BIOPAC Systems, Inc.
Registered to ISO 9001:2000

RESEARCH

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BIOPAC Systems, Inc.

Training Seminar

- About BIOPAC
- Hardware Setup
- Software Setup
- Subject Preparation
- Data Acquisition Demonstration
- Data Analysis
- Application Notes and Other Resources
- Question and Answer Session

MP36R


ACQKNOWLEDGE
ACQKNOWLEDGE
Electrode Check
CH 1
CH 2
CH 3
CH 4
Busy
Power
MP36
BIOPAC Systems, Inc.
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MP36

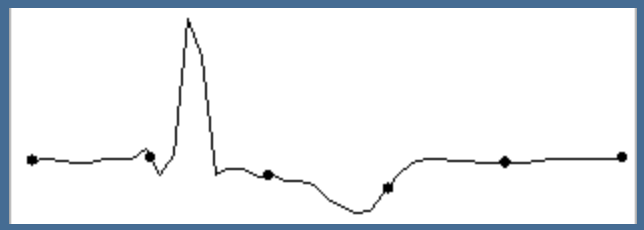
- A/D Conversion
  - Range of the MP36 system: 400microvolts to 4.0 Volts p-p;
  - A/D resolution: 24 bit
  - Dual A/D converters: Reduce Channel/Channel timing latency

    16,777,216 levels or 2.8 microvolts/bit resolution at a gain of 5 and 0.024nanovolts/bit at a gain of 50,000
  - Minimum change that can be detected is 30 uvolts. If the signal is not strong, it must be amplified.

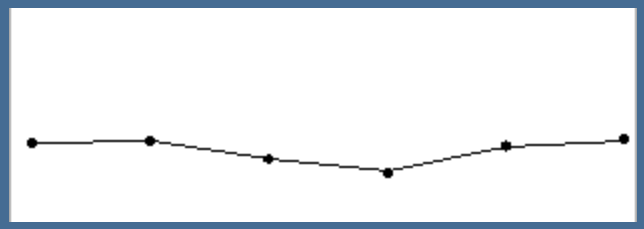
- Sample Rate
  - 4 channels @ 100K samples/second

Sampling Rate

ECG waveform sampled with relatively few samples per second. The black dots are the sample points.



Above waveform as it would look if plotted.



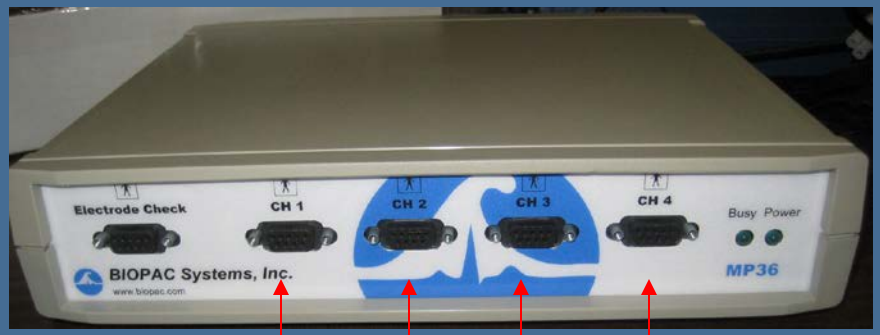
Representation of the same ECG waveform sampled at a relatively higher sampling rate.

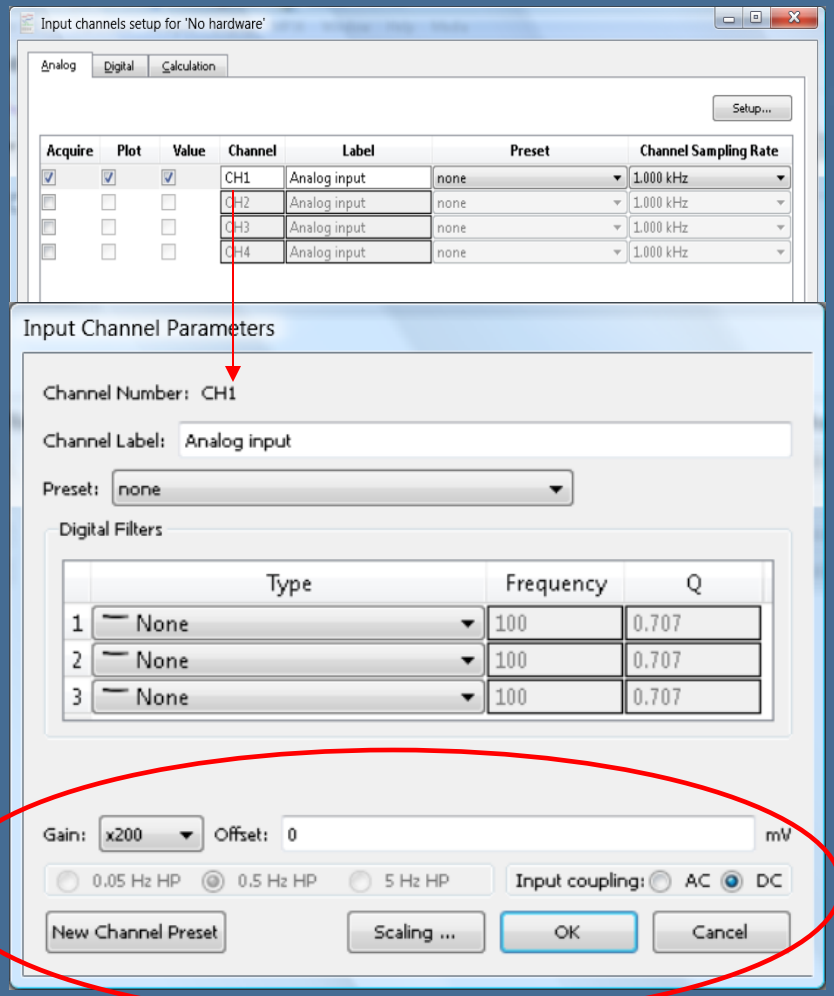
Sampling Rate

Recommended sample rates for physiological signals

ECG	200 Hz (1,000 Hz for HRV)
Respiration	50 Hz
GSR	50 Hz
EMG	1,000 Hz to 10,000 Hz
EEG	200 Hz
EOG	200 Hz
Blood pressure	100 Hz
Flow rate	50 Hz
EGG (electrogastrogram)	1 Hz

MP36R Front Panel





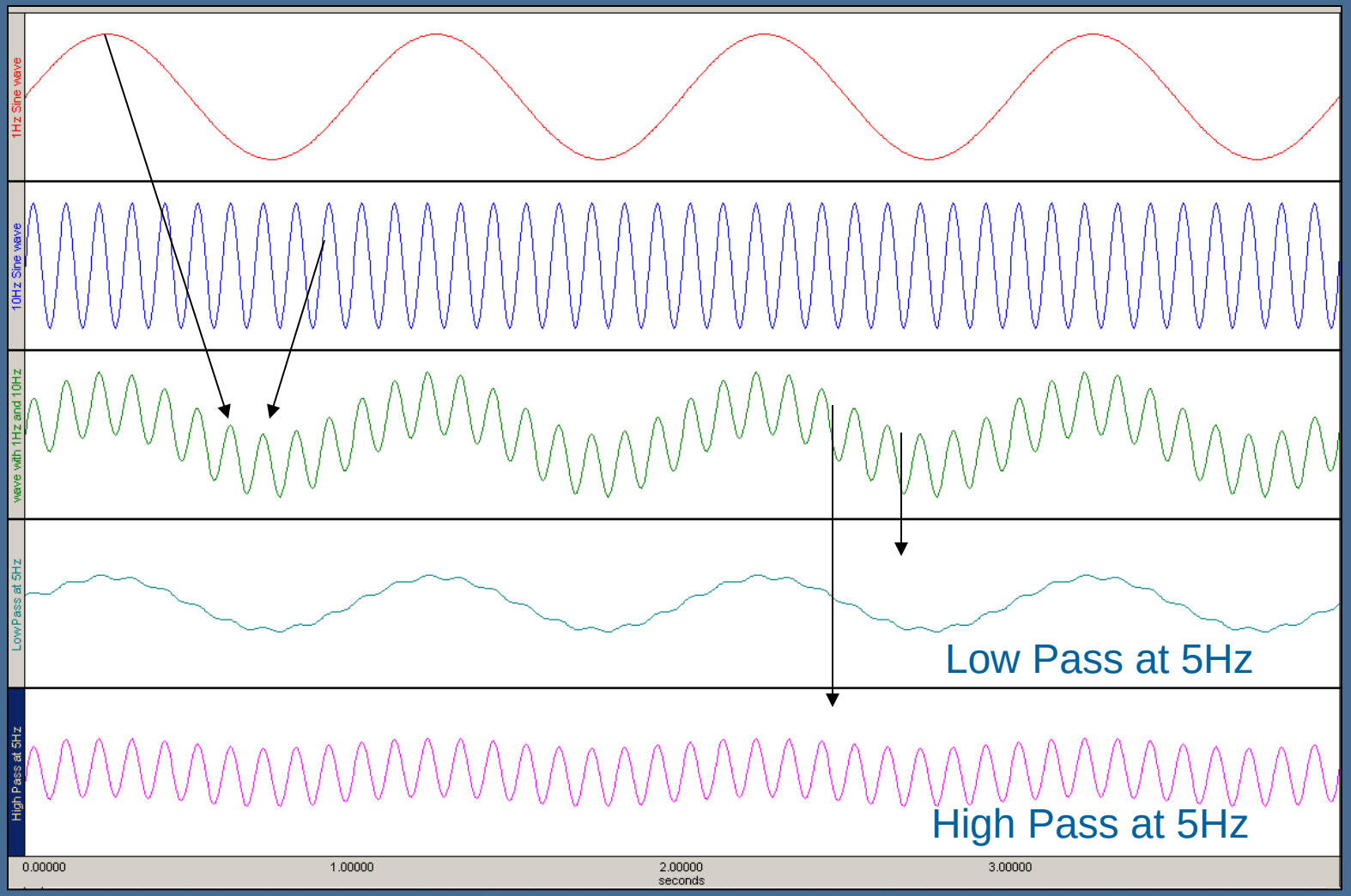
- 4 analog channels
  - Built-in universal amplifiers
  - Hardware filters

GAIN and typical physiological signal levels

Heart Potential (ECG)	0.5-4 mV
Brain Potential (EEG)	5-300 μV (scalp)
Muscle Potential (EMG)	0.1-5 mV
Electrooculogram (EOG)	50-3,500 μV
Blood Pressure: direct measurement indirect measurement	10-400 mmHg Arterial 25-400 mmHg Venous, 0-50 mmHg Venous
Blood Flow	1-300 cc/sec.
Respiratory Rate	2-50 breaths/min
Pneumotachography (flow rate)	0-600 liter/min.
Tidal Volume	50-1,000 ml/breath
Galvanic Skin Response	1-500 kΩ
Electrogastrogram (EGG)	10-1,000 μV

Source: Revised from Medical Engineering, C.C. Ray (ed.) Copyright 1974 by Year Book Medical Publishers, Inc. Chicago

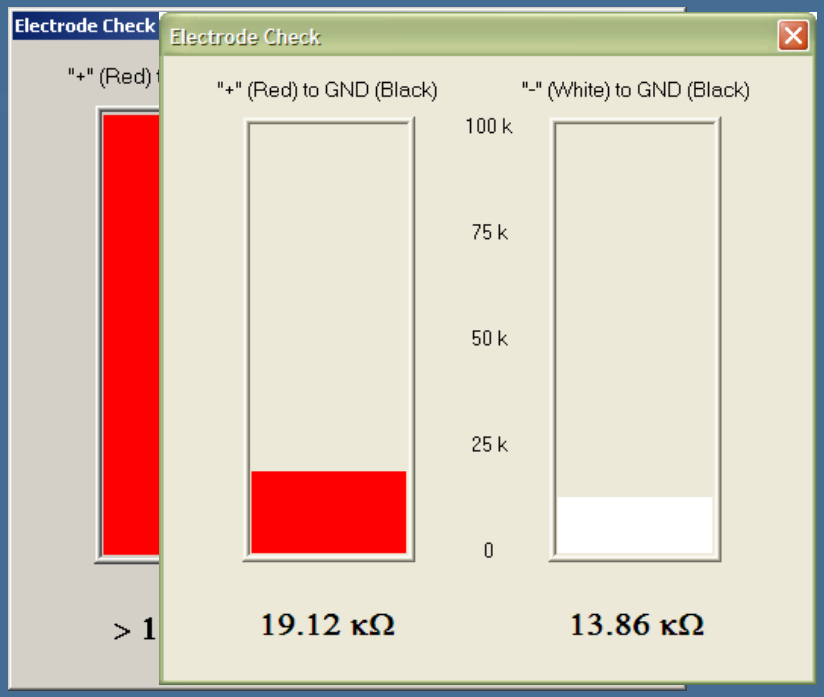
Filters: Low pass, High Pass, Band Pass, Band Stop, Notch



Filters: A practical Low Pass Filter example with ECG Part I

Filters: A practical high pass filter example with ECG Part II

MP36R Front Panel

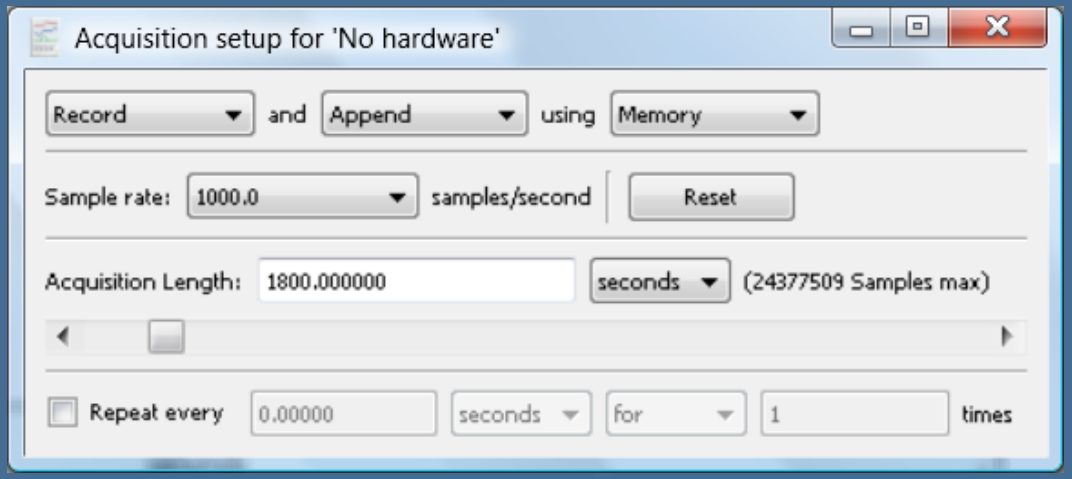


- Electrode check channel
  - Impedance Checker
- Status indicators
  - Busy status indicator is
    - Activated when the MP36 is acquiring data
    - Activated during self test (first few seconds after MP36 is turned on.
  - Power status indicator is illuminated when the MP36 is turned on.

MP36 Back Panel

- Analog Out
  - Allows signals to be sent out to headphones, stimulator, etc.
- USB connection
  - Interface connection to computer.
- Headphone connection.
  - Connects a 3.5mm Stereo headphone.
- I/O Port
  - Accepts a DB 25 Female connector.
  - Input/Output port used to connect digital devices to the MP36.
- Trigger Input
  - Accepts a male BNC connector.
  - Input port used to send trigger signals from another device to the MP36.

Software Setup
Prior to Acquisition



- MP36 Menu
  - Set Up Acquisition
    - Storage Setup
    - Sample rate: Global
    - Acquisition Length

Sampling Rate

Recommended sample rates for physiological signals

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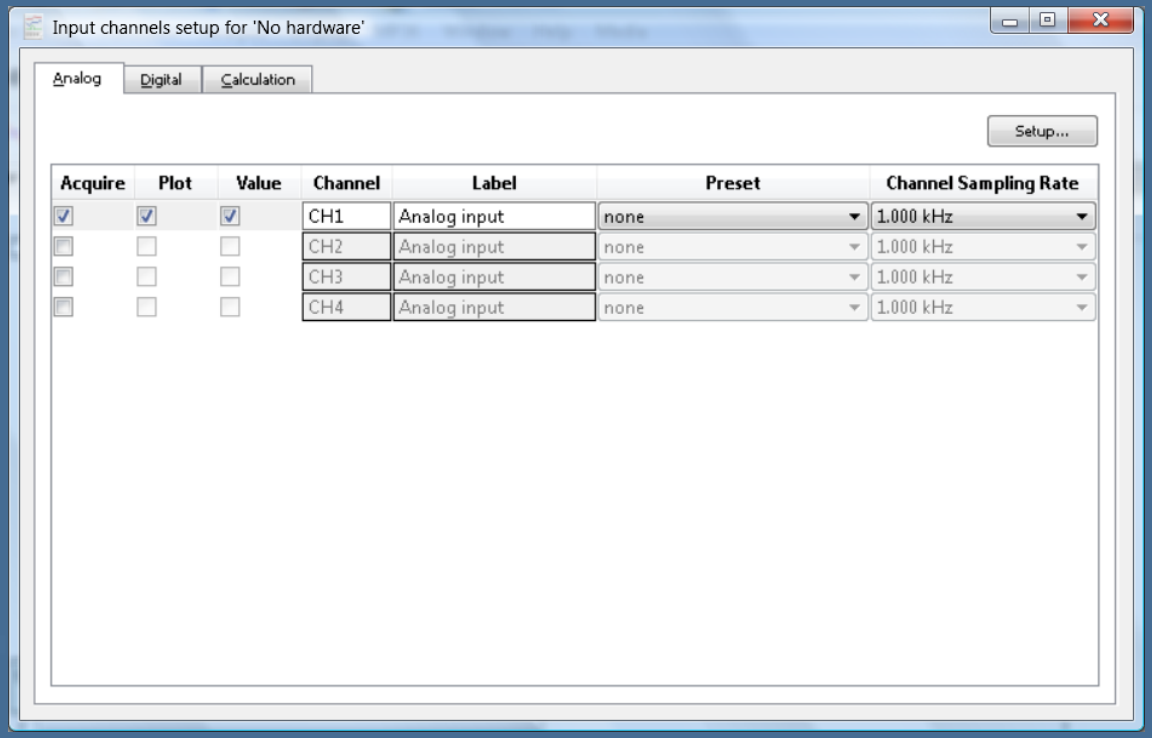
EOG	200 Hz
Blood pressure	100 Hz
Flow rate	50 Hz
EGG (electrogastrogram)	1 Hz

Software Setup
Prior to Acquisition

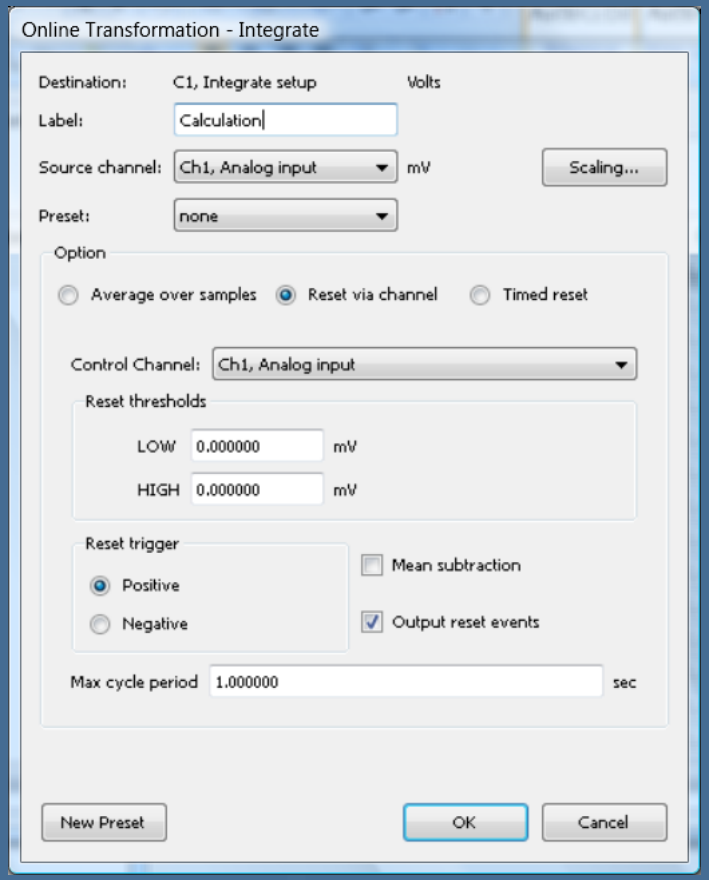
- MP36>Set up Channels Menu
  - 4 Analog Input
  - 8 Digital input
  - 16 Calculation
    - Up to 256 when using metachannels



PRESETS

✓ none	Finger Displacement (inches)	Force (0 - 50 grams)
Default	Goniometer	Force (0 - 100 grams)
Accelerometer (5 g's max.)	Goniometer (Intelitool - Flexicomp)	Force (0 - 200 grams)
Accelerometer (50 g's max.)	Heel Toe Strike	Force (0 - 500 grams)
Airflow (SS11LA)	Microphone (SS17L, .5 - 200 Hz)	Force (0 - 1000 grams)
Airflow (SS52L)	Microphone for Speech (SS62L)	Force (iWorx FT-100)
Blood Pressure Cuff (SS19L)	MP100/150 Interface (BSLCBL14)	Nerve Response (BSLCBL3,4,9)
Blood Pressure Cuff (SS19LA)	Psychological Response	Nerve Response (BSLCBL8)
BNC (SS9L, -10 to +10 Volts max.)	Pulse Plethysmograph (PPG)	pH (BSL-TCI21)
BNC (SS9L, -50 to +50 Volts max.)	Reflex Hammer Strike	Pneumogram
BNC (SS70L, -10 to +10 Volts max.)	Reflex Hammer (Intelitool - Flexicomp)	Pressure (+-2.5 cm H2O)
Cardiac Output - Z	Respiration (SS5LB)	Pressure (+-12.5 cm H2O)
Cardiac Output - dZ/dt	Stethoscope (Heart Sounds)	Pressure (+-25 cm H2O)
Clench Force - kg (SS25LA)	Stethoscope (Korotkoff Sounds)	Tobacco Hornworm (BSLCBL8)
Clench Force - lbs (SS25LA)	Stimulator-BSLSTM (0-10 Volts)	
Clench Force - N (SS25LA)	Stimulator-BSLSTM (0-100 Volts)	
Clench Force - kgf/m^2 (SS56L)	Stroboscope Flash (TSD122)	
Clench Force - kpa (SS56L)	Switch	
Clench Force - psi (SS56L)	Temperature (deg. C)	
CO2 Expired (GASSYS2)	Temperature (deg. F)	
O2 Expired (GASSYS2)	Temperature Change (deg. C)	
Electrocardiogram (ECG), .5 - 35 Hz	Temperature Change (deg. F)	
Electrocardiogram (ECG), .05 - 35 Hz	Torsiometer	
Electrocardiogram (ECG), .05 - 100 Hz, AHA	Airflow (small mouse)	
Electrocardiogram (ECG), .05 - 150 Hz	Airflow (mouse)	
Electrodermal Activity (EDA), 0 - 35 Hz	Airflow (rat/guinea pig)	
Electrodermal Activity (EDA) Change	Airflow (cat/rabbit)	
Electroencephalogram (EEG), .5 - 35 Hz	Airflow (small dog)	
Electroencephalogram (EEG), .5 - 100 Hz w/notch	Airflow (medium dog)	
Electrogastrogram (EGG)	Airflow (large dog)	
Electromyogram (EMG), 5 - 250 Hz w/notch	Blood Pressure (Arterial)	
Electromyogram (EMG), 5 - 500 Hz	Circuit Probe (Breadboard)	
Electromyogram (EMG), 5 - 1000 Hz	Current Monitor (BSLCBL10)	
Electromyogram (EMG), 30 - 250 Hz w/notch	Displacement (cm)	
Electromyogram (EMG), 30 - 500 Hz	Displacement (inches)	
Electromyogram (EMG), 30 - 1000 Hz	Displacement (AD Inst. DT-475)	
Electrooculogram (EOG), .05 - 35 Hz	Dissolved O2 (BSL-TCI16)	
Finger Displacement (cm)	Earthworm Action Potential	

CALCULATION CHANNELS



Input Devices

- Electrodes
  - attach to the surface of the skin and pick up electrical signals in the body.
- Transducers
  - convert a physical signal into a proportional electrical signal.
- Input/Output devices (I/O)
  - specialized devices like pushbutton switches and headphones.

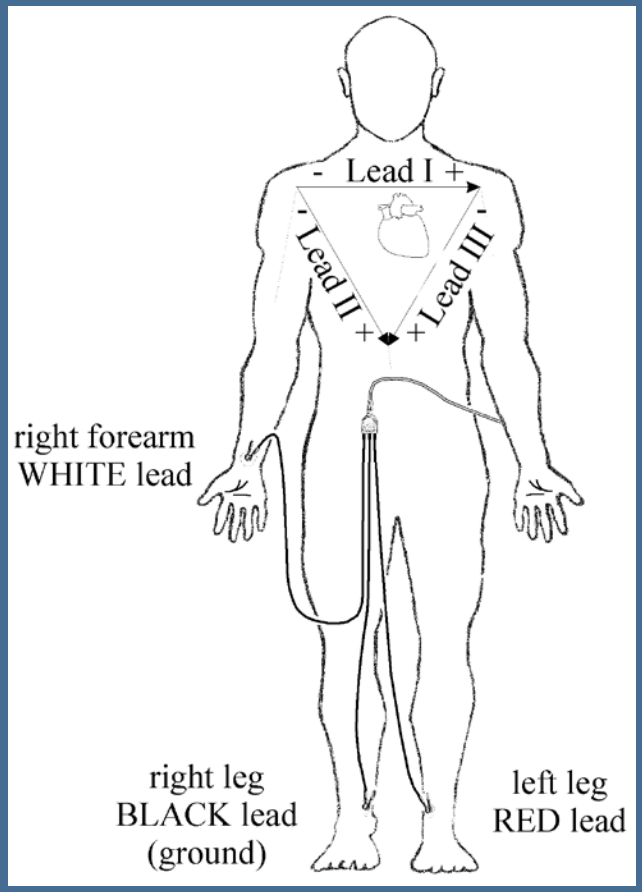
Electrodes, Leads, and Gels

ELECTRODES AND GEL FOR ECG

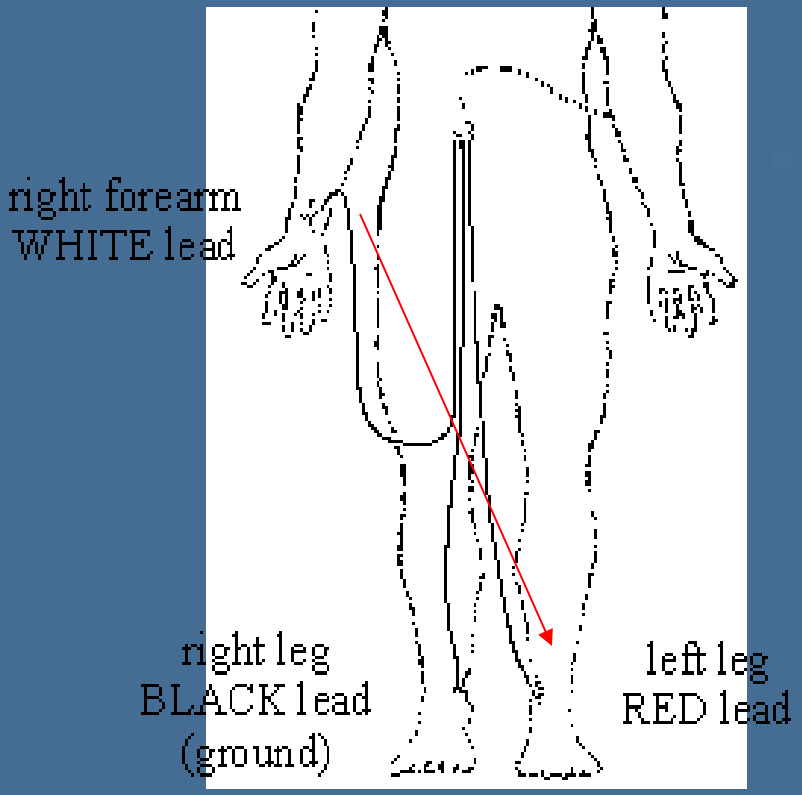
- EL503 general purpose electrode
  - Electrodes are pre-gelled
  - If crystallized apply a small amount of gel

- GEL100 general purpose gel
  - 7% saline content

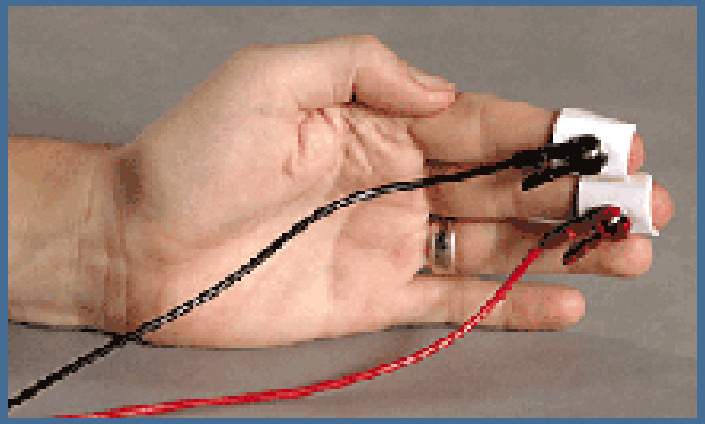
EINTHOVEN'S TRIANGLE



ECG ELECTRODE PLACEMENT OPTIONS



EDA ELECTRODES AND GEL



- SS57 with EL507 Electrodes

- GEL101 Isotonic Gel

  Low saline content 0.5%

- EL507 EDA electrode

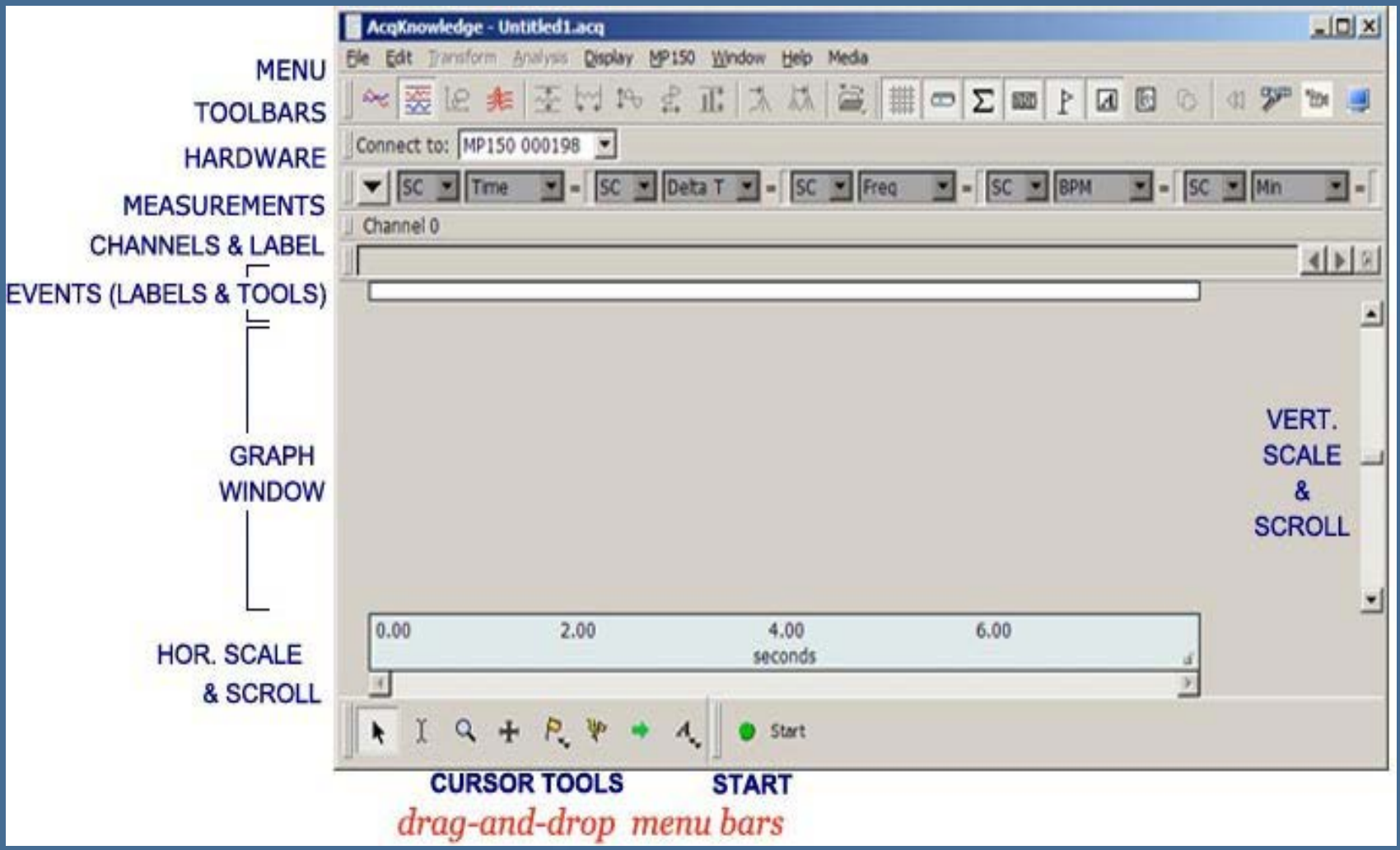
  Electrodes are pre-gelled

Subject Preparation

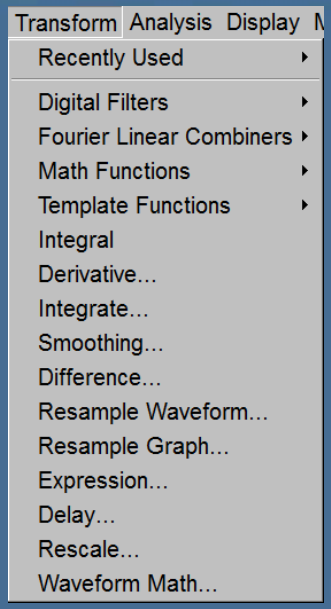
- Abrade the skin (ELPADs)

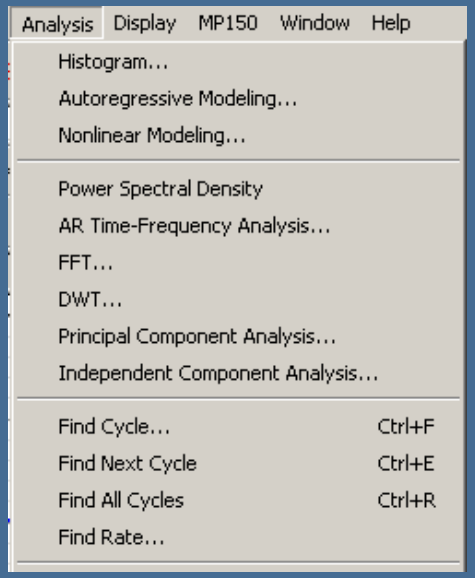
  Not for GSR
- Electrode Gel
- Wait 5 minutes for best results
- Minimal movement
  - Use tape to provide leads strain relief
- One ground per subject!

Software Features

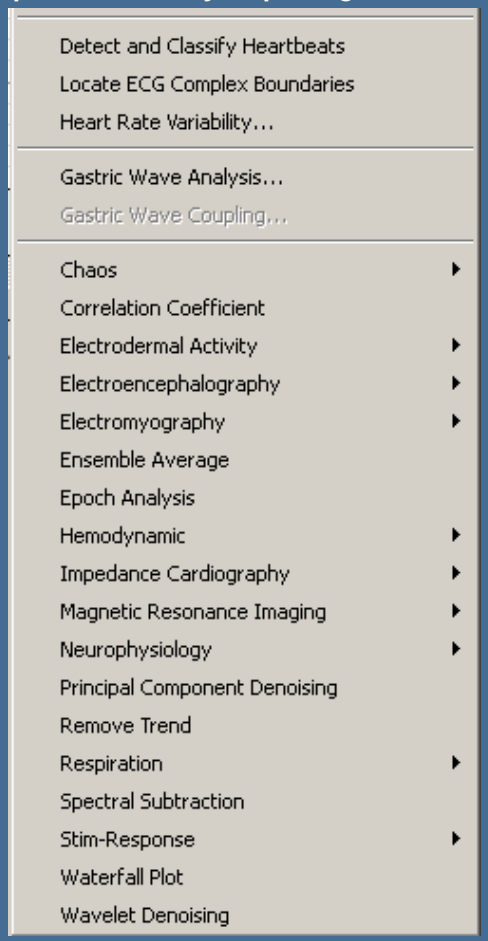


Data Analysis





Specialized Analysis package included



- Transform and Analysis Menus
  - All post-acquisition processes
  - Offline filtering
  - Waveform math
  - Fast-Fourier Transform
  - Automated analysis
    - ‘Find Rate’ functions
    - ‘Find Cycle/Peak’ functions
    - Specialized Analysis Package
      - Acq*Knowledge* 4 Windows
      - Acq*Knowledge* 3.9 Mac
- Always duplicate waveform!!

Hints for minimizing data error

- Subject should remain as relaxed as possible
- Subject must avoid excessive extraneous movement
- Press ESC to add a marker every time you give the subject an instruction
- Add text to describe all interventions
- During comparative data analysis, ensure that all scales are the same for every channel
- Remove all jewelry or other metal objects
- Check all cable connections
- RECORD BASELINE PERIOD!

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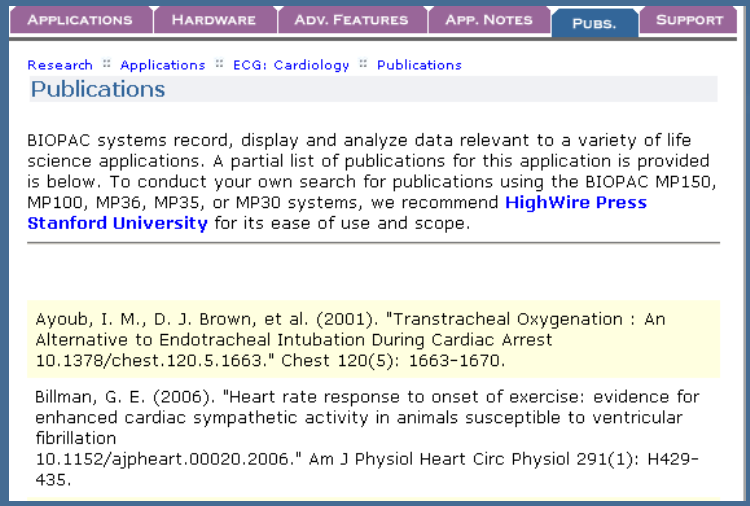
Online Resources

- Application notes

- Publications



- Knowledge base

- Product Resources tab