Sensory Perception Enhancement Device

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

DEVELOPMENT REFERENCE

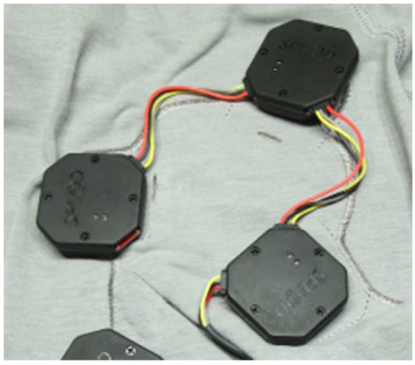
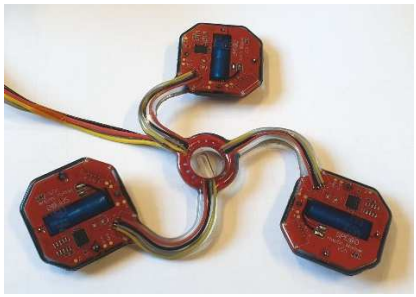
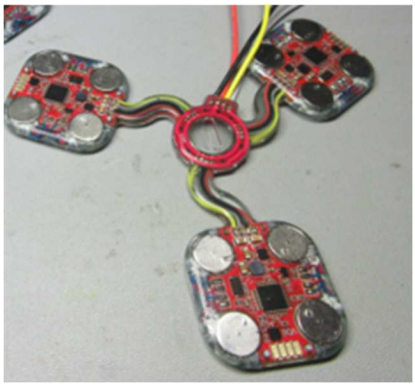
V1.0

17th December 2020

1 CONTENTS

2 VEST HAPTICS

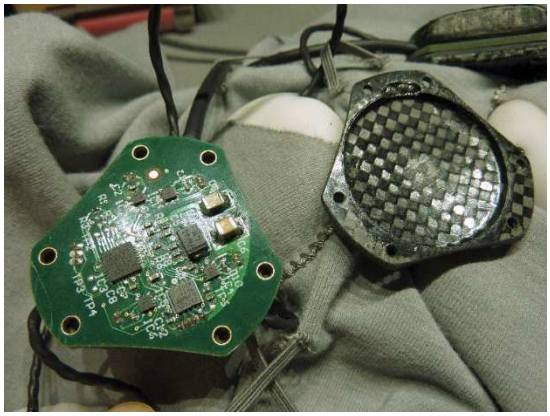
The table below provide an overview of the vest haptics.

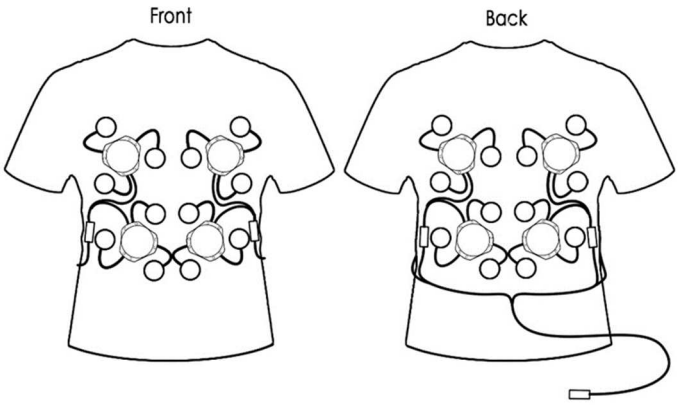
Model	Image	Description
Tiga QuadHap		Hard case. 11.6mm / 15.6mm thick. ERM satellites. Each group of 3 controlled by an additional QuadHap controller.
1st Generation		10.0mm thick haptic, hard case. Powerful ERM, 23x8.8mm Diameter. Supports flexible arrangement using pluggable wired links.
2nd Generation		10.0mm thick haptic, soft over-molding. Powerful ERM, 23x8.8mm Diameter. Waterproof. Groups of 3 with robust connector.
3rd Generation		4.8mm thick haptic, soft over-molding. 4x Coin ERMs. Waterproof. Groups of 6 with robust connector.
4th Generation	Custom Haptic	Feasibility investigation into developing a custom flat haptic engine.

2.1 TIGA QUADHAP

Haptic motor modules with carbon fibre variant.

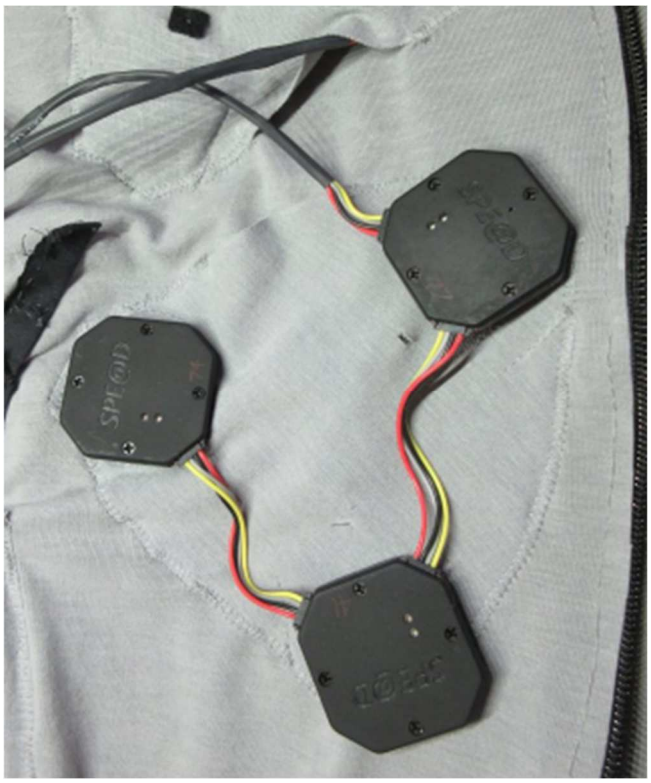
Each group of 3 haptic motor modules controlled by a QuadHap module.



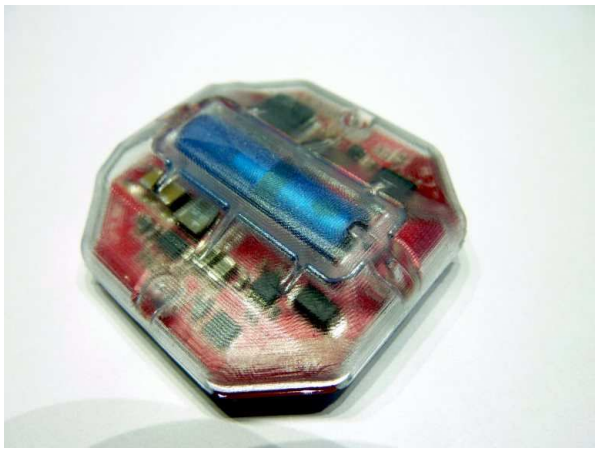


The Vest uses 8 QuadHap modules to drive a total of 24 haptic motors. Vest weight 840g.

2.2 1ST GENERATION HAPTICS



Hard cases. Supports flexible arrangement using pluggable wired links. Most powerful ERM used.



2.2.1 V04 - VESTS 3 & 4

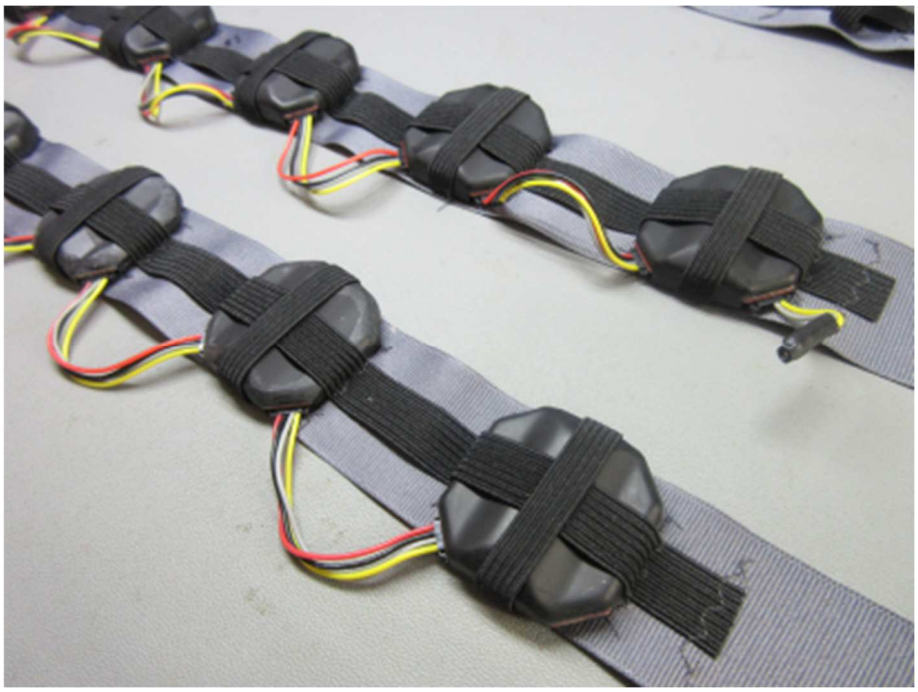
Both long sleeve with zipper. Some wiring exposed. Tested with Alex at Philip Island. Soft felt buttons didn't hold haptics. Needed tighter fit to feel front haptics. Rear haptics uncomfortable, particular upper rear haptics, near arm pits.

2.2.2 V04 - VESTS 5 & 6

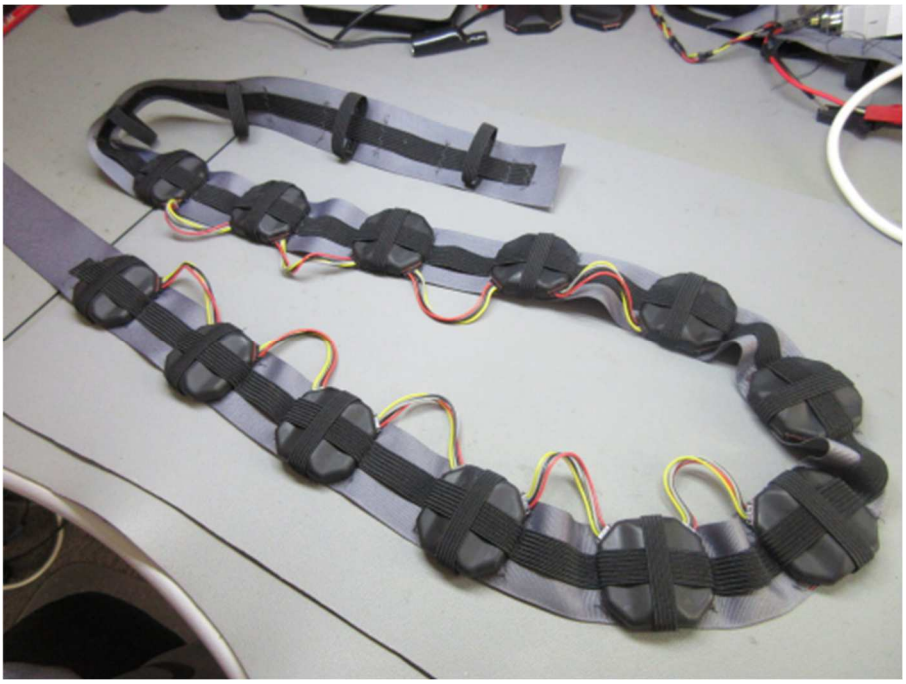
Both long sleeve. Design updated for better haptic retention and cable management.

Used in Abu Dhabi. Haptics on rear were uncomfortable. Garment stretches in the middle for wide shoulder user, which caused discomfort with custom seating.

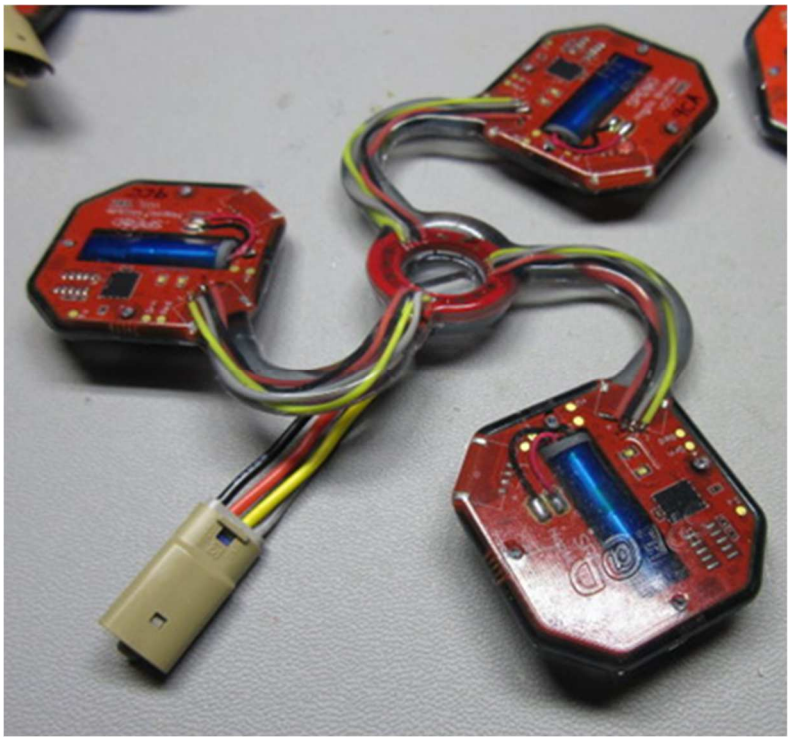
2.2.3 1ST GENERATION - HAPTICS ARRAYS



Used on simulator to test varies configurations for haptics on legs and arms.



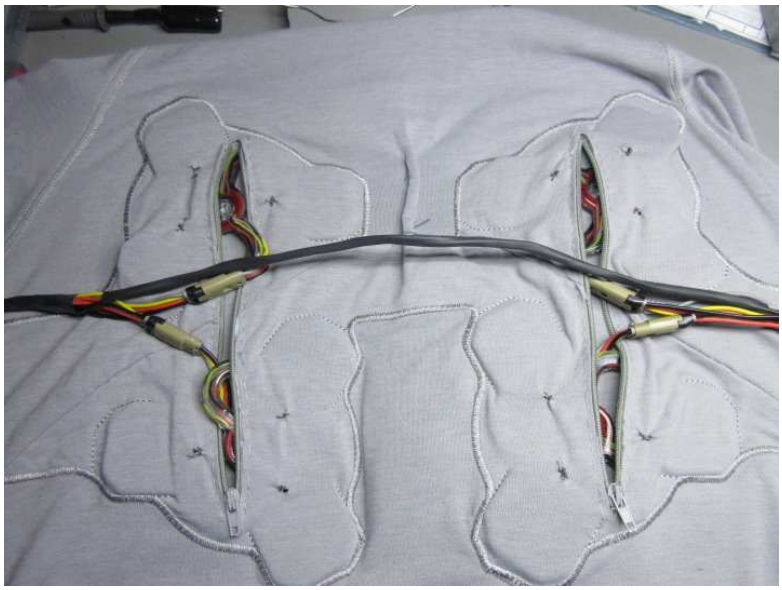
2.3 2ND GENERATION HAPTICS - OVER MOLDED



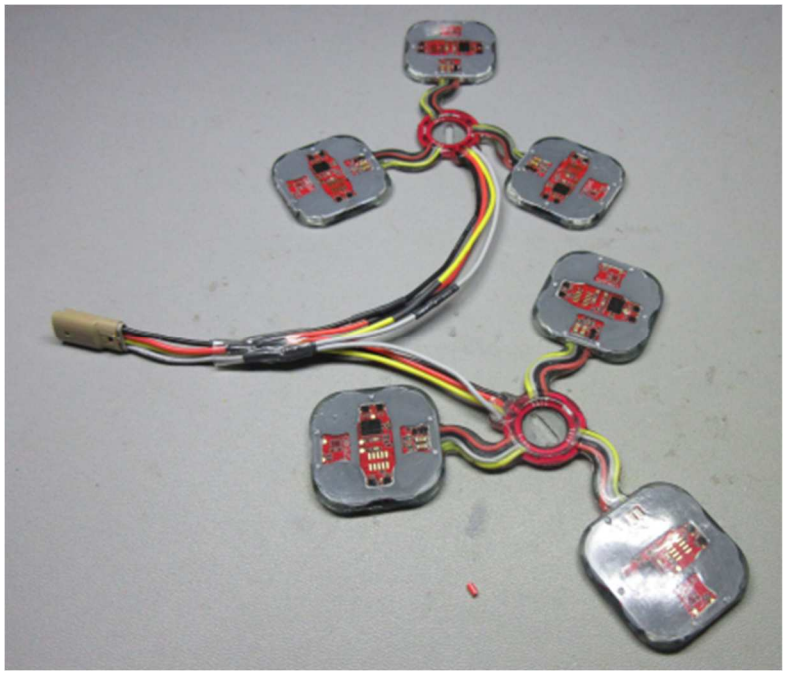
Softer material alternative. Waterproof design.

Fixed arrays of 3 units with low profile robust Molex connectors.

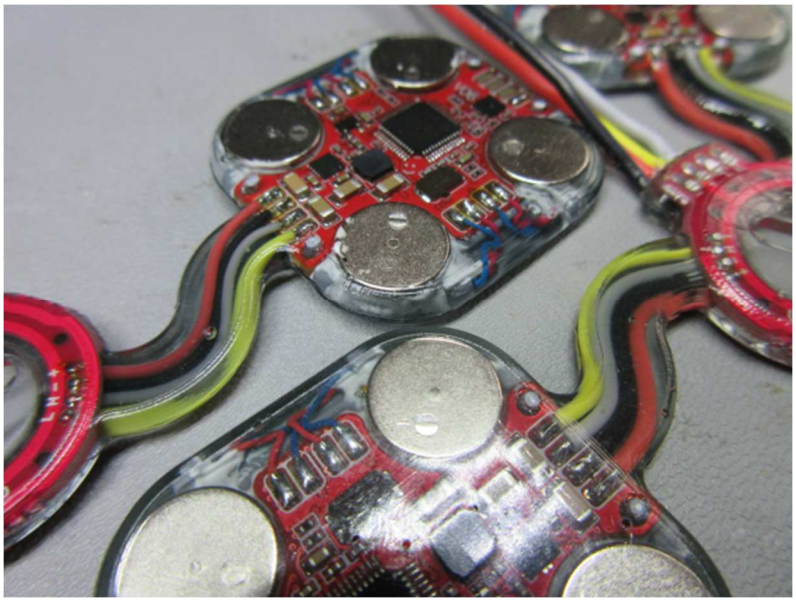
2.4 2ND GENERATION – VESTS



2.5 3RD GENERATION - LOW PROFILE HAPTICS



Integrates 4 coin ERMs. ~4.8mm thick.



One vest produced. Two vests in production.

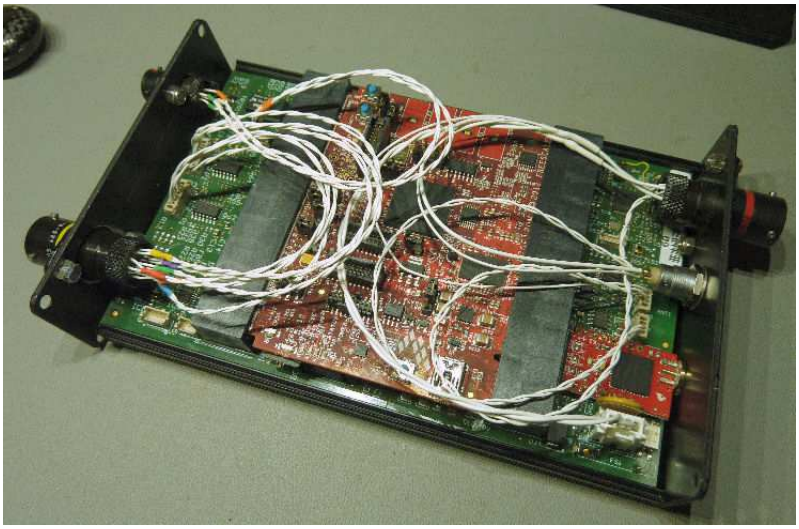
3 VEST INTERFACE MODULE

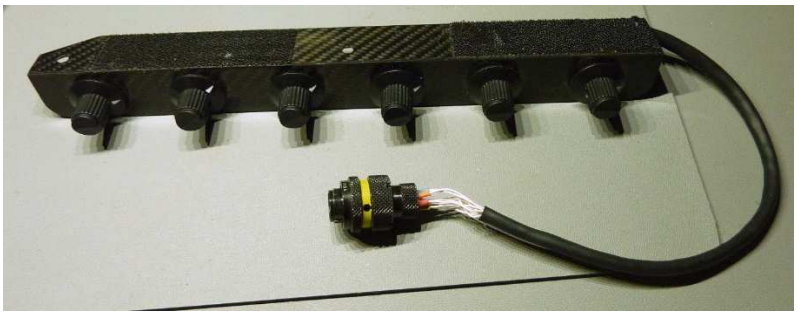
The table below provide an overview of the current vest controllers. Table excludes previous Tiga controller.

Model	**Gen1**	**Gen2**	**Gen3**	**Gen4**
Purpose	Development	Testing	Vehicle Testing Compact Format.	Racing Fully integrated design.
MPU	Tablet PC PEAK-CAN interface.	NUC Mini-PC PEAK-CAN interface.	NUC Mini-PC PEAK-CAN interface.	ARM M4 Intel Atom Integrated CAN
Vehicle Wiring	CAN 500kbps	CAN up to 1Mbps Power 6-9A peak	CAN up to 1Mbps Power 6-9A peak	CAN up to 1Mbps Power ~6A peak
Format	Pelican case. Battery powered.	271x170x60mm Fan cooling 0'C to 40'C ~2kg	231x125x60mm Lower profile option with mounting flange ~250x125x43mm. Fan cooling 0'C to 40'C Weight TBA	Dimensions TBA Passive cooling 0'C to 60'C Weight 292g
Vest Compatibility	Developed with Gen 1 Haptics	Gen 1 or Gen 2 Haptic Vest	Gen 2, 3, 4 Haptic Vest	Gen 2, 3, 4 Haptic Vest
Status	Development complete. No longer used.	Active testing format.	Active design focus to support upcoming vehicle testing. To be used as testing platform for ARM M4 and integrated CAN.	Intel Atom platform.

3.1 TIGA TWR ECU

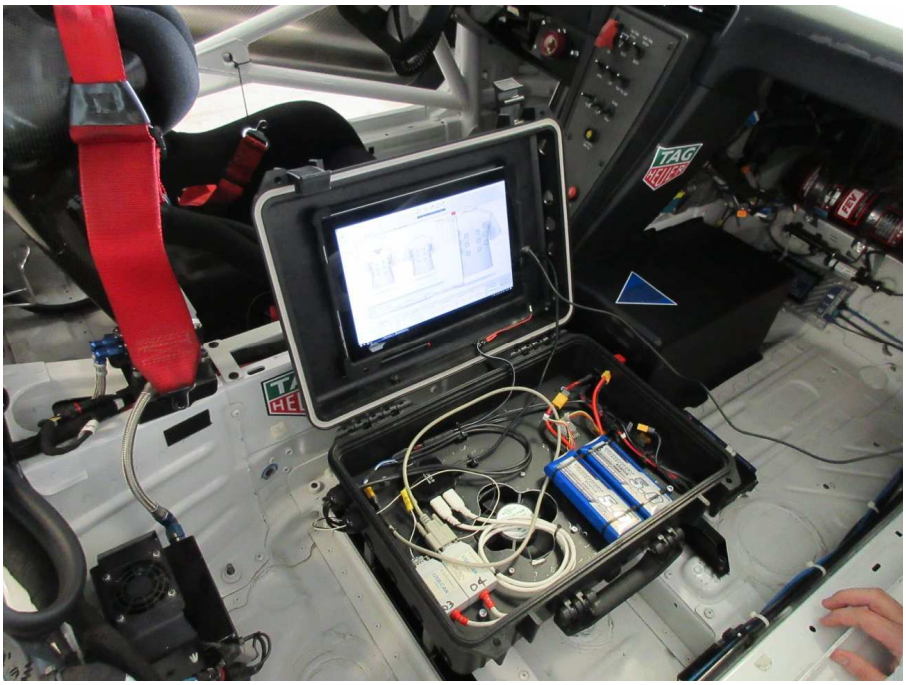
For historic reference, the prior vest controller developed by Tiga is shown below.





165x106x35mm, 472g.

3.2 1ST GENERATION VEST CONTROLLER

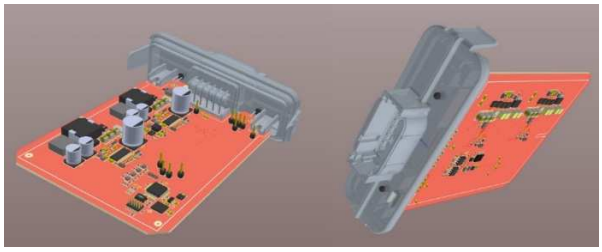


Tablet PC running from lithium-Ion batteries.

3.3 2ND GENERATION VEST CONTROLLER

NUC Mini-PC (113x112x51mm) and an interface box (Deutsch DTM13-12PA enclosure). The interface provided regulated/safe power for the NUC and vest. Future intent to integrate the NUC into the interface module.

Used in Abu Dhabi testing with Porsche RSR.

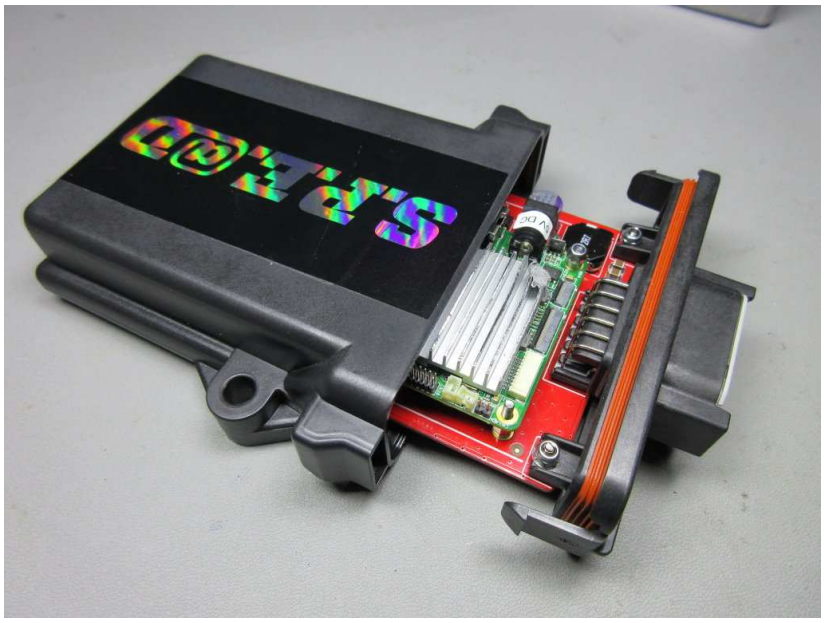


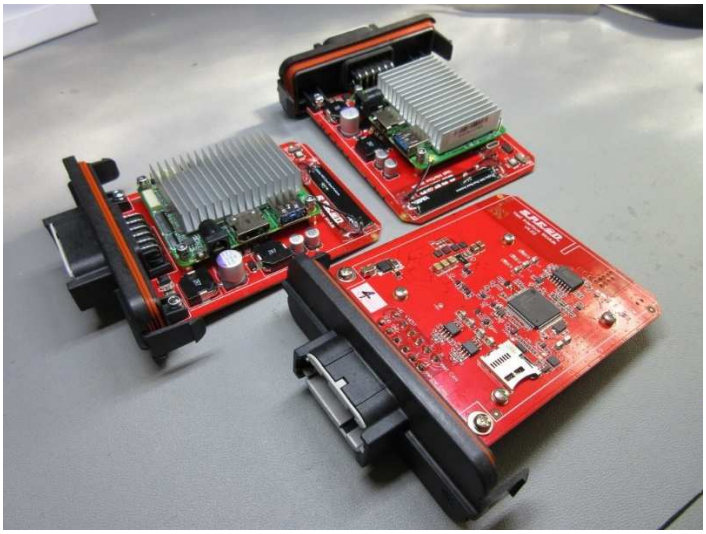
3.4 3RD GENERATION VEST CONTROLLER

Developed for Formula E Simulator testing at Porsche, Germany.

Uses Gen 2 interface for regulated/safe power, NUC and dual PCAN adaptors.

3.5 4TH GENERATION VEST CONTROLLER





Compact vest controller where vehicle data can be provided on a CAN interface.

UP-Core platform with WiFi connectivity for vest control/configuration. ARM Cortex M4 managing vehicle CAN communications.

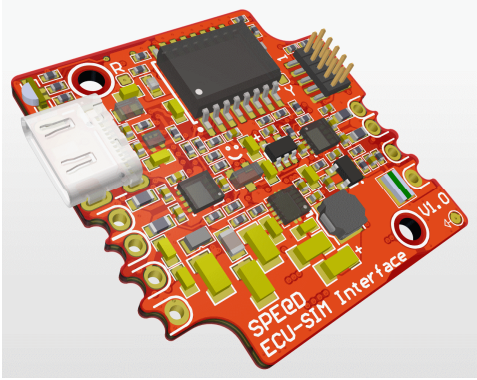
Homologation sample sent to Porsche 20th September 2019.

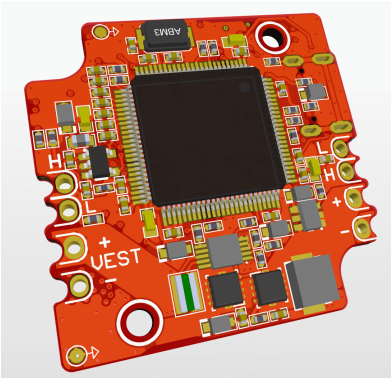
4 ECU-SIM INTERFACE

This module is a dual purpose vest interface.

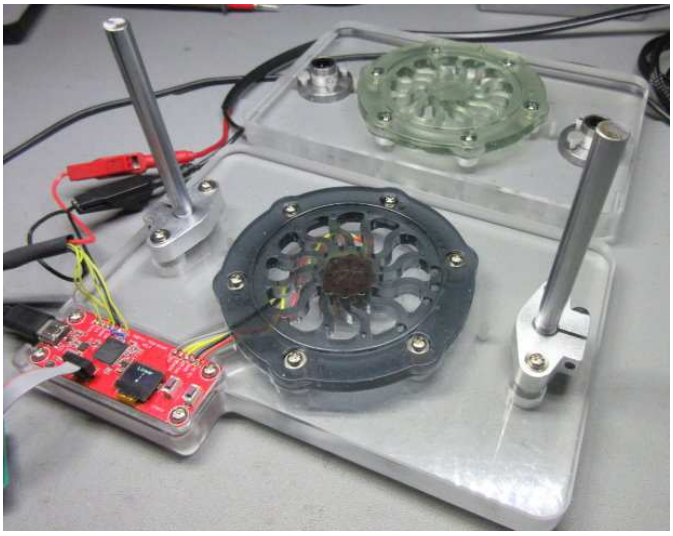
The ECU-SIM interface removes the need for the larger more expensive vest controller for the following setups.

1. Simulator only use. USB connection and vest power supply required.
2. Vest control is integrated into the Maclaren Tech 320 ECU and interfaced via CAN.

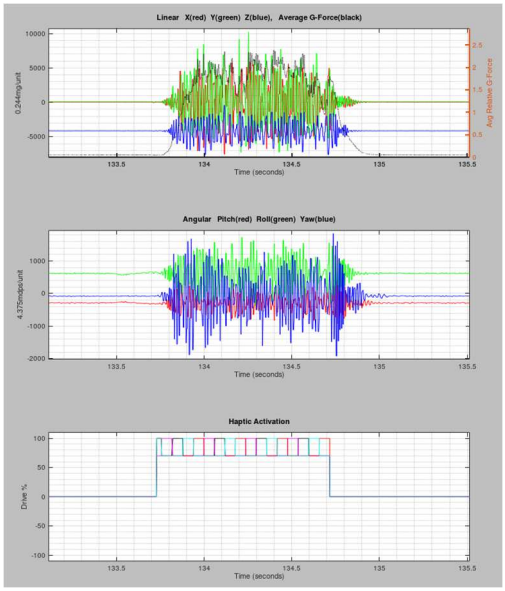


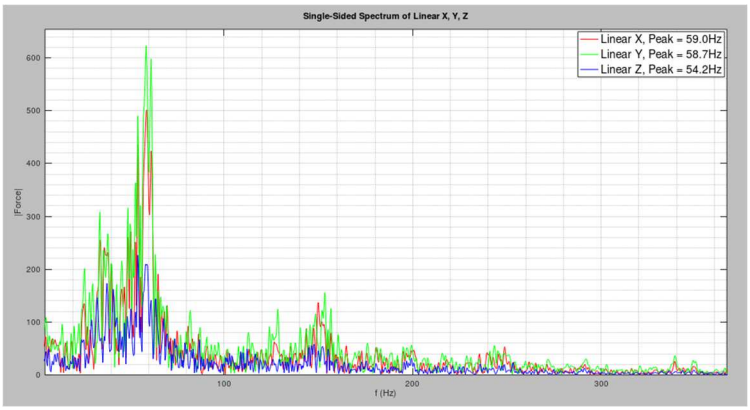


5 VIBRATION MEASUREMENT JIG

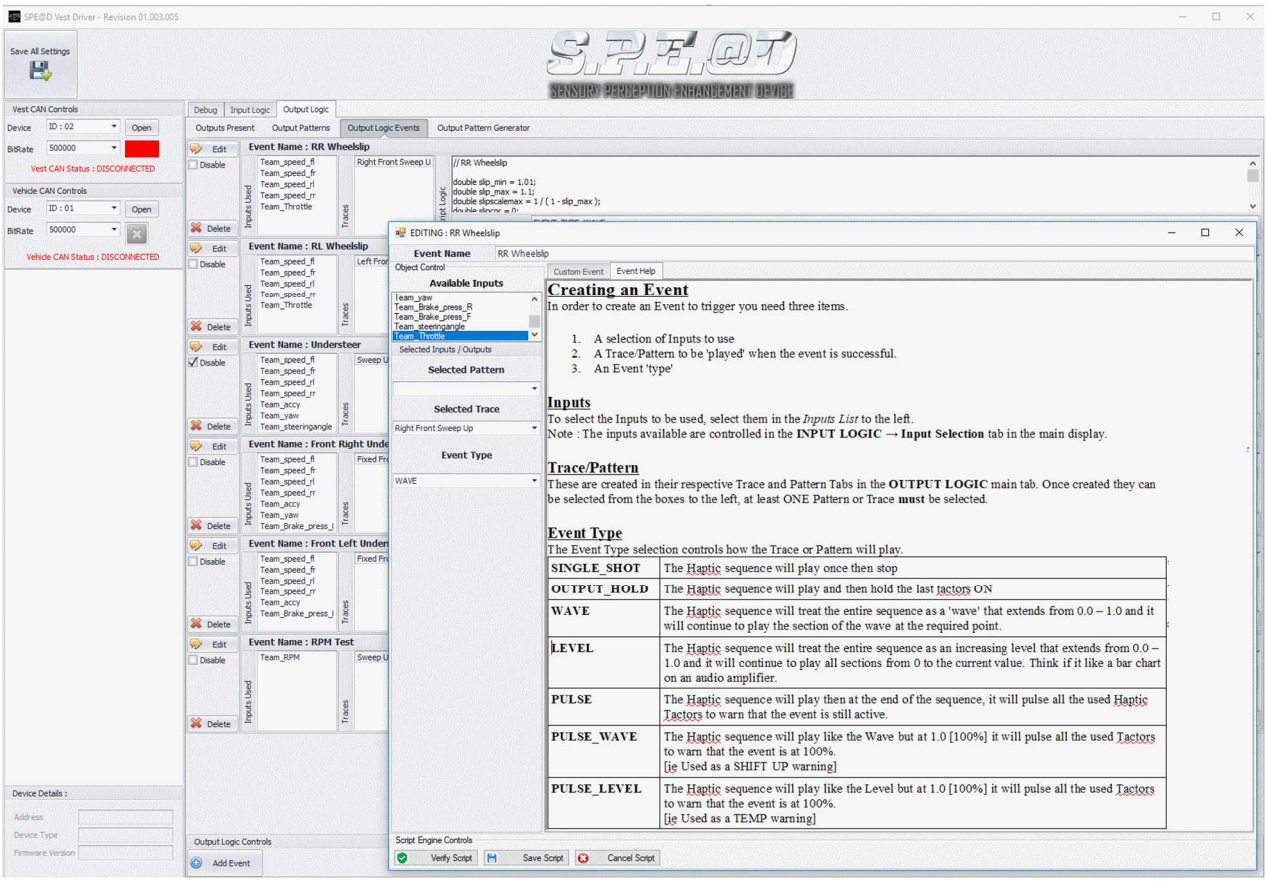


Vibration measurement jig developed. Jig provides assessment of haptic g-force. Linear and angular acceleration, 6-axis. First used to measure and tune flat haptic ERM disruption algorithm.





6 SPE@D SOFTWARE INTERFACE



7 VEST CASE

8 MAGNETIC VEST CONNECTOR.

Developed to suit cockpit exit with automatic disconnection, as well as provide a convenient kill switch function. Tested at Philip Island. Type of connector used magnetic ring. Not found suitable, as rapid current surges caused the connector to bounce. Resulted in haptics losing power/comms. Not pursued further.

9 SPE@D SOUND SYSTEM

“Language of Metaphors”

- Patent engineering content generated 28th Dec 2019.
- Patent document received, reviewed DV/TL and feedback returned 29th Feb 2020.

Patent application

“AUDIO BASED PERFORMANCE ENHANCEMENT SYSTEM”

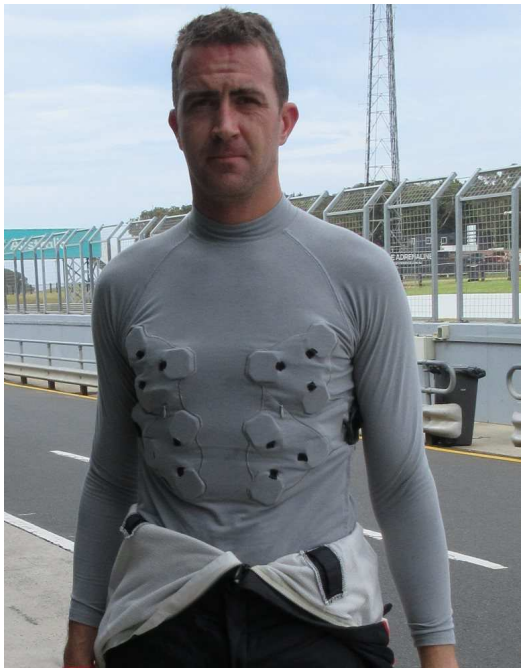
79 pages. Exciting reading material.

10 TESTING

10.1 PHILIP ISLAND TESTING

November 2018

Gen 1 Vest Controller. Vests 3, 4 with Gen 1 Haptics.



10.2 WINTON TESTING

10.3 PORSCHE – RSR TRACK TESTING

February 2019, Abu Dhabi

10.4 PORSCHE - FORMULA E SIMUATOR TESTING

September 2019, Stuggart Germany

Hardware-In-Loop testing

Formula E Simulator Testing

Driver reported the haptics on the back may limit driving to around a 1 hour period. The seat used was not an ideal fit for the driver. The driver lies a lot flatter in the cockpit than the RSR. A padded seat was used. There is possibly a lot more pressure on the back. Driver indicated the low front haptics were not well felt. The seat belt system did not provide pressure in this area.

Driver had discomfort with the rear outer haptics, middle unit. Possible future testing may involve amputation of these haptics.

10.5 PORT MELBOURNE - SIMULATOR TESTING

10.6 PORSCHE REMOTE SIMULATOR TESTING

Planning required for 2021

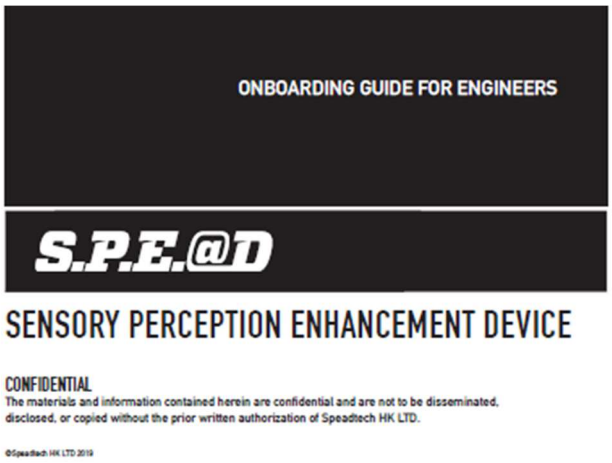
11 MEDIA PRODUCTIONS

11.1 GUIDES

11.1.1 ONBOARDING GUIDE FOR ENGINEERS

March 2019. 11 Pages.

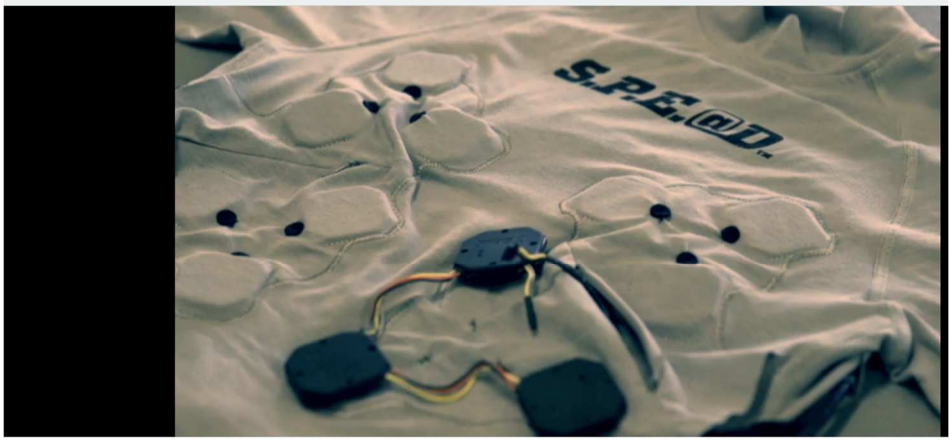
S.P.E.@D Project_2019_Engineers_Guide_V2.pdf



11.1.2 ONBOARDING GUIDE FOR ENGINEERS – VIDEO

April 2019

https://vimeo.com/321143695/39f96b56c8

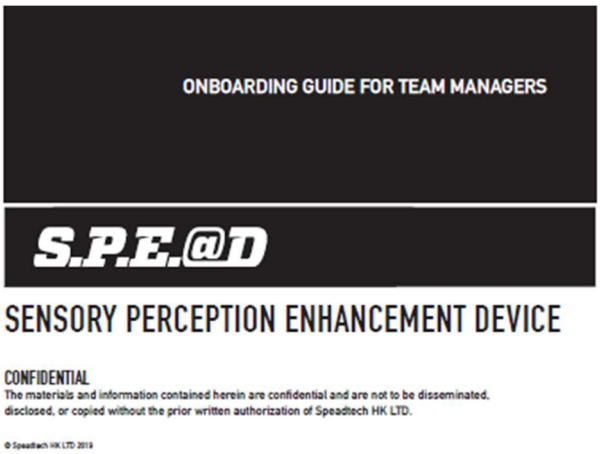


🔒 Spe@d Onboarding Guide for Engineers (Vimeo)

11.1.3 ONBOARDING GUIDE FOR TEAM MANAGERS

March 2019. 12 Pages.

S.P.E.@D Project_20219_Management_Guide_V2.pdf



11.2 TECHNICAL OVERVIEW

July 2019, 33 page technical overview.

This latest version was updated primarily for Porsche's reference.

Sensory Perception Enhancement Device

S.P.E.@D™

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

TECHNICAL OVERVIEW
JULY 2019

V1.1

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The materials and information contained herein are confidential and are not to be disseminated, disclosed, or copied without the prior written authorization of Speadtech HK LTD.

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<end of report>