bistos
Bistos Co.,Ltd

BT-710

Hand held pulse oximeter

Service Manual

BT-710

Keep this manual for future reference

P/N : 710-ENG-SVM-EUR-D00

Proprietary Material

Revision D00
November, 2017

7th Fl., A Bldg., Woolim Lions Valley 5-cha, 302,
Galmachi-ro, Seongnam-si, Gyeonggi-do,
Korea

Telephone: ++82 31 750 0340
Fax: ++82 31 750 0344

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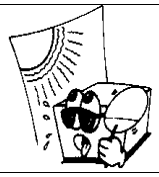
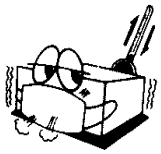
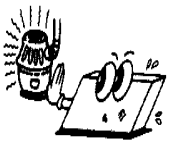
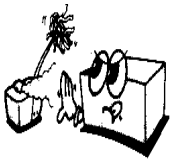
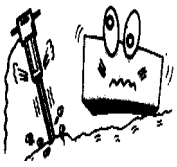
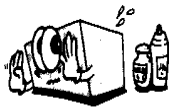
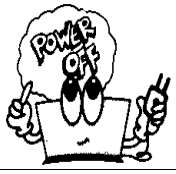
Section 1
Safety

1.1 Instructions for the Safe Operation and Use of the BT-710 Pulse oximeter

- Examine the monitor and any accessories periodically to ensure that the cable, line cords, transducers, and instruments do not have visible evidence of damage that may affect patient safety or monitoring performance. The recommended inspection interval is once per week or less. Do not use the device if there is any visible sign of damage.
- Only the AC line cord supplied with the BT-710, or its equivalent, is approved for use with the equipment.
- Do not attempt to service the BT-710 monitor. Only qualified service personnel by Bistos Co., Ltd. should attempt any needed internal servicing training.
- The BT-710 is not specified or intended for operation during the use of defibrillators or during defibrillator discharge.
- The BT-710 is not specified or intended for operation in the presence of electrosurgical equipment.
- The BT-710 is not specified or intended for operation in conjunction with any other type of monitoring equipment except the specific devices that have been identified for use in the Operation Manual.
- Perform periodic safety testing to ensure proper patient safety. This should include leakage current measurement and insulation testing. The recommended testing interval is once per year.
- Do not operate the BT-710 monitor if it fails to pass the power on self-test procedure.

WARNING	Can lead to serious injury or death.
CAUTION	Can lead to minor injury or product/property damage
NOTE	Can lead a potential hazardous situation which, if not avoided, may result in minor or moderate injury

1.2 General Precaution on Environment

	Avoid placing in an area exposed to moisture. Do not touch the pulse oximeter with wet hand.		Avoid exposure to direct sunlight
	Avoid placing in an area where high variation of temperature exists. Operating temperature ranges from 5℃ ~ 40℃. Operating humidity ranges from 30 % ~ 85 %.		Avoid in the vicinity of electric heater.
	Avoid placing in an area where there is an excessive humidity rise or ventilation problem.		Avoid placing in an area where there is an excessive shock or vibration.
	Avoid placing in an area where chemicals are stored or where there is in danger of gas leakage.		Avoid dust and especially metal material enters into the pulse oximeter.
	Do not disjoint or disassemble the pulse oximeter. Bistos Co., Ltd. does not have liability of it.		Power off when the pulse oximeter is not fully ready to operate. Otherwise, the pulse oximeter could be damaged.

1.3 Definition of Symbols

Symbol	Description
	Used to identify safety information. Be well-known this information thoroughly before using BT-710. During the operation, do not disconnect any cable.
IPX2	Indicates the protection level against the ingress of liquid.
	Refer to operation manual. Read manual before placing the device.
	Indicates DC power supply.
	Indicates the device is in the battery operation mode
	Indicates a defibrillation-proof type BF applied part.
	Indicates the packing material is recyclable.
	Indicates to not dispose the device together with unsorted municipal waste(for EU only). The solid bar symbol indicates that mains adapter is put on the market after 13 August 2005.

CAUTION Federal law restricts this device to sale by or on the order of a physician..

Section 2
Introduction

2.1 Product Overview

BT-710 Handheld Pulse Oximeter mainly to complete the monitoring of physiological parameters SpO2, CO2 etc. (CO2 can be optional function). In order to complete these functions, its function is mainly divided into the following main parts：

(1) Parameter measurement part
(2) Main control part
(3) Man - machine interface part
(4) Power part
(5) Auxiliary function part

2.1.1 Parameter measurement part

Parameter measurement and monitoring are the core functions of the system.BT-710 Handheld Pulse Oximeter measurement part of the function by the measurement probe, parameter input socket and the main control board.

Its role is to pass the physiological signal collected by the probe into electrical signal, according to the pre-set program or the main control part of the transmission of the order, to deal with the signal processing and calculation, then send the value, waveform and alarm information to the main control part, and then use the man-machine interface, displayed it.

2.1.2 Main control part

In the BT-710 Handheld Pulse Oximeter, the main control part refers mainly to the main control board. Its main function is power management allocation, drive man-machine interface, management parameter measurement and provide users with other special features, such as storage, waveform, data review, etc.

2.1.3 Main – machine interface part

BT-710 Handheld Pulse Oximeter man-machine interface includes a display, recorder, speakers, indicator light, buttons, encoders and touch screen, etc.

- The display is mainly to provide users with a large number of real-time and historical data and waveforms, and provide a variety of information and alarm tips
- The speaker mainly provides sound alarm function.
- The indicator light provides additional information on power, battery, alarm, and so on.
- Keys, encoders, and touch screens are user input interfaces through which users can enter information and instructions into the monitor.

2.1.4 Power part

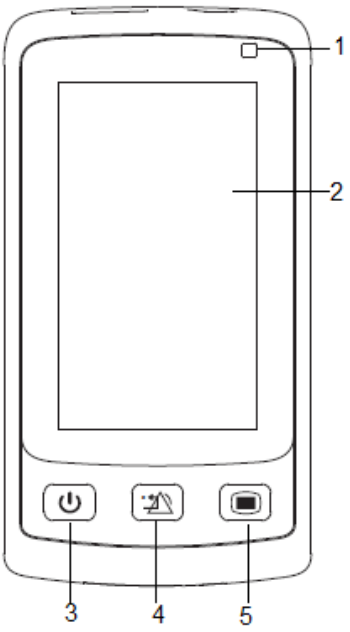
- Power is an important part of the system, including the power adapter and battery two parts.
- The power adapter converts AC mains into a 5V DC low voltage power supply to provide energy to the system.
- The battery provides a short period of time when the system is not energized.

2.1.5 Auxiliary function part

BT-710 Handheld Pulse Oximeter also provide SD card upgrade function, allowing service user to upgrade and update the software without disassembly the machine.

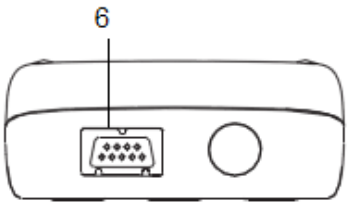
2.2 Description of Product

2.2.1 Description of the BT-710 Front



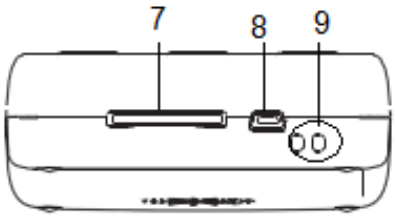
	Name	Description
1	DC power indicator	Turned on when the pulse oximeter is being powered by the adapter.
2	Display area	Display the waveform and measured value
3	 [Power]	- Power On: Press down the key more than 2 seconds. - Power Off: Press down the keys more than 2 seconds and the system will display the alarm message “The system will shut down 3 seconds”.
4	 [Alarm reset]	To reset the alarm condition.
5	 [Setting]	Enter to the setting mode. Press again to close the setting mode.

2.2.2 Description of the BT-710 Top



	Name	Description
6	SpO_2	SpO_2 cable interface

2.2.3 Description of the BT-710 Bottom



	Name	Description
7	SD card interface	For software upgrade
8	Power adapter	5V, 1A adapter
9	Lanyard eyelet	For convenient hand held

2.3 Product installation

2.3.1. Turn on

2.3.1.1 Check the pulse oximeter

- Before turn on the pulse oximeter, check whether there is mechanical damage to the pulse oximeter, and whether the external cables and accessories are connected correctly.
- Plug the power adapter into the AC power outlet. If using battery power, make sure the battery is fully charged.
- Check all the functions required to make sure that the pulse oximeter operates properly.

> ⚠ **WARNING**
> If the pulse oximeter is damaged, or fails to work normally, do not use it. Please contact the maintenance personnel or Bistos immediately.

2.3.1.2 Start the pulse oximeter

If finish to check the pulse oximeter, it is ready to start the pulse oximeter.

Press the [Power] key and the system enters the main interface within seconds.

- If any fatal error occurs during self-test, the system will alarm. If this case persists, please stop to using the pulse oximeter and contact the maintenance personnel or Bistos.
- Check all available pulse oximeter functions to ensure that the pulse oximeter operate properly.
- If the pulse oximeter equipped with a battery, charge the battery after each use to ensure sufficient power.
- After unpacking and use the pulse oximeter at first time, the pulse oximeter should be powered with adapter.

2.3.1.3 Connect the sensors

Connect the SpO_2 sensor to the pulse oximeter and the monitoring site of patient.

2.3.1.4 Start monitoring

Start monitoring in the following steps:

- Check if the patient cable and the sensor are connected properly.
- Check if the settings of the pulse oximeter are corrects, such as patient type.

3.3.2 Turn off

Turn off the pulse oximeter in the following steps

- Disconnect the cables and sensors connected to the patient.
- Press and hold the [Power] key for 2 seconds to pop up the 3 seconds countdown window, and the pulse oximeter turns off in 3 seconds.

⚠CAUTION

If the pulse oximeter is not turned off properly, you can simply disconnect the power to shutdown forcibly. But the forced shutdown may cause data loss, and it is not recommended.

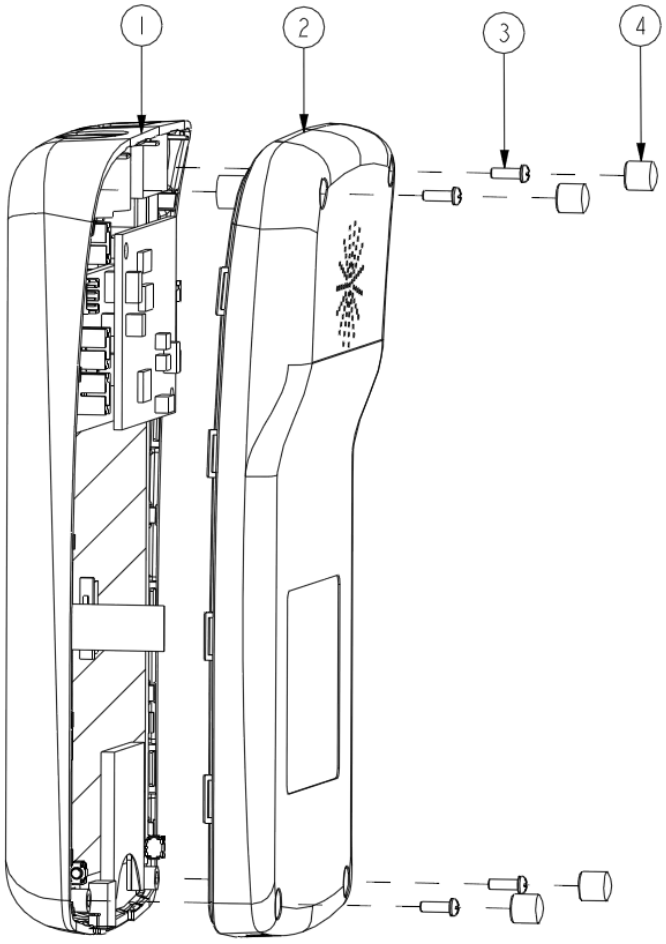
Section 3
Disassemble & Assemble

This manual contains technical details for the BT-710 Pulse oximeter. It provides a technical foundation to support effective troubleshooting and repair. It is not a comprehensive, in-depth explanation of the product architecture or technical implementation. It offers enough information how to repair the Pulse oximeter

Only qualified service personnel should attempt to install the system, disassemble the monitor, remove or replace any internal assemblies, or replace the transducer cable.

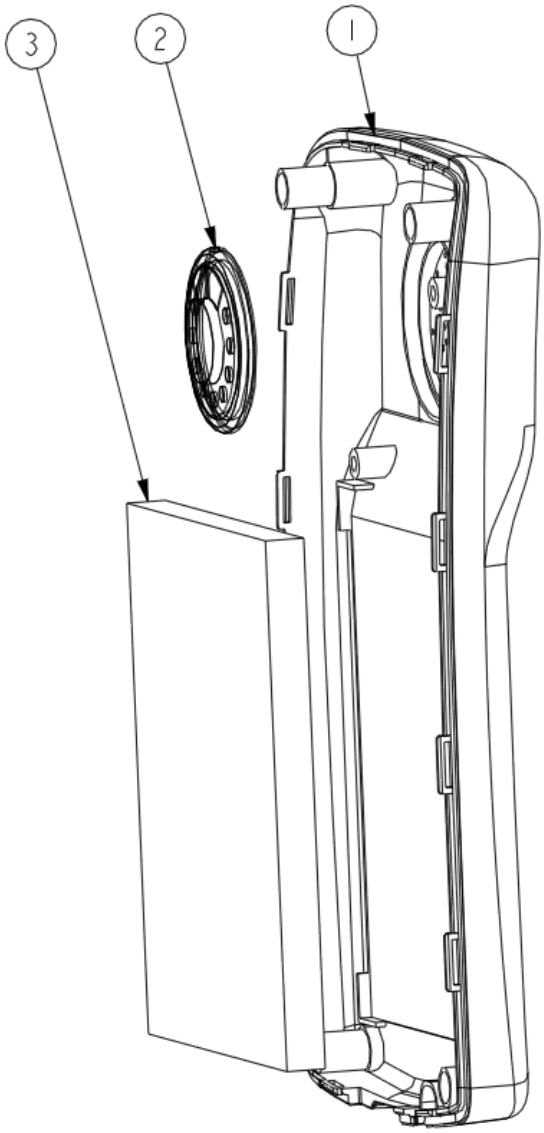
3.1 Product disassembly view

3.1.1 BT-710 Disassembly view top & bottom



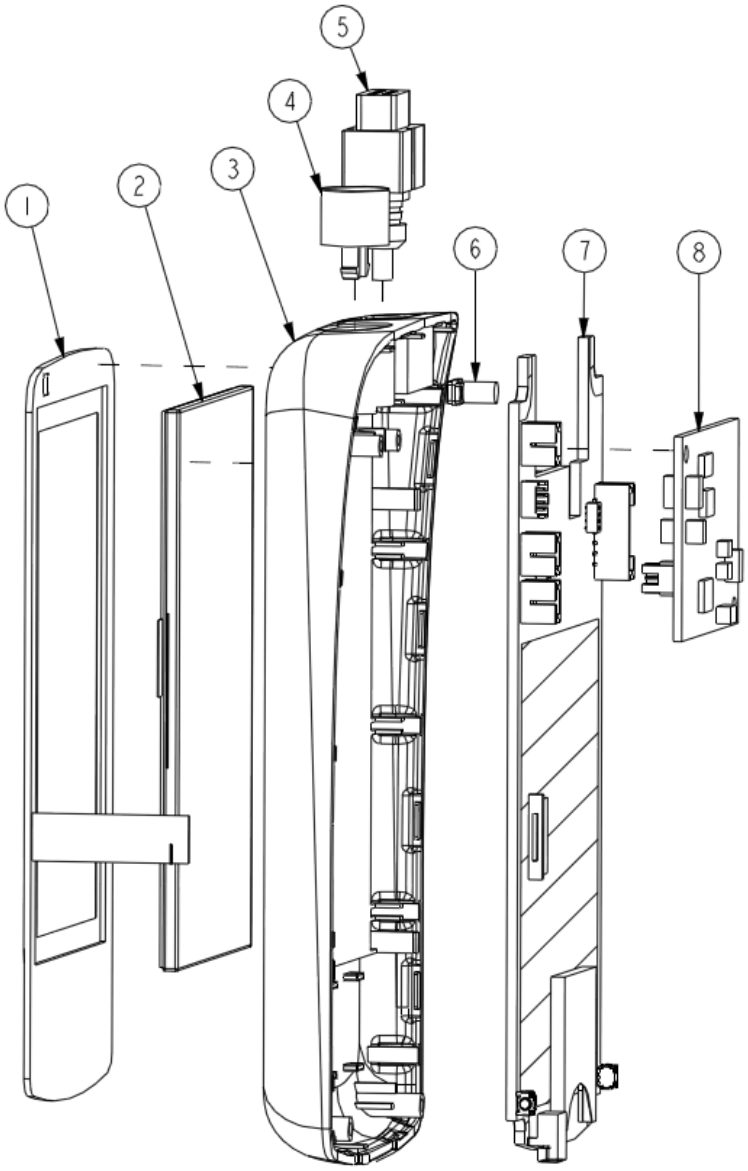
No.	Name	QTY(EA)
1	BT-710 Front Ass'y	1
2	BT-710 Bottom Ass'y	1
3	M2X6 (냄비머리 Machin 2*6 / Stanless Steel)	4
4	Screw plug	4

3.1.2 BT-710 Disassembly view of bottom



No.	Name & Specifications	QTY(EA)
1	Bottom cover	1
2	Speaker	1
3	Battery	1

3.1.3 BT-710 Disassembly view of top



No.	Name & Specifications	QTY(EA)
1	LCD bracket	1
2	LCD	1
3	Front cover	1
4	CO2 socket hole plug	1
5	SpO2 inside cable	1
6	Indicate lampshade	1
7	Main board Ass'y	1
8	SpO2 board Ass'y	1

3.2 Disassembly

It should be unplugged the power and turned off the machine before disassembly pulse oximeter.

3.2.1 Disassembly product

Cut out the 4pcs screws plug on the rear shell, use a small Phillips screwdriver to remove 4pcs M2 × 6 stainless steel Phillips pan head screws in front and rear hood components. Pull out the rear shell to unplug the wire connected to the front shell assembly, you can split the machine before and after the shell part of the two components, as shown below:

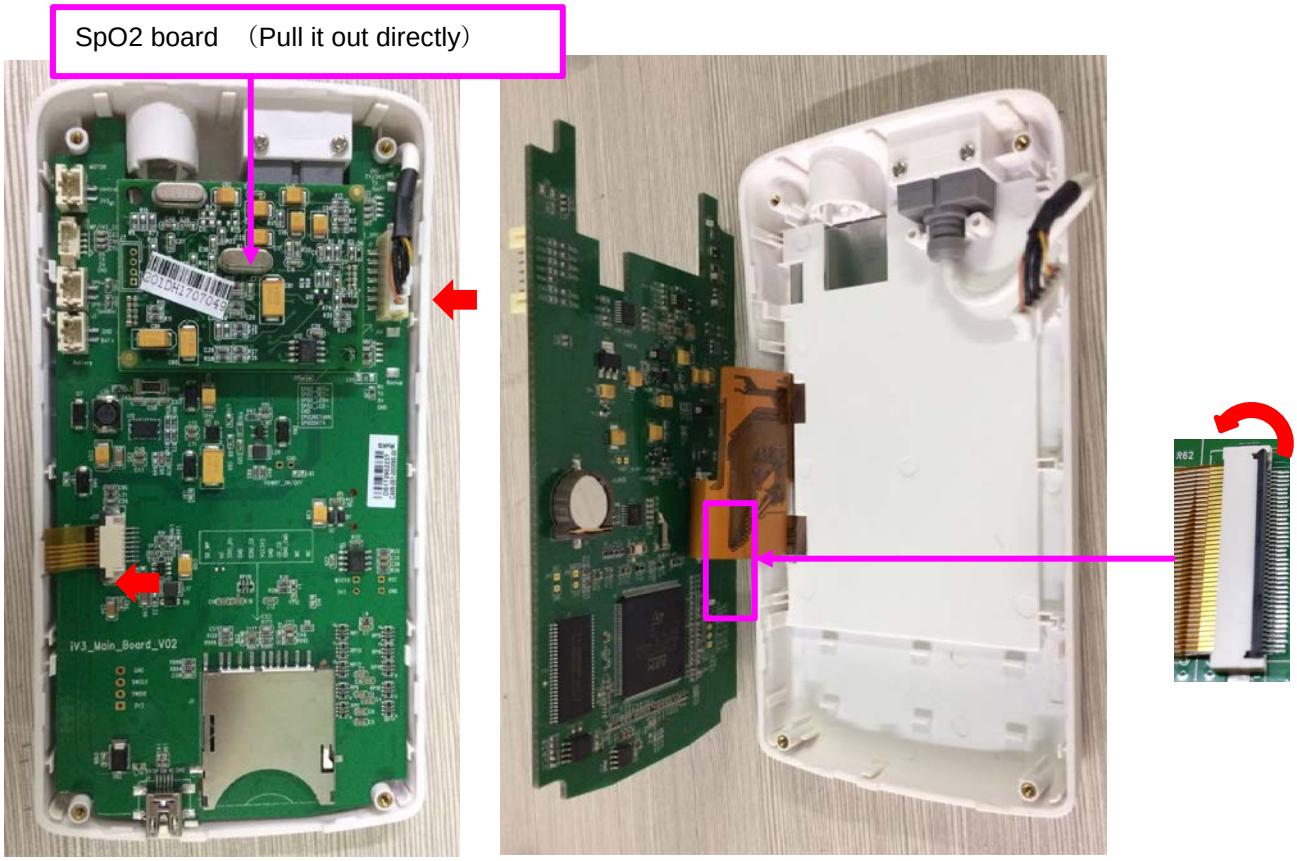
3.2.2 Disassembly front Ass'y

3.2.2.1 Disassembly SpO2 board

SpO2 board is inserted in the main control board, directly pull out can be, as shown below:

3.2.2.2 Disassembly main control board

Remove the cable connected to the main control board, open the main control board, remove the screen cable which inserted in the main control board, You can remove the main control board, as shown below:



3.2.2.3 Disassembly display screen

Demolition of the display screen is destructive, it need to tear off the front panel to remove the display, front panel is not available after tearing, need to replace the new panel.

3.2.2.4 Display battery

The battery and the rear shell is glued together, not alone, if you want to change the battery will have to change the entire rear shell components.

3.3 Assemble

Assemble the device in the reverse sequence of disassembling.

Section 4
Maintenance & Conservation

BT-710 Handheld Pulse Oximeter is a sophisticated, sophisticated electronic instrument. Good maintenance of monitor can not only play the best performance of the machine, but also to ensure the accuracy of long-term work and avoid a variety of measurement error. To prevent cross contamination, make sure that the machine has been cleaned and disinfected before maintenance.

⚠WARNING

- If the user in the various hospitals or institutions can not implement a satisfactory maintenance plan when use this monitor, it will cause function failure, and may endanger human health.

4.1 Checking

Before using the monitor, the following basic inspection work should be carried out:

- Check for any mechanical damage.
- Check all exposed wires, insert parts and accessories.
- Check all functions that may be used to monitor the patient and ensure it in good working condition

Check all instrument functions that may be used to monitor the patient and ensure that the instrument is in good working condition.
If you find evidence that the instrument is damaged, you may not use this monitor to perform any care on the patient. Please contact your hospital's professional maintenance personnel or our customer service.。
All inspections that require disassembly the instrument must be carried out by qualified service personnel. Safety and maintenance inspections may also be carried out by personnel of the Company.
Every 6-12 months or after each repair, the machine must conduct a comprehensive inspection of the equipment by trained and qualified technical service personnel, including functional safety checks, specific check items are as follows:

- Whether the environment and power supply meet the requirements.
- Whether the equipment and accessories have mechanical damage.
- Whether the power supply is worn and the insulation performance is good.
- whether to use the specified attachment。
- Whether the function of the alarm system is normal.
- Whether the performance of the battery meets the requirements.
- Whether the various monitoring functions are in good working condition.
- Whether the grounding impedance and leakage current meet the requirements.

4.2 Maintaining plan

The following tasks can only be approved by the company's professional maintenance staff to complete。
Please connect with maintenance staff if need the following services. It should be cleaned and disinfected Before testing or maintenance

4.3 Cleaning

The device should be cleaned regularly. In the heavily polluted environment, increase the frequency of cleaning. Before cleaning, please consult the hospital about device cleaning requirements.

Below are available cleaning agents:

- Diluted ammonia
- Diluted sodium hypochlorite (washing bleach)
- Diluted formaldehyde
- Hydrogen peroxide (3%)
- Ethanol (70%)
- Isopropanol (70%)

Before cleaning:

- Turn off the monitor, disconnect the power cord and remove the battery.
- Use a soft cotton ball to adsorb appropriate amount of cleaning agent and wipe the display screen.
- Use a soft lint-free cloth to adsorb appropriate amount of cleaning agent and wipe the surface of the device.
- If necessary, use a clean, dry, lint-free cloth to remove any excess detergent.
- Dry the device naturally in a ventilated cool environment.

WARNING	• Before cleaning the monitor or sensor, turn off the power and disconnect the DC power. • The monitor should be kept clean. It is recommended to regularly clean the enclosure surface and the display screen. Cleaning the enclosure with non-etching cleaner such as soap and water.

CAUTION	To avoid damaging the pulse oximeter. • Do not use strong solvents such as acetone. • Most cleaners must be diluted before use. Diluting should be according to the manufacturer's instructions. • Do not use abrasive materials (such as steel wool). • Do not allow any liquid entering into the enclosure, and never immerse any part of the device into liquid. • Do not leave any cleaning solution on the surface of any part of the device.

Note	• Wipe the monitor and sensor surface with medical alcohol, dry it naturally or with clean, dry, lint-free clot. • Bistos is not liable for effectiveness of using these chemicals for infectious disease control. Please consult the infectious disease control officers or experts of the hospital for advice.

4.4 Disinfection

In order to avoid damage to the product, we recommend that the product is disinfected only when it is deemed necessary by the hospital maintenance procedures. We also recommend that the instrument to be disinfected must first be cleaned.

⚠ **CAUTION**	• To prevent damage to the monitor, do not disinfect the monitor with gas (EtO) or formaldehyde.

Section 5 Troubleshooting

BT-710 Handheld Pulse Oximeter in the transport, storage, use the process, due to various factors (such as power grid voltage instability, ambient temperature changes, falling and impact, aging components, etc.) may affect the failure of normal use. At this time should be a certain degree of electronic medical equipment maintenance experience with the following professionals refer to the following classification of fault classification. The so-called component-level maintenance refers to the components through the analysis, replacement, test run, the fault will be positioned to the instrument components, such as the power board, the main control board, components, measuring cables or parameter modules. Parts of the maintenance that is component-level maintenance, manufacturers must have extensive experience in the maintenance of engineers using specialized equipment, in a specific environment and conditions.

5.1 Alarm Information

This chapter lists some important physiological and technical alarm information, and some alarms are not necessarily listed.

Note that in this chapter: L column indicates the default alarm level: H indicates high level, M indicates middle level, L indicates low level, and "*" indicates level set by the user.

Corresponding countermeasures are listed for each alarm message. If you operate in accordance with the countermeasures but the problem persists, contact your service personnel.

5.1.1 Physiological Alarm Information

Source	Alarm message	L	Causes and countermeasures
SpO_2	SpO_2 Too High	M*	SpO_2 value is higher than the upper alarm limit or lower than the lower alarm limit. Check the patient's physiological condition, and check if the patient category and alarm limit settings are appropriate for the patient.
	SpO_2 Too Low		
	PR Too High		PR value is higher than the upper alarm limit or lower than the lower alarm limit. Check the patient's physiological condition, and check if the patient category and alarm limit settings are appropriate for the patient.
	PR Too Low		
NIBP	NIBP signal weak	M*	NIBP value is higher than the upper alarm limit or lower than the lower alarm limit. Check the patient's physiological condition, and check if the patient category and alarm limit settings are appropriate for the patient.
	NIBP-Sys Too High		
	NIBP-Sys Too Low		
	NIBP-Mean Too High		
	NIBP-Mean Too Low		
	NIBP-Dia Too High		
IBP	Art-Sys Too High	M*	IBP value is higher than the upper alarm limit or lower than the lower alarm limit. Check the patient's physiological condition, and check if the patient category and alarm limit settings are appropriate for the patient.
	PA-Sys Too High		
	P1-Sys Too High		
	P2-Sys Too High		
	Art-Dia Too High		
	PA-Dia Too High		

5.1.2 Technical Alarm Information

Source	Alarm message	L	Causes and countermeasures
System	Battery Low	H	Connect to AC power supply, and charge the battery, and power with the battery as needed after fully charged.
SpO_2	SpO_2 Comm. Stop	H	SpO_2 module failure, or communication failure between the

Source	Alarm message	**L**	Causes and countermeasures
	SpO_2 Comm. Error	H	module and the host; please restart the device.
	SpO_2 No Sensor	L	SpO_2 sensor falls off from the patient or monitor, malfunctions, or sensor other than specified in this Manual is used. Check the sensor mounting position, whether the sensor is damaged or sensor type. Reconnect the sensor or use new sensor.
	SpO_2 Sensor Off	L	
	SpO_2 Search Timeout	L	
	SpO_2 Search Pulse	L	Sensor signal is poor or too weak. Check the patient's condition, and place the sensor in a suitable position. If the failure persists, replace the sensor.
CO2	CO2 Comm. Stop	H	CO2 module failure, or communication failure between the module and the host; please restart the device and check the CO2 module.
	CO2 Comm. Error	H	
	CO2 Sensor Off	H	Please check whether the CO2 sensor is connected well with the host.
	Replace O2 Sensor	M	please change another O2 sensor.
	Check Adapter	M	maybe there is something wrong with the adapter, please check the adapter
	Check Sampling Line	M	maybe there is something wrong with the sampling line, please check the sampling line
	one param accuracy err	M	the accuracy of the parameter is error
	Sensor Err(CO2)	M	the CO2 sensor is not match to the module
	O2 calib required	M	please calibration the O2
	Air calib required	M	please calibration the Air
	Software Error(CO2)	M	the software of the CO2 is error
	Hardware Error(CO2)	M	the hardware of the CO2 is error
	Motor out of accuracy(CO2)	M	Motor out of accuracy
	Factory Calibration lost(CO2)	M	please do the factory calibration
	O2 Sensor Error	M	the O2 sensor is not match to the module
	Replace Adapter	M	change another adapter
	Sampling line clogged	M	please replace the sampling line
	No Sampling line	M	please connect the sampling line
	No Adapter	M	there is no adapter, please connect the adapter
	O2 Port Error	M	the O2 port error, please check the O2 port
	CO2 out of accuracy	M	CO2 out of accuracy
	N2O out of accuracy	M	N2O out of accuracy
	O2 out of accuracy	M	O2 out of accuracy
	Temp out of accuracy(CO2)	M	Temp out of accuracy(CO2)
	Pressure out of accuracy(CO2)	M	Pressure out of accuracy(CO2)
	Zero required(CO2)	M	Perform zeroing operation
	CO2 is zeroing	Message	CO2 module is zeroing
	CO2 is sleeping	Message	the mode is standby
	Span Calibrating(CO2)	M	the CO2 module is calibrating
	Span Cal Error(CO2)	M	the CO2 module calibration error

5.2 Machine malfunction

Malfunction phenomenon	Possible reason	Handle method
Boot without display and power indicator do not light.	① Film key damaged ② Adaptor not plugged in and the battery no power ③ No electricity and battery power ④ Main control board damaged	① Check adaptor and battery ② Replace film key ③ Replace main control board
Boot no display or work in black, but the power indicator light is on	① Main control board damaged ② Display screen damaged	① Check display screen cable plug ② Replace display screen
One measurement function or operation failure	① Main control board and the corresponding parts damaged	① Further check main control board and the corresponding parts
Occasional crash	① Power grid instantaneous strong interference ② Poor adaptor performance ③ Poor main control board performance	Re-boot is normal , if not normal, then began to troubleshoot as follows： ① Replace main control board ② Replace power adaptor

5.3 Operating & Recording

Malfunction phenomenon	Possible reason	Handle method
Button or Encoder failure	① Film key or Encoder damaged ② The FPC cable which connected film key with main control board damaged or be suppressed ③ Main control board damaged	① Check the FPC cable in film key. ② Replace film key or encoder ③ Replace main control board
Sound hoarse or failing	① Main control board damaged ② Speaker or connection cable damaged	① Replace main control board ② Replace speaker or connection cable damaged

5.4 Battery malfunction

Malfunction phenomenon	Possible reason	Handle method
Battery can’t be charged	① Battery is damaged ② Power adaptor is damaged ③ Main control board is damaged	① Change battery ② Change power adaptor ③ Change main control board

5.5 Parameter malfunction

Malfunction phenomenon	Possible reason	Handle method
No SpO2 waveform	① SpO2 sensor damaged ② Not using original sensor or wrong sensor use ③ Poor integrated parameter board	① Replace new SpO2 sensor ② Check the sensor is compatible, try to use the original sensor ③ Replace integrated parameter board
SpO2 waveform have strong interference	① Patient in the activities ② Ambient light is too strong ③ SpO2 sensor did not folder good	① Keep patient silence ② Weaken the surrounding ambient light ③ Adjust sensor in right position
SpO2 measurement value inaccurate	① Patient with a color injection ② Patient's finger coated with sth. ③ SpO2 sensor in wrong position	① Dye exclusion before measurement ② Clean up finger which will clip sensor Adjust sensor in right position

Service Telephone and Fax. Numbers

Telephone: +82 31 750 0340
Fax: +82 31 750 0344

Bistos Co., Ltd.
7th FL., A Bldg., Woolim Lions Valley 5-cha, 302, Galmachi-ro,
Jungwon-gu, Seongnam-si, Gyeonggi-do, Korea

www.bistos.co.kr

bistos@bistos.co.kr