The Polygraph Input Box (PIB) is EGI’s physiological measurement system. It allows the simultaneous measurement of peripheral nervous system activity and EEG. The PIB includes seven bipolar channel inputs for the measurement of ECG (electrocardiogram), EMG (electromyogram), respiration (effort, temperature, and pressure), and body position.

The input box accommodates the most common sensor connector (the 1.5 mm female safety connector) that is used in both clinical and research settings.

The PIB is a plug-and-play device—it requires no software setup. The PNS toggle button on Net Station’s toolbar shows and hides all PIB channels. The PIB requires Net Station 4.4 or later.

I. Before the Patient/Subject Arrives

1. Start Net Station and set up the acquisition session. If needed, refer to the Net Station Acquisition Technical Manual.
2. Get the study room ready.
3. Prepare the physiological devices, such as snapping the ECG leads onto the ECG sensors and setting out the supplies for easy access.

II. Applying the Physiological and EEG Sensors

Use only sensors that have tested compatible with the PIB. The following compatible sensors are available from EGI as an optional sensor kit. For a list of the latest sensors that have tested compatible with the PIB, contact supportteam@egi.com.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Tested Compatible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard EEG acquisition Net</td>
<td>EGI HCGSN 120 Nets (routine and LTM)</td>
</tr>
<tr>
<td>Chest and abdomen effort belts</td>
<td>Pro-Tech zRIP System</td>
</tr>
<tr>
<td>and module</td>
<td></td>
</tr>
<tr>
<td>Pressure transducer cannula and</td>
<td>Pro-Tech PTAF Lite Airflow Sensor</td>
</tr>
<tr>
<td>module</td>
<td></td>
</tr>
<tr>
<td>Thermocouple</td>
<td>Braebon 0510 Ultima Airflow Sensor</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>Pro-Tech SPI Accelerometer Body Position Sensor</td>
</tr>
<tr>
<td>ECG/EMG leads</td>
<td>Button snap 1.5 mm leads</td>
</tr>
<tr>
<td>Disposable ECG/EMG electrodes</td>
<td>Button snap electrodes</td>
</tr>
</tbody>
</table>

**WARNING:** Accessory equipment connected to the PIB must be certified according to the respective IEC standards (e.g., IEC 601-1 for medical equipment). Furthermore, all configurations shall comply with the system standard IEC-601-1-1. Any person who connects additional equipment to the signal input part or signal output part configures a medical system, and is therefore responsible for ensuring that the system complies with the requirements of the system standard IEC-601-1-1. If in doubt, consult your EGI support engineer at supportteam@egi.com or your local sales representative.

One at a time (following the order given), attach the physiological devices and EGI Net to the patient/subject. See Figure 1.

Do the following in addition to your facility’s standard instructions.

1. Apply the ECG leads:
   - Have the patient/subject stand.
   - Clean the application areas (lower left ribcage and upper right collarbone/clavicle) with non-alcohol wipes.
   - Prepare the application areas with abrasive paper or preparation gel.
   - Apply a standard ECG sensor to the lower left ribcage.
   - Apply a standard ECG sensor to the upper right collarbone/clavicle.
   - Work the leads up through the shirt and out through the collar.
   - Plug the ribcage ECG lead into the PIB’s white ECG port and the clavicle ECG lead into the PIB’s blue ECG port.
2 Apply the respiratory inductive plethysmography effort belts:
   • Have the patient/subject lift both arms to the side.
   • Secure the thoracic (chest) belt underneath the axillae (underarms). Place it above (or at) the nipple line and above the xiphoid process (lower part of the sternum).
   • Secure the abdomen belt around the abdomen. Place it no more than one inch above the umbilicus (navel).
   • Both belts should be snug, but not tight.
   • Plug the black leads from the belts’ module into the belts.
   • Plug the blue and white leads from the belts’ module into the PIB’s corresponding blue and white chest and abdomen belt ports.

3 Apply the accelerometer body position sensor:
   • Have the patient/subject sit.
   • Attach the accelerometer body position sensor to the right side (to avoid the heartbeat on the left side) of the chest effort belt.
   • Plug the accelerometer’s blue and white leads into the PIB’s corresponding blue and white ACCL ports.

4 Apply the HydroCel Geodesic Sensor Net (HCGSN) to the patient/subject per the Net’s instructions.
   WARNING: Even though the HCGSN 210 MR Net can be used outside of the MR environment for EEG-only acquisition with the FICS-Compatible Net Amps 300 amplifier, DO NOT use the HCGSN 210 MR Net when using the Polygraph Input Box (PIB). Doing so may violate patient isolation. For details, see the “GES 300 MR – an MR Conditional System” chapter in the GES Hardware Technical Manual.

   If running an LTM session, do the following, in addition to your Net’s application instructions:
   • After the Net is placed on the head and adjusted, seat the sensor pedestals through the hair.
   • Ensure that the patient is comfortable as follows:
     ▪ Make sure that the chinstrap adjustment beads are not positioned on the jawbone.
     ▪ Place a pad of gauze between the chin and the chinstrap.
     ▪ Place a pad of gauze (or a latex-free bandage) between the nasion and the nasion tube.
   • Fill the curved tip syringe with gel, if not done in advance.
   • Fill the pedestals as follows:
     Which pedestals to fill
     ▪ Fill the COM and REF electrodes first.
     ▪ Fill the remaining pedestals in numerical order. To ensure that none are skipped, start with 1 and end with 256.
     How to fill the pedestals
     ▪ Lift and tilt the first sensor pedestal. The edge of the pedestal should remain in contact with the scalp to avoid moving the hair.
     ▪ Stick the syringe into the pedestal as far as it will go to ensure that the entire pedestal is filled.
     ▪ Fill the pedestal with gel to just above the rim of the pedestal.
     ▪ After the pedestal is filled, place it back down, pressing gently to ensure good contact.
     ▪ Continue to the next sensor pedestal.
     ▪ After all pedestals are filled, verify that the COM and REF electrodes are filled and have good contact.

5 Apply the pressure transducer:
   • Place the tube coming from one side of the cannula behind one ear.
   • Line up the cannula with both nostrils.
   • Place the tube coming from the other side of the cannula around the other ear.
   • Slide the cannula clasp up to secure the cannula.
   • Plug the cannula into the INPUT connector of the transducer.
   • Plug the transducer’s blue and white AIRFLOW leads into the PIB’s corresponding blue and white PRESSURE ports.

6 Apply the thermocouple:
   • Place the wire coming from one side of the thermocouple behind one ear.
   • Line up the thermocouple to sit under the nose and over the mouth.
   • Place the wire coming from the other side of the thermocouple around the other ear.
   • Line up the thermocouple so that its sensor tips are not touching the skin. You may need to gently bend the thermocouple to make sure it does not rest on the skin.
   • Adjust the plastic slide behind the head or under the chin.
   • Use medical tape to secure the sensor wires to the Net on both sides of the face.
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• Plug the thermocouple’s **black** lead into the PIB’s **blue** TEMP port and the thermocouple’s **red** lead into the PIB’s **white** TEMP port.

7 Apply the **leg EMG leads**:
  • Attach the leads to the sensors before application.
  • Place two sensors (no more than 1 inch apart) over the belly of the tibialis anterior muscle, which is on the lateral side of the tibia (i.e., the shin bone of the lower leg). The two sensors need to be placed along a parallel line of muscle fibers of the same muscle.
    **Note:** It may be helpful to have the patient/subject flex the foot to identify the muscle on the outside of the tibia.
  • Secure the leads to the outside of the patient/subject’s clothing with medical tape. This will assure that the patient/subject will not step or trip on the leads.
  • Plug the EMG sensor leads into the PIB’s EMG ports (color is irrelevant).

8 If a Geodesic Sensor Net is not being used, you may apply the optional **common** to reduce ambient noise:
  • Attach an EMG sensor to a bony area of the patient/subject’s body. The lowest bony portion of the knee is typically used.
  • Secure the lead to the outside of the patient/subject’s clothing with medical tape.
  • Plug the EMG sensor lead into the PIB’s COM port.

9 Gather and secure all leads with Posey wraps to avoid tangling.
  **Note:** It is important to manage the wires so that they do not pull and adversely affect the accuracy of the recordings. It is recommended that you run all wires, except the wires that may be taped to the leg, back over the shoulder of the patient/subject.

III. Final System Setup

1 Using the PIB’s DB-25 pin splitter cable, plug the PIB into the two **red** analog ports on the Net Amps 300. Each split is keyed and labeled for which analog port it plugs into (pins 1–8 or pins 9–16).

2 Plug the Net’s Hypertronics connector into the Net Amps or the articulated arm and lock the connector’s lever.

3 Within Net Station, check the data quality of all the sensors (physiological and Net) and check the impedance values of the Net’s sensors. If needed, refer to the *Net Station Acquisition Technical Manual*.
  • Check data quality by scrolling through the polygraphic and EEG waveforms.
  • Check impedance values by clicking **Panels > Impedance > Measure Impedance**.
    **Note:** Make sure that most impedances are below the threshold and that they do not vary greatly between sensors. EGI’s standard recommendation for scalp impedance is 50 kΩ. However, 100 kΩ is the recommended impedance threshold for clinical applications. Also remember that hair length, thickness, and cleanliness, as well as skin texture and whiskers, can affect impedance.

4 Fix any physiological or Net sensors that are displaying poor data quality or unacceptable impedance values.
  • Adjust any physiological sensors as appropriate.
  • Fix any Net sensors by reseating those sensors and/or by adding more electrolyte/gel/paste (depending upon the Net being used) to the pedestals of those sensors.
    **Note:** Remember that using too much electrolyte/gel/paste increases bridging between sensors.

5 Click the **Save & Close** button to save the impedance values in the Net Station session file.

6 Click the **Record** button.

7 Complete the following biocalibrations with the patient/subject. Insert a comment in the Net Station session file by each biological event so that they can be identified in the data later. If needed, refer to the Net Station Viewer manual.

  - **Eyes closed**
  - **Eyes open**
  - **Look up**
  - **Look down**
  - **Blink five (5) times**
  - **Make a snoring sound**
  - **Look to the left (eyes only)**
  - **Flex the left foot**
  - **Look to the right (eyes only)**
  - **Flex the right foot**
  - **Look up**
  - **Bite down firmly**
  - **Look down**
  - **Inhale deeply and hold for 10 seconds**

8 Verify that the thermocouple is not touching the skin.

9 Run your session.
Instructions for Using the Polygraph Input Box (PIB)

**Net Amps 300**

**Front panel**

- Hypertronics connector

**Rear panel**

- For digital connections, refer to the digital I/O port sections of the GES Hardware Technical Manual.
- Marked for analog pins 1 – 8
- Marked for analog pins 9 – 16
- FireWire
- To power supply
- Net Station on data acquisition computer (DAC)

**Note:** You will gather and secure all leads with Posey wraps. For the sake of this connection illustration, leads are not managed.

**WARNING:** For all equipment warnings and cautions, refer to these instructions and the GES Hardware Technical Manual.

**Figure 1.** System diagram for a typical PIB session

For questions or additional assistance, please contact us at:

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