Remote Electrode System
Installation Guide

Liberating Technologies, Inc has developed a new type of myoelectrode where the metal electrodes have been separated from the electrode-amplifier, thus providing more options for the clinician and possibly better signal acquisition.

Cosmetics:

Encased myoelectrodes must be placed over the belly of the muscle to capture good myoelectric signals. A "dummy" is placed over the muscle site and the socket formed over this, creating an unsightly "bulge". Often, the socket is relatively thin here and as a result, the electrode destroys the cosmetics of the prosthesis. LTI's Remote Electrode System allows the clinician to place the metal electrodes over the best site for acquiring the muscle signal, but move the electrode-amplifiers to a convenient location between the inner and outer sockets where they can be concealed. This results in a smooth socket and good cosmeses.

Electronics:

LTI's Remote Electrode System (Fig 1) consists of; an Electrode-Amplifier, Metal Electrodes (3) and a Remote Electrode Cable (REC). The Metal Electrodes are placed over the muscle site and Remote Electrode cables of an appropriate length are selected to allow the Electrode-Amplifier to be placed in a convenient and inconspicuous location. These shielded REC cables are available in four lengths; 3, 6, 12 and 21 inches. The Metal Electrodes are also available in various sizes and shapes to accommodate the user. Three sizes/shapes are available; ½" diameter – standard dome, ½" diameter – deep dome and ? " diameter – pediatric. The ½" diameter – standard dome is the default Metal Electrode and should be used for most adult applications. If a muscle site is deep within the residual limb, a deep dome Metal Electrode may be used to obtain a better signal. For smaller adult muscles and pediatric applications, the smaller ? " diameter ("pediatric") Metal Electrodes may be a better choice.

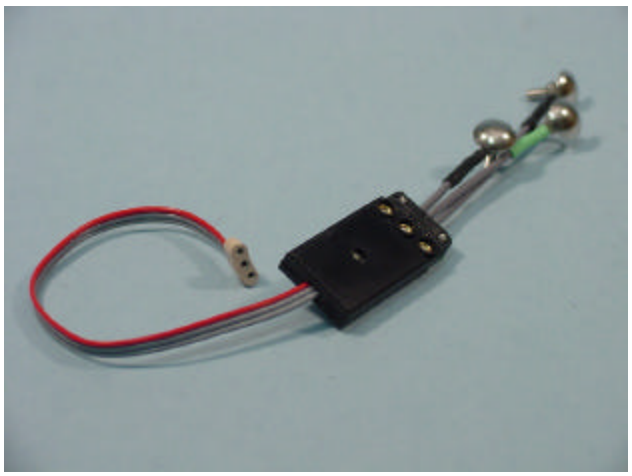


Fig 1. – Remote Electrode Kit

LTI's Remote Electrode Kit consists of;

- Electrode-Amplifier
- Metal Electrodes (3)
- Remote Electrode Cables

Remote Electrode Cables are available in four lengths:

- 3"
- 6"
- 12"
- 21"

Metal Electrodes are available in s=three shapes/sizes:

- ½" dia. – standard dome
- ½" dia. – deep dome
- ?" dia. – pediatric dome

Metal Electrodes (both sizes) are significantly larger than those used in traditional encased electrodes. The ½" diameter electrodes are approximately 6 times the surface area of traditional electrodes and the ? " diameter electrodes are approximately 3½ times the surface area. This larger surface area may result in stronger myoelectric signals. As a result, less gain may be needed in the electrode-amplifier to get myoelectric signals suitable to operate the prosthesis.

Since the Metal Electrodes are independent, the clinician can place these where they want in the socket. There are two active electrodes and one reference electrode. In general, the two active electrodes should lie along the longitudinal axis of the muscle and the reference electrode should be off to one side, equal distance from the two active electrodes. This results in a triangular pattern as shown below (Fig. 2).

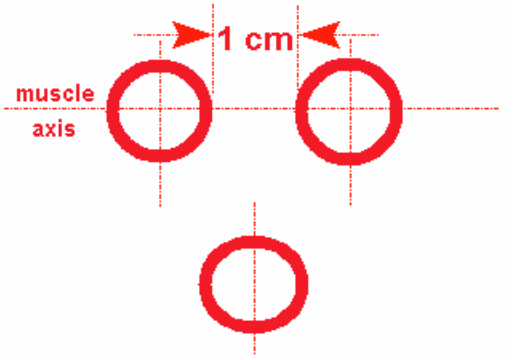


Fig 2. – Metal Electrode Spacing

The two active electrodes should be placed along the muscle axis with an edge-to-edge spacing of not less than 1 cm. The third (reference) Metal Electrode should be located off-axis, equal distance from the two active electrodes. When connecting the Remote Electrode Cables, attach the green-banded cable to this reference electrode.

Check Socket:

The spacing of these Metal Electrodes can be changed to obtain the best myoelectric signal. Generally, the two active electrodes are spaced no less than 1 cm apart, edge-to-edge. For larger muscles (i.e. bicep & triceps), these metal electrodes can be moved farther apart if this results in a better myoelectric signal. Determining the optimal spacing is best done during the check socket phase by drilling several holes along the muscle's longitudinal axis and moving the metal electrodes further apart as necessary. Select the distance between metal electrodes where the muscle signal is the strongest. The next step is to check for "signal separation". If the control strategy uses differential signals to control device speed and direction, it is critical that the muscle signals are independent (uncorrelated). Therefore, one must check for co-activation of agonistic/antagonistic muscles. If the electrode location chosen or metal electrode spacing results in unacceptable co-contraction signals, it may be wise to experiment further in an attempt to get good signal strength and good signal separation.

Gain Adjustment:

Many microprocessor-based prosthetic controllers (including LTI's VariGrip and VASI's SPM controllers) have a front-end gain stage for setting the input signal strength from the electrode-amplifiers. In these cases, it is advisable to set the gain adjustment on the back of the Remote Electrodes to the mid-point (half way between the clockwise and counter-clockwise stops on the potentiometer - see Fig. 3) and do the rest of the gain adjustment through the controller.

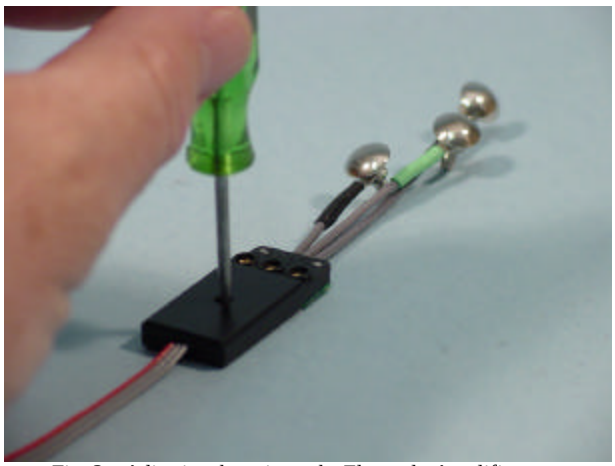


Fig. 3 – Adjusting the gain on the Electrode-Amplifier

Gently turn the screw on the back of the Electrode-Amplifier in the clockwise direction until it reaches the stop; then turn it in the counterclockwise direction until it reaches the other stop. This is the minimum gain. To increase gain, gradually turn the screw clockwise until the desired signal strength is reached. On systems where gain is adjusted through the controller, set the electrode-amplifier gain at the mid point.

Note: Remote Electrode-Amplifiers are normally shipped with the gain set at the mid-point.

For prosthetic systems without microprocessor-based controllers (like the Bock 4-in-1 controller and Animated controllers), adjust the gain on the electrode-amplifier until a satisfactory input level is achieved. To do this (Fig. 3), gently turn the potentiometer on the back of the electrode-amplifier clockwise until you reach the stop, then turn it counter-clockwise until you reach the other stop – this is the minimum gain setting. Increase the gain as necessary by turning the pot clockwise until the desired signal strength is achieved. Too little or too much gain can cause the controller to operate erratically and make it difficult for the user to reliably operate their prosthesis.

Mounting the CavityBack™ Metal Electrodes:

LTI's unique CavityBack Metal Electrodes are designed to minimize their installed height, thus improving cosmeses. These can be installed in the check socket by simply drilling holes in the appropriate locations and inserting the electrode mounting studs. To relocate them, drill new holes and remount the electrodes. Once the optimal sites are found in the check socket, transfer these Metal Electrodes to the definitive inner socket and attach the Remote Electrode Cables to the appropriate electrodes (green band – reference). Secure the eyelets with the washers and nuts provided. Once in place, cut-off the excessive electrode stud length and cover the back of the electrode with insulating tape.

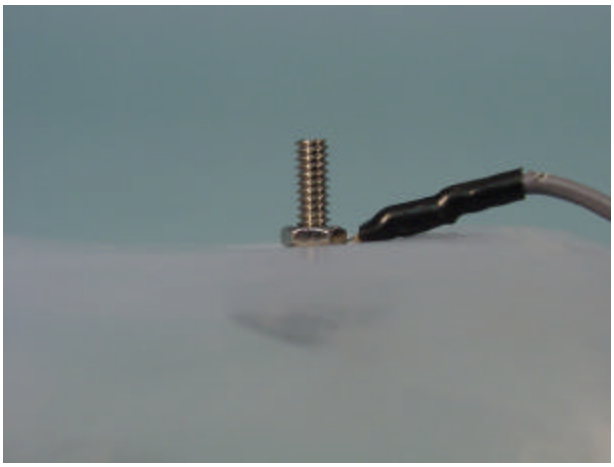


Fig. 4 – Install Metal Electrode and cable eyelet

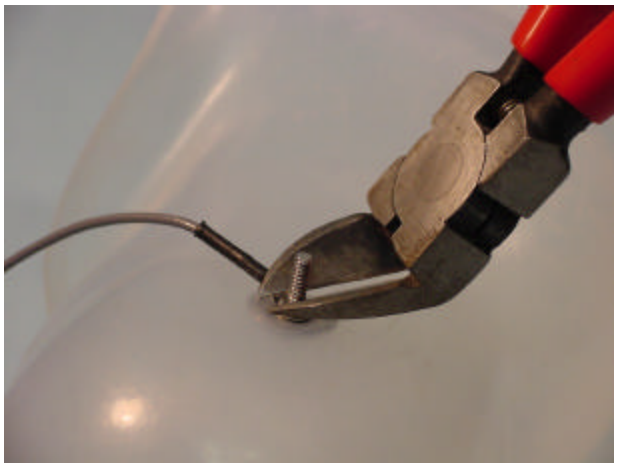
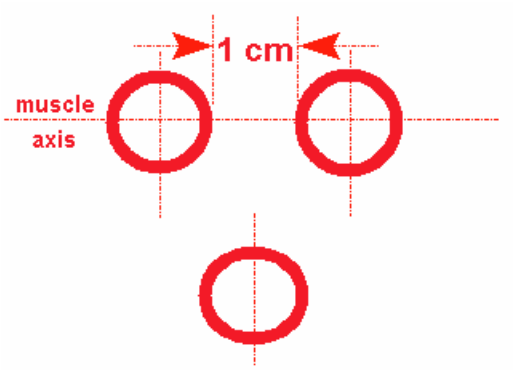


Fig. 5 – Cut off excessive stud length

Fabrication:

When assembling two-site prostheses, avoid placing the Electrode-Amplifiers directly adjacent to one another. Electrode-Amplifiers in direct contact can result in undesirable cross-talk. The symptom is similar to simultaneous co-activation of the muscle sites. To prevent this problem, place a spacer between the Electrode-Amplifier cases to isolate the two amplifiers. Additionally, ensure that the vinyl tape covering the REC cable screws on the Electrode-Amplifiers remains in place to prevent these conductive inserts from shorting.

Mounting Template (cut out and attach to prosthesis as a drill template for proper electrode spacing):



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