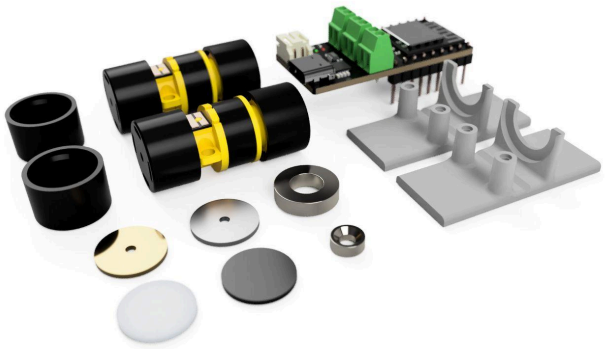
TAC**HAMMER CARLTON**
DEVELOPMENT KIT



The TacHammer Carlton Development Kit provides everything needed to prototype and fine-tune impact-based haptics. Includes TacHammer Carlton haptic motors, modular tuning components, mounts, and TITAN Core haptic evaluation board.

INCLUDES:
2x TacHammer Carlton
1x TITAN Core with pin jumper
2x Spare Caps
2x Mounts
2x Soft Impact Discs
2x Hard Impact Discs
2x Extra Magnets
1x Screwdriver

TAC**HAMMER CARLTON**

LINEAR MAGNETIC RAM (LMR) CLASS HAPTIC ACTUATOR

3 HAPTIC MODES:

IMPACT | VIBRATION | PULSE

Revised March 27, 2025

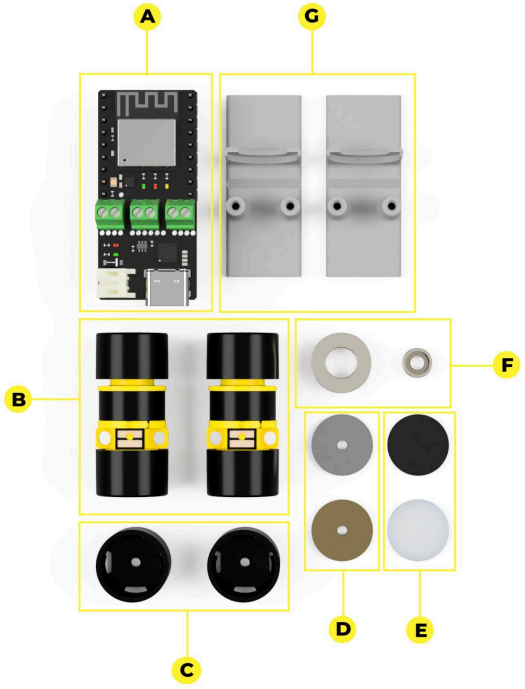
TAC**HAMMER CARLTON DEVELOPMENT KIT**

Product ID: CDK001
Revised March 27, 2025

1 Getting Started

This kit lets users experiment with customized impact haptics based on TacHammer's Linear Magnetic Ram (LMR) technology. It includes an assortment of tuning elements to customize the hammer sound and feel (discs).

1.1 Dev Kit Included Components



Dev Kit Included components

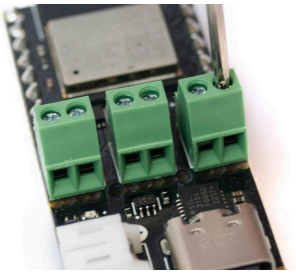
a. TITAN Core with pin jumper
b. Carlton TacHammer Motors
c. Spare Caps
d. Hard Impact Discs
e. Soft Impact Discs
f. Extra Magnets
g. Mounts

*Screwdriver (not pictured)

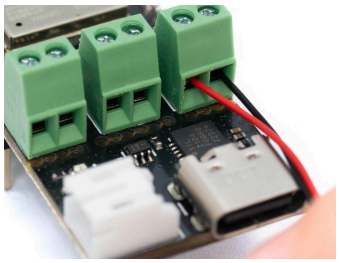
1.2 Motor Setup

Connect TacHammer Carlton motor(s) to TITAN CORE.

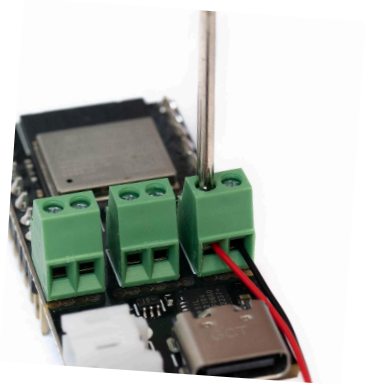
1. Using the screwdriver (PH2), unscrew (counter-clockwise) the terminal connectors until the slot opens wide enough for the motor wire to be inserted.



2. Insert motor lead wires into the terminal connectors, red to (+) and black to (-). (Polarities are printed on the bottom side of the board) You can use up to 3 motor channels (L, R, and M).



3. Once the lead wires are inserted, tighten (clockwise) the terminal connectors using the screwdriver and make sure the metal wires maintain good contact with the terminal conductive piece.

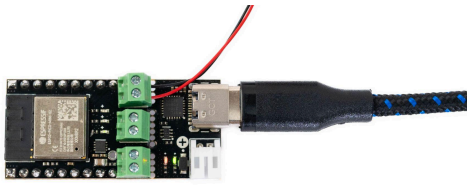


1.3 Power Source

TITAN Core can be powered by one or more sources indicated below:

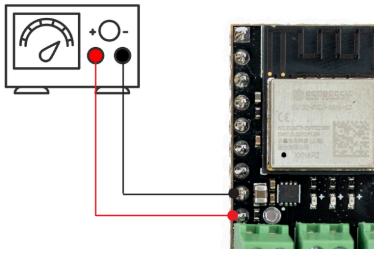
1. USB

Using a USB-C cable, plug one end of the cable to the onboard USB port, and the other end to a USB device capable of supplying power (laptop, computer, tablet, powerbank). Both the main LED and the Power module LEDs should turn on when the board is powered via USB.



2. Bench Power Supply

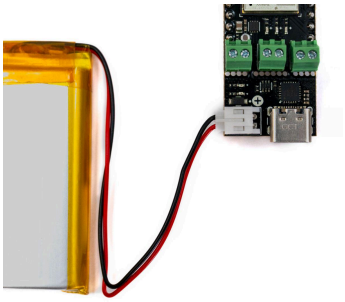
Using a 3.3 - 6V power supply, connect the positive terminal of the power supply to VIN and negative terminal of the voltage supply to GND via jumper wires. The board LED will light up when the board is powered.



3. Battery

Using a 1S lipo battery with JST-PH2 male connector, plug the battery directly into the onboard battery port to power the board. The Main LED should turn on when the board is powered.

Note: The built-in automatic LiPo battery circuit will charge a connected battery to 4.2 Volts when a powered USB-C source is connected.



2 TITAN Core Operating Modes

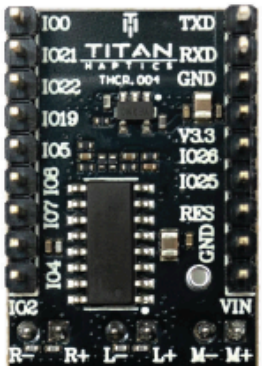
The TITAN CORE will boot into one of three operating modes. Use the included pin jumper to switch between the modes. Ensure that your TITAN Core is connected to a power supply.

2.1 Serial Monitor

The serial monitor mode requires no pin jumpers to be connected. Connect the TITAN Core via USB-C to the computer.

No Pins Connected
USB Serial Command

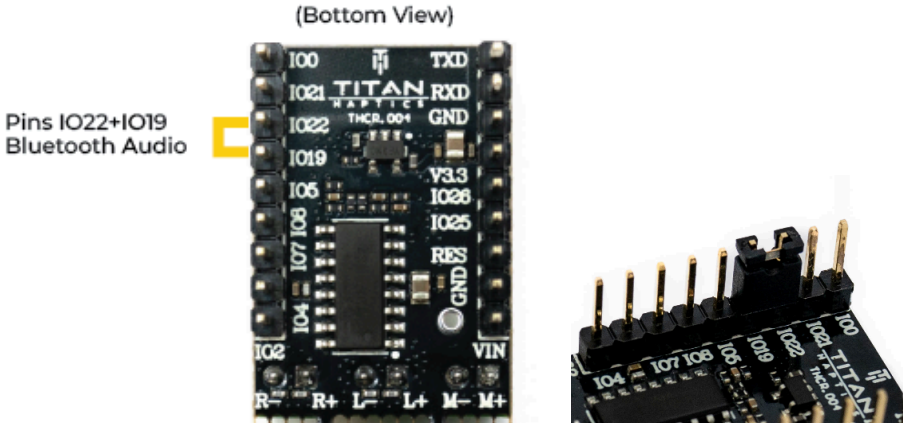
(Bottom View)



For more details on how to use Serial Monitor mode, refer to the TITAN Core Quickstart Guide and https://titanhaptics.com/titan-core-development-kit.

2.2 Bluetooth Mode

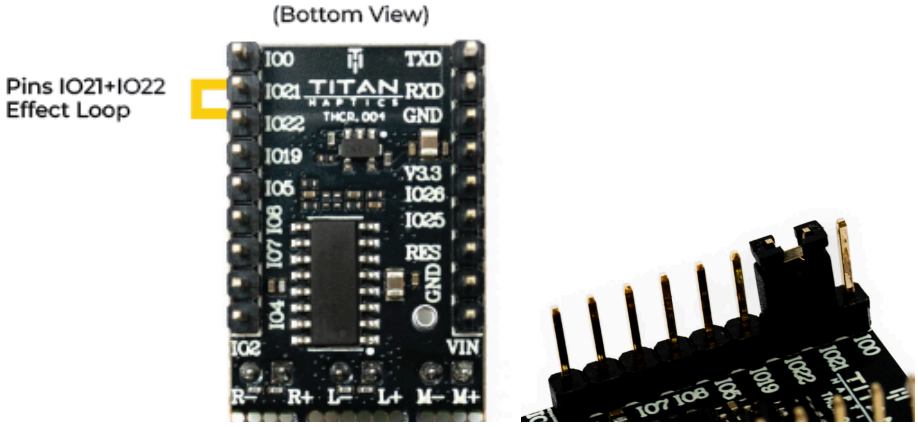
To activate “Bluetooth” mode, jump IO19 and IO22 using the pin jumper provided or jumper wires.



Once the pin jumper has been attached, your TITAN Core will be discoverable (VHDevice*number*) and you can now connect to it via bluetooth. Your TITAN Core will be capable of receiving bluetooth signals from your device and you can test this out by playing audio on YouTube/Spotify. Only the L and R channels are used in this mode.

2.3 Effect Loop

To activate “Effect Loop” mode, jump IO21 and IO22 using the pin jumper provided.



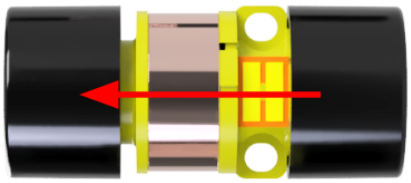
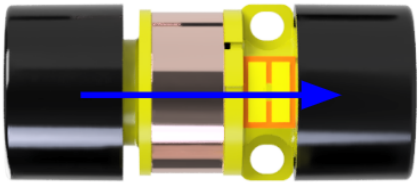
This mode plays different effects in a loop. Once the pin jumper has been attached, the haptic effects in the loop will be played automatically. To view the name of each effect, connect your TITAN CORE to a computer using a USB-C cable and open the serial monitor with a baud rate of 115200. In this mode, all three channels are used.

3 Carlton Operating Principles

The TacHammer Carlton haptic actuator provides two different haptic sensations based on the actuation direction of the ram.

A "**hit**" is an impact haptic produced when striking the ram on a mechanical feature. This feature may be internal or external to the component (i.e. part of the housing). Hits may produce audible effects which can be tuned through variations in the struck material.

A "**pulse**" is a non-impact haptic effect produced by driving the ram towards a magnetic brake within the component. Pulses are silent and do not produce audible effects. The haptics generated in this mode are similar to ERM & LRA effects.

Direction of Impact Mode Operation	Direction of Traditional Mode Operation
	

Both hits and pulses have variable intensities and actuation durations. Hits are used to generate sharp, momentary g-forces (like a click), and pulses are typically used to generate force sensations (like a bump).

Hits and pulses may be used in combination. A typical alert vibration for example is created through a chain of pulses actuated at a specified frequency. Combinations of hits and pulses provide for a range of new effects, like the snap of a latch, or the creaking of a door.

For more information on the TacHammer Carlton, please refer to the Carlton Datasheet and https://titanhaptics.com/carlton.

4 Impact Tuning

Included in the development kit are several discs that can be installed in the Carlton unit to modify and tune impact mode. It should be noted that the included materials are a suggested starting point and not a comprehensive list of materials compatible with the TacHammer. The sections below will detail the materials included as well as offer suggestions on how to use them.

4.1 Operating Mode

In order to take advantage of the impact materials, operate the TacHammer component using the *hit* commands (see Section 1.1).

4.2 Impact Materials

4.2.1 Soft Materials Overview

These materials soften the blow of the impact, primarily reducing the sound created when generating haptics and changing the quality of the haptic to be heavier and less sharp. The table and charts below detail their qualities. See Section 6.4 for details on the effect soft materials have on acceleration and SPL.

4.2.2 Hard Materials Overview

These materials enhance and sharpen the quality of the haptic on impact.

4.2.3 Description of Included Materials

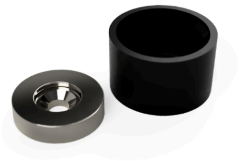
MATERIAL	COLOR		THICKNESS (MM)
Poron 1/32”	Black	Produces a more dampened or softer impact feel	0.8
Silicon 10A	White	Produces a more dampened or softer impact feel	1.6
Aluminum	Silver	Adds crispness and sharp tactile response, ideal for button-like feedback	1
Copper	Copper	Adds crispness and sharp tactile response, ideal for button-like feedback	1

4.4 Installation of Impact Discs

STEP	ACTION	
1	Insert disc between the tabs on the cap	
2	Push the disc past the remaining tab until the disc sits flat on the bottom of the cap	

4.5 Dual Array Mode

The Carlton supports a Dual Array configuration. The kit includes spare magnets that can be inserted into the caps (see images below) to convert the LFi (Low Frequency Impact) model into an LF (Low Frequency) setup. This creates a dual-array Carlton.

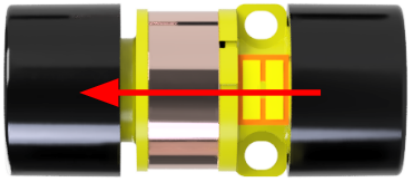
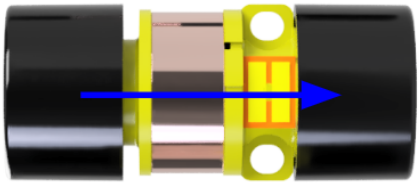
STEP	ACTION	
1	Put the smaller magnet into the larger magnet as shown.	
2	Place the magnet inside the cap. One side of the magnet will attract the hammer magnet, and the other side won't. The side that does not attract should face the hammer, so the attracting side faces outward.	
3	Place in the spare cap and re-attached to the Carlton	

5 Mounting Guide

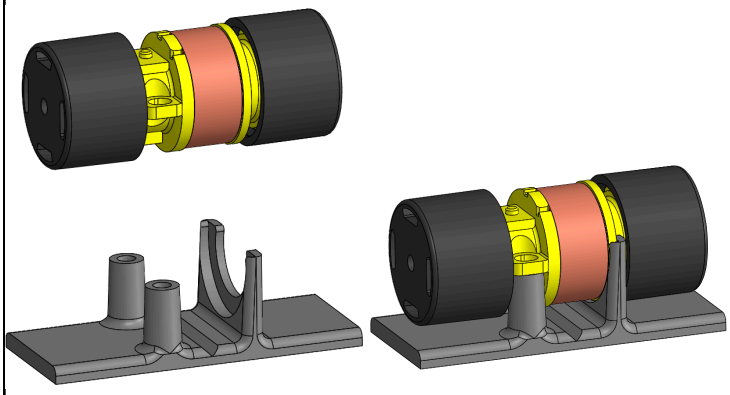
The development kit includes an adhesive backed mount to mount the TacHammer to your device of choice. Whether it's a controller or a head-mounted display, the following images will guide the placement and orientation of the TacHammer to maximise your experience

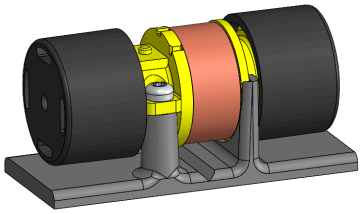
5.1 Haptics Direction

The TacHammer generates haptics primarily in the direction of travel. It is recommended that the TacHammer is mounted so that it is oriented towards the user.

Direction of Impact Mode Operation	Direction of Traditional Mode Operation
	

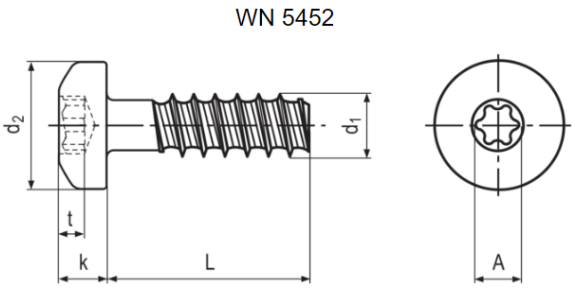
5.2 Using the Mount

STEP	ACTION	
1	Place the TacHammer inside the mount (it will click into place	

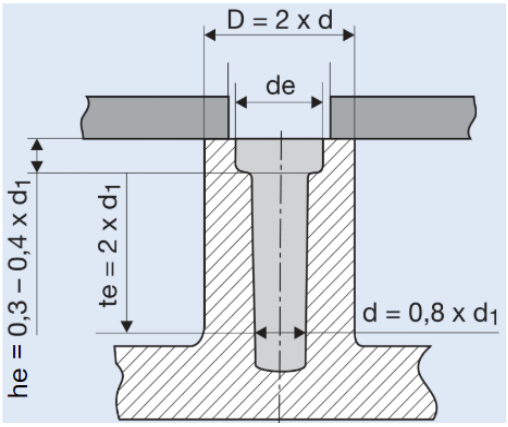
2	Use 2mm nominal plastic thread cutting screws to tightly mount the TacHammer into the Mount	

5.3 Mounting Boss Specification

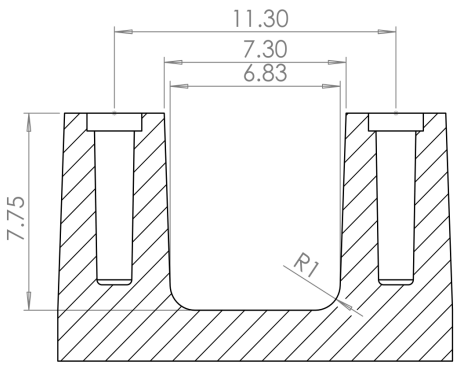
SCREW DIMENSIONS		
DIMENSION	**SYMBOL**	**VALUE (mm)**
Recess Width	A	1.75
Nominal Screw Diameter	d1	2
Screw Head Diameter	d2	3.5
Screw Height Height	k	1.6
Thread Length	L	6
Recess Depth	t	7



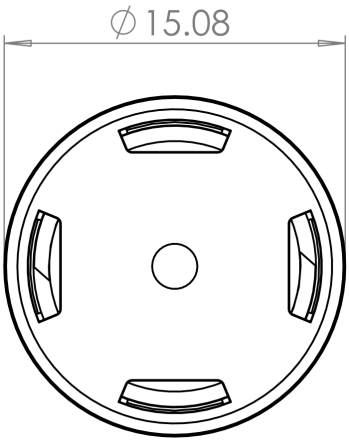
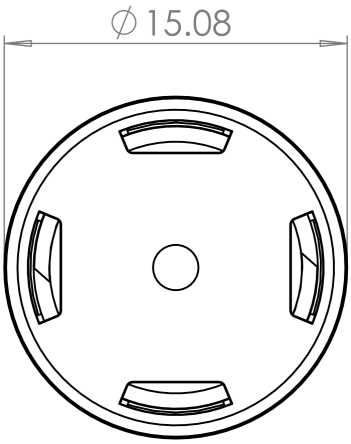
BOSS DIMENSIONS		
DIMENSION	**SYMBOL**	**VALUE (mm)**
Nominal Screw Diameter	d1	2
Boss Diameter	D	4
Edge Relief	de	2.2
Edge Relief Height	he	0.6-0.8
Thread Engagement	te	4
Pilot Hole	d	1.6
Recommended minimum 1° draft		

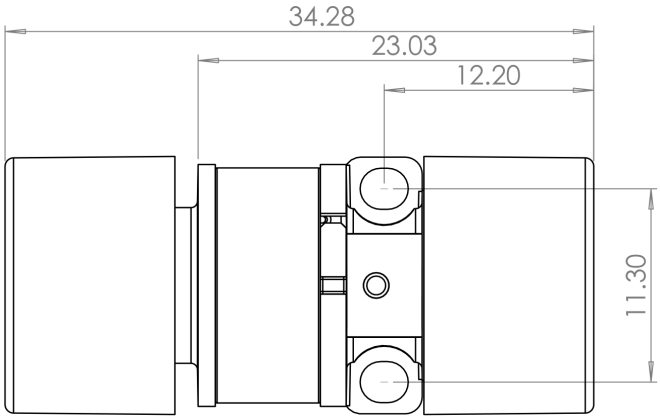


SCREW MOUNT DIMENSIONS



5.4 Product Dimension Specification

FRONT	BACK
	
SIDE	



6 Application Notes

6.1 Driving Signal

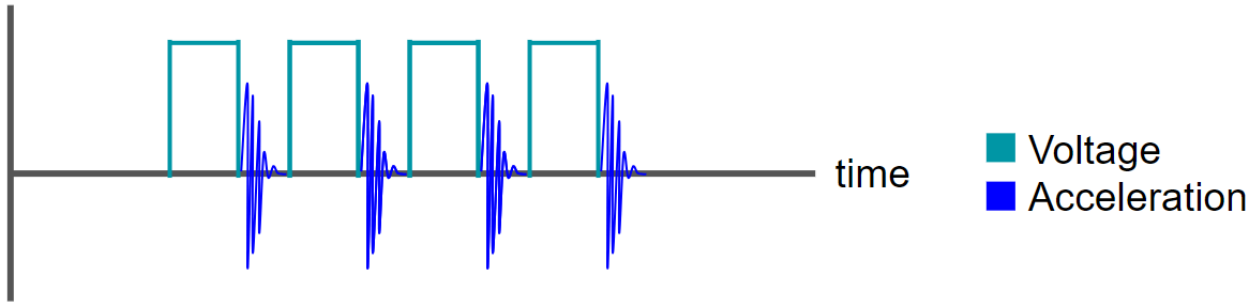
6.1.1 Single Haptics

Single haptics such as a single Hit or Pulse is optimally driven with a single pulse. The following table lists the recommended duration for the respective haptic.

HAPTIC	DURATION	UNIT
Hit	8.6	ms
Pulse	10	ms

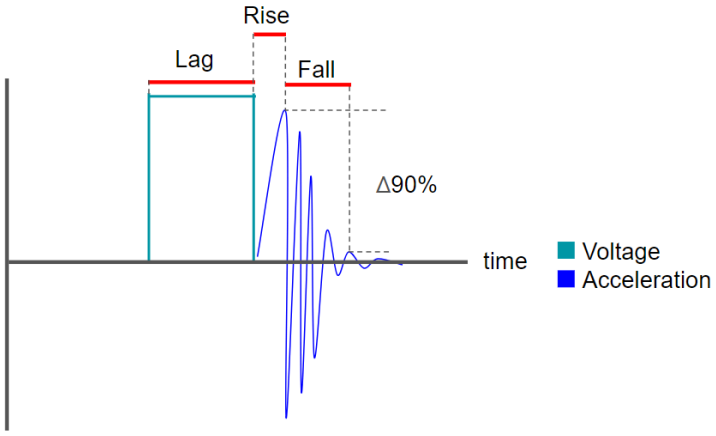
6.1.2 Repeated Haptics

For repeated haptics such as vibrations, the TacHammer™ haptic actuator is optimally driven with a square wave input. The following tables list recommended frequencies and duty cycles.



6.2 Response Time Note

The below image is a representation of the driving signal and corresponding acceleration waveform for a single impact haptic.



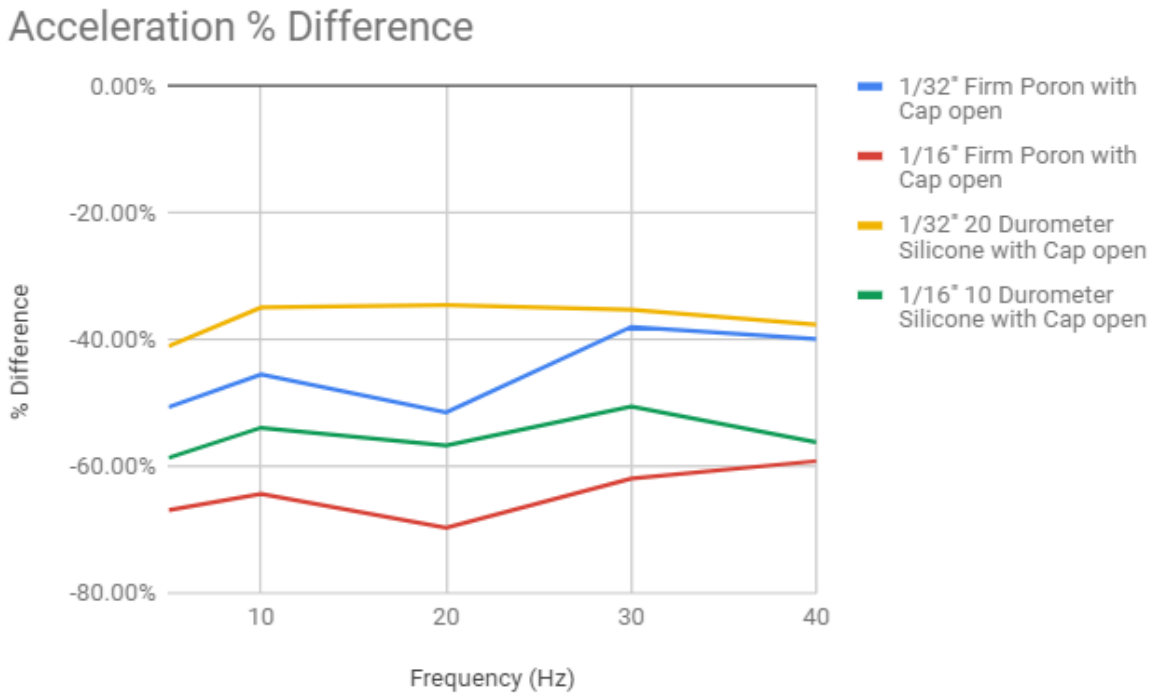
6.3 Driving Note

TacHammer Carlton may be driven using off the shelf haptic driver ICs such as the TI DRV2605 in PWM mode or by a simple H-Bridge.

Additionally, TacHammer Carlton is fully back compatible and is capable of taking advantage of LRA waveforms and libraries, such as that found on the TI DRV2605.

6.4 Acceleration and SPL Effect of Soft Impact Materials

Some of these materials are included in the Dev Kit, while others are provided for reference.



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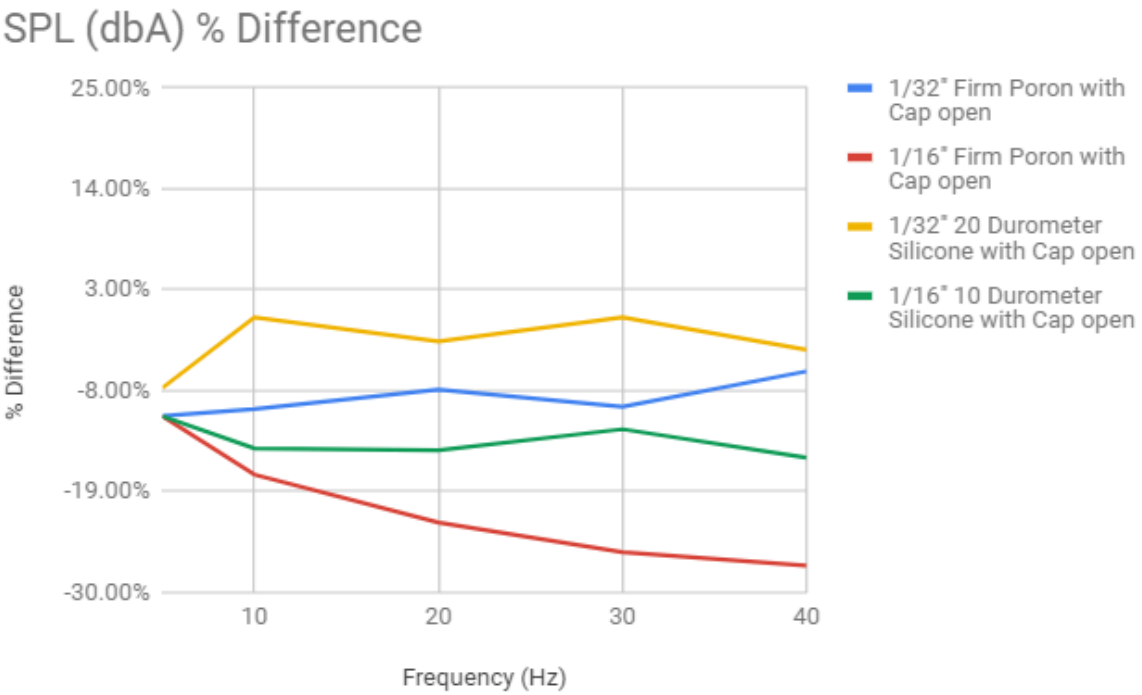

Troubleshooting

PROBLEM	PROBABLE CAUSES	SOLUTION
Board is unresponsive		Disconnect and reconnect the power source(s).
The battery is not charging	Battery may not be properly plugged in	Make sure the battery is firmly plugged to the onboard battery port with the polarities matching the printed polarity sign.
Bluetooth not connecting	Bluetooth function is not enabled	Make sure the correct pins are connected to enable bluetooth mode.
Motors not working	Bad wire connection	Check circuit continuity from screw terminal connectors to the motor wires; adjust and tighten down if necessary.
	Pin jumper in the wrong position (in default modes)	Double-check if the pin jumper has been plugged into the right pins. (see “default modes”).
	Power voltage deficiency	Make sure the board is being powered via USB or an appropriate voltage (3.3 - 6V).
No Serial Reading	Incorrect baud rate	Make sure to set the serial baud rate to 115200.
	USB cable not capable of data transferring	Use a data-capable USB cable instead of a power-only cable.
Only one motor is working during bluetooth mode	Motor is not plugged into the correct channel	Only L and R channels are used in this mode. Ensure that your motors are connected to the correct channels.