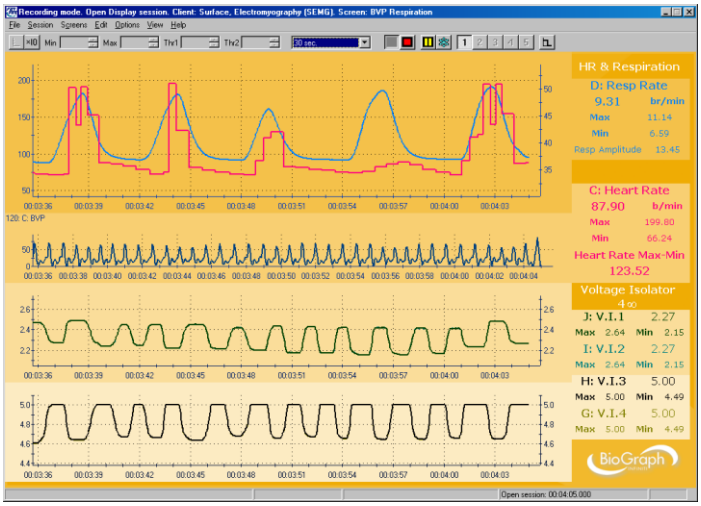
Voltage Isolator 4∞ (T9405MA)

Installation and User Guide



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Voltage 4 Isolator

- Type BF Equipment
- Internally powered equipment
- Continuous operation

- Read Instruction Manual

CAUTION

- US Federal Law restricts this device to sale by, or on order of, a physician or any other practitioner licensed by the law of the state in which he or she practices to use or order the use of this device.

WARNING

- Explosion Hazard; Do not use in the presence of a flammable anesthetic mixture with air, or with Oxygen or Nitrous Oxide.
- Not to be immersed in water.
- All of the inputs are on the same circuits and the grounds are connected together. If connecting inputs to more than one device, ensure that no significant voltage exists between device grounds. Otherwise ground loop currents could flow through the Voltage Isolator, which could affect signal integrity or, in extreme cases, damage equipment.
- The operator is responsible for ensuring the safety of any devices controlled or triggered by Infiniti equipment or software, or by any software or hardware receiving data from Infiniti equipment. Infiniti equipment must not be configured or connected in such a way that failure in its data acquisition, processing or control functions can trigger patient feedback stimulus that poses an unacceptable level of risk.

ATTENTION

- Not for diagnostic purposes, not defibrillator proof, not for critical patient monitoring.
- To prevent voiding warranty by breaking connector pins, carefully align white guiding dot on sensor plug with slot on sensor input.
- Remove batteries when the device is not being used for an extended period of time. Please dispose of battery following local regulations.

CONTRAINDICATIONS

- None

INTENDED PURPOSE

- Biofeedback, Relaxation & Muscle Re-Education purposes.

NOTE

- No preventative inspections required; maintenance must be performed by qualified personnel.
- The supplier will make available, upon request, circuit diagrams, component parts lists and description or other information required for the repair of product by qualified personnel.
- Due to the essential performance and intended use of the device, testing for immunity to electromagnetic disturbances was not required and was not performed. The device may be susceptible at levels below IEC60601-1-2 immunity test levels.
- The operator must be familiar with typical characteristics of signals acquired by this equipment, and be able to detect anomalies in the acquired signal that could interfere with treatment effectiveness. Depending on the importance of signal integrity, it may be advisable to continuously monitor the raw signals, in time and/or frequency domain, while the device is being used for biofeedback or other purposes. If anomalies are observed on acquired signals, and if you suspect a problem with electromagnetic interference, contact Thought Technology for a technical note on identification and remediation.
- This product conforms to standard EN60601-1 (electrical isolation).

MAINTENANCE AND CALIBRATION

- Wipe with a clean cloth
- Factory testing and calibration ensure equipment accuracy and frequency response. The user may recalibrate device parameters (see section in manual).

STORAGE

- Store in original case at up to 90% humidity / 30C°

TRANSPORTATION

- Transport in original case

Guidance and manufacturer's declaration – electromagnetic emissions		
The Voltage Isolator 4∞ is intended for use in the electromagnetic environment specified below. The customer or the user of the Infiniti system should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment – guidance**
RF emissions CISPR 11	Group 1 Class B	The Voltage Isolator 4∞ uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. The Voltage Isolator 4∞ is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

Manual No. SA9406MA Rev. 2

Table Of Contents

About the Voltage Isolator 4∞

The Voltage Isolator 4∞ (VI) is an interface device which provides electrical isolation. It allows Thought Technology's systems (sensors + encoder + software on computer) to be safely interfaced with the analog outputs of line-powered systems, such as computers with DAC cards, isokinetic dynamometers, or force platforms (this is a non-exhaustive list).

The Voltage Isolator 4∞ has two main features:

- It electrically isolates the examinee from the interfaced system (4kV isolation as per IEC/EN 60601-1; medical grade isolation).
- It rescales the voltage inputs.

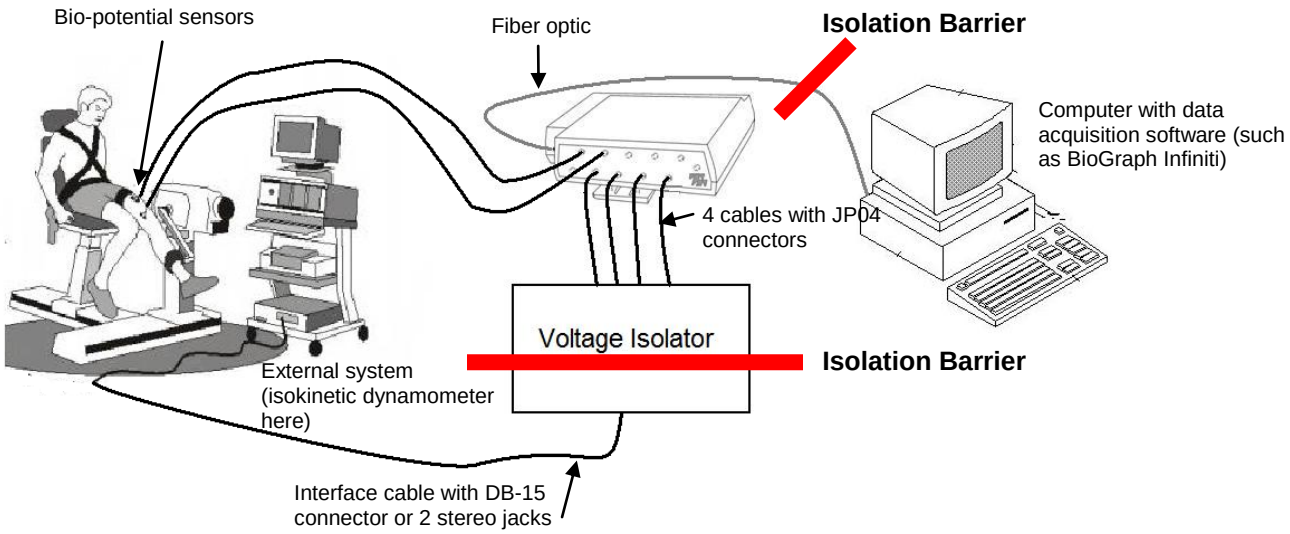


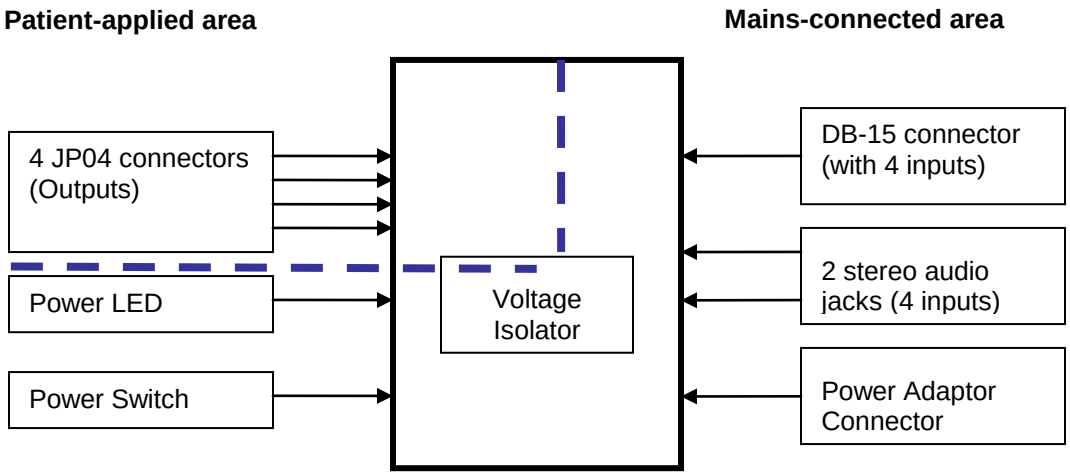
Illustration of the use of the Voltage Isolator 4∞ with an isokinetic dynamometer and EMG sensors

Hardware Description

1 Overview

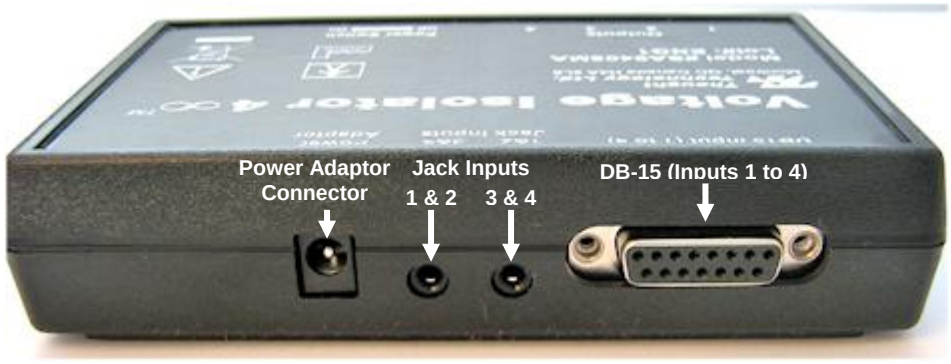
There are two areas to the Voltage Isolator 4∞:

- the patient-applied area (electrically isolated)
- the mains-connected area (non isolated)



It has two possible power sources:

- 9V battery (with low battery indicator)
- 9VDC power adaptor (provided):



Front panel of mains-connected area

Voltage Isolator 4∞ has 4 inputs. The same 4 inputs can be connected to the interfaced system outputs in two ways:

- Either via the two stereo jacks
- Or via the DB-15 connector. We can provide one of the following cable:

SA9409BNC BNC cable

SA9409PGT Pigtail cable

The cable provided may look slightly different

NOTE: each interfaced system will require its own cable. Therefore we provide only a cable with BNC connectors or the pigtail cable, which are the most common ones. If it does not fit, the customer or their dealer must manufacture it themselves.

The section **Pin-out**, on the next page, contains more information.

The input range is configured at the factory, on demand. It can be ±2.5V, ±5V, ±10V, 0 – 5V, 0 – 10V or 0 – 20V. The factory settings can be found in the battery compartment.

Front panel of patient-applied area

The output range is 2.8V ± 1.5V. The outputs can be connected to either a ProComp Infiniti or a FlexComp Infiniti, via JP04 cables provided with the Voltage Isolator 4∞.

JP04 Cables

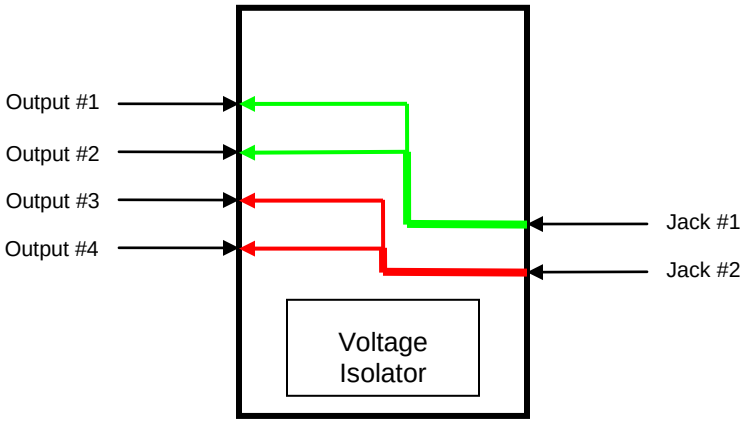
Pin-out

All of the inputs are on the same circuits and the grounds are connected together. Therefore:

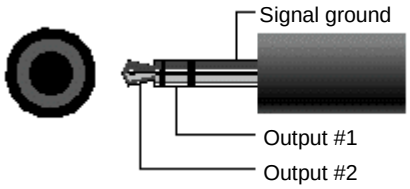
- If connecting several inputs to the same device, only one ground connection may be required.
- If connecting inputs to more than one device, ensure that no significant voltage exists between device grounds. Otherwise ground loop currents could flow through the Voltage Isolator, which could affect signal integrity or, in extreme cases, damage equipment.

1.1 Jacks

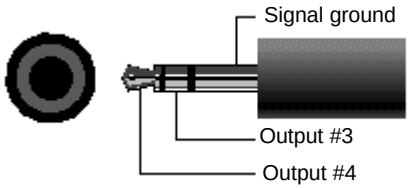
The jacks of the Voltage Isolator 4∞ are 3.5mm stereo mini-jacks.



- Jack #1 is connected to Output #1 and #2

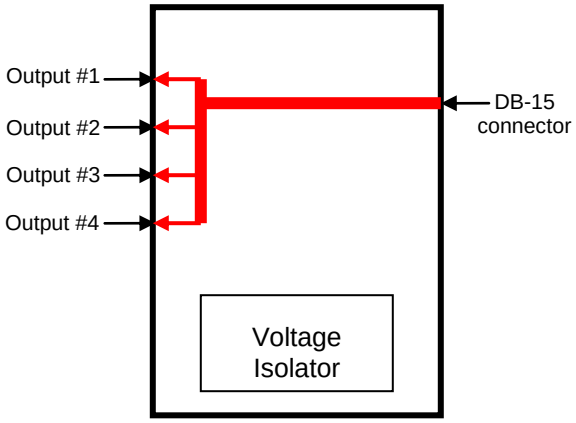


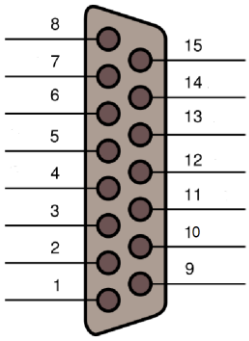
- Jack #2 is connected to Output #3 and #4



1.2 DB-15 connector

The DB-15 connector of the Voltage Isolator 4∞ is a DB-15 female.





DB-15 Pin 2 ➔ Output #1
DB-15 Pin 3 ➔ Output #2
DB-15 Pin 4 ➔ Output #3
DB-15 Pin 5 ➔ Output #4
DB-15 Pins 1, 10, 11, 12 and 13 ➔ Signal Ground
Others: reserved

BioGraph Infiniti Add-on

1 Overview

The BioGraph Infiniti Add-on is a software module that will help you to interface your system to the Infiniti software. It provides signal processing templates (channel sets) and display templates (screens) for combining your system outputs with various physiological signals, such as EMG, heart rate (from BVP or EKG), respiration, skin conductance and skin temperature.

2 Installation

Installing the BioGraph Infiniti Add-on is the same procedure as installing BioGraph Infiniti or an Application Suite. The setup follows the same sequence of steps.

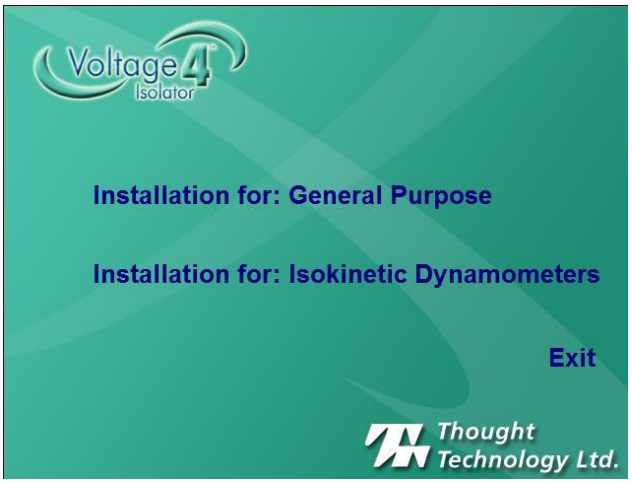
1. Place the Voltage Isolator 4∞ CD in your CD-ROM drive. The installation program starts automatically.

2. Select **Installation for: General Purpose** if the interfaced system is not listed. Or select the system in the list.

3. Click the name of the encoder type that you will use with BioGraph Infiniti.

   Then follow the BioGraph Infiniti installation sequence.

Read BioGraph Infiniti installation manual for more information.



3 Connections

Channel sets and screens have been defined for the following connections:

For ProComp Infiniti:

Voltage Isolator 4∞ Output #1 ➔ **ProComp channel H**
Voltage Isolator 4∞ Output #2 ➔ **ProComp channel G**
Voltage Isolator 4∞ Output #3 ➔ **ProComp channel F**
Voltage Isolator 4∞ Output #4 ➔ **ProComp channel E**

For FlexComp Infiniti:

Voltage Isolator 4∞ Output #1 ➔ **FlexComp channel J**
Voltage Isolator 4∞ Output #2 ➔ **FlexComp channel I**
Voltage Isolator 4∞ Output #3 ➔ **FlexComp channel H**
Voltage Isolator 4∞ Output #4 ➔ **FlexComp channel G**

4 Description

This section describes the provided screens. Screens are sorted by channel set. These channel sets must be modified at three levels (see next sections):

- Selection of the Voltage Isolator 4∞ input ranges
- Conversion of the Voltage Isolator 4∞ inputs to the desired unit
- Calibration

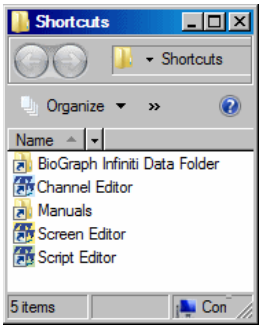
You may also want to customize these screens to your needs, as well as building scripts (protocols).

Channel sets have been designed to provide you with the most common signal processing features, such as raw EMG, EMG power spectrum or median frequency. Some of these features are not used in the provided screens.

To modify these screens and their channel sets, you need to be familiar with the **Developer Tools**.

Developer Tools are three editors (Channel Editor, Screen Editor, and Script Editor) that can be found by clicking on the shortcut **BioGraph Infiniti Docs & Editors**.

The rest of this manual assumes that you are familiar with BioGraph Infiniti and the Developer Tools.



4.1 Channel Set: Voltage Isolator 4 Infiniti – Calibration

In this channel set, the sensors are connected as follows:

FlexComp Infiniti

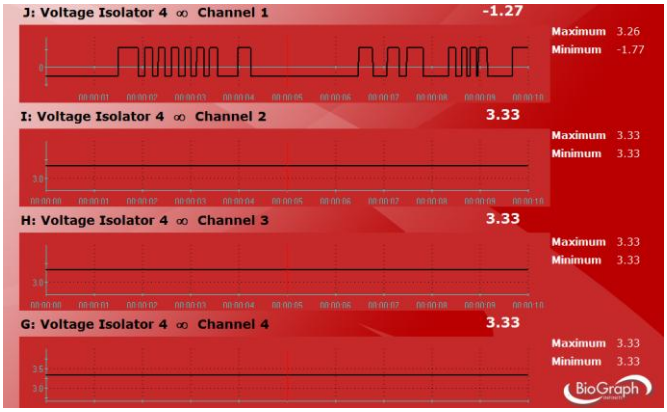
A	B	C	D	E	F	G	H	I	J
						VI4	**VI3**	**VI2**	**VI1**

ProComp Infiniti

A	B	C	D	E	F	G	H
				VI4	**VI3**	**VI2**	**VI1**

Screen: Calibration

This screen is used to calibrate the system. It shows the four Voltage Isolator 4∞ inputs before calibration. It indicates that no calibration settings have been applied to the signals shown on this screen.



4.2 Channel Set: Voltage Isolator 4 Infiniti - 2 EMG BVP Resp Temp SC (FlexComp Infiniti only)

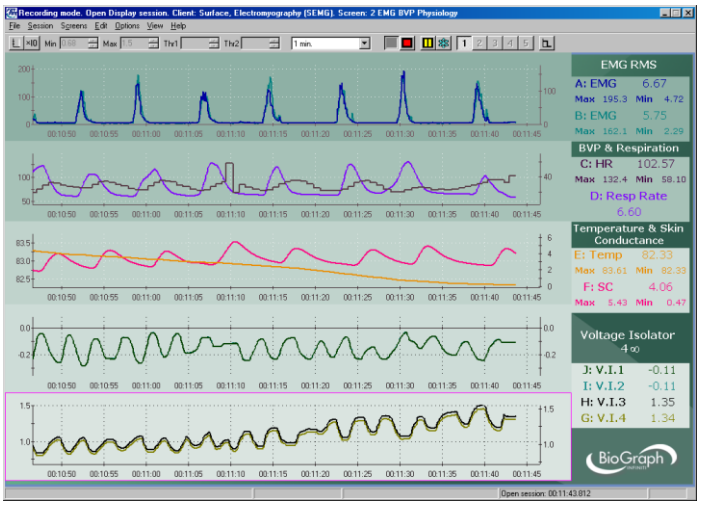
In this channel set, the sensors are connected as follow:

A	B	C	D	E	F	G	H	I	J
EMG	**EMG**	**BVP**	**Resp**	**Temp**	**SC**	**VI4**	**VI3**	**VI2**	**VI1**

Screen: 2 EMG BVP Physiology

This screen displays 2 EMG RMS signals, respiration amplitude, and heart rate from BVP, and skin temperature and skin conductance on the top 3 line graphs, with statistics on the side.

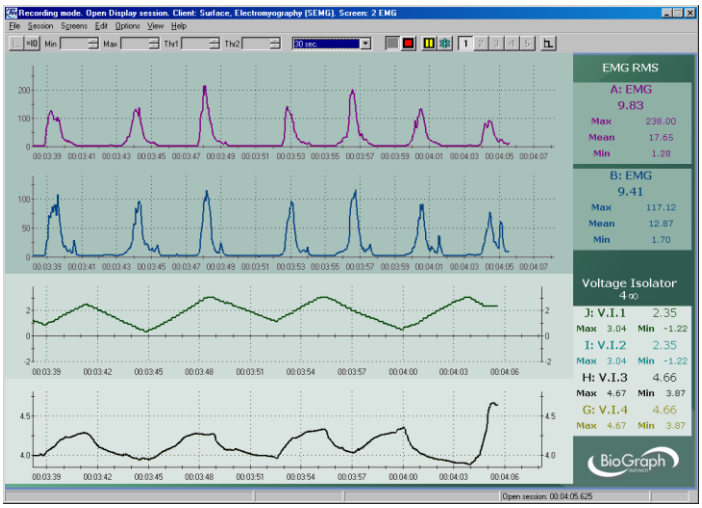
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: 2 EMG

This screen displays 2 EMG RMS signals on the top 2 line graphs, with statistics on the side.

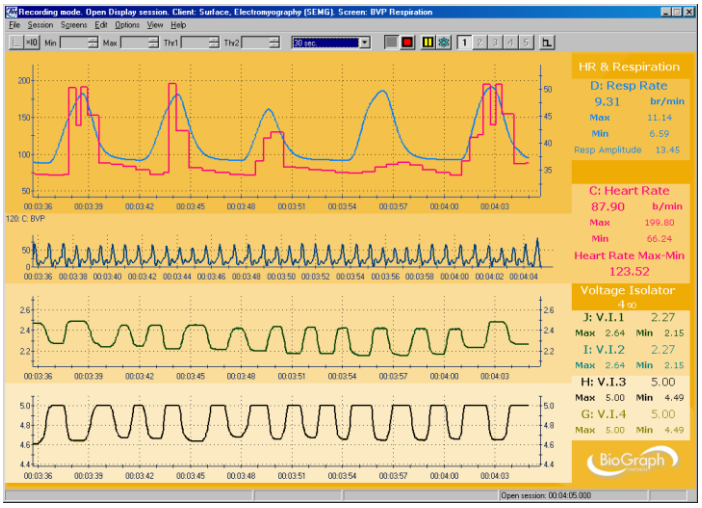
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: BVP Respiration

This screen displays heart rate and respiration amplitude on the same line graph and the raw BVP signal on another one, with statistics on the side. Statistics includes the HRV measure **$HR_{max} - HR_{min}$**.

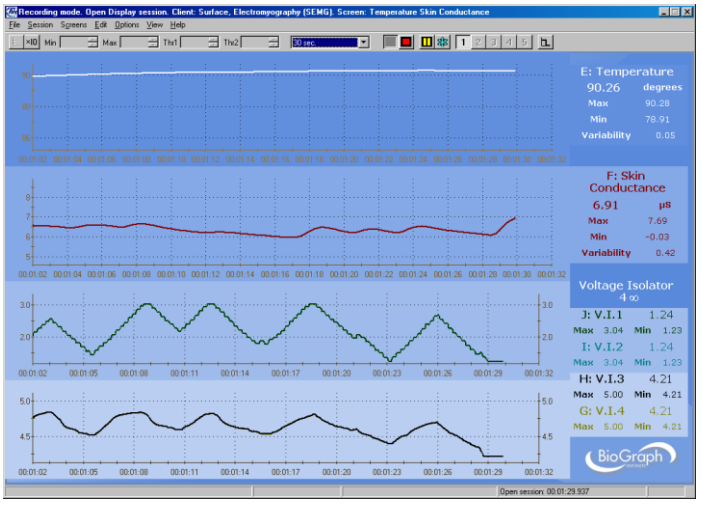
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: Temperature Skin Conductance

This screen displays skin temperature and skin conductance on the top 2 line graphs, with statistics on the side.

Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



4.3 Channel Set: Voltage Isolator 4 Infiniti - 2 EMG EKG Resp Temp SC (FlexComp Infiniti only)

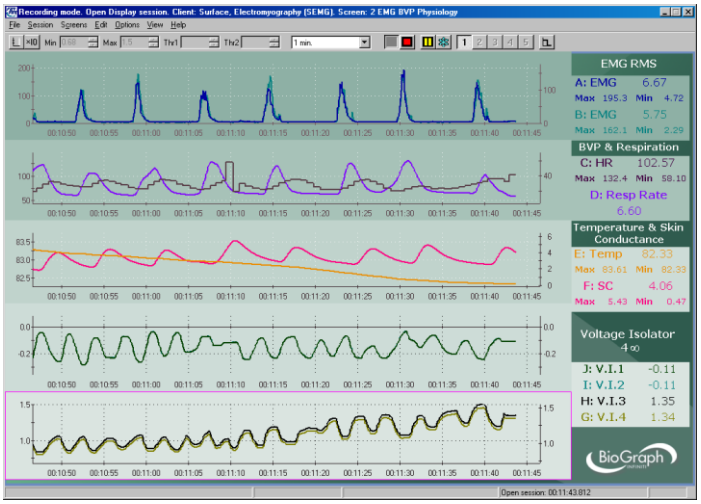
In this channel set, the sensors are connected as follow:

A	B	C	D	E	F	G	H	I	J
EMG	**EMG**	**EKG**	**Resp**	**Temp**	**SC**	**VI4**	**VI3**	**VI2**	**VI1**

Screen: 2 EMG EKG Physiology

This screen displays 2 EMG RMS signals, respiration amplitude, and heart rate from EKG, and skin temperature and skin conductance on the top 3 line graphs, with statistics on the side.

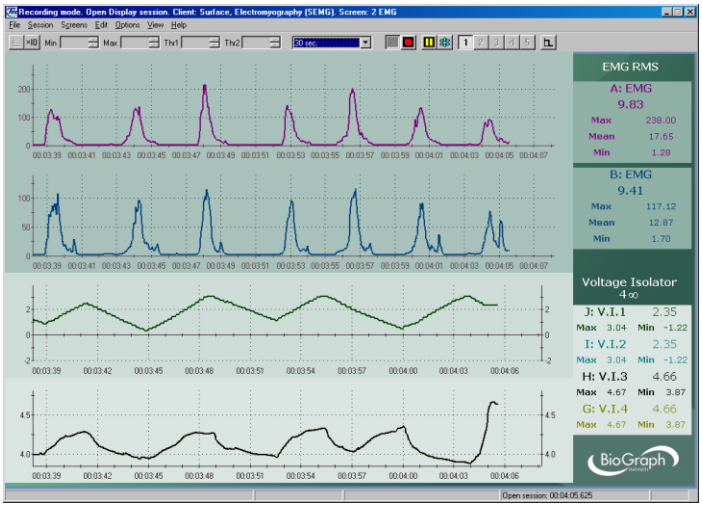
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.

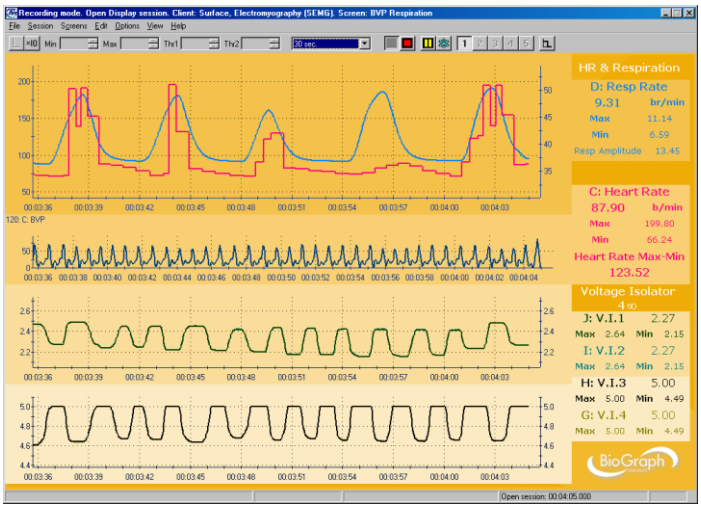
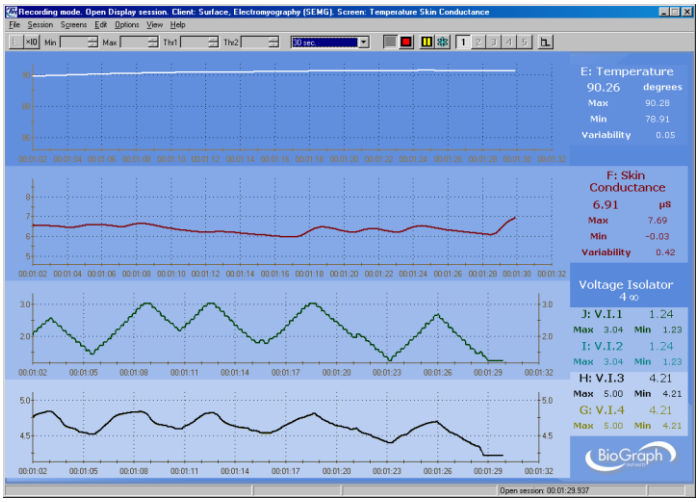


Screen: 2 EMG

This screen displays 2 EMG RMS signals on the top 2 line graphs, with statistics on the side.

Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: EKG Respiration This screen displays heart rate and respiration amplitude on the same line graph and the raw EKG signal on another one, with statistics on the side. Statistics includes the HRV measure **$HR_{max} - HR_{min}$**. Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.	
Screen: Temperature Skin Conductance This screen displays skin temperature and skin conductance on the top 2 line graphs, with statistics on the side. Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.	

4.4 Channel Set: Voltage Isolator 4 Infiniti - 6 EMG (FlexComp Infiniti only)

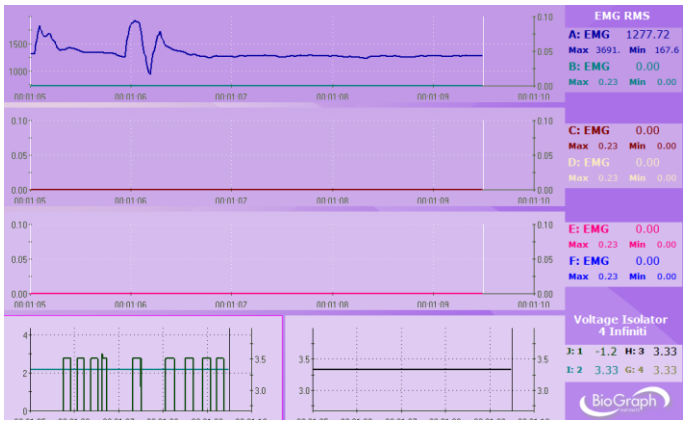
In this channel set, the sensors are connected as follow:

A	B	C	D	E	F	G	H	I	J
EMG	**EMG**	**EMG**	**EMG**	**EMG**	**EMG**	**VI4**	**VI3**	**VI2**	**VI1**

Screen: 6 EMG

This screen displays 6 EMG RMS signals on the top 3 line graphs, with statistics on the side.

Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



4.5 Channel Set: Voltage Isolator 4 Infiniti - 2 EMG BVP Resp (ProComp Infiniti only)

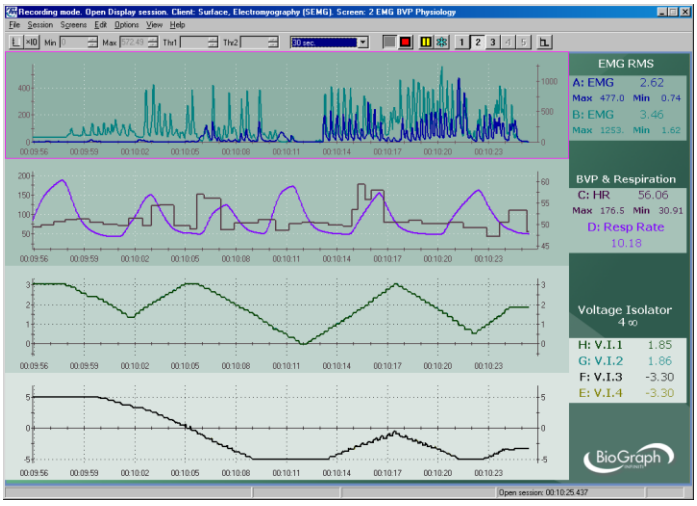
In this channel set, the sensors are connected as follow:

A	B	C	D	E	F	G	H
EMG	**EMG**	**BVP**	**Resp**	**VI4**	**VI3**	**VI2**	**VI1**

Screen: 2 EMG BVP Physiology

This screen displays 2 EMG RMS signals, respiration amplitude, and heart rate from BVP on the top 2 line graphs, with statistics on the side.

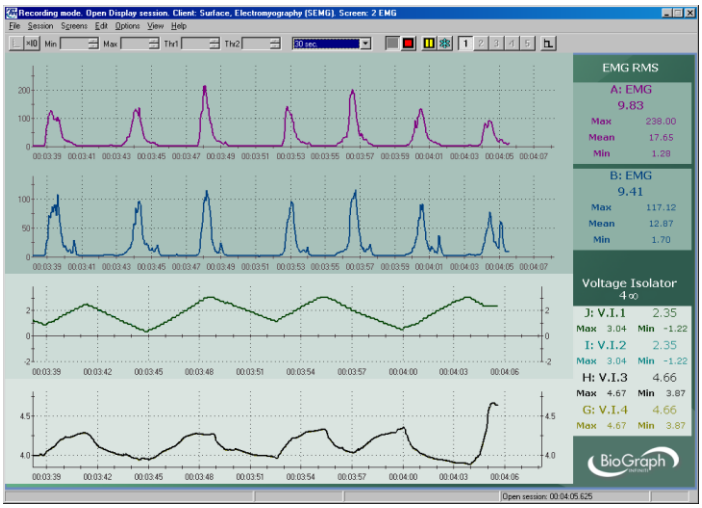
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: 2 EMG

This screen displays 2 EMG RMS signals on the top 2 line graphs, with statistics on the side.

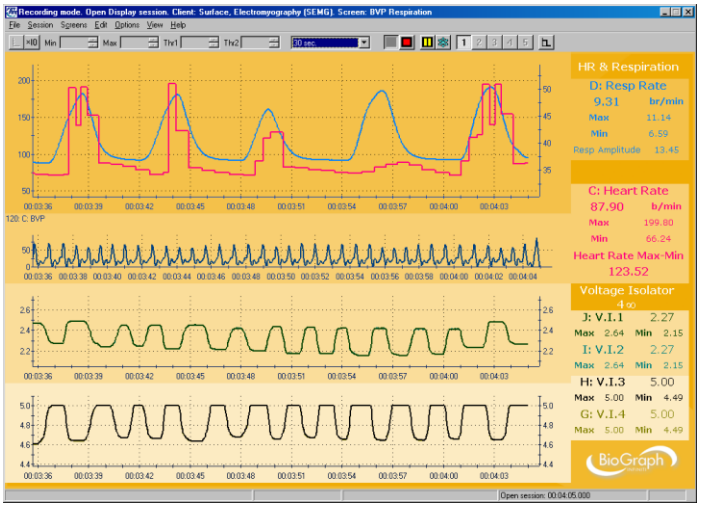
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: BVP Respiration

This screen displays heart rate and respiration amplitude on the same line graph and the raw BVP signal on another one, with statistics on the side. Statistics includes the HRV measure **HR_{max} – HR_{min}**.

Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



4.6 Channel Set: Voltage Isolator 4 Infiniti - 2 EMG EKG Resp (ProComp Infiniti only)

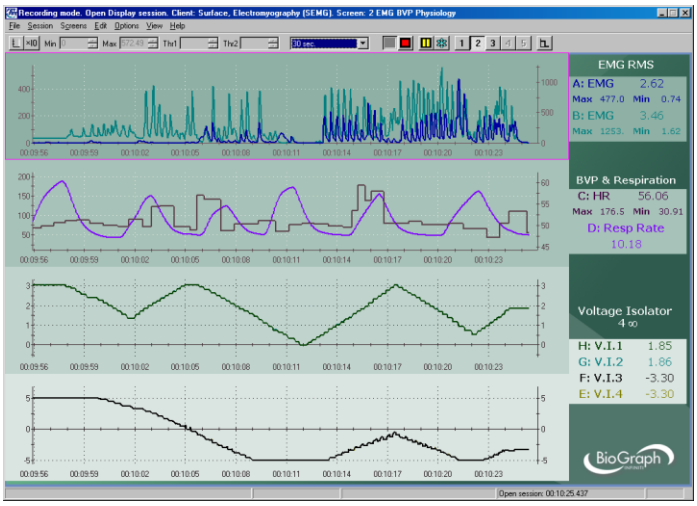
In this channel set, the sensors are connected as follow:

A	B	C	D	E	F	G	H
EMG	**EMG**	**EKG**	**Resp**	**VI4**	**VI3**	**VI2**	**VI1**

Screen: 2 EMG EKG Physiology

This screen displays 2 EMG RMS signals, respiration amplitude, and heart rate from EKG on the top 2 line graphs, with statistics on the side.

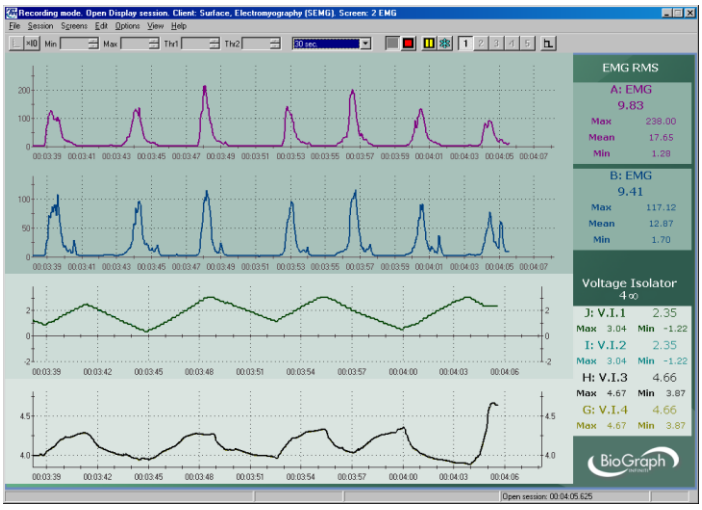
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: 2 EMG

This screen displays 2 EMG RMS signals on the top 2 line graphs, with statistics on the side.

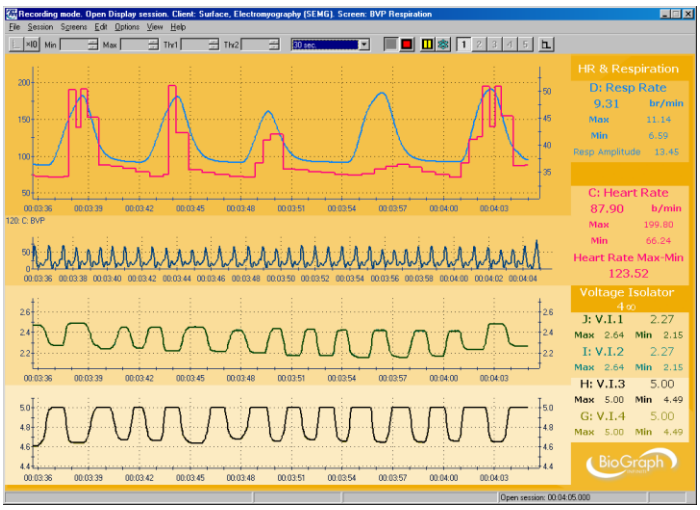
Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



Screen: EKG Respiration

This screen displays heart rate and respiration amplitude on the same line graph and the raw EKG signal on another one, with statistics on the side. Statistics includes the HRV measure **$HR_{max} - HR_{min}$**.

Voltage Isolator 4∞ inputs are displayed on the bottom two line graphs, with statistics on the side.



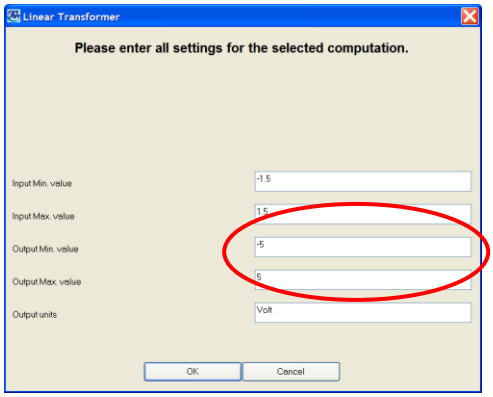
5 Selecting the Input Range

The channel sets are configured by default for a Voltage Isolator channel input range of ±5V, which is the default VI input range. However, you may have asked for a different range when you ordered your unit. If so, you have to change the channel input ranges in every channel set you will use, including the calibration channel set.

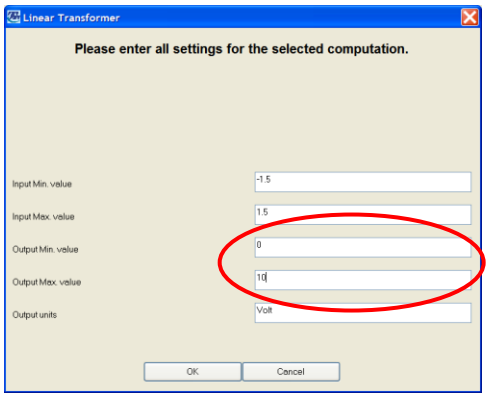
Channel sets include virtual channels with a linear transform that have been designed for this purpose:

- VC20: VI Ch#1 Gain adjustment
- VC21: VI Ch#2 Gain adjustment
- VC22: VI Ch#3 Gain adjustment
- VC23: VI Ch#4 Gain adjustment

Select one of these virtual channels (VC) in the channel editor and open the linear transformer window:



Change **"Output Min. Value"** and **"Output Max. Value"** with the new range. For instance, if the new range is 0 – 10V, enter "**0**" in **"Output Min. Value"** and "**10**" in **"Output Max. Value"**.



Note: This must be applied to all the channel sets (including the calibration channel set) and prior to calibration. These settings remain in effect unless you change them.

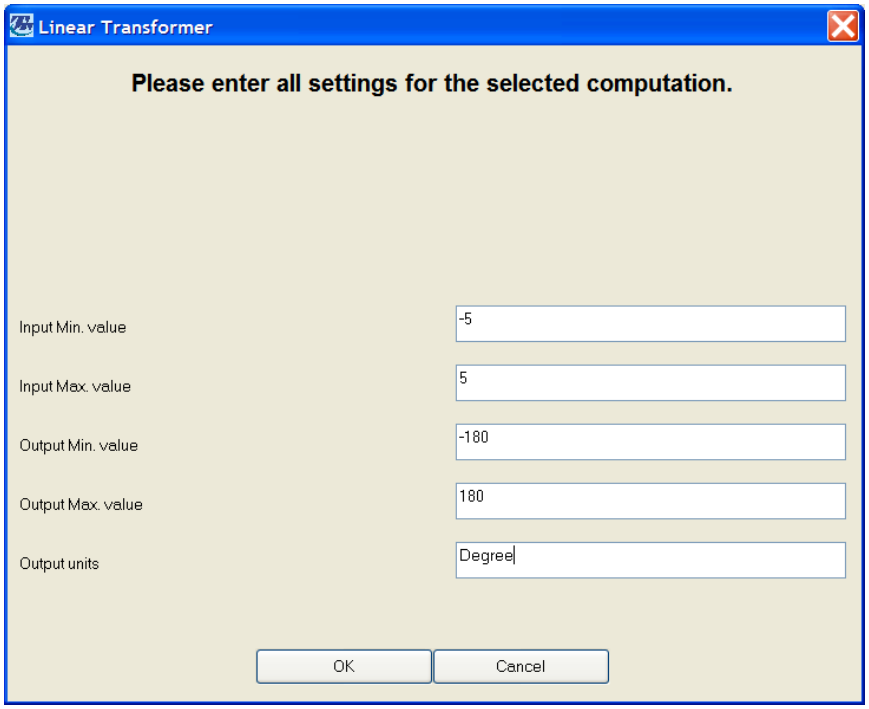
6 Converting to the Desired Unit

The signal displayed by default is the signal at the Voltage Isolator 4∞ input, or, in other words, at the interfaced system channel output, in Volts. However, the output value may have another meaning (such as angle, speed or torque), and consequently a different unit (such as degree, m/s or N.m).

You may then want to convert the signal to another unit. If so, you must change the channel input ranges in every channel set you will use, including the calibration channel set.

Similarly to the input range, apply the conversion values (inputs and outputs) to the corresponding virtual channels:

- VC24: VI Ch#1 Convers. to actual unit
- VC25: VI Ch#2 Convers. to actual unit
- VC26: VI Ch#3 Convers. to actual unit
- VC27: VI Ch#4 Convers. to actual unit



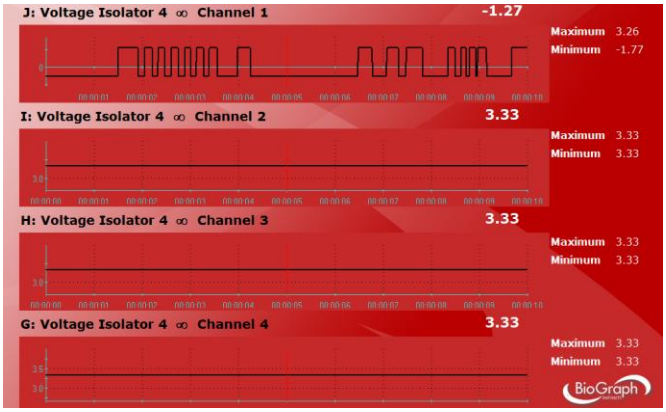
For instance, -5V means -180° and 5V means 180°. [-180° - 180°] is the full scale. Then enter "**-5**" in **"Input Min. Value"** and "**-180**" in **"Output Min. Value".** Enter "**5**" in **"Input Max. Value"** and "**180**"in **"Output Max. Value"**. Enter "**Degree**" in "**Output units**".

Note 1: These values are actual minima and maxima. The software will not take any value greater than the maximum and less than the minimum. In the example above, if the angle is 181°, the software will output 180.

Note 2: This must be applied to all the channel sets (including the calibration channel set) and prior to calibration. These settings remain in effect unless you change them.

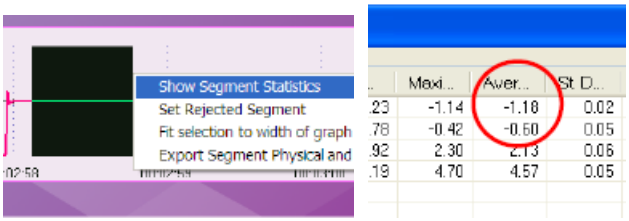
7 Calibration

Depending on the level of accuracy you need, you may need to calibrate the system.



- Start an open display session with the calibration screen.
- Run the interfaced system in such a way that you cover the entire range of the system outputs.
- Save the session and go to review mode.
- Search for the minimum and maximum for each channel and write them down.

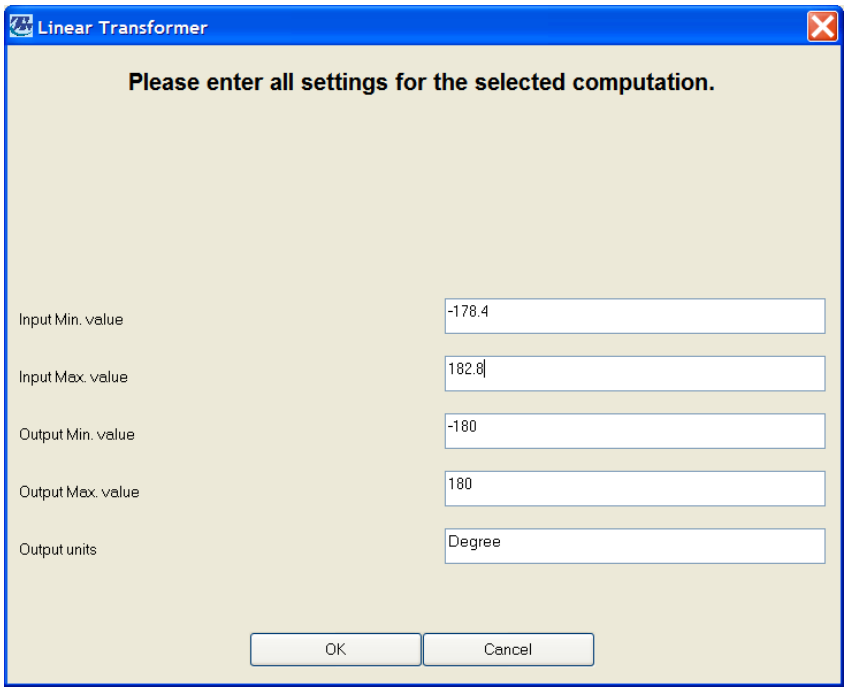
If the signal is noisy, it is recommended to take several points, as shown below:



Similarly to the unit conversion, apply the calibration values to the corresponding virtual channels (as shown in the calculation sheet):

- VC28: VI Ch#1 calibrated output
- VC29: VI Ch#2 calibrated output
- VC30: VI Ch#3 calibrated output
- VC31: VI Ch#4 calibrated output

For instance, you measured -178.4° for the minimum and 182.8° for the maximum. [-180° - 180°] is the actual full scale.

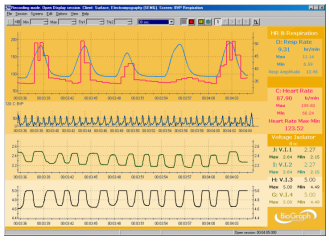


Then enter "**-178.4**" in **"Input Min. Value"** and "**-180**" in **"Output Min. Value".** Enter "**182.8**" in **"Input Max. Value"** and "**180**" in **"Output Max. Value"**.

Note 1: These values are actual minima and maxima. The software will not take any value greater than the maximum and less than the minimum. In the example above, if the angle is 181°, the software will output 180.

Note 2: This must be applied to all the channel sets. These settings remain in effect unless you change them.

Product Numbers

T9405MA – Voltage Isolator 4∞, which includes the following items:	
	• SA9405MA – Voltage Isolator 4∞ hardware
	• SA9407MA – BioGraph Infiniti Add-on Installation CD
	• SA9408 – Power Adaptor
	• SA9385 – JP04 cable x 4

SA9405MA Voltage Isolator 4∞ Specifications

Size	5.7 x 3.6 x 1.2 in (14.5 x 9 x 3 cm)
Weight	180g
Isolation Voltage	4500 Vrms
Voltage Input Range	±2.5V, ±5V, ±10V, 0 – 5V, 0 – 10V or 0 – 20V (factory setting)
Input Impedance	±2.5V, 0 – 5V: 50kΩ ±5V, 0 – 10V: 100kΩ ±10V, 0 – 20V: 200kΩ
Voltage Input Bandwidth	0 – 1kHz
Accuracy	ΔGain < ±1% Offset <1mV (bipolar), <5mV (unipolar)
Noise	<100μV RMS
Voltage Output	2.8V ± 1.5V
Frequency Response	0 – 1 KHz
Temperature range (operating)	10 - 40 ˚C
Crosstalk	< -90dB or better
Power supply	9V Alkaline battery (6LR61) Low battery threshold: 7.25V Battery life: 10 hours typical
	9VDC power adapter

9VDC Power Adapter Specifications

Rated input voltage	100 V ~ 240 V ac
Input voltage range	90 V ~ 264 V ac
Rated frequency	50~60 Hz
Rated input	Current 300mA RMS max.
No load power consumption	0.3 W max. (CEC Compliant)
Leakage current	0.25 mA
Safety approvals	UL/cUL, CE, GS
RoHS compliant	Yes
Energy Star compliant	Yes
California Energy Commission Regulations compliant	Yes
Storage temperature	10°C ~ +70° C
Operating temperature	0°C ~ +40° C
Storage humidity	10~90%
Operating humidity	20~80%

Placing Orders

Outside USA

Tel: 1-514-489-8251

Fax: 1-514-489-8255

In USA Toll-Free

Tel:1-800-361-3651

E-Mail: mail@thoughttechnology.com

Or contact your local authorized distributor.

Technical Support

Outside USA

Tel: 1-514-489-8251

Fax: 1-514-489-8255

In USA Toll-Free

Tel: 1-800-361-3651

E-Mail: techsupport@thoughttechnology.com

Or contact your local authorized distributor.

Warranty

Voltage Isolator 4∞ is guaranteed to be free from defects in material and workmanship for 1 year from the date of purchase.

In the unlikely event that repair is necessary, contact Thought Technology Ltd. to receive a Return Authorization number. Then send the unit back by a traceable method. Thought Technology will not be responsible for items not received. We will repair or replace your unit(s) that are still under warranty free of charge.

This warranty does not apply to damage incurred through accident, alteration, or abuse.

This warranty does not cover damage to the Infiniti encoder or the Voltage Isolator 4∞ caused by obvious mechanical mistreatment of the system.

Returning Equipment

Before returning the equipment, please contact first our service department and get an authorization number (RA number).

Canada and International +1 514 489-8251

USA 1-800-361- 3651

service@thoughttechnology.com

Then fill-in the return form (the form can be found at the end of the manual). You must provide a detailed description of the problem you are experiencing, and your telephone/fax number and e-mail.

The unit(s) must be sent **postage prepaid** and **insured**, with proof of purchase to one of the addresses below.

All customs and duties charges will be billed to the customer if incurred by sending the unit to the **wrong** address.

In the USA, ship insured to:

Thought Technology Ltd.
Cimetra LLC
8396 State Route 9
West Chazy, New York
12992, USA

In Canada, ship insured to:

Thought Technology Ltd.
2180 Belgrave Avenue
Montreal, Quebec
Canada H4A 2L8

For international:

- Package must be marked with “Broker: Livingston International – 133461”

- Ship insured to:

Thought Technology Ltd.
2180 Belgrave Avenue
Montreal, Quebec
Canada H4A 2L8

Repair Return Form

Be sure to contact us for authorization before returning any equipment!

Remove this sheet and include with returned unit(s).

Include copy of original invoice and return to the address in the Returning Equipment section.

Name _____

Company _____

Address _____

_____

_____

Phone No. _____

Fax No. _____

Date Purchased _____

From Whom _____

Model Name _____

Serial Number _____

_____

_____

Problem _____

_____

_____

_____

_____

_____

_____

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