

Programmable VariGrip™ Multi-Device Controllers



Programmable VariGrip circuit during set-up

- Works with all popular terminal devices
- Accept up to five inputs from electrodes, Touch Pads, linear transducer and switches
- Controls up to four device motors (elbow, wrist, hand or gripper)
- Small, light-weight in-wrist design
- Patient evaluation mode
- adjustments made through set-up software
- Ten standard control strategies, changed through software
- Simultaneous operation of two devices
- Control of TD grip force

LTI's Programmable VariGrip Multi-Device™ control system is a microprocessor-based circuits for controlling powered prosthetic devices. In the past, adjusting a prosthesis meant disassembling the unit, rewiring the hardware (possibly changing the circuit) and reassembling everything before you could test whether it worked! With the Programmable VariGrip technology, you now adapt the circuit to the user, not the user to the circuit! It's as simple as connecting the prosthesis to a computer, and changing the values in the software.

The Programmable VariGrip Multi-Device Control System has many unique features:

- A "patient evaluation" mode simplifies the process of finding the optimal muscle sites for myoelectric controls and eliminates the need for other evaluation devices.
- The ability to accept input signals from myoelectrodes, Touch Pads™ (force-sensitive resistors), servo transducers (linear variable resistors), or switches provides tremendous versatility.
- Control of up to four devices, like hands, wrist rotators, lock actuators, etc.
- Automatic gain setting allows the system to adjust the myoelectrode gain, eliminating the need for manual adjustments.
- Optional co-contraction switching allows the prosthetist to tailor the switching scheme to the patient's abilities when two or more devices are being controlled.
- Fabrication using Surface Mount Technology (SMT) ensures durability and reliable operation.
- The control system remains internal to the prosthesis with no unsightly bulges, even if a wrist rotator is used.
- A low-power circuit extends battery life.

Graphical Interface Software

The VariGrip's Graphical Interface software and interface unit are easy to use. Prosthetists can select a control strategy from the list of approximately ten standard strategies. These cover the common controls used for most prosthetic systems, consisting of single and two input sites using; switches, Touch Pads, myoelectrodes and servo control. If a unique control strategy is needed, Liberating Technologies, Inc. can provide this. Custom control strategies can be created to suit the needs of users with unusual requirements or capabilities.

Using our proprietary Graphical Interface Software, you can program the controller with any standard computer equipped with Windows 3.1 or Windows-95 and above. An LTI interface device is available to connect the computer to the prosthesis, ensuring the proper optical isolation to protect the patient during set-up.

Programmable VariGrip™ Multi-Device Controllers

MyoWizard™ and MyoAssistant™ Prosthetic Controller Software

Liberating Technologies, Inc. (LTI), in collaboration with the Bloorview-MacMillan Centre in Toronto, has developed a new class of prosthetic controller. LTI has produced the **VariGrip MultiDevice™ Programmable Controller** and the Centre has created the **MyoWizard™** and **MyoAssistant™** software. These microprocessor-based controllers and their associated software provide a way for the prosthetist to offer a wide variety of options to the user. As a result, the optimum control strategy may be achieved. In addition, since patient-specific adjustments are now made through the software, it is easy for the prosthetist to evaluate the user and adjust the system to meet the user's specific needs and then save the values to a patient file.

Many people associate electric prostheses with myoelectric control. Although this is an excellent control option, it is not the only choice; and if the user has poor muscle signals, it may not be the best choice. The Programmable VariGrip can be operated in the traditional manner with electrodes as the input, or it can be operated with switches, Touch Pads™ or Linear Transducer as input devices.

Patient Evaluation

Prior to making any decision about the best control strategy for the user, a patient evaluation should be performed. MyoAssistant software provides a convenient patient evaluation module, making it unnecessary for prosthetic shops to own a Myotester. With the Evaluation Program loaded into the circuit one or two electrodes are plugged in. The computer screen acts as a meter with convenient bar graphs representing the strength of each muscle signal. It is easy to find an optimal pair of control sites, and since both muscle signals are visible, co-contraction problems are quickly discovered. Many persons find it difficult to fully relax one or both control muscles. In this case a convenient offset can be introduced so that the system ignores unwanted signals.

With MyoAssistant, not only can the user's individual muscle signals be evaluated, but they can be individually gain adjusted with and filtered prior to making a decision on the best control strategy. Also, these adjusted signals can be saved and used with the controller in the prosthetic system.

Once the patient evaluation is completed and the quality of the muscle signals has been determined, a decision can be made about the best control strategy for the user. MyoWizard™ is the software tool to help select and program your programmable VariGrip controller. With this software, you can; review the standard control strategies, select the most appropriate one and load the strategy to the controller. MyoWizard is also used to reconfiguring a controller to adapt to changes in the user's capabilities (i.e. choosing a different strategy) or for a different client.

The next step with MyoAssistant is to invoke the appropriate software module for the control strategy chosen. This results in a series of graphical-interface screens which allow the prosthetist to perform the necessary adjustments and settings for the individual user.

Most of the MyoAssistant control strategies use the difference between two muscle signals to effect control. By carefully adjusting the offsets and gains it is easy to work with users who cannot avoid some co-contraction of the two muscles. As soon as the user becomes consistent using the bar graphs, a strategy for controlling the hand or other device can be loaded using the offsets and gains recorded during evaluation. A patient file can be saved for each session.

Single-Muscle Control

There are several strategies available for single-muscle control. Where only one muscle is available, the Single-Muscle Evaluation Program may be downloaded. With it, *Rate* – the optimal strategy for one-muscle control may not only be tested, it can also be adjusted to suit the particular user. *Rate* works by detecting how quickly a contraction is initiated. A jerk opens the hand and a slow contraction closes it. As soon as the hand moves, control is proportional. For those finding this control difficult *Alternate* is offered. Here, every other contraction opens the hand and the alternate contractions close it. Control is proportional. With MyoAssistant you do not have to accept a strategy or settings that works for an average user, you can tune the system to the individual.

Device Selection when Controlling Multiple Devices:

With MyoAssistant and LTI's MultiDevice™ Controllers, up to four motors can be activated. A typical use is two forearm muscles controlling both a hand and wrist rotator. Control is shifted by co-contracting both muscles. This shift should take place without inadvertently "dropping the hot coffee." With MyoAssistant several ways of triggering a shift are available, and the best for each user can be selected during evaluation and training. Some users will shift best with a rapid co-contraction. Others will find this difficult and will need to have delays

Programmable VariGrip™ Multi-Device Controllers

introduced into the control so that simple co-contraction does not lead to unintended motion – In any case, the program “Train to Select Device” mode will permit selecting an optimal method for initiating the shift. The same trigger may be used to shift back or a revert time may be set to automatically return to the default device. The shift may also be triggered by using a switch where that is more convenient.

Paying for Software:

MyoWizard™ and MyoAssistant™ software has been “bundled” with the controller hardware. Therefore, we can provide the software at *no charge* to the customer. Each feature in the MyoAssistant software represents many hours of software engineering. This cost is recovered by adding a software component to the cost of the Programmable VariGrip MultiDevice Controllers. Users must sign a license agreement specifying which capabilities they have purchased. This enables us to offer controllers for specific devices such as two-motor controllers at the same price as devices with one-motor. The Otto Bock 2000™ Hands and Centri UltraLite™ Hands fit into this category.

VariGrip MultiDevice™ Controllers

The Controllers below are supplied with the full suite of MyoAssistant control software for the VariGrip. Each Controller is set up to accept control strategies for one/two or three/four devices depending on which unit is ordered. All require an Interface Module and cables and connectors for the electrodes, hands, or interface cable.

Finding the Best Control Strategy

Patient fittings start with an evaluation of muscle sites using the evaluation program and one or two electrodes. With information from the evaluation in hand, prosthetists use the software MyoWizard™ to determine which of the preprogrammed control configurations would best suit the patient. In addition to the brief description provided in the MyoWizard menu, each control strategy is described in detail to help the prosthetist determine the optimal strategy for their client. These descriptors state the number and type of input device to be used, followed by the method of selecting the device to be controlled.

You then download the selected control strategy to the prosthesis and let the patient try it. Each control strategy is set up with default settings. Patients should use these briefly to see if they are suitable. If they are not, the settings can be changed to accommodate the individual capabilities of the patient. Repeated changes are easy to make, until you find the optimal control strategy for the patient’s needs.

VariGrip circuitry allows users to increase or decrease speed by varying the strength of their input signals. For example, with electrodes, a full contraction will cause a device to move quickly, while a gentle contraction will slow it down almost to a standstill. In the case of hands and grippers, once the device makes initial contact with an object, the motor slows down. Thereafter, the VariGrip controls current flow and the resulting grip force. The strength of the final grip will be proportional to the strength of the input signal from the electrode, Touch Pad, or linear transducer. Thus, users can close the hand quickly until they touch the object, then control it with a light or heavy grip-force.

Compatibility

Programmable VariGrip Multi-Device Controllers are compatible with any of the following inputs, singly or in pairs:

- Bock 13E125 Electrodes
- Bock 13E68 Electrodes
- Steeper SC01 Myoelectrodes
- LTI Touch Pads™
- LTI Linear Transducer (single only)
- switches

Programmable VariGrip control systems are compatible with the following terminal devices, alone or in combination. Except where indicated, the devices in question are ordered without the manufacturers circuitry. The LTI order department will help you select and specify the right components.

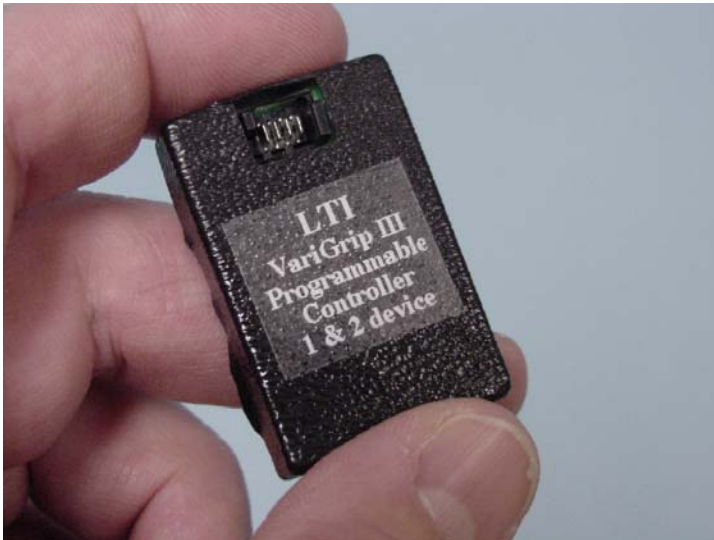
Compatible Terminal Devices:

- Otto Bock Hands and Greifers
- Bock DMC and SUVA hands *with circuits*
- Centri UltraLite Hands
- SteeperLite Hands

Programmable VariGrip™ Multi-Device Controllers

- Steeper Powered Gripper
- VASI Electric Hands
- VASI Wrist Rotators
- Bock Wrist Rotators
- VASI Electric Elbows
- RSLSteeper Electric Locking Elbow
- Hosmer Electric Elbows
- LTI-Collier Shoulder Joint, Motor-Driven Lock Actuator

VariGrip™ Multi-Device System Configurations



The Programmable VariGrip Multi-Device Control System is available in four configurations:

- **PVG11 one - device controller**
- **PVG12 two - device controller**
- **PVG13 three - device controller**
- **PVG14 four- device controller**
- **PVG15 one - 2-motor device (with two-motors)**
- **MyoWizard & MyoAssistant Software and**
- **USB or Serial Interface Box**

PVG11-PVG15 are designed in a low-profile configuration to fit inside a forearm. The one/two device model measures: 25 x 38 x 8 mm ($1 \times 1\frac{1}{2} \times \frac{5}{16}$ inches) and weighs less than 9 grams. When controlling three or four devices a second module is required. This third/fourth device controller measures: 25 x 30 x 5 mm ($1 \times 1\frac{1}{4} \times \frac{3}{16}$ inches) and weighs less than 4 grams.



PVG11 Programmable VariGrip Multi-Device Controller, one device



PVG12 Programmable VariGrip Multi-Device Controller, two devices

Programmable VariGrip™ Multi-Device Controllers



PVG13 Programmable VariGrip Multi-Device Controller, three devices
The two modules will be wired together. By bending the wires the entire unit can be fit through the opening in a Bock wrist. Once inside it will fit in the space around a rotator.



PVG14 Programmable VariGrip MultiDevice Controller, four devices
The two modules can be stacked together for minimal size.



PVG15 Programmable VariGrip Multi-Device Controller, one 2-Motor Device
Suitable for two-motor devices such as the Otto Bock 2000 hand and Centri UltraLite Hand.



INT100 – Serial Interface Unit & Programming Cable
For use with VariGrip III Controllers



INT200 – USB Interface Unit & Programming Cable
For use with VariGrip III Controllers

Programmable VariGrip™ Multi-Device Controllers

Connectors for the VariGrip III Controller

Input Connectors, 6-Way

Two 6-way input connectors can be plugged into the controller. Each provides the power to operate the named input devices and returns a control signal for each. The plug point next to the Battery/Program Plug is always used first because the program looks to these two inputs first. The second plug point is used when there are three or four inputs. In addition this plug point can act as an output to supply a control signal to a device that requires both power and analog input signals rather than current directly to a motor. The second plug point can only supply two myoelectrodes if the plug is custom wired. The following standard 6-way connectors are offered with the indicated terminations to connect to the indicated devices. Only standard combinations are offered below. For others, contact Liberating Technologies technical support group for advice.

VGC601	6-W Input, 1 13E125 Electrode
VGC602	6-W Input, 2 13E125 Electrodes
VGC603	6-W Input, 1 13E68 Electrode
VGC604	6-W Input, 2 13E68 Electrodes
VGC605	6-W Input, 1 Steeper Electrode
VGC606	6-W Input, 2 Steeper Electrodes
VGC607	6-W Input, 1 Remote-Electrode Amp
VGC608	6-W Input, 2 Remote-Electrode Amps
VGC609	6-W Input, 1 Sleeve-Electrode Amp
VGC610	6-W Input, 2 Sleeve-Electrode Amps
VGC611	6-W Input, 1 LTI Touch Pad Plug
VGC612	6-W Input, 2 LTI Touch Pad Plugs
VGC613	6-W Input, LTI Linear Transducer
VGC614	6-W Input, VASI Male Power-Signal Plugs
VGC615	6-W Input, VASI Male Signal Plug
VGC616	6-W Input, Bock Switch
VGC6-N-N	Custom 6-W Input from LTI Catalog Menu

Output Connectors, 4-Way

A single 4-way connector can serve two one-motor devices or one two-motor device. When more than two motors are required the controller must have the second add-on module attached. For this reason the controllers are offered in two styles—1-2 motor and 3-4 motor. The following standard 4-way connectors are offered with the indicated terminations to connect to the motor operated devices. Only standard combinations are offered below. For others use the connector menu in the LTI catalog to specify the connections you want.

VGC401	4-W Output, 1 Bock 2-Socket Plug
VGC402	4-W Output, 2 Bock 2-Socket Plugs
VGC403	4-W Output, 1 VASI Female Signal Plug
VGC404	4-W Output, 2 VASI Female Signal Plugs
VGC405	4-W Output, Bock 2000 Hand
VGC4-D-D	Custom 4-W Output from LTI Catalog Menu

Battery-Program Connectors, 8-Way

Two wires on this 8-way connector deliver battery power to the controller. Three connections are reserved for programming the firmware and two for altering patient settings in the field. The leftover connection is used in the rare case where five inputs are required. Only standard combinations are offered below. For others use the connector menu in the LTI catalog to specify the connections you want.

To choose the right connector below, first decide how you want to program the controller. It is easiest to use an LTI Built-in Battery which may be ordered with external receptacles on the On-Off/Switch Board for both the

Programmable VariGrip™ Multi-Device Controllers

program plug and the recharge connector. The other choices are separate internal or surface-mount program plug receptacles. The internal receptacle is small, but you need a way to get at it; the surface-mount requires a 3mm step in the axial direction in the lamination. The program plug enters from the side of the step with the receptacle flat just under the surface.

VGC801	8-W Built-in Battery, Program Plug
VGC802	8-W Bock S Piece, Internal Plug
VGC803	8-W Bock S Piece, Surface Plug
VGC804	8-W Bock Li-ion Conn., Surface Plug
VGC805	8-W Bock Li-ion Conn., Internal Plug
VGC806	8-W Steeper Mount, Internal Plug
VGC807	8-W Steeper Mount, Surface Plug
VGC808	8-W VASI Power Plug, Internal Plug
VGC809	8-W VASI Power Plug, Surface Plug
VGC8-B-P	Custom 8-W Adapter from LTI Catalog Menu

Common VariGrip III Connectors

Output Connectors



VGC401 4-W Output, one Bock 2-Socket Plug



VGC402 4-W Output, two Bock 2-Socket Plug



VGC403 4-W Output, one VASI Female Signal Plug



Programmable VariGrip™ Multi-Device Controllers

Input Connectors



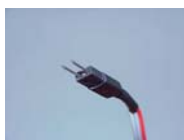
VGC601 6-W Input Connector, one 13E125 Electrode



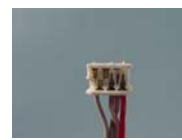
VGC602 6-W Input Connector, two 13E125 Electrodes



VGC611 6-W Input Connector, one LTI Touch Pad



VGC612 6-W Input Connector, two LTI Touch Pad



VGC614 6-W Input, VASI Male Power-Signal Plugs



Programmable VariGrip™ Multi-Device Controllers



VGC615 6-W Input, VASI Male Signal Plug



Battery Connectors



VGC801 8-W LTI Built-In Battery, Program Plug



VGC808 8-W VASI Power Plug, Internal Plug



Programmable VariGrip™ Multi-Device Controllers

Custom Cables



MC-NX-DX-BX-SX Cable/Adapter
Select specific plugs from the sections below

DV – Output Option
BX – Battery Option
SX – Special Options

NX – Input Option

Input Cable Options (NX)

- N1 One Touch Pad Input Plug
- N2 Two Touch Pads
- N3 One RSLSteeper SC01 Input Plug
- N4 Two RSLSteeper SC01 Input Plugs
- N5 One Bock 13E125 Input Plug
- N6 Two Bock 13E125 Input Plugs
- N7 One Bock 13E68 Input Plug
- N8 Two Bock 13E68 Input Plugs
- N9 VASI Male Signal (1 wire open, 1 wire close)
- NA One Cable w/Linear Transducer
- ND Bock 4-Socket Plug for Bock Switch
- NE Bock 4-Pin Plug for 13E51=1
- NF Bock Coaxial Bushing – 9E168
- NG VASI Dual-Action Push Switch (V190)
- NH 1SX1-T Microswitch

Output Cable Options (DX)

- D1 RSLSteeper 6-Pin Plug
- D2 Bock 4-Socket Plug
- D3 Bock 2-Socket Plug, Hand or Wrist
- D4 Bock 3-Socket Plugs, old Hand Switch
- D5 UltraLite Hand Plug
- D6 Power Bridge/Hosmer Elbow Plugs
- D7 Power Br/VASI F Sig Plug, Elbow
- D8 VASI F Sig Plug, Elec, Hand or Wrist
- D9 Hosmer Prehension Actuator Plug
- DA Hosmer Elbow Plugs (VGII only)
- DB VASI Elbow F Sig Plug (VGII only)
- DC Plug for Synergetic Prehensor
- DD Output to Lumberg 4-Pin
- DE Centri Hand Cable
- DF Bock 9E125 Male 2-Pin Plug
- DG Bock 3-socket Plug, 2000 Hand

Battery Cable Options (BX)

- B1 Mount for BP02 Half-Size Battery
- B2 LTI Conn for BP16-19 and all Type S batt
- B3 LTI BP63 Batt, 4.8V, 250 mAHr
- B4 LTI BP73 Batt, 6V, 250 mAHr
- B5 RSLSteeper Battery Mount, Complete
- B6 RSLSteeper External Batt Clip, 22” Cord
- B7 Bock Battery Mount, “S” Piece only
- B8 Bock External Battery Clip, 22” Cord
- B9 Bock 2-Socket Connector QD
- BA VASI Male Power Plug
- BB Hosmer Elbow Female Power Plug
- BC Color-Coded Battery Cable only
- BD Hosmer Elbow Male Power Plug
- BF Bock 9E126 for Pro Control
- BG VASI Female Power Plug
- BH Bock 4-Socket Connector, Procontrol
- BI Bock 4.8V S-Piece Battery Conn.
- BL Bock Lithium Adapter

Special Options (SX)

Use the additional option if needed. For instance, the –D6 Output option places a controller above the elbow. If this is used with a second controller, wires will cross the elbow and need a sheath for protection (option –S1). Two controllers are normally packaged back-to-back as a block measuring 0.7” X 1.1” X 1.35” (18 X 28 X 34 mm).

- S1 Sheath Cross-Elbow Wires
- S2 Make Cross-Elbow Wires HD Flex
- S3 Package Controllers Separately

Programmer Cable Options (PX)

- P1 Control to Interface Unit, 3” cable
- P2 Control to Interface Unit, 8” cable
- P3 Control to Interface Unit, 39” cable
- P4 Control to Female Plug on Socket
- P5 Male Plug on Socket to Interface Unit