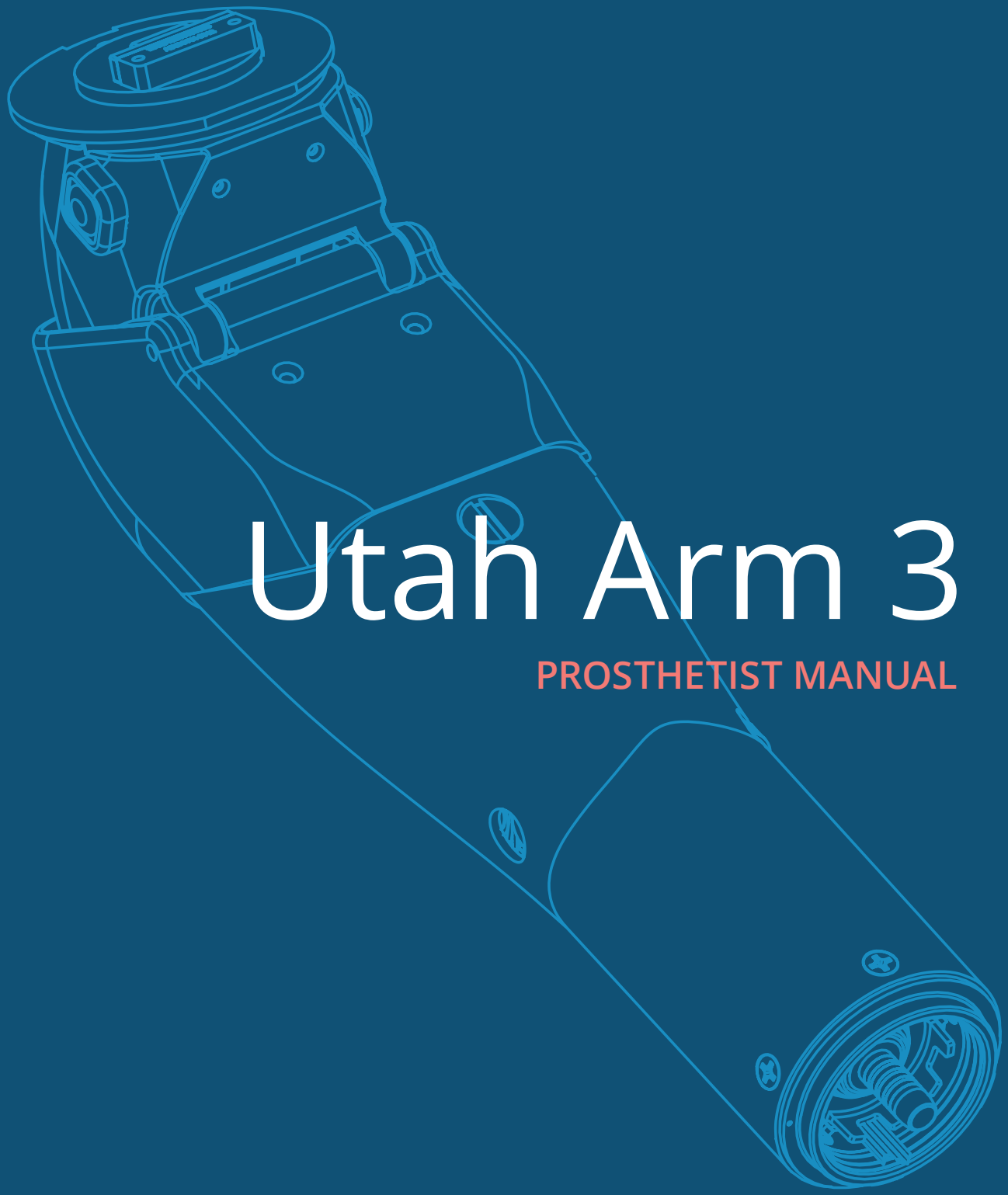


Utah Arm 3

PROSTHETIST MANUAL

Fillauer®

Special Precautions

Use caution when using this device in situations where injury to yourself or others may occur. Turn the arm OFF when driving, operating heavy machinery, and taking the arm on and off. It can still be used passively in most cases. Conditions such as a low or dead battery, loss of electrode contact, or mechanical/electrical malfunction (and others) may cause the device to behave differently than expected. The device poses a spark risk and should not be used around volatile gases.

Risk Management: To minimize the risk of device damage or injury to the user while maximizing the functions of this device, follow the instructions for installation, and use this device as described in this manual.

Use only in strict accordance with the directions for use. Use of the Arm outside of the recommendations may damage your Arm. Do not attempt to repair your Arm beyond the instructions provided in this manual. Do not remove any covers, screws, plates or any part of the elbow not described in this manual. There are no user serviceable components within the elbow. Removal of these covers will compromise the waterproof seal and void the warranty.

The Utah Arm will support 50 ft-lbs/65 Nm (22.6 kg) with the elbow in the locked position. Forces greater than 50 lbs while locked are considered beyond the capabilities of the elbow and could damage the elbow. This could include but is not limited to lifting heavy loads and/or falls onto the elbow.

Dirt, dust, grit or othe contaminants will damage the Utah Arm, and the Arm is not waterproof. Do not submerse in water or use solvents or caustic chemicals on the arm. Always cover the Arm in these environments and clean immediately after. Follow prescribed cleaning recommendations.

Serious Incidents

In the unlikely event a serious incident occurs in relation to the use of the device, users should seek immediate medical help and contact their prosthetist at the earliest possible convenience. Clinicians should contact Motion Control immediately in the event of any device failure.

Technical Specifications of the Utah Arm

- Excursion Range: 135°
- Excursion Time: With Myoelectric TD: 1.20 seconds
- Active Lift: 1 kilogram (2.2 lbs.) in the Terminal Device and using a fully charged battery
- Load Limit: 22.7 kilograms (50 lbs.), locked
- Humeral Rotation: Quick-Disconnect Wrist: 360°
- Weight: Without Hand, 913 grams (2 lbs.)
- Operating Temperatures: 0° to 44°C (32° to 110°F)
- Storage temperatures: -18° to 60°C (0° to 140°F)
- Maximum Current: 4.0 Amps Quiescent Current: 50 mA
- Voltage: Rechargeable lithium-ion, 1100 mA hours, Dual Supply, +7.2/- 4.8 Volts D.C. (total 12 V.)
- Forearm Length: from rearmost point of the Forearm to the end of the Wrist, Maximum: 27 cm (10 5/8”), Minimum: 20 cm (7 7/8”)
- Electric Shock Protection: Class III, Type B
- Device Life: 5 Years

Overview

The U3—one step closer to nature

The Utah Arm 3 is easy to adjust for both wearer and prosthetist. Here are some of the important features:

TWO microprocessors allow for simultaneous elbow and hand function

The U3 allows the wearer to both reach and grasp for an object at the same time, producing a more natural movement than what was possible before. Sequential control is also available.

Computer Interface for configuration & adjustment

The U3 uses the microprocessor technology introduced by Motion Control in the ProControl 2. The Computer Interface is easy to use and allows the prosthetist or the wearer to train and make adjustments easily as it shows the wearers' input signals in real time.

Utah Arm Computer Interface software:

- Access control options and inputs.
- Works on any Windows OS, after Windows XP.
- Download the software at www.fillauer.com

Set-Up Wizard

The Wizard guides you through the setup process step-by-step, OR, make changes directly to adjustment screens and summary screen.

AutoCal® Feature

Automatic adjustment of hand gain and threshold. This is an optional feature for older arms.

Electric Wrist Rotation

- Hand/Wrist switching through co-contraction or fast access.
- "Auto Switch Back" will return to hand control automatically after 10 seconds of relaxation.
- Push or pull switches are still available for wrist control, see the catalog page for options.

Variety of input choices:

The U3 can operate using a variety of input choices to include the Fillauer MyoOne™ waterproof electrode system. The U3 is also compatible with other manufacturers electrodes and pattern recognition technologies. Alternate inputs such as linear potentiometers, simple swithches, touchpads, and compatible FSR inputs will run the U3 and connected components.

Multiple TD Options:

MC ETD, ETD2, and MC Hand. Compatible with TASKA®, i-limb® and bebionic®, Zeus®, and Ability™ hand, and other manufacturers' terminal devices.

* Multi-articulating hands may require an additional battery or battery upgrade when ordering.

External Parts of the Utah Arm 3

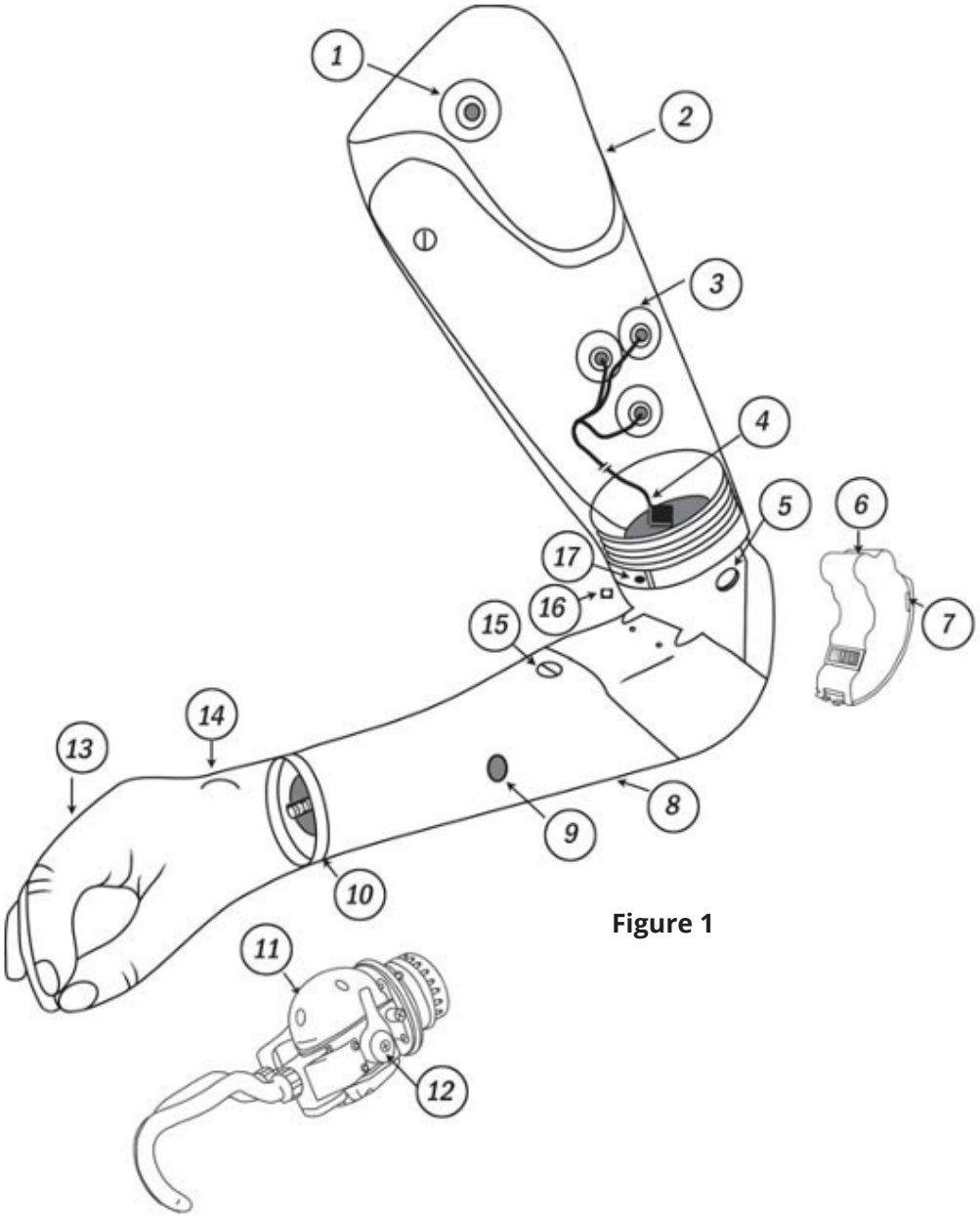


Figure 1

1. Ground Electrode
2. Outer Socket
3. EMG Electrodes (with Spacers)
4. Humeral Wire Harness
5. U3 4-pin Computer Interface Connector (on left side)
6. Battery Pack
7. Battery fuse
8. Forearm Cover
9. ON-OFF Switch for Arm
10. Lamination Collar and Coaxial Connector and/or Electric Wrist Rotator
11. Motion Control ETD (Electric Terminal Device), Motor Direct version
12. ETD safety release lever
13. Motion Control Electric Hand—Motor Direct
14. Hand ON-OFF Switch
15. Forearm Cover Screws (2)
16. Lock Override Button (on right side)
17. Humeral Rotator Clamp Band and Friction Adjustment Screw

EMG Testing and Training

Before fitting

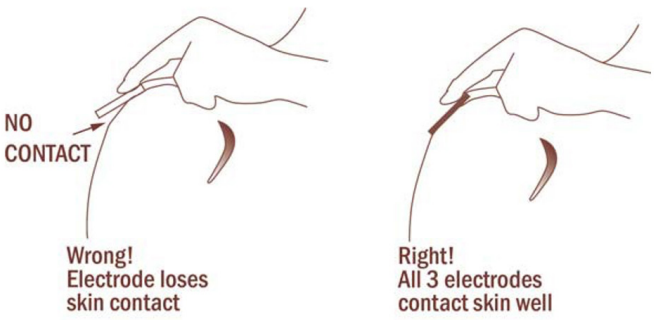
Before fitting the Utah Arm to a patient, we recommend that you familiarize yourself with its function and prepare the management software. Using the Preamplifier Set (e.g., Myolab preamp set, or alternate input, e.g. Linear Potentiometer) you may operate the U3 yourself. You can then verify all the functions described in this manual, and experiment with how their adjustment effects the control of the elbow, hand and wrist.

Basics of EMG Testing

Proper Alignment. Align the electrodes along the general direction of the muscle fibers. For very dry skin, or very hairy skin, moisten the skin slightly with water or hand sanitizer to improve the EMG signal by lowering skin resistance.

Good Contact. All the electrodes on the preamplifier must be in good contact with the skin, as shown in Figure 2.1. Hold the electrodes to the skin for a few seconds to establish good contact between skin and electrodes.

Figure 2.1, Electrode contact examples.



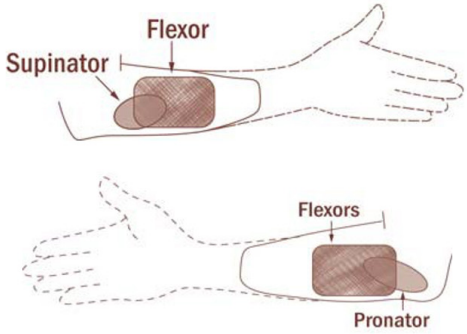
Evaluate all Potential Sites. All of the remnant muscles which could be used for control sites should be evaluated before fitting the prosthesis. Begin EMG testing with the most distal of the remnant muscles.
Likely sites on the forearm for EMG control sites are shown in Figure 2.2.

For each potential control site, palpate the muscle as the patient contracts it and place the preamplifier over the belly of the muscle. Touching the muscle may help give the subject more sensation of the muscle contraction.

NOTE: Unilateral amputees may be aided in learning to contract a particular muscle in their remnant limb by mimicking the same function in the sound side arm, e.g., flexing the sound side elbow and contracting biceps muscles simultaneously in both the remnant arm and the sound arm.

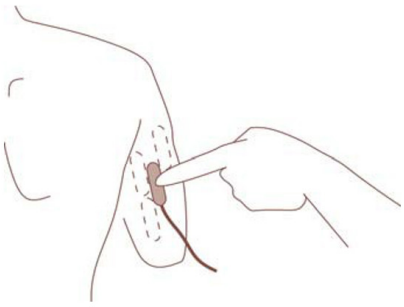
While holding the electrodes over the muscle, instruct the patient to "contract-hold-relax" in about a three second sequence. A smooth and even contraction is desired, without strenuous effort, with relaxation after each contraction. Systematically move the preamplifier by about one-half inch (1 cm.) increments testing the entire remnant limb wherever muscles exist.

Figure 2.2, Forearm EMG sites for ProControl and ProHand Fittings



Mark Location of Sites. When a potential control site is identified, mark the best electrode location on the skin, and also mark the total area in which an adequate EMG signal is obtained (Figure 2.3). This will be important in locating electrodes in the prosthetic socket. Identify all potential EMG control sites in this manner.

Figure 2.3, An example marking location for tricept EMG



Preamplifier Handling Precautions

The preamplifiers used with the Utah Arm are sensitive electronic devices, thus they require proper handling to avoid damage by static electricity.

- Discharge yourself to the ground (center) electrode, or black plastic back, before touching any other part of the preamp, each time they are handled.
- Avoid working on the socket with static-producing equipment (buffers, drills, etc.) after the preamps have been installed. If the preamps could receive a static discharge, remove them.
- Do not tug or jerk on the preamp connector wires, especially when disconnecting them. Be sure to pull on the connector, not the cord.
- Do not place the wires where they might be pinched during assembly of the sockets, or other situations.
- The electrodes should be connected to the preamp with the wire set supplied with the Utah Arm fitting kit An optional long set, 16" [40.6 cm] is available.

Prevent Moisture Damage

Always use two ground electrodes, connected with wires to the center input of each preamp. The ground electrode does not need to contact the control muscle. Position them over fleshy, non-muscled skin areas, and on generally opposite sides of the remnant limb, to insure ground contact on at least one electrode throughout the full range of motion of the prosthesis.

- Avoid moisture from perspiration (or any other source) on or into the preamps.
- Holes in the socket which could leak perspiration to the preamps must be filled in.
- If a drain hole or pull-sock is necessary in the bottom of the socket, it must drain the moisture to the outside, not into the space between the inner and outer sockets.
- If an outer socket is not covering the preamps, they must have a moistureproof cover and protection from blows or other damage.
- We DO NOT recommend potting the electrode studs with RTV silicone. The silicone can insulate the electrode threads, resulting in loss of signal.

Sweat Damage Prevention: (for high sweat or humid climates)

The Utah Arms U3+, U3 and Hybrid Arm are not water resistant. The following steps are strongly recommended for all Utah Arm wearers who have the possibility of dripping sweat into their socket, or into the elbow itself. Sweat can cause damage over time, by corroding connectors and wires, and causing electrical shorts.

- Protect the connectors and joints at the top of the Utah Arm. Fill all the connectors with silicone grease. It prevents water from entering the connector. Also, run a bead of the silicone grease around the mating surface of the Elbow Cap, then screw the Cap tightly into place.
- If the wearer produces excess perspiration (hyperhidrosis), precautions must be taken. Antiperspirant preparations and/or absorptive axilla pads may help, or a prescription for a strong topical antiperspirant. Products like Certain Dri® (over the counter) and Drysol® (requires a prescription) are powerful antiperspirants. These can be used (as directed by the pharmacist and/or physician) to reduce perspiration.
- After other measures if moisture continues dripping into the forearm and collecting in the lock strip slots. Preventive Step: Send the Utah Arm (forearm only is required) to Motion Control and we will drill a small hole at the base of the Forearm Structural Piece, which will allow sweat to drain out of these slots.
- Prevent sweat from dripping into the interior of the socket, and down to the connector area. Preventive Step: Seal the frame and socket together at the axilla with RTV silicone, so that sweat cannot drip into the inside of the socket. Also, make a large enough hole into the side of the base of the socket so that a highly absorbent sponge or a synthetic chamois cloth (available at camping stores) could be placed in that space, or a "sweat band" like a tennis player wears, could be worn around the socket. The wearer could then squeeze out the sponge or sweat band during the day.

Connections

Computer Interface Connection

Install the software onto your computer from the download available on our website. To attach the Arm, connect the Computer Interface Cable to the 4-pin connector on the U3 elbow. The Computer Interface Cable plugs into the computer. If your computer has no Serial Port, use a USB/ Serial Port adapter, a Bluetooth adapter is also available.

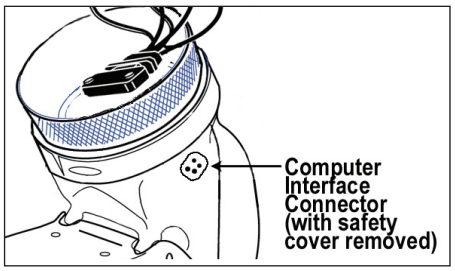


Figure 3, Computer port.

Humeral Connector System

The micro-D-miniature (MDM) connector system will allow you to connect a one, three, or five-wire harness to the Utah Arm, depending upon the number of control options you desire. The 3-Wire Harness is supplied standard with the Utah Arm 3, or when ordering, request the 1-wire or 5-wire harness. Caution: Never insert any probe into the MDM connector pins. If damaged, the entire Wire Set will need to be replaced.

Humeral Connector System Options

- **Elbow:** Connects to EMG Preamplifier Set, or Alternate Inputs: (see Fig. 4 below). For "Same Input" set up, the Elbow input is used to control both Elbow and Hand.
- **Hand:** Input for the Hand only. Same choices as for Elbow Input.
- **Switch:** Use with desired wrist control switch.
- **Lock Cable:** 2-pin connector for remote locking and unlocking.
- **Remote Power Switch:** 4-Pin connector.

Figure 4, Detail of Forearm Connection System

Forearm cover wire set:

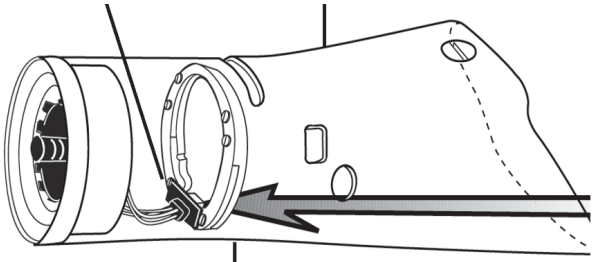
Connector automatically mates when Forearm Cover is installed. Wire Set installed in Forearm Cover automatically makes all connections for Hand and Wrist .

Adjustable Forearm Length

Maximum: 27 cm (10 5/8")

Minimum: 20 cm (7 7/8")

Please contact Motion Control for information on how to modify the forearm length.



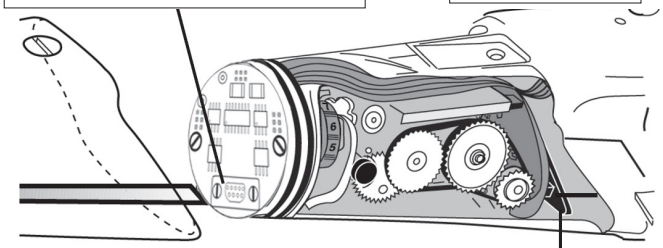
FOREARM COVER WITH MOUNTING RING

Wire Set

The distal end of the Forearm Cover Wire Set is accessed by disassembly of the coaxial connector/lamination collar. The ring mechanism which mounts at the proximal end of the Wire Set is not removeable.

Hand Circuit Connector
Micro-D-Miniature (MDM) connector. Lines up automatically when Forearm Cover is installed.

Remote Power Switch Circuit

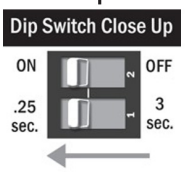


USING A REMOTE POWER SWITCH:

1. Connect one of the remote power switch options (see p.8) to the 5-wire harness. Touching an electrode in the "Electrode kit" is equivalent to activating a switch.

2. Slide both Dip Switches on the Remote Power Switch Circuit (see diagram) to the left. To switch the power on or off, hold the switch for 1/4 second.

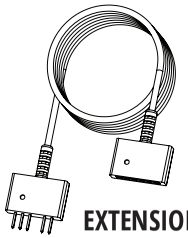
3. If a longer switching time is desired, slide DIP switch #1 to the right side. Now the remote switch must be held continuously for 3 seconds to switch the power ON or OFF (preventing accidental switching).



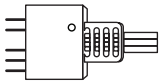
Slide both switches to the left to enable remote power. Slide right for 3-second switch time.

PARTS CATALOG UTAH ARM 3

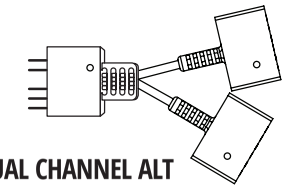
UTAH ARM 3 PACKAGE Tan: 5010035 Brown: 5010036 Jet Black: 5010038
UTAH ARM 3+ PACKAGE Tan: 5010039 Brown: 5010040 Jet Black: 5010041



EXTENSION CABLE (EMG)
Short 10" (25cm): 3010094
Long 6' (1.5m): 3010073

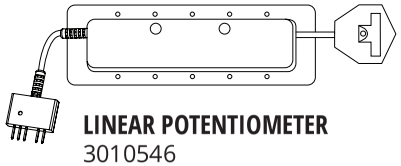


RIBBON CABLE U3 CONNECTOR
Single Channel: 300753
Dual Channel: 3010752
9-Pin Single: 3010731

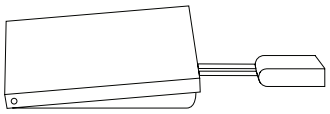


DUAL CHANNEL ALT INPUT CABLE
3010776

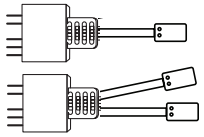
ALTERNATE INPUTS:



LINEAR POTENTIOMETER
3010546

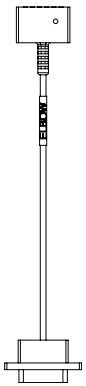


TOUCH PAD
Tan: 3010669
Brown: 3010670
Jet Black: 3010721

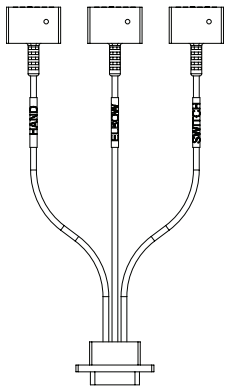


1-CHANNEL TOUCH PAD CABLE
3010548
2-CHANNEL TOUCH PAD CABLE
3010549

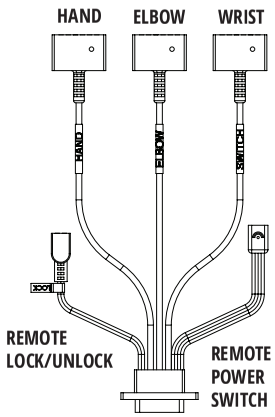
WIRE HARNESS:



1-WIRE HARNESS
3010544
• Hand & Elbow



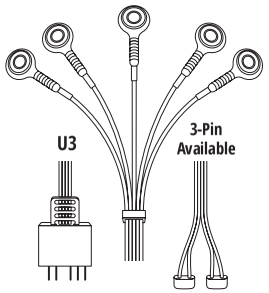
3-WIRE HARNESS
3010540
• Hand
• Elbow
• Wrist Switch

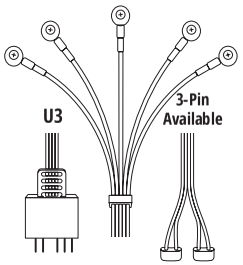


5-WIRE HARNESS
3010545
• Hand & Elbow
• Wrist Switch
• Remote Lock/Unlock
• Remote Power Switch

MYO/ONE ELECTRODES:

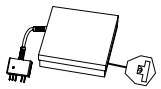
Standard 10" Cable
Long 18" Cable

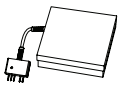


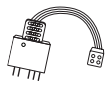


SNAP U3 STANDARD 5010155 (3mm post), 5010156 (6mm post)
CONTROL SEAL® U3 CABLE STANDARD 5010153
CONTROL SEAL® U3 CABLE LONG 5010154
Single electrode sets and 3-Pin versions of the Myo/One are also available, see website.

"A" WRIST CONTROL (12-volt proportional control)

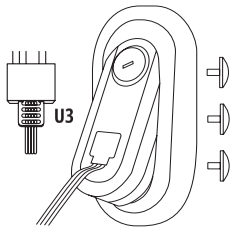






MC PULL SWITCH Jet Black: 3010259
HIGH PROFILE WRIST PUSH SWITCH
T: 3010250, B: 3010251, JB: 3010715
LOW PROFILE WRIST PUSH SWITCH
T: 3010675, B: 3010676, JB: 3010720
ADAPTER CABLE FOR "A" OTTOBOCK WRIST SWITCH 3010105
EXTENSION CABLE 9"(23cm) 3010556

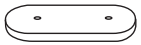
TRIAD PREAMPS:



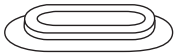
SINGLE PREAMP
3010754

ELECTRODE SET (6)
Short: 3010636
Med: 3010835
Long: 3010834

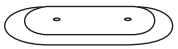
PREAMP DUMMY
1100278



PREAMP GROMMET
1100272



DUMMY PREAMP GROMMET
1100279



SETS:

DUAL CHANNEL UTAH ARM CONNECTOR
3010782

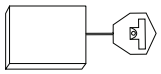
SINGLE CHANNEL UTAH ARM CONNECTOR
3010783

TRIAD SET–NO CABLE
3010786
Single electrodes available see website.

***COAPT® or IBT PATTERN RECOGNITION**
If the system is going to use COAPT or IBT, please note that during the order.

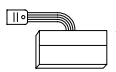
"B" WRIST CONTROL

(6-volt on/off control) Use with Wrist Control Adapter Cable for Version B (3010106)

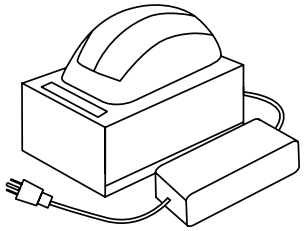


CABLE PULL SWITCH
Ottobock 1701023

HARNESS PULL SWITCH
Ottobock 1701022



ROCKER SWITCH
Ottobock 1701021
ADAPTER CABLE FOR



BATTERY CHARGER
3010732

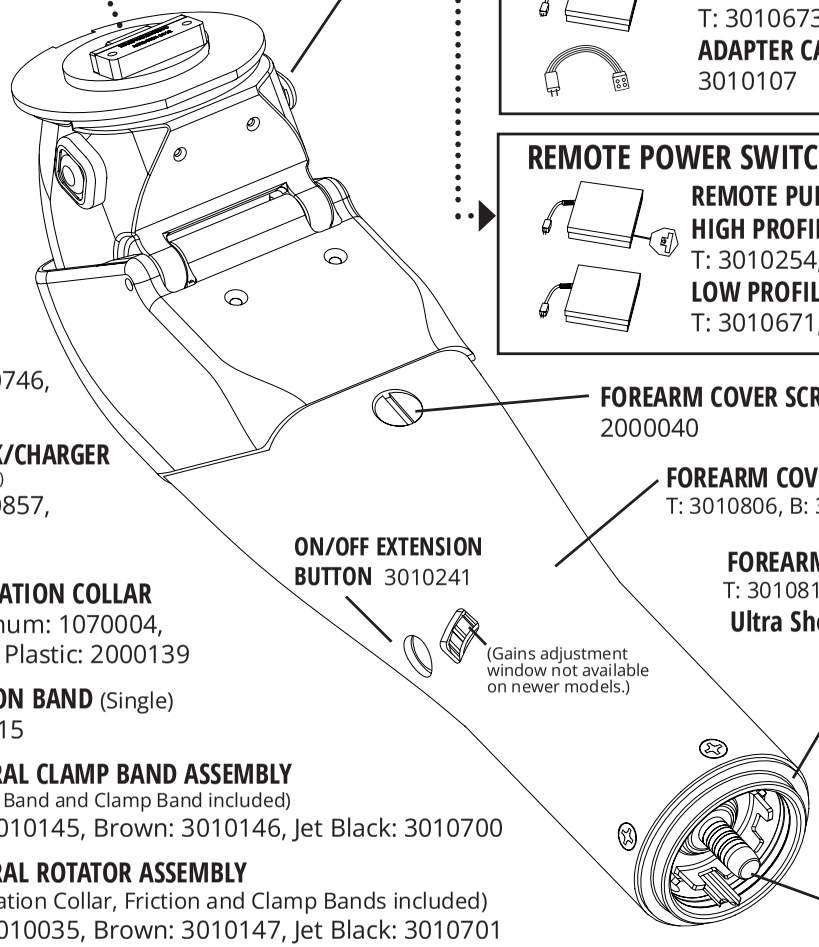
POWER SUPPLY
1390040

POWER CORDS
US: 1390043, EU: 1390043

SINGLE BATTERY (Li-ION)
Tan: 3010745, Brown: 3010746,
Jet Black: 3010747

SUPPLEMENTAL BATTERY PACK/CHARGER
(Charger, Power Supply, Cord, 2 Batteries)
Tan: 3010856, Brown: 3010857,
Jet Black: 3010858

COMPUTER INTERFACE FOR LEGACY SOFTWARE
USB: 5010075
Bluetooth: 5010037



FOREARM COVER SCREW
2000040

FOREARM COVER STANDARD
T: 3010806, B: 3010807, JB: 3010808

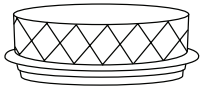
FOREARM COVER SHORT
T: 3010812, B: 3010813, JB: 3010814
Ultra Short Option: 3010551

ON/OFF EXTENSION BUTTON 3010241

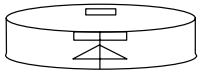
(Gains adjustment window not available on newer models.)

MC WRIST LAMINATION COLLAR
T: 1100295, B: 1100296,
JB: 1100288
Hosmer T:1100295,
B: 1100299, JB: 1100291

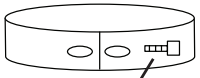
COAXIAL PLUG
4-Band: 1701009 (Ottobock)
6-Band: 1700064 (Steeper)



LAMINATION COLLAR
Aluminum: 1070004,
Temp. Plastic: 2000139



FRICTION BAND (Single)
1100015



HUMERAL CLAMP BAND ASSEMBLY
(Friction Band and Clamp Band included)
Tan: 3010145, Brown: 3010146, Jet Black: 3010700

HUMERAL CLAMP BAND SCREW
2000028

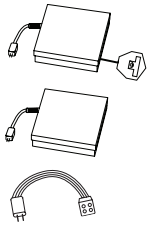
HUMERAL ROTATOR ASSEMBLY
(Lamination Collar, Friction and Clamp Bands included)
Tan: 3010035, Brown: 3010147, Jet Black: 3010701

HUMERAL PLASTIC LAMINATION COLLAR ALIGNMENT FIXTURE
(Set) 3010714

BODY POWERED ELBOW ADAPTER PLATE
1070076 - Adapts lamination collar and clamp band to E400 Hosmer Elbow

WRIST AND TD OPTIONS AVAILABLE ON WWW.FILLAUER.COM

LOCK/UNLOCK SWITCHES



MC PULL SWITCH Jet Black: 3010261
HIGH PROFILE PUSH SWITCH
T: 3010252, B: 3010253, JB: 3010717
LOW PROFILE PUSH SWITCH
T: 3010673, B: 3010674, JB: 3010722
ADAPTER CABLE FOR OTTOBOCK SWITCH
3010107

REMOTE POWER SWITCHES

REMOTE PULL SWITCH JB: 3010263
HIGH PROFILE REMOTE PUSH SWITCH
T: 3010254, B: 3010255 JB: 3010716
LOW PROFILE REMOTE PUSH SWITCH
T: 3010671, B: 3010672, JB: 3010723

"B" OTTOBOCK WRIST SWITCH 3010106

EXTENSION CABLES

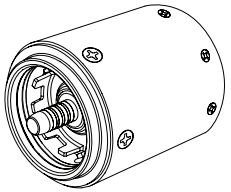
HALF-MOON EXTENSION CABLES

	2-Pin	3-Pin
12" (30.5cm):	3010951	3010989
18" (46cm):	3010842	3010990
24" (60cm):	3010952	3010991

4-PIN EXTENSION CABLES	
12" (30.5cm):	3010325
24" (61cm):	3010326
36" (91.5cm):	3010304

9-PIN PREAMP EXTENSION
3010336

WRIST ROTATORS



MOTOR DIRECT
4-Band: 5010045
6-Band: 5010159

PROWRIST
4-Band: 5010056
6-Band Sequential: 5010157
6-Band Simultaneous: 5010158

PROWRIST DISABLE SWITCH
3010846

WRIST SWITCH EXTENSION CABLE
3010556

WRIST LAMINATION DUMMY
1070495

U3 UPGRADES

MULTI-ARTICULATING HAND SUPPLEMENT BATTERY UPGRADE: 3010677

COAPT® PATTERN RECOGNITION UPGRADE
3010891

Installation of Software

System Setup

The Utah Arm 3 uses Windows®-based software and operates on any Windows OS, after Windows XP and Vista. You can download the Utah Arm Legacy Software on the Fillauer website. In addition to the U3 elbow you will also need inputs, cabling, and depending on your set up wrist control, lock/unlock and remote power on/off connections. Please see the Utah Arm catalog diagram for available options.

Step 1. Load the Software

Go to www.fillauer.com and download the Utah Arm Legacy software to your PC. Complete the software install which will be loaded on the C: drive unless you specify otherwise.

You should now see two new icons on your desktop labeled “MC 5.3.1”and “MC 5.3.1 Simulation”. Choose the “Simulation” icon to practice or review and the standard icon to begin using the software to configure your U3 Arm. NOTE: Be sure to restart the computer after install before using for the first time.

Step 2. Connect the Utah Arm Harness and Inputs

Connections are made through the 1-, 3-, or 5-wire harness (5-wire shown Fig. 5). Once you have chosen your harness configuration connect an input, either electrodes or an alternate input switch. For a diagram of cable options, refer to the Utah Arm parts catalog in this manual.

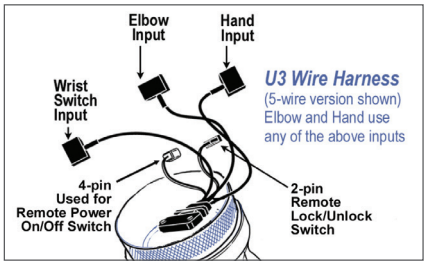


Figure 5, 5-Input Harness Diagram.

Step 3. Connect the Computer Interface Cable

For USB: Plug the USB end of the Computer Interface Cable into the back of your computer. Remove the safety cover for the Computer Interface connector on the U3 elbow and plug in the 4-pin connector from the Computer Interface Cable. Always connect to the computer first.

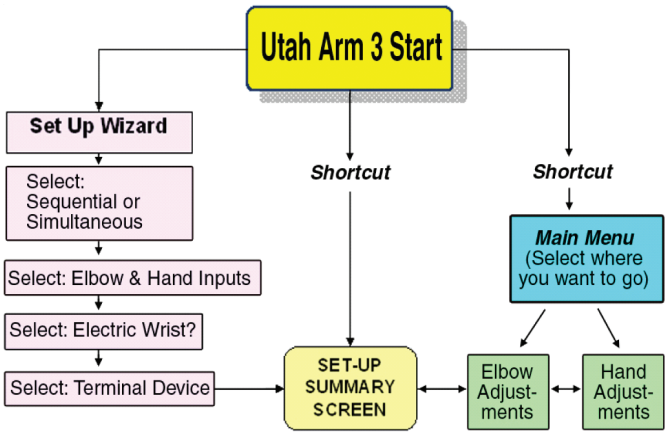
For Bluetooth®: Plug the dongle into the Computer Interface Connector in the Arm and the USB adapter chip into your computer. On your computer, open your Bluetooth connection program and choose "Firefly" to pair the device. Follow the instructions in the Bluetooth manual for more information.

Note: Computer Interface Cables must be purchased separately from the arm. USB (PN: 5010075), or Bluetooth (PN: 5010037) Wireless Bluetooth Connection Kit. An instruction sheet is provided with the kit.

Step 4. Start the Setup Wizard.

With the Arm connected, turn it on, using the power switch on the forearm. Be sure to have a fresh battery. Open the software app and click on “Utah Arm 3” and “Next” to proceed to the Setup Wizard for the U3. If you get the message “Unable to communicate with the controller via the selected Serial Port” check that the Arm is turned on, the computer connections are tight, and run the Auto Scanner by clicking Start Scan on the Desktop.

If all else fails, disconnect the Arm and try rebooting your computer. For more help see Troubleshooting section. Be sure that you are not making real adjustments to an Arm setting in “Simulation” mode as they won’t affect the arm.



U3 Legacy Software Organization.

There is a video tutorial overview of the Utah Arm Legacy Software available on the Fillauer website.

Also see the Utah Arm 3 Quick Setup Guide

Select U3 Configuration

You will need to choose between Simultaneous control or Squential control of the elbow.

- **Simultaneous Elbow and Hand control** allows the wearer to operate the elbow and the hand (or wrist) at the same time. Note: This configuration requires separate inputs for the elbow and hand.
- **Sequential Elbow and Hand control** is the same as the U2 operation. That is, control will sequence through the elbow and hand (and wrist, optionally). The elbow must be locked for the hand to operate.

The Set Up Wizard provides a summary of the choices you make as you go along. You may change your selections by clicking on the “Back” button, or go to the Set Up Summary.

Select Elbow Control Input

If using EMG control for the elbow, choose “Utah Arm Preamps.” For other inputs, choose “Alternate” Inputs. Indicate if you will be using dual or single channel inputs. Make your selections and click on “Next.” Note: If you chose “Separate Inputs,” you will also need to specify the inputs for the Hand on the next screen.

With Dual-channel EMG, you may choose “Differential” or “First Over”.

- **Differential:** Uses the difference between the two signals to run the elbow.
- **First Over:** Runs on the first signal to cross over the threshold and ignores the other signal. Best used for wearers who have a lot of co-contraction. The only “downside” for the wearer is, to reverse the direction of the Hand or Elbow, the first muscle must relax below threshold.

Hand Control Input

Same as Elbow Control screen. This will not appear if “Sequential” and “Same Inputs for Elbow and Hand” are both chosen.

Electric Wrist Control option

Indicate whether or not you will be using an electric wrist. If yes, you must specify if you will be using Version A or B.

- **Version A Wrist Control:** Redirects Hand control to wrist. Advantage: Proportional, may not require an external switch.
- **Version B Wrist Control:** Switch activates wrist. Advantage: Simple, simultaneous.

Note: If you use simultaneous control, then Hand/Wrist switching is possible by co-contraction (or high-rate of a single channel input). In this case, an external switch is not essential, though it might be useful as a backup method. (If a switch is connected, both co-contraction and the switch will cause Hand/Wrist switching.)

Automatic Terminal Device Detection

The software will “Auto-detect” the type of TD connected in the 2 seconds after you turn it on. The ‘beep’ heard during this 2 seconds may be turned off in the “Hand Menu > User Settings screen.”

Completion Screen

This screen shows a summary of all the choices you have made so far. From here you can go to the Hand or Elbow Menu to begin adjustments, or go to the Set Up Summary screen to make changes to your selection.

Setup Summary

Double-click on any item directly to make changes to your selection.

Elbow Adjustments

Elbow Main Menu

In this section you will set up the elbow settings, lock/unlock, the freeswing relax timer and the recall save parameters.

- **Look and Set screens:** Four screens are available:
  - Elbow settings (for most adjustments)
  - Lock/Unlock
  - Freeswing/Relax Timer
  - Save/Recall Settings
- **User Choice Settings:** Allows you to change polarity and set lock/unlock options.
- **Hand Menu:** Make adjustments to your Hand control.
- **Set Up Wizard:** Returns to the Set Up Wizard.
- **System Parameters:** To change the COMM port and check hardware and software settings.

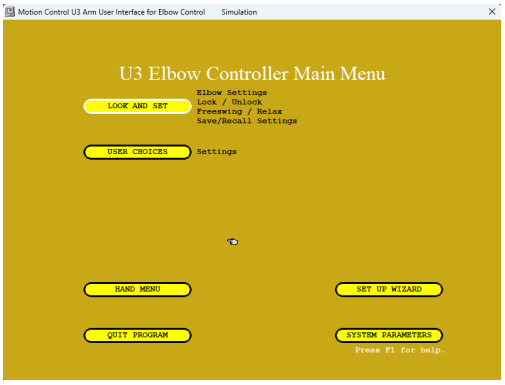


Figure 6, Elbow Main Menu.

Elbow Adjustments—Dual Site EMG

Begin by clicking on "Look and Set" to advance to the Elbow Settings screen to make adjustments and/or for patient training.

- **Columns 1 & 2, A and B Channel Gain:** These are the sensitivities of the A and B channels. You can change them to balance flexion/extension sensitivity (see "To Adjust Gains or Thresholds" below).
- **Columns 3 & 4, A and B Output:** For training muscle strength, or strength of output. This helps the wearer to visualize the signal generated by their inputs and to develop better control. Notice that the blue columns (input strength) will reach higher values with higher gain settings. The main purpose of the Gain is to balance the muscle EMG or other input. The purpose of the Threshold is to prevent unintentional motion of the Elbow. The Elbow will not move until the Input exceeds the Threshold.

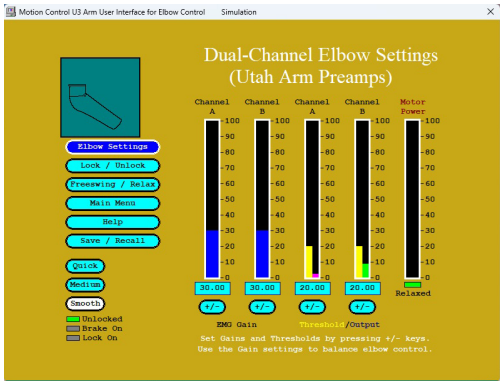


Figure 7, Dual site EMG shown.

When the Control Method is Set to "Differential"

Motor Power: Used for training muscle (or other input) difference. The bigger the difference, the greater the motor power. The U3 computes the difference between the A and B input signals to operate the Elbow. This "difference," after further electronic processing, operates the Elbow motor and is displayed in the Motor Power column.

The Motor Power bar can be very useful for training, when the wearer realizes that the strength of the input difference is what actually makes the elbow move. For example (using EMG inputs), if the wearer's A and B EMG signals contract equally, i.e., co-contract, they cancel out and there is no difference between the A and B EMG Outputs, and thus no movement of the elbow. The wearer must develop enough independence between the two muscles for the Motor Power to reach a value of approximately 10 on the scale to move the elbow.

When the Control Method is Set to "First Over"

In First Over Dual Site EMG, only the first muscle to cross the threshold controls the elbow. To reverse directions, the first muscle must relax below the threshold and the second muscle must contract above the threshold. We recommend this mode for patients with a high level of co-contraction.

To Adjust Gains or Thresholds

Identify the weaker of the two inputs (i.e.,less motor power is generated when it fires).

1. Highlight the Gain you want to change.
2. Raise the setting by pressing the "+" key on your keyboard (you don't have to shift—just press the key). Or, lower the setting by pressing the "–" key. You will see the value change in the window below the column. Hint: You

can use the “page up” or “page down” keys to increase or decrease by 10 points at a time. The software quickly changes the value, so the wearer can immediately try the new setting. Repeat this adjustment process until the wearer feels that raising and lowering the elbow require equal effort.

3. To Save the value you changed, select the Save/Recall Settings button. The Save/Recall screen will automatically appear whenever you have changed a setting, and go to another screen.

Summary of EMG Settings

- **Gains:** Test for equal effort to raise and lower the elbow. Balance the effort, if needed, with the A and B Gains.
- **Thresholds:** Test for unintentional motion when the elbow is positioned throughout the working space. Raise the Threshold, if needed.
- **Quick/Smooth Setting:** Let the wearer experiment with the different options, realizing there is a trade-off between speed and control.
  - Choose “Quick” for quickest response.
  - Choose “Medium” for balance between “Quick” and “Smooth” settings.
  - Choose “Smooth” for jittery muscle signals and added control (but slower).

Elbow Adjustments—Single Channel Input Settings

Using the Single Site Elbow control option, increasing the signal raises the elbow and decreasing the signal lowers the elbow. The input signal is proportional to the level of the signal, so slow and fast speed is under the control of the wearer. You may reverse polarity on the “User Settings” screen, if desired.

Home Threshold: Determines when the Elbow will start running, as the Input Signal is raised. Its purpose is to prevent unwanted motion of the Elbow from small fluctuations of the input.

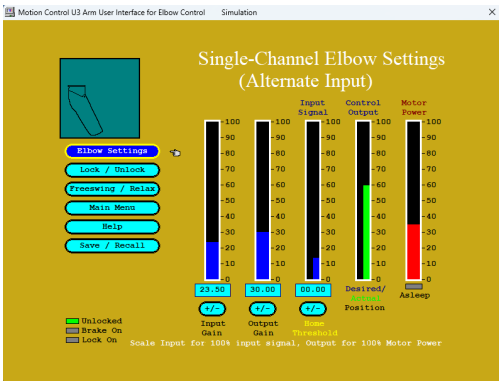


Figure 7, Single Channel Input.

Lock/Unlock—Dual Site Inputs

Use this screen to help train wearer to switch between Hand and Elbow. Input signals are shown to help with training.

Steps To Unlock:

1. Relax until “Relaxed” light goes on.
2. Co-contract (or generate alternate input signal) so both target rates are exceeded.
3. The border of each column flashes GREEN when co-contraction is successful. This feedback may help train the wearer to flash both borders green simultaneously.

Switch Window: Time allowed between two muscle contractions (or other dual inputs). Increase if contractions are not simultaneous.

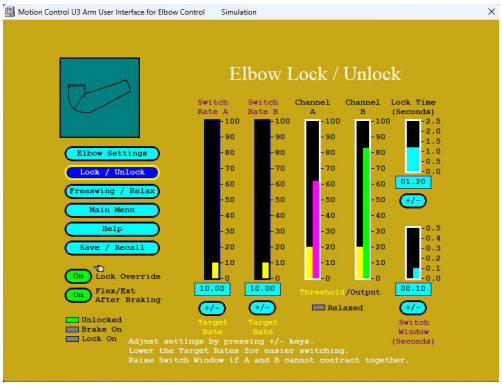


Figure 8, Lock/Unlock Screen.

Target Rates

1. Watch the Switch Rate signals as the patient attempts to co-contract to unlock.
2. Set the Target Rate at ~80% of the maximum switch rate signal, for each channel.
3. The wearer should be able to consistently reach the Target Rate. When this occurs, the border flashes green.
4. When both borders flash green unlocking will occur.

Lock Time

Elbow must be held still for this time to lock (suggested starting: 1.0–1.25 sec.). Longer lock time prevents accidental locking. Time can be shortened after a few weeks of practice if the wearer desires.

Freeswing/Relax—Dual Site Input

- Freeswing occurs when total muscle signal (A + B) falls below freeswing level.
- Adjust the Freeswing Level so wearer can relax below it, whenever Freeswing is desired.
- **Relax Time:** Prevents accidental unlock by requiring a pause before unlocking. Input signal must stay below home threshold for this time.

Freeswing/Relax—Single Site Input Settings

Functions are the same as for dual-site inputs. When you have finished with Elbow adjustments, return to “Main Menu,” then “User Settings” for the next steps in the setup.

User Settings

Elbow Polarity: reverses the direction of the elbow. Lock/Unlock—use the computer to unlock or lock. Note: User Feedback (beep and buzz) are all enabled/disabled on the "Hand Menu > User Settings".

Store and Recall Settings

Elbow Polarity: reverses the direction of the elbow. Lock/Unlock—use the computer to unlock or lock.

Store and Recall: Automatically comes up every time you exit a screen if changes were made to settings.

The left column, labeled “Previous”, indicates settings from AutoCal or the last saved settings. The right column, labeled “Adjusted”, shows the latest changes you made on the last screen you were on. The middle column shows which settings are being affected.

The buttons give you the following options:

1. **Save:** adjusted settings and Proceed—keeps the changes you made.
2. **Prodeed:** without saving adjusted settings—retains “Previous” settings shown in the left column.
3. **Recall:** starting settings—recalls “original” settings established at the start of session. These are the settings the program reads in from the U3 when the User Interface program is first started.
4. **Save:** then go to Computer File Operations to store the settings in your computer.

Computer File Operations

To save adjusted settings into permanent memory on your computer. Follow on-screen directions to select a register, rename it, store settings, or retrieve settings. To retrieve settings, be sure Set Up Wizard has the same device configuration as when they were originally stored. On this screen you can save the adjusted settings to your computer’s hard disk for later use. This can be useful to compare the settings at the beginning of training with those after training. Or you could save optimized settings, so you can return to them after experimenting with other settings.

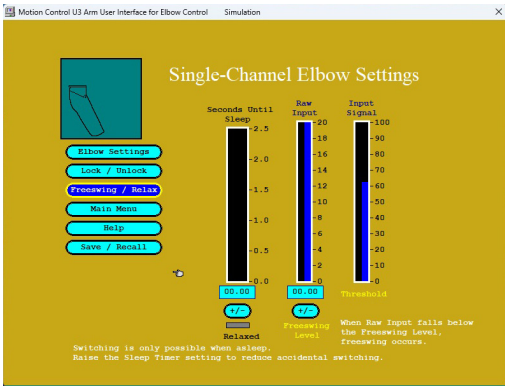


Figure 9, Freeswing/Relax.

Figure 10, User Settings.

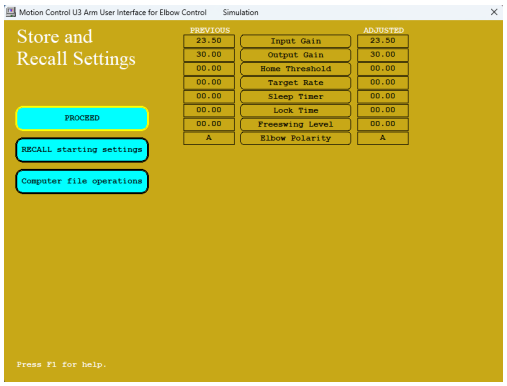


Figure 11, Store and Recall.

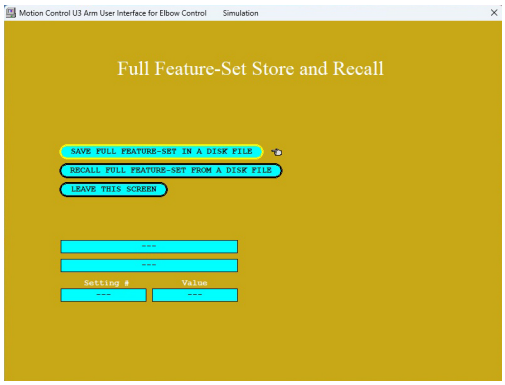


Figure 12, Computer File Operations.

How to Save Wearer Settings to the Computer

- Use the “Page Down” key to select Settings File 1 and press <Enter>.
- Press delete or use the backspace key to erase the text and type in the patient’s name and <Enter>.
- Highlight the desired operation using the up and down arrow keys (i.e., copy settings from elbow to file or vice versa). Press <Enter> to perform the selected operation.
- When you are finished, go to “Leave this screen” to return to the screen you were previously on.

Full Feature Save

This alternative save was added for two features:

- All settings, including Setup Wizard choices are saved.
- Loading new software versions will not erase previously saved settings.

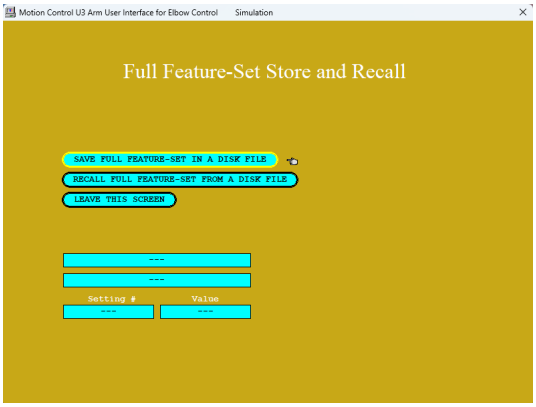


Figure 13, Full Feature Save Screen.

Hand Adjustments

U3 Hand Main Menu

The Hand Main Menu is the gateway to the Hand Settings and allows you to choose adjustment screens, or change user settings for the Hand in the same way.

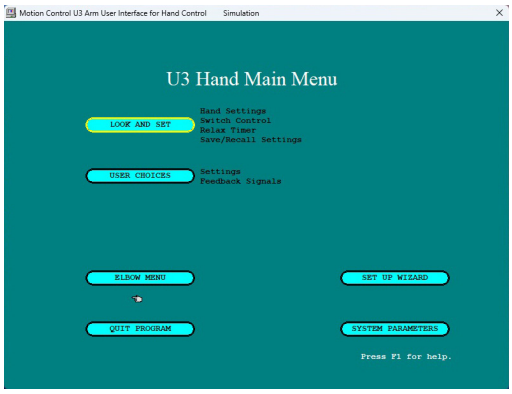


Figure 14, Hand Menu.

Hand Settings—Dual Site Inputs

(These settings are chosen in the Set-Up Wizard)

EMG Dual Site (Standard): Hand power is the difference between channel A and channel B inputs.

First Over: Hand power is the output of the first signal above the threshold. To reverse direction, the muscle (or other input signal) must relax. Use First Over when co-contraction of both inputs prevents easy operation of the Hand.

Note: If the Hand on screen is running backwards from the actual TD, press “ALT” + “H” to reverse direction.

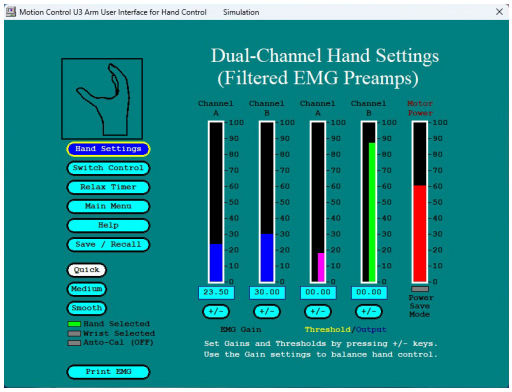


Figure 15, Hand Settings, Dual-Channel.

Hand Settings—Single Site EMG or Alternate Input

Steps to adjust Single Site input:

1. Adjust “Input Gain” so that “Input Signal” reaches 100% with moderate effort.
2. Adjust “Output Gain” so that Hand control is optimized.
3. Adjust “Home Threshold” to prevent accidental motion of the Hand.

NOTE: The single site control screen is displayed if “Single Channel Input” is chosen in the Setup Wizard.

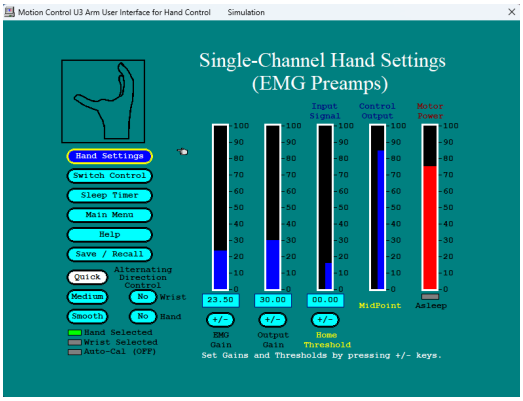


Figure 16, Hand Settings, Single-Channel.

How Single Site Control Works

Using the Single Site Hand/Wrist control option, increasing the signal closes the hand and decreasing the signal opens the hand. The closing power is proportional to the level of the signal, so slow and fast closing speed is under the control of the wearer. You may reverse polarity on the “User Settings” screen, if desired.

If you have chosen the Wrist Option, be sure the “W” output cable is connected to the wrist rotator. To switch control to the wrist: the wearer relaxes, then contracts and relaxes quickly (and lightly) to switch to wrist mode. The same rapid/light contraction returns control to the hand.

- **Home Threshold:** Determines when the Hand will start running, as the Input Signal is raised. Its purpose is to prevent unwanted motion of the Hand from small fluctuations of the input.
- **Midpoint:** This is the level the signal must fall below to reverse direction. The Midpoint automatically moves just behind the output, so that reversing Hand direction is easy. The wearer has only to relax the Input signal to reverse the Hand direction. This value is not adjustable.
- **Alternating Direction Wrist Control:** Choose “Yes” or “No” by clicking on the button. If “Yes”, when control has switched to wrist, the direction of the wrist motion reverses each time the Input signal falls below the "Home Threshold" for a length of time given by the sleep delay (see Sleep Timer screen).

Switch Control (If wrist is installed)

For Dual Site EMG or Alternate Inputs: When “separate inputs” are chosen in the Set Up Wizard, the U3 uses co-contraction, i.e., a simultaneous contraction of the two control inputs to switch between Hand and Wrist. “Fast Access” wrist switching is also available, if enabled (click on the menu button).

Note: If “Same Inputs” are chosen for Elbow and Hand in the Set Up Wizard, then co-contraction is dedicated to Elbow unlock.

Switch Control: This screen helps you to train a patient to switch between Hand and Wrist functions (if the wrist is installed). You can fine-tune the setting for Switch Rate A and B and the Switch Window (outputs are also shown here, to help with training). Note: If the Electric Wrist is not plugged into the U3 Wire Harness, the Switch function is not enabled, and thus will not occur.

In the A and B Switch Rate columns, the wearer’s actual Switch Rates are shown (in pink, on the left), along with the Target Rate settings (in green, on the right).

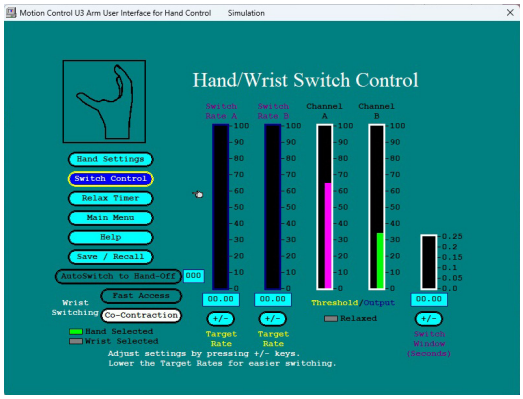


Figure 17, Hand Settings, Switch Control.

In order to switch by co-contraction, the wearer’s goal is to co-contract so that the A and B Switch rates (pink) “jump” up to the Target Rates (green) at the same time. If successful at reaching the Target Rate, the border around the Switch Rate graph will flash green. If a co-contraction takes place, the “Wrist Selected” light will turn yellow until the user relaxes below threshold. Then switching will occur.

Hand Selected & Wrist Selected: These indicators light up to show which motor the U3 will operate. They change when the switching is successful. Gray = off; Green = on; Yellow = waiting to relax.

The Switch Window (last column on the right) is the interval of time allowed between the first input signal threshold crossing, and the second input signal threshold crossing, to be considered a co-contraction. The wearer must learn to contract both control muscles at the same time (co-contraction) and at a quick rate.

Fast Access Switching: One muscle contraction, performed quickly so the Target Rate is exceeded, will begin operating the wrist rotator. The wrist function will stay in operation until both muscles relax. Switching also requires that the “Relaxed” light comes on. The wearer must relax both Threshold muscles for the length of the Relax Time.

This allows the wrist function to also be proportional. If co-contraction is also enabled, then either method may be used to perform wrist rotation. The Switch Rate border flashing green only occurs when the co-contraction function is enabled.

How to Use the Switch Control Screen to Train the Patient:

For Dual Site EMG or Alternate Input: When “separate inputs” are chosen in the Set Up Wizard, the U3 uses co-contraction, i.e., a simultaneous contraction of the two control inputs to switch between Hand and Wrist. “Fast Access” wrist switching is also available, if enabled (simply click on the menu button).

Co-contraction Switching:

Instruct the patient to perform the following sequence:

1. “Relax both muscles.” On the Switch Control screen you can see the A and B EMG outputs drop—they must drop below the threshold on the EMG Output columns. Then the “Relaxed” light comes on. The Relax Timer may be changed if needed (see page 18).
2. “Then, as quickly as possible, contract both muscles lightly.“ On the Switch Control screen you can see the A and B outputs rise. They need only rise to the Threshold level for each channel. You will also see the Switch Rate A and the Switch Rate B rise quickly. These columns measure only the quickness of the EMG contraction—so this column rises only during the start of the contraction.
3. “Train your muscles so that the A and B pink bars rise up together, and make the blue border flash green.” Then the Hand and Wrist lights change colors, in the lower left corner, showing that the function has changed.

Fast Access Wrist Control Switching:

Instruct the patient to perform the following sequence:

1. “Relax both muscles.” On the Switch Control screen you can see the A and B EMG outputs drop. They must drop below the threshold on the EMG Output columns. Then the “Relaxed” light comes on. The Relax Timer may be changed if needed.
2. "As quickly as possible, contract the A (or B) muscle enough to exceed the threshold." The Switch Rate A (or B) must exceed the Target Rate for that muscle, then the wrist will turn on. For feedback, the “Wrist Selection” light will also turn on. If co-contraction is also enabled, the blue border will also flash green.

3. As long as either A or B muscles are above threshold the wrist will remain on. The wrist turns off and control transfers back to Hand, when both A and B muscles fall below threshold, and the “Relaxed” light comes on.

To Make Switching Easier for the Wearer

1. Lower the Target Rate setting on A and/or B. Select the setting desired, then lower the Target Rate with the “–” key. Test: Ask the wearer to contract the muscle quickly enough to make the border flash green. Lower the setting until successful.
2. Decrease the Relax Time.
3. Increase the Switch Window. Do this when the test in Step 1 shows the border flashing green, but the two muscles can not contract simultaneously.

A WORD OF CAUTION: Making switching easier can result in the patient switching too easily making it unintentional. Change the settings only as far as necessary. Let the wearer practice with the screens.

Summary

- To switch easier, lower the Target Rate settings. Watch the screen and adjust settings to optimize the patient’s success.
- The Switch Window represents the time allowed between the two input signals (as they cross the threshold), to be considered a co-contraction.
- Make the time longer to make switching easier, if the signals cannot be generated simultaneously.
- Make the time shorter to help eliminate accidental switching during Hand function.
- If switching cannot be mastered, you might try using a Wrist Control switch.

Single Site EMG or Alternate Input Control

Works the same as Dual Site, except with a single input. The “Asleep” light must be on for switching to occur (see Relax Timer screen Fig. 18).

Relax Timer—Dual Site Inputs

Relax Timer: To switch between Hand and Wrist, the A and B inputs must first relax, i.e., EMG’s or alternate input signals fall below their thresholds. They must stay relaxed for the length of this setting before the U3 will allow a Hand/ Wrist switch.

The Relax Time is meant to ensure that quick opening and closing of the Hand is not mistaken for a co-contraction, thus causing an accidental switch.

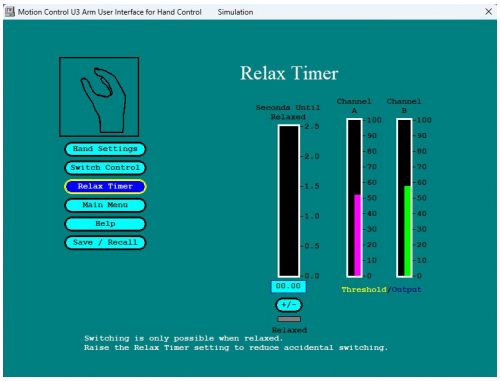


Figure 18, Relax Timer.

Fast Access Wrist

The “Relaxed” light must turn on to switch between Hand and Wrist, before a Fast Access Switch to Wrist, and after relaxing below threshold to return to Hand.

Training the Patient & Fine-Tune the Relax Timer:

While training with the Switch Screen, notice the light at the bottom of the screen, labeled “Relax.” This tells you and the patient when the Relax Time has been reached, and co-contraction will switch from hand to wrist. Awareness of the relaxation which is required may help prevent unintentional switching.

However, if during operation of the hand, the patient accidentally switches, you can lengthen the Relax Time in the Relax Time Screen. Boost it to .40 seconds (starting is .25), and then explain to the patient that they must relax until the ‘Relaxed” light is on, before attempting a co-contraction to switch.

After training for a few minutes with the function of the “Relax" light, then ask the patient to again test the fast opening and closing, to see if the accidental switching is still a problem. If it is, increase the Relax Time. Test again for accidental switching and train further using the Switch Control screen. Continue this process, with training, until no accidental switching occurs.

Sleep Timer—SS EMG or Alternate:

While training with the Switch Screen, notice the light at the bottom of the screen, labeled “Relax.” This tells you and the patient when the Relax Time has been reached, and co-contraction will switch from hand to wrist. Awareness of the relaxation which is required may help prevent unintentional switching.

- **Hand Sleep Delay:** sets the length of time the Hand must stop for the Hand to “sleep” or for the Power to turn off. A feedback “buzz” may also be enabled to indicate when Sleep occurs (see the User Feedback screen Fig. 23).
- **Wrist Sleep Delay:** sets the length of time the wrist must stop to go to “sleep.”
- **Seconds Until Sleep:** Shows actual run time of the Hand or Wrist going to sleep (border flashes green when sleep occurs). This is useful for training.

Alternating Hand/Wrist Control: When Alternating Wrist or Hand Control is enabled, the Wrist or Hand direction changes after stopping for the length of the Sleep Time.

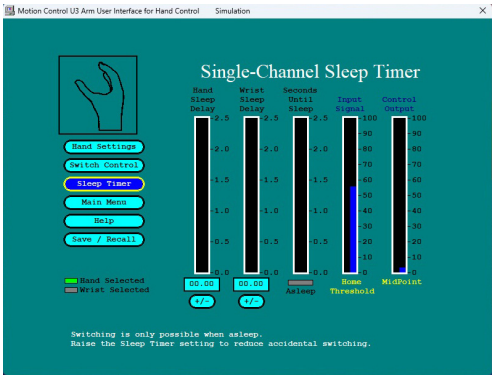


Figure 19, Sleep Timer.

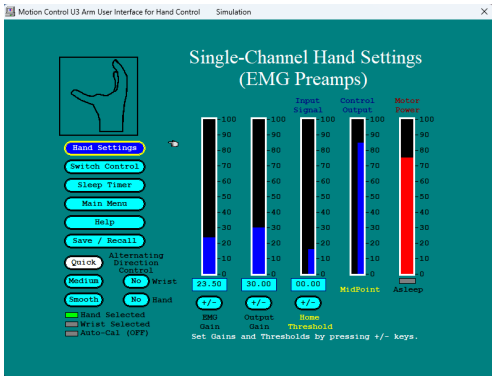


Figure 20, User Hand Settings.

User Settings for Hand

This screen is accessed from the Main Menu. In this screen you can disable or enable Auto-Cal, or electric wrist control. You can also reverse the Hand or Wrist polarity (direction) or manually switch from Hand to Wrist mode.

Hand Polarity: With this button you can reverse the direction of the Hand function. Highlight the button, then hit the space bar on your keyboard. The letter in the button will change from “A” to “B”. When “A” is selected, the A muscle will close the Hand.

Wrist Polarity: This button reverses the wrist direction. The ‘A” in the button indicates the “A” signal will rotate clockwise.

The wires to the wrist coaxial connector must also be installed with the “W” facing outwards for these directions to be correct. The Hand wire has a polarized connector.

AutoCal Enabled by Hand Switch: If enabled, this triggers AutoCal when the Hand Switch is turned OFF and ON twice within 6 seconds. See the AutoCal section for more information.

Figure 21, Hand User Choices.

Disabling/Enabling AutoCal: AutoCal can ONLY be disabled or re-enabled in this screen. Click on the AutoCal Enabled button, and the word in the button will change from “Yes” to “No”. Once disabled, AutoCal will not change the settings until you enable it again. Every time the wearer turns it on, the U3 will operate with the same saved settings.

Wrist Control Enabled: Click on the button to disable or re-enable Wrist Control. Note: If the electric wrist is not connected, the Wrist Control will automatically be disabled by the U3. Sometimes you may wish to prevent accidental switching to wrist (while training for Hand control only). With this button you can disable (or re-enable) the electric wrist, if it is connected.

Switch Between Hand and Wrist:

Use this button to manually switch between these two functions, for instance, when the patient cannot perform co- contraction successfully.

The AutoCal® feature

User Feedback Options: Feedback Signals are used to provide feedback to the wearer about the status of their system. Click on any of the buttons to turn the feedback signals on or off, as indicated. The “buzz” is caused by a vibration of the Hand motor—it may be felt through the socket.

AutoCal Automatic Adjustment (for Hand)

- AutoCal automatically sets Gains and Thresholds based on wearer’s signals. If AutoCal is enabled, manual settings of Gain & Threshold are not possible.
- After AutoCal is triggered, the wearer’s EMG is measured for 7-seconds. The wearer should open and close the Hand several times within this period.
- Gains are adjusted automatically so that the Range= 0–100% of measured EMG.
- Thresholds are set automatically to 15% above relaxed EMG. Minimum AutoCal Threshold= 31%.

Three Ways to Start AutoCal

The “AutoCal” option is enabled on the User Settings screen.

1. By Hand Switch: Turn the Hand off—then on again, twice within 6 seconds.
2. By pressing <Alt>+<A> on your keyboard (while connected to the computer).
3. AutoCal by Power Switch. AutoCal is triggered for the 7 seconds after the Arm is turned on (wait 2 seconds initially for auto-TD detect).

AutoCal Instructions to the Wearer

Available only if AutoCal is enabled—see “User Settings” screen

1. Don the prosthesis, and let the electrodes warm up to the temperature of your skin. Depending upon the pressure of the electrode on the skin, and amount of sweat on the skin, this could take up to 10 minutes.
2. Turn on the Hand Power Switch, then contract the opening muscle, without straining, so that the Hand opens.
3. Relax briefly, then contract the closing muscle, without straining, so that the Hand closes.
4. Open again, and close again, without straining.
5. Relax—try to feel the light vibration generated in the Hand at the end of the AutoCal seven second period (See “Feedback Signals” on the User Settings screen).
6. After AutoCal, test your hand control—open and close the Hand slowly, then quickly. You should be able to vary the speed of the hand by the strength of your contraction. Your maximum speed should be controllable and not jittery. If co-contraction is utilized, test for the ability to switch with co-contraction.

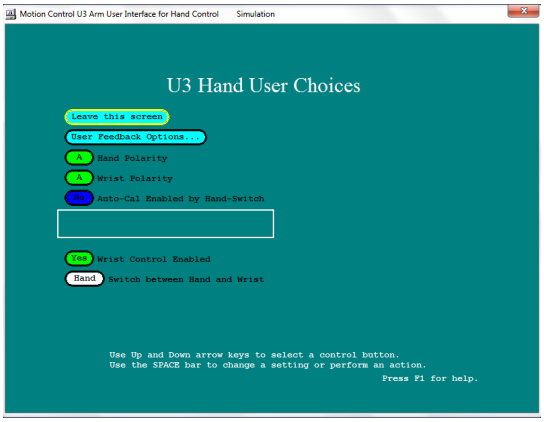


Figure 22, Feedback User Choices.

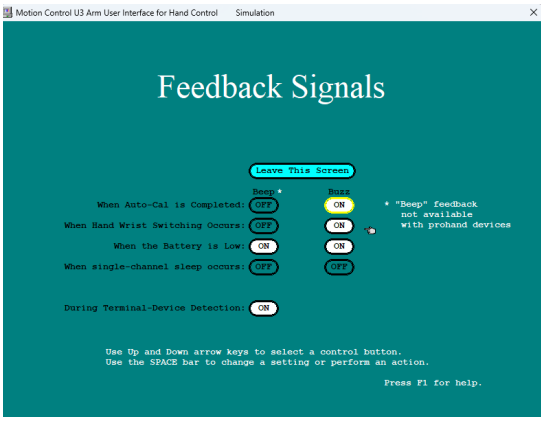


Figure 23, Feedback Signals Settings.

Troubleshooting

Contact Information

When there is a problem with the prosthesis, approach it logically, with the help of the "Basics" section below and the Flowchart on the following pages. For help from Motion Control technicians, call us at (801) 326-3434, or email motioninfo@fillauer.com

Recommended Tool List:

- Small screwdriver set
- Voltmeter (V.O.M.)—with probes and alligator clips (any simple one will do—read the instructions and learn how to use it)
- Tweezer—fine point, surgical type
- Alcohol for cleaning
- Cotton swabs
- Allen wrench—7/64"
- Myolab II or similar strongly suggested for muscle testing during fitting and follow up
- Nut driver with 1/4" socket
- Needle nose pliers
- Electrical tape
- Electrical tape or duct tape

Field Replaceable Modules:

- Battery Pack
- Hand or ETD
- Forearm Cover (including connection system)
- Humeral Connector (5-, 3- or 1-wire harness)

NOT Recommended for field replacement:

- Elbow Drive Transmission
- Load Cell
- Lock Drive
- Elbow Circuits
- Hand Circuits
- Flexible Connectors

Basic Checks

1. **Check the Battery.** Make sure the battery is charged until the status light turns green. Inspect the battery contacts on both battery and holder. Clean with alcohol and cotton swab if needed.
2. **Check the Power Switch.** Check the switch for the Hand or TD used, as well as the elbow power control. Consult the individual instructions for all TDs. In the U3 Arm, the power does not actually come on for 2 seconds after you turn the Arm on in order to perform the TD Auto-detect function.
3. **Check the integrity of all connections.** Wire Harness for all electrodes, and the Humeral wire harness to the top of the Arm. Coaxial connector to TD Computer Interface connection to Arm, and the Serial port connection to computer
4. **Check for Proper Electrode Contact in the Socket.** Confirm location of the electrodes over the optimal muscle sites—retest if needed. Look for impressions of the electrodes in the skin. Make sure the skin does not pull away during the muscle contraction. Have the patient operate the Hand or Elbow and observe the muscle signals on the Computer Interface (if the electrodes pull away from the skin, the EMG "jumps" suddenly). Use the Hand in all positions.

Define the Problem: Analyze the Functions of the Prosthesis

Ask the wearer to perform the functions of the Elbow, TD and/or Wrist: Flex and extend elbow. Relax to Freeswing; Open TD Fully; Close TD fully & close to full force. Switch to Wrist (if installed) by Co-Contraction or Wrist Control Switch. Alternatively, use your own muscles to control the prosthesis using spare preamps with electrodes on your own forearm. Touching the electrodes in the socket may move the Hand, but don't expect good function. When the electrodes are not in contact with skin, interference will operate the hand unpredictably.

Diagnostic Charger Test

1. Plug the Transformer into a standard 120-volt wall socket. (In other countries, a 220 volt Transformer is supplied.) Connect the transformer to the charger via the mating connectors. All lights should be lit except for Status.
2. Install the battery into the charger. The Status light should light yellow. Be sure contacts are clean and uncorroded.
3. Within 45-seconds after connecting the battery, the status light will turn red when charging. Note: If the status light never turns red, there is a fault in either the Fast Charger or the Battery Pack. Try a different battery pack in the Charger. If the same problem occurs, return the Battery and Charger to Motion Control.
4. If either Fuse 1 or Fuse 2 lights turn red, the opposite side fuse is faulty. So, if Fuse 1 light turns red, then Fuse 2 is faulty and vice versa. Replace the fuse, as described in Battery Pack tests.

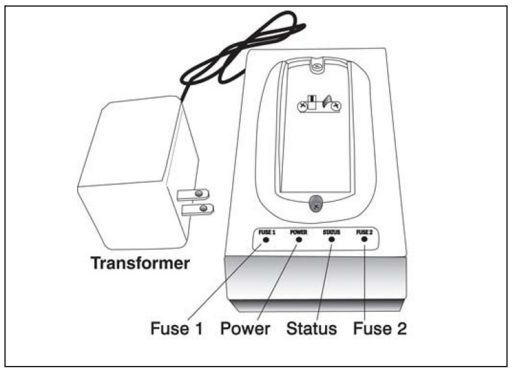


Figure 24, U3 Fast Battery Charger Base.

Jump Start

Use this only when the battery is dead and the elbow is locked.

1. Obtain a fresh 9-volt battery.
2. Remove the Utah Arm forearm cover by removing the large cover screws on top and bottom of the elbow.
3. Turn the power switch “off.”
4. Touch the “+” and “–” of the 9-volt battery to the matching terminal on the Hand Circuit. You should hear the lock motor unlock, with a “whirr” sound.
5. Bend the elbow. Remove the battery and replace with a fresh one.

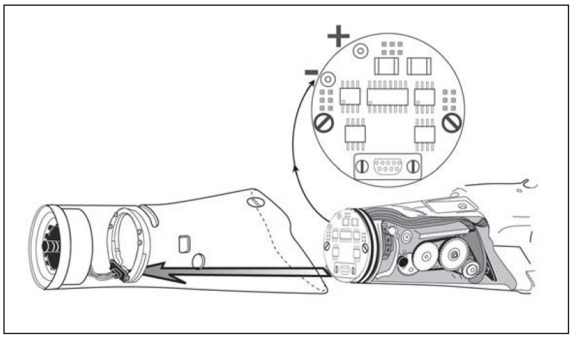


Figure 25, Jump Start Terminals

If all else fails and the arm will not unlock, return to Motion Control for repair. Be sure to obtain a repair request on the website.

CAUTION!: Do not remove the Transmission; Do not remove the Hand Circuit Boards; Do not spray oils or lubricants into the Arm. Any change to internal functions will void the warranty.

Computer Interface Problems

1. Basic Checks:

- Make sure you chose the MCUI Program, and not the MCUI Demo Simulation icon on your desktop.
- Check the integrity of all connectors.
- Try different “COM” ports. On the System Parameters screen, select a different COM port from those displayed. If no others are displayed, the program requires restarting or rebooting the computer.

2. Restarting and/or Rebooting:

- Close the program and select “Restart” from you START menu on the desktop.
- Unplug the serial or USB port while you restart.
- Plug in serial or USB port in ONLY after the desktop returns.

3. Last Resort:

- Call our Technical Specialists.

Pre-/Post-Prosthetic Therapy

For Utah Arm and other myoelectric prosthesis wearers

I. Pre-Prosthetic Goals

A. **Promote wound healing:** Instruct in dressing change techniques. Instruct in good hygiene.

B. **Control pain:** Desensitize incisional & traumatic scar tissue (rubbing, massage, use of textures, vibration, tapping). Remodel scar tissue and prevent adhesions/hypertrophy (massage, vibration, silicone gel sheeting, elastomer, compressive wrapping, weight-bearing activities).

C. **Maximize joint range of motion (ROM):** Focus on residual joints of the extremity (scapulothoracic, glenohumeral, scapulohumeral). Use passive and active exercises. Instruct in a home exercise program (AROM, stretching) and reinforce the necessity of this. Position/splint to stretch contracted tissues.

D. **Assist in psychological adjustment to loss:** Refer to other professional services. Address body image concerns (socialization activities, dressing styles, touching the limb).

E. **Control stump shaping/shrinkage:** Decrease edema (tubular elastic, air splint, intermittent positive pressure pump). Instruct in wrapping (ace bandage) in spiral, diagonal, figure of eight design.

F. **Increase strength:** Focus on residual limb muscles and contralateral limb muscles. Periscapular muscles very important. Use isometric, isotonic, progressive-resistive exercises (PREs).

G. **Test/identify muscle sites:** Myotester (gauges electrical potential of residual muscles). Biofeedback.

H. **Improve muscle site control (if already identified):** Focus on isolated muscle contraction/strength/endurance. Biofeedback in conjunction with electrical stimulation can be helpful. Consider portable home units. Proprioceptive neuromuscular facilitation (PNF) patterns address the agonist/antagonist relationship and can facilitate muscle independence).

I. **Increase daily living skill (DLS) independence:** Identify and address patient's goals/plans first. Train to change dominance. Instruct in one-handed activity completion. Minimize adaptive equipment. Focus on adaptive technique instead.

I. Post-Prosthetic Goals

A. **Orientation:** This information generally is presented by the prosthetist fitting the patient with the prosthesis, and it needs to be understood and reinforced by the therapist.

B. **Control training:** The therapist's instruction in, and the patient's practice with the muscle contractions necessary to operate the prosthesis may be the longest stage in rehabilitation. It continues to improve over time with the patient becoming more proficient. During therapeutic intervention, it is addressed in a few sessions. During therapy sessions, and at home, a patient works on drills: open/close terminal device (TD); flex/extend elbow; lock/unlock elbow; rotate the wrist; follow a target with elbow flexing/extending; follow a target, lock elbow, open TD, unlock elbow, repeat. Prosthetists are actively involved in this phase of rehabilitation as they are fitting the prosthesis to the patient and making necessary adjustments to the socket/harness/electric componentry. Therapists can provide valuable information to the prosthetist regarding adjustments needed for increased control.

C. **Use training:** Applying the mechanics of operation to repetitive tasks. This phase brings the patient to the concept of function with the prosthesis. It facilitates learning prepositioning the TD for action, controlling tension of the TD, reaching (coordinating elbow and TD), and increases endurance. During therapy sessions, and at home, a patient works on: maintained grasp, especially while the uninvolved limb is engaged in a task; repetitive grasp/release of various sized, textured, weighted objects; grasp and release in various positions; grasp of delicate objects). A therapist may have patients engage in the following activities: grasp wet sponge without squeezing water out of it; string beads; attach paper clips to paper or cardboard; hold a handful of cards and remove cards one at a time; assemble something; place pegs in and remove them from a pegboard; stack blocks or other objects.

D. **Daily living skill/functional training:** The most advanced stage of rehabilitation incorporates control training and use training, and applies these concepts to functional activities. The patient's lifestyle, interests and needs are the basis for establishing a program of activities in this phase. The prosthesis is most useful for stabilization and assistance during activities, and patients now learn to accept this. Focus on bilateral activities to avoid the patient's common behavior of minimizing use of the prosthesis. During therapy sessions, and at home, a patient works on: dressing/undressing activities; grooming/hygiene; meal preparation/eating; homemaking; school/office tasks; recreation/sports; work tasks. A therapist may have patient engage in the following activities: peel/cut vegetables; open a can/jar/package/box; make mechanical repairs on an object; peel hard boiled eggs; fasten zippers/closures on clothing/purse/briefcase; or hang clothes in a closet.

PNF Training for the Utah Arm

Home Training Program for Proprioceptive Neuromuscular Facilitation (PNF) Exercise

PNF is a pre-fitting strengthening exercise. We recommend this and/or other exercises be part of a conditioning program under the direction of a qualified Physical or Occupational Therapist. Also refer to Motion Control's video course, "Training the Client with an Electric Arm Prosthesis".

It takes about 10 minutes and will help improve the strength of the muscles for control of the Utah Arm, especially when the patient is first learning to operate the Arm. NOTE: All exercises are to be done while lying comfortably, in a relaxed state of mind. You should concentrate on imagining that your amputated arm is still there (especially the thumb) if you do experience a phantom sensation.

The instructions as written are for unilateral amputees. For bilateral amputees, replace the "uninvolved arm" wording with "one amputated arm."

Biceps

Step 1: Begin by lying down on your back. Close your eyes and concentrate on breathing slowly and rhythmically. Try to relax.

Step 2: Next, practice flexing the biceps muscles (flexion pattern). Begin by moving your uninvolved arm through the full pattern, with your arm at your side, and the palm rotated up and the thumb out. Pull your arm up and across your nose, bending the elbow and turning the arm so that your thumb is now up (Figure 1). Repeat several times, concentrating on the movement.

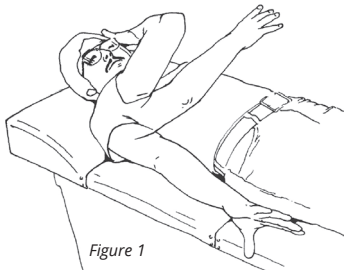


Figure 1

Step 3: Now, move both arms together through the biceps pattern. Imagine the movement of the amputated elbow and thumb (Figure 2). Repeat several times, concentrating on the movement

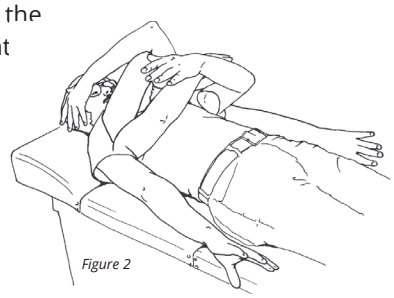


Figure 2

Step 4: Next, move your amputated arm through the pattern while you push against its movement with the uninvolved hand over the biceps muscle (Figure 3). Repeat several times, and again concentrate on imagining the movement of the missing elbow and thumb.

Step 5: Now, practice the biceps pattern with your amputated arm and concentrate on not moving your shoulder. Start with your shoulder and arm relaxed at your side and your hand over the biceps muscle (Figure 4). Without moving the shoulder, contract the biceps while imagining the elbow bending and the palm turning up. Feel the contraction with your hand. Relax completely. Repeat 10 times then rest. Repeat Step 5 a total of 3 times.

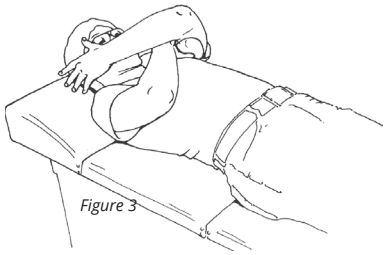


Figure 3

Triceps

Step 1: Begin by moving your uninvolved arm through the full pattern with your arm across and in front of your face with the elbow bent and the thumb up. Push your arm down and to the side, straightening the elbow and turning your arm so your thumb is out. Repeat several times, concentrating on the movement.

Step 2: Next, move both arms together through the triceps pattern. Imagine the movement of the amputated elbow and thumb. Repeat several times, concentrating on the movement.

Step 3: Now, move your amputated arm through the pattern while resisting the movement with your hand over the triceps. Do this several times, and again concentrate on imagining the movement of the elbow and thumb.

Step 4: Next, practice the triceps pattern without moving your shoulder. Start with the shoulder and arm relaxed at your side, and your hand over your triceps muscle. Imagine the elbow straightening and the palm turning down. Feel the contraction with your hand. Relax completely. Repeat 10 times then rest. Repeat Step 4 a total of 3 times.

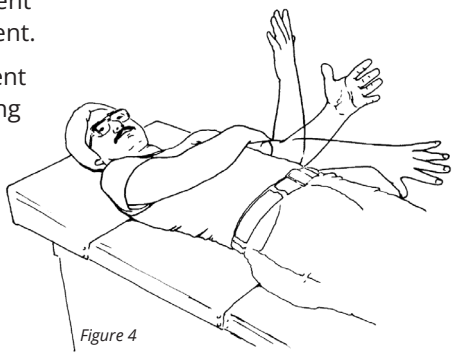


Figure 4

Co-contraction Exercise

Lastly, practice co-contraction. Place your hand around the amputated arm so you can feel both the triceps and biceps muscles. Quickly contract both muscles at the same time, immediately relax, then contract the biceps only. Repeat 10 times.

Patient Training

Online Resources

There is a free training video on our Fillauer YouTube Channel: "Training the Client with an Electric Arm Prosthesis."

Elbow-Flexion Training—EMG Dual Site

(Alternate inputs instructions shown in italics)

1. **Adjust flexion and extension gains on the forearm** (see Adjustments section). For all functions, a Therapy Cable (p/n 3010228) can be installed in the socket, allowing the Arm to be used with the Myolab II to provide visual feedback to the patient and act as a troubleshooting aid for the Prosthetist.

   With any Single-Site input, only the right side forearm gain is adjusted.

2. **Practice elbow flexion and extension.** First go to the Lock/Unlock screen in the User Interface. Change the lock override button to "Yes." This enables the lock override button on the arm to override automatic locking. Extension of the elbow is most easily performed by simply relaxing the muscles, controlling speed by the strength of contraction.

   With Linear Pot (or Force Sensor) input, flexion speed is controlled by the strength and speed of the pull on the sensor.

   Activity: Follow a target with the hand; move the elbow fast and slowly. Also, practice holding in one position steadily.

3. **Totally relax arm muscles and check for free swing of the elbow.** The elbow should drop, i.e., extend very quickly, in free-swing. The Prosthetist can adjust the Free-Swing Level, if required.

Lock/Unlock Training

1. **Lock: Instruct the wearer how to lock the elbow:** "Hold the elbow steady at one position without supporting it externally. The elbow should lock quickly after the motion is stopped." The prosthetist can adjust the Lock Time if needed. Early training is usually easier with a longer Lock Time, helping to reduce inadvertent locking while the wearer is mastering elbow function.
2. **Unlock: Instruct in unlocking the elbow:** "Relax the muscles. Then flex both muscles quickly at the same time, then relax, just like when a person 'snaps' their fingers. You should hear a faint 'whirr' when you co-contract successfully (from the lock motor). Then raise the elbow slightly." The elbow must raise slightly to release the lock. "If the elbow does not unlock at the first attempt, relax again, then attempt the quick co-contract sequence. Don't struggle to unlock. Give yourself some time to practice, so you can develop the quickness required to unlock Remember, contract both muscles quickly, not strongly."
3. **Practice lock-unlock activity: Position the elbow and lock at various positions.** You can present a target with a pencil or finger. Note: Unlocking, followed by a "jump" at the elbow is a common problem, requiring some practice to correct. Try to develop the feel in the wearer for raising the elbow just slightly to release the lock. Practice by presenting a target requiring slight lowering of the elbow below the previous locked position, i.e., lock, then unlock and lower (extend) the elbow, lock, etc. It may be necessary to lower the forearm flexion gain to minimize the accidental jumping.

Terminal Device (Hand) Training

1. After the elbow is locked, the muscles must be relaxed briefly, then control transfers automatically to the Hand.
2. Practice smooth opening and closing, developing independence of the two control muscles.
3. Proper adjustment of the Hand control by the Prosthetist will allow opening and closing with equal effort. If desired, a slight bias toward closing may be adjusted, so the Hand tends to close easier, avoiding dropping objects.
4. The arm wearer may practice controlling pinch force by grasping their own sound hand (if unilateral) and feeling the pinch force across the palm. Proportional control of the Hand will allow fine control of pinch force to be developed, as well as control over the speed of opening and closing.

CAUTION: Be Careful! Grasping delicate objects can cause harm due to the high pinch force of the Hand (~20 lbs.). Wait until your control of the Hand, and the lock/ unlock is excellent before you grasp other people or items!

Task Training

1. **Simple Grasping Tasks.** Practice controlling the grip force, gripping objects lightly and firmly. Practice stopping the Hand at full open, half open and nearly closed. Teach the best grips (for the particular T.D.) for eating utensils, especially knives, forks, mugs, etc.

   Activity: Grasp blocks, cups, ping-pong balls, table utensils, cans, etc.

2. **Practice Prepositioning.** For a variety of everyday tasks you might perform, practice positioning your shoulder, then elbow, humeral rotator and wrist, for the best performance, then open the Hand and grasp if needed.

3. **Two-Handed Tasks.** Start with simple tasks requiring holding an object to manipulate with the sound side hand (if unilateral).

   Activity: Pull tape from a roll; remove a bottle cap; open a soda can; butter bread; hold toothpaste tube and unscrew cap; hold padlock and turn the key, etc.

4. **"Grasp and Move" Tasks.** Prepositioning is very important for most tasks. Help the wearer to think through and practice the most efficient positioning of the elbow, humeral rotator and wrist rotator for each task. Working from simple to more difficult, work on the tasks most relevant for the wearer. As much as possible, try to train for the wearer's specific needs.

   Activity: Hold tray; hold mixing bowl; put clothes on a hanger; collate paper, fold and put into an envelope; draw lines with a ruler and pen; cut cardboard with an X-acto knife; use knife and fork for cutting food (teach proper knife grips for T.D. used); open and close zippers; thread and tie laces; buckles; hand tools: hammer and nails, "C" clamp, vice, hand drill, etc.

General Recommendations & Cautions for the Patient

1. Turn the power off when changing TDs. When changing from one TD to another, ALWAYS turn the power switch of the Arm OFF. Turn the Arm back on only after the new TD is securely installed.

2. Turn the Arm off when driving. When driving an automobile or other vehicle, we recommend that you leave the power OFF! An accidental movement of the Arm could distract you or interfere with your control of the vehicle. Your Arm can be used passively to steer, shift or use turn signals.

In addition, some types of electrical equipment can cause the Arm or Hand to move due to electrical interference. For example, Citizen's Band (CB) radios (especially when transmitting), have the possibility to move the Arm unexpectedly. Even if you're careful, a neighboring vehicle could have a CB transmitter!

3. Avoid excessive moisture. Keep your Arm dry! Never allow it to get wet inside—take it off before swimming, bathing, or showering! We recommend that you not wear your Arm when you have to be near water. Be extremely careful around sinks, puddles and rainstorms. When you have to be near water, wear a raincoat or waterproof jacket to cover it.

If you have a Hand, the glove should always be worn. If your Arm does get wet, dry it off as soon as possible and remove the Battery immediately! If water gets inside the Arm, drain it by turning the Arm in all directions and notify your prosthetist or Motion Control immediately! Under these circumstances only, remove the Forearm Cover and air-dry all parts.

Heavy sweating may result in erratic performance of your Arm. If you perspire heavily, dry off your skin and the electrodes. If necessary, use an anti-perspirant on your remnant limb to reduce sweating.

4. Avoid Dangerous Situations. Be careful with your Arm! Dropping or jarring it could damage the mechanism. If you ride a bicycle or motorcycle, or engage in similar activities, be careful and realize the damage which could result. Do not use your Arm in the presence of flammable gases. (In fact, you should probably get the rest of you out of there too.)

5. Avoid dust, dirt and lint. DO NOT wear your arm to the beach or where sand/dirt could get inside of it. When wearing clothes which produce lint, such as sweaters, wear a shirt or blouse underneath to protect the Arm. If you must expose it to dirt, dust, lint, sand, or moisture cover the Arm with a tightly woven shirt sleeve and wear a protective glove. If dirt could get to the forearm holes, cover them with tape. This will help prevent dirt particles from getting inside the Arm.

6. Avoid extreme temperatures. Excessive heat or cold may damage your Arm. It shouldn't be left in a closed car in the sun or outside overnight in freezing temperatures. In general, your Arm should only be exposed to temperatures at which you yourself are comfortable.

7. Avoid dyes. Your Arm can become permanently discolored and stained by many commonly used substances. Dyes from newsprint and fabrics can be transferred; pencils, ballpoint pens, and felt markers, even if not permanent, can cause stains. Clean your Arm off immediately if it is marked in this way following recommended cleaning instructions. If your Arm includes a Hand, wear an outer glove whenever appropriate to protect both your Hand and Arm.

8. Avoid excessive vibration. Activities such as operating a power mower, a jackhammer, chain saw or other vibrating power equipment should be avoided with the Utah Arm, particularly those that are also dirty and may involve water.

9. Don't lift heavy weights. Don't attempt to lift more than 50 pounds with the Arm locked. The Arm may be damaged with loads in excess of 50 pounds.

10. Be alert to interference. When you wear your Arm in a new environment, notice if any electrical devices can cause the Arm to move. If this occurs, leave the Arm OFF when you are around the interfering device. If electrical interference causes a problem for you, consult your prosthetist.

11. Use caution when donning and doffing. Always turn your Arm OFF when putting it on or removing it. Exercise caution in handling and donning your Arm as static electricity can severely damage the electronic components when the Arm is not being worn. Whenever you handle your Arm, touch a grounded point first, i.e., a Ground Electrode within the Socket (the electrodes not paired with another). Have your Prosthetist show you the location of the ground electrodes. Static electricity is not usually a hazard while wearing your Arm.

12. Leave the power OFF when not wearing the Arm. Nearby electrical equipment can cause the Arm to move when the electrodes are not connected to your skin.

13. Respect electricity. Do not connect the Arm to other electrical devices or fasten it to other machines. The Arm will not insulate you from electrical hazards. Only connect the Battery Charger to 110 volt, 50/60-cycle power (in the U.S. and Canada). In countries where other power voltages are used, obtain an appropriate A/C adaptor for 220 volt. If you are not sure, ask your prosthetist.

14. Avoid solvents. Do not expose your arm to corrosive solutions, solvents or vapors.

15. Don't over-adjust or under-adjust. Do not overtighten the Humeral Rotator. Excessive tightening can break the locking component inside the Rotator, and in extreme cases, can cause the Arm to separate from the Socket.

16. Always make sure the Forearm Cover Screws are tight.

The forearm cover screws may loosen in the course of normal use. Use a penny to tighten the screws.

17. Use only in strict accordance with the Directions for Use. Abuse will damage your Arm. Do not attempt to repair your Arm beyond the instructions provided in this manual. Return the Arm to a trained prosthetist or to Motion Control Inc. for repair. Always ship the Arm in the case provided, with the battery pack removed.

APPROACH DAILY TASKS WITH THE ATTITUDE THAT YOUR ARM IS A UNIQUE PIECE OF MACHINERY THAT IS A TOOL TO HELP YOU ACCOMPLISH TASKS AND ACTIVITIES OF DAILY LIVING. RESPECT ITS LIMITATIONS AS WELL AS ITS CAPABILITIES, AND IT WILL SERVE YOU WELL.

Declaration of Conformity

The product herewith complies with the Medical Device Directive 93/42/EEC guidelines, and with the United States Food and Drug Administration.

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