Section 3 EEG/PSG Measurement

General

Operation

WARNING

When using the NE-224S Sub-dermal Straight Needle Electrode

- **Do not use the NE-224S sub-dermal straight needle electrode as a measurement electrode for the EEG or evoked potential measurement for any longer than one hour. When measuring the EEG or evoked potential for over one hour, use the EEG disk electrode.**
- **Do not check the skin-electrode impedance when using a needle electrode or intracranial electrode. Failure to follow this warning injures the patient because these electrodes will be damaged by electrolyzation inside the body.**

- **When measuring the patient with the implantable pacemaker, leave the instrument (telemetry unit and access point) more than 22 cm from the patient. Otherwise, the radio wave from the telemetry unit or access point may interfere with the pacemaker.**
- **Do not delete any system file in the hard disk of the electroencephalograph. Otherwise the system may malfunction.**
- **Periodically back up the EEG data files to prevent loss of data if the hard disk or MO disk is damaged.**

CAUTION

- **Do not use a device which uses Bluetooth® wireless technology and wireless LAN device which complies with IEEE 802.11b near the wireless input unit at the same time. If they are used together, the radio waves interfere with each other. This may prevent the communication between the telemetry unit and access point by reducing transmission speed and transmission distance.**
- **Do not give impact to the telemetry unit. Spike noise may be superimposed on the waveform.**
- **Use the provided pouch to hold the telemetry unit, electrode junction box and/or isolator when they are attached to the patient.**
- **When moving the patient, make sure that the cable connected between the isolator and access point is disconnected. Otherwise, the patient may fall over the cable, or the cable may be broken.**
- **Do not shake or swing the telemetry unit holding the cable connected to the telemetry unit. The telemetry unit may come off and it may injure somebody or damage surrounding instruments.**
- **Do not shake or swing the electrode junction box holding the cable or EEG lead connected to the electrode junction box. The electrode junction box may come off and it may injure somebody or damage surrounding instruments.**
- **During measurement, do not change the date and time. This makes the order of the saved event data and the time of the saved waveforms incorrect.**

NOTE

Turn off any screen saver and close all application programs before opening the Acquisition program. Otherwise, the Acquisition program may not function properly.

Electrode Attachment/Cable Connection

WARNING

- **Do not connect the Z electrode lead plug on the electrode junction box to a ground or equipotential ground. Otherwise, leakage current from another instrument cause electrical shock to the patient.**
- **Only connect a BF type instrument to the DC connector on the telemetry unit. Otherwise, leakage current from the other instrument causes electrical shock to the patient.**
- **Before disconnecting or connecting the cable from/to a connecter on the telemetry unit, while the telemetry unit is turned on, discharge electrostatic charge from your body. Otherwise, the telemetry unit may malfunction due to electrostatic energy.**
- **When connecting the electrode junction box cable to the electrode junction box, align the ▼ marks on the electrode junction box cable connector and electrode junction box. Otherwise, leakage current may cause electrical shock to the patient.**

CAUTION

Using a collodion electrode or EEG paste

- **If rash, redness or itch appears on the patient skin from the use of collodion or EEG paste, immediately remove the collodion or EEG paste from the skin and perform medical treatment.**
- **Never allow collodion or acetone to get in the patient's eyes. If collodion or acetone accidentally gets in the eyes, immediately and thoroughly wash eyes with clean water and perform medical treatment immediately.**
- **If chemical solution is swallowed, have the person drink water and vomit the chemical solution. Perform medical treatment immediately.**
- **Collodion is a volatile solvent. Both patients and medical staff must take extreme care not to inhale collodion. When using collodion, make sure there is adequate ventilation. If too much collodion is inhaled, have the person lie quietly and keep warm in fresh air. Perform medical treatment immediately.**

EEG Waveform Acquisition

The Acquisition program acquires the EEG/PSG waveforms and can display up to 64 channels of EEG/PSG waveforms. You can save the acquired waveforms with the patient information, annotations, amplifier settings and display settings in a hard disk or MO disk as an EEG data file. For the operation of the Acquisition program, refer to the operator's manual of the electroencephalograph.

The communication between the telemetry unit and the access point can be checked on the Acquisition screen. You can also change the configuration settings of the telemetry unit and access point on the Acquisition screen.

About Polysomnography

Polysomnography is an examination to measure the electrical signals in the body during sleep. Many different activities are measured during a sleep study. The basic measurement parameters are electroencephalogram (EEG), eye movement (EOG), muscle activity (EMG), heartbeat (ECG), oxygen saturation (SpO_2) and respiration. These measurement parameters can help determine what is going on during sleep. In addition to the basic measurement parameters, we can find the cause of a sleep disorder by measuring the activity which is suspected to be causing the sleep disorder

Basic Measurement Parameters

Parameter	Electrode/Sensor
EEG	Disk electrode
EOG	Disk electrode
ECG	Disk electrode
EMG Chin	Disk electrode
Respiration	
Air flow	TR-101A /TR-102A Respiration pickup or Airflow sensor*
Chest/ Abdomen	TR-111A/TR-112A Respiration pickup or Effort sensor*
Periodic limb movements	PLM sensor*
Snore	Dynamic snoring microphone*
SpO2	SpO2 probe**
Sleep position	Sleep position indicator*

* Pro-Tech Service Inc.

** Nonin Medical Inc., JL-101A SpO_2 sensor adapter is required.

Flowchart of Waveform Measurement

1. Attach the EEG electrodes and sensors to the patient.
↓
2. Connect the electrode junction box and cables to the telemetry unit.
↓
3. Attach the telemetry unit to the patient.
↓
4. Turn on the telemetry unit and access point.
↓
5. Start the Acquisition program (New file automatically opens).
↓
6. Select the telemetry unit and access point.
↓
7. Enter the patient information.
↓
8. Check skin-electrode contact impedance.
↓
9. Lock the telemetry unit.
↓
10. Start EEG/PSG measurement (recording).
↓
11. Display and record the calibration waveforms.
↓
12. Measure the waveforms.
↓
13. End the measurement and close (save) the EEG data file.
↓
14. Close the Acquisition program.
↓
15. Review the saved EEG/PSG waveforms.

After measurement, use the Review program to review and print the waveforms.

Attaching the Electrodes (EEG Measurement)

Guidelines for Input Jack Use

You must follow these guidelines to obtain correct EEG recordings.

Required Electrodes

Do not perform EEG measurement without the Z, C3, C4, A1 and A2 electrodes.

Input Jack Z

Connect the lead from the electrode (Z electrode) attached on the patient's nasion to input jack Z on the electrode junction box. This input jack is used to eliminate AC interference.

The input jack Z is also used for checking electrode impedance.

Input Jacks C3 and C4

The C3 and C4 electrodes are the system reference electrodes for EEG measurement. Input jacks C3 and C4 must be used for EEG measurement even if C3 and C4 are not programmed in any montage.

Connect the leads from the electrodes on positions C3 and C4 to input jacks C3 and C4, respectively.

Input Jacks A1 and A2

The A1 and A2 electrodes are the reference electrodes for skin-electrode impedance check. Input jacks A1 and A2 in addition to Z, C3 and C4 must be used for the electrode impedance check.

When checking electrode impedance, connect the leads from the electrodes on positions A1 and A2 to input jacks A1 and A2, respectively.

Checking Original Electrode Potentials for All Active Electrodes

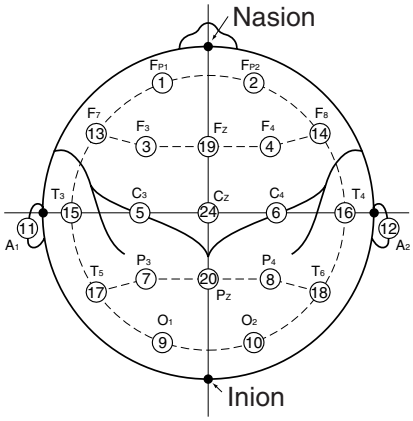
Check the original electrode potential for all active electrodes by programming a montage with the system reference (Use the pattern VA (factory default setting) or select the 0 V button for reference electrode on the Montage dialog box). Refer to "Programming Patterns" in Section 4 of the electroencephalograph operator's manual.

The digital EEG displays the EEG waveform in each channel by subtracting two electrode potentials selected to a montage. The subtracted result will be incorrect, if the electrode attachment is not correct, the original electrode potential is flat, or unstable or artifact is superimposed on the original electrode potential. Omit the measurement result if the displayed EEG waveform is incorrect.

Introduction to Electrode Position, Derivation and Montage

Electrode Position

There are various systems of electrode position, such as Illinois, Montreal, Aird, Cohn, etc. Of these, the International 10-20 system, shown below, is currently the most common. Each system has a different number of electrodes and different electrode locations. To compensate for different sized heads, the distances between electrodes are given as ratios.



10-20 system electrode positions

After determining the electrode position system, measure the head of the patient and calculate the electrode positions according to the distance ratio between each electrode position. The number of electrodes should be reduced for EEG recording on infants and little children.

Derivation

Derivation is the electrode combination for one channel. All derivations have two electrodes: reference and active. In monopolar derivation, one “electrode” can be several physical electrodes connected together. There are 3 kinds of derivations.

Monopolar Derivations (Referential Derivation)

In the monopolar derivation, one electrode is common to all channels and regarded as electrically inactive (“reference electrode”). Each amplifier has two inputs (G1 and G2). The reference electrode is connected to the G2 (+) input of the amplifier and the active electrode is connected to the G1 (–) input.

Monopolar Derivations Using Ear Reference Electrodes:

- Normal Monopolar Derivation
  Left ear for left hemispheric derivation and the right ear for right hemispheric derivation.
- A1 + A2
  Shorting both ears (in the electrode junction box).
- A1 → A2 or A1 ← A2
  Only one ear.
- A1 ↔ A2
  Left ear for right hemispheric and right ear for left hemispheric derivation.

Monopolar Derivations Using Other Site Reference Electrodes:

- Vx (Vertex reference derivation)
  Mid-line central position Cz as the reference electrode.
- AV (Average reference derivation)
  The potential of all electrodes on the scalp, except for the extra electrodes, are averaged point and used for the AV reference electrode.
  If one or more of the electrodes in the AV electrode contain ECG artifact, or two or more electrodes show simultaneous abnormal potentials, you need to exclude any unstable electrodes.
- Aav
  The potential of A1 and A2 electrodes are averaged and used for the Aav reference electrode.

Bipolar Derivation

Electrode pairs are connected to the G1 and G2 inputs of channels. The potential difference between two electrodes is recorded on each channel.

Montage (Pattern)

Montage is the combination of derivations for all channels. The instrument contains 36 patterns per set file and you can program a different montage and other settings for each pattern.

Attaching the Electrodes to the Patient

WARNING

- **Do not connect the Z electrode lead plug on the electrode junction box to a ground or equipotential ground. Otherwise, leakage current from another instrument cause electrical shock to the patient.**
- **Only connect a BF type instrument to the DC connector on the telemetry unit. Otherwise, leakage current from the other instrument causes electrical shock to the patient.**

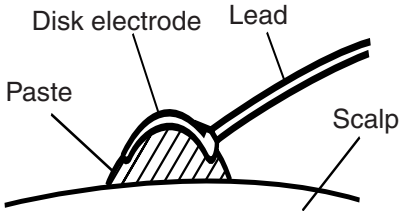
CAUTION

Using a collodion electrode or EEG paste

- **If rash, redness or itch appears on the patient skin from the use of collodion or EEG paste, immediately remove the collodion or EEG paste from the skin and perform medical treatment.**
- **Never allow collodion or acetone to get in the patient's eyes. If collodion or acetone accidentally gets in the eyes, immediately and thoroughly wash eyes with clean water and perform medical treatment immediately.**
- **If chemical solution is swallowed, have the person drink water and vomit the chemical solution. Perform medical treatment immediately.**
- **Collodion is a volatile solvent. Both patients and medical staff must take extreme care not to inhale collodion. When using collodion, make sure there is adequate ventilation. If too much collodion is inhaled, have the person lie quietly and keep warm in fresh air. Perform medical treatment immediately.**

For the collodion electrode attachment, refer to its operator's manual.

EEG Scalp Disk Electrodes



Scalp Disk Electrode Placement

1. Clean the area where the electrodes are to be mounted with a gauze pad moistened in alcohol or a medical soap solution to remove oil from the skin. Wipe the site with dry gauze.

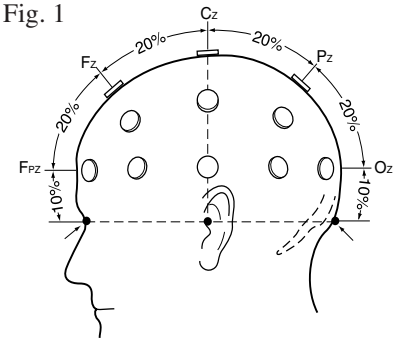
2. Apply a small amount of EEG paste to a 1 cm diameter circle on the cleaned skin. Avoid spreading the paste too thin or creating too large a space.

3. Apply a small amount of paste to the disk electrode, and press the electrode down gently on the previously pasted skin spot.

4. Cover the electrode with a small gauze pad and press the pad around the electrode. Attach the electrode with surgical tape.

Electrode Positions

Fig. 1

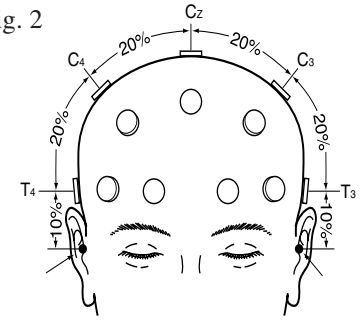


This procedure is for the Ten Twenty System.

1. Divide the longitudinal line of the head into halves and attach an electrode at the Cz point (Fig. 1).

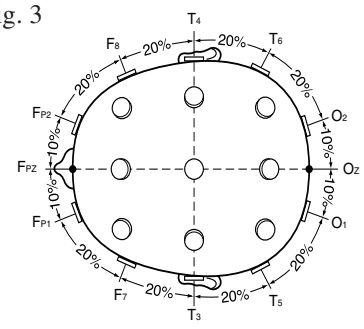
2. Divide the distance between Cz and the nasion in proportions as shown in Fig. 1 and attach an electrode at Fz and Pz. (Do not attach electrodes at Fpz and Oz.)

Fig. 2



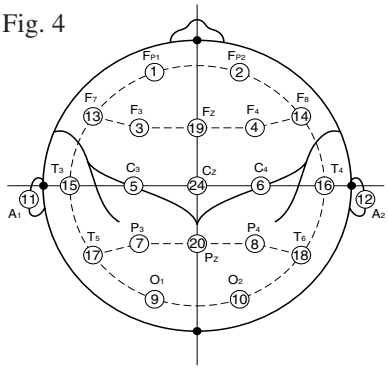
3. Divide the transverse line of the head into proportions of 10%, 20%, 20%, 20%, 20% and 10% as shown in Fig. 2 and attach electrodes at T3, T4, C3 and C4.

Fig. 3



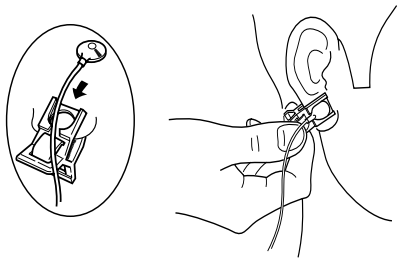
4. Divide the peripheral line passing over Fpz, T4, Oz and T3 into proportions as shown in Fig. 3 and attach electrodes at Fp2, F8, T6, O2, Fp1, F7, T5 and O1.

Fig. 4



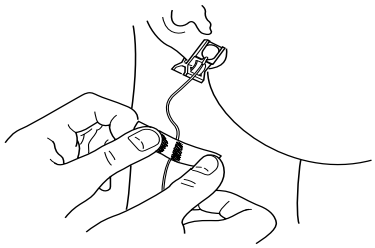
5. Take the line passing over F7, Fz and F8 and attach an electrode at the mid-point (F3) between F7 and Fz as shown in Fig. 4. Attach another electrode at the mid-point (F4) between F8 and Fz.

6. Take the line passing over T5, Pz and T6 and attach an electrode at the mid-point (P3) between T5 and PZ. Attach another electrode at the mid-point (P4) between T6 and PZ.



Earlobe Electrodes

1. Apply a small amount of EEG paste to both earlobes. Gently clip on the earlobe electrodes.



2. Secure the electrode lead to the neck with surgical tape to prevent electrode lead movement.

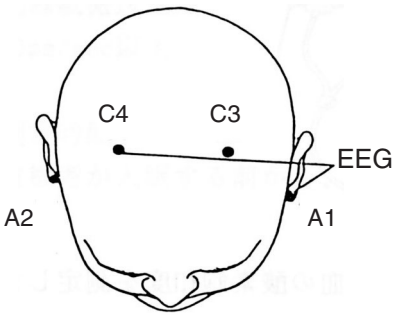
CAUTION

Do not apply excessive pressure to the electrode because this may cause direct skin-electrode contact (not through the paste), and generate unnecessary polarization voltage.

Attaching the Electrodes and Sensors (PSG Measurement)

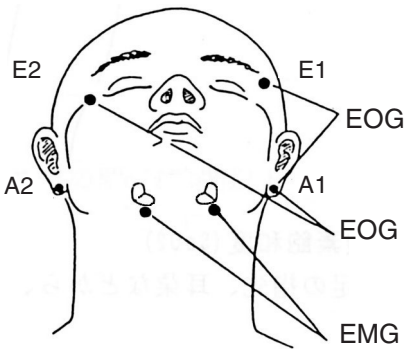
Measurement Parameters and Attachment Sites

This section explains the standard attachment sites of the electrodes and sensors for measuring polysomnogram.



Electroencephalogram (EEG)

The EEG waveforms are measured with the monopolar derivations from C3-A2 (or C4-A1) and O1-A2 (or O2-A1). The reference electrodes are the respective opposite earlobes to obtain large amplitude EEG waveforms. The central derivations can measure alpha waves, theta waves, hump waves, spindle waves and K complexes simultaneously and the occipital derivations can precisely detect the exact appearance of alpha waves. Arousals can be scored from either the central or occipital derivation EEG.
To attach the electrodes, refer to "Attaching the Electrodes".

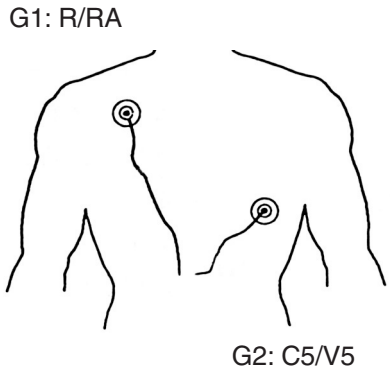


Electrooculogram (EOG)

The EOG waveforms are measured with the monopolar derivations from E1 (LOC) /A1 (or E1/A2) and E2 (ROC) /A1 (or E2/A2). The E1 and E2 electrodes should be attached 1 cm from the outer corner of the eye. The left electrode should be placed 1 cm above the corner of the eye and the right electrode 1 cm below the corner of the eye. Use A1 or A2 as a reference electrode.
To attach the electrodes, refer to "Attaching the Electrodes".

Electromyogram (EMG)

The EMG waveforms are measured with the bipolar derivation from the pair of disk electrodes on the musculus mentalis or submental muscle. The two disk electrodes are attached several cm apart along the jaw bone from the center of the chin. For male patients, select a site where there is no beard because beard grows during measurement.
To attach the electrodes, refer to "Attaching the Electrodes".



Electrocardiogram (ECG)

The ECG waveforms are measured with the CS5 lead, or modified bipolar lead (MI). To reduce the electrodes to be used, the A2 electrode is used instead of the minus electrode.

Attaching the Electrode

You must follow these guidelines to obtain correct EEG recordings.

Required Electrodes

Do not perform EEG measurement without the Z, C3, C4, A1 and A2 electrodes.

Input Jack Z

Connect the lead from the electrode (Z electrode) attached on the patient's nasion to input jack Z on the electrode junction box. This input jack is used to eliminate AC interference.

The input jack Z is also used for checking electrode impedance.

Input Jacks C3 and C4

The C3 and C4 electrodes are the system reference electrodes for EEG measurement. Input jacks C3 and C4 must be used for EEG measurement even if C3 and C4 are not programmed in any montage.

Connect the leads from the electrodes on positions C3 and C4 to input jacks C3 and C4, respectively.

Input Jacks A1 and A2

The A1 and A2 electrodes are the reference electrodes for skin-electrode impedance check. Input jacks A1 and A2 in addition to Z, C3 and C4 must be used for the electrode impedance check.

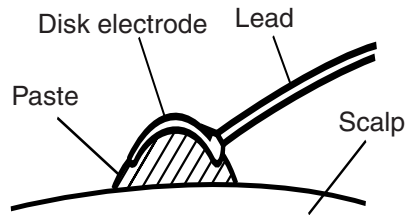
When checking electrode impedance, connect the leads from the electrodes on positions A1 and A2 to input jacks A1 and A2, respectively.

Checking Original Electrode Potentials for All Active Electrodes

Check the original electrode potential for all active electrodes by programming a montage with the system reference (Select the 0 V button for reference electrode on the Montage dialog box). Refer to "Programming Patterns" in Section 4 of the electroencephalograph operator's manual..
The digital EEG displays the EEG waveform in each channel by subtracting two electrode potentials selected to a montage. The subtracted result will be incorrect, if the electrode attachment is not correct, the original electrode potential is flat, or unstable or artifact is superimposed on the original electrode potential. Omit the measurement result if the displayed EEG waveform is incorrect.

WARNING

- **Do not connect the Z electrode lead plug on the electrode junction box to a ground or equipotential ground. Otherwise, leakage current from another instrument cause electrical shock to the patient.**
- **Only connect a BF type instrument to the DC connector on the telemetry unit. Otherwise, leakage current from the other instrument causes electrical shock to the patient.**



Scalp Disk Electrode Placement

Procedure

This section explains how to attach the disk electrodes. When using collodion disk electrodes, refer to its operator's manual.

1. Clean the skin where the electrodes are attached with a cotton swab moistened with alcohol or SkinPure (skin preparation gel) to remove oil from the skin. Wipe the skin with a dry cotton swab. When attaching the electrodes for the EEG measurement, make sure that the skin-electrode contact impedance is 5 kΩ or less.

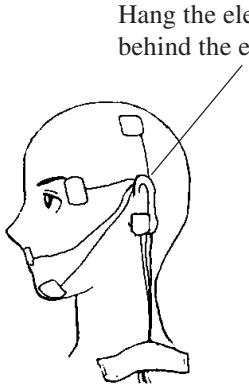
2. Apply a small amount of EEG paste to a 1 cm diameter circle on the cleaned skin. Avoid spreading the paste too thin or creating too large a space.

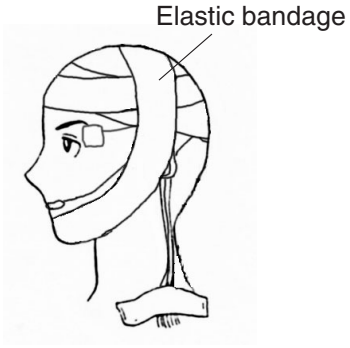
3. Apply a small amount of EEG paste to the disk electrode and press the electrode down gently on the previously pasted skin spot so that the electrode leads are toward the ear as shown below.

4. Cover the electrode with a small gauze pad and press the pad around the electrode.

5. Secure the electrode lead with surgical tape.

6. Hang the electrode leads behind the ear. For an earlobe electrode, the leads should go up, over and behind the ear.



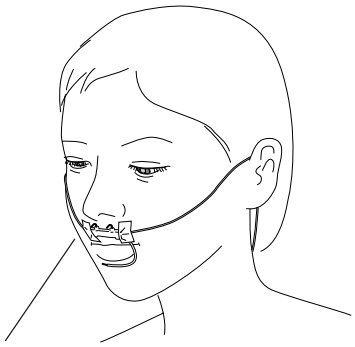


7. Secure the electrodes with the elastic bandage. Bind the elastic bandage around the jaw so that the bandage does not come off when the bandage loosens. This prevents AC interference and the electrodes from detaching when the patient stands up.

For attaching procedure and cautions/note, refer to the operator's manual of each sensor.

CAUTION

Before attaching a sensor, check whether it contains dry natural rubber or not. Natural rubber may cause allergic reaction with symptoms such as itching, redness, urticaria, swelling, fever, dyspnea, symptoms similar to asthma, reduced blood pressure and shock. If the patient shows any of the above symptoms, immediately stop using the chest movement sensor and perform appropriate medical treatment.



Airflow Sensor

Respiration (Airflow, Chest, Abdomen)

Airflow (nostril and mouse respiration)

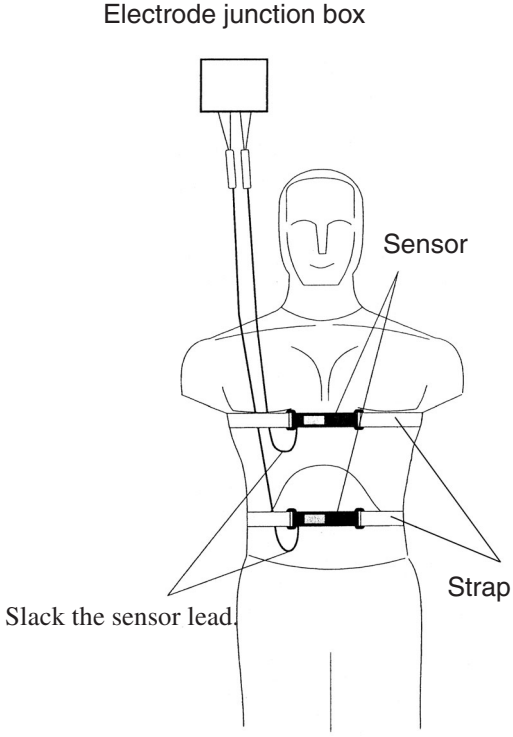
The respiration waveforms are measured from the nostril and mouth by temperature variation between inspiration and expiration. The TR-101A/102A Pro-Tech Airflow Sensor is recommended for the measurement.

- The airflow sensor are easy to damage. Take care when attaching them.
- Attach the airflow sensor where large respiration waveforms are detected.
- Do not let the thermistor of the airflow sensor contact the patient skin. Otherwise, amplitudes of the respiration waveforms are reduced.

Chest, Abdomen

The respiration waveforms are measured from the chest and abdomen by their movement. The TR-111A/112A Pro-Tech Effort Sensor is recommended for the measurement.

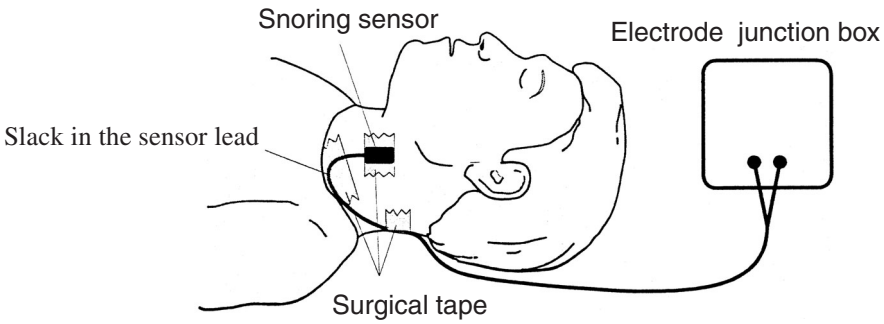
- Take care to bind the strap around the patient body properly so that the patient does not become uncomfortable. If you bind the strap too tightly, this prevents the patient entering sleep. If you bind the strap too loosely, the respiration waveform cannot be detected when the patient lies on his or her side.



Snore

The snore is measured from the neck by the airway vibration. The Pro-Tech Dynamic Snoring Microphone is recommended for the measurement.

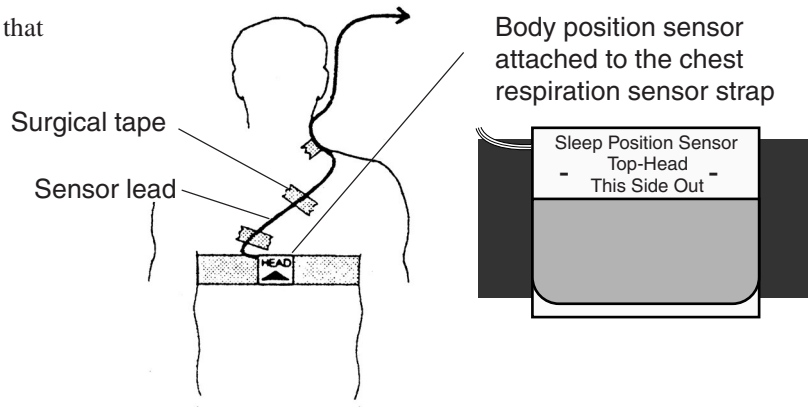
- Take care to attach the sensor because the carotid artery pulse waveforms are measured as artifact if the sensor is attached around the carotid artery.



Body Position

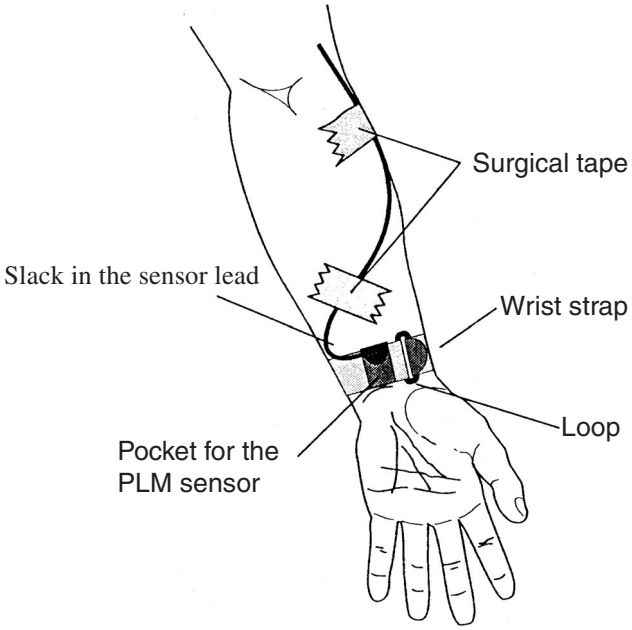
The sleeping body position is measured by the body position sensor attached on the clothing or surface of the body. The Pro-Tech Sleep Position Indicator is recommended for the measurement.

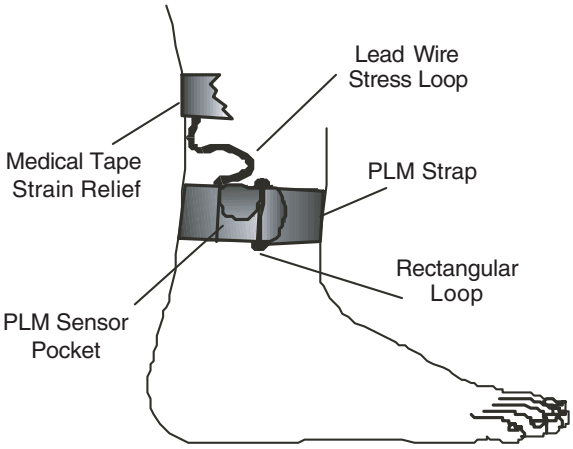
- Take care to attach the sensor to the patient so that the patient dose not become uncomfortable.



Periodic Limb Movements (PLM)

The PLM are measured from the limb or leg (heel) by the disk electrode or PRO-Tech PLM sensor.





Oxygen Saturation (SpO_2)

The oxygen saturation is measured from the finger or earlobe with the SpO_2 probe manufactured by Ninon Medical Inc. through the JL-101A SpO_2 Adapter.

WARNING

- **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 electrical surgery unit**
  - **During CPR**
  - **When there is body movement**
  - **When there is vibration**
  - **When measuring at a site with venous pulse**
  - **When the pulse wave is small (insufficient peripheral circulation)**
  - **When using an IABP (intra-aortic balloon pump)**
- **To avoid poor circulation, do not wrap the tape too tight when fixing the probe with surgical tape. 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.**
- **When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with a peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**

    For a patient with a peripheral circulation insufficiency, the measurement result may be incorrect.
- **When the SpO_2 probe is used on a neonate, low birth weight infant or patient with a fever or peripheral circulation insufficiency, a slight burn may result from the probe increasing the skin temperature at the attached site by 2 or 3°C (4 or 5°F). Periodically check the attached state of the probe and change the attachment site.**
- **When not measuring SpO_2, disconnect the SpO_2 adapter cable from the telemetry unit. Otherwise, noise from the SpO_2 probe may interfere and incorrect data is displayed on the screen.**

CAUTION

- **Only use the specified probes and JL-101A SpO_2 Adapter. Otherwise SpO_2 cannot be monitored properly and instrument performance may be degraded.**
- **Do not use a probe which is past the expiration date on the package.**
- **Do not use a damaged or disassembled probe.**
- **Disposable probes are not sterilized.**

Caution - continued

- **Use the disposable probe only once and for one patient only. Do not reuse the disposable probe for another patient. It will cause cross infection.**
- **When the attachment site is wet with blood or when the patient has nail polish on, remove the dirt and nail polish before attaching the probe. The transmitted light may decrease due to the blood or nail polish and the measurement data may be incorrect.**
- **Turn off the power of cellular telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by interference and the displayed data may be incorrect.**
- **Under normal conditions, normal light has negligible effect on this probe. However, when measuring under strong light (surgical light, bilirubin light, sunlight, etc.), cover the probe with a blanket or cloth. Otherwise, the measurement result may be incorrect.**
- **If the skin gets irritated or redness appears on the skin by the probe, change the attachment site or stop using the probe.**
- **For long term monitoring, check the circulation condition by observing the skin color of the measuring site. To avoid circulation insufficiency and skin burn, change the measurement site every specified number of hours. Refer to the operator's manual of the probe.**
- **Do not pull or bend the probe cable, and do not let caster feet run over the probe cable. Do not immerse the probe cable in chemical solutions or water. Failure to follow these cautions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data. Replace any broken probe with a new one.**
- **When removing a probe that is taped to the skin, do not pull the cable part of the probe because this can damage the probe's cable connection.**
- **While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare case SpO_2 value may not be displayed.**

Attaching the Probe

For the attaching procedure, refer to the operator's manual of the probe.

Connecting the Electrodes and Sensors to the Electrode Junction Box

Connect the electrodes and sensors to the electrode junction box. Two types of electrode junction box can be used.

- JE-011A Electrode Junction Box
  30 channels of EEG waveforms or 22 channels of EEG waveforms, 8 channels of bipolar signals and 2 channels of DC input signals.
- JE-012A Electrode Junction Box
  For polysomnogram (PSG) measurement
- JE-013A Electrode Junction Box
  62 channels of EEG waveforms and 2 channel of DC input signals

NOTE

- **Do not bend or pull the lead or cables. This may damage them.**
- **The following extra jacks can be used as bipolar jacks. To select extra jacks or bipolar jacks, refer to the System Program.**
  - JE-011A Electrode Junction Box: X2 to X9
  - JE-012A Electrode Junction Box: X17 to X24
  When using the extra jack as the extra jack, only the (+) jack is available. When using the extra jack as the bipolar jack the (+) and (-) jacks are available.

For electrode combination (montage), refer to “Changing System Settings - Programming Pattern” in Section 4 of the operator’s manual for each electroencephalograph .

EEG Measurement

When measuring the EEG waveforms, use the JE-011A (EEG 32 ch) or JE-013A (EEG 64ch) Electrode Junction Box

Example: JE-011A

Parameter	Sensor	Electrode jack	Montage G1 (-) G2 (+)
EEG	EEG disk electrode	Electrode jack: Fp1 to Cz and Z	Example: Fp1 – Fp2
Bioelectrical signal other than EEG		Extra jack: X1 (+) to X9 (+)	Example: X1 – X2
For bipolar deviation		Bipolar jack: X2 (+/-) to X9 (+/-)	Example: 0V – X2

PSG Measurement

When measuring the polysomnogram, use the JE-012A (PSG) Electrode Junction Box and connect the electrodes and sensors as shown below.

Parameter	Sensor	Electrode jack	Montage G1 (-) G2 (+)
EEG	EEG disk electrode	Z, A1, A2, C3, C4, O1, O2 and/or X5 (+) to X16 (+)	C3 – A2 O1 – A2
EOG • Left • Right		 X1 (+) X2 (+)	 X1 – A1 X2 – A1
EMG (Chin)		X3 (+) and X4 (+)	X3 –X4
ECG (V5)		X17 (+) and X17 (-) (bipolar connection)	0V –X17
Respiration • Airflow • Chest • Abdomen	 Airflow sensor* Effect sensor* Effect sensor*	 X18 (+/-) to X24 (+/-) (bipolar connection) +:Blue lead, -: White lead	 G1: X18 to X24 G2: 0V
PLM	PLM sensor*	X18 (+/-) to X24 (+/-) (bipolar connection) +/-: Either lead is available.	G1: X18 to X24 G2: 0V
Snore	Snoring sensor*		
Body Position	Sleep position sensor*	DC connector on telemetry unit (DC2/DC3)	-
SpO_2	SpO_2 probe**	SpO_2 connector on telemetry unit	-

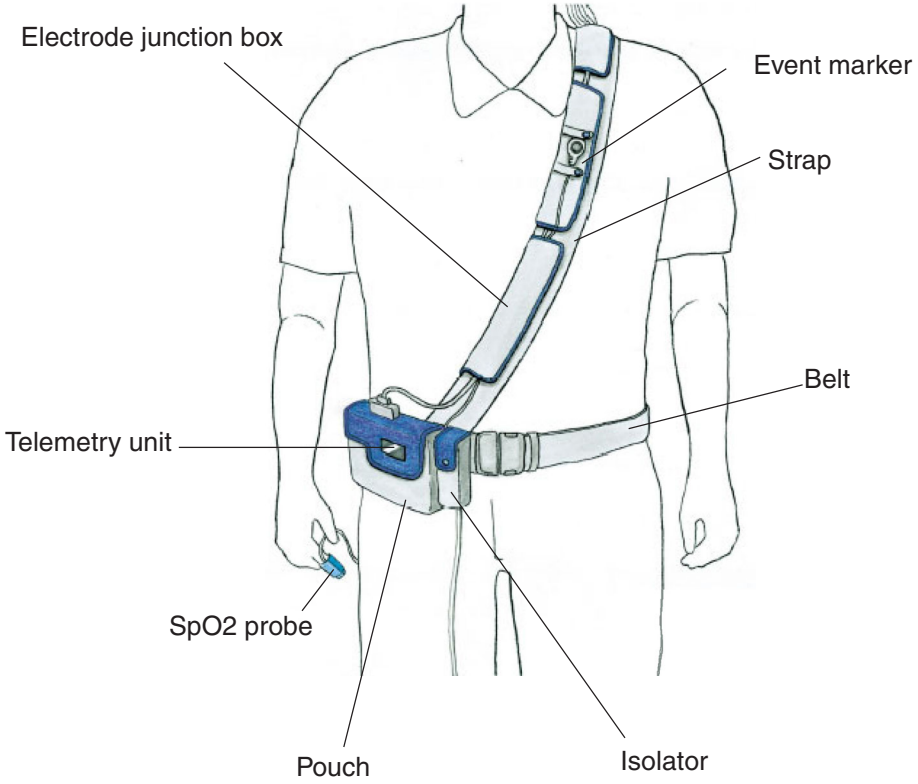
* Manufactured by Pro-Tech Service Inc.

** Manufactured by Ninon Medical Inc.

When measuring the body position and/or SpO_2, select the “TC” to DC (body position: DC2 or DC3, SpO_2: DC1).

Attaching the Telemetry Unit to the Patient

When attaching the telemetry unit to the patient use the provided, pouch, belt and strap.



Changing the Measurement Settings

Before starting measurement, check and change the following system settings in the System Program. The changed settings are saved in memory. The Acquisition program and the Review program use these settings.

- Electrode junction box setting (Select the JE-011A, JE-012A or JE-013A)
- Pattern settings
- AC line frequency setting
- Contents of the table list of the Patient Information
- Contents of the Annotation dialog box when annotating waveforms or adding annotations.
- The electrodes that are used for waveform acquisition and saved in a file with the EEG waveforms

You can save the changed system settings in a file. Each electrode junction box has its own system settings for the above settings other than the AC line frequency. For example, when the system settings which use the JE-011A electrode junction box are saved in a file, next time you can select the JE-011A electrode junction box by calling up a system settings file which uses the JE-011A electrode junction box.

Refer to “Changing the System Settings” in Section 2. For detailed information about the system settings, refer to the operator’s manual of each electroencephalograph.

NOTE

- **It is not possible to change System Program settings while the Acquisition, Review or any other EEG application program is open.**
- **Before selecting another electrode junction box in the Electrode Junction Box menu, save the current system settings in a file. Otherwise, the current system settings listed above are lost.**

Measuring Waveforms

This section explains the general procedure how to measure the waveforms.

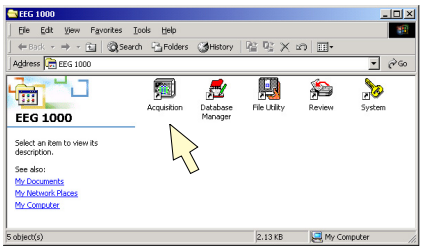
1. Start the communication between the telemetry unit and access point.
   Wireless communication:
   1) Turn on the access point
   2) Press the START/OK key on the telemetry unit. Blinking “O” is displayed on the LCD display.

   Wired communication:
   1) Turn on the access point
   2) Connect the telemetry unit and access point with the isolator. The channel “CL” is displayed on the LCD display.

2. Open the Acquisition program.

NOTE

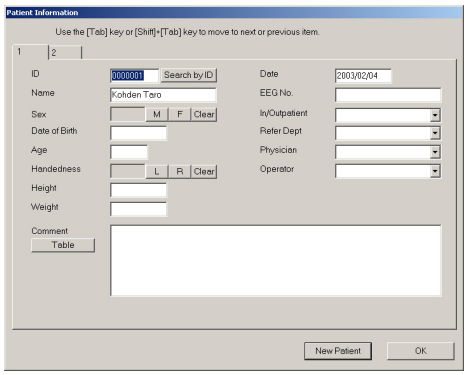
Turn off any screen saver and close all application programs before opening the Acquisition program. Otherwise, the Acquisition program may not function properly.



Example: EEG-1100

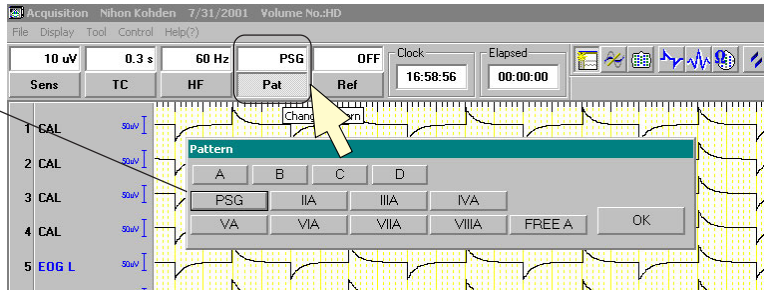
Double-click the acquisition program shortcut icons on an EEG window. A new EEG file automatically opens with the Room Selection dialog box.

3. Select the access point and telemetry unit.
   1) On the Room Selection dialog box, select the access point by selecting the room.
   2) On the Telemetry Unit Selection dialog box, select the telemetry unit.
   3) Start communication.
      When communication between the telemetry unit and access point is established, the Patient Information dialog box opens.



4. Enter the patient information. The patient ID and name must be entered.

Pattern dialog box



5. Select the pattern. You can select the pattern (montage and amplifier settings including sensitivity, high-cut filter, time constant, etc.) for the measurement with the Pattern dialog box. You can program the pattern for the measurement in the System Program. For the detailed pattern settings, refer to "Programming Pattern" in Section 4 of the operator's manual of the electroencephalograph.

6. Check the skin-electrode contact impedance for disk electrodes.

   When using the EEG disk electrodes, clean the measurement sites with a cotton swab moistened with alcohol or SkinPure (skin preparation gel) to reduce the skin-electrode contact impedance to less than 5 kΩ.

WARNING

Do not check the skin-electrode contact impedance when using a needle electrode or intracranial electrode. Failure to follow this warning injures the patient because these electrodes will be damaged by electrolyzation inside the body.

NOTE

- **The Z, C3 and C4, A1 and A2 electrodes must be attached to the patient. Otherwise, the impedance check result may be incorrect.**

The instrument checks the skin-electrode impedance for the following electrodes.

- When calibration waveforms are displayed, the electrodes that are included in all patterns are checked.
- When the EEG waveforms are displayed, the electrodes that are included in the currently selected pattern are checked.

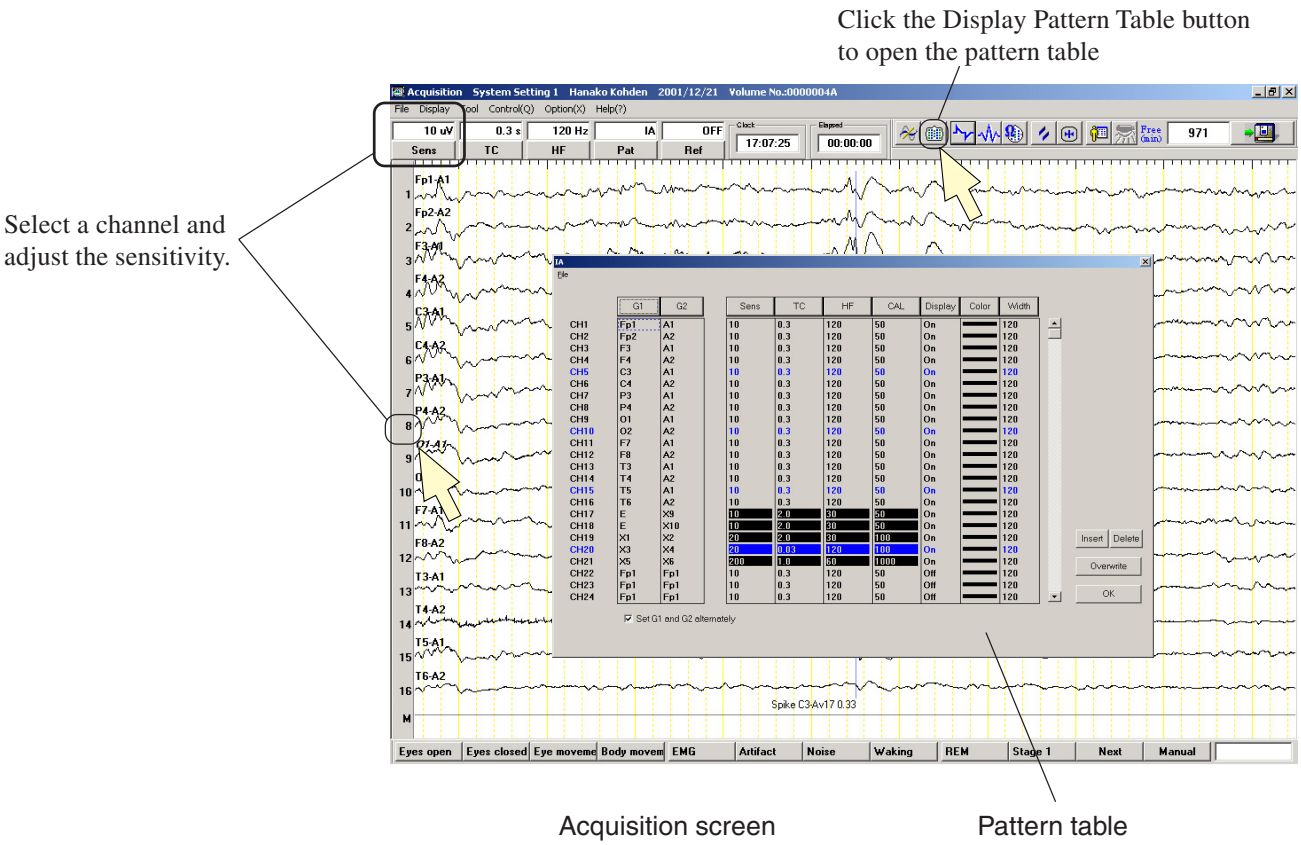
<u>On the telemetry unit:</u>

1) Select "IP" by pressing the FUNCTION key.
2) Press the START/OK key The impedance check result is displayed on LCD display. The electrode number that exceeds the threshold level and its impedance are displayed. You can display the next electrode impedance check result by pressing the FUNCTION key.
   To change the impedance threshold, press the MARK/kΩ key. Every time the MARK/kΩ key is pressed the threshold changes as follows:
   50 → 20 → 10 → 5 → 2 kΩ
3) Press the START/OK key to end the impedance check

On the screen:

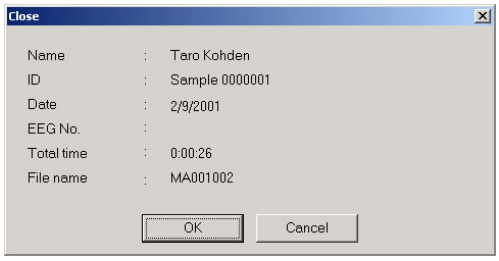
1) Move the mouse pointer to the Impedance Check button on the tool bar.
2) Press and hold the left mouse button for about two seconds to start the skin-electrode impedance check. The Impedance Check dialog box opens on the screen. The currently selected montage is displayed on the dialog box.
   The impedance check result is displayed on the screen with measured impedance and color. If an electrode's impedance exceeds the preset value (threshold) on the System program, it is highlighted on the Impedance Check dialog box.
3) Click the OK button to close the Impedance Check dialog box.

7. Check that the waveforms are acquired correctly and that the amplitude of each waveform is proper.
   Click the EEG Signal button on the tool bar and check that all waveforms are measured correctly (i.e. there is no waveform distortion and the amplitude of each waveform is proper). To change the sensitivity, select a channel number, then click the Sens button on the amp bar or Sensitivity dialog box or use the pattern table.



8. Start filing.
   Click the Start/Stop Filing button on the tool bar to start saving the acquired waveforms in an EEG data file.

9. Save the file and end the measurement.
   1) Click the Start/Stop Filing button to stop saving.
   2) From the File menu, select Close. The Close dialog box opens to let you check the patient information.



   3) Click the OK button to close the data file.
   4) From the File menu, select Exit to close the Acquisition program. The communication between the telemetry unit and access point stops.

10. Turn off the telemetry unit.