Transmitter

ZM-920PA/ZM-921PA
ZM-930PA/ZM-931PA

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

0614-007205B

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) Pay extra attention when the instrument is in combination with other instruments to avoid misdiagnosis or other problems.
   (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 prepaid.

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 IEC 60601-2 International Standard for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in IEC 60601-1-2, 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. Keep the emitter source such as cellular phone away from the equipment and/or system, or turn off the cellular phone.

2. Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:
   Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.

3. 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.

4. 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.

5. Interference of lightning:
   When lightning occurs near the location where the equipment and/or system is installed, it may induce an excessive voltage in the equipment and/or system.
   In such a case, disconnect the AC power cord from the equipment and/or system and operate the equipment and/or system by battery power, or use an uninterruptible power supply.

6. Use with other equipment:
   When the equipment and/or system is adjacent to or stacked with other equipment, the equipment and/or system may affect the other equipment. Before use, check that the equipment and/or system operates normally with the other equipment.

7. Use of unspecified accessory, transducer and/or cable:
   When an unspecified accessory, transducer and/or cable is connected to this equipment and/or system, it may cause increased electromagnetic emission or decreased electromagnetic immunity. The specified configuration of this equipment and/or system complies with the electromagnetic requirements with the specified configuration. Only use this equipment and/or system with the specified configuration.

8. Use of unspecified configuration:
   When the equipment and/or system is used with the unspecified system configuration different than the configuration of EMC testing, it may cause increased electromagnetic emission or decreased electromagnetic immunity.
   Only use this equipment and/or system with the specified configuration.

9. Measurement with excessive sensitivity:
   The equipment and/or system is designed to measure bioelectrical signals with a specified sensitivity. If the equipment and/or system is used with excessive sensitivity, artifact may appear by electromagnetic interference and this may cause mis-diagnosis. When unexpected artifact appears, inspect the surrounding electromagnetic conditions and remove this artifact source.

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/ZM-921PA/ZM-930PA/ZM-931PA 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 ZM-921PA	• ECG • Impedance respiration	The following information is indicated by LED. • Check ECG electrodes • Replace batteries
ZM-930PA ZM-931PA	• 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 transmission frequency range is as follows.

ZM-920PA/930PA: 608.0250 MHz (channel number 9002) to 613.9750 MHz (channel number 9478)

ZM-921PA/931PA: 1395.0250 MHz (channel number E002) to 1399.9750 MHz (channel number E398)
1427.0250 MHz (channel number E502) to 1431.9750 MHz (channel number E898)

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 assignment.
- 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.

WARNING

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.

CAUTION

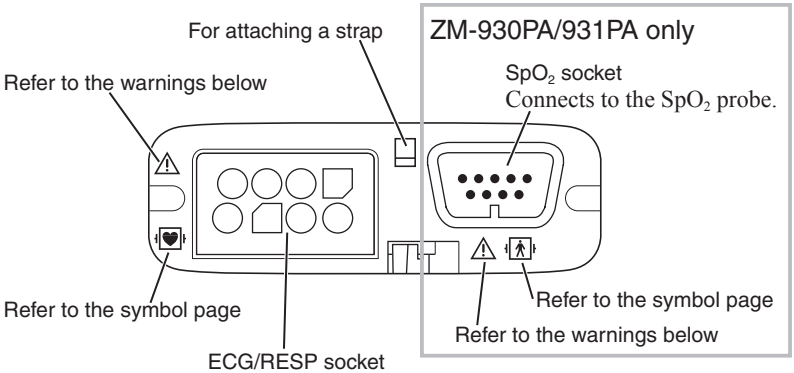
- Do not use the same channel for different patients. If the same channel is used for two patients, the two patients' data will be lost due to mutual modulation interference, or another patient's data may appear on the receiving monitor screen.
- Do not use transmitters of adjacent channels in a hospital.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

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.
- Do not diagnose a patient based on only part of the monitoring data on the transmitter or only on the data acquired by the transmitter. Overall judgement must be performed by a physician who understands the features, limitations and characteristics of the transmitter by reading this operator's manual thoroughly and by reading the biomedical signals acquired by other instruments.
- For details on the receiving monitor and upgrade information, contact your Nihon Kohden representative.

Panel Description

Top Panel



WARNING

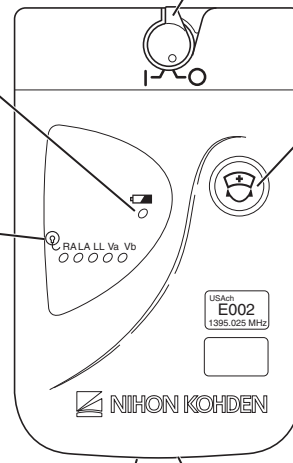
When performing defibrillation, discharge as far as possible from electrodes, patches and any gel, cream or medicine on the chest of the patient. If there is a possibility that the defibrillator paddle could touch these materials, remove them from the patient. If the defibrillator paddle directly contacts these materials, the discharged energy may cause skin burn to the patient.

WARNING

Before defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment or cord connected to the patient. Failure to follow this warning may cause electrical shock or injury.

Front Panel

ZM-920PA/921PA



Power switch
Turns transmitter power on or off.

Replace batteries LED
Lights when the batteries need replacement.

Check electrodes LED
Lights when the electrode is detached from the patient.

CALL key
When this key is pressed, a "peep" sounds at the transmitter, and "CALL" message appears at the monitor. Depending on the settings on the monitor, an ECG waveform is recorded when this key is pressed.

⚠Refer to the warning below.

Battery case
Contains two 1.5 V dry cell batteries (AA).

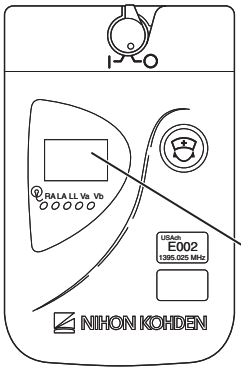
WARNING

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/931PA

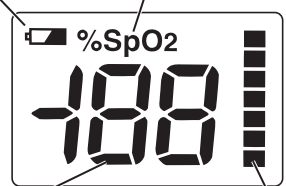


LCD

For the descriptions except for the LCD, refer to the “ZM-920PA/921PA” 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%, “uu” 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.

WARNING

Never use the transmitter in a hyperbaric oxygen chamber. Failure to follow this warning may cause explosion or fire.

WARNING

Do not take this transmitter into the MRI test room. This transmitter is not designed to be used during MRI tests.

WARNING

When performing MRI test, remove all electrodes from the patient which are connected to this transmitter. Failure to follow this warning may cause skin burn on the patient. For details, refer to the MRI manual.

WARNING

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.

WARNING

Before defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment or cord connected to the patient. Failure to follow this warning may cause electrical shock or injury.

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.

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.

WARNING

If detergent or liquid spills into the transmitter, clean it and dry it completely before use. If a wet transmitter is used, the patient or operator may receive an electrical shock or injury.

WARNING

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.

CAUTION

Only use Nihon Kohden specified electrodes, electrode leads and SpO_2 probes. Otherwise, the maximum performance from the transmitter cannot be guaranteed.

CAUTION

Do not reuse disposable parts and accessories.

CAUTION

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.

CAUTION

Attach a strap to the transmitter to prevent the transmtiter from falling.

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 pulse waves and the displayed data may be incorrect.

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 affect the receiver of the adjacent channel's transmitter and there may be interference.

Battery

WARNING

- Keep the batteries away from fire. They may explode.
- Keep the batteries away from patients.
- Never short-circuit the + and – terminals on the battery. It may cause overheating and fire.
- Do not damage, disassemble, drop or give impact to the battery.

WARNING

If the battery is damaged and the substance inside the battery contacts the eyes or skin, wash immediately and thoroughly with water and see a physician. Never rub your eyes, because you may lose your eyesight.

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.

CAUTION

The battery charger must be used outside the patient environment.

CAUTION

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 assignment.
- 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 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 representative or Nihon Kohden representative.

Output Signal

WARNING

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 ELECTRODES" message may be displayed and monitoring may stop.

CAUTION

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, 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).

WARNING

Check the circulation condition by observing the skin color at the measurement site and pulse waveform. Change the measurement site every 8 hours for disposable probes and every 4 hours for reusable probes (every 8 hours for TL-630T/TL-631T series probe). 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.

- Patient with a fever
- Patient with peripheral circulation insufficiency
- Neonate or low birth weight infant with delicate skin
- Patient who is receiving photodynamic therapy*

* Photodynamic therapy is a treatment to remove the affected tissue by using a photosensitizing agent and exposing the tissue to light. This treatment has a side effect of photosensitivity and the light from the finger probe sensor may cause a burn. This probe uses two light wavelengths in the range from 650 to 950 nm. The maximum light intensity is less than 5.5 mW/sr.

WARNING

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.

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.

CAUTION

While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value might not be displayed.

CAUTION

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.

CAUTION

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.

CAUTION

Do not use a probe which is deteriorated by aging. Accurate measurement cannot be performed.

CAUTION

Do not use a damaged or disassembled probe. It causes incorrect measurement and may injure the patient.

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.

CAUTION

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.

CAUTION

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.

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.

CAUTION

When a message indicates a faulty probe, stop monitoring and replace the probe with a new one.

CAUTION

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

- The transmitter generates “pip” sounds.
- SpO_2 data is 85% and blinking.

CAUTION

Neonatal skin is delicate. Remove the probe and tape carefully and slowly.

CAUTION

When removing a probe that is taped to the skin, do not pull the probe cable because this can damage the cable.

CAUTION

When removing the probe from the attachment tape, do not pull the sensor cable because this can damage the cable.

CAUTION

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.

CAUTION

Refer to the probe instruction manual for details.

Maintenance

CAUTION

If detergent or liquid spills into the transmitter, clean it and dry it completely before use. If a wet transmitter is used, the transmitter may malfunction or get damaged.

CAUTION

Never disassemble or repair the transmitter. Disassembly and repair must be performed by qualified service personnel.

CAUTION

Before cleaning or disinfection, remove the batteries from the transmitter. Failure to follow this instruction may result in electrical shock or transmitter malfunction.

CAUTION

The transmitter cannot be sterilized. Sterilizing the transmitter may damage it.

Preparation

Installing (Replacing) Batteries

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

Battery Lifetime

With new alkaline batteries, the transmitter can continuously measure for the following number of days. Operation time depends on the thickness of the SpO_2 probe attachment site.

Transmitter	Operating time (Measuring parameters)	
	ECG, Resp, SpO_2	ECG, Resp
ZM-920PA/930PA	3 days	4 days
ZM-921PA/931PA	2.5 days	3.5 days

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)

Recommended Batteries

Alkaline primary: Nihon Kohden Medipower (equivalent to Panasonic LR6 (G))

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.

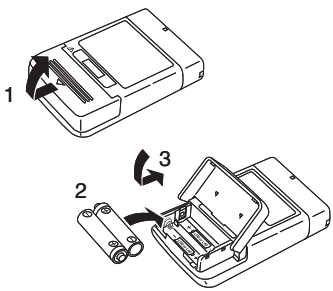
CAUTION

- Replace all 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 batteries away from fire. They may explode.
- Keep the batteries away from patients.
- Never short-circuit the + and – terminals on the battery. It may cause overheating and fire.
- Do not damage, disassemble, drop or give impact to the battery.

WARNING

If the battery is damaged and the substance inside the battery contacts the eyes or skin, wash immediately and thoroughly with water and see a physician. Never rub your eyes, because you may lose your eyesight.

CAUTION

Do not handle the batteries with wet hands.

CAUTION

When the transmitter is not in use, remove batteries. When batteries are installed, battery power is consumed even if measurement is not performed. Especially, when NiMH batteries remain in the transmitter when the transmitter is not in use, the battery may become unusable from overdischarge and leak liquid which will damage the transmitter.

CAUTION

Refer to the battery and battery charger manuals for details on handling the batteries.

CAUTION

The battery charger must be used outside the patient environment.

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

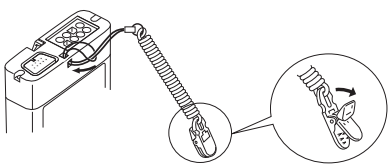
Replace the batteries when any of the following occurs.

- The "▭" LED lights (ZM-920PA/921PA) or the "▭" mark is displayed on the LCD (ZM-930PA/931PA) 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/931PA).

CAUTION

When using batteries other than alkaline, the interval between the battery replacement indication and battery discharge may be shorter. Replace the batteries immediately upon battery replacement indication.

Attaching a Strap to the Transmitter



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

CAUTION

Attach a strap to the transmitter to prevent the transmtiter from falling.

NOTE

Do not attach the clip to hard objects such as thick cloth 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.

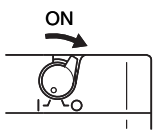
Battery

- 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.

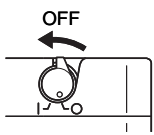
Channel Setting

- 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 LED).



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 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 representative 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 electrosurgical 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.

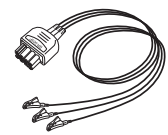
After steps 1 to 3 are finished, ECG monitoring automatically starts.

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 ELECTRODES" 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

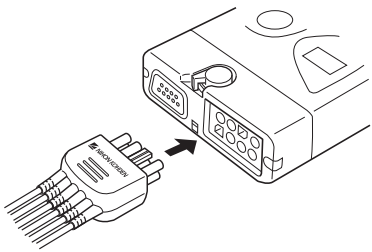
Connect the electrode lead to the ECG/RESP socket on the transmitter.

CAUTION

Do not shake or swing the transmitter while holding the leads or cables connected to the transmitter. The transmitter may come off and injure someone or damage surrounding instruments.

CAUTION

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.

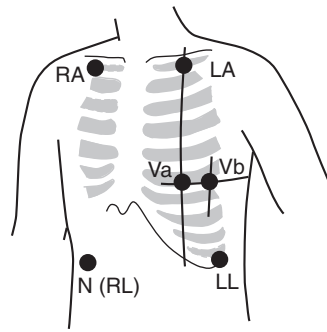
NOTE

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.

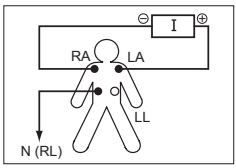


Symbol	Lead Color (Clip Color)	Electrode Position
RA	White (White)	Right infraclavicular fossa
LA	Black (Black)	Left infraclavicular fossa
LL	Red (Red)	Lowest rib on the left anterior axillary line
N (RL)	Green (Green)	Right anterior axillary line at the same level as LL
Va	Brown (Brown) (BR-906PA) Brown-blue (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)

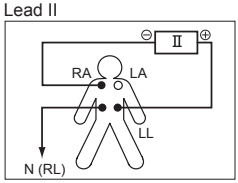
Lead Position

Standard limb leads

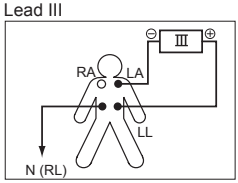
Lead I



Lead II

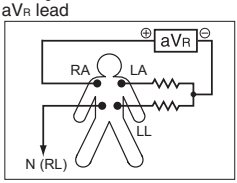


Lead III

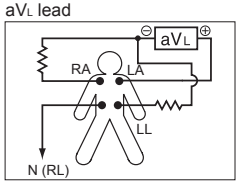


Monopolar limb leads

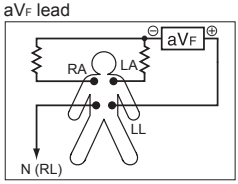
aV_R lead



aV_L lead

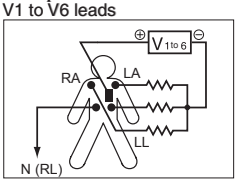


aV_F lead

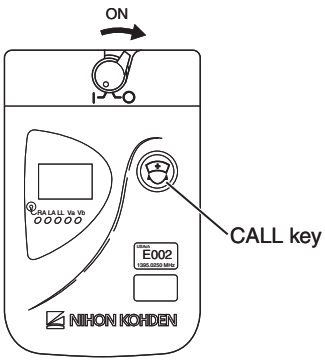


Monopolar chest leads

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.

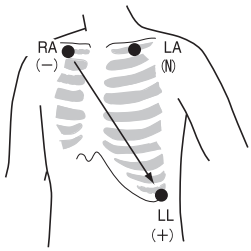
When the transmitter power is turned off and on again, the monitoring mode returns to the original mode.

Three Electrodes

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

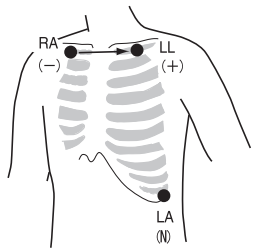
Electrode Position

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

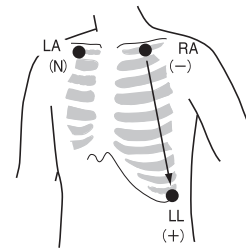


Electrode Position	Symbol	Lead Color
Left infraclavicular fossa	LA (N)	Black
Right infraclavicular fossa	RA (–)	White
Below lowest rib on the left anterior axillary line	LL (+)	Red

- 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

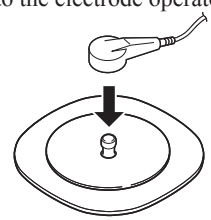
CAUTION

Do not reuse disposable parts and accessories.

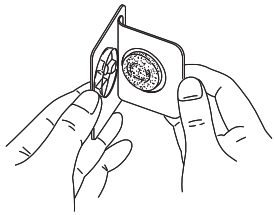
NOTE

- 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.

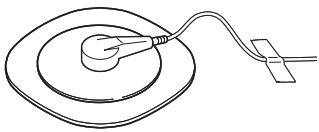
Refer to the electrode operator's manual for details.



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 "⚲" 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 does not function. Check the electrode, 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 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 representative 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, thepacemaker 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.

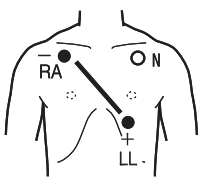
Electrode Position Examples

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

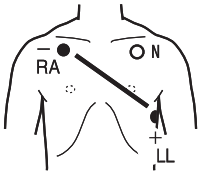
In this position, respiration measurement is available; however, there is a difference in amplitude between different patients.



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

Position 2

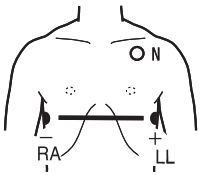
In this position, the waveform amplitude is usually large and the ECG lead is similar to Lead MII. This position can be generally recommended.



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

Position 3

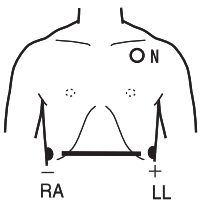
In this position, the respiration waveform is optimum, but the ECG lead is unusual.



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/931PA 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).

WARNING

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.

WARNING

Check the circulation condition by observing the skin color at the measurement site and pulse waveform. Change the measurement site every 8 hours for disposable probes and every 4 hours for reusable probes (every 8 hours for TL-630T/TL-631T series probe). 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.

- Patient with a fever
- Patient with peripheral circulation insufficiency
- Neonate or low birth weight infant with delicate skin
- Patient who is receiving photodynamic therapy*

* Photodynamic therapy is a treatment to remove the affected tissue by using a photosensitizing agent and exposing the tissue to light. This treatment has a side effect of photosensitivity and the light from the finger probe sensor may cause a burn. This probe uses two light wavelengths in the range from 650 to 950 nm. The maximum light intensity is less than 5.5 mW/sr.

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 pulse waves and the displayed data may be incorrect.

CAUTION

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.

CAUTION

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.

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.

CAUTION

While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value might not be displayed.

NOTE

ZM-930PA only

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

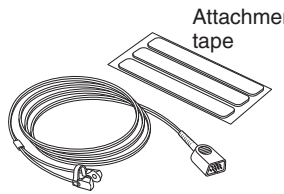
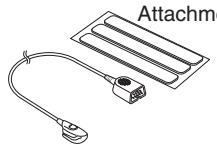
Only use Nihon Kohden specified electrodes, electrode leads and SpO_2 probes. Otherwise, the maximum performance from the transmitter cannot be guaranteed.

CAUTION

Do not use a damaged or disassembled probe. It causes incorrect measurement and may injure the patient.

Reusable Probes

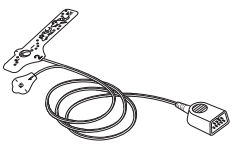
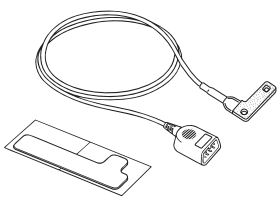
When using a TL-201T finger probe, choose the appropriate cable length for attachment.

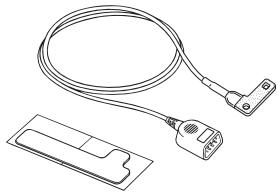
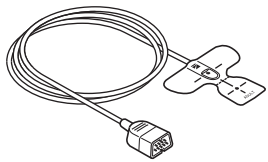
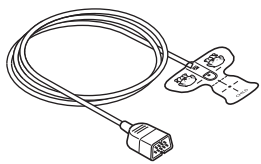
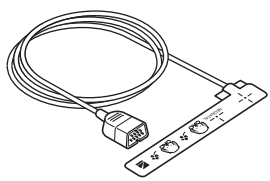
Model	Subject (Weight)	Attachment Site
Finger Probe TL-201T  Cable length: 60 cm or 160 cm	Adult or child (20 kg or more)	Finger
Multi-site probe TL-220T 	Adult or Infant (3 kg or more)	Finger or toe
	Neonate (3 kg or less)	Instep and sole
Finger probe TL-630T1/630T3/631T1/631T3  Cable length: TL-630T1/631T1: 60 cm TL-630T3/631T3: 160 cm	TL-630T1/630T3: Adult or child (50 kg or more) TL-631T1/631T3: Adult or child (20 kg or more)	Finger or toe

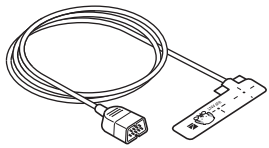
Disposable Probes

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.

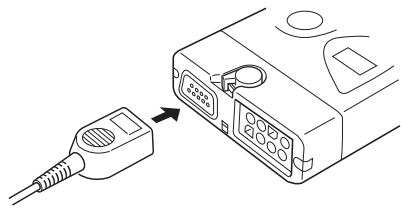
Model	Subject (Weight)	Attachment Site
TL-251T 	Adult (30 kg or more)	Finger or toe
TL-252T 	Child (3 to 40 kg)	Finger or toe
TL-253T 	Neonate (3 kg or less)	Instep and sole
TL-051S/052S  Cable length TL-051S: 80 cm TL-052S: 160 cm	Adult (50 kg or more)	Finger
	Neonate (3 kg or less)	Instep and sole

<table>
<tr><th>Model</th><th>Subject (Weight)</th><th>Attachment Site</th></tr>
<tr><td rowspan="2">TL-061S/062S
 
Cable length TL-061S: 80 cm
TL-062S: 160 cm</td><td>Adult, child
(15 to 50 kg)</td><td>Finger</td></tr>
<tr><td>Child, infant
(3 to 15 kg)</td><td>Toe</td></tr>
<tr><td>TL-271T/271T3
 
Cable length TL-271T: 80 cm
TL-271T3: 160 cm</td><td>Adult
(30 kg or more)</td><td rowspan="2">Finger or toe</td></tr>
<tr><td>TL-272T/272T3
 
Cable length TL-272T: 80 cm
TL-272T3: 160 cm</td><td>Child
(10 to 50 kg)</td></tr>
<tr><td rowspan="2">TL-273T/273T3
 
Cable length TL-273T: 80 cm
TL-273T3: 160 cm</td><td>Neonate
(3 kg or less)</td><td>Instep and sole</td></tr>
<tr><td>Adult
(40 kg or more)</td><td>Finger or toe</td></tr>
</table>

Model	Subject (Weight)	Attachment Site
TL-274T/274T3  Cable length TL-274T: 80 m TL-274T3: 160 cm	Infant (3 to 20 kg)	Finger or toe

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 leads or cables connected to the transmitter. The transmitter may come off and injure someone or damage surrounding instruments.

CAUTION

Hold the connector when connecting/disconnecting the SpO_2 probe. If you disconnect the SpO_2 probe by 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.

WARNING

Check the circulation condition by observing the skin color at the measurement site and pulse waveform. Change the measurement site every 8 hours for disposable probes and every 4 hours for reusable probes (every 8 hours for TL-630T/TL-631T series probe). 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.

- Patient with a fever
- Patient with peripheral circulation insufficiency
- Neonate or low birth weight infant with delicate skin
- Patient who is receiving photodynamic therapy*

* Photodynamic therapy is a treatment to remove the affected tissue by using a photosensitizing agent and exposing the tissue to light. This treatment has a side effect of photosensitivity and the light from the finger probe sensor may cause a burn. This probe uses two light wavelengths in the range from 650 to 950 nm. The maximum light intensity is less than 5.5 mW/sr.

CAUTION

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.

CAUTION

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.

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.

CAUTION

Do not use a probe which is deteriorated by aging. Accurate measurement cannot be performed.

CAUTION

Neonatal skin is delicate. Remove the probe and tape carefully and slowly.

CAUTION

When removing a probe that is taped to the skin, do not pull the probe cable because this can damage the cable.

CAUTION

When removing the probe from the attachment tape, do not pull the sensor cable because this can damage the cable.

CAUTION

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.

CAUTION

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.

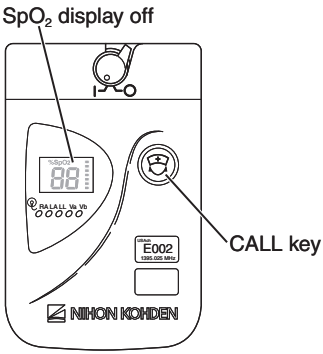
You can turn off the display of SpO_2 data and pulse level bar graph on the LCD. Refer to the "Turning SpO_2 Data and Pulse Level Bar Graph Display On/Off" section.

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

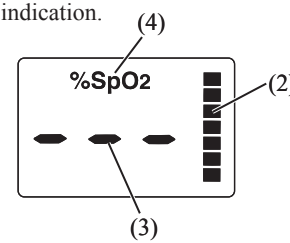
Normal external light does not affect monitoring but strong light such as a surgical light or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.

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 conditions occurs, the probe may be broken. Replace it with a new one.

- The transmitter generates "pip" sounds.
- SpO_2 data is 85% and blinking.

When Measurement Condition is Unstable

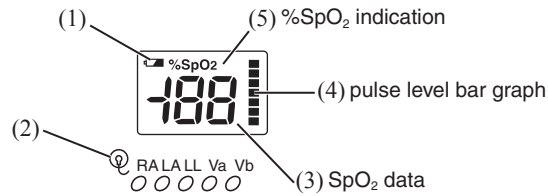
SpO_2 data blinks every 1 second when SpO_2 signal stability decreases and the transmitter cannot detect correct pulse waveform because of patient body movement, poor attachment condition or poor circulation condition at the probe attachment site.

CAUTION

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

Alarm List

Displayed as LED on ZM-920PA/921PA



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 representative.

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/ 931PA 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 representative.

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 assignment.
- 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

CAUTION

If detergent or liquid spills into the transmitter, clean it and dry it completely before use. If a wet transmitter is used, the transmitter may malfunction or get damaged.

CAUTION

Before cleaning or disinfection, remove the batteries from the transmitter. Failure to follow this instruction may result in electrical shock or transmitter malfunction.

CAUTION

The transmitter cannot be sterilized. Sterilizing the transmitter may damage it.

CAUTION

Dispose of the transmitter, options and accessories as specified by Nihon Kohden. Otherwise, it causes infection or environmental contamination.

Before cleaning or disinfecting, remove the batteries from the transmitter. Be careful not to let any liquid get inside the transmitter.

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
Chlorhexidine 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

ZM-920PA/930PA

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%
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

ZM-921PA/931PA

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 ($80\% \leq SpO_2 \leq 100\%$)

±2 digit ($50\% \leq SpO_2 \leq 80\%$)

Less than 50% is not specified

When the measuring accuracy of the SpO_2 probe is considered:

±2 digit ($80\% \leq SpO_2 \leq 100\%$)

±3 digit ($70\% \leq SpO_2 \leq 80\%$)

Less than 70% is not specified

Transmitter

FCC regulation:	FCC part 95 Subpart-H
	Wireless Medical Telemetry Service (WMTS)
Field strength limits:	<740 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:	Internal
Transmission channel:	indicated on the transmitter
Transmission frequency range:	1395.0250 to 1399.9750 MHz
	1427.0250 to 1431.9750 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:	5.0 mW (factory default setting) Can be changed to 1.0 mW if required

Safety Standards

Safety standard:
CAN/CSA-C22.2 No. 601-1 M90: 1990
CAN/CSA-C22.2 No. 601-1. 1S1-94: 1994
CAN/CSA-C22.2 No. 601-1. 1B-90: R2002
CAN/CSA-C22.2 No. 60601-2-49-04: 2004
CAN/CSA-C22.2 No. 601.2.27-98: 1998
IEC 60601-1: 1988
IEC 60601-1 Amendment 1: 1991
IEC 60601-1 Amendment 2: 1995
IEC 60601-1-2: 2001
IEC 60601-1-2 Amendment 1: 2004
IEC 60601-2-27: 2005
IEC 60601-2-49: 2001
ISO 9919: 2005

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-931PA:	approximately 2.5 days (with alkaline batteries, measuring ECG, respiration and SpO_2 of approximately 60 kg weight adult male patient at the pointing finger) approximately 3.5 days (with alkaline batteries, measuring ECG and respiration only)
ZM-921PA:	approximately 3.5 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%
Storage atmospheric pressure:	70 to 106 kPa

Dimension and Weight

Dimension:	78 W × 122 H × 26 D (mm)
Weight (without batteries):	ZM-931PA: about 190 g ZM-921PA: about 170 g

Electromagnetic Compatibility

IEC 60601-1-2: 2001
IEC 60601-1-2 Amendment 1: 2004

Electromagnetic Emissions

This Model ZM-921PA/931PA is intended for use in the electromagnetic environment specified below. The customer or the user of the ZM-921PA/931PA should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment guidance
RF emissions CISPR 11	Group 1	The ZM-921PA/931PA uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The ZM-921PA/931PA is suitable for use in all establishments, including domestic establishments.
Harmonic emissions IEC 61000-3-2	Not applicable	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Not applicable	

Electromagnetic Immunity

This Model ZM-921PA/931PA is intended for use in the electromagnetic environment specified below. The customer or the user of the ZM-921PA/931PA should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Electrical fast transient/ burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines	Not applicable	—
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	Not applicable	—
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 s	Not applicable	—
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the AC mains voltage prior to application of the test level			

Avoiding Electromagnetic Interference (Impedance Respiration)
Impedance respiration measurement is very sensitive and affected by electromagnetic interference. Technological limitations do not allow immunity levels higher than 1 V/m for radiated RF electromagnetic fields. Electromagnetic fields with field strengths above 1 V/m may cause measurement error. Do not use electrically radiating equipment near the impedance respiration measurements.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the ZM-921PA/931PA, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC 61000-4-6	3 Vrms	3 Vrms	$d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m 80 MHz to 2.5 GHz (1 V/m 80 MHz to 2.5 GHz for respiration)	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz ($d = 3.5\sqrt{P}$ 80 MHz to 800 MHz for respiration $d = 7.0\sqrt{P}$ 800 MHz to 2.5 GHz for respiration) where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as deter mined by an electromagnetic site survey*[1], should be less than the compliance level in each frequency range*[2]. Interference may occur in the vicinity of equipment marked with the following symbol: 

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies. NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
*1 Field strengths from fixed transmitters, such as base stations for radio (cellular/ cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ZM-921PA/931PA is used exceeds the applicable RF compliance level above, the ZM-921PA/931PA should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the ZM-921PA/931PA. *2 Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 1 V/m for respiration and 3 V/m for all other functions.			

Recommended Separation Distances between Portable and Mobile RF Communications Equipment

The ZM-921PA/931PA is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ZM-921PA/931PA can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ZM-921PA/931PA as recommended below, according to the maximum output power of the communications.

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter (m)		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$ (For respiration: $d = 3.5\sqrt{P}$)	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$ (For respiration: $d = 7.0\sqrt{P}$)
0.01	0.12	0.12 (0.35*)	0.23 (0.7*)
0.1	0.38	0.38 (1.1*)	0.73 (2.2*)
1	1.2	1.2 (3.5*)	2.3 (7.0*)
10	3.8	3.8 (11*)	7.3 (22*)
100	12	12 (35*)	23 (70*)

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

(* For respiration)

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Recovery Time after Defibrillation

The transmitter returns to the normal operating mode within 10 seconds after defibrillation. The stored settings are not affected.

System Composition for EMC Test

The ZM-921PA/931PA bedside monitor is tested to comply with IEC 60601-1-2: 2001 and IEC 60601-1-2 Amendment 1: 2004 with the following composition.

Units	Cable length
ZM-921PA/931PA transmitter	—
BR-906P ECG electrode lead	0.8 m
TL-201T finger probe	1.6 m

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.

Transmitter

Channel writer, QI-901PK

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
Finger probe (reusable)	0.6 m	TL-630T1		P310A
	1.6 m	TL-630T3		P310C
	0.6 m	TL-631T1		P311A
	1.6 m	TL-631T3		P311C
SpO_2 probe (for adult, disposable)	1.6 m	TL-251T	5	P201A
SpO_2 probe (for child, disposable)		TL-252T		P201B
SpO_2 probe (for neonate, disposable)		TL-253T		P201C
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/630T/631T			3 × 30 packages	P263
Probe fastener		YS-093P2	30	P267

Transmission Frequencies

Channel: 9002 to 9478

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
608.0250	9002	608.3500	9028	608.6750	9054
608.0375	9003	608.3625	9029	608.6875	9055
608.0500	9004	608.3750	9030	608.7000	9056
608.0625	9005	608.3875	9031	608.7125	9057
608.0750	9006	608.4000	9032	608.7250	9058
608.0875	9007	608.4125	9033	608.7375	9059
608.1000	9008	608.4250	9034	608.7500	9060
608.1125	9009	608.4375	9035	608.7625	9061
608.1250	9010	608.4500	9036	608.7750	9062
608.1375	9011	608.4625	9037	608.7875	9063
608.1500	9012	608.4750	9038	608.8000	9064
608.1625	9013	608.4875	9039	608.8125	9065
608.1750	9014	608.5000	9040	608.8250	9066
608.1875	9015	608.5125	9041	608.8375	9067
608.2000	9016	608.5250	9042	608.8500	9068
608.2125	9017	608.5375	9043	608.8625	9069
608.2250	9018	608.5500	9044	608.8750	9070
608.2375	9019	608.5625	9045	608.8875	9071
608.2500	9020	608.5750	9046	608.9000	9072
608.2625	9021	608.5875	9047	608.9125	9073
608.2750	9022	608.6000	9048	608.9250	9074
608.2875	9023	608.6125	9049	608.9375	9075
608.3000	9024	608.6250	9050	608.9500	9076
608.3125	9025	608.6375	9051	608.9625	9077
608.3250	9026	608.6500	9052	608.9750	9078
608.3375	9027	608.6625	9053	608.9875	9079

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
609.0000	9080	609.3750	9110	609.7500	9140
609.0125	9081	609.3875	9111	609.7625	9141
609.0250	9082	609.4000	9112	609.7750	9142
609.0375	9083	609.4125	9113	609.7875	9143
609.0500	9084	609.4250	9114	609.8000	9144
609.0625	9085	609.4375	9115	609.8125	9145
609.0750	9086	609.4500	9116	609.8250	9146
609.0875	9087	609.4625	9117	609.8375	9147
609.1000	9088	609.4750	9118	609.8500	9148
609.1125	9089	609.4875	9119	609.8625	9149
609.1250	9090	609.5000	9120	609.8750	9150
609.1375	9091	609.5125	9121	609.8875	9151
609.1500	9092	609.5250	9122	609.9000	9152
609.1625	9093	609.5375	9123	609.9125	9153
609.1750	9094	609.5500	9124	609.9250	9154
609.1875	9095	609.5625	9125	609.9375	9155
609.2000	9096	609.5750	9126	609.9500	9156
609.2125	9097	609.5875	9127	609.9625	9157
609.2250	9098	609.6000	9128	609.9750	9158
609.2375	9099	609.6125	9129	609.9875	9159
609.2500	9100	609.6250	9130	610.0000	9160
609.2625	9101	609.6375	9131	610.0125	9161
609.2750	9102	609.6500	9132	610.0250	9162
609.2875	9103	609.6625	9133	610.0375	9163
609.3000	9104	609.6750	9134	610.0500	9164
609.3125	9105	609.6875	9135	610.0625	9165
609.3250	9106	609.7000	9136	610.0750	9166
609.3375	9107	609.7125	9137	610.0875	9167
609.3500	9108	609.7250	9138	610.1000	9168
609.3625	9109	609.7375	9139	610.1125	9169

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
610.1250	9170	610.5000	9200	610.8750	9230
610.1375	9171	610.5125	9201	610.8875	9231
610.1500	9172	610.5250	9202	610.9000	9232
610.1625	9173	610.5375	9203	610.9125	9233
610.1750	9174	610.5500	9204	610.9250	9234
610.1875	9175	610.5625	9205	610.9375	9235
610.2000	9176	610.5750	9206	610.9500	9236
610.2125	9177	610.5875	9207	610.9625	9237
610.2250	9178	610.6000	9208	610.9750	9238
610.2375	9179	610.6125	9209	610.9875	9239
610.2500	9180	610.6250	9210	611.0000	9240
610.2625	9181	610.6375	9211	611.0125	9241
610.2750	9182	610.6500	9212	611.0250	9242
610.2875	9183	610.6625	9213	611.0375	9243
610.3000	9184	610.6750	9214	611.0500	9244
610.3125	9185	610.6875	9215	611.0625	9245
610.3250	9186	610.7000	9216	611.0750	9246
610.3375	9187	610.7125	9217	611.0875	9247
610.3500	9188	610.7250	9218	611.1000	9248
610.3625	9189	610.7375	9219	611.1125	9249
610.3750	9190	610.7500	9220	611.1250	9250
610.3875	9191	610.7625	9221	611.1375	9251
610.4000	9192	610.7750	9222	611.1500	9252
610.4125	9193	610.7875	9223	611.1625	9253
610.4250	9194	610.8000	9224	611.1750	9254
610.4375	9195	610.8125	9225	611.1875	9255
610.4500	9196	610.8250	9226	611.2000	9256
610.4625	9197	610.8375	9227	611.2125	9257
610.4750	9198	610.8500	9228	611.2250	9258
610.4875	9199	610.8625	9229	611.2375	9259

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
611.2500	9260	611.6250	9290	612.0000	9320
611.2625	9261	611.6375	9291	612.0125	9321
611.2750	9262	611.6500	9292	612.0250	9322
611.2875	9263	611.6625	9293	612.0375	9323
611.3000	9264	611.6750	9294	612.0500	9324
611.3125	9265	611.6875	9295	612.0625	9325
611.3250	9266	611.7000	9296	612.0750	9326
611.3375	9267	611.7125	9297	612.0875	9327
611.3500	9268	611.7250	9298	612.1000	9328
611.3625	9269	611.7375	9299	612.1125	9329
611.3750	9270	611.7500	9300	612.1250	9330
611.3875	9271	611.7625	9301	612.1375	9331
611.4000	9272	611.7750	9302	612.1500	9332
611.4125	9273	611.7875	9303	612.1625	9333
611.4250	9274	611.8000	9304	612.1750	9334
611.4375	9275	611.8125	9305	612.1875	9335
611.4500	9276	611.8250	9306	612.2000	9336
611.4625	9277	611.8375	9307	612.2125	9337
611.4750	9278	611.8500	9308	612.2250	9338
611.4875	9279	611.8625	9309	612.2375	9339
611.5000	9280	611.8750	9310	612.2500	9340
611.5125	9281	611.8875	9311	612.2625	9341
611.5250	9282	611.9000	9312	612.2750	9342
611.5375	9283	611.9125	9313	612.2875	9343
611.5500	9284	611.9250	9314	612.3000	9344
611.5625	9285	611.9375	9315	612.3125	9345
611.5750	9286	611.9500	9316	612.3250	9346
611.5875	9287	611.9625	9317	612.3375	9347
611.6000	9288	611.9750	9318	612.3500	9348
611.6125	9289	611.9875	9319	612.3625	9349

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
612.3750	9350	612.7500	9380	613.1250	9410
612.3875	9351	612.7625	9381	613.1375	9411
612.4000	9352	612.7750	9382	613.1500	9412
612.4125	9353	612.7875	9383	613.1625	9413
612.4250	9354	612.8000	9384	613.1750	9414
612.4375	9355	612.8125	9385	613.1875	9415
612.4500	9356	612.8250	9386	613.2000	9416
612.4625	9357	612.8375	9387	613.2125	9417
612.4750	9358	612.8500	9388	613.2250	9418
612.4875	9359	612.8625	9389	613.2375	9419
612.5000	9360	612.8750	9390	613.2500	9420
612.5125	9361	612.8875	9391	613.2625	9421
612.5250	9362	612.9000	9392	613.2750	9422
612.5375	9363	612.9125	9393	613.2875	9423
612.5500	9364	612.9250	9394	613.3000	9424
612.5625	9365	612.9375	9395	613.3125	9425
612.5750	9366	612.9500	9396	613.3250	9426
612.5875	9367	612.9625	9397	613.3375	9427
612.6000	9368	612.9750	9398	613.3500	9428
612.6125	9369	612.9875	9399	613.3625	9429
612.6250	9370	613.0000	9400	613.3750	9430
612.6375	9371	613.0125	9401	613.3875	9431
612.6500	9372	613.0250	9402	613.4000	9432
612.6625	9373	613.0375	9403	613.4125	9433
612.6750	9374	613.0500	9404	613.4250	9434
612.6875	9375	613.0625	9405	613.4375	9435
612.7000	9376	613.0750	9406	613.4500	9436
612.7125	9377	613.0875	9407	613.4625	9437
612.7250	9378	613.1000	9408	613.4750	9438
612.7375	9379	613.1125	9409	613.4875	9439

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
613.5000	9440	613.6625	9453	613.8250	9466
613.5125	9441	613.6750	9454	613.8375	9467
613.5250	9442	613.6875	9455	613.8500	9468
613.5375	9443	613.7000	9456	613.8625	9469
613.5500	9444	613.7125	9457	613.8750	9470
613.5625	9445	613.7250	9458	613.8875	9471
613.5750	9446	613.7375	9459	613.9000	9472
613.5875	9447	613.7500	9460	613.9125	9473
613.6000	9448	613.7625	9461	613.9250	9474
613.6125	9449	613.7750	9462	613.9375	9475
613.6250	9450	613.7875	9463	613.9500	9476
613.6375	9451	613.8000	9464	613.9625	9477
613.6500	9452	613.8125	9465	613.9750	9478

Channel: E002 to E398

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1395.0250	E002	1395.3875	E031	1395.7500	E060
1395.0375	E003	1395.4000	E032	1395.7625	E061
1395.0500	E004	1395.4125	E033	1395.7750	E062
1395.0625	E005	1395.4250	E034	1395.7875	E063
1395.0750	E006	1395.4375	E035	1395.8000	E064
1395.0875	E007	1395.4500	E036	1395.8125	E065
1395.1000	E008	1395.4625	E037	1395.8250	E066
1395.1125	E009	1395.4750	E038	1395.8375	E067
1395.1250	E010	1395.4875	E039	1395.8500	E068
1395.1375	E011	1395.5000	E040	1395.8625	E069
1395.1500	E012	1395.5125	E041	1395.8750	E070
1395.1625	E013	1395.5250	E042	1395.8875	E071
1395.1750	E014	1395.5375	E043	1395.9000	E072
1395.1875	E015	1395.5500	E044	1395.9125	E073
1395.2000	E016	1395.5625	E045	1395.9250	E074
1395.2125	E017	1395.5750	E046	1395.9375	E075
1395.2250	E018	1395.5875	E047	1395.9500	E076
1395.2375	E019	1395.6000	E048	1395.9625	E077
1395.2500	E020	1395.6125	E049	1395.9750	E078
1395.2625	E021	1395.6250	E050	1395.9875	E079
1395.2750	E022	1395.6375	E051	1396.0000	E080
1395.2875	E023	1395.6500	E052	1396.0125	E081
1395.3000	E024	1395.6625	E053	1396.0250	E082
1395.3125	E025	1395.6750	E054	1396.0375	E083
1395.3250	E026	1395.6875	E055	1396.0500	E084
1395.3375	E027	1395.7000	E056	1396.0625	E085
1395.3500	E028	1395.7125	E057	1396.0750	E086
1395.3625	E029	1395.7250	E058	1396.0875	E087
1395.3750	E030	1395.7375	E059	1396.1000	E088

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1396.1125	E089	1396.4875	E119	1396.8625	E149
1396.1250	E090	1396.5000	E120	1396.8750	E150
1396.1375	E091	1396.5125	E121	1396.8875	E151
1396.1500	E092	1396.5250	E122	1396.9000	E152
1396.1625	E093	1396.5375	E123	1396.9125	E153
1396.1750	E094	1396.5500	E124	1396.9250	E154
1396.1875	E095	1396.5625	E125	1396.9375	E155
1396.2000	E096	1396.5750	E126	1396.9500	E156
1396.2125	E097	1396.5875	E127	1396.9625	E157
1396.2250	E098	1396.6000	E128	1396.9750	E158
1396.2375	E099	1396.6125	E129	1396.9875	E159
1396.2500	E100	1396.6250	E130	1397.0000	E160
1396.2625	E101	1396.6375	E131	1397.0125	E161
1396.2750	E102	1396.6500	E132	1397.0250	E162
1396.2875	E103	1396.6625	E133	1397.0375	E163
1396.3000	E104	1396.6750	E134	1397.0500	E164
1396.3125	E105	1396.6875	E135	1397.0625	E165
1396.3250	E106	1396.7000	E136	1397.0750	E166
1396.3375	E107	1396.7125	E137	1397.0875	E167
1396.3500	E108	1396.7250	E138	1397.1000	E168
1396.3625	E109	1396.7375	E139	1397.1125	E169
1396.3750	E110	1396.7500	E140	1397.1250	E170
1396.3875	E111	1396.7625	E141	1397.1375	E171
1396.4000	E112	1396.7750	E142	1397.1500	E172
1396.4125	E113	1396.7875	E143	1397.1625	E173
1396.4250	E114	1396.8000	E144	1397.1750	E174
1396.4375	E115	1396.8125	E145	1397.1875	E175
1396.4500	E116	1396.8250	E146	1397.2000	E176
1396.4625	E117	1396.8375	E147	1397.2125	E177
1396.4750	E118	1396.8500	E148	1397.2250	E178

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1397.2375	E179	1397.6125	E209	1397.9875	E239
1397.2500	E180	1397.6250	E210	1398.0000	E240
1397.2625	E181	1397.6375	E211	1398.0125	E241
1397.2750	E182	1397.6500	E212	1398.0250	E242
1397.2875	E183	1397.6625	E213	1398.0375	E243
1397.3000	E184	1397.6750	E214	1398.0500	E244
1397.3125	E185	1397.6875	E215	1398.0625	E245
1397.3250	E186	1397.7000	E216	1398.0750	E246
1397.3375	E187	1397.7125	E217	1398.0875	E247
1397.3500	E188	1397.7250	E218	1398.1000	E248
1397.3625	E189	1397.7375	E219	1398.1125	E249
1397.3750	E190	1397.7500	E220	1398.1250	E250
1397.3875	E191	1397.7625	E221	1398.1375	E251
1397.4000	E192	1397.7750	E222	1398.1500	E252
1397.4125	E193	1397.7875	E223	1398.1625	E253
1397.4250	E194	1397.8000	E224	1398.1750	E254
1397.4375	E195	1397.8125	E225	1398.1875	E255
1397.4500	E196	1397.8250	E226	1398.2000	E256
1397.4625	E197	1397.8375	E227	1398.2125	E257
1397.4750	E198	1397.8500	E228	1398.2250	E258
1397.4875	E199	1397.8625	E229	1398.2375	E259
1397.5000	E200	1397.8750	E230	1398.2500	E260
1397.5125	E201	1397.8875	E231	1398.2625	E261
1397.5250	E202	1397.9000	E232	1398.2750	E262
1397.5375	E203	1397.9125	E233	1398.2875	E263
1397.5500	E204	1397.9250	E234	1398.3000	E264
1397.5625	E205	1397.9375	E235	1398.3125	E265
1397.5750	E206	1397.9500	E236	1398.3250	E266
1397.5875	E207	1397.9625	E237	1398.3375	E267
1397.6000	E208	1397.9750	E238	1398.3500	E268

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1398.3625	E269	1398.7375	E299	1399.1125	E329
1398.3750	E270	1398.7500	E300	1399.1250	E330
1398.3875	E271	1398.7625	E301	1399.1375	E331
1398.4000	E272	1398.7750	E302	1399.1500	E332
1398.4125	E273	1398.7875	E303	1399.1625	E333
1398.4250	E274	1398.8000	E304	1399.1750	E334
1398.4375	E275	1398.8125	E305	1399.1875	E335
1398.4500	E276	1398.8250	E306	1399.2000	E336
1398.4625	E277	1398.8375	E307	1399.2125	E337
1398.4750	E278	1398.8500	E308	1399.2250	E338
1398.4875	E279	1398.8625	E309	1399.2375	E339
1398.5000	E280	1398.8750	E310	1399.2500	E340
1398.5125	E281	1398.8875	E311	1399.2625	E341
1398.5250	E282	1398.9000	E312	1399.2750	E342
1398.5375	E283	1398.9125	E313	1399.2875	E343
1398.5500	E284	1398.9250	E314	1399.3000	E344
1398.5625	E285	1398.9375	E315	1399.3125	E345
1398.5750	E286	1398.9500	E316	1399.3250	E346
1398.5875	E287	1398.9625	E317	1399.3375	E347
1398.6000	E288	1398.9750	E318	1399.3500	E348
1398.6125	E289	1398.9875	E319	1399.3625	E349
1398.6250	E290	1399.0000	E320	1399.3750	E350
1398.6375	E291	1399.0125	E321	1399.3875	E351
1398.6500	E292	1399.0250	E322	1399.4000	E352
1398.6625	E293	1399.0375	E323	1399.4125	E353
1398.6750	E294	1399.0500	E324	1399.4250	E354
1398.6875	E295	1399.0625	E325	1399.4375	E355
1398.7000	E296	1399.0750	E326	1399.4500	E356
1398.7125	E297	1399.0875	E327	1399.4625	E357
1398.7250	E298	1399.1000	E328	1399.4750	E358

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1399.4875	E359	1399.6625	E373	1399.8375	E387
1399.5000	E360	1399.6750	E374	1399.8500	E388
1399.5125	E361	1399.6875	E375	1399.8625	E389
1399.5250	E362	1399.7000	E376	1399.8750	E390
1399.5375	E363	1399.7125	E377	1399.8875	E391
1399.5500	E364	1399.7250	E378	1399.9000	E392
1399.5625	E365	1399.7375	E379	1399.9125	E393
1399.5750	E366	1399.7500	E380	1399.9250	E394
1399.5875	E367	1399.7625	E381	1399.9375	E395
1399.6000	E368	1399.7750	E382	1399.9500	E396
1399.6125	E369	1399.7875	E383	1399.9625	E397
1399.6250	E370	1399.8000	E384	1399.9750	E398
1399.6375	E371	1399.8125	E385		
1399.6500	E372	1399.8250	E386		

Channel: E502 to E898

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1427.0250	E502	1427.3875	E531	1427.7500	E560
1427.0375	E503	1427.4000	E532	1427.7625	E561
1427.0500	E504	1427.4125	E533	1427.7750	E562
1427.0625	E505	1427.4250	E534	1427.7875	E563
1427.0750	E506	1427.4375	E535	1427.8000	E564
1427.0875	E507	1427.4500	E536	1427.8125	E565
1427.1000	E508	1427.4625	E537	1427.8250	E566
1427.1125	E509	1427.4750	E538	1427.8375	E567
1427.1250	E510	1427.4875	E539	1427.8500	E568
1427.1375	E511	1427.5000	E540	1427.8625	E569
1427.1500	E512	1427.5125	E541	1427.8750	E570
1427.1625	E513	1427.5250	E542	1427.8875	E571
1427.1750	E514	1427.5375	E543	1427.9000	E572
1427.1875	E515	1427.5500	E544	1427.9125	E573
1427.2000	E516	1427.5625	E545	1427.9250	E574
1427.2125	E517	1427.5750	E546	1427.9375	E575
1427.2250	E518	1427.5875	E547	1427.9500	E576
1427.2375	E519	1427.6000	E548	1427.9625	E577
1427.2500	E520	1427.6125	E549	1427.9750	E578
1427.2625	E521	1427.6250	E550	1427.9875	E579
1427.2750	E522	1427.6375	E551	1428.0000	E580
1427.2875	E523	1427.6500	E552	1428.0125	E581
1427.3000	E524	1427.6625	E553	1428.0250	E582
1427.3125	E525	1427.6750	E554	1428.0375	E583
1427.3250	E526	1427.6875	E555	1428.0500	E584
1427.3375	E527	1427.7000	E556	1428.0625	E585
1427.3500	E528	1427.7125	E557	1428.0750	E586
1427.3625	E529	1427.7250	E558	1428.0875	E587
1427.3750	E530	1427.7375	E559	1428.1000	E588

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1428.1125	E589	1428.4875	E619	1428.8625	E649
1428.1250	E590	1428.5000	E620	1428.8750	E650
1428.1375	E591	1428.5125	E621	1428.8875	E651
1428.1500	E592	1428.5250	E622	1428.9000	E652
1428.1625	E593	1428.5375	E623	1428.9125	E653
1428.1750	E594	1428.5500	E624	1428.9250	E654
1428.1875	E595	1428.5625	E625	1428.9375	E655
1428.2000	E596	1428.5750	E626	1428.9500	E656
1428.2125	E597	1428.5875	E627	1428.9625	E657
1428.2250	E598	1428.6000	E628	1428.9750	E658
1428.2375	E599	1428.6125	E629	1428.9875	E659
1428.2500	E600	1428.6250	E630	1429.0000	E660
1428.2625	E601	1428.6375	E631	1429.0125	E661
1428.2750	E602	1428.6500	E632	1429.0250	E662
1428.2875	E603	1428.6625	E633	1429.0375	E663
1428.3000	E604	1428.6750	E634	1429.0500	E664
1428.3125	E605	1428.6875	E635	1429.0625	E665
1428.3250	E606	1428.7000	E636	1429.0750	E666
1428.3375	E607	1428.7125	E637	1429.0875	E667
1428.3500	E608	1428.7250	E638	1429.1000	E668
1428.3625	E609	1428.7375	E639	1429.1125	E669
1428.3750	E610	1428.7500	E640	1429.1250	E670
1428.3875	E611	1428.7625	E641	1429.1375	E671
1428.4000	E612	1428.7750	E642	1429.1500	E672
1428.4125	E613	1428.7875	E643	1429.1625	E673
1428.4250	E614	1428.8000	E644	1429.1750	E674
1428.4375	E615	1428.8125	E645	1429.1875	E675
1428.4500	E616	1428.8250	E646	1429.2000	E676
1428.4625	E617	1428.8375	E647	1429.2125	E677
1428.4750	E618	1428.8500	E648	1429.2250	E678

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1429.2375	E679	1429.6125	E709	1429.9875	E739
1429.2500	E680	1429.6250	E710	1430.0000	E740
1429.2625	E681	1429.6375	E711	1430.0125	E741
1429.2750	E682	1429.6500	E712	1430.0250	E742
1429.2875	E683	1429.6625	E713	1430.0375	E743
1429.3000	E684	1429.6750	E714	1430.0500	E744
1429.3125	E685	1429.6875	E715	1430.0625	E745
1429.3250	E686	1429.7000	E716	1430.0750	E746
1429.3375	E687	1429.7125	E717	1430.0875	E747
1429.3500	E688	1429.7250	E718	1430.1000	E748
1429.3625	E689	1429.7375	E719	1430.1125	E749
1429.3750	E690	1429.7500	E720	1430.1250	E750
1429.3875	E691	1429.7625	E721	1430.1375	E751
1429.4000	E692	1429.7750	E722	1430.1500	E752
1429.4125	E693	1429.7875	E723	1430.1625	E753
1429.4250	E694	1429.8000	E724	1430.1750	E754
1429.4375	E695	1429.8125	E725	1430.1875	E755
1429.4500	E696	1429.8250	E726	1430.2000	E756
1429.4625	E697	1429.8375	E727	1430.2125	E757
1429.4750	E698	1429.8500	E728	1430.2250	E758
1429.4875	E699	1429.8625	E729	1430.2375	E759
1429.5000	E700	1429.8750	E730	1430.2500	E760
1429.5125	E701	1429.8875	E731	1430.2625	E761
1429.5250	E702	1429.9000	E732	1430.2750	E762
1429.5375	E703	1429.9125	E733	1430.2875	E763
1429.5500	E704	1429.9250	E734	1430.3000	E764
1429.5625	E705	1429.9375	E735	1430.3125	E765
1429.5750	E706	1429.9500	E736	1430.3250	E766
1429.5875	E707	1429.9625	E737	1430.3375	E767
1429.6000	E708	1429.9750	E738	1430.3500	E768

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1430.3625	E769	1430.7375	E799	1431.1125	E829
1430.3750	E770	1430.7500	E800	1431.1250	E830
1430.3875	E771	1430.7625	E801	1431.1375	E831
1430.4000	E772	1430.7750	E802	1431.1500	E832
1430.4125	E773	1430.7875	E803	1431.1625	E833
1430.4250	E774	1430.8000	E804	1431.1750	E834
1430.4375	E775	1430.8125	E805	1431.1875	E835
1430.4500	E776	1430.8250	E806	1431.2000	E836
1430.4625	E777	1430.8375	E807	1431.2125	E837
1430.4750	E778	1430.8500	E808	1431.2250	E838
1430.4875	E779	1430.8625	E809	1431.2375	E839
1430.5000	E780	1430.8750	E810	1431.2500	E840
1430.5125	E781	1430.8875	E811	1431.2625	E841
1430.5250	E782	1430.9000	E812	1431.2750	E842
1430.5375	E783	1430.9125	E813	1431.2875	E843
1430.5500	E784	1430.9250	E814	1431.3000	E844
1430.5625	E785	1430.9375	E815	1431.3125	E845
1430.5750	E786	1430.9500	E816	1431.3250	E846
1430.5875	E787	1430.9625	E817	1431.3375	E847
1430.6000	E788	1430.9750	E818	1431.3500	E848
1430.6125	E789	1430.9875	E819	1431.3625	E849
1430.6250	E790	1431.0000	E820	1431.3750	E850
1430.6375	E791	1431.0125	E821	1431.3875	E851
1430.6500	E792	1431.0250	E822	1431.4000	E852
1430.6625	E793	1431.0375	E823	1431.4125	E853
1430.6750	E794	1431.0500	E824	1431.4250	E854
1430.6875	E795	1431.0625	E825	1431.4375	E855
1430.7000	E796	1431.0750	E826	1431.4500	E856
1430.7125	E797	1431.0875	E827	1431.4625	E857
1430.7250	E798	1431.1000	E828	1431.4750	E858

Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.	Transmission frequency (MHz)	Channel No.
1431.4875	E859	1431.6625	E873	1431.8375	E887
1431.5000	E860	1431.6750	E874	1431.8500	E888
1431.5125	E861	1431.6875	E875	1431.8625	E889
1431.5250	E862	1431.7000	E876	1431.8750	E890
1431.5375	E863	1431.7125	E877	1431.8875	E891
1431.5500	E864	1431.7250	E878	1431.9000	E892
1431.5625	E865	1431.7375	E879	1431.9125	E893
1431.5750	E866	1431.7500	E880	1431.9250	E894
1431.5875	E867	1431.7625	E881	1431.9375	E895
1431.6000	E868	1431.7750	E882	1431.9500	E896
1431.6125	E869	1431.7875	E883	1431.9625	E897
1431.6250	E870	1431.8000	E884	1431.9750	E898
1431.6375	E871	1431.8125	E885		
1431.6500	E872	1431.8250	E886		