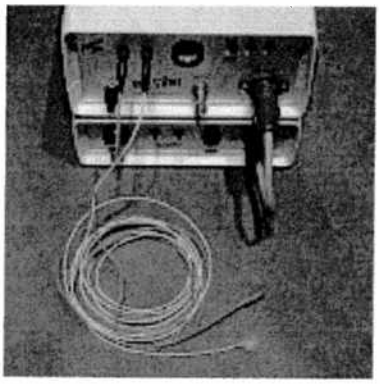
Galvanic Skin Response Module (GSR)

Using this ActiveTwo GSR accessory, the conductance of the skin can be measured. The GSR consists of 2 passive Nihon Kohden electrodes to induce an oscillator signal synchronized with the sample-rate. The GSR connects straight through the AUX input on the front panel of the ActiveTwo AD Box. Because the BioSemi GSR uses "Lock-in detection", the stimulus-current can be as low as 1uA. The low-current and synchronized oscillator ensures, that the bio-potential measurements (ECG, EEG, EMG) are not corrupted or interfered with by the GSR oscillator signal. If the GSR is ordered after the initial installation of the ActiveTwo system, modification to the AD box can be done at a later stage.

The CMS/DRL (CommonModeSense/DrivenRightLeg) electrodes need to be connected to the patient in order for the GSR electrodes to work.



Specifications:

Cable length:	150mm
Connection used:	standard 7-pol DIN connector
Electrodes made of:	stain-less steel
Current used for excitation:	1uA at 16 Hz, synchronized with the sampling rate to reject possible interference

Skin Conductance Measurement with ActiveTwo (*16 Hz SC coupler*)

The 16 Hz SC circuit in ActiveTwo uses 1 µA constant current, 16 Hz square wave signal that is synchronized with the ActiveTwo system's sample rate. The 16 Hz design is intended to make the GSR coupler consistent with traditional GSR methodology. Although the 16 Hz excitation frequency might be expected to interfere with simultaneous EEG measurements in ActiveTwo, testing has confirmed that there is minimal influence from the 16 Hz excitation frequency on the EEG signal.

The LSB value (resolution) with the 16 Hz GSR frequency is 1/32 (0,03125) nanoSiemens. With the 24-bit ADC, The GSR signal has an input range of 574 nanoSiemens (1.7 MOhm) to 262,000 nanoSiemens (3.8 kOhm). With the 16 Hz GSR in ActiveTwo, the response on subject's arousal is a DECREASE in skin resistance, instead of the INCREASE of skin resistance seen with the 512 Hz GSR.

Since many analysis programs do not have a mechanism to handle units other than uV, it is useful to know that GSR data points are scaled such that when GSR units are displayed in uV, 1 uV is equal to 1 nanoSiemens. To convert to Ohms, take the reciprocal of the Siemens value (R = 1 / S). For example: 10,000 nanoSiemens is 100 kOhm. Note that you cannot simply take the reciprocal of a conductance CHANGE, because R2-R1 is not equal to 1/(S2-S1). So, every point should be converted from Siemens to Ω separately, before calculating changes in Ω.

ActiveTwo's GSR measurement works with a DC coupled amp (same as for the EEG channels), so there is no high-pass time constant to worry about. Any high-pass filtering would be performed in software off-line. A low-pass filter of 3-10 Hz is usually applied off-line to reduce interference. ActiView displays the GSR with a 3 Hz low-pass, but the data to file are full bandwidth (no filters are applied).

Note that the GSR sensor only works in speed modes that allow recording of sensor channels (i.e. 4, 5, 6, 7 and 8). Remember that if you change the speed mode, you will need to turn off the power at the battery unit and turn it on again to let the internal firmware adjust itself to the new speed mode.

Also, your ActiView CFG file must enable the use of sensors. Since most systems are sold without GSR measurement capability, the default configuration files that come with new versions of software contain a code that disables the sensors. To edit the CFG file, open it in Windows Notepad, and go to the section entitled [FreeChoice]. Look for the code:

AuxFree=0%

If you find this, change it to:

AuxFree=1%

Remember that, if you do not explicitly select a CFG file, the DEFAULT.CFG file in the same directory as the .EXE is used. Once you open the ActiView program and the CFG file you want to use is active, click over to the sensors page to be sure that the GSR sensor is selected for display. When you click Start File, be sure to enable saving of sensor signals.
Note that the CMS and DRL electrodes must be attached to the subject and connected to the system, and the blue "CM in range" light must be on for GSR measurement to work properly. Also, the green "GSR in range" lights should be on when GSR electrodes make adequately low impedance contacts with the subject. Note that the green GSR lights always remain off if the blue CM light is off. GSR can only be measured with the blue CM light and the green GSR lights glowing.

GSR Electrode Placement

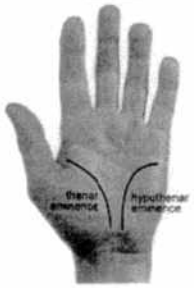
Preparation

1. Start with clean electrodes. Tarnish on the electrodes may affect the baseline resistance reading, but it will not affect the ability of the system to measure changes in skin conductance.
2. Always wash your hands with soap and water before applying electrodes to someone else. If you have any breaks in the skin of your hands, or any "weeping" rashes or lesions, wear examination gloves.
3. Always have the subject wash his/her hands with soap and water and dry them thoroughly before applying electrodes. This helps to equate the degree of skin hydration across subjects.
4. If the subject has any breaks in the skin or weeping lesions on his/her hands near the recording sites, DO NOT RUN THAT SUBJECT.

Electrode Application (adapted from http://www.oberlin.edu/psych/p305/labs/Lab3.html)

1. Strip the backing from *one side* of an electrode collar and stick it to the housing of the electrode, centering it carefully over the electrode disk. Place the electrode collar-down on the table and press to secure the collar to the housing.
2. Use SignaGel or Ten20 Paste as an electrode medium. Keep the container closed between uses.
3. Apply paste evenly to the surface of the electrode. Avoid creating air bubbles in the paste. Fill the electrode well to the top to insure contact between the entire electrode surface and the skin. Overfilling will cause paste to spread out under the collar when the electrode is applied to the subject, resulting in variation in the electrode contact area and poor adhesion of the collar. If you overfill the electrode, use the side of a toothpick to grade off the excess paste.
4. Remove the backing paper from the electrode collar and press the electrode firmly in place on the subject with the lead wire running in an appropriate direction. Be careful not to move the electrode after contact with the skin. Smooth the electrode collar with your finger so that it adheres tightly to the skin.

5. *Option 1 (standard placement).* Affix the electrodes to the volar (palmer) surface of the distill phalanges (the fingerprint region) of the left hand. Run the the leads down the fingers toward the palm, and wrap a loop of paper tape around the lead and medial phalange of each finger to relieve stress on the electrode. Further secure each electrode with a loop of paper tape around the fingertip.



6. *Option 2 (alternative placement).* If the subject has cuts or callouses on his/her fingertips, or if he/she has slender fingers that make it difficult to secure electrodes to the fingertips, opt instead for the thenar and hypothenar eminences of the subject's left hand. Place the electrodes so that the leads travel toward the wrist and secure them at that point with a strip of paper tape.

7. When using finger sites, it may be necessary to secure the electrode further by wrapping paper tape around the electrode and the subject's finger (not too tightly). For this reason, among others, the secondary sites on the thenar and hypothenar eminences may be preferable.
8. Plug the GSR electrode leads into the circular DIN connector marked GSR on the front panel of the A/D unit.
9. If you are not also recording EEG, then position CMS and DRL electrodes on the back of the hand about 2 inches apart.
10. Reliable recording requires an adaptation period of at least 10 minutes (15-20 minutes is recommended for research in which within-session change in skin conductance level is an important variable). This period allows equilibration of hydration and sodium at the interface between the subject's skin and the electrode paste.