TRANSMITTER

ZM-920PA/930PA

If you have any comments or suggestions on
this manual, please contact us at:
www.nihonkohden.com

0614-007205A

Contents

GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel. Use only Nihon Kohden approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

1. **To safely and effectively use the instrument, its operation must be fully understood.**

2. **When installing or storing the instrument, take the following precautions:**
   (1) Avoid moisture or contact with water, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and dust, saline or sulphuric air.
   (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
   (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
   (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
   (5) Choose a room where a proper grounding facility is available.

3. **Before Operation**
   (1) Check that the instrument is in perfect operating order.
   (2) Check that the instrument is grounded properly.
   (3) Check that all cords are connected properly.
   (4) Pay extra attention when the instrument is in combination with other instruments to avoid misdiagnosis or other problems.

(5) All circuitry used for direct patient connection must be doubly checked.
(6) Check that battery level is acceptable and battery condition is good when using battery-operated models.

4. During Operation

(1) Both the instrument and the patient must receive continual, careful attention.
(2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
(3) Avoid direct contact between the instrument housing and the patient.

5. To Shutdown After Use

(1) Turn power off with all controls returned to their original positions.
(2) Remove the cords gently; do not use force to remove them.
(3) Clean the instrument together with all accessories for their next use.

6. The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.

7. The instrument must not be altered or modified in any way.

8. Maintenance and Inspection:

(1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
(2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.
(3) Technical information such as parts list, descriptions, calibration instructions or other information is available for qualified user technical personnel upon request from your Nihon Kohden representative.

9. **When the instrument is used with an electrosurgical instrument, pay careful attention to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.**

10. **When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.**

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service, technical modification or any other product change performed by someone other than NKC or its authorized agents without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

This warranty does not apply to products that have been modified, disassembled, reinstalled or repaired without Nihon Kohden approval or which have been subjected to neglect or accident, damage due to accident,

fire, lightning, vandalism, water or other casualty, improper installation or application, or on which the original identification marks have been removed.

In the USA and Canada other warranty policies may apply.

CAUTION

United States law restricts this device to sale by or on the order of a physician.

Equipment Authorization Requirement

Operation of this equipment requires the prior coordination with a frequency coordinator designated by the FCC for the Wireless Medical Telemetry Service.

EMC RELATED CAUTION

This equipment and/or system complies with the International Standard IEC60601-1-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in the IEC60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   Install the equipment and/or system at another location if it is interfered with by an emitter source such as an authorized radio station. Keep the emitter source such as cellular phone away from the equipment and/or system.

2. **Effect of direct or indirect electrostatic discharge:**
   Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it. A humid room can help lessen this problem.

3. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.

If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden representative for additional suggestions.

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

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

WARNING

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

CAUTION

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

NOTE

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

Explanations of the Symbols in this Manual and Instrument

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

Symbol	Description	Symbol	Description
	Power On		Attention, consult operator's manual
	Power Off		Nurse call
	Defibrillation proof type BF applied part		Replace battery
	Defibrillation proof type CF applied part		Check electrode
	Direct current		

Introduction

The ZM-920PA/930PA transmitter transmits ECG and other data from a patient to a Nihon Kohden monitor for continuous monitoring. Available parameters and functions vary between the models. Read the operator's manual for the monitor before operation.

Model	Parameters	Functions
ZM-920PA	• ECG • Impedance respiration	The following information is indicated by LED. • Check ECG electrodes • Replace batteries
ZM-930PA	• ECG • Impedance respiration • SpO_2	The following information is indicated on LCD. • SpO_2 value • Pulse wave amplitude • Replace batteries The following information is indicated by LED. • Check ECG electrodes

The transmitter channel can be changed by the QI-901PK Channel Writer. To change the channel number, refer to the channel writer manual.

WARNING

The following actions must be taken to properly receive the transmitter signal of the correct patient on the receiving instrument, otherwise, there may be signal loss or signals may mix causing a serious accident, such as monitoring a different patient.

- **Assign a channel administrator in the hospital and only he or she should manage channel assignments.**
- **The channel administrator must manage the channels in the facility so that there is no signal interference.**
- **When the transmitter channel is changed, the channel administrator must check that the channel on the receiving monitor is also changed and the signal is properly received.**

- **The channel administrator must replace the channel number label on the transmitter with the new one after changing the channel.**

CAUTION

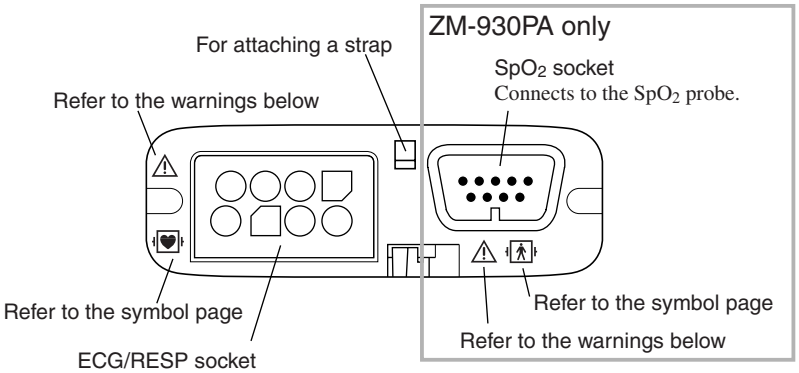
- **Do not use the same channel for different patients. If the same channel is used for two patients, the two patients' data will be lost due to mutual modulation interference, or another patient's data may appear on the receiving monitor screen.**
- **Do not use transmitters of adjacent channels in a hospital. If a transmitter of an adjacent channel is used, radio waves from one transmitter affects the receiver of the adjacent channel's transmitter and there may be interference.**
- **Do not use the same transmitter on more than one patient at the same time. Do not connect different sensors on different patients to the same transmitter.**

NOTE

- **To prevent interference between channels, assign a channel administrator in the hospital and only he or she should manage channel assignment.**
- **Use Nihon Kohden parts and accessories to assure maximum performance from your instrument.**
- **For stable signal reception, it is recommended to use a diversity antenna system on the receiving monitor. Otherwise, spike noise from transient fading of electric field strength (for example, people moving) may interfere with the transmitter signal and may be mistaken as an arrhythmia on the receiving monitor.**
- **For details on the receiving monitor and upgrade information, contact your Nihon Kohden representative.**

Panel Description

Top Panel

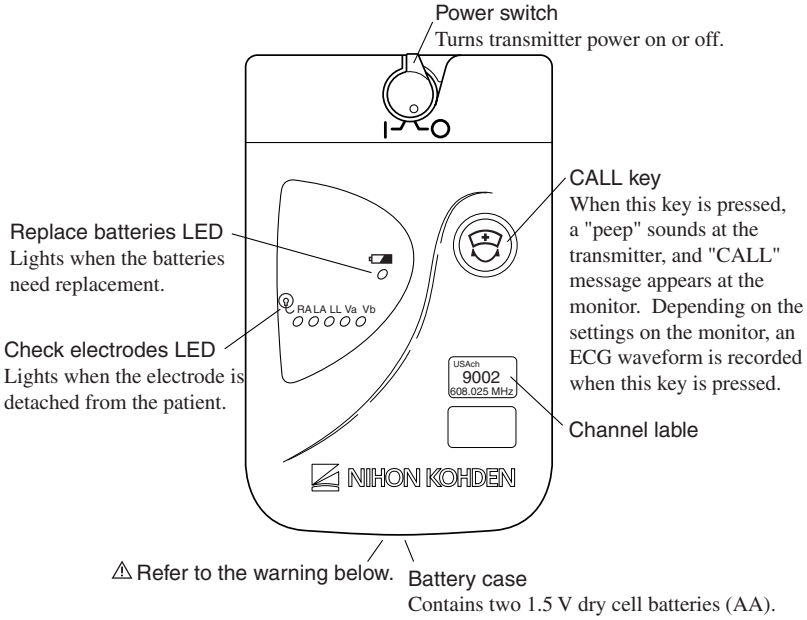


WARNING

- **Before defibrillation, check that the electrode leads and SpO_2 probe attached to the patient are properly connected to the transmitter. Touching the metal parts of disconnected leads and probes may cause electrical shock or injury by discharged energy.**
- **When performing defibrillation, discharge as far as possible from electrodes, patches and any gel, cream or medicine on the chest of the patient. If there is a possibility that the defibrillator paddle could touch these materials, remove them from the patient. If the defibrillator paddle directly contacts these materials, the discharged energy may cause skin burn to the patient.**
- **Before defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment connected to the patient. Failure to follow this warning may cause electrical shock or injury.**

Front Panel

ZM-920PA



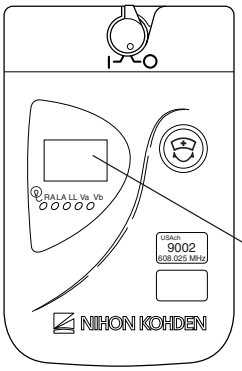
WARNING

Close the battery case cover during operation. If the transmitter is used with the battery case cover open, anyone who touches the opened battery case may receive an electrical shock when defibrillation is performed. Touching the opened battery case may cause electrostatic discharge and intermittently interfere with the waveform or data.

CAUTION

Only use your finger to press the CALL key. Do not press the key with a sharp object, otherwise the key may be damaged.

ZM-930PA

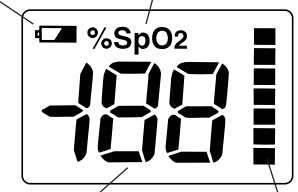


LCD

For the descriptions except for the LCD, refer to the “ZM-920PA” section on the previous page.

%SpO_2:
Displayed when the power is turned on. This indication is not displayed when SpO_2 display is turned off.

Battery replacement mark:
Appears when the batteries are weak. Immediately replace the batteries when this appears.



Pulse level bar graph:
Displays pulse level in 7 steps.

SpO_2 data:
Displays SpO_2 data.
When SpO_2 is 41 to 100%, the value is displayed. (ex. 85)
When SpO_2 is under 40%, “ ” is displayed.
When the detected pulse is too small to measure, “---” is displayed.

Important Safety Information

General

WARNING

- **Never use the transmitter in the presence of any flammable anesthetic gas or high concentration oxygen atmosphere. Failure to follow this warning may cause explosion or fire.**
- **Never use the transmitter in a hyperbaric oxygen chamber. Failure to follow this warning may cause explosion or fire.**
- **Never take this transmitter into an MRI test room.**
- **When performing MRI test, remove all electrodes from the patient which are connected to this instrument. Failure to follow this warning may cause skin burn on the patient. For details, refer to the MRI manual.**
- **Before defibrillation, check that the electrode leads and SpO_2 probe attached to the patient are properly connected to the transmitter. Touching the metal parts of disconnected leads and probes may cause electrical shock or injury by discharged energy.**
- **When performing defibrillation, discharge as far as possible from electrodes, patches and any gel, cream or medicine on the chest of the patient. If there is a possibility that the defibrillator paddle could touch these materials, remove them from the patient. If the defibrillator paddle directly contacts these materials, the discharged energy may cause skin burn to the patient.**
- **Before defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment connected to the patient. Failure to follow this warning may cause electrical shock or injury.**
- **When the transmitter is used with an electrosurgical unit (ESU), firmly attach the entire area of the ESU return plate. Otherwise, the current from the ESU flows into the electrodes of the transmitter, causing electrical burn where the electrodes are attached. For details, refer to the ESU manual.**

- **Close the battery case cover during operation. If the transmitter is used with the battery case cover open, anyone who touches the opened battery case may receive an electrical shock when defibrillation is performed. Touching the opened battery case may cause electrostatic discharge and intermittently interfere with the waveform or data.**

CAUTION

- **Only use Nihon Kohden specified electrodes, electrode leads and SpO_2 probes. Otherwise, the maximum performance from the instrument cannot be guaranteed.**
- **Do not reuse disposable items.**
- **Do not shake or swing the transmitter while holding the leads or cables connected to the transmitter. The transmitter may come off and injure someone or damage surrounding instruments.**
- **Attach a strap to the transmitter to prevent the transmitter from falling.**
- **Turn off the power of mobile phones, small wireless devices and other devices which produce strong electromagnetic interference around a patient (except for devices allowed by the hospital administrator). Radio waves from devices such as mobile phones or small wireless devices may be mistaken as respiration or pulse waves and the displayed data may be incorrect.**
- **Do not use the same channel for different patients. If the same channel is used for two patients, the two patients' data will be lost due to mutual modulation interference, or another patient's data may appear on the receiving monitor screen.**
- **Do not use transmitters of adjacent channels in a hospital. If a transmitter of an adjacent channel is used, radio waves from one transmitter affects the receiver of the adjacent channel's transmitter and there may be interference.**

Battery

WARNING

- **Keep the battery pack away from fire. It may explode.**
- **Do not damage, disassemble, drop or give impact to the battery. If the battery is damaged and substance inside the battery contacts the skin or clothes, wash immediately and thoroughly with water.**
- **Never short-circuit the + and – terminals on the battery. It may cause overheating and fire.**
- **Take care that the patient does not swallow batteries.**

CAUTION

- **Battery replacement must be performed by the operator. When replacing batteries of the transmitter currently used for a patient, disconnect electrode leads from the transmitter before replacing batteries or do not touch the patient during replacement.**
- **The battery charger must be used outside the patient environment.**
- **Refer to the battery and battery charger manuals for details on handling the batteries.**

Transmitter Channel Management

WARNING

The following actions must be taken to properly receive the transmitter signal of the correct patient on the receiving instrument, otherwise, there may be signal loss or signals may mix causing a serious accident, such as monitoring a different patient.

- **Assign a channel administrator in the hospital and only he or she should manage channel assignments.**
- **The channel administrator must manage the channels in the facility so that there is no signal interference.**
- **When the transmitter channel is changed, the channel administrator must check that the channel on the receiving monitor is also changed and the signal is properly received.**

- **The channel administrator must replace the channel number label on the transmitter with the new one after changing the channel.**

For Patients Using Implantable Pacemaker

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment.
The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker, may be affected by the transmitter which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and the transmitter may give incorrect data to the monitor. If this occurs, disconnect the electrode leads from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden representative.

Output Signal

CAUTION

Do not use the output signal from the receiving monitor as the synchronization signal for other equipment such as IABP, MRI, echocardiography or defibrillator, there may be time delay between the monitor and the other equipment caused by waveform transmission delay and spike noise may interfere on the output signal and be mistaken as a trigger.

ECG Monitoring

CAUTION

- **Only use Nihon Kohden specified electrodes and electrode leads. When other type of electrodes or electrode leads are used, the "CHECK ELECTRODE" message may be displayed and monitoring may stop.**
- **When the "ELECTRODE OFF" or "CHECK ELECTRODE" message is displayed on the receiving monitor, ECG is not monitored properly and the ECG alarm does not function. Check the electrode and electrode leads, and if necessary, replace with new ones.**

SpO_2 Monitoring

WARNING

- **SpO_2 measurement may be incorrect in the following cases.**
  - **When the patient's carboxyhemoglobin or methemoglobin increases abnormally.**
  - **When dye is injected in the blood.**
  - **When using an electrosurgical unit.**
  - **During CPR.**
  - **When measuring at a site with venous pulse.**
  - **When there is body movement.**
  - **When the pulse wave is small (insufficient peripheral circulation).**
- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**

- **A patient with peripheral circulation insufficiency**
- **Neonate or low birth weight infant with delicate skin**

- **When not monitoring SpO_2, disconnect the SpO_2 cable from the transmitter. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.**
- **When using the TL-201T finger probe, do not fasten the probe and cable to the finger by wrapping with tape. This may cause burn, congestion or pressure necrosis from poor blood circulation.**
- **When using probes other than the TL-201T finger probe, to avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.**

CAUTION

- **NIBP and SpO_2 can be measured on the same limb, but the SpO_2 monitoring may not be accurate during NIBP measurement. Be careful when reading the SpO_2 values.**
- **While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value may not be displayed.**
- **Normal external light does not affect monitoring but strong light such as a surgical light or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.**
- **If the attachment site is dirty with blood or bodily fluids, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.**
- **The disposable probe is not sterilized. Use the disposable probe only for a single patient. Never reuse the disposable probe for another patient because it causes cross infection.**

- **Do not use a probe that is deteriorated by aging. Accurate measurement cannot be performed.**
- **Do not use damaged or disassembled probe. It causes incorrect measurement and may injure the patient.**
- **If the skin gets irritated or redness appears on the skin from the probe, change the attachment site or stop using the probe. Take extreme care for the patients with delicate skin.**
- **Do not pull or bend the probe cable, and do not put caster feet on the probe cable. Do not immerse the probe cable in chemical solutions or water. Failure to follow these instructions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data. Replace any broken probe with a new one.**
- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**
- **When a message indicates a faulty SpO_2 probe, stop monitoring and replace the probe with a new one.**
- **When removing a probe that is taped to the skin, do not pull the probe cable because this can damage the cable.**
- **Neonatal skin is delicate. Remove the probe and tape carefully and slowly.**
- **Do not immerse the disposable probe in detergents or water. If the probe adhesive surface gets wet, adhesiveness becomes weak and the probe cannot be attached to the skin.**
- **Before using the TL-260T multi-site Y probe, be sure to attach the probe to the sponge attachment tape S or L. Do not use the probe without the sponge attachment tape attached. Using the probe without the sponge attachment tape causes incorrect measurement and may injure the skin at the attachment site.**
- **When fixing the TL-260T multi-site Y probe with the sponge attachment tape, confirm that the adhesive part of the tape is not on the skin. The adhesive may cause oversensitive symptoms on the skin such as redness or itch. If the adhesive touches the skin, remove it carefully and slowly because neonatal skin is very delicate.**

- **Do not use a dirty sponge attachment tape. The measurement value may be incorrect.**
- **When removing the probe from the attachment tape, do not pull the sensor cable because this can damage the cable.**
- **Use the sponge attachment tape S and L only with the specified products.**
- **Refer to the probe instruction manual for details.**
- **When any of the following occurs, the probe may be broken. Replace it with a new one and check the probe.**
    - **The transmitter generates "pip" sound every 0.25 seconds.**
    - **SpO_2 data is 85% and blinking.**

Maintenance

WARNING

If detergents or dirty liquid spills into the transmitter, clean it and dry it completely before use. If the wet transmitter is used, the patient or anyone in contact with the transmitter may receive an electric shock.

CAUTION

Never disassemble or repair the transmitter. When there is any problem with the transmitter after maintenance and inspection, contact your Nihon Kohden representative.

Preparation

Installing (Replacing) Batteries

Use two AA(R6) type alkaline dry cell batteries, manganese dry cell batteries, NiCd rechargeable batteries or NiMH batteries.

With new alkaline batteries, the transmitter can continuously measure ECG, respiration and SpO_2 for approximately 3 days or ECG and respiration for approximately 4 days. Operation time depends on the thickness of SpO_2 probe attachment site.

NOTE

The capacity of manganese, NiCd and NiMH batteries is less than that of alkaline batteries, therefore the lifetime of the battery is shorter.

Type	Lifetime
Manganese	About 1/2 of alkaline batteries
NiCd	About 1/3 of alkaline batteries (when fully charged)
NiMH	About 1/2 of alkaline batteries (when fully charged)

CAUTION

Battery replacement must be performed by the operator. When replacing batteries of the transmitter currently used for a patient, disconnect electrode leads from the transmitter before replacing batteries, or do not touch the patient during replacement.

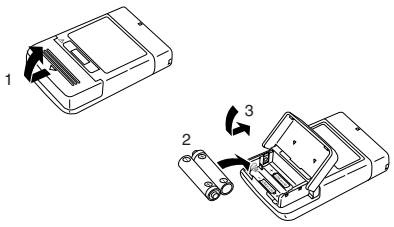
If electrode leads are attached to the patient and the person replacing the batteries touches the patient, the patient leakage current over the amount allowed may occur.

CAUTION

- **Replace both batteries at the same time.**
- **Do not use different types of batteries together.**

NOTE

Insert the batteries with the correct polarity (+ and –).



Procedure

1. Open the battery case cover.
2. Insert two dry cell batteries (LR6) into the battery case observing the correct polarity.
3. Close the cover and press it gently until it clicks.

WARNING and CAUTION for Battery Handling

WARNING

- **Keep the battery pack away from fire. It may explode.**
- **Do not damage, disassemble, drop or give impact to the battery. If the battery is damaged and substance inside the battery contacts the skin or clothes, wash immediately and thoroughly with water.**
- **Never short-circuit the + and – terminals on the battery. It may cause overheating and fire.**
- **Take care that the patient does not swallow batteries.**

CAUTION

When the transmitter is not in use, remove batteries or turn the power OFF. With the power ON, battery power is consumed even if measurement is not performed. The batteries may become unusable from overdischarge, and leakage from the battery may damage the transmitter.

NOTE

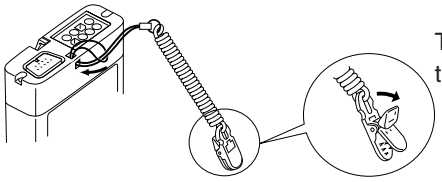
- **When using rechargeable NiCd batteries or NiMH batteries, shallow charging/discharging shortens battery capacity. For details, refer to the battery operator's manual.**
- **Remove the batteries from the transmitter before disposing of the transmitter.**

Situations Requiring Battery Replacement

Replace the batteries when any of the following occurs.

- The "▭" LED lights (ZM-920PA) or the "▭" mark is displayed on the LCD (ZM-930PA) on the transmitter.
- The transmitter generates a constant alarm (continuous "peep" sound).
- The monitor displays the battery replacement message on the screen.
- When the power of the LCD transmitter is turned on, no message or icon is displayed. (Only the ZM-930PA).

Attaching a Strap to the Transmitter



To open the clip, firmly pull out the tab in direction of the arrow.

NOTE

- **Attach a strap to the transmitter to prevent the transmitter from falling.**
- **Do not attach the clip to hard objects such as thick cloths or zippers, or the clip may break.**

Attach a strap to the transmitter and fasten the clip to the patients' clothes or bed sheets.

If the transmitter falls off, the battery cover may be opened. If the patient touches the terminals of the batteries, patient leakage current over the allowable amount can occur.

Turning On/Off the Transmitter

Check Items Before Turning On the Power

To use the instrument in a safe and optimum condition, before turning on the transmitter power switch, check the following.

Appearance

- There is no damage or dirt on the outside of the transmitter. (Power switch, LED, LCD, CALL key, junction, battery case cover, battery case, etc.)
- The transmitter is completely dry.
- The electrode lead is not broken.
- There is no damage or dirt on the SpO_2 probe or on the disposable electrodes.

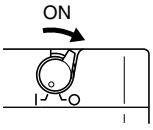
Battery

- The battery polarity is correct.
- The battery case spring is firmly fixed and the battery is not loose.
- The battery case cover is firmly closed.

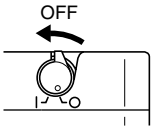
Channel Setting

- The transmitter channel corresponds to those of the receiving monitor.
- The same channel is not being used on a different transmitter in the surrounding area.

Turning On/Off the Power



To turn on the power, turn the power switch to the right. After a "peep" sound for about one second, the power is turned on. (There is no "peep" sound when the "▭" LED light or the "▭" are blinking on the LCD).



To turn off the power, turn the power switch to the left.

Check Items After Turning On the Power

After turning on the power, check the following items.

Power On

- The power switch is not damaged.
- The transmitter generates a "peep" sound for about one second.

- All LEDs light and values are displayed on the LCD for about one second.
- The transmitter does not generate a continuous “pip” sound.
- The transmitter does not liberate excessive heat.
- The “ ” LED does not light or the “ ” mark is not displayed on the LCD.
- The transmitter does not interfere with the operation of medical instruments used near it.

Basic Operation

- The “signal loss” message is not displayed on the monitor when the transmitter is inside the receiving range of the monitor.
- A “peep” sounds at the transmitter and “CALL” message appears at the receiving monitor when the CALL key is pressed and the transmitter is inside the receiving range of the monitor.
- The battery replacement message is not displayed on the monitor.

Check Items After the Power Off

- ECG electrode leads and SpO_2 probe are cleaned and disinfected.
- When the transmitter gets wet, liquid is wiped off and the transmitter is thoroughly dried.
- There are enough consumables, such as disposable electrodes.
- The power is turned off.
- The batteries are removed from the transmitter when it will not be used for a long time.
- Dead batteries are disposed of properly.

ECG Monitoring

When 6 leads are used on this transmitter, up to 8 lead (I, II, III, aVR, aVL, aVF, Va and Vb) of ECG waveforms can be displayed on the receiving monitor. The heart rate is also measured. When 3 leads are used, one channel ECG waveform of lead II can be displayed on the receiving monitor. Refer to the operator's manual of the monitor for details.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by the transmitter which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and the transmitter may give incorrect data to the monitor. If this occurs, disconnect the electrode leads from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden representative.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

For more information, see the FDA web site.
http://www.fda.gov/cdrh/safety.html

WARNING

When the transmitter is used with an electrosurgical unit (ESU), firmly attach the entire area of the ESU return plate. Otherwise, the current from the ESU flows into the electrodes of the transmitter, causing electrical burn where the electrodes are attached. For details, refer to the ESU manual

NOTE

- **This transmitter is not protected against noise generated from an electrosurgery unit.**
- **If an electric blanket is used and incorrect heart rate is displayed on the monitor, turn off the pacing pulse detection on the monitor.**

ECG Measurement Procedure

1. Select the type of electrode lead and disposable electrode according to the purpose.

2. Connect the electrode lead to the ECG/RESP socket.

3. Connect disposable electrodes to the electrode lead and attach electrodes to the patient.

After steps 1 to 3 are finished, ECG monitoring automatically starts.

Selecting Electrode Lead and Disposable Electrode

CAUTION

Only Use Nihon Kohden specified electrodes and electrode leads. When other type of electrodes or electrode leads are used, the CHECK ELECTRODE message may be displayed and monitoring may stop.

Option

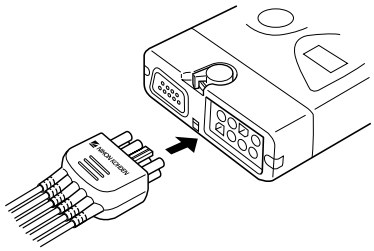
Electrode lead	
BR-916PA  6 electrodes, snap type	BR-906PA  6 electrodes, clip type
BR-913PA  3 electrodes, snap type	BR-903PA  3 electrodes, clip type

Connecting the Electrode Lead to the Transmitter

Connect the electrode lead to the ECG/RESP socket on the transmitter.

CAUTION

- **Do not shake or swing the transmitter holding the leads or cables connected to the transmitter. The transmitter may come off and injure someone or damage surrounding instruments.**
- **Hold the connector of the electrode lead when connecting/ disconnecting the electrode lead. If you disconnect the electrode lead by pulling the lead, it damages the electrode lead.**



Selecting the Electrode Position

Follow the physician's instructions for electrode placement when available.
For ECG monitoring, electrodes are attached only on the chest to allow patient movement and obtain continuous stable ECG. Following leads are examples.
When also monitoring respiration, refer to the "Electrode Position for Respiration Monitoring" section.

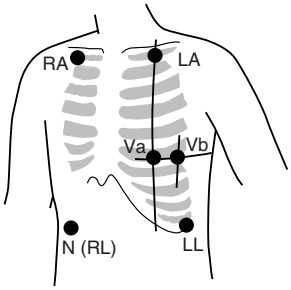
NOTE

The optimum electrode positions for ECG measurement of a patient are not always optimum for respiration measurement of the patient. Select positions suitable for both ECG and respiration measurements, or positions which have priority for one measurement.

Six Electrodes

Electrode Position

The 6-electrode method with lead II and lead V5 is effective for monitoring myocardial ischemia. You can improve monitoring accuracy considerably by adding lead V4 to this combination. Va and Vb can be at any position of the standard 12 leads V1 to V6, but V4 and V5 are most appropriate for myocardial ischemic monitoring.

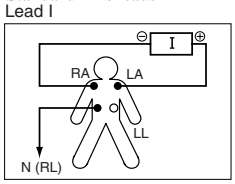


Symbol	Lead Color (Clip Color)	Electrode Position
RA	White (White)	Right infraclavicular fossa
LA	Black (Black)	Left infraclavicular fossa
LL	Red (Red)	Lowest rib on the left anterior axillary line
N (RL)	Green (Green)	Right anterior axillary line at the same level as LL
Va	Brown (Brown) (BR-906PA) Brown-blue (BR-916PA)	Fifth intercostal space on the left midclavicular line. (V4 position of standard 12 leads)
Vb	Brown (Brown) (BR-906PA) Brown-orange (BR-916PA)	Left anterior axillary line at the same level as Va. (V5 position of standard 12 leads)

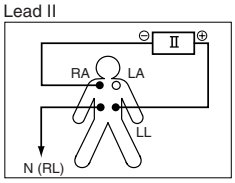
Lead Position

Standard limb leads

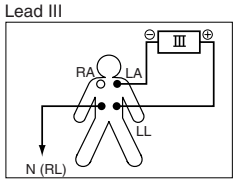
Lead I



Lead II

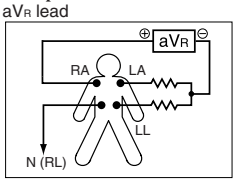


Lead III

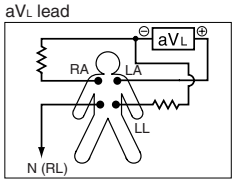


Monopolar limb leads

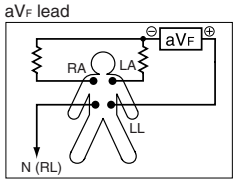
aV_R lead



aV_L lead

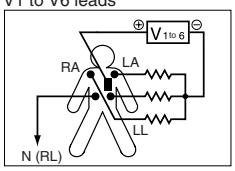


aV_F lead

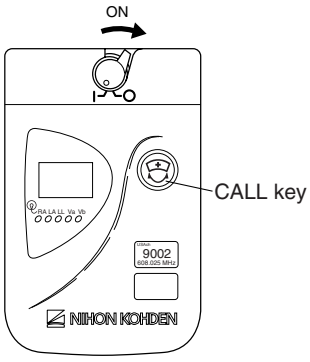


Monopolar chest leads

V1 to V6 leads



When Using 4 to 6 DIN Type Leads to Monitor 6 Lead ECG



When the BR-906PA/916PA electrode leads are not used, the transmitter is fixed to 3 lead ECG monitoring. To monitor 6 lead ECG using 4 to 6 DIN type leads, the transmitter must be fixed to 6 lead monitoring. To fix transmitter to the 6 lead ECG monitoring, turn off the transmitter power, press and hold the CALL key and turn on the transmitter power.

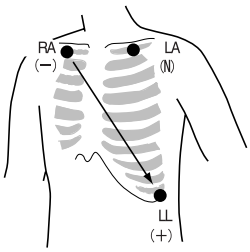
When the transmitter power is turned off and on again, the monitoring mode returns to the original mode.

Three Electrodes

By using the optional BR-913PA/903PA electrode lead, 3 lead ECG monitoring is available.

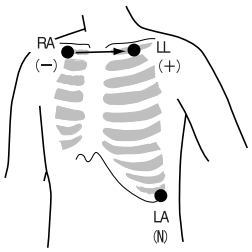
Electrode Position

- Lead MII, which is similar to standard lead II, used when ECG measurement has priority

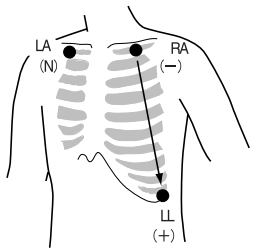


Electrode Position	Symbol	Lead Color
Left infraclavicular fossa	LA (N)	Black
Right infraclavicular fossa	RA (–)	White
Below lowest rib on the left anterior axillary line	LL (+)	Red

- Lead MI, which is similar to standard lead I
  Change LL and LA of the lead MII.



- Lead MIII, which is similar to standard lead III
  Change RA and LA of the lead MII.



If the electrode position shown above is not available due to chest surgery, attach the electrodes to the root of the limbs or below the clavicles for stable ECG monitoring.

Connecting the Electrode Lead and Disposable Electrodes

Preparing the Patient Skin

Shave off excessive body hair.

To reduce skin impedance, clean the electrode site with cream or with a cotton pad moistened with the electrode site with cream or with a cotton pad moistened with alcohol. Thoroughly dry the skin with a clean cotton pad.

NOTE

- **For a patient with frequent body movement, rub the sites with Skinpure skin preparation gel. However, do not use Skinpure skin preparation gel for sensitive skin.**
- **Do not place electrodes on a wound or on an inflamed, wrinkled or uneven skin surface.**

Attaching Electrodes to the Patient

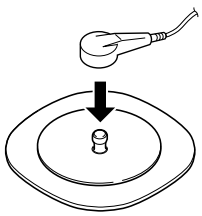
CAUTION

Do not reuse disposable items.

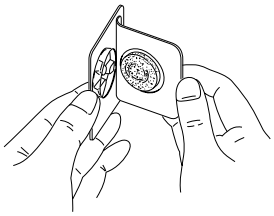
NOTE

- **To maintain good contact between the electrode and skin, check that the paste of the disposable electrode is not dry.**
- **When contact between the disposable electrode and skin becomes poor, replace electrodes with new ones immediately. Otherwise, contact impedance between the skin and the electrode increases and the correct ECG cannot be obtained.**

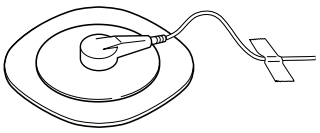
Refer to the electrode operator's manual for details.



1. Connect the electrode lead to the electrode.



2. Carefully remove the backing paper from the electrode. Avoid touching the adhesive surface.



3. Place the electrode on the previously cleaned skin. Pay attention to the electrode lead color and symbol.

4. Fasten the electrode lead wire with surgical tape with an extra length of wire between the tape and the electrode. This lessens the movement of electrode leads by body movement and helps stable monitoring.

Detection and Display of Measurement Condition

Electrode Detachment

The "Q" LED lights on the transmitter or the "CHECK ELECTRODE" message is displayed on the screen of the monitor in the following cases.

- Electrode is detached from skin.
- Electrode lead is disconnected from the electrode.
- Polarization voltage between the electrode and skin is excessively high.

In these cases, check the cause and if necessary, replace electrodes with new ones.

CAUTION

When the "ELECTRODE OFF" or "CHECK ELECTRODE" message is displayed on the receiving monitor, ECG is not monitored properly and the ECG alarm dose not function. Check the electrode and electrode leads, and if necessary, replace with new ones.

Respiration Monitoring

Respiration is monitored by measuring changes in impedance between the RA and LL ECG electrodes. This transmitter sends the changes in impedance to the monitor as a respiration waveform. The monitor displays the respiration waveform and calculates respiration rate. Refer to the operator's manual of the monitor for details.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by the transmitter which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and the transmitter may give incorrect data to the monitor. If this occurs, disconnect the electrode leads from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden representative.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

  For more information, see the FDA web site.
  http://www.fda.gov/cdrh/safety.html

Respiration Measurement Procedure

1. Select the electrode lead and disposable electrodes.

2. Connect the electrode lead to the ECG/RESP socket.

3. Connect disposable electrodes to the electrode lead and attach electrodes to the patient.

After steps 1 to 3 are finished, respiration monitoring automatically starts.

Electrode Position for Respiration Monitoring

Place the RA and LL electrodes so that the lungs are between the electrodes.

NOTE

The optimum electrode positions for ECG measurement of a patient are not always optimum for respiration measurement of the patient. Select positions suitable for both ECG and respiration measurements, or positions which have priority for one measurement.

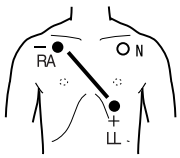
Electrode Position Examples

NOTE

The following examples are when monitoring with 3 electrodes. ECG cannot be monitored correctly when electrodes are attached as the following examples when monitoring with 6 electrodes.

Position 1

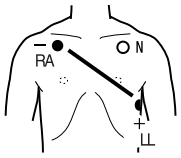
In this position, respiration measurement is available; however, there is a difference in amplitude between different patients.



RA	LL
Right infraclavicular fossa	Fifth intercostal space on the left midclavicular line, V4

Position 2

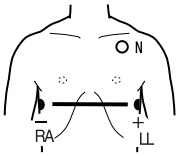
In this position, the waveform amplitude is usually large and the ECG lead is similar to Lead MII. This position can be generally recommended.



RA	LL
Right infraclavicular fossa	Fifth intercostal space on the left midaxillary line, V6

Position 3

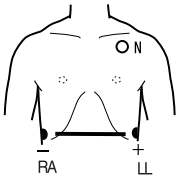
In this position, the respiration waveform is optimum, but the ECG lead is unusual.



RA	LL
Right midaxillary at the horizontal level of V4	Fifth intercostal space on the left midaxillary line, V6

Position 4

In this position, the respiration measurement is influenced by the impedance variation of the abdomen, so the cardiac pulse wave included in the respiration wave is reduced. Note that the waveform is inverted in phase compared with the chest movement (the waveform goes down during inspiration). It is difficult to measure the ECG at the same time.



RA	LL
Lowest rib on the right anterior axillary line	Lowest rib on the left anterior axillary line

SpO_2 Monitoring

The SpO_2 monitoring is only available on the ZM-930PA transmitter.

This transmitter sends SpO_2 and pulse waveform to the monitor and displays SpO_2 data and pulse level bar graph on the LCD.
Refer to the operator's manual of the monitor for details.

WARNING

- **SpO_2 measurement may be incorrect in the following cases.**
  - **When the patient's carboxyhemoglobin or methemoglobin increases abnormally.**
  - **When dye is injected in the blood.**
  - **When using an electrosurgical unit.**
  - **During CPR.**
  - **When measuring at a site with venous pulse.**
  - **When there is body movement.**
  - **When the pulse wave is small (insufficient peripheral circulation).**
- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**
- **When not monitoring SpO_2, disconnect the SpO_2 cable from the transmitter. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.**

CAUTION

- **Turn off the power of mobile phones, small wireless devices and other devices which produce strong electromagnetic interference around a patient (except for devices allowed by the hospital administrator). Radio waves from devices such as mobile phones or small wireless devices may be mistaken as respiration or pulse waves and the displayed data may be incorrect.**
- **Normal external light does not affect monitoring but strong light such as a surgical light or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.**
- **Do not pull or bend the probe cable, and do not put caster feet on the probe cable. Do not immerse the probe cable in chemical solutions or water. Failure to follow these instructions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data. Replace any broken probe with a new one.**
- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**
- **While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value may not be displayed.**

NOTE

When monitoring SpO_2, monitor ECG at the same time. The ECG electrode lead works as an antenna for transmitting data from the transmitter to the receiving monitor. If ECG is not measured, the telemetry signal may not be received.

Measurement Procedure

1. Select the SpO_2 probe.

2. Connect the SpO_2 probe to the SpO_2 socket.

3. Attach the SpO_2 probe to the patient.

After steps 1 to 3 are finished, SpO_2 monitoring automatically starts.

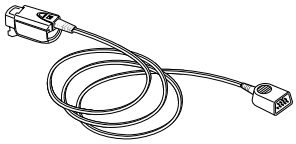
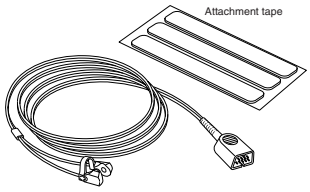
Selecting SpO_2 Probe

Select an appropriate probe for the patient.

CAUTION

- **Only use Nihon Kohden specified electrodes, electrode lead, SpO_2 probe. Otherwise, the maximum performance from the instrument cannot be guaranteed.**
- **Do not use damaged or disassembled probe. It causes incorrect measurement and may injure tha patient.**

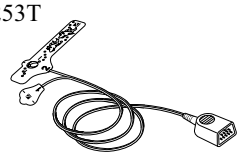
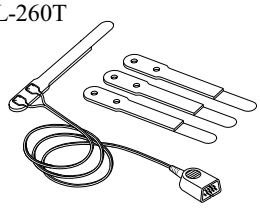
Reusable Probes

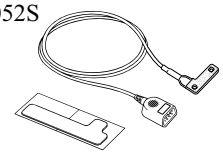
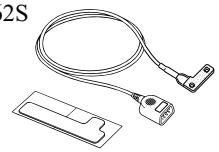
Model	Subject (Weight)	Attachment Site
Finger Probe TL-201T 	Adults, children (Weight more than 20 kg)	Finger
Multi-site probe TL-220T 	Adult or Infant 3 kg or more	Finger or toe
	Neonate 3 kg or less	Instep and sole

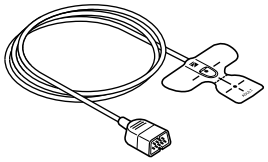
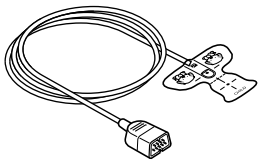
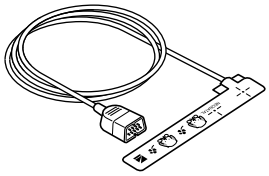
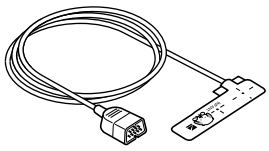
Disposable Probes

CAUTION

The disposable probe is not sterilized. Use the disposable probe only for a single patient. Never reuse the disposable probe for another patient because it causes cross infection.

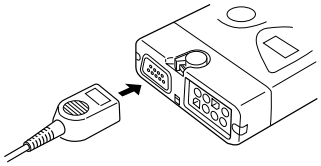
Model	Subject (Weight)	Attachment Site
TL-251T 	Adults (Weight more than 30 kg)	Finger or toe
TL-252T 	Children (Weight from 3 to 40 kg)	Finger or toe
TL-253T 	Neonates (Weight less than 3 kg)	Instep and sole
TL-260T 	Adults, children (Weight more than 3 kg)	Finger or toe
	Neonates (Weight less than 3 kg)	Instep and sole

Model	Subject (Weight)	Attachment Site
TL-051S/052S  Cable length TL-051S: 80 cm TL-052S: 160 cm	Adults (Weight more than 50 kg)	Finger
	Neonates (Weight less than 3 kg)	Instep and sole
TL-061S/062S  Cable length TL-061S: 80 cm TL-062S: 160 cm	Adults, children (Weight from 15 to 50 kg)	Finger
	Children, infants (Weight from 3 to 15 kg)	Toe

Model	Subject (Weight)	Attachment Site
TL-271T/271T3  Cable length TL-271T: 0.8 m TL-271T3: 1.6 m	Adult 30 kg or more	Finger or toe
TL-272T/272T3  Cable length TL-272T: 0.8 m TL-272T3: 1.6 m	Child 10 to 50 kg	
TL-273T/273T3  Cable length TL-273T: 0.8 m TL-273T3: 1.6 m	Neonate 3 kg or less	Instep
	Adult 40 kg or more	Finger or toe
TL-274T/274T3  Cable length TL-274T: 0.8 m TL-274T3: 1.6 m	Infant 3 to 20 kg	

Connecting SpO_2 Probe to the Transmitter

Connect the probe to the SpO_2 socket on the transmitter.



CAUTION

- **Do not shake or swing the transmitter while holding the cables connected to the transmitter. The transmitter may come off and injure someone or damage surrounding instruments.**
- **Hold the connector when connecting/disconnecting the probe. If you disconnect the SpO_2 probe pulling the cable, it damages the cable.**

Attaching the Probe to the Patient

For details, refer to the operator's manual of each probe.

WARNING

- **When using the TL-201T finger probe, do not fasten the probe and cable to the finger by wrapping with tape. This may cause burn, congestion or pressure necrosis from poor blood circulation.**
- **When using probes other than the TL-201T finger probe, to avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.**

- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**

CAUTION

- **NIBP and SpO_2 can be measured on the same limb, but the SpO_2 monitoring may not be accurate during NIBP measurement. Be careful when reading the SpO_2 values.**
- **If the attachment site is dirty with blood or bodily fluids, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.**
- **If the skin gets irritated or redness appears on the skin from the probe, change the attachment site or stop using the probe. Take extreme care for the patients with delicate skin.**
- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**
- **Do not use a probe that is deteriorated by aging. Accurate measurement cannot be performed.**
- **Neonatal skin is delicate. Remove the probe and tape carefully and slowly.**
- **When removing a probe that is taped to the skin, do not pull the probe cable because this can damage the cable.**
- **When removing the probe from the attachment tape, do not pull the**

sensor cable because this can damage the cable.

- **Do not immerse the disposable probe in detergents or water. If the probe adhesive surface gets wet, adhesiveness becomes weak and the probe cannot be attached to the skin.**
- **Before using the TL-260T multi-site Y probe, be sure to attach the probe to the sponge attachment tape S or L. Do not use the probe without the sponge attachment tape attached. Using the probe without the sponge attachment tape causes incorrect measurement and may injure the skin at the attachment site.**
- **When fixing the TL-260T multi-site Y probe with the sponge attachment tape, confirm that the adhesive part of the tape is not on the skin. The adhesive may cause oversensitive symptoms on the skin such as redness or itch. If the adhesive touches the skin, remove it carefully and slowly because neonatal skin is very delicate.**
- **Do not use a dirty sponge attachment tape. The measurement value may be incorrect.**
- **Use the sponge attachment tape S and L only with the specified products.**
- **Refer to the probe instruction manual for details.**

Starting Measurement

When monitoring starts, SpO_2 and pulse waveform are sent to the monitors and SpO_2 data and pulse level bar graph are displayed on the transmitter LCD.

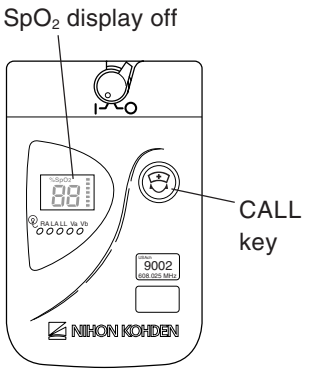
You can turn off the display of SpO_2 data and pulse level bar graph on the LCD. Refer to the "Turning SpO_2 Data and Pulse Level Bar Graph Display On/Off" section.

CAUTION

When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.

Turning SpO_2 Data and Pulse Level Bar Graph Display On/Off

You can turn off the display of SpO_2 data and pulse level bar graph on the LCD.



Press the CALL key for more than 3 seconds within 10 seconds after turning transmitter power on (after a "peep" sound).

"%SpO_2" is not displayed. When SpO_2 monitoring starts, SpO_2 data and pulse level bar graph are not displayed on the LCD.

To turn SpO_2 display on, turn the transmitter power off and turn the power on again.

Detecting and Displaying Measurement Condition

External Light Noise Alarm

CAUTION

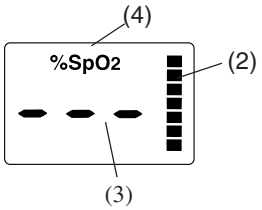
When measuring under strong light (surgical light, bilirubin light, sunlight, etc.), cover the probe with a blanket or cloth. Otherwise, noise may interfere.

Strong external light (surgical light or inverter type fluorescent lamp, etc.), may affect SpO_2 monitoring. When external light is too strong to correctly measure SpO_2, the transmitter generates an alarm tone ("pip" sound every 0.5 seconds). Cover the probe attachment site with blanket or cloth.

Insufficient Light Alarm

When sufficient light cannot be obtained from the photo emitter of the probe, the transmitter generates the following sound and indication.

(1) "peep" sound (every 1 second)
(2) pulse level bar graph is maximum (all bars are lit.)
(3) SpO_2 data is displayed as "– – –"
(4) %SpO_2 is blinking.



In this case, change the attachment site to the appropriate site. Refer to the operator's manual of the SpO_2 probe.

Probe Malfunction Alarm

CAUTION

When any of the following occurs, the probe may be broken. Replace it with a new one and check the probe.

- **The transmitter generates "pip" sound every 0.25 seconds.**
- **SpO_2 data is 85% and blinking.**

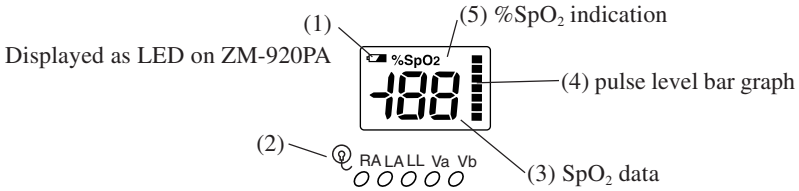
When Measurement Condition is Unstable

SpO_2 data blinks every 1 second when SpO_2 signal stability decreases and the transmitter cannot detect correct pulse waveform because of patient body movement, poor attachment condition or poor circulation condition at the probe attachment site.

CAUTION

SpO_2 data blinking every second indicates an unstable pulse waveform and displayed SpO_2 value may be inaccurate. The displayed data may not reflect sudden SpO_2 changes.

Alarm List



Sound	Display	Cause	Countermeasure
Single "peep" sound for 4 s	---	The CALL key is pressed. The sound lasts while the key is pressed.	
---	(1)	The battery voltage decreases and battery charge is almost zero.	Replace the batteries with new ones.
Continuous "peep" sound	All lights are off	Battery is completely discharged.	Replace the batteries with new ones. To stop the sound, turn off the power.
---	(2)	Electrode lead is disconnected from the electrode.	Firmly connect the electrode lead to the electrode.
		Electrode lead is disconnected from the transmitter.	Firmly connect the electrode lead to the transmitter.
		Electrode lead discontinuity	Replace the electrode lead with a new one.
		Electrode is not firmly attached to the skin.	Replace the electrode with a new one.
		Polarization voltage is abnormally high.	
Intermittent "pip" sound every 0.5 s	---	SpO_2 measurement site is under fluorescent light, surgical light, sunlight, etc.	Cover the measurement site with a blanket or cloth.

Sound	Display	Cause	Countermeasure
Intermittent “peep” sound every 1 s	(3) – – – (4) all lit (5) blinking	Cannot receive sufficient light from the probe photo emitter.	Attach probe to a site with 6 to 14 mm thickness where sufficient light can be received.
Intermittent “pip” sound every 0.25 s	(3) 85%, blinking	Broken probe	Replace the probe with a new one.
---	(3) blinking	Patient body movement	Remove the cause by checking the patient condition and changing the attachment site.
		Probe is not attached securely.	Securely attach the probe.

Troubleshooting

If the problem still remains after checking the following, contact your Nihon Kohden distributor.

Problem	Cause	Countermeasure
The power cannot be turned on.	Batteries are not installed correctly. The battery polarity is wrong.	Install the batteries correctly.
	Batteries are completely discharged.	Replace the batteries with new ones.
Nothing is displayed on the LCD after turning the power on. (ZM-930PA only)	SpO_2 display is turned off.	Turn off the power, and turn on the power again.
Nothing is displayed on the monitor after turning the transmitter power on.	The channel of the transmitter and monitor does not match.	Set the correct channel on the monitor.
Signal receiving condition is poor.	Electrode lead is not connected to the transmitter.	Connect the electrode lead to the transmitter. ECG electrode lead works as an antenna for transmitting data to the receiving monitor. If ECG is not measured, the signal may not be received.
	Another transmitter of the same channel is used near by.	Turn the transmitter power off. If the monitor still receives a signal, there is a high probability that another transmitter of the same channel is used nearby. Follow the instruction of your channel administrator and use another transmitter of a different channel.
	Signals are mixing.	Follow the instruction of your channel administrator and use another transmitter of a different channel.
	The transmitter is damaged.	Contact your Nihon Kohden distributor.

Problem	Cause	Countermeasure
3 electrode leads are properly attached to the patient but LEDs light.	The transmitter is fixed to 6 lead monitoring.	Turn off and on the transmitter power.
Heart rate of the patient who is using an electric blanket cannot be monitored on the receiving monitor.	Pacing pulse detection is set to ON on the monitor.	Turn off the pacing pulse detection.
ECG baseline is thick. (Hum is overlapping)	The gel on the electrode is dried out.	Replace the electrode with a new one.
	The gel on the electrode is coming off.	
	Electric blanket is used.	Cover the blanket with a shield cover.
	Hum filter is set to OFF on the monitor	Set the filter to ON.
Respiration waveform measurement is unstable.	The gel on the electrode is dried out.	Replace the electrode with a new one.
	The gel on the electrode is coming off.	
SpO_2 data is unstable and not reliable.	The probe size is not appropriate for the patient.	Use the appropriate probe for the patient.
	Probe is attached to the same limb that is used for NIBP measurement.	Attach the probe to the opposite limb. Avoid a site where blood circulation condition changes greatly.
	Probe attachment condition is poor. Probe is about to detach from the skin. External light gets in.	Firmly attach the probe according to the procedure in the probe operator's manual.
	Measurement site is dirty. Patient is wearing nail polish.	Remove dirt and nail polish.

Changing the Transmitter Channel

The transmitter channel can be changed by the QI-901PK Channel Writer. To change the channel number, refer to the channel writer manual.

WARNING

The following actions must be taken to properly receive the transmitter signal of the correct patient on the receiving instrument. Otherwise, there may be signal loss or signals may mix causing a serious accident, such as monitoring a different patient.

- **Assign a channel administrator in the hospital and only he or she should manage channel assignments.**
- **The channel administrator must manage the channels in the facility so that there is no signal interference.**
- **When the transmitter channel is changed, the channel administrator must check that the channel on the receiving monitor is also changed and the signal is properly received.**
- **The channel administrator must replace the channel number label on the transmitter with the new one after changing the channel.**

Lifetime and Disposal

Disposing of Used Batteries

Replacement

When the "" LED is lit or the "" is displayed on the LCD during operation, the batteries are running out.
Replace the batteries with new ones. When using rechargeable batteries, recharge them.

Disposal

Before disposing of the batteries, check with your local solid waste officials for details in your area for proper disposal. It may be illegal to dispose of these batteries in the municipal waste stream.

Disposing of Electrodes and SpO_2 Probes

Refer to the manual of each item.

Cleaning, Disinfection and Sterilization

Transmitter and Electrode Lead

WARNING

If detergents or dirty liquid spills into the transmitter, clean it and dry it completely before use. If the wet transmitter is used, the patient or anyone in contact with the transmitter may receive an electric shock.

CAUTION

- **Before cleaning or disinfecting the transmitter, remove the batteries from the transmitter.**
- **The transmitter cannot be sterilized.**

Cleaning

Wipe the transmitter and electrode leads with a soft cloth moistened with disinfecting alcohol or neutral detergent diluted with water. After cleaning, dry them completely.

Disinfection

CAUTION

- **Do not immerse the electrode lead connector in liquid.**
- **Do not disinfect with hypochlorous acid.**
- **Use the recommended concentration.**

Wipe the outside surface of the transmitter and electrode lead with a non-abrasive cloth moistened with any of the disinfectants listed on the next page. Use the recommended concentration.

Disinfectant	Concentration (%)
Glutaraldehyde solution	2.0
Alkyldiaminoethylglycine hydrochloride	0.5
Benzalkonium chloride	0.2
Benzethonium chloride solution	0.2
Chlorohexidine gluconate solution	0.5

SpO_2 Probe

Refer to the probe manual.

Replacing the Battery Case Cover

When the battery case cover is damaged, replace it with a new one.
Battery case cover, code no. 6113-046365C.

Other than the battery case cover, there are no serviceable parts for the transmitter.

Repair Parts Availability Policy

Nihon Kohden Corporation (NKC) shall stock repair parts (parts necessary to maintain the performance of the instrument) for a period of 6 years after NKC announces discontinuation of the instrument. In that period, NKC or its distributors will repair the instrument. This period may be shorter than 6 years if the necessary board or part is not available. For discontinuation announcements, contact your Nihon Kohden distributor or representative.

Specifications

ECG measurement

Channels:	4
Input range:	±5 mV or more
DC offset:	±500 mV or more
Input impedance:	5 MΩ or more (5 Hz)
Pacing pulse detection:	ANSI/AAMI EC13 Based upon Pacemaker pulse rejection Capability

Respiration measurement

Measuring method:	Impedance method
Impedance range:	0 to 2 kΩ

SpO_2 measurement

Measuring range:	0 to 100%, in 1% steps
Measuring accuracy	
When the measuring accuracy of the SpO_2 probe is not considered:	±1 digit (80% ≤ SpO_2 ≤ 100%) ±2 digit (50% ≤ SpO_2 ≤ 80%) Less than 50% is not specified.
When the measuring accuracy of the SpO_2 probe is considered:	±2 digit (80% ≤ SpO_2 ≤ 100%) ±3 digit (70% ≤ SpO_2 ≤ 80%) Less than 70% is not specified.

Transmitter

FCC regulation:	FCC part 95 Subpart-H Wireless Medical Telemetry Service (WMTS)
Field strength limits:	<200 mV/m (at 3 m)
Undesired emission:	below 960 MHz: 200 µV/m (at 3 m) above 960 MHz: 500 µV/m (at 3 m)

Antenna:	ECG electrode lead
Transmission channel:	indicated on the transmitter
Transmission frequency range:	608.0250 to 613.9750 MHz
Channel spacing:	50 kHz or 37.5 kHz (12.5 kHz when interleaved)
Modulation scheme:	FSK (Frequency Shift Keying)
Occupied bandwidth:	<20 kHz
Effective radiated power:	1.0 mW (conducted)

Safety standards

Safety standard:	CSA C22.2 No. 601-1 M90: 1994 IEC 60601-1: 1988 IEC 60601-1 Amendment 1: 1991 IEC 60601-1 Amendment 2: 1995 IEC 60601-1-2: 1993 IEC 60601-2-27: 1994
According to the type of protection against electrical shock:	INTERNALLY POWERED EQUIPMENT
According to the degree of protection against electrical shock:	
ECG/impedance method respiration:	DEFIBRILLATION-PROOF TYPE CF APPLIED PART
SpO_2:	DEFIBRILLATION-PROOF TYPE BF APPLIED PART
According to the degree of protection against harmful ingress of water:	IPX0 (Ordinary equipment)
According to the degree of safety of application in the presence of a FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:	Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE
According to the mode of operation:	CONTINUOUS OPERATION

Water resistance

Water does not get inside the transmitter except for the battery case when immersed in water up to 30 cm deep for 3 minutes.

Power requirements

Battery type:	two AA type alkaline dry cell batteries, manganese dry cell batteries, NiCd rechargeable batteries, NiMH batteries
Battery lifetime:	
ZM-930PA:	approximately 3 days (with alkaline batteries, measuring ECG, respiration and SpO_2 of approximately 60 kg weight adult male patient at the pointing finger) approximately 4 days (with alkaline batteries, measuring ECG and respiration only)
ZM-920PA:	approximately 4 days

Environment

Operating environment

Operating temperature:	5 to 40°C, 41 to 104°F
Operating humidity:	30 to 85% (non-condensing)
Operating atmospheric pressure:	70 to 106 kPa
Operating voltage:	1.6 to 3.2 V

Storage environment

Storage temperature:	–20 to 65°C, –4 to 149°F
Storage humidity:	15 to 95% (non-condensing)
Storage atmospheric pressure:	70 to 106 kPa

Dimension and Weight

Dimension:	78 W × 122 H × 26 D (mm)
Weight (without batteries):	ZM-930PA: about 180 g ZM-920PA: about 165 g

Standard Accessories

Name	Q'ty	Supply code
Strap	1	Y233

Options

CAUTION

Use only Nihon Kohden electrodes, electrode leads and SpO_2 probes to assure maximum performance from your instrument.

ECG/RESP

Name	Application	Model	Q'ty	Supply code
Electrode lead	3 electrodes, clip type, lead length 80 cm	BR-903PA	1	K911A
	3 electrodes, snap type, lead length 80 cm	BR-913PA	1	K910B
	6 electrodes, clip type, lead length 80 cm	BR-906PA	1	K912A
	6 electrodes, snap type, lead length 80 cm	BR-916PA	1	K915A

SpO_2

Name	Cable length	Model/ Code No.	Q'ty	Supply Code No.
Finger probe (reusable)	0.6 m	TL-201T	1	P225H
	1.6 m			P225F
Multi-site probe (reusable)	1.6 m	TL-220T		P225G
SpO_2 probe (for adult, disposable)		TL-251T	5	P201A
SpO_2 probe (for child, disposable)		TL-252T		P201B
SpO_2 probe (for neonate, disposable)		TL-253T		P201C
Multi-site Y probe (for low birth weight infant/child/ neonate, disposable)		TL-260T		P205A
SpO_2 probe (for adult, disposable)	0.8 m	TL-271T	24	P203A
	1.6 m	TL-271T3		P203E
SpO_2 probe (for child, disposable)	0.8 m	TL-272T		P203B
	1.6 m	TL-272T3		P203F
SpO_2 probe (for neonate/adult, disposable)	0.8 m	TL-273T		P203C
	1.6 m	TL-273T3		P203G
SpO_2 probe (for child/infant, disposable)	0.8 m	TL-274T		P203D
	1.6 m	TL-274T3		P203H
SpO_2 probe (for adult/neonate, disposable)	0.8 m	TL-051S	5	P228A
	1.6 m	TL-052S		P228B
SpO_2 probe (for child/infant, disposable)	0.8 m	TL-061S		P229A
	1.6 m	TL-062S		P229B
COTTONY tape	——	340703	20	P259
Foam tape for TL-051S/052S/ 061S/062S		——	4 × 25 packages	P260
Attachment tape for TL-220T/ 251T/252T/253T			3 × 30 packages	P263
Attachment tape S for TL-260T			24	P260A
Attachment tape L for TL-260T				P260B