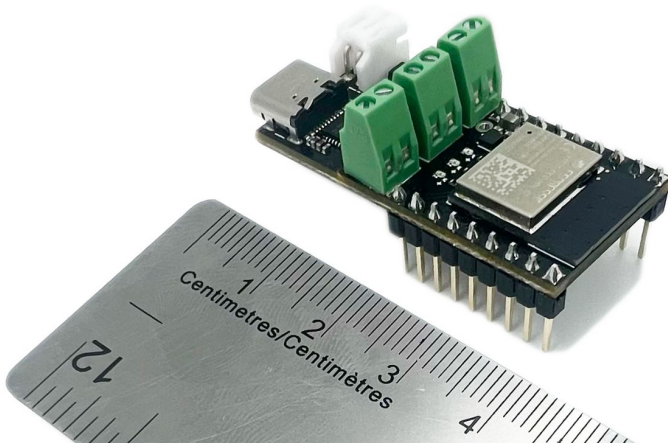# TITAN Core

Quick Start Guide

Overview

A fully contained Haptics Evaluation Board with a 32-bit ESP32 Processor, Wi-Fi, Bluetooth, Haptics, DAC, DSP, and in a tiny, low-cost footprint.
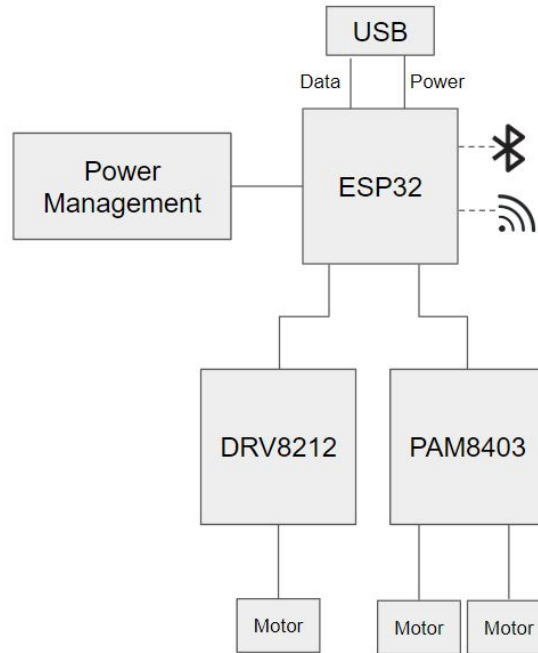
TITAN Core is perfect for prototyping haptics, and can also be used for testing motors, effects, games and other haptic applications.

Contents

Overview

Block Diagram

Board Overview

Top view

| IO1, TXD |
| IO3, RXD |
| GND |
| 3.3V |
| IO25, DAC L |
| IO26, DAC R |
| RESET |
| GND |
| 5V (3.3V - 6V) |

| IO0, ADC2_CH1 |
| IO21, SDA |
| IO22, SCL |
| IO19, (TX) |
| IO5 |
| IO8 (RTS) |
| IO7 (CTS) |
| IO4, ADC2_CH0 |
| IO2, ADC2_CH2 |

Motor_M — M+ M-
Motor_L — L+ L-
Motor_R — R+ R-

Battery +
Battery -

USB

Back view

| IO0, ADC2_CH1 |
| IO21, SDA |
| IO22, SCL |
| IO19, (TX) |
| IO5 |
| IO8 (RTS) |
| IO7 (CTS) |
| IO4, ADC2_CH0 |
| IO2, ADC2_CH2 |

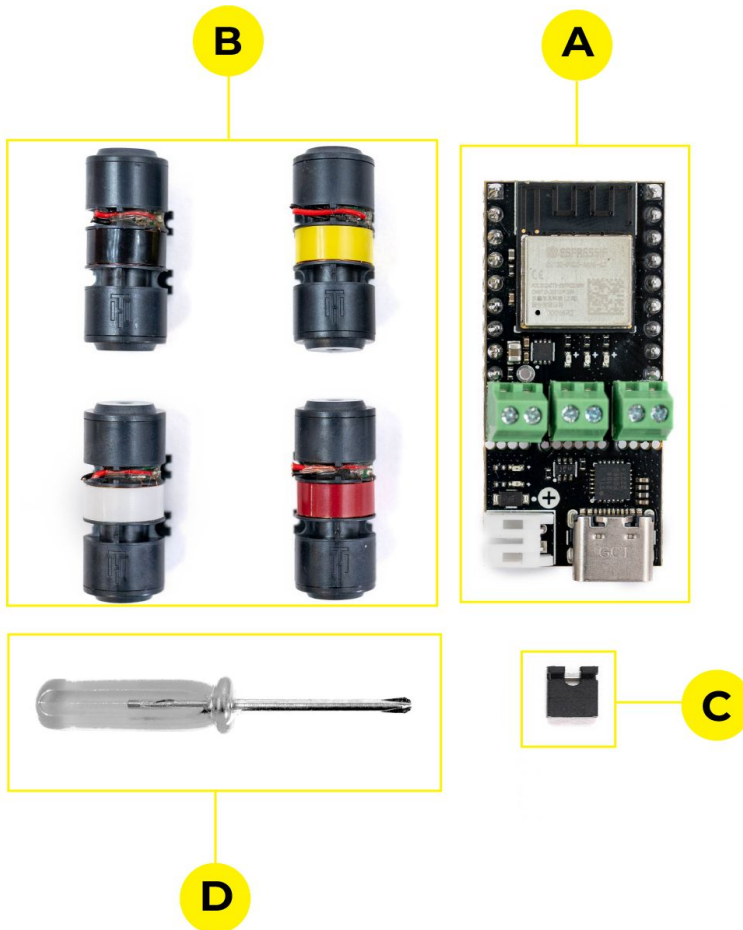| IO1, TXD |
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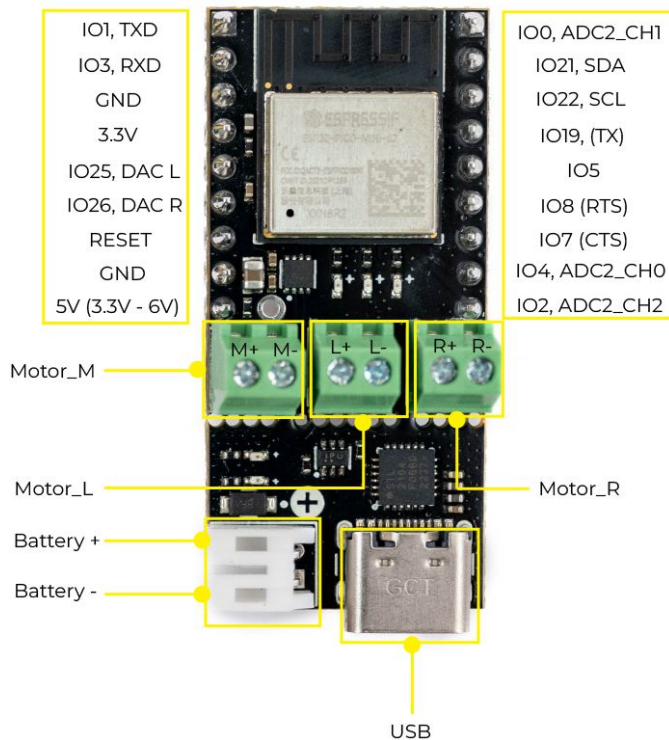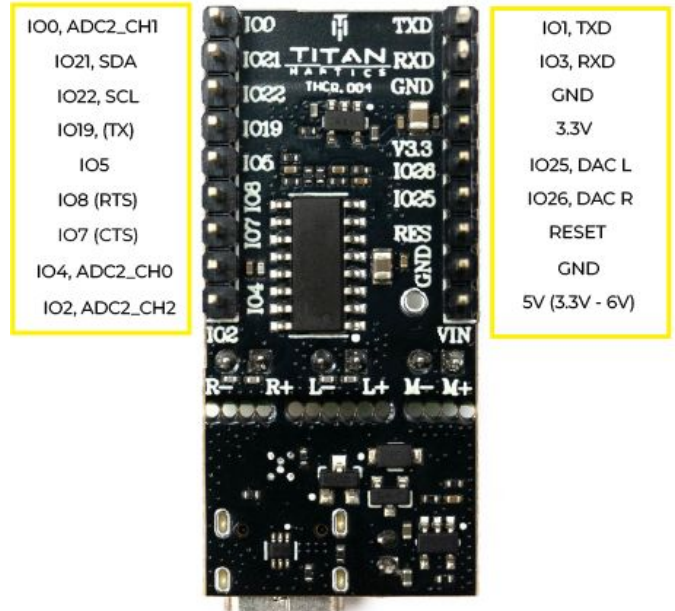
Hardware Requirements

Dev Kit Included components
a. TITAN CORE
b. DRAKE TacHammer Motors
c. Pin jumper
d. Philips-head screwdriver (PH2 size)

Power Source - one or more of the following:
1. USB-C Cable connected to a PC or power source
2. 3.3-6v Power Supply
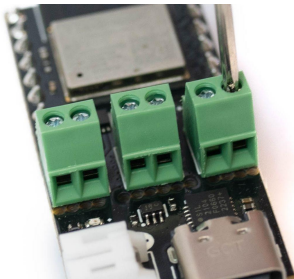3. 1S lipo with JST-PH2 male connector

Optional Tools
A computer with serial interface (Arduino V1.8.X Serial Terminal, PuTTY, etc.)

Getting Started

### Setup

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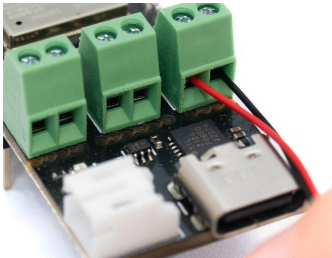
3. Once the lead wires are inserted, tighten (clockwise) the terminal connectors using the screwdriver and make sure the metal wires maintain good contact with the terminal conductive piece.
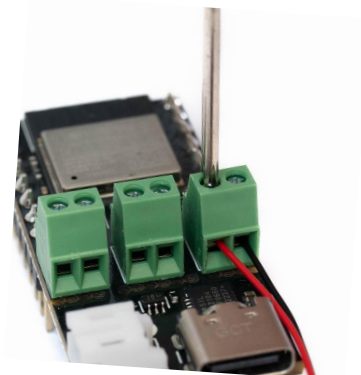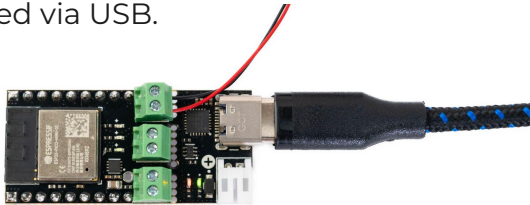
Power Source

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.
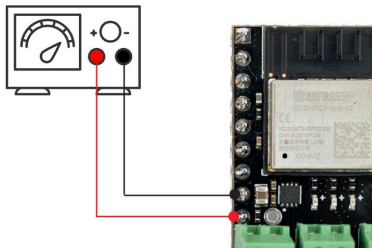
3.   Battery

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.
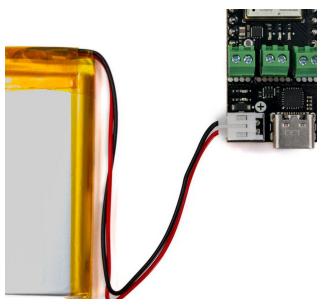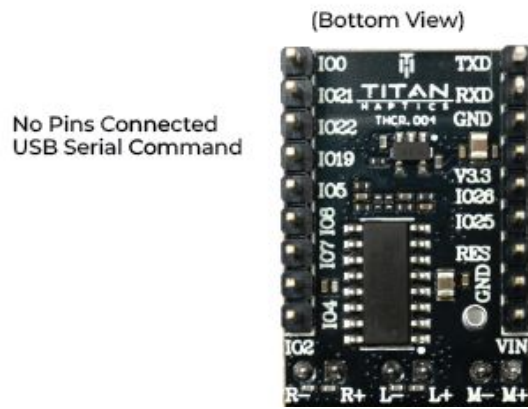
Operating Modes

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.
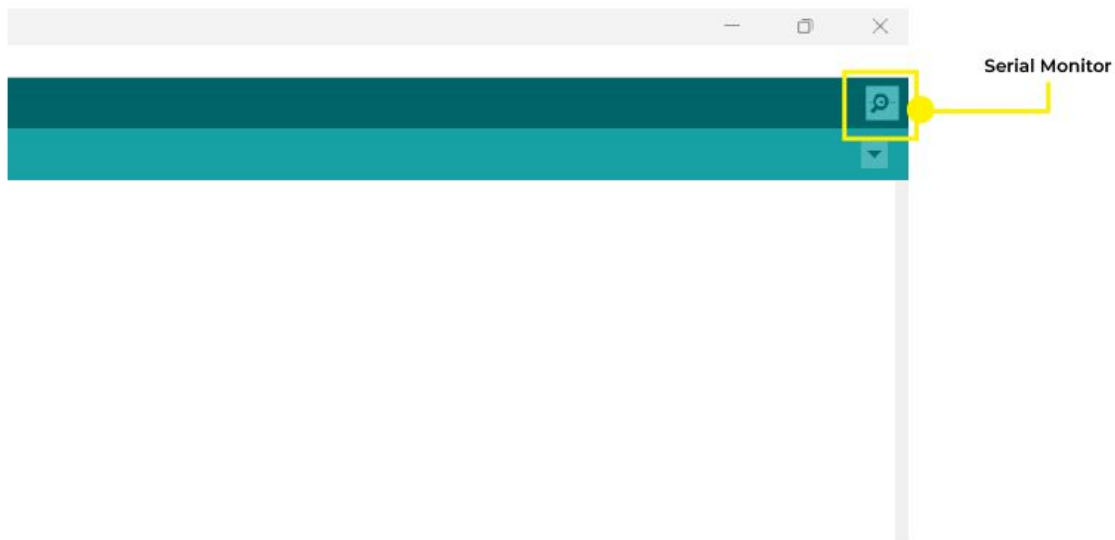
1. **Serial Monitor**

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

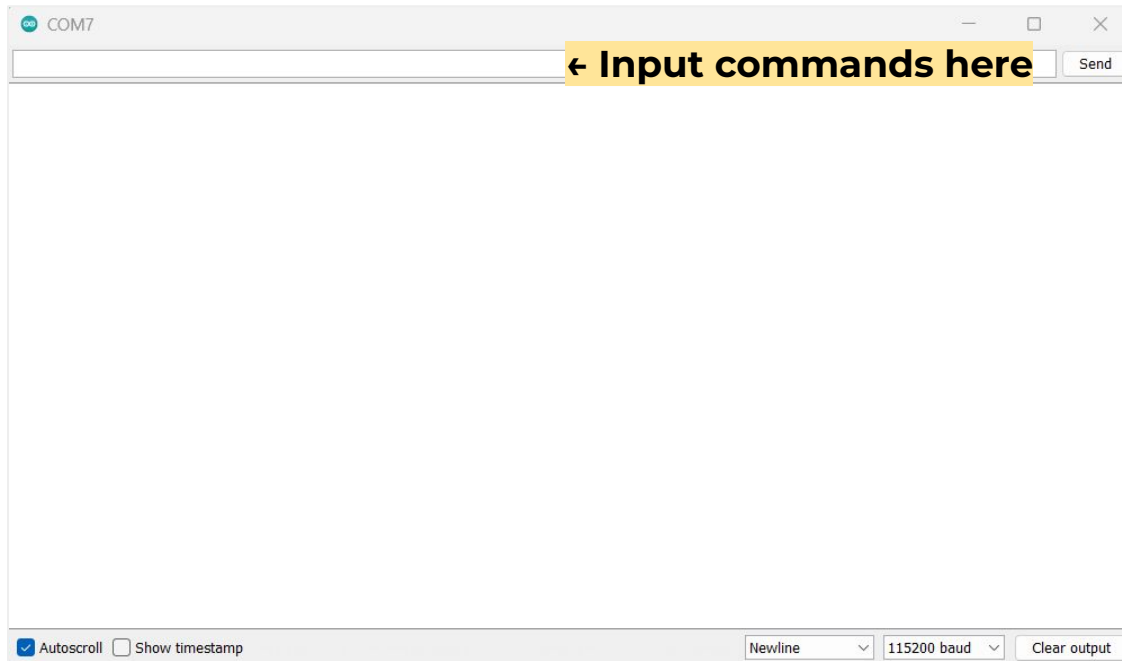
   Go to **Tools → Port** and select the COM port connected to your PC.

   Once you've installed the board, open the serial monitor and choose 115200 for the baud rate.

   Now your TITAN CORE is ready to receive serial input to actuate haptic effects. In this mode, you may program effects for all three channels or use a specific channel as desired.

## Serial Terminal (from Arduino IDE)

Command Syntax can be referred to in the following chart:

| Channel (CHNL)	CHANNEL 0=L, R and M, 1=L, 2=R, 3=M			
Usage: Determines the channel for generating the output. 0=L, R and M, 1=L, 2=R, 3=M **Example:** CHNL 3; Tick 0.85 20.5; **Result:** Single Tick will be generated from Channel 3 (M channel)				
Pulse	STRENGTH From 0 to 1	DURATION in milliseconds		
Usage: A single soft impulse for pulses, bumps, wobbles and motion forces **Example:** CHNL 2; Pulse 0.85 20; **Result:** Single Pulse at 85% strength, for 20 ms, output to 2 channel (R channel).				
Tick	STRENGTH From 0 to 1	DURATION in milliseconds		
Usage: A single sharp impulse for generating clicks, textures, taps and impacts. **Example:** CHNL 0; Tick 0.85 20; **Result:** Single tick at 85% strength, for 20 ms, output to All channel (L, R and M channel)				
Pause	DURATION in milliseconds			
Usage: Everything is paused for certain duration. **Example:** CHNL 1; vibrate 100 0.3 15000 1 1; **Result:** Pause of 20 ms between two Tick command while the is generated from Channel 1				
Vibrate	FREQUENCY in hertz	STRENGTH From 0 to 1	DURATION in milliseconds	DUTY CYCLE from 0 to 1	SHARPNESS from 0 to 1
Usage: A full swing vibration used to create alerts, textures etc. Use 'Duty Cycle' to vary the 'fullness' of the vibration and 'Sharpness' to vary the waveform between pure sine (0, rounded) and pure square (1, very sharp). **Example:** CHNL 1;vibrate 100 0.3 15000 1 1; **Result:** Vibration at 120 HZ, 30% strength, for 15000 ms, at 100% duty cycle and 100% sharpness.				
PCM	Frame Frequency Hz	Frame Size	PCM value 8 bit value (from 0 to 255)	
Usage: A PCM (Pulse-Code-Modulated) is a common format for audio based haptics. It is used to convert 8 bit audio data to vibration. **Example:** CHNL 0;F 4000 20;PCM 244,0,0,0,0,0,0,0,0,0,0,255,0,0,0,045,45,45,45; **Result:** Stream of 8 bit PCM data is generated with frame frequency 4000 and frame size 20 in channel 0.				

2. Bluetooth Mode

To activate "Bluetooth" mode, jump IO19 and IO22 using the pin jumper provided or jumper wires.
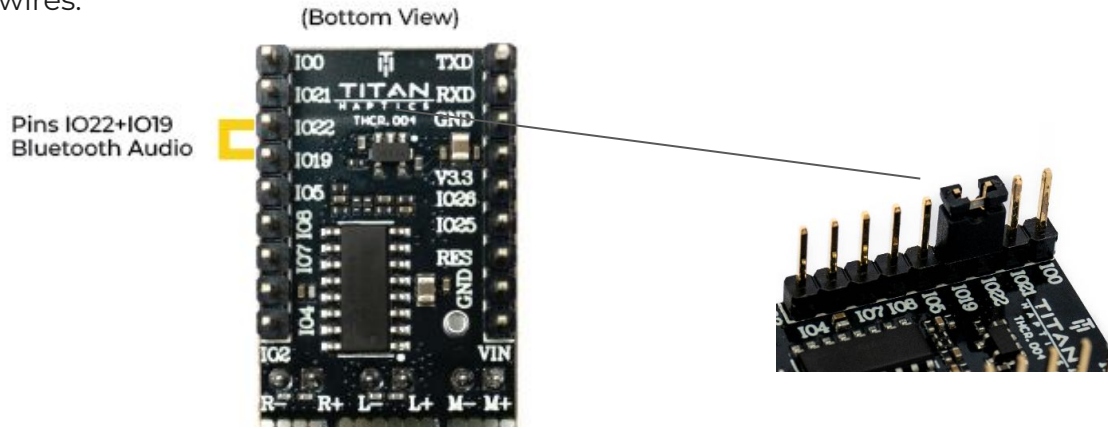
Once the pin jumper has been attached, your TITAN Core will be discoverable (VHDevice*number*) and you can now connect to it via bluetooth. Your TITAN Core will be capable of receiving bluetooth signals from your device and you can test this out by playing audio on YouTube/Spotify. Only the L and R channels are used in this mode.
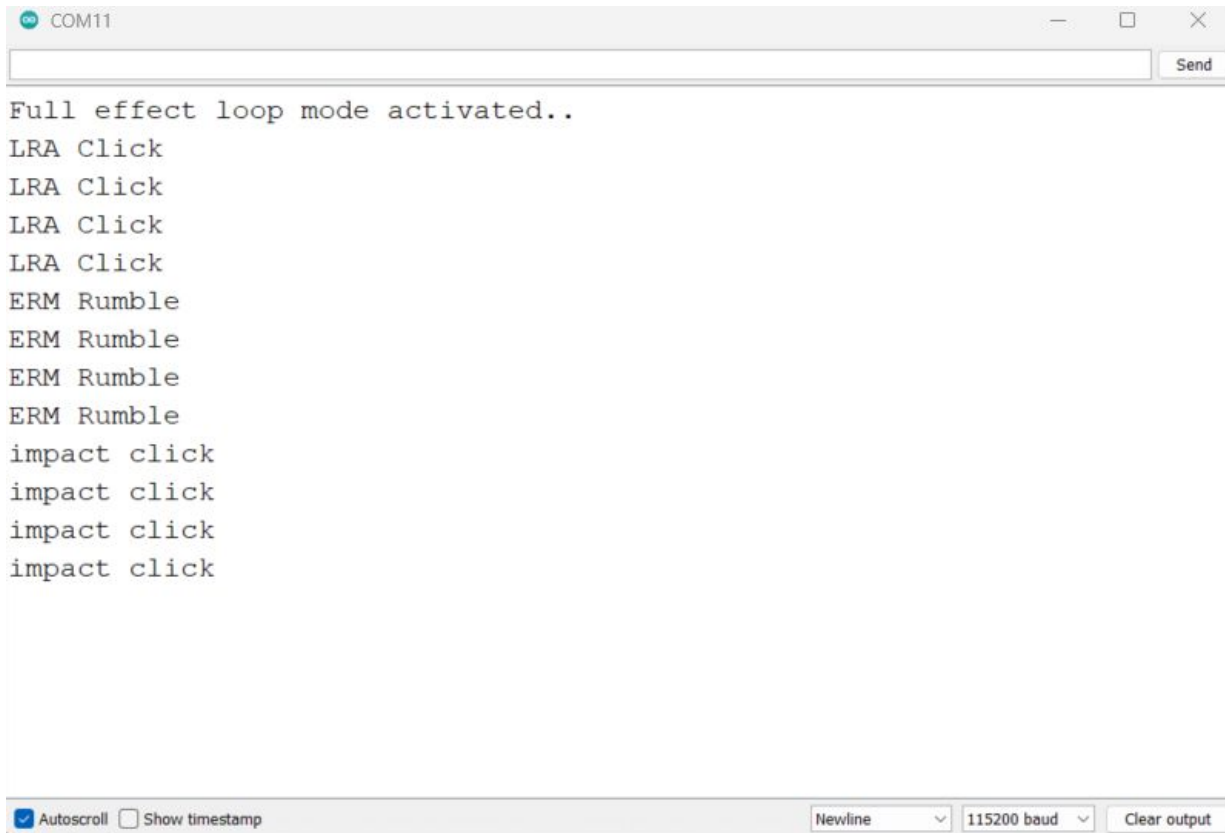
3. Effect Loop

To activate "Effect Loop" mode, jump IO21 and IO22 using the pin jumper provided.
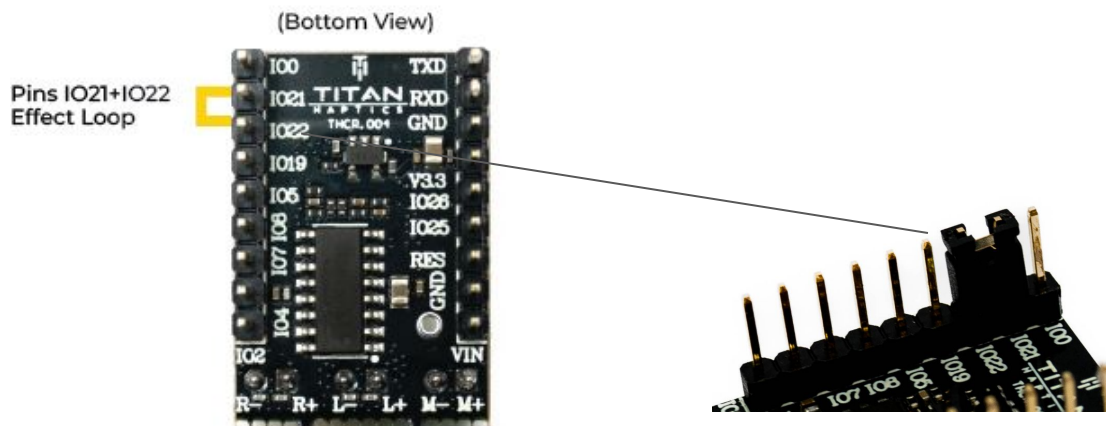
This mode plays different effects in a loop. Once the pin jumper has been attached, the haptic effects in the loop will be played automatically. To view the name of each effect, connect your TITAN CORE to a computer using a USB-C cable and open the serial monitor with a baud rate of 115200. In this mode, all three channels are used.

Serial Terminal (from Arduino IDE) showing the different effects playing

Haptic Integration

1.   Vector Haptics Firmware (Arduino)

To fully customize haptic effects using TITAN CORE, you can design your own Arduino code based on TITAN's Vector Haptics library.

### 2.   Mounting Guide

How to mount TacHammer motor

TacHammer motors vibrate linearly along the longitudinal direction, in which the haptic feedback is the most perceivable. It's recommended to align the motor's longitudinal axis perpendicular to the haptic contact surface of the device and use the built-in adhesive to secure the motor to a flat, oil-free surface.

DRAKE TacHammer - Remove the adhesive strips on the back of the DRAKE motors and adhere it to a surface.

Carlton TacHammer - Use screws to attach the motor to a surface or place the motor in a mount. To download the mount STL file, visit this web page and for more information, see *TacHammer Development Kit Guide.*
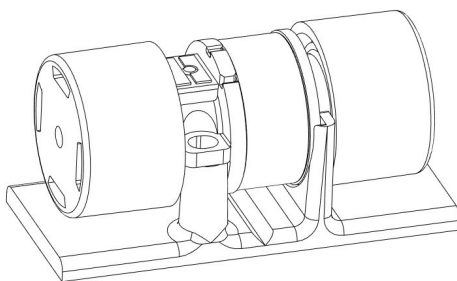
Carlton TacHammer
on mount
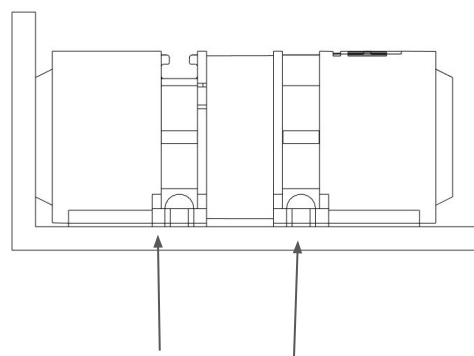
Adhesive strips on
DRAKE motor

Troubleshooting

PROBLEM	PROBABLE CAUSES	SOLUTION
Board freezes up		Disconnect and reconnect the power source(s).
The battery not charging	Batter not 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.

Links and Resources

- DRAKE Datasheet
- Carlton Datasheet
- DRAKE Cluster Prototype Guide