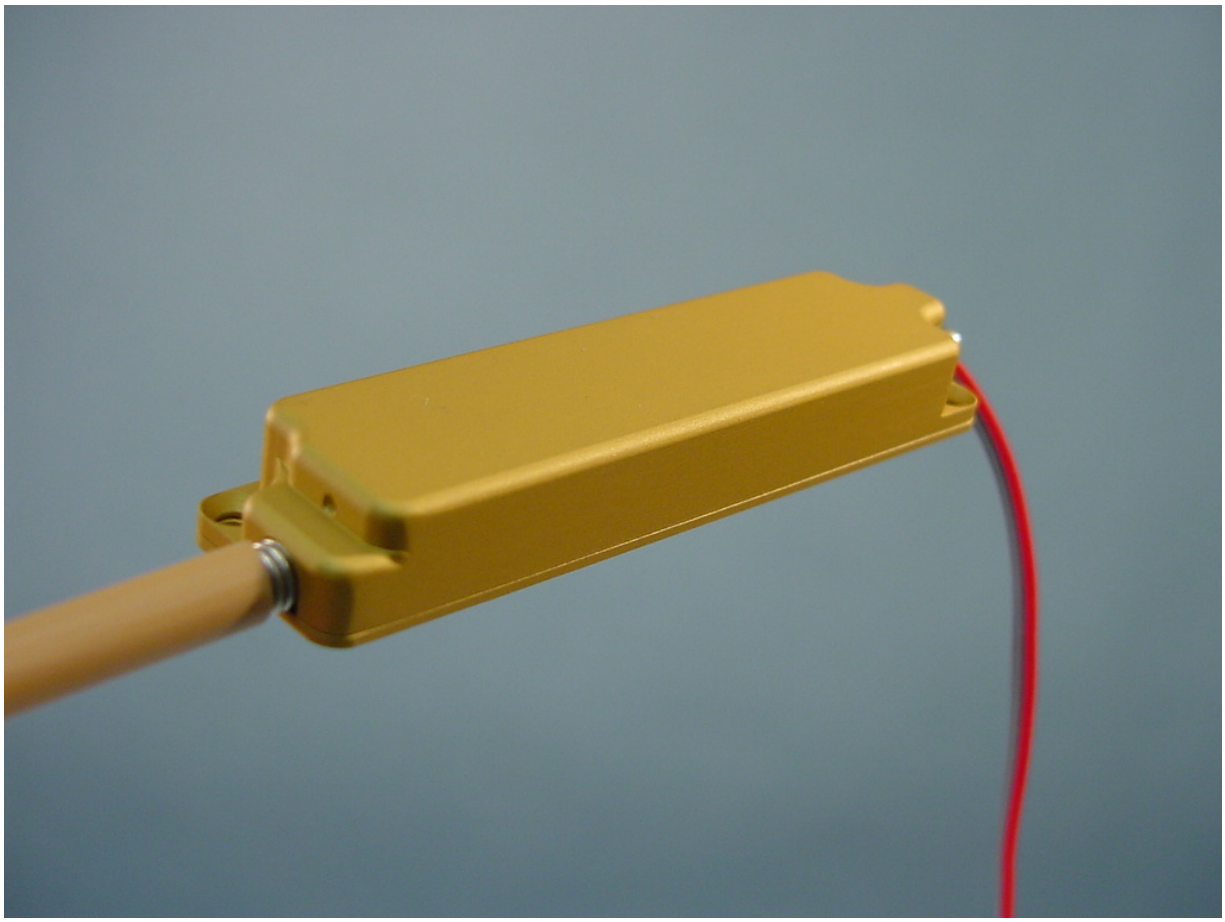
Linear Transducer

BE235

for Boston Digital Arm System



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The LTI **Linear Transducer** (BE235) is designed to be used with the Boston Digital™ Arm System, allowing the user to regulate the position of the prosthesis by making a body movement that pulls on the transducer cord. The position of the transducer determines the motion of the prosthesis. If the user pulls the transducer cord ½" (full excursion), the prosthesis goes through its full range of motion. A smaller movement of the transducer cord produces a smaller movement of the prosthesis. This motion of the prosthesis, tracking the motion of the transducer, is called "servo control". When used to control the Boston Digital Arm, the transducer's position relates directly to the position of the elbow (degree of flexion) – a fully-pulled transducer equals a fully flexed elbow. When the transducer is released, the elbow extends. Other non-servo uses of the Transducer are discussed further on. The user's abilities determine what body movement is best used to actuate the servo transducer. A typical arrangement is to mount the servo transducer into the prosthetic support harness, so that chest expansion moves the transducer and results in movement of the prosthesis. Users can accurately position the prosthesis with these transducers and by pausing, can essentially lock/leave the prosthesis in the position they choose. Positional servo transducers also provide proportional speed control.

Figure 1 - Linear Transducer

Description:

The Linear Transducer consists of a linear potentiometer in a small case with an attached 8" (200mm) Bowden sheath. A Spectra™ cord (about 16" or 400 mm) exits the sheath and is supplied with a loop strap for attaching to the harness. Pulling the cord changes the resistance of the potentiometer, thus changing the speed and position of the prosthetic device. As originally set-up, the Spectra cable moves a total of ½ inch (13 mm). Depending on where you place a knot in the cord when setting up the transducer, the cord can be set to travel ½ inch or 1 inch (13 or 25 mm). The potentiometer has a small return spring which is supplemented by a secondary, adjustable spring for proper resistance.

Mounting the Transducer:

Mount the transducer on a flat surface, using the 3 flat-head #2 self-tapping screws provided (Fig 2). Alternatively, a cavity can be molded into the outer socket and the transducer can be placed between the inner and outer sockets to conceal it. Care should be taken to mount the transducer in a location which will not require the Bowden cable to have sharp bends, thus minimizing friction in the Spectra cord.

Actuation of the Transducer:

The actual location of the Transducer is less important than the location of the loop strap on the harness. Typically, a point near the end of the Bowden sheath is fixed to a point on the posterior wing of the transhumeral socket. The other action point is the attachment of the cord running through the Bowden sheath, often on the contra-lateral side of the posterior harness. Forward motion of one or both shoulders (protraction) takes the slack out of the cord and then moves the transducer mechanism.

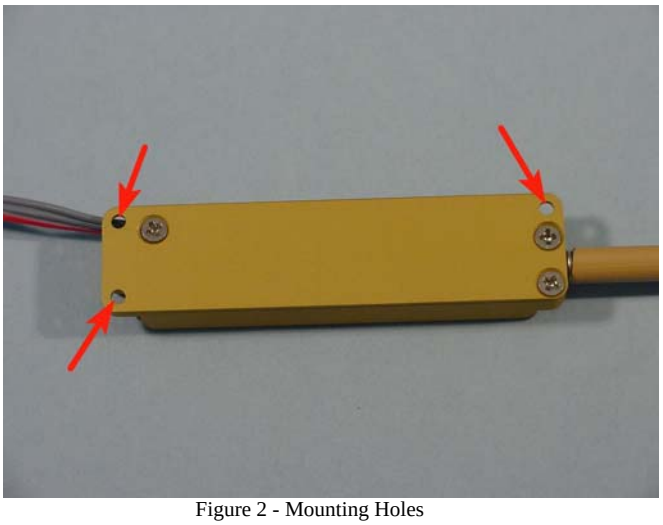

Figure 2 - Mounting Holes

Adjusting Length of Travel:

The unit is shipped with the Spectra cord secured to the Delrin piece as shown in Figure 3. This is the 0-½ inch travel setup. Generally this is the preferred configuration. If the user requires more travel, you can change to the 0-1 inch travel setup by removing the cover and rerouting the Spectra cord. Drill a 0.05“ diameter hole (#55 drill) through the case where shown in Figure 4. A dimple has been provided to center the drill. Cut off the knot at the black “pulley block”, and straighten the cord. Now loop the cord through the hole in the black Delrin block – passing it in one hole and back out the second hole (180°), then out through the new hole in the case. Tie a “figure 8” knot just outside the case. The Spectra™ cord is slippery (ultra high-molecular-weight polyethylene), so you should trap a little “superglue” (cyano acrylic cement) in the interior of any permanent knot or it will work loose. Have your user try both travel set-ups before gluing any knots.

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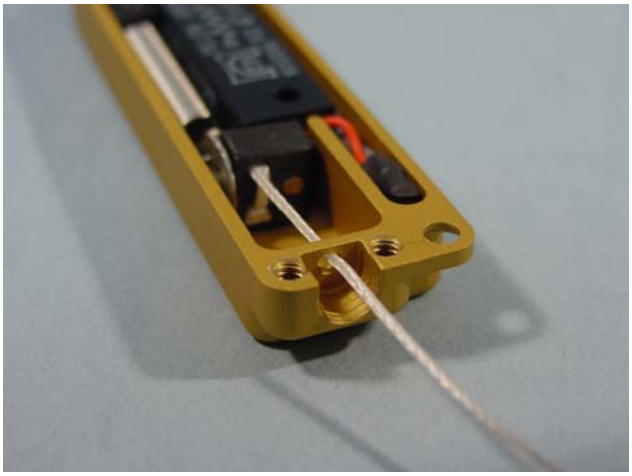

Figure 3 - Single Spectra Cord - ½” Travel

Figure 4 – Drill Hole for Rerouting Spectra Cable - 1” Travel

The case cover secures the Bowden cable sheath as shown in Figure 5. Once the sheath is in place, tighten the two cover screws, then make sure that the set screw on the top of the case is tight against the Bowden cable. If the sheath is too long, it can be cut to length. Remove the Spectra cord and cut both the Bowden shroud and the inner Teflon liner to the desired length. Then re-thread the Spectra cord through the Bowden cable and attach the end piece

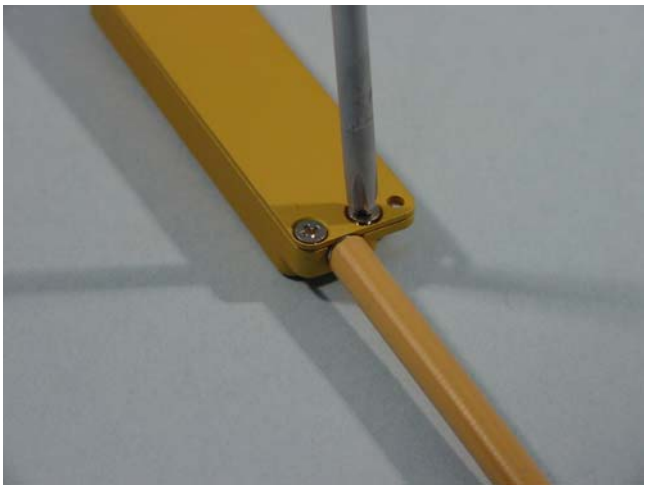

Figure 5 – Securing the End of the Bowden Cable

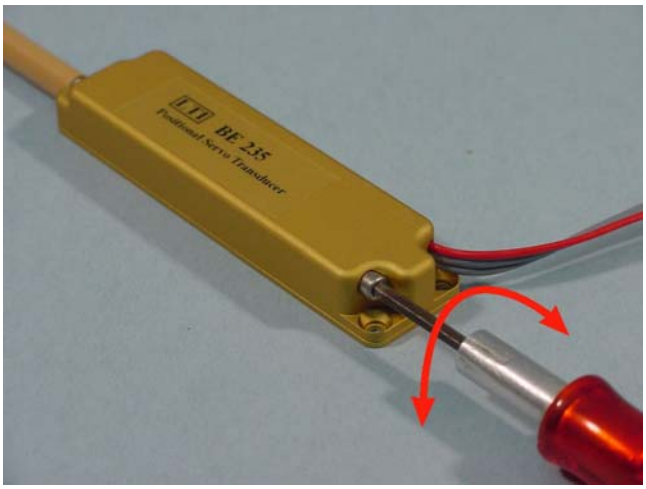

Figure 6 - Spring Tension Adjustment

Spring Return Adjustment:

Usually the transducer is pulled by a shoulder or by chest expansion. The muscles that initiate these motions are relatively strong and you may need a strong spring for your user to develop the best possible "feel" for where the transducer is in its travel. The spring tension provides feedback to the user. An adjustment screw (Figure 6) is located on the end of the transducer case. Rotating this screw **counter-clockwise**, will **reduce** tension in the spring. Rotating it **clockwise** will **increase** spring tension, assisting the user in feeling when the transducer engages. Most users will need little or no pretension, but will need at least the weakest spring to overcome friction in the system.

Routing the Spectra Cord:

The Transducer is supplied with the Bowden sheath attached. The other end of the sheath will be at the socket-side anchor point. For the transhumeral amputee using protraction of the shoulder, this anchor is usually placed right over the abduction axis of rotation on the posterior wing of the socket. The goal for the user is to be able to abduct and forward flex with minimal pull on the cord while maximizing the motion that results when the shoulder is protracted.