BIOPAC Systems, Inc.
42 Aero Camino, Goleta, CA 93117
Tel (805) 685-0066 | Fax (805) 685-0067
info@biopac.com | **www.biopac.com**

ELECTRODERMAL RESPONSE

Updated 05.31.16

Application Note AH-187 Electrodermal Response (EDR) with an MP System

This application note is concerned with how to record galvanic skin response (EDA), also known as the electrodermal response (EDR), and observe changes with the amplifier module or telemetry module of the MP System. With the MP System, you will measure both subtle and sudden changes in electrodermal activity, based on your protocols.

Electrodermal Response Basics

Electrodermal response (EDR) measurements show the activity of the eccrine sweat glands. Typically, one will place electrodes where the concentration of these glands is the highest: namely, the fingertips. Responses are a function of the pre-secretory activity of eccrine sweat glands and the filling of the sudorific tubules. The combination of these sudorific elements serves to increase the conductivity of the skin when activated.

When one applies a very small electric voltage (0.5 V) between two electrodes (Ag-AgCl), the manifested electrical conductance varies in direct proportion to the electric current flowing between the electrodes. The electrical conductance is a function of increasing eccrine activity. For instance, if a subject is presented a stimulus and the palms start to sweat, this response indicates a highly-stimulated state. The EDR of this subject will then be higher than the subject’s baseline. If another subject receives the same stimulus and the palms remain as "cool as a cucumber," the EDA reading remain unchanged with respect to the baseline. EDR undergoes relatively fast habituation (decrease of amplitude) in the event the same stimulus is repeated over and over to the same subject.

Acq*Knowledge* software features: EDR

- Automated analysis within Acq*Knowledge* software, version 4 or greater
- Automated event-related analysis determining specific or non-specific responses
- Textual event markers
- On-line and off-line analysis
- Remote monitoring through the TEL100C
- On-line journal for note taking
- Automatic stimulation presentation (up to 16 on/off control channels)
- Export results to statistical programs for further analysis

Applications: EDR

- Polygraph ("lie detector")
- Measure stress, arousal, emotional excitement
- Physiological biofeedback
- Measure absolute or relative response levels to different stimuli
- Relaxation Training

MP System Equipment: EDR

EDR data can be collected via the following devices: EDA100C, EDA100C-MRI, the BN-PPGED Bionomadix wireless and the TEL100C (the wireless model TEL100C-RF is not recommended for EDR applications).

- If using the EDA100C/EDA100C-MRI

Acquisition Unit:	MP150 or MP100
Amplifier:	EDA100C or EDA100C-MRI module
Transducer/Electrode option:	TSD203 electrodermal response transducer set *or* EL507 disposable electrodes with a pair of LEAD110C electrode leads. **For MRI**: EL509 disposable electrodes, LEAD108 leads connecting to the MECMRI-TRANS cable/filter combination.
Electrolyte:	GEL101 skin conductance electrode paste or other electrolytic mixture
Optional:	Module extension MEC100C (3 meter cable extends lead between EDA100C and TSD203)

- If using the BN-PPGED

Acquisition Unit:	MP150 or MP100
Transmitter/Receiver:	BN-PPGED
Transducer/Electrode option	EL507 disposable electrodes and BN-EDA-LEAD2 or BN-EDA25-LEAD2
Electrolyte:	EL101 skin conductance electrode paste or other electrolytic mixture

- If using the TEL100C

Acquisition Unit:	MP150 or MP36R
Amplifier:	TEL100C module
Transducer/Electrode option:	SS3A electrodermal response transducer *or* EL507 disposable electrodes with SS57L leads
Electrolyte:	GEL101 skin conductance electrode paste or other electrolytic mixture

Hardware Setup

EDA100C/EDA100C-MRI

1. Set the Gain switch on the EDA100.

   To measure galvanic skin responses, estimate the approximate units of the skin conductance (µmho) to be investigated.

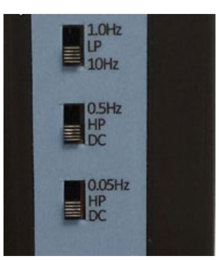
   - The unit of measurement for the EDA100 is the µmho(micromho). Note: µmho = µsiemens. The mho is the reciprocal of the unit of measurement for resistance, the ohm.
   - Larger values indicate a higher level of conductivity; smaller values indicate less conductivity. For example.
     - If the subject is shown provocative slides, the response may be in the 0-50 µmho range.
     - If the subject is presented with a sudden 120dB buzzer in a quiet room, the response may be in the 0-200 µmho range.

   Once the appropriate range for the experiment has been determined, choose the proper switch setting from the chart below.

Conductance Range		EDA100C Gain Switch
DC	0.05 Hz	
0-200 µmho	±200 µmho	20 µmho/V
0-100 µmho	±100 µmho	10 µmho/V
0-50 µmho	±50 µmho	5 µmho/V
0-20 µmho	±20 µmho	2 µmho/V

For example, for the 0-100 µmho range, set the module Gain switch to the 10 µmho/V setting (on the module Gain switch, mho is an upside down ohm symbol).

2. Set the three Filter switches on the EDA100C to the appropriate filtering option for your protocol.



Low Pass (LP)	1 Hz LP 10 Hz LP	Sufficient for almost all EDR studies Use to investigate higher frequency components of the EDR.
DC	DC	Gives direct (absolute) EDR readings from the subject.
High Pass (HP)	0.5 Hz HP	Provides relative EDR recordings. Removes low frequency signals. The effect of using the 0.5 Hz HP setting will be that the subject's baseline will return to nearly zero 1 second after a response change. The result provides an indicator of EDR changes as opposed to a specific EDR level.
	0.05 Hz HP	Provides relative EDR recordings. Removes very low frequency signals. The effect of using the 0.05 Hz HP setting will be that your subject's baseline will return to nearly zero 10 seconds after a response change. The result provides an indicator of EDR changes as opposed to a specific EDR level.

3. Set the **Channel** switch on the top of the EDA100.
   - Select 1-16 to correspond with an available Analog Input channel.
4. Plug in inputs:

   o If using **TS203** transducer:

   a) Plug the two colored electrode cables into the VIN+ and VIN- inputs.
      - Either blue lead can be connected to either VIN input.

   b) Plug the black cable into the GND.

   o If using **LEAD110C/EL507**:

   a) Plug the two cables into the VIN+ and VIN- inputs.

   o If using **LEAD108/EL509**:

   a) Plug the two cables into the VIN+ and VIN- of the MECMRI-1 cable.

   b) Gel the EL509 electrodes when applying to the subject.

GROUNDING When using the EDA100C amplifier with other biopotential amplifiers attached to the same subject, do not attach the ground lead from the biopotential amplifier(s) to the subject. The subject is already appropriately referenced (grounded) to the system via the VIN- attachment to the EDA100C. If a biopotential ground is attached to the subject, then currents sourced from the EDA100C will be split to the biopotential amplifier ground lead, potentially resulting in measurement errors. If biopotential amplifiers do require a ground lead, when used with a EDA100C, then the AC lead (CBL205) can be used in series with the biopotential ground lead.

Optional If using the module extension cable for up to three meters of extra distance between the subject and the MP acquisition unit, plug the **MEC100C** into the EDA100C inputs and then plug the TSD203 into the MEC100C inputs.

BN-PPGED

1. If using the BioNomadix wireless monitoring system, gain and filter settings are factory set. Filter settings can be changed, please refer to the MP Hardware guide, in the BioNomadix section for further details.
2. Attach the BN-EDA-LEAD2 or BN-EDA25-LEAD2 to channel B of the BioNomadix transmission module.

TEL100C

1. If using the TEL100 Remote Monitoring System, for EDA measurements, the following gain settings correspond to µmhos. These settings can then be used to calibrate the signal using the rescaling feature in Acq*Knowledge* (see AH-103 for more details on TEL100 setup). Set the filter setting for DC.

TEL100 Gain	µmho/V
50	200
100	100
200	50
500	20
1,000	10

TEL100 Gain	µmho/V
2,000	5
5,000	2
10,000	1
20,000	0.5
50,000	0.2

2. Connect the SS3A to the channel that will be recording the EDA. If using disposable EL507 electrodes, connect the SS57L to the recording channel.

Subject Setup *using TSD203 Electrode*

The TSD203 transducer provides a small constant current between the electrode sites when used with the EDA100C, and the measured resistance between the two electrodes constitutes the electrodermal response. When using the TSD203 to measure electrodermal response, you will need to determine the choice of electrolyte. For effective monitoring of local eccrine activity, use a higher impedance electrolyte with hyposaturated electrolyte concentrations of Cl- (on the order of physiological levels). Many of our researchers have found electrolyte mixtures of 0.05M NaCl are optimal; BIOPAC GEL101 skin conductance electrode paste is a convenient option.

EDA100C with MEC100C andTSD203

1. Apply GEL101 to the skin at the point of electrode contact and rub it in. The gel must have a chance to be absorbed and make good contact before recording begins.
2. Make sure the cavities of the TSD203 transducer are clean and fill them with GEL101 (or your own electrolyte mixture).
3. Attach the TSD203 electrode to the subject's fingertips as shown in the picture above, and then wrap the electrode around the fingers with the Velcro straps, applying mild tension.
4. Wait 5 minutes (minimum) before starting to record data.

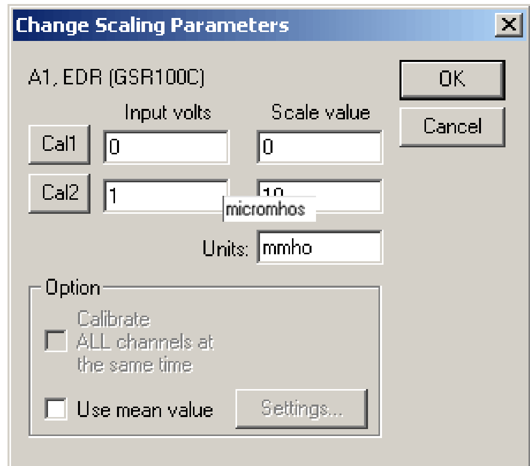
Software Setup

Acq*Knowledge* 4.0 and above "walk" through the calibration process; Acq*Knowledge* 3 and below require manual entry of scale values for appropriate scaling of the EDA signal. The following steps are shown for reference for those running older versions of the software; note that these values are not applicable to BioNomadix units.

1. Open the Change Scaling Parameters dialog for the selected EDA100C channel (MP menu > Setup Channels>Scaling).
2. Enter CAL1 Input Value as 0.
3. Enter CAL1 Scale Value as 0.
4. Enter CAL2 Input Value as 1.
5. Enter CAL2 Scale Value to match the Gain setting on the EDA100C per the chart below.

EDA100C Gain Switch	Cal 2 Scale value
20 µmho/V	20
10 µmho/V	10
5 µmho/V	5
2 µmho/V	2

6. Enter the Units as µmho.
7. Click OK to establish the settings and close out of the Scaling Parameters dialog.



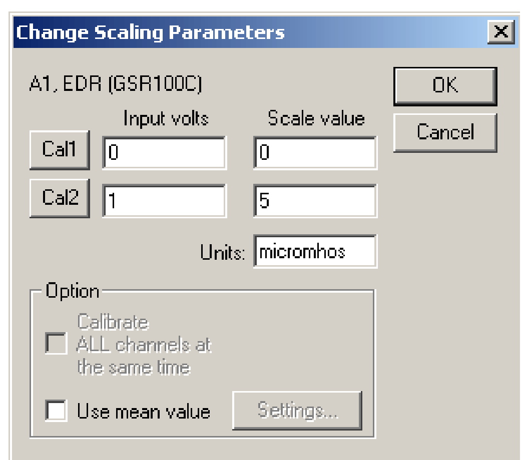
Scale settings for EDA100C @ 10 µmho/V Gain

For example: To use the 0-100 µmho range, set the switch on the EDA100C front panel to 10 µmho/V, set the channel on top of the module to the corresponding software channel, open Scaling for that channel, and type in these values: Cal1: Input: 0, Scale 0
Cal2: Input 1, Scale 10
Units: micromhos

Optional Calibration

To verify the Gain setting of the EDA100C:

1. Calibrate Acq*Knowledge* for lower frequency response at DC:
2. Place both lower frequency response (HP) filters on the EDA100C to **DC**.
3. Set the **Gain** switch on the EDA100C to 5µmho/V.
4. Perform measurement with electrodes disconnected.
5. Acq*Knowledge* should produce a reading of 0 µmho. If slightly off, adjust he ZERO trim pot on the top front of the EDA100C to perfectly zero the reading.
6. Insulate a 100kohm resistor and place it from electrode pad to electrode pad resistor must be insulated from fingers). Perform measurement with electrode-resistor setup.
7. Acq*Knowledge* should produce a reading of 10 µmho.



Input voltages mapped to sensitivity

For example: In the Scaling window, set the Input voltages so they map to the "DC" conductance ranges indicated by the sensitivity setting. Cal 1: Input 0, Scale 0
Cal2: Input 1, Scale 5
Units: micromhos