

# MRI RESEARCH

## CATALOG

*For the Life Sciences*



### MRI Solutions for Human and Animal Studies

- Physiological Data Acquisition Systems
- AcqKnowledge Software—automation & specialized MRI tools
- Remote Monitor
- MRI Smart Amplifiers
- **New!** Transducers, Electrodes, and Accessories
- Human-safe Isolated RF Cable/Filter Systems

**NOW  
MORE SIGNALS!**  
CITED IN THOUSANDS  
OF PUBLICATIONS



**BIOPAC**<sup>®</sup>  
Systems, Inc.

Registered to ISO 9001:2015



# BIOPAC – High-Quality Data for

**BIOPAC provides physiological data acquisition and analysis systems specifically for human and small animal MRI life science research applications.**

BIOPAC offers data acquisition systems, MRI Smart Amplifiers, transducers, stimulus options, electrodes, and leads with advanced software tools for safe data collection, subject monitoring, and cleaner physiological signals in the MRI environment.

**MP Systems and amplifiers are placed in the MRI Control Room, and specialized cable systems optimize data quality with isolated and RF filtered interfacing between the subject/MRI Chamber and the Control Room. Filter leakage currents and dielectric isolation satisfy IEC60601-1.**

Systems include AcqKnowledge software with rich display and monitoring features, plus automation and scoring routines to provide a flexible solution for life science research.

MRI Smart Amplifiers incorporate advanced signal processing circuitry which removes spurious MRI artifact from the source physiological data.

Use the BIOPAC Remote Monitor licensed feature for a simplified view of subject data across an IP network on another computer or a mobile device. The monitor displays trend data

## **Amplifier & Transducer Options:**

- **Biopotentials: ECG, EEG, EGG, EMG, EOG**
- **Airflow & Gas Analysis**
- **Blood Pressure—Human and Animal**
- **Differential Pressure**
- **Electrodermal Activity (EDA)**
- **Gating Units (digital trigger)**
- **Force**
- **Laser Doppler Flow**
- **Micro Pressure Measurement**
- **Pulse**
- **SpO<sub>2</sub>**
- **Respiration**
- **Stimulation**
- **Subject Feedback**
- **Temperature**

Additional amplifiers & transducers available for non-MRI applications.



Demos online



and current data values. It's a convenient way to view the data on other computers in the MRI suite.

Each MP System includes all the necessary hardware and software required to turn any computer into a powerful data acquisition workstation specifically designed for life science applications.

The MP System will reduce your equipment setup time and increase the quality of your physiological data. The MP System gives you publication results with minimum effort.

BIOPAC's range of amplifiers further enhances your ability to create a system to suit your application requirements. Amplifiers snap together and pull apart for simple substitutions. The system is small and easily transported from the lab to the MRI Control Room.

To put together a system for your specific needs, start with one of our Starter Systems, then add the amplifier modules, transducers, isolated RF cable/filter systems, and electrodes to match your research design.

## **Isolated RF Filtered Cable Systems**

**MRI Cable/Filter systems include the cables and isolated RF filtering necessary to safely connect from the subject in the MRI chamber room to the amplifier in the MRI control room. Systems are available for biopotential and transducer amplifiers, general and high-level transducer amplifiers, stimulus isolation, and more!**

## **Electrodes & Leads**

*MR Safe and MR Conditional options*

**Reusable and disposable electrodes and leads provide high quality signals. Gels and accessories also available.**

## MP160 Data Acquisition & AcqKnowledge®

Combine the sophistication and performance of BIOPAC data acquisition hardware with the power and flexibility of AcqKnowledge software to customize your acquisition and analysis system for life science research in the MRI.



### MP160 data acquisition provides:

- High resolution – 16 bit
- High speed – up to 400 kHz aggregate
- Variable sample rates (analog & calculation channels)
- 16 analog inputs and 2 independent analog outputs
- Digital I/O lines (receive/send TTL triggers)
- 16 online calculation channels
- Ethernet connectivity – fast & efficient
- Safety

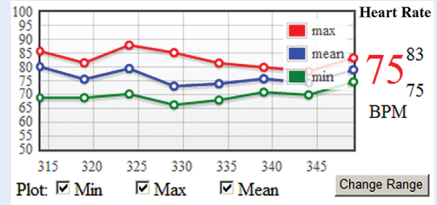
### AcqKnowledge® SOFTWARE

The AcqKnowledge software included with each MP System is a highly interactive user-friendly application with intuitive controls that lets you instantly view, measure, analyze, and transform data. Perform complex data acquisition, triggering and analyses using simple pull-down menus and dialogs – no need to learn a programming language or new protocol.

- **Acquisition Features** – variable sample rates, pause mode, and stimulation design and control. Online analysis settings, filters and transformations provide real-time recording feedback.

Software runs on Windows OS or Mac OS X.

- **Remote Monitor** – Simplified user interface to view subject data on another machine – bedside monitor display. Track the welfare of the subject with alarms to warn when signals fall out of range. The system will work on any device that has access to the same IP based network as the MP160.



- **Display Features** – multiple display modes, advanced grid system, journal facility for note taking, textual event markers, and measurement tools. Mouse-over tool tips (for sample rate, channel rate, measurement results, etc.) help guide application use.
- **Analysis Features** – signal averaging, sophisticated pulmonary integration routines, filtering, FFT, histogram, automatic data reduction, template analysis, peak detection features, find rate settings, and an equation generator.
- **Automated Analysis Routines** – ECG, HRV, EDA, EMG, EEG, BP, LVP, MRI, Pulmonary, and more!
- **MRI optimization routines** – artifact removal, signal blanking, and slew rate limiter.
- **BIOPAC Developer** – Customize and automate your analysis routines with Developer tools including BIOPAC Basic Scripting, Network Data Transfer, or API.
- **Support Features** – real-time, searchable user guides (PDF) as well as extensive online support and training options. Plus, Quick Start template files are included to make it even easier to start your experiment.





## MRI Product Line for Human and Animal Protocols

**NEW!**

BIOPAC has expanded its line of specialized MRI products. MRI Smart Amplifiers and the MRI Cable/Filter systems provide isolated and RF-filtered interfacing between the subject/MRI chamber and the MRI control room to improve signal quality and optimize safety.

With BIOPAC's expanded line of MRI Smart Amplifiers and compatible transducers, you can record physiological signals such as: ECG, EEG, EGG, EMG, EOG, noninvasive blood pressure for human and animal, pulse, respiration, SpO<sub>2</sub>, temperature, electrodermal activity, hand grip strength (dynamometry), finger twitch, and a variety of pressure-based signals.

For small animal cardiovascular and neuro studies, use the TSD104A-MRI Pressure Transducer or a Micro Pressure Measurement System to record pressure signals such as BP, LVP, and cranial pressure. Measure microvascular blood perfusion with the Laser Doppler Flow System.

Specified electrodes, leads, and stimulus options provide safe data acquisition of physiological signals in the MRI environment. Caution is required whenever employing electrode leads and electrodes in an MRI environment—see “[Safety Guidelines](#)” online.

“MR Safe” Products are non-conducting, non-metallic, and non-magnetic items that pose no known hazards in all MRI environments.

“MR Conditional” Products pose no known hazards in a specified MR environment with specified conditions of use, e.g., field strength or lead configuration.

Generally considered, if a transducer is MR Safe or MR Conditional, the transducer signal can be recorded during MRI scanning. Transducer signals are typically high level and slow moving. These two features allow the transducer signal to be easily filtered to remove MRI artifact, if any.

For MR Declarations and Application Notes on connections, analysis tools, and safety when recording physiological data in MRI or fMRI, go to [www.biopac.com](http://www.biopac.com).

### BIOPAC's MRI solutions include:

Airflow & Gas Analysis	Gating (Trigger/Synch)	SpO <sub>2</sub>
Biopotential Signals	Laser Doppler Flow	Stimulation
Blood Pressure	Pulse	Subject Feedback
Electrodermal Activity	Respiration	Temperature

*Learn more online!*



### MRI Cable/Filter System Interface Guide



Sample isolated RF filters and cables



#### MECMRI-BIOP SYSTEM

Biopotential Amplifiers  
 ECG100C-MRI EMG100C-MRI  
 EEG100C-MRI EGG EOG

#### MECMRI-DA SYSTEM

General-Purpose Trans. Amplifier  
 TSD104A-MRI TSD117A-MRI  
 TSD121B-MRI

#### MECMRI-HLT SYSTEM

High-level Transducer Amplifier  
 TSD131-MRI TSD115-MRI

#### MECMRI-NICO SYSTEM

Impedance Cardiography Amplifier  
 NICO100C-MRI STMEPM-MRI

#### MECMRI-TRANS SYSTEM

Transducer Amplifiers  
 EDA100C-MRI RSP100C  
 SKT100C PPG100C-MRI

#### MECMRI-STMISO SYSTEM

STMISOC/D/E TO STM100C  
 CBL207 TO STM200

#### PNEUMATIC LINES

No Electrical MRI Cable/Filter  
 Required—Use DA100C  
 TSD110-MRI TSD137 SERIES



When recording biopotentials in the MRI, several scenarios are possible:

- A. MRI Gating: gate the MRI using a cardiac signal (ECG, pulse, or BP) and/or a respiration signal—see DTU100 and DTU200/300, *page 6*.
- B. Record between periods of MRI operation (gradient switching and RF pulsing) with latency periods long enough to acquire the signal of interest.
- C. Record continuously concurrent with MRI operation—see *MRI App. Notes* for details.

MRI Smart Amplifiers remove MRI artifact from the source physiological data. Signal processors distinguish between the physiological signal and MRI artifact as manifested by gradient switching/RF pulsing during MRI sequences, such as any Spin Echo Sequence (e.g., EPI). Since MRI Smart Amplifiers remove most MRI-related artifact at the source, signals can often be sampled at the same rate as during non-MRI recording.

Many variables can influence biopotential recording in an MRI (lead placement and length, electrode location, MRI protocol, etc.). For best performance, use the shortest lead possible. Attention to detail is required to record continuous biopotentials during MRI scanning.

**IMPORTANT!** Caution is required whenever employing electrode leads and electrodes in an MRI environment—see “Safety Guidelines” online.



### Radiotranslucent Leads & Electrodes

- Leads: LEAD108 (1.8 m), LEAD108A (3.6 m), LEAD108B (15 m), LEAD108C (30 m)
- Electrodes: Disposable EL508 (gel), EL509 (dry) or EL510 (3 x gel with leads)
- Reusable EL254RT (4 mm) or EL258RT (8 mm)

### ECG Electrocardiogram

- MECMRI-BIOP + ECG100C-MRI amp + lead/electrodes
- Record small animal ECG with the cable/filter system and radiotranslucent electrodes
- For an audible reference of the subject's heart rate while in the imager, add an ECG alarm (OUT102)
- Alternatives when looking at real-time BPM, HRV, etc.
  - MECMRI-DA + DA100C + AFT30-XL tubing (included) through wave guide + TSD110-MRI

### EEG Electroencephalogram

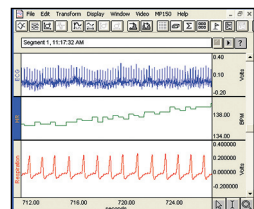
- MECMRI-BIOP + EEG100C-MRI amp + lead/electrodes

### EGG Electrogastrogram or EOG Electrooculogram

- Contact BIOPAC for setup options.

### EMG Electromyogram

- MECMRI-BIOP + EMG100C-MRI amp + lead/electrodes
- Recommended alternatives—see Subject Feedback, *page 9*.
- Clench Force: MECMRI-DA + DA100C amp + TSD121B-MRI
- Hand Response: DA100C amp + TSD114-MRI
- Facial Twitch/Finger Tap Response: DA100C amp + TSD110-MRI
- Finger Twitch: MECMRI-HLT + HLT100C interface + TSD131-MRI



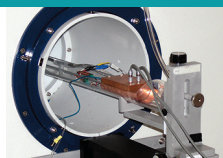
Mouse ECG, HR, Respiration



**Airflow & Gas Analysis**  
**Biopotentials — page 4**  
**Blood Pressure**

**Gating Systems**  
**Respiration**  
**SpO<sub>2</sub>**

**Microvascular Flow**  
**Stimulation — page 10**



## Airflow & Gas Analysis

**Setup:** TSD137 or TSD237 series + DA100C amp (flow heads from .05 L/sec to 2.6 L/sec)

Transducers consist of a low flow, pneumotach airflow head coupled to a highly sensitive, differential pressure transducer and connect directly to an airflow cannula and non-rebreathing valve.

TSD137 (heated) or TSD237 (unheated; low thermal inertia)

**MR Conditional:** Contains ferrous material—must be clamped down in the safe MRI operating area.

## Gas Analysis

**Setup:** CO2100C amp + 02100C amp + AFT31-MRI gas sampling tubing

## Blood Pressure

### Arterial Blood Pressure

#### General Arterial Pressure

**Setup:** MECMRI-DA + DA100C amp + TSD104A-MRI transducer

#### Micro Pressure

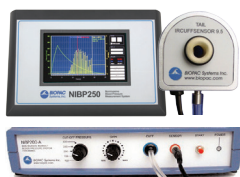
**Setup:** MPMS200 control unit + TSD281 (5 cm) or TSD283 (15 cm) transducer

This compact, rugged, single-channel fiber optic micro pressure measurement system is ideal for small animal physiological pressure monitoring. Provides an analog output signal in the  $\pm 5$  V range and has a 250 Hz frequency range; sensor tip diameter 0.30 mm (1 French). High resolution system easily interfaces with BIOPAC or 3rd-party DAQs and has automatic atmospheric pressure correction.



### Small Animal Noninvasive Blood Pressure

**Setup:** NIBP200A or NIBP250 system + RXCUFSEN9.5/11/13-MRI transducer



These NIBP modules incorporate a built-in pump that automatically inflates the blood pressure cuff to occlude the vessel. Once the pump reaches the inflation point it slowly deflates the cuff, providing a linear drop in pressure. A single pushbutton controls both the inflation and deflation cycles, making the system very operator friendly.

**MR Conditional** fiber optic cuff/sensor transducers have an 8 m cable and fit 9.5, 11, or 13 mm tail diameters (approx. animal size 100 g-350 g).

## Oxygen Saturation

**Setup:** OXY300-MRI

*Monitor Subject health or use for MRI Gating*

Noninvasive Vital Signs Monitor provides immediate access to and alarms for pre-, intra-, and post-operative Arterial Oxygen Saturation, Heart Rate, and Pulse Distention. Supports heart rates 90-900 BPM for conscious or anesthetized neonatal mice, rats, or other small animals  $\leq 500$  grams.

Includes MouseOx<sup>®</sup> Plus Monitor, MRI sensor cabling with four disposable sensor clips, StarrLink analog output unit, interface cables to BIOPAC MP System.



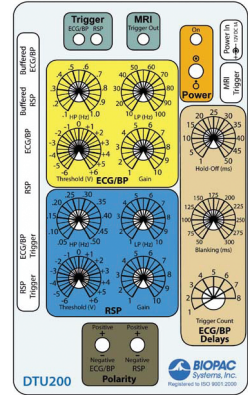
### Gating Units

The gating unit is placed in the control room with the MP System and amplifiers.

#### Dual-Channel Gating

*Setup:* DTU200 Gating system

- Cardio/Respiratory System (DTU200) - Dual channel gating unit for small animal cardiac gating. The unit simultaneously monitors a cardiac signal (ECG, pulse, or BP) and a respiration signal, and provides amplification and signal conditioning. A TTL MRI trigger is output for a predetermined number of heart beats after the respiration cycle. The MRI trigger is coincident with each heartbeat and incorporates blanking to remove MRI artifact to prevent false triggering. The MRI is triggered during the animal's quiet time, which minimizes movement and maximizes image quality. A variety of output signals and conditions can be monitored during the experiment.



#### Digital Trigger

*Setup:* HLT100C interface module + DTU100 Trigger

- Single channel gating unit (DTU100) - provides a TTL trigger pulse from any physiological signal. The system is usually used with either ECG, blood pressure, or respiration signals. See page 7 for more information.

### Microvascular/Laser Doppler Flow

*Setup:* LDF100C amp + TSD147AL probe (1 m) + TSD148 driver (2 m)

For acute preparations inside the MRI, use the LDF100C laser Doppler tissue perfusion monitor to measure microvascular blood flow in tissue. The LDF100C amplifier delivers a low power beam of laser light down an optical fiber to the tissue being studied; typically, the volume of tissue sampled by the light is in the order of 1mm<sup>3</sup>.

### Respiration

*Setup:* DA100C amp + TSD110-MRI transducer/sensor/tubing

For high-quality respiration signals, place the anesthetized animal on the sensor pad and run the tubing through the wave guide to attach to the pressure transducer on the DA100C amp.

### Temperature

#### Stand-alone Fiber-Optic Temperature System

*Setup:* FOTS100 + TSD180 fiber-optic temperature transducer. See page 10 for details.

Recommended for rectal temperature, due to size.

#### Temperature Amplifier

*Setup:* MECMRI-TRANS + SKT100C amp + TSD202A or E surface transducer

The SKT100C amplifier module measures surface, core, or air temperature with resolution of 0.0001°C.





## Airflow & Gas Analysis

**Biopotentials** — page 4

**Electrodermal Activity** — EDA (GSR)

**Gating Units**

## Noninvasive Blood Pressure

**Noninvasive Cardiac Output**

**Pulse**

**Respiration**

## SpO<sub>2</sub>

**Stimulation** — page 10

**Subject Feedback**

**Temperature**

## Airflow & Gas Analysis

Perform a variety of tests. Place transducer outside the bore in the MRI Chamber Room and run tubing to connect to the subject and breathing accessories; place amp in Control Room.

*End Tidal CO<sub>2</sub> Setup:* CO2100C amp + AFT31-MRI tubing + AFT35-MRI airflow kit

*Airflow & Lung Volume Setup:* DA100C + MECMRI-DA + TSD117A-MRI ±300 L/min transducer + AFT11A + AFT7-L + AFT35-MRI + Optional - add End Tidal: AFT31-MRI + CO2100C

*Metabolic Setup:* DA100C + MECMRI-DA + TSD117A-MRI ±300 L/min transducer + to transducer port A: AFT11A + AFT7-L + AFT35-MRI and to transducer port B: AFT11A + AFT7 + AFT15A/B + AFT31-MRI + CO2100C and/or O2100C



**AFT Accessories** Go to [biopac.com](http://biopac.com) for the complete line of MR Safe options

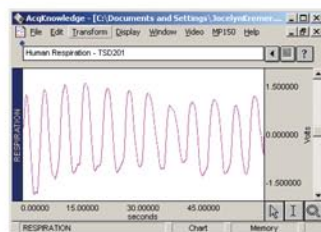
- Subject Airflow Kit: AFT35-MRI (right-angle port, T-valve, mouthpiece, face mask, and noseclips) provides 6 cm or 12 cm clearance from mouth to fMRI coil.
- Tubing: 30 mm ID AFT7 (1 m) and AFT7-L (3 m)  
3.175 mm ID AFT31-MRI (10 m, male & female Luer locks, “Y” adapter)
- Couplers: AFT11D joins AFT7 tubing segments, AFT11A connects AFT7 to TSD117-MRI
- Mixing Chamber: AFT15A ( 5 L) or AFT15B (8 L)

## Respiration

### Fully-pneumatic Respiration Transducer

*Setup:* DA100C amplifier + TSD221-MRI transducer

Measure thoracic or abdominal respiration in the MRI with minimal resistance to movement. The TSD221-MRI includes the respiration sensor in a mesh strap with self-adhering band (70 cm), a pressure transducer ( $\pm 12.5$  cm H<sub>2</sub>O), and three cascable segments of tubing for up to 15.8 m. Has no ferrous metals or conductive parts and does not require the MECMRI-DA.



Respiration data

## Gating & Trigger Units

### Digital Trigger / R-Wave Sync DTU100

*Setup:* HLT100C interface module + DTU100 Trigger

Trigger a MRI System with the occurrence of the R-wave present in ECG, respiratory data or blood pressure for gating purposes. This external hardware unit accepts data from any pulsatile analog output associated with an MP System and converts it into a TTL-compatible trigger to trigger an MRI.

### Cardio/Respiratory Gating DTU300

*Setup:* DTU300 Gating System

Use the DTU300 to trigger the MRI on the basis of two physiological signals, such as a cardiac signal (ECG, pulse, or BP) plus a respiration signal. See page 6 for details.

### Trigger Isolation INISO-TRIG

*Setup:* HLT100C interface module + INISO-TRIG

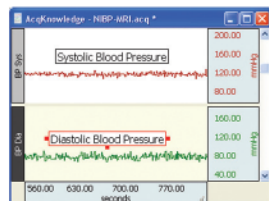
Provides isolation and allows trigger pulses to be recorded at lower sample rates.



## Noninvasive Blood Pressure - Wireless, real-time beat-to-beat values

**Setup:** HLT100C interface module + NIBP-MRI

Track systolic and diastolic BP (using Pulse Decomposition Analysis technology); analyze timing and amplitudes of the primary left ventricular ejection pulse as well as the arterial pulse reflections.



NIBP-MRI data



## Noninvasive Cardiac Output

**Setup:** MECMRI-NICO + NICO100C-MRI amp + leads/electrodes

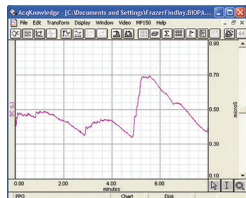
Simultaneously measure impedance magnitude ( $Z_o$ ) and derivative ( $dZ/dt$ ).



## Electrodermal Activity

**Setup:** MECMRI-TRANS + EDA100C-MRI amplifier + lead/electrodes

Record EDA inside the MRI. Use AcqKnowledge software filters to improve the quality of the EDA signal, if required, and provide automated analysis.



EDA data

### Electrodes

- **Disposable:** For excellent EDA responses, BIOPAC recommends EL509 dry disposable electrodes with GEL101 and LEAD108 (1.8 m), LEAD108A (3.6 m), LEAD108B (15 cm), or LEAD108C (30 cm).
- **Reusable:** Disposable electrodes are recommended, but reusable TSD203 electrodes will also work for skin conductance.



## Pulse

### Pulse - Photo Plethysmograph

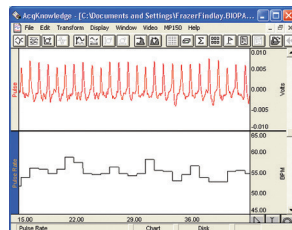
**Setup:** MECMRI-TRANS + PPG100C-MRI amp + TSD200-MRI transducer

The TSD200-MRI transducer is sensitive to Blood Volume Pulse (BVP) via photo-plethysmographic methods. Use it to record the blood volume pulse pressure waveform. It's primarily designed for finger or toe attachment, but can be taped to other body locations with TAPE1.

### Pulse - Pressure Pad

**Setup:** DA100C amp + AFT30-XL tubing (included) through wave guide + TSD110-MRI transducer

The TSD110-MRI consists of a differential pressure transducer, sensor, and tubing. Use it to record pulse and pulse rate—it requires no electrical connections between MRI control and chamber rooms and works on a number of body locations. Affix to finger or major pulse point with TAPE1.



Pulse data



## Oxygen Saturation

**Setup:** OXY-MRI

**New!** Use as stand alone system or connect to MP System

SpO<sub>2</sub> amplifier with fiber-optic finger sensor for adult human pulse oximetry. Pulse Rate Range: 18-321 BPM, Saturation Accuracy (Arms): 70-100% ± 2 digits. Includes isolation adapter and cables to connect to an existing HLT100C for MP Systems. Additional finger sensors available: OXY-MRI-SENSOR.



### Subject Feedback

BIOPAC offers a range of subject feedback devices for use inside the MRI.

#### Clench Force

*Setup:* MECMRI-DA + DA100C amp + TSD121B-MRI transducer

Use TSD121B-MRI hand dynamometer to measure clench force. The lightweight, ergonomically designed transducer provides direct readings in kilograms or pounds. The isometric design improves experiment repeatability and accuracy.



#### Hand Response

*Setup:* DA100C amp + TSD114-MRI transducer

Use TSD114-MRI Pump Bulb Transducer when the subject has to give either a monotonically variable or on/off response. The subject holds the bulb in one hand and squeezes to give a response. Use two bulbs for more complicated responses. The bulb is attached to a length of tubing that connects to the included pressure transducer.

#### Response Pad

*Setup:* DA100C amp + TSD110-MRI transducer

Mount the TSD110-MRI pressure pad in the scanner so that the subject can tap it to respond (monotonically variable or on/off) to a stimulus. Use multiple transducers for complex applications. Consists of differential pressure transducer, sensor, and tubing. See *Pulse* on page 8 for transducer details.

The multi-purpose assembly can also be used to measure small pressing forces (like pinching fingers together) for Parkinson's evaluations, human facial expressions (including startle blink response, smiling, frowning, etc.), or spacing and pressure between teeth coming together.

#### Finger Twitch/Position

*Setup:* MECMRI-HLT + HLT100C interface + TSD131-MRI transducer

Use TSD131-MRI to record finger twitch responses or finger position from human subjects in the MRI. Conforms to the shape of the finger and attaches via Velcro straps.



#### Tri-Axial Accelerometry

*Setup:* HLT100C interface + TSD109C2-MRI transducer (includes MECMRI-7)

Use this very small tri-axial accelerometer to capture subtle gestures, slow movements, or tapping responses. The high level output transducer ( $\pm 5$  G) is 33 mm x 28 mm x 9 mm and provides three outputs, simultaneously measuring acceleration along the X-, Y- and Z-axes, with frequency response from DC to 500 Hz. Place on fingers, hand, toes, foot, etc.



#### Variable Assessment

*Setup:* MECMRI-HLT + HLT100C interface + TSD115-MRI transducer

The TSD115-MRI incorporates a slide control with graduated scale that allows the user to gauge his/her subjective response to a variety of different stimuli. The transducer is lightweight and fits easily into the subject's hand or lap.



#### Fiber Optic Response Devices

BIOPAC offers a range of fiber optic response devices that interface with the MP160 and a variety of visual presentation systems; call for details.



### Temperature

#### Temperature Amplifier

*Setup:* MECMRI-TRANS + SKT100C amp + TSD202A-MRI probe

The SKT amplifier module measures surface or air temperature with resolution up to 0.0001°C.

- TSD202A-MRI - Very small, fast response probe.



### Stand-alone Fiber-Optic Temperature System

**Setup:** FOTS unit + TSD temperature probe

Fiber-Optic Temperature (FOTS100 for up to 3T) and High-field Fiber Optic Temperature (FOTS200) Systems — no local heating. Stand-alone FOTS can easily interface BIOPAC with added cabling.



- FOTS100 + Temp Probe: TSD180 or TSD182 rectal 0.42 mm OD, surface TSD181 3 mm OD
- FOTS200 + High-field Temp Probe: TSD380 rectal 0.9 mm OD, surface TSD381 3 mm OD

## STIMULATION

For Comprehensive Safety Guidelines, see “Safe Use of Electrical Stimulators” online.

### Stimulation—Constant Current/Constant Voltage

**Setup:** MECMRI-STMISO + STMISOC/D/E stim isolation adapter + STM100C stimulator + lead/electrodes

Use the stimulator to deliver a variety of electrical stimulation paradigms. AcqKnowledge software provides single pulse, pulse trains, and arbitrary waveform output options.



### Stimulation—Unipolar Wide Pulse

**Setup:** MECMRI-STMISO + CBL207 + STM200 stimulator + lead/electrodes

Use the stimulator for animal studies, including pain and stress studies that require lower voltages and wider pulse widths. Trigger the stimulator from the MP160 or a visual presentation system (see below). Use for high-energy nerve or muscle stimulation.



### Stimulation Electrodes

Use disposable or reusable electrodes for subject stimulation.

- Disposable: EL509 dry electrodes plus GEL104 + LEAD108 Series electrode leads
- Reusable: EL254RT/258RT plus GEL104 + ADD200 Series collars
- Gel: GEL104 salt-free and chloride-free electrically conductive gel

### Visual Presentation

#### SuperLab

**Setup:** STP100W Stimulus Presentation System

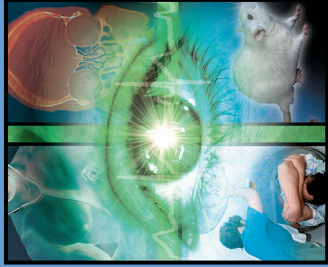
The STP100W can present visual stimuli or auditory stimuli, and simultaneously (1ms resolution) send trigger signals to an MP160 for data synchronization and collection purposes. *Optional:* STIMTRACKER universal marker interface, provides digital trigger info from SuperLab

#### E-Prime, DirectRT, MediaLab, Presentation, etc.

**Setup:** STP100C isolated digital interface with CBL110C (optional: splitter CBL110C-Y) Connect to the computer’s parallel printer port to send digital I/O info.

*Optional:* STMEPM-MRI Programmable Stim System for E-Prime. Control stim frequency/intensity for real-time stim delivery based on a subject’s responses, or predefine stim levels for presentation.

## High-Quality Physiological Data for MRI Studies



- MRI Smart Amplifiers
- Biopotentials
- Airflow & Gas Analysis
- Blood Pressure
- Differential Pressure
- Electrodermal Activity
- Gating Trigger Units
- Force
- Laser Doppler Flow
- Micro Pressure
- Noninvasive Blood Pressure
- Respiration
- SpO<sub>2</sub>
- Stimulation
- Subject Feedback
- Temperature
- Visual Presentation



Registered to ISO 9001:2015

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Golesta, CA 93117

