DELSYS®

Bagnoli™ EMG System

User's Guide

Bagnoli™ EMG System

User's Guide

PM-B05

Specifications and procedures outlined in this document are subject to change without notice.

MAN-004-1-5

Important Information

Intended Use

The Bagnoli™ EMG Systems are biofeedback devices intended for research, investigational and scholarship purposes only. Delsys® products are not intended for measurement purposes or for use in the treatment and diagnosis of disease. Interpretation of the EMG signal by a qualified professional is required.

Rx ONLY

Contraindications

DO NOT USE on Patients with implanted electronic devices of any kind, including cardiac pace-makers or similar assistive devices, electronic infusion pumps, and implanted stimulators.

DO NOT USE on irritated skin or open wounds.

DO NOT USE on Patients with allergies to Silver.

Technical Service and Support

For information and assistance visit our web site at:

www.delsys.com

Contact us at:

E-mail: support@delsys.com
tel: (508) 545-8200

Warnings and Precautions

Consult all accompanying documents for precautionary statements and other important information.

Consult accompanying user's guide for detailed instructions.

Keep the device dry. The presence of liquids may compromise the safety features of the device.

Handle with care.

Sensitive electronic device. Avoid static discharges. Do not operate or store near strong electrostatic, electromagnetic, magnetic or radioactive fields. Interference from external sources may decrease the signal-to-noise ratio or result in corrupted data.

This device may cause electrical disturbances in sensitive equipment within its operating environment.

Connect only to Delsys-approved devices.

Connecting a patient to high-frequency surgical equipment while using Delsys EMG systems may result in burns at the site of the EMG sensor contacts.

Immediately discontinue device use if skin irritation or discomfort occurs.

Immediately discontinue device use if a change in the device's performance is noted. Contact Delsys technical support for assistance.

Delsys Inc. guarantees the safety, reliability, and performance of the equipment only if assembly, modifications and repairs are carried out by authorized technicians; the electrical installation complies with the appropriate requirements; and the equipment is used in accordance with the instructions for use.

Device Information

Complies with Requirements put forth by the Medical Device Directive 93/42/EEC. Class I device, Annex VII.

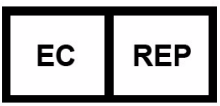
Type BF device (IEC 60601-1).

Isolated device, (Class II, IEC 60601-1)

Do not dispose this product with house waste. Contact Delsys Inc. for instructions on responsibly disposing this device. This product should not be mixed with other commercial wastes.

Date of Manufacturing (appears on device)

Serial Number (appears on device)



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Manufacturer

Disclaimer

DELSYS INC. makes no warranties, express or implied, as to the quality and performance of this product including but not limited to, any implied warranty of applicability for other than research uses by qualified individuals. DELSYS INC. shall not be liable to any person for any medical expenses or any direct or consequential damages resulting from any defect, failure or malfunction, whether a claim for such damages is based upon theory of warranty, contract, tort or otherwise. No representative, agent, or licensed practitioner is authorized to waive this disclaimer. DELSYS INC. makes no diagnosis or prescription by virtue of anything about this product.

Limited Warranty

The Bagnoli™ EMG Systems are warranted against failure of materials and workmanship for a period of 1 year from the date of delivery, provided that the product is given proper care and has not been subject to abuse during this period. This warranty is in lieu of all other warranties expressed or implied. Operation of this device outside specifications determined by DELSYS INC. or use with any other input devices other than DELSYS INC. sensors constitute an invalidation of this limited warranty. This warranty is not transferable.

Bagnoli EMG System

The Bagnoli EMG Systems are available in 4, 8, and 16 channel models, and are designed to make the acquisition of EMG signals hassle-free and reliable. These units produce conditioned, isolated, analog signals which can be readily connected to all Motion Capture or stand-alone data acquisition systems. Selectable gains, built-in signal quality checks, and ultralight parallel-bar sensors make Bagnoli EMG Systems practical in both lab and field environments.

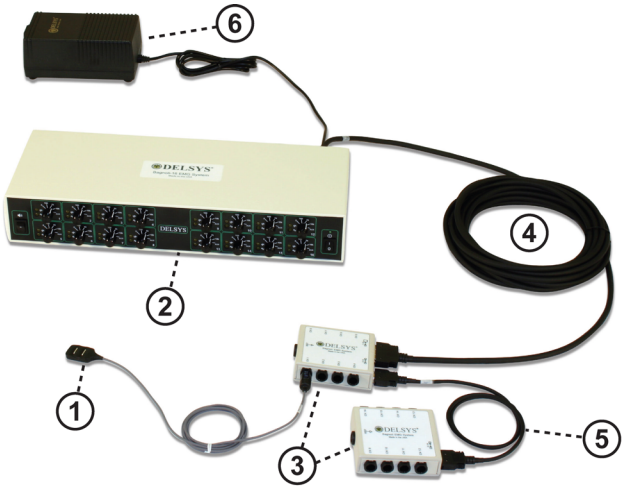


Figure 1. Bagnoli-16 EMG System

1	Sensor	4	Input Module Cable
2	Main Amplifier	5	InterModule cable
3	Input Module(s)	6	International Power Supply

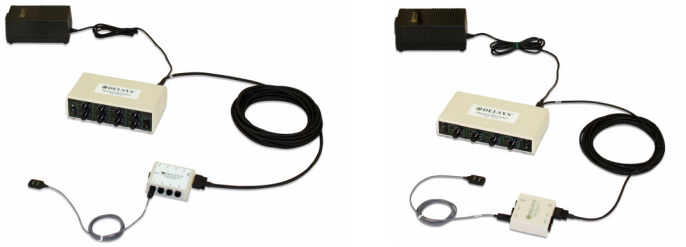


Figure 2. Bagnoli-8 (left) and Bagnoli-4 (right) EMG Systems.

Bagnoli System Components

Main Amplifier Unit

This desktop unit supplies power to the EMG and Biosignal Sensors, and provides conditioning and management of the detected signals to produce robust outputs.

Each channel has a selectable gain which can be set to a factor of 100, 1000 or 10000. At these gain settings, the Main Amplifier Unit filters the signals to a bandwidth between 20 Hz and 450 Hz and checks for excessive amounts of line interference as well as channel clipping due to over-amplified signals. The presence of these errors is signaled via yellow LEDs and through a user-enabled audio buzzer alarm. There is also an “AUX” setting for each channel, which is designed for the use of Delsys Biosignal Sensors.

The analog channel outputs can be accessed via convenient BNC connectors or connected directly to a data acquisition system via the high-density D-Sub (HD68) connector located on the rear panel. A triggering port located on the rear panel allows the user to start and stop data acquisition with an external signal or to output a trigger signal to synchronize other data collection equipment.

Figure 3. Bagnoli-16 Main Amplifier Unit

DE-2.1 Single Differential Surface EMG Sensor

The DE 2.1 EMG Sensor subtracts EMG potentials detected at two distinct locations on the surface of the skin directly above an active muscle. The EMG potentials are always measured with respect to the electric potential of a neutral site located away from the EMG muscle source. This potential is detected by the Reference Electrode.

The sensor is designed using a parallel-bar contact geometry for ensuring signal stability, repeatability between recordings and optimal frequency content representation. This versatile sensor is well-suited for most EMG applications and ideal for both large and small muscles.

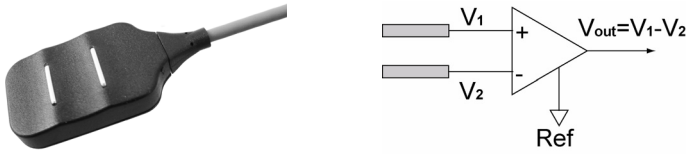


Figure 4. DE-2.1 Single Differential Surface EMG Sensor. The surface EMG signal is the result of the potential difference between V_1 and V_2 on the skin surface.

The sensor housing is constructed from durable polycarbonate and completely sealed. It is also internally shielded to reject ambient electrical noise. The sensor contacts are made from 99.9% pure silver bars measuring 10mm in length, 1mm in diameter and spaced 10mm apart for optimal signal detection and consistency. The curved enclosure geometry is designed to maximize skin contact and adhesion while minimizing the negative effects of sweat during vigorous activities.

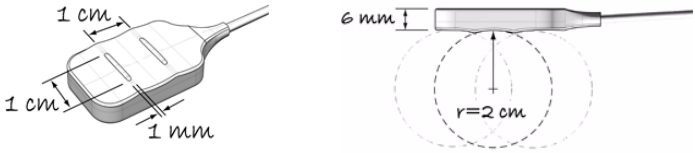


Figure 5. DE-2.1 EMG Sensor Geometry.

Input Modules

The Input Modules host the EMG and Biosignal Sensors, and the Reference Electrode cable. The Input Module for the Bagnoli-4 hosts four Sensors while that for the Bagnoli-8 hosts eight. The Bagnoli-16 uses two Input Modules that each host eight Sensors. Each Input Module has a belt clip which facilitates easy fastening to waist belts or other articles of clothing.

Figure 6. Input Modules

Input Cable

The Input Cable connects the primary Input Module with the Main Amplifier Unit, supplying power to the active EMG and Biosignal Sensors and transmitting signals back to the Main Amplifier Unit.

Figure 7. Input Cable.

InterModule Cable (Bagnoli-16 Only)

The Bagnoli-16 EMG System uses two Input Modules. The InterModule cable is used to bridge these together. The modular design allows the user to use only the Ch. 1-8 Input Module if channels 9-16 are not being used.

Figure 8. InterModule Cable.

EMG Accessory Kit

All Bagnoli Systems include the essential accessories to get started with hassle-free EMG detection, including:

- Adhesive Sensor Interfaces
- Reference Electrodes
- Reference Electrode Cable

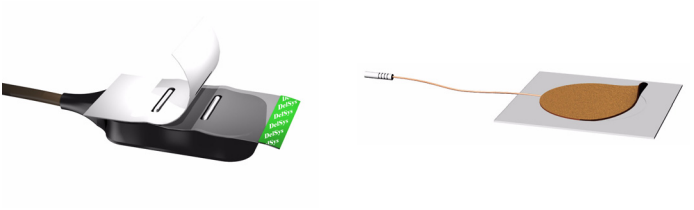


Figure 9. The EMG Accessory Kit includes Adhesive Sensor Interfaces and Reference Electrodes.

Power Supply

The Bagnoli EMG Systems include a Medical Grade power supply. This supply conforms to IEC 60601-1 safety standards. The power supply is fitted with a universal IEC 320 input plug so as to accept power cables from all countries. The input is satiable to 115 or 230 VAC, accepting either 50 or 60 Hz. The user should make sure that the power supply is configured to the local line voltage by setting the red Line Voltage Selector switch on the underside of the power supply to the correct voltage. An incorrect setting will result in an internal fuse expiration. Information for replacing the fuse can be found in the Appendices.

Delsys strives to supply the correct power cable for each destination however, it occasionally may be necessary to purchase power cords suitable for the local receptacles in use.

Figure 10. Power Supply.

Figure 11. Underside of Power Supply showing the red Line Voltage Selector switch.

EMGworks® Package (Optional)

The EMGworks Data Acquisition and Analysis Package includes all of the components necessary to control data acquisition using a Bagnoli EMG System and EMGworks on a PC or laptop:

- EMGworks Data Acquisition and Analysis Software
- National Instruments Data Acquisition Card (multiple options are available for PC and laptop)
- National Instruments DAQmx Software
- Output Cable (Connects Bagnoli EMG System to A/D Card)

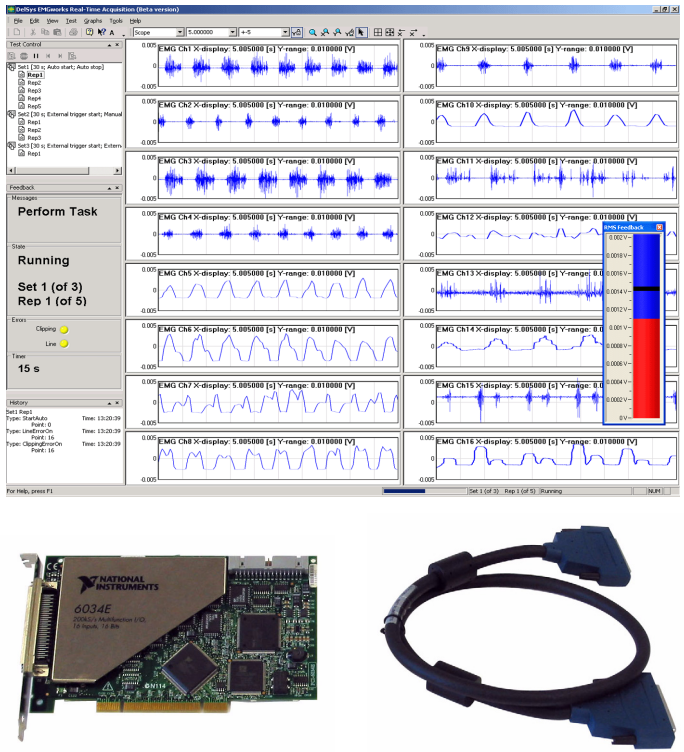


Figure 12. EMGworks Data Acquisition and Analysis Package.

Getting Started with the Bagnoli System

All input and output connections of the Main Amplifier Unit are located on the rear panel of the assembly. The following sections give a detailed description of the steps necessary to set up the system for data acquisition.

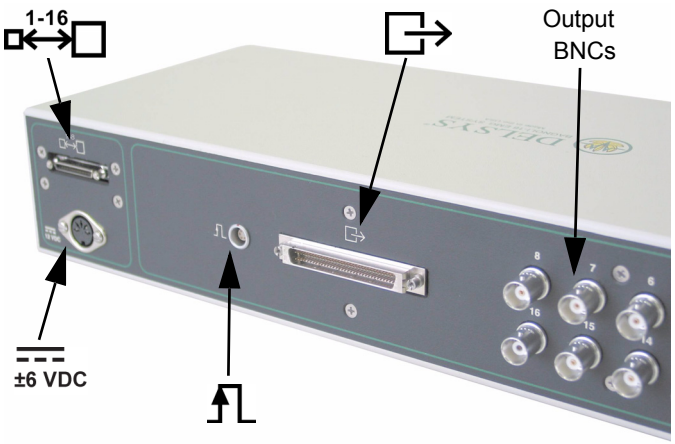


Figure 13. Rear panel view of Bagnoli-16 EMG System showing the input and output connectors.

Connecting the Power Supply

⎓ ±6 VDC

The Power Supply is connected to the circular DIN socket on the left side of the rear panel labeled "+/-6 VDC". Note that the connector is polarized so that it can only be inserted with the correct orientation. The 3-prong line-voltage plug of the power supply should be inserted in a properly functioning and grounded power supply outlet.

Always ensure that the Line Voltage Selector on the Power Supply is correctly set to the mains voltage of your location. An incorrect setting will cause the fuse to expire.

Bagnoli EMG Systems are approved for use only with the power supply provided. Using any other power supply may damage the system and create hazardous situations.

Always use an IEC320 power cable and a properly functioning mains receptacle for powering the Bagnoli EMG System. Non-conforming plugs can result in safety hazards.

Connecting the Output Signals

The Bagnoli EMG System outputs single-ended, analog voltage signals in the ± 5 Volt range. The rear panel of the Main Amplifier Unit hosts two types of output connections: an HD68 Connector and BNC Sockets.

HD68 Connector for EMGworks Package

The HD68 Connector was designed to be used with the EMGworks Signal Acquisition and Analysis Package. It used to connect the Bagnoli EMG System to a National Instruments Data Acquisition Card so that data acquisition can be controlled with EMGworks Software.

To set up the system for use with EMGworks, the National Instruments DAQmx Software must first be installed on the computer that will be used for data acquisition. The National Instruments Data Acquisition Card can then be physically installed.

Consult the documentation provided with the National Instruments A/D Data Acquisition Card for software and hardware installation instructions.

The Output Cable provided with the National Instruments A/D Data Acquisition Card then connects the Main Amplifier Unit HD68 Connector to the A/D Card.

EMGworks must be installed on the computer after the National Instruments Software and A/D Card are properly installed.

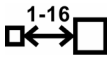
Refer to the documentation provided with EMGworks for detailed installation instructions.

BNC Connectors

The BNC Sockets can be used to easily connect the Main Amplifier Unit to an oscilloscope or other data acquisition devices.

The BNC connectors on the Bagnoli Main Amplifier are outputs only. Connecting signals from other measurement equipment to the BNC connectors will damage the Bagnoli output circuitry.

Connecting the Input Modules



The Input connector is located in the top-left corner of the Bagnoli System rear panel. It is labeled with a connection symbol and reads “1-4” for the Bagnoli-4, “1-8” for the Bagnoli-8, and “1-16” for the Bagnoli 16. Align the connection symbols on the rear panel and the Input Cable, inserting the cable into the receptacle until the latching mechanism secures the connection. Follow the same procedure when connecting the Input Cable to the Input Module.

For the Bagnoli-16 only, the InterModule Cable connects the Channel 1-8 Input Module to the Channel 9-16 Input Module. If Channels 9-16 are not being used, the user does not need to use the InterModule Cable and the second Input Module.

The Input Modules are equipped with belt-clips to facilitate attachment to the patient.

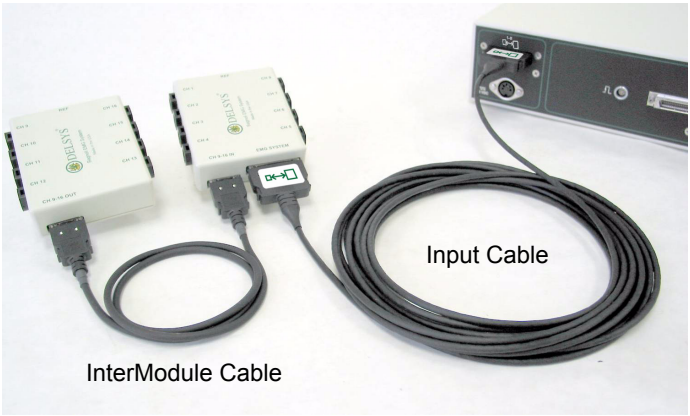


Figure 14. Connecting the Bagnoli-16 Main Amplifier Unit and Input Modules via the Input Cable and InterModule Cable.

Do not use force when mating the Input Cable with the Main Amplifier or Input Module. Take care to observe correct connector orientations. Improper or forceful insertion will damage the connectors and the system.

Using the Sensors

The Bagnoli EMG System is supplied with DE-2.1 Single Differential Surface EMG Sensors. These plug into the receptacles on the Input Modules that are labeled with channel numbers. The connectors have a key so that they can only be inserted with a specific orientation. The order of the sensors can be interchanged with no consequences to the performance of the EMG System. The sensor cables are five feet in length so that they can be placed on any part of a user's body when the Input Modules are mounted at waist level.

Only use sensors that have been approved by Delsys. Connecting unapproved sensors to the Bagnoli System constitutes an invalidation of the Delsys Warranty and may result in personal injury and/or permanent damage to the system or the sensors.

Orienting the EMG Sensors on the Skin

The DE-2.1 EMG Sensor is fitted with two silver bar contacts for detecting the EMG signal at the skin surface. It is crucial that the orientation of these bars be perpendicular to the muscle fibers for maximum signal detection. The top of the sensor is stamped with an arrow to aid in the determination of this orientation. The arrow should be placed parallel to the muscle fibers underneath the sensor. The sensor should also be placed in the center of the muscle belly away from tendons and the edge of the muscle. The sensor is easily attached to the skin using the Delsys Adhesive Sensor Interface.

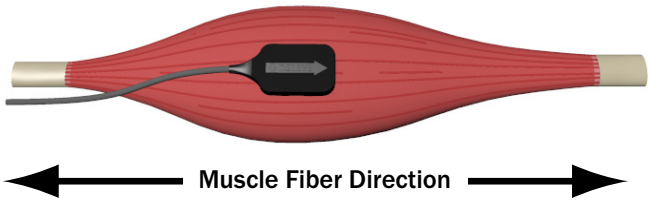
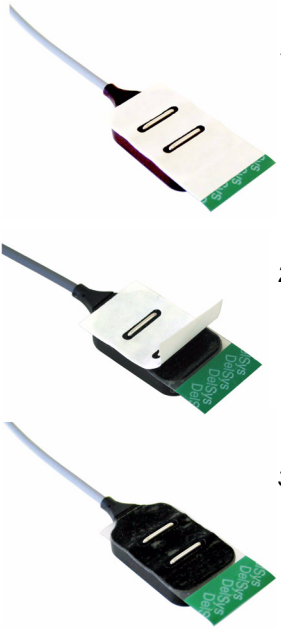


Figure 15. EMG Sensor orientation with respect to the muscle fibers. It is important that the orientation of the arrow on the sensor be parallel to the underlying muscle fibers.

Using the Delsys Adhesive Sensor Interface

The Adhesive Sensor Interfaces use medical-grade adhesive specifically designed for dermatological applications. Usage of the interface promotes a high quality electrical connection between the sensor bars and the skin, minimizing motion artifacts and the ill-effects of line interference. To ensure a strong bond with the skin, it is advised to remove excessive hair and wipe the skin area and the EMG Sensor with isopropyl alcohol to remove oils and surface residues. Allow the skin to dry completely before applying the interfaces.



1) *Remove the interface from its strip and apply to the sensors.*

2) *Remove liner to expose the adhesive.*

3) *Apply to the skin site. Do not reposition once skin contact is made.*

Figure 16. Application of the Adhesive Sensor Interface.

Adhesive Sensor Interfaces are for single use only.

Immediately discontinue use if skin irritation or discomfort occurs. All Adhesive Sensor Interfaces and Reference Electrodes are for single use only. Discard after using. Reseal storage bag to maintain freshness.

Connecting the Reference Electrodes

Connect the Reference Electrode Cable to the Input Module using the "banana" jack.

Apply the Reference Electrode to the skin considering the points below:

- A high quality electrical connection between the Reference Electrode and the skin is critical for obtaining reliable EMG signals. Be sure to clean and, if necessary, shave the skin prior to affixing the Reference Electrode.
- Only one Reference Electrode is required when collecting EMG signals. The site should be an electrically inactive area on the skin surface.
- The EMG Accessory Kit includes disposable disc Reference Electrodes that provide a robust connection and superior conductance. These electrodes are lined with a conductive gel. Conductive electrodes other than the ones supplied may be used as substitutes, but note that performance may vary significantly between manufacturers.

Consult the labeling of the supplied Reference Electrodes for details on their proper use.

Immediately discontinue use if skin irritation or discomfort occurs. All Adhesive Sensor Interfaces and Reference Electrodes are for single use only. Discard after using. Reseal storage bag to maintain freshness.

Turning the System "On"

The main power switch is located on the right edge of the Main Amplifier Unit front panel.

The switch is labeled with an "I" to indicate the "on" position and an "O" to indicate the "off" position or with an LED that illuminates in the "on" position. The rocker switch is in the "on" position when the top half is depressed and in the "off" position when the bottom half is depressed.

It is normal for all of the LEDs on the front panel to illuminate for a brief moment when the unit is initially turned on. If any of the LEDs do not turn off after 2 seconds have passed, refer to the "Error Detection Features" section of this manual.

Selecting Appropriate Amplifier Gains

The knobs located on the front panel of the Main Amplifier Unit each control the gain of one channel. Each knob can be set to one of the following options:

0 This position forces the input to the channel to be the reference potential. No EMG signals can be detected with this setting. All channels not in use should be set to the "0" position to minimize the unwanted detection of noise and its detrimental effects associated with channel crosstalk.

100 This position sets the channel gain to 100. Gains of 100 should be used when recording abnormally large EMG signal amplitudes. Surface potentials ranging from ±10 mV to ±50 mV will result in output signal voltages of ±1 to ±5 Volts. Using this gain on EMG signals lower than ±10 mV will result in recorded signals of poor resolution.

1k This position sets the channel gain to 1000. This is the nominal gain for typical surface EMG signals ranging from ±100µV to ±5 mV, resulting in output voltage signals of ±100mV to ±5 Volts. This setting provides the ideal resolution when sampling with 16-bit A/D acquisition systems.

10k This position sets the channel gain to 10000 and is not needed if a 16 bit measurement is made. This extremely sensitive gain should only be selected when attempting to record particularly faint EMG signals, in the range of ±100µV to ±500 µV in the presence of a 12-bit (or similar) A/D system. The output yielded in this case is ±1 V to ±5 V, but care must be taken to prevent amplifier saturation.

AUX This position is for custom configurations. It is designed to be used with Delsys Biosignal Sensors such as EKG sensors, goniometers, accelerometers, footswitches, and others.

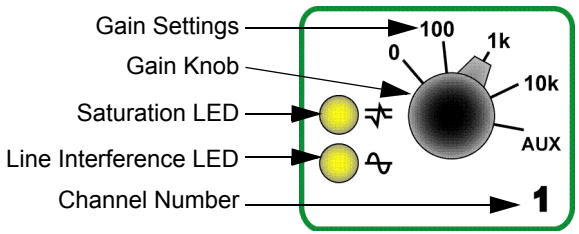


Figure 17. Channel including gain knob, saturation LED, and Line Interference LED.

Beginning Data Acquisition

HD68 Connector for EMGworks Package

The HD68 Connector is used to connect the Bagnoli EMG System to a National Instruments A/D Data Acquisition Card so that data acquisition can be controlled with EMGworks Software.

Refer to the "EMGworks User's Guide" for detailed data acquisition instructions.

BNC Connectors

Data acquisition with the BNC Sockets requires an oscilloscope or other data acquisition system.

Consult the documentation for the oscilloscope or data acquisition system being used for instructions.

Signal Quality Assurance Features

Each channel of the Bagnoli EMG System is equipped with circuitry to detect amplifier saturation and line interference, both common sources distortion in the recording environment. There are two LEDs for each channel on the front panel of the Main Amplifier Unit to alert the user of these errors. In addition, there is an Audible Buzzer Alarm that indicates when there is any error. This alarm can be disabled.

Saturation Level Detector

This LED warns the user when the signal on a channel is at risk of being clipped due to amplifier saturation.

The Bagnoli EMG System is designed to operate with an output in the range of ±5 V. Due the amplitude variability of the EMG signal, it is possible to saturate the amplifiers if the channel gain is set too high and this range is exceeded. For this reason, the Saturation Level LED is set to illuminate as a warning when the amplitude of the signal on the channel approaches 96% of the maximum range. If the Saturation Level LED illuminates regularly, the gain for that channel should be reduced by a factor of 10.

Delsys recommends a gain setting of 1000 with a 16-bit A/D system, since this maximizes the available range and provides ample resolution.

Note that transient signals, such as motion artifacts or static discharges, may trigger the saturation alarm.

Line Interference Detector

This LED indicates the presence of excessive 50 or 60 Hz line interference in the channel.

Line interference is typically caused by poor sensor-skin contact or by unconnected sensors. To avoid the presence of line interference, ensure that all EMG Sensor bars are in contact with the skin surface and that the Reference Electrode is appropriately attached.

In North America, line interference appears as a cyclic signal with a fundamental frequency of 60 Hz. In Europe and other countries, this cyclic signal has a fundamental frequency of 50 Hz. The Bagnoli EMG System is set to detect the line frequency

of the destination country when manufactured. The system will only detect deterministic signals, so that 50 or 60 Hz components of the EMG signal will not trigger the alarm.

Audible Buzzer Alarm

An audible buzzer alarm is included to aid in the monitoring of line interference and saturation errors. When enabled, the alarm will sound if at least one of the yellow LED indicators on the front panel illuminates. This feature allows the user to recognize erroneous conditions without needing to see the LED indicators on the front panel.

The alarm is enabled and disabled by the rocker switch located beneath the loudspeaker symbol on the left edge of the Main Amplifier Unit front panel. The alarm is enabled when the rocker switch is depressed towards the loudspeaker symbol and disabled when depressed away from the loudspeaker.

Additional Bagnoli Hardware Features

Trigger Port

The Trigger Port on the rear panel of the Bagnoli EMG System allows the user to input and output triggering signals to manage and synchronize data collection. These options are only available when using the EMGworks Acquisition and Analysis Package. The four trigger signals are:

Start In	Starts data collection on a +5V rising edge
Stop In	Ends data collection on a +5V rising edge
Start Out	Outputs a +5V pulse once data collection is started
Stop Out	Outputs a +5V pulse once data collection is stopped

The recommended way to interface with the trigger port is to use the Trigger Module (SP-U02), which greatly facilitates the signal connections and the necessary signal conditioning.

Please refer to the "Trigger Module User's Guide" for operational and functional details. For a detailed description of the triggering capabilities of the A/D Data Acquisition Card, please consult the National Instruments manual.

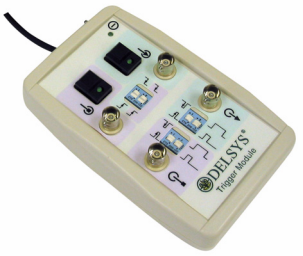


Figure 18. Trigger Module

HD68 Connector Pinout

The HD68 Connector was designed to connect the Bagnoli EMG System to a National Instruments A/D Data Acquisition Card so that data acquisition can be controlled with EMGworks Software.

Please contact Delsys for custom solutions regarding integration with particular measurement systems.

Delsys does not support the use of the HD68 Connector to connect the Bagnoli EMG System to any unapproved A/D System. Incompatible connections may result in damage to the Bagnoli system and/or the data acquisition system.

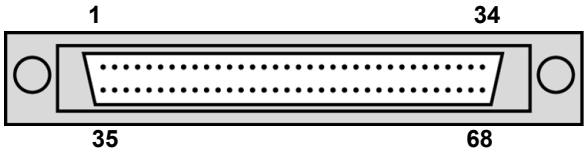


Figure 19. Signal Pinout of the HD68 Output Connector.

Signal	Pin	Signal	Pin
Channel 1	68	Channel 9	34
Channel 2	33	Channel 10	66
Channel 3	65	Channel 11	31
Channel 4	30	Channel 12	63
Channel 5	28	Channel 13	61
Channel 6	60	Channel 14	26
Channel 7	25	Channel 15	58
Channel 8	57	Channel 16	23
Analog GND	32	Analog GND	67

Maintenance and Care of the Bagnoli System

Main Amplifier Unit and Input Modules

The Bagnoli System is designed to provide years of reliable service when proper care is followed. A one-time calibration is performed at the time of manufacturing. No further calibration is needed. While the Main Unit and the Input Module cases are made of durable plastic, the following points should be kept in mind when using and handling them:

- The device and its accessories should be visually inspected before every use to ensure that no mechanical deterioration has occurred.
- The Main Unit and Input Modules can be easily cleaned with a damp cloth and mild detergent.
- The units are not shockproof and should not be dropped or be subjected to excessive forces or accelerations.
- Provide ample strain relief for the interconnecting cables so that none of them are under excessive tension. Do not pull on any of the interconnecting cables. Grasp all cables by the plug when mating and disconnecting. Note correct orientation of connectors before mating.

Only use sensors that have been approved by Delsys. Connecting unapproved sensors to the Bagnoli System constitutes an invalidation of the Delsys Warranty and may result in personal injury and/or permanent damage to the system or the sensors.

The Main Unit and the Input Modules are not water-resistant. Under no circumstance should the units be exposed to water or any other type of liquids. Caution: The risk of electric shock exists if the Main Unit is operated while in contact with liquids.

DE Series Surface EMG Sensors

The DE Series Surface EMG Sensors are encased in a sealed polycarbonate case. The following points should be kept in mind when handling the sensors.

- All sensors should be visually inspected before each use to ensure that no mechanical deterioration has occurred
- The sensors can be cleaned and sterilized with a damp cloth and mild detergent, with isopropyl alcohol swabs, or with a 70% isopropyl alcohol solution. It is crucial that the sensor contacts remain clean at all times.
- The sensors are completely sealed and are water-resistant. These can be used on damp skin surfaces and in the presence of sweat without compromise to safety, sensor integrity or operation. The sensors should never be completely submerged in any liquid.
- The sensors contacts are made of pure silver and are quite soft. Care should be taken to preserve the integrity of these contacts. Do not scrape or dent these contacts.
- Do not pull on the sensor cable. Avoid kinks in the cable, as these will result in damage to the internal cable wires and intermittent connections.
- Handle the sensors with care: do not drop them on the ground or step on them.

The sensors must only be used with Delsys EMG Systems. The DE-2.1 and the DE-3.1 EMG Sensors are specifically designed for the Bagnoli series EMG Systems. Using these sensors as inputs to any other EMG system constitutes an invalidation of the Delsys Warranty and may result in personal injury and/or permanent damage to the sensors or the system.

Do not submerge the sensors in any liquid under any circumstance.

The sensors contain sensitive electronic circuitry. Static discharges and intense magnetic fields should be avoided to prevent possible irreparable damage to the sensors.

Specifications

Main Amplifier Unit (Common)

Number of Channels	4, 8 or 16 analog
Overall Amplification per Channel	0, 100, 1000, 10000, Custom (AUX setting)
Max. Output Voltage Range	± 5 Volts
Channel Frequency Response	20±5 Hz to 450±50 Hz, 80 dB/decade
EMG Sensors	DE-2.1 (single differential) or DE-3.1 (double differential)
System Noise (R.T.I.)	<1.2 µV(rms) for the specified bandwidth
Channel Output Isolation	3750 V(rms) @ 60 Hz for 60 sec.
Output Signal Connectors	4, 8, or 16 BNC connectors 68-pin 0.05" pitch high-density D-Sub male
Signal Quality Check	Line Frequency Interference (50 or 60 Hz) Channel Saturation Check (± 4.8 V threshold)
Signal Quality Warnings	Yellow LED, Selectable Audio Buzzer
Operating Temperature	15°C to 40°C

Bagnoli-4 Main Amplifier Unit

Case Dimensions	205 mm x 108 mm x 39 mm
Weight	511 grams
Power Requirements	860 mW (± 6V)

Bagnoli-8 Main Amplifier Unit

Case Dimensions	205 mm x 108 mm x 57 mm
Weight	820 grams
Power Requirements	1400 mW (± 6V)

Bagnoli-16 Main Amplifier Unit

Case Dimensions	406 mm x 152 mm x 70 mm
Weight	2.1 kg
Power Requirements	2500 mW (± 6V)

SC-P02 / SC-P03 Power Supply for Bagnoli Systems

Case Dimensions	160 mm x 65 mm x 90 mm
Rating	30VA
Voltage Output	+/-6VDC
Fuse Replacement (115V)	400mA, 250V, Type T (5x20mm)
Fuse Replacement (230V)	200mA, 250V, Type T (5x20mm)

DE 2.1 Single Differential Surface EMG Sensor

Sensor Contacts	2 silver bars 10 mm x 1 mm diameter
Contact Spacing	10 mm 0.394"
Sensor Dimensions	19.8 mm x 5.4 x 35 mm
Preamplification	10 V/V
CMRR	100 dB (typical) 94 dB (minimum)
Power	± 18 mW (quiescent)
Cable Length	1.67 m
Number of Conductors	4 (shielded)
Case Material	Polycarbonate plastic

Input Module

Sensor Contacts	3 silver bars 10 mm x 1 mm diameter
Contact Spacing	10 mm double differential configuration
Sensor Dimensions	19.8 mm x 5.4 x 35 mm
Preamplification	10 V/V (per differentiator)
CMRR	100 dB (typical) 94 dB (minimum)
Power	± 41 mW (quiescent)
Cable Length	1.67 m
Number of Conductors	4 (shielded)
Case Material	Polycarbonate plastic

Number of Sensor Inputs	4 or 8
Case Dimension	89 mm x 83 mm x 32 mm
Mass	100 g

Input Cable

Conductor Count	32 (16 twisted pairs, shielded)
Cable Length	7.62 m
Weight	442 grams

InterModule Cable

Conductor Count	16 (8 twisted pairs, shielded)
Cable Length	0.76 m
Weight	45 grams

Reference Electrode Cable

Connector	“Banana” & 2mm “Tip” plug
Conductor Count	Single
Length	1.67 m

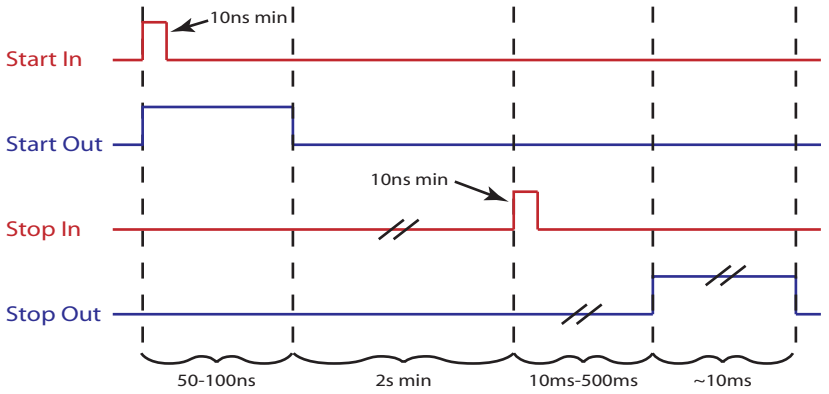
Trigger Port*

General	
Required Connector[2]	Manufacturer - LEMO Part Number - FGG.0B.306.CLAD56
Connector Pinout 1 2 3 4 5 6 shell	 Stop In GND Stop Out Start Out Power 5V Start In GND
Logic	0, 5V only
Pulse Duration Start In Start Out Stop Out Stop In	See timing diagram for more detail 10ns (min) 50-100ns approximately 10ms 10ns (min)

*** Please note the following:**

1. **Delsys recommends the use of the Trigger Module (SP-U02) for integration of the Bagnoli EMG System with other systems.**
2. **Delsys does not stock mating connectors and cannot support custom trigger solutions.**

Trigger Port Timing Diagram



Component References

Part Description	Part Number
EMG System	
Bagnoli-4	DS-B02
Bagnoli-8	DS-B03
Bagnoli-16	DS-B04
Main Amplifier Unit	
Bagnoli-4	SP-B06
Bagnoli-8	SP-B07
Bagnoli-16	SP-B08
DE-2.1 EMG Sensor	SP-E09
DE-3.1 EMG Sensor	SP-E11
Input Module	
Bagnoli-4	SP-N03
Bagnoli-8	SP-N04
Bagnoli-16 (Ch 1-8 and Ch 9-16)	SP-N05 and SP-N06
Input Cable	
Bagnoli-4	DC-N09 (25ft), DC-N12 (50ft)
Bagnoli-8 and Bagnoli-16	DC-N10 (25ft), DC-N11 (50ft)
InterModule Cable	DC-N08
Adhesive Sensor Interfaces	
For DE-2.1 Sensors	SC-F01
Reference Electrode Cable	DC-R02
Power Supply	
Bagnoli-4	SC-P03
Bagnoli-8 and Bagnoli-16	SC-P02
Carrying Case	
Bagnoli-4 and Bagnoli-8	SC-C05
Bagnoli-16	SC-C06
Bagnoli EMG System User's Guide	PM-B05