Thank you for purchasing the iPex II apex locator. Please read this Operation Manual carefully before use to become familiar with operation instructions and care & maintenance. Keep this Operation Manual for future reference.

English

— CONTENTS —

1 User and Intended Use

User: Qualified Professionals
Intended use: Determination of the apical foramen position and measurement of the root canal length

2 Precautions for handling and operation

- Please read these precautions carefully and use only as intended or instructed.
- Safety instructions are intended to avoid potential hazards that could result in personal injury or damage to the device. Safety instructions are classified as follows in accordance with the seriousness of the risk.

Class	Degree of Risk
⚠**WARNING**	Hazard that could result in serious injury or damage to the device if the safety instructions are not correctly followed.
⚠**CAUTION**	Hazard that could result in light or moderate injury or damage to the device if the safety instructions are not correctly followed.
NOTICE	General product specification information highlighted to avoid product malfunction and performance reduction.

⚠ WARNING

- This is a medical product, and only doctors familiar with the procedures should use this product. Use this product in accordance with its intended use and proper method of use.
- Portable and mobile RF communications equipment can affect Medical Electrical equipment. Do not use RF equipment near the product.
- The system may present a possibility of malfunction when used in the presence of an electromagnetic interference wave. Do not install the system in the vicinity of any device which emits magnetic waves. Turn off the Main Power Switch of the system an ultrasonic oscillation device or an electrode knife is located close to the vicinity of use.
- This product is not waterproof. Avoid water or chemical solution on the control unit as it may cause electric shock due to a short circuit.
- If you should notice a fluid leak from the dry cell batteries, deformation or discoloration of the control unit exterior, stop using immediately and contact your Authorized NSK Dealer. Fluid leakage accident, electric shock or fire may result.

- If the battery fluid leaks and gets into your eyes, immediately flush your eyes with water and consult with a medical specialist as it may cause vision loss or blindness.
- If the battery fluid leaks and adheres to your skin or clothing, immediately flush it out with water as it may cause damage to your skin.
- Conduct a maintenance check after each patient, following the instructions in '6. Check before Treatment'. If all the bar graphs are not displayed during the check, root canal length will not be correctly measured. In this case stop using immediately and contact your Authorized NSK Dealer for repair.
- The numerical values displayed on the LCD panel do not indicate the actual distance from the end of the root canal. Only use them as guidance for measurement.
- Do not keep using the product with the battery indicator "  " flashing. Normal operation or indication may not be performed.
- Should the product function abnormally during operation, cease operation immediately.
- Do not use in combination with other equipments while the lip hook is attached to the patient. The product may not perform correct measurement.
- Be sure to prevent the lip hook, file clip and their connector parts from getting contact with household power supply sources (such as electric outlets) as it may cause electric shock.
- Be sure to sterilize the file clip and lip hook by autoclave sterilization after each patient.
- Do not operate close to patients with cardiac pacemakers as there is a danger that it may affect the pacemaker.
- Do not use the product by connecting or integrating into other medical devices.
- Keep away from explosive substances and flammable materials.

⚠ CAUTION

- Do not allow any impact on to the product. Do not drop the product. Personal injury or damage to the product may result.
- This product is designed for use with dry cell batteries only. Use commercially available dry cell batteries specified in this operation manual. Carefully read the instruction manual of the dry cell batteries prior to use.
- If the probe plug is not sufficiently inserted, measurement may not be performed.
- Avoid chemical solution for treatment on the lip hook or file clip. Use with the solution adhered to the instrument may cause inflammation.

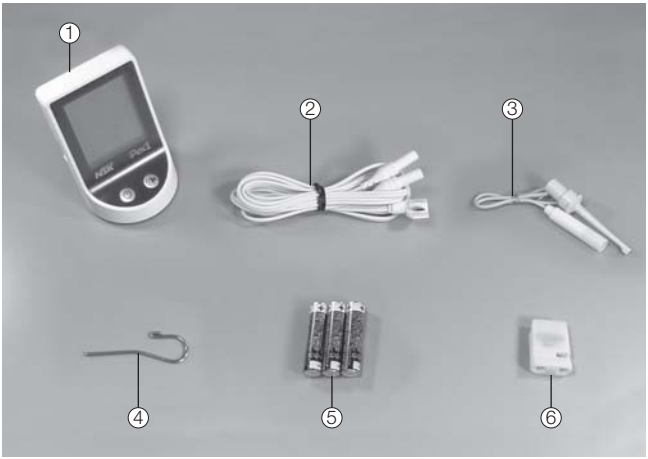
- When pinching the metallic part of a file or reamer with the file clip, pinch the upper part (near the handle). If the lower part (blade transition part and blade part) is pinched, the root canal length cannot be correctly measured, or the tip of the file clip may be broken.
- Sterilize the product only by autoclave sterilization.
- Do not use or leave the product in a high-temperature environment such as under strong direct sunlight, in a car under a blazing sun, or near the fire or a stove as it may cause overheating or fire due to a failure of the internal circuit.
- When a chemical, solvent or disinfectant solution adheres to the product, immediately wipe it off. If it is left adhered, discoloration or deformation of the product may result.
- When inserting a dry cell battery, do not forcibly press the contact spring in the battery box against the end of the battery's negative terminal as it may cause damage to the battery coating, resulting in a short circuit or battery fluid leakage.
- Do not use rechargeable batteries such as a nickel metal hydride battery and nickel-cadmium battery.
- Always use batteries of the same type and manufacturer and replace all three batteries at the same time. Using batteries of different types or mixing new and old or exhausted batteries may cause battery fluid leak or battery rupture.
- If fluid leakage occurs, thoroughly wipe the fluid adhered to battery mounting parts before inserting new batteries.
- Prevent conductive objects such as wires or safety pins from entering the battery box as it may cause overheating or fire due to a short circuit.
- Do not attempt to disassemble the product nor tamper with the mechanism except as recommend by NSK in this Operation Manual.
- Read this Operation Manual before use to fully understand the product functions.
- When operating the product always consider the safety of the patient.
- The end user shall be responsible for any judgment that relates to the application of this product to a patient.
- This product does not consider patient's age (except infants), gender, weight or nationality.
- This product does not consider operator's age (mature person), height, weight, gender, or nationality.
- This device is for indoor use only.
- Keep the control unit on a level surface.

- Do not use high acid water or sterilizing solutions to wipe, immerse or clean the product.
- The products are delivered in a non-sterile condition and must be autoclaved prior to use.
- Perform regular function and maintenance checks.
- If the product is not used for a long period check it is functioning correctly before using on a patient.
- To avoid clinical downtime it is recommended that a spare be kept on hand in case of a breakdown during surgery.
- This product is rated Medical Electrical equipment. EMC (Electromagnetic compatibility) is described in the documentation included.
- Installation and use of this product requires special precautions regarding EMC according to the EMC information.
- The use of ACCESSORIES such as cables, with the exception of cables sold by the manufacturer of this product as replacement parts for internal components, may result in increased EMISSIONS or decreased IMMUNITY of this product.
- This product should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, this product should be observed to verify normal operation in the configuration in which it will be used.

NOTICE

- If the product is stored for a long time, remove batteries from the battery box to protect the product from possible fluid leakage.
- Users are responsible for the operational control, maintenance and continual inspection of this product.
- No special training is required for this device.
- The product during operation could interfere with the computers, LAN cables in vicinity of use or could cause noise in radio receivers nearby.

3 Package Contents



No.	Description	Quantity
1	Control Unit	1
2	Probe (1.8m)	1
3	File Clip	3pcs.
4	Lip Hook	3pcs.
5	Dry Cell Battery	3
6	Tester	1

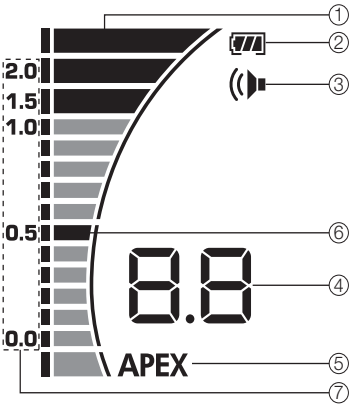
* Probe, file clip, lip hook and dry cell batteries are consumables.

4 Component Names

4-1 Control Unit

1	LCD Panel	Displays the position of the file tip, remaining battery level and alarm sound volume.
2	Power Key	When the Power Key is pressed, the power turns ON sounding an alarm, then the LCD panel lights up. When the Power Key is pressed for approximately one second or longer while the power is ON, the power and the LCD panel turns OFF.
3	Alarm Key	When the Alarm Key is pressed, the alarm audio volume can be adjusted (rotation of OFF->Low -> Medium -> High).
4	Probe Connector	Connector of the probe is attached.
5	Battery Cover	Secures dry cell batteries in place.
6	Battery Cover Screw	Prevents battery cover from detaching.

4-2 LCD Panel



1	Bar Graph	Displays the approximate position of the file end.
2	Battery Indicator	Displays the remaining battery level. When the Battery Indicator flashes, immediately replace with new dry cell batteries.
3	Alarm Mark	Displays the alarm audio volume (rotation of OFF->Low -> Medium -> High).
4	Number Display	Displays the present position from the end of the root canal in numerical value. When the value reaches '1.0' or below, an alarm corresponding to each value sounds. When the value goes below '0.0', a short alarm sounds with the mark 'oA' on the LCD panel.
5	APEX Mark	Turns ON when the value representing the present position of the file end reaches "0.0" and flashes when the value goes below '0.0'.
6	Target Value Bar	Displays the target value by flashing.
7	Meter Bar Value	Displays the present position from the end of the root canal in numerical value.

* 4 and 7 are NOT values to show the actual distance from the end of the root canal in the unit of mm. Only use them as guidance for measurement.

5 Installation and Assembly

(1) To insert dry cell batteries
Insert dry cell batteries into the battery box on the bottom surface of the control unit. (Refer to “10. Changing Batteries”)

(2) To connect the probe
Securely insert the plug of the probe into the probe connector on the control unit. (Fig. 1)

Fig. 1

(3) To connect the file clip
Connect the plug of the file clip to either plug of the probe. (Fig. 2)

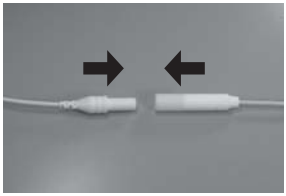


Fig. 2

(4) To connect the lip hook
Connect the lip hook to the other plug of the probe. (Fig. 3)

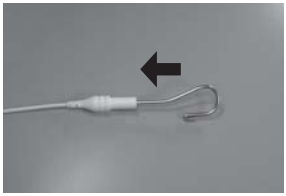


Fig. 3

6 Check before Treatment

Be sure to perform an operation check with the tester before use to confirm that the product operates properly.

1) Press the Power Key to turn ON the power. (The alarm sounds and the LCD panel lights up.)
2) Pinch one terminal on the tester with the file clip, and contact the lip hook to the other terminal. (Fig. 4)
3) Check that the number display on the LCD panel is within the range of “0.4 and 0.6.”
4) If the displayed value is within the permitted range, remove the tester then operate the product following the instructions in ‘7. Operation’. If not correctly displayed, follow the procedure below.
5) Remove the file clip and lip hook from the probe then insert the probe sockets directly into the tester (Fig. 5). Check that number display on the LCD panel is within the range of “0.4 and 0.6.” If not correctly displayed, follow the procedure below.
6) Remove the probe from the control unit then insert the tester directly into the probe connector. Check that number display on the LCD panel is within the range of “0.4 and 0.6.”

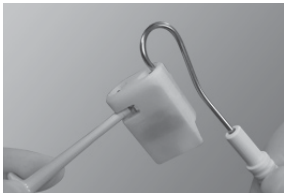


Fig. 4

Fig. 5

CAUTION

- If the number is not displayed correctly, check the following.
  - That the tester, probe, and file clip are securely connected.
  - That the tester and file clip are not wet, or skin is not in contact with the electrode of the tester.
- If the number display is outside the range of “0.4 to 0.6” or the value is not correctly indicated in 6, the control unit may have an abnormality. Contact your Authorized NSK Dealer.
- If the number display is outside the range of “0.4 to 0.6” in 3 and 5 even though it operates correctly in 6, there may be a break in a cord. Contact your Authorized NSK Dealer.

7 Operation

1) Pinch the file inserted in the root canal with the file clip. Pinch the upper part (near the handle) of the file’s metallic part.
2) Hang the lip hook on a corner of the patient’s mouth.
3) Move the inserted file and measure the root canal length.
4) After use, press the Power Key for approximately one second or longer to turn OFF the power. (The alarm sounds and the LCD panel turns off.)

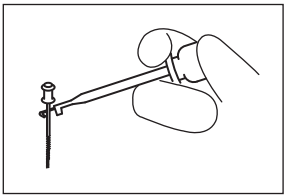


Fig. 6

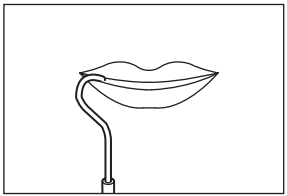


Fig. 7

NOTICE

- After completing the operation, if the control unit is left unused (with the Number Display indicating ‘- -’) for about 10 minutes, the power automatically turns OFF. (Auto power-off function)

5) Remove the file from the file clip.
6) Remove the lip hook and file clip from the probe.

CAUTION

- Never hold the probe cord when removing the lip hook and file clip from the probe. Be sure to hold the connector part.

7) Remove the probe from the control unit.

CAUTION

- Never hold the probe cord when removing the probe from the control unit. Be sure to hold the connector part.
- The root canal length cannot be correctly measured in some cases. ALWAYS confirm in combination with X-ray photography.
  Example:
  1. The apical foramen is large.
  2. Closed root canal.
  3. Bleeding from the root canal orifice.
  4. Tooth crown is broken.
  5. Tooth root is broken.
  6. The root canal is filled with gutta-percha.
  7. Metal prosthesis on the tooth crown is in contact with gum.
  8. Immature tooth or broken root tooth.

8 Audio Alarm Volume Control

Alarm audio volume can be adjusted to “OFF”, “Low ( ) ”, “Medium ( ) ” and “High ( ) ”.

1) Press the Alarm key.
2) The Alarm Mark on the LCD panel and the sound volume change.
3) Each time the Key is pressed the sound volume changes.

CAUTION

- Do not press the Alarm Key too strongly as it may be damaged.

NOTICE

- The last setting is stored when the control unit is switched OFF.

9 Maintenance

After each patient maintain the product as follows.

9-1 Cleaning of control unit, probe, file clip and lip hook

Preparation prior to cleaning

Remove the file clip and lip hook from the probe, and remove the probe from the control unit.

Check for damage on each cord or deformation on each connector.

Cleaning

Wipe the product with cloth moistened with clean water.

Then wipe clean with alcohol-immersed cotton or cloth.

⚠ CAUTION

- To clean the product never use any solvent such as benzine or thinner.
- Do not use a chlorinated cleaner.
- Do not clean the product with an ultrasonic cleaning apparatus.
- Do not soak the control unit and probe into water.
- Prevent water from entering the connector part.

9-2 Sterilization of the file clip and lip hook

Sterilize the file clip and lip hook by autoclave sterilization.

* Autoclave Procedure:

1) Insert into an autoclave pouch. Seal the pouch.
2) Autoclavable under the conditions below.
   Autoclave for more than 20 min. at 121°C, or 15 min. at 132°C, or 3 min. at 134°C.
3) The product should remain in the autoclave pouch until required for use.

⚠ CAUTION

- Sterilize only the file clip and lip hook in the autoclave. The control unit and probe cannot be autoclaved.
- The product can be sterilized only by autoclave sterilization.
- Do not autoclave the product with other instruments even when it is in a pouch. This is to prevent possible discoloration and damage to the product from chemical residue on other instruments.
- Keep the product in suitable atmospheric pressure, temperature, humidity, ventilation, and sunlight. The air should be free from

dust, salt and sulphur.

CAUTION

- Do not heat or cool the product too quickly. Rapid change in temperature could cause damage to the product.
- If the sterilizer chamber temperature may exceed 135°C during the dry cycle then delete the dry cycle.
- Autoclave sterilization is recommended for the product. The validity of other sterilization methods is not confirmed.
- Do not touch the product immediately after autoclaving as it will be very hot and must remain in a sterile condition.

NOTICE

- NSK recommends Class B sterilizers as stated in EN13060.

10 Changing the batteries

CAUTION

- When the Battery indicator flashes, immediately replace original batteries with new dry cell batteries.

1) Turn OFF the power.
2) Loosen the battery cover screw on the bottom of the control unit then remove the battery cover.
3) Remove old batteries.
4) Insert new batteries, following the positive (+)/negative (-) indication in the battery box.

CAUTION

- Make certain the positive (+) and negative (-) terminals are correctly aligned.
- When it is hard to insert, do not forcibly insert the battery as it may be inserted incorrectly.

5) Attach the battery cover to the control unit and tighten the battery cover screw.

CAUTION

- For optimal performance.always use alkaline or manganese dry cell batteries.
- Before use be sure to attach the battery cover to the control unit with the battery cover screw.
- If using without the battery cover, it may cause an electric shock to the patient.
- Dispose of used alkaline or manganese dry cell batteries in accordance with the regulations of each country.

11 Periodical Maintenance Checks

Perform periodical maintenance checks every three months, referring to the check sheet below. If any abnormalities are found, contact your Authorized NSK Dealer.

Points to check	Details
ON/OFF operation	Check that the power turns ON and OFF correctly.
Remaining battery level	Check if the Battery indicator does not flash. If the mark flashes, replace with new batteries following the instruction in '10. Changing the batteries.'
Alarm sound volume	Press the Alarm Key and check that the alarm audio volume changes. (rotation of OFF->Low -> Medium -> High)
Connector part	Check for debris or corrosion on the lip hook or connector terminals of the cable.
Product Operation	Check with the tester that the cable and the control unit operate properly, following the instructions in '6. Check before Treatment'.

12 Error Codes

If an error code appears on the LCD panel, see the following table.

Error code	Error	Cause	Remedy
E0	Alarm audio volume setting at the last operation was not stored.	The battery voltage dropped when the alarm audio volume was set.	If the battery remaining level is low, replace the batteries.
E1	An incompatible probe is connected to the control unit.	The control unit cannot recognize the probe.	Connect a correct probe. Check if the probe is securely connected.
E2	Power source failure at the measuring part.	The voltage exceeded the voltage range at the measuring part.	If the battery remaining level is low, replace the batteries.
E9	Communication failure with the measuring part.	The measuring part is not operating.	If the battery remaining level is low, replace the batteries.

*Error indication is reset by turning off the power.

13 Troubleshooting

When a problem is detected, check the following again before requesting a repair. If none of these is applicable or if the trouble is not remedied even after an action has been taken, a failure of this product is suspected. Contact your Authorized NSK Dealer.

Trouble	Cause	Remedy
The power does not turn on.	Dry cell batteries are not inserted.	Insert dry cell batteries.
	Dry cell batteries are not inserted correctly.	Correctly insert the batteries.
	The remaining battery level is low.	Replace with new dry cell batteries.

Trouble	Cause	Remedy
Root canal length measurement cannot be performed.	The probe or other connectors are not properly connected.	Securely insert the connector.
	The cable of the probe is disconnected.	Connect the lip hook and file clip with the tester to check whether the probe is disconnected.
Alarm sound volume is low.	The alarm sound volume is adjusted to 'Low'.	Check the alarm sound volume.
The LCD panel does not display.	The remaining battery level is low.	If the LCD panel does not display even after the batteries are replaced, failure of the LCD panel is suspected.
Bar graph is not stable.	The lip hook is not firmly in contact with the mucous membrane of the patient's oral cavity.	Adjust the lip hook position so that it stably contacts the mucous membrane in the oral cavity.
	The file clip is not clean.	Wipe the file clip using rubbing alcohol.
Bar graph frequently moves.	The file is in contact with the gingiva.	When the file contacts the gingiva, the bar graph deflects. Check if the file is in contact with gingiva.
	The file is in contact with a metal prosthesis.	When the file contacts a metal prosthesis, the measured current flows to the gingiva or periodontal tissues and the bar graph moves. Check if the file contacts a metal prosthesis.
	Current leakage to the gingiva is occurring due to a major collapse of the crown.	Use diaphragms to prevent leakage to the gingiva.
	The file clip is not clean or damaged.	Replace or clean the file clip.

Trouble	Cause	Remedy
Bar graph does not move.	The root canal is closed.	Bar graph operates correctly when the file reaches the apical constriction. In this case, always check in combination with X-ray photography.
	The inside of the root canal is extremely dry.	Moisten the root canal with physiological saline solution.

14 Specifications

Model		iPexII
Power Source		DC 4.5V (AAA dry cell battery 1.5V x 3)
Rated Power		100mW
Measurement Voltage		AC 80mV or less
Measurement Current		AC 100μA or less
Display		Reflective color LCD display
Control Unit	Dimensions	W60×D60×H86.5 mm
	Weight	About 76g (Dry Cell Batteries not included)

	Temperature	Humidity	Atmospheric Pressure
Use environment	0 - 40°C (No Condensation)	30 - 75%	700 - 1,060hPa
Store and transportation environment	-10 - 50°C	10 - 85%	500 - 1,060hPa

* Remove dry cell batteries from the control unit before storage.

15 Classification of Equipment

- Type of protection against electric shock :
  -Internally powered equipment
- Degree of protection against electric shock :
  -Type BF applied part (Applied part: File clip and Lip hook)
- Method of sterilization or disinfection recommended by the manufacturer :
  -See '9-2 Sterilization of file clip and lip hook'
- Degree of protection against ingress of water as detailed in the current edition of IEC 60529 :
  -Control Unit…IPX0
- Degree of safety of application in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide :
  -Equipment NOT suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- Mode of operation :
  -Continuous operation

16 Operation Principle

The lip hook and file clip as electrodes are attached to the patient's mouth and the operation instrument such as a file, respectively. And the motion of the instrument end in the root canal causes an impedance variation between the pair of electrodes. The position of the apical foramen is detected by measuring the impedance variation using two different frequencies.

17 Symbol

C US TUV Rhineland of North America is a Nationally Recognized Testing Laboratory (NRTL) in the United States and is accredited by the Standards Council of Canada to certify electro-medical products with Canadian National Standards.

CE 0197 Conforms to CE European Directive of "Medical equipment directive 93/42/EEC."

Type BF applied part.


Consult operation instructions.


Marking on the outside of Equipment or Equipment parts that include RF transmitters or that apply RF electromagnetic energy for diagnosis or treatment.


Follow the waste of electric and electronic equipment (WEEE) Directive (2002/96/EC) for product and accessory disposal.


Manufacturer.

EC REP Authorized representative in the European community.

18 Warranty

NSK products are warranted against manufacturing errors and defects in materials. NSK reserves the right to analyze and determine the cause of any problem. Warranty is voided should the product be not used correctly or for the intended purpose or has been tampered with by unqualified personnel or has had non NSK parts installed. Replacement parts are available for seven years beyond discontinuation of the model.

19 Spare Parts List

Model	Order Code
Probe	U1109352
File Clip	U1109351
Lip Hook	U501513
Tester	U1109353

20 Disposing Product

In order to avoid the health risks of operators handling the disposal of medical equipment, as well as the risks of environmental contamination caused thereof, a surgeon or a dentist is required to confirm the equipment is sterile. Ask specialist firms who are licensed to dispose of specially controlled industrial wastes, to dispose the product for you.

The used batteries are recyclable, but their disposal may sometimes not be permitted by the respective country.

21 EMC Information (Electromagnetic Compatibility Information)

Guidance and manufacturer's declaration - Electromagnetic Emissions		
The product is intended for use in the electromagnetic environment specified below. The customer or the user of the product should assure that is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR11/ EN55011	Group 1	The product 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 CISPR11/ EN55011	Class B	The product is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions EN/IEC61000-3-2	Not Applicable	
Voltage fluctuations/ flicker emissions EN/IEC61000-3-3	Not Applicable	

Guidance and manufacturer's declaration - Electromagnetic Immunity			
The product is intended for use in the electromagnetic environment specified below. The customer or the user of the product should assure that is used in such an environment.			
Immunity test	IEC60601 test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) EN/IEC61000-4-2	±6kV contact ±8kV air	±6kV contact ±8kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst EN/IEC61000-4-4	±2kV for power supply lines ±1kV for input/ output lines	Not Applicable Not Applicable	Mains power quality should be that of a typical commercial or hospital environment.
Surge*1 EN/IEC61000-4-5	±1kV line(s) to line(s) ±2kV line(s) to earth	Not Applicable Not Applicable	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines*1 EN/IEC61000-4-11	<5% Ut (>95% dip in Ut) for 0.5 cycles 40% Ut (60% dip in Ut) for 5 cycles 70% Ut (30% dip in Ut) for 25 cycles <5% Ut (>95% dip in Ut) for 5 sec	Not Applicable Not Applicable Not Applicable Not Applicable	Mains power quality should be that of a typical commercial or hospital environment. If the user of the product requires continued operation during power mains interruptions, it is recommended that the product be powered from an uninterruptible power supply or a battery.
Power frequency (50/60Hz) magnetic field EN/IEC61000-4-8	3A/m	3.15A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

NOTE: 'Ut' is the AC mains voltage prior to application of the test level.

Guidance and manufacturer's declaration - Electromagnetic Immunity			
The product is intended for use in the electromagnetic environment specified below. The customer or the user of the product should assure that is used in such an environment.			
Immunity test	IEC60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF EN/IEC61000-4-6 Radiated R EN/IEC61000-4-3	3Vrms 150kHz to 80MHz 3V/m 80MHz to 2.5GHz	3.15Vrms 3.5V/m	Portable and mobile RF communications equipment should be used no closer to any part of the product, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d=1.11\sqrt{P}$ $d=1.00\sqrt{P}$ 80MHz to 800MHz $d=2.00\sqrt{P}$ 80MHz to 2.5 GHz 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 determined by an electromagnetic site survey[a] should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
NOTE1: At 80MHz and 800MHz, the higher frequency range applies. NOTE2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
a: 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 product is used exceeds the applicable RF compliance level stated above, the product should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the product.			
b: Over the 150kHz to 80MHz frequency range, the field strength should be less than 3V/m.			

Recommended separation distances between portable and mobile RF communications equipment and the product

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

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150kHz to 80MHz $d=1.11\sqrt{P}$	80MHz to 800MHz $d=1.00\sqrt{P}$	800MHz to 2.5GHz $d=2.00\sqrt{P}$
0.01	0.11	0.10	0.20
0.1	0.35	0.32	0.63
1	1.11	1.00	2.00
10	3.51	3.16	6.32
100	11.10	10.00	20.00

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.

NOTE 1 At 80MHz and 800MHz, 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.