October 2017

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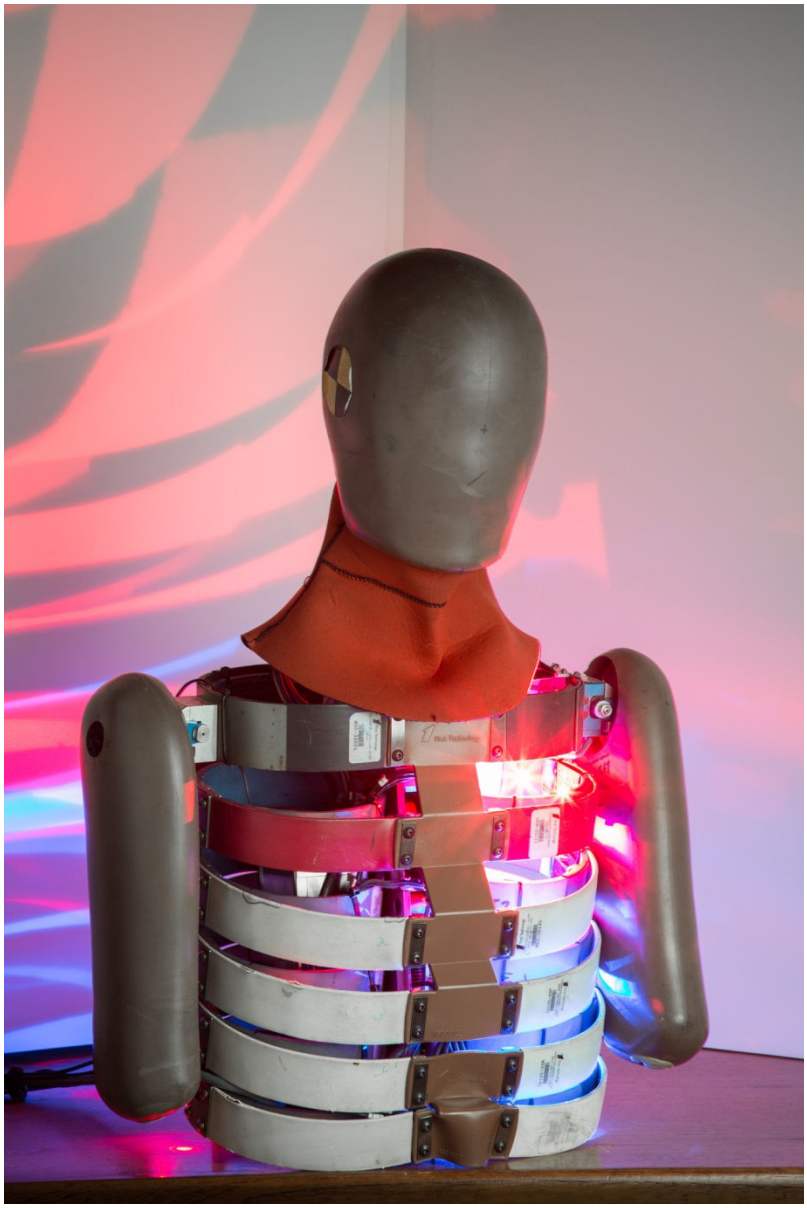
HARDWARE USER MANUAL

RibEye™ Multi-Point Deflection Measurement System:

3-Axis Version for the WorldSID 50th Male ATD



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RibEye™ Multi-Point Deflection Measurement System: 3-Axis Version for the WorldSID 50th Male ATD

1.0 WorldSID RibEye Description

The RibEye for the WorldSID anthropomorphic test device (ATD) provides X, Y, and Z position data for 18 light-emitting diodes (LEDs) mounted on the WorldSID ribs. Three LEDs are mounted on each of the six ribs. The RibEye for the WorldSID can be mounted on either side of the dummy to measure left-side or right-side impacts. Appendix A provides the RibEye measurement range and other specifications, including details on the cables and connector pinouts. Appendix B explains how to switch the WorldSID RibEye from left-side to right-side-impact.

Up to 25 seconds of data can be collected at a 10-kHz sample rate. Two types of non-volatile flash memory are installed in the controller: a Micro-SD card stores all 25 seconds of data from a test, and onboard flash memory stores 1.7 seconds of data (from –200 ms to 1500 ms) that is retained after power is turned off. If external power is lost, the RibEye will operate on internal batteries. Communication to the RibEye is via Ethernet.

Two sets of three sensors monitor the LED positions, as shown in Figure 1. The top set of sensors uses red optical filters and monitors the red LEDs mounted on the first three ribs: the shoulder rib, the thoracic 1 rib, and the thoracic 2 rib. The bottom set of sensors uses blue optical filters and monitors the blue LEDs mounted on the lower three ribs: the thoracic 3 rib, the abdominal 1 rib, and the abdominal 2 rib.

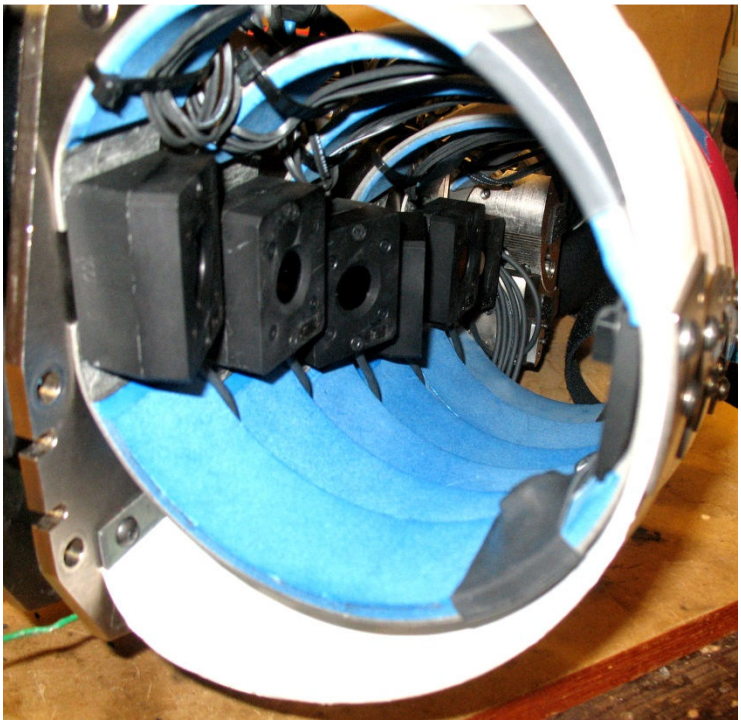


Figure 1. RibEye sensors mounted in the dummy (view from pelvis upward)

Three RibEye LEDs are mounted on each rib. Figure 2 shows the RibEye LEDs installed in the WorldSID dummy. The center LEDs are lined up along the dummy's left or right side. The forward LEDs are closer to the front of the dummy and the rearward LEDs closer to the dummy's back.

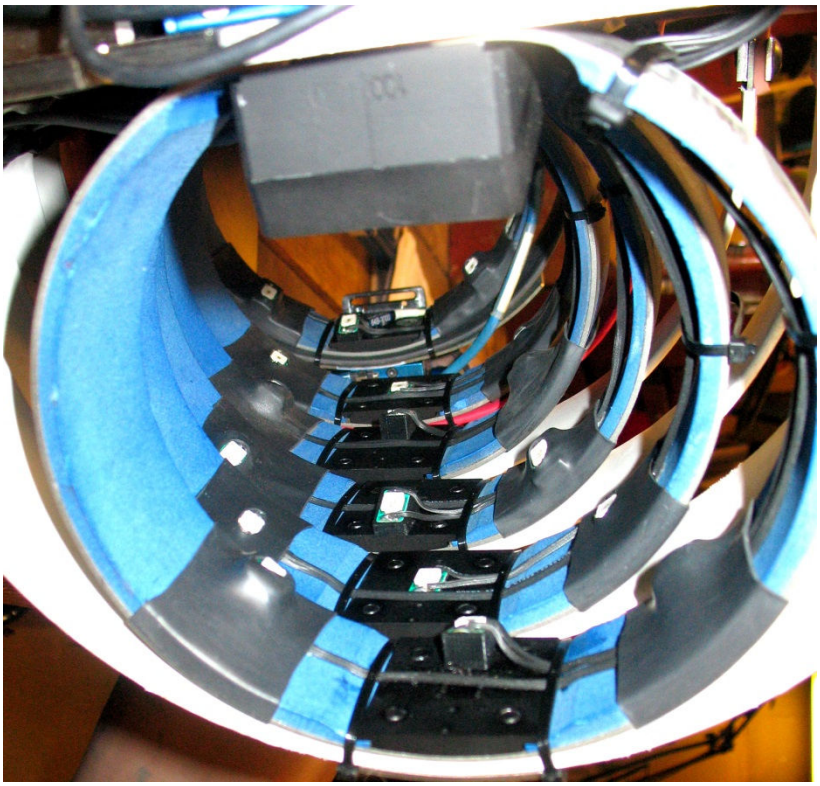


Figure 2. RibEye LEDs mounted in the dummy (view from pelvis upward)

The RibEye controller mounts on the non-struck side of the dummy. The controller enclosure also contains the RibEye's battery pack. Figures 3–6 show the following views of the controller:

- Figure 3 shows the controller as shipped, with connector covers installed at each end.
- Figure 4 shows the controller with the two end covers removed.
- Figure 5 shows the connectors for the sensors at one end of the controller.
- Figure 6 shows the connectors for the LED cables, status cable, and dummy exit cable at the other end of the controller.

Figure 3. RibEye controller with connector end covers in place

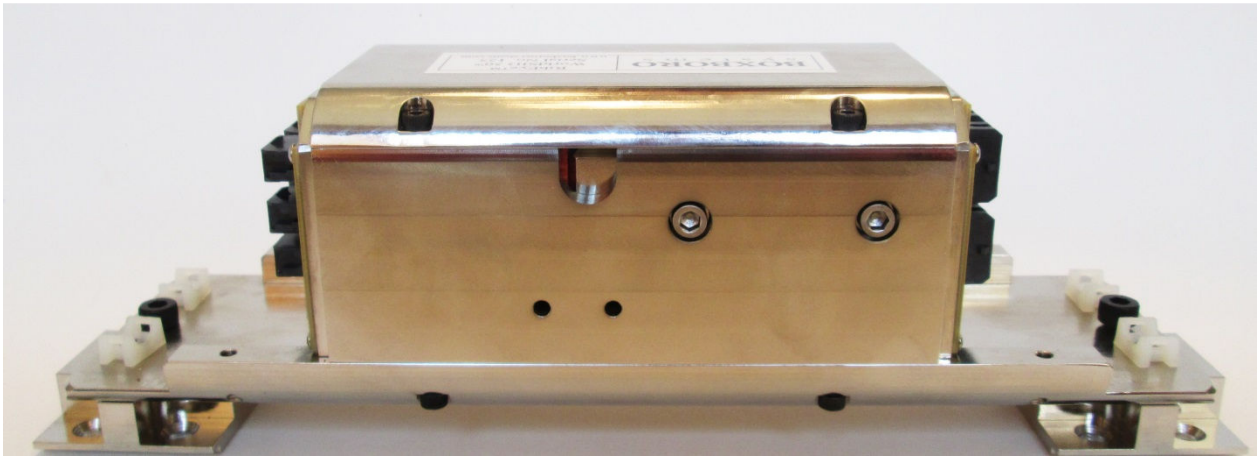


Figure 4. RibEye controller with connector covers removed

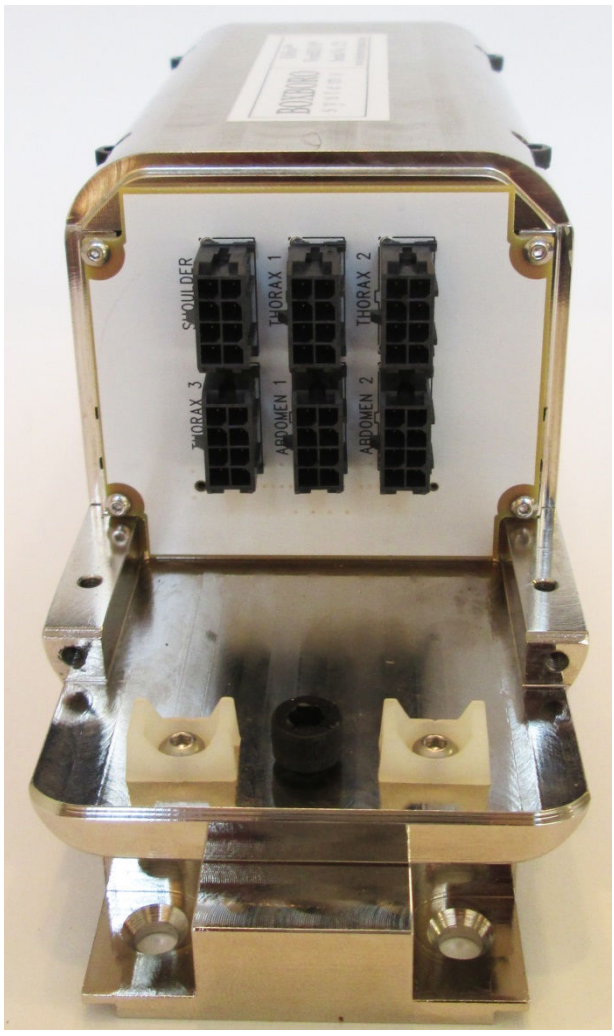


Figure 5. Controller sensor connectors

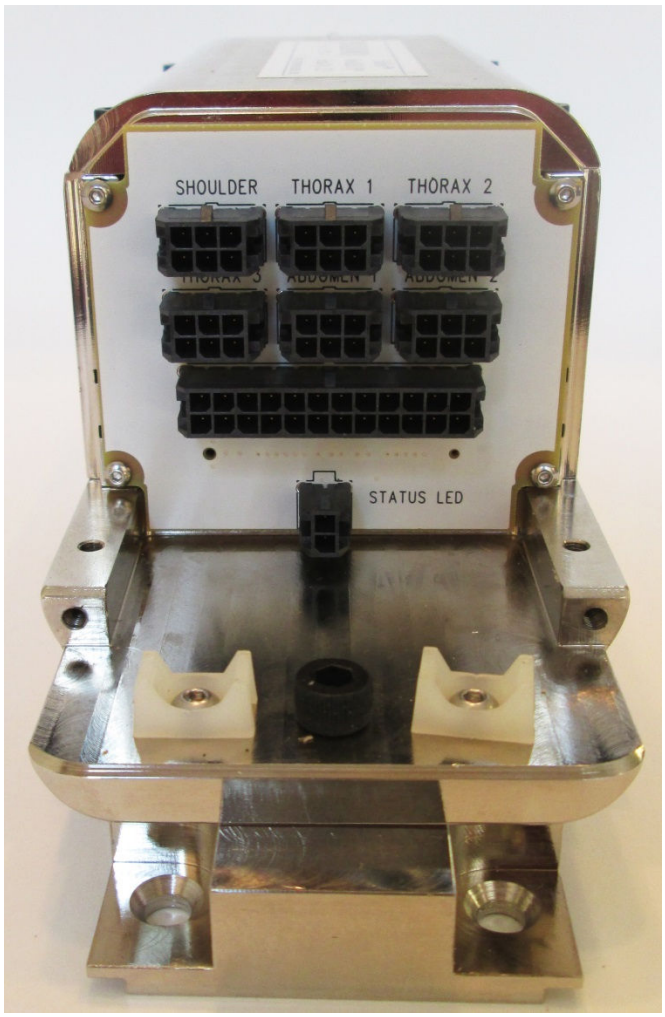


Figure 6. Controller connectors for LED cables, status cable, and dummy exit cable

2.0 RibEye Installation

This section explains how to mount the RibEye components into the WorldSID 50th Male ATD. The instructions cover the installation of the LEDs, sensors, and controller, as well as the cable routing. Some components are mounted before the ribs are assembled in the dummy, and others during or after rib assembly. See section 2.3 below for the specific order of assembly.

2.1 LED installation

Table 1 summarizes the LED positions and mounting methods for all 18 LEDs. The following sections describe in detail how to mount the LED assemblies onto the ribs. The forward LEDs are closer to the front of the dummy and the rearward LEDs closer to the dummy's back. Please refer back to Figure 2 for a visual showing three LEDs mounted onto each of the six ribs.

Table 1. Summary of LED positions and mounting methods

Rib number/type		Rearward LEDs	Center LEDs	Forward LEDs
Rib #1 (shoulder)	Position	Bottom edge of rib		
	Mounting	Snap LED assembly to angled block; Tape and heat-shrink in place	LED assembly already glued to LED adaptor plate; Screw LED adaptor plate to clamp plate	Snap LED assembly to angled block; Tape and heat-shrink in place
Rib #2 (thoracic 1)	Position	Center of rib, mounted flat		
	Mounting	Tape and heat-shrink in place	LED assembly already glued to clamp plate	Tape and heat-shrink in place
Rib #3 (thoracic 2)	Position	Top edge of rib		
	Mounting	Snap LED assembly to angled block; Tape and heat-shrink in place	LED assembly already glued to angled block; Screw angled block into clamp plate	Snap LED assembly to angled block; Tape and heat-shrink in place
Rib #4 (thoracic 3)	Position	Bottom edge of rib		
	Mounting	Snap LED assembly to angled block; Tape and heat-shrink in place	LED assembly already glued to angled block; Screw angled block into clamp plate	Snap LED assembly to angled block; Tape and heat-shrink in place
Rib #5 (abdominal 1)	Position	Center of rib, mounted flat		
	Mounting	Tape and heat-shrink in place	LED assembly already glued to clamp plate	Tape and heat-shrink in place
Rib #6 (abdominal 2)	Position	Top edge of rib		
	Mounting	Snap LED assembly to angled block; Tape and heat-shrink in place	LED assembly already glued to angled block; Screw angled block into clamp plate	Snap LED assembly to angled block; Tape and heat-shrink in place

2.1.1 LED assemblies

Figure 7 shows a LED assembly, with its lead cable attached, and an angled mounting block. The LED is soldered onto a metal-clad printed circuit board (MCPCB). Figure 8 shows the LED assembly snapped into the angled mounting block. If the LED does not snap tightly into the angle block, it can be held in place with super-glue (cyanoacrylate) or epoxy.

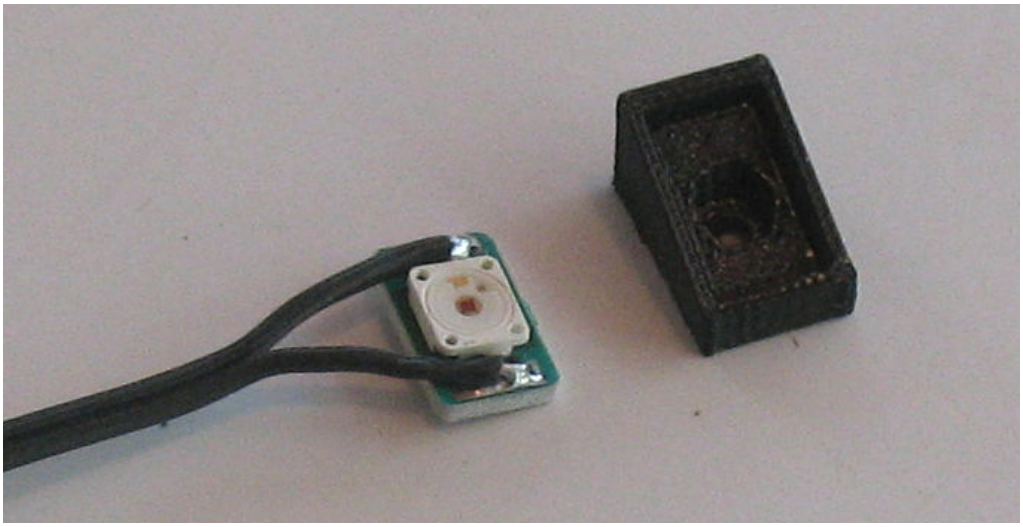


Figure 7. LED and angled mounting block

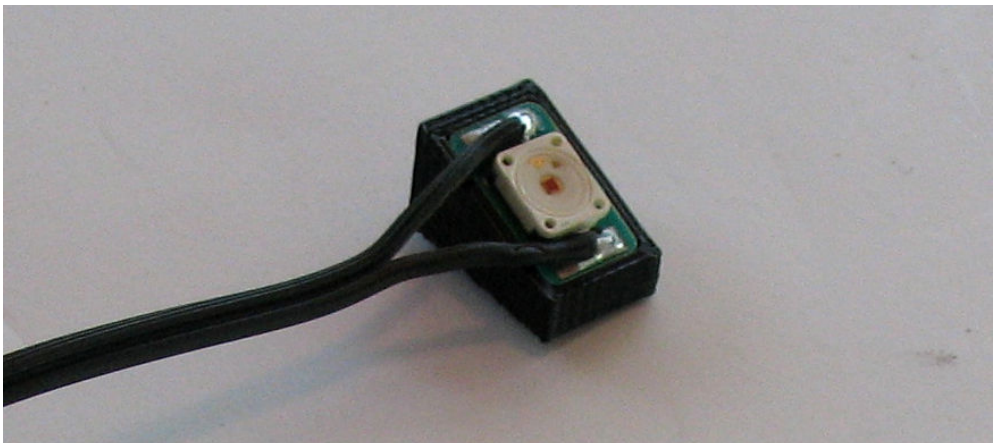


Figure 8. LED snapped into angled mounting block

The angled mounting blocks are used on four of the dummy's six ribs – the shoulder, thoracic 2, thoracic 3, and abdominal 2 ribs. On the shoulder and thoracic 3 ribs, the LEDs are mounted on the bottom edge of the ribs. On the thoracic 2 and abdominal 2 ribs, the LEDs are mounted on the top edge of the ribs.

On the dummy's other two ribs – the thoracic 1 and abdominal 1 – all three LEDs are mounted flat, without a block. This becomes more clear if you refer back to Figure 2, which shows three LEDs mounted on each rib.

The center LED on the shoulder rib is epoxied on to a LED adaptor plate. The adaptor plate is attached to the shoulder inner rib clamp using two 2-56 x 1/4 button-head cap screws (BHCS). An optional foam stopper plate intended to prevent the shoulder foam from dropping in front of the LED can be attached to the top of the shoulder inner rib clamp with two 4-40 x 5/16 cross-head screws.

The shoulder center LED assembly, adaptor plate, inner rib clamp, and foam stopper plate are shown in Figure 9. Also shown in Figure 9 are two plastic wire clamps that are bolted to the inner rib clamp plate with 2-56 x 1/4 BHCS. There are two sizes of plastic wire clamps. The smaller wire clamp (0.093-inch diameter) is sized for a single LED cable and is mounted on the left side of the inner rib clamp for the cable that goes to the rear LED. The larger wire clamp (0.125-inch diameter) holds two LED cables and is mounted on the right side of the rib clamp for the two cables that come from the controller, past the front LED.

The cable clamps are from Micro Plastics Inc.:

- 22CC16A0093-B for the 0.093-inch-diameter clamp
- 22CC16A0125-B for the 0.125- inch-diameter clamp.

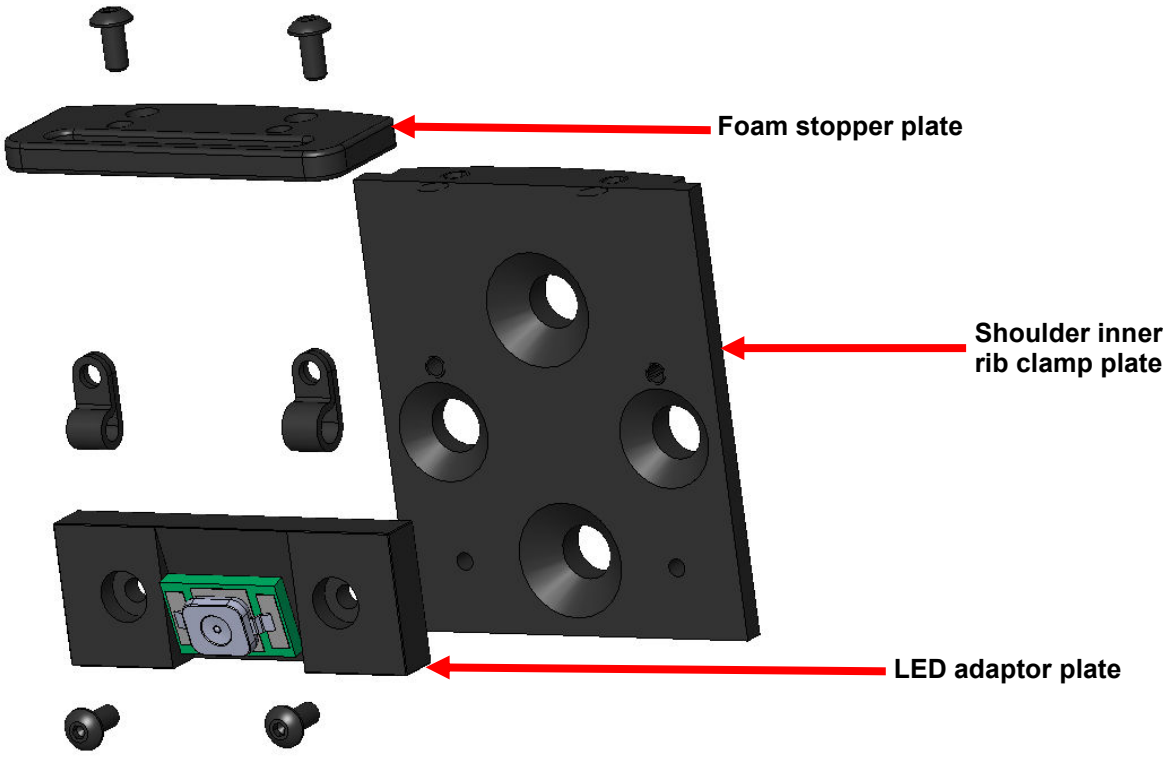


Figure 9. Shoulder center LED adaptor plate, inner rib clamp, and foam stopper plate

Figure 10 shows a photo of a shoulder center LED assembly on the shoulder rib clamp. In the picture, stainless-steel screws and natural nylon wire clamps are shown for clarity. However, black screws and black wire clamps are shipped with the RibEye. These should be used to prevent reflections.

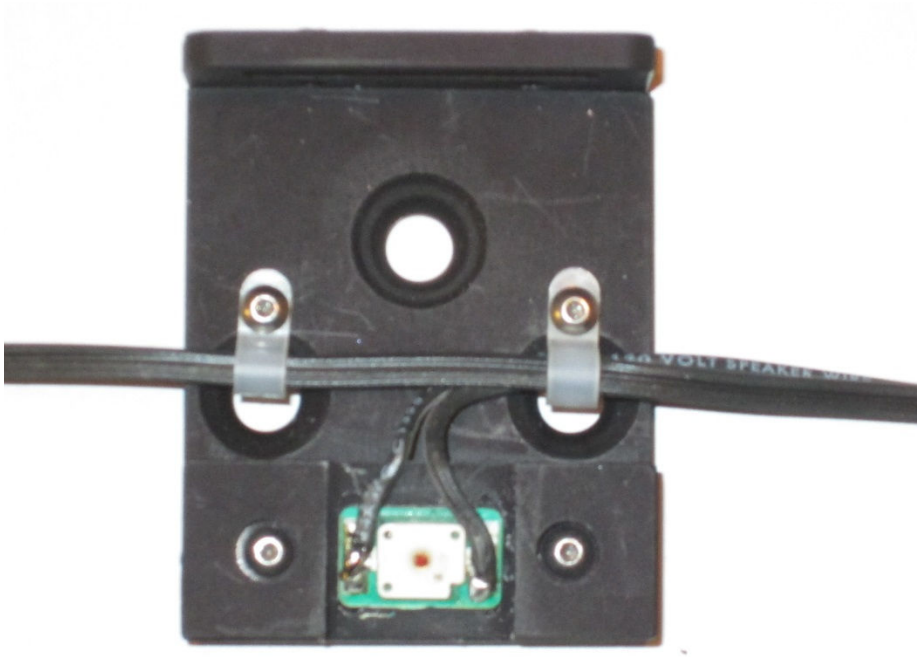


Figure 10. Shoulder center LED assembly photo

The center LEDs on the thoracic and abdominal ribs are mounted to inner rib clamp plates. A CAD drawing of an inner rib clamp plate is shown in Figure 11:

- Hole A is for installing the angled blocks, which are screwed to the clamp plates using a 1/4-inch long, 2-56 button-head screw that engages in a captive 2-56 nut inside the angled blocks.
- Recess B is for gluing flat LED assemblies to the clamp plate. The clamp plates for the thoracic 1 and abdominal 1 ribs are shipped with the LED assemblies already glued into recess B.
- The two C holes are for mounting the nylon wire clamps using 2-56 x 1/4 BHCS screws.
- The two D holes are for mounting a 7264-type accelerometer on any rib. We recommend that the accelerometers be removed when using the RibEye, as they can cause reflections or block the LED light to the sensors. If accelerometers must be used, they should be painted with flat black paint or covered with flat black tape to prevent reflections.

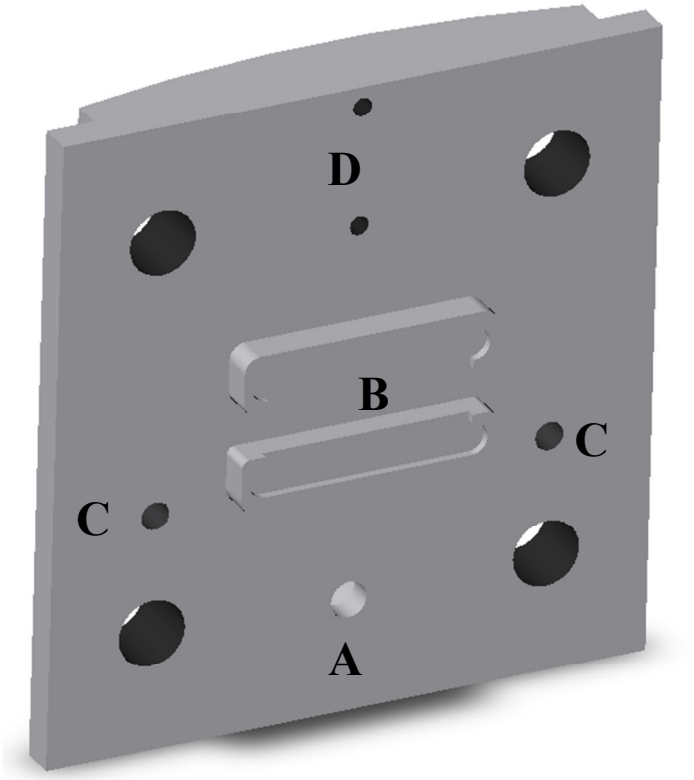


Figure 11. Inner rib clamp plate for thoracic and abdominal ribs

As noted earlier, the forward LEDs are closer to the front of the dummy and the rearward LEDs closer to the dummy's back. These rearward and forward LEDs on all ribs are held in place with high-strength double-sided foam tape and heat-shrink tubing. The foam tape is 3M #4952 (1/2-inch wide, VHB acrylic tape). The heat-shrink tubing is 1-1/4 inches in diameter. The heat-shrink tubing supplied with the RibEye is made by Qualtek, 2:1 shrink ratio, 1-1/4 inches in diameter, part number Q2-Z-1 1/4-01-MS50FT.

Figures 12 and 13 show the inner rib clamp plates with the LEDs and wire clamps installed for 1) the thoracic 1 and abdominal 1 ribs and 2) the thoracic 2, thoracic 3, and abdominal 2 ribs. In both of these photos, stainless-steel screws and natural color nylon cable clamps are shown for clarity, but the RibEye ships with black screws and black wire clamps, which should be used to prevent reflections.

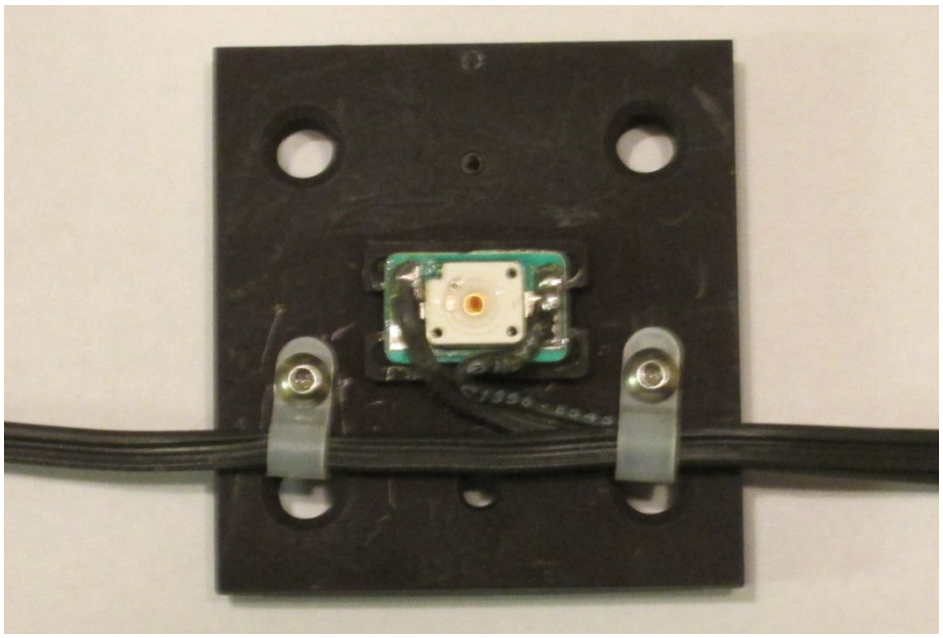


Figure 12. Thoracic 1 and abdominal 1 inner rib clamp plate with LEDs and wire clamps installed

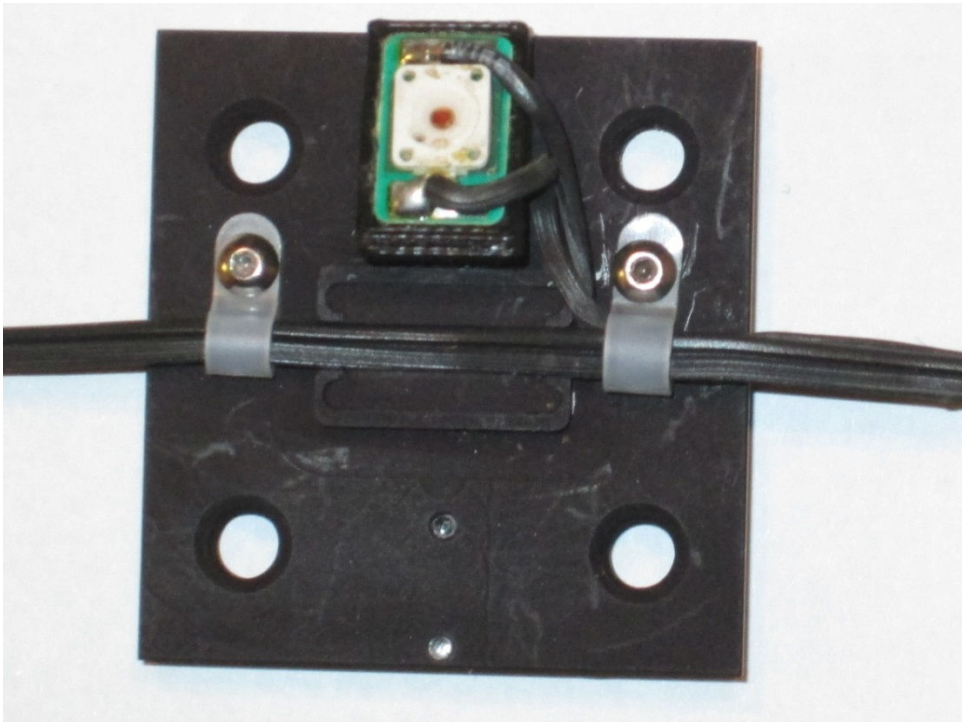


Figure 13. Thoracic 2, thoracic 3, and abdominal 2 inner rib clamp plate with LEDs and wire clamps installed

The LED cables are run from the bottom of the controller on the non-struck side, up along the front of the spine plates, and then across to the front of the inner ribs. The front, center, and rear LED cables are attached to the inner rib, running from the front to the rear.

The rearward and forward LEDs are typically mounted 35 mm from the center of the rib as shown in Figure 14. The 35-mm dimension is the straight-line distance to the edge of the angled block or LED metal-clad circuit board.

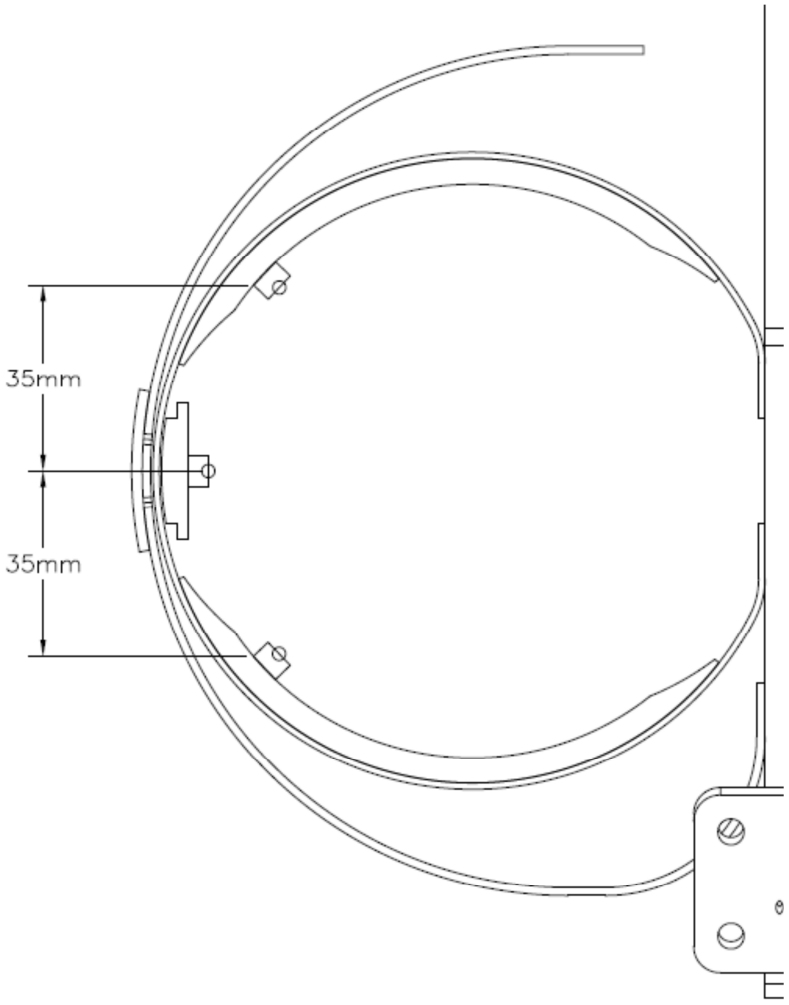


Figure 14. Rearward and forward LED locations

As noted earlier, the LEDs must be mounted to the ribs before the ribs are installed in the dummy. The 18 LED cables are marked with the rib number (1–6) and one of three LED positions as follows:

Rib #1 (shoulder)	F (Forward)	C (Center)	R (Rearward)
Rib #2 (thoracic 1)	F	C	R
Rib #3 (thoracic 2)	F	C	R
Rib #4 (thoracic 3)	F	C	R
Rib #5 (abdominal 1)	F	C	R
Rib #6 (abdominal 2)	F	C	R

Thus, for example, the LED with the cable marked 4-R should be mounted on the thoracic 3 rib in the rearward position.

On each rib, the rearward LEDs should be mounted first, then the center LEDs, and finally the forward LEDs. Before mounting the LEDs, remove grease and mold-release compound by wiping down the mounting area on the ribs and the back of the LEDs and mounting blocks, using isopropyl alcohol. When installing the foam tape, squeeze it onto the rib with at least 15 psi of force. When putting the LED assembly onto the foam tape, press it on with at least 15 psi of force; however, do *not* press on the soft silicone face of the LEDs.

2.1.2 Mounting rearward LEDs on the ribs

The rearward LEDs should be mounted according to the following procedure:

Place a strip of double-stick tape on the rib at the rearward LED mounting location. Add a second piece of tape that will hold the LED cable in position. Place the LED on the first piece of tape and arrange the cable on the second piece of tape so that the cable avoids the spot where the center LED will be mounted (see Figure 15).

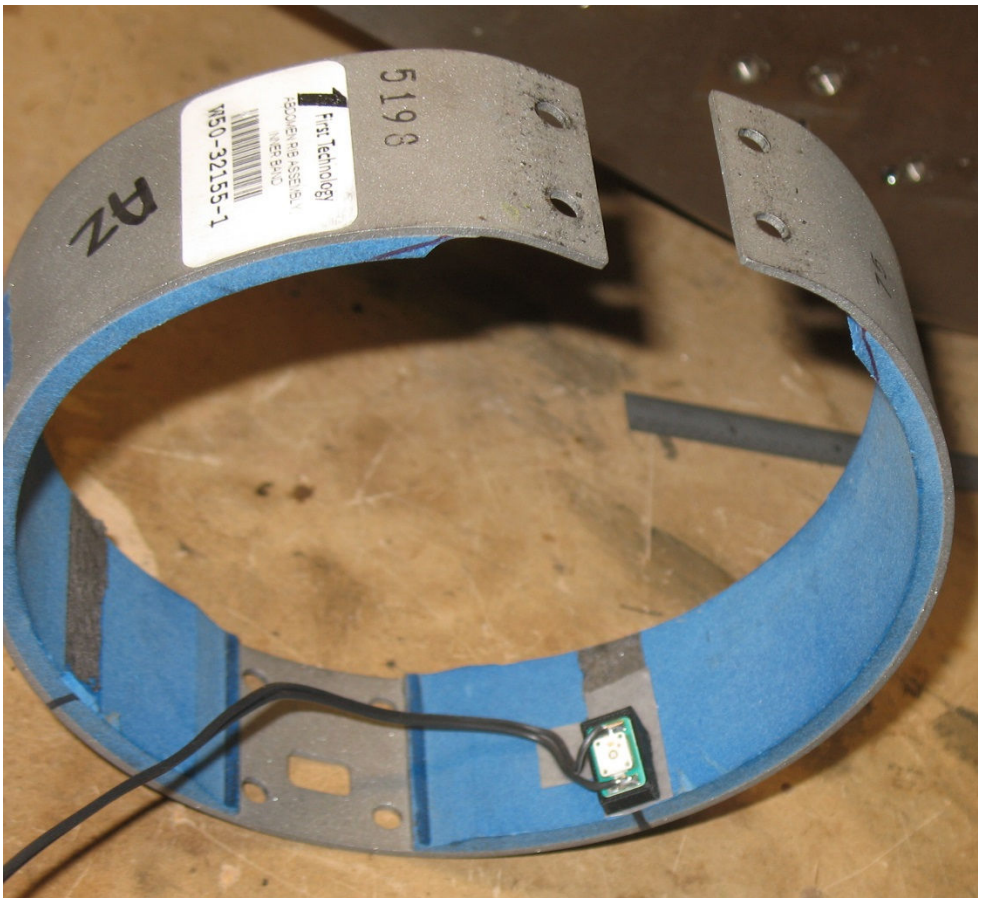


Figure 15. Rearward LED placed on double-stick tape
(with cable arranged to avoid center LED position)

Heat-shrink "sleeves" are provided with the RibEye (tubing that has been pre-cut and hole-punched). To make additional sleeves, cut a piece of heat-shrink tubing 1½ to 2 inches long and punch a hole in the tubing where the center of the LED will be (this can be done using a standard paper hole punch or similar tool). Slide the tubing sleeve over the rib and LED as shown in Figure 16. Center the hole directly over the red or blue square in the center of the LED.

NOTE: Do not use any glue-lined heat-shrink tubing because the glue can bubble out of the LED hole and cover the LED, blocking its light.

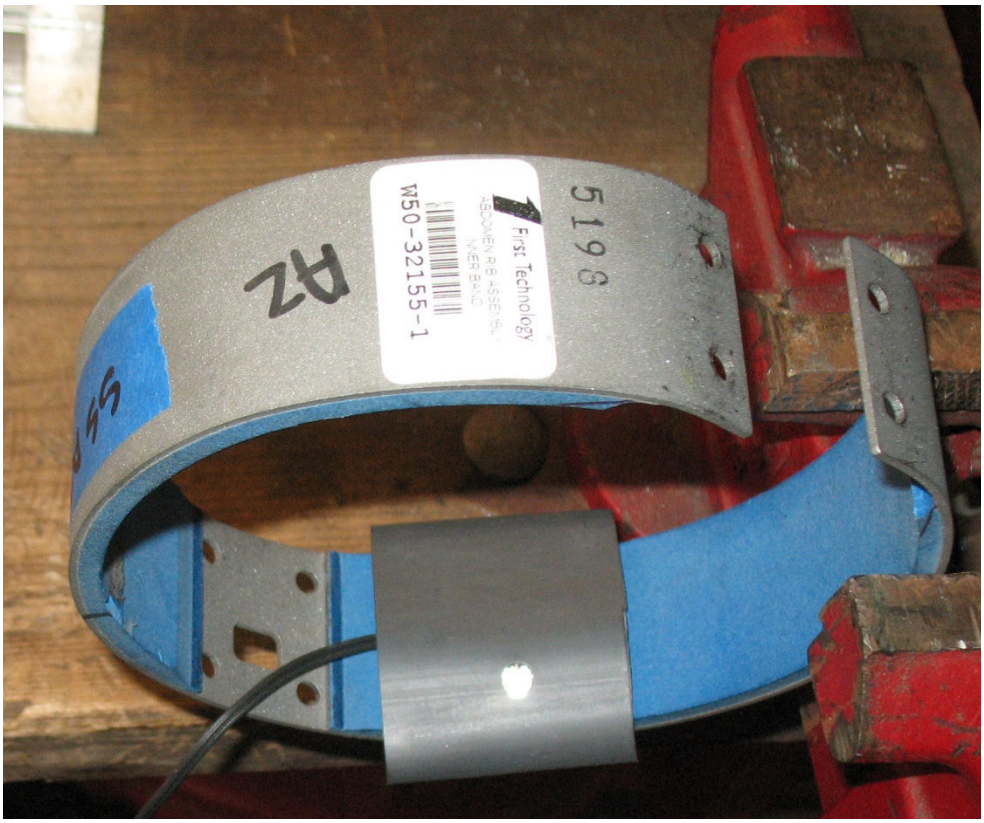


Figure 16. Heat-shrink tubing placed over rearward LED

Carefully begin shrinking the tubing using a heat gun while holding the hole over the LED. The heat-shrink tubing will shrink at temperatures of 70 to 100 degrees C.

Danger: Some heat guns are very high temperature. Do not burn yourself.

Start heat-shrinking along the outside of the rib. Then do the inner side of the rib, starting from the edges of the heat-shrink tubing and working toward the center over the LED. When heat is applied to the hole over the LED, the hole will expand, exposing the whole white rectangular body of the LED. You might need to stretch the round hole with your finger so that it fits around the rectangular edge of the LED. Do not touch the soft silicone face of the LED with sharp objects. Figure 17 (right-hand side) shows a rearward LED after the tubing has been shrunk.

NOTE: It takes a little practice to master the technique of mounting LEDs with heat-shrink tubing. You can always cut off the tubing and try again.

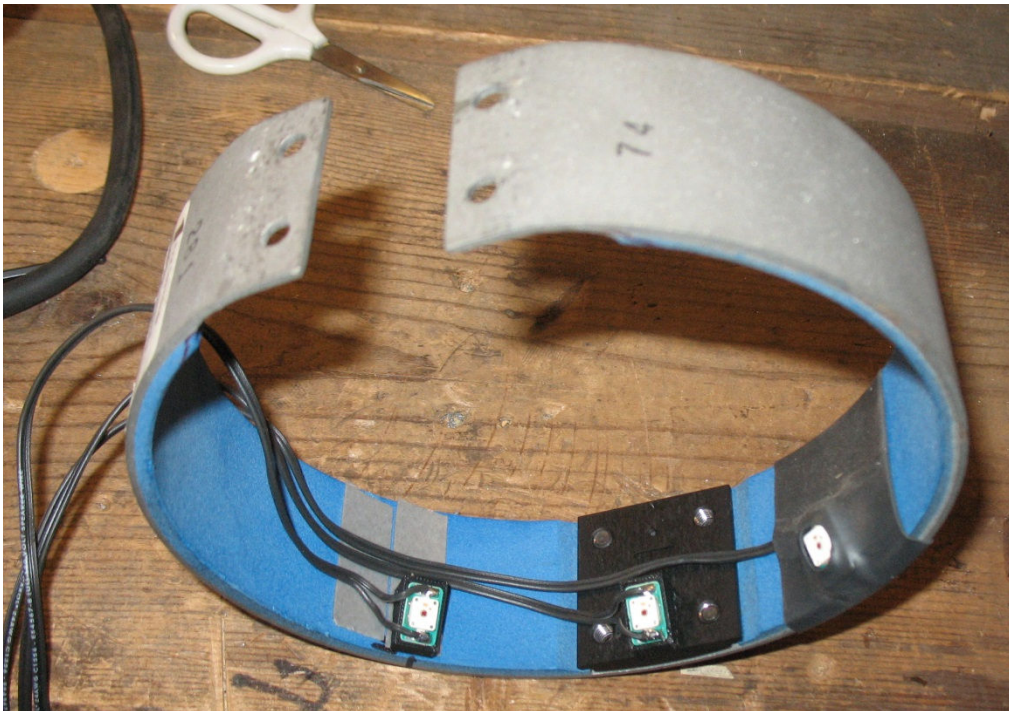


Figure 17. Cable routing for rearward and center LEDs

2.1.3 Mounting center and forward LEDs on the ribs

The next step is to install the center LEDs and route the cables. As noted earlier, the center LEDs are mounted on the inner rib clamp plates, which either have the LED glued onto them or have the LED/angled block screwed into them.

Temporarily install the inner rib clamp with LED assembly using one of the M5 x 12 button-head cap screws. Then place the double-stick tape for the forward LED and route the cables from the center and rearward LEDs as shown in Figure 17 above. Note how the LED cables are routed to avoid crossing in front of any LEDs.

Place the forward LED in position on the double-stick tape and slide a piece of heat-shrink tubing over the LED. The tubing should also cover all three LED cables. Heat-shrink the tubing over the forward LED in the same way described above for the rearward LED. When heat-shrinking is complete, the tubing will hold the LED and the cables in place.

In addition, put nylon zip-ties holding the cables from the forward LED position to where the rib is attached. As an alternative to the zip-ties, you can use short pieces of the heat-shrink tubing to secure the LED cables to the rib.

NOTE: It is important to secure all the cables so that they do not block the light from the LEDs to the sensors during a test.

2.2 Installing the sensors on the spine

NOTE: For customers who will be connecting the RibEye exit cable to Kistler NXT32 DAS systems mounted between the spine plates, you should attach the RibEye exit cable to the NXT32 now. The RibEye exit cable for the NXT32 system (cable number 70020) connects to the last NXT32 in the chain. The last NXT32 is mounted at the top of the dummy's thorax between the spine plates.

To access the connector on the NXT32 interface module, remove the neck adaptor from the top of the thorax by removing the six M6 x 10 flat-head cap screws (three on each side) that hold the neck bracket to the spine plates. You can then plug in the Harwin connector end of the RibEye exit cable to the mating receptacle on the last NXT32 interface module. Replace the neck bracket with the six M6 x 10 screws.

The RibEye's sensor assemblies take the place of the existing rib-to-spine clamps. Each sensor assembly has a front piece that contains the sensor and a base for mounting to the spine. It is the sensor bases that act as the rib clamps.

The sensor bases are installed to the spine's existing rib-mounting holes using four special M5 x 10 flat-head cap screws that have precision-machined shoulders. Figure 18 shows the M5 x 10 shoulder screws. The shoulder screws ensure that the sensor bases are properly aligned to the spine.

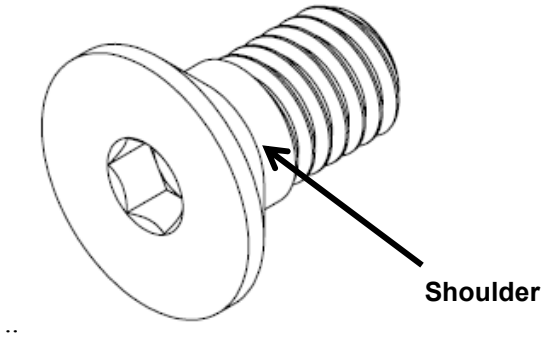


Figure 18. M5 x 10 flat-head cap screw with precision-machined shoulder

The sensor bases have different angles depending on their mounting positions (Table 2).

Table 2. Sensor base part numbers and angles

Rib	Sensor Base Part Number	Base Angle, degrees
Shoulder	10071-11	11
Thoracic 1	10071-0	0 (flat)
Thoracic 2	10071-23	23
Thoracic 3	10071-20	20
Abdominal 1	10071-0	0 (flat)
Abdominal 2	10071-20	20

The sensor bases have a sticker on the inside with the RibEye serial number (S/N), rib number, the rib name, and the screw installation order, as shown in Figure 19. To install the sensor bases, use four shoulder screws. Install the first screw in the upper-left hole (position 1) and tighten the screw loosely – "finger tight", so the base can still rotate about the screw. Next, install the second screw in the lower-right hole (position 2) and tighten the screw finger tight. Then put in screws in positions 3 (upper-right) and 4 (lower-left). Finally, tighten the screws in the order 1-2-3-4.

Figure 19. Sensor base with label

Figure 20 shows the sensor bases mounted to the spine.

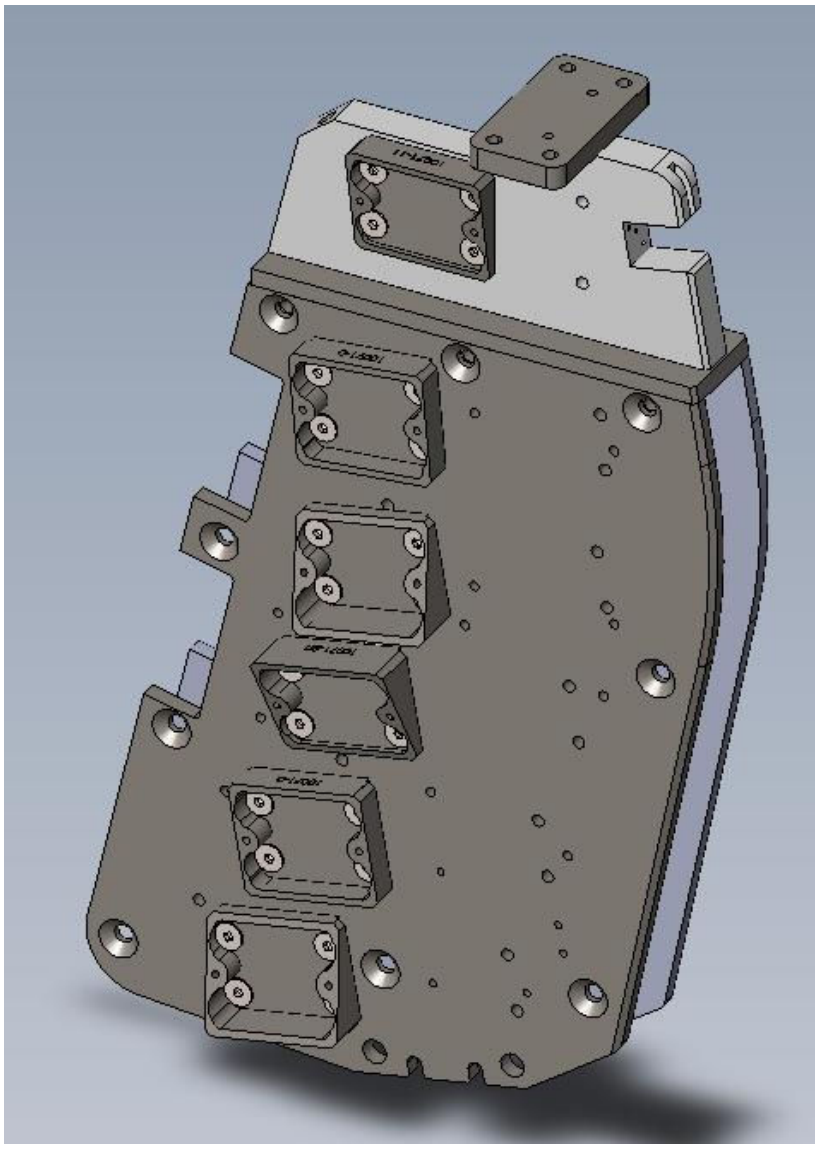


Figure 20. RibEye sensor bases mounted to spine
(ribs not shown)

The sensor front piece containing the electronics and optics (Figure 21) is attached to the sensor base by two M3 x 16 flat-head cap screws. Although the sensor front pieces look identical, each piece is marked with the RibEye serial number (S/N) and the number of the rib that it must be mounted on. The sensor front piece must be installed on that rib.

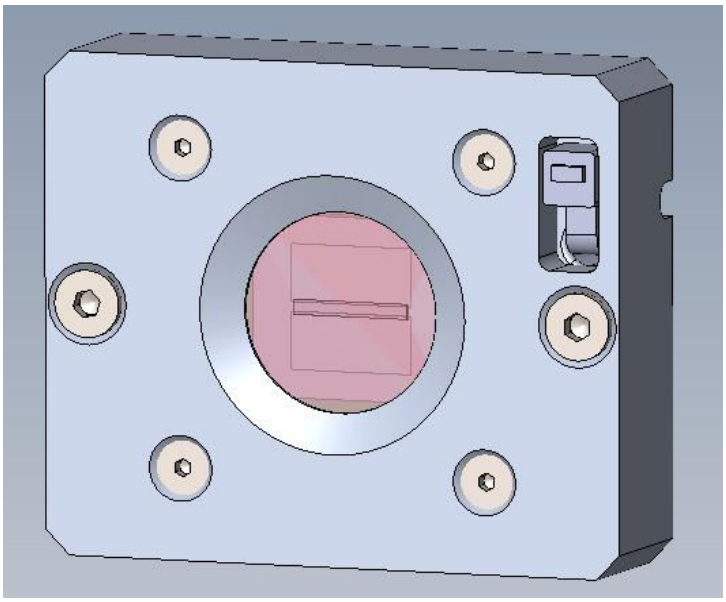


Figure 21. RibEye sensor front piece

WARNING: ***Never remove the sensor printed circuit board or loosen the circuit-board mounting nuts. Doing so will ruin the calibration of the RibEye.***

Figure 22 shows the back side of the sensor front piece with the label showing the rib it must be installed on. Note that the sensor front pieces must be installed so that the cable is oriented to the rear of the dummy for left-side impact (see Appendix B for right-side impact instructions). The sensor has two alignment pins that fit into mating holes on the sensor bases.

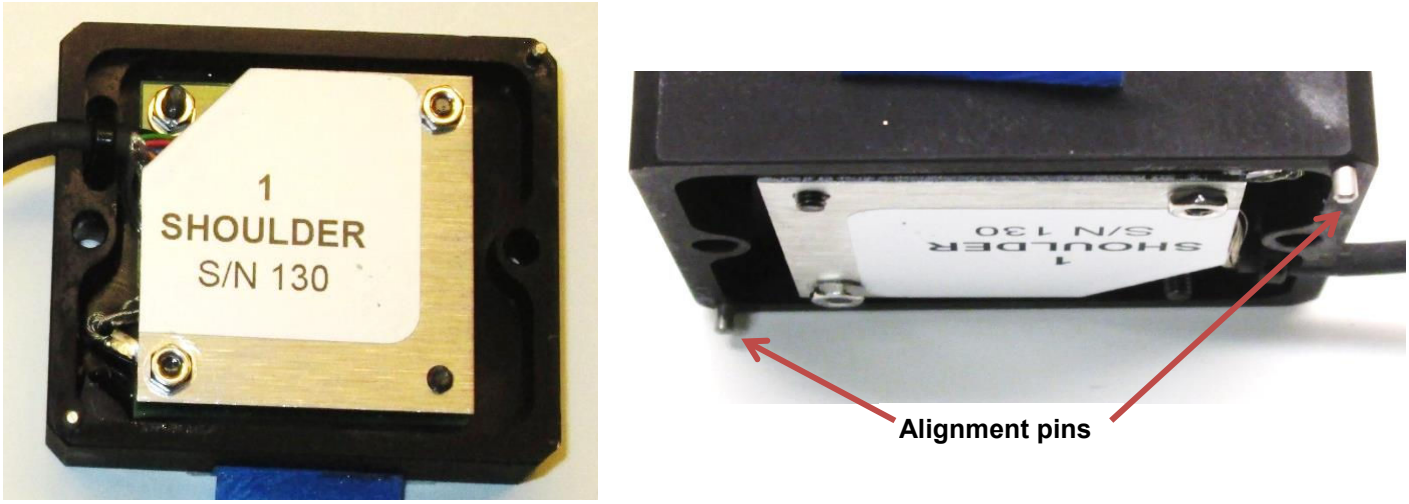


Figure 22. RibEye sensor label on back (left) and alignment pins (right)

Figure 23 shows the spine with the entire sensor assemblies installed (bases and front pieces). However, the sensor front pieces are not mounted to their bases until the ribs are in place inside the dummy (see Section 2.3 below).

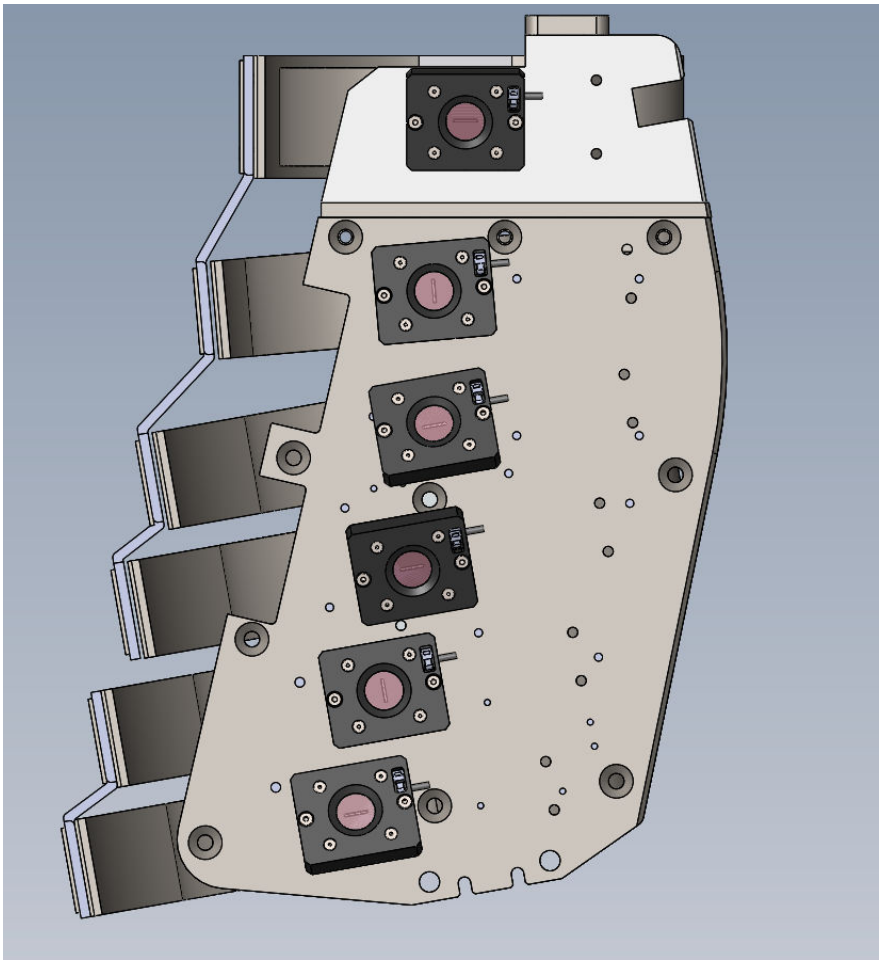


Figure 23. RibEye sensor assemblies mounted to spine
(ribs not shown)

2.3 Order of assembly (LEDs, ribs, and sensors)

1. Mount the LEDs on all of the ribs, as described above in section 2.1.
2. Mount the ribs to the spine starting at the bottom rib (abdominal 2) and working upwards, as follows:
   a. Install the outer rib first
   b. Attach the inner rib to the outer rib
   c. Attach the inner rib and sensor base to the spine
   d. Attach the sensor front piece to the sensor base
   e. Route the sensor cables as described below in section 2.4.

Note again that each sensor base number must match the rib where it belongs, and each sensor front piece must match the rib marked on the back label.

2.4 Sensor cables

Route the sensor cables between the ribs toward the back of the dummy, as shown in Figure 24.
Then route the cables along the inside of the outer ribs toward the dummy's head, as shown in Figure 25.
Zip-tie the cables to the inside of the outer rib as close to the spine plate as possible.

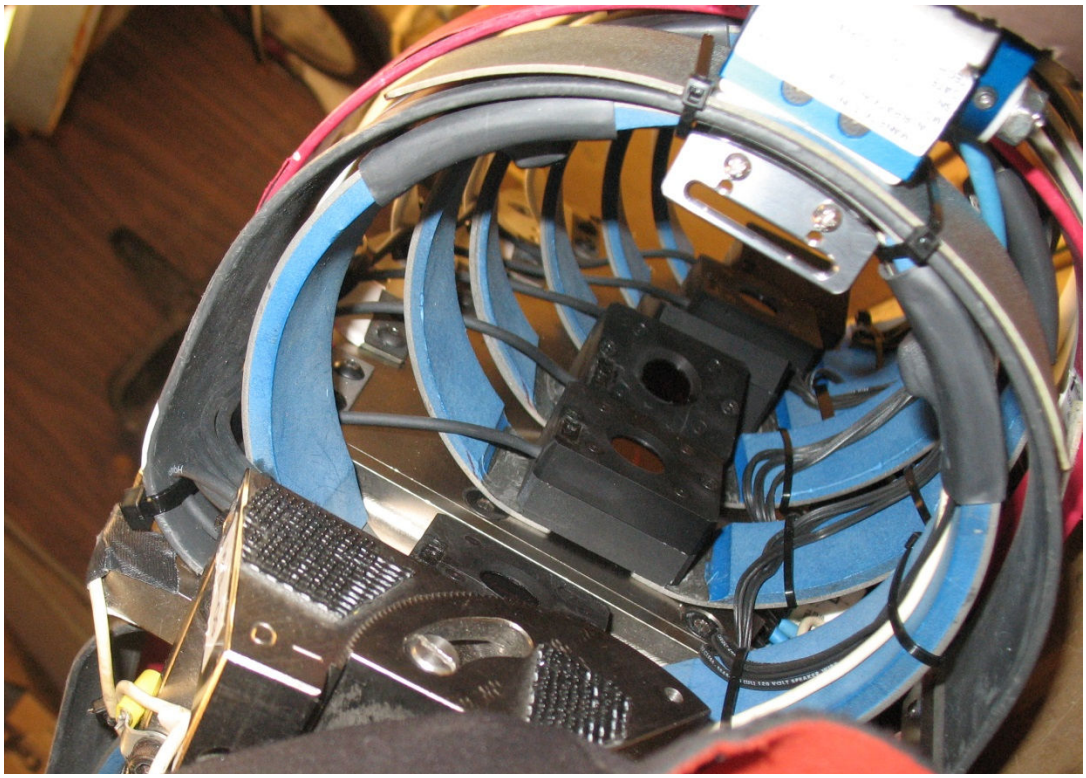


Figure 24. Sensor cables routed to back of dummy

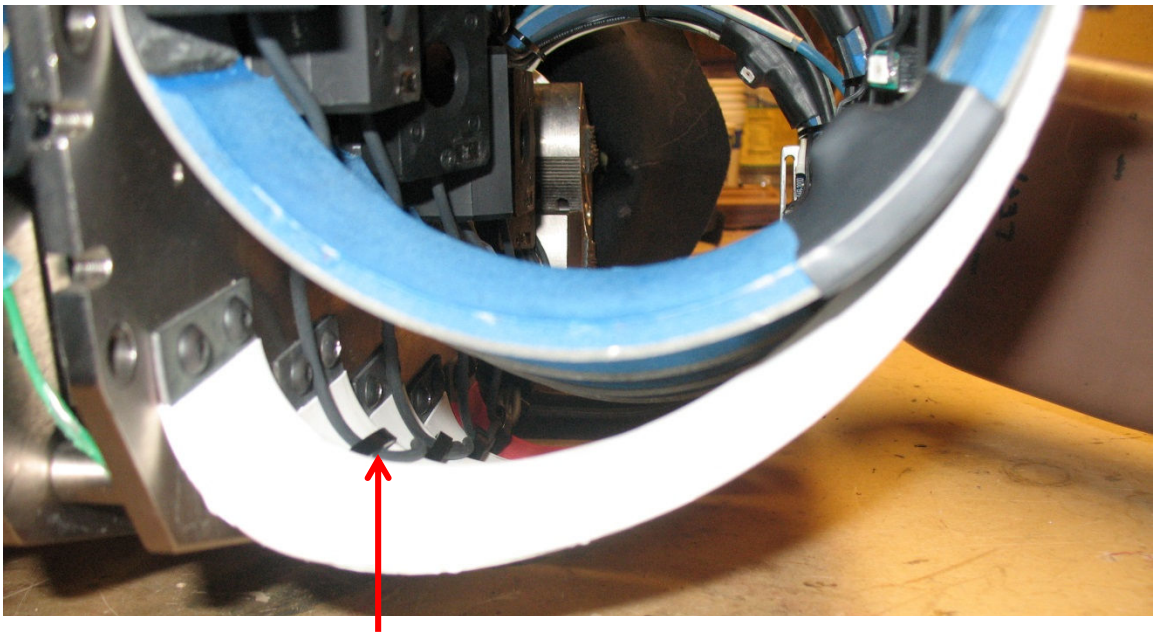


Figure 25. Sensor cables tied to outer ribs near spine plate

The bundle of sensor cables should go above the top sensor and below the bottom of the neck assembly, as shown in Figure 26. On the non-struck side, zip-tie the sensor cables to the shoulder rib.

Figure 26. Sensor cables routed over the top sensor and below the neck assembly

2.5 Controller installation

The RibEye controller is installed on the non-struck side of the dummy. In existing WorldSID dummies, the RibEye controller takes the place of the ballast weight, which is removed. Mounting the controller and attaching the LED cables and dummy exit cable are much easier to do if the four bolts holding the thorax to the pelvis are removed. This opens the gap between the bottom ribs and the top of the pelvis flesh, allowing you to reach in between them. Wires between the thorax and pelvis do not have to be disconnected, but cable ties may have to be removed to provide some slack.

2.5.1 Mounting the adaptor plates

The controller mounts to two adaptor plates that take the place of the rib clamps on the non-struck side of the thoracic 1 rib and the abdominal 2 rib (Figures 27 and 28). The adaptor plates are installed by removing the four rib clamp bolts, removing the rib clamp plates, and then installing the adaptors using four M5 x 10 flat-head cap screws, which are provided with the RibEye.

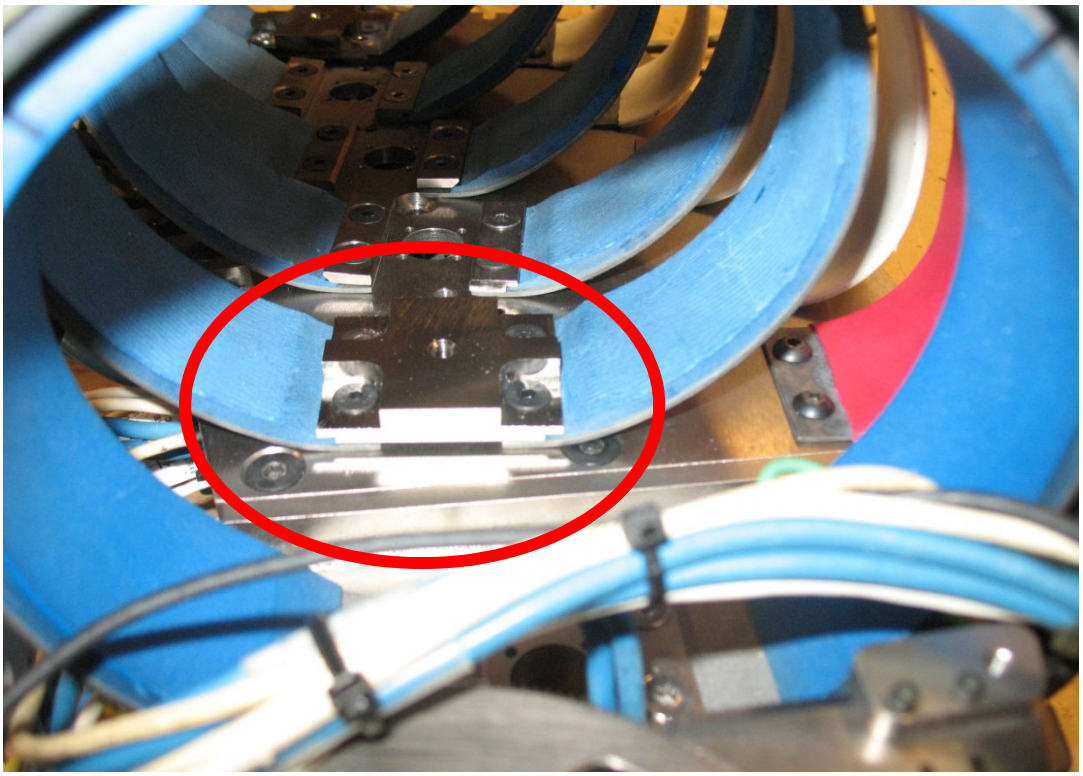


Figure 27. Controller adaptor installed on thoracic 1 rib

Figure 28. Controller adaptor installed on abdominal 2 rib

2.5.2 Removing the controller end covers

The controller is shipped with two covers screwed in place, one at each end (shown previously in Figure 3). The covers protect the connectors for the RibEye sensors on one end (Figure 5) and the connectors for the LED cables, status cable, and dummy exit cable at the other end (Figure 6).

During installation, the two end covers must be removed to allow access to the connectors. Remove the covers by unscrewing two M3 x 50 socket-head cap screws from the top of each cover and two M3 x 10 socket-head cap screws from the end of each cover. Figure 29 shows the locations of the four cover attachment screws on one of the end covers.

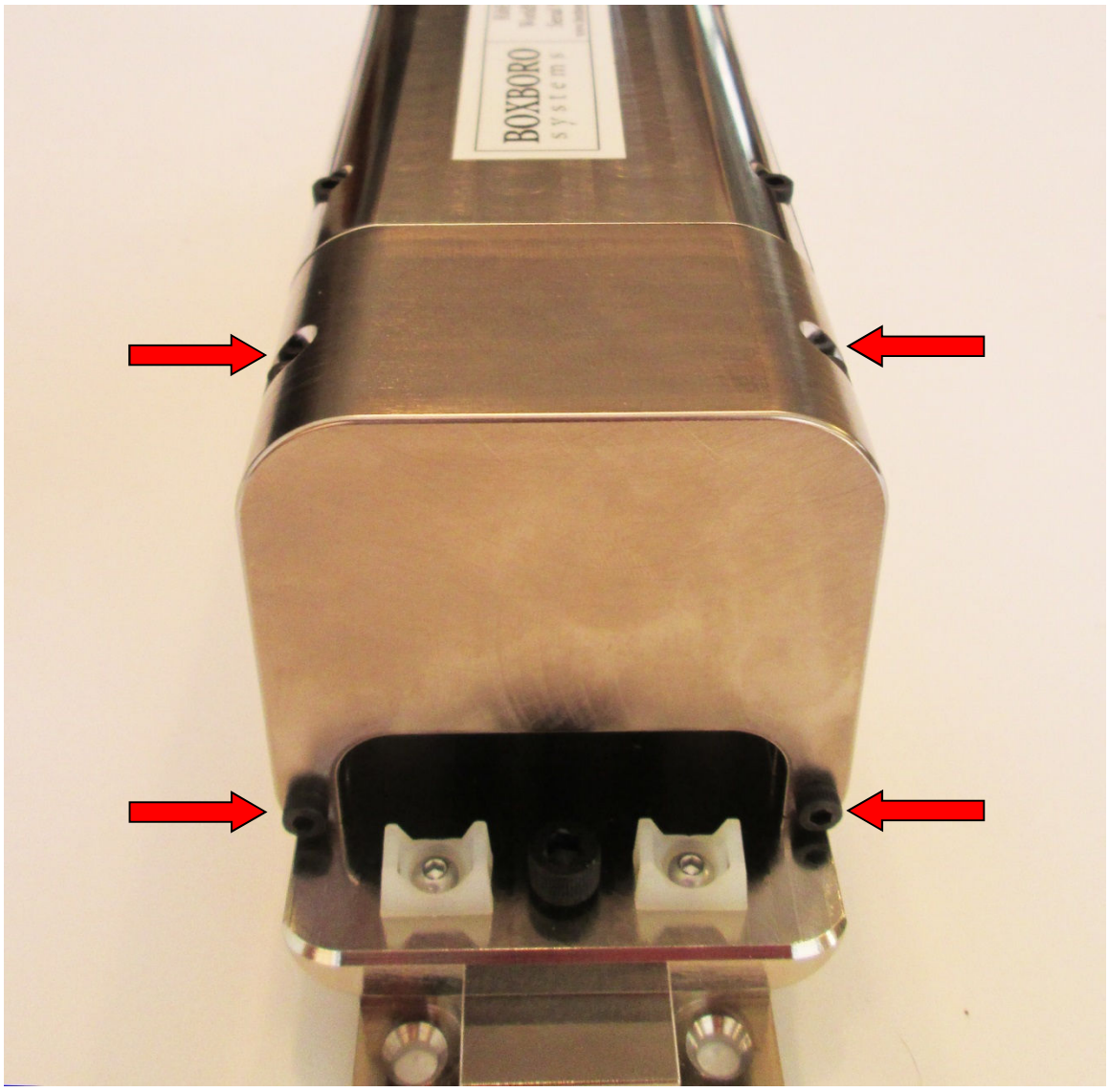


Figure 29. Controller end cover attachment screws

2.5.3 Attaching the controller

When the covers have been removed, slide the controller into the non-struck side of the ribs from the pelvis end of the dummy. The sensor connector panel should be facing toward the dummy's head, and the cable connector panel (connections for LED, status, and dummy exit cables) should be facing toward the pelvis.

The controller is attached to the two adaptor plates on the ribs using two M5 x 16 socket-head cap screws, one at each end, as shown in Figures 30 and 31.

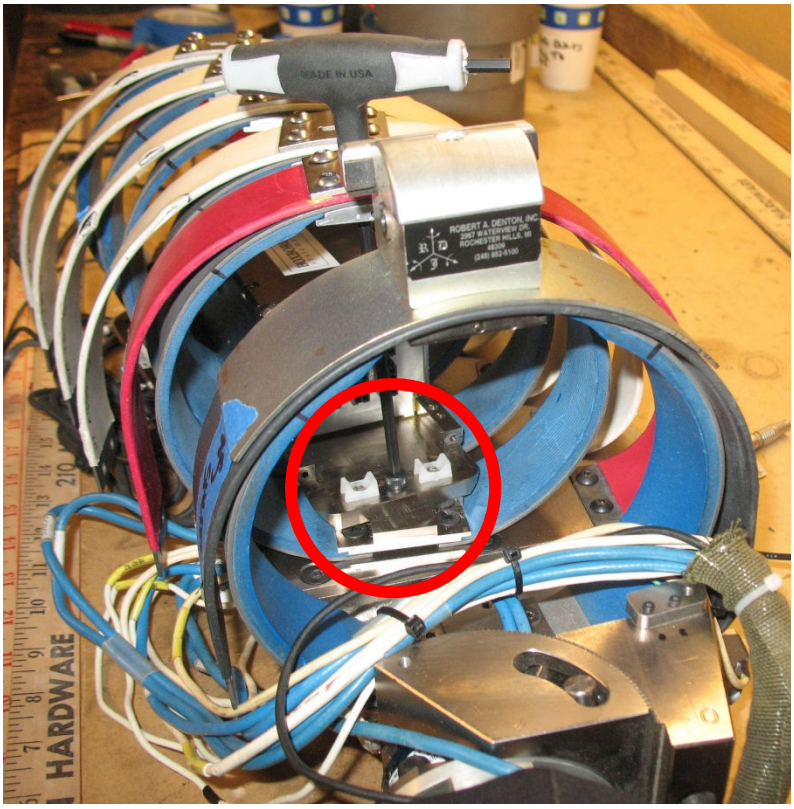


Figure 30. Controller (sensor connector end) attached to adaptor at thoracic 1 rib

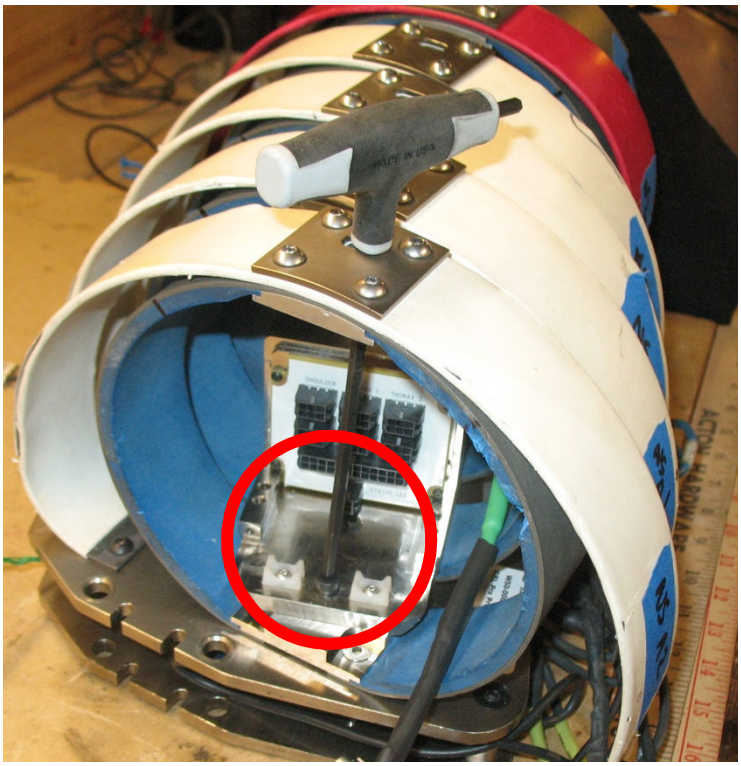


Figure 31. Controller (cable connector end) attached to adaptor at abdominal 2 rib

2.6 Cable routing

2.6.1 Status cable

First, plug in the status cable at the 2-pole connector at the bottom end of the controller. This cable is routed to the outside of the dummy, and has a LED on it that flashes at different rates so you can see that the RibEye is working and what state it is in (see Section 3.2).

2.6.2 Dummy exit cable

The WorldSID RibEye controller, when mounted in the dummy, needs connections for power, trigger, and Ethernet. All external connections to the RibEye controller come from the 24-pole "Exit Cable" connector on the lower end of the controller, shown in Figure 32.

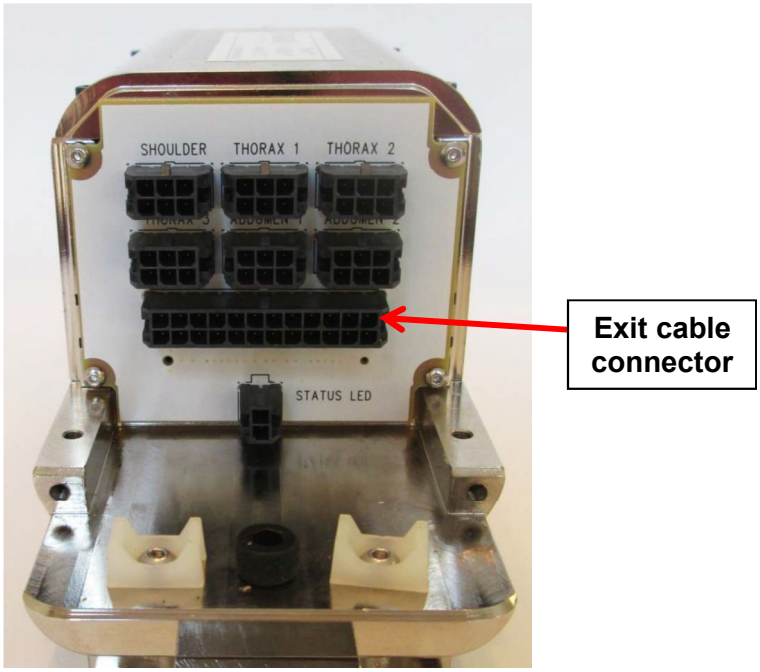


Figure 32. Exit cable connector in RibEye controller

The dummy exit cable's 24-pin Microfit plug should be plugged into the exit cable connector and tied to the strain relief saddle with a nylon zip tie. Boxboro Systems provides several cable options to connect the RibEye controller to the customer's equipment to get power, trigger, and Ethernet connections. You must specify the cable option you need when ordering the RibEye.

For customers with DTS TDAS G5 or Slice in-dummy DAS with external DTS Distributor (see Figure 33)

Exit cable #70011 connects to the RibEye controller at one end and to an extension cable #70200 at the other end. The 70200 is the same extension cable used to connect the G5 DAS units to the DTS distributor. This cable set uses the RibEye high-impedance trigger input compatible with the DTS trigger output.

For customers with Kistler NXT32 in-dummy DAS (see Figure 34)

Exit cable #70020 connects to the RibEye controller at one end and at the other end, to the last NXT32 module in the chain of modules in the dummy. This cable uses the RibEye opto-isolated trigger input compatible with the Kistler CrashLink trigger.

Note: Customers who use CrashLink II with a 48-Volt power supply must use exit cable #70022 and WorldSID RibEye model #600002, which has an internal DC-DC converter.

For customers with other types of internal or external DAS (see Figures 35 and 36)

Separate exit and breakout cables

Exit cable #70025 connects to the RibEye controller at one end and to a breakout cable #70201 at the other end. The breakout cable is terminated in pigtails for power, opto-isolated trigger, and an armed output. The Ethernet connection is a standard RJ45 plug for connecting to an Ethernet hub/switch.

Single exit/breakout cable

Exit/breakout cable #70026 connects to the RibEye controller at one end. The other end is terminated in pigtails for power, opto-isolated trigger, and an armed output. The Ethernet connection is a standard RJ45 plug for connecting to an Ethernet hub/switch.

For customers with Kyowa DAS with external DIS-61A Junction Unit (see Figure 37)

Exit cable #70027 connects the RibEye controller at one end to a #70207 extension cable at the other end. The extension cable plugs into a Kyowa DIS-61A Junction unit.

Note: A Kyowa C-LL61-6 extension cable may be used instead of the #70207 extension cable. However, you can not use the #70207 cable to replace a Kyowa C-LL61-6 cable for connecting to the Kyowa DAS units inside the dummy.

For customers with Kistler DTI DAS with External KiHub or KiDau (see Figure 38)

Exit cable #70028 connects the RibEye controller at one end to extension cable #70208 at the other end. The 70208 cable plugs into a KiHub or KiDau. This configuration uses a WorldSID RibEye with a built-in DC-DC converter so that it can accept CrashLink II 48-Volt DC power.

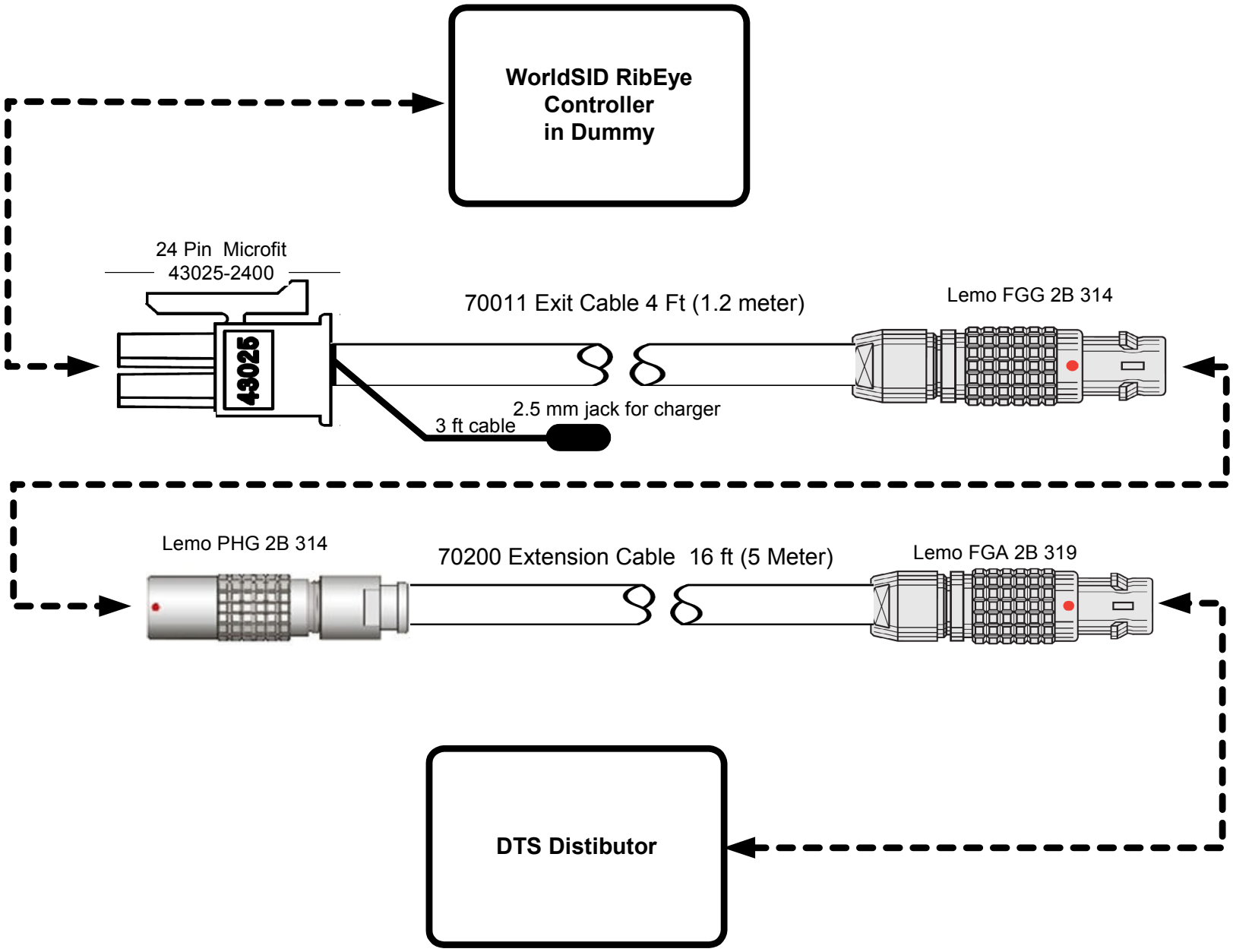


Figure 33. Cable option for DTS DAS – exit cable 70011 and extension cable 70200

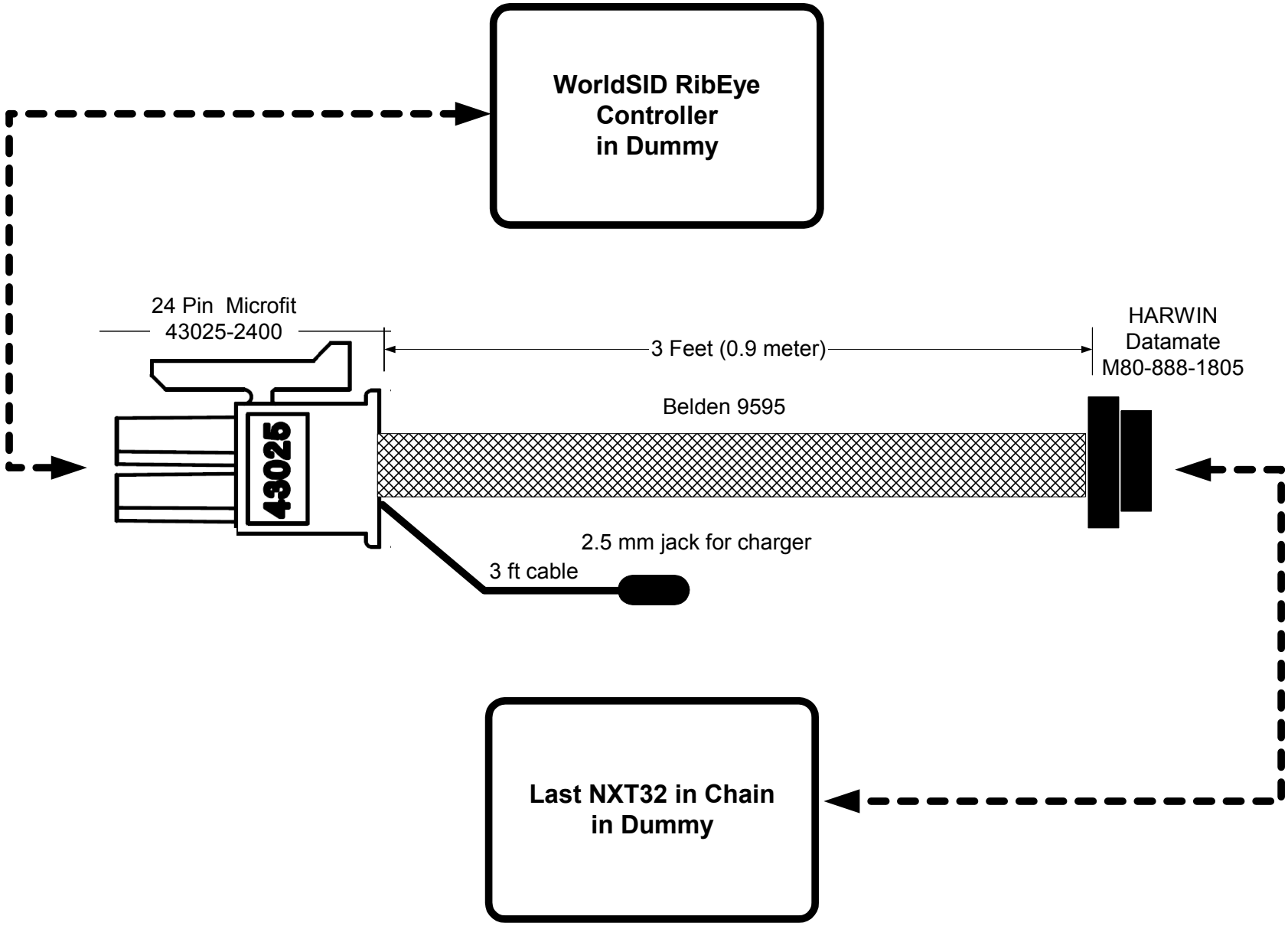


Figure 34. Cable option for Kistler NXT32 DAS – exit cable 70020
(or for 48-Volt systems, exit cable 70022 and RibEye model 600002 with internal DC-DC converter)

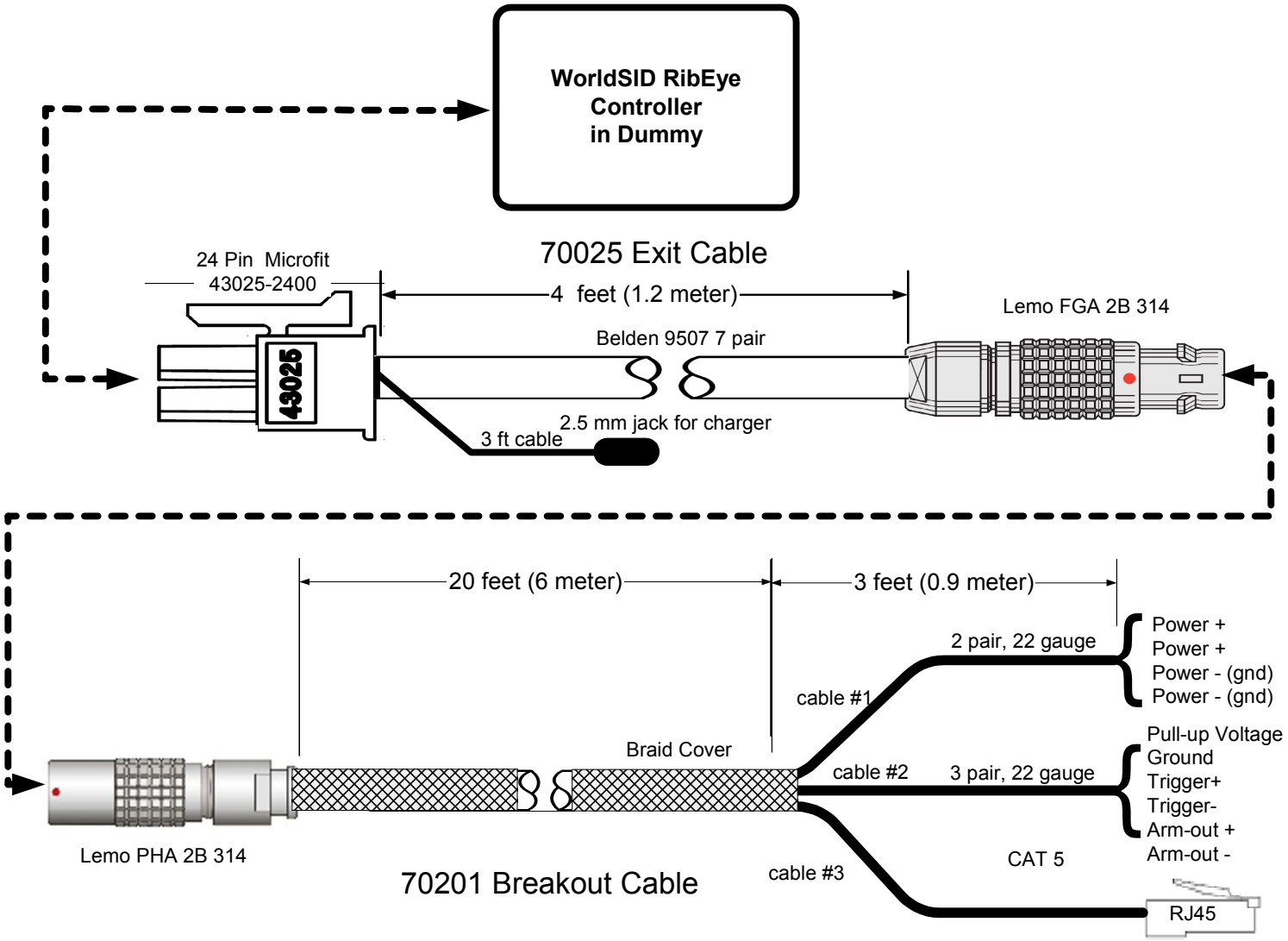


Figure 35. Cable option for generic DAS with separate exit and breakout cables – exit cable 70025 and breakout cable 70201 with opto isolated trigger input and armed output
(see Table 3 below for pigtail connection wire colors)

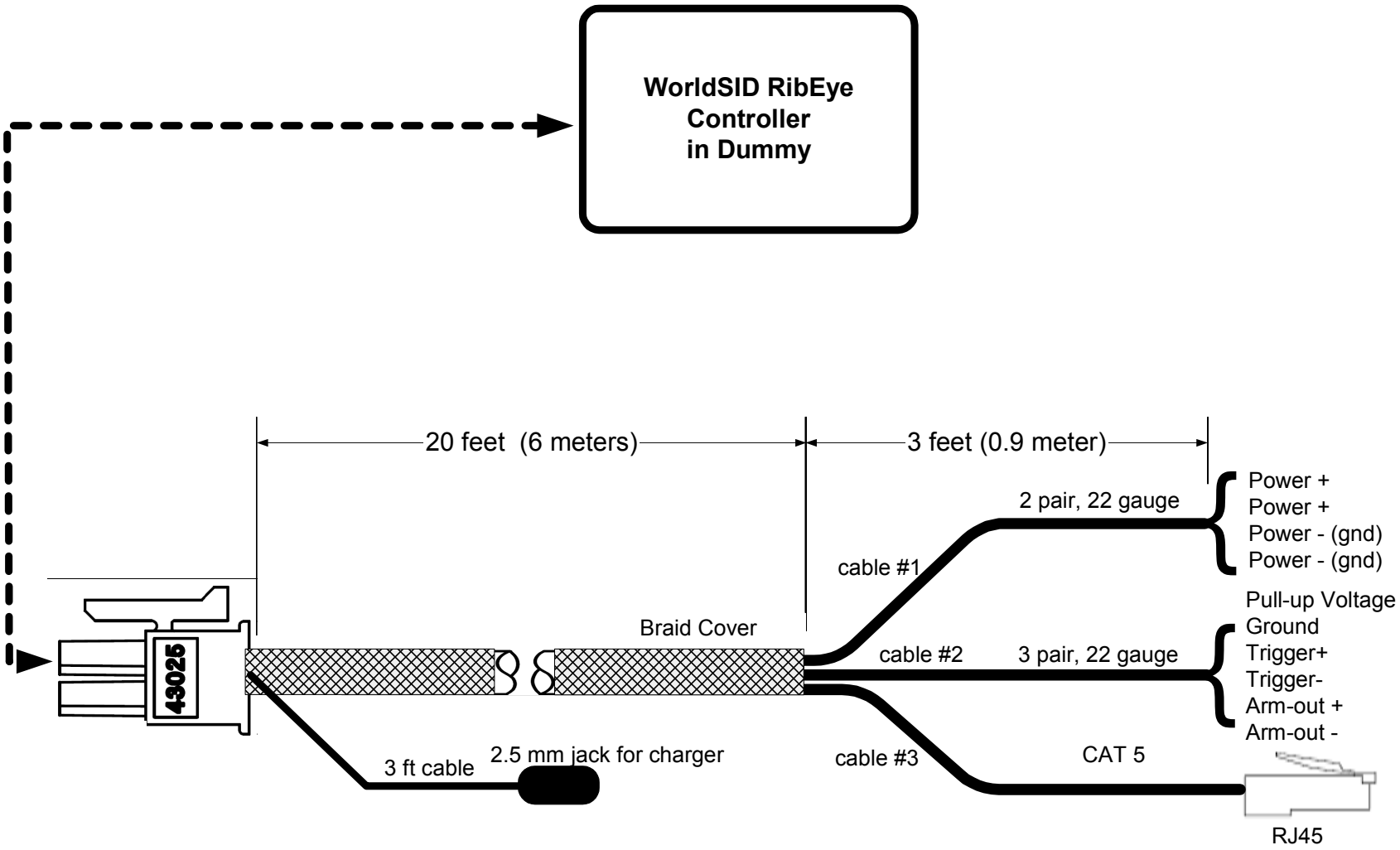


Figure 36. Cable option for generic DAS with single exit/breakout cable 70026 terminating in opto isolated trigger input and armed output
(see Table 3 below for pigtail connection wire colors)

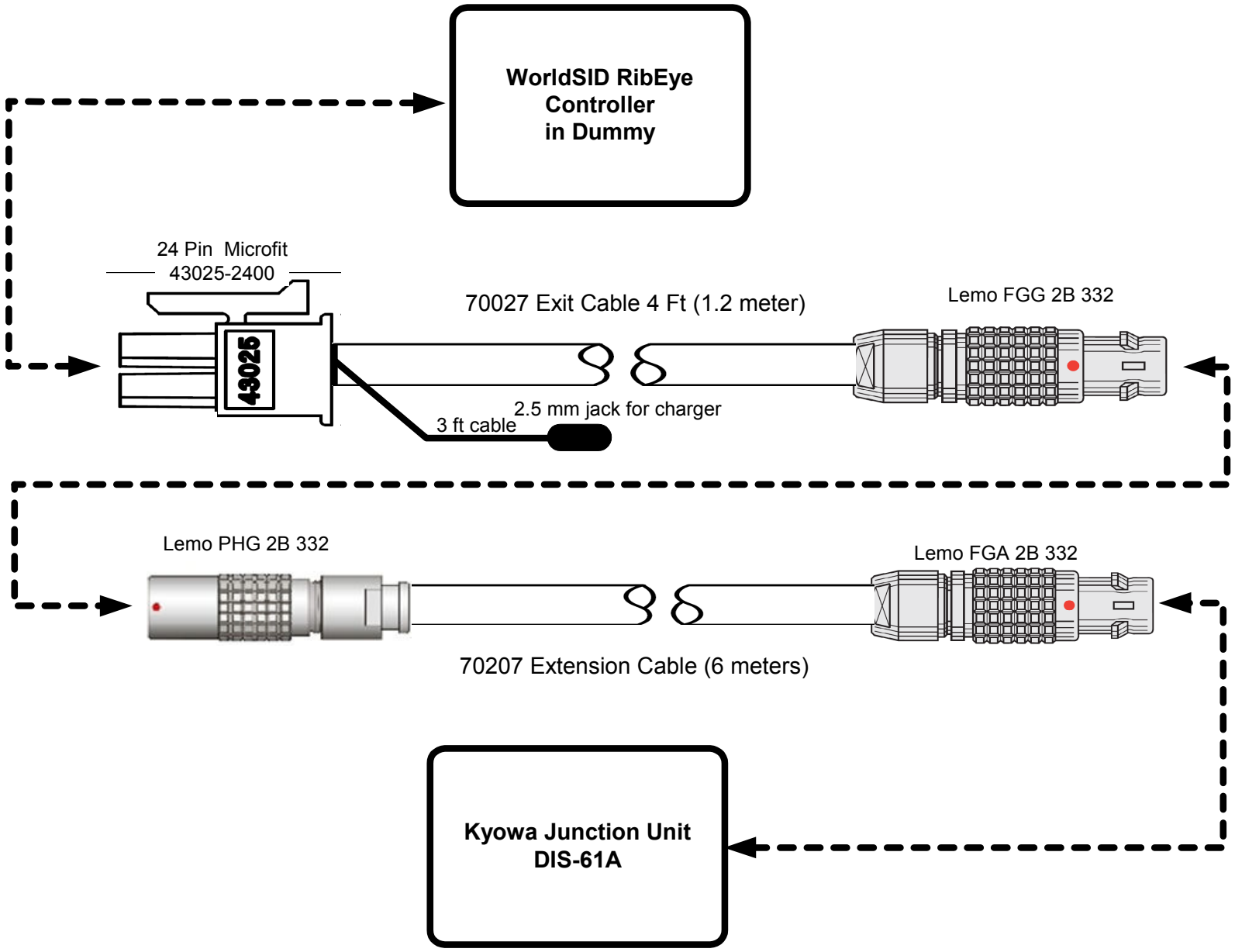


Figure 37. Cable option for Kyowa DAS – exit cable 70027 and extension cable 70207

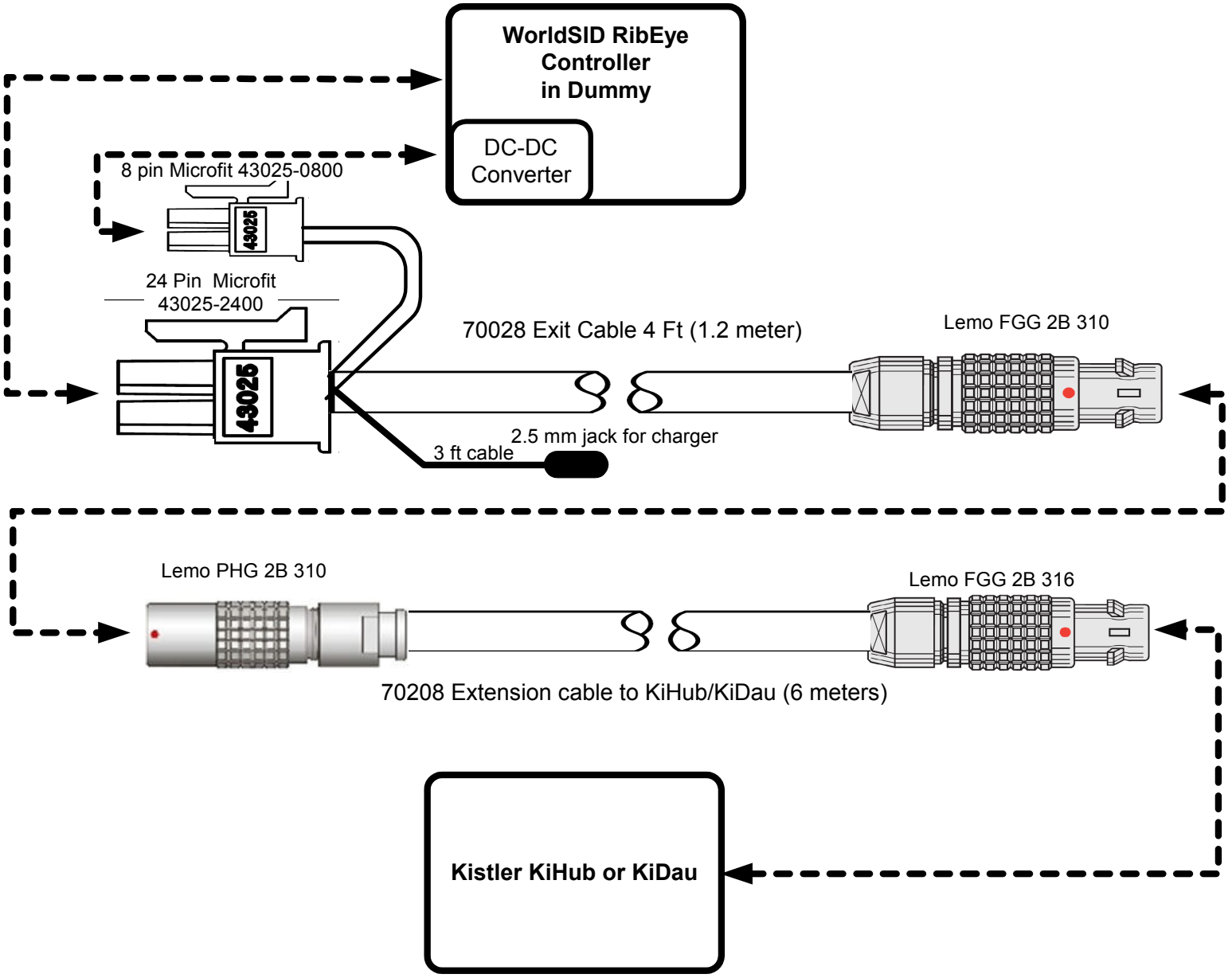


Figure 38. Cable option for Kistler KiHub/KiDau DAS – exit cable 70028 and extension cable 70208

Table 3. Wire colors for breakout cable 70201 and exit/breakout cable 70026

Cable #1 (two-pair)		Cable #2 (three-pair)	
Power+	red	Pull-up Voltage	red
Power+	white	Ground	black (paired with red)
Power– (ground)	black (paired with red)	Trigger +	white
Power– (ground)	black (paired with white)	Trigger –	black (paired with white)
		Arm-out +	green
		Arm-out –	black (paired with green)

2.6.3 LED cables

Route the rib LED cables between the ribs and over the front of the dummy, under the sternum, then downward to the bottom end of the controller. The LED cables exit from the six ribs as follows:

- Shoulder (rib #1): LED cables exit from the bottom of the rib and go between the shoulder rib and the thoracic 1 rib to the non-struck side.
- Thoracic 1 (rib #2): LED cables exit from the top of the rib and go between the shoulder rib and the thoracic 1 rib to the non-struck side.
- Thoracic 2 (rib #3): LED cables exit from the top of the rib and go between the thoracic 1 rib and the thoracic 2 rib to the non-struck side.
- Thoracic 3 (rib #4): LED cables exit from the bottom of the rib and go between the thoracic 2 rib and the thoracic 3 rib to the non-struck side.
- Abdominal 1 (rib #5): LED cables exit from the bottom of the rib and go between the abdominal 1 rib and the abdominal 2 rib to the non-struck side.
- Abdominal 2 (rib #6): LED cables exit from the top of the rib and go between the abdominal 1 rib and the abdominal 2 rib to the non-struck side.

Tie the LED cables together on the non-struck side and tie the cable bundle to the inside of the ribs along the side of the controller. Then plug the connectors into the LED sockets on the bottom end of the controller and zip-tie the bundle to one of the cable tie-downs on the end of the controller. Zip-tie the dummy exit cable and the status cable to the other cable tie-down at the end of the controller.

After all the LED cables and the dummy exit cable are connected, the cover on the bottom end of the controller can be re-installed. Two M3 x 50 socket-head cap screws attach the cover top to the base. Two M3 x 10 socket-head cap screws attach the cover at the end of the controller. The cover screw locations were shown previously in Figure 22.

Plug the sensor cables into the sensor sockets at the top end of the controller. Plug in the cables in the following order:

1. Abdominal 2 rib (cable #6)
2. Abdominal 1 rib (cable #5)
3. Thoracic 3 rib (cable #4)
4. Thoracic 2 rib (cable #3)
5. Thoracic 1 rib (cable #2)
6. Shoulder rib (cable #1)

Zip-tie the cables to the cable tie-downs on the end of the controller (Figure 39). Then re-install the cover on the top end of the controller using two M3 x 50 socket-head cap screws and two M3 x 10 socket-head cap screws.

Figure 39. Sensor cables tied to controller

3.0 RibEye Operation

This section describes the operation, coordinate systems, and connections used in the RibEye. The RibEye for the WorldSID can be mounted on either side of the dummy to measure left-side or right-side impacts. If the RibEye will be used for right-side impacts, it must be calibrated for the right side. When ordering the RibEye, specify left, right, or both side impacts.

Please refer to the RibEye Software User Manual for software details and instructions on how to change the RibEye network's IP address. The manual is included on the USB thumb drive shipped with the RibEye and can also be downloaded from our website, www.boxborosystems.com.

3.1 Data coordinate systems

As noted earlier, two sets of three sensors monitor the LED positions. The top set of sensors monitors the red LEDs mounted on the first three ribs (shoulder, thoracic 1, and thoracic 2). The bottom set of sensors monitors the blue LEDs mounted on the lower three ribs (thoracic 3, abdominal 1, and abdominal 2).

Position data from each sensor set is reported with respect to a coordinate system that has its origin in the center (middle) sensor of each set (Figure 40). For both upper and lower rib sets, the origin of the coordinate system is 21 mm from the face of the spine plate in the Y direction.

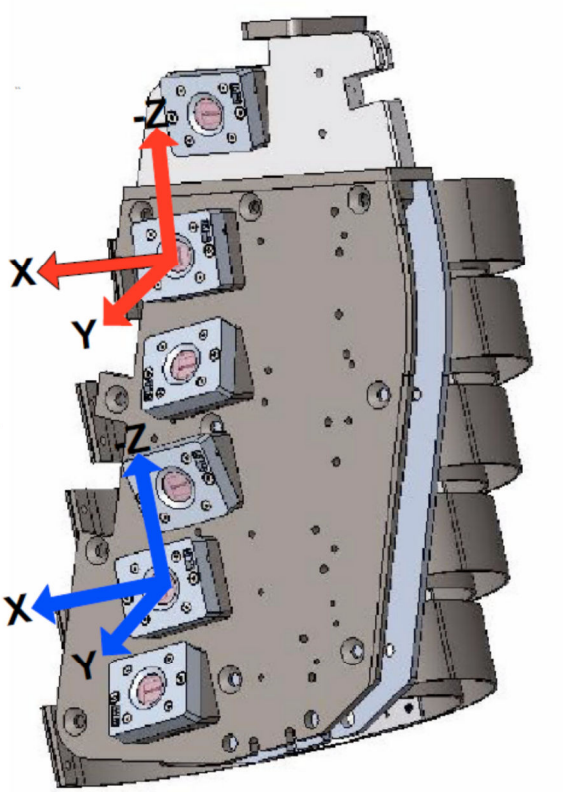


Figure 40. RibEye coordinate system

For the top three ribs –

- The center of the coordinate system is the center of the inside face of the lens in the sensor mounted on the thoracic 1 rib. (Note that the inside face is 2 mm from the outside face.) The X-axis is parallel to the rib, the Y-axis is perpendicular to the spine plate, and the Z-axis is perpendicular to the rib.
- The shoulder rib center in the X direction is 19.86 mm to the rear of the thoracic 1 rib
- The thoracic 2 rib center in the X direction is 4.72 mm to the front of the thoracic 1 rib.

For the lower three ribs –

- The center of the coordinate system is the center of the inside face of the lens in the sensor mounted on the abdominal 1 rib. The X, Y, and Z axes are the same as for the upper sensor set (X parallel to the rib, Y perpendicular to the spine plate, and Z perpendicular to the rib).
- The thoracic 3 rib center in the X direction is 20 mm to the rear of the abdominal 1 rib
- The abdominal 2 rib center in the X direction is 20 mm to the front of the abdominal 1 rib.

Note: The X offsets from rib centers defined above are for the WorldSID RibEye mounted for left-side impact. For right-side impact RibEyes, simply change the sign of the X offsets ("to the rear" becomes "to the front", and vice versa).

For R&D testing, the LEDs can be placed anywhere within the RibEye's measurement range (see Appendix A-1). For example, a user could place nine LEDs on a single rib to show the shape of the rib.

3.2 Status indicator

The status light flashes at varying rates to indicate that the RibEye is operating and what it is doing:

- 0.5 Hz = idle with data in memory
- 1.0 Hz = idle with memory erased
- 2.0 Hz = acquiring data
- 5.0 Hz = storing data in NOR flash memory
- 10 Hz = erasing flash memory or downloading data
- 20 Hz = writing to SD card flash memory

3.3 Ethernet link and activity lights

There are two lights on the side of the controller. The green light is the Ethernet link light, and the orange light is the Ethernet activity light.

3.4 Batteries and chargers

There is one battery pack in the RibEye controller enclosure. It can be accessed by removing the top cover of the controller. Figure 41 shows the battery pack inside controller with the top cover removed (and end covers also removed).

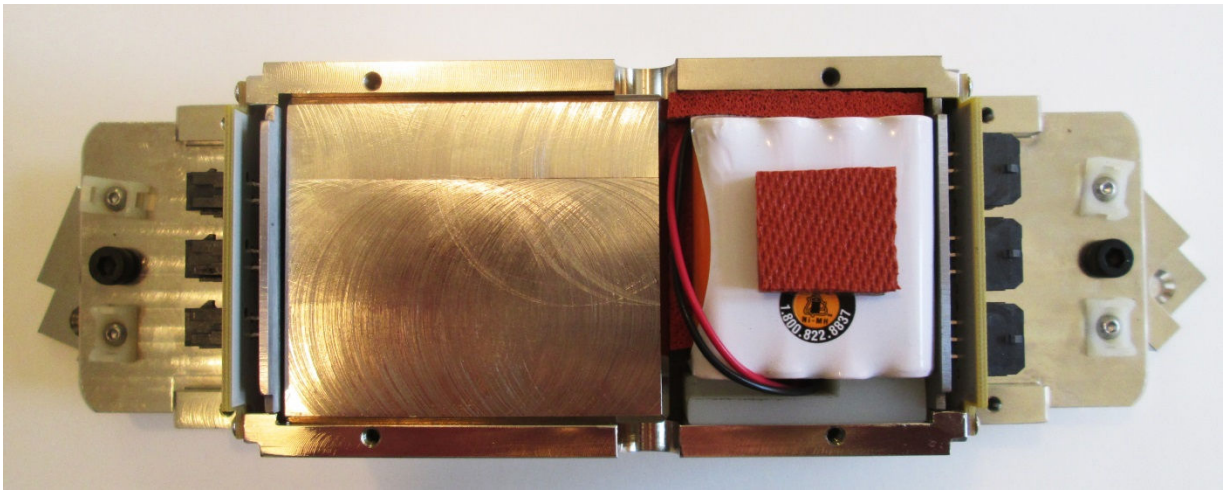


Figure 41. Battery pack

The RibEye battery pack consists of 12 AAA NiMH batteries. It is plugged directly into the controller with a connector under the white nylon spacer. The RibEye batteries are turned on only when the RibEye is armed or storing collected data to flash memory. They will provide a minimum of 20 minutes of run-

time. Whenever the charger is plugged in, the RibEye will automatically disconnect the batteries from the RibEye circuits to allow the charger to function properly, even if the RibEye is armed.

The charger for the RibEye battery pack is a Cell-Con Model 452115-01071-3311. A LED on the charger indicates its current mode, as shown in Table 4. Figure 42 shows the charger and the exit cable charger receptacle. Please refer to the Cell-Con Manual, which is supplied with the charger, for information on safety, operation, maintenance, etc.

Table 4. Cell-Con battery charger modes

LED Color	Mode
Orange	Battery not connected
Orange	Battery initialization and analysis (7 seconds)
Red	Fast charge
Green with intermittent orange flash	Top-off charge
Green	Trickle charge
Alternating Red-Green	Error

Figure 42. RibEye battery pack Cell-Con charger and exit cable charger receptacle

3.5 Error codes

If the RibEye cannot calculate a LED position, the software will insert error codes in the data. If an error code occurs, data from all three axes, X, Y, and Z, will be forced to the same error code.

Usually error codes occur when the light from a LED is blocked and cannot reach one of the sensors. Typically, this results when a loose cable gets between the LED and the sensor. Also, if the center rib on either set of three ribs compresses significantly more than the upper or lower ribs of the set, it can block the light from the upper or lower rib LEDs to one of the sensors. Too much ambient light can also cause the RibEye to generate error codes.

If an error code occurs, you must discount the data for a few milliseconds before and after the drop-out in the plots. Before and after the light is completely blocked, the obstacle partially blocks light, which confuses the sensor and causes bad data to be reported. That's why a few milliseconds of data must be discounted before and after the blockage and drop-out.

NOTE: ***The error codes can get masked by filtering the data. Therefore, we strongly recommend reviewing and saving a copy of the unfiltered data so that the error codes are preserved.***

The error codes for each sensor set are as follows:

1. The top sensor is blocked or sees too much ambient light
2. The bottom sensor is blocked or sees too much ambient light
3. Both top and bottom sensors are blocked or see too much ambient light
4. The middle sensor is blocked or sees too much ambient light
5. The middle and top sensors are blocked or see too much ambient light
6. The middle and bottom sensors are blocked or see too much ambient light
7. All three sensors are blocked or see too much ambient light
8. A divide-by-zero condition occurred in the data processing
9. Out of range error.

The out-of-range error, code 9, occurs when the data from the sensor goes beyond the end of a calibration curve, indicating that the LED moved significantly out of the RibEye's guaranteed range.

To verify that a LED has moved out of range, create X-Y or Z-Y plots of the RibEye's absolute data and overlay the range limits on the plot. An example is shown below in Figure 43. RibEye software 5.2 or later will generate X-Y and Y-Z plots with the RibEye range overlaid.

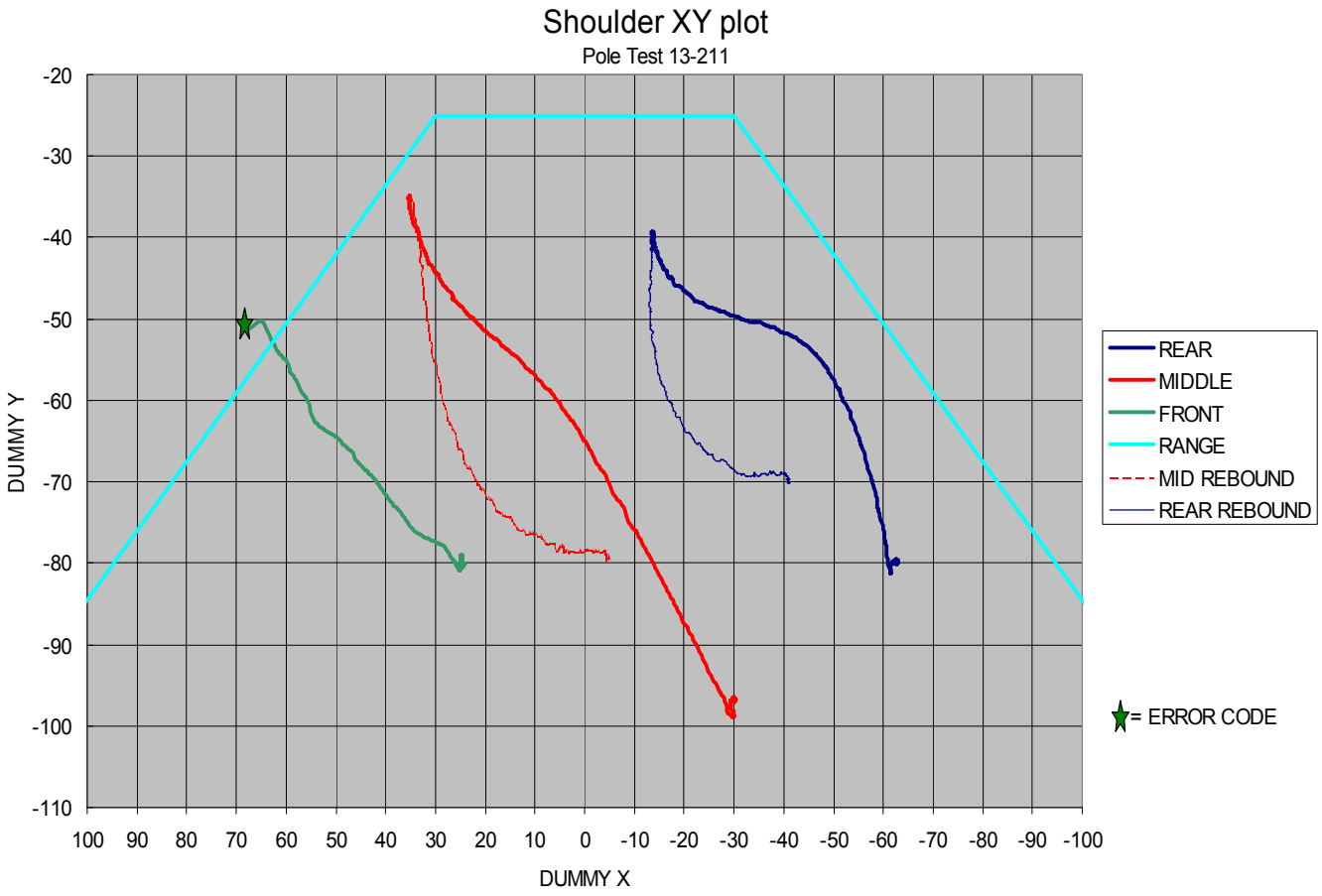


Figure 43. Plot overlay verifying whether LED moved out of range

4.0 RibEye Maintenance

The only maintenance required for the RibEye is to keep the sensor lenses clean.

A dirty camera lens will create a fuzzy photo, and smudged eyeglasses will distort vision. The same holds true for RibEye: If the lenses are not clean, the data will be less accurate.

Make sure that the lenses are clean before each and every test.

If the lenses need to be cleaned, follow this procedure:

1. Blow dust off the lenses with clean, dry air.
2. If there is grease or dirt on the lenses, clean them with eyeglass or camera-lens cleaning solution and lens cleaning paper or a lens cleaning cloth. You can also use isopropyl alcohol (70 vol %).
3. Make sure there is no residue from the cleaning solution remaining on the lens.

WARNING: ***DO NOT USE cotton-tipped swabs like Q-Tips. They leave fibers on the lens.***

Note: If you can't get enough light into the thorax to see the lenses well, you can arm the RibEye to turn on the LEDs.

DANGER: ***Do not look directly at the LEDs, as they are very bright.***

Also clean the inside of the dummy to remove all loose debris such as dirt, pieces of foam, and zip-tie ends. Any objects, even very small, that are flying around inside the dummy during a test can interfere with the light from the LEDs to the sensors, causing spikes in the data.

WARNING: Never remove the sensor printed circuit board or loosen the circuit-board mounting nuts. Doing so will ruin the calibration of the RibEye.

4.1 Dummy maintenance for RibEye

The inside of the thorax must be kept clean. Dirt and other particles can fly though the field of view between the LEDs and the sensors during a test, causing data spikes and anomalies. We recommend vacuuming or blowing out the thorax to remove and loose particles.

Appendix A. RibEye Specifications and Cable Details

A-1. Measurement accuracy and range

The RibEye meets the requirements of SAE J211/1 (July 2007) as a combined sensor and data acquisition system. It also meets the ISO 6487-2000 specifications.

Figure A1 shows the RibEye measurement range in the X-Y plane for all six ribs. The plot also shows the LED positions.

Figure A2 shows the RibEye measurement range in the Y-Z plane for the upper set of three ribs (shoulder, thoracic 1, and thoracic 2). The plot also shows the LED positions for all of the upper three rib LEDs.

Figure A3 shows the RibEye measurement range in the Y-Z plane for the lower set of three ribs (thoracic 2, abdominal 1, and abdominal 2). The plot also shows the LED positions for each of the lower three rib LEDs.

The maximum error for the Y and Z data is less than 1 mm, and the maximum X error is less than 1.5 mm.

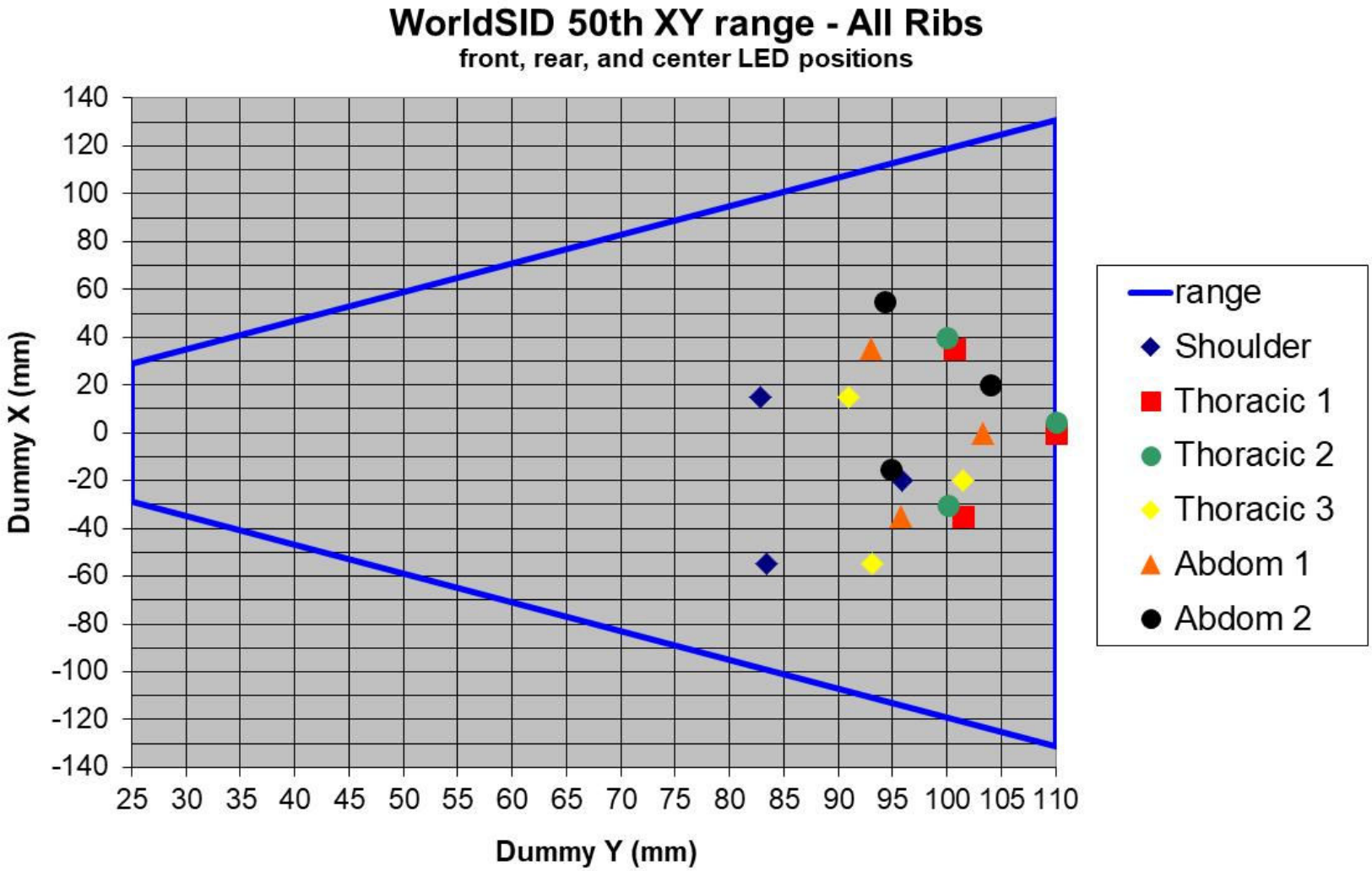


Figure A1. RibEye measurement range in X-Y plane – all ribs

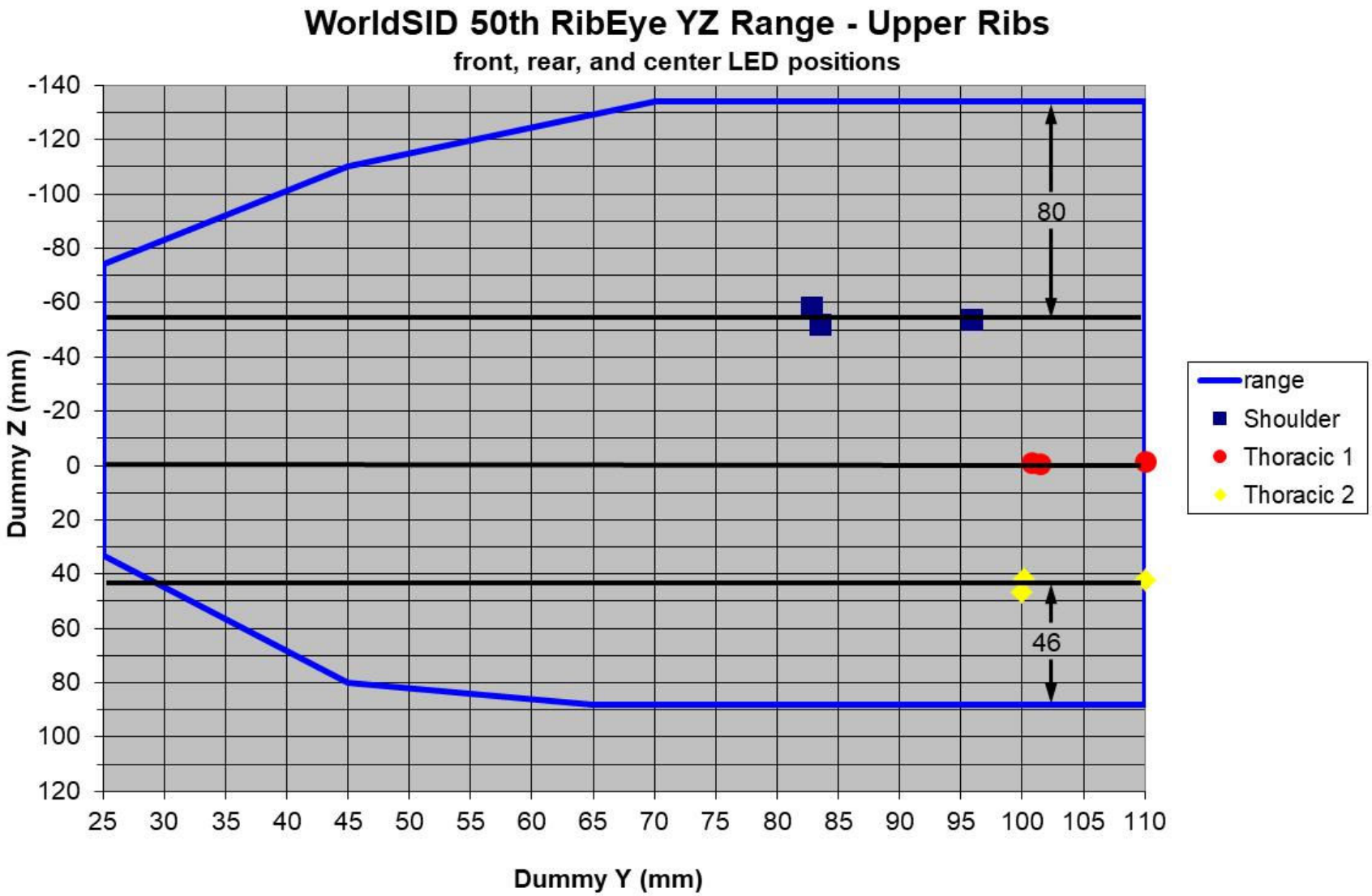


Figure A2. RibEye measurement range in Y-Z plane – upper three ribs

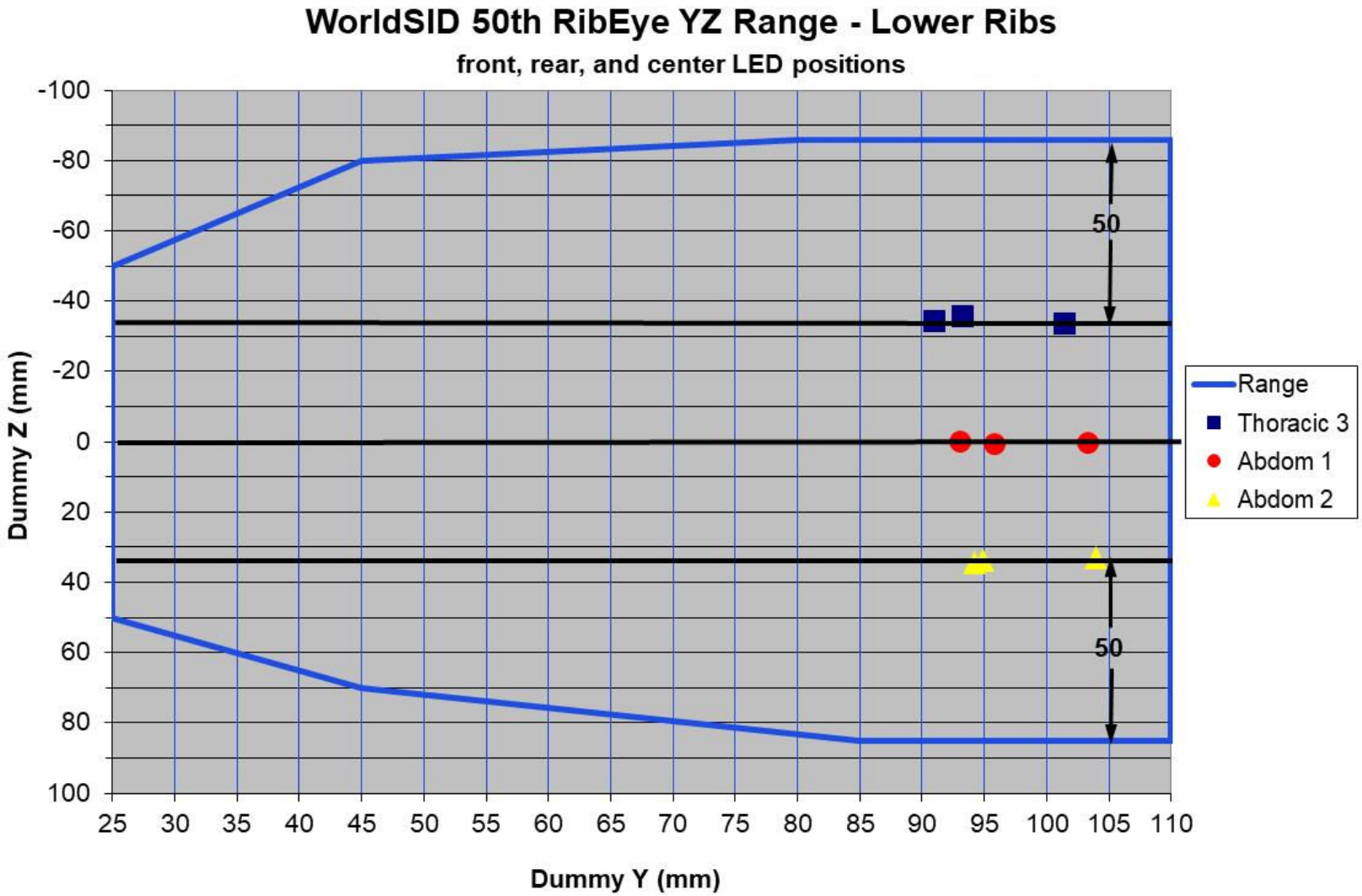


Figure A3. RibEye measurement range in Y-Z plane – lower three ribs

A-2. Power requirements

The RibEye model 600001 can be powered by a high-quality DC voltage source from 12 to 36 Volts. RibEye model 600002 has a built-in, isolated DC-DC converter that can accept 12 to 60 Volts DC. At idle, the RibEye draws 8 Watts. When collecting data, it draws 12 Watts typically and up to 20 Watts maximum. If all LEDs were blocked and driven to full power, the RibEye could draw up to 40 Watts.

When the batteries are fully charged, the backup battery pack can power the RibEye while collecting data for at least 20 minutes. After running the RibEye on batteries for 20 minutes, it will take about 2 hours to fully recharge the batteries.

The RibEye controller has a self-resetting polymer fuse on its power input. If this fuse ever opens, it can take up to 4 hours to self-reset.

A-3. Data acquisition and storage

Data is collected to RAM memory and stored post-test in flash memory.

Sample rate: 10,000 samples per second per LED (10 kHz)

Modes: Linear or circular buffer

Total acquisition time: 25 seconds

Data storage:

- 25 seconds in RAM
- 25 seconds in SD card flash (non-volatile)
- 1.7 seconds in backup flash (non-volatile)

A-4. Ethernet communication

Communication between the RibEye and the PC software is via 10/100 MBS Ethernet. The IP address can be set by the user. (Factory default = 192.168.0.240.)

Please refer to the RibEye Software User Manual for software details and instructions on how to change the RibEye network's IP address. The software manual is included on the USB thumb drive shipped with the RibEye and can also be downloaded from our website, www.boxborosystems.com.

The RibEye communicates with the PC software using port 3000. An open protocol is used to send commands to the RibEye and to receive data. See the RibEye Communications Protocol document on our website for more information.

A-5. Trigger circuits

The trigger circuit can be configured for a variety of options including a high-impedance input or a lower impedance, optically isolated input. Please contact Boxboro Systems for your requirements.

Figure A4 shows the generic trigger circuit inside the RibEye controller.

Figure A5 shows the trigger input configured for connection to an external DTS Distributor using Boxboro Systems cable #70011 and extension cable #70100.

Figure A6 shows the trigger input configured for a Kistler NXT32-supplied trigger using Boxboro Systems cable #70020.

Figure A7 shows the trigger input configured for generic pigtail cable assembles using Boxboro Systems exit cable #70025 and breakout cable #70201 or Boxboro Systems exit/breakout cable #70026.

Figure A8 shows a trigger switch wiring example for the generic pigtail assemblies.

A-6. Armed-out circuit

Boxboro Systems exit cable #70025 and breakout cable #70201 or exit/breakout cable #70026 have an "Armed-out" signal that turns on when the RibEye is armed and turns off when the RibEye has completed storing the data for the test in flash memory.

Figure A9 shows the armed-out circuit.

Figure A10 shows an example of how to wire an indicator light to the armed-out circuit.

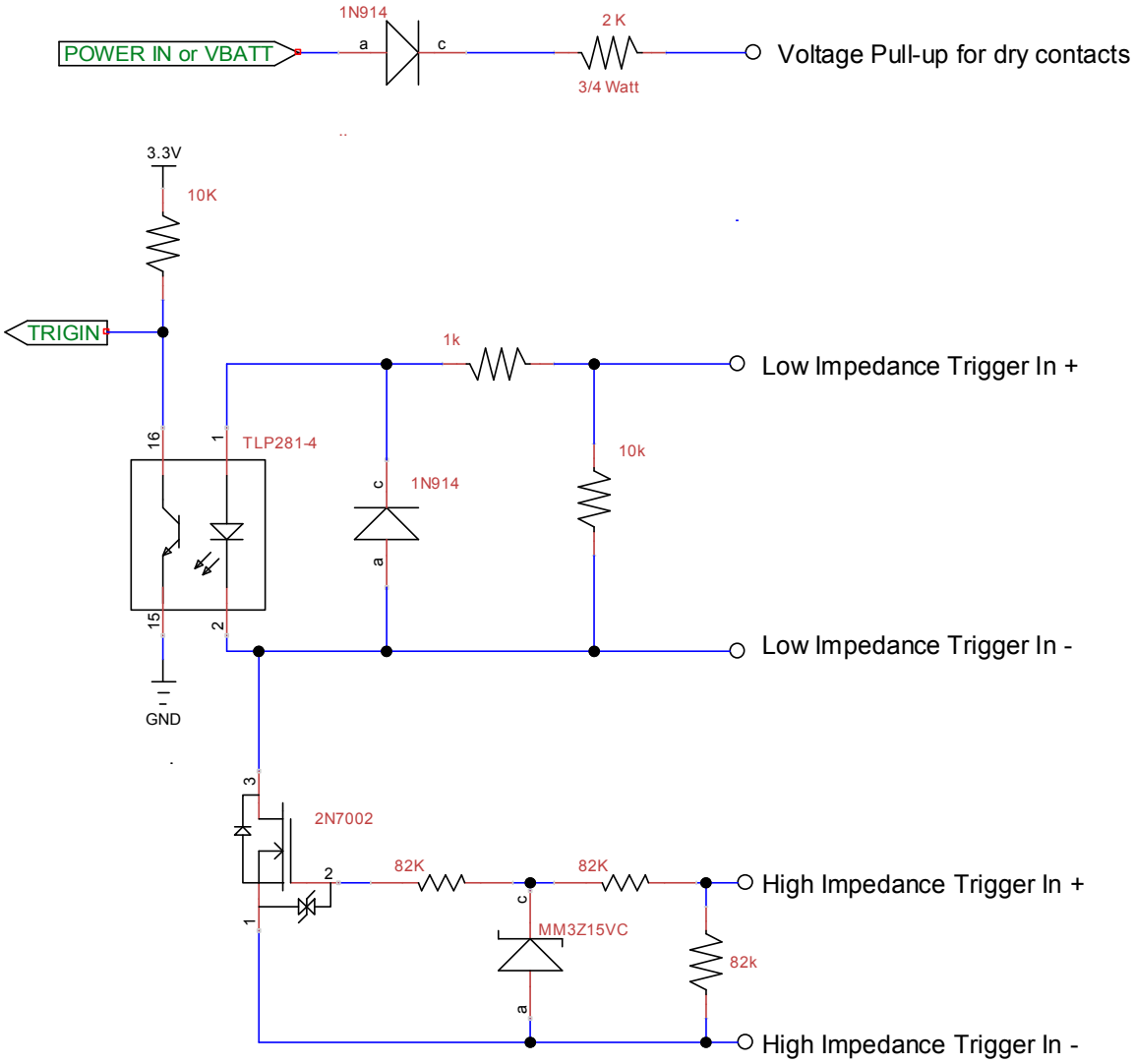


Figure A4. Trigger input circuits

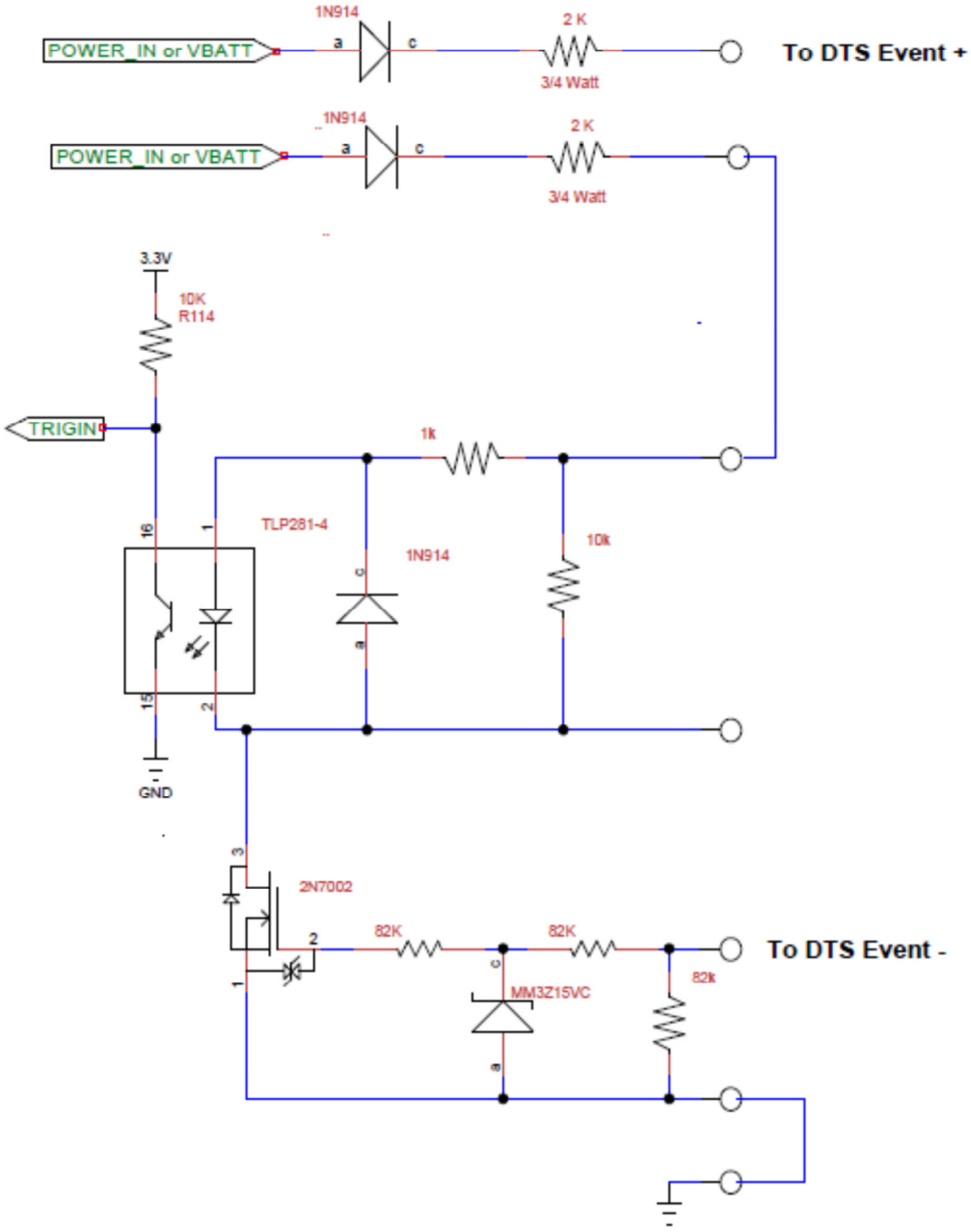


Figure A5. Trigger input configured for DTS MDB-supplied trigger
(Note: Power-in and ground are supplied from the DTS MDB)

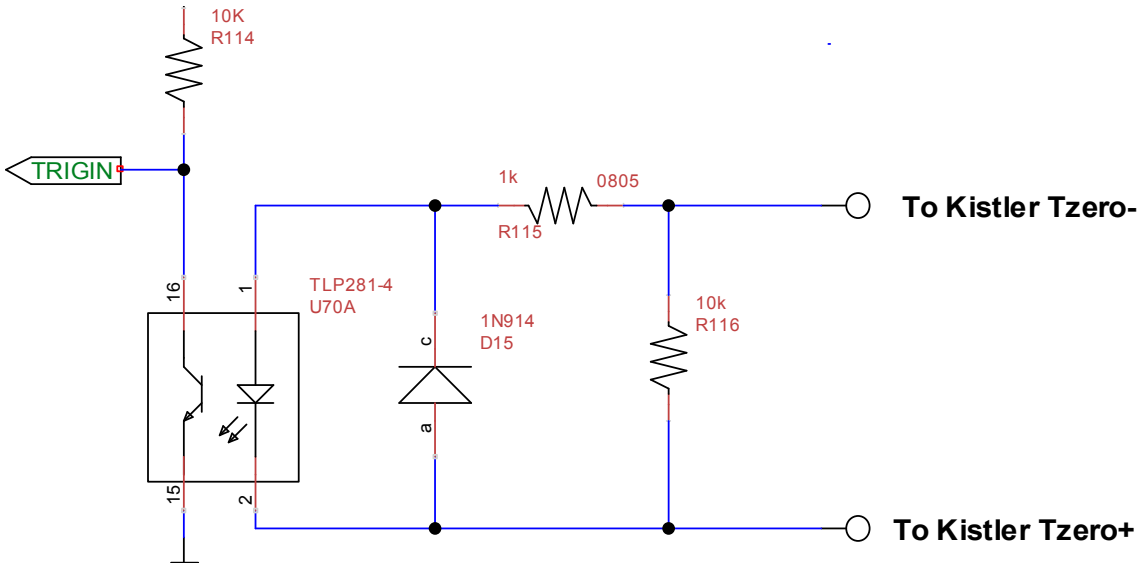


Figure A6. Trigger input configured for Kistler NXT32-supplied trigger

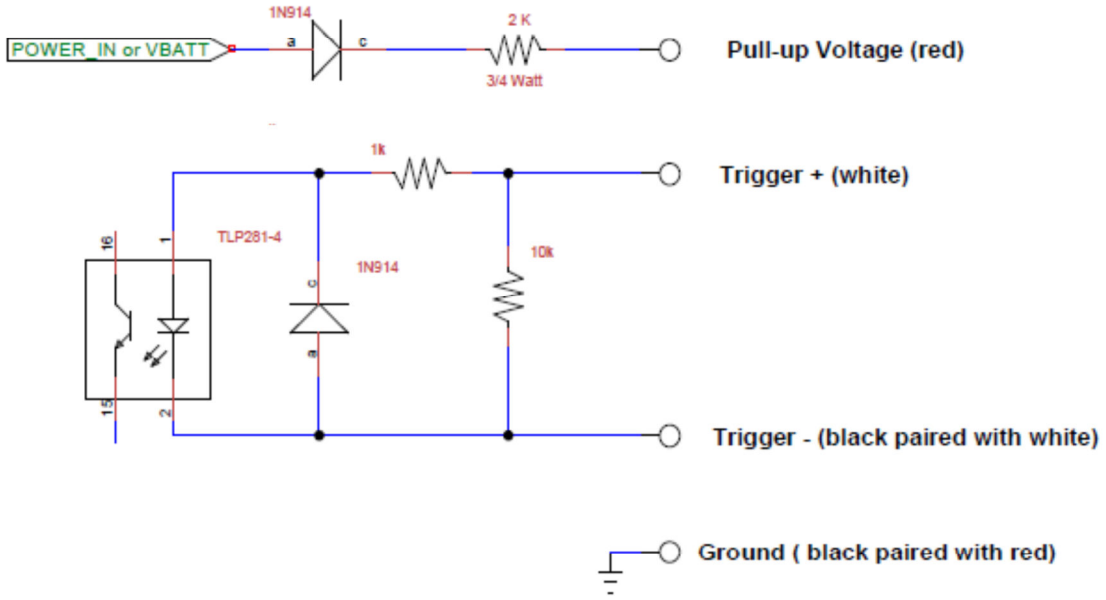


Figure A7. Trigger input configured for generic pigtail cable assemblies

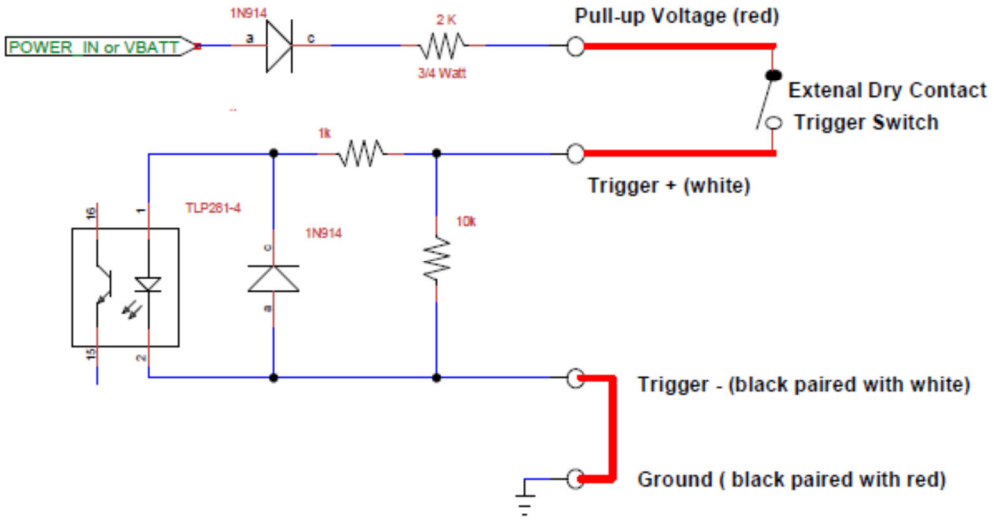


Figure A8. Trigger switch wiring example for generic pigtail cable assemblies

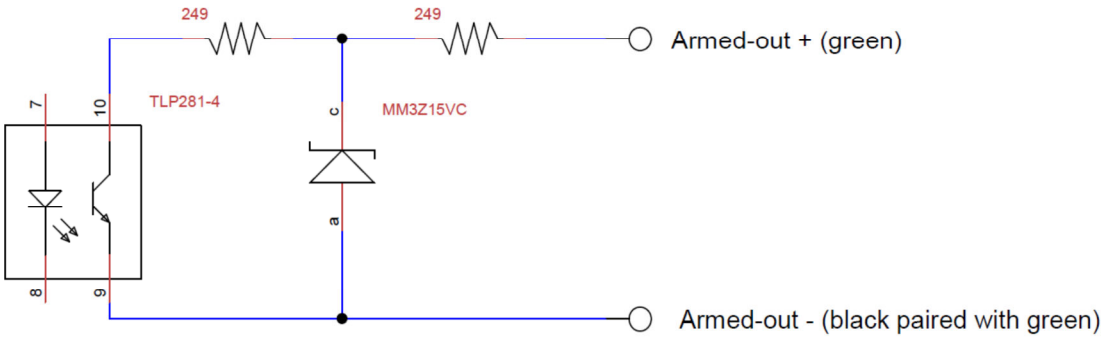


Figure A9. Armed-out circuit for generic pigtail cable assemblies
(Note: The opto-isolated output transistor turns on
when the RibEye is armed and collecting or storing data)

WARNING: ***The maximum current through the circuit must be less than 20 milliamps.***

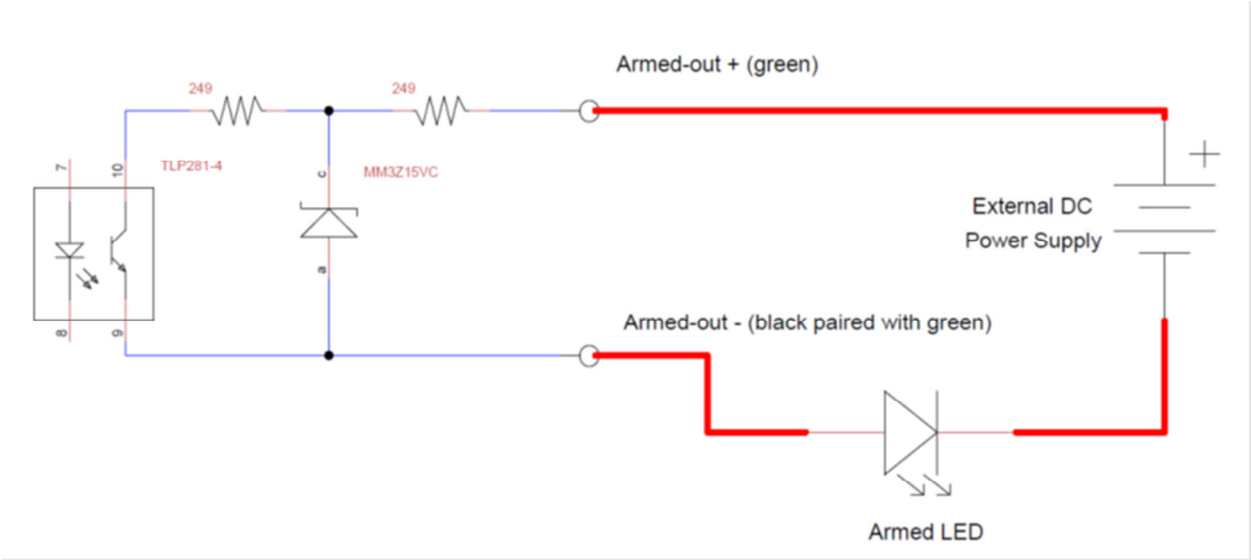


Figure A10. Example of armed-out indicator light wiring for generic pigtail cable assemblies

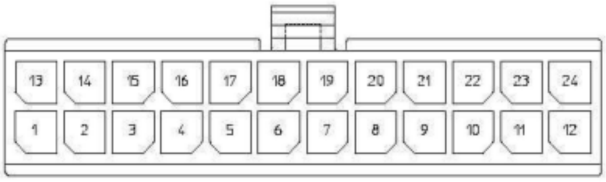
A-7. RibEye cable details

This section contains the connector wiring for the various RibEye cables to facilitate field-repair of damaged cables.

Table A1. DTS DAS exit cable 70011

Microfit connector	43025-2400
Microfit crimp terminals	43030-0009, 20-24 gauge
Lemo connector	FGG.2B.314.CLAD82
Cable type	Belden 9507

Microfit connector, view from mating plug side

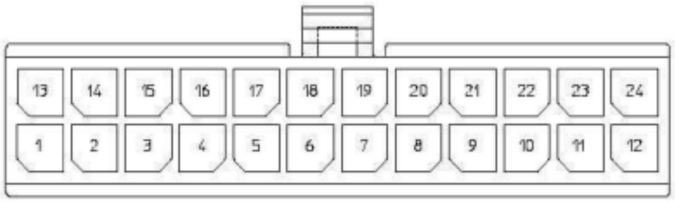


Microfit #	RibEye Name	Wire Color	Lemo 14 #	DTS Name
1	ERx+	orange	7	ETHERNET RX+
2	ETx+	green	5	ETHERNET TX+
3	GND	brown	8	MAIN PWR – (GND)
4	Voltage Pull-up 2	red jumper to 9		
8	15V PULLUP	white	9	EVENT+
9	LO I TRIGIN+	red jumper to 4		
10	HI I TRIGIN+	black (white)	10	EVENT –
11	GND	black (brown)	4	MAIN PWR – (GND)
12	+Vin	black (red)	1	MAIN PWR +
13	ERx–	black (orange)	3	ETHERNET RX–
14	ETx–	black (green)	6	ETHERNET TX–
16	BAT CHARGE – C+	center term on 2.5 mm jack		
20	GND	black jumper to 22		
22	HI I TRIGIN–	black jumper to 20		
23	GND – C–	outer term on 2.5 mm jack		
24	+Vin	red	2	MAIN PWR +

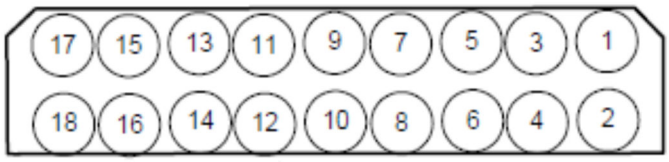
Table A2. Kistler NXT32 DAS exit cable 70020

Microfit connector	43025-2400
Microfit crimp terminals	43030-0009, 20-24 gauge; 43030-0012, 26-30 gauge
Harwin Datamate connector	M80-8881842
Cable type	Belden 9505

Microfit connector,
view from mating plug side



Harwin connector,
view from wire side

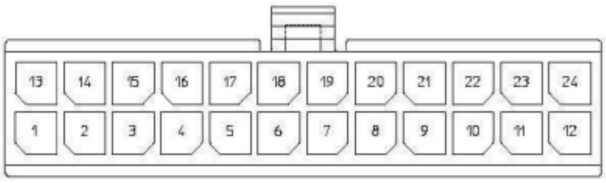


Microfit #	RibEye Name	Wire Color Belden 9505	NXT32 Pin#	NXT32 Name
1	ERx+	blue	2	ETx+
2	ETx+	yellow	4	ERx+
9	LO I TRIGIN+	green	8	Tzero–
11	GND	black (paired with red)	15	PWR Return
12	+Vin	red	18	PWR+
13	ERx–	black (paired with blue)	1	ETx–
14	ETx–	black (paired with yellow)	3	ERx–
15	GND	charger cable / 2.5 mm jack solid black lead outer terminal on jack		
16	BAT CHARGE+	charger cable / 2.5 mm jack white dashed lead center terminal on jack		
21	LO I TRIGIN–	black (paired with green)	7	Tzero+
23	GND	black (paired with white)	16	PWR Return
24	+Vin	white	17	PWR+

Table A3. Generic DAS exit cable 70025

Microfit connector	43025-2400
Microfit crimp terminals	43030-0009, 20-24 gauge
Lemo connector	FGA.2B.314.CLAD72
Cable type	Belden 9507

Microfit connector, view from mating plug side



RibEye Name	Microfit	Wire Color	Lemo
ERx+	1	orange	1
ETx+	2	green	3
PULLUP V	8	brown	5
LO I TRIGIN+	9	white	9
HI I TRIGIN+	10	black jumper to 22 *	
GND	11	black (yellow)	14
+Vin	12	yellow	12
ERx–	13	black (orange)	2
ETx–	14	black (green)	4
GND	15	2.5 mm socket outer *	
BAT CHARGE	16	2.5 mm socket center *	
CTRL COM	17	black (blue)	8
ARM OUT+	19	blue	7
GND	20	black (brown)	6
LO I TRIGIN–	21	black (white)	10
HI I TRIGIN–	22	black jumper to 10 *	
GND	23	black (red)	13
+Vin	24	red	11
		drain wire	case

* not in Belden cable

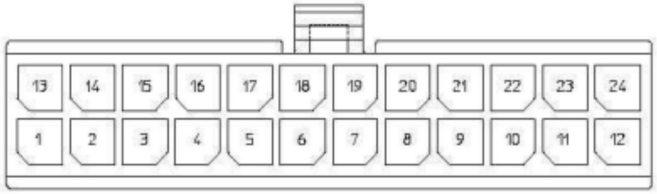
Table A4. Generic DAS breakout cable 70201

RibEye Name	Lemo PHA.2B.314.CLDD99Z	Cable 1 Power Alpha 2212C	Cable 2 Trigger Alpha 2213C	Cable 3 CAT5e Ethernet Assmann DK-1511-025/BL
ERx+	1			3 ETH_RX+ White//Green
ERx–	2			6 ETH_RX– Green
ETx+	3			1 ETH_TX+ White/Orange
ETx–	4			2 ETH_TX– Orange
PULLUP V	5		red	
GND	6		black (red)	
ARM OUT+	7		green	
ARMOUT–	8		black (green)	
LO I TRIGIN+	9		white	
LO I TRIGIN–	10		black (white)	
+Vin	11	red		
+Vin	12	white		
GND	13	black (red)		
GND	14	black (white)		
	case	drain	drain	

Table A5. Generic DAS exit/breakout cable 70026

Microfit connector	43025-2400
Microfit crimp terminals	43030-0009, 20-24 gauge

Microfit connector, view from mating plug side

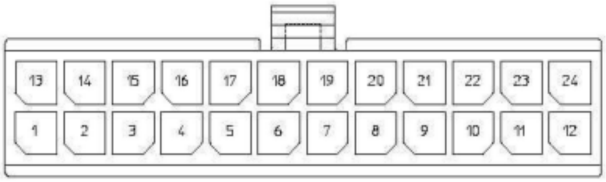


RibEye Name	Microfit 43025-2400	2.5 mm charger socket and jumpers	Cable 1 Power Alpha 2212C	Cable 2 Trigger Alpha 2213C	Cable 3 CAT5e Ethernet Assmann DK-1511-025/BL
ERx+	1				3 ETH_RX+ white/green
ETx+	2				1 ETH_TX+ white/orange
PULLUP V	8			red	
LO I TRIGIN+	9			white	
HI I TRIGIN+	10	black jumper to 22			
GND	11		black (red)		
+Vin	12		red		
ERx–	13				6 ETH_RX– green
ETx–	14				2 ETH_TX– orange
GND	15	2.5 mm socket outer			
BAT CHARGE	16	2.5 mm socket center			
ARM OUT–	17			black (green)	
ARM OUT+	19			green	
GND	20			black (red)	
LO I TRIGIN–	21			black (white)	
HI I TRIGIN–	22	black jumper to 10			
GND	23		black (white)		
+Vin	24		white		

Table A6. Kyowa DAS exit cable 70027

Microfit connector	43025-2400
Microfit crimp terminals	43030-0009, 20-24 gauge
Lemo connector	FGG.2B.332.CLAD92
Cable type	Belden 8138

Microfit connector, view from mating plug side



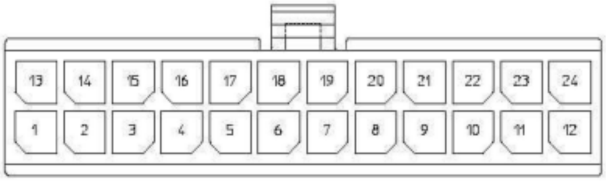
RibEye Name	Microfit 43025-2400	Wire Color Belden 8138	Lemo FGG.2B.332	Kyowa Name
ERx+	1	orange/white	9	TX+
ETx+	2	green/white	11	RX+
PULLUP V	8	red jumper to 9 *		
LO I TRIGIN+	9	red jumper to 8 *		
HI I TRIGIN+	10	blue jumper to 22 *		
GND	11	white/brown	5	PWR– (GND)
		brown/white	6	
+Vin	12	red/blue	1	PWR+ (+15 V)
		blue/red	2	
ERx–	13	white/orange	10	TX–
ETx–	14	white/green	12	RX–
GND	15	2.5 mm socket outer *		
BAT CHARGE	16	2.5 mm socket center *		
GND	20	blue/white	31	SW_COM
LO I TRIGIN–	21	white/blue	29	SW_START+
HI I TRIGIN–	22	blue jumper to 15 *		
GND	23	white/gray	7	PWR– (GND)
		gray/white	8	
+Vin	24	red/orange	3	PWR+ (+15 V)
		orange/red	4	
		drain wire	case	

* not in Belden cable

Table A7. KiHub/KiDau exit cable 70028

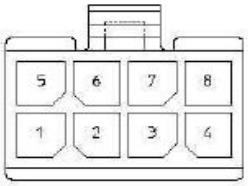
Microfit connector 43025-2400, view from mating plug side

Microfit connector	43025-2400
Microfit crimp terminals	43030-0009, 20-24 gauge
Lemo connector	FGG.2B.310.CLAD72
Cable type	Belden 9505



Microfit connector 43025-8000, view from mating plug side

Microfit connector	43025-8000
Microfit crimp terminals	43030-0009, 20-24 gauge



RibEye Name	Microfit 43025-2400	Microfit 43025-0800	Wire Color Belden 9505	Lemo FGG.2B.310	KiHub Name
ERx+	1		blue	1	TX+
ETx+	2		yellow	2	RX+
LO I TRIGIN+	9		green	5	TRIGGER–
HI I TRIGIN+	10		jumper to 22 *		
DC-DC IN–		3	black (paired with red)	7	POWER 0
DC-DC IN+		4	red	9	POWER+
ERx–	13		black (paired with blue)	3	TX–
ETx–	14		black (paired with yellow)	4	RX–
GND	15		2.5 mm socket outer *		
BAT CHARGE+	16		2.5 mm socket center *		
LO I TRIGIN–	21		black (paired with green)	6	TRIGGER+
HI I TRIGIN–	22		jumper to 10 *		
DC-DC IN–		7	black (paired with white)	8	POWER 0
DC-DC IN+		8	white	10	POWER+
			drain wire	case	
GND	11	2	*		
+Vin	12	1	*		
GND	23	6	*		
+Vin	24	5	*		

* not in Belden cable

Table A8. LED cables 70001-70006

Microfit connector	43025-0600
Microfit crimp terminals	43030-0009 20-24 gauge

RibEye Name	Microfit 43025-0600
rear LED cathode	1
middle LED cathode	2
front LED cathode	3
rear LED anode	4
middle LED anode	5
front LED anode	6

View from mating side

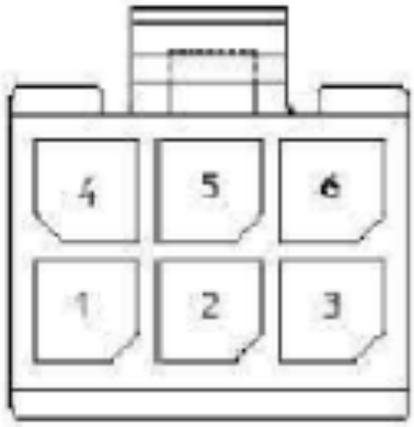


Table A9. Sensor cables 70001-70006

Microfit connector	43025-0800
Microfit crimp terminals	43030-0012, 26-30 gauge

Wire Color	Microfit 43025-0800
shield	1
brown	2
blue	3
orange	4
black	5
yellow	6
red	7
green	8

View from mating side

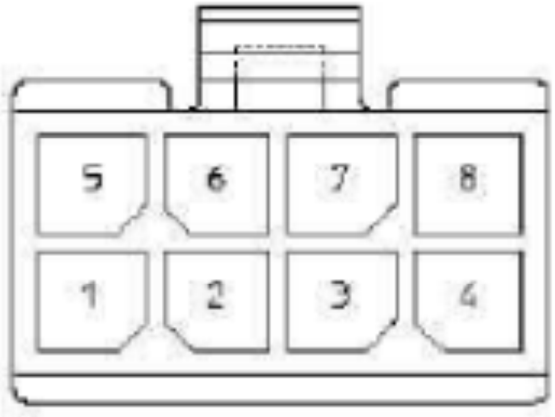
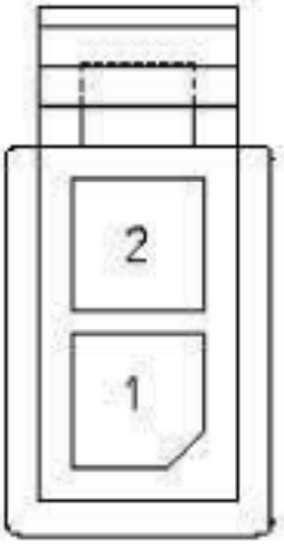


Table A10. Status LED cable

Microfit connector	43025-0200
Microfit crimp terminals	43030-0009, 20-24 gauge

RibEye Name	Microfit 43025-0600
LED cathode	1
LED anode	2

View from mating side



Appendix B. Switching RibEye WorldSID from Left-Side to Right-Side Impact

For right-side impact, all RibEye components are mounted in a similar way as they are for left-side impact. For right-side impact, the sensor cables exit toward the front of the dummy (Figure B1). The red arrow in Figure B1 points to the sensor cables. Instead of routing the cables between the inner and outer rib bands as in the left-side impact setup, bundle the sensor cables as shown in Figure B1. Use black zip-ties to bundle the cables. Make sure that the cables can not move in front of the sensors.

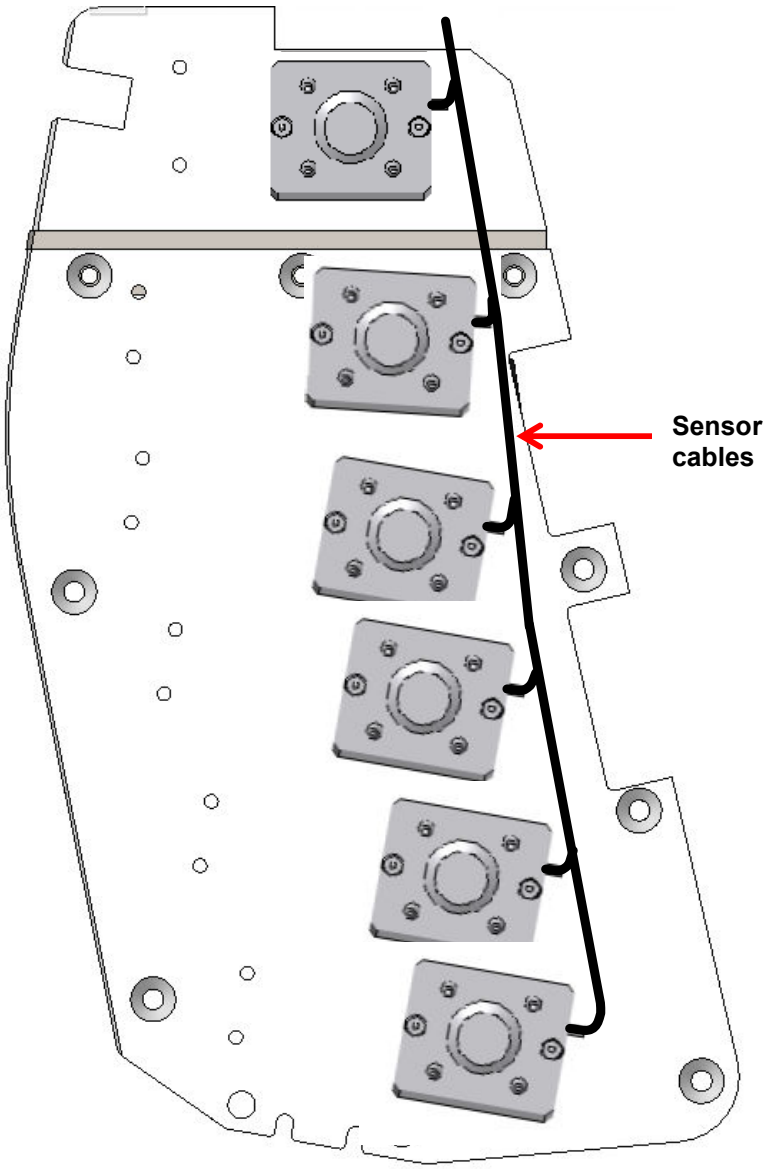


Figure B1. RibEye sensor positions and cable routing for right-side impact

Also, different calibration curves are used for left-side and right-side impact. To load the correct calibration curve to the RibEye, see the Software User Manual Version 5.3, Section 2.6, "RibEye Pointed Toward Dummy" Field.

Normally, a WorldSID RibEye is provided with only left-side impact calibration curves. If you plan to install the RibEye for right-side impact, please request that the RibEye be calibrated for right-side impact when you order the RibEye.