Sensory Perception Enhancement Device

Speadtech founded by Peter Hill and acclaimed driver instructor Rob Wilson.

SPE@D WIRING

V6.0

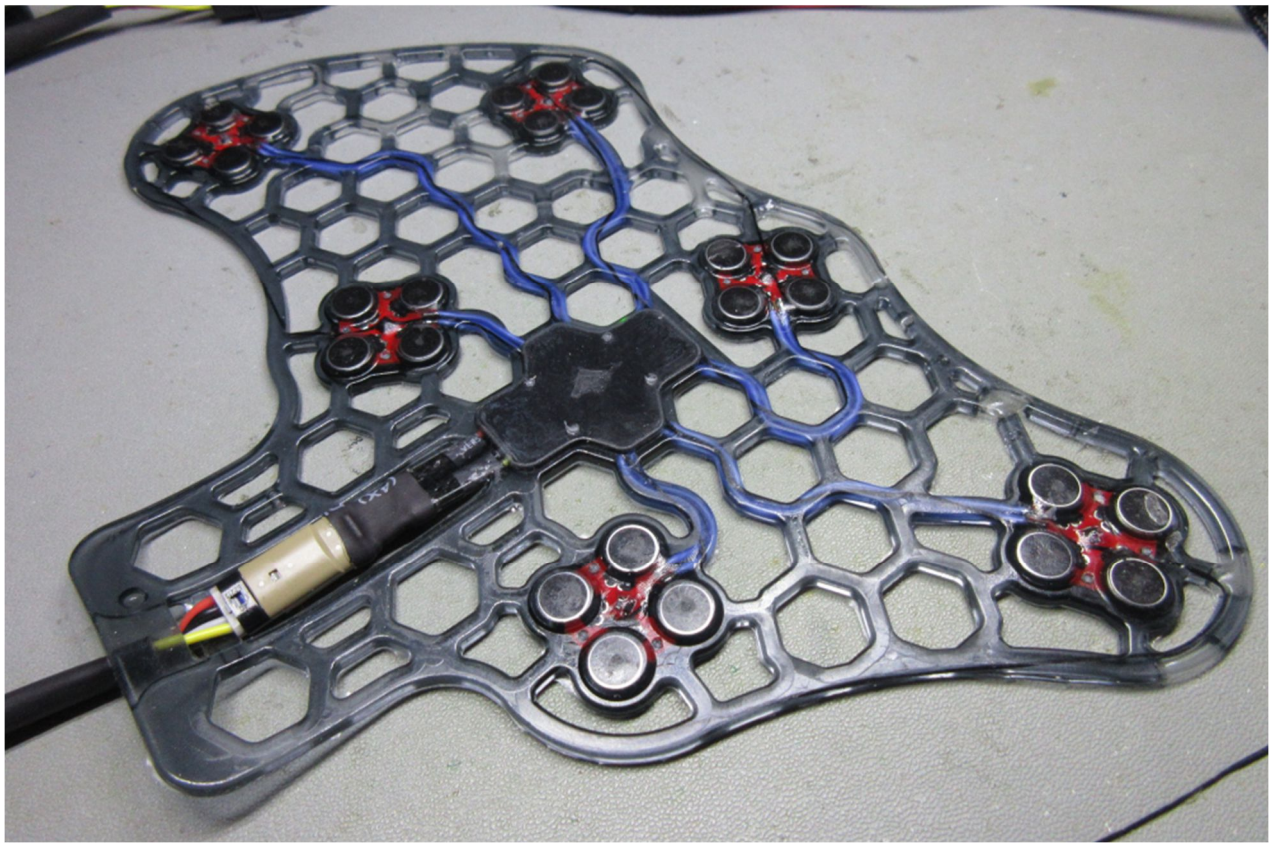
28th August 2022

1 CONTENTS

2 INTRODUCTION

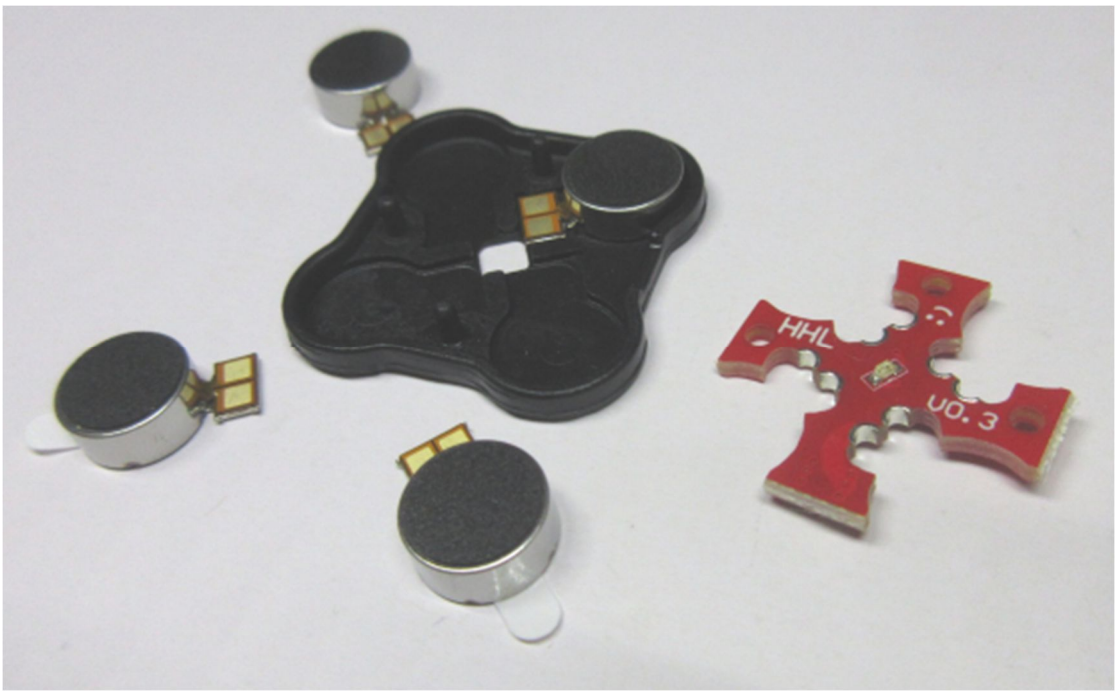
There are two quadrant versions. These are named LHS and RHS. The wiring is very specific, as only correct lengths with enable all parts to sit within the mold set for the over-molding process. It is impossible to close the mold set if the wiring is not assembled to a high degree of accuracy.

Finished Spe@d Quadrant pictured below…

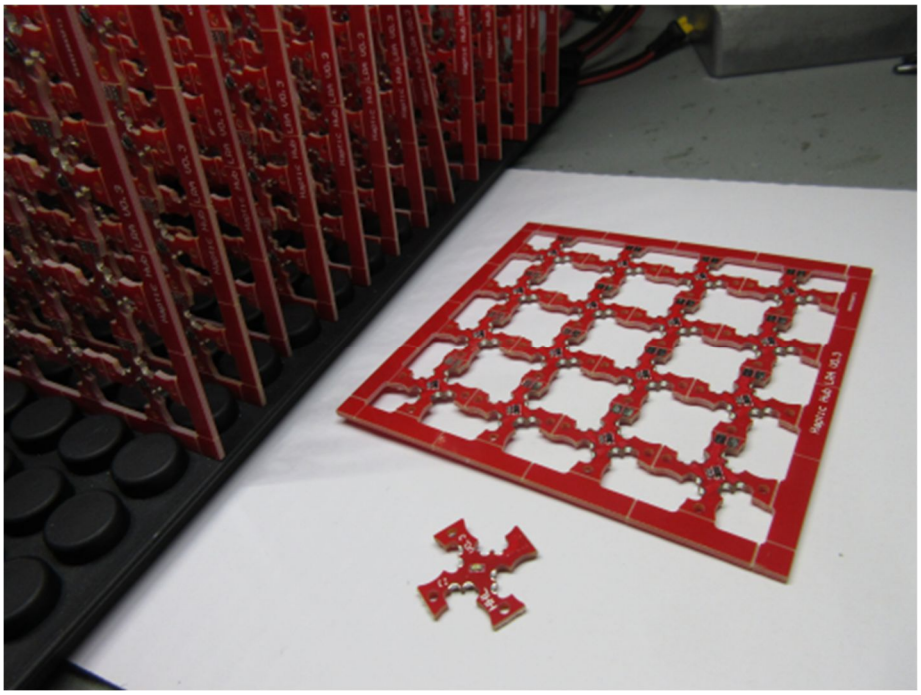


3 TACTOR ASSEMBLY

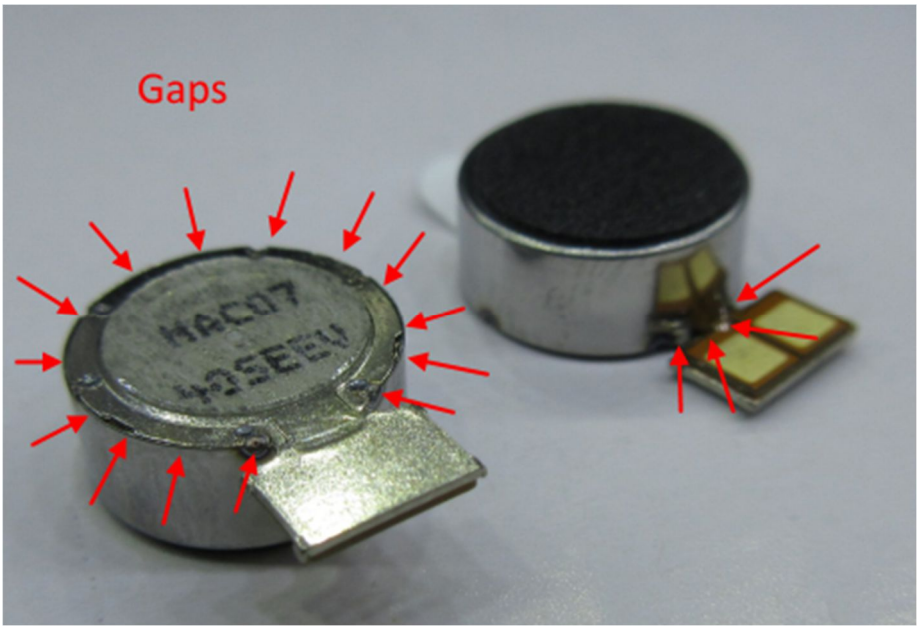
Each tactor has 4 LRA motors position with adhesive into the tactor tray, soldered and additional adhesive applied. The application of the adhesive is a critical requirement. It is specifically required to seal the LRA “can” edges, as well as the opening between can and LRA pad connections.



Tactor PCBAs are paneled with V-score break-off. They are loaded both sides with components. To de-panel, localize the bend action at the V-score lines to avoid damage to PCBs.



The over-molding process draws resin into the mold cavity under extreme vacuum. The LRA motors are not sealed or custom part that is suited to either vacuum or injection molding. Without sealing, resin would ingress into the LRA motors and render them inoperable. The gaps are shown by the arrows in the image below.



One of the purposes for the tactor tray is to facilitate either adhesive or die-cut double sided sealing film to be used. Current production uses a bead of adhesive for each LRA as shown below. This targets to seal the circumferential press fit can edge.

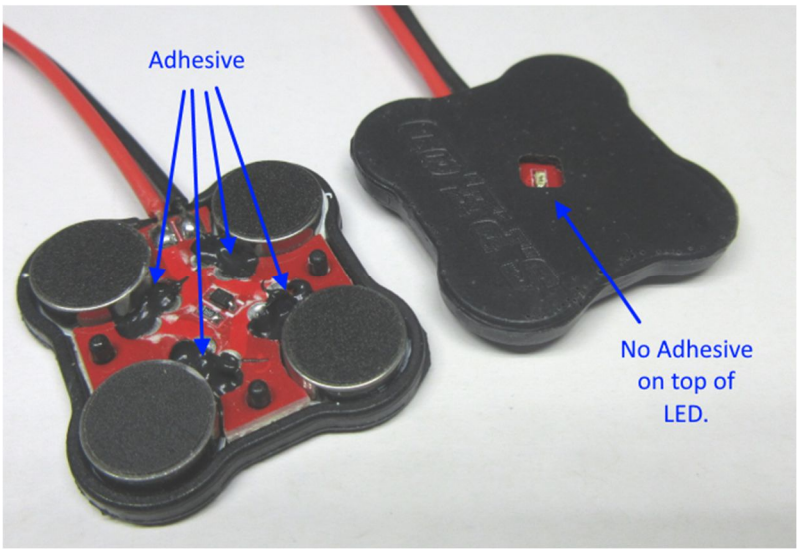
Use of adhesive should be done with syringe application for accuracy. Kafuter K-704B (black).

While the adhesive is still wet, the tactor PCB should be placed on top. Use additional dots of adhesive to adhere the PCB to the tray, however, avoid adhesive from pushing through the bottom side LED indicator. Ensure the PCB is flush against the tray before allowing adhesive to cure.

Solder the connections only after the adhesive has first fully cured. Soldering of the LRA connections needs to be done with a chisel tip. As the LRA contact pads are backed by metal, the heat and starting bead of soldering wetting must be applied to this contact pad first. Once wet, then the PCB castellation can be wet with solder. If the castellation is wet first, it will bead the solder away from the LRA contact pad and make it difficult to form a bridge without extended soldering time. The soldering process should be done efficiently, as the tactor tray is plastic and will not tolerate excessive soldering heat.

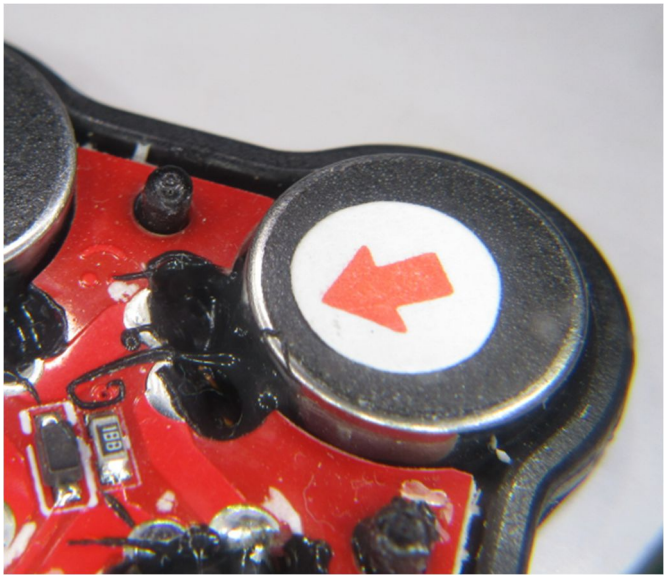
Test each soldered tactor at the main wiring pads. With 4 LRA in series, the expected resistance is typically 55ohms.

Apply adhesive to the gap on the LRA, between can and contact pads. Very important… do not inject resin into the LRA. Adhesive is to only cover the gap, not be squirted into the hole. The importance is to seal the gap between LRA can to LRA contacts. There is no specific requirement for the adhesive to otherwise fill the area or cover the PCB castellations.



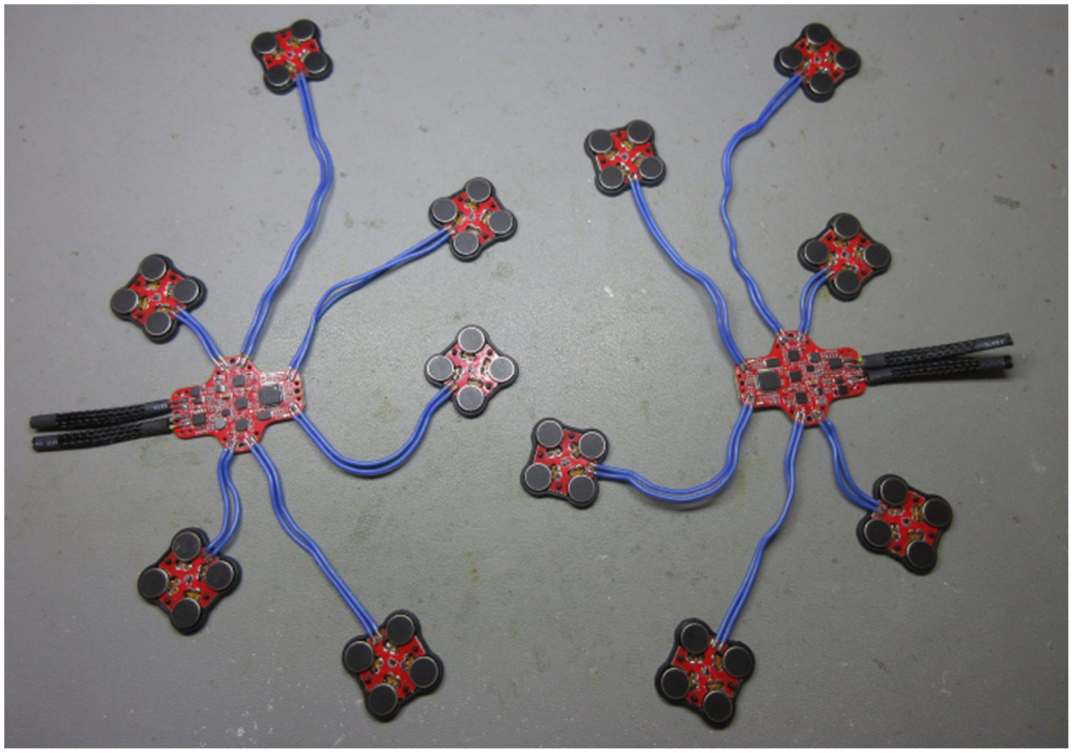
Every tactor must be inspected under magnification after adhesive has cured. Check the gap between LRA can and LRA contact pad to ensure the area is sealed. Look for bubble holes and where adhesive may not have bonded. Majority of adhesive at the location removed before re-application.

Any seals not strictly passing visual inspection should be re-worked. A seal that fails during over-molding is not repairable, hence due diligence is required at this point of manufacturing.

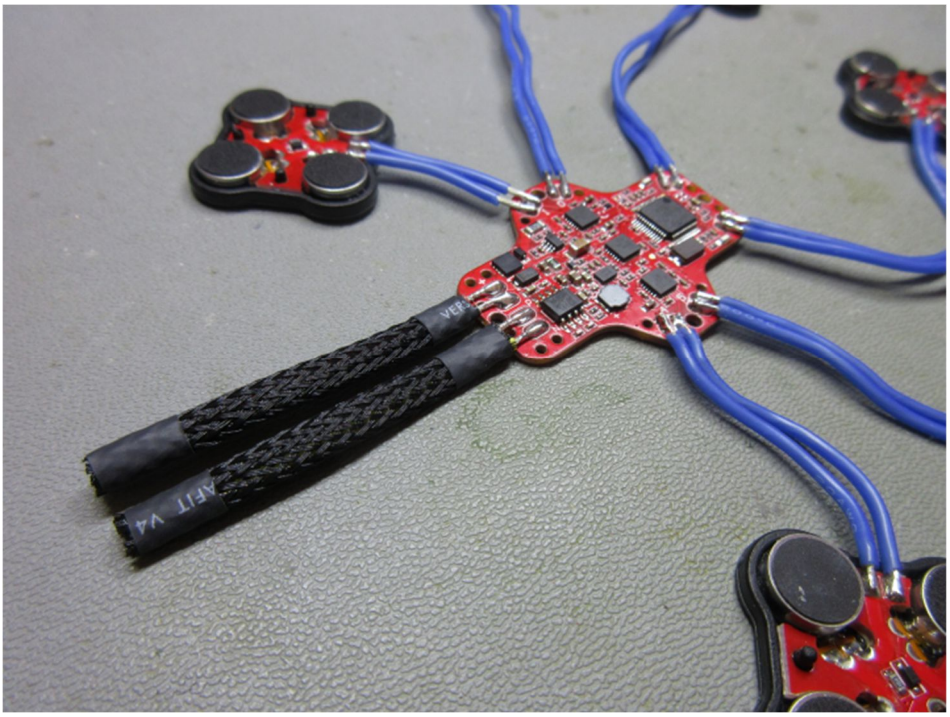


4 QUADRANT WIRING

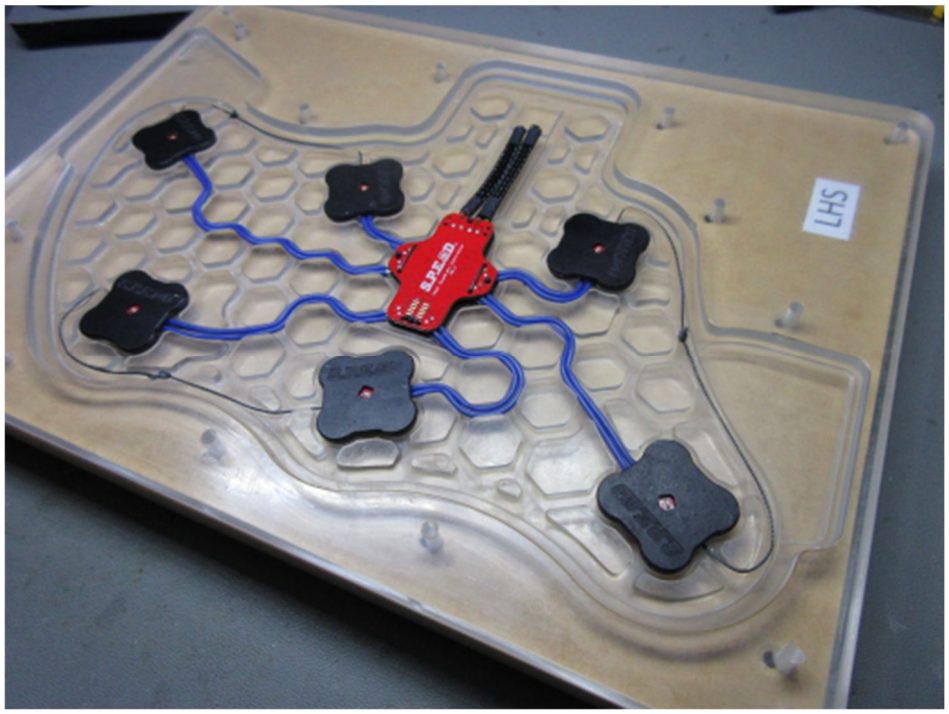
Image below shows both quadrant sides prior to being loaded in their respective mold sets.



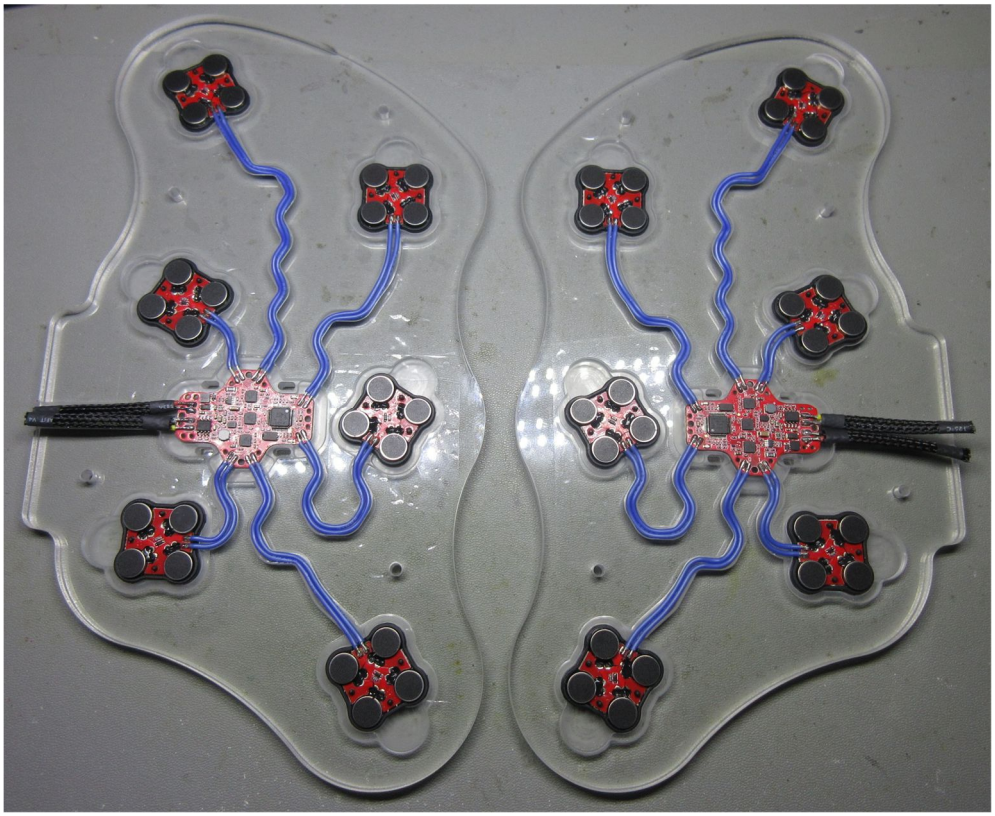
Note: The braided wires here are shown trimmed for loading into the mold set. They will however be ~100mm to allow for testing prior to over-molding.



Mold set below shows how wiring has the requirement to fit and hold in place.

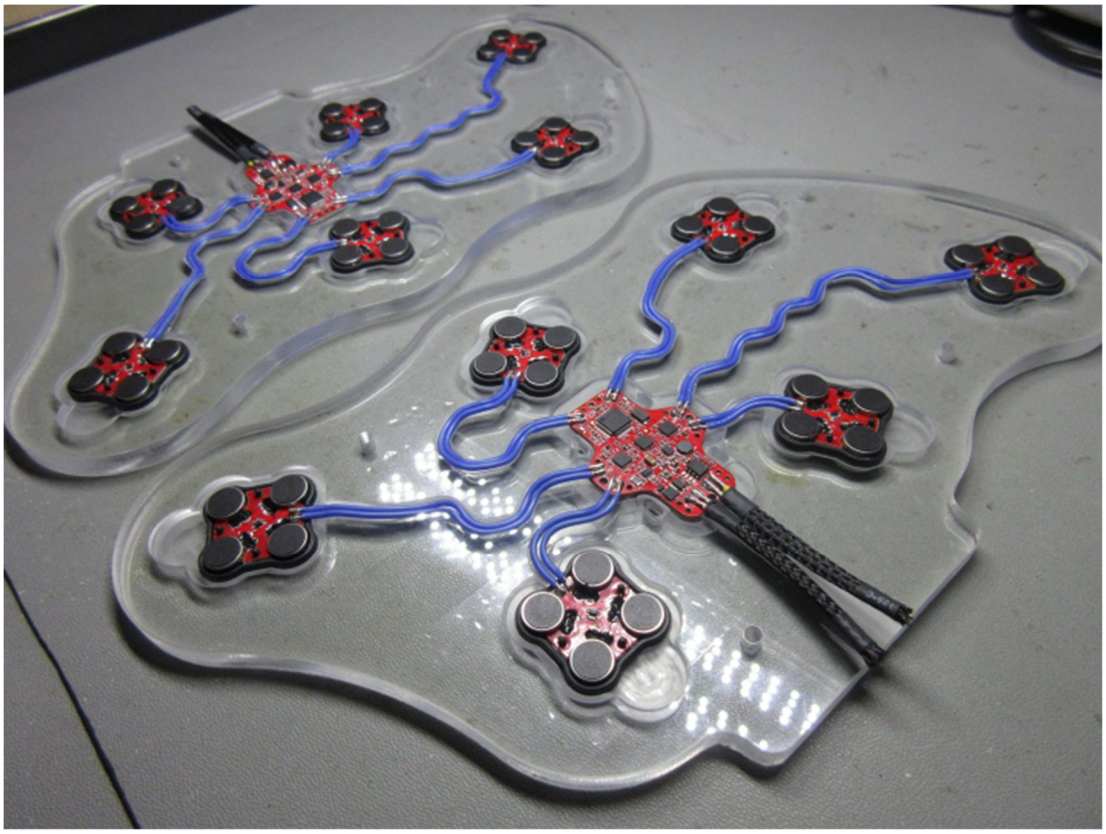


The wiring production process uses dedicated jig templates, which replicate wiring path geometry. In addition, jigs enable mounting components the correct way around for access to soldering points.



The jig incorporates magnets, which hold tactors to their respective location. Main controller PCBA can be temporarily fixed in place with cable ties using provisioned holes if needed.

Wiring must be laid such that it is bent/push into corners. Wiring that is too tight or too loose will not sit in place.

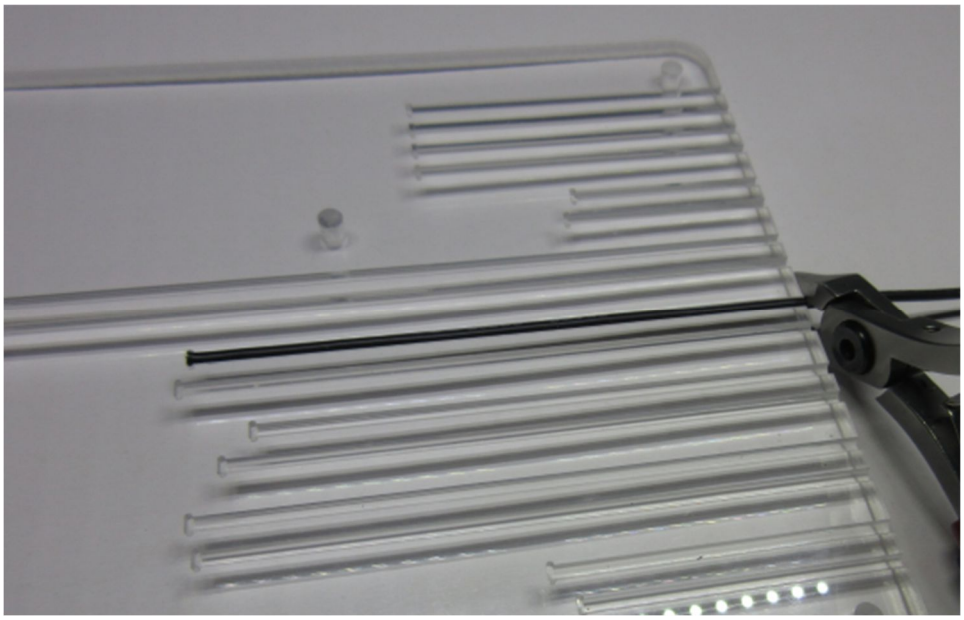


The wiring used is Silicon insulated 20AWG, 0.5mm^2.

The quadrant controller has 4 wires, black, red, yellow, grey.

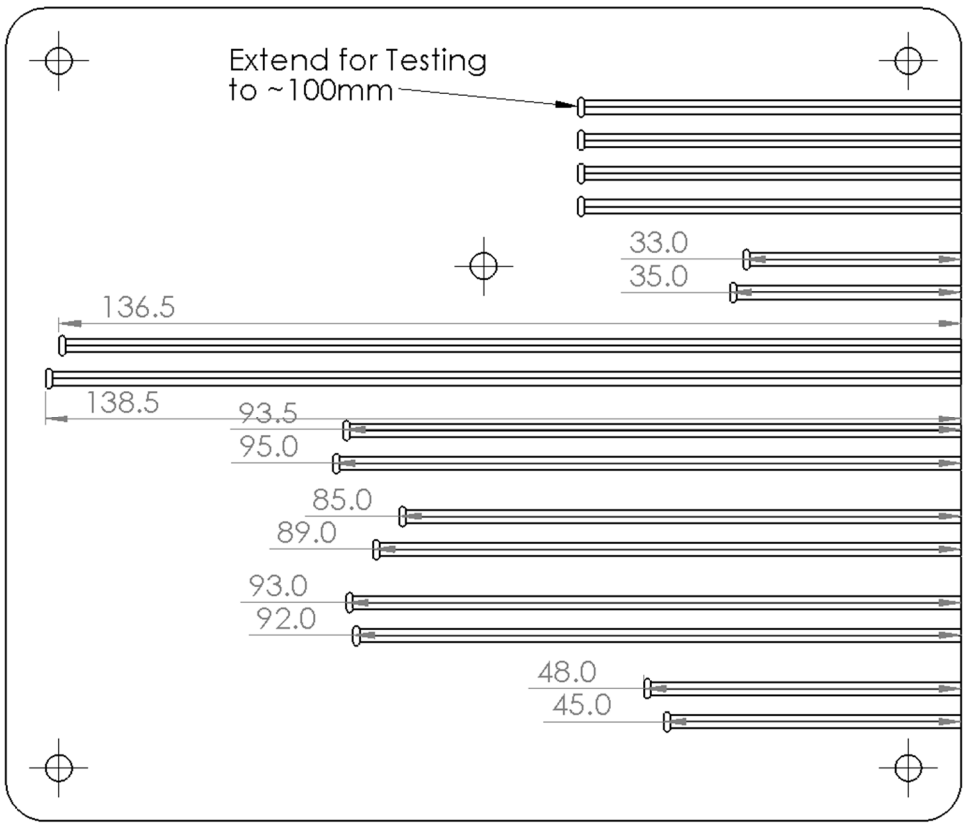
The tactor wiring used for the first sample was blue. **Production is to use black.**

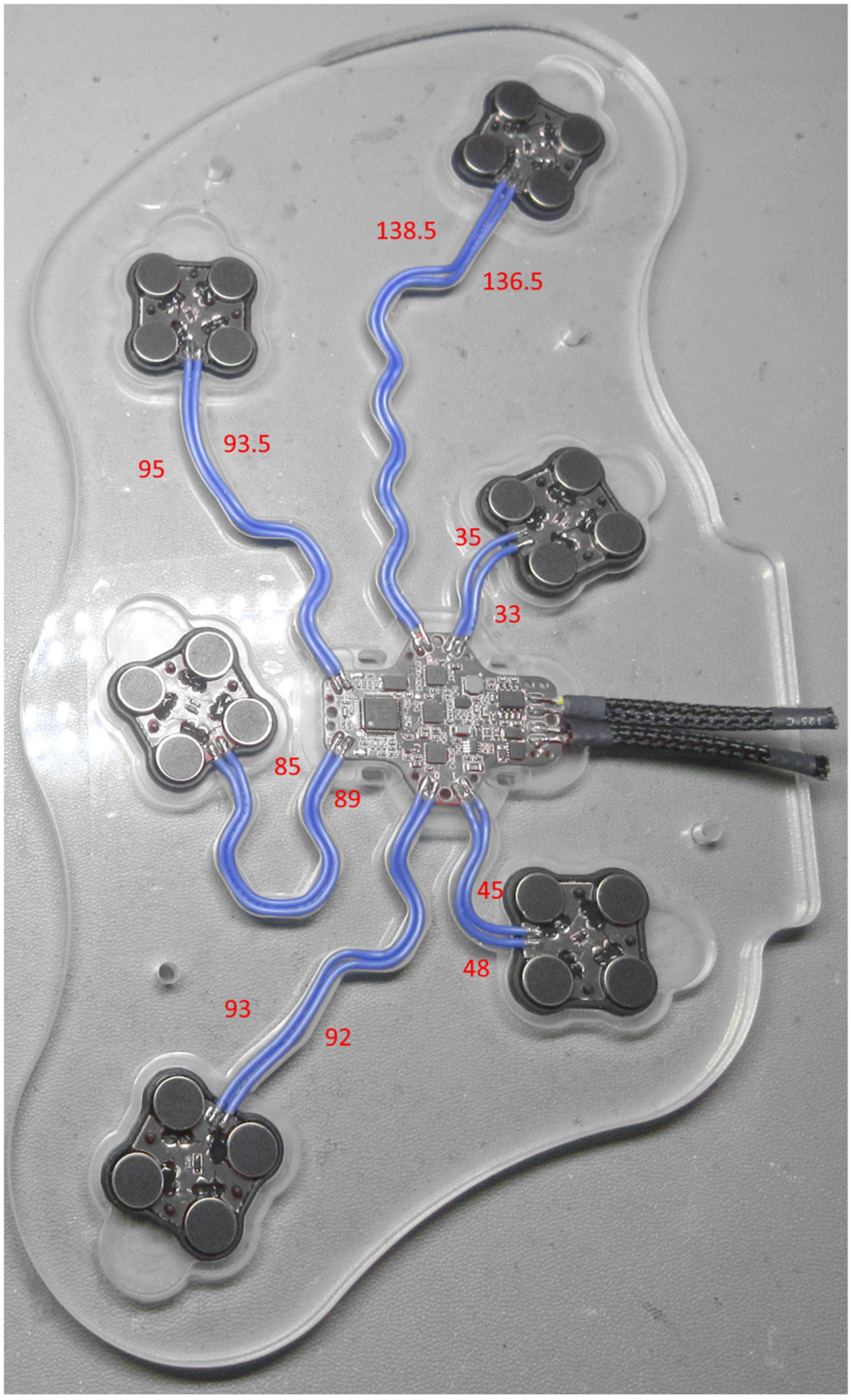
The wiring length must be very accurately cut and soldered, within 1mm. To assist with repeatable production accuracy, a wiring cut jig is provided. Each individual length is loaded and cut at the edge.



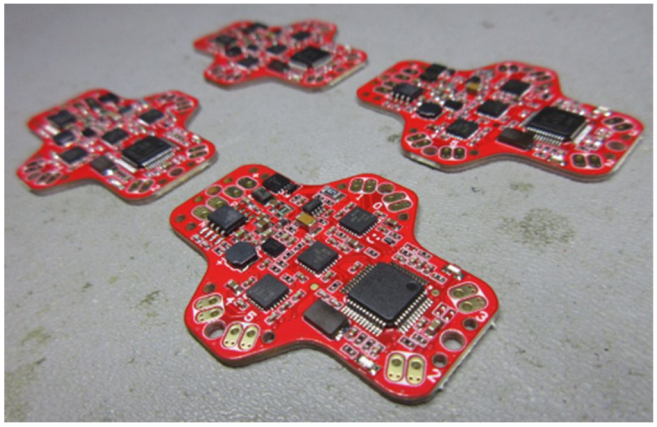
The overlay below shows the dimensions for the wire slots. These match in length and order with the jig pattern, as show on the next page.

Wiring Length Jig V0.2

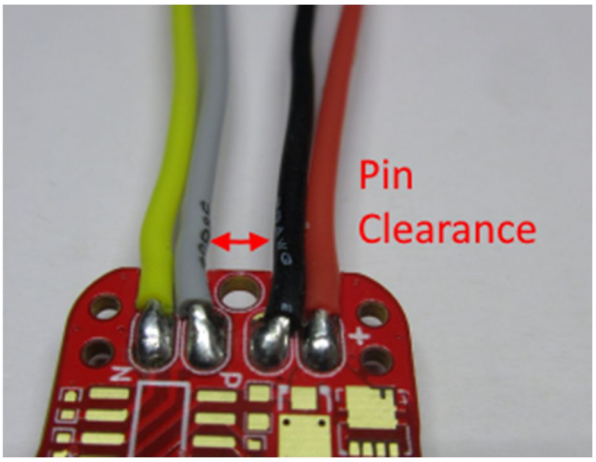



138.5
136.5
93.5
95
35
33
85
89
45
48
93
92

Quadrant controllers, prior to wiring.



Wiring colour to the quadrant controller PCBA is show below. Note, soldering of wires needs to facilitate clearance for the cover pin. Not enough clearance is given by the pad placement alone. These wires should be ~100mm long, to allow testing connection. They will later be trimmed prior to loading into the tool mold.



Yellow & Grey wires to be sleeved with 4mm braid, with length 50mm +/-5mm. Each end with ~10mm heatshrink (non-glue lined). Black & Red wires sleeved the same.

Assembly Requirements

- All soldered points must be flat against the PCB.
- If additional flux used, it must be removed to prevent interference with the resin chemical curing.
- All wiring soldered to the quadrant controller to have flush cut on the bottom side of the PCB.

5 QUADRANT CONNECTOR FITMENT

Mizu-P25 connectors are fitted to the quadrant mesh after over-molding. The length/position of the connector is important, as its mating connector is to fit with the provisioned corridor.

Part numbers for the connectors is shown below. Note for this connector fitment, the Plug is used.

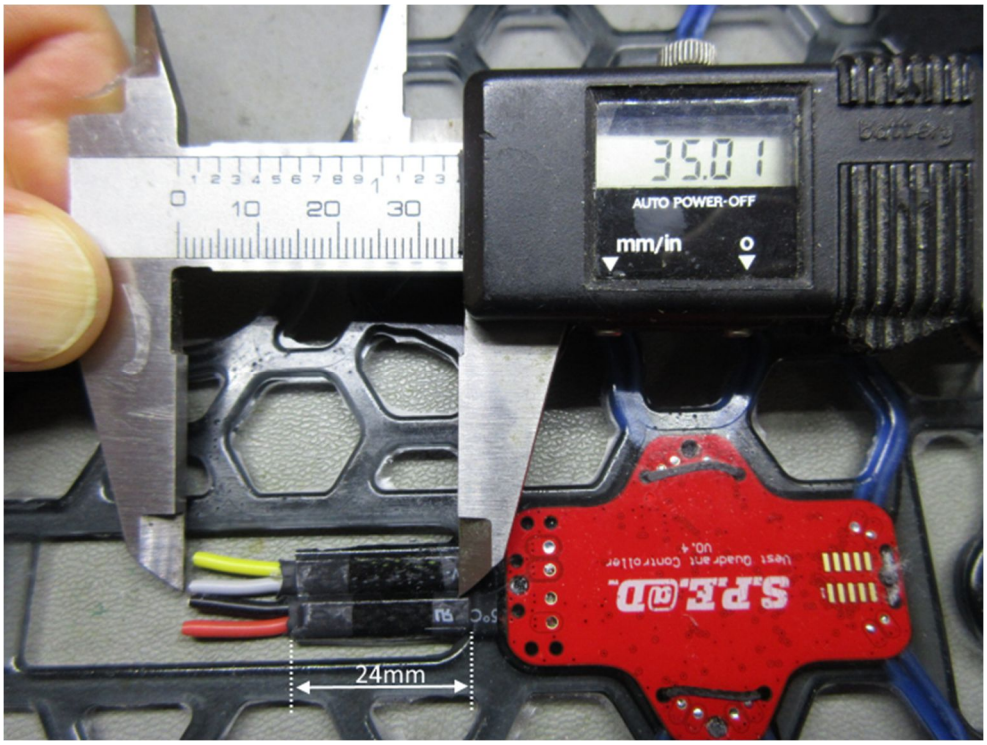
Mizu-P25 (Mini Type)

Receptacle (Black)	52213-0411	Vest Wiring Harness
Receptacle (Brown)	52213-0417	
Plug (Black)	52266-0411	
Plug (Brown)	52266-0417	Quadrant Mesh

Mizu-P25 Terminals, 3.0A (22AWG), 4.0A (20AWG)

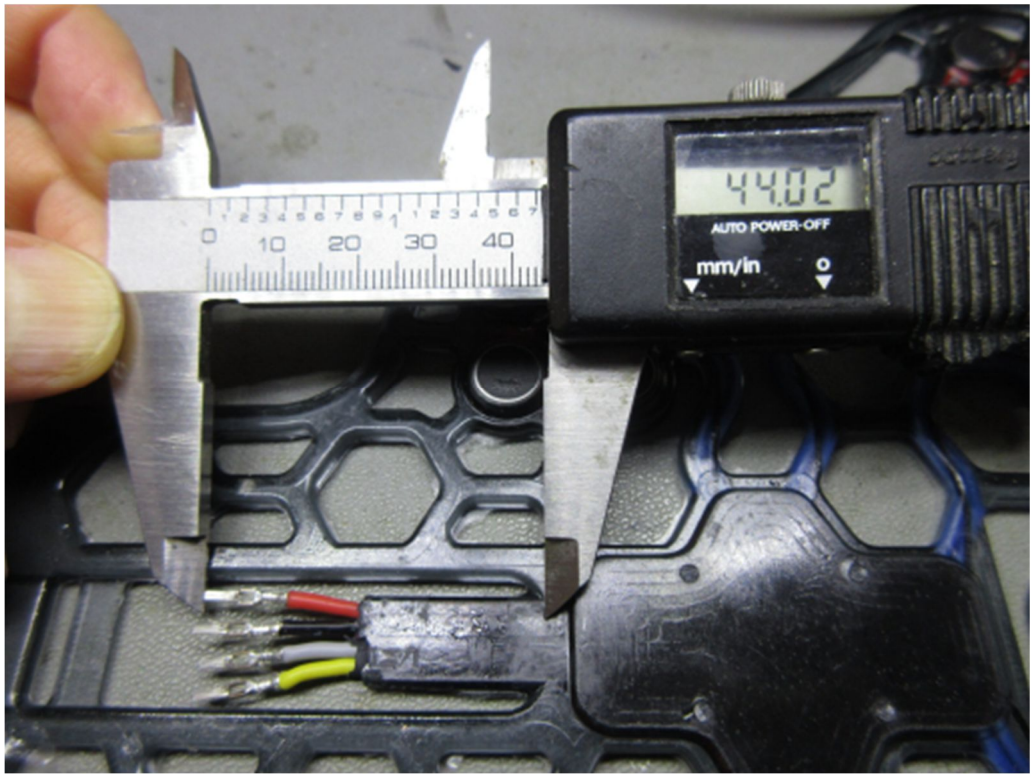
Insulation Range	1.40 to 1.90mm	
Strip Length	2.00 to 2.50mm	
Terminal, Female (Reel)	50148-8000	Vest Wiring Harness
Terminal, Female (Bag)	50148-8100	Vest Wiring Harness
Terminal, Male (Reel)	50147-8000	Quadrant Mesh
Terminal, Male (Bag)	50147-8100	Quadrant Mesh

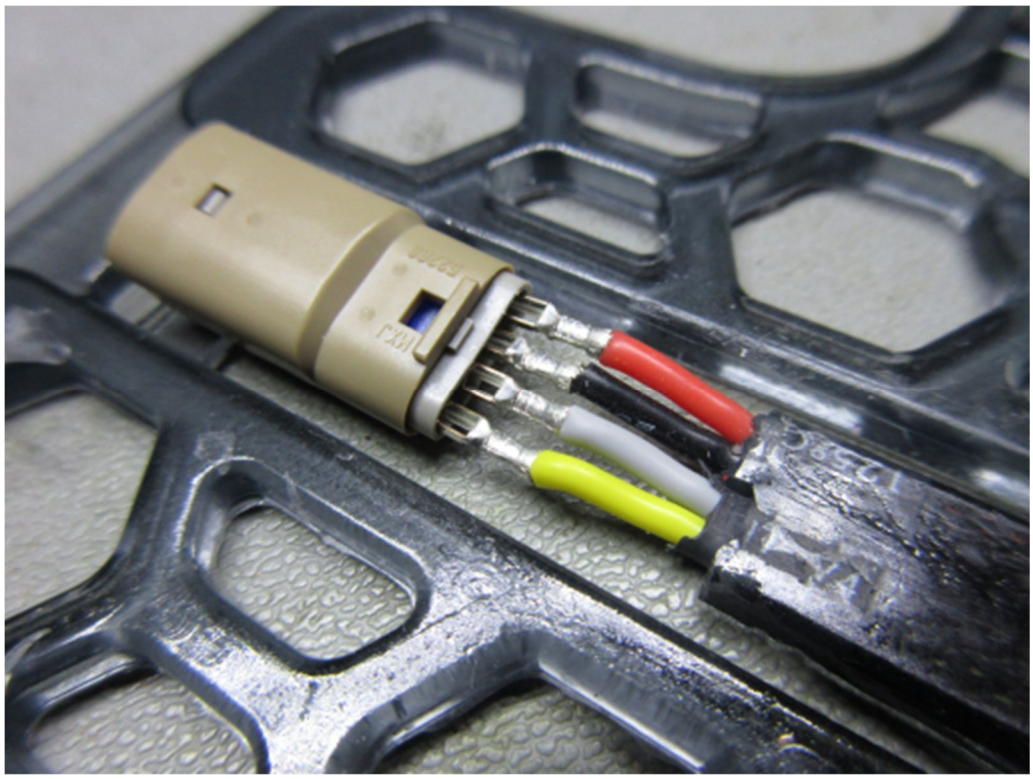
The polyurethane must be trimmed from the wiring. Wire length to be trimmed as shown to 35mm, with exposed length at 24mm. The polyurethane does not adhere to the silicon insulation of the wiring, which makes it relatively easy to remove. The braided sleeve provides some protection to score through without cutting the over-molding material.



Note the “Strip Length” in the connector detail for terminal crimping / insulation removal.

**Recommended. Practice wiring a P25 to loose wire before wiring a quadrant mesh. Loading the 4th wire is the hardest, particularly with silicon insulated wire.





Ensure all terminals fully seated and locked. Example below show left terminal note fully seated.

Use 12mm glue lined heatshink, 28mm length.

6 VEST WIRING

The wiring harness supports 4 vest quadrants.

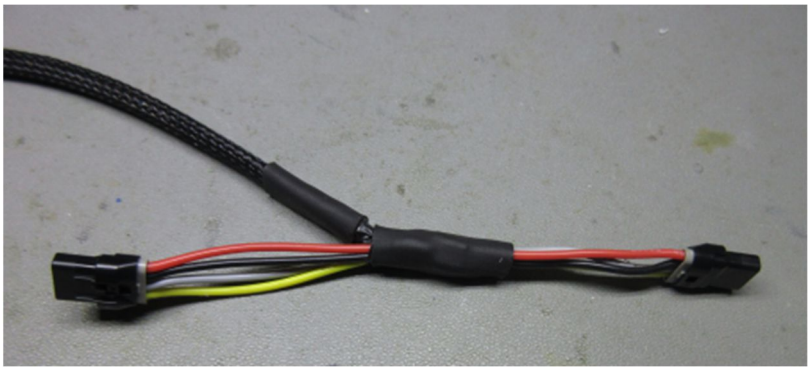
V14 Design

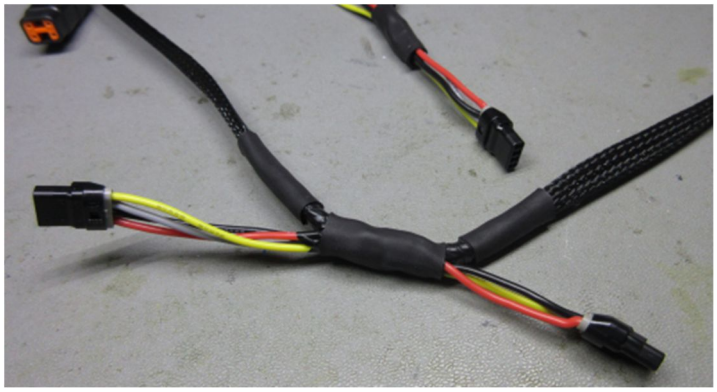
Vest Connector

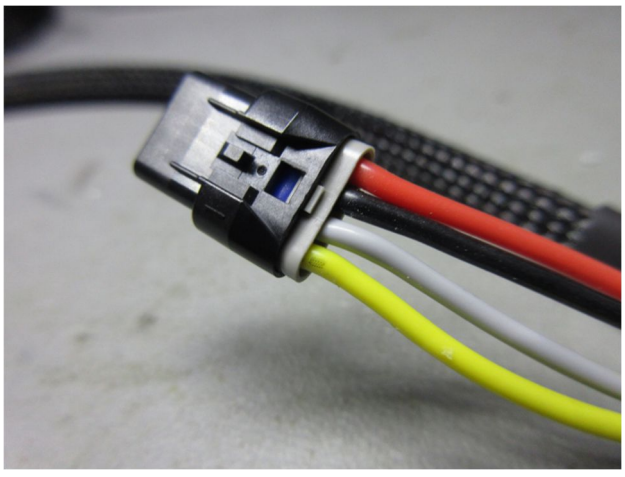
- DTM06-4S-E004
- Contact terminal size 20, #0462-201-20141
- Wedge WM-4S

Wiring

- 8mm Braid.
- 10mm Heatshrink, glue lined.
- Silicon insulated 20AWG, 0.5mm^2. Red, Black, Grey, Yellow.
- 120R resistor (CAN termination).

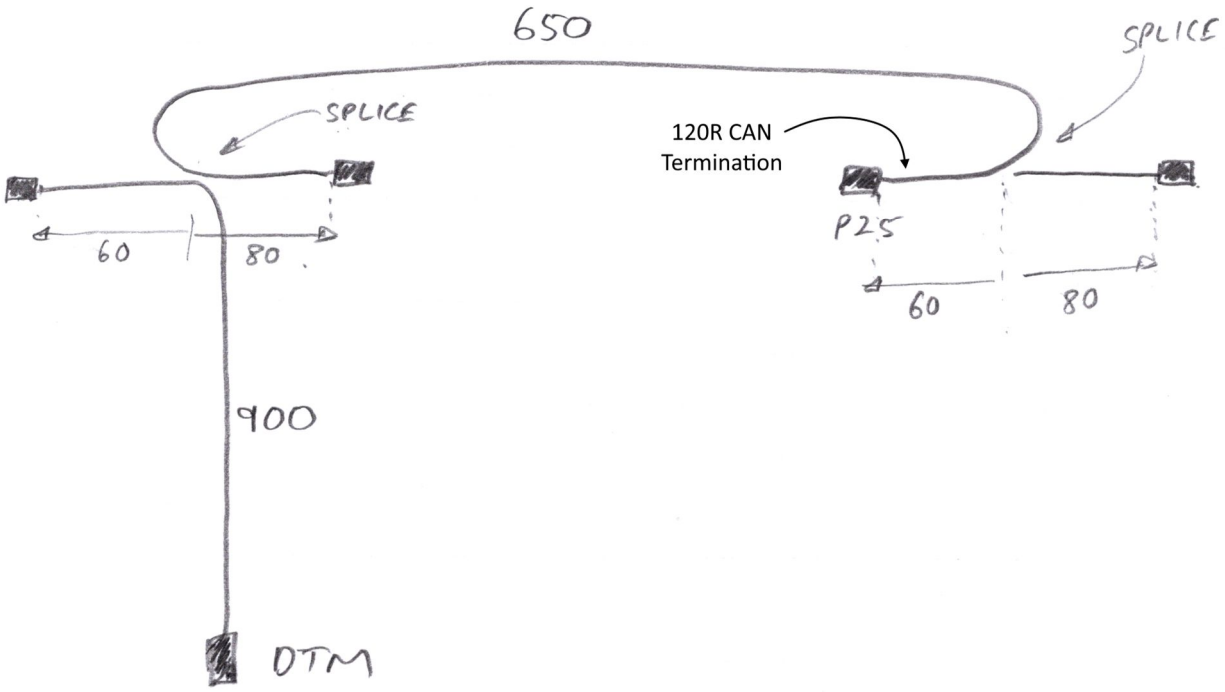






Wiring circuit diagram not yet drawn or finalized. Details below are not for construction.

Sketch below shows the wiring plan from prototype harness. All 4 circuits between P25 and DTM connectors are wired in parallel. To avoid excessive splicing bulk, the plan below uses 3 wire lengths, with minimal 2 splice locations. Wires bundles cut at 900, 600 & 80mm. 120R resistor is incorporated at either the further splice location (from DTM) or where convenient near one of the furthest P25.



The intent with the harness is to provide flexibility, with minimum bulk that can causes discomfort. Subsequently, minimum use of glue lined heatshrink preferred. Heatshrink should also not be used close to any connector, where it could restrict movement and result in single wire tension loading.

The cable length across the back of the vest is a concern for comfort, as the 4 wires bundled together is likely not ideal for those seated in a non-padded bucket seat. An approach being considered is to instead run the power and CAN in separate smaller 4mm braided sleeves. Wiring has more opportunity to lay flatter in pairs, than a twisted bundle of 4.

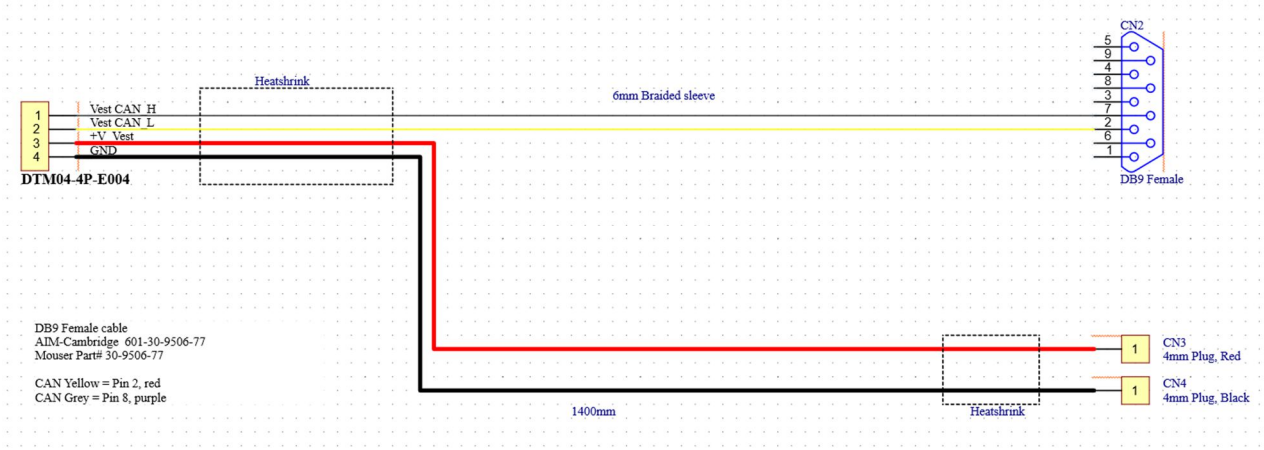
Further consideration is to have the vest controller electronics fitted inline with the vest harness. TBA.

7 VEST CONTROLLER WIRING

TBA.

8 SIMULATOR PC CABLE

Simulator PC Cable V6.0



9 BATTERY PACK WIRING

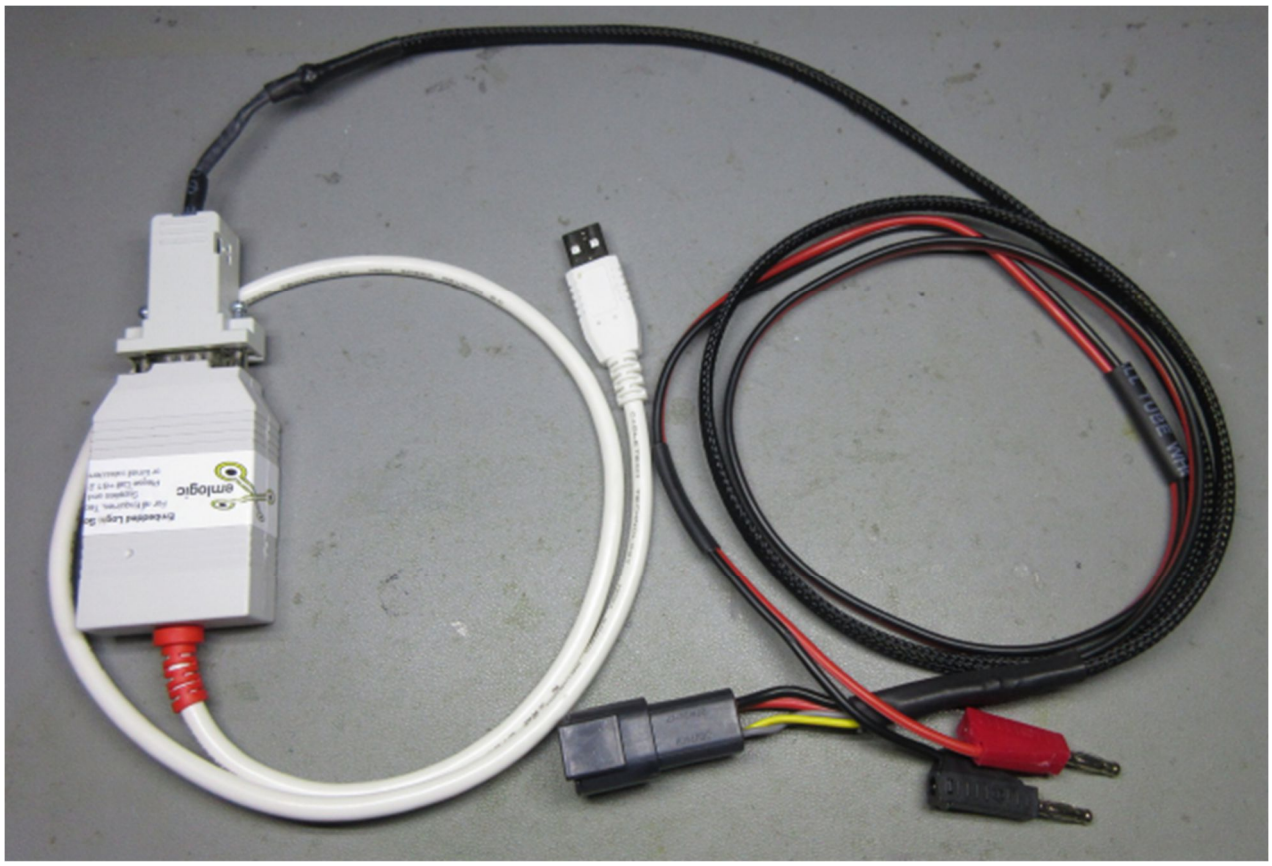
Requirement for portable demonstration, running from notebook and USB re-chargeable power bank.

10 DEVELOPMENT TEST HARNESS

Peak-CAN tool.

4mm power connection.

4-pin DTM connector.



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