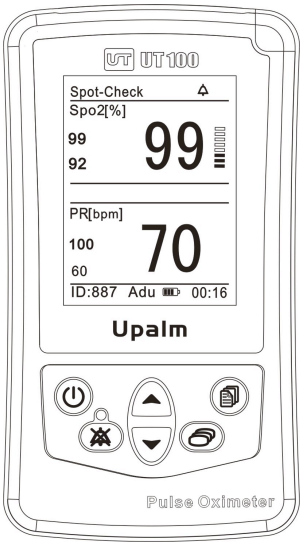
UT100 Handheld Pulse Oximeter

Service Manual



— English

Version 1.0, June 2011

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Chapter 1: Introduction

1.1 About this Manual

This manual is written for technical personnel servicing the UT100 Handheld Pulse Oximeter.

UTECH reserves the right to change specification without notice.

1.2 Technical Description

Per requirement of IEC 601-1, the model UT100 is classified as class II equipment, internally powered, with type BF applied part, and an enclosure protection rating of IPX1.

Transport/Storage: -10 to +55℃ (14-131 F), 10-95% R.H. non-condensing
Operating Conditions:10 to +40℃ (50-104 F), 10-90% R.H. non-condensing

1.3 Manufacturing Quality & Safety

The UTECH manufacturing facility is certified to both ISO 13485 and EC 46002 (MDD 93/42/EEC Annex II). UTECH products bare the “CE 0482” mark; and tested by TUV Rheinland to IEC 601-1/EN60601-1.

1.4 Declaration of Conformity with European Union Directive

The Authorized Representative for UTECH equipment is:

Wellkang Ltd t/a Wellkang Tech Consulting
Suite B, 29 Harley Street, LONDON W1G 9QR,
England, United Kingdom

Phone: +44 (20)30869438
Fax: +44 (20)76811874

1.5 Limited Warranty

UTECH CO., LTD. (“Seller”) warrants each new device to be free from defects in workmanship and materials under normal use and service for a period of one (1) years from the date of shipment. The sole obligation of UTECH company under this warranty will be repair or replace, at its option, products that prove to be defective during the warranty period. The foregoing shall be the sole warranty remedy. Except as set forth herein, seller makes no warranties, either expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. No warranty is provide if the products are modified without the express written consent of UTECH company and seller shall not be liable in any event for incidental or consequential damage. This warranty is not assignable.

Warranties are subject to change. Please contact UTECH company for current warranty information.

1.6 Service Support

Repairs for devices manufactured by UTECH company under warranty must be made at authorized repair centers. If the device needs repair, contact your local distributor or the UTECH company after-service department. When calling, have the device’s model and serial number ready.

If you need to ship the device, pack the device and accessories carefully to prevent shipping damage. All accessories should accompany the device.

UTECH CO., LTD.
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Chongqing, China
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E-mail: service@chinautech.com

Chapter 2: General Description

2.1 Intended Use

The UT100 Handheld Pulse Oximeter is a low cost monitor for spot checking, continuous, noninvasive monitoring or recording of functional oxygen saturation of arterial hemoglobin (SpO_2), pulse rate and pulse strength. The monitor is a battery powered pulse oximeter. It may be used in the hospital, clinical environment, homecare, and during emergency land transportation. The oximeter works with given sensors providing SpO_2 and pulse rate on all patients from neonatal to adult.

This device is intended for continuous patient monitoring with adjustable alarm limits as well as visible and audible alarm signals.

NOTE! The monitor was not designed or tested to be an apnea monitor.

2.2 Patient Safety

For maximum patient and operator safety, the following are recommended:

- Care should be exercised to assure continued peripheral perfusion distal to the SpO2 sensor site after application.
- Do NOT attach an SpO2 sensor distal to a blood pressure cuff. Valid data CANNNOT be processed when the cuff is inflated. Attach the sensor to the limb opposite to the site used for the blood pressure cuff.
- Keep the device and its accessories clean. Do not operate the device when it is wet due to spills or condensation.
- Where electromagnetic devices (i.e., electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electromagnetic fields up to 3V/m will not adversely affect system performance.
- The device contains no user serviceable parts. Refer servicing to qualified service personnel.

2.3 Warning Information

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

Warnings

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

WARNING! EXPLOSION HAZARD: Do NOT use the device in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.

WARNING! Failure of Operation: If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.

WARNING! Patient Safety: Care should be exercised to assure continued peripheral perfusion distal to the SpO2 sensor site after the application.

WARNING! Do not position the sensor cable in any manner that may cause entanglement or strangulation.

Cautions

CAUTION! Do not operate the device when it is wet due to spills or condensation.

CAUTION! Do not operate the product if it appears to have ben dropped or damaged.

CAUTION! Never sterilize or immerse the monitor and sensors in liquids.

CAUTION! No tension should be applied to any sensor cable.

CAUTION! Operate at temperatures between 10 to +40℃.(50 to 104F), 10-95% R.H.non-condensing.

CAUTION! Avoid storing the monitor at temperatures less than -10C or greater than +55C (<14F or >131 F0) 10-95% R.H. non-condensing.

Notes

NOTE! Use only the manufacturer approved sensors and accessories with the device.

NOTE! The product and its accessories with have patient contact are free of latex.

NOTE! Data Validity: As with all pulse oximeters, inaccurate SpO2 and Pulse Rate values may be caused by:

- **Incorrect application or use of a sensor**
- **Significant levels of dysfunctional hemoglobin; carboxyhemoglobin or methemoglobin**
- **Significant levels of indocyanine green, methylene blue, or other intravascular dyes**
- **Exposure to excessive illumination such as surgical lamps-especially ones with a xenon light source, or direct sunlight**
- **Excessive patient movement**
- **Venous pulsations**
- **Electrosurgical interference**

2.4 Definition of Symbols

SYMBOLS	DEFINITION
	Attention, see in instructions for use
	Type BF Defibrillation
	Power on/off
	Alarm silence
	Up and Down Arrows
	Mode Change Key
	Menu Key
	Date of Manufacturing
IPX1	Drip Proof (monitor only)

CE 0482	CE Mark
	Indicates separate collection for electrical and electronic equipment.

2.5 Preparation for Use

2.5.1 Getting Acquainted

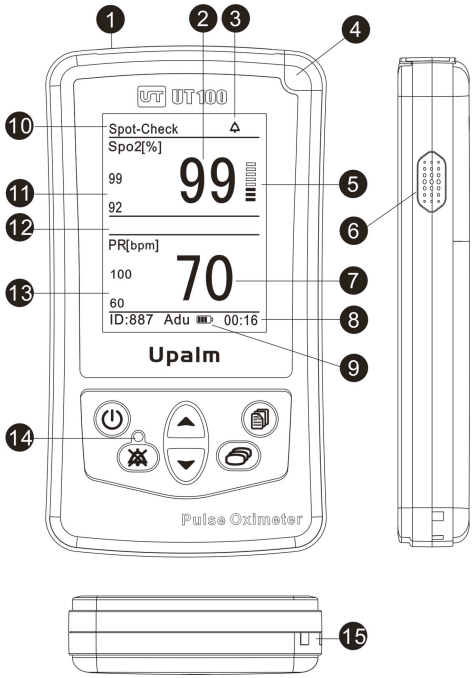

Figure 2.1: Monitor Controls, and Features

1. Sensor Connector

The sensor connects here, or an oximetry extension cable can be connected between the monitor and the sensor.

2. SpO_2 Numeric Display

A number shows the patient's SpO_2 value in percent. Dashes (- - -) mean the monitor is not able to calculate the SpO_2 value.

3. Mute icon

The mute icon is displayed at the status bar and it has three statuses:

"  " this icon means the normal status of alarm sound.
"  " this icon is displayed during temporary 30sec, 60sec, 90sec, 120sec alarm silence.
"  " this icon is displayed steadily during permanent alarm silence.

4. Power Indicator
This indicator lights steadily to inform the working status of the monitor. Green means the monitor working normally and red means alarm occurred.

5. Pulse Strength Bar Graph
The pulse strength bar graph "sweeps" with the patient's pulse beat. The height of the bar graph shows the patient's pulse strength.

6. Speaker
It provides audible indication of alarm conditions, pulse tone and feedback for key-presses. Ensure the speaker is not covered.

7. Pulse Rate Numeric Display
A number shows the patient's pulse rate value in beats per minute. Dashes (- - -) mean the monitor is not able to calculate the pulse rate value

8. Information Bar
The information bar displays patient's ID/ type, battery level icon, date/time.

9. Battery level Icon
This icon is displayed at the information bar and has four levels. It flashes when there is only 15 minutes left for the monitor shut down it self.

10. Status Bar
The status bar displays the there measuring modes, sensor no connect/sensor offline/pulse search/low perfusion icon and volume icon.

11. Current Alarm Limits of SpO_2
If the high/low alarm limit has been changed from the default settings, there will be a decimal point displayed after it.

12. Alarm bar
The alarm bar displays high and medium alarm events to alert users.

13. Current Alarm Limits of Pulse Rate
If the high/low alarm limit has been changed from the default settings, there will be a decimal point displayed after it.

14. Silence Indicator
This indicator flashes during temporary two-minute alarm silence. The indictor lights steadily during permanent/indefinite alarm silence.

15. Slot for hanging strap

2.5.2 Power Supply Options

Batteries. Fresh disposable "AA" alkaline batteries provided approximately 10 hours of operation. Battery capacity maybe reduced in colder temperatures or with excessive power cycling.

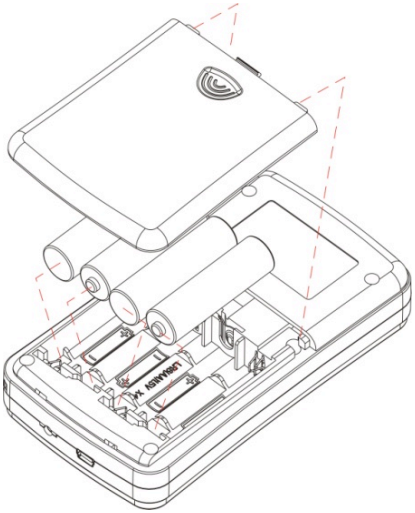

Figure 2.2: Installing the Batteries

To install/replace the batteries:

1. Depress the battery door and remove it downward.

2. Install the negative end of each battery first, compressing the battery terminal spring until the positive terminal clears the positive tab. Press the battery down into place.

3. Place battery door into the slots of the monitor back panel, depress the door tab, and press the door into place.

NOTE! If you install disposable batteries, be sure to dispose of them in compliance with your institution's guidelines and local ordinances.

NOTE! The unit will hold data for about one and a half minutes with no battery power. This will insure the safety of trend data during battery replacement.

AC Charger. The AC adapter can be used to charge rechargeable batteries and used as a power supply without any battery.

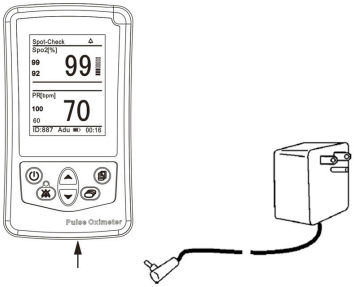

Figure 2.2: Connecting AC Charger

2.5.3 Power On/Off

To turn the pulse oximeter on, press the power key.

- "Check ok" and software version will be displayed.
- An audible tone sounds.
- The power indicator is briefly illuminated.

To turn the pulse oximeter off, press the power key.

2.5.4 Auto Power Off

A battery power saving feature allows the pulse oximeter to shut itself off after waiting 5 minutes without detecting any pulsatile activity.

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Chapter 3: Theory of Operation

3.1 Theory of Operation

The pulse oximeter determines %SpO_2 and pulse rate by passing two wavelengths of low intensity light, one red and one infrared, through body tissue to a photodetector. Information about wavelength range can be especially useful to clinicians. Wavelength information for this device can be found in the *SpO_2 Specifications* section of this manual.

Pulse identification is accomplished by using plethysmographic techniques, and oxygen saturation measurements are determined using spectrophotometric oximetry principles. During measurement, the signal strength resulting from each light source depends on the color and thickness of the body tissue, the sensor placement, the intensity of the light sources, and the absorption of the arterial and venous blood (including the time varying effects of the pulse) in the body tissues.

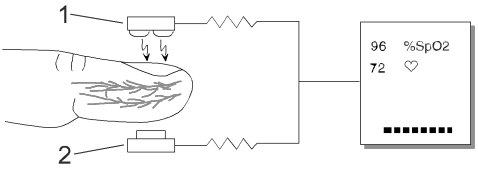

Figure 3.1: Theory of Operation

1. Low intensity Red and Infrared LED light sources
2. Detector

Oximetry processes these signals, separating the time invariant parameters (tissue thickness, skin color, light intensity, and venous blood) from the time variant parameters (arterial volume and SpO_2) to identify the pulses and calculate functional oxygen saturation. Oxygen saturation calculations can be performed because blood saturated with oxygen predictably absorbs less red light than oxygen-depleted blood.

WARNING! Since measurement of SpO_2 depends on a pulsating vascular bed, any condition that restricts blood flow, such as the use of a blood pressure cuff or extremes in systemic vascular resistance, may cause an inability to determine accurate SpO_2 and pulse rate readings.

WARNING! Under certain clinical conditions, pulse oximeters may display dashes if unable to display SpO_2 and/or pulse rate values. Under these conditions, pulse oximeters may also display erroneous values. These conditions include, but are not limited to: patient motion, low perfusion, cardiac arrhythmias, high or low pulse rates or a combination of the above conditions. Failure of the clinician to recognize the effects of these conditions on pulse oximeter readings may result in patient injury.

3.2 Circuit Structure Diagram

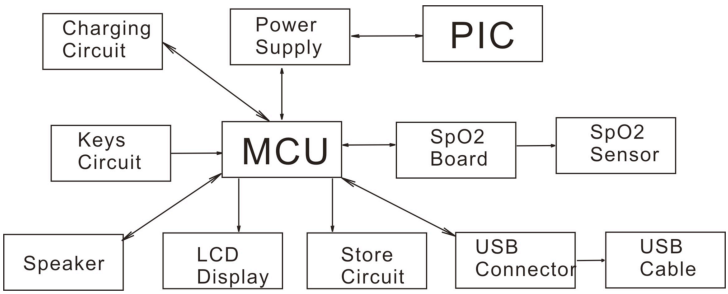

Figure 3.2: Circuit Structure Diagram

3.2.1 ON/OFF Switch

When the monitor is turned ON (pressing the POWER key for 3 seconds) a positive pulse will make the signal of KEY_POWRE to a low level and the output signal PWR_STB of U4 to a high level. Then the monitor is starting to work. Press the POWER key for 3 seconds again which makes the output signal PWR_STB of U4 to a low level. Then turn the monitor off.

3.2.2 3.3V Digital Supply

A switch-mode boost regulator U10 is used to generate the 3.3 volt digital supply (VCC_MCU) from the battery voltage. It is designed to operate over an input voltage range of 2.8V ~ 16.0V. The switch-mode controller U10 includes an Output Voltage Sense, and use the resistor R25, R26to adjust the output voltage. The output voltage can be calculated like this Vout = Vth (R25/R26 + 1).

3.2.3 5V SPO2 Power Supply

A PWM Controlled Step-Up DC/DC Converters U1 transfers the charging voltage to +5.5V. Output +5V to supply power to the SpO2 board by a highly precise, low noise, positive voltage LDO regulators U9.

3.2.4 Battery Charging Circuit

The Ni-MH battery controller IC U12 is used to charge full AA Ni-MH batteries. The highly precision ADC can judge the charging status precisely.

3.2.5 Micro controller

The micro controller chosen for the pulse oximeter is the STMicroelectronics group of companies STM32F103VCT6. The core is an ARM 32-bit Cortex™-M3 CPU, capable of running off a 3.3V supply, at up to 72Mhz. Combined with it is ample internal program memory (512 Kbytes of Flash memory) and 64 Kbytes of SRAM.

This device also includes a number of integrated peripherals, which make it ideal for this application. There are several timers, and a timing pattern generator, which will be used to generate the front end timing signals; an 8 bit A/D converter, which will be used to monitor the battery status; Two UART serial ports: one is used to communicate with SpO2 board, the other is used to communicate with PC. Two SPI interfaces: one connects the SPI Serial Flash, the other connects the Acceleration. The flexible static memory controller (FSMC) can be configured to interface seamlessly with most graphic LCD controllers. It supports the Intel 8080 and Motorola 6800 modes, and is flexible enough to adapt to specific LCD interfaces. This LCD parallel interface capability makes it easy to build cost-effective graphic applications using LCD modules with embedded controllers or high-performance solutions using external controllers with dedicated acceleration.

3.2.6 Real-time Clock

The micro controller integrates RTC function. The real-time clock provides a set of continuously running counters which can be used with suitable software to provide a clock calendar function, and provides an alarm interrupt and a periodic interrupt. It is clocked by a 32.768 kHz external crystal, resonator or oscillator, the internal low power RC oscillator or the high-speed external clock divided by 128. The internal low-speed RC has a typical frequency of 40 kHz.

The RTC can be calibrated using an external 512 Hz output to compensate for any natural quartz deviation. The RTC features a 32-bit programmable counter for long term measurement using the Compare register to generate an alarm. A 20-bit prescaler is used for the time base clock and is by default configured to generate a time base of 1 second from a clock at 32.768 kHz.

3.2.7 Serial wire JTAG debug port (SWJ-DP)

The ARM SWJ-DP Interface is embedded, and is a combined JTAG and serial wire debug port that enables either a serial wire debug or a JTAG probe to be connected to the target. The JTAG TMS and TCK pins are shared respectively with SWDIO and SWCLK and a specific sequence on the TMS pin is used to switch between JTAG-DP and SW-DP.

3.2.8 Audio

The micro controller's general-purpose timers used to generate a PWM signal. Use 1.1 Watt Audio Power Amplifier U7 to drive the speaker.

3.2.9 Control Keys

Six user operated, control keys are provided (Power, Up, Down, Mode, Silence, Menu). The state of these keys can be read by the software GPIO, which are configured as inputs. The switch lines are normally pulled high, until a key is pressed.

Chapter 4: Tests

4.1 Function Tests

The functional testing verifies overall functional integrity of the monitor and sensor. If the oximeter does not pass these tests, remove from use and contact the manufacturer service department for repair/replacement assistance.

This procedure assumes the technician performs each as indicated-leaving the monitor in a know state prior to performing the next step. If the steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

4.1.1 Equipment Required

1. SpO2 Finger Sensor, Adult.
2. (4) “AA” rechargeable batteries (Half charged)
3. AC Charger.
4. PC.
5. Date analysis software CD.
6. USB Cable.

4.1.2 Test Procedure

1. Visually inspect the monitor and verify that there are no cosmetic defects.
2. Verify all labels are properly placed.
3. Install four AA batteries into the battery compartment. Be careful to follow polarity markings. Close battery door.
4. Turn on the unit by pressing the power button. Verify the following power up sequence occurs: monitor will beep on power on, power indicator will be lit, and the current software revision will be displayed.
5. Adjust the measure mode from the defaulted “Spot-check” to the

"Monitoring" mode. Verify that all the keys are usable.

6. Connect the SpO2 finger sensor to the unit and place the sensor over your finger.

7. Verify saturation and pulse rate values are displayed with no error messages displayed.

8. Verify the Battery level Icon is moving when connect the AC charger to the device.

9. Take off the AC charger and remove your finger from the sensor. Verify a "Sensor Offline" message is displayed.

10. Leave the unit running in this state for approximately 5 minutes. Verify after 5 minutes that the unit shuts off automatically.

11. The procedure is complete remove the batteries and disconnect the finger sensor from the unit.

4.1.2 Checking Data Output

When you conduct the above fifth step, the measuring data have been store to the device.

1. Install the software.

2. Connect USB cable.

3. Download all the stored data.

4.2 Accuracy Tests

The Accuracy Tests verified the performance accuracy of the device. This test is typically performed in conjunction with (after) the Functional Tests. If the monitor does not pass the Accuracy Tests, remove from use and contact the manufacturer service department.

This procedure assumes the technician performs each steps as indicated-leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

4.2.1 Equipment Required

1. (4) “AA” rechargeable batteries (fully charged)

2. FLUKE Saturation Sensor Simulator, PN: 1170018.

3. SpO2 Finger Sensor, Adult.

4.2.2 Procedure

1. Plug the four fully charged AA batteries into the battery compartment. Be sure to follow the correct polarity. Connect the battery door.

2. Press the power button. Verify the proper power up sequence is displayed. The monitor will beep. And the display shows software revision.

3. Verify the display shows “Sensor no connect”.

4. Turn on the FLUKE and set it to the settings listed in the chart below. Verify the saturation values are in the specified tolerance:

FLUKE Settings		Monitoring Settings	
Saturation	Attenuation	Saturation	Pulse Rate
98	3	96-100	75±1
90	3	88-92	75±1
80	3	78-82	75±1
70	3	68-72	75±1

5. Connect the FLUKE to the monitor using the SpO2 sensor. Set the ATTENUATION to 3 and SATURATION to 98.

6. Verify the displayed saturation of 96-100 and a pulse of 75.

7. Change the FLUKE power switch to OFF. Verify “Sensor Offline” is displayed.

8. Change the FLUKE power switch to ON. Verify warning message clears and a saturation and pulse value are displayed.

9. Place the finger sensor on your finger. Verify the monitor is displaying a saturation and pulse value with no warning messages.

10. Verify the pulse bar is moving up and down smoothly.

11. Disconnect the finger sensor from the monitor. Verify the monitor delivers two short audio beeps every 10 seconds after the finger sensor is disconnected. Verify the monitor shuts off approximately 5 seconds after the beeping starts.

12. The Accuracy Test is complete.

4.3 Electronic Tests

The Electronic Tests verify the calibration and operation of the electronic circuits within the monitor. These tests Do not need to be performed on a regular (preventative) basis. Perform these tests only if the monitor fails to operate as expected of fails the Accuracy Tests or the Functional Tests. The Electronic Tests should be performed only by qualified service personnel.

The Electronic Tests require access to the internal components of the monitor. Refer to the Maintenance section for disassembly instructions.

CAUTION! The monitor contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

The procedure assumes the technician performs each step as indicated-leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

4.3.1 Equipment Required

1. DC Power Supply, model: PS-305D. PN: 010952932.
2. DC Current Meter
3. Multimeter.
4. 4 “AA” 2200mAh Ni-MH batteries.
5. AC Charger

4.3.2 Procedure

1. Resistance’s Tests: use to test the short circuit on the main board. Switch the Multimeter to . There are total 6 test points:

Location	Resistance
Opposite of GND on TP1	>10K
Opposite of GND on TP2	>500K
Opposite of GND on TP3	>10K
Opposite of GND on TP4	>50K
Opposite of GND on TP10	>2.5 K
Opposite of GND on TP13	>500K

2. Voltage Tests: Connect the AC charger to the J6 on the main board, and switch the Multimeter to DC voltage. There are total five test points.

Location	Nominal Value	Voltage Range
TP3	3.3V	3.12V-3.48V
Hold the SW6 key for 3 second, test TP1	3.3V	3.12V-3.48V
TP3	3.3V	3.12V-3.48V
TP2	5V	4.8V-5.2V
TP10	5V	4.8V-5.2V

3. Electric Current Test

Test the working current of the main board.

1) Connect the DC Current Meter to the BAT+ on the main board.
2) Hold the power key to turn on the monitor and plug the SpO2 sensor.
3) The reading on the DC Current Meter shoud be between 100mA-300mA, normally between 110mA-130mA. If the current is more than 1A, please cut down the power supply at once.

Test the shutdown electric current of the main board.

1) Connect the DC Current Meter to the BAT+ on the main board.
2) The reading on the DC Current Meter should be 560μA. It is abnormal if the current is more than 1mA.

Test the charging current of the main board.

1) Series connect 4 “AA” 2200mAh Ni-MH batteries to the BAT+ on the main board.

2) Series connect the DC Current Meter.

3) Connect the AC charger to J6 of the main board. The reading on the DC Current Meter should be 680mA. It is abnormal if the current is more than 1A.

4. Electric Test is complete.

Chapter 5: Accessories

5.1 Standard Configuration

CAT.NO	DESCRIPTION	QTY
UT100B	UT100 Handheld Pulse Oximeter	Each
US10BS	Adult Finger SpO_2 Sensor	Each
1615	AA size Alkaline Batteries	Four
5479	Hanging Strap	Each
9230	Operation Manual	Each

5.2 Optional Accessories

CAT.NO	DESCRIPTION	QTY
1616	AA size Ni-MH Batteries	Four
2319	Hanging Strap	Each
1617	AC Charger	Each
4210	Reusable sensor, Adult, Finger	Each
4211	Reusable sensor, Pediatric, Finger	Each
4212	Reusable sensor, Neonatal/infant, Foot	Each
4213	Single patient use sensor, Adult>30kg	Each
4214	Single patient use sensor, Ped 3-50kg	Each
4215	Single patient use sensor, neonatal <3kg	Each
3425	SpO_2 extension cable	Each

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Chapter 6: Maintenance and Troubleshooting

6.1 Schedule of Maintenance

The electronic circuits within the pulse oximeter do not require scheduled calibration or service.

The pulse oximeter performs a diagnostic self-test at power-up that checks the internal electronics. If this self-test fails the normal monitoring display will not appear. Remove the oximeter from use and contact qualified service personnel.

6.2 Cleaning and Sterilization

To clean and/or sterilize the oximeter and its accessories:

6.2.1 Pulse oximeter

Do not immerse the oximeter. Do not sterilize the oximeter.

Turn the oximeter off and upplug the external adapter (if used) from the AC power source before cleaning.

The oximeter can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutaraldehyde, or 10% bleach solution. Then wipe down with a water dampended clean cloth to rinse. Do before use.

6.2.2 SpO2 Finger Sensor

Do not immerse the finger sensor. Do not sterilize the finger sensor.

The oximeter can be cleaned and disinfected with solutions such as a 70% isopropyl alcohol, 2% glutaraldehyde, or 10% bleach solution. Then wipe down with a water dampended clean cloth to rinse. Do before use.

Make certain that the finger sensor windows are clean and dry before use. After cleaning the finger sensor, perform a Quick Check to verify the sensor is functional.

CAUTION! Do not allow isopropyl alcohol or water to enter any of the openings on the monitor. Evidence that liquid has been

allowed to enter the monitor voids the warranty.

6.3 Storage

WARNING! To ensure accurate performance and prevent device failure, do not subject the UT100 to extreme moisture such as direct exposure to rain. Such exposure may cause inaccurate performance or device failure.

Whenever possible, the monitor should be stored at room temperature in a dry environment.

If it is necessary to store the monitor for an extended period of time, the unit should be packed in its original shipping container. Storing the monitor for a long period of time may degrade the battery capacity. Batteries should be removed from the monitor before storing.

Storage specifications are as follows:

Temperature: -20oC to +55oC
Relative Humidity: 10% to 95% (noncondensing)

6.4 Assembly Exchanges

Disassembly should be performed by qualified service personnel only.

6.4.1 Internal Assemblies

1. Ensure that the monitor is OFF. Remove the battery compartment cover and place aside, remove the batteries.

2. Turn the monitor over and remove the six screws from the back cover

3. Carefully lift the back and front cover from the monitor.

4. Remove the two braces of LCD display on the Main board by a tweezers and take off the LCD display by welding the FPC.

5. The separate assemblies of the monitor can now be accessed.

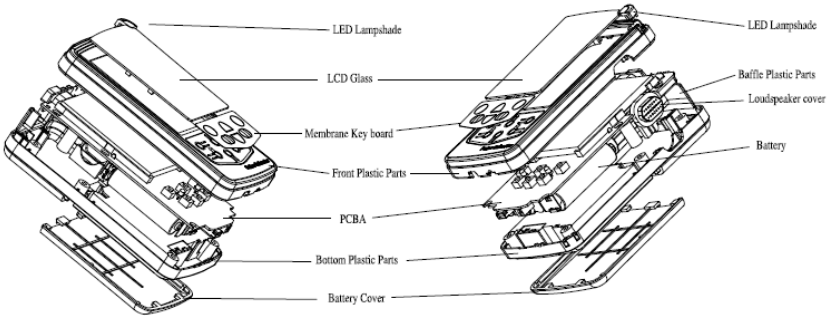

Figure 6.1: Exploded Structure Drawing

6.4.2 Reassembling the oximeter

1. Reconnect the LCD display and main board by welding the FPC.

2. Reinstall the two braces of LCD display by a tweezers.

3. Seat the display/main board assembly into the back cover.

4. Replace the top cover and the six screws, batteries and battery compartment cover.

6.3 Troubleshooting

Table 6.1:

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
No pulse shown on the bargraph.	•Patient cable or sensor is disconnected from the oximeter. •Sensor is incorrectly positioned on the patient. •Poor patient perfusion. •Defective sensor or patient cable.	•Check sensor connections to the patient cable and to the oximeter. •Reposition the sensor. •Reposition the sensor. •Try a new sensor or contact your authorized repair center for help.

Pulse rate is erratic, intermittent, or incorrect.	•Sensor incorrectly positioned. •Patient motion	•Reposition the sensor. •Patient must remain still to obtain an accurate measurement.
SpO2 value is erratic, intermittent, or incorrect.	•Poor patient perfusion. •Patient motion.	•Reposition the sensor. •Patient must remain still to obtain an accurate measurement.
No PR and SpO2 values.	• Defective sensor or patient cable or monitor.	•Try a new sensor or contact your authorized repair center for help.
Battery Abnormal	•Batteries incorrectly installed. •There are no batteries.	• Reposition batteries correctly. •Equip with oximeter with batteries.
The oximeter doesn't turn on.	•Batteries weak. •Batteries not installed or batteries incorrectly installed.	•Replace the batteries. •Ensure the batteries are installed correctly.
The oximeter turns off unexpectedly.	•Batteries are weak or dead.	•Replace the batteries.
Sensor	•Patient cable or sensor is disconnected from the oximeter. •Sensor is incorrectly positioned on the patient. •Poor patient perfusion. •Defective sensor or patient cable	•Check sensor connections to the patient cable and to the oximeter. •Reposition the sensor. •Reposition the sensor. •Try a new sensor or contact the Service Department for help.

Table 6.2:

No.	PROBLEM	CORRECTIVE ACTION
1	LCD display flashes with the power indicator when alarm occurs. The louder the alarm volume, the stronger of the flashing and vice versa.	Check the welding of L26 and make it correctly.

2	Overload of the charging voltage and working current.	Test the resistance of R8. Add tin to U13, U12, Q5 and Q8.
3	Can not work with AC charger but batteries.	Welding the CPU again.
4	The resistance on TP1 or TP3 is short circuit and no resistance.	This is problem is caused by the short circuit of CPU's Pin. Welding the Pin on the welding table again.
5	No voltage on TP1 and TP3.	Replace Q9.
6	Short Circuit on TP13.	Replace CPU.
7	LCD display shows full battery level even without batteries.	Replace Q10.
8	Short Circuit between TP1 and GND as well as TP3 and GND. No voltage on TP1, TP2, and TP3.	Replace CPU, PLC chip and U9.
9	No voice after turning on the monitor	Check the cable of speaker. Replace a new speaker.
10	The monitor shows "battery normal" and the charging current is 2.6～2.9A	Replace R51.
11	The battery level icon shows full battery when using the AC charger or even without battery.	Replace Q10.
12	LS2516 becoming hot when charging.	Replace LS2516.
13	No response of the power key and silence key.	The PCB washing water may leakage to these keys. Replace all keys.

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Chapter 7: Specification

7.1 Equipment Classification

Type of Protection Against Electric shock:	Internally Powered
Mode of operation:	Continuous
Degree of Protection Against ingress of Liquids:	IPX1, drip proof
Degree of Mobility:	Handheld
Degree of Protection Against Electric Shock:	Type BF
Safety Requirements:	EN60601-1:1990

7.2 SpO_2

Range:	0-100%
Accuracy:	±2 at 70 - 100% <70%, undefined
Resolution:	1%
Display Response:	The display is to functional saturation. The pulse strength bar graph is not proportional to pulse volume.

7.3 Pulse Rate

Range:	30-250bpm
Accuracy:	±2 at 30 – 250bpm
Resolution:	1bpm

7.4 Default Settings of Alarm

	High Alarm Limits					ts
	Adult	Pediatric	Ne			Neonatal
SpO_2	99	99				92
PR	100	110	120	60	70	80

7.5 Power Requirements

Four standard “AA” alkaline or Ni-MH cells (1.5Vdc,IEC Type LR6)

7.6 Battery Life

Alkaline Cells: 20 hours

7.7 Dimensions

Width:	75mm (2.95 inches)
Height:	135mm (5.31 inches)
Depth:	28mm (1.10 inches)
Weight:	258grams (9.10 ounces) with batteries

7.8 Environmental Specif

Operating Temp.:	0 to 45℃
Storage Temp.:	-20 to +55℃
Shipping Temp.:	-40 to +55℃
Relative Humidity:	30 to 95% (operating)
	10 to 95% (storage)
	0 to 95% (shipping)

Chapter 8: Drawings

No.	Description
1	Exploded Structure Drawing
2	Schematic, Main Board
3	Schematic, Power
4	Schematic, Battery Charger
5	Schematic, Acceleration
6	Schematic, Key

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