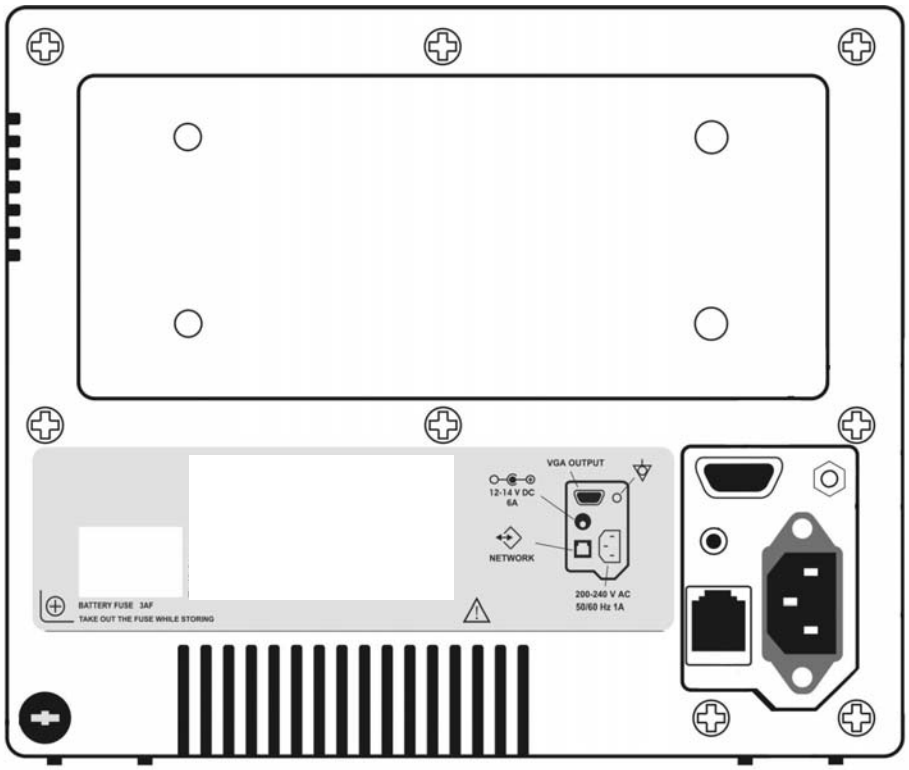


Fig 1.3.3.1

Related to SpO_2 module type, there are two forms for side sockets. (fig. 1.3.3.1)

These parts are fixed at the back of system:
1. Power AC socket (AC-IN)
2. Power DC socket (DC-IN)
3. Network interface Socket
4. Earth jack
5. Battery fuse



Notice: If you don't want to use system for more than two weeks, you should take out battery fuse to disconnect battery from circuit.

1.4 The symbols of system

There are symbols on system that their meaning is in the following:

 This symbol means "be careful" refer to the manual.

 Indicates that the device is an IEC-601-1 type CF equipment. The units displaying this symbol an F-type isolated (floating) patient applied part providing a high degree of protection against shock and is suitable for use during defibrillation.

Warning: If you want to use this system and electro shock at the same time you should use approved ECG cable of company so you shouldn't use another cables.

Chapter 2. Theory of operation

2.1 Principles of monitoring

In depend on, what kinds of modules are fixed in monitors, they can measure following parameters:

- **ECG**
- **Saturated Pulse Oximeter SpO_2**
- **Respiration**
- **Temperature (2 channel)**
- **Non – Invasive Blood Pressure**
- **Invasive Blood Pressure (2 channel)**
- **Co2**

2.1.1 ECG

The ECG or electrocardiograph is a graphic representation of heart's bioelectric current, which stimulates the heart muscle to contract.
These currents are also conducted to the surface of the body, where they are measured via electrodes attached to the skin.
The low-level signals from the electrodes are amplified and processed to provide the ECG signal.

2.1.2 Respiration

Respiration is measured through the ECG electrodes by means of importance Anemography. As the chest change size and shape during inspiration and expiration, the impedance between two ECG electrodes placed across the patient's abdomen / chest change respiration rate is calculated from this change in resistance.

2.1.3 Temperature

Temperatures are measured by meaning of the change in resistance of Thermistor located in temperature prob.

2.1.4 Saturated Pulse Oximeter (SpO_2)

SpO_2 is determined using principles of spectrophotometry. The SpO_2 sensor consist two LEDs and a photo detector.

LEDs emit two specific wavelengths of red and infrared light.
Photo detector receives each light that is crossed through body tissue.
Wavelengths are absorbed selectively by oxyhemoglobin and reduced hemoglobin.
We can calculate $\%SpO_2$ from waveforms of two wavelengths.

The resulting measurement is the ratio of oxyhemoglobin to the total hemoglobin available for binding to oxygen.

$$\%SpO_2 = (HbO_2/HbO_2+Hb) \times 100$$

2.1.5 Non-Invasive Blood Pressure (NIBP)

The monitor measures non-invasion blood pressure using oscillometric method to obtain the systolic, diastolic and mean pressure.
Since the monitor controls the pressure within the cuff, it is considered an automatic invasive blood pressure device.
The monitor measures the pressure within the cuff where the patient's pulse is detected as small pressure variations (oscillations).
The mean arterial pressure is identified as the largest oscillation.
The systolic and diastolic pressures are derived from the pulse amplitude data.

2.1.6 Invasive Blood Pressure (IBP)

The monitor measures invasive blood pressure using pressure sensors.
These sensors are located at outer end of tube. The other end of tube is placed through human vessel to the site the pressure to be monitored via the liquid in the tube.

2.1.7 Co2

Co2 module provides side stream method for CO2 measurement.
Capnography is the noninvasive measurement and graphic display of airway CO2 concentration as a function of time. The resulting waveform is called a capnogram. The evaluation of the capnogram is useful in the assessment of adequacy of carbon dioxide exchange in the lungs, integrity of the patient's airway, cardiopulmonary function and ventilator function

2.2 Modules

There are following modules in system:

- **HOST CPU board**
- **Indicator and key board**
- **Display**
- **Power board**
- **Power control board and input/output**
- **ECG, RESP, TEMP board**
- **SpO_2 board**
- **NIBP board**
- **IBP board**
- **Co2**

2.2.1 HOST CPU Board

This board consist of CPU, memory for main program, RAM for trend and system setup data, A/D for control of battery and D/A for making analog output sound, IC-controller of display and hardware of serial connection with internal modules and external network.
Keyboard and display are connected to HOST CPU board.
On the other hand, these boards communicate with modules for data transmitting.

2.2.2 Indicator and Keyboard

This board is fixed in front panel and all of keys are located on that.
HOST CPU controls condition of keys.
Indicator lights for power and battery charge status are fixed in this board.
In **NEPTUNE** model, backlight inverter of display is fixed in this board**.**

2.2.3 Display

Display of **NEPTUNE** monitor is 12" or 15” color TFT 800 x 600 resolutions.

2.2.4 Power board

The power board converts 110~240 V, 50/60 HZ AC–Power to 14.6 V DC – Power.
Input and output of this board are isolated above 4000Vac
There isn’t control for turn on/off in this board. If this board connect to AC–Power, It will be turn on otherwise, It will be turn off.

2.2.5 Power Control Board and Input/Output

This board is identified “SPC”.
“SPC” board will charge battery if power board is connected to AC power.
If “SPC” is powered by power board, in addition to charging battery (whether the system is on or off), System will function by power board.
If system turns on without AC–Power connection, System will use battery for functioning.
If DC-Input at the back of system connects to "SPC" board, it will be able to drive system.
System turn on/off be performed by means of electronic switches, isolation of central network connection and amplifier of speaker are other parts of “SPC” board.

2.2.6 ECG, RESP, and TEMP Board

This board is identified “SE”.
This board is able to measure one channel ECG, one channel RESP and two channels TEMP.
The signals are transferred by means of ECG cable and temperature probes then are amplified and after the conversion, these signals enter to micro controller.
Filtering and processing of signals are performed by hardware and soft ware.
These parameters/waveforms are provided:
ECG waveform, HR, RESP waveform, RR, measuring of T_1 and T_2 and status.
All of these data are transmitted to HOST CPU board.
Some control commands are received from HOST CPU such as:
ECG lead, gain, pace condition, kind of filter.
Application part and enclosure are isolated from AC – Power by Transformer and Optocoupler.

2.2.7 SpO_2 Board

This board reports percentage of SpO_2 and pulse rate value to the HOST CPU.

2.2.8 NIBP Board

NIBP board provides the systolic / diastolic and mean pressure values to the HOST CPU.
This board inflates a cuff and measures the blood pressure by using non-invasive method

2.2.9 IBP Board

IBP board provides the systolic / diastolic and mean pressure values to the HOST CPU.
The pressure transition of tube causes the dome sensor to change its value, so this board amplifies this transition and send them to the HOST CPU

2.2.10 Co2 Board

Co2 module provides capnogram and Etco2, Fico2 and AWRR to the HOST CPU.

Chapter 3. Technical specification of system

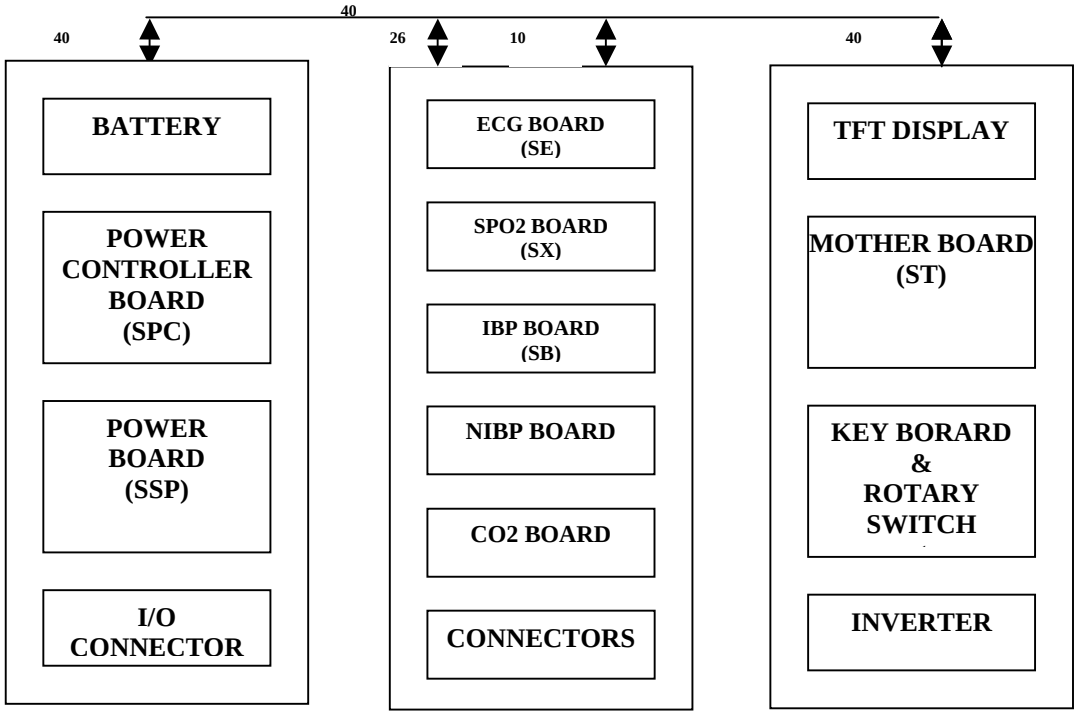
3.1 Block Diagram

In the next pages, block diagram and relation between different parts are illustrated.

The system is made from three parts:

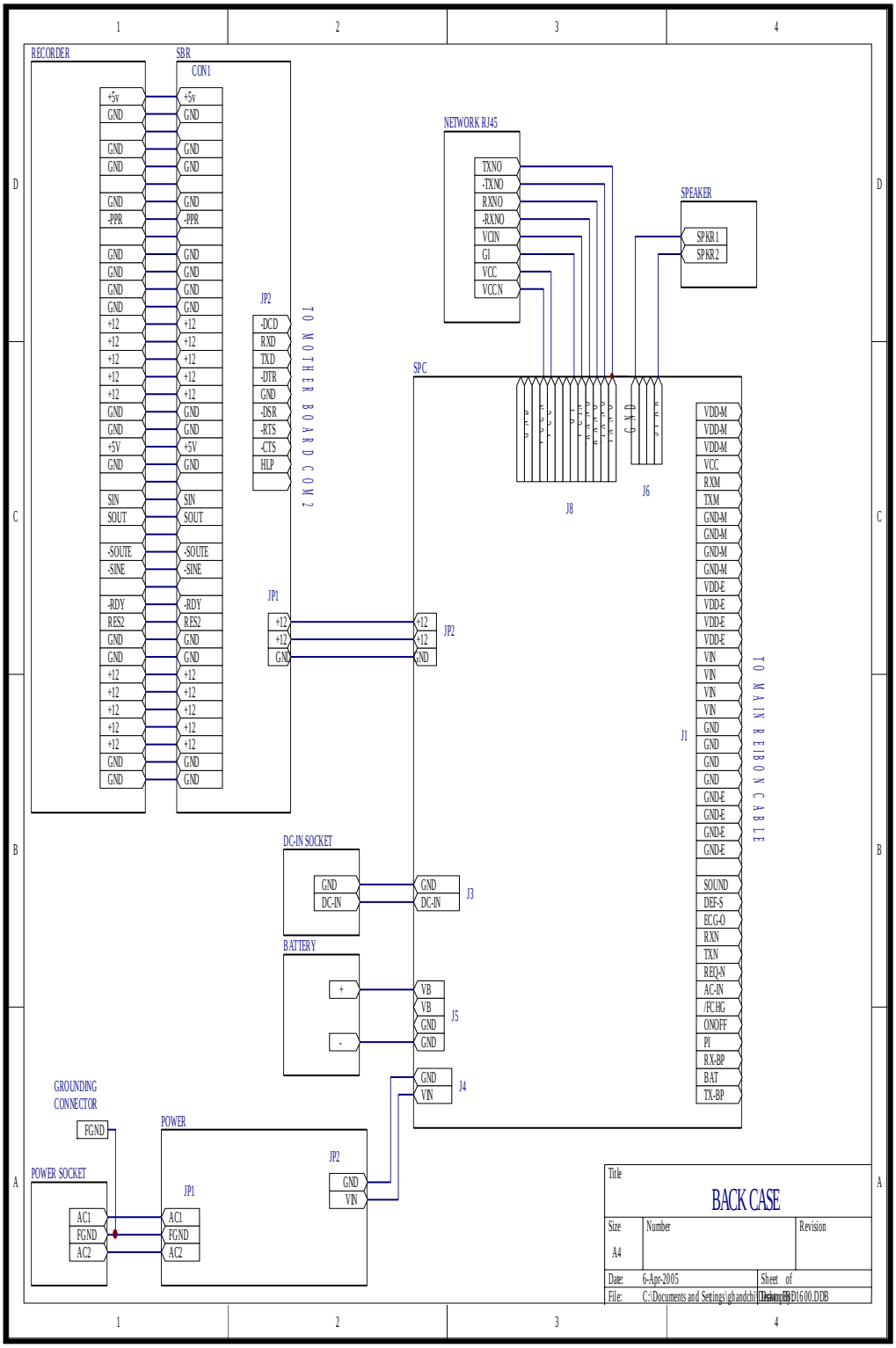
1. **Back case**
2. **Modules**
3. **Front panel**

3.1.1 NEPTUNE Block Diagram

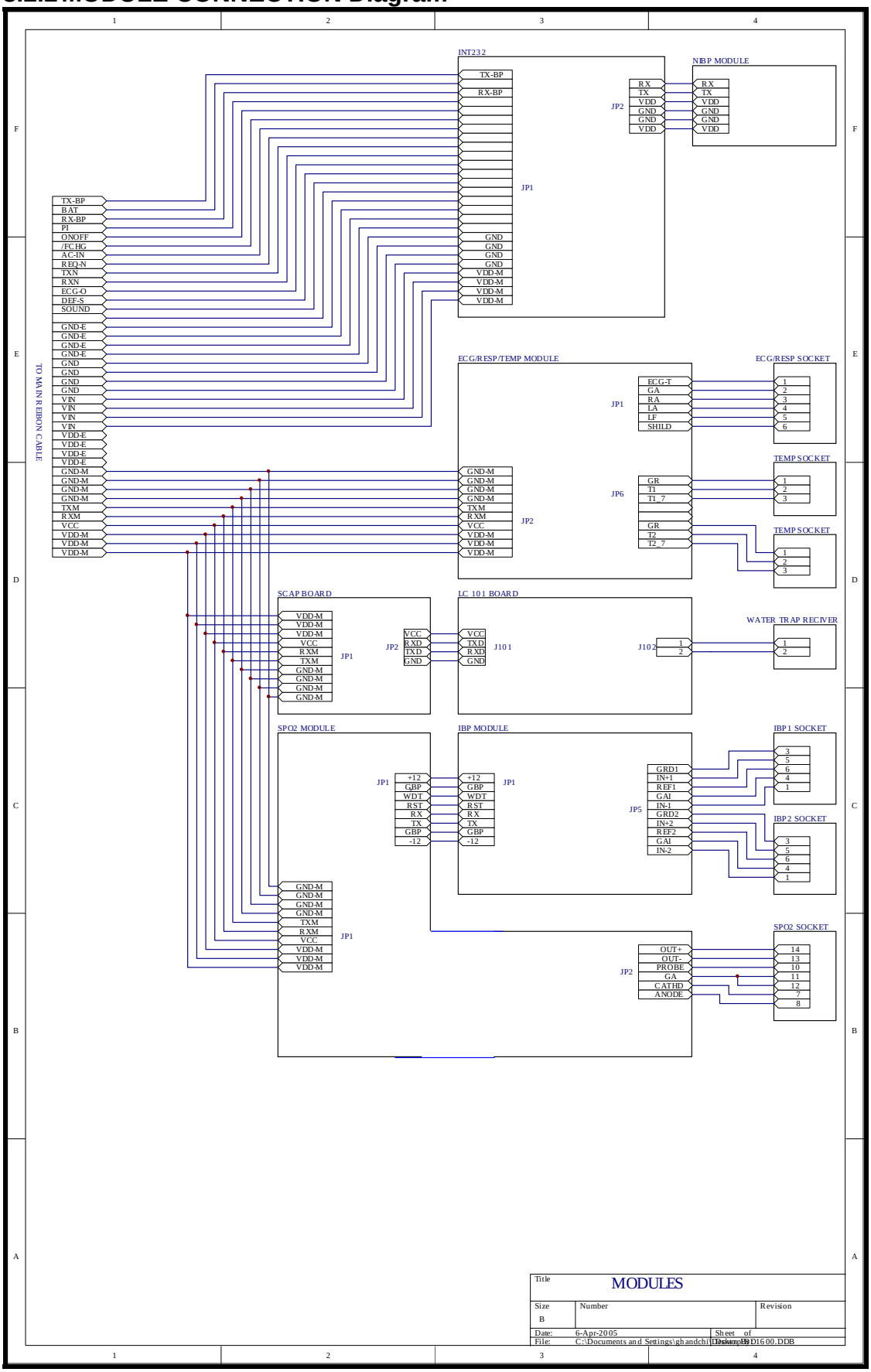


3.2 CONNECTION Diagram

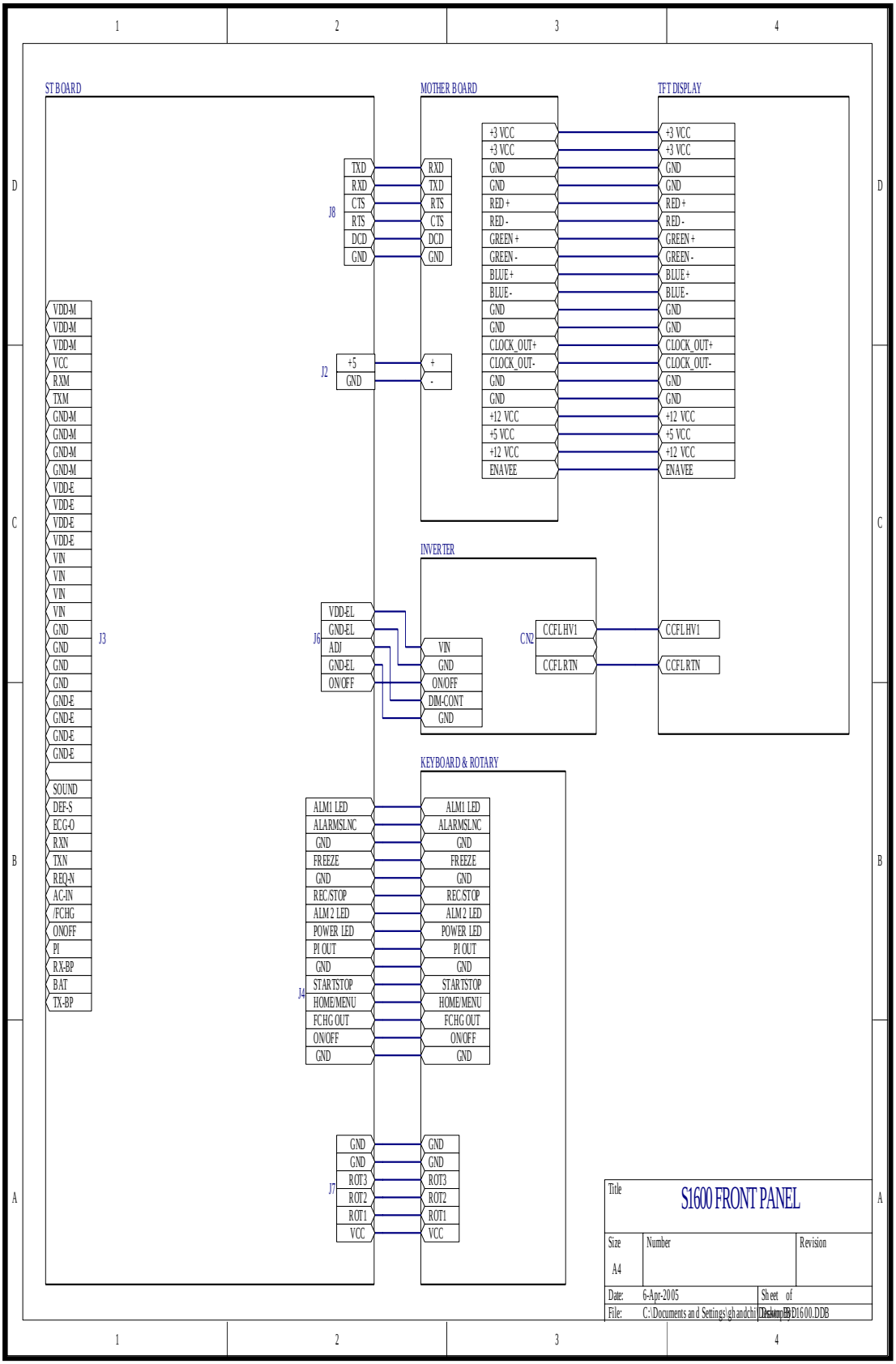
3.2.1 BACK CASE CONNECTION Diagram



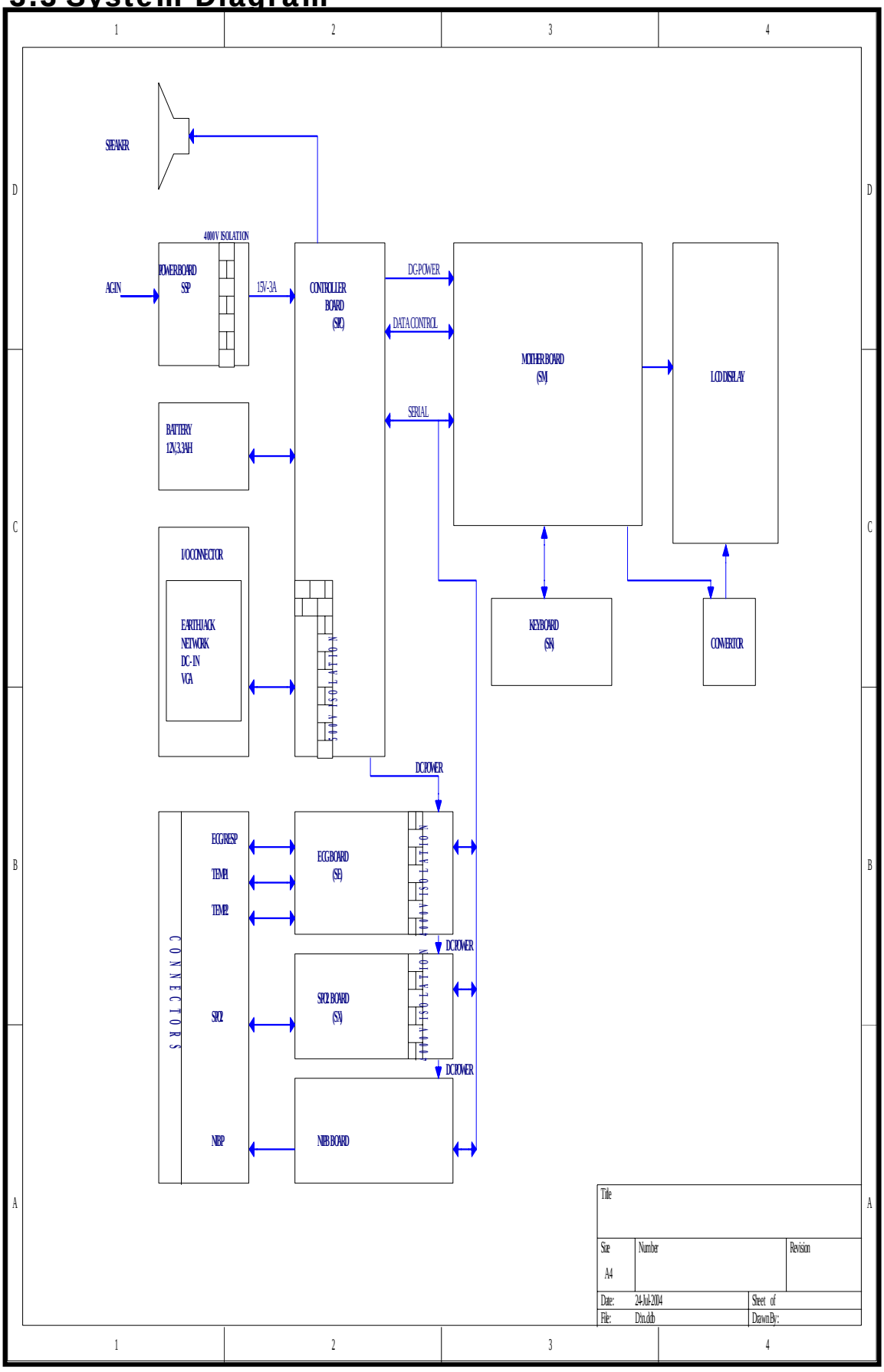
3.2.2 MODULE CONNECTION Diagram



3.2.3 NEPTUNE FRONT PANEL CONNECTION Diagram



3.3 System Diagram



3.4 Circuit diagram & part lists

Last revision of circuit diagrams & part lists are available on master document in **SIARE**
For more information please contact following e-mail: mail@siare.it

Chapter 4.Installation

4.1 System installation

1. Make sure the package is not damaged

2. Take out the accessory package and make sure that the accessory (depending on system model) are complete

3. Install the proper stand according to 5.2.a &5.2.b

4. Install the system on stand according to 5.2.c

5. place the battery fuse in fuse holder on the back left corner of system

6. Place the cable holder and plug AC-cable to system. Check safety grounding system.

7. Plug the system to AC-line and turn on system

8. Unplug system. It must continue working (internal battery operation).
   Note:
   It is necessary to charge the battery completely before using, charge the battery for at least 8 hours.
   Note:
   Take out battery fuse if stored for more than 2 weeks

9. Test the system according to test III procedure and fill out test reports

10. Fill out the warranty card

4.2 Fixed stand & trolley installation

4.2.a fixed stand installation

Warning:
Use only fixed stands approved by **SIARE**

Unpack the stand; install stand about 135 Cm heights, Select the proper place for stand and system, assign the screws place.

Warning:
Take care about undersurface cables, pipes and etc.
Make holes on the wall with proper drill (drill No 7 is recommended) tight the fixed stand to wall by fastening all screws.

4.2.b Trolley installation

Warning:
Use only trolley approved by **SIARE**

Open the trolley package and tight the separated parts (basket , star wheels , handle ….) together.

4.2.c System installation on fixed stand or trolley

System must be tight to trolley or fixed stand by 6 screws. Recommended screws height is 10 mm and diameter is 4mm. 4 of these screws are placed at back of the system and 2 of them under the system.

Warning:
Use only screws with appropriate height

Warning:
Turn off system and unplug it before any installing operation.

Chapter 5. Test procedures

5.1 Test equipment

1. **ECG Simulator**
2. **RESP Simulator**
3. **IBP Simulator**
4. **SpO_2 Simulator**
5. **NIBP Simulator**
6. **Leakage Tester**
7. **Watertrap with sample line**
8. **Co2 absorber**

5.2 Performance Test

5.2.1 Power-on Test

1. Connect AC-Power cable to AC-Input socket of system and press power key until system turns on.
Notice: press power key about 1 second.
After that, suitable wave forms and parameters will be displayed in monitor.
In this case, green power LED should be light.

2. Indicator light of charging battery should be green or orange.
When internal battery is being charged, indicator is orange.
While the battery is fully charged, indicator will be green.

3. Disconnect the system from AC power and turn it on.
In this case, the battery symbol is displayed on screen to indicate the status of battery charge.

4. Use all keys and enter to different menus to make sure all keys are operating correctly.

5.2.2 ECG functions

1. Connect ECG patient cable to its connector on the left side of system.
2. Connect ECG simulator to ECG cable.
3. Set monitor in lead II and gain x1 and Set simulator to 60 Bpm.
4. Notice that ECG signal is displayed correctly and HR displayed by monitor is 60 ± 2 Bpm
5. Disconnect the RA lead from the simulator.
The “CHECK LEAD RA“message should flash on display.
6. Reconnect the RA lead and disconnect the LF lead from the simulator.
The “CHECK LEAD LF“message should flash on display.
7. Reconnect the LF lead and disconnect the LA lead.
The “CHECK LEADS“message should flash on display.

5.2.3 RESP function

Set the RESP simulator to 15 Brpm.
Notice the monitor displays a normal RESP signal and calculates RR to 15 ± 2 BRPM.

5.2.4 SpO_2 functions

1. Connect a SpO_2 finger sensor to the monitor from the inner side of finger clamp, the red LED flashing should be seen and "SpO_2 PROBE OFF" message should be displayed on screen.

2. Attach sensor to finger for few seconds addition to PLETH signal, SpO_2 measurement value and pulse will be displayed.
If you want to have HR from pulse waveform you should disconnect ECG cable from system.

3. Connect the finger clamp to the simulator, and set the Spo2 simulator to 98% and pulse rate to 60 Bpm.
In this case, monitor displays PLETH signal, SPO_2 and pulse carefully.

5.2.5 NIBP functions

1. Connect one end of air hose to the monitor and the other end to a three way adaptor supplied with the NIBP simulator, connect adult patient cuff and air hose of simulator to the other way. Wrap the cuff around simulator block in a suitable condition.

2. Set the NIBP simulator to 120/80 mmHg and start monitor.

3. The measurement should be done and the NIBP read of the monitor should be the value of simulator setting monitor
(120/80 mmHg with tolerance of ±5 mmHg for both systolic and diastolic)

4. Disconnect cuff from the air hose after that start monitor for measuring of pressure.
The monitor should start inflating automatically after 10 seconds the inflation are stopped and the error massage be displayed in monitor.

5. Block the air outlet with finger and start monitor to inflat.
The inflation should be immediately stopped and the error message be displayed.

5.2.6 IBP functions

1. Connect the IBP simulator to the monitor.
Set pressure of simulator on zero and do “zero set” in system.
2. Set the IBP simulator on 120/80 mmHg.
System displays pressure with tolerance ± 1 mmHg.
3. Do above functions for both BP_1 & BP_2.

5.2.7 Co2 functions

1. Make sure that watertrap is not connected to system. From Resp menus select capno. "CO2 NO WATERTRAP" error will be displayed. After 30 second,"CO2 MODULE STANDBY" will be replaced by previous massage.
2. Connect co2 absorber to the watertrap and go to zero menu." low run time "error will be displayed. Wait for 5 minutes and try again. "ZERO OK" will be displayed.
3. Connect sample line to filter and breath through it. Capnogram and other parameters will be displayed.
4. Occlude the sample line or exhaust and wait for "CO2 INLET OCCLUDE" or "CO2 EXHAUST OCCLUDE" error massages

5.2.7 Alarm functions

1. Connect ECG cable to the monitor.
Connect their leads to off simulator (HR= 0).
After about 10 seconds, “Systolic” message should be displayed and alarm should be activated.

2. Press silence key, the alarm sound should be silenced and “SILENCED" message should be displayed on monitor.

3. After 2 minutes, the alarm should be activated again.

5.2.8 Leakage test

1. Connect the patient monitor power cable, ground cable, and ECG cable to the “SAFETEY ANALYSER”.

2. Measure the chassis leakage current to ground with normal polarity.
The leakage current should be less than 500 uA.

3. Measure the ECG lead leakage current to ground with normal and reverse polarity.
These leakage currents should be less than 10 uA.

4. Repeat previous test in single fault condition.
The leakage current should be less than 50 uA.

5. Measure the leakage current between all leads with normal and reveres polarity.
The leakage currents should be less than 10 uA.

6. Measure the isolation leakage current in normal and single fault condition.
The leakage current should be less than 50 uA.

4.3 calibration

System calibration should be performed every two years or as frequent as dictated by hospital policy.
When you need calibration services, contact after sale service of **SIARE**

4.3.a Capno module calibration

It is recommended to calibrate your NEPTUNE systems with Capnograph feature every 6 month
To calibrate the module go through OPERATION MANUAL instruction

Chapter 6. Care and Cleaning

6.1 General Care

Qualified staff should perform using the system.
Before using this device, do the following check:
- Check if there is any damage of enclosure such as: ruin, break or crushed.
- Check cables, probes and accessories of device.
- Control function of device to make sure that device operates correctly.
If you find any damage on the device, stop using it and contact the qualified technicians of hospital or after sale service of **SIARE.**
Qualified technicians of **SIARE** should perform all checks that need to open the monitor.

6.2 General cleaning

Warning: Before cleaning the monitor and accessories, turn off the monitor and disconnect it from power line.
Non-caustic detergents such as soap and water can do regular cleaning of enclosure, display, cables and accessory probes.
Alcohol, isopropanol and hospital–grad ethanol are useable for cleaning.
Notice: The cleaning agents don’t enter in to the chassis of the device and make sure that cleaning agent doesn't leave at any part of device.
Warning: avoid using of the ammoniac–based and Acetone-based cleaners.

6.3 Sterilization and disinfecting

It's better that sterilization and disinfecting be performed when necessary.
Before sterilization and disinfecting, clean monitor.
Recommended sterilization materials are Ethylate and Acetaldehyde.
Notice: No part of the device can be subjected to immersion in liquid.
Notice: Do not pour liquid on to the device during sterilization.

Chapter 7. Trouble shooting

Repairing internal parts of the monitor must be only done by trained and authorized personnel of After Sale Service; otherwise **SIARE** will not take any responsibility for any possible hazard to the patient and the monitor.

Troubleshooting guide is intended to help users to solve minor problems caused by incorrect use of the monitor or failure of accessories.

When you face any problem, please be sure that you have followed all procedure mentioned in Correct Action column before you contact with After Sale Service.

Fault Symptoms	Possible Cause	Correct Action
Not to be turned on		- Check POWER AC cable - Call for service
Unable to work with Battery	- Battery is discharged - Fuse of Battery is faulty - Others	- Charge the battery for more than 10 hours - Check fuse existence - Call for service
NO ECG waveform	- ECG cable is not connected correctly - Bad placement of leads and electrodes - Others	- Connect ECG cable correctly - Check leads and electrodes. - Don’t use old and faulty electrodes - Call for service
Noisy ECG waveform	- Loose connection of electrodes - Earth connection failure - Wrong ECG filter - Others	- Check electrodes and leads - Check earth - Set filter mode correctly - Call for service
Spike on ECG waveform	- If "PACE ON" for patient without Pace marker ,ECG noise will be received as PACE. - Others	- Turn “Paced detect” OFF in ECG menu
Unstable HR	- ECG signal is noisy or isn’t suitable - Others	- Check leads and electrodes. - Change lead to display the best ECG signal - Call for service
No “RESP” signal Unstable waveform Unstable RR	- Electrodes are not connected correctly - Patient movement during measurement - Others	- Check leads and electrodes. - change RESP lead - Calm patient - Call for service

Fault Symptoms	Possible Cause	Correct Action
Strange T1,T2	- Location of sensor isn't suitable - Faulty sensor - Others	- Put the sensor in suitable place - Change sensor - Call for service
No SPO_2 waveform Noisy waveform	- SPO_2 probe is in an unsuitable place. - Faulty sensor - Others	- Change the place of probe on patient - Change probe - Call for service
Strange SPO_2 value	- Patient movement during measurement - Probe is in an unsuitable place. - Others	- Calm patient - Change the place of probe - Call for service
NIBP can not inflate	- Incorrect air hose connection. - Air hose occluded or tangled. - Air hose or cuff leakage - Others	- Check connection - Check Air hose - Change faulty accessory - Call for service
NIBP measurement is not successful strange NIBP value.	- No cuff or Air hose is connected - Wrong cuff placement - Patient movement during measurement - Others	- Check cuff and air hose - Change cuff placement - Calm patient - Call for service
Strange IBP value Noisy IBP signal	- No zeroing before use - noisy source exists near by system or accessories - faulty sensor - Others	- zeroing - keep system and cable away from noise source - change sensor - Call for service
CO2 System fault #01	- Communication Error	- Call for service
CO2 System Fault#02	- Host command with invalid data	- Call for service
CO2 System fault#03	- Unprotected operation violation	- Call for service
CO2 System fault#51	- Customer code mismatch	- Call for service
CO2 System Fault#57	- CO2 Sensor not found	- Call for service
CO2 System fault#60	- CO2sensor EEPROM error in revision #	- Call for service
CO2 System fault#65	- CO2 sensor EEPROM error in read or write operation	- Call for service
CO2 System fault#66	- CO2 sensor EEPROM **e**rror in **CCTTT/CRC** code	- Call for service

CO2 System fault#70	- CO2 sensor temperature too high	- Call for service
CO2 System fault#71	- CO2 sensor temperature too low	- Call for service
CO2 System fault#40	- Watchdog error	- Call for service
CO2 System fault#44	- System EEPROM error in **CCITT/CRC** Code	- Call for service
CO2 System fault#46	- System FLASH ROM Error in **CCITT/CRC** Code	- Call for service
CO2 System fault#47	- System communication Error	- Call for service
CO2 System fault#4B	- System external RAM Error	- Call for service
CO2 System fault#4C	- System internal RAM Error	- Call for service
CO2 System fault#4D	- System FLASH ROM Error in Checksum	- Call for service
CO2 System fault#4E	- Stack overflow error	- Call for service
CO2 System fault#4F	- System main program exited	- Call for service
CO2 System fault#80	- Pump failure	- Call for service
CO2 System fault#84	- Barometric pressure too high	- Call for service
CO2 System fault#85	- Barometric pressure too low	- Call for service
CO2 No water trap	- Watertrap is not connected to the system (16)	- Connect watertrap - Call for service
CO2 INLET OCCLUDE	- Obstructed watertrap cannula (17).	- Change watertrap or sample line - Call for service
CO2 EXHUST OCCLUDE	- Exhaust occlusion or pneumatic leak (18)	- Call for service
CO2 Unexpected reverse flow	- Unexpected reverse flow or vacuum offset too large.(15,81)	- Delete the negative pressure source, or vacuum - Call for service
CO2 Unexpected forward flow	- Unexpected Forward flow (82)	- Delete the positive pressure source, or flow source - Call for service
RESP APNEA	- No respiration condition overruns adjusted time	- Call for service
CO2 NO MODULE	- No module or communication Error	- There is no CO2 module or another problem appeared. - Call for service

Chapter 8. Specifications

8.1 NEPTUNE Specifications

DISPLAY

Displaying	TFT COLOR 800 × 600, (NEPTUNE)
Waveforms	ECG, ECG Cascade SPO2, RESP, IBP1 IBP2, CO2 (all Freezable)
Sweep Speed	12.5,25,50 mm/sec
Numeric Parameters	HR, SPO2, NIBP (SYS, DIA, MAP), DT RR, T1, T2, IBP1 & IBP2 (SYS, DIA, MEAN) CO2, FiCO2, EtCO2, AWRR
Operation Method	Membrane and rotary knob

ECG

Leads	3 Wires, I, II, III
Dynamic Range	± 5 mV
Leakage Current	< 10 μA
Lead Off Current	< 90 nA
Gain	4, 2, 1, 1/2, 1/4, Auto
Calibration	1mV, 0.5 sec
Filters	“MONITOR” (0.5 - 28 Hz) “NORMAL” (0.5 - 40 Hz) “EXTENDED” (0.05-100 Hz)
CMRR	> 98 dB
Internal Noise	< 30 μV RTI
Input Impedance	> 10 Mohm
QRS Detection	Duration: 40 to 120 msec Amplitude:0.5 to 5 mV for Adult 0.2 to 5 mV for Neonate
Heart Rate Range	25 - 250 bpm
Tall T-Wave	Reject up to 1.2 mV Amp.
Pacer Detection/Rejection	
	Duration: 0.1 - 2 msec Amp: ±2 to ± 700 mV (Without over/undershoot) Reject From Heart Rate Counter Re-insert into ECG to display on screen
Protection	Defibrillator and Electrosurgery
Standards	IEC 60601-1, ANSI/AAMI EC-13

NIBP

Measurement method	Oscillometric
Measurement mode	Manual/Automatic
Measurement time	18-26 sec (excluding cuff pressurization time)
Measurement Range	Adult:
	SYS 25 ~ 250 mmHg
	DIA 10 ~ 220 mmHg
	MAP 15 ~ 250 mmHg
	Neonate:
	SYS 25 ~ 135 mmHg
	DIA 10 ~ 110 mmHg
	MAP 15 ~ 125 mmHg
Pressure Transducer accuracy	
	±3 mmHg full range
Initial Inflation Target	Adult 150 mmHg, Neonate 70 mmHg
Overall System Efficacy	
	Meet ANSI/AAMI SP-10/1992
Memory	100 Records

SPO2 (Pulse Oximetry)

Method	2 Wave Length Pulse Wave Type
Range	50 to 100 %
Accuracy	2% (SPO2 70 ~ 100%)
	3% (SPO2 50 ~ 70%)
Pulse Rate Range	25 - 250 bpm

TEMPERATURE

Probe Type	YSI-700/400 Compatible
Range	0 - 50 °C
Accuracy	± 0.2 °C

RESPIRATION

Method	Impedance
Base Resistance	250 -1250 Ohm
Dynamic Range	0.2 - 2 Ohm
Breath Rate Range	6 - 150 Brpm

IBP

Channel	2
Press Sensor Sensitivity	
	5 µV / V / mmHg
Press Sensor Impedance	
	300 ~ 2500 Ohm
Resolution	1 mmHg
Error	2 % or 2mmHg which ever is greater

CO2

Method	Infra-red absorption
Measuring mode	Side stream
Measuring rang	
Co2	0~99mmHg
AWRR	0~250BPM
Resolution	
Co2	1mmHg
AWRR	1BPM
Accuracy	
Co2	±4mmHg 0~40mmHg
	±10% of reading 41~76mmHg
	±12% of reading 77~99mmHg
AWRR	±2BPM

Typical accuracy is based on the following:

Ambient temperature 22ºC
Standard gas mixture of CO2 in balance air
Barometric pressure at 760 mmHg (sea level)
CO2 sample line 7 foot, ID 0.55'' (1.4mm)
Sampling flow rate 175ml/min
Respiratory rate<30BPM, stable to ±3BPM
I: E ratio =1:2
CO2 accuracy is derated between 5ºC to 15ºC and 45ºC to 55ºC

Start up time	Less than 10 seconds to acquire CO2 waveform data

Less than 3 min to full operating specification

Calibration	Zero calibration and two user calibration
Rise time	200 msec (10% to 90%)
Delay time	1.12 sec
Patient application	Neonatal to adult
Flow rate	100,150,200ml/min
Flow rate accuracy	-20/+15% of set value
Pressure compensation	Automatic at power on and watertrap replacement
BTPS compensation	yes
N2O, O2, and Desflurane compensation	yes

ALARM

Sources	Limits, Error messages, All other Parameter Limits
Alarm On/Off	Selectable for All Parameters
Alert	Blinking on Display, Volume Selectable Audio Alarms Light indicator

TREND

Sources	HR, SPO2, NIBP, RR, T1, T2, IBP1, IBP2
Trend Time	1, 2, 4, 8, 16, 24 Hours
Resolution	20 sec
List	NIBP (100 Records)

INPUT/OUTPUT

Network	Digital, Serial, RS422, Full Duplex
Connection	8 BED to One CENTRAL system

GENERAL

Safety	IEC 60601-1, Class I, Type CF
Protection	Against Electro surgery and Defibrillator
AC Power	200 - 240 VAC, 50/60 Hz
Internal Battery	Sealed Lead Acid, Rechargeable, 12V, 3.3AH Usage: 45 min (Full Charge)
DC Power Plug	12-14 V, 3 A
Dimension	26 (W) × 21 (H) × 19 (D)
Weight	Approx: 7 Kg

ENVIRONMENTAL

Temperature	Operating: 0 to 40 °C Storage: - 20 to 60 °C
Humidity	0-90 % (Noncondensing)
Altitude	-200 to 3000 m

SIARE applies the UNI EN ISO 13485:2004 Quality System and the EEC 93/42 Medical Devices Directive.

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